Atlas

of the European dragonflies and damselflies

This work is the first detailed and comprehensive overview of the distribution of the dragonflies and damselflies of Europe. It is an important milestone for professionals and amateurs alike.

- Covers the distribution and habitat selection of all 143 European species of dragonflies and damselflies.
- Gives a complete description of their global and European distribution, illustrated by over 200 distribution maps.
- Gives for each species information on taxonomy, range, population trends, flights season and habitat.
- Includes unique photos and flight season diagrams for virtually all European species.
- Contains extensive background information on taxonomy, conservation, and for each country an overview of the history of odonatological studies.

The book is the result of a co-operation of over 50 European dragonfly experts who over the past decade compiled all records of dragonflies and damselflies, from the Azores to the Ural and from the North Cape to Lampedusa. These records were gathered by thousands of volunteers from across Europe. This endeavour was coordinated by Jean-Pierre Boudot (Société Française d'Odonatologie) and Vincent Kalkman (European Invertebrate Survey – Netherlands/Naturalis Biodiversity Centre).

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ISBN 978-90-5011-480-6
9 789050 114806 >

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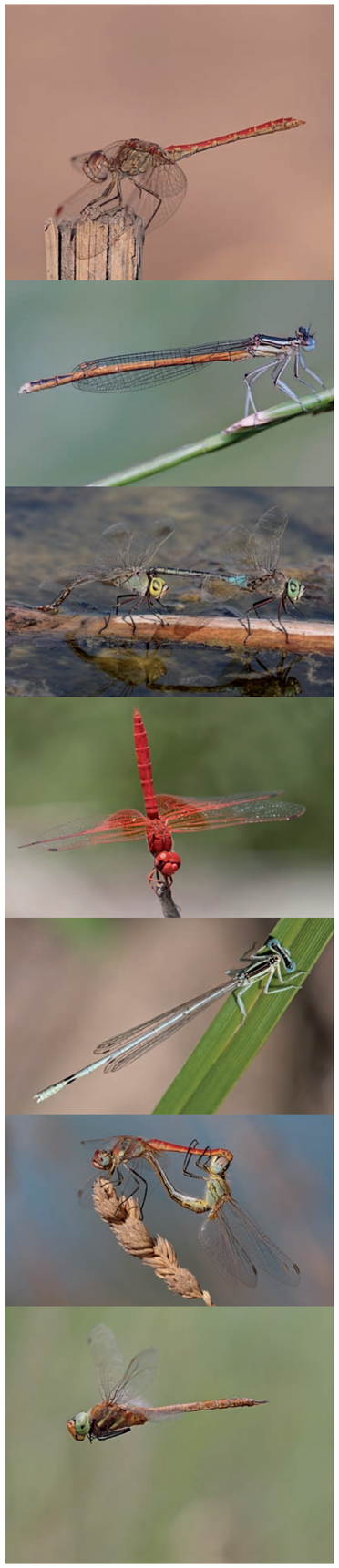

Editors: Jean-Pierre Boudot & Vincent J. Kalkman

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Photographs by Fons Peels

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Colophon

Title: **Atlas of the European dragonflies and damselflies**

Edited by: Jean-Pierre Boudot & Vincent J. Kalkman

Species accounts by: Kaare Aagaard, Andras Ambrus, Rafał Bernard, Tomislav Bogdanović, Jean-Pierre Boudot, Martiño Cabana Otero, David Chelmick, Klaus-Jürgen Conze, Adolfo Cordero Rivera, Stanislav David, Geert De Knijf, Godwin Degabriele, Dag Dolmen, Jean-Louis Dommanget, Elena Dyatlova, Sónia Ferreira, Bernat Garrigós Bogić Gligorović, Sönke Hardersen, Otakar Holuša, Lars Iversen, Povilas Ivinskis, Miloš Jović, Vincent Kalkman, Mārtiņš Kalniņš, Sami Karjalainen, Despina Kitanova, Dejan Kulijer, Yordan Kutsarov, Michael Lockwood, Mathias Lohr, Olalla Lorenzo-Carballa, Milen Marinov, Mati Martin, Rüdiger Mauersberger, Christian Monnerat, Brian Nelson, Erland Nielsen, Steve Prentice, Roland Proess, Florent Prunier, Rainer Raab, Jolanta Rimšaitė, Elisa Riservato, Anxos Romeo Barreiro, Dušan Šácha, Göran Sahlen, Ali Šalamun, David Sparrow, Christoph Willigalla.

Chapters by: Jean-Pierre Boudot, Geert De Knijf, Klaas-Douwe B. Dijkstra, Jürgen Ott, Vincent J. Kalkman, Tim Termaat

Photographs by: Fons Peels

Additional photographs by: Valentina Assumma, Arno Braam, Christophe Brochard, Magnus Billqvist, Jean-Pierre Boudot, Rafal Bernard, Adolfo Cordero Rivera, Enrique Calzado Rivillas, Karen Conniff, Geert De Knijf, Klaas-Douwe B. Dijkstra, Pim Edelaar, Tim Faasen, Roy van Grunsven, Matías de las Heras Carmona, Dejan Kulijer, Philippe Lambret, Rene Manger, Erland Nielsen, Dennis Paulson, Florent Prunier, Evert Ruiter, Javier Ripoll Rodríguez, Albert Vliegenthart, Cedric Vanappelghem, Marcel Wascher

Please cite book as: Boudot, J.-P. & V.J. Kalkman (eds) 2015. *Atlas of the European dragonflies and damselflies*. – KNNV publishing, the Netherlands.

Please cite chapters, country accounts or species accounts as: De Knijf *et al*. 2015. Conservation of European dragonflies and damselflies. *In*: Boudot, J.-P. & V.J. Kalkman (eds.), *Atlas of the European dragonflies and damselflies*. – KNNV publishing, the Netherlands.

Design & layout: Henri van Santen, Imago Mediabuilders, Amersfoort, The Netherlands

Printer: Printer Trento, Italy

ISBN: 978 90 5011 4806
NUR: 432
www.knnvpublishing.nl

This book is published in cooperation with EIS Kenniscentrum Insecten en andere ongewervelden and Naturalis Biodiversity Center

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Acknowledgements

This book is based on at least 5 million records collected by volunteers across Europe in the past decades. If you would collect a new record each five minutes, making days of eight hours and have a field season which runs for at least 200 days a year than you would still need to spend more than 260 years in the field. And that would only accounts for the fieldwork… Volunteers are the backbone of the study and conservation of nature. Hurrah for volunteers!

The databases used to make the maps were maintained by the authors of this book or by the organizations they work for (see chapter Country Accounts). Additional help with preparing the database was received from: Kaare Hilmar Aagaard (Norway), Thomas Brockhaus (Germany), Jean-Michel Catil (France), David Chelmick (United Kingdom), Andreas Chovanec (Austria), Adolfo Cordero Rivera (Spain), Julien Dabry (France), Jean-Louis Dommanget (France), Sonia Ferreira (Portugal), Bernat Garrigós (Spain), Philippe Goffart (Belgium), Clément Henniaux (France), Paul Hope (United Kingdom), Eike Julius (Austria), Sami Karjalainen (Finland), Mladen Kotarac (Slovenia), Tapani Lahti (Finland), Michael Lockwood and all members of the Oxygastra group (Spain), Julia Lopau (Germany), Wolfgang Lopau (Germany), Cosmin Manci (Romania), Nino Mihokovic (Croatia), Christian Monnerat (Switserland), Mercedes Paris (Spain), Florent Prunier (Spain, France), Adolfo Cordero Rivera (Spain), Göran Sahlén (Sweden), Victor Salvador Vilarano (Spain), Eric Sansault (France), Wolfgang Schneider (Germany), Paul Schrijvershof (Netherlands), Vincent Ternois (France), Antonio Torralba Burrial (Spain), Bernd Trockur (Germany), Hisko de Vries – Observado.org (Netherlands), Martin Waldhauser (Czech Republic) and Michael Winterholler (Germany).

Nowadays an increasing amount of data is submitted to websites and data collected by the following websites have strongly contributed to the project: atlas.libellules-et-papillons-lr.org; assoslo.free.fr; allodonata.com; artskart.artsdatabanken.no; british-dragonflies.org.uk; www.ornitho.fr portal and all subordinate web sites; www.baznat.net; fugleognatur.dk; Hatikka.fi; observado.org; odonata.it/libe-italiane; www.cscf.ch; www.odonata-algarve.info and www.poitou-charentes-nature.asso.fr.
Vasil Ananian (Armenia) and Marc Tailly (Belgium) provided us with a database for Armenia, Azerbaijan and Georgia. Many people submitted additional data for poorly explored region or let us use (still) unpublished records of rare species: Matjaz Bedjanic (Slovenia), Christophe Brochard (Netherlands), Andrew Chambers (United Kingdom), Laurent Chevallier (France), Geert De Knijf (Belgium), Jan van der Dort (Netherlands), Ulrich Flenker (Germany), Richard Gaab (United Kingdom), Benoît Gauquier (France), Andreas German (Germany), Bogic Gligorovic (Montenegro), Bernd Gliwa (Lithuania), Katharine Glen (United Kingdom), Dietmar Ikemeyer (Germany), Eugene Karolinskiy (Ukraine), Bernd Kunz (Germany), Sylvain Lethuillier (France), Rüdiger Mauersberger (Germany), Pablo Martinez-Darve Sanz, Jan-Joost Mekkes (Netherlands), Rainald Moratin (France), Harm Niesen (Netherlands), Ewoud van der Ploeg (Netherlands), Fons Peels (Italy), Richard Porter (United Kingdom), Thomas Roussel (France), Ali Šalamun (Slovenia), Asmus Schrötter (Germany), Boudjéma Samraoui (Algeria), David Sannier (France), Nuno de Santos Loureiro (Portugal), Cédric Vanappelghem (France), David Walsh (United Kingdom) and Sabine Zèges (France). In addition we are grateful to all people who sent us their latest publications, allowing us to keep the maps as updated as possible.

The maps of the global distribution profited strongly from the comments delivered by Viola Clausnitzer (Germany), Matti Hämäläinen (Finland), Haruki Karube (Japan), Jens Kipping (Germany), Oleg Kosterin (Russia), Asmus Schröter (Germany), Vladimir Skvortsov (Russia) and Haomiao Zhang (China). André van Loon assisted with making the maps of the global distribution.

Although Fons Peels (Netherlands) is the primary person delivering the photographs of the species many other pictures of habitats or non-European species were delivered by: Valentina Assumma (Italy), Arno Braam (Netherlands), Christophe Brochard (Netherlands), Magnus Billqvist (Sweden), Rafal Bernard (Poland), Adolfo Cordero Rivera (Spain), Enrique Calzado Rivillas (Spain), Karen Conniff (Nepal), Bogusław Daraż (Poland), Geert De Knijf (Netherlands), KD Dijkstra (Netherlands), Pim Edelaar (Netherlands), Tim Faasen (Netherlands), Roy van Grunsven (Netherlands), Matías de las Heras Carmona (Spain), Dejan Kulijer (Bosnia and Herzegovina), Philippe Lambret (France), Rene Manger (Netherlands), Erland Nielsen (Denmark), Dennis Paulson (United States), Florent Prunier (Spain, France), Javier Ripoll Rodríguez (Spain), Evert Ruiter (Netherlands), Lee Ruth (United States), Dawid Tatarkiewicz (Poland), Albert Vliegenthart (Netherlands), Cedric Vanappelghem (France) and Marcel Wascher (Netherlands).

Only four of the fifty authors of this book have English as native language and we are grateful to David Chelmick (Great Britain), Brian Nelson (Great Britain), Adrian Parr (Great Britain), Steve Prentice (Great Britain) and especially Albert Orr (Australia) for correcting the English.

***Onychogomphus costae*, River Escalona near Quesa, Valencia, Spain.** Photograph Fons Peels.

Introduction

J.-P. Boudot & V.J. Kalkman

The history of the atlas project

For most of the 20th century, information on the distribution of European dragonflies was difficult to find and as late as the 1980s information on the distribution of dragonflies in such countries as Greece and Spain was extremely sparse. Since that time, the publication of field guides, the increased cooperation between people studying dragonflies and the possibilities offered by computers to construct databases has greatly increased our knowledge. From the late 1990s onwards the number of regional and national books published on the distribution of dragonflies began to increase markedly. During the same period it became more and more common for naturalists, mainly from western Europe, to venture to poorly explored countries in southern and eastern Europe, which in turn stimulated interest in dragonflies by local naturalists. By the beginning of the present century it had become clear that the production of an atlas of the European dragonfly fauna was an achievable goal. The Dutch-organised European Invertebrate Survey – the Netherlands, began investigating the possibilities for creating such an atlas. It soon became clear that funding the project would be difficult as national funding agencies would deem such a project too international and it was beyond the scope of existing Europe-oriented funding agencies. It was therefore decided in 2003 to begin the project without external funding by allowing Vincent Kalkman the time to build a network of national coordinators and encouraging them to build distribution databases. During the same period the IUCN started the Global Freshwater Assessments, which included dragonflies. In 2007 this resulted in a project for Red Lists of the dragonflies of North Africa and the Mediterranean (Riservato *et al.* 2009, Samraoui *et al.* 2010). To facilitate this project a workshop was held in Porto, Portugal in October 2007 bringing together people working on dragonflies in the Mediterranean. It was there that the idea for an atlas of the Mediterranean and North Africa was conceived. A fruitful collaboration between the seventeen authors and the editorial board of the German journal '*Libellula*' enabled this atlas to be published in early 2009 (Boudot *et al.* 2009). It was well received and convinced people that a general European atlas was possible, hence, from this time on, Jean-Pierre Boudot and Vincent Kalkman worked together on the organization of the European atlas project. At that time no database was available for several European countries, but a huge effort by several national coordinators filled these gaps, so that by summer 2012 distribution databases for all European countries were available. It was agreed that all national coordinators would author one or several of the species texts. As the time for the final editing of the text was limited, it was decided that J.-P. Boudot and V.J. Kalkman would write draft texts and that the national coordinators would edit these. This ensured a uniform format for the different species accounts. The literature on European dragonflies is very rich and the current book contains only a fraction on what is known. We feel however that the present publication gives a good overview of the knowledge regarding the distribution, habitat requirements and conservation status of European odonates to date.

Geographic scope

This book deals with all 143 species of extant dragonflies recorded in Europe. The easternmost boundaries of Europe are considered to be the Ural Mountains, the lower Volga valley and the Caspian sea. Also included in Europe are the Canary Islands, Madeira, the Azores and Iceland, as well as Cyprus and all Aegean Greek and Turkish Islands adjacent to Turkey. The crest of the Caucasus Mountains is considered to be the south-eastern border of Europe. The southern part of the Russian Krasnodar Oblast, south of the crest of the Caucasus Mountains is excluded and *Coenagrion ponticum* is therefore not considered as an European species.

Excluded species

This atlas deals with the species indigenous to Europe. Increasingly dragonflies and damselflies not native to Europe are introduced with aquarium plants. At least forty species are known to have been introduced in this way, the vast majority of these being Asian in origin. Thus far all these records are from contained environments (often glasshouses) and no non-native damselfly or dragonfly is known to reproduce in Europe in natural conditions. These species are not discussed in this atlas and for detailed information on non-native species recorded in Europe the reader should refer to Laister *et al.* (2014). A special case is the record in early September 1999 of a dead female of the North American *Pachydiplax longipennis* found on the oil rig Sedco 706 in the North Sea at 60°38'N, 01°39'E (Parr 2000). As it is not clear if the animal reached the oil rig alive and by its own means or if it has been carried there with cargo, it is not included in the European list.

Species accounts

The species accounts include for each species a dot map of its European distribution and a text giving information on taxonomy, distribution, population trends, conservation and habitat. In addition, for nearly all species, a graph of the flight period is given and for species occurring outside the area shown on the European map a map of its global range is given. The species accounts include the following paragraphs:

Taxonomy: Here the taxonomy of subspecies within Europe and nearby regions is discussed. The taxonomy

of non-European taxa is discussed when their status as either a species or subspecies is of importance to the information presented on the range of the species. Information on how the species are related to other species or genera can be found in the chapter on taxonomy. This header is absent when no relevant information is available. Synonyms that have been in use since 1980 can be found in the taxonomic checklist on page 323.

Distribution: Discusses the global and the European distribution, giving background information to the maps (see below). Information on distribution and abundance is in most cases taken from key references listed in the country accounts (pages 37-50) and citations are given only in specific cases.

Trend and conservation: The status and trend of a species on the Habitats Directive, European Red List and the Red List of the European Union member states 2010 (EU27) is tabulated. Details on range shifts, trends and threats are briefly discussed when appropriate.

Habitat: Gives a general overview of the habitats where the species is most likely to be encountered. The type of habitats favoured by a species often varies between regions, making it difficult to give a detailed description which is correct for its whole range. Instead, we tried to define key features of the habitat of importance throughout its range. Although not always cited, much of the information on the habitat of species is derived from the following references: Askew 1988, Sternberg & Buchwald 1999, 2000, Wildermuth *et al.* 2005, NVL 2002, Bernard *et al.* 2009.

Flight period: Here a graph showing the flight-period for several countries is given. Information on how these were arrived at can be found below in the paragraph 'Flight period'. A short text giving an indication of the flight period is given in cases where, due to the lack of a suitable database, no information on flight period could be presented as a graph.

European distribution maps

Coverage

This book deals with the 143 species included in the European checklist. For most species a standardized map is used. The distribution of the European species in areas adjacent to Europe, e.g. North Africa, southwest Asia and the Middle East is also shown. In Africa this area encompasses the whole of Morocco and Tunisia and the northern parts of Algeria, Libya, Western Sahara and Egypt. In Asia the maps include the whole of Armenia, Azerbaijan, Georgia, Iraq, Israel, Jordan, Kuwait, Lebanon, Syria, Turkey, Palestine and West Bank. The maps include parts of Iran, Kazakhstan, Saudi Arabia, Turkmenistan and Uzbekistan. Non-European species occurring in these areas are not considered. For a number of species with a small range in Europe, either regional endemics or sporadic migrants, an inset is given showing the distribution in more detail. For some species a slightly different map is shown, allowing the full range of the species to be shown.

Grid system, mapping period and symbols

A 50 x 50 km UTM grid (WGS84 geodesic system, Lambert conical projection) is used for the European dot maps and a 5 x 5 km UTM grid (same datum and projection) for the insets. Records prior to 1990 are depicted with a red dot and those from 1990 onwards with a blue dot. A relatively large proportion of the records from Russia is based on larvae although this is not always clearly stated in the literature. This makes it difficult to be certain about the identification. As European Russia is very poorly explored, we nonetheless decided to include them, representing less reliable records by green rather than blue or red dots. Plausible but uncertain records in other countries are also mapped as green dots. The majority of Hungarian records for the period since 1990 are based on larvae. Due to this it was impossible to identify the species-pairs *Somatochlora metallica* and *S. meridionale* to species level. The Hungarian records of this species-pair are therefore shown in green on the map of *S. metallica*.

The political borders shown in the figures have been chosen according to United Nations specifications, which are also used in IUCN publications. It is emphasized that the authors do not endorse any political considerations regarding country definition, nomination and delineation.

All maps in this publication showing the distribution of species with dots were made with the use of the following two programs:

- 'Data Fauna Flora v. 5.05', © Yvan Barbier (Laboratoire de Zoologie, Université de Mons-Hainaut, 6 Avenue du Champ de Mars, B-7000 Mons, Belgium), Pierre Rasmont (same affiliation), Marc Dufrêne (Région Wallonne, CRNFB) and Jean-Marie Sibert (Société entomologique du limousin), 2002-2015. This program was used for the database and adjustment of UTM coordinates,
- 'Carto Fauna Flora v. 2.1.5', © Yvan Barbier & Pierre Rasmont, 1995-2007. This program was used to generate the maps.

Databases and coverage

The maps presented in this book are based on a large number of national and regional databases. The country account (pages 37-50) gives for each country a short summary of the study of dragonflies, the most relevant publications and an impression of the size and quality of the database. The different databases contain nearly all published records. In addition, most national databases contain unpublished records. For most countries records are included up to the period 2010-2012. Publications and unpublished records appearing in the

period 2012-June 2015 were included in the database when they were deemed to have a significant impact on the maps. Figure 1 shows all the 50 x 50 km squares for which records are available prior to 1990, and figure 2 shows all records from 1990 onwards. For most countries records of dragonflies are available for nearly all 50 x 50 km squares. For Iceland and the northern parts of Scandinavia records are lacking in several quadrats due to the absence of dragonflies. Other squares without records of dragonflies occur in central Spain, parts

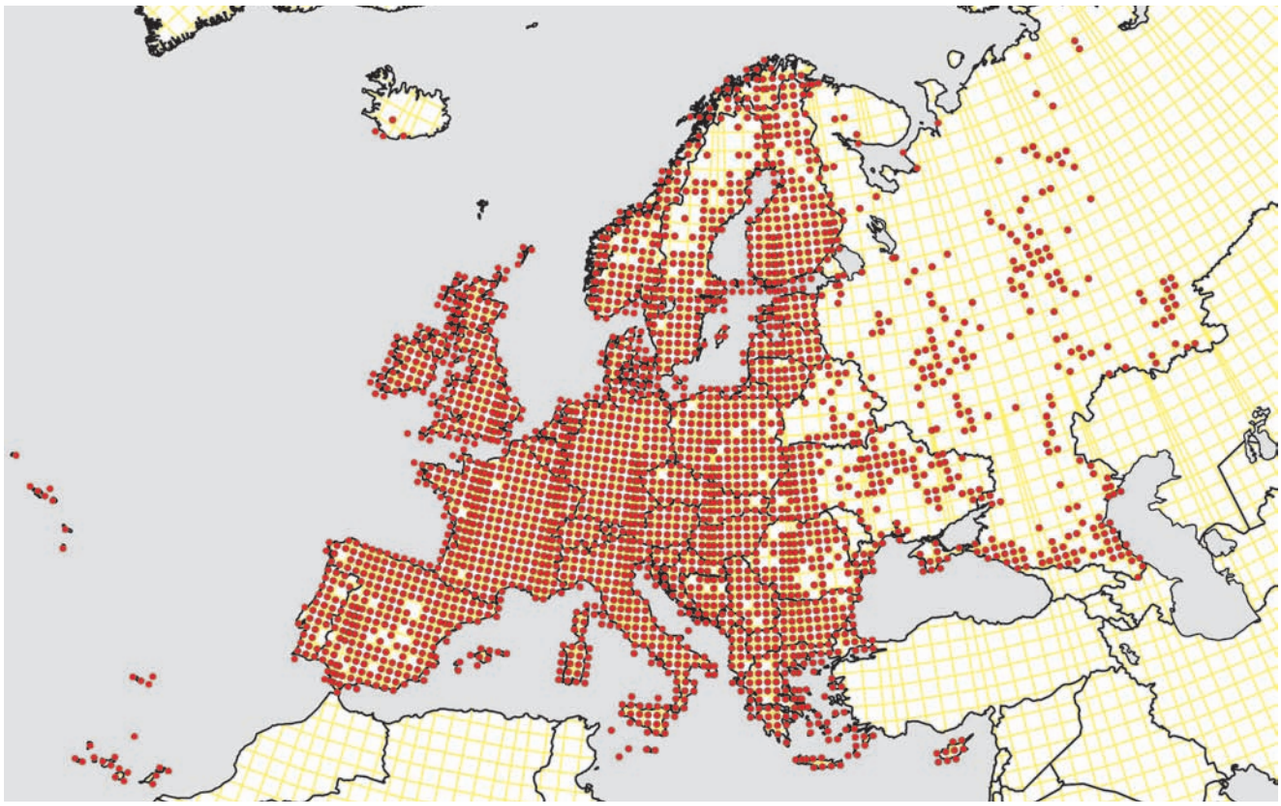


Figure 1. All 50x50 km squares from which records of dragonflies prior to 1990 are included in the database.

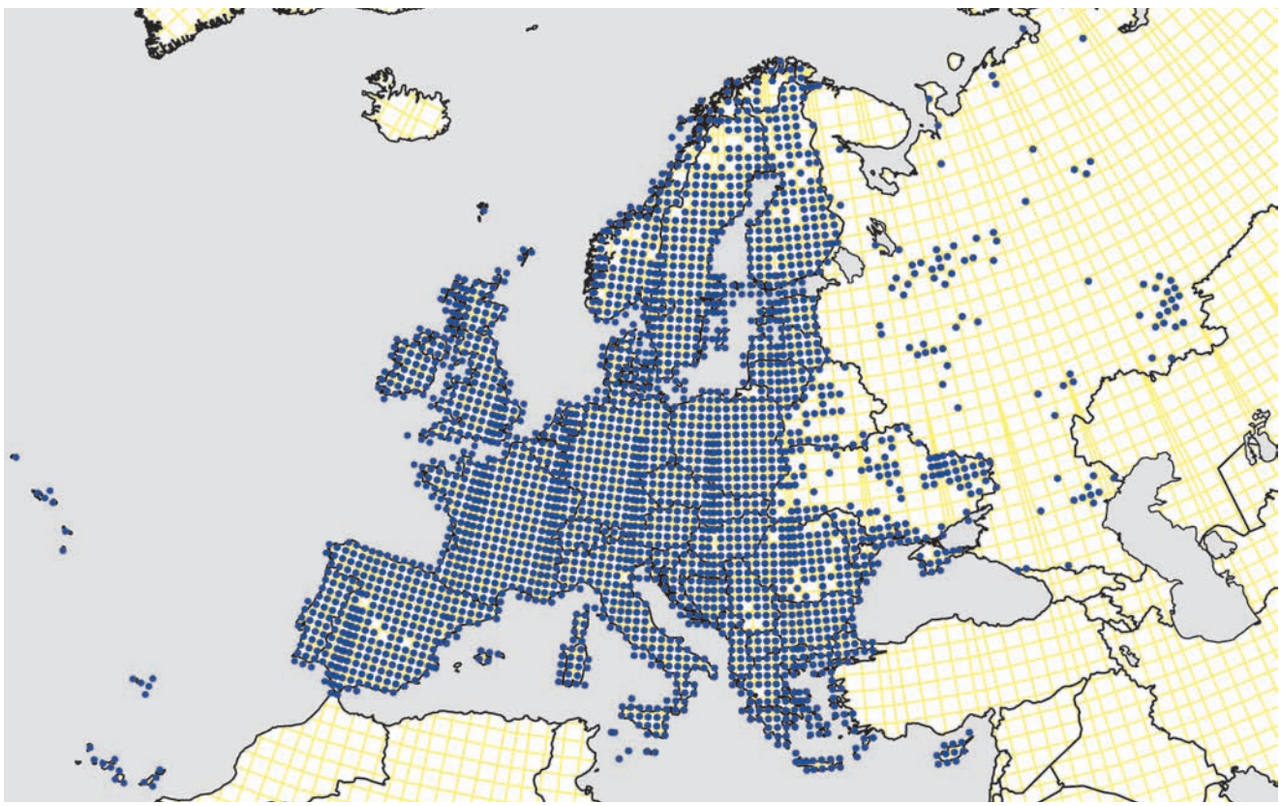


Figure 2. All 50x50 km squares from which records of dragonflies from 1990 onwards are included in the database.

of Romania and especially in Ukraine and Belarus. European Russia is a case on its own. It covers about one third of Europe but very few records have been published and many publications contain obvious misidentifications. For this reason the database for Russia has been based on a selection of papers in which the data were deemed to be sufficiently accurate.
In general it can be concluded that the information on the countries in western and central Europe is very good, that the information on Scandinavia and southern Europe is good to very good and that information on distribution in Romania, Moldova and Ukraine is sufficient to understand the general patterns of species distribution. These latter countries were poorly explored prior to 1990 but the amount of information recently increased greatly due to the efforts of Cosmin Manci in Romania and Elena Dyatlova, Lyudmyla Khrokalo and Alexander Martynov in Moldova and the Ukraine. Large areas of Belarus and especially of Russia are insufficiently explored.

The data from North Africa, the Middle East and southwest Asia are from a database maintained by Jean-Pierre Boudot, summarised in Boudot *et al.* (2009). The database has been updated since that time and includes records published for this area up to August 2015. For Armenia, Georgia and Azerbaijan a database was constructed by Vasil Ananian and Marc Tailly from the literature and collectively georeferenced. This information has been updated with both their own findings and data collected by Asmus Schröter and other visitors (Durand & Rigaux 2015, Rodriguez Martinez & Conesa Garcia 2015, Schröter *et al.* 2015).

Validation

Validation of the data was largely the responsibility of those constructing the regional or national databases. The European maps were sent to all authors for a quality check. Dots regarded as anomalous were rechecked by consulting the original data in the database and revising the coordinates where necessary. Records regarded as incorrect or doubtful are not shown on the map. Incorrect or doubtful records available in the literature which are of importance to the general distribution pattern of species are in most cases discussed in the species accounts.

Global distribution maps

Maps of the global distribution have been made for European species occurring outside Europe in areas not covered by the dot maps. The information on the distribution of species outside Europe is in many cases relatively poor. This makes that the global distribution maps must be used with caution as they are often based on the interpretation of a relatively low number of records.

Africa – The distribution in Africa south of the Sahara is based on the Odonata Database of Africa (ODA) maintained under the collaborative efforts of Jens Kipping, 'K.D.' Dijkstra, Viola Clausnitzer, Frank Suhling, Andreas Martens and Michael J. Samways. Most of the European species found south of the Sahara are common and often widespread throughout Africa with the exception of parts of the Sahara and the areas with closed rain forest.
America – Information on the distribution in North America is largely based on the maps available on www.odonatacentral.org and maps found in Paulson (2009, 2011).
Southeast Asia and Australia – Only a few European species are shared with Southeast Asia and Australia. Information from these areas was derived from the Melanesian Odonata Database (Dow & Kalkman, unpublished) and from Theischinger & Endersby (2009).
Mainland Asia – Many European species extend eastwards into Asia sometimes reaching as far east as Japan. Information is poor and/or difficult to access for large parts of Central Asia, India and China. Table 1 lists the main literature used for the global distribution maps of European species in Asia.

Country	Name
Afghanistan	Schmidt 1961
Burma	Fraser 1933, 1934, 1936
China	pers. com. Haomiao Zhang
India	Fraser 1933, 1934, 1936
Japan	Sugimura *et al.* 2001, Ozono *et al.* 2012
Kazakhstan	Chaplina 2007, Kosterin & Gorbunov 2010, Kosterin & Borisov 2010
Kirgizstan	Borisov & Haritonov 2007, 2008, Schröter 2010
Mongolia	Peters 1985, Dumont 2003
Nepal	Vick 1989, Clausnitzer & Wesche 1996
North Korea	Lee 2001, Yum *et al.* 2010
Pakistan	Fraser 1933, 1934, 1936
Russia (Asian part)	Belyshev 1973a, b, 1974, Kosterin 2004, Kosterin 2005, Yanybaeva *et al.* 2006, Popova & Haritonov, 2008, Kosterin & Sivtseva 2009, Malikova & Kosterin 2009, Bernard & Kosterin 2010, Kosterin & Zaika 2010
South Korea	Lee 2001, Yum *et al.* 2010
Sri Lanka	Bedjanič *et al.* 2014
Tajikistan	Borisov & Haritonov 2007, 2008
Thailand	Hämäläinen & Pinratana 1999
Turkmenistan	Borisov & Haritonov 2007, 2008
Uzbekistan	Borisov & Haritonov 2007, 2008
Vietnam	Do & Dang 2007

Table 1. Key references used for the global distribution maps of European species in Asia.

Flight period

The flight period is shown in a graph and gives information on the overall flight period (pale shade) and the main flight period (dark shade) in seven different European regions (table 2). France has been split into a

northern (north of 46°N) and a southern region (south of 45°N, without Corsica). For a number of rare southern European species additional information on the flight period is given based on records from Turkey or from the Maghreb (Morocco, Algeria and Tunisia). The regions in these tables are ordered from north to south. The first and last dates for species often refer to rare events and do not give a proper impression of the normal flight period. For this reason the start and end of the flight season has been defined as the first ten days in which respectively at least 1 or 99 percent of the cumulative records have been made. A record is defined as a species on a single day at a single locality. The number of specimens observed is not taken into account. Only records pertaining to imagoes with complete information on date from the period 1990 onwards were used. The main flight period gives the period in which the species is most likely to be observed. This period is determined by the first and last ten days in which 10 percent or more of the total number of records of a species were made. In a few species a flight period shows two distinct peaks and in these cases the main flight period is bimodal. Both species of *Sympecma* have a very long flight period and due to this rarely have ten percent of the records made in one observation period. In these species the limit for the main flight period was set at five percent of the records falling in one ten day period. For countries where less than 50 records were available the number of records is given in the last column.

Region	Number of records from 1990-2011
Norway & Sweden	47 790
Netherlands	939 649
Bavaria	100 557
France, north of 46°N	133 119
France, without Corsica	274 224
France, south of 46°N, without Corsica	69 527
Bulgaria & Greece	18 875

Table 2. Regions for which information on flight period is tabulated in the species accounts. The second column gives the number of records on which the information is based.

The information of the flight period in the Maghreb, Turkey and Greece is largely based on records made by people holidaying in these countries. Due to this records from the summer period are over-represented. Fieldwork at other times of the year will probably show the flight period of many Mediterranean species to be longer than currently known.

***Somatochlora borisi*, River Diavolorema, near Mikro Derio, Thrace, Greece.** Photograph Fons Peels.

Phylogeny and classification

K.-D.B. Dijkstra & V.J. Kalkman

The first dragonfly to receive its scientific name was *Libellula quadrimaculata*, which was described by Linnaeus in 1758 in his "Systema Naturae". Numerous species descriptions followed and eighty years later Charpentier (1840) and Selys-Longchamps (1840) simultaneously provided the first syntheses of the European odonate fauna. It is not unlikely that both thought the taxonomy of European dragonflies was nearly complete and that they would be astonished to hear that 175 years later we are still describing new species and unravelling their evolutionary relationships (phylogeny). Striking examples are the description of *Somatochlora borisi* as new to science as recently as 2001 and the discovery in 2009 that "*Brachythemis leucosticta*" found north of the Mediterranean Sea was not what Burmeister (1839) named as such from South Africa. It seems unlikely that any other new species will be discovered in Europe but discovering new species in the Western Palaearctic is still possible as evidenced by the recent discovery of *Onychogomphus boudoti* in Morocco and *Aeshna vercanica* in northern Iran (Ferreira *et al*. 2014, Schneider *et al*. 2015) (Figures 3 and 9). Illustrative for the ongoing discussion on the taxonomy of dragonflies is that the placement of species into genera still varies between authors. There are still many issues regarding the phylogeny of European dragonflies to be solved (Table 3). Molecular research has rapidly increased knowledge, especially since the start of the 21st century, as it allows more objective testing of the relationships between species and genera. With current progress it seems likely that most remaining issues will be resolved in the next two decades.

This chapter provides an overview of how European dragonflies are related with each other as well as with non-European species and describes recent or anticipated changes in taxonomy. Information on taxonomic problems regarding subspecies can be found in the species texts. This chapter is based on a more extensive review published elsewhere (Dijkstra & Kalkman 2012).

Figure 3. New species are still to be found in the Western Palaearctic as evidenced by the recent discovery of *Aeshna vercanica* in northern Iran. Photograph: Dietmar Ikemeyer.

What do we consider a species?

Linnaean nomenclature aims for two conflicting things: (1) to offer stable labels for taxa and (2) to provide information about relationships of these taxa in a nested classification. Consequently new insights into relationships may lead to names changing. When defining a species, most people apply a biological concept: a species is a group of populations with nearly constant features whose members can produce viable and fertile offspring in nature. However, in most cases such detailed knowledge is unavailable, forcing taxonomists to apply more practical (usually morphological, but increasingly genetic) criteria to define species. Where populations appear different, but it is uncertain whether they constitute distinct species, the subspecies category is often applied. Most lower-level taxonomic problems with European Odonata concern either (1) whether a subspecies is so distinct that recognising it as full species is more appropriate, or (2) whether subspecies are distinct enough to be named at all. Criteria that may be applied are: (1) distinctness, i.e. both species and subspecies differ genetically from their nearest relatives without much gradual variation in-between, (2) distribution, i.e. subspecies of the same species by definition cannot breed at the same location, and (3) appropriateness, i.e. is it more preferable to recognise a full species rather than a subspecies? The first two points are not absolute and should not be applied dogmatically, as subspecies (and species) often originate from the fragmentation of their common ancestor's range (e.g. by environmental change) and may subse-

1.	*Aeshna* and *Anax*; generic identity of *A. affinis*, *A. isoceles*, *A. mixta* and *A. ephippiger* (Peters 1987, Gentilini & Peters 1993, Peters 2000, von Ellenrieder 2002, 2003).
2.	*Libellula*; generic identity of *L. depressa* and *L. fulva* in relation to *Ladona* (Ware *et al.* 2007, Fleck *et al.* 2008).
3.	*Gomphus* (*sensu lato*); generic identity of *G. flavipes* in relation to *Stylurus*, status of *G. schneiderii* in relation to *G. vulgatissimus*.
4.	*Somatochlora*; validity of *Corduliochlora* for *S. borisi*, status of *S. meridionalis* in relation to *S. metallica* (Marinov & Seidenbusch 2007, Fleck et al. 2007).
5.	*Lestes*; specific identity of *L. virens* taxa in relation to *L. numidicus* (Samraoui et al. 2003, Samraoui 2009).
6.	*Sympetrum*; separation of *S. nigrifemur* and *S. striolatum*, identity of *S. vulgatum ibericum*.
7.	*Caliaeschna*; generic identity of *C. microstigma* in relation to *Cephalaeschna* (von Ellenrieder 2002).

Table 3. Foremost remaining challenges regarding the phylogeny of European dragonflies.

quently meet, overlap, hybridize and thus produce intermediates. The third criterion is largely practical, because the presence of overlap is easier to prove than its absence, and because the characters distinguishing subspecies tend to be closer to ordinary individual variation, good species are easier to recognise than good subspecies. Nonetheless, past taxonomists often named variations (e.g. of size or paleness under environmental influence), thus swamping well-defined taxa with poorly defined ones. The paradox is that recognising a lower rank (subspecies) actually requires more scrutiny: (1) phenotypic expression must be ruled out to explain differences, (2) geographic analysis is needed to rule out gradual variation, (3) the possibility of recognising the taxon as a full species must be considered, and (4) the previous three criteria must be considered also for the nominotypic subspecies, which is created automatically by the introduction of a subspecies.

What do we consider a genus?

Once a species' distinctness is confirmed, the question arises to which genus it belongs. Unlike with species, there is no biological definition for genera, families or any other higher taxonomic category. Their use can be governed by stability (names and classifications should change as little as possible) and monophyly (each group should include all descendants of a single ancestor, a so called monophyletic group). Thus any change in name combinations should be preceded by (1) phylogenetic analysis, to preclude creation of non-monophyletic groups, and (2) consideration of the solution that leads to least change, considering splits with additional care. Because genera are practical tools rather than biological entities, supplementary subjective arguments may be considered, such as numbers of species included. By unravelling evolutionary histories, phylogenetic studies aid to classify species into natural groups. Informative characters for phylogenetic reconstructions are generally either morphological or molecular. While venation was used as the main guide to define families and genera in the past, recent work has shown that such features may not identify groups of close relatives reliably, as similar characters, such as the reduction of certain veins, have evolved multiple times. Studies incorporating other morphological features, such as of genitalia and larvae, may help overcome this problem. Generally, when molecular and morphological evidence are in agreement, often in synchrony with geographical or ecological patterns, relationships are resolved most convincingly.

Odonata – damselflies and dragonflies

Dragonflies belong to the superorder Odonatoptera, one of the oldest insect radiations to take flight, dating back at least to the early Carboniferous. This radiation includes the largest insect that ever lived, the griffenfly *Meganeuropsis permiana*, with a wingspan of about 70 cm. The radiation led to the rise of the order Odonata, with the oldest fossils dating back to the Permian. The present-day Odonata is regarded as a monophyletic group, which is divided into three suborders: Zygoptera or damselflies and Anisoptera or true dragonflies – each with approximately 3,000 species – and a small suborder Anisozygoptera with four species in Asia (Dijkstra *et al.* 2013a). Unique features of odonates are the strongly modified larval labium and the mechanism of indirect sperm transfer using a male copulatory organ at the abdomen base.

Zygoptera- damselflies

Imagines of damselflies have a broad head with widely separated eyes and a slender abdomen. The fore and hind wings are similar in shape, and most species rest with their wings closed. The larvae have three (sometimes two) caudal gills for respiration, which can also be used as flippers for swimming. Damselflies are divided into 27 families, most of which are restricted to the tropics and only five occur in Europe (Figure 4a). The position of 14 genera remains uncertain and these are considered *incertae sedis* (Latin for "of uncertain seat, i.e. taxonomic position"). It is likely that further work will show that these constitute seven additional families (Dijkstra *et al.* 2013b).

Lestidae

The genus ***Lestes*** is heterogeneous and is likely to be split in several genera in the future. The five European species of *Lestes* fall into a northern (*dryas*, *sponsa*) and southern group (*barbarus*, *macrostigma*, *virens*), but probably the nearest relatives of many species are North American or north-east Asian. A global phylogeny of *Lestes* is needed to resolve that and will probably lead to the tropical species being split off as separate genera (see e.g. Dumont *et al.* 2010).

The two species of ***Chalcolestes*** differ notably from the five European species of *Lestes* by their larger, sleeker and greener (no pruinosity) appearance, as well as by their habit of laying eggs in living wood. The genus *Chalcolestes* was already created by Kennedy (1920) for *C. viridis* based on small differences in venation and the penis, and Lohmann (1993b) noted that the larval prementum lacked the distinctive stalked shape found in *Lestes*. More recently molecular work showed that *Chalcolestes* forms a monophyletic group with *Sympecma* and the Asian genus *Indolestes*, distant from the true *Lestes* species (Dumont *et al.* 2010, Gyulavári *et al.* 2011).

While many tropical odonates survive unfavourable periods as adult, ***Sympecma*** is the only temperate genus with a similar strategy. The three closely similar species occur together in Central Asia, but while *S. gobica* is restricted to that region, *S. fusca* extends from Europe and North Africa to Central Asia and *S. paedisca* from The Netherlands and Switzerland to Japan.

Calopterygidae

The phylogeny of Calopterygidae has been well-studied (Misof *et al.* 2000, Weekers *et al.* 2001, Dumont *et al.* 2005, 2007, Sadeghi *et al.* 2010). Males of most

species have distinct wing pigmentation, which plays a role in often elaborated agonistic and courtship behaviour. All species are confined to running water. The family's greatest diversity is found in eastern Asia. Probably the genus ***Calopteryx*** originated there, with dispersal to North America leading to a monophyletic radiation of five species, and westwards across the Palaearctic to an unresolved complex of about twenty species (Misof *et al.* 2000, Dumont *et al.* 2007). Several eastern species probably do not belong to *Calopteryx* and are either more closely related to the Asian genera *Matrona* Selys, 1853 or *Atrocalopteryx* Dumont *et al.*, 2005, or belong to still unnamed genera. All Western Palaearctic species appear closely related and the limits between them are hazy, in part due to the large number of subspecies described and the meagre morphological differences between them, most notably in the *splendens*-complex. Various studies indicate that this complexity stems from the isolation of populations during glaciations and their subsequent expansion resulting in large-scale hybridisation and sometimes overlapping ranges between taxa. These studies also show that similarities in the shape of the wing and its markings do not necessarily reflect close relationships and cannot help define the taxa more clearly (Misof *et al.* 2000, Weekers *et al.* 2001, Dumont *et al.* 2005, Sadeghi *et al.* 2010). The *splendens*-complex was the focus of several papers but unfortunately these all used different molecular methods and different selection of taxa, making the results difficult to interpret and inconclusive. Most 'subspecies' of *splendens* (e.g. *amasina* Bartenev, 1911, *ancilla* Selys, 1887, *balcanica* Fudakowski, 1930, *caprai* Conci, 1956, *cartvelica* Bartenev, 1930, *faivrei* Lacroix, 1915, *intermedia* Selys, 1887, *mingrelica* Selys, 1869, *taurica* Selys, 1853, *tschaldirica* Bartenev, 1909, *transcaspica* Bartenev, 1912) are probably hybrid populations from at least four ancestral gene pools, three in western Asia and one in the western Mediterranean, and should not be defined as subspecies, let alone as species. Currently only *C. exul* Selys, 1853 from North Africa and *C. xanthostoma* (Charpentier, 1825) from Iberia and southern France are commonly treated as distinct from *C. splendens*, the first because it is conveniently completely separated in range and appearance, the second because it overlaps rather than intergrades with *splendens* in France and is genetically rather distinct there (Weekers *et al.* 2001). Other potentially valid species in the complex are

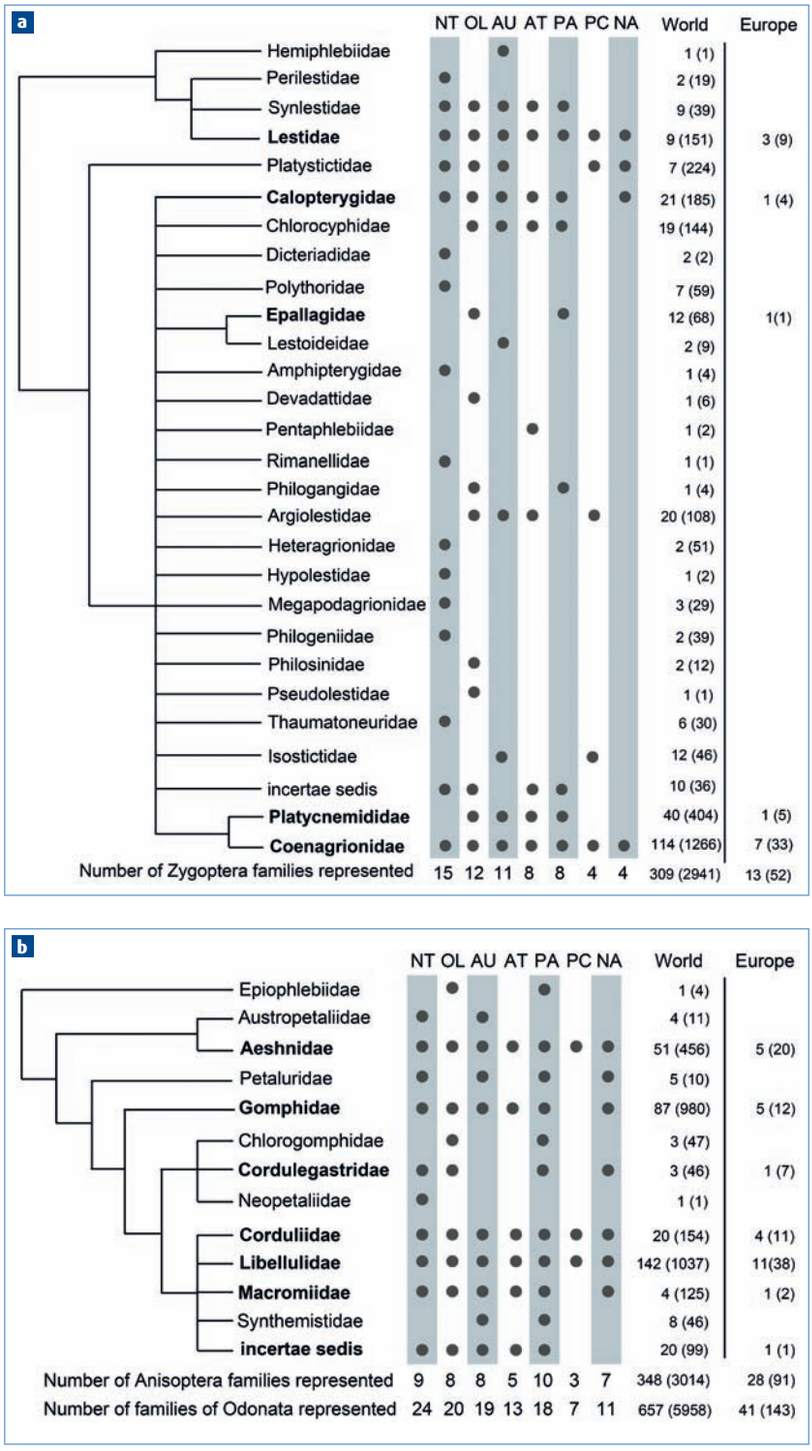


Figure 4. Summary of the phylogeny of (a) Zygoptera and (b) Anisoptera. For each family the known number of genera and species (in brackets) are shown for the world and Europe, as is their presence in biogeographic regions: Afrotropical (AT), Australasian (AU), Nearctic (NA), Neotropical (NT), Oriental (OL), Pacific (PC) and Palaearctic (PA) regions. A number of genera cannot be placed into families at present and are shown as *incertae sedis*. The information is based on Dijkstra *et al.* (2013a, b) and Suhling *et al.* (2015).

C. waterstoni Schneider, 1984 on the south-eastern fringe of the Black Sea and *C. orientalis* Selys, 1887 on the southern fringe of the Caspian Sea, while other seemingly distinctive taxa, like *C. syriaca* Rambur, 1842 and *C. hyalina* Martin, 1909 in the Near East, have simply not been studied genetically at all (Sadeghi *et al.* 2010).

Epallagidae/Euphaeidae

The discussion whether actually Epallagidae is the correct name for this family has not been settled (Dijkstra *et al.* 2013a), see Bechly (1999) for details. It is the only damselfly family largely endemic to the Oriental region. With their rather large size, sturdy build and numerous antenodal cross-veins, the approximately 70 species resemble Calopterygidae, although they lack metallic colours. Their larvae are easily recognised by their sack-like caudal gills and unique finger-like lateral abdominal gills, a character that supports the family's monophyly. Many species have coloured wings, which presumably have a function in courtship or territorial behaviour, but no species have been studied in detail. All species breed in running water, most of them in forest. The monotypic (having one species only) European genus ***Epallage*** ranges from south-eastern Europe to Pakistan. Other species of the family are found from the Himalayas of western India eastwards and do not overlap with *Epallage*. The genus *Bayadera* Selys, 1853 might be its nearest relative (Figure 5), but the almost unstalked wings, robustness and appendage shape make *E. fatime* unique enough to merit its own genus. Also, *Epallage* usually holds its wings outstretched (shared with *B. melanopteryx* Ris, 1912) when perched, rather than closed or half open, and is the only species of the family with completely densely pruinose males, which is possibly an adaptation to open sunny habitats.

Figure 5. *Bayadera indica*, Nepal. The Oriental genus *Bayadera* may be the nearest relative of the genus *Epallage*. Photograph: Karen Conniff.

Figure 6. *Mecistogaster linearis*, Peru. The 'giant damselflies' of the Neotropics were until recently placed a the family Pseudostigmatidae. Molecular work showed that they fall into the family Coenagrionidae with the European genera *Ceriagrion*, *Nehalennia* and *Pyrrhosoma* being more closely related to these giants than to any other European genus of Coenagrionidae. Photograph: Tim Faasen.

Platycnemididae

The family Platycnemididae is confined to the Old World with the highest diversity found in tropical Africa, south-eastern Asia and New Guinea. ***Platycnemis*** is the only genus present in Europe and includes ten species of which four are found in eastern Asia and six in the Western Palaearctic. The six Western Palaearctic species form a monophyletic group of which three species occur widely in Europe, two in the Near East (with one just reaching the south of European Russian), and one in north-western Africa (vagrant to the Canary Islands).

Coenagrionidae

With almost 1300 species, the Coenagrionidae is the largest family of damselflies, forming a major part of the odonate fauna in all continents. With Lestidae, it is the only damselfly family of which many species inhabit standing waters. Many species have good dispersal powers and comparatively large distributions. Molecular studies indicate that Coenagrionidae includes two large and almost certainly monophyletic groups, each including about half of the world's species, and further work might show that it is convenient to divide this huge family into multiple subfamilies or even families (Dijkstra *et al.* 2013b). *Ceriagrion*, *Nehalennia* and *Pyrrhosoma* belong to the 'ridge-faced Coenagrionidae', while all remaining European genera fall in the 'core Coenagrionidae' (Figure 6). Many genera in the ridge-faced group, including *Ceriagrion*, possess a marked transverse ridge between the antennae but lack postocular spots, while all in the core group have a rounded frons and often postocular spots.

About fifty ***Ceriagrion*** species occur in the warm parts of Africa and Asia with one species reaching northern Australia. Like our *C. tenellum* and *C. georgifreyi*, most species are red, but they can also be blue, green or yellow. Generally, however, dark markings are absent. Thus the two European species are not only unusual by their temperate distribution, although they favour warm microhabitats, but also by their dark bronzy tho-

rax (Kalkman 2005). The only similar species is *C. sinense* Asahina, 1967, which is known from a handful of mountainous sites in south-eastern China (Asahina 1967). These sites also have a temperate climate and *C. sinense* is a good candidate to be the nearest relative of the European species.

Coenagrion has around 40 species in the Palaearctic and three more in the Nearctic. Nineteen species are found in the Western Palaearctic, with fourteen in Europe. Swaegers *et al.* (2014) provided a molecular revision based on sixteen *Coenagrion* species, including all European species except *C. ecornutum* and *C. intermedium*. The northern European species all inhabit standing waters. While *C. hylas* stands apart, the other species are closely related: *C. armatum*, *C. glaciale*, *C. hastulatum, C. johanssoni*, *C. lunulatum*, and probably *C. ecornutum*. This group also includes the North American *C. angulatum* Walker, 1912, which is very closely related to the Eurasian *C. lunulatum*. The southern European species fall into two groups, one including *C. scitulum* and *C. caerulescens* and one with *C. puella*, *C. pulchellum*, *C. ornatum, C. mercuriale* and *C. intermedium*. Both groups include species of standing and species of flowing waters. While the former group is centred in the western Mediterranean, the latter is most diverse to the east, with several additional (but extremely similar) species in south-western Asia.

While forty ***Enallagma*** species occur in the New World (mostly North America), only four inhabit the Old World. Morphological and genetic studies revealed that *Enallagma* consists of two subgenera (Brown *et al.* 2000, May 2002, Turgeon & McPeek 2002, Turgeon *et al.* 2005). The subgenus *Chromatallagma* May, 2002 includes seventeen species with a mostly southern Nearctic distribution. The species of this subgenus are often colourful (red, orange, yellow, green) and radiated largely before the Quaternary. The diversity of *Enallagma* (*sensu stricto*) is much younger and it has a more northern Holarctic distribution. Males of nearly all its species are blue with a black pattern, resembling the European *E. cyathigerum*. The subgenus includes two large North American radiations. A third radiation originates from the colonisation of northern Eurasia, resulting in the four Palaearctic taxa (*E. cyathigerum, E. risi* Schmidt, 1961*, E. deserti* Selys, 1871*, E. circulatum* Selys, 1883) that are variably considered as species or as subspecies of *E. cyathigerum* (Samraoui *et al.* 2002, Kosterin & Zaika 2010, Stoks *et al.* 2005). The male appendages and larval morphology and behaviour of the Palaearctic *E. cyathigerum* are nearly identical to those of the Nearctic *E. annexum* (Hagen, 1861) and *E. vernale* Gloyd, 1943, as are those of the Palaearctic *E. circulatum*, *E. risi* and *E. deserti* to the Nearctic *E. boreale* (Selys, 1875), although these similar species are not closely related. This remarkable case of parallel evolution is thought to be driven by similar selection pressures in both areas, mainly in response to predation (Stoks *et al.* 2005).

The red-eyed ***Erythromma*** species *E. najas* and *E. viridulum* resemble each other strongly, but the blue-eyed *E. lindenii* looks very different on first sight. Until recently it was placed in *Cercion* Navás, 1907 but Heidemann & Seidenbusch (1993) first postulated that it should be included in *Erythromma* based on larval characters. This was not accepted until Weekers & Dumont (2004) provided molecular support. Several characters of the adults agree with these findings, including the shape of the appendages, the configuration of blue markings, and the male's habit to perch on vegetation far from banks. Also *E. lindenii*, like the two red-eyed species, lacks the dark dorsum of the eye that is present in other European coenagrionids. The Palaeotropical genus *Pseudagrion* Selys, 1876 and the Oriental *Paracercion* Weekers & Dumont, 2004 may be the nearest relatives of *Erythromma* (Bybee *et al.* 2008, Carle *et al.* 2008, Dumont *et al.* 2010).

The nearly 70 species of ***Ischnura*** are found on all continents except Antarctica. Most species inhabit standing or slow-flowing waters, and especially in the temperate region they are often among the most common and widespread odonates. Males of most species possess a bicoloured pterostigma, while females often occur in genetically discrete colour forms that also vary with age. Published molecular phylogenies suffer from a limited taxon-sampling but indicate that the two most widespread European species might fall into two different clades, the *elegans*-group and the *pumilio*-group (Chippindale *et al.* 1999, Dumont *et al.* 2010, Dumont 2013). The Eurasian *pumilio*-group (*sensu stricto*) is closest to a Nearctic radiation that includes *I. hastata*, of which the world's only parthenogenetic odonate populations occur in the Azores. *Ischnura hastata* has been placed in a separate genus as *Anomalogrion hastatum* based on the unique teardrop-shaped pterostigmas that are separated from the costal edge of the male forewings. Molecular study showed, however, that this species falls within the genus *Ischnura* (Chippindale *et al.* 1999). Besides *I. pumilio*, the *pumilio*-group includes several other Eurasian species including *I. intermedia* and *I. forcipata* found in south-west Asia (Dumont & Borisov 1995). The *elegans*-group (*sensu stricto*) consists of *I. elegans* which is widespread throughout the middle-latitudes of Eurasia, *I. graellsii*, present from Iberia to the Atlas Mountains in North Africa, *I. saharensis*, present throughout the Sahara south of the latter from the Atlantic to Chad and Libya, *I. fountaineae* from northern Africa to the Middle East and central Asia, *I. aralensis* in western Asia and *I. genei* on the Tyrrhenian islands. The group is related to some of the most widespread tropical damselflies, such as *I. senegalensis* found from Africa to East Asia, *I. heterosticta* (Burmeister, 1839) from Australia, *I. aurora* Brauer, 1865 in Australasia and the Pacific, and *I. ramburii* (Selys, 1850) from the Americas. This suggests that the *elegans*-group originates from this warm-adapted diversification and represents a presumably recent radiation. The species are very

closely related and almost completely separated geographically. Where they meet – *elegans* and *graellsii* in Spain, *elegans* and *genei* in the Tyrrhenian islands, *graellsii* and *saharensis* in North-Africa – they are able to interbreed and hybridize (Monetti *et al*. 2002, Sanchez-Guillen *et al*. 2011, 2013).
Five of the six ***Nehalennia*** species are American, while *N. speciosa* is found from Europe to Japan. All species are very small and possess a distinctively spiny abdomen tip, but while the four temperate species are largely metallic green, the two tropical American ones are black (Paulson 2009). They inhabit standing waters, often with dense sedges and grasses. The nearest relative of this distinctive genus is among the ridge-faced coenagrionids like *Ceriagrion*, but their precise relationships are unclear. The Nearctic bog species *N. gracilis* is the sister species of *N. speciosa* (De Marmels 1984). It presumably is a relatively recent American arrival in the Palaearctic and shows almost no genetic diversity across its huge and fragmented range (Bernard & Schmitt 2010, Bernard *et al.* 2011, Suvorov 2011). Such poverty may be explained by the colonisation of large parts of the Palaearctic from a single refugium, most likely in the Asian Far East, since the end of the last Ice Age only 12,000 years ago (Bernard *et al.* 2011).

Figure 7. Being blue, the North American *Chromagrion conditum* does not resemble the European *Pyrrhosoma* species although it shares its banded eyes. However, appearances can be deceiving: both morphology and molecular analyses show this is their nearest relative. Photograph: Dennis Paulson.

Figure 8. *Oxygastra curtisii* is the only member of the genus *Oxygastra*. It belongs to a group of genera that are considered of uncertain taxonomic position. Perhaps the Neotropical genus *Neocordulia* or Madagascan *Nesocordulia* are the nearest relatives of the genus *Oxygastra*. Photograph: Fons Peels.

The two species of ***Pyrrhosoma*** are completely (*P. elisabethae*) or largely confined to Europe (*P. nymphula*) (Kalkman & Lopau 2006). The genera *Chromagrion* Needham, 1903 with one species in North-America and *Huosoma* Guan *et al.*, 2013 with two species in China are their closest relatives (Guan *et al.* 2013) (Figure 7). Especially the species of *Huosoma* resemble *Pyrrhosoma* closely and are also rather robust red damselflies marked with black and yellow, which lack postocular spots (Yu *et al.* 2008).

Anisoptera

Anisopteran imagines are on average larger and more robust than those belonging to Zygoptera. Their hind wings are distinctly broader at the base than the fore wings, and in most families the eyes touch on top of the head. At rest most species spread their wings. The larvae are typically also sturdier and lack caudal gills. At present eleven families are recognised of which six are found in Europe (Figure 4b). From the European perspective the most important recent study is that of Ware *et al.* (2007) which showed that the Macromiidae is better regarded as a family distinct from the Corduliidae. Furthermore it was shown that several other genera included earlier in the Corduliidae are not closely related and some are now placed in the Australasian family Synthemistidae while twenty other genera are considered *incertae sedis* (Dijkstra *et al.* 2013a). It is clear that these do not belong to any of the currently recognised families, but it is uncertain whether they form one large family or several small ones, so further study is needed. The only European genus of this group is ***Oxygastra***, whose most striking feature is the dorsal crest on the terminal abdominal segment. The Neotropical *Neocordulia* Selys, 1882 and Madagascan *Nesocordulia* McLachlan, 1882 possess somewhat similar structures, but these genera were not studied by Ware *et al.* (2007). Whether such a distant relationship is proven or not, it appears that *Oxygastra* represents the phylogenetically most isolated odonate in Europe and possibly its oldest relict (Figure 8).

Aeshnidae

In contrast to all other European Anisoptera the Aeshnidae, like the Zygoptera, have an unreduced ovipositor. Von Ellenrieder (2002, 2003) provided a phylogeny based on the morphology of all existing aeshnid genera (2002) and the species assigned to *Aeshna* (2003), but no extensive molecular work on the family has been published to date. Nonetheless, both morphology and genetics support that the two crepuscular stream-loving genera *Boyeria* and *Caliaeschna* are more closely related to each other than to the European standing-water aeshnids *Aeshna*, *Anax* and *Brachytron*. The genus ***Boyeria*** contains seven species, two in North America, three in eastern Asia and two in Europe. All

of them are crepuscular stream-dwellers but it is uncertain if the species of the different continents are indeed closely related. The European *B. irene* is confined to south-western Europe and north-western Africa. The isolated *B. cretensis* from Crete was only recognised as a distinct species 141 years after its discovery (Peters 1991). The differences between *B. cretensis* and *B. irene* are small and relate mostly to male markings, but its validity was confirmed by molecular data (Kohli *et al.* 2014).

The range of *B. cretensis* is completely surrounded by that of the only ***Caliaeschna*** species, *C. microstigma*, which replaces *Boyeria* on streams from south-eastern Europe to Iran. The morphology of *Caliaeschna microstigma* closely resembles that of the genus *Cephalaeschna* (von Ellenrieder 2002), which occurs from Afghanistan to China and Taiwan. Further study may well show that *C. microstigma* is a western representative of *Cephalaeschna* and is better subsumed in that genus, although it lacks the latter's characteristic inflated frons.

The genus ***Brachytron*** contains only a single species and is largely confined to Europe. The species of *Aeschnophlebia* Selys, 1883, from eastern Asia, and the single species of *Nasiaeschna* Selys, 1900 and *Epiaeschna* Hagen, 1875, from eastern North America, resemble *Brachytron* in morphology and ecology, flying in temperate marshlands often early in the season, and might be its closest relatives (Von Ellenrieder 2002).

The genus ***Aeshna*** once included about 80 superficially similar species found all over the world, but many from warmer parts of the Americas, Africa and Australia have since been recognised as distinct genera. According to von Ellenrieder (2003), all European species except *A. affinis*, *A. mixta* and *A. isoceles*, belong to a purely Holarctic radiation of at most 30 species that includes the type species *A. grandis* and can thus be regarded as the 'true' *Aeshna*. Both *A. affinis* and *A. mixta* are difficult to place and probably fall outside the 'true' *Aeshna* and may be placed in a different genus in the future. *Aeshna isoceles* differs from true '*Aeshna*' in both morphology and ecology and has frequently been placed in *Anaciaeschna*, but is not closely related to that genus (von Ellenrieder 2002) and is more likely to represent a monotypic genus.

Compared to *Aeshna*, the genus ***Anax*** presents relatively few problems, the only discussion being whether *A. ephippiger* and its Australasian relative *A. papuensis* (Burmeister, 1839) should be placed in their own genus *Hemianax*. Based on wing venation, Peters (2000) argued that *Hemianax* falls within *Anax* and should be regarded a synonym of the later.

Gomphidae

Although Gomphidae constitutes the third largest odonate family after the Libellulidae and the Coenagrionidae, it is relatively poorly represented in Europe. Nearly all gomphids prefer running water and their larvae show diverse adaptations for living in different substrates. Carle (1986) recognised eight subfamilies, of which Lindeniinae (*Lindenia*), Gomphinae (*Gomphus*) and Onychogomphinae (*Onychogomphus*, *Ophiogomphus* and *Paragomphus*) occur in Europe. With no extensive molecular phylogeny available, the validity of this classification remains untested, although published data is congruent with it for the European genera. Moreover, many gomphid genera are poorly defined and of all European odonate genera, the three most in need of global revision are gomphid: *Gomphus*, *Onychogomphus* and *Paragomphus*. The first two are almost certainly non-monophyletic, with many non-European species likely to be placed in different genera in the near future.

The monotypic genus ***Lindenia*** appears to be unique among Gomphidae in three ways. Firstly, *L. tetraphylla* may develop pruinosity with age. Secondly, it has distinct melanism which might also be (partly) age-related, although in some populations tenerals are already completely black, suggesting it is determined by environmental conditions. Finally, it has clear migratory tendencies (Schneider 1981), although this has never been observed in Europe. In Europe, *L. tetraphylla* is the only gomphid mainly inhabiting lakes, and the species seems well adapted to the ephemeral conditions prevailing in its range from the Mediterranean shores to Pakistan and southern Arabia (Schorr *et al.* 1998). Its nearest relatives are likely *Ictinogomphus* Cowley, 1934 and *Gomphidia* Selys, 1854, which are found in the tropical part of the Old World and share the distinctive shape of the larva.

Almost forty Nearctic, ten West Palaearctic and nearly twenty East Palaearctic species have been placed in ***Gomphus***. The genus *Gomphus* has been used as a receptacle for 'difficult' gomphines and is likely to be non-monophyletic. Several subgenera have been in use in North America, but a revision of the group is needed to evaluate their validity: according to Carle (1986) *Gomphus* forms a group with the North American *Arigomphus* and *Dromogomphus*, the Chinese *Gastrogomphus* and the North American and East Asian genus *Stylurus*. While molecular data seem to support the North American (sub-) genera, the problem is that the phylogenetic position of the type species of *Gomphus* (the European *G. vulgatissimus*) has not been determined. Furthermore, Schmidt (1987, 2001) argued that the Eurasian *Gomphus flavipes* belongs in *Stylurus*. This is supported by characters in both adults (slender posterior hamules) and larvae (drawn-out abdomen, absence of tibial hooks). While it seems wiser to retain *flavipes* in *Gomphus* until a proper study of the gomphines is conducted, its genus is quite likely to change as it does not seem part of what appears to be a tight West Palaearctic *Gomphus* radiation. Beside the five remaining European species, this radiation includes localised species in North Africa (*G. lucasii*) and the Near East (*G. davidi*, *G. kinzelbachi*).

Species currently placed in the genus ***Onychogomphus*** are found in the Afrotropics (twelve), the West Palaearctic (eight) and the East Palaearctic and Oriental region (over 40). *Onychogomphus* is almost certainly non-monophyletic and probably all tropical species should be removed to other genera. Together with four south-west Asian species, the European *O. forcipatus* (the genus's type), *O. uncatus* and *O. costae* form the 'core *Onychogomphus*'. This group also includes the recently described *O. boudoti*: known only from a single locality in Morocco, it may well be the rarest dragonfly in the West Palaearctic (Ferreira *et al.* 2014) (Figure 9).

While twenty species of ***Ophiogomphus*** are found in the Nearctic, only four occur in the Palaearctic. In addition to this, a few Oriental species are placed in this genus, although probably none of these belong there (e.g. Wilson & Xu 2009). True *Ophiogomphus* share a similar general appearance, being robust with a green thorax and bold yellow middorsal abdominal spots. The nearest relative of the European *O. cecilia* seems to be the East Palaearctic *O. obscurus*. They probably form a monophyletic group with the central and eastern Asian *O. reductus* and *O. spinicornis*, probably originating from a single dispersal event from North America.

Paragomphus is a large Palaeotropical genus with about thirty species in Africa and adjacent Eurasia and an additional sixteen in Asia. Males typically have prominent foliations on the eighth and ninth abdominal segment and long hooked cerci. Many Afrotropical species are poorly known, with variation in markings and slight differences in appendages complicating their taxonomy. Although most species breed in running water, *P. genei* favours standing and even temporary water. Consequently it is the most numerous and wide-ranging gomphid in Africa and the only one to reach Europe. Based on morphology, the six species of the African genus *Crenigomphus* Selys, 1892 seem to fall within *Paragomphus* (Suhling & Marais 2010). In case this is supported by a molecular study, the name *Paragomphus* will have to be replaced by the older name *Crenigomphus*.

Figure 9. *Onychogomphus boudoti* is the most recently described of the eight species of *Onychogomphus* occurring in the West-Palaearctic and is only known from one site in Morocco. Species of *Onychogomphus* found in other parts of the world are probably not closely related and will probably in the future be moved to other genera. Photograph: Jean-Pierre Boudot.

Cordulegastridae

Females of Cordulegastridae have a prolonged spike-like subgenital plate, a character unique within Odonata. Until recently the Asian Chlorogomphidae were included in this family but they are now generally regarded as a separate family based on differences in venation and the absence of the prolonged subgenital plate. Generally three cordulegastrid genera are recognised, of which *Anotogaster* Selys, 1854 and *Neallogaster* Cowley, 1934 are largely confined to the East Palaearctic and the northern Oriental region. The nearly fifty species of ***Cordulegaster*** are found in the Holarctic. Ten of these are found in the Nearctic and seven in Europe while another three occur in other parts of the West Palaearctic (*C. mzymtae* Bartenef, 1929, *C. vanbrinkae* Lohmann, 1993 and *C. princeps* Morton, 1916). The Palaearctic species are traditionally split into two groups, the *bidentata*-group and the *boltonii*-group, based on small differences in markings, venation and appendages. This split was recently confirmed based on molecular data (Froufe *et al.* 2014). While the *bidentata*-group is mainly found at seepages and the upper courses of streams, the *boltonii*-group has a preference for the lower stream reaches. Lohmann (1992b) proposed to restrict *Cordulegaster* to the *boltonii*-group and further divide the *bidentata*-group in *Thecagaster* and *Sonjagaster*, but this has found almost no support. Nonetheless the American *Cordulegaster* species are morphologically very diverse and the genus may well be subdivided more definitively in the future, with *Thecagaster* possibly emerging as a valid taxon.

Many European species were recognised relatively recently: the Italian *C. trinacriae*, the Balkan *C. heros* and the Greek *C. helladica* were described within the last forty years (Waterston 1976, Theischinger 1979, Lohmann 1993c). The validity of these species was confirmed by a recent molecular study (Froufe *et al.* 2014). Many *Cordulegaster* species vary regionally in markings, which has led to the description of various subspecies. Froufe *et al.* (2014) failed to find molecular support for the subspecies of *C. boltonii* and *C. bidentata*, but did find the Greek endemic *C. helladica* and its subspecies *C. h. buchholzi* to be distinct.

Macromiidae

Based on morphology, May (1997) showed that *Macromia*, together with the African *Phyllomacromia*, the North American *Didymops* and the Asian *Epophthalmia* forms a monophyletic group. The molecular phylogeny of Ware *et al.* (2007) confirmed that this group is best treated as the family Macromiidae. While *Epophthalmia* and some species of the other genera breed in lakes, most species of ***Macromia*** are exclusive

to running waters. The genus has a curious distribution. Over seventy species are found from the (sub-) tropical parts of Asia to northern Australia and seven in North America. Two species occur in the Palaearctic, with *M. amphigena* in Japan and Siberia and *M. splendens* in the southwest of Europe. The latter is separated by 4,000 km from the nearest locality of *M. amphigena* and 6,400 km from that of *M. moorei* Selys, 1874 in northern India. Surprisingly both the molecular studies of Fleck *et al.* (2008) and Dumont *et al.* (2010) found *M. splendens* to be closer related to the latter than to *M. amphigena*, which was found to be most closely related to the North American radiation of *Macromia*.

Corduliidae

Corduliidae are well-represented in temperate regions of the Northern Hemisphere but have only a marginal presence in the tropics and south, generally being either montane (e.g. Oriental *Procordulia* Martin, 1907), peripheral (*Rialla* Navás, 1915 in Chile) or insular in occurrence (most notably *Hemicordulia* Selys, 1870 in Australia and the Indo-Pacific).

Cordulia has a unique deeply bifid epiproct with a pair of dorso-apical teeth. Jödicke *et al.* (2004) found no evidence of gene flow among the North American *C. shurtleffii*, Western Palaearctic *C. aenea* and its Eastern Palaearctic subspecies *amurensis*, and thus recognized them as three distinct species. However, no differences in morphology, behaviour or ecology are known, and thus whether and where *C. aenea* and *C. amurensis* meet and if they merge or coexist is unknown as well. Kosterin & Zaika (2010) argued that the lack of gene flow does not mean that speciation has occurred and therefore regarded the decision to consider the taxa as a good species premature.

Epitheca females possess a large and bilobed vulvar scale, which is used to hold an egg-mass that unfolds as a gelatinous strand after deposition in water. Two Palaearctic species (*E. marginata* in eastern Asia and *E. bimaculata* from western Europe to Japan) belong to the subgenus *Epitheca*, while the Nearctic species have been placed in the subgenera *Epicordulia* Selys, 1871 (one species) and *Tetragoneuria* Hagen, 1861 (nine species).

Somatochlora is represented by 26 species in North America and about twenty in the Palaearctic and adjacent parts of the Oriental region. Based on morphology the most widespread European species can be divided into two groups: the *metallica*-group (*S. flavomaculata*, *S. meridionalis* and *S. metallica*), of which adults have a mostly bright metallic body and larvae mid-dorsal abdominal spines, while adults of the *arctica*-group (*S. alpestris*, *S. arctica* and *S. sahlbergii*) are duller black and have hairy larvae which lack mid-dorsal spines. It is unclear to which group *S. graeseri* belongs as its larvae resemble that of the *metallica*-group but the dull black abdomen of mature individuals matches the *arctica*-group. The species of the *arctica*-group inhabit small standing waters in cold environments and have a boreo-alpine distribution. The European members of the *metallica*-group extend further south, have a broader habitat preference, but generally favour warmer environments. Further work must also determine the position of the European groups within the much greater eastern Asian and (especially) American diversity. Marinov & Seidenbusch (2007) erected the genus *Corduliochlora* for *S. borisi* based on several adult characters, of which the broadly notched male epiproct and the short deeply split vulvar scale are most notable. The larvae, however, match those of the *metallica*-group (Fleck *et al.* 2007) and genetic analysis is needed to resolve this issue.

Oxygastra is no longer considered part of Corduliidae (see text on Anisoptera).

Libellulidae

Libellulidae is found worldwide and is the second largest family in Odonata after Coenagrionidae with over 1000 species. It is the dominant family of Anisoptera at most European habitats. Although a few clusters of related genera have been identified with molecular methods, no overall divisions within Libellulidae are apparent yet, and thus traditionally recognized subfamilies seem largely invalid. In Europe only four genera are dominant in species and individual numbers: *Libellula* and *Orthetrum* are part of the largely tropical 'libelluline' diversification; *Sympetrum* and *Leucorrhinia* belong to the mostly Holarctic 'sympetrine' group. Aside from these, seven heat-loving genera occur regularly in Europe, but with the exception of *Trithemis* all of these are represented by only a single species.

Brachythemis is a small genus with four species in Africa, one in the Near and Middle East, and one in the Oriental region. According to Pilgrim & von Dohlen (2008), the East Asian *Deielia phaon* Selys, 1883 probably falls within *Brachythemis* too. *Brachythemis* belongs to a group of genera of which many species are crepuscular, including the widespread tropical genera *Tholymis* Hagen, 1867 and *Zyxomma* Rambur, 1842 (Dijkstra 2003, Pilgrim & von Dohlen 2008, Ware *et al.* 2007).

Crocothemis and ***Diplacodes*** belong to a large tropical radiation that includes *Erythrodiplax* Brauer, 1868 with almost 60 species in the Americas and *Neurothemis* Brauer, 1867 with thirteen species in Australasia. *Crocothemis* and *Diplacodes* are both small Palaeotropical genera with very widespread species: *Diplacodes* has five species each in the African and Australasian tropics, while *Crocothemis* is principally African (five species) with single species confined to Madagascar, Asia and Australia. The species that reached Europe, *D. lefebvrii* and *C. erythraea*, are both the most widespread African representative of their genus, being found together at almost any open stagnant habitat in the continent.

With about 70 species, the holarctic *Leucorrhinia* and *Sympetrum* and the Nearctic *Celithemis* Hagen, 1861

form the only truly Holarctic libellulid radiation, as all other genera probably originated from the tropics. In Europe they represent two-thirds of libellulid species north of the Alps. While *Leucorrhinia* and *Sympetrum* occur throughout the Holarctic with only a few species in the adjacent tropics, *Celithemis*, whose species recall *Leucorrhinia* with strongly patterned wings, is purely Nearctic. ***Leucorrhinia*** is the only larger European genus for which a complete global molecular phylogeny has been published (Hovmöller & Johansson 2004). A group of pruinose species, including the pair *L. albifrons* and *L. caudalis* plus the American *L. frigida*, is sister to the remaining species. The latter separates into an American group of six species and a group with all remaining Palaearctic species.

Figure 10. The European *Libellula fulva* seems more closely related to the here depicted North-American *Ladona deplanata* (Rambur, 1842) than to the two other European species of *Libellula* and might therefore in the future be moved to the genus *Ladona*. Photograph: Lee Ruth.

Figure 11. Many of the genera of Libellulidae have wide global distributions. Examples of this are the genera *Orthetrum* and *Crocothemis* which are found from Africa over Asia as far as Australia. Here two examples of species occurring in Australia: (a) *Crocothemis nigrifrons* and (b) *Orthetrum villosovittatum*. Photograph: Fons Peels.

The work by Ware *et al.* (2007) and Fleck *et al.* (2008) suggests that ***Libellula*** is not monophyletic, and that several tropical genera are inserted within it. Although further analysis of related genera is needed to resolve this matter, it seems likely that *L. fulva* and *L. depressa* will have to be reclassified in the near future, probably in *Ladona* (Figure 10) although the latter has also been called *Platetrum depressum* or *Plathemis depressa*. The 'true' *Libellula* is a largely Nearctic assemblage including the Holarctic *L. quadrimaculata* and its two close relatives, the eastern Asian *L. angelina* and the North American *L. semifasciata*, and an American radiation of twenty species.

Orthetrum includes about sixty species, of which one half is tropical African and the other extends across Eurasia to Australia (Figure 11). Their phylogeny has not been studied in detail but the European species seem to fall in three distinct groups with most of them (*O. brunneum*, *O. chrysostigma*, *O. coerulescens* and *O. nitidinerve*) belonging to a radiation of probably African origin. The other groups are the closely related *O. albistylum* and *O. cancellatum* which probably have Asian roots and the African *O. trinacria* which forms a distinct group with the oriental *O. sabina* and the Australasian *O. serapia* Watson, 1984 (Dijkstra & Kalkman, unpublished data). The species of the latter group have slender abdomens, a peculiar hamule structure, aggressive behaviour (often taking dragonflies as prey) and a strong colonising potential. *Orthetrum trinacria* occurs in Africa and southernmost Europe, while *O. sabina* is tropical Asia's most abundant dragonfly reaching west as far as northern Africa and Turkey.

Selysiothemis belongs to a distinct group including the heat-loving *Aethriamanta*, *Macrodiplax* and *Urothemis*, which are sometimes separated as the subfamily (or even family) Urothemistinae (= Macrodiplactinae). Their venation is very open, the secondary genitalia simple in structure, and the vulvar scale strongly bilobed. Although the genus has only a single species, *S. nigra* is very close to *Macrodiplax* morphologically and ecologically, and may actually belong inside the latter genus. Like *Selysiothemis*, both *Macrodiplax* species are tolerant to brackish water and are found mainly in coastal regions.

A phylogeny based on morphological and genetic data showed that the over 50 ***Sympetrum*** species probably originated in the tropics (Pilgrim 2006, 2012). The large temperate radiation of *Sympetrum* consists of five genetically well-separated groups, three of which occur in Europe, namely (1) the *flaveolum*-group with over five Nearctic species, (2) the *danae/depressiusculum*-group with three Asian and two Nearctic species, and (3) the *vulgatum*-group. The latter includes *S. meridionale*, *S. sanguineum*, *S. striolatum*, *S. vulgatum*

and probably *S. sinaiticum* together with two Nearctic species. *Sympetrum fonscolombii* falls outside this temperate radiation and belong to a group with a more tropical distribution. The genus name *Tarnetrum* Needham & Fisher, 1936 has been used for *S. fonscolombii*, but because *Tarnetrum* as proposed is not monophyletic and its type species is not closely related to any of the other species, it is inappropriate to recognise it. Interestingly, *S. corruptum*, the American sister-species of *S. fonscolombii*, is similar both in appearance and ecology, being strongly migratory.

There is some support that *Pantala*, *Trithemis* and *Zygonyx* and some other predominantly tropical genera are quite closely related (Ware *et al.* 2007, Pilgrim & von Dohlen 2008, Dumont *et al.* 2010, Fleck *et al.* 2008). These superficially dissimilar genera share features such as a reduced pronotal hindlobe, narrowing forewing discoidal field and a large-hooked hamule.

Zygonyx contains over twenty species in the African and Asian tropics, which are peculiar for patrolling in flight over fast-flowing waters, especially rapids and waterfalls. The most widespread species is *Z. torridus*, which is even capable of finding suitable habitat in deserts. Not surprisingly, it was that common African species that colonised India, Mauritius and southern Europe. The African (and thus sole European) species may not be closely related to the Asians, in which case they would need to be relegated to the genus *Pseudomacromia*.

No dragonfly develops faster and wanders further than ***Pantala*** *flavescens*. This capacity made it the most widespread (and possibly most abundant) of all odonates. The genus's second species, *P. hymenaea*, is confined to the Americas.

Trithemis is the largest anisopteran genus in Africa and the over 40 species dominate dragonfly communities across the continent, while only a handful of species is found in Asia. A detailed molecular study of *Trithemis* showed that *T. kirbyi* is distinct and sister to all other *Trithemis* species. Most other species, including *T. annulata* and *T. arteriosa*, evolved relatively recently, approximately in the last 4 million years, suggesting that the diversification of *Trithemis* coincided with the expansion of savannah in Africa (Damm *et al.* 2010).

***Oxygastra curtisii*, Lago della Rancia, near Orgia (SI), Italy.** Photograph Fons Peels.

Conservation

G. De Knijf, T. Termaat & J. Ott

"Although it is species themselves that typically have the greater impact on public consciousness when they are threatened with extinction, it is their habitats, and the ecosystems and biotopes that contain those habitats, that must constitute the primary targets for protection, because no species can persist for long without a suitable place in which to live"
(Corbet 1999)

Introduction

Efforts to protect and conserve dragonflies need to focus on the protection, conservation and management of their habitats, particularly the aquatic habitats where they reproduce. That of course does not mean that actions should not sometimes be directed at specific species, especially those less mobile, rare or endemic to limited areas.

On a global scale, the most urgent need is to conserve a wide range of habitats in nature reserves, giving priority to streams in rainforest and surviving lowland marshes (Moore 1991d in Corbet 1999). Biotopes for dragonflies, terrestrial as well as aquatic ecosystems, are being lost or degraded all over the world at an accelerating rate (Corbet 1999). On regional and local scales, conservation efforts should be focused on the most valuable and threatened habitats. In most parts of Europe the large variation in biomes in combination with human pressure on many habitats makes conservation planning a complex matter. Hence it is an impossible task to propose general conservation measures for all European species (Sahlén *et al.* 2004). Each region must look at the species pool present and take appropriate measures.

The first plea for the protection of some European dragonflies goes back to the early seventies, when Dumont (1971) drew attention to the need for protection of six species in Europe. Forty years later, the list of protected species has expanded to sixteen through the European Habitats Directive in its last version, and an assessment was made of all European dragonfly species, resulting in the first European Red List of dragonflies (Kalkman *et al.* 2010).

Legislation and Legal Protection

Species of dragonflies and their habitats can be protected on a global, European and national level. The oldest and at the same time the only global treaty of importance related to dragonflies is the Ramsar Convention. It is seldom taken into account when it comes to protection of dragonflies but is nonetheless very important for the conservation of wetlands and the species they host. The only pan-European treaty is the Convention of Bern, which aims to protect European wildlife and natural habitats. The European Union (EU) ratified the Bern Convention in 1982, incorporating it in 1992 in the Habitats Directive which came into force in 1994 and was updated several times following the inclusion of additional countries into the European Community. This Directive has several implications and resulted in a list of species protected in all member states of the European Union, either directly or through their habitat(s). Besides, in several countries of Western and Central Europe some or even all dragonfly species and their habitats are officially protected by national legislation. An overview of these different legislations is given below and their implications for the conservation of dragonflies and their habitats are discussed.

The Ramsar Convention

The Convention on Wetlands of International Importance, known as the Ramsar Convention, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation of wetlands. It is the only global treaty that deals with a particular ecosystem. An assignment as a Ramsar site is mostly based on the presence of (water) birds, often called the 1 % rule of the total population of a species which is present. The criteria for identifying wetlands of International importance are not only applicable to birds but also to other taxonomic groups although this has to our knowledge never been applied to dragonflies. The following three official criteria used in the Ramsar Convention could be applied to dragonflies:

- A wetland should be considered internationally important if it supports vulnerable, endangered, or critically endangered species.
- A wetland should be considered internationally important if it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region.
- A wetland should be considered internationally important if it regularly supports 1 % of the individuals in a population of one species or subspecies of wetland-dependent non-avian animal species.

This means that localities which harbour populations of (nearly) endemic European species such as *Pyrrhosoma elisabethae* (Albania, Greece), *Boyeria cretensis* (Crete – Greece), *Somatochlora borisii* (Bulgaria, Greece, Turkey) and *Macromia splendens* (France, Portugal, Spain) could be incorporated into this internationally protected network. Also the localities of very rare species within a specific biogeographic region could be included. This is the case, among others, for *Coenagrion hylas* in the Alpine region, *Somatochlora sahlbergi* in the Boreal region, *Aeshna caerulea* in the Atlantic region in Scotland and the large populations of *Leucorrhinia pectoralis* in the Atlantic Biogeographic region.

The Bern Convention

The Convention on the Conservation of European Wildlife and Natural Habitats, called the Bern Convention, is a binding international legal instrument in the field of nature conservation that aims to protect the natural heritage in Europe (including the Russian Federation, Georgia, Armenia and Turkey). Its aims are to conserve wild flora and fauna and their natural habitats and to promote European cooperation in that field. It places particular importance on the need to protect endangered natural habitats and endangered vulnerable species, including migratory species. This convention included annexes listing plant and animal species requiring protection but does not refer to networks of protected areas. A total of 16 dragonfly species are listed, 14 of them being also included in the Habitats Directive (Table 5). Only *Calopteryx syriaca* and *Brachythemis fuscopaliata* were not considered for the Habitats Directive, as these two do not occur in Europe. In the European Union member states, the Bern Convention has been implemented by means of the Habitats Directive which has effectively replaced the Bern Convention.

Species	Bern Convention	Habitats Directive	Endemic	Red List Europe	Red List EU 27
Calopteryx xanthostoma			•	LC	LC
Lestes macrostigma				VU	EN
Sympecma paedisca	•	IV		LC	LC
Ceriagrion georgifreyi				CR	CR
Coenagrion hylas	•	II		VU	VU
Coenagrion intermedium			•	VU	VU
Coenagrion mercuriale	•	II		NT	NT
Coenagrion ornatum		II		NT	NT
Ischnura fountaineae				VU	VU
Ischnura genei			•	LC	LC
Ischnura hastata				VU	VU
Nehalennia speciosa				NT	VU
Pyrrhosoma elisabethae			•	CR	CR
Platycnemis acutipennis			•	LC	LC
Platycnemis latipes			•	LC	LC
Aeshna viridis	•	IV		NT	NT
Anax immaculifrons				VU	VU
Boyeria cretensis			•	EN	EN
Cordulegaster bidentata			•	NT	NT
Cordulegaster helladica *			•	EN/CR	EN/CR
Cordulegaster heros		II – IV	•	NT	NT
Cordulegaster insignis				EN	EN
Cordulegaster picta				VU	VU
Cordulegaster trinacriae	•	II – IV	•	NT	NT
Gomphus flavipes	•	IV		LC	LC
Gomphus graslinii	•	II – IV	•	NT	NT
Gomphus pulchellus			•	LC	LC
Onychogomphus costae				EN	EN
Ophiogomphus cecilia	•	II – IV		NT	NT
Lindenia tetraphylla	•	II – IV		VU	VU
Macromia splendens	•	II – IV	•	VU	VU
Oxygastra curtisii	•	II – IV		NT	NT
Somatochlora borisi			•	VU	VU
Leucorrhinia albifrons	•	IV		LC	NT
Leucorrhinia caudalis	•	IV		LC	NT
Leucorrhinia pectoralis	•	II – IV		LC	LC
Orthetrum nitidinerve				VU	VU
Sympetrum depressiusculum				VU	VU
Sympetrum nigrifemur			•	LC	LC
Zygonyx torridus				VU	VU

Table 5. Dragonflies which are either mentioned in the Bern Convention, or listed in Annexes II or IV of the Habitats Directive, or which are endemic to Europe or threatened in Europe or the EU27. * The three subspecies of *Cordulegaster helladica* have been each assessed and were classified as Critical Endangered (ssp. *kastalia*) or Endangered (ssp. *helladica* and ssp. *buchholzi*).

Outside the EU member states, the Bern Convention has not been fully implemented in national legislation and therefore has not resulted in better protection of dragonflies and their habitats.

Habitats Directive

Since its implementation in 1994, the Habitats Directive (Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora) has become a fundamental and increasingly important way of implementing nature conservation within the European Union. This measure and the Birds Directive (1979) together provide the main pieces of legislation ensuring the protection of nature in Europe. One of the regulations of the Habitats Directive is that member states must designate Special Areas of Conservation for some 220 specific types of habitats (Annex I) and some hundred species mentioned in Annex II. Species of community interest in need of strict protection are listed in Annex IV. For species in Annex II, Special Areas of Conservation must be designated, whereas for the Annex IV species, measures must be taken in order to ensure the continuing conservation of populations in respective countries. Altogether 16 dragonfly species are now mentioned in either or both Annexes (Table 5). Eleven are listed in Annex II, and for these species member states must designate Special Areas of Conservation. Thirteen are listed in Annex IV, meaning that they are protected in the 28 member states, together with their habitats. The Special Areas of Conservation form, together with the Special Protection Areas under the Birds Directive, the Natura 2000 network of protected sites across the European Union. One of the main disadvantages of the species lists in the various Annexes is that they are based on scientific knowledge at the end of the 1970s and the beginning of the 1980s, and represent western Europe disproportionately. With the extending of the EU in 2004 to include most countries of Eastern Europe, only a few species were added to the Habitats Directive species list. In addition, many of the species threatened in the 1980s have recovered, partly due to protection afforded by the Directive, and are no longer considered to be strongly threatened, although they are still good indicators of habitats needing protection. Comparing the list of Annex species with the list of threatened species in Europe (Kalkman *et al.* 2010), it is clear that species in need of protection at a European scale are not covered by the Habitats Directive (Cardoso 2011). Therefore for adequate protection of dragonflies in Europe the selection of species listed in the Habitats Directive should be updated.

National legislation and protection

The Habitats Directive (HD) is by far the most important legislation for the protection of species in the member states, but most European countries have in addition a national legislation which often protects a different set of species. The aim of these national legislations and the enforcement varies greatly between countries, making comparisons difficult. In many cases the protection prohibits the catching and collecting of dragonflies which is, from a conservation point of view, a useless measure. A summary of legal protection of dragonflies (status as in January 2012) in each European country is given in table 6. We were not able to obtain information for Albania and Belarus or for the so-called micro-states (Andorra, Liechtenstein, Monaco, San Marino, Vatican). As dragonflies, except the wandering *Anax ephippiger*, do not occur in Iceland, they have no protection status there. Elsewhere, at one end of the spectrum, dragonflies receive no legal protection at all in Bosnia & Herzegovina, Cyprus, Malta,

All species and their habitats protected	Only species of the Habitats Directive protected	Limited set of protected species	No species protected	No Information
Austria	Bulgaria	Belgium (Wallonia)	Bosnia Herzegovina	Albania
Belgium (Flanders & Bruxelles)	Croatia	Czech Rep.	Cyprus	Andorra
Germany	Denmark	Greece	Malta	Belarus
Luxemburg	Estonia	Hungary	Montenegro	Liechtenstein
Spain	Finland	Ireland	Moldova	Monaco
	France	Latvia		San Marino
	Italy	Poland		Vatican
	Lithuania	Russia		
	Macedonia	Serbia		
	the Netherlands	Slovakia		
	Norway	Slovenia		
	Portugal	Switzerland		
	Romania	United Kingdom		
	Sweden	Ukraine		

Table 6. Summary of the legal protection of dragonflies in Europe (status January 2012).

Montenegro and Moldova. Although Cyprus and Malta belong to the EU, none of the species of the Habitats Directive occurs on those Mediterranean islands. At the other extreme are Austria, Belgium, Germany, Luxemburg and Spain, where all dragonflies and their habitats are protected. Not only is killing dragonflies prohibited, but also netting for identification purposes or sampling larvae is forbidden. These different legislations aim also to protect the habitats of dragonflies, although in reality this is seldom achieved effectively. Indeed, it can be argued that the protection of all species is counter-productive as it gives a false impression of proper conservation. A good example is the continuing pollution of many streams and rivers from agriculture and household sewage (e.g. Belgium), and also the construction of dams (e.g. Spain). Outside of those five countries half the European odonate fauna (68 species) receives no protection at all. With the exception of the species listed in the Habitats Directive, there are only a few species protected in more than one country. Only six species (*Lestes dryas*, *Aeshna isoceles*, *Aeshna subarctica*, *Anax imperator*, *Cordulegaster boltonii* and *Epitheca bimaculata*) are protected in four countries and all others are protected in less than three countries. Several European Red List species (Kalkman *et al.* 2010) and regionally threatened species remain entirely without protection.

Fifteen of the species listed in a threat category on the European Red List (including the Near Threatened) are not protected anywhere in Europe. Besides those five countries where all species are protected, only three species listed in a threat category on the European Red List receive some kind of national legal protection, namely *Lestes macrostigma* (Hungary, Slovenia), *Nehalennia speciosa* (Latvia, Poland, Switzerland) and *Sympetrum depressiusculum* (Hungary, Slovenia, Switzerland).

National Red Lists

National Red Lists give to a certain extent an indication of which species are considered threatened and/or declining in a certain country. In most cases they do not have any legal status, hence species listed are not necessarily protected. The methods used to make red lists vary greatly between countries, and are thus seldom directly comparable, providing only a limited overview of those species which are threatened throughout Europe. We were unable to obtain information on Albania, Belarus, Lithuania and the micro-states. Nine European countries do not have a national Red List of dragonflies, namely two Mediterranean islands (Cyprus and Malta), four countries from the former Yugoslavia (Bosnia & Herzegovina, Macedonia, Montenegro and Serbia), as well as Portugal, Romania and Iceland.
More than 70 % of all European dragonfly species are mentioned in at least one of the national Red Lists. An overview of the 10 most listed species (Red List categories: Critically Endangered, Endangered or Vulnerable) is given in table 7. Except for *Coenagrion mercuriale*, all nine other species have a clearly northern and cen-

Species	Times mentioned in Red List
Leucorrhinia pectoralis	17
Nehalennia speciosa	15
Ophiogomphus cecilia	14
Epitheca bimaculata	13
Leucorrhinia caudalis	13
Coenagrion lunulatum	12
Coenagrion mercuriale	12
Somatochlora arctica	12
Sympetrum depressiusculum	12
Coenagrion hastulatum	11
Aeshna subarctica	11

Table 7. The ten species that are most often listed in the different national Red Lists of European countries (n=28) (status January 2012).

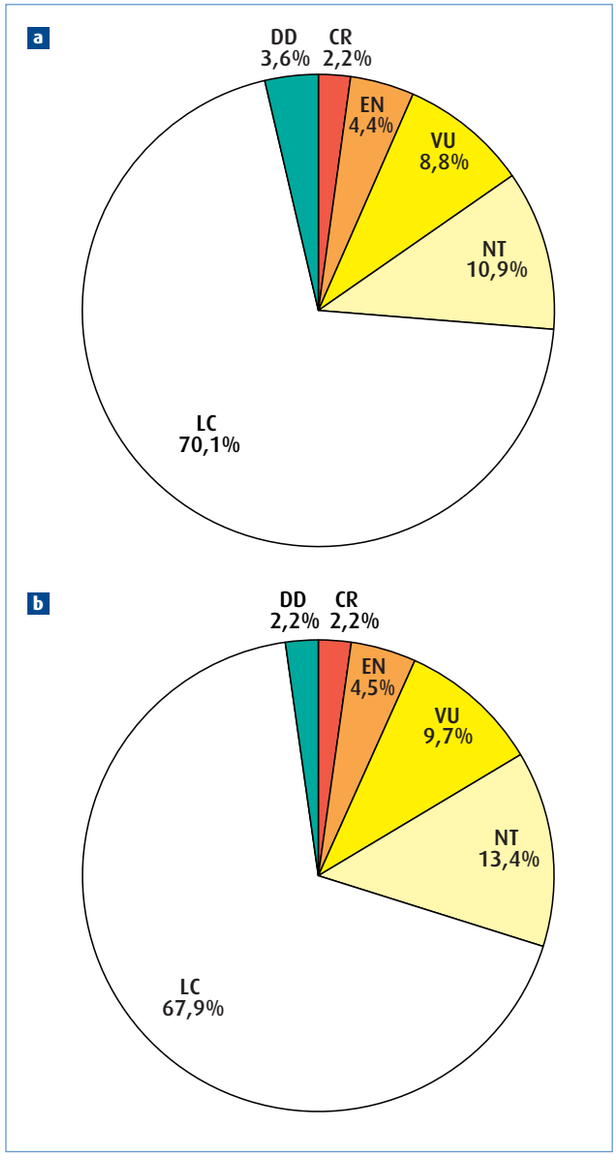


Figure 12. Red List status of dragonflies in Europe (a) and in the EU27 (b) (Kalkman *et al.* 2010).

IUCN Red List categories	No. (sub) species Europe (no. endemic species)	No. species EU 27 (no. endemic species)
Critically Endangered (CR)	3 (2)	3 (1)
Endangered (EN)	5 (3)	6 (3)
Vulnerable (VU)	13 (3)	13 (2)
Near Threatened (NT)	15 (4)	18 (2)
Least Concern (LC)	96 (6)	91 (6)
Data Deficient (DD)	5 (0)	3 (0)
Total number of threatened taxa	36 (12)	40 (8)
Total number of (sub)species assessed*	137 (18)	134 (14)
Not Applicable (NA)	5	5
Not Evaluated (NE)	1	4
Total All species	143	140

Table 8. Summary of the numbers of dragonfly species within each IUCN category of threat (Kalkman *et al.* 2010). *Excluding species that are considered Not Applicable

tral European distribution. Surprisingly, only two of the 10 species are listed in a threat category in the European Red List (Kalkman *et al.* 2010): *Sympetrum depressiusculum* is Vulnerable in Europe and *Nehalennia speciosa* is Vulnerable in EU27 and Near Threatened in Europe. In addition *Coenagrion mercuriale*, *C. ornatum* and *Leucorrhinia caudalis* are mentioned as Near Threatened in Europe or in EU27. These findings can be explained by populations decreasing in large parts of Europe, while remaining widespread in many areas to the north and east, most notably Fennoscandia and Russia, so that they do not meet the IUCN criteria for listing. Many rather common European species are on the Red List in countries where they are found at the edge of their distribution. Only four common species, *Chalcolestes viridis*, *Coenagrion puella*, *Ischnura elegans* and *Crocothemis erythraea* do not appear in any national Red List in Europe.

European Red List

The status of all native and vagrant dragonfly species in Europe (excluding those accidentally introduced) was assessed in 2009, based on the 'Guidelines for Application of IUCN Red List criteria at Regional Levels' (IUCN 2003, Kalkman *et al.* 2010). Assessments were made at two regional levels: for the 27 then member states of the European Union and for geographical Europe which, unlike this atlas, excluded the northern part of the Caucasus. Although the European Union now includes 28 member states, the assessment of conservation status was made only for the 27 member states in 2010. In total the conservation status in Europe of 133 species was assessed. Two of these (*Cordulegaster helladica* and *Onychogomphus forcipatus*) each have three subspecies with a taxonomy and distribution sufficiently well known to allow each to be assessed separately. Therefore, in total, 137 taxa (species and subspecies) were assessed.

At the European geographical level, 26 % of the assessed (sub)species of dragonflies are threatened, with 2 % Critically Endangered, 4 % Endangered, 9 % Vulnerable and 11 % Near Threatened. Within the EU27, the pattern is similar: 30 % of the taxa are threatened (Table 8, Figure 12). Over half the European taxa is considered stable (54 %), about a quarter (24 %) is declining and 10 % is increasing. For the remaining 12 %, the available information is insufficient to identify any trend. Most of the threatened species (18 of the 22) are confined to southern Europe (Figure 13). The exceptions are *Coenagrion hylas*, *Ischnura hastata*, *Nehalennia speciosa* and *Sympetrum depressiusculum*. In Mediterranean Europe, there is a very clear concentration of threatened species in the Balkan region and Crete, with twelve of the 22 threatened European taxa not occurring in other parts of Europe. A second concentration of threatened taxa is found in the Iberian Peninsula and southern France, with four threatened species largely confined to this area. Europe is especially responsible for the eighteen species that are endemic to Europe (Table 5). Of these 14 are only found in the EU27 (Figure 14). Sixteen of the 18 endemics are either confined to islands, the Balkan Peninsula or to a large extent to the Iberian Peninsula and France.

Species protection

Dragonflies are on average not as severely threatened as certain other groups such as amphibians (Temple & Cox 2009) but nonetheless some dragonfly species need conservation efforts to prevent national or regional extinction. Many of these threatened species are habitat specialists throughout their range while others are habitat specialists in the periphery of their range but not in the core of their range. A good example of this is the damselfly *Coenagrion hastulatum*, which is a typical species of soft oligotrophic waters in the western part of its range but inhabits a much wider range of habitats in northeastern Europe (Figure 15). As a consequence, this species is threatened in e.g. the Netherlands (Termaat & Kalkman 2012), Belgium (De Knijf *et al.* 2006) and Great Britain (Daguet *et al.* 2008), whereas it is fairly common and widespread in countries like Poland and Sweden.

Protection programs focused on dragonflies have been launched in several European countries. They differ in

the number of species included, the geographical scale (national, regional or local) and the scientific level of the research on which recommendations are based. Some of the programs have been published as national species protection plans (*Aeshna viridis* – de Jong *et al.* 2001, *Somatochlora arctica* – Ketelaar *et al.* 2005, *Oxygastra curtisii* – Ott *et al.* 2007). Conservation measures are also mentioned in many other publications with a broader scope, such as national or regional atlases, local habitat restoration plans, and in a wide range of research articles. It is unrealistic to list all of these but some deserve special attention. Probably the first overview of the habitat requirements, threats and conservation of all central European species was given by Schorr (1990). A large amount of detailed information on dragonfly species in general, including conservation measures, can be found in the books on the dragonflies of Baden-Württembergs (Sternberg & Buchwald 1999, 2000) and in Moore (1997). A practical guide to the management and restoration of all dragonfly habitats occurring in Switzerland was provided by Wildermuth & Küry (2009a, b). Much has been published on the conservation of *Coenagrion mercuriale*, a species mentioned in the Annex II of the Habitats Directive. This included scientific articles on the ecology, genetic variation and dispersal behaviour of this species in the United Kingdom and parts of France (e.g. Purse *et al.* 2003, Rouquette & Thompson 2005, 2007, Watts *et al.* 2005, Lorenzo Carballa et al. 2015). It is perhaps alarming that no species protection programs have so far been published for the dragonfly species mentioned in the European Red List (Kalkman *et al.* 2010), although measures have been carried out on a local scale for a few of them.

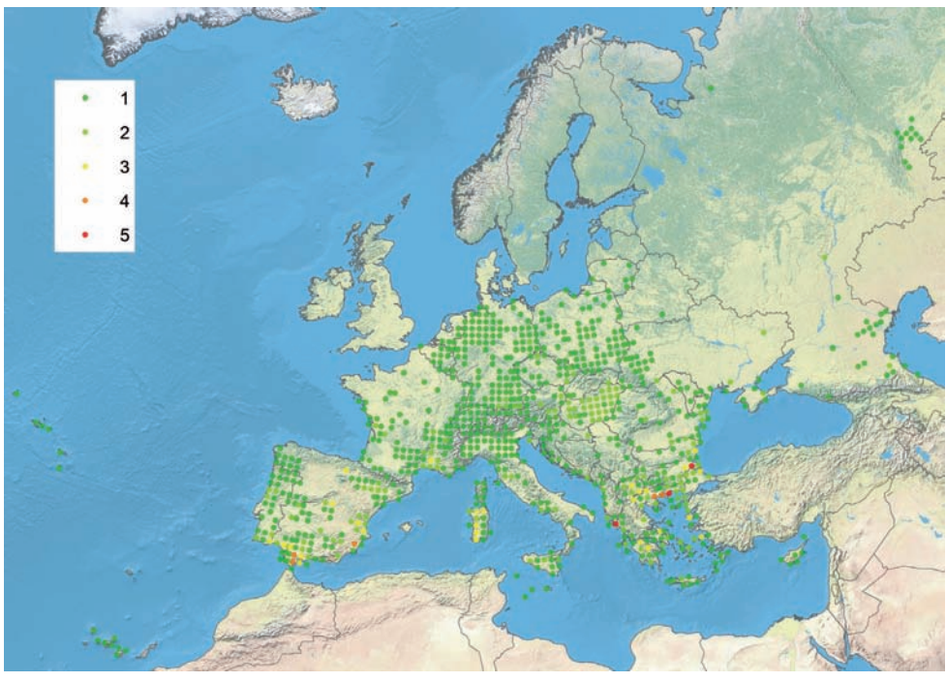


Figure 13. Distribution of threatened dragonflies (CR, EN, VU) in Europe based on records from both before and after 1990 (Kalkman *et al.* 2010).

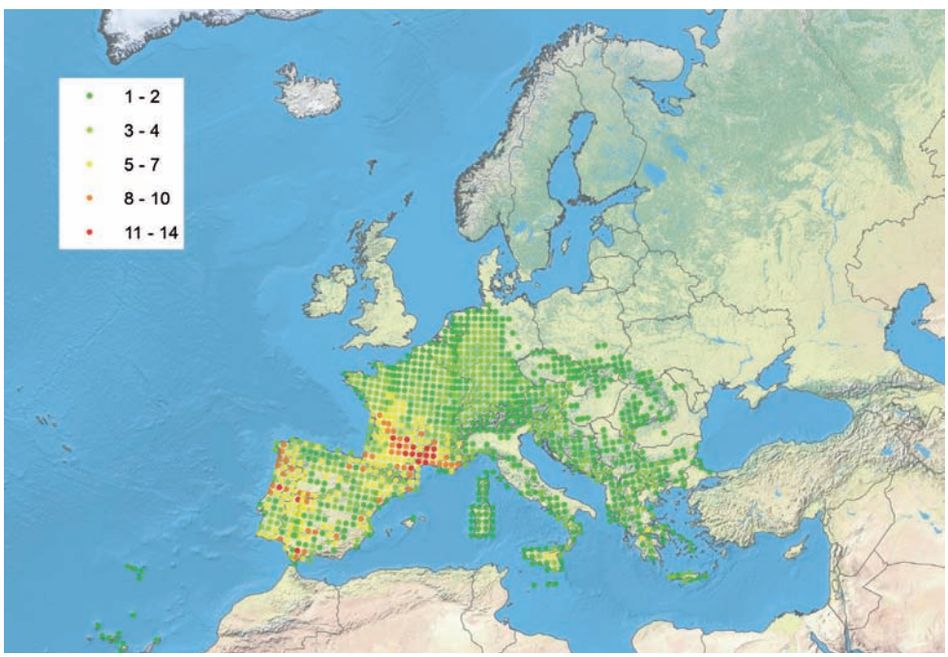


Figure 14. Distribution of endemic dragonflies in Europe.

The threats dragonflies face are almost exclusively caused by quantitative and qualitative loss of habitat. This basically means that protecting a dragonfly species can only succeed by protecting its habitat. Water quality improvement, restoring the natural water regime and water table, the creation of new water bodies, restoration of running waters and vegetation management are among the most effective conservation measures for dragonflies. In this respect a dragonfly species does not stand alone: other organisms benefit from these measures as well and dragonflies in their turn may benefit from measures taken for other fresh water species. From a dragonfly's point of view however, it is advisable to

phase the removal of (semi-)aquatic vegetation over time and space. This minimizes the risk of accidently wiping out a population and reduces the time in which dragonfly larvae are able to recolonise the restored parts of their habitat.

Threats to and changes in the European dragonfly fauna

Threats to European dragonflies vary regionally and have changed over time. During most of the twentieth century, large scale land conversion, canalisation of rivers, water pollution and eutrophication were the main drivers of decline, especially impacting species dependent on mesotrophic stagnant or running waters. Declines were particularly severe in western Europe from the 1950s to the 1980s, resulting in the extinction of several species over large areas.

A few decades ago, several lotic odonate species were rare and threatened, as water quality in European rivers and streams was very poor. As a consequence of increased water purification in sewage treatment plants, most rivers and streams have improved in quality since the 1990s. This had a clear positive impact and many of the species dependent on running waters have recovered surprisingly rapidly. Species such as *Calopteryx splendens*, *C. virgo*, *Gomphus vulgatissimus* and *G. flavipes* repopulated streams where they had been absent for decades and even were able to colonise waterways where they had never been known. In many countries they recovered to such an extent that they no longer qualified for the national or regional Red List (Figure 16). It is likely that the recovery of running water species will continue due to the implementation of the Water Framework Directive which will probably result in a further improvement in water quality and the structural integrity of habitats. Recently it has also become clear that species dependent on meso-eutrophic stagnant waters, such as *Aeshna isoceles*, *Brachytron pratense* and even more critical species such as *Leucorrhinia caudalis* and *L. pectoralis* are also recovering in large areas of Europe.

Figure 15. *Coenagrion hastulatum* is one of the species which is not uncommon in the core of its range but rare and declining at the margins. Photograph Fons Peels.

Figure 16. *Gomphus flavipes* showed a strong decline during the 20th century and was considered one of the most threatened European species. It has however shown a strong recovery since the 1990th and is currently considered of least concern on the European Red List. Photograph Fons Peels.

A remaining concern is the situation of species dependent on oligotrophic habitats such as bogs and fens, as many of these nutrient-poor waters are still threatened in large parts of Europe. In some regions these habitats are negatively affected by the still elevated deposition of atmospheric nitrogen which leads to changes in vegetation composition. Other factors, such as desiccation due to drainage and ground water extraction, are also having a negative impact in many regions. These habitats are largely restricted to areas with a temperate or boreal climate and are restricted to the northern half of Europe and to higher altitudes in central and southern Europe. Especially in the latter the impact of climate change is expected to be severe. Changes in the pattern of rainfall during the last two decades has led to an increased frequency and duration of droughts in spring and summer and this has locally led to the desiccation of fens and peat bogs, resulting in the local extinction of odonate and other aquatic species.

In contrast to western and central Europe, threats to dragonflies in the Mediterranean region are rapidly increasing. Not only do the Mediterranean dragonflies have generally a smaller distributional range but they also often have a strong preference for running waters which are strongly impacted by human activity throughout the region. Due to this, 18 of the 22 dragonflies species currently threatened in Europe occur preferentially in the Mediterranean Basin. Mediterranean species are especially affected by a greater demand for water for agriculture and for the growing (tourist) population, as well as by the increased frequency and duration of hot, dry periods (Kalkman *et al.* 2010). Riverine species are affected by the construction of dams and reservoirs as well as by desiccation of their habitats. Several of those species occur in brooks and seepage systems which can easily be destroyed by single local events such as the extraction of water for local agriculture or domestic use.

Throughout Europe many conservation measures have been undertaken, such as the restoration of peat-bogs, ponds, gravel pits or brooks and these have had many positive effects on odonates. The creation of several types of novel water-bodies such as excavation pits and garden ponds has resulted in the availability of new habitats for many aquatic insects. As dragonflies are good indicators of environmental and landscape diversity and quality, and as they have a short life cycle, they react rapidly to changes in their habitats. They also have a high dispersal capacity and are capable of swift colonisation of new habitats. In addition, the effects of climate change have become apparent in the past two decades, with several southern species showing a northwards expansion. Best known examples of this are *Crocothemis erythraea* which colonised central and northern Europe in the 1990s and several African species, such as *Trithemis annulata* and *T. kirbyi*, which in the past two decades started to colonise large parts of Europe (Figure 17).

Monitoring of dragonflies

In order to determine which dragonfly species need protection and to evaluate the effects of conservation and restoration activities, information is required on trends in dragonfly abundance (population size). Trend information can be obtained directly from monitoring schemes, which aim to produce population indices. Currently only a few monitoring schemes exist for dragonflies on a national or regional scale and a European monitoring scheme is yet to be realized. Monitoring schemes typically require searching for species year after year using standardized field protocols at so-called constant study sites. This minimizes the risk of variation in observation efforts across years, which otherwise may result in biased trend information. These strict requirements however complicate the recruitment of sufficient qualified volunteers and make large-scale monitoring impossible in many countries. Recently a new statistical method has become available which is less time consuming and which allows the use of opportunistic presence-absence data (i.e. observations made without a standardized field protocol) to determine trends of species. This method, called site-occupancy modelling, accounts for imperfect data on species detection and hence corrects for year-by-year variability in observation effort (Kéry *et al.* 2010, MacKenzie *et al.* 2006). The method has been recently successfully applied in deriving trend information from opportunistic data in various species groups, including birds, butterflies and dragonflies (Kéry *et al.* 2010, van Strien *et al.* 2010, 2011). Since opportunistic data on dragonflies are readily available in several European countries, it should be possible to derive trends in occupied sites for those countries as well. Furthermore, van Strien *et al.* (2013.) showed that

Figure 17. The increased temperatures in southern Europe resulted in a strong expansion of the range of *Trithemis annulata*. The grey dots show its distribution prior to 1990 and the red dots show the region it colonised since.

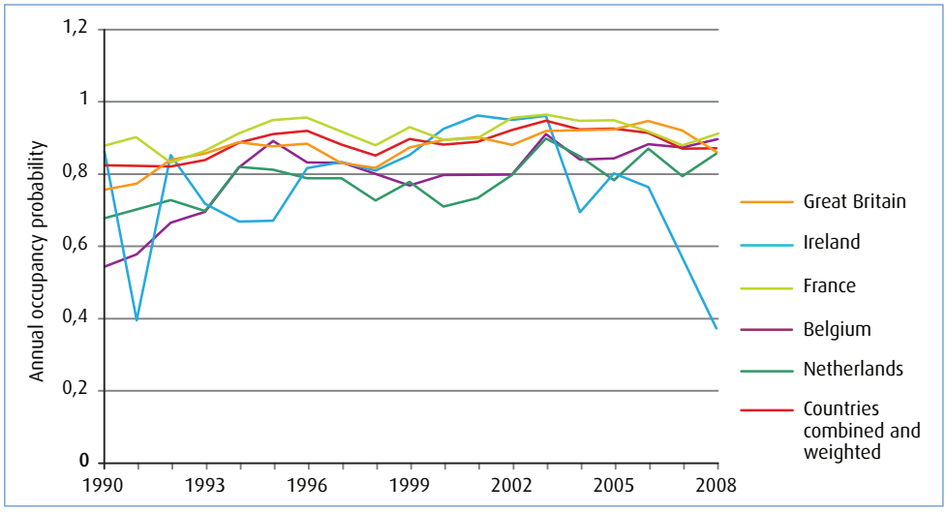


Figure 18. Annual occupancy probability of *Calopteryx splendens* in Great Britain, Ireland, France, Belgium and the Netherlands since 1990, analysed with a dynamic site-occupancy model. The red line is the combination of these five countries, each being weighted according to their specific sampling effort.

it is possible to combine these national data to produce supranational occupancy trends (Figure 18). This allows comparison of trends between European countries and makes it possible to assemble Europe-wide trends and multispecies indicators for dragonflies, and thus to initiate a European Dragonfly Monitoring Network.

Future prospects

The study of dragonflies in Europe has a long-standing tradition and history with many people being involved, resulting in a very good knowledge about the distribution, ecology, behaviour and habitat preferences for most European species. The achievements are innumerable: various excellent field guides in several languages, both for adults and exuviae; distribution atlases for many countries and regions; a European Red List and now at last an atlas for the whole of Europe. All this was only possible through the collaboration of countless volunteers who collected masses of data through citizen science projects. These volunteers are often organised in national/regional Dragonfly Associations such as in the UK, the Netherlands, Belgium, France, Spain, Germany, Italy, Croatia, Poland and Cyprus, and many of these societies publish their own journal or newsletter.

Dragonflies and damselflies are very attractive by virtue of their beautiful colours, aerobatic flight and amazing behaviour, and are among the most popular groups of animals studied by volunteers. They are also considered as good indicators for the overall quality of aquatic habitats. This makes them particularly suitable as flagship species in conservation and restoration projects, and in evaluating Europe's biodiversity.

In 2004, the Streamlining European Biodiversity Indicators (SEBI) process was established to monitor progress towards the EU biodiversity strategy 2010, and later towards the 2020 Biodiversity Targets. For that purpose, 16 'headline indicators' were developed and a provisional set of 26 European biodiversity indicators was proposed by the European Environment Agency. The main objectives are 1) to generate information on biodiversity trends which is useful to decision makers; 2) to ensure that improved global biodiversity indicators are implemented and available; and 3) to establish links between biodiversity initiatives at the regional and national levels to enable capacity building and to improve the delivery of biodiversity indicators. At the moment, no European dragonfly monitoring programme exists and as a consequence, dragonflies were not selected as a SEBI indicator. Monitoring based on standardized field protocols for many European countries is scarcely feasible. In order to produce sound trend information of European dragonflies we must rely on data collected through citizen projects and analyse them using site-occupancy models. This would allow dragonflies to be included in the SEBI process. As a first step this could be done for a selection of common European species. Other possibilities are the development of a 'Index of southern dragonflies in Central and Northern Europe' and an 'Indicator of running water species'.

The release of the European Red List of Dragonflies (Kalkman *et al.* 2010) showed that many threatened species in Europe are not listed on the Annexes of the Habitats Directive and, therefore, do not receive the necessary attention and protection in European conservation policy. One of the recommendations in the Habitats Directive is that an update of its Annexes is needed when new data become available, i.e. when a European Red List or a European atlas is published. Moreover, most of the threatened species are not covered by national legislations. A recognition of present knowledge in European and national legislations is therefore urgently needed to increase the protection of dragonflies and their habitats. This is especially important for the protection of species in the Mediterranean region, where most of the European endemics and threatened species are found. It is clear that not only the dragonflies themselves should be protected, but their habitats as well. Also, this protection should be reinforced in practice. Species protection programmes should be established at the European level for some of the most threatened species (e.g. *Nehalennia speciosa* and *Pyrrhosoma elisabethae*).

The data used for this atlas are very suitable for identifying prime areas for dragonfly conservation. Such an analysis, covering the total number of species, whether they are common, rare or threatened, would highlight centres of biodiversity ('hot spots') within Europe, within the different biogeographical regions and within countries. As a result, conservation programmes for the most valuable or threatened areas could be developed.

Finally, capacity building projects should receive attention, especially in those countries where nature study by volunteers is still undermanned. In countries such as Romania, Bulgaria, Greece, very few local people are interested in dragonflies, but their dragonfly fauna is nevertheless relatively well investigated due to the many western odonatologists visiting as tourists. Despite the large amount of data included in this atlas, nearly half of Europe (Belarus, Ukraine and especially the European part of Russia) remains largely 'terra incognita' due to the absence of local volunteers. Improving the knowledge of dragonflies in those countries remains a challenge.

***Somatochlora flavomaculata*, Achrain (GAP), Germany.** Photograph Fons Peels.

Country accounts

This chapter provides for each European country, information on the history of the study of damselflies and dragonflies, including references to key publications. The Azores (Portugal), Canary Islands (Spain), Madeira (Portugal) and Kaliningrad (Russian Federation) are discussed separately although they do not in themselves constitute independent political entities. The following small countries are not discussed separately: Andorra, Liechtenstein, Monaco, San Marino and Vatican City.

Albania V.J. Kalkman

Albania is one of the least explored countries of Europe and much remains to be discovered. Bilek (1966) summarized all records published prior to 1966; papers dealing specifically with the Odonata of Albania published since then are Dumont *et al.* (1993), Kalkman (2000) and Muranyi (2007). Records from two recent papers (Eltjon *et al.* 2010, Striniqi *et al.* 2010) have not been used for the European atlas as they contain many obvious mistakes. At present no one is working on the fauna of Albania and no distribution atlas is being prepared. Information on distribution prior to 1990 is very poor and that for the period from 1990 onwards is only slightly better. The database used for this atlas (57 species) contains all published information and a handful of unpublished records collected e.g. during the post symposium tour of the Second European Congress on Odonatology, 2012, including the first record of *Coenagrion scitulum* (Kitanova *et al.* 2013).

Austria A. Chovanec

The Austrian Odonata fauna is well studied. Comprehensive investigations began in the mid-19th century when the first detailed records from the geographical area of present-day Austria were published e.g. by Brittinger (1850) and Brauer (1856). In 2006 a national dragonfly atlas was published, edited by the Federal Environment Agency (Raab *et al.* 2006). It contained distribution maps for the 77 species known from Austria before the editorial deadline of 2003, as well as information on ecology, phenology and altitudinal distribution, the first national Red List of Odonata and chapters on the fauna of special habitat types and dragonfly conservation. The database used for the atlas comprised 71 000 records from the period between 1800 and 2003, 82% of which were collected between 1985 and 2003. Two years after the editorial deadline for the atlas, records of a 78th species were documented in Austria (*Lestes parvidens*; Olias 2005). In addition to the national atlas, several regional atlases have been published (Stark 1976, Laister 1996, Raab & Chwala 1997, Hostettler 2001, Landmann *et al.* 2005, Holzinger & Komposch 2012).

Relative to its size, Austria has a large variety of landscape types and climate zones offering habitats for both Mediterranean (e.g. *Somatochlora meridionalis* and *Lestes macrostigma*) and boreo-alpine species (e.g. *Aeshna caerulea*). The western, central and southern parts of Austria are dominated by the Alps, the eastern regions by the Pannonian Lowlands while the north is part of the Bohemian Massif. The highest diversity is found in the floodplain areas of the rivers Danube and March (Morava), the shallow Neusiedler See (Lake Neusiedl) and the saline lakes of the Seewinkel area, the alpine Lech valley, the Rhine delta and Lake Constance as well as the bogs and ponds in the Waldviertel region in Lower Austria.

Besides striving to improve knowledge of Odonata species distribution, odonatological research in Austria since 2000 has focused on the development of dragonfly-based methods for assessing the ecological status of lowland rivers, river-floodplain systems and lake shores and for evaluating the ecological success of river restoration (Chovanec & Waringer 2001, Chovanec *et al.* 2010, 2014a, b).

Belarus R. Bernard

The earliest publications on the distribution of dragonflies in Belarus date from the start of the 20th century (Arnold 1902). The amount of fieldwork conducted in Belarus remained low throughout the 20th century and has since increased only slightly. Many publications on the dragonflies of Belarus contain very little information or include doubtful records and obvious mistakes. The papers by Wnukowsky (1937) and Kipenvarlits (1939) are among the few more informative papers. In the late 1990s and the first decade of the 2000s, knowledge on the Belarusian dragonfly fauna increased slightly, mainly due to hydrobiological studies carried out by M. Moroz. Together with Polish collaborators, the latter published a set of papers documenting the aquatic entomofauna of some protected areas (e.g. Moroz *et al.* 2002, Moroz *et al.* 2006) and papers on species new to the country (Lewandowski & Moroz 2001: *Orthetrum brunneum*; Buczyński & Moroz 2004: *Aeshna affinis*, *Sympetrum depressiusculum*; Buczyński & Moroz 2008: *Sympecma fusca*, *Lestes viridis* and *Orthetrum albistylum*). The first review on dragonflies of Belarus gave little detailed information and is of little use (Pisanenko 1985). Far more informative, though still based on a regional scale of Belarusian provinces ('oblast') is the review by Buczyński *et al.* 2006. Eight species are listed in a national Red Book (Gurin 2004) but the seemingly uncritical selection of species makes this Red List of little use for conservation.

Thus far 64 species have been recorded with certainty from Belarus but it is certain that several remain undiscovered. Together with Albania and European Russia, Belarus is one of the least explored European countries and reliable information is available for a few areas

only. The results of local studies in northern Belarus, with the first record of *Aeshna crenata* (Mauersberger 2000), and especially the description of the odonate fauna of the Pripyat National Park (Dijkstra & Koese 2001) undoubtedly illustrate the real richness of the Belarusian dragonfly fauna.
The data used in the present atlas were prepared by Rafał Bernard on the basis of reliable published data which could be located on a scale of at least 50 x 50 km UTM units.

Belgium G. De Knijf
The study of dragonflies in Belgium has a long history and the country has always been among the best surveyed in Europe. The earliest published information on Belgian dragonflies is to be found in Vander Linden (1825) and Selys (1837). Baron Michel-Edmond de Selys Longchamps was without doubt the most famous odonatologist of the 19th century. He is best known for describing over 700 species from around the world and for being the patron of the 'Collections Zoologiques du Baron Edm. de Selys Longchamps', which was the first and thus far only series of books aimed to give a complete overview of all dragonflies known at that time. His overview of the Belgian dragonfly fauna published in 1888 contained information on the distribution of 65 of the presently 70 species known from the country. Only a small number of entomologists collected dragonflies in Belgium during the first half of the 20th century. This changed in the 1960s when several workers, including Henri Dumont, began faunistic research. From 1970 onwards, members of the Flemish Youth Organisation for Nature Study became interested in dragonflies, resulting in a steady increase of observations. A second review of the Belgian fauna, based mainly on collected material, was published by Cammaerts in 1979. In 1982 the Belgian Working Group *Gomphus* was established with the goal of collecting data for a distribution atlas (Michiels 1986). The continuing increase in records made it possible to produce a Red List for Flanders (De Knijf & Anselin 1996) and a new bilingual distribution atlas (Goffart *et al*. 2006; De Knijf *et al*. 2006). These Atlasses were based on a database containing over 65 000 records, with those from 1990 onwards being available from nearly all 10 x 10 km squares within the area. These books also contains the revised Red List of Flanders and the first Red List of Wallonia. After the publication of the Belgium atlas, the national *group Gomphus* split up into the *Flemish Dragonfly Society* (www.odonata.be) and the *Group Gomphus Wallonie* (http://biodiversite.wallonie.be).
The records from Wallonia were made available by SPW-DGARNE-DEMNA-GT Gomphus et Natagora/Observations.be. The records from Flanders are part of the databank of the Flemish Dragonfly Society and the common database from Natuurpunt Studie and the Flemish Dragonfly Society, and were collected through www.waarnemingen.be. The database of Belgium, that is, Wallonia and Flanders combined, contains over 300 000 records.

Bosnia and Herzegovina D. Kulijer
The dragonfly fauna of Bosnia and Herzegovina is poorly known and despite good progress in the past decade the country is still among the least explored of Europe. The first papers dealing with dragonflies from Bosnia and Herzegovina were published at the end of 19th century (Petrović *et al*. 1891, Puschnig 1896, Klapalek 1898). A key paper by Adamović (1948) contained a list of material comprising 45 species collected between 1888 and 1932, and stored in The National Museum in Sarajevo. Over 30 publications have appeared since, but many of them contain only a small number of records. An important contribution to our knowledge was the paper by Jovic *et al*. (2010a) that summarised all published data and added 232 new records. Fieldwork intensified after 2009, as a mapping scheme was started by the National Museum of Bosnia and Herzegovina. A review based on 1 400 new records and including an annotated checklist was published by Kulijer *et al*. (2013). In this paper five species were added to the national list (*Anax parthenope*, *Gomphus flavipes*, *G. schneiderii*, *Cordulegaster heros* and *Selysiothemis nigra*). It also confirmed the presence of *Somatochlora metallica* in Bosnia and Herzegovina, bringing the number of species to 63.

Bulgaria Y. Kutsarov & M. Marinov
The first major review of the dragonflies of Bulgaria was published by Beschovski in 1994. Since then available information from the country has increased greatly, resulting in an updated checklist, an atlas of Bulgarian dragonflies and various publications on distribution and taxonomy (Marinov 2000, 2001a, b, c, 2003; Grozeva & Marinov 2007). All records from the literature and a great deal of unpublished data are included in the database used for the present atlas. Recent additions to the fauna of Bulgaria (*Somatochlora arctica*, *Leucorrhinia dubia* and *Lindenia tetraphylla*) (Marinov & Simov 2004, Gashtarov & Beshkov 2010) bring the total number of species known from the country to 70. Without doubt, the highlight of recent years was the discovery in Bulgaria of an entirely new species, *Somatochlora borisi* Marinov 2001c, which may well be the last new dragonfly species to ever be described from Europe. There is no Red List of dragonflies in Bulgaria and no species protection plan is in place.

Croatia T. Bogdanovic
There are two distinct peaks in publications dealing with dragonflies of Croatia: namely the second part of the 19th century and the 80s-90s of the last century. Frankovic (1994) summarized all Croatian records of dragonflies and published distribution maps. A great deal of fieldwork has since been carried out and the distribution of dragonflies in the country is currently relatively well known. The most recent addition to the

Croatian fauna, *Pantala flavescens*, recorded as a vagrant on Krk island (Finkenzeller 2010) brought the total number of species known from the country to 68. Two odonatological organizations are active in the country: the *Croatian Odonatological Society – Platycnemis* and the working group which maintains a database of Croatian dragonflies (CROD). The database of Croatian dragonflies contains all published records as well as a large number of unpublished records. A Red List including maps of many species has recently been published (Belančić *et al.* 2008). Current odonatological work includes inventories of National and Nature Parks, the mapping of rare species and a monitoring of the status of *Lindenia tetraphylla*. Information on Croatian Odonata including a bibliography can be found at www.vretenca.hr.

Cyprus J.-P. Boudot
Records prior to 1952 were summarised by Valle (1952a) with some additions published by Kiauta (1963). These publications contained in total less than 200 records. Lopau & Adena (2002) brought together nearly 1000 additional records based on the fieldwork since 1980 by several odonatologists and on material held in the British Museum of Natural History and the Naturalis Biodiversity Center. In addition to new records this publication includes maps of all 33 species known from the island at that time. Since *Erythromma viridulum* was found on the island in 2004 (Flint, unpublished) and more recently *Brachythemis impartita* and *Trithemis arteriosa* were recorded (Cottle 2007). The surprising discovery of *Ischnura intermedia* in 2014 (De Knijf *et al.* submitted) brings the total number of species presently known from Cyprus to 37. Information on the early spring fauna was published by De Knijf & Demolder (2013).

Czech Republic O. Holusa
The history of odonatological surveys in the territory of the current Czech Republic stretches over 150 years and includes several hundreds of publications. The earliest records from Bohemia date back to 1849 and those from Moravia and Silesia to 1859. Intensive and well-organised study of dragonflies began in the 1990s, resulting in a large number of publications on distribution, ecology and behaviour. Virtually the entire territory of the Czech Republic was explored during a very intensive national survey of dragonflies from 2000 to 2007. The database resulting from these efforts includes approximately 70 000 records. In 2007 an atlas of the Czech dragonflies was published, comprising an extensive overview of the distribution, ecology and habitat of every species (Dolný *et al.* 2007). A check-list of dragonflies occurring in the Czech Republic was published by Jeziorski (1998) and Jeziorski & Holuša (2012). Species newly recorded since the publication of the Czech atlas (Dolný *et al.* 2007) are *Somatochlora meridionalis* (Holuša 2007), *Erythromma lindenii* (Waldhauser 2009) and *Cordulegaster heros* (Staufer & Holuša 2010). At present 73 species are known. A Red List of the Czech dragonflies was published in 2005 (Hanel *et al.* 2005) and a field guide with updated distribution maps appeared very recently (Walhauser & Černý 2014).

Denmark L. Iversen & E. Nielsen
Denmark was among the first European countries to have published an overview of its dragonfly fauna that included accounts of species ecology (Esben-Petersen 1910, Wesenberg-Lund 1913a, b). Following these early contributions, interest in dragonflies was for a time limited, especially when compared with some other West European countries. Holmen (1996) provided a detailed review of the most important Danish publications and data-sources prior to 1996. The turning point in modern Danish odonatology came with the work on the national Red List in 1997 (Holmen & Pedersen 1998) and with the publication of a handbook with distribution maps and an updated key for Danish adult dragonflies and larvae (Nielsen 1998). This established an ongoing interest in dragonflies in Denmark, and around 60 % of the 28 000 records now available were collected after 2000. The number of amateurs interested in dragonflies is rising and dragonflies increasingly receive attention in nature management. An updated Red List was published in 2005 (Rasmussen 2005) and the Habitats Directive species *Leucorrhinia pectoralis*, *Aeshna viridis* and *Ophiogomphus cecilia* are included in a national monitoring program. The increased number of observers and the general northwards expansion of dragonflies have resulted in five species new to Denmark being found in the last decade, including the westernmost population of *Aeshna serrata* (Bell *et al.* 2014). They bring the national total to 58 species. The information on the distribution of Danish dragonflies is good and for a large part of the country records are available from both before and after 1990. There are nevertheless areas where knowledge is very limited, especially in western Jutland and in many of the Danish islands, with the exception of Funen and Sealand.

Estonia R. Bernard & M. Martin
The first odonatological faunistic publication from Estonia appeared in the last quarter of the 19th century (Bruttan 1878). The level of research activity then remained very low for the next 120 years. The few papers published in this period include the description of *Aeshna osiliensis* (syn. *A. serrata*) (Mierzejewski 1913), the first synthetic article with maps (Kauri 1949), remarks about the distribution of dragonflies in Estonia (Spuris 1968) and keys to the adults and larvae (Remm 1957, Remm 1963). A large quantity of new data has been collected in the past 15 years, mostly by Estonian entomologists but also by some foreign visitors (e.g. Kalkman *et al.* 2002), allowing Estonian specialists to prepare new distribution maps (Martin *et al.* 2008). Following the latter publication, *Aeshna isoceles*, *Anax parthenope* and *Sympecma*

fusca arrived from the south (Piirainen 2000, Martin 2009) and were added to the national list. Currently, 57 species are known from Estonia and a further three or four are expected to occur as their ranges have recently expanded northwards. The data used in the European atlas were prepared by Mati Martin (mostly) and Rafał Bernard on the basis of published information summarized in the Estonian atlas (Martin *et al.* 2008) and unpublished data compiled in the observado.org database.

Finland S. Karjalainen

The earliest overview of the Finnish dragonfly fauna was by Hisinger (1861). Some time later, from the 1920–1950s, K.J. Valle consolidated knowledge of the Finnish dragonfly fauna in a series of publications, including several faunistic papers, two handbooks (Valle 1922, 1952c) and the first distribution maps of Finnish dragonflies, which showed the distribution of Finnish species throughout Fennoscandia and Estonia (Valle 1952b). The next worker to publish distribution maps of Finnish dragonflies (based on 10 x 10 km squares) was Valtonen (1980). During the last three decades of the 20th century relatively few people in Finland were interested in dragonflies with most new distributional records during this period being provided by Matti Hämäläinen and Pekka Valtonen. Following the publication of Sami Karjalainen's (2002) book 'Suomen sudenkorennot' (The dragonflies of Finland), interest in dragonflies increased greatly, resulting in a considerable increase in recording activity. The Finnish Dragonfly Society, which was founded in 2006, publishes the journal Crenata and maintains a database of dragonfly distribution, with 5 000 to 9 000 new records being added annually. The southernmost part of Finland is well explored, but records from the northern part of the country are still inadequate. Updated range maps were published in the second edition of Karjalainen's (2010) book, covering all the 55 species known from that country at this time. Eight new species were found in the south of the country since 2008: *Aeshna affinis* (2008), *Anax imperator*, *Sympetrum pedemontanum* (both 2010), *Lestes virens*, *Sympetrum fonscolombii* (both 2011), *Anax parthenope* (2013), *Anax ephippiger*, *Gomphus flavipes* (both 2014). For information on the recording history of Finnish dragonfly species, see Hämäläinen (2010). A new Red List was published in 2010 (Valtonen 2010).

France J.-P. Boudot & J.-L. Dommanget

The study of Odonata in France has a long history dating back to Réaumur (1742) who illustrated and described several species as well as figuring larvae, emergence, copulation and internal anatomy. The fauna has been well studied and all 50 by 50 km-squares were surveyed both before and after 1990. Dommanget (1987) summarized all information available prior to 1986. From 1982 onwards, the creation of the INVOD (INVentory of ODonata) program resulted in an increase in the number of records collected. Many of the more important new records were published in *Martinia*, the journal of the French Dragonfly Society (*Société française d'Odonatologie*, SFO) and the Notulae odonatologicae as well as in more regional journals. A preliminary Atlas was published in 1994 (Dommanget 1994) and a new synthesis on the French odonate fauna appeared in 2006 (Grand & Boudot 2006). Distribution maps are available online (www.libellules.org). The INVOD program ended formally in 2001 but is now extended under the CILIF inventory program. As a result of these efforts, a database of about 354 700 records has been assembled and was used for the present atlas. Records prior to 1970 are not included in this database and for these a separate database with about 6 800 published records was created. In the last two years several regional atlases have been produced (eg. Ternois & Fradin 2014), many of which are freely available on internet. All these contributions of regional associations have been used to update the INVOD and CILIF databases. A national Red List of the French Odonata is being prepared by a triple partnership (*Société française d'Odonatologie* (SFO), *Office pour les insectes* et *leur environnement* (OPIE) and Muséum national d'histoire naturelle (MNHN)) and will appear in 2016. A national conservation action plan for 18 threatened species has been published (Dupont 2010) and developed regionally (e.g. Conservatoire des Sites Lorrains & Société Lorraine d'Entomologie, 2012. The recent records of *Lindenia tetraphylla*, *Brachythemis impartita*, *Selysiothemis nigra* and *Orthetrum trinacria* in Corsica (Tellez 2010, Duborget 2013, Berquier 2013, D. Sannier pers. com.) brings the national total to 96 species, some represented within France by two distinct subspecies.

Germany K.-J. Conze

Germany has a strong tradition of research on dragonflies dating back to the first half of the 18th century with the contributions of Rösel (1749) and later Charpentier (1840) being particularly noteworthy. Another important earlier work published in Germany and including information on German Odonata was a dissertation by Hagen (1840), a Prussian scientist who later became the first professor of entomology at Harvard University, USA. In this work he reviewed the literature on the 78 species recorded for Europe at the time. By the beginning of the 20th century 72 species were already known from Germany (Le Roi 1914). The partition following the Second World War into East and West Germany and its current political structure, with strong federal states, means that most research is regionally organized. Due to this, faunistic overviews for the whole country are relatively scarce compared to the large number of papers published. No other country in Europe and possibly the world has seen so many publications on dragonflies. A recently published bibliography of the Odonata literature of Germany included over 6 400 references (Schorr &

Wolf 2012). An important early initiative to amalgamate information on habitats and conservation for the dragonfly fauna of West Germany was done by Schorr (1990). The *Gesellschaft deutschsprachiger Odonatologen* (GdO, society of German-speaking odonatologists), founded in 1982, has been of key importance in furthering knowledge of German odonates. This society has over 600 members, organizes annual meetings and publishes the journal "*Libellula*" (www.libellula.org). Since 1997 distribution atlases of several federal states have been published (Schleswig-Holstein: Brock *et al.* 1996, Bavaria: Kuhn & Burbach 1998, Saxony: Brockhaus & Fischer 2005, Thuringia: Zimmermann *et al.* 2005, Saarland and Rhineland-Palatinate: Trockur *et al.* 2010, Hesse: Hill *et al.* 2011, Brandenburg: Mauersberger *et al.* 2013). The encyclopaedic guide to the Odonata of Baden-Württemberg (Sternberg & Buchwald 1999, 2000), incorporating detailed distribution data, is considered a milestone for European odonatology as it gives an very extensive overview of the general biology, ecology and habitats of a large part of the European dragonfly fauna.

In 2006 the GdO commenced work on a distribution atlas for the whole country that resulted in the first atlas covering the whole of Germany (Brockhaus *et al.* 2015). Over a million records have been brought together from all federal states. The same database has been used for the current European atlas, meaning that Germany is one of the countries best covered here. Dragonflies are an important focal group for conservation and management in Germany and every state has a regional Red List. A first countrywide Red List was published in 1984 (Clausnitzer *et al.* 1984) while an updated Red List, based on the data used for the German atlas, appeared in 2015 (Ott *et al.* 2015). Müller & Schorr (2001) presented the first compilation of the dragonfly fauna of the sixteen federal states of the reunited Germany, which included 80 species. The only subsequent addition is the discovery of two populations of *Boyeria irene*, one at Lake Constance (Bodensee) (Schmidt & Strang 2005) and the other, isolated and unexpected but seemingly flourishing, in lower Saxony (Clausnitzer *et al.* 2010). Among the 81 species recorded from Germany, two occur either as a vagrant (*Lestes macrostigma*) or only reproduce in certain years (*Anax ephippiger*), while another two (*Coenagrion hylas* and *Onychogomphus uncatus*) are deemed extinct. The other 77 species are autochthonous and currently have populations in Germany with a majority (44) assessed as of least concern on the Red List.

Great Britain S. Prentice

The dragonfly fauna of Great Britain is one of the best studied and all 50 x 50 km squares have records from both before and since 1990. Important early accounts of British dragonflies include those of Harris (1782), McLachlan (1884), Lucas (1900) and Longfield (1937, 1949). In the first edition of Longfield's book (Longfield 1937) the distribution was given by county; in her second edition (Longfield 1949) more detail was provided by using the Watsonian vice-county system. Longfield also compiled maps using this system for Corbet *et al.* (1960). Maps showing distribution based on 10 x 10 km squares were produced in Hammond (1997) and this has been the scale used in subsequent atlases, the first of which appearing in 1978 (Heath 1978). This was updated a year later by Chelmick (1979). The next atlas was published almost twenty years later (Merritt *et al.* 1996) and a third appeared in 2014 (Cham *et al.* 2014). A number of individual county atlases have been published that use 1 km resolution. In recent years a number of key dragonfly sites have been established at both regional and national levels. Three species became extinct in Britain in the 1950s. However, one of these, *Coenagrion scitulum*, returned and bred in 2010. Moreover, species that were hitherto regular migrants from the continent have started breeding in Great Britain (e.g. Parr 2010), and a number of species have extended their range northwards in recent years (Hickling *et al.* 2005, Brooks *et al.* 2009, Mill *et al.* 2010, Cham *et al.* 2014). Currently there are about 43 breeding species present among the 58 species ever recorded from the United Kingdom, a figure which includes the two species visiting the Channel Islands (*Orthetrum brunneum* and *Sympetrum meridionale*) and the one (*Crocothemis erythraea*) breeding there (Cham *et al.* 2014). The British database contains around 767 600 records and currently about 60 000 new records are being received each year. Most British records are available via the National Biodiversity Gateway: www.nbn.org.uk at 100 m resolution and have been recorded using the British National Grid. A Red List has been published (Daguet *et al.* 2008). Four species are listed as Endangered nationally: *Coenagrion mercuriale*, *C. hastulatum*, *Aeshna isoceles* and *Leucorrhinia dubia*. National conservation action plans have been instigated for both *Coenagrion mercuriale* and *Aeshna isoceles*.

Greece J.-P. Boudot

A general account of the dragonflies of the Greek Islands was published by Cowley (1940) but it took more than half a century before such information on the mainland fauna became available. From 1980 onwards, several odonatologists began fieldwork in Greece, resulting in a greatly increased knowledge of the distribution of species. All published records were summarized in a provisional atlas published by Lopau & Wendler (1995). Later, several thousand hitherto unpublished records were brought together, chiefly in four issues of *Libellula* Supplements published as "Studies on the Odonata fauna of Greece" (Lopau 1999, 2000, 2005, 2010a). The fourth issue of this series contains an atlas giving distribution maps and flight period histograms of 78 species known from Greece at that time (Lopau 2010b). In addition, it includes a checklist of the distribution of dragonflies on 36 Greek islands and references to nearly all relevant publications. Subsequently Stobbe (2012) reported

Trithemis arteriosa, a species new to Greece, from the island of Crete although it was not found again on subsequent visits. The distribution of the 79 species now known from Greece is reasonably well known but there are still parts of the country that are poorly explored, for example the north-west. Greece harbours more species listed on the European Red List than any other European country. This includes four species, (*Pyrrhosoma elisabethae*, *Ceriagrion georgifreyi*, *Somatochlora borisi* and *Cordulegaster helladica*), for which a large part of the world population is found in Greece and two species, (*Boyeria cretensis* and *Coenagrion intermedium*), which are endemic to Crete. At present there is almost no interest in dragonflies in Greece and no programmes to conserve threatened species are in place.

Hungary A. Ambrus
The first records of dragonflies from Hungary were published in 1896 (Kohaut 1896), but most of the localities underwent changes in their names and are difficult to locate. During the 20th century, several workers investigated the Hungarian dragonfly fauna, with S. Pongrácz, J. Sátori, S. Újhelyi being mainly active in the first half of the century while Z. Varga, H. Steinmann, P. Benedek, S. Tóth, and G. Dévai were active in the second half. György Dévai organized the Fraternity of Hungarian Odonatists (MOBK) which brought together people interested in different fields of odonatology. His former students in Debrecen University are still working on dragonflies at different institutions, including national parks. An atlas showing the distribution of species for two periods (prior to 1961 and 1961 to 1982) was published by Dévai *et al.* (1994). The records on which these maps are based were not available for the European atlas. In order to overcome this difficulty the points shown on the maps published by Dévai *et al.* (1994) were digitised. Recent fieldwork since 1992 has focused strongly on larva with a small team (A. Ambrus, K. Bánkuti, T. Kovács) surveying large parts of the country (e.g. Kovács & Ambrus 2003, Kovács *et al.* 2004). The database used for the European atlas is largely based on these records. Due to this emphasis on larvae relatively few records of the species pairs *Somatochlora metallica-meridionalis* and *Chalcolestes viridis-parvidens* are identified to species level (see introduction) and their distribution is poorly known. Nevertheless, the country is among the best documented areas of East Europe. The most recent addition to the fauna is *Erythromma lindenii* found in the southeast of the country (Móra & Farkas 2015). Currently in Hungary, over a third of dragonfly species (24 of the 65 species known from the country) are under legal protection, including those listed in the Habitats Directive. In recent years the study of dragonflies has focused on a biodiversity monitoring program and water quality monitoring (Water Framework Directive). A checklist together with distribution maps can be found on http://szitakotok.hu.

Iceland V.J. Kalkman
There are no dragonflies that reproduce in Iceland and the only species which has ever been recorded as vagrant is the Afrotropical *Anax ephippiger* (Norling 1967, Mikkola 1968, Tuxen 1976). This species was found in 1941 (one), 1964 (one) and 1971 (three specimens).

Ireland B. Nelson
The year 1845 marked the beginning of Irish odonatalogy, owing to a visit by Selys Longchamps, who published a summary account of his visit, which recorded several species that have not been seen since (Selys 1846). In the succeeding years the study of dragonflies relied mostly on the efforts of a few accomplished and energetic enthusiasts. The first authoritative and reliable checklist was produced in 1910 (King & Halbert 1910). The period from 1920 to 1970 marked the time of greatest activity by two eminent Irish odonatologists, Cynthia Longfield and Niall MacNeill. Longfield authored the first accessible and illustrated guide to the British and Irish species, a work that remained in print for many decades (Longfield 1937). MacNeill was inspired by Longfield and wrote many notes on the distribution of Irish species. He was especially interested in larvae and reared many of the Irish species. Since 1970, the main focus of interest has been the recording of distributions. Don Cotton was pre-eminent in this endeavour, most notably adding *Coenagrion lunulatum* to the Irish list in 1981 (Cotton 1982). During the 1980s, provisional atlases showing coverage of the island became more even and comprehensive. This recording period culminated in the first comprehensive atlas of the British and Irish species showing records gathered up to 1990 (Merritt *et al.* 1996). Finally, the last decade of the 20th century saw the increase in interest in watching and identifying insects and the planning of the *DragonflyIreland* project. This was the first all-Ireland insect recording project funded and run entirely within the island. *DragonflyIreland* ran from 2000 to 2003 and the results were published in 2004 (Nelson and Thompson 2004). A Red List of Irish odonates was completed in 2011 (Nelson *et al.* 2011). The distribution data for the 32 odonates recorded from the Republic of Ireland (24 breeding species only) can be viewed online through www.habitas.org.uk or www.biodiversityireland.ie.

Italy S. Hardersen & E. Riservato
The first major publication on the Italian dragonfly fauna was the book "Fauna d'Italia – Odonata" (Conci & Nielsen 1956). The numerous line drawings in this book meant that it was for a long time a major source of information on European odonates, especially larvae. The first publication to provide an overview on the regional distribution of the Italian dragonfly species was the paper by Carchini *et al.* (1985). Subsequently Utzeri & D'Antonio (2005) summarized most faunistic records published prior to 1999 and provided distribution maps for all species. Over the last ten years, the

study of Odonata has intensified resulting in the discovery of six species new for Italy: *Aeshna subarctica*, *Cordulegaster heros*, *Sympetrum sinaiticum*, *Trithemis kirbyi*, *Pantala flavescens* and *Zygonyx torridus*, bringing the total species number for Italy to 93 (Bedjanič & Salamun 2003, Festi 2011, Holuša 2008, Kunz *et al.* 2006, Corso *et al.* 2012). The 94th and most recent species discovered in Italian territory is *Diplacodes lefebvrii*, found and photographed in 2013 and 2014 on the island of San Pietro (Sardinia), where it seems to be now established (Rattu *et al.* 2014). The publication of the Atlas of Piedmont and Aosta Valley (Boano *et al.* 2007) was important as it was the first to collect a large number of unpublished records collected by volunteers. Overall, the Italian dragonfly fauna is reasonably well studied. Some Italian regions, such as Abruzzo and Umbria, however remain poorly investigated. The first national meeting of Italian odonatologists was held in 2007 and resulted in 2010 in the founding of the Italian Society for the Study and Conservation of Dragonflies – ODONATA.IT. This society, which currently has 140 members, is active in coordinating annual meetings, collecting the national literature and maintaining a national odonatological database. These data, which are mainly collected by volunteers, were also the basis for both the preliminary national atlas of Odonata and the Italian red data book, which appeared in 2014 (Riservato *et al.* 2014a, b).

Latvia R. Bernard & M. Kalniņš

The first paper on Latvian odonates which included detailed locality data was published in the 1860s (Kawall 1864). During the 20th century, Latvian odonatology was dominated by the systematic work of Zandis Spuris who published many informative papers between the early 1940s and the late 1990s. He also prepared an early synthesis, "Dragonflies of the Latvian SSR" (Spuris 1956). However, being published in Russian, it remained almost unknown to foreign workers. Spuris also prepared a dragonfly catalogue (Spuris 1980), a supplement (Spuris 1996) and the Latvian Red Data Book (Spuris 1998). From the early 2000s onwards, several articles focusing on particular species were published, including papers on protected species (*Nehalennia speciosa*: Kalniņš *et al.* 2011, *Aeshna subarctica*: Kalniņš 2012c) and papers on species new to Latvia (*Sympetrum pedemontanum*: Kalniņš 2002, *Aeshna crenata*: Bernard 2003, *Orthetrum brunneum*: Kalniņš 2007, *Anax parthenope*: Kalniņš 2009). Recently, two large, wide-ranging publications appeared (Kalniņš 2012a, b), summarizing knowledge of the dragonflies of Latvia, including information on the history of local odonatology, detailed distribution maps and an analysis of the Latvian odonate fauna. The data used in the European atlas have been prepared by Mārtiņš Kalniņš (mostly) and Rafał Bernard on the basis of recent synthesis (Kalniņš 2012a) and unpublished data. Until recently, 59 species were known in Latvia, but in September 2012 a 60th species, *Erythromma viridulum*, was found and published on the internet. Four or five species, whose ranges have recently shifted to the north, will likely be found in the country in the near future.

Lithuania R. Bernard, P. Ivinskis & J. Rimšaitė

The first information on Lithuanian Odonata was published at the beginning of the 20th century (Bartenev 1907) while the first works dedicated solely to the odonates of Lithuania were published by Polish authors in the early 1920s (Prüffer 1923, Znamierowska 1923). The level of odonatological investigation in the 20th century remained rather low, with most work carried out by A. Stanionytė between the late 1950s and the early 1990s. She summarised the distribution of species based on Lithuanian districts but did not give details of localities (Stanionytė 1993). Most currently available data were collected after 2000, mainly by R. Bernard from Poland, P. Ivinskis, J. Rimšaitė, D. Dapkus, G. Švitra, B. Gliwa and several Hungarian visitors. Seven species new to Lithuania were recorded this century: *Aeshna crenata* (Bernard 2002), *Orthetrum brunneum* (Bernard & Ivinskis 2004), *Aeshna affinis* (Bernard 2005), *Erythromma viridulum* (Ivinskis & Rimšaitė 2010, Gliwa & Stukonis 2011), *Sympecma fusca* (Ivinskis & Rimšaitė 2010), *Orthetrum albistylum* (Gliwa 2013) and *Crocothemis erythraea* (D. Račkauskaitė & B. Gliwa *in litt.*). Other important papers published during this period include e.g. Bernard & Samoląg 2002, Briliūtė & Budrys 2007, Bernard *et al.* 2008, Kovács *et al.* 2008, Švitra & Gliwa 2008, Ivinskis & Rimšaitė 2009, Švitra 2010 and Kovács *et al.* 2011. An identification key (Dapkus 2010) and Red Data Book (Aidukaitė *et al.* 2007) have been published and a survey of both older and recent data is in preparation (Bernard & Ivinskis). Bernard (2005) removed two species from the Lithuanian list, *Aeshna caerulea* and the south-east Asian *Sympetrum eroticum*, the record of the latter being based on an accidental introduction. In total, 65 species have been recorded from Lithuania and it is likely that certain species whose ranges have shifted northward may be recorded in the near future. The data used in the European atlas were prepared by Rafał Bernard, Povilas Ivinskis and Jolanta Rimšaitė on the basis of published and extensive unpublished data.

Luxembourg R. Proess

Luxembourg is a small country and is among the best surveyed in Europe. The study of the dragonflies of Luxembourg began late, with the first paper published in 1960 (Hoffmann 1960). The paper lists 50 species, but unfortunately gives little detailed distribution data. The second paper appeared in 1978 but from then onwards, several enthusiasts (T. Battin, R. Gerend, C. Junck, F. Schoos, R. Proess and B. Trockur) started collecting detailed faunistic data and over 25 publications dealing with Odonata were published after 1980. A Red List was published in 1994 (Gerend & Proess 1994) with updates appearing in 1998 and 2006 (Proess & Gerend 1998, Proess 2006a). All records were summarized in a distribution atlas showing the distribution of the 62

national species for two periods (1960-1979, 1980-2006) using squares of 5 x 5 km (Proess 2006b). After the publication of the atlas, work was focused on species listed on the Habitats Directive *Leucorrhinia caudalis*, *Oxygastra curtisii* and *Coenagrion mercuriale*.

Macedonia, Republic of D. Kitanova
The dragonflies of Macedonia are still insufficiently studied although good progress has been made in recent years. Papers summarizing earlier information on Macedonian dragonflies were published by Karaman (1969) and Peters & Hackethal (1986). The majority of publications focused on standing water ecosystems (Petkow 1921, Filevska 1954, Buchholz 1963, Karaman 1969, 1979a, 1979b, 1981, 1984-1985, 1992, Melovski *et al.* 2008 and Jović 2009). The large Lakes Ohrid, Dojran and Prespa have been especially well studied (Filevska 1954, Karaman 1979a, 1981, 1984-85, Peters & Hackethal 1986, Zaval *et al.* 2010). By contrast, relatively little work has been done on riverine ecosystems with most investigations being fairly recent (e.g. Adamović 1990, Kitanova *et al.* 2008, Jović 2009). The collections of the Macedonian Natural History Museum in Skopje and the Nikola Nezlobinski Museum in Struga were recently reorganised and digitized (Bedjanič *et al.* 2008, Jović & Mihajlova 2009). Recently, four species were published as new for Macedonia: *Aeshna cyanea*, *A. juncea*, *Cordulegaster insignis* and *Somatochlora flavomaculata* (Micevski *et al.* 2008, Bedjanič *et al.* 2008, Holuša & Křivan 2012, Holuša & Holušova 2012, Kitanova *et al.* 2013) bringing the total for Macedonia to 62 species. Protection of the odonate fauna in Macedonia has received little attention and no Red List has been compiled to date.

Malta, Republic of G. Degabriele
The Maltese Islands comprise an archipelago of four small islands of sedimentary origin, with a total area of circa 360 km^2. The islands have a limited number of freshwater habitats with a majority being negatively impacted by agricultural activities. This means that relatively few suitable breeding habitats are available and many records relate to vagrants from within the islands or from mainland Africa or Europe. Literature on the dragonflies of the Maltese Islands prior to 1980 is sparse. The earliest records are those of McLachan (1899) and Cowley (1940) who both recorded only *Ischnura genei*, *Crocothemis erythraea* and *Sympetrum striolatum*. Valletta (1949, 1957) published the first then comprehensive list of eleven species from the Maltese Islands. Recent publications include the study by Degabriele (1992) that focused on the ecology and behaviour of Maltese Odonata and Ebejer *et al.* (2008) who provided an updated list of species, adding *Trithemis annulata*. Since then, *Calopteryx haemorrhoidalis*, *C. virgo meridionalis*, *Orthetrum nitidinerve*, *O. chrysostigma* and *Pantala flavescens* have been added, the two first found only as single specimens found in a collection, bringing the list to a total of 19 species (Sciberras *et al.* 2010, Gauci *et al.* 2011, Gauci 2014, Degabriele 2013, Sciberras & Sammut 2013. The fauna of Malta was recently reviewed in a paper on the dragonflies of the islands of the Sicilian Channel (Corso *et al.* 2012) and an extensive overview of the fauna was given in Degabriele (2013).

Moldova E. Dyatlova
Moldova is amongst the least known of the European countries. There are few papers containing information on Moldovan dragonflies and these contain very few records that can be located with certainty (Artobolevsky 1917, Bezvali 1932, Brauner 1910, Andreev 1998, Osenimskiy 2006). New records, including five new species (*Lestes macrostigma*, *Coenagrion ornatum*, *C. scitulum*, *Aeshna grandis* and *Orthetrum brunneum*), and preliminary distribution maps were presented by Dyatlova (2010) and Skvortsov (2010). At present 35 species are known with certainty from identified localities in Moldovan territory and several others are in need of confirmation, namely (*Chalcolestes viridis*, *Nehalennia speciosa*, *Aeshna juncea* and *Erythromma lindenii* with the first three most likely being misidentifications). It seems probable that between 10 and 20 additional species remain to be discovered. The database used for the European atlas was constructed by Elena Dyatlova and contains all published records and some unpublished records.

Montenegro B. Gligorović
Only a few records of Odonata were published from the territory of Montenegro up to the 1990s, mainly by visiting scientists (Stein 1863, Bartenev 1912, Pongracz 1914, 1923, Capra 1945, Adamović 1948, Bilek 1966, Kumerloeve 1970, Dumont 1977b, Kemp 1989). Since the 1990s papers published have been based on more thorough fieldwork and often concentrate on small areas (eg. Adamović 1996, Adamović *et al.* 1996, Gligorović & Pešić 2007a, b, Gligorović *et al.* 2008, 2009, 2010a, b, c). Jović (2008a) gives an overview of the fauna of coastal Montenegro including a review and bibliography of the Odonata of Montenegro. The dragonfly fauna of Montenegro is still inadequately known and many areas warrant further investigation. Jović *et al.* 2008a added seven species to the national total, and since then, *Epitheca bimaculata* (sight record to be confirmed), *Gomphus pulchellus*, *Ophiogomphus cecilia*, *Trithemis annulata* and *Pantala flavescens* have been added, bringing the total to 67 (Buczyński *et al.* 2013a, b, Gligorović *et al.* 2010a, Ober 2008, De Knijf *et al.* 2013). An annotated checklist can be found in Buczyński *et al.* (2013b) and De Knijf *et al.* (2013), the latter including information on regional diversity and information on species of European concern.

The Netherlands V.J. Kalkman
Dragonflies are very popular among Dutch amateur naturalists and the country is among the best surveyed in Europe. Odonatological studies in the Netherlands

began as early as the 17th century with the descriptions of the life history of dragonflies by Johann Swammerdam, first to describe the process of emergence and to depict the copulation of dragonflies (Swammerdam 1669). The first distribution records of dragonflies are from the 19th century. In 1925 and 1926 the first book on Dutch dragonflies was published in two issues of the Journal Tijdschrift voor Entomologie by the 21 years old M.A. Lieftinck. In the 1920s and 1930s, both Lieftinck and D.C. Geijskes explored mainly the southern and western parts of the Netherlands, increasing knowledge of distributions and adding *Oxygastra curtisii* and *Leucorrhinia albifrons* to the Dutch list. After they departed for the Dutch colonies of Indonesia and Suriname respectively, fieldwork in the country diminished. The 1960s onwards saw resurgence in interest in dragonflies stemming mainly from the activities of members of the Dutch youth organizations for nature study, resulting in a steady increase in the number of records up to the 1980s. In 1983 the second review of the Dutch fauna was published (Geijskes & van Tol 1983), which presented for the first time distribution maps for all species. By the early 1990s the number of records had increased to over 50 000. This number increased rapidly after the start of the Dutch dragonfly project organized by the Dutch youth Organizations for Nature Study in 1992 and the publication of the first Dutch Field Guide (Bos & Wasscher 1997). The resulting distribution atlas (Nederlandse Vereniging voor Libellenstudie 2002) included fully 215 000 records. From the start of the present century, between 50 000 and 100 000 records have been collected annually. The latest update on odonate distribution was published by Bouwman *et al.* (2008) and presently the national checklist includes 71 species. Recent records and updated maps can be found on http://waarneming.nl. A monitoring scheme for dragonflies has been in place since 1998 (Van Swaay *et al.* 2010) and Red Lists were published in 1999 and 2012 (Wasscher 1999, Termaat & Kalkman 2012). Conservation action plans have been prepared for several species, the most recent being for *Somatochlora arctica* (Ketelaar *et al.* 2005).

Norway K. Aagaard & D. Dolmen

Due to its long cold winters and short rainy summers large parts of Norway have a depauperated dragonfly fauna. These climatic conditions are more severe than in neighbouring Sweden and Finland as Norway not only lies within high northern latitudes but is also dominated by mountainous landscapes. These conditions mean that many species reach their northern limit within the country in the south-eastern tip of Norway (e.g. *Ischnura pumilio*, the most recently discovered of the 48 national Odonata species). The low diversity in dragonflies meant that this group has received relatively little attention, with most publications discussing the zoogeographical composition of the fauna (Sømme 1937, Tjønneland 1953, Dolmen 1996). Some information on Norwegian odonates can be found in reports such as Dolmen (1995), who showed the impact of acid rain on the dragonfly fauna in southern Norway. Dragonflies were among the first invertebrates to be included in the national Red Lists, of which the most recent one was published in 2010 (Olsvik & Dolmen 1992, Kjærstad *et al.* 2010). Most of the species currently placed in a threatened category on the Red List are southern species, which due to their small range in Norway are dependent on a relatively small number of suitable habitats. There is currently no book available dedicated to the Norwegian dragonfly fauna. Information and maps of all species can be found on http://artskart.artsdatabanken.no.

Poland R. Bernard

The history of odonatology in Poland began with the arrival of Toussaint de Charpentier, who settled in Brzeg in about 1820 and described ten new dragonfly species from Silesia (Charpentier 1825, 1840). During the next 150 years, dragonflies were studied by numerous odonatologists from three nations. These included Polish workers, e.g. J. Dziędzielewicz, J. Zaćwilichowski, J. Fudakowski and S. Mielewczyk, as well as German and Russian workers, among them several great authorities, such as H.A. Hagen, A.N. Bartenev, E. Schmidt and P. Münchberg. The first synthesis, "*Odonata Haliciae reliquarumque provinciarum Poloniae*", appeared at the beginning of the 20th century (Dziędzielewicz 1902). The first critical checklist was published mid-century (Urbański 1948), the second at the end of the 1980s (Mielewczyk 1990) and the most recent one in 2007 (Tończyk & Mielewczyk 2007).

Odonatological studies in Poland increased significantly since the beginning of the 1990s. The rapid increase in data collection led to the publication of papers synthesizing knowledge of a selection of species (e.g. Bernard 1998, 2000a, 2000b, Buczyński 2000, Bernard & Buczyński 2008) and conservation aspects (Bernard *et al.* 2002a, 2002b), and finally a distribution atlas (Bernard *et al.* 2009). The latter is based on all published and a large number of unpublished records and contains maps of the distribution of all 73 species, a thorough analysis of the fauna and the current national Red List. The general distribution of dragonflies in Poland is relatively well known although information on a finer scale is scarce in many regions. The Odonatological Section of the Polish Entomological Society organizes annual national symposia and publishes *Odonatrix*, a faunistic bulletin. The data used in the European atlas have been prepared by Rafał Bernard on the basis of the Polish atlas (Bernard *et al.* 2009) and papers published between 2009 and the beginning of 2012.

Portugal, mainland S. Ferreira

The first records of dragonflies from Portugal were published as early as 1797 (Vandelli 1797). Nevertheless, information on the Odonata of mainland Portugal prior to 1990 is sparse and contained in fewer than 50 publications. Many of these articles largely restate previously published information originating from a few

popular sites for entomological research such as the Serra da Estrela or the surroundings of Coimbra, where the oldest University in Portugal is located. From the 1990s onwards publications started appearing with information from other areas such as the Guadiana River and its tributaries, and the southernmost region of Algarve. Also important was the list of new records from eight Portuguese districts published by Jödicke (1996b). The first distribution maps of Portuguese species appeared in Malkmus (2002). The publication of an annotated bibliography (Ferreira & Weihrauch 2005) and a critical checklist (Ferreira *et al.* 2006) allowed older records to be traced and clarified several questionable species records for the country. Important recent publications include papers on the fauna of the Alentejo and Algarve Natural Parks (Moreira *et al.* 2008, Ferreira *et al.* 2009, De Knijf & Demolder 2010) and publications on new records of *Orthetrum trinacria* (Loureiro 2012). In 2013, a bi-lingual field guide (English and Portuguese) for Portugal was published. This will undoubtedly create further interest in Portuguese dragonflies (Maravalhas & Soares 2013). The database used for the present atlas includes all published and some unpublished data and includes a national total of 64 species. There is no National Red List available for Portugal and no conservation action plans for dragonflies have been made.

Portugal, Madeira archipelago S. Ferreira
The dragonfly fauna of Madeira is very poor with only seven species (Boudot *et al.* 2009, Weihrauch 2011) and the total number of known records, including those of the Observado.org database, is very low, scarcely reaching 140. The most recent publications devoted to the archipelago include Gardner (1960, 1963), Stauder (1991), Kunz *et al.* (2006), Pelny (2006), Malkmus & Weihrauch (2010) and Weihrauch (2011).

Portugal, Azores S. Ferreira
A review of older literature on the dragonflies of the Azores can be found in Cordero Rivera *et al.* (2005). In total five species have been recorded, three widespread European species (*Ischnura pumilio*, *Anax imperator* and *Sympetrum fonscolombii*), one widespread American species (*Ischnura hastasta*) and the circumtropical migrant *Pantala flavescens*, the most recent addition to the list (Belle 1992, Vieira 2015). Only females of *Ischnura hastasta* were recorded which made Belle & Van Tol (1990) suggest that the populations on the island are parthenogenetic which was later confirmed by Cordero Rivera *et al.* (2005). The distribution of dragonflies on the archipelago is well known (Lorenzo-Carballa 2009, Vieira & Cordero 2013).

Romania C. Manci
The dragonfly fauna of Romania is still relatively poorly known although good progress has been made in recent years. The first paper mentioning Romanian dragonflies, a survey of the entomological fauna of Transylvania, was published in 1853 (Fuss 1853). Since then around 100 papers have been published, including the first Romanian checklist by Pór (1956). The two most productive authors were F. Bulimar and C. Cîrdei who in 1965 produced a monograph on the dragonflies of Romania (Cîrdei & Bulimar 1965). This monograph is now outdated but remained for over fifty years the only synthesis of the Romanian dragonfly fauna. Only since 1990 has the number of papers started to increase, partly due to contributions by foreigners (e.g. De Knijf *et al.* 2011, Huber 2000, 2004, Kipping 1998, Flenker 2011). In the last decade a series of faunistic papers was published as part of the PhD thesis of Cosmin Manci (Manci 2012). In addition, most of the larger odonatological collections in Romania were digitised, information also included in Manci's PhD-thesis (Manci 2012). The recent survey activity has resulted in more records becoming available, increasing from ca. 2 000 in 2005 to around 6 000 to date. Only a few areas have been well studied and, especially in the mountains, there are still large areas entirely lacking records. Currently, 71 species of dragonflies are known from Romania, the most recent addition being *Selysiothemis nigra* in June 2013.

Russian Federation except Kaliningrad R. Bernard & J.-P. Boudot
European Russia has been very poorly investigated by odonatologists, curiously much less than Siberia and the Russian Far East. This area is also the most problematic one with respect to the reliability of published data. While the fauna of the southern Ural Mountains is now reasonably well known (Yanybaeva *et al.* 2006, Haritonov & Eremina 2010), reliable information on other parts of European Russia is very limited (Dumont 1996, Schröter 2011, Bernard 2012, Brockhaus 2013). With exception of the Kaliningrad province, the database of Russia has been prepared by J.-P. Boudot with the help of Thomas Brockhaus and expertise of R. Bernard regarding the reliability of the data. Many publications contain numerous misidentifications and careful consideration of the available records was needed, particularly so in the north-east of European Russia. In this area, green dots on the maps are those published in the book by Tatarinov & Kulakova (2009) that seem plausible. We maintained only those records for which the northern border is compatible with their Fennoscandian distribution. Many other records seem obvious misidentifications and are not included (*Ischnura elegans*, *I. pumilio*, *Erythromma najas*, *Coenagrion pulchellum*, *C. puella*, *Gomphus vulgatissimus*, *Aeshna isoceles*, *A. mixta*, *Sympetrum sanguineum* and *S. vulgatum*). Red and blue dots in this region are based on data collected in 2012 by Thomas Brockhaus (Brockhaus 2013) and entries from his database from the Komi Republic he thought to be reliable, with the exception of records of *A. isoceles* which we consider unreliable. The database of the Komi Republic is assembled from records from

Peters (1997), Sedych (1985) *in litt.* to G. Peters, Spuris (1996), who checked the Sedych collection, Stronk (1977) and Belyshev, Spuris & Sedych in Sedych (1974). We believe the most reliable sources are Peters (1997), the records of Sedych checked by Spuris (1996) and the records contained in Belyshev *et al.* (1974). We removed from Stronk's data records that were found unreliable by Peters and all data based on larva only (mainly *Ischnura*). The scattered data from other parts of the European Russia came from a critical survey of the sparse general Russian literature and from Skvortsov's book (2010). We hope that the overall "Russian picture" obtained with the 91 species retained is acceptable, although this is still open to discussion and changes.

Russian Federation, Kaliningrad province R. Bernard
The Kaliningrad province of Russia was for a long time part of German East Prussia (Ostpreußen). Hermann August Hagen, one of the foremost odonatologists of all time, lived in Königsberg (now Kalinigrad) and published several papers between 1839 and 1855, including "Die Netzflügler Preußens" (Hagen 1846). Early knowledge was thoroughly summarized in a synthesis, "Die Odonaten von Ostpreußen" (le Roi 1911). However, using this work requires knowledge of historical place names as East Prussia also included large areas of present Poland and the borderlands of present Lithuania. During the next hundred years only a handful of papers were published (e.g. Lewandowski 1996), often dealing with dragonflies caught in large bird traps near the seaside ornithological station of Rybachii (Bertram & Haacks 1999, Shapoval & Buczyński 2012, Buczyński *et al.* 2014). The most recent novelty for Kalingrad was the surprising discovery of a male of *Panatala flavescens* caught in a large bird trap (Buczyński *et al.* 2014). It must be stressed that no publications by O. Tumilovich can be used as they include obvious misidentifications and data of doubtful origin. The data used in the European atlas have been prepared by Rafał Bernard based on reliable publications, to which we have added a few more recent records. Although more probably remain to be discovered, 60 species have been recorded with certainty in the Kaliningrad province of Russia despite the small area involved.

Serbia M. Jovic
The distribution database of Serbia includes all available data from the literature as well as unpublished data from various collections and odonatologists. There are two periods of peak research activity: from the 1940s to the 1950s and from 1980 onwards. Most of the records from the former period were summarised by Adamović (1948, 1949). A large number of recent records including references to later papers are found in Andjus (1992) and Jović *et al.* (2009). Although 63 species have been recorded and mapped, the dragonfly fauna of Serbia is still insufficiently known as there remain large areas for which only a handful of records are available. The increased fieldwork in the last decade led to the discovery of populations of *Leucorrhinia caudalis* (Jović *et al.* 2008b), *Chalcolestes viridis* (Jović *et al.* 2009) and *Aeshna grandis* (Jović *et al.* 2010b), and to the rediscovery of both *Epitheca bimaculata* (Jović & Andjus 2003) and *Erythromma lindenii* (Jović *et al.* 2009). Since 2010 seven species (*Gomphus flavipes*, *Ophiogomphus cecilia*, *Cordulegaster heros*, *Epitheca bimaculata*, *Leucorrhinia caudalis*, *L. pectoralis* and *L. dubia*) have been protected by law (Službeni glasnik Republike Srbije, 5/2010). This means that any action that may harm the populations and/or their habitats is banned, including collecting specimens without a valid permit issued by the Ministry of Environment, Mining and Spatial Planning of the Republic of Serbia.

Slovakia S. David & D. Šácha
Research on the dragonflies of Slovakia started during the periods of the Austrian and Austro-Hungarian empires but only a few records from that time are available (e.g. Rumi 1807, Mocsáry 1900, Pazsiczky 1914). Several records were published in the time of the first Czechoslovak Republic and during World War II (e.g. Fekete 1925, Fudakowski 1930, Balthasar 1938, Hrabě 1942). Work on odonates intensified during the second Czechoslovak Republic, with the studies of Trpiš (1957, 1965, 1969).
Several papers summarising knowledge of dragonflies of the region were published after 1980, including bibliographies (Straka 1985, Okáli 1994, David 2000a) and analyses of the Slovakian dragonfly fauna (Straka 1990, Bulánková 2003, David 2005, 2006). The increased level of research in the past two decades resulted in several additions to the fauna: *Coenagrion armatum* (David 2000b), *Anax ephippiger* (Miňová *et al.* 2011), *Cordulegaster heros* (Blaškovič *et al.* 2003, Janský & David 2008), *Somatochlora meridionalis* (David 2000b), *Crocothemis erythraea* (David 1990), *Leucorrhinia caudalis* (Kúdela *et al.* 2004). *Anax ephippiger* is known only as a vagrant. Three species, *Lestes macrostigma*, *Nehalennia speciosa* and *Lindenia tetraphylla*, have been recorded for Slovakia (Straka 1990, Lukáš 1995, Fudakowski 1930, Trpiš 1969) but voucher material is lacking and misidentification cannot be ruled out, for which reason they are omitted from the Slovakian checklist. A national atlas has not yet been prepared but maps of all species can be found at the national dragonfly website www.vazky.sk (Šácha *et al.* 2007) and two regional atlases have been published as parts of doctoral theses (David 2002, Šácha 2011). There is also an ongoing online project to map the distribution of rare dragonfly species (www.vazky.sk/mapovanie).
The database used for the European Atlas contains almost 11 400 records and contains approximately 90 % of published as well as some unpublished records from

Slovakia, making a total of 69 Odonata species known from the country. However, strong regional disparities exist in the knowledge of the Slovakian odonate fauna with records only available from a little over half the country (247 of the 429 grid cells used in Slovakia, 11.2 × 12 km).

Slovenia M. Kotarac
In 1997 Slovenia was one of the first countries in Europe to produce a distribution atlas (Kotarac 1997). This atlas contained nearly 13 000 records from over 1400 localities. Since then, a steady flow of publications appeared on the Slovenian Odonata fauna and the distribution of the 72 species known from that country is now well known. The present database includes all published as well as many unpublished records.

Spain A. Cordero Rivera
The first comprehensive study of the odonates of Spain was published by Longinos Navás (1924), the father of Spanish odonatology. He usually authored his papers under his ecclesiastical title, "R. P. Longinos Navás, S. J.". This has caused many problems with citations as "R. P." stands for "*Reverendo Padre*" (Reverend Father) and "S. J." for "*Sacerdote Jesuita*" (Jesuit Priest), but both have been mistaken for personal initials. Navás published many papers between 1900 and 1935, providing information on the distribution of odonates from many parts of Spain. His 1924 monograph included 63 species. After the Spanish Civil war (1936-1939) the number of papers published on the odonate fauna was very limited until the review by Benítez Morera (1950), which added many new distribution records although most are rather imprecise. In the 1960s and 1970s, several papers were published by Arturo Compte Sart, curator of Entomology at the Spanish Museum of Natural Sciences in Madrid. Compte Sart (1965) published a new catalogue of the Spanish fauna, which included 69 species. The review by Ocharan (1987), forms the basis of the present national Odonata list. Ocharan reviewed all previous publications, made a detailed taxonomic study and published the first atlas with detailed information based on 10x10 km squares; this included 70 species. Since the 1980s an increasing number of regional studies have been published and faunistic reviews are currently available for many Spanish regions (Andalucia: Ferreras Romero & Puchol Caballero 1984, Herrera Grao *et al.* 2010; Aragón: Torralba Burrial & Ocharan 2005; Cataluña: Martín Casacuberta 2004; Extremadura: Benítez-Donoso 1990, Pérez-Bote *et al.* 2006, Sanchez *et al.* 2009; Galicia: Azpilicueta Amorín *et al.* 2007; Madrid: Martín 1983; Valencia: Baixeras *et al.* 2006). An important compilation of papers on the Iberian Peninsula was edited by Jödicke (1996b), in which hundreds of unpublished records were noted. In contrast to many previous publications these were all in English and therefore more accessible for non-Spanish speaking odonatologists.

Work on the first modern atlas based on systematic sampling was begun in Catalonia by the group *Oxygastra* (www.oxygastra.org) in 2003, and subsequently several regional fauna and atlas have been published. Particularly noteworthy is the book on odonates of Extremadura (Sánchez *et al.* 2009), which not only includes a comprehensive atlas but also reviews information on biology and contains excellent photographs of all species recorded in that region. Extremadura was also the first region in Spain to establish management plans for odonates, these being for species included in the National List of Endangered species (in that region, *Coenagrion mercuriale, Gomphus graslinii, Macromia splendens* and *Oxygastra curtisii*). Another regional atlas was published for the region of Valencia (Baixeras *et al.* 2006) and the recently published national Atlas of Endangered Invertebrates reviewed the status of odonates of conservation concern (Verdú & Galante 2009; Verdú *et al.* 2011). Large additional data sets were provided by D. Chelmick, A. Cordero Rivera, M. Lockwood, M. Paris, F. Prunier, A. Torralba Burrial and the 'Oxygastra group', so that the database currently approaches 72 000 records. Currently there are atlas projects running in several Spanish regions (Galicia, La Rioja, Catalonia, Andalusia). The distribution of the 80 Spanish Odonata species is reasonably well known although new important findings can be expected everywhere. Spain has acted as a entry point for many advancing African species with *Trithemis kirbyi* being the latest arrival, and it seems likely that more African species will appear in the coming decade.

Spain, Canary Islands A. Cordero Rivera
With just 15 species, the dragonfly fauna of the Canary Islands is fairly well studied, with several recent publications focused on the dragonflies of the islands (e.g., Báez 1985, Malmqvist *et al.* 1993, Malkmus 2002, Bemmerle 2005, Kunz *et al.* 2006, Brauner 2007, Malkmus & Weihrauch 2010, Weihrauch 2011, Peels 2014). An increasing number of records is being published by both foreign visitors and local photographers, recently resulting in three new species being recorded from the archipelago; two from Fuerteventura (*Trithemis annulata* (2003) and *Orthetrum trinacria* (2000, 2003, 2011)) (Boudot *et al.* 2009) and one (*Ischnura senegalensis*) from both Tenerife (2009, 2014) and La Palma (2011, 2012, 2014) (Peels 2014, Sanchez Guillen & Cordero Rivera 2015).

Sweden G. Sahlen
Being within the homeland of Linnaeus, the dragonflies of Sweden have been studied and described since the early 18th century (Linnaeus 1736). The first national overview was published by Johansson (1859), including many (albeit vague) distribution records. The late 1800s and early 1900s saw the publication of identification keys (Wallengren 1894, Sjöstedt 1914) but detailed distribution records were few. From the 1930s onwards Kjell Ander provided many more records, including the

first provincial distribution atlas (Ander 1944, 1953). Valle (1952b) published distribution maps for the whole of Fennoscandia and Estonia. In 1985, Göran Sahlén published a key with an updated distribution atlas, still based on provinces (with a 2nd edition in 1996). This book inspired a small number of young people to work on dragonflies and during the 1990s the Nordic association 'Nordisk Odonatologisk Forum', became active and published several updated lists and new provincial records. In 2003 the 'Species Gateway' (Artportalen), an internet site for recording sightings of species in Sweden, opened for invertebrates and at the same time many bird-watchers turned their interest to dragonflies. The publication of field guides also increased interest (Dannelid *et al.* 2008, Billqvist *et al.* 2013). By 2010, over 37 000 observations of dragonflies were in the database, with at least 5 000 records being added annually. There are still large areas, especially in the northern parts of the country, which are poorly surveyed, but at least for the southern half information on species distribution is good. Presently, 64 species are known from the country. Red Lists have been published since 1993. In the current edition (Gärdenfors 2010) only three species, *Nehalennia speciosa*, *Ophiogomphus cecilia* and *Somatochlora sahlbergi* are listed. Monitoring programmes for species covered by the Habitats Directive are implemented. As in other parts of northern Europe, new species are arriving due to the warming climate, the increase of *Anax imperator* being perhaps the most rapid dispersal so far documented (c. 60 km north a year; Flenner & Sahlén 2008).

Switzerland C. Monnerat

The first reference to dragonflies in Switzerland dates back to the 17th century (Wagner 1680), but the real beginning of odonatology was in the middle of the 19th century thanks to entomologists such as R.L. Meyer-Dür (important publications in 1846, 1874 and 1884) and G. Schoch (first key to Swiss dragonflies in 1878). Meyer-Dür was also one of the founders of the Swiss entomological Society in 1858. The internationally renowned odonatologist Friedrich Ris is best known for describing nearly 250 exotic species and as author of the Libellulidae monographs which appeared in the series Collections Zoologiques du Baron Edm. de Selys Longchamps. However he also published numerous observations on the dragonflies of Zurich and other parts of the country from 1886, when he was only 19 years old, until the beginning of the 1920s. An important milestone in the middle of the 20th century was the publication of the work of Paul-André Robert entitled 'Libellules' (in French) (Robert 1958). This publication has been translated into German by O.-P. Wenger, another eminent Swiss odonatologist. This book was one of the first to include information on ecology and behaviour, largely based on the author's observations and has been an important source of information for all European odonatologists. Increased work on dragonflies in the 1970s and 1980s resulted in a comprehensive review of the Swiss literature (Kiauta 1978) and the first national atlas of Swiss dragonflies (Maibach & Meier 1987). Later, the Swiss Centre for Biological Records (CSCF) was established (1985) and still maintains the Swiss national Odonata database. Increased fieldwork in the 1990s resulted in more than 31 000 new records that were used for a Red List (Gonseth & Monnerat 2002) and a new Swiss Atlas (Wildermuth *et al.* 2005). The information on the distribution and ecology of the 77 Odonata species of Switzerland is very good. Nonetheless, there are still parts of the alpine region that are inadequately explored because of reduced accessibility.

Over the last ten years, the national database has received over 10 000 new entries annually thanks to the efforts of about 50 observers. At the end of 2010, it included no fewer than 222 372 records that have all been used for the European atlas. The distribution maps of the Swiss dragonflies species are updated regularly and are available on the CSCF map server in a 5 x 5 km grid (http://www.cscf.ch/).

Turkey V.J. Kalkman

As early as the 19th century several papers mentioned material of dragonflies collected in Turkey, with the two most important works being Schneider (1845) and Selys (1887). The former included the description of three new Asian species that have gained a foothold in Europe: *Cordulegaster insignis*, *Orthetrum taeniolatum* and *Caliaeschna microstigma*, while the latter included a review of the dragonflies of Asia Minor, which largely corresponds with present day Asian Turkey. The first odonatologist to travel to Turkey was Erich Schmidt, who gave a detailed account of his travels along the still unspoiled south coast of Turkey (Schmidt 1954). All information prior to 1977, including many new records, was summarised by Dumont (1977a). From the 1990s onwards, interest in the Odonata of Turkey increased greatly, resulting in the publication of numerous papers, including an annotated checklist (Kalkman *et al.* 2003) (see van Pelt & Kalkman (2004) for an overview). In 2006 an atlas of the distribution of Turkish Odonata showed species distributions on a 10 x 10 km UTM grid (Kalkman & Van Pelt 2006). During this period, Nurten Hacet contributed greatly to knowledge of Odonata in northwest Turkey, including European Turkey (Hacet & Aktaç 1997, 2004, 2006, 2008, 2009, Hacet 2010, Hacet & Çokkuvvetli 2012), while Ali Salur and others (Salur & Kıyak 2006, 2007) published a large number of records from southern Turkey. About the same time Miroğlu *et al.* (2011) published an overview of the fauna of the eastern Black Sea region, including many new records. Records published by N. Kazancı (Kazancı & Girgin 2008; Kazancı 2008, 2010) contain many obvious errors including an unlikely record of *Ischnura senegalensis* and have all been discarded for this atlas. A book on the dragonflies of the Muğla province including information on where to find scarcer species was published by Hope (2007), the records

of which have been used in this atlas. Turkey is an increasingly popular destination for Europeans to visit for a dragonfly-watching holiday. Most areas of Turkey have been explored reasonably well since 1990, with the exceptions of the more arid and politically unstable south-east and some remote high altitude regions in the north. The latter situation was emphasized by the recent discovery of *Sympetrum danae* in the north-east (Miroglu 2011). The subsequent capture of a voucher *Orthetrum trinacria* (Kalkman *et al.* 2012) constituted the 101rd species known from the country. Only 56 species occur in the European part of Turkey whereas 96 are known from Turkish Anatolia. In this atlas all European species are mapped in Turkey but purely Asian species are omitted.

Ukraine E. Dyatlova

Ukraine is, after Russia, the second largest country of Europe by area and together with Russia and Belarus is one of the least well studied of the European countries. The first records of Ukrainian odonates were published in the second half of the 19th century. Some regions that are currently part of Ukraine were part of Poland, Hungary, Slovakia or Romania before 1939-1945. Due to this, papers with records from Ukraine were published by Ukrainian, Russian, Polish, Hungarian and Romanian scientists. Important authors from before the Second World War include Artobolevskij, Brauner, Bartenev and Dziêdzielewicz. Relatively few records were published between the Second World War and the 1980s although Pavlyuk published a series of papers on the western parts of the country and Oliger published a number of papers on the Donets'k region in the east. The first review of the fauna of Ukraine was by Gorb *et al.* (2000), which summarized all published records and provided an identification key. This publication, together with a key to the larvae (Matushkina & Khrokalo 2002), prompted studies of the Ukrainian odonates. Another important paper is the annotated bibliography of odonatological literature dealing with Ukraine (Khrokalo 2005a). Over the last decade a series of important faunistic studies on particular regions or nature reserves have been published. Some of the more recent are Dyatlova & Kalkman for Southwest Ukraine (2008), Khrokalo & Prokopov for the Crimean Peninsula (2009), Khrokalo & Krylovskaya on the distribution of *Coenagrion armatum* (2008), Martynov on the Seversky Donets river (2010) and Matuskina on various rare species (2006). The database used for the atlas includes all published records and some unpublished records by the above mentioned authors as well as E. Karolinskiy, V. Gramma and V. Savchuk. Despite the recent increase in publications, there are still large areas that have been very poorly explored. Many of the records from the Carpathian Mountains are prior to 1990 and there are only a few more recent publications relating to this area (Holuša 2009). Several dragonflies are included on the national Ukrainian Red List (Khrokalo 2005b) but at least one of them (*Coenagrion mercuriale*) has never been recorded in the country while two others (*Anax imperator* and *Calopteryx virgo*) are common and not threatened. The latest additions to the Ukrainian dragonfly fauna have been *Selysiothemis nigra*, found on the Kinburn peninsula (south Ukraine) in 2002 (Tytar 2007), in Crimea in 2006 (Matushkina 2007) and in the Khersonska Oblast in 2008 (Khrokalo *et al.* 2009), and *Lindenia tetraphylla*, discovered in Crimea in 2013 (Savchuk & Karolinskiy 2013). The latter brought the national odonate fauna to 74 species.

Lestidae

1 Lestes macrostigma. Habitat of *Lestes macrostigma*, Tour du Valat natural reserve, The Camargue, southern France. *L. macrostigma* typically occurs at temporary and brackish temporary ponds often with dense growths of See club rush *Bolboschoenus maritimus*, although this plant is not essential for succesfull reproduction. Photograph Philippe Lambret.

2 Sympecma paedisca. Habitat of *Sympecma paedisca*, Woldlakebos, Overijssel province, Netherlands. Other species occurring here include *Aeshna grandis, A. isoceles, Brachytron pratense, Coenagrion pulchellum, Cordulia aenae, Erythromma najas, Lestes sponsa* and *Libellula fulva*. Photograph Christophe Brochard.

3 Chalcolestes parvidens. Habitat of *Chalcolestes parvidens*, Hutovo blato, Bosnia-Herzegovina. Other species occurring here include *Aeshna isoceles, Anax ephippiger, A. parthenope, Brachytron pratense, Coenagrion pulchellum, Libellula fulva, Selysiothemis nigra, Somatochlora flavomaculata* and *Sympetrum meridionale.* Photograph Dejan Kulijer.

Chalcolestes parvidens (Artobolevskij, 1929)

J.-P. Boudot & E. Dyatlova

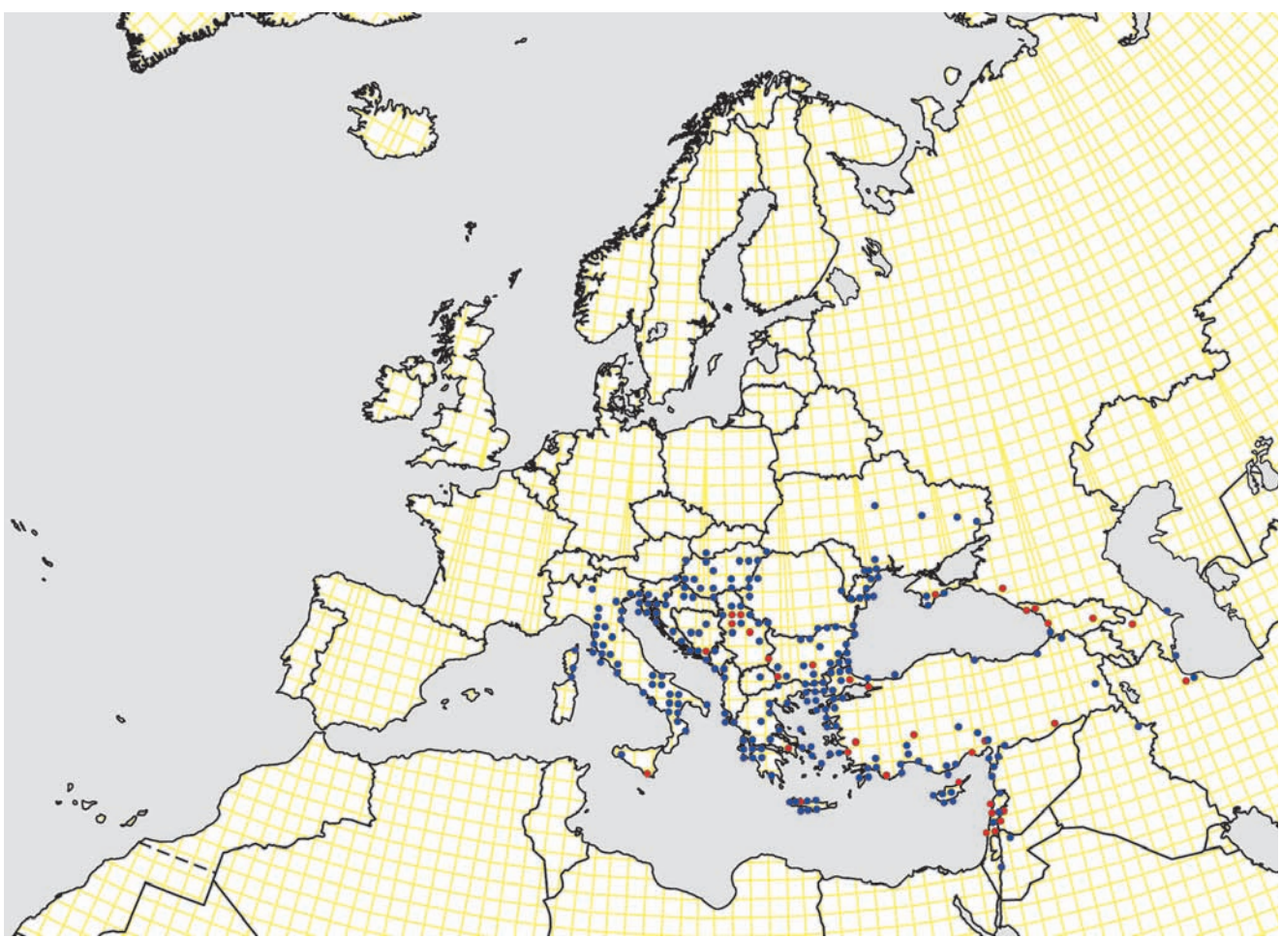
Taxonomy

Chalcolestes parvidens was for a long time considered to be a subspecies of *C. viridis*. Dell'Anna *et al.* (1996) were the first to show that mixed populations of both taxa in Italy are differentiated in seasonal and daily activity. More recently it was demonstrated that the two taxa overlap widely across south-eastern Europe (Olias *et al.* 2007). Although specimens with intermediate characters are known across a wide area (Olias *et al.* 2007) and have been demonstrated to be hybrids (Dell'Anna 1996), Gyulavári *et al.* (2011) did not find any shared haplotypes and consequently treated these two taxa as distinct species.

Distribution

World: The species is limited to the Western Palaearctic, where it extends from Italy across south-eastern Europe to the Levant, Turkey, Transcaucasia, Ukraine and the north-west of Iran.

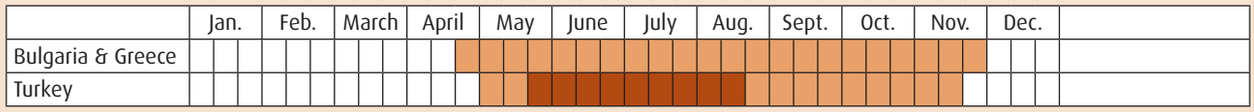
Europe: Up to this century the separation of *C. parvidens* and *C. viridis* was often problematic and, due to this, the exact range of *C. parvidens* is still not precisely known. In Europe the species is known from Corsica, Sicily, mainland Italy, central and south-east Europe and Ukraine. Old publications from south-east Europe refer to *C. viridis*, but Olias *et al.* (2007) showed that many of these records pertain to *C. parvidens*. The northernmost records are from Slovenia, south-east Austria, Hungary and the south of Slovakia (Olias 2005, Olias *et al.* 2007). Most of the records of *Chalcolestes* from Hungary refer to larvae and have hence not been identified to species level and *C. parvidens* is probably much com-



World distribution

Flight period

The flight period of *C. parvidens* in Bulgaria and Greece is extended for eight months with a dip in the number of records in the second half of August. Over 300 records are available from these two countries and this dip, which does not seem to be an artefact of recording intensity, might be the result of adults leaving the water during the hottest period of the year.



moner there than the map suggests. In Romania, the species is only known from lowlands in the west, the south and the east, but is probably more widely distributed than is presently known. It has not been recorded with certainty from Moldova although an old record of *C. viridis* probably refers to *C. parvidens* (Dyatlova 2010). It is regionally common in the marshlands along the Danube and the Dnieper Rivers in southern Ukraine, but seems to remain scattered in other parts of this country. A record by Skvortsov (2010) from Kaliningrad is considered erroneous. Only one record is available between Ukraine and the Caucasus range, but reliable information on this area is scarce and the species may well be widely distributed in this region. The overall picture is of a species that is rather common in its range, but which has been under-recorded due to its similarity and partial overlap with *C. viridis*.

Trend and conservation status

Habitats Directive	No
Red List EU27	Data Deficient
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Unknown

Habitat

Chalcolestes parvidens seems to have the same habitat preferences as *C. viridis* and reproduces in both standing and slow-flowing waters surrounded by trees and bushes. These should have a soft bark and wood to be used by the females for laying their eggs. The species is rare to absent in fast-running streams and acidic waters such as bogs.

Chalcolestes viridis (Vander Linden, 1825)

J.-P. Boudot & C. Willigalla

Taxonomy

See text on *Chalcolestes parvidens*.

Distribution

World: *Chalcolestes viridis* is endemic to the Western Palaearctic and is confined to Europe and the northern part of the Maghreb.

Europe: The species is common and widespread in much of western, central and southern Europe. In large parts of Corsica, Italy, Austria, Hungary, Romania and the Balkan Peninsula, it overlaps with *C. parvidens* and it is likely that some records of *C. viridis* in this area in fact pertain to *C. parvidens*. *Chalcolestes viridis* occurs over most of south-east Europe but becomes progressively rarer towards the south in Romania, Bulgaria, Serbia, Macedonia, Albania and Montenegro. It is common in Poland but information from more eastern localities is scarce, with the species seemingly rare in the Baltic States, Belarus and Ukraine and lacking from Moldova (Buczyński *et al.* 2006, Dyatlova 2010). Old records from the west of Ukraine (Pavliuk 1990, Gorb *et al.* 2000) were published as *C. viridis* but it cannot be excluded that some pertain to *C. parvidens*. New records in central and eastern Ukraine by Khrokalo & Matushkina (1999) and Martynov (2010) have confirmed the occurrence of *C. viridis* in the country and fixed the known eastern limit of the range of this species, which is apparently absent further east in Russia.

Trend and conservation status

Chalcolestes viridis has expanded northwards and increased in north-east Poland and the Baltic States. It was recently recorded as new to Belarus and Denmark (both 2005) (Buczyński & Moroz 2008, Bernard *et al.* 2009). An ongoing increase is well documented in

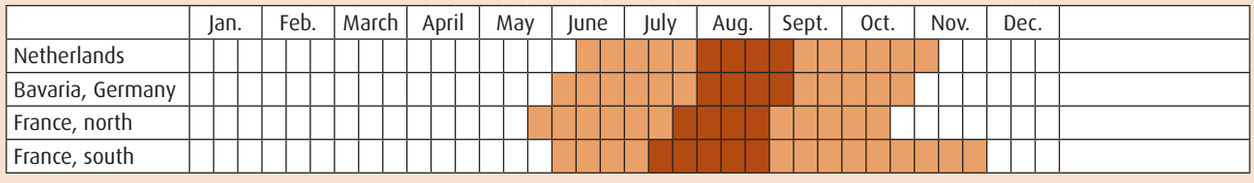
Great Britain, where the species is now not uncommon in large parts of south-eastern England whereas only three records were known prior to 2009 (Taylor 2013, Cham *et al.* 2014).

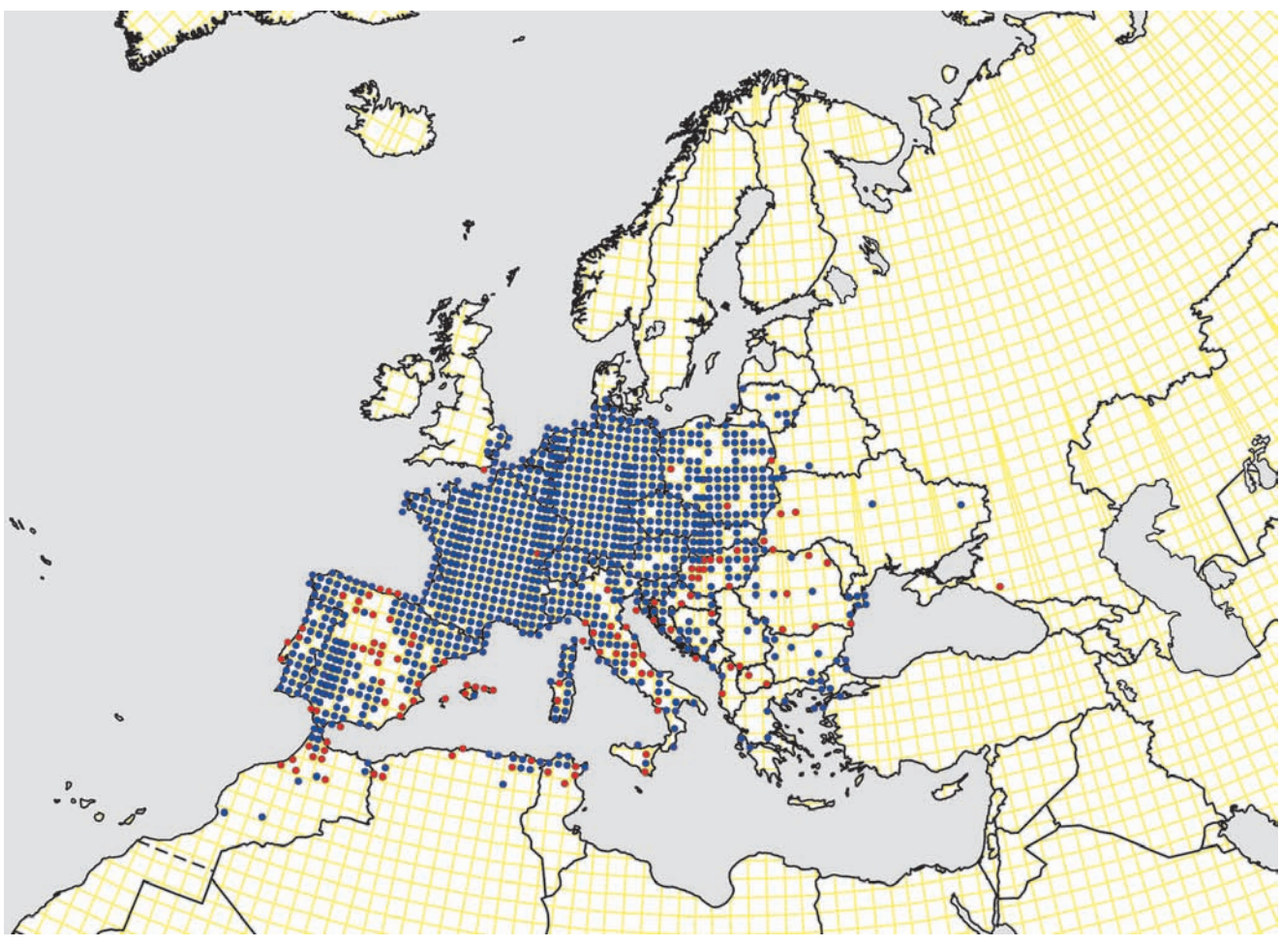
Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

Chalcolestes viridis reproduces in a great variety of standing and slow-flowing water ranging from ponds, rain storage ponds and lakes to canals, streams, rivers and their backwaters. The species also occurs in anthropogenically heavily modified biotopes. In all occupied habitats, it is dependent on the presence of trees or bushes with soft bark and wood (e.g. willows and poplars) at the water's edge as these are used by females for oviposition. Neither species of *Chalcolestes* occurs in ephemeral water conditions, in contrast to *Lestes* species. *Chalcolestes viridis* is mainly found in lowlands but has been found up to 1 500 m.

Flight period





World distribution

Lestes barbarus (Fabricius, 1798)

J.-P. Boudot & E. Dyatlova

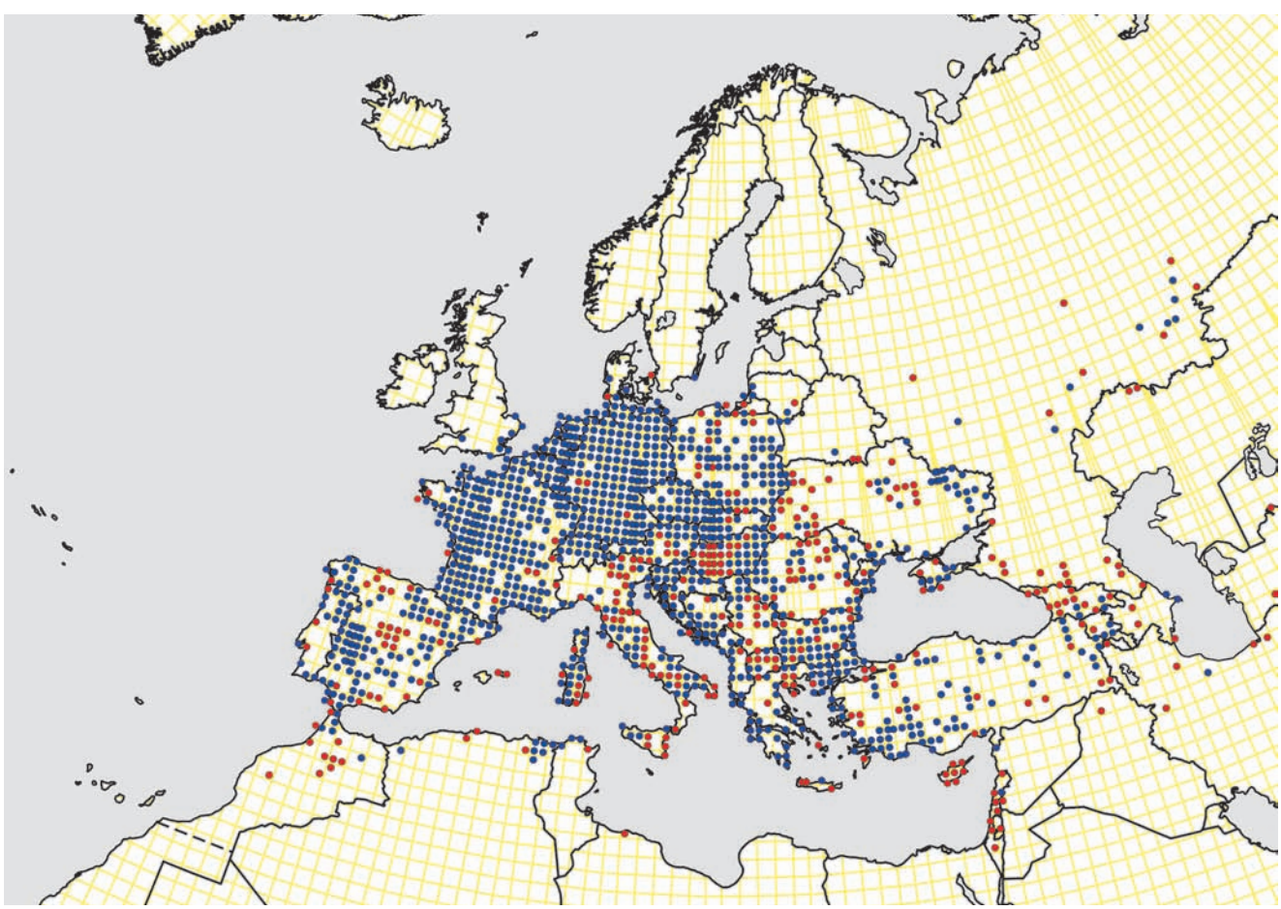
Distribution

World: *Lestes barbarus* ranges from western Europe eastwards across Kazakhstan and Central Asia to north-west China and Mongolia. In Africa it is limited to the northern parts of Morocco, Algeria and Tunisia with one isolated record from north-western Libya. The species is largely absent from the arid parts of south-western and Central Asia. The south-easternmost records are from Kashmir (Fraser 1933).

Europe: *Lestes barbarus* is common in southern and central Europe and is at present common in Belgium, the Netherlands, northern Germany and Poland. This

Flight period

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Netherlands												
Bavaria, Germany												
France, north												
France, south												
Bulgaria & Greece												



European distribution

World distribution

century it expanded its range further northwards reaching Denmark, Lithuania and the south of both Great Britain and Sweden.

Trend and conservation status

Lestes barbarus was rare in large parts of central and west Europe up to the 1990s, being largely dependent on sporadic invasions from the south. These invasions resulted in isolated and often short-lived populations, sometimes followed by years of absence. In the mid-1990s the species showed a decisive northward range expansion in Europe resulting in the permanent colonisation of the Netherlands, the permanent settlement in Denmark and a strong increase in northern Poland. This northwards expansion has continued since 2000, producing the first records for Great Britain (2002) and the second record for both Lithuania and Sweden (2011) (Briliūtė & Budrys 2007, Billqvist 2012, Cham *et al.* 2014).

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

Lestes barbarus favours sunny and shallow, often temporary, soft and brackish standing waters. The larvae are able to survive at salinity levels of 13 %. Suitable habitats include large coastal wetlands, inland lakes, ponds, gravel pits, dune lakes and shallow bogs. The species is quick to colonise new habitats and often occurs at temporary ponds that are flooded in spring and desiccate in summer. Oviposition often takes place when the habitat is dry and eggs remain in diapause until the habitat is flooded again in spring.

Lestes dryas Kirby, 1890

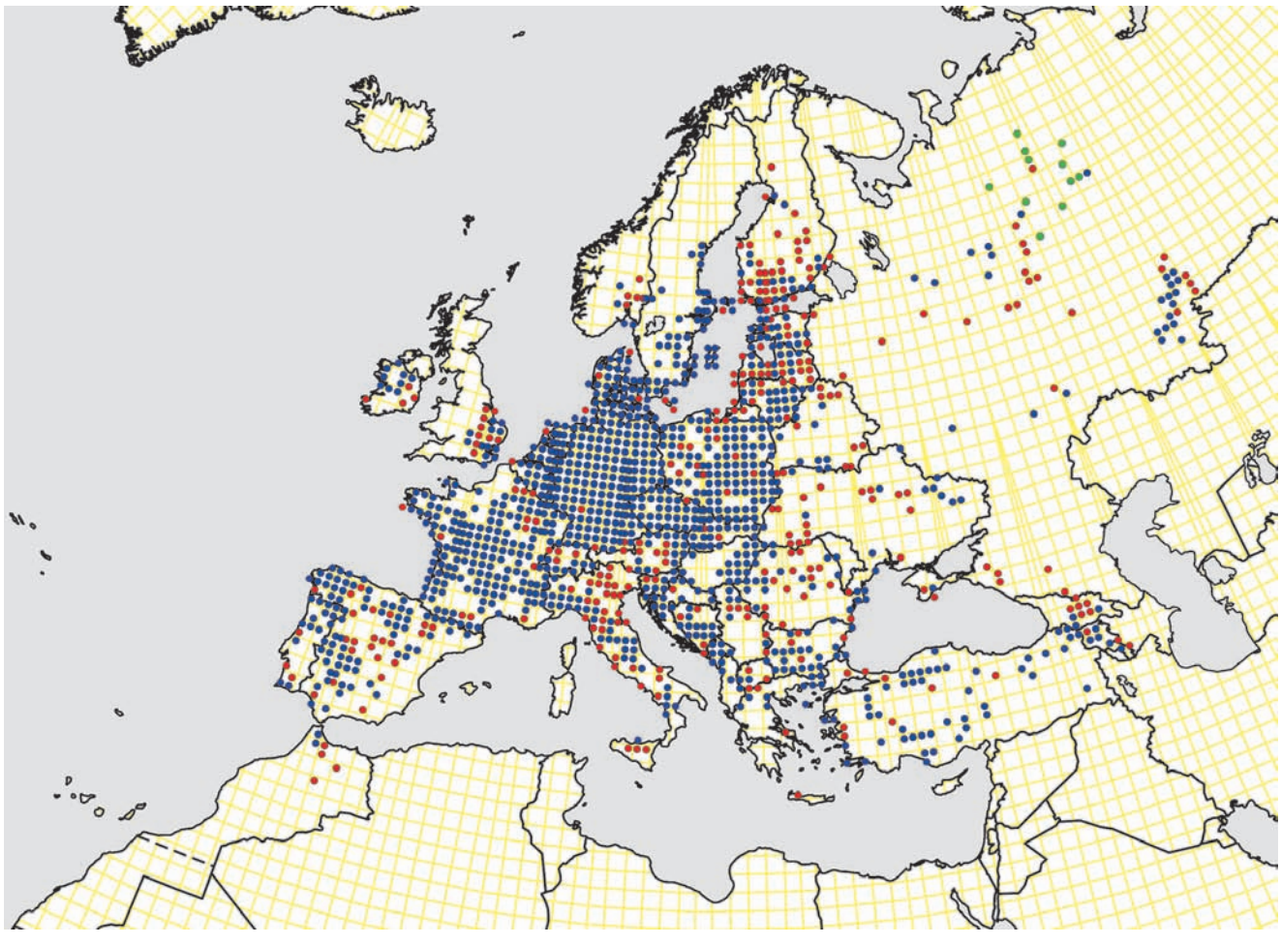
J.-P. Boudot & R. Raab

Distribution

World: *Lestes dryas* is a Holarctic species which occurs in the northern part of Eurasia and North America. In Africa it is found only in the north of Morocco (Rif and Middle Atlas mountains). Its Eurasian distribution largely overlaps with the closely related *L. sponsa*.

Europe: *Lestes dryas* is widespread in most of Europe although it is absent from the northern parts of Fennoscandia and has a more scattered occurrence in the Mediterranean region. It is absent from

most of the Mediterranean islands. It is common in the lowlands of central Europe but large populations in the south of its range are mostly found at higher altitudes.



European distribution

World distribution

Flight period

	Jan.			Feb.			March			April			May			June			July			Aug.			Sept.			Oct.			Nov.			Dec.			
Norway & Sweden																																					
Netherlands																																					
Bavaria, Germany																																					
France, north																																					
France, south																																					
Bulgaria & Greece																																					

Trend and conservation status

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

Lestes dryas is found at standing waters such as ponds, small lakes, bogs and occasionally gravel pits, and is mostly found in habitats with a dense growth of rushes and sedges. It favours standing waters and swamps that partially or completely dry out in the course of summer, but is also found at permanent waters that have shallow edges with rushes or grasses providing warm micro-habitats for the larvae.

Lestes macrostigma (Eversmann, 1836)

J.-P. Boudot & R. Raab

Distribution

World: *Lestes macrostigma* ranges from western Europe to Mongolia. It has a fragmented distribution with locally strong populations interspersed with large areas where the species is rare or absent. In the western part of its range it is mostly found in coastal wetlands along the Atlantic Ocean (rare), the Mediterranean Sea and the Black Sea. Inland populations are found in brackish steppe lakes and wetlands in the Pannonian Plain of eastern Austria and Hungary and in south-western and Central Asia. The species seems to be absent from North Africa although suitable habitats such as coastal brackish wetlands and brackish inland lakes are present. Two undocumented records from Morocco are in need of confirmation (Martin 1910, Guemmouh 1988).

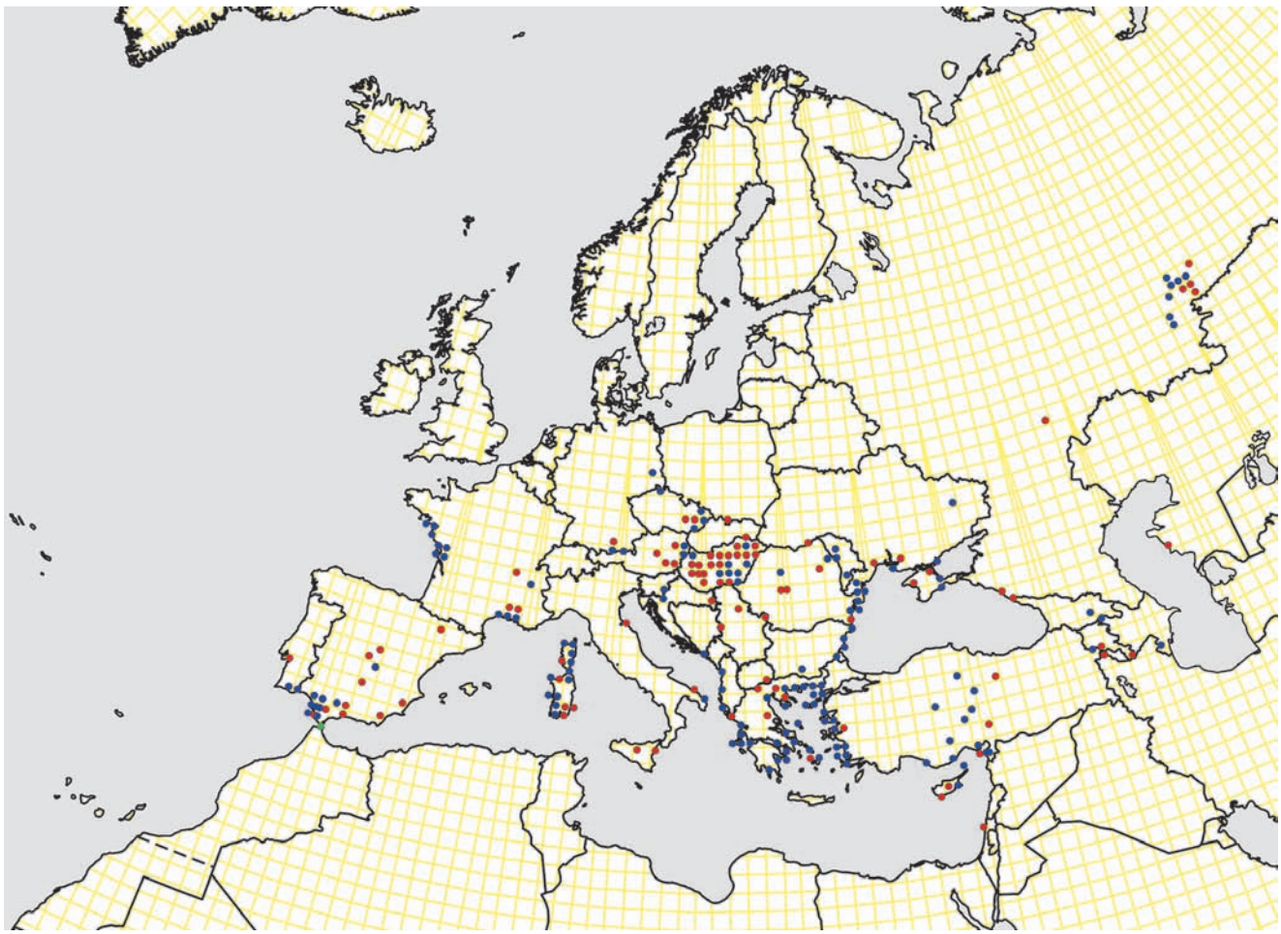
Europe: The European distribution of *L. macrostigma* is largely restricted to coastal areas, the Pannonian Plain of eastern Austria and Hungary, and to small areas in the Balkans, Moldova, Ukraine and southern Russia. A small number of populations exist along the Atlantic coast of France, Portugal and Spain. The majority of the European populations occur in Mediterranean wetlands with the greatest densities of settlements found in the east, especially in Greece, where many strong populations are known. Large inland populations are found in the Pannonian Plain of eastern Austria around the Neusiedler See, and, formerly, in Hungary. Other records in central Europe are rare and mostly relate to wanderers (e.g. Germany, Poland, Slovenia). The species seems to be reasonably common in the wetlands of the north-western Black Sea coast, with most records coming from Ukraine. Information from the southern Urals and European Russia (Yanybaeva *et al.* 2006, Skvortsov 2010) suggest that *L. macrostigma* is relatively widespread in the south of the European Russia, although inland records from Ukraine are rare (Dyatlova 2010, Martynov 2010).

Trend and conservation status

Lestes macrostigma has a fragmented distribution and is rare in large parts of its range, although it occurs locally at very high densities. The available records suggest that in Spain and Hungary at least, the species has declined during the 20th century due to the destruction of coastal and inland wetlands for agriculture or urban development. In some cases, suitable habitats such as natural brackish swamps have been converted into commercial salt works or to vineyards. Climate change is likely to impact on the species but it is difficult to judge if this will be positive or negative. The natural strong annual fluctuations in the number of individuals make it difficult to judge any trends in this species.

Flight period

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
France													
Bulgaria & Greece													
Turkey													Based on 27 records



European distribution

World distribution

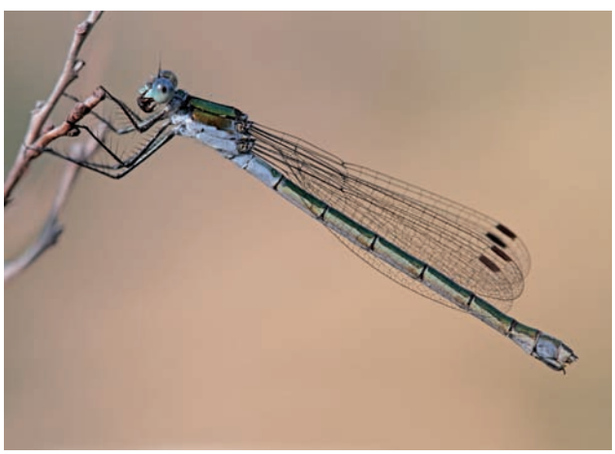
Habitats Directive	No
Red List EU27	Endangered
Red List Europe	Vulnerable
Red List Mediterranean	Near Threatened
EU27 endemic	No
European endemic	No
Trend Europe	Decreasing

Habitat

Lestes macrostigma is largely confined to large coastal and inland brackish wetlands with low rainfall and high evaporation, mostly in lowland areas. Reproduction takes place mostly in shallow brackish waters with a dense vegetation of Sea clubrush (*Bolboschoenus maritimus*), Common clubrush (*Schoenoplectus lacustris*) or Sea rush (*Juncus maritimus*) (Lambret *et al.* 2009, Lambret 2010, 2015). Larvae develop in temporary waters such as abandoned salt-pans, salt marshes and dune and steppe lakes with salinity up to 20-22 ‰ (Lambret *et al.* 2009). The combination of salinity and desiccation makes the habitat unsuitable for many other species of invertebrates or vertebrates, hence interspecies competition and predation is reduced. The larvae grow quickly in the warm waters and emergence takes place before the habitat is desiccated. Either the early desiccation of breeding sites or an above average amount of rainfall in summer can make the habitat unsuitable for the species, resulting in strong annual fluctuations in population density. Successful reproduction of the species in freshwater has been confirmed by chemical analysis in Corsica, but the resulting populations seem to be rather short-lived (P. Lambret pers. com).

Lestes sponsa (Hansemann, 1823)

J.-P. Boudot & R. Raab



Distribution

World: *Lestes sponsa* is found from western Europe to Japan and is generally common within its range.

Europe: This species is common and widespread throughout Europe with the exception of the Mediterranean and northern Fennoscandia. It is rare on the Mediterranean coasts and is often confined to higher elevations in the south of its range.

Trend and conservation status

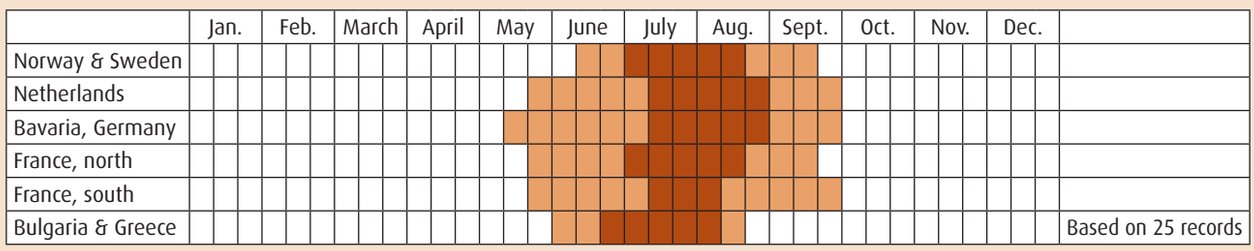
In Great Britain, *L. sponsa* has expanded its range about 140 km northwards since 1970, which was attributed to global warming (Hickling *et al.* 2005). A decline has been noted in some areas of western Europe, and in the Netherlands a decrease in abundance of 38 % was measured between 1999 and 2009. It is unlikely that this decline occurred over large areas in Europe and the species was considered to be stable on the European level in the 2010 European Red List.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Stable

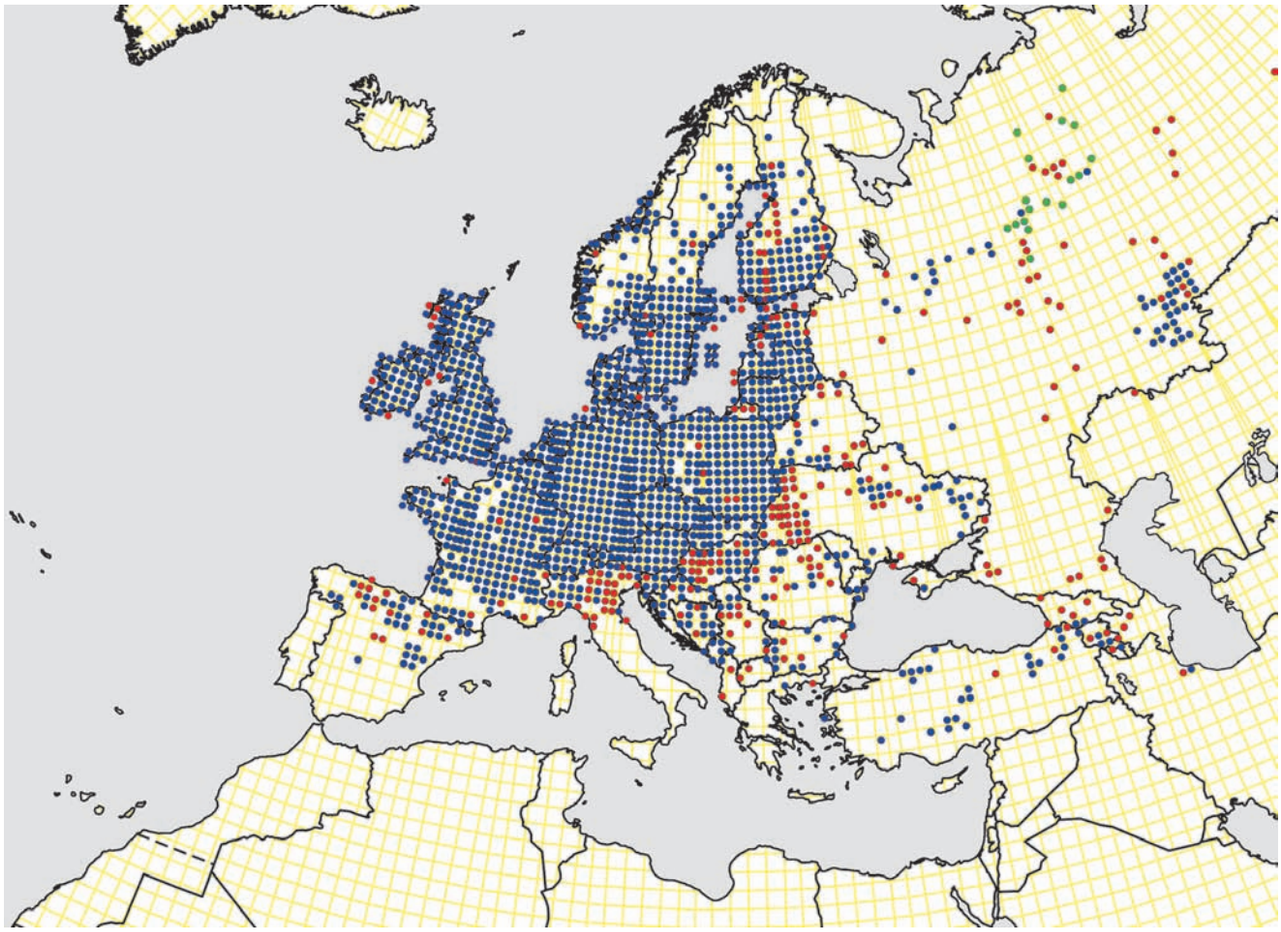
Habitat

Lestes sponsa inhabits a wide range of standing, largely unshaded waters with emergent vegetation, including ditches, ponds, lakes and peat bogs. This includes

Flight period



both permanent and temporary waters and waters that are acidic, alkaline or brackish. It can be numerous at newly created shallow habitats but most often occurs at well-vegetated waters. *Lestes sponsa* has a wide altitudinal range and reproduces from sea level up to 2 500 m.



European distribution

World distribution

Lestes virens (Charpentier, 1825)

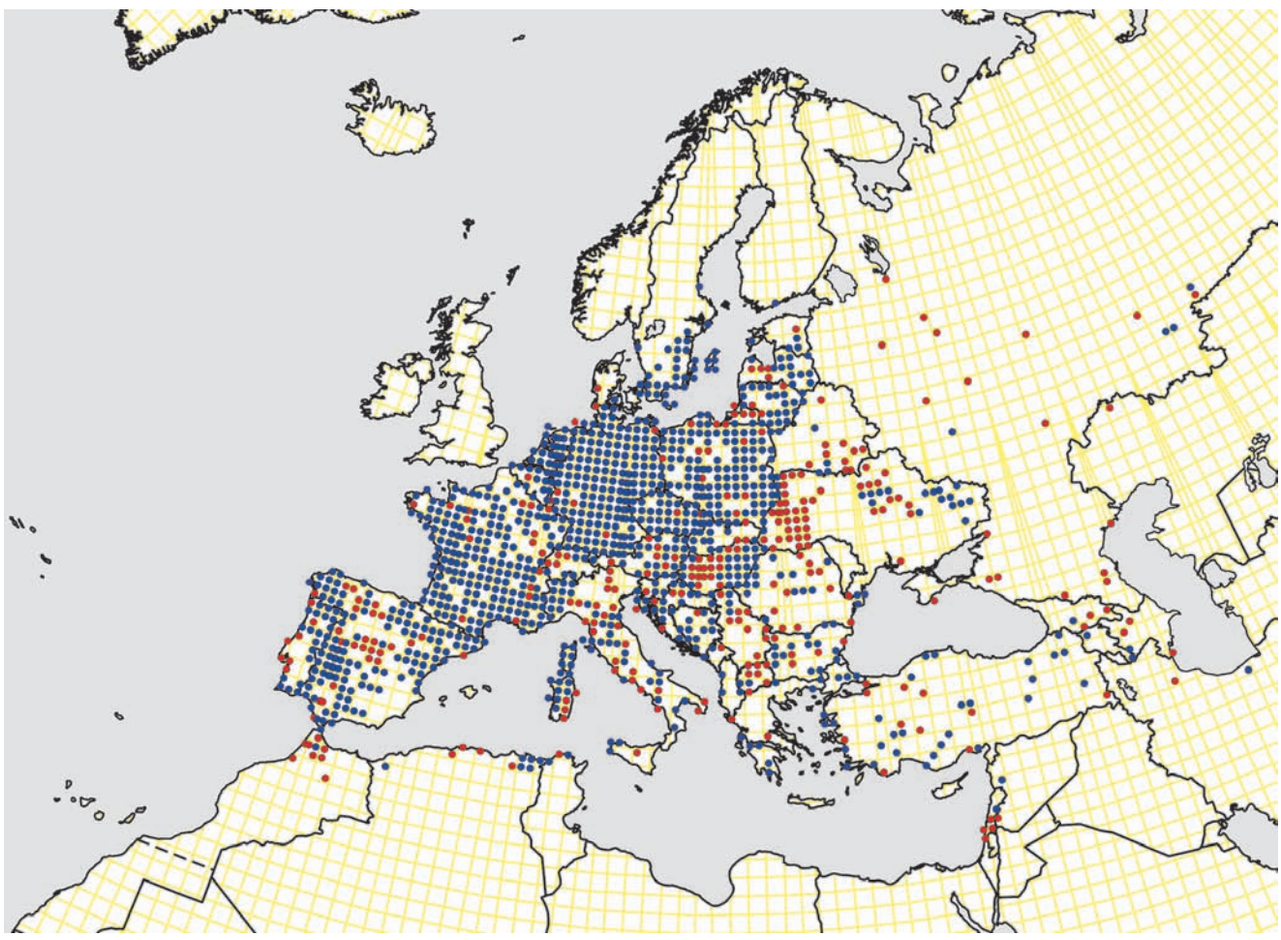
J.-P. Boudot & C. Willigalla

Taxonomy

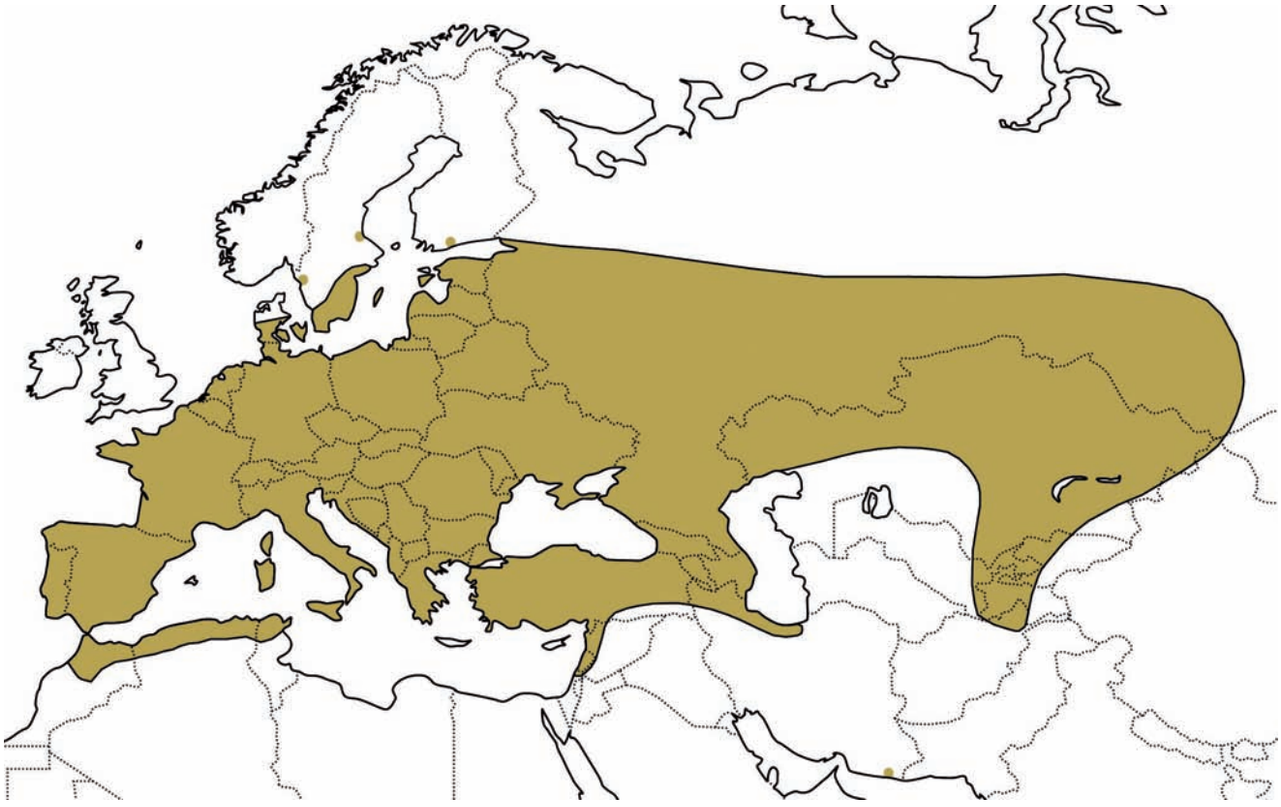
Jödicke (1997a) summarised the information on the subspecies of *Lestes virens* and showed that their distribution and identification is not clear. Traditionally, the European populations are divided in two subspecies, with *L. v. virens* found in the south-west and *L. v. vestalis* in the rest of Europe. The identification of these subspecies in their contact zone is often not possible. Some populations in south-east Europe resemble *L. v. marikovskii* Belyshev, 1961 which was originally described from eastern Kazakhstan, but it is unclear if these populations and the populations found in adjacent south-west Asia belong to that subspecies. This situation is further complicated by the discovery of two genetically distinct and seasonally segregated (and thus reproductively isolated) taxa belonging to the *L. virens* group in Algeria. One was described as a new species, *L. numidicus*, while the other was recognised as conspecific with *L. virens virens* (Samraoui *et al.* 2003, Samraoui 2009). A molecular study is needed to determine the taxonomic status of these taxa as well as those from Turkey and the Levant.

Distribution

World: *Lestes virens* ranges from western France, Iberia and northern Africa to Central Asia. To the south, the species is present in the Maghreb, in the Levant and from Turkey to the north-west of Iran.



European distribution



World distribution

Flight period

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Netherlands													
Bavaria, Germany													
France, north													
Bulgaria & Greece													

Europe: This species is widespread in Europe but the density of populations varies greatly between regions and the species is rare in relatively large areas. Its northern limit reaches the south of Sweden and the Baltic States with a single recent record known from the coast of southern Finland. Remarkably, it is absent from Great Britain and Ireland although suitable habitats and climate seem to be present in these countries.

Trend and conservation status

Lestes virens has extended its range northward, probably partly caused by climate change, and it has become more abundant in the Netherlands, Germany and Sweden. In recent years in parts of the western Mediterranean low rainfall in autumn and winter has resulted in pools drying out in spring and this might have resulted in a decline of the species.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

Lestes virens is found in a variety of standing waters, either seasonal or permanent, particularly in lakes, ponds bordered with bushes, reeds, rushes, sedges and grasses, marshes and brackish swamps, and also in acidic peat bogs. The water bodies are often located in the vicinity of forests, where they are sheltered from the wind. They need to be exposed to direct sunlight and are often shallow. The species is most common in lowlands, although it has been found up to 1 400 m in the south of its range.

Sympecma fusca (Vander Linden, 1820)

V.J. Kalkman & C. Willigalla

Distribution

World: *Sympecma fusca* is mostly a European and central and western Asiatic species extending into North Africa. From western Europe it occurs eastwards through the southern parts of Russia and Kazakhstan to Central Asia, where it is found in the lower mountains of Tajikistan, Kyrgyzstan, Uzbekistan and southern Turkmenistan (Borisov & Haritonov 2007). It was noted to be the most common damselfly in large parts of the southern half of Kyrgyzstan (Schröter 2009). In the south of its range it is common in both Turkey and the coastal regions of Syria, Lebanon and Israel. Further to the east it extends up to northern Iran and the Kopet Dag range on the Irano-Turkmen border where its range is bordered by the arid steppe and deserts of Central Asia. In North Africa it is common and widespread in the northern parts of the Maghreb. Two old records are known from Egypt (Andres 1928).

Europe: *Sympecma fusca* is common in southern and central Europe. The species becomes scarcer to the north through the Netherlands, Germany and Poland. North of these countries it is generally rare although presently increasing, and is found in Sweden, Belarus and the Baltic States. A vagrant was found in Great Britain in 2008 (Parr 2009).

Trend and conservation status

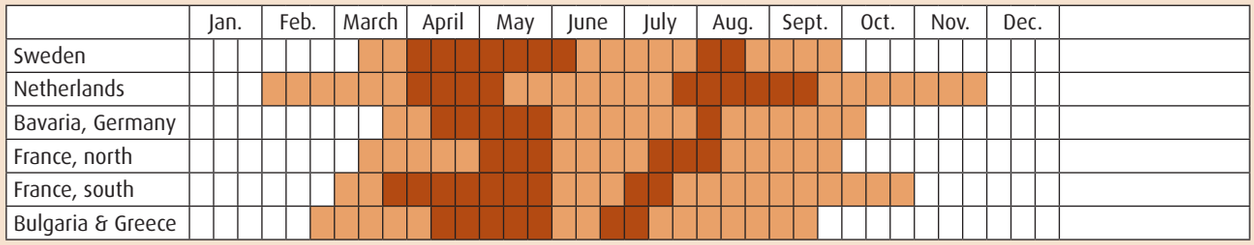
For unknown reasons, the species suffered a decline in some northern parts of its range in the 1960s and 1970s. In the 1980s it was considered rare in large parts of central and north-western Europe and was deemed threatened on several national Red Lists such as those of Germany, the Netherlands and Belgium. It has shown a strong recovery since the 1990s, probably as a result of higher summer temperatures, and has greatly expanded its range northwards in the Netherlands, Germany and Poland. The species is a recent arrival to Sweden where it was first recorded in 1989 and where it is now fairly common in the south-east of the country up to the Uppsala region (Billqvist 2012). During the same period it also arrived in the Baltic States and Belarus, with records published from Kaliningrad (Bertram & Haaks 1999, Shapoval & Buczyński 2012), Lithuania (Ivinskis & Rimšaitė 2010), Estonia (Martin 2013) and Belarus (Buczyński & Moroz 2008).

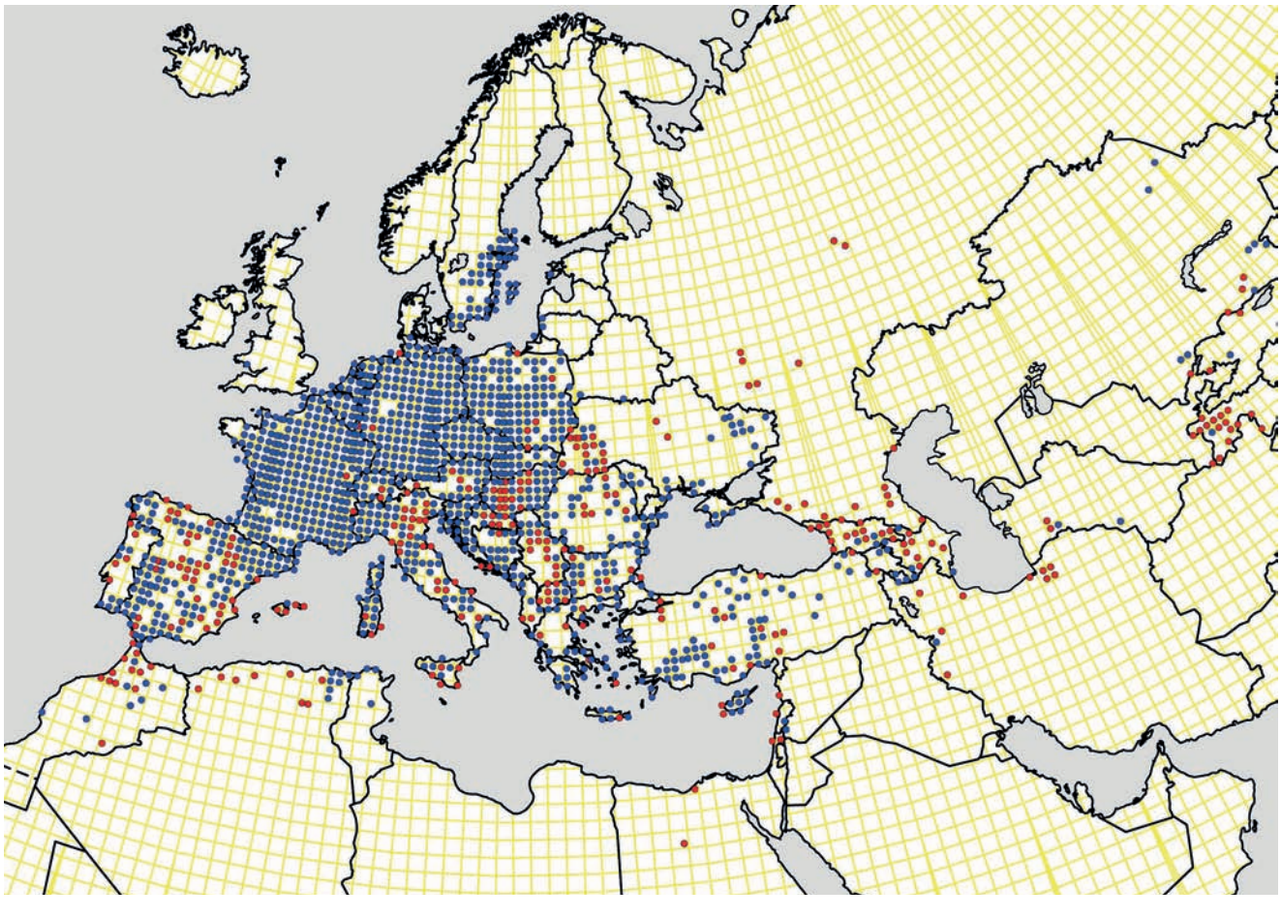
Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Increase

Habitat

Sympecma fusca occurs at fairly shallow, standing or slow-flowing waters with abundant bankside vegetation. The presence in spring of floating plant remains is essential as these are used for oviposition. The species uses a wide variety of habitats, such as bogs, marshes, ponds, large lakes and gravel pits. It mates and lays eggs throughout the spring, and the new adults emerge in summer and hibernate before reproducing the next spring. The habitat needs to have a sufficiently warm local climate that allows the adults to be active in the spring and larvae to develop over a period of several weeks to three months. After emergence, the adults feed until autumn, after which they disperse to find overwintering sites. The latter are often several kilometres from the reproduction site and often include vegetation of tall (0.5 to 1 m) dead herbs or grasses near or in open forests. *Sympecma fusca* is most common in the lowlands, but has also been found up to 1 600 m in southern Europe.

Flight period





World distribution

Sympecma paedisca (Brauer, 1877)

V.J. Kalkman & R. Mauersberger

Taxonomy

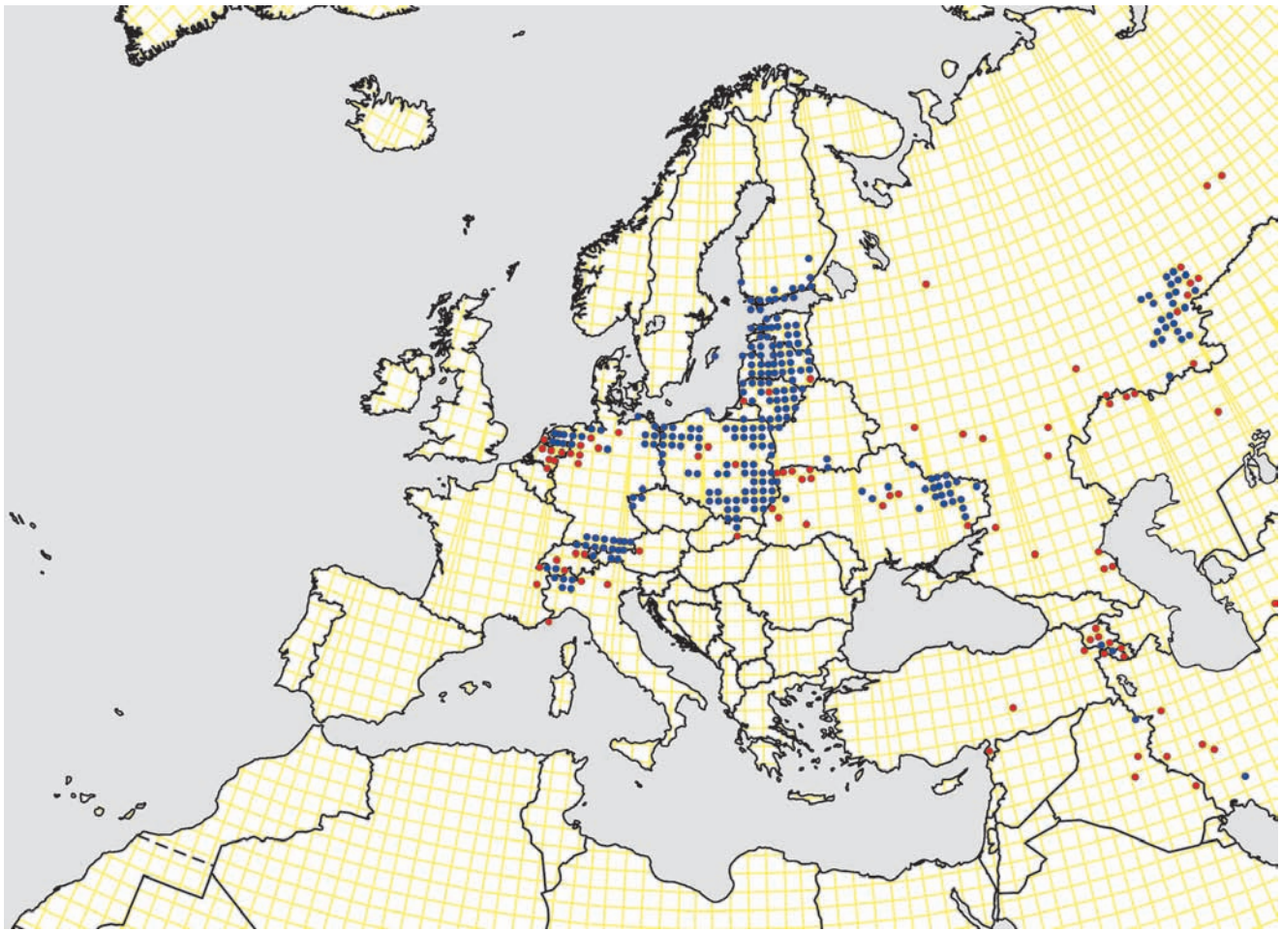
This species is known under different names which until recently were in frequent use. Jödicke (1997a) summarised the nomenclatural history of this species and showed that the name *S. paedisca* has priority over the names *annulata*, *braueri* and *striata*. The latter three names are still sometimes used for subspecies occurring in the south-east of the species range. These subspecies are largely based on the reduced dark pattern on the thorax, a character that seems to be merely correlated with the hot climate of south-west and Central Asia, where specimens become gradually paler over a large area through clinal variation. Due to this it is not possible to distinguish clearly definable subspecies and the species is here considered to be monotypic.

Distribution

World: *Sympecma paedisca* has a wide range that extends from western Europe eastwards to Japan. The species mainly occurs in the temperate region, being largely absent from arid or boreal areas. It is widespread in the temperate parts of Russia, Kazakhstan, Mongolia, northern China and Korea. In large parts of this range, it is among the most common damselflies (e.g. Kosterin 2004, Chaplina *et al*. 2007, Kosterin & Zaika 2010). In Central Asia it is widespread and common in the mountains of Tajikistan, Kyrgyzstan, Uzbekistan and Turkmenistan (including the Kopet Dag) (Borisov & Haritonov 2007, Schröter 2009). In south-west Asia, it is known from Armenia ("common" according to Akramowski (1948) although only two recent records are available), Iran (scattered but probably uncommon) (Heideri & Dumont 2002), Afghanistan (Schmidt 1961) and Turkey (Kalkman & Van Pelt 2006). No record is available from either

Georgia or Azerbaijan. Most records from south-west Asia are old despite of an increase in fieldwork in the past decades, suggesting that the species has decreased in the region.

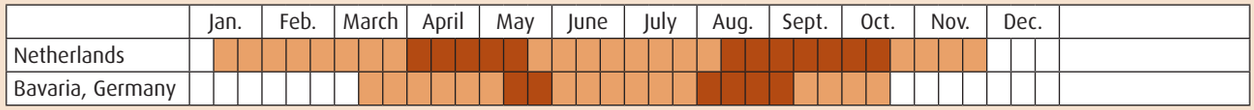
Europe: *Sympecma paedisca* is rare to uncommon in most of its European range with the exception of the north-east. The latter area includes large parts of Poland, the Baltic States and the southern margin of Finland. The species is probably under-recorded in Belarus, northern Ukraine and the European Russia. In western Europe, it is limited to a narrow strip running from the Netherlands across northern Germany to Poland. In central Europe it occurs on the northern side of the Alps in Bavaria, Baden Württemberg and Austria, with additional relict populations found in the south-west of Switzerland and in the western mountains of the Czech Republic. South of the Alps, the species survives in northern Italy (Piedmont) but is extinct in the lower alpine area of south-eastern France.



European distribution

World distribution

Flight period



Trend and conservation status

Sympecma paedisca went through a severe decline in both western Europe and the Alps in the second half of the 20th century. The reasons for this decline are not fully understood but eutrophication has often been mentioned as a factor. This probably played an important role in western Europe and the Alps, but less so in north-east Germany and Poland where the species occurs mostly in habitats which are already eutrophic or even hypertrophic. In the Netherlands, the abandonment of traditional management practices might have been the most important factor. The cessation of peat extraction and the decrease of the land areas where reeds are harvested resulted in a major reduction of suitable habitat, with woodland areas expanding at the cost of open fenland (Ketelaar *et al*. 2007a, b). The continuation of peat extraction resulted in a subsequent recovery of this species in the Netherlands since the 1990s. In the area of Lake Constance, Germany, where the species prefers small ponds and shallow edges of lakes, the species seems to have been affected by decreasing amounts of meltwater and drier spring seasons. Its recent decline in north-east Germany cannot readily be explained by clear changes in habitats and is thought to be related to climate change. Climate change is also considered to be the cause of its expansion to Finland, where it was first recorded in 2002 and since has colonised the southern fringe of the country (Karjalainen 2010).

Management plans are needed, especially for isolated populations such as those occurring in western Europe and the Alps. In Italy, the distribution of the species is poorly known, making it presently impossible for this country to give this species the protection required according EU legislation.

Habitats Directive	IV
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Endangered
EU27 endemic	No
European endemic	No
Trend Europe	Decreasing

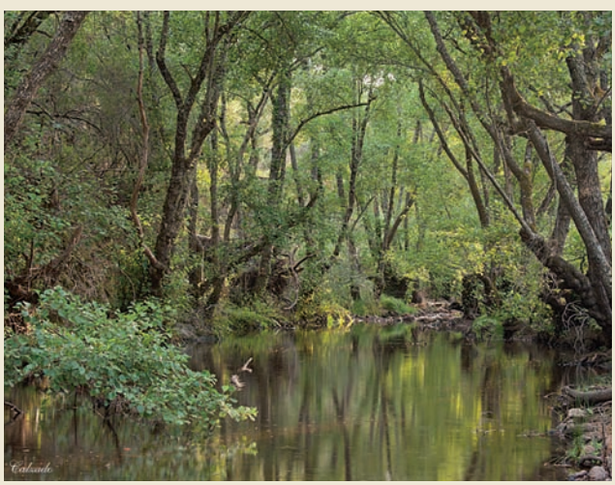
Habitat

Considering its scarcity, *S. paedisca* is found in a remarkably wide variety of habitats. In Europe, it occurs in mesotrophic to hypertrophic standing or, seldom, slow-flowing waters (Ellwanger & Mauersberger 2003). These range from large lakes, fenlands and peat-bogs to gravel pits. In the Netherlands it is restricted to mesotrophic fenlands but in north-east Germany and Poland it is mainly found in small forest lakes which are often eutrophic or hypertrophic. The species behaves more like a generalist to the east and in eastern Poland it is found in all kinds of standing waters. The habitats always have an abundance of bank side and aquatic vegetation. As in *S. fusca*, the adults hibernate and mate and lay eggs in spring. Emergence of the new generation takes place in the second half of summer, after which the adults leave the reproduction site to hibernate often far from their larval habitat. Different habitat types can be suitable for overwintering as long as there is vegetation of knee-high herbs or grasses protected by higher bushes or trees. This low vegetation is used in autumn for foraging perches and in winter as a refuge, with the surrounding higher vegetation providing shelter from the wind. In the Netherlands it was noted that the adults prefer relatively dry conditions during winter, suggesting that they are sensitive to moisture.

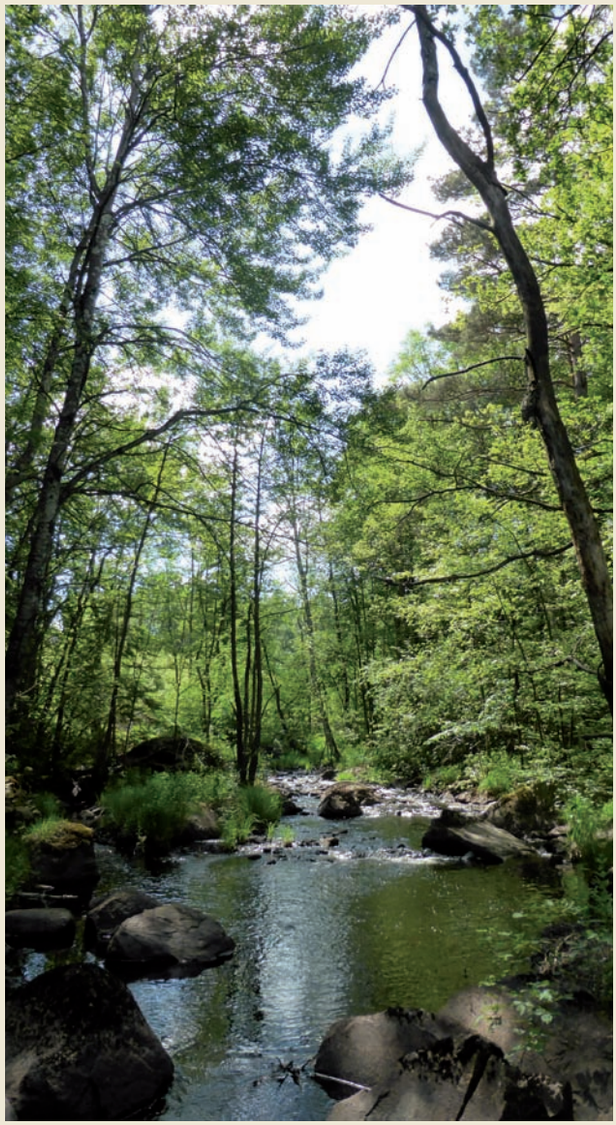
***Calopteryx splendens*, La Fossetta, near Rosia (SI), Italy.** Photograph Fons Peels.

Calopterygidae

1 Calopteryx splendens Habitat of *Calopteryx splendens*, Žabljak river, Bosnia-Herzegovina. Other species occurring here include *Anax imperator, Calopteryx virgo, Coenagrion puella, Ischnura elegans, Platycnemis pennipes* and *Pyrrhosoma nymphula*. Photograph Dejan Kulijer.



2 Calopteryx haemorrhoidalis. Habitat of *Calopteryx haemorrhoidalis*, River Robledillo, Solana del Pino, Ciudad Real, Spain. Other species occurring here include *Boyeria irene, Calopteryx virgo, Chalcolestes viridis, Cordulegaster boltonii, Onychogomphus uncatus, Orthetrum chrysostigma* and *Platycnemis latipes.* Photograph Enrique Calzado Rivillas.



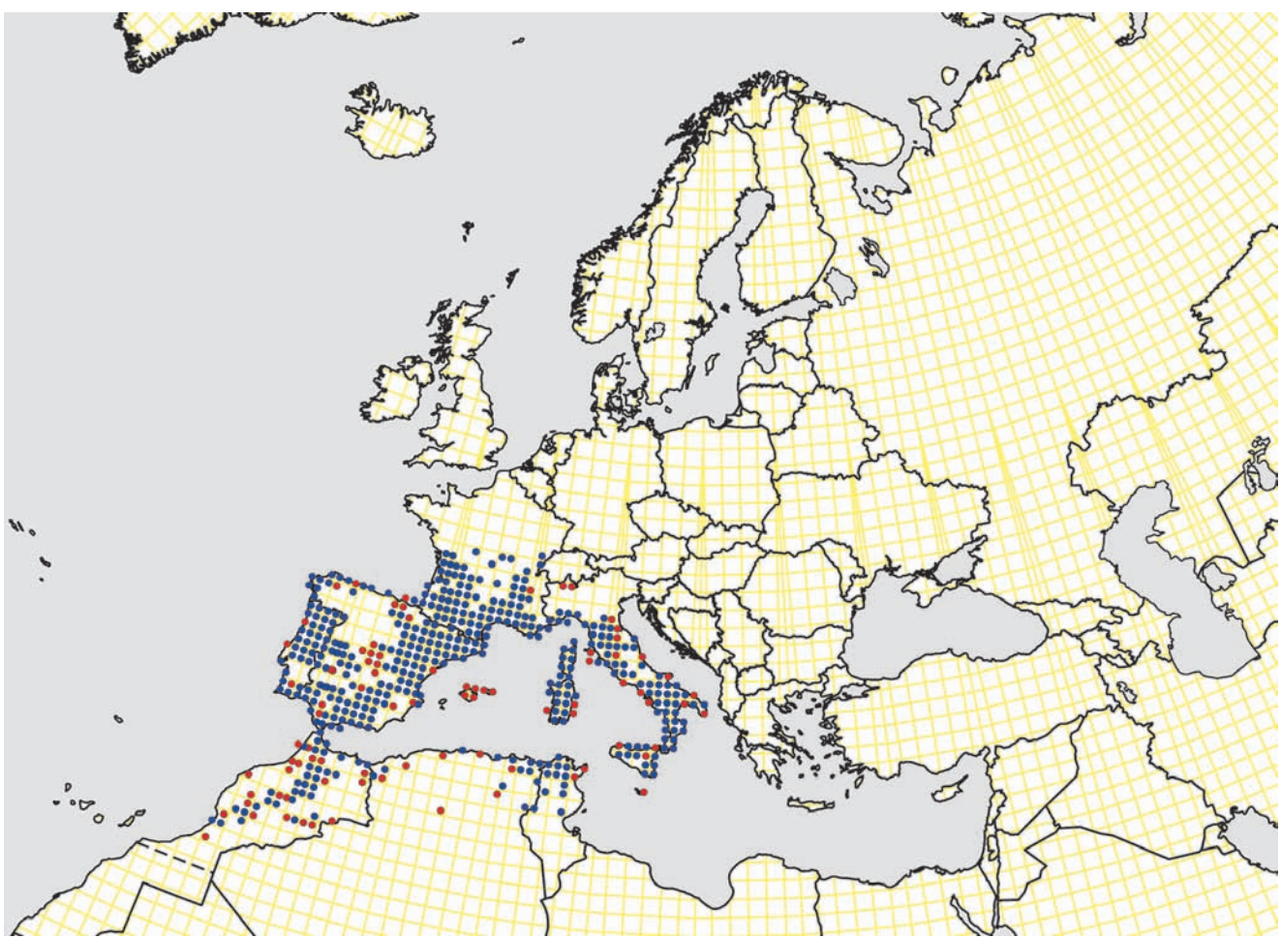
3 Calopteryx virgo. Habitat of *Calopteryx virgo*, Holje Stream, north of Bjärnum, province of Skåne, Sweden. Other species occurring here include *Cordulegaster boltonii, Gomphus vulgatissimus, Onychogomphus forcipatus* and *Platycnemis pennipes*. Photograph Magnus Billqvist.

Calopteryx haemorrhoidalis (Vander Linden, 1825)

J.-P. Boudot, M. Lockwood & A. Cordero Rivera

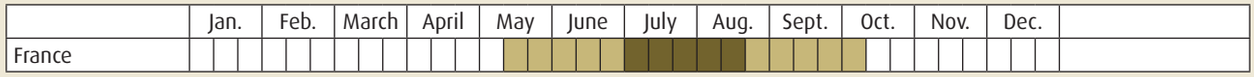
Taxonomy

Several subspecies have been described based on the extent of the dark areas of the wing and on body coloration. These include *C. h. occasi* from Italy and France and *C. h. asturica* from north-west Spain. Maibach (1985, 1986, 1987) and Weekers *et al.* (2001) carried out comparative morphological and molecular studies on these subspecies but could not find clear characters between populations and considered the subspecies invalid. Subspecies *C. h. almogravensis* Hartung, 1996 from south Portugal is a dwarf form of the *C. h. occasi* phenotype and does not warrant separate taxonomic status (Ferreira *et al.* 2006). Nevertheless, regional differences in male body coloration do occur, with those from mainland Italy, Sardinia, Sicily, Northern Africa and some areas of the east and south of the Iberian Peninsula being metallic black and those in southern France and the north and west coasts of the Iberian Peninsula metallic purple with red reflections (authors' observations). Intermediate populations are known from north-east Spain (Catalonia). Whether such variability is of taxonomic relevance is still unclear. The recent discovery of hybridization between *C. haemorrhoidalis* and *C. splendens* in central Italy (Lorenzo Carballa *et al.* 2014), resulting in novel phenotypes in males, further complicates our understanding of the significance of body coloration in *Calopteryx* taxonomy. In addition, two allopatric Italian and Iberian populations were found to differ markedly in behavioural and morphological aspects of their post-copulatory sexual selection mechanisms (Cordero Rivera *et al.* 2004). The spatial variability and representativeness of these mechanisms is also unknown and further studies are needed to determine if the observed differences might have taxonomic implications.



World distribution

Flight period



Distribution

World: *Calopteryx haemorrhoidalis* is a west Mediterranean endemic, widespread over south-west Europe, including the Mediterranean islands and the north-west of Africa. In Africa it occurs in a large part of Morocco and northern Algeria and Tunisia. The species is common throughout most of its range.

Europe: This species is common in large parts of south-west Europe from Italy and southern France to the Iberian Peninsula, including islands of the western Mediterranean. The species does not reproduce on the Maltese islands and the only record from the Maltese islands refers to a poorly preserved male found in a collection (Sciberras & Sammut 2013).

Trend and conservation status

In recent years, an increasing number of small isolated populations or vagrants have been recorded north of the established range of the species (e.g. on the French Jura Plateau). These are regarded as attempts by the species to expand northwards in response to climate warming.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

The species favours clear and well-oxygenated streams and rivers, generally with a swift current and partly shaded, lightly wooded, banks. It is restricted to low and middle elevations below 1 100 m. In the north and north-west of the Iberian Peninsula it is found only in very small streams close to the coast.

Calopteryx splendens (Harris, 1780)

J.-P. Boudot & S. Prentice

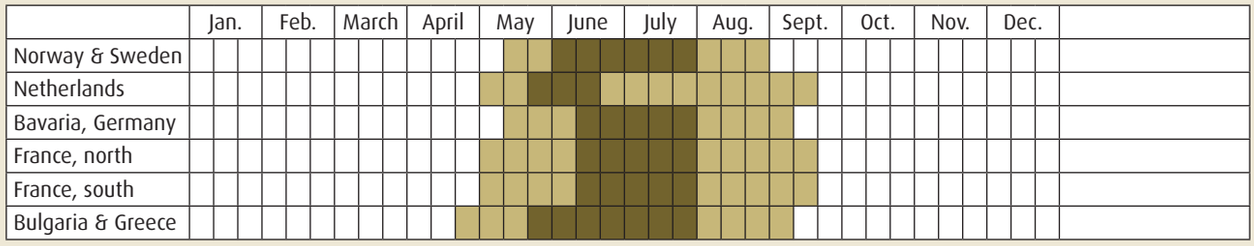
Taxonomy

Calopteryx splendens is part of the so-called *splendens*-complex, a group of closely related species and subspecies. The identification of the taxa within this group is mainly based on the shape and the extent of the coloured wing patch. Molecular studies have shown that the shape of the wing and its markings do not necessarily reflect the relationships between taxa. The most recent conclusion of ongoing studies is that most subspecies of *C. splendens*, including the European *ancilla*, *balcanica*, *caprai*, *splendens* and *taurica*, are probably hybrid populations from at least three ancestral gene pools in western Asia and one in the western Mediterranean (see chapter Taxonomy for background). The situation is still far from clear and the use of subspecies names for the various forms is currently of limited use.

Distribution

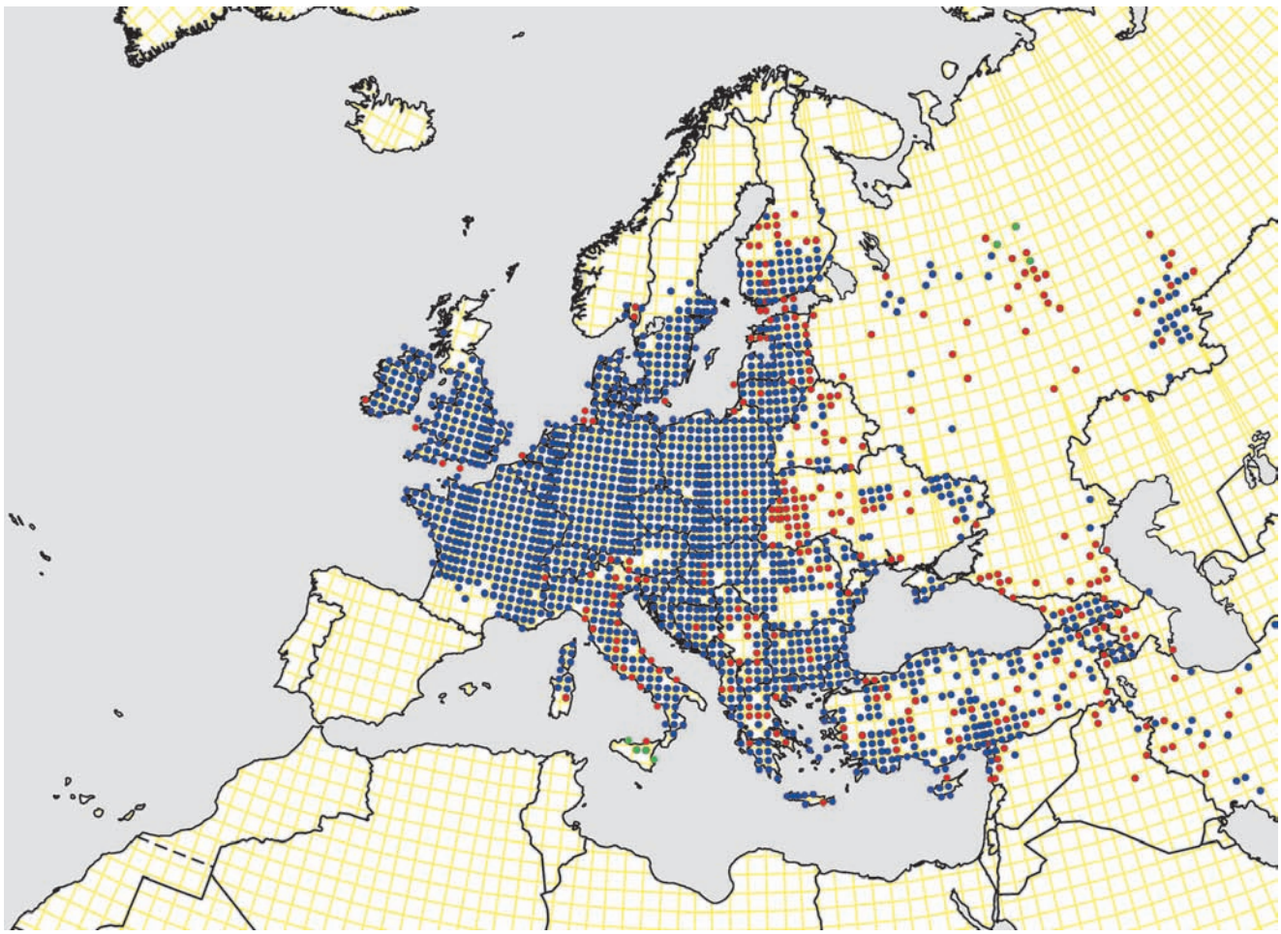
World: The *C. splendens*-complex is among the most widespread taxa in the Western Palaearctic. It extends

Flight period



from the Atlantic coasts of Europe to the south-west of Yakutia and to the north-east of Lake Baikal in central Siberia (Kosterin & Sivtseva 2009). The southern distribution of the complex is limited by the arid areas in south-western and Central Asia, where it is largely restricted to mountainous areas. Its northernmost occurrence is in southern Fennoscandia.

Europe: The *C. splendens*-complex is widespread and common throughout most of Europe. It is absent from most of Scotland and Fennoscandia and is replaced by *C. xanthostoma* on the Iberian Peninsula. Some of the records from Sicily published by Galletti *et al.* (1987) as *C. xanthostoma* are likely to pertain to the *C. splendens*-complex and are mapped as such.



European distribution

World distribution

Trend and conservation status

The *C. splendens*-complex is common and abundant in most of Europe although it declined in large parts of western Europe in the 1960s and 1970s as a consequence of intensified stream management and water pollution. Populations underwent a significant recovery in the 1990s (Van Strien *et al.* 2013). It is considered stable on the European scale and is listed as Least Concern on the European Red List.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Vulnerable
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

The species favours unshaded streams and rivers and is generally absent from torrents and shaded waters. The highest densities occur when the morphology of the watercourses is relatively natural although the species can also be found on sections that are (partly) canalized as long as sufficient bank side vegetation is left. More rarely, *C. splendens* is found in ditches and canals with some current as well as in seepage-fed backwaters of rivers. The species is restricted to low and middle elevations below 1 200 m. Optimal current velocity ranges from 3 to 30 $cm.s^{-1}$ with the maximum tolerated less than 60 $cm.s^{-1}$. Summer water temperature ideally ranges from 18 to 24 °C.

Calopteryx virgo (Linnaeus, 1758)

J.-P. Boudot & S. Prentice

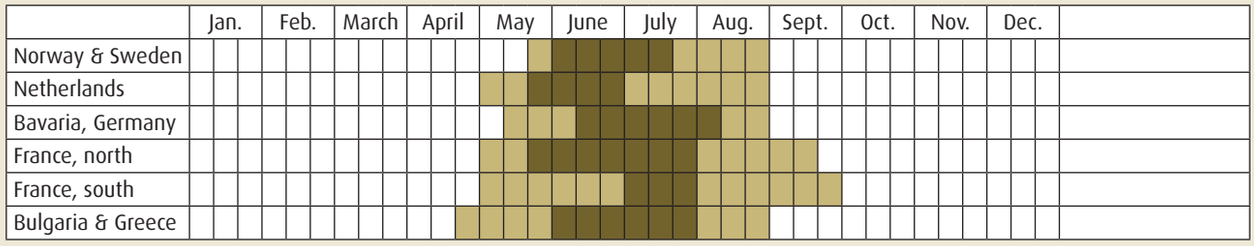
Taxonomy

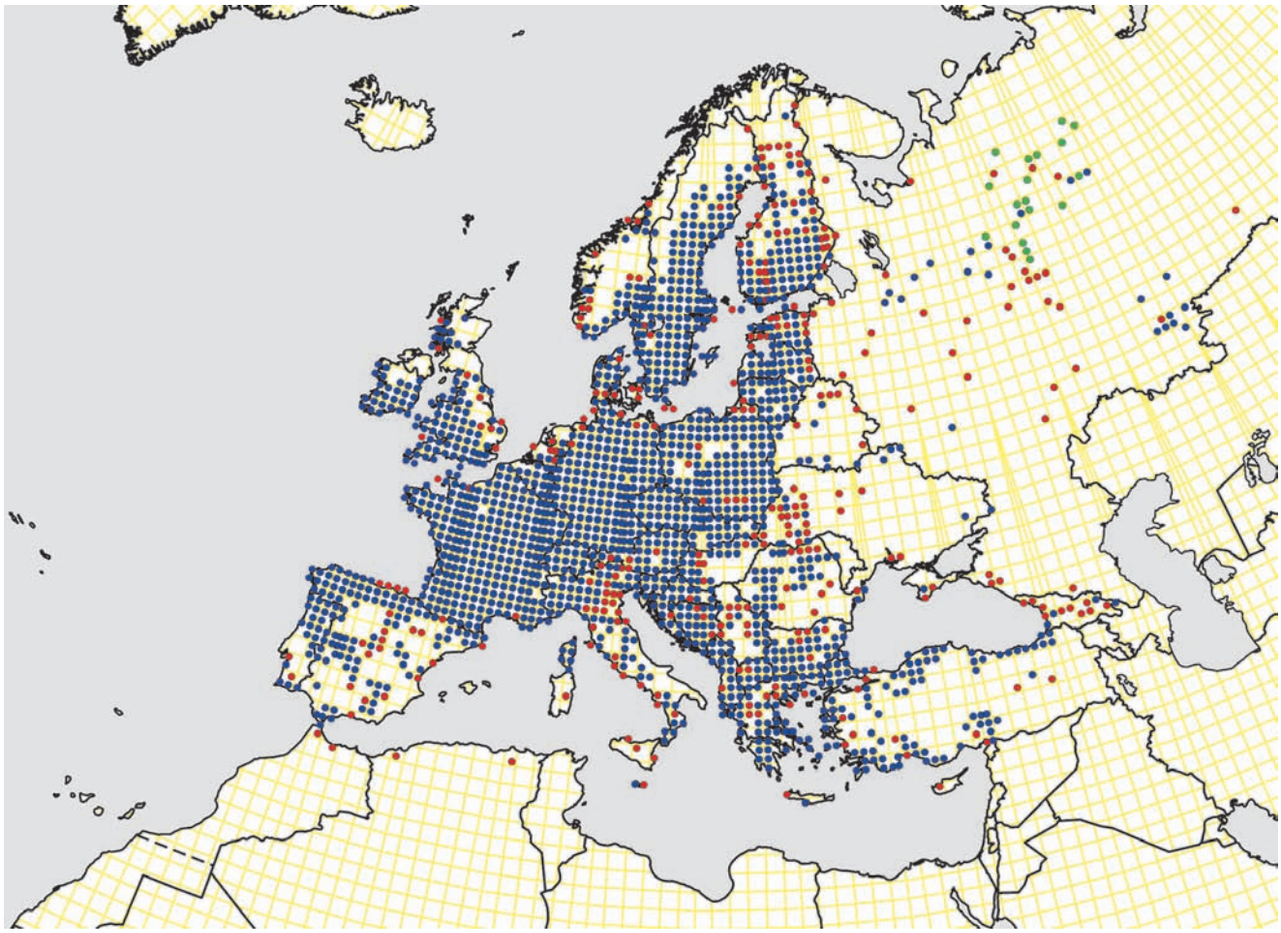
In addition to the nominotypical subspecies, which occurs throughout most of Europe, two subspecies, *C. v. meridionalis* and *C. v. festiva* are found in the south-west and the south-east of Europe, respectively. Transition areas with intermediate forms are known between these subspecies and the nominotypical subspecies. *Calopteryx japonica* Selys, 1869 was a long time considered to be a subspecies of *C. virgo*, due to which the range of these two species in parts of Asia is still unclear.

Distribution

World: *Calopteryx virgo* seems to be largely confined to the Western Palaearctic. It is widespread and generally common over most of Europe but is very rare in North Africa, where only four localities have been reported from Morocco and Algeria. Its eastern range limit is unclear. It is rare in eastern Turkey, being largely confined to the Black Sea coast. It is recorded from Georgia and Armenia and seems to be widespread in European Russia. It is moderately common in the southern Urals (Yanybaeva *et al.* 2006). It is unclear if the species penetrates into the Siberian lowlands and further east as most records date from the time where *Calopteryx japonica* was considered a subspecies of *C. virgo* and was not always correctly differentiated from the latter (see e.g. Belyshev 1973). It is however unlikely that its range extends east of the longitude of Lake Baikal (Kosterin 1999, Kosterin & Sivtseva 2009). Belyshev & Shevchenko (1971) mention the species from south-east Kazakhstan but this is believed to be incorrect; there are no confirmed records for this country. A record in Kyrgyzstan in Borisov & Haritonov (2007) based on a note by Bartenev (1929) is also considered incorrect and may refer to *C. samarcandica* Bartenev, 1911.

Flight period





World distribution

Europe: *Calopteryx virgo* is found across almost the whole of Europe, being absent only from the north in Great Britain and Ireland and from western and northern Fennoscandia. It becomes more scattered in the drier parts of the Iberian Peninsula. In Ukraine it occurs mostly in the west, becoming patchy and scarcer in the other parts of the country. The nominotypical subspecies inhabits the cold and temperate climatic areas, whereas *C. v. meridionalis* is confined to the western Mediterranean and the French Atlantic districts. A wide transition area occurs between these two subspecies. *Calopteryx v. festiva* occurs in the south of Italy, the southern parts of the Balkan Peninsula, the east Mediterranean islands, Turkey and Transcaucasia. A transition area to the nominotypical subspecies occurs in the north of the Balkan Peninsula.

Trend and conservation status

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Calopteryx virgo underwent a decline in parts of central and western Europe in the second part of the 20th century, especially in the lowlands. A recovery was noted in recent decades, although not so marked as that shown by *C. splendens*.

Habitat

Calopteryx virgo reproduces in flowing waters, particularly in hilly and mountainous areas, and prefers small and medium-sized, partly shaded, streams and rivers. It is generally less common in lowlands, where the current is slower, and there are often fewer well-shaded streams with high oxygen levels. The species is generally rare in agricultural landscapes. *Calopteryx virgo* breeds up to 1 600 m. Optimal current velocity ranges from 3 to 30 $cm.s^{-1}$ with the maximum tolerated less than 60 $cm.s^{-1}$. Summer water temperature ideally ranges from 13 to 18 °C. Within this temperature range larval respiratory rates are higher than in *C. splendens*, whereas both species exhibit similar rates at 24 °C. This emphasizes a higher tolerance of *C. virgo* for cooler climates but also a greater dependence on high oxygen levels. Many populations are found in forests and adults are often encountered in shaded conditions. The species is more susceptible to organic pollution than *C. splendens*, often disappearing when streams become contaminated.

Calopteryx xanthostoma (Charpentier, 1825)

J.-P. Boudot, M. Cabana Otero & A. Cordero Rivera

Taxonomy

This taxon was formerly regarded as a subspecies of *C. splendens* but is currently considered to be a full species. Based on molecular analysis, it has been suggested that *C. xanthostoma* survived the Pleistocene glaciations in the western Mediterranean. In its contact zones with *C. splendens*, both taxa are reported to hybridize, for example in Liguria, Italy and between the Loire and Garonne in France, leading to a genetic assimilation of *C. xanthostoma* by *C. splendens* and to a decrease in the range of the former species (Weekers *et al.* 2001, Dumont *et al.* 2005b).

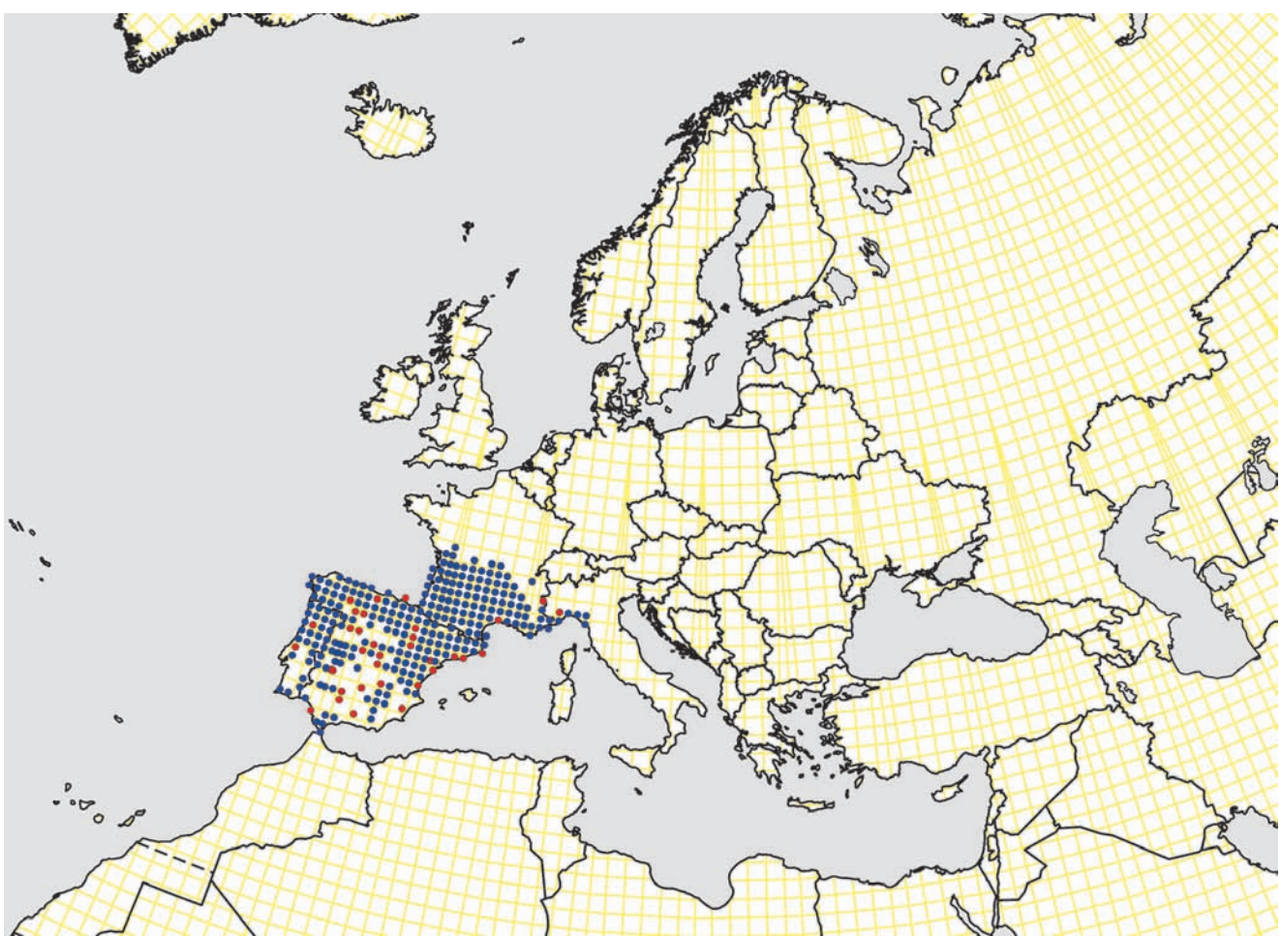
Distribution

World: *Calopteryx xanthostoma* is endemic to south-west Europe. Records from North Africa (Selys 1871) are regarded as erroneous.

Europe: *Calopteryx xanthostoma* is common and widespread in the south and the south-west of France and in most of the Iberian Peninsula, becoming patchy in the south of Spain and Portugal. In Italy it occurs only in Liguria. Old records from Sicily (Ghiliani 1842, Pirotta 1879, Galletti *et al.* 1987), often based on females and immature males, are here considered to be incorrect and to pertain to a local form of *C. splendens*.

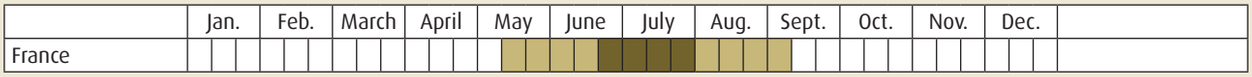
Trend and conservation status

Calopteryx xanthostoma has declined in France, Italy and the Iberian Peninsula due to the alteration of its habitat including water pollution. The increased water demand for irrigation and domestic use in combination with increased temperatures and drought will probably result in greater desiccation of Mediterranean streams and rivers, further compromising available habitats.



World distribution

Flight period



The species is however still common although a continuing decline is expected in the future.

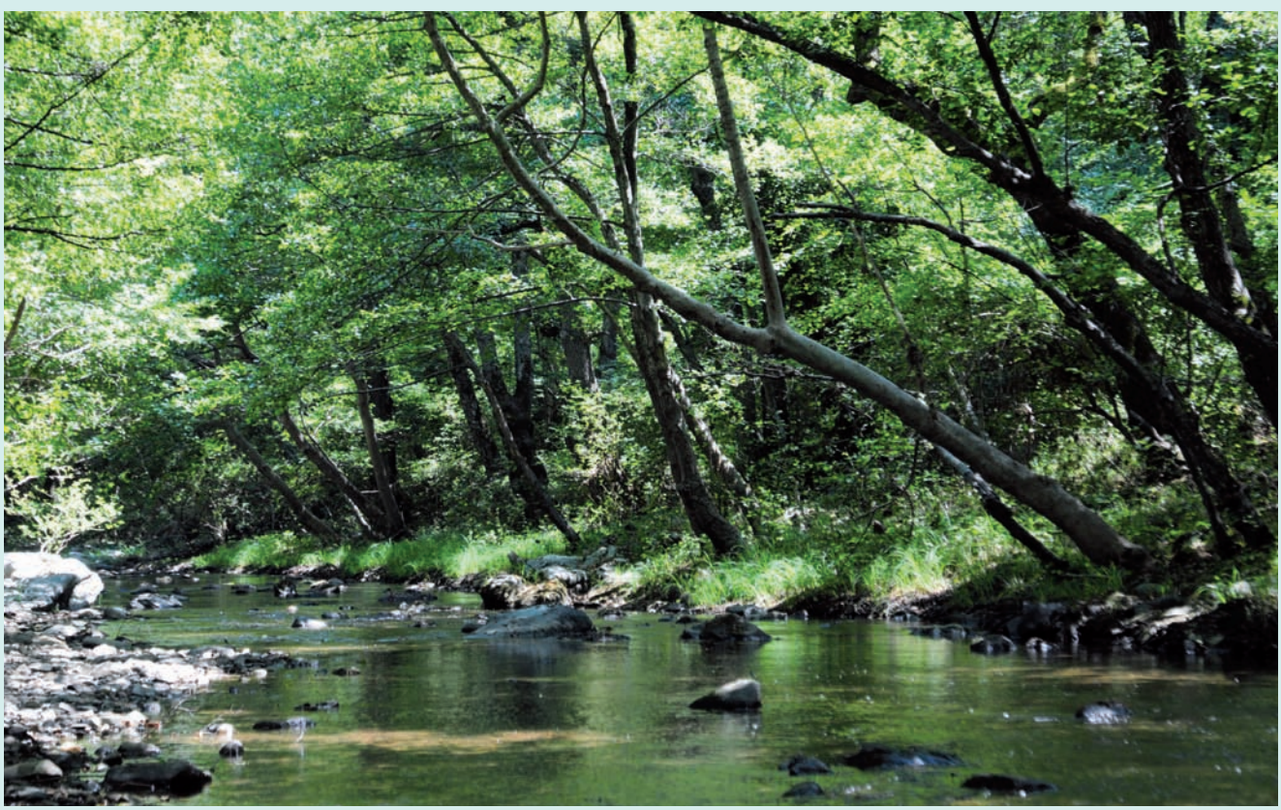
Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	Endemic
European endemic	Endemic
Trend Europe	Stable

Habitat

This species favours unshaded to partly shaded large lowland streams, rivers and canals with submerged or floating vegetation. It is mainly found in slow-flowing to moderately fast water but is absent from swift, cold, mountainous streams as well as from largely shaded habitats. In the Massif Central, *C. xanthostoma* breeds up to 1200 m.

Epallagidae/Euphaeidae

1 Epallage fatime. Habitat of *Epallage fatime*, Toparlar, waterfall near arboretum Yünüs Emry, Muğla province, Turkey. Other species occurring here include *Aeshna isoceles, Calopteryx splendens, Gomphus schneiderii, Onychogomphus forcipatus, Orthetrum taeniolatum, Platycnemis pennipes* and *Trithemis festiva*. Photograph Christophe Brochard.



2 Epallage fatime. Habitat of *Epallage fatime*, Rhodope mountains, Bulgaria. Other species occurring here include *Caliaeschna microstigma, Calopteryx virgo, Onychogomphus forcipatus, Somatochlora meridionalis*. Photograph Albert Vliegenthart.

Epallage fatime (Charpentier, 1840)

V.J. Kalkman, M. Marinov & Y. Kutsarov

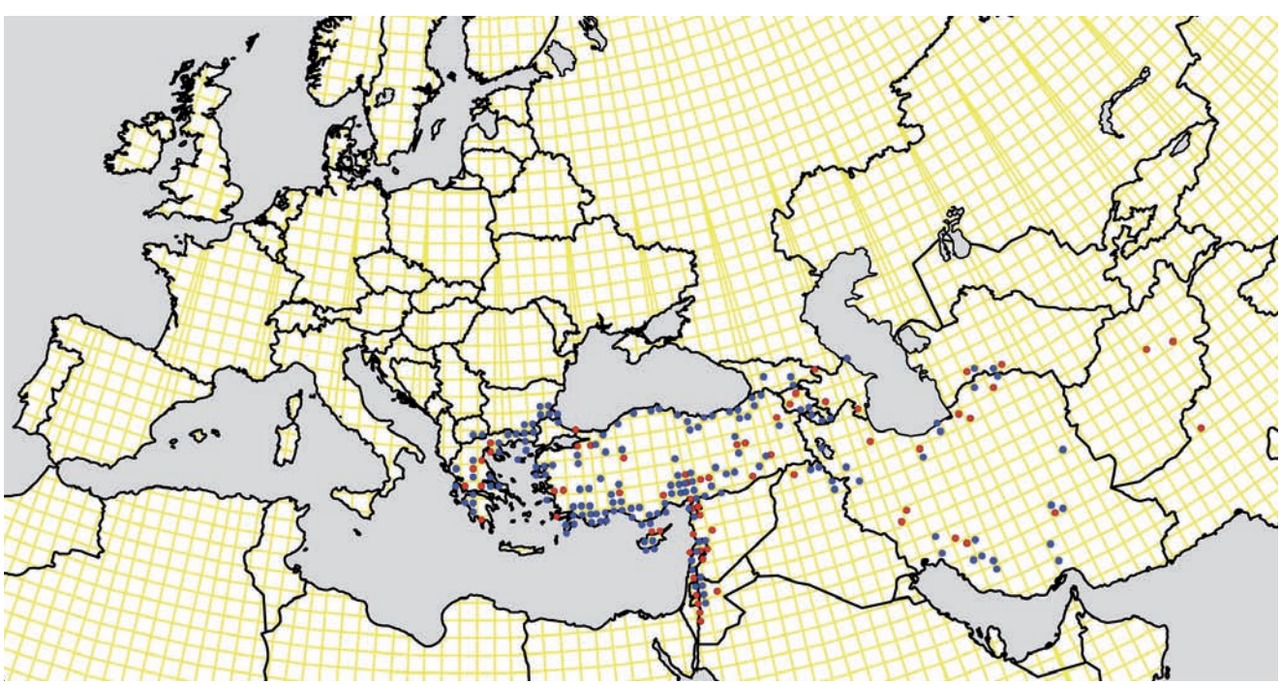
Taxonomy

There is considerable variation within populations in the extent and intensity of the dark wing tip, especially in females, with some specimens even having completely smoky wings. This variation has led to the description of several subspecies; none is presently regarded as valid (Schneider 1986).

Distribution

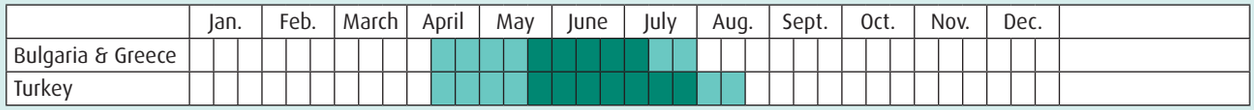
World: *Epallage fatime* is largely confined to the hilly and mountainous areas of south-western Asia. In the south its range extends over the whole of the Levant but is limited by the arid regions of the Middle East. An old record from central Saudi Arabia is considered as erroneous (Schneider & Krupp 1993). The northernmost records range from Bulgaria to Transcaucasia and the Kopet Dag mountains in Turkmenistan near the Iranian border (Schoorl 2000, Reinhardt *et al.* 2000, Borisov & Haritonov 2007). The easternmost records are from 30 km west of Kabul (Afghanistan) and Quetta (west Pakistan) (Fraser 1934, Schmidt 1961).

Europe: The European range of *Epallage fatime* is limited to Cyprus, Turkey in Europe, continental Greece, the Aegean islands, south-east Bulgaria and Macedonia. In addition, Skvortsov (2010) recorded the species from the Dagestan in the European part of the Caucasus region, without giving a precise locality or an original reference. Over most of its European range, *E. fatime* is uncommon although it has been found at almost two hundred streams and rivers. It has a scattered distribution in Turkey in Europe and in continental Greece, but is absent from Crete and from most of the smaller Greek islands, being only known from Lefkada, Evia, Limnos, Samothraki, Lesbos, Samos, Kos and Rhodes. In Bulgaria and Macedonia, the species is limited to areas adjacent to Turkey and Greece. In Macedonia it was for a long time known from only two old records but several small populations have been found since 2010 (Bedjanič & Vinko 2012). It has not been recorded from Albania but may occur in the south of the country. Suitable habitats seem to be present in areas further north in Macedonia and Bulgaria where *Epallage* is currently absent, making it likely that the northern limit of its European range is largely determined by climate. A record from Kiskunság in Hungary published by Steinman (1986) is doubtful and is here regarded as incorrect. The occurrence of the species in Romania and Ukraine indicated by the map in Askew (1988, 2004) is incorrect.



World distribution

Flight period



Trend and conservation status

The habitat of *Epallage fatime* is under threat due to desiccation of streams caused by increased frequency of drought periods and the increased extraction of water for irrigation. No detailed information is currently available on trends in abundance of this species in Europe but it is believed to be in decline. In the future, increased frequency of habitat desiccation due to climate change is likely to have an impact on the European populations but it is also not unlikely that the species will expand its range to the north with rising temperatures.

Habitats Directive	No
Red List EU27	Near Threatened
Red List Europe	Near Threatened
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Decreasing

Habitat

Epallage fatime is largely limited to permanent running waters and only rarely occurs at streams that become intermittent during summer. The species is mostly found along streams, although it can also occur at rivers. It is generally found at swift flowing habitats in hilly areas and has a strong preference for clear streams with pebbles and rocks bordered with grasses, herbs and low bushes. It occurs only in small numbers on shady streams. The larvae are rather sturdy and have short and flattened legs, which seem to be an adaption for living in swift waters, and are found among gravel and under stones.

***Platycnemis acutipennis*, River Chassezac near Grospierres (Ardèche), France.** Photograph Fons Peels.

Platycnemididae

1 Platycnemis latipes. Habitat of *Platycnemis latipes*, Río Guadalhorce near Antequera, Malaga province, Spain. Other species occurring here include ***Ischnura graelsii***. Photograph Javier Ripoll Rodríguez.

2 Platycnemis pennipes. Habitat of *Platycnemis pennipes*, River Vecht, Netherlands. Other species occurring here include *Calopteryx splendens, Erythromma najas, Ischnura elegans* and *Gomphus vulgatissimus*. Photograph Evert Ruiter.

Platycnemis acutipennis Selys, 1841

J.-P. Boudot, M. Cabana Otero & A. Cordero Rivera

Distribution

World: *Platycnemis acutipennis* is endemic to south-west Europe.

Europe: *The species is* common and widespread in the south-western parts of the Iberian Peninsula and of France, with more scattered occurrences in the other parts of Spain and central and south-eastern parts of France. It seems to be less common than *P. latipes* in Spain. Records published from north-east France are incorrect.

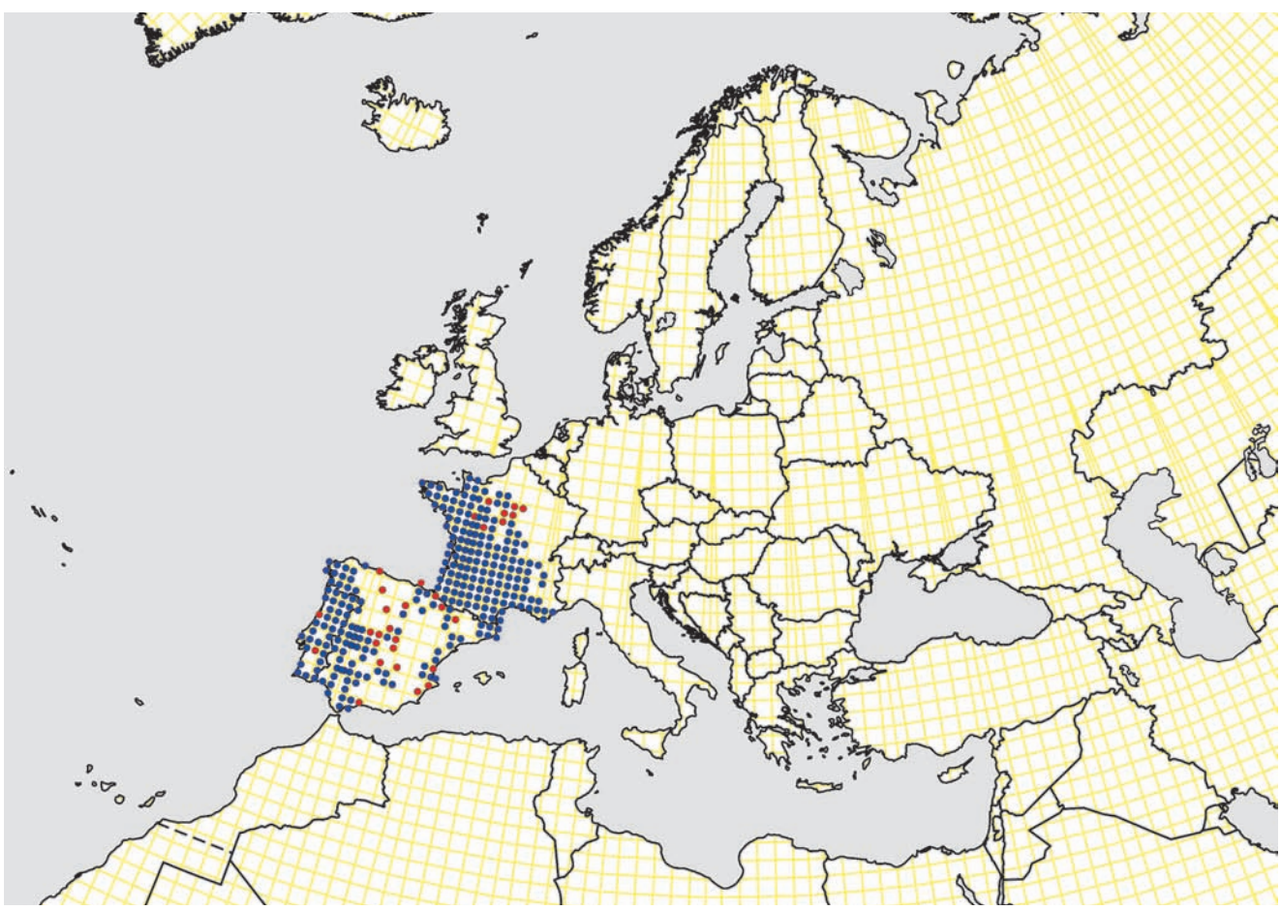
Trend and conservation status

The species is common and stable within most of its range and is not considered threatened.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	Endemic
European endemic	Endemic
Trend Europe	Stable

Flight period

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
France													



World distribution

Habitat

Platycnemis acutipennis occurs in a wide range of habitats and is found at standing, slow-flowing and swift waters, although its preferred habitat in most of its range is medium sized rivers. It is restricted to lowlands and hilly areas, being widespread and often common below 500 m, decreasing rapidly with increased elevation although reaching locally 1 150 m in the Mediterranean.

Platycnemis dealbata Selys, 1850

J.-P. Boudot

Distribution

World: *Platycnemis dealbata* is common and often abundant in large parts of south-west Asia, occurring from southeast Turkey and the Levant to Kashmir in the east. It is limited in the south by the Sinai, the Syrian Desert and the Persian Gulf.

Europe: In Europe, *Platycnemis dealbata* is restricted to the Republic of Dagestan in the northern Caucasus, where it is known from three old records along the Caspian coast (Eichwald 1830, Bartenev 1913, Artobolevskij 1929). This area is poorly investigated and it is unknown if the species is still present in Europe.

Trend and conservation status

Platycnemis dealbata is common throughout its range and although population trends are unknown it is not considered to be threatened on a global scale. No information is available about its present status in Europe and it is unknown if it still occurs. Threats affecting the habitats of *P. dealbata* throughout its range include desiccation and the general degradation of freshwater habitats.

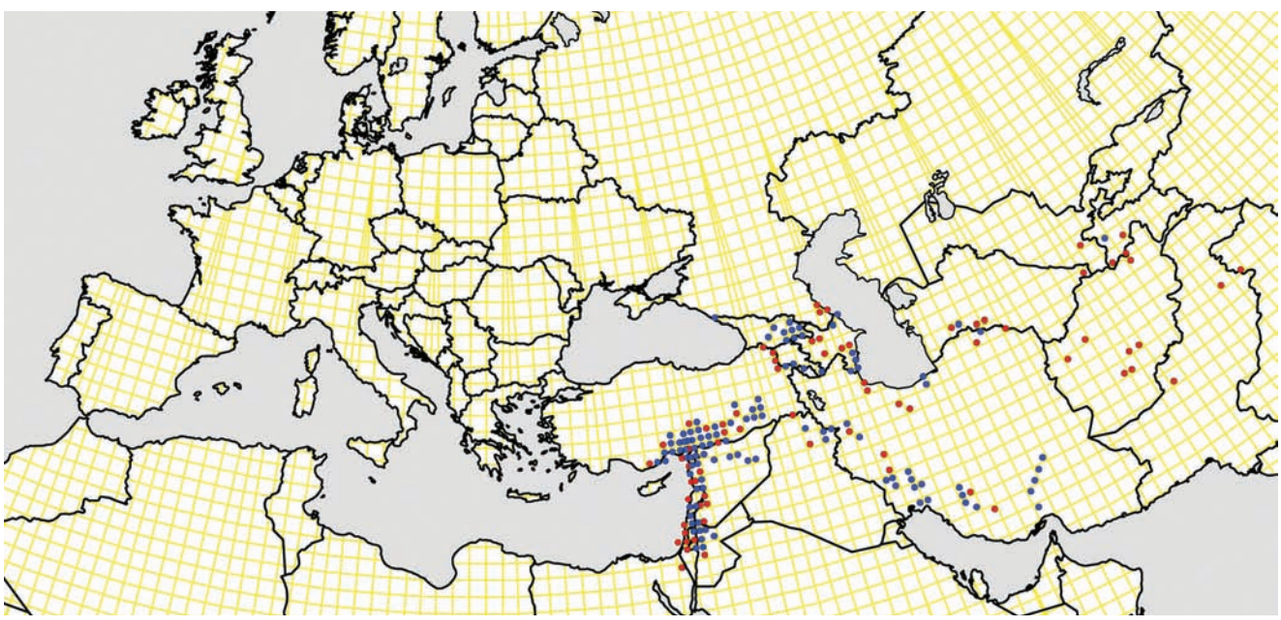
Habitats Directive	No
Red List EU27	Not Evaluated
Red List Europe	Not Evaluated
EU27 endemic	No
European endemic	No
Trend Europe	Unknown

Habitat

Platycnemis dealbata occurs at all kinds of running but non-torrential waters.

Flight period

In Europe, the species was recorded from 21 May to 23 July but very few records are available. In Turkey its flight period extends from the end April to late September.



World distribution

Platycnemis latipes Rambur, 1842

J.-P. Boudot, A. Romeo Barreiro & A. Cordero Rivera

Distribution

World: *Platycnemis latipes* is endemic to south-west Europe.

Europe: *Platycnemis latipes* is common in most of the Iberian Peninsula and the south-west of France, and often occurs in large populations. Published records north of the rivers Loire and the Rhône are omitted as they are based on conflation with immature *P. pennipes*.

Habitat

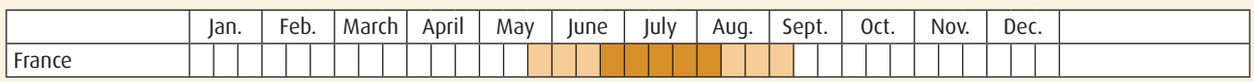
Platycnemis latipes occurs mainly in slow-flowing to moderately fast running waters in lowlands and hilly areas. Reproduction at standing waters is rare.

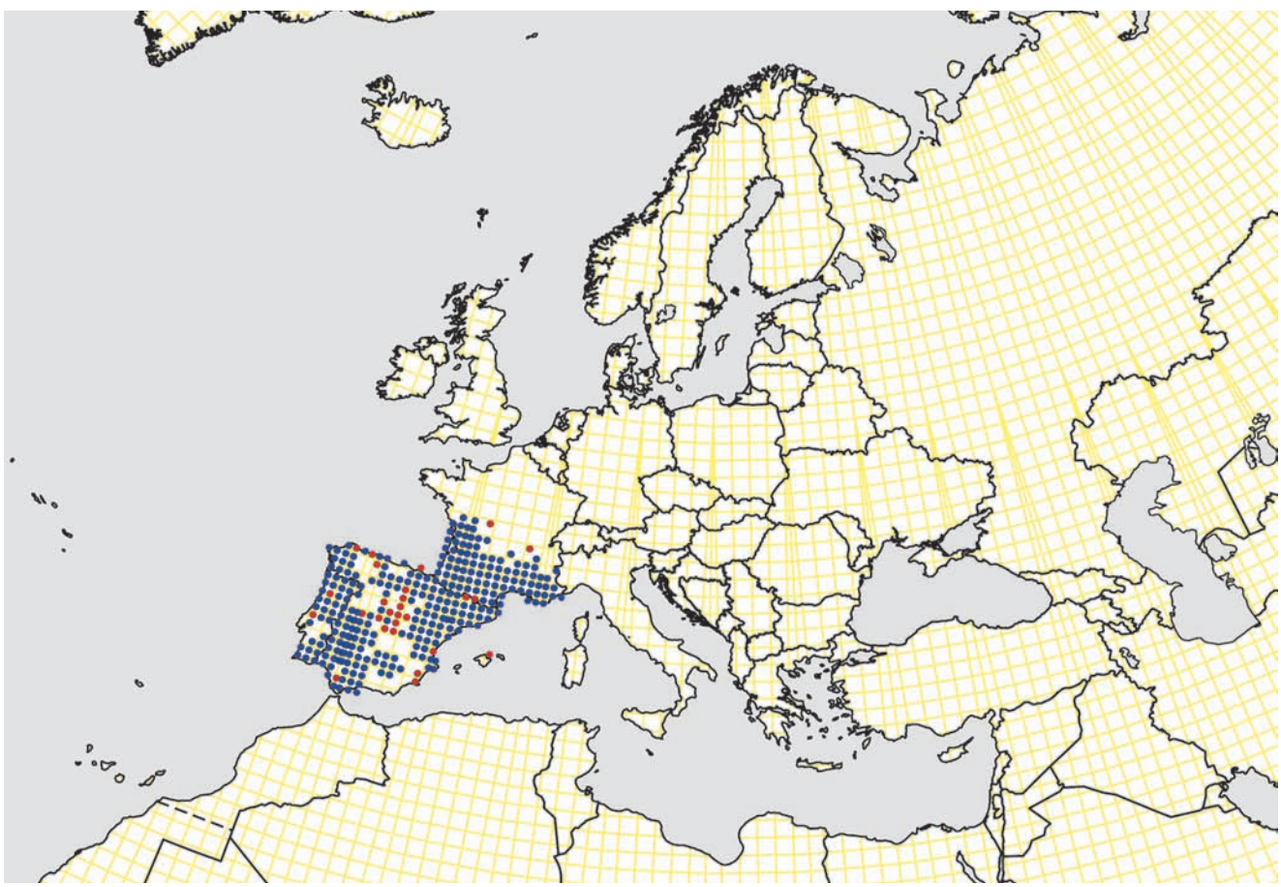
Trend and conservation status

The species is common and stable within most of its range and is not considered threatened.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	Endemic
European endemic	Endemic
Trend Europe	Stable

Flight period





World distribution

Platycnemis pennipes (Pallas, 1771)

J.-P. Boudot, J. Rimšaitė & R. Bernard

Taxonomy

The subspecies *P. p. nitidula* (Brullé, 1832), sometimes regarded a full species, is mainly characterised by its broader tibiae, which recall those of *P. latipes*. This subspecies has a narrow range and is largely restricted to the coastal areas of Montenegro, Albania and Greece. It seems to hybridize with the nominotypical subspecies, giving rise to intermediate populations over a large area in Greece. This makes identification to subspecies level difficult and due to this the range of *P. p. nitidula* is poorly known.

Distribution

World: *Platycnemis pennipes* is largely confined to the Western Palaearctic. In Asia, it reaches the east of Kazakhstan and the upper reach of the Yenisei River in Russia. It has been stated to be common in most of Kazakhstan (Chaplina *et al*. 2007) but very few records have been published and it is unclear if there is a continuous range from northern Kazakhstan to the population north of the border with Kyrgyzstan. A single very isolated record from the Middle Amur has never been confirmed and is considered incorrect (Malikova 1995). The species is replaced by *P. dealbata* in the south of Central Asia and parts of south-west Asia.

Europe: *Platycnemis pennipes* is a widespread and common species occurring throughout most of Europe, lacking, however, in Ireland, the northern half of Great Britain, the western and northern parts of Fennoscandia and northern Russia. In south-west France, the species is sympatric with *P. acutipennis* and *P. latipes*. It is absent from the Iberian Peninsula apart from the extreme north-east of Catalonia near the French border. Moreover it is absent from all the large Mediterranean islands with the exception of Crete, from where an old record (1844) was reported by Selys & Hagen (1850). This record was considered doubtful but the former presence of *P. pennipes* on Crete is now supported by the discovery in the Berlin Museum collection of a male of *P. pennipes nitidula* collected by Eberhard von Oertzen in April-Mai 1887 and labelled 'Griechenland; Kreta' (B. Kunz *in litt*.). The subspecies *P. p. nitidula* is restricted to the Adriatic coast from Montenegro to mainland Greece, the Peloponnese and some Adriatic and Aegean Islands.

Trend and conservation status

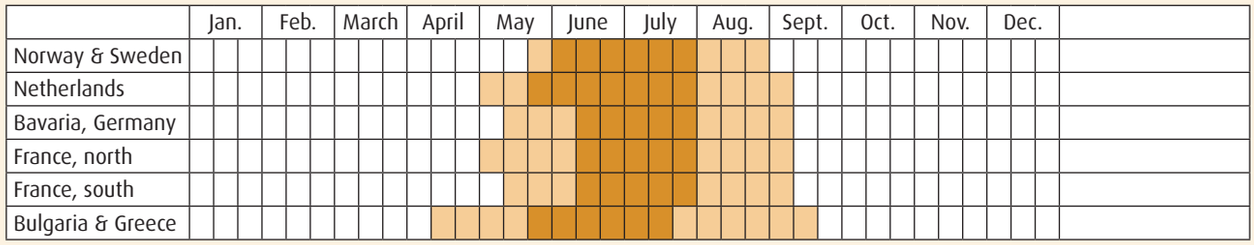
Platycnemis pennipes is one of the most common species within its range and over the last decades no change in its distribution or abundance has been observed. Records suggest that it might have had populations on Crete in the 19th century that have since become extinct.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Stable

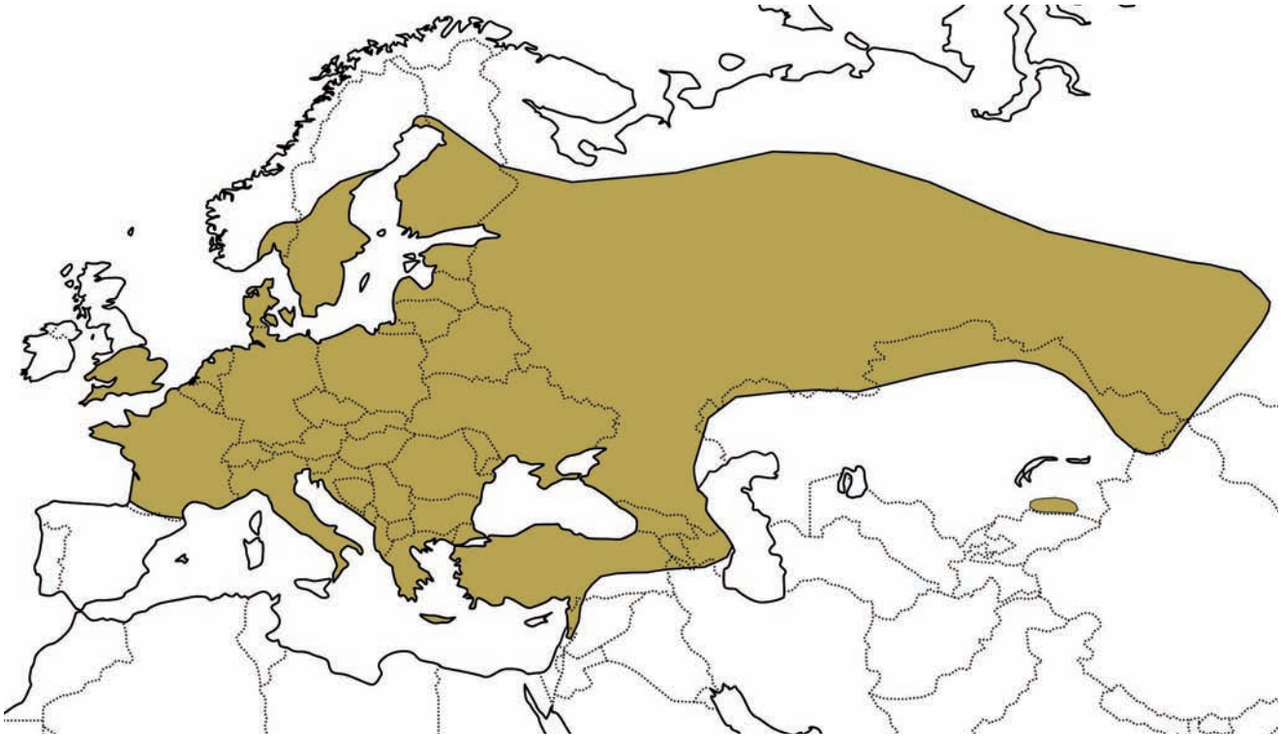
Habitat

In most of its range, *P. pennipes* is common at all kinds of running water habitats, except torrential streams, and at many types of standing water. These range from rivers, streams, oxbow lakes, larger ponds and fishponds to abandoned gravel pits. Standing waters where the species is found are often large and relatively deep so that the wave action mimics conditions found in running water. The presence of an emergent bank side and aquatic vegetation favours the development of large populations. The species is absent from largely

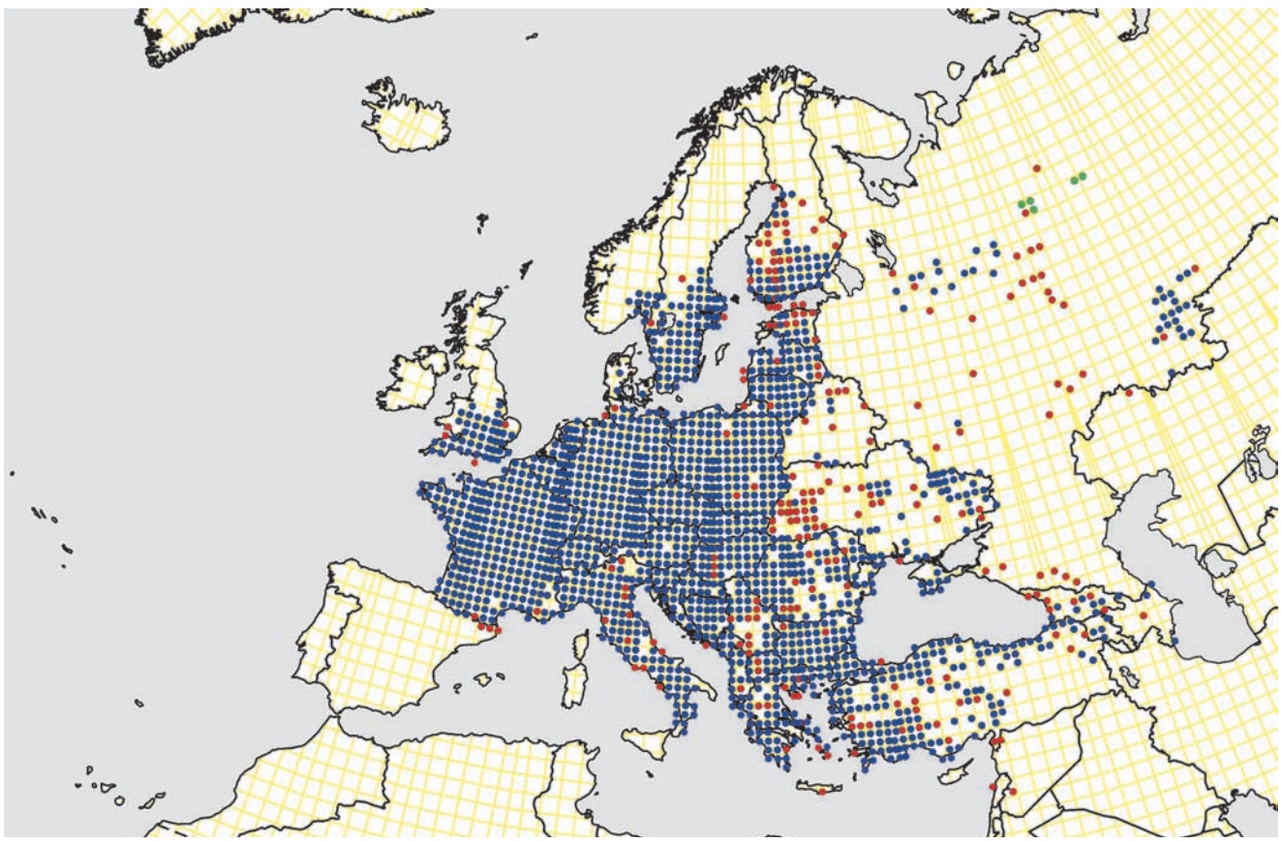
Flight period



shaded waters, temporary waters, acidic waters and heavily polluted rivers and standing water bodies. It has a more restricted habitat choice in the north and is there largely confined to rivers. It is common below 500 m, decreasing at higher altitude and rarely present above 1 000 m.



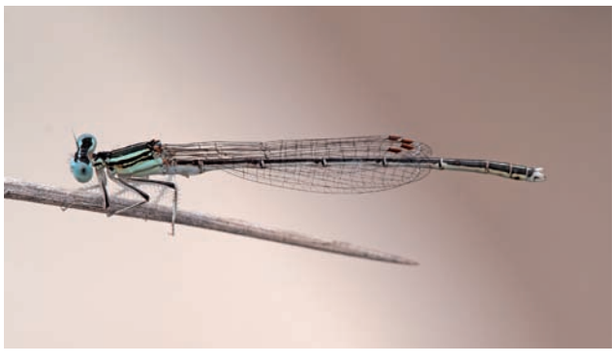
World distribution



European distribution

Platycnemis subdilatata Selys, 1849

J.-P. Boudot



Distribution

World: *Platycnemis subdilatata* is endemic to the Maghreb. One specimen has been collected on the Canary Island of Tenerife.

Europe: The only European record of *P. subdilatata* pertains to a single male specimen labelled as 'Canaries Islands, Tenerife, Puerto de la Cruz, 28 March 1971, J.H. Stocks' (Kalkman & Smit 2002). There is no reason to suggest that the specimen was mislabelled and the latter is therefore presumed to have been a vagrant from Morocco. The species is not expected to reproduce in the Canaries.

Trend and conservation status

The species is very common in the Maghreb, but only a vagrant specimen has been found on the European territory, possibly brought via sand storms. Accordingly, it was classified Not Applicable on the European Red List.

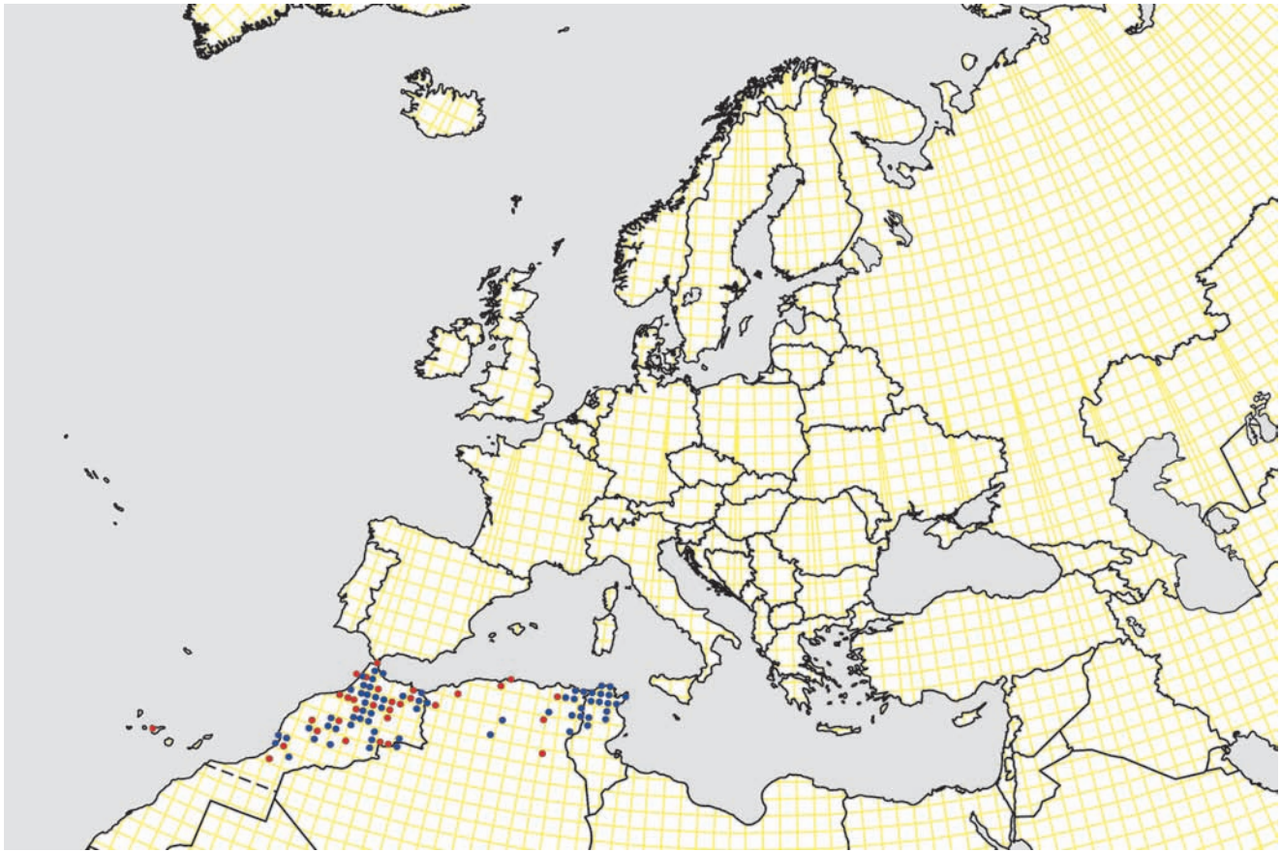
Habitats Directive	No
Red List EU27	Not Applicable
Red List Europe	Not Applicable
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Not Evaluated relevant

Habitat

The species is mainly found in permanent flowing waters in lowlands and valleys and 95 % of the Moroccan localities are either rivers or streams (Jacquemin & Boudot 1999). It reaches 2 000 m in the Atlas range.

Flight period

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Maghreb												



World distribution

1 Ischnura hastata. Habitat of *Ischnura hastata*, Sao Jorge, Azores, Portugal with the mountain of Pico in the background. Other species occurring here include *Anax imperator, Ischnura pumilio* and *Sympetrum fonscolombii*. Photograph Adolfo Cordero.

2 Nehalennia speciosa. Habitat of *Nehalennia speciosa*, Lisią Kepa Sierżno, Poland. Other species occurring here include *Aeshna grandis, A. subarctica, Coenagrion hastulatum, C. puella, Enallagma cyathigerum, Leucorrhinia dubia* and *Sympetrum danae*. Photograph Dawid Tatarkiewicz.

3 Coenagrion glaciale. Habitat of *Coenagrion glaciale*, Maletino, European Russia. Other species occurring here include *Aeshna crenata, A. grandis, A. juncea, Coenagrion johanssoni, Cordulia aenea, Leucorrhinia dubia* and *Libellula quadrimaculata*. Photograph Bogusław Daraż.

Coenagrionidae

4 Ischnura intermedia. Habitat of *Ischnura intermedia*, Diarizos valley, Cyprus. Other species occurring here include *Calopteryx splendens, Epallage fatime, Ischnura elegans, Orthetrum brunneum, O. chrysostigma, Sympecma fusca* and *Trithemis festiva*. Photograph Geert De Knijf.

5 Coenagrion johanssoni. Habitat of *Coenagrion johanssoni*, Margitbrännan, province of Jämtland, Sweden. Other species occurring here include *Aeshna caerulea, A. grandis* and *Coenagrion hastulatum*. Photograph Magnus Billqvist.

6 Pyrrhosoma elisabethae. Habitat of *Pyrrhosoma elisabethae*, river one kilometer south-southeast of Sidari, Corfu, Greece. Other species occurring here include *Brachytron pratense, Calopteryx virgo, Coenagrion puella, C. pulchellum, Ischnura elegans, Libellula fulva* and *Platycnemis pennipes*. Photograph Christophe Brochard.

7 Ischnura senegalensis. Habitat of *Ischnura senegalensis*, El Monte, Tenerife, Spain. Other species occurring here include *Anax imperator, Crocothemis erythraea* and *Sympetrum fonscolombii*. Photograph Valentina Assumma.

8 Coenagrion armatum. Habitat of *Coenagrion armatum*, Hyby, province of Skåne, Sweden. Other species occurring here include *Aeshna isoceles, Leucorrhinia rubicunda* and *L. pectoralis*. Photograph Magnus Billqvist.

Ceriagrion georgifreyi Schmidt, 1953

V.J. Kalkman

Taxonomy

Ceriagrion georgifreyi has variously been considered a subspecies of *C. tenellum* or as a distinct species. As both male and female show distinct structural characters, it is now recognised as a full species (Schneider 1986, Kalkman 2005).

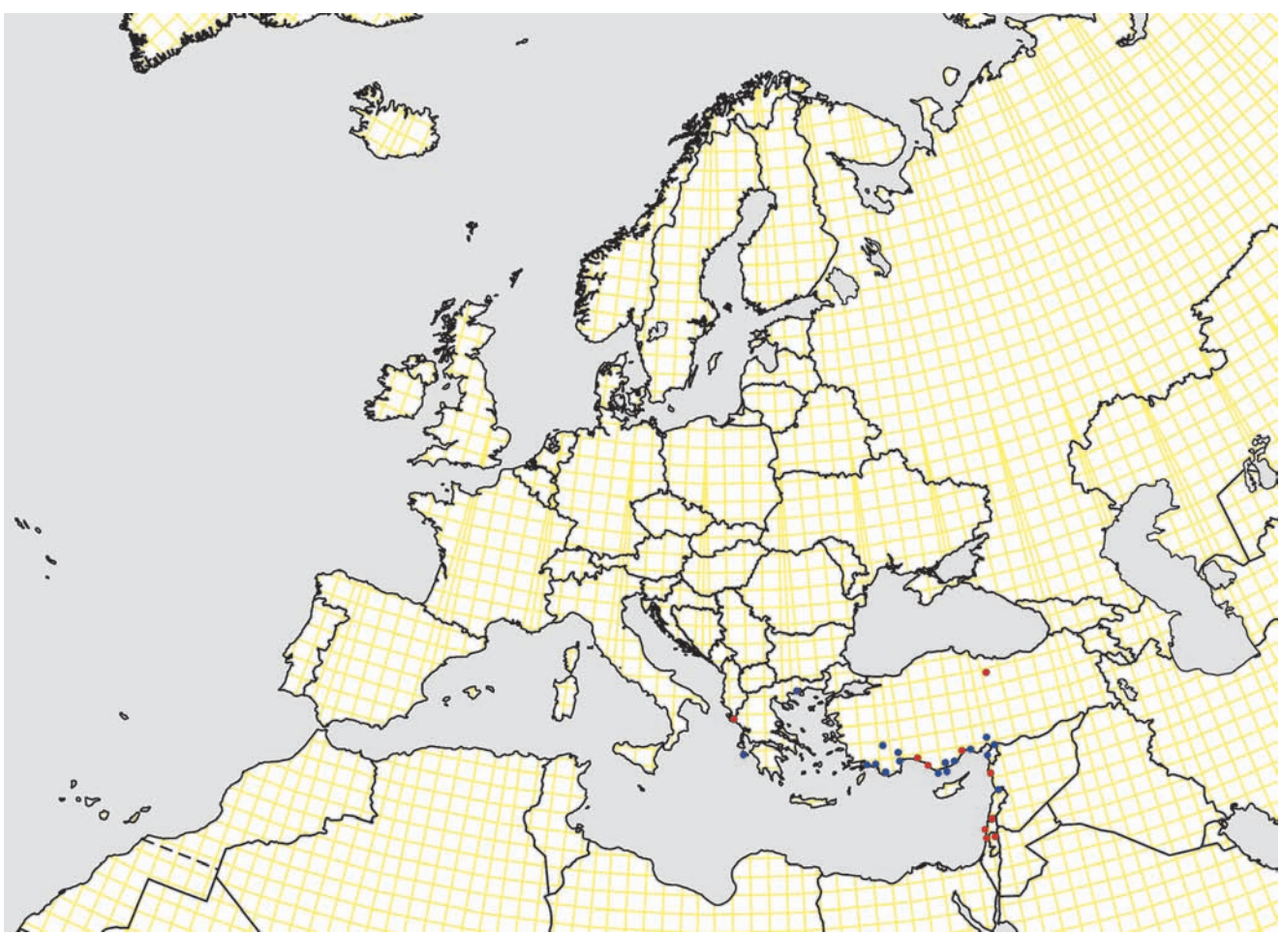
Distribution

World: *Ceriagrion georgifreyi* has a relatively small range and occurs along a narrow coastal strip in the northern half of Israel, western Syria, southern Turkey and three Greek islands. A record of *C. georgifreyi* from Niksar in north Turkey was reported by Schneider (1986) based on a series from the Royal Scottish Museum, Edinburgh. This population is the northernmost known to date, although a labelling error or a confusion of localities bearing the same name cannot be ruled out.

Europe: In Europe the species is only known from three Greek islands. From each, only a single record is available: Kerkyra (1971), Thasos (1997) and Zakynthos (1998) (Kalkman 2005). Records of *Ceriagrion* from Lesbos and from continental Greece published as *C. tenellum* may refer to *C. georgifreyi*. No voucher specimens are available for these records and fieldwork needs to be undertaken to establish the true identity of these populations.

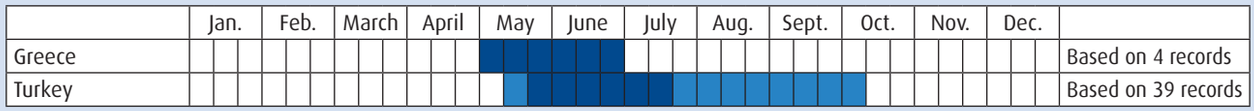
Trend and conservation status

The reproduction sites occupied by *C. georgifreyi* are generally small and easily destroyed by agriculture and building activity. Climate change resulting in the desiccation of habitats is the main present and future threat and will affect the species over its whole range. Presently, only three European localities are known for this



World distribution

Flight period



taxon. For none of them is information on population size, size of the habitat and conservation status available. It seems likely, however, that all European populations are small and can probably be destroyed by a single minor event such as the construction of a house, increased extraction of water or a very dry year. In order to prevent this species from becoming extinct in Europe, immediate actions are needed.

Habitats Directive	No
Red List EU27	Critically Endangered
Red List Europe	Critically Endangered
Red List Mediterranean	Vulnerable
EU27 endemic	No
European endemic	No
Trend Europe	Decreasing

Habitat

Ceriagrion georgifreyi is poorly known and there are no detailed accounts of the habitats occupied in Europe. On the Turkish south coast, the species is found at slowly flowing, muddy streams and at the grassy and marshy margins of mostly small standing waters (Dumont 1977a, Hope 2007, Kalkman *et al.* 2004). Localities where Hope (2007) assumed breeding were heavily vegetated with spikerushes (*Eleocharis*) and Water parsnip (*Berula erecta*). Based on the above and unpublished records, the habitat can best be described as streams, runnels, seepages and ponds with rich aquatic vegetation. The species only occurs at low altitudes.

Ceriagrion tenellum (Villers, 1789)

V.J. Kalkman & A. Šalamun

Distribution

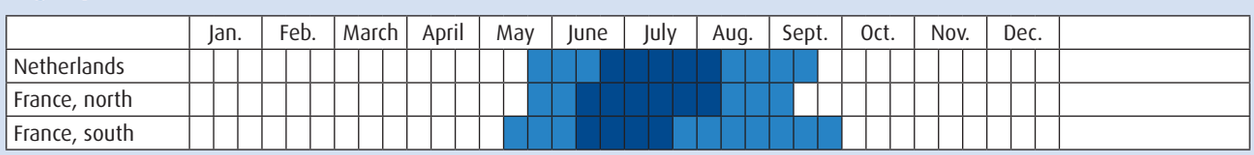
World: Outside Europe, the species is found only in north-west Africa. Over 98 % of known localities occur within Europe.

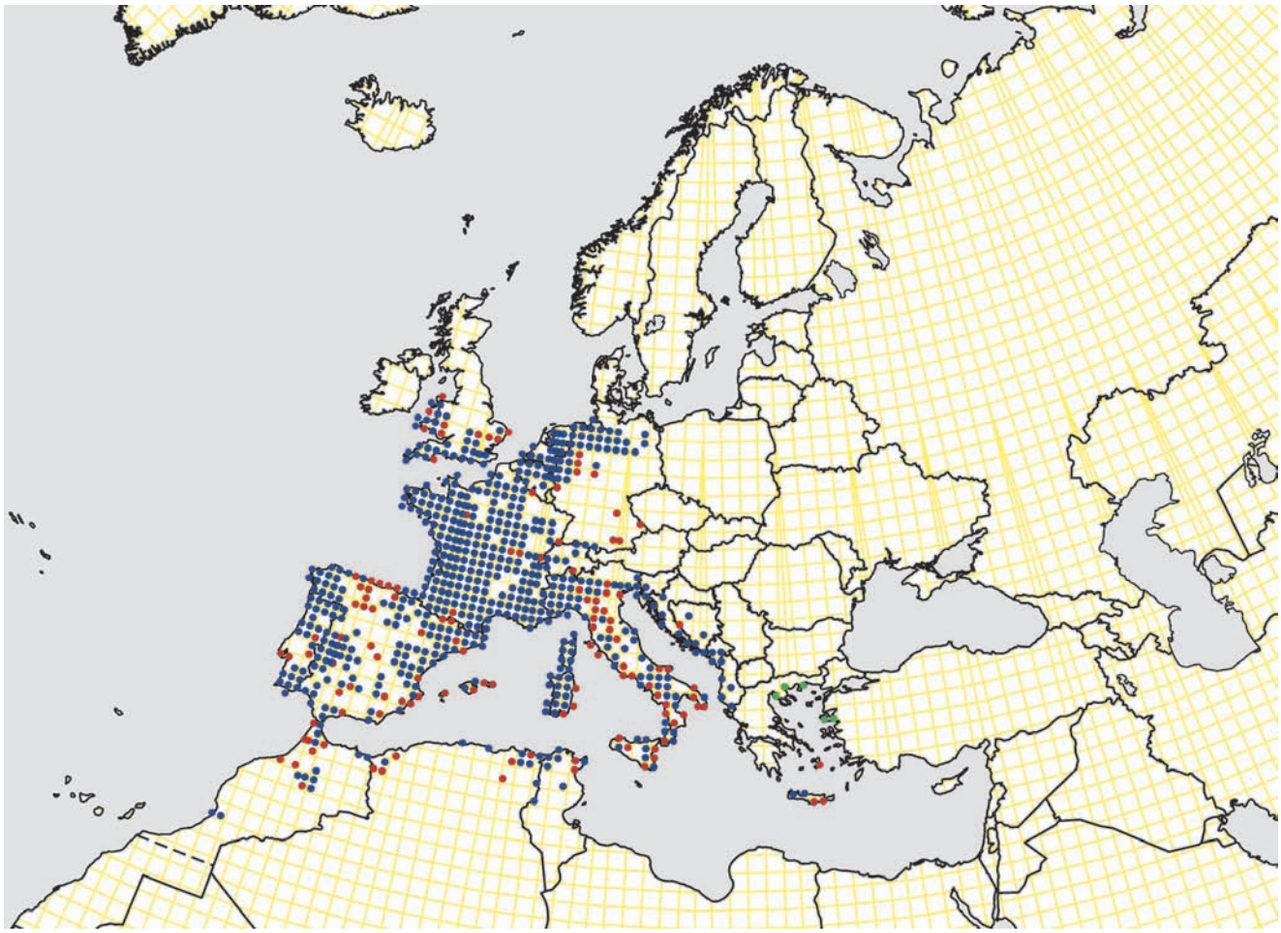
Europe: This Atlanto-Mediterranean species is widespread in the western Mediterranean basin, from where its range extends widely into north-west Europe. To the north it reaches the south of Great Britain, the Netherlands and northern Germany. It has recently expanded its range eastwards to Brandenbug, with the first record made in 2008 (Brauner 2009). It is widespread in Italy but becomes rare and patchily distributed east of the Adriatic Sea in Slovenia, Croatia, Bosnia and Herzegovina, Montenegro and Albania. Its occurrence in mainland Greece and Lesbos is uncertain, as published records may result from confusion with *C. georgifreyi*. It is found with certainty on Crete and the nearby island of Ios

Trend and conservation status

Ceriagrion tenellum is in most of its range not threatened and has not shown a decline over larger areas. It seems stable in the Iberian Peninsula and France, and has increased recently in Belgium, the Netherlands and northern Germany, possibly due to the increased summer temperatures. It declined significantly during the second part of the 20th century in some areas of Germa-

Flight period





World distribution

ny such as Bavaria (now extinct) and Baden-Württemberg (Kuhn & Burbach 1998, Sternberg & Buchwald 1999). In Switzerland, two-thirds of the populations known before 1987 are now lost (Wildermuth *et al.* 2005). Many of the remaining populations in these regions are small and isolated. However, most of them lie in nature reserves and there was no indication of a decline during the last decade (Hunger *et al.* 2006). It is inferred that the species has declined in parts of Italy and the northern Balkans. Here it is limited to mostly small and isolated populations and it is likely that many of them will have been destroyed by agricultural practices and building activities.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

In the south of its range, *C. tenellum* is mainly found at seepages, streams, small rivers and standing waters with a rich aquatic vegetation. Further north, in the west and east of France (Brittany, Haute-Saône), northern Belgium, the Netherlands, Germany and Great Britain, the species is mainly found in acidic *Sphagnum* peat bogs and heaths. In this area, it has proliferated since 2000 and is now increasingly found in other types of habitats such as small streams. Many of the microhabitats where the larvae are found have the following factors in common: the water temperature can rise quickly in summer and the dense vegetation, the acidity and/or a low water table limit predation by other dragonflies or fish. The species mainly occurs at lower altitudes and is not found above 1 000 m.

Coenagrion armatum (Charpentier, 1840)

J.-P. Boudot & G. Sahlén

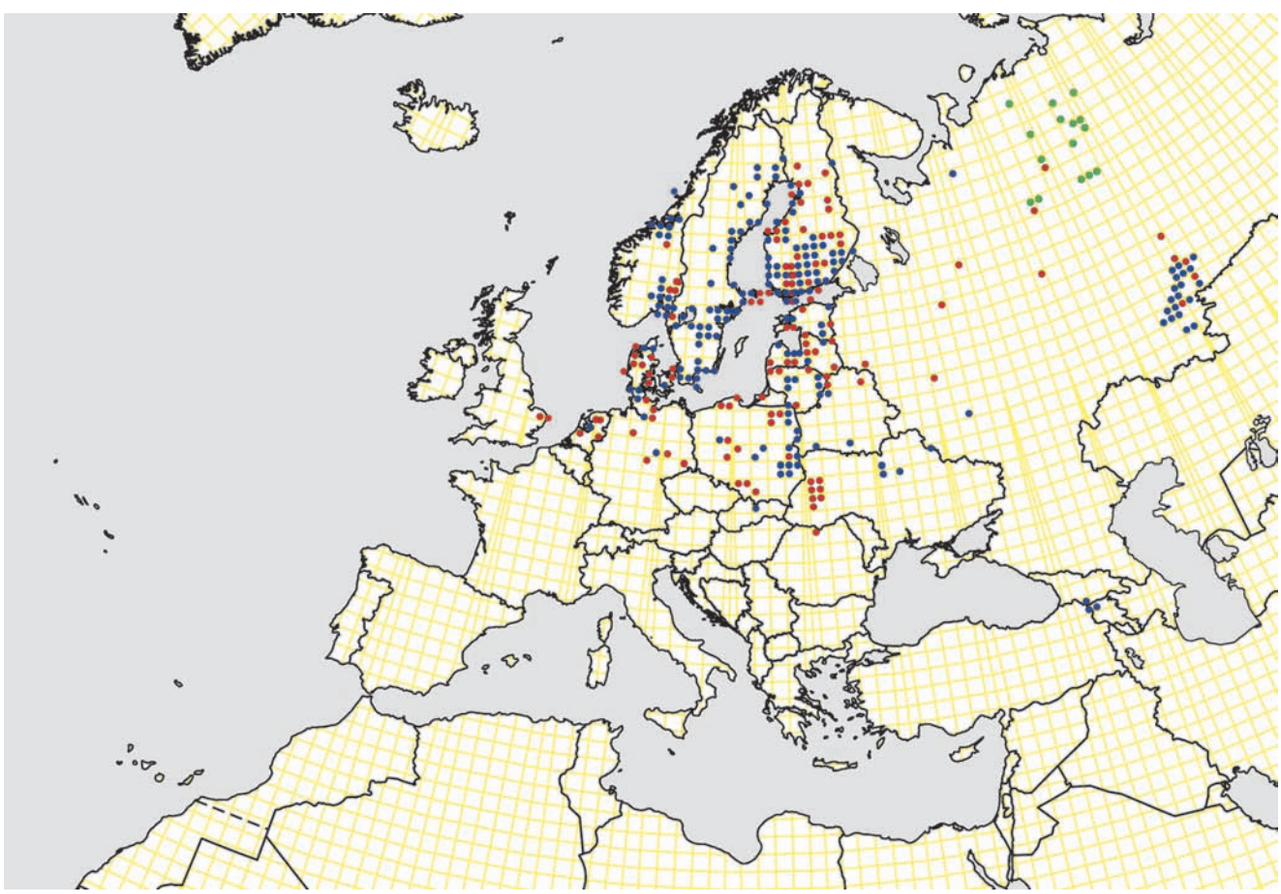
Distribution

World: *Coenagrion armatum* occurs in temperate lowlands from north-western Europe to eastern Russia and the Kamchatka Peninsula. The species is scarce throughout most of its range. Further south, it is known from two small disjunct areas at high elevation, one in Central Asia in Kyrgyzstan (Schröter 2010b), and the other in the south Caucasus in Georgia (Shengelia 1975, Schröter *et al.* 2015) and Armenia (Tailly 2006, Durand & Rigaux 2015). It possibly occurs in the adjacent part of Turkey as similar habitats are present.

Europe: *Coenagrion armatum* is found throughout northern Europe but is at present rare to very rare in large areas. The species has probably always been scarce in Great Britain, the Netherlands and Germany. It is currently extinct in Great Britain and only known from a small number of relict populations in the Netherlands, Germany and Denmark. It has a more continuous range in north-eastern Europe, including Fennoscandia, the Baltic States, eastern Poland and northern Ukraine. In Slovakia it is only known from two records (1913, 1999). It is likely to be reasonably common in Belarus and the European parts of Russia but data for these regions are scarce. The populations found in Georgia and Armenia are isolated from the main known range of the species as there are no records from southern Ukraine or southern Russia.

Trend and conservation status

During the last century, *C. armatum* suffered a dramatic reduction in the number of its populations in the southern part of its European range, with the species becoming extinct in Great Britain (last record 1957) and large parts of the Netherlands, Germany and western Poland. The species has also declined in the core of its European range, with many sites lost in Denmark,



European distribution

World distribution

Flight period

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Norway & Sweden													
Netherlands													

Finland and the Baltic States prior to 1990. In Poland it disappeared from over half of the known localities and is presently largely restricted to the east of the country (Bernard 2009). Field searches at all former sites of *C. armatum* in the Ukraine failed to relocate the species, indicating a strong decline also in that part of its range (Khrokalo & Krylovskaya 2008). The only country where the species seems to be as common now as prior to 1990 is Sweden. In 2008, flourishing populations were discovered in Schleswig-Holstein in northern Germany, at sites where the species supposedly was absent in the previous decades (Bouwman & Ketelaar 2008), suggesting a local recovery. No proper overview of the causes of decline is available but is seems likely that a combination of habitat destruction and eutrophication caused a reduction in natural habitats. Besides, it seems that the species remains safest mostly in landscapes and habitats with low agricultural activity and that populations disappear when the intensity of agriculture either increases or decreases.

The species is in many places confined to small habitat pockets. Key threats are water pollution, unmanaged natural succession of the vegetation and, locally, fish farming. *Coenagrion armatum* is ranked as Least Concern on the European Red List as it is still widespread in Fennoscandia and probably common in the northern part of European Russia. It is however much more rare in the EU27 and listed there as Near Threatened.

Habitats Directive	No
Red List EU27	Near Threatened
Red List Europe	Least Concern
Red List Mediterranean	Not present
EU27 endemic	No
European endemic	No
Trend Europe	Decreasing

Habitat

Coenagrion armatum is found at shallow unshaded parts of mesotrophic to weakly eutrophic pools, ponds and lakes. In Fennoscandia it is occasionally found in slow-flowing river sections. Here it occurs among large swathes of sedges, Water horsetail (*Equisetum fluviatile)* and low reed. The key factor determining habitat suitability is the vegetation which needs to be a rather dense growth of helophytes in shallow water of generally up to half a meter deep (Bouwman & Ketelaar 2008). In order to provide both shelter and space to move, the vegetation should be neither too low nor too high during the flight period. Suitable conditions can be found in natural and semi-natural habitats and in low intensity agricultural habitats such as reed beds and peat excavations in fens and wet meadows. In the latter type of habitats, the species is dependent on mowing and the cyclical creation of new peat excavations, as otherwise its preferred habitats disappear due to the natural regrowth of vegetation.

Coenagrion caerulescens (Fonscolombe, 1838)

J.-P. Boudot & S. Ferreira

Taxonomy

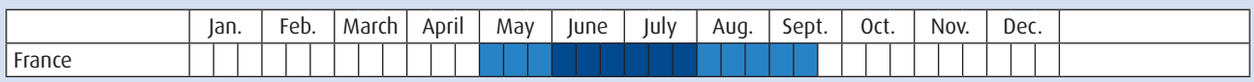
The extent of the dark markings varies strongly between and within populations and has led to the description of various subspecies (Schmidt 1959, Conesa Garcia 1995); none is presently regarded as valid (Lieftinck 1966, Dumont 1972, Jacquemin & Boudot 1999).

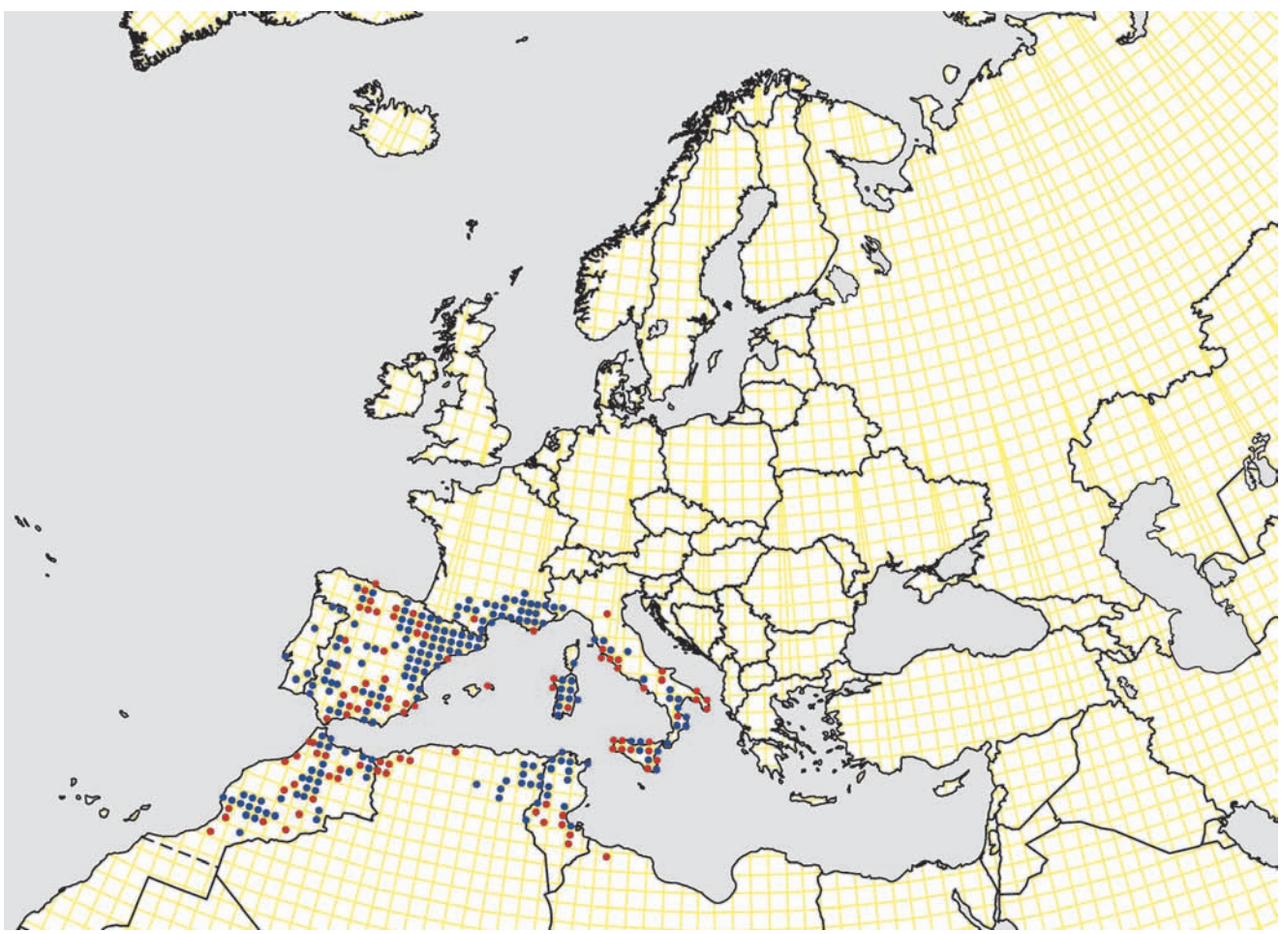
Distribution

World: *Coenagrion caerulescens* is endemic to the western Mediterranean. Outside Europe it only occurs in Africa, where it is widespread and not uncommon in the north of Morocco, Algeria and Tunisia. It is known from a single old record from north-west Libya.

Europe: The species is widespread and reasonably common in large parts of Spain, Sardinia, Sicily and the southern tip of Italy. It has a scattered distribution, generally being very rare, in Portugal, Corsica, southern France and the northern half of Italy. A single population is known from Menorca in the Balearic Islands. An old lacustrine record from south-west France by Selys (1858) is considered erroneous and is here omitted.

Flight period





World distribution

Trend and conservation status

The relatively high proportion of areas where the species is known only from prior to 1990 suggests that it has declined throughout its range. It is however still reasonably common in large parts of the western Mediterranean and is currently considered Near Threatened on the European Red List. Habitats of *C. caerulescens* suffer from degradation due to pollution, water extraction and desiccation due to increased frequency of droughts.

Habitats Directive	No
Red List EU27	Near Threatened
Red List Europe	Near Threatened
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Decreasing

Habitat

Coenagrion caerulescens is found at sunlit running waters with hydrophytes and/or bordered by herbaceous plants. These habitats vary from small streams and seepages to medium-sized rivers. The aquatic vegetation often consists of submerged watermilfoil (*Myriophyllum*). In Europe, it is restricted to the warmer regions and generally found below 600 m, although it may locally reach 1 100 m. In the Maghreb, the species is found up to 2 300 m. It is replaced by its close relative, *C. scitulum*, in standing and slow-flowing waters.

Coenagrion ecornutum (Selys, 1872)

J.-P. Boudot & R. Bernard

Distribution

World: *Coenagrion ecornutum* is an East Palaearctic, Far Eastern and south Siberian species, which has two additional and apparently disjunct areas of occurrence to the north and the west. Its range extends from northern Japan (Hokkaido), Sakhalin and Korea westwards to the steppes north-west of the Altai in south-western Siberia, parts of Mongolia, Inner Mongolia and north-eastern China (Belyshev 1968, 1973, Kosterin 1999, 2004, Dumont 2003). In eastern Siberia, a seemingly isolated aggregation of populations is found near Yakutsk (Kosterin & Sivtseva 2009). In the west, a second apparently disjunct group of populations was discovered in 1996 in the southern Urals and adjacent easternmost areas of the West Siberian Plain. The species seems to have expanded in the latter area to be now fairly common (Yanybaeva 1999b, Yanybaeva *et al.* 2006, Popova & Haritonov 2008, Haritonov & Eremina 2010). It has been suggested that erroneous records of *C. mercuriale* from the Caucasus region (Akramowsky 1948, Spuris 1988) might pertain to *C. ecornutum* (see Kosterin 2005) but evidence for this is lacking.

Europe: The first European record of *C. ecornutum* was in 1996 in the Bashkortostan Republic, on the western side of the south Urals. Further fieldwork in the southern Urals resulted in the discovery of a second site in 1998 and two more in 2004 (Yanybaeva *et al.* 2006). During fieldwork in 2005 and 2006 a total of 30 localities were found in this area (Popova & Haritonov 2008). Half of these localities fall within the European part of the Urals (Bashkortostan), the other half are in the Chelyabinsk province on the Asian side. Based on this, Popova & Haritonov (2008) concluded that *C. ecornutum* has expanded strongly since 2000. It is not clear, however, if the species has been present in this region in low numbers for a long time and was simply overlooked, or if it has established itself since the 1990s as immigrant from its main range, 990-1170 km to the east. The recent discovery of a single male of this species in Chany Lake in the eastern part of the West Siberian Plain (Haritonov & Eremina 2010) and localities in the Chelyabinsk province in the extreme west of the plain suggests a more continuous (possibly patchy) occurrence between the species' core range and the southern Urals. The dragonfly fauna in the southern Urals has undergone a considerable change in the last century, with most of this attributed to the creation of new artificial habitats rather than to climate change (Popova & Haritonov 2008, Haritonov & Eremina 2010). However *C. ecornutum* is mainly found in natural habitats and is therefore not a likely candidate to have profited from human activity.

Trend and conservation status

It is not clear if *C. ecornutum* has been present for a long period in the southern parts of the Urals or represents a relatively recent arrival from the east. According to Popova & Haritonov (2008), it has, since its discovery in 1996, shown a clear expansion along the eastern border of Europe. It is listed as Data Deficient on the European Red

Flight period

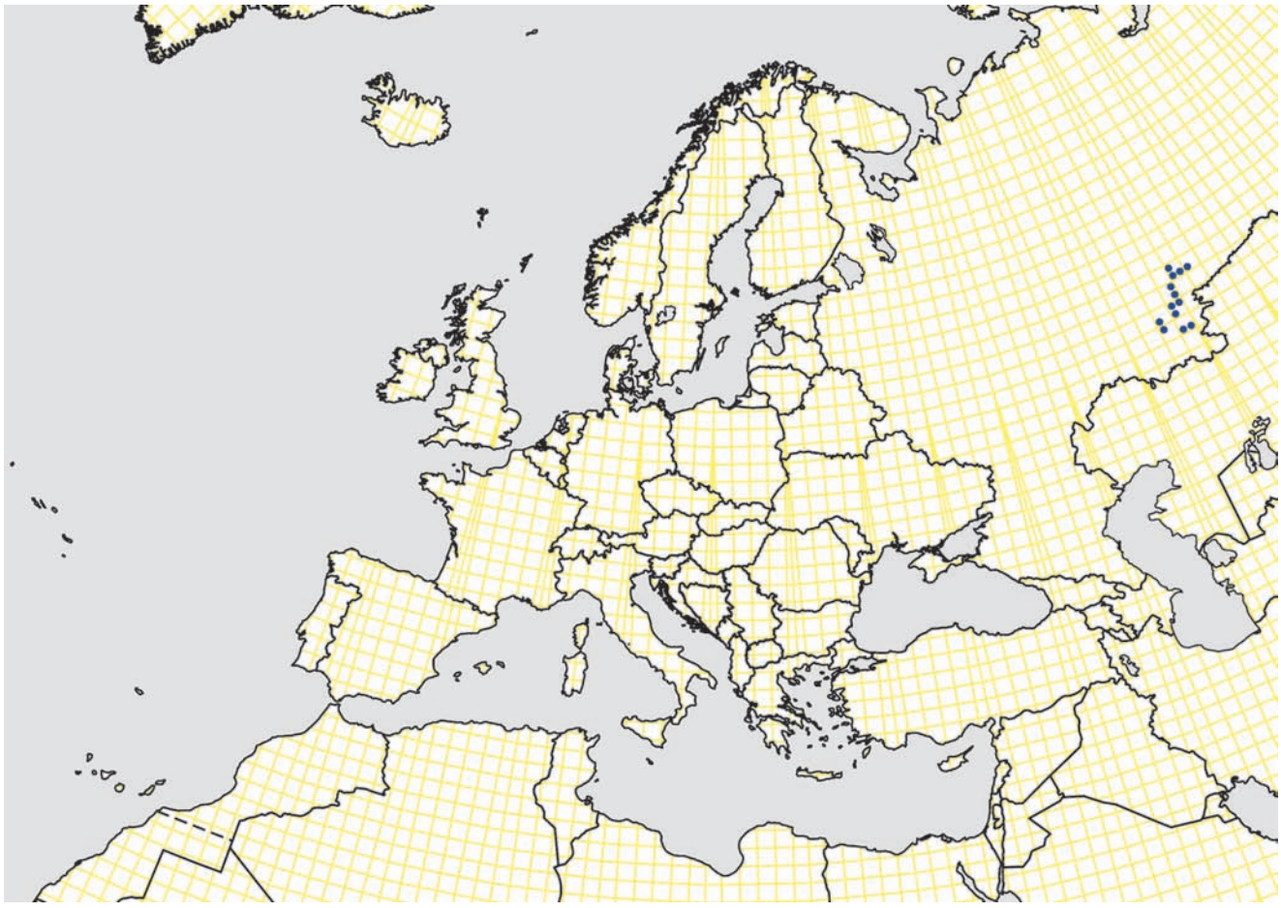
The European flight period of this south Siberian species extends from June to July.

List but a new assessment using the new data would probably lead to the species being classified as Least Concern.

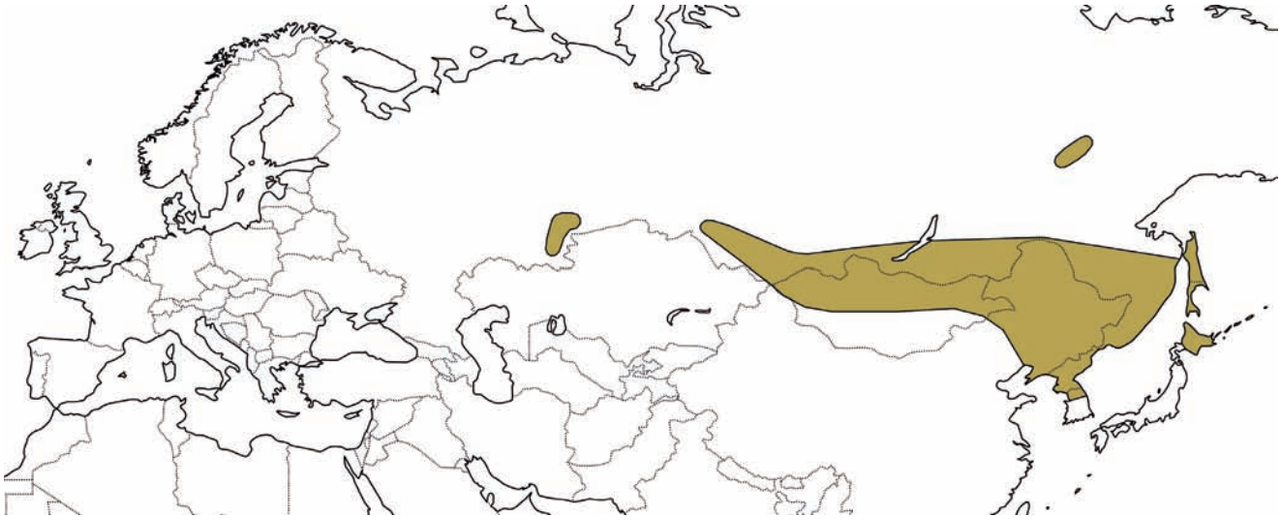
Habitats Directive	No
Red List EU27	Not present
Red List Europe	Data Deficient
Red List Mediterranean	Not present
EU27 endemic	No
European endemic	No
Trend Europe	Increasing

Habitat

In the Urals, *C. ecornutum* is mainly found at standing waters but it also occurs at flowing waters and their stagnant backwaters (oxbow ponds and lakes). In its main range in eastern Russia, it is found at small bodies of standing water in river floodplains, small bogs and lakes (Kosterin 2010).



European distribution



World distribution

Coenagrion glaciale (Selys, 1872)

J.-P. Boudot & R. Bernard

Distribution

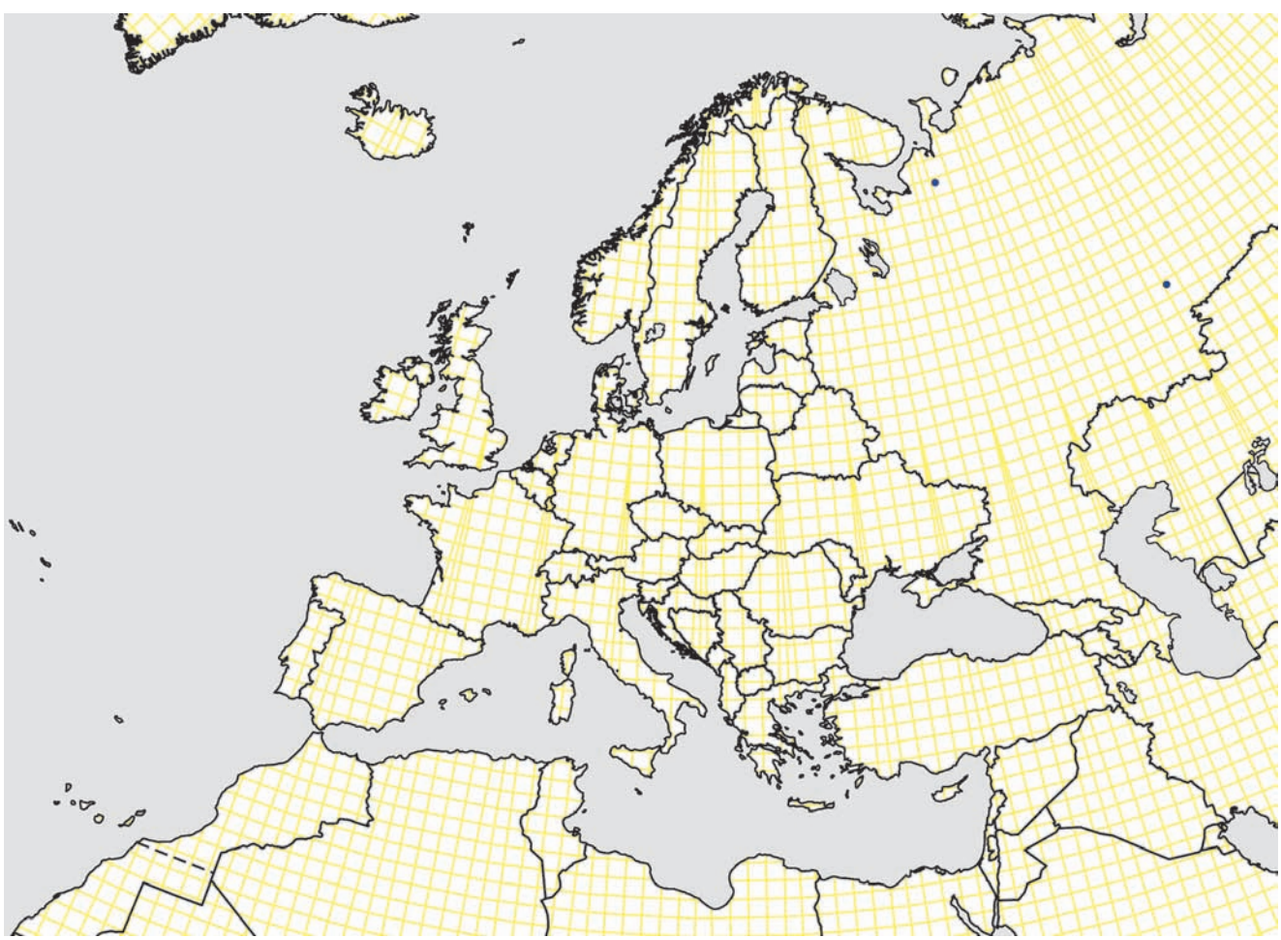
World: The main area of distribution of *Coenagrion glaciale* is in the Eastern Palaearctic. The species is largely confined to eastern Siberia, the Russian Far East and the north-east of China (Bernard & Daraż 2010). It very likely occurs in North Korea as it has been found not far from the border. The western border of the main range of the species seems to reach the north-eastern-most foothills of the Kuznetsk Alatau mountain range, north of the Altai (Kosterin *et al*. 2011). Two isolated occurrences have been found considerably further west, one in the Asian part of the southern Urals in Chelyabinsk province (Eremina 2010), the other in the north of European Russia (Bernard & Daraż 2010).

Europe: The first European record of this species was made in 2009 in Arkhangelsk province, in the boreal part of northern Russia. Here, the species was found at three localities in two areas in the Pinega karst region (Bernard & Daraż 2010). Two records from the Asian part of the southern Urals suggest that this species might also occur in the European part of the Urals. The European population is situated ca 2 600 km north-west of the main range of the species and ca. 1 350 km from the population in the Urals. The northern part of both Siberia and the European Russia is very poorly explored for Odonata and *C. glaciale* could well be more widespread than is currently realised.

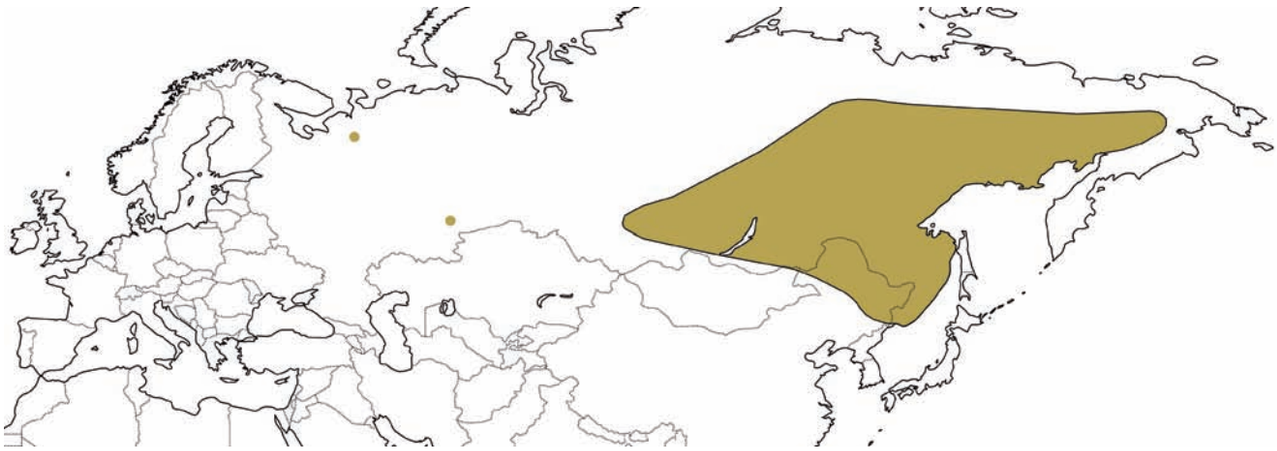
Trend and conservation status

Coenagrion glaciale was not assessed in the European Red List as it was not known to occur in Europe at the time. Given the small number of records, the species would probably be assessed as Data Deficient. It is not clear if it is genuinely rare or largely overlooked due to the scarcity of fieldwork in this area. The populations in northern Russia occur in sparsely inhabited areas and there is no reason to assume that the species is threatened there. However, climate change may have a negative impact on populations of this cold-adapted stenothermal species.

Habitats Directive	No
Red List EU27	Not present
Red List Europe	Not Evaluated
Red List Mediterranean	Not present
EU27 endemic	No
European endemic	No
Trend Europe	Not Evaluated



European distribution



World distribution

Habitat

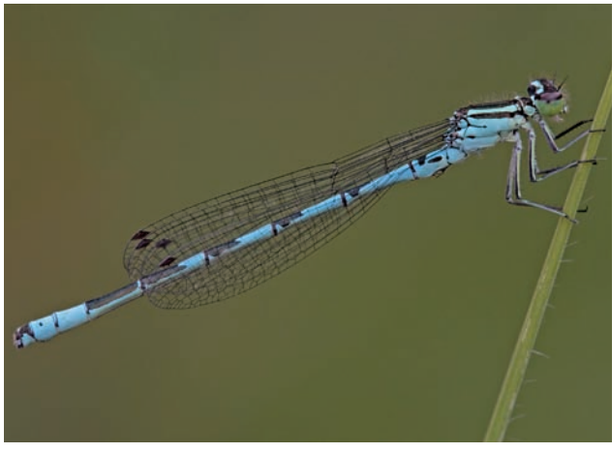
The species favours small meso- and oligotrophic, cold-water bodies, especially small lakes girdled with sedges, *Sphagnum* and other mosses and situated in forest landscapes. In Europe, it has been found in the Taiga zone at three small lakes surrounded by spruce and pine forests. The area where the species has been found is karstic, of high habitat diversity, with a greater frequency of non-acidic, mineral-rich wetlands than in most other parts of the Taiga zone. These characteristics, together with the severe local climatic conditions might have contributed to its presence in this area. Based on information in Belyshev (1973) and their own observation on the European populations, Bernard & Daraż (2010) described three key factors for the habitat: (1) surrounding forest providing shelter from the wind, (2) low water temperature, deeply frozen for a long period in the year and/or fed by a cold inflow, and (3) diversified vegetation, especially sedges and other low-growing species.

Flight period

Bernard & Daraż (2010) recorded *Coenagrion glaciale* at its European locations between 3 and 7 July and noted that it was probably at the end of its flight season. The records from southern Urals are from 9 June 2009 and 26 May 2010. Kosterin (2004) mentioned records from late June and early July but stated that the species has an early flight period in the Trans-Baikal region of Russia. In his synthesis of the dragonflies of Siberia, Belyshev (1973) described *C. glaciale* as one of the first species to emerge in spring but as being on the wing locally up to 24 July.

Coenagrion hastulatum (Charpentier, 1825)

J.-P. Boudot, M. Martin & R. Bernard



Distribution

World: *Coenagrion hastulatum* is widespread and common in the temperate and boreal parts of Eurasia.

Europe: *Coenagrion hastulatum* is widespread in northern and central Europe. In the south of its range it becomes restricted to higher elevations. The species is rare in the lowlands of south Germany but is reasonably widespread in the Alps and other mountains of central Europe. To the southwest, disjunct occurrences are found in the Massif Central and the Pyrenees. In the latter, less than fifteen localities are known. The species is very rare in the Balkan Peninsula with about a dozen localities known in total from Bosnia and Herzegovina, Serbia, Montenegro and Bulgaria (Bedjanič & Weldt 2000, Bedjanič 2011). The westernmost populations of its main range are found in the eastern and southern parts of the Netherlands and in Belgium. In the British Isles, the species is confined to north-eastern Scotland where it is regionally widespread (Cham *et al*. 2014).

Trend and conservation status

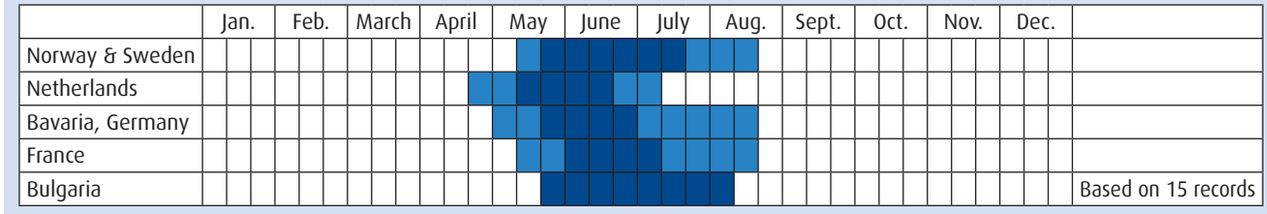
Coenagrion hastulatum is one of the most common and widespread damselflies in northern and north-eastern Europe and the species is not threatened on a European level. The situation in western Europe varies according to the elevation, with the species being stable in the mountains of France and Scotland while a sharp decline has occurred in the Netherlands, Belgium and parts of Germany. In these areas, it is one of the few species showing a continuing decline, with a decrease in numbers of over 70 % in the Netherlands in the period 2001-2010. The species is largely confined to mesotrophic and oligotrophic bogs and acidic ponds and lakes bordered with narrow-leaved sedges, and in the lowlands of western Europe many of these habitats have disappeared or became unsuitable due to eutrophication and changes in water management. In some lowland localities, the species has been affected by desiccation due to climate change and the same might occur in the mountains of southern Europe, particularly in the Balkan Peninsula.

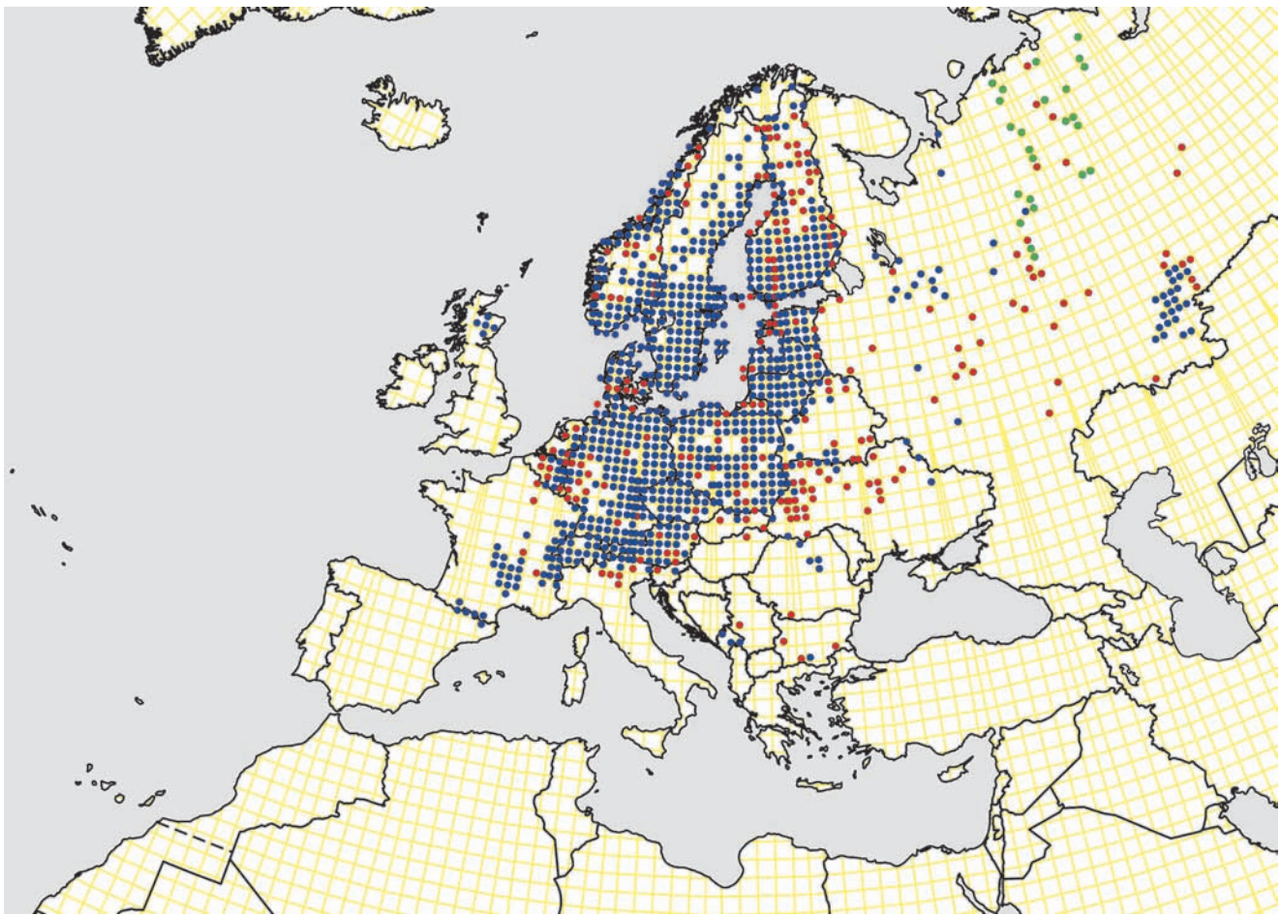
Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Unknown

Habitat

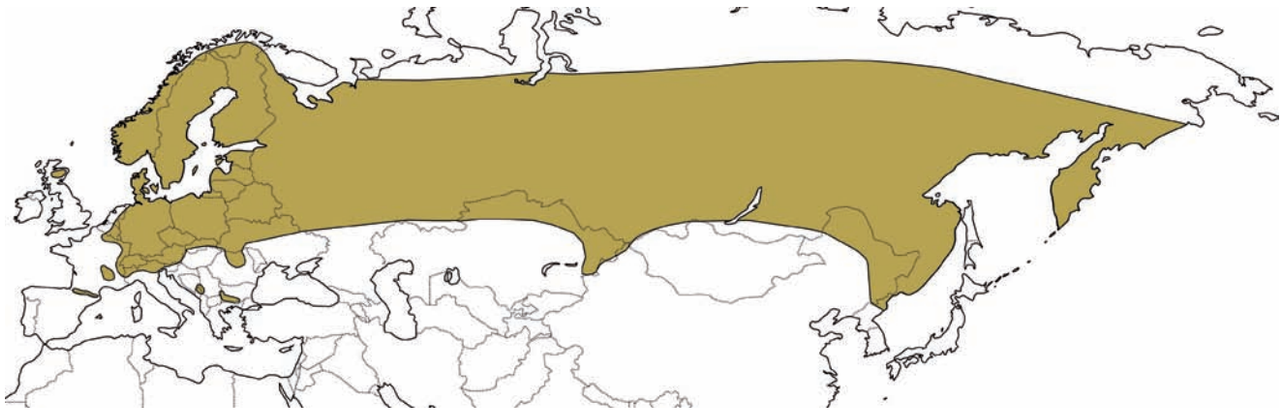
Coenagrion hastulatum is, at the core of its European range, found in a wide range of habitats including largely unshaded ponds, lakes and bogs. The species favours slightly acidic water bodies with narrow-leaved

Flight period





European distribution



World distribution

sedges (e.g. *Carex rostrata*) and peat mosses on peat, sandy, sandstone or granite substrates. In many cases breeding habitats are formed by pooled rainwater. In the west of its range and in the mountains of south and south-east Europe, the species is largely limited to peat bogs and oligotrophic to mesotrophic lakes and ponds often in or near forests and nearly always with a well-developed belt of sedges. In the north of the species range it is found mostly in lowlands but, in the south, populations are confined to higher elevations up to 2 500 m. For example 80 % of the localities in Switzerland are situated between 900 and 1 900 m.

Coenagrion hylas (Trybom, 1889)

J.-P. Boudot, R. Raab & R. Bernard

Taxonomy

The central European populations of *C. hylas* were, after their initial discovery, thought to represent a new species and were described as *C. freyi* Bilek, 1954. Schmidt (1956) and Lieftinck (1964) synonymised this species with the East Palaearctic *C. hylas* after which the name *freyi* was applied to the European populations to indicate subspecific status. Lohmann (1992a) showed that there are no good characters to separate the European and the Asian populations and no subspecies of *C. hylas* are currently recognised.

Distribution

World: The main area of distribution of *C. hylas* is found in the Eastern Palaearctic, where it is widespread in central and eastern Siberia and in the Russian Far East. The species reaches the Kamchatka Peninsula, Sakhalin Island and the northern Japanese island of Hokkaido. From Siberia westwards, the species extends up to the Altai and the eastern tip of Kazakhstan, and its southern limit reaches northern Mongolia, Heilongjiang and Jilin provinces in north-eastern China, North Korea and a single locality in South Korea (Schmidt 1956, Yu & Bu 2011). To the west of this core area, the species is known, from three records in north-west Russia and from a small number of localities in central Europe. It is unclear if the populations in north-west Russia are isolated from the main area of distribution or if it ranges continuously from eastern Siberia to the Urals and further west along the north of the continent. The populations in central Europe are assuredly isolated from the main area.

Europe: *Coenagrion hylas* is very local in Austria (valley of the Lech River) and Bavaria, Germany, where the single known population is now extinct (Zwingsee near Inzell) (Müller 2000, Landmann *et al.* 2005, Raab *et al.* 2006). In Austria the species is currently known from 14 localities, some of which are small while others yield between 800 and 5 000 exuviae every year. Further isolated pockets are found in the north of European Russia, namely in Arkhangelsk province about 2 700 km north-east of the Austrian localities (Bernard & Daraż 2010) and on both the European and Asian sides of the boreal part of the Urals (Lohmann 1992a, Tatarinov & Kulakova 2009) (the latter Russian data requires confirmation as this publication contains several obvious misidentifications). The northern parts of Russia have been very poorly explored for Odonata and more populations probably remain to be found in this region. The frag-

mented distribution of this species is attributed to post-glacial climate oscillations, with the species expanding westwards to Europe after the last Glacial Maximum (late Pleistocene and early Holocene, 14 500–10 000 BP), and its range becoming fragmented during the warm Atlantic period (postglacial climatic optimum, 8 000–5 500 BP) (Bernard & Daraż 2010).

Trend and conservation status

This East Palaearctic species is one of the rarest damselflies in Europe with only a limited number of mostly small populations. Populations in the north of Russia occur in sparsely inhabited areas and are probably not threatened. The German population went extinct due to fish farming in the area of its habitat. The Austrian populations are part of the "Tiroler Lech Naturpark", which is also designated as a Natura 2000 area. The population trend is monitored and appears to be currently stable, so that the species is not presently threatened. The inclusion of *C. hylas* in the Annex II of the European Habitats Directive makes the species and its habitats legally protected within the European Union. In the future, this cold-adapted stenothermal species might be impacted by climate warming.

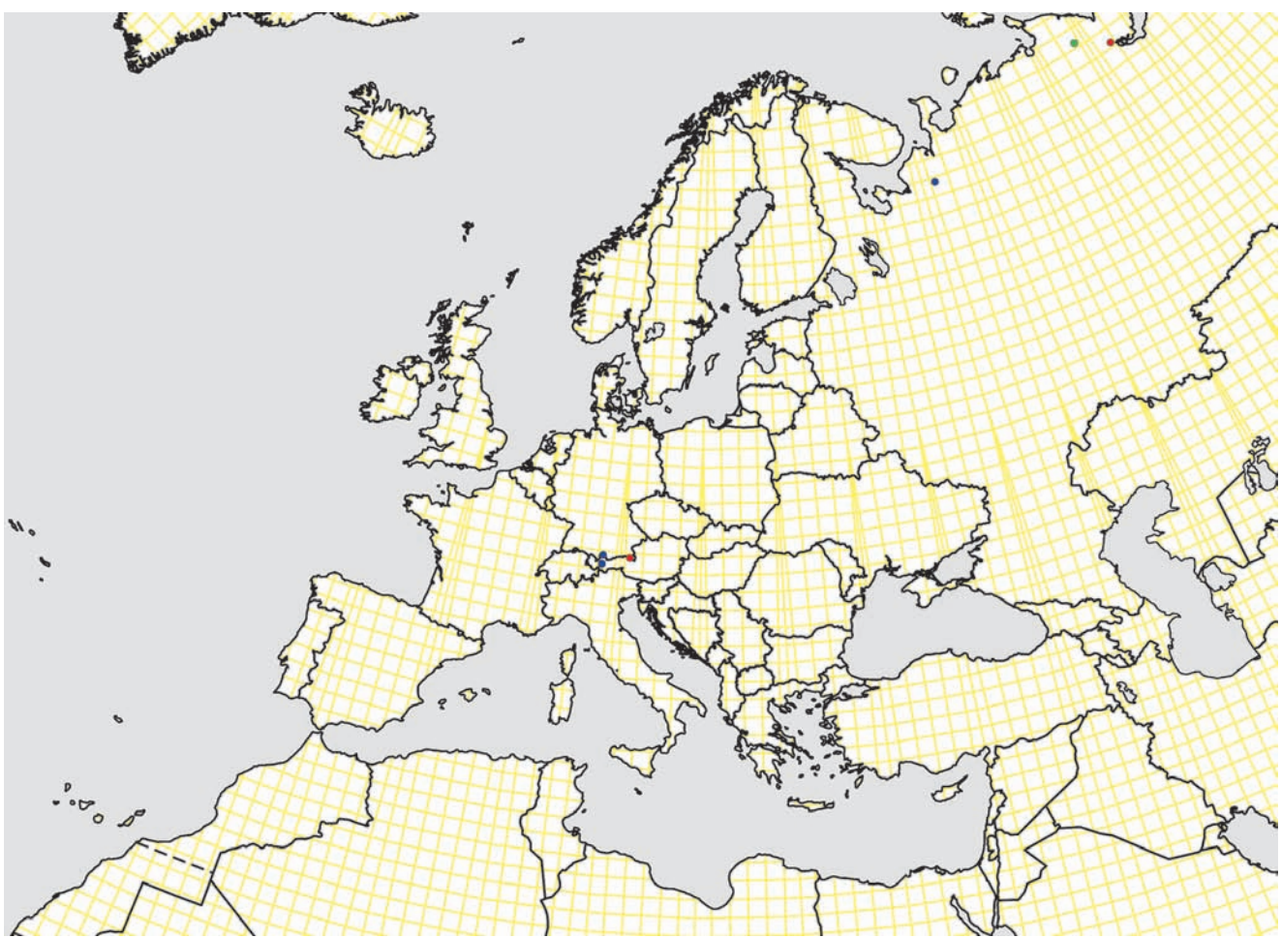
Habitats Directive	II+IV
Red List EU27	Vulnerable
Red List Europe	Vulnerable
Red List Mediterranean	Not present
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

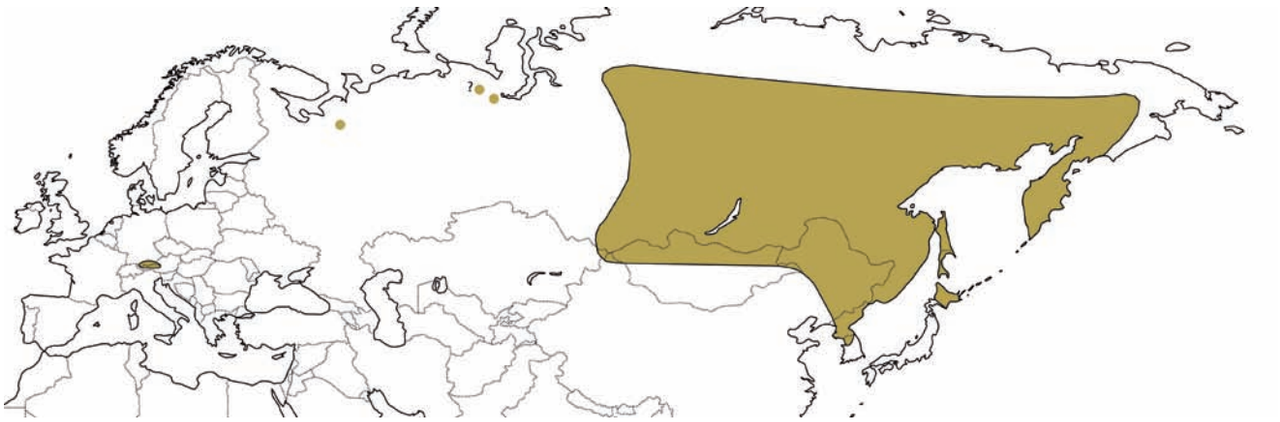
The European populations in the Alps and the Arkhangelsk province are found at cold, clear, and mostly shallow peaty marshes, ponds and small lakes fed by ground water and trickles of neutral to calcareous waters with low nutrient content. In the Alps, the species is confined to forested areas between 800 and 1 600 m. In European Russia, it was reported from peaty lakes in the Taiga with adjacent swampy transition mires, bogs and fens partly fed by karstic alkaline water. It is present in a wider selection of habitats in Siberia, where it is often found at small oxbow swamps in river floodplains.

Flight period

The flight period extends from early May to mid-August with the highest densities being recorded from late May to late July.



European distribution



World distribution

Coenagrion intermedium Lohmann, 1990

J.-P. Boudot

Taxonomy

This species was originally described as a subspecies of *Coenagrion ponticum* Bartenev, 1929, which occurs in south-western Asia, but Battin (1993) showed it should be best regarded as a full species.

Distribution

World: *Coenagrion intermedium* is endemic to Crete (Lohmann 1990b, Boudot *et al.* 2009, Lopau 2010b).

Europe: The species occurs only in Crete, where it is presently known from 19 different rivers. Jödicke (2005) described the species as widespread and common, finding them in a large proportion of sites he visited. Records of *C. puella* from the Peloponnese should be carefully checked to confirm that they do not refer to the present species.

Trend and conservation status

According to Grove & Racham (2001), in 1625 Crete had about 28 permanent large rivers, of which only four still persist today. This greater number of running waters in the 17th century is attributed to the higher precipitation during the so-called 'Little Ice Age', and the subsequent reestablishment of the Mediterranean climate resulted in a reduction of permanent running waters. During the same period the forest cover on the island has diminished, and the decrease in both running waters and gallery forests probably resulted in a decline of the species. At present many streams and rivers in Crete remain under pressure from both the destruction of adjacent gallery forests and increasing water demand for agriculture and domestic use. The species is not rare in Crete but available habitat is limited and it seems likely that in the future it will be affected by climate change and the resulting desiccation of streams. Better control of water use and the conservation of gallery forests are required together with a detailed census of the populations and assessment of their conservation status. The small number of populations and the continuing decline in habitat quality mean that *C. intermedium* is classified as Vulnerable on the European Red List.

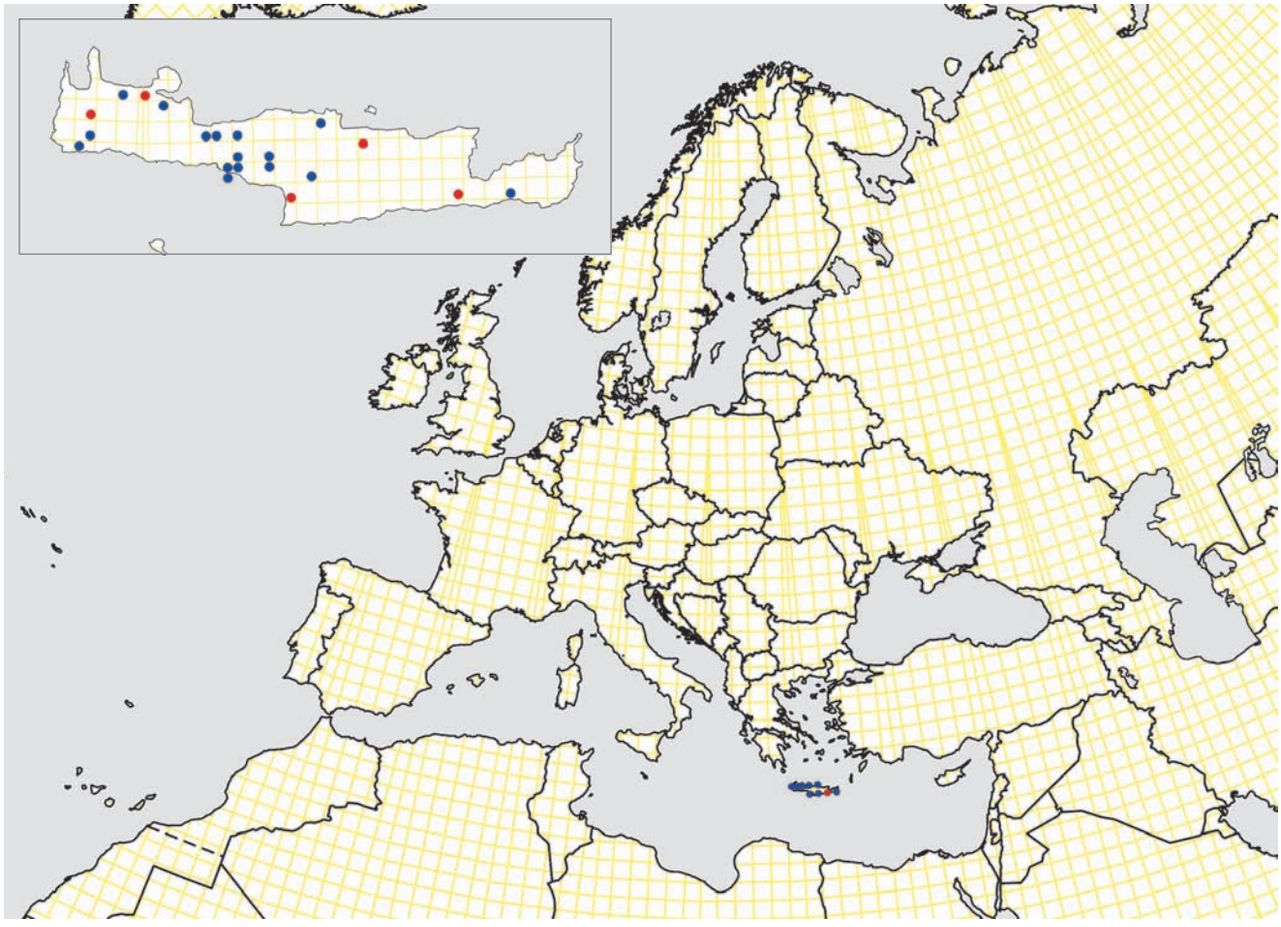
Habitat Directive	No
Red List EU27	Vulnerable
Red List Europe	Vulnerable
Red List Mediterranean	Near Threatened
EU27 endemic	Endemic
European endemic	Endemic
Trend Europe	Unknown

Habitat

Coenagrion intermedium is confined to small streams with moderate flow rates flanked by gallery forests of

Flight period

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Greece					■	■	■						Based on 15 records



World distribution of *Coenagrion intermedium*. The inset shows its distribution on Crete based on a 5 by 5 km grid.

the Oriental plane (*Platanus orientalis*). The single record from standing water was from nearby a stream, so that no self-sustaining population is known from strictly standing waters. The species is absent from open unshaded streams. Most localities are in the upper and middle parts of streams, rarely along lower reaches. The highest densities of individuals are found at spots with a slow current and herbaceous banks. At faster flowing sections, population density is lower.

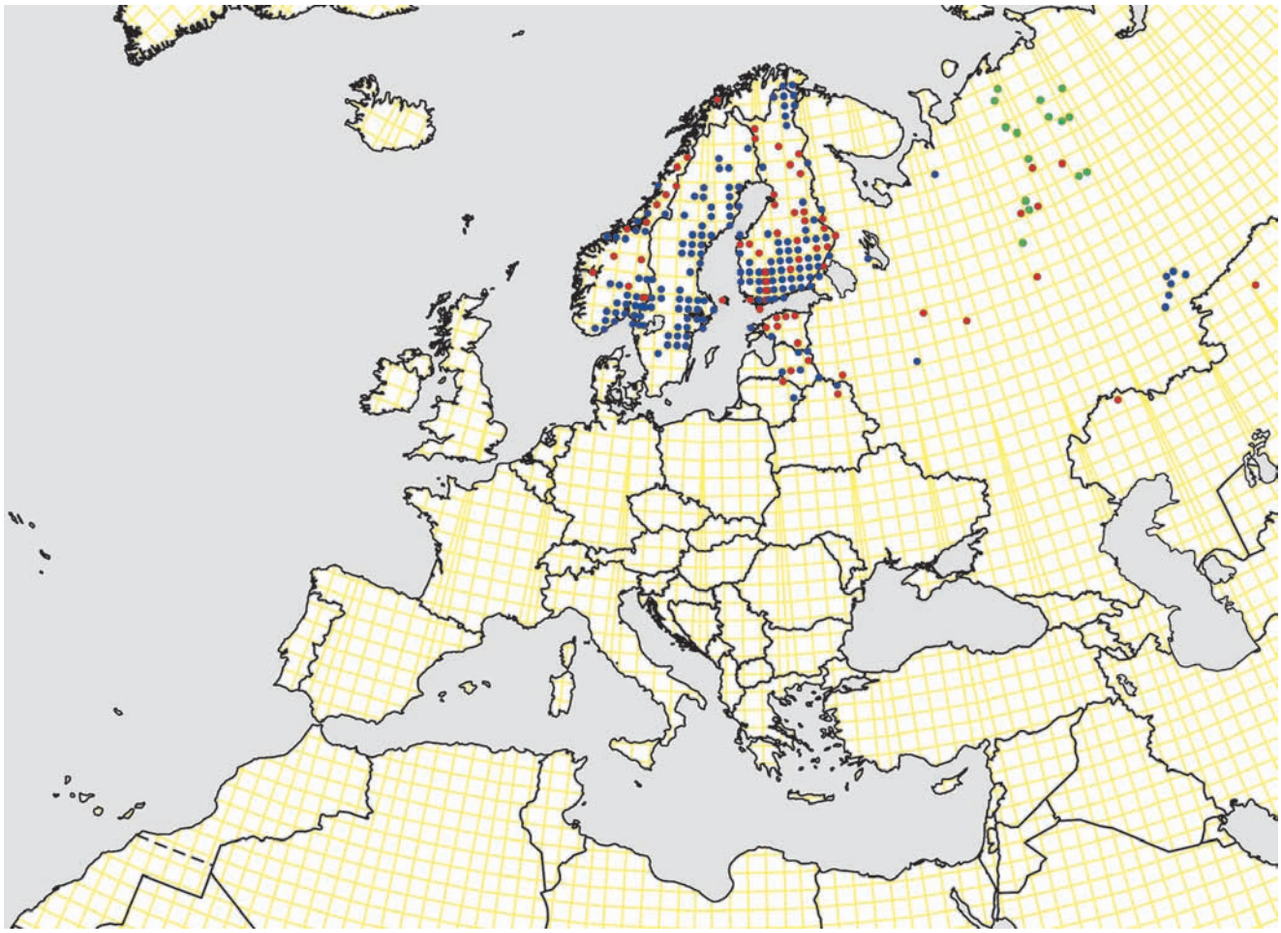
Coenagrion johanssoni (Wallengren, 1894)

J.-P. Boudot & G. Sahlén

Distribution

World: *Coenagrion johanssoni* is widespread in the boreal and northern temperate regions of Eurasia. In the west, it is restricted to the north of Europe but further east it reaches south as far as Mongolia and Korea, probably as a result of colder winter temperatures.

Europe: *Coenagrion johanssoni* has the northernmost distribution of all European damselfly species, almost completely overlapping the taiga forest. More rarely small populations are found in the tundra and in the transition area between the taiga and the tundra. The species is widespread and moderately common in most of Fennoscandia, although it is rare in the mountains of Norway and Sweden. It is reasonably widespread, although decreasing from the north to the south, in the Baltic States and Belarus. The species is probably common and widespread in the boreal part of the European Russia, although many of the records



European distribution

World distribution

Flight period

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Norway & Sweden													

from this area need confirmation. It is well established in the southern Urals and two records are known from the north of Kazakhstan.

Trend and conservation status

The species is common and widespread in Fennoscandia and probably also in boreal Russia, with populations apparently stable.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Not present
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

In Europe, this boreal species is found in peat bogs, transition mires, fens, ponds and lakes bordered with peat moss (*Sphagnum*) rafts. Suitable habitats are often in or nearby forests. *Coenagrion johanssoni* is mostly found in lowlands but has been recorded up to 1 000 m in Norway and Sweden.

Coenagrion lunulatum (Charpentier, 1840)

J.-P. Boudot & B. Nelson

Distribution

World: *Coenagrion lunulatum* is widespread in the temperate parts of the Palaearctic, ranging from western Europe (Ireland and France) eastwards to Kamchatka. An additional, disjunct area of occurrence is found in Georgia, Armenia and eastern Turkey, where the species occurs in marshes and lakes in mountainous steppe habitats, 1 900–2 200 m (Shengelia 1975, Schröter *et al*. 2015).

Europe: *Coenagrion lunulatum* has a disjunct distribution in Europe. The core of its range includes the Netherlands, northern Germany, Poland, the south of both Sweden and Finland, and the Baltic States, from where it is expected to continue east to the Ural Mountains. The species is rare south and north of this core region and is mostly found in scattered, small and often isolated populations from the Ukrainian Carpathians to the Czech Republic and the Alps, and throughout most of Fennoscandia. In contrast to its rarity in the Alps, it is well established in the Massif Central in France, which constitutes a disjunct area of occurrence. Another disjunct area is found in Ireland, where *C. lunulatum* is widespread but uncommon in the northern half of the island. It is remarkably and unaccountably absent from Great Britain.

Trend and conservation status

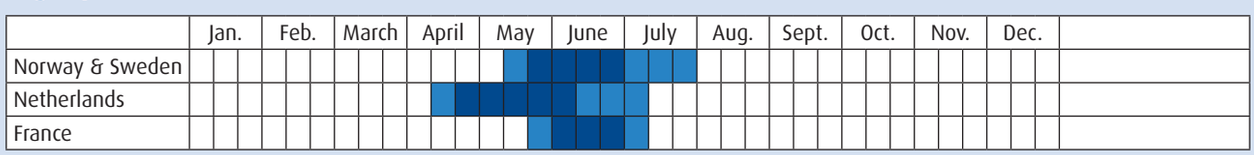
Although reasonably widespread in the core of its European range, *C. lunulatum* has shown a significant decline in some regions and is mostly uncommon. It is currently assessed as Least Concern at the European scale but might qualify as Near Threatened in the future. It has shown a serious decline in southern Germany, Switzerland (extinct), Austria, southern Poland and in the Czech Republic. Lack of recent records from Slovakia and Ukraine may be due either to a low level of recording or to a true decline. The reasons for this decline are poorly understood and might be due to a combination of eutrophication, destruction of habitats and climate change. Its habitats are often shallow and might be prone to desiccation during hot summers. In central Europe especially, many populations are isolated, reducing the chances of secondary colonisation after local extinction.

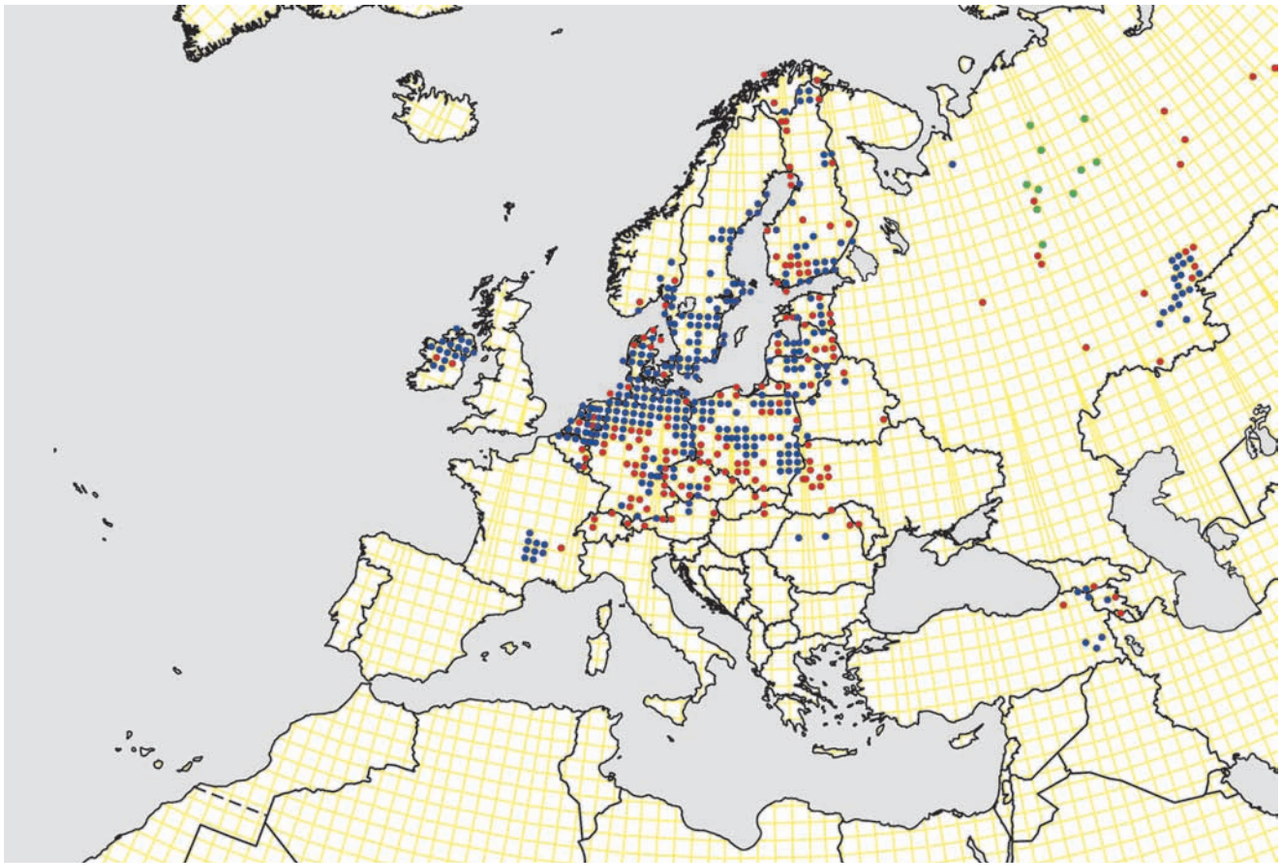
Habitat Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Not present
EU27 endemic	No
European endemic	No
Trend Europe	Unknown

Habitat

In most of its European range *C. lunulatum* is predominantly found in oligotrophic to mesotrophic, acidic to slightly acidic ponds and small lakes, *Sphagnum* peat bogs and fens. These often support a vegetation of small sedges and peat mosses (*Sphagnum*), and are largely unshaded. Most habitats lie within or in direct proximity to forests. In the east of its range, the species is found in a wider range of habitats such as cattle ponds and gravel and clay pits, where it occurs regularly in slightly more eutrophic water bodies with rather ordinary fringing vegetation. *Coenagrion lunulatum* is mainly found in lowlands and low hills in the north of its range, and is confined to mountains up to 1 500 m in the south. It is very rare in the Alps, which correlates with its rarity in the boreal belt.

Flight period





European distribution

World distribution

Coenagrion mercuriale (Charpentier, 1840)

J.-P. Boudot & S. Prentice

Taxonomy

The Italian populations were described as a distinct species, *C. castellani* Roberts, 1948, based on a male of *C. mercuriale* and a female of *C. caerulescens* (Conci 1949, Jacquemin & Boudot 1990). *Coenagrion castellani* was subsequently reported from Morocco (Ben Azzouz *et al.* 1989a, b) but these records refer to either *C. scitulum* and/or *C. caerulescens* (Jacquemin & Boudot 1990). Another subspecies name, *C. m. hermeticum* (Selys, 1872), has been in use for the population in

the Maghreb. These subspecies were described based on the extent of the black pattern but too few specimens were studied and the study of additional material showed these characters to be unreliable (Lieftinck 1966, Dumont 1972, Jacquemin & Boudot 1999). At present no subspecies are recognised.

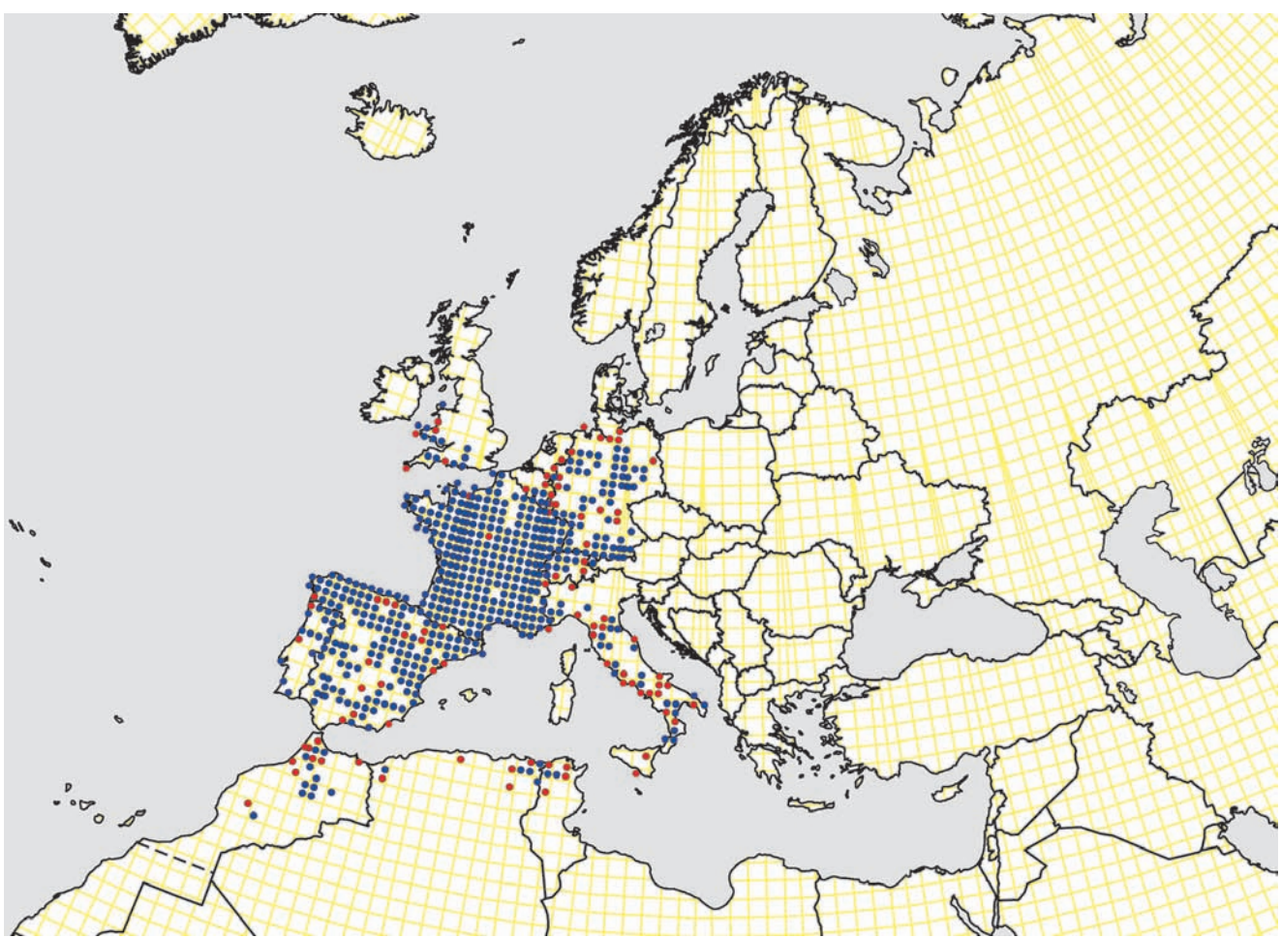
Distribution

World: *Coenagrion mercuriale* is endemic to the west of Europe and to the northern parts of the Maghreb.

Europe: The main range of *C. mercuriale* covers France and the northern half of the Iberian Peninsula, where it is widespread and common. The species has a more scattered occurrence in the southern half of Spain and in Italy, where it is lacking north of the Po River. Among the Mediterranean islands, it is known only from two old records from Sicily where it is now probably extinct. The recent record of *C. mercuriale* from Sicily shown in the Italian atlas (Riservato *et al*. 2014b) is based on a misidentification of a female *C. scitulum*. The eastern limit of its range runs from the eastern border of Germany and the western tip of Austria to the southernmost part of Italy. In Germany the species is widespread but remains rare with, in most areas, only small and isolated populations. *Coenagrion mercuriale* is now very rare in Belgium, where it is limited to two small areas in southern Wallonia, while in the Netherlands it is presumed extinct although vagrants were found in 2011. In Great Britain the species is restricted to a small number of populations in Wales and the south and west of England, many of which are currently isolated (Watts *et al*. 2005, 2006). Misidentifications led to this species being recorded for many central, southern and eastern European countries including Albania, Hungary, Slovenia, Slovakia, the Czech Republic, Macedonia, Moldova, Bulgaria, Romania and the Caucasus region. All these records are considered incorrect and no confirmed record is presently available for this part of Europe (see for instance Marinov 2001a for Bulgaria).

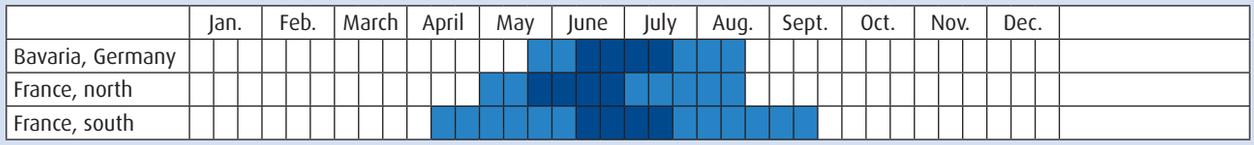
Trend and conservation status

Coenagrion mercuriale has decreased in North Africa (Ferreira *et al*. 2015), Great Britain, Belgium, Switzerland and Germany. Many of the populations have declined due to intensified agricultural practices, which has led to eutrophication and landscape modification often resulting in the drainage of suitable habitats. The species is dependent on lush aquatic and riparian vegetation in open seepages, streams and small rivers. Changes in both water quality and management lead to changes in the vegetation and to the decline of the species. In Great Britain, the removal of grazing animals that maintained open conditions is thought to have been one of the main reasons for the decline of the species. Mowing or excessive removal of vegetation for



World distribution

Flight period



hay production also can lead to habitat degradation and population decline.

Habitats Directive	II+IV
Red List EU27	Near Threatened
Red List Europe	Near Threatened
Red List Mediterranean	Near Threatened
EU27 endemic	No
European endemic	No
Trend Europe	Decreasing

Habitat

Coenagrion mercuriale is found at unshaded, often calcareous runnels, small streams and irrigation ditches, preferably with a rich aquatic and riparian vegetation of Watercress (*Nasturtium officinale*) and Fool's-watercress (*Helosciadium nodiflorum*). The water is typically shallow and slow-flowing over a gravel or marl bed with patches of organic detritus. The vegetation near the banks often consists of low herbs and grasses and is frequently used for hay production or grazing. It is one of the few species that is mainly found in extensive agricultural areas. Here it benefits from mowing of bank side vegetation and cleaning of waterways which prevents the habitat from becoming overgrown and shaded. In Great Britain the species is found in runnels and streams in acidic heathland, chalk streams and calcareous fens (Cham *et al*. 2014). *Coenagrion mercuriale* is mostly found below 700 m in the middle latitudes, whereas it reaches 1 500 m in the Iberian Peninsula and exceeds 2 100 m in Morocco.

Coenagrion ornatum (Selys, 1850)

J.-P. Boudot & D. Kulijer

Taxonomy

The relationships of *C. vanbrinkae* Lohmann, 1993 with *C. ornatum* and its putative range are unclear hence this taxon is here considered a synonym of *C. ornatum*.

Distribution

World: *Coenagrion ornatum* occurs in Europe and south-west Asia, with the easternmost records from Iran and south-west Turkmenistan. In south-west Asia it is absent from the more arid parts and remains largely confined to hilly or mountainous regions. The species is widespread and not uncommon in Turkey and is expected to be similarly common in western Iran.

Europe: The core of the range of *C. ornatum* is in south-east Europe, with small and isolated areas of occurrence in central and western Europe. The area where the species is reasonably widespread, although populations are often small, runs from Hungary and Slovenia southwards to Bulgaria and northern Greece. To the east, this core area extends to Romania and western Ukraine. The species is rare in the south of Greece and absent from the Mediterranean islands. It is rare to very rare in central and western Europe, with large populations only found in the Danube Valley in Bavaria in southern Germany, and the Nièvre and Saône-et-Loire departments in central France. Outside these areas, only a few dozen central European populations are currently

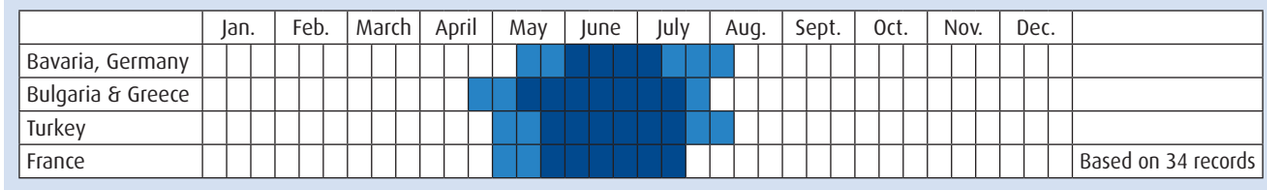
known. Most records from Ukraine are old and located in the Carpathians. Further east, the species is very rare but is known to extend to the south of European Russia and the Caucasus region (Skvortsov 2010), where it connects with populations in Transcaucasia, Turkey and Iran. An old record, dated 1939, was published by Schmidt (1952) from near Foggia in south Italy, but the species is most probably extinct there.

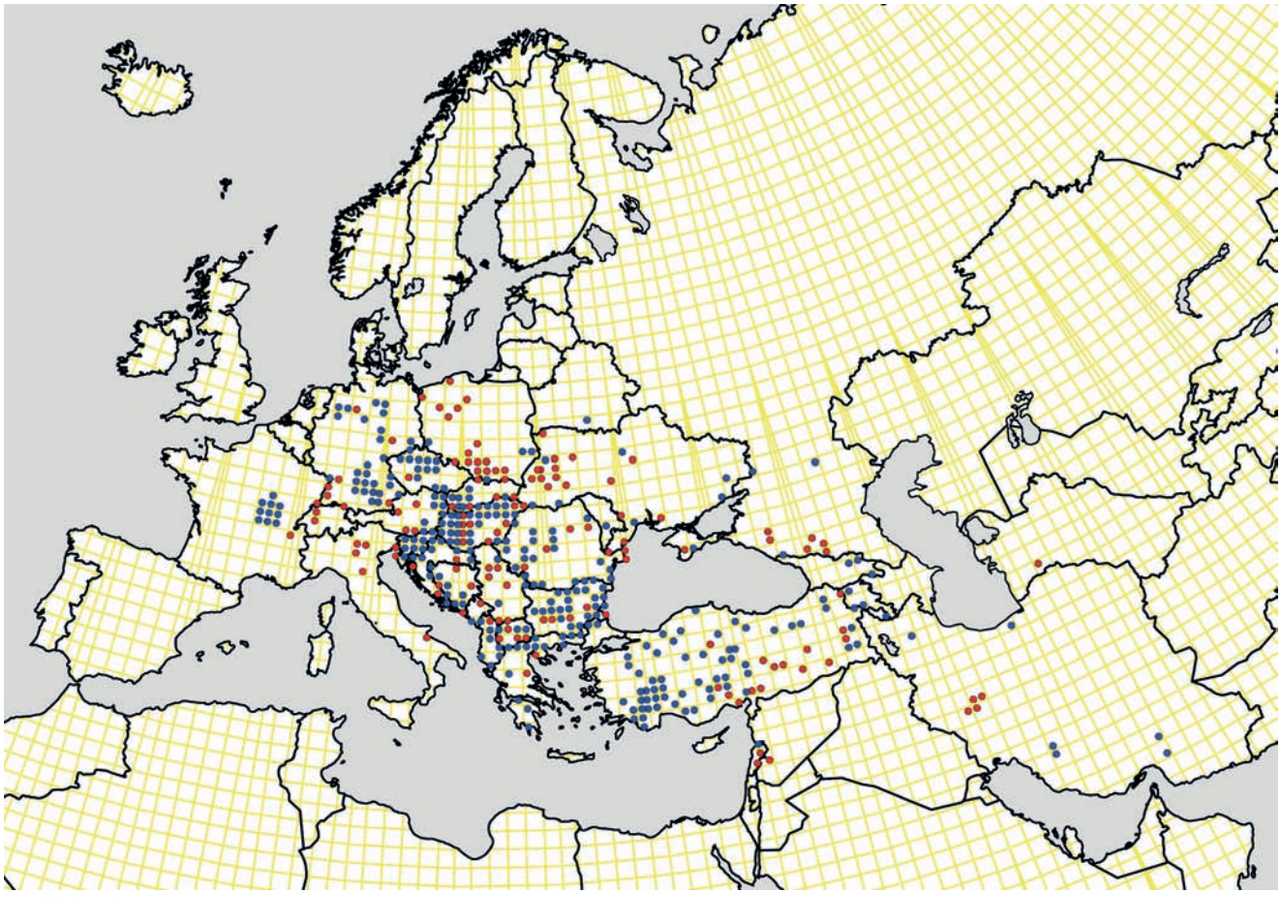
Trend and conservation status

In Europe, *C. ornatum* is generally rare, being moderately common only in the Balkan Peninsula. Populations are mostly small and suitable habitats restricted. The species has shown a clear decline throughout central Europe and is extinct in Italy (last record dated 1944), Switzerland (last record 1957) and large parts of Poland. It has probably also declined in the Ukraine although this is uncertain due to the lack of recent fieldwork in the west of the country. The current trend of the species in south-east Europe is not clear. In central Europe especially, a large proportion of the sites are found in agricultural areas. Eutrophication and increased drainage are important reasons for its decline. Both an increase and a decrease of the frequency of mowing and cleaning of the waterways can lead to a decline of the species. The abandonment of agricultural areas in south-east Europe might result in suitable habitat becoming overgrown. Climate change might lead to the desiccation of habitats, especially in south-east Europe, but could also favour the species in the north of its range and allow it to expand northwards.

Habitats Directive	II
Red List EU27	Near Threatened
Red List Europe	Near Threatened
Red List Mediterranean	Near Threatened
EU27 endemic	No
European endemic	No
Trend Europe	Decreasing

Flight period





World distribution

Habitat

Coenagrion ornatum occurs at sunny seepages and permanent and mostly small streams generally with a slow current and shallow water. In most cases there is organic mud and detritus on the stream-bed and moderately dense herbaceous vegetation. The water is often calcareous and relatively warm. Natural habitat types where these circumstances occur are spring marshes, karstic springs and streams. Most of the European populations are presently found in agricultural areas, at small ditches and streams. Many of these habitats depend on both the cyclic cleaning of water courses and the mowing of bank side vegetation to prevent the habitat becoming overgrown. In Slovenia it was noticed that the species readily colonises newly created or cleaned ditches and streams (Kotarac 1997). In most of Europe the species favours largely open habitats below 600 m. In the Balkan Peninsula, populations have been found up to 900 m while in Turkey it occurs in mountain streams up to 1 800 m, some of which are extensively snow-covered in winter.

Coenagrion puella (Linnaeus, 1758)

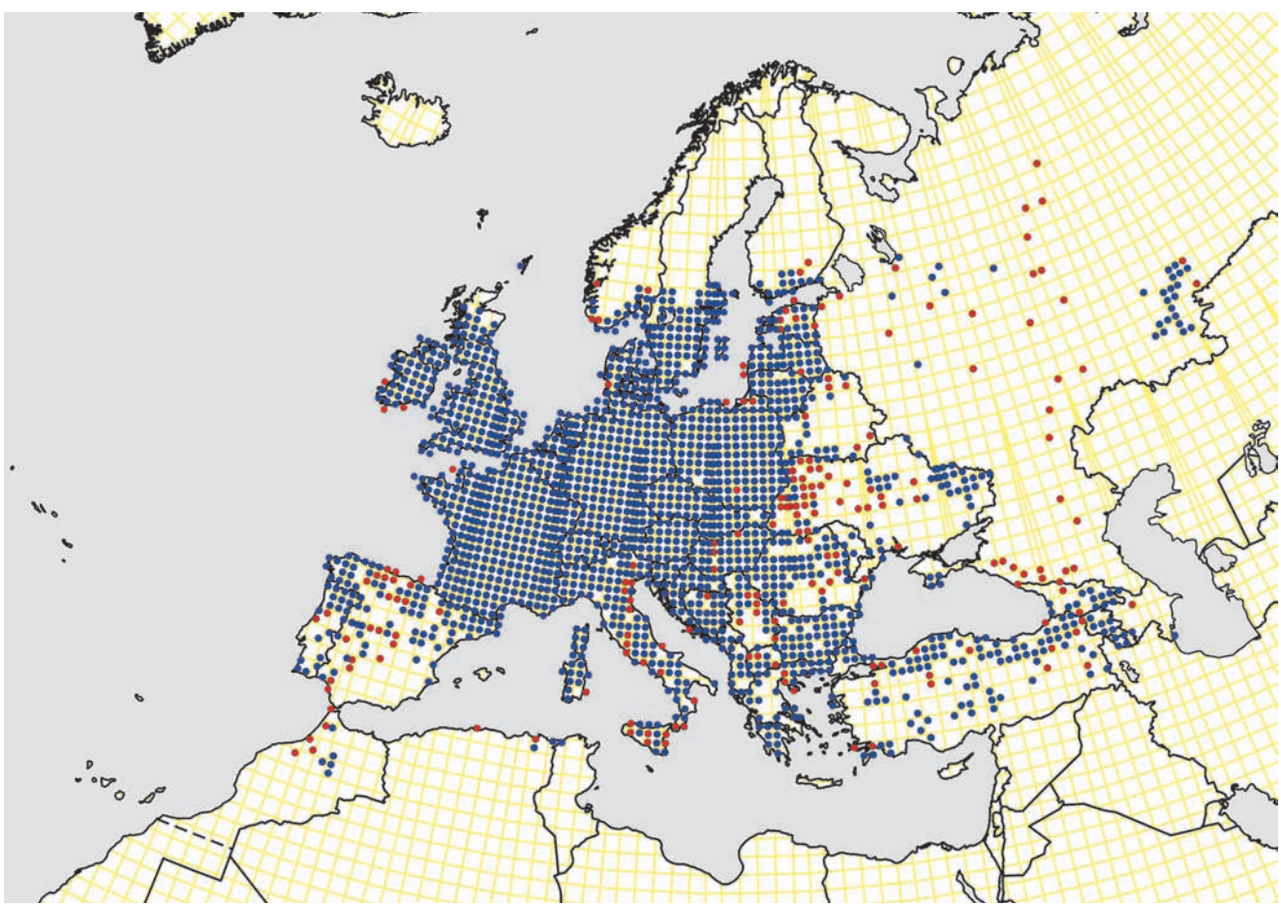
J.-P. Boudot & B. Nelson

Taxonomy

Specimens from the Maghreb with a pair of black spots on segment eight have been described as subspecies *C. p. kocheri* Schmidt, 1960. Similar males have been found in Spain, suggesting the variation is clinal and does not warrant erection of a subspecies. The species is considered to be monotypic.

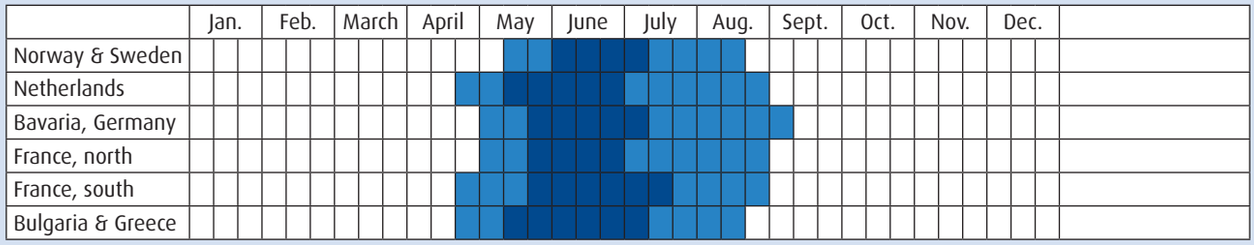
Distribution

World: *Coenagrion puella* is widespread and very common in Europe and ranges east to the western Siberian lowland. It is widespread and common in most of Kazakhstan (Chaplina *et al.* 2007), but rare



World distribution

Flight period



in Kyrgyzstan and absent from the rest of Central Asia (Schröter 2010b). The species is widespread and common in most of Turkey, Armenia and Georgia. In Africa, it is confined to the north of the Maghreb, where it is rare. It is replaced by the closely related *C. intermedium* in Crete, by *C. syriacum* (Morton, 1924) in parts of the eastern Mediterranean coastland and by *C. australocaspicum* Dumont, 1996 along the southern coast of the Caspian Sea. It overlaps with *C. ponticum* (Bartenev, 1929) in the north-east of Turkey and in Georgia.

Europe: *Coenagrion puella* is among the most widespread and common European damselflies and often occurs at high densities. It is absent from north-eastern Scotland and from most of Fennoscandia, and is rare or absent in the most arid parts of the Iberian Peninsula.

Trend and conservation status

Coenagrion puella is one of the most widespread and common damselflies of Europe and there is no indication of a decline. In Great Britain, it has expanded its range about 100 km to the north since 1970, which is attributed to global warming (Hickling *et al.* 2005).

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

Coenagrion puella is found at a wide range of standing and slow-flowing waters. These are largely unshaded and generally mesotrophic to eutrophic with well-developed bank-side vegetation. The species clearly favours water with floating vegetation, which is used as substrate for oviposition. It is generally absent from temporary and fluctuating waters as well as from brackish habitats. Suitable habitats include drainage ditches and other canals, garden ponds, natural lakes and ponds, peat bogs and fens with open water and, although generally in lower numbers, lowland streams, rivers and backwaters (oxbow lakes and ponds). Population density is generally low on peaty or clay soils, where the species tends to be outnumbered by *C. pulchellum*. *Coenagrion puella* has a wide altitudinal range and is found up to 2 000–2 500 m in the south of its range.

Coenagrion pulchellum (Vander Linden, 1825)

J.-P. Boudot & B. Nelson

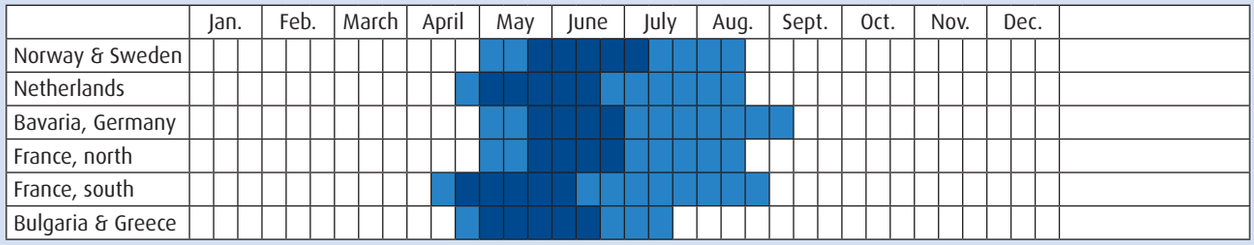
Taxonomy

Coenagrion pulchellum exhibits strong variation in the extent and shape of the black pattern on thorax and abdomen in both sexes, with populations from southern and eastern Europe being clearly darker than those of central and western Europe. This variability has led to the description of various subspecies, of which *Coenagrion p. interruptum* (Charpentier, 1840) and *C. p. mediterraneum* Schmidt, 1964 have been mentioned as occurring in Europe. None of these, however, have well-defined characters or a well-defined range and the species is currently considered to be monotypic.

Distribution

World: *Coenagrion pulchellum* is found in most of central Europe, extending eastwards to the West Sibe-

Flight period

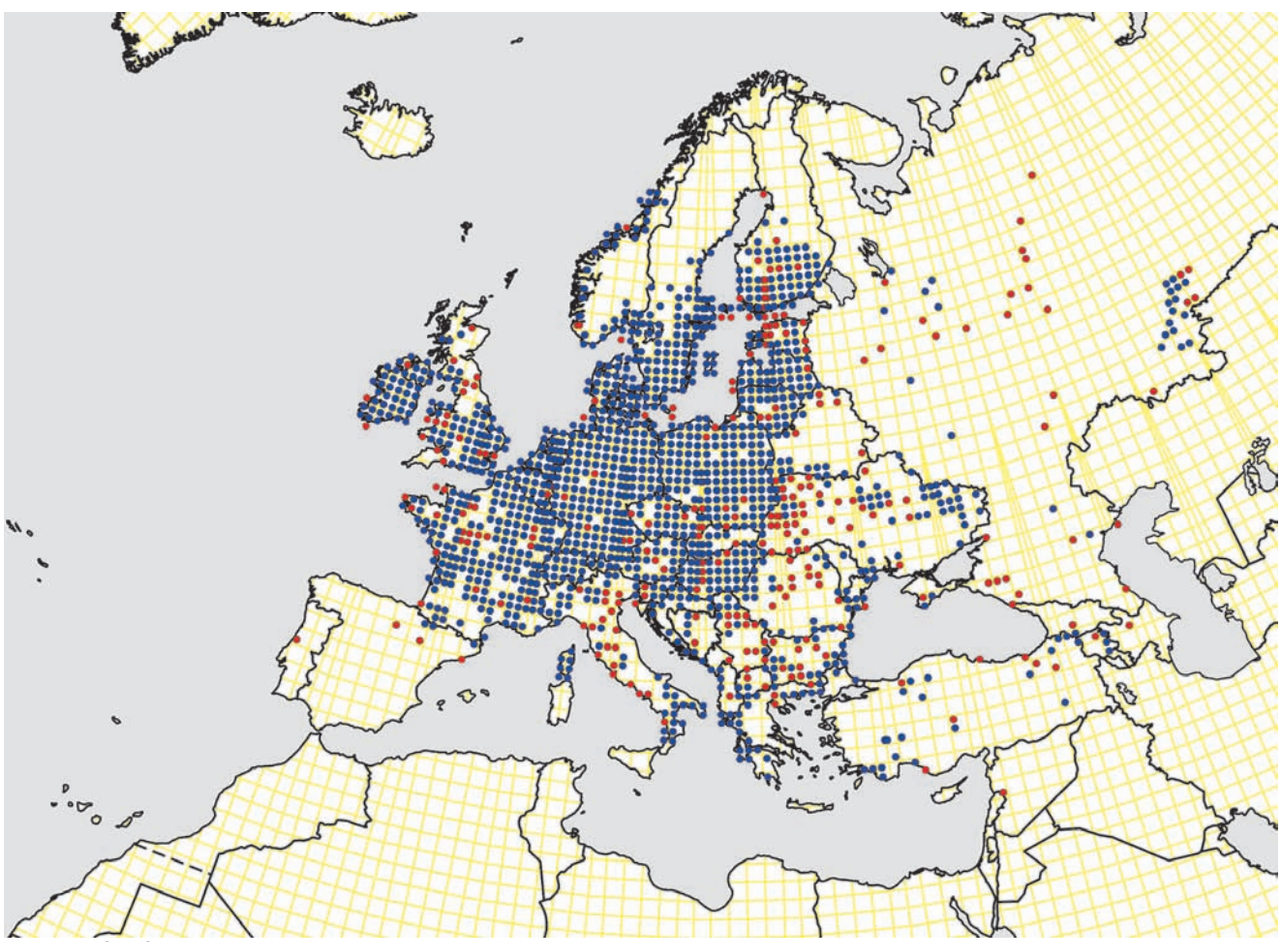


rian lowlands and the northern parts of Central Asia, and reaching south as far as Tajikistan. The species is widespread but scarce in Armenia, Georgia and Turkey, and is known from a single old record from western Syria (Schneider 1986).

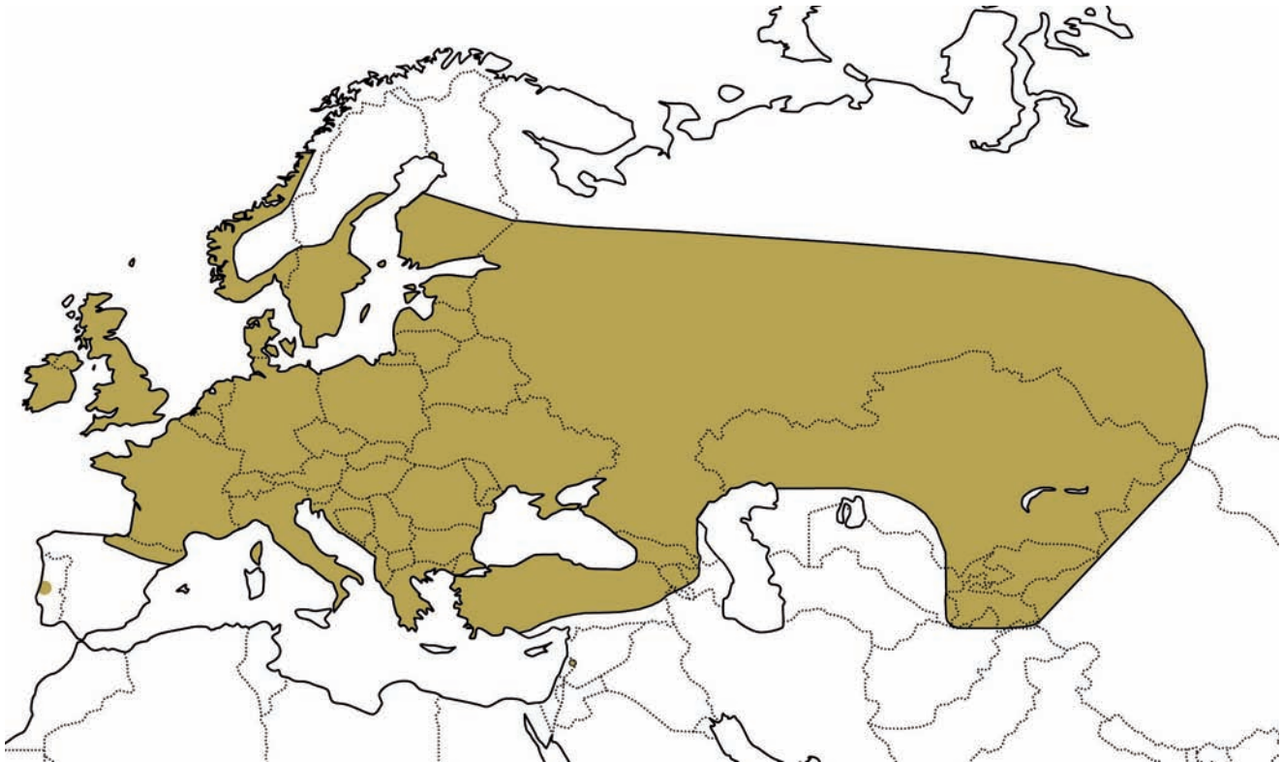
Europe: *Coenagrion pulchellum* is widespread in central Europe but is missing from most of the Iberian Peninsula and large parts of Fennoscandia. It is rare in parts of mainland Italy and absent from Sicily. The species is reasonably common on Corsica but two old records from Sardinia (Bentivoglio 1905) are unreliable (Bucciarelli *et al*. 1980). In the Balkan Peninsula it becomes increasingly scarcer towards the south, but reaches the southern Peloponnese in Greece. In the Iberian Peninsula, the species is rare and scattered with one confirmed record from Portugal (Coimbra) (Ferreira *et al*. 2006) and six confirmed records from Spain in La Rioja (Logrono), Aragon (Huesca, Zaragoza) and Catalonia (Barcelona, Gerona) (Anselin & Hoste 1996, Jödicke 1996b, Martin 2011, M. Lockwood *in litt*.). Other small, isolated and overlooked populations might occur in the north of the Iberian Peninsula. The species is widespread in Ireland but much more local in Great Britain.

Trend and conservation status

Coenagrion pulchellum is not threatened at the European scale although some regional declines have been observed. It is one of a group of species that has expanded its range to the north since 1970 (Hickling *et al*. 2005, Flenner & Sahlén 2008), probably due to climate change. It is not unlikely that further global warming will lead to a decline of the species in the south of its range.



European distribution



World distribution

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Near Threatened
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

Coenagrion pulchellum is found in standing waters and slow-flowing sections of rivers. Habitats are largely unshaded, oligotrophic, mesotrophic or eutrophic and nearly always have a well-developed bank-side and aquatic vegetation. Favoured habitats include lakes, ponds, fens, peat bogs, oxbows, ditches and canals. The species is generally absent from fast-flowing waters. *Coenagrion pulchellum* is mainly found in lowlands but breeds locally up to 1 500 m in southern Europe.

Coenagrion scitulum (Rambur, 1842)

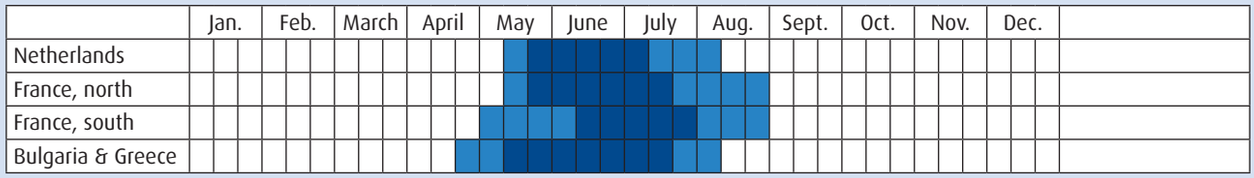
J.-P. Boudot & M. Jović

Distribution

World: *Coenagrion scitulum* has a disjunct distribution, with its main range in the south-west of Europe and large parts of the Mediterranean, and a smaller isolated occurrence in Central Asia. It is widespread in the south-west of Europe but is relatively scarce and scattered in the Maghreb, Turkey, the Levant, parts of the Balkan Peninsula, the south of European Russia and the Caucasus area. The easternmost records of its western range are from Azerbaijan (Dumont 2004). After a gap of 1 500 km, the species reappears in Central Asia in Tajikistan (seven localities), Kazakhstan (one) and Kyrgyzstan (one) (Borisov & Haritonov 2007, Schröter 2012).

Europe: *Coenagrion scitulum* is widespread in the southern half of Europe, being fairly common in

Flight period

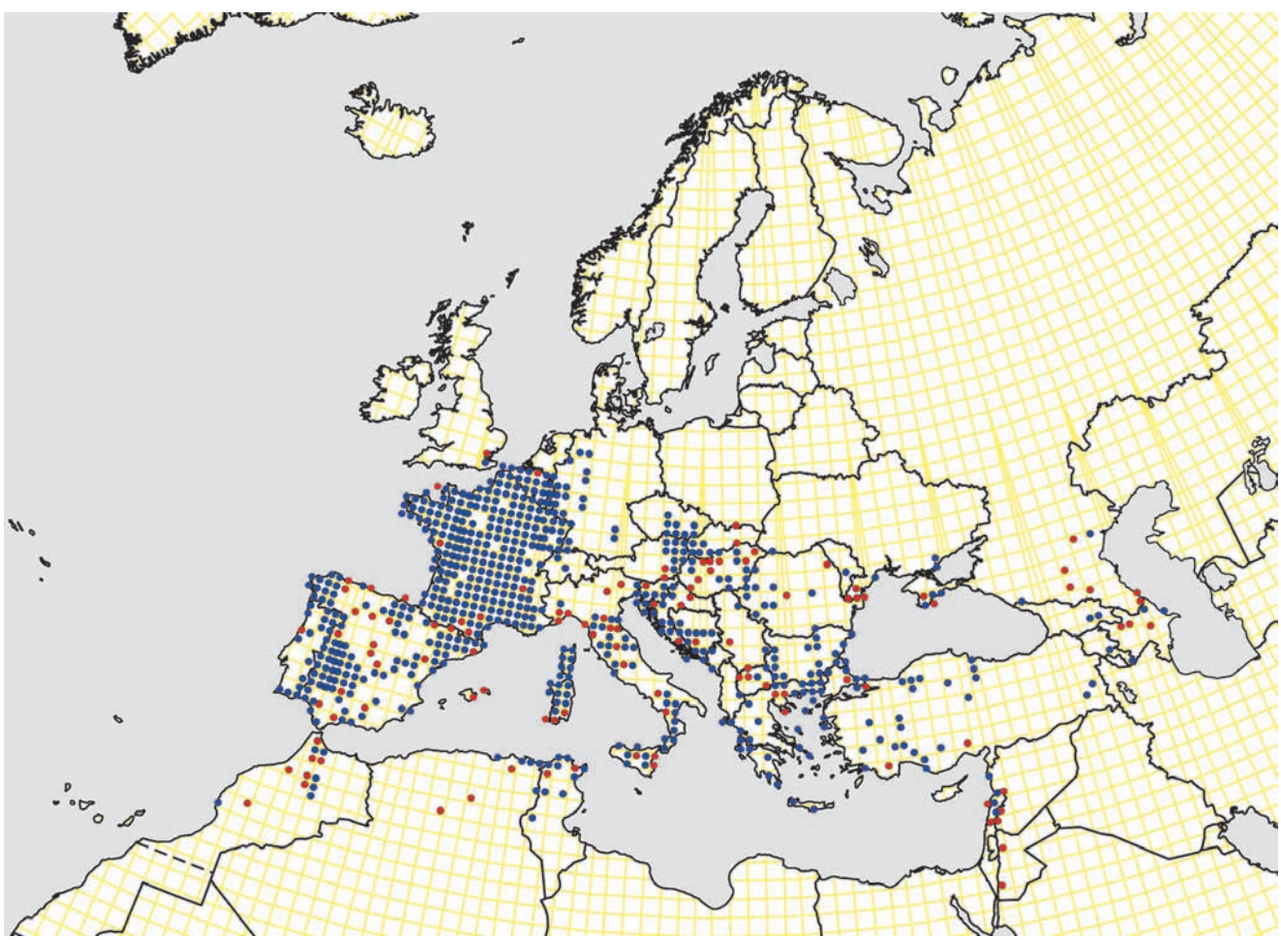


mainland France, parts of the Iberian Peninsula and the largest western Mediterranean islands. It is scarce but increasing in Belgium, the Netherlands and parts of Germany. It is widespread but scarcer than in most of western Europe in Italy and the Balkan Peninsula, where e.g. the first documented Albanian locality was found in July 2012 (Kitanova *et al*. 2013). The species is scattered and uncommon in the south of both Ukraine and European Russia.

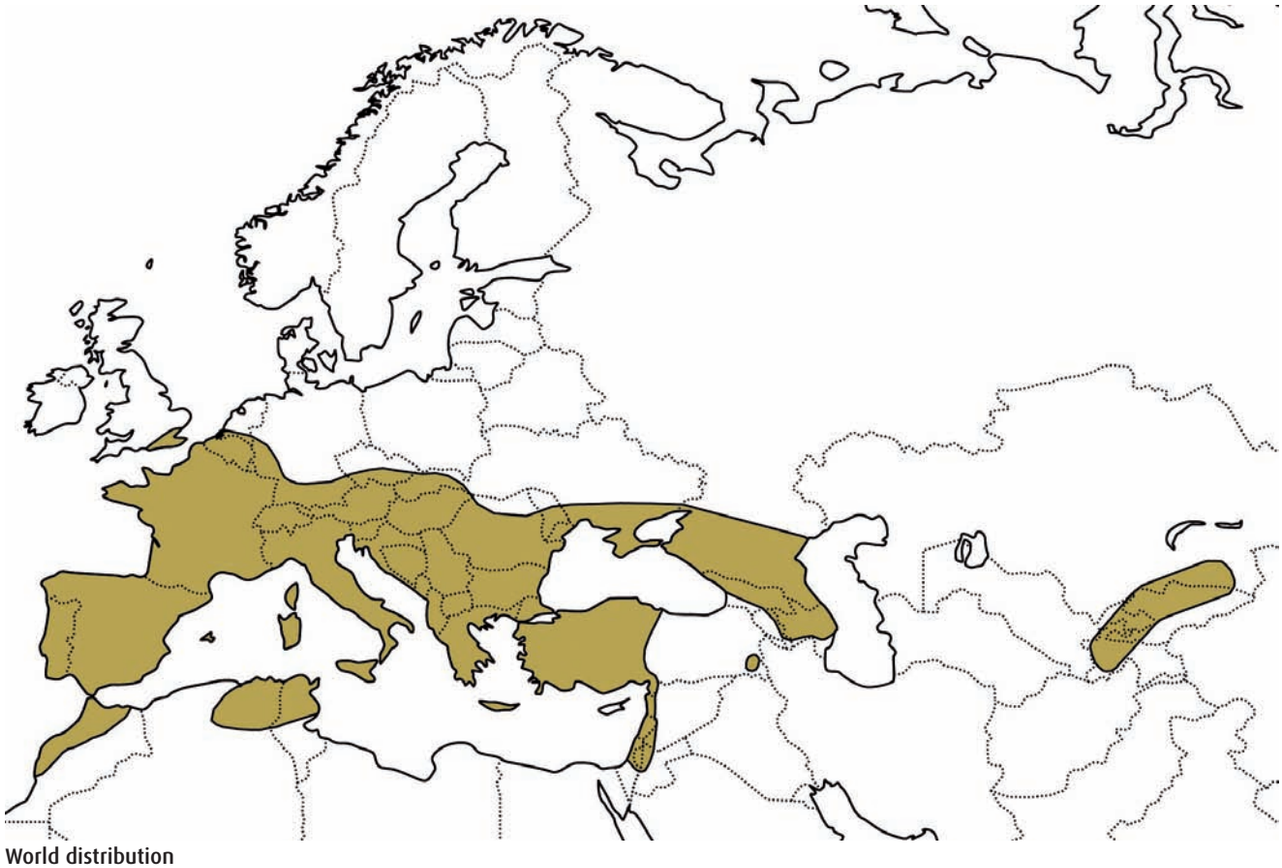
Trend and conservation status

After an apparent decrease during the 20th century, *C. scitulum* has shown a strong northwards expansion since the 1990s and has colonised north-eastern France (1988 onwards), Belgium (1998), Nordrhein-Westfalen, Germany (2002), Baden-Württemberg, Germany (2010) and south-east England (2010). It was recently recorded as new for Luxembourg (1996), Switzerland (2001), the Netherlands (2003) and the German states of Bavaria (2003), Rheinland-Pfalz (2006), Saarland (2008) and Hessen (2008) (Proess 1997, Lingenfelder 2011, Weihrauch *et al*. 2011). It is unclear if a similar northwards increase is taking place in the east of its range. The increasing summer temperatures that allow its northwards expansion might also result in a decrease in its southern range due to the desiccation of habitats.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Stable



European distribution



World distribution

Habitat

Coenagrion scitulum is found at sunny, standing, and, more rarely, slow-flowing habitats with generally shallow water rich in hydrophytes. The presence of extensive aquatic vegetation is important and the species is most common at habitats with mats of watermilfoil (*Myriophyllum*) and hornworts (*Ceratophyllum*). The bank-side vegetation seems to be of minor importance and often consists of grasses or is largely lacking. Suitable habitats include oxbow lakes, ditches, cattle ponds and quarries. In the south of its range, where larval development takes place within six months, the species is also found in temporary waters. It is most common in the lowlands but has been found up to 1 100 m in the south of its range.

Enallagma cyathigerum (Charpentier, 1840)

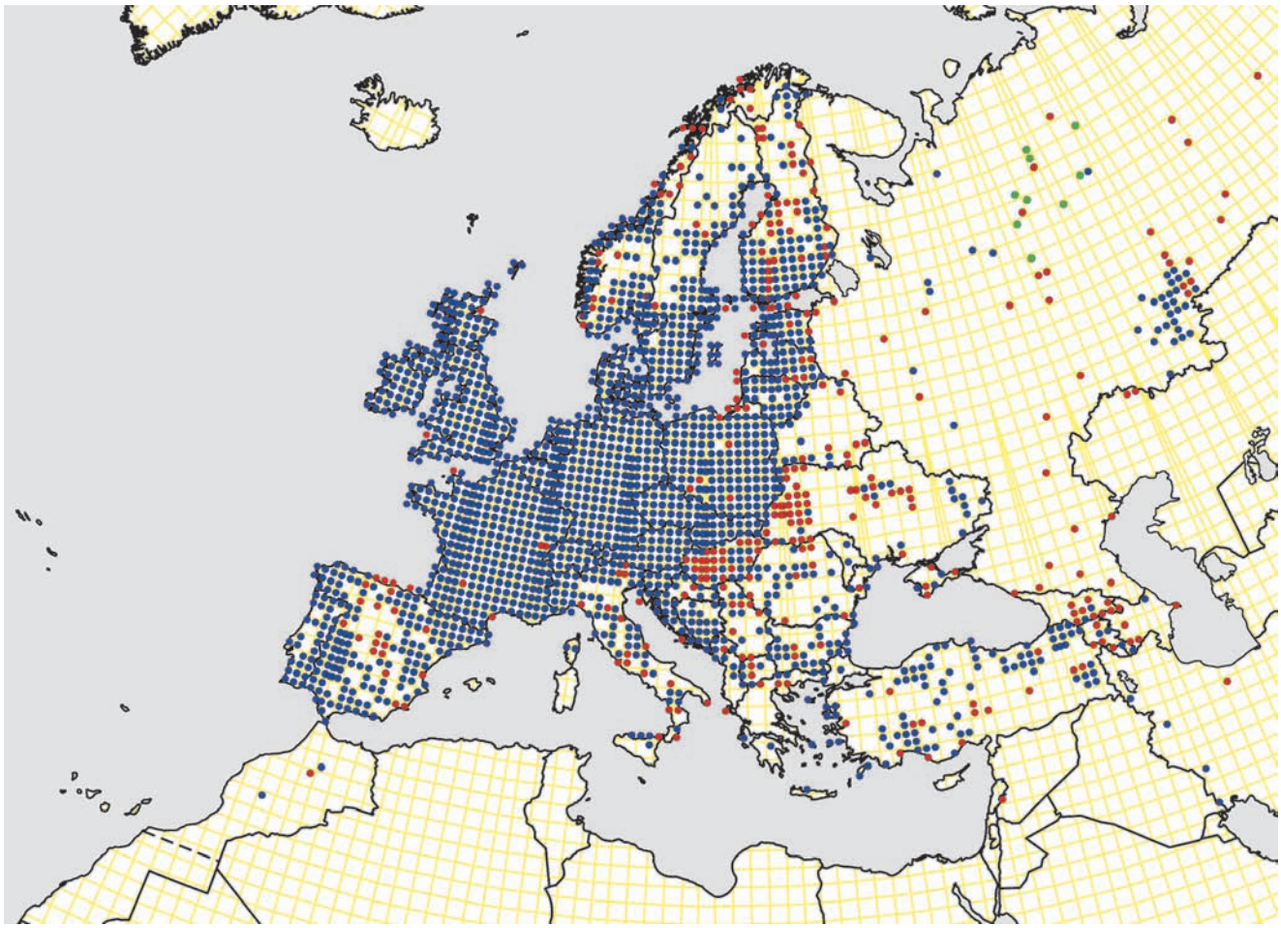
V.J. Kalkman & D. Kitanova

Taxonomy

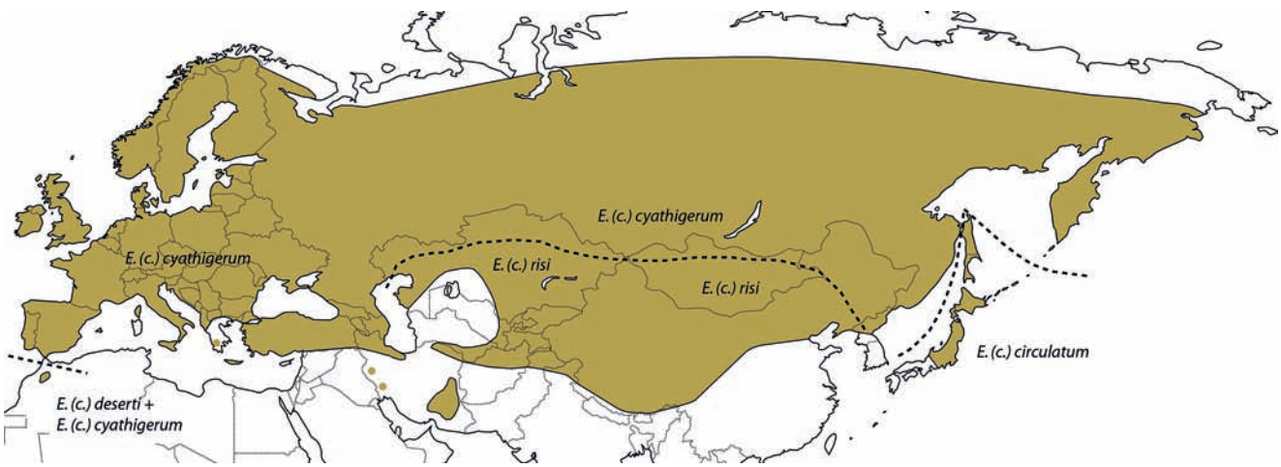
Enallagma cyathigerum belongs to a Palaearctic clade of four closely related taxa (*cyathigerum, risi, deserti, circulatum*) that are variously considered as subspecies of *E. cyathigerum* or full species (Samraoui *et al*. 2002, Stoks *et al*. 2005, Kosterin & Zaika 2010). Of these, *E. risi* and *E. circulatum* are found in the Eastern Palaearctic, *E. deserti* in North-Africa and *E. cyathigerum* throughout most of the Palaearctic. Older literature gives *E. cyathigerum* as occurring in North-America, but molecular studies showed that these populations belong to *E. annexum* (Hagen, 1861), a morphologically similar species which nonetheless belongs to a different genetic clade of *Enallagma* (Stoks *et al*. 2005).

Flight period

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Norway & Sweden												
Netherlands												
Bavaria, Germany												
France, north												
France, south												
Bulgaria & Greece												



European distribution



World distribution

Distribution

World: *Enallagma cyathigerum* is one of the most widespread damselflies in the world. Its range covers Europe, Asia and a small part of north-west Africa in Morocco only. The Moroccan populations in the Middle Atlas are probably relicts dating from the last glacial period, when the Mediterranean basin constituted a refuge area for many dragonfly species. Records from North-America pertain to another taxon (see taxonomy).

Europe: This Palaearctic species is widespread and common in the European part of its range, where it reaches the far north of Scandinavia. It becomes less frequent towards the Mediterranean, where it has a patchy distribution throughout most of the Balkan Peninsula and in the driest regions of Spain and Italy, and is rare in large parts of Greece. It is present on only some of the Mediterranean islands including Corsica, Sicily, Crete and several Aegean islands.

Trend and conservation status

Enallagma cyathigerum is widespread in Europe and within the core of its range is one of the most common species encountered. There is no indication of any general decline although a decrease in abundance due to climate change may occur in parts of the Mediterranean.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
Red List EU27 - endemic	No
Red List Europe - endemic	No
Trend Europe	Stable

Habitat

Enallagma cyathigerum occurs at standing and slow-flowing waters and is especially common at sites lacking fish, such as acidic ponds and bogs, or at sites where belts of vegetation provide shelter from fish. It occurs at brackish waters and is one of several species that commonly reproduces in the Baltic Sea. It is able to endure cold climates, due to which it is not only found in the far north but is also present at high altitudes with populations in the Alps found well over 2 000 m.

Erythromma lindenii (Selys, 1840)

V.J. Kalkman & E. Dyatlova

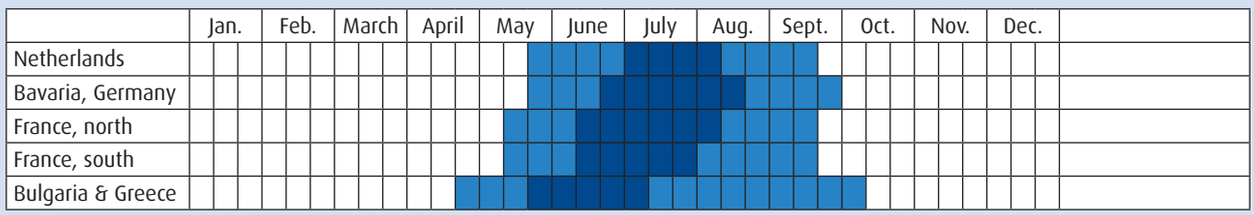
Taxonomy

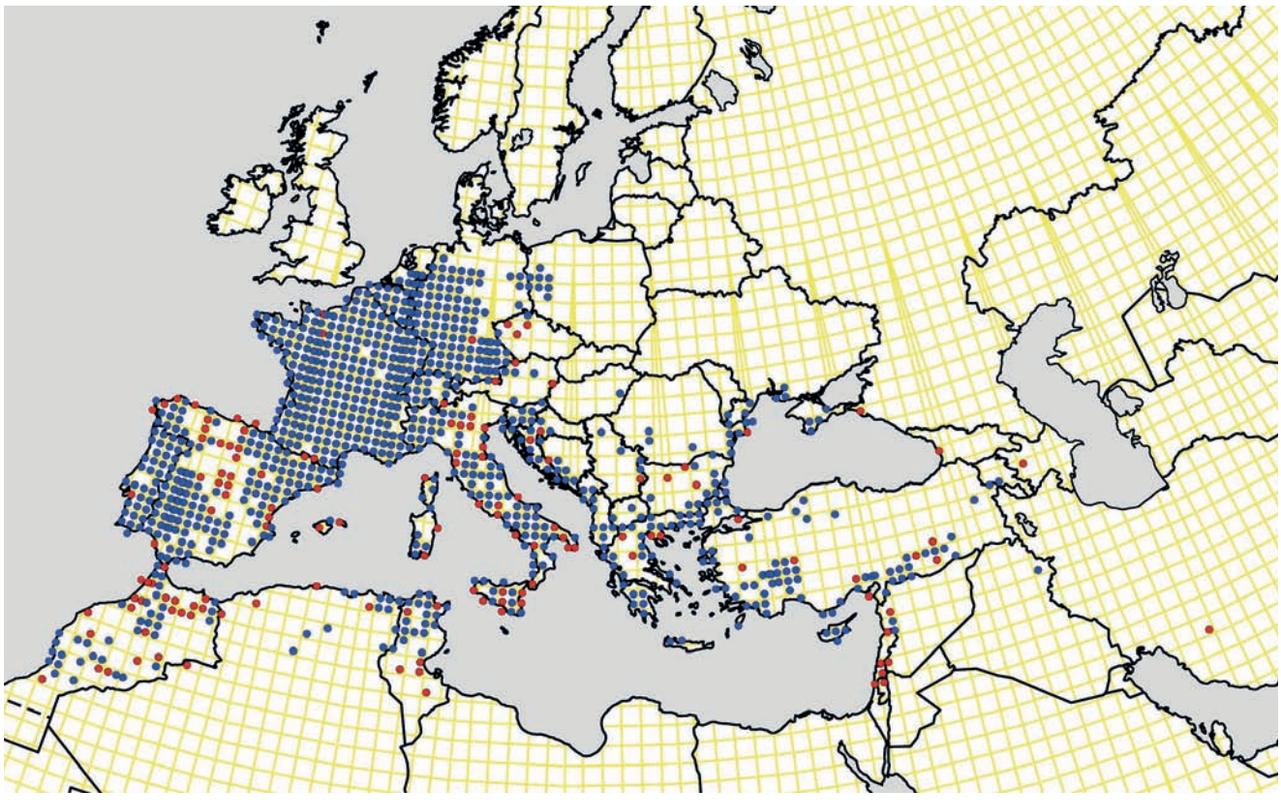
The subspecies *Erythromma lindenii lacustre* Beutler, 1985, which was applied to isolated sub-populations in eastern Germany and western Poland, is currently considered a synonym of the nominotypical subspecies (Bernard 2000a). The subspecies *E. lindenii zernyi* Schmidt, 1938, which occurs in the Middle East, is paler with segment eight almost devoid of black and the dorsum of the head with extensive pale markings (Dumont *et al*. 1995). For some populations it has been noticed that the spring specimens resemble *E. l. lindenii* while the summer specimens resemble *E. l. zernyi*. It is unclear if the two phenotypes represent genetically distinct subspecies with different times of larval development (Dumont *et al*. 1995) or are just seasonal morphs.

Distribution

World: *Erythromma lindenii* is an Atlanto-Mediterranean species with its main distribution in western Europe and the west-Mediterranean basin. It has a more scattered occurrence in the eastern parts of the Mediterranean and is scarce in large parts of the Balkan Peninsula and Turkey, with the easternmost records known from the southern Ukraine to the Caucasus,

Flight period





World distribution

Iraq (R. Porter, pers. com.) and Iran (Schmidt 1954, Heidari & Dumont 2002). *Erythromma lindenii* is common and widespread in the northern Maghreb and its southern limit is determined by the northern fringe of the Sahara. Populations of the pale subspecies *E. l. zernyi* occur from the south-east of Turkey to the Levant and Iran. Spring specimens from northern Iraq and south-east Turkey fit the nominotypical subspecies.

Europe: *Erythromma lindenii* is very common and widespread in the Iberian Peninsula, Italy, France and parts of Germany. Further north, it becomes scarcer, having its northern limit in the Netherlands and northern Germany. The species had for a long time an isolated occurrence in mid-eastern Germany (Brandenburg), western Poland and northern part of the Czech Republic (Beutler 1985, Waldhauser 2009). Due to its recent expansion in Germany, the gap between the central European enclave and other European populations is growing smaller and might completely disappear in the near future. In the rest of Europe, the species is largely confined to low elevations and to the Mediterranean fringes, extending along the Black Sea coast as far as the Crimean Peninsula (Khrokalo & Prokopov 2009, Khrokalo *et al.* 2009) and reaching the south of European Russia. *Erythromma lindenii* has expanded its range northwards by nearly 200 km from the 1990s onwards. This expansion has been noted in Belgium, the Netherlands, and northern Germany (De Knijf *et al.* 2006, Hunger *et al.* 2006, Bouwman *et al.* 2008) and was most likely caused by increasing temperatures during recent decades. It is unclear if the increase in records from south-east Europe also represents an expansion or is the result of changes in the available habitats or increased fieldwork.

Trend and conservation status

Erythromma lindenii is common and widespread in large parts of the Mediterranean, and has expanded northwards by almost 200 km since the 1990s. There is no indication of a decrease in the south.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	increasing

Habitat

Erythromma lindenii is found in running waters including large streams, connected oxbows, rivers, canals and larger standing waters such as lakes, (fish)ponds and gravel pits. Breeding habitats are generally large, largely unshaded with clear, oxygen rich water. The species is less common on fast-flowing waters; and in streams and rivers with a strong current it is often confined to areas where the flow is the weakest. In most cases there is a rich submerged aquatic vegetation with helophyte belts poorly developed or even absent. In fish-free waters, the presence of aquatic vegetation is of less importance, suggesting that the latter is mainly impor-

tant in providing shelter against predation. Standing waters where the species occurs are often influenced by wind, which generates waves, or are fed by seepage, both of which help to oxygenate the water and break down stratification. This produces conditions resembling to those found in running waters. Throughout its range, the species is confined to lower altitudes and most of the records are from below 500 m.

Erythromma najas (Hansemann, 1823)

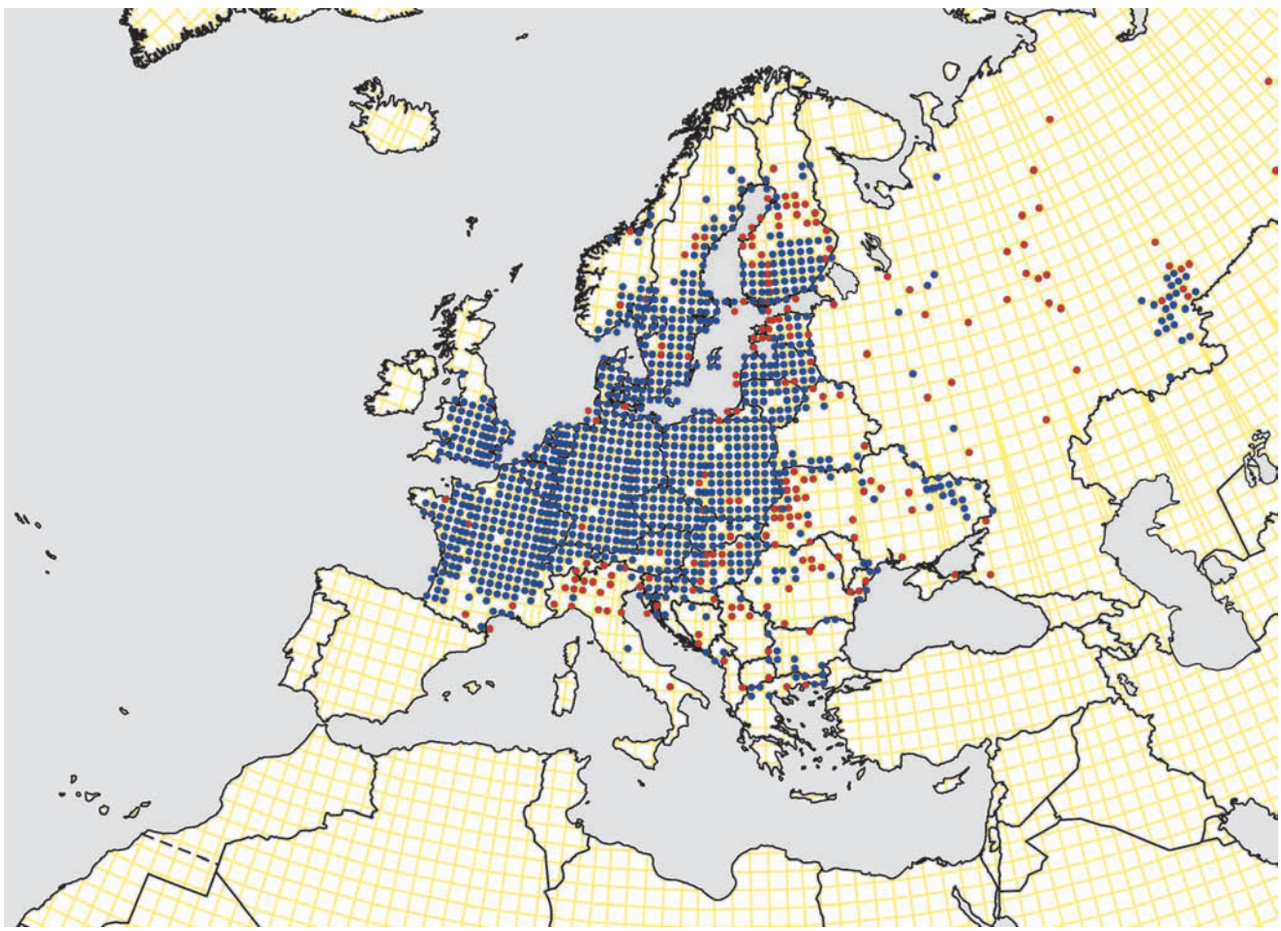
V.J. Kalkman, S. David & D. Šácha

Taxonomy

Two subspecies are known, with *E. n. najas* occurring in Europe and west Siberia. In central and eastern Siberia it is replaced by the subspecies *E. najas humerale* Selys, 1887, which extends to northern Japan. The latter differs from the nominotypical subspecies by having larger humeral stripes and some quantitative differences in larval morphology (Malikova & Kosterin 2009). There is however clear individual variation in the development of the humeral stripes and in many areas the two subspecies cannot be convincingly separated. *Erythromma n. humerale* is in some publications regarded a full species, but the evidence supports at most subspecies rank.

Distribution

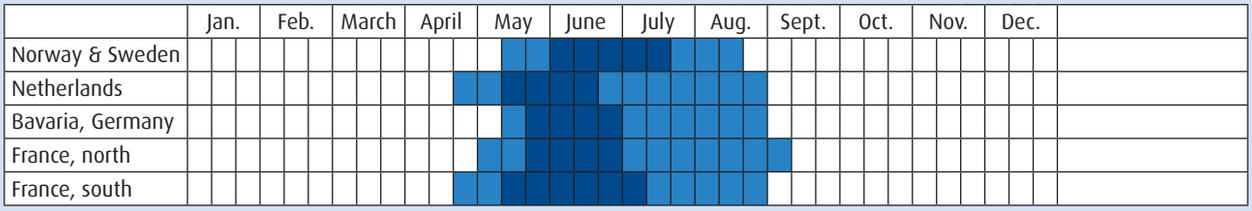
World: *Erythromma najas* occurs in the temperate zones of Europe and Asia and is found from the Atlantic countries to northern Japan in Hokkaido. It is largely absent from the southern parts of European Russia and does not occur south of the Caucasus.



European distribution

World distribution

Flight period



Records from Persia by Martin (1912) and from the Maghreb by Gadeau de Kerville (1908) and Martin (1910) are considered incorrect and are probably based on confusion with *E. viridulum*. In Asia, the southern limit of its range occurs in Kazakhstan, Mongolia and north-east China. The species is relatively common throughout most of its range.

Europe: The main European range of *Erythromma najas* lies in west, central and north-eastern Europe, where the species is common and widespread in the lowlands. It reaches northward to central Fennoscandia. In the British Isles it is limited to England and parts of north Wales with no confirmed records from Ireland. It becomes less common to the south in central Europe but is still fairly widespread in parts of southern France although it clearly declined in northern Italy. *Erythromma najas* is absent from the Iberian Peninsula, very rare in central and southern Italy, and known only from scattered records in the Balkan Peninsula. The situation in Romania and the Ukraine is not clear but it is likely to be common in the north.

Trend and conservation status

The species is common and abundant in most of its western and northern European range. In the south of its range it often occurs in isolated populations that might be affected by drought and poor water management. An example of an isolated and threatened population is that of Lago Monticchio in the south of Italy, which has been adversely affected by tourism development.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Near Threatened
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

Erythromma najas occurs at largely unshaded, standing or slow-flowing eutrophic to mesotrophic waters, and more rarely and in smaller numbers in oligotrophic waters. An important characteristic of the habitat is the presence of stands of floating leaves of waterlilies (*Nuphar lutea, Nymphaea alba*) or pondweeds (*Potamogeton*). The species occurs less often in situations with mainly submerged aquatic vegetation that emerges periodically from the water, such as watermilfoil (*Myriophyllum*) and hornworts (*Ceratophyllum*). It is absent from waters devoid of aquatic vegetation. Most reproductive habitats are close to taller vegetation such as trees or hedges and the species is generally absent from open windy areas. It occurs mostly in areas below 500 m and is rare above 1 000 m.

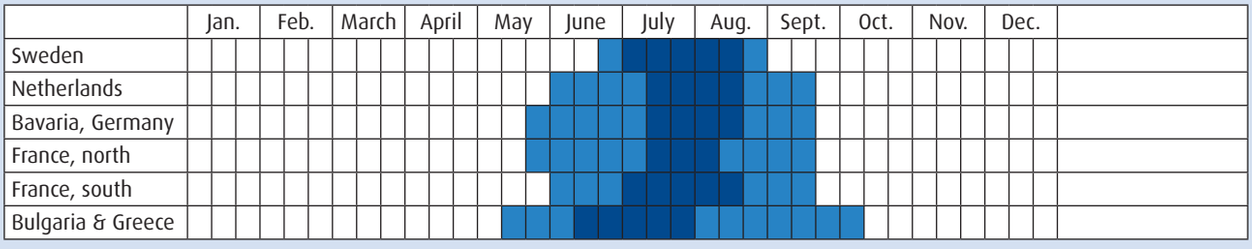
Erythromma viridulum (Charpentier, 1840)

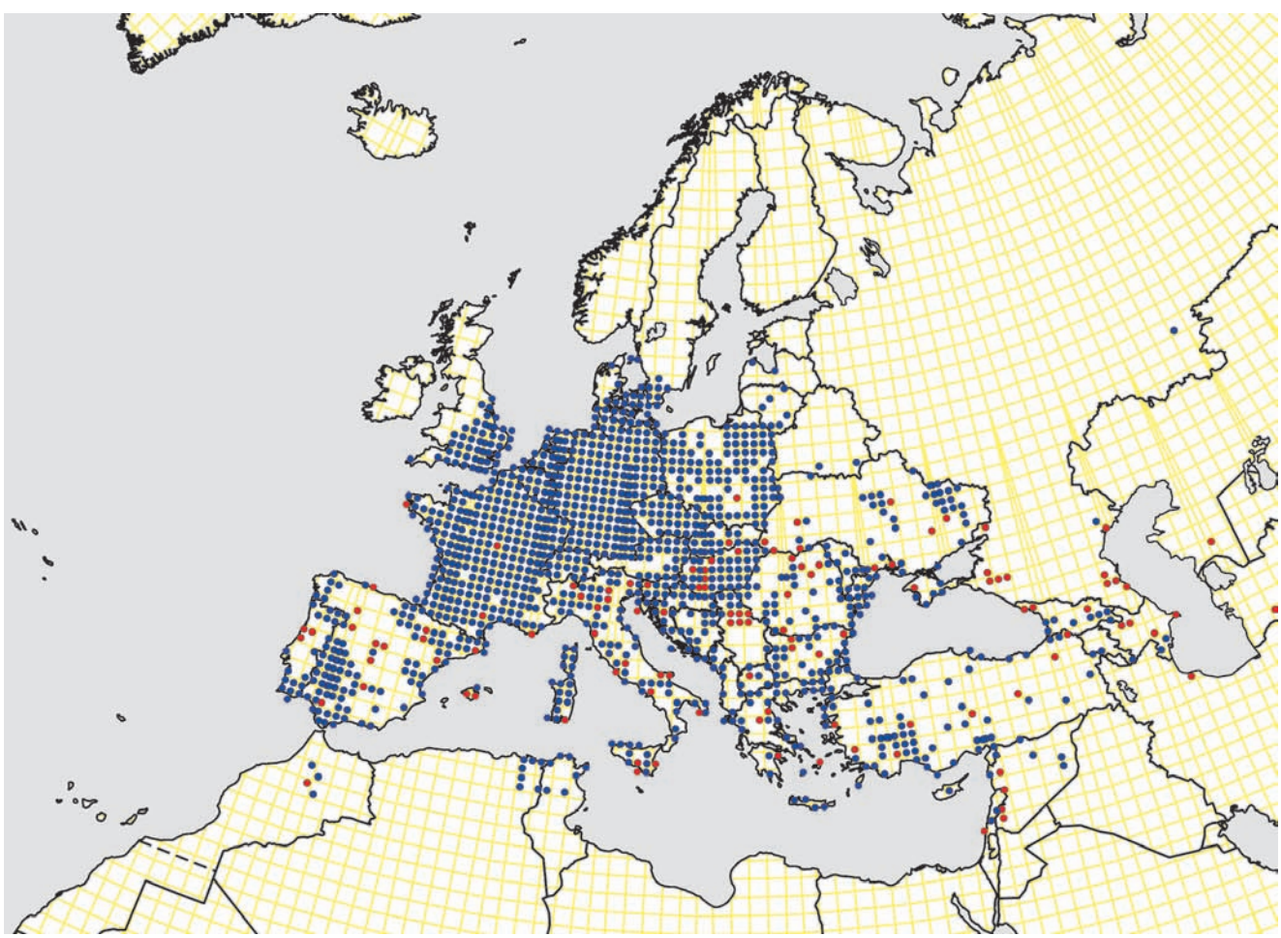
V.J. Kalkman & T. Bogdanovic

Taxonomy

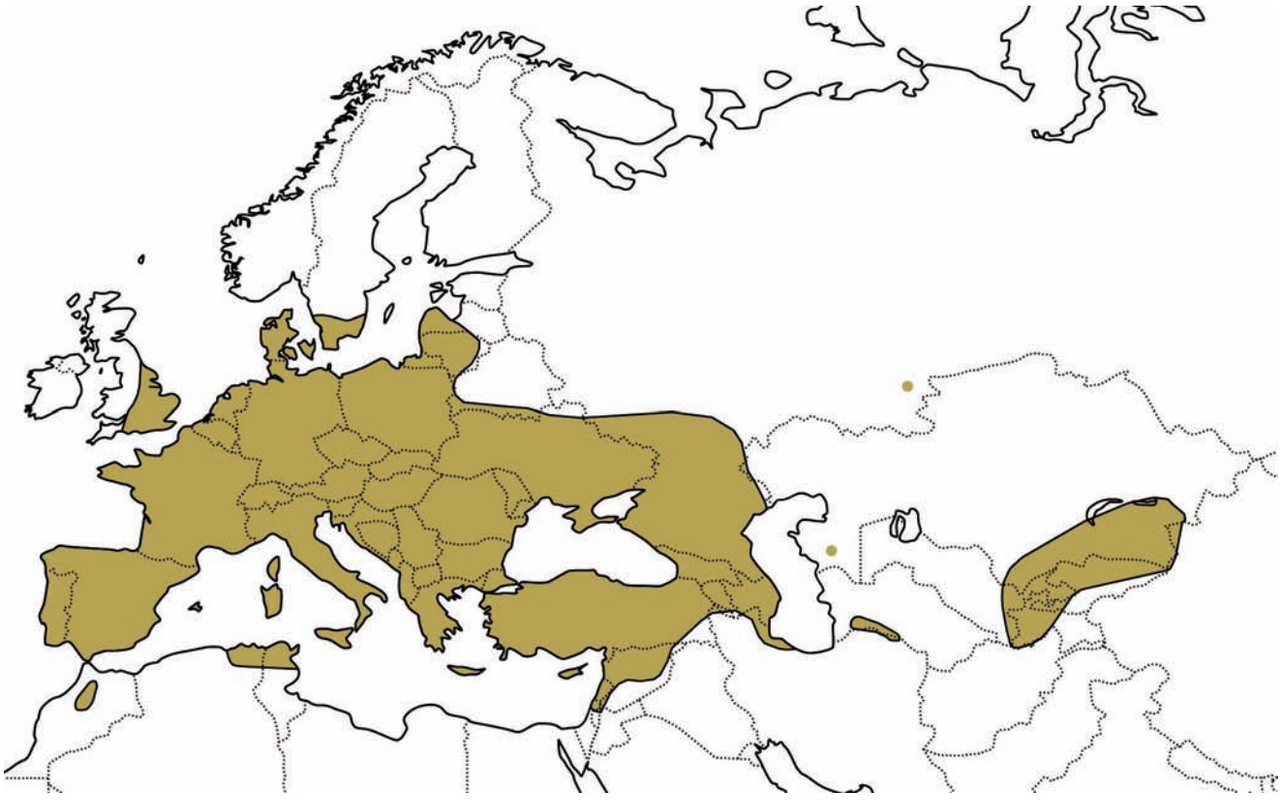
The subspecies, *Erythromma viridulum orientale* Schmidt 1960, was described from Syria. It is mainly characterized by having more pronounced ante-humeral stripes and small yellow-brown ante-ocellar spots on the head. Boudot & Jacquemin (1988) pointed out that several west European and Moroccan populations are closer to the Syrian specimens reported by Schmidt than to some central European populations, meaning these variations represent only intra-species variability, and subspecies *E. v. orientale* is therefore a junior synonym of the nominotypic race.

Flight period





European distribution



World distribution

Distribution

World: E*rythromma viridulum* has a large European distribution with a continuous range eastwards to the Caspian Sea. More to the east, it is found from the south-west of Turkmenistan to south-eastern Kazakhstan but seems to be largely absent from the desert areas of Central Asia. It extends south to the Levant and occurs locally in the Maghreb.

Europe: The main range of *E. viridulum* is in south and west Europe where the species is common and widespread. An expansion of its range has taken place since the 1970s, which, since the 1980s, has extended over 100-500 km northwards. It was recorded as new to Great Britain (1999), Denmark (2001), Sweden (2004), Belarus (2005) (Buczyński & Moroz 2008), Lithuania (2007) (Gliwa & Stukonis 2011) and Latvia (2008) (M. Bulte pers. com., R. Matrozis & M. Kalnins pers. com.). Prior to 1970 this species was scarce in the Netherlands, with only a few dozen records, but presently it is the second most common damselfly. This range expansion might be linked with increased temperatures, but the species might also have benefited from nitrogen enrichment of aquatic habitats by aerial deposition. The species has a scattered occurrence in parts of the Balkan Peninsula and Ukraine and relatively few records are known from European Russia, probably due to poor sampling.

Trend and conservation status

The species is widespread and common in large parts of Europe and is currently expanding its range northwards. It is not unlikely that it will decrease in parts of southern Europe due to increased drought.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Increasing

Habitat

Erythromma viridulum is found in largely unshaded, standing or slow-flowing, waters with aquatic vegetation, including brackish waters. It often co-occurs with *E. najas* at habitats with large floating leaves. In contrast with this species, however, it is especially common at waters with rich, fine-leaved, aquatic vegetation such as waterweed (*Elodea*), hornwort (*Ceratophyllum*), watermilfoil (*Myriophyllum*) and mats of algae on the water surface.

Ischnura aralensis Haritonov, 1979

J.-P. Boudot & R. Bernard

Taxonomy

Ischnura aralensis is unusual compared with other Palaearctic species of *Ischnura* in having two morphs of the female differing both in coloration and in the structure of the lamina mesostigmalis, with one morph having the lamina mesostigmalis structurally similar to males. These different female morphs led to confusion resulting in the description of *I. haritonovi* Dumont, 1997, which was later shown to be a synonym of *I. aralensis* (Yanybaeva *et al*. 2006).

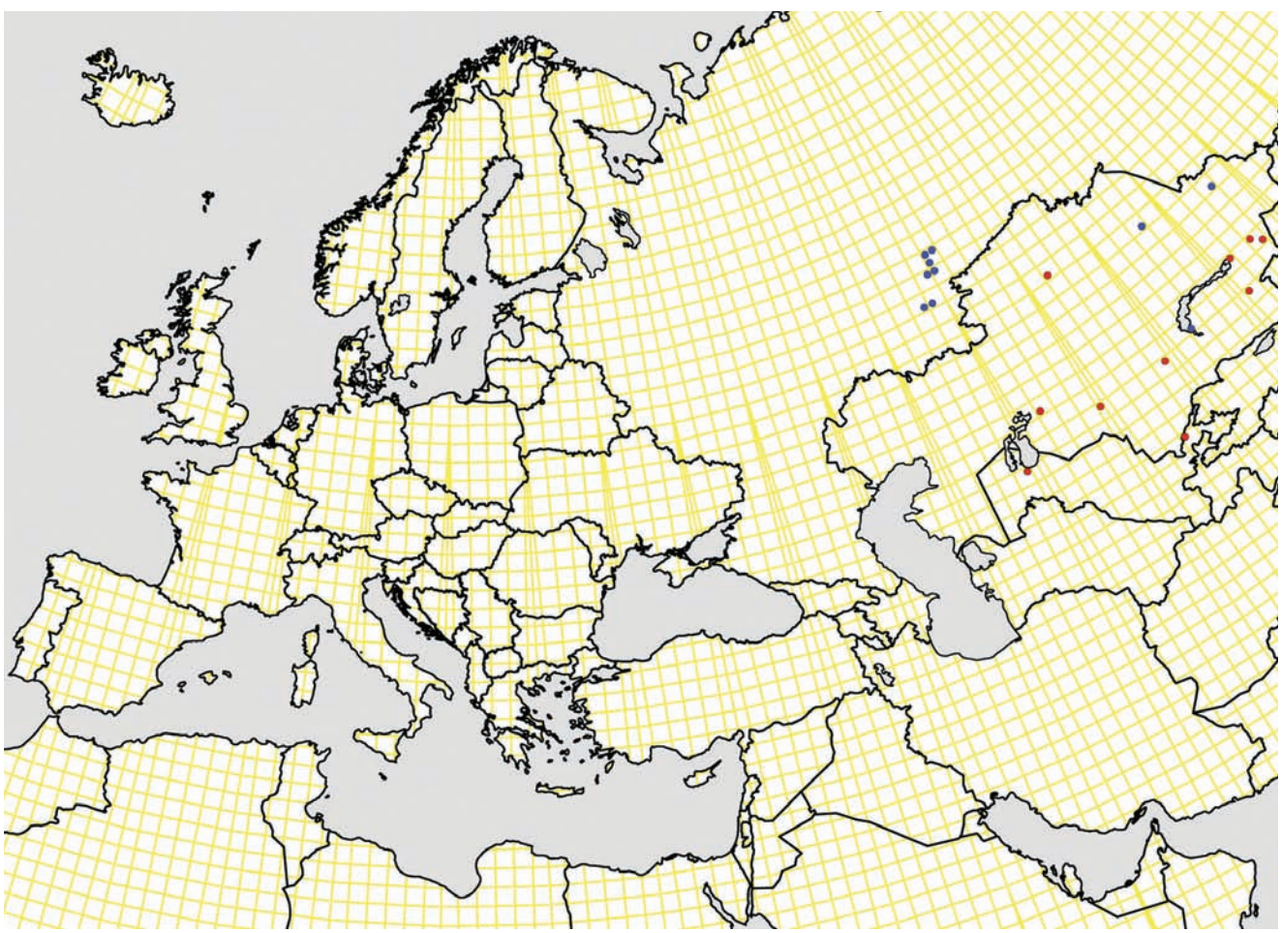
Distribution

World: The range of *Ischnura aralensis* is roughly centred on Kazakhstan, extending from the southern Urals and the Aral Sea (Kazakhstan and Uzbekistan) eastwards to Lake Balkhash and the western foothills of the Altai Mountains (Yanybaeva *et al*. 2006, Borisov & Haritonov 2007, Haritonov & Eremina 2010). In addition to a concentration of sixteen localities in the southern Urals, ten localities are scattered over Kazakhstan and two are known from Uzbekistan. This distribution pattern, with widely scattered and disjunct areas of occurrence, separated by arid and semi-arid steppe landscapes, is believed to have resulted from the occurrence of an originally continuous range during a favourable wet period in the Holocene (9 000-3 000 BP), followed by its fragmentation during the subsequent desertification of the area (Yanybaeva *et al*. 2006).

Europe: *Ischnura aralensis* is known from only nine localities from the Bashkortostan Republic in the southern Urals. Haritonov & Eremina (2010) concluded that the species has increased since its first European record in 1997 by Yanybaeva (1999b) and reported that it is now fairly common within the surveyed part of the southern Urals. Large parts of the south-east of European Russia are underexplored for odonates and it is possible that the species is more widespread than currently known.

Flight period

Known dates for adults range from May to August (Haritonov & Eremina 2010).



World distribution

Trend and conservation status

Ischnura aralensis seems to have decreased over recent decades in Kazakhstan and Uzbekistan, due to natural drought and human-induced desiccation of the tributaries of the Aral Sea through cotton cultivation. The species is considered extinct at the Aral Sea and in the Syr Darya valley. It seems, however to be expanding its range in the southern Urals and is considered fairly common, both on the European and Asian sides. Although it was assessed as Data Deficient on the European Red List, further fieldwork will probably show this species to be of Least Concern.

Habitats Directive	No
Red List EU27	Not Evaluated
Red List Europe	Data Deficient
Red List Mediterranean	Not present
EU27 endemic	No
European endemic	No
Trend Europe	Increasing

Habitat

Details on the species habitat are sparse. In Europe, *Ischnura aralensis* is known only from lake shores.

Ischnura elegans (Vander Linden, 1820)

J.-P. Boudot & A. Šalamun

Taxonomy

Several subspecies have been described (Schmidt 1939, 1967) but have subsequently received very little attention from field workers so that their distribution is poorly known. Of the European subspecies, *I. e. elegans* (most of Europe), *I. e. ebneri* (approximately southern Italy, Crete, Cyprus and Asian Turkey) and, to a lesser degree, *I. e. pontica (*approximately from the Hungarian Plain and northern Balkans in the west to Central Asia), are presently widely accepted. However, their distribution is poorly understood and conflicting, and a thorough study based on morphological and molecular techniques is needed.

Distribution

World: *Ischnura elegans* occurs from western Europe to Japan.

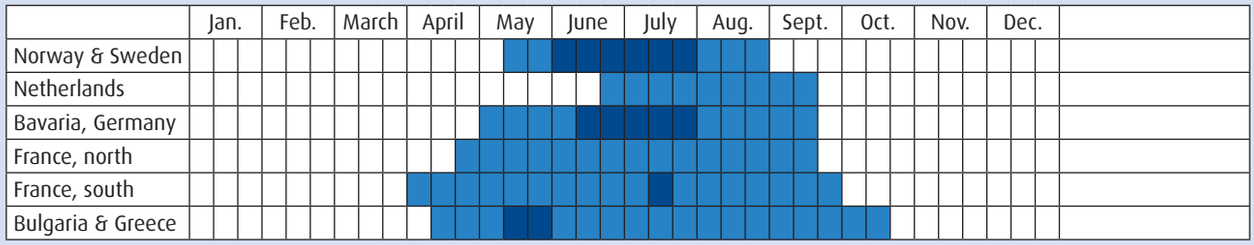
Europe: *Ischnura elegans* is widespread and is one of the most common and abundant damselflies in Europe. Its range overlaps with *I. graellsii* in parts of the Iberian Peninsula and the species is largely replaced by *I. genei* on the Tuscan archipelago, the Tyrrhenian islands and the Maltese islands, although locally both species occur sympatrically and appear to produce hybrids.

Trend and conservation status

The species has expanded its range in Great Britain by about 140 km northwards since 1970, which has been attributed to global warming (Hickling *et al.* 2005). *Ischnura elegans* has in parts of Europe probably profited from eutrophication of habitats although this is poorly documented. A decline in abundance of 47 % in the period 1999-2009 was found in the Netherlands and could be caused by the decrease in eutrophication, in which case the decline of the species should be interpreted as a sign of improved habitat quality (Termaat & Kalkman 2012).

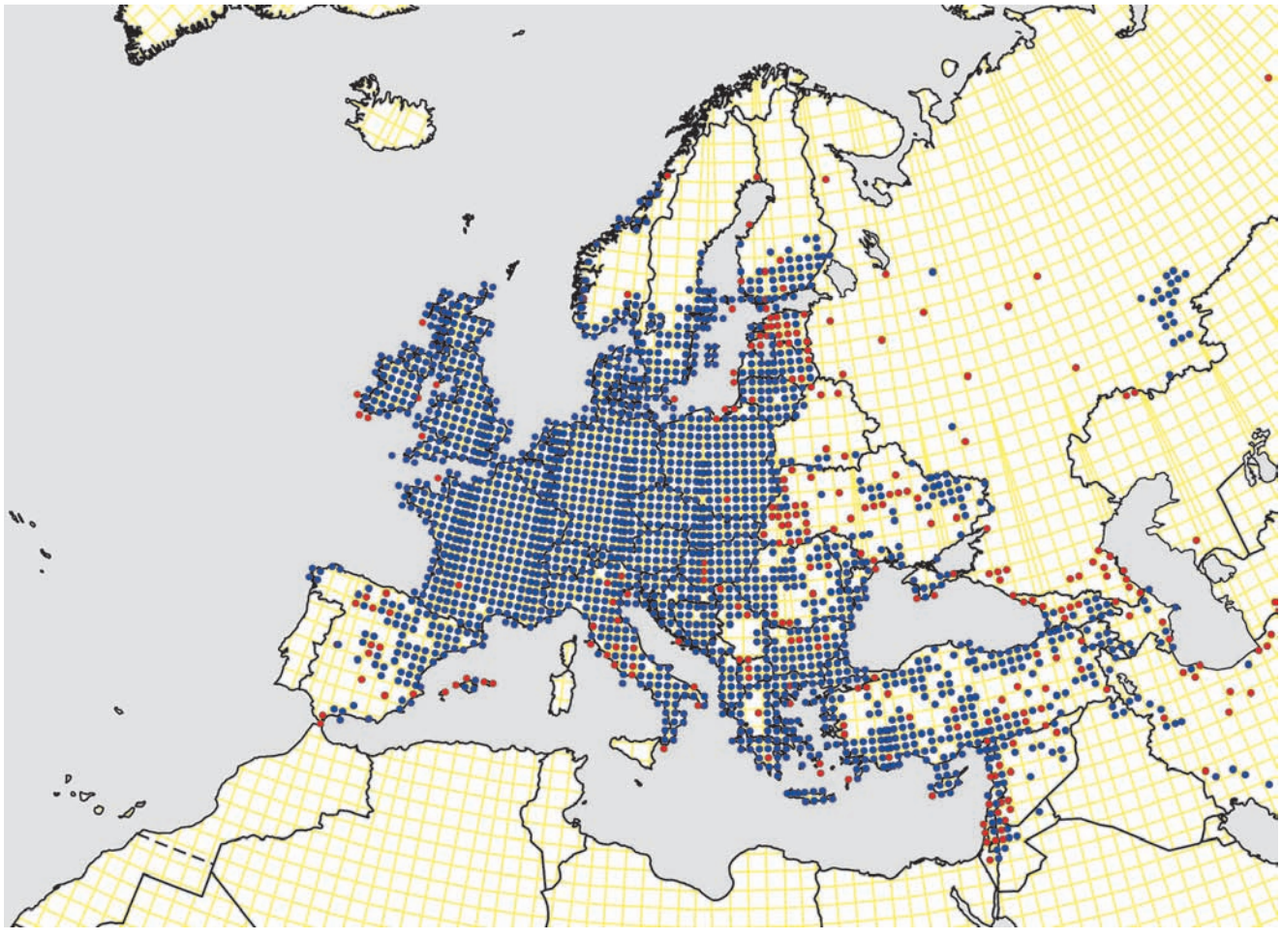
Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Flight period



Habitat

In large parts of Europe *Ischnura elegans* is the most common damselfly, being found in all kinds of standing and slow-flowing waters. It is very common on mesotrophic to eutrophic sites and is tolerant to rather high salinity and moderate acidity. The species is found from lowlands up to 1 600 m.



European distribution

World distribution

Ischnura fountaineae Morton, 1905

J.-P. Boudot , E. Riservato & S. Hardersen

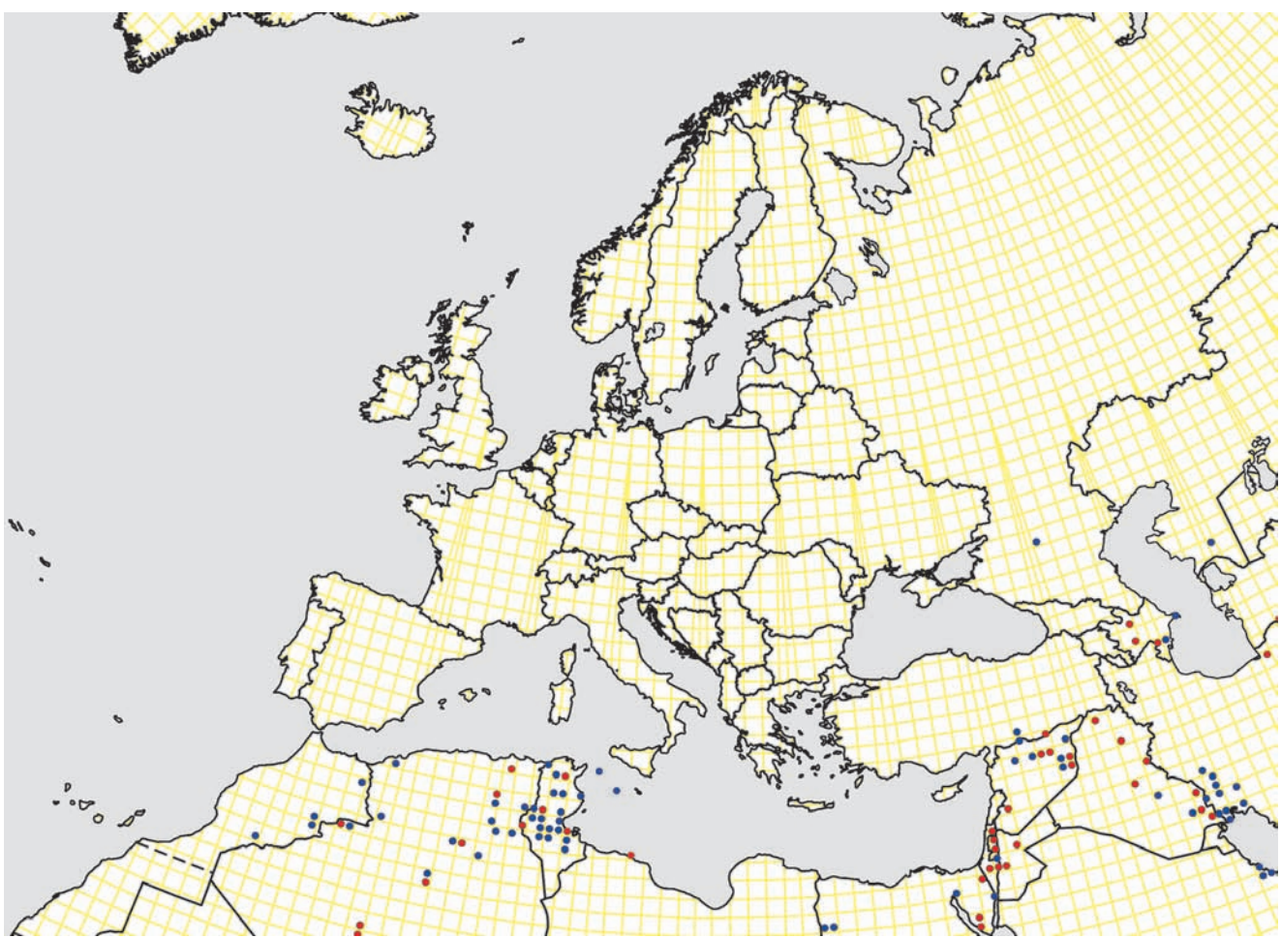
Distribution

World: *Ischnura fountaineae* ranges from North Africa and the Middle East to Central Asia and is generally common and often abundant within its range. The easternmost records are from Kazakhstan and western China (Ris 1897 as *I. senegalensis*).

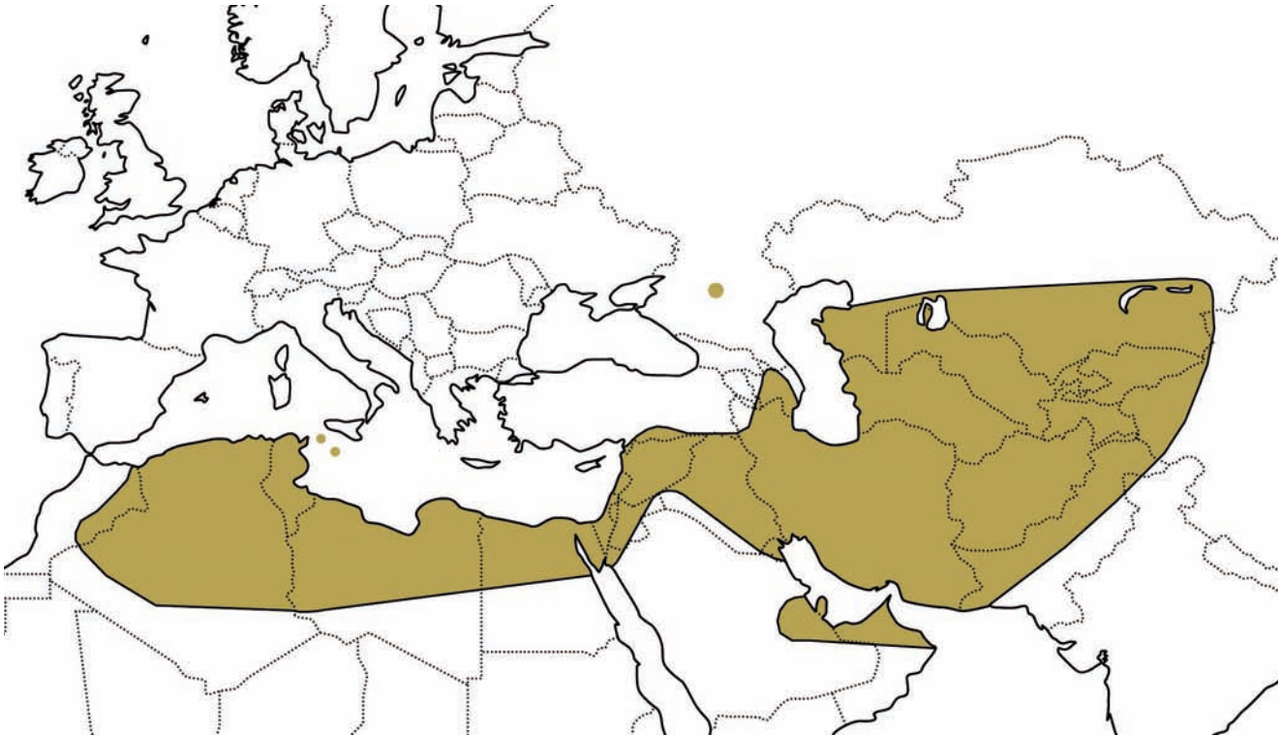
Europe: This species is only known from the Kalmykia Republic in the south of the European Russia and from the small Italian islands of Pantelleria and Linosa (Lohmann 1989, Utzeri & d'Antonio 2005, Skvortsov & Kuvaev 2010, Corso *et al*. 2012). At Pantelleria the species is abundant at Specchio di Venere (also known as Bagno dell'Acqua), a hot sulphurous crater lake where it was first collected in 1954. The only record from Linosa, an island lacking in natural surface water, is that of a teneral female caught in 2010, which either refers to a vagrant or a specimen originating from a local population from one of the few man-made water dams on the island. The single reliable record from mainland Europe is that of one male collected in 2007 in Kalmykia Republic in southern European Russia (Skvortsov & Kuvaev 2010). Other Russian records, from Dagestan, are unreliable as they refer to incomplete specimens.

Trend and conservation status

Specchio di Venere, which is home to the only confirmed European breeding population, is listed as a nature reserve but is nonetheless under anthropogenic pressure with many people swimming in the lake or walking along the edges trampling the vegetation. Corso *et al*. (2012) suggested restricting access to the best preserved part of the area. Monitoring from 2006 to 2012 revealed no negative trend (Corso *et al*. 2012). It is likely that the record from southern European Russia also relates to a breeding population and it



European distribution



World distribution

Flight period

The species is mostly bivoltine in north Africa, with adults found throughout the year but with peaks of emergence in spring and autumn. The earliest emergence on Pantelleria was found in the first half of May despite searches being conducted in April. No tenerals could be observed by August, suggesting the species is largely univoltine at its northern extremity (Corso et al. 2012).

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Maghreb													

could be that the species is more widely distributed in the steppe areas of the southern parts of European Russia than presently known.

Habitats Directive	No
Red List EU27	Vulnerable
Red List Europe	Vulnerable
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Unknown

Habitat

Ischnura fountaineae favours brackish waters in arid to semi-arid areas (wadis, oases and coastal wetlands, hot thermal waters). The larvae of *I. fountaineae* are tolerant to high salinity (up to e.g. 2.3 % in both Pantelleria and Tunisian brackish brooks) and high water temperatures, allowing the species to live permanently in Pantelleria crater lake, which is fed by sulphurous springs reaching 56 °C with the water at the shore sometimes reaching 50 °C. Adults were found to be abundant in the sparse belt of rushes surrounding the lake.

Ischnura genei (Rambur, 1842)

J.-P. Boudot & G. Degabriele

Distribution

World: *Ischnura genei* is an insular species endemic to the western Mediterranean.

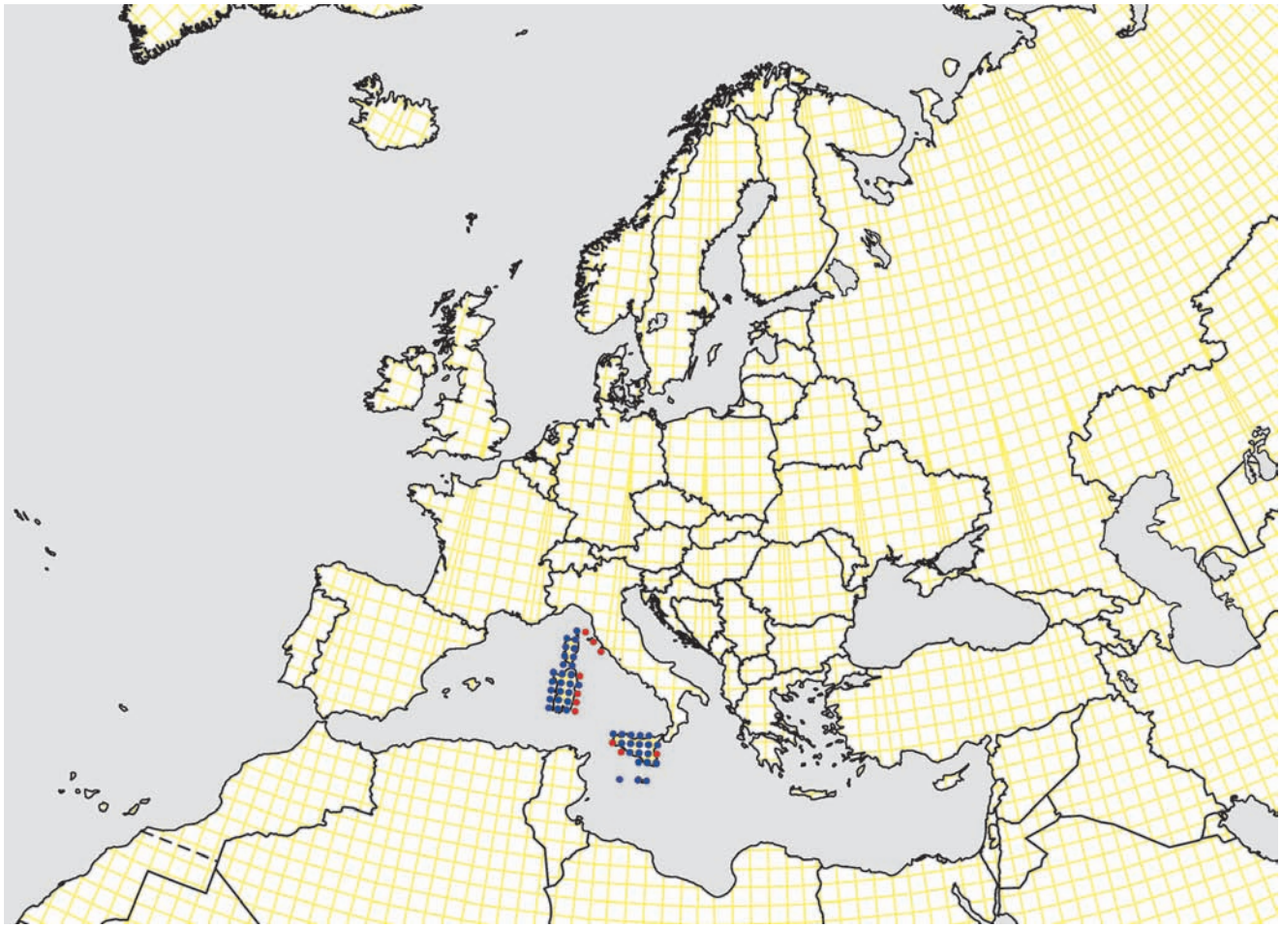
Europe: *Ischnura genei* is endemic to the Tuscan archipelago and the Tyrrhenian and Maltese islands, and is common and widespread within its range. It is absent from mainland Europe and replaces *I. elegans* on the above islands, except in Giglio where both species cohabit. A male and female were caught on the Italian island of Linosa, between the Maltese islands and the Tunisian coast, in 2010 (Corso *et al.* 2012). Whether they belonged to a local population breeding in the few man-made water tanks present on the island or were vagrants is unknown.

Trend and conservation status

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	Endemic
European endemic	Endemic
Trend Europe	Stable

Flight period

The flight period of *I. genei* ranges from March to the end of October.



World distribution

Habitat

Ischnura genei breeds in all kinds of standing waters and sometimes in slow-flowing rivers and ditches up to 1 000 m. This species usually frequents water bodies rich in surrounding vegetation. Like *I. elegans*, it is capable of breeding in waters with relatively high salinities, and larvae have been recorded from brackish water (Degabriele, 2013).

Ischnura graellsii (Rambur, 1842)

J.-P. Boudot & S. Ferreira

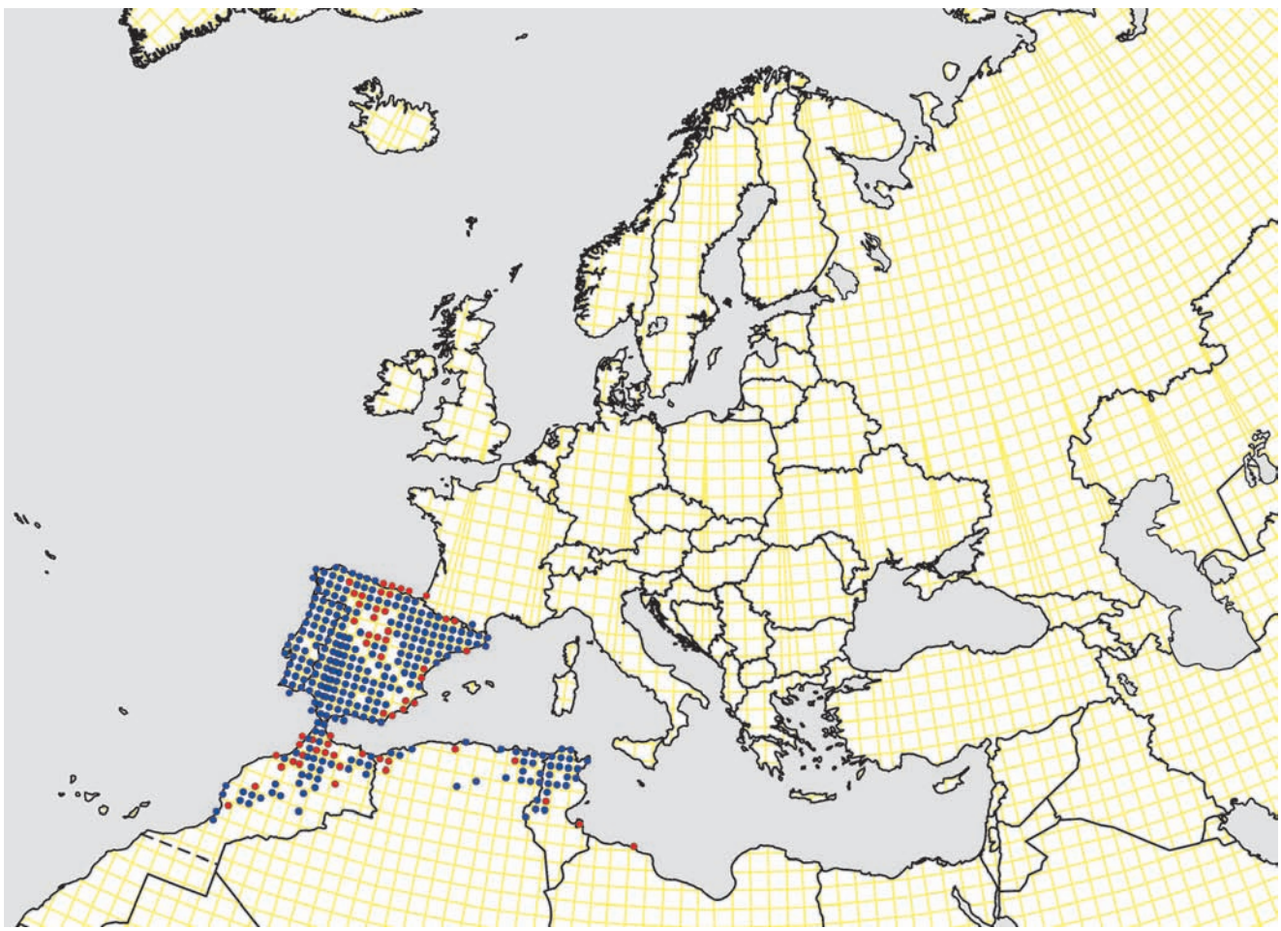
Distribution

World: *Ischnura graellsii* is endemic to the Iberian Peninsula and the Maghreb. In North Africa it is limited to the northern parts of Morocco, Algeria, Tunisia and north-west Libya, being replaced by *I. saharensis* in the more arid inland areas to the south.

Europe: The European populations of *Ischnura graellsii* are presently confined to the Iberian Peninsula. Records from the south-west of France at ca 15 km north of the Spanish border (1913) by Morton (1925) cannot be checked but are believed to be correct. In 2015 a population was found in the French part of

Flight period

The flight period of *I. graellsii* extends from early March to December. The species is bivoltine on the northern half of the Iberian Peninsula, trivoltine in Andalusia and quadrivoltine on the Atlantic coast of Morocco, where it is on the wing all year round.



World distribution

Cerdagna, eastern Pyrenees (Louboutin *et al.* 2015). Records published for Sardinia (Burmeister 1989) refer to misidentifications.
Unidirectional hybridization between females of *I. graellsii* and males of *I. elegans* has been observed in the north of Spain, where the ranges of both species overlap. Hybrids are fertile and backcross with *I. elegans*. This unidirectional hybridisation might lead to a progressive introgression of *I. elegans* genes in *I. graellsii* (Monetti *et al.* 2002; Sánchez-Guillén *et al.* 2011). Nevertheless, even though both species hybridize in many areas of the Iberian Peninsula, there are strong pre-mating mechanical barriers that help to maintain significant reproductive isolation (Sánchez-Guillén *et al.* 2012).

Trend and conservation status

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

Ischnura graellsii is found in a wide variety of habitats, including running, standing and brackish waters. The species has been found up to 1 300 m.

Ischnura hastata (Say, 1839)

J.-P. Boudot & M.O. Lorenzo-Carballa

Distribution

World: *Ischnura hastata* is native to the American continent, where it is widespread and common in North and Central America, the Caribbean and the Galapagos Islands, occurring as far south as Venezuela, Colombia and Ecuador and north to Canada. The species is common over most of its range and is often found in high densities. It is a strong disperser, a trait that has allowed it to colonise isolated islands groups as the Galapagos and the Azores archipelagos.
Europe: Within Europe, *I. hastata* has been found only in the Azores archipelago, where it is widely distributed and locally common. It is thought that only females are present and all populations in the Azores reproduce by parthenogenesis (Cordero Rivera *et al.* 2005, Lorenzo-Carballa & Cordero Rivera 2009). Populations have been recorded at ca. 35 localities ranging from 500 to 5000 females at favourable localities. The species is found on all islands of the archipelago with the exception of Graciosa. On Santa Maria it is very rare as suitable habitat is nearly absent.

Trend and conservation status

Although *Ischnura hastata* is still widespread and common in the Azores, it is threatened by the increase in cattle density leading to the destruction of fringing vegetation in its habitats by trampling and grazing, and to eutrophication, which results in blooms of cyanobacteria. The increased intake of water by cattle leads to lower water levels and results in ponds without emergent vegetation at the water edge. This has led to some local populations disappearing in recent decades (Lorenzo-Carballa *et al.* 2009). For these reasons, the species is listed as Vulnerable on the European Red List.

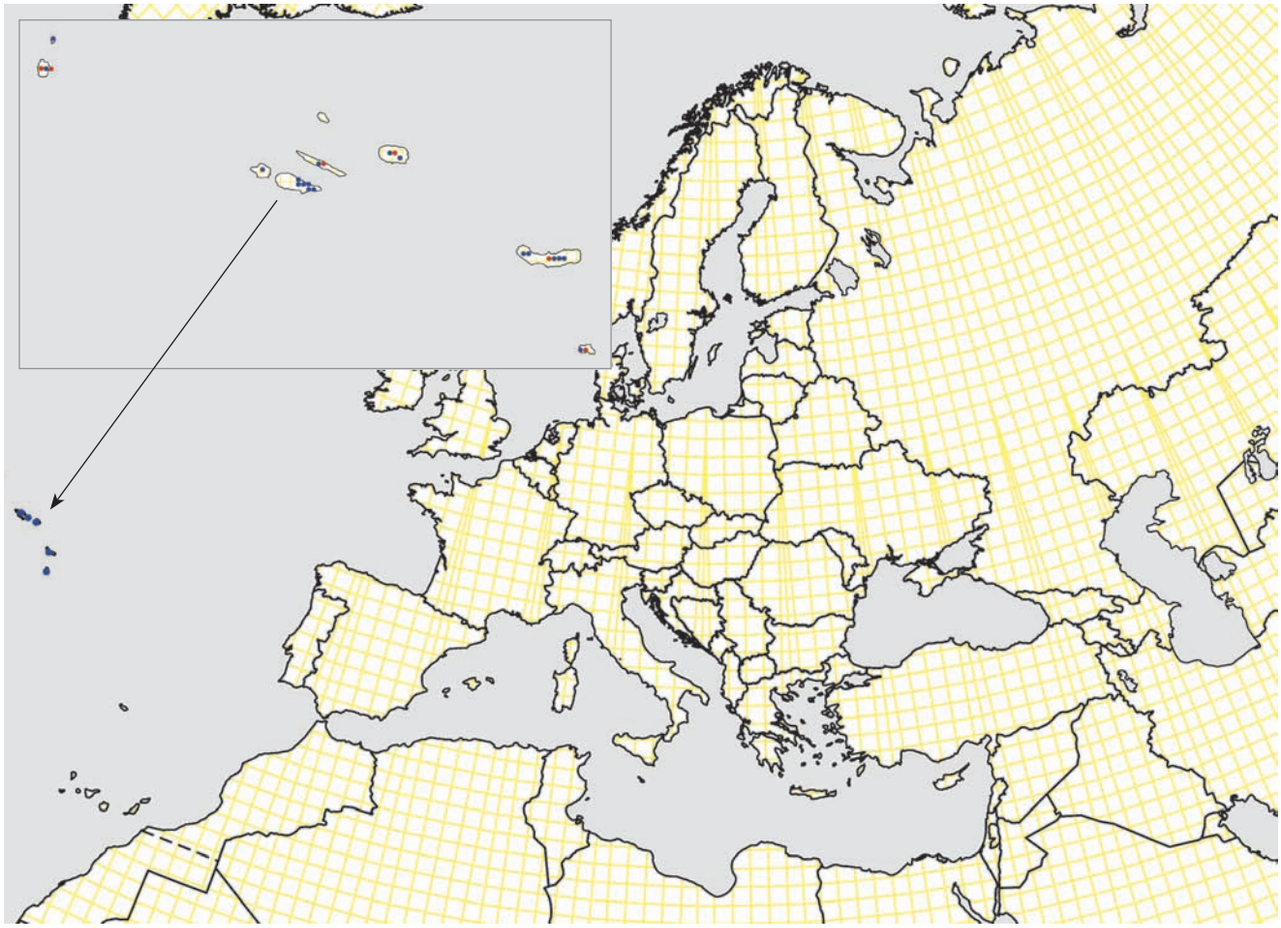
Habitats Directive	No
Red List EU27	Vulnerable
Red List Europe	Vulnerable
Red List Mediterranean	Not present
EU27 endemic	No
European endemic	No
Trend Europe	Decreasing

Habitat

In the America's, *I. hastata* is found at well vegetated parts of lakes and ponds as well as in ponds, swamps, ditches and seepage waters overgrown with rushes. The species occurs also at temporary ponds and in brackish waters. This wide ecological tolerance means

Flight period

The species is on the wing throughout the year in the tropical parts of the America's (Paulson 2009) and has been recorded from mid-March to early September in the Azores.



European distribution. The inset shows its distribution in the Azores archipelago based on a 5 by 5 km grid.

World distribution

it can be found at a wide variety of well vegetated waters (Dunkle 1990). In the Azores, the species is found from sea level to 850 m, where it inhabits mostly permanent ponds and lakes with a rich vegetation of pondweeds (*Potamogeton*), spikerushes (*Eleocharis*) and other hydrophytes, surrounded by well-developed vegetation on the banks. On São Jorge, the species has been recently reported to occur at a brackish pond (A. Cordero-Rivera, pers. com.). In the Azores, *I. hastata* is prone to local extinction by eutrophication of the water, when grazing and trampling by cattle lead to the degradation of the bank side belt of grasses (Lorenzo-Carballa *et al.* 2009). The low genetic variability of these parthenogenetic populations could be the reason why they are unable to adapt to eutrophic conditions (Lorenzo-Carballa *et al.* 2009).

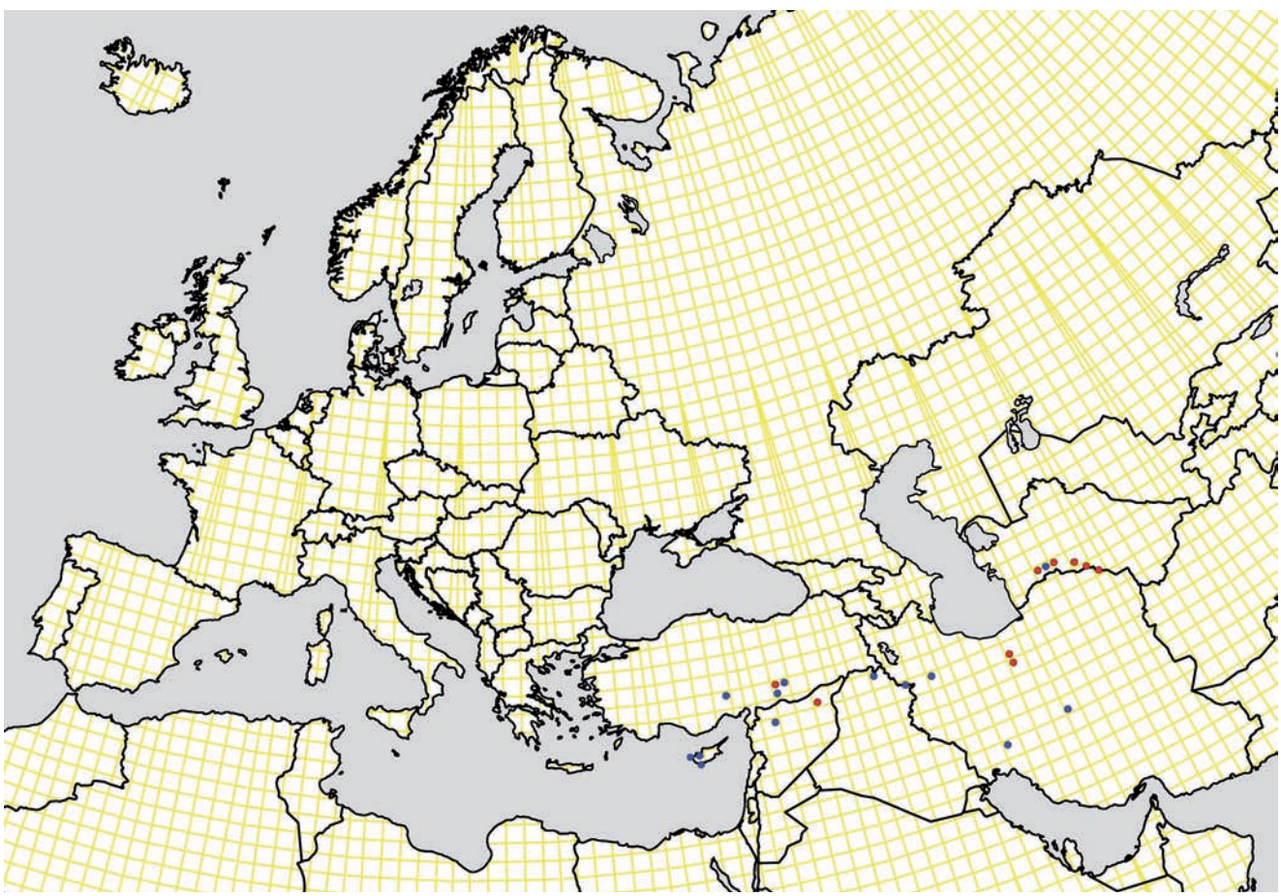
Ischnura intermedia Dumont, 1974

G. De Knijf & D.J. Sparrow

Distribution

World: The range of *Ischnura intermedia* is restricted to Southwest Asia and Cyprus. The species seems to be generally uncommon within its range with only 23 localities known from Cyprus, south-central Turkey, northern Syria, northern Iraq, Iran and the region of the Kopet Dagh in southern Turkmenistan (Dumont 1974, Dumont *et al.* 1988, Dumont & Borisov 1995, Schneider & Krupp 1996, Heidari & Dumont 2002, Salur & Kiyak 2006, Borisov & Haritonov 2007, Kiany & Sadeghi, 2012a, b, Ghahari *et al.* 2012, Bakhshi & Sadeghi 2014, De Knijf *et al.* (submitted), various unpublished records on Observado.com). In the south of its range, the species extends well into the Zagros mountains at least partly profiting from man-made irrigation channels. It is replaced by its sister taxon, *I. forcipata* Morton, 1907 in Central Asian and to the east of the Central Iranian deserts. Both species are believed to share a common ancestor, of which the range became fragmented by the desertification of Central Asia and parts of Iran since the early quaternary.

Europe: *Ischnura intermedia* was discovered in Europe in 2013 and has since been found at three river valleys in the south-west of Cyprus, especially the Diarizos basin (De Knijf *et al.* submitted). There is no reason to assume that it is a new arrival to the island, rather the species was most probably overlooked during previous surveys. *Ischnura intermedia* is an inconspicuous taxon



World distribution

Flight period

Ischnura intermedia has a long flight period in Cyprus, extending from the end of March until mid-November with at least two generations a year. Data from the Middle East point to a similar flight period, with records available from 26 April to 27 October.

which can easily escape to attention and alternatively be confused with other species of *Ischnura*.

Trend and conservation status

Following its initial discovery in Cyprus several sites were found where the species was moderately common with up to a few dozen individuals per site. The species was found to disappear at sites that dry up during the summer months and from two seasons of observations it appears that reasonable sized populations are only found at sites that have permanently water. Increase of warmer summers and drier winters linked to global warming are therefore likely to impact the species throughout its range. The construction of dams might also be a serious threat to the species, as shown by the loss of the type locality in Turkey, which became flooded due to the construction of the Ataturk dam. For these reasons, *I. intermedia* was classified as Near Threatened at the world scale by the IUCN (Boudot 2014c, Boudot & Kalkman 2014)

Habitat Directive	No
Red List EU27	Not Evaluated
Red List Europe	Not Evaluated
Red List Mediterranean	Data Deficient
EU27 endemic	No
European endemic	No
Trend Europe	Unknown

Habitat

In Cyprus, *Ischnura intermedia* seems to be confined to small channels adjacent to streams and rivulets where the current slows and water is retained. Marshy and small swamps occur locally in the streambed and taller grasses, such as southern reed (up to 4 m) is growing adjacent to the stream. This seems to be in accordance with the limited information available on its habitat in Southwestern Asia (Dumont 1974, Kiany & Sadeghi 2012b).

Ischnura pumilio (Charpentier, 1825)

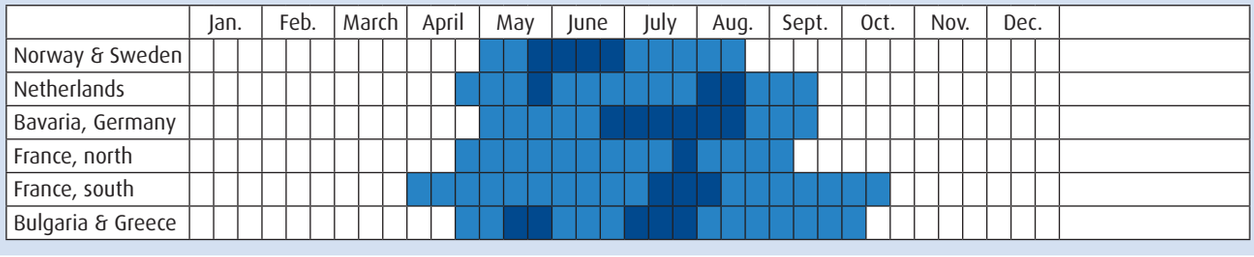
J.-P. Boudot & A. Šalamun

Distribution

World: *Ischnura pumilio* is largely confined to the Western Palaearctic, although it extends across Mongolia and Inner Mongolia up to the north-east of China (Dumont 1996, 2003). The species is common in south-west Asia although it is absent from the more arid parts of this region. Old records from Iraq are erroneous and refer to *I. evansi* (Schneider 1986). The first validated record from Iraq is from 2014 when it was collected in the north of the country (H.J. Groenenberg & P. Krijnen *in litt.*). In Africa, *I. pumilio* is scattered in the north of the Maghreb, in both inland and coastal situations.

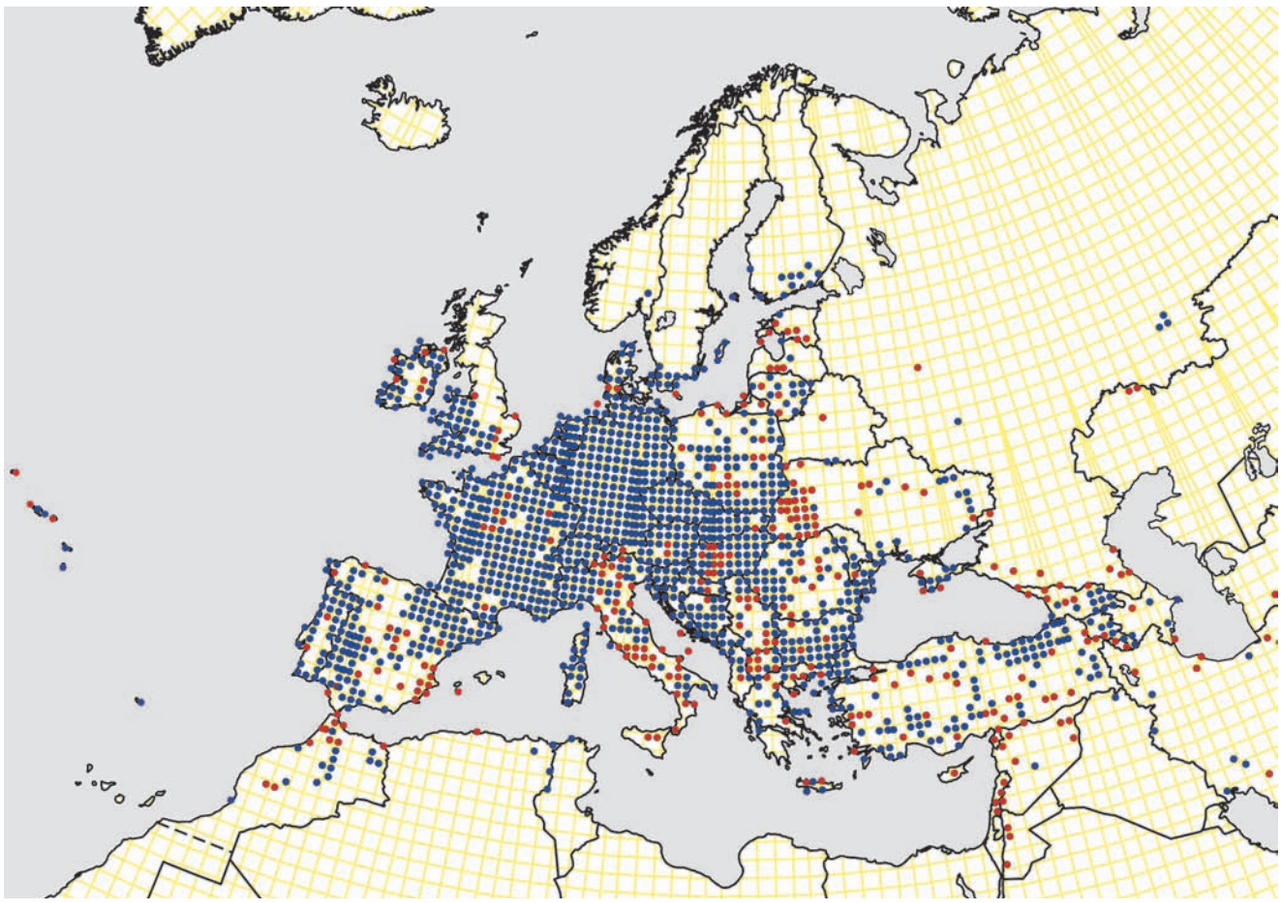
Europe: *Ischnura pumilio* has a wide range in Europe, where it remains generally scattered and occurs at fluctuating densities due to its pioneer life style. It reaches north to parts of the British Isles, Denmark and the south of Fennoscandia. At mid and northern latitudes, populations are often short-lived and the presence of this species at the northern extent of its range depends on immigration from the south. The species has a strong dispersal power and is among the few which have successfully colonised the Azores and Madeira archipelagos.

Flight period



Habitat

As a pioneer species, *I. pumilio* is mostly found in habitats with shallow water and sparse vegetation which are either newly created or where vegetation has been removed, such as quarries, ephemeral ponds in agricultural fields and ditches. Typically, the number of adults increases sharply in the first years after colonisation and drops when the vegetation becomes denser and competition from other animals increases. Populations in more natural habitats are generally



European distribution

World distribution

small but more long-lived. These latter types of habitats include swamps, *Sphagnum* peat bogs, springs and, mainly in the Mediterranean, streams. The species is most common in lowlands but populations are also found in mountains up to at least 1 800 m in southern Europe.

Trend and conservation status

In the north of its range, *Ischnura pumilio* has shown both a northwards expansion and an increase in density of populations, probably taking advantage of warmer summers. The species was new for Norway in 2012. Continuing climate change with reduced rainfall in southern Europe might result in a regional decline in the Mediterranean populations but to a further increase in the north. Change in the management of rice cultivation and water management led to a decline of the species in Italy.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Ischnura saharensis Aguesse, 1958

J.-P. Boudot & S. Ferreira

Distribution

World: *Ischnura saharensis* is found throughout a large part of the Sahara west of Egypt and Sudan. It reaches the Mediterranean coast in Libya and north-east Morocco, the Atlantic coast in south-west Morocco and in the western Sahara, with the westernmost occurrences found on the Canary archipelago. It is replaced by *I. senegalensis* in the east and south of its range, and by *I. graellsii* in the north, being sympatric and even syntopic with these species only locally in the Maghreb, the Canary Islands and Mauritania.

Europe: *Ischnura saharensis* is known with certainty from the Canary Islands but old records of "*Agrion maderae*" (Selys & Hagen 1850) and *I. senegalensis* (Gardner 1963) from the Madeira archipelago (specimens lost) probably also refer to this species (Jacquemin & Boudot 1999, Ferreira *et al.* 2006). It is common and widespread in the Canary archipelago, with over 20 localities distributed among all islands with the exception of Hierro.

Trend and conservation status

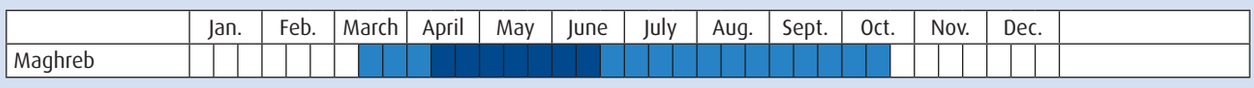
The species has a small European range but is widespread and common on the Canary Islands and adjacent parts of Morocco. It does not appear to be threatened.

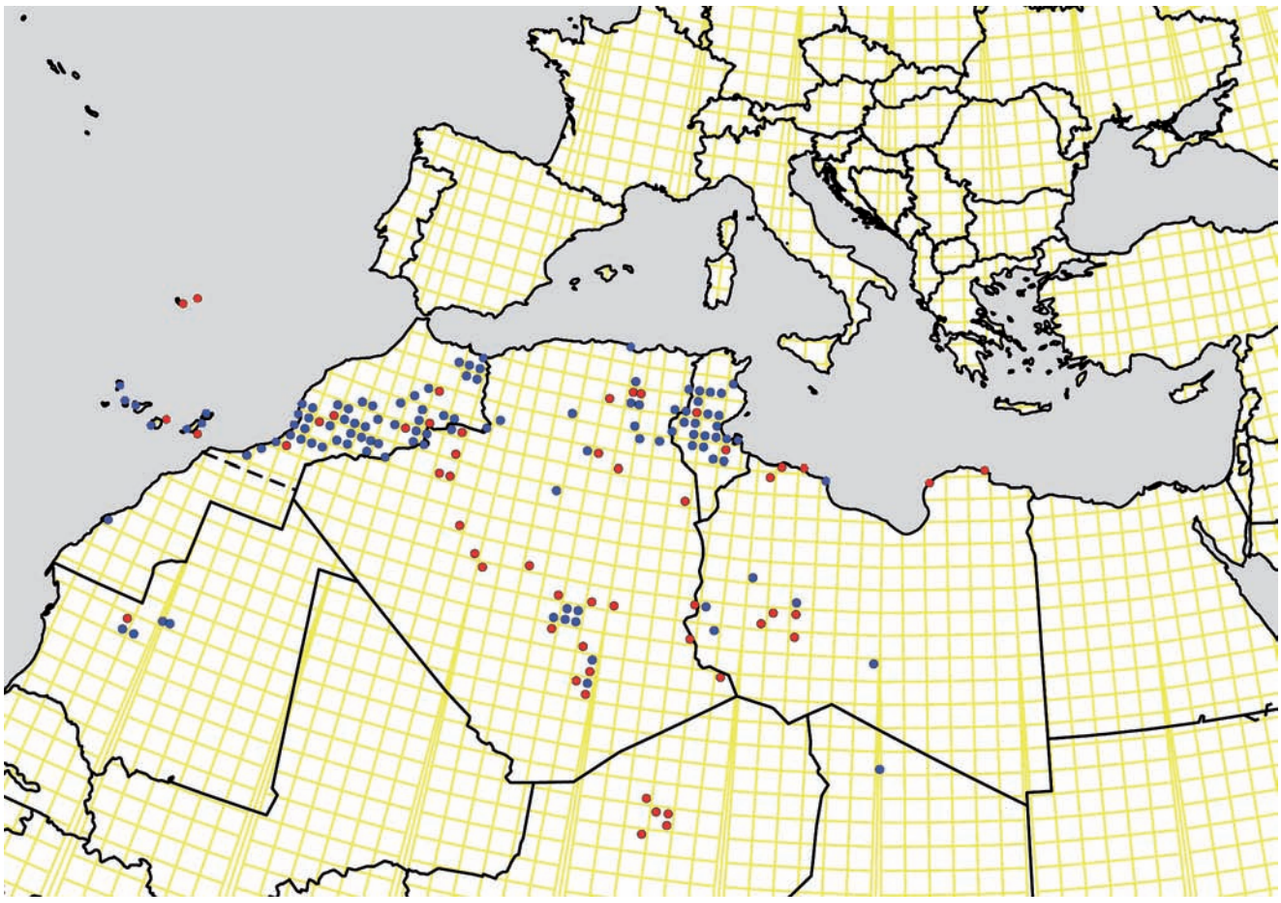
Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

Ischnura saharensis is found at all kinds of standing and running waters in desert and semi-desert areas, including ditches, rivers, ponds and lakes with fresh or brackish, permanent or ephemeral waters. This species is well adapted to arid environments, as it is salt-tolerant and highly mobile. It is known to readily colonise newly available habitats, and its rapid larval development allows it to reproduce successfully in areas where a large portion of the available aquatic habitats consists of ephemeral water bodies flooded only during the rain season (Dumont 2007, Boudot 2008).

Flight period





World distribution

Ischnura senegalensis (Rambur, 1842)

J.-P. Boudot

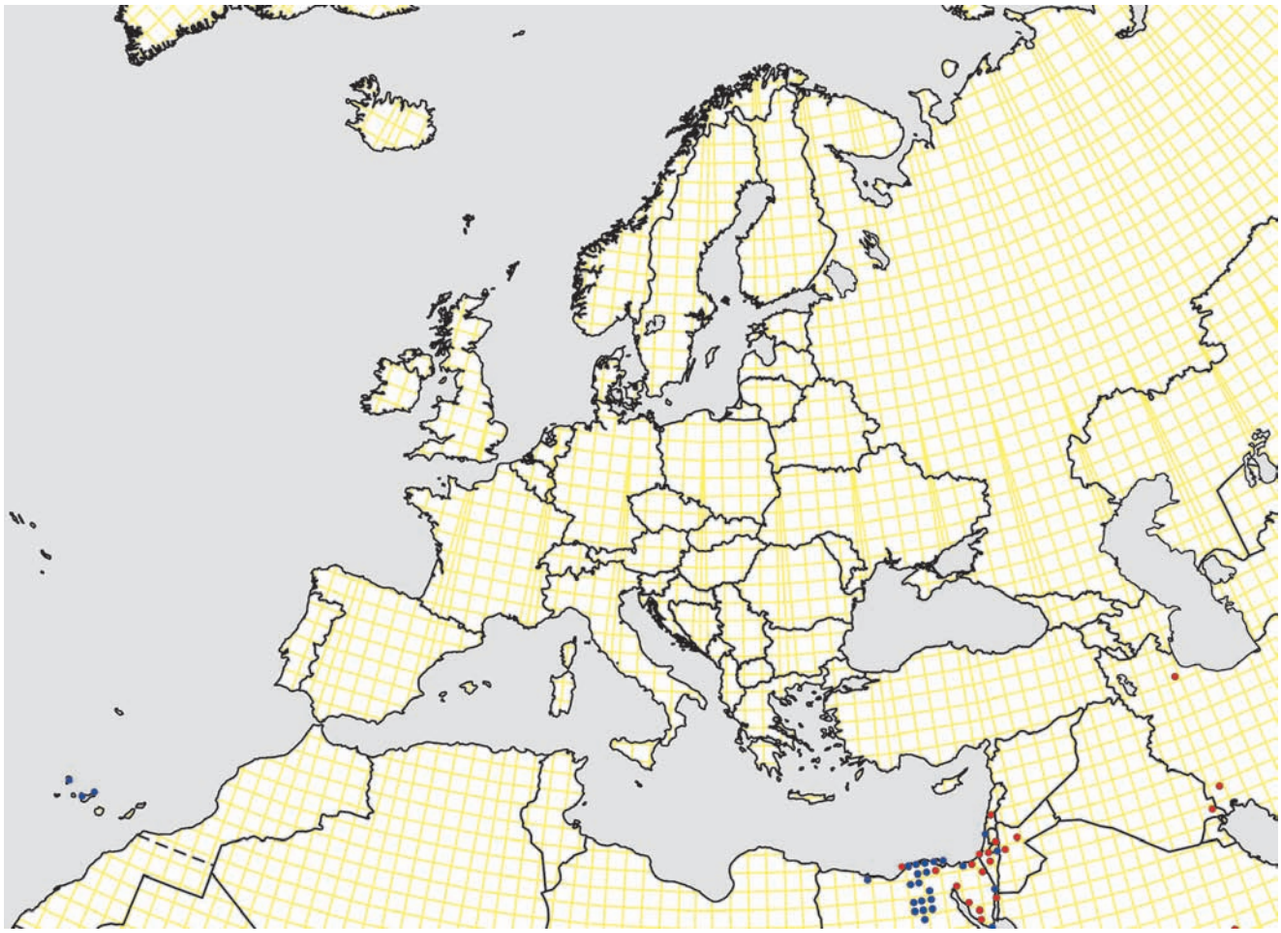
Distribution

World: *Ischnura senegalensis* is among the most wide-ranging dragonflies in the world and is found throughout the tropics of Africa and Asia. In Africa it is found across the whole sub-Saharan area and the nearby Atlantic and Indian Islands. Its distribution includes the whole Nile Valley up to the Mediterranean Sea, parts of the Arabian Peninsula and the Middle East. In Asia it occurs from Iran and Afghanistan to the east, including large parts of the Indian subcontinent, south-east Asia, parts of China and Japan. In South-east Asia, its range extends to the Philippines and the western parts of Indonesia. An old record from Uzbekistan (Brauer 1881) is doubtful and might result from confusion with the regionally widespread *I. fountaineae*.

Europe: The species is in Europe restricted to the Canary Islands from where it was first recorded in 2008-2009 as *I. saharensis*, the only known *Ischnura* species in the Canaries at the time. A small number of records has since become available from the islands of La Palma and Tenerife and at least some of these refer to populations (Peels 2014). All previous published records of *I. senegalensis* from the Canary Islands proved to be based on misidentified specimens of *I. saharensis* (Hämäläinen 1986). However, *I. senegalensis* itself seems to have been misidentified as *I. saharensis* during the 1990s, as it is believed to have been observed in one of its present localities as early as 1993 (D. Smallshire *in litt.*).

Trend and conservation status

The species has not been assessed for the European Red List as it was not known to occur in Europe when the list was drawn up. Information on its trend on the Canary Islands is absent.



European distribution

World distribution

Flight period

The species is on the wing all year round in large parts of its range. At the north of its range it is often one of the earliest species to appear in spring and one of the last to disappear in autumn. The records from the Canary Islands range from 27 February to 10 November. It is likely that the species is on the wing all year round in this region.

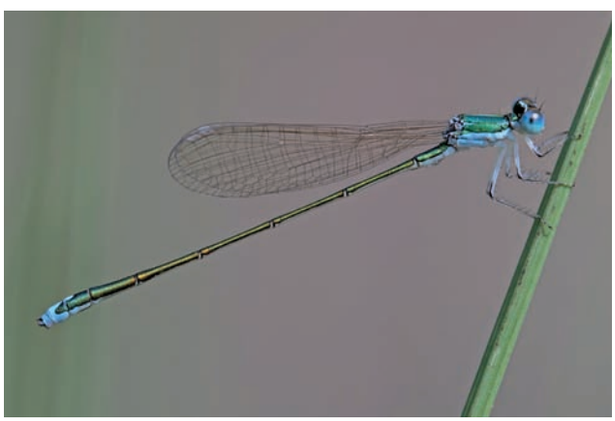
Habitats Directive	No
Red List EU27	Not Evaluated
Red List Europe	Not Evaluated
Red List Mediterranean	Not present
EU27 endemic	No
European endemic	No
Trend Europe	Not Evaluated

Habitat

Ischnura senegalensis reproduces in all kinds of unshaded standing and running waters providing some vegetation, such as grasses or rushes, is available. The species is most abundant at standing water and is tolerant of organic pollution. Habitats even include polluted ditches in urban areas, brackish waters, sulphurous hot springs and fish ponds. Throughout most of its range it is one of the dominant damselfly species in urban or agricultural areas. The European records in the Canary Islands come from man-made lakes and water tanks. *Ischnura senegalensis* is a strong disperser which rapidly colonises new habitats such as ephemeral pools and ornamental urban ponds.

Nehalennia speciosa (Charpentier, 1840)

R. Bernard & V.J. Kalkman

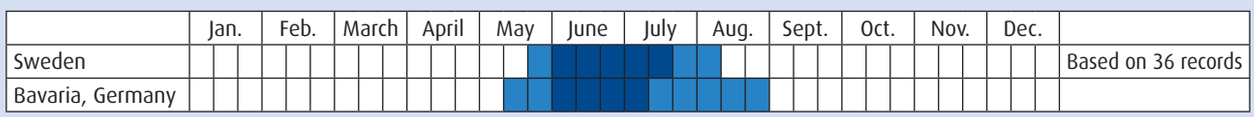


Distribution

World: *Nehalennia speciosa* has a wide but apparently fragmented Trans-Palaearctic range from western Europe across northern Asia to Japan. There is no certain record between the upper reaches of the Yenisei River in the west and Amurland in the far east of Russia, a disjunction of 2 450 km. It is unclear whether the species is indeed wholly absent from this gap or if the lack of records simply reflects a lack of surveys in this part of Siberia. The species localities in the Tura River and Konda River Basins and especially those in the Vasyugan Plain (Bernard & Kosterin 2010) show that *N. speciosa* is likely to be more widespread than presently known in the southern half of western Siberia, and that the large gaps in the species distribution in this area and the European Russia are probably the result of little fieldwork. The same situation may explain other gaps in the Siberian part of its range. In eastern Asia the species extends from the Amurland to the Khabarovskii Krai, northern North Korea and Japan. A record from the north of South Korea (Lee 2001, Yum *et al.* 2010) remains to be confirmed. The species is likely to occur in north-east China but no record has been published to date. Old records from the steppe zone in southern Ukraine and at the border of Kazakhstan and Kyrgyzstan in Central Asia (Brauner 1902, Artobolevskij 1915, Bernard & Wildermuth 2005, Chaplina *et al.* 2007) seem doubtful and are omitted here.

Europe: *Nehalennia speciosa* is limited to central and northern Europe, with the southernmost confirmed records coming from the foothills of the Italian Alps, Austria, Czech Republic, northern Romania and western and northern Ukraine (Bernard & Wildermuth 2005). It is mainly found between 400 and 700 m in the southern parts of central Europe and in the Alps, while it occurs at lower elevations further north. The species probably had a more continuous range in the past but declined severely over time. Only in parts of Poland, the Baltic States and probably in Belarus and central latitudes of Russia is the density of populations such that it can be regarded as a continuous distribution. It is extinct in the Netherlands (last reliable record in 1912), Belgium (1960), Luxembourg (1960) and Slovakia (1960).

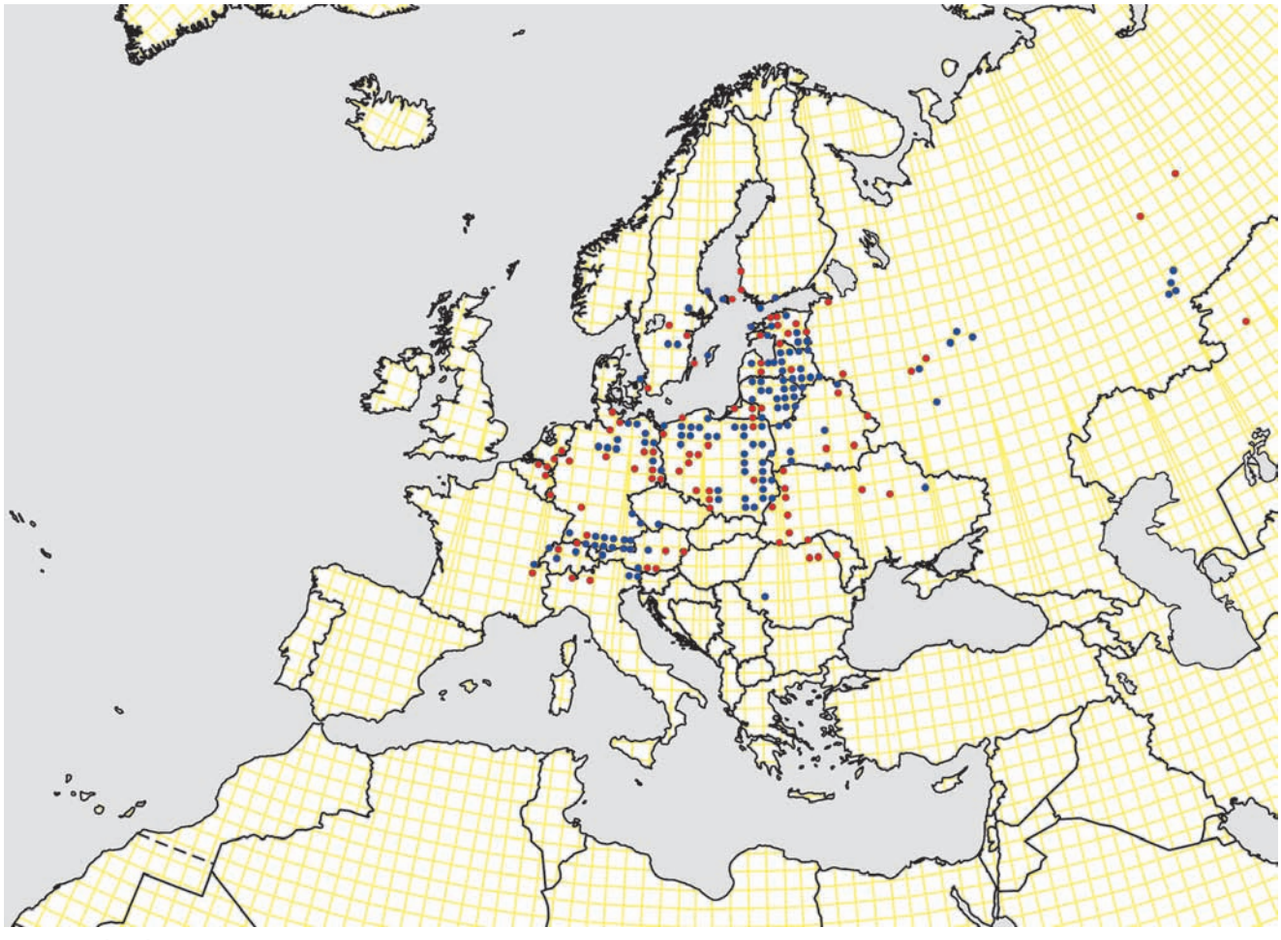
Flight period



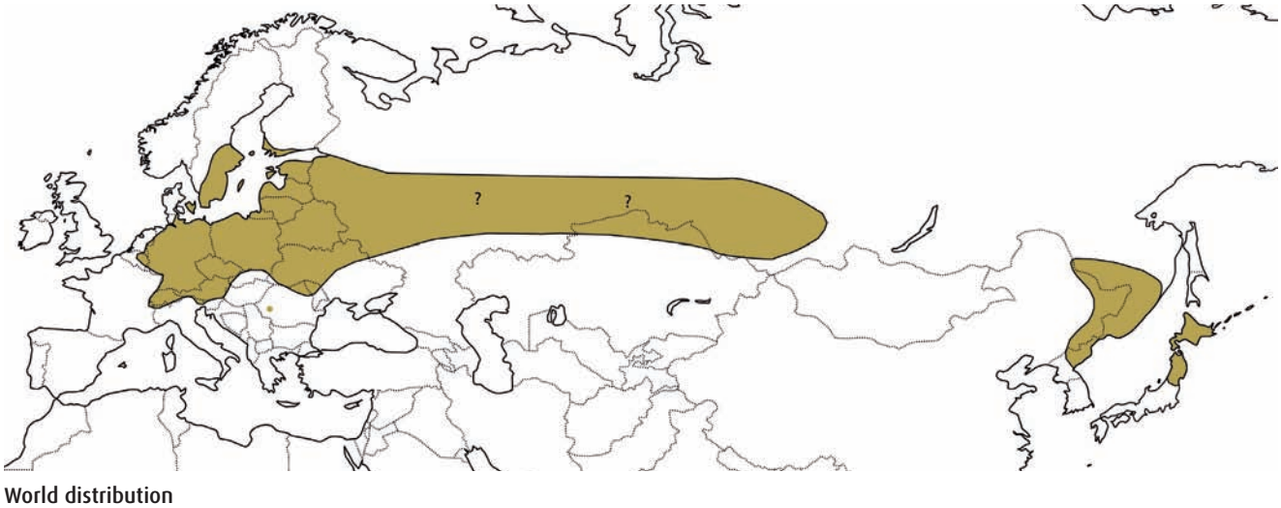
In most other countries, the species has also declined during the 20th century and in several countries only few isolated populations remain, e.g. five populations in Italy (Fiorenza & Pecile 2009), three in Switzerland (Monnerat 2008) and one in Denmark and the Czech Republic. In the recent years, numerous new localities have been found in Poland, Lithuania, Latvia, Estonia and Sweden. In 2009 the species was rediscovered in France and Romania after not being observed since 1876 and 1953, respectively (Dehondt *et al.* 2010, Doucet *et al.* 2012, Manci 2012). The 2009 rediscovery in France was in a recently restored peat bog where the species had been absent and which was dry in July 2008, so that this occurrence obviously indicates dispersal and (re)colonization. It is unclear whether the new Romanian record is the result of more intensive surveys or a genuine dispersion of the species into a favourable area.

Trend and conservation status

In many European localities the species became extinct due to habitat destruction caused by drainage and land reclamation. From the 1960s onwards, both pro-



European distribution



World distribution

longed spells of hot and dry weather resulting in the desiccation of habitats and increase in nitrates (eutrophication), became a dominant factor in the decline of the species. Eutrophication, which is still an important factor, resulted in the alteration of the composition and structure of the vegetation. Local threats are degradation of habitats by livestock and tourism. After the long decline throughout the 20th century, the species' conservation status has recently become more stable and in some places a local increase is being observed (e.g. in parts of Poland).
The species has a very specific habitat choice and the density of potential sites is very low in many parts of Europe, especially in the western and southern parts of its range. Therefore, many of the remaining European localities are isolated and local extinction at these sites might be final. Actions to be undertaken for this species are:

- Mapping the distribution of the remaining populations by checking all suitable locations.
- Eliminating direct local threats such as impact by livestock and tourism.
- Combating nitrate increase and desiccation. This can be done by planting forests around sites, which will help shield the areas from diffuse nitrate inputs from adjacent farmlands. Such forests should not be too close to the water body due to their negative impact on hydrology, and cutting the adjacent several metres of existing trees is recommended to allow for a rise the water level.

The creation of habitats in 2005 in Niedersachsen resulted in a successful reproduction in 2008 (Clausnitzer 2009), showing that it is possible to create new habitats for the species. The case of the (re)colonisation since 2009 of restored habitat in France shows that the species is able to colonise newly available habitats, despite its supposed poor dispersal capacity. In areas where there are only small and isolated populations left, similar experiments are needed to find ways to secure or to increase populations in the long term.

This species is severely threatened in large parts of its European range and should be legally protected at the European and national levels.

Habitats Directive	No
Red List EU27	Vulnerable
Red List Europe	Near Threatened
Red List Mediterranean	Critically Endangered
EU27 endemic	No
European endemic	No
Trend Europe	Decreasing

Habitat

Nehalennia speciosa occurs at ponds, small lakes, bogs, fens and marshes and is most often found in the shallow fringes of acidic, nutrient-poor, water bodies and in small pools in bogs and fens. The habitat is largely unshaded but almost always lies within woodland areas of, typically pine (*Pinus*) or occasionally spruce (*Picea*). Habitat requirements are narrow and include the need for well-structured vegetation with uniform growth of thin-leaved sedges, 30-80 cm high, spaced densely enough to provide protection, but loosely enough to allow free movement and providing favourable microclimate. Slender sedge (*Carex lasiocarpa*) and Mud sedge (*C. limosa*) most frequently form the dominant vegetation at European locations. Other plants, which may form a dominant part of the vegetation in some areas, include Beaked sedge (*C. rostrata*), Tufted sedge (*C. elata*), Water horsetail (*Equisetum fluviatile*) and Purple moor-grass (*Molinia caerulea*). A crucial factor for the species microhabitat is shallow water (e.g. below 20 cm) with abundant submerged vegetation. This allows the water to warm up quickly, favouring rapid development of the larvae, and makes the habitat unsuitable for predators such as fish. *Nehalennia speciosa* is one of the few European dragonfly species that is nearly restricted to primary (e.g. not altered by humans) habitats (Bernard & Wildermuth 2005).

Pyrrhosoma elisabethae Schmidt, 1948

V.J. Kalkman & M. Jović

Taxonomy

Until recently this species was regarded as subspecies of *Pyrrhosoma nymphula*. Kalkman & Lopau (2006) illustrated the structural differences between the adults of the two taxa and confirmed that they are distinct species. This was later confirmed by the structural differences found in their larvae (Brochard & van der Ploeg 2013a) and the genetic differences between the European populations of the two species (Guan *in litt*. 2013).

Distribution

World: The species is only known from Greece and Albania and is not likely to occur outside Europe.

Europe: *Pyrrhosoma elisabethae* is endemic to the southern Balkan Peninsula and is only known from Albania and Greece from a total of fourteen locations. In Albania it is found only at the Blue Eye Spring (Syri i Kalter), a large spring that forms the source of the Bistrica River (Dumont *et al.* 1993, Muranyi 2007). In Greece it is known from mainland Greece (one site in the north-west), the northern Peloponnese (five sites) and Corfu (Kérkira, seven sites) (Kalkman & Lopau 2006, Lopau 2010b, Sutton 2012, Brochard & van der Ploeg 2013a, b). The species has been recorded at several sites on Corfu in the past but during a recent survey it was only found at two streams, only one of which had a strong population. *Pyrrhosoma elisabethae* has an early flight and can easily be missed during a summer visit. Further fieldwork might show it to be wider spread in north-west Greece and south Albania than currently known.

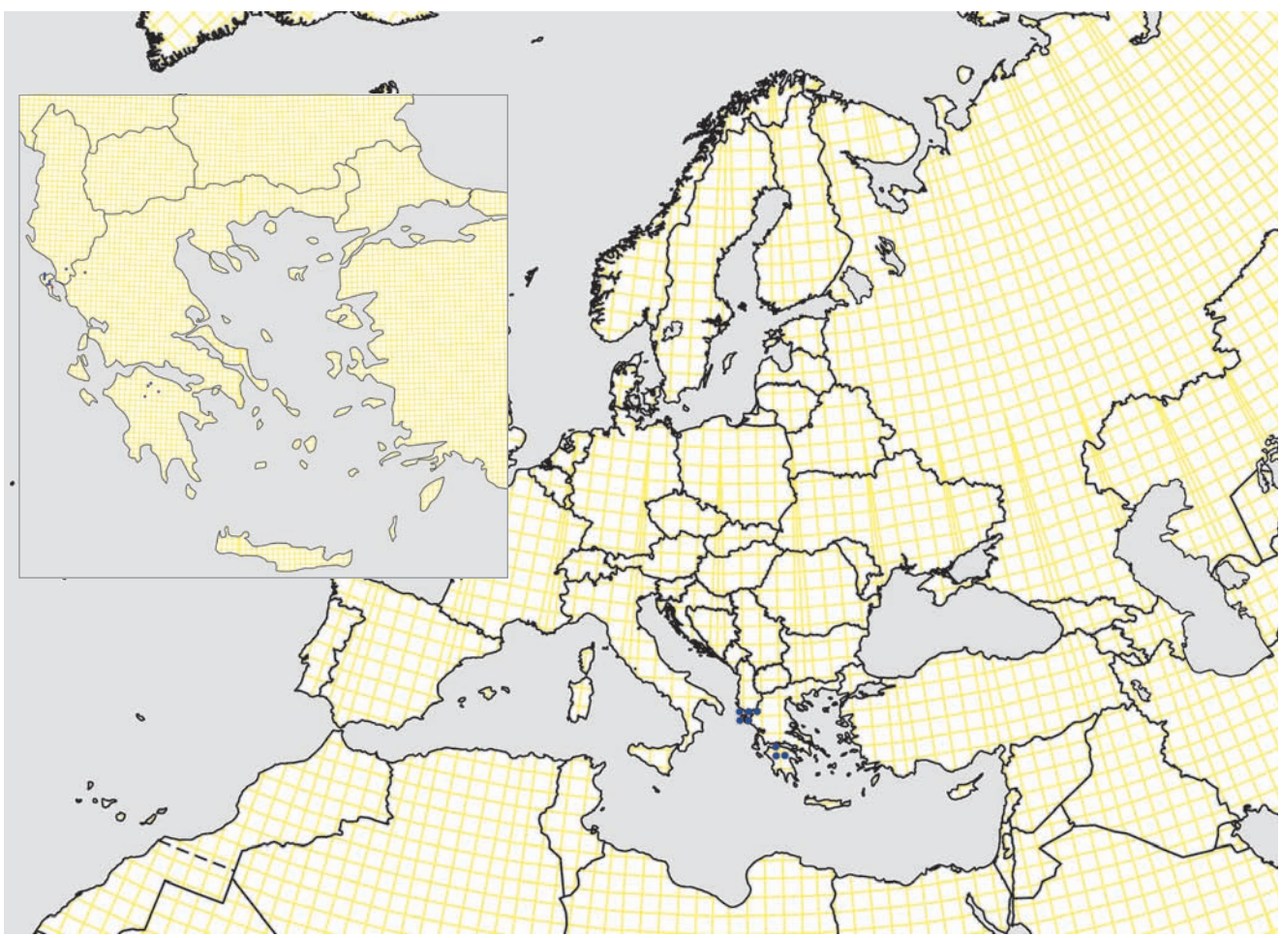
Trend and conservation status

Pyrrhosoma elisabethae is among the rarest and the most threatened European dragonflies. Only fourteen localities are on record and at some of these the species has become extinct due to human impact. The location in north-west Greece was found destroyed in 2007 due to the restoration of a well. A stream south of Kalávrita where the largest population in the Peloponnese was found was recently desiccated in a dry winter; nonetheless good numbers were found at this site in 2013 (M. Jović pers. obs.).

The majority of streams and rivers on Corfu have become unsuitable for the species and the habitat of the single remaining strong population could easily be destroyed by changes in water management or pollution. Both Albania and Greece have generally poor management of their water resources and many streams have been replaced by concrete ditches or pipes, have had the banks cleared of natural vegetation or suffer from water pollution. Prolonged hot and dry summers and increasing winter rainfall deficits, forest fires and water extraction for irrigation result in the desiccation of springs and streams. Conservation actions are urgent and a survey to map current populations and identify their threats is needed.

Flight period

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Greece					■	■							Based on 13 records



World distribution. The inset shows its distribution in the southern Balkan Peninsula based on a 5 by 5 km grid.

Habitats Directive	No
Red List EU27	Critically Endangered
Red List Europe	Critically Endangered
Red List Mediterranean	Endangered
EU27 endemic	No
European endemic	Endemic
Trend Europe	Decreasing

Habitat

Very little information on habitat has been published. The species seems limited to larger streams or spring-fed ponds and lakes with abundant aquatic vegetation. It is likely that the species cannot survive in habitats that regularly desiccate for longer periods during dry and hot years. *Pyrrhosoma elisabethae* is known from hilly regions and lowlands, down to sea level in Corfu.

Pyrrhosoma nymphula (Sulzer, 1776)

V.J. Kalkman, K. Aagaard & D. Dolmen

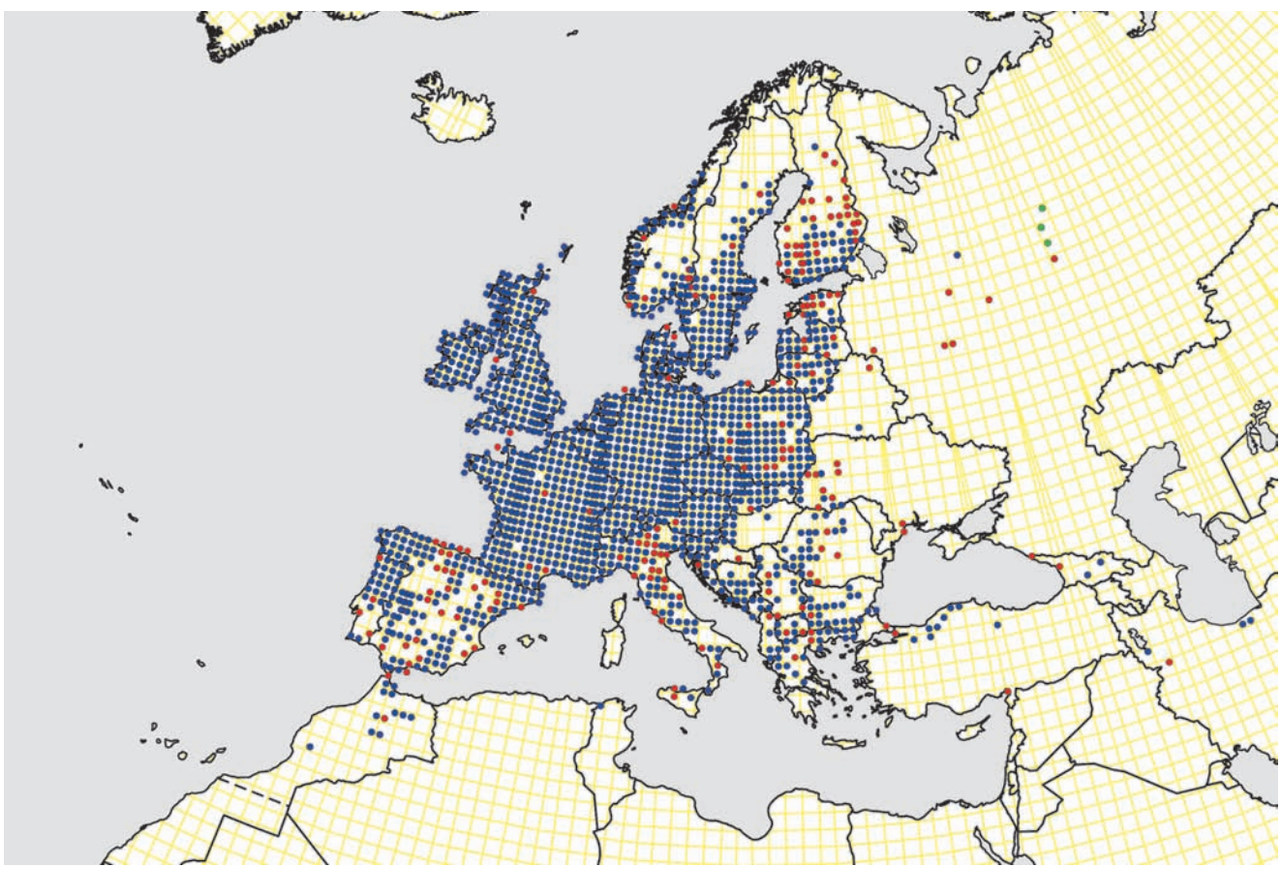
Taxonomy

Claims of intermediates between *P. nymphula* and *P. elisabethae*, including the description of an intermediate subspecies named *P. nymphula interposita* Varga, 1968, have shown to be insupportable (Kalkman & Lopau 2006). Although the populations of *Pyrrhosoma* in Morocco are structurally identical to *P. nymphula*, a genetic study showed that they are genetically closer to *P. elisabethae*. It was suggested that they represent the remnants of the common ancestor to the two European taxa (Guan *et al.* 2013).

Distribution

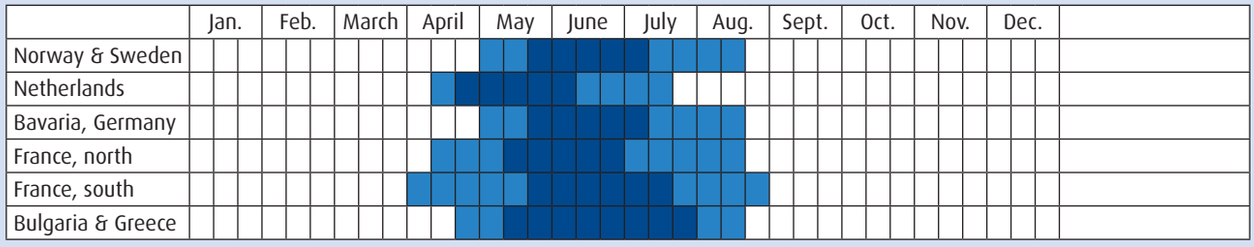
World: *Pyrrhosoma nymphula* is almost completely confined to Europe with only a small number of sites in the Moroccan mountains, Tunisia (Korbaa *et al.* 2014) and south-west Asia (Turkey, Georgia and northern Iran).

Europe: *Pyrrhosoma nymphula* is one of the most widespread and most common damselflies of Europe.



World distribution

Flight period



In Fennoscandia it just reaches the Arctic Circle. The species is absent from most of the Mediterranean islands although populations are known from the mountains of northern Sicily. It is patchy in the Balkan Peninsula and seems to be absent from large parts of European Russia and Ukraine and does not reach the Ural Mountains.

Trend and conservation status

Pyrrhosoma nymphula is common and widespread in Europe, and there is no indication of a decline.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

In most of Europe the species is found both in standing and running waters. In eastern and northern Europe, it is less common in standing waters and mostly reproduces at running waters. It is absent from temporary habitats, although the larvae are capable of surviving for some time in wet mud and detritus. The habitats are often partly shaded or at least in the vicinity of bushes or trees. Standing waters where the species is found have rich aquatic and bank-side vegetation and are in most cases nutrient rich. Nevertheless, *P. nymphula* is regularly found in oligotrophic acidic ponds and natural depressions and man-made excavations in *Sphagnum* peat bogs, although in lower abundance. Standing water habitats include fenlands, peat bogs, marshes, oxbows, pools, ponds, lakes and canals. In running water, the species is most often found in gently flowing lowland streams and slow-flowing rivers with rich aquatic and bank-side vegetation. However, it can also be found, in lower numbers, in swift mountain streams where otherwise only *Calopteryx* virgo and *Cordulegaster* species are found. The species is most common at altitudes below 700 m, but has been found up to 2 100 m in the Alps and the Pyrenees.

***Caliaeschna microstigma*, Stream near Kouteli, Peloponnese, Greece.** Photograph Fons Peels.

1 Anax immaculifrons. Habitat of *Anax immaculifrons*, Toparlar, Muğla province, Turkey. Other species occurring here include *Epallage fatime, Lindenia tetraphylla, Onychogomphus forcipatus, Orthetrum taeniolatum* and *Trithemis festiva*. Photograph Valentina Assumma.

2 Caliaeschna microstigma. Habitat of *Caliaeschna microstigma*, Drosato, Corfu, Greece. Other species occurring here include: *Calopteryx virgo, Gomphus schneiderii, Libellula fulva, Onychogomphus forcipatus, Platycnemis pennipes* and *Somatochlora meridionalis*. Photograph Christophe Brochard.

3 Aeshna serrata. Habitat of *Aeshna serrata*, Han Vejle, Denmark. Other species occurring here include *Aeshna grandis, A. mixta, Enallagma cyathigerum* and *Sympetrum vulgatum*. Photograph René Manger.

4 Aeshna crenata. Habitat of *Aeshna crenata*, Maletino, European Russia. Other species occurring here include *Aeshna juncea, A. subarctica, Coenagrion glaciale, C. johanssoni, Cordulia aenea, Leucorrhinia dubia, Libellula quadrimaculata* and *Somatochlora graeseri*. Photograph Rafał Bernard.

5 Aeshna viridis. Habitat of *Aeshna viridis*, Woudbloem, Groningen, Netherlands. Other species occurring here include *Aeshna grandis, A. isoceles, Coenagrion pulchellum, Lestes sponsa* and *Sympetrum vulgatum*. Photograph Christophe Brochard.

6 Boyeria irene. Habitat of *Boyeria irene*, Örtzë River, Lower Saxony, Germany. Other species occurring here include *Calopteryx virgo, Cordulegaster boltonii* and *Ophiogomphus cecilia*. Photograph Arno Braam.

Aeshna affinis Vander Linden, 1820

V.J. Kalkman & E. Dyatlova

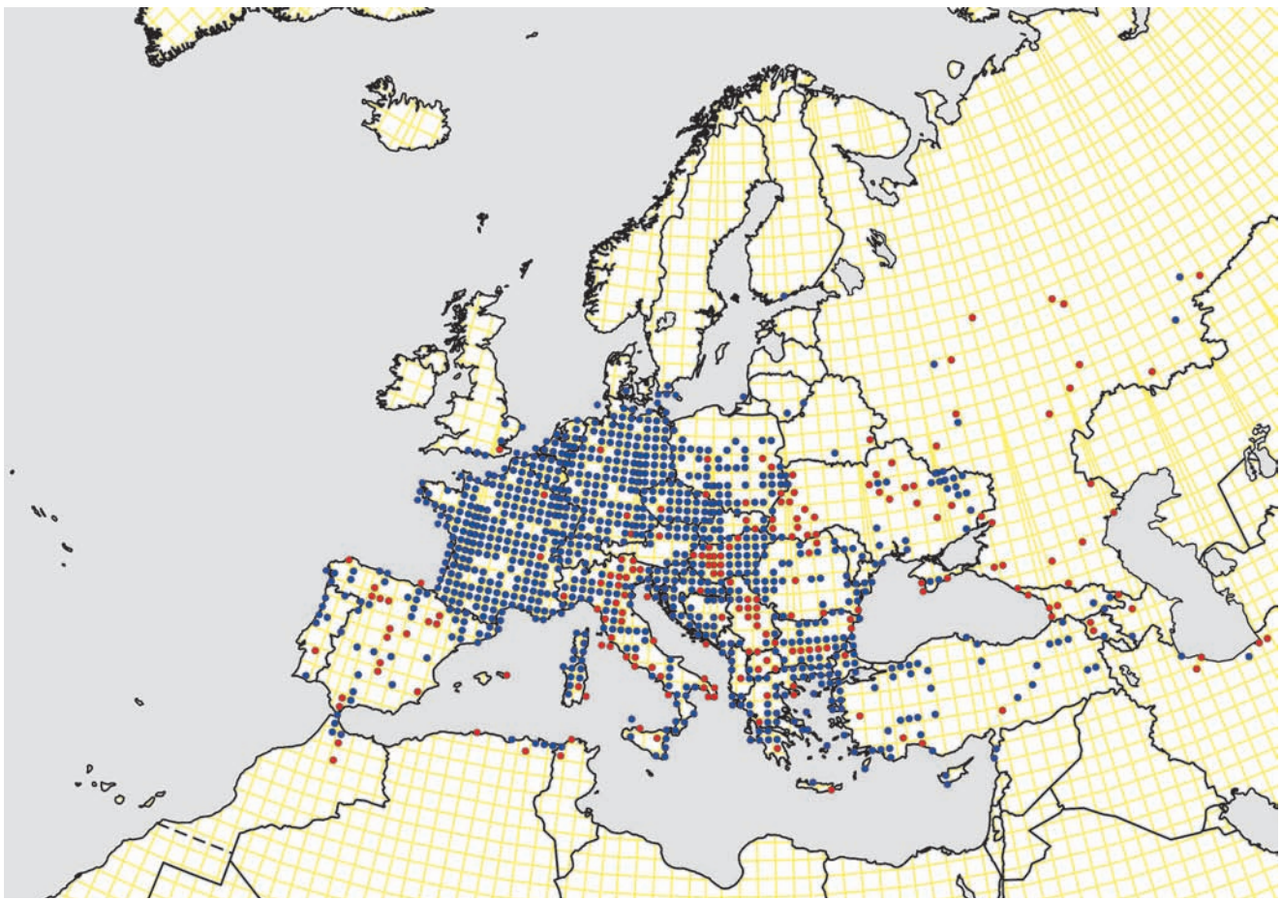
Distribution

World: *Aeshna affinis* is largely a Western Palaearctic species confined to north-west Africa, Europe and south-western Asia. In Africa, it is only found at the Mediterranean coastal areas of Morocco, Algeria and Tunisia. In Asia it occurs eastwards to Mongolia and north-west China (Xinjiang province).

Europe: The species is widespread in southern Europe and parts of central Europe, becoming scarcer to the north. It is relatively uncommon in many areas, including large parts of the Iberian Peninsula and, to a lesser extent, Italy, but is common in much of south-east Europe and locally abundant in Ukraine.

Trend and conservation status

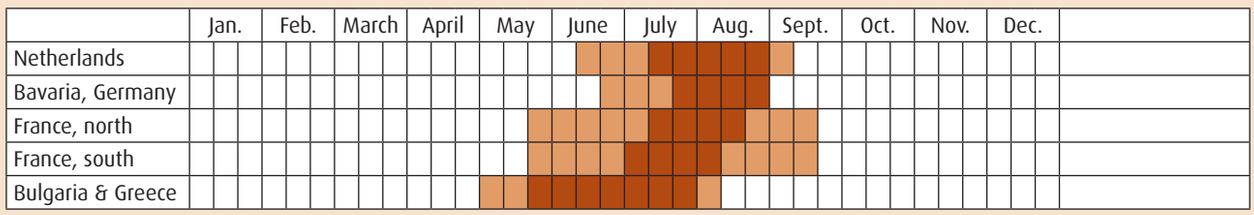
The species has shown an increase in central and north-west Europe, probably as a result of the recent rise in summer temperatures. This has led to an expansion of its range by several hundred kilometres since the 1990s. This has been recorded in Great Britain, where emerging individuals were found in 2011 (Cham *et al*. 2014), France, Belgium, the Netherlands, Germany and Poland. It was discovered as new to Lithuania in 2003, Denmark in 2006, Finland in 2008 and Sweden in 2010 (Bernard 2005, Schröter & Karjalainen 2009, Billqvist & Heitzenberg 2010) and has been recorded as invasive in Belgium (1995), the Netherlands (1995) and Great Britain (2006, 2010). During these invasions, most specimens were found at localities with an apparently suitable habitat, indicating the species is highly efficient at finding potential habitats. Twelve specimens were collected in Heligoland traps set for birds in the Kaliningrad region of Russia in the period 2007-2010 (Shapoval & Buczyński 2012). This is near the extremity of its



European distribution

World distribution

Flight period



northern range and shows that northwards migration is taking place regularly.

It is not clear if the range of this species is contracting in the south. For Baden-Württemberg, Germany, it has been suggested that the species might decrease due to the succession of riverine vegetation in habitats where suitable management has ceased. The wide variety of habitats used by *A. affinis* makes it unlikely that this factor will negatively impact the species across Europe.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
Red List Europe - endemic	No
Trend Europe	Increasing

Habitat

The species reproduces exclusively in standing water, preferring shallow well-vegetated waters sheltered from the wind and exposed to the sun. Many habitats dry up partially or fully during summer and have patches of mud often bordered by loose to dense vegetation of rushes, sedges, Black bogrush (*Schoenus nigricans*) or low reeds. A wide selection of water types can support suitable habitats for *A. affinis*, including marshes, temporarily flooded depressions in agricultural landscapes, old oxbows, small (dune) lakes and ponds or shallow edges of large lakes with helophytes belts. Despite of the broad array of habitats, suitable habitats are generally scarce. Many of the habitats where *A. affinis* occurs become unsuitable after several decades or even a few years due to natural succession of vegetation, for example, following inundation of floodplains. In other situations, management such as grazing or mowing is needed to maintain suitable habitat. In contrast with other species with a strong preference for warm climatic conditions, it is rarely found in quarries or gravel pits. In Italy it is also found in rice fields, but it has decreased in this habitat. *Aeshna affinis* is found mainly in lowlands and in central Europe is rarely observed above 700 m.

Aeshna caerulea (Ström, 1783)

V.J. Kalkman & C. Monnerat

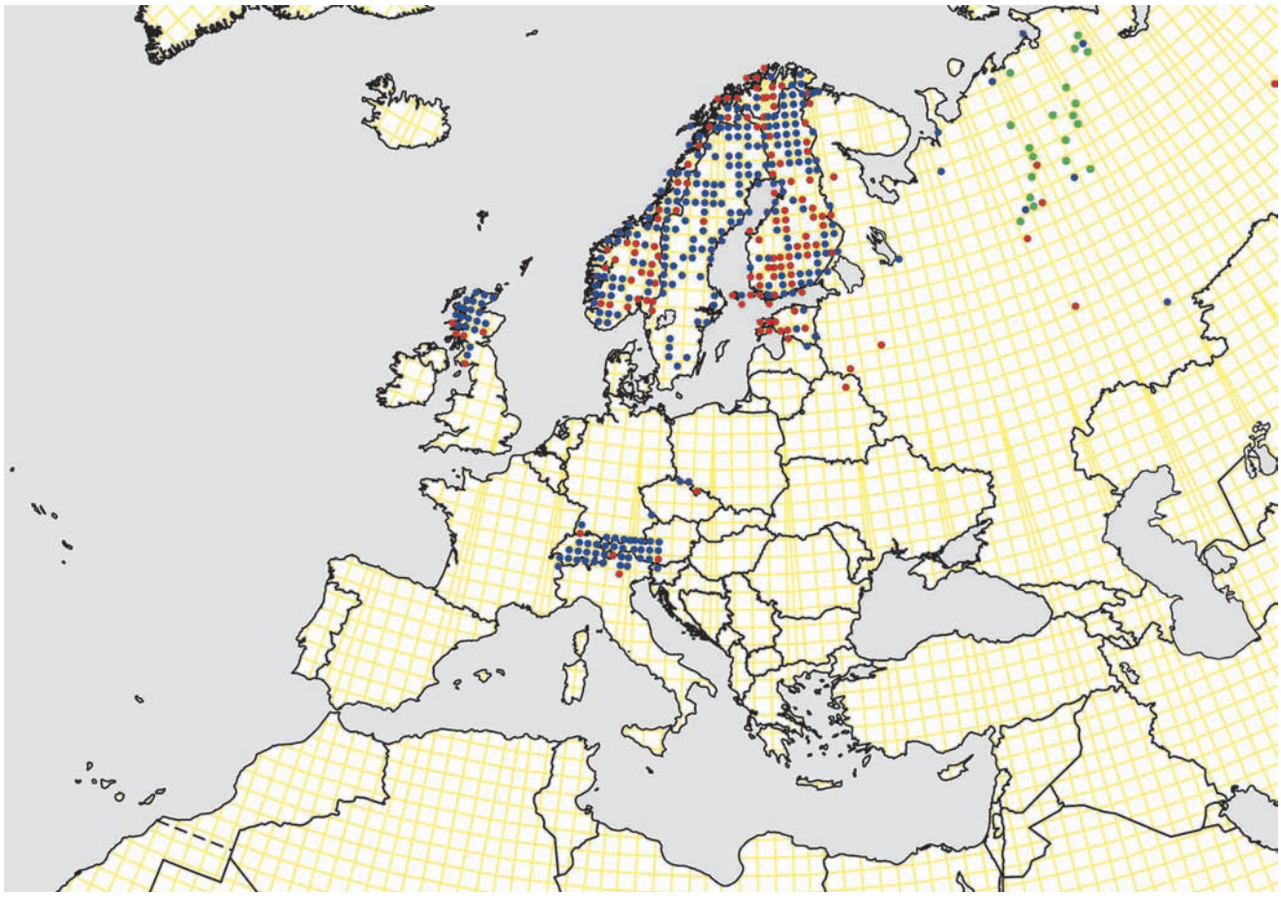
Taxonomy

In the Nearctic, the species is replaced by its sister species *Aeshna septentrionalis* (Burmeister, 1839) which is sometimes considered a subspecies of *A. caerulea*.

Distribution

World: *Aeshna caerulea* ranges from Scotland to the Bering Strait and the Kamchatka Peninsula. In Europe it has a boreo-alpine distribution, being common and widespread at low elevation in the north in the Taiga and Tundra belts and having several smaller, disjunct, 'relict' areas of distribution in alpine areas of Europe. It extends further south in the Siberian part of its range, reaching the regions around Lake Baikal. Along with certain *Somatochlora* species, it is one of the most northerly distributed species in the world, extending up to North Cape in Fennoscandia and the Arctic Ocean in northern Siberia.

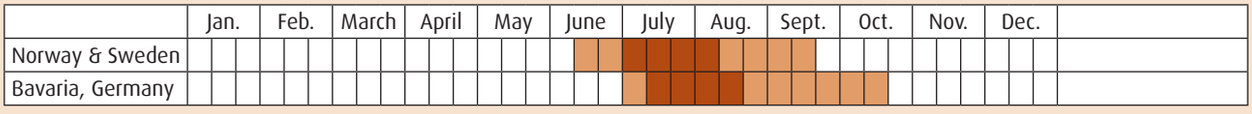
Europe: In Europe, the lowland distribution of *A. caerulea* includes Scotland and most of Fennoscandia, Estonia, northern Latvia and northern Russia. A record in northern Belarus (Gomelskaya province) is in need of confirmation (Buczyński *et al.* 2006), although seemingly valid records exist from nearby in Russia (Skvortsov 2010). In central Europe, the species is confined to mountains. It is reasonably widespread in the Alps with many populations in Switzerland and Austria and small numbers of populations in France (four, all in Haute-Savoie department), Italy (fewer than ten) and Germany, with one, possibly extinct, in Baden-Württemberg (Black Forest) and several others in the south of Bavaria. Other mountain ranges where the species occurs in central Europe are the Sudetes Mountains in the north of the Czech Republic and the south of Poland, and the western parts of the Bohemian Forest (Šumava Mountains).



European distribution

World distribution

Flight period



In Slovenia, the species is only known from one poorly documented record, and so far, no population has been found. Currently, all published records from Slovakia, Romania (Bihar Mountains) and the Caucasus are considered doubtful or have been shown to be incorrect, although the occurrence of the species in these countries remains possible (Manci 2012, D. Sacha & A. Schröter pers. com.).

Trend and conservation status

In the north of its range, where it is one of the most common dragonfly species, *A. caerulea* is mainly present in areas experiencing low environmental pressure and there is no indication of a decline. The species is listed as Vulnerable in Scotland although evidence for a decline is lacking (Daguet *et al.* 2008). Most of the populations in the central European mountains are also located in areas where there is relatively little human impact. However, populations in farmland or in recreational areas are threatened by trampling by cattle and water eutrophication as well as by fish introduction and winter sports management. The distribution of the species is largely determined by its need for a cold climate, which reduces competition with other species. Climate warming is probably already influencing the distribution of this species. The impact is likely to be most severe in its central European range where its distribution is highly fragmented and refuges at higher elevations are unavailable. Several populations in the Sudetes Mountains became extinct and the species might also be lost from the German Black Forest. Nevertheless, it is considered of Least Concern on European scale due to the large area in northern Europe where the species is common.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Vulnerable
EU27 endemic	No
Red List Europe - endemic	No
Trend Europe	Decreasing

Habitat

Aeshna caerulea is adapted to live in areas with long and severe winters and short summers and low air temperatures, where many other dragonflies are unable to survive. It seems that in warmer areas it is out-competed by other large dragonflies such as *Aeshna juncea*. In colder areas, its habitat range is broader, probably due to reduced pressure from other species. In the north of Europe, it is predominantly found in lowlands, with a maximum breeding habitat elevation around 550 m in Scotland. The species is present in standing and sometimes in slow-flowing water, namely in fens and bog ponds and depressions, palsa mires and sedge swamps in moors, heaths and tundra depressions. Above the tree line, it is mostly found at peaty ponds. In its central European range, almost all records are from 1 000 m to 2 600 m with the main breeding habitats between 1 400 and 2 200 m. Here it is found in bogs and permanent peaty water with a surface ranging mostly from 5 to 80 m^2 and a water depth of generally 20 cm or less. The vegetation consists of peat moss (*Sphagnum*), sedges (*Carex*) and cottongrass (*Eriophorum*). The water is frozen for a large part of the year but the water temperature can rise quickly during the day in spring and summer, exceeding 20 °C.

Aeshna crenata Hagen, 1856

R. Bernard & V.J. Kalkman

Taxonomy

Molecular studies have recently shown that the Japanese *Aeshna nigroflava* Martin, 1909 is conspecific with *A. crenata* (Futahashi 2011).

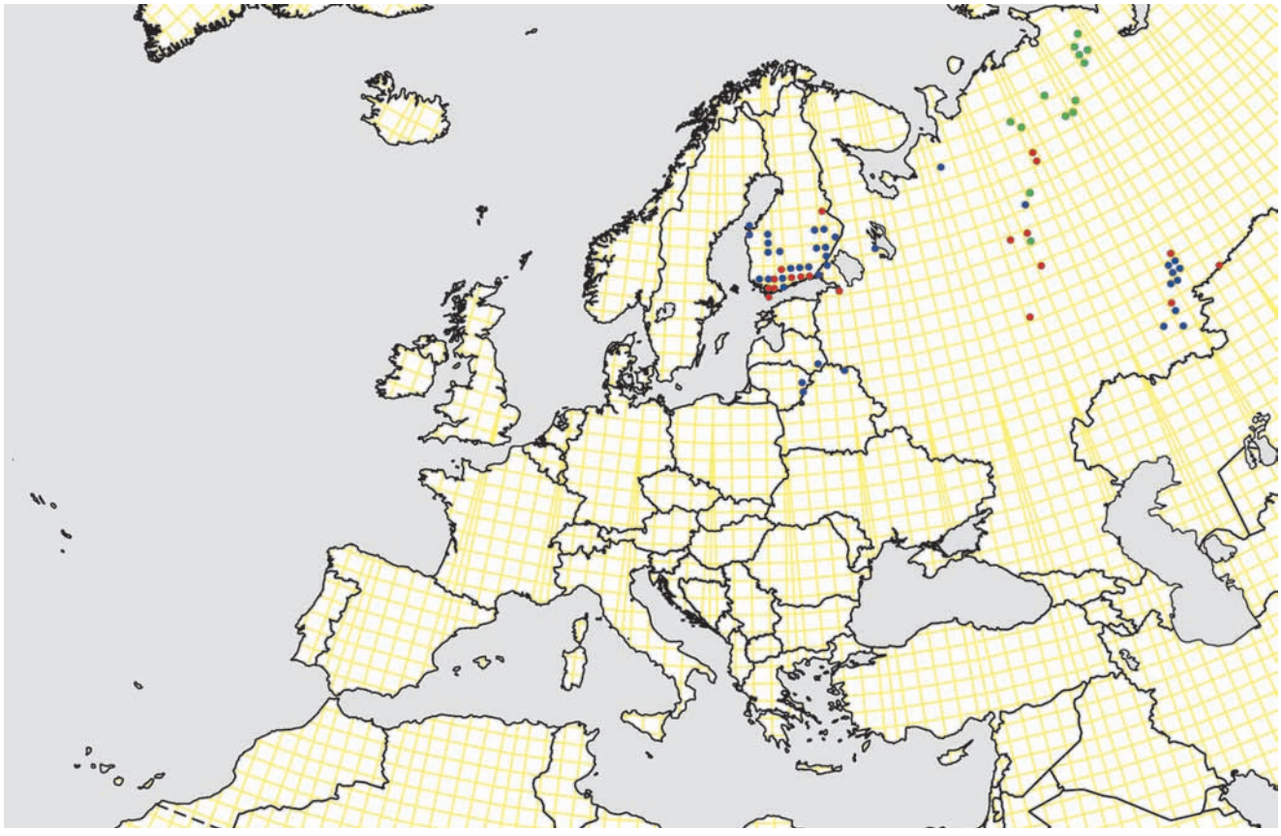
Distribution

World: *Aeshna crenata* occurs from north-east Europe eastwards to Kamchatka, Sakhalin, South Korea and Japan. The majority of its range lies in Russia. It occurs mostly in areas with a temperate climate but is locally present north of the Arctic Circle. The species seems to be common in large parts of temperate Asia.

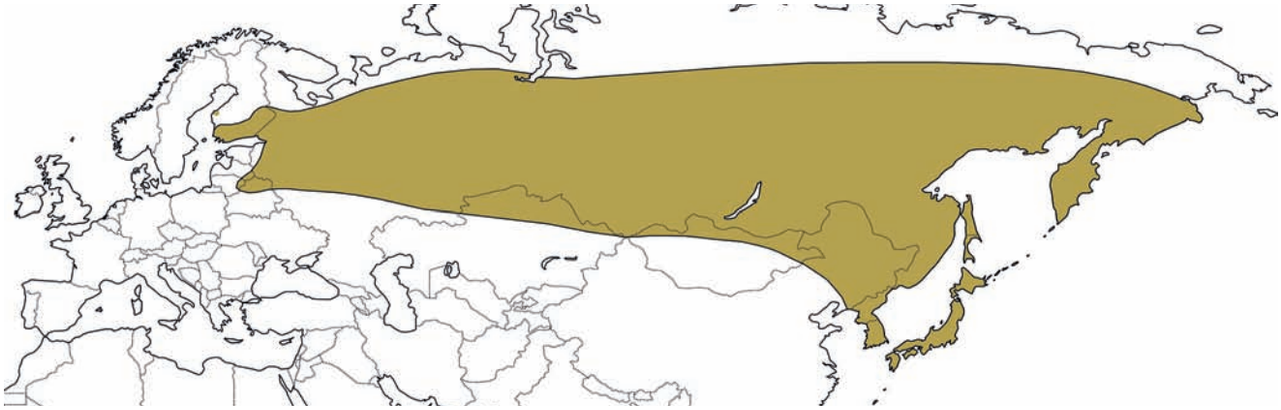
Europe: In Europe, *A. crenata* is known from scattered localities in southern Finland (several dozen localities), eastern Lithuania (eight localities), south-eastern Latvia (one locality), northern Belarus (one locality) and Russia (e.g. Valtonen 1988, Peters 1997, Mauersberger 2000, Bernard 2002, 2003, Korkeamäki *et al.* 2012). It is probably not rare in the north of Russia (see Bernard 2010), where it is at least common in the Pinega region (Bernard, unpublished). As far as is known it is absent from the more southern parts of Russia with the exception of the southern Urals where it seems to be common (Yanybaeva *et al.* 2006). Its range continues from the Urals into temperate Asia, where it is widespread. The species is rare in the west of its European range and over 90 % of its European range is in Russia.

Trend and conservation status

Most of the European range of *A. crenata* is in Russia and the limited information available suggests that there it is fairly widespread and not rare in the north and across the Urals to the south. The species was therefore assessed as being of Least Concern on a European scale. The distribution of the species within the 27 member states of the European Union is confined to a small part of Finland and the Baltic States in rather specialised habitats (Korkeamäki 2013). Although there is no reason to believe it is presently experiencing a significant decline in this region, ongoing large-scale logging and climate change in the extreme south-west of the species range might adversely affect this species in the next ten years and for this reason it was assessed as Near Threatened in the EU27 region.



European distribution



World distribution

Flight period

Emergence starts in the end of June. Adults have been found up to the first half of September with the highest numbers in July and August (Karjalainen 2002).

Habitats Directive	No
Red List EU27	Near Threatened
Red List Europe	Least Concern
Red List Mediterranean	Not present
EU27 endemic	No
Red List Europe - endemic	No
Trend Europe	Stable

Habitat

In both Finland and the Baltic States, *A. crenata* seems to have rather specialised habitat requirements and occurs mainly in small, circular, oligotrophic forest ponds with a swampy shoreline, sustained by clear groundwater (see e.g. Korkeamäki 2013). In most cases, the banks are covered with a vegetation of peat moss (*Sphagnum*), beak-rush (*Rhynchospora*) and sedges, followed by mature forests in the direct vicinity. In the northern and eastern parts of European Russia the habitat spectrum is broader, also including non-acidic water, larger lakes and river backwaters with oxbow ponds and lakes and a vegetation of water horsetail (*Equisetum fluviatile*) and sedges. In Siberia the species is eurytopic.

Aeshna cyanea (Müller, 1764)

V.J. Kalkman & D. Kitanova

Taxonomy

Aeshna vercanica Schneider *et al*. 2015, a species closely related to *A. cyanea*, was recently described from northern Iran and south-east Azerbaijan. It matches *A. cyanea* in the structure of the genitalia and appendages but differs in the head morphology, pterostigma length and a clearly different colour pattern.

Distribution

World: *Aeshna cyanea* has a Western Palaearctic distribution with almost its entire range within Europe. In Africa it is limited to the Maghreb where it is rare and restricted to the mountains of Algeria (Samraoui & Menai 1999), Tunisia (Korbaa *et al*. 2014) and possibly northern Morocco (Navas 1934). In the south-east of its range, it is found in the mountains of north Turkey, Armenia, Georgia, Azerbaijan and the Caucasus. Records from south-east Azerbaijan (Dumont 2004, Skvortsov & Snegovaya 2014, 2015) were found to belong to the recently described *Aeshna vercanica* and the only record from northern Iran could not be reliabely identified and is here omitted as it cannot be rulled out that it pertains to *A. vercanica* (Schneider *et al*.

2015). The easternmost records are from the southern parts of the Ural Mountains (Chaplina *et al.* 2007, Skvortsov 2010), and the species is absent from most of the Siberian lowland. Its occurrence in the Ural Mountains makes it likely that it is also present in the northwest of Kazakhstan; however, a record from Kazakhstan in the Altai Mountains (Reinhardt & Samietz 2003) in fact refers to *A. caerulea* (Kosterin & Gorbunov 2010) and a record based on a young larva from Lake Balkhash in east Kazakhstan (Reinhardt & Seidenbusch 1999) is also considered to be incorrect.

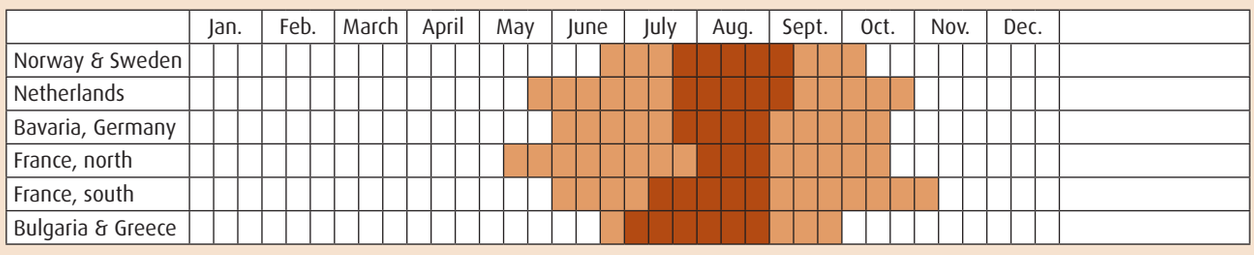
Europe: The core of the European range of *A. cyanea* is located in central and western Europe at middle latitudes, where the species is widespread and among the most common anisopterans. It does not reproduce in Ireland where, however, a vagrant has been recorded, and is rare in Scotland. In Fennoscandia it is found in no more than the southernmost third of Finland, Sweden and Norway. It is currently expanding its range northwards. It is less common in the south of Europe, where it is largely confined to mountain areas and some Mediterranean islands (Baleares, Corsica, Sicily and Rhodes).

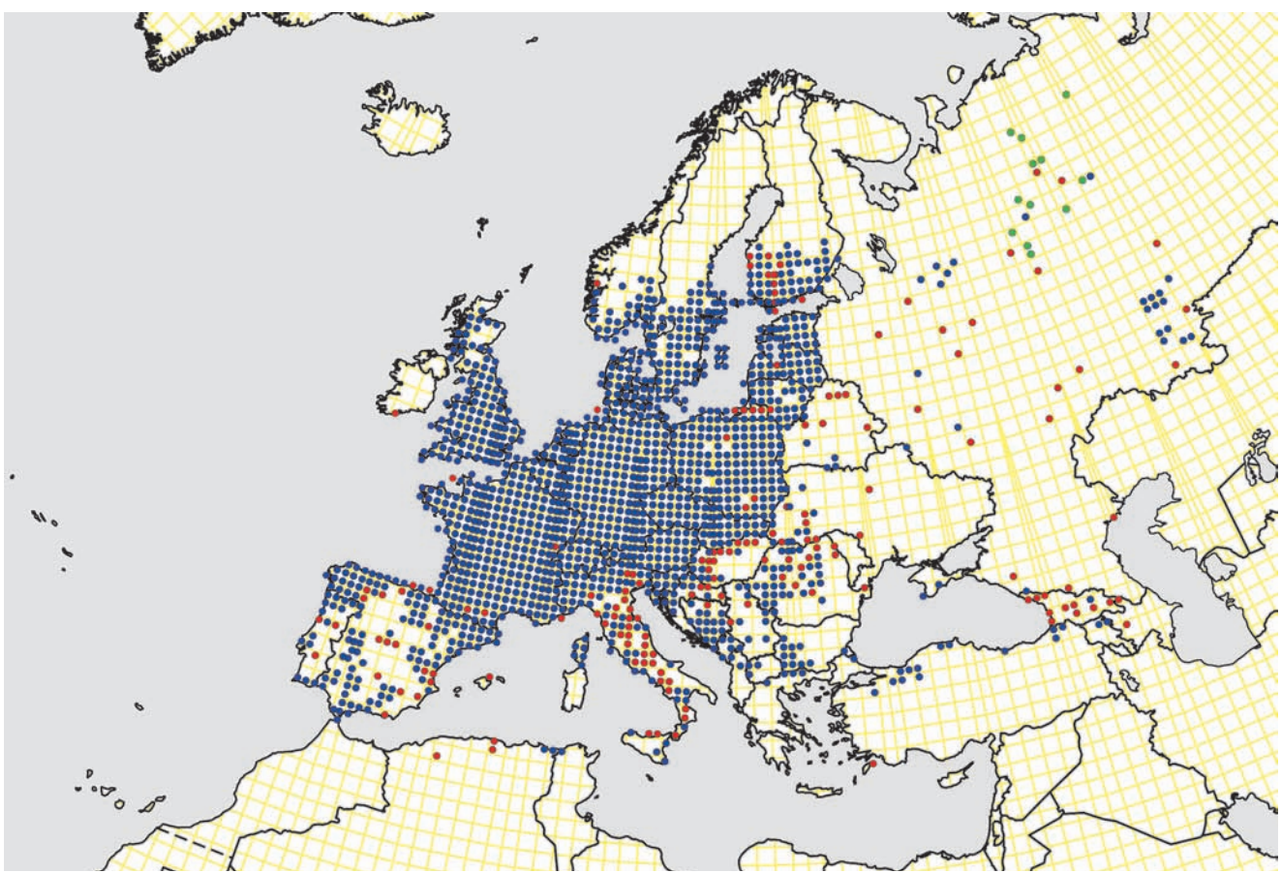
Trend and conservation status

The species is widespread and common in most of Europe and is not threatened. Only in the south of Europe does it have a more patchy distribution and here the species is likely to be affected by climate change.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
Red List Europe - endemic	No
Trend Europe	Stable

Flight period





World distribution

Habitat

Aeshna cyanea is found at standing and, less often, at slow-flowing waters. It has a clear preference for small and at least partly shaded habitats. On larger water bodies it favours sections that are visually demarked from the main area of water, for example by higher vegetation. Often the bottom is partly free of emergent vegetation. Such situations occur in ponds that are still in the early stages of succession or, more often, in ponds where leaves from nearby trees and bushes cover a part of the bottom. It is often the only dragonfly present in small, largely shaded forest ponds, pools and puddles with a substrate of leaf litter, and in these situations larvae can occur at very high densities. In central Europe it is also one of the most common dragonflies at garden ponds. The species is able to resist weeks of desiccation. It has a wide altitudinal range, being mostly abundant up to 700 m but still regularly present and reproducing up to 1 700 m.

Aeshna grandis (Linnaeus, 1758)

V.J. Kalkman, L.L. Iversen & E. Nielsen

Taxonomy

Populations in northern Fennoscandia are smaller and have narrower yellow bands on the thorax than those from the other parts of Europe. It is unclear if these differences are simply the result of the colder climate or if they have a phylogeographic base. In the latter case the subspecies name *A. g. linnaei* Ander, 1953 is available.

Distribution

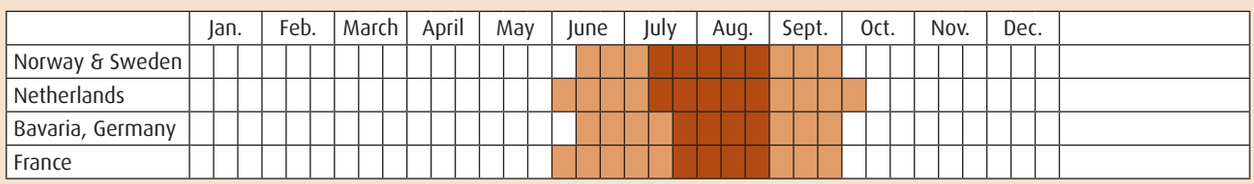
World: *Aeshna grandis* occurs from western Europe east to the Lake Baikal in south Siberia. It is locally common and widespread in both the Ural Mountains and the south of the Siberian lowland. The species is known from scattered records in the north and the south of Kazakhstan and north-west of Mongolia (Peters 1985, Chaplina *et al*. 2007, Borisov & Haritonov 2008).

Europe: *Aeshna grandis* is widespread in the northernmost two-thirds of Europe, with a continuous range reaching south to the Massif Central in France, the Alps, the mountains of Romania, and the northern half of Ukraine. In the French Pyrenees and south-east Europe populations are mostly small and isolated. In the west and the south, the species favours forested areas and is, for example, lacking from the open landscapes of Hungary. *Aeshna grandis* is widespread and locally common in much of central Europe, but its population levels are generally low compared with other aeshnids co-occurring in the region. Far higher densities are found in the European mountains and the species is often very abundant, even omnipresent, in the north and north-east of its European range.

Trend and conservation status

There are no specific threats to this species, although southern localities like those in Serbia and Bosnia and Herzegovina might become threatened by climate change.

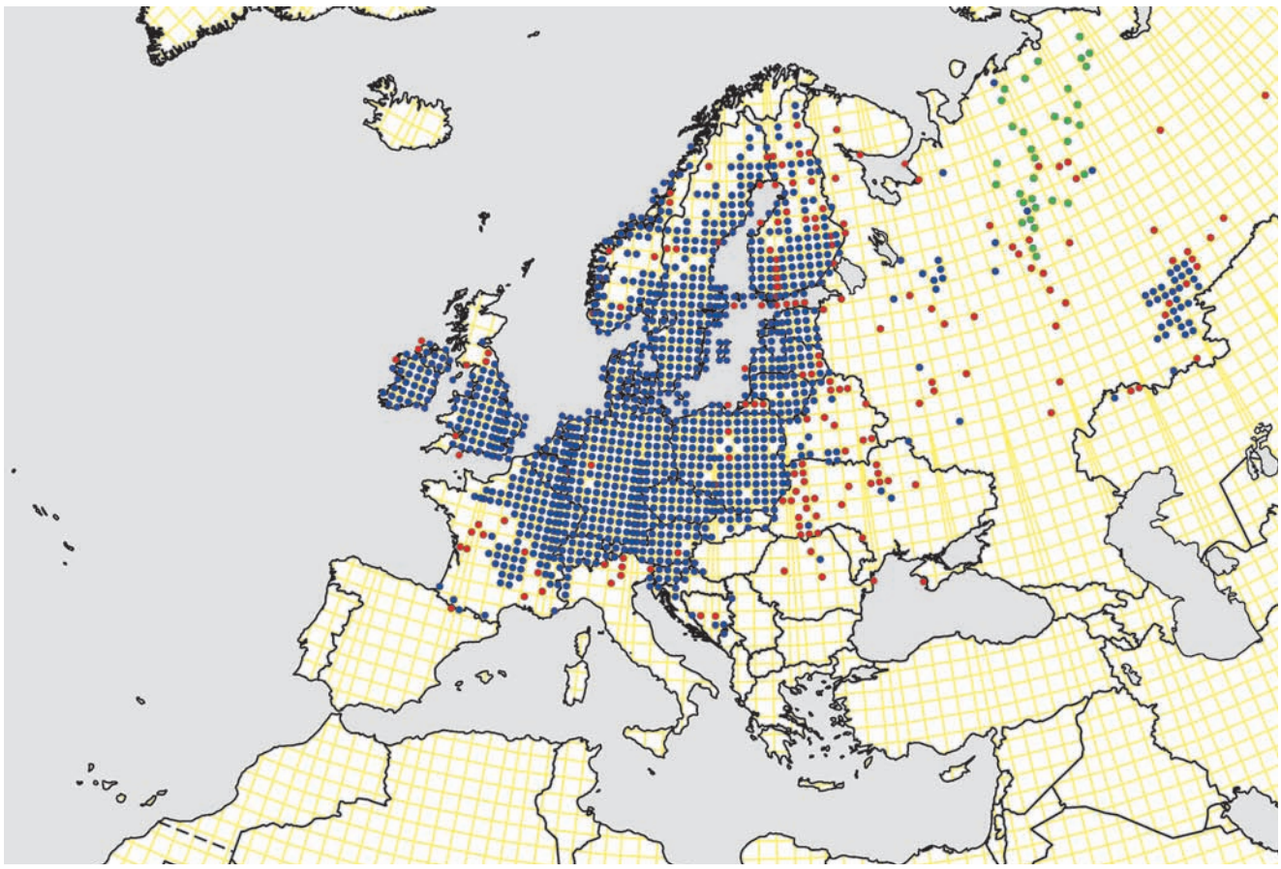
Flight period



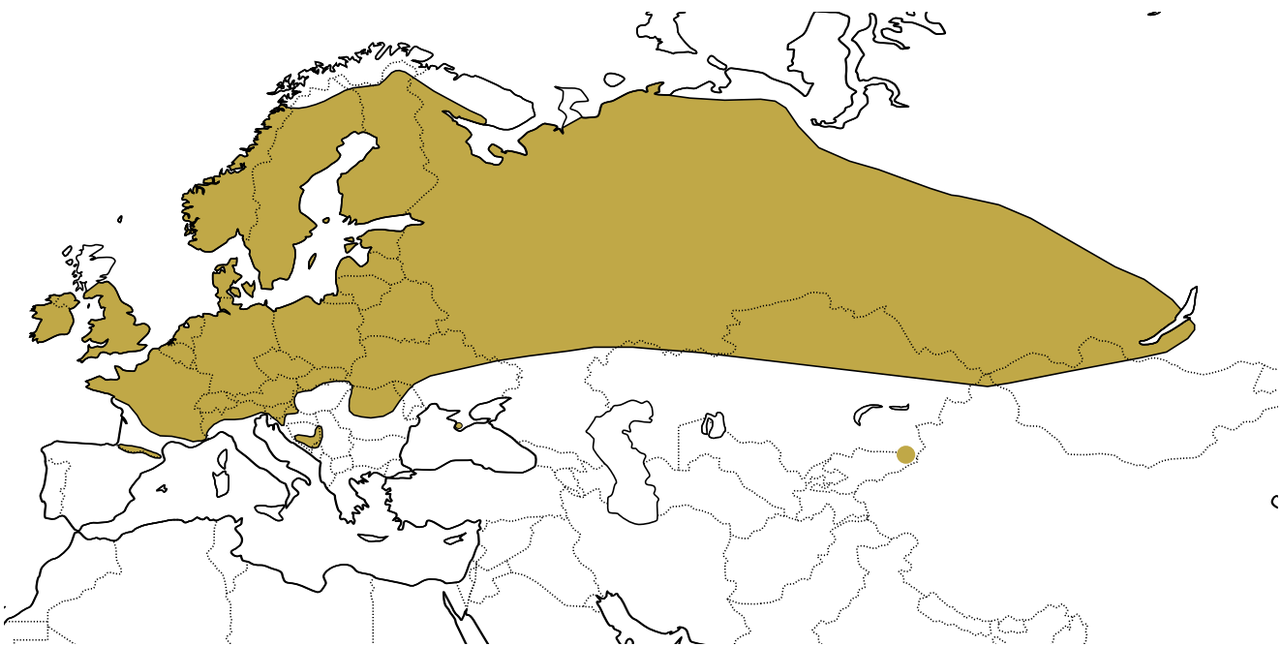
Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
Red List Europe - endemic	No
Trend Europe	Stable

Habitat

Aeshna grandis is found in a wide variety of standing and slow-flowing habitats such as large peaty ponds, lakes, canals, oxbows, peat bogs and fenlands, and to a lesser extent water storage facilities, ditches and man-made peat excavations. Habitats mostly have several characteristics in common, typically being situated in forest areas and fringed by a belt of helophytes or peat



European distribution



World distribution

moss (*Sphagnum*), or having dense floating or submerged vegetation. In the south of its European range, the species is absent from habitats in the early stages of succession, apparently requiring more mature habitats. Most of the populations in central and northern Europe are found in lowlands up to 500 m in altitude, but in the west and the south of its range long-lasting populations are confined to higher altitudes, although in the Alps most populations are found below 1 000 m. Nevertheless, it is frequently found up to 2 000 m in Austria and the French Pyrenees and reproduction has been recorded up to 2 250 m.

Aeshna isoceles (Müller, 1767)

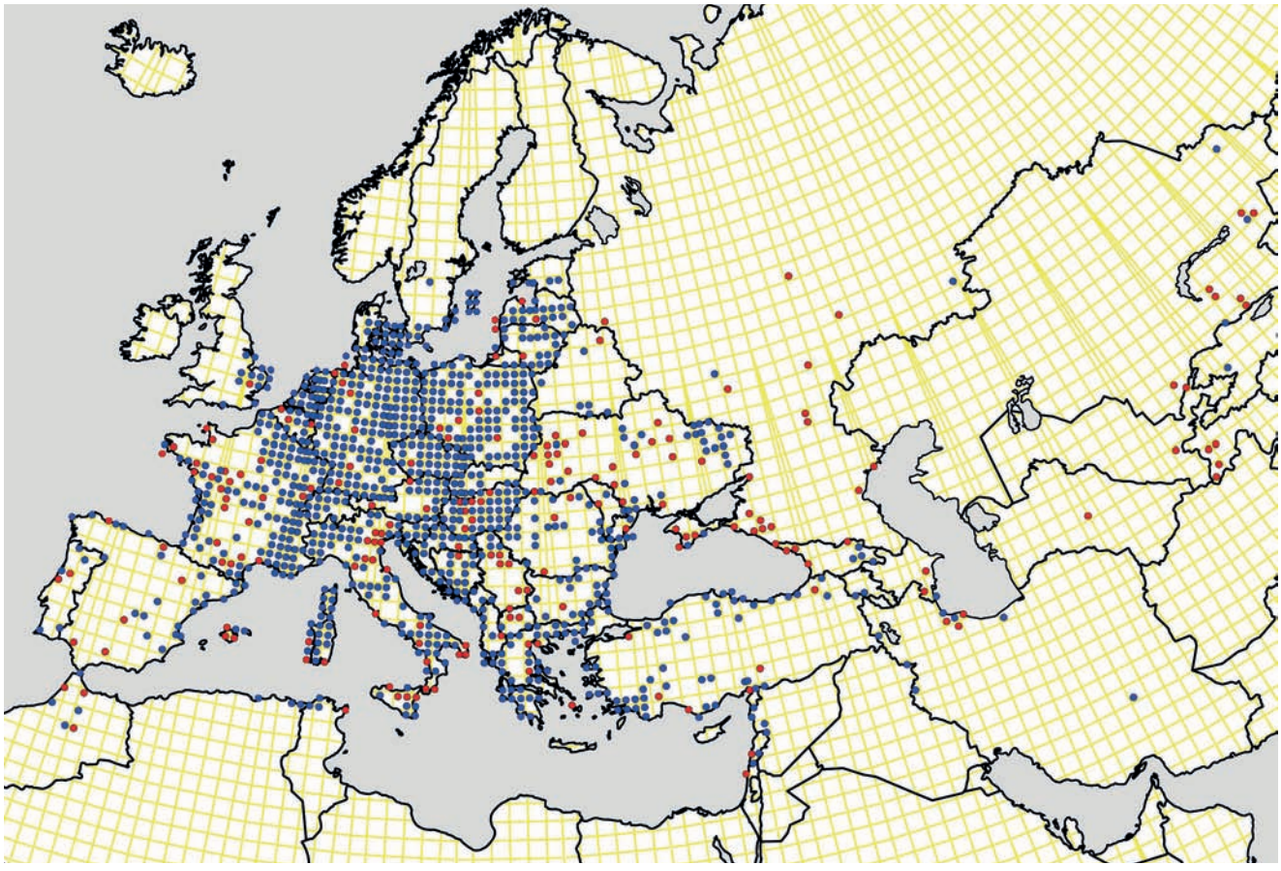
V.J. Kalkman, L.L. Iversen & E. Nielsen

Taxonomy

Populations in south-east Europe and south-west Asia with a more extensive yellow pattern on the thorax are often referred to as subspecies *A. i. antehumeralis* Schmidt 1950. However the characters of this subspecies are poorly defined and seem to be related to climatic conditions, hence it is now generally considered to be monotypic.

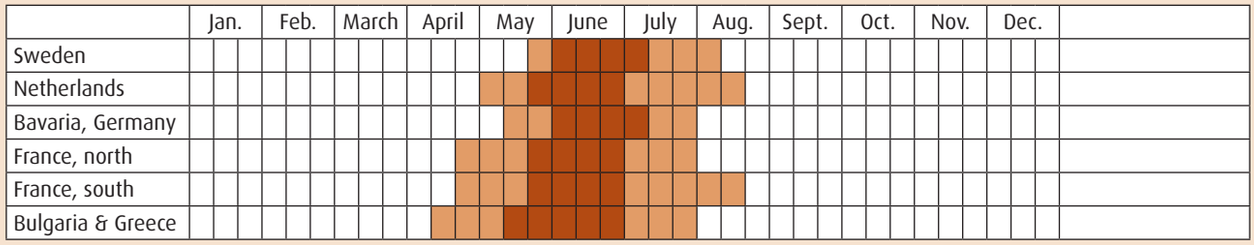
Distribution

World: *Aeshna isoceles* is mostly a European species ranging as far as the Levant and eastward throughout Turkey to the Caspian Sea. Sparse isolated records are available to the south as far as the Kerman province of Iran (De Knijf, pers. comm.). The species becomes rarer east of the Caspian Sea but reaches the south of the Ural Mountains (Haritonov & Eremina 2010) and Central Asia in southern and eastern Kazakhstan, Kyrgyzstan, eastern Uzbekistan, and Tajikistan (Chaplina *et al.* 2007, Borisov & Haritonov 2008, Schröter 2009). Further fieldwork in these regions might show the range in European Russia to be connected with the populations in Central Asia.



World distribution

Flight period



Europe: *Aeshna isoceles* has a wide European range and is found in the southernmost two-thirds of Europe. In the British Islands, stable populations are known only in Norfolk and Suffolk and other records were of vagrants (Cham *et al.* 2014). In northern Europe, the species reaches the southern tip of Sweden and Estonia. To the east it appears to be fairly common in eastern Ukraine (Martinov 2010) and scattered in the southern half of European Russia (Morton 1920, Skvortsov 2010). Although it is distributed over a large part of Europe, in large areas it is rare to absent. This pattern seems to be largely explained by its preference for warmer areas combined with a habitat preference for extensive reed marshes or well-developed beds of submerged aquatic vegetation. Due to this, it is absent from the highest mountain regions and most of northern Europe, while it is rare in the Iberian Peninsula and parts of France due to a lack of extensive reed marshes.

Trend and conservation status

Aeshna isoceles declined in many areas in Europe in the second half of the 20th century. Since the 1990s the species seems to be stable in most of its range and has clearly increased in areas such as the Netherlands, Denmark and Great Britain, and has recently established (2007) in Estonia (Martin 2009, 2013). This might be due to a combination of improved water quality and climate warming. In large parts of Europe, such as the Iberian Peninsula and to a lesser extent southern Germany, *A. isoceles* has a patchy distribution, being dependent on a small number of scattered populations. In these areas, it can easily become regionally extinct due to habitat destruction or unsustainable water management.

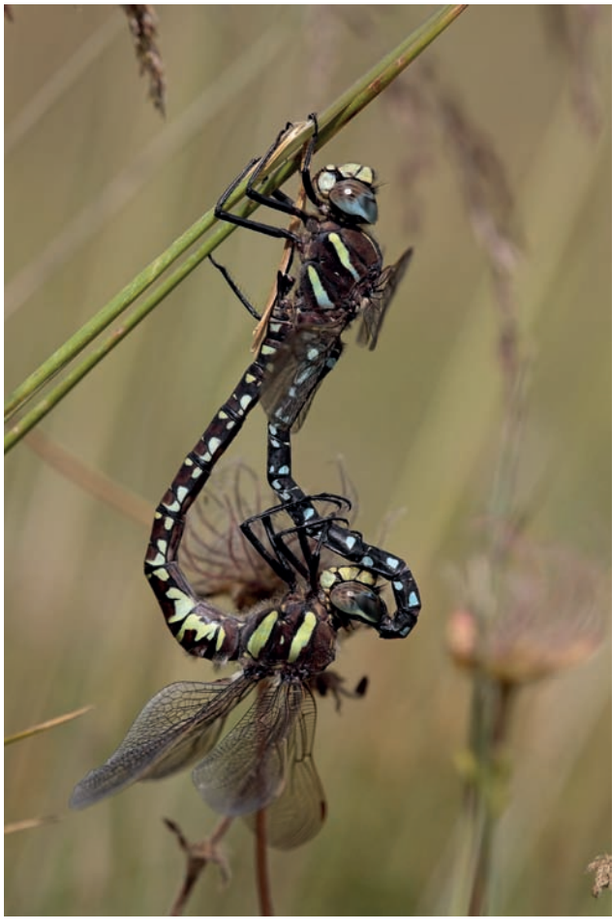
Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
Red List Europe - endemic	No
Trend Europe	Stable, increasing to the north

Habitat

Aeshna isoceles prefers habitats with extensive belts of reed, bulrush (*Typha*), sedges (*Carex*) or water soldier (*Stratiotes aloides*). Throughout its range, it reproduces at reed beds at standing water or along slow-flowing water including canals, marshes, ponds and lakes. It prefers sunny habitats offering some shelter from the wind. A well-developed aquatic vegetation provides shelter for the larvae, enabling the species to co-occur with predatory fish.

Aeshna juncea (Linnaeus, 1758)

V.J. Kalkman, L.L. Iversen & E. Nielsen



Taxonomy

A series of subspecies have been described, largely based on differences in colour pattern on the thorax and abdomen. None of these are currently commonly recognised. Nevertheless specimens from America are obviously different from those found in Europe, to a same extent as the differences between *A. s. subarctica* (Nearctic) and *A. subarctica elisabethae* (Palearctic). There is no clear variation in colouration within Europe.

Distribution

World: *Aeshna juncea* has the widest range of all *Aeshna* species occurring in the northern parts of Europe, Asia and North America. In North America it is widespread in Alaska, Canada and parts of the northern states of the USA. Further south it is limited to the Rocky Mountains, ranging south to northern New Mexico. In south-west Asia it is found southwards to the mountains of the Caucasus and north-east Turkey. In Central Asia it is mostly confined to the mountains, occurring as far south as northern Afghanistan and Kashmir. The species seems to be widespread throughout Siberia, the Far East, Mongolia, northern China, North Korea, the northern parts of South Korea and Japan.

Europe: *Aeshna juncea* is widespread and common in the north, becoming scarcer and confined to higher altitudes in the south. It is fairly common and widespread in the Alps and the Pyrenees, but is scarce and known only from scattered high altitude localities in south-east Europe (Micevski 2008, Manci 2012) and the Iberian Peninsula.

Trend and conservation status

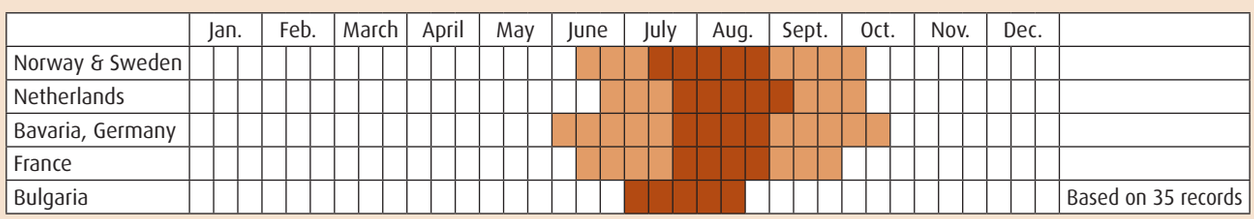
In the past, populations in the lowlands of west and central Europe decreased mainly due to the conversion of bogs to farmland. The eutrophication of water had a negative impact on the species. Climate warming and related droughts are likely to be important threats in the future, with an expected decrease of the species in its southernmost populations (Iberian Peninsula, Romania and the Balkan Peninsula).

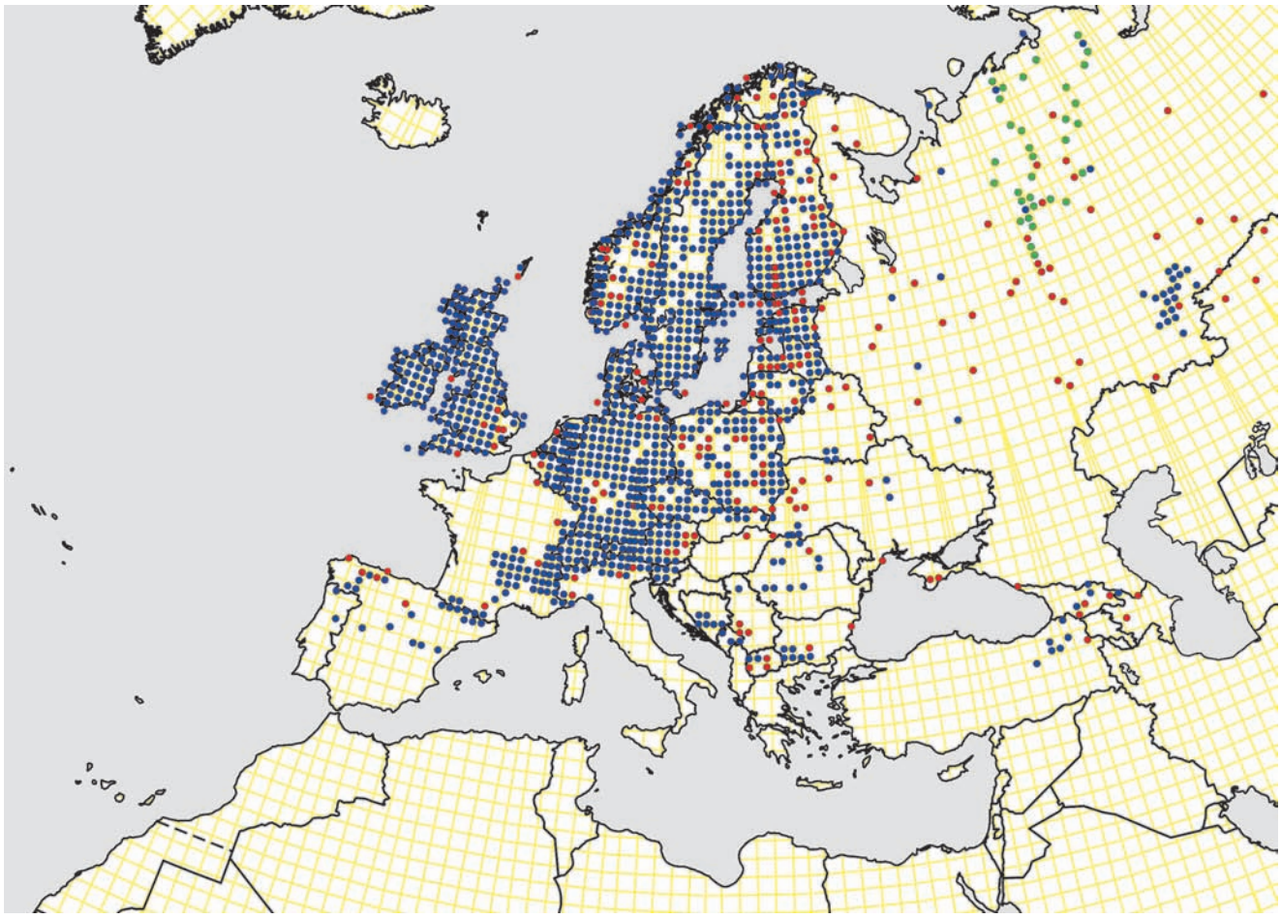
Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
Red List Europe - endemic	No
Trend Europe	Stable

Habitat

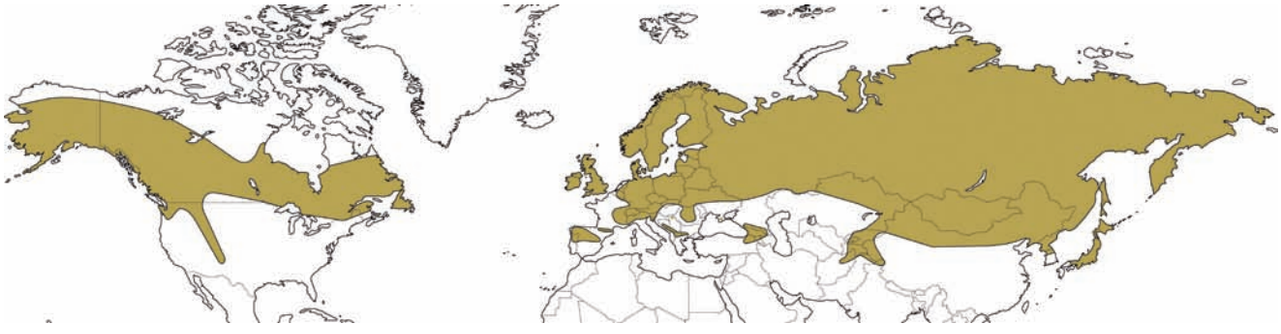
Aeshna juncea is mostly confined to standing and largely unshaded water in meso- to oligotrophic habitats, having a preference for bogs and other standing water with well-developed *Sphagnum* vegetation. At lower altitudes in central and western Europe, the vast majority of populations are found at larger bogs with peat moss (*Sphagnum*) and sedges or rushes. More rarely, it is present in lower numbers at other habitats such as

Flight period





European distribution



World distribution

quarries, dune ponds, fens, or peaty areas with fields of water soldier (*Stratiotes aloides*). The species uses a wider range of habitats in Fennoscandia and in the mountains of central Europe, where habitats also include slow-flowing water and lakes or ponds with sparse vegetation.

Aeshna mixta Latreille, 1805

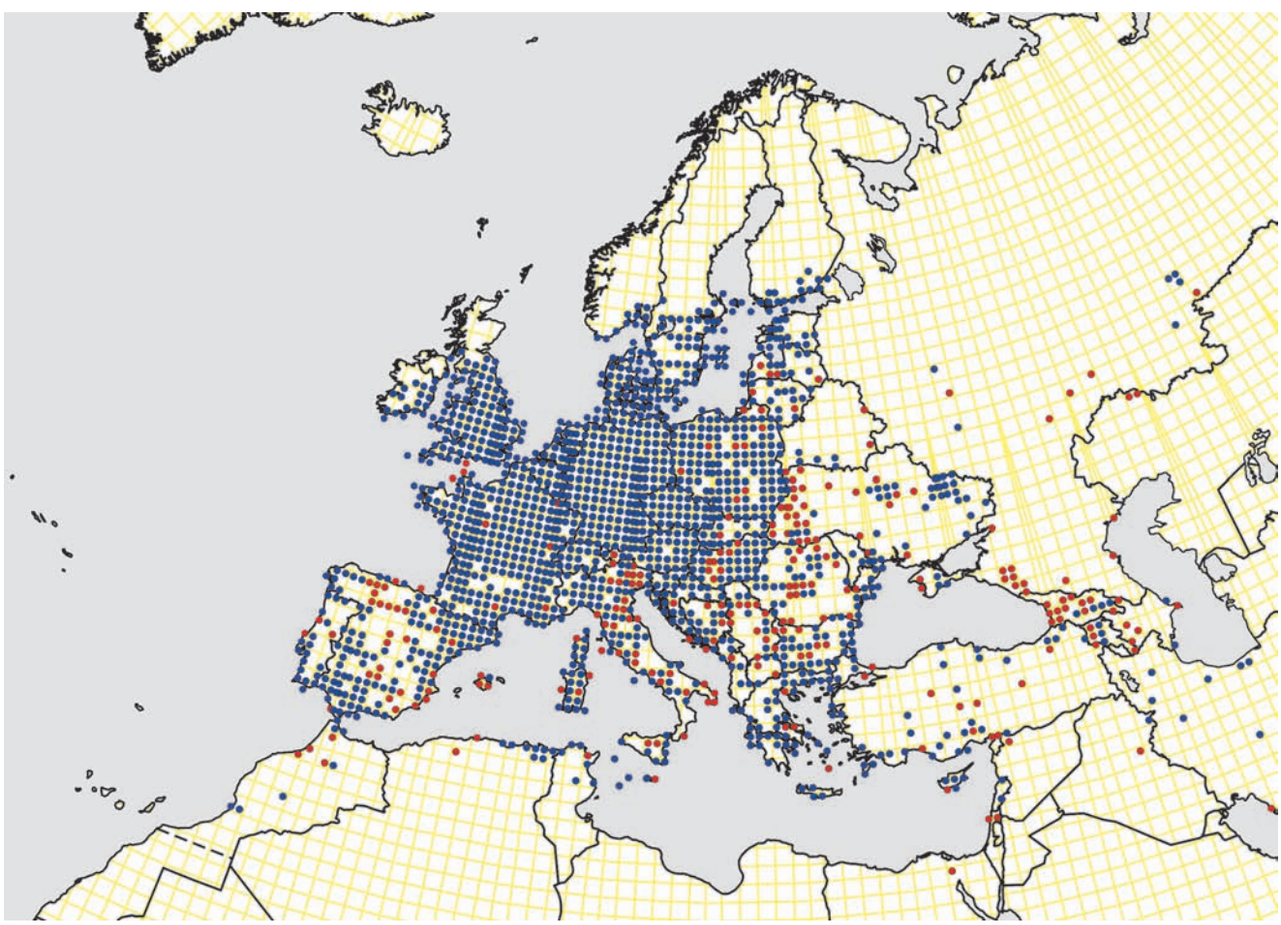
V.J. Kalkman, L.L. Iversen & E. Nielsen

Distribution

World: *Aeshna mixta* has a wide range, extending from western Europe to Japan, although it is absent from most of Siberia. In south-west Asia, it has a scattered distribution in Turkey and the Levant, with migrating swarms known as far south as the Suez Canal, extending eastwards to western Iran and the Caspian Sea. *Aeshna mixta* is almost absent from the lowlands of Central Asia, but occurs regularly in the mountains from Kyrgizstan, Tajikistan and Kashmir. It is widespread in Mongolia and northern China, North Korea and Japan. In Africa it has been recorded from the northern parts of the Maghreb in Morocco, Algeria and Tunisia.

Flight period

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Norway & Sweden												
Netherlands												
Bavaria, Germany												
France, north												
France, south												
Bulgaria & Greece												



European distribution

World distribution

Europe: The species is common across a large part of Europe, being absent only from most of Fennoscandia, northern Russia, northern Ireland and Scotland. It reaches its highest abundance in parts of southern and central Europe.

Trend and conservation status

Aeshna mixta has been steadily expanding its range northwards in the last two decades, increasing in Great Britain, establishing in Ireland since 2000 (Nelson & Thompson 2004) and reaching Finland in 2003 (Karjalainen 2007). In Sweden, it has been extended its range 300 km northwards in the last ten years. The species is common and widespread in large parts of Europe and is assessed as of Least Concern.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
Red List Europe - endemic	No
Trend Europe	Increasing

Habitat

The species mainly reproduces in largely unshaded standing water, but is also found at slow-flowing water. It occurs in a wide range of habitats, including brackish water, but seldom reproduces in acidic ponds and lakes. It is mainly found at larger water bodies with abundant open riparian vegetation of reed and bulrush (*Typha*), and large populations are found both in natural and artificial habitats.

Aeshna serrata Hagen, 1856

V.J. Kalkman & S. Karjalainen

Taxonomy

The name *A. (serrata) osiliensis* Mierzejewski 1913 has been used for populations referable to *A. serrata* from around the Baltic Sea. However the characters separating these two taxa are weak and treating Asian and Fennoscandian populations as separate taxa was partly based on the assumption that the European population is separated from the main range of the species. Although more investigations are needed in this respect, *A. osiliensis* is regarded here as a synonym of *A. serrata*.

Distribution

World: Although the species is found around the Baltic Sea and the north of European Russia (Bernard & Daraż 2010), its main range runs from the Ural Mountains to east of Lake Baikal, including north and east Kazakhstan, Kyrgyzstan and northern Mongolia (Peters 1985, Yanybaeva *et al.* 2006, Schröter 2010b). Within this range, it shows a preference for open and semi-open steppes in the temperate parts of Asia. There is an isolated record from Kamchatka (Dumont 2005a) and it is unclear if the species occurs between there and its main Asian range. In south-west Asia, it is known from a disjunct area with sparse records from Georgia, Armenia, eastern Turkey and north-west Iran (Morton 1914, Akramowski 1948, Rastergar *et al.* 2013, Schröter *et al.* 2015).

Europe: In Europe, *A. serrata* is common and widespread in the southern parts of the Ural Mountains where it is found at steppe and forest-steppe lakes (Yanybaeva *et al.* 2006). Further west, it is found along the Baltic Sea and its coastal wetlands (Russia, Estonia, Finland and Sweden), and also at inland lakes in southern Sweden. The westernmost population is found in north-western Jutland, Denmark, where it was discovered in 2006 (Bell *et al.* 2014). A sighting in Norway in 1995 has been reported (Olsvik 1996) but has not been confirmed by additional records. In 2009, several populations were discovered in the Arkhangelsk province in the north of European Russia (Bernard & Daraż 2010). A single record from the Komi Republic in northern Russia (Sedykh 1974) and records, two old and one more recent, from eastern Ukraine (Oliger 1980) have been considered doubtful (Peters 1987, Gorb *et al.* 2000) and are omitted here. It seems however possible that the species is far more widespread at forest and steppe lakes in the European part of Russia than is presently known and it might very well occur in eastern Ukraine in brackish wetlands along the Black Sea.

Trend and conservation status

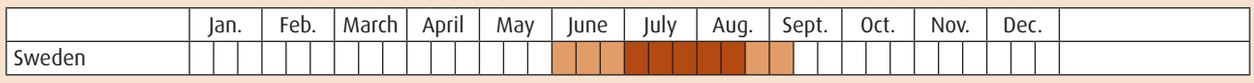
Aeshna serrata seems to have increased in Sweden in recent decades and has expanded its range from the east coast to inland localities and the west coast (Olsvik 1997, Billqvist 2012, Bell *et al.* 2014). It is uncertain if the Danish population is the result of a recent range expansion or was overlooked in the past. The range of the species in eastern Europe is poorly known and little information on its biology and habitat is available, making it difficult to assess its conservation status. It seems however to be well distributed and common in the southern Urals and does not appear to be threatened there. Overall there is no indication of a decline and the species is therefore considered to be stable in Europe. The Baltic population is dependent on coastal wetlands and the species could be threatened by human habitat alteration on the coast of Estonia and Finland. It is quite possible that the majority of the Baltic population breeds in the Baltic Sea, which has a low salinity, or in habitats strongly influenced by its water. Thus, changes in the water quality of the Baltic Sea could potentially have an adverse impact on the species across a large part of its European range. Several Swedish populations occur in protected bird areas and might be negatively impacted by artificial flooding which is done to promote the conservation of birds.

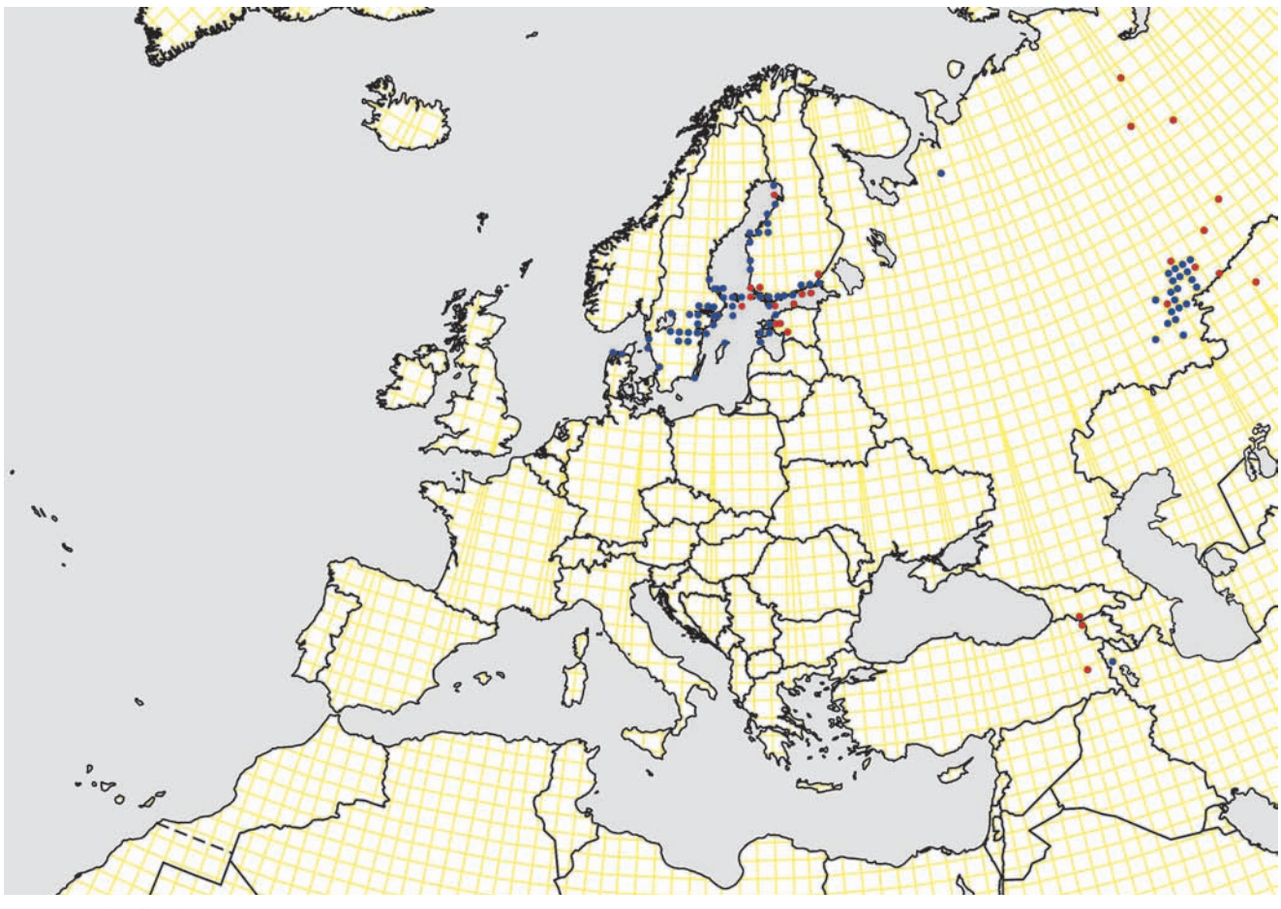
Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Not present
EU27 endemic	No
Red List Europe - endemic	No
Trend Europe	Stable

Habitat

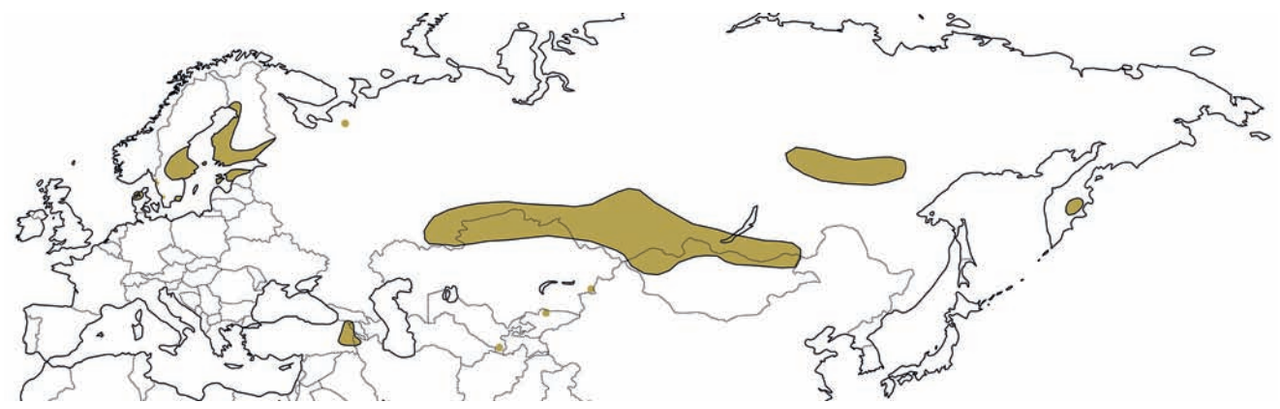
Aeshna serrata is found at standing water and, compared to the closely related *A. crenata*, prefers more open landscapes. In the south of Russia, the species is found in steppe and forest-steppe lakes (Belyshev 1973, Kosterin *et al.* 2001, Kosterin & Zaika 2003, Dumont *et al.* 2005a). In inland Sweden, it occurs at open, often eutrophic lakes and ponds with extensive beds of reed or bulrush (*Typha*). The species is relatively common around the Baltic Sea where it occurs in coastal wetlands, apparently reproducing in waters along or connected with the Baltic Sea. The Baltic Sea at these places has a low salinity allowing for the growth of extensive belts of reed. In Denmark it occurs in large, open marshlands dominated by extensive reed beds and intersected by clear, slightly brackish water often containing hornworts (*Ceratophyllum*) (Bell *et al.* 2014, Manger 2014).

Flight period





European distribution



World distribution

Aeshna subarctica Walker, 1908

V.J. Kalkman, L.L. Iversen & E. Nielsen

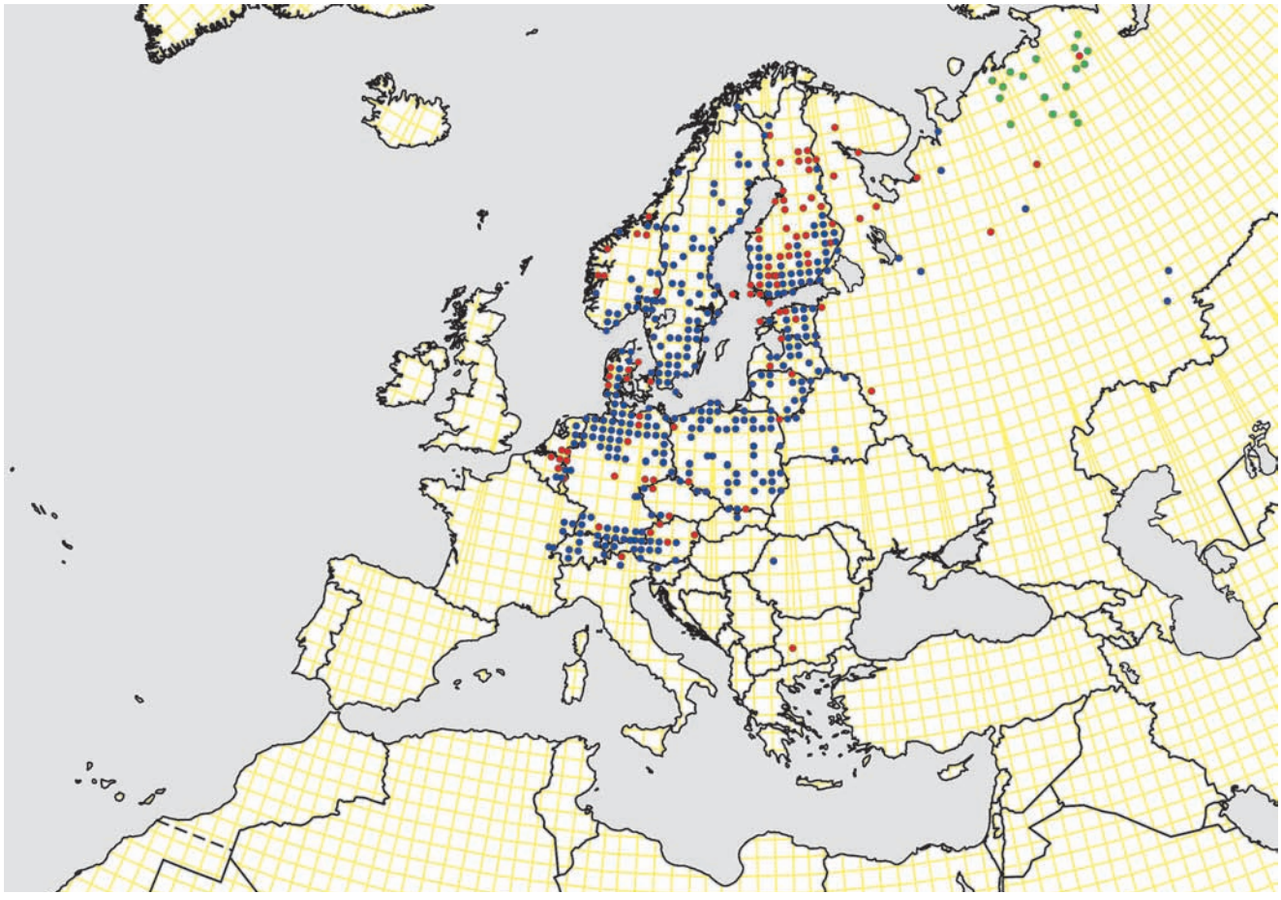
Taxonomy

The nominotypical subspecies is restricted to North America whereas the subspecies *A. subarctica elisabethae* Djakonov, 1922 is found in Europe and Asia. Two forms of *A. s. elisabethae* occur in Europe, which differ mainly in the extent of the yellow pattern on the thorax. It appears that in cooler climates the darker type prevails while in the lowland of central Europe the paler type is more common. These types can be found together and are at least partly determined by climatological conditions; they are therefore not considered to be subspecies.

Distribution

World: The nominotypical subspecies *A. s. subarctica* occurs in North America and is found in Alaska, Canada and the northern states of the United States. The subspecies *A. s. elisabethae* is found in the northern parts of Europe and Asia, where it reaches eastwards to the Bering Strait, Kamchatka, the north Japanese island of Hokkaido, Korea and north-eastern China.

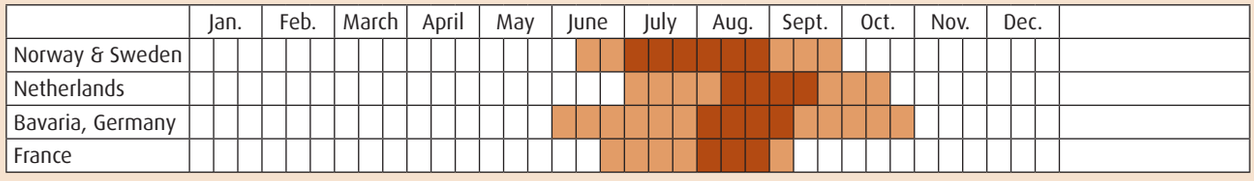
Europe: In Europe the species is largely confined to the north, where it reproduces in the lowlands. It is probably common in the northern part of European Russia, from where its range extends to the whole of Fennoscandia, the Baltic States, Poland, northern Germany, Denmark and the Netherlands. Only a handful of records are available from Belarus. Further to the south, the species is restricted to higher altitudes, occurring for example in the Hautes Fagnes (Hohes Venn) (Belgium), the Vosges and Jura mountains (France), the Black Forest (Germany), the central Alps, the Bohemian Forest and the western Carpathians. It is difficult to distinguish in the field from the more common *Aeshna juncea*, with which it typically co-occurs. In remote mountain areas, localities have been difficult to find, but increased search effort has recently resulted in its discovery in the Italian Alps and the Romanian



European distribution

World distribution

Flight period



Carpathians (Festi 2011, Flenker 2011). The Romanian locality is at considerable distance from the nearest known population, suggesting that the species has a wider distribution in the mountains of south-east Europe than is currently known. These records also give credibility to an old, never confirmed, Bulgarian record from 1954 (Marinov 2003). It is expected that the species occurs at more locations along the Carpathians and will be discovered in the future in south-west Ukraine.

Trend and conservation status

Most populations of *A. s. elisabethae* are found in areas with relatively little human activity or in nature reserves, and the species is therefore safe from large-scale habitat destruction. The present climate trend with increased temperatures and lower rainfall in south and central Europe will increase the risk of desiccation of many peat bogs in the summer months. This has already led to the disappearance of some populations in the Vosges Mountains. Locally, natural succession that overruns flooded depressions and man-made excavations in peat bogs, and an increased influx of nutrient from nearby farmlands, are a threat to populations.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Near Threatened
EU27 endemic	No
Red List Europe - endemic	No
Trend Europe	Decreasing

Habitat

The species is confined to acidic moors and *Sphagnum* peat bogs with naturally flooded depressions or man-made excavations resulting from peat extraction. It strongly favours habitats with floating peat moss (so-called *Sphagnum*-soup), which serves as larval habitat. It is also found in habitats where the peat moss either forms floating rafts as part of the bankside or lies on the bottom. It is found in lowlands in the north of its range but is confined to higher altitudes in the south, where it occurs mostly above 700 m.

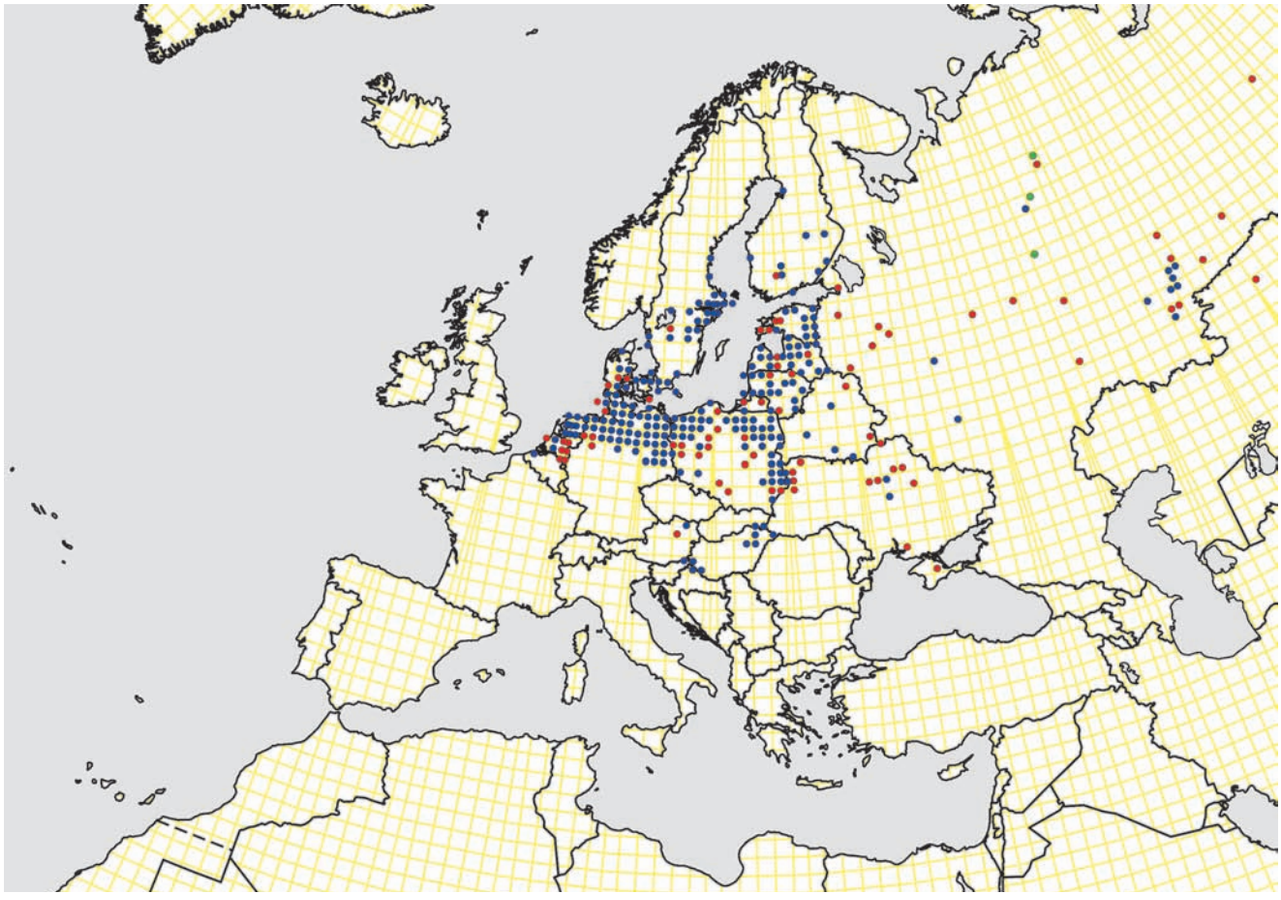
Aeshna viridis Eversmann, 1836

V.J. Kalkman, M. Kalniņš & R. Bernard

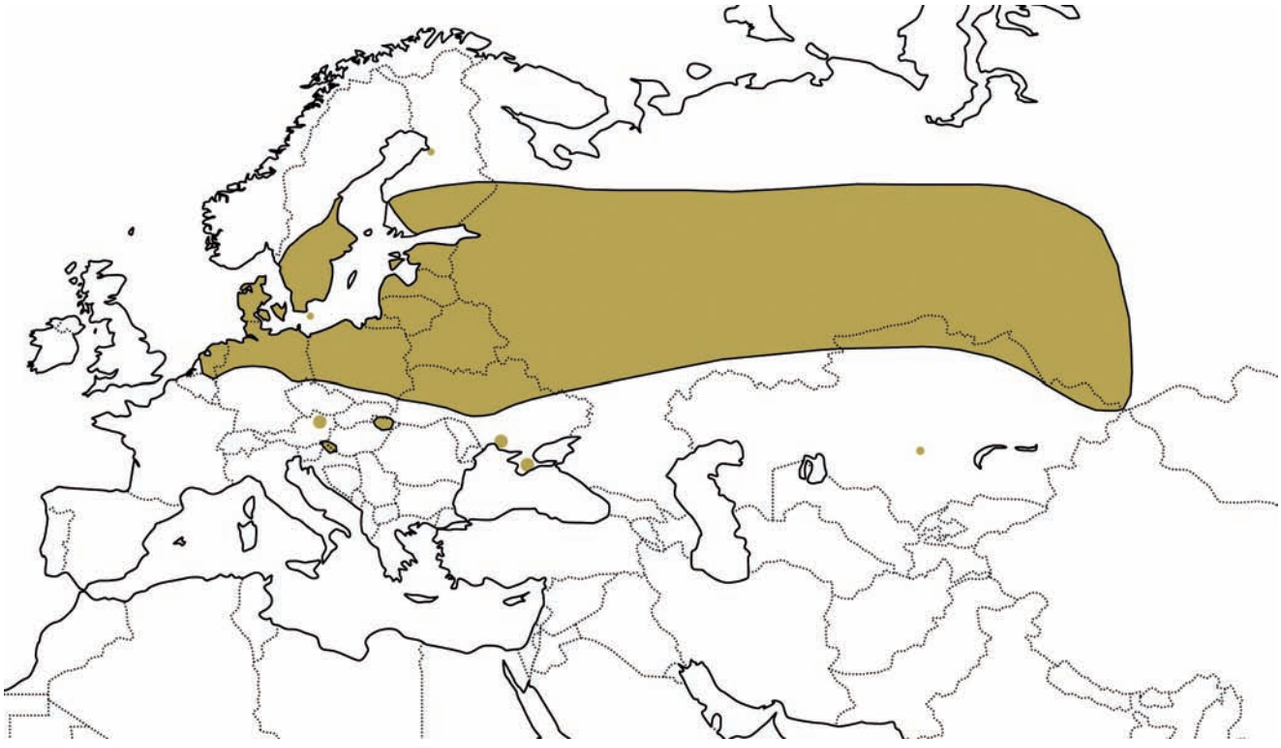
Distribution

World: *Aeshna viridis* is nearly confined to the Western Palaearctic and is found from the Netherlands to the western edge of the Central Siberian Plateau. The species is widely distributed and common in the southern half of western Siberia (Belyshev 1973, Kosterin *et al.* 2001) and is known from a few records from Kazakhstan (Hagen 1856, Chaplina *et al.* 2007, Kosterin & Gorbunov 2010). An old record from the Russian Far East (Belyshev 1958, 1968) is believed to be incorrect (Malikova & Kosterin 2009).

Europe: The European range of *A. viridis* is largely confined to the north and the east of Europe, in areas rich in lakes or largely natural river floodplains. It is relatively widespread in the northern parts of European Russia, the Baltic States and Poland, and probably also in Belarus and parts of northern Ukraine although records from these countries are sparse. In Fennoscandia, populations are confined to the southernmost third of Finland and Sweden. In western Europe it is found in the Netherlands, Denmark and the north of Germany. Only isolated populations are found in the southern part of central Europe, with records from the floodplains of the Drava River on the borders of Slovenia and Croatia, and of the Tisza River in north-eastern



European distribution



World distribution

Flight period

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Sweden													
Netherlands													

Hungary (Devai *et al*. 1994, Kotarac 1997, Belančić *et al*. 2008). Only two records, both of a single specimen, are known from Austria and these could relate to vagrants although the earlier presence of a population in the floodplains of the Donau cannot be excluded (Raab *et al*. 2006).

Trend and conservation status

Aeshna viridis has decreased in large parts of western and central Europe and is probably experiencing a continuing decline in large areas on the continent. Its strict dependence on fields of water soldier (*Stratiotes aloides*) means that it quickly disappears as the plant becomes rare due to pollution. At least in western Europe, the species became dependent on agricultural areas after concentrations of water soldier disappeared from natural habitats such as oxbows in river floodplains. Populations in agricultural areas are found in man-made waters such as ditches and canals where the natural succession of the vegetation will eventually lead to the water soldier being replaced by other plants. Here, it is dependent on the removal of the vegetation every few years in order to maintain the habitat. This management needs to be done in a rotation model in such a way that every year large stretches of suitable habitat are available. Management plans are needed especially for populations dependent on man-made habitats, and for many areas in the Netherlands and Germany these are already in place. The isolated populations in Germany, Hungary and Croatia especially need attention.

Habitats Directive	IV
Red List EU27	Near Threatened
Red List Europe	Near Threatened
Red List Mediterranean	Not present
EU27 endemic	No
Red List Europe - endemic	No
Trend Europe	Decreasing

Habitat

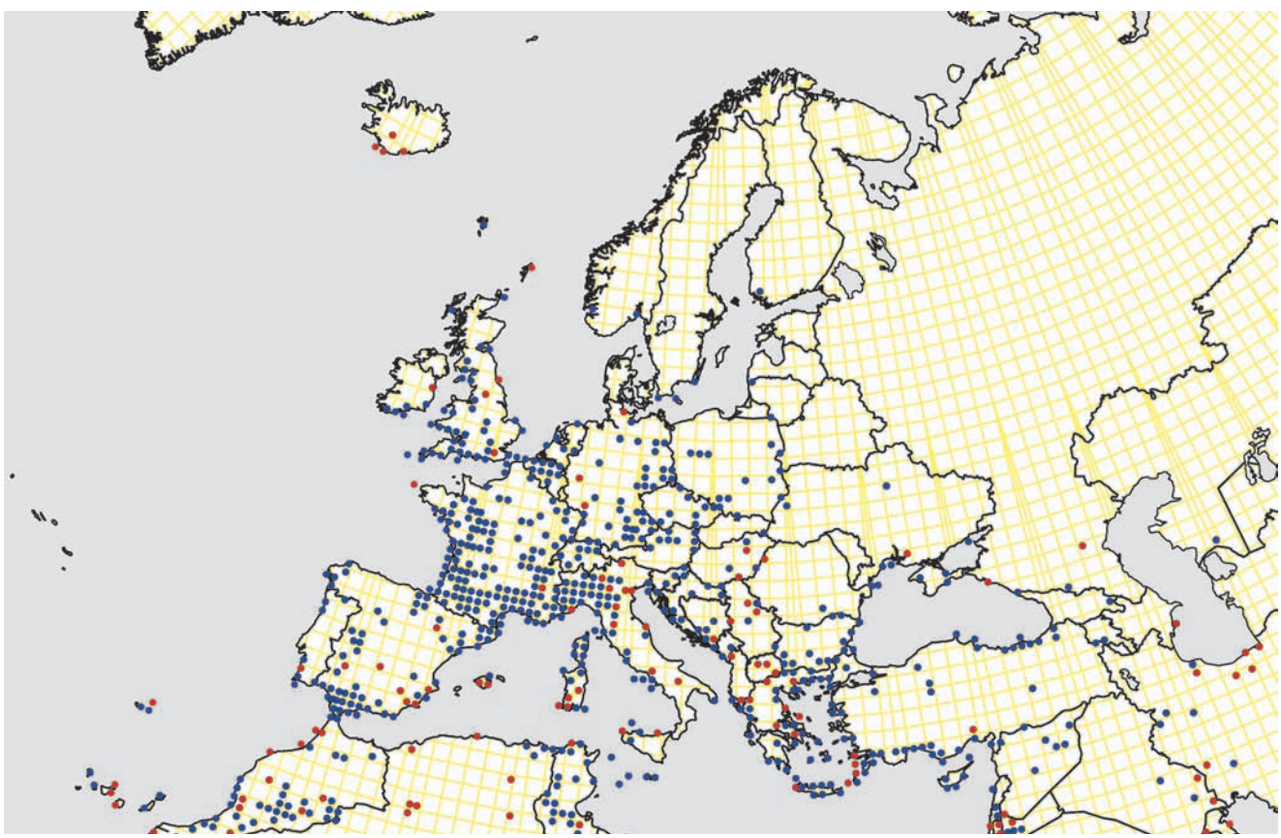
In the European part of its range, *A. viridis* is almost completely confined to habitats with large fields of water soldier (*Stratiotes aloides*). These fields are found in standing or slowly flowing, largely unshaded, waters with a mesotrophic to moderately eutrophic status. Natural habitats where this species occurs are lakes and oxbows in the floodplains of large rivers. The species also inhabits man-made peat-excavation ponds in later stages of vegetation succession, close to climax. In western Europe, the species has become rare in natural habitats and is mainly found in man-made waters such as large ditches and canals in low peat areas.

Anax ephippiger (Burmeister, 1839)

V.J. Kalkman & C. Monnerat

Distribution

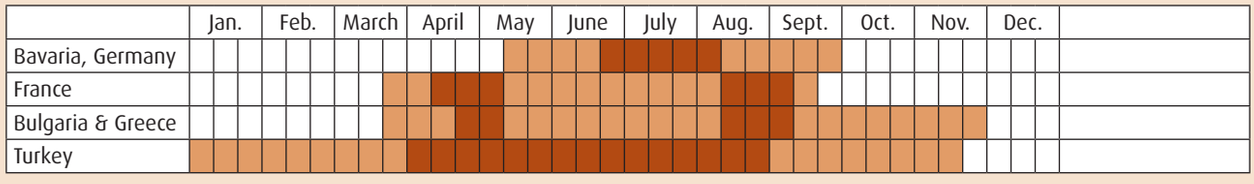
World: *Anax ephippiger* has a very wide range that includes large parts of Africa and extends over the Arabian Peninsula into north-east India and parts of Central Asia. It has been listed for China by Needham (1930) but no actual locality is known. There are three records of single vagrants each, from the years 1995, 1996, 1997, from Japan (Ozono *et al*. 2012), which suggest that vagrants may occur throughout most of eastern Asia. The species is mostly indigenous to areas with distinct wet and dry seasons, where it reproduces in seasonal waters that dry out in most summers. The regional availability of these kinds of breeding habitat depends strongly on the amount of rain and varies markedly between years. This species is an obligate migrant that generally leaves its reproductive habitat even in the early post-teneral stage (Corbet 1999). Its strong migratory behaviour regularly leads to invasions of areas far outside its normal breeding range, resulting in records from the Faroe Islands (Parr 2011) and Iceland (Norling 1967, Olafsson 1975, Tuxen 1976). Amazingly, this species has recently begun to colonise the New World, the first record being a male caught in 2002 in French Guiana. The first record for the Caribbean was a female captured in 2006 in Guadeloupe (Machet & Duquef 2004, Meurgey 2006) and the first record for Brazil (Belém) was made in 2012. Subsequently it has been found on several Caribbean islands with increasing frequency. The



European distribution

World distribution

Flight period



discovery of a teneral female, in this part of the New World makes it obvious it reproduces there (Meurgey & Picard 2011, Duquef 2012, Paulson *et al*. 2014).

Europe: The presence of *A. ephippiger* in Europe is largely dependent on migration from Africa or south-west Asia and the number of individuals arriving varies greatly between years. In the Mediterranean, large numbers can be seen during these influxes, with, for instance, thousands being noted on Gozo (Maltese islands), in March 2011, and a strong migration with up to 20 individuals per minute witnessed in Portugal in April 2011 (Parr 2011). In some years the migration reaches central and northern Europe and on these occasions it can turn up anywhere in Europe, reaching as far north as Iceland (see above). Recent years with large numbers of migrants include 1989, 1990, 1995 and 2011 (Dumont & Desmet 1990, Burbach & Winterholler 1997, Askew 2004, Parr 2011, SFO 2013). The direction and probably the origin of the invasions varies between years, with the event of 1995 resulting in high numbers mainly in northern Anatolia (Boudot *et al*. 2009) and central Europe (Burbach & Winterholler 1997), and that of 2011 mainly noted in western Europe, particularly along the Atlantic coast and the nearby landmass (SFO 2013). The invasion of 1995 was especially large, with the species being recorded all over the continent (Burbach & Winterholler 1997). *Anax ephippiger* breeds sporadically but with increasing regularity in southern Europe. Arrivals in spring followed by oviposition regularly results in successful reproduction in the Mediterranean, resulting in a new summer generation the same year. However successful reproduction in central and western Europe is rare (Sternberg & Buchwald 2000, Parr 2011), with the most northern cases of spring/summer reproduction known from the south of Germany and western Poland (Bernard & Musiał 1995, Burbach & Winterholler 1997). All these populations are short-lived as the larvae are unable to survive the European winter, except locally along the Mediterranean coast. The only two European records clearly referring to larvae surviving the winter are those of a teneral female in the Doñana National Park in Andalusia (Spain) found on March 27, 1979 (Belle 1984) and the record of fresh exuviae, tenerals and immatures on April 29, 2000 in the Rhône delta (Faton, 2003). Other European records from winter and early spring are believed to pertain to vagrants from Africa (Weihrauch & Weihrauch 2003). The distribution map suggests the species to be more common in southern France and northern Italy than in Spain and southern Italy, but this is probably an artefact of sampling effort.

Trend and conservation status

This species is likely to benefit from climate change, which may result in increased migration into Europe with successful winter reproduction in the Mediterranean.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Increasing

Habitat

The biology of the species is strongly adapted to breeding in seasonal habitats. In its main range, migrating swarms travel with rain bearing winds (seasonal monsoon fronts), which allows the species to use temporary flooded depressions to breed. The eggs and larvae have a rapid rate of development of two to three months, which allows the adults to emerge before the habitat dries out (Gambles 1960, Sternberg & Buchwald 2000). Mass emergences occur often at the end of the winter (Dumont 1977c, Dumont & Desmet 1990, Corbet 1999). As in its main range, the main European breeding sites also consist of standing, shallow and sometimes temporary waters, with the amount of vegetation often very limited. The low water table and the lack of vegetation result in a high water temperature, allowing for a rapid growth of the larvae. As might be expected for a species living mainly in seasonal waters, the larvae tolerate high salinity and many reproduction sites in the Mediterranean are found in brackish coastal wetlands.

Flight period

The species is on the wing throughout the year in northern Africa. Migrations also takes place throughout the year, with records from all months in western and central Europe. The highest number of records are generally made from March to May in the Mediterranean and in summer and autumn in west and central Europe.

Anax immaculifrons Rambur, 1842

V.J. Kalkman

Taxonomy

There are two colour forms of *A. immaculifrons*. In adult males from Europe, south-western Asia and the Indian subcontinent, the frons, eyes, thorax and first two segments of the abdomen are pale bluish, and there is a bold pattern of black and yellow to orange brown on the abdomen. Males from south-east Asia and China are strikingly different, lacking bluish colours on head and thorax and with a largely reddish brown abdomen. It is not unlikely that further study will show these represent two distinct species.

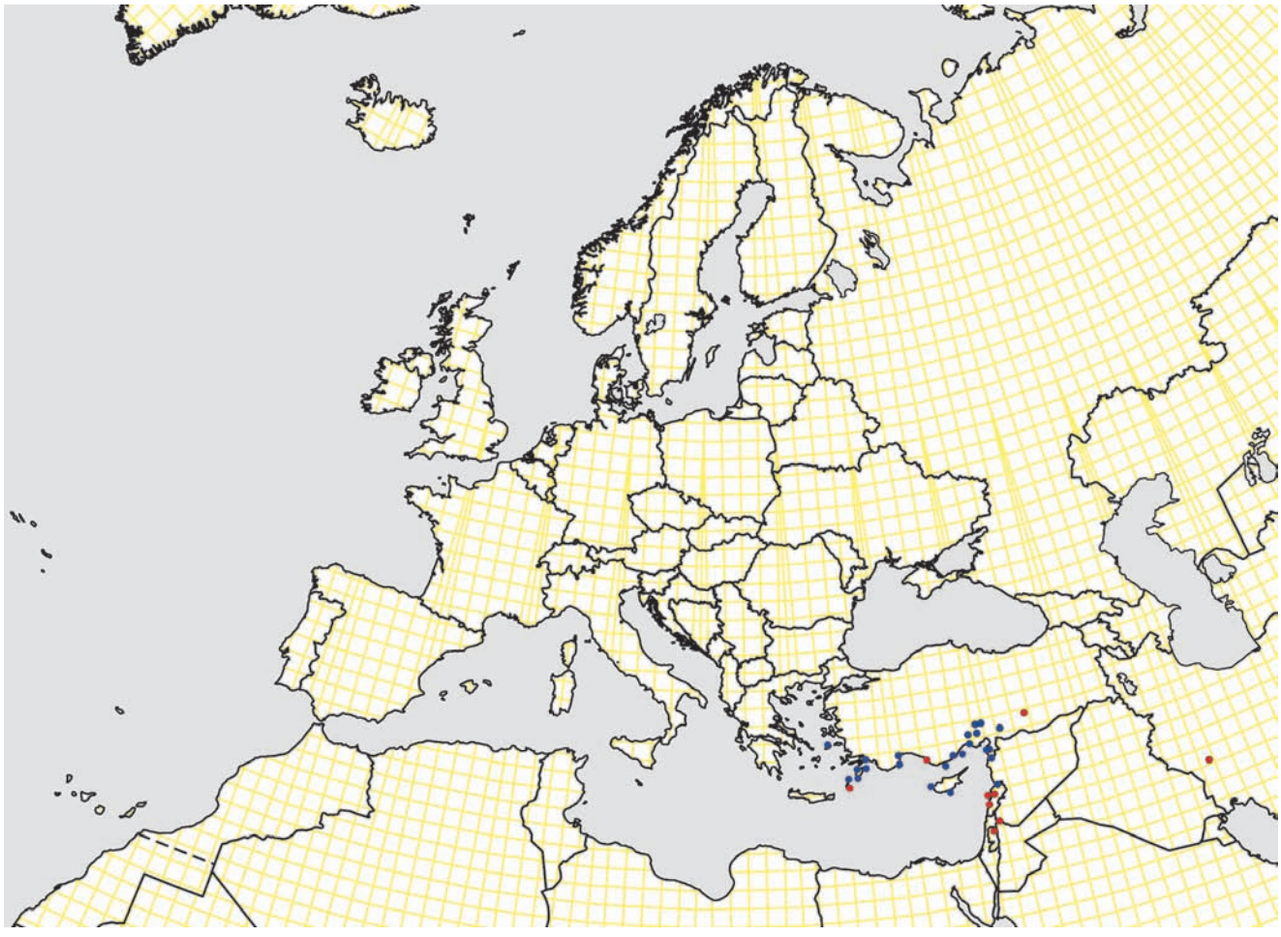
Distribution

World: The main range of *A. immaculifrons* is found on the Indian subcontinent and Sri Lanka, south-east Asia and the tropical parts of China. Fraser (1936) wrote that the species is common in all mountain areas between 300 m to above 2 000 m south of Bombay, but is rare in the Himalayans. However Khaliq *et al*. (1994) recorded it from many localities in the Pakistani part of Kashmir (Gilgit-Baltistan), which suggests that the species is at least common in western parts of the Himalaya range, and probably also in adjacent areas in Afghanistan, although only a few records are known from this country. In the eastern Mediterranean, the species is found on a few Greek Islands, Cyprus and the Mediterranean regions of Turkey, Syria and Lebanon. Between the easternmost Turkish record and the westernmost record of its main range in Afghanistan is a gap of over 2 500 km, from which only three records are known, all from the Zagros Mountains in south-western Iran (Lohmann 1990a, Sadeghi & Mohammadalizadeh 2009). It seems likely that further surveys in the lower mountains of Iran, Afghanistan and Pakistan will show its range to be continuous.

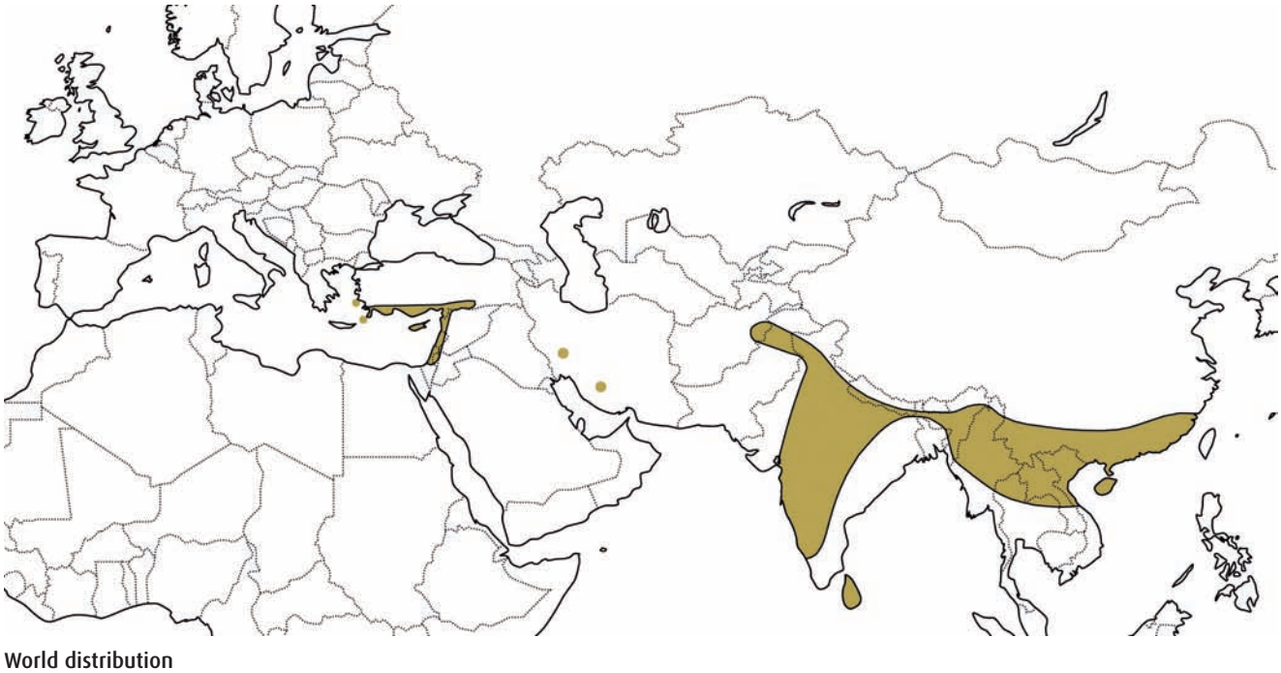
Europe: *Anax immaculifrons* reaches its westernmost limit in the east Mediterranean. The species has been found on three Greek Islands; Karpathos (five localities), Ikaria (one male only) and Rhodes (at least three localities) (Lopau 2010b). Four localities are known from Cyprus (Lopau & Adena 2002). These localities are a natural extension of the Turkish populations, which are scattered along the south Mediterranean coast of Anatolia.

Flight period

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Greece					■	■	■						Based on 12 records
Turkey					■	■	■	■	■				Based on 18 records



European distribution



World distribution

Trend and conservation status

Although it may be expected that further fieldwork will result in the discovery of additional localities in Europe, it is certain the total number of locations will remain low. Throughout much of its range suitable habitats are threatened by both the loss of the natural vegetation and stream desiccation due to winter rainfall deficit and related increased uptake of water for agriculture. The species is therefore likely to be declining although direct evidence is lacking. It is unclear what impact climate change will have on its populations, as on the one hand habitats may desiccate, while on the other hand increased temperature might allow a northward shift of the boundaries of its distribution.

Habitats Directive	No
Red List EU27	Vulnerable
Red List Europe	Vulnerable
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Unknown

Habitat

All records in the east Mediterranean are from permanent rocky streams a few metres wide. Unlike other European *Anax* species, *A. immaculifrons* does not breed in open stagnant waters. It has been found in both largely shaded and sunny habitats (Battin 1990, Lopau & Adena 2002, Kalkman *et al.* 2004). Larvae have been found in rock pools along quiet reaches of streams (Battin 1990, Dijkstra & Kalkman 2001, Kalkman *et al.* 2004). Battin (1990) describes the substrate of the larvae as gravel, sand and organic detritus sediments. The habitat description given for India and Sri Lanka by St. Quentin (1970) and Kumar & Prasad (1981) is comparable with that of the east Mediterranean. Fraser (1936), however, stated that *A. immaculifrons* 'breeds in all mountain streams, and especially in the sluggish brooks … where the larva may be seen in numbers on the muddy bottom'. In a later paper, he reported the species from sluggish canals of grassy moors, from ponds and even reservoirs (Fraser 1943). Bedjanic *et al.* (2007) reported the species in 'streams, sluggish brooks and occasionally lakes in the mid-hill to upper-hill region' of Sri Lanka. This suggests that the species has a wider range of habitats in the Indian region than in the eastern Mediterranean.

Anax imperator Leach, 1815

V.J. Kalkman & R. Proess

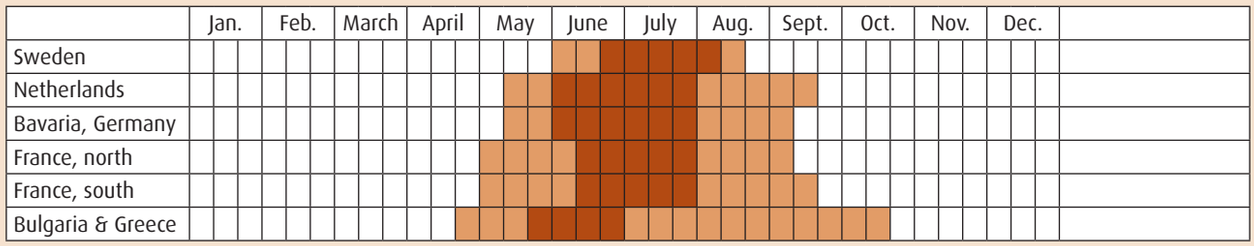
Taxonomy

Some authors regard the doubtfully distinct subspecies *A. imperator mauricianus* Rambur, 1842 as endemic to Mauritius while others suggest its range includes the whole of sub-Saharan Africa. One of its main characteristics, a slightly brownish thorax resembling that of *A. p. parthenope* (Rambur 1842), is also sometimes found in European populations. Populations from the southern margin of the Arabian Peninsula have a light brown to dark brown thorax whereas individuals from the island of La Réunion ascribed to *A. i. mauricianus* have a fully green thorax (Martiré 2010). Fraser (1956) showed that the supposedly greater length of the superior appendages of *A. i. mauricianus* (Rambur 1842, Martin 1908) is far from being constant and is of no use in separating the subspecies. Given this overall variability and without further evidence *A. i. mauricianus* is best regarded as a synonym of *A. i. imperator*.

Distribution

World: *Anax imperator* is widespread and common in large parts of Africa (including Madagascar), Europe, the

Flight period



Middle East and south-west Asia, and has been recorded on several Atlantic archipelagos (Azores, Cape Verde, Canary Islands and Madeira) (Boudot *et al*. 2009, Martens 2010). The species is still common in south-east Europe and parts of Turkey but becomes scarcer further east. It is scattered in the southern Urals and Kazakhstan, with its easternmost populations occurring in eastern Kazakhstan, the eastern parts of the other Central Asian states and the northern borders of Afghanistan, Pakistan and India. It is rare in Iran and has not been recorded from the lowlands of India and Pakistan.

Europe: *Anax imperator* is one of the most common and widespread species in southern and western Europe. In the north, its range seems to be constrained mainly by summer temperatures and the species is absent from parts of Ireland, Scotland and most of Fennoscandia. The species was new to Sweden in 2002 and to Finland in 2010, and a further range expansion is likely to occur with continuing climate warming.

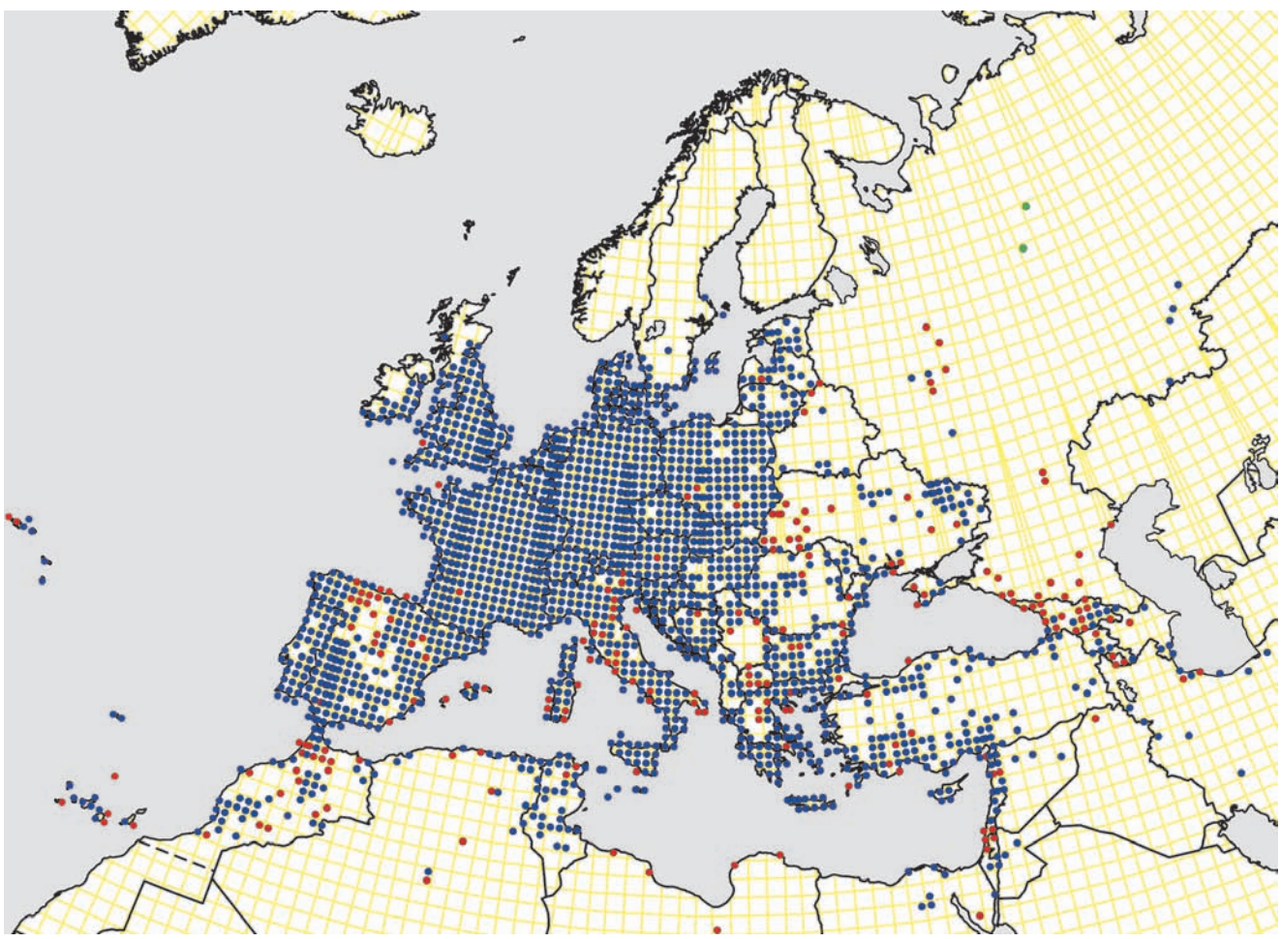
Trend and conservation status

Anax imperator is one of the most common European species and has shown a strong northwards expansion in the past decades, becoming more abundant throughout the northern part of its range and reaching Denmark in 1994, Sweden in 2002, the nearby Finnish Åland Islands in 2010 (Saikko *et al*. 2011) and currently likely to continue its expansion in both the Baltic States and Fennoscandia.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Increasing

Habitat

Anax imperator is generally common to very common at low altitude standing waters but also occurs at very slow running waters. Suitable habitats are largely unshaded and often expansive and well-vegetated. It is found in a wide variety of natural and man-made habitats such as lakes, fens, bogs, quarries and larger garden ponds.



European distribution

World distribution

Anax junius (Drury, 1773)

V.J. Kalkman & S. Prentice

Distribution

World: *Anax junius* ranges throughout the USA, Central America and most of the Caribbean Islands. The species is strongly migratory, with yearly northwards spring migrations reaching the southern parts of Canada. After successful reproduction, at least a fraction of the new adults return to the south. In large parts of its northern range the species is not capable of surviving the winter as larvae or as adults. Migrants and vagrants are sometimes blown across oceans and continents and have been found in Bermuda, Bahamas, western Europe, Alaska, Hawaii, Kamchatka, Japan and eastern China. Individuals commonly appear on oil platforms in the Gulf of Mexico (Dumont *et al*. 2005a, Paulson 2009).

Europe: The first European records coincided with an Atlantic depression with strong westerly winds. This resulted in records of up to eight individuals, including both males and females, from six sites on the Isles of Scilly and in Cornwall in September 1998 (Pellow 1999). The only other European record is that of a

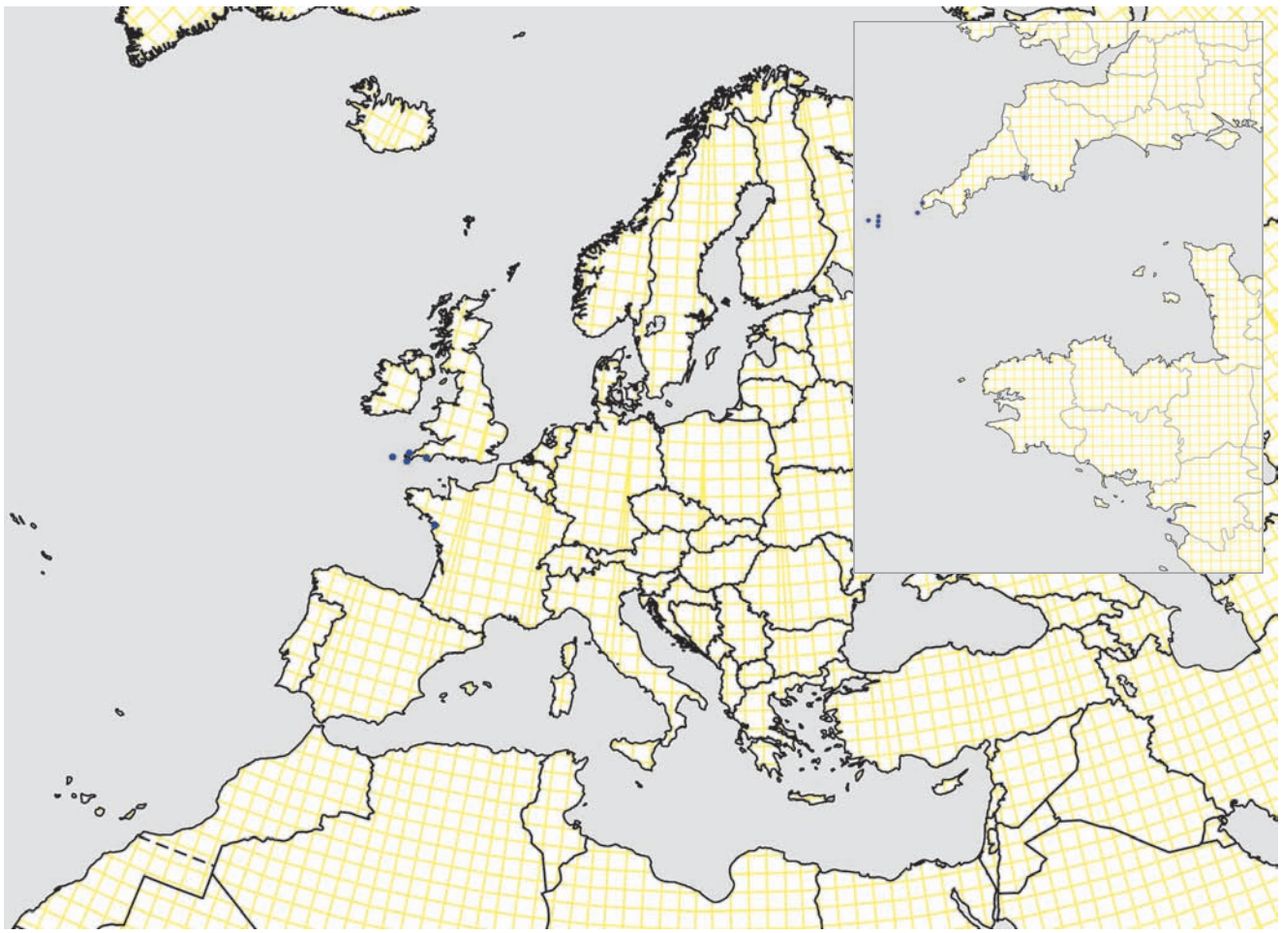
Flight period

Adults are on the wing year round in Mexico and the southern states of the USA. In early spring mature adults migrate northwards and in many areas migrants arrive before the local population starts emerging. Further north, these migrants reach areas were *A. junius* does not survive the winter, often arriving before other resident species start to emerge. In most of North America, reproduction starts early spring. In warmer areas, reproductive individuals are represented both by migrants (coming from the south) and by locally emerged specimens. The larvae cannot survive the winter in the north and all egg-laying individuals are immigrants. The larvae have a rapid development and emerge in late summer. Those emerging in the north migrate to the south when they still have their immature colours. It seems likely that they fly to areas in Mexico and the southern USA, where they reproduce during late autumn and winter. All European records are from September, which corresponds with the time of year when the species' southward migration coincides with the beginning of seasonal transatlantic storms.

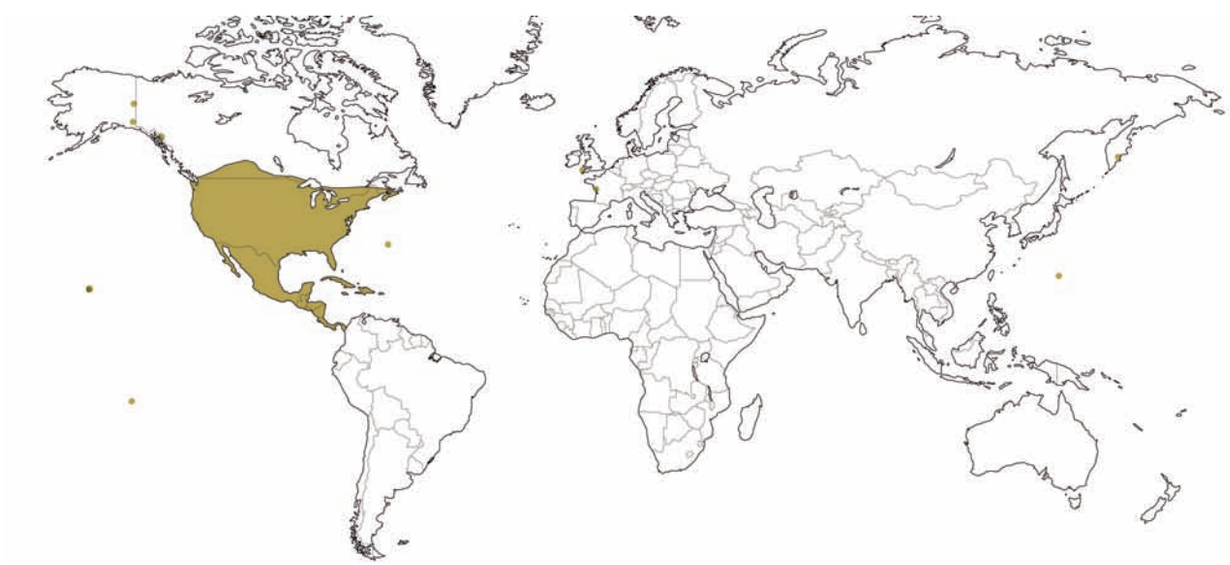
male captured on the French Atlantic coast near Nantes in September 2003 (Meurgey & Perron 2004). The species strongly resembles the common European *Anax imperator* and probably vagrants have been overlooked in the past. *Anax junius* has a long flight season and it might therefore be rewarding to pay special attention to very early or very late specimens of *Anax* in coastal areas of western Europe.

Trend and conservation status

There is no evidence that *Anax junius* reproduces in Europe and the species was therefore listed as Not Applicable on the European Red List. It is common in central and northern America and will possibly expand its range due to climate change in the future, increasing the chance that vagrants will reach Europe.



European distribution. The inset shows its distribution based on a 5 by 5 km grid.



World distribution

Habitats Directive	No
Red List EU27	Not Applicable
Red List Europe	Not Applicable
Red List Mediterranean	Not present
EU27 endemic	No
European endemic	No
Trend Europe	Sporadic visitor

Habitat
Reproduction takes place in lakes, ponds and slow-flowing streams. The species is a transatlantic vagrant in Europe and is therefore most likely to be found at lakes and ponds in coastal areas.

Anax parthenope (Selys, 1839)

V.J. Kalkman & R. Proess

Taxonomy
The two subspecies, *A. p. jordansi* and *A. p. geyri*, described by Buchholz (1955) represent continuous variation and are junior synonyms of *A. parthenope* (Lieftinck 1966, Peters 1987). The closely related *A. julius* Brauer, 1865 replaces *A. parthenope* in the Eastern Palaearctic. This taxon is often considered a subspecies of *A. parthenope* but differs in coloration, having for example a green thorax (instead of brown), a longer pterostigma and slightly different superior appendages.

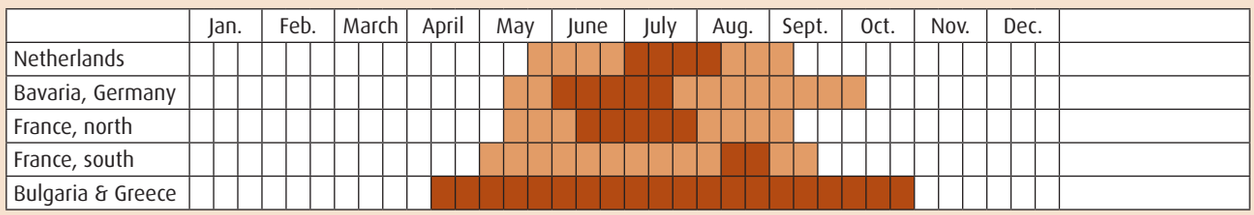
Distribution
World: *Anax parthenope* ranges from Europe and North Africa over the Arabian Peninsula and Central Asia eastwards to the Indian subcontinent. In the north, the easternmost validated records are from Xinjiang province (China), western Mongolia, the Tuva Republic and the Krasnoyarsk area in the south of Siberia (Russian Federation) (Borisov 2012). A northern expansion of the species' range has been noted in Europe during the last two decades. Similarly, *A. parthenope* was increasingly recorded in both southern Urals and the southern part of the West Siberian Plain (Kosterin 2007, Haritonov & Eremina 2010). The closely related *A. julius* is found from northern Vietnam to north-eastern China and eastern Russia, including Taiwan, Japan and both Korea's. The ranges of both species probably meet in Mongolia and China and might even overlap. Records published for this area are partly based on observations only or do not state exactly which of the two species was recorded, so that their respective distribution in this area remains unclear (Peters 1985, 1987).

Europe: The species is common in large areas of western and south-western Europe but is scarce in parts of Iberia and south-east Europe. In central and eastern Europe it becomes scarcer. Most records from The British Isles and the Netherlands are of vagrants and reproduction is still very rare in these areas. Reproduction is far more common in the northern Germany and even more so in Poland, where it is regionally abundant.

Trend and conservation status
Anax parthenope is common in large parts of Europe and has expanded its range northwards since the 1990s. The first successful reproduction in Great Britain was in 1999, in the Netherlands in 2006, and the species was found as new to Sweden and to Finland in 2010 and 2013, respectively (Parr *et al.* 2004, Bouwman *et al.* 2008, Billqvist 2012).

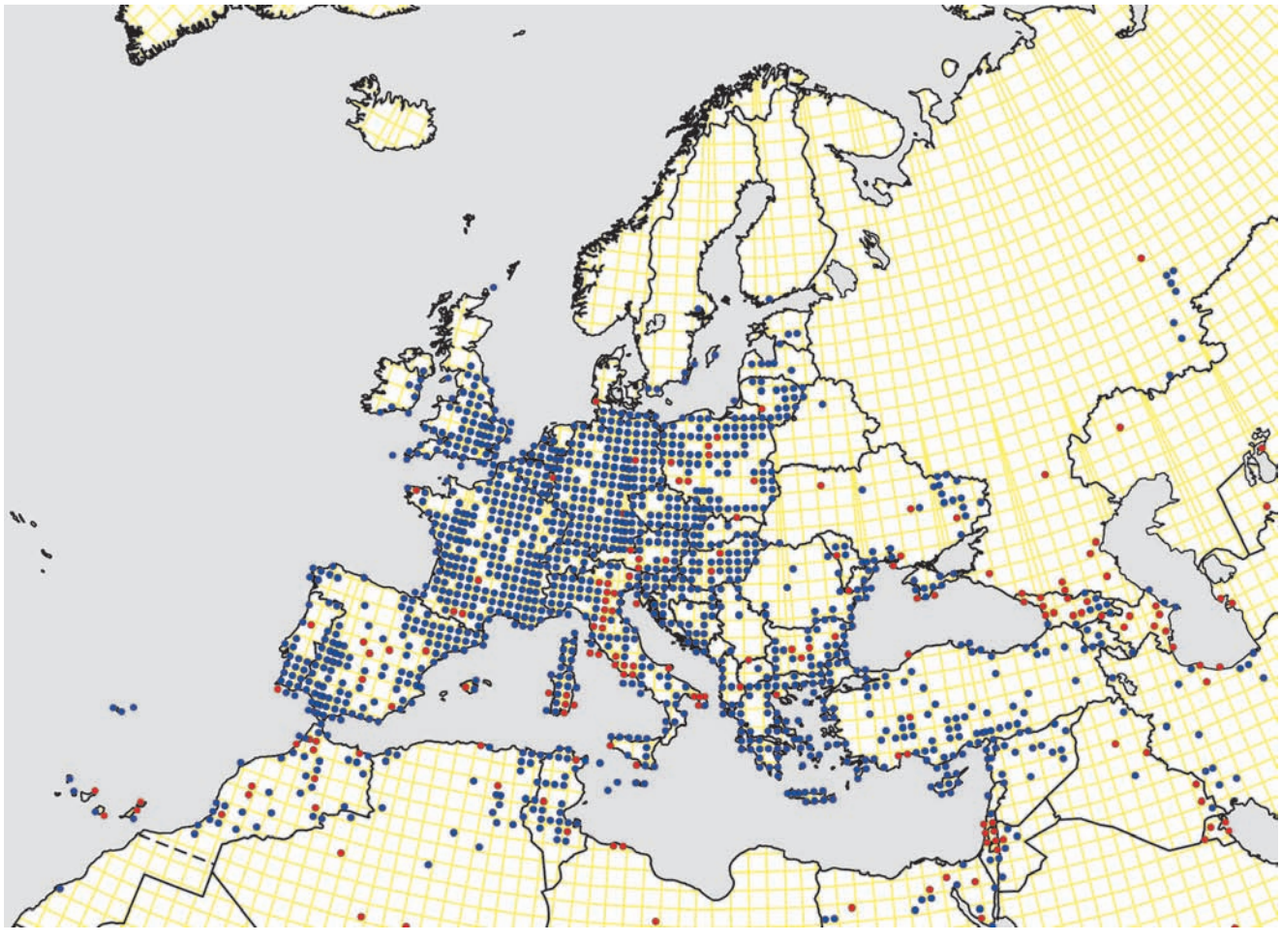
Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Increasing

Flight period



Habitat

The species occurs at standing, often expansive and sometimes brackish, water bodies, and, in the Mediterranean, sometimes at slow-flowing waters. Suitable habitats are largely unshaded and are on average of greater expanse than those of *A. imperator* with



European distribution

World distribution

which the species often co-occurs. In many cases a well-developed bank side vegetation and stretches with floating hydrophytes are present but more importantly the centre of the water body is nearly always free of vegetation. Many records in temperate Europe are from large lakes, sand quarries and gravel pits. Despite its preference for larger water bodies, the species also occurs at lesser habitats such as newly created ponds.

Boyeria cretensis Peters, 1991

J.-P. Boudot

Taxonomy

Boyeria cretensis is closely related to *B. irene* and was only recognised as distinct taxon in 1991. A recent molecular study (Kohli *et al.* 2013) confirmed its full species rank.

Distribution

World: *Boyeria cretensis* is endemic to the island of Crete (Greece).

Europe: *Boyeria cretensis* is endemic to Crete where it is known from fifteen river systems. The populations are concentrated in two areas, with five populated rivers at the Lefka Ori mountains in the westernmost part of Crete and nine populated rivers in the region between the Lefka Ori and the Psiloritis mountains (Mount Idi) and north of the latter in central Crete. In addition there is a single isolated locality known east of the Dikti mountains in the easternmost part of Crete (Battin 1989, Lopau 2000, Schneider & Müller 2006, Boudot *et al.* 2009, Brochard & van der Ploeg 2013b). The species generally occurs in low densities, but populations ranging between 100 to 600 imagines per year (basing on exuviae) have been recorded (Schneider & Müller 2006, Brochard & van der Ploeg 2013b).

Trend and conservation status

According to Grove & Racham (2001), Crete had about 28 permanent large rivers in 1625, of which only four still persist today. The higher number of running water systems in the 17th century is attributed to the higher precipitation during the so-called 'Little Ice Age', and the subsequent reestablishment of the Mediterranean climate resulted in a reduction in permanent running waters. During the same period the forest cover on the island diminished and both probably resulted in a decrease of the species over the past centuries.

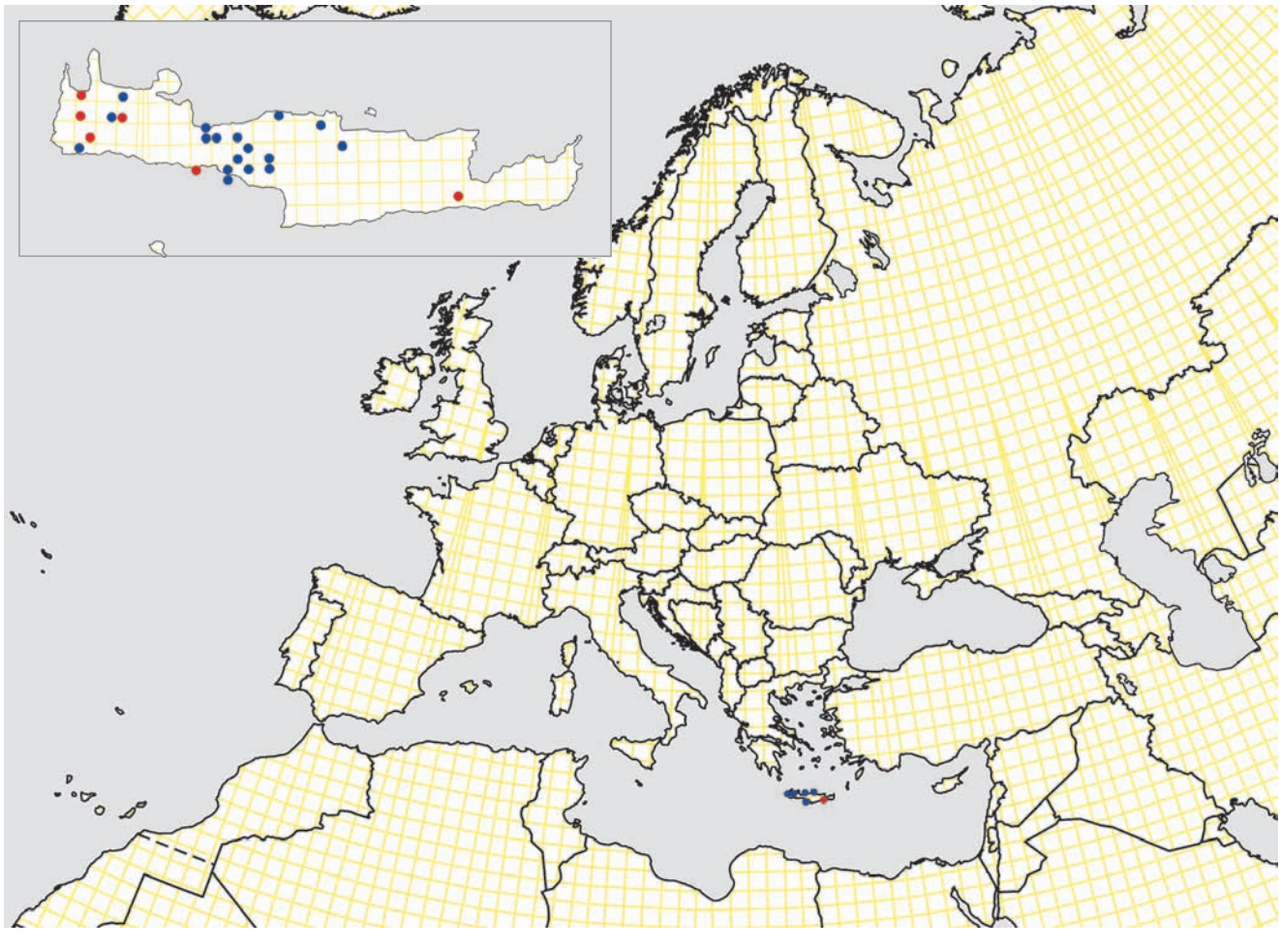
In the last two decades the species suffered due to continuing destruction of gallery forest and a decrease of the quality and quantity of water. The latter is caused by increased extraction of water for agriculture (irrigation), pumping water from the upper reaches of streams for domestic use and increased erosion caused by overgrazing and the removal of natural vegetation cover. The water quantity is further negatively affected by decreasing rainfall associated with climate change.

These pressures resulted in the loss of the population from its type locality and the probable loss from four other localities. Conservation measures required are the protection of all gallery forests and the restriction of water extraction from springs and headwaters. Mapping of the remaining populations is needed in order to judge its conservation status and establish an appropriate number of protected reserves. The species is threatened due to its restricted range, the low number of populations and their expected continuing decline. It is therefore listed as Endangered on the European Red List.

Habitats Directive	No
Red List EU27	Endangered
Red List Europe	Endangered
Red List Mediterranean	Vulnerable
EU27 endemic	Endemic
European endemic	Endemic
Trend Europe	Decreasing

Flight period

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Greece						■	■	■					Based on 24 records



World distribution. The inset shows its distribution on Crete based on a 5 by 5 km grid.

Habitat

Boyeria cretensis is limited to running water and is mainly found near the upper courses of permanent streams with a moderate to strong current (Schneider & Müller 2006, Müller 2008). It is largely confined to streams with extensive gallery forests of Plane trees (*Platanus orientalis*) where the water is partly shaded. The species has been recorded up to 450 m.

Boyeria irene (Fonscolombe, 1838)

J.-P. Boudot, M. Lockwood & A. Cordero Rivera

Distribution

World: *Boyeria irene* is endemic to the western Mediterranean. Outside Europe it is found only in Morocco and along the northern fringe of Algeria and Tunisia.

Europe: The species is widespread and generally common across most of the Iberian Peninsula and southern France, becoming progressively scarcer in the north where it reaches Brittany, Normandy, Champagne-Ardenne and north-east France. In Italy, it is largely confined to the western parts of the country, where it is generally uncommon, a distribution also shown by *Oxygastra curtisii* and *Onychogomphus uncatus*. The species is reasonably common on Corsica and Sardinia but is in Sicily only known from a single record. It is absent from the Balearic Islands. In Switzerland, it is known from the south (Lake Lugano, extinct) and from several lakes in the centre of the country, with certain evidence of reproduction from Lakes Lucerne, Zug and Aegeri. In 2007 a freshly emerged female was found on the Swiss part of Lake Constance (Bodensee), which was the first evidence of reproduction of the species north of the Alps. Vagrants have been recorded from the southernmost part of the Vosges Mountains in France and from the southern border of Bavaria, Germany, where it was first recorded in 2002 (Kuhn & Gutser 2003, Schmidt 2005). Most surprizing was the recent discovery of a strong population along the Örtzë River in Lower Saxony, Germany, about 600 km north of the nearest known populations (Clausnitzer *et al*. 2010).

Trend and conservation status

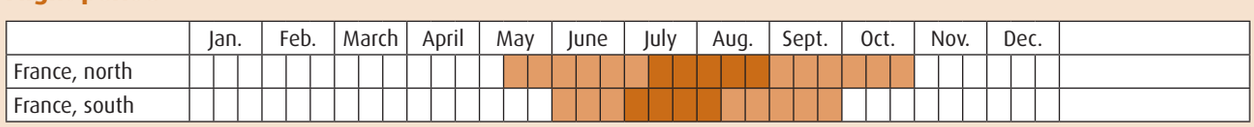
Boyeria irene is common in south-western Europe and there is no indication of a decline, although its preferred habitats are under pressure (Torralba-Burrial, 2009). The species might profit from climate change, which may explain the recently discovered populations at Lake Constance. It is unclear if the population recently discovered in Lower Saxony has been present for many years or is the result of a recent colonisation facilitated by climate change. The presence of a population so far north indicates that a large part of the area separating this population and the northernmost known populations in France and Switzerland is potentially suitable for the species, in which case an expansion in the next decade might be expected.

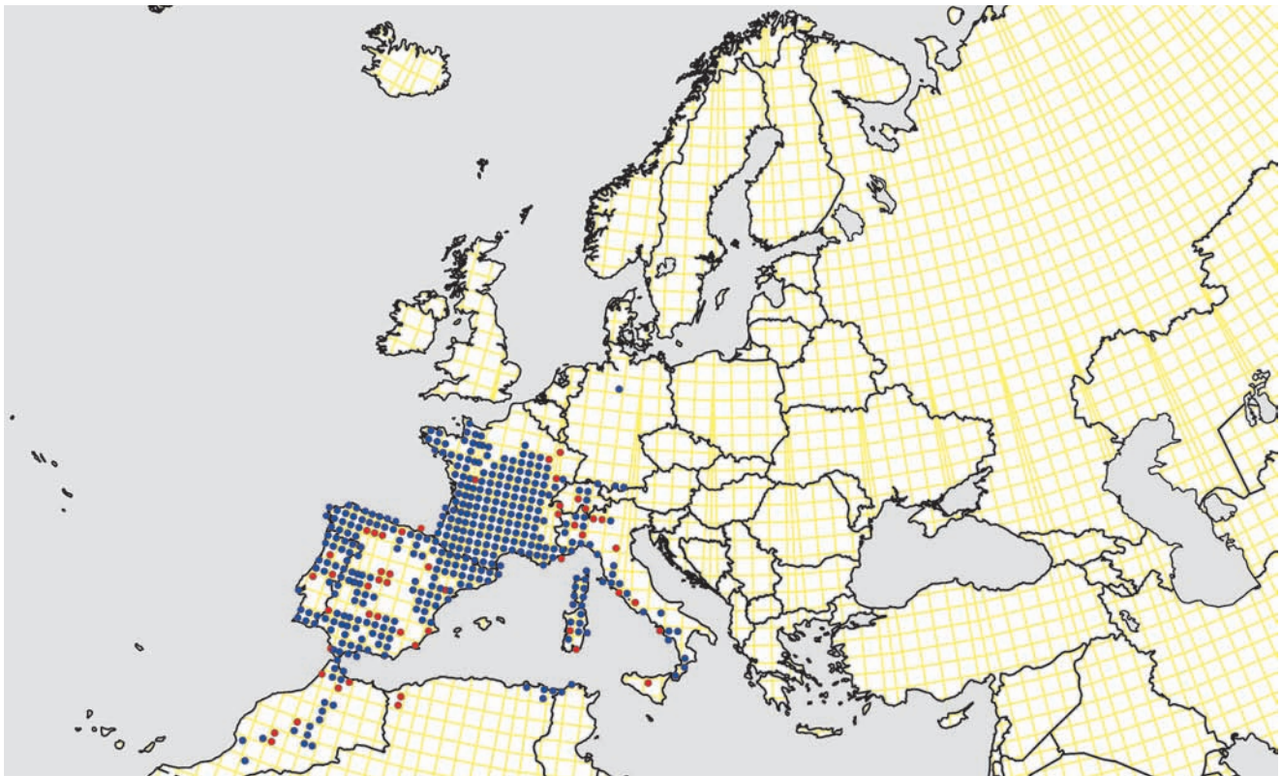
Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

Boyeria irene is found on larger streams and rivers where the banks are at least partly shaded. In north-west Spain and northern Portugal it is also common at small streams, even those experiencing interrupted flow due to summer drought. In northern Spain it is, together with *Cordulegaster boltonii*, considered a good indicator of river water quality (Torralba-Burrial 2009). Throughout most of its range it is largely restricted to running waters although in Switzerland and the French Alps it reproduces in large lakes between 400 and 800 m in altitude, where wave motion produces conditions similar to those found in running waters. These lakes are deep and sometimes have rocky or steep man-made banks with little vegetation. The species is mainly found in lowlands and hilly countries but has been found breeding up to 1 300 m in the southern Alps in France.

Flight period





World distribution

Brachytron pratense (Müller, 1764)

R. Bernard, V.J. Kalkman & P. Ivinskis

Distribution

World: *Brachytron pratense* is largely confined to Europe, being absent from North Africa and having only a limited range in Asia. It has been recorded from the southern Urals but is absent further east and has been found neither in Kazakhstan nor in the south-eastern part of European Russia (Yanybaeva *et al.* 2006, Chaplina *et al.* 2007, Skvortsov 2010). It is generally scarce in south-west Asia, where it has been recorded from western Turkey, Georgia and northern Iran (mainly along the Caspian Sea) (Heideri & Dumont 2002, Kalkman 2006, Kalkman & Van Pelt 2006).

Europe: The main range of the species is found in west and central Europe but even there it shows strong regional differences in population densities, being common only regionally. Its most northerly occurrence is the south of Fennoscandia. In southern Europe it is generally rare, being largely absent from the Iberian Peninsula and the driest parts of Italy and the Balkan Peninsula. In the east it appears to be widespread but uncommon in northern Ukraine and Belarus, but this is at least partly a result of less intensive odonatological exploration. Records from European Russia are rare and the small number of localities available from the well-explored southern Urals shows that this cannot be entirely ascribed to the paucity of fieldwork in this area. No record is available east of the Urals.

Trend and conservation status

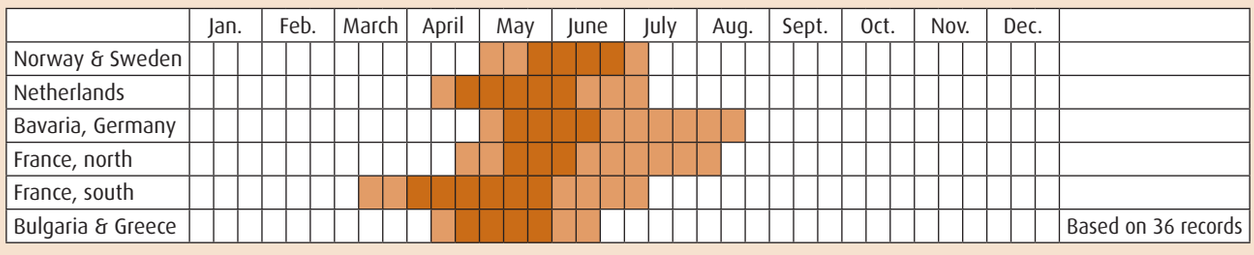
Regional declines have been reported in the 20th century from north-west Europe (e.g. Great Britain, northern Belgium, Luxemburg, the Netherlands and parts of Germany) (Merritt *et al*. 1996, De Knijf *et al*. 2006, Proess 2006a, b), due to the conversion of grasslands to agriculture, wetland drainage, eutrophication and, more locally, to the impact of introduced Grass Carp on the aquatic and bank side vegetation. A recovery has been noted in several areas (e.g. Great Britain and the Netherlands) and the species is now regionally increasing (Merritt *et al*. 1996, Bouwman *et al*. 2008). In south Europe, where the species has a much more patchy distribution, a decline due to climate change is expected.

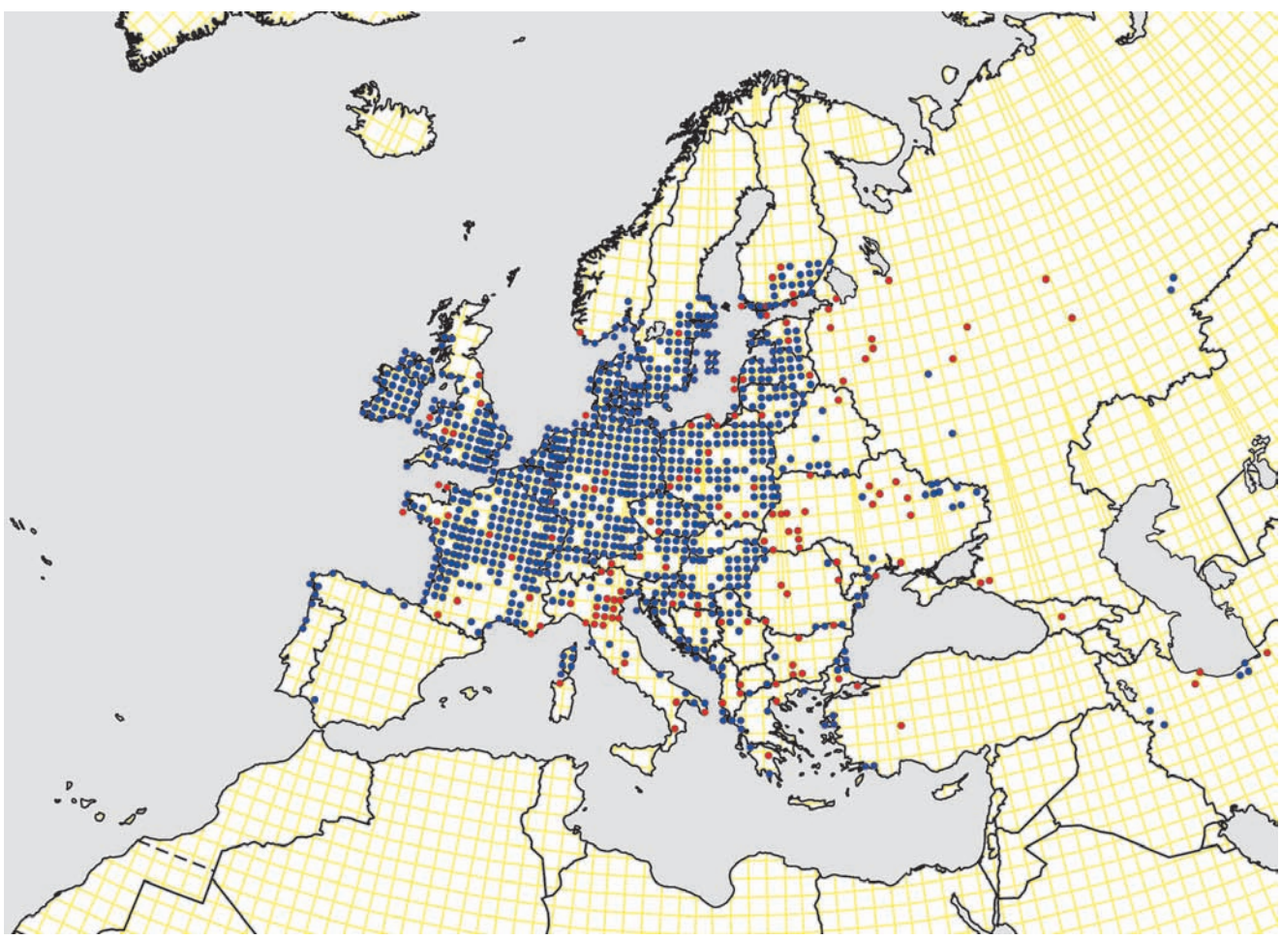
Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Near Threatened
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

Most populations are found at standing or slow-flowing waters, frequently with forest or bushes in the vicinity. The species is most often found around reed belts, bulrush (*Typha*), bur-reed (*Sparganium*), clubrush (*Schoenoplectus*), high sedges and, in parts of its range, areas with stretches of water soldier (*Stratiotes aloides*).

Flight period





World distribution

Suitable habitats are found at lakes, ponds, old oxbow ponds, gravel, sand and clay pits, (fish) ponds, canals, marshes, and less often at water bodies in bogs, dune ponds and ponds in municipal parks. The highest densities are found at lakes, waters in abandoned excavations, fenlands and backwaters in floodplains, but it is mostly absent from annually flooded oxbows that lack belts of helophytes. *Brachytron pratense* is a lowland species, rarely breeding above 600 m.

Caliaeschna microstigma (Schneider, 1845)

V.J. Kalkman & M. Jović

Distribution

World: *Caliaeschna microstigma* ranges from the Adriatic to western and northern Iran. A single locality is known from the south-west of Turkmenistan. Its distribution is limited in the south by the deserts of the Middle East. Its northern range seems to be constrained by climatological conditions, as apparently suitable habitat exists on the Balkan Peninsula and in the Caucasus north of its area of occurrence.

Europe: The European range of *C. microstigma* is restricted to Cyprus, the Aegean Islands and the Balkan Peninsula. It is widespread in mainland Greece and found on most of its larger islands as well as on the Turkish island of Gökçeada. It is absent from Crete but occurs further east on Rhodes and to the north-west on the Peloponnese. The northern limit of *C. microstigma* runs from northern Bulgaria to south-west Croatia. Along the Adriatic, it is found from the south-western tip of Croatia and Bosnia and Herzegovina to the coastal mountains of Montenegro, Albania and Greece. There is an unconfirmed record from Serbia (Karaman 1979b). The species is not uncommon in the Balkan Peninsula but often occurs in low densities (Lopau 2010b, De Knijf *et al.* 2013, Kulijer *et al.* 2012, 2013, Kovács & Murányi 2013).

Trend and conservation status

Caliaeschna microstigma is fairly common in Cyprus, Greece, Albania and parts of Bulgaria and Montenegro, but is scarce and local in the south of Croatia and Bosnia and Herzegovina. Its habitat, fast-flowing shaded waters, is under pressure throughout its European range and, as a result, at present there is probably a widespread population decline in Europe. For these reasons, the species has been assessed as Near Threatened in the European Red List.

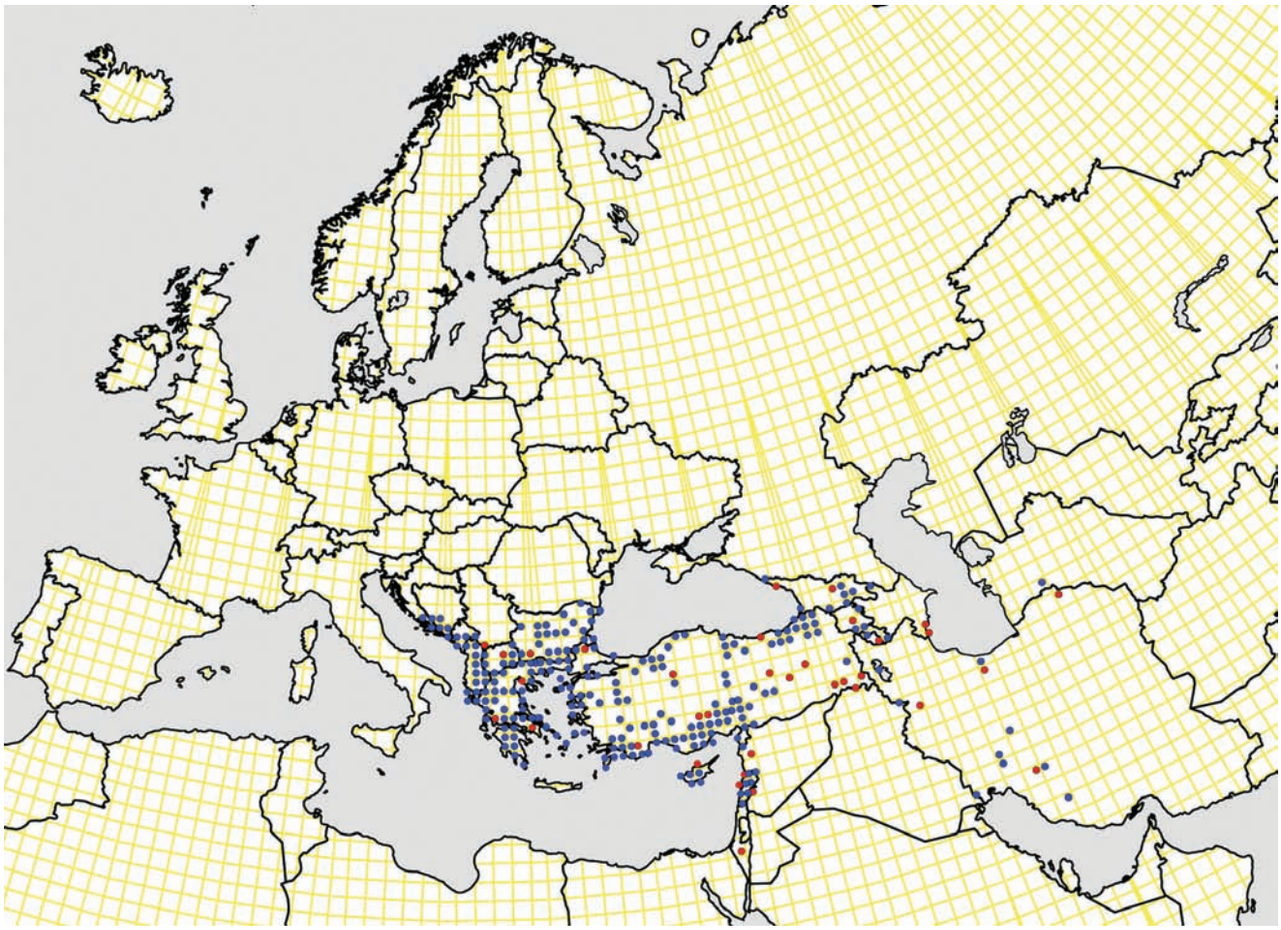
Habitats Directive	No
Red List EU27	Near Threatened
Red List Europe	Near Threatened
Red List Mediterranean	Near Threatened
EU27 endemic	No
European endemic	No
Trend Europe	Decreasing

Habitat

Caliaeschna microstigma occurs at swift stony streams and small rivers which are at least partly shaded and where pools of calm water provide refuges for the larvae (Breuer & Douma-Petridou 2000). The species occurs mainly in hilly or mountainous regions but most European populations are found below 500 m. Both Beschovski (1964) and Hecker (1999) mention that in

Flight period

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Bulgaria & Greece												
Turkey												



World distribution.

a laboratory situation the larvae are well capable of walking overland and suggest that this enables it to search for water when streams desiccate during hot and dry summers. There is, however, no indication that populations can survive in streams that partly dry out in some years. Larvae are mainly found in dense mats of mosses and aquatic plants but also between roots along the banks or in bundles of dead twigs and branches on the river-bed.

***Ophiogomphus cecilia*, River Paar, Unterbernbach (AIC), Germany.** Photograph Fons Peels.

Gomphidae

1 Ophiogomphus cecilia. Habitat of *Ophiogomphus cecilia*, River Roer, province of Limburg, Netherlands. Other species occuring here include *Calopteryx splendens* and *Gomphus vulgatissimus*. Photograph René Manger.

3 Gomphus flavipes. Habitat of *Gomphus flavipes*, River Waal near Rossum, Netherlands. Other species occurring include *Ischnura elegans* and *Orthetrum cancellatum*. Photograph Marcel Wasscher.

2 Onychogomphus costae. Habitat of *Onychogomphus costae*, Guadalhorce near Cártama, Malaga province, Spain. Other species occurring here include *Platycnemis latipes* and *Trithemis kirbyi*. Photograph Javier Ripoll Rodríguez.

4 Paragomphus genei. Habitat of *Paragomphus genei*, Burghidu, Rio Mannu near Lago de Coghinas, Sardinia, Italy. Other species occurring here include *Brachythemis impartita, Calopteryx haemorrhoidalis, Ceriagrion tenellum, Ischnura genei, Lindenia tetraphylla, Orthetrum trinacria, Sympecma fusca* and *Trithemis annulata*. Photograph Cédric Vanappelghem.

5 Lindenia tetraphylla. Habitat of *Lindenia tetraphylla*, Murici, Skadar Lake, Montenegro. Other species occurring here include *Anax parthenope, Crocothemis erythraea, Erythromma lindenii, E. viridulum, Orthetrum albistylum, O. cancellatum, Platycnemis pennipes nitidula* and *Selysiothemis nigra*. Photograph Geert De Knijf.

Gomphus flavipes (Charpentier, 1825)

J.-P. Boudot & E. Dyatlova

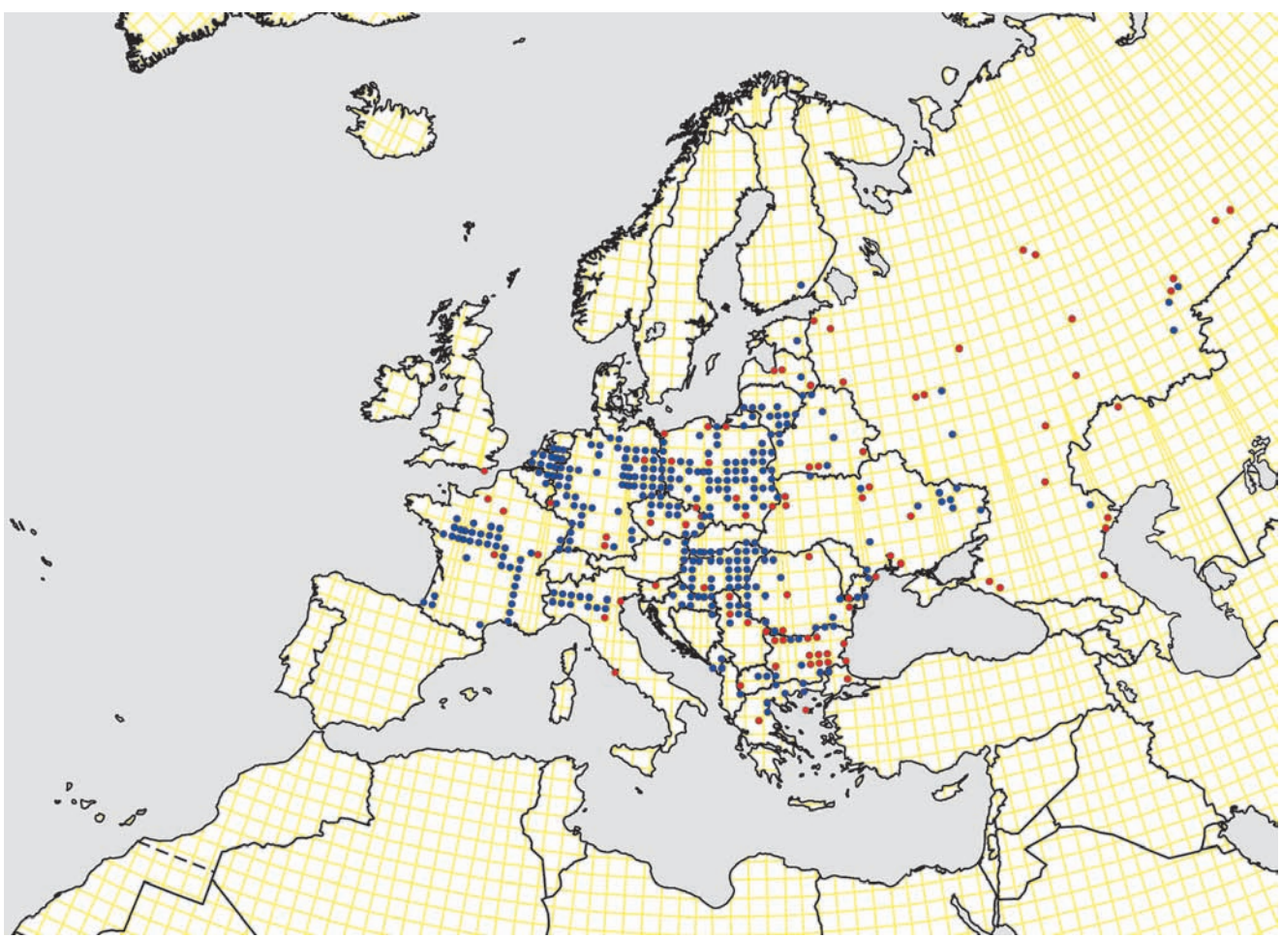
Taxonomy

The south-west Asian *Gomphus ubadschii* Schmidt, 1953 (syn: *Gomphus lineatus* Bartenev, 1929) was previously considered to be a subspecies of *G. flavipes*. It is currently regarded as a full species based on minor structural differences in both adults and larvae, and on small differences in adult coloration.

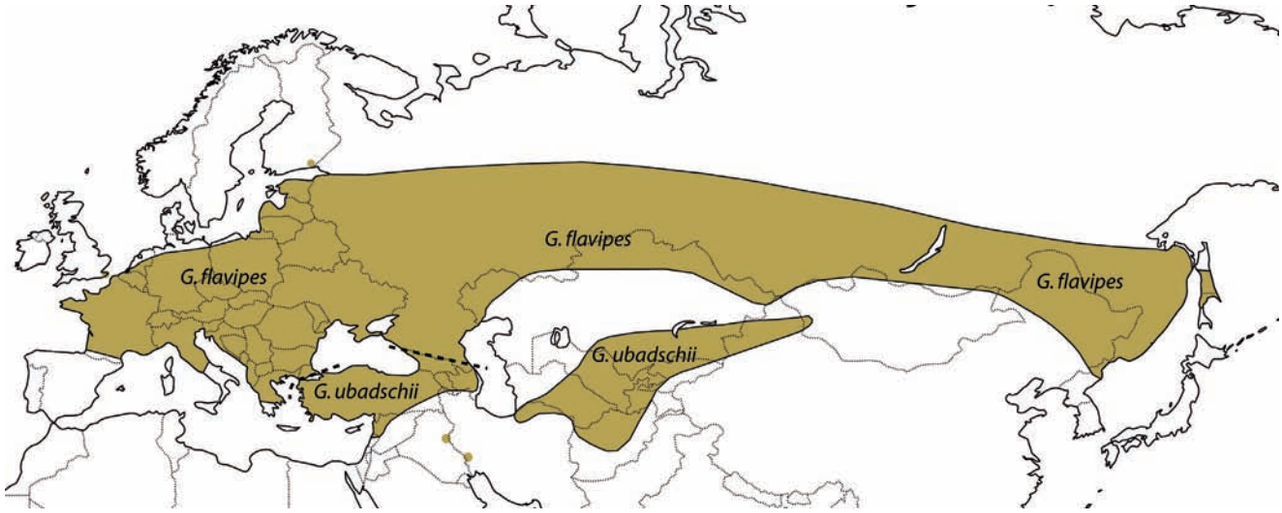
Distribution

World: For many old records it is unclear whether they refer to *G. flavipes* or to the closely related *G. ubadschii*, and therefore the ranges of both species are combined on the map of the world distribution. This species pair ranges from western Europe to eastern Siberia and the Far East. The Bosphorus and the Caucasus seem to lie along the western border between *G. flavipes* and *G. ubadschii* (Boudot *et al.* 2009). All validated records from the Asian parts of Turkey, the Levant, Transcaucasia and Iran belong to *G. ubadschii* (Heidari & Dumont 2002, Kalkman & Van Pelt 2006, Schröter *et al.* 2015). Borisov & Haritonov (2008) mapped the distribution in southern Kazakhstan, Turkmenistan, Uzbekistan and Tajikistan as *G. ubadschii* and records for Kyrgyzstan and Afghanistan have also been published as *G. ubadschii* (Schmidt 1961, Schröter 2010b). Borisov & Kosterin (2014) referred the populations from northeast Kazakhstan to *G. flavipes* and considered the Turanian plain as the gap separating the two taxa.

Europe: *Gomphus flavipes* is confined to western, central and eastern Europe. The species is largely restricted to large lowland river systems such as the Rhine, Rhône, Loire, Po, Elbe and Danube. There is a single record of a vagrant individual from the southern coast of Great Britain dated 1818. The species was new in Finland in 2014. The species is one of the most difficult



European distribution



Combined World distribution of *Gomphus flavipes* and G. *ubadschii*

Flight period

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Netherlands													
France													
Bulgaria & Greece													Based on 29 records

dragonflies to observe as an adult, and can best be found by searching for exuviae. Populations can therefore easily go unnoticed, and it has in the past been under-recorded. *Gomphus flavipes* is generally rare but may be locally abundant.

Trend and conservation status

This species has suffered a very severe decline in the past, which had probably already started at the end of the 19th century and progressed unchecked until the late 1980s. At that time it had become extinct in large parts of western and central Europe, with the only known remaining populations being found on the Oder and Spree catchments in eastern Germany, the Loire and Allier catchments in France and the Po catchments in Italy. The species has shown a remarkable recovery since the 1990s, probably as a result of improvements in water quality and better river management. This has taken place across a wide area, with convincing evidence of recent population increases in Belgium, the Netherland and Germany (e.g. NVL 2002, Brockhaus & Fischer 2005, Hunger *et al.* 2006, Bouwman *et al.* 2008, De Knijf *et al.* 2014). Recent rediscoveries in France (Grand *et al.* 2011a, b, Blanchon *et al.* 2011) could also represent recolonisation, although it cannot be excluded that the species had been previously overlooked there. It is not unlikely that the same decrease followed by a rapid increase took place in parts of eastern and south-eastern Europe, but detailed information on this is lacking. Currently, the species is once more found throughout all of its former distribution range. The decline that occurred in the 20th century was generally attributed to the deterioration of water quality and to alterations in the primary structure of river systems. Its recovery coincides with an improvement in water quality and with better river management. *Gomphus flavipes* was for a long time regarded as one of the most threatened dragonflies in Europe, but is at present regarded as stable and not threatened.

Habitats Directive	II+IV
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Near Threatened
EU27 endemic	No
European endemic	No
Trend Europe	Increasing

Habitat

Gomphus flavipes is the only European species that is nearly completely confined to larger lowland rivers, and nearly all populations are found below 400 m. Most populations are found in rivers from ten to several hundred metres wide with a sandy bed. The key factor of the habitat seems to be the river regime and the resulting composition of the river sediments. The larvae prefer areas with a slow current, a sandy bottom and not too much organic detritus. In the winter, during periods of high water, new sand is deposited while detritus is washed away, meaning that during the following summer clean stretches of sand are again available to the larvae. The highest numbers of exuviae are often found in regions where the current is relatively slow, such as the insides of river bends, sheltered areas behind islands and man-made breakwaters. The latter

often also result in areas with relatively low current in summer with suitable habitats present just downstream. Most populations occur in localities where the rivers are relatively unspoiled, but the species can also occur at sites strongly altered by man, so long as the water quality is reasonable and the river regime is natural. A good indication of suitable habitat is the presence of small stretches of beach along the river in summer.

More rarely, *G. flavipes* is found in smaller numbers at small rivers or larger streams. In the plain of the Po River it is found along the network of canals used for rice field management (Riservato 2009). In Belgium the species recently colonised the Albert Canal, which is one of the busiest waterways in Europe and which has predominantly concrete banks, thus showing little resemblance to the species' most-favoured habitat (De Knijf *et al.* 2014).

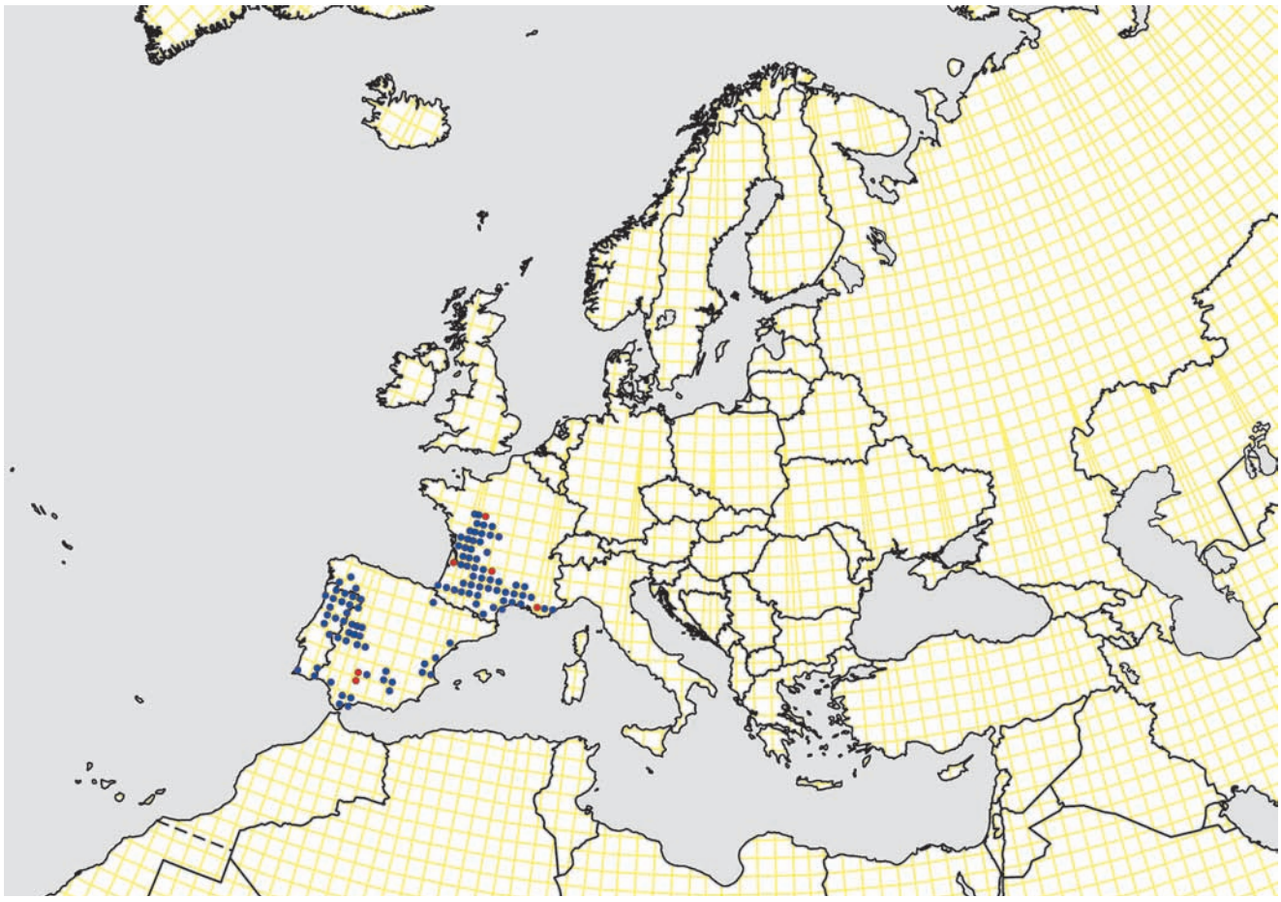
Gomphus graslinii Rambur, 1842

J.-P. Boudot & S. Ferreira

Distribution

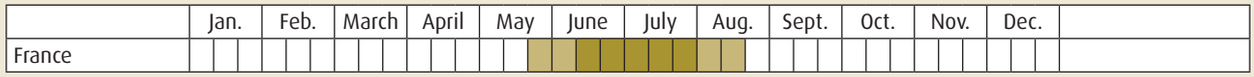
World: *Gomphus graslinii* is endemic to south-west Europe.

Europe: Most of the populations of *G. graslinii* are found in two areas, one in south-west France and the other in the western Iberian Peninsula. In France this species is common only in an area extending from the lower Rhône River through the southern part of the Massif Central to the Charente-Maritime department. Here large populations are found in the rivers and tributaries of the Hérault, Tarn and Lot. This species is rare in other areas in France and has become extinct in some regions. It is very rare in most of the Iberian Peninsula but is reasonably widespread in the west, with



World distribution

Flight period



several new localities having recently been found in Portugal (Malkmus 2002, Lohr 2005a), Valencia, Catalonia and Aragon (Baixeras *et al*. 2006, Luque Pino & Serra Sorribes 2006, Luque Pino *et al*. 2013). Most of the Iberian Peninsula populations are small.

Trend and conservation status

In the northernmost part of its range in France, *G. graslinii* suffered a severe decline during the 20th century due to pollution and poor river management, which brought many populations to extinction. On the Iberian Peninsula, several new populations have been found since the 1990s, but no information related to population trends is available (Azpilicueta-Amorín *et al*. 2009, Torralba-Burrial *et al*. 2012). In addition to water pollution and changes in stream structure, the main present threat to the species is an increased frequency of summer droughts, which result in decreased water quality during periods of low flow, which in several cases have led to the drying out of river beds.

Habitats Directive	II+IV
Red List EU27	Near Threatened
Red List Europe	Near Threatened
Red List Mediterranean	Endangered
EU27 endemic	Endemic
European endemic	Endemic
Trend Europe	Decreasing

Habitat

Gomphus graslinii favours slow-flowing parts of large streams and rivers surrounded by low forest and bushes, but can also be found along small permanent streams. Larvae favour sandy stretches covered with organic detritus. Several strong populations are known from hydroelectric dams on the rivers of the Massif Central in France, however recently these were found to have strongly decreased probably due to the high amounts of accumulated sediments. The species is found up to 300-400 m in France and has been found up to 1 000 m in Spain (Weihrauch & Weihrauch 2006).

Gomphus pulchellus Selys, 1840

J.-P. Boudot & K.-J. Conze

Distribution

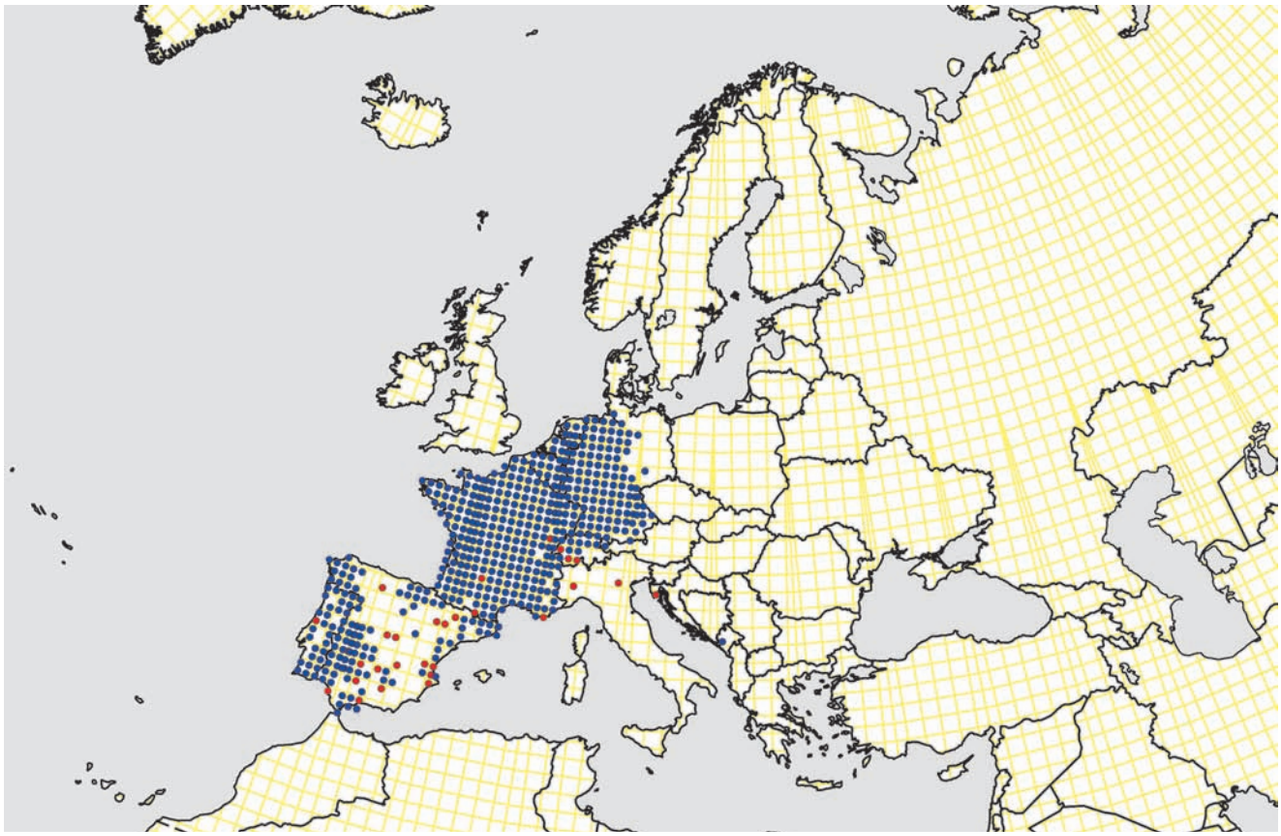
World: *Gomphus pulchellus* is a west European endemic ranging from Iberia to Germany.

Europe: *Gomphus pulchellus* ranges from the Iberian Peninsula to the Netherlands and to the western and southern parts of Germany. During recent decades it has expanded northwards and eastwards, and is presently known from the westernmost parts of Austria and the western two-thirds of Germany. The species is widespread in the south-western half of the Iberian Peninsula but has a much more scattered occurrence in other parts of Spain. Two old, isolated records from Italy and one from Croatia may refer to vagrants. A recent record from Montenegro by Buczyński *et al*. (2013a) is well beyond its known range and is in need of confirmation as it was based on a young larva only. Several published records from central and eastern Europe are regarded as misidentifications.

Trend and conservation status

The species has expanded its range in the Netherlands and parts of Germany to the north and east since the start of the 20th century, and this expansion has accelerated since the 1980s. The reasons for this are unclear, and both climate change and the creation of man-made water bodies (especially deep lake-like gravel pits) and canals between different catchment areas may have contributed. The species is one of the most common and widespread European endemics and is not threatened.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	Endemic
European endemic	Endemic
Trend Europe	Stable



World distribution

Flight period

	Jan.			Feb.			March			April			May			June			July			Aug.			Sept.			Oct.			Nov.			Dec.			
Netherlands																																							
Bavaria, Germany																																							
France, north																																							
France, south																																							

Habitat

Gomphus pulchellus breeds in many different kinds of standing and slow to moderately fast flowing habitats including large rivers, canals, oxbows, lakes, gravel pits, larger cattle ponds and occasionally mountain peat bogs. The species is absent from rocky or faster flowing streams and is mainly found in the lowlands. It is rarely found in mountains although breeding has been recorded up to 1 500 m.

Gomphus schneiderii Selys, 1850

J.-P. Boudot & M. Jović

Taxonomy

This species is very similar to *Gomphus vulgatissimus* and is sometimes considered as a subspecies of the latter. In the Balkan Peninsula, where the ranges of the species meet, there is a broad zone where intermediates are found and populations cannot be ascribed to either of the species with certainty. The status of *G. schneiderii* as species or subspecies is still under debate and the matter can only be solved by a thorough investigation of material from a wide range of localities from south-west Europe and south-west Asia, preferably using both morphological

and molecular methods. The subspecies *G. schneiderii helladicus* Buchholz, 1954, described from the Peloponnese, is not recognised as a valid taxon as the characters described for males, females and larvae combine features of both *G. vulgatissimus* and *G. schneiderii* and seem to refer to transitional, probably hybrid, populations.

Distribution

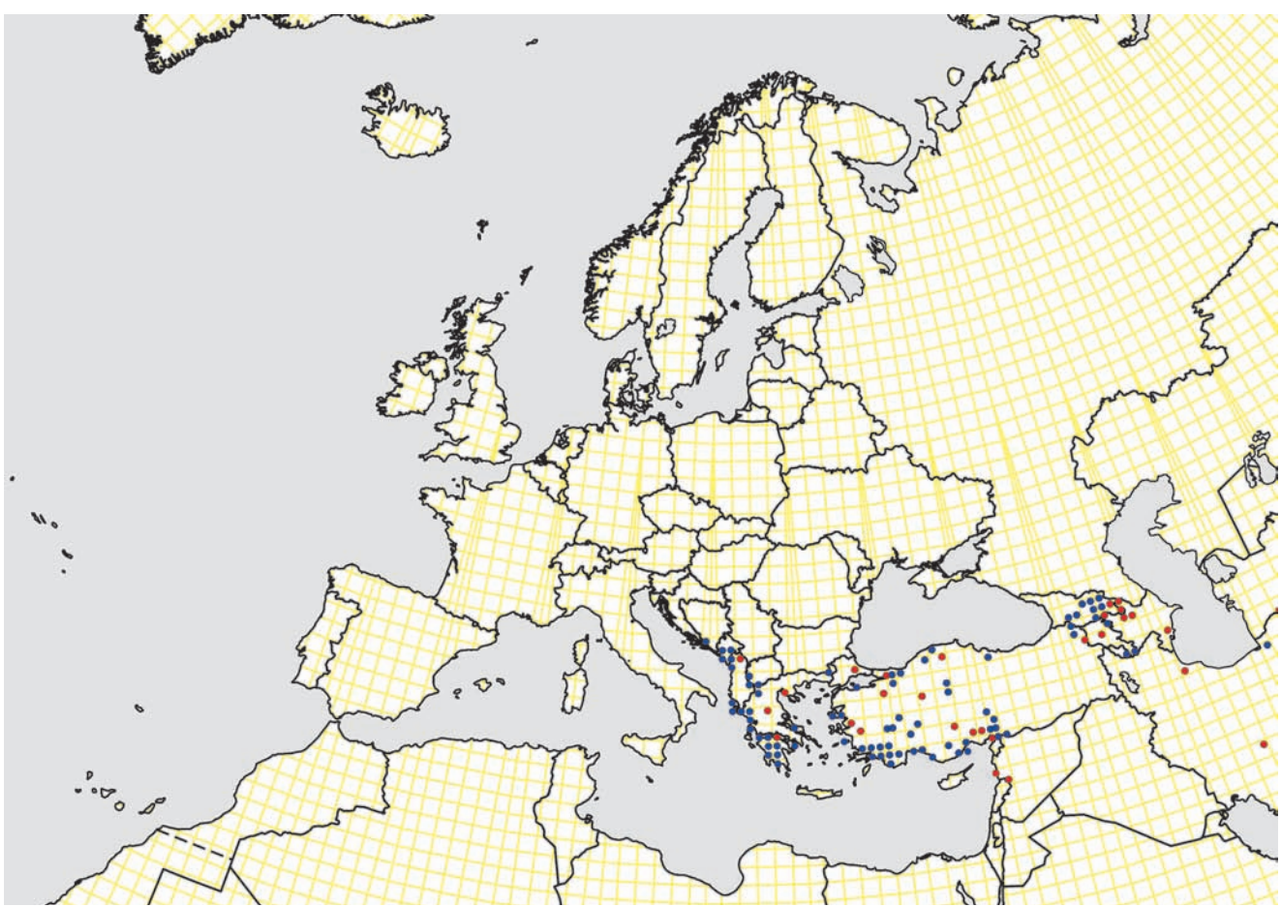
World: *Gomphus schneiderii* is found in the Balkan Peninsula, Turkey, Syria, Armenia, Georgia, the northern half of Iran and southern Turkmenistan. To the east, its range is delimited by arid areas and the high mountains of Afghanistan. It is parapatric with *G. vulgatissimus* in south-east Europe and the Caucasus with the limits of its range in the contact zone being unclear as identification is often impossible (see taxonomy). Current knowledge suggests that south of the Caucasus *G. schneiderii* is found while *G. vulgatissimus* occurs north of this mountain range.

Europe: *Gomphus schneiderii* is not uncommon in the Peloponnese but is rare in the rest of continental Greece, the Greek islands (Corfu, Evia, Lesbos and Samos) and the European part of Turkey. Its distribution in the north of Greece, where it meets with *G. vulgatissimus*, is unclear as identification is difficult due to the occurrence of intermediates, making many records unreliable. The species has been recorded from Albania (Muranyi & Kovaks 2014), Montenegro (De Knijf *et al*. 2013), Macedonia and southern Bosnia and Herzegovina (Kulijer *et al*. 2013) but these countries lie in the region where *G. schneiderii* and *G. vulgatissimus* meet and identification often problematic (see taxonomy). The current known distribution suggests that *G. schneiderii* is restricted to the warmer lower parts of the Balkan Peninsula with *G. vulgatissimus* replacing it in climatologically less suitable areas.

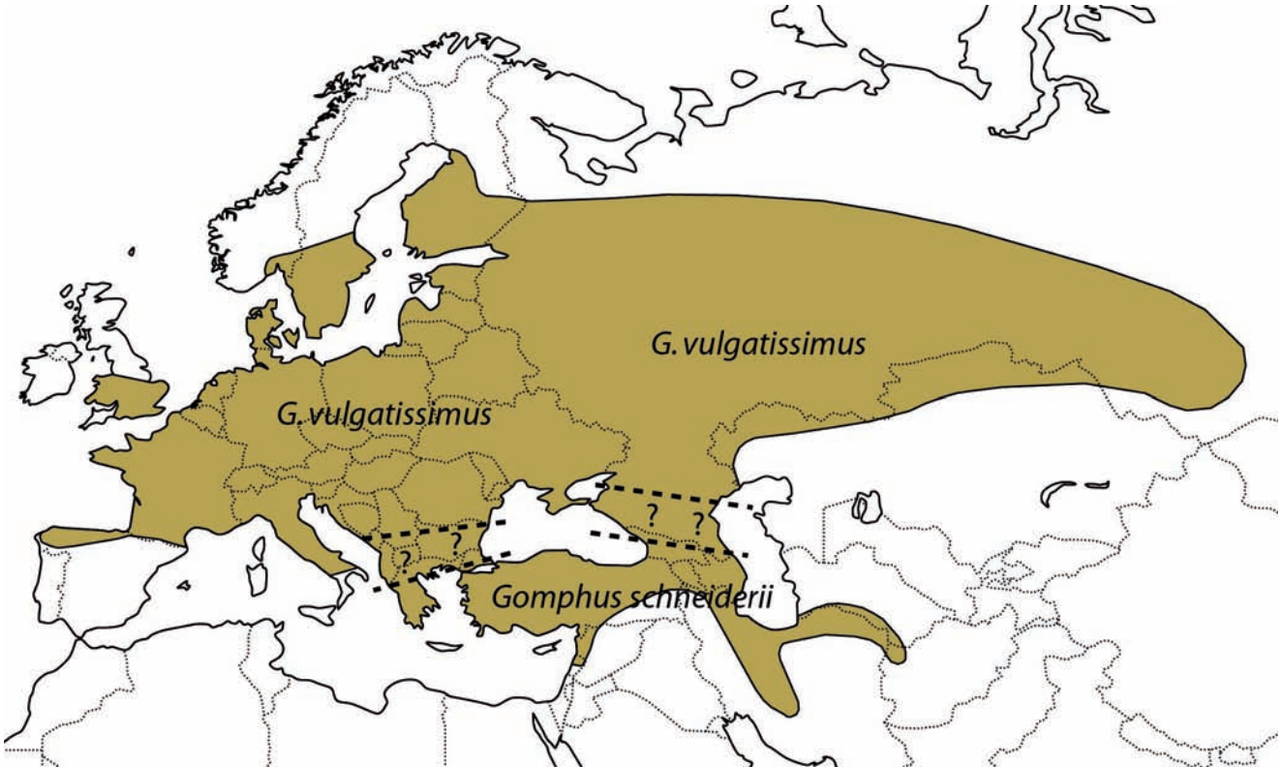
Trend and conservation status

Information on the distribution of *G. schneiderii* in the Balkan Peninsula is limited and its current trend is unclear. In Greece, the types of streams where the species occurs are under pressure from water pollution, gravel mining and from stream desiccation due to increased winter rainfall deficit and to extraction of water for irrigation and domestic use. These threats and its relatively small European range mean that *G. schneiderii* was assessed as Near Threatened on the European Red List.

Habitats Directive	No
Red List EU27	Near Threatened
Red List Europe	Near Threatened
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Unknown



European distribution



Combined World distribution of *Gomphus schneiderii* and *G. vulgatissimus*

Flight period

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Bulgaria & Greece													

Habitat

Gomphus schneiderii is mainly found on slow rivers and streams with a sandy or silty bottom. Occasionally it breeds in ponded backwaters fed with ground water, or in large lakes where wave motion produces conditions similar to those found in running waters. In most cases its habitats are bordered by forest, bushes, hedges or extensive hay production meadows.

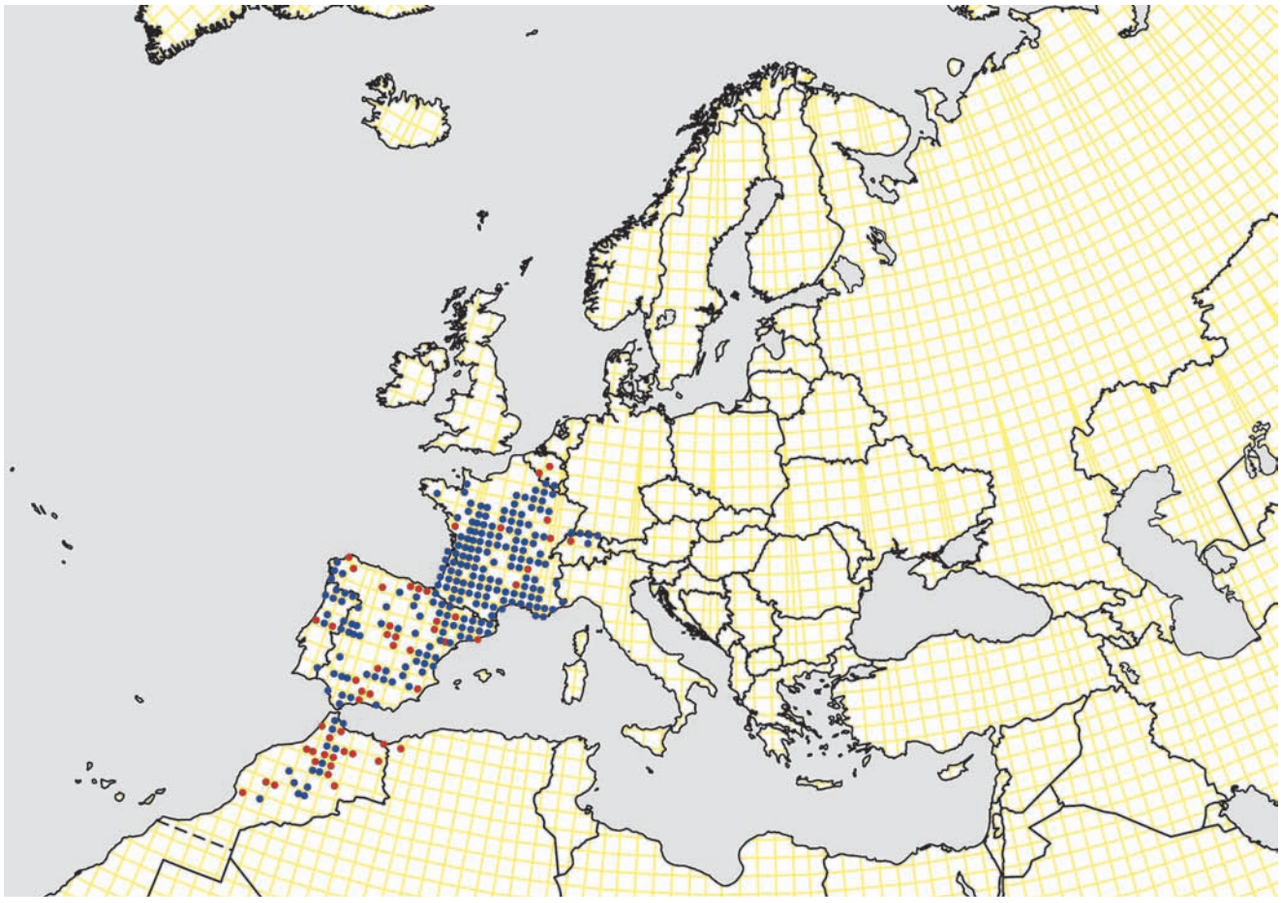
Gomphus simillimus Selys, 1840

J.-P. Boudot & J.-L. Dommanget

Distribution

World: *Gomphus simillimus* is endemic to western Europe and the Maghreb, with its core range in the west Mediterranean. The nominotypical subspecies is endemic to Europe while the distinct but variable Maghrebian subspecies *G. s. maroccanus* is restricted to Morocco and the north-west of Algeria.

Europe: *Gomphus simillimus* ranges from the south of the Iberian Peninsula to north-east France. Five records from Belgium are considered vagrants. The eastern-most populations are from the upper Rhine River around the border of Germany and Switzerland. Records published from areas further east (e.g. from Slovakia and the Czech Republic) are based on misidentifications. The highest density of populations is found in the south-western half of France, where the species is rather common. In other parts of France it is rarer, with a more scattered distribution. It is generally rather rare in the Iberian Peninsula, although slightly



World distribution

Flight period

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
France													

less so in the north-east, and in most areas it is only known from scattered populations.

Trend and conservation status

Gomphus simillimus is likely to be affected by water pollution, habitat destruction (e.g. gravel extraction from rivers beds) and irrigation. Given these threats and its scattered distribution in large parts of Europe, it is classified as Near Threatened on the European Red List.

Habitats Directive	No
Red List EU27	Near Threatened
Red List Europe	Near Threatened
Red List Mediterranean	Near Threatened
EU27 endemic	No
European endemic	No
Trend Europe	Decreasing

Habitat

Gomphus simillimus breeds mainly in large slow-flowing rivers and to a lesser degree in streams. It is found more rarely in canals and oxbow lakes and ponds fed by ground water, where it can, however, reach high densities. Reproduction has also been noted from standing waters such as abandoned gravel pits and Lake Constance (Bodensee). It is restricted to the lowlands and is rarely found above 500 m.

Gomphus vulgatissimus (Linnaeus, 1758)

J.-P. Boudot, S. David & D. Šácha

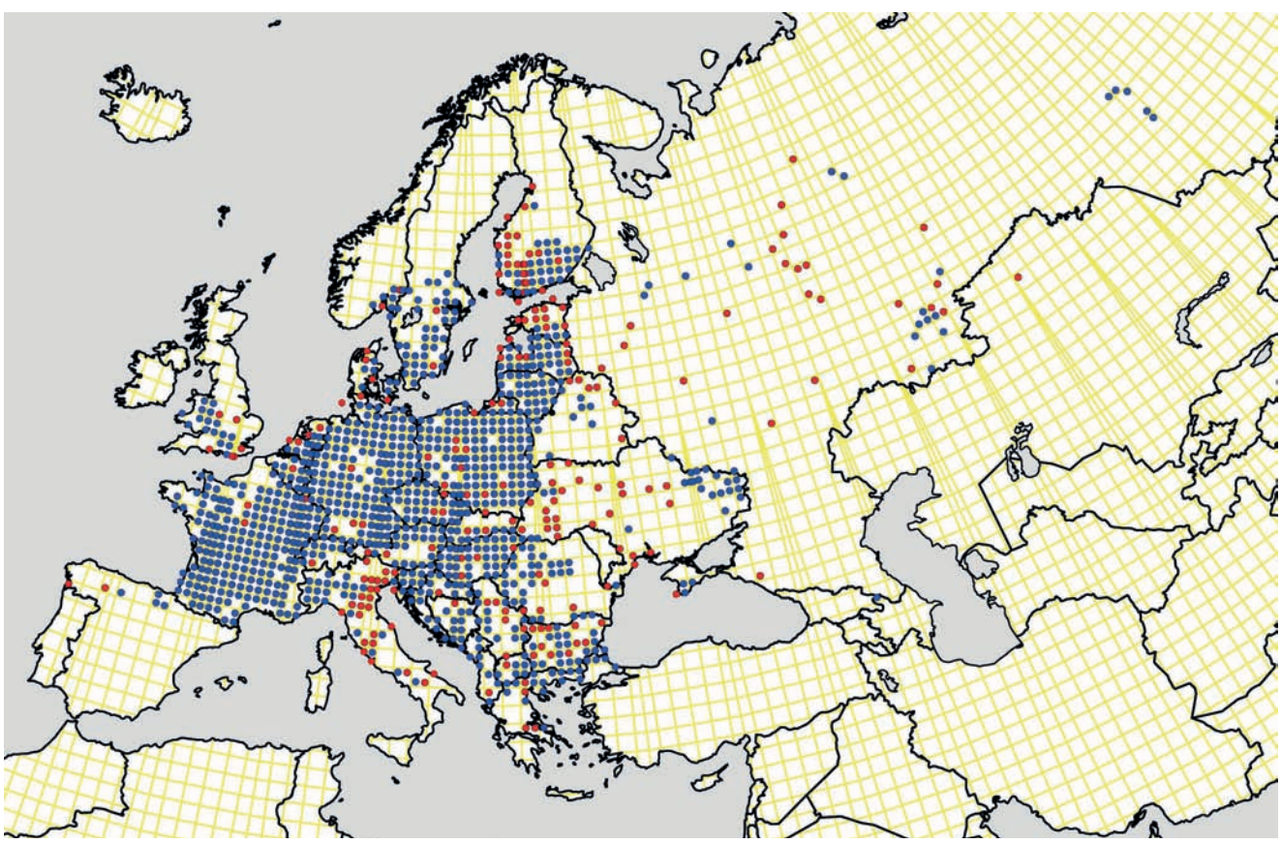
Taxonomy

See *Gomphus schneiderii*.

Distribution

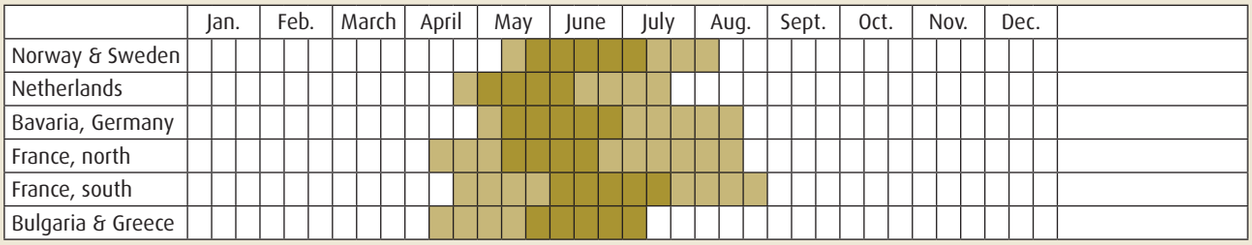
World: *Gomphus vulgatissimus* has a largely Western Palaearctic distribution, reaching eastwards to the south of the West Siberian Plain (Bernard & Kosterin 2010). It is replaced by *G. schneiderii* in parts of the Balkan Peninsula and south-west Asia. The limit between the two species is unclear but current knowledge suggests that south of the Caucasus *G. schneiderii* is found while *G. vulgatissimus* occurs north of this mountain range.

Europe: *Gomphus vulgatissimus* is common and widespread in much of western, central and eastern Europe. Physically suitable habitats occur north of its present range hence its northern limits appear to be determined by climatic conditions. It is absent from most of the Mediterranean, being very rare in Spain and parts of Italy. In the southern part of the Balkan Peninsula, its range meets that of its near relative *G. schneiderii* and a broad zone of introgression occurs, making identification to species level often impossible.



World distribution

Flight period



Trend and conservation status

Gomphus vulgatissimus experienced a severe decline over large parts of western and central Europe during the second half of the 20th century, due to pollution, eutrophication and canalisation of rivers and streams. Improvements in water quality have led to a rapid recovery of the species since the 1990s, and at present it is considered to be stable and of Least Concern at a European level. In Great Britain, a northwards expansion of its range by about 100 km since 1970 has been noticed, which was attributed to global warming (Hickling *et al*. 2005). The same might probably have taken place within Fennoscandia. Conversely, climate change might well lead to a decline in Spain and parts of Italy.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

Gomphus vulgatissimus occurs mainly in lowland streams and rivers, where it may be abundant. Occasionally, populations are found at small streams and ditches with running water. In rare cases breeding occurs at sandy banks of well-oxygenated standing waters such as lakes, ponded backwaters and gravel pits fed by ground water. The species favours landscapes with a combination of agricultural fields, forest and bushes. The highest densities are found at largely unshaded running waters, but the species also occurs in forest areas as long as there are sunny stretches. It mostly occurs at sites with sandy to silty or clay-rich sediments, and is generally absent from fast flowing rocky streams.

Lindenia tetraphylla (Vander Linden, 1825)

V.J. Kalkman & T. Bogdanovic

Taxonomy

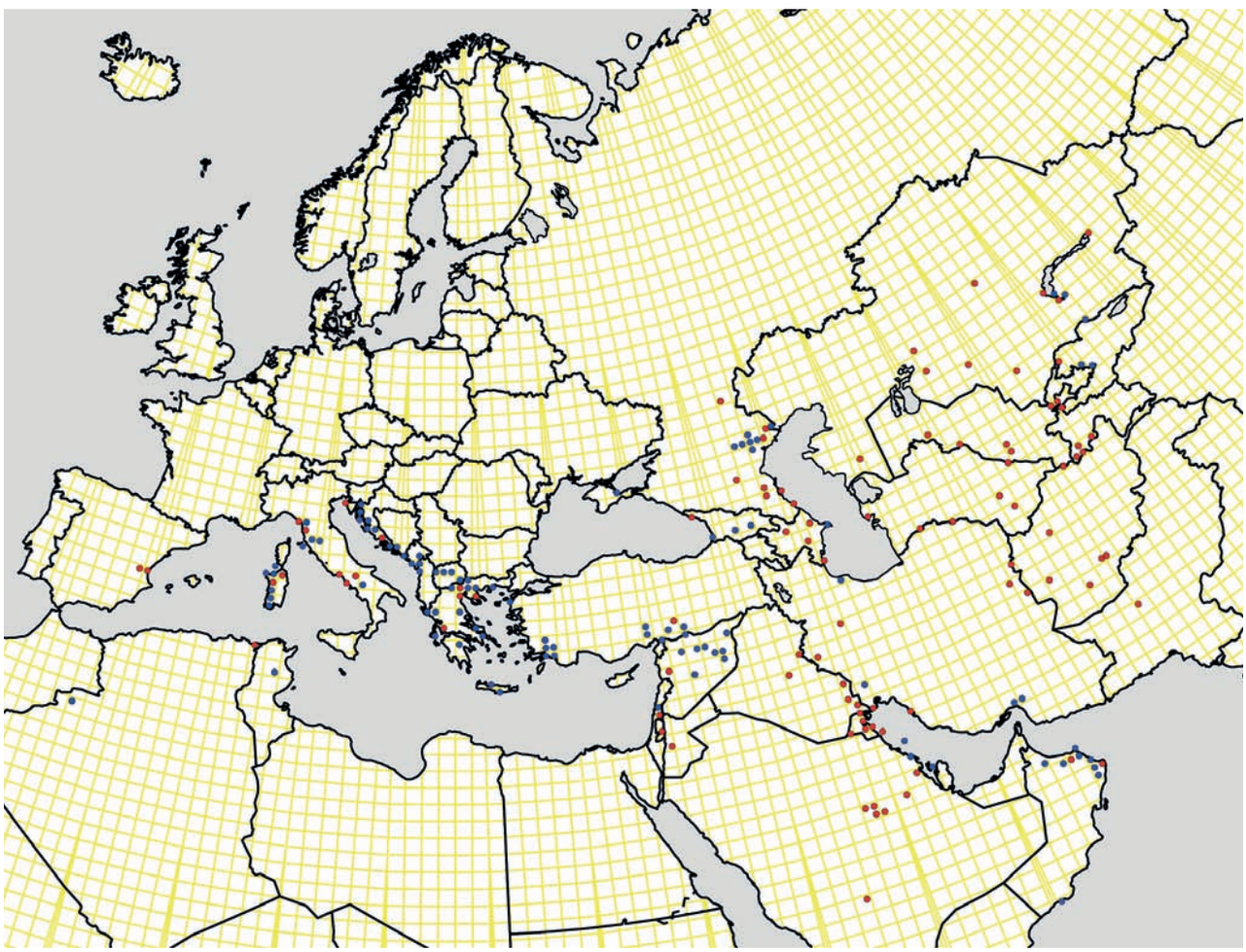
Lindenia is a monotypic genus and *L. inkiti* Bartenev, 1929, described from Georgia, is considered a synonym of *L. tetraphylla* (Kalkman 2004). At least in the south of Croatia and Montenegro, specimens of *L. tetraphylla* are largely black and this has led to the suggestion that a separate species is involved (Belančić *et al*. 2008). It seems however more likely that this is the result of the cold, spring-fed habitats where those specimens are found.

Distribution

World: *Lindenia tetraphylla* is predominantly a central and south-west Asian species which extends over the Arabian Peninsula and the Mediterranean (Schorr *et al*. 1998). The easternmost populations are found in Kazakhstan, Afghanistan and Pakistan (Waterston 1980, Borisov & Haritonov 2008). The lack of recent records in Central Asia is at least partly caused by the limited amount of fieldwork in the past decades. In the Mediterranean, it is mainly found in the east with populations known from the Levant, Turkey, the Balkan

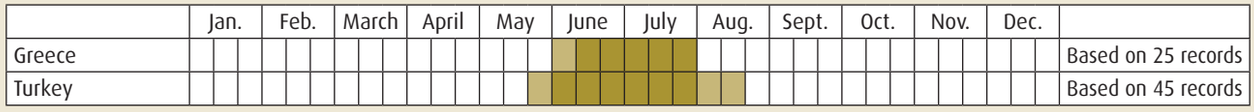
Peninsula and Italy (mainland and Sardinia). The westernmost records are from Spain (probably now extinct) and the Maghreb, where the species was recorded in Tunisia in 2000 and 2002 and in Algeria in 2014 after an absence of over a century (Kunz & Kunz 2001, Boudot *et al*. 2009, Hamzaoui *et al*. 2015).

Europe: All European records with the exception of those from Russia are confined to the Mediterranean, and most populations are found in coastal lowlands. The species is regularly found away from suitable habitat and probably some of the dots shown on the maps indicate to vagrants. In the eastern Mediterranean islands, it was found breeding at several barrage lakes in Gökçeada (Turkey) (Hacet & Aktaç 2006, Kalkman & van Pelt 2006), Thasos (Greece) (vagrant only) and Crete (Greece). In the latter, the first records are from 2012, when exuviae were found at five barrage lakes, some only a few years old (Brochard & van der Ploeg 2013b, Boudot 2014a). It seems likely that *Lindenia* is a recent arrival on the east Mediterranean islands, establishing itself only after suitable open water habitats were created. In continental Greece, the species is known to have a large population at the natural Lake Vólvi (mainland) and the man-made Lake Doxis (Peloponnese). Several other records near lakes probably also pertain to populations (e.g. Lake Stimfalia on the Peloponnese and Lake Distos on Euboea). It seems likely that additional surveys will reveal populations on several other larger lakes in Greece (Lopau 2010b). Probably the largest European population, and possibly the largest population worldwide, is found at Lake Skadar in Montenegro and Albania. An extrapolation of sample counts of exuviae along four stretches of the Montenegrin part of this lake in 2011 led to an estimated total of over a million exuviae (De Knijf *et al*. 2013). The only other site in Montenegro where the species is assumed to breed regularly is Lake Šasko. *Lindenia tetraphylla* was recently found in Bosnia and Herzegovina with populations in Hutovo Blato Nature Park (Deransko Lake and the Krupa River) (Kulijer *et al*. 2012). The species is present at several coastal sites in Croatia, including a population on the island of Cres (Belančić *et al*. 2008). The northernmost record in the Balkan Peninsula is from Slovenia, where a single female was captured in the 1960s (Kotarac 1997). *Lindenia tetraphylla* was formerly considered very rare in mainland Italy and Sardinia, but new records by Utzeri *et al*. (2006) and Hardersen & Leo (2011) showed that it is presently regionally well established and locally abundant. A presumably vagrant individual was found in 2009 in the south of Corsica (Tellez



World distribution

Flight period



& Dommanget 2009). There are a few old records from Spain from three localities from the period 1906–1965, all from the surroundings of Valencia (Valencia city, Godella and Godelleta) (Navás 1906, 1924, Compte-Sart 1965, Bonet-Betoret 1990, Ocharan-Larrondo 1997, Ocharan *et al*. 2012). The large coastal lake that is part of the Parque Natural de la Albufera south of Valencia seems the most probable origin of these specimens. East of the Mediterranean region, the species is well distributed north-west of the Caspian Sea in the south of European Russia, occurring in semi-desert and often brackish habitats (Skvortsov & Kuvaev 2007, 2010). In 2013 it was discovered in the Crimea Peninsula (Savchuk & Karolinskiy 2013).

Trend and conservation status

Lindenia tetraphylla is, in Europe, dependent on a small number of reproductive habitats sparsely distributed across a relatively large area. Despite recent surveys, a good understanding of the number of populations and their size is still lacking, with in many cases it being obvious that records represent vagrants. The status of the species at several localities is unclear, but based on present information a rough estimate suggests that there are currently 30-50 large viable European populations. In several localities that were known to support viable populations, water pollution and increased extraction of water has resulted in deterioration of habitat quality, and in some cases in local extinction. Examples of this are Lake Koronia in northern Greece and Lake Stimfalia in the Peloponnese, which were found dry, or nearly dry, in July 2008. There is no information on any subsequent recolonisation. An increasing demand for water combined with the effects of climate change is expected to lead to future reduction in the number of populations and mean population size.

Habitats Directive	II+IV
Red List EU27	Vulnerable
Red List Europe	Vulnerable
Red List Mediterranean	Near Threatened
EU27 endemic	No
European endemic	No
Trend Europe	Decreasing

Habitat

In Europe, *Lindenia tetraphylla* is mostly found on large lakes and more rarely at large slow-flowing waters (Schorr *et al*. 1998). Most populations in Greece, Croatia and Italy are found on lakes with extensive beds of reed (Belančić *et al*. 2008, Lopau 2010b) or mats of hydrophytes over which the females were observed to oviposit (Boudot 2014a). The species also occurs in abandoned gravel pits (Utzeri *et al*. 2006) and habitats with scarcely any vegetation. It was found breeding in barrage lakes with rocky shores on both the Turkish island of Gökçeada and in Crete (Kalkman & van Pelt 2006, Brochard & van der Ploeg 2013b, Boudot 2014a). Some of these barrage lakes on Crete were only a few years old (just three years in one case), showing that the species is readily able to colonise new, isolated habitats thanks to its nomadic behaviour. In Sardinia and Syria, it occurs in brackish habitats (Krupp & Schneider 1988), but the majority of the European habitats are freshwater.

Onychogomphus costae Selys, 1885

J.-P. Boudot & B. Garrigos

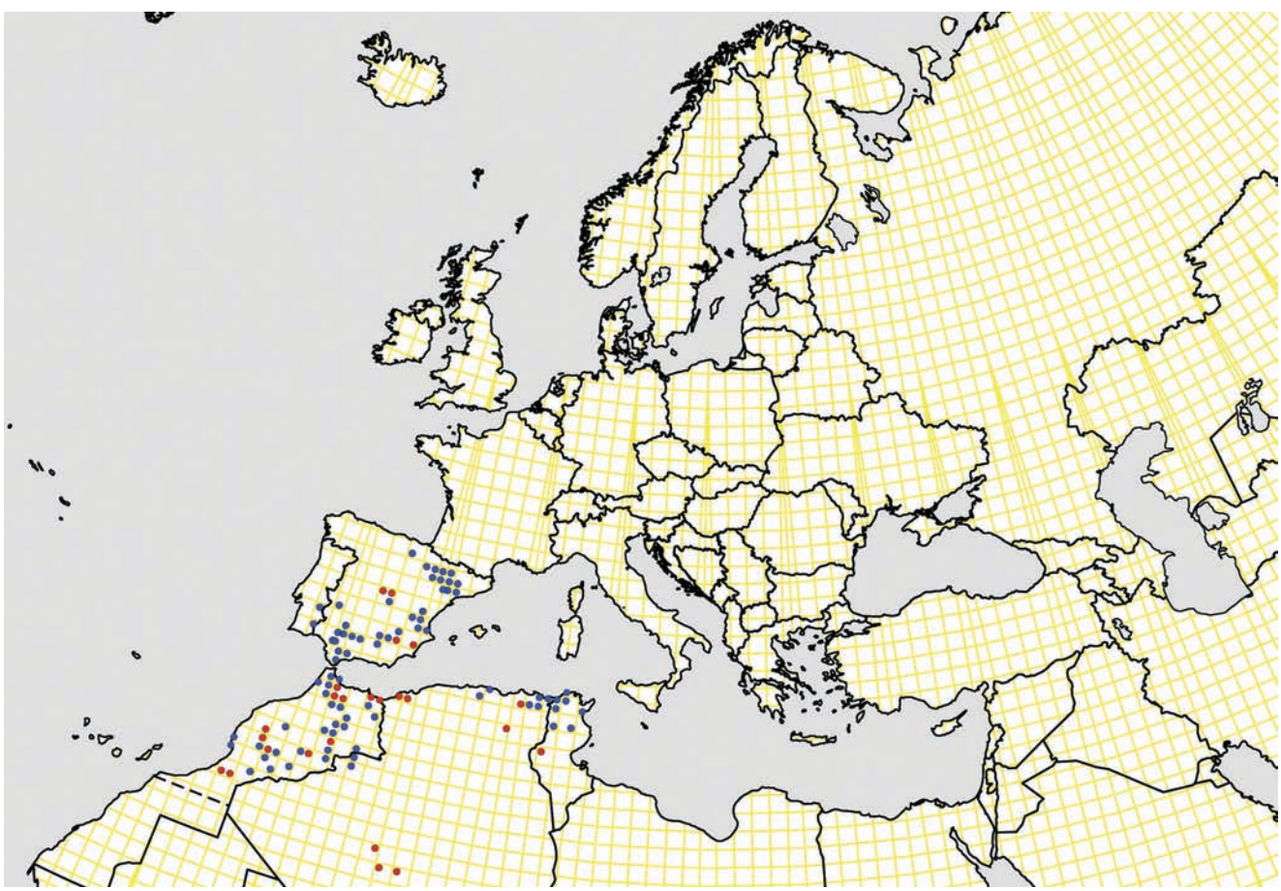
Distribution

World: *Onychogomphus costae* is restricted to the western Mediterranean and is found in the Iberian Peninsula and the Maghreb. The species is reasonably widely distributed in the north of Morocco and Tunisia, and a recent survey showed that in Algeria it penetrates further south into in the Sahara than previously thought (Hamzaoui *et al*. 2015) and thus might be more widespread there than supposed.

Europe: *Onychogomphus costae* is found in the south and east of the Iberian Peninsula, reaching north to the foothills of the Pyrenean and the Cantabrian mountains along the Ebro valley. The species is very rare in Portugal and absent from the whole north-west of the peninsula, probably due to the colder and more humid climate. It is relatively rare and localised within its European range when compared with the Maghreb. Information on the size and extent of the European populations is very limited.

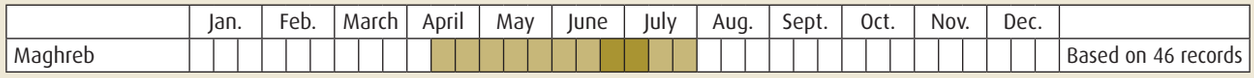
Trend and conservation status

Onychogomphus costae is endemic to the western Mediterranean and is threatened by poor management of running waters, with threats including the construction of dams, the alteration of river structure and the increasing



World distribution

Flight period



demands on water for irrigation and domestic use. The impact of climate change is difficult to predict as it might result in both a northwards expansion of the species and the drying out of currently suitable habitats. Several populations have become extinct in the past few decades, although the total number of known populations has increased due to an increase in fieldwork. The habitat quality of running waters is deteriorating in the Iberian Peninsula, for which reason this already rare species was classified as Endangered on the European Red List.

Habitats Directive	No
Red List EU27	Endangered
Red List Europe	Endangered
Red List Mediterranean	Near Threatened
EU27 endemic	No
European endemic	No
Trend Europe	Decreasing

Habitat

Onychogomphus costae is found in running waters in arid and semi-arid environments. In Europe, it is restricted to the driest lowland areas. The running water habitats in such places are challenging for the aquatic fauna as they are often intermittent in summer but can be torrential during the rainy season. *Onychogomphus costae* seems to be well adapted to this and is sometimes observed at residual pools in largely dry river beds. It seems more resistant to sudden fluxes in water flow than other species of dragonfly (Melahoui & Boudot 2009). In the Maghreb it is often the only dragonfly present, although at low densities, along permanent river systems with seasonal catastrophic discharge (Melahoui & Boudot 2009, Boudot & De Knijf 2012). The species is tolerant of naturally brackish rivers with a salinity ranging from 4 to 7.9 ‰ (Boudot 2008).

Onychogomphus flexuosus (Schneider, 1845)

V.J. Kalkman

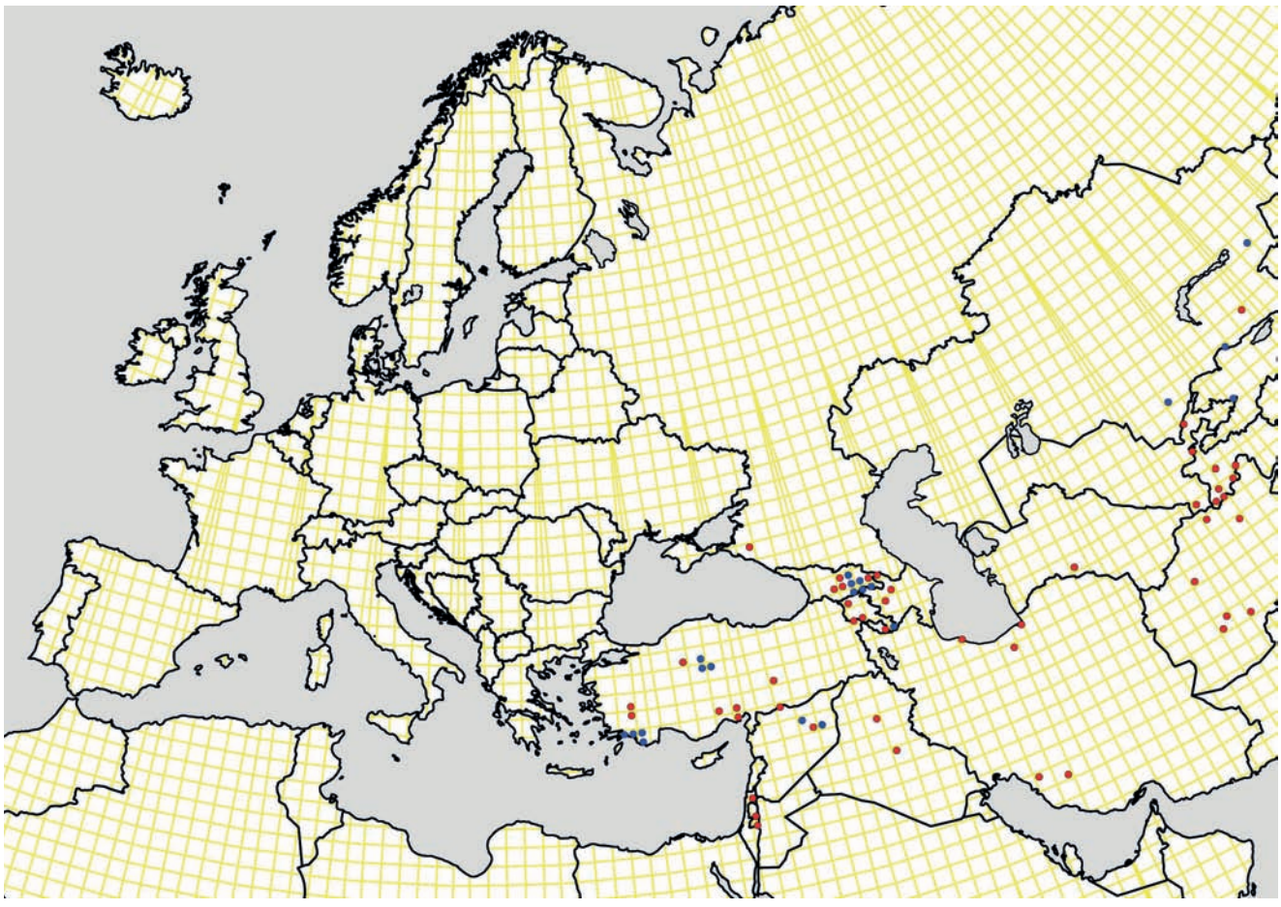
Distribution

World: *Onychogomphus flexuosus* is confined to south-west and central Asia, where most populations are found on rivers at the feet of mountain ranges (Boudot *et al.* 2009, Borisov & Haritonov 2008, Dumont *et al.* 1992). These ranges include from west to east the Taurus, Zagros, Caucasus and Elburz Mountains, the mountain ranges in the west of Afghanistan and the western and northern reaches of the Tian Shan. The species is widespread but scarce in south-west Asia, where it is known from the Dalaman, Menderes and Esen Rivers (all three in south-western Turkey), the Seyhan and Ceyhan Rivers (both in the Adana delta, Turkey), the Jordan River in Israel, the Euphrates River in Syria, the Tigris River in Iraq and several smaller rivers in Transcaucasia, the southern side of the Zagros Mts. and the northern side of the Elburz Mts. Recent fieldwork in Armenia and Georgia suggests the species is locally common in this region (Schröter 2010a, Ananian & Tailly 2013, Schröter *et al.* 2015).

Europe: The only known record of *O. flexuosus* from Europe is that of a single male collected on 15 May 1906 in the surroundings of Ekaterinodar city, now Krasnodar, just north of the western end of the Caucasus range (Bartenev 1912). The species was not found again in 1931 when the same author reinvesti-

Flight period

The date of the only European record is given by Bartenev (1912) as 28 May 1906 (Julian calendar) which corresponds with 10 June 1906 under to the present Gregorian calendar. The records from Armenia, Georgia and Turkey are from the period mid-May to the end of July (Kalkman & van Pelt 2006, Schröter 2010a, Ananian & Tailly 2013).



World distribution

gated the same area (Bartenev 1932) and therefore this record is regarded as a vagrant only from nearby Georgia south of the Caucasus, where it is rather common. No European populations are known but the presence of populations is not unlikely considering its distribution in Georgia.

Trend and conservation status

The habitats where *Onychogomphus flexuosus* occurs are often under pressure from gravel mining and the creation of barrage dams resulting in changed water regimes. In addition, the water quality of larger rivers has often deteriorated due to pollution from agriculture and sewage from towns.

Habitats Directive	No
Red List EU27	Not Applicable
Red List Europe	Not Applicable
Red List Mediterranean	Not Applicable
EU27 endemic	No
European endemic	No
Trend Europe	Unknown

Habitat

The sparse information on habitat suggests that this species prefers large unshaded streams and rivers with extensive gravel banks in generally arid and hot areas (Kalkman 2006, Hope 2007, Dumont *et al.* 1992). Such situations are mainly found at the feet of mountains where they give way to plain. These situations can be found at low elevation in coastal situations or at higher elevations in steppe or semi-deserts. These habitat preferences seem to be reflected by its distribution with records being concentrated along mountain chains.

Onychogomphus forcipatus (Linnaeus, 1758)

J.-P. Boudot & R. Proess

Taxonomy

Boudot *et al*. (1990) demonstrated that when sufficient numbers of specimens from different locations were studied, three subspecies of *O. f. forcipatus* could be recognised based on the shape of the male lower appendage. Together with *O. lefebvrii* from south-west and Central Asia, these subspecies probably form a monophyletic group, each taxon with a discrete and non-overlapping range although they can be locally syntopic (Boudot *et al.* 1990, Schneider & Dumont 2015). Genetic studies however failed to find any genetic differentiation between the three subspecies of *O. forcipatus* (Ferreira et al. 2014).

Distribution

World: *Onychogomphus forcipatus* is largely confined to the Western Palaearctic, reaching eastwards to northern Kazakhstan (nominotypical ssp.) and south-west Turkmenistan (ssp. *albotibialis*). In Africa, it occurs in northern Morocco, Algeria and Tunisia (ssp. *unguiculatus*). It is common in most of Turkey and Transcaucasia, from where it reaches northern Iran (ssp. *albotibialis*). The species is replaced by the closely related *O. lefebvrii* from the Levant and south-east Turkey through to Central Asia.

Europe: *Onychogomphus forcipatus* is the most common and widespread species of Gomphidae occurring in Europe. Nevertheless, its distribution shows a remarkable gap in parts of central Europe, where it is absent from large parts of northern France, Belgium, the Netherlands, Germany and Poland. As the species is again common in large areas further north, climatic limitation is unlikely and its absence is probably due to a combination of the lack of suitable habitats and poor water quality. The nominotypical subspecies is found in most of Europe. It is replaced by *O. f. unguiculatus* in the western Mediterranean, including the northern Maghreb. This subspecies is widespread and common in the Iberian Peninsula, the French Mediterranean fringes and, except for the north-east, most of mainland Italy. Surprisingly, specimens from Sicily belong to the nominotypical subspecies based on the structure of the appendages. The species is absent from Corsica and Sardinia although there are suitable habitats. *Onychogomphus f. albotibialis* is largely confined to south-west Asia, reaching Cyprus and the eastern Aegean islands to the west. The Caucasus might form the border between the nominotypical subspecies and *O. f. albotibialis*, which seems to be confirmed by recent fieldwork in Transcaucasia (Schröter *et al*. 2015).

Trend and conservation status

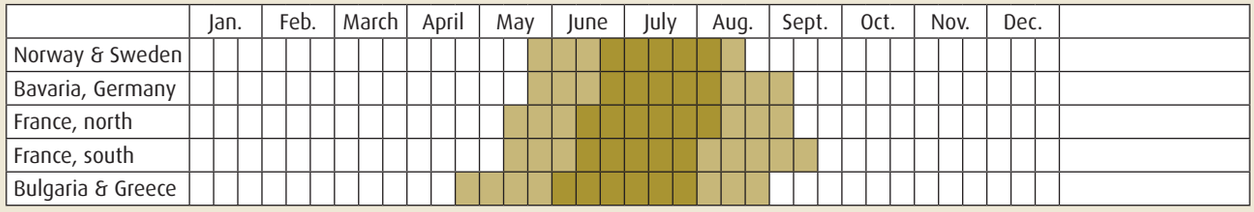
Both *O. f. forcipatus* and *O. f. unguiculatus* have been assessed as of Least Concern on the European Red List. The third subspecies, *O. f. albotibialis*, has a small range in Europe and is threatened by pollution and desiccation of streams due to increasing water demand and rainfall deficit. This subspecies has therefore been assessed as Near Threatened in Europe.

	Subspecies forcipatus and unguiculatus	Subspecies albotibialis
Habitats Directive	No	No
Red List EU27	LC	NT
Red List Europe	LC	NT
Red List Mediterranean	LC	NT
EU27 endemic	No	No
European endemic	No	No
Trend Europe	Stable	Declining

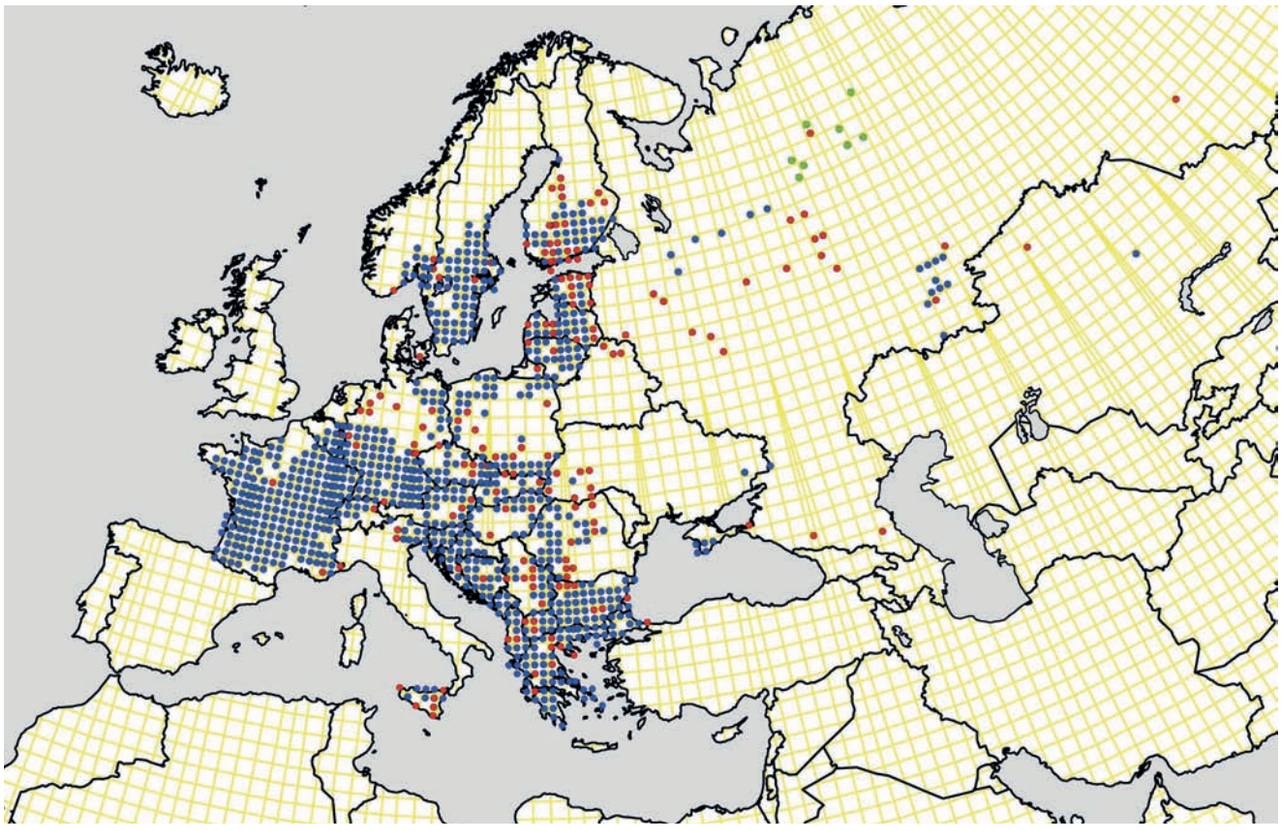
Habitat

Onychogomphus forcipatus is mainly found at unshaded or partially shaded swift to slow-flowing streams and rivers. These are most often sandy, with or without gravel or stones, and sometimes predominantly clayey. The species is also locally found at open beaches of large lakes, where the breaking of waves creates conditions similar to those found in running water, and at

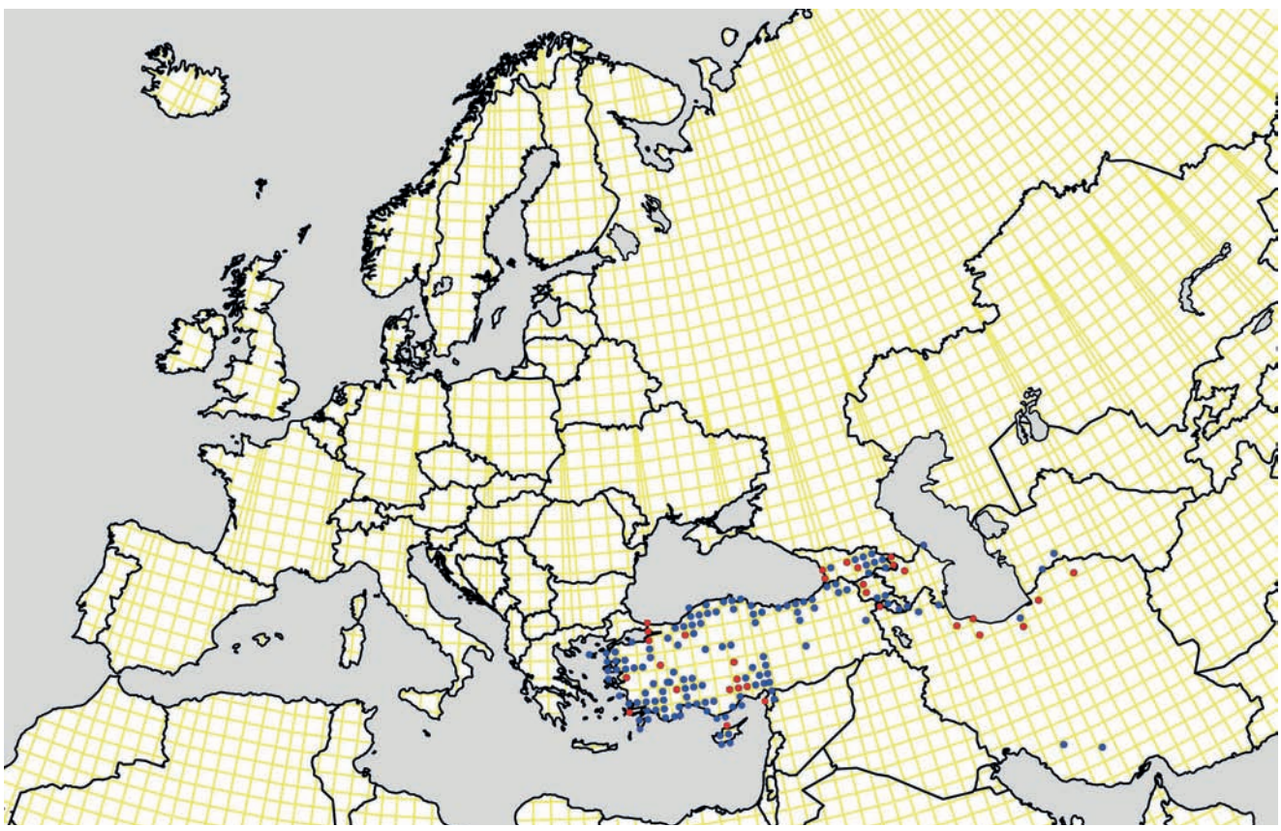
Flight period



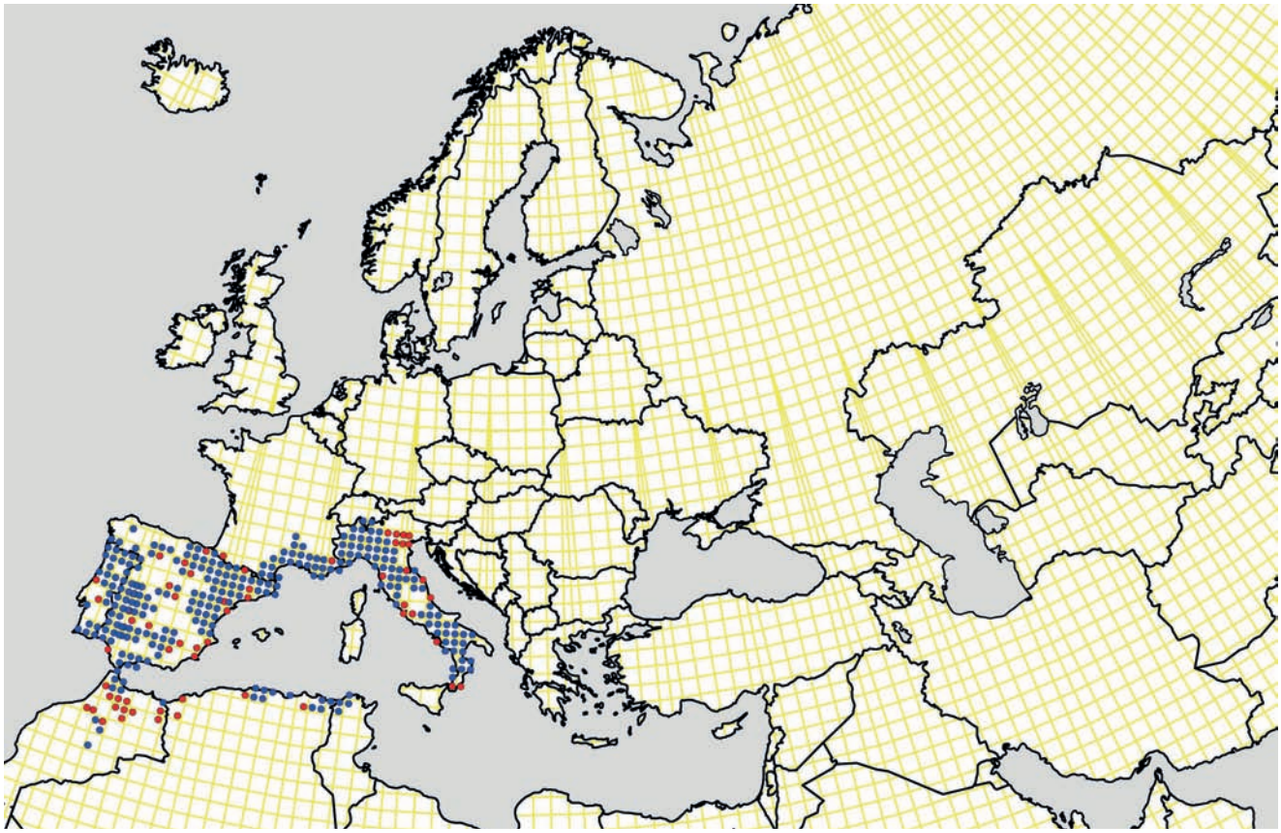
ponded backwaters fed with well oxygenated groundwater. The occurrence of the species at lakes seems to be relatively common in the north-east and the south-east of its range (Poland, Turkey). *Onychogomphus forcipatus* is found in lowlands and hilly regions, but breeding occurs up to 1 200 m in the south of Europe and to 1 600 m in Morocco.



World range of *Onychogomphus forcipatus forcipatus*



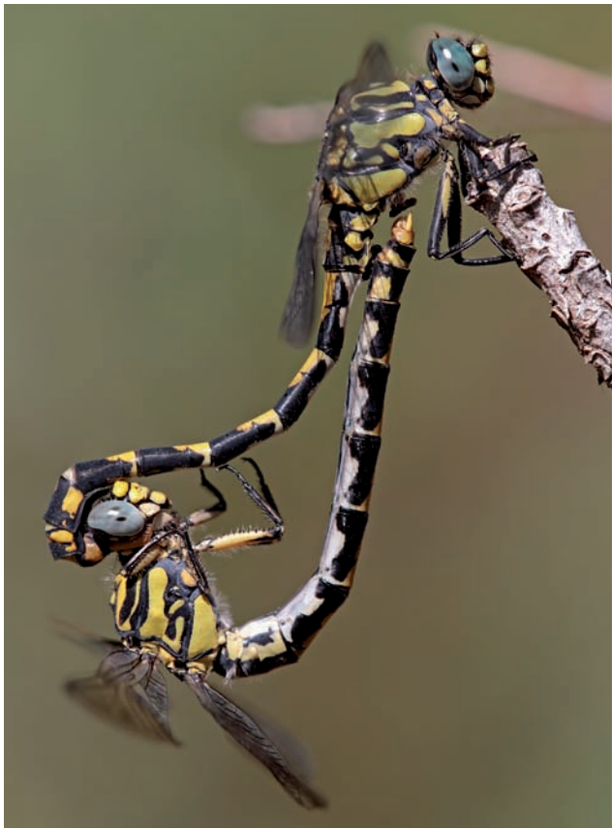
World range of *Onychogomphus forcipatus albotibialis*



World range of *Onychogomphus forcipatus unguiculatus*

Onychogomphus uncatus (Charpentier, 1840)

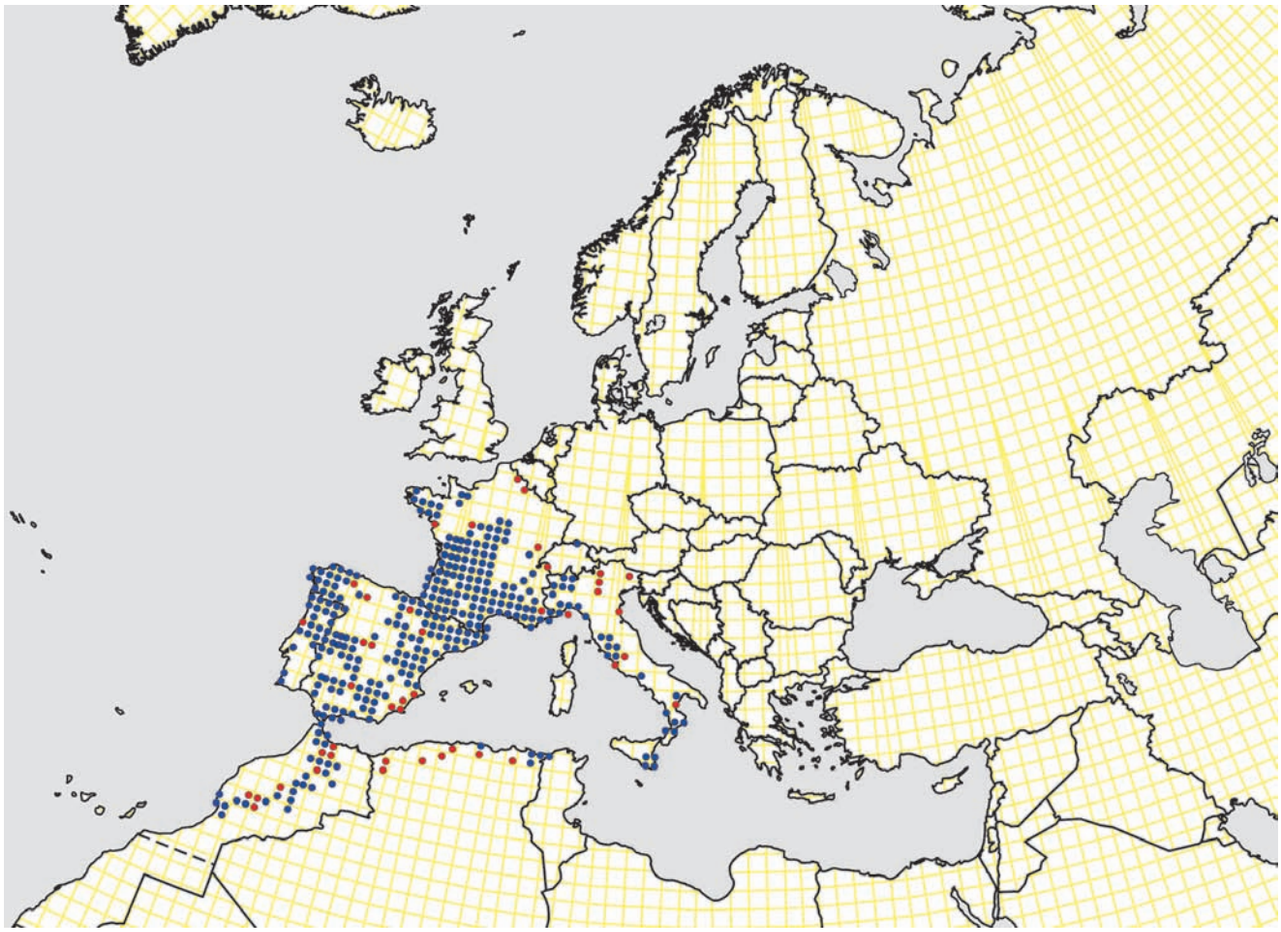
J.-P. Boudot & J.-L. Dommanget



Distribution

World: *Onychogomphus uncatus* is endemic to the western Mediterranean. In North Africa it is found in the hills and mountains of northern Morocco, Algeria and Tunisia.

Europe: The main range of *Onychogomphus uncatus* is from the south-western half of France west to the Iberian Peninsula and east to Italy. It is absent from the Mediterranean islands with the exception of Sicily (six localities in the south-east of the island). The highest density of populations is found in the south-west of France and parts of the Iberian Peninsula, and in these areas the species is generally common. It has a scattered distribution in the Iberian Peninsula, being regionally absent in the driest parts. It is relatively uncommon in Italy, with populations confined to areas in the north and the western half of the country. An isolated population occurred on the Rhine River at the border of Switzerland and Germany, where it was first found in 1883. It has not been seen there since 1991 despite thorough surveys and is now considered to be locally extinct. Vagrants have been recorded from Belgium (1975, 1979), the Vaud province in Switzerland and the Doubs department in France.



World distribution

Flight period

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
France													

Trend and conservation status

Onychogomphus uncatus is widespread and common, and there is no evidence of an overall decline. The main threats are pollution, the alteration of river structure and drying out of streams due to rainfall deficit and the increased demand for domestic and irrigation water.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

Onychogomphus uncatus tolerates higher water velocities than *O. forcipatus*, and is more frequently found in fast-flowing stony streams and rivers than the latter, with a preference for partially shaded habitats. It is common in rapid headwaters in hilly and mountainous landscapes usually up to 800 m, locally up to 1 300 m in Europe and 2 340 m in Morocco, but it also often occurs in large, slow-flowing, lowland rivers in the west of its range.

Ophiogomphus cecilia (Geoffroy in Fourcroy, 1785)

V.J. Kalkman & A. Ambrus

Taxonomy

Asahina (1979) showed that *O. cecilia* is distinct from the east Asian *O. obscurus*, which was recently confirmed by Kosterin & Zaika (2010).

Distribution

World: *Ophiogomphus cecilia* has a Palaearctic distribution, ranging from Europe, west Siberia and northern Kazakhstan eastwards to Lake Baikal. In the east of its range it meets three other closely-related species of *Ophiogomphus*. In that part of its range it is largely confined to forest steppes while the other three species mainly occur in taiga (*O. obscurus*), steppe (*O. spinicornis*) or desert (*O. reductus*) habitats (Borisov 2005, Kosterin & Zaika 2010). *Ophiogomphus obscurus* overlaps in range with *O. cecilia* over about 1600 km in central Siberia and replaces the latter further east. Chaplina *et al*. (2007) gave several locations for *O. cecilia* throughout Kazakhstan. Recent findings showed, however, that in Kazakhstan *O. cecilia* is restricted to the north of the country and is replaced by *O. reductus* in the east and the south (Borisov & Haritonov 2008, Borisov & Kosterin 2014). Records of larvae from the Iberian Peninsula and Asian Turkey are erroneous and originate from confusion with *Onychogomphus forcipatus*.

Europe: The species is widespread in central and north-eastern Europe, but is generally scarce in the west and rare to absent in the south. In the core of its European range, it has a semi-continuous distribution and occurs on both streams and larger rivers. In France and Italy, however, it is largely confined to the river systems of the Loire, Rhine and Po, respectively. It is absent from the Iberian Peninsula and the southern parts of Italy, and becomes progressively rarer to the south in the Balkan Peninsula, with the southernmost populations found in the north-east of Greece and European Turkey (Rödel 1991, Hacet & Aktaç 2008). In eastern Europe, the species is probably more widely distributed than currently known in Belarus, north-western Ukraine and large parts of European Russia

Trend and conservation status

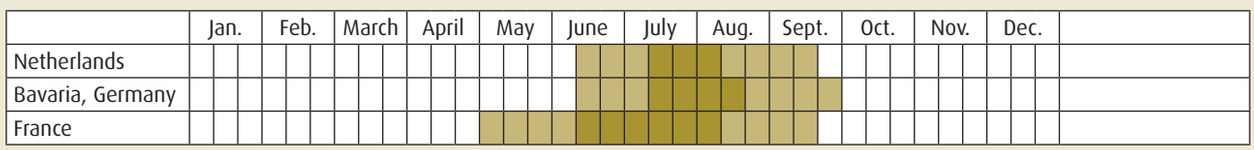
The species suffered a severe decline in parts of its range during the first three-quarters of the last century and became extinct in several countries. Most of the decline was probably due to water pollution and large-scale canalisation of streams and rivers. A recovery has taken place since the mid-1990s and the species has returned to several areas where it was previously extinct. This recovery probably resulted from improved water quality and better management of river systems. There are currently no significant threats to the species in the core of its range. In the south, it is threatened by the increasing use of water for irrigation (for example in the Po floodplain) and by the canalisation of watercourses, which causes strong fluctuations in water levels and seasonal desiccation. In some river systems, waves caused by large boats passing might lead to increased mortality of the species during emergence and to damage to the structure of the river banks.

Habitats Directive	II+IV
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Stable

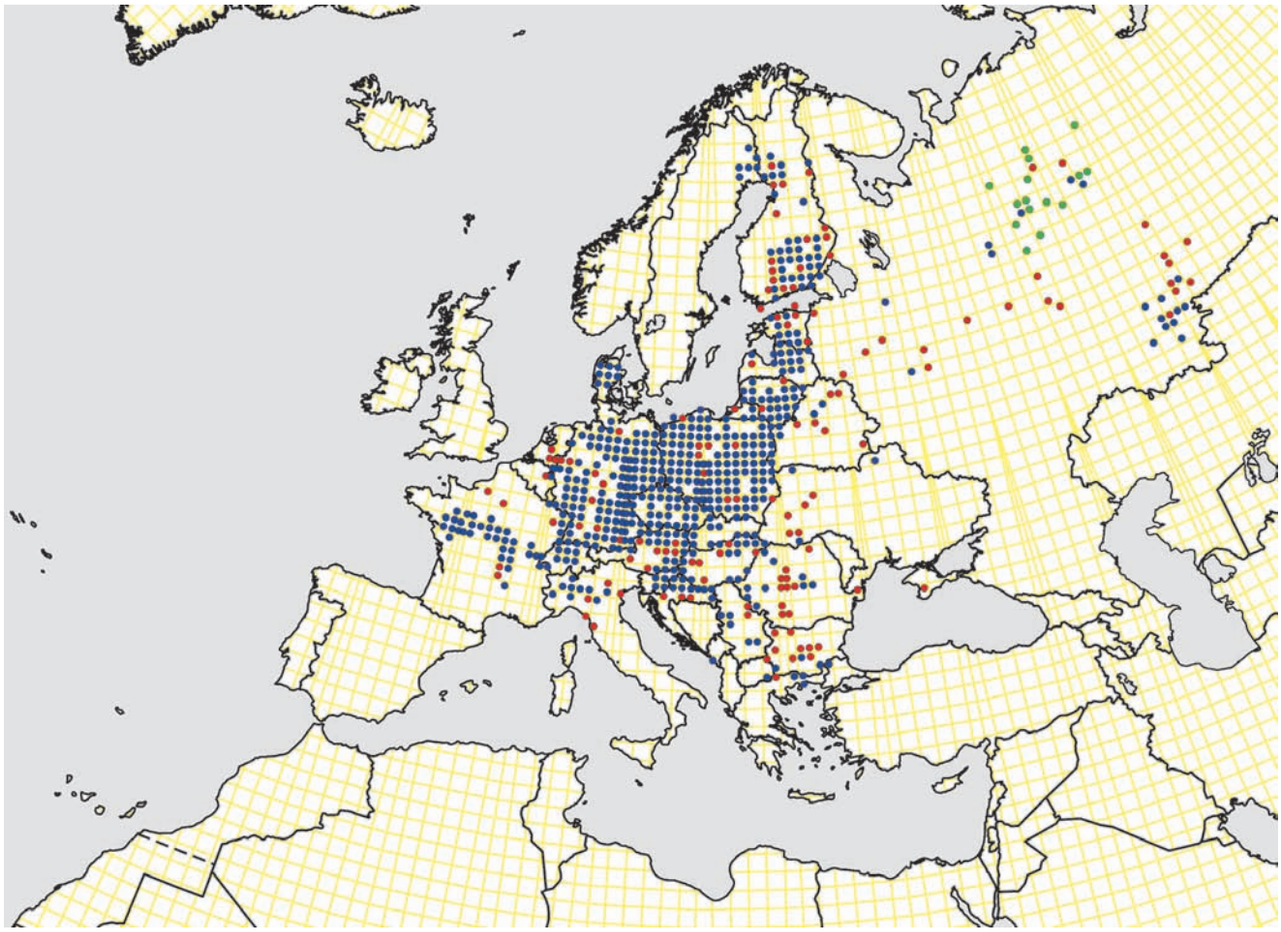
Habitat

Ophiogomphus cecilia is mainly found on rivers and large streams, less frequently on small streams and sporadically on canals. In most cases the water's edge is at least partly unshaded, although bushes and trees often grow in the vicinity. Most populations of *O. cecilia* are found on rivers and streams which have a largely natural geomorphology in which meanders, wild flow paths and an uncontrolled regime result in a mosaic of sand

Flight period



and gravel. Aquatic vegetation is largely absent due to swift water currents and the frequent changes in channels during spates. The species is absent when sand deposits are lacking, and is seldom found in fast-flowing stony mountain streams or in slow-flowing muddy or clayey rivers.



European distribution

World distribution

Paragomphus genei (Selys, 1841)

J.-P. Boudot & G. De Knijf

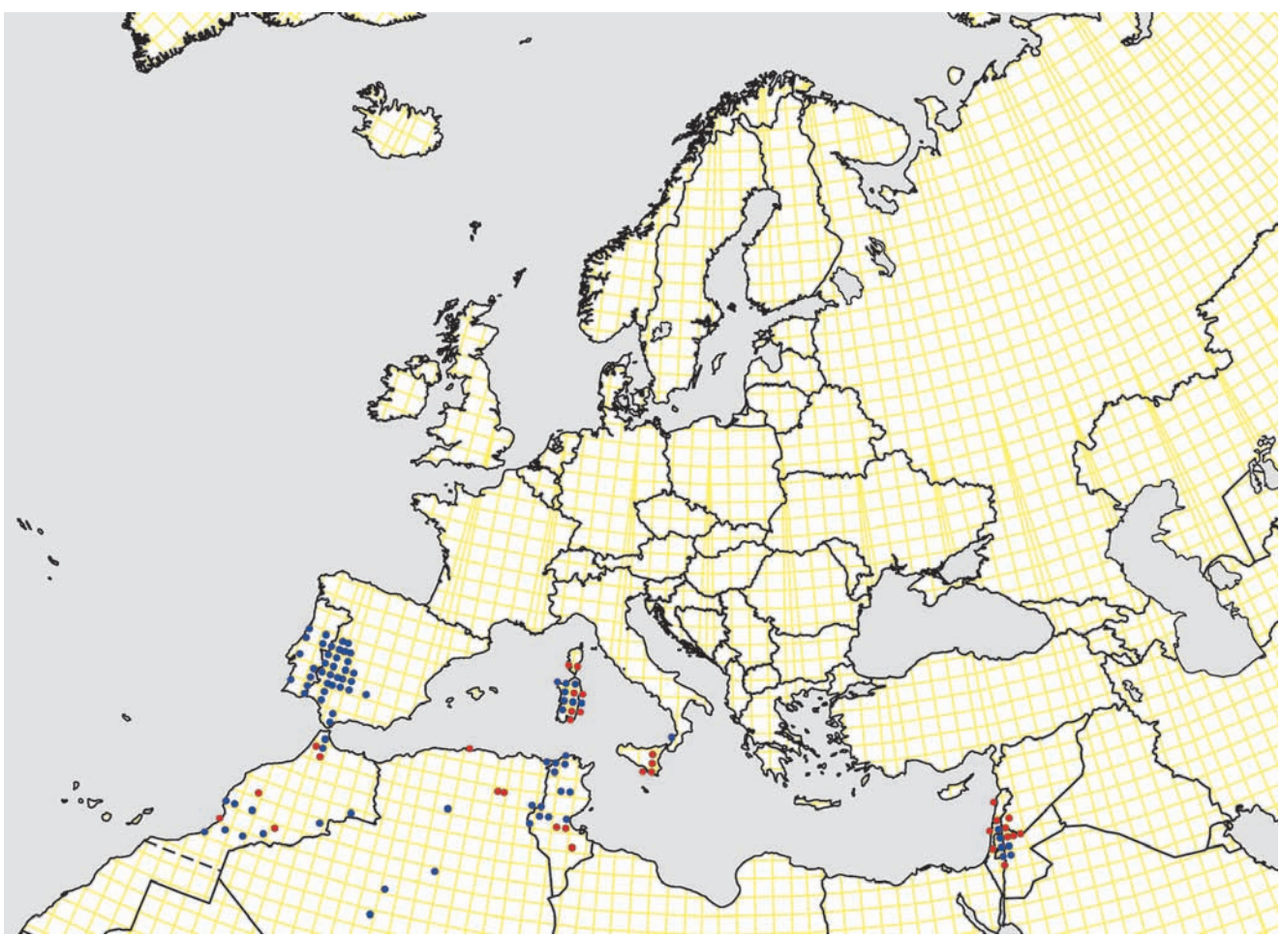
Distribution

World: *Paragomphus genei* is the most common species of Gomphidae in Africa, occurring commonly throughout a large part of the continent, although it is apparently lacking in closed rainforests and most of the Saharan desert. North of the Sahara, it is scattered across the Maghreb although uncommon in Morocco and Algeria. It has not been recorded from Libya and Egypt, and is replaced by *Paragomphus pumilio* in most of the Nile system. In the Arabian Peninsula it is confined to the south and the north-eastern tip, while in the Levant it was common until recently in the Jordan Valley. Recently published records from the north of Syria (Mousatat *et al.* 2010) were found to be the Oriental *P. lineatus* (J. van 't Bosch, pers. com.). North of Africa, *P. genei* reaches the south of Europe in the Iberian Peninsula and the large islands of the western Mediterranean.

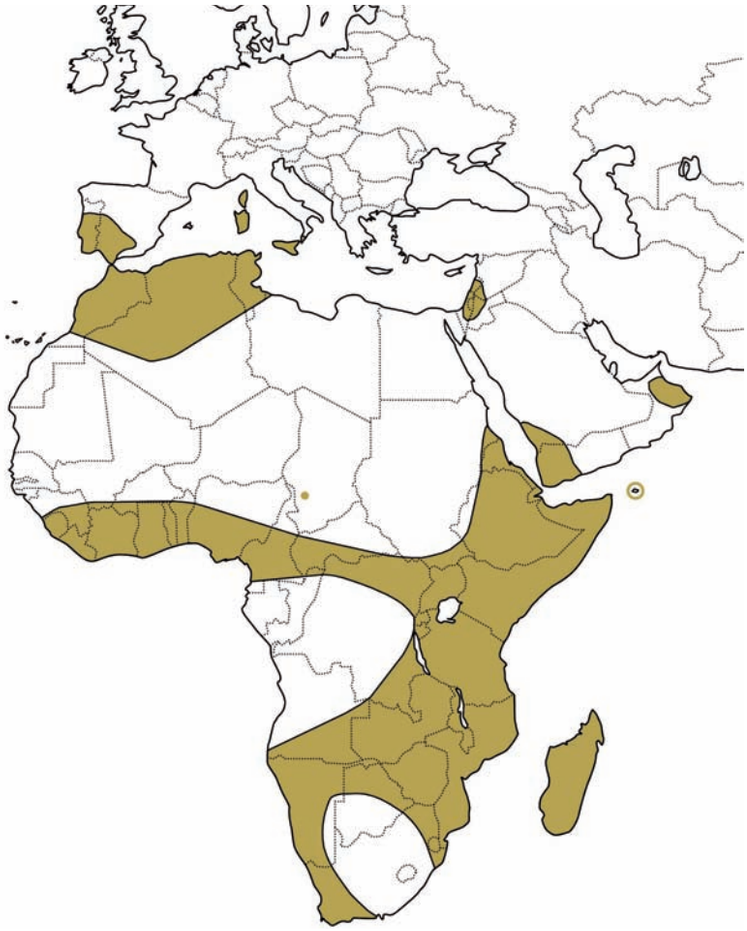
Europe: *Paragomphus genei* has a limited range in Europe and is known only from the south-west of the Iberian Peninsula, Sicily, Sardinia and Corsica. A single record, probably a vagrant, exists from Calabria in the very south of mainland Italy. It is presently rather common in Sardinia and the south-west of the Iberian Peninsula, but remains very rare in Corsica. The last Sicilian record dates from 1978.

Trend and conservation status

Although *P. genei* has been known from Sardinia and Portugal since the end of the 19th century (Costa 1882, Girard 1891), it was not recorded from Sicily or Spain until the early 1970s (Testard 1975, Bucciarelli 1977). Since the turn of the millennium, the species has



European distribution



World distribution

Flight period

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Europe													
Maghreb													

increased significantly in density and range, taking advantage both of new large reservoirs in Sardinia and small man-made ponds constructed for cattle in Iberia. Further range expansion linked to climatic warming is possible.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
Red List EU27 - endemic	No
Red List Europe - endemic	No
Trend Europe	Stable

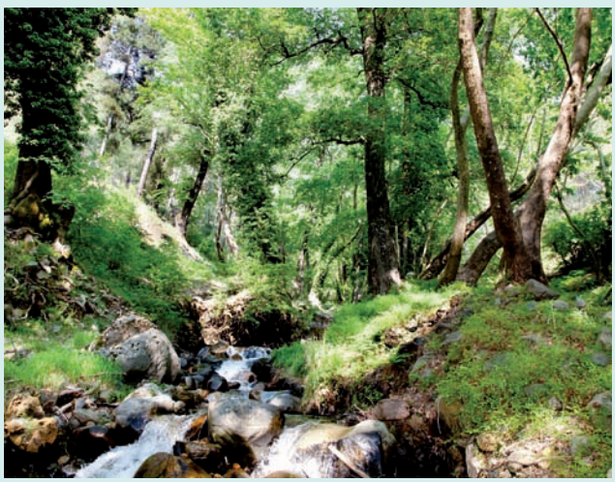
Habitat

This species inhabits a very wide range of habitats, and is found throughout its range in both standing and running waters. These include perennial streams and rivers, intermittent streams, backwaters of permanent rivers, cattle ponds, pools, large lakes and man-made reservoirs (Suhling & Martens 2007, Samways 2008, Sánches García *et al.* 2009, De Knijf & Demolder 2010). Standing waters where the species breeds often have bare shores of sand or gravel with sparse aquatic and fringing vegetation, but on rivers *P. genei* can also be found at places with well-vegetated banks. In Europe, this species is mainly restricted to lowlands and is not found above 500 m.

Cordulegastridae

1 Cordulegaster trinacria. Habitat of *Cordulegaster trinacria*, 800 m north of Cropani, Torrente Peschiera, Bosco Magnano, Italy. Other species occurring here include *Anax imperator, Calopteryx virgo* and *Cordulegaster bidentata.* Photograph Christophe Brochard.

2 Cordulegaster heros. Habitat of *Cordulegaster heros*, Konavočica River, Konavle, Croatia. Other species occurring here include *Calopteryx virgo, Caliaeschna microstigma, Onychogomphus forcipatus* and *Orthetrum coerulescens*. Photograph Geert De Knijf.



3 Cordulegaster insignis. Habitat of *Cordulegaster insignis*, Yayla, Sandras mountain, Muğla province, Turkey. Other species occurring here include *Aeshna isoceles, Caliaeschna microstigma, Crocothemis erythraea* and *Epallage fatime*. Photograph Christophe Brochard.

4 Cordulegaster helladica. Habitat of *Cordulegaster helladica*, Pagkrataiika Kalyvia, Peloponnese, Greece. Other species occurring here include *Caliaeschna microstigma* and *Gomphus schneiderii*. Photograph Christophe Brochard.

Cordulegaster bidentata Selys, 1843

J.-P. Boudot & O. Holuša

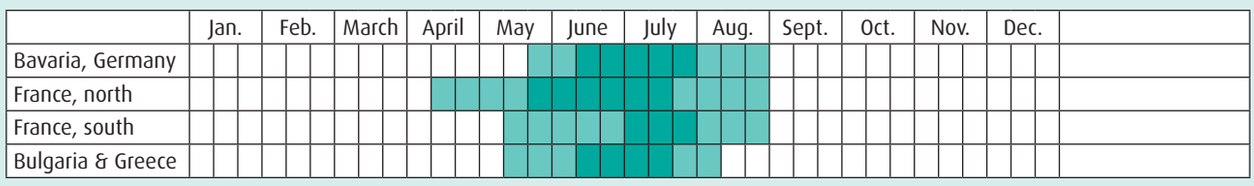
Taxonomy

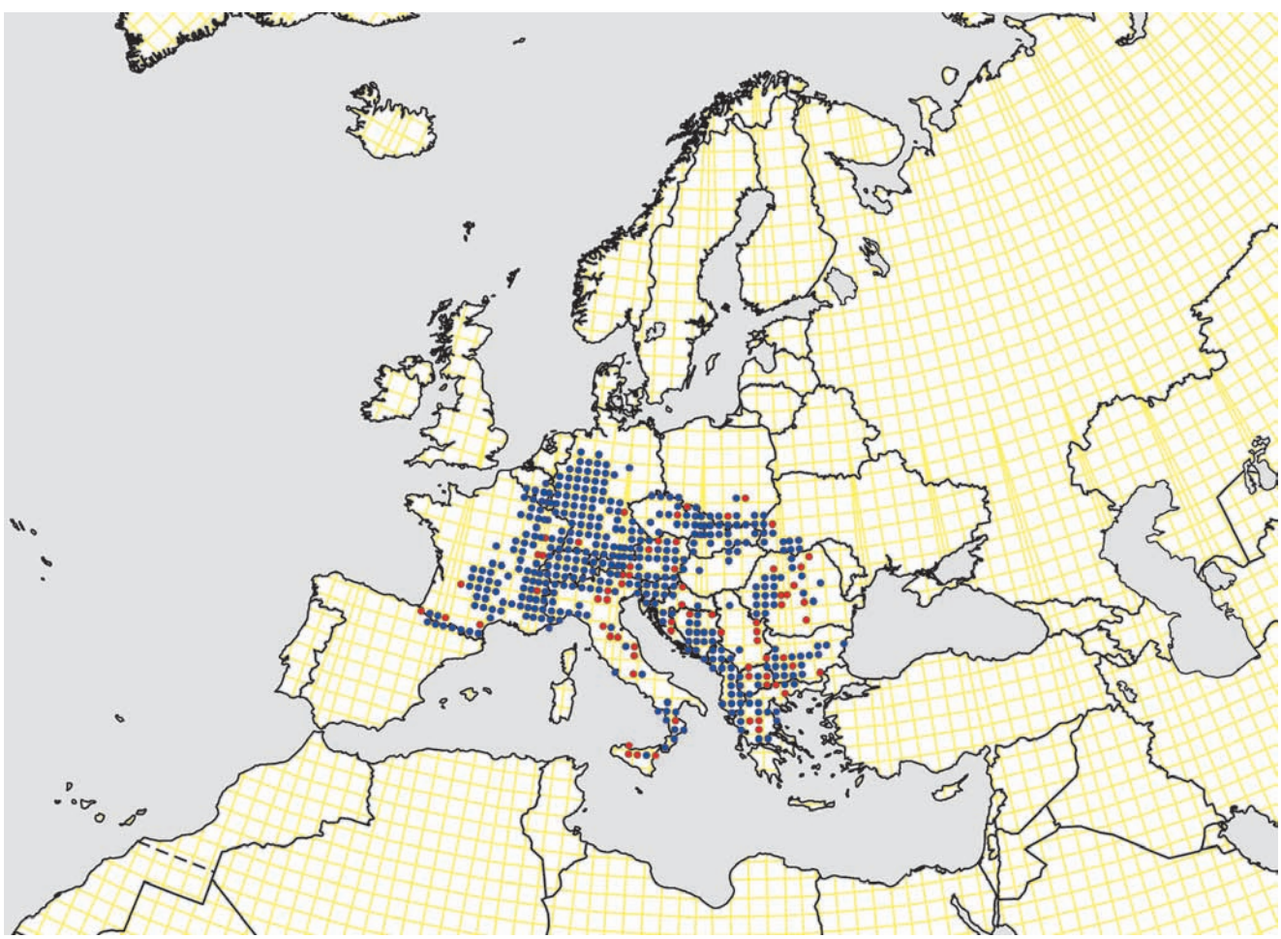
Cordulegaster bidentata shows variation in the extent of the yellow spots on the abdomen, with populations from the southern parts of the Balkan Peninsula, Sicily and Calabria having more extensive yellow marking than those from central and western Europe. Two subspecies have been described - the widespread *Cordulegaster b. bidentata* and subspecies *C. b. sicilica* Fraser 1929 with a smaller range in Calabria (Southern Italy) and Sicily. A molecular study by Froufe *et al.* (2014) found no evidence to support the validity of these subspecies.

Distribution

World: *Cordulegaster bidentata* is a European endemic. It is replaced by two other members of the *bidentata*

Flight period





World distribution

group, *C. helladica* and *C. insignis*, in south-eastern Europe (i.e. the Balkan Peninsula) and south-western Asia.

Europe: *Cordulegaster bidentata* is the most wide-ranging endemic dragonfly of Europe, occurring in large parts of west, south, south-east and central Europe. The easternmost records are found in the Carpathians in the west of Ukraine and in the east of Romania and Bulgaria. Its specialised habitat means that it is much more localised than *Cordulegaster boltonii,* and in large areas of central and western Europe only scattered populations occur, although closely aggregated sites are found in tufa regions. Population densities vary strongly between regions and sites, but are generally low. The highest densities occur mainly in the western Carpathians and the Balkan Peninsula, as well as in some tufa regions in France. The habitat is sometimes difficult to recognise or to access, particularly in mountainous regions, and, as the species often occurs in low numbers, populations are easily overlooked and in the past the species was erroneously thought to have become extinct in countries such as Switzerland.

Trend and conservation status

Cordulegaster bidentata is relatively safe in large parts of Europe, as most populations are found in the mountains, nature reserves and deciduous and mixed forest areas where there is relatively little human impact. The major threats to the species are from water extraction for irrigation and from increased frequency of droughts, particularly in the south of its range. In western and central Europe, several populations have disappeared due to the replacement of broadleaf and mixed forests with conifer plantations. In the south of France and Greece, former flourishing populations have become extinct as a result of desiccation due to the recent hot and dry summers, or as a result of the extraction of water for irrigation at springs.

Habitats Directive	No
Red List EU27	Near Threatened
Red List Europe	Near Threatened
Red List Mediterranean	Near Threatened
EU27 endemic	No
European endemic	Yes
Trend Europe	Decreasing

Habitat

Cordulegaster bidentata has a strong affinity with open woodlands of temperate or Mediterranean mixed and deciduous forests in hilly and mountainous areas. It occurs up to 1 400 m in the Alps and the Pyrenees. The larvae are mostly limited to seepage and spring waters, runnels and the upper courses of streams, although older larvae sometimes drift to the lower parts of the stream. They do not cope well with strong currents (Leipelt 2005). Adults breed mainly in short, often remote stretches of headwater areas, with the most suitable habitats being sandy or muddy springs, tufa springs and small calcareous streams. Populations can even be regularly found in places where water is trickling from a rocky slope with almost no visible open water. Suitable waters are often calcareous, but this could be a correlate with the preferred habitat type, which is more common in calcareous areas. The species is regionally absent in areas where acidic streams result from acid rain (Sternberg & Buchwald 2000), but in other areas can still be recorded in streams with a pH below 4.

Cordulegaster boltonii (Donovan, 1807)

J.-P. Boudot & O. Holuša

Taxonomy

Four subspecies have been described: the widespread *Cordulegaster b. boltonii* and three subspecies with a smaller range: *C. b. immaculifrons* Selys, 1850, *C. b. iberica* Boudot & Jacquemin, 1994 and *C. b. algirica* Morton, 1916. A molecular study by Froufe *et al.* (2014) could not find evidence supporting *C. b. iberica* and *C. b. immaculifrons* as genetically distinct groups, so these are better regarded as phenotypic varieties rather than subspecies. In contrast, the populations of *C. b. algirica* from the Maghreb do not share haplotypes with the European populations of *C. boltonii* (including the so-called *C. b. algirica* from southern Spain). The European populations show some genetic variation, with the Italian populations from Liguria and the Apennines forming a separate clade. These populations differ from other European populations in their occipital triangle, which is black, or black with a pair of minute yellow dots, instead of yellow (Boudot 2001).

Distribution

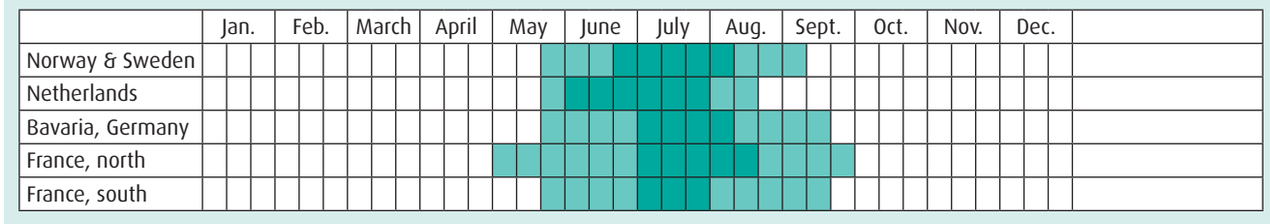
World: *Cordulegaster boltonii* is a west Palearctic endemic, with the only populations outside Europe occurring in the north of Morocco and Algeria.

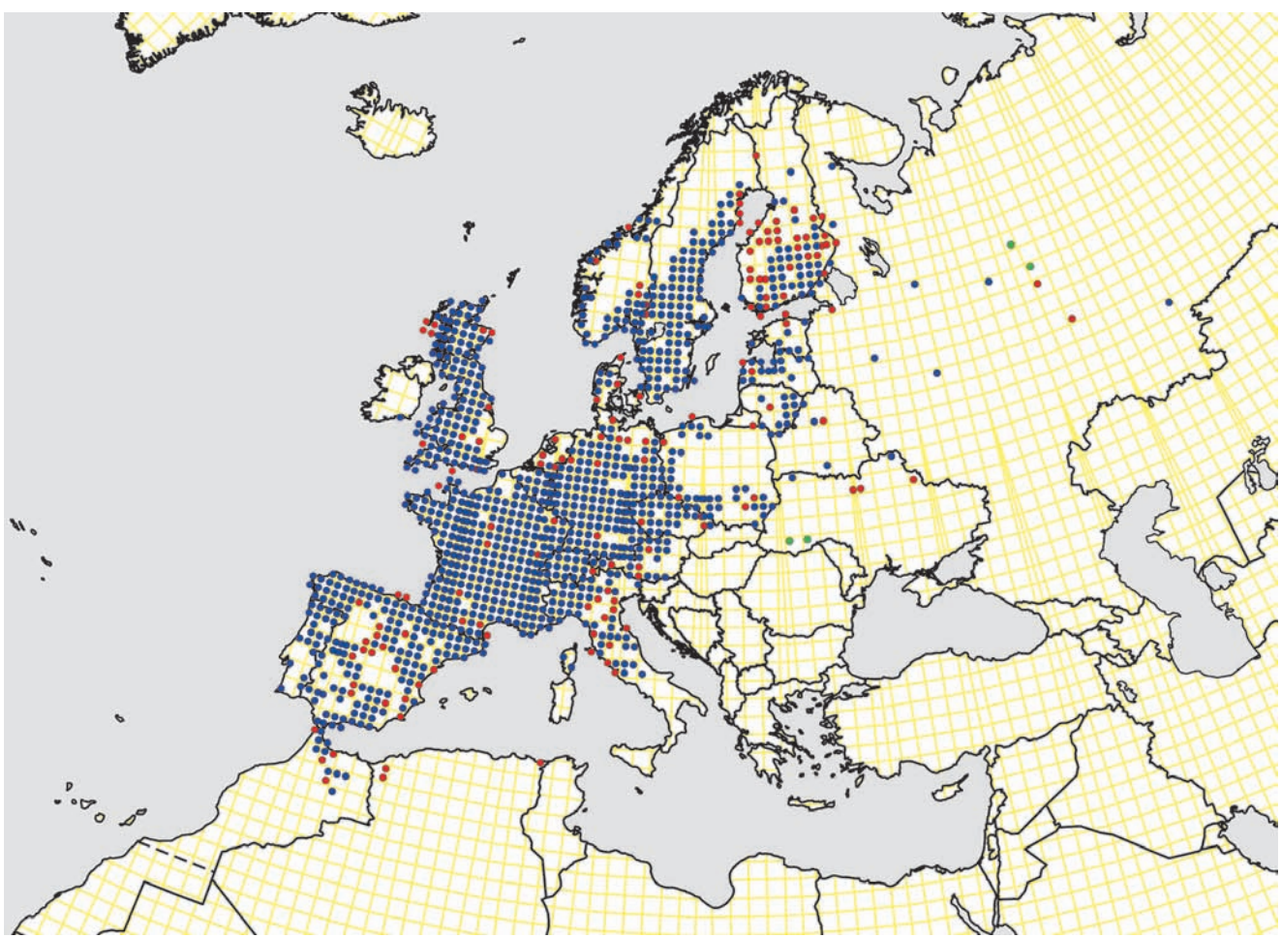
Europe: The core of the range of *C. boltonii* extends from western Europe to western and southern Poland, the southern part of Fennoscandia and the Baltic States. The closely related *C. heros* was only described in 1979, and some former records published as *C. boltonii* from central Europe and all from the Balkan Peninsula in fact belong to *C. heros*. It is not unlikely that the old Carpathian record of *C. boltonii* from the Ukraine (Brauner 1910) pertains to *C. heros*. To the east, it is scattered and apparently rare from the Ukraine and Belarus across European Russia to the southern Urals (Haritonov & Eremina 2010). To the west, it was recently recorded three times from Ireland, with all records dating from 2005 onwards and from a relatively small area, suggesting that the species has recently established a small population in the country (Nelson 2011). None of the old Irish records could be validated (Nelson & Thompson 2004). The species breeds from the lowlands up to 1 600 m, but vagrants and foraging individuals have been observed up to 2 000 m in the Alps and the Pyrenees.

Trend and conservation status

Cordulegaster boltonii is widespread and fairly common in hilly and mountainous regions throughout most of western, central and northern Europe, with no indication of an overall decline. It remains rare in lowlands where swift waters are lacking. Locally, the species has declined as a result of pollution and canalisation of watercourses. The Mediterranean populations increasingly suffer from stream desiccation due to low winter

Flight period





World distribution

rainfall and increased periods of drought, and several populations have been lost during the last two decades.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

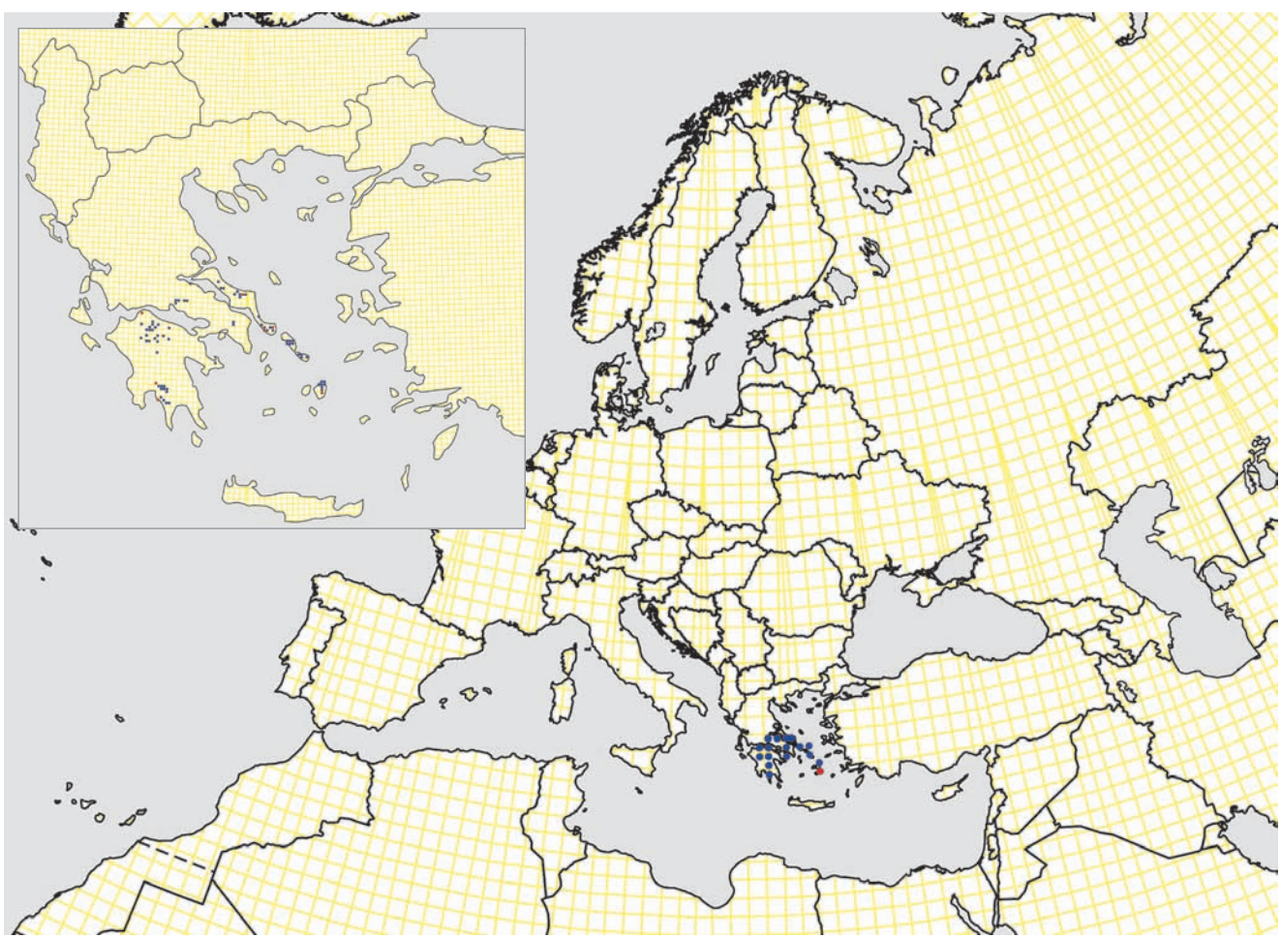
Cordulegaster boltonii favours woodlands, but also occurs along streams in open moorland and heath. The species is found in swift clear running waters including mountain torrents, runnels at headwaters, sandy or sand-gravel streams, streams and small rivers. In small headwater streams and runnels it sometimes co-occurs with *C. bidentata*. In contrast with the latter, the larvae are able to cope with strong currents fairly well (Leipelt 2005), enabling this species to colonises both upper and lower sections of rivers.

Cordulegaster helladica (Lohmann, 1993)

J.-P. Boudot & O. Holuša

Taxonomy

Three subspecies of this Greek endemic are currently recognised: *Cordulegaster h. helladica* (Peloponnese to the Euboea Island), *C. h. buchholzi* (Cyclades Islands) and *C. h. kastalia*, known from only two localities in central Greece. A molecular study by Froufe *et al.* (2014) showed that the subspecies *C. h. helladica* and *C. h. buchholzi* are clearly distinct. The study did not include *C. h. kastalia* as no DNA material was available.



World distribution. The inset shows the distribution in the southern Balkan Peninsula based on a 5 by 5 km grid.

Distribution

World: *Cordulegaster helladica* is endemic to Greece.

Europe: The nominotypical subspecies is by far the most widespread of the three, with its range including the Peloponnese, Euboea island and Attica in the south-east of mainland Greece. *Cordulegaster h. buchholzi* is restricted to the Cyclades Islands of Andros, Tinos and Naxos. *Cordulegaster h. kastalia* is known from the Kastalian spring, a karstic outflow at the Delphi archaeological site, and from another remote locality on the eastern coast of mainland Greece (Van Pelt 2009).

Trend and conservation status

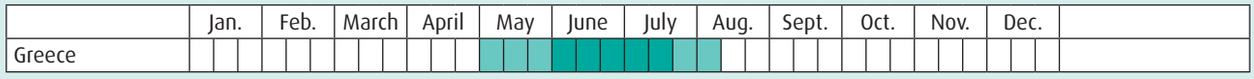
The species is classified as Endangered on the European Red List due to its small range and specialised habitat. The survival of many populations is threatened by climate change and the strong decrease of winter rainfall in Greece. Some populations have been reduced in numbers or have become extinct due to drying out of springs and streams as a result of forest fires and deforestation, rainfall deficit and extraction of water for irrigation and domestic use directly from the springs. *Cordulegaster h. kastalia* is only known from two localities and is classified as Critically Endangered (CR).

Habitats Directive	No
Red List EU27	Endangered to Critically Endangered depending on subspecies
Red List Europe	Endangered to Critically Endangered depending on subspecies
Red List Mediterranean	Endangered
EU27 endemic	Endemic
European endemic	Endemic
Trend Europe	Decreasing

Habitat

Cordulegaster helladica is known from hilly and mountainous forests or open woodlands with Mediterranean scrub, and occurs up to 1 400 m. It inhabits the upper reaches of rocky and boulder streams. As usual in Mediterranean streams, these habitats often show strong fluctuations in flow rates (Holuša 2013).

Flight period



Cordulegaster heros Theischinger, 1979

J.-P. Boudot & O. Holuša

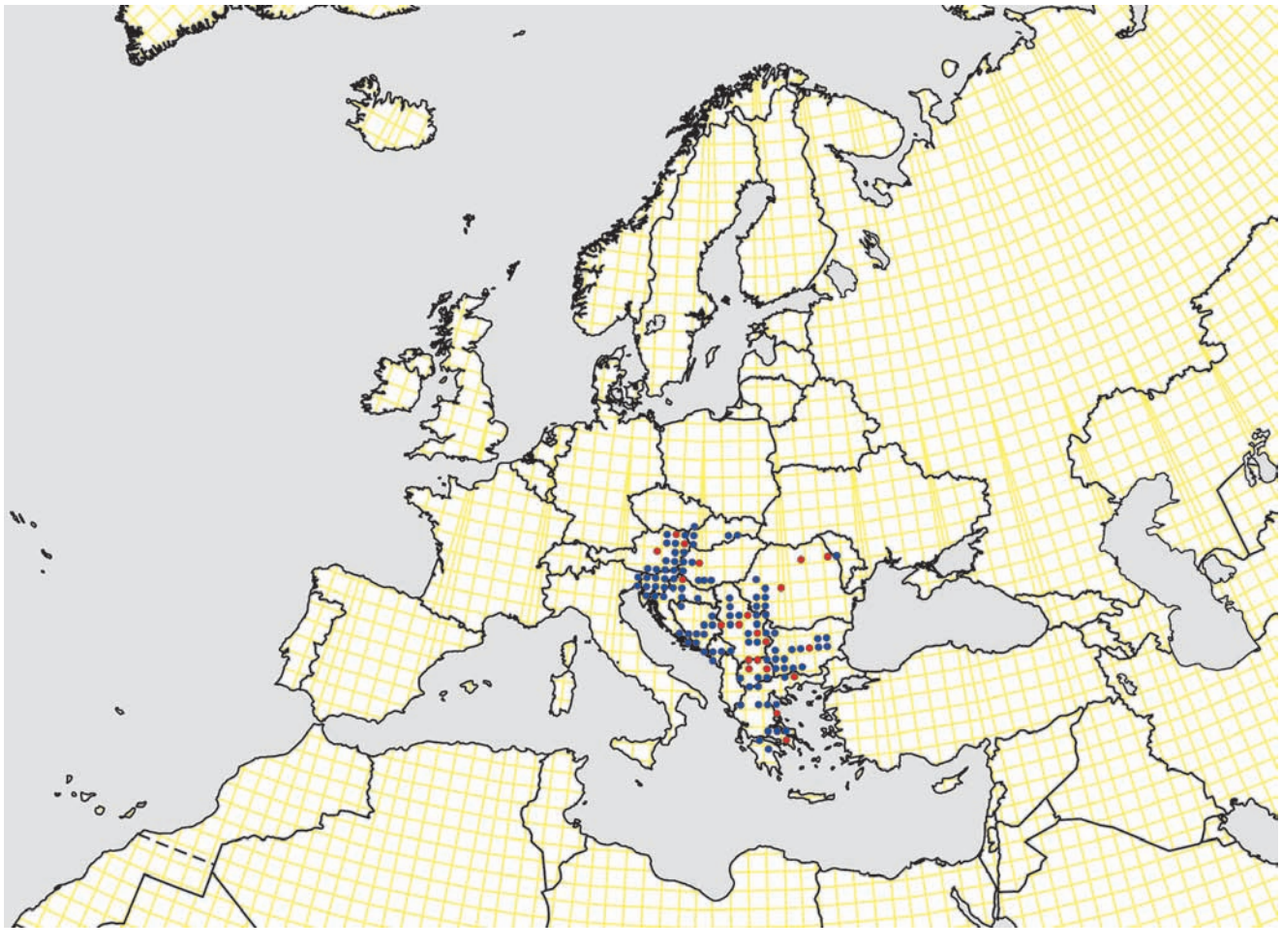
Taxonomy

The two described subspecies, *Cordulegaster h. heros* and *C. h. pelionensis* Theischinger, 1979, differ only in the size and shape of the black bar on the frons in males. Their validity has not yet been tested by molecular analysis.

Distribution

World: *Cordulegaster heros* is endemic to central and south-eastern Europe.

Europe: The species was only recognised in 1979 and some of the records published as *C. boltonii* from central Europe, and all from the Balkan Peninsula, in fact belong to this species. Most knowledge on the distribution of *C. heros* has become available only in the past 15 years, and the limits of its distribution in the north and east of its range are still poorly known. *Cordulegaster heros* extends from central to south-eastern Europe over nearly the whole Balkan Peninsula. Its northern limit is found from the south-easternmost part of the Czech Republic to southern Slovakia (Blašković *et al.* 2003, Janský & David 2008, Holuša & Kúdela 2010, Staufer & Holuša 2010, Holuša *et al.* 2011, Holuša 2013) and northern Romania (Cirdei & Bulimar 1965 (as *C. annulatus*), Manci 2012). To the south, the species reaches the north of the Peloponnese in Greece, and to the west the north-east of Italy close to the Slovene border (Bedjanič & Šalamun 2003, Uboni *et al.* 2007). To the east it is widely distributed in Bulgaria but is replaced by *C. picta* in the south-east of this country, the north-east of Greece and the European part of Turkey (Boudot *et al.* 2009). *Cordulegaster heros* is regionally common in the east of Austria, Slovenia,



World distribution

Flight period

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Bulgaria & Greece													

southern Slovakia, Croatia, Bosnia and Herzegovina, Montenegro, Serbia, Macedonia, mainland Greece, Bulgaria and south-western Romania. Gaps in its range are probably caused by a lack of surveys rather than by the genuine absence of the species. The species has not been recorded from Ukraine but it seems possible that two old records of *C. boltonii* from the Carpathians in the west of the country (Brauner, 1910) in fact refer to *C. heros*.

Trend and conservation status

Cordulegaster heros is adversely affected by stream management including the destruction of surrounding trees and increased water extraction for irrigation, as well as by drying out of streams and rivers due to winter rainfall deficit with longer drought periods. Additional threats are large-scale logging and the increased frequency of forest fires in the south of its range resulting in desiccation of springs. Nevertheless the species has not yet shown a clear decrease over large areas, and is therefore assessed only as Near Threatened on the European Red List.

Habitats Directive	II+IV
Red List EU27	Near Threatened
Red List Europe	Near Threatened
Red List Mediterranean	Vulnerable
EU27 endemic	No
European endemic	Endemic
Trend Europe	Stable

Habitat

Cordulegaster heros is found at shaded streams and small rivers with at least some sandy substrate in mountainous and hilly landscapes. It has been found breeding up to c. 1 500 m, but is, in contrast to *C. bidentata*, usually found in the lower parts of streams. Like all other species of the *boltonii*-group, it can, however, colonise both upper and lower sections of streams and small rivers. At small streams and springs as well as in hydrologically heterogeneous habitats, it may co-occur with *C. bidentata*. Co-occurrence with *C. boltonii* is known from Austria, but seems rare.

Cordulegaster insignis Schneider, 1845

J.-P. Boudot, M. Marinov & Y. Kutsarov

Taxonomy

Cordulegaster insignis shows considerable variation in the size and shape of its yellow pattern throughout its range. This has led to the description of numerous subspecies that are often poorly defined and are in need of validation by molecular studies. The south Romanian *C. i. montandoni* is presently regarded as a synonym of the nominotypical subspecies. Molecular analyses shows that *C. coronata* Morton, 1916, a Central Asian endemic (Schröter 2010b) regarded as a subspecies of *C. insignis* by Fraser (1929), is the sister taxon of the *bidentata-helladica-insignis* group and should be ranked at the full species level (S. Ferreira, pers. com.).

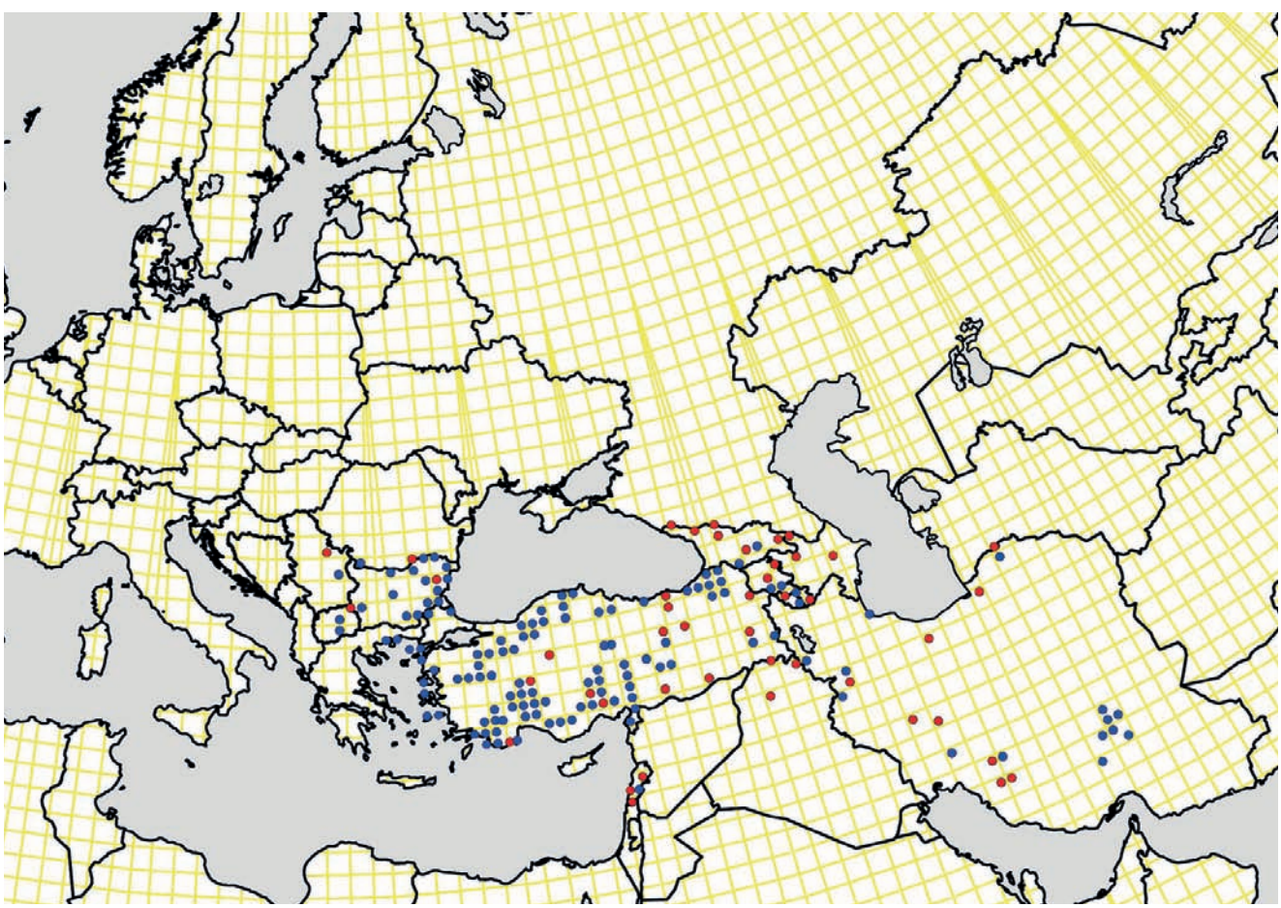
Distribution

World: *Cordulegaster insignis* extends from the Balkan Peninsula to Lebanon and Iran and is the most common species of *Cordulegaster* in Turkey. It does not cross the Caucasus to the north and is replaced by *C. coronata* in Central Asia.

Europe: *Cordulegaster insignis* has a small European distribution, being found in Bulgaria, southern Romania, Macedonia, Serbia and the European part of Turkey (Boudot *et al*. 2009, Lopau 2010b, Holuša & Křivan 2012, Kulijer & Boudot 2013, Kulić *et al*. 2013). In addition, it occurs on a number of northern and eastern Aegean islands (Thasos, Samothraki, Göckçeada, Lesbos, Hios, Samos, Ikaria) (Boudot *et al*. 2009, Lopau 2010b). It is generally uncommon in the European part of its range.

Trend and conservation status

Cordulegaster insignis is uncommon in its relatively small European range. It is likely that the species is declining in the Aegean islands due to stream desicca-



World distribution

Flight period

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Bulgaria & Greece												
Turkey												

tion caused by forest fires, rainfall deficit and extraction of water for irrigation directly at springs. The species is classified as Endangered on the European Red List.

Habitats Directive	No
Red List EU27	Endangered
Red List Europe	Endangered
Red List Mediterranean	Near Threatened
EU27 endemic	No
European endemic	No
Trend Europe	Unknown

Habitat

Cordulegaster insignis is found at small shaded streams and trickles with rocky pools and sandy beds, ditches along roads, spring areas and seepage waters. The larvae are not able to cope with strong water currents and consequently are not found in the lower courses of rivers (Leipelt 2005). When present near large rivers such as the Danube, it breeds only in seepage areas and springs near the riverbanks (Marinov *et al*. 2007). As in several *Cordulegaster* species, the larvae seem to be able to resist short drought periods by burying themselves in moist sediment. The species occurs up to 2 100 m in south-west Asia but has not been found above 750 m in Europe.

Cordulegaster picta Selys, 1854

J.-P. Boudot, Y. Kutsarov & M. Marinov

Taxonomy

Cordulegaster picta shows striking regional variation in the extent of its abdominal yellow spots (Boudot 2014b), but in contrast to most other species of *Cordulegaster*, no subspecies have been described. Populations from the western Rhodope Mountains are dark and approach the colour pattern of *C. bidentata*. Populations from north-west Turkey resemble the colour pattern of *C. boltonii* and *C. trinacria*. Populations in the eastern Greek Aegean islands and parts of western Turkey have, in contrast, larger yellow spots approaching the pattern found in some populations of *C. insignis* and *C. helladica*. Specimens intermediate in pattern between that of populations from the western Rhodope and those from south Turkey are found in the eastern Rhodope and can easily be confused with *C. heros*. The correct identification of any *Cordulegaster*, and especially *C. picta*, is therefore dependent on the examination of the terminal appendages rather than colour pattern.

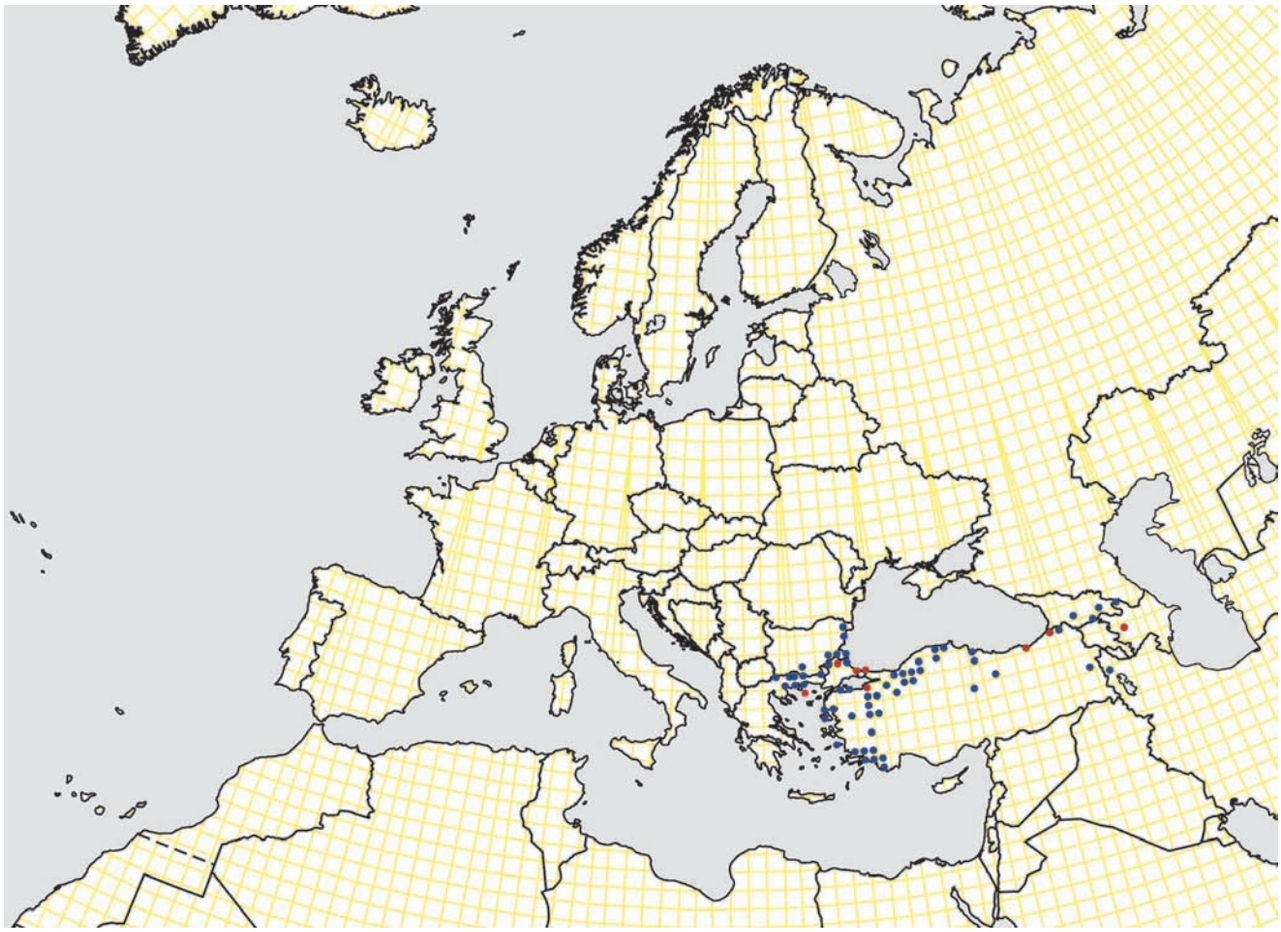
Distribution

World: *Cordulegaster picta* ranges from south-east Europe to the east of Georgia and the western part of Azerbaijan, though the core range is relatively small, being largely limited to eastern Greece, southern and eastern Bulgaria and the west and north-west of Turkey. It is reasonably common in the west and north-west of Turkey, but in eastern Turkey is rare and known only from scattered locations. Recent findings have shown the species is more common than previously thought in Transcaucasia (Schröter *et al*. 2015)

Europe: *Cordulegaster picta* is known from some Greek Aegean islands (Samos, Lesbos, Thasos), north-eastern Greece, European Turkey and southern and eastern

Flight period

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Bulgaria & Greece												
Turkey												



World distribution

Bulgaria (Boudot *et al.* 2009, Lopau 2010b). The correct identification of a record from Montenegro (Gligorović *et al.* 2008) is still subject to debate as local populations of *C. heros* show unusual colour details which were believed to be specific to *C. picta* (De Knijf *et al.* 2013). Old records from Macedonia and Serbia are not reliable, might refer to *C. heros* and cannot be validated as the collections where the vouchers were kept have been destroyed (M. Jović *in litt.*).

Trend and conservation status

In its relatively small European range, *C. picta* is likely to be adversely affected by increasing periods of drought, winter rainfall deficit, forest fires and increased water extraction for irrigation and domestic use. The species is classified as Vulnerable on the European Red List.

Habitats Directive	No
Red List EU27	Vulnerable
Red List Europe	Vulnerable
Red List Mediterranean	Vulnerable
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

The species breeds in running waters, ranging from tiny shaded trickles and streamlets to medium-sized semi-open rivers, in hilly and mountainous areas. It breeds from sea level up to 1 100 m in Europe but has been found up to 1 800 m in Turkey. At seepage areas and springs, as well as on the upper reaches of rivers, it sometimes co-occurs with *C. insignis*.

Cordulegaster trinacriae Waterston, 1976

J.-P. Boudot, E. Riservato & S. Hardersen

Taxonomy

The colour pattern of *Cordulegaster trinacriae* resembles that of *C. boltonii* and the two species were recognised as distinct only in 1976 based on differences in the shape of the male terminal appendages. Molecular studies confirmed that both taxa are distinct and deserve full species rank (Froufe *et al*. 2014).

Distribution

World: *Cordulegaster trinacriae* is a European endemic restricted to Sicily and the southern half of mainland Italy.

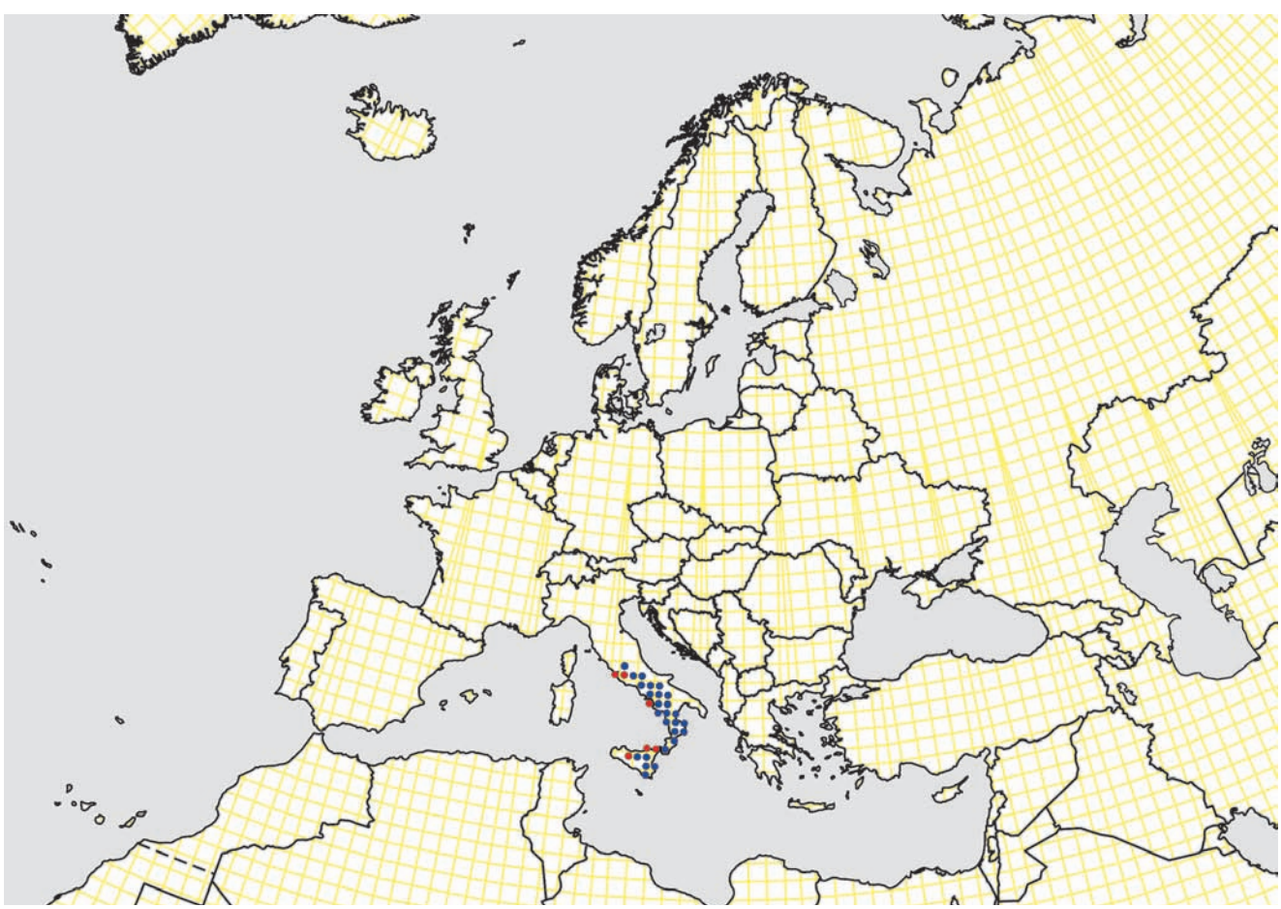
Europe: *Cordulegaster trinacriae* was described relatively recently and all records from southern Italy published as *C. boltonii* are nowadays considered to belong to *C. trinacriae*. *Cordulegaster trinacriae* is restricted to the Italian regions of Lazio, Molise, Campania, Calabria, Basilicata and Sicily. Its range meets, and seems to slightly overlap, that of *C. b. boltonii* in Lazio; the distribution of both species in this area is poorly studied. So far, around 70 localities have been reported for this species, which seems more common than previously thought. In mainland Italy, *C. trinacriae* is locally abundant although many populations are small and isolated. The species is rare in Sicily.

Trend and conservation status

Cordulegaster trinacriae is listed as Near Threatened on the European Red List as it has a relatively small range and has probably declined in the past due to

Flight period

Adults have been recorded from mid-May to mid-September.



World distribution

urbanisation and habitat alteration in mainland Italy and Sicily. The species is, however, well distributed and considered safe in the southern half of mainland Italy, with many flourishing populations known in nature reserves in forested hilly and mountainous areas. Even so, it has probably declined in some of these regions. Its range in Sicily is fragmented as forest cover is absent in many places due to deforestation in relatively recent times, and many watercourses have also been strongly altered (Gerecke 1991). Only a small number of populations are known and a survey is needed to assess the conservation status of the species on this island.

Habitats Directive	II+IV
Red List EU27	Near Threatened
Red List Europe	Near Threatened
Red List Mediterranean	Near Threatened
EU27 endemic	Endemic
European endemic	Endemic
Trend Europe	Decreasing

Habitat

Cordulegaster trinacriae is found at running waters ranging from mountain streams to rivers, and favours woodland areas up to around 1 600 m.

1 Oxygastra curtisii. Habitat of *Oxygastra curtisii*, Meuse River, Pagny-la-Blanche-Côte, Lorraine lowland, France. Other species occurring here include *Erythromma lindenii, Gomphus vulgatissimus, G. pulchellus* and *Onychogomphus forcipatus*. Photograph Jean-Pierre Boudot.

2 Oxygastra curtisii. Habitat of *Oxygastra curtisii*, Río Verde, Málaga province, Spain. Other species occurring here include *Macromia splendens*. Photograph Matías de las Heras Carmona.

Oxygastra curtisii (Dale, 1834)

J.-P. Boudot, E. Riservato & S. Hardersen

Taxonomy

Ware *et al.* (2007) showed that *Oxygastra curtisii* does not belong in the family Corduliidae. It constitutes probably the phylogenetically most isolated species in Europe and is probably its oldest relict. It is not clear in which family is should be placed and is therefore considered *incertae sedis* (Latin for "of uncertain seat, i.e. taxonomic position").

Distribution

World: *Oxygastra curtisii* is, except for three isolated populations in Morocco, confined to south-west Europe. The three Moroccan populations are all small and one has probably become extinct due to pollution and urban development.

Europe: *Oxygastra curtisii* is confined to south-west Europe with the highest density of populations being found in the south-western and Mediterranean parts of France, northern Portugal and western Spain. France harbours over 80 % of the currently known European populations. In central and eastern Spain the species has a scattered distribution, generally being found in low densities. It is not uncommon in north-west Italy and adjacent regions of Switzerland. Other Italian populations are mostly found in the western part of the country, a distribution mimicking that of *Onychogomphus uncatus*. The species occurs locally in the north and north-east of France and only one population remains in Belgium (Ourthe River). In Germany it was found from 1940 to 1943 along the Sieg River in North Rhine-Westphalia, and a vigorous population has been known since 1997 along the Our River, which forms the border between Germany and Luxembourg (Lohr *et al.* 2004). *Oxygastra curtisii* is extinct in Great Britain (last record in 1957) and the Netherlands (1982).

Trend and conservation status

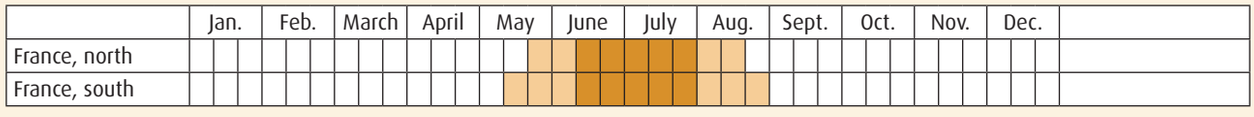
Oxygastra curtisii is nearly endemic to Europe, where more than 99 % of its populations occur. The species is fairly common in large parts of its range and overall populations seem to be stable. Its habitats are however under threat and both reduction in water quality and structural alteration of streams may result in local extinctions, with populations in parts of the Iberian Peninsula and Italy seemingly particularly at risk.

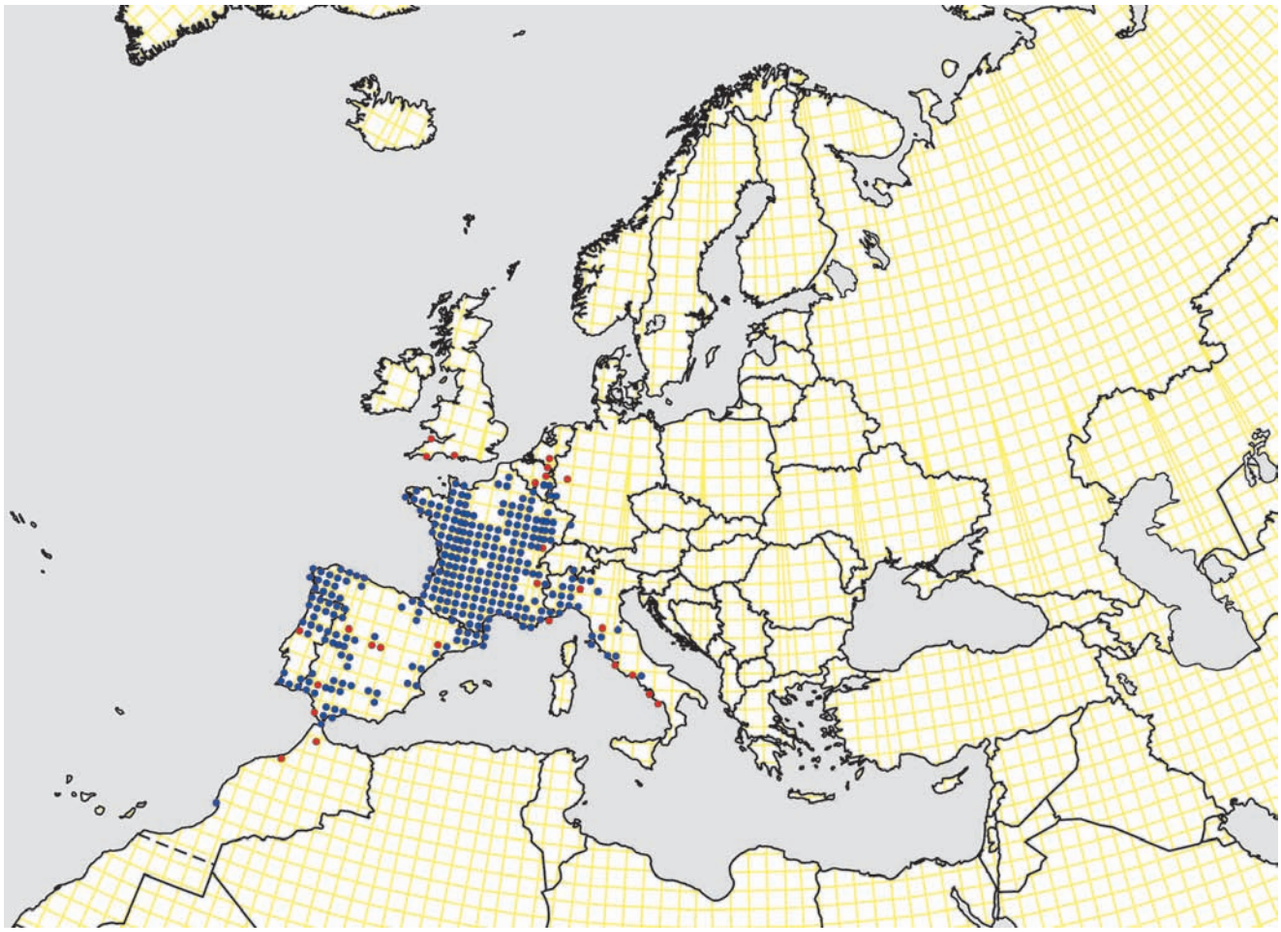
Habitats Directive	II+IV
Red List EU27	Near Threatened
Red List Europe	Near Threatened
Red List Mediterranean	Least Concern
Red List EU27 - endemic	No
Red List Europe - endemic	No
Trend Europe	Stable

Habitat

Oxygastra curtisii breeds mainly in slow-flowing, medium to large streams bordered by trees, and more rarely in standing waters such as large alpine lakes, ponds and abandoned gravel pits. The species favours situations where the water is surrounded by trees situated directly at the waters' edge, where larvae can remain within the extensive submerged root systems. *Oxygastra curtisii* favours lowlands and hilly regions below 800 m, although it is occasionally found up to 1 000 m in Spain (Weihrauch & Weihrauch 2006).

Flight period





World distribution

***Macromia splendens*, Arroyo San Carlos del Tiradero, Los Barrios, Andalusia, Spain.**
Photograph Fons Peels.

1 Macromia splendens. Habitat of *Macromia splendens*, river Tera at Ribadelago, Zamora, Spain. Species occurring here include *Calopteryx xanthostoma, Ceriagrion tenellum, Erythromma lindenii, Gomphus graslinii, Orthetrum coerulescens, Oxygastra curtisii, Platycnemis acutipennis* and *P. latipes*. Photograph Adolfo Cordero.

2 Macromia splendens. Habitat of *Macromia splendens*, reservoir of Abarellos at Avión, Ourense, Spain. Only *Orthetrum cancellatum* breeds regularly at the same locality. Photograph Adolfo Cordero.

Macromia amphigena Selys, 1871

J.-P. Boudot

Taxonomy

The nominotypical subspecies is restricted to Japan, whereas the populations from mainland Asia and the adjacent part of Europe belong to the subspecies *Macromia amphigena fraenata* Martin, 1906. *Macromia sibirica* Djakonov, 1926 and *Macromia bartenevi* Belyshev, 1973 are synonyms of *M. a. fraenata*.

Distribution

World: *Macromia amphigena* is found in four regions: (1) the southern Urals, (2) the Altai Mountains and surroundings, (3) the Russian Far East with the adjacent parts of China and North Korea, and (4) Japan. The nominotypical subspecies is present in Japan, while in the three other regions the subspecies *M. a. fraenata* is found.

Europe: A single European record from the Bashkortostan Republic in the south-west of the European side of the Urals reported by Boev *et al.* (1989) was regarded as doubtful and omitted by Kosterin (2005). However, more recently, a larva was collected on the Asian side of the southern Urals supporting the reliability of the nearby European record (Haritonov & Eremina 2010, Borisov & Kosterin 2014).

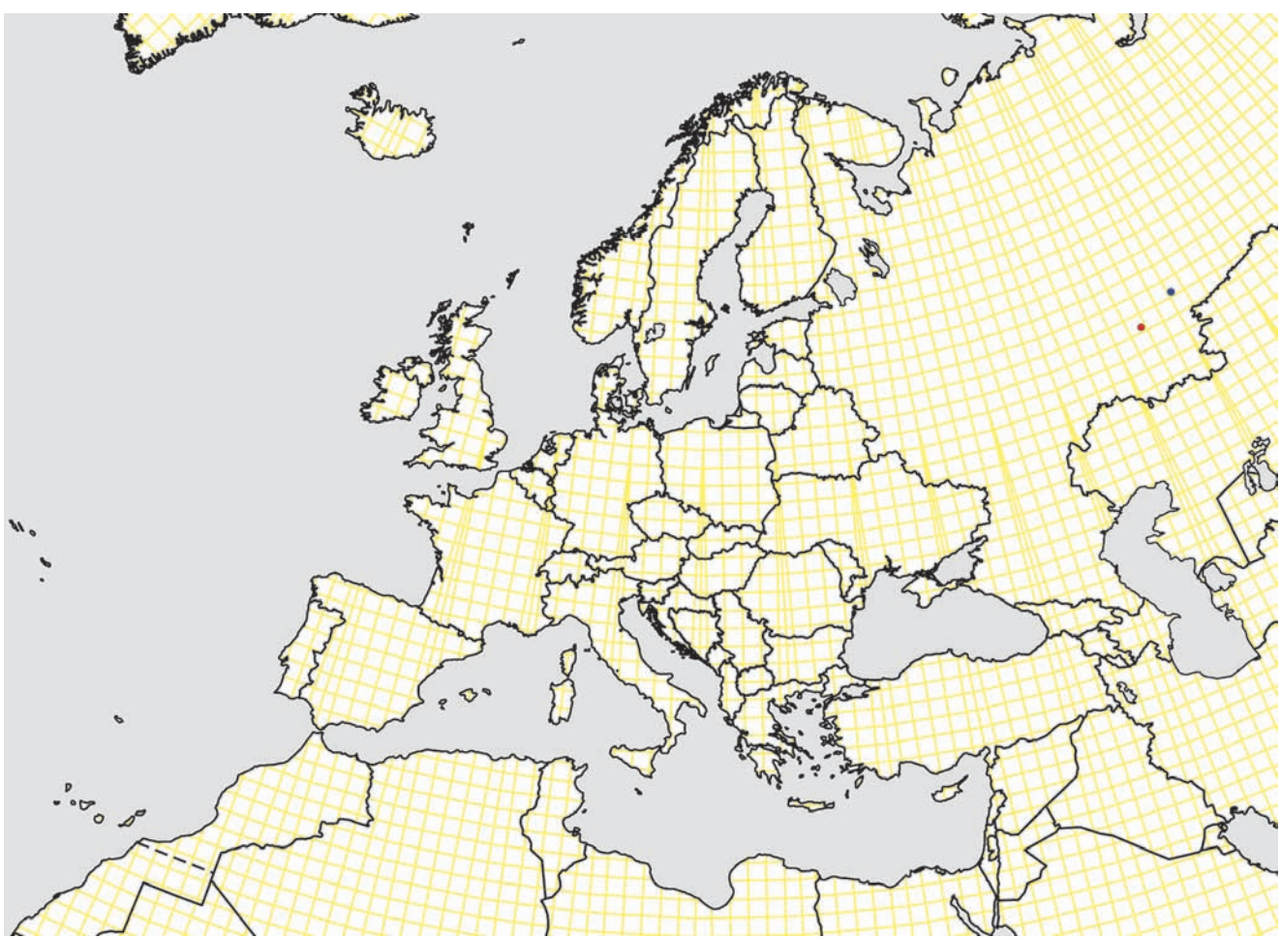
Trend and conservation status

Despite an increase in fieldwork in the southern Urals over recent years, only two records are available. Kosterin *et al.* (2001) reported that at sites further east in Russia, the species is relatively easy to observe. The scarcity of records in the southern Urals therefore suggests that the species is genuinely rare in this area. Currently no statement can be made on the size of the European population or its trend. *Macromia amphigena* was not considered for the European Red List and in any case would have been classed as Data Deficient.

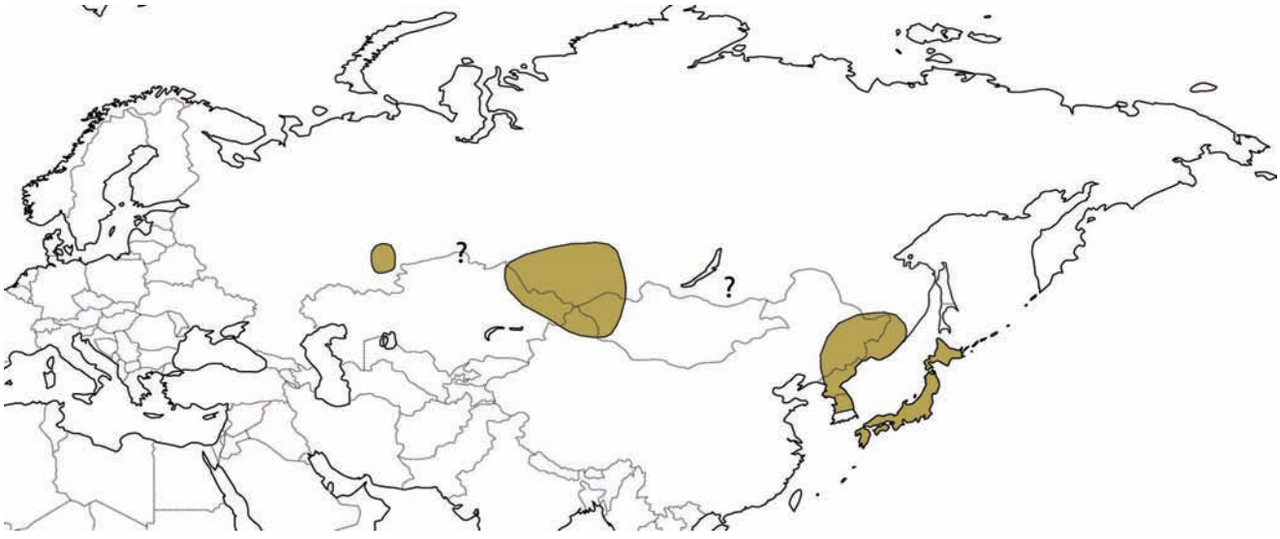
Habitats Directive	No
Red List EU27	Not present
Red List Europe	Not Evaluated
Red List Mediterranean	Not present
EU27 endemic	No
European endemic	No
Trend Europe	Unknown

Habitat

This species is found in rivers throughout its range. One record is from a stream-fed lake on the eastern side of southern Urals.



European distribution



World distribution

Flight period

The flight season in Japan, where the nominotypical subspecies occurs, is given as April to the end of September, with most records being from May to early September. In Siberia, the flight period of the species seems more restricted, with emergences being observed in early and mid-June, and the last adults seen in mid-August.

Macromia splendens (Pictet, 1843)

J.-P. Boudot & J.-L. Dommanget

Distribution

World: *Macromia splendens* is endemic to the south-west of Europe.

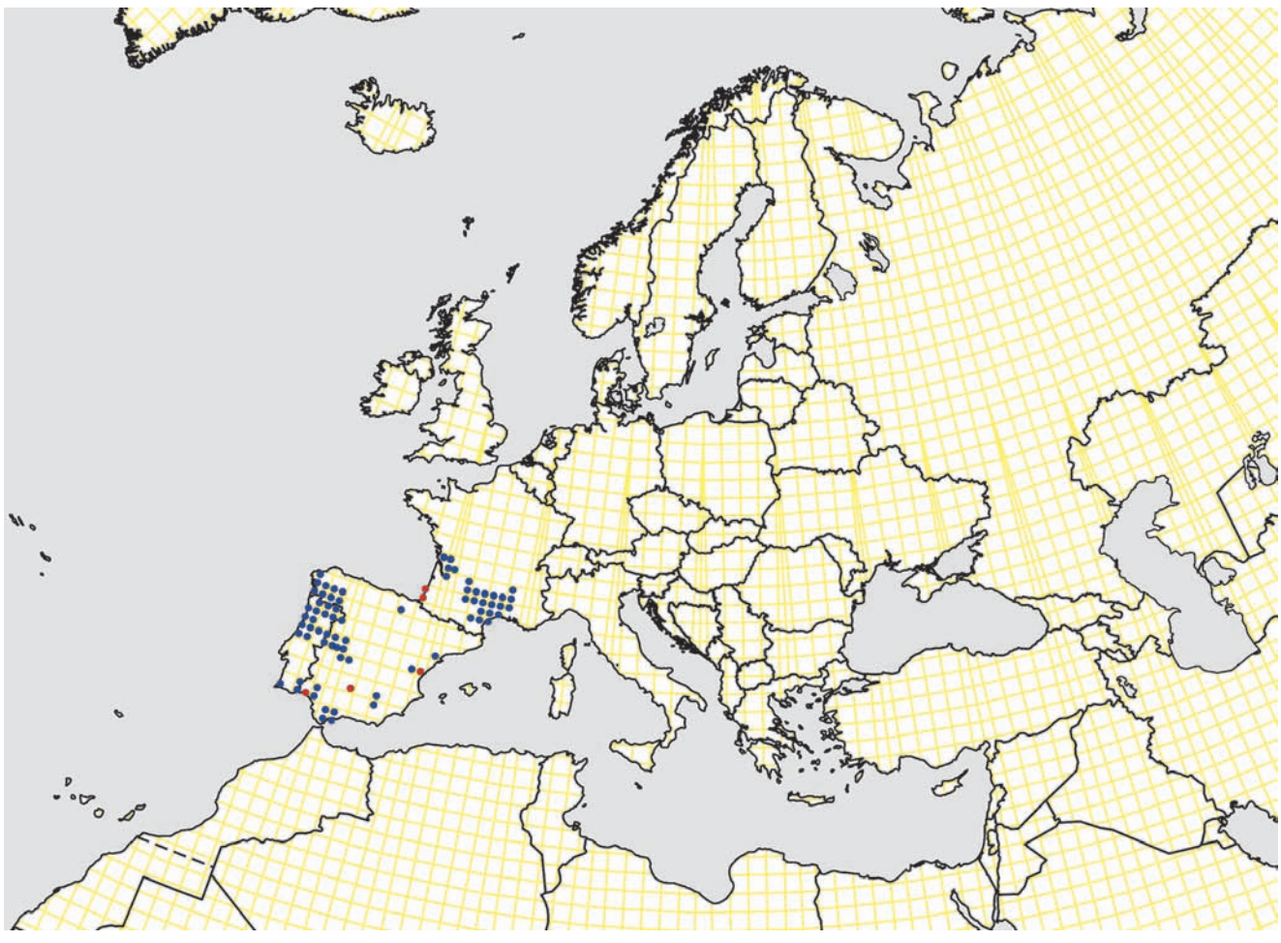
Europe: The main distribution of *Macromia splendens* is centred on the south and south-west of France and the western half of the Iberian Peninsula. This species is not uncommon in Galicia and the north of Portugal, but only scattered populations are found elsewhere in the peninsula. The largest populations in France occur on rivers flowing west, south and east from the southern half of the Massif Central. The species is also not uncommon on some rivers along the Atlantic region of south-west France. *Macromia splendens* has received much attention since 1990, resulting in many new populations being found in the Iberian Peninsula and western France, showing that it is more widely distributed than previously believed. Densities are very variable and the species is often difficult to observe and hence is easily overlooked. It is therefore possible that new populations remain to be discovered, as shown by the recent records from Catalonia and Aragon in Spain, and from the Corbières in France.

Trend and conservation status

The species is listed as Vulnerable on the European Red List as it is dependent on a relatively small number of river systems, many of which have previously suffered, or are currently experiencing, a general degradation of

Flight period

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
France					■	■	■	■					



World distribution

water quality. The species evidently disappears rapidly from polluted waters. It has, at least regionally, profited from the creation of hydroelectric dams on rivers, so long as these have a regular flow of water and reasonable water quality. However, more recent surveys revealed a clear decline in such hydroelectic dams reservoirs (Delpon et al. 2014), probably as a result of increased sedimentation, interruption of waterflow during drought periods, increased pollution and perhaps the introduction of exotic crayfish (J.-L. Dommanget, 2000–2008, unpublished).

Habitats Directive	II+IV
Red List EU27	Vulnerable
Red List Europe	Vulnerable
Red List Mediterranean	Least Concern
EU27 endemic	Endemic
European endemic	Endemic
Trend Europe	Decreasing

Habitat

Macromia splendens is found at slow-flowing stretches of large rivers and on streams and small rivers with deep permanent pools in which the larvae survive the dry season. Suitable habitats are generally found in well-preserved and (semi)-natural landscapes where pollution is minimal. Hydroelectric barrage dams can support large populations when the water quality and regime mimic those of large rivers. The species does not breed in standing water bodies, although foraging individuals have been observed at such habitats. *Macromia splendens* is restricted to the lowlands and hilly regions below 500 m in France and generally below 700 m in the Iberian Peninsula, though it has been found up to 1 000 m in Spain (Weihrauch & Weihrauch 2006).

1 Somatochlora arctica. Habitat of *Somatochlora arctica*, Lispach peat bog, Vosges mountains, 950 m, France. Other species occurring here include *Aeshna subarctica, A. juncea* and *Somatochlora metallica*. Photograph Jean-Pierre Boudot.

2 Somatochlora sahlbergi. Habitat of *Somatochlora sahlbergi*, vicinity of Lake Davvajavri, Pulsujärvi, province of Torne Lappmark, Sweden. Other species occurring here include *Aeshna caerulea, A. juncea, Leucorrhinia dubia, L. rubicunda* and *Somatochlora arctica*. Photograph Magnus Billqvist.

3 Somatochlora borisi. Habitat of *Somatochlora borisi*, River Diavolorema near Mikro Derio, Thrace, Greece. Other species occurring here include *Calopteryx splendens, Lestes parvidens* and *Somatochlora meriodinalis*. Photograph Valentina Assumma.

4 Epitheca bimaculata. Habitat of *Epitheca bimaculata*, Etang de Blonnaux, Broussey-Raulecourt, Lorraine lowland, France. Other species occurring here include *Leucorrhina caudalis*. Photograph Jean-Pierre Boudot.

Cordulia aenea (Linnaeus, 1758)

V.J. Kalkman & M. Lohr

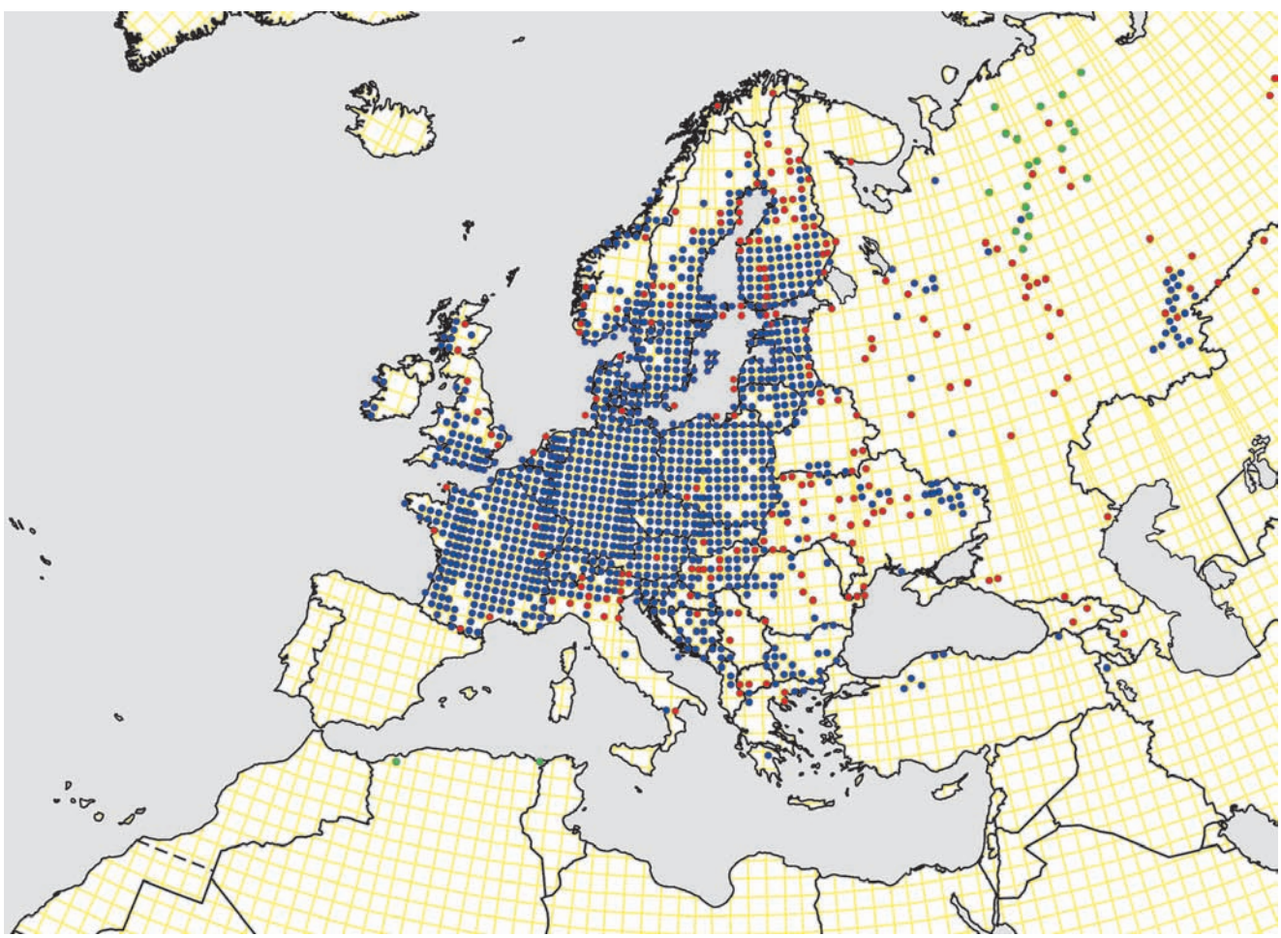
Taxonomy

Jödicke *et al.* (2004) found no evidence of gene-flow between the North American *Cordulia shurtleffii* Scudder, 1866, the Western Palaearctic *C. aenea aenea* and its East Palaearctic close relative *C. aenea amurensis* Selys, 1887, and so recognised them as three distinct species. However, there are no clear known differences in morphology, behaviour or ecology and it is unknown if *C. aenea aenea* and *C. aenea amurensis* meet and/or coexist. With this in view, Kosterin & Zaika (2010) argued that the lack of gene-flow between isolated lineages does not necessarily mean that speciation has occurred and therefore regarded the taxonomic decision to consider *C. a. aenea* and *C. aenea amurenesis* as good species premature, a position followed here.

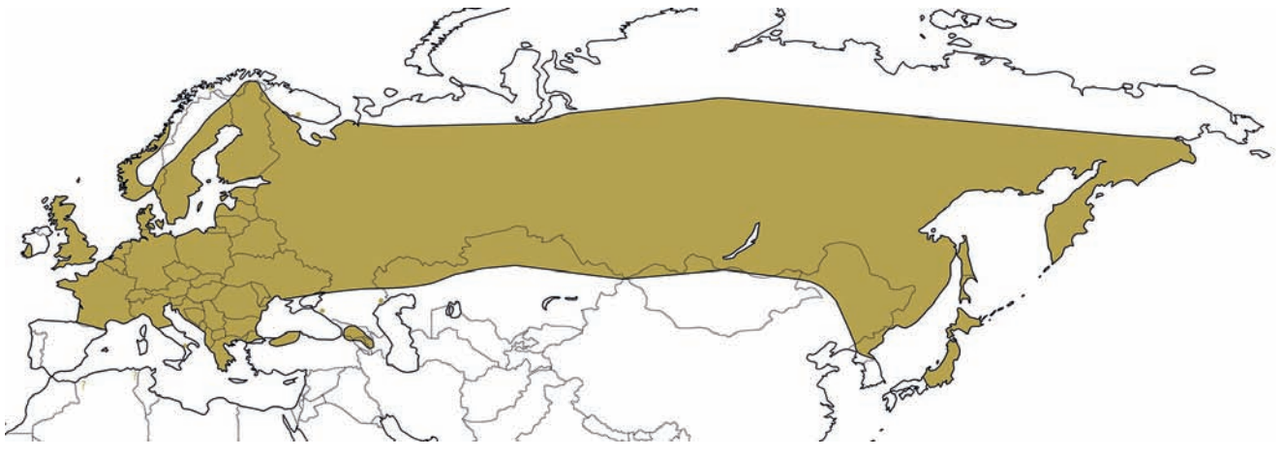
Distribution

World: *Cordulia aenea* has a vast range, occurring from western Europe to Japan and Kamchatka in the east. The species is common and widespread in the temperate parts of the Palearctic. Two old records from the Maghreb (Selys 1871, Martin 1910) have never been confirmed and are considered uncertain although they were from independent sources and based on voucher specimens. The occurrence of the species in south-west Asia is restricted to a small number of populations in the northern hills and mountains of Turkey and in Transcaucasia.

Europe: *Cordulia aenea* is very widespread and common in western, central and part of northern Europe. It is largely absent from the mountainous parts of Fennoscandia and is scarce in both Scotland and Ireland. The restricted distribution in these two latter regions

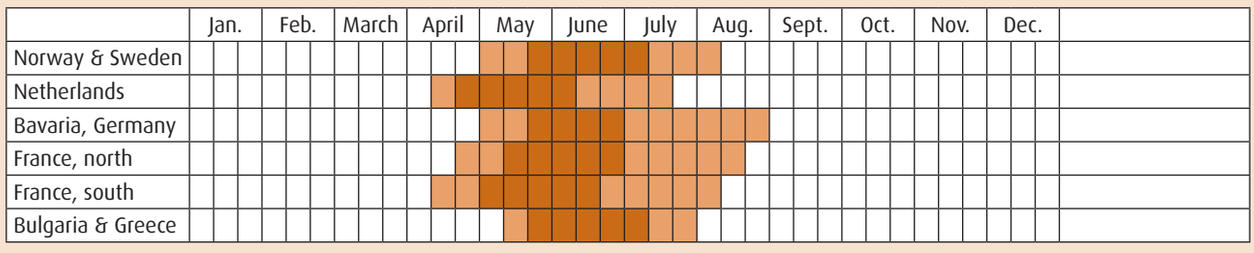


European distribution



World distribution

Flight period



coincides with the scarcity of woodland with which *C. aenea* seems to have a close association. The southernmost regular occurrences in western Europe are in the Pyrenees, the southern Alps and northern Italy, with a few isolated records in central and southern Italy. The species extents further south in the Balkan Peninsula, reaching the hills and mountains of northern Greece with a few isolated records known from the Peloponnese. The seemingly scattered distribution of the species in Belarus, Ukraine and most of Russia is most likely due to insufficient field investigations. Populations from the Pontic Alps in northern Turkey extend further eastwards up to the Caucasus (Artobolevskij 1915, Akramowski 1948, Kasymov 1965, Shengelia 1975, Skvortsov 2010), but the species seems to be rare and isolated in the lowlands of southern European Russia.

Trend and conservation status

Cordulia aenea is very common in most of its European range and is not currently threatened. The isolated populations in southern Italy and the southern parts of the Balkan Peninsula might perhaps be threatened by climate change.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Near Threatened
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

The species is found at permanent medium to large standing water bodies, and more rarely at slow-flowing waters on stretches with coarse organic detritus on the bottom. Suitable habitats are generally more than one metre deep with well-developed vegetation. Thus, the banks are in most cases well vegetated, while the water surface is often partly, but never completely, covered with semi-emergent or floating hydrophytes. The species is mostly found at woodland lakes, oxbows ponds including fishponds, peat bogs, fenlands and heath ponds and in older gravel pits. The habitats where it occurs are often, but not necessarily, exposed to sunlight and nearly always close to woodlands where the adults forage between trees and in clearings.

Epitheca bimaculata (Charpentier, 1825)

J.-P. Boudot, R. Bernard & M. Martin

Taxonomy

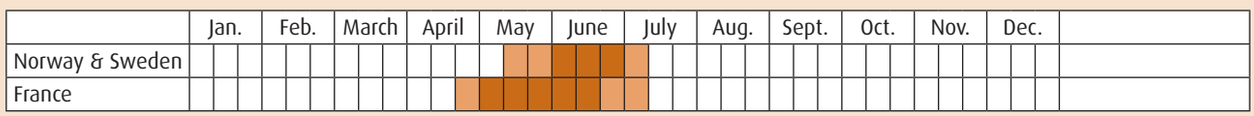
Central Asian and Siberian populations were until recently referred to as subspecies *E. b. altaica* and *E. b. sibirica*, respectively, but the species is at present considered to be monotypic (Kosterin 2004).

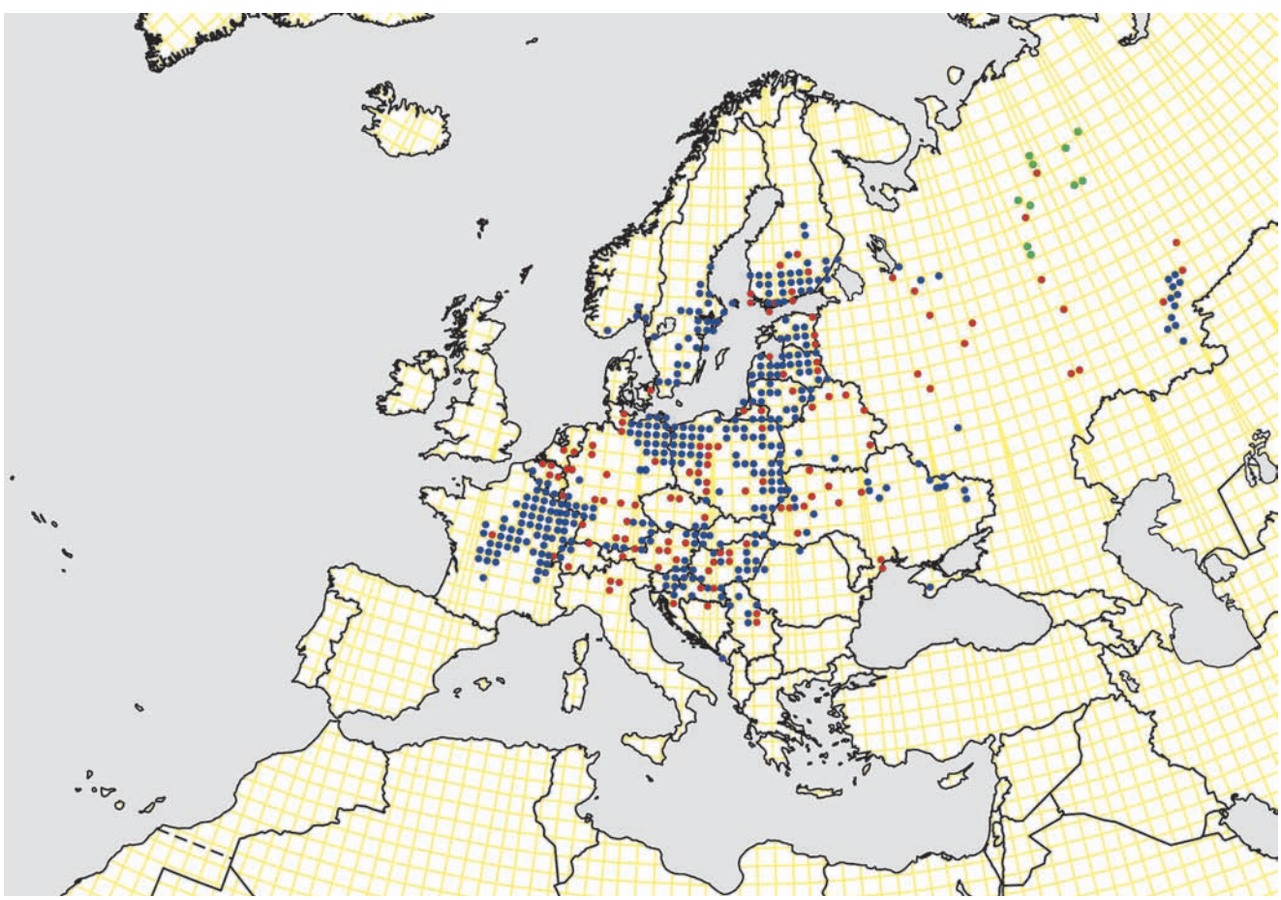
Distribution

World: *Epitheca bimaculata* has a Trans-Palaearctic distribution, ranging from western Europe to southernmost Kamchatka and Japan within an area mostly between latitudes 44 °N and 63 °N, although the Japanese populations extend further south to 35 °N.

Europe: Although *Epitheca bimaculata* has a wide distribution in Europe, it is nowhere common and is rare and scattered in large parts of its range. Concentrations of records are found in central and north-east France, north-east Germany, northern and eastern Poland, southern Sweden and Finland, the Baltic States and the Hungarian lowland and adjacent regions. Mature adults are difficult to detect, so the species is frequently overlooked, and in some regions it might be more common than currently believed. The species becomes more common to the east and is probably more widely distributed in European Russia

Flight period





European distribution

World distribution

than suggested by available records. Only old records are known from Italy, the Netherlands (both 19th century) and Bosnia and Herzegovina (before 1948), but *E. bimaculata* has always been very rare in these countries. Several new localities for Serbia have been found since the turn of the millennium and a sight record has been published from Lake Skadar in Montenegro in 2009, suggesting that the species might be more widely distributed in the states of the former Yugoslavia than presently known (Jović *et al.* 2009, De Knijf *et al.* 2013). Adults are generally difficult to find as they spend much time away from water and, when at their breeding habitat, tend to fly over the water surface away from the bank. Searching for exuviae is therefore the best method to find the species, and further surveys might show it to be more widely distributed than currently known.

Trend and conservation status

The species seems to have decreased during the 20th century and has become extinct in parts of Austria, Belgium, Germany, Italy and Switzerland, probably due to changes in the management of lakes and ponds, including their banks, and a decrease in water quality. At present, it seems to be stable and was assessed as of Least Concern, as it is still widespread in parts of Europe. In several areas, many new, sometimes very large populations have been discovered in the past three decades, largely due to increased surveys of exuviae. It also seems likely that in some areas the species has profited from recent improvements in water quality, particularly in backwaters and abandoned gravel pits fed by seepage water. A further increase in the future is quite possible.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Data Deficient
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

Epitheca bimaculata is most often found at medium to large, oligotrophic to eutrophic, forest lakes, oxbows and abandoned gravel pits, and, more rarely, at fishponds. Regionally, for example in the Baltic region, it also occurs in small peaty lakes, even slightly acidic ones. The species occurs mostly in lowlands although it has been found up to 1 000 m in Switzerland. Many habitats have a mosaic of open water and areas with abundant submerged and floating vegetation such as waterlilies (*Nuphar*, *Nymphaea*), watermilfoil (*Myriophyllum*) and pondweeds (*Potamogeton)*, but there are also localities with little to no aquatic vegetation. Most localities are at least partially surrounded by trees or bushes. Banks can be open or densely vegetated with helophytes, for instance reed, bulrush (*Typha*) and sedges. Population densities vary strongly between sites and between years, with counts of exuviae in France ranging from single records to more than 5 000 at seemingly similar sites.

Somatochlora alpestris (Selys, 1840)

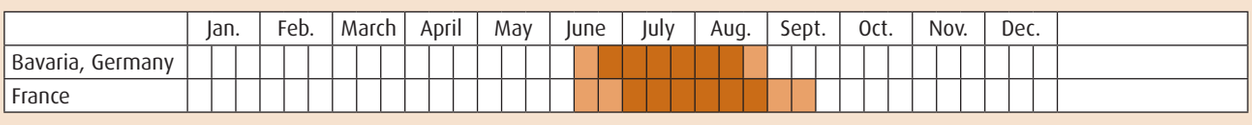
J.-P. Boudot

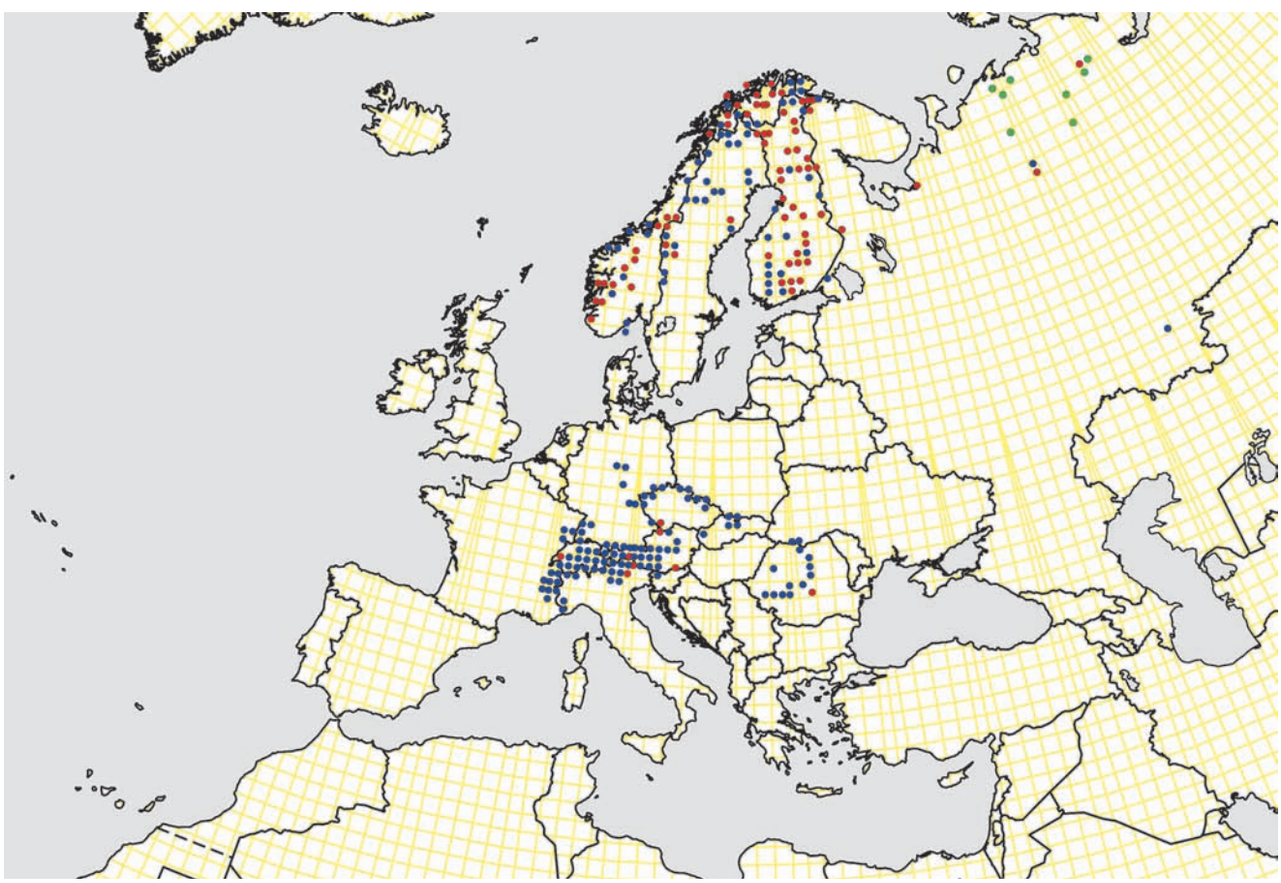
Distribution

World: *Somatochlora alpestris* is a Palaearctic species ranging from Europe to northern Japan (Hokkaido) and Kamchatka. The species is widely distributed in the central European mountains and in large parts of Fennoscandia and (probably) north-west Russia. In Asia its range seems to be largely restricted to the southern part of Siberia, particularly in central Siberia, but it is unclear if this reflects the actual situation or just the limited faunal surveys of the northern part of the continent. The species seems very rare in Amurland and the Russian Far East.

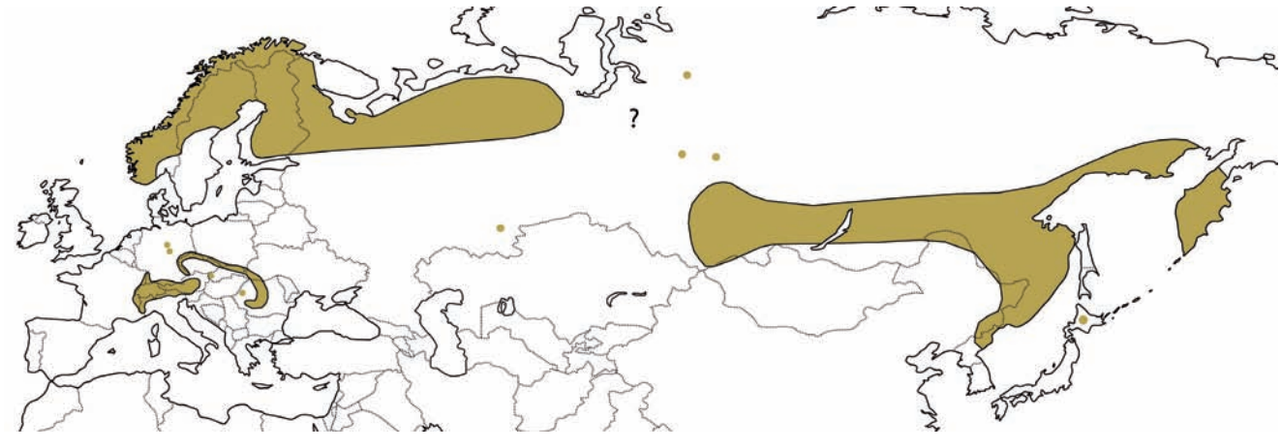
Europe: *Somatochlora alpestris* is, together with *Aeshna caerulea*, one of the best examples of a dragonfly with a boreo-alpine distribution. It is widely distributed in Fennoscandia and (probably) the north of European Russia, and is reasonably common throughout the higher parts of the central European mountains. In Fennoscandia it occurs from sea level in the north to more mountainous areas in the south. In central Europe, it is confined to mountain ranges from 800 m (rarely as low as 600 m) to ca. 2 500 m. It is widespread and generally common in the Alps but is less frequent in other mountain ranges. Other inhabited mountain ranges include, the Vosges in France, the Fichtelgebirge, Ore Mountains (= Erzgebirge), Thuringian Forest, Harz and

Flight period





European distribution



World distribution

Black Forest in Germany, and the Tatra and the Carpathian Mountains in the Czech Republic, Poland, Slovakia, Ukraine and Romania. Recent field works have shown the species to be more common in the Carpathian range than previously thought (Holuša 2009, De Knijf *et al.* 2011, Flenker 2011). A low elevation record from Bulgaria (Beschovski 1994) was later found to refer to *Somatochlora borisi* (Wildermuth 2008).

Trend and conservation status

About half the European range is in Fennoscandia, where the species is regarded as common, widespread and not under threat. The lack of recent records from parts of Fennoscandia is believed to be due to insufficient surveys, and probably does not represent a true decline. In central Europe, many populations are isolated and habitats may be adversely affected by eutrophication and grazing by cattle. In addition, the cessation of small-scale peat extraction results in a local reduction in available habitat. Increasing temperatures will probably result in an upward shift of the altitudinal range of the species (De Knijf *et al.* 2011). *Somatochlora alpestris* is presently listed as of Least Concern at the European level; it is however expected it will be threatened by global warming in parts of its central European range.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Near Threatened
EU27 endemic	No
European endemic	No
Trend Europe	Unknown

Habitat

Somatochlora alpestris favours flooded depressions in peat bogs, small peaty ponds and man-made peat diggings in *Sphagnum* bogs and transitional mires. More seldom, it is found in larger acidic peaty waters in open alpine meadows, semi-wooded areas or coniferous forests. The species is confined to cold arctic and mountain climates. The larvae are well adapted to these conditions, as they are tolerant to freezing in winter and to desiccation of the peat layers in which they live in summer (Johansson & Nilsson 1991). Conversely, adults show a great sensitivity to summer weather conditions, being decimated by summer snowfalls lasting longer than three to four days (Wildermuth & Knaus 2002).

Somatochlora arctica (Zetterstedt, 1840)

J.-P. Boudot & S. Karjalainen

Distribution

World: *Somatochlora arctica* has a wide range covering the northernmost two-thirds of the Palaearctic. It extends east through to Kamchatka, Japan and North Korea. Some isolated localities are known south of its main range, notably in south-west France, Bulgaria, Romania, Central Asia and central Japan.

Europe: *Somatochlora arctica* is mainly found in Fennoscandia and in west to central European mountains and foothills. Contrary to *S. alpestris*, it is not confined to high elevation in central Europe and

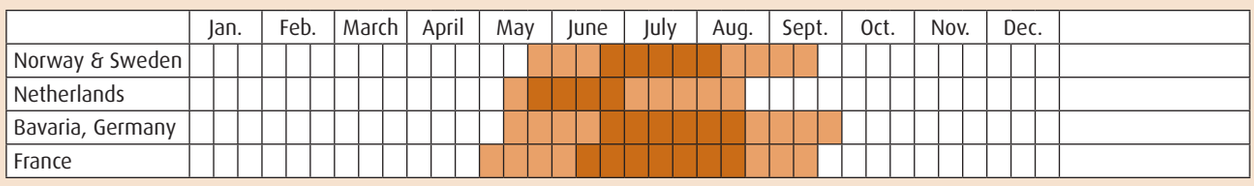
occurs in the central and northern lowlands, and is found in both Scotland and Ireland. In the latter country, it is remarkably rare considering the amount of habitat available and its relatively wide distribution in Scotland. It is widespread in the Alps, the French Massif Central and the Vosges mountains and foothills. Further south, it is rare and local in the eastern part of the Pyrenees and in the mountains of Romania and Bulgaria (Marinov 2004, De Knijf *et al.* 2011, Manci 2012). The low number of records from Belarus and the north of the Ukraine is at least partly the result of a low recording intensity in these areas. *Somatochlora arctica* is an elusive species, and adults are often seen in low numbers even at places where exuviae are numerous.

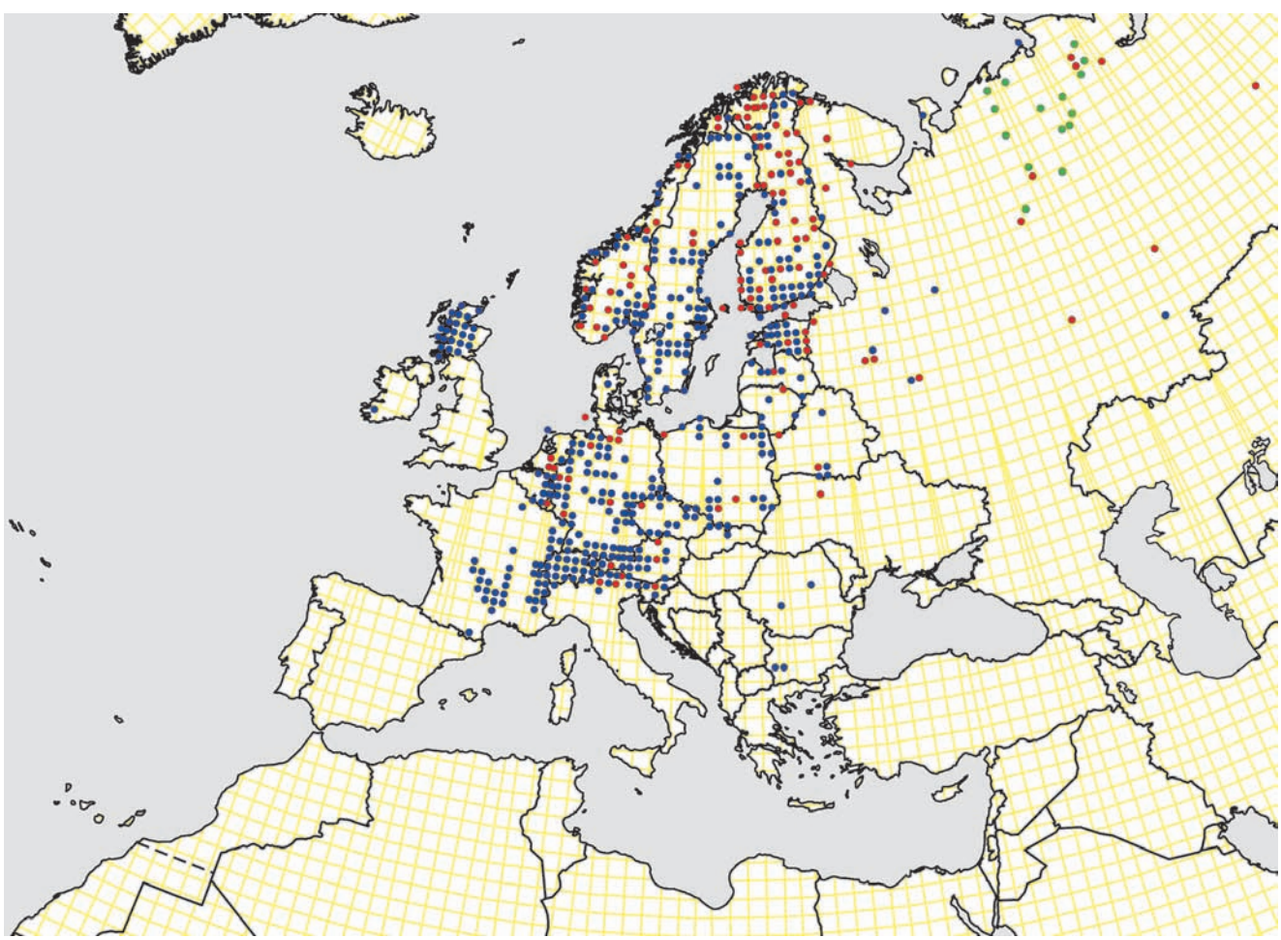
Trend and conservation status

Somatochlora arctica is widespread and is not threatened in northern Europe and the mountains of central Europe. It is rare in most of the lowlands of central Europe as well as in the mountains of southern and south-eastern Europe, and has locally declined due to habitat destruction. The sites in the mountains of south-eastern Europe are especially isolated and re-colonisation after extinction would be unlikely. Local extinction following an abnormal summer drought has been recorded from Germany at low elevation (Ott 2006) and might occur more regularly in the near future due to climate change.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Near Threatened
EU27 endemic	No
European endemic	No
Trend Europe	Unknown

Flight period





European distribution

World distribution

Habitat

Somatochlora arctica favours *Sphagnum* peat bogs and transitional mires where the larvae are generally found in places with only very small amounts of open water, often around one square metre and sometimes just a few square decimetres. These situations can be found at small depressions and runnels in active peat bogs, abandoned peat diggings and small water holes in marshes, moorlands and tundra. Occasionally there is some barely visible flow of ground or surface water. It is one of the few species that can survive in peat bogs where the vegetation approaches the climax stage. Suitable breeding habitats are nearly always free of fish, often devoid of Amphibians and support a limited number of other dragonfly species. The key for success of *S. arctica* seems to be that it is able to occur in marginal habitats and so avoids competition with other species. Adults typically rest in, or hunt near trees, and populations are often found near forests, although populations in largely open landscapes also commonly occur. This species is found from sea level in the north of its range to 2 000 m in the extreme south of its range, where it is restricted to mountains.

Somatochlora borisi Marinov, 2001

J.-P. Boudot, Y. Kutsarov & M. Marinov

Distribution

World: *Somatochlora borisi* is endemic to south-eastern Europe.

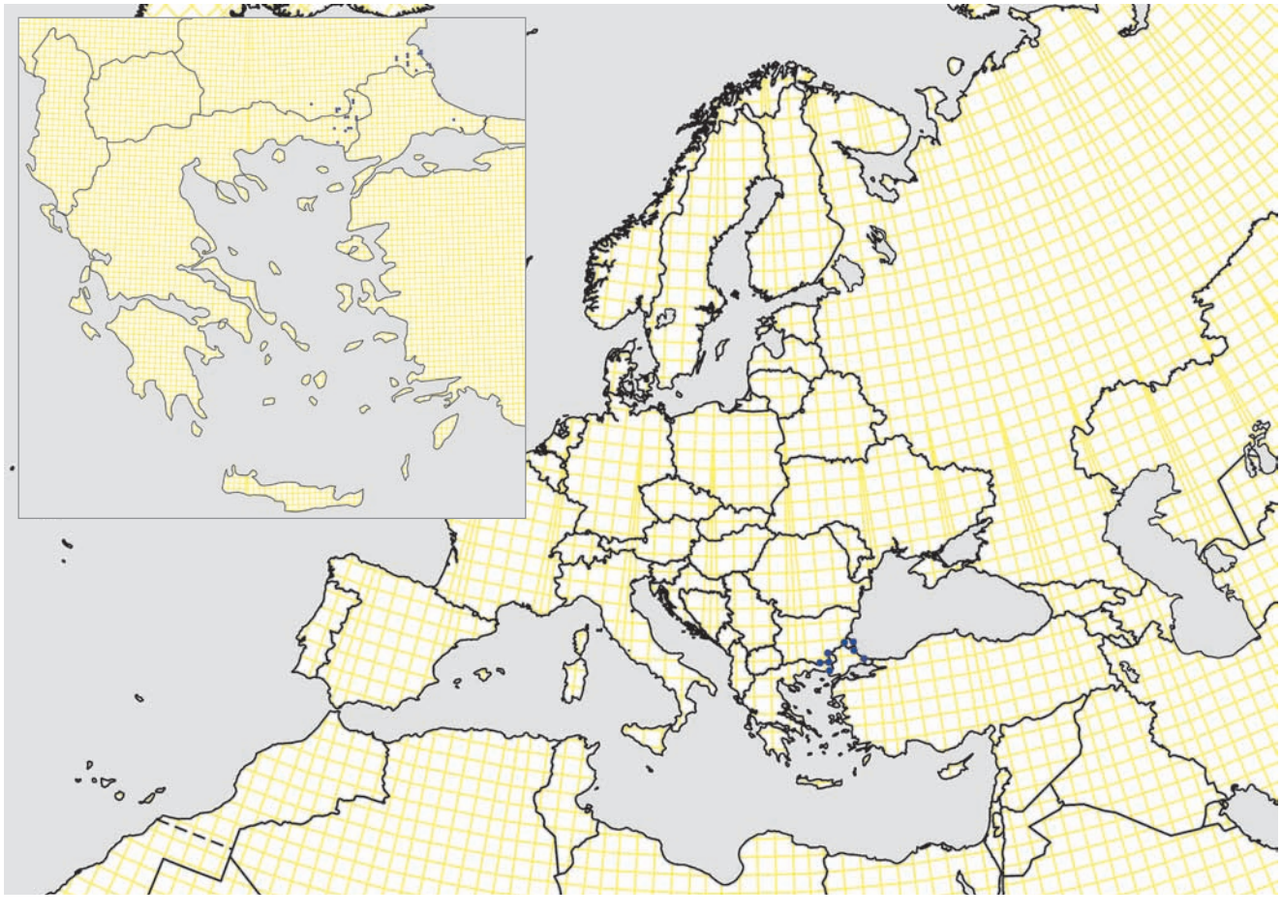
Europe: *Somatochlora borisi* is restricted to rivers originating in the eastern Rhodope and Istranca mountains of north-east Greece, south-east of Bulgaria and European Turkey.

Trend and conservation status

Most populations are found in areas with broadleaved or mixed forest that are often used as grazing areas for cattle. Changes in the intensity of the grazing regime might lead to either forest closure or to a reduction in forest cover. Locally, there has been large scale logging and establishment of conifer plantations, which are probably unfavourable for the species. *Somatochlora borisi* seems to be adapted to intermittently flowing rivers that form residual pools in summer. Nevertheless, climate change will increased the frequency, length and intensity of summer drought periods, which might

Flight period

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Bulgaria & Greece													Based on 39 records



World distribution. The inset shows its distribution in the southern Balkan Peninsula based on a 5 by 5 km grid.

result in some of these streams becoming unsuitable for the species. *Somatochlora borisi* is listed as Vulnerable on the European Red List as it is restricted to a relatively small number of streams and is likely to be adversely affected by changes in water regime and land use.

Habitats Directive	No
Red List EU27	Vulnerable
Red List Europe	Vulnerable
Red List Mediterranean	Vulnerable
EU27 endemic	No
European endemic	Endemic
Trend Europe	Decreasing

Habitat

Somatochlora borisi is found in large streams and rivers in hilly regions that are generally covered with extensive broadleaved forests. Most of the forests are used for low intensity goat and sheep farming, which results in them having a relatively open structure with scattered clearings. The species does not breed in ponds or lakes, and is limited to habitats with running water. At least some of the habitats where the species occurs are intermittently-flowing streams which are fragmented into residual and more or less disconnected, pools during the summer. The species is confined to areas with a hot and dry summer below 300 m.

Somatochlora flavomaculata (Vander Linden, 1825)

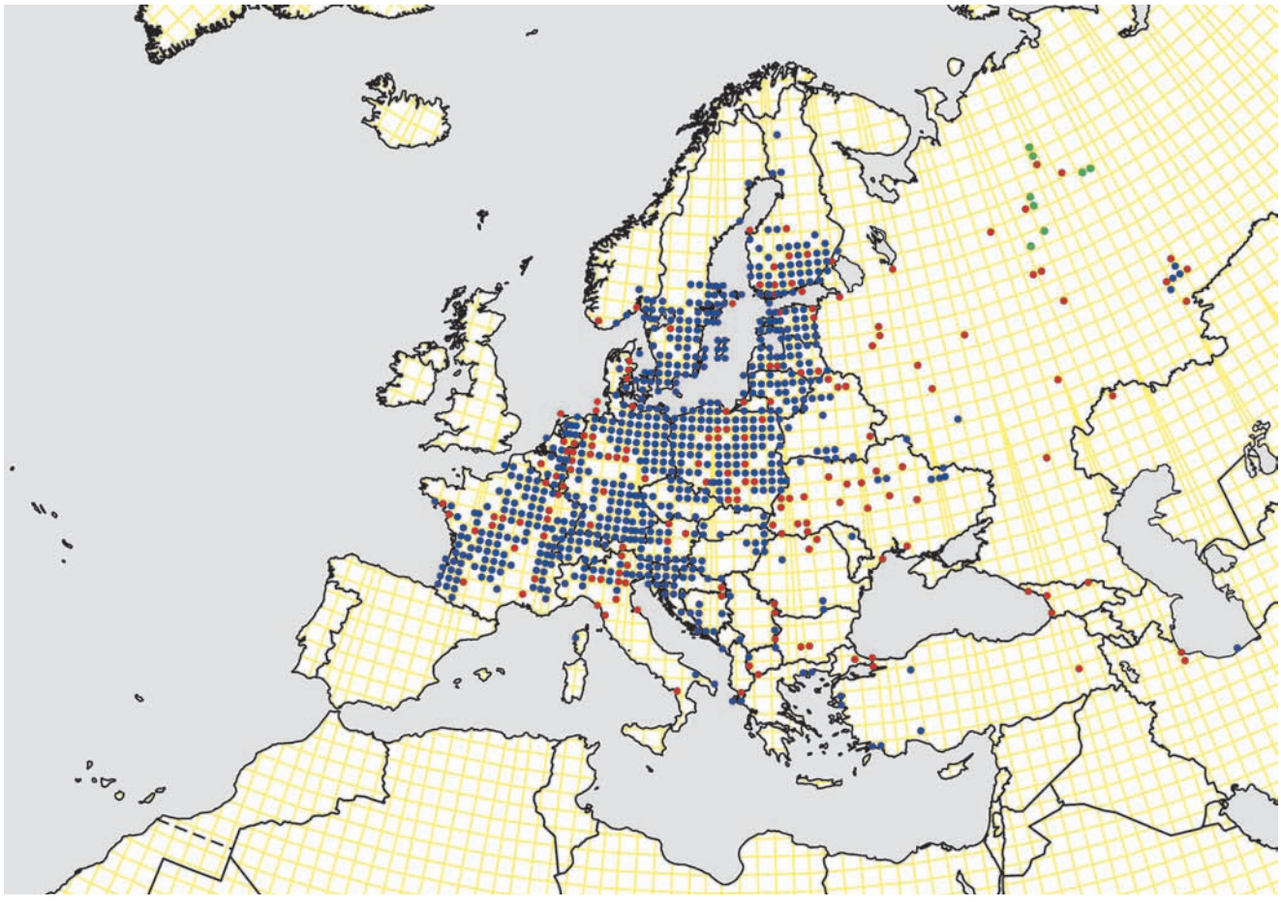
J.-P. Boudot, R. Bernard & M. Kalniņš

Distribution

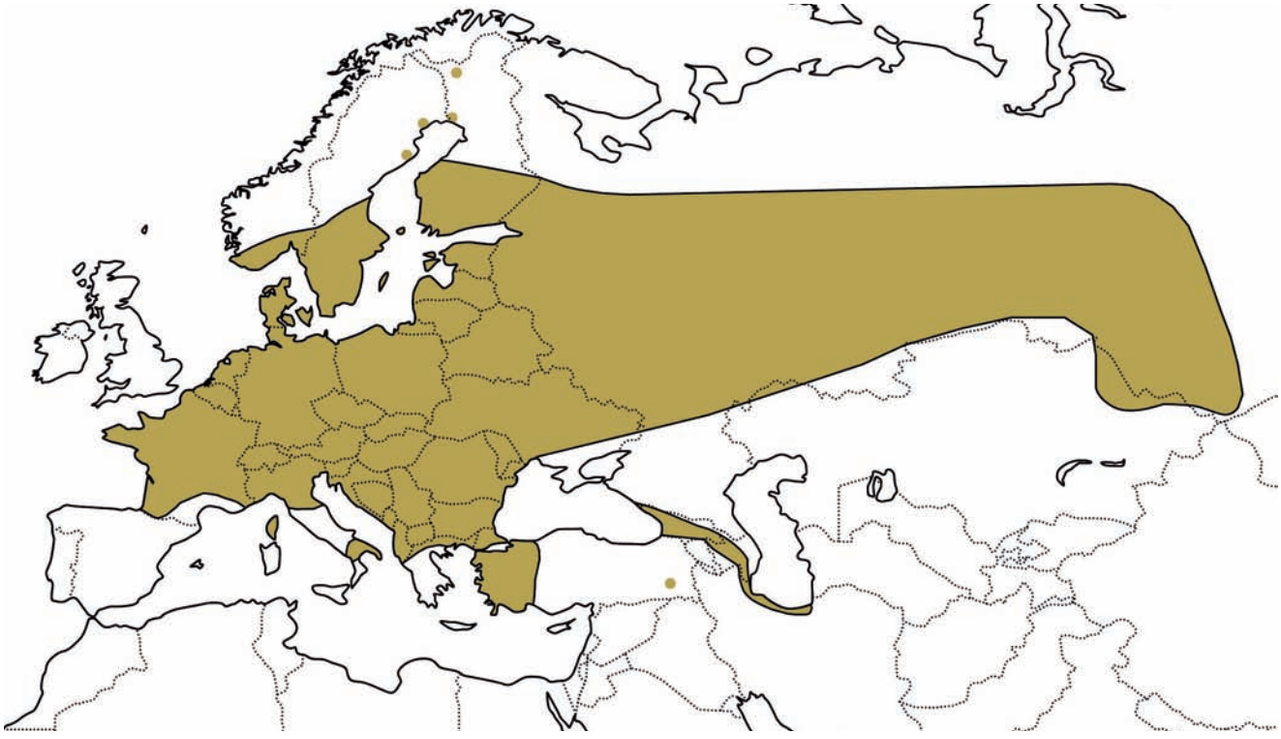
World: *Somatochlora flavomaculata* extends from France and southern Fennoscandia to western Siberia and western Kazakhstan. In the south, only scattered populations are known from southern Italy, the Balkan Peninsula and the Middle East.

Europe: *Somatochlora flavomaculata* is fairly common in southern Fennoscandia and central and north-east-

ern Europe. It is less common in the western and southern parts of its range, where populations are often small and isolated. It occurs locally at high densities and in some areas it is the most common species of *Somatochlora*. Suitable habitats and climate seem to occur in Great Britain and the species absence from this country is therefore surprising.

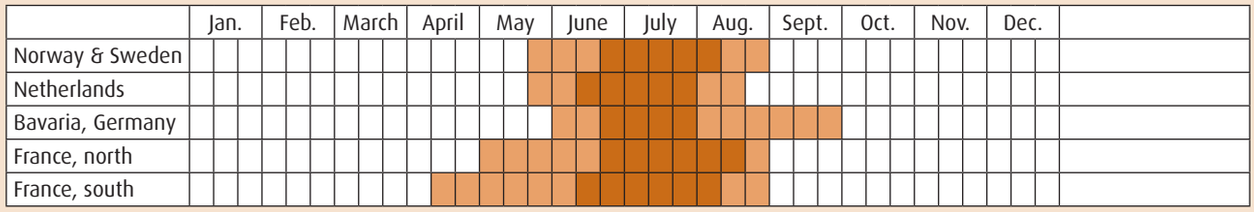


European distribution



World distribution

Flight period



Trend and conservation status

The species suffered a decline in large parts of its western and southern European range principally from the 1960s to the 1980s, due to the destruction of lowland marshes through drainage and water eutrophication. This resulted in it becoming rare in parts of its range. The decline seems to have largely ceased and a revival has been noted in some regions. However, increased periods of drought linked to climate change might increasingly lead to desiccation of habitats and regional extinctions of the species in the south of its range. In Fennoscandia, climate change may favour this species, and it is expected to expand further north in the coming years.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

Somatochlora flavomaculata generally prefers oligotrophic to weakly eutrophic peaty water bodies with abundant and dense vegetation. Suitable habitats can be found at fens, marshes, oxbow lakes, wet meadows, ponds, peaty pools including abandoned excavations, *Sphagnum* peat bogs, and, more rarely, at slow-flowing waters such as ditches and canals. Most of its habitats have a reduced surface of open water due to the density and expanse of the vegetation. In many cases, a layer of at least 10 cm organic material is present on the bottom, while the water is generally shallow. Larvae are capable of surviving an absence of free water for a period of a few weeks. Favoured habitats are fish free and largely unshaded, but often near forest. At such sites, adults are mostly found at the periphery of their breeding habitat, often foraging in meadows and sunny spots in, or along, the forest edges. Most records are from below 600 m, but populations have been found up to 1 270 m in the south of its range.

Somatochlora graeseri Selys, 1887

J.-P. Boudot & R. Bernard

Distribution

World: The main range of *Somatochlora graeseri* is in the Eastern Palaearctic, where the species is widespread and generally common from Japan and Kamchatka to the western limit of central Siberia and the Altai Mountains in both Russia and eastern Kazakhstan (Kosterin 2005, Chaplina *et al.* 2007). Further west, a narrow and apparently disjunct area is known from foothills on both sides of the Ural Mountains, where the species is known from eight localities (Yanybaeva 1999a, Kosterin 2005, Yanybaeva *et al.* 2006, Haritonov & Eremina 2010, Bernard 2012, Brockhaus 2013). A single more westerly locality, ca. 800 km west of the known distribution in the Urals, was discovered in 2009 in the north of European Russia, with exuviae and emergences recorded (Bernard 2012).

Europe: In Europe, *S. graeseri* is restricted to Russia with a total of six localities known: one in the far north, namely in the Pinega region of the Arkhangelsk Oblast, two in the western Ural foothills in the Komi Republic, and three from the Bashkirian Nature Reserve in the Bashkortostan Republic, on the western side of the southern Urals, where the species is not uncommon (Yanybaeva *et al.* 2006, Haritonov & Eremina 2010, Bernard 2012, Brockhaus 2013). It is at present unclear whether the population of the Arkhangelsk Oblast is connected to those of the Ural Mountains through northern European Russia.

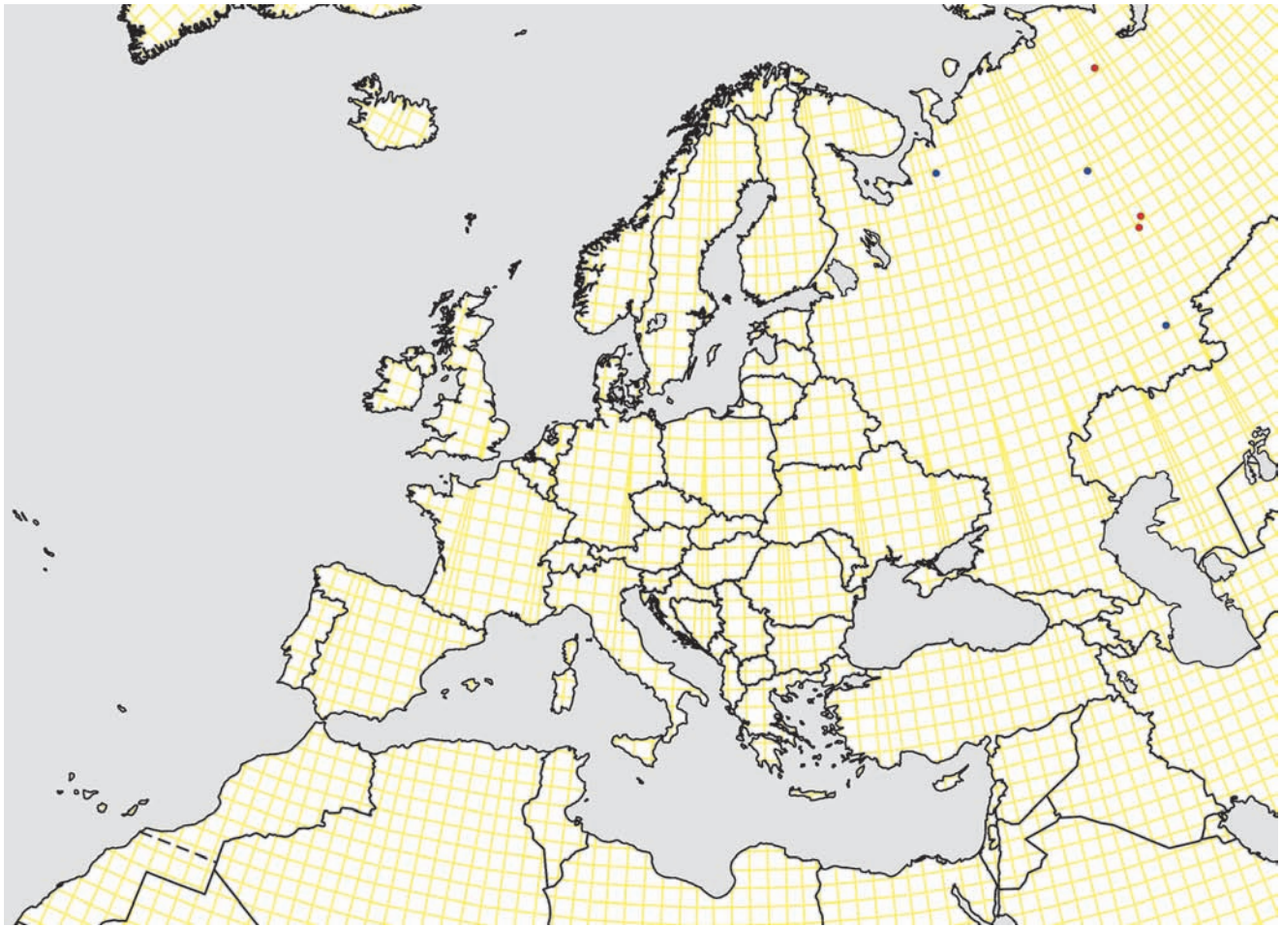
Flight period

European records range from the end of May to August (Haritonov & Eremina 2010). In Asia, the species is on the wing from June to September.

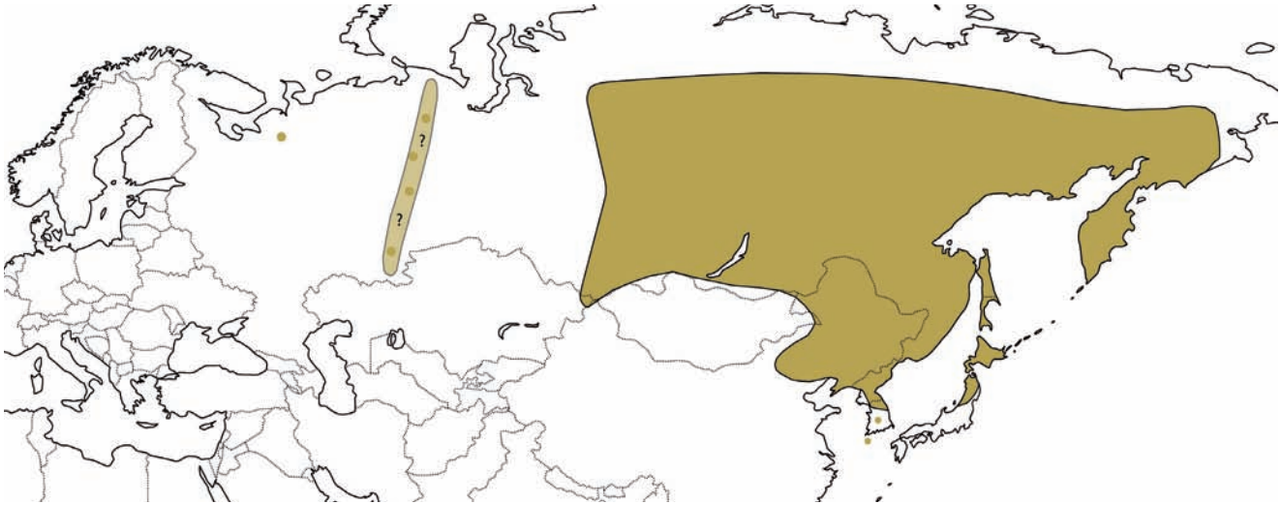
Trend and conservation status

Somatochlora graeseri is only known from six localities in Europe, though it is likely that the species is more common throughout its range in the Urals than presently known. The paucity of data currently makes it impossible to assess the conservation status of the species in Europe, for which reason it has been classified as Data Deficient on the European Red List. However, in the future, this cold-stenothermal species might be adversely affected by climate warming in the south of its range.

Habitats Directive	No
Red List EU27	Not Evaluated
Red List Europe	Data Deficient
Red List Mediterranean	Not present
EU27 endemic	No
European endemic	No
Trend Europe	Unknown



European distribution



World distribution

Habitat

Throughout its range, *S. graeseri* favours marshy lakes, oxbows and ponds in the forested or scrubby parts of river flood plains. It is also present at slow flowing stretches of rivers and at larger lakes. The species appears to be well adapted to cold climates as it was reported to be associated with rather deep and cold water, and adults have been reported to patrol over ice-cold waters during the breeding season (Kosterin & Zaika 2010, Bernard 2012).

Somatochlora meridionalis Nielsen, 1935

J.-P. Boudot & B. Gligorović

Taxonomy

Due to the lack of clear structural differences and the occurrence of intermediate specimens in Italy, Slovenia and Austria (Obersteiermark), *Somatochlora meridionalis* has often been regarded as a subspecies of *S. metallica*. Both taxa can be, however, easily recognised by small but stable differences in coloration and show clear ecological preferences in areas where they co-occur, with *S. metallica* limited to elevated lakes and bogs, and *S. meridionalis* to lowland running waters.

Distribution

World: *Somatochlora meridionalis* ranges from south-east France and Corsica to western Turkey. The species is nearly endemic to Europe, with only a handful of populations known from the western half of Turkey.

Europe: The main range of *S. meridionalis* extends over most of south-east Europe, with high densities of populations being found in Slovenia, Croatia, Bosnia and Herzegovina, Montenegro, Bulgaria and the European part of Turkey. This species has a more scattered occurrence in Albania, Macedonia, Serbia, Romania and Greece (including Crete). Further north, it is known from mostly isolated populations in Austria (Raab *et al.* 2006), Slovakia (David 2000b) and the Czech Republic (Holuša 2007). The situation in Hungary is unclear as most national *Somatochlora* records are based on larvae that were not identified to species. Confirmed *Somatochlora meridionalis* adults have been found in western Hungary, but these records were either unpublished or published under *S. metallica* (A. Ambrus *in litt.*). A review of records of *S. metallica* and *S. meridionalis* in central Europe is essential to properly understand their respective distributions in this area. It is unclear how far east the species can be found and future work might show the species to be present in Moldova and southwest Ukraine. In the western Mediterranean, disjunct populations of *S. meridionalis* are known from central Italy, Corsica (Mashaal 2002, Grand & Roché 2003, Doucet & Duret 2011) and from an area running from north-west Italy to south-east France (Kotarac 1995, Grand 1996, 1997 Rault *et al.* 2015).

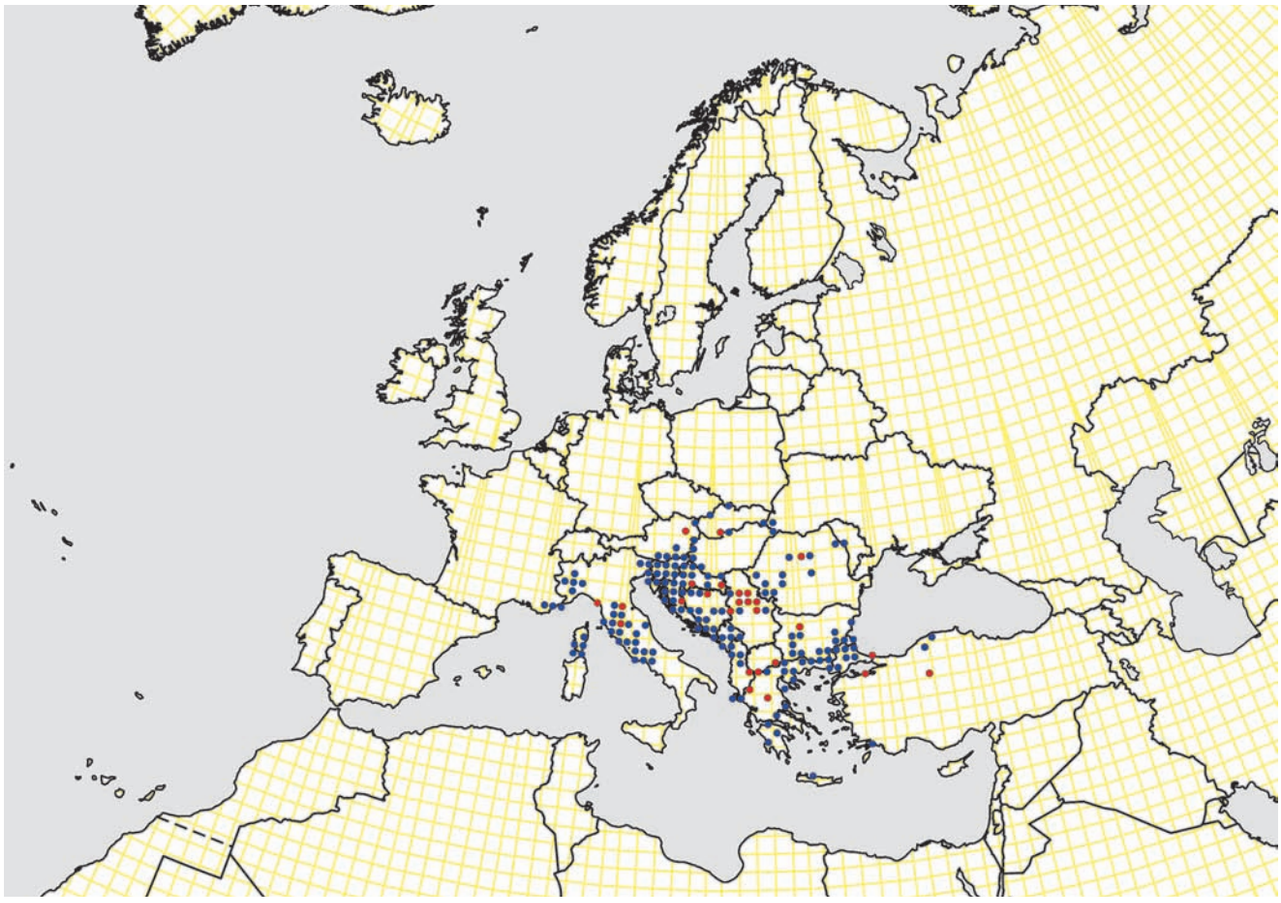
Trend and conservation status

Somatochlora meridionalis has a relatively small global range but is relatively common in the Balkan Peninsula, where it is not currently under threat. Removal of trees along watercourses, the drying out of springs and watercourses due to rainfall deficit linked to climate change, and over-irrigation or forest fires are the main threats to the species.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Unknown

Habitat

Somatochlora meridionalis is found at largely or completely shaded streams and small rivers, and is mainly confined to running waters, although there are reports of reproduction in standing waters in Italy. Most breeding habitats are small to large streams or small rivers with clear water and generally sparse vegetation. The species is also found at runnels and small irrigation canals in agricultural landscapes in northern Italy. It can be common in intermittently flowing streams that become fragmented into residual, largely disconnected pools during summer, where the larvae are able to survive the dry season. Adults are mostly seen along shaded stretches of watercourses and the presence of shade on most of the water surface is an important habitat characteristic. *Somatochlora meridionalis* is mainly a



World distribution

Flight period

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Bulgaria & Greece													
Turkey													Based on 17 records

lowland species most common below 500 m. It can, however, occur at higher elevations and was, for example, found between 1 200 and 1 600 m in the Rhodope Mountains in Bulgaria (Marinov 2007).

Somatochlora metallica (Vander Linden, 1825)

J.-P. Boudot, P. Ivinskis & R. Bernard

Taxonomy

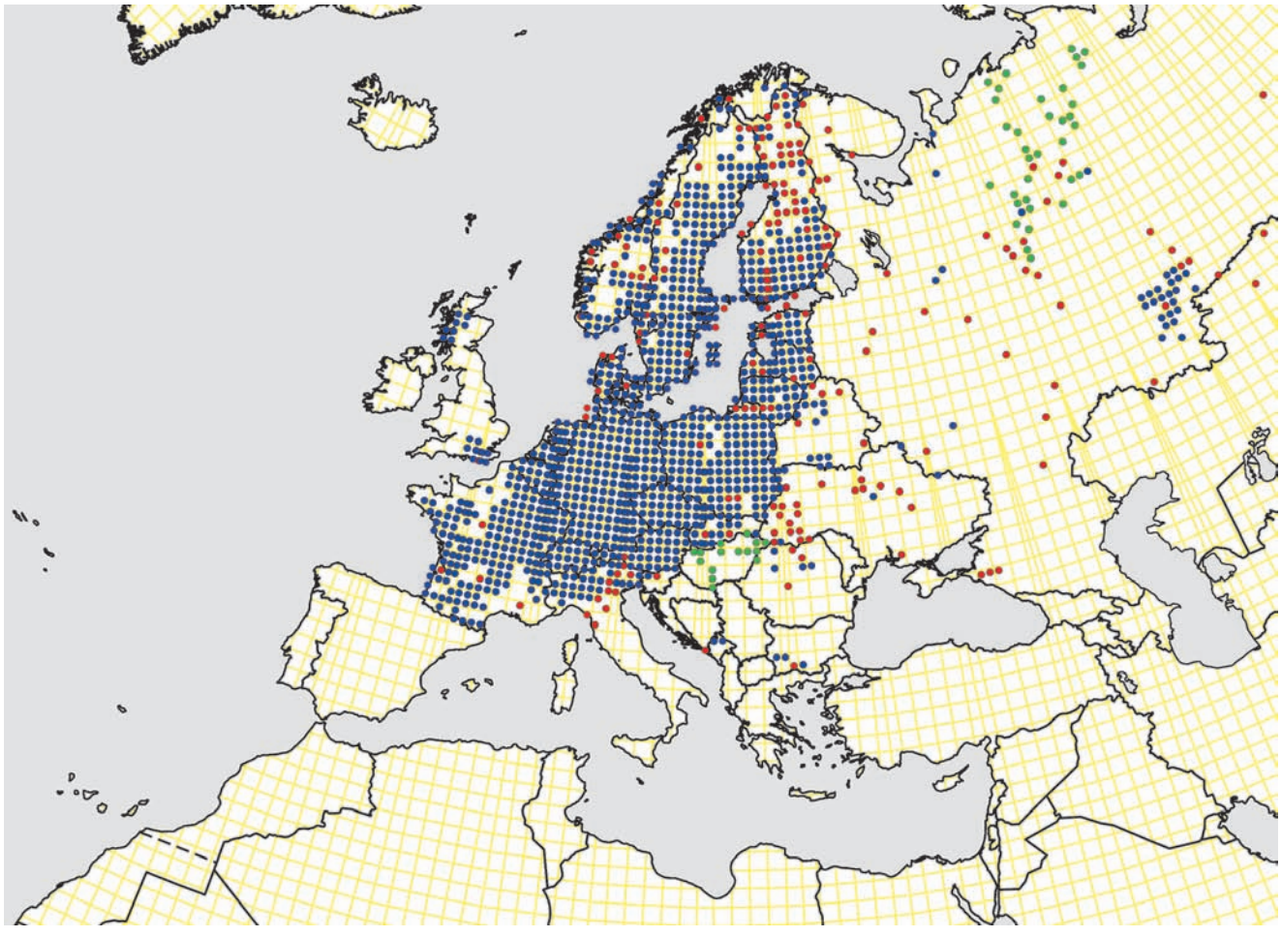
See text on *Somatochlora meridionalis*.

Distribution

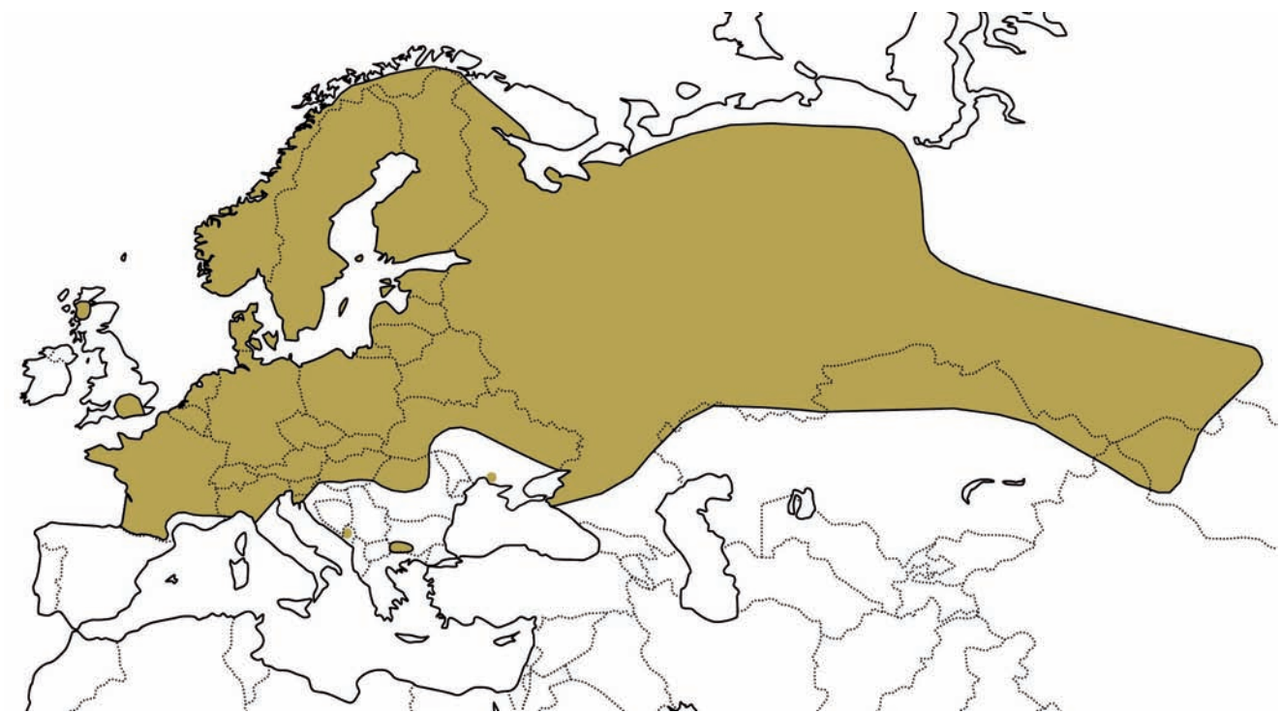
World: *Somatochlora metallica* is a west Eurasian species. To the east, it reaches northern Kazakhstan and the south-west of central Siberia. Further east, it is replaced by the closely related *S. exuberata* Bartenev 1910, which was formerly regarded as a subspecies of *S. metallica*.

Europe: *Somatochlora metallica* is common throughout most of Europe and reaches well north of the Arctic Circle. It is rare or absent in the Mediterranean area and the lowlands of the Balkan Peninsula. It is also absent from Ireland and occurs only at two small, disjunct areas in Great Britain, one in Scotland

and the other in the south-east of England. To the south, it reaches the Pyrenees (both on the French and Spanish sides) and the north of Italy. In south-east Europe it is confined to mountain lakes in Romania, Bosnia and Herzegovina, Montenegro and Bulgaria (Marinov 2007, De Knijf *et al.* 2012, Kulijer *et al.* 2012, Manci 2012), and is replaced by *S. meridionalis* at running waters in the lowlands. Old records

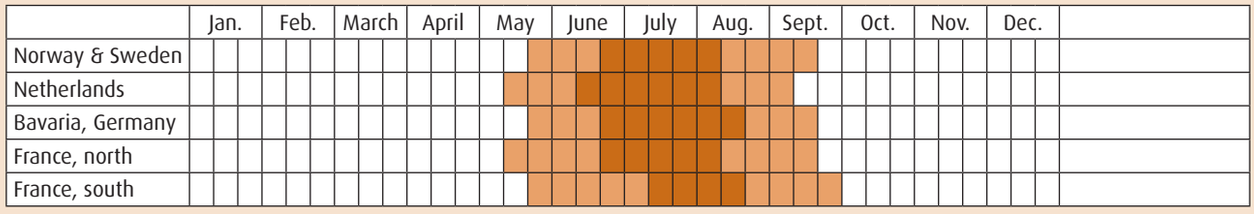


European distribution



World distribution

Flight period



from Serbia were found to belong to *S. meridionalis* (Jović *et al.* 2009) and no confirmed record is available from Albania (Muranyi 2007). The situation in Hungary, where both species occur, is unclear as most records of *Somatochlora* from the country are based on larvae that were not identified to species (see under *S. meridionalis*).

Trend and conservation status

Somatochlora metallica is a common and widespread species and is not currently threatened. In south-eastern Europe it is dependent on relatively few mountain lakes and many populations are isolated. Here, habitat destruction and desiccation due to climate change may lead to its decline.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Near Threatened
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

Somatochlora metallica occurs at standing and slow-flowing waters, which may be partially or nearly completely shaded. Lowland and mid-elevation localities are often in forested or semi-forested areas. Suitable habitats include mostly standing waters such as lakes, ponds, large pools and open water in fenland and *Sphagnum* peatbogs. More rarely the species is found at slow-flowing to moderately swift streams and rivers, as well as at man-made canals. Most habitats have a bankside vegetation of trees, high reeds or *Sphagnum* rafts, with stretches of open water without vegetation. The water is generally over a metre deep and bottom sediments are rich in organic detritus and often muddy. In the highest European mountains, the species extends beyond the tree line and is well established in a number of lakes and large open bogs. It is present in low numbers in the tundra landscapes of northern Fennoscandia, north of the taiga (Schröter 2012). The species has a wide altitudinal range and in temperate Europe it occurs from the lowlands up to 2 400 m. However, it is the most common at the middle elevations, with for example 70 percent of Swiss records coming from around 600 m (Wildermuth 2005). In the south of its range, the species becomes progressively more restricted to higher altitudes, being confined to mountain lakes between 850 and 2 350 m in Spain and the Balkans.

Somatochlora sahlbergi Trybom, 1889

J.-P. Boudot & S. Karjalainen

Distribution

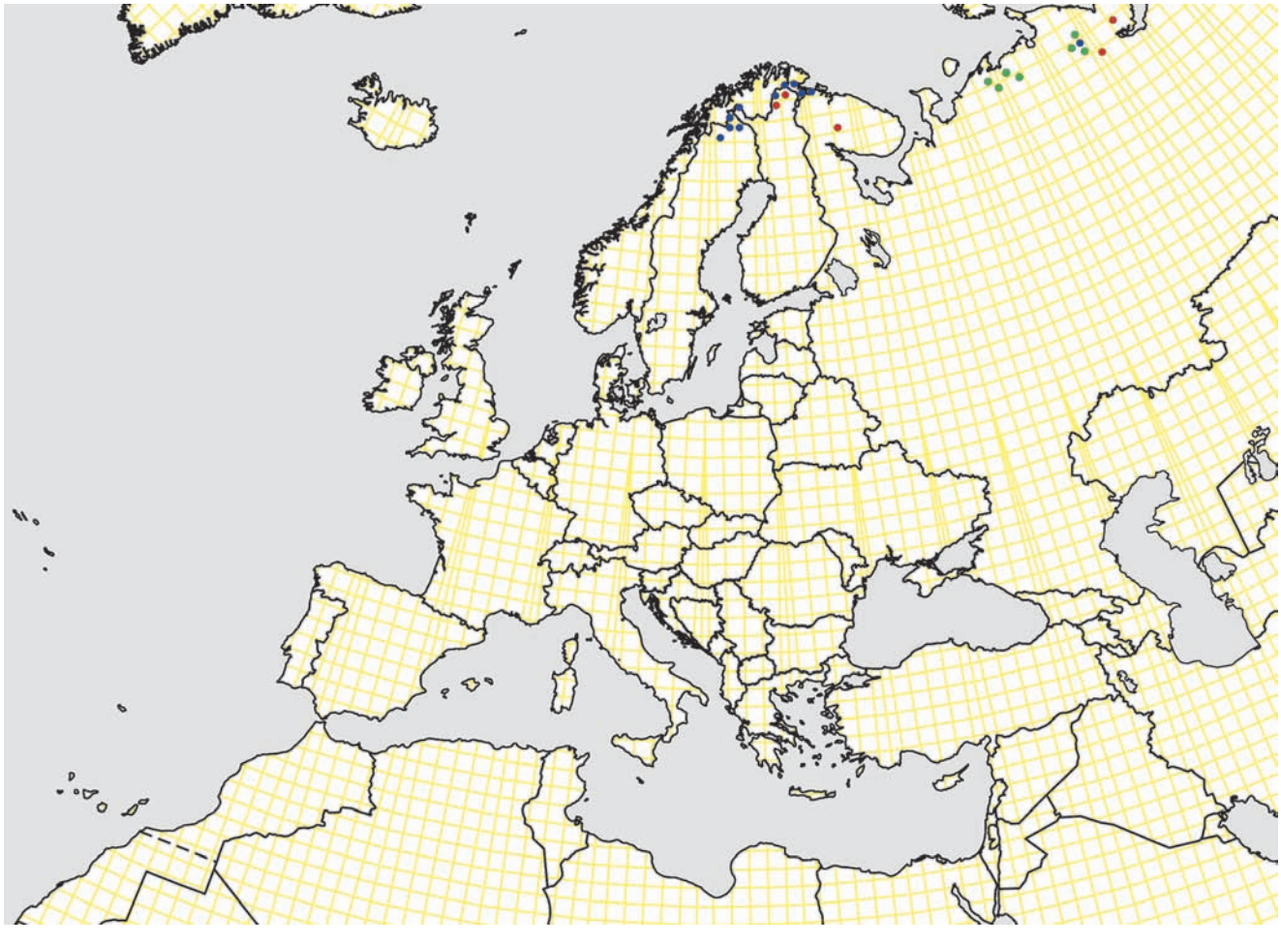
World: *Somatochlora sahlbergi* is a Holarctic species of which most localities are found near or north of the Arctic Circle, with a few others occurring in areas of cold climate. The species is often referred to as the northernmost dragonfly in the world. Despite its large range, it is rather poorly known and less than eighty sites are currently documented worldwide (Cannings & Cannings 1997, Schröter 2011). Most of these are found around the tree line in the transition area between taiga and tundra. In North America, it extends from Alaska to north-west Canada. In Eurasia it is found in several apparently disjunct areas, one in the extreme north of Fennoscandia and Russia, another

extending from the Altai across the south of Siberia with isolated records in Amurland and a relatively small area of occurence in Kamchatka (Kosterin 1992). Siberia is, however, is poorly explored and the presence of populations in the intervening areas, particularly at higher altitudes, cannot be ruled out.

Europe: Fewer than 30 European localities for *S. sahlbergi* are known, all found in the region from the north of Fennoscandia to the north-east of European Russia. The records from the north-east of European Russia by Tatarinov & Kulakova (2009) are probably based on larvae but are supported by a record of an adult from the same general area published by Brockhaus (2013). All European populations are found in areas with permafrost, near and north of the Arctic Circle, in either the tundra or the northern parts of the taiga. To the east these localities are contiguous with those found in the north of central and western Siberia (Kosterin 1992, Schröter 2011). Most populations of the species are either small, or fluctuate greatly in the number of adults present annually. In large parts of its range the habitats of *S. sahlbergi* are difficult to access and, as adult activity is largely restricted to sunny periods, poor weather conditions often limit the chances of finding the species on the wing. Most of the regions where *S. sahlbergi* occurs are poorly surveyed and many populations probably remain to be discovered.

Trend and conservation status

Somatochlora sahlbergi was assessed as Data Deficient on the European Red List due to the scarcity of available data. The areas where the species occurs are amongst the best preserved in Europe, human impact being gen-



European distribution

World distribution

Flight period

There are few records available for *S. sahlbergi*, and details of its flight period are scant. People visiting the habitats where *S. sahlbergi* occurs tend to go at the peak of its flight period, and thus information on the start and end of the flight period is especially scarce. Valle (1931) showed that in the tundra emergences begin during the first week of July. Records from Norway, Sweden and Finland range from the beginning of July to the end of August, with a peak in late July.

erally low and suitable habitat common. However, *S. sahlbergi* is likely to be adversely affected by climate change through the loss of its preferred habitat (palsa mires), increased competition with species experiencing northwards expansion such as *S. metallica* (Schröter 2012), and increased defoliation of the birch transition forest by two geometrid moths, which serves as shelter for the dragonflies (Schröter 2011).

Habitats Directive	No
Red List EU27	Data Deficient
Red List Europe	Data Deficient
Red List Mediterranean	Not present
EU27 endemic	No
European endemic	No
Trend Europe	Unknown

Habitat

All European populations of *S. sahlbergi* are found north of 67 ° N in the transition zone between the taiga and the tundra and further north. These landscapes are either open or covered by an open bush formation of stunted subarctic Mountain Birch *Betula pubescens tortuosa*. According to Butler (1992) and Schröter (2011), the species is found at habitats such as peaty lakes bordered with sedges and flooded depressions in *Sphagnum* peat bogs, with a water depth of at least 50 cm. According to Cannings & Cannings (1985, 1997), the two common parameters correlated with the occurrence of *S. sahlbergi* in Canada are the presence of aquatic peat moss (*Sphagnum*) as the dominant vegetation and deep, cold water. The species seems to be confined to areas with long and cold winters and short summers in regions with a moderate amount of summer precipitation. These conditions allow the formation of palsa mires and bogs (ice lenses covered by peat hummocks giving rise to flooded bogs and peaty pools after melting). *Somatochlora sahlbergi* is in Europe largely restricted to such habitats, which ensure permanent cold water throughout the year, although it does not occur over the whole palsa area (Schröter 2011). In eastern Russia, the species also occurs in areas without palsa mires, showing that it is not strictly dependent on this kind of habitat. The overall picture is that *S. sahlbergi* is more a climatic specialist than a habitat specialist (Schröter 2011).

1 Selysiothemis nigra. Habitat of *Selysiothemis nigra*, Velo Blato, Pag Island, Croatia. Other species occurring here include *Lindenia tetraphylla*. Photograph KD Dijkstra.

2 Trithemis kirbyi. Habitat of *Trithemis kirbyi*, Sanlucar la Mayor, Sevilla, Spain. Successful reproduction occurs after disuse of the pool from September onwards, with emergence in March and April. Other species that have emerged here include *Anax ephippiger, Crocothemis erythraea, Ischnura graellsii, Orthetrum chrysostigma* and *Trithemis annulata*. Photograph Pim Edelaar.

3 Leucorrhinia caudalis. Habitat of *Leucorrhinia caudalis*, Blistorp, province of Skåne, Sweden. Other species occurring here include *Cordulia aenea, Epitheca bimaculata, Erythromma najas, Leucorrhinia albifrons* and *Orthetrum cancellatum*. Photograph Magnus Billqvist.

4 Sympetrum sinaiticum. Habitat of *Sympetrum sinaiticum*, 1 km east of Teresa de Cofrentes, Spain. No other species were observed here. Photograph Christophe Brochard.

5 Zygonyx torridus. Habitat of *Zygonyx torridus*, Rio Genal, Málaga province, Spain. Other species occurring here include ***Calopteryx haemorrhoidalis, Onychogomphus forcipatus unguiculatus, Orthetrum chrysostigma*** and ***Trithemis kirbyi.*** Photograph Roy van Grunsven.

6 Brachythemis impartita. Habitat of *Brachythemis impartita*, Lago di Ci Xerri, Sardinia, Italy. Other species occurring here include ***Ischnura genei*** and ***Orthetrum trinacria.*** Photograph Geert De Knijf.

7 Orthetrum nitidinerve. Habitat of *Orthetrum nitidinerve*, Ci Xerri river near Siliqua, Sardinia, Italy. Other species occurring here include ***Calopteryx haemorrhoidalis, Ceriagrion tenellum, Erythromma lindenii, Ischnura genei, Orthetrum cancellatum, O. coerulescens*** and ***Trithemis annulata.*** Photograph Geert De Knijf.

Brachythemis impartita (Karsch, 1890)

V.J. Kalkman & G. De Knijf

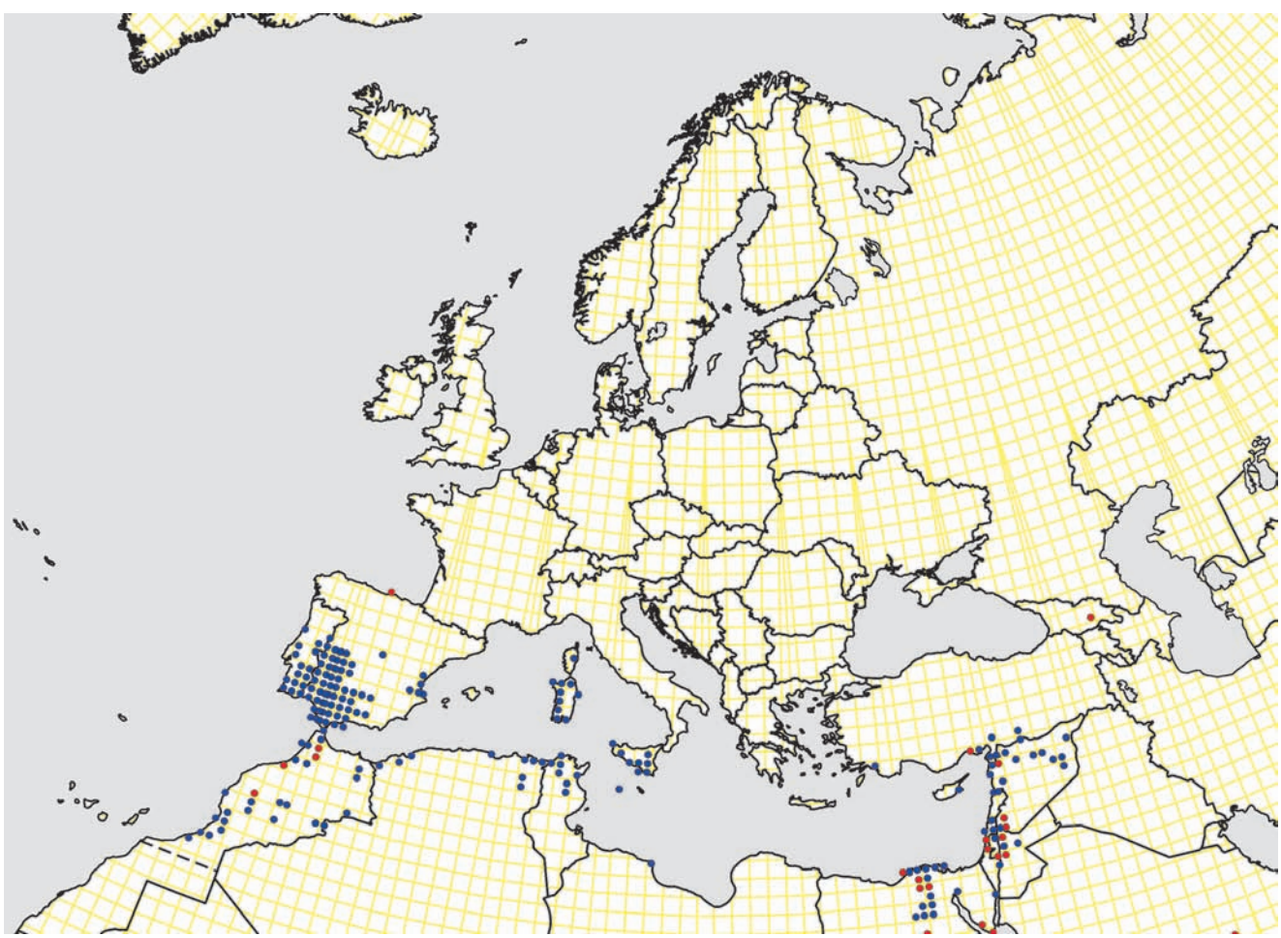
Taxonomy

Until 2009 the name *Brachythemis leucosticta* (Burmeister, 1839) was used for the *Brachythemis* species occurring in Europe and North Africa. Dijkstra & Matushkina (2009) showed that what was considered one species are in fact two closely related species, which differ in both male abdominal structure and the coloration of the wing venation. True *B. leucosticta* is confined to the southern two-thirds of Africa and Madagascar whereas the species occurring in the northern two-thirds of Africa is *B. impartita*.

Distribution

World: The species has a scattered distribution over the northern two-thirds of Africa, although it is absent from desert areas. Since the end of the 1970s, it has become increasingly common in the southern half of the Iberian Peninsula, Sardinia and parts of Sicily. In western, central and eastern Africa its range broadly overlaps with that of its sibling species *B. leucosticta*, which replaces it in the southern part of Africa and Madagascar (Dijkstra & Matushkina 2009). In northern Africa *B. impartita* has just scattered occurrences in the region from Morocco to Tunisia and in Mauritania and the Nile Valley, where it is generally uncommon although locally abundant. In South-west Asia it extends across the Levant to southern Turkey and was recently found on Cyprus. An old museum specimen from Georgia (Bartenev 1913) probably refers to a wanderer. The few records of *Brachythemis* from the Arabian Peninsula that were checked were found to refer to *B. impartita*.

Europe: *Brachythemis impartita* is a newcomer to Europe, being first recorded in Portugal in 1957 (Reis Moura 1960). Further findings remained rare until the beginning of the eighties, with first records in Spain in 1961 (Compte Sart 1962), Sardinia in 1979 (Crucitti *et*



European distribution

al. 1981) and Sicily in 1980 (Carchini 1983). Since then, the species has expanded to Cyprus (2007) (Cottle 2007) and Corsica (2013) (Duborget 2013). At present, it is locally common in southern Sicily, Sardinia (Hardersen & Leo 2011) and the south-west of the Iberian Peninsula. Scattered records are known from central and eastern parts of Spain. Densities can be locally very high and the species is, for example, the most common summer dragonfly on Sardinia (Hardersen & Leo 2011). Over 10 000 adults were recently seen along several hundred metres of the shoreline of a Portuguese barrage dam and the lake itself was estimated to be home to millions of individuals (De Knijf & Demolder 2010). For Cyprus there is only one record of three individuals observed in August 2006 and it is unclear if the species is established on the island (Sparrow *et al.* 2015).

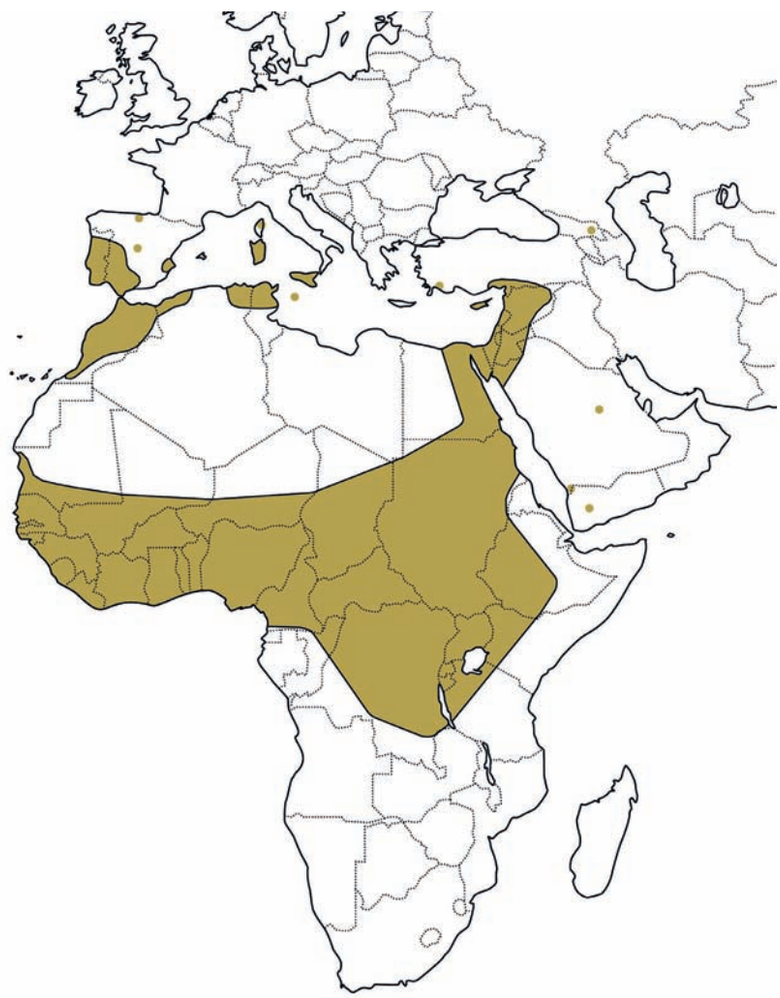
Trend and conservation status

Records suggest that in recent decades, *B. impartita* has increased in northern Syria and the nearby part of Turkey as well as in south-western Europe, expanding significantly to the north. However, only vagrants have been found in the European part of the East Mediterranean and thus far no significant expansion has occurred there. Despite its relatively small European range, the species is considered of Least Concern, as it probably profits from both climate warming and the creation of a number of dam lakes which allowed it to spread both southwards in Morocco and Tunisia (Boudot & De Knijf 2012) and northwards in Europe and the Levant.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Increasing

Flight period

Brachythemis impartita has a long flight period and in Europe is on the wing from April/May to September/October (Sánchez García *et al.* 2009, Maravalhas & Soares 2013, Riservato *et al.* 2014b).



World distribution

Habitat

Brachythemis impartita breeds in a wide range of stagnant water bodies with a preference for large lakes. Many European populations established on large man-made barrage lakes. The species is also found, albeit much less frequently, on slow flowing rivers. Preferred habitats have open water with varying level and are surrounded by gentle sloping and fully sun-exposed dirt banks with little or no vegetation (Jacquemin & Boudot 1999, Sánchez García *et al.* 2009, De Knijf & Demolder 2010). The species often occurs in high densities and shows a nomadic behaviour, resulting in a readily colonisation of newly created water bodies and in records of vagrants outside of its breeding range.

Crocothemis erythraea (Brullé, 1832)

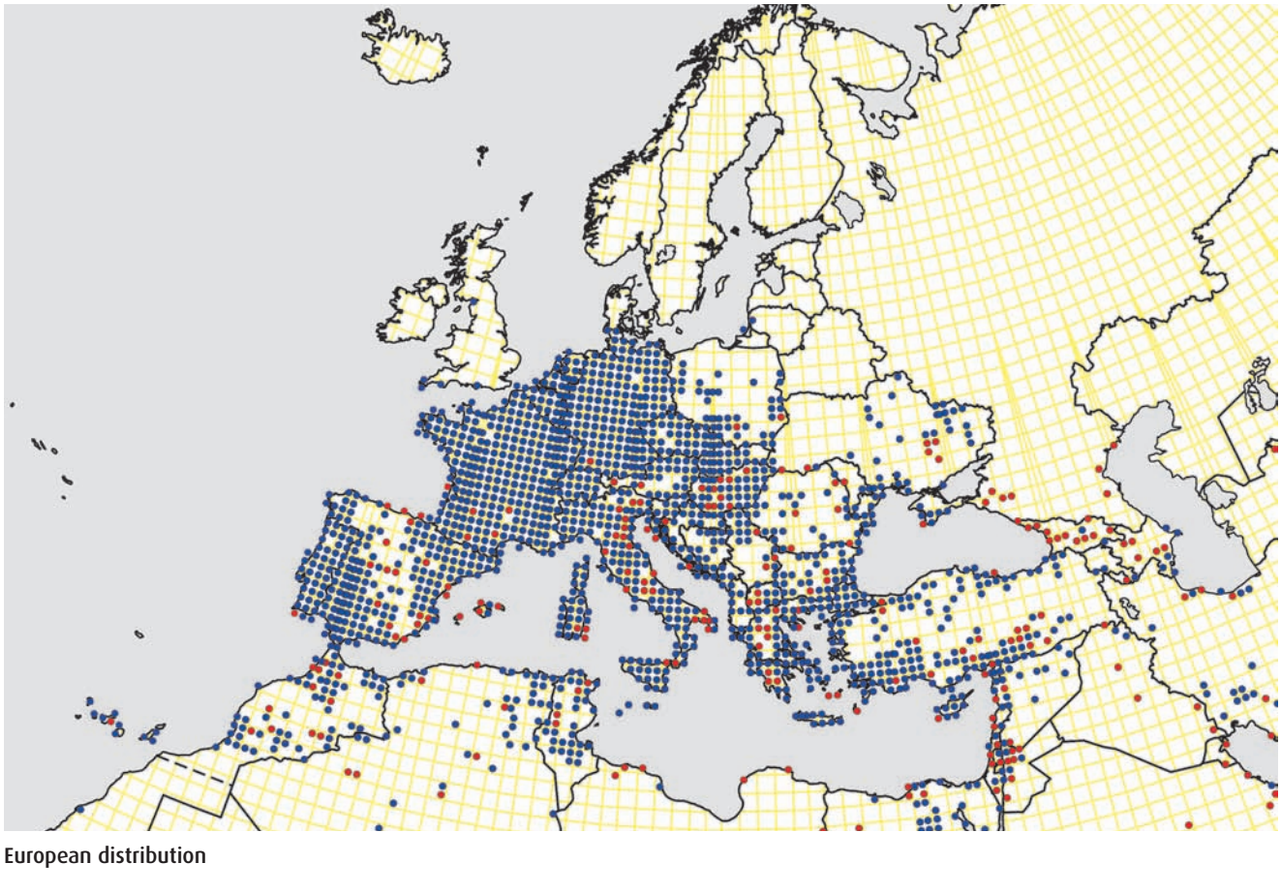
V.J. Kalkman

Taxonomy

In several European countries, *Crocothemis erythraea* was regarded as a subspecies of *C. servilia* for most of the 20th century. The two taxa are however structurally distinct (Schneider 1985) and are currently regarded as full species. *Crocothemis servilia* is an Oriental species extending west as far as the Levant and part of the southern coast of Turkey; it does not occur in Europe. The relationship of the European and west Asian populations of *C. erythraea* with those in the Middle East described as *C. erythraea chaldaeorum* Morton 1920 is still unclear, as well-defined characters separating the two have not yet been identified (see e.g. Schneider 1985, Borisov & Haritonov 2008, Schröter 2011).

Distribution

World: *Crocothemis erythraea* is very common and widespread throughout Africa, the Mediterranean, the Arabian Peninsula and large parts of south-west Asia. In the latter, it overlaps with its Oriental sibling species, *C. servilia*. Correct identification of these two



European distribution

World distribution

Flight period

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Netherlands												
Bavaria, Germany												
France, north												
France, south												
Bulgaria & Greece												

taxa became only possible after Schneider (1985) illustrated the structural differences between them. Many older and even some recently published records of *Crocothemis* from south-west Asia are unreliable as identification was based on colour pattern only. The north-easternmost records of *C. erythraea* are from Central Asia, where the species is common in Kyrgyzstan (Schröter 2010b) and southern Kazakhstan (Chaplina *et al.* 2007, Borisov & Haritonov 2008), reaching to the east the Xinjiang province of China (Ris 1897). In the south-east of its range, *C. erythraea* is found in Kashmir and from there it occurs along a small fringe in the southern parts of the Himalayas, at least as far east as Nepal (Vick 1989, Clausnitzer & Wesche 1996).

Europe: *Crocothemis erythraea* is common in most of southern and central Europe. The lack of records from parts of south-east Europe is largely due to insufficient fieldwork. The species has expanded northwards in recent decades (Ott 2010) but is still very rare in Great Britain and northern Poland. It is expected to continue its northwards expansion in the coming decades.

Trend and conservation status

In the 1980s, the northern limit of *C. erythraea* was in northern France and southern Germany. Since it has shifted northwards by 600-700 km (Ott 2010, Khrokalo 2010) and the species is currently reasonably common in areas where it was absent at the start of the 1990s such as the Netherlands, northern Germany and southern Poland. Although vagrants were first record-

ed in Great Britain in 2005 and the species has since been observed several times, reproduction has not been recorded to date in the British Islands (Parr 2010). *Crocothemis erythraea* was recorded as new to Kaliningrad (2008) and Lithuania (2014) recently (Shapoval & Buczyński 2012, D. Račkauskaitė & B. Gliwa *in litt.*) and it is expected to colonise the Baltic States in coming decades. It is likely to be present in Belarus although records are still lacking in this poorly investigated country. Future expansion into the south of Fennoscandia is possible.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Increasing

Habitat

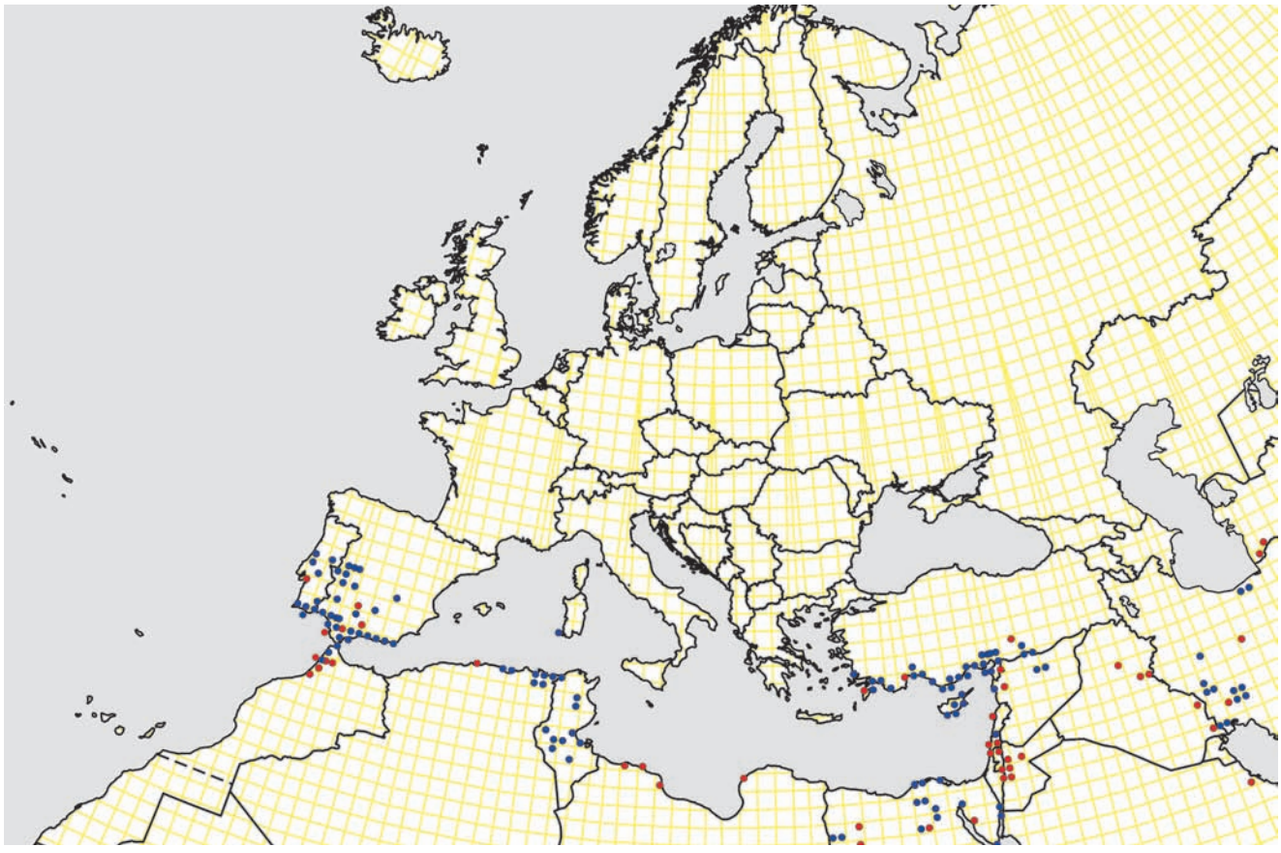
The species occurs at a wide range of running and standing unshaded waters, including rice paddies and brackish lagoons. In the northern part of its range, it is mostly found in well-vegetated waters of reasonable depth.

Diplacodes lefebvrii (Rambur, 1842)

V.J. Kalkman & G. De Knijf

Distribution

World: *Diplacodes lefebvrii* is a widespread and common Afrotropical species which extends eastwards over southern Arabia, the Persian Gulf coasts and inland Iran to Pakistan and south-western India. To the north it has a semi-continuous range from the whole of Egypt to large parts of the Middle East, whence its range runs east to Afghanistan and Tadjikistan. Its distribution in northern Africa outside Egypt is restricted to a few local occurrences within the Saharan belt and relatively sparse occurrences in



European distribution

World distribution

Flight period

Little information on its flight period in Europe is available. Sánchez García (2009) mentions the species as occurring from April to October in Extremadura and Maravalhas & Soares (2013) give April to September for Portugal. In Cyprus records range from 5 May until 20 October (Sparrow *et al.* 2015). Moroccan records are from mid-April to the start of October (Jacquemin & Boudot 1999). The dates available for Sardinia range from 11 September to 18 October (Rattu et al. 2014).

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Turkey													

the Maghreb, from where it has colonised the south-western part of the Iberian Peninsula and the south of Sardinia.

Europe: The European range of *D. lefebvrii* is confined to Rhodes (scarce), Cyprus (moderately common, first record from 1983) (Lopau & Adena 2002, Lopau 2010b) and the south-west of the Iberian Peninsula. The first Italian population was discovered in 2014 at a pond on Carloforte Island, south-west Sardinia (Rattu *et al.* 2014). As in the western Maghreb, the species remains rare in southern Europe.

Trend and conservation status

Records suggest that a slight increase and northwards expansion has taken place in the Iberian Peninsula but this increase is comparatively modest in comparison with other Afrotropical species. It is remarkable that the species has not colonised mainland Italy and Greece, even though both offer suitable climate and habitats. Present information suggests that *D. lefebvrii* is threatened in the southern coast of Iberia due to urbanization and water extraction, but has fared better at more inland localities. It is unclear if this results from a genuine increase or simply from increased survey activity.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

Diplacodes lefebvrii inhabits unshaded fresh and brackish standing waters, drainage ditches and sometimes quiet reaches of streams. It is mostly found in natural or man-made pools and at well vegetated lakes and flooded depressions with stretches of marshy vegetation, in both inland and coastal situations (Jacquemin & Boudot 1999, Sánchez García 2009, De Knijf & Demolder 2010). Primary habitats for the European populations seem to be (brackish) coastal wetlands and dune ponds. The creation of inland ponds and barrage lakes seem to have favoured the expansion of the species away from their coastal habitats, which is also the case with *Orthetrum trinacria*. In most localities dense and relatively low vegetation is present, often consisting of grasses and sedges. In Cyprus, the species was found at a man-made lake fringed with reed and Reedmace (*Typha sp.*) (Lopau & Adena 2002). In Tunisia it is frequent in brackish drainage ditches in oases. In Namibia the species is often observed at waters with grass-like vegetation and mats of floating algae (Suhling & Martens 2007).

Leucorrhinia albifrons (Burmeister, 1839)

G. Sahlén & V.J. Kalkman

Distribution

World: *Leucorrhinia albifrons* is a Palaearctic species ranging from western and northern Europe to the north-east of the Altai Mountains (Kosterin *et al.* 2011). Although relatively few records are available from its Asian range, the species is probably more widely distributed in the region, but generally uncommon. It was reported on one occasion from the west of Kazakhstan, but with no detailed locality data (Chaplina *et al.* 2007).

Europe: Despite its relatively large range, *L. albifrons* is among the rarest European odonate species and throughout most of its range population density is low. The principal area of occurrence runs from eastern Germany and southern Fennoscandia to the Ural Mountains. The paucity of records from Belarus and Russia, in contrast to the numerous sites known from the Baltic States and southern Urals, is probably due to limited surveys. In this case, the majority of the European populations are probably to be found in Russia. To the south, only a few localities are known from Ukraine, including the Crimean Peninsula (Matushkina 2006). In central Europe, the species' range continues through the Czech Republic, Austria, Germany, the Netherlands and Switzerland to the Jura and the Alpine regions of eastern France. In this part of its range, the species is generally rare with widely scattered and generally small populations. An exception is the area in western France along the Atlantic coast of Aquitaine, where *L. albifrons* is widespread in acid peaty ponds and dune lakes in the Pine forest.

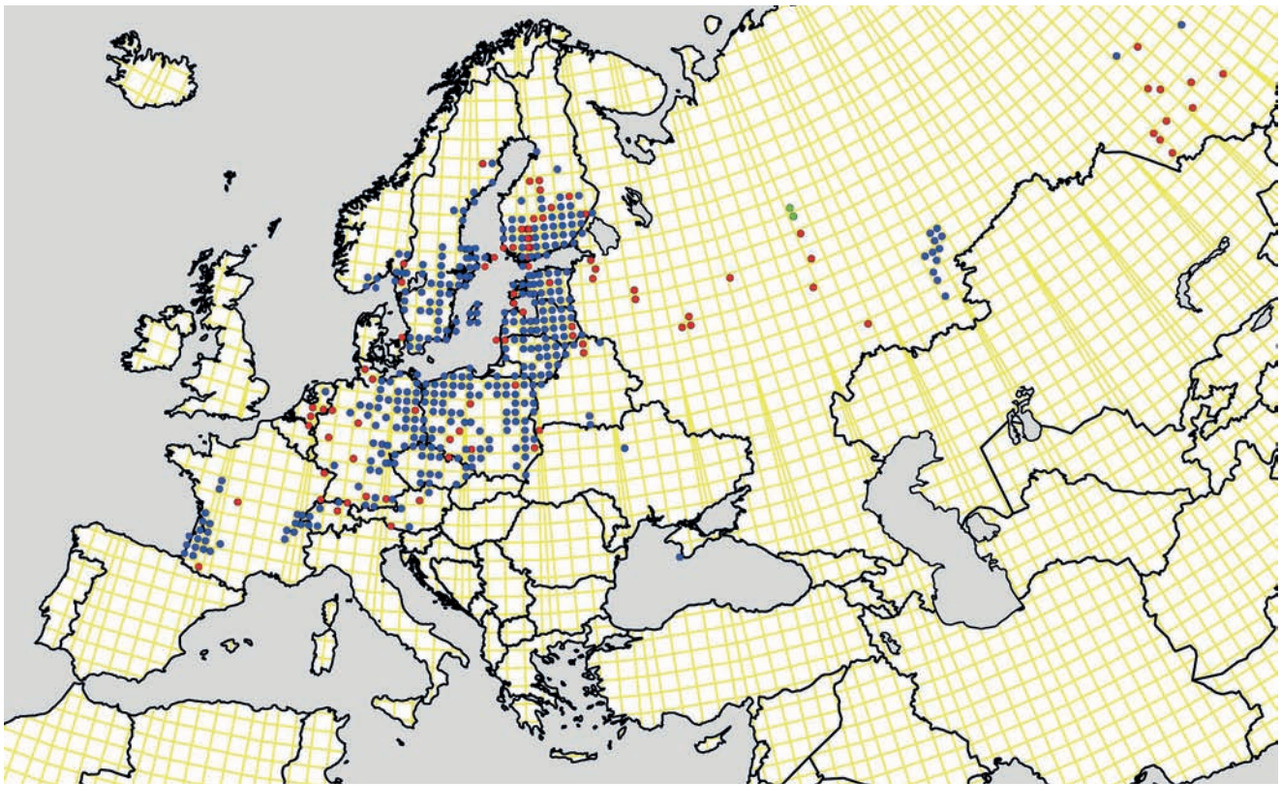
Trend and conservation status

Leucorrhinia albifrons experienced a severe decline in western Europe, especially during the second half of the 20th century. This resulted in the loss of a majority of populations in Germany, the Netherlands, Austria and Switzerland. At present, populations appear to be stable in most of these countries although the species is still declining in France due to the continuing expansion of agriculture in the Aquitaine coastal forest and the increasing use of lakes for water sports in the Alps. The major decline in western Europe was largely caused by the large-scale conversion of peat bog systems for agricultural purposes (mainly first half of the 20th century) and the eutrophication of mesotrophic lakes (mainly second half of the 20th century). Fortunately, outside France, large-scale habitat destruction has now largely ceased and the intensity of eutrophication has diminished; it is possible that the species will recover in coming decades. *Leucorrhinia albifrons* has its European stronghold in Sweden, Finland and the Baltic states and the species remains stable in these areas. For that reason it is only listed as Near Threatened on the EU27 Red List.

Habitats Directive	IV
Red List EU27	Near Threatened
Red List Europe	Least Concern
Red List Mediterranean	Endangered
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

Leucorrhinia albifrons is mainly found at oligotrophic to mesotrophic acidic lakes which are largely unshaded but often surrounded by forests. Many populations occur at *Sphagnum* peat bogs and in lakes which are



World distribution

Flight period

	Jan.			Feb.			March			April			May			June			July			Aug.			Sept.			Oct.			Nov.			Dec.			
Norway & Sweden																																						
Netherlands																																						
Bavaria, Germany																																						
France																																						

part of larger bog systems. Suitable habitats often have dark, organic-rich but non-turbid, water and generally have extensive bank side vegetation including peat rafts and moderately dense emergent and floating vegetation. More rarely the species is found at oligotrophic alkaline or weakly eutrophic lakes, oxbows with clear water or flooded quarries. It can coexist with fish in habitats where the vegetation offers shelter against predation; otherwise it is restricted to acidic waters, where fish are absent. It is largely confined to lowlands and rarely occurs above 500 m, although it is found up to 1 150 m in the Jura Plateau and 1 400 m in the French Alps.

Leucorrhinia caudalis (Charpentier, 1840)

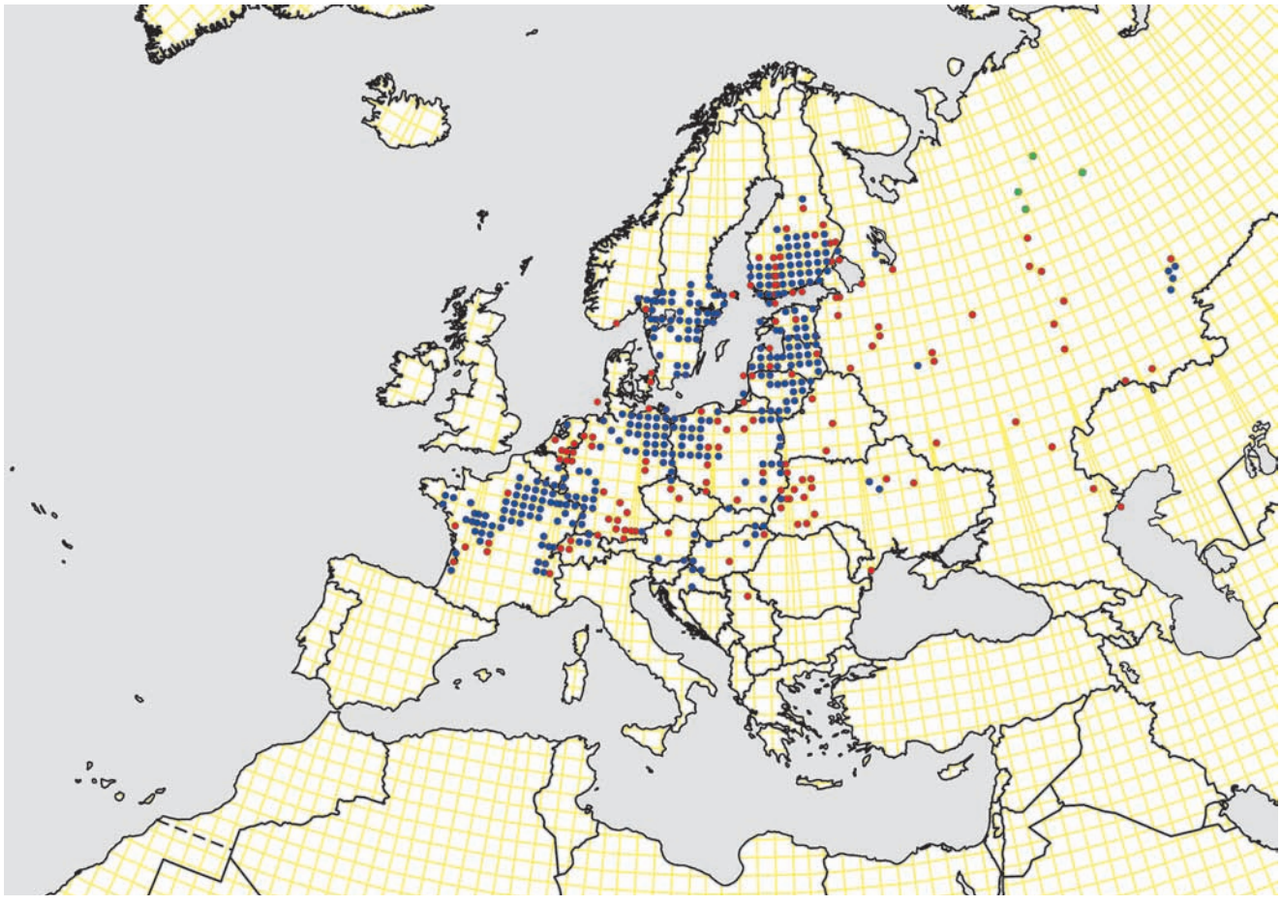
V.J. Kalkman & G. Sahlén

Distribution

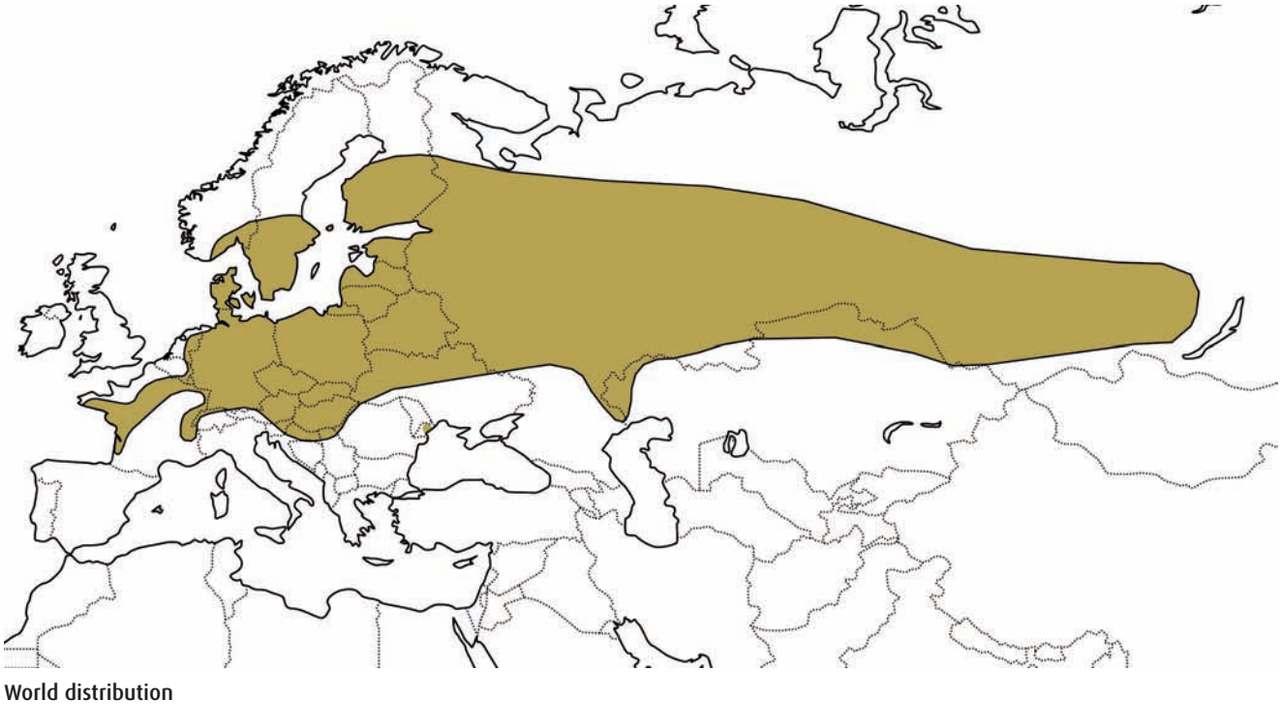
World: *Leucorrhinia caudalis* is a Palearctic species ranging from western Europe to the south of central Siberia (Belyshev 1973). There are less than twenty records within its Asian range, most being concentrated on the eastern side of the southern Urals and the northern foothills of the Altai. There is a single record from the Central Siberian Plateau, ca. 300 km west of Lake Baikal in the Angara River valley (Belyshev 1973; Deubelius & Jödicke 2010), suggesting that the species is widely scattered and scarce in the area between the

Urals and the Baikal. *Leucorrhinia caudalis* was reported only once from the western part of Kazakhstan but no locality data was given (Chaplina *et al.* 2007).

Europe: *Leucorrhinia caudalis* has a reasonably large European range but is only regionally common. The core of its European range includes northern France and north-east Germany to the Baltic States and southern Fennoscandia. Few records are available from the European Russia, Belarus and Ukraine, but this probably reflects a lack of surveys in this region, with the species expected to be present at many more

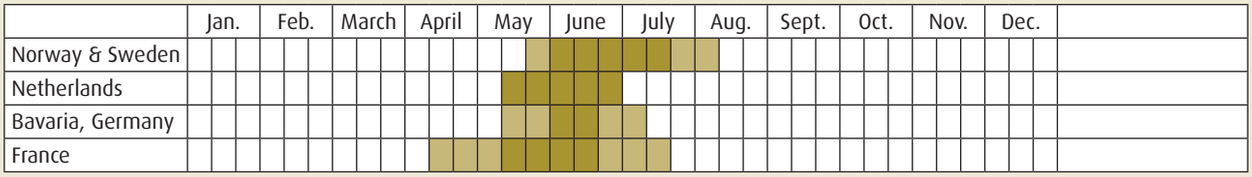


European distribution



World distribution

Flight period



sites in these countries than are presently known. In central Europe it is rare and populations are confined to the lower Alpine region and the Pannonian lowlands. In southeast Europe records are scattered along the Danube, Tisza and Drava rivers, the latter forming the border between Hungary and Croatia. Further south only isolated populations are known from Croatia and the north of Serbia (Jović *et al.* 2008b). In western Europe the species is well established from western Germany along the Rhine to the Atlantic coast in France, reaching an area running from northern Aquitaine to southern Brittany.

Trend and conservation status

Leucorrhinia caudalis experienced a considerable decline during the 20th century in large parts of Europe. In the second half of the century, it became extinct in the Netherlands, Belgium, Denmark, parts of Germany and parts of Switzerland, Austria and Poland. The distribution map suggests also a decline in western Ukraine and Russia, but this might be due to a lack of recent fieldwork. A recovery has been observed since the beginning of this century, resulting in an increase in the number of populations and an expansion of the species' range to the west. This expansion has been noted in Belgium, the Netherlands, Germany and France, where the species has recently been found in the west of the country (Mauersberger 2009, Deubelius & Jödicke 2010, Courant & Même-Lafond 2011, Muuse & Veurink 2011, Olthoff *et al.* 2011, Baeta *et al.* 2012). This recovery is likely to continue in the coming years. The decline in the 20th century was caused by eutrophication and an increasingly intensive management of water bodies, resulting in the loss of suitable mesotrophic habitats. The present recovery is more likely related to a general improvement in water quality than to global climate change, as this would be expected to result to a northward range contraction for this and other north-east European species (Jaeschke *et al.* 2012). *Leucorrhinia caudalis* has its European stronghold in northern France and in the region from north-eastern Germany to Finland and the species appears stable in these areas, for which reason it is only listed as Near Threatened on the EU27 Red List.

Habitats Directive	IV
Red List EU27	Near Threatened
Red List Europe	Least Concern
Red List Mediterranean	Near Threatened
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

Leucorrhinia caudalis is most frequently found at mesotrophic to weakly eutrophic lakes or bogs with a rich submerged vegetation often including hornworts (*Ceratophyllum*), watermilfoil (*Myriophyllum*) or Stoneworts (*Chara*). The species is often found at places with floating hydrophytes such as Waterlily (*Nymphaea alba)* on which males tend to perch; however, it also occurs at waters in which floating hydrophytes are largely absent. Most waters where the species occurs are relatively deep (1-3 metres) and have clear water. The banks are steep or shallow and are usually unshaded despite most populations being found in forested or semi-forested areas. Such habitats include lakes and oxbows fed with phreatic water, fishponds, peat excavations, gravel pits and lakes in quarries, mostly in lowland (rarely above 500 m). This species is much less sensitive to fish predation than the other *Leucorrhinia* species thanks to their well-developed mid-dorsal spines, which increase their survival chances in attacks from behind (Mikolajewski & Rolff 2004).

Leucorrhinia dubia (Vander Linden, 1825)

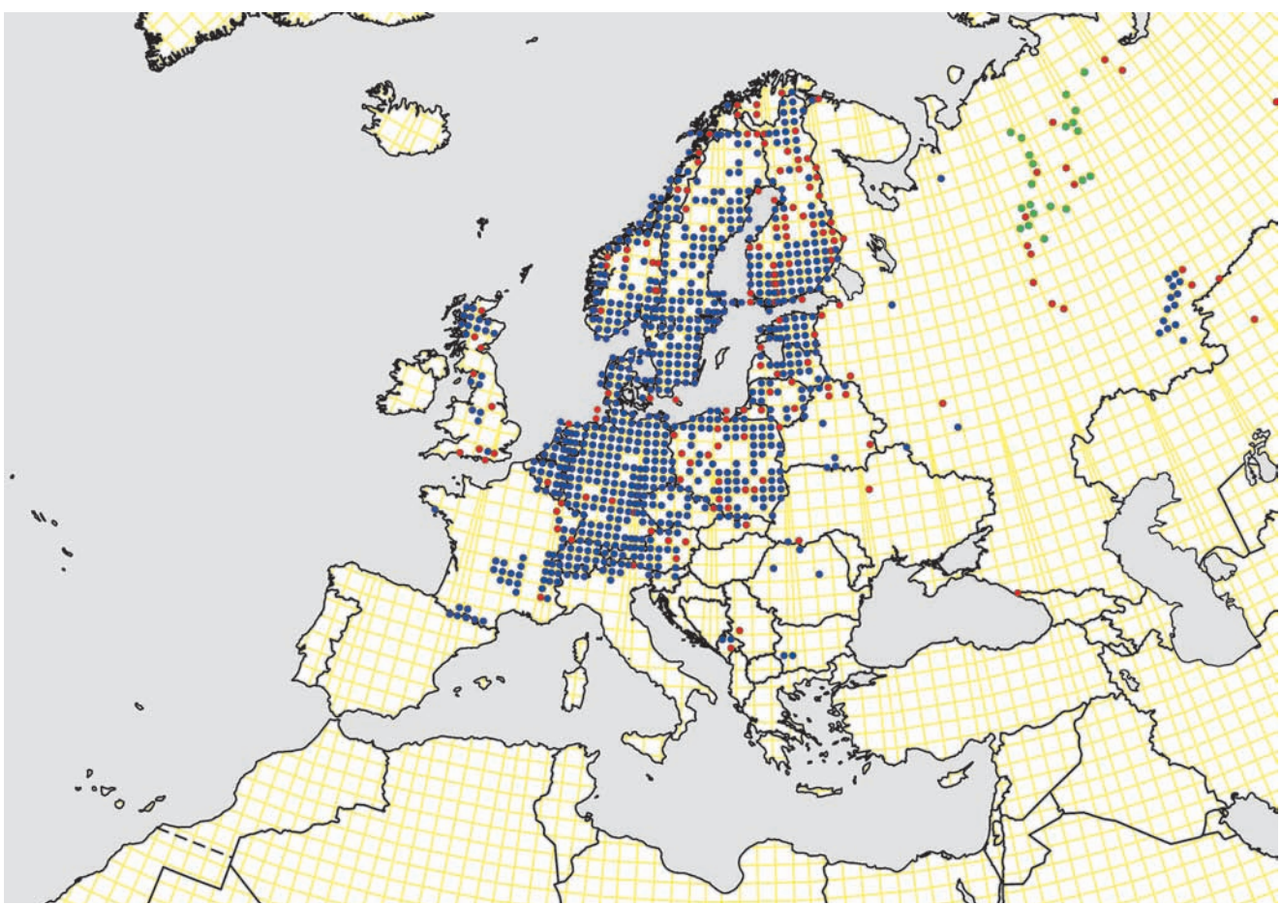
V.J. Kalkman, K. Aagaard & D. Dolmen

Taxonomy

There are two widely accepted subspecies, sometimes regarded as distinct species. A review of their characters and distribution is found in Kosterin & Zaika (2010). The principal distinguishing features of the Eastern Palaearctic *L. dubia orientalis* Selys, 1887 are the absence of spots on segments 4, 5 and generally 6, and the yellow colour of the spots on segments 6 and 7, which do not turn red with maturity. The larvae of *L. d. orientalis* often have strong curved spines on segment 4 to 7 and very long lateral spines. Based on the latter character this subspecies is sometimes regarded as a full species. It has, however, been shown that the size of the spines can vary regionally and locally in response to presence or absence of fish and, therefore, this feature appears to have little taxonomical value. In this work we follow Kosterin & Zaika (2010) and regard the taxon *orientalis* as a subspecies of *L. dubia*. *Leucorrhinia circassica* Bartenev, 1929 was described from the western Caucasus in Russia (see below). This taxon, close to *L. d. dubia*, is at most a subspecies of *L. dubia*. It has been largely ignored in the literature and may well fall within the range of variability of *L. d. dubia*.

Distribution

World: *Leucorrhinia dubia* has the widest range of all *Leucorrhinia* species and is found from Europe eastwards to Japan and Kamchatka. Most of the populations from central and eastern Siberia are referable to subspecies *L. dubia orientalis*, which extends westwards up to the boreal Urals across the north of western Siberia, while European populations to the west of this area refer to *L. d. dubia*. In large parts of northern Europe and Russia, it is among the most common and widespread spring species. It is absent from the warm and dry parts of Asia and does not extend south of northern Kazakhstan and the North Korean highlands.



European distribution

World distribution

Flight period

	Jan.			Feb.			March			April			May			June			July			Aug.			Sept.			Oct.			Nov.			Dec.		
Norway & Sweden																																				
Netherlands																																				
Bavaria, Germany																																				
France																																				

Europe: The species is common in central and northern Europe. It is expected to be much more common than presently known in a large part of Belarus and northern and central European Russia. It is absent from the southern lowlands of Ukraine and Russia. An isolated locality is known from the western Caucasus and it seems likely that the species is more widely distributed throughout this mountain range. In the south of Europe, *L. dubia* is rare and populations are mostly confined to mountainous areas and their foothills. By way of example, long-lasting populations are lacking in the French lowlands, rare in the lowlands of Belgium, southern Germany, the Czech Republic and Slovakia, but become common in the Vosges Mountains, the Jura Plateau, the northern Alps and the core of the Massif Central in France. In Switzerland and Austria, it is almost completely confined to higher altitudes, mostly above 1 000 m, where it is generally common. Further south, it is uncommon and mostly local on both sides of the Pyrenees. An ovipositing female was found on the Atlantic coast of Brittany in July 2013; this specimen was considered to be a vagrant as suitable habitats are regionally absent. A small number of isolated populations are known from the Carpathians and the mountainous regions of the Balkan Peninsula (Adamović 1990, Adamović *et al.* 1996, Gorb *et al.* 2000, Marinov 2004, Manci 2012). The distribution of the species in Great Britain mirrors that of the mainland, with the species widespread in Scotland but rare and more scattered in the south. Strangely, it is absent from Ireland although suitable habitats and climate seem to be present.

Trend and conservation status

Leucorrhinia dubia is widespread and common in large parts of Fennoscandia, northern Europe and most of the central European mountains. It is considered stable throughout most of its range. It has declined in Great Britain and has disappeared from the south of England, partly as a result of drought and natural succession (Cham *et al.* 2014). To a lesser extent this has also occurred along the southern edge of its main range (e.g. southern Germany, Switzerland and Austria). Here the decline seems to have mostly taken place during the second half of last century and was largely caused by the destruction of bogs. Populations in the French Pyrenees are stable. There is no information on the trend of the isolated populations in south-east Europe, but it seems likely that these will be negatively impacted by climate change.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Near Threatened
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

Leucorrhinia dubia occurs at bogs and acidic ponds, and also at lakes in the north of its range. Habitats are generally acidic and oligotrophic, with abundant stretches of peat moss (*Sphagnum*), rushes and sedges. Most sites are unshaded despite being often found in woodland. The water depth varies from a few centimetres to well over a metre. The extent of the habitat can be small (a few square decimetres to square metres) and generally includes either seasonally flooded depressions with peat moss (*Sphagnum*) or sections with open water with or

without floating peat moss (*Sphagnum*). In contrast to *L. rubicunda*, it is generally absent, or present only in low numbers, in waters with fish populations. In the past, populations in Fennoscandia have increased when acid precipitations led to a decrease in fish numbers (Nilsson 1981, Stenson & Eriksson 1989).

Leucorrhinia pectoralis (Charpentier, 1825)

V.J. Kalkman & R. Mauersberger

Distribution

World: *Leucorrhinia pectoralis* is a Palaearctic species ranging from western Europe across the south of western Siberia and the northern half of Kazakhstan to the foothills of the Altai Mountains. To the south the species extends across a large part of European Russia to the south Caucasus countries and the west and the north-east of Anatolia. Further fieldwork may show that it is more widely distributed in the Transcaucasus and Turkey than is currently known.

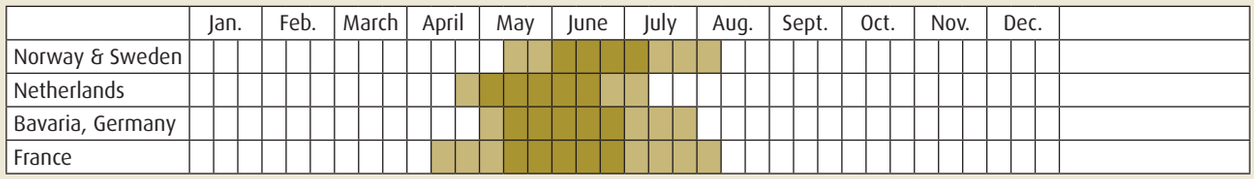
Europe: *Leucorrhinia pectoralis* is widely distributed in central Europe and the south of Fennoscandia but is rare in many countries. It is relatively common in the south of Sweden and the north of central Europe and is probably widely distributed in Belarus, northern Ukraine and large parts of the European Russia, although records in this region are few due to a lack of surveys. In the southern parts of western and central Europe, enduring populations become increasingly rare and are lacking in large areas in e.g. France and southern Germany. Nonetheless the species shows a more southerly distribution than its congeners, with scattered populations found down as far as south-western France, northern Italy, Slovenia and Croatia. Some of these southern localities might pertain to short-lived colonisations by migrants from more northern areas. Further south, there are scattered records partly belonging to vagrants from both sides of the Pyrenees, Bosnia and Herzegovina, Bulgaria, Macedonia, Romania and Serbia.

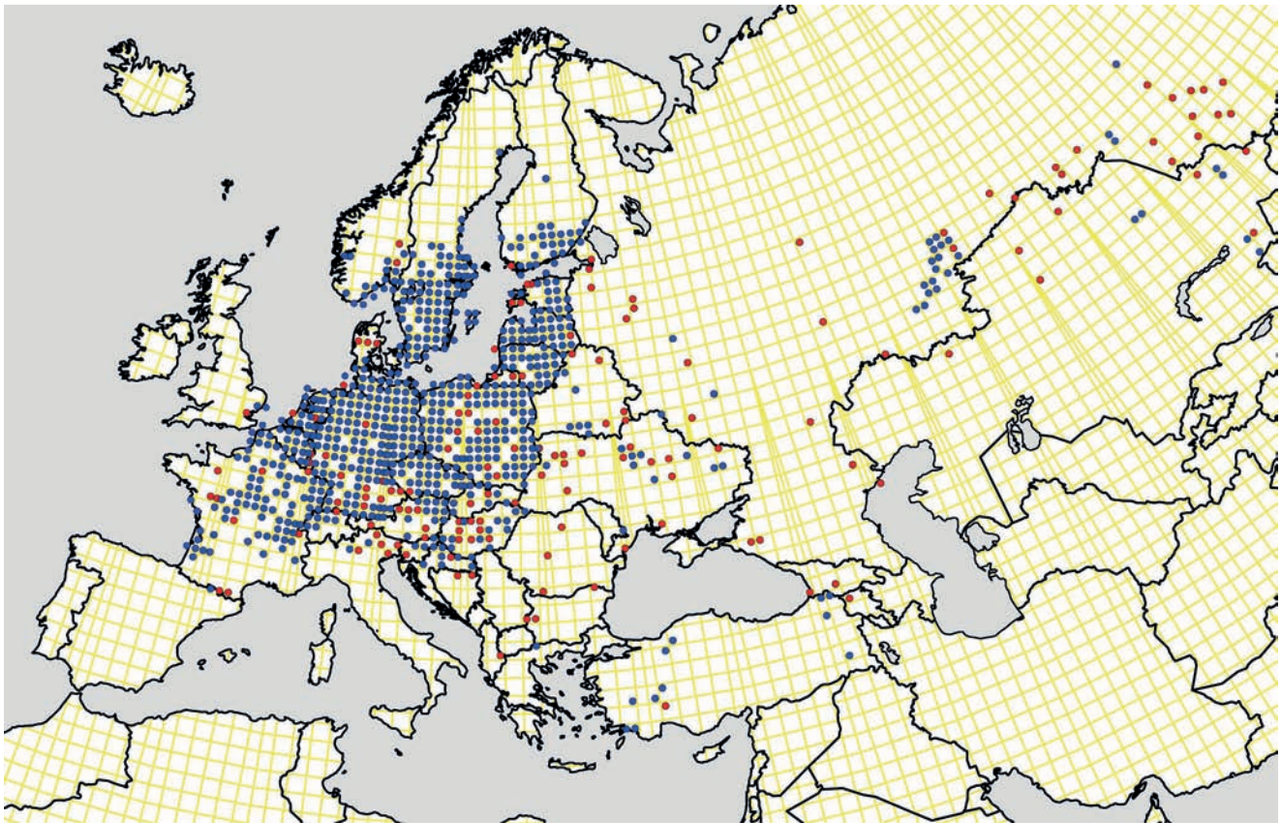
Trend and conservation status

Leucorrhinia pectoralis has declined in large parts of its European range, particularly in the western and southern parts of central Europe. In many countries such as Italy, Switzerland, Austria and Belgium, more than half of the localities were lost during the second half of the last century. The species is rare in most of the Balkan Peninsula with many of the records referring only to vagrants and, except for Slovenia and Croatia, very few recent records are available. Throughout Europe, *L. pectoralis* suffered mainly from eutrophication, large-scale conversion of fenlands and peat systems for agriculture and closure of former peat extraction excavations by natural succession (Wildermuth 2001). The decline of the species seems to have been halted since the 1990s and since the beginning of this century, a trend towards recovery has been reported in several areas, episodically assisted by large-scale migrations (Bouwman *et al.* 2008, Ott 2012). A large influx in western Europe in 2012 resulted in the species being recorded in Germany, Belgium, the Netherlands and northern Italy in areas where it was previously absent or very rare (Ott 2012, Festi 2012, Macagno *et al.* 2012). Two males were even recorded in Suffolk in the East of England, constituting the second and third record for this species in Great Britain (Parr 2013).

Habitats Directive	II + IV
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Decreasing

Flight period





World distribution

Habitat

The optimal habitat of *L. pectoralis* varies strongly between regions and compared with other *Leucorrhinia* species this species is found in a relatively wide array of habitat types, such as borders of *Sphagnum* bogs, gravel pits, forest lakes, fish ponds with large stands of reed, fenlands, marshy ditches, oxbows and even sluggish canals. The water surface of the larval habitat is typically unshaded and dominated by submerged vegetation, e.g. bladderworts (*Utricularia*) and hornworts (*Ceratophyllum*) in early and middle succession stages. This species is considered to be a specialist of shallow swampy and peaty habitats with black water in parts of central and eastern Europe, with the water varying from acidic to neutral. Larvae are sensitive to predation by fish and populations reach their highest density in fish-free waters. Larvae can coexist with fish, depending on fish species and density, but larval numbers are generally low in these situations (Mauersberger 2010). Nonetheless flourishing populations can be found in ponds with fish when surrounding belts of reeds and reed maces provide the larvae with adequate shelter (Grand & Boudot 2006).

Leucorrhinia rubicunda (Linnaeus, 1758)

V.J. Kalkman & M. Lohr

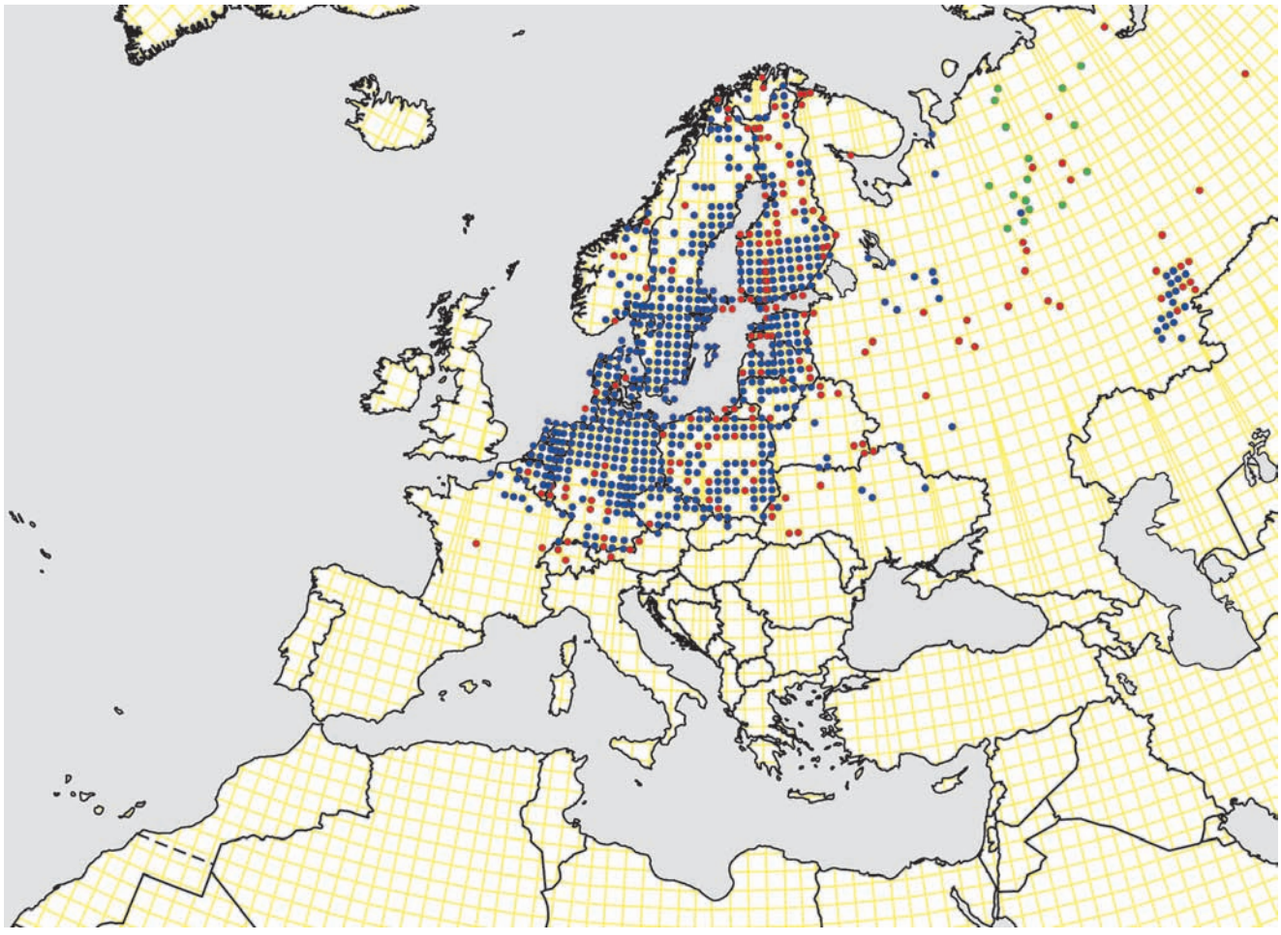
Taxonomy

We follow Kosterin & Zaika (2010) and regard *L. intermedia* as a distinct species, based on the differences in the lobes of the vulvar scale of the females. These are very short in *L. rubicunda* and clearly longer in *L. intermedia*. Other morphological characters have been shown to be unreliable in distinguishing these two species.

Distribution

World: *Leucorrhinia rubicunda* occurs from the north and the north-west of mainland Europe eastwards to north-east Kazakhstan, western Siberia and the eastern part of the Altai Mountains in the Tuva republic. *Leu-*

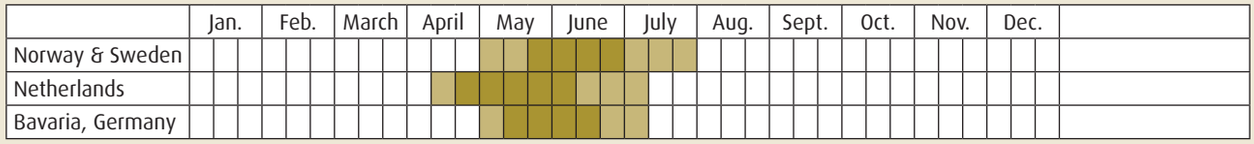
corrhinia rubicunda has a very northern distribution and is one of the few species common north of the Arctic Circle. East of its range, it is replaced by its close relative, *L. intermedia*, which reaches Hokkaido Island in northern Japan. At far northern latitudes in Siberia, the latter extends much further west, as with other



European distribution

World distribution

Flight period



eastern species, and approaches the boreal Urals. In the Yamal Peninsula, *L. rubicunda* and *L. intermedia* occur together (Kosterin & Sivtseva 2009, Kosterin & Zaika 2010).

Europe: *Leucorrhinia rubicunda* has, together with *L. dubia*, the northernmost distribution of all the European species of *Leucorrhinia*. The core of its range runs from northern Belgium, central Germany, the Czech Republic and Poland northwards almost to North Cape. It is among the most widespread and common species in Fennoscandia, although it is largely absent from the upland parts of Norway and Sweden. It is probably more widely distributed in Belarus, northern Ukraine and the European Russia than currently known. It is rare south of its core European range and the southernmost localities are found in the northern parts of the Alps with less than twenty small, isolated populations in Bavaria, Baden-Württemberg, and, formerly, Switzerland (Wildermuth *et al.* 2005). The species no longer breeds in eastern France, Switzerland and Luxemburg where it is considered extinct. In contrast to *L. dubia*, it has no isolated occurrences in mountains further south. Records outside its permanent range in France (Martin 1887, Gavory & Dommanget 1998, Vanappelghem & Veille 2001, Ternois *et al.* 2012, Moratin 2014), Luxemburg (Gerend 1998), Germany (Ott 2012) and Switzerland (Reiss 1990) are likely to refer to vagrants.

Trend and conservation status

Leucorrhinia rubicunda is thought to be stable in most of Europe. A decrease has been noted in the south and the west of its range and the species is extinct in France, Luxemburg, Switzerland and Austria. It is now very rare in Belgium and the German states of Bavaria and Baden-Württemberg. The southern populations of this boreal species might be increasingly impacted by global warming in the future.

Habitat

In the core of its range, *L. rubicunda* is common in peat bogs and fenlands, where it often co-occurs with *L. dubia* and, in some areas, with *L. pectoralis*. In these conditions the majority of its habitats are acidic and oligotrophic with a vegetation of *Sphagnum*, sedges and rushes. It can also be found in lakes and ponds, being less sensitive to fish predation and therefore less strongly confined to acidic fish-free waters. Habitats are largely unshaded but often situated in forest areas. Small, mostly short-lived populations occur in more nutrient-rich habitats such as dune lakes and quarries.

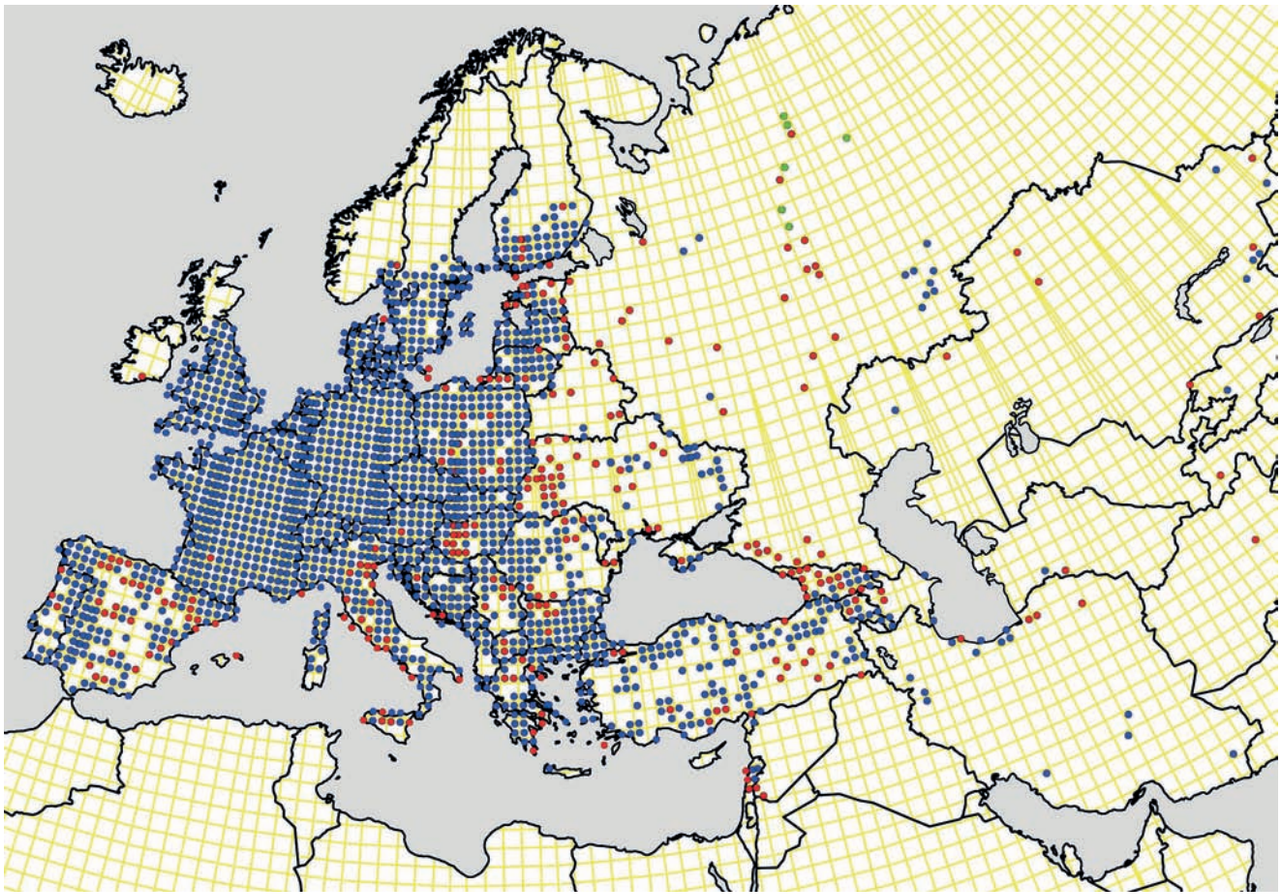
Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Not present
EU27 endemic	No
European endemic	No
Trend Europe	Decreasing

Libellula depressa Linnaeus, 1758

V.J. Kalkman & D. Chelmick

Taxonomy

A poorly defined subspecies, *L. d. taurica* Beutler, 1984, was described based on two males collected on the Crimean Peninsula (Ukraine) (Beutler 1984). The specimens differed from the nominotypical subspecies in the shape of the wings and abdomen, with their more slender abdomen being the most obvious difference. No records of similar specimens have since been published although typical *L. depressa* has been found at numerous localities in the Crimea (Khrokalo & Prokopov 2009). It therefore seems likely that the specimens described by Beutler (1984) were aberrations rather than representing a valid taxon.



World distribution

Flight period

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Norway & Sweden												
Netherlands												
Bavaria, Germany												
France, north												
France, south												
Bulgaria & Greece												

Distribution

World: *Libellula depressa* is largely confined to the Western Palaearctic, although it reaches south-western and central Asia from Iran to the east of Kazakhstan across to the mountains of Afghanistan, Tajikistan and Kirghizstan. Further east in China, it is replaced by the closely related *Libellula melli* Schmidt 1948. It is absent from Siberia and from the whole of Africa. Its southernmost populations are found in south-east Iran.

Europe: *Libellula depressa* is one of the most common and widespread European species. To the north it is limited to the southern parts of Fennoscandia and Scotland. There is a single old record (1834), presumably of a vagrant, from Ireland (Nelson & Thompson 2004).

Trend and conservation status

Libellula depressa is a very widespread and common species throughout much of its range. In Great Britain, it has expanded its range by approximately 100 km northwards during the last half century, which is largely attributed to climate warming (Hickling *et al.* 2005).

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

Libellula depressa is found in almost any type of still and slow flowing waters, ranging from slow rivers to

deep lakes. It is often found in habitats in the early stages of succession where parts of the banks are still bare and is often one of the first species to colonise man-made water bodies, including garden ponds. *Libellula depressa* is most common in lowland areas up to 700 m. However, breeding has been recorded in the Alps up to 1 400 m.

Libellula fulva Müller, 1764

V.J. Kalkman & D. Chelmick

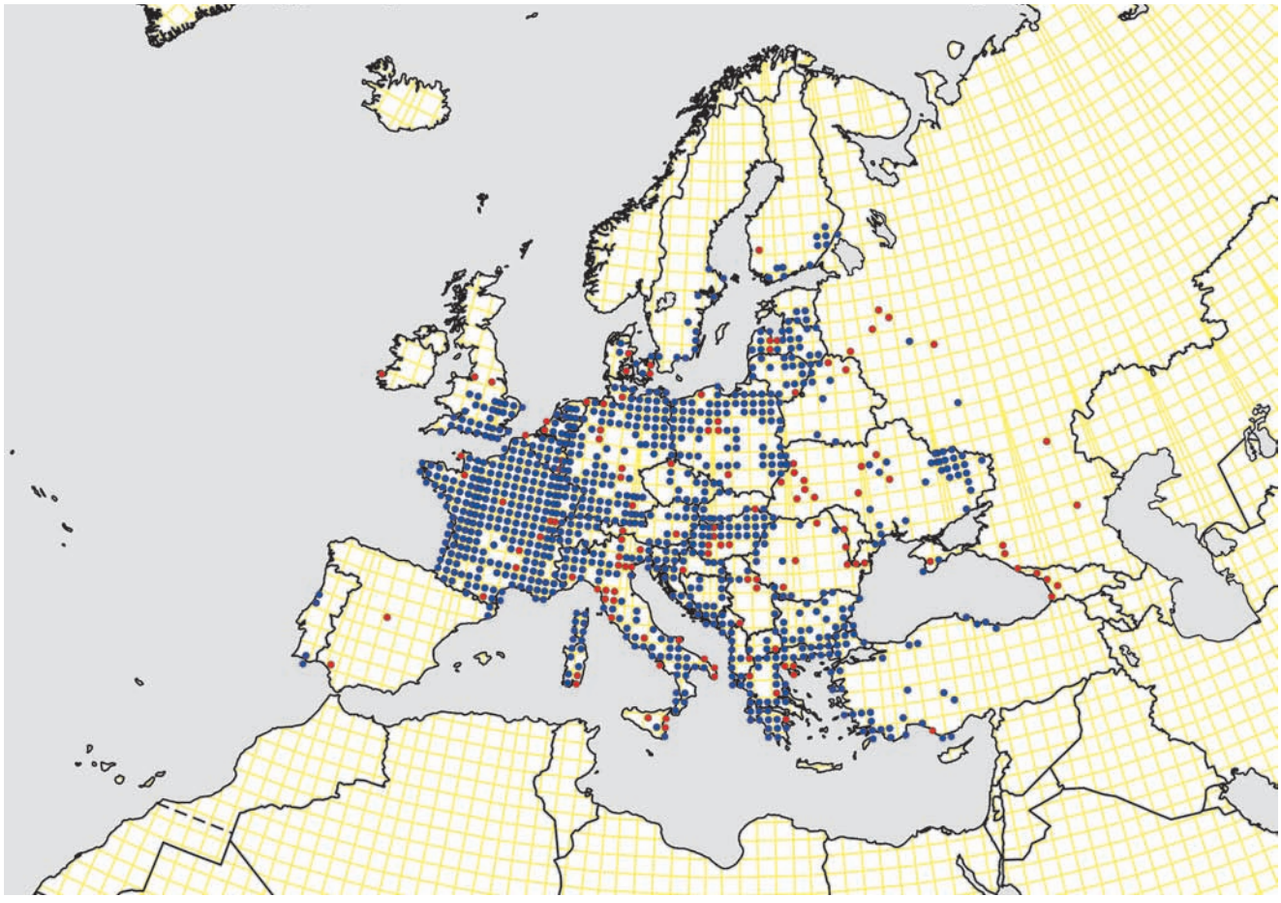
Taxonomy

In south-west Asia, *L. fulva* overlaps with *L. pontica*, the latter being considered until recently a subspecies of the former. The morphology of *L. pontica* is identical to that of *L. fulva*, save that the former is smaller and differs in the pattern on abdomen and wings and the colours of the body in mature males. The full species status of these taxa is supported by their broad range overlap in Turkey without any evidence of interbreeding.

Distribution

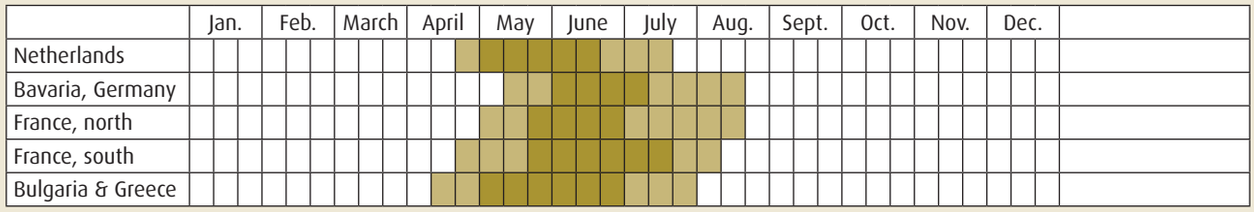
World: *Libellula fulva* is endemic to the Western Palearctic and occurs outside Europe only in Georgia and western and northern Turkey, where it is only locally common.

Europe: The species is widespread in large parts of Europe but has in many areas a patchy distribution, being uncommon or even rare in parts of its range. It is absent from most of Fennoscandia, where it is restricted to southern Sweden and Finland. The species is very rare in the Iberian Peninsula and is known from only a



World distribution

Flight period



handful of locations, although suitable habitats seem to be present. The only Irish record was made in 1849 and probably refers to a vagrant (Nelson & Thompson 2004).

Trend and conservation status

After an apparent decline during the 1970s and the 1980s, *L. fulva* has increased during recent decades in western Europe. It is now common in most of France, Belgium and the Netherlands, and in large parts of Germany, Poland and southern UK. The decline in the 1970s and 1980s was probably caused by large scale habitat destruction, water pollution and poor management of wetlands. Both habitat changes and the improved water quality which occurred in western and central Europe since the 1990s are probably largely behind the recent increase. As the northern border of the species range did not change significantly during the three last decades in the British Islands and Fennoscandia, the effect of rising temperatures is unlikely to have exerted an influence. The species may benefit from conservation action in the Iberian Peninsula, where it is still very rare.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

Libellula fulva is a rather ubiquitous species and occurs at lakes, ponds, pools, low peat marshes, coastal wetlands, drainage ditches and slow-flowing canals and rivers. Occasionally it is also found at quarries. The species prefers largely unshaded mesotrophic to eutrophic non-acidic waters. It is mainly present, but not always, at places where banks are fringed with an extensive, high and dense riparian vegetation such as beds of reed, reed mace (*Typha*), Bullrush (*Scirpus*) and/ or tall sedges. It is often found near forests but is absent from shaded waters. *Libellula fulva* is a lowland species and is mainly found below 500 m.

Libellula quadrimaculata Linnaeus, 1758

V.J. Kalkman, K. Aagaard & D. Dolmen

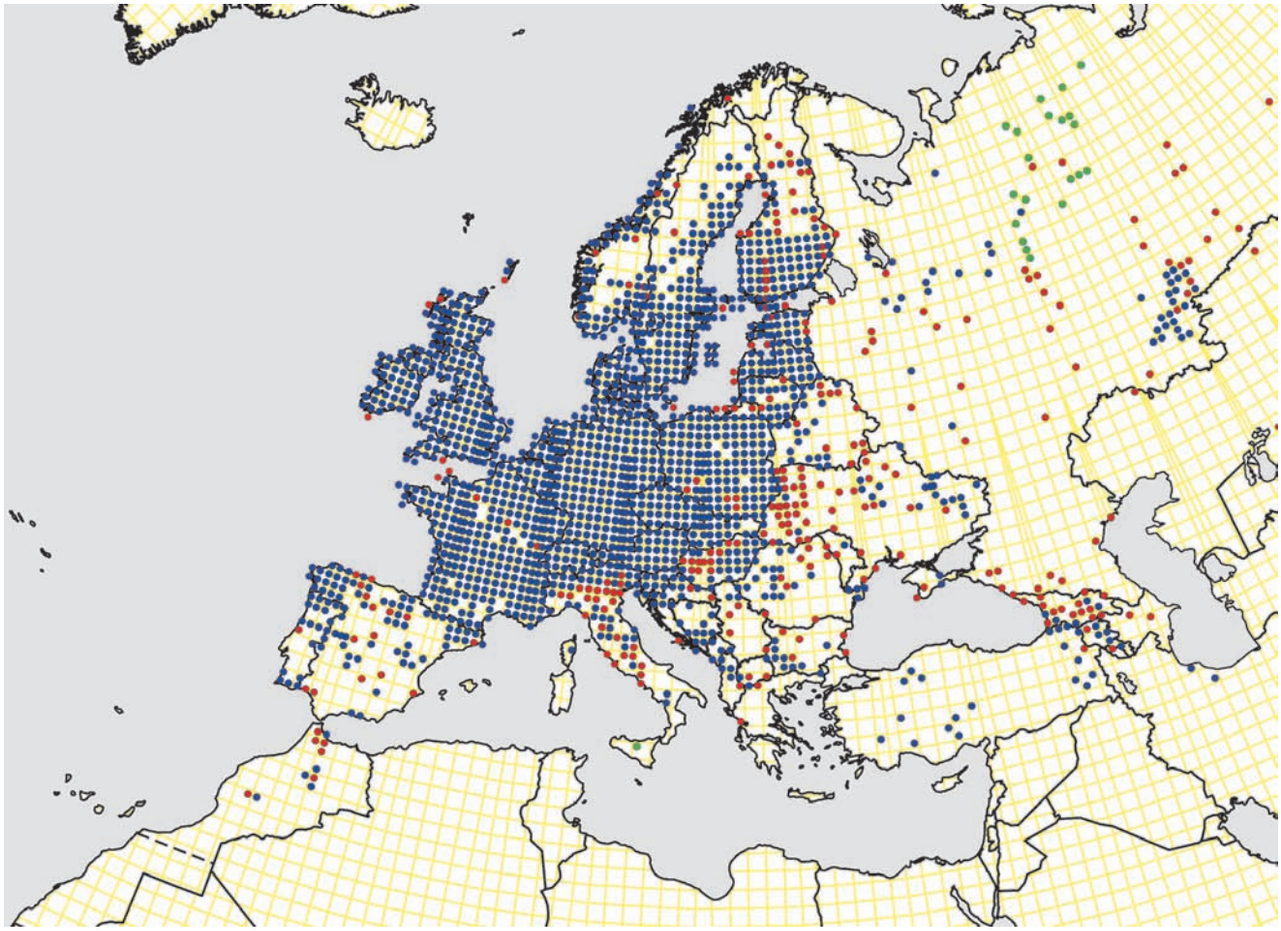
Distribution

World: *Libellula quadrimaculata* is one of the most widespread and common dragonflies in the world, ranging across large parts of both the Palaearctic and the Nearctic. Its African distribution is limited to the Atlas and Rif mountains in Morocco. In Asia, isolated records are available to the south as far as Iran, Afghanistan and southern China.

Europe: *Libellula quadrimaculata* is one of the most common and abundant dragonflies throughout most of Europe. It becomes rarer towards the Mediterranean, where it is largely confined to mountains. It is often abundant, and numerous reports have been published on large migrating swarms (e.g. Dumont & Hinnekint 1973).

Trend and conservation status

Libellula quadrimaculata is common in most of Europe and there is no indication of a serious decline. Dumont & Hinnekint (1973) reviewed the publications on migrating swarms of this species for western Europe over the last two centuries and concluded that large scale migrations take place on average every 10 years (range 6 to 14 years). Since the 1970s, no large scale migration of this species has been



European distribution

World distribution

Flight period

	Jan.			Feb.			March			April			May			June			July			Aug.			Sept.			Oct.			Nov.			Dec.			
Norway & Sweden																																						
Netherlands																																						
Bavaria, Germany																																						
France, north																																						
France, south																																						
Bulgaria & Greece																																						

reported in Europe, which might reflect a decline in numbers.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

The species occurs in a large variety of mainly standing waters but is most common on largely unshaded lakes and ponds with extensive riparian and aquatic vegetation as well as stretches of open water. High densities can be encountered in acidic lakes, ponds, bogs, fens and peat excavations; however the species also occurs commonly at man-made waters such as ditches and garden and fish ponds.

Orthetrum albistylum (Selys, 1848)

V.J. Kalkman & A. Ambrus

Taxonomy

The nominotypical subspecies is replaced by the subspecies *O. a. speciosum* (Uhler, 1858) in Japan, Taiwan, Korea and the eastern parts of Russia and China. This subspecies is identical in coloration and general morphology and differs only by its larger size and more slender abdomen.

Distribution

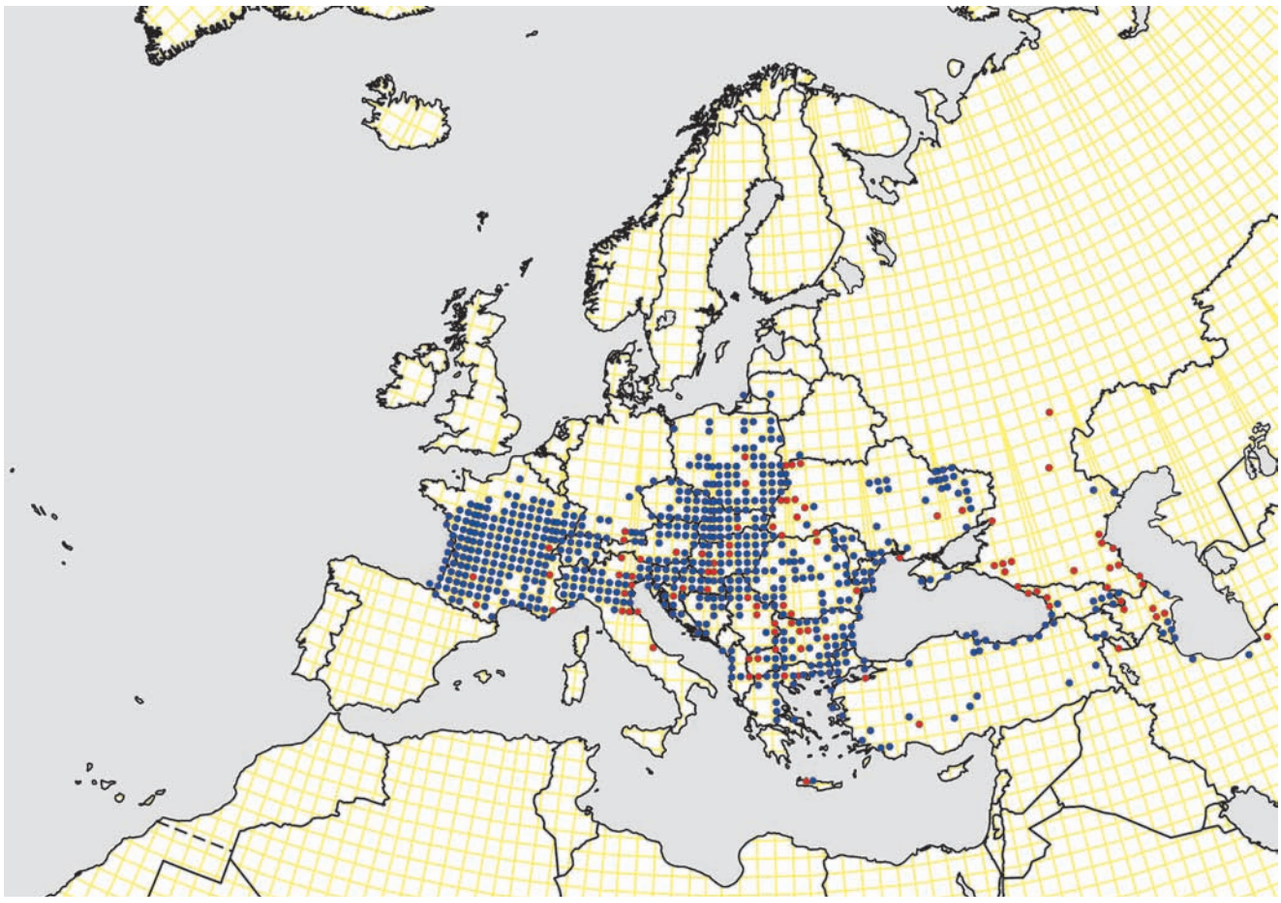
World: *Orthetrum albistylum* ranges from western Europe eastwards to Japan, occupying mainly the warmer parts of the temperate regions of Europe and Asia. In Europe it is absent from large, seemingly suitable areas and similar gaps in distribution might occur in its Asian range. It has numerous isolated occurrences in hot springs far north of its main range in central Siberia around Lake Baikal (Belyshev 1960, Borisov 2014), where larvae develop in water between 25 and 35 °C. The species is relatively scarce in south-western Asia, where it has a scattered distribution around the Caspian Sea and south of the Black Sea.

Europe: The core of the European range of *O. albistylum* runs from south-west France to the southern half of Poland, the Balkans and Ukraine. In some regions, for instance in the Pannonian Basin and south-western Ukraine, it is among the most abundant *Orthetrum* species, outnumbering its close relative, *O. cancellatum*. The species appears to be widespread in eastern Ukraine and, at least in the past, the south of European Russia, reaching both sides of the Caucasus and connecting with the Turkish and the few north Iranian populations. It is virtually absent from the Mediterranean islands, although two records are known from Crete (Lopau 2010b). Its near-absence from the Iberian Peninsula and central and southern Italy is noteworthy (one record each) and cannot be readily explained by the lack of suitable habitat or by climate conditions. Its northern distribution within Europe seems, to a large extent, to be determined by summer temperatures and the species is currently exhibiting a continued northwards expansion.

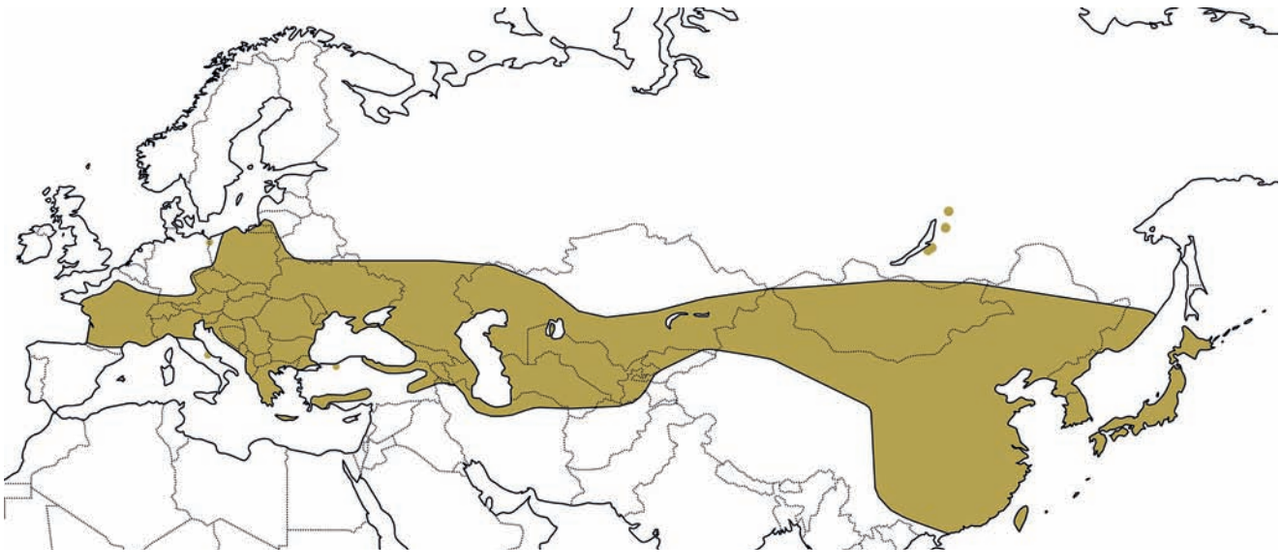
Trend and conservation status

Orthetrum albistylum has experienced a northwards expansion throughout most of its European range in the last forty years, particularly since the 1990s. This is attributed to both the creation of suitable man-made water bodies and the increase of summer temperatures. Examples of this are Switzerland, where *O. albistylum* was first found in 1970 and has since established itself in parts of the Swiss Plateau (Monnerat 2005), and Poland, where it has expanded northwards by 400 km since the 1990s (Buczyński *et al.* 2002). This range expansion is still taking place with a further recent extension noted in northern France (Ternois 2005, 2006, Ternois & Druart 2008,) and southern Germany (Weihrauch *et al.* 2003, Hunger 2006). The species has been recently discovered in Belarus in 2005 (Buczyński & Moroz 2008), Kaliningrad in 2011 (Shapoval & Buczyński 2012) and Lithuania in 2013 (Gliwa 2013). A further expansion in the Baltic States is expected in the future. There is no certain evidence of an increase in Ukraine or Russia although it seems likely this is occurring.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Increasing



European distribution



World distribution

Flight period

	Jan.			Feb.			March			April			May			June			July			Aug.			Sept.			Oct.			Nov.			Dec.			
France, north																																						
France, south																																						
Bulgaria & Greece																																						
Turkey																																						

Habitat

Orthetrum albistylum is found at a wide range of sunny standing and, more rarely, at slow-flowing waters. In the Mediterranean region it is also found at small intermittent streams with residual pools in summer. It favours relatively shallow areas where part of the fringes dry up in summer, but can also be found in deeper waters with steep banks such as fish ponds. This species appears to have a preference for man-made habitats, including quarries, sandpits and fish ponds and is largely confined to such areas in the north of its range, where it often acts as a pioneer species. Its occurrence in more natural habitats includes oxbows, pools in floodplains, shallow ponds with extensive reed belts and peaty ponds and lakes surrounded with banks and rafts of peat moss (*Sphagnum*), sedges and rushes. The water quality can vary from acidic and mesotrophic to neutral and eutrophic with low transparency. The water bodies often have submerged or floating vegetation such as watermilfoil (*Myriophyllum*) and/or waterlilies (*Nuphar lutea*, *Nymphaea alba*). The species appears not to be dependent on bank side vegetation and is able to cope with the presence of fish although it does require high water temperature, which is probably a key factor for its establishment. It is mainly confined to areas below 500 m but has been found breeding up to 860 m in Switzerland.

Orthetrum brunneum (Fonscolombe, 1837)

V.J. Kalkman & A. Ambrus

Taxonomy

The poorly known subspecies *O. b. cycnos* (Selys 1848), which was described from Sardinia, has the rear of the head white marked with distinct black bars and, when immature, has a pair of broad brown longitudinal stripes on the sides of the abdomen. These features are, to a lesser extent, also present in specimens from some islands in the eastern Mediterranean. A detailed study is needed to assess if *O. b. cycnos* is a valid subspecies or simply represents intraspecific variability.

Distribution

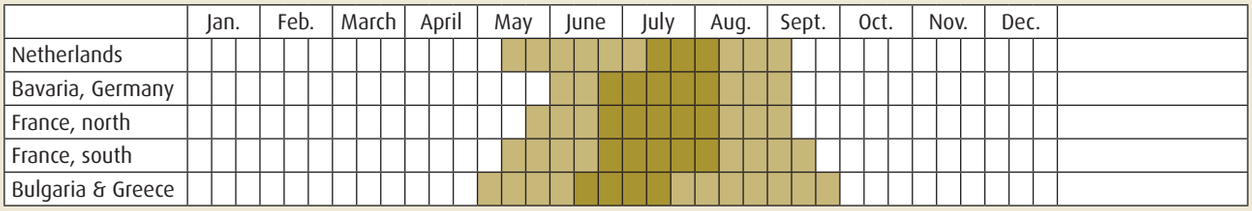
World: *Orthetrum brunneum* ranges from western Europe and the Maghreb eastwards to southern and eastern China. The species is stated to be common in Kazakhstan, with the exception of the north, although rather few records have been published (Chaplina *et al.* 2007, Borisov & Haritonov 2008). It is widespread in Central and south-western Asia, reaching south to Afghanistan and Iran (Borisov & Haritonov 2008, Heidari & Dumont 2002). To the south-east its range extends to Kashmir, north-east India, Burma and southern China along the southern slopes of the Himalaya (Fraser 1936, Mitra 1996, 2002). Scattered records are known from Siberia at Lake Baikal, the south of Mongolia and the north of China (Inner Mongolia) (Asahina 1978, Jödicke *et al.* 1997). In the areas adjacent to Europe, it is common in Turkey and extends south through to the Levant and the Sinai Peninsula. It is scattered in the Maghreb and is apparently absent from most of northern Algeria.

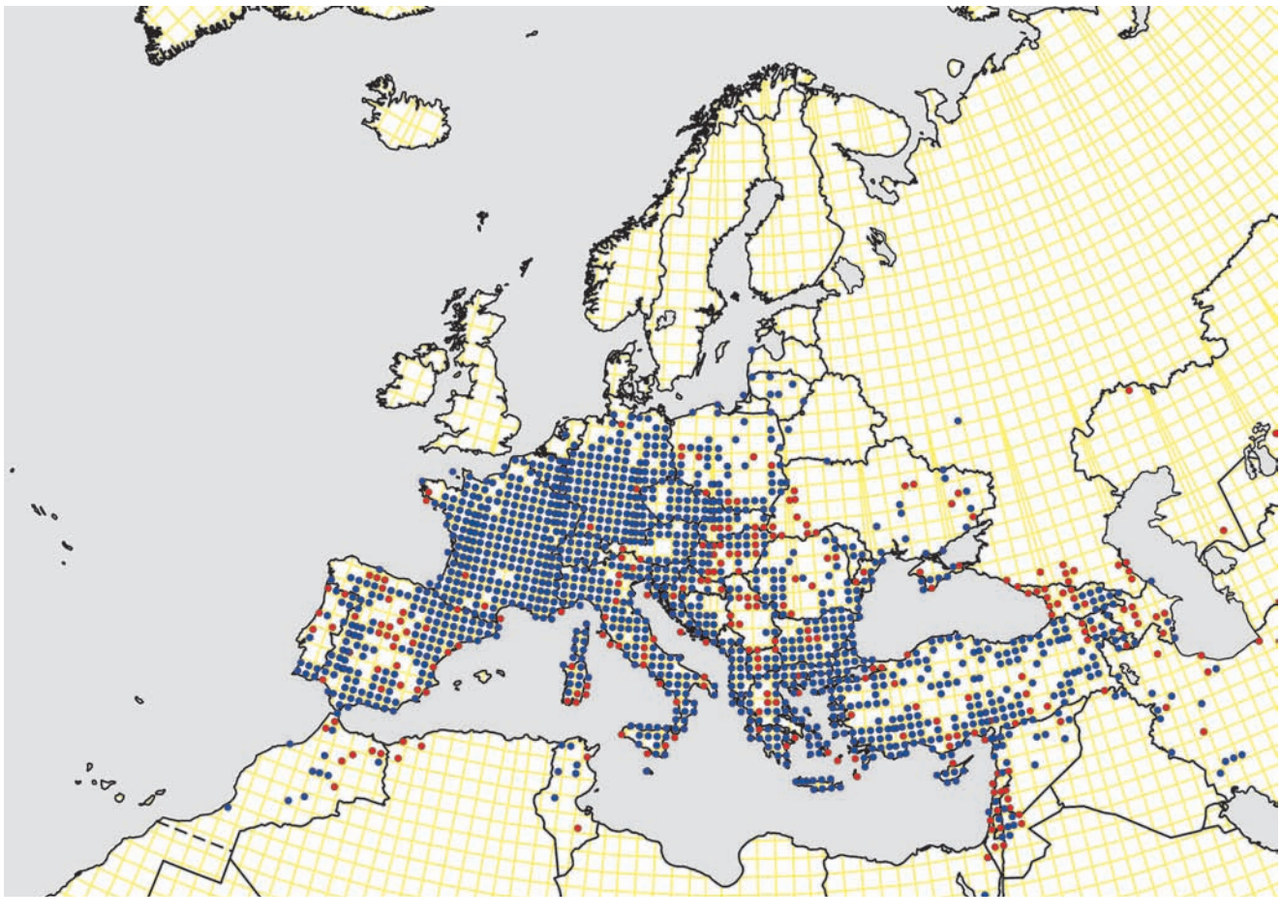
Europe: *Orthetrum brunneum* is widespread and common in the southern half of Europe, becoming scarcer to the north. In large parts of central and north-western Europe it is widely distributed although generally uncommon, and has few permanent populations. The scarcity of records in Ukraine and Russia and, especially its absence from the well-explored southern Urals suggests that the species is genuinely rare and restricted to southern latitudes in this part of Europe.

Trend and conservation status

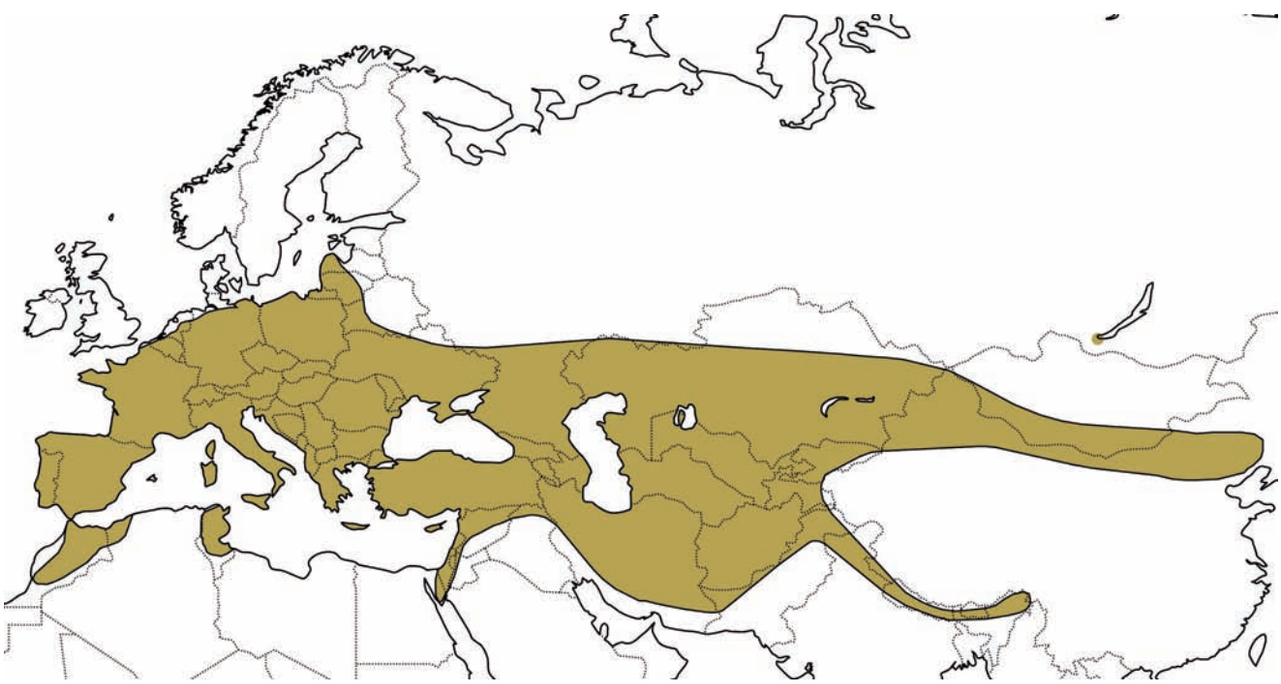
Orthetrum brunneum has profited from the increase in temperatures and has since the 1990s expanded its

Flight period





European distribution



World distribution

range northwards in Belgium, Germany and Poland, establishing itself in the Netherlands. It was recently found as new to Belarus (2001, 2005), Lithuania (2001, 2003, 2004, 2012, 2013), Latvia (2005) and Kaliningrad (2007, 2008, 2011), suggesting that the number of vagrants and probably populations is increasing in the north (Bernard & Ivinskis 2004, Kalniņš 2007, 2011, Buczyński & Moroz 2008, Shapoval & Buczyński 2012). Established populations remain to be demonstrated in these countries.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Increasing

Habitat

Orthetrum brunneum is found in a wide range of habitats including sunny streams, slow-flowing rivers, ditches, seepages and springs as well as man-made pools, quarries and gravel pits. The species is mostly found at sites in early stages of succession with relatively little bankside or aquatic vegetation. In the north of its range it is often a pioneer species and appears promptly at new, often man-made, warm habitats, declining or even disappearing as the vegetation develops. It is a lowland species in most of Europe and in the Alps populations above 600 m are rare; however it is more common in mountains in the south of its range.

Orthetrum cancellatum (Linnaeus, 1758)

V.J. Kalkman & A. Ambrus

Distribution

World: *Orthetrum cancellatum* is widespread throughout Europe and extends eastwards to the south of central Siberia, western Mongolia and western China. Several records from further east in a small area in the Middle Amur region (Malikova 2010) suggest that the species has a scattered distribution along the southern margin of eastern Siberia, Mongolia and northern China. *Orthetrum cancellatum* is widespread in Kazakhstan, except in the north (Chaplina *et al.* 2007, Borisov & Haritonov 2008) and has been recorded from all Central Asian States although it seems to be uncommon in this part of its range. It is known from the north of Pakistan and Kashmir and may occur in the north of Afghanistan, although records are lacking. It is moderately common throughout Transcaucasia, Turkey, Syria, Lebanon and the northern parts of the Maghreb, and appears to be rare and scattered in Iran.

Europe: *Orthetrum cancellatum* is one of the most widespread and common European species. It is found throughout the southern two-thirds of Europe, including all large and many small Mediterranean islands. In the north, its range is limited by climatic conditions, resulting in the species being absent from most of Scotland and Fennoscandia. In the Baltic States, southern Finland and Sweden, *O. cancellatum* is common in coastal areas and breeds in the Baltic Sea, frequenting reed beds and brackish lagoons along the shores. Locally it either visits or colonises more inland waterbodies. The northernmost Finnish populations are confined to brackish coastal localities, suggesting that the higher water temperature of the Baltic during the winter allows the species to develop more readily in such habitats than in inland lakes and ponds at these northern latitudes.

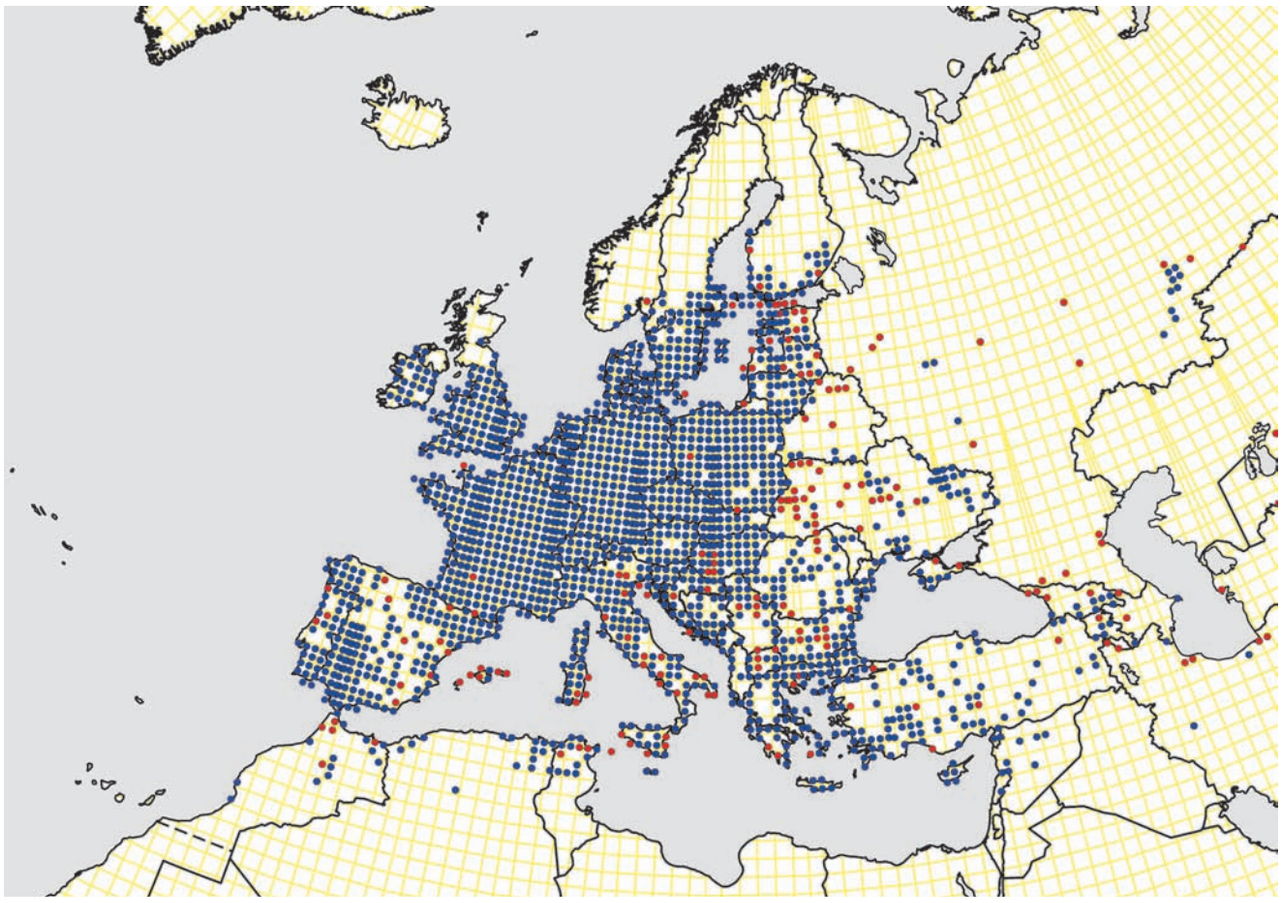
Trend and conservation status

The species is very common in Europe and often benefits from the human impact on landscapes. It has expanded northwards by about 100 km in the Great Britain since the 1960s (Hickling *et al.* 2005) and has increased in abundance in parts of its northern range, which is ascribed to climate warming.

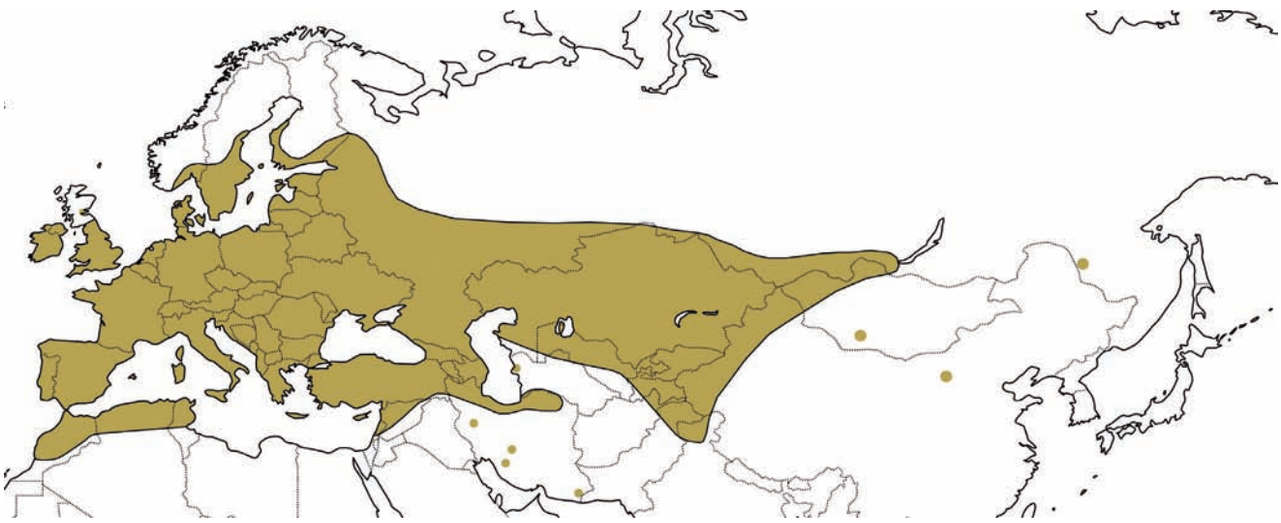
Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

Orthetrum cancellatum is an ubiquitous species occurring in all kinds of standing and slow-flowing waters. Habitats include ponds, natural and man-made lakes, fens, larger garden ponds, rivers, concrete basins and brackish coastal lagoons and swamps. The species is rare to absent from largely shaded waters, fast running rivers and oligotrophic acidic habitats, but is often very abundant at large water bodies with banks of sand or stones with or without vegetation. In many locations it is a pioneer species and is often abundant at newly created habitats. It is mainly confined to lowlands and most common below 500 m. Breeding populations above 1 000 m are rare in Europe but are known up to 2 265 m in Morocco (Boudot & De Knijf 2012).



European distribution



World distribution

Flight period

	Jan.			Feb.			March			April			May			June			July			Aug.			Sept.			Oct.			Nov.			Dec.			
Norway & Sweden																																						
Netherlands																																						
Bavaria, Germany																																						
France, north																																						
France, south																																						
Bulgaria & Greece																																						

Orthetrum chrysostigma (Burmeister, 1839)

V.J. Kalkman & C. Monnerat

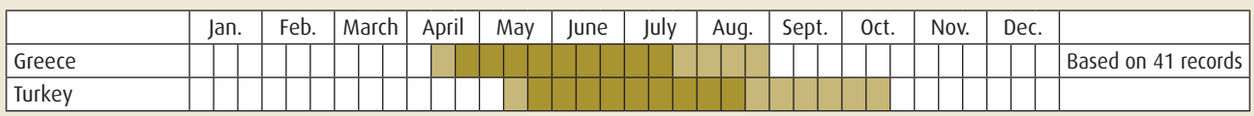
Taxonomy

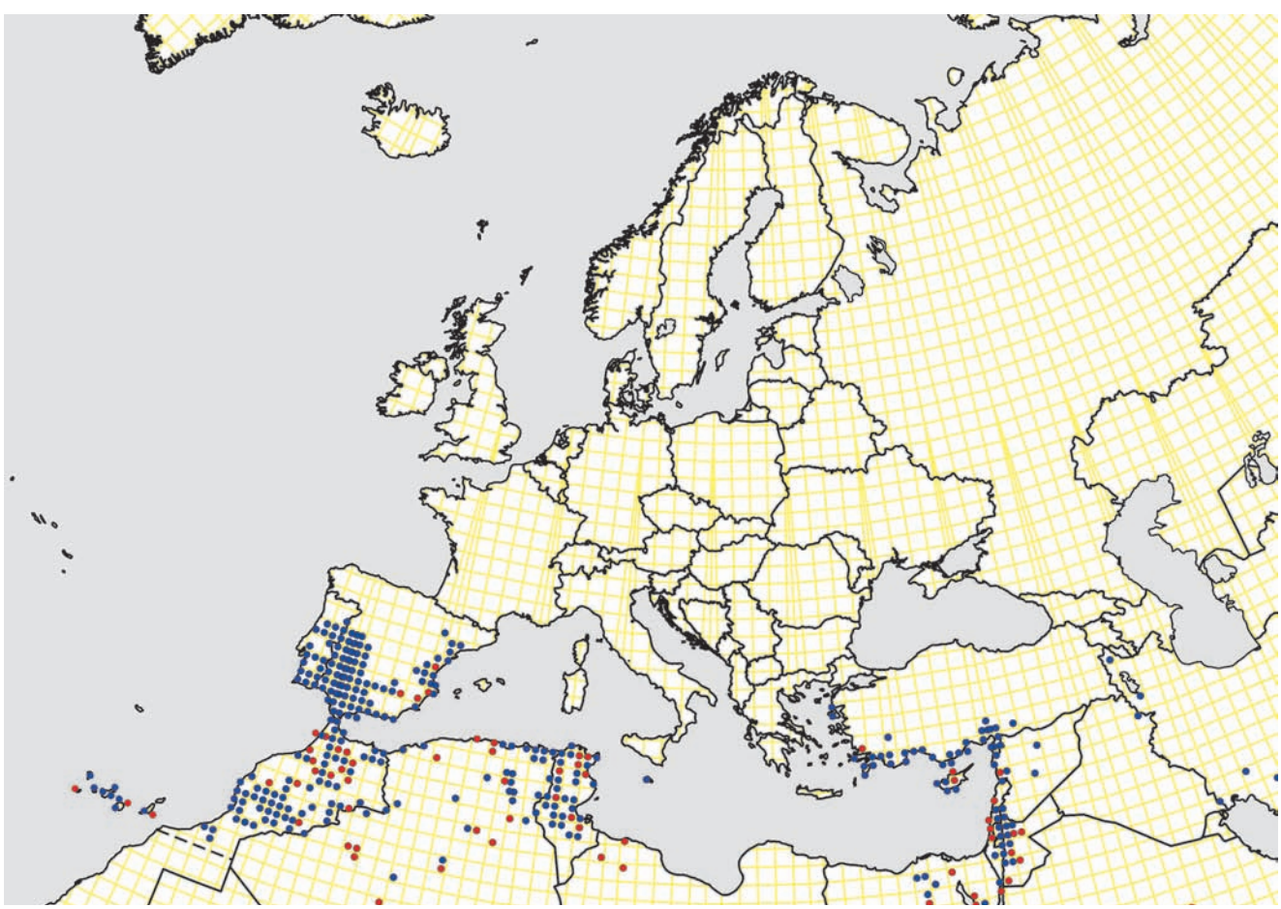
We follow Dumont & Heidari (1996) in regarding *O. luzonicum* as a distinct species rather than as a subspecies of *O. chrysostigma*. Dumont & Heidari (1996) pointed out differences in the secondary genitalia of the males, colour differences in the forelegs, and also the co-occurrence of both species in Iran. This analysis was however based on a limited sample and a more extensive study is needed to confirm these findings.

Distribution

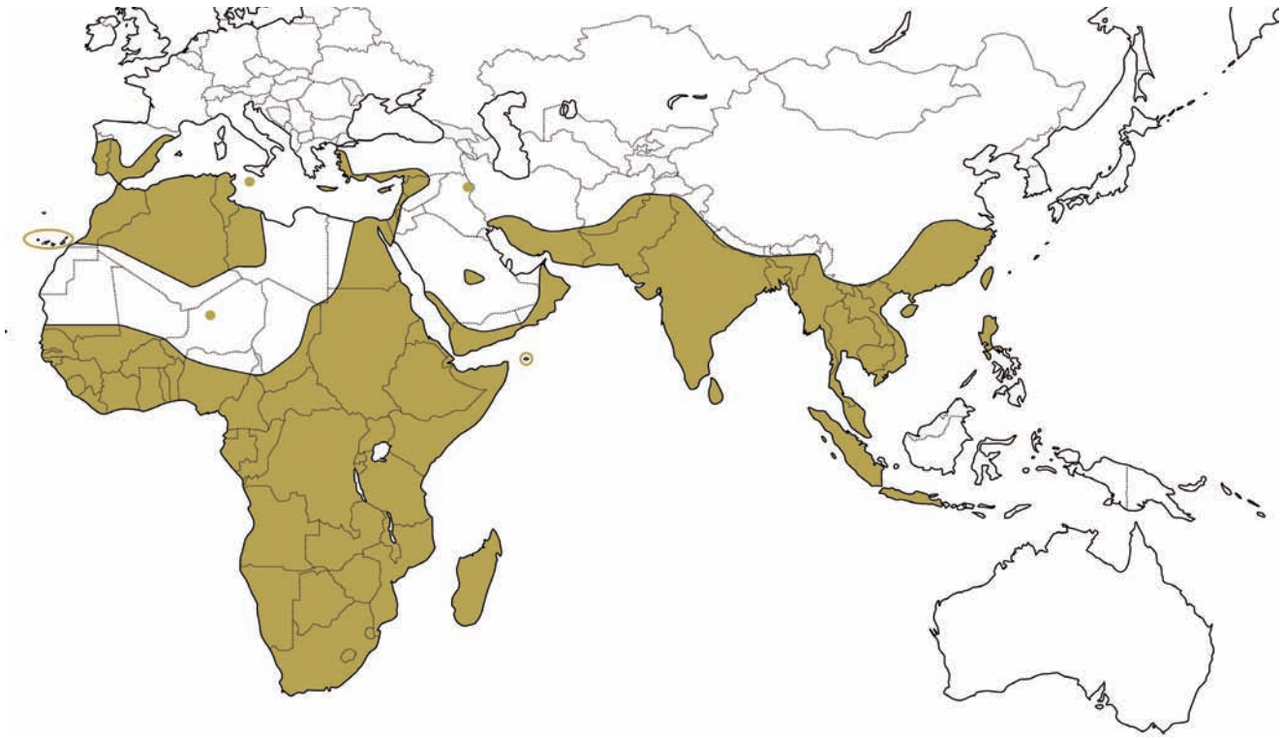
World: *Orthetrum chrysostigma* is found throughout Africa and Madagascar and is common in the northern Maghreb. It is sparsely scattered in the Sahara due to the rarity of potential habitats. It reaches the Canary Islands, the Iberian Peninsula, Cyprus and the east Aegean Greek islands. In south-west Asia, it is restricted to southern Turkey, the Levant, parts of the Arabian Peninsula and the southern half of Iran. It is sympatric with its close Oriental relative *O. luzonicum* at least in south-west Iran. Discrimination between these two species has received little attention and it is unknown if the two taxa overlap over a wider area.

Flight period





European distribution



Combined World distribution of *Orthetrum chrysostigma* and *O. luzonicum*

Europe: The European range of *O. chrysostigma* includes the Iberian Peninsula, the Maltese islands, a small number of east Mediterranean islands and the Canary archipelago. The species is widely distributed and common at low elevations in the south-west and the east of the Iberian Peninsula. It is the most common *Orthetrum* in southern Portugal (De Knijf & Demolder 2010). It is comparatively rare in the eastern Mediterranean islands where it is known from about 30 river systems and standing water bodies from Rhodes, Kos, Lesbos and Cyprus. An old record from Crete (Selys 1887) has never been confirmed and is omitted here.

Trend and conservation status

Like several other African species, *O. chrysostigma* has expanded its range northwards in the Iberian Peninsula since the 1980s. Strangely, there is no clear evidence of a similar increase in the eastern Mediterranean. The first records from Rhodes (1993), Lesbos (1998) and Kos (2009) are all relatively recent but this might simply reflect the lack of earlier fieldwork. Changes in habitats and particularly the creation of a number of manman dam lakes and reservoirs on the Iberian Peninsula rivers obviously allowed the species to expand northwards, but this trend may have also been influenced by rising temperatures, which, in the future will probably result in a further northwards expansion.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

In Europe, *O. chrysostigma* favours warm, open and sunlit running and standing waters in arid to semi-arid lowlands. Habitats range from small streams which dry out in summer to large permanent rivers, and from natural ponds and lakes to large man-made reservoirs. Preferred habitats have little aquatic vegetation with rocky, stony or sandy banks that heat up quickly (Lopau & Adena 2002, De Knijf & Demolder 2010). These habitat requirements restrict the species to standing waters where considerable changes in water level limit the establishment of extensive aquatic or bank side vegetation. In Africa, however, *O. chrysostigma* also reproduces in overgrown habitats (Suhling & Martens 2007). In Namibia, it exhibits rapid larval development of less than 50 days, allowing it to occur in temporary waters and to produce several generations a year in perennial waters (Suhling & Martens 2007).

Orthetrum coerulescens (Fabricius, 1798)

V.J. Kalkman & A. Ambrus

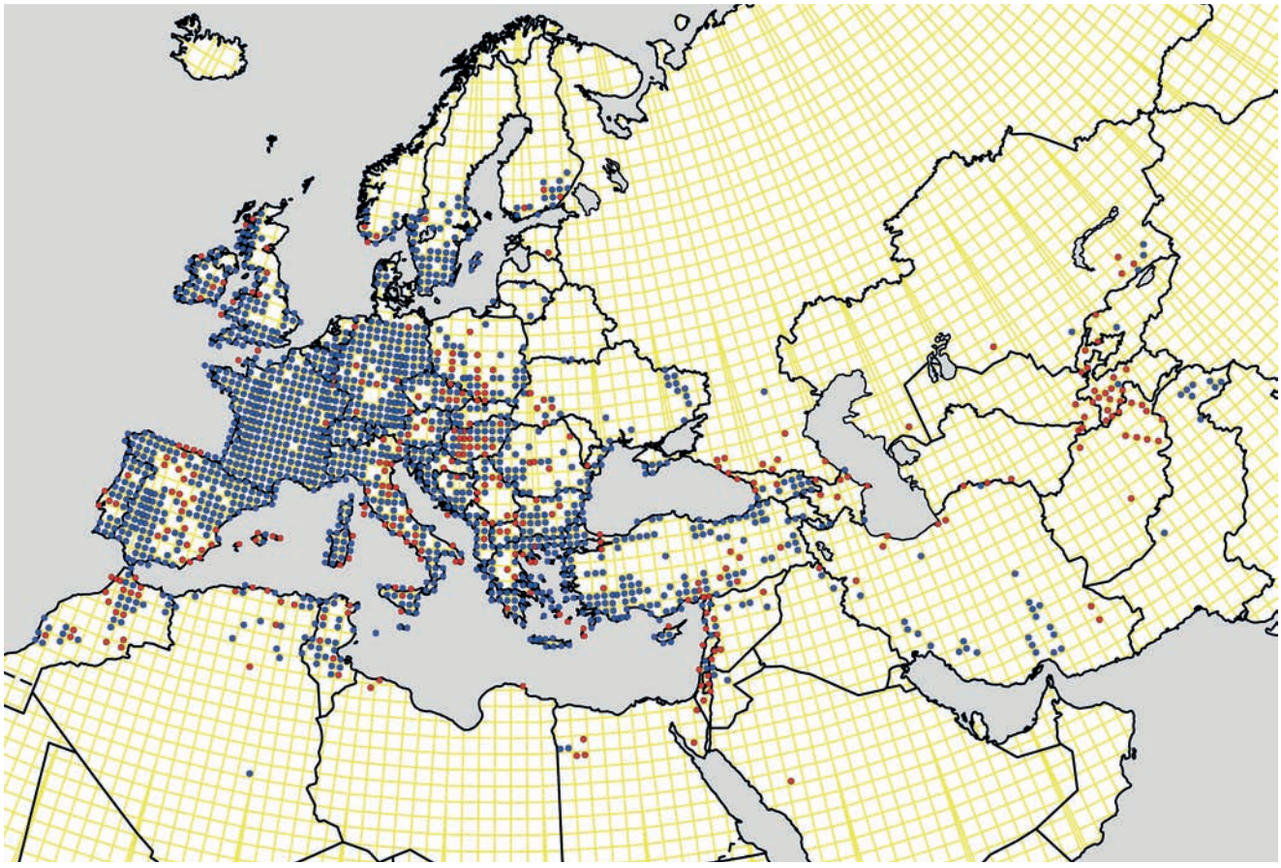
Taxonomy

Many authors regard *O. coerulescens coerulescens* and *O. c. anceps* as distinct species or subspecies while others treat them as synonyms. Mauersberger (1994) demonstrated that Sardinia, Sicily and large parts of south-eastern Europe are inhabited by intermediate phenotypes with typical *O. c. coerulescens* occurring in the west of Europe and typical *O. c. anceps* found in south-west Asia and North Africa. A single intermediate form was reported from the southern Spanish coast (Malaga) by Klingenberg & Martens (1996). The distribution of these two morphs and their intermediates suggest a large overlap of a western and an eastern pool isolated during the last glacial times and mixing again with hybridisation during the Holocene. Future genetic studies might help to elucidate their taxonomic rank.

Distribution

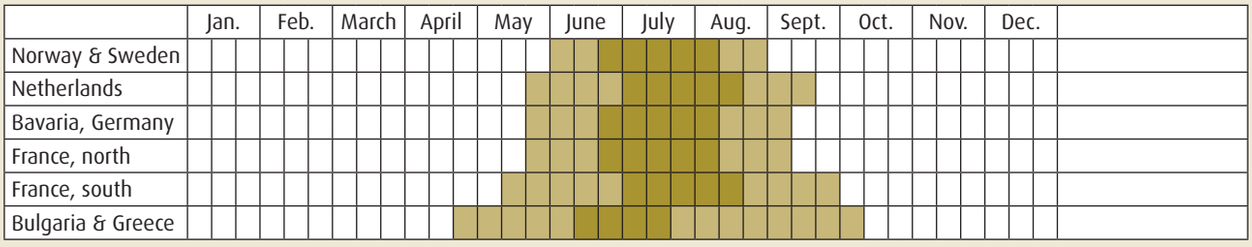
World: *Orthetrum coerulescens* is largely a West Palaearctic species and is widespread in Europe and the Maghreb, extending to Pakistan and Kashmir in the east (Mauersberger 1994). To the north, it reaches southern Fennoscandia. In south-west Asia, the species is common in Turkey, the Caucasus, Iran and the Levant southwards to Sinai. It is also common in the lower mountains of Central Asia but is largely absent from the more arid lowlands (Borisov & Haritonov 2008, Schröter 2010b). It is common in the Maghreb, where it reaches the north-west of Libya. There is an isolated area of occurrence in the oases of the Western Desert in Egypt (Kimmins 1950, Dijkstra & Boudot 2010) and a single record from the north-west of Saudi Arabia (Waterston 1980).

Europe: *Orthetrum coerulescens* is widespread in the southern two-thirds of Europe, including most of the Mediterranean islands. It becomes progressively scarcer to the north and the north-east with large gaps in its distribution, for example in the British Isles where it occurs mainly in the south and western half, as well as



World distribution

Flight period



in Poland and the Baltic States. As in the case of *O. brunneum*, *O. coerulescens* is much scarcer in the northern areas of eastern of Europe. It is widespread in the east of Ukraine but appears to be rare in the south of Russia, and has not been found north of the Caspian Sea or in the well explored southern Urals.
The nominotypical subspecies extends from the Iberian Peninsula to central Europe, mainland Italy, southern Fennoscandia and the British Isles, whereas pure populations of typical *O. c. anceps* are found from northern Africa to the Middle East, Asia Minor, Kashmir, Central Asia, the southern parts of the Balkan Peninsula and southern Ukraine (Mauersberger 1994, Dyatlova 2006). Intermediate forms between *O. c. anceps* and *O. c. coerulescens* are known from the Balkan Peninsula and most Mediterranean islands (Cyclades, Cyprus, Crete, Sicily, Sardinia).

Trend and conservation status

Orthetrum coerulescens seems stable across most of its range and is considered as Least Concern at the European level.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

The species is most often found at largely unshaded small running waters like streams, runnels or ditches with moderately dense or no vegetation. It also inhabits *Sphagnum* peat bogs, spring-fed marshes, springs, seepage waters and quarries. In the Mediterranean it is largely restricted to rocky and stony streams and rivers while in parts of central and north-west Europe, including Great Britain, it is confined to shallow open and sunny waters such as ditches, bogs and runnels in quarries and heathlands. The species is most common in lowlands but populations are found up to 1 700 m in the Alps and 2 040 m in southern Spain (Cano-Villegas *et al.* 2013).

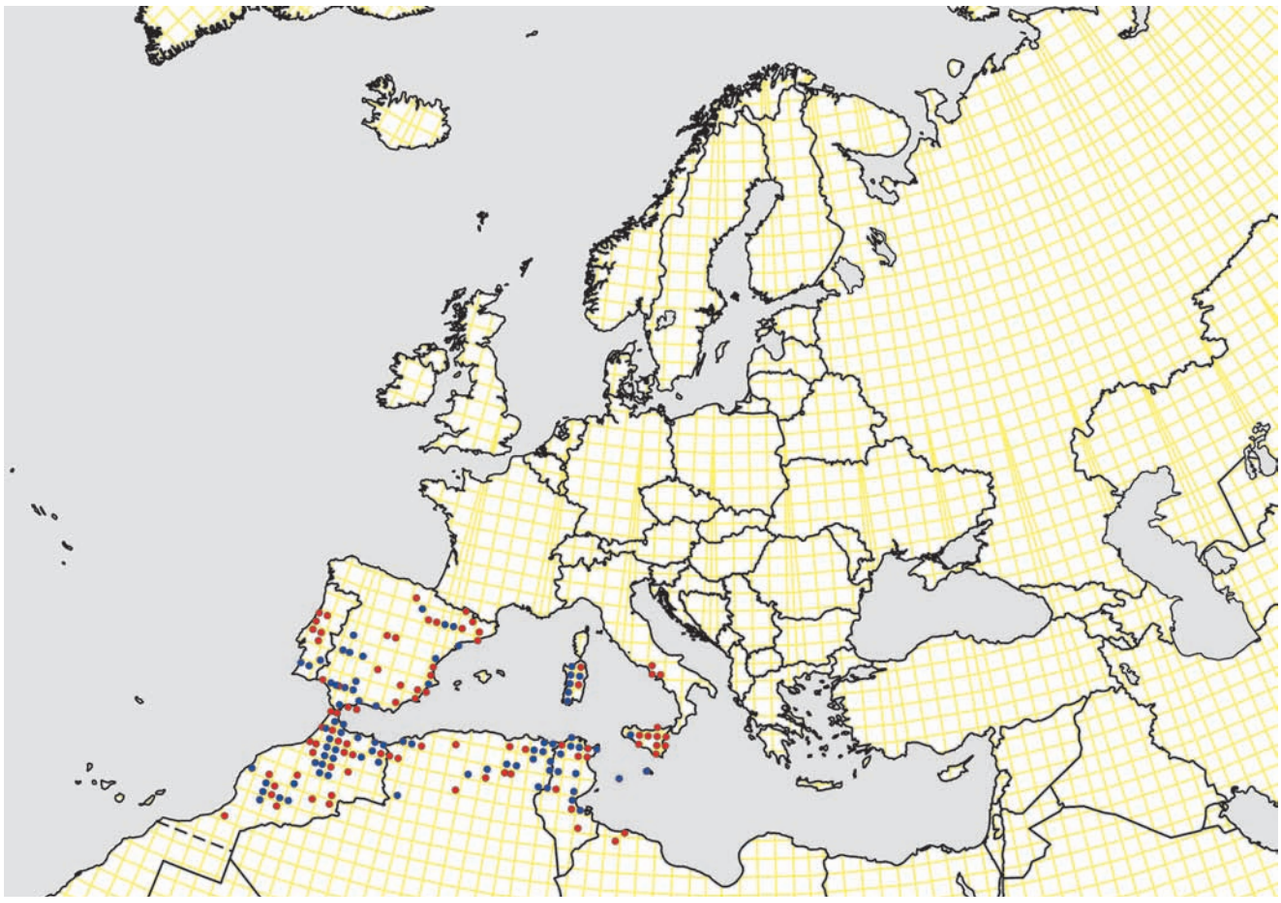
Orthetrum nitidinerve (Selys, 1841)

V.J. Kalkman & B. Garrigos

Distribution

World: *Orthetrum nitidinerve* is a West Mediterranean endemic. It is relatively common in Morocco, northern Algeria and Tunisia, becoming scarcer towards the Sahara. The south-easternmost records are from north-west Libya (S. Ober, pers. com.). It is scattered in the Iberian Peninsula, Sardinia and Sicilia and very local in mainland Italy.

Europe: *Orthetrum nitidinerve* is restricted to the West Mediterranean. Records from mainland Italy are all from Campania, where the species was last recorded in the 1980s. Records from Sicily are mostly old but several recent records are available from Sardinia. A single record from Lampedusa (2010) is regarded as a vagrant (Corso *et al.* 2012). The first records for the Maltese islands were made in 2008 with an additional one from 2010. However, there is no evidence of breeding and these records also appear to be vagrants (Sciberras *et al.* 2010, Sciberras & Sammut 2013). The species is scattered and uncommon within the warmest parts of the Iberian Peninsula, with the most recent records being from the south-west of the region, the eastern coast and the arid Ebro valley. It is absent from the cooler and more humid north-west.



World distribution

Flight period

In the north of Africa, adults of *O. nitidinerve* were recorded from 15 April (Juillerat & Monnerat 2009) to 6 November (Faucheux *et al.* 2005). In Europe the earliest records of adults are from 17 March in the Spanish Extremadura (Perez Bote & Ledesma Carpi 2001) and 10 April in the Ebro Delta, Catalonia, Spain. In the latter region tenerals were observed up to 10 September (Márquez-Rodrígues & Ferreras-Romero 2013), suggesting that the species is on the wing at least up to October. A vagrant in Lampedusa was found on 14 September (Corso *et al.* 2012). The species flight period does not seem to differ significantly between the Maghreb and Europe and adults can therefore be expected to be on the wing from the second half of March to the first half of November.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Maghreb													

Trend and conservation status

Orthetrum nitidinerve has exhibited a significant decline throughout its European range. The species was listed as Vulnerable on the European Red List in 2010 as fewer than 40 localities had been recorded since 1990 and it had declined by at least 30 % over the previous decade. Recent fieldwork in Sardinia and the Iberian Peninsula has increased the number of localities known since 1990 to 56. *Orthetrum nitidinerve* has strong populations in Sardinia but records suggest that it declined significantly in Sicily and has disappeared from mainland Italy (no record since the late 1980s). It also seems to have decreased significantly in the Iberian Peninsula, despite increased survey efforts in both Spain and Portugal (Cano-Villegas *et al.* 2012). Field observations suggest that desiccation of habitats due to rainfall deficit, regulation of rivers and their backwaters, lowering of the water table due to water extraction, water pollution, draining of springs, seepages and marshes and trampling by livestock have all contributed to the species' decline. The future impact of climate change is difficult to assess as the increase of temperature may allow an expansion of the species range while rainfall deficiency will increase further loss of suitable habitats.

Habitats Directive	No
Red List EU27	Vulnerable
Red List Europe	Vulnerable
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Decreasing

Habitat

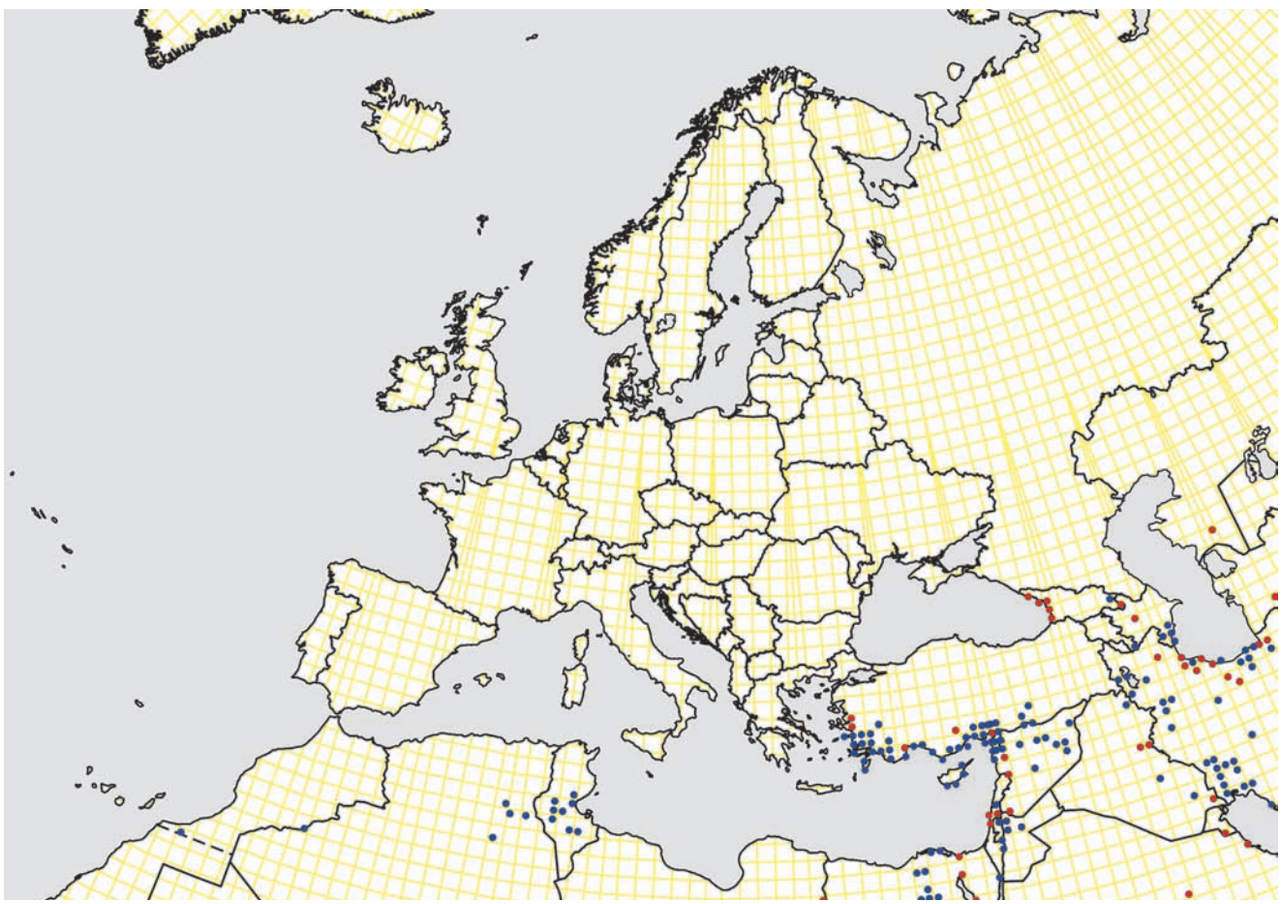
Orthetrum nitidinerve reaches its highest densities in springs, seepages and small streams in marshy open areas with an abundance of grassy vegetation. It is mostly found at fresh waters but large populations have been encountered in brackish conditions (J.-P. Boudot, unpublished). It also occurs, but mostly in lower densities, at slow- to relatively fast-flowing rivers and streams (Jacquemin & Boudot 1999, Garcia *et al.* 2009, Boudot & De Knijf 2012, Márquez-Rodrígues & Ferreras-Romero 2013). The species is also regularly found at intermittent streams which are reduced to residual stagnant pools in summer. Some records are from stagnant waters but it is doubtful that the species can reproduce at sites that are stagnant throughout the year. It is possible that small streams and marshy springs and seepages with trickles are the main habitat for this species and that its occurrence at large rivers is dependent on either regular re-colonisation or vagrancy from core habitats. *Orthetrum nitidinerve* occupies a wide altitudinal range with stable populations found up to 2 020 m in Morocco and up to 1 100 m in Sardinia.

Orthetrum sabina (Drury, 1773)

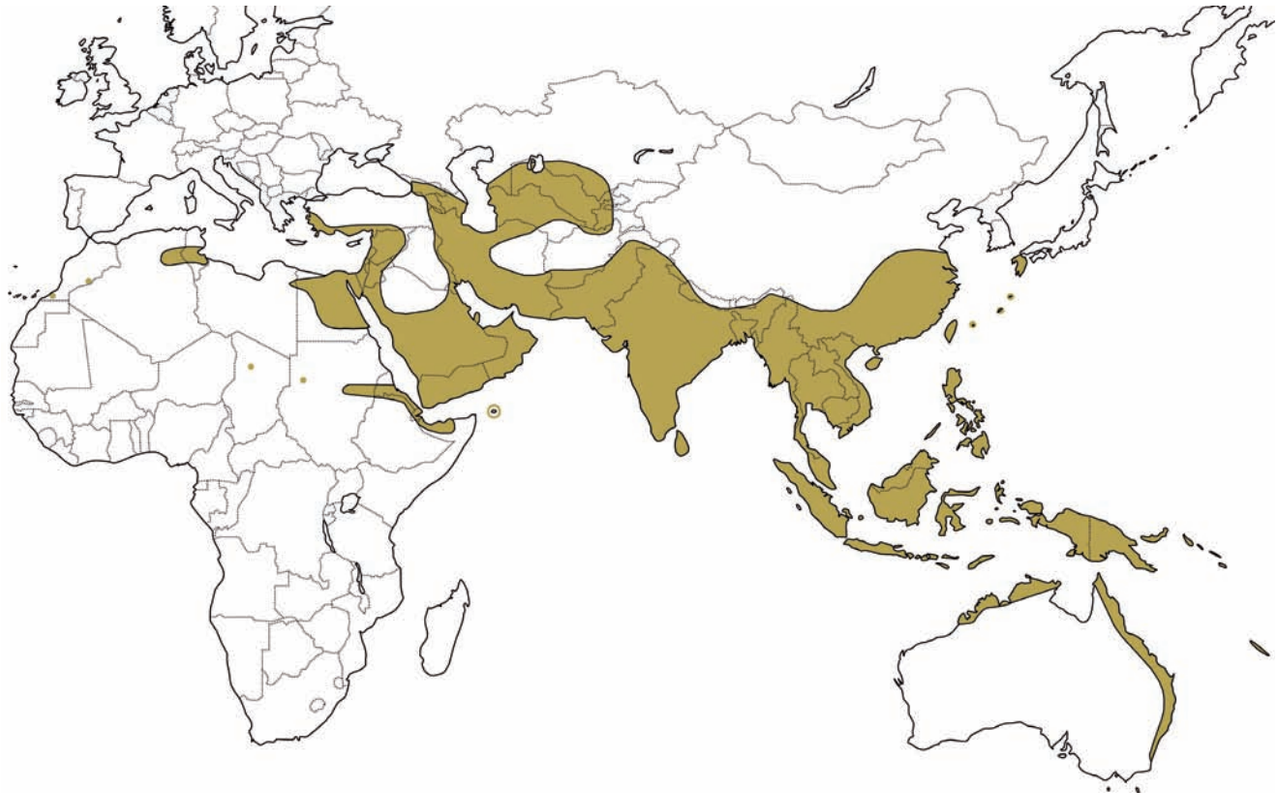
V.J. Kalkman

Distribution

World: *Orthetrum sabina* is widespread in the Old World tropics and subtropics. Throughout most of its range, it is among the most abundant of *Orthetrum* species. It is often found at ditches and ponds near villages or in agricultural areas, taking advantage of man-made habitats. Its range spans tropical and subtropical regions of mainland Asia and the Melanesian Archipelago, extending eastwards to the Solomon Islands and New Caledonia, southward to northern and eastern Australia, and north-eastwards to Taiwan and the southernmost parts of Japan. To the west, it is wide-



European distribution



World distribution

Flight period

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Greece													Based on 29 records
Turkey													

spread in Central Asia and the Middle East, reaching south and west Turkey. In Africa it is known from drier parts of the north-east, including most of Egypt and a broad band along the inner part of the horn of Africa, to north-eastern Algeria. Recently two isolated localities, among which one at least pertains to a flourishing population, have been discovered in Morocco as far west as the Atlantic coast (R. Gabb & N. Stones pers. com., K. Glen pers. com.). Most north-east African records are from Egypt, where the species is locally common in oases and the Nile delta. Scattered records are known from Chad, Djibouti, Eritrea, Ethiopia, Somalia and Sudan, but further fieldwork might show the species is more common in these regions than currently believed. The populations in the Maghreb, first recorded in 1914, seem isolated by the Libyan desert from the main range, and the Moroccan localities are themselves apparently disjunct from the Algero-Tunisian populations. Whether the Libyan gap reflects the genuine absence of the species or is due to lack of faunistic surveys in Libya is unclear. The Algero-Moroccan discoveries are most probably linked to the nomadic behaviour of the species, which enables it to colonise remote outposts.

Europe: In Europe, *O. sabina* is restricted to Cyprus and the Greek islands of Samos, Kos and Rhodes, where fewer than 20 localities are known. Although the species is common and abundant in suitable habitats on the Turkish Mediterranean coast, most European records refer to fewer than ten individuals.

Trend and conservation status

Orthetrum sabina has a very marginal occurrence in Europe. It is nonetheless listed as Least Concern as it can breed in a wide range of standing water habitats and is likely to benefit from the increasing summer temperatures.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

Orthetrum sabina is found at a wide range of unshaded standing and slow-flowing waters, including canals, runnels, ponds and ditches, at low elevation. It occurs mainly at freshwater, but has also been found in brackish habitats in arid and semi-arid regions, where females sometimes oviposit over super-saturated saline waters. In large parts of its range, it is one of the most common species at man-made habitats such as ditches and ponds in villages and in agricultural areas. In Europe it is confined to coastal lowlands.

Orthetrum taeniolatum (Schneider, 1845)

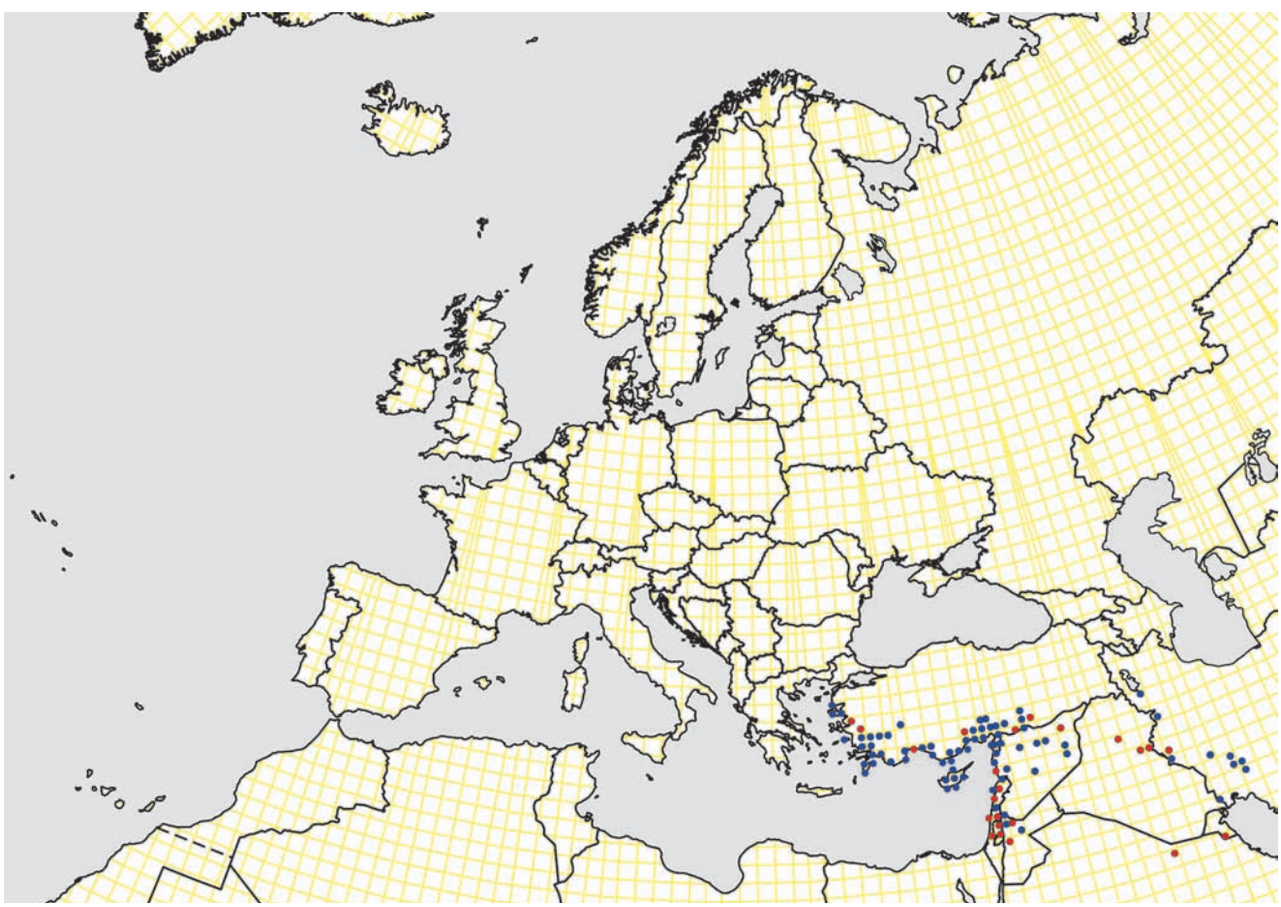
V.J. Kalkman

Taxonomy

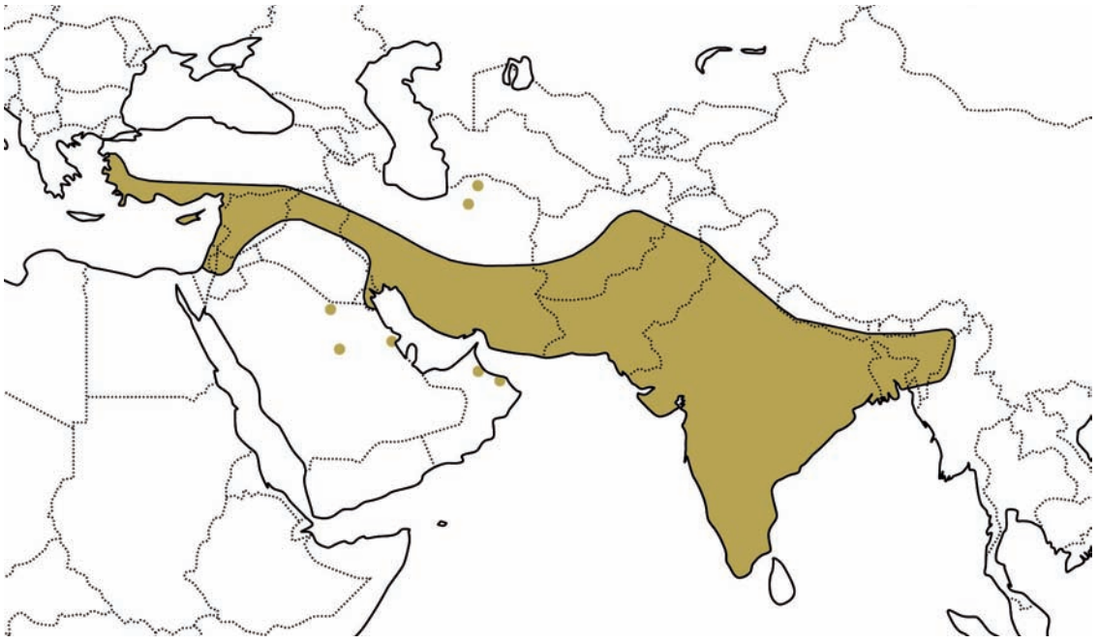
This small *Orthetrum* is mainly Asian in distribution and is replaced in Northeast Africa and western Arabia by its sister taxon *O. brevistylum* Kirby, 1898 of which *O. kollmannspergeri* Buchholz, 1959 is a synonym. The two were only recently recognised as valid species based on differences in the secondary genitalia (Clausnitzer & Dijkstra 2005, Dumont & Verschuren 2005).

Distribution

World: The main range of *O. taeniolatum* is on the Indian subcontinent, where it is common and widespread. From there, it continues westwards through Afghanistan and southern Iran to the east of the Arabian Peninsula, the Levant, the Mediterranean coast of Turkey, Cyprus and some east Aegean Greek islands. Records from the Levant and eastern Arabia are included in the maps but are in need of confirmation as they might pertain to *O. brevistylum*, as was the case with those from Yemen (Clausnitzer & Dijkstra 2005).

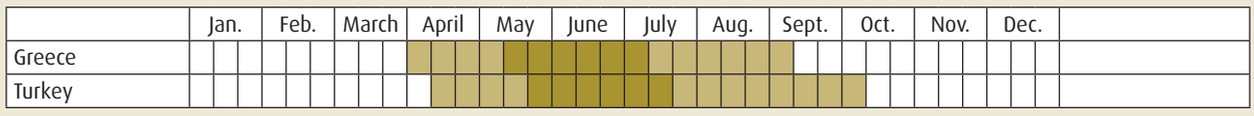


European distribution



World distribution

Flight period



Records from the Red Sea coasts of Saudi Arabia and the Sudan are also in need of confirmation, but are almost certainly *O. brevistylum*, hence are omitted.

Europe: The European range of *O. taeniolatum* is very small and limited to Cyprus, Rhodes and Lesbos, where the species is common (Lopau 2010b). Only two records are available from Samos (Lopau & Adena 2002).

Trend and conservation status

There is no indication of a decline of *O. taeniolatum* in Europe and it is possible that this species will expand northwards in the East Aegean in the future, benefiting from increasing temperatures.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

Orthetrum taeniolatum is mostly found at sunny slow-flowing waters in semi-arid open landscapes, and sometimes at standing waters, including man-made barrage lakes. The habitats are often sparsely vegetated with large stretches of exposed sand or gravel. In Europe, the species is confined to coastal lowlands.

Orthetrum trinacria (Selys, 1841)

V.J. Kalkman & S. Ferreira

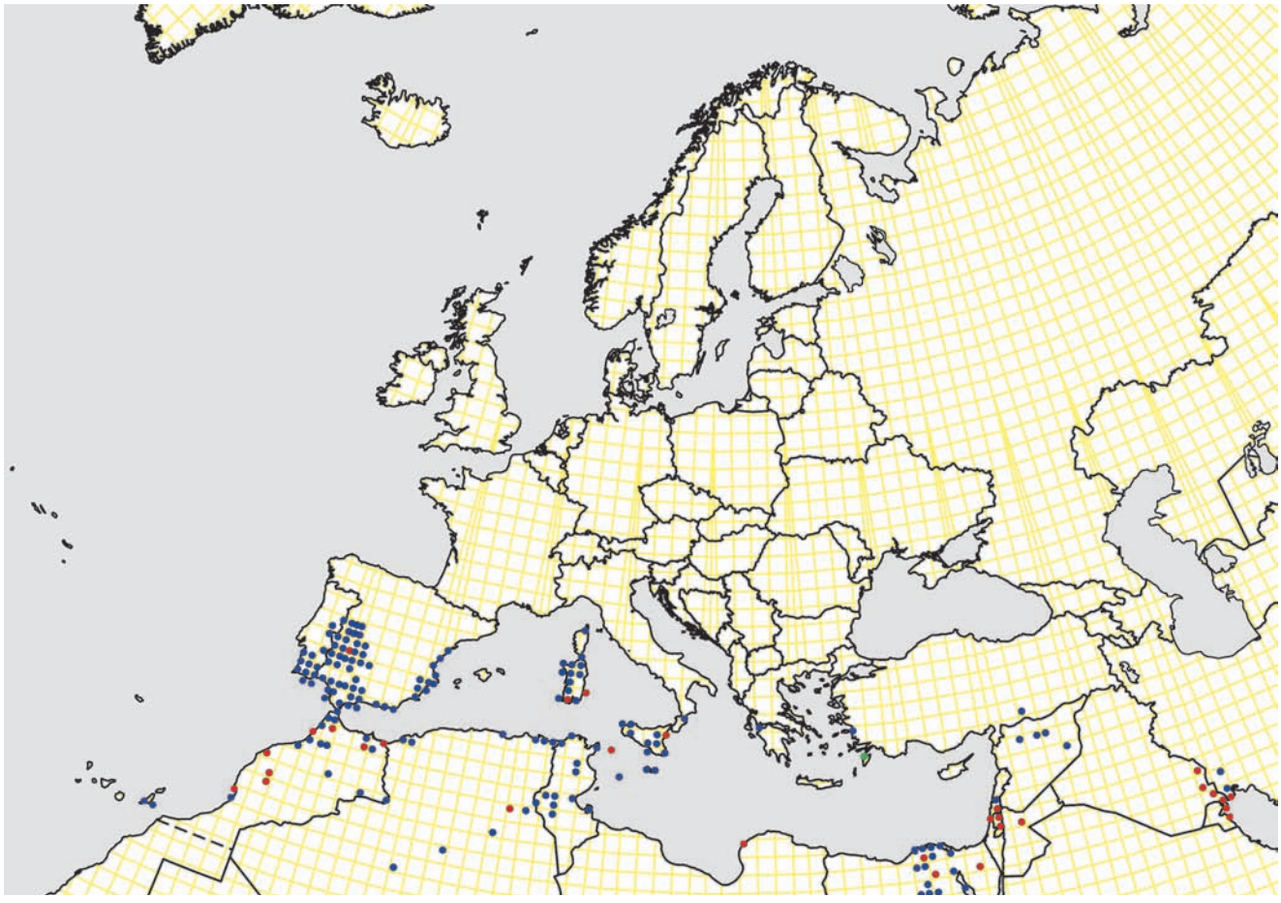
Taxonomy

The poorly known subspecies, *O. trinacria igarashii* Asahina, 1973 has been described from Iraq based on its smaller size and slight differences in wing venation. The validity of this subspecies requires confirmation.

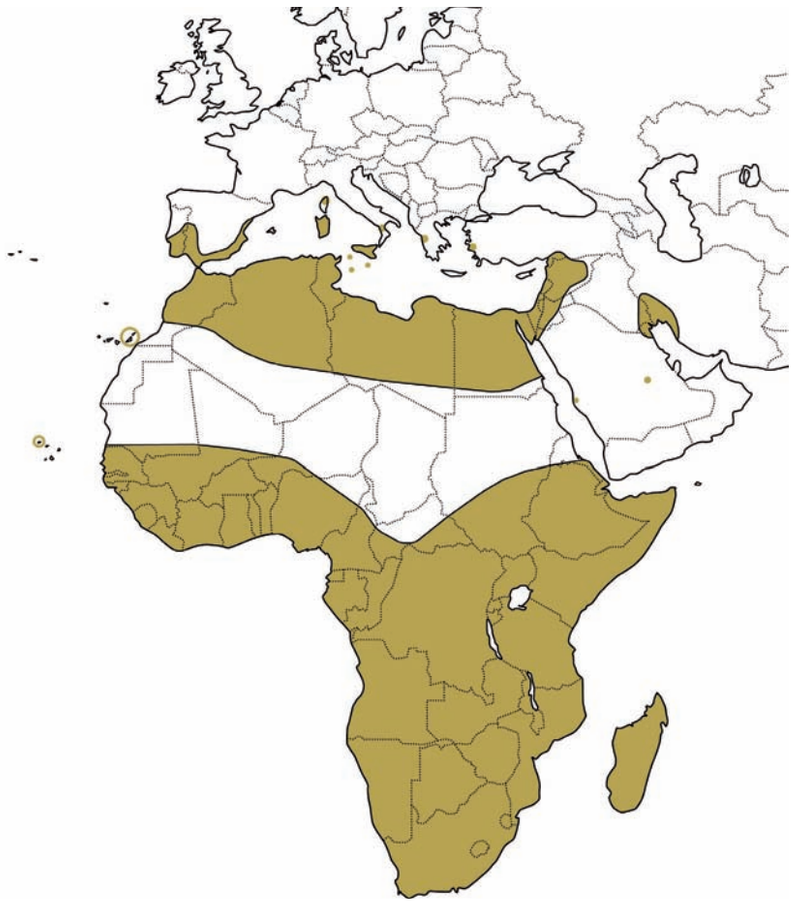
Distribution

World: *Orthetrum trinacria* is a widespread and common Afrotropical species which occurs throughout most of the African continent, although it is absent from the tropical forest and has only a patchy occurrence in the Saharan belt. The species is moderately common in North Africa. Outside Africa, it occurs in parts of Mediterranean Europe and the Middle East. The species is probably common in the Jordan Valley although recent records are scarce. It was only recently discovered in Syria, south and south-west Turkey and mainland Greece (Kalkman *et al.* 2012), suggesting the onset of a northwards expansion in the east Mediterranean similar to its recent expansion from Africa to Europe in the west. Older published records from Turkey are considered to refer to misidentifications (Kalkman *et al.* 2003) and an old record from Rhodes by Bentivoglio (1929) is considered doubtful (Lopau 2010b). The populations from southern Iraq, Kuwait and nearby Iran, described as *O. t. igarashii* by Asahina (1973) (see taxonomic section), appeared until recently to be isolated from the main range of the species. The recent expansion of the latter to the Syrian part of the Euphrates River makes it likely that it now has a continuous range along this watercourse, although contemporary observations from Iraq are lacking.

Europe: Although originally described from Sicily in 1841, *O. trinacria* has a limited distribution in Europe. Disregarding a dubious record from Rhodes by Bentivoglio (1929) (Lopau 2010b), it took more than a



European distribution



World distribution

century before it was rediscovered elsewhere in Europe, with the first record from Sardinia in 1972 (Bucciarelli 1977) followed by its discovery in Spain in 1980 (Hartung 1985), Portugal in 1991 (Jahn 1996), Fuerteventura in 2000 (Boudot *et al.* 2009), the Maltese islands in 2003 (Ebejer *et al.* 2008) and mainland Greece in 2011 (Kalkman *et al.* 2012). The record of wanderers on Pantelleria (Lohmann 1989), Lampedusa (Corso *et al.* 2012) and Corsica including the nearby Lavezzi Islands (Berquier 2013, Engler 2014) illustrates its ability to reach and colonise remote islands. The species has recently established itself on the Maltese islands (Degabriele 2013). It is now well settled in the entire south-western region of the Iberian Peninsula, whence it extends along the Mediterranean coast and approaches the Ebro Delta in the east (Baixeras *et al.* 2006). It is now relatively common in Extremadura (Sánchez *et al.* 2009), Algarve (Loureiro 2012), Sicily and Sardinia (Hardersen & Leo 2011). The species is remarkably scarce in mainland Italy, although it was recently found in Calabria (Riservato *et al.* 2014b). Given its expansion in Syria and Turkey, it is possible this species will appear on the east Aegean islands in the future.

Trend and conservation status

Orthetrum trinacria still has a limited European distribution but seems to have expanded its range throughout the Mediterranean, particularly in the west. The species is restricted to lentic habitats and its expansion in the south-west Iberian Peninsula was expedited by the creation of man-made reservoirs throughout the region (De Knijf & Demolder 2010, Loureiro 2012). The contribution of climate warming is difficult to assess, but the northwards progression of the species along the Mediterranean coast of Spain is meaningful in this respect as the species increases although suitable habitats are decreasing there. It is possible that this expansion will continue in some regions in the coming decades.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

In Europe significant populations are restricted to lentic systems such as man-made reservoirs and large open sunny ponds, pools and marshes with well-developed bank side vegetation (Sánchez *et al.* 2009, De Knijf & Demolder 2010, Loureiro 2012). More rarely the species is found at slow-flowing stretches of rivers. In Morocco it occurs at coastal marshes and ponds (Jacquemin & Boudot 1999), but more recently it has

Flight period

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Europe													

established itself further inland, taking advantage of man-made barrage lakes. It was also found to be common at concrete water tanks lacking any vegetation in the oases of the northern Saharan fringe in Morocco (Boudot & De Knijf 2012). The species is restricted to lowland areas.

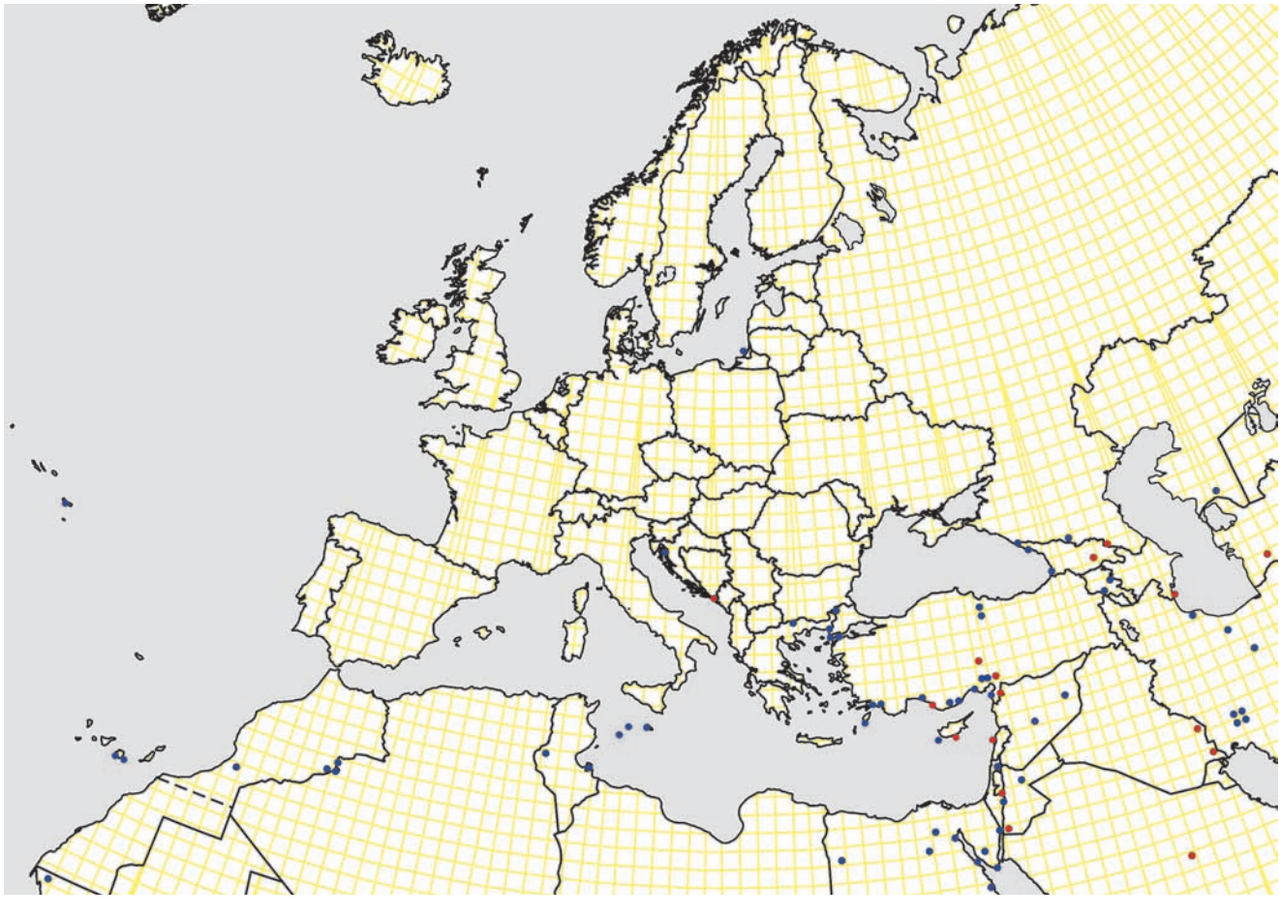
Pantala flavescens (Fabricius, 1798)

V.J. Kalkman & C. Monnerat

Distribution

World: The circumtropical *Pantala flavescens* is common and often abundant in the tropics and subtropics of both the Old and the New World. It is in large parts of its range a migratory species (Corbet, 1999) which appears in huge swarms along the monsoon fronts. Beyond the intertropical range, the species migrates as far north as Canada, northern Europe, Central Asia and the Kamchatka Peninsula. These migrations are complex. Isotope studies suggest that annual appearance of millions of adults on the Maldive Islands is part of a two-way, multi-generational migratory circuit, 14 000-18 000 km in length, involving north Indian or even Trans-Himalayan insects traversing the Indian Ocean to eastern Africa, with the following generation making the return flight (Anderson 2009, Hobson *et al.* 2012). According to Borisov (2012), the Central Asian populations are dependent on immigration from the south in the spring. The incoming adults breed, larval development takes two months and the emerging adults contribute to a much larger summer population. Records from Central Asia suggest that adults migrate southwards in late summer and early autumn. European records are very rare and no reverse migration has yet been recorded from Europe to Africa.
Despite its very wide distribution, the species is rare in most of the Western Palaearctic. In the north of Africa, a few records, probably mostly migrants, are available from every country except Libya (Kimmins 1934, Jödicke 1995, Jödicke *et al.* 2000, Dijkstra & Boudot 2010). Swarms are regularly observed in Lower Egypt from May to January (J. Burrell *in litt.*), and a photograph of a final instar larva at a small desert pool in north-western Egypt in May 2009 (J.-P. Boudot, unpublished) indicates that the species is able to breed successfully in this country. *Pantala flavescens* is not uncommon and sometimes abundant in Central Asia (Schröter 2010b, Borisov 2012) and occasionally reaches the south of Siberia (Kosterin 2004) and Kamchatka. A few dozen records are known from the Levant, Turkey and Transcaucasia, but breeding was observed in only a few cases (e.g. Arlt 1999).

Europe: The species is one of the rarest dragonflies observed in Europe with records from Cyprus (four, 1957, 2010), Rhodes (one, 2001), mainland Greece (one, 2005), European Turkey (four, including Göckçeada island, 1998), Montenegro (one, 1972), Croatia (one, 2010), Linosa (one, 2012), Lampedusa (one, 2012), Bulgaria (one, 2012), the Maltese islands (three, 2013), the Canary Islands in Gran Canaria (two, 2013) and the Azores archipelago in São Miguel (one, 2014) (Kiauta 1963, Lopau & Adena 2002, Hacet & Aktaç 2004, 2006, Laister 2005, Ober 2008, Finkenzeller 2010, Lopau 2010b, Corso *et al.* 2012, Degabriele 2013, Vieira & Cordero 2015; unpublished records by J. Blincow (Greece), G. De Knijf (Bulgaria) and K. Hessel (Cyprus)). The records from Cyprus in May 1998 (Monnerat 1999) are incorrect (pers. com. C. Monnerat). Other unpublished records are available from European Russia where a total of six specimens where recorded around Sochi on 19-24 August 1987 (R. Mauersberger pers. com.). A male caught in a bird trap on the coast of Kaliningrad in 2013 is by far the northernmost record in Europe (Buczyński *et al.* 2014). A record from Rhodes referred to a female in a late teneral condition and might indicate local breeding. All other records referred to one to three specimens and no sign of breeding has ever been observed in Europe. A record from the Moscow province presented by Skvortsov (2010) is now considered unreliable by the observer and is therefore omitted. *Pantala flavescens* has been rumoured to occur in France and Spain (Aguesse 1968) but no documentation is available and these records are regarded as incorrect. Two records from the 19th and 20th centuries from England are considered erroneous (Laister 2005). Three



European distribution

World distribution

Flight period

Pantala flavescens has a rapid larval development which in some cases takes less than forty days (Suhling *et al.* 2003). The species is found throughout the year in the tropical part of its range. Records suggest that it flies throughout the year in the Nile valley, although migrating swarms are mainly observed between May and January. All records from Europe and Anatolia are from June to October, excepting those from Cyprus in November. In the Levant and North Africa adults fly year round.

European records referring to human introductions are known: two with shipments of bananas and one found on a warship (Corbet 1960, Kipping 2006, Merritt *et al*. 1996, Laister *et al*. 2014).

Trend and conservation status

The number of records in the north of Africa, the Levant and the south of Europe has increased in the two last decades but it is unclear if this is a genuine increase of migrations or simply reflects the increased number of observers. It is expected that the species will benefit from higher summer temperatures and an increase in numbers of records is expected in the Mediterranean.

Habitats Directive	No
Red List EU27	Not Applicable
Red List Europe	Not Applicable
Red List Mediterranean	Not Applicable
EU27 endemic	No
European endemic	No
Trend Europe	Unknown

Habitat

Pantala flavescens reproduces at all kinds of standing water but is most successful at small and warm, often temporary, waters with little or no vegetation. Examples include rain pools and concrete basins. In some tropical regions, the species migrates with monsoon fronts, arriving just after rains have started and using fresh rainwater pools as a breeding habitat. Its rapid larval growth enables it to reproduce successfully before the pools desiccate. The temporary nature of the habitat ensures that there is little competition from predators such as fish and that *Pantala* is at the top of the local food chain.

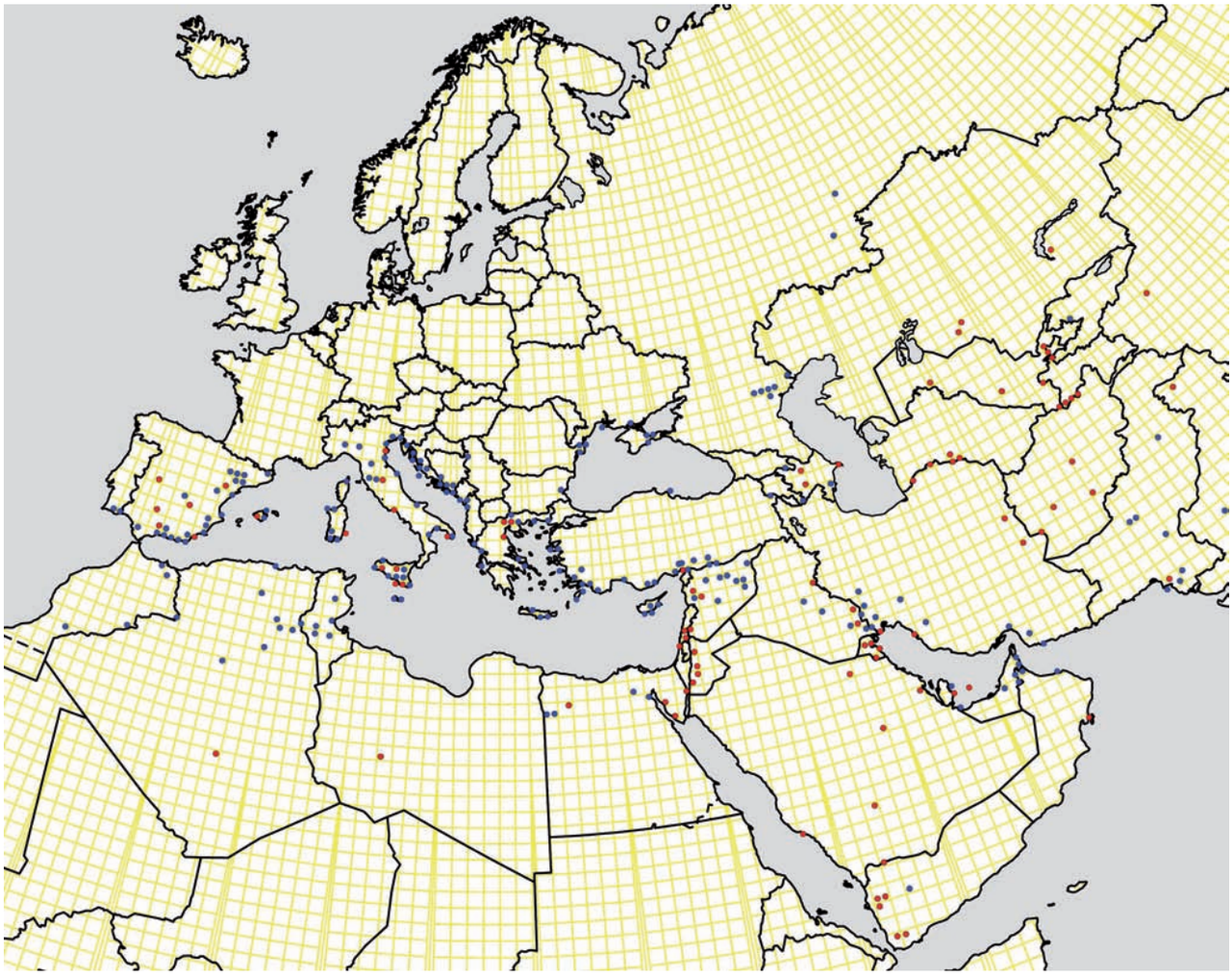
Selysiothemis nigra (Vander Linden, 1825)

V.J. Kalkman & T. Bogdanovic

Distribution

World: *Selysiothemis nigra* has a widespread but patchy distribution from south-west and Central Asia to the Arabian Peninsula, North Africa and the Mediterranean basin. In the east it reaches Pakistan, north-west India, Kashmir and the Chinese province of Xinjiang. Recently it has been recorded from Liaoning Province in the far east of China (pers. com. H. Zhang), which suggests that it occurs also in northern China and perhaps Mongolia. The northernmost records are from the southern Urals, with a teneral male collected in 2000 on the western slopes and a population present at least from 2004 to 2006 on the Asian side (Yanybaeva *et al.* 2006, Popova & Haritonov 2008). Despite being widely distributed, the species is generally scarce throughout most of its range. In North Africa and Asia, it occurs primarily in inland desert and semi-desert environments. In the east Mediterranean Basin, including the Black Sea and the Adriatic, it is often restricted to coastal localities although many inland records are known from Syria, Iraq, Iran and southern Turkey. Throughout its range, there have been numerous new records in recent decades, which partly result from increasing levels of observation but also reflect a genuine increase in populations due to the creation of man-made habitats. In Transcaucasia, the species was first discovered in Armenia in 2006 and in Georgia in 2014 (Schröter *et al.* 2015). In North Africa several new localities were found in Algeria and Egypt, while the species was discovered as new to Tunisia in 1998 and Morocco in 2007 (Samraoui & Menai 1999, Jödicke *et al.* 2000, Boudot 2008, Juillerat & Monnerat 2009, Dijkstra & Boudot 2010, Boudot & De Knijf 2012). Recent records suggest that the species is currently present at several oases and lakes throughout the northern Sahara.

Europe: *Selysiothemis nigra* is distributed throughout most of the Mediterranean Basin. The northern border of its European range runs from the extreme north of Spain (at 25 km south of the French border) to northern Italy, Slovenia, coastal Ukraine and the south of European Russia along the northern Caspian area. The two records from southern Ural suggest that the species is also present between the southern Urals and the Caspian basin. According to Popova (1997), both this species and *Lindenia tetraphylla* became common in the north Caucasus area due to the creation of man-made lakes and ponds, but detailed information has not been published. In the Balkan Peninsula, *S. nigra* is mostly confined to the Adriatic and Mediterranean coasts. The species is generally rare although locally abundant along the western coast of the former Yugoslavia, Albania and Greece. Recent records from this area suggest that several very large populations exist there, and this region is probably the main hotspot for the species in Europe (Koren *et al.* 2012, Kulijer *et al.* 2012, De Knijf *et al.* 2013, Kulijer *et al.* 2013).



World distribution of *Selysiothemis nigra*, with the exception of the record from Liaoning, China

Selysiothemis nigra is uncommon in Italy and Spain and is known from just a handful of records from southern Portugal and a single post-teneral male from France in northern Corsica. It is a very mobile species and many records probably refer only to vagrants. In many instances, such as Slovenia, there is no evidence of breeding.

Trend and conservation status

The species has recently been discovered as new in several countries, namely Bulgaria in 1996, Portugal in 2003, Ukraine in 2007, Bosnia and Herzegovina in 2009, Slovenia in 2012, Romania in 2013 and France (Corsica) in 2015 (Beschovski & Gashtarov 1997, Lohr 2005b, Matushkina 2007, Tytar 2007, Kulijer *et al.* 2012, Šalamun 2012; unpublished data: Phil Benstead (Romania), David Sannier (France)). Part of the recent increase in records can be explained by increased levels of observation. However, it is clear that a genuine increase in the number of populations within its existing range has taken place in the last decades due to the creation of numerous man-made ponds and reservoirs (Popova 1997, Boudot & De Knijf 2012, Brochard & van der Ploeg 2013b, Boudot 2014a, Uboni *et al.* 2015). It is unclear if the recent increase in records in the region of the Black Sea and southern Russia is due to a genuine increase or is caused by the increased survey efforts. Although the continuing destruction of coastal wetlands might lead to a local decline of the species in some areas, the creation of new man-made reservoirs might favour new settlements within the present range.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Increasing

Habitat

Many records of *Selysiothemis nigra* are from shallow ponds and lakes and it seems well adapted to brackish habitats that partly desiccate during summer. Suitable habitats include inland lakes in hot and arid regions, inundated floodplains and brackish coastal wetlands. In recent years the species has been increasingly found to reproduce at perennial and deep man made water bodies (Uboni *et al.* 2015) which are strikingly different from what was previously believed to be its main habitat. In many cases

Flight period

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Bulgaria & Greece													Based on 36 records
Turkey													

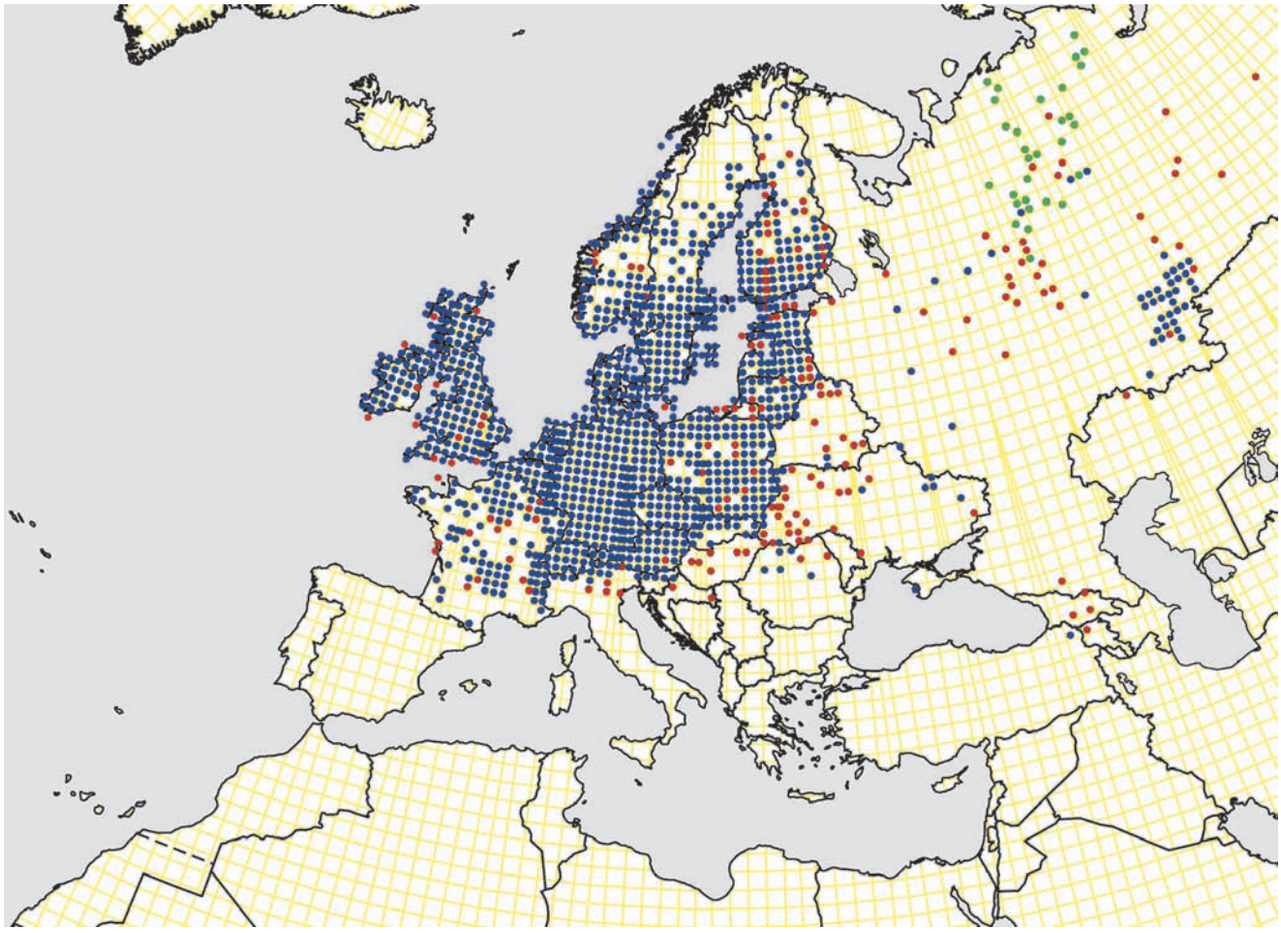
the habitat is well vegetated but populations can also be found in sparsely vegetated areas and at concrete water tanks. *Selysiothemis nigra* is highly nomadic as evidenced by several reports of groups and swarms far from water during migration (Fraser 1936, Asahina 1973, Schneider 1981, Holuša 2011, De Knijf *et al.* 2013).

Sympetrum danae (Sulzer, 1776)

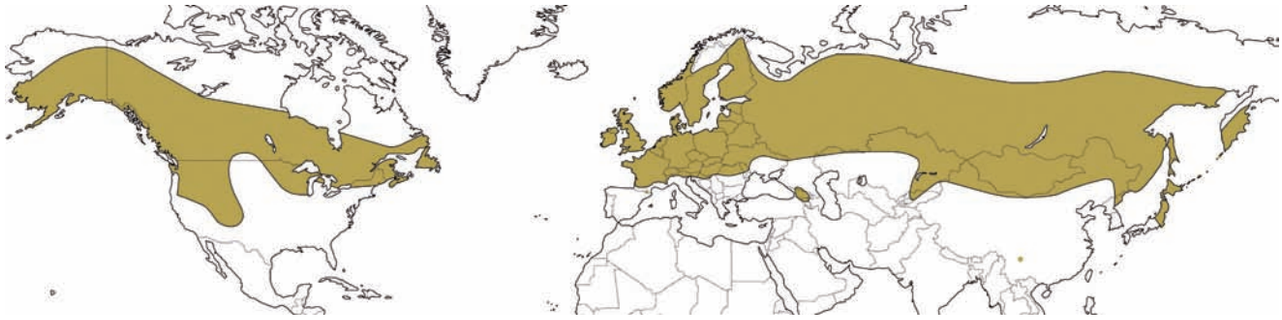
V.J. Kalkman, M. Martin & R. Bernard

Distribution

World: *Sympetrum danae* has a vast Holarctic distribution and is widespread and common in large parts of northern Eurasia and North-America. An isolated cluster of records is available from the northern and southern Caucasus countries, including European Russia, Georgia, north-west Armenia and north-east Turkey (Akramowski 1948, Miroğlu 2011). The species is also known from the southern Chinese province of Sichuan (H. Zhang pers. com.).

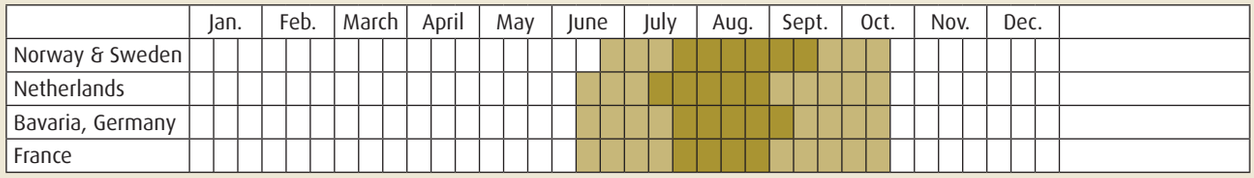


European distribution



World distribution

Flight period



Europe: *Sympetrum danae* is common and widespread in central and northern Europe. In the south of its range it is confined to higher elevations including the Massif Central, the Pyrenees, the Alps, the Carpathians and the Caucasus, where reproduction is known up to 2 040 m. In some years, influxes occur in areas where the species is usually absent or rare, producing short-lived populations outside the normal species range. Despite its preference for boreal habitat types, the occurrence of *S. danae* decreases rapidly with increase in latitude in the northern half of Fennoscandia.

Trend and conservation status

Climate change might adversely affect isolated mountain populations such as those in the Pyrenees, as few habitats are available at higher elevations. Recently, a decline of over 40 % in abundance was noted in the Netherlands, although the extent of its range remained the same (Termaat & Kalkman 2012). This could be due to either a decrease in acidic habitats resulting from lower atmospheric pollution or climate change, or to a combination of both. It is not clear if this decline in abundance is taking place in other lowland habitats in Europe.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

Sympetrum danae mainly occurs in sunny moorlands, *Sphagnum* peat bogs and shallow acidic lakes, ponds without fish but with extensive margins comprising sedges and rushes. It is less often found, and then at lower densities, at partly desiccated ponds, ditches, fens and marshes. In calcareous mountains such as the Jura, the species also occurs at alkaline waters where either a lack of fish or the presence of vegetation providing shelter against fish predation is a key factor (Fliedner 2005). Individuals recorded at old gravel pits in the west and south-west of its range at low elevation are generally vagrants and do not result in viable populations in the long term. In the Mediterranean region, the species is confined to mountain bogs and lakes.

Sympetrum depressiusculum (Selys, 1841)

V.J. Kalkman & K.-J. Conze

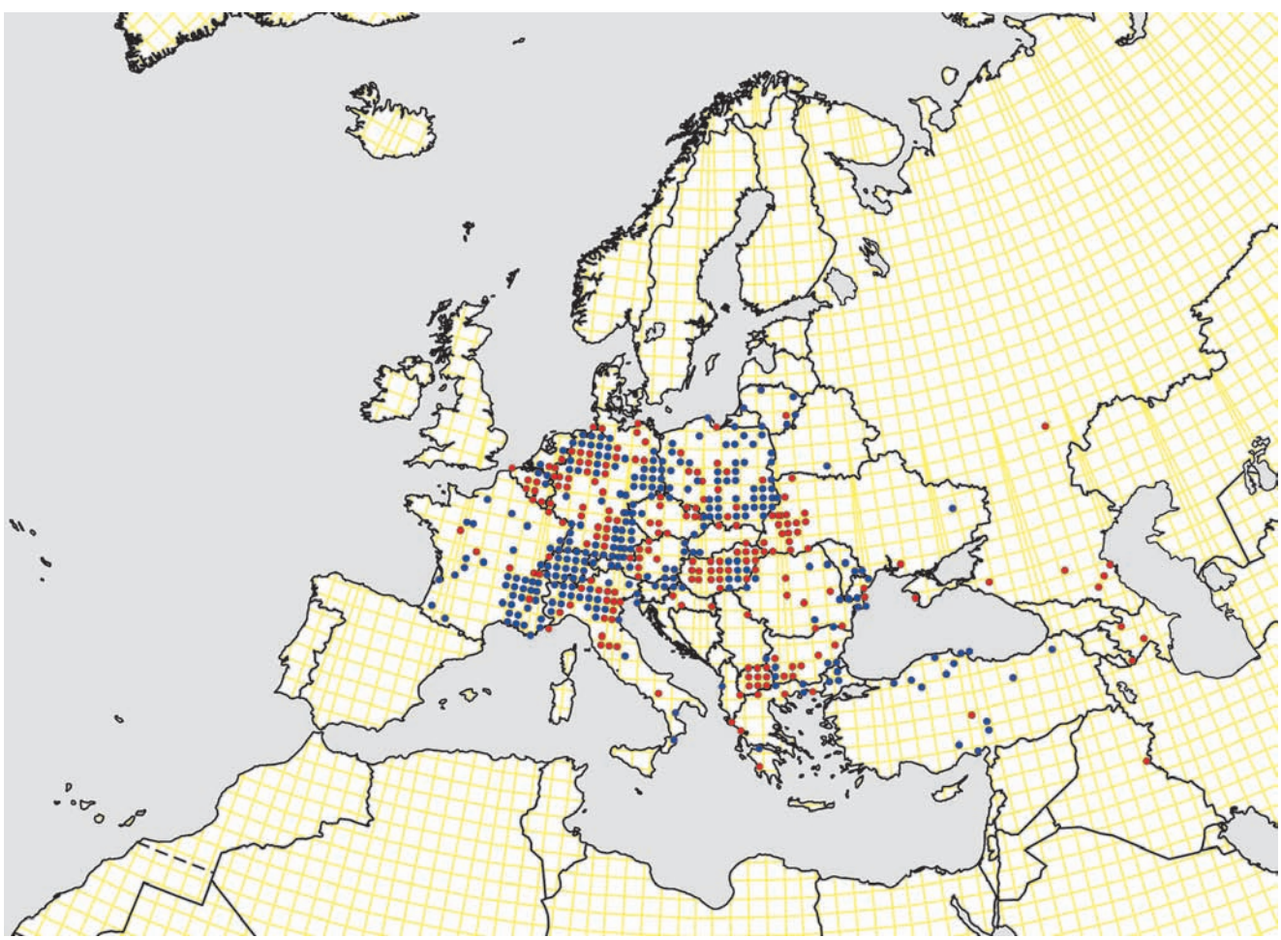
Taxonomy

Sympetrum frequens has long been considered an endemic Japanese species close to *S. depressiusculum*, showing only slight differences in size and pattern. A molecular study by Sawabe *et al.* (2004) showed that both taxa lie within a single clade, suggesting that *S. frequens* is a synonym of *S. depressiusculum*.

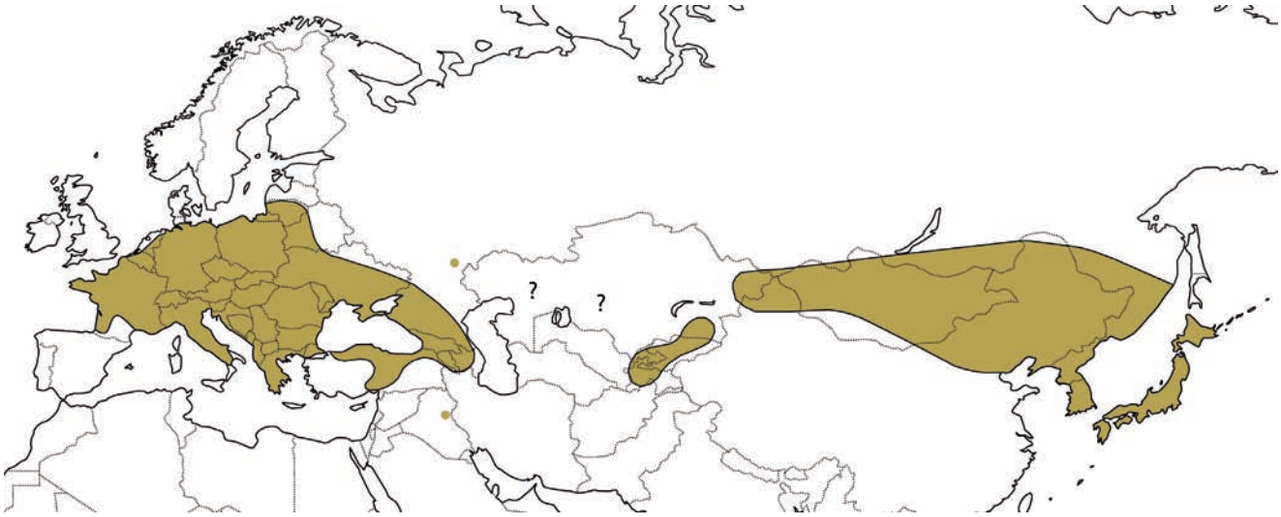
Distribution

World: *Sympetrum depressiusculum* is found in the temperate regions of Eurasia from the Atlantic to Japan. Its range is apparently interrupted in Central Asia by the Turkmen, Uzbek and Kazakh steppe and deserts. The species is moderately common in the Central Asian mountains in Tajikistan, eastern Uzbekistan, Kyrgyzstan and eastern Kazakhstan. The western distribution of *S. depressiusculum* extends east up to the western Caspian coast (Skvortsov 2010) and eastern Iraq with a single record (Sage 1960). The species is rare and local in Turkey.

Europe: The European range of *S. depressiusculum* covers central, eastern and south-eastern Europe. The species has a patchy distribution with large areas within its main range where it is rare or absent. The main concentrations of populations are found in the lower regions of the Alps and adjacent lowlands, and in eastern Germany and Poland. It is rare in north-east Germany, the Netherlands and Belgium, where it is concentrated in a small number of often large populations. In France, the species is concentrated in the Rhône-Alpes region although isolated populations or records are found across the country. It was formerly very abundant in the rice fields of the Camargue in the Rhône river delta and of the Pô Valley in northern Italy, but decreased strongly due to changes in rice cultiva-



European distribution



World distribution

tion. It is now very rare or absent in these regions, and in the lower Rhône area it is currently found only at sedimentation tanks along motorways (Iorio 2012). The species has a scattered to patchy distribution in south-east Europe and can probably be found in all countries, although it has not yet been recorded from Bosnia and Herzegovina and Montenegro. It is generally very rare in this region, with concentrations of (mostly old) records in Macedonia and recent records scattered in Albania (single record in 2006), Greece, European Turkey, Bulgaria, Romania, Moldova and South-west Ukraine. Old records from Sardinia, Sicily and Algeria are considered doubtful, although valid records of single individuals are known from southern Italy (Boudot *et al.* 2009).

Trend and conservation status

Sympetrum depressiusculum has shown a strong decline in the second half of the 20th century and in contrast with many other species, this decline is continuing. The species has been assessed as Vulnerable at the European scale, based on an estimated decline of over 30 % in the last ten years and an expected decline of over 30 % in the next ten years. In Belgium, France, Germany, Switzerland, Austria and Italy, the number of sites and populations has decreased strongly with probably more than 50 % of localities lost since the 1970s. For example, the last record from the Camargue was in 1987 (De Knijf *et al.* 2006, Deliry *et al.* 2008). The scarcity of recent records from, for example, Bulgaria, Macedonia and Ukraine suggests that a strong decline has also taken place in south-east Europe. There is no evidence of a decline in Poland, where the species is not rare (Bernard *et al.* 2009).

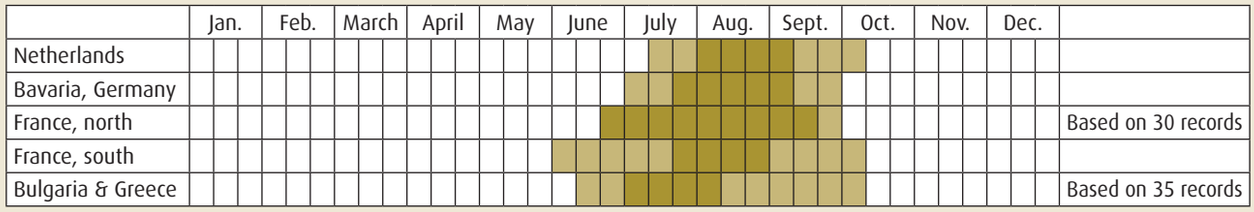
The decline in Europe has taken place in all of its major habitats: natural flooded wetlands and floodplains, rice fields and fish ponds. In natural flooded wetlands and floodplains, major problems are the drainage of temporary wetlands and the intensification of land use in flood plains. In the south, rice production was mechanized in the last decades of the 20th century and at present flooded rice fields have generally very shallow water with the water being drained several times a year, rendering them unsuitable for both dragonflies and amphibians. In the north-west of Europe the raising of young carp (*Cyprinus carpio*) in temporary flooded conditions formerly provided suitable habitats for *S. depressiusculum*. The traditional maintenance of fish ponds has now largely ceased, as the breeding of carp is cheaper elsewhere, in countries such as Hungary, due both to a better climate and lower wages (Schmidt 2012). This has resulted in the disappearance of *S. depressiusculum* from many habitats even when permanently flooded carp ponds remain. There are no indications that the species' decline has levelled out and it is expected to continue. Research on how the management of rice fields and fish ponds can be adapted to suit the needs of *S. depressiusculum* is required. Some suggestions on the management of fish ponds are made by Schmidt (2012).

Habitats Directive	No
Red List EU27	Vulnerable
Red List Europe	Vulnerable
Red List Mediterranean	Vulnerable
EU27 endemic	No
European endemic	No
Trend Europe	Decreasing

Habitat

Sympetrum depressiusculum is largely restricted to open sunny and shallow habitats that dry out in late autumn and are flooded again in late spring. The flooding in late spring often results in the inundation of established vegetation and the rapid development of vegetation in the water. Natural habitats with such conditions are to be found at the foothills of mountains flooded by snowmelt in spring (Vonwil 2005). Man-made habitats of similar nature include barrage lakes that are subject to strong seasonal changes in water level (Ulmer 2011). In southern Europe and particularly in southern France and northern

Flight period



Italy these conditions were encountered in rice fields where rice production was often combined with the breeding of carp. This required the maintenance of water levels of a few decimetres throughout the summer, creating ideal conditions for *S. depressiusculum*. In central and north-eastern Europe these unusual habitat requirements were formerly provided by carp breeding ponds.
Traditionally, these ponds were dry in winter and sown with Rye (*Secale cereal*) or Rapeseed (*Brassica napus*), and then inundated in late spring, mimicking a flooded floodplain, the natural reproductive habitat of carp. The shallow ponds where the first year carp are raised were most suitable for *S. depressiusculum*. It is thought that this fish farming practice has probably allowed this species to extend north of its natural range. Oviposition of *S. depressiusculum* can be observed in a variety of habitat types, but not all of them lead to long-term viable populations.

Sympetrum flaveolum (Linnaeus, 1758)

V.J. Kalkman & D. Kulijer

Distribution

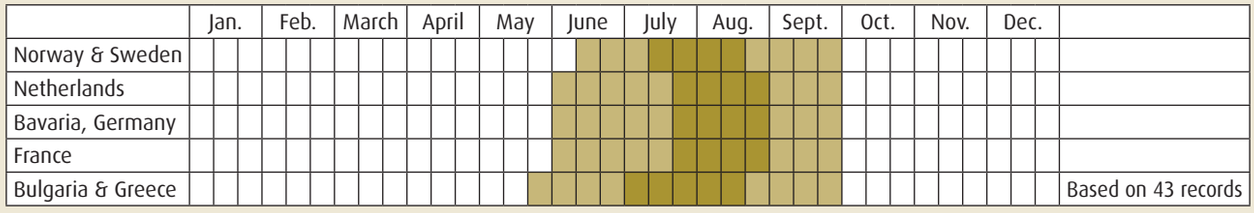
World: *Sympetrum flaveolum* occurs in the cold temperate zone of Eurasia and is common and abundant in most of its range. It is generally confined to mountains in the south and the south-west of its range and in Central and south-west Asia.

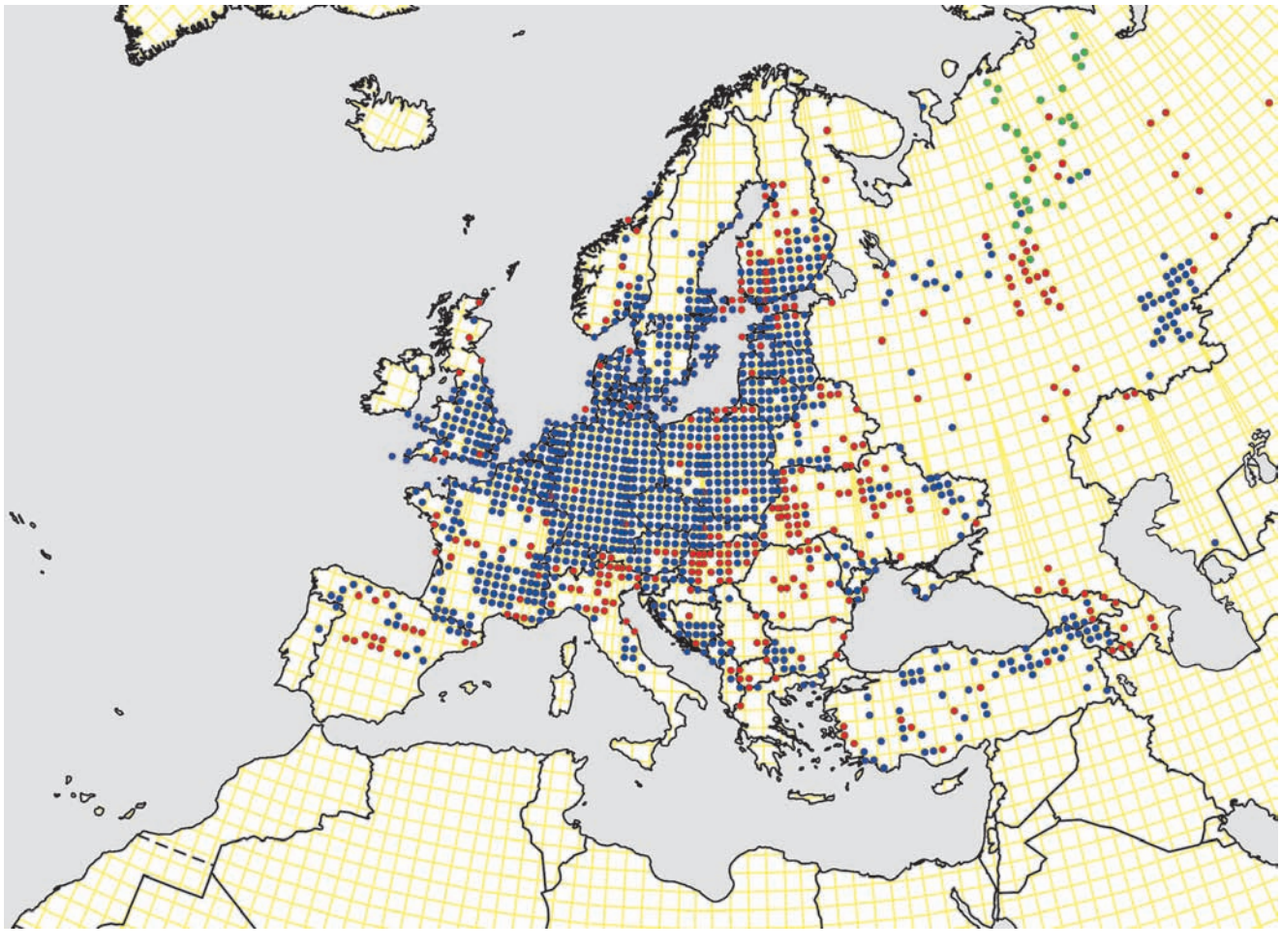
Europe: The species is widespread and often very abundant in large parts of eastern and central Europe and the southern half of Fennoscandia. It has a permanent presence in most of the mountainous areas in western and parts of southern Europe, including the Pyrenees, the Massif Central, the Alps and the Dinaric Alps. Its occurrence in the lowlands of western and southern Europe is largely dependent on influxes from central and eastern Europe, which are associated with eastern winds. These invasions, such as those in 1995 and 2006, can be substantial and often result in the establishment of numerous temporary populations. In 1995, swarms of several tens of thousands of individuals reached Great Britain and there was a single record for Ireland (Murdoch 1998, Nelson & Thompson 2004). The resulting lowland populations are short-lived and in most cases become extinct after a few years. This pattern of influxes followed by decline and extinction is especially evident in Great Britain, with the species being absent or very rare in years between influxes.

Trend and conservation status

Sympetrum flaveolum is common and often very abundant in the core of its European range and no decline has been noted. The species is subject to significant natural variations in abundance in the west and the south of its range due to irregular waves of immigrations,

Flight period





European distribution

World distribution

which mostly only result in short-lived populations. Consequently, no long-term trend can be ascertained in these regions (Schmidt 1998).

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

In the core of its European range, *S. flaveolum* is found in a wide range of standing waters, which are neither too eutrophic nor heavily shaded. In the west and the south, it shows a strong preference for standing waters with shallow banks, which partially or completely dry out during summer. Suitable conditions occur at temporary flooded meadows, shallow dune lakes and small depressions in fen land, bogs and quarries. The stable mountain populations of southern and western Europe are found at *Sphagnum* peat bogs, small alkaline or acidic lakes and temporary ponds.

Sympetrum fonscolombii (Selys, 1840)

V.J. Kalkman & T. Bogdanovic

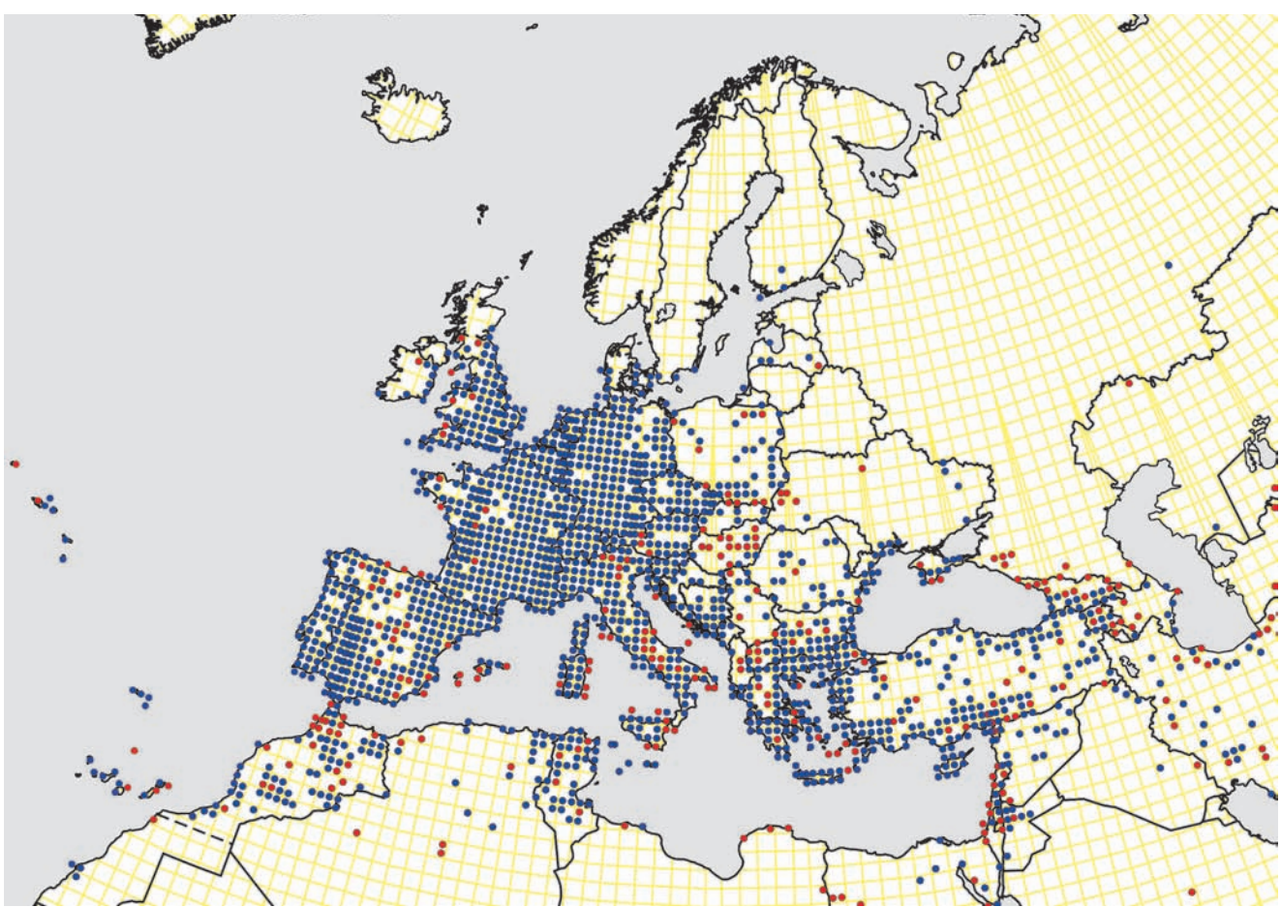
Distribution

World: *Sympetrum fonscolombii* is widespread and common in most of Africa, the Middle East, the Indian Peninsula and Central Asia. The species is a habitual wanderer and has colonised the Canary Islands, Madeira and the Azores. In eastern mainland Asia, records are known from several widely scattered localities although its status in these regions is unclear as breeding details are lacking. There are numerous records from Japan, all regarded as vagrants from mainland Asia (Ozono *et al.* 2012).

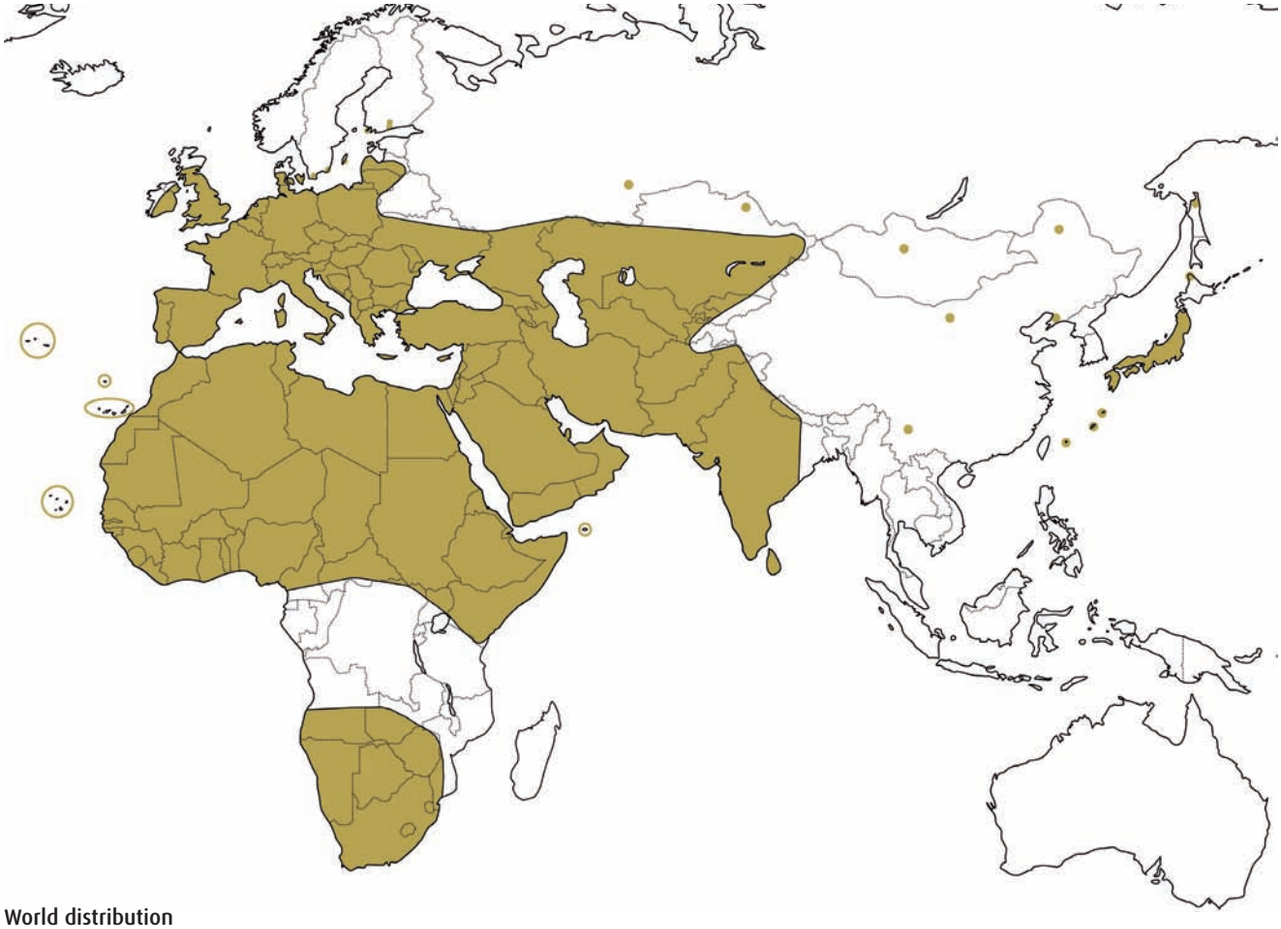
Europe: *Sympetrum fonscolombii* is one of the most common and abundant species in the Mediterranean. Its abundance decreases to the north although it is far from being rare in most of western and central Europe. In the northern part of its range the species shows strong yearly fluctuations, being especially common in years where spring immigration from the south is followed by a warm summer enabling local breeding.

Trend and conservation status

The occurrence of *S. fonscolombii* in western and central Europe was until the 1990s largely dependent on influxes from the south, although short-lived populations have been recorded since the 19th century. In central Europe, large influxes took place in 1928, 1947 and 1964, while in Great Britain similar immigration waves were noted in 1911, 1941 and 1946 (Lempert 1987, Parr 1997). Since the 1990s, the species has considerably expanded its range to the north in a series of large influxes. The best documented is that of 1996, when a large migration reached the north-west of Europe, resulting in the colonisation of large parts of Germany, Belgium, the Netherlands and Great Britain, all areas from where the species was previously almost absent (Lempert 1997). These areas seem now to be part of its permanent range, at least partly as a result



European distribution



World distribution

Flight period

	Jan.			Feb.			March			April			May			June			July			Aug.			Sept.			Oct.			Nov.			Dec.		
Netherlands																																				
Bavaria, Germany																																				
France, north																																				
France, south																																				
Bulgaria & Greece																																				

of climate warming. The northwards expansion has continued, with first records in Denmark (2003), Sweden (2010) and Finland (2011) (Billqvist *et al.* 2012), and an increase in the number of vagrants in Latvia (Kalniņš 2012a). Currently, the most northern breeding record is from southern Finland and the species is expected to be recorded more regularly in northern Europe, from either vagrant individuals or breeding populations.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Increasing

Habitat

Sympetrum fonscolombii reproduces mostly at sunny, shallow standing waters and more rarely at slow-flowing stretches of rivers. In the Mediterranean it is especially abundant in coastal brackish wetlands and lagoons, rice fields and at man-made barrage lakes. Successful breeding can also occur at bare, warm and shallow flooded quarries, sand pits, dune ponds, newly created ponds, depressions in bogs or recently flooded meadows. Newly created waters are readily colonised and are, especially in the north, an important habitat where the species can reach high numbers within a few years. Population size often drops when the vegetation becomes lusher. *Sympetrum fonscolombii* is mainly a lowland species but vagrants have been regularly encountered high in the mountains, although reproduction at high altitudes outside the Mediterranean is rare.

Sympetrum meridionale (Selys, 1841)

V.J. Kalkman, E. Riservato & S. Hardersen

Distribution

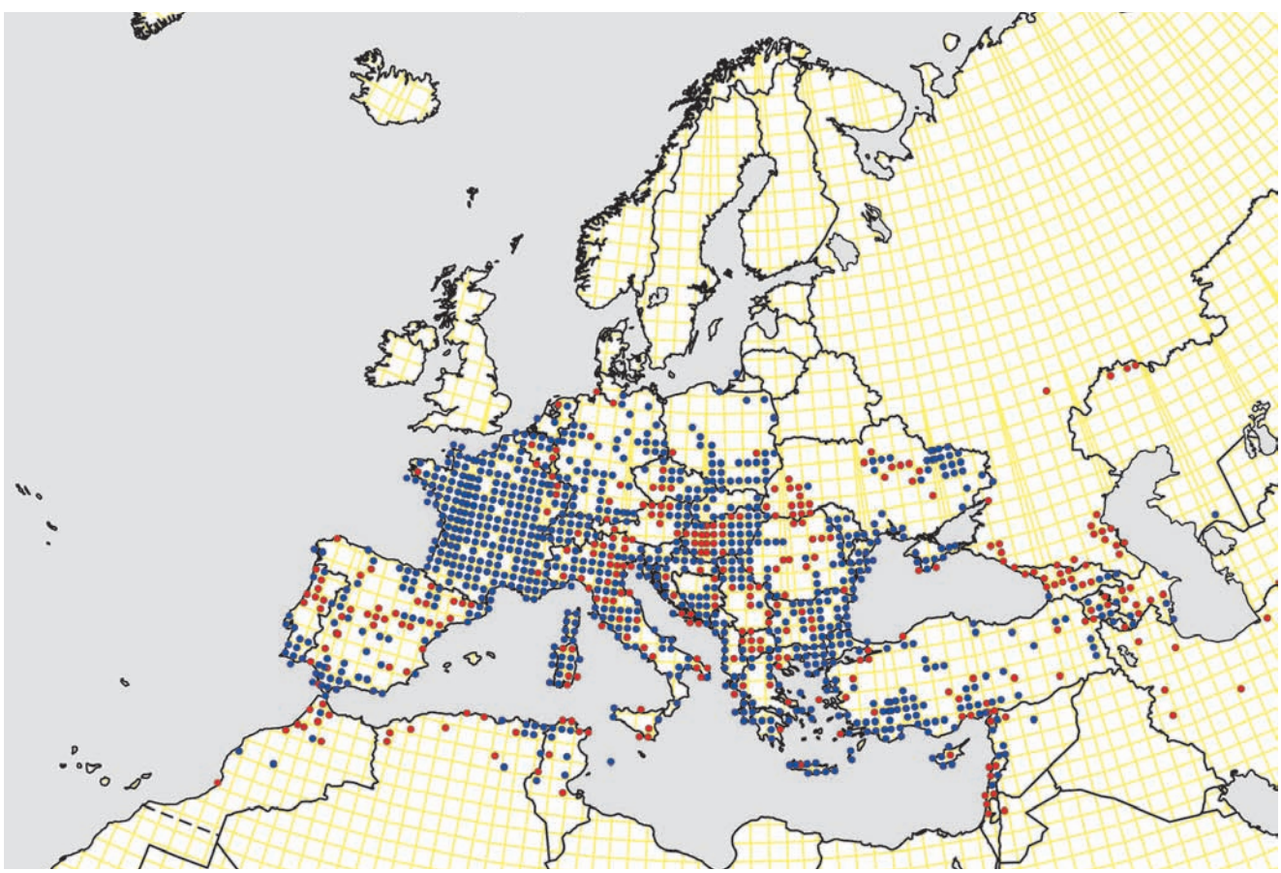
World: The range of *S. meridionale* is mainly the southern half of Europe, Central and western Asia. In Africa, the species is limited to the Maghreb, where it is sparsely distributed but can be locally very abundant.

Europe: *Sympetrum meridionale* is common in the Mediterranean and in parts of central Europe. It shows strong regional differences in population density, being very abundant in parts of the Mediterranean coast, the Balkan Peninsula and along the western Black Sea coast (Dyatlova & Kalkman 2008, Boudot *et al.* 2009, Manci 2012). It is uncommon in most of the Iberian Peninsula (Sánchez García *et al.* 2009) and southern Italy and becomes increasingly scarce to rare north of mid-France, the Alps and Hungary.

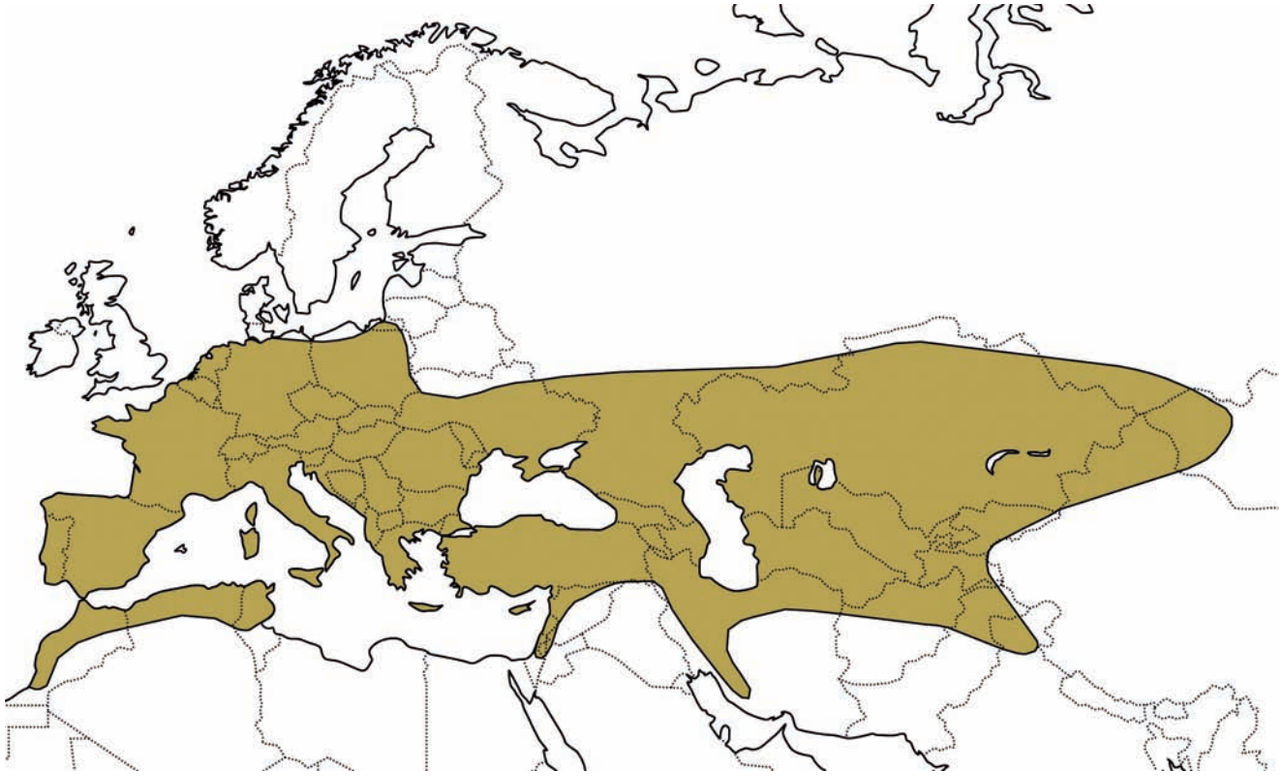
Trend and conservation status

Sympetrum meridionale has been largely restricted to the Mediterranean for most of the 20th century although vagrants were originally recorded in the north of its present range during the 19th century. In recent decades it has increased in abundance in northern France and in southern Germany. Small influxes in other parts of west and central Europe have been observed since 2000, which have resulted in the establishment of mostly small and short-lived populations in Belgium, the Netherlands and northern Germany (De Knijf & Termaat 2010, Roland & Stübing 2014). It is likely that future increases in summer temperatures will lead to a further expansion in northern parts of temperate Europe.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Increasing



European distribution



World distribution

Flight period

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Netherlands													
France, north													
France, south													
Bulgaria & Greece													

Habitat

Sympetrum meridionale is typically found at sunny, shallow standing waters that often dry out during summer. Suitable habitats generally receive most of their water from winter rains, melt water or spring flooding. Habitats are in most cases densely vegetated and marshy and the species is, unlike many others in ephemeral habitats, not a typical pioneer. Suitable conditions for breeding are present in a range of habitats including brackish coastal lagoons, shallow dune lakes, shallow temporary ponds, pools in quarries, seasonally flooded depressions along rivers or lakes and large rain puddles in agricultural fields. *Sympetrum meridionale* is a lowland species but in warm regions it requires forested upland refuges to aestivate before returning to its breeding sites after they are flooded by autumn rain (Samraoui *et al.* 1998, Samraoui & Corbet 2000).

Sympetrum nigrifemur (Selys, 1884)

V.J. Kalkman & S. Ferreira

Taxonomy

Sympetrum nigrifemur belongs to a group of taxa closely related to *S. striolatum* and is sometimes considered a subspecies of the latter. A molecular study based on a wide selection of relevant material is needed to clarify its status.

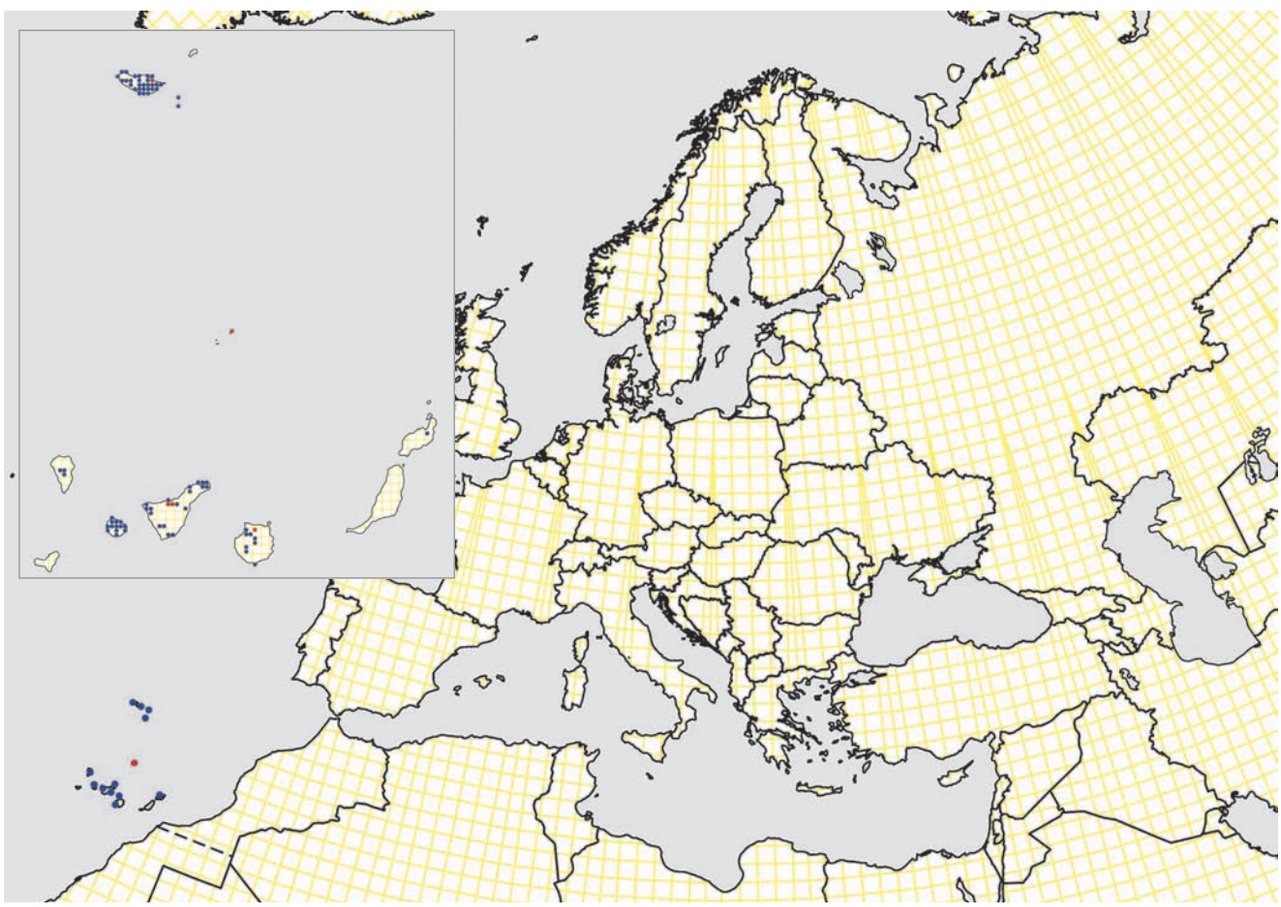
Distribution

World: *Sympetrum nigrifemur* is endemic to the Canary Islands and Madeira archipelago.

Europe: *Sympetrum nigrifemur* has a small range, being known only from Madeira, the Selvagens and the Canary Islands. It is known from only nine islands and breeds commonly on Madeira, La Gomera, Tenerife, Gran Canaria and La Palma (Brauner 2007, Malkmus & Weihrauch 2010). Records from Lanzarote, Selvagem Grande, Deserta Grande and Ilhéu Chão refer to vagrants only.

Trend and conservation status

Only 14 localities were known before 1990 and up to the start of this century the conservation status of the species was unclear. Increased field work since the 1990s has resulted in records from nearly 150 localities so that the species can now be regarded as common without any sign of decline (Malkmus &



World distribution of *Sympetrum nigrifemur*. The inset shows its distribution on the Canary Islands and Madeira archipelago.

Flight period

Sympetrum nigrifemur is found throughout the year with emergences recorded from April to May and from August to September. Oviposition has been recorded from November to March and in July. Current information suggests that it has a bivoltine life cycle with a rapid larval growth during summer and a slower larval growth in winter. However, a univoltine or even multivoltine life cycle cannot be ruled out (Malkmus & Weihrauch 2010).

Weihrauch 2010). It has a good dispersal capacity and vagrants are commonly found on islands where reproduction is unlikely. This capacity for dispersal makes it very likely that new habitats will be promptly colonised.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Not present
EU27 endemic	Endemic
European endemic	Endemic
Trend Europe	Stable

Habitat
Most records are from running waters, which are the most common aquatic habitats in its range; however, the species is also regularly found at pools, ponds, water tanks and man-made barrage lakes.

Sympetrum pedemontanum (Müller in Allioni, 1766)
V.J. Kalkman

Taxonomy
Popova (2004) reviewed the subspecies of *S. pedemontanum* occurring in mainland Asia and concluded that all are invalid, as they are based on individual or clinal variation. The insular *S. p. elatum* (Selys, 1872) from Sakhalin, the Kurile Islands and Japan was not included in this study, so that it is still unclear if *S. pedemontanum* is a monotypic species.

Distribution
World: *Sympetrum pedemontanum* has a wide range that extends from western Europe to Japan. The species has a lacunary distribution and is scarce over large areas. In south-west Asia it is largely limited to Transcaucasia with a few additional populations in Turkey.

Europe: *Sympetrum pedemontanum* is widely distributed but remains uncommon in large parts of its European range, with the density of populations varying strongly between regions. It has a rather continuous range from northern Italy and southern France across central Europe to northern Germany and the Netherlands, whereas its distribution is highly patchy more to the East. The species is rare in large parts of the Balkan Peninsula, almost absent from Spain (mostly vagrants, except in Catalonia), the western half of France (vagrants only), England (single record in 1995), and southern Fennoscandia (new to Finland in 2010) (Lockwood 2007, Boudot *et al.* 2009, Cham *et al.* 2014, S. Karjalainen pers. com.). It is moderately widespread in Bulgaria, Romania and Macedonia (mostly old records), with few records known from adjacent Greece and European Turkey (Marinov 2000, Kalkman & van Pelt 2006, Jović 2009, Lopau 2010b). It is remarkably rare or absent in Croatia, Bosnia and Herzegovina, Serbia, Montenegro and Albania (Belančić *et al.* 2008, Jović *et al.* 2010a). The scarcity of recent records in northern Ukraine and Belarus probably reflects the lack of recent fieldwork in these areas.

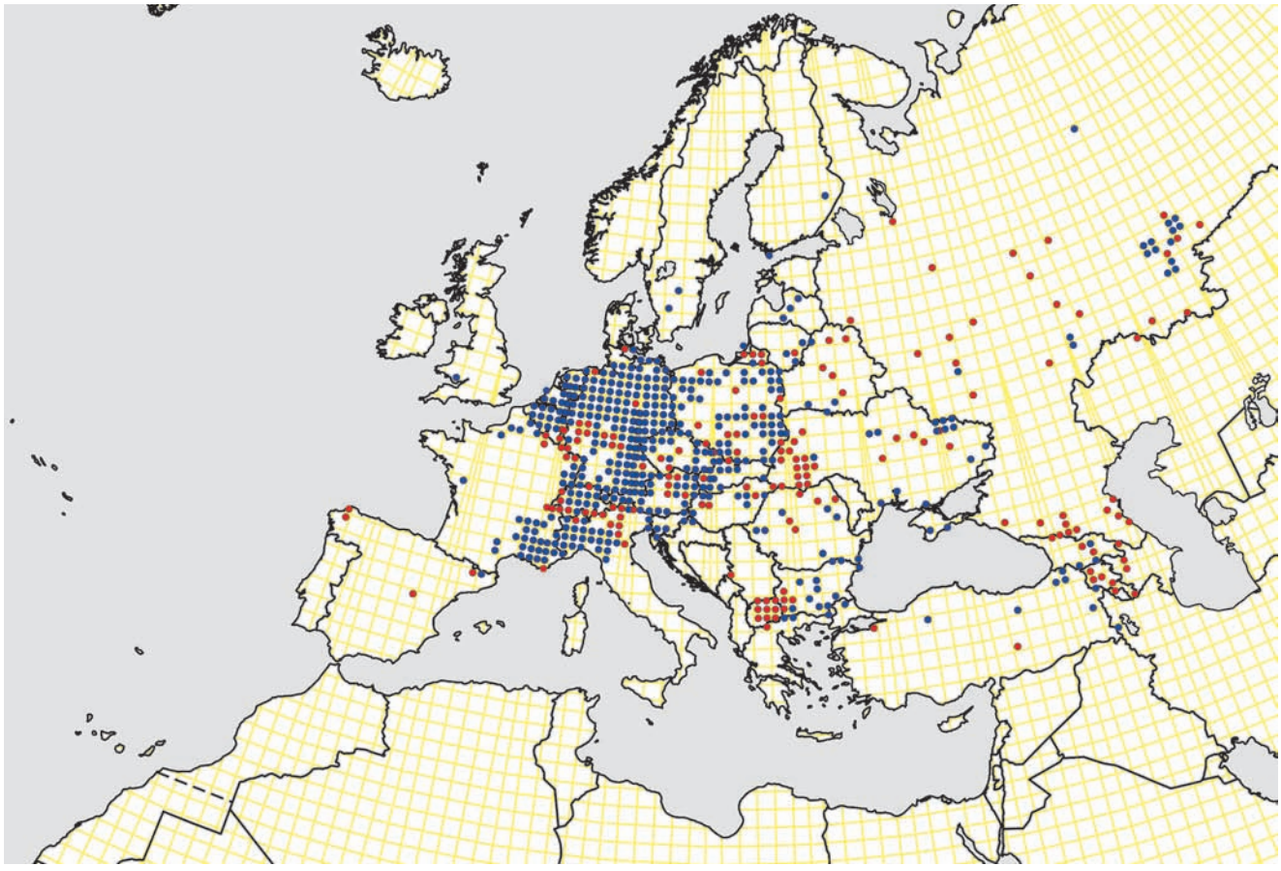
Trend and conservation status
According to Robert (1958), *Sympetrum pedemontanum* was initially largely confined to the mountain foothills; however since the middle of the 20th century it has expanded its range to the lowlands, colonising large parts of Germany and becoming regionally common in the Netherlands (first record in 1981). To the north, it has reached Denmark (1998), Latvia (2001), Finland (2010) and Sweden (2011). It is very rare in these countries but might become more abundant in the future.
Despite its recent expansion, *S. pedemontanum* remains rare in large parts of its range. For some regions such as the German state of Baden-Württemberg, a strong decline has been noted while at the same time the species has increased in, for example the Netherlands and the rice fields of the Po valley in northern Italy. This patchy distribution and regional differences in trends make it difficult to assess its conservation status. Overall there is no reason to assume that the species has shown a strong decline on a European scale and therefore it has been assessed as of Least Concern.
The threats for *S. pedemontanum* vary strongly between regions. In areas where it is largely dependent on man-made habitats, the intensification of agricul-

tural land use and the abandonment of traditional practices such as low intensity mowing of periodically flooded meadows are likely to have the greatest impact.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

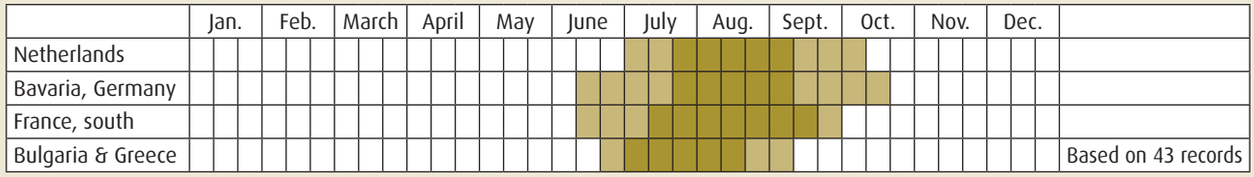
Sympetrum pedemontanum shows strong regional differences in habitat preference but is generally associated with sunny mesotrophic to eutrophic standing and slow-flowing waters. It favours habitats with extensive emergent vegetation, which is neither too tall nor too dense. Many habitats become partially inundated in winter or early spring and the species regularly occurs at sites that dry out in winter or in summer. Such situations are often found at habitats flooded by melting snow such as the flood plains of lakes and streams. This could explain why the species was originally mainly confined



European distribution

World distribution

Flight period



to mountain valleys and foothills (Robert 1958). Presently, many of these natural habitats have been altered and their water regime changed, so that *S. pedemontanum* occurs today mostly at man-made habitats such as slow-flowing ditches, canals, quarries, complexes of (fish) ponds and, in northern Italy, rice fields. Many of these man-made habitats are seepage-fed and are mown or cleaned every few years, which ensures that the vegetation does not grow too high or become too dense. In some instances, conditions mimicking temporary natural flooding are found on the banks of man-made barrage lakes subjected to strong seasonal changes of water level (Ulmer 2011). The species is often found at waters with a high calcium content but this is not a requirement as it is also found at runnels near acidic lakes and at bogs. *Sympetrum pedemontanum* is one of the few uncommon European species that is capable of developing sizeable populations in agricultural areas. Most populations are found below 500 m although the species is not rare up to 1 000 m.

Sympetrum sanguineum (Müller, 1764)

V.J. Kalkman, M. Kalniņš & R. Bernard

Distribution

World: *Sympetrum sanguineum* is widespread across large parts of Europe, reaching east to the south of central Siberia. The species is among the most common and abundant species throughout much of its range. It is rare in south-west Asia and mostly restricted to mountains in Central Asia. In Africa, it is largely confined to the coastal parts of the northern Maghreb and to the Rif Mountains in Morocco.

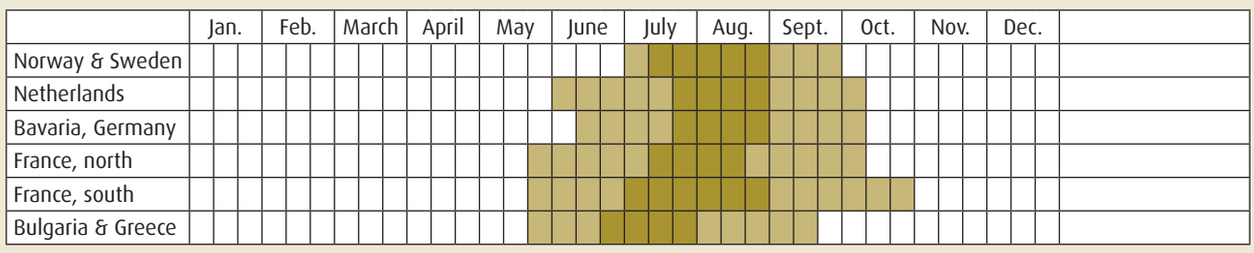
Europe: *Sympetrum sanguineum* is one of the most widespread species in Europe and is abundant in most of its range. To the south, it becomes rare in the more arid regions of the Mediterranean and in the north it is limited by cold, being absent from most of Scotland and the two northern thirds of Fennoscandia. Its apparent low density in the central part of the European Russia, Belarus and parts of Ukraine is likely to be due to lack of field surveys in those countries.

Trend and conservation status

Sympetrum sanguineum is widespread and common within its range and considered of Least Concern.

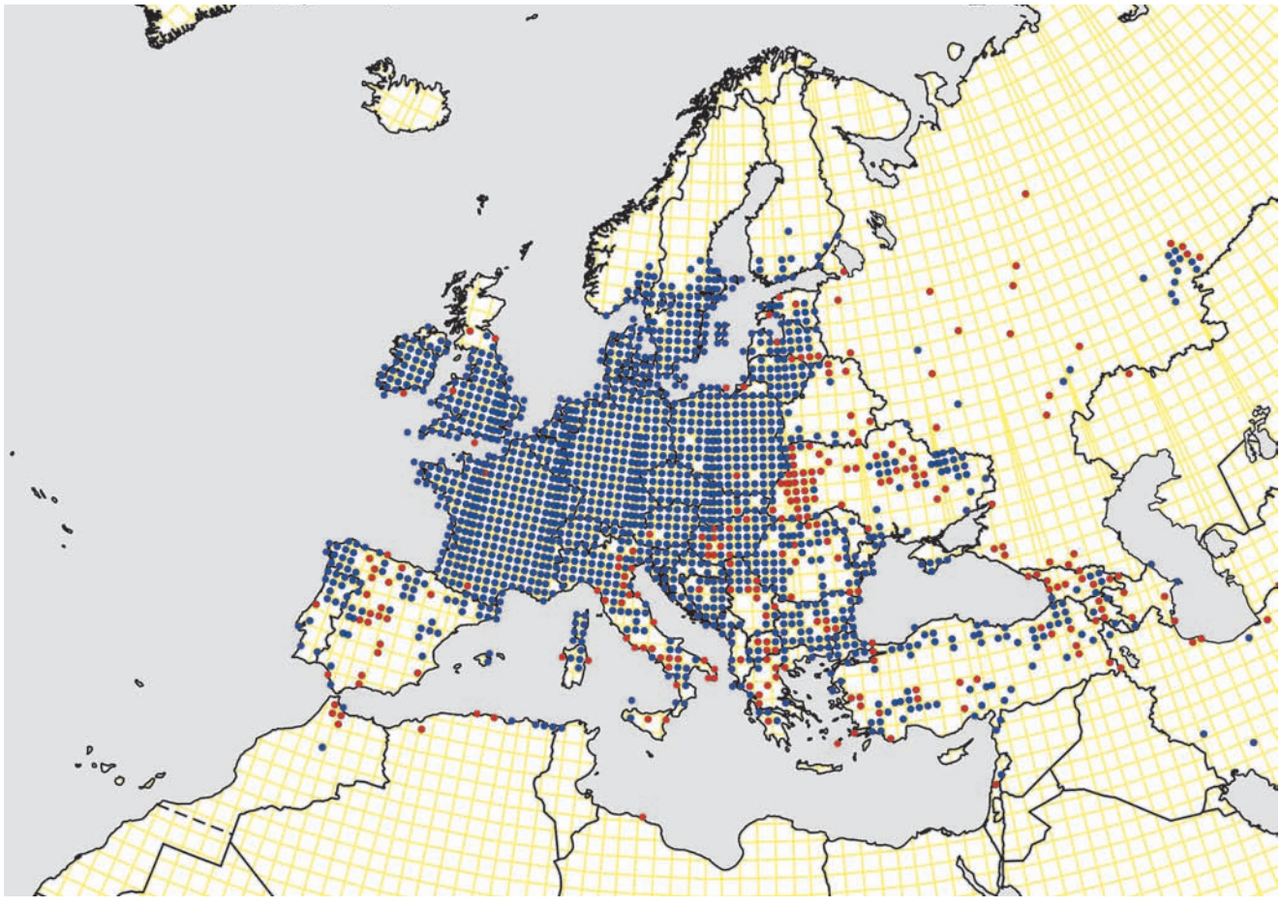
Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Flight period



Habitat

Sympetrum sanguineum occurs in a wide range of standing or slow-flowing waters, preferring those with a rich aquatic and bank side vegetation. It is mostly found in permanent, not too shallow, largely unshaded waters, often near bushes or trees. Habitats include lakes, oxbows, excavations, garden ponds, fens, ditches, canals and slow-flowing stretches of rivers. The species is generally absent or scarce in acidic water bodies with peat moss (*Sphagnum*) and in habitats with little vegetation such as newly created ponds.



European distribution

World distribution

Sympetrum sinaiticum Dumont, 1977

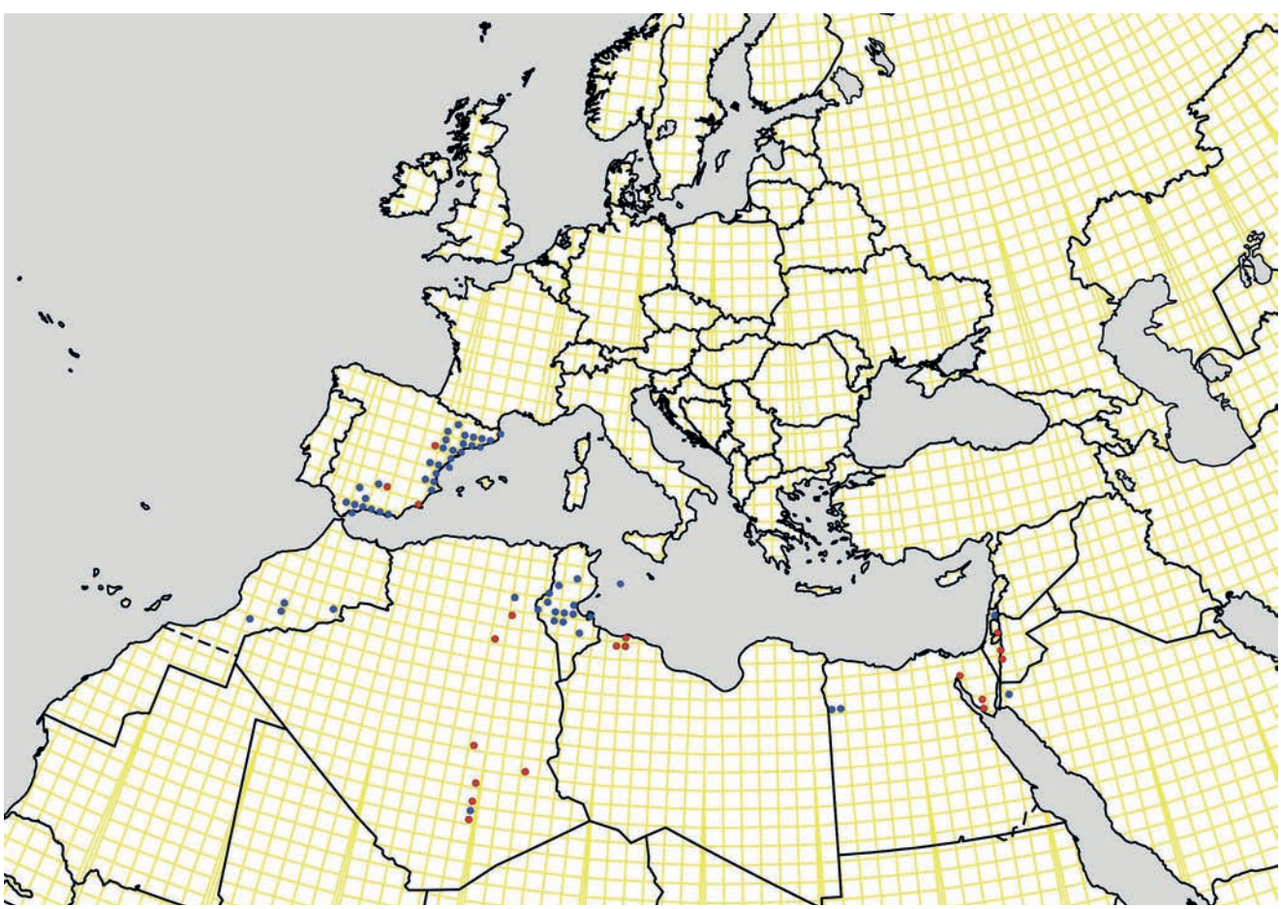
V.J. Kalkman & B. Garrigos

Taxonomy

Sympetrum sinaiticum has a confusing taxonomical history and for a full account, Jödicke *et al.* (2000) should be consulted. In 1994 the species, thought to occur from Spain and North Africa to Central Asia, was split into four subspecies (Jödicke, 1994). Based on additional material and characters of the larvae, Jödicke *et al.* (2000) showed that these four subspecies in fact belong to two distinct species. The two eastern subspecies (*S. s. deserti* Jödicke, 1994 and *S. s. arenicolor* Jödicke, 1994) were combined in a single monotypic species, *S. arenicolor* Jödicke, 1994, which is found from Turkey and Syria to Central Asia. The two western subspecies (*S. s. sinaiticum* Dumont, 1977 and *S. s. tarraconense* Jödicke, 1994) were combined in the monotypic *S. sinaiticum* Dumont, 1977, the differences between these two subspecies being based on an aberration in the holotype of *S. sinaiticum*.

Distribution

World: *Sympetrum sinaiticum* occurs in North Africa, the Levant and Spain. Its distribution in North Africa and the Levant is fragmented as regions with suitable habitats are isolated by extensive arid areas (Jödicke *et al.* 2000, Juillerat & Monnerat 2009, Dijkstra & Boudot 2010). The distribution of this species is poorly known as the main peak of adult activity is in autumn and winter, resulting in the species being overlooked in many areas. The discovery of the species in Morocco in 2007 (Juillerat & Monnerat 2009) is therefore not considered as an expansion of its range but simply the result of increased fieldwork. Many localities have been found since the 1990s, which is largely explained by the fact that the species is now better known to observers and can more easily be distinguished from *S. meridionale* in the field. Further fieldwork from late autumn to early spring will probably show *S. sinaiticum* to be more common than presently known in oases and streams in Palearctic Africa and the Levant.



World distribution

Flight period

Information on the life cycle of *S. sinaiticum* in Europe is sparse and available knowledge is based on studies from both North Africa and Spain. The life cycle appears to coincide with the Mediterranean rains, with a short larval period. The long emergence period occurs from April to June in North Africa and from June to July in Spain. After emergence, the adults move away from the water and aestivate, returning to the water only in autumn. Mating and oviposition takes place during autumn and winter, mostly from October to December in Spain, extending up to March in the north of Africa (Le Roi 1915, Jödicke 2003).

Europe: The European range of *S. sinaiticum* is confined to southern and eastern Spain, with vagrants recorded on the Italian Sicilian Channel Islands (Corso *et al.* 2012). The species was one of the last to have been recognised in Europe (Ferreras-Romero 1989). However it was not a recent arrival, as shown by the presence in the Museo Nacional de Ciencias Naturales in Madrid of several specimens collected in November 1900 at Cartagena (Murcia), in August 1906 at Gava and Antiga (Barcelona), in September 1910 at Oliete (Teruel) and in August 1961 at Úbeda (Jaen) (Askew 2004, Paris *et al.* 2014). Field work in the past two decades has shown this species to be fairly common in parts of eastern Spain, although less common in the south of the country (Jödicke 1997b).

Trend and conservation status

Sympetrum sinaiticum is found at a wide variety of habitats ranging from intermittent Mediterranean streams, which partially dry out during summer, to man-made barrage lakes and basins, and oases. There are no specific threats to its habitats besides the general degradation of surface waters and the pressures of water extraction. The species is probably not strongly impacted by climate change as it is univoltine and aestivates during its adult life, enabling it to tolerate summer desiccation of its habitat.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

Sympetrum sinaiticum occurs at permanent and temporary standing and running waters such as intermittently-flowing brooks and streams, dam lakes, sunny ponds, pools and basins, marshy depressions and ditches. The habitat preferences of this species are poorly understood as it appears to occupy a broad range of habitats but is often absent at seemingly suitable locations. It is well adapted to arid and semi-arid regions as its egg and larval phases largely coincide with the rainy season from autumn to winter. It might be that *S. sinaiticum* is most successful in areas which frequently dry out during summer, thus reducing competition with other species and predators.

Sympetrum striolatum (Charpentier, 1840)

V.J. Kalkman, D. Šácha & S. David

Taxonomy

Several subspecies of *S. striolatum* and closely related species have been described in Eurasia. Molecular studies by Pilgrim & von Dohlen (2007) and Parkes *et al.* (2009) showed that the north European *S. nigrescens* Lucas, 1912 is just a melanic variation of *S. striolatum*. No genetic study is available for *S. nigrifemur* from the Canaries and Madeira and the latter is still provisionally considered as a valid species endemic to the Macaronesian islands.

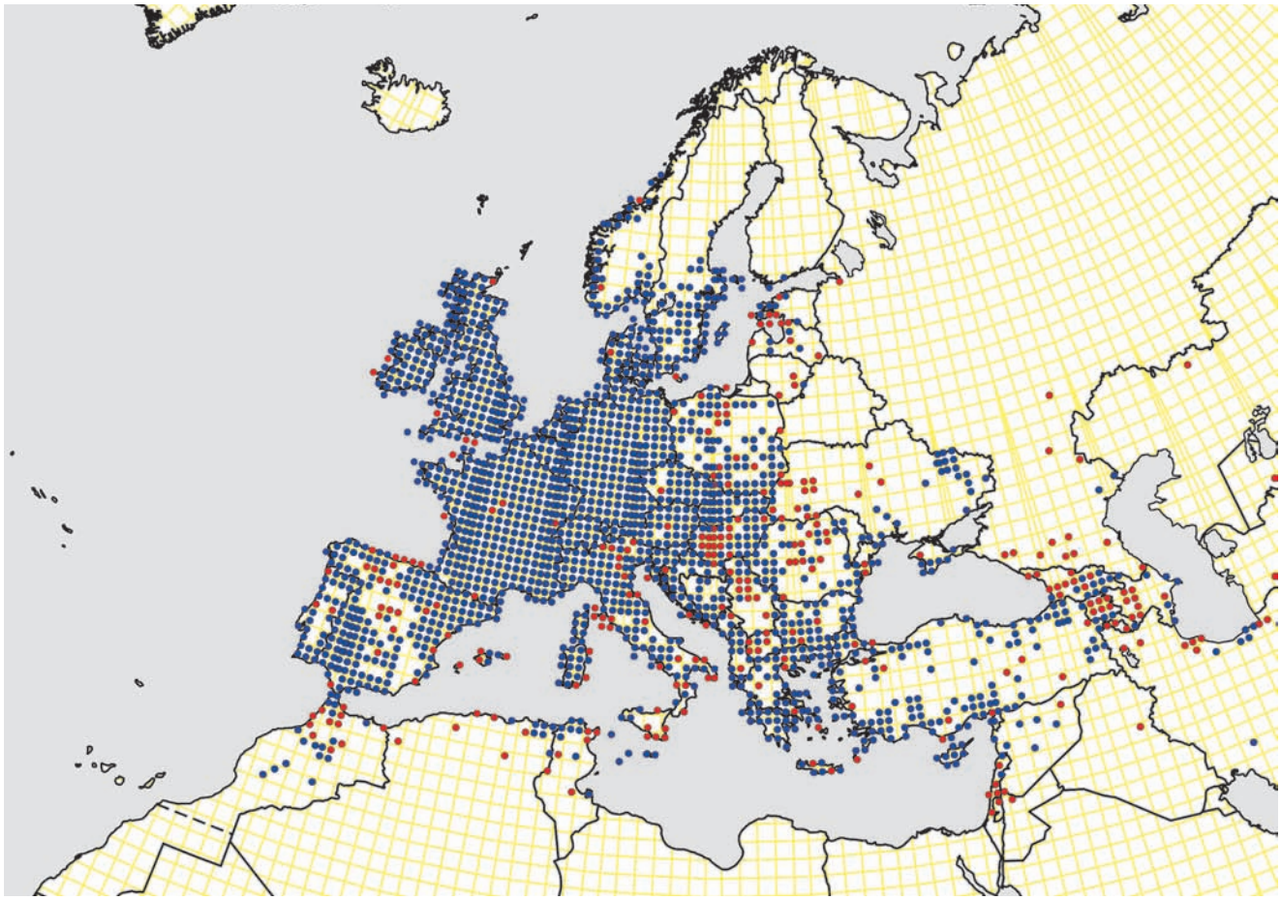
Distribution

World: *Sympetrum striolatum* is widespread in Eurasia and North Africa, extending eastwards to Japan. In Asia it has a rather southern distribution and has not been recorded from Siberia. Further taxonomic work might show that some of the eastern subspecies deserve full species status (Schröter 2010b). The species is common in Turkey and the Levant but in Africa is confined to the northern Maghreb.

Europe: *Sympetrum striolatum* is among the most common and widespread European species. Darker specimens found along the Atlantic coast of Ireland, Scotland and Norway were previously assigned to *S. nigrescens* (see taxonomy). It occurs frequently in the southern quarter of Fennoscandia but seems to be

Flight period

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Norway & Sweden												
Netherlands												
Bavaria, Germany												
France, north												
France, south												
Bulgaria & Greece												



European distribution

World distribution

scarce in the Baltic States. Lack of records in Belarus, part of Ukraine and the south of the European Russia might originate from the paucity of field studies in this area. However, its absence from the well-known southern Urals indicates that the species is restricted to the warm, southern regions in eastern Europe.

Trend and conservation status

There is no indication of change in the range of *S. striolatum* although it is likely that present rising temperatures will enable the species to expand northwards.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

In the temperate zone, *S. striolatum* is found in a wide range of open and sunny standing waters and, less frequently, in habitats with slow-flowing water. In the Mediterranean basin, it is very common on streams which are reduced in summer to narrow running stretches or to residual pools. It is also often found in man-made habitats and is one of the first species to colonise new ponds and quarries. It occasionally occurs in brackish waters.

Sympetrum vulgatum (Linnaeus, 1758)

V.J. Kalkman, D. Šácha & S. David

Taxonomy

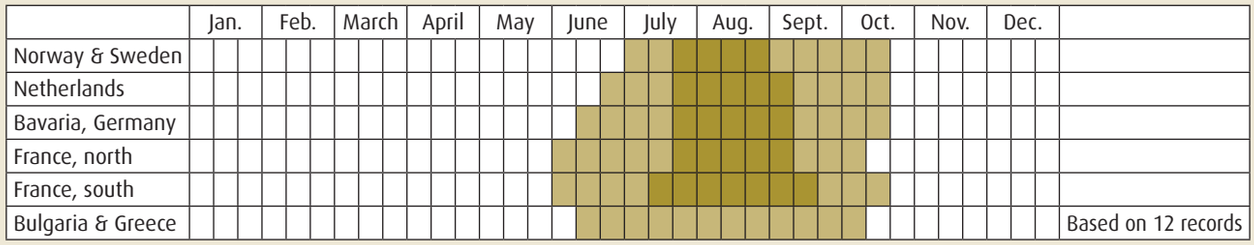
Two subspecies occur in Europe, with *S. v. ibericum* Ocharan, 1985 occuring in Spain and the east of the French Pyrenees and the nominotypical subspecies occurring throughout most of Europe. Subspecies *ibericum* differs mainly by its smaller size, less extensive black pattern and reduced red coloration of males. Another pale subspecies, *S. v. decoloratum* (Selys, 1884), is found in the Asian part of Turkey (see Jödicke, 1994 for its complicated nomenclatural history). A phylogenetic study is needed to confirm the status of these taxa as well as the validity of other east Asian subspecies.

Distribution

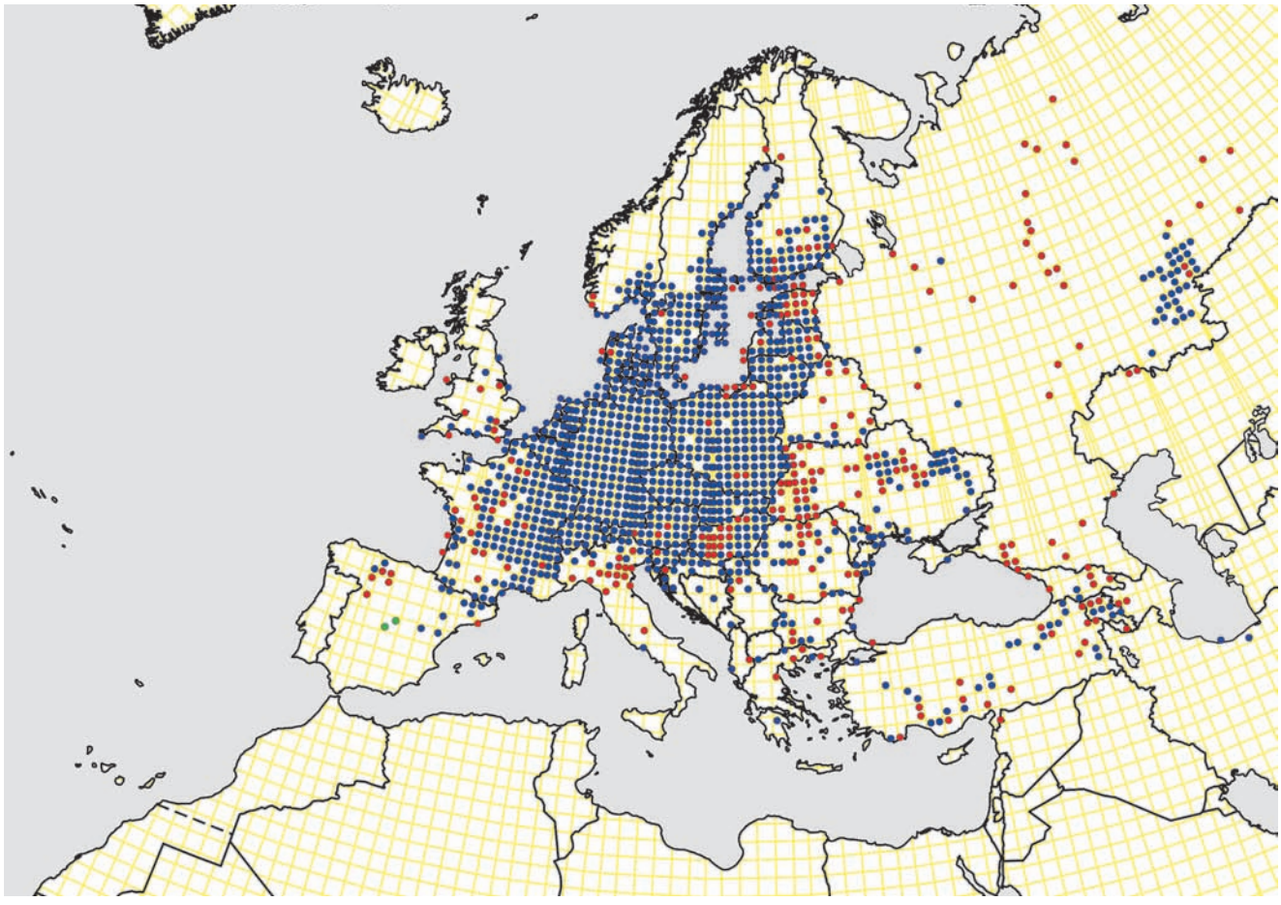
World: *Sympetrum vulgatum* ranges from western Europe to the Russian Far East and Sakhalin. Vagrants have been recorded in Japan (Ozono *et al.* 2012). Subspecies *S. v. ibericum* is restricted to the south-west of the species range whereas subspecies *S. v. decoloratum* extends from Turkey to Central Asia. The latter meets the nominotypical subspecies in Georgia (Shengelia 1975) and in Central Asia, with specimens of intermediate coloration occurring in Kyrgyzstan (Schröter 2010b).

Europe: *Sympetrum vulgatum* is a common and widespread species in eastern, central and continental western Europe. The species is largely absent from both the westernmost regions and the southern third of Europe, where reproductive populations are mainly confined to higher elevations (although influxes to the lowlands are known). It is the rarest of *Sympetrum* species in Spain,

Flight period



central and southern Italy and the Balkan Peninsula. Old records from the Mediterranean islands probably result from confusion with other *Sympetrum* species and are omitted (c.f. Utzeri & D'Antonio 2005). Only vagrants are known from the British Isles, which is remarkable as it is one of the commonest species in the adjacent continental lowlands. In western and central Europe *S. vulgatum* overlaps with *S. striolatum* and over large parts of their range both species are common. *Sympetrum striolatum* has, however, a more southerly distribution, occurring extensively in the Mediterranean where *S. vulgatum* is rare or absent. *Sympetrum vulgatum* tends to outnumber *S. striolatum* in northern latitudes where they overlap. In the southwest, the nominotypical subspecies reaches the French Pyrenees. It is replaced by subspecies *S. v. ibericum* in northern Spain and the east of the French Pyrenees. The latter subspecies seems to be scarce and confined



European distribution

World distribution

to hilly and mountainous regions. Two records from Valencia province (Baixeras *et al.* 2006) are omitted from the map as they fall outside the expected range of the species and are in need of reconfirmation. Similarly, a series of recent lowland records from Madrid province (Garcia Avilés 2002) require confirmation.

Trend and conservation status

Climate change will possibly result in a decrease of *S. vulgatum* in the south of its range and the Iberian subspecies may be seriously threatened.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Near Threatened
EU27 endemic	No
European endemic	No
Trend Europe	Stable

Habitat

Sympetrum vulgatum is found in a wide range of sunny standing waters including ponds, lakes, marshes, gravel pits and canals. In the south of its range, its distribution is restricted to higher elevations with breeding recorded up to 1 400 m in the Alps and 2 100 m in the Pyrenees. Subspecies *S. v. ibericum* has been found at well vegetated marshlands, mountain lakes and gravel pits (Ocharan 1985, Lockwood 2007) and probably inhabits a range of habitats similar to that of the nominotypical subspecies.

Trithemis annulata (Palisot de Beauvois, 1807)

V.J. Kalkman, E. Riservato & S. Hardersen

Distribution

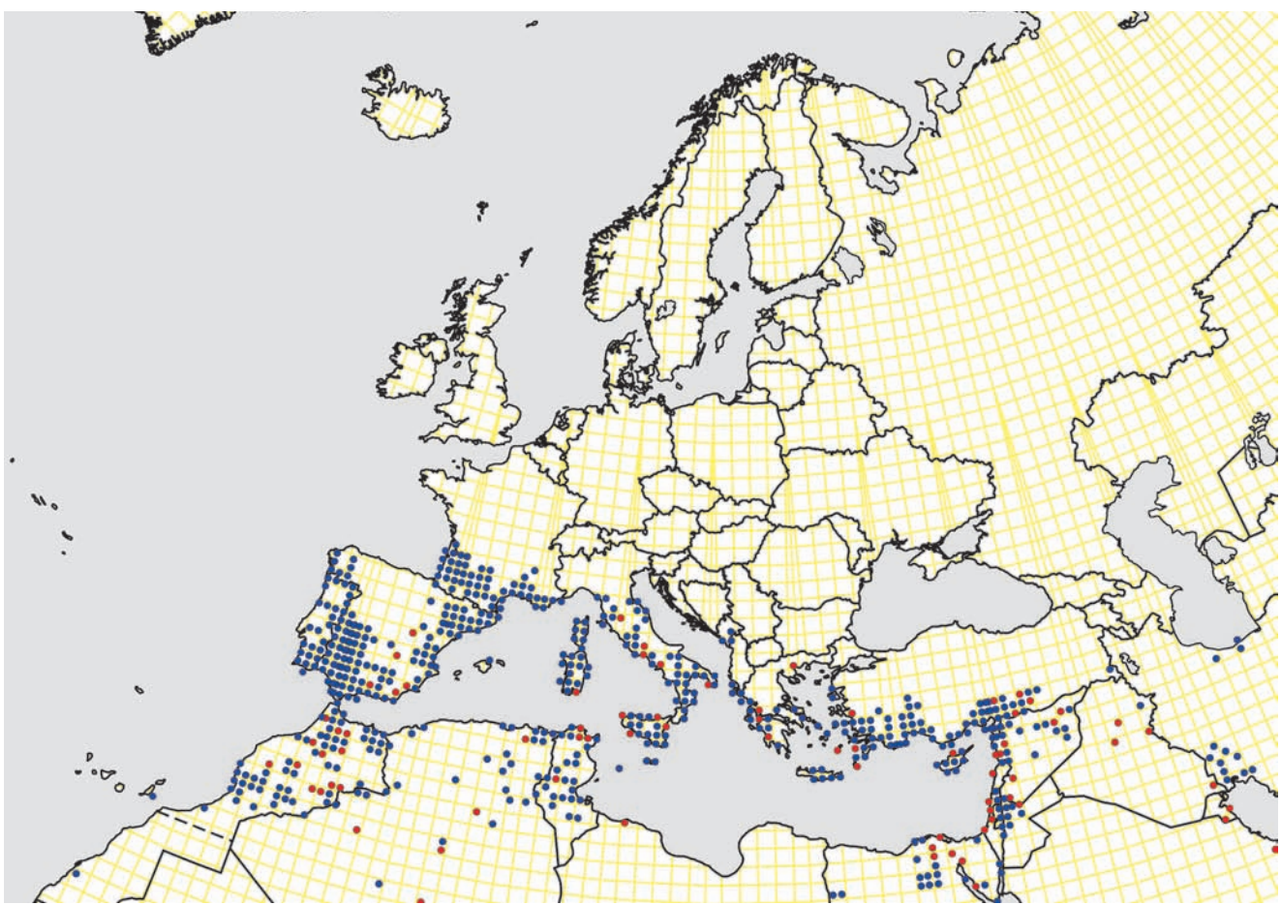
World: *Trithemis annulata* is a wide-ranging Afrotropical species that in recent decades has spectacularly expanded its range in south-western Europe. It is common throughout most of Africa, except in areas with closed tropical forest, and widespread in most of the Arabian Peninsula, extending to eastern Iran and southern Turkey.

Europe: This Afrotropical species has been recorded in Europe since the 19th century when it was recorded from Sicily, Sardinia, mainland Italy and Cyprus (Hagen 1840, 1863, Selys 1841, Rambur 1842, Selys & Hagen 1850, Brauer 1868, Pirotta 1879, Bentivoglio 1905). However, it remained rare and local until the second half of the 20th century, when it expanded across the Mediterranean basin. It is now widespread and common in large parts of the eastern and western Mediterranean but is unknown from the Black Sea area and remains confined to Greece, Albania and Montenegro in the Balkans.

The first records from the Iberian Peninsula were made in 1978 in southern Spain (Lieftinck 1979, Ferreras Romero 1981) and the species has since expanded its range over most of the Iberian Peninsula, with the exception of the colder and wetter northern areas where it is rather local. It reached Corsica in 1988 (Roché 1989) and the south-west of France in 1994 (Grand 1994), and is now widespread from the Garonne estuary to the Alpes-Maritimes with bridgeheads up to the Isère department (ONEM 2009). During this same period it has increased its density and range in Italy and the species is now well distributed in Sicily, Sardinia and the mainland up to the northern borders of Tuscany and Marche.

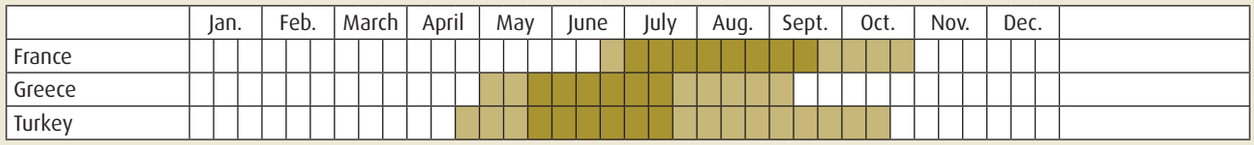
Until the middle of the last century, the only two Greek records were from the islands of Astipalia and Rhodes, suggesting that the species was at that time restricted to the southern Aegean islands. It has since expanded its range in the Aegean and Ionian regions with the first record from the Peloponnese in 1977 (Stobbe, 1978, Lopau 2010b). It remained rather rare up to the 1990s but today the species is common on most of the Greek islands and on the Adriatic coast of the country, reaching Corfu and the Albanian border (Lopau 2010b). Although it was not found in Albania during the most recent surveys (1993-2012) (Dumont *et al.* 1993, Kalkman 2000, Kitanova *et al.* 2013), it was recorded in Montenegro in June 2008 (Gligorović *et al.* 2010a). The first evidence of successful reproduction in this country was

World distribution



European distribution

Flight period



in July 2011 (De Knijf *et al.* 2013). It is therefore likely that the species is now present in Albania and records from Bosnia and Herzegovina and Croatia are likely in the future.

Trend and conservation status

Within a few decades, *T. annulata* has colonised most of Mediterranean Europe and is now common and widespread at both coastal and inland localities. Suitable habitats were already available before it commenced its expansion suggesting that the warming climate is the main driver of this extension of its range. It is likely that the species will continue to increase its range in the future.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Increasing

Habitat

Trithemis annulata is an ubiquitous species and inhabits a wide range of sun-exposed, slow-flowing and standing water. It favours warm conditions and is often found in ditches, gravel pits, natural lakes, large man-made barrage lakes, small basins and sluggish streams and rivers.

Trithemis arteriosa (Burmeister, 1839)

J.-P. Boudot & S. Ferreira

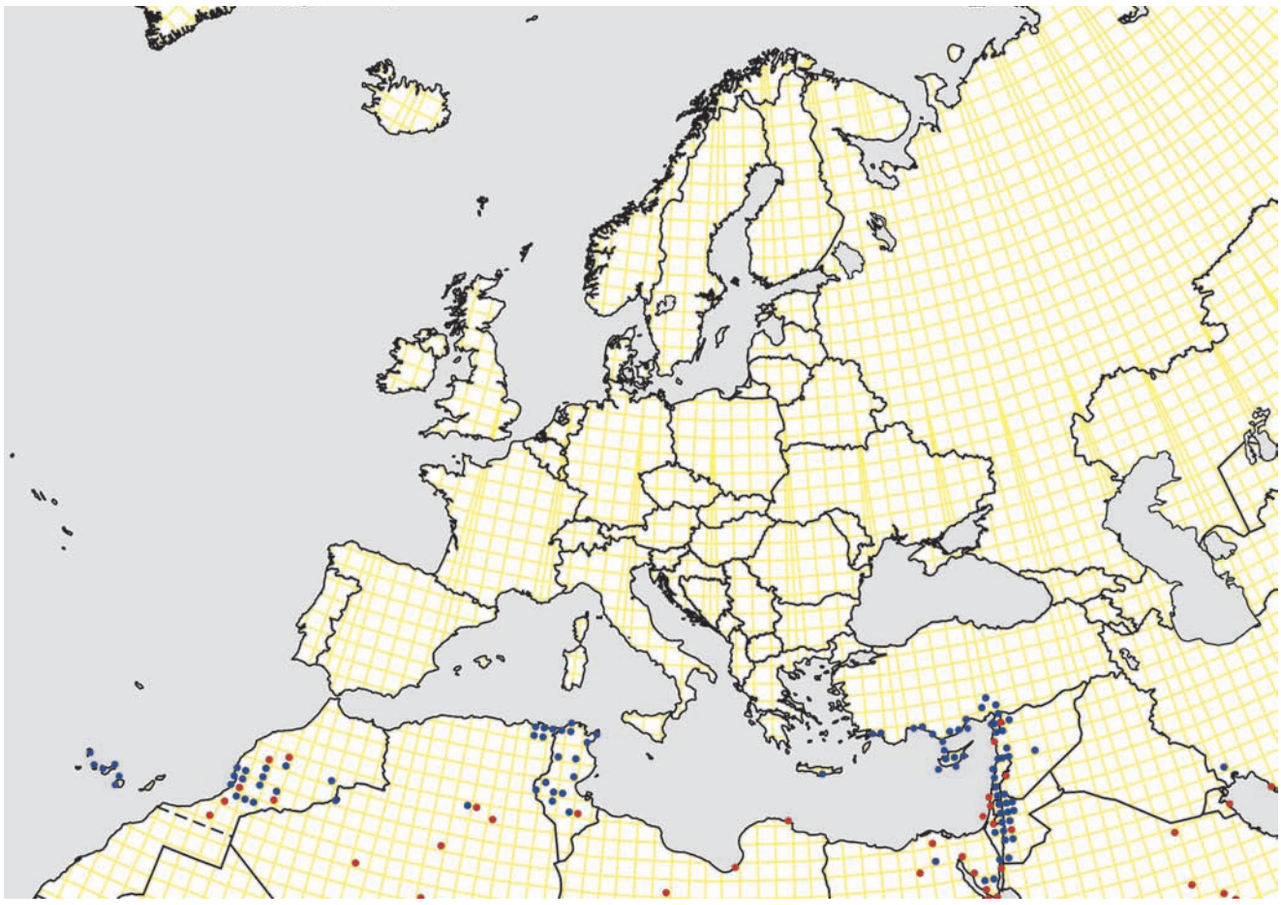
Distribution

World: *Trithemis arteriosa* is one of the most widespread and abundant dragonflies in Africa, although it is patchy in the North of the continent. It is widespread and abundant in the Levant, but in Europe is restricted to the Canary Islands and Cyprus, and also appeared once in Crete (Stobbe 2012) apparently as a vagrant. It was first recorded in Turkey in 1988 (Dumont *et al.* 1988), and since then has extended its range to the west. It is now found along much of the southern coast of Turkey with its easternmost records from Iran and Oman.

Europe: European records are known from the Canary Islands, Cyprus and Crete. The species is fairly common on the Canary Islands and is known from La Palma, La Gomera, Tenerife and Gran Canaria. The first published record from Cyprus is from 2006 when the species was encountered at several localities in the east of the island (Cottle 2007). However, older unpublished and unconfirmed records are known from earlier dates going back to 1990-1999 (database W. Lopau). A single record from Crete was from October 2011 when several individuals were found at a man-made barrage lake near Skourvoulis (Stobbe 2012). Despite further research, the species was not found again on this island (Brochard & van der Ploeg, 2013b; J.-P. Boudot unpublished). A female specimen published for Malta was later shown to pertain to *T. annulata* (Ebejer *et al.* 2008, Sciberras 2008).

Trend and conservation status

Trithemis arteriosa has significantly increased to the west in the eastern Mediterranean along the southern coast of Turkey and Cyprus, where it is now recorded on a yearly basis. However, there is no sign of long-term settlement in Crete, so the imagos found in 2011 were most probably vagrants. In the Canary Islands, eighty per cent of known localities were discovered during the last decade but, as few systematic field investigations had been previously undertaken in the archipelago, this should be merely the result of increased survey activity. In the Maghreb the species range is stable without any signs of expansion and there are no indications that *T. arteriosa* will penetrate into the south of the Iberian Peninsula in the short term. The species was classified as Not Applicable on the European Red List, as its European range is marginal compared with its world range.



European distribution

World distribution

Flight period

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Turkey													Based on 37 records

Habitats Directive	No
Red List EU27	Not Applicable
Red List Europe	Not Applicable
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Unknown

Habitat

Trithemis arteriosa is found in arid and semi-arid landscapes and reproduces in a large variety of sunny, standing or slow flowing waters such as gravel pits, ponds, lakes, permanent and intermittent wadis and ditches. Its rapid larval development allows the species to reproduce in temporary waters.

Flight period

The species is multivoltine and is found all year round in large parts of Africa. Adults have been observed from early February to early November on the Canary Islands, from mid-March to the end of December in the Maghreb and from April to October in Turkey.

Trithemis festiva (Rambur, 1842)

J.-P. Boudot

Distribution

World: *Trithemis festiva* is a widespread Oriental species extending from the eastern Mediterranean to the Philippines and east to New Guinea. It is especially common in the tropical and subtropical parts of mainland Asia. Its westernmost records are from the southern coast of Turkey, Rhodes and Cyprus, where it is common, and from the Levant (Israel, Syria), where it is rare. Records suggest that the species is rare in northern and western Iran and the eastern half of southern Turkey but this might result from lack of surveys.

Europe: *Trithemis festiva* is common in Cyprus and Rhodes with about 20-25 localities on each island.

Trend and conservation status

Trithemis festiva has a restricted distribution in Europe but is common where found. In Europe, it is dependent on running waters but, compared with other flowing water species, appears relatively tolerant to pollution and habitat degradation.

Habitats Directive	No
Red List EU27	Least Concern
Red List Europe	Least Concern
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Stable

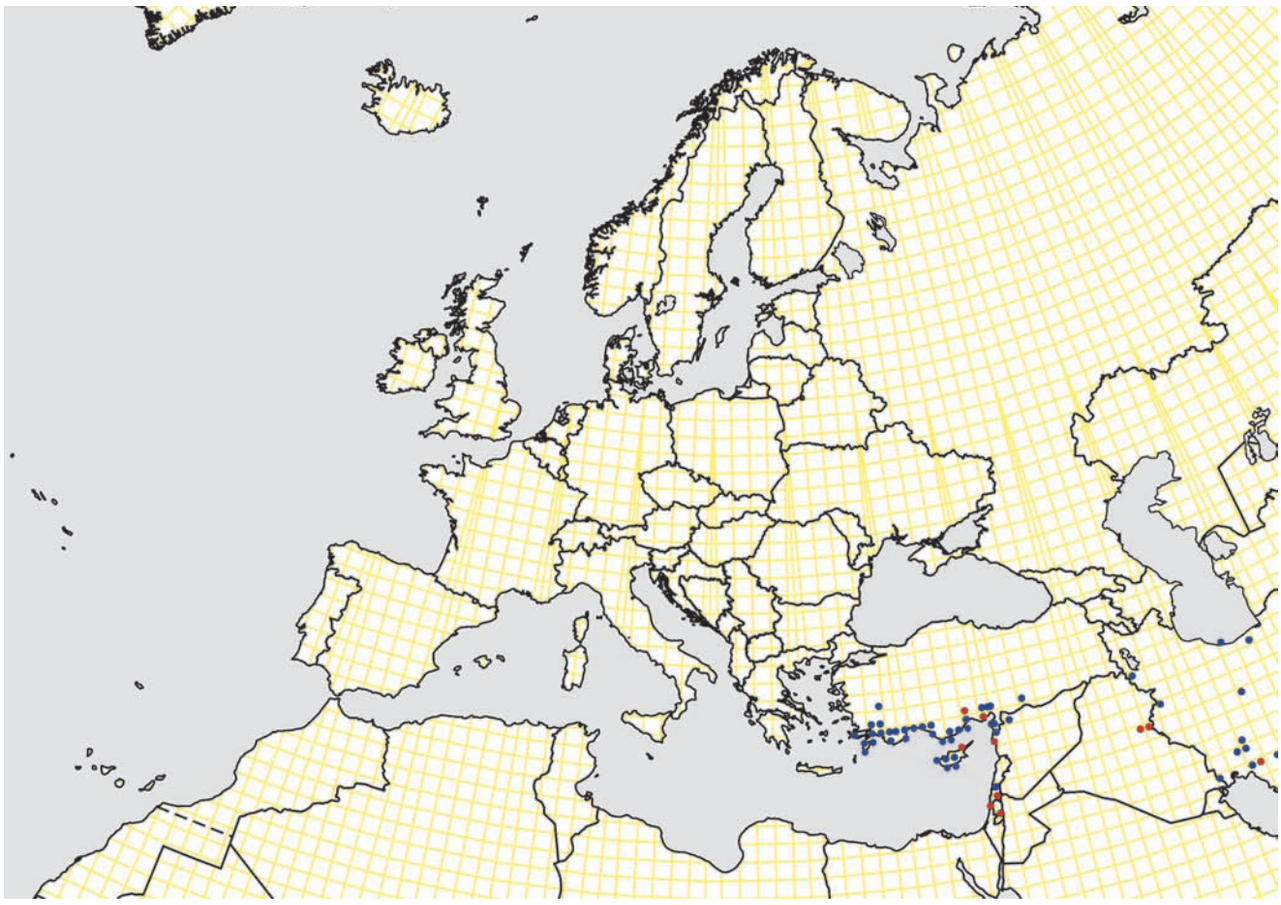
Habitat

In the eastern Mediterranean, the species is mainly found at stony streams and small rivers often with swift and clear water. It occurs in a wider range of habitats in the Orient, where it also occurs at slow-flowing rivers and canals, paddy fields and ponds.

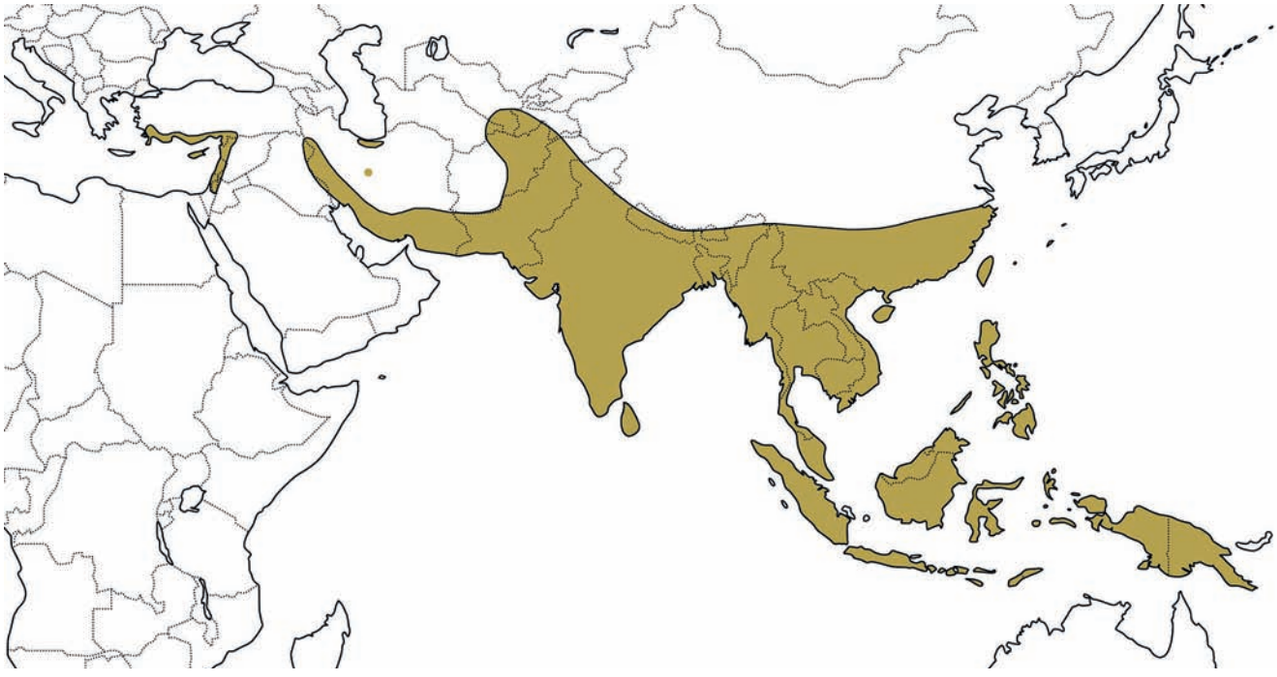
Flight period

The species has been found from 18 April to 9 November on Cyprus (Lopau & Adena 2002), from 20 May to 1st November on Rhodes.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Greece													
Turkey													



European distribution



World distribution

Trithemis kirbyi Selys, 1891

V.J. Kalkman & F. Prunier

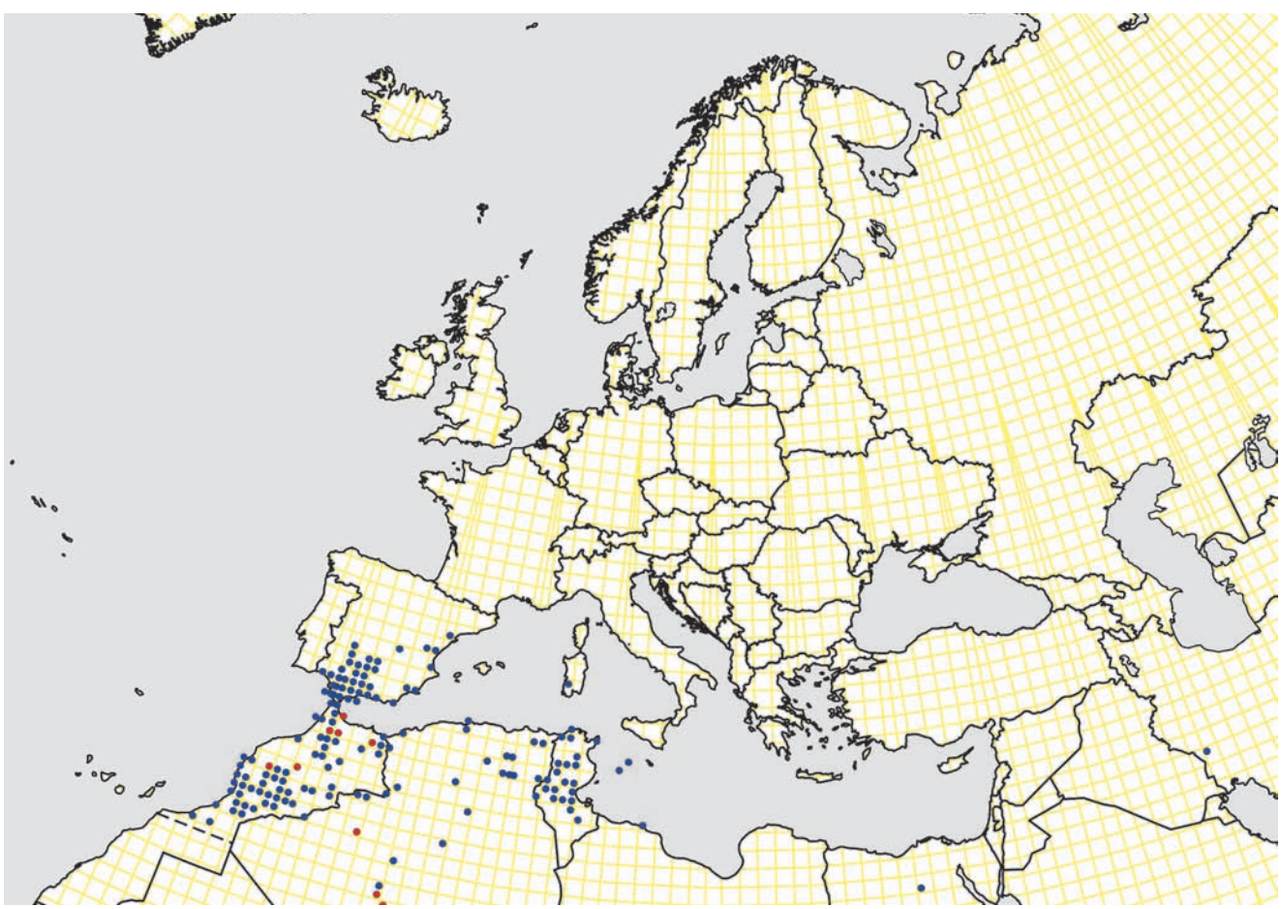
Taxonomy

Two subspecies have been described based on the extent of the amber in the wing base, with *T. k. kirbyi* occurring in the Indian Peninsula and *T. k. ardens* in Africa. However, the extent of the amber area in the wing shows clear regional variation, with the populations from the Arabian Peninsula and North Africa being intermediate (Dumont 1991, Jacquemin & Boudot 1999). These subspecies are therefore considered invalid.

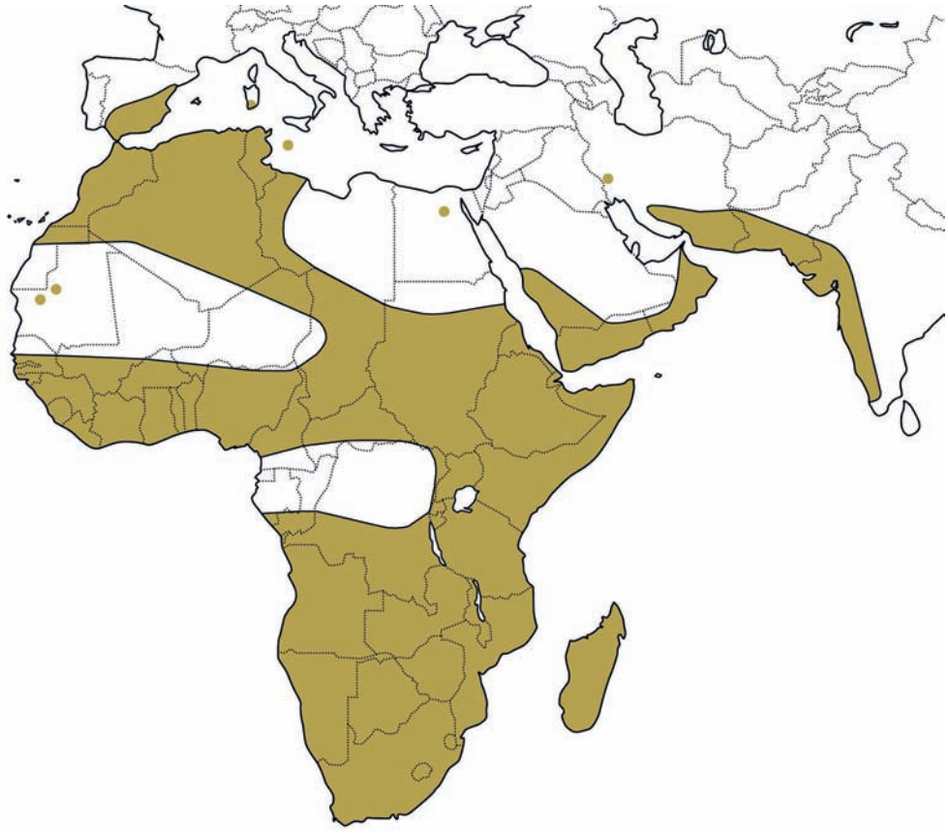
Distribution

World: *Trithemis kirbyi* is one of the most common and widespread African species, occurring throughout most of sub-Saharan Africa, absent only from areas with closed tropical forests. It is most common in arid and semi-arid savannah regions. The species is also found in southern parts of the Arabian Peninsula, extending into western India through southern Iran and Pakistan. It is now widespread and common in the Maghreb, where it began to increase in the 1980s and from where it expanded its range recently to southern Europe. It has only been recorded once each from Libya, Egypt, Sardinia and the Italian islands Linosa and Lampedusa.

Europe: *Trithemis kirbyi* is the most recent dragonfly to have arrived in Europe, being recorded for the first time in Sardinia in 2003, when a single male adult was found (Holuša 2008). No subsequent record was made in this area despite searches and this record is considered to refer to a vagrant (Corso *et al.* 2012). Other records of probable vagrants were reported from the Italian islands of Lampedusa (one male and one female, 2012) and Linosa (three males, 2013) (Corso *et al.* 2012). In the west, the species was found for the first time in the Iberian Peninsula in May 2007, when three males were seen in Andalusia approximately 50 km north of Gibraltar (Chelmick



European distribution



World distribution

Flight period

Trithemis kirbyi is a recent arrival in Europe and there is little information available on its flight period. Based on records from Andalusia collected in the period 2007-2013, the species is on the wing throughout most of the summer season with the highest numbers from June to October.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Maghreb													
Andalusia													

& Pickess 2008). Surveys at suitable locations in the Malaga Province in the following year succeeded in finding the species in 8 of the 29 locations explored. This uncovered the first evidence of breeding in Europe (Cano-Villegas & Conesa-Garcia 2009, Marquez-Rodriguez 2011). The species has since been found in numerous new locations and is now widespread and common in Andalusia. Further inland records were made in Extremadura (2010, 2012) and Castilla-La Mancha (2013) (Obregon-Romero *et al.* 2013, López Rodríguez & Sánchez Fernández 2014). At the same time the species expanded rapidly along the east Mediterranean coast in Murcia, Valencia, Catalonia and Aragon (Herrera-Grao *et al.* 2012, Prieto-Lillo & Jacobo-Ramos 2012, Prieto-Lillo *et al.* 2012). It is likely that this expansion will continue and records from Portugal are likely in the future.

Trend and conservation status

Trithemis kirbyi was not assessed for the European Red List as its occurrence in Europe was marginal at the time the list was compiled. It is likely that the species will continue to expand in the Iberian Peninsula following a similar pattern to that of *T. annulata* some decades earlier, and will eventually reach the north of Spain. It may well colonise Sardinia, Sicily and mainland Italy in coming decades.

Habitats Directive	No
Red List EU27	Not Applicable
Red List Europe	Not Applicable
Red List Mediterranean	Least Concern
EU27 endemic	No
European endemic	No
Trend Europe	Increasing

Habitat

Throughout its range, this species favours open, arid and semi-arid landscapes, where it is found in rivers, streams and runnels with a bare, stony or rocky bottom and banks with little or no vegetation. These streams often dry out partly in summer, leaving only

residual connected or disconnected pools. It is a strong wanderer which easily colonises new habitats and is able to reproduce in ornamental ponds, fountains, swimming ponds, concrete ditches and water tanks. It is only present in hot areas and, in Europe, is confined to low elevations. In contrast to other species with a rapid larval development, its larvae are relatively inactive and this, in combination with their cryptic colouration, allows them to co-occur with fish (Suhling & Martens 2007).

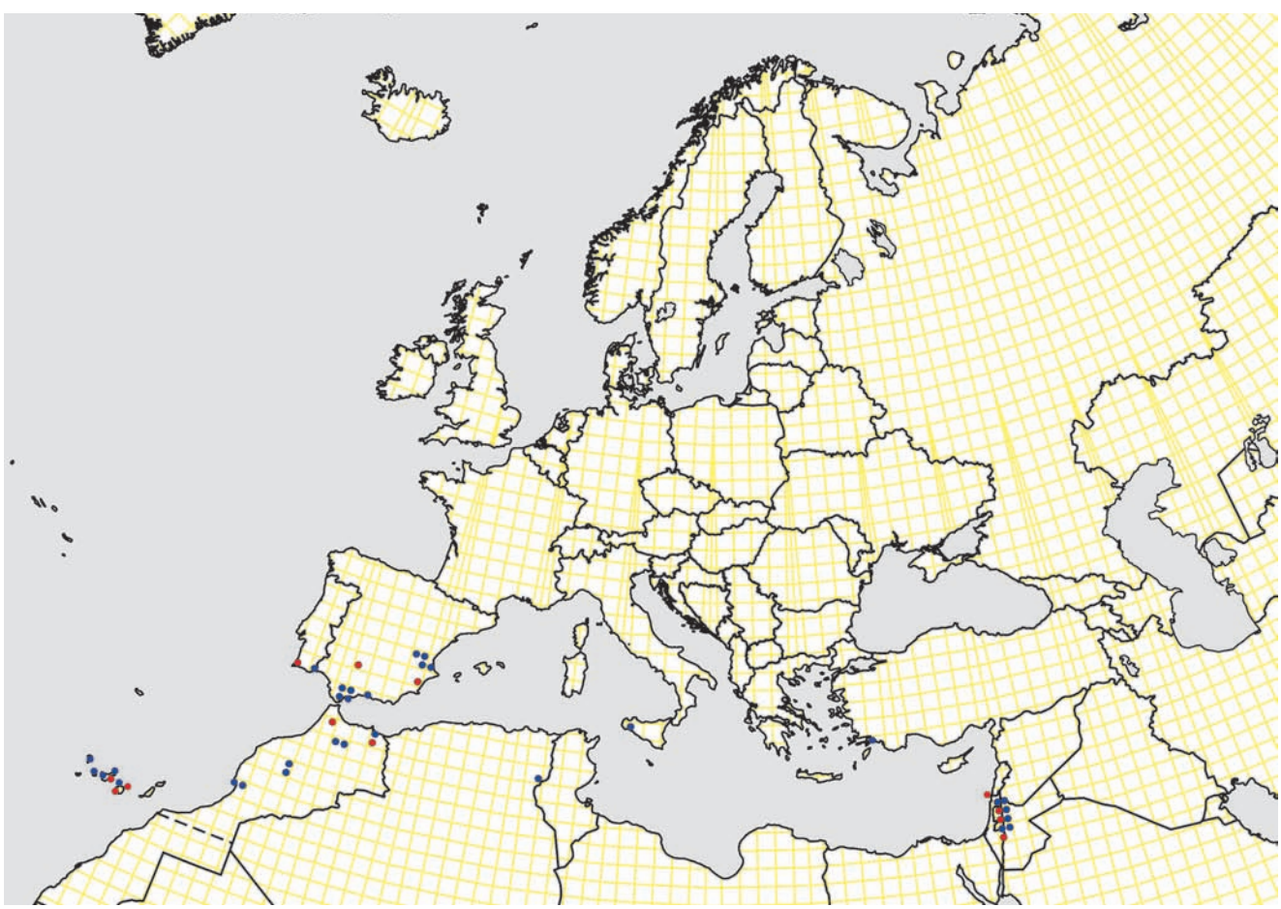
Zygonyx torridus (Kirby, 1889)

J.-P. Boudot & G. De Knijf

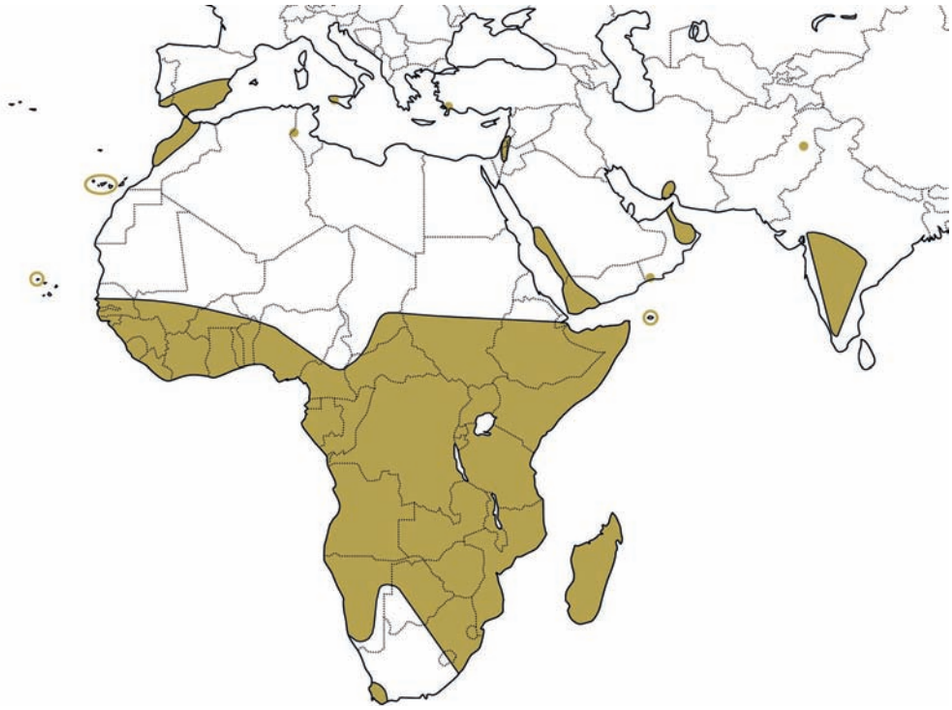
Distribution

World: *Zygonyx torridus* ranges throughout sub-Saharan Africa across the southern parts of the Arabian Peninsula and Iran to the Indian subcontinent and may be rare or common, depending on the region. To the north, it occurs in patches in the Canary Islands, the northern Maghreb and southern Iberia to Sicily, southwest Turkey and the Levant (Kunz *et al.* 2006). The species is known to wander and some Mediterranean records might refer to vagrants only (Boudot 2008). Nevertheless, there is ample evidence of the presence of permanent populations in Morocco, mainland Spain, the Canary Islands and Sicily.

Europe: The European populations are confined to the Canary Islands, southern Iberia and Sicily. In the Canary Islands, the species is reasonably common on La Palma, Gomera, Tenerife and Gran Canaria (Bemmerle 2005, Kunz *et al.* 2006). In Spain, concentrations of records, including evidence of breeding, are found at the southern tip of Andalucía and the border of the Province of Valencia (Grand 2013). Breeding has not yet been recorded from other parts of the Ibe-



European distribution



World distribution

Flight period

The species is on the wing all year round on the Canary Islands and has been found from the first half of May (Portugal, Andalusia) to the end of September (Valencia) in mainland Europe.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Maghreb													Based on 17 records

rian Peninsula. Only two records (1985, 2009) are available from the south of Portugal (Kunz *et al.* 2006, Ferreira *et al.* 2006, De Knijf & Demolder 2010). Three males were collected on Sicily in 1976, a male was photographed in 2013 and three exuviae were collected in 2014 at the same locality, demonstrating the presence of a population (Riservato *et al.*, 2014b, Soinsky 2015).

Trend and conservation status

The European populations of *Z. torridus* are fragmented with the highest density found on the Canary Islands and in mainland Spain. The Canary Islands, particularly Tenerife and Gran Canaria, suffer from drought and from an increased frequency of forest fires, with the resulting increase in the risk of desiccation of springs and streams. It is therefore likely that the species is currently in decline in the Canary Islands. In many parts of southern Spain, running waters are threatened by habitat destruction and the increased demand of water for agriculture, domestic use and recreation. There are several examples of populations lost due to severe changes in habitat. The species is listed as Vulnerable as a future decline is expected. It is unknown how the species will respond to climate change; it may be threatened by reduced rainfall and the drying up of rivers but might also respond positively to increasing temperatures by extending its range northward.

Habitats Directive	No
Red List EU27	Vulnerable
Red List Europe	Vulnerable
Red List Mediterranean	Near Threatened
EU27 endemic	No
European endemic	No
Trend Europe	Decreasing

Habitat

Zygonyx torridus is found primarily in very warm environments at fast-running sections of permanent streams and rivers (Martens 2015). It breeds at waterfalls and rapid flowing stretches of streams and rivers, often holding quite small territories in shallow areas. It is a very mobile species and vagrants are often found far away from their breeding habitat (Suhling *et al.* 2003, Suhling & Martens 2007, Boudot, 2008).

Checklist of European dragonflies

Information on the classification used can be found in the chapter Phylogeny and classification. Names of subspecies are given when more than one subspecies is found in Europe or when the subspecies in Europe is not the nominate subspecies. Synonyms of species are given when they have been described since 1980 or have been regularly used since 1980. Synonyms of subspecies are only given when they have been published for Europe and were described since 1980 or have been regularly used since 1980. Alternative genus names are given when they are well-known or have been in regular use since 1980. It has become clear that *Oxygastra* does not belong in Corduliidae (Ware 2007) but it is at present unclear in which family it should be placed. Therefore it is currently considered *incertae sedis* (Latin for "of uncertain taxonomic position").

ZYGOPTERA	**DAMSELFLIES**
Lestidae	
Chalcolestes Kennedy, 1920	
C. parvidens (Artobolevskij, 1929)	Eastern Willow Spreadwing
= *Lestes parvidens* Artobolevskij, 1929	
C. viridis (Vander Linden, 1825)	Western Willow Spreadwing
= *Lestes viridis* (Vander Linden, 1825)	
Lestes Leach, 1815	
L. barbarus (Fabricius, 1798)	Migrant Spreadwing
L. dryas Kirby, 1890	Robust Spreadwing
L. macrostigma (Eversmann, 1836)	Dark Spreadwing
L. sponsa (Hansemann, 1823)	Common Spreadwing
L. virens (Charpentier, 1825)	Small Spreadwing
L. v. virens (Charpentier, 1825)	
L. v. vestalis Rambur, 1842	
Sympecma Burmeister, 1839	
S. fusca (Vander Linden, 1820)	Common Winter Damsel
S. paedisca (Brauer, 1877)	Siberian Winter Damsel
syn: *S. annulata* (Selys, 1887)	
syn: *S. braueri* (Bianki in Yakobson & Bianki, 1904)	
Calopterygidae	
Calopteryx Leach, 1815	
C. haemorrhoidalis (Vander Linden, 1825)	Copper Demoiselle
syn: *C. h. occasi* Capra, 1945	
syn: *C. h. asturica* Ocharan, 1983	
syn: *C. h. almogravensis* Hartung, 1996	
C. splendens-complex (Harris, 1780)	Banded Demoiselle
C. virgo (Linnaeus, 1758)	Beautiful Demoiselle
virgo virgo (Linnaeus, 1758)	
syn: *C. virgo padana* Conci, 1956	
virgo meridionalis Selys, 1873	
virgo festiva (Brullé, 1832)	
C. xanthostoma (Charpentier, 1825)	Western Demoiselle
Epallagidae/Euphaeidae	
Epallage Charpentier, 1840	
E. fatime (Charpentier, 1840)	Odalisque

Platycnemididae

Platycnemis Burmeister, 1839	
P. acutipennis Selys, 1841	Orange Featherleg
P. dealbata Selys, 1850	Ivory Featherleg
P. latipes Rambur, 1842	White Featherleg
P. pennipes (Pallas, 1771)	Blue Featherleg
P. p. pennipes (Pallas, 1771)	
P. p. nitidula (Brullé, 1832)	
P. subdilatata Selys, 1849	Barbary Featherleg

Coenagrionidae

Ceriagrion Selys, 1876	
C. georgifreyi Schmidt, 1953	Turkish Red Damsel
C. tenellum (Villers, 1789)	Small Red Damsel
Coenagrion Kirby, 1890	
C. armatum (Charpentier, 1840)	Dark Bluet
C. caerulescens (Fonscolombe, 1838)	Mediterranean Bluet
syn: *C. c. theryi* (Schmidt, 1959)	
syn: *C. c. caesarum* (Schmidt, 1959)	
syn: *C. c. isabelae* Conesa García, 1995	
C. ecornutum (Selys, 1872)	Eastern Bluet
C. glaciale (Selys, 1872)	Russian Bluet
C. hastulatum (Charpentier, 1825)	Spearhead Bluet
C. hylas (Trybom, 1889)	Siberian Bluet
syn: *C. freyi* (Bilek, 1954)	
C. intermedium Lohmann, 1990	Cretan Bluet
C. johanssoni (Wallengren, 1894)	Arctic Bluet
syn: *C. concinnum* (Johansson, 1859)	
syn: *C. bifurcatum* Zhu & Ou-yan, 2000	
C. lunulatum (Charpentier, 1840)	Crescent Bluet
syn: *C. vernale* (Hagen, 1839)	
C. mercuriale (Charpentier, 1840)	Mercury Bluet
syn (?): *C. castellani* Roberts, 1948	
C. ornatum (Selys, 1850)	Ornate Bluet
syn (?): *C. vanbrinkae* Lohmann, 1993	
C. puella (Linnaeus, 1758)	Azure Bluet
C. pulchellum (Vander Linden, 1825)	Variable Bluet
syn: *C. p. interruptum* (Charpentier, 1840)	
syn: *C. p. mediterraneum* Schmidt, 1964	
C. scitulum (Rambur, 1842)	Dainty Bluet
Enallagma Charpentier, 1840	
E. cyathigerum (Charpentier, 1840)	Common Bluet
Erythromma Charpentier, 1840	
E. lindenii (Selys, 1840)	Blue-eye
= *Cercion lindenii* (Selys, 1840)	
syn: *E. l. lacustre* (Beutler, 1985)	
E. najas (Hansemann, 1823)	Large Redeye
E. viridulum (Charpentier, 1840)	Small Redeye
Ischnura Charpentier, 1840	
I. aralensis Haritonov, 1979	Kazakh Bluetail
syn: *I. haritonovi* Dumont, 1997	
I. elegans (Vander Linden, 1820)	Common Bluetail

I. e. elegans (Vander Linden, 1820)	
I. e. ebneri Schmidt, 1938	
I. e. pontica Schmidt, 1938	
I. fountaineae Morton, 1905	Oasis Bluetail
I. genei (Rambur, 1842)	Island Bluetail
I. graellsii (Rambur, 1842)	Iberian Bluetail
I. hastata (Say, 1839)	Citrine Forktail
= *Anomalagrion hastatum* Say, 1839	
I. intermedia Dumont 1974	Persian Bluetail
I. pumilio (Charpentier, 1825)	Small Bluetail
I. saharensis Aguesse, 1958	Sahara Bluetail
I. senegalensis (Rambur 1842)	Tropical bluetail
Nehalennia Selys, 1850	
N. speciosa (Charpentier, 1840)	Sedgling
Pyrrhosoma Charpentier, 1840	
P. elisabethae Schmidt, 1948	Greek Red Damsel
P. nymphula (Sulzer, 1776)	Large Red Damsel
syn: *P. n. interposita* Varga 1968	

ANISOPTERA **DRAGONFLIES**

Aeshnidae

Aeshna Fabricius, 1775	
A. affinis Vander Linden, 1820	Blue-eyed Hawker
A. caerulea (Ström, 1783)	Azure Hawker
A. crenata Hagen, 1856	Siberian Hawker
syn: *Aeshna nigroflava* Martin, 1908	
A. cyanea (Müller, 1764)	Blue Hawker
A. grandis (Linnaeus, 1758)	Brown Hawker
A. isoceles (Müller, 1767)	Green-eyed Hawker
= *Anaciaeschna isoceles* (Müller, 1767)	
syn: *A. i. antehumeralis* Schmidt, 1950	
A. juncea (Linnaeus, 1758)	Moorland Hawker
A. mixta Latreille, 1805	Migrant Hawker
A. serrata Hagen, 1856	Baltic Hawker
syn (?): *A. osiliensis* Mierzejewski, 1913	
A. subarctica Walker, 1908	Bog Hawker
A. s. elisabethae Djakonov, 1922	
syn: *A. subarctica interlineata* Ander, 1944	
A. viridis Eversmann, 1836	Green Hawker
Anax Leach, 1815	
A. ephippiger (Burmeister, 1839)	Vagrant Emperor
= *Hemianax ephippiger* (Burmeister, 1839)	
A. immaculifrons Rambur, 1842	Magnificent Emperor
A. imperator Leach, 1815	Blue Emperor
A. junius (Drury, 1773)	Common Green Darner
A. parthenope Selys, 1839	Lesser Emperor
syn: *A. p. jordansi* Buchholz, 1955	
syn: *A. p. geyri* Buchholz, 1955	
Boyeria McLachlan, 1896	
B. cretensis Peters, 1991	Cretan Spectre
B. irene (Fonscolombe, 1838)	Western Spectre

Brachytron Evans, 1845	
B. pratense (Müller, 1764)	Hairy Hawker
Caliaeschna Selys, 1883	
C. microstigma (Schneider, 1845)	Eastern Spectre
Gomphidae	
Gomphus Leach, 1815	
G. flavipes (Charpentier, 1825)	River Clubtail
= *Stylurus flavipes* (Charpentier, 1825)	
G. graslinii Rambur, 1842	Pronged Clubtail
G. pulchellus Selys, 1840	Western Clubtail
G. schneiderii Selys, 1850	Turkish Clubtail
syn: *G. s. helladicus* Buchholz, 1954	
G. simillimus Selys, 1840	Yellow Clubtail
G. vulgatissimus (Linnaeus, 1758)	Common Clubtail
Lindenia de Haan, 1826	
L. tetraphylla (Vander Linden, 1825)	Bladetail
syn: *Lindenia inkiti* Bartenef, 1929	
Onychogomphus Selys, 1854	
O. costae Selys, 1885	Faded Pincertail
O. flexuosus (Schneider, 1845)	Waved Pincertail
O. forcipatus (Linnaeus, 1758)	Small Pincertail
O. f. forcipatus (Linnaeus, 1758)	
O. f. unguiculatus Vander Linden, 1820	
O. f. albotibialis Schmidt, 1954	
O. uncatus (Charpentier, 1840)	Large Pincertail
Ophiogomphus Selys, 1854	
O. cecilia (Geoffroy in Fourcroy, 1785)	Green Snaketail
Paragomphus Cowley, 1934	
syn: *Mesogomphus* Förster, 1906	
P. genei (Selys, 1841)	Green Hooktail
Cordulegastridae	
Cordulegaster Leach, 1815	
C. bidentata Selys, 1843	Sombre Goldenring
syn: *C. b. sicilica* Fraser, 1929	
C. boltonii (Donovan, 1807)	Common Goldenring
syn: *C. b. immaculifrons* Selys, 1850	
syn: *C. b. algirica* Morton, 1916 (pars)	
syn: *C. b. iberica* Boudot & Jacquemin, 1994	
C. helladica (Lohmann, 1993)	Greek Goldenring
C. h. buchholzi (Lohmann, 1993)	
C. h. helladica (Lohmann, 1993)	
C. h. kastalia (Lohmann, 1993)	
C. heros Theischinger, 1979	Balkan Goldenring
C. h. heros Theischinger, 1979	
C. h. pelionensis Theischinger, 1979	
C. insignis Schneider, 1845	Blue-eyed Goldenring
syn: *C. i. montandoni* St Quentin 1971	
C. picta Selys, 1854	Turkish Goldenring
C. trinacriae Waterston, 1976	Italian Goldenring

incertae sedis

Oxygastra Selys, 1870	
O. curtisii (Dale, 1834)	Orange-spotted Emerald

Macromiidae

Macromia Rambur, 1842	
M. amphigena Selys, 1871	Siberian Cruiser
M. a. fraenata Martin, 1906	
syn: *M. sibirica* Djakonov 1926	
syn: *M. bartenevi* Belyshev, 1973	
M. splendens (Pictet, 1843)	Splendid Cruiser

Corduliidae

Cordulia Leach, 1815	
C. aenea (Linnaeus, 1758)	Downy Emerald
Epitheca Burmeister, 1839	
E. bimaculata (Charpentier, 1825)	Eurasian Baskettail
syn: *E. b. sibirica* Selys, 1887	
syn: *E. b. altaica* Belyshev, 1951	
Somatochlora Selys, 1871	
S. alpestris (Selys, 1840)	Alpine Emerald
S. arctica (Zetterstedt, 1840)	Northern Emerald
S. borisi Marinov, 2001	Bulgarian Emerald
S. flavomaculata (Vander Linden, 1825)	Yellow-spotted Emerald
S. graeseri Selys, 1887	Russian Emerald
S. meridionalis Nielsen, 1935	Balkan Emerald
S. metallica (Vander Linden, 1825)	Brilliant Emerald
S. sahlbergi Trybom, 1889	Treeline Emerald

Libellulidae

Brachythemis Brauer, 1868	
B. impartita (Karsh, 1890)	Northern Banded Groundling
Crocothemis Brauer, 1868	
C. erythraea (Brullé, 1832)	Broad Scarlet
Diplacodes Kirby, 1889	
D. lefebvrii (Rambur, 1842)	Black Percher
Leucorrhinia Brittinger, 1850	
L. albifrons (Burmeister, 1839)	Dark Whiteface
L. caudalis (Charpentier, 1840)	Lilypad Whiteface
L. dubia (Vander Linden, 1825)	Small Whiteface
L. pectoralis (Charpentier, 1825)	Yellow-spotted Whiteface
L. rubicunda (Linnaeus, 1758)	Ruby Whiteface
Libellula Linnaeus, 1758	
L. depressa Linnaeus, 1758	Broad-bodied Chaser
= *Platetrum depressum*	
= *Plathemis depressa*	
L. fulva Müller, 1764	Blue Chaser
= *Ladona fulva*	
L. quadrimaculata Linnaeus, 1758	Four-spotted Chaser

Orthetrum Newman, 1833	
O. albistylum (Selys, 1848)	White-tailed Skimmer
O. brunneum (Fonscolombe, 1837)	Southern Skimmer
O. b. brunneum (Fonscolombe, 1837)	
syn (?): *O. b. cycnos* (Selys 1848)	
O. cancellatum (Linnaeus, 1758)	Black-tailed Skimmer
O. chrysostigma (Burmeister, 1839)	Epaulet Skimmer
O. coerulescens (Fabricius, 1798)	Keeled Skimmer
O. c. coerulescens (Fabricius, 1798)	
O. c. anceps (Schneider, 1845)	
syn: *O. ramburii* (Selys, 1848)	
O. nitidinerve (Selys, 1841)	Yellow-veined Skimmer
O. sabina (Drury, 1773)	Slender Skimmer
O. taeniolatum (Schneider, 1845)	Small Skimmer
O. trinacria (Selys, 1841)	Long Skimmer
Pantala Hagen, 1861	
P. flavescens (Fabricius, 1798)	Wandering Glider
Selysiothemis Ris, 1897	
S. nigra (Vander Linden, 1825)	Black Pennant
Sympetrum Newman, 1833	
S. danae (Sulzer, 1776)	Black Darter
S. depressiusculum (Selys, 1841)	Spotted Darter
S. flaveolum (Linnaeus, 1758)	Yellow-winged Darter
S. fonscolombii (Selys, 1840)	Red-veined Darter
= *Tarnetrum fonscolombii*	
S. meridionale (Selys, 1841)	Southern Darter
S. nigrifemur (Selys, 1884)	Island darter
S. pedemontanum (Müller in Allioni, 1766)	Banded Darter
S. sanguineum (Müller, 1764)	Ruddy Darter
S. sinaiticum Dumont, 1977	Desert Darter
syn: *S. s. tarraconense* Jödicke, 1994	
S. striolatum (Charpentier, 1840)	Common Darter
syn: *S. nigrescens* Lucas, 1912	
S. vulgatum (Linnaeus, 1758)	Moustached Darter
S. s. vulgatum (Linnaeus, 1758)	
S. v. ibericum Ocharan, 1985	
Trithemis Brauer, 1868	
T. annulata (Palisot de Beauvois, 1807)	Violet Dropwing
T. arteriosa (Burmeister, 1839)	Red-veined Dropwing
T. festiva (Rambur, 1842)	Indigo Dropwing
T. kirbyi Selys, 1891	Orange-winged Dropwing
Zygonyx Hagen, 1867	
Z. torridus (Kirby, 1889)	Ringed Cascader

Distribution checklist

Distribution of dragonflies and damselflies in the European countries before 1990 and from 1990 onwards. For Turkey and Russia only those species are given which have been recorded in the European part of these countries.

○ recorded before 1990
• recorded from 1990 onwards
⊙ recorded both before and since 1990

	Albania	Andorra	Austria	Belarus	Belgium	Bosnia Herzegovina	Bulgaria	Croatia	Cyprus	Czech Republic	Denmark	Estonia	Finland	France (without Corsica)	France Corsica	Germany	Greece (without Crete)	Greece Crete	Hungary	Iceland	Ireland	Italy (mainland)
Lestidae																						
Chalcolestes parvidens	⊙		•			⊙	⊙	⊙	⊙						⊙		⊙	⊙	•			⊙
Chalcolestes viridis	○		⊙	•	⊙	⊙	⊙	⊙		⊙	•			⊙	⊙	⊙	•		⊙			⊙
Lestes barbarus	⊙		⊙	⊙	⊙	⊙	⊙	⊙	○	⊙	⊙			⊙	⊙	⊙	⊙	○	⊙			⊙
Lestes dryas	•	•	⊙	⊙	⊙	⊙	⊙	⊙		⊙	⊙	⊙	⊙	⊙		⊙	⊙	○	⊙		⊙	⊙
Lestes macrostigma	•		⊙			•	⊙	⊙	⊙	⊙				⊙	⊙	⊙	⊙		⊙			⊙
Lestes sponsa	○	•	⊙	⊙	⊙	⊙	⊙	⊙		⊙	⊙	⊙	⊙	⊙		⊙	⊙		⊙		⊙	⊙
Lestes virens	⊙		⊙	⊙	⊙	⊙	⊙	⊙			⊙	⊙	•	⊙	⊙	⊙	⊙		⊙			⊙
Sympecma fusca	⊙		⊙	•	⊙	⊙	⊙	⊙	⊙	•		•		⊙	⊙	⊙	⊙	⊙	⊙			⊙
Sympecma paedisca			⊙	•						•		•	•	○		⊙						⊙
Calopterygidae																						
Calopteryx haemorrhoidalis														⊙	⊙							⊙
Calopteryx splendens	⊙		⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	•	⊙	⊙	⊙	⊙		⊙	⊙
Calopteryx virgo	⊙	○	⊙	⊙	⊙	⊙	⊙	⊙	○	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙		⊙	⊙
Calopteryx xanthostoma														⊙								⊙
Epallagidae/Euphaeidae																						
Epallage fatime							⊙		⊙								⊙					
Platycnemididae																						
Platycnemis acutipennis														⊙								
Platycnemis dealbata																						
Platycnemis latipes														⊙								
Platycnemis pennipes	⊙		⊙	⊙	⊙	⊙	⊙	⊙		⊙	⊙	⊙	⊙	⊙		⊙	⊙		⊙			⊙
Platycnemis subdilatata																						
Coenagrionidae																						
Ceriagrion georgifreyi																	⊙					
Ceriagrion tenellum	⊙				⊙	⊙		⊙						⊙	⊙	⊙	•	⊙				⊙
Coenagrion armatum				⊙							⊙	⊙	⊙			⊙						
Coenagrion caerulescens														⊙	⊙							⊙
Coenagrion ecornutum																						
Coenagrion glaciale																						
Coenagrion hastulatum			⊙	⊙	⊙	•	⊙			⊙	⊙	⊙	⊙	⊙		⊙			○			⊙
Coenagrion hylas			⊙													○						
Coenagrion intermedium																		⊙				
Coenagrion johanssoni				⊙								⊙	⊙									
Coenagrion lunulatum			⊙	⊙	⊙					⊙	⊙	⊙	⊙	⊙		⊙			○		⊙	
Coenagrion mercuriale			⊙		⊙									⊙		⊙						⊙
Coenagrion ornatum	⊙		⊙	•		⊙	⊙	⊙		•				⊙		⊙	⊙		⊙			○
Coenagrion puella	⊙		⊙	⊙	⊙	⊙	⊙	⊙		⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙		⊙		⊙	⊙
Coenagrion pulchellum	⊙		⊙	⊙	⊙	⊙	⊙	⊙		⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙		⊙		⊙	⊙
Coenagrion scitulum	•		⊙		⊙	⊙	⊙	⊙		⊙				⊙	⊙	⊙	⊙	⊙	⊙			⊙
Enallagma cyathigerum	•	⊙	⊙	⊙	⊙	⊙	⊙	⊙		⊙	⊙	⊙	⊙	⊙	•	⊙	⊙	•	⊙		⊙	⊙
Erythromma lindenii	•		⊙		⊙	⊙	⊙	⊙	•	•				⊙	⊙	⊙	⊙	⊙	•			⊙
Erythromma najas			⊙	⊙	⊙	⊙	⊙	⊙		⊙	⊙	⊙	⊙	⊙		⊙	⊙		⊙			⊙
Erythromma viridulum	•		⊙	•	⊙	⊙	⊙	⊙	•	⊙	•			⊙	⊙	⊙	⊙	•	⊙			⊙
Ischnura aralensis																						

Italy Sardinia	Italy Sicily & nearby small islands	Latvia	Lithuania	Luxembourg	Macedonia, Republic of	Malta, Republic of	Moldova	Montenegro	Netherlands	Norway	Poland	Portugal	Portugal Azores	Portugal Madeira	Romania	Russian Federation	Russian Federation, Kaliningrad	Serbia	Slovakia	Slovenia	Spain	Spain Baleares	Spain Canary Islands	Sweden	Switzerland	Turkey in Europe	Ukraine	United Kingdom - Great Britain	United Kingdom - Northern Ireland
	⊙				•		•	⊙							⊙	○		⊙	•	•						⊙	⊙		
⊙	⊙		⊙	⊙	○			⊙	⊙		⊙	⊙			⊙	○	•	⊙	⊙	•	⊙	⊙			⊙	•	⊙	⊙	
⊙	⊙		⊙	⊙	⊙		•	⊙	⊙		⊙	⊙			⊙	⊙	⊙	⊙	⊙	•	⊙	○		⊙	⊙	⊙	⊙	•	
	⊙	⊙	⊙	⊙	⊙			⊙	⊙	⊙	⊙	⊙			⊙	⊙	○	⊙	⊙	⊙	⊙			⊙	⊙	○	⊙	⊙	
⊙	○				○		•	⊙			○	⊙			⊙	⊙		○		•	⊙					•	⊙		
		⊙	⊙	⊙	○		•	⊙	⊙	⊙	⊙	•			⊙	⊙	⊙	⊙	⊙	⊙	⊙			⊙	⊙		⊙	⊙	⊙
⊙	⊙	⊙	⊙	⊙	⊙			⊙	⊙		⊙	⊙			⊙	⊙	○	⊙	⊙	•	⊙			⊙	⊙	⊙	⊙	•	
⊙	⊙		•	⊙	⊙		•	•	⊙		⊙	⊙			⊙	○	•	⊙	⊙	•	⊙	⊙		⊙	⊙	⊙	⊙	•	
		⊙	⊙						⊙		⊙					⊙			⊙					•	⊙		⊙		
⊙	⊙					○						⊙									⊙	○							
⊙	○	⊙	⊙	⊙	⊙		•	⊙	⊙	⊙	⊙				⊙	⊙	⊙	⊙	⊙	⊙				⊙	⊙	⊙	⊙	⊙	⊙
○	○	⊙	⊙	⊙	⊙	○		⊙	⊙	⊙	⊙	⊙			⊙	⊙	○	⊙	⊙	•	⊙			⊙	⊙	⊙	⊙	⊙	
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		⊙	⊙	⊙	⊙		•	⊙	⊙	⊙	⊙				⊙	⊙	○	⊙	⊙	•	⊙			⊙	⊙	⊙	⊙	⊙	
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⊙	⊙							•	⊙			⊙								•	⊙	⊙			⊙			⊙	
		⊙	⊙						⊙	⊙	⊙				○	⊙	○		•					⊙			⊙	○	
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		⊙	⊙					⊙	⊙	⊙	⊙				⊙	⊙	⊙	○	⊙	⊙	•			⊙	⊙		⊙	⊙	
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		⊙	⊙							⊙						⊙								⊙					
		⊙	⊙						⊙	⊙	⊙				⊙	⊙	○		○					⊙	○		⊙		⊙
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⊙	⊙	⊙	⊙	⊙	⊙		•	⊙	⊙	⊙	⊙	⊙			⊙	⊙	○	⊙	⊙	•	⊙			⊙	⊙	⊙	⊙	⊙	⊙
		⊙	⊙	⊙	⊙		•	⊙	⊙	⊙	⊙	○			⊙	⊙	○	⊙	⊙	⊙	•			⊙	⊙	•	⊙	⊙	⊙
⊙	⊙			•	⊙		•	•	•		○	⊙			⊙	⊙		⊙	⊙	⊙	⊙	○			⊙	⊙	⊙	⊙	
	⊙	⊙	⊙	⊙	⊙		•	⊙	⊙	⊙	⊙	⊙			⊙	⊙	⊙	⊙	⊙	•	⊙			⊙	⊙	•	⊙	⊙	⊙
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		⊙	⊙	⊙	○			⊙	⊙	⊙	⊙				⊙	⊙	○	⊙	⊙	⊙				⊙	⊙		⊙	⊙	
⊙	⊙	•	•	⊙	⊙		•	•	⊙		⊙	⊙			⊙	⊙		⊙	⊙	⊙	⊙	⊙		•	⊙	•	⊙	•	
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	Albania	Andorra	Austria	Belarus	Belgium	Bosnia Herzegovina	Bulgaria	Croatia	Cyprus	Czech Republic	Denmark	Estonia	Finland	France (without Corsica)	France Corsica	Germany	Greece (without Crete)	Greece Crete	Hungary	Iceland	Ireland	Italy (mainland)
Coenagrionidae (continued)																						
Ischnura elegans	⊙		⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙		⊙	⊙	⊙	⊙		⊙	⊙
Ischnura fountaineae																						
Ischnura genei															⊙							○
Ischnura graellsii														⊙								
Ischnura hastata																						
Ischnura intermedia									•													
Ischnura pumilio	⊙	•	⊙	⊙	⊙	⊙	⊙	⊙	○	⊙	⊙	⊙	•	⊙	•	⊙	⊙	⊙	⊙		⊙	⊙
Ischnura saharensis																						
Ischnura senegalensis																						
Nehalennia speciosa			⊙	⊙	○					•	•	⊙	⊙	⊙		⊙						⊙
Pyrrhosoma elisabethae	•																⊙					
Pyrrhosoma nymphula	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙		⊙	⊙	⊙	⊙	⊙		⊙	⊙		⊙		⊙	⊙
Aeshnidae																						
Aeshna affinis	⊙		⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	•		•	⊙	⊙	⊙	⊙	⊙	⊙			⊙
Aeshna caerulea			⊙	○						⊙		⊙	⊙	•		⊙						⊙
Aeshna crenata				•									⊙									
Aeshna cyanea	•	•	⊙	⊙	⊙	⊙	⊙	⊙		⊙	⊙	⊙	⊙	⊙	•	⊙	⊙		⊙		○	⊙
Aeshna grandis			⊙	⊙	⊙	⊙		⊙		⊙	⊙	⊙	⊙	⊙		⊙			•		⊙	⊙
Aeshna isoceles	•		⊙	⊙	⊙	⊙	⊙	⊙		⊙	⊙	•		⊙	⊙	⊙	⊙		⊙			⊙
Aeshna juncea		•	⊙	⊙	⊙	⊙	⊙			⊙	⊙	⊙	⊙	⊙		⊙			○		⊙	⊙
Aeshna mixta	•		⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	•	•	⊙	⊙	⊙	⊙	•	⊙		•	⊙
Aeshna serrata											•	⊙	⊙									
Aeshna subarctica			⊙	•	⊙		○			⊙	⊙	⊙	⊙	⊙		⊙						•
Aeshna viridis			⊙	⊙				•			⊙	⊙	⊙			⊙			⊙			
Anax ephippiger	○		⊙		⊙	⊙	⊙	⊙	⊙	⊙	•		•	⊙	⊙	⊙	⊙	⊙	⊙	○	⊙	⊙
Anax immaculifrons									•								⊙					
Anax imperator	•	•	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	•	•	•	⊙	⊙	⊙	⊙	⊙	⊙		•	⊙
Anax junius														•								
Anax parthenope	•		⊙	⊙	⊙	•	⊙	⊙	⊙	⊙		•	•	⊙	⊙	⊙	⊙	⊙	⊙		•	⊙
Boyeria cretensis																		⊙				
Boyeria irene														⊙	⊙	•						⊙
Brachytron pratense	⊙		⊙	⊙	⊙	⊙	⊙	⊙		⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙		⊙		⊙	⊙
Caliaeschna microstigma	⊙					⊙	⊙	⊙	⊙								⊙					
Gomphidae																						
Gomphus flavipes			⊙	⊙	•	•	⊙	⊙		⊙		⊙	•	⊙		⊙	⊙		⊙			⊙
Gomphus graslinii														⊙								
Gomphus pulchellus		○	⊙		⊙			○						⊙		⊙						○
Gomphus schneiderii	○					•											⊙					
Gomphus simillimus					⊙									⊙		⊙						
Gomphus vulgatissimus	⊙		⊙	⊙	⊙	⊙	⊙	⊙		⊙	⊙	⊙	⊙	⊙		⊙	⊙		⊙			⊙
Lindenia tetraphylla	•					•	•	⊙							•		⊙	•				⊙
Onychogomphus costae																						
Onychogomphus flexuosus																						
Onychogomphus forcipatus	⊙		⊙	○	⊙	⊙	⊙	⊙	⊙	⊙	○	⊙	⊙	⊙		⊙	⊙		⊙			⊙

	Italy Sardinia	Italy Sicily & nearby small islands	Latvia	Lithuania	Luxembourg	Macedonia, Republic of	Malta, Republic of	Moldova	Montenegro	Netherlands	Norway	Poland	Portugal	Portugal Azores	Portugal Madeira	Romania	Russian Federation	Russian Federation, Kaliningrad	Serbia	Slovakia	Slovenia	Spain	Spain Baleares	Spain Canary Islands	Sweden	Switzerland	Turkey in Europe	Ukraine	United Kingdom - Great Britain	United Kingdom - Northern Ireland
			⊙	⊙	⊙	⊙		•	⊙	⊙	⊙	⊙				⊙	⊙	⊙	⊙	⊙	•	⊙	⊙		⊙	⊙	⊙	⊙	⊙	⊙
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	⊙	⊙		•	⊙	⊙		•	⊙	⊙		⊙	⊙			⊙	⊙	•	⊙	⊙	•	⊙	◯		•	⊙	⊙	⊙	⊙	
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			⊙	⊙	⊙			○	⊙	⊙	⊙	⊙				⊙	⊙	•	⊙	⊙	•				⊙	⊙		⊙	⊙	⊙
	⊙	⊙	⊙	⊙	•	⊙		•	•	⊙		⊙	⊙			⊙	⊙	◯	⊙	•	•	⊙	⊙		•	⊙	•	⊙	⊙	
			⊙	⊙	◯	⊙			⊙	⊙	⊙	⊙	⊙			•	⊙	⊙	⊙	⊙	•	⊙			⊙	⊙		⊙	⊙	⊙
	⊙	⊙	⊙	⊙	⊙	⊙	◯	•	⊙	⊙	•	⊙	⊙			⊙	⊙	⊙	⊙	⊙	•	⊙	⊙		⊙	⊙	⊙	⊙	⊙	•
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	⊙	⊙	•			◯	⊙		⊙	•	•	•	⊙		⊙	⊙	⊙		⊙	•	•	⊙	⊙	⊙	•	⊙	•	⊙	⊙	
	⊙	⊙	⊙	⊙	⊙	⊙	⊙	•	⊙	⊙		⊙	⊙	•	⊙	⊙	⊙	•	⊙	⊙	•	⊙	⊙	⊙	•	⊙	⊙	⊙	⊙	•
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	⊙	⊙	•	⊙	⊙	⊙	⊙	•	•	⊙		⊙	⊙		•	⊙	⊙	•	⊙	⊙	•	⊙	⊙	⊙	•	⊙	⊙	⊙	⊙	•
	⊙	◯											⊙									⊙				⊙				
	◯		⊙	⊙	⊙	⊙			•	⊙	⊙	⊙	⊙			⊙	⊙	◯	⊙	⊙	•	⊙			⊙	⊙	⊙	⊙	⊙	⊙
						⊙			⊙								⊙										⊙			
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						⊙			⊙																		○			
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			⊙	⊙	⊙	⊙			⊙	⊙	⊙	⊙				⊙	⊙	◯	⊙	⊙	⊙	⊙			⊙	⊙	⊙	⊙	⊙	
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																	○													
		⊙	⊙	⊙	⊙	⊙			⊙	⊙	⊙	⊙	⊙			⊙	⊙	◯	⊙	⊙	•	⊙			⊙	⊙	⊙	⊙		

	Albania	Andorra	Austria	Belarus	Belgium	Bosnia Herzegovina	Bulgaria	Croatia	Cyprus	Czech Republic	Denmark	Estonia	Finland	France (without Corsica)	France Corsica	Germany	Greece (without Crete)	Greece Crete	Hungary	Iceland	Ireland	Italy (mainland)
Gomphidae (continued)																						
Onychogomphus uncatus					○									⊙		⊙						⊙
Ophiogomphus cecilia			⊙	⊙	•		⊙	⊙		⊙	⊙	⊙	⊙	⊙		⊙	•		⊙			⊙
Paragomphus genei															○							•
Cordulegastridae																						
Cordulegaster bidentata	⊙	○	⊙		⊙	⊙	⊙	⊙		⊙				⊙		⊙	⊙		⊙			⊙
Cordulegaster boltonii		⊙	⊙	⊙	⊙					⊙	⊙	⊙	⊙	⊙	•	⊙					•	⊙
Cordulegaster helladica																	⊙					
Cordulegaster heros	•		⊙			•	⊙	⊙		•							⊙		⊙			•
Cordulegaster insignis							⊙										⊙					
Cordulegaster picta							⊙										⊙					
Cordulegaster trinacriae																						⊙
incertae sedis																						
Oxygastra curtisii					⊙									⊙		⊙						⊙
Macromiidae																						
Macromia amphigena																						
Macromia splendens														⊙								
Corduliidae																						
Cordulia aenea	•		⊙	⊙	⊙	⊙	⊙	⊙		⊙	⊙	⊙	⊙	⊙		⊙	⊙		⊙		⊙	⊙
Epitheca bimaculata			⊙	⊙	⊙	○		⊙		⊙	○	⊙	⊙	⊙		⊙			⊙			○
Somatochlora alpestris			⊙							⊙			⊙	⊙		⊙						⊙
Somatochlora arctica			⊙	•	⊙		•			⊙	⊙	⊙	⊙	⊙		⊙					⊙	⊙
Somatochlora borisi							⊙										•					
Somatochlora flavomaculata	○		⊙	⊙	⊙	•	○	⊙		⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙		⊙			⊙
Somatochlora graeseri																						
Somatochlora meridionalis	•		⊙			⊙	⊙	⊙		•				⊙	•		⊙	•	•			⊙
Somatochlora metallica			⊙	⊙	⊙	⊙	⊙	○		⊙	⊙	⊙	⊙	⊙		⊙			•			⊙
Somatochlora sahlbergi													⊙									
Libellulidae																						
Brachythemis impartita									•						•							
Crocothemis erythraea	⊙		⊙		⊙	⊙	⊙	⊙	⊙	⊙				⊙	⊙	⊙	⊙	⊙	⊙			⊙
Diplacodes lefebvrii									⊙								⊙					•
Leucorrhinia albifrons			⊙	⊙						⊙	○	⊙	⊙	⊙		⊙						
Leucorrhinia caudalis			⊙	⊙	⊙			⊙		○	○	⊙	⊙	⊙		⊙			⊙			
Leucorrhinia dubia			⊙	⊙	⊙		•			⊙	⊙	⊙	⊙	⊙		⊙						⊙
Leucorrhinia pectoralis			⊙	⊙	⊙	○	⊙	⊙		⊙	⊙	⊙	⊙	⊙		⊙			⊙			⊙
Leucorrhinia rubicunda			⊙	⊙	⊙					⊙	⊙	⊙	⊙	⊙		⊙						
Libellula depressa	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙		⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	•	⊙		○	⊙
Libellula fulva	•		⊙	⊙	⊙	⊙	⊙	⊙		⊙	⊙	•	⊙	⊙	⊙	⊙	⊙		⊙		○	⊙
Libellula quadrimaculata	•	•	⊙	⊙	⊙	⊙	⊙	⊙		⊙	⊙	⊙	⊙	⊙	•	⊙	⊙		⊙		⊙	⊙
Orthetrum albistylum	•		⊙	•		⊙	⊙	⊙		•				⊙		⊙	⊙	⊙	⊙			⊙
Orthetrum brunneum	⊙	•	⊙	•	⊙	⊙	⊙	⊙	⊙	⊙				⊙	⊙	⊙	⊙	⊙	⊙			⊙
Orthetrum cancellatum	•		⊙	⊙	⊙	⊙	⊙	⊙	•	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙		⊙	⊙
Orthetrum chrysostigma									⊙								•	○				
Orthetrum coerulescens	⊙		⊙		⊙	⊙	⊙	⊙	⊙	⊙	⊙	○	⊙	⊙	⊙	⊙	⊙	⊙	⊙		⊙	⊙

	Italy Sardinia	Italy Sicily & nearby small islands	Latvia	Lithuania	Luxembourg	Macedonia, Republic of	Malta, Republic of	Moldova	Montenegro	Netherlands	Norway	Poland	Portugal	Portugal Azores	Portugal Madeira	Romania	Russian Federation	Russian Federation, Kaliningrad	Serbia	Slovakia	Slovenia	Spain	Spain Baleares	Spain Canary Islands	Sweden	Switzerland	Turkey in Europe	Ukraine	United Kingdom - Great Britain	United Kingdom - Northern Ireland
		⊙											⊙									⊙				○				
			⊙	⊙	•	⊙			•	⊙		⊙				⊙	⊙	○	⊙	⊙	•				•	⊙	⊙	⊙		
	⊙	⊙											⊙									⊙								
		⊙			⊙	⊙			⊙			⊙				⊙			⊙	⊙	⊙	⊙				⊙		⊙		
			⊙	⊙	•					⊙	○	⊙	⊙				⊙	○				⊙			⊙	⊙		⊙	⊙	
						⊙			•							⊙			⊙	⊙	•									
						•										○	○		⊙								⊙				
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			⊙	⊙	⊙	○			⊙	⊙	⊙	⊙				⊙	⊙	⊙	⊙	⊙	•	•			⊙	⊙		⊙	⊙	
			⊙	⊙	⊙				•	○	•	⊙				•	⊙	○	⊙	⊙	•				•	⊙		⊙		
											⊙	⊙				⊙	⊙			⊙	•				⊙	⊙		⊙		
			⊙	⊙						⊙	⊙	⊙				•	⊙			⊙	⊙				⊙	⊙		⊙	⊙	
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			⊙	⊙	⊙	○		•	⊙	⊙	•	⊙				⊙	⊙	⊙	⊙	⊙	•				⊙	⊙	○	⊙		
																	⊙													
						○			⊙							⊙			⊙	⊙	•						⊙				
			⊙	⊙	⊙				⊙	⊙	⊙	⊙				⊙	⊙	⊙		⊙	⊙	⊙			⊙	⊙		⊙	⊙	
											⊙						⊙								•						
	⊙	⊙											⊙									⊙								
	⊙	⊙		•	⊙	⊙	⊙						⊙			⊙	○	•	⊙	⊙	•	⊙	⊙	⊙		⊙	⊙	⊙	⊙	
	•												⊙									⊙								
			⊙	⊙						⊙	⊙	⊙					⊙	•							⊙	⊙		⊙		
			⊙	⊙	•					⊙	⊙	⊙					⊙	○	○	•	•				⊙	⊙		⊙		
			⊙	⊙	⊙				⊙	⊙	⊙	⊙				•	⊙	⊙	○	⊙	•	⊙			⊙	⊙		⊙	⊙	
			⊙	⊙	⊙	○		•		⊙	⊙	⊙				○	⊙	○	⊙	⊙	•	•			⊙	⊙		⊙		
			⊙	⊙	⊙					⊙	⊙	⊙					⊙	⊙		•					⊙	⊙		⊙		
	⊙	⊙	⊙	⊙	⊙	⊙		•	⊙	⊙	⊙	⊙				⊙	⊙	⊙	⊙	⊙	•	⊙	○		⊙	⊙	⊙	⊙		
	⊙	⊙	⊙	⊙	⊙	⊙			⊙	⊙		⊙				⊙	⊙		⊙	⊙	•	⊙			•	⊙	•	⊙	⊙	
		○	⊙	⊙	⊙	⊙		•	⊙	⊙	⊙	⊙				⊙	⊙	⊙	⊙	⊙	•	⊙			⊙	⊙		⊙	⊙	⊙
				•		⊙		•	⊙			⊙				⊙	⊙	•	⊙	⊙	•	•				⊙	•	⊙		
	⊙	⊙	•	•	⊙	⊙	⊙	•	⊙	⊙		⊙	⊙			⊙	○	•	⊙	⊙	•	⊙				⊙	•	⊙		
	⊙	⊙	⊙	⊙	⊙	⊙	⊙	•	⊙	⊙	⊙	⊙	⊙			⊙	⊙	○	⊙	⊙	•	⊙	⊙		⊙	⊙	⊙	⊙	⊙	
							•						•									⊙		⊙						
	⊙	⊙		⊙	⊙	⊙	⊙		⊙	⊙	⊙	⊙	⊙			⊙	⊙	•	⊙	⊙	•	⊙	⊙		⊙	⊙	⊙	⊙	⊙	⊙

	Albania	Andorra	Austria	Belarus	Belgium	Bosnia Herzegovina	Bulgaria	Croatia	Cyprus	Czech Republic	Denmark	Estonia	Finland	France (without Corsica)	France Corsica	Germany	Greece (without Crete)	Greece Crete	Hungary	Iceland	Ireland	Italy (mainland)
Libellulidae (continued)																						
Orthetrum nitidinerve																						○
Orthetrum sabina									⊙								⊙					
Orthetrum taeniolatum									⊙								⊙					
Orthetrum trinacria															•		⊙					⊙
Pantala flavescens							•	•	⊙								•					
Selysiothemis nigra	•					•	•	⊙	•						•		⊙	⊙				⊙
Sympetrum danae			⊙	⊙	⊙			○		⊙	⊙	⊙	⊙	⊙		⊙			•		⊙	⊙
Sympetrum depressiusculum	•		⊙	•	⊙		⊙	⊙		⊙				⊙		⊙	⊙		⊙			⊙
Sympetrum flaveolum	○		⊙	⊙	⊙	⊙	⊙	⊙		⊙	⊙	⊙	⊙	⊙		⊙	⊙		⊙		•	⊙
Sympetrum fonscolombii	⊙	•	⊙		⊙	⊙	⊙	⊙	⊙	⊙	•		•	⊙	⊙	⊙	⊙	⊙	⊙		⊙	⊙
Sympetrum meridionale	⊙		⊙		⊙	⊙	⊙	⊙	⊙	⊙				⊙	⊙	⊙	⊙	⊙	⊙			⊙
Sympetrum nigrifemur																						
Sympetrum pedemontanum			⊙	⊙	⊙		⊙	⊙		⊙	•		•	⊙		⊙	○		⊙			⊙
Sympetrum sanguineum	⊙		⊙	⊙	⊙	⊙	⊙	⊙		⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙		⊙		⊙	⊙
Sympetrum sinaiticum																						
Sympetrum striolatum	⊙	○	⊙		⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙		⊙	⊙
Sympetrum vulgatum	•	•	⊙	⊙	⊙	•	⊙	⊙		⊙	⊙	⊙	⊙	⊙		⊙	⊙		⊙			⊙
Trithemis annulata									⊙					•	⊙		⊙	⊙				⊙
Trithemis arteriosa									•									•				
Trithemis festiva									⊙								⊙					
Trithemis kirbyi																						
Zygonyx torridus																						
Prior to 1990	34	8	77	53	68	53	65	66	29	64	49	50	51	86	37	80	70	28	59	1	27	84
1990 onwards	51	14	78	62	68	61	68	65	34	72	54	56	62	88	47	80	75	32	62	0	29	83
Total	57	18	78	64	70	63	70	68	37	73	58	57	62	89	48	81	76	35	65	1	32	88

Italy Sardinia	Italy Sicily & nearby small islands	Latvia	Lithuania	Luxembourg	Macedonia, Republic of	Malta, Republic of	Moldova	Montenegro	Netherlands	Norway	Poland	Portugal	Portugal Azores	Portugal Madeira	Romania	Russian Federation	Russian Federation, Kaliningrad	Serbia	Slovakia	Slovenia	Spain	Spain Baleares	Spain Canary Islands	Sweden	Switzerland	Turkey in Europe	Ukraine	United Kingdom - Great Britain	United Kingdom - Northern Ireland
⊙	⊙					•						⊙									⊙								
⊙	⊙					•						•									⊙		•						
	•					•		◯					•			⊙	•						•			•			
⊙	⊙					⊙		•				•			•	•				•	⊙	⊙				•	•		
		⊙	⊙	⊙					⊙	⊙	⊙				⊙	⊙	⊙		⊙	•				⊙	⊙		⊙	⊙	⊙
			⊙	◯	◯		•		⊙		⊙				⊙	⊙		⊙	•	•					⊙	•	⊙		
		⊙	⊙	⊙	⊙		•	⊙	⊙	⊙	⊙	⊙			⊙	⊙	⊙	⊙	⊙	⊙	⊙			⊙	⊙		⊙	⊙	•
⊙	⊙	⊙		⊙	⊙	⊙		⊙	⊙		⊙	⊙	•	⊙	⊙	⊙	•	⊙	⊙	•	⊙	⊙	⊙	•	⊙	⊙	⊙	⊙	•
⊙	⊙			•	⊙		•	⊙	⊙		⊙	⊙			⊙	◯	•	⊙	⊙	•	⊙				⊙	⊙	⊙		
														⊙									⊙							
		•	⊙	◯	◯				⊙		⊙				⊙	⊙	⊙	◯	⊙	•	⊙			•	⊙	•	⊙	•	
◯	⊙	⊙	⊙	⊙	⊙		•	⊙	⊙	⊙	⊙	⊙			⊙	⊙	⊙	⊙	⊙	•	⊙	•		⊙	⊙	⊙	⊙	⊙	⊙
	•																				⊙								
⊙	⊙	⊙	⊙	⊙	⊙	⊙	•	⊙	⊙	⊙	⊙	⊙			⊙	⊙		⊙	⊙	•	⊙	⊙		⊙	⊙	⊙	⊙	⊙	⊙
		⊙	⊙	⊙	⊙		•	•	⊙	⊙	⊙				⊙	⊙	⊙	⊙	⊙	⊙	⊙			⊙	⊙		⊙	⊙	
⊙	⊙					•		•				⊙									⊙		•						
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•																					•								
	•											⊙									⊙		⊙						
41	52	54	58	55	60	14	1	53	69	43	71	58	1	6	65	89	46	62	62	18	73	26	11	50	75	38	72	49	17
40	47	59	65	56	51	16	34	66	68	47	71	63	5	6	68	80	38	58	68	71	78	18	14	64	74	53	74	53	22
43	55	60	65	62	62	19	35	67	71	48	73	64	5	7	71	91	60	63	69	72	79	27	15	64	77	56	74	55	22

List of authors and their affiliation

The authors and country coordinators are given in alphabetical order. The country for which the person acted as country coordinator is given between brackets.

Aagaard, Kaare (*Norway) NTNU Vitenskapsmuseet, Norway*

Ambrus, Andras (*Hungary*) Fertő-Hanság National Park, Hungary

Bernard, Rafał (*Belarus*, *Estonia*, *Latvia*, *Lithuania*, *Poland*, *Kaliningrad*) Department of Nature Education and Conservation, Adam Mickiewicz University, Poznań, Poland

Bogdanović, Tomislav (*Croatia*) Department of Biology, University J.J. Strossmayer, Osijek, Croatia

Boudot, Jean-Pierre (*France*, *Russian Federation except Kaliningrad*, *chapter author*) Société Française d'Odonatologie, France

Cabana Otero, Martiño (*Spain*) Department of Animal Biology, Vegetal Biology and Ecology, University of A Coruña

Chelmick, David (*Spain*) Macromia Scientific, Haywards Heath, West Sussex, United Kingdom

Chovanec, Andreas (*Austria*) Department of National and International Water Management, Federal Ministry of Agriculture, Forestry, Environment and Water Management, Vienna, Austria

Conze, Klaus-Jürgen (*Germany)* GdO (Gesellschaft deutschsprachiger Odonatologen), Germany

Cordero Rivera, Adolfo (*Spain*) Departamento de Ecoloxía e Bioloxía Animal, Universidade de Vigo, Pontevedra, Spain

David, Stanislav (*Slovakia*) Department of Ecology and Envioronmental Sciences, Faculty of Natural Sciences, Constantine the Philosopher University, Nitra, Slovak Republic

De Knijf, Geert (*Belgium*, *chapter author*) Research Institute for Nature and Forest (INBO), Belgium

Degabriele, Godwin (*Malta*) Biology Department, G.F. Abela Junior College, University of Malta, Malta

Dijkstra, Klaas-Douwe B. (*chapter author*) Naturalis Biodiversity Center, Netherlands

Dolmen, Dag (*Norway*) NTNU Vitenskapsmuseet, Norway

Dommanget, Jean-Louis (*France*) Société Française d'Odonatologie, France

Dyatlova, Elena (*Ukraine*) Ukraine

Ferreira, Sónia (*Portugal*) CIBIO/InBIO - Centro de Investigação em Biodiversidade e Recursos Genéticos da Universidade do Porto, Portugal & University of Liverpool, United Kingdom

Garrigos, Bernat (*Spain*) Spain

Gligorović, Bogić (*Montenegro*) Elementary school "Sutjeska", Podgorica, Montenegro.

Hardersen, Sönke (*Italy*) Società Italiana per lo Studio e la Conservazione delle Libellule - ODONATA.IT

Holuša, Otakar (*Czech Republic*) Faculty of Forestry and Wood Technology, Mendel University in Brno, Czech Republic

Iversen, Lars (*Denmark*) Freshwater Biology Section. University of Copenhagen, Denmark

Ivinskis, Povilas (*Lithuania*) Institute of Ecology, Nature Research Centre, Vilnius, Lithuania

Jović, Miloš (*Bosnia and Herzegovina, Macedonia, Montenegro and Serbia*) Prirodnjački muzej u Beogradu, Serbia

Kalkman, Vincent (*Netherlands*, *chapter author*) European Invertebrate Survey / Naturalis Biodiversity Center, Netherlands

Kalniņš, Mārtiņš (*Latvia*) Latvijas Entomoloģijas biedrība (Entomological Society of Latvia), Latvia

Karjalainen, Sami (*Finland*) Finnish Dragonfly Society, Finland

Kitanova, Despina (*Macedonia*) Macedonian Ecological Society (MES), Macedonia

Kulijer, Dejan (*Bosnia and Herzegovina*) National Museum of Bosnia and Herzegovina, Bosnia and Herzegovina

Kutsarov, Yordan (*Bulgaria*) Bulgaria

Lockwood, Michael (*Spain*) OXYGASTRA Grup d'Estudi dels Odonats de Catalunya, Spain

Lohr, Mathias (*Germany*) Hochschule Ostwestfalen-Lippe, Höxter & GdO (Gesellschaft deutschsprachiger Odonatologen), Germany

Lorenzo-Carballa, M. Olalla (*Azores*) Department of Evolution Ecology and Behaviour, Institute of Integrative Biology, University of Liverpool, United Kingdom.

Marinov, Milen (*Bulgaria*) Plant Health & Environment Laboratory, Ministry for Primary Industries, New Zealand

Martin, Mati (*Estonia*) Department of Zoology, Institute of Ecology and Earth Sciences, University of Tartu, Estonia

Mauersberger, Rüdiger (*Germany)* GdO (Gesellschaft deutschsprachiger Odonatologen), Germany

Monnerat, Christian (*Switzerland*) Info fauna - CSCF, Switzerland

Nelson, Brian (*Ireland*) National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Ireland

Nielsen, Erland (*Denmark*) Engineer and photographer, Denmark

Ott, Jürgen (*chapter author*) L.U.P.O. GmbH/UFZ, Germany

Peels, Fons (*photographs*) Italy

Prentice, Steve (*Great-Britain*) British Dragonfly Society, United Kingdom (retired)

Proess, Roland (*Luxembourg*) Umweltplanungsbüro ECOTOP, Luxembourg

Prunier, Florent (*Spain*) ROLA Red de Observadores de Libélulas en Andalucía, Spain

Raab, Rainer (*Austria*) Österreichische Arbeitsgemeinschaft Libellen

Rimšaitė, Jolanta (*Lithuania*) Institute of Ecology, Nature Research Centre, Vilnius, Lithuania

Riservato, Elisa (*Italy*) Società Italiana per lo Studio e la Conservazione delle Libellule - ODONATA.IT

Romeo Barreiro, Anxos (*Spain*) Spain

Šácha, Dušan (*Slovakia*) NGO Spoločnosť Aqua vita, Slovakia

Sahlen, Göran (*Sweden)* Halmstad University, Sweden

Šalamun, Ali (*Slovenia*) Centre for Cartography of Fauna and Flora, Slovenia

Sparrow, David (*Cyprus*) P3A Dragonfly Study Group, Cyprus

Termaat, Tim (*chapter author*) Dutch Butterfly Conservation, Netherlands

Willigalla, Christoph (*Germany*) GdO (Gesellschaft deutschsprachiger Odonatologen), Germany

Localities of photographs

All photographs which are part of the species accounts are by Fons Peels. Information on the localities is given below.

Aeshna affinis, Lago della Rotonda, near Lauria (PZ), Italy, 5-7-2012
Aeshna caerulea, Ponds and lakes, Nuorgam (Lapland), Finland, 27-7-2013
Aeshna crenata, Santastenlammi, Tammela (Tavastia Proper), Finland, 16-7-2010
Aeshna cyanea, Forest pond at Bagnaia (SI), Italy, 25-10-2013
Aeshna grandis, Trindsjö, Pohja (Uusimaa), Finland, 30-6-2008
Aeshna isoceles, Lago dell'Accesa, Pesta (GR), Italy, 31-5-2011
Aeshna juncea, Baita Segantini, Passo di Rolle (TN), Italy, 12-8-2012
Aeshna mixta, Lake at Petriccio, Siena (SI), Italy, 30-9-2010
Aeshna serrata, Uutela, Helsinki (Uusima), Finland, 22-7-2010
Aeshna subarctica, Lago Nero, Monte Corno NP (TN), Italy, 17-8-2011
Aeshna viridis, Ponds and ditches, Woudbloem (GR), Netherlands, 24-8-2012
Anax ephippiger, Ponds near Fossoli (MO), Italy, 25-8-2007
Anax immaculifrons, Waterfall near Toparlar, Muğla, Turkey, 4-6-2009
Anax imperator, River S. Angelo near Scalea (CS), Italy, 14-7-2008
Anax parthenope, Barrage el Haouareb, near Kairouan, Tunisia, 4-10-2009
Boyeria cretensis, River Mili, Mili Gorge, Crete, Greece, 29-6-2010
Boyeria irene, Arroyo San Carlos del Tiradero, Los Barrios, Andalusia, Spain, 15-6-2012
Brachythemis impartita, Embalse de Arrocampo-Almaraz, near Saucedilla, Extremadura, Spain, 21-9-2008
Brachytron pratense, Padule di Scarlino, Il Puntone (GR), Italy, 27-4-2010
Caliaeschna microstigma, Stream near Kouteli, Peloponnese, Greece, 5-7-2010
Calopteryx haemorrhoidalis, River S. Angelo near Scalea (CS), Italy, 3-7-2009
Calopteryx splendens, River Merse near Orgia (SI), Italy, 2-6-2015
Calopteryx virgo, Stream near Kouteli, Peloponnese, Greece, 2-7-2010
Calopteryx xanthostoma, River Auzon near St. Germain (Ardèche), France, 19-6-2008
Ceriagrion georgifreyi, Lake Köyceğiz, Muğla, Turkey, 31-5-2009
Ceriagrion tenellum, Beegderheide, Heel (LB), Netherlands, 10-9-2008
Chalcolestes parvidens, Forest pond at Bagnaia (SI), Italy, 8-10-2012
Chalcolestes viridis, Lago della Rancia, near Orgia (SI), Italy, 10-8-2007
Coenagrion armatum, Lake Ruotsalainen, Heinola (Päijät-Häme), Finland, 28-6-2008
Coenagrion caerulescens, La Fossetta, near Rosia (SI), Italy, 3-5-2013
Coenagrion hastulatum, Kollerfilze, Nicklheim (RO), Germany, 16-6-2007
Coenagrion hylas, Pfrillensee, Stanzach (RE), Austria, 16-6-2011
Coenagrion intermedium, River Mili, Mili Gorge, Crete, Greece, 29-6-2015
Coenagrion johanssoni, Bakunkärrs Träsket, Sipoo (Uusima), Finland, 27-6-2008
Coenagrion lunulatum, Talingven, Hatertse Vennen (GD), Netherlands, 1-5-2009
Coenagrion mercuriale, La Fossetta, near Rosia (SI), Italy, 23-4-2009
Coenagrion ornatum, Vorflutgraben near Eittingermoos (FS), Germany, 18-6-2009
Coenagrion puella, Etang du Grand Montfaucon, Heudicourt sous le Côtes (Meuse), France, 16-5-2014
Coenagrion pulchellum, Etang du Grand Montfaucon, Heudicourt sous le Côtes (Meuse), France, 15-5-2014
Coenagrion scitulum, Pond at Le Mandrie, Bagnaia (SI), Italy, 20-6-2015
Cordulegaster bidentata, River Caffaro, Lauria (PZ), Italy, 8-7-2014
Cordulegaster boltonii, Arroyo San Carlos del Tiradero, Los Barrios, Andalusia, Spain, 15-6-2012
Cordulegaster helladica, Stream near Kouteli, Peloponnese, Greece, 3-7-2015
Cordulegaster heros, Stream near Kouteli, Peloponnese, Greece, 8-7-2010
Cordulegaster insignis, River Yuvarlak near Pinar, Muğla, Turkey, 10-6-2013
Cordulegaster picta, River Yuvarlak near Pinar, Muğla, Turkey, 27-5-2009
Cordulegaster trinacriae, River Argentino near Orsomarso (CS), Italy, 4-7-2012
Cordulia aenea, Doort, Echt (LB), Netherlands, 8-5-2010
Crocothemis erythraea, Lake at Monteaperti (SI), Italy, 10-8-2011
Diplacodes lefebvrii, Oasis at Jemna, Tunisia, 8-10-2009
Enallagma cyathigerum, Lago della Rancia, near Orgia (SI), Italy, 16-6-2014
Epallage fatime, River Namnam near Hamitköy, Muğla, Turkey, 28-5-2009
Epitheca bimaculata, Lake near Trélon (Nord), France, 19-5-2013

Erythromma lindenii, Lake at Colle Malamerenda (SI), Italy, 3-6-2008
Erythromma najas, Alte Donau, Niederalteich (DEG), Germany, 13-5-2009
Erythromma viridulum, Lago Baratz, near Alghero (SS), Italy, 30-5-2007
Gomphus flavipes, River Po, S. Giacomo Po (MN), Italy, 14-8-2011
Gomphus graslinii, River Cazuma near Quesa, Valencia, Spain, 4-7-2011
Gomphus pulchellus, River Cañuelo, Jimena de la Frontera, Andalusia, Spain, 1-6-2010
Gomphus schneiderii, Ditches near Tepearası, Muğla, Turkey, 4-6-2009
Gomphus simillimus, River Genal, Algatocín, Andalusia, Spain, 3-6-2010
Gomphus vulgatissimus, River Foenna near Rigomagno (SI), Italy, 25-5-2011
Ischnura elegans, Lago di Ventina, Terni (RT), Italy, 11-6-2008
Ischnura fountaineae, Oasis at Tozeur, Tunisia, 7-10-2009
Ischnura genei, River Mare Foghe near Riola Sardo (OR), Italy, 4-6-2011
Ischnura graellsii, Laguna Chica, Archidona, Andalusia, Spain, 23-9-2014
Ischnura hastata, Florida City (FL), USA, 30-9-2013
Ischnura pumilio, La Fossetta, near Rosia (SI), Italy, 27-4-2009
Ischnura saharensis, Pond at Visvique, Gran Canaria, Spain, 2-6-2014
Ischnura senegalensis, Reservoir at El Monte, Tenerife, Spain, 29-5-2014
Lestes barbarus, Lago della Rotonda, near Lauria (PZ), Italy, 7-8-2010
Lestes dryas, Lago della Rotonda, near Lauria (PZ), Italy, 6-7-2013
Lestes macrostigma, Salina Manna, near Putzu Idu (OR), Italy, 4-6-2011
Lestes sponsa, Tyräjänsuo, Loppi (Tavastia Proper), Finland, 16-7-2010
Lestes virens, Forest pond at Bagnaia (SI), Italy, 28-9-2012
Leucorrhinia albifrons, Lake at Odilampi (Uusima), Finland, 2-7-2008
Leucorrhinia caudalis, Einbessee near Eggstätt (RO), Germany, 22-6-2014
Leucorrhinia dubia, Kollerfilze, Nicklheim (RO), Germany, 15-6-2007
Leucorrhinia pectoralis, Gumnäs, Pohja (Uusimaa), Finland, 30-6-2008
Leucorrhinia rubicunda, Talingven, Hatertse Vennen (GD), Netherlands, 23-4-2011
Libellula depressa, River Gonna near Monticiano (SI), Italy, 16-8-2009
Libellula fulva, Lago della Rancia, near Orgia (SI), Italy, 21-5-2007
Libellula quadrimaculata, Lago dell'Accesa, Pesta (GR), Italy, 27-4-2008
Lindenia tetraphylla, Lago della Rancia, near Orgia (SI), Italy, 23-6-2011
Macromia splendens, Arroyo San Carlos del Tiradero, Los Barrios, Andalusia, Spain, 13-6-2015
Nehalennia speciosa, Kollerfilze, Nicklheim (RO), Germany, 15-6-2007
Onychogomphus costae, River Alcanadre, Ballobar, Aragon, Spain, 26-6-2012
Onychogomphus flexuosus, River Eşen near Alaçat, Muğla, Turkey, 14-6-2013
Onychogomphus forcipatus, Fosso Tirolle near Treviano (VT), Italy, 16-7-2011
Onychogomphus uncatus, River Tea near Pías, Galicia, Spain, 24-7-2009
Ophiogomphus cecilia, River Paar, Unterbernbach (AIC), Germany, 27-8-2009
Orthetrum albistylum, River Po, S. Giacomo Po (MN), Italy, 21-8-2013
Orthetrum brunneum, River Gonna near Monticiano (SI), Italy, 1-9-2010
Orthetrum cancellatum, Forest pond at Bagnaia (SI), Italy, 19-5-2010
Orthetrum chrysostigma, River Hozgarganta, Jimena de la Frontera, Andalusia, Spain, 30-5-2010
Orthetrum coerulescens, Rio Murtazzolu, near Bortigali (NU), Italy, 26-6-2013
Orthetrum nitidinerve, Oasis at Tamerza, Tunisia, 6-10-2009
Orthetrum sabina, Pond near Küçükkaraağaç, Muğla, Turkey, 1-6-2009
Orthetrum taeniolatum, Waterfall near Toparlar, Muğla, Turkey, 30-5-2009
Orthetrum trinacria, Embalse de Arrocampo-Almaraz, near Saucedilla, Extremadura, Spain, 21-9-2008
Oxygastra curtisii, Lago dell'Accesa, Pesta (GR), Italy, 2-6-2011
Pantala flavescens, Tropical Park, Miami (FL), USA, 3-10-2013
Paragomphus genei, River Hozgarganta, Jimena de la Frontera, Andalusia, Spain, 26-8-2010
Platycnemis acutipennis, River Auzon near St. Germain (Ardèche), France, 19-6-2008
Platycnemis latipes, River Tietar near Jaraíz de la Vera, Extremadura, Spain, 25-9-2008
Platycnemis pennipes, Lake at Petriccio, Siena (SI), Italy, 1-7-2007
Platycnemis subdilatata, Oued Maarouf, near Kairouan, Tunisia, 3-10-2009
Pyrrhosoma elisabethae, Stream near Kouteli, Peloponnese, Greece, 6-7-2015
Pyrrhosoma nymphula, Etang du Grand Montfaucon, Heudicourt sous le Côtes (Meuse), France, 16-5-2014
Selysiothemis nigra, Lakes at Spedaletto, Pienza (SI), Italy, 25-8-2011
Somatochlora alpestris, Korppiaapa swamp, Sodankylä (Lapland), Finland, 24-7-2012
Somatochlora arctica, Lago Bianco, Monte Corno NP (BZ), Italy, 19-8-2008

Somatochlora borisi, River Diavolorema, near Mikro Derio, Thrace, Greece, 12-5-2011
Somatochlora flavomaculata, Lake Köyceğiz, Muğla, Turkey, 5-6-2009
Somatochlora meridionalis, River Gonna near Monticiano (SI), Italy, 1-9-2010
Somatochlora metallica, Ponds and lakes, Nuorgam (Lapland), Finland, 23-7-2011
Somatochlora sahlbergi, Ponds and lakes, Nuorgam (Lapland), Finland, 27-7-2013
Sympecma fusca, La Fossetta, near Rosia (SI), Italy, 31-3-2011
Sympecma paedisca, Wasserwiesen near Rosenheim (RO), Germany, 2-5-2008
Sympetrum danae, Lago Bianco, Monte Corno NP (BZ), Italy, 19-8-2008
Sympetrum depressiusculum, Hageven, Neerpelt (LIM), Belgium, 17-9-2009
Sympetrum flaveolum, Beegderheide, Heel (LB), Netherlands, 16-7-2006
Sympetrum fonscolombii, Lakes at Spedaletto, Pienza (SI), Italy, 9-9-2011
Sympetrum meridionale, Lake at Colle Malamerenda (SI), Italy, 28-8-2008
Sympetrum nigrifemur, Erjos ponds, Tenerife, Spain, 21-3-2011
Sympetrum pedemontanum, Vorflutgraben near Eittingermoos (FS), Germany, 28-8-2009
Sympetrum sanguineum, Lake at Modanella (SI), Italy, 9-8-2011
Sympetrum sinaiticum, Oasis at Tozeur, Tunisia, 5-10-2009
Sympetrum striolatum, Lakes at Spedaletto, Pienza (SI), Italy, 7-9-2012
Sympetrum vulgatum, Vorflutgraben near Eittingermoos (FS), Germany, 28-8-2009
Trithemis annulata, Lago della Rancia, near Orgia (SI), Italy, 3-10-2007
Trithemis arteriosa, Stream at Igueste de San Andrés, Tenerife, Spain, 1-6-2014
Trithemis festiva, Mountain stream near Günlükbası, Muğla, Turkey, 3-6-2009
Trithemis kirbyi, River Genal, Benarraba, Andalusia, Spain, 24-8-2010
Zygonyx torridus, River Guadiaro, El Colmenar, Andalusia, Spain, 22-8-2010

References

Aagaard K. & D. Dolmen 1977 Vann-nymfer i Norge. – Fauna 30: 61-74.

Adamović Ž. 1948 La liste de la collection des odonates du Musée d'État à Sarajevo. – Godišnjak Biološkog Instituta u Sarajevu 1: 79-94.

Adamović Ž. 1949 La liste des odonates du Muséum d'histoire naturelle du Pays Serbe. – Glasnik Prirodnjačkog Muzeja srpske Zemlje B (1/2): 275-293.

Adamović Ž. 1990 Odonata collected in Strumicka Kotlina, Macedonia, Yugoslavia. – Bulletin of the Natural History Museum in Belgrade B 45: 47-58.

Adamović Ž. 1996 Odonata taken and observed in Donji Ceklin, Montenegro. – Acta entomologica serbica 1: 39-48.

Adamović Ž., L. Anđus & L. Mihajlović 1996 Odonata (Insecta). In: G. Karaman (ed.), The Fauna of Durmitor. – The Montenegrin Academy of Sciences and Arts, Podgorica 5: 43-80.

Aidukaitė D., E. Budrys, D. Dapkus & G. Švitra 2007 [Odonata]. In: V. Rašomavičius (ed.), Lietuvos raudonoji knyga. – Lututė, Kaunas: 44-56.

Akramowski [Akramovskij] N.N. 1948 Fauna strekoz Sovietskoi Armenii [The dragonfly fauna of the Soviet Armenia]. – Zoologicheskij Sbornik, Akademiya Nauk Armyanskoj SSR 5: 117-188.

Akramowski [Akramovskij] N.N. 1964 Dopolnenie k fauna Strekoz Vostotchnogo zakavkazia (Insecta: Odonata) [Supplement to the dragonfly fauna of eastern Transcaucasia (Insecta: Odonata)]. – Izvestia Akademii Nauk Armyanskoj SSR 17: 99-101.

Ananian V.Y. & M. Tailly 2013 Additions to the dragonfly (Odonata) fauna of Armenia, with new records of rare or uncommon species. – Russian Entomological Journal 22: 249-254.

Ander K. 1944 Catalogus Insectorum Sueciae, IV, Odonata. – Opuscula entomologica 9: 157-163.

Ander K. 1950 Zur Verbreitung und Phänologie der boreoalpinen Odonaten der Westpaläarktis. – Opuscula entomologica 15: 53-71.

Ander K. 1953 Catalogus Insectorum Sueciae; Odonata additamenta. – Opuscula entomologica 18: 87-88.

Anderson R.C. 2009 Do dragonflies migrate across the western Indian Ocean? – Journal of Tropical Ecology 25: 347-348.

Andjus L. 1992 New data on the distribution of Odonata in Serbia. – Glasnik Prirodnjačkog muzeja u Beogradu B 47: 149-170.

Andreev A. 1998 O faune Odonata v Moldove i strekozakh Talmazskogo uchastka reki Dnestr [On Odonata fauna of Moldova and the dragonflies of Talmaza's section of the Dniester river]. – Biotica 6-7: 14-16.

Anselin A. & I. Hoste 1995 Dragonfly records from the Sierra de la Demanda and the Sierra de Urbión (Spain), with notes on habitat and altitudinal range. – Advances in Odonatology, Supplement 1: 9-12.

Argyroudi A., Y. Chatzinikolaou, K. Poirazidis & M. Lazaridou 2009 Do intermittent and ephemeral Mediterranean rivers belong to the same river type? – Aquatic Ecology 43: 465-476.

Arlt J. 1999 Entwicklungsnachweis von *Pantala flavescens* (Fabricius) in der Türkei (Anisoptera: Libellulidae). – Libellula 18: 95-96.

Arnold N.M. 1902 Katalog nasekomykh Mogilevskoi gubernii. – Sankt-Peterburg.

ArtDatabanken 2015 Rödlistade arter i Sverige 2015. ArtDatabanken, SLU, Uppsala.

Artobolevskij G. 1917 K faune strekoz Bessarabii [On the fauna of Odonata of Bessarabia]. – Materialy k poznaniyu fauny yugo-zapadnoy Rossii 2: 58.

Asahina S. 1967 A revision of the Asiatic species of the damselflies of the genus *Ceriagrion* (Odonata, Agrionidae). – Japanese Journal of Zoology 15: 255-334.

Asahina S. 1973 The Odonata of Iraq. – Japanese Journal of Zoology 17: 17-36.

Asahina S. 1978 Notes on Chinese Odonata, VII. Further studies on the Graham Collection preserved in the U.S. National Museum of Natural History, Suborder Anisoptera. – Kontyû, Tokyo 46: 234-252.

Askew R.R. 1988 The dragonflies of Europe. – Harley Books, Colchester, United Kingdom.

Askew R.R. 2004 The Dragonflies of Europe (revised edition). – Harley Books, Colchester, United Kingdom.

Azpilicueta-Amorín M., C. Rey Rañó Docampo, F. Barrueco, X.L. Rey Muñiz & A. Cordero-Rivera 2007 A preliminary study of biodiversity hotspots for odonates in Galicia, NW Spain. – Odonatologica 36: 1-12.

Azpilicueta-Amorín M., A. Cordero-Rivera & F.J. Ocharan 2009 *Gomphus graslinii* (Rambur, 1842). In: J.R. Verdú, & E. Galante (eds), Atlas de los Invertebrados Amenazados de España (Especies En Peligro Crítico y En Peligro). – Dirección General para la Biodiversidad, Ministerio de Medio Ambiente, Madrid.

Baeta R., E. Sansault & J. Present 2012 Répartition et première estimation quantitative des populations de *Leucorrhinia caudalis* (Charpentier, 1840) en Indre-et-Loire, région Centre (Odonata, Anisoptera: Libellulidae). – Martinia 28: 109-119.

Báez M. 1985 Las libelulas de las Islas Canarias. Enciclopedia Canaria 28. – Aula de Cultura del Excmo. Cabildo Insular de Tenerife, Santa Cruz.

Baixeras J., J.M. Michelena, P. González, F.J. Ocharan, C. Quirce, M.A. Marcos, E. Soler, J. Domingo, S. Montagud, A. Gutiérrez & M. Arles 2006 Les libèl.lules de la Comunitat Valenciana. – Generalitat Valenciana, Conselleria de Territori i Habitatge, Valencia.

Bakhshi Y. & S. Sadeghi 2014 Odonata fauna of Khuzestan province (Iran) with a note on an Oriental species *Trithemis aurora* (Burmeister, 1839) as a new

record for the south-west of Iran. – Zoology in the Middle East 60: 372-374.

Balthasar V. 1938 Další příspěvek k entomologickému výzkumu Slovenska. – Entomologické listy [Folia entomologica] 2: 121-123.

Bartenev A.N. 1907 Odonata Polesskoi i Vilenskoi ekspeditsii [Odonata der Polesje und Wilno-expedition]. – Trudy Studencheskogo Kruzhka dlya Issledovaniya Russkoi Prirody sostoyashchgo pri Moskovskom Imperatorskom Universitete 3: 133-146.

Bartenev A.N. 1912 Notice sur les odonates du Montenegro. – Revue russe d'Entomologie 12: 76-80.

Bartenev A.N. 1913 Contribution à la connaissance des Odonates de l'Asie Paléarctique du Musée Zoologique de l'Académie Impériale des Sciences de St. Pétersbourg. 2. – Annuaire du Musée zoologique de l'Académie impériale des Sciences de St.-Pétersbourg 17 (1912): 289-310 [Russian].

Bartenev A.N. 1929a Données nouvelles sur les Odonates de la Transcaucasie, de la Perse et du Turkestan. – Revue russe d'Entomologie 23 (1-2): 125-129.

Bartenev A.N. 1929b On the species groups of *Aeschna juncea* and *Aeschna clepsydra* (Odonata, Aeschninae) in the Palaearctic. – Trudy Severo-Kavkazskoi Assotiatsii Nauchno-Issledovatel'skikh Institutov 54: 1-65.

Battin T. 1989 Überblick über die Libellenfauna der Insel Kreta (Insecta: Odonata). – Zeitschrift der Arbeitsgemeinschaft Österreichischer Entomologen - Entomologisches Nachrichtenblatt 41: 52-64.

Battin T. 1990 *Anax immaculifrons* Rambur, 1842 from the island of Karpathos, Greece: an oriental representative in the European dragonfly fauna (Odonata: Aeshnidae). – Opuscula zoologica fluminensia 47: 1-10.

Battin T. 1993 Revision of the *puella* group of the genus *Coenagrion* Kirby, 1890 (Odonata, Zygoptera), with emphasis on morphologies contributing to reproductive isolation. – Hydrobiologia 262: 13-29.

Bechly G. 1996 Morphologische Untersuchungen am Flügelgeäder der rezenten Libellen und deren Stammgruppenvertreter (Insecta; Pterygota; Odonata) unter besonderer Berücksichtigung der phylogenetischen Systematik und des Grundplanes der Odonata. – Petalura (Special Volume) 2: 1-402.

Bechly G. 1999 Epallagidae versus Euphaeidae revisited. – International Journal of Odonatology 2: 137-139.

Bedjanič M. 2011 *Coenagrion hastulatum* (Charpentier, 1825), new for the dragonfly fauna of Bosnia and Herzegovina (Odonata: Coenagrionidae). – Natura Sloveniae 13 (2): 31-36.

Bedjanič M. & A. Šalamun 2003 Large golden-ringed dragonfly *Cordulegaster heros* Theischinger 1979, new for the fauna of Italy (Odonata: Cordulegastridae). – Natura Sloveniae 5 (2): 19-29.

Bedjanič M. & D. Vinko 2012 New records of *Epallage fatime* (Charpentier, 1840) in Macedonia (Odonata: Euphaeidae). – Natura Sloveniae 14 (1): 15-22.

Bedjanič M., N. Micevski & B. Micevski 2008 On the dragonfly collection in the Natural History Museum in Struga, Macedonia (Insecta: Odonata). – Biologia Macedonica 61: 97-105.

Bedjanič M., Conniff, N. van der Poorten & A. Šalamun 2014 Dragonfly fauna of Sri Lanka: distribution and biology, with threat status of its endemics. – Pensoft, Sofia.

Belančić A., T. Bogdanović, M. Franković, M. Ljuština, N. Mihoković & B. Vitas 2008 Crvena knjiga Vretenaca Hrvatske [Red data book of dragonflies of Croatia]. – Ministry of Culture, State Institute for Nature Protection, Republic of Croatia.

Bell N., E. Dylmer & K. Olsen 2014 Status of *Aeshna serrata* in Denmark. – Brachytron 16: 38-42.

Belle J. 1984 *Orthetrum trinacria* (Selys) new to the fauna of Spain, with records of three other afrotropical Odonata Anisoptera. – Entomologische Berichten, Amsterdam 44: 79-80.

Belle J. 1992 The Odonata of the Azores. – Entomologische Berichten 52: 63-65.

Belle J. & J. van Tol 1990 *Anomalagrion hastatum* (Say), an American damselfly indigenous to the Azores (Odonata, Coenagrionidae). – Tijdschrift voor Entomologie 133: 143-147.

Belyshev B.F. 1958 Die Verbreitung der Odonaten in Sibirien. – Deutsche Entomologische Zeitschrift, N.F. 5: 79-85.

Belyshev B.F. 1960 Conditions of existence of the larvae of a relict dragonfly *Orthetrum albistylum* Selys in an hot spring of north-east Baikal territory. – Zoologiceskij Zhurnal 39: 1432-1433.

Belyshev B.F. 1968 Contributions to the knowledge of the fauna of Dragonflies (Odonata) of Siberia. IV. Geography of the Dragonflies of Siberia. – Fragmenta faunistica, Warszawa 14: 406-536.

Belyshev B.F. 1973 The dragonflies of Siberia (Odonata) Volume I, part 1-2. – Nauka, Novosibirsk.

Belyshev B.F. 1974 The dragonflies of Siberia (Odonata) Volume II, part 3. – Nauka, Novosibirsk.

Belyshev B.F. & V.V. Shevchenko 1971 Fauna strekoz (Odonata, Insecta) I raspredelenia ee komponentov v Kazakhstane. – Biologicheskie Nauki 1971: 73-77.

Bemmerle B. 2005 *Zygonyx torridus* auf La Gomera, Kanarische Inseln (Odonata: Libellulidae). – Libellula 24: 249-256.

Ben Azzouz B., R. Guemmouh & P. Aguesse 1989a A propos des *Coenagrion* du groupe *mercuriale* (Charpentier, 1840) et de la présence de *C. castellani* Roberts, 1984 au Maroc (Zygoptera: Coenagrionidae). – Odonatologica 18: 279-283.

Ben Azzouz B., R. Guemmouh & P. Aguesse 1989b Position systematique et description de la larve de *Coenagrion castellani* Roberts (1948) au Maroc (Odonata, Coenagriidae). – Nouvelle Revue d'Entomologie 6: 375-381.

Benítez Morera A. 1950 Los Odonatos de España. – Madrid: CSIC.

Benítez-Donoso A. 1990 Los Odonatos de Extremadura. – Licenciatura thesis, Universidad de Oviedo.

Bentivoglio T. 1905 Libellulidi della Sardegna esistenti nel Museo Zoologico della R. Università di Napoli. – Annuario del Museo zoologico della Regia Università di Napoli, (NS) 1: 1-7.

Bentivoglio T. 1929 Odonati. Ricerche faunistiche nelle isole Italiane dell'Egeo. – Archivio zoologico Italiano, Napoli 13: 199-210.

Bernard R. 1998 Stan wiedzy o rozmieszczeniu i ekologii *Nehalennia speciosa* (Charpentier, 1840) (Odonata: Coenagrionidae) w Polsce. – Rocznik Naukowy Polskiego Towarzystwa Ochrony Przyrody 'Salamandra' 2: 67-93.

Bernard R. 2000a On the occurrence of *Cercion lindenii* (Sélys, 1840) in Poland (Odonata: Coenagrionidae). – Opuscula zoologica fluminensia 177: 1-11.

Bernard R. 2000b Stan wiedzy o występowaniu i biologii *Cordulegaster boltonii* (Donovan, 1807) w Polsce (Odonata: Cordulegastridae). – Rocznik Naukowy Polskiego Towarzystwa Ochrony Przyrody 'Salamandra' 4: 55-87.

Bernard R. 2002 First records of *Aeshna crenata* Hagen, 1856 in Lithuania with selected aspects of its biology (Odonata: Aeshnidae). – Opuscula zoologica fluminensia 202: 1-21.

Bernard R. 2003 *Aeshna crenata* Hag., a new species for the fauna of Latvia (Anisoptera: Aeshnidae). – Notulae odonatologicae 6 (1): 8-10.

Bernard R. 2005 First record of *Aeshna affinis* Vander Linden, 1820 in Lithuania (Anisoptera: Aeshnidae) and corrective notes on the Lithuanian Odonata checklist. – Notulae odonatologicae 6 (6): 53-55.

Bernard R. 2012 East Palaeartic *Somatochlora graeseri* Selys occurs as a postglacial relict in Europe west of the Urals (Anisoptera: Corduliidae). – Odonatologica 41: 309-325.

Bernard R. & P. Buczyński 2008 Stan zachowania i wybiórczość siedliskowa iglicy małej *Nehalennia speciosa* (Charpentier, 1840) w Polsce. – Odonatrix 4: 43-60.

Bernard R. & B. Daraż 2010 Relict occurrence of East Palaearctic dragonflies in northern European Russia, with first records of *Coenagrion glaciale* in Europe (Odonata: Coenagrionidae). – International Journal of Odonatology 13: 39-62.

Bernard R. & P. Ivinskis 2004 *Orthetrum brunneum* (Fonscolombe, 1837), a new dragonfly species in Lithuania (Odonata: Libellulidae). – Acta zoologica Lituanica 14 (3): 31-36.

Bernard R. & O.E. Kosterin 2010 Biogeographical and ecological description of the Odonata of eastern Vasyugan Plain, West Siberia, Russia. – Odonatologica 39: 1-28.

Bernard R. & J. Musiał 1995 Observations of an abundant occurrence of *Hemianax ephippiger* (Burmeister, 1839) in western Poland in 1995 (Odonata: Aeshnidae). – Opuscula zoologica fluminensia 138: 1-9.

Bernard R. & J. Samoląg 2002 *Coenagrion johanssoni* (Wallengren) in Lithuania (Zygoptera: Coenagrionidae). – Notulae odonatologicae 5 (10): 117-120.

Bernard R. & T. Schmitt 2010 Genetic poverty of an extremely specialized wetland species, *Nehalennia speciosa*: implications for conservation (Odonata: Coenagrionidae). – Bulletin of Entomological Research 100: 405-413.

Bernard R. & H. Wildermuth 2005 *Nehalennia speciosa* (Charpentier, 1840) in Europe: a case of a vanishing relict (Zygoptera: Coenagrionidae). – Odonatologica 34: 335-378.

Bernard R., P. Ivinskis & B. Daraż 2008 *Lestes barbarus* (Fabricius), a forgotten species in the fauna of Lithuania (Zygoptera: Lestidae). – Notulae odonatologicae 7 (1): 1-4.

Bernard R., P. Buczyński, G. Tończyk & J. Wendzonka 2009 A distribution atlas of dragonflies (Odonata) in Poland. – Bogucki Wydawnictwo Naukowe, Poznań.

Bernard R., M. Heiser, A. Hochkirch & T. Schmitt 2011 Genetic homogeneity of the Sedgling *Nehalennia speciosa* (Odonata: Coenagrionidae) indicates a single Würm glacial refugium and trans-Palaearctic postglacial expansion. – Journal of Zoological Systematics and Evolutionary Research 49: 292-297.

Berquier C. 2013 Première observation en France d'*Orthetrum trinacria* (Selys, 1841) sur l'île de Corse (Odonata, Anisoptera: Libellulidae). – Martinia 29: 15-18.

Bertram G. & M. Haacks 1999 Beobachtungen von windverdrifteten Libellen auf der Kurischen Nehrung im September 1998. – Libellula 18: 89-94.

Beshovski V. 1964 Odonata from the Bulgarian Black Sea coast. – Bulletin de l'Institut et Musée de Zoologie, Sofia 15: 115-129.

Beshovski V. 1994 Fauna of Bulgaria 23. Insecta, Odonata. – Bulgarian Academy of Sciences, Sofia.

Beshovski V. & V. Gashtarov 1997 *Selysiothemis nigra* (Vander Linden, 1825) a new genus and species for the Bulgarian fauna (Odonata: Anisoptera: Libellulidae). – Entomologische Zeitschrift 107 (7): 309-310.

Beutler H. 1984 Eine neue Unterart von *Libellula depressa* L. 1758 auf der Halbinsel Krim (UdSSR) (Insecta, Odonata, Libellulidae). – Faunistische Abhandlungen Staatliches Museum fur Tierkunde Dresden 12: 55-58.

Beutler H. 1987 Odonaten aus dem Kaukasus und Transkaukasien (Georgische SSR, UdSSR). – Notulae odonatologicae 2 (9): 137-139.

Bezvali V. 1932 Odonata de Bessarabie. – Buletinul Muzeului National de Istorie Naturala din Chisinau 4: 68-69.

Bilek A. 1954 Eine neue Agrionide aus Bayern (Odonata). – Nachrichtenblatt der Bayerischen Entomologen 3: 97-99.

Bilek A. 1966 Ergebnisse der Albanien-Expedition 1961 des Deutschen Entomologischen Institutes, 46: Odonata. – Beiträge zur Entomologie 16: 327-346.

Billqvist M. & F. Heitzenberg 2010 Två nya trollsländor i Swerige. *Aeshna affinis* och *Anax parthenope* påträffade 2010. – Fauna & Flora 105: 20-23.

Billqvist M., D. Smallshire & A. Swah 2012 Svenska Trollsländeguiden. – Hirschfield Media, Malmö.

Blanchon Y., E. Durand & P. Lambret 2011 Redécouverte de *Gomphus flavipes* (Charpentier, 1825) en Provence-Alpes-Côte d'Azur (Odonata, Anisoptera: Gomphidae). – Martinia 27: 121-122.

Blaškovič T, E. Bulánková & J. Šíbl 2003 First record of *Cordulegaster heros* ssp. *heros* Theischinger, 1979 (Cordulegastridae, Odonata) from Slovakia. – Biologia, Bratislava 58: 293-294.

Boano G., R. Sindaco, E. Riservato, S. Fasano & R. Barbero 2007 Atlante degli Odonati del Piemonte e della Valle d'Aosta. – Associazione Naturalistica Piemontese, Memorie VI.

Boev V.G., M.G. Bayanov & I.L. Karataeva 1989 [Material towards the dragonfly distribution retrieval of the Bashkir USSR]. – Tezisy Dokl. vseoyuz. Soveshch. Probl. Kadastra i Ucheta zhivot. Mira 1: 100-101.

Borisov S.N. 2005 Distribution and habitat characteristics of *Ophiogomphus reductus* Calvert, 1898 (Odonata, Gomphidae). – Euroasian Entomological Journal 4: 273-278.

Borisov S.N. 2012 Migrant dragonflies in Middle Asia. Report 4. *Anax parthenope parthenope* (Selys, 1834) (Odonata, Aeshnidae). – Euroasian Entomological Journal 11: 239-248.

Borisov S.N. 2014 Dragonflies (Odonata) of thermal springs in Barguzinskaya depression of Baikalian rift zone, Russia. – Euroasian Entomological Journal 13: 121-132.

Borisov S.N. & A.Y. Haritonov 2007 The Dragonflies (Odonata) of Middle Asia. Part 1. – Caloptera, Zygoptera. – Euroasian Entomological Journal 6: 343-360.

Borisov S.N. & A.Y. Haritonov 2008 The Dragonflies (Odonata) of Middle Asia. Part 2. (Anisoptera). – Euroasian Entomological Journal 7: 97-123.

Borisov S.N., O.E. Kosterin & A.Y. Haritonov 2014 On the fauna of Odonata of Chukotka and other northern regions of the Holarctic. – Euroasian Entomological Journal 13: 315-320.

Bos F. & M. Wasscher 1997 Veldgids libellen. – KNNV-Uitgeverij, Utrecht.

Boudot J.-P. 1998 Differences in male colour patterns between *Boyeria cretensis* Peters, 1991 and *B. irene* (Fonscolombe, 1838) (Odonata: Aeshnidae). – Opuscula zoologica fluminensia 161: 1-3.

Boudot J.-P. 2001 Les *Cordulegaster* du Paléarctique occidental: identification et répartition (Odonata, Anisoptera, Cordulegastridae). – Martinia 17: 3-34.

Boudot J.-P. 2008 *Selysiothemis nigra* (Vander Linden, 1825), nouveau pour le Maroc, et autres observations sur les Odonates du Magreb nord-occidental (Odonata: Anisoptera: Libellulidae). – Martinia 24: 3-29.

Boudot J.-P. 2014a A brief observation of egg laying in *Lindenia tetraphylla* (Odonata: Gomphidae) on Kríti (Crete), Greece. – Notulae odonatologicae 8 (4): 94-96.

Boudot J.-P. 2014b Kempny's "Adampol" elucidated: a Polish settlement in Anatolia in the mid 19th century. – Notulae odonatologicae 8 (4): 77-82.

Boudot J.-P. 2014c *Ischnura intermedia*. – The IUCN Red List of Threatened Species. Version 2015.1. <www.iucnredlist.org>. Downloaded on 14 June 2015.

Boudot J.-P. & G. De Knijf 2012 Nouvelles données sur les Odonates du Maroc oriental et méridional (Odonata). – Martinia 28: 1-28.

Boudot J.-P. & G. Jacquemin 1988 A note on the variability of a population of *Erythromma viridulum* (Charp.) from eastern France, with special reference to *E. viridulum orientale* Schmidt (Zygoptera: Coenagrionidae). – Notulae odonatologicae 3 (2): 17-19.

Boudot J.-P. & G. Jacquemin 1995 Revision of *Cordulegaster boltonii* (Donovan, 1807) in Southwestern Europe and Northern Africa, with description of *C. b. iberica* ssp. nov. from Spain (Anisoptera, Cordulegastridae). – Odonatologica 24: 149-173.

Boudot J.-P. & V.J. Kalkman 2014 Odonata (dragonflies and damselflies). In: K.G. Smith, V. Barrios, W.R.T. Darwall & C. Numa (eds), The status and distribution of freshwater biodiversity in the Eastern Mediterranean. – Cambridge, UK, Malaga, Spain and Gland, Switzerland: IUCN.

Boudot J.-P., G. Jacquemin & H.J. Dumont, 1990. Revision of the subspecies of *Onychogomphus forcipatus* (Linnaeus, 1758) in Europe and Asia Minor, and the true distribution of *Onychogomphus forcipatus unguiculatus* (Vander Linden, 1823) (Odonata, Gomphidae). – Bulletin et Annales de la Société royale belge d'Entomologie 126: 95-111.

Boudot J.-P., D. Grand, B. Grebe, N. Hacet & M. Marinov 2004 Description of the female of *Somatochlora borisi* with distributional notes on the species (Odonata: Corduliidae). – International Journal of Odonatology 7: 431-438.

Boudot J.-P., V.J. Kalkman, M. Azpilicueta-Amorín, T. Bogdanović, A. Cordero-Rivera, G. Degabriele, J.-L. Dommanget, S. Ferreira, B. Garrigós, M. Jović, M. Kotarac, W. Lopau, M. Marinov, N. Mihoković, E. Riservato, B. Samraoui & W. Schneider 2009 Atlas of the Odonata of the Mediterranean and North Africa. – Libellula Supplement 9: 1-256.

Bouwman J. & R. Ketelaar 2008 New records of *Coenagrion armatum* in Schleswig-Holstein (Odonata: Coenagrionidae). – Libellula 27: 185-190.

Bouwman J.H., V.J. Kalkman, G. Abbingh, E.P. de Boer, R.P.G. Geraeds, D. Groenendijk, R. Ketelaar, R. Manger & T. Termaat 2008 Een actualisatie van de verspreiding van de Nederlandse libellen [An update of the distribution of dragonflies in The Netherlands]. – Brachytron 11: 103-198.

Brauer F. 1856 Verzeichniss der im Kaiserthume Oesterreich aufgefunden Odonaten und Perliden. – Verhandlungen des Zoologisch-Botanischen Vereins in Wien 6: 229-234.

Brauer F. 1868 Verzeichniss der bis jetzt bekannten Neuropteren im Sinne Linné's. – Verhandlungen der Zoologisch-Botanischen Gesellschaft in Wien 18: 711-742.

Brauner A. 1910 Materialy po entomologicheskoy faune Bessarabii. Zametka o strekozakh Bessarabii. [Material on the entomological fauna of Bessarabia. Notes on Odonata of Bessarabia]. – Trudy Bessarabskogo Obschestva Estestvoispytateley 2: 3-5.

Brauner O. 2007 Winterbeobachtungen von Libellen auf La Gomera und La Palma, Kanarische Inseln (Odonata). – Libellula 26: 213-232.

Brauner O. 2009 Erstnachweis von *Ceriagrion tenellum* in Brandenburg (Odonata: Coenagrionidae). – Libellula 28: 25-29.

Breuer M. & E. Douma-Petridou 2000 A Greek mountain stream (N Peloponnesus) as habitat of *Caliaeschna microstigma* (Odonata: Aeshnidae). – Libellula Supplement 3: 1-7.

Briliūtė A. & E. Budrys 2007 New record of damselfly *Lestes barbarus* in the South of Lithuania (Odonata: Lestidae). – New and Rare for Lithuania Insect Species 19: 10-12.

Brittinger C. 1850 Die Libelluliden des Kaiserreichs Oesterreich. – Sitzungsberichte der mathematisch-naturwissenschaftlichen Classe der kaiserlichen Akademie der Wissenschaften 4: 328-336.

Brochard C. & E. van der Ploeg 2013a Description of the exuvia and larva of *Pyrrhosoma elisabethae* (Odonata: Coenagrionidae). – Libellula 32: 159-174.

Brochard C. & E. van der Ploeg 2013b Searching for exuviae of endemic Odonata species in Greece. – Brachytron 15: 83-101.

Brock V., J. Hoffmann, O. Kühnast, W. Piper & K. Voss 1997 Atlas der Libellen Schleswig-Holsteins. – Landesamt für Natur und Umwelt des Landes Schleswig-Holstein, Kiel (Hrsg.)..

Brockhaus T. 2013 Einige faunistisch-zoogeografische, ökologische und morphologische Besonderheiten der Libellenfauna des Nordurals (Komi-Republik, Russische Föderation). – 32. Jahrestagung der Gesellschaft deutschsprachiger Odonatologen.

Brockhaus T. & U. Fischer 2005 Die Libellenfauna Sachsens. – Natur & Text, Rangsdorf.

Brockhaus T., H.-J. Roland, T. Benken, K.-J. Conze, A. Günther, K.G. Leipelt, M. Lohr, A. Martens, R. Mauersberger, J. Ott, F. Suhling, F. Weihrauch & C. Willigalla 2015 Atlas der Libellen Deutschlands (Odonata). – Libellula Supplement 14: 1-394

Brooks S., A. Parr & P.J. Mill 2007 Dragonflies as climate-change indicators. – British Wildlife 19: 85-93.

Brown J.M., M.A. McPeek & M.L. May 2000 A phylogenetic perspective on habitat shifts and diversity in the North American *Enallagma* damselflies. – Systematic Biology 49: 697-712.

Bruttan A. 1878 Die Odonaten Liv- und Estlands. – Sitzungsberichte der Naturforscher- Gesellschaft zu Dorpat 4: 420-428.

Bucciarelli I. 1977 Dati preliminari sul popolamento odonatologico di Calabria, Sicilia e Sardegna. (VIII contributo alla conocenza degli Odonati). – Annali del Museo civico di Storia naturale Giacomo Doria, Genova 81: 374-386.

Buchholz K.F. 1955 Morphologische Differenzierung bei der Rassenbildung von *Anax parthenope* Selys (Odonata: Aeschnidae). – Bonner zoologische Beiträge 6: 118-131.

Buchholz K.F. 1963 Odonaten aus Mazedonien. – Opuscula zoologica 70: 1-16.

Buczyński P. 2000 On the occurrence of *Coenagrion armatum* (Charpentier, 1840) in Poland (Odonata: Coenagrionidae). – Opuscula zoologica fluminensia 179: 1-10.

Buczyński P. & M. Moroz 2004 *Aeshna affinis* Vander Linden and *Sympetrum depressiusculum* (Sélys) found in Belarus (Anisoptera: Aeshnidae, Libellulidae). – Notulae odonatologicae 6 (4): 37-39.

Buczyński P. & M.D. Moroz 2008 Notes on the occurrence of some Mediterranean dragonflies (Odonata) in Belarus. – Polish Journal of Entomology 77: 67-74.

Buczyński P., A. Zawal & E. Filipiuk 2002 Neue Nachweise von *Orthetrum albistylum* in Nordpolen: Erweitert sich sein Verbreitungsgebiet in Mitteleuropa? (Odonata: Libellulidae). – Libellula 21: 15-24.

Buczyński P., K.-D.B. Dijkstra, R. Mauersberger & M.D. Moroz 2006 Review of the Odonata of Belarus. – Odonatologica 35: 1-13.

Buczyński P., A. Zawal, E. Stępień, E. Buczyńska & V. Pešić 2013a *Gomphus pulchellus* Selys recorded on the eastern edge of its distribution area in Montenegro (Anisoptera: Gomphidae). – Odonatologica 42: 293-300.

Buczyński P., A. Zawal, E. Stępień, E. Buczyńska & V. Pešić 2013b Contribution to the knowledge of dragonflies (Odonata) of Montenegro, with the first record of *Ophiogomphus cecilia* (Fourcroy, 1785). – Annales Universitatis Mariae Curie-Skłodowska 68: 57-71.

Buczyński P., A.P. Shapoval & E. Buczyńska 2014 *Pantala flavescens* at the coast of the Baltic Sea (Odonata: Libellulidae). – Odonatologica 43: 3-11.

Bulánková E. 2003 Odonata. In: F. Šporka (ed.), Vodné bezstavovce (makroevertebráta) Slovenska, súpis druhov a autekologické charakteristiky. – Slovenský hydrometeorologický ústav, Bratislava.

Burbach K. & M. Winterholler 1997 Die Invasion von *Hemianax ephippiger* (Burmeister) in Mittel- und Nordeuropa 1995/1996 (Anisoptera: Aeshnidae). – Libellula 16: 33-59.

Burmeister E.G. 1989 Spätsommeraspekt der Libellenfauna Sardiniens (Italien) (Insecta, Odonata). – Nachrichtenblatt der Bayerischen Entomologen 38: 80-83.

Burmeister H.C.C. 1839 Handbuch der Entomologie 2: 805-862. – Berlin, Enslin.

Butler S.G. 1992 Notes on the collection and rearing out of the larva of *Somatochlora sahlbergi* Trybom from Finland (Odonata: Corduliidae). – Opuscula zoologica fluminensia 84: 1-5.

Bybee S.M., T.H. Ogden, M.A. Branham & M.F. Whiting 2008 Molecules, morphology and fossils: a comprehensive approach to odonate phylogeny and the evolution of the odonate wing. – Cladistics 23: 1-38.

Cammaerts R. 1979 Atlas provisoire des Insectes de Belgique et des régions limitrophes. Cartes 1333 à 1400. Les Odonates de Belgique et des régions limitrophes. –Faculté universitaire des Sciences agronomiques de Gembloux, Gembloux.

Campion, H. 1914 List of odonata collected at Tozeur, S. Tunesia, by Mr. G.C. Champion in May, 1913. – Entomologist's Monthly Magazine Series 2, 25: 118.

Cannings S.G. & R.A. Cannings 1985 The larva of *Somatochlora sahlbergi* Tryböm, with notes on the species in the Yukon Territory, Canada (Anisoptera: Corduliidae). – Odonatologica 14: 319-330.

Cannings S.G. & R.A. Cannings 1997 Dragonflies (Odonata) of the Yukon. In: H.V. Danks & J.A. Downes (eds), Insects of the Yukon. – Biological Survey of Canada (Terrestrial Arthropods), Ottawa.

Cano-Villegas F.J. & M.A. Conesa-García 2009 Expansión de *Trithemis kirbyi* (Sélys, 1891) (Odonata: Libelluidae) en la provincia de Málaga (Sur de la Península Ibérica). – Boletín de la S.E.A. 44: 569-572.

Cano-Villegas F.J., A. Bernal-Sánchez, I. Frutos-Cuadrado & M.A. Conesa-García 2012 Sobre la situación de *Orthetrum nitidinerve* (Selys, 1841) (Odonata: Libellulidae) en Andalucía (España). – Boletín de la Asociación española de Entomología 36: 469-475.

Capra F. 1945 Alcuni odonati e neurotteri dell' Albania settentrionale. – Annali del Museo civico di Storia naturale di Genova 62: 292-300.

Carchini G. 1983 Odonati (Odonata). Guide per il riconoscimento delle specie animali delle acque interne italiane. 21 – Consiglio Nazionale delle Ricerche, Roma.

Carchini G., E. Rota & C. Utzeri 1985 Lista aggiornata degli odonati italiani e loro distribuzione regionale. – Fragmenta entomologica 18: 91-103.

Cardoso P. 2011. Habitats Directive species lists: urgent need of revision. – Insect Conservation and Diversity 5: 169-174.

Carle F.L. 1986 The classification, phylogeny and biogeography of the Gomphidae (Anisoptera). I. Classification. – Odonatologica 15: 275-326.

Carle F.L. & K.M. Kjer 2002 Phylogeny of *Libellula* Linnaeus (Odonata: Insecta). – Zootaxa 87: 1-18.

Carle F.L., K.M. Kjer & M.L. May 2008 Evolution of Odonata, with special reference to Coenagrionoidea (Zygoptera). – Arthropod Systematics & Phylogeny 66: 37-44.

Cham S., B. Nelson, A. Parr, S. Prentice, D. Smallshire & P. Taylor 2014 Atlas of Dragonflies in Britain and Ireland. – BDS, Peterborough & CEH, Wallingford.

Chaplina I.A., H.J. Dumont, A.Y. Haritonov & O.N. Popova 2007 A review of the Odonata of Kazakhstan. – Odonatologica 36: 349-364.

Charpentier T. (de) 1825 Horae entomologicae. – Gosohorsky, Wratislaviae.

Charpentier T. (de) 1840 Libellulinae europaeae descriptae ac depictae. – Voss, Lipsiae.

Chelmick D.G. (ed.) 1979 Provisional Atlas of the Insects of the British Isles Part 7, Odonata, Dragonflies. – Institute of Terrestrial Ecology, Huntingdon.

Chelmick D.G. 2006 Some observations of *Macromia splendens* (Pictet) in Andalucia, Spain (Anisoptera: Macromiidae). – Notulae odonatologicae 6 (7): 69-72.

Chelmick D.G. & B.P. Pickess 2008 *Trithemis kirbyi* Selys in southern Spain (Anisoptera: Libellulidae). – Notulae odonatologicae 7 (1): 4-5.

Chippindale P.T., V.K. Davé, D.H. Whitmore & J.V. Robinson 1999 Phylogenetic relationships of North American damselflies of the genus *Ischnura* (Odonata: Zygoptera: Coenagrionidae) based on sequences of three mitochondrial genes. – Molecular Phylogenetics & Evolution 11: 110-121.

Chovanec A. & J. Waringer 2001 Ecological integrity of river-floodplain systems - assessment by dragonfly surveys (Insecta: Odonata). – Regulated Rivers: Research & Management 17: 493-507.

Chovanec A., M. Schindler, K. Pall & K. Hostettler 2010 Bewertung des österreichischen Bodenseeufers auf der Grundlage libellenkundlicher Untersuchungen. – Schriftenreihe Lebensraum Vorarlberg 59: 1-43.

Chovanec A., J. Waringer, R. Wimmer & M. Schindler 2014 Dragonfly Association Index - Bewertung der Morphologie von Fließgewässern der Bioregion Östliche Flach- und Hügelländer durch libellenkundliche Untersuchungen. – Federal Ministry of Agriculture, Forestry, Environment and Water Management, Vienna.

Chovanec A., M. Schindler, J. Waringer & R. Wimmer 2015 The Dragonfly Association Index (Insecta: Odonata) – a tool for the type-specific assessment of lowland rivers. – River Research and Applications 31: 627-638.

Cîrdei F. & F. Bulimar 1965 Fauna Republicii Populare Române. Insecta. Odonata. – Academiei RPR, Bucureşti.

Clausnitzer H.-J. 2009 Hilfsmaßnahmen für *Nehalennia speciosa* in Niedersachsen. – Gesellschaft deutschsprachiger Odonatologen (GdO), 28. Jahrestagung, Basel 20.-22. März 2009.

Clausnitzer H.-J., P. Pretscher & E. Schmidt 1984 Rote Liste der Libellen. In: J. Blab, E. Nowak, W. Trautmann & H. Sukopp (eds), Rote Liste der gefährdeten Tiere und Pflanzen in der Bundesrepublik Deutschland. – Kilda (Greven): 116-118.

Clausnitzer H.-J., R. Hengst, C. Krieger & A. Thomes 2010 *Boyeria irene* in Niedersachsen (Odonata: Aeshnidae). – Libellula 29: 155-168.

Clausnitzer V. & K.-D.B. Dijkstra 2005 The dragonflies (Odonata) of Ethiopia, with notes on the status of endemic taxa and the description of a new species. – Entomologische Zeitschrift 115: 117-130.

Clausnitzer V. & K. Wesche 1996 Odonata records from Nepal (around Annapurna, Chitwan District, Royal Bardia National Park). – Opuscula zoologica fluminensia 147: 1-8.

Compte Sart A. 1962 Un Odonato nuevo para España, *Brachythemis leucosticta* (Burm.). – Vie et Milieu 13: 604-607.

Compte Sart A. 1965 Distribución, ecología y biocenosis de los Odonatos ibéricos. – Publicaciones del Instituto de Biología Aplicada 39: 33-64.

Conci C. 1949 L'*Agrion mercuriale castellanii* in Italia. – Bollettino della Società entomologica Italiana 79: 62-64.

Conci C. & C. Nielsen 1956 Odonata. Fauna d'Italia. – Calderini, Bologna.

Conesa-García M.A. 1995 Notes on infraspeciation in *Coenagrion caerulescens* (B. de Fonscolombe, 1839), with description of *C. c. isabelae* ssp. nov. from Morocco (Zygoptera: Coenagrionidae). – Odonatologica 24: 425-440.

Conservatoire des Sites Lorrains & Société Lorraine d'Entomologie 2012 Déclinaison régionale du Plan national d'actions en faveur des Odonates. – DREAL Lorraine.

Corbet P.S. 1957 The life-histories of two summer species of dragonflies. – Proceedings of the Zoological Society of London 128: 403-418.

Corbet P.S. 1999 Dragonflies: Behaviour and Ecology of Odonata. – Harley Books, Colchester.

Corbet P.S. 2002 Stadia and growth ratios of Odonata: a review. – International Journal of Odonatology 5: 45-73.

Corbet P.S., C. Longfield & N.W. Moore 1960 Dragonflies. – The New Naturalist Series. Collins, London.

Cordero-Rivera A. 2000 Distribution, habitat requirements and conservation of *Macromia splendens* Pictet (Odonata: Corduliidae) in Galicia (NW Spain). – International Journal of Odonatology 3: 79-80.

Cordero-Rivera A., C. Utzeri & S. Santolamazza Carbone 1999 Emergence and adult behaviour of *Macromia splendens* (Pictet) in Galicia, northwestern Spain (Anisoptera: Corduliidae). – Odonatologica 28: 333-342.

Cordero-Rivera A., J.A. Andrés, A. Córdoba-Aguilar & C. Utzeri 2004 Postmating sexual selection: allopatric evolution of sperm competition mechanisms and genital morphology in calopterygid damselflies (Insecta: Odonata). – Evolution 58: 349-359.

Cordero-Rivera A., M.O. Lorenzo-Carballa, C. Utzeri & V. Vieira 2005 Parthenogenetic *Ischnura hastata* (Say), widespread in the Azores (Zygoptera: Coenagrionidae). – Odonatologica 34: 1-9.

Corso A., O. Janni, M. Pavesi, M. Sammut, A. Sciberras & M. Viganò 2012 Annotated checklist of the dragonflies (Insecta Odonata) of the islands of the Sicilian Channel, including the first records of *Sympetrum sinaiticum* Dumont, 1977 and *Pantala flavescens* (Fabricius, 1798) for Italy. – Biodiversity Journal 3: 459-478.

Costa A. 1882 - Notizie ed osservazioni sulla Geo-Fauna sarda Memoria Prima Risultamento di ricerche fatte in Sardegna nel Settembre 1881. – Atti della Reale Accademia delle Scienze fisiche e matematiche di Napoli 9 (11): 1-42.

Cottle N. 2007 *Brachythemis leucosticta* (Burmeister, 1839) (Anisoptera: Libellulidae): a new dragonfly species for Cyprus and *Trithemis arteriosa* (Burmeister, 1839) (Anisoptera: Libellulidae): a rarely recorded dragonfly species in Cyprus. – The Bulletin of the Amateur Entomologists' Society 66: 59-63.

Cotton D.C.F. 1982 *Coenagrion lunulatum* (Charpentier) (Odonata: Coenagrionidae) new to the British Isles. – Entomologist's Gazette 33: 213-214.

Courant S. & B. Meme-Lafond 2012 Écologie et gestion des populations de *Leucorrhinia albifrons* (Burmeister, 1839) et *L. caudalis* (Charpentier, 1840) (Odonata, Anisoptera: Libellulidae) sur un étang du Saumurois (département du Maine-et-Loire). – Martinia 27: 81-94.

Cowley J. 1940 A list of the Odonata of the islands of the western [sic!] Mediterranean area. – Proceedings of the Royal Entomological Society of London (B) 9: 172-178.

Crucitti P., P.A. Galletti & M. Pavesi 1981 Un interessante reperto Sardo: *Brachythemis leucosticta* (Burmeister), genere nuovo per la fauna Italiana (Anisoptera: Libellulidae). – Notulae odonatologicae 1 (7): 115-117.

Daguet C., G. French & P. Taylor 2008 The Odonata Red Data List for Great Britain. – Joint Nature Conservation Committee Species Status Assessment No. 11. JNCC, Peterborough.

Damm S., K.-D.B. Dijkstra & H. Hadrys 2010 Red drifters and dark residents: the phylogeny and ecology of a Plio-Pleistocene dragonfly radiation reflects Africa's changing environment (Odonata, Libellulidae, *Trithemis*). – Molecular Phylogenetics & Evolution 54: 870-882.

Dannelid E, G. Sahlén & G. Liljeberg 2008 Trollsländor i Sverige - en fälthandbok. – Länsstyrelsen i Södermanlands län.

Dapkus D. 2010 Vadovas Lietuvos žirgelių (Insecta, Odonata) rūšims pažinti. – VPU, Vilnius.

David S. 1990 Vážky (Odonata) Vozokanských ramen Hronu s poznámkami k výskytu *Crocothemis erythraea* (Brullé, 1832) [Dragonflies (Odonata) of the Vozokanské ramena - oxbow-lakes Hron river with comments on the occurrence *Crocothemis erythraea* (Brullé, 1832)]. - Entomologické Problémy, Bratislava 20: 49-66.

David S. 2000a Bibliografie vážek (Insecta: Odonata) Slovenska - III (1993-2000). – Sborník referátů III. celostátního semináře odonatologů v CHKO Třeboňsko, 2000, ČSOP Vlašim: 175-183.

David S. 2000b New records of dragonflies (Insecta: Odonata) from Slovakia. – Biologia, Bratislava 55 (5): 1-444.

David S. 2002 Bioindikační využití vážek (Insecta: Odonata) na příkladě potamalu řeky Ipeľ. – Dizertačná práca, ÚKE SAV Nitra.

David S. 2005 Výsledky výzkumu vážek (Odonata) ve Slovenské republice. – Ochrana prírody, Banská Bystrica 24: 168-187.

David S. 2006 Hypsometrická distribuce vážek (Odonata) na Slovensku. In: P. Kočárek, V. Plášek & K. Malachovská (eds), Environmental Changes and Biological Assessment III. – Spisy prací Přírodovědecké fakulty Ostravské univerzity, Ostravská univerzita 163/2006: 174-182.

De Knijf G. 2015 *Pantala flavescens* – a new species for the fauna of Bulgaria (Odonata: Libellulidae). – Notulae odonatologicae 8 (6): 191-196.

De Knijf G. & A. Anselin 1996 Een gedocumenteerde Rode lijst van de libellen van Vlaanderen. – Mededelingen van het Instituut voor Natuurbehoud 1996 (4), Brussel.

De Knijf G. & H. Demolder 2010 Odonata records from Alentejo and Algarve, southern Portugal. – Libellula 29: 61-90.

De Knijf G. & H. Demolder 2013 Early spring observations of Odonata from Cyprus. – Libellula 32: 59-74.

De Knijf G. & H. Demolder 2015 Some dragonfly records from Albania, with *Somatochlora metallica* and *Cordulegaster heros* new for the country. – Libellula 34: 181-185.

De Knijf G. & T. Termaat 2010 De zuidelijke heidelibel (*Sympetrum meridionale*) in België en Nederland. Herkenning, verspreiding en status in Noordwest Europa. – Brachytron 13: 4-17.

De Knijf G., A. Anselin, P. Goffart & M. Tailly (eds) 2006 De libellen (Odonata) van België: verspreiding - evolutie - habitats [Dragonflies (Odonata) of Belgium: distribution - evolution - habitats]. – Libellenwerkgroep Gomphus i.s.m. Instituut voor Natuur- en Bosonderzoek, Brussel.

De Knijf G., U. Flenker, C. Vanappelghem, C.O. Manci, V.J. Kalkman & H. Demolder 2011 The status of two boreo-alpine species, *Somatochlora alpestris* and *S. arctica*, in Romania and their vulnerability to the impact of climate change (Odonata: Corduliidae). – International Journal of Odonatology 14: 111-126.

De Knijf G., C. Vanappelghem & H. Demolder 2013 Odonata from Montenegro, with notes on taxonomy regional diversity and conservation. – Odonatologica 42: 1-29.

De Knijf G., T. Adriaens, R. Vermylen & P. Van der Schoot 2014 Ontdekking van een populatie Rivierrombout (*Gomphus flavipes*) op het Albertkanaal (België), een van de drukst bevaren kanalen van Europa, en een overzicht van de status in West- en Midden-Europa. – Brachytron 16: 3-17.

De Knijf G., D.J. Sparrow, A. Demetriou, R. Kent, H. Kent, K. Siedle & L. Crossley (submitted) Phylogeny and ecology of a threatened damselfly *Ischnura intermedia* (Insecta: Odonata), a new species for Europe, and comments on the species of the genus *Ischnura* in Cyprus.

De Marmels J. 1984 The genus *Nehalennia* Selys, its species and their phylogenetic relationships (Zygoptera: Coenagrionidae). – Odonatologica 13: 501-527.

De Marmels J. 2002 A study of *Chromagrion* Needham, 1903, *Hesperagrion* Calvert, 1902, and *Zoniagrion* Kennedy, 1917: three monotypic North American damselfly genera with uncertain generic relationships (Zygoptera: Coenagrionidae). – Odonatologica 31: 139-150.

Degabriele G. 1992 Aspects in the ecology of Maltese Odonata. – Unpublished dissertation, University of Malta.

Degabriele G. 2013 An overview of the dragonflies and damselflies of the Maltese Islands (Central Mediterranean) (Odonata). – Bulletin of the Entomological Society of Malta 6: 5-127.

Dehondt F., F. Mora & Y. Ferrez 2010 Redécouverte en France de *Nehalennia speciosa* (Charpentier, 1840) (Odonata, Zygoptera: Coenagrionidae). – Martinia 26: 3-8.

Deliry C. 2008 Atlas illustré des libellules de la région Rhône-Alpes. – Biotope, Mèze.

Dell'Anna L. 1996 Approccio multidisciplinare allo studio dell'isolamento riproduttivo tra *Chalcolestes viridis* e *Chalcolestes parvidens* (Insecta: Odonata). – Tesi di dottorato, Dipartimento di Biologia Animale e dell'Uomo, Università "La Sapienza", Roma.

Delpon G., A. Costes, D. Alquier, E. Haber, P. Polisset & L. Pelozuelo 2014 Nouvelles observations de *Macromia splendens* en région Midi-Pyrénées (Odonata : Macromiidae). – Martinia 30 (2) : 47-58.

Deubelius K. & R. Jödicke 2010 *Leucorrhinia caudalis* in Nordwestdeutschland (Odonata: Libellulidae). – Libellula 29: 1-12.

Dévai G.Y., M. Miskolczi, G. Pálosi, I. Dévai & J. Harangi 1994 A magyarországi zitakötő-imágók (Insecta: Odonata) 1982-ig közölt előfordulási adatainak bemutatása UTM hálótérképeken. [A UTM grid map survey of the occurrence data of Hungarian dragonfly adults (Insecta: Odonata) published by the year 1982.]. – Studia odonatologica hungarica 2: 1-100.

Dewick S & R. Gerussi 2000 Small Red-eyed Damselfly *Erythromma viridulum* (Charpentier) found breeding in Essex - the first British records. – Atropos 9: 3-4.

Dijkstra K.-D.B. 2003 Fooled by the double: *Brachythemis liberiensis* is *Parazyxomma flavicans*, with a note on the Zyxommatini (Odonata: Libellulidae). – International Journal of Odonatology 6: 17-21.

Dijkstra K.-D.B. & J.-P. Boudot 2010 First update of the Atlas of the Odonata of the Mediterranean and North Africa: *Orthetrum machadoi* new to the Palaeartic and *Agriocnemis sania* new to the Egyptian Nile Valley. – Libellula 29: 107-125.

Dijkstra K.-D.B. & V.J. Kalkman 2001 Early spring records of Odonata from southern Turkey, with special reference to the sympatric occurrence of *Crocothemis erythraea* (Brullé) and *C. servilia* (Drury) (Anisoptera: Odonata). – Notulae odonatologicae 5 (7): 85-88.

Dijkstra K.-D.B. & V.J. Kalkman 2012 Phylogeny, classification and taxonomy of European dragonflies and damselflies (Odonata): a review. – Organisms Diversity & Evolution 12: 209-227.

Dijkstra K.-D.B. & B. Koese 2001 Dragonflies of Pripyat National Park, Belarus (Odonata). – Opuscula zoologica fluminensia 192: 1-20.

Dijkstra K.-D.B. & R. Lewington 2006 Field guide to the Dragonflies of Britain and Europe. – British Wildlife Publishing, Gillingham.

Dijkstra K.-D.B. & N. Matushkina 2009 Kindred spirits: "*Brachythemis leucosticta*", Africa's most familiar dragonfly, consists of two species (Odonata: Libellulidae). – International Journal of Odonatology 12: 237-256.

Dijkstra K.-D.B., G. Bechly, S.M. Bybee, R.A. Dow, H.J. Dumont, G. Fleck, R.W. Garrison, M. Hämäläinen, V.J. Kalkman, H. Karube, M.L. May, A.G. Orr, D. Paulson, A.C. Rehn, G. Theischinger, J.W.H. Trueman, J. van Tol, N. von Ellenrieder & J. Ware 2013a The classification and diversity of dragonflies and damselflies (Odonata). In: Z.-Q. Zhang (ed.), Animal biodiversity: An outline of higher-level classification and survey of taxonomic richness. – Zootaxa 3703: 36-45.

Dijkstra K.-D.B., V.J. Kalkman, R.A. Dow, F.R. Stokvis & J. van Tol 2013b Redefining the damselfly families: the first comprehensive molecular phylogeny of Zygoptera (Odonata). – Systematic Entomology 39: 68-96.

Do M.C. & T.H. Dang 2007 Checklist of dragonfly from Vietnam. – Vietnam National University Publisher, Hanoi.

Dolmen D. 1995 Habitatvalg og forandringer av øyen-stikkerfaunaen i et sørlandsområde, som følge av sur nedbør, landbruk og kalking. – Universitetet i Trondheim, Vitenskapsmuseet Rapport Zoologisk Serie 1995-2.

Dolmen D. 1996 Odonata. In: K. Aagaard & D. Dolmen (eds), Limnofauna norvegica. – Tapir, Trondheim: 139- 145.

Dolný A., M. Waldhauser, O. Holuša, D. Bárta & L. Hanel 2007 Vážky České republiky. Ekologie, ochrana a rozšíření. – Český svaz ochránců přírody, Vlašim.

Dommanget J.-L. 1987 Étude faunistique et bibliographique des Odonates de France. – Collection Inventaires de Faune et de Flore, fascicule 36. Secrétariat Faune/Flore, Muséum national d'histoire naturelle Paris.

Dommanget J.-L. 1994 Atlas préliminaire des Odonates de France. État d'avancement au 31/12/93. – Coll. Patrimoines naturels Vol 16 Paris SFF/MNHN SFO et Ministère de l'Environnement.

Doucet P.G. & P. Jacquot 2012 Éléments sur l'émergence et les exuvies de *Nehalennia speciosa* (Charpentier, 1840) en France (Odonata: Zygoptera: Coenagrionidae). – Martinia 28: 69-88.

Duborget R. 2013 Observation probable de *Brachythemis impartita* en Haute-Corse (Odonata: Libellulidae). – Martinia 29: 103-104.

Dumont H.J. 1971 Need for protection of some European dragonflies. – Biological Conservation 3: 223-228.

Dumont H.J. 1972 Contribution à la connaissance des Odonates du Maroc. – Mémoires de la Société des Sciences naturelles et physiques du Maroc 52: 149-179.

Dumont H.J. 1974 *Ischnura intermedia* spec. nov. from Turkey, and its relations to *I. forcipata* Morton, 1907 and *I. pumilio* (Charpentier, 1825). – Odonatologica 3: 153-165.

Dumont H.J. 1977a A review of the dragonfly fauna of Turkey and adjacent Mediterranean islands (Insecta: Odonata). – Bulletin et Annales de la Société royale belge d'Entomologie 113: 119-171.

Dumont H.J. 1977b Sur une collection d'odonates de Yougoslavie, avec notes sur la faune des territoires adjacents de Roumanie et de Bulgarie. – Bulletin et Annales de la Société royale belge d'Entomologie 113: 187-209.

Dumont H.J. 1977c On migration of *Hemianax ephippiger* (Burmeister) and *Tramea basilaris* (P. de Beauvois) in West and North-West Africa in the winter 1975/76 (Anisoptera: Aeshnidae, Libellulidae). – Odonatologica 6: 13-17.

Dumont H.J. 1991 Fauna Palaestina, Insecta. V- Odonata of the Levant. – The Israel Academy of Sciences and Humanities, Jerusalem.

Dumont H.J. 1996 Dragonflies of Lake Glubokoe near Moscow, Russia. – Notulae odonatologicae 4 (7): 118-119.

Dumont H.J. 2003 Odonata from the Republic of Mongolia and from the Autonomous Region of Inner Mongolia. – International Journal of Odonatology 6: 127-146.

Dumont H.J. 2004 Dragonflies of Azerbaijan. – Zoology of the Middle East 31: 87-92.

Dumont H.J. 2007 Odonata from the Mouydir Plateau (North Central Sahara, Algeria). – Bulletin de la Société royale belge d'Entomologie 143: 164-168.

Dumont H.J. 2013 Phylogeny of the genus *Ischnura*, with emphasis on the Old World taxa (Zygoptera: Coenagrionidae). – Odonatologica 42: 301-308.

Dumont H.J. & S.N. Borisov 1994 Status and range of the species-pair *Ischnura forcipata* Morton, 1907 and *Ischnura intermedia* Dumont, 1974 (Insecta: Odonata: Coenagrionidae). – Biologisch Jaarboek Dodonaea 62: 157-163.

Dumont H.J. & K. Desmet 1990 Transahara and trans-Mediterranean migratory activity of *Hemianax ephippiger* (Burmeister) in 1988 and 1989 (Anisoptera: Aeshnidae). – Odonatologica 19: 181-185.

Dumont H.J. & H. Heidari 1996 On a collection of spring Odonata from Iran, with the description of *Coenagrion australocaspicum* n. sp. – Bulletin et Annales de la Société royale belge d'Entomologie 132: 63-78.

Dumont H.J. & B.O.N. Hinnekint 1973 Mass migration in dragonflies, especially in *Libellula quadrimaculata* L.: a review, a new ecological approach and a new hypothesis. – Odonatologica 2: 1-20.

Dumont H.J. & D. Verschuren 2005 Odonata from the Ennedi and Ounianga regions of northern Chad, with a note of the status of *Orthetrum kollmannspergeri* Buchholz, and a checklist of the species currently known from the Republic of Chad. – Odonatologica 34: 291-297.

Dumont H.J., A. Demirsoy & J. Mertens 1988 Odonata from south-east Anatolia (Turkey) collected in spring 1988. – Notulae odonatologicae 3 (2): 22-26.

Dumont H.J., J. Mertens & A. Miho 1993 A contribution to the knowledge of the Odonata of Albania. – Opuscula zoologica fluminensia 113: 1-10.

Dumont H.J., W. Schneider, D. Verschuren & M. Pavesi 1995 *Coenagrion lindenii zernyi* (Schmidt), an East Mediterranean taxon threatened with extinction by introgression from the west (Zygoptera: Coenagrionidae). – Odonatologica 24: 451-459.

Dumont H.J., A.Y. Haritonov, O.E. Kosterin, E.I. Malikova & O. Popova 2005a A review of the Odonata of Kamchatka Peninsula, Russia. – Odonatologica 34: 131-153.

Dumont H.J., J.R. Vanfleteren, J.F. De Jonckheere, & P.H.H. Weekers 2005b Phylogenetic relationships, divergence time estimation, and global biogeographic patterns of Calopterygoid damselflies (Odonata, Zygoptera) inferred from ribosomal DNA sequences. – Systematic Biology 54: 347-362.

Dumont H.J., A. Vierstraete & J.R. Vanfleteren 2007 A revised molecular phylogeny of the Calopteryginae (Zygoptera: Calopterygidae). – Odonatologica 36: 365-372.

Dumont H.J., A. Vierstraete & J.R. Vanfleteren 2010 A molecular phylogeny of the Odonata (Insecta). – Systematic Entomology 35: 6-18.

Dunkle S.W. 1990 Damselflies of Florida, Bermuda, and the Bahamas. – Scientific Publishers, Gainesville, FL and Washington, D.C.

Dupont P. 2010 Plan national d'actions en faveur des Odonates. Office pour les insectes et leur environnement / Société française d'Odonatologie. – Ministère de l'Écologie, de l'Énergie, du Développement durable et de la Mer.

Duquef M. 2012 Reproduction probable d'*Hemianax ephippiger* (Burmeister, 1839) en Guyane (Odonata, Anisoptera: Aeshnidae). – Martinia 28: 126.

Durand E. & J. Rigaux 2015 Further additions to the knowledge of the odonate fauna of Armenia, with first record of *Pantala flavescens* (Odonata: Libellulidae). Notulae odonatologicae 8 (6): 184-190.

Dyatlova E.S. 2006 The Odonata of southwestern Ukraine. – Opuscula zoologica fluminensia 221: 1-15.

Dyatlova E.S. 2010 Dragonflies of Moldova: state of knowledge and personal observations. – International Dragonfly Fund - Report 25: 1-43.

Dyatlova E.S. & V.J. Kalkman 2008 The Odonata of southwestern Ukraine, with emphasis on the species of the EU Habitats Directive. – Libellula 27: 275-290.

Dzięddzielewicz J. 1902 Ważki Galicyi i przyległych krajów polskich (Odonata Haliciae reliquarumque provinciarum Poloniae). – Muzeum im Dzieduszyckich we Lwowie, 5, Lwów.

Ebejer M. J., G. Degabriele & A. Sciberras 2008 An annotated checklist of Odonata of the Maltese Islands, with evidence for a recent influx of species. – Libellula 27: 133-145.

Eltjon H., A. Paparisto, T. Dritan & M. Kastriot 2010 The impact of environmental conditions on the biodiversity of aquatic insects, Odonata, from aquatic ecosystems of Karavasta and Spillea, in Albania. – BALWOIS Conferences publications 25-29 May 2010, Republic of Macedonia, Ohrid.

Engler J.O. 2014 Zoogeographic notes on *Orthetrum trinacria* with special emphasis on its recent discovery on Corsica, France (Odonata, Libellulidae). – Libellula 33: 21-26.

Eremina E.E. 2010 New records of dragonfly species (Insecta, Odonata) for Southern Urals. – Euroasian Entomological Journal 9: 19-21.

Esben-Petersen P. 1910 Guldsmede, Døgnfluer, Slørvinger og Copeognather (Pseudoneuropterer). – Danmarks Fauna 8, København.

Faton J.-M. 2003 Avancement de la prospection dans la Drôme et découverte de trois nouvelles espèces dans le département: *Coenagrion caerulescens* (Fonscolombe, 1838), *Gomphus graslinii* Rambur, 1842 et *Hemianax ephippiger* (Burmeister, 1839). – Martinia 19: 61-64.

Faucheux M.J., F. Meurgey & Y. El Wahbi 2005 Odonates des environs d'Essaouira (Maroc méridional). – Bulletin de la Société des Sciences naturelles de l'ouest de la France, N.S. 27: 122-130.

Fekete G. 1925 Adatok Trencsén - vármegye Neuroptera - és Trichoptera - faunájához. – Folia entomologica hungarica 1: 71-83.

Ferreira S. & F. Weihrauch 2005 Annotated bibliography of odonatological literature from continental Portugal, Madeira and the Azores (Odonata). – Libellula 24: 109-128.

Ferreira S. & F. Weihrauch 2008 Odonata. In: P.A.V. Borges, C. Abreu, A.M.F. Aguiar, P. Carvalho, R. Jardim, I. Melo, P. Oliveira, A.R.M. Serrano & P. Vieira (eds), A list of the terrestrial fungi, flora and fauna of Madeira and Selvagens archipelagos. – Direcção Regional do Ambiente da Madeira and Universidade dos Açores, Funchal and Angra do Heroísmo: 294.

Ferreira S., J.M. Grosso-Silva, M. Lohr, F. Weihrauch & R. Jödicke 2006 A critical checklist of the Odonata of Portugal. – International Journal of Odonatology 9: 133-150.

Ferreira S., J.M. Grosso-Silva & P. Sousa 2009 The Dragonflies of Serra da Estrela Natural Park, Portugal (Insecta, Odonata). – Boletín de la S.E.A. 44: 417-424.

Ferreira S., G. Velo-Antón, C. Brochard, C. Vieira, P.C. Alves, D.J. Thompson, P.C. Watts & J.C. Brito 2014 A Critically Endangered new dragonfly species from Morocco: *Onychogomphus boudoti* sp. nov. (Odonata: Gomphidae). – Zootaxa 3856: 349-365.

Ferreira S., F. Martínez-Freiría, J.-P. Boudot, M. El Haissoufi, N. Bennas, P.C. Alves, P.C. Watts, D.J. Thomp-

son & J.C. Brito 2015 Local extinctions and range contraction of the endangered *Coenagrion mercuriale* in North Africa. – International Journal of Odonatology 18 (2): 137-152.

Ferreras-Romero M. 1989 *Sympetrum decoloratum sinaiticum* Dumont capturado en Andalucia, España (Anisoptera: Libellulidae). – Notulae odonatologicae 3 (3): 44.

Ferreras-Romero M. & V. Puchol Caballero 1984 Los insectos odonatos en Andalucía. Bases para su e studio faunístico. – Servicio de Publicaciones de la Universidad de Córdoba, Córdoba.

Festi A. 2011 *Aeshna subarctica elisabethae*, new to the fauna of Italy (Odonata: Aeshnidae). – Libellula 30: 65-76.

Festi A. 2012 *Leucorrhinia pectoralis* (Charpentier, 1825) (Odonata: Libellulidae) presso il Lago di Monticolo - importante segnalazione per l'Alto Adige e l'Italia. – Gredleriana 12: 201-208.

Filevska A. 1954 Vidovi na Odonati vo Ohrid. – Fragmenta balcanica 1 (9): 79-91.

Finkenzeller M. 2010 First record of *Panatala flavescens* for Croatia (Odonata: Libellulidae). – Libellula 29: 205-208.

Fiorenza T. & I. Pecile 2009 The pygmy damselfly *Nehalennia speciosa* is still part of the odonate fauna of Italy (Insecta, Odonata, Coenagrionidae). – Bollettino del Museo civico di Storia naturale di Venezia 60: 17-27.

Fleck G. 2011 Phylogenetic affinities of Petaluridae and basal Anisoptera families (Insecta: Odonata). – Stuttgarter Beiträge zur Naturkunde A, Neue Serie 4: 83-104.

Fleck G., D. Grand & J.-P. Boudot 2007 Description of the last stadium larva of *Somatochlora borisi*, with comparison to that of *Somatochlora metallica meridionalis*. – International Journal of Odonatology 10: 43-52.

Fleck G., B. Ullrich, M. Brenk, C. Wallnisch, M. Orland, S. Bleidissel & B. Misof 2008 A phylogeny of anisopterous dragonflies (Insecta, Odonata) using mtRNA genes and mixed nucleotide/doublet models. – Journal of Zoological Systematics and Evolutionary Research 46: 310-322.

Flenner I. & G. Sahlén 2008 Dragonfly community re-organisation in boreal forest lakes: rapid species turnover driven by climate change? – Insect Conservation and Diversity 1: 169-179.

Franković M. 1994 Popis vretenaca Hrvatske. Online (16-i-2009), URL: <www.botanic.hr/cisb/doc/fauna/odonata/odopornovi.htm.>.

Fraser F.C. 1929 A revision of the Fissilabioidea, part 1: Cordulegastridae. – Memoirs of the Indian Museum 9: 69-167.

Fraser F.C. 1933 The fauna of British India including Ceylon and Burma. Odonata. Volume 1. – Taylor and Francis, London.

Fraser F.C. 1934 The fauna of British India including Ceylon and Burma. Odonata, volume 2. – Taylor & Francis, London.

Fraser F.C. 1936 The fauna of British India including Ceylon and Burma. Odonata, volume 3. – Taylor & Francis, London.

Fraser F.C. 1943 New Oriental Odonata larvae. – Proceedings of the Royal Entomological Society of London (B) 12: 81-93.

Fraser F.C. 1956 Faune de Madagascar. I. Insectes. Odonates Anisoptères. – Publications de l'Institut de Recherche scientifique Tananarive-Tzimbazaza.

Froufe E., S. Ferreira, J.-P. Boudot, P.C. Alves & D.J. Harris 2014 Molecular phylogeny of the Western Palaearctic *Cordulegaster* taxa (Odonata: Anisoptera: Cordulegastridae). – Biological Journal of the Linnean Society 111: 49-57.

Fudakowski J. 1930 Fauna ważek (Odonata) Tatr polskich. – Sprawozdanie Komisji Fizjograficznej, Kraków 64: 87-174.

Fuss C. 1853 Notizen und Beiträge zur Insectenfauna Siebenbürgens. – Verhandlungen und Mittheilungen des siebenbürgischen Vereins für Naturwissenschaften zu Hermannstadt 4: 207-210.

Fuss C. 1855 Beitrag zur Insectenfauna Siebenbürgens. – Verhandlungen und Mittheilungen des siebenbürgischen Vereins für Naturwissenschaften zu Hermannstadt 6: 23-24.

Futahashi R. 2011 A revisional study of Japanese dragonflies based on DNA analysis. – Tombo 53: 67-74.

Gadeau de Kerville H. 1908 Odonates. In: H. Gadeau de Kerville (ed.), Voyage zoologigue en Khroumirie (Tunisie) mai-juin 1906. – Baillère, Paris: 59-61.

Gambles R.M. 1960 Seasonal distribution and longevity in Nigerian dragonflies. – Journal of the West African Science Association 6: 18-26.

García-Avilés J. 2002 Biodiversidad de los humedales del Parque Regional del Sureste. II. Libélulas. – Centro de Investigaciones Ambientales de la Comunidad de Madrid Fernando González Bernáldez. Consejería de Medio Ambiente, Serie Documentos 36.

Gärdenfors U. (ed.) 2010 Rödlistade arter i Sverige 2010 - The 2010 Red List of Swedish Species. – artDatabanken, SLU, Uppsala.

Gardner A.E. 1960 Odonata from the Azores and Madeira. – Boletim do Museu Municipal do Funchal 13: 119-122.

Gardner A.E. 1963 Report on the insects collected by E. W. Classey and A. E. Gardner expedition to Madeira in December 1957 (with special reference to the life-history of *Sympetrum nigrifemur* (Selys)). Part III. Odonata. – Proceedings of the South London Entomological and Natural History Society 1962: 62-85.

Gashtarov V. & S. Beshkov 2010 *Lindenia tetraphylla* (Vander Linden, 1825) (Odonata, Gomphidae) a new genus and species for the Bulgarian fauna. – The Entomologist's Record and Journal of Variation 122: 272—274.

Gauci C. 2014 A Review of the Odonata of the Maltese islands. – Journal of the British Dragonfly Society 30: 1-31.

Gauci C. & A. Sciberras 2010 First records of *Orthetrum chrysostigma* (Burmeister, 1839) in the Maltese Islands (Odonata: Libellulidae). – Central Mediterranean Naturalist 5: 78-80.

Gavory L. & J.L. Dommanget 1998 Redécouverte de *Leucorrhinia rubicunda* (L., 1758) en France. – Martinia 14: 47-52.

Geijskes D.C. & J. van Tol 1983 De libellen van Nederland. – KNNV, Hoogwoud.

Gerecke R. 1991 Taxonomische, faunistische und ökologische Untersuchungen an Wassermilben (Acari, Actinedida) aus Sizilien unter Berücksichtigung anderer aquatischer Invertebraten. – Lauterbornia 7: 1-303.

Gerend R. 1989 Nachweis von *Leucorrhinia rubicunda* (Linnaeus, 1758) im Süden Luxemburgs (Odonata: Anisoptera). – Paiperlek 11: 57-61.

Gerend R. & R. Proess 1994 Nachweis neuer und interessanter Libellen aus Luxemburg nebst einer provisorischen Roten Liste der einheimischen Odonaten (Insecta, Odonata). – Bulletin de la Société des Naturalistes luxembourgeois 95: 299-314.

Ghahari H., A. Thipaksorn, H. Naderian, H. Sakenin & A.A. Tajali 2012 A faunistic study on the Odonata (Insecta) from Kurdistan province and vicinity, western Iran. – Linzer Biologische Beiträge 44: 1079-1085.

Girard A.A. 1891 Liste des Odonates du Portugal et note critique sur les *Onychogomphus Genei*, Selys et *Hagenii*, Selys. – Revista de Sciencias Naturaes e Sociaes 2: 26-45.

Gligorović B. & V. Pešić 2007a A contribution to knowledge of the dragonflies (Odonata) from the Skadar lake drainage basin (Montenegro). – Acta entomologica serbica, Beograd 12: 11-16.

Gligorović B. & V. Pešić 2007b A contribution to knownledge of the dragonflies (Odonata) of the river Zeta (Montenegro). – Natura Montenegrina, Podgorica 6: 73-89.

Gligorović B., V. Pešić & A. Zeković 2008 A contribution to the knowledge of dragonflies (Odonata) from the area Gornji Crnci-Piperi (Montenegro). – Acta entomologica serbica, Beograd 13: 1-7.

Gligorović B., V. Pešić & A. Zeković 2009 A contribution to the knowledge of dragonflies (Odonata) from the mountainous area Lukavica (Montenegro). – Natura Montenegrina, Podgorica 8: 31-39.

Gligorović B., V. Pešić & A. Gligorović 2010a A contribution to the knowledge of the dragonflies (Odonata) from the river Morača (Montenegro). – Acta entomologica serbica, Beograd 15: 149-159.

Gligorović B., V. Pešić & A. Zeković 2010b Check list of the Dragonflies of the Skadar Lake Area. – Scripta Scientiarum Naturalium, Podgorica 1: 101-107.

Gligorović B., V. Pešić & A. Zeković 2010c A contribution to the knowledge of dragonflies (Odonata) of the river Brestica. – Natura Montenegrina, Podgorica 9: 151-159.

Gliwa B. 2013 First record of *Orthetrum albistylum* (Odonata: Libellulidae) in Lithuania. – New and Rare for Lithuania Insect Species 25: 5-6.

Gliwa B. & V. Stukonis 2011 *Erythromma viridulum* (Odonata: Coenagrionidae) – a new species to Lithuania. – New and Rare for Lithuania Insect Species 23: 5-7.

Goffart P., G. De Knijf, A. Anselin & M. Tailly 2006 Les Libellules (Odonata) de Belgique : répartition, tendances et habitats. – Publication du Groupe de Travail Libellules Gomphus et du Centre de Recherche de la Nature, des Forêts et du Bois (MRW-DGRNE) Série "Faune-Flore-Habitats" n° 1., Gembloux.

Gonseth Y. & C. Monnerat 2002 Rote Liste der gefährdeten Libellen der Schweiz. – CSCF, Neuchâtel & BUWAL, Bern.

Gorb S.N., R.S. Pavlyuk [Pavljuk] & Z. D. Spuris 2000 Babky (Odonata) Ukrainy: faunistychniy oglyag [Odonata of Ukraine: a faunistic overview]. – Vestnik zoologii, suplement 15: 3-155.

Grand D. 2013 Les libellules du rio Cabriel, provinces d'Albacete, Cuenca et Valencia (Espagne) (Odonata): distribution et observations biologiques. – Martinia 29: 1-8.

Grand D. & J.-P. Boudot 2006 Les Libellules de France, Belgique et Luxembourg. – Éditions Biotope, Collection Parthénope, Mèze.

Grand D. & J.-L. Dommanget 2007 Derniers travaux et synthèse sur les Libellules de Corse. In: M. Levasseur, G. Dommanget & S. Jolivet (éds), Actes des Rencontres odonatologiques Ouesteuropéennes 2005. La Pommeraie, Vallet (Loire-Atlantique), France, 24-27 juin 2005. Société française d'Odonatologie, pp. 35-40.

Grand D., G. David, J. Hahn, J.-L. Hentz, R. Krieg-Jacquier & P. Roncin 2011a *Gomphus flavipes* (Charpentier, 1825) (Anisoptera: Gomphidae) à Lyon (Rhône) et nouvelles localités rhônalpines. – Martinia 27: 27-32.

Grand D., B. Pont, R. Krieg-Jacquier, R. Barlot, B. Feuvrier, N. Bazin, C. Biot, C. Deliry, V. Gaget, J.-L. Michelot & L. Michelot 2011b *Gomphus flavipes* (Charpentier, 1825) redécouvert dans le bassin hydrographique du Rhône (Odonata, Anisoptera: Gomphidae). – Martinia 27: 9-26.

Grebe B., B. Baierl & E. Baierl 2002 Libellen der Flusstäler Nordost-Griechenlands. Erstnachweis von *Somatochlora borisi* für Griechenland (Odonata: Corduliidae). – Libellula Supplement 6: 1-14.

Green J. 1974 Territorial behaviour in some Nigerian dragonflies. – Zoological Journal of the Linnean Society 55: 225-233.

Grove A.T. & O. Racham 2001 The nature of Mediterranean Europe. An ecological history. – Yale University Press, New Haven, London.

Grozeva S. & M. Marinov 2007 Cytogenetic study of *Somatochlora borisi* Marinov, 2001 (Odonata: Corduliidae), and three relative species. – Acta zoologica bulgarica 59: 53-58.

Guan Z., H.J. Dumont, X.Yu, B.-P. Han & A. Vierstraete 2013 *Pyrrhosoma* and its relatives: a phylogenetic study (Odonata: Zygoptera). – International Journal of Odonatology 16: 247-257.

Guemmouh R. 1988 Contribution à l'étude de quatre représentants du genre *Orthetrum* (Odonata: Libellulidae) au Maroc: Ecologie, répartition, géographie et croissance larvaire. – Thèse Doctorat 3ème cycle, Université Mohammed V Agdal, Faculté des Sciences Rabat.

Gurin V.M. 2004 Strekozy. In: G.P. Pashkov (ed.), Krasnaya Kniga Respubliki Belarus', Zhivotnye: redkie i nakhodyashchiesya pod ugrozoi ischeznoveniya vidy dikikh zhivotnykh. – Belaruskaya Entsyklapedya, Minsk: 199-206.

Gyulavári H.A., T. Felföldi, T. Benken, L.J. Szabó, M. Miskolczi, C. Cserháti, V. Horvai, K. Márialigeti & G. Dévai 2011 Morphometrical and molecular studies on the populations of two damselfly taxa, *Chalcolestes viridis* and *C. parvidens* (Odonata, Zygoptera), including intermediate forms. – International Journal of Odonatology 14: 329-339.

Hacet N. 2010 Notes on flight periods and distributions of some dragonflies in Turkey. – Munis Entomology and Zoology 5: 158-162.

Hacet N. & N. Aktaç 1997 Istranca Dağlari Odonata Faunası [Odonata Fauna of Istranca Mountains]. – Turkish Journal of Zoology 21: 275-289.

Hacet N. & N. Aktaç 2004 Considerations on the odonate fauna of Turkish Thrace, with some taxanomic notes. – Odonatologica 33: 237-352.

Hacet N. & N. Aktaç 2006 The Odonata of Gökçeada island, Turkey; a biogeographical assessment. – Entomological News 117: 357-368.

Hacet N. & N. Aktaç 2008 Two new records of Odonata (Gomphidae) for Turkey, *Gomphus flavipes* (Charpentier, 1825) and *Ophiogomphus cecilia* (Geoffroy in Fourcroy, 1785), with distributional notes on *G. flavipes* and *G. ubadschii* Schmidt, 1953. – Entomological News 119: 81-89.

Hacet N. & N. Aktaç 2009 Contribution to the knowledge of Odonata fauna of Southern Marmara Region of Turkey. – Turkiye Entomoloji Dergisi 33: 171-178.

Hacet N. & K.T. Çokkuvvetli 2012 Records of Odonata from rice fields in the Edirne province in Turkish Thrace. – Notulae odonatologicae 7 (10): 89-92.

Hagen H.A. 1840 Synonymia Libellularum Europaearum. – Dissertatio Inauguralis. Regiomontii Prussorum, E.J. Dalkowski.

Hagen H.A. 1846 Die Netzflügler Preußens. – Neue Preußische Provinzial-Blätter, Königsberg 2: 25-31.

Hagen H.A. 1863 Die Odonaten- und Neuropteren-Fauna Syriens und Klein-Asiens. – Wiener Entomologische Monatsschrift 7: 193-199.

Hämäläinen M. 1986 Note on the misidentification of the first Zygoptera material from the Canary Islands. – Notulae odonatologicae 2 (8): 131-132.

Hämäläinen M. 2010 The discovery of Finnish dragonflies: a chronological list. – Crenata 3: 2-7.

Hämäläinen M. & A. Pinratana 1999 Atlas of the Dragonflies of Thailand. – Brothers of St. Gabriel in Thailand.

Hammond C.O. 1977 The Dragonflies of Great Britain and Ireland. – Curwen Press, London.

Hamzaoui D., H. M. Hafiane, M. Mebarki, A. Arab, A. Alfarhan & B. Samraoui 2015 The Gomphidae of Algeria and the Maghreb: status, ecology and conservation (Insecta: Odonata) – International Journal of Odonatology 18: 175-191.

Hanel L., A. Dolný & J. Zelený 2005 Odonata (Vážky). In: J. Farkač, D. Král & M. Škorpík, Červený (eds), Seznam ohrožených druhů České republiky. – Bezobratlí, Agentura ochrany přírody a krajiny ČR, Praha: 125-127.

Hardersen S. & P. Leo 2011 Dragonflies of Iglesiente (SW Sardinia) and additional records of rare or poorly known species from Sardinia (Odonata). In: G. Nardi, D. Whitmore, M. Bardiani, D. Birtele, F. Mason, L. Spada & P. Cerretti (eds), Biodiversity of Marganai and Montimannu (Sardinia). Research in the framework of the ICP Forests network. – Conservazione Habitat Invertebrati 5: 243-253.

Haritonov A.Y. & E.E. Eremina 2010 The dragonflies (Odonata) of South Ural: the value of regional faunistic research. – Euroasian Entomological Journal 9: 263-273.

Haritonov A.Y. & O.N. Popova 2008 Migrations of dragonflies (Odonata) in the south of the West Siberian plain. – Entomological Review 91: 411-419.

Harris M. 1782 An exposition of English insects including the several classes of Neuroptera, Hymenoptera, & Diptera, or bees, flies, & libellulae. – White & Robson, London.

Hartung M. 1985 *Orthetrum trinacria* (Sel.) as a part of the dragonfly fauna in southern Spain (Anisoptera: Libellulidae). – Notulae odonatologicae 2 (6): 101-102.

Heath J. (ed.) 1978 Provisional Atlas of the Insects of the British Isles Part 7, Odonata. – Institute of Terrestrial Ecology, Huntingdon.

Hecker F. 1999 Beobachtungen zur Lebensweise von *Caliaeschna microstigma* (Schneider) an einem Bach in Nordost-Griechenland (Anisoptera: Aeshnidae). – Libellula Supplement 2: 17-31.

Heidari H. & H.J. Dumont 2002 An annotated check-list of the Odonata of Iran. – Zoology in the Middle East 26: 133-150.

Heidemann H. & R. Seidenbusch 1993 Die Libellenlarven Deutschlands und Frankreichs: Handbuch für Exuviensammler. – Keltern, Erna Bauer.

Herrera Grao T., O. Gavira Romero & F. Blanco Garrido 2010 Habitantes del Agua. Odonatos. Agencia Andaluza del Agua. – Consejeria de Medio Ambiante. Junta de Andalucia.

Herrera-Grao T., N. Bonada, O. Gavira & F. Blanco-Garrido 2012 First record of *Trithemis kirbyi* Sélys, 1891 in Catalonia (Odonata, Libellulidae). – Boletín de la Asociación española de Entomología 36: 457-459.

Hickling R., D.B. Roy, J.K. Hill & C.D.Thomas 2005 A northward shift of range margins in British Odonata. – Global Change Biology 11: 502-506.

Hill B., H.-J. Roland, S. Stübing & C. Geske 2011 Atlas der Libellen Hessens. – Hessen-Forst FENA, Gießen.

Hisinger E. 1861 Bidrag till kännedomen om Finlands libellulider. – Notiser ur Sällskapet pro Fauna et Flora Fennica förhandlingar 6: 109-121.

Hobson K.A., R.C. Anderson, D.X. Soto & L.I. Wassenaar 2012 Isotopic evidence that dragonflies (*Pantala flavescens*) migrating through the Maldives come from the northern Indian subcontinent. – PLoS ONE 7 (12): e52594. doi:10.1371/journal.pone.0052594.

Hoffmann J. 1960 Les Odonates du Grand-Duché de Luxembourg, Arthropoda, Hexapoda, Odonata. – Archives / Institut Grand-Ducal de Luxembourg, Section des Sciences naturelles, physiques et mathématiques 27: 219-238.

Holmen M. 1996 Annotations to Danish Odonata and odonatology. – Selysia 24: 3-4.

Holmen M. & H. Pedersen 1998 Guldsmede. In: M. Stoltze & S. Pihl (eds), Rødliste 1997 over planter og dyr i Danmark. – Miljø- og Energiministeriet, København.

Holuša O. 2007 Vážka *Somatochlora meridionalis* (Odonata: Corduliidae) zjištěna na území České republiky. In: J. Bryja, J. Zukal & Z. Řehák (eds) Zoologické dny Brno 2007 - Sborník abstraktů z konference 8.-9. února 2007. – Ústav biologie obratlovců AV ČR, Brno: 65-66.

Holuša O. 2008 *Trithemis kirbyi* auf Sardinien: Erstnachweis für Europa (Odonata: Libellulidae). – Libellula 27: 111-115.

Holuša O. 2011 Observation of swarming behavior in *Selysiothemis nigra* on the island of Évia, Greece (Odonata: Libellulidae). – Libellula 30: 233-236.

Holuša O. 2013 Taxonomy, ecology and zoogeography of dragonflies of genus *Cordulegaster* (Odonata: Cordulegastridae) in the Central Europe. – Faculty of Natural Sciences, Comenius University, Bratislava.

Holuša O. & K. Holušova 2012 The first finding of larvae of *Cordulegaster insignis* (Schneider, 1845) (Odonata: Cordulegastridae) in the Macedonia. – Acta Musei Beskidensis 4 (1): 51-54.

Holuša O. & V. Křivan 2012 A population of *Cordulegaster insignis* (Schneider, 1845) in Macedonia (Odonata: Cordulegastridae). – Acta Musei Moraviae, Scientiae biologicae (Brno) 97 (2): 1-5.

Holuša O. & M. Kúdela 2010 New records of occurrence of *Cordulegaster heros* Theischinger, 1979 in Slovakia. – Acta Musei Beskidensis 2: 75-87.

Holuša O., V. Dalecký & K. Holušová 2011 First record of larvae of *Cordulegaster heros* (Odonata: Cordulegastridae) in the Czech Republic. – Acta Musei Beskidensis 3: 65-69.

Holzinger W.E. & B. Komposch 2012 Die Libellen Kärntens. – Sonderreihe Natur Kärnten, Band 6. Naturwissenschaftlicher Verein für Kärnten, Klagenfurt.

Hope P. 2007 The Dragonflies of Eastern Muğla province South-west Turkey. – Land of light publishing, Fethiye.

Hostettler K. 2001 Libellen (Odonata) in Vorarlberg (Österreich). – Vorarlberger Naturschau 9: 9-134.

Hovmöller R. & F. Johansson 2004 A phylogenetic perspective on larval spine evolution in *Leucorrhinia* (Odonata: Libellulidae) based on ITS1, 5.8 S and ITS2 rDNA sequences. – Molecular Phylogenetics & Evolution 30: 653-662.

Hrabě S. 1942 O bentické zvířeně jezer ve Vysokých Tatrách. – Physiographica Slovaca, Acta Eruditae Societatis Slovacae 8: 124-177.

Huber A. 2000 On the Odonate fauna of the Szamos (Somes) River and its surroundings in Romania. – Notulae odonatologicae 5 (6): 80-82.

Huber A. 2004 Contribution to the knowledge of the fauna of Transsylvania Sighisoara, Romania. – Notulae odonatologicae 6 (3): 25-27.

Hunger H., F.-J. Schiel & B. Kunz 2006 Verbreitung und Phänologie der Libellen Baden-Württembergs (Odonata). – Libellula Supplement 7: 15-188.

Iorio E. 2012 Nouvelles données sur la répartition et l'écologie de *Sympetrum depressiusculum* (Selys, 1841) dans les Bouches-du-Rhône (Odonata, Anisoptera: Libellulidae). – Martinia 28: 29-42.

IUCN 2003 Guidelines for Application of IUCN Red List Criteria at Regional Levels: Version 3.0. – IUCN Species Survival Commission, IUCN, Gland, Switzerland and Cambridge, United Kingdom.

Ivinskis P. & J. Rimšaitė 2009 Odonata of Purvinas wetland in eastern Lithuania. – Acta Biologica Universitatis Daugavpiliensis 9 (1): 39-42.

Ivinskis P. & J. Rimšaitė 2010 Data on some spreading insects and spiders species in Lithuania. In: A. Aleksejeva, D. Oļehnovičs, L. Paņina, I. Zuģiska (eds), Abstracts of the 52nd International Scientific Conference of Daugavpils University. – Difra, Daugavpils.

Jacquemin G. & J.-P. Boudot 1990 A propos de *Coenagrion mercuriale* (Charpentier, 1840) au Maroc (Zygoptera: Coenagrionidae). – Notulae odonatologicae 3 (6): 91-94.

Jacquemin G. & J.-P. Boudot 1999 Les Libellules (Odonates) du Maroc. – Société française d'Odonatologie, Bois d'Arcy, France.

Jaeschke A., T. Bittner, B. Reineking & C. Beierkuhnlein 2012 Can they keep up with climate change? - Integrating specific dispersal abilities of protected Odonata in species distribution modeling. – Insect Conservation and Diversity 6: 93-103.

Jahn P. 1996 Libellen im Einzugsgebiet des Guadiana in Südostportugal. – Advances in Odonatology, Supplement 1: 65-76.

Janský V. & S. David 2008 Výskyt vážky *Cordulegaster heros* ssp. *heros* (Odonata: Cordulegastridae) na Slovensku [Occurence of the dragonfly *Cordulegaster heros* ssp. *heros* (Odonata: Cordulegastridae) in Slovakia]. – Acta rerum naturalium Musei nationalis Slovaci, Bratislava 54: 61- 68.

Jeziorski P. 1998 Check list of dragonflies (Odonata) of the Czech Republic. – Časopis Slezského Muzea Opava (A) 47: 173-177.

Jeziorski P. & O. Holuša 2012 An updated checklist of the dragonflies (Odonata) of the Czech Republic. – Acta Musei Beskidensis 4: 143-149.

Jödicke R. 1996a Faunistic data of dragonflies from Portugal. – Advances in Odonatology, Supplement 1: 149-153.

Jödicke R. (ed.) 1996b Studies on Iberian Dragonflies. – Advances in Odonatology, Supplement 1.

Jödicke R. 1997a Die Binsenjungfern und Winterlibellen Europas: Lestidae. – Magdeburg: Westarp Wissenschaften.

Jödicke R. 1997b Die verbreitung von *Sympetrum sinaiticum tarraconense* Jodicke (Odonata, Anisoptera: Libellulidae). – Opuscula zoologica fluminensia 155: 1-7.

Jödicke R. 2005 Bemerkungen zu *Coenagrion intermedium* (Odonata: Coenagrionidae). – Libellula Supplement 6: 15-24.

Jödicke R., B. Thiesmeier & H. Greven 1997 *Orthetrum brunneum* (Fonsc.) from northwestern Xinjang, China (Anisoptera: Libellulidae). – Notulae odonatologicae 4 (10): 162-163.

Jödicke R., J. Arlt, B. Kunz, W. Lopau & R. Seidenbusch 2000 The Odonata of Tunisia. – International Journal of Odonatology 3: 41-71.

Jödicke R., S.N. Borisov, A.Y. Haritonov & O. Popova 2000 Additions to the knowledge of *Sympetrum sinaiticum* Dumont (Odonata: Libellulidae). – International Journal of Odonatology 3: 131-140.

Johansson C.H. 1859 Odonata sueciæ. Sveriges trollsländor beskrifne. – A. F. Bergh, Västerås.

Johansson F. 2000 The slow-fast life style characteristics in a suite of six species of odonate larvae. – Freshwater Biology 43: 149-159.

Johansson F. & A.N. Nilsson 1991 Freezing tolerance and drought resistance of *Somatochlora alpestris* (Selys) larvae in boreal temporary pools (Anisoptera: Corduliidae). – Odonatologica 20: 243-252.

Jong T. de, P. Verbeek, F. Smolders & P. van Hoof 2001 Beschermingsplan groene glazenmaker 2002-2006. – Rapport Directie Natuurbeheer nr. 2001/015, Expertisecentrum LNV, Wageningen.

Jović M. 2008 Report on Adriatic Montenegro 2007 project. – International Dragonfly Fund - Report 15: 1-25.

Jović M. 2009 Report on Macedonia 2008 project, Odonata. – International Dragonfly Fund - Report 21: 1-23.

Jović M. & L. Andjus 2003 *Epitheca bimaculata* (Charpentier) recorded from Serbia again (Odonata: Corduliidae). – Opuscula zoologica fluminensia 214: 1-7.

Jović M. & B. Mihajlova 2009 Catalogue of the Odonata collection in the Macedonian Museum of Natural History. – Acta entomologica serbica 14: 133-146.

Jović M., L. Anđus, M. Bedjanič & S. Santovac 2008a Review of the Odonata fauna of Montenegro. – Opuscula zoologica fluminensia 224: 1-27.

Jović M., S. Santovac & L. Andjus 2008b *Leucorrhinia caudalis* (Charpentier, 1840), a new or an ex dragonfly species in Serbian fauna? – Bulletin of the Natural History Museum 1: 161-171.

Jović M., L. Andjus & S. Santovac 2009 New data on some rare and poorly known Odonata species in Serbia. – Bulletin of the Natural History Museum in Belgrade 2: 95-108.

Jović M., B. Gligorović & M. Stanković 2010a Review of faunistical data on Odonata in Bosnia and Herzegovina. – Acta entomologica serbica 15 (1): 7-27.

Jović M., M. Stanković & L. Andjus 2010b *Aeshna grandis* (Linnaeus 1758), a new species in Serbian fauna (Odonata: Aeshnidae). – Bulletin of the Natural History Museum 3: 137-140.

Juillerat L. & C. Monnerat 2009 Odonata in southern Morocco, with first records of *Orthetrum ransonnetii* and *Sympetrum sinaiticum* (Odonata: Libellulidae). – Libellula 28: 97-115.

Kalkman V.J. 2000 Records on the dragonfly fauna of northwestern Albania (Odonata). – Libellula 19: 107-111.

Kalkman V.J. 2004 *Lindenia inkiti* (Bartenev, 1929) a synonym of *Lindenia tetraphylla* (Vander Linden, 1825) (Anisoptera: Gomphidae). – Notulae odonatologicae 6 (3): 34.

Kalkman V.J. 2005 On the distribution of the genus *Ceriagrion* Selys in the Balkan, with *C. georgfreyi* Schmidt new for Europe. – Libellula Supplement 6: 25-32.

Kalkman V.J. & W. Lopau 2006 Identification of *Pyrrhosoma elisabethae* with notes on its distribution and habitat (Odonata: Coenagrionidae). – International Journal of Odonatology 9: 175-184.

Kalkman V.J. & G.J. van Pelt 2006 The distribution and flight period of the dragonflies of Turkey. – Brachytron 10: 83-153.

Kalkman V.J., G.A. van Duinen, H. Esselink & J.T. Kuper 2002 New records of Odonata from Estonia, with notes on breeding in the Baltic Sea and on species assemblages of raised bog systems. – Notulae odonatologicae 5 (10): 120-125.

Kalkman V.J., M. Wasscher & G.J. van Pelt 2003 An annotated checklist of the Odonata of Turkey. – Odonatologica 32: 215-236.

Kalkman V.J., A. Kop, M. Wasscher & G.J. van Pelt 2004 The dragonflies of the surroundings of lake Köyceğiz and the River Eşen, Muğla province, SW Turkey. – Libellula Supplement 5: 39-63.

Kalkman V.J., J.-P. Boudot, R. Bernard, K.-J. Conze, G. De Knijf, E.S. Dyatlova, S. Ferreira, M. Jović, J. Ott, E. Riservato & G. Sahlén 2010 European Red List of Dragonflies. – Office for Official Publications of the European Union, Luxembourg.

Kalkman V.J., R.M.J.C. Kleukers & J. Tiago Tavares 2012 First well documented records of *Orthetrum trinacria* for Greece and Turkey (Odonata: Libellulidae). – Libellula 31: 89-96.

Kalniņš M. 2002 Banded Darter *Sympetrum pedemontanum* (Allioni, 1766) (Odonata, Libellulidae), a new dragonfly species in the fauna of Latvia. – Latvijas Entomologs 39: 50-51.

Kalniņš M. 2007 Brown Orthetrum *Orthetrum brunneum* (Fonscolombe, 1837) (Odonata: Libellulidae), a new dragonfly species in Latvia. – Acta Biologica Universitatis Daugavpiliensis 7 (1/2): 109-111.

Kalniņš M. 2009 Lesser Emperor *Anax parthenope* (Selys, 1839) (Odonata: Aeshnidae), a new dragonfly species in Latvia. – Latvijas Entomologs 47: 16-20.

Kalniņš M. 2012a Dragonflies (Odonata) in Latvia: history of research, bibliography and distribution from 18th century until 2010. – Latvijas Entomologs 51: 91-149.

Kalniņš M. 2012b The dragonflies (Odonata) species composition changes, spatial distribution and their determining factors in Latvia. Summary of the Doctoral Thesis. – Faculty of Biology, University of Latvia, Riga.

Kalniņš M. 2012c The ecology and conservation of the Bog Hawker *Aeshna subarctica* Walker, 1908 (Odonata: Aeshnidae) in Latvia. – Latvijas Entomologs 51: 40-57.

Kalniņš M., R. Bernard & I. Miķelsone 2011 Protected aquatic insects of Latvia: *Nehalennia speciosa* (Charpentier, 1840) (Odonata: Coenagrionidae). – Latvijas Entomologs 50: 41-54.

Karaman B. 1969 Contribution à la connaissance des Odonates en Macedoine. – Fragmenta Balcanica anica 1: 79-89.

Karaman B. 1979a Contribution à la connaissance de l'écologie des larves dans l'écosystème du Lac de Doiran. – Annales Fakultet Biologija, Skopje 32: 191-199.

Karaman B. 1979b Ekološko faunistička istraživanja faune Odonata SR Makedonije. – PhD Thesis, University in Zagreb, Faculty of science and mathematics.

Karaman B. 1981 Contribution à la connaissance de la faune des Odonates du Lac de Doiran. – Annales Fakultet Biologija, Skopje 34: 215-222.

Karaman B. 1984-85 Les odonates du lac de Prespa (Macedonie, Jugoslavie) I partie: La composition qualitative et l'analyse zoogeographique de la faune. – Annales Fakultet Biologija, Skopje 37-38: 97-110.

Karaman B. 1992 Fauna na Odonata na Kruševo (Makedonija). – Annales Fakultet Biologija, Skopje 45: 43-50.

Karjalainen S. 2007 Sudenkorentojen (Odonata) uudet maakuntahavainnot 2002-2007 [New provincial records of Finnish dragonflies (Odonata) in 2002-2007]. – Sahlbergia 13: 13-25.

Karjalainen S. 2010 Suomen sudenkorennot [The Dragonflies of Finland]. – Tammi, Helsinki.

Kauri H. 1949 Die Odonaten-Fauna von Estland. In: Apophoreta Tartuensia. – Societas Litterarum Estonica in Svecia, Stockholm: 408-420.

Kawall J.H. 1864 Die Orthopteren und Neuropteren Kurland's. – Correspondenzblatt des Naturforschenden Vereins zu Riga 14: 155-168.

Kazancı N. 2008 Contribution to the knowledge of Odonata Fauna Turkey: Central Anatolia. – Review of Hydrobiology 2: 119-128.

Kazancı N. 2010 Contribution to the knowledge of Odonata (Insecta) Fauna of Turkey: Eastern and Southeastern Anatolia. – Review of Hydrobiology 3: 1-11.

Kazancı N. & S. Girgin 2008 Ephemeroptera, Odonata, Plecoptera (Insecta) Fauna of Ankara Stream (Turkey). – Review of Hydrobiology 1: 37-44.

Kemp R.G. 1989 On a small collection of Odonata from Montenegro, Yugoslavia. – Notulae odonatologicae 3 (4): 60.

Kennedy C.H. 1920 Forty-two hitherto unrecognised genera and subgenera of Zygoptera. – Ohio Journal of Science 21: 83-88.

Kéry M., J.A. Royle, H. Schmid, M. Schaub, B. Volet, G. Häfliger & N. Zbinden 2010 Site-occupancy distribution modelling to correct population-trend estimates derived from opportunistic observations. – Conservation Biology 24: 1388-1397.

Ketelaar R. & C. Plate 2001 Manual Dutch Dragonfly Monitoring Scheme. – Report VS2001.028. - Dutch Butterfly Conservation & Centraal Bureau voor de Statistiek, Wageningen & Voorburg.

Ketelaar R., D. Groenendijk & P. Joop 2005 Soortbeschermingsplan Hoogeveenglanslibel. – Directie Kennis, Ministerie van Landbouw, Natuur en Voedselkwaliteit, Wageningen.

Ketelaar R., R. Manger, E.J. Ruiter, H.M.G. Uilhoorn & E.P. de Boer 2007a Analyse van de verspreiding van de Noordse winterjuffer (*Sympecma paedisca*) in Nederland. – Brachytron 11: 5-20.

Ketelaar R. , E.J. Ruiter, H.M.G. Uilhoorn, R. Manger & E.P de Boer 2007b Habitatkeuze van de Noordse winterjuffer (*Sympecma paedisca*) in Nederland. – Brachytron 11: 21-33.

Khaliq A., M. Ayub., M.A. Nafees & F. Maula 1994 A collection of odonata from Gilgit and Baltistan, Kashmir, with three new species for Pakistan. – Notulae odonatologicae 4 (4): 68-69.

Khrokalo L.A. 2005a Annotated bibliography of the odonatological papers of Ukraine. – International Dragonfly Fund - Report 8: 1-51.

Khrokalo L.A. 2005b Babky (Insecta, Odonata) Chervonoi knygy Ukrainy [Dragonflies (Insecta, Odonata) of Ukrainian Red Data book]. – Transactions of conference on rare and endangered insect species and Red Data book of Ukraine: 124-127.

Khrokalo L.A. 2010 Expansion of *Crocothemis erythraea* in Ukraine. – BioRisk 5: 211-223.

Khrokalo L.A. & S. Krylovskaya 2008 Distribution and current status of *Coenagrion armatum* (Charpentier, 1840) in Ukraine. – International Dragonfly Fund - Report 13: 1-16.

Khrokalo L.A. & G. Prokopov 2009 Review of the Odonata of Crimea (Ukraine). – International Dragonfly Fund - Report 20: 1-32.

Khrokalo L.A., V.V. Savchuk & E.S. Dyatlova 2009 New records of rare dragonflies (Insecta, Odonata) in Ukraine. – Vestnik Zoologii 43: 378.

Kiany M. & S. Sadeghi 2012a New record and description of *Ischnura intermedia* Dumont, 1974 (Odonata:

Coenagrionidae) from Iran. – Conference paper at the 17th National & 5th International Iranian Biology Conference, Shahid Bahonar University, Kerman, Iran, September 2012.

Kiany M. & S. Sadeghi 2012b A preliminary study on Odonata fauna of Yazd province. – Conference paper at the 17th National & 5th International Iranian Biology Conference, Shahid Bahonar University, Kerman, Iran, September 2012.

Kiauta B. 1963 Additions to the Cyprus list of Odonata, with some notes on the annotated list given by K.J. Valle. – Commentationes biologicae 26 (8): 1-6.

Kiauta B. 1978 An outline of the history of odonatology in Switzerland, with an annotated bibliography on the swiss odonate fauna. – Odonatologica 7: 191-222.

King J.J.F.X. & J.N. Halbert 1910 A list of the Neuroptera of Ireland. – Proceedings of the Royal Irish Academy B 28: 29-112.

Kipenvarlits A.F. 1939 Vragi lichinok malyariinogo komara, *Anopheles maculipennis* Mgn. – Trudy Akademii Nauk Belorusskoi Sovetskoi Sotsialisticheskoi Respubliki 3: 183-194.

Kipping J. 1998 Ein Beitrag zur Libellenfauna Rumäniens. – Mauritiana (Altenburg) 16: 527-538.

Kipping J. 2006 Globalisierung und Libellen: Verschleppung von exotischen Libellenarten nach Deutschland (Odonata: Coenagrionidae, Libellulidae). – Libellula 25: 109-116.

Kitanova D., V. Slavevska Stamenković, V. Kostov & M. Marinov 2008 Contribution to the knowledge of dragonfly fauna of the Bregalnitsa River, Macedonia (Insecta: Odonata). – Natura Montenegrina 7: 169-180.

Kitanova D., J.-P. Boudot, E. Nielsen, S. Ferreira, K.-J. Conze., M. Post & M. Vilenica 2013 Ergebnisse einer einwöchigen Geländeexkursion zur Kartierung von Libellen in Macedonien und Albanien im Juli 2012. – 32. Jahrestagung der Gesellschaft deutschsprachiger Odonatologen.

Kjærstad G., T. Andersen, H.A. Olsvik & J.E. Britttain 2010 Døgnfluer, øyenstikkere, steinfluer og vårfluer. In: J.A. Kålås, Å. Viken, S. Henriksen & S. Skjelseth (eds), The 2010 Norwegian Red List for Species. – Norwegian Biodiversity Information Centre, Norway.

Klapalek F. 1898 Notes on Neuroptera and Pseudoneuroptera collected in Bosnia and Herzegovina. – Věstnik České Akademie Cisare Františka Josefa pro vědy, slovesnost Umeni 7: 126-134.

Klingenberg K. & A. Martens 1996 Record of an intermediate form between *Orthetrum coerulescens* (Fabricius) and *O. anceps* (Schneider) in southern Spain (Anisoptera: Libellulidae). – Advances in Odonatology, Supplement 1: 117-121.

Knaus P. 1999 Untersuchungen zur Emergenz, zur Mobilität und zum Paarungssystem an einer Metapopulation von *Somatochlora alpestris* (Selys, 1840) in den Zentralalpen (Anisoptera: Corduliidae). – Diplomarbeit, Zoologisches Institut für Wildforschung und Naturschutzökologie, Universität Zürich.

Knaus P. & H. Wildermuth 2002 Site attachment and displacement of adults in two alpine metapopulations of *Somatochlora alpestris* (Odonata: Corduliidae). – International Journal of Odonatology 5: 111-128.

Kohaut R. 1896 A magyarországi szitakötö-félék természetrajza (Libellulidae auct., Odonata Fabr.). – Budapest.

Kohli M.K., T. Schneider, O. Müller & J.L. Ware 2014 Counting the spots: a molecular and morphological phylogeny of the spotted darner *Boyeria* (Odonata: Anisoptera: Aeshnidae) with an emphasis on European taxa. – Systematic Entomology 39: 190-195.

Korbaa M., M. Ferreras-Romero, M. Bejaoui & M. Boumaiza 2014 Two species of Odonata newly recorded from Tunisia. – African Entomology 22: 291-296.

Koren T., D. Trkov, K. Vukotić & M. Črne 2012 New records of the rare dragonfly, Black Pennant *Selysiothemis nigra* (Vander Linden, 1825) (Insecta: Odonata) in Bosnia and Herzegovina. – Natura Sloveniae 14 (2): 65-69.

Korkeamäki E. 2013 Isoukonkorennon (*Aeshna crenata*) elinympäristöt Salpausselällä [Siberian Hawker (*Aeshna crenata*) in the Salpausselkä Ridge area]. – Kymijoen vesi ja ympäristö ry:n tutkimusraportti 217: 1-18.

Korkeamäki E., P. Metsälä & P. Parkko 2012 Isoukonkorennon (*Aeshna crenata*) elinympäristöt Salpausselän harjualueella. – Crenata 5: 29-33.

Kosterin O.E. 1992 New distribution records of *Somatochlora sahlbergi* Trybom (Odonata, Corduliidae). – Acta hydroentomologica Latvica 2: 22-26.

Kosterin O.E. 1999 Dragonflies (Odonata) of the Daurskii State Nature Reserve and its surroundings. In: V.V. Dubatolov et al. (eds), Insects of Dauria and Adjacent Territories 2. – Novosibirsk.

Kosterin O.E. 2004 Odonata of the Daurskiy State Nature Reserve area, Transbaikalia, Russia. – Odonatologica 33: 41-71.

Kosterin O.E. 2005 Western range limits and isolates of eastern odonate species in Siberia and their putative origins. – Odonatologica 34: 219-242.

Kosterin O.E. 2007 The first record of *Anax* on the West Siberian plain: *A. p. parthenope* Selys in Omsk (Anisoptera: Aeshnidae). – Notulae odonatologicae 6 (10): 112-115.

Kosterin O.E. & S.N. Borisov 2010 Dragonflies (Odonata) of the Dzhungarskiy Alatau mountains, South-East Kazakhstan. – Euroasian Entomological Journal 9: 299-302.

Kosterin O.E. & P.G. Gorbunov 2010 Notes on the Odonata of Kazakhstan, including the first record of *Ischnura evansi* Morton (Zygoptera: Coenagrionidae). – Notulae odonatologicae 7 (5): 45-48.

Kosterin O.E. & L.V. Sivtseva 2009 Odonata of Yakutia (Russia) with description of *Calopteryx splendens njuja* ssp. nov. (Zygoptera: Calopterygidae). – Odonatologica 38: 113-132.

Kosterin O.E. & V.V. Zaika 2010 Odonata of Tuva, Russia. – International Journal of Odonatology 13: 277-328.

Kosterin O.E., A.Y. Haritonov & K. Inoue 2001 Dragonflies of the part of Novosibirsk Province east of the Ob' River, Russia. – Sympetrum Hyogo 7-8: 24-49.

Kosterin O.E., N.V. Skalon & T.N. Skalon 2011 Interesting findings of Odonata in the Kuznetskiy Alatau Mts. north-eastern foothills. – Amurian Zoological Journal 3: 124-127.

Kotarac M. 1995 *Somatochlora meridionalis* Nielsen, 1935, a new species for the odonate fauna of France. – Exuviae 2: 15-16.

Kotarac M. 1997 Atlas of the dragonflies (Odonata) of Slovenia with the Red Data List. Atlas faunae et florae Sloveniae 1. – Center za kartografijo favne in flore, Miklavž na Dravskem polju.

Kovács T. & A. Ambrus 2003 Data to the Odonata fauna of the Szigetköz. – Folia historico-naturalia Musei Matraensis 27: 73-80.

Kovács T. & D. Murányi 2013 Larval data of *Caliaeschna microstigma* (Schneider, 1845) from the Balkan Peninsula, with contributions to its biology (Odonata: Aeshnidae). – Folia historico-naturalia Musei Matraensis 37: 21-28.

Kovács T., A. Ambrus, P. Juhász & K. Bánkuti 2004 Lárva és exuvium adatok Magyarország Odonata faunájához. – Folia historico-naturalia Musei Matraensis 28: 97-110.

Kovács T., A. Ambrus, P. Juhász, P. Olajos & G. Szilágyi 2008 Larval and exuvial data to the Odonata fauna of Lithuania. – Folia historico-naturalia Musei Matraensis 32: 149-159.

Kovács T., P. Olajos & G. Szilágyi 2011 Records of Ephemeroptera, Odonata and Plecoptera from Lithuania, with notes on aquatic arthropods. – Folia historico-naturalia Musei Matraensis 35: 21-32.

Krüner U. 1989 Die Schlupfrate der Späten Adonislibelle, *Ceriagrion tenellum* (De Villers, 1789) an einem Heidegewässer im Naturpark Schwalm-Nette (Odonata: Coenagrionidae). – Decheniana 142: 74-82.

Krupp F. & W. Schneider 1988 Die Süßwasserfauna des Vorderen Orients. Anpassungsstrategien und Besiedlungsgeschichte einer zoogeographischen Übergangszone. – Natur und Museum 118: 193-213.

Kúdela M., A. Dolný, D. Bárta, T. Blaškovič & E. Bulánková 2004 First records of *Leucorrhinia caudalis* (Odonata, Libellulidae) in Slovakia. – Biológia, Bratislava 59: 152.

Kuhn K. & K. Burbach 1998 Libellen in Bayern. – Verlag Eugen Ulmer, Stuttgart.

Kuhn J. & D. Gutser 2003 Beobachtung einer *Boyeria irene* bei Mittenwald, Oberbayern (Odonata: Aeshnidae). – Libellula 22: 41-48.

Kulijer D. & J.-P. Boudot 2013 First evidence of the occurrence of *Cordulegaster insignis* Schneider, 1845 in Serbia (Anisoptera: Cordulegastridae). – Odonatologica 42: 55-62.

Kulijer D., D. Vinko, M. Billqvist & J.J. Mekkes 2012 Contribution to the knowledge of the Odonata fauna of Bosnia and Herzegovina - Results of the ECOO 2012. – Natura Sloveniae 14 (2): 23-38.

Kulijer D., G. De Knijf & M. Franković 2013 Review of the Odonata of Bosnia and Herzegovina. – Odonatologica 42: 109-123.

Kumar A. 1972 Studies on the life history of *Trithemis festiva* (Rambur, 1842) (Odonata: Libellulidae). – Odonatologica 1: 103-112.

Kumar A. 1984 On the life history of *Pantala flavescens* (Fabricius) (Libellulidae: Odonata). – Annals of the Entomological Society of America 2: 43-50.

Kumar A. & M. Prasad 1981 Field ecology, zoogeography and taxonomy of the Odonata of Western Himalaya, India. – Records of the Zoological Survey of India, Miscellaneous Publication: 1-118.

Kumerloeve H. 1970 Massenzug von Libellen in montenegrinischen Küstenland im Spätsommer 1969. – Nachrichtenblatt der Bayerischen Entomologen 18: 122-126.

Kunz B. & D. Kunz 2001 *Lindenia tetraphylla*: Wiederfund für Nordafrika (Odonata: Gomphidae). – Libellula 20: 79-85.

Kunz B., S.V. Ober & R. Jödicke 2006 The distribution of *Zygonyx torridus* in the Palaearctic (Odonata: Libellulidae). – Libellula 25: 89-108.

Laister G. 1996 Verbreitungsübersicht und eine vorläufige Rote Liste der Libellen Oberösterreichs. – Naturkundliches Jahrbuch der Stadt Linz 40/41: 307-388.

Laister G. 2005 *Pantala flavescens* auf Rhodos, mit einem Überblick über den Status der Art in Europa (Odonata: Libellulidae). – Libellula Supplement 6: 33-40.

Laister G., G. Lehmann & A. Martens 2014 Exotic Odonata in Europe. – Odonatologica 43: 125-135.

Lambret P. 2010 Dynamique d'une population d'adultes de *Lestes macrostigma* (Eversmann, 1836) et implications pour son suivi: l'exemple de la Camargue (Odonata, Zygoptera: Lestidae). – Martinia 26: 19-28.

Lambret P., A. Besnard & N. Matushkina 2015 Plant preference during oviposition in the endangered dragonfly *Lestes macrostigma* (Odonata: Zygoptera) and consequences for its conservation. – Journal of Insect Conservation 19: 741-752.

Lambret P., D. Cohez & A. Janczak 2009 *Lestes macrostigma* (Eversmann, 1836) en Camargue et en Crau (Département des Bouches-du-Rhône) (Odonata, Zygoptera, Lestidae). – Martinia 25: 51-65. [erratum in Martinia 25: 115].

Landmann A., G. Lehmann, F. Mungenast & H. Sonntag 2005 Die Libellen Tirols. – Berenkamp, Wattens.

le Roi O. 1911 Die Odonaten von Ostpreußen. – Schriften der Physikalisch-ökonomischen Gesellschaft zu Königsberg in Preußen 52: 13-30.

le Roi O. 1914 Zur Odonatenfauna Deutschlands. – Archiv für Naturgeschichte 79 (1913): 102-120.

le Roi O. 1915 Odonaten aus Äquatorial-Afrika. – In: H. Schubotz (ed.) Ergebnisse der Zweiten Deutschen Zentral-Afrika-Expedition 1910/1911. Band 1: 319-360.

Lee S.M. 2001 The Dragonflies of Korean Peninsula (Odonata). – Junghaeng-Sa, Seoul.

Leipelt K.G. 2005 Behavioural differences in response to current: implications for the longitudinal distribution

of stream odonates. – Archiv für Hydrobiologie 163: 81-100.

Lempert J. 1987 Das Vorkommen von *Sympetrum fonscolombei* in der Bundesrepublik Deutschland. – Libellula 6: 59-69.

Lempert J. 1997 Die Einwanderung von *Sympetrum fonscolombii* (Selys) nach Mitteleuropa im Jahre 1996 (Anisoptera: Libellulidae). – Libellula 16: 143-168.

Lewandowski K. 1996 A preliminary description of dragonflies (Odonata) of the Zehlau Peatbog. – I International Conference 'Flora and fauna of the Bog Zehlau', Kaliningrad, Russia, 24-25 September 1996, summaries: 46-47.

Lewandowski K. & M.D. Moroz 2001 *Orthetrum brunneum* (Fonscolombe, 1837), pervoe upominanie novogo vida strekozy dlya fauny Belarusi. In: Raznoobrazie zhivotnogo mira Belarusi: itogi izucheniya i perspektivy sokhraneniya, Materialy Mezhdunarodnoi nauchnoi konferentsii, Minsk, 28-30 noyabrya 2001 g. – Belorusskii Gosudarstvennyi Universitet, Biologicheskii Fakul'tet, Minsk: 97-98.

Lieftinck M.A. 1964 Aantekeningen over *C. hylas* (Trybom) in Midden-Europa (Odonata: Coenagrionidae). – Tijdschrift voor Entomologie 107: 159-166.

Lieftinck M.A. 1966 A survey of the dragonfly fauna of Morocco (Odonata). – Bulletin de l'Institut royal des Sciences naturelles de Belgique 42: 1-63.

Lieftinck M.A. 1979 Libellen (Odonata). In: J.A. Guldemon et al. (eds), Verslag biospeleologische Expeditie Algerije 1978. Biospeleologische Werkgroep, Wageningen.

Lingenfelder U. 2011 *Coenagrion scitulum* im südwestdeutschen Raum, eine aktuelle Übersicht (Odonata: Coenagrionidae). – Libellula 30: 51-64.

Linnaeus C. 1736 Animalia per Sueciam observata. – Acta literaria et scientiarum Sveciae, Upsala 4: 97-138.

Linnaeus C. 1758 Systema Naturae, 10th edition. – Laurentius Salvius, Holmiae, Sweden.

Lohmann H. 1989 *Ischnura fountainei* Morton auf der Insel Pantelleria, Italien: Erstnachweis für Europa (Zygoptera: Coenagrionidae). – Odonatologica 22: 203-211.

Lohmann H. 1990a *Anax immaculifrons* Rambur, 1842 in Iran (Odonata: Aeshnidae). – Opuscula zoologica fluminensia 54: 9-10.

Lohmann H. 1990b *Coenagrion ponticum intermedium* subspec. nov. von der Insel Kreta, Griechenland (Odonata: Coenagrionidae). – Opuscula zoologica fluminensia 54: 1-7.

Lohmann H. 1992a Ein Beitrag zum Status von *Coenagrion freyi* (Bilek, 1954) und zur subspezifischen Differenzierung von *C. hylas* (Trybom, 1889), *C. johanssoni* (Wallengren, 1894) und *C. glaciale* (Selys, 1872), mit Bemerkungen zur postglazialen Ausbreitung ostpaläarktischer Libellen (Zygoptera: Coenagrionidae). – Odonatologica 21: 421-442.

Lohmann H. 1992b Revision der Cordulegastridae. 1. Entwurf einer neuen Klassifizierung der Familie (Odonata: Anisoptera). – Opuscula zoologica fluminensia 96: 1-18.

Lohmann H. 1993a *Coenagrion vanbrinki* spec. nov. und *C. persicum* spec. nov. aus Vorderasien (Zygoptera: Coenagrionidae). – Odonatologica 22: 203-211.

Lohmann H. 1993b Occurence of *Chalcolestes viridis parvidens* (Artobolevski, 1929) in southern Europe (Zygoptera: Lestidae) Notulae odonatologicae 4 (1): 4-6.

Lohmann H. 1993c Revision der Cordulegastridae. 2. Beschreibung neuer Arten in den Gattungen *Cordulegaster*, *Anotogaster*, *Neallogaster* und *Sonjagaster* (Anisoptera). – Odonatologica 22: 273-294.

Lohr M. 2005a Libellenbeobachtungen in Südportugal (Odonata). – Libellula 24: 87-107.

Lohr M. 2005b *Selysiothemis nigra* (Vander Linden, 1825) new for Portugal (Anisoptera: Libellulidae). – Notulae odonatologicae 6 (6): 57-58.

Lohr M., R. Proess, M. Schorr & M. Zimmermann 2004 Reproduktionsnachweise für *Oxygastra curtisii* am luxemburgisch-deutschen Grenzfluss Our (Odonata: Corduliidae). – Libellula 23: 173-178.

Longfield C. 1937 The Dragonflies of the British Isles. – The Wayside and Woodland Series. Warne, London.

Longfield C. 1949 The Dragonflies of the British Isles. (2nd edition). – The Wayside and Woodland Series. Warne, London.

Lopau W. 1999 Bisher unveröffentlichte Libellenbeobachtungen aus Griechenland. – Libellula Supplement 2: 91-131.

Lopau W. 2000 Bisher unveröffentlichte Libellenbeobachtungen aus Griechenland II (Odonata). – Libellula Supplement 3: 81-116.

Lopau W. 2005 Bisher unveröffentlichte Libellenbeobachtungen aus Griechenland III (Odonata). – Libellula Supplement 6: 49-84.

Lopau W. 2010a Bisher unveröffenlichte Libellenbeobachtungen aus Griechenland IV (Odonata). – Libellula Supplement 10: 155-260.

Lopau W. 2010b Verbreitungsatlas der Libellen in Griechenland (Odonata). – Libellula Supplement 10: 5-153.

Lopau W. & J. Adena 2002 Die Libellenfauna von Cypern. – Naturkundliche Reiseberichte 19: 1-73.

Lopau W. & A. Wendler 1995 Arbeitsatlas zur Verbreitung der Libellen in Griechenland und den umliegenden Gebieten. – Naturkundliche Reiseberichte 5: 1-109.

López-Rodríguez M.C. & P. Sánchez-Fernández 2014 Primeras citas de *Trithemis kirbyi* (Sélys, 1891) (Odonata: Libellulidae) en la llanura manchega (España: Albacete y Cuenca). – Boletín de la S.E.A. 55: 335-336.

Lorenzo-Carballa M.O., A. Cordero-Rivera, S. Giere & H. Hadrys 2007 Isolation and characterization of microsatellite loci to study parthenogenesis in the citrine forktail, *Ischnura hastata*. – Molecular Ecology Notes 7: 839-841.

Lorenzo-Carballa M.O., C.D. Beatty, C. Utzeri, V. Vieira & A. Cordero-Rivera 2009 Parthenogenetic *Ischnura hastata* revisited: present status and notes on population ecology and behavior (Odonata: Coenagrionidae). – International Journal of Odonatology 12: 395-411.

Lorenzo-Carballa M.O., P.C. Watts & A. Cordero-Rivera 2014 Hybridization between *Calopteryx splendens* and *C. haemorrhoidalis* confirmed by morphological and genetic analyses. – International Journal of Odonatology 17: 149-160.

Lorenzo-Carballa M.O., S. Ferreira, A.M. Sims, D.J. Thompson, P.C. Watts, Y. Cher, V. Damoy, A. Evrard, W. Gelez & C. Vanappelghem 2015 Impact of landscape on spatial genetic structure and diversity of *Coenagrion mercuriale* (Zygoptera: Coenagrionidae) in northern France. – Freshwater Science 34 (3): 1065-1078.

Loureiro N.S. 2012 New data on the distribution of *Orthetrum trinacria* in Algarve, southern Portugal (Odonata: Libellulidae). – Libellula 31: 77-87.

Louboutin B., M. Nicolas & C. Gautier 2015 Redécouverte d'*Ischnura graellsii* en France (Odonata: Coenagrionidae). – Martinia 31 (2) (*in press*).

Lucas W. J. 1900 British Dragonflies (Odonata). – Upcott Gill, London.

Lukáš J. 1995 K výskytu vzácnych a ohrozených druhov vážok (Odonata) na Slovensku. – Entomofauna Carpathica 7: 83-84.

Macagno A.L.M., M. Gobbi & V. Lencioni 2012 The occurrence of *Leucorrhinia pectoralis* (Charpentier, 1825) (Odonata, Libellulidae) in Trentino (Eastern Italian Alps). – Studi Trentini di Scienze naturali 92: 33-36.

Machet P. & M. Duquef 2004 Un visiteur inattendu et de taille !... *H. ephippiger* (Burmeister, 1839) capturé à la Guyane française. – Martinia 20: 121-124.

MacKenzie D.I., J.D. Nichols, J.A. Royle, K.H. Pollock, J.E. Hines & L.L. Bailey 2006 Occupancy estimation and modelling: Inferring patterns and dynamics of species occurrence. – Elsevier, San Diego.

Maibach A. 1985 Révision systématique du genre *Calopteryx* Leach (Odonata, Zygoptera) pour l'Europe occidentale. I. Analyses biochimiques. – Mitteilungen der Schweizerischen Entomologischen Gesellschaft 58: 477-492.

Maibach A. 1986 Révision systématique du genre *Calopteryx* Leach (Odonata, Zygoptera) pour l'Europe occidentale. II. Analyses morphologiques et synthèse. – Mitteilungen der Schweizerischen Entomologischen Gesellschaft 59: 389-406.

Maibach A. 1987 Révision systématique du genre *Calopteryx* Leach (Odonata, Zygoptera) pour l'Europe occidentale. III. Révision systématique, étude bibliographique, désignation des types et clé de détermination. – Odonatologica 16: 145-174.

Maibach A. & C. Meier 1987 Verbreitungsatlas der Libellen der Schweiz (Odonata), mit roter Liste. – Fauna Helvetica 4.

Malikova E.I. 2010 Zoogeographically interesting dragonflies (Odonata) records from the Upper Amur region. – Euroasian Entomological Journal: 9: 291-294.

Malikova E.I. & O. Kosterin 2009 English translation of: E.I. Malikova 1995. Strekozy (Odonata, Insecta) Dal'nego Vostoka Rossii. [Dragonflies (Odonata, Insecta) of the Far East of Russia]. (Autoreferate of the dissertation for aspiration of the scientific degree of candidate of biological sciences). Institute of Systematics and Ecology of Animals, Novosibirsk. – International Dragonfly Fund - Report 22: 1-22.

Malkmus R. 1996 Libellen im Gebiet des unteren Rio Guadiana, Portugal. – Advances in Odonatology, Supplement 1: 123-126.

Malkmus R. 2002 Die Verbreitung der Libellen Portugals, Madeiras und der Azoren. – Nachrichten des Naturwissenschaftlichen Museums der Stadt Aschaffenburg 106: 117-143.

Malkmus R. & F. Weihrauch 2010 Verbreitung und Phänologie von *Sympetrum nigrifemur* auf den Makaronesischen Inseln (Odonata: Libellulidae). – Libellula 29: 91-106.

Malmqvist B., A.N. Nilsson, M. Baez, P.D. Armitage & J. Blackburn 1993 Stream macroinvertebrate communities in the island of Tenerife. – Archiv für Hydrobiologie 128: 209-235.

Manci C.-O. 2012 Dragonfly Fauna (Insecta: Odonata) from Romania. – PhD thesis abstract, Cluj-Napoca, Romania.

Manger R. 2014 Een bezoek aan de Getande glazenmaker (*Aeshna serrata*) in Denemarken. – Brachytron 16: 43-47.

Maravalhas E. & A. Soares 2013 Libélulas de Portugal, The Dragonflies of Portugal. – Booky Publisher.

Marinov M. 2000 Pocket field guide to the dragonflies of Bulgaria. – Eventus Publishing House, Sofia.

Marinov M. 2001a Does *Coenagrion mercuriale* (Charpentier, 1840) occur in Bulgaria? – Exuviae 8: 13-19.

Marinov M. 2001b The *Orthetrum coerulescens* complex in Bulgaria (Odonata: Libellulidae). – International Journal of Odonatology 4: 35-40.

Marinov M. 2001c *Somatochlora borisi* spec. nov., a new European dragonfly species from Bulgaria (Anisoptera: Corduliidae). – International Dragonfly Fund - Report 3: 46-53.

Marinov M. 2003 Chorology, biotope and habitat commitment of the insects of the order Odonata in Bulgaria. – Dissertation, Institute of Zoology, Bulgarian Academy of Sciences.

Marinov M. & R. Seidenbusch 2007 *Corduliochlora* gen. nov. from the Balkans (Odonata: Corduliidae). – International Dragonfly Fund - Report 10: 1-13.

Marinov M. & N. Simov 2004 *Somatochlora arctica* (Zett.) and *Leucorrhinia dubia* (Vander L.) new for the fauna of Bulgaria (Anisoptera: Corduliidae, Libellulidae). – Notulae odonatologicae 6 (3): 34-35.

Marinov M., B. Grebe & Y. Kutsarov 2007 *Cordulegaster insignis* (Schneider, 1845) in Bulgaria with notes on its

biology and ecology. In: B.K. Tyagi (ed.), Odonata: Biology of Dragonflies. – Scientific Publishers, India: 51-61.

Márquez-Rodríguez J. 2011 *Trithemis kirbyi ardens* (Gerstaecker, 1891) (Odonata: Libellulidae); datos de campo sobre su ecología en el Sur España y primeros registros para la provincia de Sevilla (España). Métodos en Ecología y Sistemática 6 (1-2): 10-20.

Márquez Rodríguez J. & M. Ferreras-Romero 2013 *Orthetrum nitidinerve* in the southern Iberian Peninsula: two breeding populations in the Seville Province (Odonata: Libellulidae). – Libellula 32: 141-149.

Martens A. 2010 Ecology of the dragonflies at the westernmost spot of Africa, the island of Santo Antão, Cape Verde (Odonata). – International Journal of Odonatology 13: 241-254.

Martens A. 2015 Alternative oviposition tactics in *Zygonyx torridus* (Kirby) (Odonata: Libellulidae): modes and sequential flexibility. – International Journal of Odonatology 18: 71-80.

Martin M. 2009 Kuningkiilid vallutavad Eestit. – Eesti Loodus 5: 26-29.

Martin M. 2013 Eesti kiilide määraja. – Keskkonnaamet, Tallinn.

Martin M., J. Luig, J. Ruusmaa & M. Heidemaa 2008 Distribution maps of Estonian insects. 3. Odonata, maps 166-219. – Eesti Loodusfoto, Tartu.

Martin R. 1887 Les odonates du département de l'Indre. – Revue entomologique 5: 231-251.

Martin R. 1908 Aeschnines. – Collections Zoologiques du Baron Edm. de Selys-Longchamps. Catalogue systématique et descriptif 18: 1-84.

Martin R. 1910 Contribution à l'étude des Nevroptères de l'Afrique. II. Les odonates du département de Constantine. – Annales de la Société Entomologique de France 79: 95-104.

Martín F.J. 1983 Contribución al estudio de los Zigópteros (Odon.) de la provincia de Madrid. – Boletín de la Asociación española de Entomología 6: 159-172.

Martín-Casacuberta R. 2004 Odonatos de Cataluña: catálogo y análisis geográfico. – Boletín de la Asociación española de Entomología 28: 55-69.

Martiré D. 2010 Les Libellules et Éphémères de la Réunion. – Biotope, Mèze (collection Parthénope).

Martynov A.V. 2010 The Odonata fauna of the basin of the river Severskyi Donets in its middle current (Eastern Ukraine). – International Dragonfly Fund - Report 31: 1-41.

Mashaal M. 2002 *Somatochlora metallica* (Vander Linden, 1825), espèce nouvelle pour la Corse (Odonata, Corduliidae). – Martinia 18: 25-27.

Matushkina N. 2006 New records of rare Odonata in Ukraine (Insecta). – Proceedings of the Zoological Museum, Kyiv National Taras Shevchenko University 4: 155-161.

Matushkina N.A. 2007 *Selysiothemis nigra* (Vander L.) new for the fauna of the Ukraine (Anisoptera: Libellulidae). – Notulae odonatologicae 6 (10): 118-119.

Matushkina N.O. & L.A. Khrokalo 2002 Vyznachnyk babok (Odonata) Ukrainy: lychynky ta ekzuvii. (Identification key of dragonflies (Odonata) of Ukraine: larvae and exuviae). – Manual for the students of biology specialities, Kyiv, Fitositsiocentr: 1-72.

Mauersberger R. 1994 Zur wirklichen Verbreitung von *Orthetrum coerulescens* (Fabricius) und *O. ramburi* (Selys) = *O. anceps* (Schneider) in Europa und die Konsequenzen für deren taxonomischen Rang (Odonata, Libellulidae). – Deutsche Entomologische Zeitschrift 41: 235-256.

Mauersberger R. 2009 Nimmt *Leucorrhinia caudalis* im Nordosten Deutschlands rezent zu? – Libellula 28: 69-84.

Mauersberger R., O. Brauner, F. Petzold & M. Kruse 2013 Die Libellenfauna des Landes Brandenburg. – Naturschutz und Landschaftspflege in Brandenburg 3-4: 4-166.

Mauersberger R.G. 2000 *Coenagrion johanssoni* (Wallengren), *Aeshna crenata* Hagen and *A. subarctica elisabethae* Djakonov found in Belarus (Zygoptera: Coenagrionidae; Anisoptera: Aeshnidae). – Notulae odonatologicae 5 (5): 56-57.

McLachlan R. 1884 The British Dragonflies annotated. – Entomologist's Monthly Magazine 20: 251-256.

McLachlan R. 1898 On Neuroptera collected by Mr. Malcolm Burr in Wallachia, Bosnia, Herzegovina. – The Entomologist's Monthly Magazine 2: 248-249.

McLachlan R. 1899 Remarques sur quelques odonates de l'Asie Mineure meridionale comprenant une espèce nouvelle pour la faune paléarctique. – Annales de la Société entomologique de Belgique 43: 301-302.

Melhaoui M. & J.-P. Boudot 2009 Diagnostic de la biodiversité aquatique dans le Bassin Hydraulique de la Moulouya. Projet UICN/ABHM Moulouya, Maroc, Intégration des considérations sur la biodiversité aquatique dans la planification de la gestion au niveau du Bassin Hydraulique de la Moulouya. Rapport d'expertise. – UICN Med. Décembre 2009.

Melovski L., G. Ivanov, N. Angelova, M. Velevski & S. Hristovski 2008 [Monospitovsko Swamp. The last swamp in Macedonia]. – Municipality of Bosilovo, Bosilovo.

Merritt R. & G.S. Vick 1983 Is *Sympetrum nigrescens* Lucas a good species? – Journal of the British Dragonfly Society 1: 7-8.

Merritt R., N.W. Moore & B.C. Eversham 1996 Atlas of the dragonflies of Britain and Ireland. – Institute of Terrestrial Ecology Research Publication No. 9, HMSO, London.

Meurgey F. 2006 *Anax ephippiger* (Burmeister, 1839), a new species for the West Indies. – Argia 18: 21-22.

Meurgey F. & C. Perron 2004 First French record for *Anax junius* (Drury, 1773). – Argia 16: 25.

Meurgey F. & L. Picard 2011 Les Libellules des Antilles françaises. – Biotope, Mèze, collection Parthénope.

Meyer-Dür R.L. 1846 Übersicht der im Canton Bern und namentlich in der Umgegend von Burgdorf vorkom-

menden Arten der Libellen. – Mitteilungen der Naturforschenden Gesellschaft in Bern 81/82: 193-202.

Meyer-Dür R.L. 1874 Die Neuroptera-Fauna der Schweiz, bis auf heutige Erfahrung (I). – Mitteilungen der Schweizerischen entomologischen Gesellschaft 4: 281-352.

Meyer-Dür R.L. 1884 Seltene Libellen der schweizerischen Fauna. – Mitteilungen der Schweizerischen entomologischen Gesellschaft 7: 52-55.

Micevski N., B. Micevski & M. Bedjanič 2008 *Aeshna cyanea* and *A. juncea*, new for the fauna of Macedonia (Odonata: Aeshnidae). – Libellula 27: 267-274.

Michiels N., A. Anselin, P. Goffart & M. Van Mierlo 1986 Voorlopige verspreidingsatlas van de Libellen (Odonata) van België en het Groothertogdom Luxemburg / Atlas provisoire des Libellules (Odonata) de Belgique et du Grand-Duché de Luxembourg. – Euglena/Gomphus extra, special issue 2 (1).

Mielewczyk S. 1990 Odonata – Ważki. In: J. Razowski (ed.), Checklist of animals of Poland, vol. I, Part XXXII/1-20 Insecta: Protura-Planipennia. – Ossolineum, Wrocław-Warszawa-Kraków: 39-42.

Mierzejewski W. 1913 *Aeshna osiliensis* nov. sp. – Bulletin international de l'Académie des Sciences de Cracovie, Classe des Sciences mathématiques et naturelles, Série B: Sciences naturelles 1913: 79-87.

Mikkola K. 1968 *Hemianax ephippiger* (Burm.) (Odonata) carried to Iceland from the Eastern Mediterranean by an air-current? – Opuscula entomologica 33: 111-13.

Mikolajewski D.J. & J. Rolff 2004 Benefits of morphological defence demonstrated by direct manipulation in larval dragonflies. – Evolutionary Ecology Research 6: 619-626.

Mill P.J., S. Brooks & A. Parr 2010 Dragonflies (Odonata) in Britain and Ireland. In: N. Maclean (ed.), Silent Summer. – Cambridge University Press, Cambridge: 470-494.

Miňová S., M. Balla & S. David 2011 First record of *Hemianax ephippiger* (Odonata: Aeschnidae) from Slovakia. – Folia faunistica Slovaca 16: 25-26.

Miroğlu A. 2011 First record of the Black Darter, *Sympetrum danae* (Sulzer, 1776) (Odonata: Libellulidae), from Turkey. – Zoology in the Middle East 53: 129.

Miroğlu A., V. Kartal & A. Salur 2011 Odonata of the Eastern Black Sea region of Turkey, with some taxonomic notes. – Odonatologica 40: 105-122.

Misof B., C.L. Anderson & H. Hadrys 2000 A phylogeny of the damselfly genus *Calopteryx* (Odonata) using mitochondrial 16S rDNA markers. – Molecular Phylogenetics & Evolution 15: 5-14.

Mitra M.T. 1996 Additions to the odonate fauna of Manipur, Eastern India (Odonata). – Opuscula zoologica fluminensia 141: 1-6.

Mitra T.R. 2002 Geographical distribution of Odonata (Insecta) of Eastern India. – Memoirs of the Zoological Survey of India 19: 1-208.

Mocsáry A. 1900 Ordo Pseudo - Neuroptera. In: J. Paszlavszky (ed.), Fauna Regni Hungariae - III Arthropoda. – Természettudományi társulát, Budapest: 23-32.

Monetti L., R.A. Sanchez-Guillén & A. Cordero-Rivera 2002 Hybridization between *Ischnura graellsii* (Vander Linden) and *I. elegans* (Rambur) (Odonata: Coenagrionidae) are they different species? – Biological Journal of the Linnean Society 76: 225-235.

Monnerat C. 2005 *Orthetrum albistylum* (Selys, 1848). In: H. Wildermuth, Y. Gonseth & A. Maibach (eds), Odonata - Die Libellen der Schweiz. – CSCF/SEG, Neuchâtel.

Monnerat C. 2008 Neufund einer Population von *Nehalennia speciosa* in der Westschweiz (Odonata: Coenagrionidae). – Libellula 27: 39-51.

Moore N.W. 1997 Dragonflies. Status Survey and Conservation Action Plan. IUCN/SSC Odonata Specialist Group. – International Union for Conservation of Nature and Natural Resources, Gland, Switzerland, and Cambridge, United Kingdom.

Móra A. & A. Farkas 2015 First records of *Erythromma lindenii* (Selys, 1840) from Hungary (Odonata: Coenagrionidae). – Notulae odonatologicae 8 (6): 169-175.

Moratin R. 2014 La Liste rouge des Odonates menacés en Alsace. – IMAGO, ODONAT.

Moreira P., P. Arnaldo & P. Barros 2008 Odonata records from Natura 2000 Network Site Alvão-Marão (Portugal). – Boletín de la S.E.A. 43: 395-398.

Moroz M.D., M.V. Maksimenkov, S. Czachorowski & P. Buczyński 2002. Rezul'taty issledovaniya vodnykh nasekomykh (Insecta: Collembola, Ephemeroptera, Odonata, Trichoptera, Heteroptera, Coleoptera) biologicheskogo zakaznika "Sporovskii". – Prirodnye Resursy 2002 (2): 88-94.

Moroz M.D., S. Czachorowski, K. Lewandowski & P. Buczyński 2006 Nasekomye (Ephemeroptera, Plecoptera, Odonata, Heteroptera, Trichoptera) vodoemov poimennykh dubrav Natsional'nogo parka «Pripyatskii». – Vestsi Natsyyanal'nai Akademii Navuk Belarusi, Seryya Biyalagichnykh Navuk 2006 (2): 111-116.

Morton K.J. 1914 Notes on a collection of Odonata from Van, Turkey in Asia. – The Entomologist's Monthly Magazine 50: 56-59.

Morton K.J. 1920 Odonata collected in Mesopotamia by the late Major R.Brewitt-Taylor, R.A.M.C. – Annals and Magazine of Natural History 9 (5): 293-303.

Morton K.J., 1925 *Macromia splendens* al least: an account of dragonfly hunting in France. – Entomologist's monthly Magazine 61: 1-5.

Mousatat F., H.J. Dumont, M. Karrom, N. Mouhamad Ali 2010 Dragonflies from northern Syria (Insecta: Odonata). – Zoology in the Middle East 51: 105-112.

Müller J. & M. Schorr 2001 Verzeichnis der Libellen (Odonata) Deutschlands. – Entomofauna Germanica 5: 9-44.

Müller J.M. 2000 Untersuchungen zur Ökologie und Verbreitung der Sibirischen Azurjungfer (*Coenagrion hylas*) im Tiroler Lechtal (Odonata: Coenagrionidae).

– Zulassungsarbeit zur wissenschaftlichen Prüfung für das Lehramt an Gymnasien. Fach Biologie, Institut für Experimentelle Ökologie der Tiere der Universität Ulm.

Müller O. 2008 Larval habitats and life history of the Crete Island endemic *Boyeria cretensis* (Odonata: Aeshnidae). – International Journal of Odonatology 11: 195-207.

Murányi D. 2007 Contribution to the Odonata fauna of Albania. – Folia entomologica hungarica 68: 41-53.

Murdoch D. 1998 The size of the 1995 influx of *Sympetrum flaveolum* (L.). – Journal of the British Dragonfly Society 14: 11-12.

Muusse T. & G. Veurink 2011 Sierlijke witsnuitlibel (*Leucorrhinia caudalis*) voortplantend waargenomen in De Weerribben. – Brachytron 14: 14-27.

Navás L. 1924 Sinopsis de los Paraneurópteros (Odonatos) de la Península Ibérica. – Memorias de la Sociedad Entomológica de España 1.

Navás L. 1934 Insectes del Marroc. Paraneuropters. Junta de Ciències Naturals de Barcelona 11 (8): 3-7.

Nederlandse Vereniging voor Libellenstudie (Editors K.-D.B. Dijkstra, V.J. Kalkman, R. Ketelaar & M.J.T. van der Weide) 2002 De Nederlandse libellen (Odonata) [The Dutch dragonflies (Odonata)]. – Nationaal Natuurhistorisch Museum Naturalis, KNNV Uitgeverij & European Invertebrate Survey, Leiden.

Nelson B. & R. Thompson 2004 The Natural History of Ireland's Dragonflies. – MAGNI Publication No 013, National Museums and Galleries of Northern Ireland, Belfast.

Nelson B., C. Ronayne & R. Thompson 2011 Irish Red List No. 6, Odonata. – National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin.

Nielsen O.F. 1998 De danske guldsmede. Danmarks Dyreliv, 8. – Denmark, Stenstrup.

Nilsson A.N., B. Malmqvist, M. Báez, J.H. Blackburn, & P.D. Armitage 1998 Stream insects and gastropods in the island of Gran Canaria (Spain). – Annales de Limnologie 34: 413-435.

Nilsson B.I. 1981 Susceptibility of some odonate larvae to fish predation. – Verhandlungen des Internationalen Verein Limnologie 21: 1612-1615.

Norling U. 1967 *Hemianax ephippiger* (Burm.) found in Iceland (Odonata). – Opuscula entomologica 32: 99-100.

O'Grady E.W. & M.L. May 2003 A phylogenetic reassessment of the subfamilies of Coenagrionidae (Odonata: Zygoptera). – Journal of Natural History 37: 2807-2834.

Ober S. 2008 First record of *Pantala flavescens* for the western Balkans (Odonata: Libellulidae). – Libellula 27: 117-121.

Obregón-Romero R., F.J. Cano-Villegas, R. Tamajón-Gómez & J. López-Tirado 2013 First records of *Trithemis kirbyi* Sélys, 1891 (Odonata, Libellulidae) in the provinces of Ciudad Real and Huelva, and new records in the province of Badajoz (Spain). – Boletín de la Sociedad Andaluza de Entomología 22: 88-93.

Ocharan F.J. 1987 Los Odonatos de Asturias y de España. Aspectos Sistemáticos y Faunísticos. – Ph.D. Thesis Universidad de Oviedo.

Ocharan F.J., A. Torralba-Burrial, D. Outomuro, M. Azpilicueta-Amorín & A. Cordero-Rivera 2012 *Lindenia tetraphylla*. In: Bases ecológicas preliminares para la conservación de las especies de interés comunitario en España: Invertebrados. – Ministerio de Agricultura, Alimentación y Medio Ambiente. Madrid.

Okáli I. 1994 Bibliografia vážok (Odonata) Slovenska II. – Správy Slovenskej entomologickej Spoločnosti 6: 55-58.

Olafsson E. 1977 Drekaflugan *Hemianax ephippiger* (Burm.) (Odonata), óvæntur gestur á Íslandi. Náttúrufræðingurinn 45: 209-212.

Olias M. 2005 *Lestes parvidens* am Südostrand Mitteleuropas: Erste Nachweise aus Österreich, der Slowakei, Ungarn und Rumänien (Odonata: Lestidae). – Libellula 24: 155-161.

Olias M., F. Weihrauch, M. Bedjanič, N. Hacet, M. Marinov & A. Šalamun 2007 *Lestes parvidens* and *L. viridis* in southeastern Europe: a chorological analysis (Odonata: Lestidae). – Libellula 26: 243-272.

Oliger A.I. 1980 Fenologiya i sutochnaya activnost' strekoz (Odonata) v uygovostochnoy chasti Ukrainy (Phenology and diurnal activity of dragonflies in the southeastern part of Ukraine). – Zoologicheskiy Zhurnal 59: 1425-1427.

Olsvik H. 1995 *Hemianax ephippiger* og *Aeshna serrata* observert i Norge 1995. – Nordisk Odonatologisk Forum 2: 24.

Olsvik H. & D. Dolmen 1992 Distribution, habitat, and conservation status of threatened Odonata in Norway. – Fauna Norvegica Serie B 39: 1-21.

Olthoff M., N. Menke & J. Rodenkirchen 2011 *Leucorrhinia caudalis* in der Ville bei Köln: Wiederfund für Nordrhein-Westfalen (Odonata: Libellulidae). – Libellula 30: 1-12.

Osenimskiy B.I. 2006 Short results of inventory of the fauna of the Jagorlyk reserve. In: I.D. Trombitskiy & T.D. Sharapovskaya (eds), Reserve Jagorlyk, Eco-TIRAS. – Tiraspol: 28-36.

Ott J. 2006 Die Arktische Smaragdlibelle - *Somatochlora arctica* (Zetterstedt, 1840) - in der Pfalz: übersehen oder kurz vor dem Aussterben? (Insecta: Odonata: Corduliidae). – Fauna Flora Rheinland-Pfalz 10: 1323-1338.

Ott J. 2007 The expansion of *Crocothemis erythraea* (Brulle, 1832) in Germany - an indicator for climatic changes. – Scientific Publishers, Jodhpur.

Ott J. 2008 Libellen als Indikatoren der Klimaänderung. Ergebnisse aus Deutschland und Konsequenzen für den Naturschutz. – Insecta 11: 75-89.

Ott J. 2010 Dragonflies and climatic changes - recent trends in Germany and Europe. – BioRisk 5: 253-286.

Ott J. 2012. Zum starken Auftreten der Großen Moosjungfer *Leucorrhinia pectoralis* (Charpentier, 1825)

im Jahr 2012 in Rheinland-Pfalz nebst Bemerkungen zu *Leucorrhinia rubicunda* (L.). – Fauna Flora Rheinland-Pfalz 12: 571-590.

Ott J., M. Schorr, B. Trockur & U. Lingenfelder 2007 Artenschutzprogramm für die Gekielte Smaragdlibelle (*Oxygastra curtisii*, Insecta: Odonata) in Deutschland: das Beispiel der Population an der Our [Species protection programme for the Orange-spotted Emerald (*Oxygastra curtisii*, Insecta: Odonata) in Germany: the example of the River Our population]. – Pensoft, Bulgaria.

Ott J., K.-J. Conze, A. Günther, M. Lohr, R. Mauersberger, H.-J. Roland & F. Suhling 2015 Rote Liste und Gesamtartenliste der Libellen Deutschlands mit Analyse der Verantwortlichkeit, dritte Fassung, Stand Anfang 2012 (Odonata). – Libellula Supplement 14: 395-422.

Ozono A., I. Kawahima & R. Futahashi 2012 Dragonflies of Japan. – Bunichi-Sogo Syuppan Co. Ltd.

París M., S. Ferreira, J. Mañani, A. Parrón, F. Prunier, J. Ripoll & S. Saldaña 2014 Los Odonatos ibéricos en la colección de Entomología del Museo Nacional de Ciencias Naturales (MNCN-CSIC). – Boletín ROLA 4: 33-61.

Parr A.J. 1997 The 1996 Red-veined Darter *Sympetrum fonscolombii* (Selys) influx into Britain. – Atropos 2: 44-46.

Parr A.J. 2000 Blue Dasher *Pachydiplax longipennis* (Burmeister) on an Oil Rig in the North Sea. – Atropos 10: 3-5.

Parr A.J. 2009 Winter damselfly *Sympecma fusca* Vander Linden in West Glamorgan. – Atropos 37: 28-31.

Parr A.J. 2010 Migrant and dispersive dragonflies in Britain during 2010. – Journal of the British Dragonfly Society 27: 69-79.

Parr A.J. 2010 Monitoring of Odonata in Britain and possible insights into climate change. – Biorisk 5: 127-139.

Parr A.J. 2011 The Vagrant Emperor *Anax ephippiger* in Britain and Europe during early 2011. – Journal of the British Dragonfly Society 27: 80-87.

Parr A.J. 2013 The Large White-faced Darter *Leucorrhinia pectoralis* (Charp.) in Britain during 2012. – Journal of the British Dragonfly Society 29: 40-45.

Parr A.J., G. De Knijf & M. Wasscher 2004 Recent appearances of the Lesser Emperor *Anax parthenope* (Selys) in north-western Europe. – Journal of the British Dragonfly Society 20: 5-16.

Paulson D.R. 2009 Dragonflies and damselflies of the west. – Princeton University Press, Princeton, New Jersey.

Paulson D.R. 2011 Dragonflies and damselflies of the east. – Princeton University Press, Princeton, New Jersey.

Paulson D.R., C. de Haseth & A.O. Debrot 2014 Odonata of Curaçao, southern Caribbean, with an update to the fauna of the ABC islands. – International Journal of Odonatology 17: 237-249.

Pavesi M. & C. Utzeri 1995 Odonata. In: B. Massa (ed.), Arthropoda di Lampedusa, Linosa e Pantelleria (Canale di Sicilia, Mar Mediterraneo). – Il Naturalista siciliano 19 (supplement): 151-162.

Pazsiczky J. 1914 Adatok Trencsén vármegye recésszárnyú rovarainak faunájához. – A Trencsénvár megyei Muzeum, egyesület értesitöj, Trenčín, pages 67-83.

Peels F. 2014 The occurrence of *Ischnura senegalensis* in the Canary Islands, Spain (Odonata: Coenagrionidae). – Notulae odonatologicae 8 (4): 105-111.

Pellow K. 1999 An influx of Green Darner *Anax junius* (Drury) into Cornwall and the Isles of Scilly, the First European Records. – Atropos 6: 3-7.

Pelny H.-J. 2006 Erster Nachweis von *Anax parthenope* auf dem Madeira-Archipel (Odonata: Aeshnidae). – Libellula 25: 27-30.

Pelt G.J. van & V.J. Kalkman 2004 Research on dragonflies in Turkey: present status and future aims (Odonata). – Libellula Supplement 5: 167-192.

Pérez-Bote J.L., J.M. Torrejón, F. Ferri, A.J. Romero, J.M. García & A. Gil 2006 Aproximación al atlas odonatológico de Extremadura (SO de la Península Ibérica) (Odonata). – Boletín de la S.E.A. 39: 329-343.

Peters G. 1985 Die Libellenfauna der westlichen und nördlichen Mongolei und einige Phänomene ihrer intrakontinentalen Isolation. – Mitteilungen aus dem Zoologischen Museum in Berlin 61: 11-42.

Peters G. 1987 Die Edellibellen Europas: Aeshnidae. – Die Neue Brehm Bücherei, Wittenberg Lutherstadt.

Peters G. 1991 Die Schattenlibelle auf Kreta (*Boyeria cretensis* spec. nov.) und die Monophylie der "Gattung" *Boyeria* McLachlan, 1896 (Odonata Anisoptera, Aeshnidae). – Deutsche Entomologische Zeitschrift (NF) 38: 161-196.

Peters G. 1997 Beobachtungen an Aeshniden (Odonata; Anisoptera) im unbekannten Nordosten Europas. – Hagenia 13: 15-20.

Peters G. 2000 Unbekannte Bekannte: die *Anax*-Species in Europa (Odonata: Aeshnidae). – Libellula 19: 53-64.

Peters G. & A. Günther 2000 Frühjahrsbeobachtungen an *Anax ephippiger* auf Rhodos nebst Anmerkungen über den Invasionsraum der Art. – Libellula Supplement 3: 49-61.

Peters G. & H. Hackethal 1986 Notizen über die Libellen (Odonata) in Mazedonien. – Acta Musei Macedonici Scientiarum Naturalium 18 (5/151): 125-157.

Petkov P. 1921 Prinos kam izutchvan na balgarskite odonati [A contribution to the study of Bulgarian Odonata]. – Annals of Sofia University, Physico-Mathematical Faculty 15-16: 1-39.

Petrović N.J., L. Miljković, P.A. Tipa, P.S. Pavlović & Ž.J. Jurišić 1891 [The second journey of the teachers and pupils of the Second Belgrade secondary school, over Serbia and Bosnia]. – Prosvetni Glasnik, 12 (3): 104-116, (4): 189-194, (5): 247-254, (6): 320-325, (7/8): 384-398.

Piirainen T. 2000 Retki Saarenmaan nummille. – Diamina 9: 40-43.

Pilgrim E.M. 2006 Systematics of the sympetrine dragonflies with emphasis on the phylogeny, taxonomy, and historical biogeography of the genus *Sympetrum* (Odonata: Libellulidae). – Master's thesis, Utah State University.

Pilgrim E.M. & C.D. Von Dohlen 2007 Molecular and morphological study of species-level questions within the dragonfly genus *Sympetrum* (Odonata: Libellulidae). – Annals of the Entomological Society of America 100: 688-702.

Pilgrim E.M. & C.D. von Dohlen 2008 Phylogeny of the Sympetrinae (Odonata: Libellulidae): further evidence of the homoplasious nature of wing venation. – Systematic Entomology 3: 159-174.

Pilgrim E.M. & C.D. von Dohlen 2012 Phylogeny of the dragonfly genus *Sympetrum* (Odonata: Libellulidae). – Organisms Diversity & Evolution 12: 281-295.

Pirotta R. 1879 Libellulidi italiani. – Annali del Museo civico di Storia naturale „Giacomo Doria" 14: 401-489.

Pisanenko A.D. 1985 Faunisticheskii ocherk strekoz (Insecta, Odonata) Belorussii. – Vestnik Belorusskogo Gosudarstvennogo Universiteta imeni V.I. Lenina (Seriya II) 3: 37-41.

Pongracz S. 1914 Magyarország neuropteroidái (Enumeratio Neuropteroidum Regni Hungariae). – Rovartani Lapok 21: 130-135.

Pongracz S. 1923 Recésszárnyúak. Neuropteroiden. In: E. Csiki (ed.), Állattani Kutatásai Albániában, Explorationes zoologicae ab E. Csiki in Albania peractae. – Magyar Tudományos Akadémia, Budapest: 143-166.

Popova O.N. 1997 Dragonflies of the Caucasus. – Abstracts of Papers and Posters presented at the 14th International Symposium of Odonatology 1997: 31.

Popova O.N. 2004 Infraspecific taxonomy of *Sympetrum pedemontanum* (Müller, 1766) (Anisoptera: Libellulidae). – Odonatologica 32: 207-216.

Popova O.N. & A.Y. Haritonov 2008 Interannual changes in the fauna of dragonflies and damselflies. – Russian Journal of Ecology 39: 405-413.

Prieto-Lillo E. & A. Jacobo-Ramos 2012 Primeras citas de *Trithemis kirbyi* Sélys, 1891 (Odonata: Libellulidae) y *Macromia splendens* (Pictet, 1843) (Odonata: Corduliidae) para Aragón (España). – Boletín de la S.E.A. 51: 329-330.

Prieto-Lillo E., M.J. Sanchis, J. Rueda, C. Molina, J.A. Tornero, J.J. Herrero-Borgoñón & S. Teruel 2012 Primeras citas de *Trithemis kirbyi* (Sélys, 1891) (Odonata: Libellulidae) en la Comunidad Valenciana: confirmación de su rápida expansión hacia el NE de la Península Ibérica. – Boletín de la S.E.A. 51: 363-364.

Proess R. 1997 Erstnachweis der Gabel-Azurjungfer (*Coenagrion scitulum* Rambur, 1842) in Luxemburg (Insecta, Odonata, Coenagrionidae). – Bulletin de le Société des Naturalistes luxembourgeois 98: 129-131.

Proess R. 2006a Rote Liste der Libellen Luxemburgs (3. Fassung: Stand 2006) (Insecta, Odonata). – Bulletin de la Société des Naturalistes luxembourgeois 107: 123-131.

Proess R. 2006b Verbreitungsatlas der Libellen des Großherzogtums Luxemburg. – Ferrantia 47, Musée d'histoire naturelle, Luxembourg, pp. 1-172.

Proess R. & R. Gerend 1998 Rote Liste der Libellen Luxemburgs (2. Fassung: Stand 1998) (Insecta, Odonata). – Bulletin de la Société des Naturalistes luxembourgeois 99: 137-149.

Prüffer J. 1923 Z badań nad wileńskiemi formami zalotek (*Leucorrhinia*). – Prace Towarzystwa Przyjaciół Nauk w Wilnie 1 (1): 1-16.

Purse B.V., G.W. Hopkins, K.J. Day & D.J. Thompson 2003 Dispersal characteristics and management of a rare damselfly. – Journal of Applied Ecology 40: 716-728.

Pusching R. 1896 Bericht über die reise des naturwissenschaftlichen Vereines a.d. U.W. nach Bosnien, der Herzegovina und Dalmatien. – Mitteilungen Naturwissenschaftlichen Vereines Universität Wien 33-54.

Raab R. & E. Chwala 1997 Rote Listen ausgewählter Tiergruppen Niederösterreichs - Libellen (Insecta: Odonata), 1. Fassung 1995. – Amt der NÖ Landesregierung, Abteilung Naturschutz, Wien.

Raab R., A. Chovanec & J. Pennerstorfer 2006 Libellen Österreichs. – Umweltbundesamt (ed.), Springer: Wien, New York.

Rambur M.P. 1842 Histoire naturelle des insectes - Névroptères. – Librairie Encyclopédique de Roret, Paris.

Rasmussen J.F. 2005 Odonata. In: P. Wind & S. Pihl (eds), The Danish Red List. – The National Environmental Research Institute, Aarhus University.

Rastegar J., M. Havaskary, S. Khodaparast & A. Rafeii 2013 A contribution to the knowledge of Odonata (Insecta) from West Azarbaijan province, northwestern Iran. – Entomofauna 34: 369-376.

Rattu A., P. Leo, R. Moratin & S. Hardersen 2014 *Diplacodes lefebvrii* in Sardinia, a new species for the Italian fauna (Odonata: Libellulidae). – Fragmenta entomologica 46 (1-2): 121-124.

Rault, P.-A., P. Gourdain, D. Guicheteau, G. George & Y. Braud 2015 Découverte de nouvelles stations de Cordulie méridionale *Somatochlora meridionalis* Nielsen, 1935 dans le Var et les Alpes-Maritimes. – Nature de Provence - Revue du CEN PACA octobre 2015: 1-4

Réaumur M. (de) 1742 Mémoires pour servir à l'histoire des Insectes. Tome sixième. Onzième Mémoire: Des mouches à quatre aisles nommées Demoiselles. – Imprimerie Royale, Paris.

Reinhardt K. & J. Samietz 2003 Libellenfunde in Ostkasachstan (Odonata). – Entomologische Nachrichten und Berichte 47: 71-76.

Reinhardt K. & R. Seidenbusch 1999 Zur Libellenfauna des Ili-Gebietes, Kasachstan (Insecta: Odonata). – Faunistische Abhandlungen Staatliches Museum für Tierkunde Dresden 21: 221-228.

Reinhardt K., R. Seidenbusch, O. Foitzik & S. Roth 2000 A small dragonfly collection from Turkmenistan. – Notulae odonatologicae 5 (5): 61-63.

Reis Moura A. 1960 Contribuição para o conhecimento dos Odonata portugueses: género e espécie novos para Portugal: *Brachythemis leucosticta* (Burm.). – Memórias e Estudos do Museu Zoológico da Universidade de Coimbra 264: 1-6.

Reiss T. 1990 Libellen des Kantons Baselland, Schweiz (Odonata). – Opuscula zoologica fluminensia 56: 1-5.

Remm E. 1963 Eesti kiilivastsete määraja. Abiks loodusevaatlejale 47. – Loodusuurijate Selts Eesti NSV Teaduste Akadeemia juures, Tartu.

Remm H. 1957 Eesti NSV kiilid. Abiks loodusevaatlejale 31. – Loodusuurijate Selts, Eesti NSV Teaduste Akadeemia, Tartu.

Reymond A. 1952 Insectes de divers ordres récoltés au Sahara central au cours d'une mission du Centre National de la Recherche Scientifique en 1947-1948. – Bulletin de la Société de Sciences naturelles du Maroc 32: 77-89.

Ris F. 1886 Fauna insectorum Helvetiae. Neuroptera. Die schweizerischen Libellen. – Mitteilungen der Schweizerischen Entomologischen Gesellschaft 7: 35-85.

Ris F. 1897 Note sur quelques odonates de L'Asie centrale. – Annales de la Société entomologique de Belgique 41: 42-50.

Riservato E. 2009. Atlante delle Libellule della Provincia di Novara. – Provincia di Novara, Novara.

Riservato E., J.-P. Boudot, S. Ferreira, M. Jović, V.J. Kalkman, W. Schneider, B. Samraoui & A. Cuttelod 2009 The status and distribution of dragonflies of the Mediterranean basin. – Gland, Switzerland & Malaga, Spain: IUCN.

Riservato E., R. Fabbri, A. Festi, C. Grieco, S. Hardersen, F. Landi, C. Utzeri, C. Rondinini, A. Battistoni, C. Teofili 2014a Lista Rossa IUCN delle libellule italiane. – Comitato Italiano IUCN e Ministero dell'Ambiente e della Tutela del Territorio e del Mare, Roma.

Riservato E., A. Festi, R. Fabbri, C. Grieco, S. Hardersen, G. La Porta, F. Landi, M.E. Siesa & C. Utzeri 2014b Odonata – Atlante delle libellule italiane – Preliminare. – Società Italiana per lo Studio e la Conservazione delle Libellule, Edizione Belvedere, Latina, "le scienze" (17).

Robert P.A. 1958 Les Libellules (Odonates). – Delachaux & Niestlé, Lausanne-Paris.

Roché B. 1989 *Trithemis annulata* (Palisot de Beauvois, 1805): nouvelle espèce pour la Corse et la faune de France (Odonata, Anisoptera: Libellulidae). – Martinia 5: 23-24.

Rodel M.-O. 1991 Erstnachweis von *Ophiogomphus cecilia* (Fourcroy, 1785) für Griechenland. – Mitteilungen des Internationalen Entomologischen Vereins 16: 93-96.

Rodríguez Martínez D. & M.A. Conesa-García 2015 *Coenagrion lunulatum* (Charpentier, 1840) & *Sympetrum flaveolum* (L., 1758) in Lake Tabatskuri, Georgia (Caucasus). – Boletín de la Asociación odonatológica de Andalucía 3: 18-24.

Roland H.-J. & S. Stübing 2014 *Sympetrum meridionale* in Deutschland – langfristige Bestandsentwicklung und aktuelle Vorkommen (Odonata, Libellulidae). – Libellula 33: 75-98.

Rösel von Rosenhof A.J. 1749 Der monatlich herausgegebenen Insecten-Belustigung zweyter Theil. – Nürnberg.

Rouquette J.R. & D.J. Thompson 2005 Habitat associations of the endangered damselfly, *Coenagrion mercuriale*, in a water meadow ditch system in southern England. – Biological Conservation 123: 225-235.

Rouquette J.R. & D.J. Thompson 2007 Patterns of movement and dispersal in an endangered damselfly and the consequences for its management. – Journal of Applied Ecology 44: 692-701.

Rumi G. K. 1807 Forsetzung des Versuches einer Igloer entomographischen Fauna. In: S. Bredetzsky (ed.), Neue Beiträge zur Topographie und Statistik Königreichs Ungarn, Wien und Triest, 334-352.

Rychła A. 2013 Vorkommen der Arktischen Smaragdlibelle *Somatochlora arctica* (Zetterstedt, 1840) in Hochmooren der polnischen Ostseeküste und in Pommern. – International Dragonfly Fund - Report 63: 1-31.

Sácha D. 2011 Ecosozological evaluation of dragonfly assemblages at the sites of the European and national significance in Northern Slovakia. – Dissertation, Department of Ecosozology and Physiotactics, Faculty of Natural Sciences, Commenius University, Bratislava.

Sácha D., S. David, E. Bulánková, I. Jakab & I. Konvit 2007 Vážky Slovenskej republiky. – (www.vazky.sk, I/2011).

Sadeghi S. & J. Mohammadalizadeh 2009 Additions to the Odonata Fauna of Iran. – Iranian Journal of Science & Technology 33 (A4): 355-359.

Sadeghi S., T. Kyndt & H.J. Dumont 2010 Genetic diversity, population structure and taxonomy of *Calopteryx splendens* (Odonata: Calopterygidae): an AFLP analysis. – European Journal of Entomology 107: 137-146.

Sage B.L. 1960 Notes on the Odonata of Iraq. – Entomologist 93: 118-125.

Sahlén G. 1985 Sveriges trollsländor (Odonata). – Fältbiologerna, Sollentuna.

Sahlén G., R. Bernard, A. Cordero-Rivera, R. Ketelaar & F. Suhling 2004 Critical species of Odonata in Europe. – International Journal of Odonatology 7: 385-398.

Saikko P., P. Pynnönen & K. Soilevaara 2011 Keisarikorento (*Anax imperator*) ensi kertaa Suomessa 12.7.2010 Lemlandin Lågskärillä. – Crenata 4: 40-41.

Šalamun A. 2012 Temni slaniščar *Selysiothemis nigra*, nova vrsta v Sloveniji… in druge zanimive fotografske najdbe v škocjanskem zatoku in drugod po Sloveniji. – Erjavecia 27: 5-7.

Salur A. & S. Kıyak 2006 Additional records for the Odonata fauna of East Mediterranean region of Turkey. – Munis Entomology & Zoology 1: 239-252.

Salur A. & S. Kıyak 2007 Additional records for the Odonata fauna of South-Western Anatolia. Part I: Anisoptera. – Munis Entomology & Zoology 2: 63-78.

Samraoui B. 2009 Seasonal ecology of Algerian Lestidae (Odonata). – International Journal of Odonatology 12: 383-394.

Samraoui B. & P.S. Corbet 2000 The Odonata of Numidia, northeastern Algeria. Part II: Seasonal ecology. – International Journal of Odonatology 3: 27-39.

Samraoui B. & R. Menai 1999 A contribution to the study of Algerian Odonata. – International Journal of Odonatology 2: 145-165.

Samraoui B., S. Bouzid, R. Boulahbal, P.S. Corbet 1998 Postponed reproductive maturation in upland refuges maintains life-cycle continuity during the hot, dry season in Algerian dragonflies (Anisoptera). – International Journal of Odonatology 1: 118-135.

Samraoui B., P.H.H. Weekers & H.J. Dumont 2002 The *Enallagma* of the western and central Palaearctic (Zygoptera: Coenagrionidae). – Odonatologica 31: 371-381.

Samraoui B., P.H.H. Weekers & H.J. Dumont 2003 Two taxa within the North African *Lestes virens* complex (Zygoptera: Lestidae). – Odonatologica 32: 131-142.

Samraoui B., J.-P. Boudot, E. Riservato, S. Ferreira, M. Jović, V.J. Kalkman & W. Schneider 2009 Chapter 5. The Odonata of North Africa: Red List Status and distribution. In: N. Garcia, A. Cuttelod & D. Abdul Malak (eds), The status and distribution of freshwater biodiversity in Northern Africa. – IUCN report, Cambridge.

Sánchez-Guillén R.A. & A. Cordero-Rivera 2015 Confirmation of the presence of *Ischnura senegalensis* (Rambur, 1842) on the Canary Islands. – Animal Biodiversity and Conservation 38 (1): 71-76.

Sánchez A., J. Pérez, E. Jiménez & C. Tovar 2009 Los Odonatos de Extremadura. – Consejería de Industria, Energía y Medio Ambiente, Cáceres.

Sánchez-Guillén R.A., M. Wellenreuther, A. Cordero-Rivera & B. Hansson 2011 Introgression and rapid species turnover in sympatric damselflies. – BMC Evolutionary Biology 11: 210.

Sánchez-Guillén R.A., M. Wellenreuther & A. Cordero-Rivera 2012 Strong asymmetry in the relative strengths of prezygotic and postzygotic barriers between two damselfly sister species. – Evolution 66: 690-707.

Sánchez-Guillén R.A., A. Córdoba-Aguilar, A. Cordero-Rivera & M. Wellenreuther 2013 Genetic divergence predicts reproductive isolation in damselflies. – Journal of Evolutionary Biology 27: 76-87. .

Savchuk V.V. & E.A. Karolinskiy 2013 New Records of Rare Dragonflies (Insecta, Odonata) in Ukraine. – Vestnil Zoologii 47: 506.

Sawabe K., T. Uéda, K. Higashi & S.-M. Lee 2004 Genetic identity of Japanese *Sympetrum frequens* and Korean *Sympetrum depressiusculum* inferred from mitochondrial 16S rRNA sequences (Odonata: Libellulidae). – International Journal of Odonatology 7: 517-527.

Schmidt B. 2005 Erste Beobachtungen von *Boyeria irene* am Bodensee (Odonata: Aeshnidae). – Libellula 24: 31-37.

Schmidt B. & I. Strang 2005 Seltene Libellen am Bodensee - Arten der Flüsse und Brandungsufer – AGBU e.V. (Hrsg.), Thema des Monats August 2005, www.bodensee-ufer.de, Konstanz.

Schmidt E. 1929 Ordnung: Libellen. – Die Tierwelt Mitteleuropa 4: 1-66.

Schmidt E. 1950 Was ist *Libellula isoceles* O.F. Müller 1767? Entomologische Zeitschrift 60: 1-7 & 13.

Schmidt E. 1952 Libellensammelreise nach Sizilien, 1951. – Entomologische Zeitschrift 62: 6-14.

Schmidt E. 1956 Uber das neue *Agrion* aus Bayern (Odonata). – Entomologische Zeitschrift 66: 233-234.

Schmidt E. 1959. Versuch einer Analyse der Libelle *Agrion caerulescens* Fonsc., 1838. – Bulletin de l'Institut royal des Sciences naturelles de Belgique 35: 1-20.

Schmidt E. 1961 Ergebnisse der Deutschen Afghanistan-Expedition 1956 der Landessammlung für Naturkunde Karlsruhe sowie der Expedition J. Klapperich, Bonn 1952-53 und Dr. K. Lindberg, Lund (Schweden) 1957-60. Libellen (Odonata). – Beiträge zur naturkundlichen Forschung in Südwestdeutschland 19: 399-435.

Schmidt E.G. 1987 Generic reclassification of some West-Palaearctic Odonata taxa in view of their Nearctic affinities (Anisoptera: Gomphidae, Libellulidae). – Advances in Odonatology 3: 135-145.

Schmidt E.G. 1998 Die ökologische Nische von *Sympetrum flaveolum* (L., 1758) und die Problematik von Artenschutz und Einstufung in Rote Listen bei Odonaten mit temporärer Habitat-Besiedlung (Odonata: Libellulidae). – Entomologia Generalis 23: 129-138.

Schmidt E.G. 2001 Strittige systematische Fragen auf Gattungsniveau bei mitteleuropäischen Libellen (Odonata). – Abhandlungen und Berichte des Naturkundemuseums Görlitz 73: 69-77.

Schmidt E.G. 2012 Die ökologische Nische von *Sympetrum depressiusculum* in Nordwestdeutschland (Odonata: Libellulidae). – Libellula Supplement 12: 161-176.

Schneider T. & H.J. Dumont 2015 Odonata records from southern Iran. – Notulae odonatologicae, 8 (5): 117-155.

Schneider T. & O. Müller 2006 Der Endemit *Boyeria cretensis*: Beobachtungen zur Verhaltensbiologie der Imagines (Odonata: Aeshnidae). – Libellula 25: 135-146.

Schneider T., E. Schneider, J. Schneider, A. Vierstraete & H.J. Dumont 2015 *Aeshna vercanica* sp. nov. from Iran with a new insight into the *Aeshna cyanea*-group (Odonata: Aeschnidae). – Odonatologica 44: 81-106.

Schneider W. 1981 Eine Massenwanderung von *Selysiothemis nigra* (van der Linden, 1825) (Odonata: Macrodiplactidae) und *Lindenia tetraphylla* (van der Linden, 1825) (Odonata: Gomphidae) in Südjordanien. – Entomologische Zeitschrift 91: 97-102.

Schneider W. 1985 Die Gattung *Crocothemis* Brauer 1868 im Nahen Osten (Insecta: Odonata: Libellulidae). – Senckenbergiana biologica 66: 79-88.

Schneider W. 1986 Systematik und Zoogeographie der Odonata der Levante unter besonderer Berücksichtigung der Zygoptera. – Dissertation, Universität Mainz.

Schneider W. & F. Krupp 1996 A possible natural hybrid between *Ischnura elegans ebneri* Schmidt, 1939 and *Ischnura fountainei* Morton, 1905 (Odonata: Coenagrionidae). – Zoology of the Middle East 12: 75-81.

Schneider W.G. 1845 Verzeichnis der von Herrn Prof. Dr. Loew im Sommer 1842 in der Türkei und Kleinasien gesammelten Neuropteren nebst kurzer Beschreibung der neuen Arten. – Stettiner Entomologische Zeitung 6: 110-116, 133-135.

Schoch G. 1878 Analytische Tafeln zum Bestimmen der schweizerischen Libellen. – Mitteilungen der Schweizerischen Entomologischen Gesellschaft 5: 331-352.

Schoorl J.W. 2000 Notes on Central Asian dragonflies (Insecta: Odonata). – Zoologische Mededelingen 74: 205-213.

Schorr M. 1990 Grundlagen zu einem Artenhilfsprogramm Libellen der Bundesrepublik Deutschland. – Ursus Scientific Publishers and Societas Internationalis Odonatologica (S.I.O.), Bilthoven.

Schorr M. & J. Wolf 2012 Bibliografie der für Deutschland publizierten Libellenliteratur (Odonata). – Libellula Supplement 11: 1-420.

Schorr M., W. Schneider & H.J. Dumont 1998 Ecology and distribution of *Lindenia tetraphylla* (Insecta, Odonata, Gomphidae): a review. – International Journal of Odonatology 1: 65-88.

Schröter A. 2010a On a collection of dragonflies from eastern Georgia, with the first record of *Sympetrum arenicolor* (Odonata: Libellulidae). – Libellula 29: 209-222.

Schröter A. 2010b The Odonata of Kyrgyzstan, part 1 - Critical national checklist, annotated list of records and collected data of the summer half-years 2008 and 2009. – International Dragonfly Fund - Report 28: 1-72.

Schröter A. 2011 Review of the distribution of *Somatochlora sahlbergi* (Odonata: Corduliidae). – International Dragonfly Fund - Report 41: 1-27.

Schröter A. 2013 Zur verbreitung und Ölologie des zentralasiatischen Endemiten *Cordulegaster coronata* Morton, 1916. – 32. Jahrestagung der Gesellschaft deutschsprachiger Odonatologen.

Schröter A. & S.N. Borisov 2012 *Coenagrion scitulum* in Central Asia: a biogeographical analysis and rectification (Odonata: Coenagrionidae). – Libellula 31: 267-283.

Schröter A. & S. Karjalainen 2009 Hohtoukonkorento (*Aeshna affinis*) tavattiin Suomessa ensi kerran. – Crenata 2: 36-38.

Schröter A., T. Schneider, E. Schneider, S. Karjalainen & M. Hämäläinen 2012 Observations on adult *Somatochlora sahlbergi* - a species at risk due to regional climate change? (Odonata: Corduliidae). – Libellula 31: 41-60.

Schröter A., M. Seehausen, B. Kunz, A. Günther, T. Schneider & R. Jödicke 2015 Update of the Odonata fauna of Georgia, southern Caucasus ecoregion. – Odonatologica 44: 279-342.

Sciberras A. 2008 A contribution to the knowledge of Odonata in the Maltese Islands. – The Central Mediterranean Naturalist 4: 275-288.

Sciberras A., & M. Sammut 2008 On the occurrence of *Calopteryx virgo meridionalis* (Selys, 1873) (Odonata: Calopterygidae) in the Maltese islands. – Central Mediterranean Naturalist 4: 339-342.

Sciberras A. & M. Sammut 2013 The occurrence of the Copper Emerald *Calopteryx haemorrhoidalis* (Vander Linden, 1825), records of rare species, changing population trends of some hitherto common species and recent colonisers in the Maltese Islands. – Journal of the British Dragonfly Society 28: 1-9.

Sciberras A., J. Sciberras & B. Kunz 2010 *Orthetrum nitidinerve* new to the Maltese Islands (Odonata: Libellulidae). – Libellula 29: 55-60.

Selys Longchamps E. (de) 1837 Catalogue des Lépidoptères ou Papillons de la Belgique, précédé du tableau des Libellulines de ce pays. – Desoer, Liège.

Selys Longchamps E. (de) 1841 Nouvelles libellulidées d'Europe. – Revue zoologique 4: 243-246.

Selys Longchamps E. (de) 1846 Revision of the British Libellulidae. – Annals and Magazine of Natural History 18: 217-227.

Selys Longchamps E. (de) 1887 Odonates de l'Asie Mineure et révision de ceux des autres parties de la faune dite Européenne. – Annales de la Société entomologique de Belgique 31: 1-85.

Selys Longchamps E. (de) 1888 Catalogue raisonné des Orthoptères et des Névroptères de Belgique. – Annales de la Société entomologique de Belgique 32: 103-203.

Selys Longchamps E. (de) & H.A. Hagen 1850. Revue des Odonates ou Libellules d'Europe. – Roret, Paris.

SFO (Société française d'Odonatologie) 2013 *Hemianax ephippiger*: migration 2011. – Martinia hors-série, mai 2013.

Shapoval A.P. & P. Buczyński 2012 Remarkable Odonata caught in ornithological traps on the Courish Spit, Kaliningrad Oblast, Russia. – Libellula 31: 97-109.

Shengelia E.S. 1975 Strekozy Gruzii [Dragonflies of Georgia]. In: Materialy to Fauna Gruzii, 5. – Tbilisi, pp. 61-81.

Sjöstedt Y. 1914 Sländor, Pseudoneuroptera, 1, Odonata. – Svensk insektfauna 3: second edition, Stockholm.

Skvortsov V.E. 2010 The dragonflies of Eastern Europe and Caucasus: An illustrated guide. – Moscow, KMK Scientific Press Ltd.

Skvortsov V.E. & A.V. Kuvaev 2007 *Lindenia tetraphylla* (Vander Linden, 1825) and *Selysiothemis nigra* (Vander Linden, 1825) (Insecta, Odonata), new records for European Russia. – Eurasian Entomological Journal 6: 448-449.

Skvortsov V.E. & A.V. Kuvaev 2010 *Ischnura fountaineae* Morton, *Lindenia tetraphylla* (Vander Linden) and *Selysiothemis nigra* (Vander Linden) new for European Russia (Zygoptera: Coenagrionidae; Anisoptera: Gomphidae, Libellulidae). – Notulae odonatologicae 7 (5): 49-51.

Skvortsov V.E. & N.Y. Snegovaya 2014 Additions to the knowledge of the Odonata fauna of Azerbaijan, with six new records. – Notulae odonatologicae 8 (3): 37-76.

Skvortsov V.E. & N.Y. Snegovaya 2015 A second additions to the Odonata fauna of Azerbaijan. – IDF Report 87: 1-38.

Soinski M. 2015 Erster entwicklungsnachweis von *Zygonyx torridus* für Sizilien (Odonata, Libellulidae). – Libellula 34 (1/2): 85-89.

Sømme S. 1937 Contributions to the biology of Norwegian fish food animals. III, Zoogeographische Studien über Norwegische Odonaten. – Avhandlinger utgitt av Det Norske Videnskaps-Akademi i Oslo. I. Matematisk-naturvidenskapelig klasse 12: 1-133.

Sparrow D.J., R.L. Sparrow & G. De Knijf 2015 Odonata. – In: D.J. Sparrow & E. John (eds), An Introduction to the Wildlife of Cyprus. – Moufflon Publications.

Spuris Z. 1956 Strekozy Latviiskoi SSR [Dragonflies of the Latvian SSR]. – Akademiya Nauk Latviiskoi SSR, Riga.

Spuris Z. 1968 Zametki o rasprostranenii strekoz v Estonii. – Latvijas Entomologs 12: 72-76.

Spuris Z. 1980 Latvijas kukaiņu katalogs. 1. Spāres (Odonata). – Latvijas Entomologs 23: 5-19.

Spuris Z. 1988 The species composition of the dragonflies fauna of the USSR. – Latvijas Entomologs 31: 5-24.

Spuris Z. 1996 Latvijas kukaiņu katalogs. 12. Spāres (Odonata), papildinājums. – Acta hydroentomologica Latvica 3: 30-36.

Spuris Z. 1998 Red Data Book of Latvia, vol. 4, Invertebrates. – Institute of Biology, University of Latvia, Rīga.

St. Quentin D. 1964 Odonaten aus Anatolien und dem Irak. – Entomologische Mitteilungen des Zoologischen Staatsinstituts und Zoologischen Museums Hamburg 3: 5-7.

Stanionytė A. 1993 The check-list of dragonflies (Odonata) of Lithuania. – New and Rare for Lithuania Insect Species. Records and descriptions of 1993: 50-60.

Stark W. 1976 Die Libellen der Steiermark und des Neusiedlerseegebietes in monographischer Sicht. – Dissertation an der naturwissenschaftlichen Fakultät der Karl Franzens-Universität Graz.

Stauder A. 1991 Water fauna of a Madeiran stream with notes on the zoogeography of the Macaronesian Islands. – Boletim do Museu Municipal do Funchal 43: 243-299.

Staufer M. & O. Holuša 2010 First record of *Cordulegaster heros* in the Czech Republic, with notes on *Cordulegaster* spp. in southern Moravia (Odonata: Cordulegastridae). – Libellula 29: 197-204.

Stein J.P.E.F. 1863 Beitrag zur Neuropteren-Fauna Griechenlands (mit Berücksichtigung dalmatinischer Arten). – Berliner Entomologische Zeitschrift 7: 411-422.

Steinman H. 1986 The odonate fauna of the Kiskunság National Park. In: S. Mahunka (ed.), The Fauna of the Kiskunság National Park I. – Akadémiai Kiadó, Budapest: 85-91.

Stenson J.A.E. & M.O.G. Eriksson 1989 Ecological Mechanisms Important for the Biotic Changes in Acidified Lakes in Scandinavia. – Archives of Environmental Contamination and Toxicology 18: 201-206.

Sternberg K. & R. Buchwald 1999 Die Libellen Baden-Würtembergs. Band 1: Algemeiner Teil, Kleinlibellen (Zygoptera). – Verlag Eugen Ulmer, Stuttgart.

Sternberg K. & R. Buchwald 2000 Die Libellen Baden-Würtembergs. Band 2: Großlibellen (Anisoptera), Literatur. – Verlag Eugen Ulmer, Stuttgart.

Stobbe H. 2012 Besondere Libellenfunde auf Kreta im Oktober 2011 (Odonata). – Libellula 31: 251-256.

Stoks R., J.L. Nystrom, M.L. May & M.A. McPeek 2005 Parallel evolution of ecological and reproductive traits to produce cryptic dragonfly species across the Holarctic. – Evolution 59: 1976-1988.

Straka V. 1985 Bibliografia vážok (Odonata) Slovenska. – Biológia, Bratislava 40: 1091-1095.

Straka V. 1990 Vážky (Odonata) Slovenska. – Zborník Slovenského Národného Múzea, Prírodné Vedy (Bratislava) 36: 121-147.

Strien A.J. van , T. Termaat, D. Groenendijk, V. Mensing & M. Kéry 2010 Site-occupancy models may offer new opportunities for dragonfly monitoring based on daily species lists. – Basic and Applied Ecology 11: 495-503.

Strien A.J. van, C.A.M. van Swaay & M. Kéry 2011 Metapopulation dynamics in the butterfly *Hipparchia semele* changed decades before occupancy declined in The Netherlands. – Ecological Applications 21: 2510-20.

Strien A.J. van, T. Termaat, V.J. Kalkman, M. Prins, G. De Knijf, A.L. Gourmand, X. Houard, B. Nelson, C. Plate, S. Prentice, E. Regan, D. Smallshire, C. Vanappelghem & W. Vanreuse 2013 Occupancy modelling as a new approach to assess supranational trends using opportunistic data: a pilot study for the damselfly *Calopteryx splendens*. – Biodiversity Conservation 22: 673-686.

Striniqi A., K. Misja & J. Oga 2010 Larvae of Odonata as Indicators of Water Pollution in Lake Shkodra. – BALWOIS Conferences publications, Ohrid, Republic of Macedonia 25-29 May 2010.

Sugimura M., S. Ishida, K. Kojima, K. Ishida & T. Aoki 2001 Dragonflies of the Japanese Archipelago in Colour. – Hokkaido University Press, Sapporo.

Suhling F. & E. Marais 2010 *Crenigomphus kavangoensis* sp. nov. from the Okavango River, Namibia (Odonata: Gomphidae). – International Journal of Odonatology 13: 267-276.

Suhling F. & A. Martens 2007 Dragonflies and Damselflies of Namibia. – Gamsberg Macmillan Publishers, Windhoek, Namibia.

Suhling F. & O. Müller 1996 Die Flußjungfern Europas. Gomphidae. – Die Neue Brehm-Bücherei, 628, Westarp-Wissenschaften.

Suhling F., R. Jödicke & W. Schneider 2003 Odonata of African arid regions - are there desert species? – Cimbebasia 18: 207-224.

Suhling F., G. Sahlén, S. Gorb, V.J. Kalkman, K-D.B. Dijkstra & J. van Tol 2015 Order Odonata. – In: J. Thorp & D.C. Rogers (eds.), Ecology and General Biology – Thorp and Covich's Freshwater Invertebrates, Academic Press: 893-932.

Sutton G. 2012 Durrellian Odyssey - An entomological journey to the island of Corfu. – Antenna 36: 224-233.

Suvorov A. 2011 Comparative molecular genetics of *Nehalennia speciosa* (Charpentier) from geographically distant populations (Zygoptera: Coenagrionidae). – Odonatologica 40: 131-136.

Švitra G. 2010 Data on eight protected species of dragonflies (Odonata) recorded in Lithuania in 2003-2009. – New and Rare for Lithuania Insect Species 21: 5-11.

Švitra G. & B. Gliwa 2008 New records of *Nehalennia speciosa* (Charpentier, 1840) (Odonata, Coenagrionidae) in Lithuania in 2006-2008. – New and Rare for Lithuania Insect Species 20: 10-13.

Swaegers J.U., S.B. Janssens, S. Ferreira, P.C. Watts, J. Mergeay, M.A. McPeek & R. Stoks 2014 Ecological and evolutionary drivers of range size in *Coenagrion* damselflies. – Journal of Evolutionary Biology 27: 2386-2395.

Swammerdam J. 1669 Historia insectorum generalis. – Meinard van Dreunen, Utrecht.

Tailly M., V. Ananian & H.J. Dumont 2004 Recent dragonfly observations in Armenia with an updated checklist. – Zoology in the Middle East 31: 93-102.

Tatarinov A.G. & O.I. Kulakova 2009 Fauna of the European North-East of Russia, volume 10, Odonata. – Nauka Publishing House.

Taylor P. 2013 A change in status of the Willow Emerald Damselfly *Lestes viridis* (Vander Linden) in the United Kingdom. – Journal of the British Dragonfly Society 29: 40-45.

Taylor P., D. Smallshire & A. Parr 2009 Revised list of Odonata recorded in the United Kingdom. – Journal of the British Dragonfly Society 25: 57-61.

Tellez D. & J.-L. Dommanget 2009 *Lindenia tetraphylla* (Vander Linden, 1825) en Corse du sud (Odonata: Anisoptera: Gomphidae). – Martinia 25: 117.

Temple H.J. & N.A. Cox 2009 European Red List of Amphibians. – Office for Official Publications of the European Union, Luxembourg.

Termaat T. & V.J. Kalkman 2012 Basisrapport Rode Lijst Libellen 2011 volgens Nederlandse en IUCN-criteria. – Brachytron 14: 75-187.

Ternois V. 2005 Sur la présence d'*Orthetrum albistylum* (Selys, 1848) dans le Parc naturel régional de la Forêt d'Orient et le Nord-Est aubois (Odonata, Anisoptera, Libellulidae). – Martinia 21: 59-68.

Ternois V. 2006 L'Orthétrum à stylets blancs *Orthetrum albistylum* (Selys, 1848) dans le Parc naturel régional de la Forêt d'Orient et le Nord-Est aubois : quelques précisions (Odonata, Anisoptera, Libellulidae). – Naturale 1: 51-54.

Ternois V. & D. Druart 2008 Nouvelles observations d'Orthétrum à stylets blancs *Orthetrum albistylum* (Selys, 1848) dans le département de la Haute-Marne (Odonata, Anisoptera, Libellulidae). – Bulletin de la Société de Sciences naturelles et d'Archéologie de la Haute-Marne, 7 (NS): 14-17.

Ternois V. & E. Fradin (coord.) 2014 Pré-atlas des Odonates de Champagne-Ardenne. Bilan cartographique des programmes INVOD et CILIF (Actualisation 2013). – Société française d'Odonatologie (Champagne-Ardenne).

Ternois V., E. Fradin, A. Gajdos & J.-L. Lambert (coord.) 2013 Pré-atlas des Odonates de Champagne-Ardenne. Bilan cartographique des programmes INVOD et CILIF. Actualisation 2013. – Société française d'Odonatologie (Champagne-Ardenne).

Testard P. 1975 Note sur l'émergence, le sex-ratio et l'activité des adultes de *Mesogomphus genei* Selys, dans le sud d'Espagne (Anisoptera: Gomphidae). – Odonatologica 4: 11-26.

Theischinger G. 1979 *Cordulegaster heros* sp. nov. und *Cordulegaster heros pelionensis* ssp. nov., zwei neue Taxa des *Cordulegaster boltonii* (Donovan)-Komplexes aus Europa (Anisoptera: Cordulegasteridae). – Odonatologica 8: 23-38.

Theischinger G. & I. Endersby 2009 Identification guide to the Australian Odonata. – Department of Environment, Climate Change and Water, New South Wales.

Thompson D.J. & P.C. Watts 2006 The structure of the *Coenagrion mercuriale* populations in the New Forest, southern England. In: A. Cordero-Rivera (ed.), Forests and dragonflies. – Pensoft Publishers, Sofia.

Tjønneland A. 1953 A contribution to the zoogeography of Norwegian dragonflies. – Universitetet i Bergen, Naturvitenskapelig rekke, årbok N° 17.

Tończyk G. & S. Mielewczyk 2007 Ważki Odonata. In: W. Bogdanowicz, E. Chudzicka, I. Pilipiuk, E. Skibińska (eds), Fauna Polski. Charakterystyka i wykaz gatunków. – Muzeum i Instytut Zoologii PAN, Warszawa 2: 293-314.

Torralba-Burrial A. 2009 Estado ecológico, comunidades de macroinvertebrados y de Odonatos de la red fluvial de Aragón. – Doctoral thesis. – Consejo Económico y Social de Aragón, Zaragoza.

Torralba-Burrial A. & F.J. Ocharan 2005 Catálogo de los odonatos de Aragón. – Catalogus de la Entomofauna Aragonesa 32: 3-25.

Torralba-Burrial A., F.J. Ocharan, D. Outomuro, M. Azpilicueta-Amorín & A. Cordero-Rivera 2012 *Gomphus graslinii*. In: Bases ecológicas preliminares para la conservación de las especies de interés comunitario

en España: Invertebrados. – Ministerio de Agricultura, Alimentación y Medio Ambiente, Madrid.

Trockur B. 2004 Untersuchungen zur Habitatwahl von *Epitheca bimaculata* Charpentier, 1825. – Dissertation, Institut für Naturschutz und Umweltbildung der Hochschule, Vechta, Germany.

Trockur B., J.-P- Boudot, V. Fichefet, P. Goffart, J. Ott & R. Proess 2010 Atlas der Libellen / Atlas des libellules (Insecta, Odonata); Fauna und Flora in der Großregion / Fauna et Flore dans la Grande Région. – Zentrum für Biodokumentation, Landsweiler-Reden.

Trpiš M. 1957 Predbežný prehľad vážok (Odonata) Žitného ostrova. – Biológia, Bratislava 12: 433-447.

Trpiš M. 1965 Poznatky o vážkach (Odonata) Tatranského národného parku. – Sborník prác o Tatranskom národnom parku, Osveta Martin 8: 71-78.

Trpiš M. 1969 Vážky (Odonata) východného Slovenska. – Acta rerum naturalium Musei nationalis Slovaci, Bratislava 15 (2): 31-38.

Trueman J.W.H. 2007 A brief history of the classification and nomenclature of Odonata. – Zootaxa 1668: 381-394.

Turgeon J. & M.A. McPeek 2002 Phylogeographic analysis of a recent radiation of *Enallagma* damselflies (Odonata: Coenagrionidae). – Molecular Ecology 11: 1989-2001.

Turgeon J., R. Stoks, R.A. Thum, J.M. Brown, M.A. McPeek 2005 Simultaneous Quaternary radiations of three damselfly clades across the Holarctic. – American Naturalist 165: 75-107.

Tuxen S.L. 1976 Odonata. In: E. Munksgaard (ed.), The Zoology of Iceland. – Copenhagen & Reykjavik.

Tytar V.M. 2007 The First Record of *Selysiothemis nigra* (Insecta, Odonata) from Ukraine. – Vestnik Zoologii 41: 122.

Uboni C., N. Bessi & A. Colla 2007 Una popolazione urbana di *Cordulegaster heros* Theischinger, 1979 in Italia (Odonata, Cordulegastridae). – Atti del Museo civico di Storia naturale di Trieste 53 (2006): 207-211.

Uboni C., G. Nadalon & A. Schröter 2015 Evidence of breeding of *Selysiothemis nigra* in the regions of Friuli Venezia Giulia and Veneto, northeastern Italy (Odonata: Libellulidae). – Notulae odonatologicae 8 (5): 128-136.

Ulmer A. 2011 *Sympetrum pedemontanum* (Allioni, 1766) nouveau pour les départements de la Loire et de la Haute-Loire, et sites majeurs pour *S. depressiusculum* (Selys, 1841) dans ces deux départements. – Martinia 27: 95-100.

Urbański J. 1948 Krytyczny przegląd ważek (Odonata) Polski. – Annales Universitatis Mariae Curie-Skłodowska C 3: 289-317.

Utzeri C. & C. D'Antonio 2005 Insecta Odonata. In: S. Ruffo & F. Stoch (eds), Checklist e distribuzione della fauna italiana. 10.000 specie terrestri e delle acque interne. – Memorie del Museo civico di Storia naturale di Verona, seconda serie, Sezione Scienze della Vita: 131-132.

Utzeri C., C. Belfiore & F. Peels 2006 Some new records of *Lindenia tetraphylla* (Vander Linden) in Italy (Anisoptera: Gomphidae). – Notulae odonatologicae 6 (8): 90-92.

Valle K.J. 1922 Suomen sudenkorennoiset. – Otava, Helsinki.

Valle K.J. 1931 Materialien zur Odonatenfauna Finnlands. II. *Somatochlora sahlbergi* Trybom. – Notulae entomologicae 11: 41-51.

Valle K.J. 1952a Die Odonatenfauna von Zypern. – Commentationes biologicae 13 (5): 1-8.

Valle K.J. 1952b Die Verbreitungsverhältnisse der ostfennoskandischen Odonaten. – Acta entomologica Fennica 10: 1-87..

Valle K.J. 1952c Sudenkorennot, Odonata (Suomen eläimet Animalia Fennica 7). – Helsinki, Porvoo.

Valletta A. 1949 A preliminary list of the Odonata of the Maltese Islands. – The Entomologist 82: 85-87.

Valletta A. 1957 Second contribution to the Odonata of the Maltese Islands. – The Entomologist 90: 306-307.

Valtonen P. 1980 Die Verbreitung der finnischen Libellen (Odonata). – Notulae entomologicae 60: 199-215.

Valtonen P. 1988 *Aeshna crenata* Hagen in Finland. – Notulae odonatologicae 3 (2): 28-31.

Valtonen P. 2010 Sudenkorennot / Dragonflies and damselflies , Odonata. In: P. Rassi, E. Hyvärinen, A. Juslén & I. Mannerkoski (eds), The 2010 Red List of Finnish Species. – Ympäristöministeriö & Suomen ympäristökeskus, Helsinki.

Van Swaay C.A.M., D. Groenendijk, T. Termaat & C.L. Plate 2010 Vlinders en libellen geteld. Jaarverslag 2009. – Rapport VS2010.001, De Vlinderstichting, Wageningen.

Vanappelghem C. & F. Veille 2001 Observations de *Leucorrhinia rubicunda* (L., 1758) dans le Nord-Pas-de-Calais en 2000 (Odonata, Anisoptera, Libellulidae). – Martinia 17: 91-94.

Vandelli D. 1797 Floræ et faunæ lusitanicæ specimen. – Memorias da Academia Real das Sciencias de Lisboa 1: 37-79.

Vander Linden P.L. 1825 Monographiae Libellulinarum Europearum Specimen. – J. Frank, Bruxelles.

Verdú J.R. & E. Galante 2009 Atlas de los Invertebrados Amenazados de España (Especies en Peligro Crítico y en Peligro). – Madrid: Direccion General para la Biodiversidad, Ministerio de Medio Ambiente.

Verdú J.R., C. Numa & E. Galante 2011 Atlas y Libro Rojo de los Invertebrados Amenazados de España (Especies Vulnerables). – Madrid: Dirección General de Medio Natural y Política Forestal, Ministerio de Medio Ambiente, Medio Rural y Marino.

Vick G.S. 1989 List of the dragonflies from Nepal, with a summary of their altitudinal distribution (Odonata). – Opuscula zoologica fluminensia 43: 1-21.

Vieira V. & A. Cordero-Rivera 2013 New data on the Odonata fauna from Graciosa Island (Azores). – Arquipélago. – Life and Marine Sciences 30: 79-82.

Vieira V. & A. Cordero-Rivera 2015 First record of *Pantala flavescens* from the Azores (Odonata: Libellulidae). – Odonatologica 44: 1-9.

von Ellenrieder N. 2002 A phylogenetic analysis of the extant Aeshnidae (Odonata: Anisoptera). – Systematic Entomology (London) 27: 1-31.

von Ellenrieder N. 2003 A synopsis of the Neotropical species of '*Aeshna*' Fabricius: the genus *Rhionaeschna* Förster (Odonata: Aeshnidae). – Tijdschrift voor Entomologie 146: 67-207.

Vonwil G. 2005 *Sympetrum depressiusculum*. In: H. Wildermuth, Y. Gonseth & A. Maibach (eds) 2005 Odonata. Les Libellules de Suisse. Fauna Helvetica 11. Centre Suisse de Cartographie de la Faune & Schweizerische Entomologische Gesellschaft, Neuchâtel. 344-347.

Waldhauser M. 2009 První nález šidélka lindenova, *Erythromma lindenii* (Sélys, 1840) (Odonata, Coenagrionidae) v České republice. – Bulletin Lampetra 6: 26-29.

Walhauser M. & M. Černý 2014 Vážky České republiky - příručka pro určování našich druhů a jejich larev. – Český svaz ochránců přírody Vlašim.

Wallengren H.D.J. 1894 Öfversikt av Skandinaviens Pseudoneuroptera, I - Fam. Odonata Fabr. – Entomologisk Tidskrift 15: 235-270.

Ware J., M. May & K. Kjer 2007 Phylogeny of the higher Libelluloidea (Anisoptera: Odonata): an exploration of the most speciose superfamily of dragonflies. – Molecular Phylogenetics & Evolution 45: 289-310.

Wasscher M. 1999 Bedreidigde en kwetsbare libellen in Nederland (Odonata). Basisrapport met voorstel voor de Rode lijst. – Stichting EIS-Nederland, Leiden.

Waterston A.R. 1976 On the genus *Cordulegaster* Leach, 1815 (Odonata) with special reference to the Sicilian species. – Transactions of the Royal Society of Edinburgh 69: 457-466.

Waterston A.R. 1980 Insects of Saudi Arabia, Odonata. – Fauna of Saudi Arabia 2: 57-70.

Watts P.C., S.J. Kemp, I.J. Saccheri & D.J. Thompson 2005 Conservation implications of genetic variation between spatially and temporally distinct colonies of the damselfly *Coenagrion mercuriale*. – Ecological Entomology 30: 541-547.

Weekers P.H.H. & H.J. Dumont 2004 A molecular study of the relationship of the coenagrionid genera *Erythromma* and *Cercion*, with the creation of *Paracercion* gen. nov. for the East Asiatic "*Cercion*" (Zygoptera: Coenagrionidae). – Odonatologica 33: 181-188.

Weekers P.H.H., J.F. De Jonckheere. & H.J. Dumont 2001 Phylogenetic relationships inferred from ribosomal ITS sequences and biogeographic patterns in representatives of the genus *Calopteryx* (Insecta: Odonata) of the West Mediterranean and adjacent West European zone. – Molecular Phylogenetics & Evolution 20: 89-99.

Weihrauch F. 2011 A review of the distribution of Odonata in the Macaronesian Islands, with particular reference to the *Ischnura* puzzle. – Journal of the British Dragonfly Society 27: 28-46.

Weihrauch F. & S. Weihrauch 2003 Spring odonata records from Alentejo (Portugal), Andalusia and Extremadura (Spain). – Opuscula zoological fluminensia 207: 1-18.

Weihrauch F. & S. Weihrauch 2006 Records of protected dragonflies from Rio Tera, Zamora province, Spain (Odonata). – Boletín S.E.A. 38: 337-338.

Weihrauch F., K. Burbach, U. Hölken, H.J. Netz & C. Stettmer 2003 Neue Nachweise von *Orthetrum albistylum* aus Bayern (Odonata: Libellulidae). – Libellula Supplement 4: 59-70.

Weihrauch F., A. Karle-Fendt, J.E. Krach, M. Lohr & R. Seidenbusch 2011 *Coenagrion scitulum* in Bayern: Richtigstellung und Statusbericht (Odonata: Coenagrionidae). – Libellula 30: 33-42.

Wesenberg-Lund C. 1913a Mitteilungen aus den biologischen Süßwasserlaboratorien Hilleröd u. Lyngby (Dänemark). Nr. XVI. Odonaten-Studien. – Internationale Revue der gesamten Hydrobiologie und Hydrographie 6 (2-3): 155-228.

Wesenberg-Lund C. 1913b Odonaten-Studien. – Internationale Revue der gesamten Hydrobiologie und Hydrographie 6 (4-5): 373-422.

Westfall M.J. & M.L. May 2000 Damselflies of North America, revised edition. – Gainesville: Scientific Publishers.

Wikelski M., D. Moskowitz, J. Adelman, J. Cochran, D. Wilcove & M. May 2006 Simple rules guide dragonfly migration. – Biology Letters, Royal Society, London 2: 325-329.

Wildermuth H. 2001 Das rotationsmodell zur Pflege kleiner Moorgewässer. Simulations naturgemässer dynamik. – Naturschutz und Landschaftsplanung 33 (9): 269-273.

Wildermuth H. 2008 Die Falkenlibellen Europas. – Die Neue Brehm-Bücherei, Westarp-Wissenschaften.

Wildermuth H. & D. Küry 2009a Libellen schützen, Libellen fördern: Leitfaden für die Naturschutzpraxis. – Schweizerische Arbeitsgemeinschaft Libellenschutz (SAGLS), Pro Natura, Basel.

Wildermuth H. & D. Küry 2009b Protéger et favoriser les libellules. Guide pratique de protection de la nature. – Groupe de travail pour la conservation des libellules de Suisse (GTCLS), Pro Natura, Bâle.

Wildermuth H. & P. Knaus 2002 The impact of incidental summer snowfall on two alpine metapopulations of *Somatochlora alpestris* (Selys) (Anisoptera: Corduliidae). – Odonatologica 31: 55-63.

Wildermuth H., Y. Gonseth & A. Maibach (eds) 2005 Odonata, Die Libellen der Schweiz. – Fauna Helvetica 12. – Centre Suisse de Cartographie de la Faune & Schweizerische Entomologische Gesellschaft, Neuchâtel.

Willet J. 2013 Species Review 7: The Azure Hawker *Aeshna caerulea* (Ström). – Journal of the British Dragonfly Society 29: 1-19.

Wilson K.D.P. & Z. Xu 2009 Gomphidae of Guangdong & Hong Kong, China (Odonata: Anisoptera). – Zootaxa 2177: 1-62.

Wnukowsky W. 1937 Beiträge zur Kenntnis der Odonaten-Fauna Weiss-Russlands (Weiss-Rutheniens). In: Festschrift zum 60. Geburtstage von Professor Dr. Embrik Strand. – Riga 3: 568-581.

Yanybaeva V.A. 1999a Kharakteristike odonatofauny Bashkirskogo zapovednika [To the characteristics of the fauna of dragonflies in the Bashkir Reserve]. – Izuchenie Prirody v Zapovednikah Baskortostana 1: 200-203.

Yanybaeva V.A. 1999b O novykh nakhodkakh strekoz Yuzhnogo Urala. - [New data on dragonflies of South Ural] [On New Findings of Odonates in the Southern Urals]. In: Fauna i flora Respubliki Bashkortostan: problemy ikh izucheniya i okhrany [Fauna and Flora of Bashkortostan: Problems in Studies and Conservation]. – Ufa: 65-69.

Yanybaeva V.A., H.J. Dumont, A.Y. Haritonov & O.N. Popova 2006 The Odonata of South Ural, Russia, with special reference to *Ischnura aralensis* Haritonov, 1979. – Odonatologica 35: 167-185.

Yong H.S., P.-E. Lim, J. Tan, Y.D. Ng, P. Eamsobhana & I.W. Suana 2014 Molecular phylogeny of *Orthetrum* dragonflies reveals cryptic species of *Orthetrum pruinosum*. – Scientific Reports DOI: 10.1038/srep05553.

Yu X, G.-H. Yang & W.-J. Bu 2008 A study of the genus *Pyrrhosoma* from China with description of a new species (Odonata, Coenagrionidae). – Acta Zootaxonomica Sinica 33: 358-362.

Yum J.W., H.Y. Lee & Y.J. Bae 2010 Taxonomic Review of the Korean Zygoptera (Odonata). – Entomological Research Bulletin 26: 41-55.

Zawal A., S. Stojanovski & S. Smiljkov 2010 Preliminary investigations of odonata from the lake Ohrid (Macedonia). – Biotechnology & Biotechnological Equipment 24: 636-638.

Zimmermann W., F. Petzold & F. Fritzlar 2005 Verbreitungsatlas der Libellen (Odonata) im Freistaat Thüringen. – Naturschutzreport 22, Thüringen.

Znamierowska M. 1923 Ważki okolic Wilna. – Prace Towarzystwa Przyjaciół Nauk w Wilnie mat. przyr. 1 (2): 1-11.

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