Atlas of the dragonflies and damselflies of West and Central Asia

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Preface

Until the 1970s, it could be argued that the distribution of dragonflies in any geographical area reflected the distribution of odonatologists rather than that of odonates. That was true of the tropics, of course, but also of the Holarctic.

As well, among the numerous insect orders, large-sized, charismatic and colorful groups like butterflies and carabid beetles attracted many amateurs, collecting and studying them. Dragonflies still remained the domain of few, although dedicated students.

All that started changing in the 1970s and into the 1980s. It is no coincidence that this was the time when personal computers became widely available, small, and ever more powerful. Photographic cameras improved tremendously as well and pictures could be stored on laptops. Dragonfly digital photography became a giant success. With the growing concern over the environment, a type of nature lover was born that did not carry a net but a camera, and attempted to identify the animals on his pictures to species. In fact, this is now feasible in all majority of cases. Dragonflies became popular. Odonatologists can now be spotted in the field, not only by their hand net but, like ornithologists, by their binoculars. Voucher specimens are still collected, but only as necessary for research. The next step will probably be that field workers will carry a wrist computer coupled to a hand-held DNA sequencer, the size of an USB-shield.

The 1980s were also the time when ever more sophisticated software programs were written that allowed the storage of data, recording where exactly a species had been seen or collected. The inflow of such distribution data for Europe only currently runs in the hundreds of thousands of records per annum. Most west European countries can now be considered (almost) fully explored. So, time has come to turn east, into West Asia, and that is exactly what the present study is offering.

Most commendable about it is the large number (24) of political units (countries) covered. Starting in the west with Anatolia, the Levant, the island of Cyprus and the Sinai, it includes the Arabian Peninsula and the island of Socotra, far out into the Indian Ocean. Overland it goes on to the Caucasian states, Iran, and the semi-arid countries bordering the Caspian Sea. Although Kazakhstan is not explicitly included, about 90 % of its fauna is covered, as well as that of mountain states like Uzbekistan, Kyrgyzstan and Tajikistan. Afghanistan is the only large and biogeographically important country that is only marginally represented, for obvious reasons. There is only a handful of studies dealing with that important state at the border of the Palaearctic. However, by and large it can be said that this study covers the giant piece of Eurasia between the Mediterranean and the Oriental.

Altogether about 173 species are discussed. This number is not final because taxonomic problems waiting to be solved still persist in *Calopteryx* and *Cordulegaster*. Moreover, the possibility remains that additional species will be found and described. Since two new *Onychogomphus* were discovered within the last decade in the western Mediterranean, such a possibility can indeed not be excluded.

Each species is accompanied by a concise text with background information about its range, ecology and other points of interest. A color picture, usually of the male, and usually of excellent quality is also given. However, it should be stressed that this work does not claim to be an identification guide, and often, a single picture will not be enough to arrive at a credible identification to species. For a full identification, the reader is advised to turn to the specialized literature.

With this in the back of my mind, I have only one word for the authors of this work: Bravo!

Henri J. Dumont
Teralfene, August 2021

Cordulegaster picta

Robert Pieters

Atlas of the dragonflies and damselflies of West and Central Asia

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Abstract

Based on a database of nearly 46,000 records (a species on a day at a location) the distribution of all 173 species of dragonflies and damselflies occurring in the 24 countries of West and Central Asia is presented. For practical reasons, Kazakhstan is not included in this atlas but Afghanistan is. Distributions are shown for two time periods: prior to 1990 (approximately 13,000 records) and from 1990 onwards (approximately 33,000 available records). The fauna of the region is a mixture of species of African, Oriental and Palearctic origin with, in total, 25 species being endemic to the region and another 25 species being near endemic with roughly over 80% of their world range found in the region. For each species, a short text is provided containing additional information on taxonomy, general and regional distribution, and also habitat preference. This is accompanied by at least one picture of an adult. The introduction contains a summary of the history of the study of dragonflies in each country of the region, including references to the most relevant papers. The article ends with a checklist tabulating the presence of each species in each of the relevant countries, and with a table showing the flight period of all species.

Introduction

Although the study of dragonflies and damselflies had already begun in the 18th century, for a long time our detailed understanding of the distribution of species from the Western Palearctic was very poor. Only at the turn of the last century was more detailed information on distribution starting to become available, as a result of a steady flow of national or regional distribution atlases being published. These included those covering Britain and Ireland (Merrit et al. 1996, Cham et al. 2014), Slovenia (Kotarac 1997), the Netherlands (Nederlandse Vereniging voor Libellenstudie 2002), Switzerland (Wildermuth et al. 2005), Belgium (De Knijf et al. 2006), Turkey (Kalkman & Van Pelt 2006), Austria (Raab et al. 2006), Central Asia (Borisov & Haritonov 2007, 2008), Estonia (Martin et al. 2008), Extremadura (Sanchez Garcia et al. 2009), Poland (Bernard et al. 2009), Greece (Lopau 2010), Russia & Caucasus (Skvortsov 2010), Italy (Riservato et al. 2014), Germany (Brockhaus et al. 2015) and Cataluña (Martin et al. 2016). The Atlas of the Odonata of the Mediterranean and North Africa (Boudot et al. 2009) provided an overview of species distribution for a large part of the southern section of the Western Palearctic, while the Atlas of the European dragonflies and damselflies (Boudot & Kalkman 2015) presented species distributions from the Azores to the Urals at a 50 x 50 km UTM

grid square resolution. An overview of the distribution of species in the remainder of the Palearctic region remains wanting, although an increasing amount of distribution data has become available in the literature. With the present Atlas, we fill part of this gap by providing distribution maps which cover Central Asia (Tajikistan, Kyrgyzstan, Uzbekistan, Turkmenistan and Afghanistan) and the whole of West Asia, including Turkey, the South Caucasian countries (Georgia, Armenia and Azerbaijan), Iran, Iraq, the Levant (Cyprus, Syria, Lebanon, Israel and Palestine) and the entire Arabian Peninsula up to Oman, Yemen and the United Arab Emirates. Some areas in this territory have previously been covered by national Atlases; however, as many recent and important records have since appeared, an update was needed.

Methods

Area under consideration

This atlas deals with the distribution of all dragonflies and damselflies found in West and Central Asia. All species recorded from the countries shown in Figure 1 are included in this atlas, with the exception of those which are only recorded from the European part of Turkey. Kazakhstan, which in most cases is considered to be a part of Central Asia, is not included in this atlas as this country is large, poorly explored and has a predominantly Palearctic fauna with many boreal species not found in other parts of our region.

Database

The database on which this atlas is based is the result of over two decades of work by the senior author, and is thought to contain all records

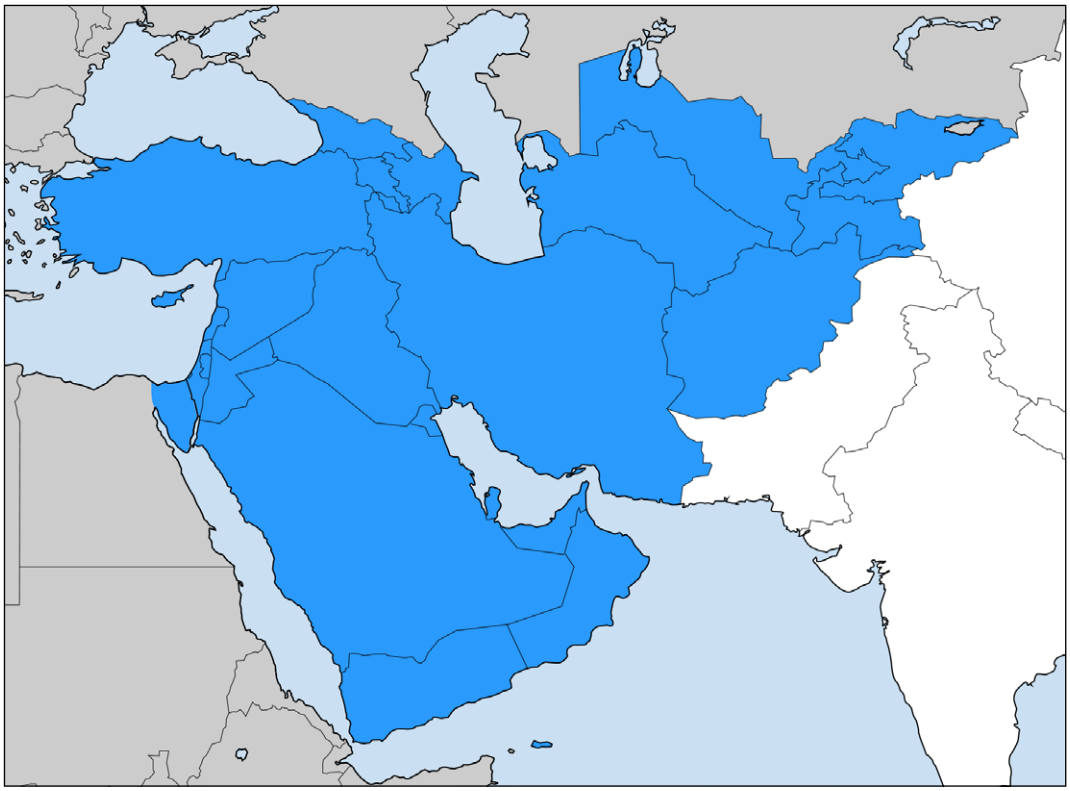


Figure 1. Countries included in this atlas. Blue: countries for which all known species are included in the atlas; grey: countries for which the range is shown for species occurring in the blue area, but for which not all species are included; white: countries (China, Pakistan, India) for which no records are shown.

Figure 2. Definition of geographical regions as used in this publication. [Central Asia, Levant, Arabian Peninsula, South Caucasus and Iran, Iraq & Turkey].

published in the standard scientific literature. In addition, it includes numerous unpublished records from the area, either from the authors themselves, or those communicated by various other observers, included in internet photo galleries or available on the citizen science recording portal Observation.org. Some existing databases have been merged into this database, the larger ones including those made for Turkey (Kalkman & Van Pelt 2006) and for the South Caucasus by Vasil Ananian. In total, nearly 46,000 records are available from the countries under consideration: approximately 13,000 records prior to 1990 and 33,000 from 1990 onwards. All records used for this atlas have been made available through GBIF, together with data collected by the senior author from other regions in the Palearctic. The data used for this atlas is available through GBIF, it can be found using: https://doi.org/10.15468/gt3j2u.

Distribution maps and coverage of data

The distribution of each taxon is shown based on a 50 x 50 km UTM grid (WGS84 geodesic system). Records prior to 1990 are depicted with red dots and those from 1990 onwards with blue dots. Uncertain but plausible records are depicted with green dots. Aberrant records due to obvious species misidentification and records of low reliability which have appeared in journals with poor peer review have been rejected. Figure 3 shows the distribution of all available records prior to 1990 and Figure 4 the distribution of records from 1990 onwards. Some countries such as Turkey, Iran, Cyprus, Georgia, Armenia and Oman, have been extensively explored in the past few decades. Other areas have for obvious (Afghanistan and Iraq) or less obvious reasons (Israel) received far less attention. In addition, the Arabian Peninsula, Iran and parts of Central Asia include large tracts of desert for which very few distribution records

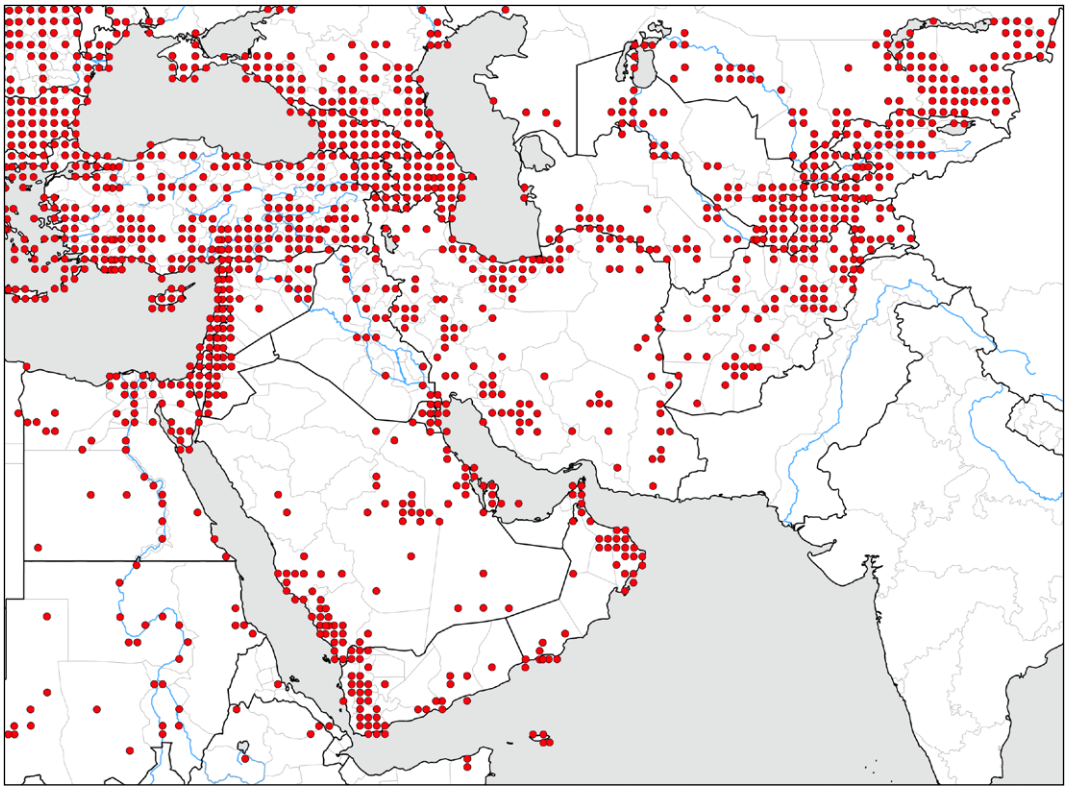


Figure 3. Distribution of records of dragonflies prior to 1990.

are available. This reflects the scarcity of water and therefore of dragonflies; however, it is likely that some widespread species with a strong dispersal ability, such as *Anax ephippiger*, *Pantala flavescens*, *Lindenia tetraphylla* and *Selysiothemis nigra*, could be found in these areas at least as migrants. The scarcity or lack of data in some regions should be taken into account when judging the distribution patterns based on the maps. However, in our opinion, the density of observations is such that the general distribution patterns shown on the maps are trustworthy. Nonetheless, major surprises could still be found everywhere in the region. Most notably, Yemen, Oman and the western part of Saudi Arabia are likely places for the discovery of Afrotropical species not yet known from the region, while Oman, southeast Iran and Afghanistan are likely places to record additional species from the Oriental region. An example of the latter is the recent finding of *Diplacodes trivialis*, which is believed to have been brought to Masirah Island (Oman) by cyclone Kyarr, which impacted the Indian Ocean during late October 2019 (Dobson & Childs 2019). The description as “new to science” of the large and rather striking *Aeshna vercanica* as recently as 2015 shows that new species can still be discovered in the area. The extensive work done in Iran (Schneider & Ikemeyer 2019) and in the south of the Arabian Peninsula (numerous papers 1991–2019) renders the likelihood of finding new species to science more limited in these regions. The area with the greatest potential for the discovery of undescribed species is Afghanistan. Fewer than 300 records are available from this huge country, with the most recent records being from 1977. Finding species new to the region or even new to science is no longer easy, but there are many other ways to increase our knowledge of the region. A good example of this is the recent advances made in our understanding of the range and distribution of the near-endemic *Urothemis thomasi*, together with the description of its last instar larva (Chelmick et al. 2016, Lambret et al. 2017).

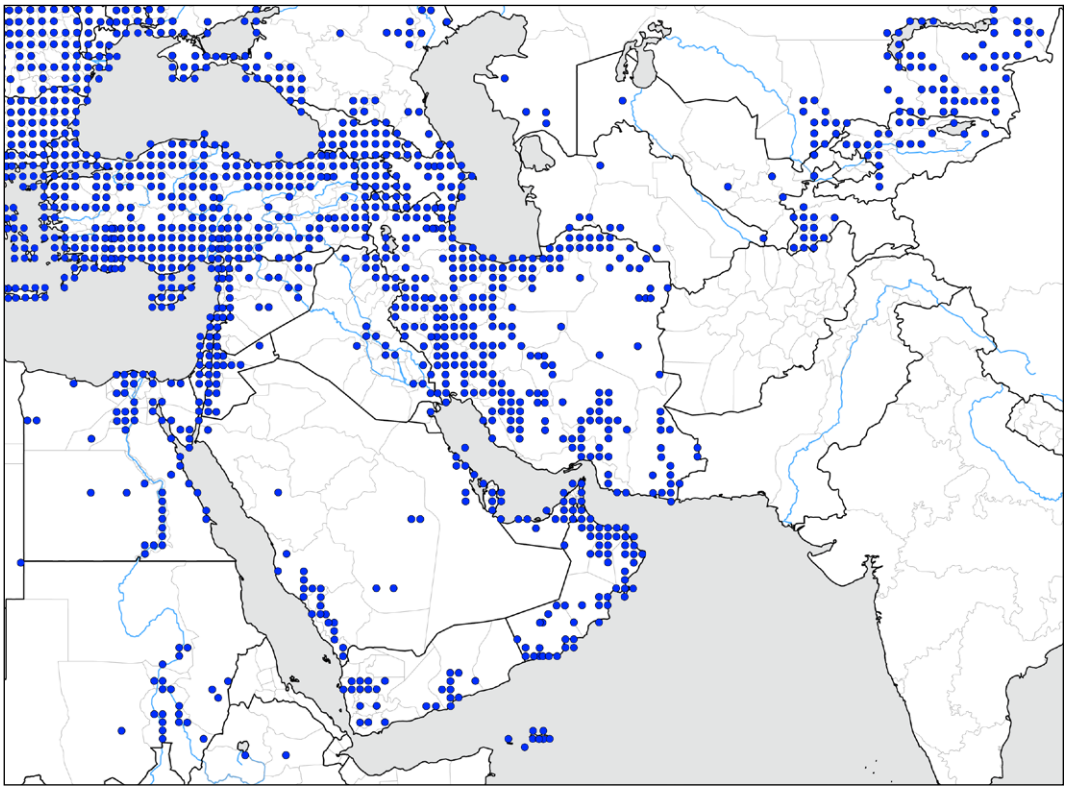


Figure 4. Distribution of records of dragonflies from 1990 onwards.

It is emphasized that the authors do not endorse any political considerations regarding country definition, nomination and delineation.

Biogeography

The region under consideration is at the crossroads of the Palearctic, Afrotropical and Oriental realms. The borders between these regions are not clear cut, as there are no hard natural barriers. In general most of the area of this atlas is considered Palearctic, with the southern Arabian coast in Yemen and Oman (Dhofar), Socotra and sometimes also a small area in the south of Iran considered to belong to the Afrotropical region. Including the Nile valley, the Afrotropical region also borders the southern part of the Levant, where several Afrotropical species occur. Part of southeast Iran and southeast Afghanistan is considered to belong to the Oriental region, although the separation from the Palearctic is far from clear here. The Dasht-e-Kavir Desert to the north and the mountains in Afghanistan are often considered as the dividing line. At the southeastern border of Iran the Afrotropical region borders the Oriental region. This again is rather arbitrary as the border does not follow a natural barrier. As many dragonfly species are very mobile it is not surprising that several species are not restricted to one of the biogeographic realms but that species of different affinities meet in this region. In addition to species more widespread in these biogeographic realms the region also contains 25 endemic species and another 25 species being near endemic with roughly over 80% of their world range found in the region.

Phenology

The flight period of each species in the area under consideration is presented in Appendix 2. For this appendix, all records from the study area with information on the month of recording were used (approximately 37,000). The main flight period, shown in slightly darker tint, is defined as each month in which 10% or more of the observations (a species at a locality on a

date) of that species were made. The main flight period is only shown for species with 100 or more observations. The information on phenology has to be interpreted with care. For species for which only a few records are available the flight period is probably longer than the data indicates. For widespread species the start of the flight period is based on records from areas where the species flies early in the year (south and/or lowland), while records towards the end of the season will come from areas where the species flies later in the year (north and/or higher elevation). This will result in the indicated flight period being longer than that found at any given location.

Taxonomy

The scientific nomenclature follows Paulson & Schorr (2020) and the English names are according to Dijkstra (2021; see appendix 3). The maps show the distribution of species and not those of subspecies, as the latter are not always indicated in the literature and often no consensus exists about their definition. Exceptions are the two subspecies of *Onychogomphus forcipatus*, which we here discuss seperately: *Onychogomphus (forcipatus) forcipatus* and *O. (forcipatus) albotibialis*. They are structurally distinct, although Ferreira et al. (2014) did not find any genetic differences in the mitochondrial COII and nuclear PRMT markers, making the status of these taxa still open to debate. In general, the taxonomy of the dragonflies of the region is well known and considerable progress has been made in the past 20 years. There are still a few open issues and we have taken a pragmatic approach in these cases. The taxonomy of the *Calopteryx splendens* group is problematic. We have made the choice not to regard the taxon *orientalis* as a separate species, but to consider it as a subspecies of *C. splendens*. We however regard *C. waterstoni* as a separate species. *Coenagrion vanbrinkae* (Lohmann, 1993) has been regarded as a proper species occurring to the east of its sister taxon *C. ornatum*, but Kosterin & Ahmadi (2018) showed that they should be regarded as conspecific. The distinction of *Enallagma risi* from *E. cyathigerum* has been a permanent challenge in the past, and whether they constitute two separate species or just two subspecies remains a matter of opinion; we treat them here as two distinct species. Taxonomically the most difficult genus is *Cordulegaster*, where the nomenclature and the taxonomy is still subject of research. In this atlas we have made the choice to recognise the following taxa: *charpentieri* (including *C. nobilis*, *C. lagodechica*, *C. nachitschevanica* and *C. plagionyx*, which are mostly variations in colour pattern), *coronata, insignis* (including *amasina* and some closely related Turkish and Levantine populations), *mzymtae, picta* and *vanbrinkae*. The taxon *Coenagrion hastulatum* is not discussed in this atlas as the only record from our area (Azerbaijan by Skvortsov & Snegovaya 2015a) is regarded as doubtful. Similarly, two records of *Gomphus vulgatissimus* made by Skvortsov & Snegovaya (2014) and Snegovaya (2020) have been rejected as, due to strong variation in both taxa, this species is difficult to separate from *G. schneiderii* on the basis of colour pattern (De Knijf et al. 2013) and intermediate individuals are known where the two taxa meet. The authors themselves have expressed some doubts ("most probably belong to true *G. vulgatissimus*"), and as these records fall within the range of *G. schneiderii* we regard the records as doubtful and have thus omitted *G. vulgatissimus* from this atlas. Whether the records represent *G. schneiderii* or intermediate individuals is unknown. Lastly, three somewhat aberrant records by Albarda described in Selys (1887) from Turkey (*Orthetrum ransonnetii* and *Ophiogomphus reductus* misidentified as *O. cecilia*) and in Schoorl (2000) from the present Uzbekistan (*Libellula pontica*) are also rejected, for the published localities are obviously erroneous as outlined by Boudot et al. (2020).

Study area

Arabian Peninsula

The Arabian Peninsula is one of the driest regions of the world. It is, therefore, not surprising that dragonflies are rare in large parts of this area, and that relatively few species occur. Biogeographically the majority of the Peninsula forms part of the Palearctic; only the southern and southwestern fringes are Afrotropical. The northern part overlaps with

Yemen, Socotra islands, Wadi Zeriq. Habitat of the endemic *Azuragrion granti.* Other species found at this wadi include *Ceriagrion glabrum, Diplacodes lefebvrii, Tramea limbata, Trithemis arteriosa* and *Zygonyx torridus.* Photo: Jaap Bouwman

Oman, Dhofar, Khawr-Taqah. This brackish coastal lagoon is home to populations of *Agriocnemis pygmaea, Macrodiplax cora* and *Urothemis edwardsii*. Photo: Jean-Pierre Boudot

Oman, Ayn Razat. Habitat of *Paragomphus sinaiticus, Nesciothemis farinosa, Zygonyx torridus* and *Tramea limbata*. Photo: Geert De Knijf

Oman, Wadi Ash Shab. Habitat of *Arabineura khalidi, Arabicnemis caerulea, Pseudagrion decorum, Lindenia tetraphylla* and *Urothemis thomasi.* Photo: Geert De Knijf

the fauna of the Levant, Iraq and Iran. While the Peninsula is a continuous landmass, the deserts form a substantial barrier and, as a result, the southern parts are, for flying insects such as odonates, more closely connected to the Horn of Africa, across the narrow Red Sea, than with the Levant. This results in a number of species only occurring in the southern half of the Arabian Peninsula as endemics (e.g. *Arabineura khalidi*, *Arabicnemis caerulea*) or being widespread in Africa and only reaching Asia in this region. The Sarawat Mountains in western Yemen and southwest Saudi-Arabia, and the relatively wet Dhofar region in Oman are rich in afrotropical species. The island of Socotra stands apart with its unique flora and fauna; it has a dragonfly fauna with both Asian and African species, and harbours one endemic species of African descent.

Bahrain The Odonata fauna of Bahrain has received little attention from odonatologists for obvious reasons: it is small (765 km^2), water is scarce, and desert covers 92% of its territory. Only six species have been recorded on the main island, records of which are included in three documents: one paper dealing with a large part of southern Arabia (Waterston & Pittaway 1991) (*Lindenia tetraphylla*, *Crocothemis erythraea*), a currently deleted photo gallery on the internet (*Orthetrum sabina*) and an internet document published by Abdulqader Khamis (2010) but now deleted (*Ischnura evansi*, *L. tetraphylla*, *C. erythraea*, *C. servilia*, *Orthetrum sabina*, *Trithemis annulata*).

Kuwait Kuwait is a sandy desert with, apart from some man-made water bodies and coastal lagoons, few habitats suitable for Odonata. Just over 50 records are known totalling 13 species, mostly from museum collections or listed, sometimes without localities, in three publications (Al-Houty 1985, Waterston & Pittaway 1991, Schorr et al. 1998). It is unclear how many of the 13 recorded species do reproduce in the country. Since 1985 only one formal record has been made (*Brachythemis fuscopalliata* in 1994), so virtually nothing is known about the odonates from Kuwait over the last 35 years.

Oman Situated at the southeastern tip of the Arabian Peninsula, Oman consists largely of a sandy and rocky desert, with two wetter regions: the Hajar Mountains in the north and the Dhofar coastal area in the south. The latter is, together with Yemen, the only region in our area reached by the monsoon rains, resulting in more extensive freshwater habitats harbouring many Afrotropical species. Fewer than 10 records were published prior to 1980, and the start of our knowledge of the dragonflies of Oman basically corresponds to the publications of Waterston (1980, 1984). Since then, a steady flow of in total 27 papers has appeared, including Schneider (1988), Waterston & Pittaway (1991), Schneider & Dumont (1995, 1997), Dumont & Heidari (1998), Giles (1998), Feulner (1999), Feulner et al. (2007), Reimer (2008), Van der Weide & Kalkman (2008), Wilson (2008), Reimer et al. (2009), Frankovic (2012), Cowan & Cowan (2015, 2017, 2018), Kunz (2015), Schneider & Ikemeyer (2016a), Dobson & Childs (2019) and Boudot et al. (2020). Lambret et al. (2017) provided the most complete and recent overview of the fauna. Due to this surge in recent activity, Oman is the best documented country on the Arabian Peninsula.

Qatar Qatar constitutes a small sandy desert country of 11,586 km^2 with only sparse natural and man-made water bodies present. It is therefore not surprising that only 12 species have been reported, based on 48 records in three papers (Abdu & Shaumar 1985, Waterston & Pittaway 1991, Grunwell 2010).

Saudi Arabia With a surface area of 2,150,000 km^2, Saudi Arabia is not only the largest state of the Arabian Peninsula but also the largest state covered in this atlas. The country is dominated by the Arabian Desert, associated semi-deserts and shrublands, and includes several mountain ranges and highlands. In the southeast, the Rub' al Khali erg ('Empty Quarter') is the world's largest contiguous sand desert. Few lakes are found in the country. Among the largest of these are the Layla Lakes, which were overexploited in the late 80's and have been dry since 1995, leading to the extinction of

the single Arabian population of the damselfly *Azuragrion vansomereni*. Saudi Arabia is the largest country in the world with no permanent rivers. However temporarily flowing desert rivers (wadis) are very numerous and many harbour well-developed Odonata communities, particularly so in the western mountain ranges. In total 42 species, including two vagrants, have been recorded from the country. A little over 450 records published in 17 papers are known. The more prominent papers include Shalabi (1961), Waterston (1980, 1984), Waterston & Pittaway (1991), Schneider & Krupp (1993), Schorr et al. (1998), Jödicke et al. (2000), Lambret & Boudot (2009), El-Hawagry et al. (2013), Monnerat & Al Dhafer (2016) and Dumont et al. (2017).

United Arab Emirates Fewer than 40 records were known from this country prior to 1990, mostly published by Waterston & Pittaway (1991). Since then, a steady flow of 26 publications, a good number of reliable personal communications and records stored in national society newsletters and internet open access databases have ensured that the fauna is now relatively well known. Currently 30 species are known from the Emirates, including several that are endemic, or near endemic, to the southern part of the Arabian Peninsula. These include the damselflies *Arabineura khalidi*, *Arabicnemis caerulea* and the dragonfly *Urothemis thomasi*, which, outside of Arabia, is known only from a single African record in Somalia. The most important information on the odonate fauna of the United Arab Emirates can be found in Waterston & Pittaway (1991), Schneider & Dumont (1995, 1997), Giles (1998), Feulner (1999), Tourenq et al. (2005), Feulner et al. (2007), Wilson (2008), Reimer et al. (2009), Reimer (2011), Feulner & Judas (2013), Boudot et al. (2020). Lambret et al. (2017) provides the most recent overview of the fauna.

Yemen - Mainland At the very south of the Arabian Peninsula, Yemen is mountainous in the west, becoming semi-arid and, in the northeast, inland behind the mountains, partly sandy desert where the Arabian Desert begins. The Indian Monsoon just reaches the western mountains and the southern coast, which, as a result, has developed a significant network of rivers and brooks flowing towards the Red Sea or the Arabian Sea. A set of nine papers (Waterston 1984, Al-Safadi 1990, 1995, Dumont & Al-Safadi 1991, 1993, Carfi et al. 1995, Schneider & Parr 1998, Krupp et al. 2006, Schneider & Nasher 2013) contain a total of 899 records encompassing 42 species, including occasional migrants. One species, the dragonfly *Pinheyschna yemenensis*, is endemic to the country, although fieldwork further north in the mountains of southwest Saudi Arabia might show the species also to be present there.

Yemen - Socotra Island The island of Socotra, belonging to Yemen, is famous as a hotspot of biodiversity and is often mentioned as the island of the living fossils, which it has inherited from ancient geological times and which are now extinct on most of the continental landmass. Its uniqueness is obvious at first glance simply by examining the vegetation; the amazing and stunning Dragon Blood trees and the endemic Cucumber tree are striking examples. Over 700 species of plants and animals, including reptiles, birds, spiders, crabs and one damselfly, *Azuragrion granti*, are endemic to the island. A small set of seven papers (McLachlan et al. 1898, McLachlan 1903, Kimmins 1961, Schneider & Dumont 1998, Riservato et al. 2010, Schneider & Nasher 2013, Van Damme et al. 2020) contains an impressive total of 897 records encompassing 23 species, including occasional migrants. Most species are found in the more mountainous eastern half of the island, which receives more rainfall and contains more permanent wet areas than the western half. Van Damme et al. (2020) provides a richly illustrated and detailed overview of the dragonfly fauna of the island.

Levant

The Levant is an historical geographical term referring to a region in the Asian part of the Eastern Mediterranean encompassing present-day Syria, Lebanon, Jordan, Israel, the West Bank, the southeast of Turkey (west of the Euphrates river) and the island of Cyprus.

The topography of the Eastern Mediterranean is rather diverse, and strongly influences the regional climate. The coastal plains by the Mediterranean Sea have a pleasant climate and Mediterranean vegetation. Adjacent to these plains runs a north-south mountain range with the highest peaks found in the north (Mount Hermon, 2814 m a.s.l.); these mountains have extensive forest vegetation. Annual rainfall varies with latitude and altitude, being highest in northern Israel, Lebanon and west Syria (up to 900 mm) and dropping to below 100 mm in southern Israel and Jordan, where the climate is arid or semi-arid (Schiebel 2013). This mountain range gives rise to several streams and rivers, of which the Orontes, the Litani and the Jordan Rivers are the most important. The Jordan valley is the lowest depression found on the Earth's continents (424 m below sea level), and extends from Syria to the Red Sea. The eponymous river drains the valley, from north to south, feeding Lakes Hula and Tiberias (= lake Kinneret or Sea of Galilee), and flows into the Dead Sea. On the eastern Jordanian shore, the steep escarpments of the Transjordan Plateau rise up to ca. 1200 m a.s.l. and culminate at Jabal Ram (1754 m a.s.l.) in its southern part. Several east-to-west running rivers cross the Transjordan Plateau, and drain into the Jordan River or directly into the Dead Sea. To the east, the Transjordan Plateau has a gentler slope, gradually merging with the Syrian Desert.

The Odonata fauna of **the Levant** is diverse compared to that of the other parts of the region covered in this atlas, due largely to its location in a climatic transition zone and its diversified orography. Within a relatively small range, it is possible to find Eurasiatic species like *Coenagrion pulchellum*, *C. ornatum*, *Libellula depressa* and *Aeshna mixta*, Afrotropical species such as *Pseudagrion torridum*, *Crocothemis sanguinolenta* and the regionally extinct *Rhyothemis semihyalina* and *Urothemis edwardsii*. Asian species linked to steppes, deserts and semi-deserts such as *Selysiothemis nigra*, *Lindenia tetraphylla* and *Orthetrum ransonnetii*, and also Oriental species such as *Orthetrum sabina*. In addition, there are a good number of local species with a very restricted range, including several Levantine endemics; such species include *Calopteryx hyalina*, *C. syriaca*, *Coenagrion syriacum*, *Pseudagrion syriacum*, *Gomphus davidi* and *Onychogomphus macrodon*. Human settlements have been present for several millennia, commencing during the Fertile Crescent time (10,500 BP). Until relatively recently, the human population has had little impact on freshwater biodiversity; however, since the 1950s the growth of the human population together with the increased demand for water for consumption and irrigation, has had a strong negative impact on the natural environment and water resources. As a result, many of the regional endemic species are currently considered threatened. The Levant has attracted researchers for many years. Odonatological investigations were already under way during the 19th century and continue to this day. Key contributions to the regional fauna were published by Schmidt (1938), Dumont (1973, 1974, 1975a, 1991), Schneider (1981b, 1986), Schneider & Moubayed (1985) and Katbeh-Bader & Schneider (2002).

Cyprus Cyprus is the third largest Mediterranean island, and lies at the eastern extremity of the Mediterranean basin. Although politically part of Europe, it belongs biogeographical to West Asia, and is part of the Levant. The island is characterised by two mountain ranges, the Troodos Massif and the Kyrenia (Pentadaktylos), separated by a broad east–west plain called the Mesaoria. The Troodos Massif, which covers almost half of the island's area, dominates the western part and reaches its highest point at Mount Olympus, some 1951 m a.s.l. The narrow Kyrenia range is a largely unbroken ridge that runs for approximately 160 km along the north coast. Cyprus has an intense Mediterranean climate with hot rainless summers from mid-May to mid-September and generally mild and rainy winters from November to mid-March. Cyprus suffers high water stress levels, and parts of the island are classified as semi-arid. The island has a high regional variation in rainfall with the wettest area (1100 mm per year) at the top of the Troodos massif, dropping to as low as 300 to 350 mm to the east of this range.

Syria, Idlib province, near Kafriyah. Habitat of *Platycnemis kervillei*, *Onychogomphus lefebvrii, Paragomphus lineatus, Gomphus davidi* and *Trithemis festiva*. Photo: Johan van t' Bosch

Cyprus, Diarizos valley. Habitat of *Ischnura intermedia, Epallage fatime* and *Onychogomphus (forcipatus) albotibialis*. Photo: Geert De Knijf

The study of the dragonflies of Cyprus has a long history, with several papers containing records published from the 19th century to the 1990s (Hagen 1863, Selys 1887, Martin 1894, Navas 1932, Schmidt 1938, Valle 1952, Compte Sart 1960, Kiauta 1963, Monnerat 1999). The first systematic study of the dragonflies of Cyprus was carried out by Lopau & Adena (2002). They reviewed all relevant literature, included unpublished observations from visiting observers, and did a thorough survey of the island resulting in 933 observations and an updated checklist of 33 species, five of which were new to the island. Two species, however, have only ever appeared in the literature. Navas (1932) reported on the presence of *Calopteryx virgo*, though this is now thought likely to be a misidentification (Lopau & Adena 2002). The other species, *Ischnura pumilio*, was reported only once (Martin 1894), and is now considered extinct on the island. Cottle (2007) documented the first and only sighting of *Brachythemis impartita*, and also reported for the first time on the presence of *Trithemis arteriosa*, although it had been present on the island for some time. The most recent, and arguably most interesting, surprise has been the discovery of several populations of *Ischnura intermedia* on Cyprus (De Knijf et al. 2016); the authors also provided evidence for a second old record of *I. pumilio.* In recent years, more faunistical and ecological papers have been published (Kemp 1990, Grand 2001, De Knijf & Demolder 2013, Tamm 2014). Flint (2019) mentioned the earliest observation of *Erythromma viridulum*, and in 2013 a group of expats and Cypriots established the Cyprus Dragonfly Study Group (CDSG), which organises a monitoring scheme in which around 140 sites are surveyed regularly. The CDSG has its own database containing nearly 30,000 records, making Cyprus the best and most regularly investigated country within this region and, as far as we are aware, the only one which has its own Dragonfly Society. The surveys have resulted in a superb overwiew on the dragonfly fauna of Cyprus (Sparrow et al. 2016), the finding of *Aeshna isosceles* as a new species for the island, the rediscovery of *Lestes barbarus* (Sparrow et al. 2020b) and a thorough analysis of the presence of *Pantala flavescens* (Sparrow et al. 2020a).

Israel Israel is primarily fed and drained by the Jordan River catchment and its large lakes such as the former Hula Lake (drained in the early 1950s but now partially restored), the Tiberias Lake and the Dead Sea. These sites are famous worldwide for various ecological, touristic and religious reasons. In total, 1153 records of Odonata of 64 species are known from Israel, based on 31 publications and some personal communications. Key publications are the compilations by Dumont (1991) and Schneider (1982, 1986), which have provided a good basis of knowledge of the regional fauna. Other important papers include Morton (1924, 1929), Schmidt (1939), Dumont (1972, 1973, 1974, 1975a), De Marmels (1995), Dumont et al. (1995b) and Dijkstra & Dingemanse (2000). Recent records published since the turn of the millenium, including the discovery of new localities for rare and threatened taxa, are to be found in Katbeh-Bader et al. (2002), Kunz et al. (2006), Bar Zakay et al. (2016), Shaish (2019) and Waldhauser (2020). Schneider et al. (2013a) brought our attention to the strong degradation of wetlands and rivers in the region, resulting in an impoverished dragonfly fauna. It is noteworthy that although Israel is among the richest countries in the region and birdwatching is relatively popular, the study of dragonflies has lagged behind, though a group dedicated to the study of Odonata is just starting to form.

Jordan The western part of Jordan is characterised by dry shrubland and even Mediterrranean forest. The southern and eastern part of the country consists of a sandy and rocky desert in which some oases, such as Al-Azraq, occur. The most suitable habitats for benthic invertebrates, including Odonata, are provided by the Jordan River and its tributaries. The Dead Sea, which forms part of the western border, is too saline to harbour any Odonata populations. The first, and seminal, collecting trips in the Levantine regions, including Jordan, were undertaken from 1956 to 1969 by Klapperich (Monnerat & Hoess 2011). Several other studies

have brought the number of species known from Jordan to 44 (943 records). These records are found in 24 scientific publications, of which the most prominent are Morton (1924), Schmidt (1939), Dumont (1973, 1977b, 1991), Kappes & Kappes (1981), Schneider (1981a, 1982, 1985, 1986), Terzani (1995), Amr et al. (1997), Katbeh-Bader et al. (2002, 2004), Kunz et al. (2006), Amr et al. (2013) and Waldhauser (2020). Both the eastern and western tributaries of the Jordan River and of the Dead Sea harbour a largely Afrotropical fauna with *Crocothemis sanguinolenta* and *Orthetrum abbotti* regarded as relicts of the Holocene pluvial period (Dumont 1977b, Waldhauser 2020).

Lebanon Lebanon is a small hilly and mountainous coastal state in the east of the Mediterranean, and is part of the Levant. In total, 400 records of 48 species are available from the country, which have been recorded in 18 publications (Hagen 1863, Selys 1887, Morton 1924, Gadeau de Kerville 1926, Martin 1909, 1926, Schmidt 1939, Buchholtz 1955, Schmidt 1967, Dumont 1973, 1977b, 1991, Schneider & Moubayed 1985, Schneider 1986, Battin 1993, Storey et al. 2006, Dia & Dumont 2011, Monnerat & Hoess 2011), or else are based on personal communications.

State of Palestine The State of Palestine encompasses the Gaza strip, East Jerusalem and the West Bank. Nearly all records of dragonflies originate from the West Bank, for which reason this name is used throughout the current publication. The West Bank encompasses the former part of the state of Jordan situated west of the Jordan River and the Dead Sea, which has been occupied by Israel since 1967. In total, 33 Odonata species have been reported from this small area of 5879 km^2. This comprises a total of 238 records published in a handful of papers (Morton 1924, 1929, Schmidt 1939, Dumont 1973, 1975a, 1977b, 1991, Schneider 1986, Kunz et al. 2006, Monnerat & Hoess 2011, Adawi et al. 2017, Waldhauser 2020).

Syria The study of the dragonflies of Syria has a relatively long history, with several papers containing records from the country being published from the 19th century to the 1960s. These comprise Selys (1887), Martin (1909, 1926) and Schmidt (1939, 1953, 1954b, 1967). Somewhat later, a dedicated study of the fauna of the country was undertaken by Wolfgang Schneider, resulting in numerous papers appearing in the 1980s (Schneider 1981b, 1983, 1984a, 1985, 1986, 1987). These were based on field-work in a country where many of the freshwater habitats were, at that time, relatively unspoiled. Up to the turn of the 21th century, slightly fewer than 460 records had been published. Since then, only one further paper containing records has appeared (Mousatat et al. 2010). Fortunately unpublished records, collected mainly by J. van ´t Bosch, E. van der Burg, M. Roos and P. Schrijvershof in 2010 (see Observado.org), have made a strong contribution to the database. As a result, just over 1400 records are now known from Syria, spread over a total of 67 species. Due to political conflict and war, no new records have become available since 2010.

South Caucasus (Armenia, Azerbaijan, Georgia)

The South Caucasus region, sometimes also called Transcaucasia, covered by this atlas corresponds to the three successor states of the former Soviet republics: Azerbaijan, Georgia and Armenia. Apart from a small area in northeast Georgia, which drains into the Caspian Sea via Russia, this region is entirely situated south of the European drainage divide which runs along the crest of the Caucasus. This high mountain range, sometimes referred to as the 'Greater Caucasus', stretches for approximately 1200 km along the border with Russia. The highest peak of the Caucasus range reaches 5200 m a.s.l. and the range gives rise to many glacier-fed rivers, particularly in the central and western parts. Due to the high relief intensity and denudation rate of these mountains, the rivers transport huge volumes of sediment and show a typical nival regime, with discharge peaks in early summer after snow and ice melt. Discharge during winter is therefore low; however, heavy torrential

Georgia, Javakheti, Madatapa lake. Habitat of *Coenagrion armatum* and *Coenagrion lunulatum*. Photo: Asmus Schröter

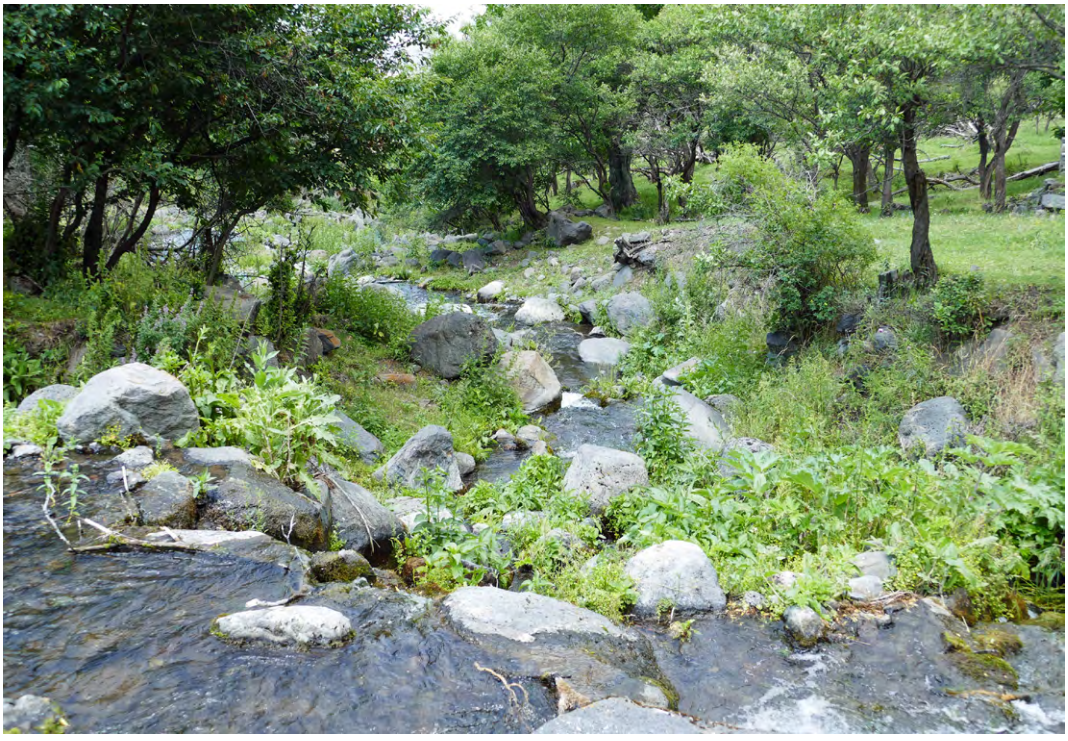
Georgia, Tbilisi, Vere river. Habitat of *Epallage fatime* and *Onychogomphus assimilis*. Photo: Asmus Schröter

rains are common throughout the area, often resulting in strong daily discharge amplitudes. The southern part of the region is dominated by another major mountain range, the volcanic Armenian Highlands which form the central part of the long Anatolian-Iranian fold mountain range. The bordering range to the north and the east of the Armenian Highlands is often referred to as the 'Lesser Caucasus', which covers the southern part of Georgia, much of Armenia and the southwest of Azerbaijan. Its highest peaks exceed 4000 m a.s.l. and the range is rich in volcanogenic lakes. It runs roughly parallel with the Caucasus in a northwest–southeast direction, and is divided from it by the Transcaucasian depression. In the southeastern tip of Azerbaijan, the Talysh Mountains rise from the Caspian Sea, reaching 2490 m a.s.l. These mountains are a subrange of the Alborz Mountains on the Iranian Plateau and form part of the border with Iran.

From a biogeographical perspective the South Caucasus occupies a unique position. Here, western Asian endemics and species of the Caspian Hyrcanian mixed forest, such as *Onychogomphus assimilis* and *Aeshna vercanica*, respectively, meet disjunct relict populations of species widespread along the belts of boreal forests and forest steppes of temperate parts of Europe and Asia, for instance *Coenagrion armatum* and *Aeshna serrata*. This blend of endemics and northern Palearctic relics is a result of the region's geographical position at the isthmus between the Black and Caspian Seas, and its specific topography and high geomorphological diversity. This provides an extraordinary variety of landscape units and regional climates. A fundamental factor is the Caucasus range, which serves as an effective climate divide protecting the area from cold northern air masses. Without this wall of high mountains the region would otherwise be overwhelmed by the Siberian anticyclone, which causes extreme freezing winter weather typical of the Steppes and winter-cold deserts of Central Asia. Hence, the Caucasus range ensures a subtropical transitional climate in the depression to the south. This is further enhanced by the balancing effect of the Black Sea on the Colchic lowland at the western end of the depression, and of the Caspian Sea on the Kura-Aras lowland to the eastern end of the basin. Due to this sharp climate border the Caucasus range marks the northern limit for a considerable number of species including *Epallage fatime*, *Onychogomphus assimilis*, *O. albotibialis*, *Cordulegaster picta*, *Libellula pontica*, and *Orthetrum sabina*. On the other hand, it also forms a barrier for species more adapted to the harsh continental climate, meaning that species like *Sympetrum tibiale* and *Sympecma gobica* are not found south of the Caucasus.

The odonatological exploration of the South Caucasus began comparatively early during the Russian Empire in the 19th century. The first general data on odonates were collected by Eichwald (1837) from the Colchic lowland, and by Kolenati (1846) from the eastern part of the Transcaucasian depression, this latter work including the description of *Cordulegaster charpentieri*. Hagen (1856) reviewed the dragonfly fauna of the Russian Empire and listed eight species for Transcaucasia. New data were provided by Selys (1869) who analysed insects collected by T. Deyrolle in Mingrelia, a historical province in the west of Georgia. He stated that *Calopteryx virgo* found in the South Caucasus corresponded to Brullé's taxon *festiva*, and described the new taxon *mingrelica* of *Calopteryx splendens*. By presenting new data of alleged *Coenagrion pulchellum*, Selys also unknowingly provided the first records of *C. ponticum*, which was only described from the region, as new to science, more than 60 years later by A.N. Bartenev. During the final phase of the Russian Empire and into the beginnings of the subsequent Soviet age, A.N. Bartenev commenced publication of a series of articles dealing with various aspects of the dragonfly fauna of the South Caucasus, including description of species and taxa new to science (cf. Bartenev 1909, 1911, 1912a, 1912b, 1912c, 1913a, 1913b, 1916, 1919b, 1924, 1929a, 1929b, 1929c, 1930a, 1930b). Based on this knowledge, understanding of the regional odonate fauna was further expanded by Akramowski (1939, 1948,

Georgia, Vashlovani reserve, Alazani river. Habitat of *Onychogomphus flexuosus* and *Stylurus ubadschii*. Photo: Asmus Schröter



Georgia, Javakheti. Habitat of *Cordulegaster charpentieri* and *Caliaeschna microstigma*. Photo: Asmus Schröter

1958, 1964) and Shengelia (1953, 1964, 1975). These works were followed by several papers reviewing the status and distribution of species specific to the Caucasus region (Akramowski & Shengelia 1967, Dumont & Schneider 1984) or whose terra typica was located in the South Caucasus, for example *C. charpentieri* (Dumont 1976). Following the demise of the Soviet Union, odonatological exploration of the region underwent a sharp increase. Besides faunistic data and many additions to the regional dragonfly fauna, critical reviews and preliminary results of ongoing long-term projects, such as national atlasses, were published (Dumont 2004, Tailly et al. 2004, Tailly & Tabarroni 2006, Schröter 2010a, Ananian 2012, 2014, Ananian & Tailly 2012, 2013, 2016, Durand & Rigaux 2015, Skvortsov & Snegovaya 2014, 2015a, Schröter et al. 2015, Seehausen et al. 2016, Durand 2019, Ananian & Muddeman 2019, Ananian & Schröter 2020, Snegovaya 2019, 2020, 2022).

Armenia Of the three states of the region, Armenia's territory has the smallest area but the highest average elevation, and is without lowlands. Much of Armenia is occupied by the vast Armenian Highlands, rising up to 4090 m a.s.l. at Mount Aragats. More than 70% of the country is situated above 1500 m a.s.l., which explains why Armenia's climate is predominantly highland continental, and areas with other than very harsh conditions are limited. A slightly mitigated dry continental climate is found in regions below 900 m a.s.l., such as the Aras river valley at the border region with Turkey in the west and Iran in the far south. Similar conditions are also found in small regions of the northeast along the valleys of the Debet and the Aghstev rivers (tributaries of the Kura river) at the borders with Georgia and Azerbaijan, respectively. Lake Sevan, at an altitude of 1900 m a.s.l., is one of the largest alpine freshwater lakes in the world, and the largest water body in the South Caucasus.

Armenia's topography and prevailing climatic conditions are also reflected in the composition of the country's Odonata fauna. With adjacent Georgia, whose southern part stretches into the Armenian Highlands, it harbours some isolated populations of more northern species, including *Coenagrion armatum* and *Aeshna serrata*. On the other hand, Armenia's fauna lacks several species which occur in the subtropical transition climate of the Transcaucasian depression, such as *Chalcolestes parvidens* and *Libellula fulva*. A speciality of the region is *Cordulegaster vanbrinkae*, a species of the Caspian Hyrcanian mixed forests of Iran and Azerbaijan, which occurs in an isolated pocket in Armenia's southern Syunik province.

Exploration of the country's dragonfly fauna started relatively late, at the turn of the 20th century (Radde 1899). With his pioneering work on the Armenian Odonata fauna, Akramowski (1948) established a new standard for regional dragonfly faunas. His review, as well as several papers published subsequently, provided a good basis for further exploration. Tailly et al. (2004) picked up these threads, resulting in a series of subsequent publications including a preliminary online distribution atlas (Ananian 2012, 2014, Ananian & Tailly 2012, 2013, 2016, Durand & Rigaux 2015, Durand 2019, Ananian & Muddeman 2019, Ananian & Schröter 2020).

Azerbaijan Azerbaijan is dominated by the vast Kura-Aras lowland. Due to its geographical position in proximity to the Caspian Sea and its high geomorphological diversity, Azerbaijan has a very diverse climate. The Kura-Aras lowland, defined by the two eponymous major rivers, drains the eastern part of the Transcaucasian depression into the Caspian Sea. To the north, this arid lowland with cool winters is bordered by the eastern foothills of the Caucasus range. To the southwest, the Armenian Highlands form a natural border to the Kura-Aras lowland, with the Murovdag massif rising up to 3725 m a.s.l. In Nakhchivan, a landlocked and largely semi-arid exclave between Turkey and Armenia, the highest peak of the Zangezur range reaches 3900 m a.s.l. To the southeast, in the Lenkaran region, the climate of semi-desert and dry steppe is replaced by a humid subtropical transitional climate. The eastern slopes of the Talysh Mountains are the most humid region of

Azerbaijan, with up to 1800 mm annual rainfall.

As regards landscape, Azerbaijan is basically similar to its western neighbour, Georgia, and therefore the fauna of both countries shows a high degree of overlap. Although the total number of species is currently higher in Georgia, this might turn out to be simply a question of exploration, and it is likely that Azerbaijan will catch up in the near future. The most important differences between the two countries refer to species centered around the Black Sea, e.g. *Cordulegaster mzymtae* or *Libellula fulva*, as well as species of temperate latitudes with disjunct relict populations, such as *Coenagrion armatum*, *Pyrrhosoma nymphula* and *Leucorrhinia pectoralis*, which are not known to occur in Azerbaijan. Several other species, such as *Coenagrion australocaspicum* and *Aeshna vercanica*, occur in Azerbaijan whilst being absent from Armenia and Georgia. This is especially true for the latter species, which penetrates into Azerbaijan at the Talysh Mountains in the country's very southeastern tip, and is unlikely to be found elsewhere in the South Caucasus.

The first dragonfly records from the territory of present-day Azerbaijan date back to the first half of the 19th century (cf. Kolenati 1846). Despite this early start, hardly any new data became available during the 150 years that followed. During Soviet times, apart from a short paper by Bogachev (1937) on a tiny district at the border to Georgia, not a single publication dedicated to the country was published. All new data published during that time came from larger faunistic inventories or papers of a more general focus (e.g. Bartenev 1911, 1912a, c, 1913c, Bogachev 1937, Akramowski 1939, 1948, 1958, Kasimov 1972). Dumont (2004) was the first to provide an update and review, which resulted from a targeted survey of the odonate fauna of the country. Following this approach, Skvortsov & Snegovaya (2014) published their first results and in subsequent years both authors successfully continued their systematic research, adding many new species to the Azerbaijanian fauna (Skvortsov & Snegovaya 2015a, 2019, Snegovaya 2019, 2020, 2021).

Georgia Due to its geographic position at the eastern shore of the Black Sea and its unique geomorphological characteristics, Georgia is the most diverse of the South Caucasus states with regards to altitude and climatic gradients. Georgia covers much of the central and western part of the Caucasus range, including heavily glaciated areas such as the so-called 'Bezingi wall'. This 5000 m high summit ridge stretches for about twelve kilometers along the border with Russia. The Likhi range connects the Caucasus in the north with the Armenian Highlands in the south and divides the Transcaucasian depression into two parts. The first, the perhumid Rioni river basin in the west, with locally over 4000 mm annual precipitation, forms the so-called 'Colchic lowland'. The second part is the semi-arid Kura river basin (with locally less than 250 mm annual precipitation) in the east. This Likhi range forms an effective climate barrier which traps moist air masses from the Black Sea, forcing them to ascend and subsequently to release their moisture as precipitation. Due to the maritime influence of the Black Sea, the region also has warm winters. This distinct climatic dichotomy between western and eastern Georgia, with mixed (evergreen/broadleaved) temperate forests in the west and semi-deserts and dry steppes in the area bordering Azerbaijan, shapes the distribution of the Odonata fauna.

Georgia's dragonfly fauna is the most diverse of the South Caucasus, and essentially similar to that of neighboring Azerbaijan (see that country). Glaciated mountain ranges and regions with exceptionally high precipitation give rise to many streams and rivers, which is why Georgia is generally rich in lotic species, and harbours strong populations of 'Globally Threatened' or 'Data Deficient' gomphids, such as *Onychogomphus assimilis*, *O. flexuosus*, and *Stylurus ubadschii*. Oxbows and channels in the east of the country are a global stronghold for the rare and threatened *Libellula pontica*. Other specialties include the disjunct relict populations of primarily temperate species to be found in the Armenian Highlands, e.g. *Coenagrion*

armatum, *C. lunulatum*, and *Aeshna serrata* which occur locally in huge numbers in shallow lakes in the uplands. *Libellula fulva* is restricted to the maritime climate of the Georgian Black Sea coast. *Pyrrhosoma nymphula* is another temperate species associated with the influence of the Black sea and within the region is found exclusively in Georgia. These influences also apply to the endemic Turkic-Georgian *Cordulegaster mzymtae*.

The description of '*Agrion colchicum*' (synonym of *Calopteryx virgo*) by Eichwald (1837) from Mingrelia, an historic landscape in the Colchic lowland of western Georgia, represents the first odonate record from the country. Eichwald was followed by Kolenati (1846), who also provided a species description (*Cordulegaster charpentieri*, sub *Aeschna charpentieri*) whose terra typica can be traced to the territory of present-day Georgia. In the first review of the odonates of the Russian Empire, Hagen (1856) listed a few records from eastern Georgia, and Selys (1869) reported on dragonflies collected from Mingrelia. Survey activities and publications by Bartenev (1909, 1911, 1912a, c, 1916, 1919b, 1924, 1929a, b, c, 1930a, b) fundamentally improved our knowledge of the country's dragonfly fauna. Further important steps were the compilations of Georgian Odonata records by Shengelia (1953, 1975) and the description of the male of *Cordulegaster mzymtae* by Akramowski & Shengelia (1967). Beutler (1987) provided new data from the Georgian Black Sea coast. The following two decades saw work on dragonflies in the area largely cease, with the notable exception of Reinhardt (1992). An extensive update and critical overview by Schröter et al. (2015) marked the start of a systematic and long-term study of the Odonata fauna of the country. The most recent additions to the knowledge of the Georgian dragonfly fauna were given by Durand (2019).

Iran, Iraq & Turkey

When looking at a map of Turkey and Iran, one of the first things people will notice is that these countries are dominated by large wide-ranging mountain ranges. These mountains run almost uninterrupted from the west coast of Turkey through Iran and Afghanistan to the Himalayan region. This does not mean that these mountain ranges are uniform in their climate, landscape, habitats or biodiversity. The northern ranges, namely the Pontic Mountains in Turkey and the Alborz in Iran (reaching as high as 5610 m a.s.l.) are humid and wet with mild winters, and their slopes are covered with lush forest. Both form climatic pockets, with the Pontic Mountains bordered in the south by steppe landscapes and the Alborz surrounded by more arid lowland. In both cases this relative isolation results in a characteristic dragonfly fauna consisting of a combination of wide-ranging Palearctic species and endemics. Both are in the centre of the range of endemic species, with *Cordulegaster mzymtae* and *Coenagrion ponticum* found in or adjacent to the Pontic Alps and *Cordulegaster vanbrinkae* and *Coenagrion australocaspicum* in the Alborz. The Alborz is, in addition, home to the recently described *Aeshna vercanica*, most likely the sister species of *A. cyanea*.

The south of Turkey and Iran are dominated by the Taurus and the Zagros Mountains, respectively. The Turkish Taurus Mountains are bordered to the south by a relatively small stretch of lowland along the Mediterranean. Here can be found, within a relatively short distance, species with an Oriental or African distribution while slightly to the north in the higher parts of the Taurus, Palearctic species such as *Lestes dryas* and *Sympetrum flaveolum* occur. The Taurus Mountains gradually continue into the mountains of northeastern Turkey, where they meet the Zagros Mountains that run in a northwest to southeast direction from the border area of Iraq, Iran and Turkey along the Persian Gulf. Two species are largely restricted to the Zagros Mountains, namely *Coenagrion persicum* and *Gomphus kinzelbachi*. The large mountain systems of Turkey and Iran result in a wealth of springs, brooks and rivers, and both countries have a rich fauna typical of running waters, resulting in the presence of a high diversity of species from the families Calopterygidae, Gomphidae and Cordulegastridae. Turkey and Iran are of course more than just mountain ranges. The map of

Iraq, Rawanduz. The landscape in the north and northeast of Iraq resembles the landscape of large parts of Turkey and Iran. Probably the same set of species can be found here but the area is largely unexplored. At this site *Epallage fatime* was found. Photo: Peter Krijnen

Turkey, Toparlar waterfall. Typical habitat of *Anax immaculifrons*. Other species occurring at this stream include *Epallage fatime, Platycnemis pennipes, Caliaeschna microstigma, Gomphus schneiderii, Trithemis annulata* and *Trithemis festiva*. Photo: Jean-Pierre Boudot

Turkey shows several large lakes; in the southwest are several large but, for odonates, relatively uninteresting freshwater lakes, in the centre is the large ephemeral brackish Tuz Gölü, while to the east is the impressive large Lake Van. The last is deep and does not desiccate in summer like the Tuz Gölü, but is nonetheless slightly brackish. The lake is situated in an extensive high altitude steppe landscape that crosses the borders with Armenia and Iran. In the scattered marshes occurring here, some rare Palearctic species can be found, including *Coenagrion lunulatum* and *Leucorrhinia pectoralis.* In Iran, between the Alborz and the Zagros Mountains, two extensive desert areas are found, namely the Dasht-e-Kavir (200,000 km^2) and the Dasht-e-Lut (166,000 km^2). These areas are far less rich than the surrounding mountains, with species of running water largely absent and the species composition dominated by wide-ranging species with a strong dispersal power capable of breeding in temporary waters. In northeastern Iran, the Kopet Dag Mountains form the border with the flat and desert dominated Turkmenistan and here some Central Asian species, such as *Sympecma gobica* and *Cordulegaster coronata* just penetrate the country. In the southeast of Iran, along the Persian Gulf, the influence of the Oriental region is stronger and several common species of the Indian subcontinent, such as *Ischnura nursei* and *Pseudagron laidlawi*, reach their westernmost permanent settlements here.

In contrast to Turkey and Iran, large parts of Iraq are relatively flat and low. The main exception is in the north where the Zagros Mountains of Iran extend into Iraq, resulting in a rich and varied fauna comparable to both Iran and Turkey. The topology of Iraq is dominated by the Euphrates and Tigris Rivers, which run north to south through the country before flowing into the Persian Gulf. Both originate from the Taurus Mountains of Turkey, with the Euphrates running first through Syria before entering Iraq. These rivers are the source of water for extensive freshwater lakes and marshes, and are probably still home to a rich dragonfly fauna though information on this is scant. Older records give little indication of the density in which species occurred, while recent records are almost absent. Based on old records we know that relatively rare and poorly known species such as *Anormogomphus kiritshenkoi* and *Brachythemis fuscopaliata* occur in the area and, given the type of habitats they prefer, they may even have their largest populations here. Many of the freshwater systems of the region became degraded in the 1980s and 1990s, but more recently initiatives have been taken to restore some of them. Recent records from the area are however absent, and it is unclear how the dragonflies of the Euphrates and Tigris freshwater systems are currently fairing.

Iran Understanding of the dragonfly fauna of Iran had a slow start, gaining speed only in the 1990s; a substantial increase in the amount of field work over the past decade has culminated in the publication of the monumental book 'The Damselflies and Dragonflies of Iran' (Schneider & Ikemeyer 2019). Older key papers include those by Schmidt (1954a) which provided the first faunistic overview, and Heidari & Dumont (2002) which included an updated checklist and references to all relevant literature prior to 2002. Much of the progress made in the period 1995 to 2011 was the work of Henri Dumont, Hossein Heidari and Saber Sadeghi, who published numerous new distribution records including several species new to Iran and one new to science (*Coenagrion australocaspicum*) (e.g. Dumont & Heidari 1998, Heidari & Dumont 2002, Sadeghi & Dumont 2004, 2014, Sadeghi & Mohammadalizadeh 2009, Dumont et al. 2011). Recently, a substantial increase in the number of available distribution records has come from 16 field visits made by Thomas Schneider and Dietmar Ikemeyer over the period 2013-2019, which resulted in a series of publications (Jeziorski 2013, Ikemeyer & Schneider 2014, Ikemeyer et al. 2015, Schneider et al. 2014, 2015a, 2015b, 2016, 2017a, 2017b, Dumont et al. 2017, Schneider et al. 2018a, 2018b). Beside numerous new distribution records, these publications also included detailed analyses of previously poorly known species such as *Coenagrion persicum*, *Gomphus kinzelbachi* and *Cordulegaster vanbrinkae*, as well as the description of a species new to science (*Aeshna*

Iran, Lorestan province, Afrineh waterfall. Species occurring here include *Ischnura elegans, Ischnura intermedia, Ischnura pumilio, Platycnemis dealbata, Crocothemis erythraea, Crocothemis servilia, Diplacodes lefebvrii, Orthetrum coerulescens anceps, Orthetrum taeniolatum, Sympetrum fonscolombii, Trithemis annulata, Trithemis festiva, Trithemis kirbyi.* Photo: Mohsen Kiany

Iran, Gilan province, Hajiabad lagoon near Lahijan. In the lagoons at the coast of the Caspian sea species such as *Coenagrion australocaspicum, Lindenia tetraphylla, Aeshna isoceles* and *Libellula quadrimaculata* occur. Photo: Mohsen Kiany

vercanica). All this data, together with distribution maps and photographs of habitats and species, are combined in the book 'The Damselflies and Dragonflies of Iran' (Schneider & Ikemeyer 2019). During late 2020 and early 2021, three important papers appeared with an analysis of the ecology and diversity of Odonata in Iran; these contained numerous records from the Zagros Mountains and the arid and semi-arid regions to the north of it (Eslami Barzoki et al. 2020a, b, 2021). Due to the large amount of fieldwork conducted over the past decade, the fauna of Iran is fairly well explored, although surprising discoveries can undoubtedly still be made. Probably the most interesting poorly-explored region is formed by the mountain ranges adjacent to the Afghanistan border. Further fieldwork in the southeast of the country, especially the lowland along the Makran Coast, is likely to result in the discovery of additional Oriental species.

Iraq The Odonata fauna of Iraq was relatively well explored during, and directly after, the first World War, especially during the times of the 'British Mandate of Mesopotamia'. This resulted in numerous papers, including those by Fraser (1917, 1929), Morton (1919, 1920a, 1920b,1921) and Ris (1928). Expeditions in 1958 (Sage 1960a, 1960b) and in 1969 and 1970 (*Asahina* 1973, 1974) resulted in a good number of additional records, while smaller numbers of records from various sources were published in papers by St. Quentin (1964) and Schneider (1984, 1986). All these records meant that, in the mid 1980s, Iraq was amongst the best studied countries in this part of the world. The unstable situation in the country during the period from 1990 to 2009 meant that no new data was collected during those years, except for a small number of papers with few records and little detail on locality. Recently, new records from the mountainous northeast of the country were published by Porter (2016) (records from 2009-2013), Peter Krijnen (Observado.org records from 2014) and Nabil Musa (Nature-Iraq; records from 2015-2016). In total 602 records of 47 species are available. In the north, the mountainous part of the country shares many species with southeastern Turkey and western Iran. The most extensive freshwater systems in the country are the two huge catchments of the Tigris and Euphrates Rivers which, in the south, form extensive marshes rich in biodiversity. Sadly the dragonfly fauna of this area has not been properly studied, and few records from south Iraq have been made in the past fifty years (e.g. Porter 2016).

Turkey Among the countries discussed in this atlas, Turkey was the first where the modern day study of dragonflies took off, with the publication of the treatise on Turkish odonates by Dumont (1977a), followed by a book by Demirsoy (1982). In the decades thereafter, knowledge of Turkish odonates gradually built up, with field-work by visiting amateur odonatologists increasing sharply since 2000. This has resulted in numerous publications, including an updated checklist and a distribution atlas (Kalkman et al. 2003, Kalkman & Van Pelt 2006). Numerous more faunistic studies have been published by several Turkish specialists (e.g. Salur & Kıyak 2006, 2007, Salur et al. 2012, Miroglu et al. 2011, Hacet 2009, 2017). In addition, the Mediterranean coast of Turkey in particular has become a destination well visited by dragonfly enthusiasts from Europe, resulting in many new records being published on the citizen science recording portal Observation.org. The recent increase in our knowledge of taxonomy, distribution and habitat preference of relevance to Turkey is the result of the work done in Iran, which recently culminated in the publication of 'The Damselflies and Dragonflies of Iran' by Schneider & Ikemeyer (2019). The dragonfly fauna of Turkey is currently fairly well known, although some taxonomic problems, especially with *Cordulegaster*, remain. The southeast of Turkey is still poorly explored, and the distribution of species like *Ischnura intermedia* or the presence of *Gomphus kinzelbachi* is still unclear. The Black Sea region and the Mediterranean coastal region are home to relatively many endemics. Eastern Mediterranean endemics such as *Ceriagrion georgifreyi* and *Coenagrion syriacum* are probably in decline, but hard information on this is lacking.

Central Asia & Afghanistan

Central Asia is a vast region extending between the Caspian Sea, the Altai Mountains and the western Himalayas, which according to the definition applied in this atlas covers four of the five successor states of the former Central Asian Soviet republics: Turkmenistan, Uzbekistan, Kyrgyzstan and Tajikistan. We did not include Kazakhstan, which in most cases is also considered to be a part of Central Asia, as this country is large, poorly explored and has a predominantly Palearctic fauna with many boreal species not found in other parts of our region. For convenience we also include Afghanistan. The wider region is characterised by winter cold deserts and semi-deserts. Large mountain ranges such as the Tian Shan, Pamir-Alay and Hindu Kush are part of the Himalayan orogenic belt, and have peaks exceeding 7500 m a.s.l. These mountain ranges are rich in glaciers, amongst which are the largest ice streams outside the polar regions. All five countries are entirely landlocked, resulting in a harsh continental climate which is only locally slightly balanced by coastlines of endorheic basins, such as the Caspian Sea (the world largest lake) and Lake Issyk-Kul. Due to hydrologic deficit, surface water tends to be brackish to saline over much of the area. The majority of rivers show a pronounced variation in flow, with a high discharge in early summer after the ice melt, and a low discharge from late autumn to early spring. Torrential rains are common in the mountains, and a high daily variation in discharge is typical for many rivers throughout the year. The development of irrigation systems and numerous artificial reservoirs has altered the habitats of many species. Although the first man-made oases and irrigation systems in Central Asia date back thousands of years, it was mainly during the Soviet period that irrigation and hydro-engineering started on a large scale. These projects had a massive impact on the natural hydrologic regime, resulting in desertification with catastrophic consequences, such as the near disappearance of the Aral Sea. The odonatological exploration of the region began during the middle of 18th century with the expansion of the Russian Empire into Central Asia, when most of the region was called West Turkestan. The first data on odonates was published by Brauer (1880), this information being collected during expeditions by the Russian explorer A.P. Fedtschenko. Thirty years later, Bartenev resumed Brauer's work and continued to publish his research into the beginnings of the subsequent Soviet age (Bartenev 1911, 1912a, 1912b, 1913a, 1913b, 1913c, 1915, 1919a, 1929a, 1929b, 1929c, 1930c), during which further contributions were provided by Shorygin (1926), Valle (1942), Borisov (1983, 1984, 1985, 1986, 1987a, 1987b, 1990a, 1990b) and Belyshev et al. (1989). In post-Soviet times, odonatological exploration of the region experienced a renaissance due to travel opportunities and free exchange between scholars, resulting in a sharp increase in publications. Extensive review articles by Borisov & Haritonov (2007, 2008) provided new data and summarised information on the distribution of dragonflies in the region. Besides faunistic papers such as Schoorl (2000), this increase was also characterised by an extension of topics and themes, such as the first assessment of threatened species (Kosterin et al. 2004). Several papers also dealt either with the status, distribution and ecology of largely Central Asian species such as *Sympetrum haritonovi* (Dumont et al. 1995a), *Ophiogomphus reductus* (Borisov 2005), *Sympetrum arenicolor* (Borisov 2006a) and *S. tibiale* (Dumont et al. 2018), or else with dragonflies from thermal springs (Borisov 2015a). A characteristic feature of the Central Asian Odonata fauna is the lack of eastern Palearctic species and a relatively high level of overlap with that of Europe (Belyshev 1973). Three species are endemic or near endemic: *Calopteryx samarcandica*, *Ophiogomphus reductus* and *Cordulegaster coronata*. Populations of several species are geographically isolated from their main range, such as *Coenagrion scitulum* (Schröter & Borisov 2012) and *Sympetrum depressiusculum* (Borisov & Haritonov 2008). Species of the genus *Sympecma*, as well as *Aeshna mixta*, *Sympetrum arenicolor*, *S. meridionale*, and *S. striolatum* ssp. *pallidum* have adapted to the prevailing desert environment by exhibiting a life cycle with postponed maturation

Tajikistan, Petr Pervyi ridge, Lake Kharikul at an altitude of 3120 m a.s.l. with carpets of floating and flowering *Polygonum amphibium*. *Enallagma risi* and *Aeshna juncea* reproduce here making it the highest non-thermal locations where dragonflies reproduce in the Palaearctic. Photo: Alexei Pokivajlov

Tajikistan, Tigrovaya Balka nature reserve, lakes in the Vakhsh river floodplain. Nineteen species of dragonflies and damselflies are known to occur in this area including *Sympecma fusca, S. gobica, S. paedisca, Ischnura evansi, I. fountaineae, Aeshna isoceles, Crocothemis erythraea, C. servilia, Orthetrum sabina, Selysiothemis nigra* and *Sympetrum arenicolor*. Photo: Sergey Borisov

and aestivation in seasonal mountain refuges. For *Anax ephippiger*, *Pantala flavescens*, and *Sympetrum fonscolombii*, seasonal latitudinal migrations have been demonstrated (Borisov 2006a, 2006b, 2009a, 2010, 2011a, 2011b, 2012a, 2012b, 2015b, Borisov & Borisov 2019, Borisov et al. 2020a, 2020b).

Afghanistan This large mountainous country is dominated by the Hindu Kush range whose highest peak rises to 7485 m a.s.l., and less than 10% of the country's territory is situated below 600 m a.s.l. Afghanistan is the least explored state covered by this atlas and virtually an odonatological terra incognita. This is mainly due to the Afghan conflict, a series of wars that have been fought from 1979 to the present day, making odonatological research almost impossible in this biogeographically highly interesting region. After the first publication dealing with Afghan odonates by Bartenev (1912) only six further papers have been published. Material collected during a handful of zoological expeditions during the 1940s-1960s still represents the backbone of our knowledge (Kimmins 1950, Schmidt 1961, Asahina 1963, 1966), with the most recent data collected half a century ago (Dumont 1975b, Carfi et al. 1982). Nothing is known about the current status, distribution or ecology of Afghan dragonfly species. One species, *Neallogaster schmidti*, is only known from two specimens collected at one single Afghan locality, and it is one of the few species included in this atlas for which no images are available. *Gomphus amseli* Schmidt, 1961 was described from north-western Afghanistan but its status (full species, subspecies or merely a pale form) is unclear and we decided to include it in *G. schneiderii*. All present assessments are based on what can tentatively be drawn from scanty historical faunistic lists. More than a dozen Oriental species recorded from south of the Hindu Kush do not penetrate further north into Central Asia, for example *Calicnemia eximia*, *Agriocnemis pygmaea*, *Cephalaeschna klapperichi* and *Acisoma panorpoides*. In contrast to the otherwise harsh continental climate, eastern regions at the southern slopes of the Hindu Kush, such as the Nangarhar, Kunar and Nurestan provinces, have a more pleasant climate and might well hold further species that are common in some parts of Pakistan.

Kyrgyzstan Kyrgyzstan is predominantly mountainous, extending over much of the central and western parts of the Tian Shan and Trans-Alay ranges. Almost half of the territory is situated at an altitude above 3000 m a.s.l., and 90% above 1500 m a.s.l. Low-lying foothill plains are restricted to the very north in the valley of the Chu river and to the Fergana valley in the west. The majority of dragonfly records from Kyrgyzstan were published as scattered individual records within larger faunistic inventories of Central Asia. Prior to 2010, only some short references that concentrated exclusively on the country's dragonflies were available (Krylova 1969, 1972). The first general information on Kyrgyz odonates referred to eight species collected at Issyk-kul, the world's second-largest mountain lake (Grigoriev 1905). Additional records published by Bartenev (1929, 1930c) were followed by a survey of the dragonfly larvae of the endorheic Chu river, which drains the northern part of the country before flowing into, and eventually evaporating within, the deserts of adjacent Kazakhstan. Valle (1942) examined the collection at the entomological museum of the University of Helsinki, which contained a handful of Kyrgyz specimens collected during expeditions across Central Asia at the turn of the nineteenth century. More recently, studies of the dragonflies of Kyrgyzstan were carried out by Schröter (2010b, 2011) and Schröter & Borisov (2012), providing the first information on the country's dragonfly fauna to be published in the English language. The odonatological exploration of Kyrgyzstan generally remains at a very low level and, at present, significant parts of the territory have never been visited by any odonatologist; these include the mountainous regions in the southeast bordering China. Kyrgyzstan is at the crossroads of several biogeographic units, resulting in Central Asian near-endemics such as *Ophiogomphus reductus* and *Cordulegaster coronata* meeting with widespread boreal species such as *Aeshna serrata*, *Sympetrum danae* and *Coenagrion armatum*.

Kyrgyzstan, Song Köl at an altitude of over 3000 m a.s.l. Habitat of *Aeshna juncea*. Photo: Asmus Schröter

Kyrgyzstan, Arslanbob suu. Habitat of *Ophiogomphus reductus*. Photo: Asmus Schröter

Tajikistan Tajikistan is a mountainous country and, just like its northern neighbour Kyrgyzstan, about half of its territory is situated above 3000 meter a.s.l., with the highest peaks reaching about 7500 m a.s.l. Mountains of the Pamir and Alay Ranges cover more than 90% of the country's area, giving rise to many glacier-fed rivers, which have been used to irrigate agricultural land since ancient times. The few major areas of lower land are situated in the north at the Fergana Valley, and in the south along the river valleys of the Pyanj and Vakhsh, rivers which later merge to form the Amu Darya, the largest river of the region. Tajikistan's dragonfly fauna is comparatively well studied and in several aspects better known than that of neighbouring countries. The fundamental work on the Tajik Odonata fauna by Popova (1951) was hitherto unmatched in all Central Asia in terms of coverage, quality and accuracy. Prior to Popova's comprehensive study, only a few single records of dragonflies were known (Brauer 1880, Bartenev 1912a, 1915). Supplementary data collected in the eastern Pamirs by Gorodkov (1961) and Yankovskaya (1965), as well as in the central part (Schoorl 2000), were followed by the review papers of Borisov & Haritonov (2007, 2008). These comprehensive reviews of the dragonfly fauna of all five Central Asian countries also included results of targeted surveys carried out by S. Borisov in 1978-1992. Despite this progress, many regions nevertheless remain poorly surveyed, for example the vast mountainous region of Gorno-Badakhshan.

Turkmenistan More than 90% of the territory of Turkmenistan is characterised by the flat desert plains of the Karakum Desert. Mountains are comparatively low, do not exceed 3200 m a.s.l., and are restricted to spurs of the Hissor range in the very southeast and to the Kopet Dag in the southwest, on the border with Iran. The availability of freshwater habitats is massively influenced by large-scale irrigation projects, mainly for cotton monoculture. These irrigation projects date back to the Soviet period, when the 1400 km long navigable Karakum canal was dug. This canal takes water from the Amu Darya across the Karakum Desert, and is the main cause of the recent near drying up of the Aral Sea; it is among the largest water supply canal in the world. In the present day, other hydro-engineering projects of similar scale are also taking place, for instance construction of the artificial Altyn Asyr Lake in the middle of the Karakum. Filling of its 2500 km long system of supply channels began in 2000, and by the end of 2021 the lake should have reached its final size of 1900 km². For obvious reasons, the majority of Turkmenistan has never been odonatologically explored. No dragonfly data is, for instance, available from the Sarykamysh depression situated in the ancient river bed of the Uzboy (a tributary of the Amu Darya), though there are numerous water bodies which were formed during the artificial redistribution of the Amu Darya runoff. Only the Kopet Dag and adjacent areas along the Karakum canal are relatively well studied (Valle 1942, Pavlyuk & Kurbanova 1984, Dumont et al. 1992, Dumont & Borisov 1994, Reinhardt et al. 2000, Schoorl 2000, Borisov 2008, Borisov & Haritonov 2007, 2008). The composition of the Odonata fauna of the Kopet Dag is unique for the region, and species such as *Epallage fatime*, *Coenagrion ornatum*, *Ischnura intermedia*, *Onychogomphus assimilis*, O. (*forcipatus*) *albotibialis*, *Cordulegaster charpentieri* and *Caliaeschna microstigma* are restricted to this part of Turkmenistan and do not penetrate further east into Central Asia.

Uzbekistan Uzbekistan is one of just two doubly landlocked states in the world - that is, it is surrounded completely by other landlocked countries. Due to this unique geographical position, it shares borders with all five Central Asian countries and occupies a rather middle position between flat desert topography and high mountain ranges, the two major landscape types of Central Asia. Although more than half of the territory is dominated by the vast Kyzylkum Desert, foothills of the Tian Shan and Hissor ranges extend into southeastern Uzbekistan, reaching about 4500 meters a.s.l. Since the beginning of the Soviet period, large-scale irrigation and hydro-engineering projects (such as the Aydar-Arnasay lake system, which covers 4000 km^2) have had a massive impact on the

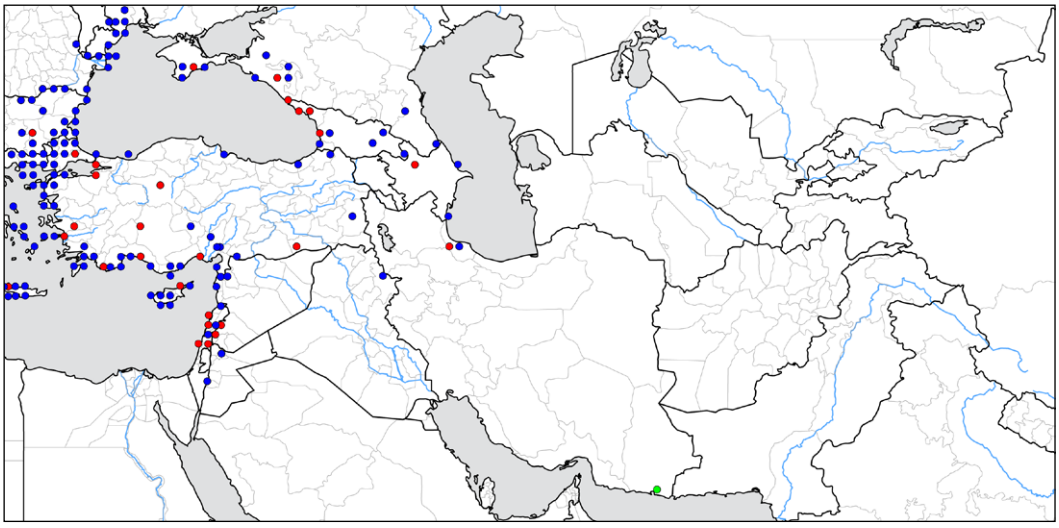
quantity and quality of freshwater ecosystems. The expeditions across Central Asia by A.P. Fedtschenko and his wife Olga mark the starting point of odonatological research, a significant proportion of the specimens brought home from these expeditions being collected in the territory of today's Uzbekistan (Brauer 1880). Further individual records of Uzbek odonates have been mainly published within larger faunistic inventories, such as those by Bartenev (1911, 1912a, 1913a, 1915, 1919a, 1930c), Sokolov (1931), Sadykova (1959) and Belyshev (1961). The comprehensive review of the Central Asian dragonfly fauna by Borisov & Haritonov (2007, 2008) also includes previously unpublished records which were obtained before the turn of the millenium. Since then, no new records have been published, and our knowledge of the Odonata fauna of Uzbekistan is entirely based on data from the last century.

Lestidae

In the area covered by this atlas the family Lestidae is represented by ten species in three genera. In addition to this, *Chalcolestes viridis* (until recently known as *Lestes viridis*) occurs just west of the region, in the European part of Turkey. The characters suitable to distinguish this species from *C. parvidens* only became widely known from the 1990s onwards, which resulted in a clarification of the range limits of both species (Olias 2005, Olias et al. 2007, Gyulavári et al. 2011). Currently it is believed that all records published as *C. viridis* from the area covered by this atlas in fact belong to *Chalcolestes parvidens*.

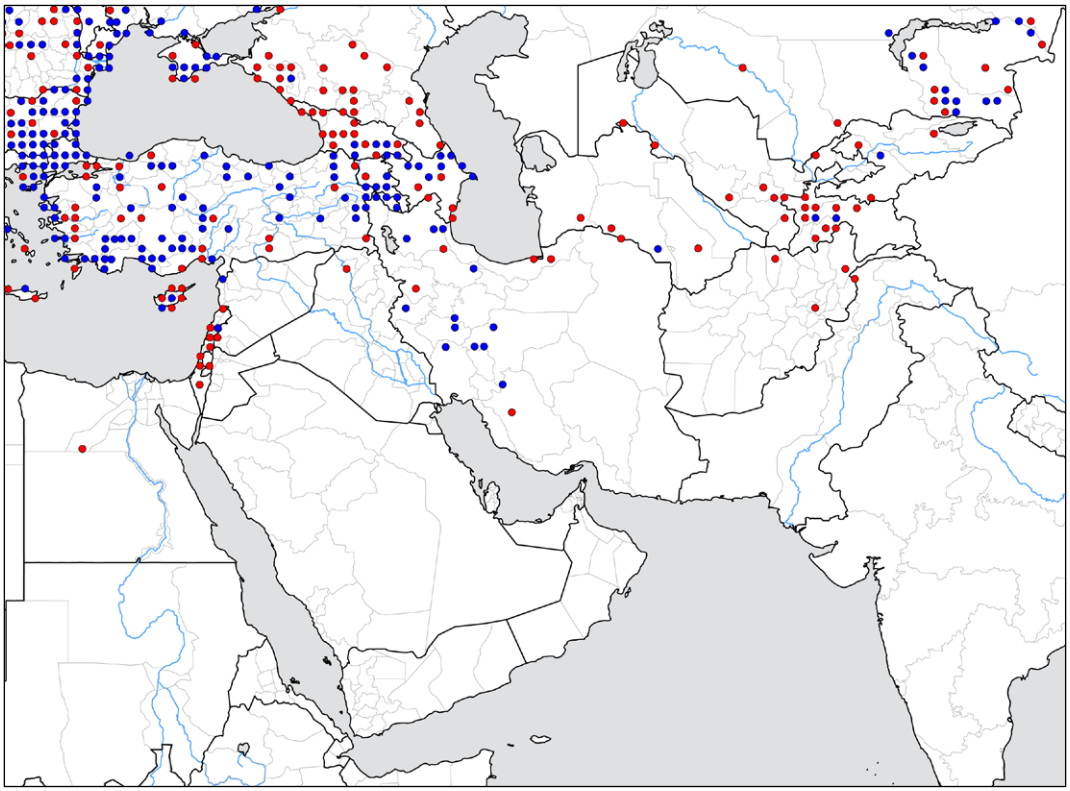
***Chalcolestes parvidens* (Artobolevskij, 1929) — Eastern Willow Spreadwing**

Chalcolestes parvidens has for a long time been considered as a subspecies of *C. viridis*, and individuals with intermediate characters are known and have been demonstrated to be hybrids. *Chalcolestes viridis* is primarily a western and central European species which is rare in southeast Europe and not expected to be present in the region of this atlas. In the region covered here, *Chalcolestes parvidens* is confined to Turkey, the Levant (Cyprus, Syria, Lebanon, Israel, Jordan), northern Iraq, the South Caucasus (Georgia, Azerbaijan) and northwestern Iran. More to the west, its range overlaps with that of *C. viridis* right across to Italy and Corsica. A record from southeast Iran published as *C. viridis* (Sadeghi & Mohammadalizadeh 2009) is very questionable and most likely refers to a *Lestes* species (*L. concinnus*?). *Chalcolestes parvidens* is mostly found at standing waters where branches of bankside trees and bushes overhang the water.



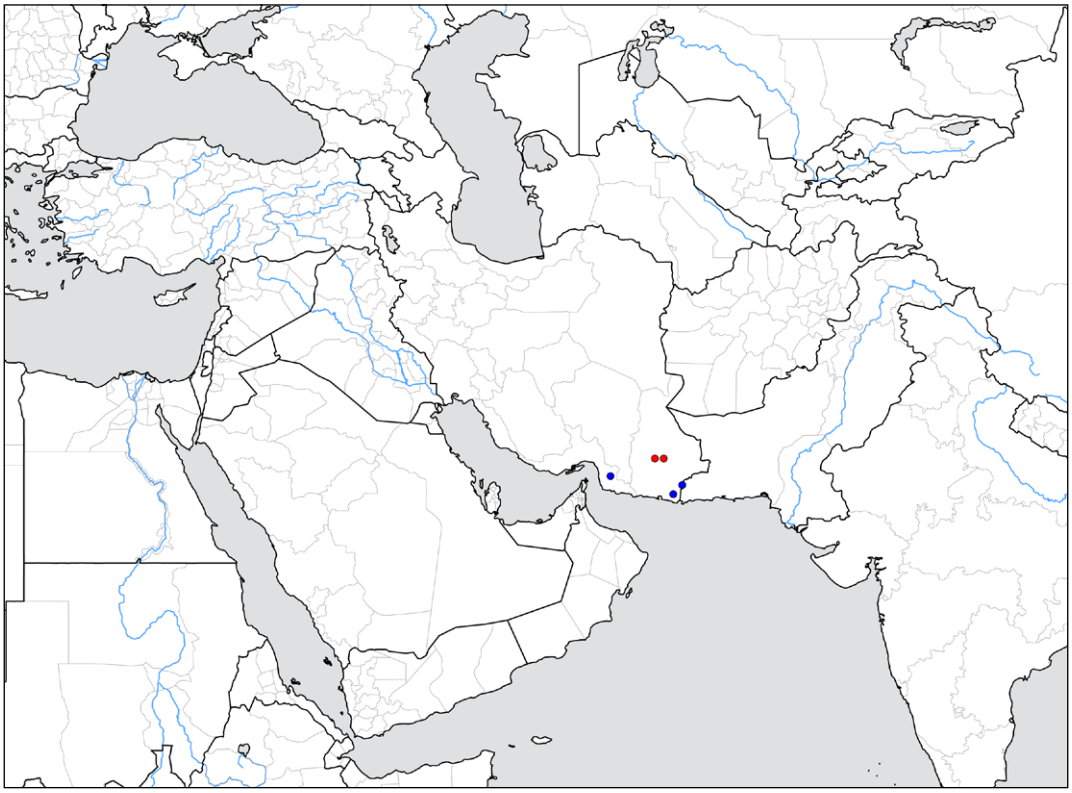
***Lestes barbarus* (Fabricius, 1798) — Migrant Spreadwing**

Lestes barbarus is widespread in the southern half of Europe and around the Mediterranean, reaching eastwards to China and the western parts of Mongolia. In the areas covered in this atlas it is absent from the arid regions but reasonably common and widespread in Turkey, the South Caucasus countries and the mountainous and more humid parts of the Levant. It is very rare in Cyprus. In Iran it reaches south through the Zagros mountains and east along the Caspian coast, narrowly connecting with the population in Central Asia. In Central Asia it is mainly recorded from the more mountainous Kyrgyzstan and Tajikistan regions, reaching southeast through Afghanistan to the Indian part of Kashmir. It occurs at standing, often shallow, waters with a belt of rushes and sedges.



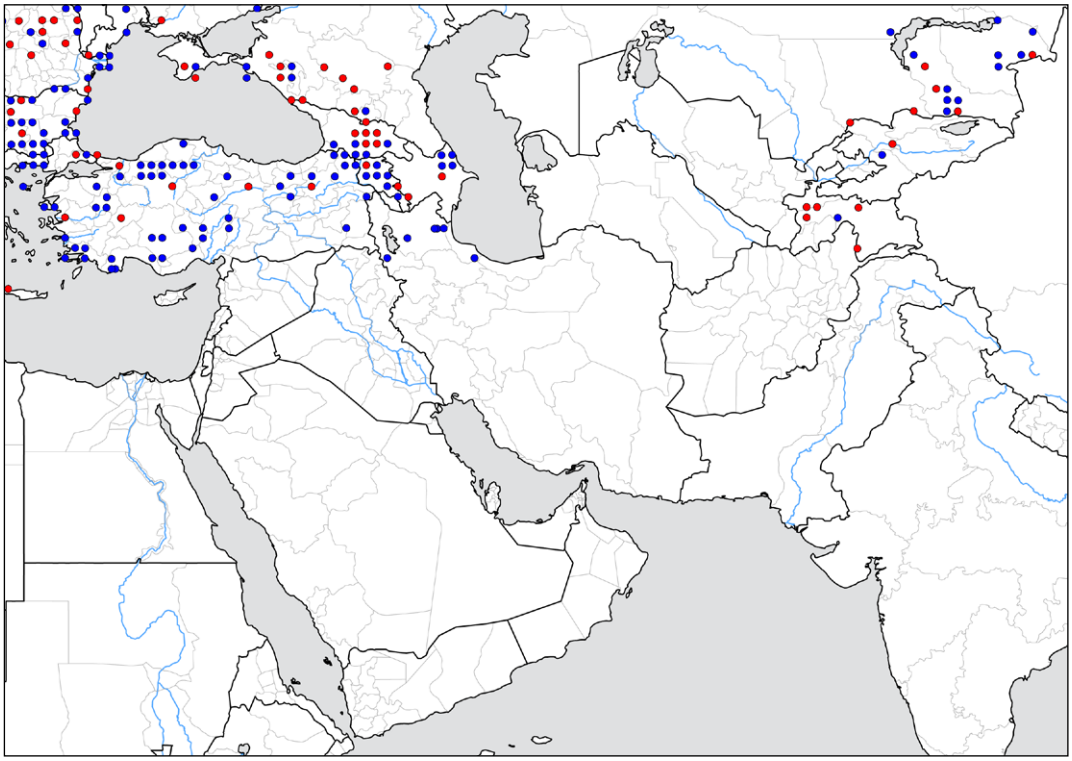
***Lestes concinnus* Hagen in Selys, 1862 — Dusky Spreadwing**

Lestes concinnus ranges from northern Australia and New Caledonia through the Indonesian archipelago and the Philippines to mainland Southeast and South Asia. In large parts of this area it is rather rare. Based on the number of observations, the species also seems to be rather scarce in India, but it may simply be under-recorded. The westernmost records are from southeast Iran, where it was first recorded in 1949 (Schmidt 1954a, as *L. umbrinus*) and was later found to be relatively common with 12 additional localities being discovered (Dumont et al. 2017, Schneider et al. 2018). One record of *Chalcolestes viridis* and one of *Lestes virens* from Pir Sohrab, Sistan-va-Baluchistan province by Sadeghi & Mohammadalizadeh (2009) are inconsistent with the general distribution of these species and might refer to *L. concinnus*. In southeast Iran the species occurs at shallow, warm, standing waters (Schneider & Ikemeyer 2019).



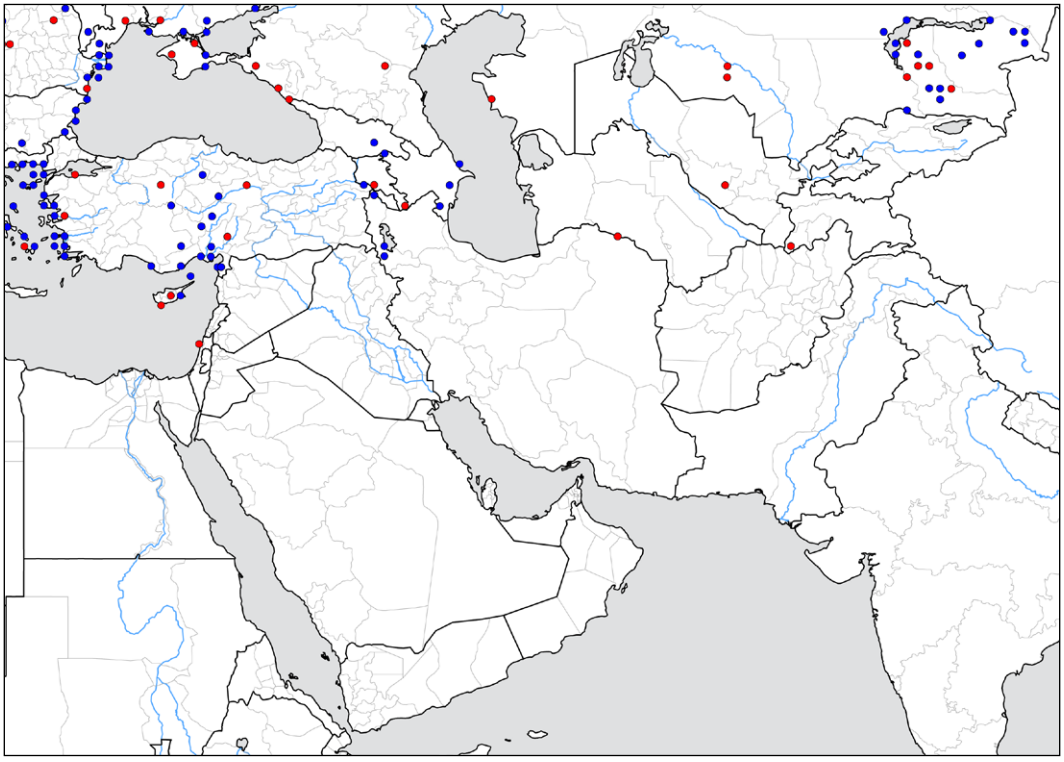
***Lestes dryas* Kirby, 1890 — Robust Spreadwing**

Lestes dryas is a widespread Holarctic species extending from western Europe to eastern Russia (Kamchatka, Sakhalin) and northern Japan, and across large parts of North America. In Eurasia and North Africa, the southernmost localities are known from Morocco, Turkey and northwest Iran. The species is widespread but generally uncommon in Turkey, the countries of the South Caucasus and northwest Iran. It is well distributed in the mountainous areas of Tajikistan, Kyrgyzstan and Kazakhstan and can be expected to occur in northern Afghanistan. *Lestes dryas* is found in habitats that are at least partially shallow with an abundance of rushes and sedges, favouring places which desiccate every few years. It is also found in peat bogs at their final stage of development where depressions are only seasonally flooded. In these habitats it is often syntopic with *Sympetrum flaveolum*. It is also known from permanent montane and coastal ponds, pools, lagoons and, rarely, brackish lagoons.



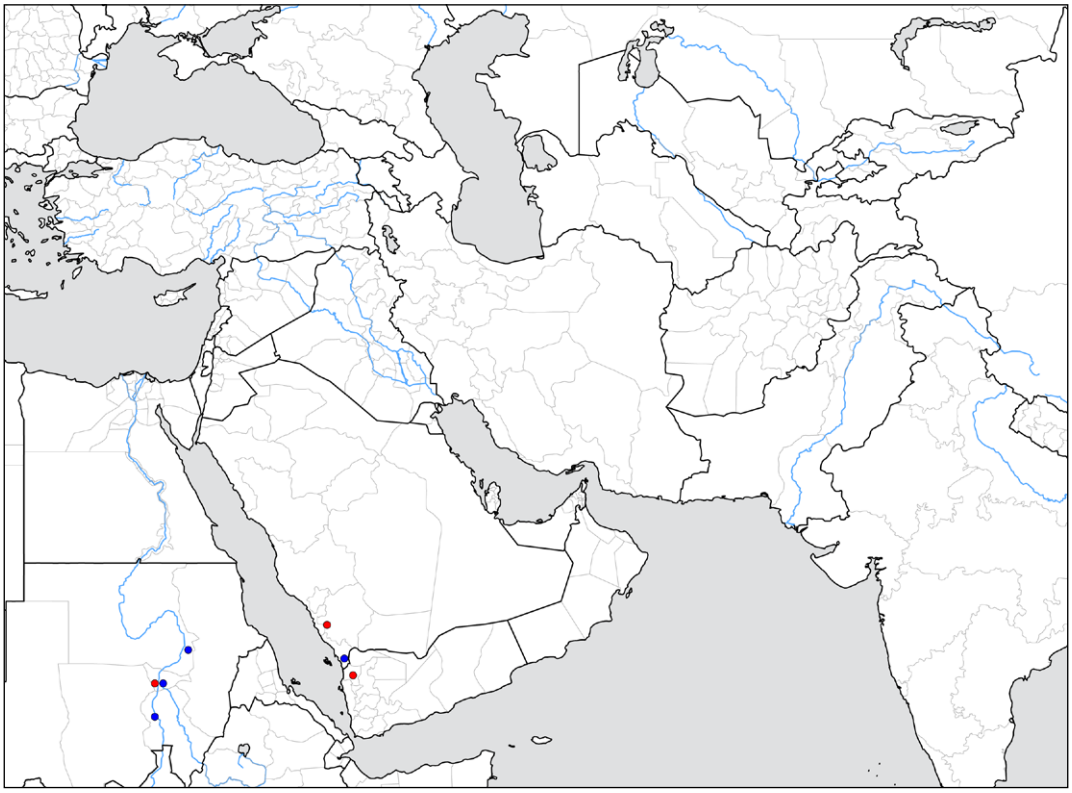
***Lestes macrostigma* (Eversmann, 1836) — Dark Spreadwing**

The range of *Lestes macrostigma* stretches from the Atlantic coastal areas of southern Europe across to Mongolia, but within this range it has a very fragmented distribution. Within the region covered in this atlas the species is widely distributed in Turkey, Cyprus, the South Caucasus countries and in northwestern Iran near Lake Urmia. From each of Turkmenistan, Uzbekistan, Tajikistan and Kyrgyzstan there is only a single documented record, indicating that the species is surprisingly rare in this part of Central Asia. *Lestes macrostigma* is predominantly found at shallow waters, often brackish, that tend to fall dry during summer, and the species often occurs at coastal or inland salt lakes or steppe lakes, though populations at freshwater sites are also known. Suitable waters are characterised by the presence of a dense vegetation belt of *Bolboschoenus* sp. or *Juncus* sp., which are used as ovipositing substrates (Lambret et al. 2015). The species is known for its erratic occurrence, with years with thousands of individuals at a site being followed by periods of near absence.



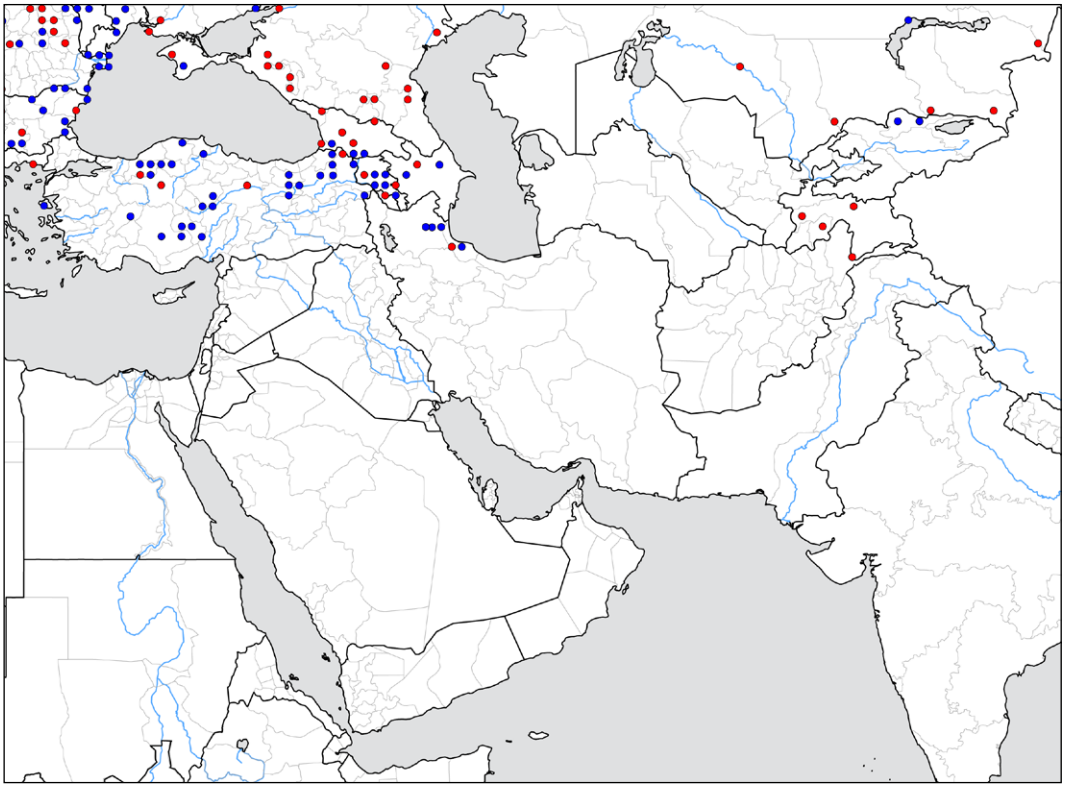
***Lestes pallidus* Rambur, 1842 — Pallid Spreadwing**

Lestes pallidus is widespread and not uncommon in the drier, non-forested parts of Sub-Saharan Africa. It has been recorded in Sudan, Ethiopia and Somalia from where its range continues to the Arabian Peninsula. In the latter region it is scarce, being known from three localities in Saudi Arabia and one locality in Yemen (Waterston 1984, Monnerat & Al Dhafer 2016, Dumont et al. 2017). The records are from low elevation. Monnerat & Al Dhafer (2016) found the species at a small pool with gravel substrate and no vegetation in a dry wadi bed.



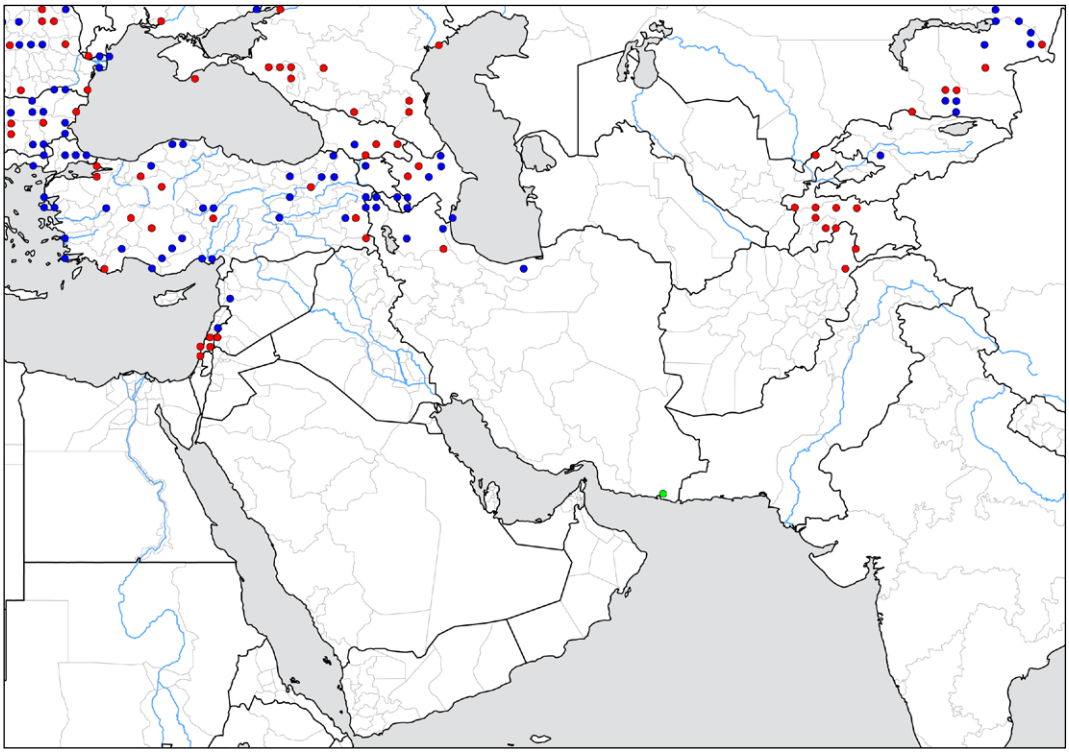
***Lestes sponsa* (Hansemann, 1823) — Common Spreadwing**

Lestes sponsa ranges from Europe across to Sakhalin Island (Russia) and Japan. In the area covered in this atlas, the species is present in parts of Turkey, the South Caucasus and northwest Iran, where it is mostly confined to higher altitudes. In Central Asia it is found in Kyrgyzstan, Tajikistan and Kazakhstan. More to the east it is widespread throughout Mongolia, Siberia and the Russian Far East. This species prefers marshes, bogs, pools, ponds and small lakes surrounded by rushes and sedges.



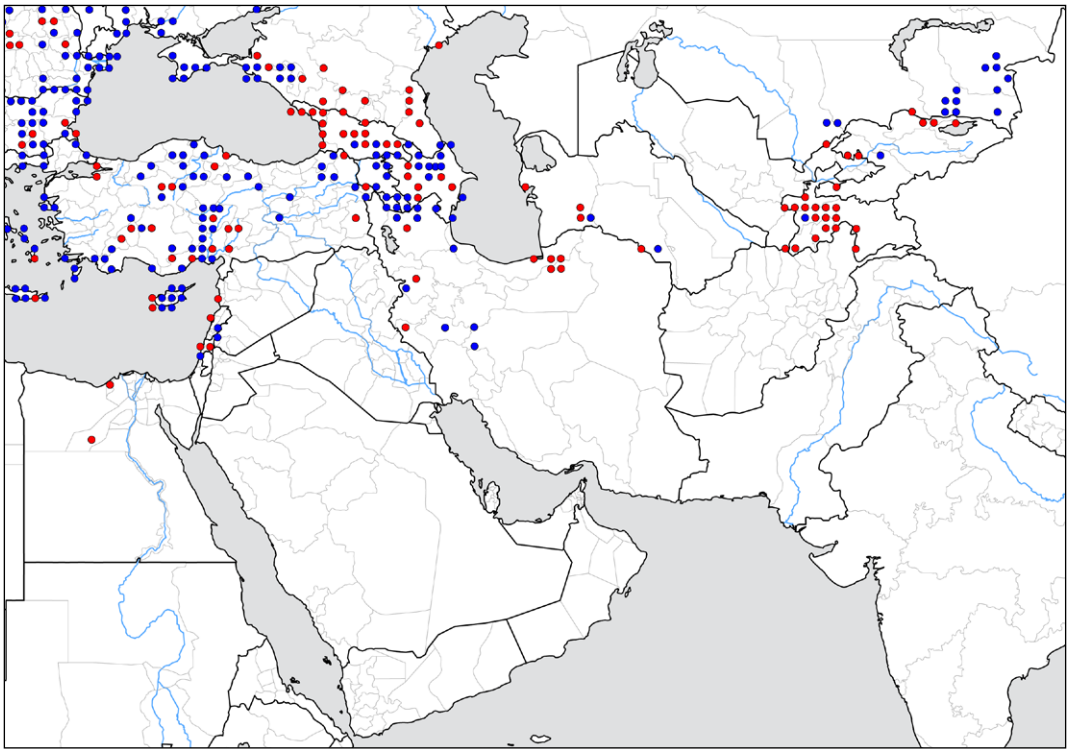
Lestes virens (Charpentier, 1825) — Small Spreadwing

The range of *Lestes virens* extends from western Europe to western China. It is uncommon and localised in the area of this atlas, ranging from Turkey and the Levant to the South Caucasus, and into northwestern Iran. In Turkey and in the adjacent South Caucasus, the species is widely distributed but rare. The species seems to be much scarcer in Israel, Lebanon and Syria. There is a published record from the very south of Sistan-va-Baluchestan province in Iran (Sadeghi & Mohammadalizadeh 2009), but this is inconsistent with the overall species distribution and most likely refers to *Lestes concinnus*. In Central Asia, *Lestes virens* is generally uncommon and is found in northern Afghanistan, Tajikistan, Kyrgyzstan and the adjacent part of Uzbekistan; locally it may occur in considerable abundance. The species seems to be absent from the arid and semi-arid parts of Arabia, Iran and Central Asia.



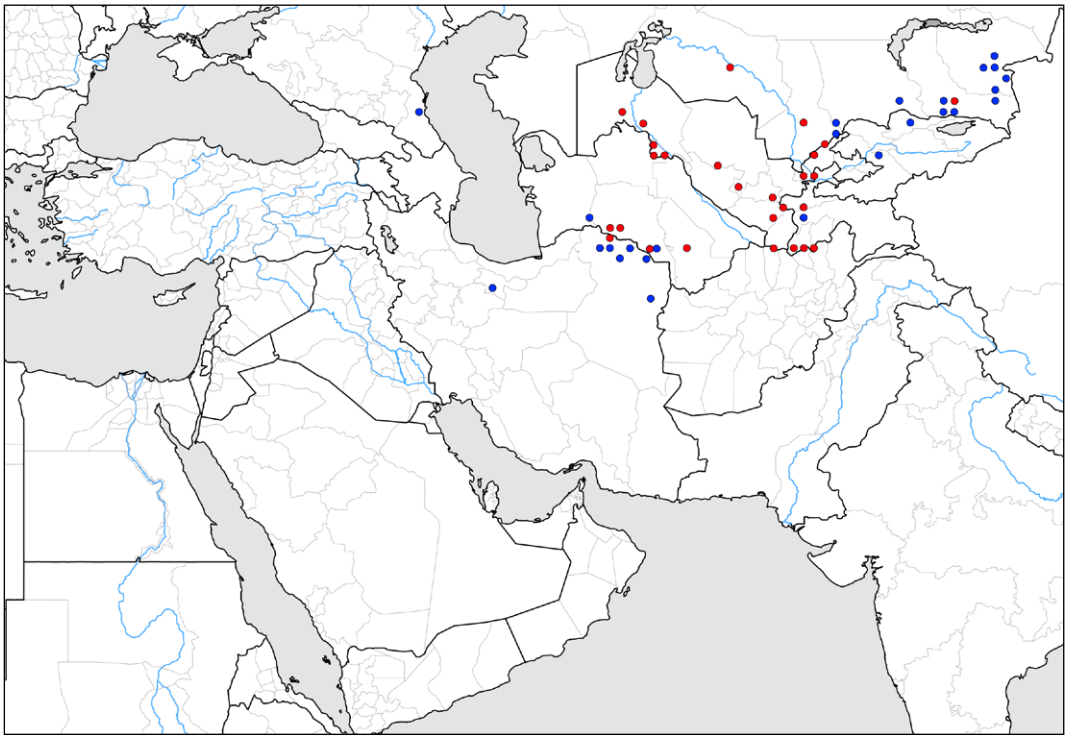
***Sympecma fusca* (Vander Linden, 1820) — Common Winter Damsel**

A West Palearctic species, distributed eastward to eastern Kazakhstan and Altai Krai in southern Siberia. An isolated old record from Irkutsk (Selys 1872) suggests that the species may have scattered populations in southern Siberia from the northern Altai regions to Lake Baikal. In the area of this atlas, this species is present in Turkey, Cyprus, the Levant, the South Caucasus and in western and northern Iran. *Sympecma fusca* is also present in the Kopet Dag Mountains on the border of Turkmenistan and Iran, and from northern Afghanistan across the mountainous eastern part of Central Asia. The species seems to be absent from the arid and semi-arid parts of Arabia, Iran and Central Asia. In hot summers, individuals from the lowland populations fly to the mountains immediately after emergence in order to aestivate, and only return to the foothill plains in the autumn, where they then overwinter as adults and breed in the following early spring. In some years, adults of all three *Sympecma* species can be found active throughout the year in southwestern Tajikistan (Borisov & Haritonov 2007).



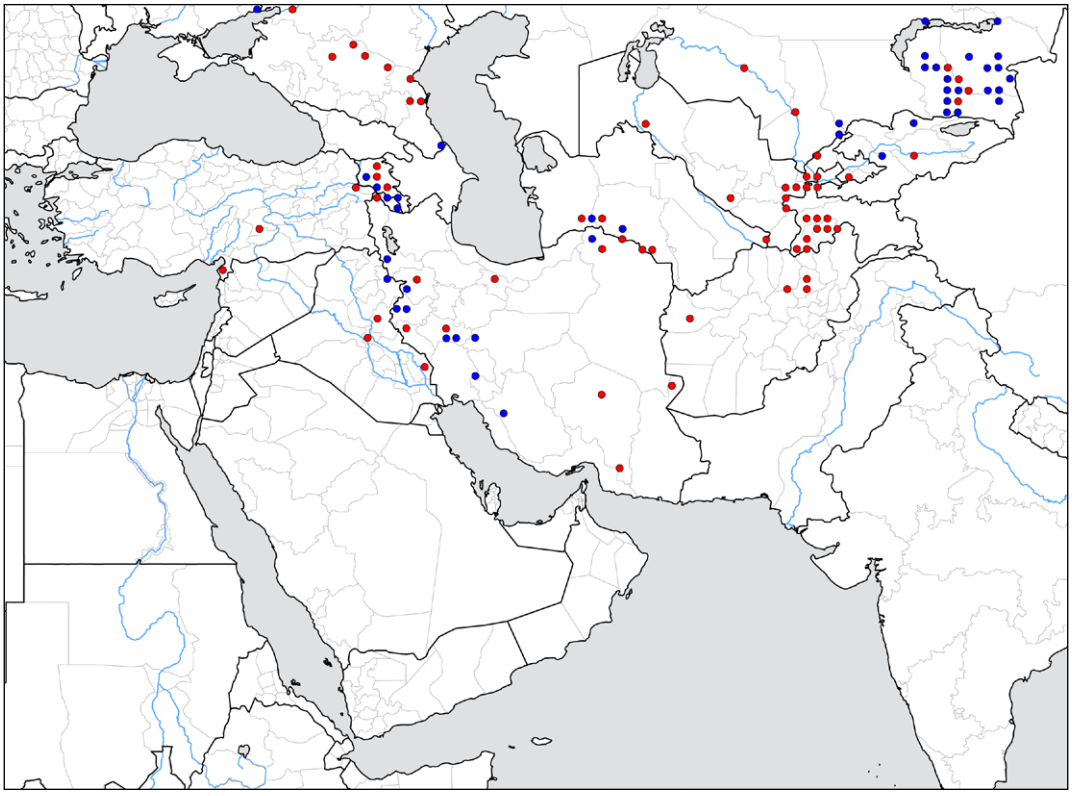
***Sympecma gobica* Förster, 1900 — Turkestan Winter Damsel**

The range of this species stretches from northeastern Iran over much of Central Asia to the Gobi Desert in the east. It has also been found in the foothills of the Alborz Mountains in northern Iran. *Sympecma gobica* is most abundant in the foothills of the Tian Shan and Pamir-Alay (southern Kazakhstan, Uzbekistan, Tajikistan, Kyrgyzstan). Outside the region of this atlas, the species was recently recorded in Russian Dagestan, north of the Caucasus. In Iran it was found near shrubs and trees and other riparian vegetation along fast-flowing mountain brooks (Ikemeyer et al. 2015, Schneider & Ikemeyer 2016). In Kyrgyzstan the species seems to prefer bushy meadows and open sheltered *Juniperus* forest along the banks of streams and small rivers at about 1500-2000 m altitude during aestivation (Schröter 2010b). There is considerable individual, as well as inter-population, variation in the extent of the brown markings on the sides of the thorax, which has in the past resulted in several misidentifications; Dumont & Borisov (1993) and Jödicke 1997 published decisive information about the taxonomy and identification of the three *Sympecma* species. This species, like *S. fusca*, makes seasonal high-altitude migrations.



***Sympecma paedisca* (Brauer, 1877) — Siberian Winter Damsel**

The range of this widespread Eurasian species extends from western Europe across to Korea and Japan in the east. *Sympecma paedisca* has been found in eastern Turkey, Armenia, Iraq, Iran, Afghanistan and in all Central Asian countries. The species shows a gradual decrease in the extent of the dark bronze pattern on the sides of the thorax from north to south, particularly in the area covered in this atlas. Many intraspecific forms have been described, but all are currently considered invalid (Jödicke 1997). *Sympecma paedisca* prefers grassy or other low riparian vegetation along standing or slow-flowing waters, especially with floating dead leaves and stems of reeds or rushes. In Central Asia, the species makes seasonal high-altitude migrations but, unlike other species of the genus, some individuals do not migrate and remain at the location where they emerged.

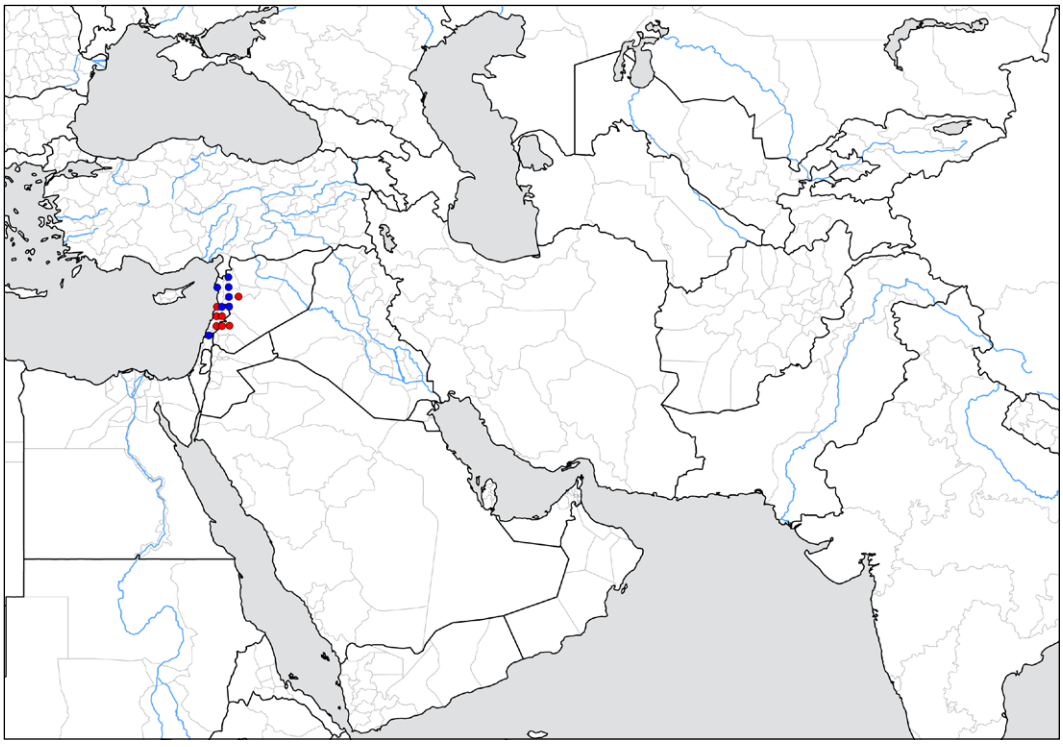


Calopterygidae

Calopteryx, the only genus of this family occuring in our area, is represented by six species. The delimitation of the species and subspecies in this genus is often problematic, and in particular the situation with regards the many taxa of *C. splendens* remains unclear. The validity and distribution of the various subspecies are not discussed in this atlas.

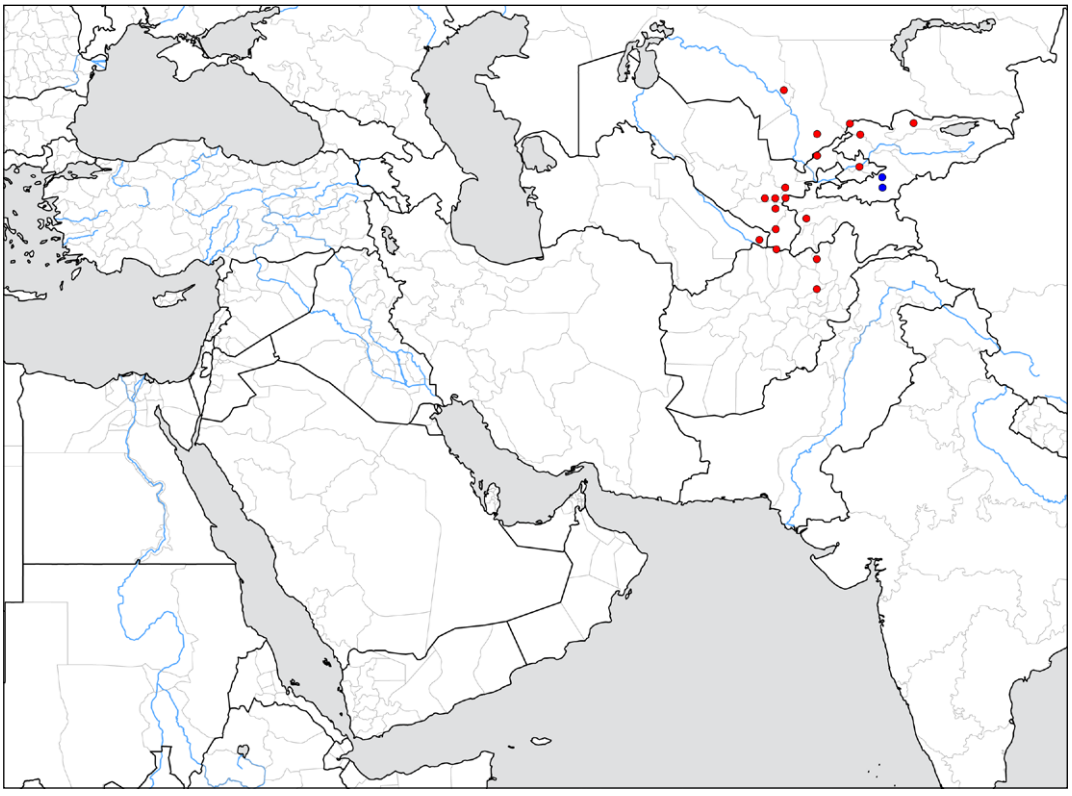
***Calopteryx hyalina* Martin, 1909 — Clear-winged Demoiselle**

Calopteryx hyalina is a Levantine endemic which is largely restricted to Syria and Lebanon. It does not occur as far south in the Levant as *C. syriaca*. Females are hard to distinguish from other regional *Calopteryx* females (Dumont 1991). The species was described from the area of Lake Homs (Syria) and is found in the coastal areas of Syria and Lebanon as far south as the Litani River. The species has undergone a strong decline due to increased water demand and is currently highly threatened, and might be close to extinction.



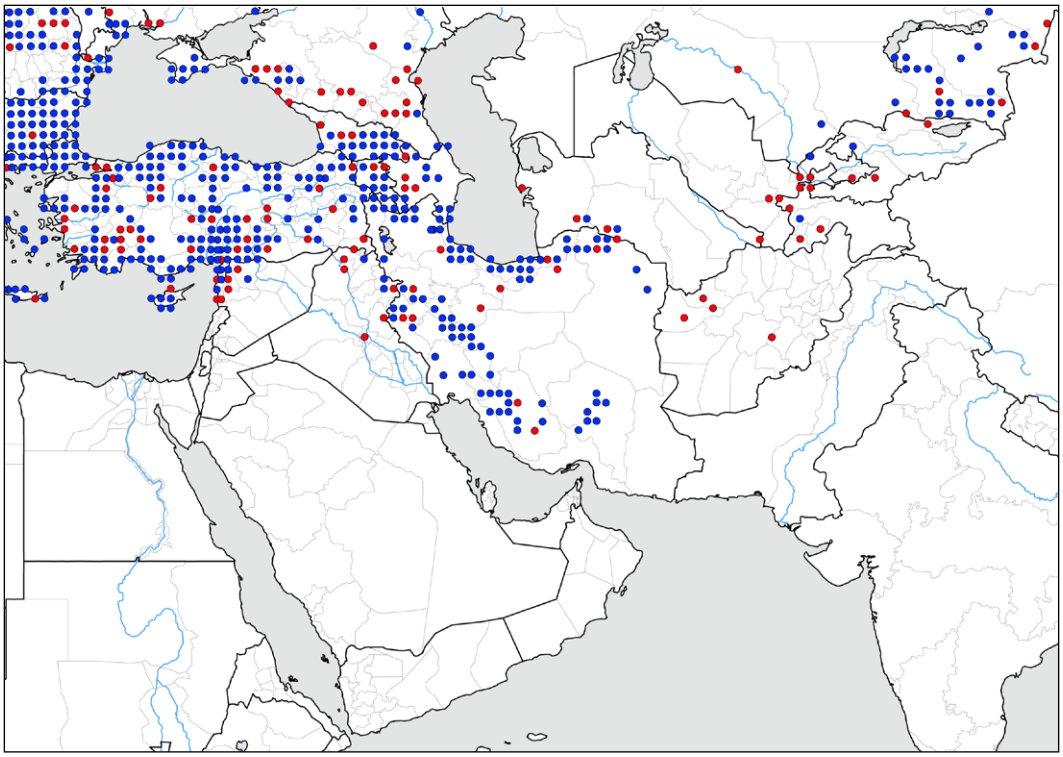
***Calopteryx samarcandica* Bartenev, 1912 — Samarkand Demoiselle**

This species is restricted to Central Asia where it can be found in northern Afghanistan, the eastern parts of Uzbekistan and Turkmenistan, western Tajikistan, Kyrgyzstan and southern Kazakhstan. The species is common in the lower mountains and foothill regions of the western Tian Shan, Pamir-Alay and the northern part of the Hindu Kush. The main habitats are watercourses with natural water sources (springs and small rivers fed by seepage); compared to *C. splendens*, it is only rarely found in ditches and irrigation canals. Androchromic females are found in the Fergana valley in Uzbekistan and in the southwest of Tajikistan.



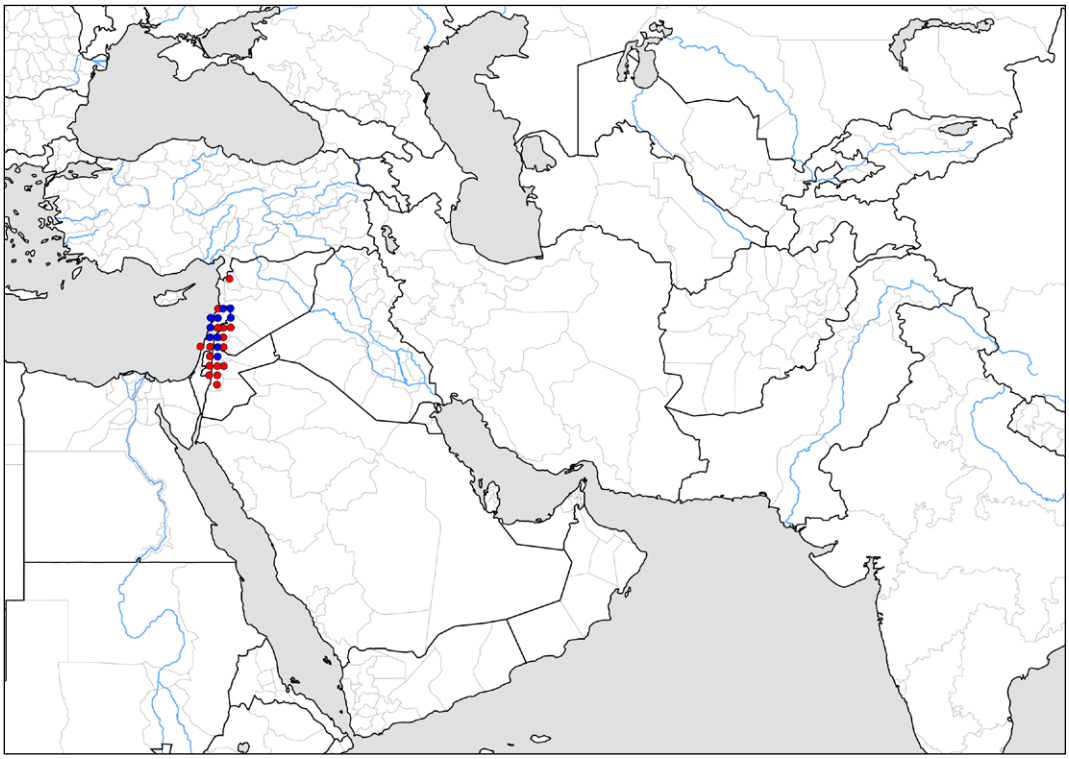
***Calopteryx splendens* (Harris, 1780) — Banded Demoiselle**

The taxonomy of the *C. splendens* group is problematic. This species complex has a large Eurasian range and is found in a wide range of running water types, including artificial waters like canals and channels. The status and distribution of the various forms which have been described as subspecies is far from clear, and their validity can be questioned. Comparison of wing spot positions and size with biogeography revealed a number of gradients and extensive hybrid zones as well as morphological convergences which cannot be related to phylogeny. Many of these subspecies can only be identified based on their range, which casts doubt on their status (Sadeghi & Dumont 2014). The very distinctive *C. waterstoni* with its hyaline wings and a very narrow range is here treated separately at a full species rank. *Calopteryx splendens* as we consider it here occurs widely in Turkey, the northern Levant, South Caucasus, eastern Iraq, Iran and Central Asia, where individual and interpopulation variation is very high.



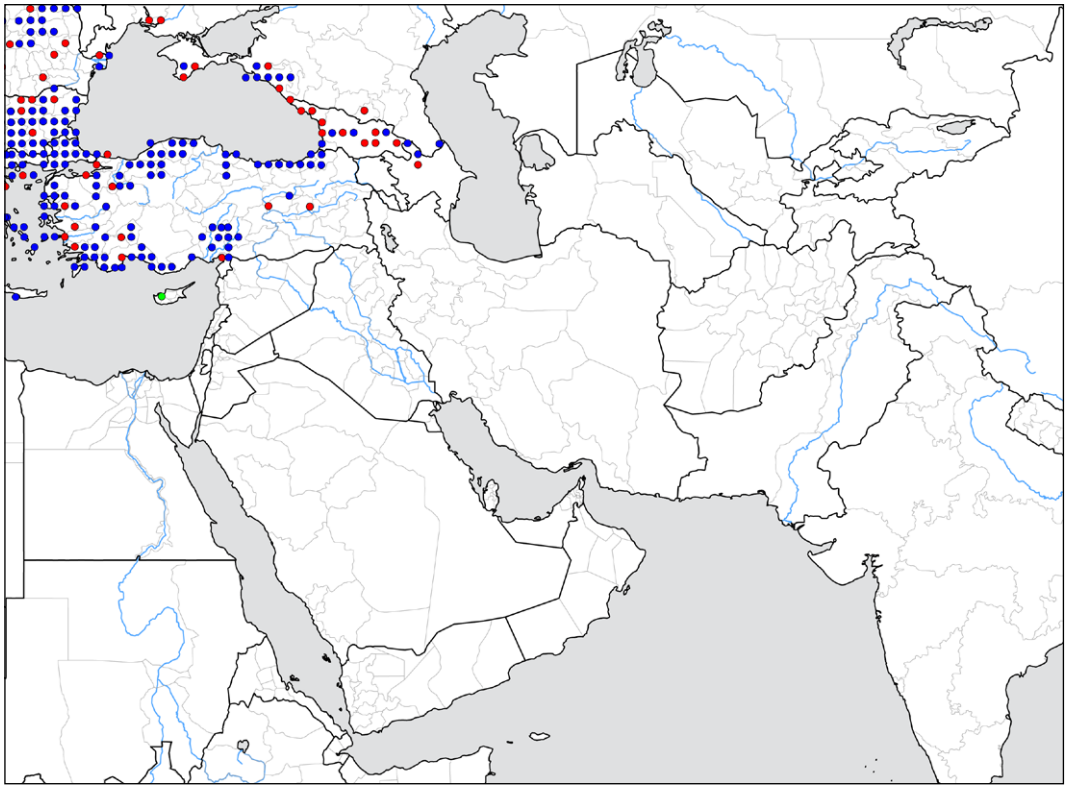
***Calopteryx syriaca* Rambur, 1842 — Syrian Demoiselle**

Calopteryx syriaca is a Levantine endemic and is known from Syria, Lebanon, Israel, Jordan and the West Bank. It occurs also on the eastern drainages of the Dead Sea and is typical of river ecosystems. Like *C. hyalina*, the species has undergone a strong decline due to increased anthropogenic water demand resulting in desiccation of streams and rivers.



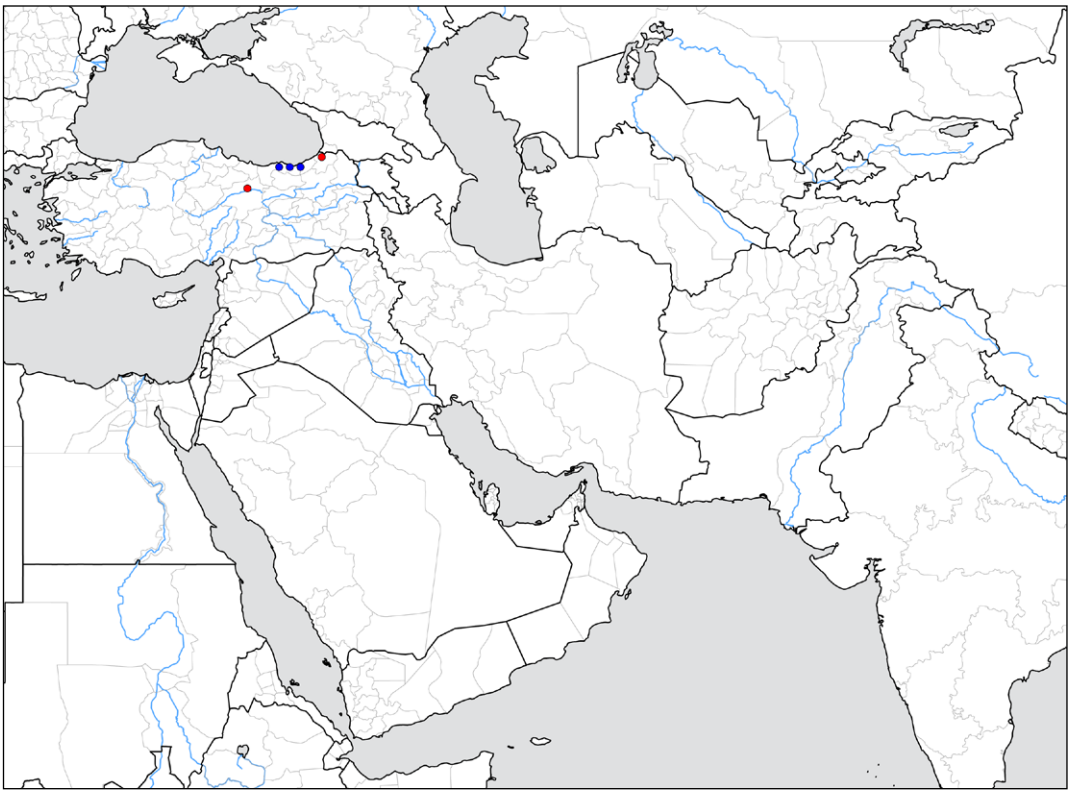
***Calopteryx virgo* (Linnaeus, 1758) — Beautiful Demoiselle**

Three subspecies are traditionally recognized: *C. v. virgo* (Linnaeus, 1758) (West, Central and North Europe), *C. v. meridionalis* Selys, 1873 (Western Mediterranean) and *C. v. festiva* (Brullé, 1832) (Eastern Mediterranean). In many areas, however, intermediate forms occur which cannot be attributed clearly to one or other of the subspecies. The closely related *C. japonica* Selys, 1869 from eastern Asia is considered a separate species (Malikova & Kosterin 2019). In the region covered in this atlas, the species is represented by the subspecies *C. v. festiva* and occurs in Turkey, Georgia and Azerbaijan. The single record of *Calopteryx virgo* from Cyprus was reported by Navas (1932) who examined material collected by Mavromoustakis in 1930; this is here considered to be a misidentification of a particularly blue *C. splendens*. *Calopteryx virgo* inhabits oxygen-rich, shaded, fast flowing streams.



***Calopteryx waterstoni* Schneider, 1984 — Pontic Demoiselle**

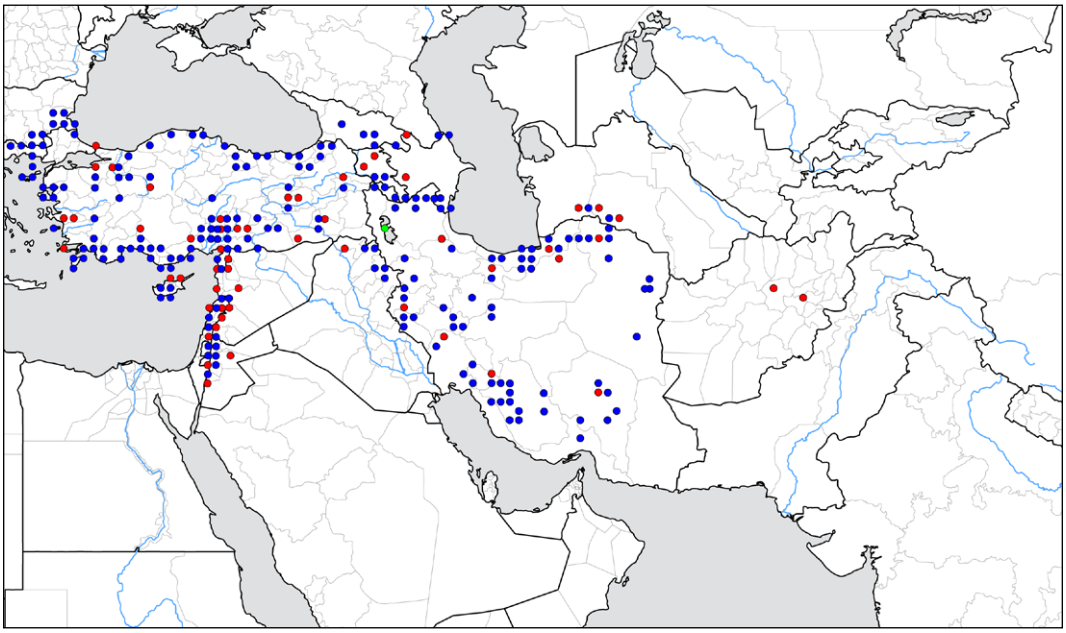
Calopteryx waterstoni is endemic to the low-altitude coastal zone of the Turkish Black Sea, between the Görele River in the west and the border with Georgia in the east (Dumont et al. 1987). The successive rivers drain towards the Black Sea along parallel courses, resulting in each system being rather isolated from the next. The taxon is treated here as a valid species although it regularly hybridises with *C. splendens* in the west of its very small range (Dumont el al. 1987), and is therefore sometimes treated as a subspecies of *C. splendens*.



Epallagidae/Euphaeidae
In the area covered by this atlas, the Oriental family Epallagidae/Euphaeidae (see Bechly 1999 for discussion on the family name) is only represented by the monotypic genus *Epallage*.

***Epallage fatime* (Charpentier, 1840) — Odalisque**

Epallage fatime is largely confined to the hilly and mountainous regions of West Asia. Its range extends from the eastern Balkans and Cyprus over Turkey, Iraq and Iran to Afghanistan and Pakistan. Only three old records (<1980) are known from the latter two, but this might be the result of a paucity of recent surveys in both countries. To the southwest, the species is also present in Lebanon, Syria, Israel, Jordan and the West Bank. Its southern distribution seems to be limited by the presence of the deserts of the Arabian Peninsula. *Epallage fatime* reaches its northernmost distribution in eastern Bulgaria and in the Caucasus countries (Armenia, Azerbaijan, Georgia and Russia [Dagestan]) and in the Kopet Dag Mountains along the border of Turkmenistan and Iran. It prefers fast flowing, sunny permanent streams with pebbles, rocks, herbaceous vegetation, bushes and low trees. It less frequently occurs on rivers.

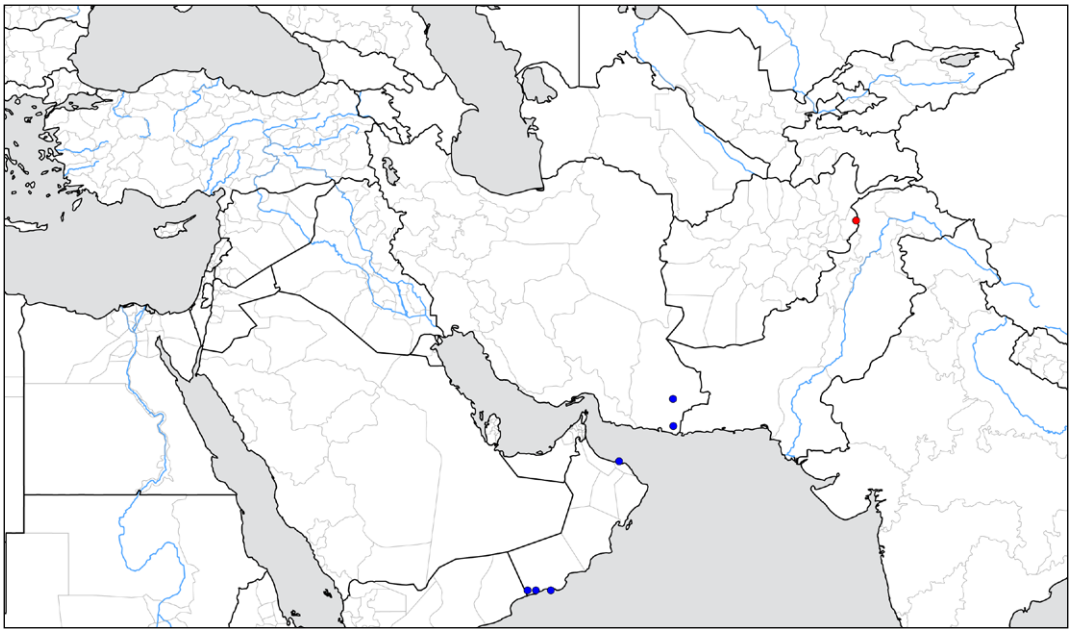


Coenagrionidae

With 42 species found in the region, the family Coenagrionidae is the second most species-rich after the Libellulidae. These two families make up 60 percent of the species found in the region and together they dominate the dragonfly fauna throughout, especially so at standing waters.

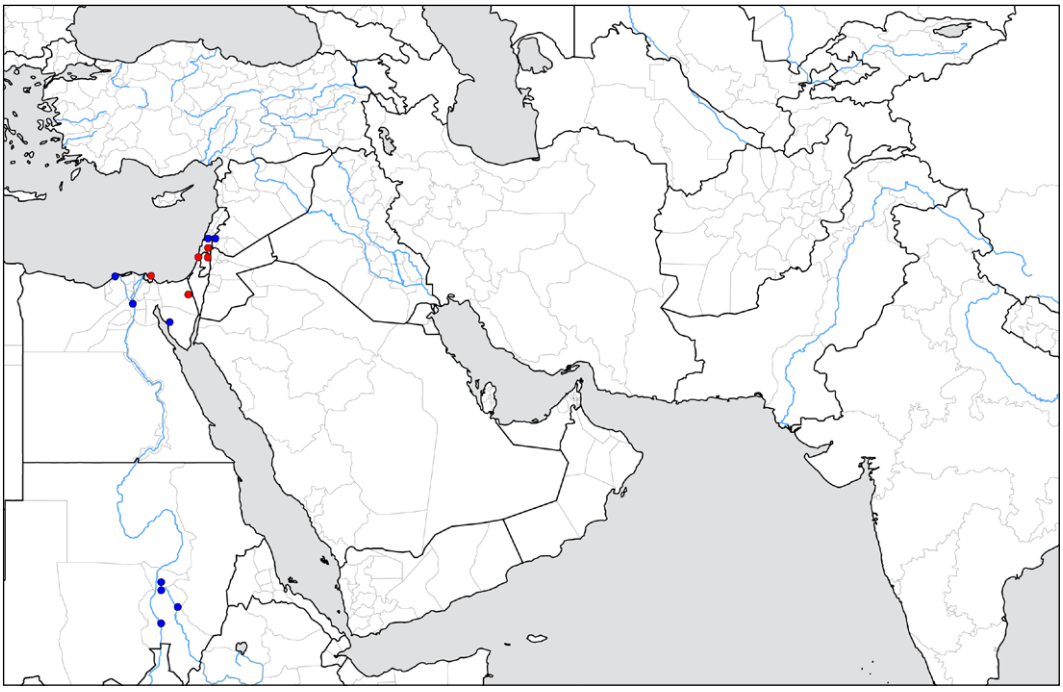
***Agriocnemis pygmaea* (Rambur, 1842) — Wandering Wisp**

Agriocnemis pygmaea has a large range and occurs from Australia and the Solomon islands across the Indonesian and Philippines Archipelago to the tropical parts of mainland Asia, reaching southeast Iran and Oman in the west. It is common in large parts of its range, occurring at all kinds of open, shallow, standing waters with dense vegetation often of grasses, for example rice paddies or the grassy shallow shores of lakes, ponds and pools. Due to its tiny size and its habit of flying low between grasses and rushes it is easily overlooked. The species seems to be widespread in Pakistan (Zia et al. 2011, Zia 2016) and further field work might show it to be not uncommon in southeast Iran, where it is currently known from two records (Schneider & Ikemeyer 2019). It was first recorded from Oman in 1992 (Schneider & Dumont 1997) and is currently known from three sites in the Dhofar region and one from the Muscat area (Lambret et al. 2017).



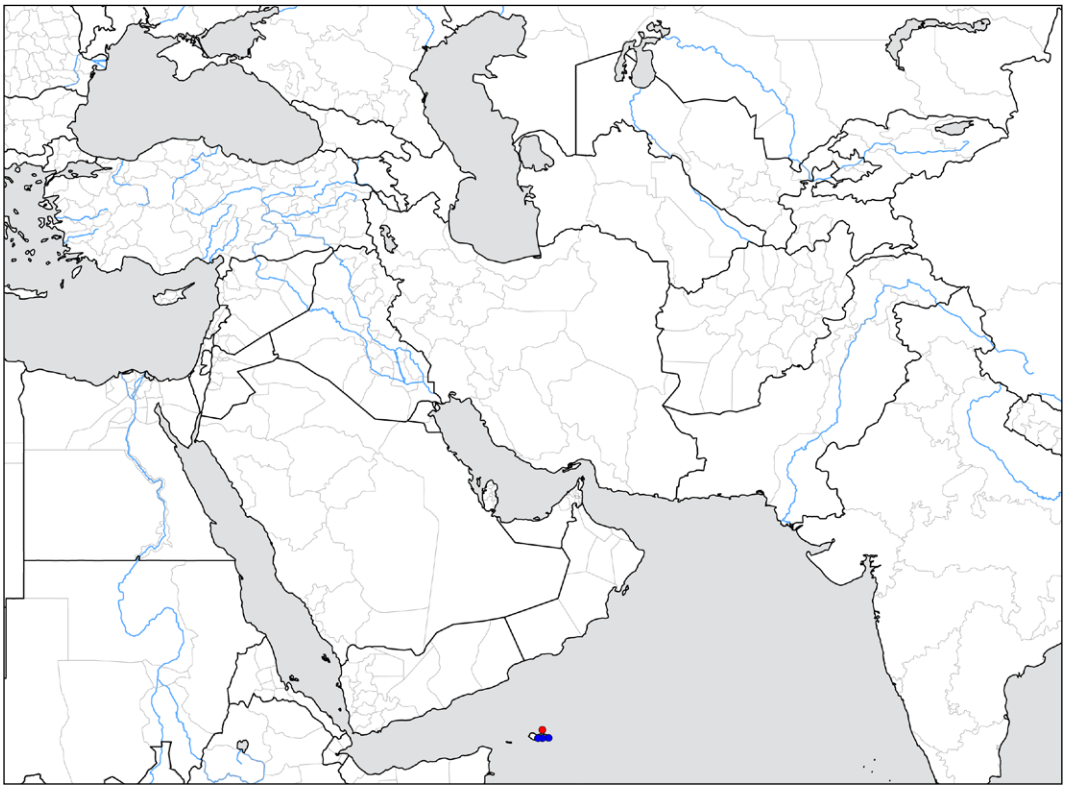
***Agriocnemis sania* Nielsen, 1959 — Nile Wisp**

Agriocnemis sania is a scarce African species found in East Africa (Kenya, Sudan, Ethiopia) and further north in Egypt and Libya (Clausnitzer et al. 2012). Outside Africa it also occurs in the Levant and the Sinai Desert. In Libya it was only known from a single locality, Ghat Oasis, its type locality, where it went extinct due to the introduction of Mosquitofish (*Gambusia* sp.) for mosquito control (Dumont 1991). In Israel it was known from several records in the northern parts of the Jordan valley, where it was common at the beginning of the 1970s (Dumont 1974). The last record from the Jordan valley dates back to 1986, and the species has subsequently been considered extinct due to pollution, water extraction and conversion of swamps into fish farms (Katbeh-Bader et al. 2002, 2004, Schneider et al. 2013a). In 2014 it was rediscovered at the Golan Heights (Shaish 2019), and in 2020 in the Hula Valley and along the Mediterranean coast (pers. com. Itai Shanni). In 2009 the species was discovered at two locations in the Nile Delta, Egypt, outside the area of this atlas (Dijkstra & Boudot 2010). Based on these reports, a record of *A. exilis* from Port Said by Martin (1915) is now believed to pertain to *A. sania* and is shown as such on the map. In Egypt *A. sania* was found in areas with tall floating grasses.



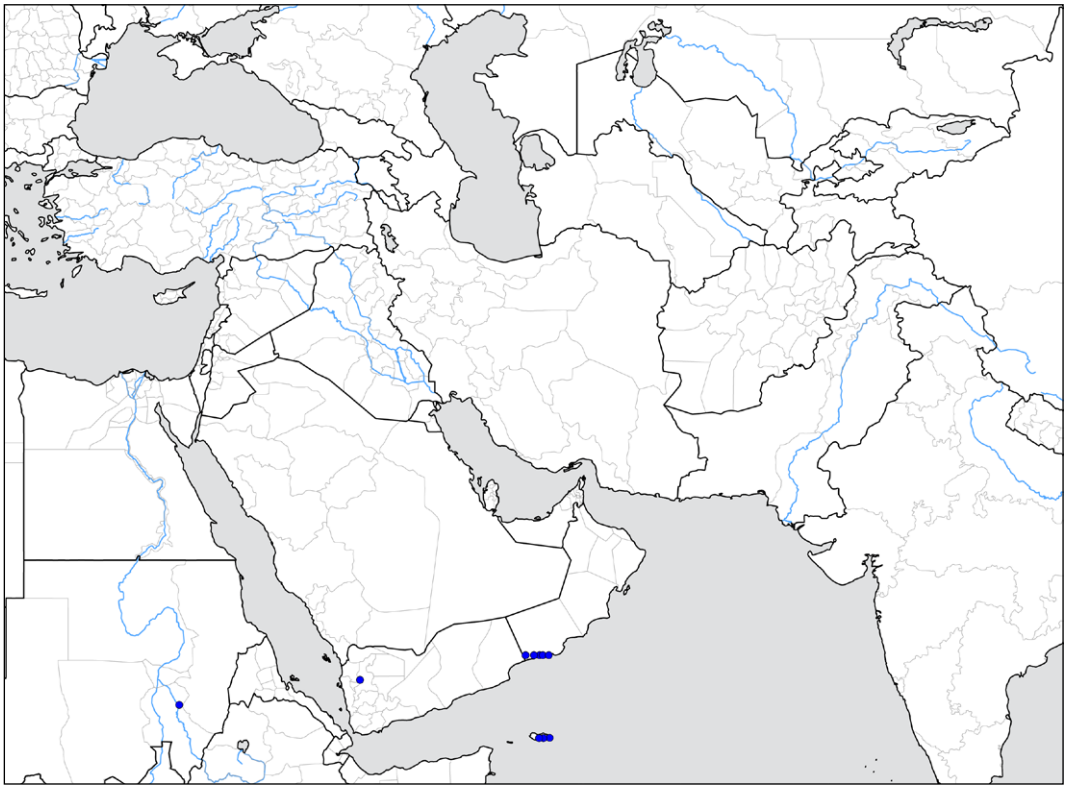
***Azuragrion granti* (McLachlan, 1903) — Socotra Bluet**

Azuragrion granti is endemic to Socotra Island, where it is relatively common and widespread on the eastern half of the island. The species is primarily found in the mountains (typically above 300 m a.s.l.), where it occurs in permanent running waters, although it can also be found down to sea level. It prefers fast running waters and is locally abundant, especially around deep clear wadi pools (Van Damme et al. 2020). Eighty records from 67 distinct localities are known from eight publications and a small number of images published on the internet (currently deleted). Due to human impacts on the environment, populations are decreasing and the species has disappeared from the northern agricultural lowland and several mountain rivers (Van Damme et al. 2020).



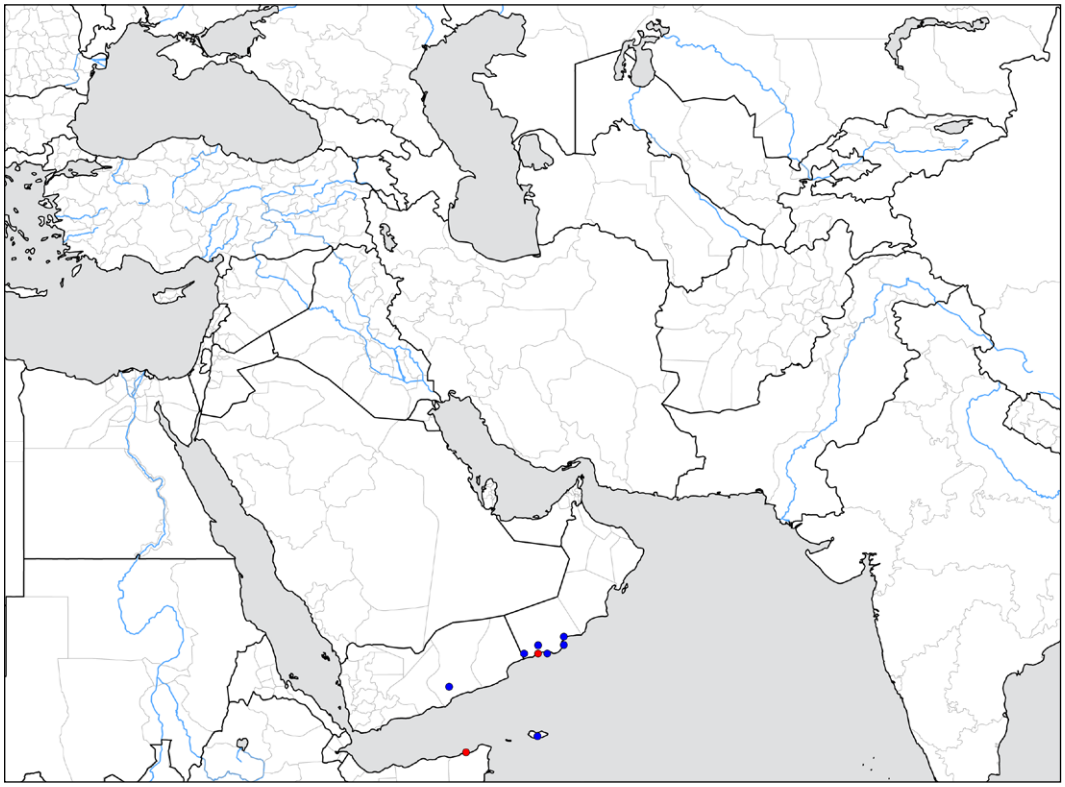
***Azuragrion nigridorsum* (Selys, 1876) — Sailing Bluet**

Azuragrion nigridorsum is an Afrotropical damselfly whose main range is found from Kenya southwards (Clausnitzer et al. 2012). North of this country, the species is known from Ethiopia and the southern Arabian Peninsula, where it occurs in Yemen (including Socotra) and the Dhofar region in southern Oman. In the Arabian Peninsula it is known from about 35 locations in the region reached by the monsoon rains, where it occurs at temporary flowing wadis, irrigation channels and coastal lagoons. On Socotra Island this species does not occur in fast-flowing streams, but can be seen on floating algae and grassy vegetation along slow flowing streams and in marshes (Van Damme et al. 2020).



***Azuragrion somalicum* (Longfield, 1931) — Somali Bluet**

Azuragrion somalicum has a small range, being confined to Somalia and the south of the Arabian Peninsula. In our region it has been recorded from 17 localities in the Afrotropical enclaves of south Yemen and Dhofar in Oman, where it is confined to a string of isolated populations along the southern slopes of the Dhofar Mountains between 30 and 685 m a.s.l. (Lambret et al. 2017). It was only recorded once on Socotra Island at ca. 900 m a.s.l. in 1999 (Van Damme et al. 2020). *Azuragion somalicum* is mostly recorded at large and small well-vegetated wadi pools in the lower parts of Dhofar. Those pools are characterised by floating vegetation, which is used for oviposition.

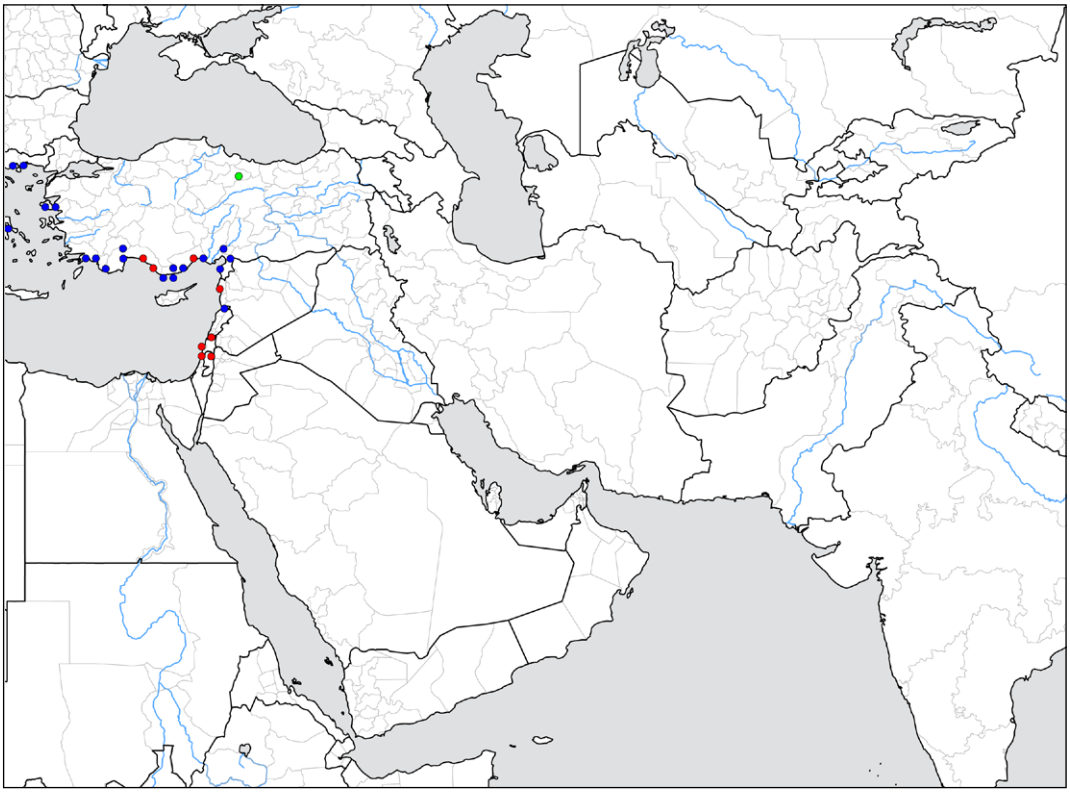


***Azuragrion vansomereni* (Pinhey, 1955) — Tiny Bluet**

Azuragrion vansomereni is an African species ranging north of the Equator from Senegal to Uganda and Eritrea (Clausnitzer et al. 2012). Its only Arabian record dates from 14 May 1981 from the Layla lakes in the centre of Saudi Arabia (Waterston 1984), a string of flooded sinkholes. Water extraction for irrigation and touristic purposes (now abandoned) resulted in dessication of these lakes in the first half of the 1990's, as a result of which the species became regionally extinct (Schneider & Krupp 1993, Kempe & Dirks 2008, Schneider & Samraoui 2015).

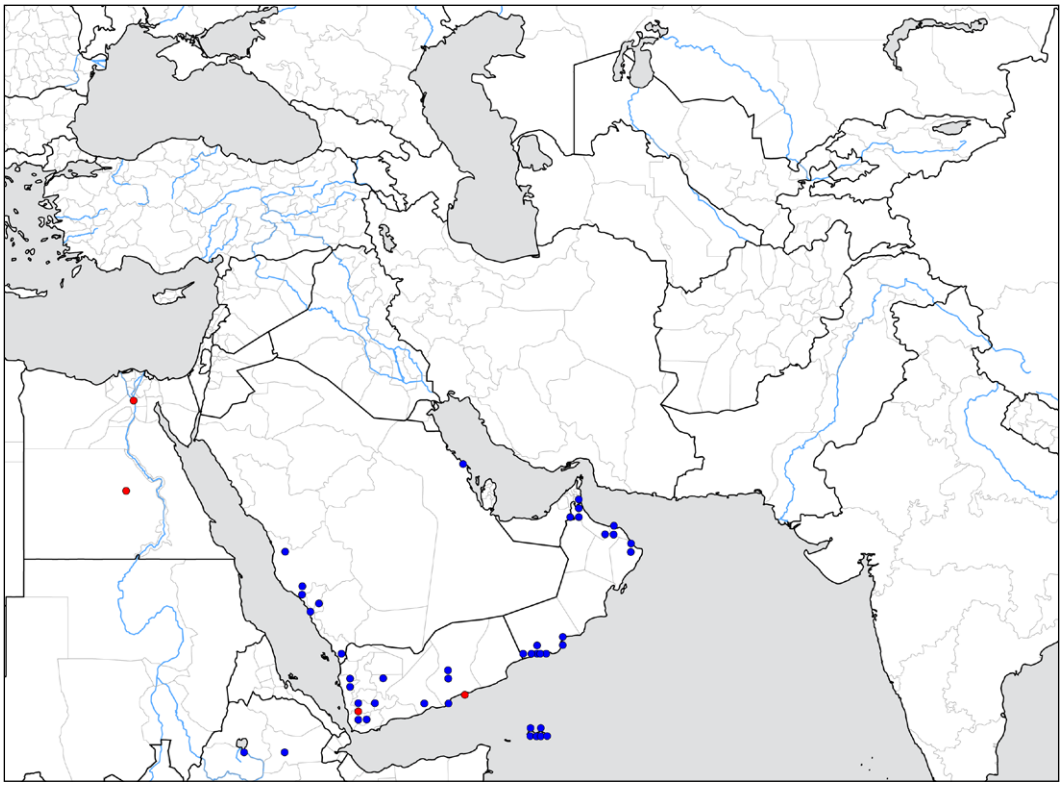
***Ceriagrion georgifreyi* Schmidt, 1953 — Turkish Red Damsel**

Ceriagrion georgifreyi has a small range and is confined to the Eastern Mediterranean. It occurs in a narrow band along the Mediterranean coast from Greece and Turkey to Syria and northern Israel. As all records from Israel are old, the most recent being from Rosh HaAyin (Yarkon River springs) in 1972, we expect that the species is highly threatened in Israel. A record of *Ceriagrion georgifreyi* from Niksar in northern Turkey, based on a specimen in the museum collection at the Royal Scottish Museum, Edinburgh (Schneider 1986), is likely the result of a labelling error or a confusion of localities bearing the same name (Kalkman 2005). The species is not uncommon along the south coast of Turkey and prefers seepages, small streams and rivulets, but has also been found at ponds with rich aquatic vegetation.



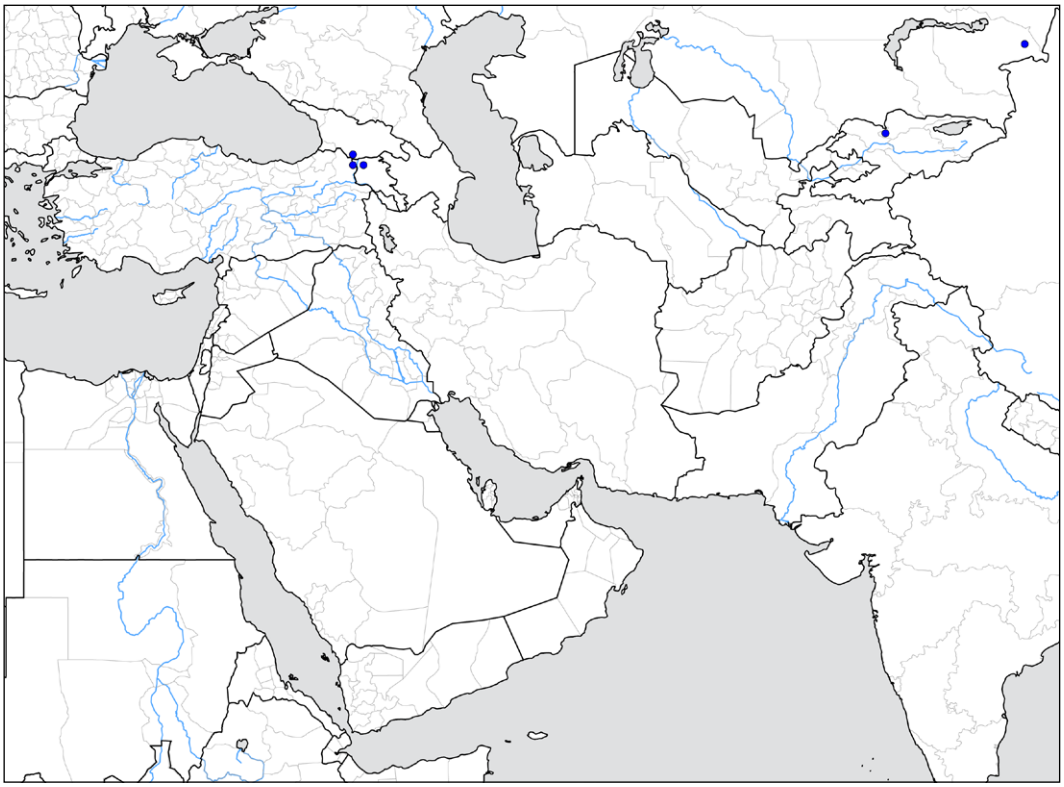
***Ceriagrion glabrum* (Burmeister, 1839) — Common Citril**

Ceriagrion glabrum is a common Afrotropical species and occurs along the rather humid coast of the Arabian Peninsula. Populations occur along the Red Sea coast of Saudi Arabia and Yemen, on the island of Socotra, along the southern and northern coast of Oman and in the United Arab Emirates. The species prefers coastal wetlands, lagoons and ponds with well-developed riparian vegetation that often consists of *Juncus*, *Typha* and *Phragmites*.



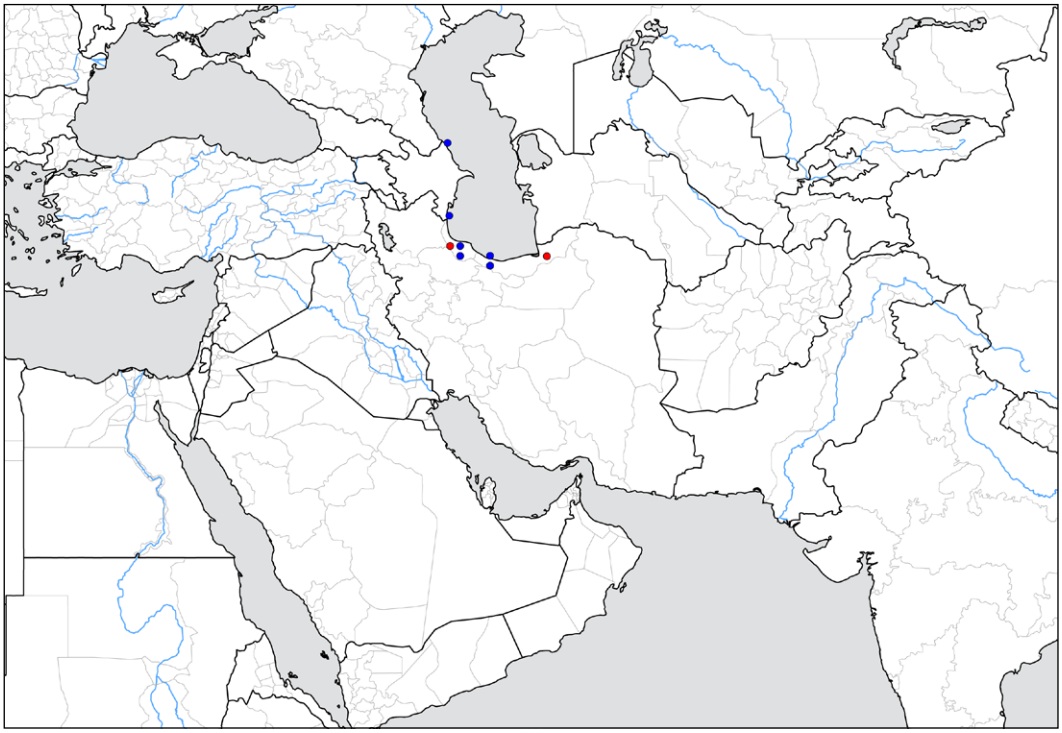
***Coenagrion armatum* (Charpentier, 1840) — Dark Bluet**

Coenagrion armatum is a northern species occurring from northwestern Europe to eastern Kazakhstan and Russia. It is very rare in the region covered by this atlas, and is only known from one record in Kyrgyzstan in 2009 (Schröter 2010b) and several localities in the South Caucasus. Here it only occurs in the mountain steppe of the Javakheti volcanic plateau in the Armenian highland of Georgia and Armenia. (Ananian & Tailly 2013, Schröter et al. 2015). In most of its Palaearctic range the species has an early flight season, however in our area it occurs at higher altitude resulting in a relatively late flight season. In Georgia the species can be found in high abundance (copulae and ovipositing) till the beginning of July, and in both Georgia and Kyrgyzstan adults are on the wing until at least the end of July.



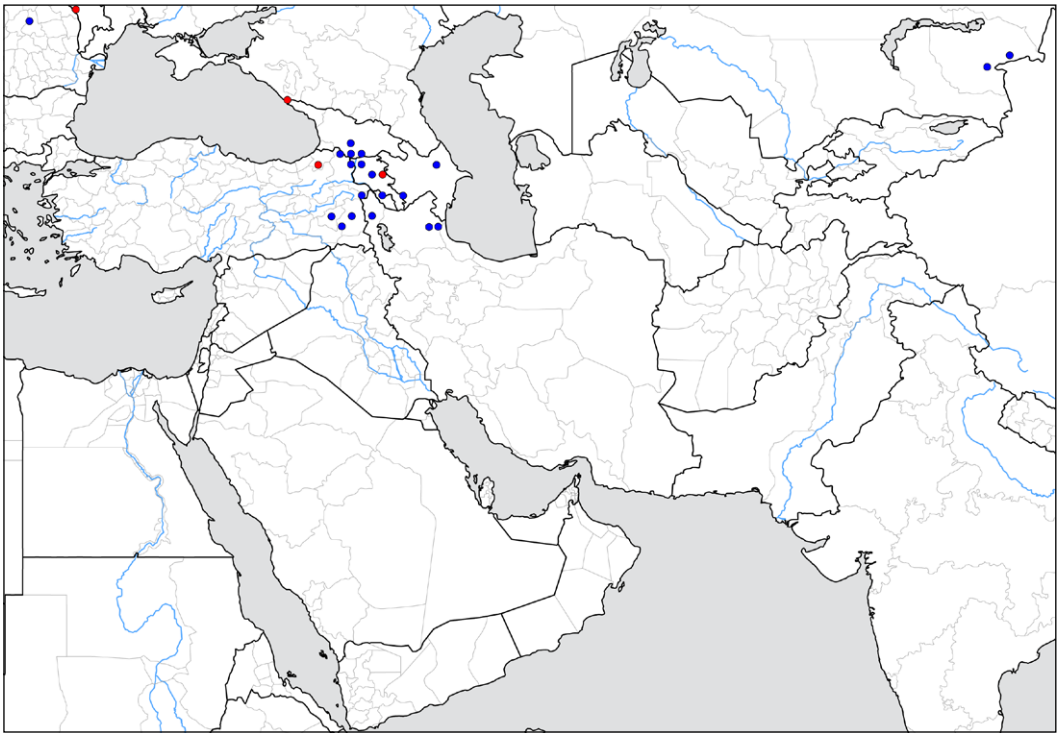
***Coenagrion australocaspicum* Dumont & Heidari, 1996 — Hyrcanian Bluet**

This species was described as late as 1996, and since its initial description has been found at ten additional localities along the southern shore of the Caspian sea in Iran (Dumont & Heidari 1996, Magidi-Shilasar et al. 1998, Schneider et al. 2018b) and at two sites in Azerbaijan (Dumont 2004, Skvortsov & Snegovaya 2015a). The northernmost locality in Azerbaijan is north of the main range of the Caucasus, making it likely that the species can also be found in the Dagestan republic of Russia. *Coenagrion australocaspicum* is part of the *puella* group, which contains the widespread *C. puella* and the more range-restricted *C. ponticum*, *C. intermedia* and *C. syriaca*. In Azerbaijan and northwestern Iran, *C. australocapicum* overlaps in range with *C. puella* and *C. ponticum* and is known to co-occur with the latter in at least one locality in Iran (Schneider et al. 2018). The species is mostly found at low elevation, with one locality at 800 m a.s.l. and all others below 200 m a.s.l. The habitat preference is poorly known and the species has been recorded at large lakes, coastal wetlands, concrete ditches and stagnant water bodies with dense reed belts.



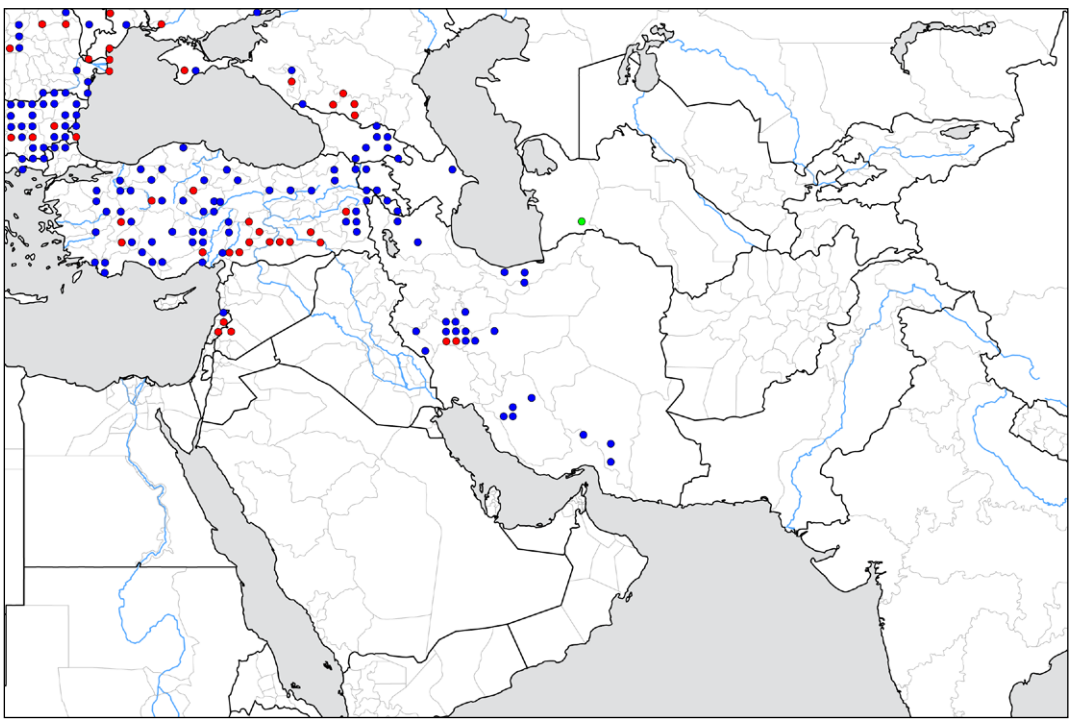
***Coenagrion lunulatum* (Charpentier, 1840) — Crescent Bluet**

This dark damselfly is limited to mountainous regions and high-altitude steppe areas in eastern Turkey, northwestern Iran, Armenia, Georgia and Azerbaijan. This region of occurrence is isolated from its main range further north, which extends from Ireland across the northern half of Europe and Siberia to eastern Russia (Kamchatka, Sakhalin), reaching Kazakhstan, Mongolia and China to the south. The inclusion of this species for Kyrgyzstan in the checklist of Borisov & Haritonov (2007) is erroneous (pers. com. Sergey Borisov). *Coenagrion lunulatum* is the most common odonate at the Javakheti volcanic plateau in the Armenian Highland of Georgia, where thousands of individuals can be observed.



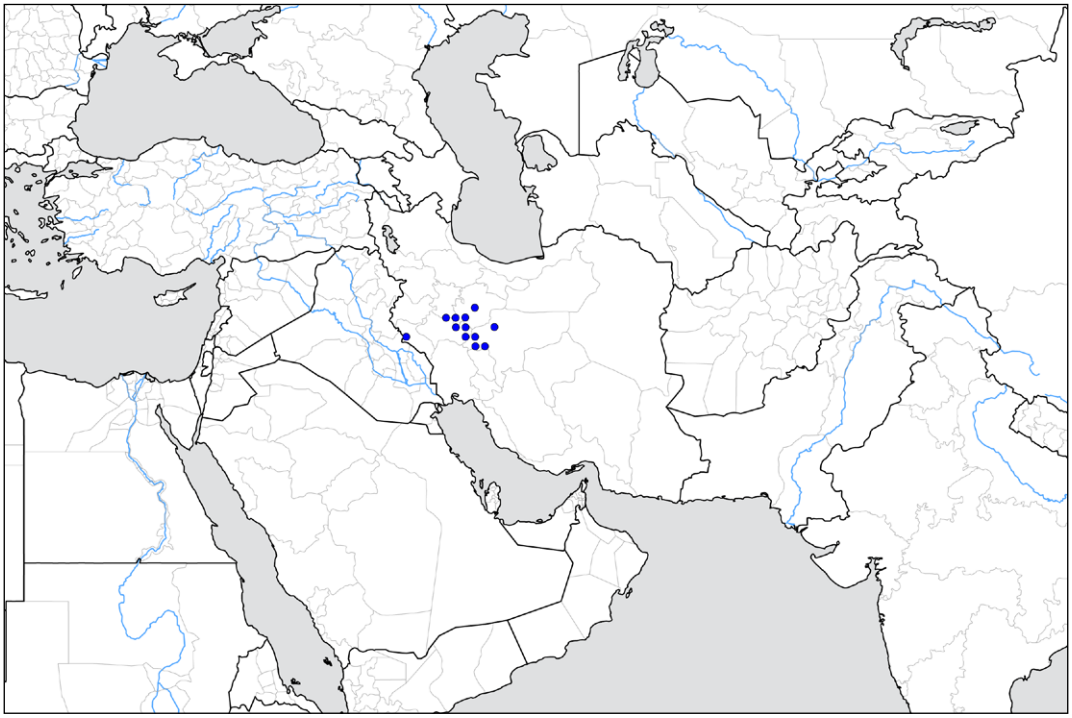
***Coenagrion ornatum* (Selys, 1850) — Ornate Bluet**

Coenagrion ornatum ranges from central France and northern Germany over southeast Europe and Turkey to Iran. In the area covered here, this species is found throughout Turkey, the South Caucasus and Iran. There are also records from Lebanon and west Syria. The lack of records from Iraq probably reflects a lack of data and not genuine absence, as permanent streams in the northeast of the country are likely to be suitable for the species. In 1988 a *Coenagrion* female was collected from the mountains of the Kopet Dag in Turkmenistan and published as *C. ornatum* (Belyshev et al. 1989, Borisov and Haritonov 2007). This specimen is however lost and the author has his doubts about its correct identification (unpublished data Sergey Borisov). *Coenagrion vanbrinkae* is considered a junior synonym of *C. ornatum*; the only described character separating both species is found in the shape of the cerci, but strong variation within populations indicates that this is merely intraspecific variability (Kosterin & Ahmadi 2018).



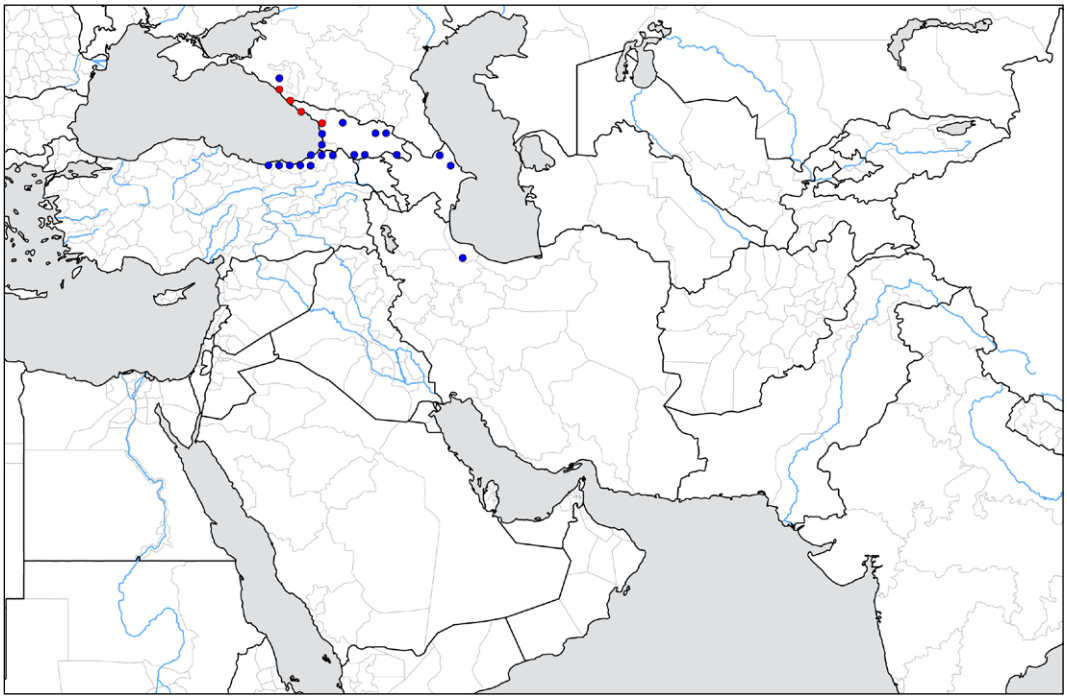
***Coenagrion persicum* Lohmann, 1993 — Persian Bluet**

This species is endemic to western Iran where it has been reported from 24 localities, most of them in a relatively small area in the Zagros Mountains (Lohmann 1993a, Schneider et al. 2016, Schneider & Ikemeyer 2016c, 2019, Kosterin & Ahmadi 2018, Eslami et al. 2020a, 2020b, 2021). *Coenagrion persicum* was described based on a single male by Lohmann (1993a) and was extensively redescribed by Schneider et al. (2016) who regarded it as a valid species distinct from its closest relative, *C. pulchellum*, based on differences in pattern, female pronotum structure, and genetic features (analyses of two nuclear DNA gene fragments). Kosterin & Ahmadi (2018) noted, however, that the pattern described for *C. persicum* can also be found in *C. pulchellum* from West Siberia. The nearest known localities for *C. pulchellum* are found at about 700 km distance in Armenia, Azerbaijan, northwestern Iran and southeast Turkey. *Coenagrion persicum* occurs between 1600 and 2300 m a.s.l. at springs and along brooks in the mountains. It is also common on marshy meadows around springs (Schneider & Ikemeyer 2019).



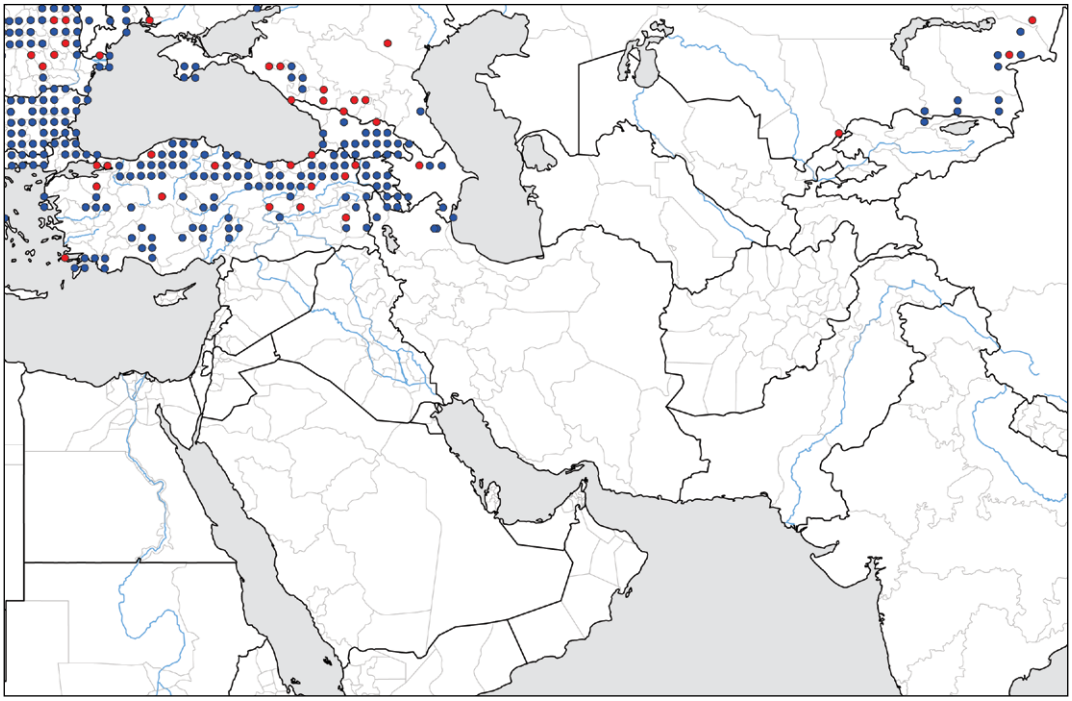
***Coenagrion ponticum* (Bartenev, 1929) — Pontic Bluet**

Coenagrion ponticum belongs to the *puella* group and overlaps in range with *C. puella* and *C. australocaspicum*. It occurs in the wet northeast of Turkey along the Black Sea coast, and further east in the South Caucasus and in northern Iran. The species has a more extensive black pattern than *C. puella* and can, with experience, be separated from *C. puella* in the field, although it is safer to examine the male appendages or the prothorax of the female. *Coenagrion ponticum* and *C. puella* are known to co-occur at the same habitats in Georgia; it is likely that, due to their close resemblance, the syntopic occurrence of *C. ponticum* and *C. puella* often escapes attention. Information on the range of this species has increased greatly over the past two decades, with the species being discovered in Azerbaijan (Dumont 2004, Skvortsov & Snegovaya 2015a) and in Iran (Schneider et al. 2018b). In Russia it is only found in the westernmost parts of the Caucasus range. *Coenagrion ponticum* occurs in areas with relatively high precipitation, and is found from lowland areas up to 2000 m a.s.l. It occurs at brooks and lakes, being especially abundant at well vegetated lakes at elevation.



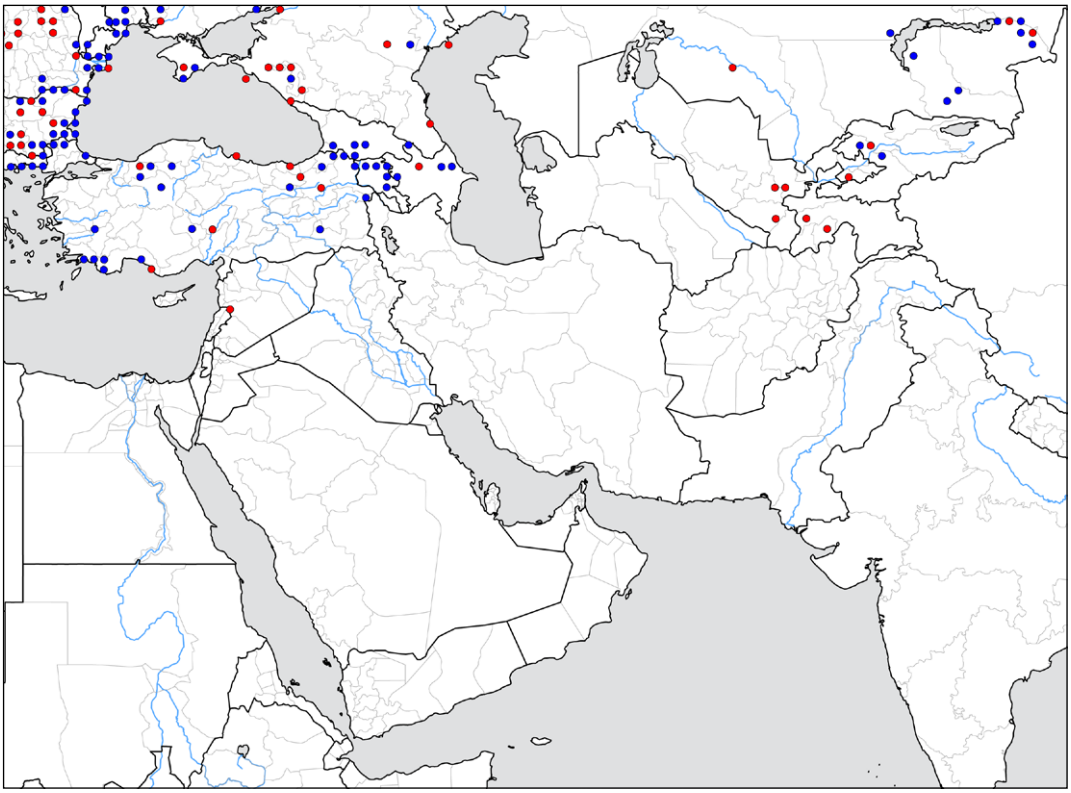
***Coenagrion puella* (Linnaeus, 1758) — Azure Bluet**

Coenagrion puella is widespread and common in large parts of Europe, ranging east to the western Siberian lowland. In Turkey and the South Caucasus countries it becomes scarce towards the south, reaching its southern range in southeast Turkey and northeast Iran. In Central Asia the species just reaches the north of Kyrgyzstan. In parts of our area *C. puella* is replaced by close relatives with which it partly co-occurs (*C. ponticum*, *C. syriacum* and *C. australocaspicum*), with a fifth member of this group occurring in Crete (*C. intermedium*).



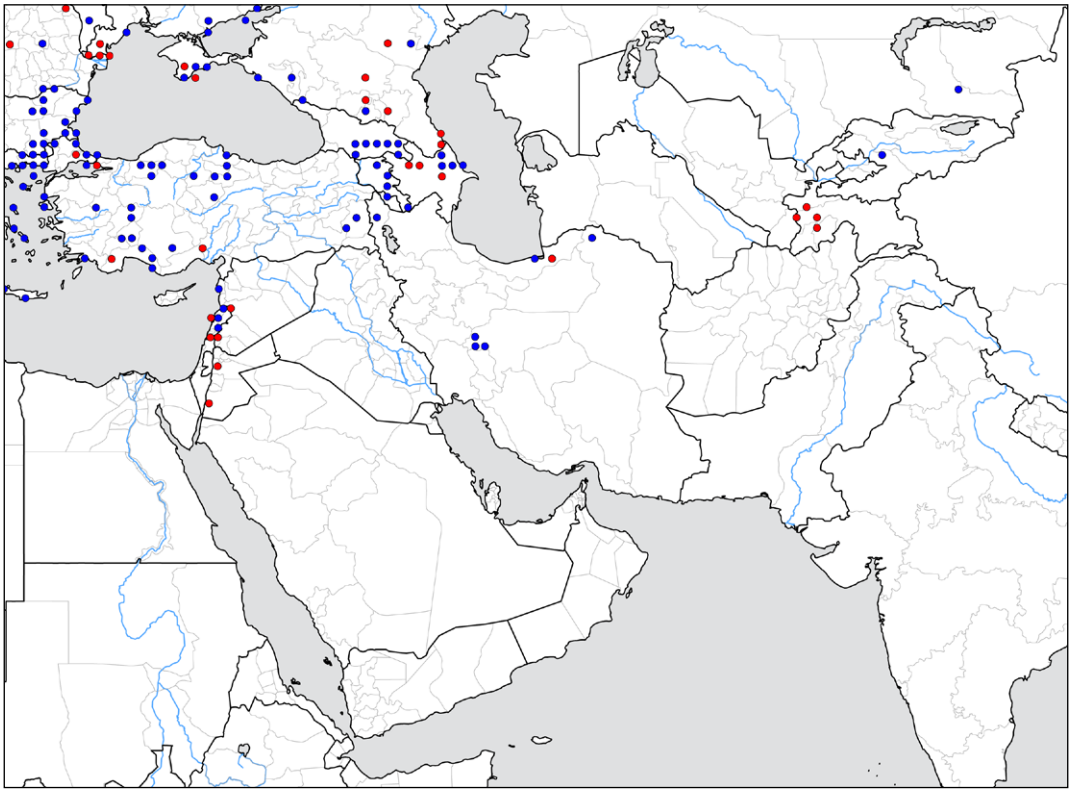
***Coenagrion pulchellum* (Vander Linden, 1825) — Variable Bluet**

Coenagrion pulchellum is widespread in Europe, reaching east across to western Siberia. It seems reasonably widespread in the South Caucasus but is generally scarce in Turkey and rare in Kyrgyzstan, Tajikistan and the eastern parts of Uzbekistan, being confined to the wetter and higher regions. It was recently found in northwest Iran close to the border of Turkey (Schneider et al. 2018b). More to the south in Iran its close relative, *Coenagrion persicum* occurs. The specimens of *C. pulchellum* occurring in West and Central Asia are generally darker than the specimens found in most of Europe, and more like the specimens found in West Siberia.



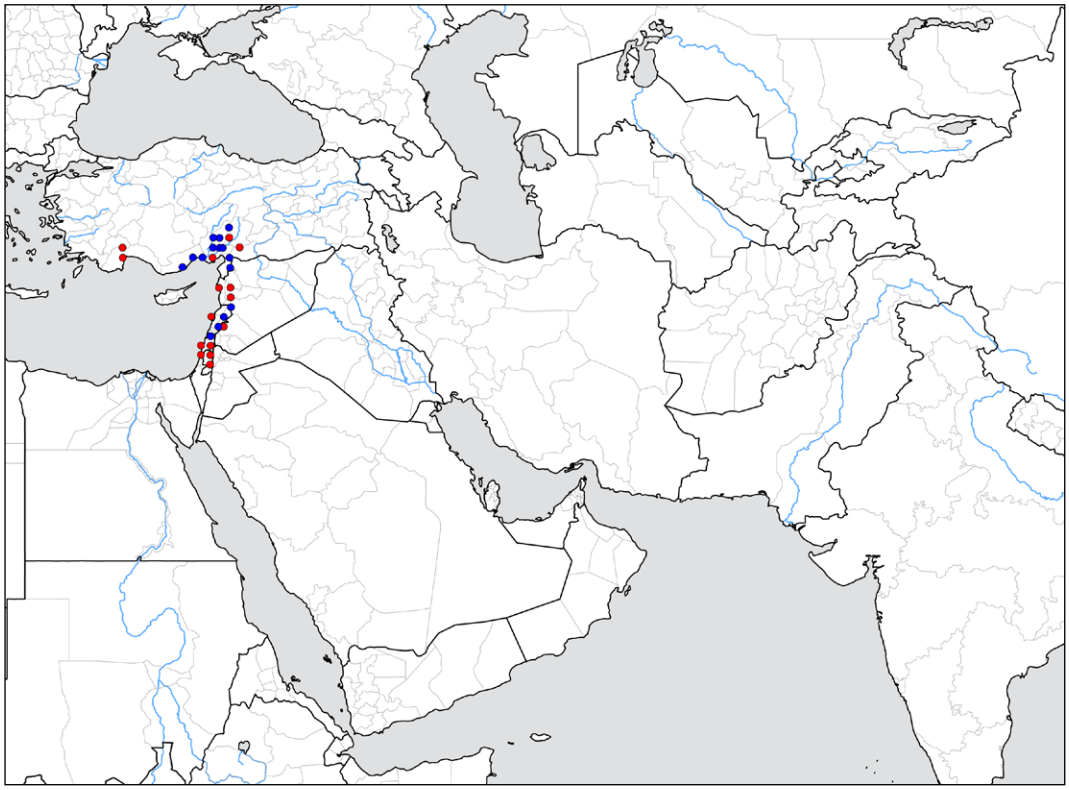
***Coenagrion scitulum* (Rambur, 1842) — Dainty Bluet**

Coenagrion scitulum is widespread but scattered in its range. It occurs from the West Mediterranean and Atlantic regions of Europe east to the Caspian Sea. It also occurs in Central Asia in the foothills of the Tian Shan mountains, but seems to be absent from the intermediate area, making the populations in Central Asia isolated from the main range by a gap of 1000-1700 km (Schröter & Borisov 2012). A record from 2016 in northeast Iran indicates that the gap is smaller than previously thought (Schneider & Ikemeyer 2016b). *Coenagrion scitulum* is found at standing waters, preferably with well developed riparian and helophyte vegetation.



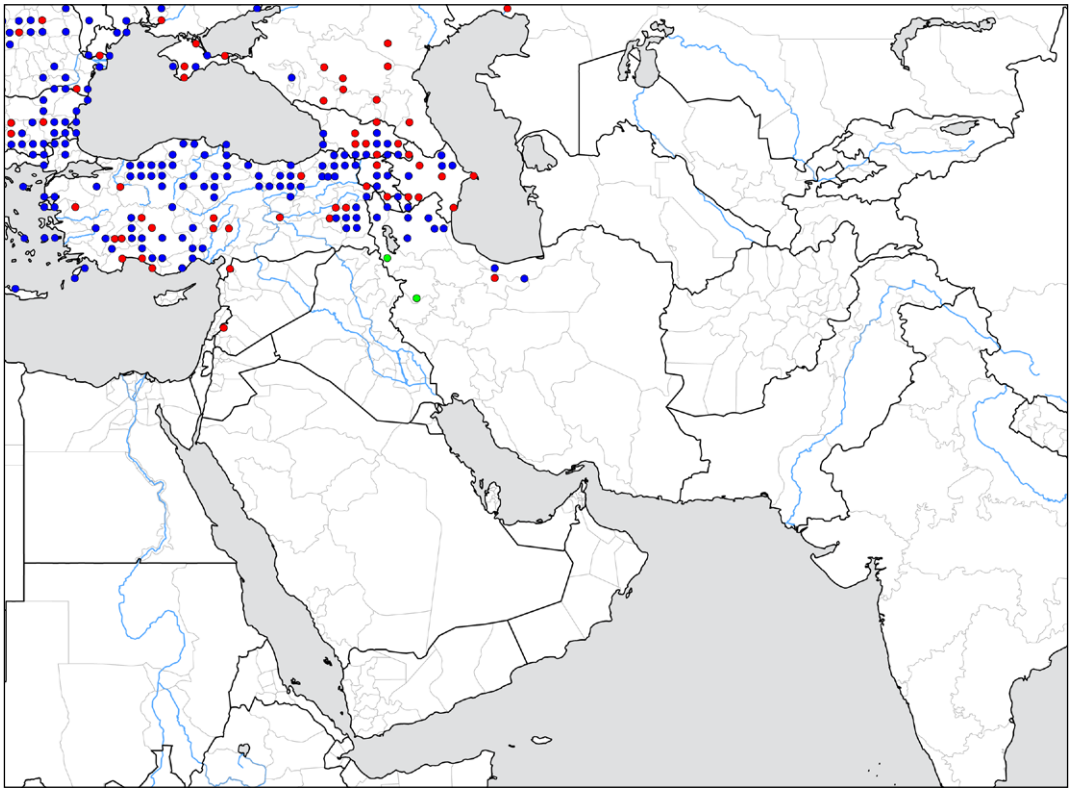
***Coenagrion syriacum* (Morton, 1924) — Syrian Bluet**

Coenagrion syriacum has a small range, being confined to the coastal regions of Syria, Lebanon and Israel, and the coastal area around Adana in Turkey. In Turkey the species is not uncommon within its range but might have disappeared from the westernmost regions near Antalya. There are relatively few recent records for Syria, Lebanon and Israel, but this at least in part reflects a lack of field work. Nonetheless, it is likely that the species has decreased in this region due to intensified pressure on water resources and to degradation of freshwater habitats.



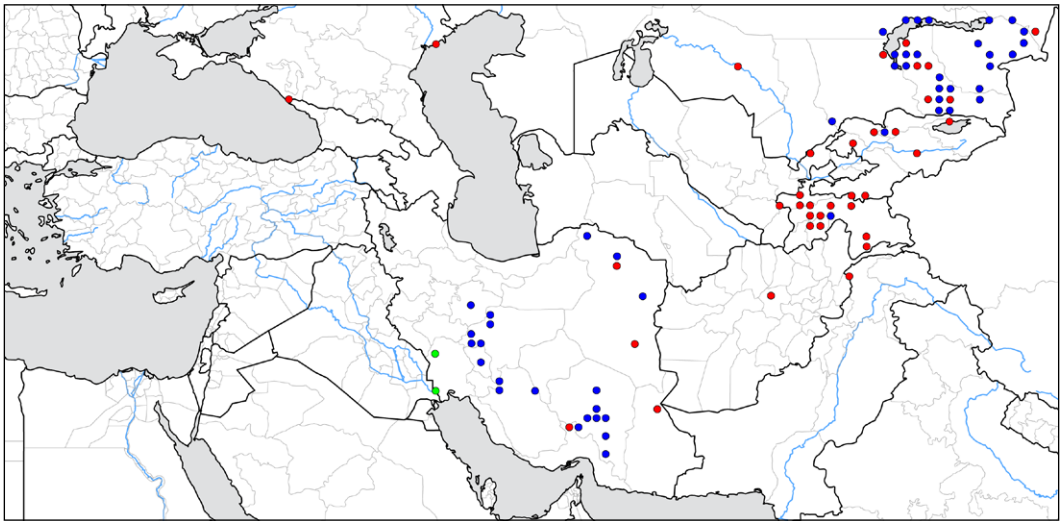
***Enallagma cyathigerum* (Charpentier, 1840) — Common Bluet**

Enallagma cyathigerum is a widespread and, in most areas, common species, ranging from western Europe across to Kamchatka (Russia) in the east. In our area it is common in Turkey and the South Caucasus, from where it reaches the Alborz Mountains in northern Iran. In other areas of Iran and Central Asia, *E. cyathigerum* is replaced by its close relative *E. risi.* Records of *E. cyathigerum* from the Isfahan, Markazi, Chahar Mahal, Kohkilhuyeh, Fars and Kerman provinces of Iran by Ebrahimi et al. (2009) and Eslami et al. (2020a, 2020b, 2021), from Kyrgyzstan by Valle (1942) and Borisov (1987), from south Pakistan (Sindh province) (Mitra & Babu 2009) and from northeastern Pakistan (Khaliq et al. 1994) are believed to pertain to *E. risi* (see that species for more information).



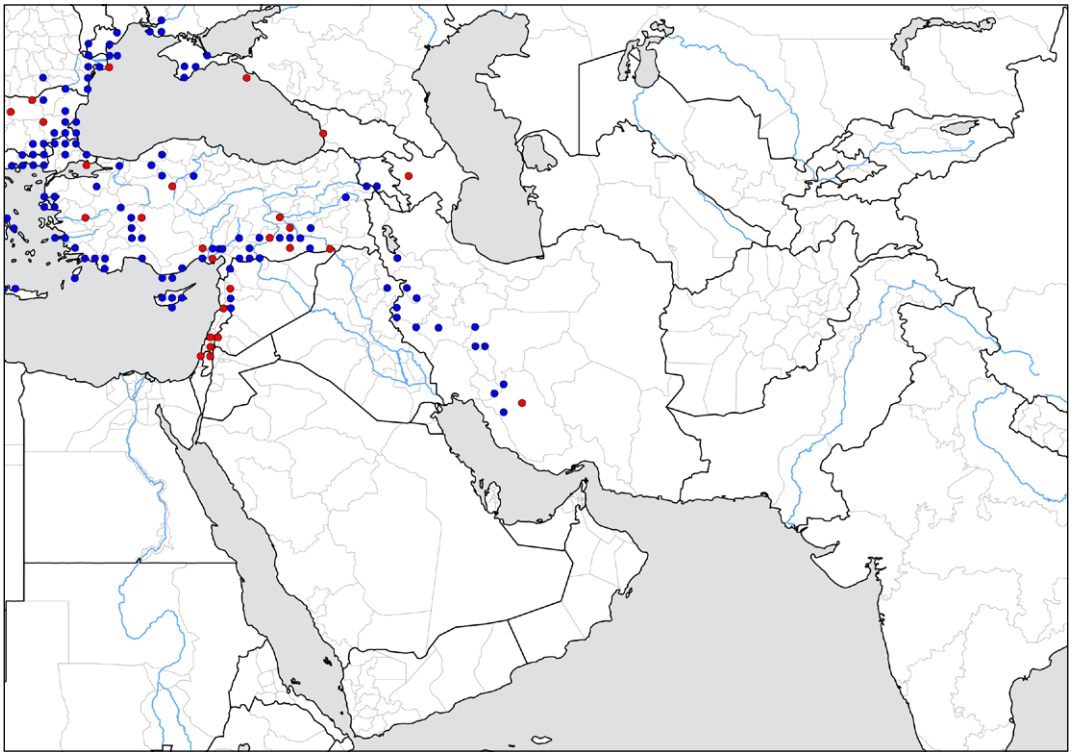
Enallagma risi Schmidt, 1961 — Ris's Bluet

Enallagma risi is the Central Asian relative of *E. cyathigerum*, from which it can only be distinguished by close examination of the male appendages (see Schneider et al. 2018b). Not all records of *Enallagma* have been identified with enough precision to be certain if they pertain to *E. cyathigerum* or *E. risi.* As a result of this, the exact distribution of these two taxa is not yet completely clear. In this atlas we have assumed that both taxa do not overlap in range, and based on records for which identification is certain, we have attributed the other less-precise records in the same general area to either *E. cyathigerum* or *E. risi* as appropriate. The available information shows that *E. cyathigerum* is found in northwest Iran and the Alborz Mountains in northern Iran, while in other parts of Iran and Central Asia *E. risi* occurs (Schneider & Ikemeyer 2019). *Enallagma risi* is restricted to mountains, with most records from southern Iran localised at altitudes between 1000 and 3000 m a.s.l. Records from the east and northeast of Kazakhstan are believed to pertain to *E. risi* while those to the north of Kazakhstan are believed to be *E. cyathigerum*. If that is correct, and if the taxa do not overlap, then *E. risi* is the only taxon expected to occur south of Kazakhstan. It seems likely that *Enallagma cyathigerum* var. *rotundatum* Bartenev 1929, described and recorded from the western Caucasus (Achishkho Mount, Khmelevskiye lakes) by Bartenev (1929a, 1930a), is identical to *E. risi* (Kosterin 2004, Malikova & Kosterin 2019). If this is true then *E. risi* will become a junior synonym of Bartenev's name, in which case the correct name would become *E. rotundatum*.



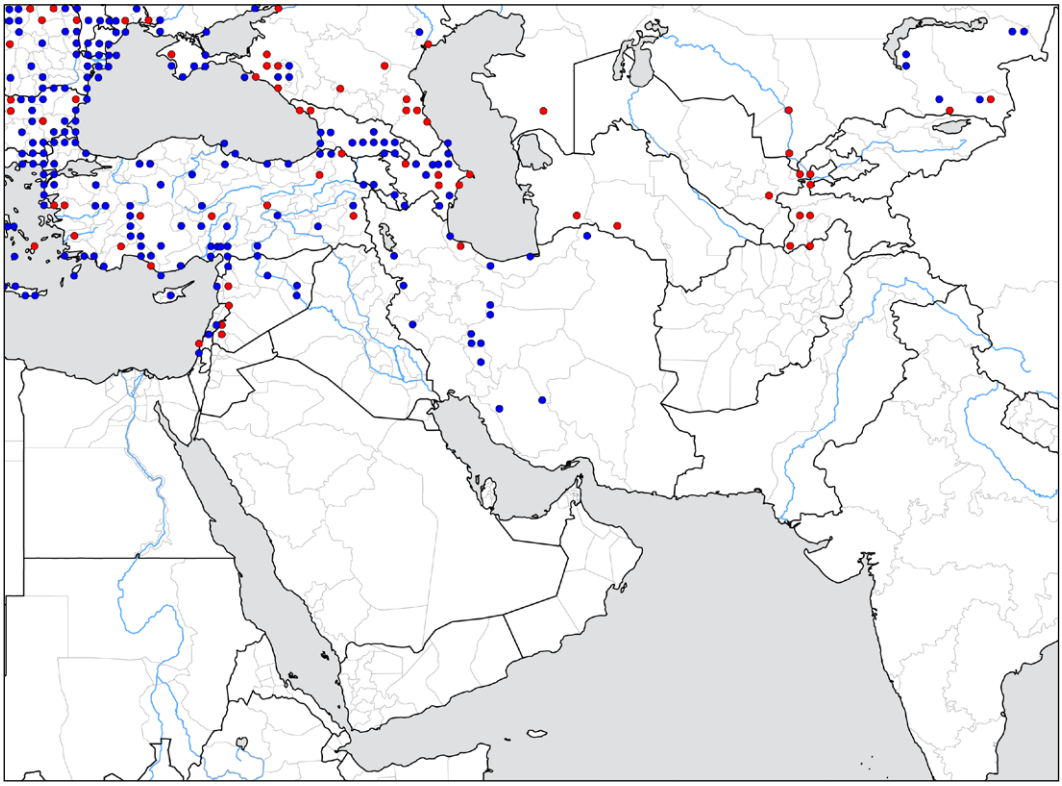
***Erythromma lindenii* (Selys, 1840) — Blue-eye**

This blue eyed *Erythromma* ranges from the Atlantic coast of Europe and North Africa eastwards to the South Caucasus countries and western Iran. It is rather widespread in Turkey and the Levant, but very scattered further east. Most populations in Turkey pertain to the nominotypical subspecies, but in the Jordan valley and in southeastern Turkey the subspecies *E. l. zernyi* is found. This taxon is smaller with a less extensive dark pattern. The intensity with which these characters are expressed varies between populations and between seasons, with individuals found in summer being paler. Intermediate populations are known from northeastern Iraq (Porter 2016) and western Syria. Dumont et al. (1995b) suggested this to be the result of introgression (hybridisation) between the nominotypical taxon and the subspecies *zernyi,* with the later increasingly being replaced by the former. The species is found along slow-flowing rivers with some floating vegetation, but occurs also at larger standing waters.



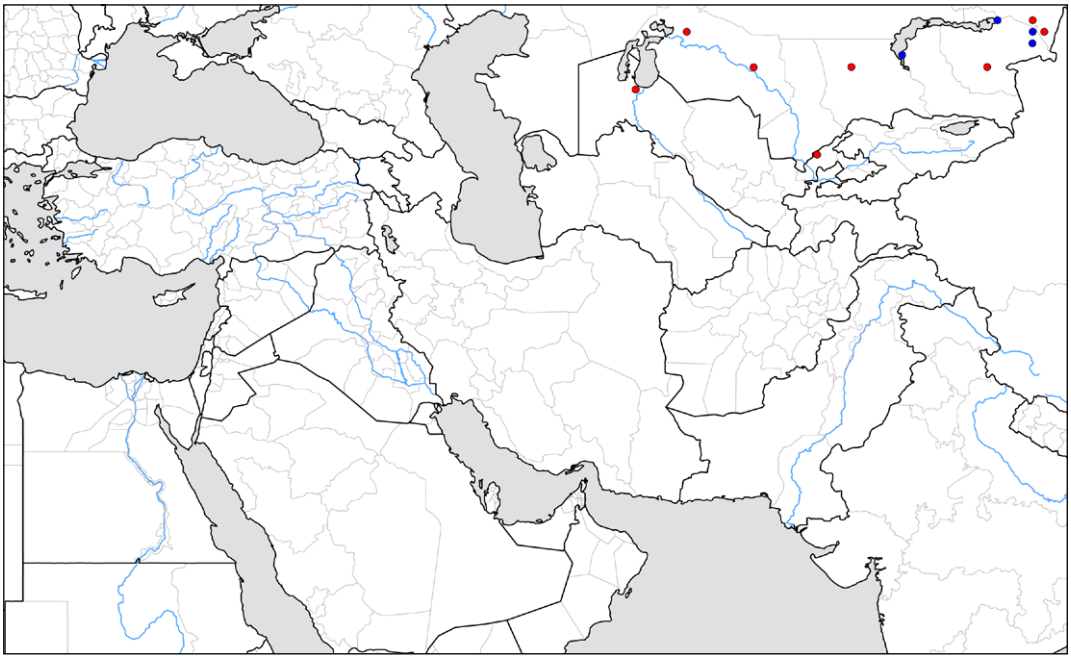
***Erythromma viridulum* (Charpentier, 1840) — Small Redeye**

The main range of this species is found in Europe, where it often occurs in anthropogenic habitats and is commonly found in standing waters with submerged plants or floating algae. It is widespread in the less dry parts of West Asia, being moderately common in Turkey, the Southern Caucasus, the northern parts of the Levant and parts of Iran. Most of the Iranian records are recent, thanks to increased research during the last decade (Ikemeyer et al. 2015, Schneider & Dumont 2015, Schneider & Ikemeyer 2016c, Schneider et al. 2018b, Eslami et al. 2020a, 2020b, 2021). In Central Asia it is scarce and known mostly from older records, with only a few recent records from southeast Kazakhstan.



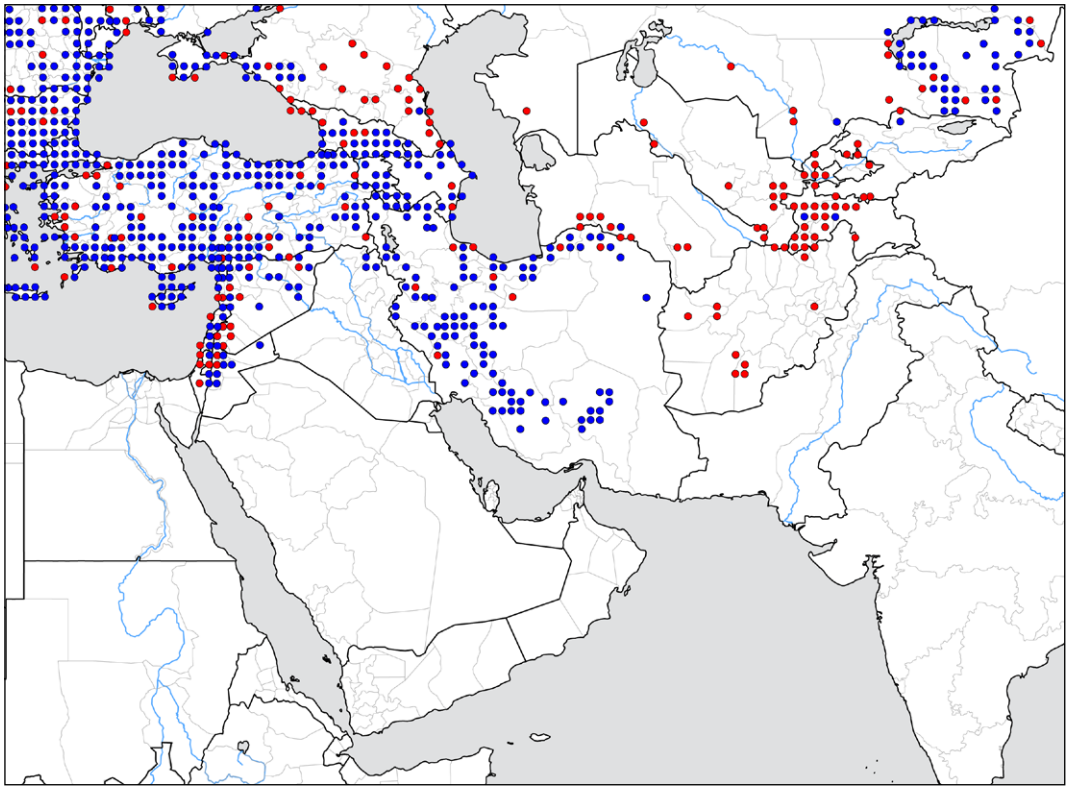
***Ischnura aralensis* Haritonov, 1979 — Kazakh Bluetail**

Ischnura aralensis has a patchy distribution, being known from the southern parts of the Urals (Russia), Kazakhstan and Uzbekistan. This range is unique and has no analogues among other Odonata species. It has been suggested that formerly the range was wider, but it became fragmented during the continuous aridification of Central Asia initiated by the Tertiary and Quaternary Himalayan system orogenese (40-20 My BP onwards), which prevented the monsoon rains from reaching the region (Dumont 1996, Yanibaeva et al. 2006). In the area covered by this atlas it has only ever been recorded at two localities in Uzbekistan, namely in the former delta of the Amu Darya River, where it became extinct due to the desiccation of the Aral Sea in the 20th century, and near Tashkent, where it was collected between 1933 and 1936 by Bartenev but has not been found since (Yanibaeva et al. 2006, Borisov & Haritonov 2007). In Kazakhstan, it is most common in the Balkhash-Alakol hydrosystem, where seven localities have been found since 1992. It does not seem to cross the Dzungaria depression to reach northwestern China in the east. The species is found near large lakes, where the larvae live in small shallow ponds or marshes, isolated from the main part of the lakes by sandy banks.



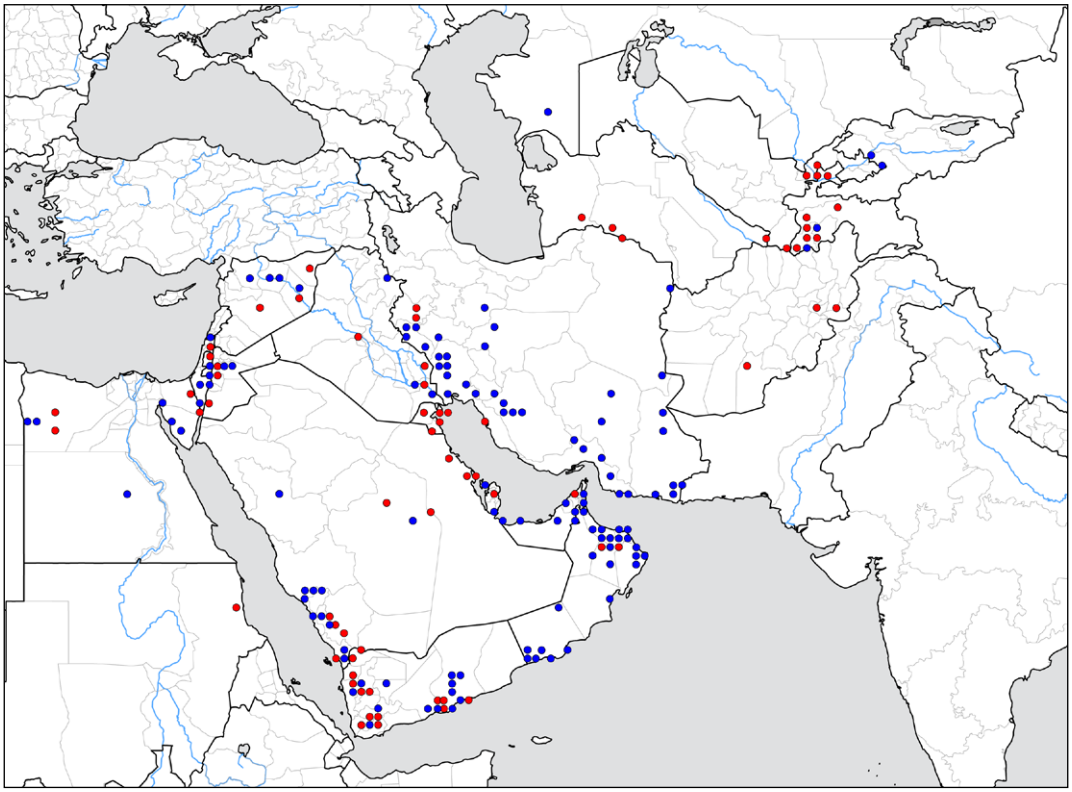
***Ischnura elegans* (Vander Linden, 1820) — Common Bluetail**

Ischnura elegans is one of the most widespread and common species in Europe and the temperate parts of Asia, and ranges from western Europe to eastern Russia, Mongolia, China, Korea and northern Japan. In western Asia, it is common in Turkey, Cyprus, the Levant and the South Caucasus but is absent from Arabia. In Iran it is widely present, though absent from the desert area. In Central Asia it is widespread in the higher and wetter areas in the east, but scarce in most of Turkmenistan and Uzbekistan. It is also present in Afghanistan where it is probably relatively common, and from where it reaches the north of Pakistan and northern India. The species occurs in both standing and slowly flowing waters, and is often one of the last species to be present in polluted habitats.



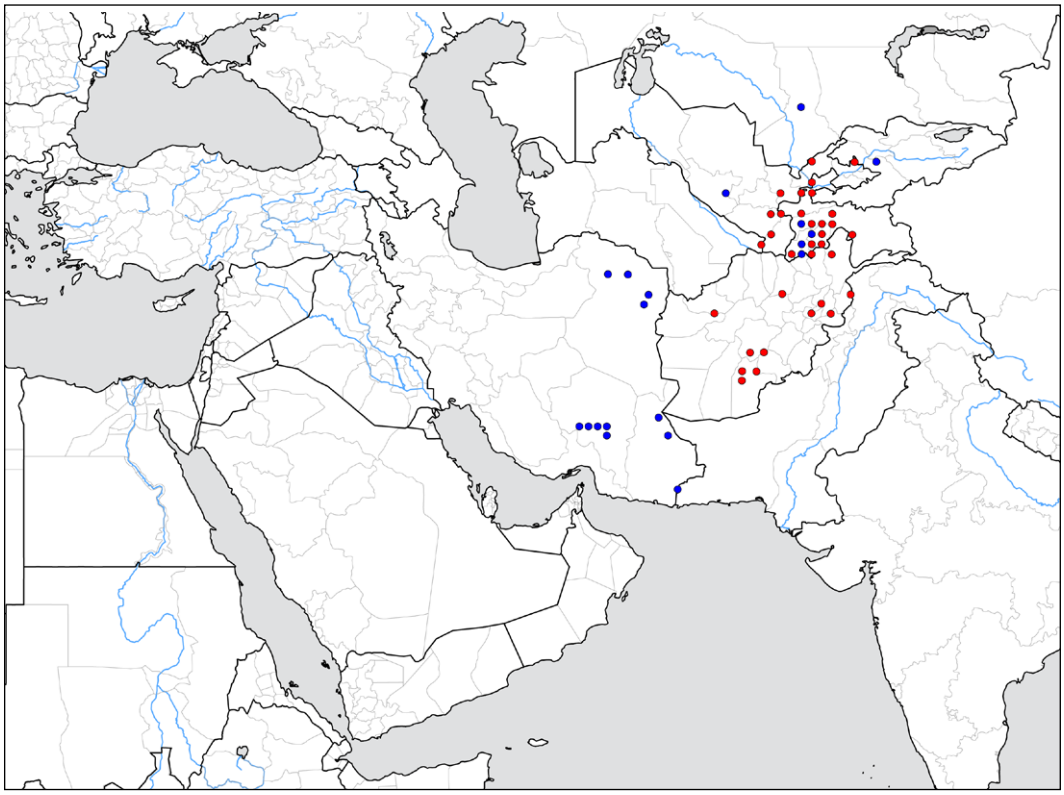
***Ischnura evansi* Morton, 1919 — Desert Bluetail**

Ischnura evansi ranges from Egypt (Dijkstra & Boudot 2010) and Sudan through the Levant, Iraq, Iran and the Arabian Peninsula to Central Asia. Within the region treated in this atlas it is well distributed in the Levant, along the southwestern part of the Arabian Peninsula, along the Persian Gulf and over the whole southern part of Iran. It has also been found at the Caspian margin of Kazakhstan. A single isolated record comes from the Chinese Autonomous Region of Inner Mongolia (Dumont 1996). This is roughly 3000 km east of the nearest other record, in Kyrgyzstan. It therefore seems likely that the species is also present in the more arid regions of the Chinese provinces of Xinjiang and Gansu. *Ischnura evansi* is often abundant where it occurs, and is well able to colonise new habitats. It inhabits both freshwater and brackish waters and is found in pools, ponds, swamps and slow-flowing intermittent streams and rivers.



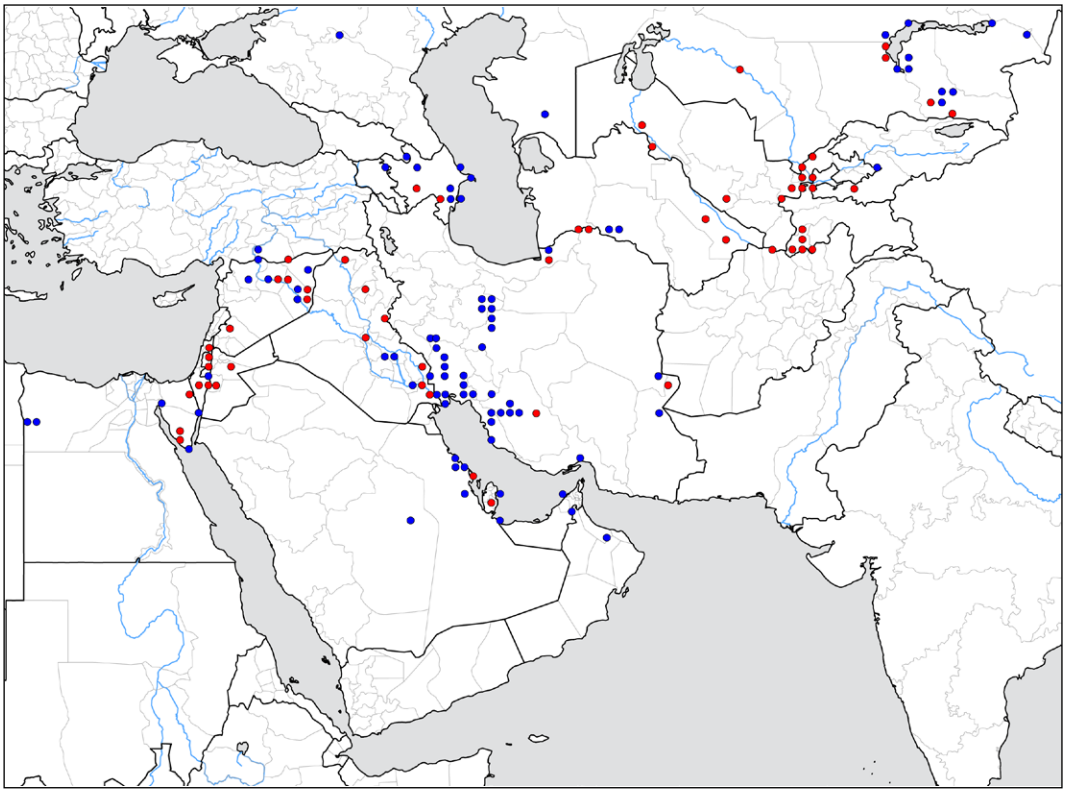
***Ischnura forcipata* Morton, 1907 — Forked Bluetail**

Ischnura forcipata is the eastern sister species of *Ischnura intermedia* (Dumont & Borisov 1995, De Knijf et al. 2016). The species occurs east of the Karakum Desert in Turkmenistan and of the Dash-e-Kavir and Dash-e-Lut Deserts in eastern Iran (Dumont & Borisov 1995). *Ischnura forcipata* is widely distributed in the mountains of the Tian Shan and Pamir-Alay in Central Asia (Borisov 2014a) and in Afghanistan, and occurs outside this region well into northern Pakistan (Khaliq et al. 1994) and the Himalaya (Gyeltshen et al. 2017, Kalkman et al. 2020). It is found along fast-flowing streams and their inundation zone. In eastern Iran, it is commonly found along springs and brooks with dense vegetation, up to 2000 m a.s.l. (Schneider & Ikemeyer 2019). In Central Asia it also breeds in the foothill plains, probably where the water slows down and abundant riparian vegetation is present, as in the case of *I. intermedia* more to the west.



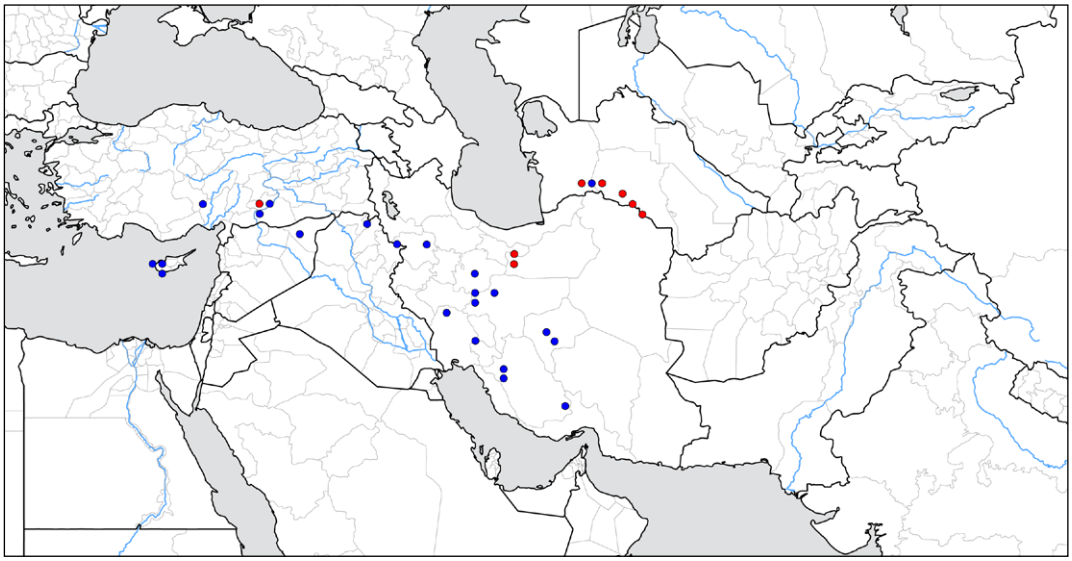
***Ischnura fountaineae* Morton, 1905 — Oasis Bluetail**

Ischnura fountaineae is found in the semi-arid and arid parts of North Africa from Morocco to Egypt, over most of West Asia, and east to Central Asia. In our area, the species seems to be most common in the Levant, Iraq and Iran, but it is also found in southeast Turkey, the South Caucasus (especially Azerbaijan) and along the Persian Gulf; records from the south of Oman pertain to misidentified *I. evansi.* Records from Afghanistan and Central Asia are mostly old, but circa 15 recent records show that the species is still widely present there. *Ischnura fountaineae* inhabits oases, wadis, coastal wetlands and also brackish or saline habitats, both inland and coastal. In Iran it additionally occurs along the flooded parts of large rivers (Schneider & Ikemeyer 2019). It tolerates high water temperatures and high salinity (up to 2.3%) (unpublished data Jean-Pierre Boudot).



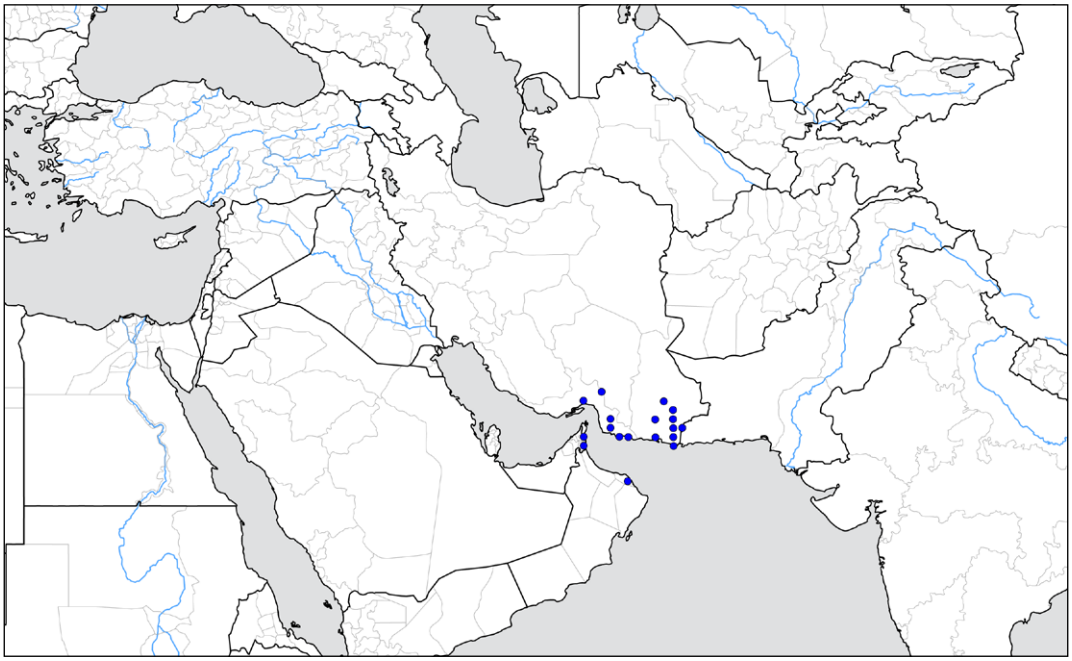
Ischnura intermedia Dumont, 1974 — Persian Bluetail

Ischnura intermedia is endemic to West Asia, occurring from western Cyprus to the Kopet Dag Mountains along the border of Iran and Turkmenistan. The species is confined to Cyprus, southern Turkey, adjacent northern Syria and Iraq (Dumont & Borisov 1995, De Knijf et al. 2016) and also Iran (Schneider & Ikemeyer 2019). In the latter country it occurs especially in the Zagros Mountains, and is often found at ancient drainage systems (Karizes or Qanats, at least 3000-5000 Years BP) (Kiany & Sadeghi 2016, Schneider & Ikemeyer 2019). Old records of *I. forcipata* by Schmidt (1954a) from around Teheran have been found to pertain to *I. intermedia* (Dumont & Borisov 1995). *Ischnura intermedia* breeds in slow-flowing, well vegetated streams, and is often confined to small secondary channels adjacent to streams and rivulets where the current slows and water is retained. Marshy areas and short swamp vegetation typically occur locally in or near the streambed, and taller grassy margins (often reeds, up to 4 m) grow adjacent to the stream. Populations can only become established at sites that have permanent water (De Knijf et al. 2016). The species seems to be threatened throughout its range, as many streams in the area fall dry during the summer months due to rainfall deficit and an increase in water abstraction. There have also been recent changes in water hydrology due to river damming, with the type locality in Turkey indeed now being flooded by the Ataturk Dam lake. Populations of *I. intermedia* seem to be restricted to those streams that are fed with a constant flow of water from the mountains.



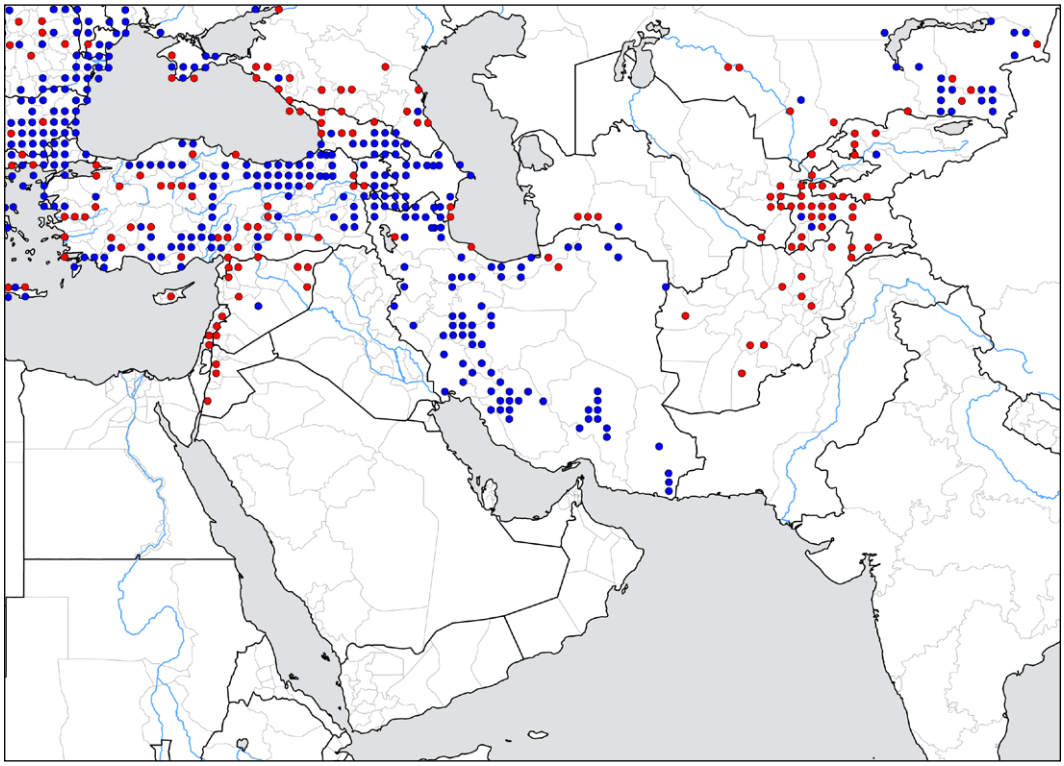
***Ischnura nursei* Morton, 1907 — Pixie Bluetail**

Until fairly recently this species was placed in its own genus, *Rhodischnura*, but based on molecular data Dumont et al. (2013) showed that it is part of *Ischnura*. The species is largely restricted to the Indian subcontinent and is known from Nepal, the northern two-thirds of India, Pakistan and southeast Iran. It was first found in Iran in 1995 (Dumont et al. 2011), but has since been found at 28 different localities (Dumont et al. 2011, Schneider & Dumont 2015, Schneider et al. 2015b, 2018b) and the species might be expanding its range westwards (Schneider & Ikemeyer 2019). In 2003 it was found in Oman (Kunz 2015), but has not been recorded there since. In 2013 it was discovered in the United Arab Emirates (Feulner & Judas 2013), with additional records in 2015 and 2017 bringing the total to six different Emirates localities. The lack of historical records makes the situation difficult to judge, but recent records give the impression that the species has increased in the western part of its range over the past two decades. *Ischnura nursei* is found along banks of rivers, brooks, ditches and ponds, sometimes occurring at localities with little vegetation; it is resilient to poor water quality (Schneider & Ikemeyer 2019).



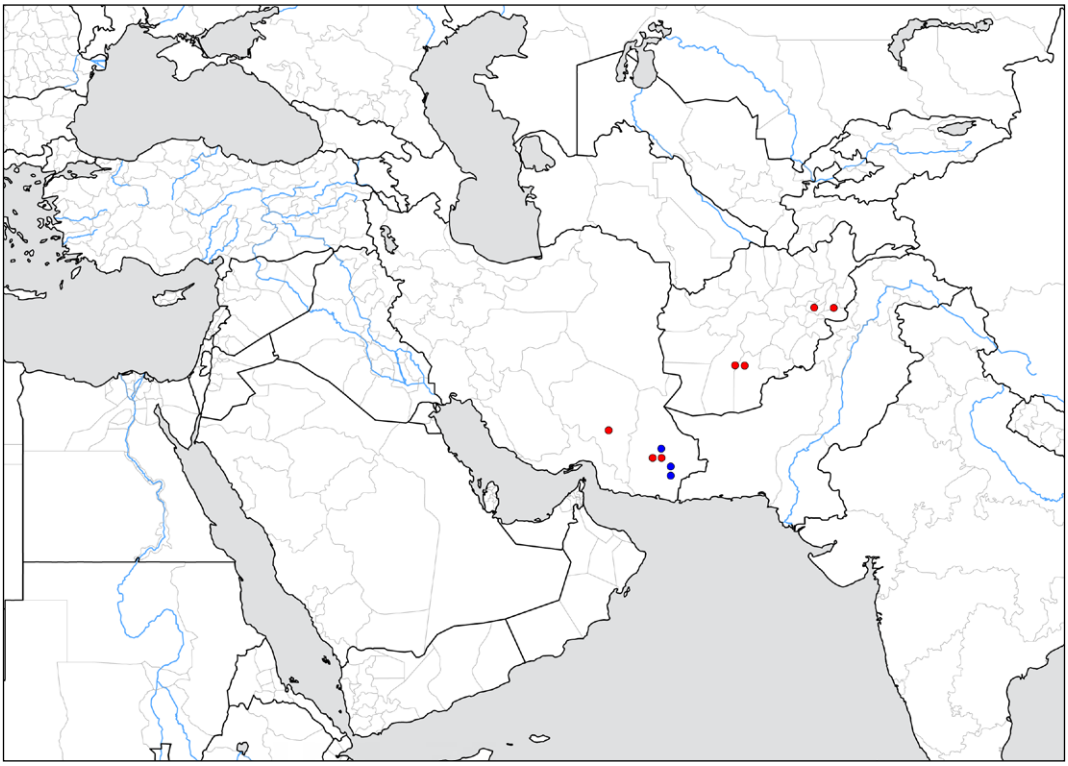
***Ischnura pumilio* (Charpentier, 1825) — Small Bluetail**

Ischnura pumilio occurs extensively in the Western Palearctic, and extends east across Mongolia up to northeastern China. More to the east it is replaced by its close relative *I. asiatica* (Brauer, 1865). In West Asia it is widespread in Turkey, the Levant, the South Caucasus and Iran, where it is common in the mountain areas but absent from the arid zones. In Central Asia, *I. pumilio* is common in the wetter and more mountainous east, being absent from most of Turkmenistan and Uzbekistan with the exception of the Kopet Dag at the border with Iran. Old records suggest that the species is widespread in Afghanistan. It is mostly a pioneer species which appears, sometimes in high numbers, at newly created water bodies. It also occurs at seepages springs or seepage-fed marshes, albeit generally in lower numbers.



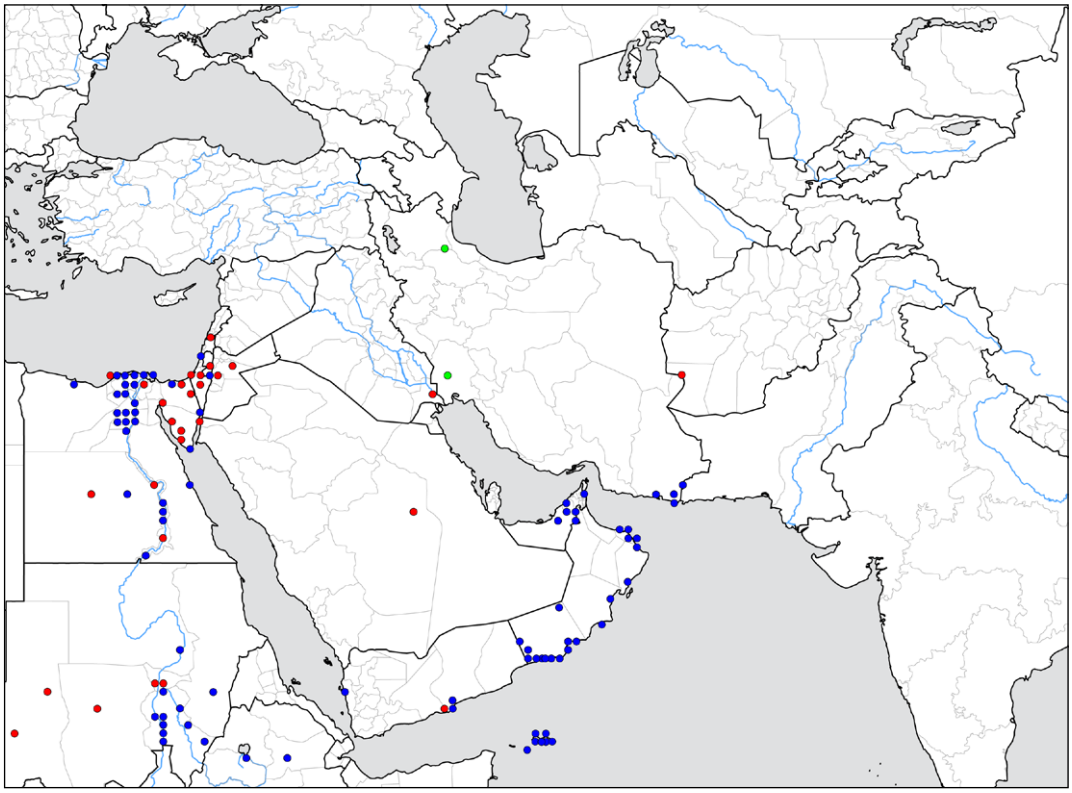
***Ischnura rubilio* Selys, 1876 — Golden Bluetail**

Until fairly recent *I. rubilio* was considered to be a subspecies of *I. aurora* but both are currently regarded as distinct species, with *I. rubilio* being the taxon found west of Indochina-Thailand (Papazian et al. 2007). The species is common across most of the Indian subcontinent including Sri Lanka (Bedjanič et al. 2014). Its western range limit is found in the eastern part of Afghanistan and in southeast Iran. Due to lack of recent field work, only old records are known from Afghanistan; these were published as *I. delicata* (Hagen, 1858), which is synonym of *I. aurora* (Schmidt 1961). The species has been known from Iran since 1949 (Schmidt 1954a), and has been recorded from eight different localities in total. In India the species is found at both standing and running, mostly largely unshaded, waters occurring from the lowlands up to 2000 m a.s.l. In Iran it occurs along sparsely vegetated banks of rivers and brooks, and seems to be restricted to regions between 800-1200 m a.s.l. (Schneider & Ikemeyer 2019).



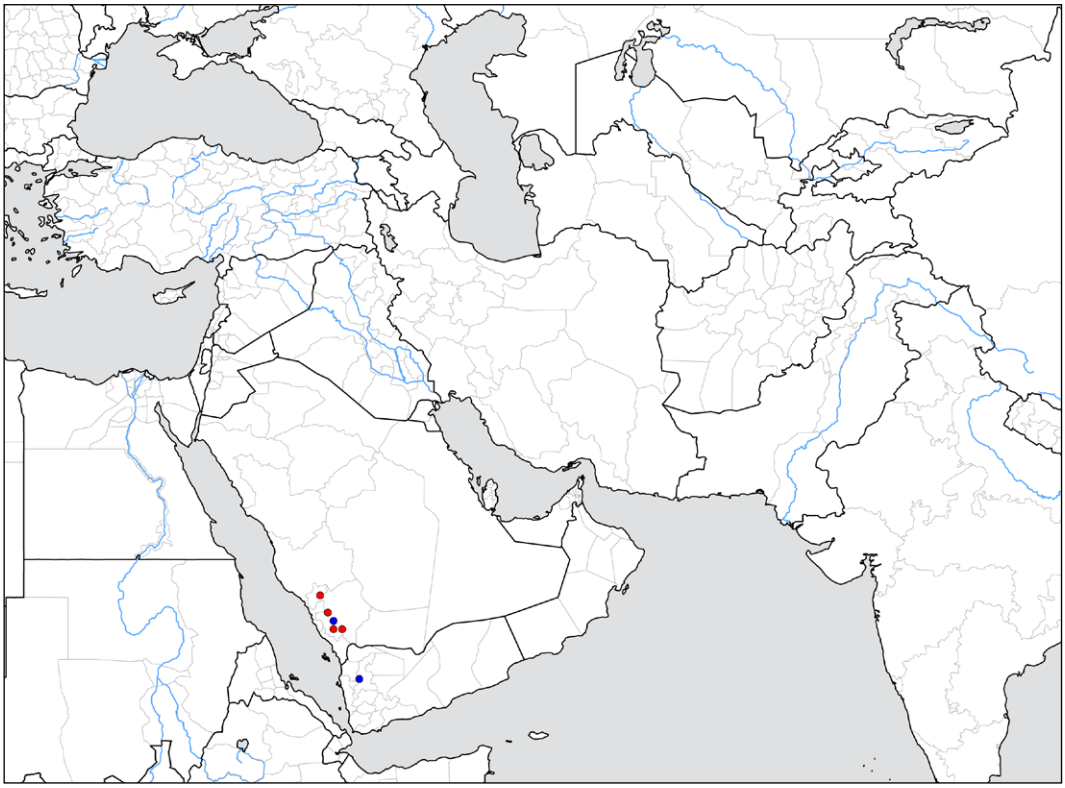
***Ischnura senegalensis* (Rambur, 1842) — Tropical Bluetail**

The range of *Ischnura senegalensis* goes from the west of Africa (including some Canary Islands) through Arabia, the Levant and South Asia to China, Japan and Indonesia. It is very common in the tropical regions of Africa and Asia. In the region covered by this atlas, *Ischnura senegalensis* occurs in the southern Levant (Israel, Jordan, West Bank), the Sinai Desert in Egypt and along the southeastern coast of the Arabian Peninsula (Yemen, Socotra Island, Oman and the United Arab Emirates). The species is also present along the Makran coast in southeast Iran. Old records are known from the interior of Saudi Arabia and from the Basra marshes in southern Iraq. *Ischnura senegalensis* occurs in all kinds of vegetated fresh and brackish standing and slow-flowing waters (e.g. lagoons, ponds, lakes, fish farms, streams and rivers). It shows a high tolerance to polluted water and is often the last odonate surviving in strongly altered habitats.



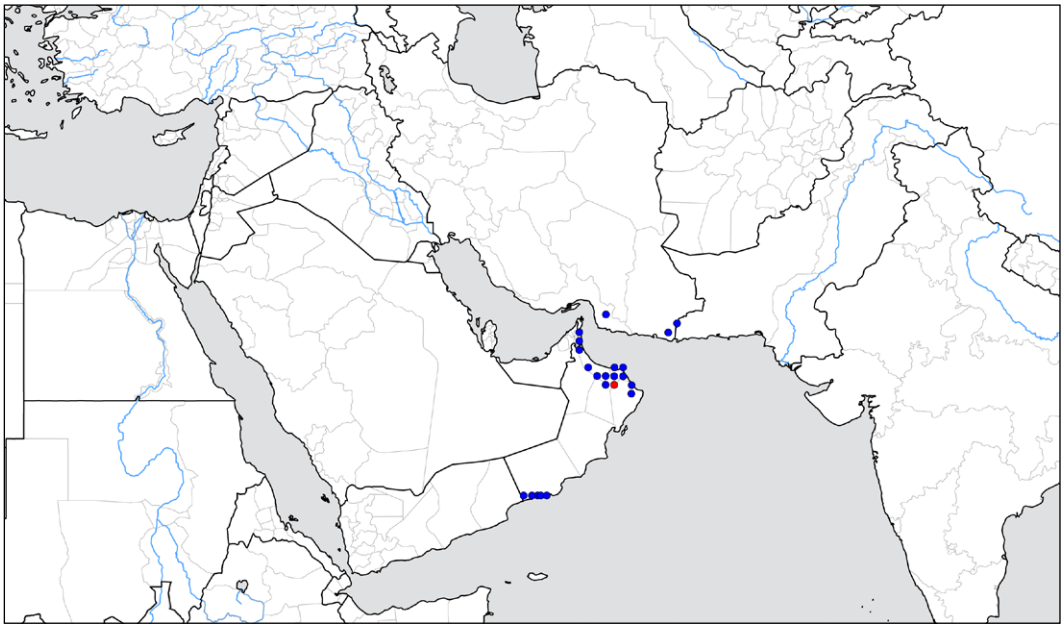
***Pseudagrion arabicum* Waterston, 1980 — Arabian Sprite**

This species, described from Saudi Arabia as a subspecies of *Pseudagrion inconspicuum* Ris, 1931, has been subsequently erected to full species rank (Waterston 1984). *Pseudagrion arabicum* is endemic to the southern part of the mountain range along the Red Sea in Saudi Arabia (Asir and Gizan) and northwestern Yemen, where it occurs from 2000 to 3000 m a.s.l. It is a poorly known species with only 11 records from seven different localities (these being either rivers, wadis, waterfalls or man-made ponds fed by wadis). The species is regarded as Endangered by the IUCN (Schneider et al. 2013b) and the most recent records date from 2007, making it difficult to judge its current status.



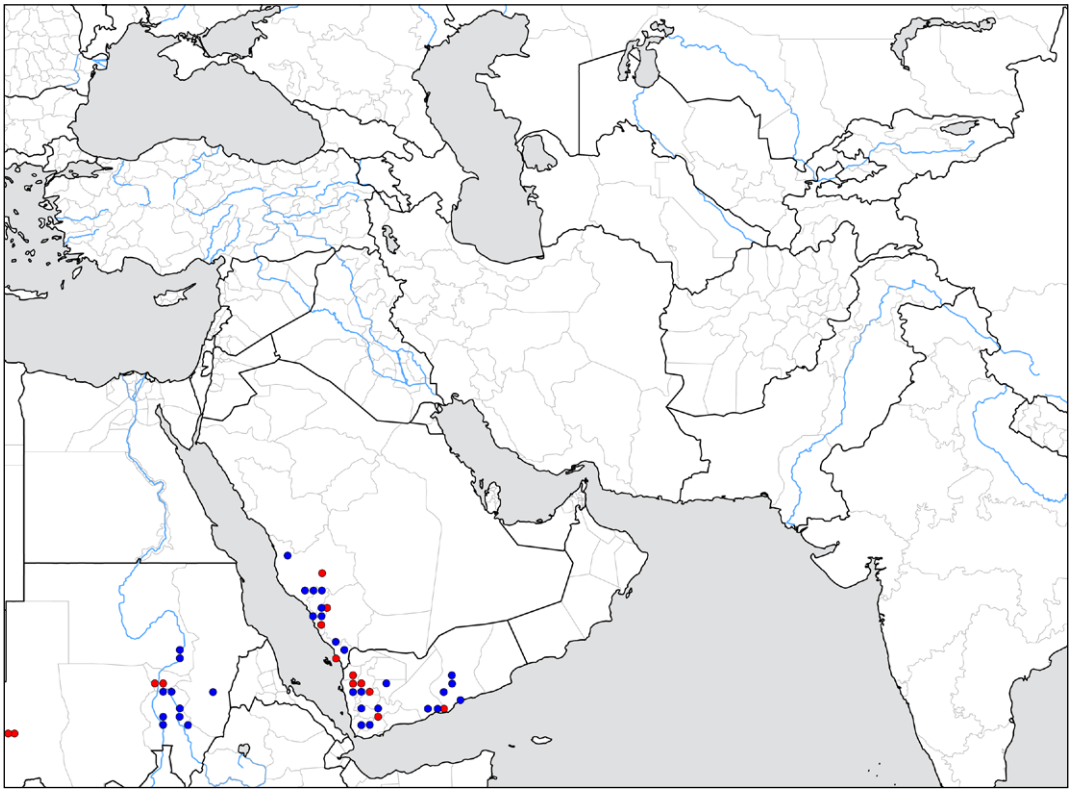
***Pseudagrion decorum* (Rambur, 1842) — Azure Sprite**

Pseudagrion decorum is common across large parts of South Asia and occurs in Pakistan, India, Sri Lanka, Nepal, Bangladesh and Myanmar. Its western range extends to southeast Iran, where it is known from a handful of locations (Schneider & Ikemeyer 2019), and to the southeastern part of the Arabian Peninsula. Here it is known from nearly a hundred localities in the Hajar Mountain range of northern Oman and the United Arab Emirates, and in Dhofar in southern Oman (Lambret et al. 2017); it is found close to the border with Yemen, so the species might also be present in that country. *Pseudagrion decorum* prefers wadis, pools, ponds and coastal lagoons with dense vegetation. Fraser (1933) mentioned the species to be 'essentially an insect of the plains'. This corresponds well with recent observations in Oman, where the median altitude of 64 known sites for the species is 190 m a.s.l. (Lambret et al. 2017). Of interest is the mention by Fraser (1933) that 'during September this species takes to flight, the migration taking place in a northwesterly direction up to the West Coast of India, when millions may be seen in company with *P. microcephalum*'. If this still happens today, then wanderers from the Indian mainland can, at times, be expected to reach parts of Iran or the Arabian Peninsula.



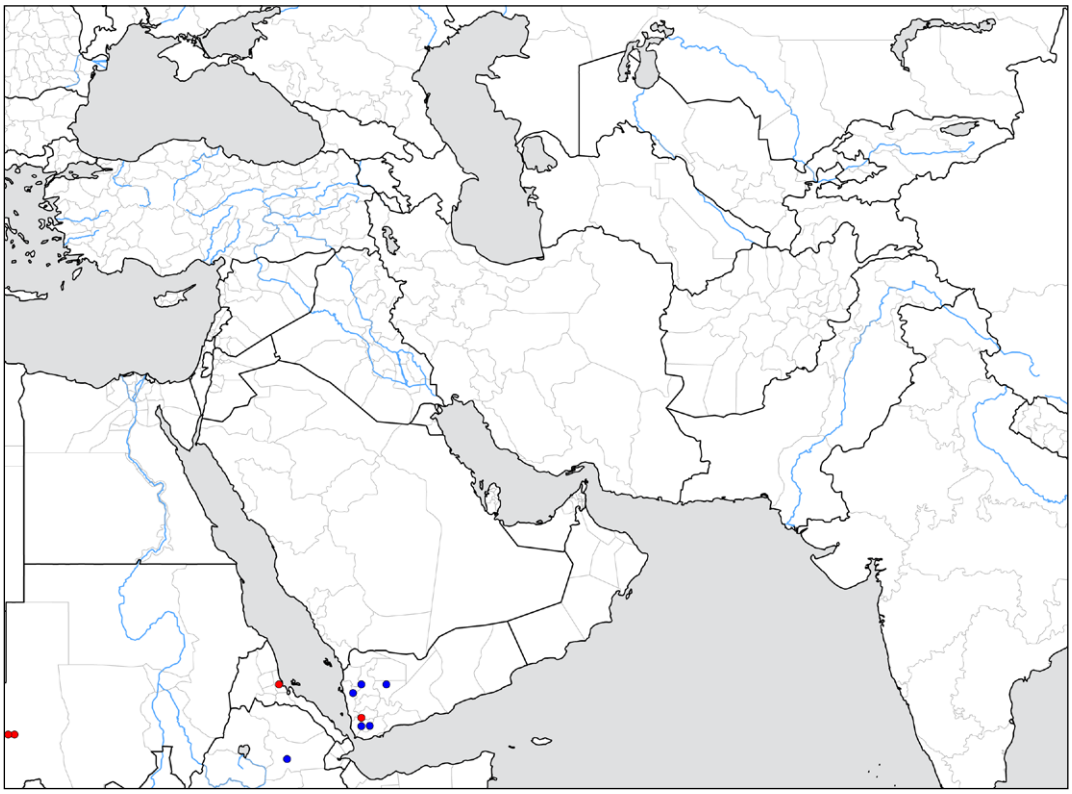
***Pseudagrion hamoni* Fraser, 1955 — Swarthy Sprite**

Pseudagrion hamoni is an Afrotropical species widespread in Sub-Saharan Africa, which has a string of isolated relict populations in the mountains of the western and central Sahara in Mauritania, Algeria and Libya, believed to date back to the early Holocene pluvial period. In our area it is found in the foothills and mountains up to 2400 m a.s.l. in southwest Saudi Arabia and Yemen. In Sub-Saharan Africa the species inhabits rivers and ponds in open landscapes, and in Sudan it is known from a crater lake. In the Sahara and Arabia it occurs at temporary flowing wadis and gueltas (residual pools in wadis in the dry season).



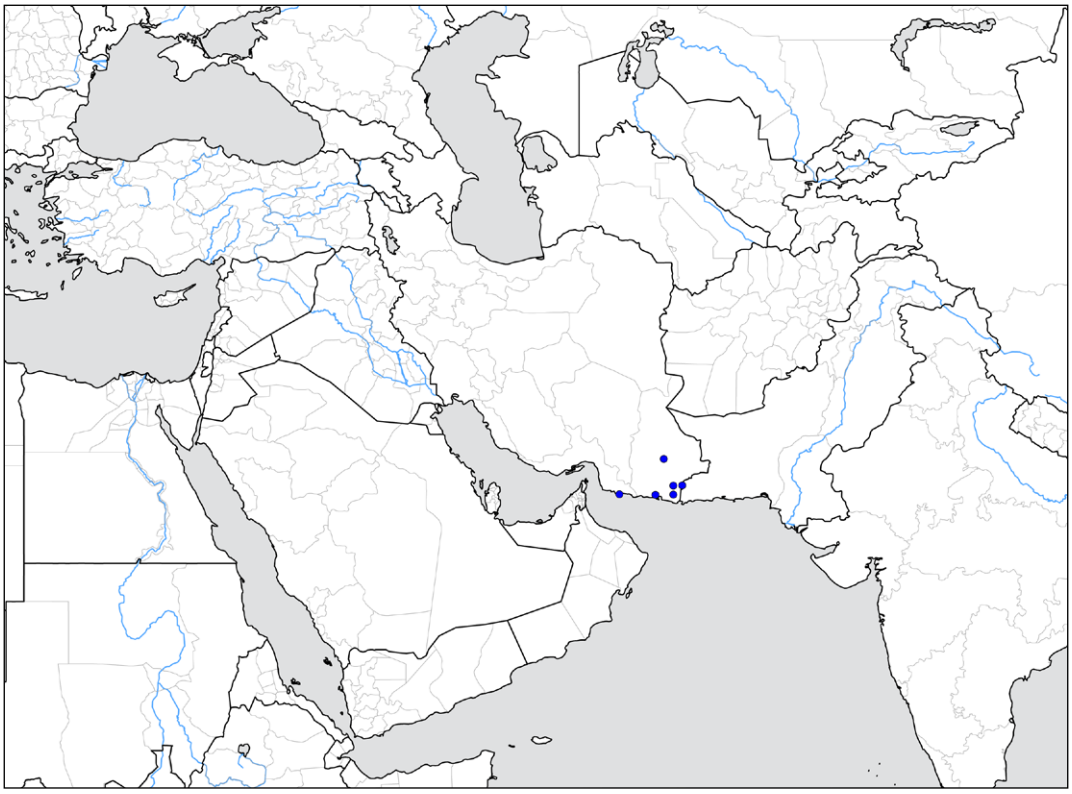
***Pseudagrion kersteni* (Gerstäcker, 1869) — Powder-faced Sprite**

Pseudagrion kersteni is one of the most widespread damselflies of Sub-Saharan Africa. Its range runs from South Africa and West Africa through Ethiopia, Eritrea and Somalia to the southwestern corner of the Arabian Peninsula. Here it is restricted to the mountains of western Yemen, from where it is known from 10 localities based on 15 records (Waterston 1984, Al-Safadi 1990, Dumont & Al-Safadi 1991, Dumont & Al-Safadi 1993, Al-Safadi 1995, Schneider & Parr 1998). The species occurs in this region at shaded or partly shaded wadis and rivers below 2300 m a.s.l. Although not threatened globally, the species is scarce in Arabia and classified as Vulnerable in the Arabian Peninsula (Schneider & Samraoui 2015).



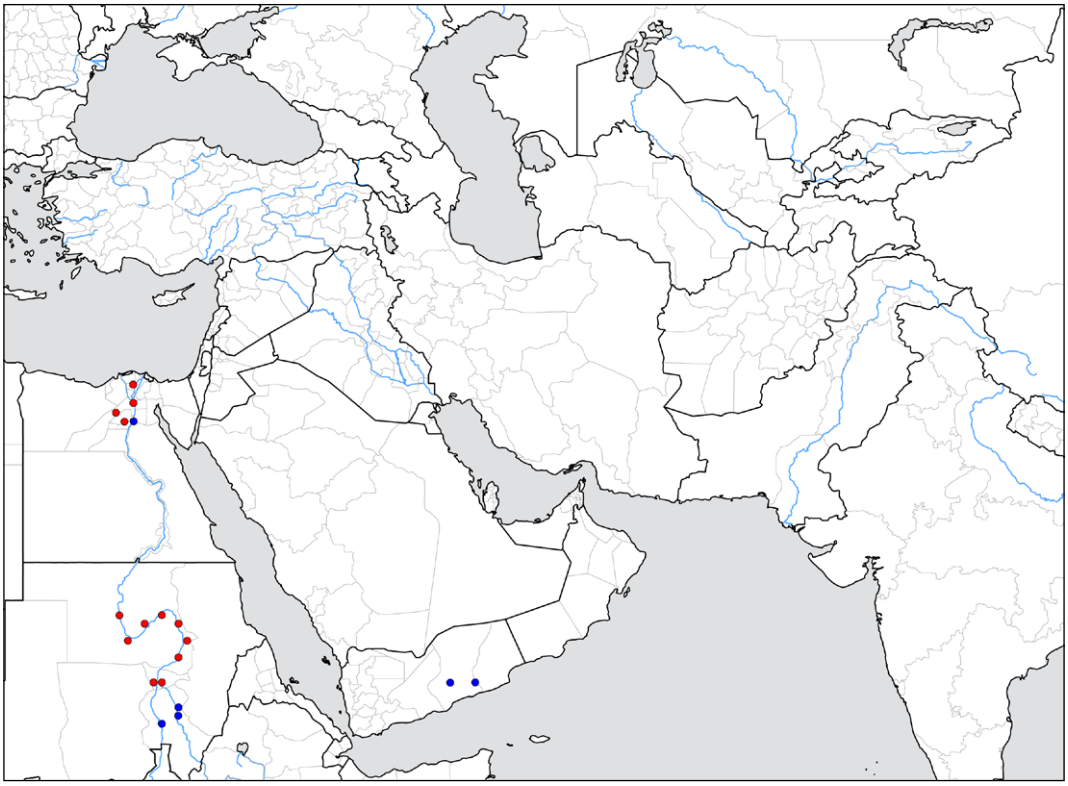
***Pseudagrion laidlawi* Fraser, 1922 — Dusky Sprite**

Pseudagrion laidlawi has a relatively restricted range, being confined to west India, Pakistan and southeast Iran. It seems rather common in Pakistan (Zia et al. 2010) but relatively few records are known from India, though this is probably due to a lack of exploration of the dryer western parts of the country. The first record from Iran dates from 1993 (Dumont & Heidari 1998), and at present the species is known from 11 localities along the Makran coast in southeastern Iran. It breeds in slow-running brooks, streams and rivers, where it can be common. The species is often seen resting in low vegetation, or even on floating aquatic vegetation (Schneider & Ikemeyer 2019).



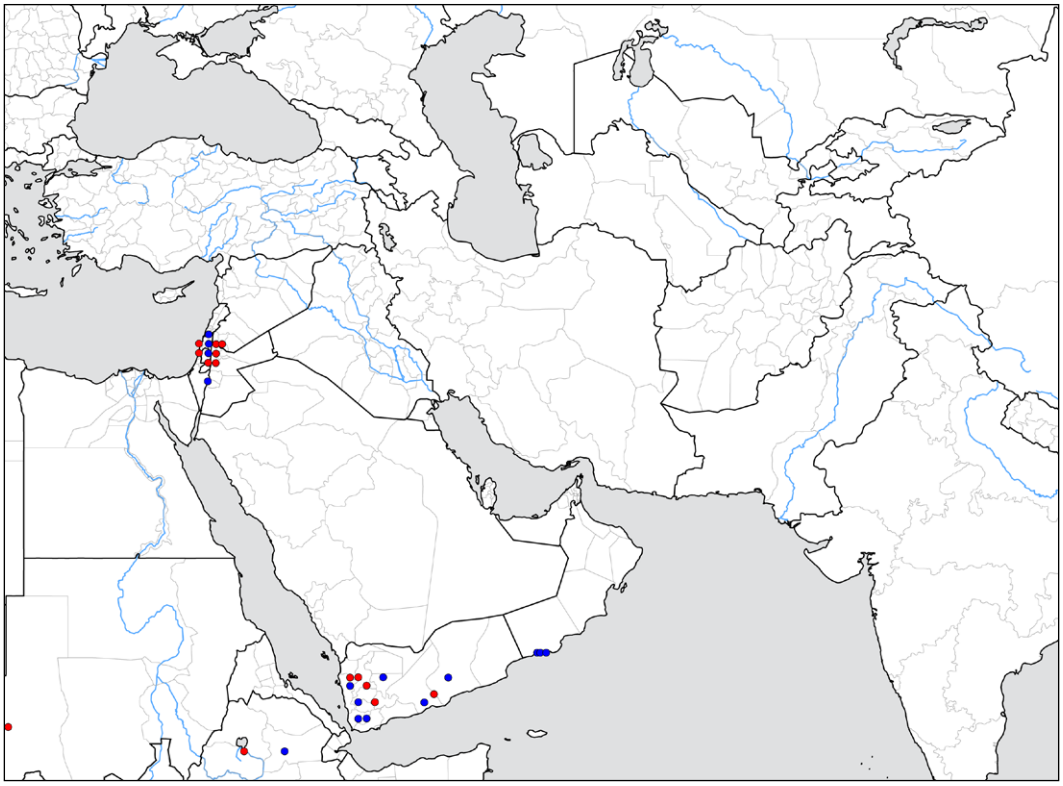
***Pseudagrion niloticum* Dumont 1978 — Nile Sprite**

Pseudagrion niloticum is an East African species ranging from Kenya and Uganda to Ethiopia, Somalia, South Sudan, Sudan and Egypt, mostly within the Nile River hydrographic system (Clausnitzer et al. 2012). Surprisingly, it is also found in the eastern half of Yemen, where three records are known from two wadis in the Hadhramout Desert (Schneider & Nasher 2013). The species is most likely very rare in the south of Arabia.



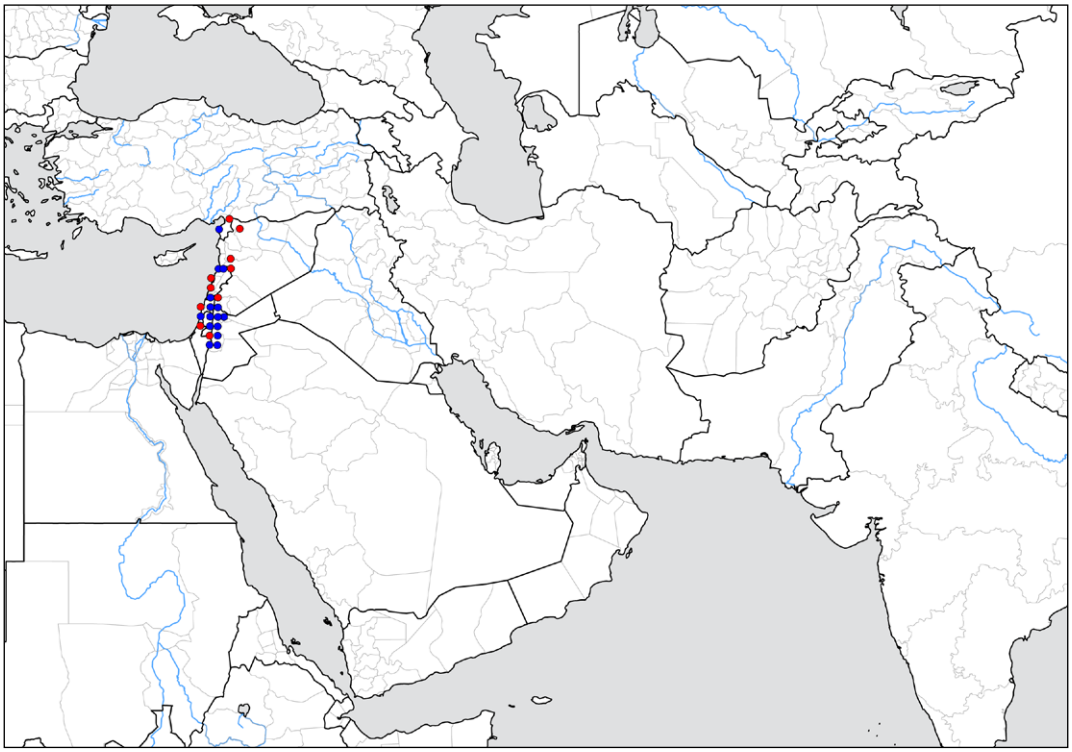
***Pseudagrion sublacteum* (Karsch, 1893) — Cherry-eye Sprite**

Pseudagrion sublacteum is widespread in Sub-Saharan Africa, with additional disjunct areas of occurrence to the north and northeast in northern Morocco and the Levant (Syria, Israel, Jordan and West Bank) respectively. These disjunct populations are thought to result from a former continuous range in the early Holocene pluvial period becoming fragmented during the post pluvial desertification of the Arabian and Saharan belt over the last 4500 years (Dumont 1975a). The populations in Yemen and southern Oman (Dhofar) are also derived from this former continuous range, but are less separated from their main Sub-Saharan range. In Yemen and Oman, this species breeds in rivers and temporary flowing wadis which fall partly dry during the dry season and so result in the formation of intermittent ponds. With 72 distinct localities reported in the Levant and southern Arabia, this species is considered as 'not threatened' in the Arabian Peninsula (Schneider & Samraoui 2008).



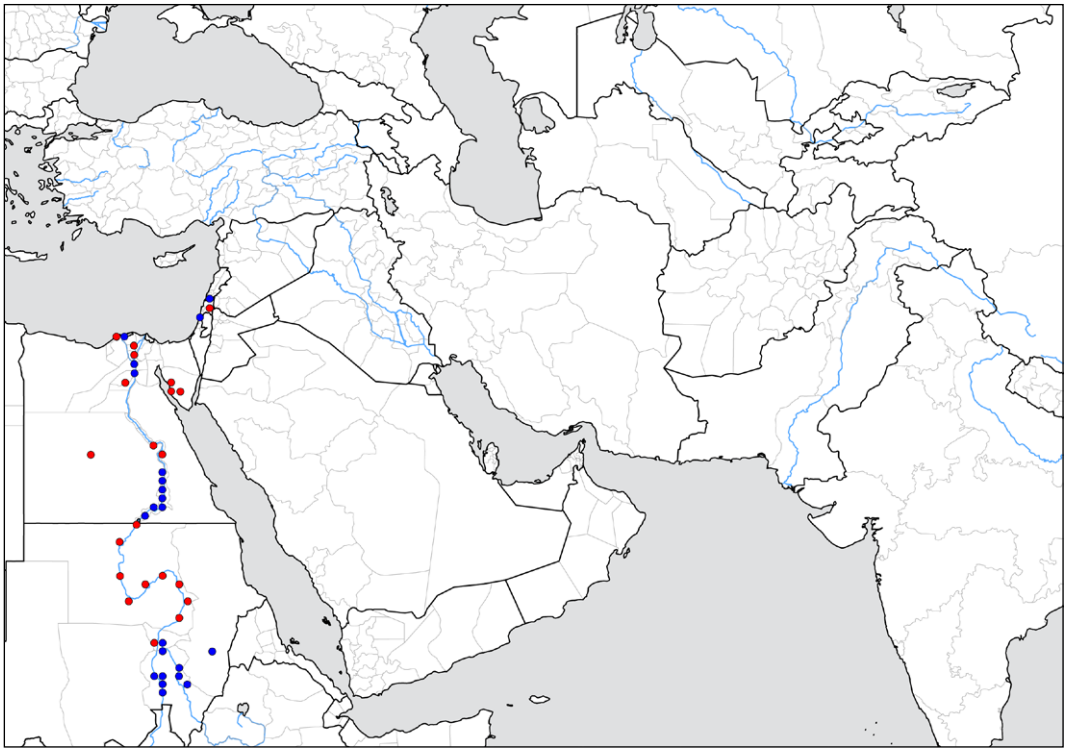
***Pseudagrion syriacum* Selys, 1887 — Syrian Sprite**

Pseudagrion syriacum is a Levantine endemic confined to a small area extending from Israel to the province of Antakia in southern Turkey. It is known from a total of 84 localities in Israel, Jordan, Palestine State, Lebanon, Syria and Turkey. The species is similar in appearance to *P. kersteni* (Gerstäcker, 1869), although the two taxa do not overlap and are probably sister species derived from a common ancestor (Dumont 1975). *Pseudagrion syriacum* prefers slow flowing wadis, streams and rivers with dense vegetation (Schneider 1982). Adults can be seen flying low over the water; this, in combination with their dark pruinosity, means they can easily be overlooked. Despite its small range, and the strong human impact on freshwater habitats within its range, *P. syriacum* is currently not considered threatened. Recent reports show that the species is still abundant at some localities in Jordan and the West Bank territory (Waldhauser 2020). No recent information is, however, available from Syria due to the local political conflict.



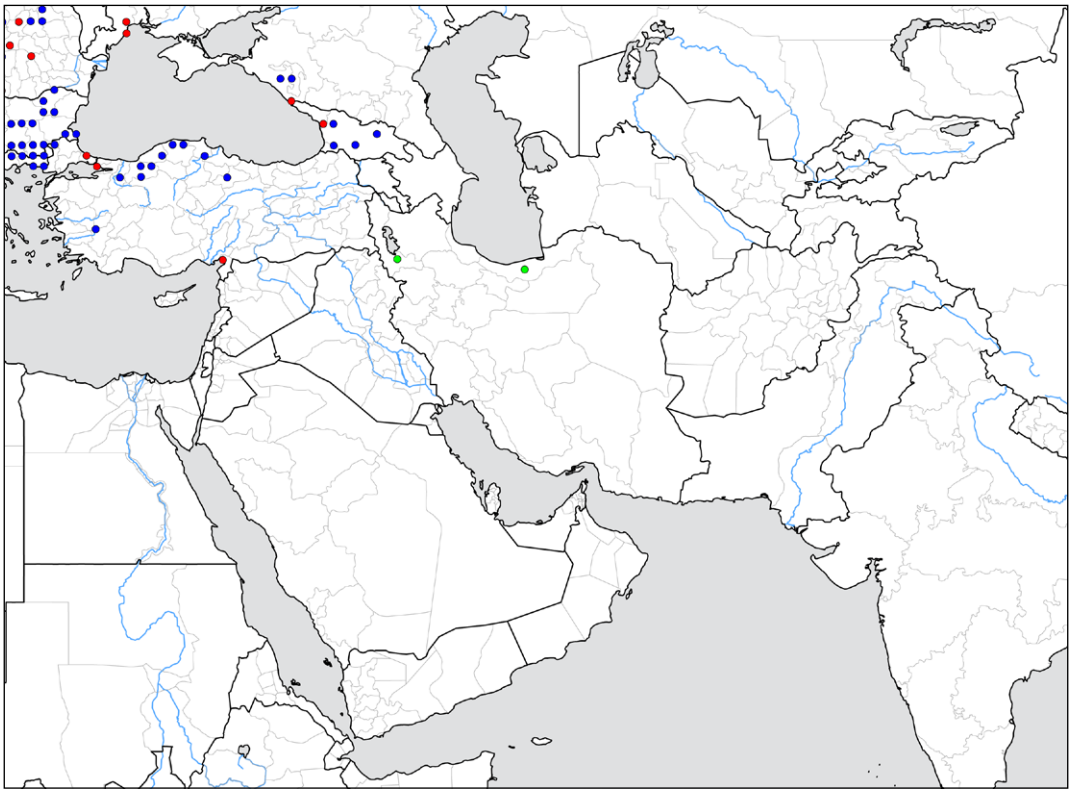
***Pseudagrion torridum* Selys, 1876 — Wing-tailed Sprite**

Pseudagrion torridum is an African species found from just south of the equator northwards to the Sahara, reaching the Mediterranean coast through the Nile River hydrosystem (Clausnitzer et al. 2012). The species is common along the Nile River. Populations away from the Nile are found on the Red Sea coast of the Sinai Peninsula, where it was recorded from 1969 to 1973 (Dumont 1973), and in the Levant in Israel (Dumont 1975a). Most records from Israel are old, but recently a population was discovered near Tel-Aviv (Bar Zakay et al. 2016). This species breeds primarily in rivers, but sometimes also in streams and large standing waters, such as lakes. A population was formerly present at Lake Hula and nearby marshes in Israel, but this disappeared after their drainage. Recently the species has, however, been rediscovered in the newly restored lake (Lake Agmon = Lac Semechonite) (Schneider et al. 2013a).



***Pyrrhosoma nymphula* (Sulzer, 1776) — Large Red Damsel**

This conspicuous red damselfly is almost entirely confined to Europe, with small populations also occurring in North Africa and West Asia. In our area it is very nearly restricted to the Black Sea coast of northern Turkey and to Georgia. There is one record from the southwest of Turkey, at Suleymanli Lake near Denizli (Duran & Akyildiz 2011), and a very old one in the far south of Turkey, near Iskenderun in Hatay Province (Selys 1887). The latter record, in particular, is far from the species' main range and is considered incorrect by some authors, probably resulting from mislabelling (Kalkman & Lopau 2006), though Schneider (1986) regarded it as a genuine record. All records from Iran are considered doubtful and are rejected here, following Schneider et al. (2018b) and Schneider & Ikemeyer (2019).

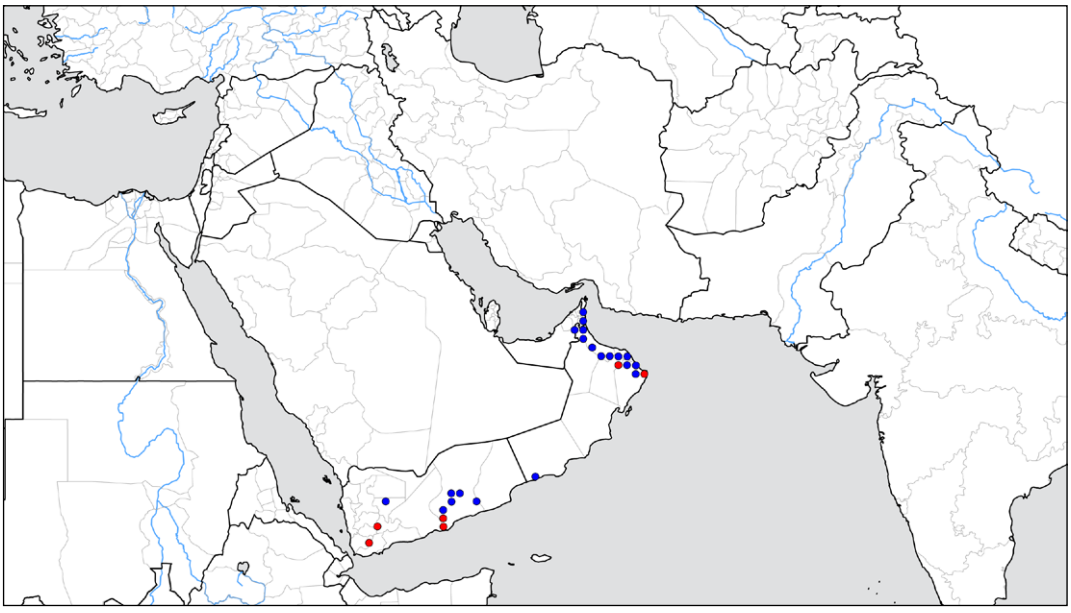


Platycnemididae

In the area covered by this atlas the family Platycnemididae is represented by just six species in four genera. *Arabineura khalidi* was until fairly recently considered to belong to the family Protoneuridae, but this family has been submerged into Platycnemididae (Dijkstra et al. 2014).

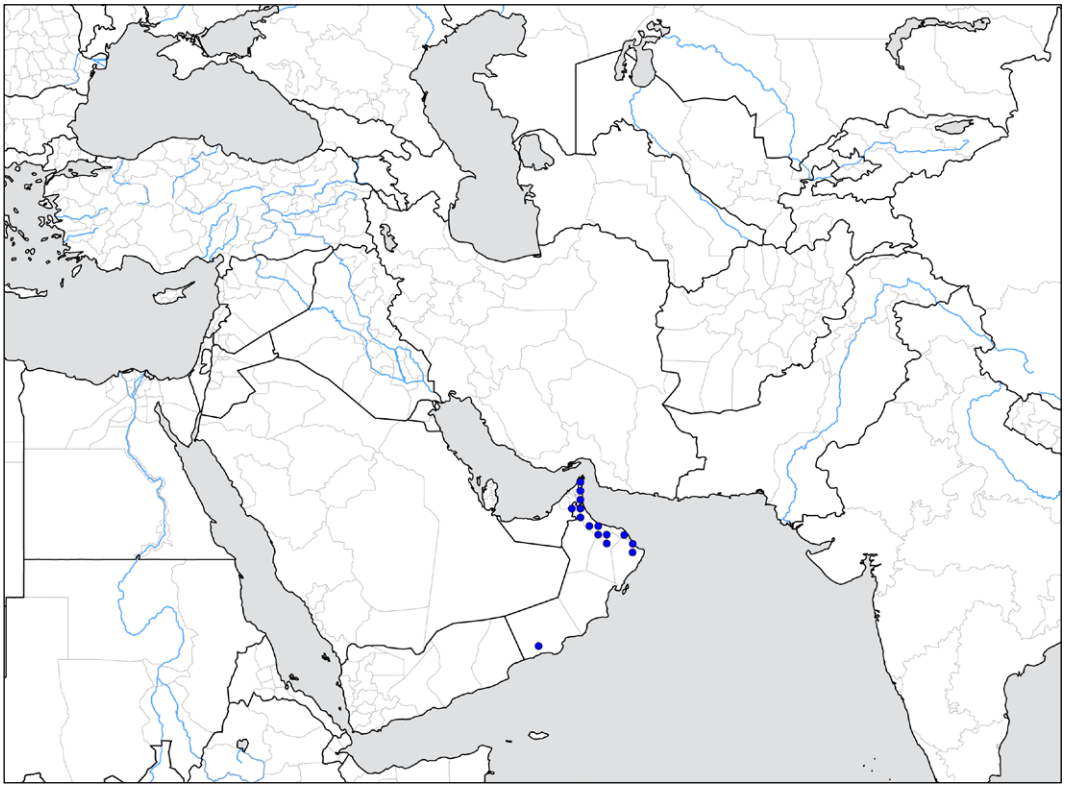
***Arabicnemis caerulea* Waterston, 1984 — Powderblue Damsel**

Arabicnemis caerulea is endemic to the southern and southeastern parts of the Arabian Peninsula. Despite being not uncommon, it was described less than 40 years ago. The species is fairly common along the Hajar Mountains in the United Arab Emirates and Oman, whereas records remain more scattered in Yemen, though this could be the result of a lower intensity of field work. Recently, it has also been discovered in the Dhofar region in southern Oman, where two exuviae were found ca 76 km east of the border with Yemen (Lambret et al. 2017); these exuviae were carefully identified by comparison with known exuviae collected in northern Oman during emergence. *Arabicnemis caerulea* is largely confined to streams and small rivers characterised by small and large boulders, but where some riparian vegetation is also present; it also occurs at intermittent pools in river beds. Algae and floating leaves are used as oviposition substrates (Lambret et al. 2017).



***Arabineura khalidi* (Schneider, 1988) — Hajar Threadtail**

Aabineura khalidi is a south Arabian endemic which is largely confined to the Hajar Mountains in northern Oman and the United Arab Emirates, where it is reasonably common and widespread. In 2014 it was found at one locality in Dhofar, southern Oman (Lambret et al. 2017). The species was originally described as *Ellatoneura khalidi* but was later transferred to its own genus, *Arabineura* (Schneider & Dumont 1995). Until recently, this genus was placed in the family Protoneuridae, but that family has now been split up, with its Neotropical members placed in Coenagrionidae as the subfamily Protoneurinae, and its Old World taxa placed in the family Platycnemididae as the subfamily Disparoneurinae (Dijkstra et al. 2014). *Arabineura khalidi* is often found in the same habitats as *Arabicnemis caerulea*, but prefers faster flowing streams and small rivers.

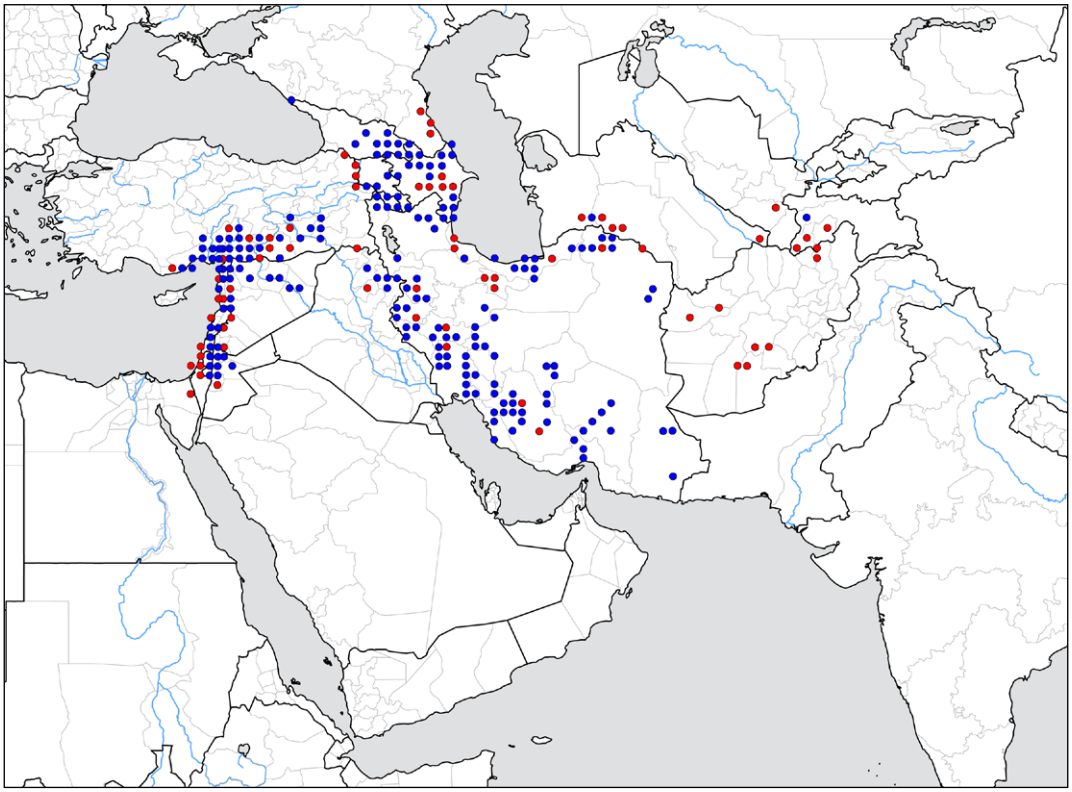


***Calicnemia eximia* (Selys, 1863) — Scarlet Oread**

The distribution of the genus *Calicnemia* is centred around the southern Himalayan region and the mountains of southern China and adjacent areas of Myanmar, Thailand, Laos and Vietnam, running southwards as far as Peninsular Malaysia. Most species have relatively small ranges but *C. eximia* is the exception to this rule, having a range that includes large parts of Southeast Asia, running westwards along the southern edge of the Himalayan region to Pakistan and Afghanistan. Like its congeners it is restricted to running waters and is found in smaller, mostly shaded, streams. Zia (2016) recorded the species from six localities in the north of Pakistan at elevations between 600-1200 m a.s.l., suggesting that the species is fairly common. The records from Pakistan range from the second half of June to the second half of September. The only record from Afghanistan is from 15 July 1952 at Kamu (1300 m a.s.l.) near the border with Pakistan (Schmidt 1961).

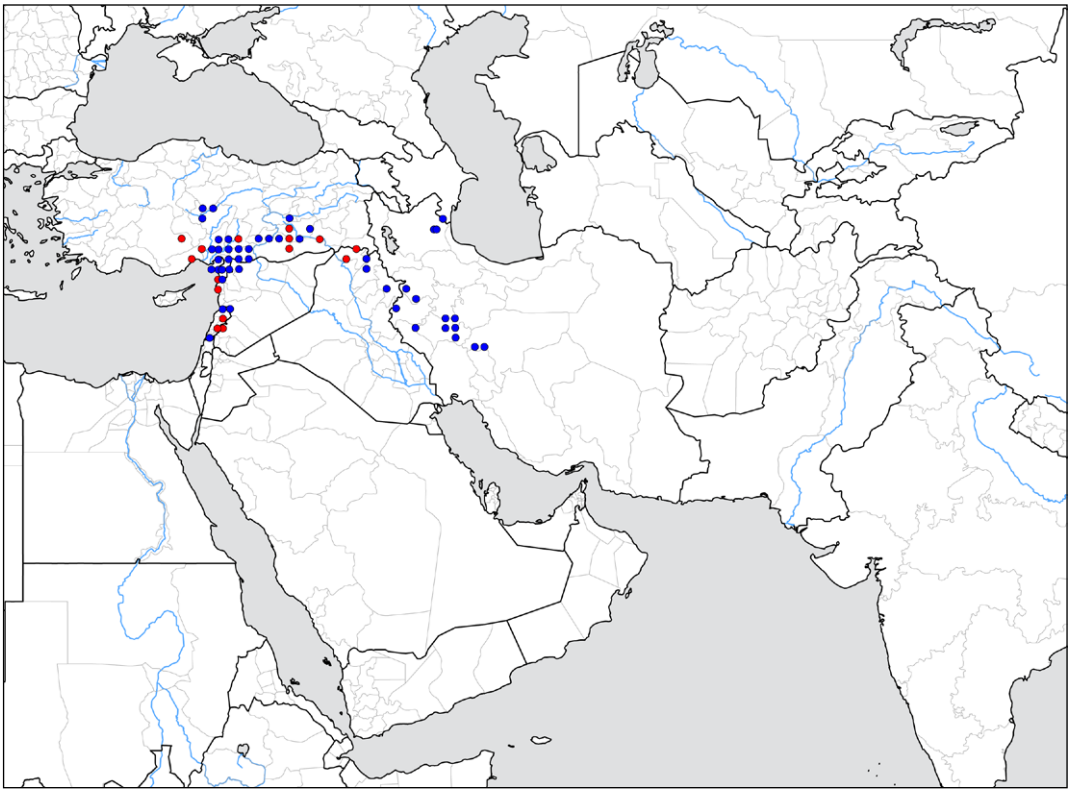
Platycnemis dealbata Selys, 1850 — Ivory Featherleg

With a range running from Kashmir in the east to the coast of southern Turkey in the west, *P. dealbata* is almost completely confined to the area covered in this atlas. The species is found in almost all mountainous areas in the Levant, southeastern Turkey, South Caucasus, Iraq and Iran. In the south, east and northeast, its range is limited by the dryer and warmer areas of the Arabian Peninsula, the Indian Peninsula and the deserts of Iran and Central Asia. It is remarkable that this species does not have a wider distribution in Tajikistan towards Uzbekistan and Kyrgyzstan, and presumably the lower winter temperatures prevent it from occurring further north. In the west of its range the species meets *P. pennipes*, probably its sister species. These two species overlap in range in Turkey and the South Caucasus countries over a zone of a few hundred km, with *P. dealbata* predominantly in the warmer and dryer regions. The species is mostly found in running water with a slow to moderately fast current.



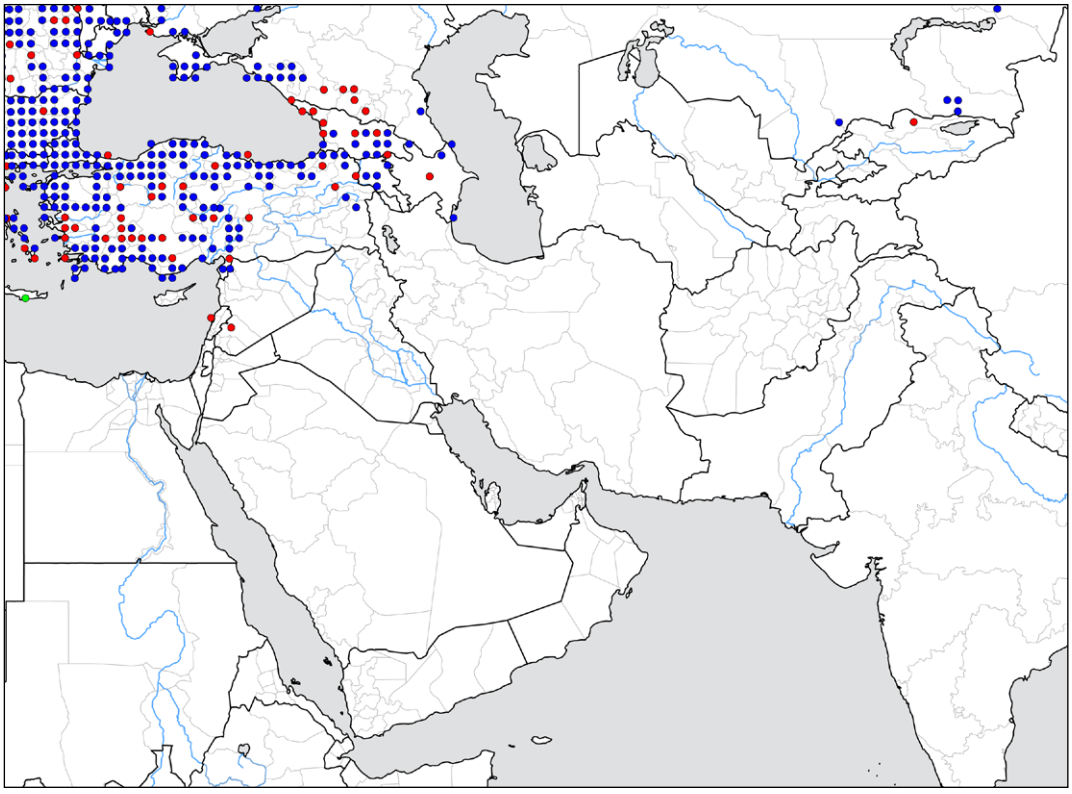
***Platycnemis kervillei* (Martin, 1909) — Powdered Featherleg**

Platycnemis kervillei is endemic to West Asia. It occurs from the Levant and southeastern Turkey to western Iran, where it was only recently reported (Schneider & Ikemeyer 2016b). The southernmost localities are found in the northern tip of Israel. The species seems to be well established in the coastal mountains of Syria and Lebanon, and in the mountains of northeast Iraq and western Iran. *Platycnemis kervillei* is confined to running waters, notably springs, brooks and small rivers with shaded and well-developed bankside vegetation.



***Platycnemis pennipes* (Pallas, 1771) — Blue Featherleg**

Platycnemis pennipes is widespread in Europe, large parts of Turkey and the South Caucasus. Its range continues east through Russia to the upper reaches of the Yenisei River. In the southeast of Kazakhstan the species occurs in a narrow strip between 70° and 80°E on the northern slopes of the Tian Shan mountains, with one record known from Kyrgyzstan (Borisov & Haritonov 2007). In the warmer, dryer, parts of West Asia the species is replaced by *P. dealbata*, with which it overlaps in parts of Turkey and in the South Caucasus countries. The species is common at many kinds of running and standing waters, but is absent from very fast flowing streams and rivers. It has a clear preference for sunny or partly shaded habitats.

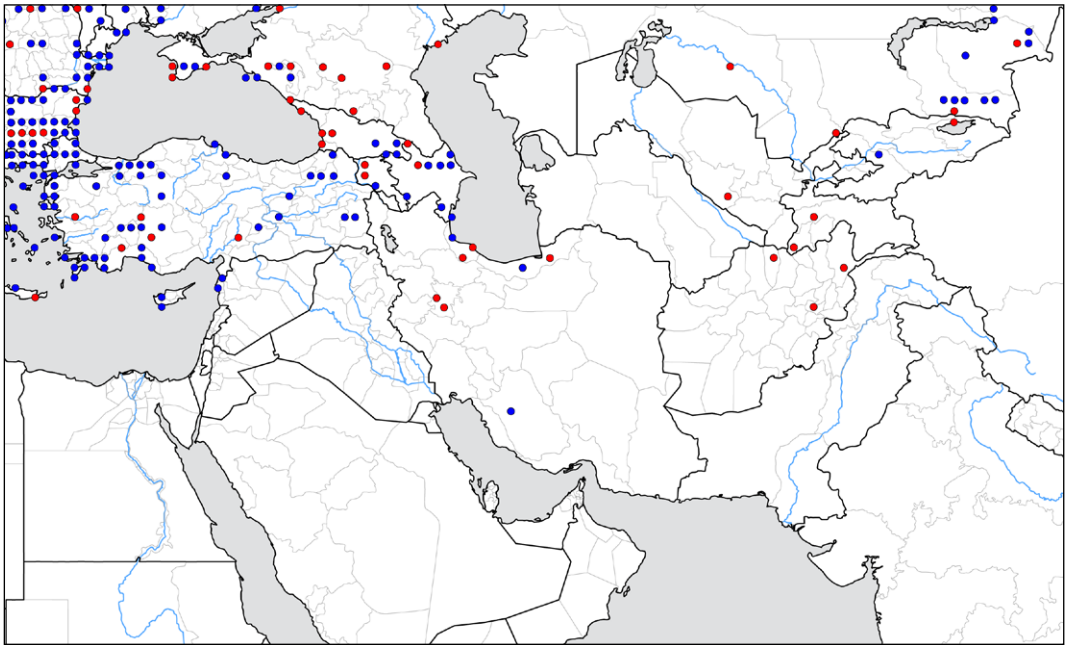


Aeshnidae

In the area covered by this atlas the family Aeshnidae is represented by 16 species in 5 genera. *Aeshna isoceles* is currently placed in the genus *Aeshna* but might in the near future be transferred to its own genus as it does not seem to be particularly closely related to other species of the genus *Aeshna.*

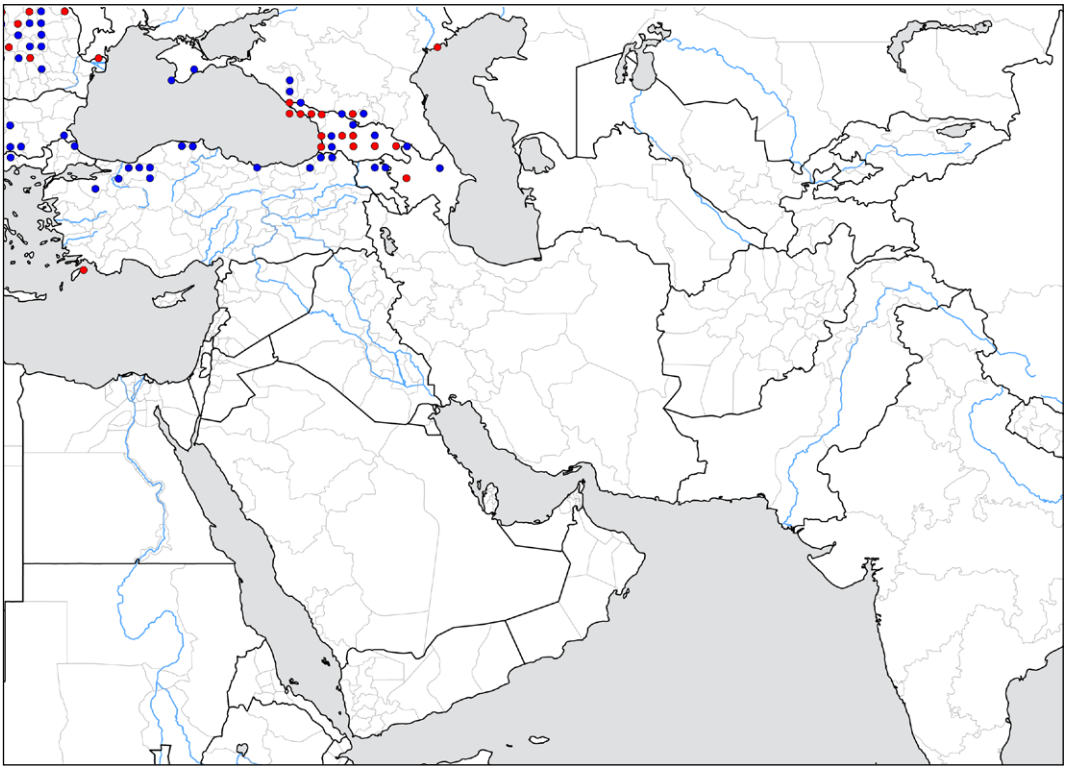
***Aeshna affinis* Vander Linden, 1820 — Blue-eyed Hawker**

The range of *Aeshna affinis* is largely confined to the Western Palearctic, and the species is especially common in West, Central and Southeast Europe. It has expanded its range in the past decade due to climate change and is now also found in the most eastern tip of the British Islands and the most southern part of Scandinavia. In the area covered by this atlas, the species is rather scarce and found in Turkey, the South Caucasus, northern Iran and Central Asia. In contrast with most other *Aeshna* species it completes its life cycle in one year due to which it can successfully reproduce at flooded depressions in meadows surrounding ponds and lakes that desiccate in summer. Outside of the most arid regions this habitat will likely be present in the form of small ponds in moderately grazed meadows. The species is linked to standing water with emergent vegetation, such as reeds, sedges and rushes.



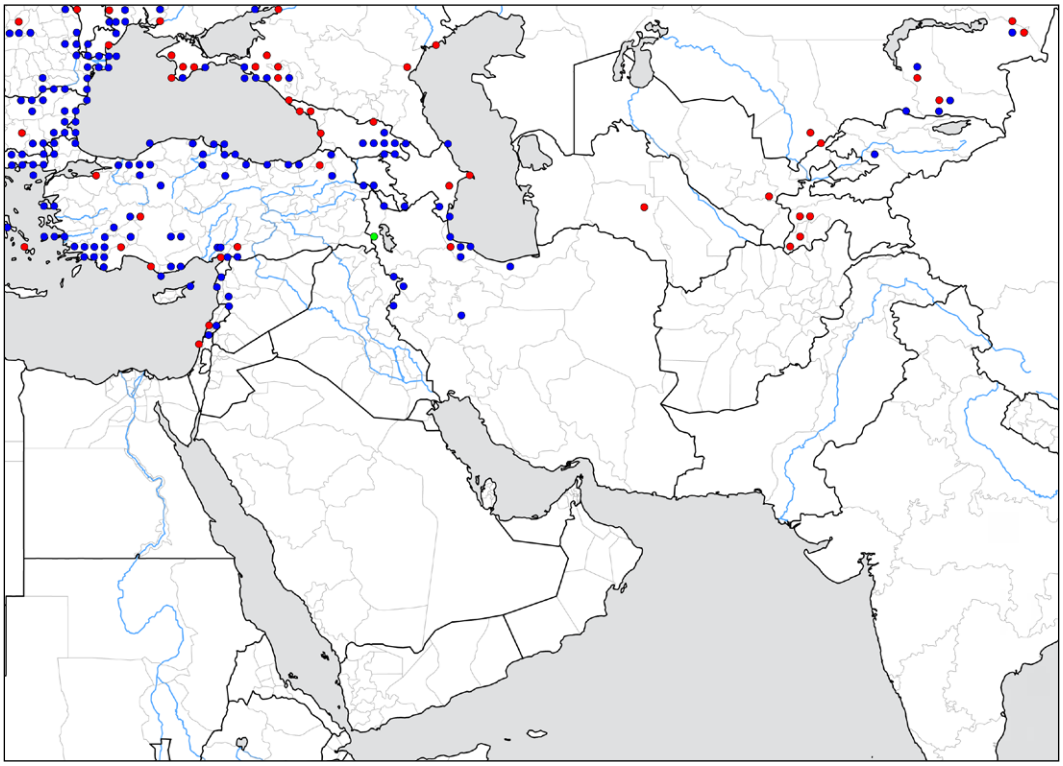
***Aeshna cyanea* (Müller, 1764) — Blue Hawker**

Aeshna cyanea is largely confined to Europe where, with the exception of the Mediterranean and the north of the continent, it is common and widespread. Outside Europe it is found in a limited number of places in the Maghreb, Turkey and the South Caucasus. Within the region covered by this atlas, *Aeshna cyanea* is uncommon in northern Turkey, Georgia, northern Armenia and Azerbaijan (Snegovaya 2021), where it is largely restricted to higher altitudes. All published records of *A. cyanea* from Iran and one record from Azerbaijan (Dumont 2004) have been found to belong to the recently described *A. vercanica* (Schneider et al. 2018). Nevertheless, a record of *A. cyanea* at the mountain lake Goygol (= Geygel) in Azerbaijan by Bartenev (1912b) may well be correct considering the habitat and the nearness to the Armenian localities.



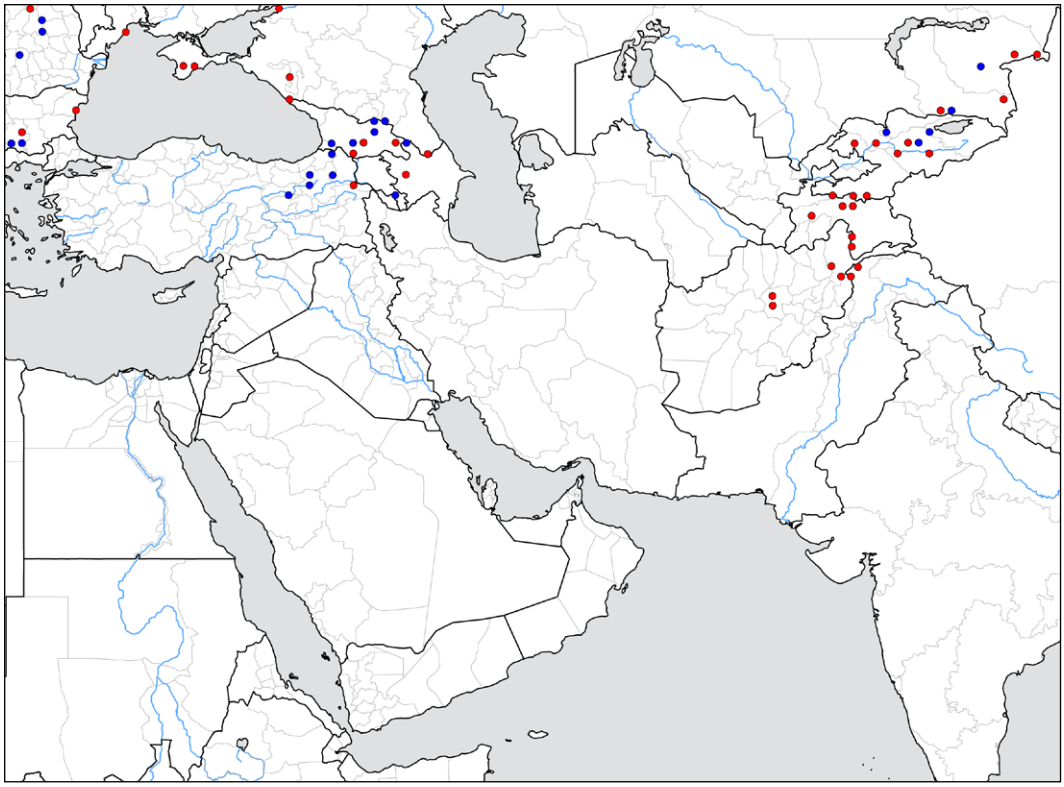
***Aeshna isoceles* (Müller, 1767) — Green-eyed Hawker**

This atypical aeshnid has in the past been suggested to belong to the genus *Anaciaeschna*; however, von Ellenrieder (2002) showed that the taxon *isoceles* does not group with this genus and for the time being it is retained in the genus *Aeshna.* The species prefers well vegetated standing or slow flowing water and, in contrast to other species of the genus *Aeshna* flies relatively early in the year. The core range of *A. isoceles* is found in Europe from where its continuous range stretches eastwards to the southern parts of the Urals. Although absent from most of Kazakhstan, it occurs in the eastern part and in the other countries of Central Asia. The species is relatively common in the non-arid parts of Turkey, the Levant, the South Caucasus and northwest Iran but is scarce in Central Asia. Two recent records from Kermanshahah and Markazi provinces of Iran (Sadeghi & Mohammadalizadeh 2009, Kosterin & Ahmadi 2018) indicate that it might be present more widely in western Iran than currently known.



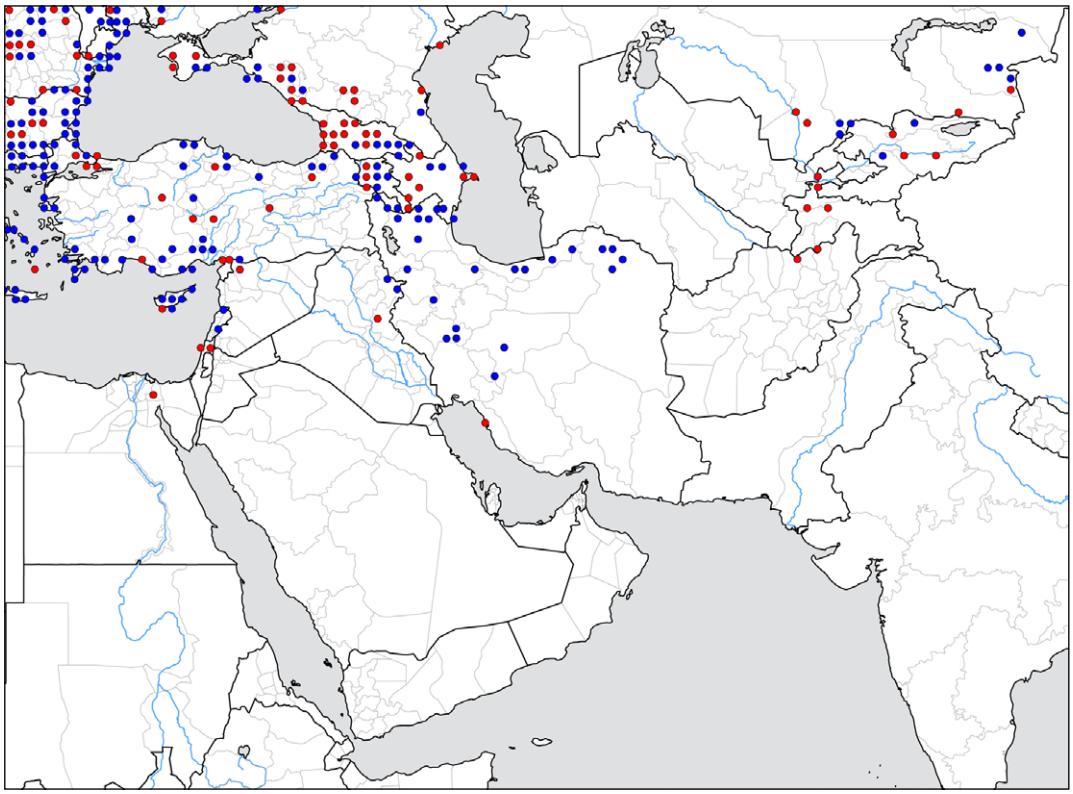
***Aeshna juncea* (Linnaeus, 1758) — Moorland Hawker**

Aeshna juncea is widespread and common in northern Europe but becomes scarcer and confined to higher altitudes in southern Europe. It is among the dragonflies with the largest range occurring in Eurasia from Ireland and Portugal to Japan, but is also found in Canada and the northern parts of the United States. In the area covered by this atlas the species is generally scarce and limited to higher altitudes. It is only found in the northeastern parts of Turkey, the South Caucasus countries, Afghanistan, Tajikistan and Kyrgyzstan. *Aeshna juncea* occurs in peatlands and mountain lakes bordered with sedges and rushes or by peat rafts. The populations occurring in Armenia and Turkey have a more extensive yellow pattern on their thorax, recalling *A. cyanea*. The taxonomic status of these populations is currently unclear.



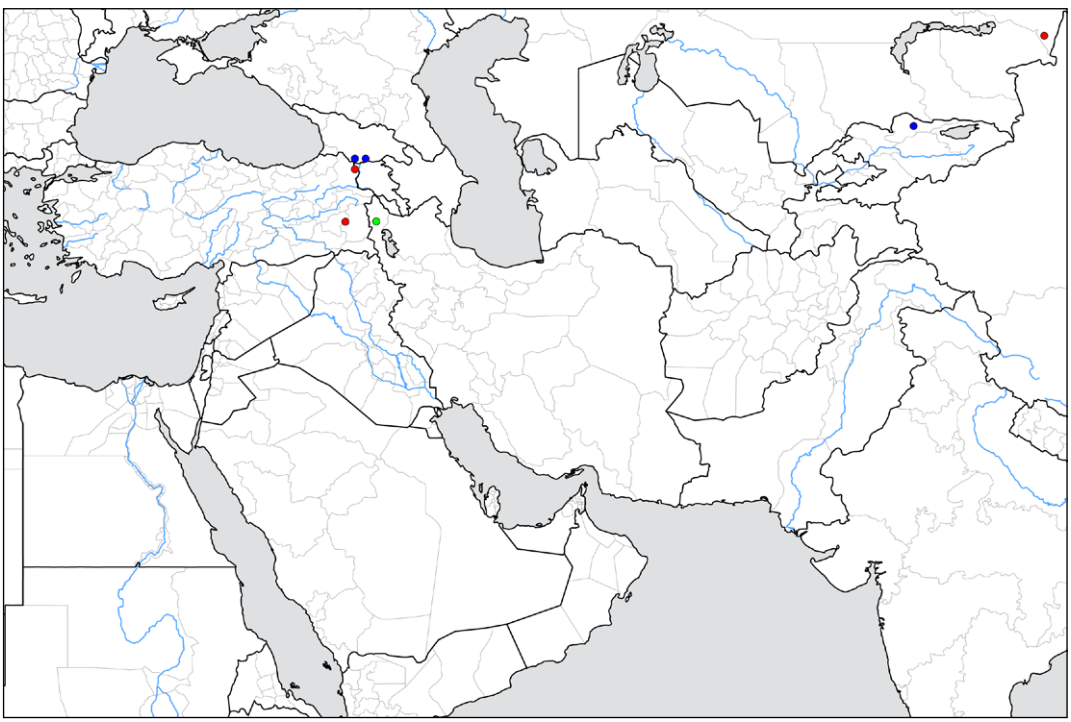
***Aeshna mixta* Latreille, 1805 — Migrant Hawker**

The range of *Aeshna mixta* includes western Europe and the north of the Maghreb extending eastwards through large parts of Europe, southern Siberia, Kazakhstan, Mongolia and Japan in the east. In our area the species is found in the South Caucasus countries, Turkey, Cyprus, the higher areas of the Levant and the Alborz and Zagros Mountain ranges in Iran. It occurs in the wetter and higher eastern parts of Central Asia (Tajikistan, Kyrgyzstan and southern Kazakhstan) and in northern Afghanistan. The species occurs in many different types of standing water as long as there is emergent vegetation and can for instance be very numerous in reed beds in river deltas. In some areas the imagos aestivate, spending the summer period away from the water in forested uplands, returning in autumn to reproduce.



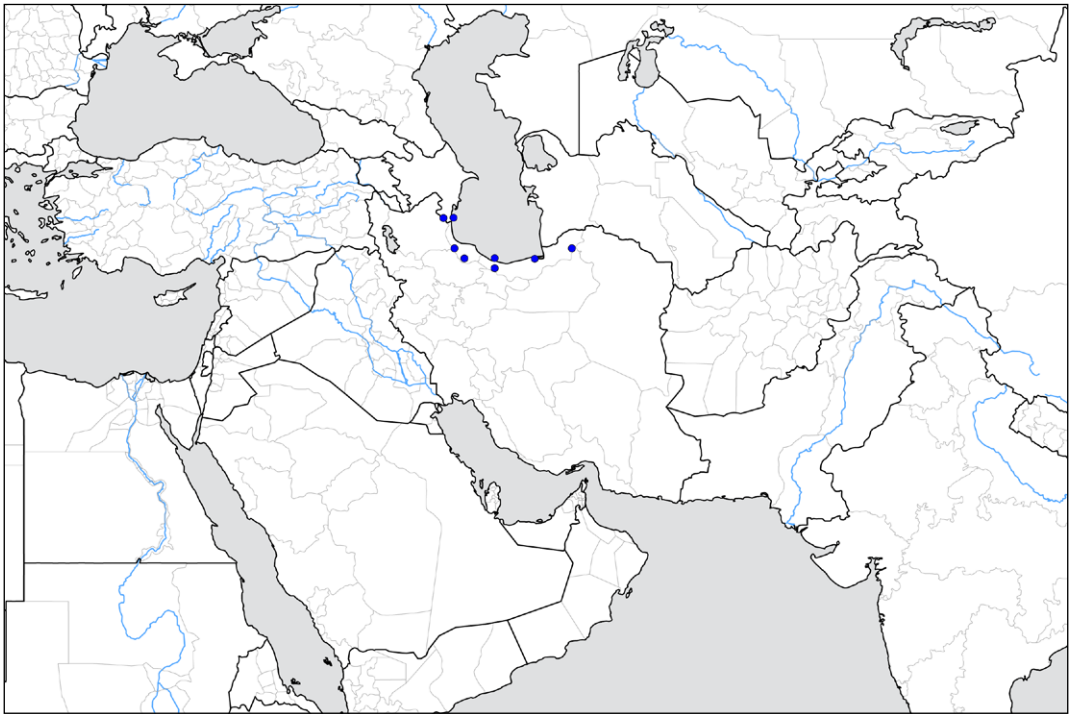
***Aeshna serrata* Hagen, 1856 — Baltic Hawker**

The main range of *A. serrata* is found in the temperate heartland of Asia with most records coming from the southern Urals, southern Siberia, northern Kazakhstan and the western parts of Mongolia. The easternmost records are from eastern Siberia (Sakha Republic) and Kamchatka. In Europe *A. serrata* occurs in the countries surrounding the Baltic Sea with the westernmost localities found in the northern tip of Denmark. These populations were for a long time believed to be separated from the main range of the species and are, in older literature, often regarded as a separate (sub)species *Aeshna* (*serrata*) *osiliensis* Mierzejewski, 1913. Recently however the species was found in the north of European Russia, suggesting it is present, albeit rare, in the areas between its Baltic range and its main range (Bernard & Daraz 2010). In the area discussed in this atlas the species is rare, being restricted to higher altitude with records from eastern Turkey (single old record at Lake Van), Georgia, Armenia and Kyrgyzstan. It is found at lakes and ponds often with larger reedbeds and favouring open, often steppe, landscapes.



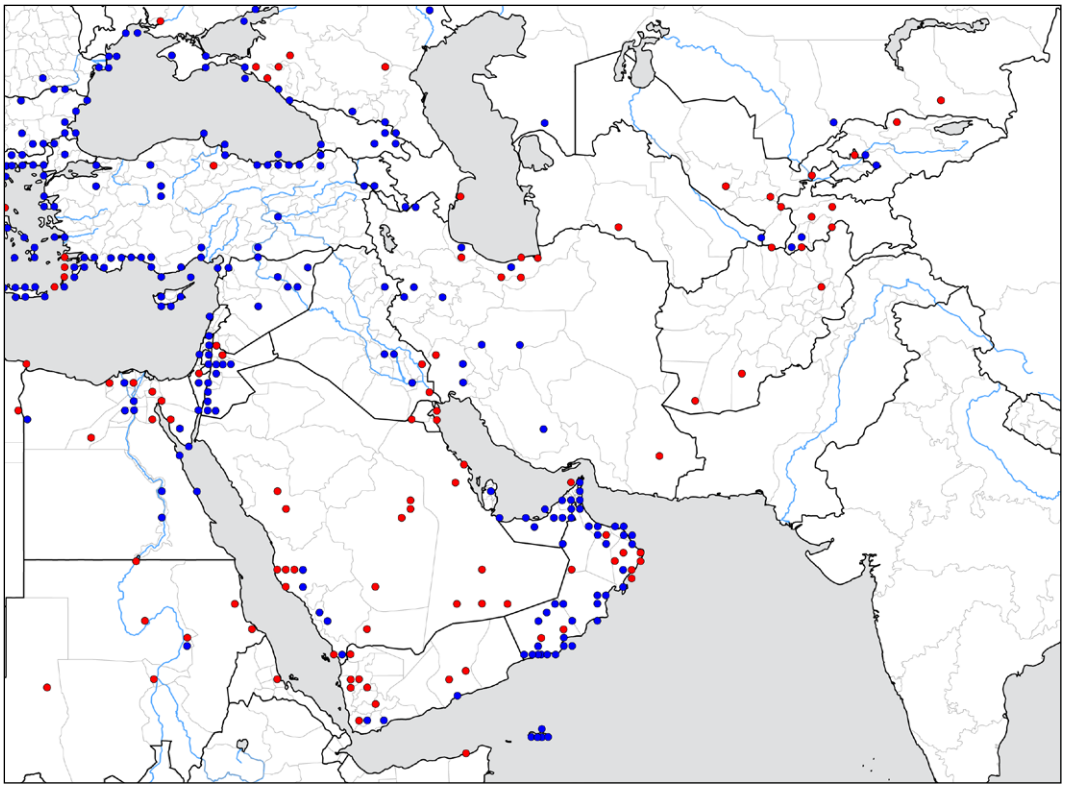
***Aeshna vercanica* Schneider et al. 2015 — Hyrcanian Hawker**

This is one of the most recently described species in the region and the Palearctic. It is related to *A. cyanea* and shares its hooked appendages in the males; however, it is much darker and has small paired blue spots on the abdomen. This south Caspian endemic seems to be restricted to the Hyrcanian mixed forest, along the northern slopes of the Alborz Mountains in the Golestān and Māzandarān provinces in northern Iran (Schneider & Ikemeyer 2019) and the Talysh Hills in southern Azerbaijan. This area forms a continuous mountain range along the southern edge of the Caspian that is relatively wet and forested. The species seems to prefer lower altitudes (< 700 m a.s.l.) where it reproduces in brooks (Schneider et al. 2015).



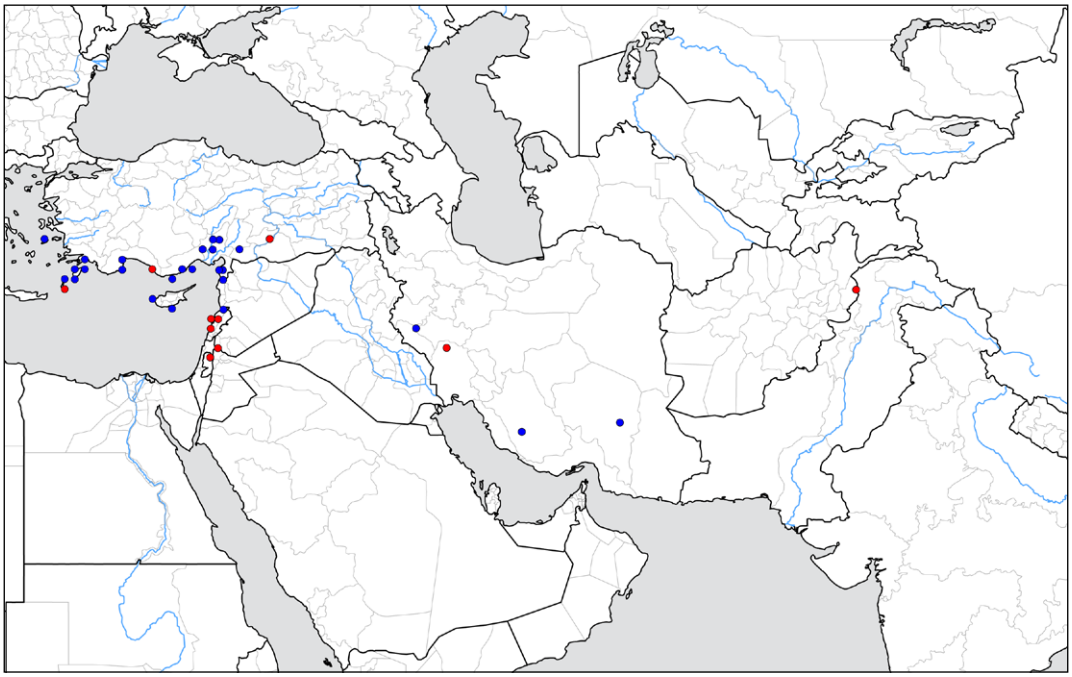
***Anax ephippiger* (Burmeister, 1839) — Vagrant Emperor**

The main range of this obligate migrant is found in Africa and the Arabian Peninsula from where large numbers regularly migrate northwards. Due to this, the species is found over large areas as a migrant often resulting in temporary established populations. Migrants have been found northwards to Iceland, eastwards to Thailand and Japan and westwards to the Caribbean, where it has been able to establish long lasting populations in the past decade (Hedlund et al. 2020). Due to this migratory behaviour it can be found throughout the region and in the more arid environments it is often one of the most regularly encountered species. The species has a very rapid larval development with larvae being ready to emerge only three months after oviposition. Due to this, temporary water bodies are suitable for reproduction. In these situations, the species is often the top predator as fish and amphibians are missing in such temporary habitats. This often results in mass emergence and in spring huge numbers cross into the Arabian Peninsula, the Levant, Central Asia and sometimes also Europe. The number of individuals involved in the migrations varies strongly between years, depending on winds and rainfall patterns. Following the spring migration in April to mid-June, a reverse southwards autumnal migration has been observed from late August to mid October in Central Asia (Borisov 2011a).



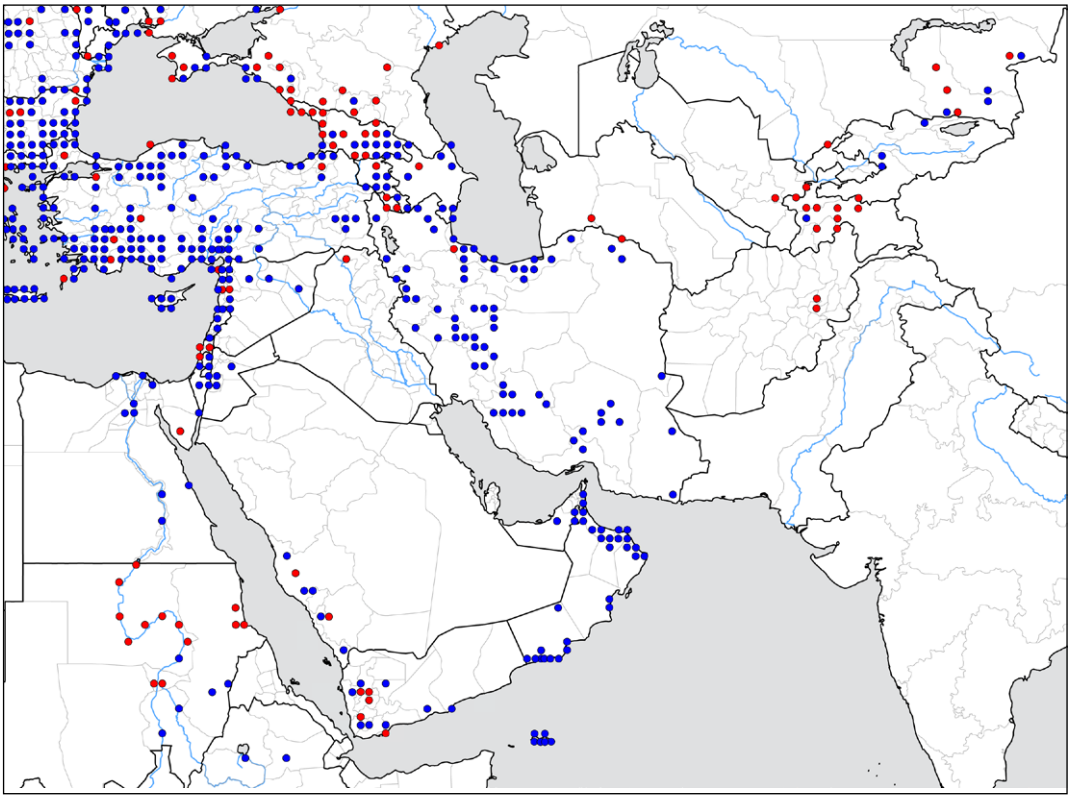
***Anax immaculifrons* Rambur, 1842 — Magnificent Emperor**

The range of the large and strikingly coloured *A. immaculifrons* extends from the Greek islands Ikaria and Karpathos, Cyprus, the Meditteranean coast of Turkey and the Levant to China in the east. The populations found east of the Indian subcontinent have a clearly different coloration being orange-brown instead of yellow and further morphological or molecular study might show these populations to belong to a different albeit closely related species. West of the Indian subcontinent the species is generally rare and apparently absent from large areas. In southern Turkey, Cyprus and the Levant it has a small but more or less continuous range. Between these populations and its occurrence in the Indian subcontinent only a handful records are known from the southern part of Iran. Thanks to the increased amount of fieldwork in Iran in the past decade we now know that this absence of records is not merely the result of a lack of fieldwork but that it is genuinely scarce between its Mediterranean populations and the populations in the Indian subcontinent. The species reproduces in running water usually in small to medium large rocky streams often at places which are difficult to access.



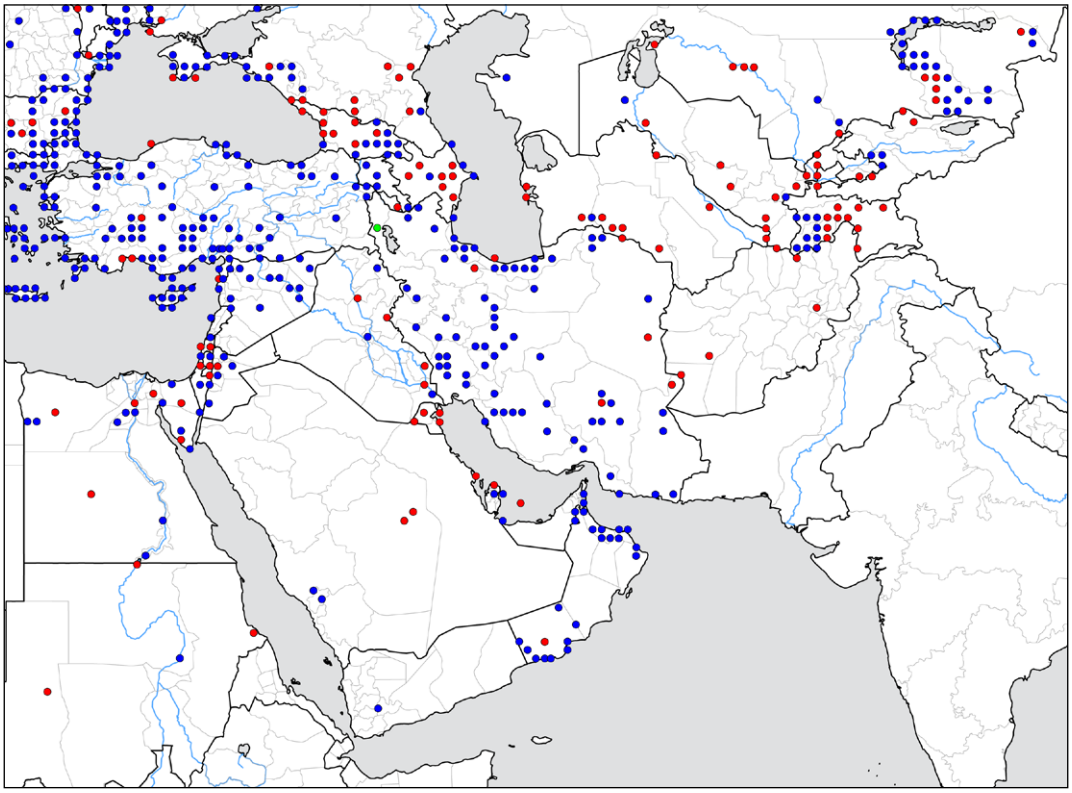
Anax imperator Leach in Brewster, 1815 — Blue Emperor

Anax imperator is widespread In Africa and Europe and occurs as far east as Central Asia in eastern Kazakhstan. In the region of this atlas it is only absent from the arid regions. It is a very conspicuous species and can occur at stagnant and in all but the fastest flowing waters. Unlike the usual European populations and those from West Asia, the populations from the south of the Arabian Peninsula show more colour variability with the thorax varying from dark brown (even darker than *A. parthenope*) to greenish brown and to green, which may make the identification of females against *A. parthenope* by sight difficult.



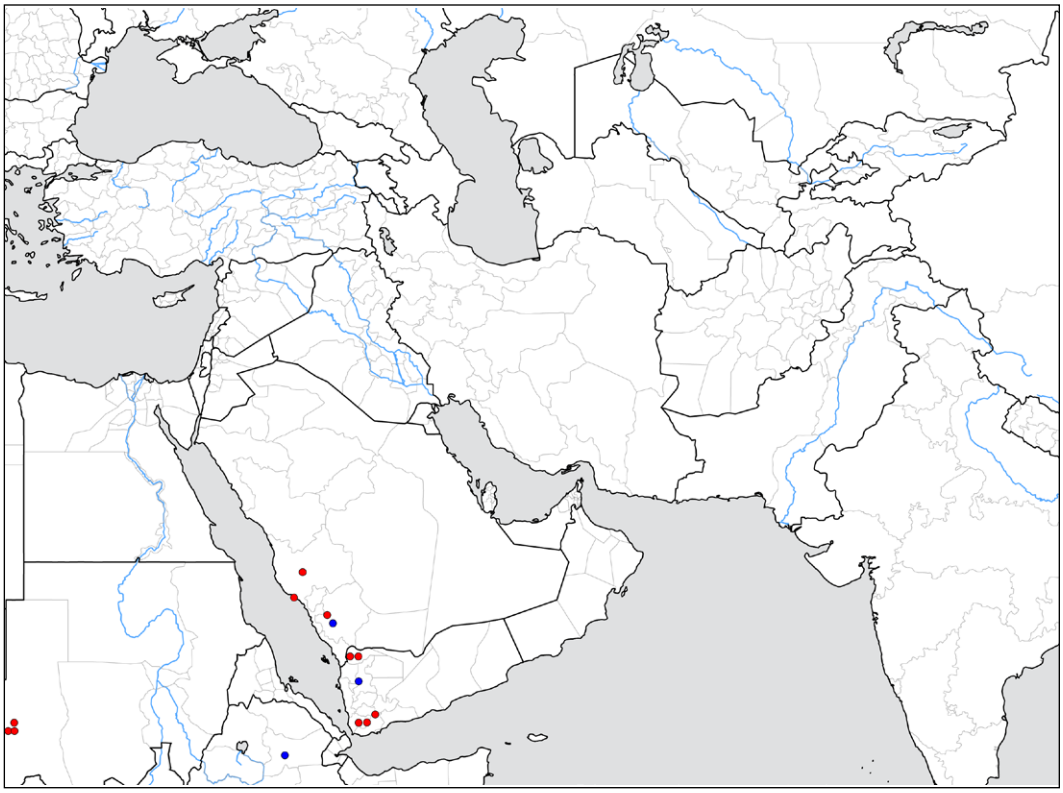
***Anax parthenope* (Selys, 1839) — Lesser Emperor**

This *Anax* species is widespread and generally common from western Europe and North Africa to Siberia, the Russian Far East and Japan. East of Lake Baikal the nominotypical subspecies, which nearly always has a brown thorax, is replaced by subspecies *A. p. julius* Brauer 1865, which has a green thorax and small structural differences in male appendages and is sometimes regarded as a full species. Larger standing waters and rice fields are important habitats but this species can also occur in slow flowing rivers and is tolerant of brackish waters.



***Anax speratus* Hagen, 1867 — Eastern Orange Emperor**

A primarily African species that is rather widespread in eastern and southern Africa and barely reaches southwest Arabia. It occurs in the Sarawat Mountains in the west of Yemen and Saudi-Arabia, which is not far from populations in Eritrea, Ethiopia and Somalia on the African side of the Red Sea. It reproduces in streams and stream fed pools. This species is probably restricted to this area which is very different from the rest of the Arabian Peninsula. It is a very conspicuous and unmistakable species. Males patrol the streams and are easily identified by their orange colour and their large size.

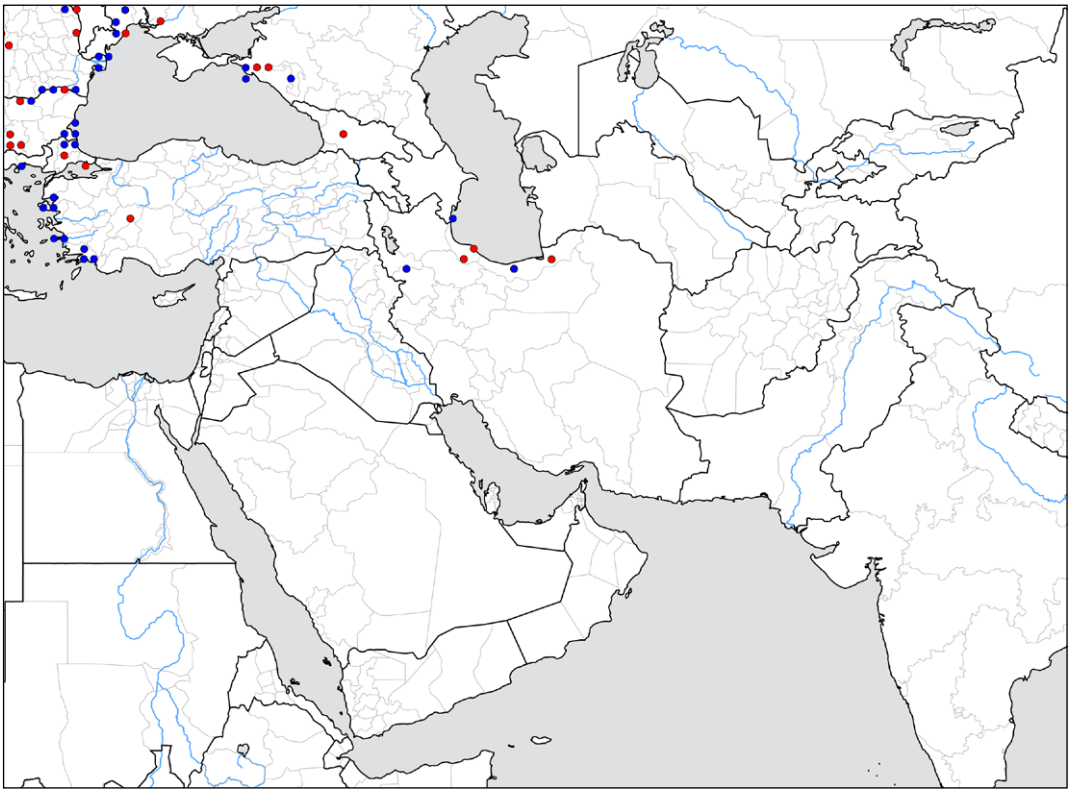


***Anax tristis* Hagen, 1867 — Black Emperor**

This species is known from one record from Oman in 1992 (Schneider & Dumont 1997). This was a vagrant from Africa where this very large dragonfly is widespread south of the Sahel; it probably does not occur in the Horn of Africa (Clausnitzer & Dijkstra 2005). The individual, which represents the only record, was seen in a group with *Tramea basilaris*, *T. limbata*, and *Anax ephippiger*, all species that often show vagrancy and migration, in a gravel desert with no water, strongly suggesting that they arrived from Africa as a result of a storm.

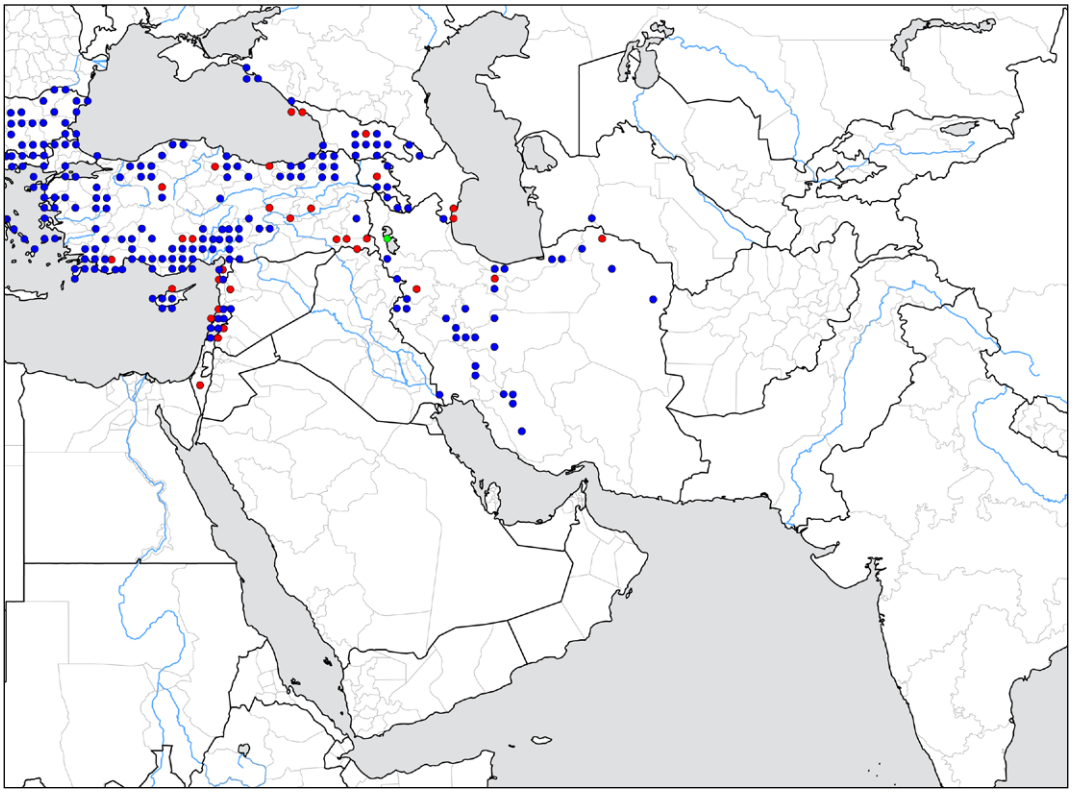
***Brachytron pratense* (Müller, 1764) — Hairy Hawker**

Brachytron pratense is primarily an European species ranging from Ireland and Iberia to European Russia. It only barely reaches Asia in western Turkey. It is also found in northern Iran and the South Caucasus countries. There is a single record from Georgia and Azerbaijan each, but several records are known from northern Iran, especially a small fringe along the Caspian Sea (Schneider & Ikemeyer 2019). This species occurs in well vegetated slow flowing or standing waters, primarily in ponds and marshes.

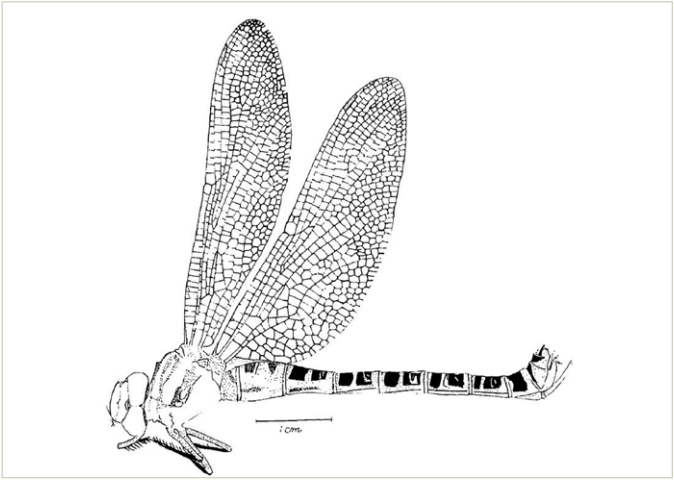


***Caliaeschna microstigma* (Schneider, 1845) — Eastern Spectre**

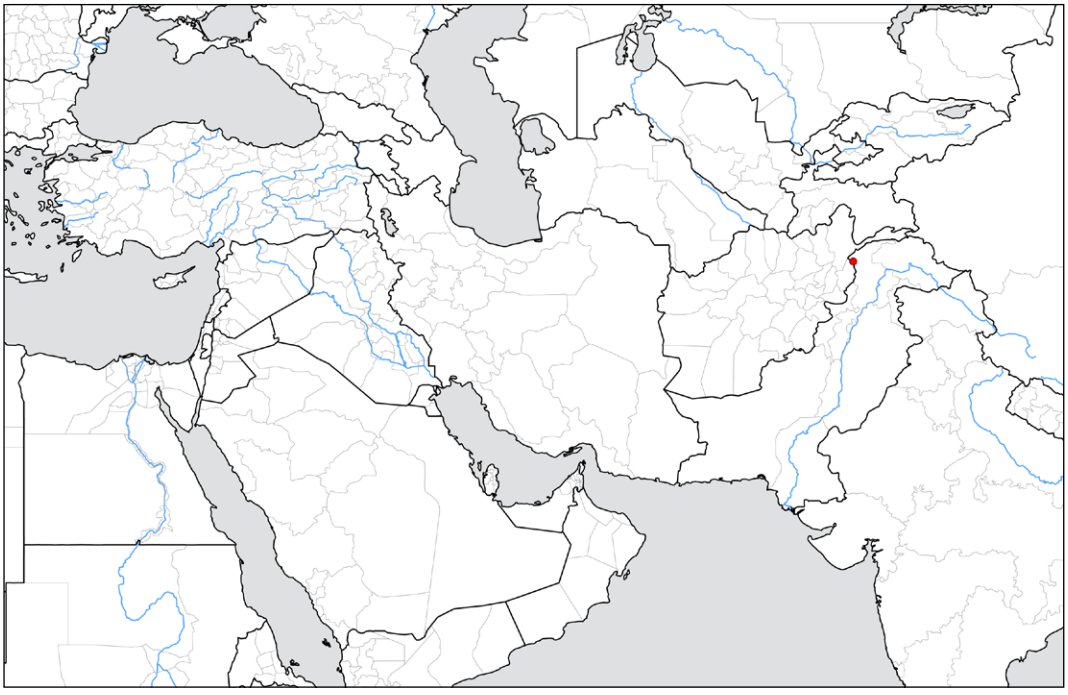
Caliaeschna microstigma has a comparatively restricted range, being found from southeast Europe and the coast of the Levant to the Caucasus and Iran. It is common in Turkey, the Levant, the South Caucasus countries and the western and northern parts of Iran, avoiding the desert parts. In Iran its range runs southeast through the Zagros Mountains and in the north of Iran eastwards through the Alborz Mountains to the Kopet Dag in the border area with Turkmenistan. The easternmost record is from near the border with Afghanistan, but further field work might show *Caliaeschna* to be present in Afghanistan. *Caliaeschna microstigma* is the only species in the genus *Caliaeschna* but it is close to the genus *Cephalaeschna* which is found eastwards from east Afghanistan. It inhabits shaded brooks and streams and is a crepuscular flyer avoiding open sunny parts.



***Cephalaeschna klapperichi* Schmidt, 1961 — Western Harvest-hawker**

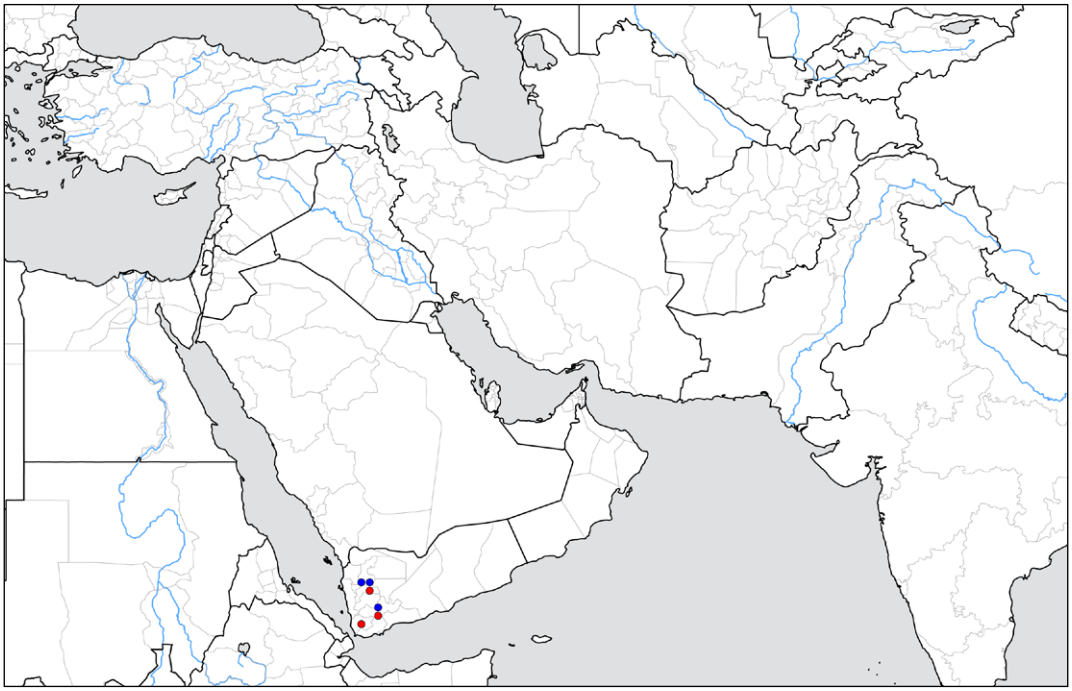


The genus *Cephalaeschna* contains 28 described species found in the Himalayan region and mountain ranges in China and Southeast Asia. In contrast to the closely related genus *Caliaeschna*, species of *Cephalaeschna* tend to occur at high altitude (generally above 1000 m) and fly mostly in autumn. *Cephalaeschna klapperichi* was described based on 2 males and one female from Nuristan in the east of Afghanistan not far from the border with Pakistan (Schmidt 1961). Its occurrence in western Nepal and northern India allowed Asahina (1981, 1983) to provide additional descriptions and figures. The border region between Afghanistan and Pakistan is poorly explored and, in combination with the late flight period of *C. klapperichi*, this makes it likely that the species is far more common than currently known. It is not unlikely that additional field work will show it to be present in a large part of Afghanistan. The currently available records range from 2600 to 3000 m a.s.l. and are from late summer up to mid autumn (27 July and 26 September). No information of habitat has been published but all species of *Cephalaeschna* occur at often stony brooks and there is no reason to assume that this is different for *C. klapperichi*.



***Pinheyschna yemenensis* (Waterston, 1985) — Yemen Hawker**

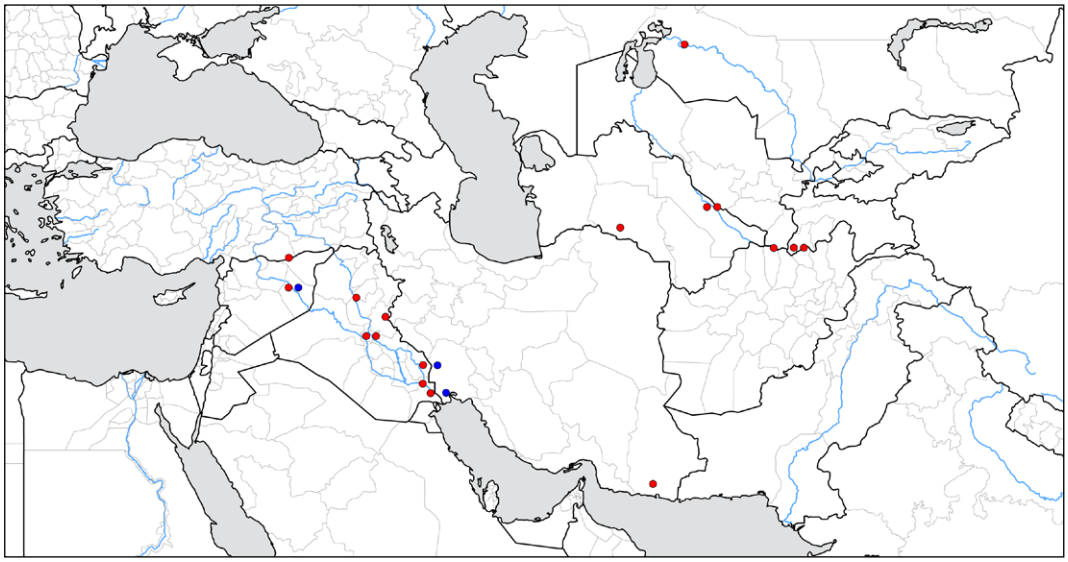
Pinheyschna yemenensis is among the least known species in the Western Palearctic with only seven or eight known localities, all in western Yemen, found between 1937 and 2007; it has not been recorded in the past 14 years. It was originally described in 1984 as an *Aeshna* but Peters & Theischinger (2011) erected the genus *Pinheyschna* in which this species and five other African species were placed. Most striking characters for this genus are the presence in the male of a strong tooth on the dorsum of segment 10 and a drawn out and often pointed genital lobe. Information on its habitat is limited. The species was found in mountains between 1890 and 2800 m a.s.l. at an 'artificial pond fed by waterfall' (Schneider & Nasher 2013) and a 'tributary of the Wadi Bana at Damt: richly flowing freshwater, locally lined by emergent macrophytes (*Typha* sp.)' (Dumont & Al-Safadi 1993). From the latter site it was stated that 'They patrolled the wadi banks in a typical *Aeshna* fashion, but without being strictly territorial'. Other species of *Pinheyschna* breed in streams (Dijkstra & Clausnitzer 2014) and it seems likely that the same is true for *P. yemenensis*. Records were made in February, May, June and October suggesting that the species is on the wing throughout the year.



Gomphidae
In the area covered by this atlas the family Gomphidae is represented by 16 species in 7 genera.

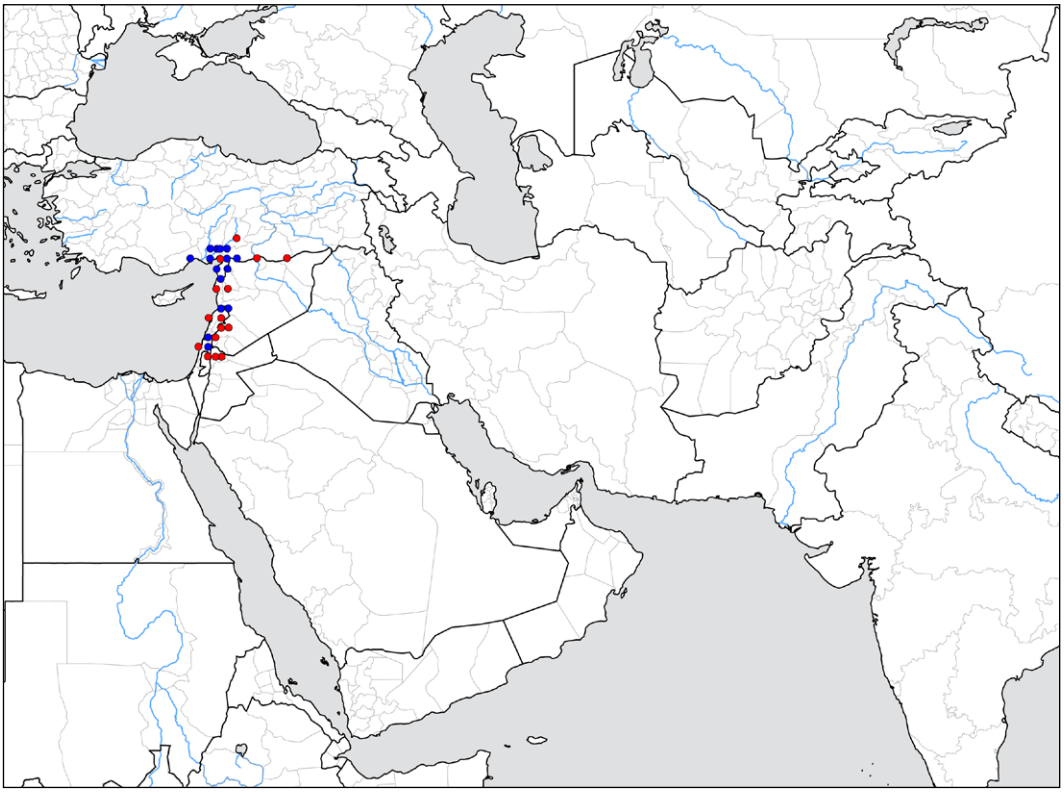
***Anormogomphus kiritshenkoi* Bartenev, 1913 — Sallow Clenchtail**

Anormogomphus kiritshenkoi is one of the least known dragonfly species in the region. Worldwide only 29 records from 23 localities are known for this species, which is, at least partly, the result of its pale coloration which makes it difficult to spot. In addition, its weak flight is never sustained thus making observations difficult (Schneider & Ikemeyer 2019). Based on the limited number of records available, the range of *A. kiritshenkoi* stretches from southeastern Turkey (Börzsöny 1996, one locality only), and Syria to Pakistan and India in the east. The northernmost locality is known from south Kazakhstan at the former mouth of the Syr Darya River (one male from the surroundings of Kazalinsk) (Borisov & Haritonov 2008). Large populations were reported from the lower Tigris River in Iraq (Morton 1919, 1920a, b, 1921) and recently it has been found in the adjacent parts of southwestern Iran (Schneider & Ikemeyer 2019). The southernmost point of the range is on the coast of Makran (Fraser 1934), although no information is known of the precise locality. The species is confined to large rivers like the Tigris and Euphrates in the arid zone where it favours the flood zone with sparse vegetation. The larvae live buried in sandy or muddy riverbeds. They were found in large numbers in the Karakum Canal in the vicinity of Ashgabat (Turkmenistan) in the 1990s (Borisov 2008).



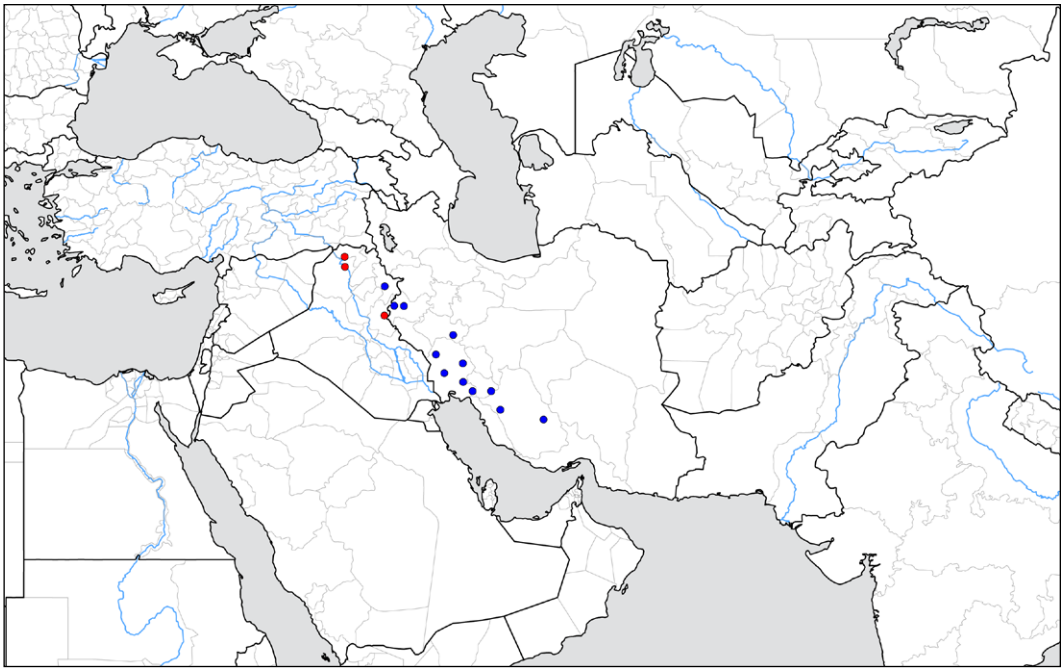
***Gomphus davidi* Selys, 1887 — Levant Clubtail**

Gomphus davidi is largely restricted to the Levant occurring from Jordan, the West Bank and from Israel to Lebanon, Syria and southern Turkey. Most records are from the Mediterranean coast although one record from Dadat on the Sajur river by Schmidt (1954b) in northern Syria and another, more to the east, from Ras al Ayn (1986-1989) (unpublished data Wolfgang Schneider) shows that the species also occurs at more inland localities. From northern Iraq eastwards the species is replaced by its close relative *Gomphus kinzelbachi* with which it is not known to overlap. *Gomphus davidi* reproduces in streams and rivers, and has also been recorded breeding at a large residual pond just below a large dam in Antakia province in southern Turkey (unpublished data Jean-Pierre Boudot).



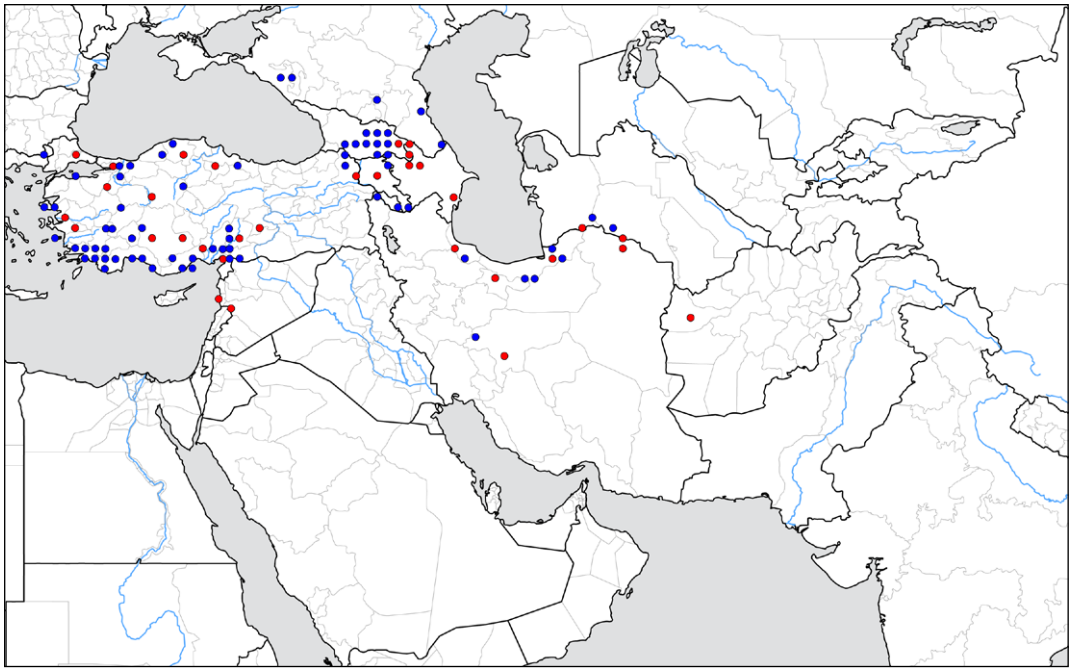
***Gomphus kinzelbachi* Schneider, 1984 — Zagros Clubtail**

Gomphus kinzelbachi is a West Asian species which replaces *Gomphus davidi* to the east of the Syrian-Iraq border. It is found along streams, brooks and rivers and is in southwestern Iran mainly found at streams and rivers surrounded by alluvial forest (Schneider & Ikemeyer 2019). Its range runs through the Zagros Mountains from the north of Iraq to southwest Iran being found at elevations between 50 and 1450 m a.s.l. Along smaller mountain streams in Iran, the species prefers slow-flowing waters shaded by willows on river banks where the adults can be seen resting on twigs. Its tolerance to changes in river system, for instance the construction of dam, seems lower than that of *G. davidi*. The species was poorly known until 2017 when the adults and larvae were (re)described, habitat information became available and several new records were known through the publications of Schneider et al. (2017a, 2017b, 2018b). These records together with photographic evidence from northern Iraq (Nature-Iraq association) suggest its range to be around 130,000 km^2. In 2006 the species was listed as Data Deficient on the IUCN Red List but with the new distribution information and its apparent dependence on pristine flowing water systems the species may qualify for one of the threatened categories.



***Gomphus schneiderii* Selys, 1850 — Turkish Clubtail**

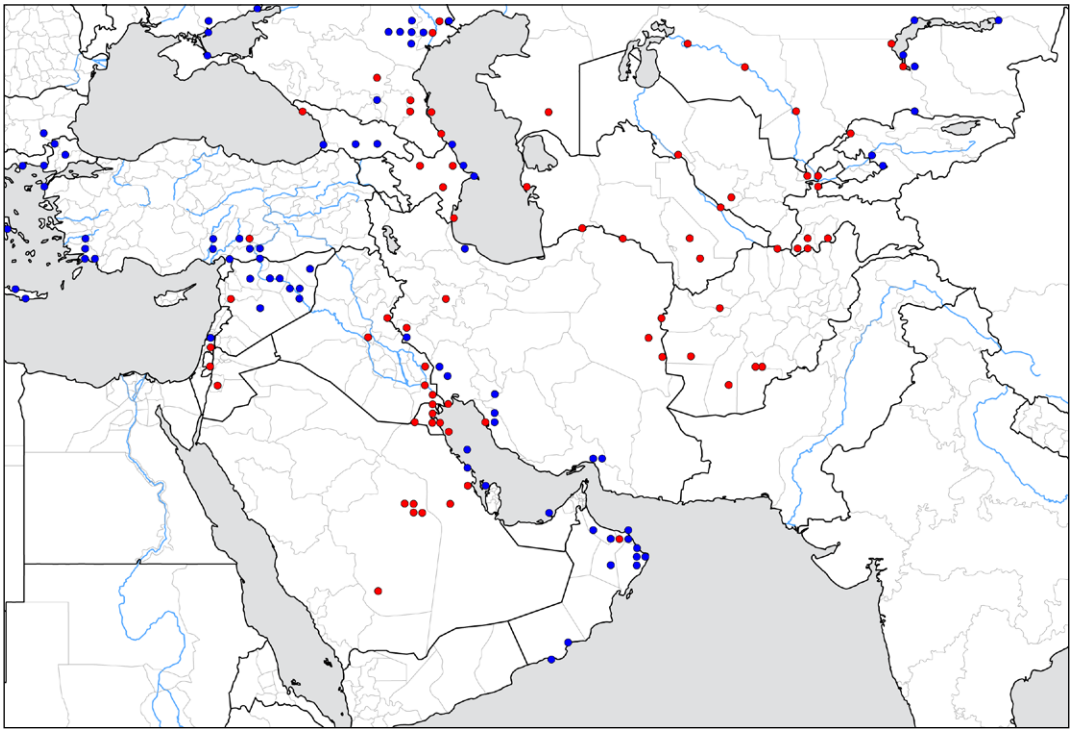
The range of *Gomphus schneiderii* extends from the southern Balkans (De Knijf et al. 2013) through Turkey and the South Caucasus countries to the border area of Iran with Turkmenistan. The species is fairly common in southwest Turkey (Kalkman 2006) but absent in most of eastern Turkey and occurring again in the very northeast of the country (Kars province). The latter populations are well connected with those in Armenia, Azerbaijan and Georgia, where it is notably common and widespread in central and eastern Georgia. In Iran, *G. schneiderii* is rare and mainly found in the Alborz Mountains in the north of the country, whereas it is largely absent from the Zagros range in the west (Schneider & Ikemeyer 2018). In the Turkmen part of the Kopet Dag, *G. schneiderii* ranges marginally into Central Asia (Borisov & Haritonov 2008), whereas the record of two males and two females from Herat on the western spurs of the Hindukush range in Afghanistan marks the species' easternmost range limit (Schmidt 1961). The latter specimens were described as *G. amseli* by Schmidt (1961) but further study is needed to decide on its taxonomic status. The species prefers shaded small rivers, streams and brooks in forested environments. The adults are mostly seen resting on branches and leaves near the waterside.



***Lindenia tetraphylla* (Vander Linden, 1825) — Bladetail**

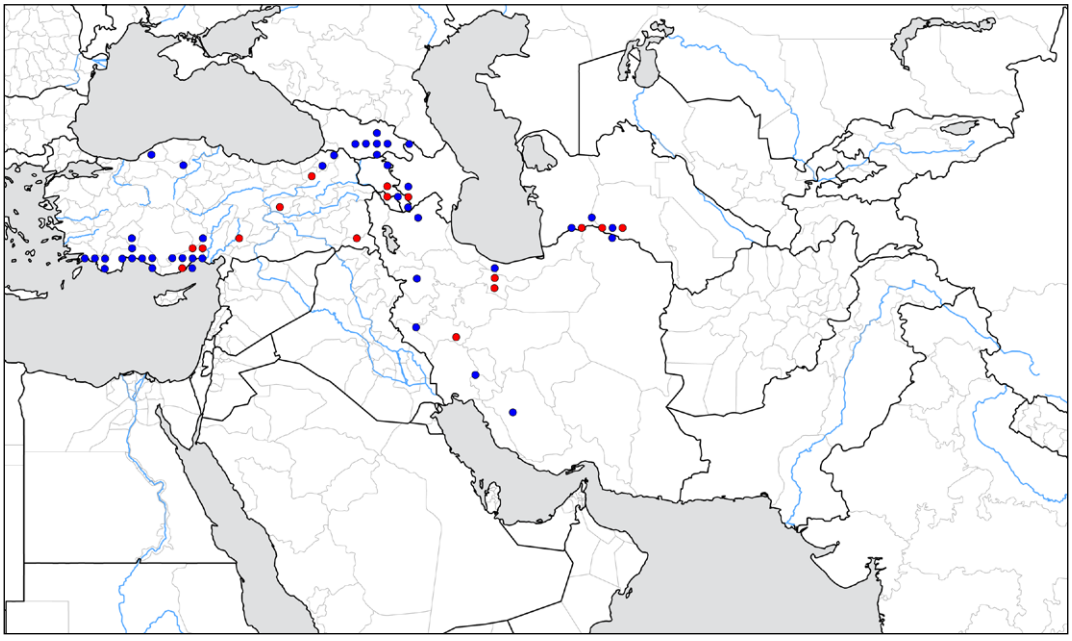
The main range of *Lindenia tetraphylla* is found in West and Central Asia from where the species extends west well into the Mediterranean where it is widely distributed in the Balkans (De Knijf et al. 2013) and Italy and extends to the Maghreb and formerly to Spain. Although its range is extensive, it is uncommon in large areas with breeding often limited to a few large lakes or river systems, especially in Europe. The species is present in much of the area discussed in this atlas but is most common in northern Oman, along the Persian Gulf and further along the Euphrates and Tigris Rivers in Syria and in southern Turkey. This pattern cannot be explained by differences in the amount of field work as it was found several times in Syria, which is poorly explored, while relatively few records are available for the rather well explored Iran (Schneider & Ikemeyer 2019). The species seems to be absent along the western part of Saudi Arabia and Yemen and most of Turkey. *L. tetraphylla* is the only gomphid known to migrate (Schneider 1981) and it cannot be ruled out that many of the records concern vagrant individuals.

The species breeds in large stagnant waters, but also in slow-flowing rivers and its residual pools and even in temporary ponds in both freshwater and brackish waters (Schorr et al. 1998, De Knijf et al. 2013). The species seems to benefit from the construction of new man-made reservoirs which it rapidly colonizes thanks to its nomadic behaviour. This is evidenced by the findings of adults and exuviae in Crete, an island where no gomphid was known before the construction of reservoirs (Brochard & van der Ploeg 2013, Boudot 2014).



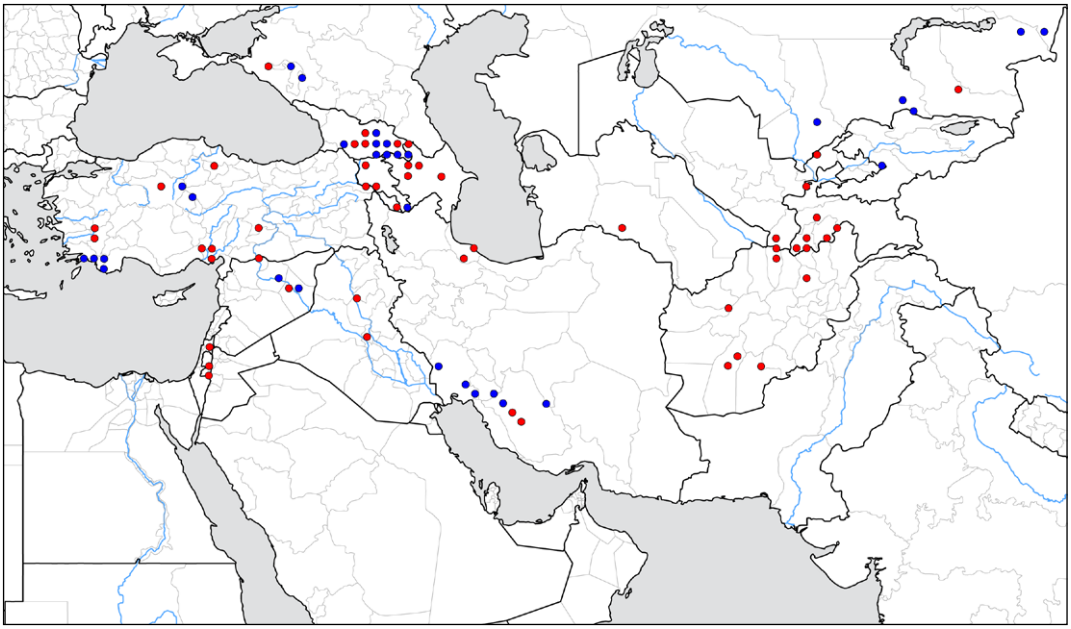
***Onychogomphus assimilis* (Schneider, 1845) — Dark Pincertail**

Onychogomphus assimilis has a comparatively small range from Turkey in the west across the South Caucasus to the Iranian plateau and the Kopet Dag Mountains in Turkmenistan. This species is globally threatened (IUCN) and remains scarce and local over much of its range. In Turkey it was widespread and fairly common along the western and central parts of the Taurus Mountains (Kalkman 2006) but many river systems have suffered from strong degradation during the three last decades (pollution, extraction of sediment from the river bed), leading to the decline of several populations. Recently discovered populations in northern Turkey (Ikemeyer & Olthoff 2013) suggest that the species might be more widespread along the Pontic Mountains than presently known. In the South Caucasus, *O. assimilis* is widespread and common on rivers and streams in eastern Georgia (Schröter et al. 2015), but seems to be rare in Armenia (Ananian 2012) and Azerbaijan (Snegovaya 2019, 2021). In Iran it seems to be restricted to the Zagros and Alborz ranges (Schneider & Dumont 2015, Schneider et al. 2018). In Turkmenistan *O. assimilis* appears to be locally very abundant in the catchment area of the Sumbar river in the Kopet Dag Mountains (Dumont et al. 1992). Throughout its range the species prefers rather fast-flowing and cool rivers with wooded banks typical of middle stretches of rivers running through forested foothills of mountain ranges.



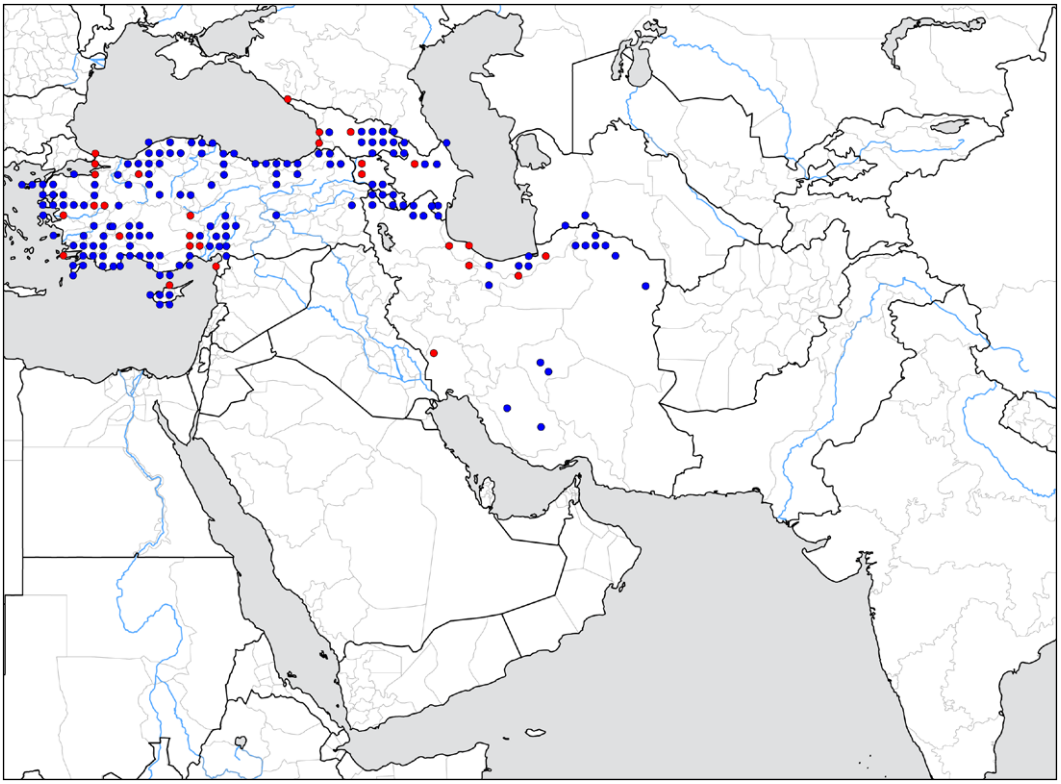
***Onychogomphus flexuosus* (Schneider, 1845) — Waved Pincertail**

This gomphid occurs from western Turkey and the Levant to Central Asia and is generally scarce and local. Most of the recent Turkish records are from Mugla province (Kalkman 2006). In Iran it is mainly known from a few large rivers draining the western slopes of the Zagros range, such as the Marun and Zohreh (Schneider et al. 2018). More sites are known from southern Tajikistan, Afghanistan and to a lesser extent also from Uzbekistan and Kyrgyzstan. Outside our region it is present in the Kuban river basin in southern Russia (Shapovalov & Korotkov 2019) and in eastern Kazakhstan. In Georgia it is common and widespread in the Kura and Alazani river catchment (Schröter et al. 2015). The species prefers lower stretches of large rivers with high loads of sediment. These rivers have a nival discharge regime, with large sand deposits. Such sandy rivers are also preferred by *Stylurus ubadschii* with which it regularly co-occurs. Such rivers may hold very large populations, resulting in thousands of exuviae per 100 m shoreline (unpublished data Asmus Schröter). Males do not perch on river boulders to grasp females, and mating takes place away from the river (Schröter et al. 2015, Seehausen et al. 2016). This very loose attachment to water in males as well as the mating behaviour with rendezvous places in the open landscape, make this species rather problematic for systematic recording and status assessment.



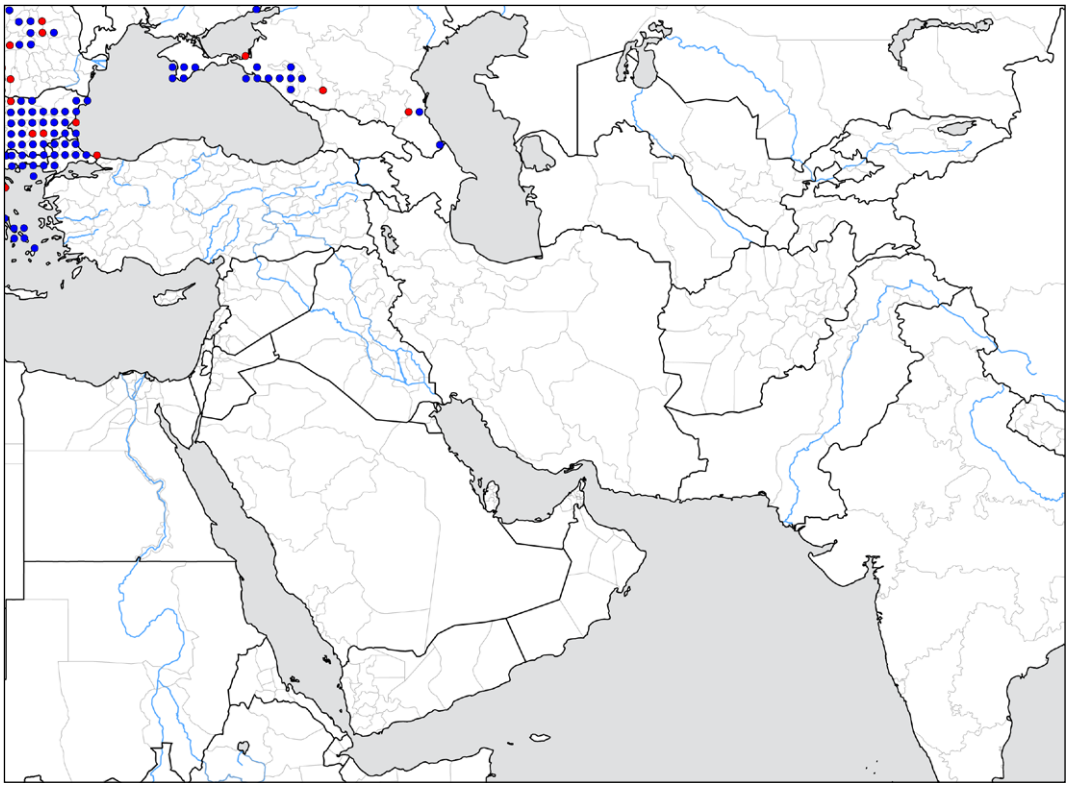
***Onychogomphus (forcipatus) albotibialis* Schmidt, 1954 — Eastern Small Pincertail**

This taxon, which is generally regarded as an eastern subspecies of *O. forcipatus*, ranges from the Eastern Aegean Greek islands, Cyprus, Turkey to the South Caucasus, northern Iran and as far east as the Kopet Dag Mountains in Turkmenistan and is widespread. In addition, there are a few records from the Zagros Mountains in the southern part of Iran, where the species occurs locally and sympatric with the closely related *O. lefebvrii*. The latter also replaces *O.* (*forcipatus*) *albotibialis* in the Levant and southeastern Turkey.



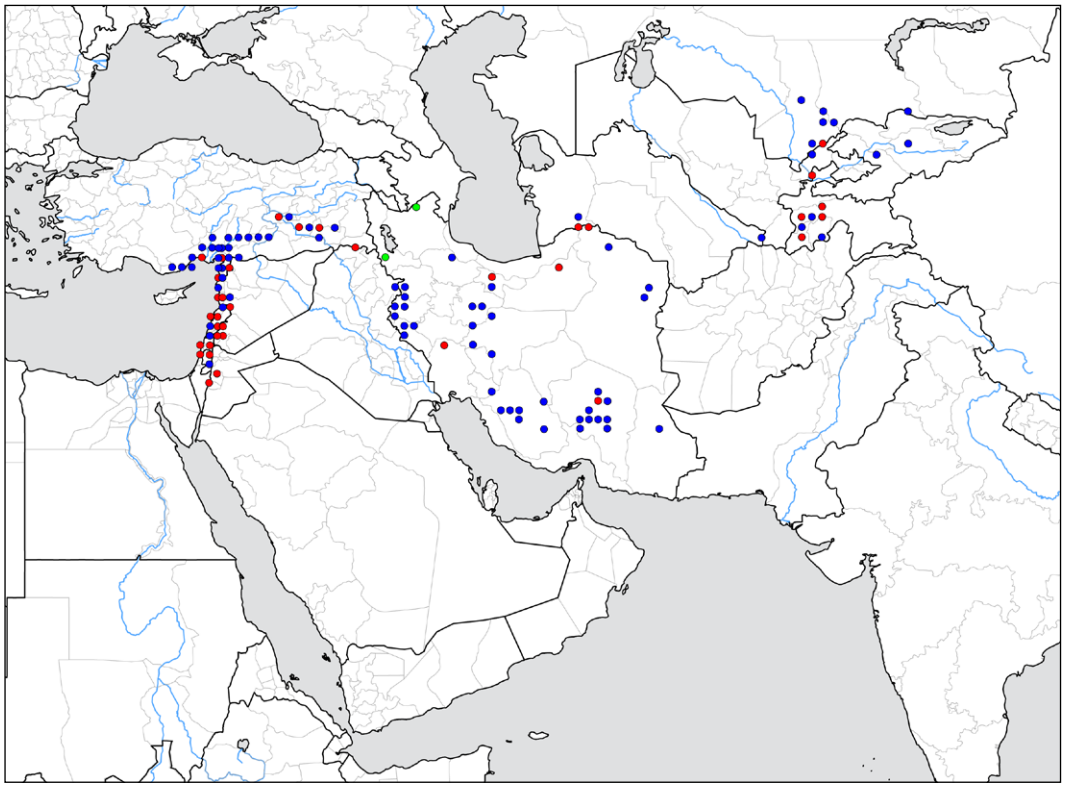
***Onychogomphus (forcipatus) forcipatus* (Linnaeus, 1758) — Small Pincertail**

Onychogomphus (forcipatus) forcipatus is widespread in Europe and reaches eastwards through Russia into Kazakhstan. It also occurs in Greece and in European Turkey. No population is known from the Asian part of Turkey but in the BMNH, there is one specimen from the Asiatic part of Istanbul 'Kücüksu on the Asiatic side of the Bosporus, Leg. M. Burr, 27 June 1946'. This is likely a vagrant from the nearby European part of Turkey where this taxon is common. This (sub-) species tends to be darker than *O.* (*forcipatus*) *albotibialis* but the only reliable trait is in the shape of the subterminal knob of the lower appendage. This character is slightly variable for which reason it is best to check several specimens within every population in order to distinguish between *forcipatus* and *albotibialis*. The identification of an isolated individual animal is therefore often not possible making the correct identification of the specimen found in the Asiatic part of Turkey problematic.



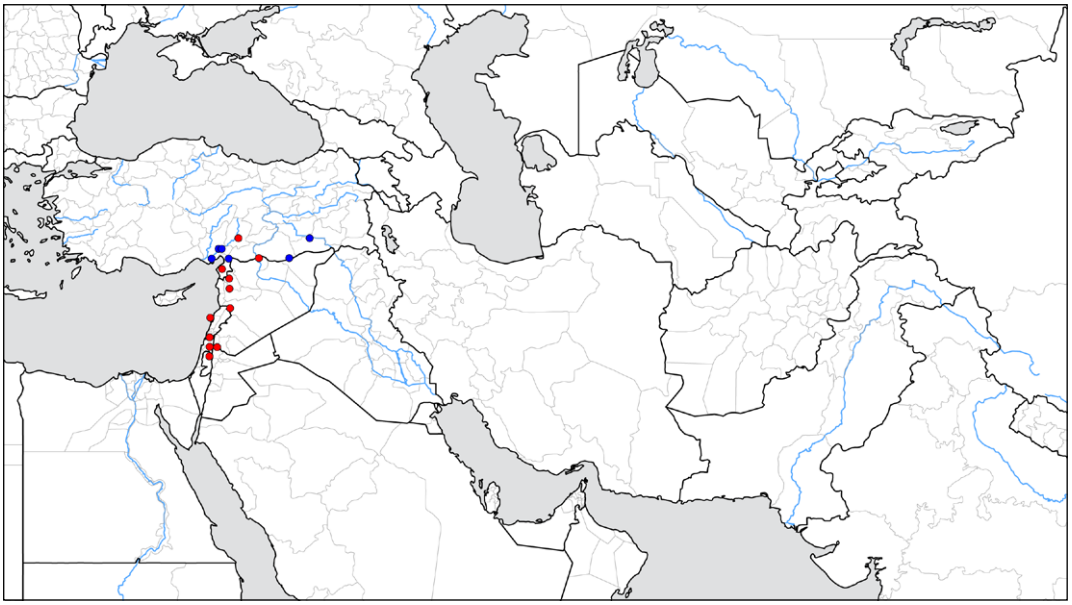
***Onychogomphus lefebvrii* (Rambur, 1842) — Pale Pincertail**

Onychogomphus lefebvrii is widespread and not uncommon in much of its range, which extends from the Levant and southeast Turkey across Iran (Kalkman 2006, Schneider et al. 2018) to Central Asia. *Onychogomphus lefebvrii* is found in Central Asia in western Tajikistan and in parts of the Turkmen Kopet Dag (Dumont et al. 1992, Borisov & Haritonov 2008). Its discovery in Kyrgyzstan and, more recently, in the adjacent regions of Kazakhstan (Schröter 2010b, Borisov & Kazenas 2017) suggest that *O. lefebvrii* is more widespread in the Syr Darya watershed than previously believed. Two records from northwestern Iran are doubtful and probably based on confusion with *O.* (*forcipatus*) *albotibialis*. The occurrence of *O. lefebvrii* in eastern Iran and in southern Tajikistan makes it likely that the species also occurs in Afghanistan.



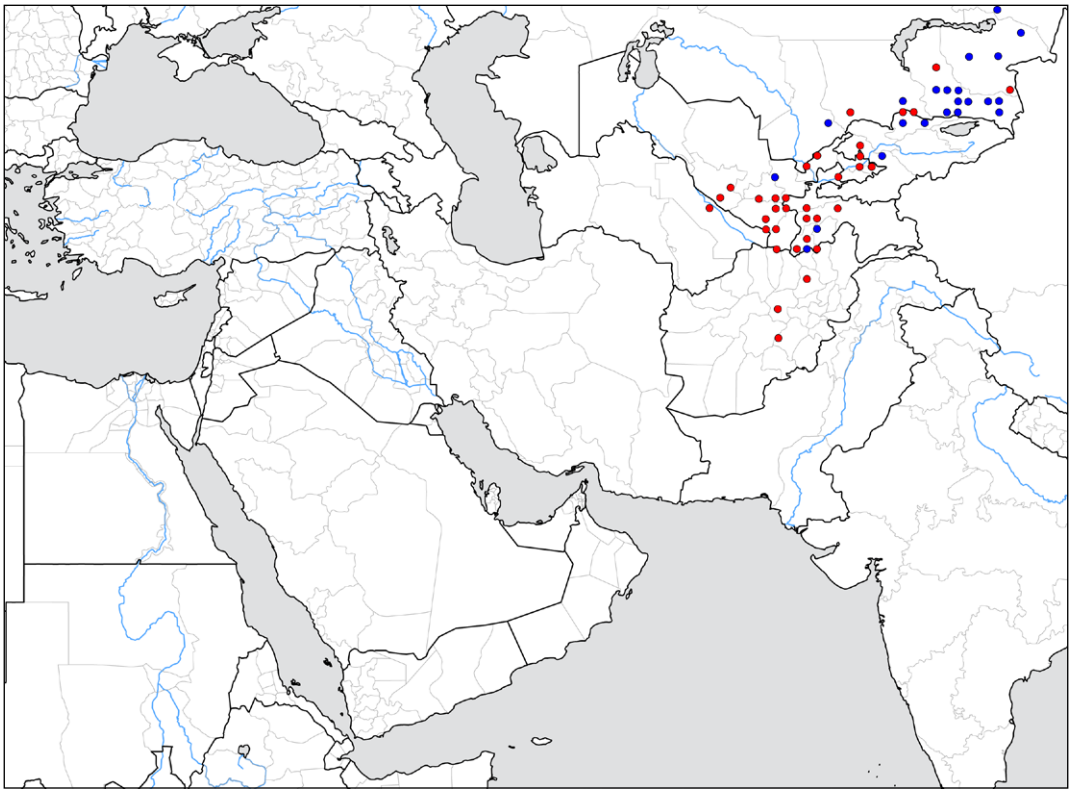
***Onychogomphus macrodon* Selys, 1887 — Levant Pincertail**

Onychogomphus macrodon is an East Mediterranean endemic ranging from southern Turkey to the Jordan Valley, the north of Israel and Jordan. Very little information was known about this species prior to the papers of Schneider (1986, 1987) on the Levant and the publication by Schneider & Schneider (2010) on Turkey. *O. macrodon* is restricted to large rivers and has strongly declined in recent years due to the continuous degradation of rivers throughout its range. This degradation is caused by a combination of decreased water quality, changes in river regime and structure brought about by the construction of dams, other building activities and gravel mining. Since 1990 this species has only been recorded from four river systems. One in Syria, with one record somewhere in the period 1990-1995 near Ras al Ayn at a tributary of the Euphrates River. Three are from Turkey, Batman river near Batman (2010); Kamislar village near the Kurusu river (2003) (Salur & Kiyak 2006) and the Ceyhan (1994, 2000, 2001, 2009, 2013). The scarcity of records can at least partially be explained by the fact that these larger rivers are not always the easiest or most interesting places for field work on dragonflies. In addition, this species' sandy colouration means it could easily be overlooked. Nonetheless, the strong negative human impacts on its habitat, its relatively small range, the fact that most records are old and no protection measures are taken makes this species a good candidate for extinction in coming decades.



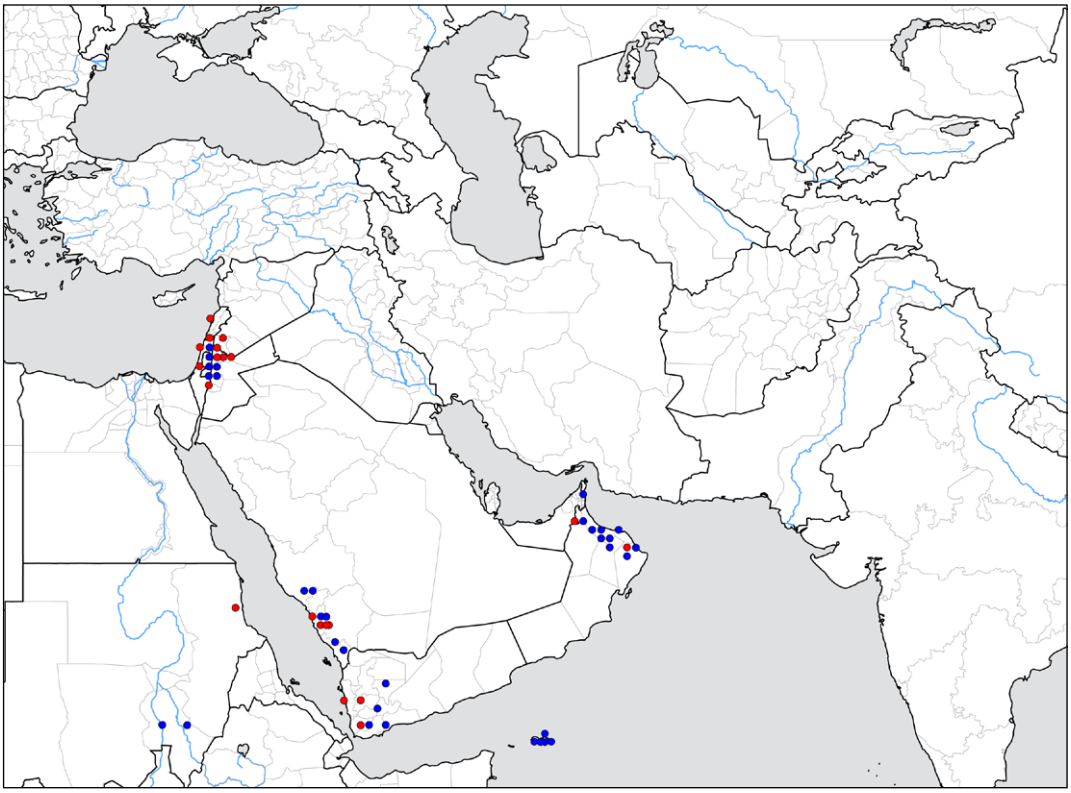
***Ophiogomphus reductus* Calvert, 1898 — Pale-green Snaketail**

The range of *O. reductus* extends from Mongolia and northwestern China through eastern Central Asia south to Afghanistan, northern Pakistan and northwestern India. *Ophiogomphus reductus* is a typical species of the mountainous areas in this region where it inhabits small rivers and streams fed by snow or groundwater in the Tian Shan and Pamir-Alay Mountains. The species is most numerous on the foothill plains, where it is mainly found in the artificial streams of irrigation systems, canals and irrigation ditches. Although mainly found in mountainous landscapes, the westernmost localities in Turkmenistan and Uzbekistan are from a rather flat and more arid region. *Ophiogomphus caudoforcipus* Yousuf & Yunus, 1977 only known from the male holotype from northern Pakistan was recently shown to be a synonym of *O. reductus* (Kalkman 2021).



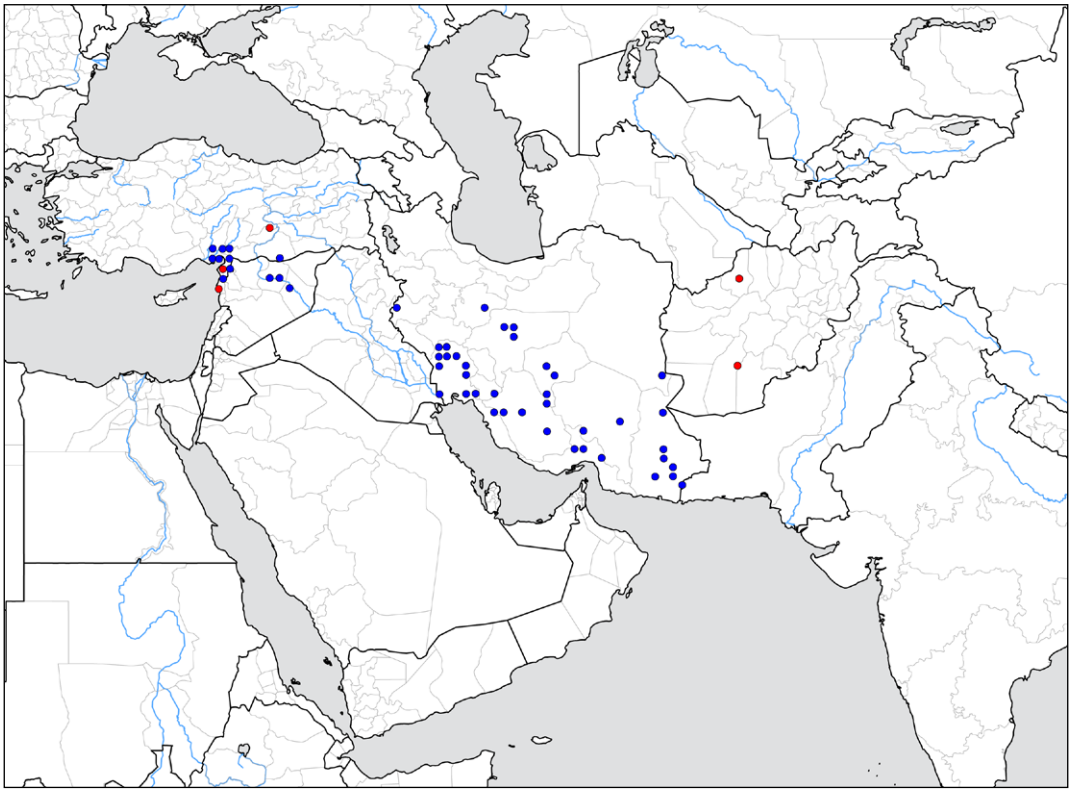
***Paragomphus genei* (Selys, 1841) — Common Hooktail**

Paragomphus genei is primarily an Afrotropical species widespread south of the Sahara and showing a disjunct range north of the Sahara in Morocco, Algeria and Tunisia. *Paragomphus genei* is also present in the south of Europe in Portugal, Spain, Sicily, Sardinia, Corsica and in the south of mainland Italy. In West Asia the species is found in the Levant from central Lebanon and western Syria into Israel, Jordan and the West Bank. In addition, *P. genei* occurs along the coastal mountains of Saudi Arabia well into Yemen and is also present on the Yemeni island of Socotra and in the Hajar Mountains in northern Oman and the United Arab Emirates. This species reproduces in wadis, rivers, and irrigation channels but also in man-made ponds created for livestock and large dams and lakes.



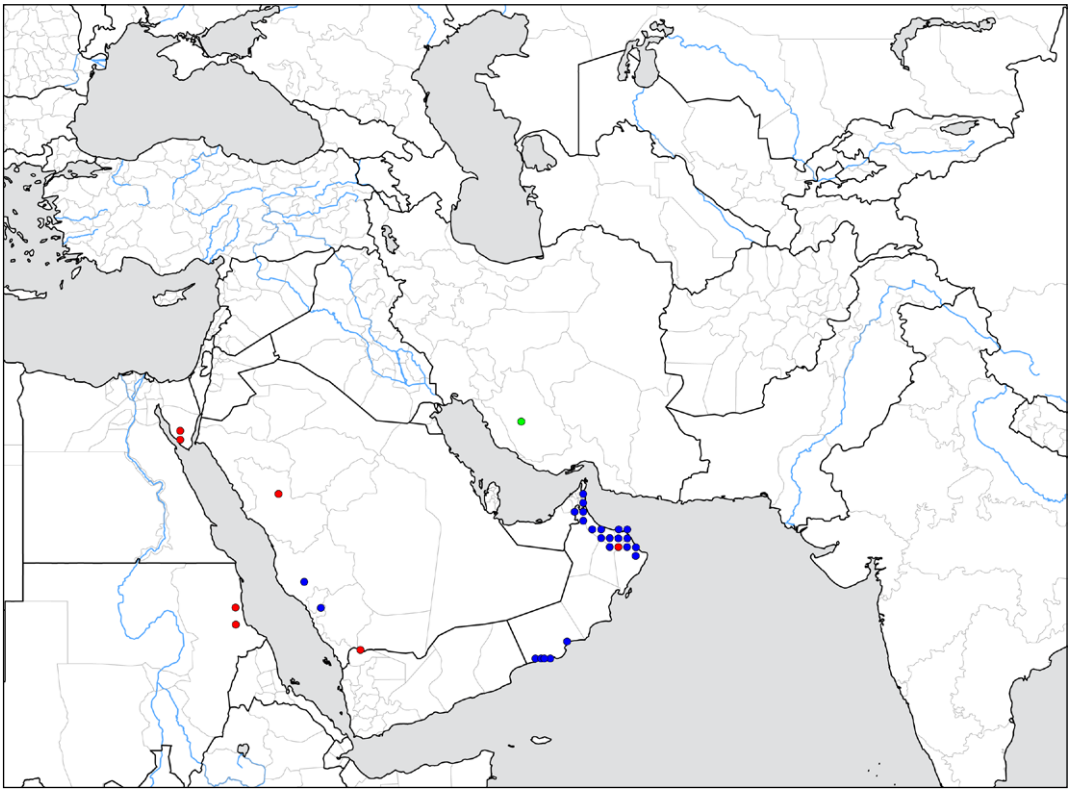
***Paragomphus lineatus* (Selys, 1850) — Lined Hooktail**

Paragomphus lineatus is an Oriental member of this genus and is widespread and common throughout large parts of northern India, Nepal and Pakistan. To the west its range extends across Afghanistan and Iran to the region of the Adana delta in Turkey. The species is common in the southern half of Iran and moderately common in parts of Syria and Turkey making it likely to be present in northern Iraq as well. In the Levant it replaces *P. genei* north of Lebanon, in northern Syria and southern Turkey. It occurs at a wide variety of standing or slowly flowing waters including streams, canals and ditches.



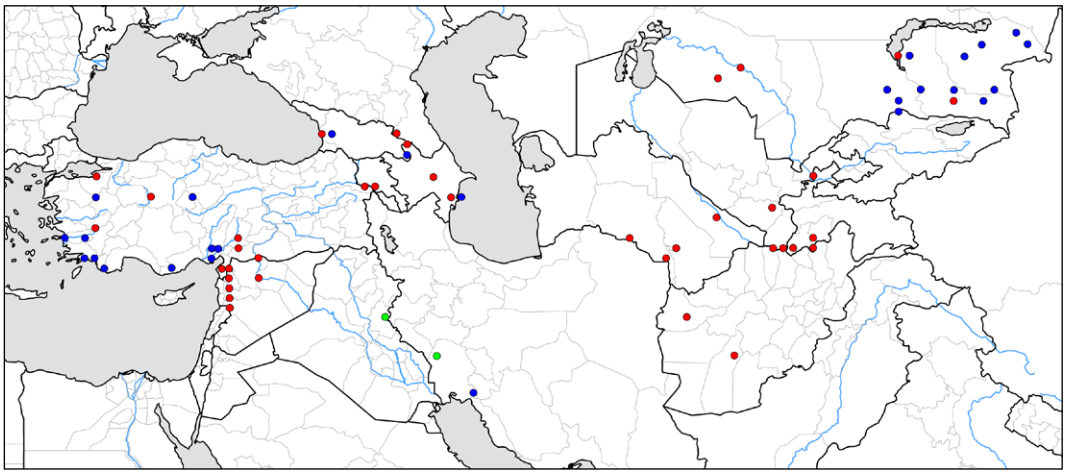
***Paragomphus sinaiticus* (Morton, 1929) — Desert Hooktail**

Paragomphus sinaiticus has a remarkably fragmented range and is outside our region known from a series of mountains in the Sahara in Niger (Aïr mountains), Chad (Tibesti), and eastern Sudan (Red Sea Hills). In our region it is found in the Sinai Peninsula, at several localities along the Red Sea coastal mountains in southwestern Arabia, in the Dhofar region of Oman and in the Hajar Mountain range of northern Oman and the United Arab Emirates where it was found to be common. It is possible that more field work along the Red Sea in Saudi Arabia might show the species to be common there as well. A record published from Iran by Sadeghi & Mohammadalizadeh (2009) requires confirmation as it might refer to confusion with *P. lineatus* (Schneider & Ikemeyer 2019). P. sinaiticus is found in slow flowing streams and pools in riverbeds from just a few meters wide to 40 × 500 m in size (Lambret et al. 2017).



***Stylurus ubadschii* (Schmidt, 1953) — Syrian Clubtail**

Until recently both this species and its close relative *S. flavipes* were considered to belong to the genus *Gomphus* but recent molecular analysis (Ware et al. 2017) confirmed the placement of *S. flavipes* in the predominantly Nearctic genus *Stylurus*. Adults are generally difficult to observe, spending much of their time away from the water. This results in fewer records referring mostly to single imagines or exuviae only. It is, therefore, considered to be one of the least known species in our area. It occurs from western Turkey, the Levant across the South Caucasus countries to Central Asia. Very few observations have been published since 2000; no recent record is available from the Levant or from large parts of Central Asia. In the South Caucasus it occurs along the Alazani and Rioni Rivers in Georgia, but again, has not been seen since 1950 in Armenia (Tailly et al. 2004). In addition to old larval records from Azerbaijan (Kasymov 1965), recent exuviae have been recorded from the Alazani River and a record of a single male at the lower Kura River has just been published (Snegovaya 2021). Onishko & Kosterin (2021) include images from the northern Caucasus (North Ossetia) showing either *S. flavipes* or *S. ubadschii* but study of material is needed to determine which of these two species occurs on the northern side of the Caucasus. Apart from doubtful reports from the first half of the 20th century, only one well documented record of six males from the Zohreh River near its outflow into the Persian Gulf is available from Iran (Schneider et al. 2018). Even taking account of the poor quality of data over a very large range, it seems very likely that *S. ubadschii* has undergone a strong decline during recent decades as its habitat, large sandy lowland rivers, are under severe pressure throughout its range, due to large scale irrigation schemes, hydro-engineering, pollution and overexploitation.

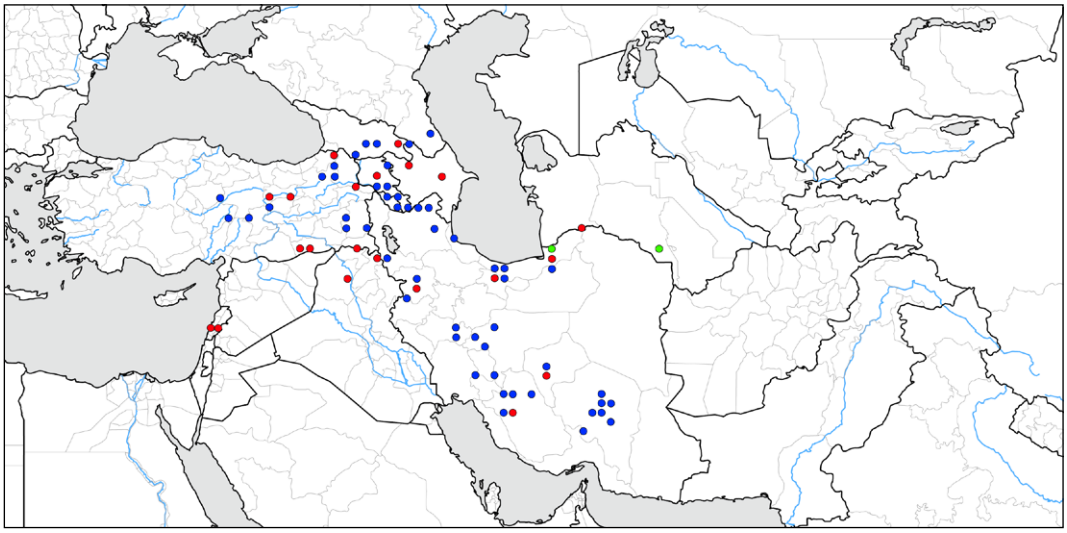


Cordulegastridae

In the area covered by this atlas the family Cordulegastridae is represented by 7 species in 2 genera. The taxonomy of the genus *Cordulegaster*, especially concerning the many species or subspecies in the *C. insignis* group and their relation with *C. mzymtae*, is complex and it is likely that molecular data will lead to taxonomic changes in the future.

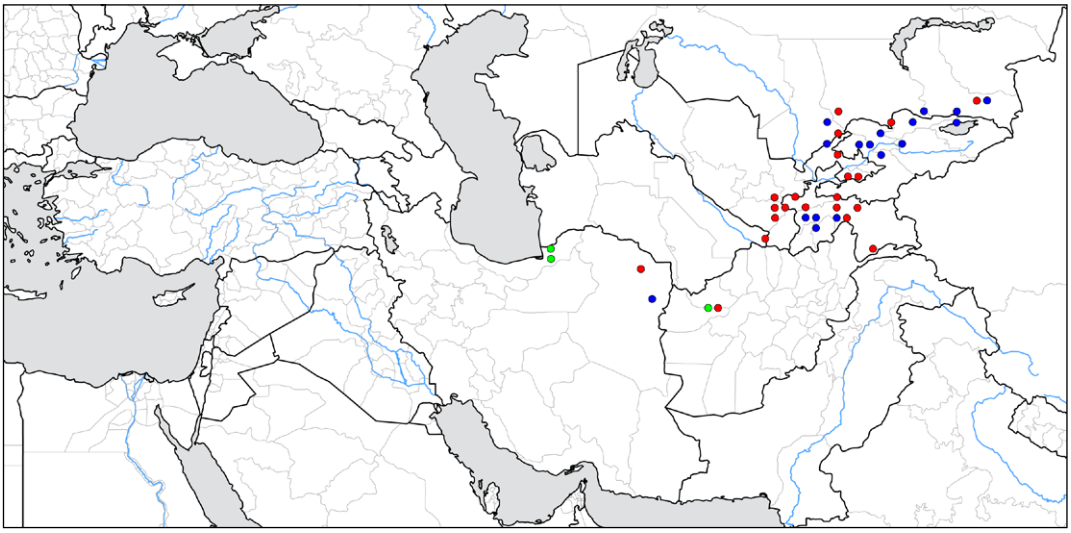
Cordulegaster charpentieri (Kolenati, 1846) — Persian Goldenring

Cordulegaster charpentieri, sometimes considered as a subspecies of *Cordulegaster insignis*, will be treated here at the full species rank (Lohmann 1993b). It replaces *C. insignis* to the east, occurring from central Turkey eastwards to the South Caucasus and Iran. The species was recently found in Russia in the east of Dagestan where the northeastern Caucasus lowers towards the Caspian Shore (Onishko & Kosterin, 2021). The taxonomic status of the species is very problematic and numerous names, which here, for convenience, are regarded as synonyms, have been applied in the South Caucasus countries, eastern Anatolia and Iran: *C. charpentieri* (Kolenati, 1846), *C. lagodechica* Bartenev, 1930, *C. nobilis* Morton, 1916, *C. plagionyx* Skvortsov & Snegovaya, 2015b and *C. nachitschevanica* Skvortsov & Snegovaya, 2015b. *Cordulegaster* specimens from southern Turkmenistan mentioned by Borisov & Haritonov (2008) and a museum specimen originating from Tedzhen in the BMNH, London labelled as '*C. amasina* ex coll. Cowley. Leg. Staudinger; det. Waterston 1975' might also belong to the *C. charpentieri* taxon. The species is found at brooks and streams with good water quality from the forest belt to alpine-like meadows and high altitude pastures.



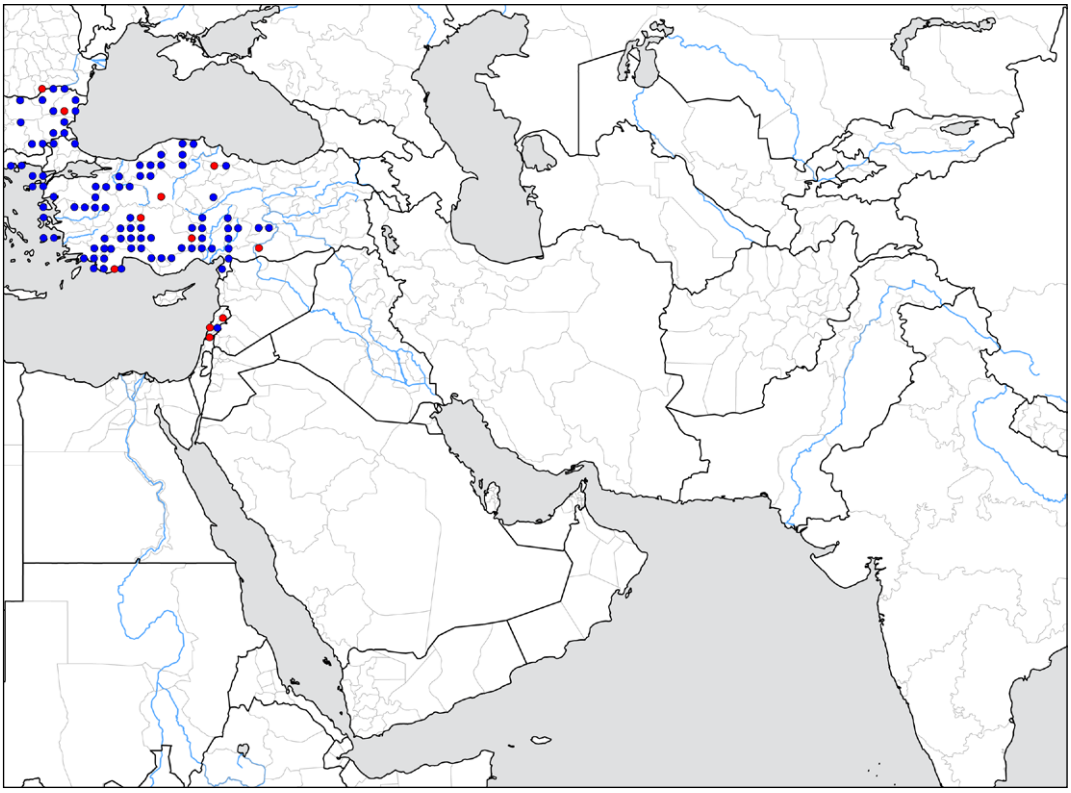
***Cordulegaster coronata* Morton, 1916 — Turkestan Goldenring**

Formerly considered to be a member of the *insignis* group, this central Asian endemic is now regarded as a good species. Until recently it was thought to be confined to southeastern Kazakhstan, Kyrgyzstan, Uzbekistan, Tajikistan and Afghanistan but recently it has been found in the northeastern part of Iran (Schneider & Ikemeyer 2016b, 2019, Schneider et al. 2018b). Moreover, an old record of *C. brevistigma folia* Fraser, 1929 from Afghanistan (Carfi et al. 1982) is suggested to have been misidentified and to be a close relative if not identical to *C. coronata* (pers. com. Heinrich Lohmann), expanding the species range to the south. Other records of *C. coronata* from Afghanistan by Schmidt (1961) are not included as they, at least partly, refer to *Neallogaster schmidti* (*Asahina* 1982). It also remains unclear whether the report of '*C. insignis coronatus*' from two northwest and southeast Afghan localities by Kimmins (1950) is correct or also belongs to *Neallogaster schmidti*. *Cordulegaster coronata* reproduces mostly in mountain spring brooks, brooks and streams within the broadleaved forest belt and in open pastures above the tree line up to 2300 m a.s.l. (Schröter 2010b).



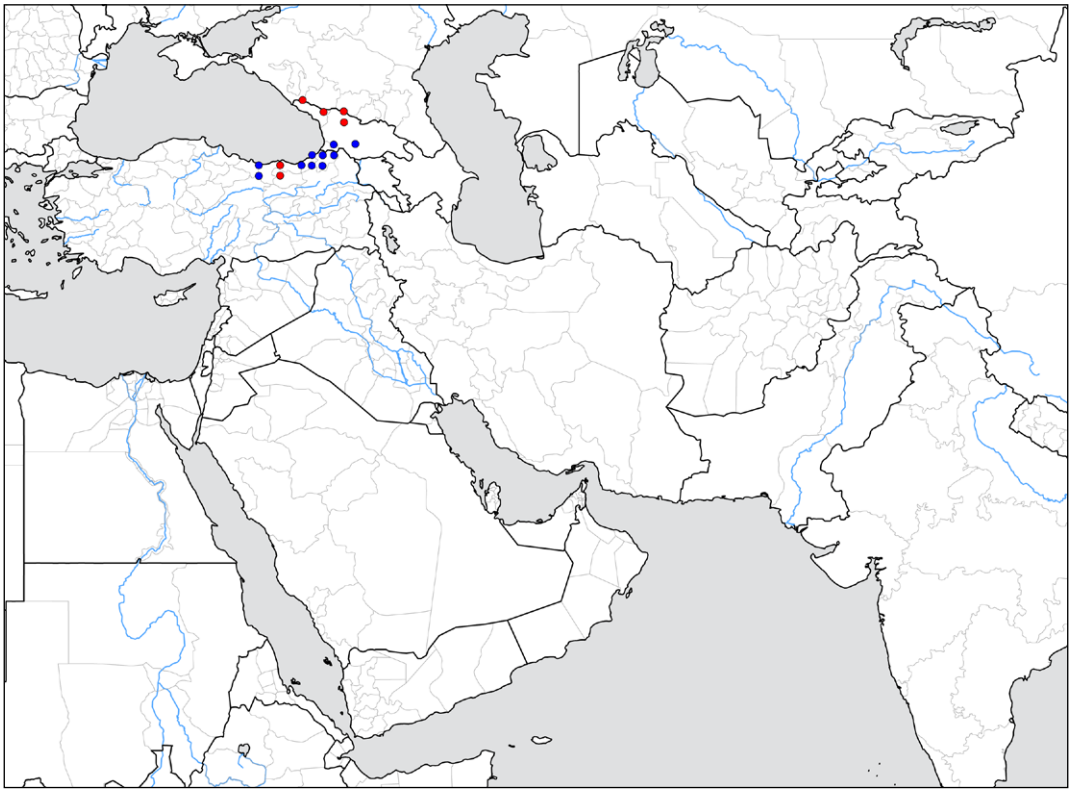
***Cordulegaster insignis* Schneider, 1845 — Blue-eyed Goldenring**

Cordulegaster insignis is considered to be the western counterpart of *C. charpentieri* and ranges from the southern Balkans (Macedonia, Serbia, Bulgaria, Romania, Greek Aegean islands and European Turkey) to roughly the westernmost two thirds of Turkey and the mountains of Lebanon in the Levant. As treated here, this is a somewhat heterogeneous aggregate of populations differing by small colour details and known under various poorly defined names (*including C. insignis Schneider, 1845, C. amasina Morton, 1916, C. montandoni St. Quentin, 1971*), whose status needs to be determined using modern phylogenetic methods. All members of this group reproduce in brooks, streams, spring areas and seepages in forested mountains, particularly in headwaters with low flow as the larvae do not cope well with strong currents of middle and lower parts of rivers and easily drift downstream (Leipelt 2005).



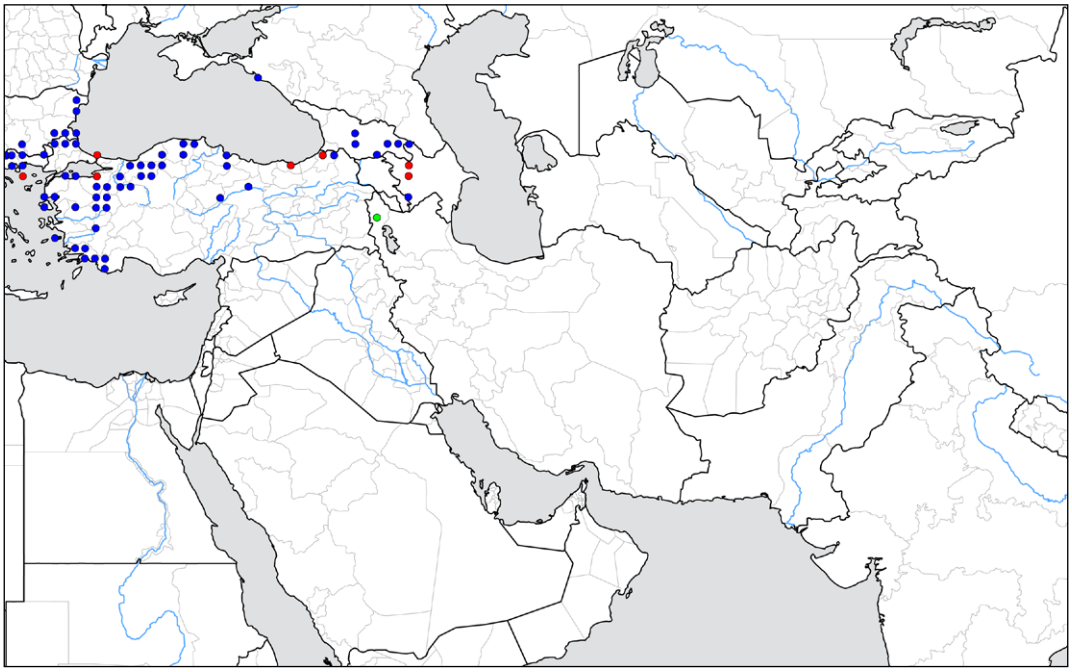
***Cordulegaster mzymtae* Bartenev, 1929 — Pontic Goldenring**

Cordulegaster mzymtae is restricted to the mountains bordering the eastern part of the Black Sea. It is found from the western half of the Caucasus in Georgia and Russia to the eastern part of the Pontic Alps in Turkey; an area with a relatively cool and humid climate. The species reproduces in seepage springs, brooks, and upper course of rivers with water trickles and is sometimes encountered hunting over marshes and bogs. Due to its dark appearance, the species, which may be closely allied to some morphs of *C. insignis*, is difficult to spot in dark forest environments.



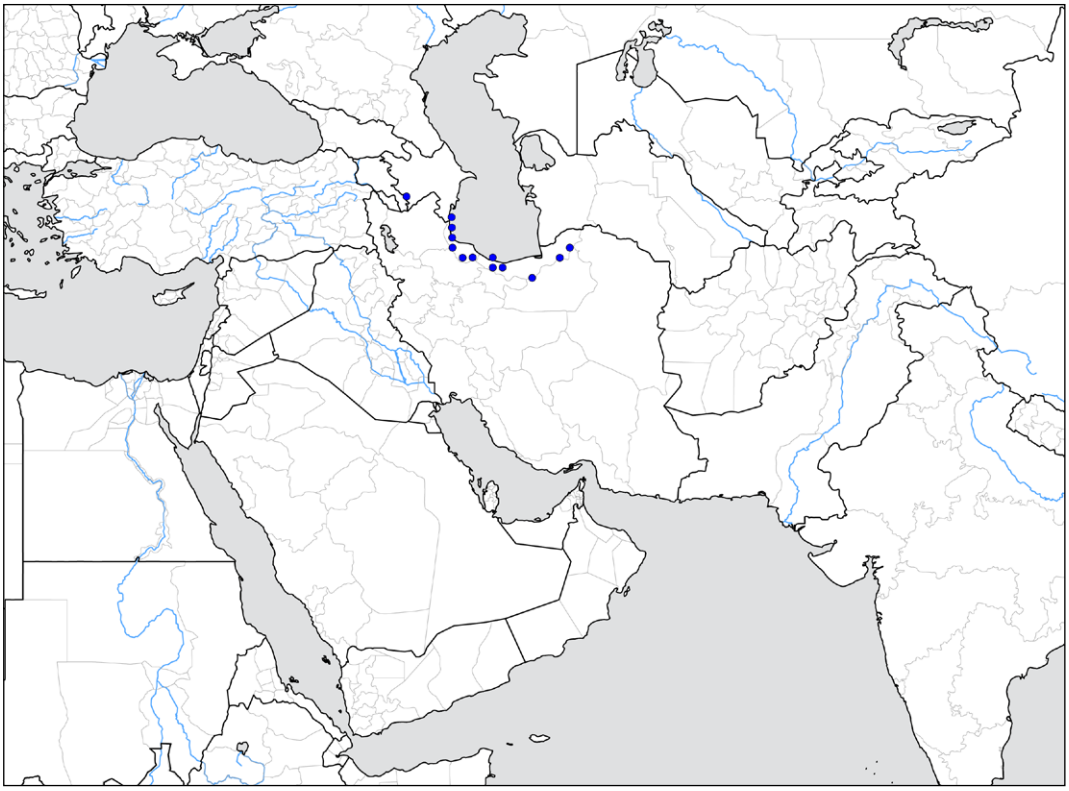
Cordulegaster picta Selys, 1854 — Turkish Goldenring

Cordulegaster picta has a relatively small range, being restricted to southeast Europe and West Asia. In Europe it is found in the Rhodope Mountains (the border region of Greece, Bulgaria and the European part of Turkey) and several east Aegean islands such as Samos and Lesvos. It has also been discovered recently on the Black Sea coast in Russia (Kosterin & Solovyev 2017). In Asia this species is relatively common over a large part of northwestern Turkey, slightly less common in the northeast of this country. It is also found in Georgia. All records from Azerbaijan (Selys 1873, Skvortsov & Snegovaya 2015a) and northeastern Turkey should be re-examined as reliable characters have become known only recently. This species breeds in a variety of flowing water systems from seepage springs to small brooks and rivers, as it shows more tolerance to strong water flow than the other *Cordulegaster* species with which it shares its range. Adults sometimes can be seen patrolling along river banks but mostly only visit the water rather briefly before disappearing into the canopy, making them difficult to catch and identify reliably.

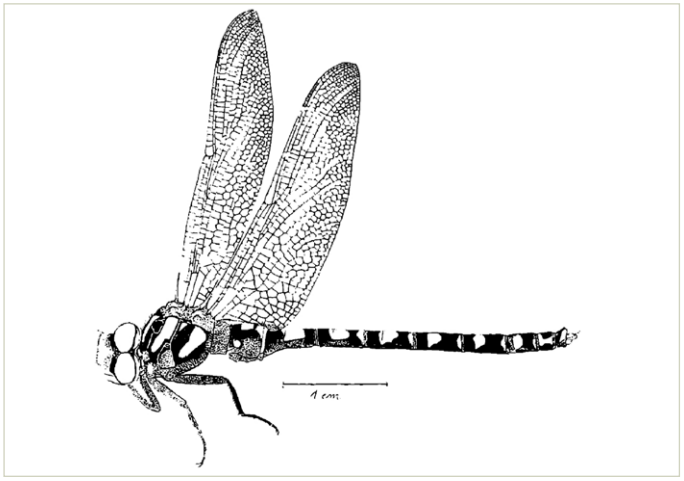


***Cordulegaster vanbrinkae* Lohmann, 1993 — Hyrcanian Goldenring**

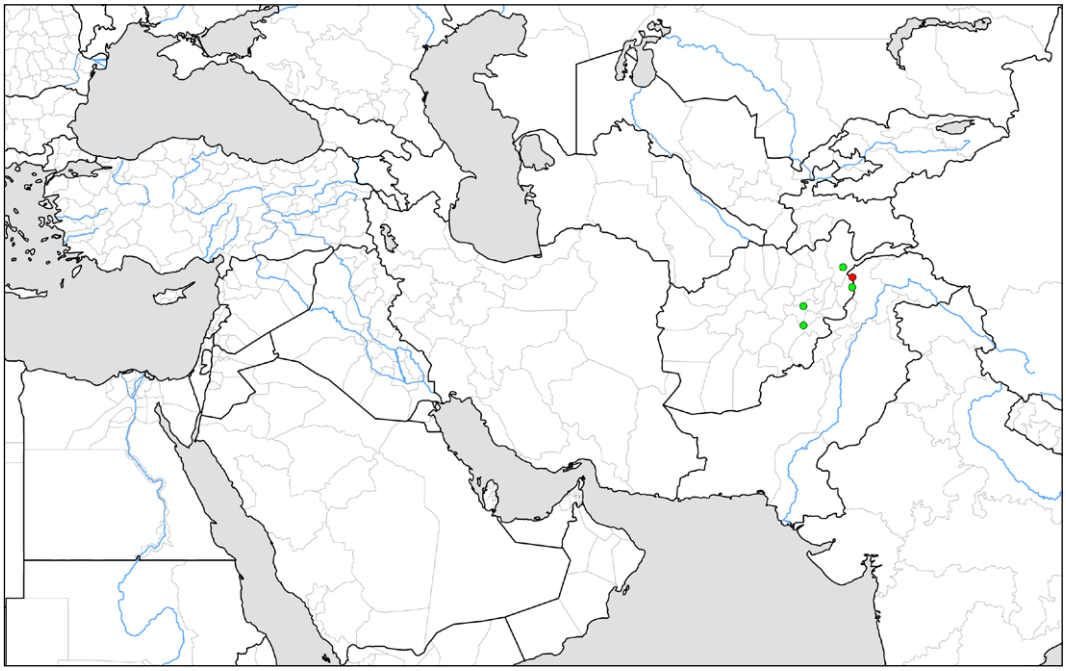
Cordulegaster vanbrinkae was until recently poorly known but a redescription of the species (Schneider et al. 2014) and several recent records have improved our knowledge of its range. The species is almost completely restricted to the broadleaved Hyrcanian forest along the southern fringe of the Caspian Sea in Iran (Holusa et al. 2015, Ikemeyer et al. 2015, Balazs & Holusa 2018, Schneider et al. 2018) and Azerbaijan (Skvortsov & Snegovaya 2014, 2015a). In addition, this species occurs in southeast Armenia (Ananian & Tailly 2012, 2013). A record by Eslami et al. (2020b) from the Isfahan province of Iran is regarded as erroneous and is rejected here. The species inhabits brooks and small rivers in forests occurring from sea level to 2000 m a.s.l (Schneider & Ikemeyer 2019).



***Neallogaster schmidti* Asahina, 1982 — Afghan Goldenring**



This name applies to one male and one female collected in 1952 at Achmede Dewane at 2700 m a.s.l. (now Ahmad Diwana, Nuristan, eastern Afghanistan) and published by Schmidt (1961) as *Cordulegaster insignis coronatus*. Asahina (1982) re-studied these specimens as part of his work on the Cordulegastridae of the Himalayan region and placed them in the genus *Neallogaster* Cowley, 1934, describing them as the new species *N. schmidti* in honor of Erich Schmidt. It is possible that the other specimens listed as '*Cordulegaster insignis coronatus*' from three other localities from eastern Afghanistan by Schmidt also pertain to *N. schmidti* but this is uncertain as *Asahina* did not study them. No other reliable record of this species has been published (Mitra 2010). It is unclear which taxa are involved in the two records of '*C. insignis coronatus*' published by Kimmins (1950), one in the northwest of Afghanistan near the locality of *C. coronata* (published as *C. brevistigma folia* by Carfi et al. 1982), the other in the southeast of the country closer to the area corresponding to the type locality of *N. schmidti*. The species is one of the least known of our region, a feature likely to remain for the future given the unstable situation in Afghanistan and nearby territories in northwestern Pakistan.

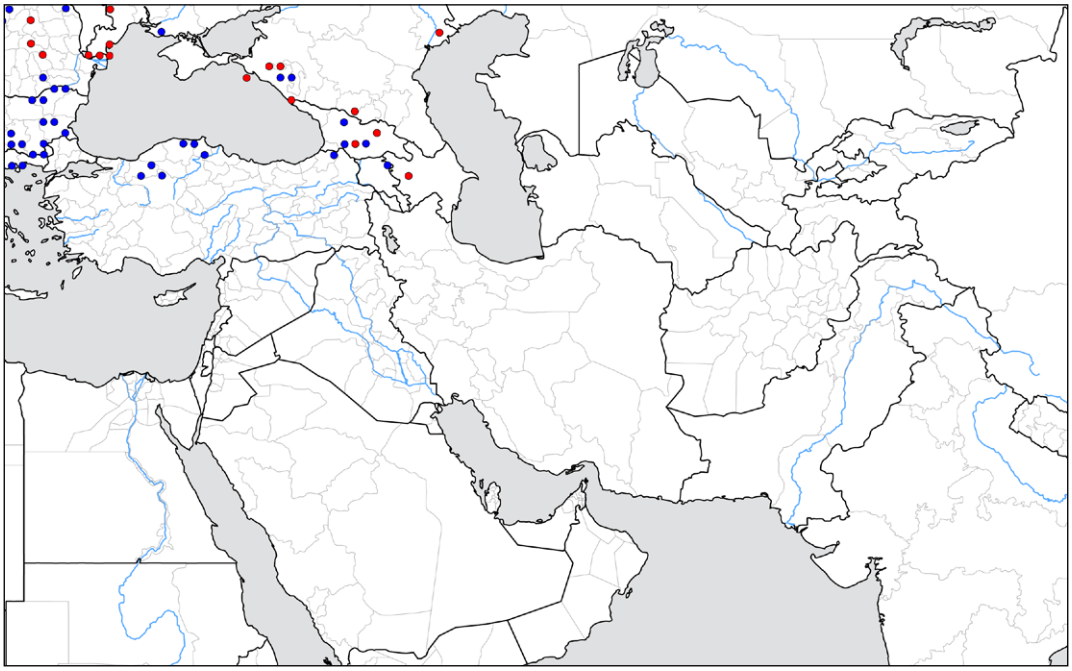


Corduliidae

In the area covered by this atlas the family Corduliidae is represented by 3 species in 2 genera. A further species, *Somatochlora borisi* Marinov, 2001, which is sometimes placed in its own genus *Corduliochlora*, occurs just west of our region in the European part of Turkey, southern Bulgaria and northeastern Greece (Rhodope Mountains). According to current knowledge, this Thracian endemic does not occur in Asia.

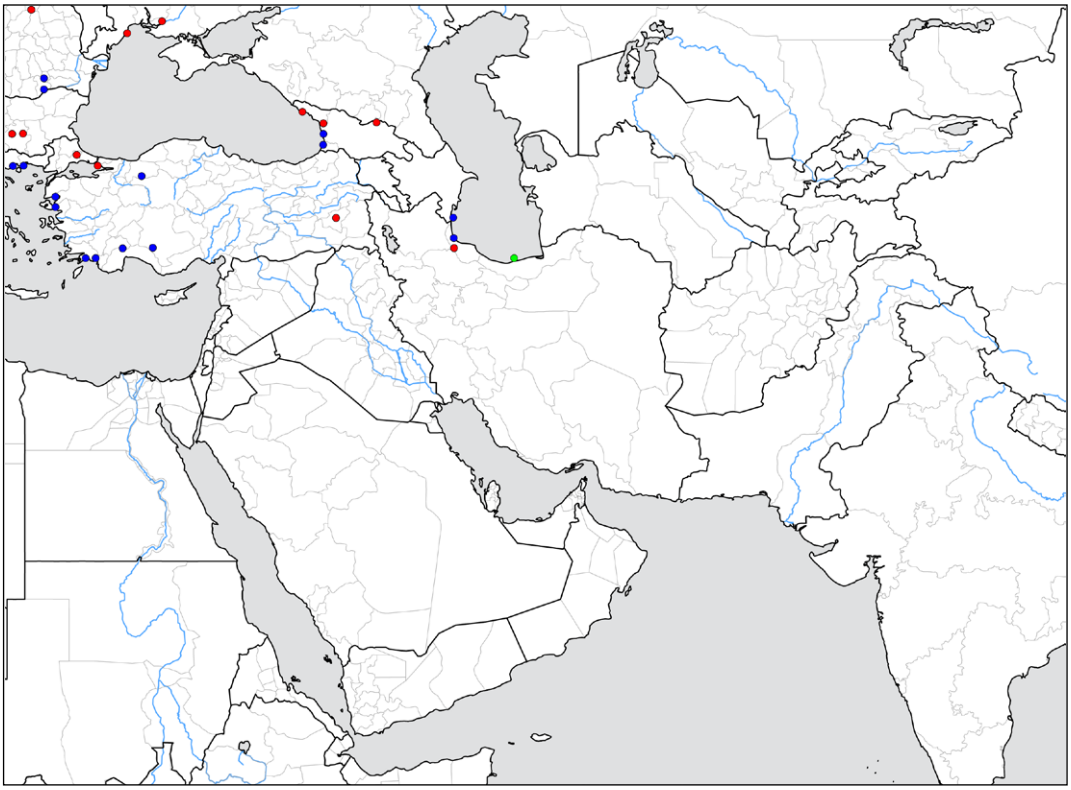
***Cordulia aenea* (Linnaeus, 1758) — Downy Emerald**

Cordulia aenea occurs across the whole Palearctic from lowland to mountains; however, in our region, it is restricted to higher altitudes (>800 meters) and occurs in the north and northeast of Turkey and the South Caucasus countries. The populations in Turkey are the southern end of a more or less continuous range and here it is much less common than in Europe. While it often occurs in small waters, to the north, in Turkey and the South Caucasus, it appears to be restricted to mountain lakes both large and small. It is possible that such habitats provide more stable temperatures and, in particular, stay cooler in summer.



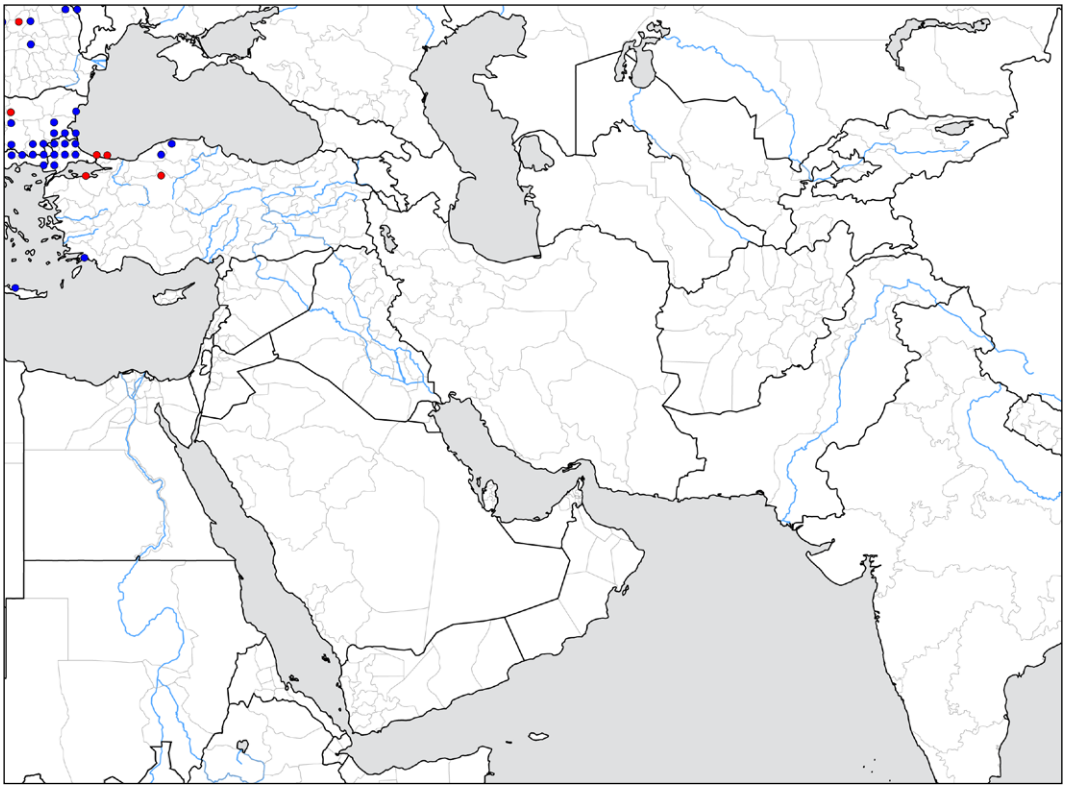
***Somatochlora flavomaculata* (Vander Linden, 1825) — Yellow-spotted Emerald**

Somatochlora flavomaculata is widely distributed in most of Europe. Whilst it is not uncommon, it is absent from large parts of the Mediterranean, the far north and the British Isles. Its range stretches east into West Siberia. In western Turkey the species is rare and known from a handfull of scattered localities. Further east the species is found along the Black Sea coast in Georgia and at the marshes and lowland forests along the Caspian Sea north of the Alborz Mountains in Iran. It is known from a seemingly isolated record from 1947 near Lake Van (Schneider 1985). The later record might be an indication that this elusive species is more widespread in northeast Turkey than presently known. It occurs in densely vegetated marshes where very little water is visible and the adults are most often seen flying over this habitat or along forest edges.



***Somatochlora meridionalis* Nielsen, 1935 — Balkan Emerald**

A species of southeastern Europe that occurs roughly from the extreme southeastern tip of France and Corsica to Italy and the Balkans. To the north it reaches Slovakia and the extreme west of Ukraine. To the east it extends into Turkey, where it is relatively common in European Thrace. In the region of this atlas it has only been found in northwestern Turkey along the Bosporus, the Sea of Marmara and from three records in the north along the Black Sea coast. It has also been observed in the southwest of Turkey. *Somatochlora meridionalis* inhabits completely shaded streams and small rivers.

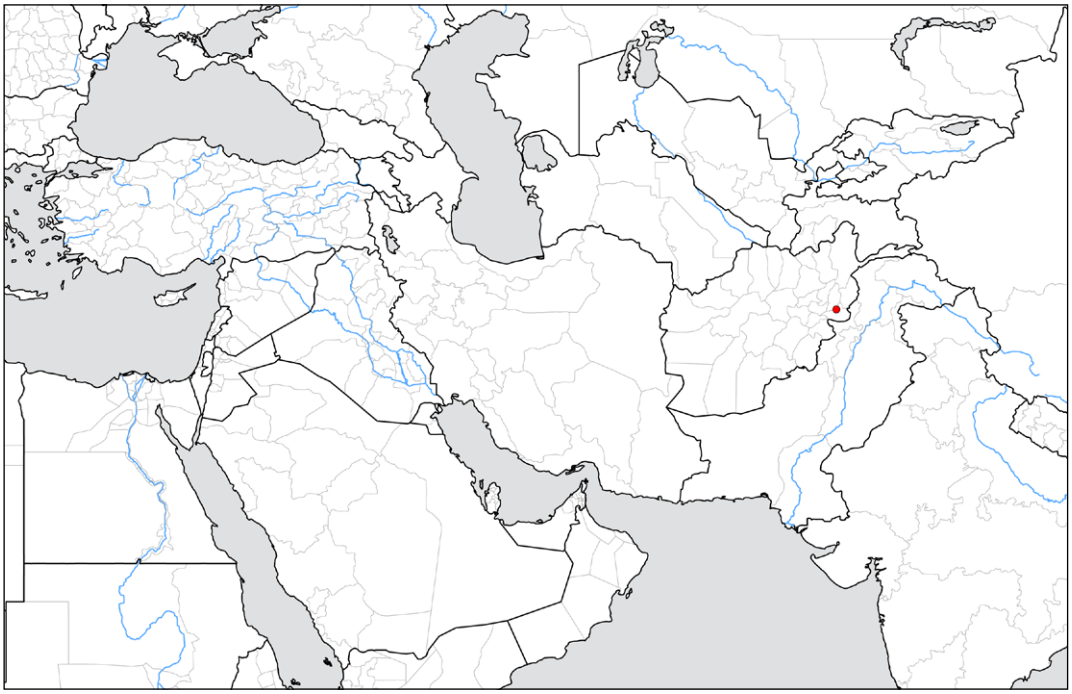


Libellulidae

In the area covered by this atlas the family Libellulidae is represented by 64 species in 19 genera. Together with the damselfly family Coenagrionidae, these species dominate the dragonfly and damselfly fauna of our region. A very old record of *Orthetrum brachiale* from the Sinai is regarded doubtful and is not taken into account.

***Acisoma panorpoides* Rambur, 1842 — Asian Pintail**

Acisoma panorpoides is common and widespread in tropical Asia and is found eastwards to Japan and south to the Philippines and large parts of Indonesia. It inhabits all kinds of largely unshaded, standing, eutrophic waters, often occurring in man-made habitats such as ditches and paddy fields. It is widespread in India, known from a handful of locations in Pakistan and from one record in Afghanistan (Jalalabad, Kabul valley; 11 July 1952; Schmidt 1961). It seems likely that further fieldwork in the south of Pakistan will show the species to be common in this region and records from the southeast of Iran are to be expected.

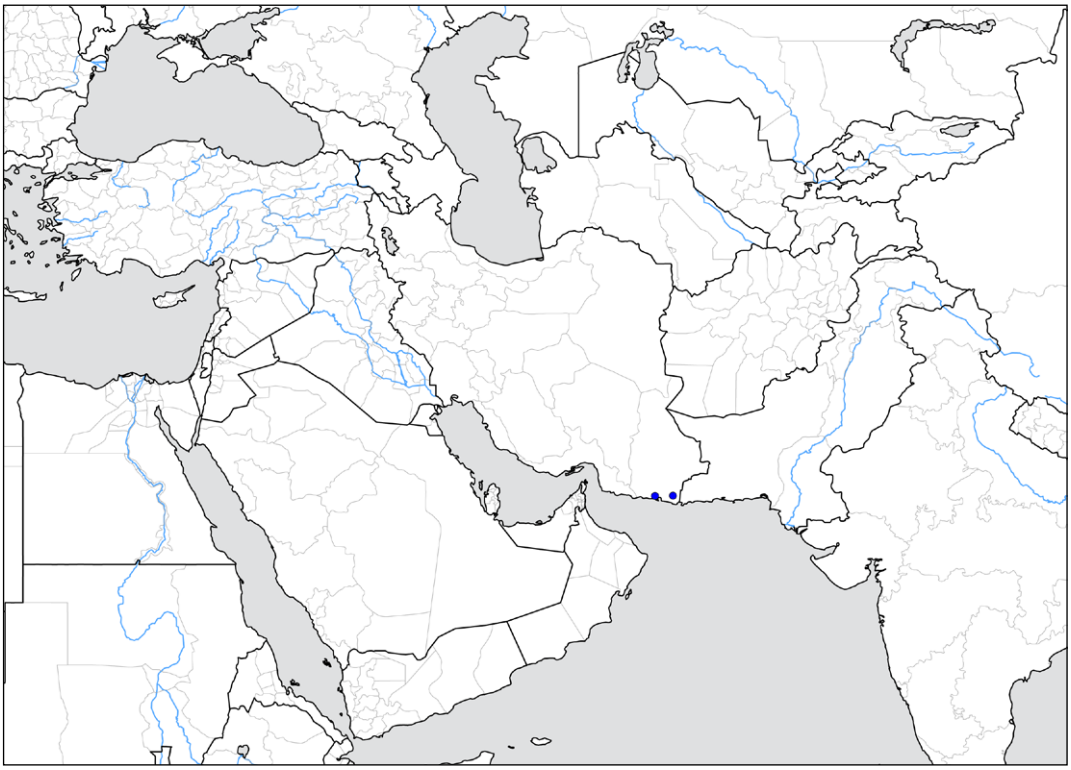


***Acisoma variegatum* Kirby, 1898 — Slender Pintail**

This Afrotropical species is, in our area, restricted to the Dhofar region in the south of Oman (Waterston & Pittaway 1991, Schneider & Dumont 1997) where it is found at residual standing waters in seasonnaly flowing wadis. Most African and Arabian records of the genus *Acisoma* have originally been published as *A. panorpoides ascalaphoides* but Mens et al. (2016), who revised the genus, found *A. panorpoides* to be a strictly Asian species, while the taxon *A. ascalaphoides* is restricted to Madagascar and is better regarded a full species. The already existing name *variegatum* was re-established for a species widespread in tropical Africa reaching our area in the south of the Arabian Peninsula. Records of *Acisoma* previously published as *A. panorpoides* from Algeria, Libya, Egypt and Sudan are now known to pertain to *A. inflatum* Selys 1889, a close relative of *A. variegatum*.

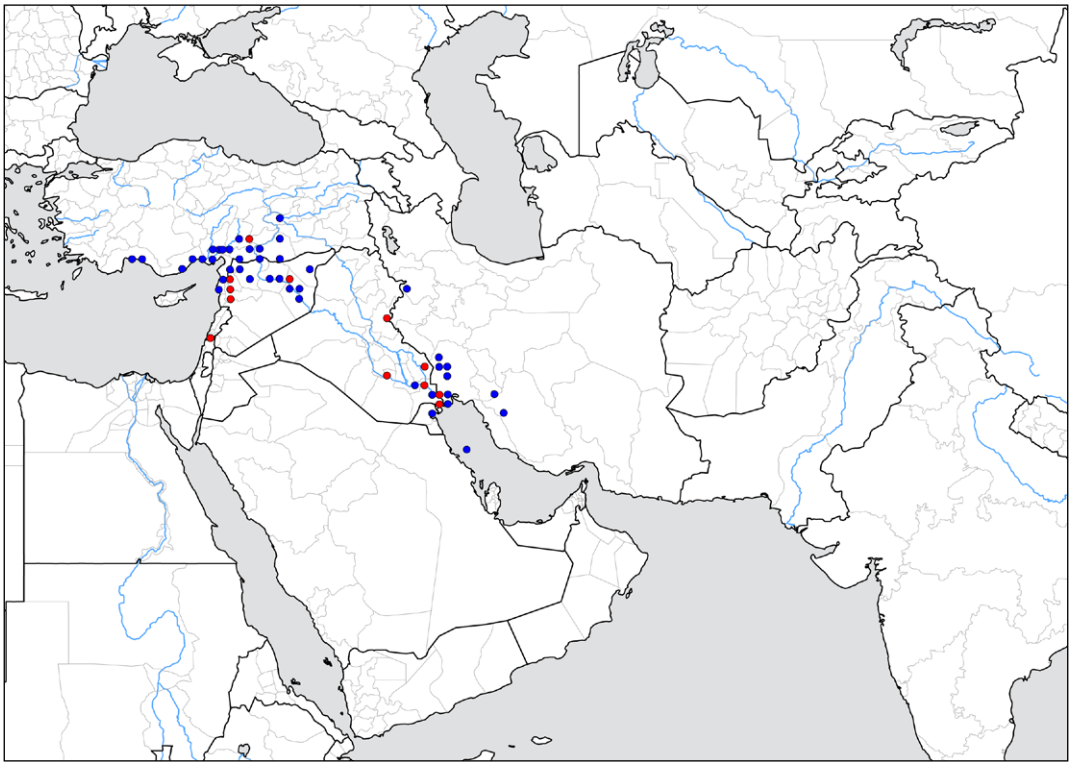
***Brachythemis contaminata* (Fabricius, 1793) — Orange-winged Groundling**

Brachythemis contaminata is a widespread and very common Oriental species occurring widely throughout the subtropical and tropical parts of Asia, where it has been found from India to Indonesia and Japan. In our region, it has only been observed along the Makran Coast in Sistan-va-Baluchestan, Iran (Schneider & Ikemeyer 2019). The species occurs here in shallow, warm waters, mainly ditches both standing and slow-flowing with dense vegetation. It has a good capacity to colonize new habitats and seems to tolerate polluted waters.



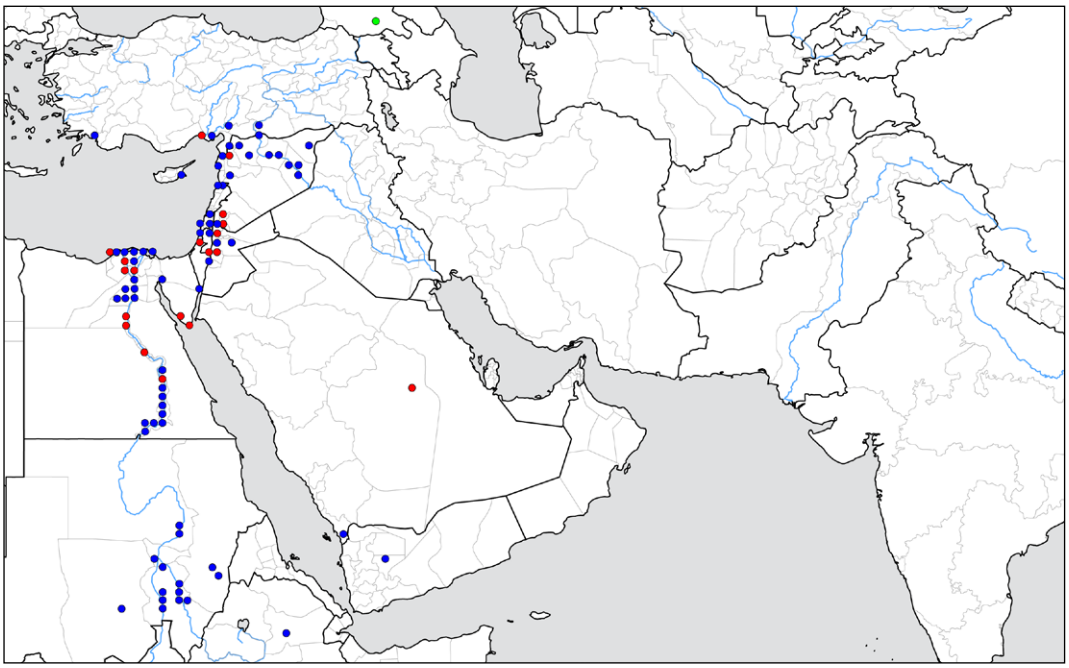
***Brachythemis fuscopalliata* (Selys, 1887) — Dark-winged Groundling**

Brachythemis fuscopalliata is endemic to West Asia predominantly in southern Turkey, Syria, Iraq and western Iran. The species has also been found in Kuwait and on Karan Island (Saudi Arabia); however, these two records probably pertain to vagrants. Some old records from the 1950s came from Lake Hula in northern Israel but the species seems to be lost there as a consequence of the drainage of the entire Hula depression in order to fight malaria (Dumont 1991). Whether it will be able to recover in this area recolonising from distant localities and taking advantage of the Hula lake restoration (Lake Agmon) remains to be seen. Populations have also gone extinct at several sites in Turkey and along the Tigris and Euphrates, usually as a result of habitat destruction through dam construction. *B. fuscopalliata* is also found along slow flowing rivers and densely vegetated lakes in Iran (Schneider & Ikemeyer 2019) and on similar habitat in Israel (Dumont 1991). Much of this key habitat in river valleys has already disappeared and, as a consequence, the species is threatened.



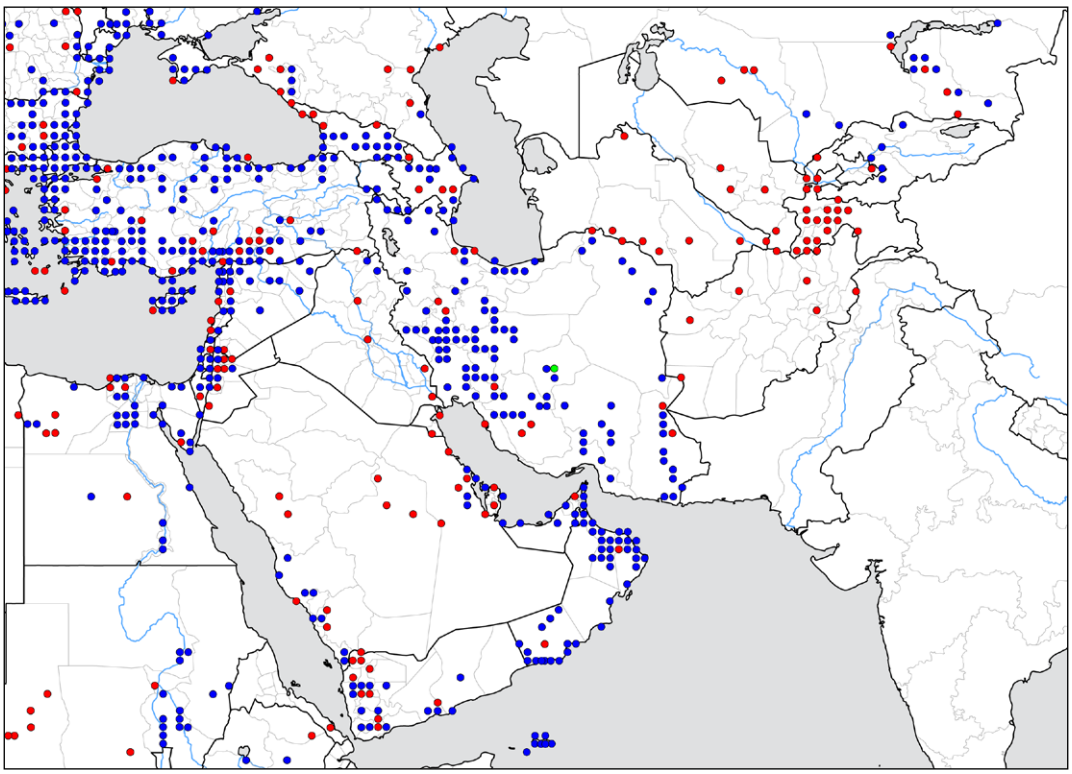
***Brachythemis impartita* (Karsch, 1890) — Northern Banded Groundling**

Until 2009 the name *Brachythemis leucosticta* was used for the banded *Brachythemis* species occurring in North Africa, Europe and the Middle East. What was considered one species are in fact two closely related species (Dijkstra & Matushkina 2009). *Brachythemis leucosticta* only occurs in the southern two-thirds of Africa whereas *B. impartita* is common and widespread in the northern two-thirds of the continent from where it extends into Europe and West Asia. In the region covered by this atlas, the species is common in Israel and Syria, locally common in the Sinai, Jordan, West Bank and Lebanon; however, it is rare or even very rare in Cyprus, southern Turkey, Saudi Arabia and Yemen. The records from the interior of Saudi Arabia are presumed to be *B. impartita* and date from around 1980. A record from Tbilisi, Georgia on 28 May 1909 (Bartenev 1913c, 1919) is doubtful and may be a label error, although a vagrant individual cannot be excluded. *B. impartita* breeds in a wide range of stagnant habitats with a preference for large lakes, especially dammed reservoirs with fluctuating water levels and gentle open sandy slopes with little or no vegetation. In such habitats, the species often occurs in very high densities. *B. impartita* can also be found in low numbers along slow flowing rivers.



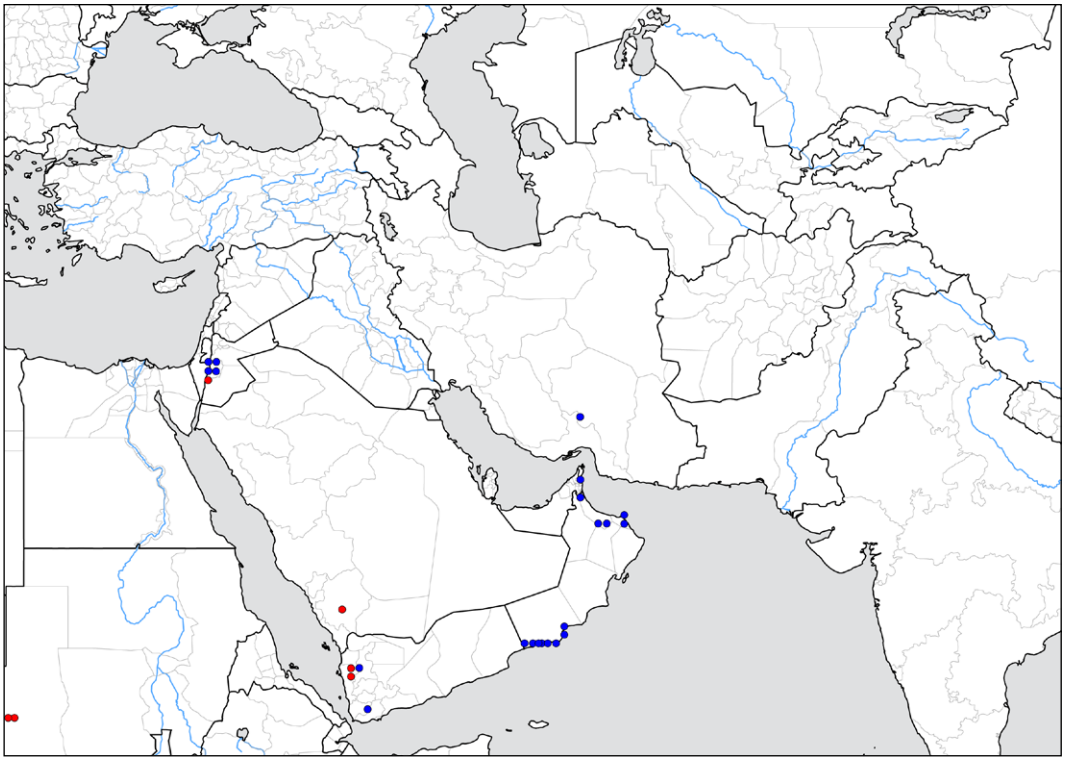
***Crocothemis erythraea* (Brullé, 1832) — Broad Scarlet**

Crocothemis erythraea is a widespread and common inhabitant of standing unshaded waters occurring in most of Africa, Europe and West and Central Asia. In Asia it reaches north to Lake Balkhash in central Kazakhstan and northwestern China. The species is common in most parts of the region covered by this atlas and, although only a small number of records are known, is probably also common in Afghanistan and the western parts of Pakistan. As far as is currently known *C. erythraea* is absent from most of Pakistan and India, where it is replaced by *C. servilia*, but in the Himalayan region it occurs as far east as Bhutan where it is found at higher elevations. The subspecies *C. e. chaldeorum* Morton 1920 has been described from Iraq and reported from various Arabian and Asian countries. It is a poorly defined subspecies which has in various publications been identified based on varying criteria (venation, size, colour tone). A study of a wider set of material is needed to determine whether this subspecies is valid and, if so, what characters can be used to reliably separate it from *C. e. erythraea*.



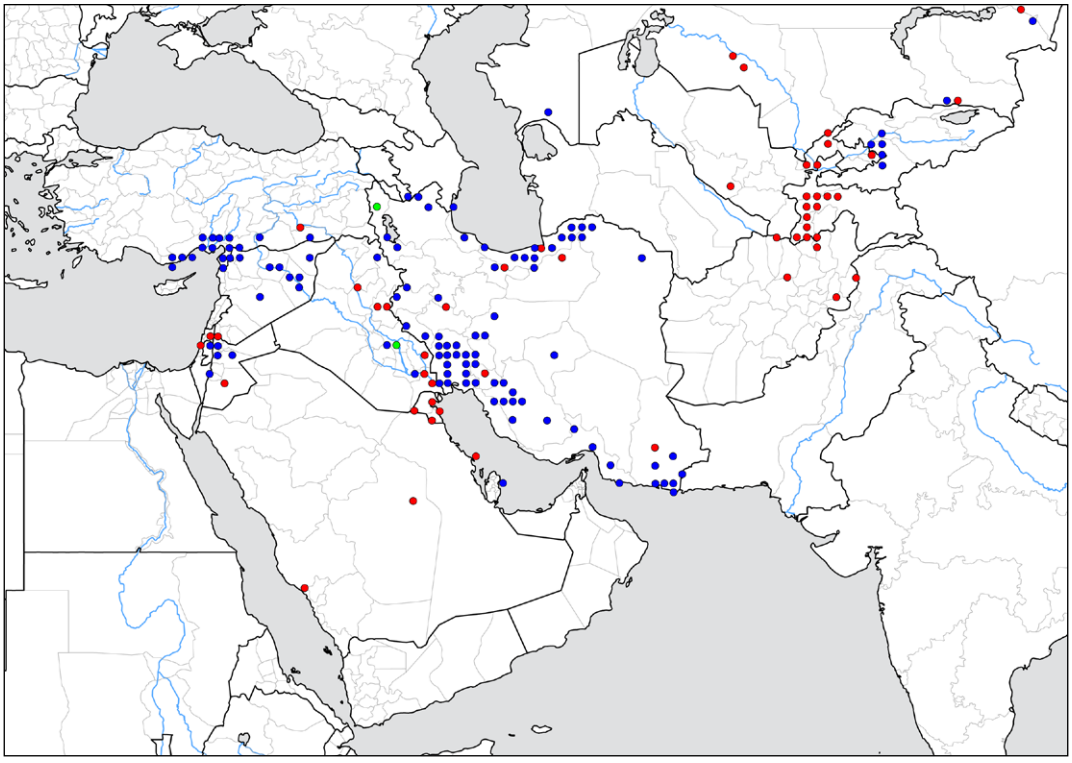
***Crocothemis sanguinolenta* (Burmeister, 1839) — Little Scarlet**

Crocothemis sanguinolenta is common and widespread south of the Sahara in Africa. In West Asia it is scarce with populations being found in the Dead Sea basin and the south of the Arabian Peninsula, especially the Dhofar region in southern Oman and north of the Hajar Mountains in Oman. There is a record of one or two males and a female from Kerman province, Iran at 1980 m a.s.l. (14 July 2018) (Schneider & Ikemeyer 2018a, 2019). However, given the winter temperatures in this region the involved individuals were considered to be wanderers either of regional origin or coming from the Arabian Peninsula. Conditions in the coastal region of southern Iran are probably favourable for the species and further field work might show this species to be present there. In contrast to the other two species of *Crocothemis*, *C. sanguinolenta* favours running waters often resting on nearby stones (Schneider & Ikemeyer 2016a).



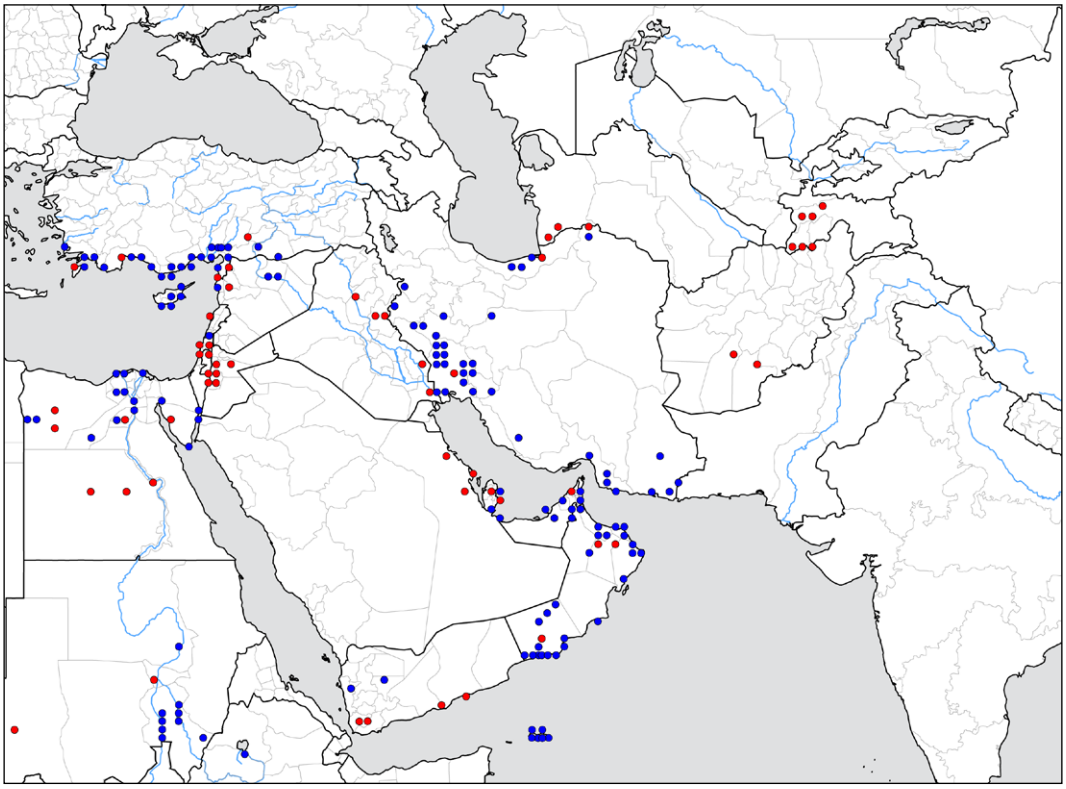
***Crocothemis servilia* (Drury, 1773) — Oriental Scarlet**

Crocothemis servilia is the Oriental sibling of the largely African *C. erythraea*. Its westernmost localities are found in the Levant and the southeastern Mediterranean coast of Turkey (Adana region). In West and Central Asian it often overlaps in range and often co-occurs with *C. erythraea* although it tends to favour even hotter environments and seems to be absent from higher elevations where *C. erythraea* can occur. Like *C. erythraea* it occurs at standing, unshaded and often eutrophic waters. In comparison with *C. erythraea* it is often slightly smaller, more slender with a more pronounced and sharply defined longitudinal stripe on its abdomen and, when teneral, having a yellow tint to the wings. With the exception of this wing feature, none of these characteristics gives absolute certainty on the identification for which the secondary genitalia of the males have to be studied with a hand lens. It is important to highlight characterstics used for identification when publishing records from *C. erythraea* or *C. servilia* from West and Central Asia, as confusion is easy.



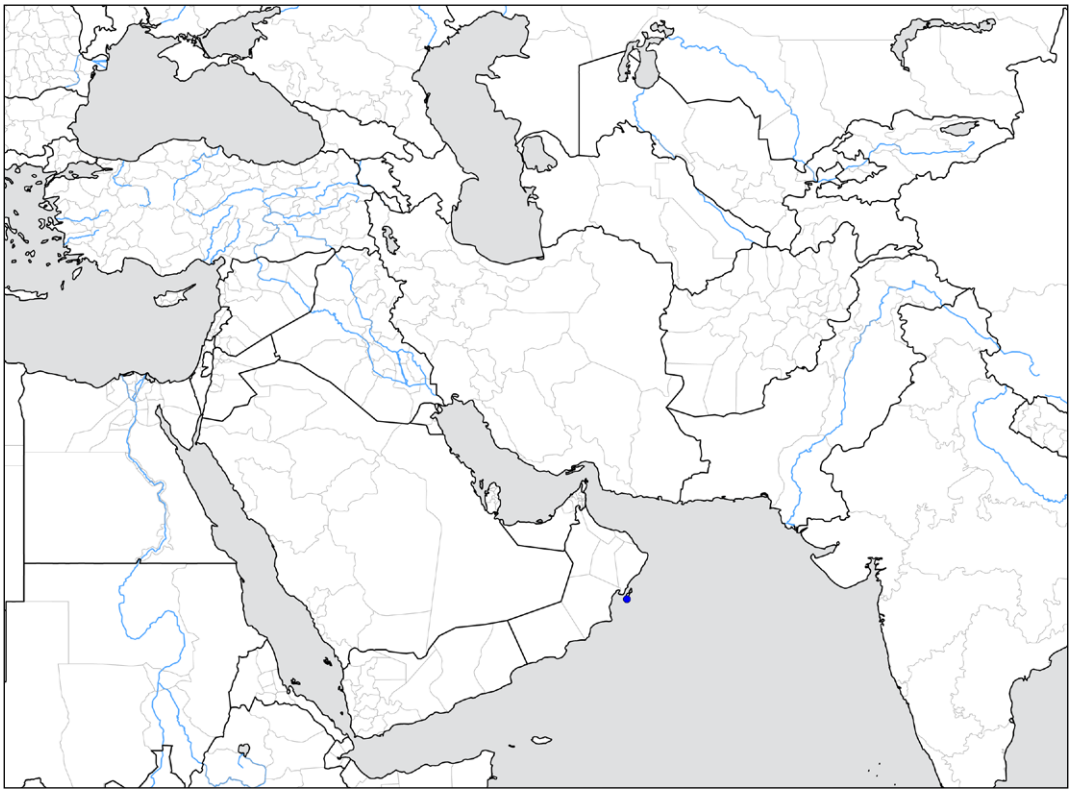
***Diplacodes lefebvrii* (Rambur, 1842) — Black Percher**

Diplacodes lefebvrii is a common and widespread Afrotropical species, which extends eastwards over the Arabian Peninsula into India and Central Asia. To the north it reaches southern Europe in Iberia and the Greek island of Rhodos. In the area covered by this atlas, *D. lefebvrii* extends from the Mediterranean coast of Turkey and Cyprus to the southeast of the Arabian Peninsula and across Iran to Afghanistan and Tajikistan. It is found in a wide range of habitats, from inland and coastal ponds, pools and brackish lagoons to desert oases and fountains in city parks.



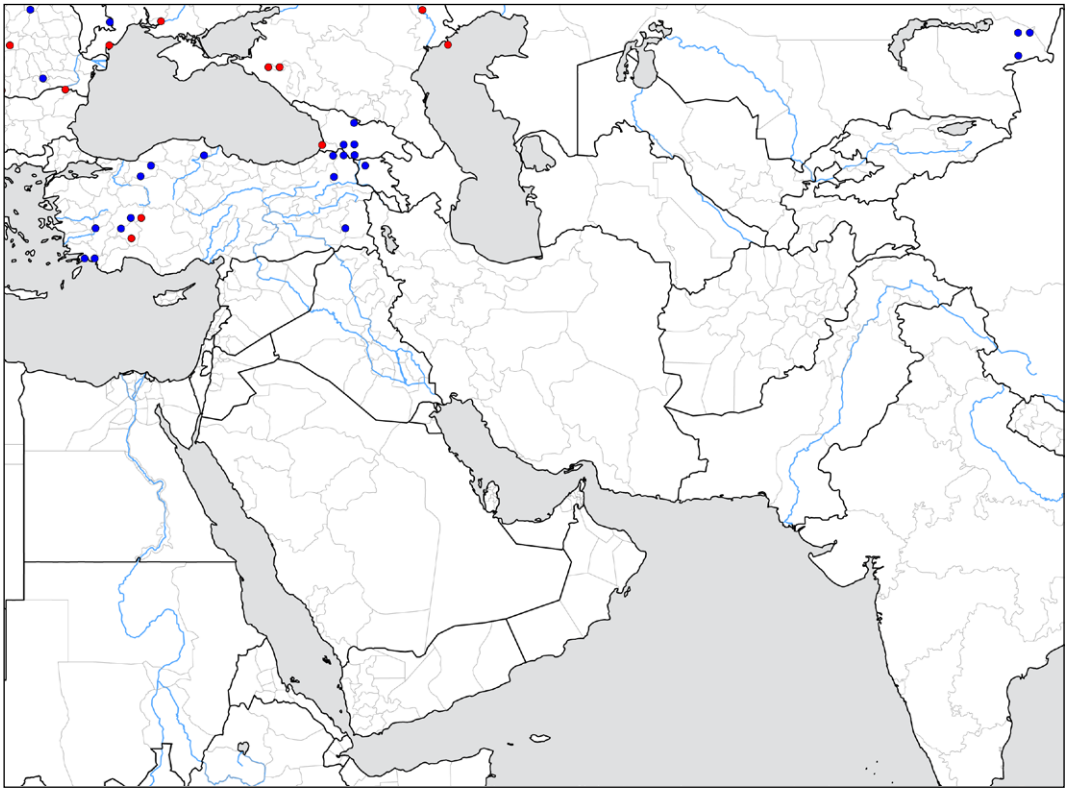
***Diplacodes trivialis* (Rambur, 1842) — Blue Percher**

Diplacodes trivialis is one of the most common and widespread Asian species, occurring widely throughout the subtropical and tropical parts of Asia east to Japan and reaching southwards to Australia. It occurs in open, standing waters such as paddy fields, ditches and pools and is often one of the more common species in man-made or degraded habitats. Adults tend to sit on bare ground or low grasses often away from the water and are often encountered along roadside verges. The species is common in large parts of India and Pakistan and might be found in the southeast of Iran. The only record within the area covered by this atlas is that of a single male photographed on 14 November 2019 on the Masirah Island offshore of Oman (Dobson & Childs 2019). This record was made two weeks after a tropical cyclone reached the southeastern part of the Arabian Sea and could therefore pertain to an airborne specimen drifting from the Indian continent to the Arabian Peninsula.



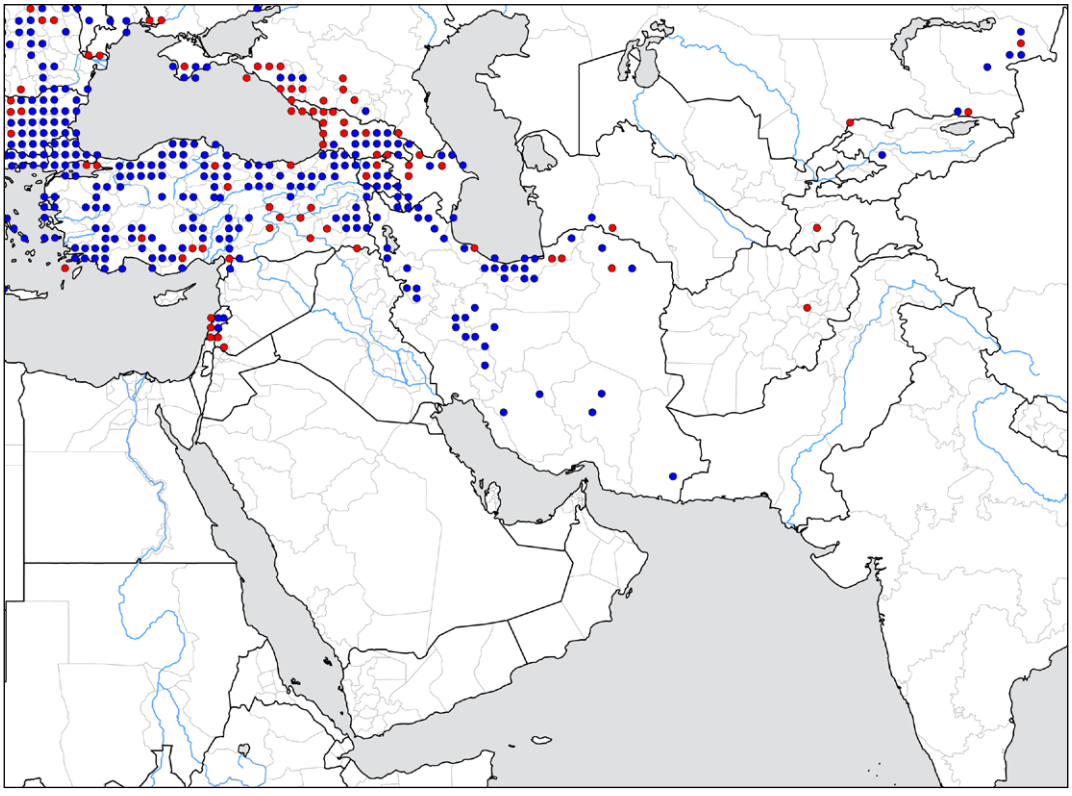
***Leucorrhinia pectoralis* (Charpentier, 1825) — Yellow-spotted Whiteface**

Leucorrhinia pectoralis is rare and very local in our area and only known from Turkey and the South Caucasus. In Turkey, the species is known from a few scattered records, mostly in the western part of the country. *L. pectoralis* has also been found in southeast Turkey and in the border area between northeast Turkey, Georgia and Armenia. This border region is rich in lakes and fens resulting in a good transboundary metapopulation (Durand & Rigaux 2015, Durand 2019). The species occurs in a comparatively wide array of different habitats. Most populations in this region are found in bogs and fens at higher altitudes. These include subalpine fens, or fen-like habitats in peat bogs (Olthoff & Ikemeyer 2012), marshland in open steppe landscape and mesotrophic oxbows in the submontane zone. Further research might well show that *L. pectoralis* is more widely distributed in the region than current data suggest. It might also be found in the mountains of northern Iraq and western Iran.



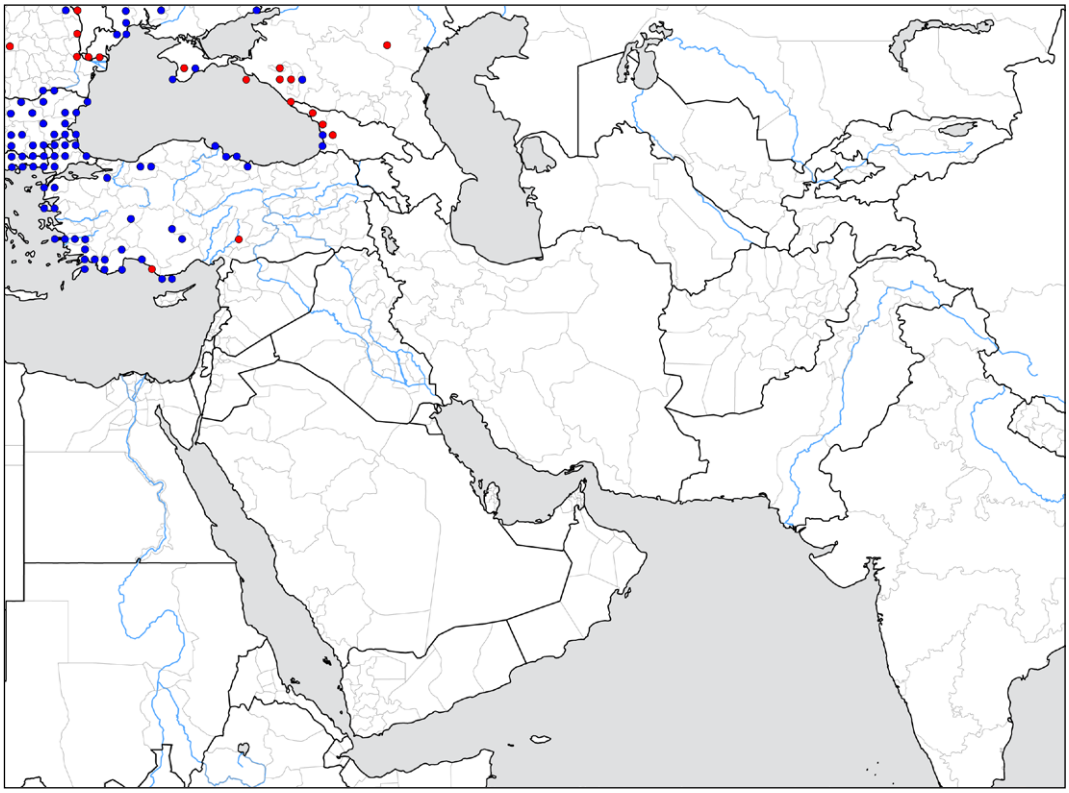
***Libellula depressa* Linnaeus, — 1758 Broad-bodied Chaser**

Libellula depressa is a Western Palearctic species which in our region is common and widespread in Turkey, a small part of the Levant, the South Caucasus countries, and in parts of Iran where it is mainly found in the region of the Alborz and Zagros Mountains. Moving east it becomes very rare and has only been observed in the mountain areas of Tajikistan, Kyrgyzstan and Afghanistan. It is a pioneer species that prefers small ponds and often temporary waters with little vegetation where the males defend their territory.



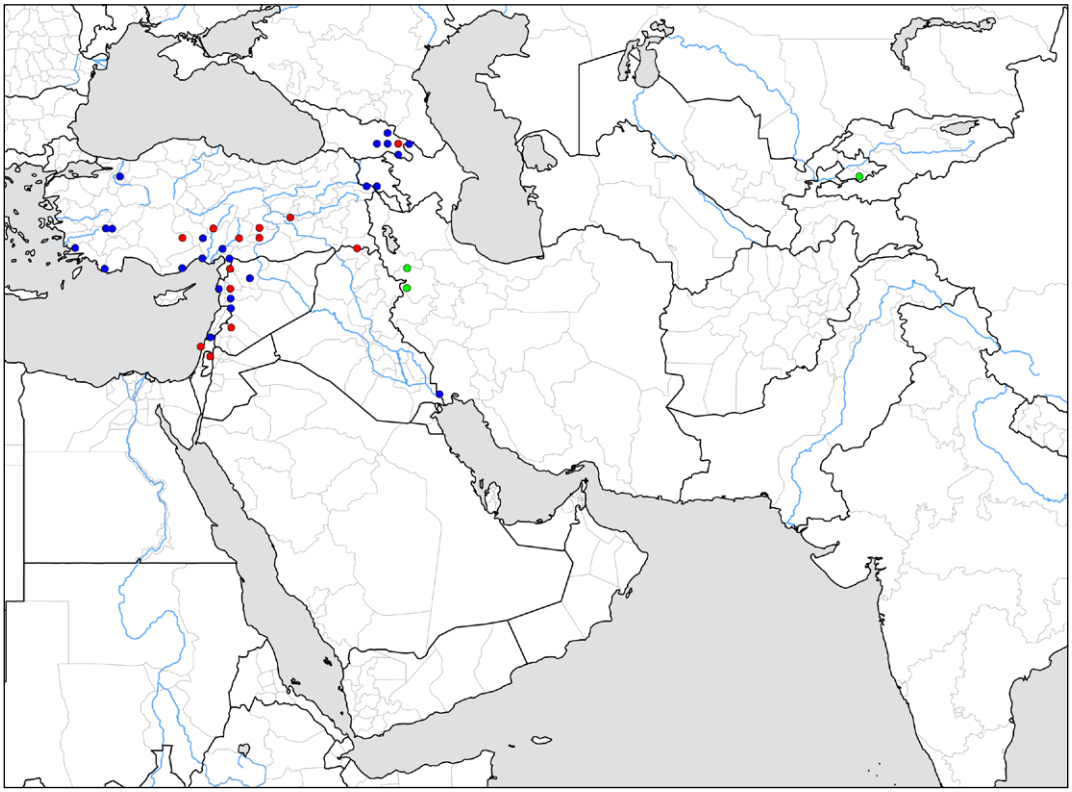
***Libellula fulva* Müller, 1764 — Blue Chaser**

Libellula fulva is a largely European species whose range extends to the western half of Turkey and Georgia. In the latter country it was rediscovered after a period of over 40 years, along the Black Sea coast (unpublished data Asmus Schröter). *L. fulva* occurs at ponds, pools, coastal wetlands as well as at slow flowing canals, ditches and streams. The species prefers habitats with dense and tall vegetation on the banks often of Reed (*Phragmites*) or Bullrush (*Typha*). It can also occur in forested environments as long as the bank side vegetation remains largely unshaded.



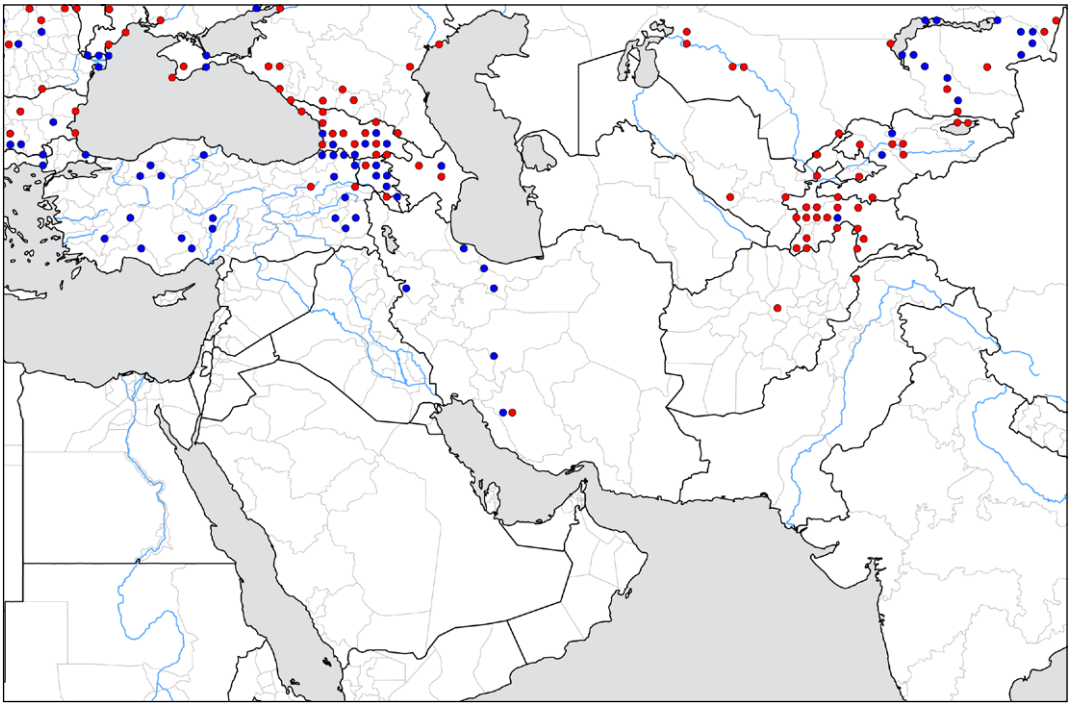
***Libellula pontica* Selys, 1887 — Red Chaser**

Libellula pontica is endemic to West Asia and ranges from western Turkey and the Levant to the South Caucasus countries and northwestern Iran (Schneider & Ikemeyer 2019). The species is quite rare throughout its range, except in eastern Georgia, which probably constitutes its main stronghold. The only published record from Iran is from the southwest (4 September 2001; Sadeghi & Dumont 2001); however, unpublished records are known from several places in the west of the country suggesting that it is not uncommon in this area (pers. com. Mohsen Kiany). An old specimen present in the Albarda collection, collected in 1892 in the east of the present Uzbekistan (Schoorl 2000), is rejected as it probably involves a labelling error (see Boudot et al. 2020 for details). *Libellula pontica* is often found on reeds or shrubs along the side of slowly flowing channels and ponds, not unlike *L. fulva* to which species it has a number of similarities; however, the strikingly red colouring of *L. pontica* is unmistakable.



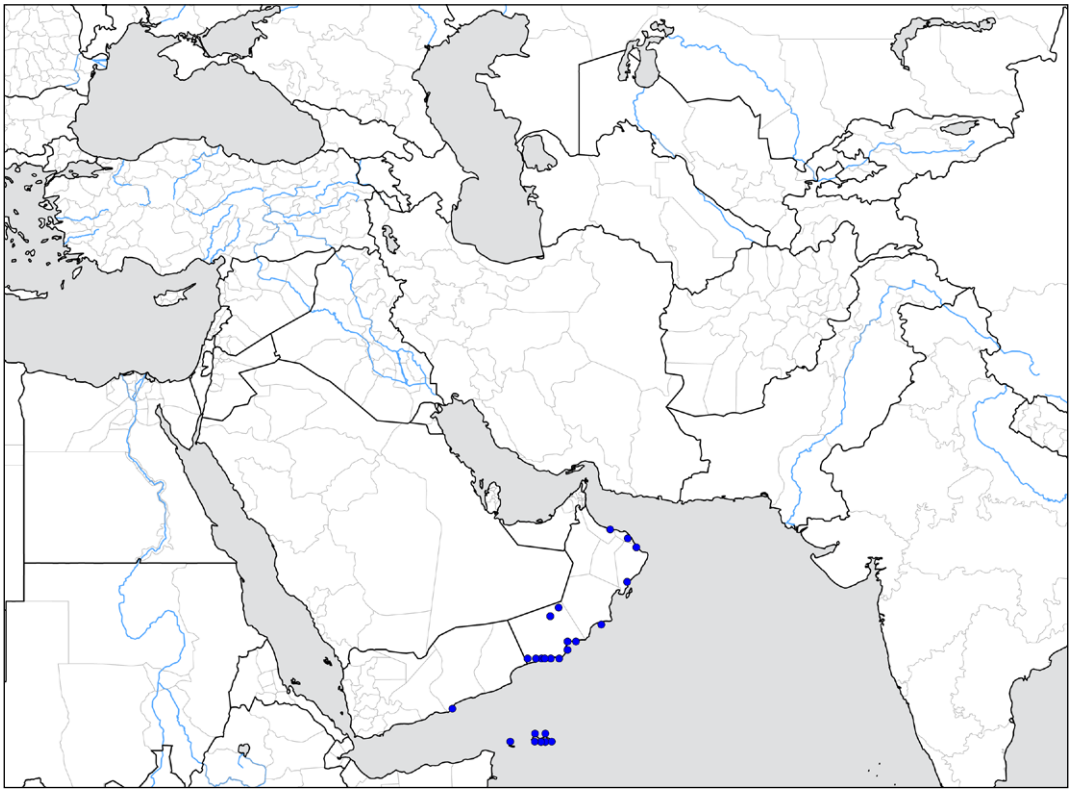
***Libellula quadrimaculata* Linnaeus, 1758 — Four-spotted Chaser**

Libellula quadrimaculata is a common and very widespread Holarctic species ranging from the west of Europe and Morocco to Japan in the east. The species is also present in North America, from Alaska to the Atlantic coast of Canada and the northern USA. In the area covered by this atlas, this species is rather common in the South Caucasus but scarce in Turkey and western Iran, being mainly restricted to mountainous areas. It is common in the mountainous areas of Central Asia in Tajikistan and Kyrgyzstan and also found to the southeast deep into Baltistan, north Pakistan where it is known from several localities. The number of records from Baltistan, Tajikistan and from Kyrgyzstan make it likely that it is also fairly widespread in the mountains of Afghanistan. The species can occur in very high densities and mass migration has been reported from both Europe and its Asian range. A mass occurrence in 2015 was described for central Kazakhstan (Koshkin et al. 2016). It seems likely that this can in some years also take place in lakes in Tajikistan and Kyrgyzstan. *Libellula quadrimaculata* is absent from the arid and semi-arid parts of Iran and Central Asia and from the Levant.



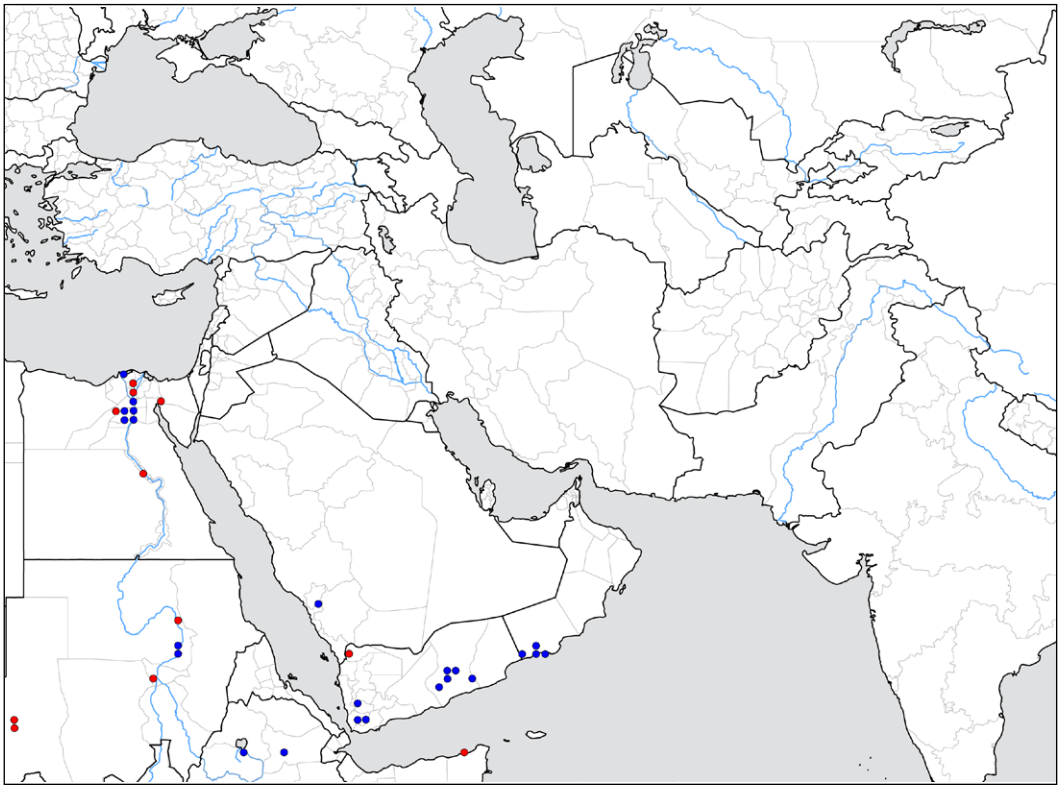
***Macrodiplax cora* (Kaup in Brauer, 1867) — Coastal Pennant**

Macrodiplax cora is a tropical Asian and Australasian species extending west to the south of the Arabian Peninsula. Here it is found in mainland Yemen, Socotra Island and especially Oman (Lambret et al. 2017). *Macrodiplax cora* is a well-known vagrant and migratory species, which has colonised several islands in the Indian Ocean and reached the eastern coast of Africa into Somalia and South Africa, where it also breeds. In the region covered in this atlas *M. cora* is primarily found at coastal lagoons, pools and estuaries, many of which are brackish (Lambret et al. 2017). There are also some observations from oases in the deserts of Oman.



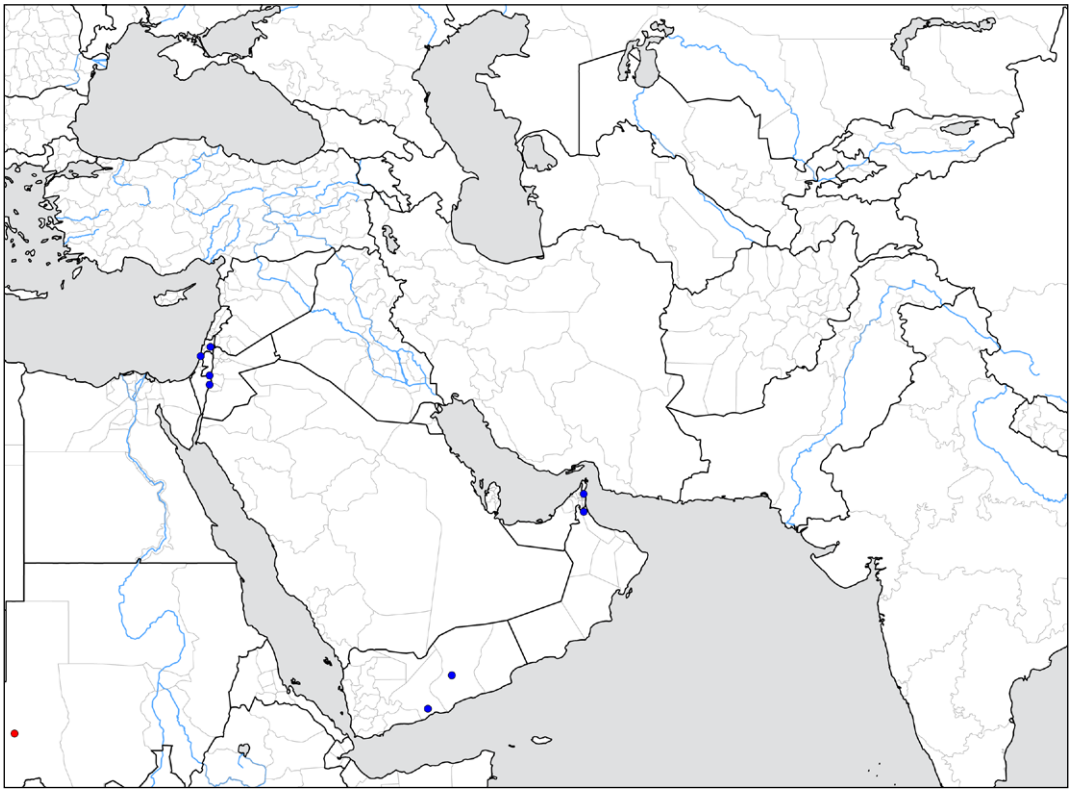
***Nesciothemis farinosa* (Förster, 1898) — Eastern Blacktail**

Nesciothemis farinosa is an African species, widespread in Sub-Saharan Africa extending northwards along the Nile valley to the Mediterranean coast where it is fairly common in the Nile Delta. In southern Arabia, it is found in the mountains of southwest Saudi Arabia and Yemen and, at lower altitudes, in the wetter Dhofar region of south Oman (Lambret et al. 2017). *Nesciothemis farinosa* is found at well vegetated and partly shaded pools and ponds as well as brooks and channeled headwaters.



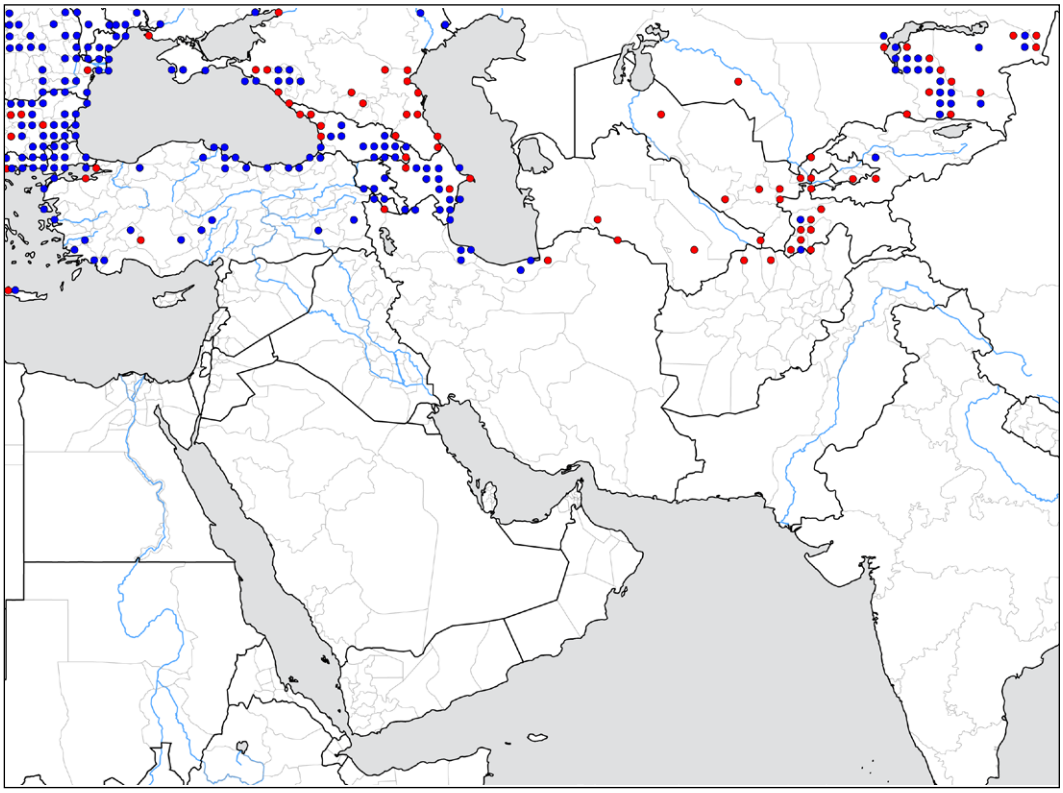
***Orthetrum abbotti* Calvert, 1892 — Little Skimmer**

Orthetrum abbotti is a common and widespread Afrotropical species found south of the Sahara. In the region of this atlas some isolated populations are found in the Dead Sea basin (Dumont 1977b, Waldhauser 2020), in Yemen (Dumont & Al-Safadi 1993, Schneider & Nasher 2013) and in northern Oman (Frankovic 2012). In 2013 and 2017 it was found significantly north of its Dead Sea range in the Israeli Territory, east of Tel Aviv and northwest of Beit Shean (pers. com. D. Bar-Zakay). In the United Arab Emirates a single vagrant male was photographed at Wadi Wurayah National Park (managing team, unpublished), close to the border of Oman. The widely scattered localities suggest that in desert and semi-desert regions, the species is able to find and colonise temporary habitats suitable for breeding. *Orthetrum abbotti* inhabits temporary and permanent seepage springs and headwater streams, but occurs also in standing waters, often in open landscapes.



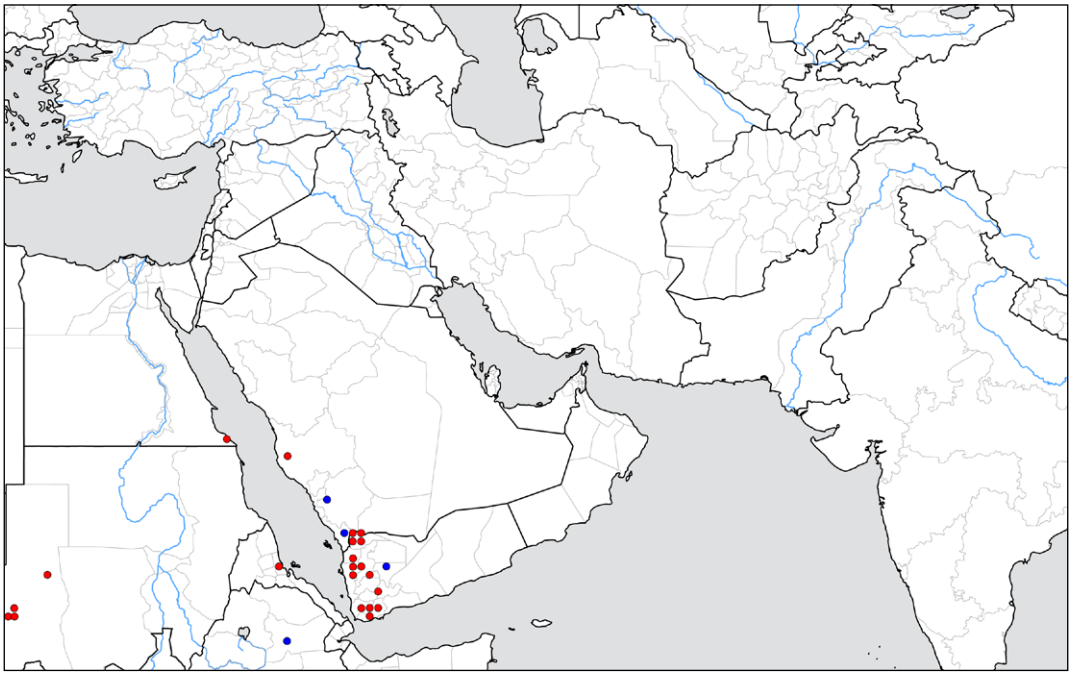
***Orthetrum albistylum* (Selys, 1848) — White-tailed Skimmer**

Orthetrum albistylum occurs predominantly in summer warm temperate regions, ranging from southwest Europe to Japan. In the region under consideration, it occurs from Turkey and the South Caucasus countries across northern Iran to Central Asia. *Orthetrum albistylum* occurs in a diverse range of standing waters such as fishponds, eutrophic lakes, pools and a wide range of man-made habitats. The species is also known to occur in slow flowing brooks.



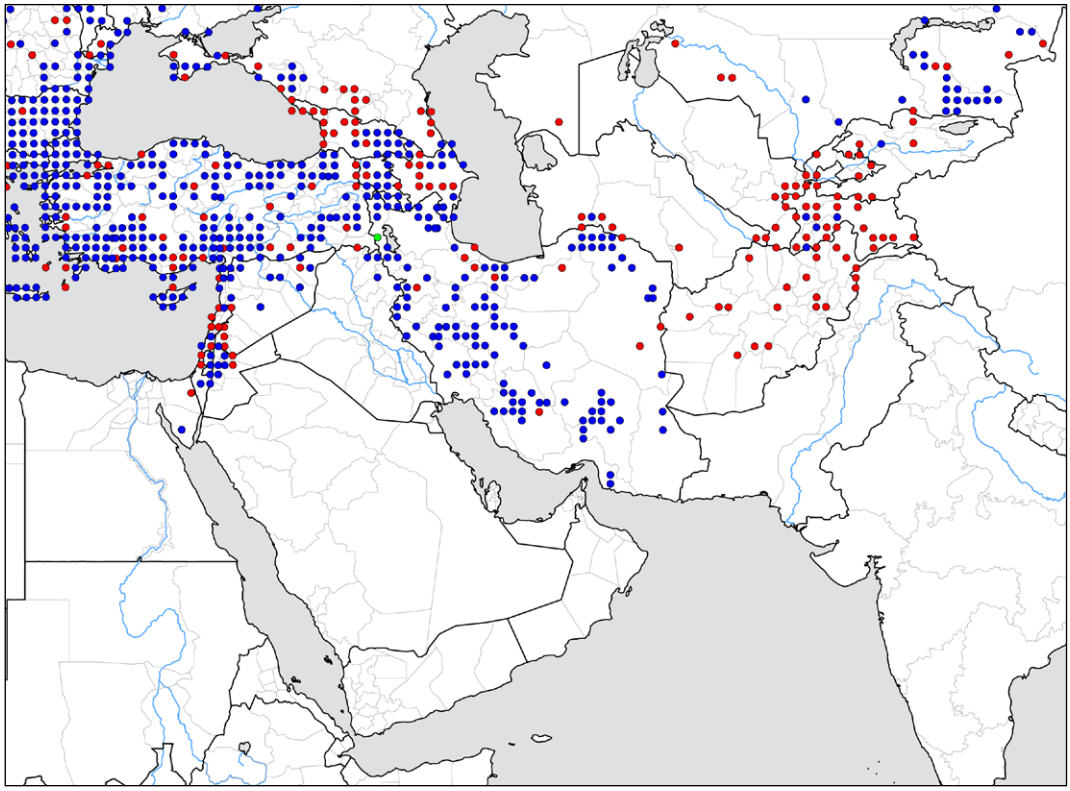
***Orthetrum brevistylum* Kirby, 1896 — Three-striped Skimner**

Orthetrum brevistylum looks very similar to and might be the sister species of *O. taeniolatum*. The two species are not known to overlap as *O. brevistylum* occurs from the southwestern margin of the Arabian Peninsula in Yemen and Saudi Arabia westwards across to both east and west Africa. *Orthetrum taeniolatum* is found to the north and east of this range, with the nearest records along the Persian Gulf in the Arabian Peninsula. Characteristics for use when separating these two species were redescribed by Dumont & Verschuren (2005) under the name *O. kollmannspergeri* Buchholz, 1959, which is a junior synonym of *O. brevistylum* (Clausnitzer & Dijkstra 2005). Many records prior to 2005 have been published as either *O. taeniolatum* or *O. kollmanspergeri*. In Africa *O. brevistylum* has been recorded from Sudan, Eritrea, Ethiopia Somalia, Nigeria and Ivory Coast. The habitat of *O. brevistylum* is not well known but in Africa it includes streams and temporary standing waters in open landscapes ranging from 200 to 2600 m a.s.l. (Dijkstra 2016). On the Arabian Peninsula it seems to be moderately common in the mountainous region in the west of Yemen and the southwest of Saudi Arabia, being found up to 2400 m a.s.l.



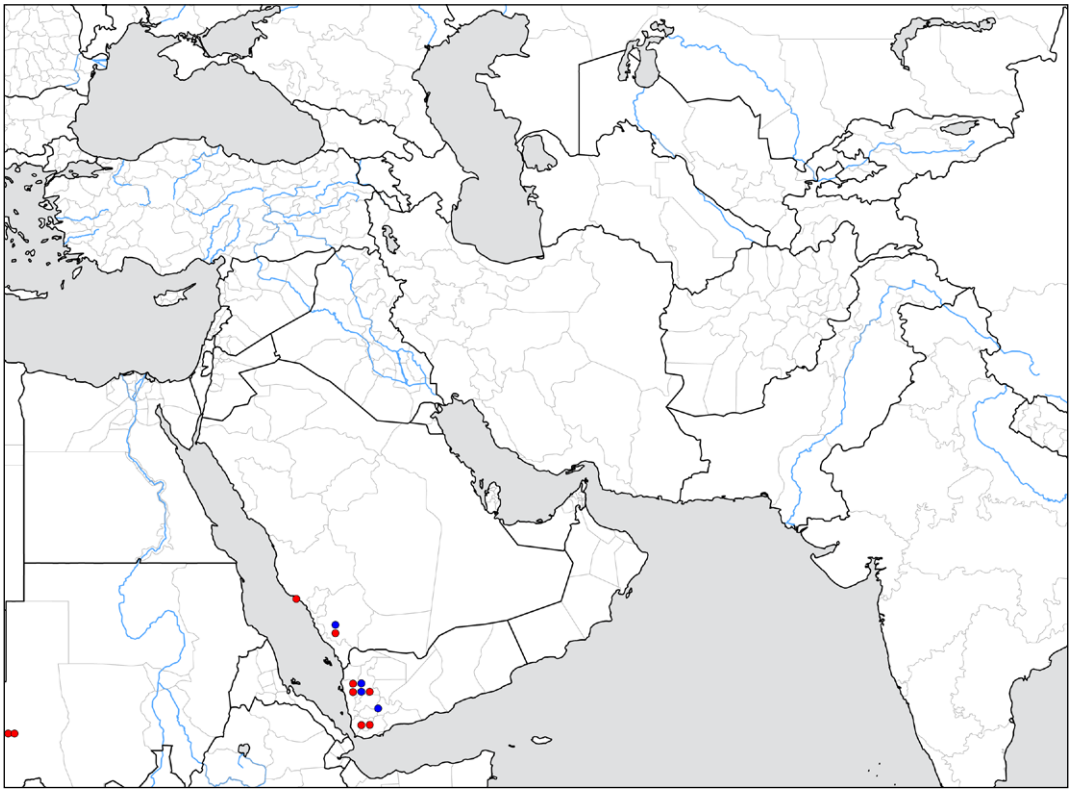
***Orthetrum brunneum* (Fonscolombe, 1837) — Southern Skimmer**

Orthetrum brunneum ranges from western Europe and Morocco in the west to Central Asia including Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan and Kazakhstan in the east. Further east in China, Mongolia and Korea it is replaced by its close relative *O. lineostigma* (Selys, 1886). The latter is regarded either as a distinct species or as a subspecies of *O. brunneum*. In West and Central Asia *O. brunneum* is one of the more common species of *Orthetrum* and occurs widely in all areas that are not too dry. It is absent from the Arabian Peninsula (although an incorrect record has been published from Yemen). The abundance of this species in the Levant, Turkey and Iran suggest that it is more widespread in northern Iraq than currently known. Its habitat ranges from streams, springs and seepage waters to ditches, shallow pools and quarries with little vegetation. The species generally has a clear preference for pioneer situations with little vegetation.



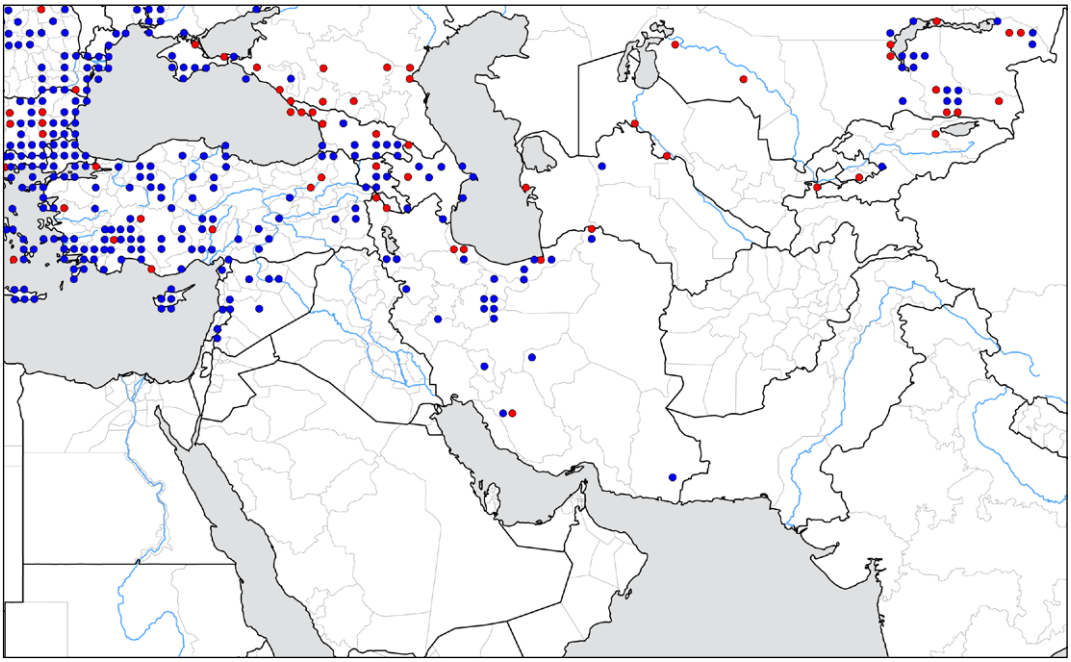
***Orthetrum caffrum* (Burmeister, 1839) — Two-striped Skimmer**

Orthetrum caffrum is an Afrotropical species widespread in large parts of Sub-Saharan Africa although missing from West Africa. It is common in Ethiopia whence its range extends to Eritrea and the southwest of the Arabian Peninsula (Clausnitzer et al. 2012). In the area covered by this atlas, *O. caffrum* occurs in the mountains of southwestern Saudi Arabia and western Yemen mainly at altitude between 1000 and 3000 m a.s.l. (one record at 350 m a.s.l.). In Africa, the species is mostly found in open landscapes: at temporary waters with emergent vegetation, springs, seepages and headwaters. It can also be found along slow flowing parts of rivers and permanent montane ponds (Suhling & Martens 2007, Samways 2008, Dijkstra 2020). In the Arabian Peninsula, it has been reported from wadis and man-made pools (Al-Safadi 1990, Dumont & Al-Safadi 1991, Schneider & Krupp 1993, Carfi et al. 1995, Schneider & Nasher 2013).



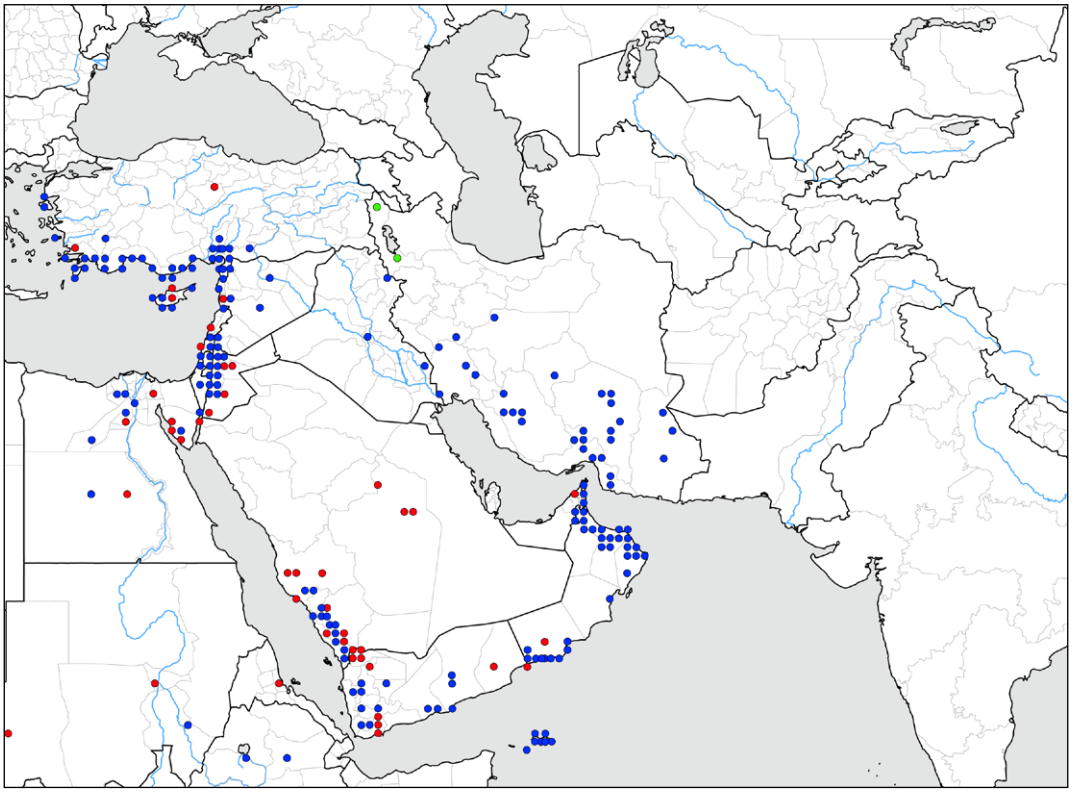
***Orthetrum cancellatum* (Linnaeus, 1758) — Black-tailed Skimmer**

Orthetrum cancellatum is one of the most common and widespread species in Europe and extends as far east as Central Siberia near Lake Baikal. In the region covered by this atlas, it is common in Turkey and the South Caucasus countries, becoming scarcer further east and south in Iran and the Levant. In Central Asia it is known only from scattered records in the lowlands. It is rare in the lower parts of Kyrgyzstan, but locally common in the adjacent areas of southeast Kazakhstan. Records from Baltistan in northeastern Pakistan suggest that it might occur in Afghanistan. It occurs in many water types but has a preference for standing waters with bare, sandy or rocky substrate. Some individuals found in Kazakhstan, Turkmenistan and the Chinese province of Xinjiang have yellow to light brown instead of deep black pterostigmas. These have been described as subspecies *O. c. kraepelini* Ris, 1897. However, this character only appears in some of the specimens found in this region and is better regarded as a regional intraspecific variability for which reason this subspecies is regarded as invalid. The Siberian subspecies *O. c. orientale* Belyshev, 1958 found in Siberia also has yellow to light brown pterostigmas and, until further data are provided, is also regarded as invalid.



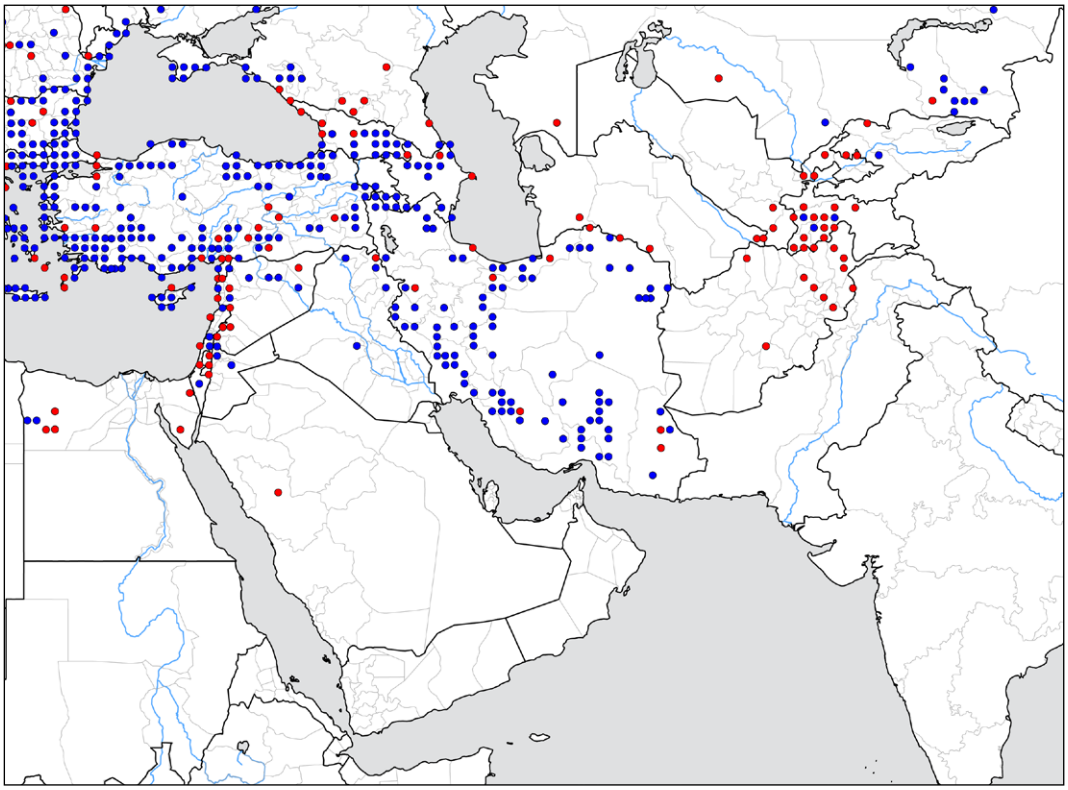
***Orthetrum chrysostigma* (Burmeister, 1839) — Epaulet Skimmer**

Orthetrum chrysostigma is among the most common African species and is widespread in the Arabian Peninsula, southern Iran, the Levant and southern Turkey. It breeds in a broad spectrum of habitats, from standing to slow-flowing waters, both fresh and brackish waters, and can also be found in arid and semi-arid environments. The species does not occur in the winter cold regions of Central Asia. In southeastern Iran *O. chrysostigma* co-occurs locally with its close relative *O. luzonicum*, which replaces it in Southeast Asia.



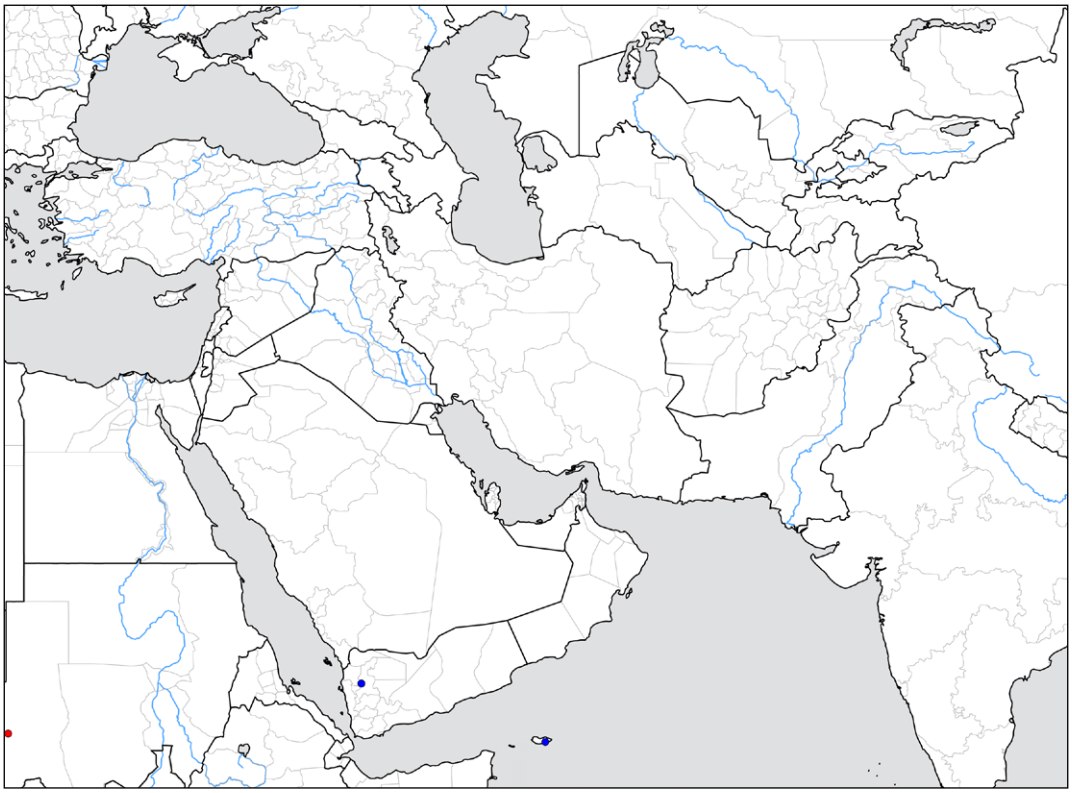
***Orthetrum coerulescens* (Fabricius, 1798) — Keeled Skimmer**

Orthetrum coerulescens is predominantly a western Palearctic species which ranges east to Central Asia and Pakistan. In the region of this atlas it is common in Turkey, the Levant, the South Caucasus countries, Iran and Central Asia, but is absent from the Arabian Peninsula and from the semi-arid parts of Central Asia. The subspecies found in this area is *O. c. anceps*, which is likely to have evolved from an eastern ice age refugium. The nominate subspecies, *O. c. coerulescens*, occurs in most of Europe. A large area of introgression between these two subspecies occurs in southeastern Europe and here most populations show intermediate characters making it impossible to identify them to subspecies level (Mauersberger 1994). *Ortherum coerulescens* primarily occurs in running waters in the southern half of its range whereas in the north and mountainous areas, it usually inhabits seepage springs, marshes, swamps and *Sphagnum* peat bogs.



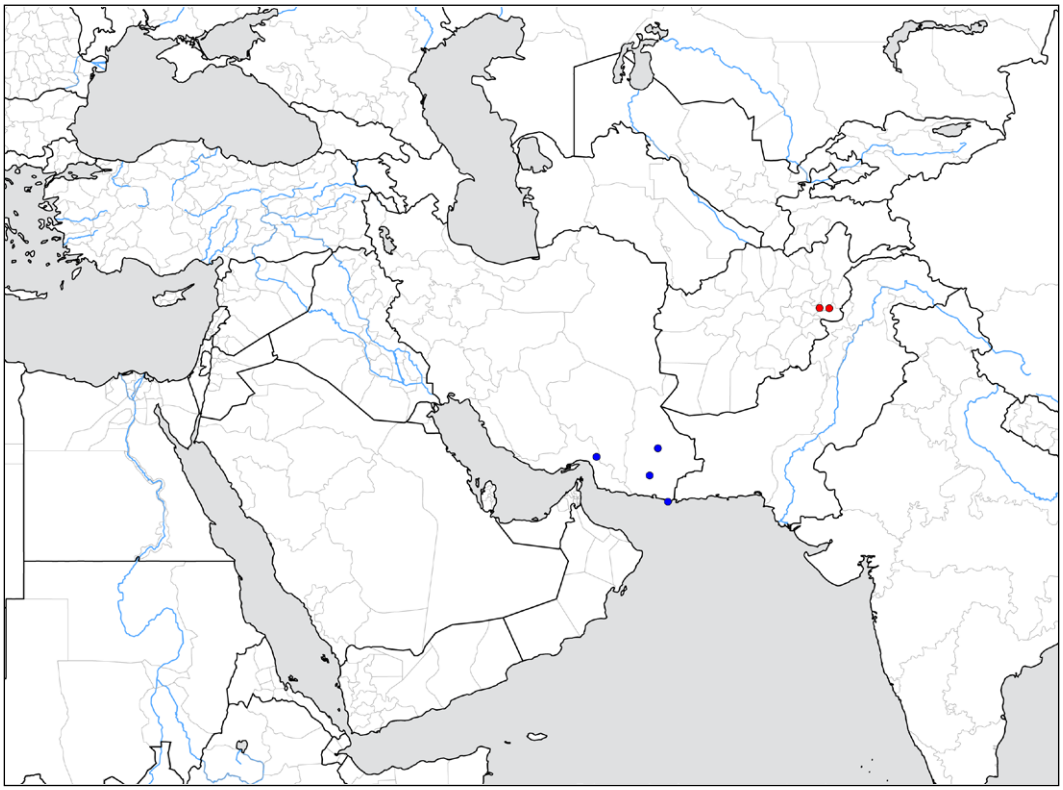
***Orthetrum julia* Kirby 1900 — Julia Skimmer**

Orthetrum julia is one of the most common African species, widespread south of the Sahara. The subspecies *O. j. falsum* Longfield, 1955 is found in Yemen and Socotra Island. In mainland Yemen it has been found at two nearby locations between 2200 and 2500 m a.s.l. (Schneider & Parr 1998, Schneider & Nasher 2013). On Socotra Island it is uncommon and known from a handful of localities only (Van Damme et al. 2020). In mainland Africa it is mostly found at streams, but can occur at standing and sometimes temporary waters. On Socotra it is mainly restricted to permanent shallow water with dense grassy vegetation.



***Orthetrum luzonicum* (Brauer, 1868) — Marsh Skimmer**

This species is common and widespread on the Indian subcontinent and in Southeast Asia. Until recently, *O. luzonicum* was often considered a subspecies of *O. chrysostigma* with scant attention being paid to its correct identification. As a result of this, little is known on its exact distribution in the area where the two species meet and overlap in range. Dumont & Heidari (1996) pointed out morphological differences and highlighted their co-occurrence in southeastern Iran, which argues in favour of their status as distinct species. Two old records from eastern Afghanistan (Schmidt 1961) are from the Nangarhar province and adjacent part of Kabul province, which might be the species' northwestern range limit.

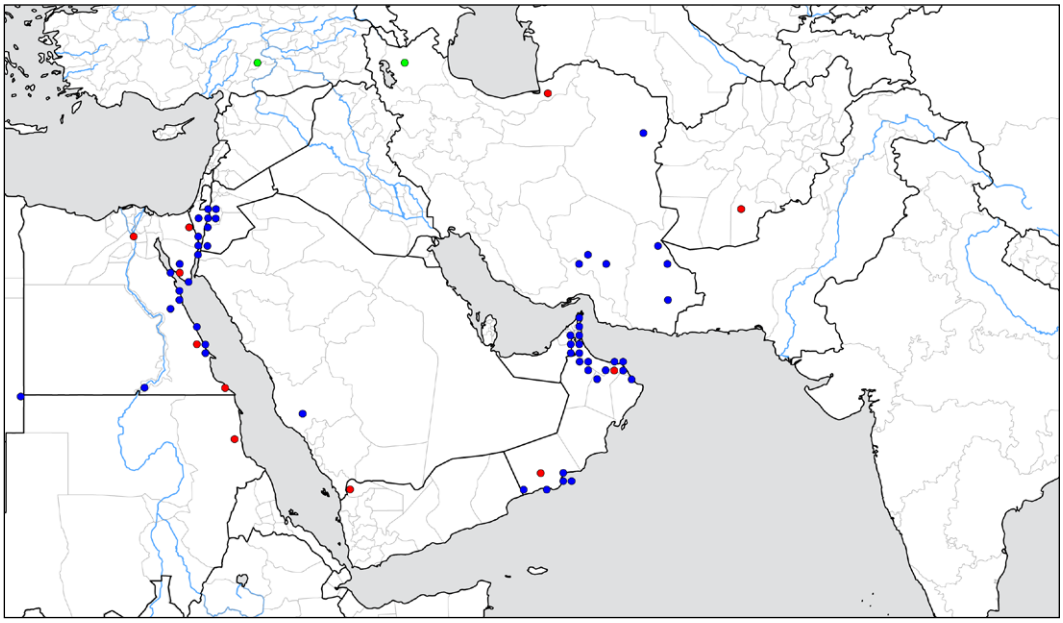


***Orthetrum pruinosum* (Burmeister, 1839) — Pink Skimmer**

The only records for *Orthetrum pruinosum* from the region covered by this atlas are from the northeast of Afghanistan at the border with Pakistan (Schmidt 1961). Further field work will probably show that this species is also present in the southeast of Iran. Males of *O. pruinosum* are very conspicuous with a broad red to purple-red abdomen and a dark purple thorax. The species is commonly encountered at seepages, puddles, ponds, wells, tanks, canals and murky rivers throughout the tropical and subtropical parts of the Oriental region. The species is common in India and the lower parts of Pakistan.

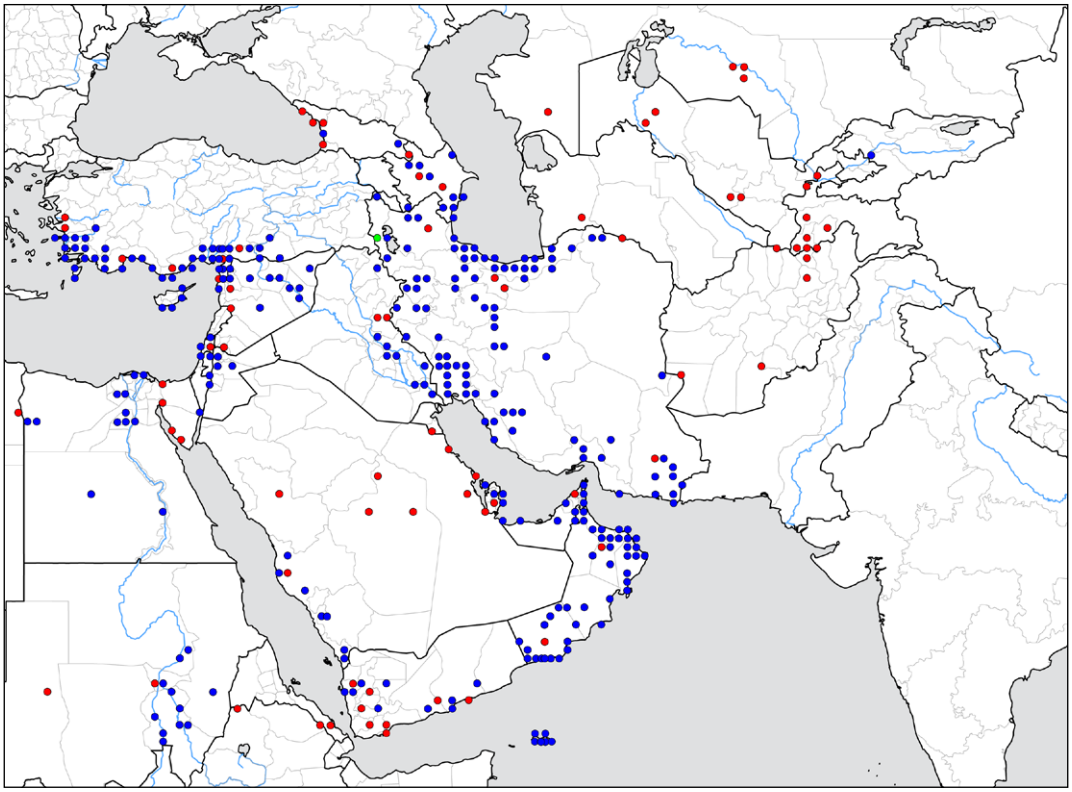
***Orthetrum ransonnetii* (Brauer, 1865) — Desert Skimmer**

This is one of very few true desert dragonflies found in Asia and Africa (hence its English vernacular name 'Desert Skimmer'). *Orthetrum ransonnetii* ranges from Afghanistan, Iran and the Arabian Peninsula through the Central Sahara up to Morocco and even the Canary archipelago, where it has been known since 2018 and where it also breeds. (Boudot et al. 2020, Nowak & Weihrauch 2021). The species occurs over a vast area but is rare in most of its range. Its main strongholds in the area of this atlas are the Hajar Mountains in northern Oman and the United Arab Emirates and in an area from the Sinai Peninsula to the south of the Dead Sea basin. In North Africa it is mostly found in the mountains of the central Sahara and the Anti-Atlas in Morocco. A record from northwestern Iran (Ghahari & Thipaksorn 2014) is considered doubtful, as well as a record from Malatia, Turkey by Selys (1887), which is possibly based on a mislabeled specimen (Boudot et al. 2020). The populations of the central parts of the Sahara have been known since 1914 but records further west are all of much more recent dates (Juillerat & Monnerat 2009, Boudot & De Knijf 2012, Durand & Renoult 2012, Mearns 2018). This might be the result of more intensive field work but is also believed to be partially due to a genuine range expansion. *Orthetrum ransonnetii* favours small flowing brooks and rivers in desert and semi-desert landscapes. It reproduces in both fresh and brackish water.



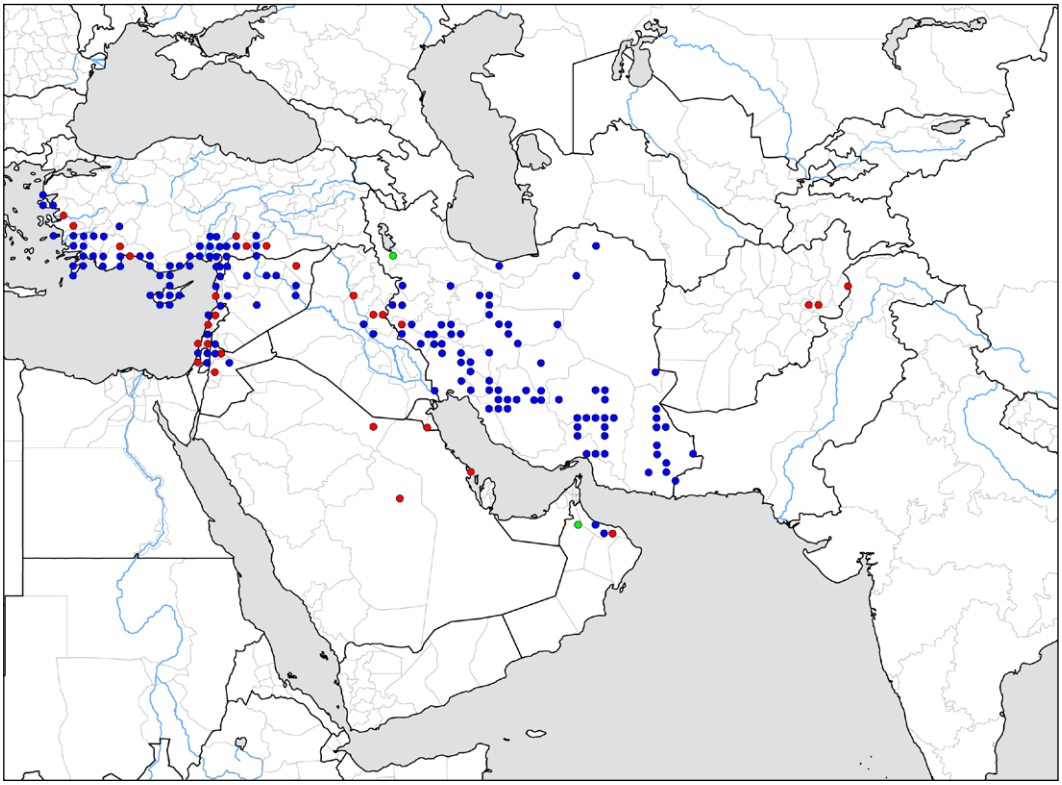
***Orthetrum sabina* (Drury, 1773) — Slender Skimmer**

This very common Oriental species occurs from North Africa across west Asia and the Indian subcontinent to southeast Asia and Australia. In addition, *O. sabina* is widespread and abundant along a thin stretch of the Mediterranean coast in Turkey, the Levant and Iran (Schneider & Ikemeyer 2019). In Arabia, it is common in Yemen and southern Oman and well represented in northern Oman and the United Arab Emirates. In the South Caucasus countries *O. sabina* is mainly found in the coastal areas of the Black Sea and the Caspian Sea. The majority of observations from Central Asia including the border area of Tajikistan and Afghanistan are only historical.



***Orthetrum taeniolatum* (Schneider, 1845) — Small Skimmer**

The range of *Orthetrum taeniolatum* extends from the Greek islands, Turkey and Cyprus in the west to the eastern parts of the Indian subcontinent. It is one of the most common dragonflies of Iran (Dumont & Heidari 1996) and is widely distributed from the Levant to the coastal areas of southern Turkey and Cyprus (Kalkman 2006, Sparrow et al. 2016). In the Arabian Peninsula, *O. taeniolatum* is known from a small number of scattered sites in the northeastern part of Saudi Arabia and from the Hajar Mountains in northern Oman. Old records from Afghanistan (Schmidt 1961) suggest that further field work might show that the species is widespread in parts of that country. *Orthetrum taeniolatum* prefers sunny slow-flowing waters in open landscapes. Its habitat is characterised by sparsely vegetated sections alternating with stretches of exposed sand or gravel; however, it can also be found on dams and pools (Sparrow et al. 2016).

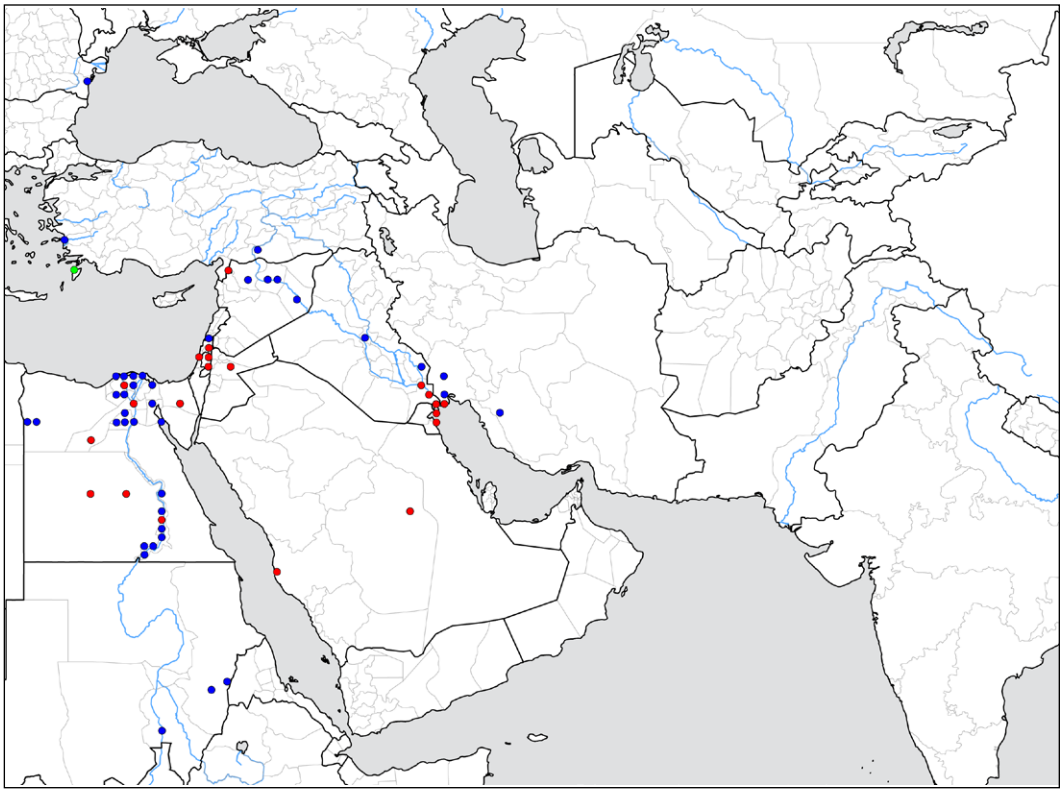


***Orthetrum triangulare* (Selys, 1878) — Triangle Skimmer**

Orthetrum triangulare is an Oriental species widely distributed from the Indian subcontinent to Southeast Asia. Within the scope of this atlas *O. triangulare* is only known from a single old record from the Kunar province in Afghanistan (Schmidt 1961). Due to lack of fieldwork the current status of *O. triangulare* in Afghanistan is unclear, but might be more widespread in southeastern Afghanistan given its wide occurrence in adjacent Pakistan and northern India.

***Orthetrum trinacria* (Selys, 1841) — Long Skimmer**

Orthetrum trinacria is a common and widespread species throughout most of Africa extending to the south of Europe. In the region covered by this atlas, it occurs throughout the Levant (Israel, Lebanon, Syria, Jordan and West Bank), southern Turkey, Syria and along the lower Euphrates and Tigris Rivers and marshes of southern Iraq and adjacent Iran and Kuwait. Two old records (1956 and 1957) are known from Saudi Arabia. *Orthetrum trinacria* is found at irrigation ditches and tanks in oases and at richly vegetated lakes, ponds, pools and marshes along large rivers.



***Palpopleura deceptor* (Calvert, 1899) — Deceptive Widow**

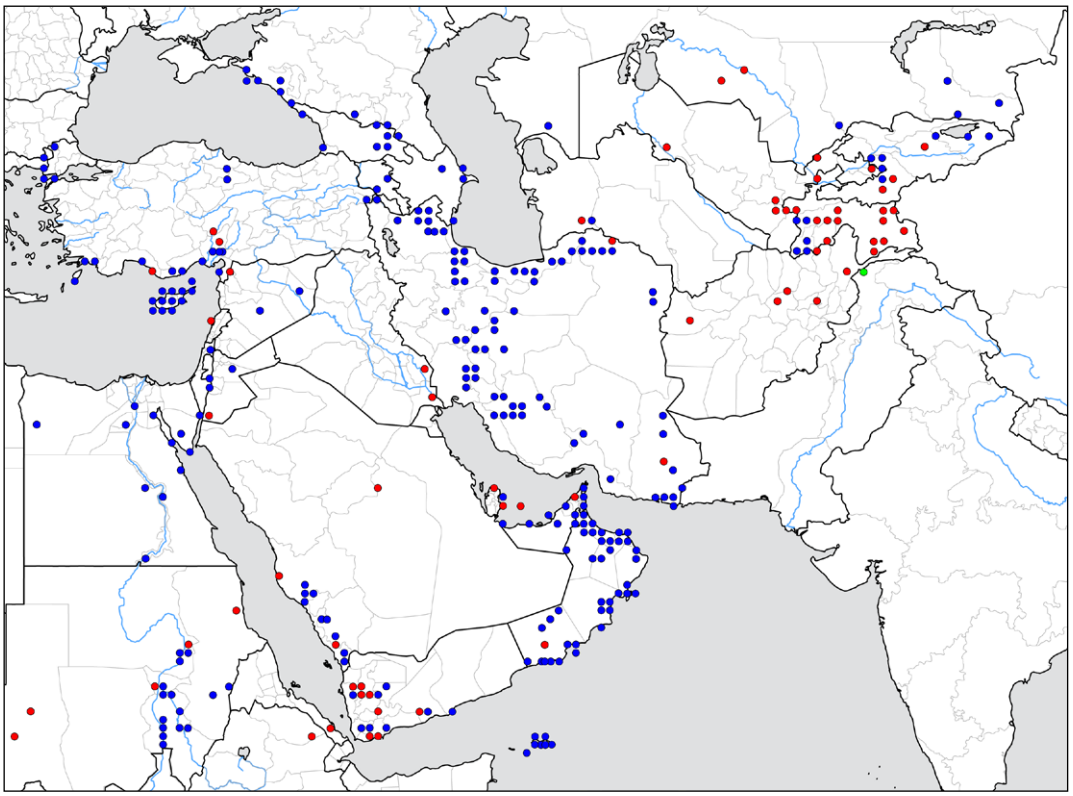
Palpopleura deceptor is common in most of Sub-Saharan Africa where it is primarily found in unshaded, standing, usually shallow, well-vegetated waters. The only record in the region covered by this atlas is that of a single female collected on 1st January 1989 at Wadi Jawwah in Saudi Arabia near the Yemeni border (Schneider & Krupp 1993). More recent field work in Yemen and the Omani Dhofar, the two most likely areas for African species to be observed or to establish a population, did not result in new records. For this reason, the record from Saudi Arabia is considered to be a vagrant.

***Palpopleura sexmaculata* (Fabricius, 1787) — Asian Widow**

Palpopleura sexmaculata is common and widespread at open, standing, often man-made habitats in the tropical part of mainland Asia. It is common in India and, although available records are limited, it probably also occurs commonly in parts of Pakistan and can be expected in the southeast of Iran. From our area only three records are known, all from the very east of Afghanistan collected in 1953 between 1100 and 1500 m a.s.l. (Schmidt 1961). Considering the lack of enthusiastic dragonfly volunteers in Afghanistan, the possibility exists that the species is more widespread in this country than currently known.

***Pantala flavescens* (Fabricius, 1798) — Wandering Glider**

Pantala flavescens is the most wide-ranging dragonfly in the world and is common on all continents with the exception of Europe and Antarctica. In recent years the number of records in Europe, West Asia and North Africa has increased, resulting in proof of successful breeding in several European countries (Günther 2019, Henseler et al. 2019, Lewandowska et al. 2020). The best documented expansion is from Cyprus where *P. flavescens* has been recorded annually as a scarce migrant from 2013 to 2017. In 2018 and especially 2019 it was found to be common and widespread (Sparrow et al. 2020a). In 2019 large numbers (at least tens of thousands) were also observed at the Goksu delta at the southeast coast of Turkey (pers. com. Michel Huysmans, Observation.org). Despite proof of local breeding, it is believed that the vast majority of individuals observed on Cyprus originate from other areas, most likely the Nile Delta (Sparrow et al. 2020a). It is likely that

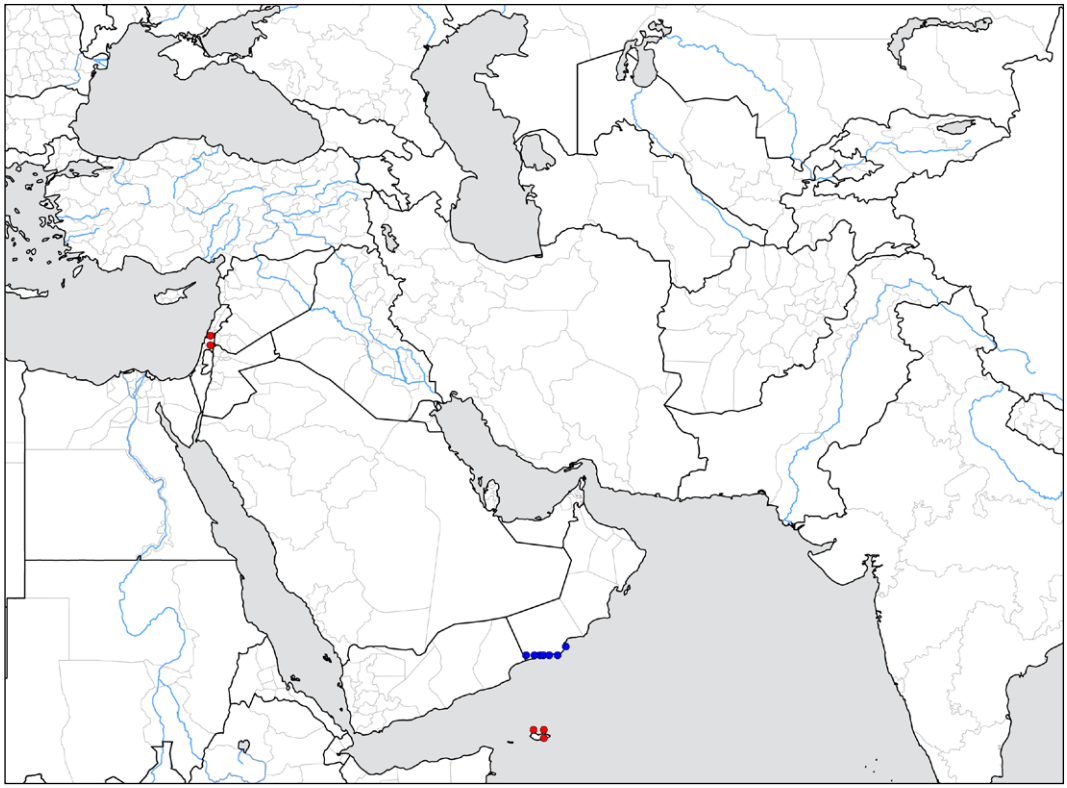


Pantala flavescens

such an increase has also taken place in other parts of this atlas region as suggested by the numerous records in Oman, northern Iran and the South Caucasus countries when compared to the scarcity of records in (southeast) Turkey and the Levant. The latter two areas have received relatively little attention in the way of field work in the past decade, allowing the probable increase of *Pantala* to have gone unnoticed there. In Central Asia, field investigations and isotopic evidences show that the species arrives in spring from East Africa and/or the Arabian Peninsula, reproduces locally and that the new generation migrates southwards towards India, Arabia and Africa in autumn (Borisov 2012, Borisov & Borisov 2019, Borisov et al. 2020b). *Pantala flavescens* is a strong wanderer and can be expected anywhere throughout the region. It mainly breeds in warmer regions in standing waters, often with little vegetation. Based on the records from Cyprus the main flight period in West Asia is from August to November whereas in Central Asia the species is present from spring to autumn.

***Rhyothemis semihyalina* (Desjardins, 1835) — Phantom Flutterer**

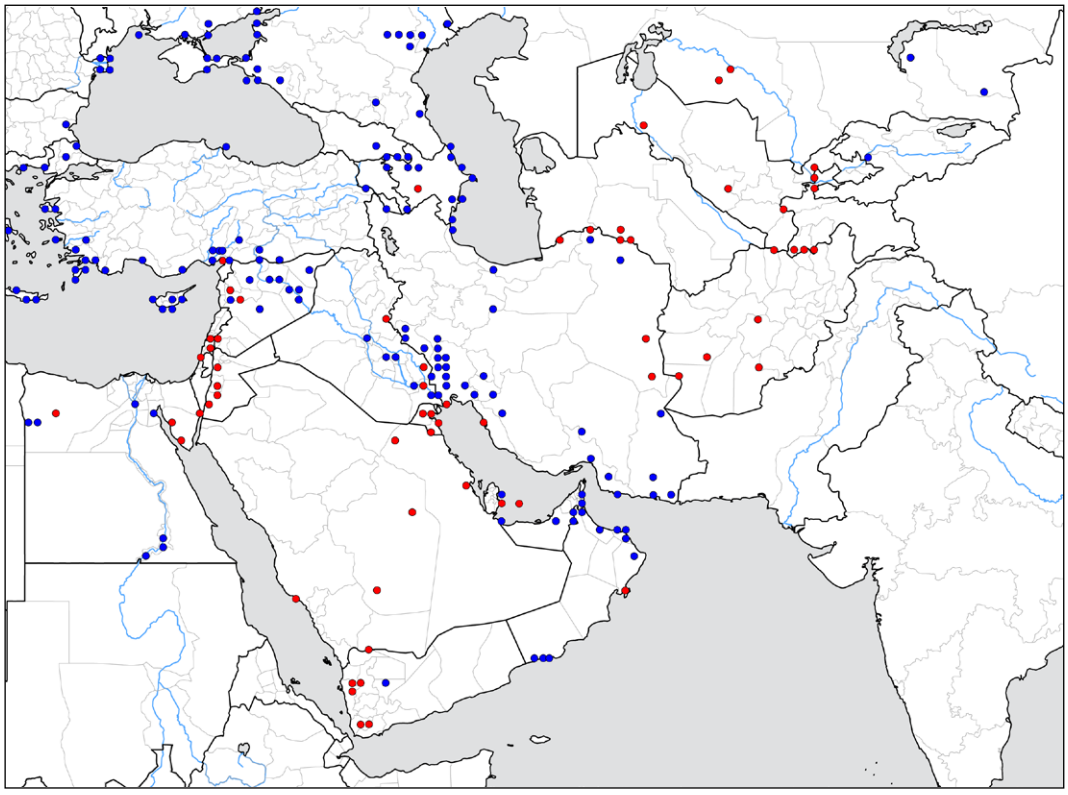
Rhyothemis semihyalina is common and widespread in most of Sub-Saharan Africa, where it is found at standing and slow flowing well vegetated water. Away from its key area, it has been recorded from northeast Algeria, northern Israel (as the poorly distinct, and no longer recognised, subspecies *R. s. syriaca* (Selys 1850)), the Dhofar region of Oman and Socotra Island. The last records date from 1840–1842 in Algeria (Selys in Lucas 1849), from 1953 in Socotra (Kimmins 1961), and from 1954 in Israel (Dumont 1975a). As a result, *R. semihyalina* is considered to be extinct in these three countries. In the area covered by this atlas, the only known populations are present in southern Oman (Lambret et al. 2017).



***Selysiothemis nigra* (Vander Linden, 1825) — Black Pennant**

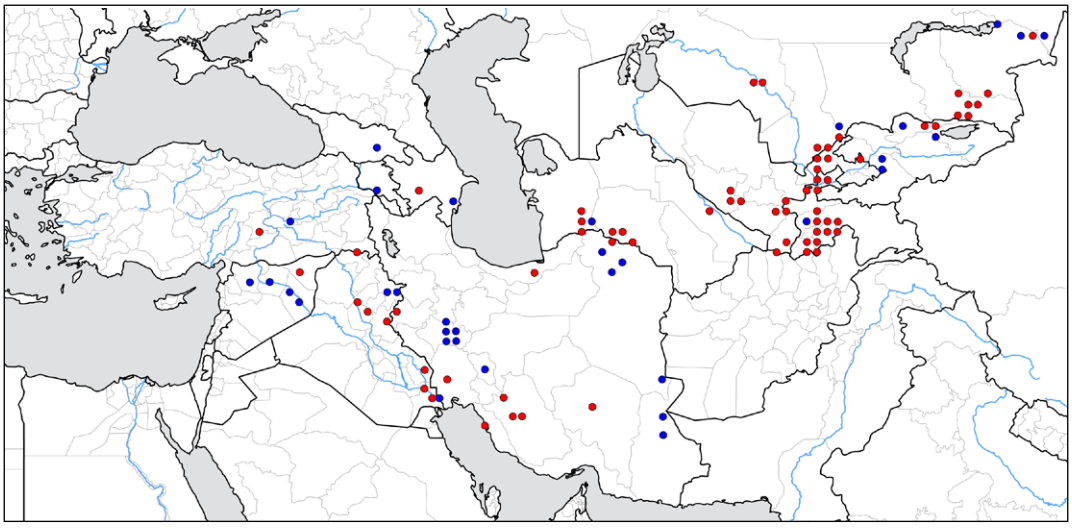
Selysiothemis nigra has a large range extending from the Mediterranean to China but is generally rare throughout its range although common and abundant in some regions. The eastern part of its range is poorly known. It occurs in parts of the Indian Peninsula and has been recorded from the Chinese provinces of Inner Mongolia, Beijing, Liaoning and Hebei (Zhang 2019). It occurs throughout the region discussed in this atlas but is largely absent from the more mountainous areas. It has been observed regularly in Cyprus, the Mediterranean coast in Turkey, Syria, the southern border region of Iran and Iraq, Azerbaijan and the north of Oman and adjacent United Arab Emirates. In Central Asia most records are old but it is unclear if this reflects a decline or a lack of recent field work. The number of records have increased in the West Mediterranean and along the Black Sea in Ukraine, although the overall species range remains largely unchanged. In

Ukraine this increase seems to be related to the availability of new man-made habitats (ponds, irrigation reservoirs, gravel pits) (Martynov et al. 2015). *Selysiothemis nigra* is a strong wanderer well able to colonise new or temporary habitats. It occurs at fresh and brackish waters often in coastal areas, and in seasonal ponds in arid environments.



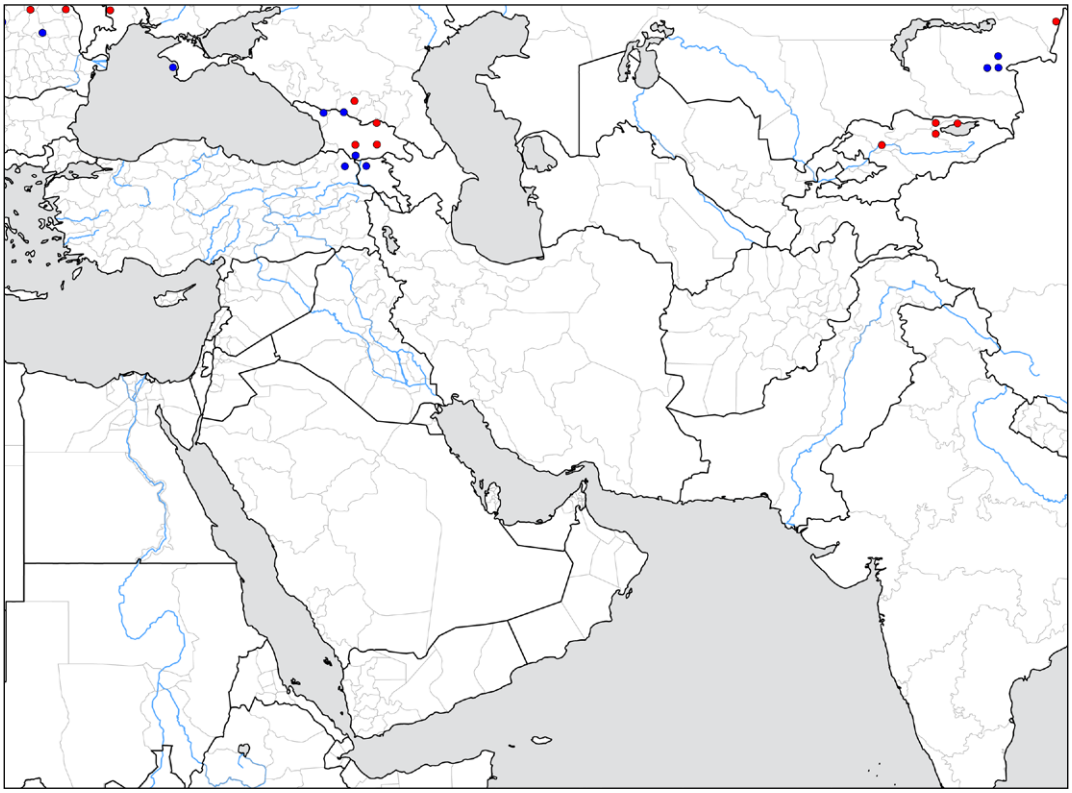
***Sympetrum arenicolor* Jödicke, 1994 — Sandy Darter**

Sympetrum arenicolor ranges from Turkey, Syria, Iraq, the South Caucasus countries, Iran to Central Asia. It is common and widespread along the foothills and adjoining plains of the Tian Shan and Pamir-Alay ranges in Central Asia, which roughly corresponds to the catchment areas of the Amu Darya and Syr Darya River. It is also present in the Kopet Dag Mountains along the border of Turkmenistan and Iran. Most records from Iran are from the Zagros Mountains (Kosterin & Ahmadi 2018, Schneider & Ikemeyer 2018) and the species is also present along the river valleys of Euphrates and Shatt al-Arab in Syria and Iraq. The first authenticated and well documented records from Turkey and the South Caucasus countries date from after the turn of the millennium and refer to single individuals only (Kalkman 2006, Jödicke et al. 2009, Schröter 2010a, Ananian & Muddeman 2019). *Sympetrum arenicolor* is not known but is likely to occur in Afghanistan considering the nearby records in Iran, Tajikistan and North Pakistan, where there is an old record from Quetta (Morton 1907). This species is primarily found along mountain streams (Schneider & Ikemeyer 2019), but can be encountered almost everywhere from the plains up to the treeline. It is seldom abundant and is typically encountered as isolated individuals. The species has a specialized life cycle with postponed reproductive maturation and seasonal migration to mountainous aestivation refuges after emergence in spring and early summer (Borisov 2006a). It is unclear whether *S. arenicolor* is genuinely rare in this region or simply overlooked due to its resemblance to other *Sympetrum*-species and late flight season.



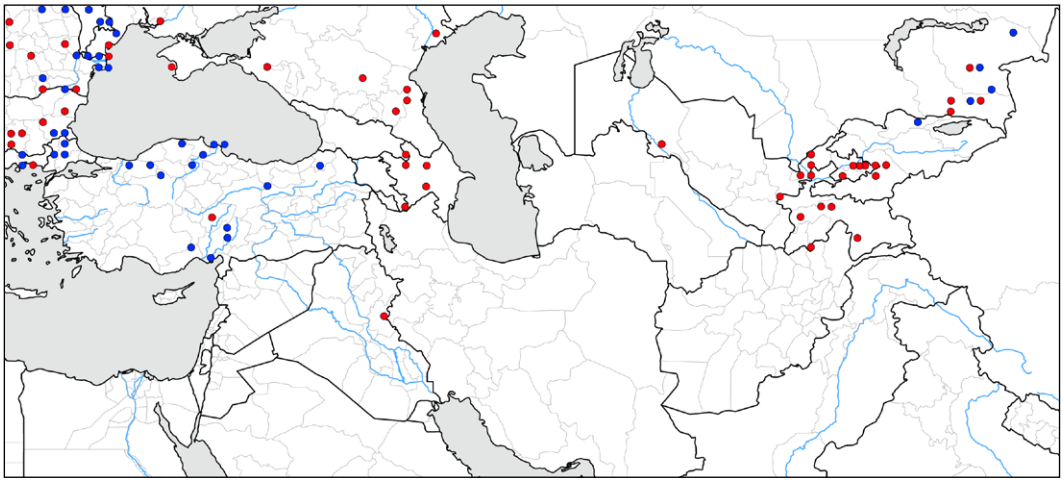
***Sympetrum danae* (Sulzer, 1776) — Black Darter**

Sympterum danae has a vast Holarctic range and is widespread in the temperate part of Europe and Asia. In the area of this atlas, this species is very rare and restricted to the extreme northern part, being present in both the Tian Shan Mountains in Kyrgyzstan and in the South Caucasus countries. The records from the Dzungarian Alatau (Kosterin & Borisov 2010) in southeastern Kazakhstan suggest that the Kyrgyz population might be connected via the Tarbagatai Mountains with the main range of the species in Siberia. Conversely, the Caucasus population appears to be isolated and limited to the north by a broad belt of dry lowland steppes where the species is unlikely to occur. The only Turkish record refers to a single female collected at Ardahan province in the Turkish part of the Armenian highlands (Miroglu 2011).



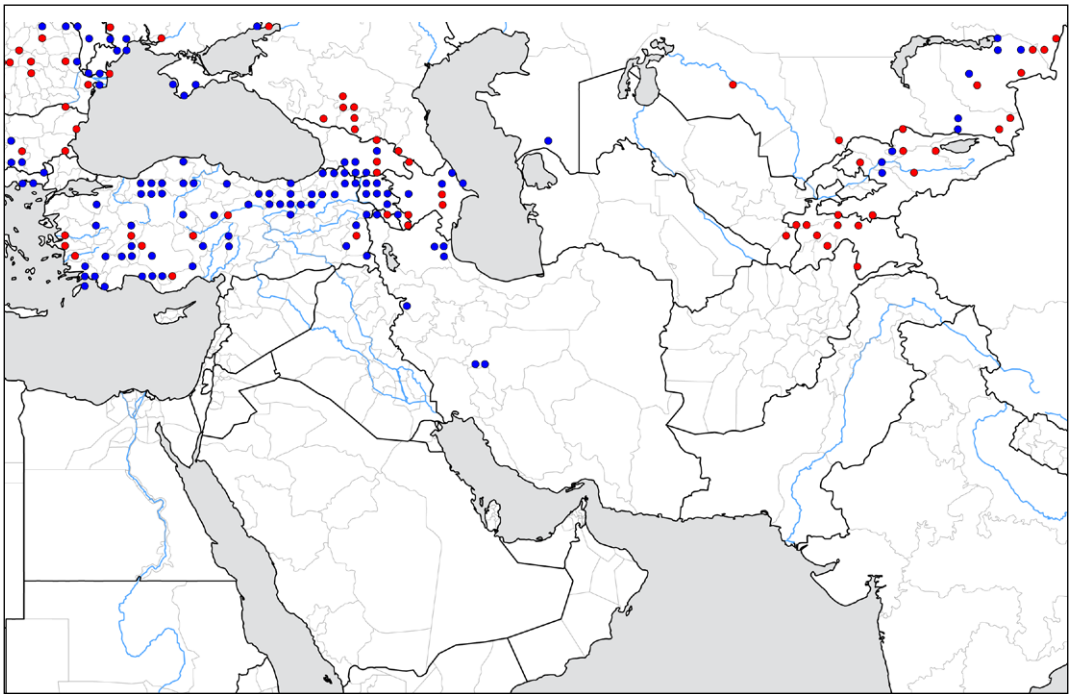
***Sympetrum depressiusculum* (Selys, 1841) — Spotted Darter**

Sympetrum depressiusculum ranges from western Europe to Japan but is uncommon to rare in large parts of its range. The species favours habitats with an unusual seasonal water regime, reaching its highest densities in localities which dry out in late summer and during the winter period. In such habitats there is no competition from fish or Aeshnidae whilst the low water table ensures high temperatures and high prey densities enabling the larvae to emerge from the egg in spring and complete development to emerge in summer. Under natural conditions these kinds of situations occur in lakes and floodplains which are fed by meltwater from nearby mountains. This kind of water regime can also be found at fish ponds and paddy fields although, at least in Europe, changes in management have resulted in a strong decline of the species in such areas (e.g. in rice fields in Italy and France). In western Asia the species is rare and is confined to Turkey, Georgia and Azerbaijan. The species is not known from Iran but surprisingly there is one record from 1958 from eastern Iraq (Sage 1960a, b), of which confirmation is required. In Central Asia, *S. depressiusculum* is restricted to the more mountainous eastern area extending from Tajikistan to eastern Kazakhstan with the exception of one odd record in the west of Uzbekistan (Bartenev 1915). Most of the records are from before 1990 which partly reflects the lack of field work in the area but might also be partially caused by a decline of the species. The only recent record from Central Asia is from Kyrgyzstan (Schröter 2010a) where a large population was found at backwaters and flood ponds at the fringes of the remaining riparian Tugai forest of the river Chui at the border with Kazakhstan. Several recent records are known from the southeast of Kazakhstan, not far from this location.



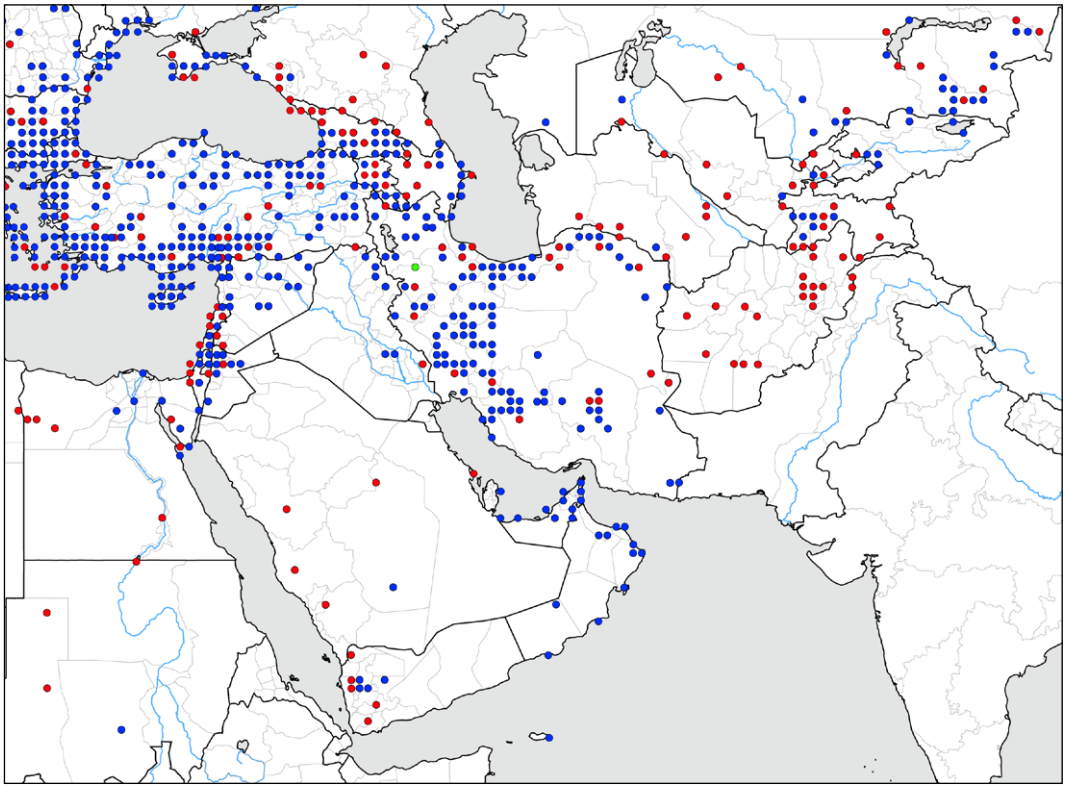
***Sympetrum flaveolum* (Linnaeus, 1758) — Yellow-winged Darter**

Sympetrum flaveolum is a wide ranging species occurring from western Europe across the northern part of the Palearctic reaching east as far as Kamchatka in Russia and Japan. In the south of its range stable populations are largely confined to mountain areas with records from the lowland often being the result of influxes resulting in short lived populations. In the area covered by this atlas, populations are restricted to the mountains of Turkey, the South Caucasus countries and to northwestern Iran, with a seemingly isolated southern ccurence in the Zagros Mountains in Iran. In Central Asia it is widely distributed in Tajikistan, Kyrgyzstan and Kazakhstan. This species often co-occurs with *Lestes dryas* in swamps which partially dessicate during summer. Large populations are also found at peat bogs in late succession stage where depressions are seasonally flooded, as well as in pools, ponds and small lakes characterised by swampy riparian zones. Populations from Turkey and the South Caucasus are reputed to show a more reduced yellow area in the wings than in other regions and have been described as subspecies *S. f. austrinum* Akramowski, 1948. This variation, which also occurs in lower numbers in Europe, is no longer recognised as a valid subspecies.



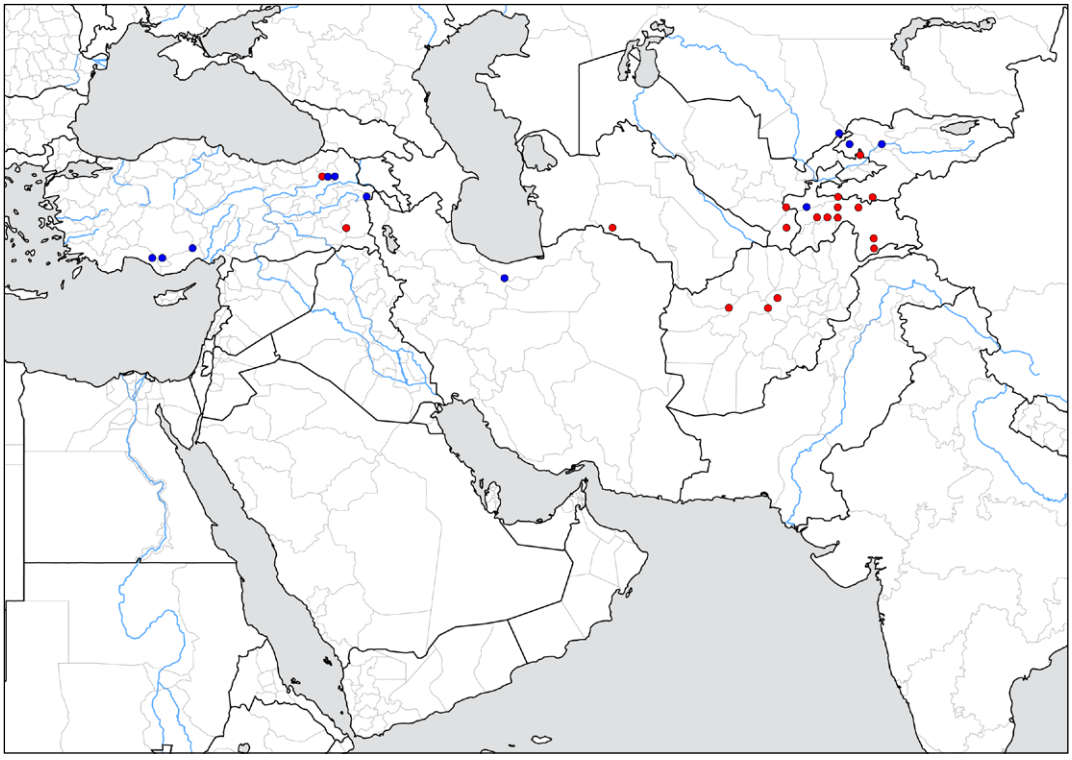
***Sympetrum fonscolombii* (Selys, 1840) — Red-veined Darter**

The Afrotropical *Sympetrum fonscolombii* is a strong migrant and is widespread and often common from the Atlantic coasts of Europe and North Africa to the Balkans, Turkey, the Levant and Iran. The records become more and more scattered towards Central Asia and it only occurs sporadically in the Arabian Peninsula. In Central Asia regular two-way seasonal migrations are known, originating from southwest Asia below ca. 36°N in spring and reaching the south of the Urals and western Siberia to 54–55° in the north. The descendants of these spring migrants fly south in autumn with the maximum combined migration distance exceeding 4000 km over two generations (Borisov 2009a, 2011, 2012, 2015, Borisov & Borisov 2019, Borisov et al. 2020a). More to the east, records of migrants are also known from Mongolia, China and Japan. The species favours standing waters such as dam lakes constructed on rivers, rice fields and temporary ponds.



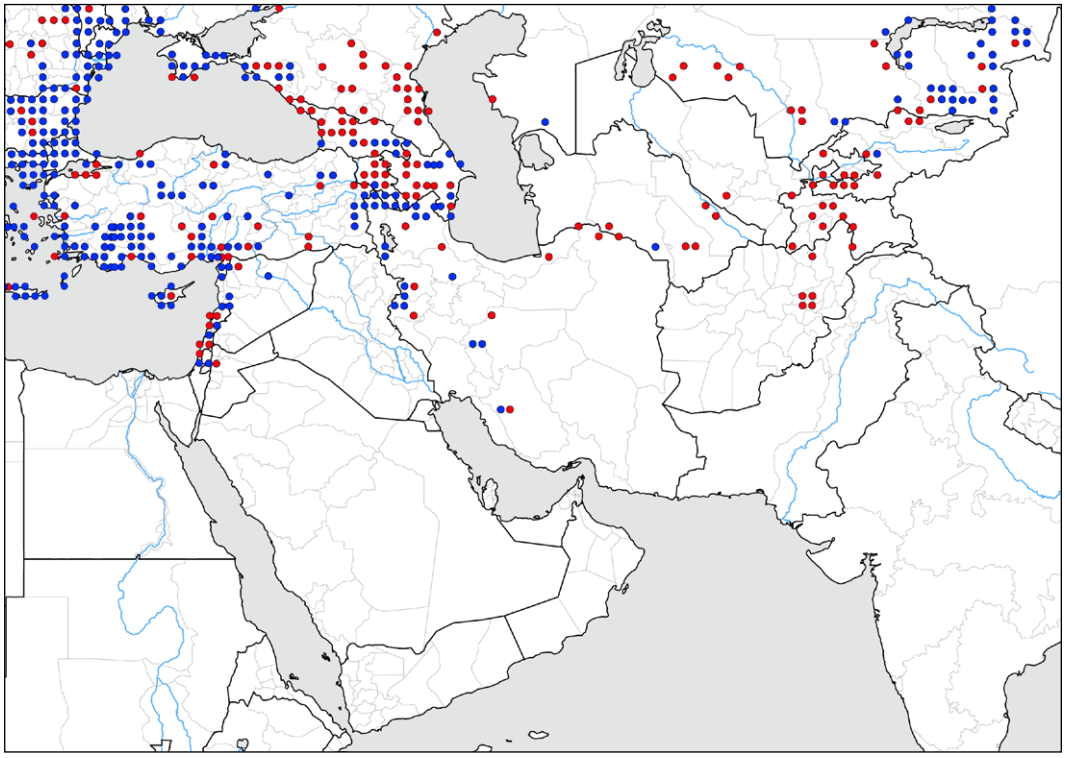
***Sympetrum haritonovi* Borisov, 1983 — Dwarf Darter**

Sympetrum haritonovi is a West and Central Asian mountain species distributed from Turkey over northern Iran to Central Asia. In Turkey it has only been found in the Taurus Mountains in the south and at high altitudes in the east. Recently a large population of *S. haritonovi* was discovered in the Armenian highlands of northwestern Iran (Schneider & Ikemeyer 2017). The species has also been found in the Alborz Mountains in northern Iran and in the Kopet dag Mountains in Turkmenistan. *S. haritonovi* appears to have its strongholds in the eastern Pamir and Tian Shan in Central Asia and is also found at several locations in Afghanistan. The known populations range from 780-800 m a.s.l. in the mountains of the Kopet Dag to 3550 m a.s.l. in thermal springs in the eastern Pamirs (Borisov & Haritonov 2004, Borisov 2015a). This small species occurs in sparsely vegetated swamps or spring meadows fed by groundwater seepages or streams both on the mountain slopes and on floodplain terraces.



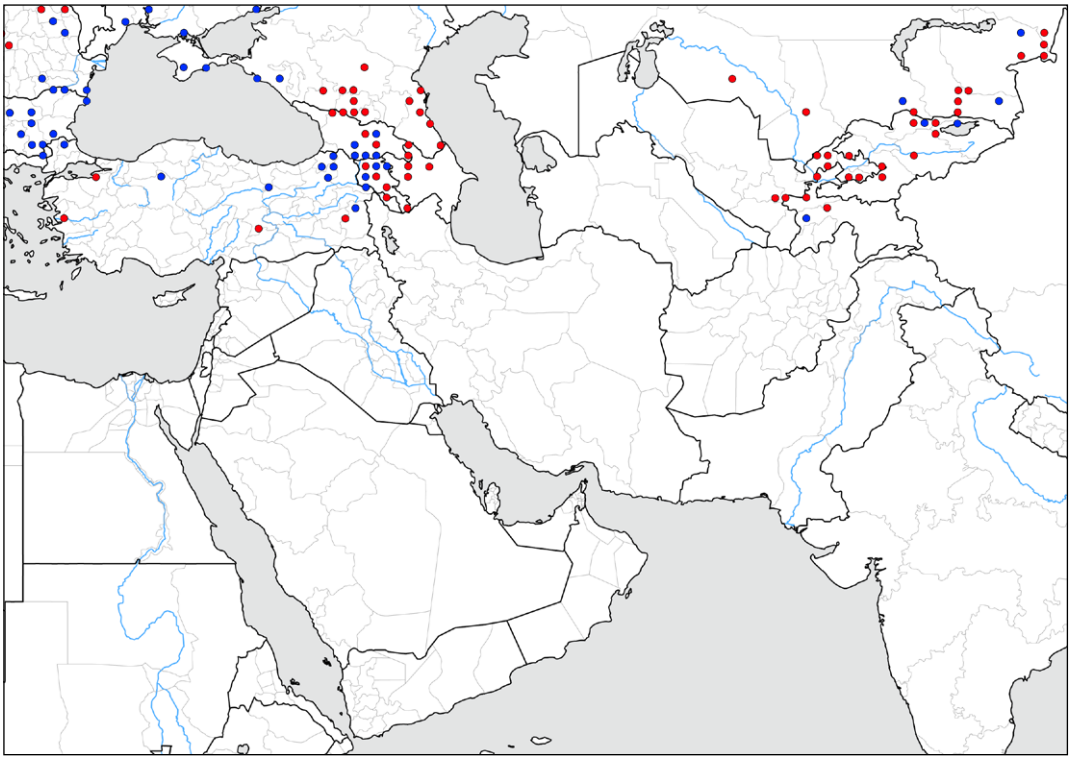
***Sympetrum meridionale* (Selys, 1841) — Southern Darter**

The main range of *Sympetrum meridionale* extends from the southern half of Europe over Turkey, the Levant, Iran to Central Asia. As a result of the increased summer temperatures in recent decades, the species has expanded its range northwards in Europe. In western Asia, *S. meridionale* is common in Turkey, Cyprus, the northern part of the Levant and the South Caucasus countries. In Iran it is remarkably scarce and largely confined to the north and the west of the country. In Central Asia it is absent from the arid parts and is mainly found in the more mountainous east, particularly from Tajikistan across Kyrgyzstan to southeast Kazakhstan. To the south, it is present in northern Afghanistan and further east to the Indian part of Kashmir. At least in Central Asia the species shows two-way seasonal vertical migrations with the lowland spring generation migrating to higher elevation for aestivation and sexual maturation, returning to the plains for oviposition in autumn (Borisov 2009b, 2014b). *Sympetrum meridionale* usually breeds in pools and ponds and in brackish coastal areas.



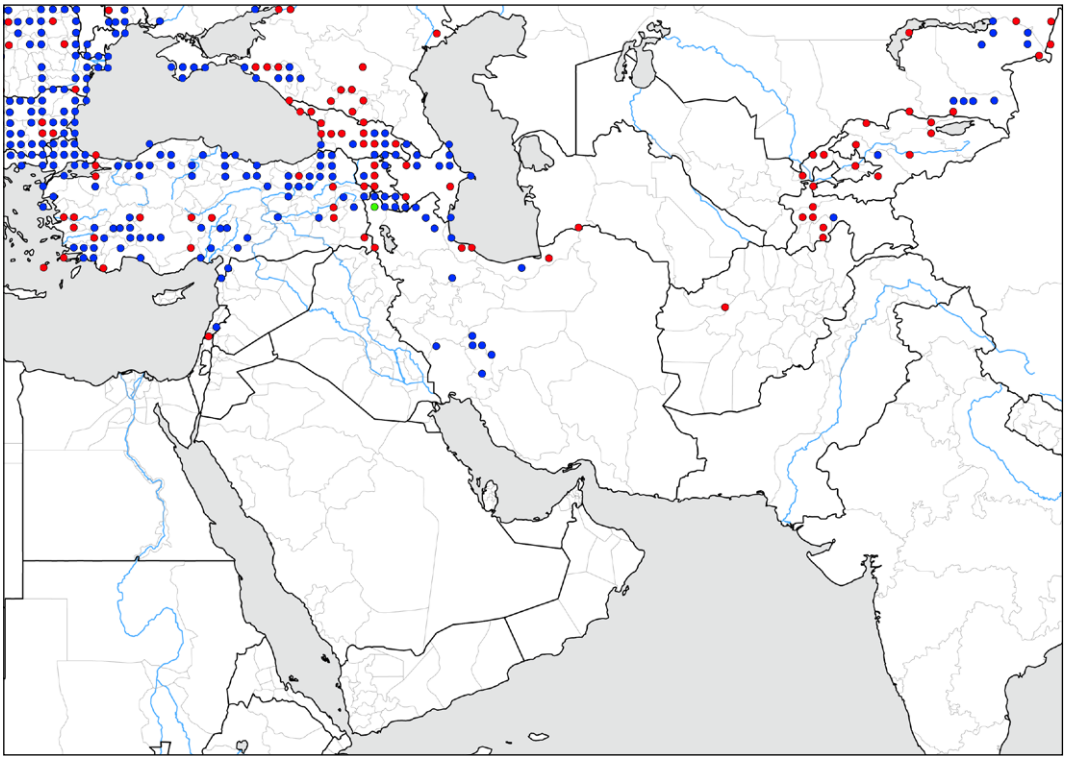
***Sympetrum pedemontanum* (Müller in Allioni, 1766) — Banded Darter**

Sympetrum pedemontanum ranges from western Europe to Japan in the east. In West Asia the species is rare and is confined to Turkey, Armenia, Georgia and Azerbaijan. In Central Asia it is more common occurring on both the lowlands and foothills of the mountains. *Sympetrum pedemontanum* has a clear preference for open sunny waters, either standing or slow-flowing with extensive helophyte vegetation. In standing water habitats, the species prefers places that are partially inundated during late winter and spring and fall dry later in the season. In Central Asia such habitats are available at the foot of mountains (hence its name *pedemontanum*) where marshes and floodplains are fed by snowmelt in spring. Here it often co-occurs with *S. depressiusculum* which favours similar habitats.



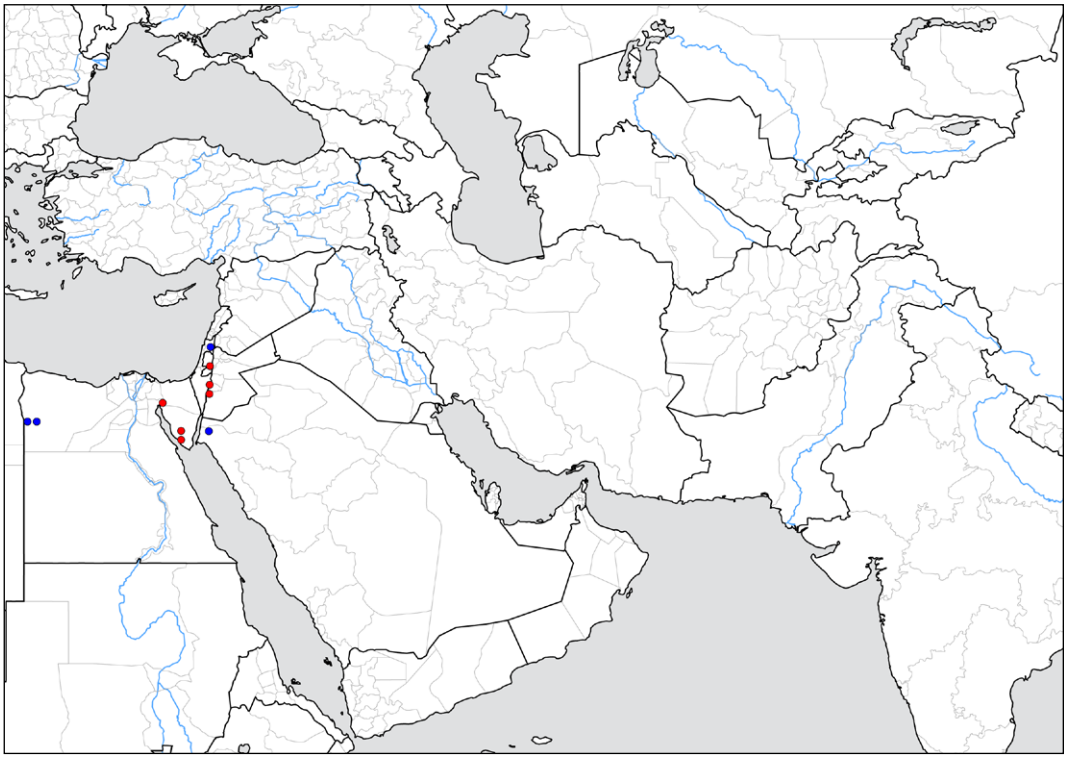
***Sympetrum sanguineum* (Müller, 1764) — Ruddy Darter**

Sympetrum sanguineum ranges from western Europe and the northern Maghreb to western Siberia and western Mongolia. Asian subspecies with yellow stripes on the legs and/or more yellowish wings than the nominotypical West European populations have been described as *S. s. armeniacum* Selys, 1884 (Turkey, northwestern Iran, Tajikistan, Uzbekistan) and *S. s. obsoletum* Bartenev 1919 (Kazakhstan, Kyrgyzstan, Mongolia, Russia). Their taxonomic status remains to be confirmed through modern genetic tools. In West Asia, *S. sanguineum* extends across Turkey, the South Caucasus and the western and northern parts of Iran. It is rare in the Levant and has not been recorded from Iraq. In Central Asia records are available from Afghanistan across Tajikistan, Kyrgyzstan, eastern Uzbekistan and east Kazakhstan to Altai and west Mongolia. The species breeds mainly in standing waters such as marshes, pools, ponds and lakes.



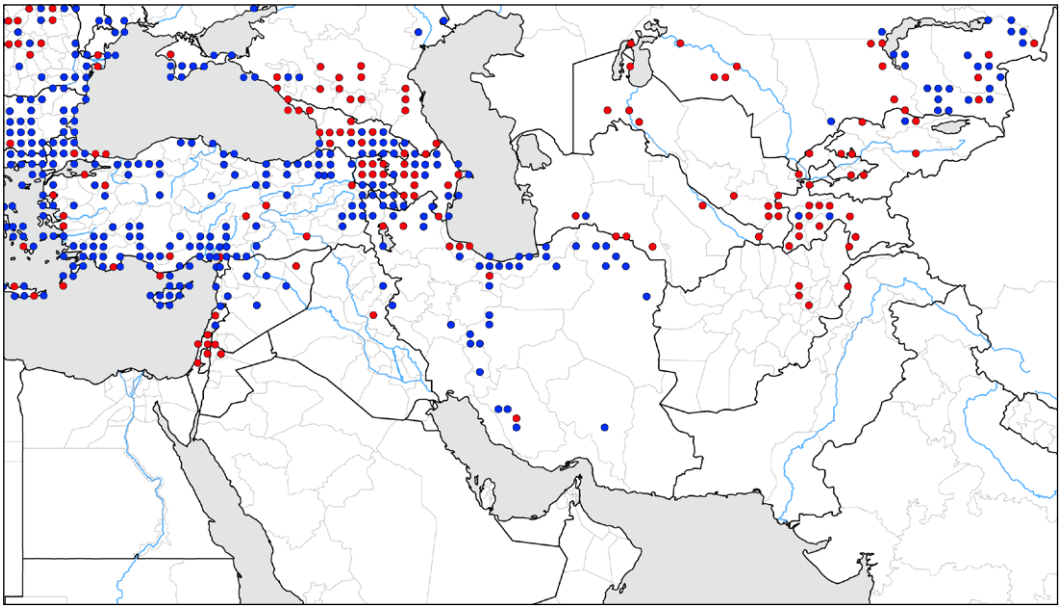
***Sympetrum sinaiticum* Dumont, 1977 — Desert Darter**

Sympetrum sinaiticum occurs in North Africa and Spain and reaches as far east as the southern Levant. The species is closely related to *S. arenicolor* which occurs in northeastern Syria, Iran and Central Asia. *Sympetrum sinaiticum* has been found in Sinai, Jordan, Israel and northwestern Saudi Arabia. Both species are not only very similar in appearance but also in ecology. Taking advantage of the mediterranean climate with mild to warm winters which it inhabits, the main activity in *S. sinaiticum* is late in the year; with mating and ovipositing mainly taking place in late autumn (Spain) or winter (North Africa). This phenology, in which its main peak of activity falls outside the period when most other dragonflies are active, means that *S. sinaiticum* is often overlooked during inventories. This peculiar phenology together with a low degree in fieldwork in the southern Levant, makes that relatively few records are available and the species is probably more common in the area around the Red Sea than records suggest.



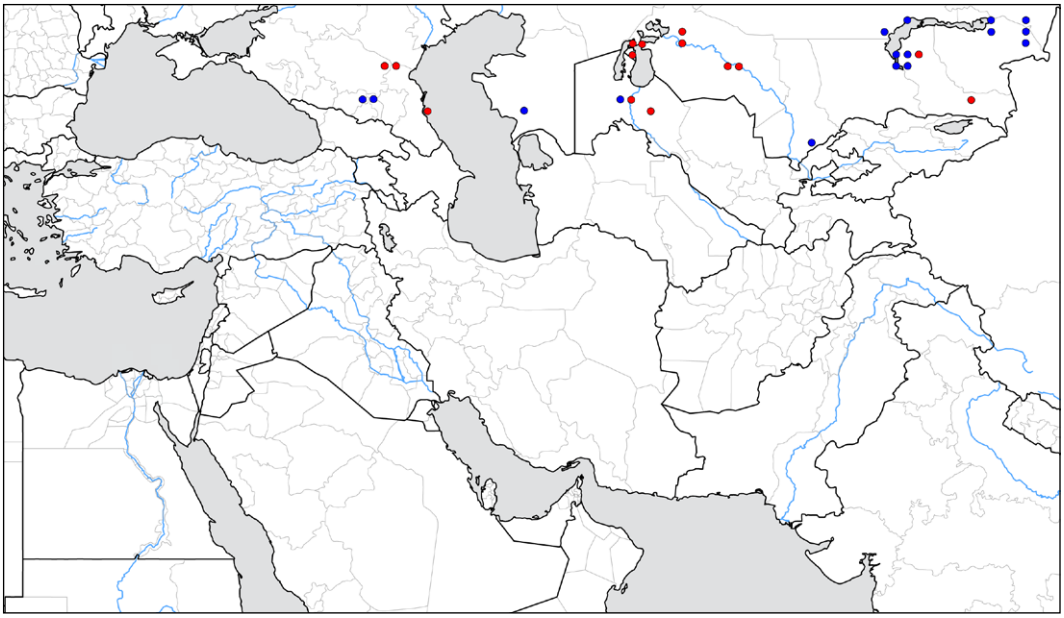
***Sympetrum striolatum* (Charpentier, 1840) — Common Darter**

Sympetrum striolatum is mostly a west Eurasian species but is also present in North Africa and in the region covered by this atlas. Here it is widespread and common in Turkey, the northern Levant and the South Caucasus. Towards the east in Iran it is restricted to mountains, and its distribution here corresponds roughly to the Zagros, Alborz and Kopet Dag ranges. The map for this species suggests that there is a gap between these populations and those found further east in the mountainous regions of Central Asia. As far as is known the specimens from Iran are largely similar to those found in Turkey and Europe. Those from Kyrgyzstan belong to the subspecies *S. s. pallidum* and have a clearly paler coloration and are very similar to *S. meridionale* (Schröter 2010b). The range of this subspecies is not fully known as there is much confusion in older literature regarding the pale species of *Sympetrum*. However, it seems likely that most records from Central Asia belong to this subspecies. At higher altitudes in the Himalyan region from Pakistan eastwards, subspecies *S. s. commixtum* occurs which is, in contrast to *S. s. pallidum*, much darker than the nominal subspecies, having largely black legs. It is possible that this subspecies also occurs at higher elevation in Afghanistan and Tajikistan in which case the very pale subspecies *S. s. pallidum* and the very dark *S. s. commixtum* occurs at nearby locations separated by elevation rather than by distance.



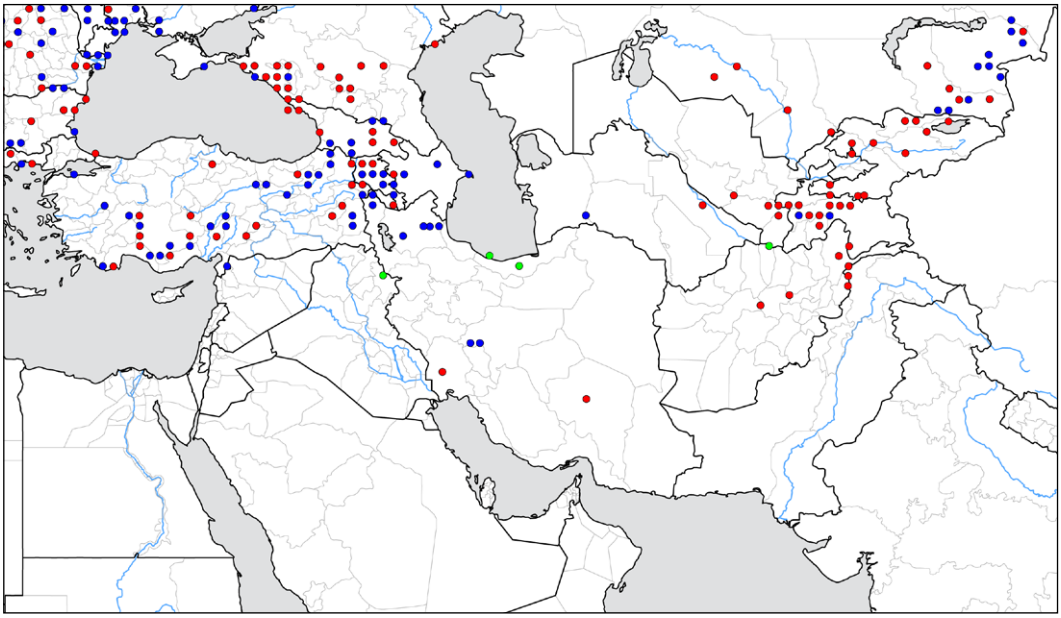
***Sympetrum tibiale* (Ris, 1897) — Steppe Darter**

Sympetrum tibiale is patchily distributed along the Asian steppes and deserts, ranging from north of the Caucasus Mountains in the west to western Mongolia and the Chinese Tarim basin in the east. This is one of the least studied species, and photographs shown here are among the first available for this species. The species was not included in the European Atlas (Boudot & Kalkman 2015) as it had been previously rejected from the European Odonata fauna by Skvortsov (2010) However, it has recently been confirmed as occurring in Europe (Dumont et al. 2018). *Sympetrum tibiale* is scarce and very local in the area covered by this atlas, but is regionally well established in Mongolia and in Kazakhstan, especially in the Syr Darya basin and around Lake Balkash (Dumont et al. 2018). *S. tibiale* is a lowland species generally associated with saline environments. Its range largely coincides with remote and poorly explored regions and it is therefore not unlikely that the species is more common within its range than available records suggest. This applies especially for the Chinese Tarim basin and the Taklamakan Desert, from where only historical data are available, but probably also for the catchment areas of Kuma and Terek rivers in the European part of the Caucasus. Although unlikely, it is not impossible that the species reaches west as far as the steppe belt in the Ukraine.



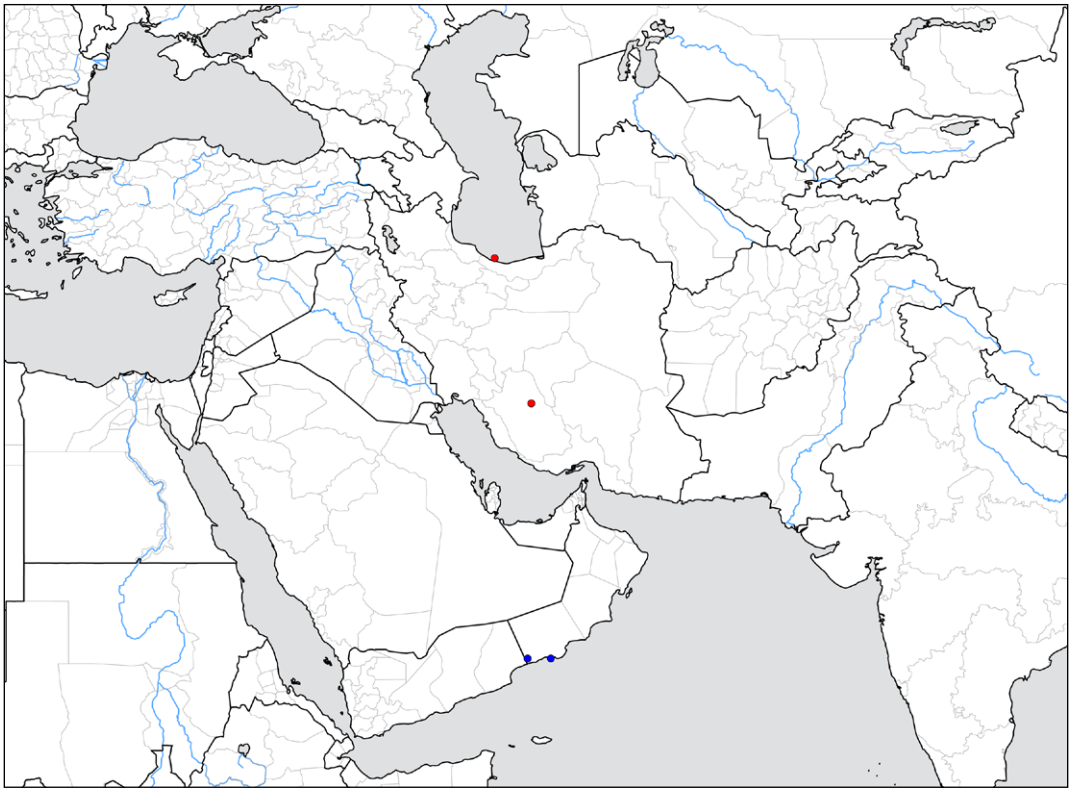
***Sympetrum vulgatum* (Linnaeus, 1758) — Moustached Darter**

Three subspecies of *Sympetrum vulgatum* are known from Europe and West and Central Asia: *S. v. vulgatum* is found over large parts of temperate Europe and Asia, *S. v. ibericum* Ocharan, 1985 is known from northern Spain and the French Pyrenes and *S. v. decoloratum* (Selys, 1884) is found in West and Central Asia. Their validity has been recently confirmed by a genetic study (Hinojosa et al. 2017). The species name *decoloratum* has a complex nomenclatural history summarised in Jödicke (1994), which highlights the fact that the correct identification of pale species of *Sympetrum* in the literature prior to 1994 is often doubtful. As a result the range limits of subspecies *S. v. vulgatum* and *S. v. decoloratum* are still unclear. According to Seehausen et al. (2016) both subspecies occur in the South Caucasus countries, with the nominotypical *S. v. vulgatum* occurring on the Black Sea coast of Georgia and in the northernmost Georgian Caucasus. Elsewhere in our region *S. v. decoloratum* is found, possibly meeting the nominotypical subspecies again in Kyrgyzstan where a small percentage of intermediate individuals have been reported (Schröter 2010b). *Sympetrum v. decoloratum* occurs in the region of this atlas in Turkey, the South Caucasus countries, Iran and Central Asia. All the members of *S. vulgatum* favours standing waters and are found at seepage areas, marshes, puddles, ponds and lakes.



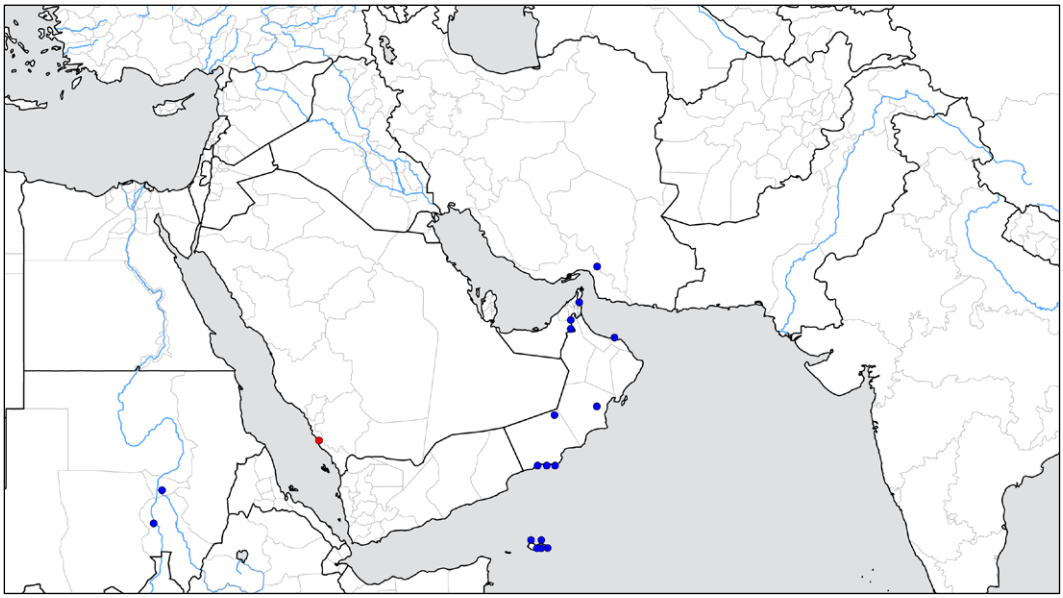
***Tholymis tillarga* (Fabricius, 1798) — Twister**

Tholymis tillarga is widespread in the tropics of Africa and Asia, extending to northern Australia in the south. It occurs at standing or slow flowing eutrophic waters and is commonly found in ditches and pools in or near human settlements. The species has been found twice in the Dhofar region of Oman: on 11 November 2010 (Lambret et al. 2017) and in 2012 (Ball 2014). In Iran it has been found at Passargade on two dates (27 July and 24 September 1956) (Asahina 1963). A record from Tchalus also from 1956 is from the present Chaloos (formerly Chalus or Čalus) by the Caspian Sea in North Iran and is well outside the known permanent range of the species. All records from this atlas region might pertain to wanderers. *Tholymis tillarga* is one of the few species of Libellulidae mainly active at dusk and due this it may be easily overlooked during a day-time visit. It is therefore not unlikely that it is more common than the currently available records suggest.



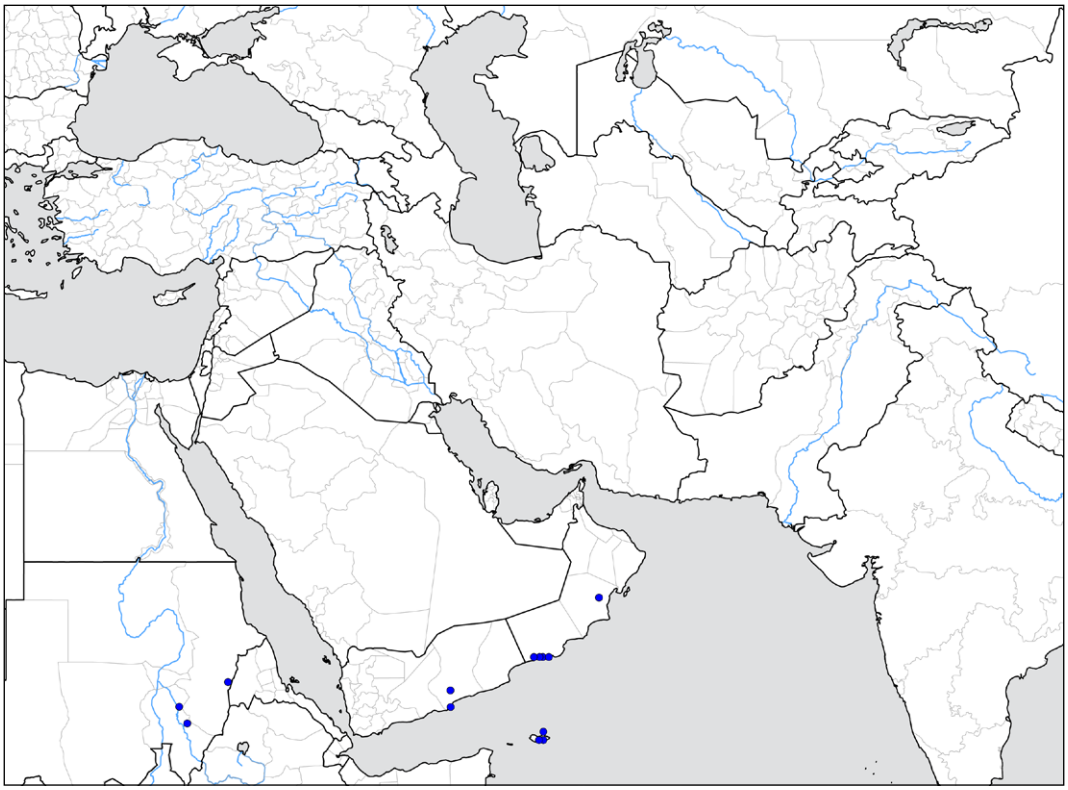
***Tramea basilaris* (Palisot de Beauvois, 1817) — Keyhole Glider**

Tramea basilaris is a widespread species occurring from tropical Africa to Southeast Asia and Japan. It is a strong wanderer and has been recorded as far afield as South America (Meurgey & Picard 2011) and recently also from Linosa Island, Italy (Viganó et al. 2017). In the area covered by this atlas, the species is known from Oman, the United Arab Emirates (Lambret et al, 2017), Socotra Island (Van Damme et al. 2020) and Iran (Dumont & Heidari 1996). There is also one record from 1989 from the Red Sea coast in southern Saudi Arabia (Schneider & Krupp 1993). Only 3 of the 29 available records were made prior to 1990 suggesting that the species has increased. This increase could be linked to the greater frequency of tropical cyclones in the Indian Ocean (Singh 2010, Sebastian & Behera 2015) resulting in more wanderers reaching the Arabian Peninsula from India. The increase could also partly be attributed to the greater use of binoculars by present day odonatologists allowing them to identify this difficult to catch species without collecting. The exuviae of one individual found on Socotra Island (Van Damme et al. 2020, pers. com. Jaap Bouwman) shows that the species, at least on occasion, reproduces in the region. Of the 27 records with an exact date 19 are from November-December, 8 from January to April and none from May-October. This might reflect periods with the highest intensity of field work but could also be the result of the peak in cyclones in November (Singh 2010).



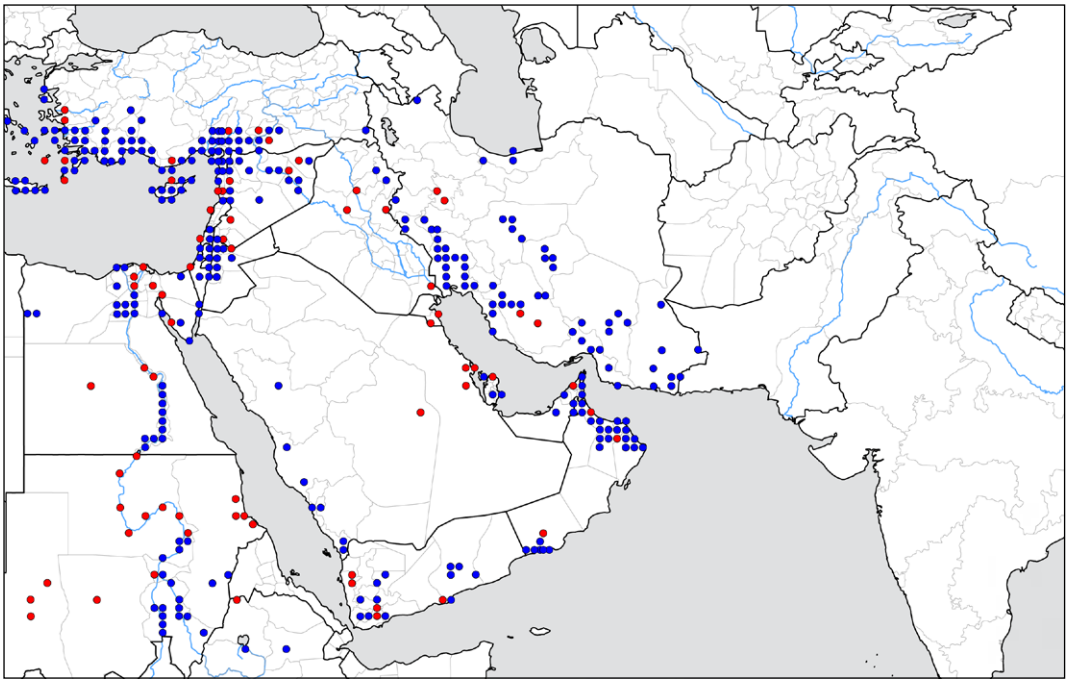
***Tramea limbata* (Desjardins, 1832) — Ferruginous Glider**

This species is widespread across Sub-Saharan Africa and the Indian subcontinent, extending as far east as China's Guangxi province (Zhang 2019). In the area covered by this atlas the species is localized and confined to the southern coast of Oman and Yemen, and to the island of Socotra. It probably breeds in Oman and Yemen, and oviposition has been observed at one site on Socotra (Van Damme et al. 2020) and in Oman (Lambret et al. 2017). It cannot be excluded, however, that part or even most of the records pertain to wanderers. The majority of records are from 320 m a.s.l. or lower with the exception of one record from around 1250 m a.s.l. in mainland Yemen (Schneider & Nasher 2013).



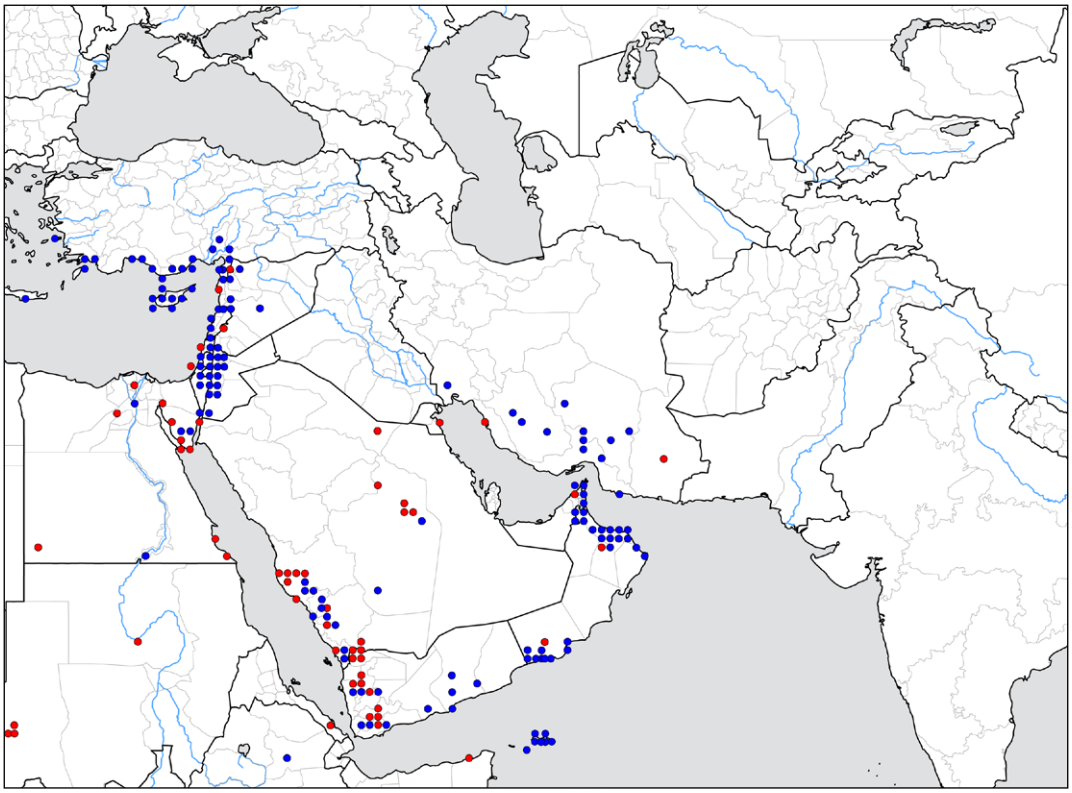
***Trithemis annulata* (Palisot de Beauvois, 1807) — Violet Dropwing**

Trithemis annulata is a widespread pan African species which is widely established around the Mediterranean and in the Levant, the Arabian Peninsula and Iran. The northernmost populations are found in Iran along the Caspian coast and the most southerly are southeastern records from Sistan-va-Baluchistan near the border with Pakistan. In the southern part of Iran the range of *T. annulata* overlaps with that of its close relative *T. aurora* which is a predominantly Asian species. *Trithemis annulata* is not known from the Indian Peninsula (Kalkman et al. 2020) but given its wide occurrence in the southeast of Iran it is almost certainly present in Pakistan and might also occur in Afghanistan. It is not certain if the range expansion which has taken place in the Mediterranean in the past decades (Boudot & Kalkman 2015) also happened around the Arabian Sea. However, the relatively large number of recent records and wide occurrence in Iran compared to the relative scarcity of older records suggests that range expansion is occurring. It is an ubiquitous species which breeds in both slow flowing and standing waters.



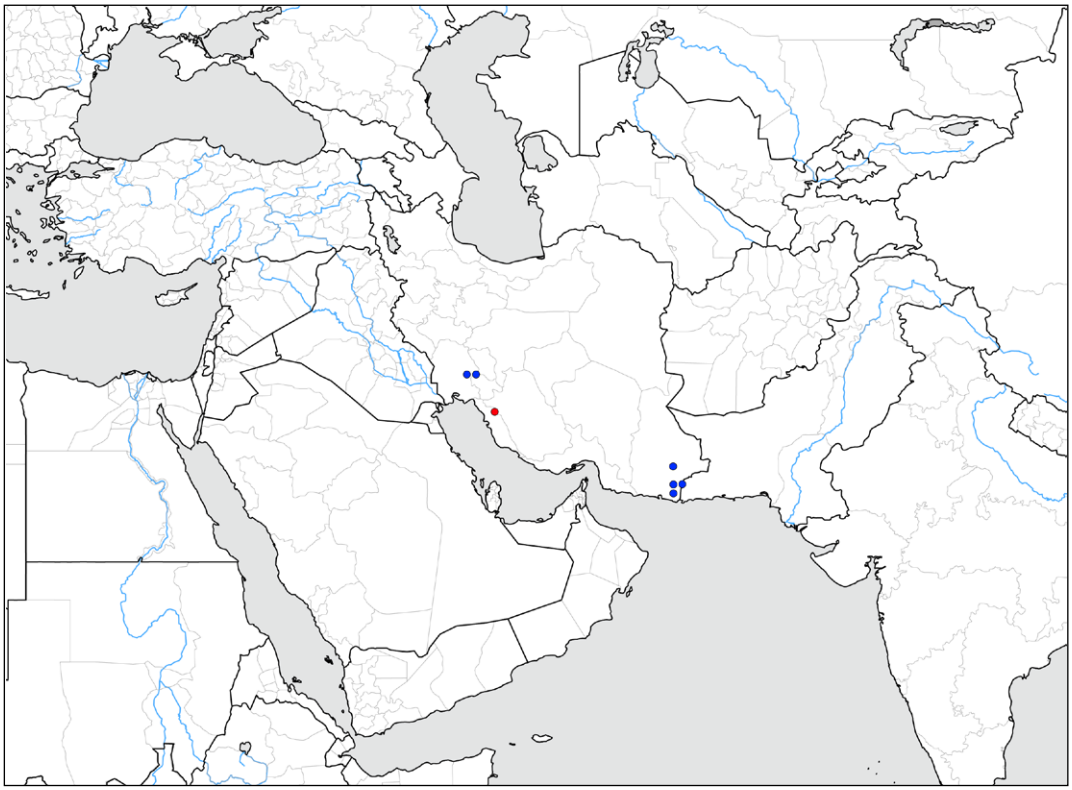
***Trithemis arteriosa* (Burmeister, 1839) — Red-veined Dropwing**

Trithemis arteriosa is a widespread and common pan African species whose range extends to the Levant and the Arabian Peninsula and occurs as far east as the southern part of Iran. The species has gradually extended its range westwards and northwards in the East Mediterranean during the last two decades resulting in the colonisation of the Mediterranean coast of Turkey, Cyprus and the Greek island of Samos. Small numbers of individuals have been observed on Rhodos (Heins 2016) and Crete (Stobbe 2012), although evidence of reproduction on these islands is missing. It is unclear if a similar expansion has taken place in Iran but the species is presently regularly found in the south of the country. As with *T. annulata*, the number of records in southern Iran show that the species could be expected to occur in Pakistan.



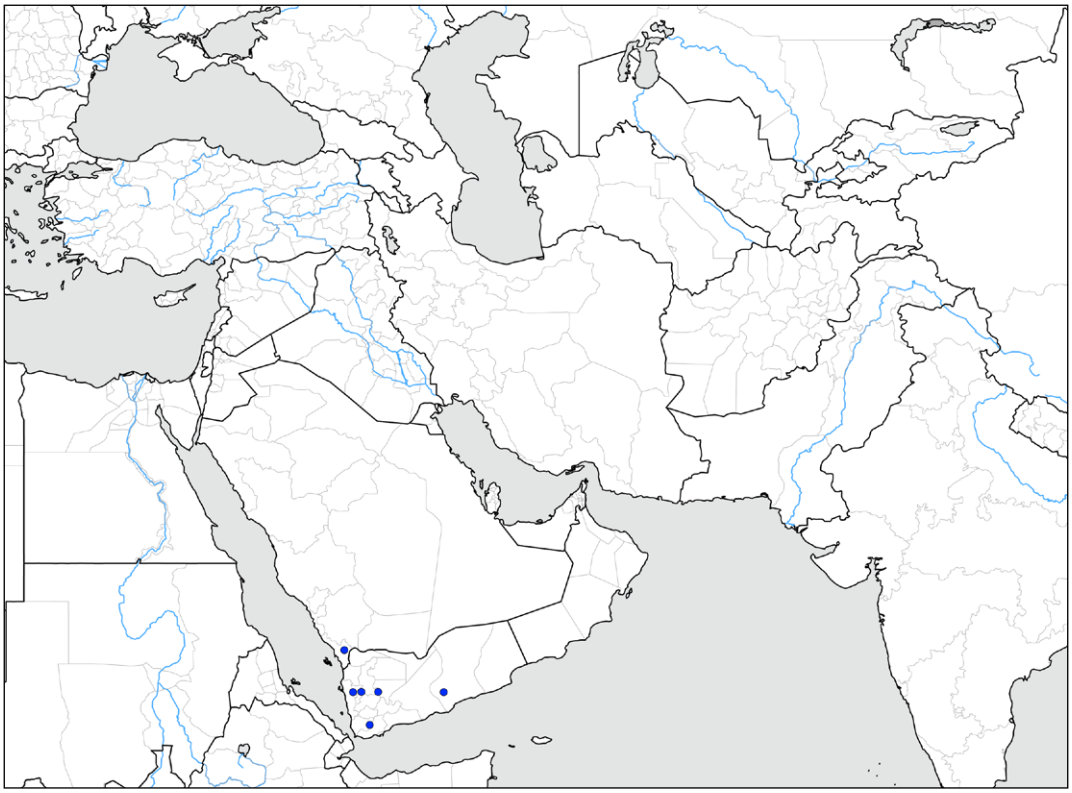
***Trithemis aurora* (Burmeister, 1839) — Crimson Dropwing**

Trithemis aurora is a widespread Oriental species occurring commonly throughout the (sub) tropical parts of Asia eastwards from Iran to Japan and southwards to the Lesser Sunda islands and Sulawesi in Indonesia. It is among the most common species in the Indian subcontinent, occurring at unshaded standing waters where it is among the most dominant species at man-made or degraded habitats. The species is not uncommon in the southeast of Iran and has more recently been found in southwest Iran which could possibly indicate a westwards range expansion (Schneider & Ikemeyer 2019). Based on these records its presence in Kuwait and south Iraq seems possible. This species is closely related to *T. annulata* and the separation of both species in the field or on photographs is sometimes difficult.



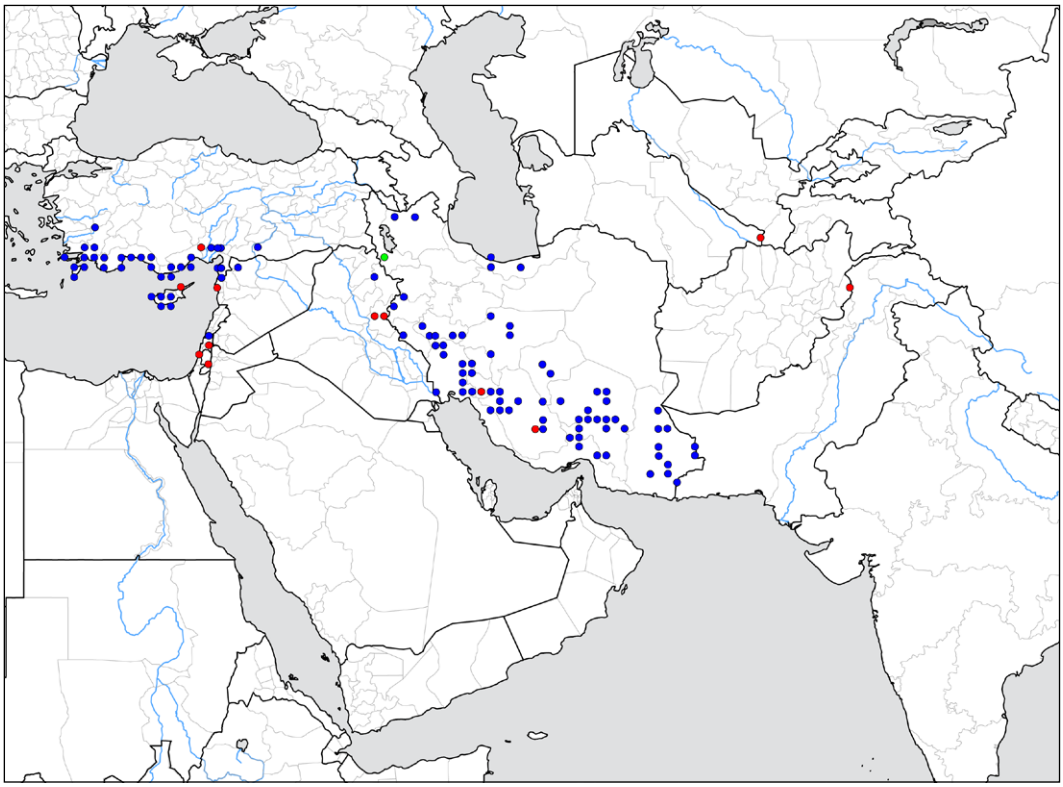
***Trithemis dejouxi* Pinhey, 1978 — Stonewash Dropwing**

Trithemis dejouxi occurs in a relatively small band from West Africa (Guinea) eastwards to Ethiopia and the south of the Arabian Peninsula. In the latter it is known from two localities in Saudi Arabia and five localities in Yemen (see Monnerat & Al Dhafer 2016 for overview). The localities for which the altitude is known range from 460-1180 m a.s.l. suggesting the species is limited to slightly higher altitudes which might explain in part why it was never found in the more extensively explored Dhofar region of southern Oman. As far as is known all records from the Arabian Peninsula refer to running waters.



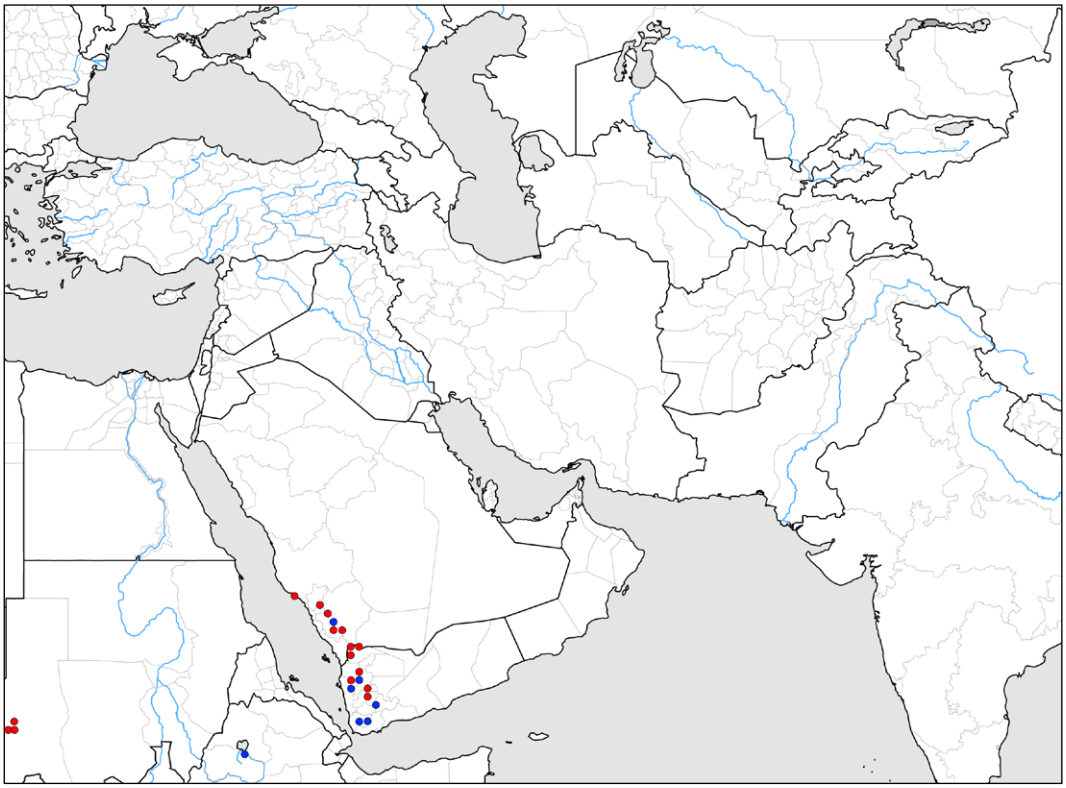
***Trithemis festiva* (Rambur, 1842) — Indigo Dropwing**

This Oriental species is widespread and common in the tropical part of Southeast Asia and in the Indian subcontinent from where it extends to Iran, the Levant, Turkey, Cyprus and Rhodes in the west. *Trithemis festiva* is common along the Mediterranean coast of Turkey and in Cyprus; however, in Turkey, it is not known to occur east of the Euphrates. It is widespread and moderately common in south and southwestern Iran (Schneider & Ikemeyer 2019) but rare and local in the Levant where it seems to be missing in Lebanon (Dumont 1991, Dia & Dumont 2011). The records from Central Asia refer to an apparently isolated small population in the Kugitangtau range, a spur of the Pamir-Alay, in southeast Turkmenistan (Haritonov & Borisov 1985) and from the Afghan province of Nuristan.



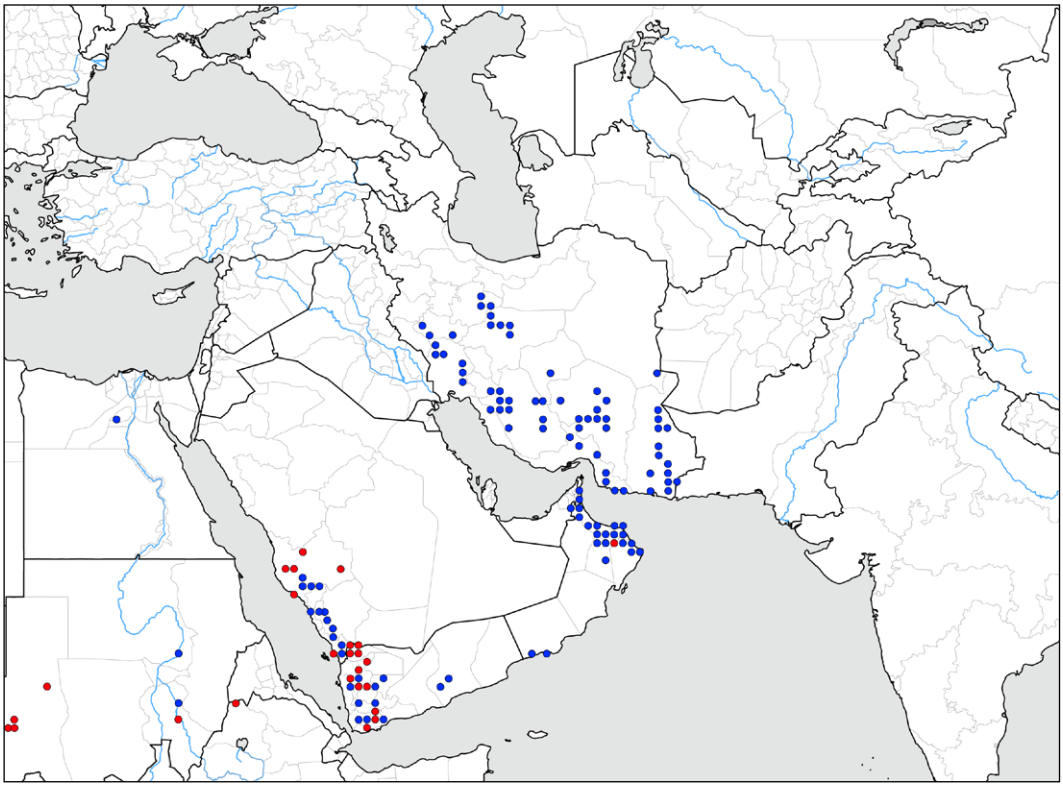
***Trithemis furva* Karsch, 1899 — Navy Dropwing**

Trithemis furva is widespread in Sub-Saharan Africa although it is absent from western Africa, favouring dryer and less forested areas (Clausnitzer et al. 2012). In eastern Africa it is widespread in Ethiopia from where it extends to Eritrea, Somalia and the western Arabian Peninsula (Asir Mountains and the Sarat or Sarawat Mountains) in Yemen where it is rather common. Records for which the elevation is known, range from 1180 to 2480 m a.s.l. in Yemen and Saudi Arabia. Its preference for higher elevations in this part of its range explains in part why the species is not found further east. *Trithemis furva* favours running waters and is in the Arabian Peninsula mainly recorded from wadis.



***Trithemis kirbyi* Selys, 1891 — Orange-winged Dropwing**

Trithemis kirbyi is a very common and widespread African species which recently expanded its range to southwestern Europe, where it has become established in Spain, Portugal and southwestern France. In the region of this atlas, it occurs from the southern part of the Arabian Peninsula to Iran and India. In the Arabian Peninsula it is especially common along the Red Sea coastal mountains in Saudi Arabia and Yemen, and in northern Oman, with only scattered records from eastern Yemen and the Dhofar coast in Oman. It is also rather common in Iran where it was found as far north as Teheran. Curiously, *Trithemis kirbyi* has never been recorded in the Levant or in southern Turkey, where suitable habitats seem to be widely available. The species favours sunny, open sites and is found in a wide range of habitats, both running and standing waters and in wadis. These habitats often have stony, or rocky bottoms with little or no vegetation.

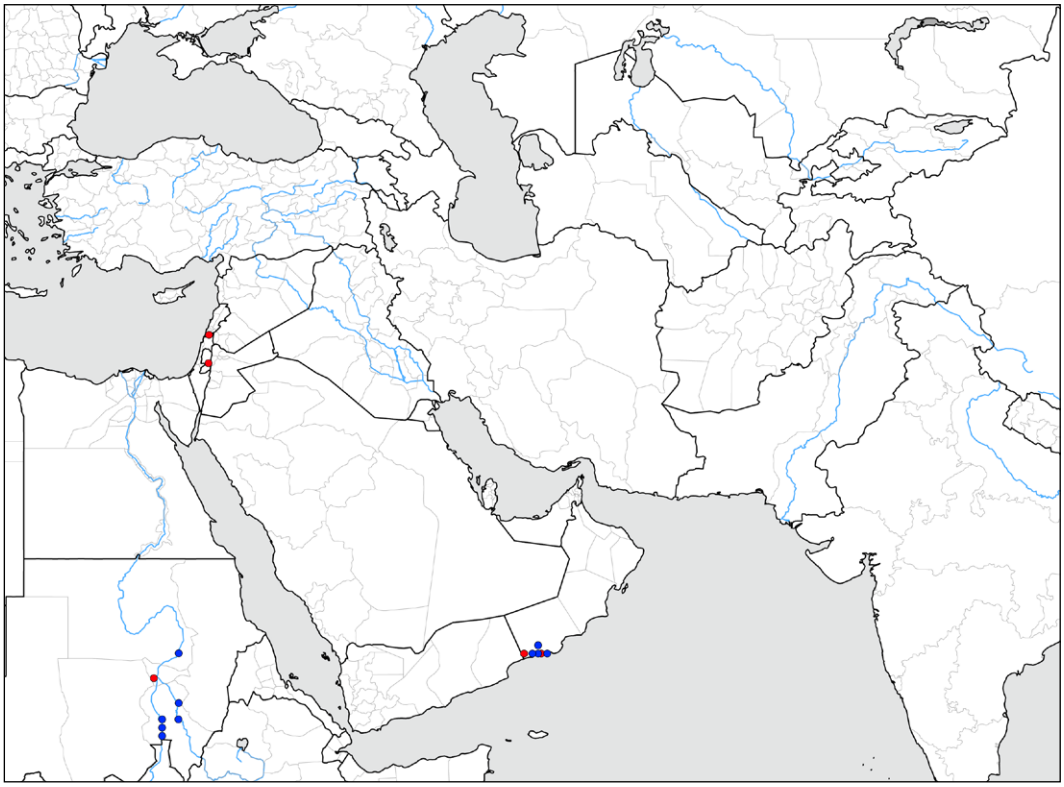


***Trithemis pallidinervis* (Kirby, 1889) — Dancing Dropwing**

Trithemis pallidinervis is a widespread and, in most of its range, common Oriental species occurring across (sub) tropical Asia east as far as Taiwan and the Philippines and southwards to Sumatra. The species is common across the Indian subcontinent and found in unshaded standing waters. The species is probably still relatively common in the south of Pakistan. Within the region of this atlas only isolated vagrants have been recorded, one from southeast Iran (17 April 2015) (Schneider et al. 2015b) and two from Muscat in the north of Oman (29 November and 1 December 1976) (Waterston & Pittaway 1991). These immigrants are thought to have been brought by tropical storms crossing the Indian Ocean and the Arabian Sea.

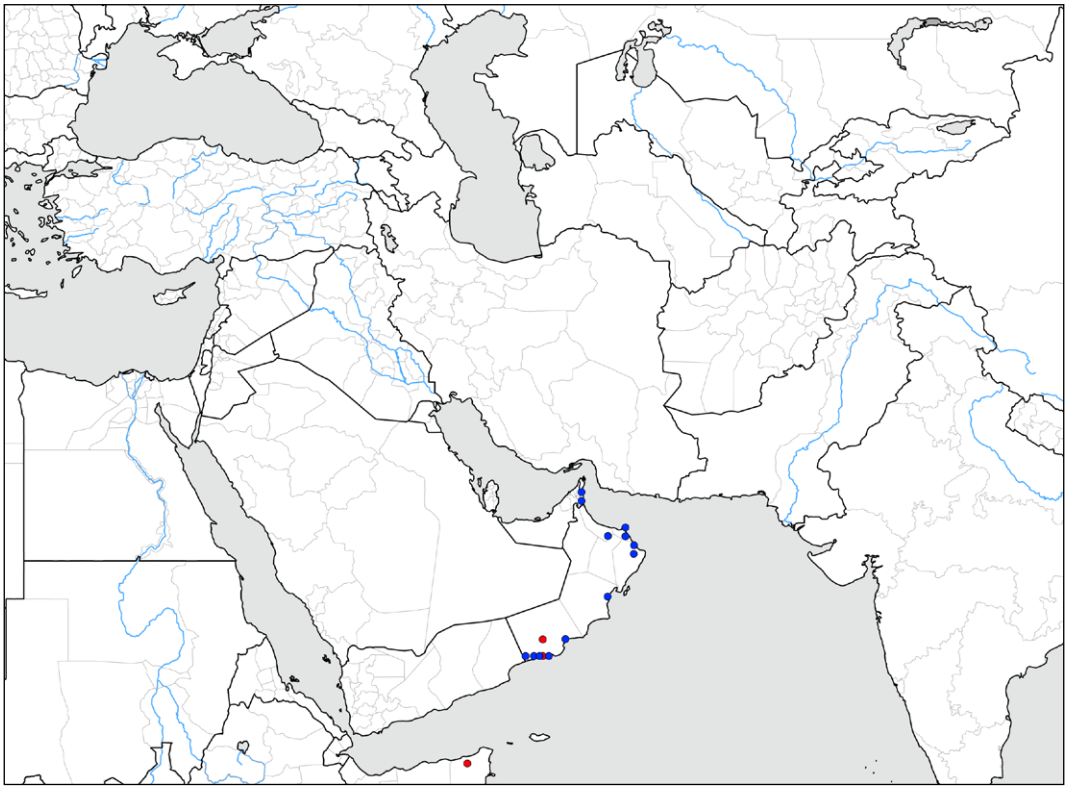
***Urothemis edwardsii* (Selys in Lucas, 1849) — Blue Basker**

Urothemis edwardsii is widespread in Sub-Saharan Africa with only a few isolated populations north of the Saharo-Arabian desert belt. A small and isolated population is found in northeast Algeria (Samraoui et al. 1993), another relic population occurred in northern Israel in the wetlands of the Hula depression but became extinct due to the drainage of the Hula wetland in the 1950's. A final area of occurrence disjunct from the main species range is the Dhofar region in south Oman where the species is found mainly below 250 m a.s.l. (Lambret et al. 2017). Here the species has a preference for open sunny pools and ponds in temporary flowing wadis and marshy lagoons with well-developed vegetation of low and tall herbs and low bushes. In Africa, *U. edwardsii* is also found at slow-flowing rivers and flowing channels in swamps.



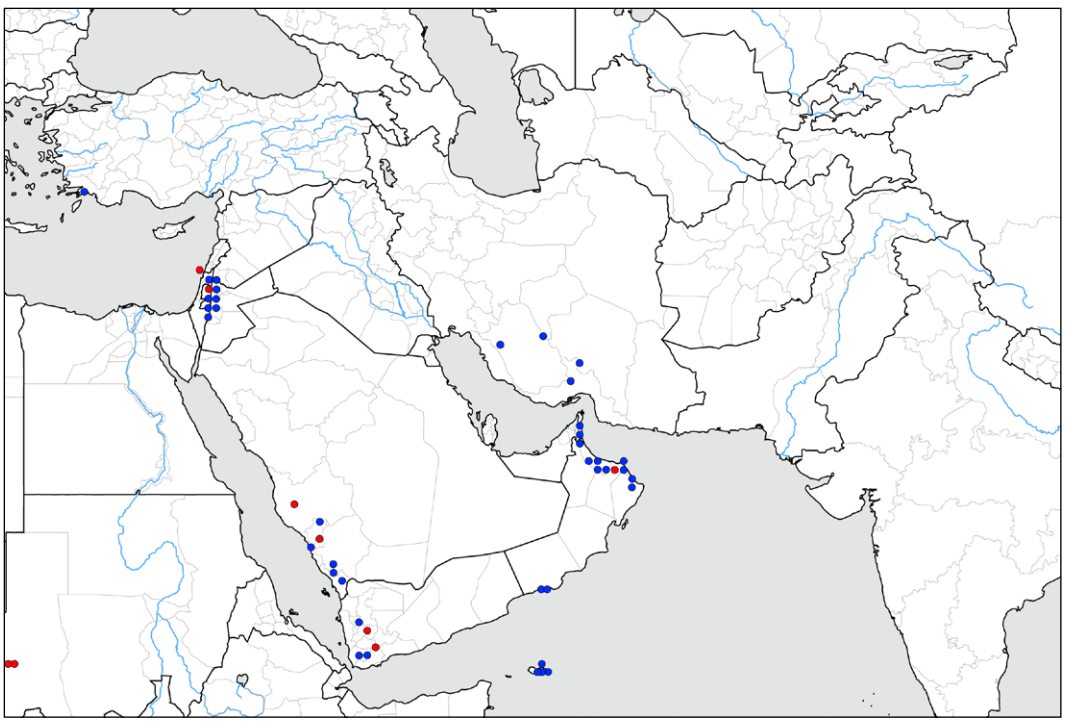
***Urothemis thomasi* Longfield, 1932 — Desert Basker**

Urothemis thomasi is, except for a single locality in Somalia, only known from the south of the Arabian Peninsula where it is confined to a narrow strip running from the northern Hajar range in the Fujairah Emirate (Feulner & Judas 2013) to the Dhofar province in south Oman (Lambret et al. 2017). The species is found at wadis and in oases with small brooks in fresh or brackish water. The only record from outside our area was made in 1953 in northern Somalia (Nielsen 1957). Almost no field work has been done in Somalia and it is not known if the species is indeed rare in this country or simply under-recorded. This species was poorly known until recently but field work in the last decade resulted in numerous new records and a better understanding of its range (Feulner & Judas 2015, Chelmick et al. 2016, Schneider & Ikemeyer 2016a, Cowan & Cowan 2017, 2018, Lambret et al. 2017).



***Zygonyx torridus* (Kirby, 1889) — Ringed Cascader**

Zygonyx torridus is widespread throughout Sub-Saharan Africa and is patchily distributed and generally rare throughout the Cape Verde and Canaries archipelagos and in Morocco, Tunisia, Spain, Portugal and Sicily. In our regions it occurs in the Levant (Israel, Jordan, West Bank), in the mountains of southwestern Saudi Arabia and Yemen, on Socotra Island, in the Dhofar region in south Oman, and in the Hajar Mountains of northern Oman and the United Arab Emirates (Kunz et al. 2006, Lambret et al. 2017). The individuals observed in Iran are believed to be regular immigrants from Arabia and it is uncertain whether the species reproduces (Schneider & Ikemeyer 2019) although favourable habitats are certainly present in south Iran. There are only a handful of records from India and Pakistan and it remains unclear if these pertain to rare vagrant individuals or to scattered populations. There is also one record from the southwest coast of Turkey, which might also be a vagrant. *Zygonyx torridus* prefers warm environments at fast flowing streams and rivers, irrigation channels, rapids and waterfalls.



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Appendix 1

Checklist of the 24 countries covered by this distribution atlas. An (o) indicates that the species was only observed prior to 1990 and a (x) indicates that the species was observed from 1990 onwards. An asterisk (*) behind the species name indicates that the species is endemic to the region.

Species name	AFG	KGZ	TJK	TKM	UZB	ARM	AZE	GEO	IRN	IRQ	TUR	CYP	ISR	JOR	LBN	SYR	PSE	BHR	KWT	OMN	QAT	SAU	UAE	YEM
	Afghanistan	Kyrgyzstan	Tajikistan	Turkmenistan	Uzbekistan	Armenia	Azerbaijan	Georgia	Iran	Traq	Turkey	Cyprus	Israel	Jordan	Lebanon	Syria	State of Palestine	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	United Arab Emirates	Yemen
Lestidae																								
Chalcolestes parvidens							x	x	x		x	x	x	x	x	x	o							
Lestes barbarus	o	x	x	x	o	x	x	x	x	o	x	x	o		x	x	o							
Lestes concinnus									x															
Lestes dryas	o	x	x			x	x	x	x		x													
Lestes macrostigma		x	o	o	o	x	x	x	x		x	x	o											
Lestes pallidus																						x		o
Lestes sponsa	o	x	o			x	x	x	x		x													
Lestes virens	o	x	o		o	x	x	x	x		x		o		x	x	o							
Sympecma fusca		x	x	x	o	x	x	x	x		x	x	o		x	o	x							
Sympecma gobica		x	x	x	o				x															
Sympecma paedisca	o	x	o	x	o	x	x		x	x	o													
Calopterygidae																								
Calopteryx hyalina *													x		x	x								
Calopteryx samarcandica	o	x	o	o	o																			
Calopteryx splendens	o	x	x	x	x	x	x	x	x	x	x	x				x								
Calopteryx syriaca *													x	x	x	o	o							
Calopteryx virgo							x	x			x													
Calopteryx waterstoni *											x													
Epallagidae/Euphaeidae																								
Epallage fatime	o			x		x	x	x	x	x	x	x	x	x	x	x	x							
Coenagrionidae																								
Agriocnemis pygmaea	o								x											x				
Agriocnemis sania													x				x							
Azuragrion granti *																								x
Azuragrion nigridorsum																				x				x
Azuragrion somalicum																				x				x
Azuragrion vansomereni																						o		
Ceriagrion georgifreyi											x		o			x								
Ceriagrion glabrum																				x		x	x	x
Coenagrion armatum		x				x		x																
Coenagrion australocaspicum *							x		x															
Coenagrion lunulatum						x	x	x	x		x													
Coenagrion ornatum						x	x	x	x		x				x	o								
Coenagrion persicum *									x															

Species name	AFG	KGZ	TJK	TKM	UZB	ARM	AZE	GEO	IRN	IRQ	TUR	CYP	ISR	JOR	LBN	SYR	PSE	BHR	KWT	OMN	QAT	SAU	UAE	YEM
Coenagrion ponticum *							x	x	x		x													
Coenagrion puella						x	x	x	x		x													
Coenagrion pulchellum		x	o		o	x	x	x	x		x					o								
Coenagrion scitulum		x	o			x	x	x	x		x		o	o	x	x	o							
Coenagrion syriacum *											x		o		x	o								
Enallagma cyathigerum						x	x	x	x		x					o								
Enallagma risi	o	x	x		o				x															
Erythromma lindenii						x	o	o	x	x	x	x	o			x	o							
Erythromma viridulum			o	o	o	x	x	x	x		x	x	x		x	x								
Ischnura aralensis					o																			
Ischnura elegans	o	o	x	x	o	x	x	x	x	x	x	x	x	x	x	x	o							
Ischnura evansi	o	x	x	o	o				x	x			x	x		x	x	x	o	x	x	x	x	x
Ischnura forcipata	o	x	x	o	x				x															
Ischnura fountaineae		x	o	x	o	x	x	x	x	x	x		x	x		x	o			x	x	x	x	
Ischnura intermedia *				x					x	x	x	x				x								
Ischnura nursei									x											x			x	
Ischnura pumilio	o	x	x	x	o	x	x	x	x		x	o	o	o	o	x	o							
Ischnura rubilio	o								x															
Ischnura senegalensis	o								x	o			x	x			o			x		o	x	x
Pseudagrion arabicum *																						x		x
Pseudagrion decorum									x											x			x	
Pseudagrion hamoni																						x		x
Pseudagrion kersteni																								x
Pseudagrion laidlawi									x															
Pseudagrion niloticum																								x
Pseudagrion sublacteum													x	x		o	o			x				x
Pseudagrion syriacum *											x		x	x	x	x	x							
Pseudagrion torridum													x											
Pyrrhosoma nymphula								x			x													
Platycnemididae																								
Arabicnemis caerulea *																				x			x	x
Arabineura khalidi *																				x			x	
Calicnemia eximia	o																							
Platycnemis dealbata	o		x	x	o	x	x	x	x	x	x		x	x	x	x	x							
Platycnemis kervillei *									x	x	x		x		x	x								
Platycnemis pennipes		o				x	x	x			x				o	o								
Aeshnidae																								
Aeshna affinis	o	x	o		o	x	x	x	x		x	x				x								
Aeshna cyanea						x	x	x			x													
Aeshna isoceles		x	o	o	o	x	x	x	x		x	x	x		x	x								
Aeshna juncea	o	x	o			x	o	x			x													
Aeshna mixta		x	o		o	x	x	x	x	x	x	x	o		x	x								
Aeshna serrata		x				o		x			o													
Aeshna vercanica *							x		x															
Anax ephippiger	o	x	x	x	o	x	o	x	x	x	x	x	x	x	x	x	x		o	x	x	x	x	x
Anax immaculifrons	o								x		x	x			o	x	o							

Species name	AFG	KGZ	TJK	TKM	UZB	ARM	AZE	GEO	IRN	IRQ	TUR	CYP	ISR	JOR	LBN	SYR	PSE	BHR	KWT	OMN	QAT	SAU	UAE	YEM
Anax imperator	o	x	x	o	o	x	x	x	x	o	x	x	x	x	x	x	x			x		x	x	x
Anax parthenope	o	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		o	x	x	x	x	x
Anax speratus																						x		x
Anax tristis																				x				
Brachytron pratense							x	o	x		x													
Caliaeschna microstigma				x		x	x	x	x	o	x	x	x		x	x								
Cephalaeschna klapperichi	o																							
Pinheyschna yemenensis *																								x
Gomphidae																								
Anormogomphus kiritshenkoi			o	o	o				x	o	o					x								
Gomphus davidi *											x		x	o	o	x	o							
Gomphus kinzelbachi *									x	x														
Gomphus schneiderii	o			x		x	o	x	x		x					x								
Lindenia tetraphylla	o	x	o	o	o		x	x	x	o	x		x	o		x	o	x	o	x		x	x	
Onychogomphus assimilis				x		x	x	x	x		x													
Onychogomphus flexuosus	o	x	o	o	o	x	x	x	x	o	x		o	o		x	o							
O. (forcipatus) albotibialis				x		x	x	x	x		x	x												
O. (forcipatus) forcipatus											x													
Onychogomphus lefebvrii		x	x	x	x				x	x	x		x	o	x	x	x							
Onychogomphus macrodon *											x		o	o	o	x								
Ophiogomphus reductus	o	x	x	o	x																			
Paragomphus genei													x	x	o	o	x			x		x	x	x
Paragomphus lineatus	o								x		x					x								
Paragomphus sinaiticus																				x		x	x	o
Stylurus ubadschii	o	x	o	o	o	o	x	x	x		x				o	o								
Cordulegastridae																								
Cordulegaster charpentieri *				o		x	x	x	x	o	x				o									
Cordulegaster coronata	o	x	x	o	o				x															
Cordulegaster insignis											x				x									
Cordulegaster mzymtae *								x			x													
Cordulegaster picta						x	o	x			x													
Cordulegaster vanbrinkae *						x	x		x															
Neallogaster schmidti *	o																							
Corduliidae																								
Cordulia aenea						x	o	x			x													
Somatochlora flavomaculata							x	x	x		x													
Somatochlora meridionalis											x													
Libellulidae																								
Acisoma panorpoides	o																							
Acisoma variegatum																				x				
Brachythemis contaminata									x															
Brachythemis fuscopalliata *									x	x	x		o			x			x			x		
Brachythemis impartita											x	x	x	x	x	x	x					x		x
Crocothemis erythraea	o	x	o	o	o	x	x	x	x	o	x	x	x	x	x	x	x	x	o	x	x	x	x	x
Crocothemis sanguinolenta									x				x	x						x		o	x	x
Crocothemis servilia	o	x	o		o	x	x		x	x	x		o	x		x			o		x	o		

Species name	AFG	KGZ	TJK	TKM	UZB	ARM	AZE	GEO	IRN	IRQ	TUR	CYP	ISR	JOR	LBN	SYR	PSE	BHR	KWT	OMN	QAT	SAU	UAE	YEM
Diplacodes lefebvrii	o		o	o					x	o	x	x	x	o	o	x				x	x	o	x	x
Diplacodes trivialis																				x				
Leucorrhinia pectoralis						x		x			x													
Libellula depressa	o	x	o	x		x	x	x	x	o	x		o		x	x	o							
Libellula fulva								x			x													
Libellula pontica *						x	x	x	x	o	x		x	o		x								
Libellula quadrimaculata	o	x	x		o	x	x	x	x		x													
Macrodiplax cora																				x				x
Nesciothemis farinosa																				x		x		x
Orthetrum abbotti													x	x						x			x	x
Orthetrum albistylum	o	x	x	o	o	x	x	x	x		x													
Orthetrum brevistylum																						x		x
Orthetrum brunneum	o	x	x	x	o	x	x	x	x	x	x	x	x	x	o	x	x							
Orthetrum caffrum																						x		x
Orthetrum cancellatum		x	o	x	o	x	x	x	x		x	x			x	x	x							
Orthetrum chrysostigma									x	x	x	x	x	x	x	x	x			x		x	x	x
Orthetrum coerulescens	o	x	x	x	o	x	x	x	x	x	x	x	x	x	o	x	o					o		
Orthetrum julia																								x
Orthetrum luzonicum	o								x															
Orthetrum pruinosum	o																							
Orthetrum ransonnetii	o								x				x	x						x		x	x	o
Orthetrum sabina	o	x	o	o	o	x	x	x	x	x	x	x	x	x	o	x		x	o	x	x	x	x	x
Orthetrum taeniolatum	o								x	x	x	x	x	x	x	x	x		o	x		o		
Orthetrum triangulare	o																							
Orthetrum trinacria									x	x	x		x	o		x	o		o			o		
Palpopleura deceptor																						o		
Palpopleura sexmaculata	o																							
Pantala flavescens	o	x	x	x	o	x	x	x	x	o	x	x	x	x	o	x				x	x	x	x	x
Rhyothemis semihyalina													o							x				o
Selysiothemis nigra	o	x	o	o	o	x	x	x	x	x	x	x	o	o		x	o		o	x	x	o	x	x
Sympetrum arenicolor		x	x	x	o	x	x	x	x	x	x					x								
Sympetrum danae		o				x		x			x													
Sympetrum depressiusculum		x	o		o	o	o	x		o	x													
Sympetrum flaveolum	o	x	o		o	x	x	x	x		x													
Sympetrum fonscolombii	o	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x
Sympetrum haritonovi	o	x	x	o	o				x		x													
Sympetrum meridionale	o	x	o	x	o	x	x	x	x		x	x	x	o	x	x	x							
Sympetrum pedemontanum		x	x		o	x	o	x			x													
Sympetrum sanguineum	o	x	x	o	o	x	x	x	x		x		o		x									
Sympetrum sinaiticum													x	o			o					x		
Sympetrum striolatum	o	x	x	x	o	x	x	x	x	x	x	x	o	o	x	x								
Sympetrum tibiale					x																			
S. vulgatum decoloratum	o	o	x	x	o	x	x	x	x		x													
Tholymis tillarga									o											x				
Tramea basilaris									x											x		o	x	x
Tramea limbata																				x				x

Species name	AFG	KGZ	TJK	TKM	UZB	ARM	AZE	GEO	IRN	IRQ	TUR	CYP	ISR	JOR	LBN	SYR	PSE	BHR	KWT	OMN	QAT	SAU	UAE	YEM
Trithemis annulata									x	x	x	x	x	x	x	x	x	x	o	x	x	x	x	x
Trithemis arteriosa									x		x	x	x	x	x	x	x		o	x		x	x	x
Trithemis aurora									x															
Trithemis dejouxi																						x		x
Trithemis festiva	o			o					x		x	x	x			x								
Trithemis furva																						x		x
Trithemis kirbyi									x											x		x	x	x
Trithemis pallidinervis									x											o				
Urothemis edwardsii													o				o			x				
Urothemis thomasi																				x			x	
Zygonyx torridus									x		x		x	x			x			x		x	x	x
TOTAL	**59**	**56**	**56**	**52**	**52**	**65**	**69**	**71**	**100**	**44**	**98**	**37**	**65**	**44**	**48**	**67**	**43**	**13**	**13**	**45**	**34**	**42**	**30**	**45**

Appendix 2

Flight period for each species in the area under consideration. The numbers give the percentage of records of adult dragonflies and damselflies made during the indicated month. Months in which over 10 percent of the records were made (peak of flight season) are shown in dark green. See method section for more information.

Species name	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Lestidae												
Chalcolestes parvidens	0	0	0	0	14	22	22	23	10	8	2	0
Lestes barbarus	0	0	0	2	9	23	36	24	6	0	0	0
Lestes concinnus	0	0	7	50	29	0	7	0	7	0	0	0
Lestes dryas	0	0	0	2	4	30	41	21	1	1	0	0
Lestes macrostigma	0	0	2	8	30	41	17	2	0	0	0	0
Lestes pallidus	0	0	0	25	0	0	0	0	25	0	50	0
Lestes sponsa	0	0	0	0	2	19	50	26	3	0	0	0
Lestes virens	0	0	0	1	10	13	39	32	5	0	0	0
Sympecma fusca	0	1	3	5	9	23	31	20	6	2	0	0
Sympecma gobica	0	0	0	0	12	21	24	26	3	6	9	0
Sympecma paedisca	0	0	1	6	14	21	22	18	6	5	7	0
Calopterygidae												
Calopteryx hyalina	0	0	18	7	39	18	5	14	0	0	0	0
Calopteryx samarcandica	0	0	0	0	0	60	40	0	0	0	0	0
Calopteryx splendens	0	0	1	2	19	34	28	11	3	1	0	0
Calopteryx syriaca	0	0	9	18	35	13	7	4	2	11	1	0
Calopteryx virgo	0	0	0	0	10	29	46	12	1	0	1	0
Calopteryx waterstoni	0	0	0	0	0	35	35	30	0	0	0	0
Epallagidae/Euphaeidae												
Epallage fatime	0	0	2	8	26	35	23	4	1	0	0	0
Coenagrionidae												
Agriocnemis pygmaea	0	11	28	39	0	0	6	0	6	6	6	0
Agriocnemis sania	0	0	11	0	0	33	22	22	0	11	0	0
Azuragrion granti	3	42	14	9	0	0	0	3	5	15	6	3
Azuragrion nigridorsum	8	22	12	22	0	3	0	3	8	13	8	0
Azuragrion somalicum	8	33	4	29	4	0	0	0	8	13	0	0
Azuragrion vansomereni	0	0	0	0	100	0	0	0	0	0	0	0
Ceriagrion georgifreyi	0	0	0	0	36	35	13	6	7	3	0	0
Ceriagrion glabrum	3	18	15	18	7	6	3	3	3	6	12	5
Coenagrion armatum	0	0	0	0	0	38	50	13	0	0	0	0
Coenagrion australocaspicum	0	0	0	18	36	45	0	0	0	0	0	0
Coenagrion lunulatum	0	0	0	0	4	47	45	4	0	0	0	0
Coenagrion ornatum	0	0	0	0	28	46	23	2	0	0	0	0
Coenagrion persicum	0	0	0	0	60	40	0	0	0	0	0	0
Coenagrion ponticum	0	0	0	0	6	34	33	27	1	0	0	0
Coenagrion puella	0	0	0	1	12	44	36	5	1	0	0	0
Coenagrion pulchellum	0	0	0	1	43	37	16	2	0	0	0	0
Coenagrion scitulum	0	0	0	2	14	53	29	1	1	0	0	0
Coenagrion syriacum	0	0	17	20	47	12	2	2	0	0	0	0
Enallagma cyathigerum	0	0	0	0	10	25	43	19	3	0	0	0

Species name	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Enallagma risi	0	0	0	3	15	18	43	18	5	0	0	0
Erythromma lindenii	0	0	2	2	25	36	23	11	1	0	0	0
Erythromma viridulum	0	0	0	1	9	31	45	12	2	0	0	0
Ischnura aralensis	0	0	0	0	0	0	0	100	0	0	0	0
Ischnura elegans	0	0	1	6	20	28	25	11	6	2	0	0
Ischnura evansi	2	7	16	18	14	14	4	4	2	9	7	4
Ischnura forcipata	0	0	5	7	21	22	17	12	13	4	0	0
Ischnura fountaineae	1	0	8	15	29	15	12	6	4	6	3	1
Ischnura intermedia	0	0	0	8	8	46	8	12	12	8	0	0
Ischnura nursei	0	0	0	44	31	8	3	3	0	0	6	6
Ischnura pumilio	0	0	1	3	11	25	31	21	7	1	0	0
Ischnura rubilio	0	0	21	57	7	0	7	7	0	0	0	0
Ischnura senegalensis	5	18	11	23	4	4	3	4	5	7	13	4
Pseudagrion arabicum	0	0	18	9	9	36	18	0	0	9	0	0
Pseudagrion decorum	6	5	22	27	2	2	1	2	6	11	9	8
Pseudagrion hamoni	0	9	9	11	17	16	3	1	3	13	13	5
Pseudagrion kersteni	0	7	7	0	36	21	7	7	0	14	0	0
Pseudagrion laidlawi	0	0	0	45	45	0	0	9	0	0	0	0
Pseudagrion niloticum	0	0	0	0	0	100	0	0	0	0	0	0
Pseudagrion sublacteum	2	4	4	13	15	15	10	4	7	17	9	0
Pseudagrion syriacum	0	0	4	14	20	24	9	10	8	6	6	0
Pseudagrion torridum	0	0	0	0	20	20	0	10	30	10	10	0
Pyrrhosoma nymphula	0	0	0	9	14	49	26	3	0	0	0	0
Platycnemididae												
Arabicnemis caerulea	0	4	22	27	4	16	0	3	4	13	4	3
Arabineura khalidi	0	2	29	24	2	4	0	0	1	29	4	3
Calicnemia eximia	0	0	0	0	0	0	100	0	0	0	0	0
Platycnemis dealbata	0	0	2	7	18	35	24	6	6	1	1	0
Platycnemis kervillei	0	0	2	3	42	34	13	5	1	0	0	0
Platycnemis pennipes	0	0	0	1	15	35	33	13	2	0	0	0
Aeshnidae												
Aeshna affinis	0	0	0	1	7	31	35	13	3	8	0	0
Aeshna cyanea	0	0	0	0	0	10	33	42	10	3	1	0
Aeshna isoceles	0	0	0	2	41	43	10	2	1	0	0	0
Aeshna juncea	0	0	0	0	2	3	32	51	12	0	0	0
Aeshna mixta	0	0	0	0	5	19	27	21	12	12	2	0
Aeshna serrata	0	0	0	0	0	14	0	71	14	0	0	0
Aeshna vercanica	0	0	0	7	7	13	47	20	7	0	0	0
Anax ephippiger	7	9	9	15	7	8	4	16	5	3	13	4
Anax immaculifrons	0	0	0	9	15	44	25	4	4	0	0	0
Anax imperator	2	4	6	10	13	26	19	8	2	5	3	2
Anax parthenope	1	1	2	9	18	28	17	10	8	5	2	1
Anax speratus	0	0	13	0	20	20	7	0	13	27	0	0
Anax tristis	0	0	0	0	0	0	0	0	0	0	100	0
Brachytron pratense	0	0	1	8	77	14	0	0	0	0	0	0
Caliaeschna microstigma	0	0	0	1	12	40	38	8	0	0	0	0

Species name	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Cephalaeschna klapperichi	0	0	0	0	0	0	100	0	0	0	0	0
Pinheyschna yemenensis	0	36	0	0	9	27	0	0	0	27	0	0
Gomphidae												
Anormogomphus kiritshenkoi	0	0	0	5	23	41	14	14	5	0	0	0
Gomphus davidi	0	0	2	8	52	38	0	0	0	0	0	0
Gomphus kinzelbachi	0	0	0	50	32	18	0	0	0	0	0	0
Gomphus schneiderii	0	0	0	3	38	38	17	5	0	0	0	0
Lindenia tetraphylla	1	0	9	16	13	34	20	4	0	1	2	0
Onychogomphus assimilis	0	0	0	2	19	39	30	4	0	4	0	0
Onychogomphus flexuosus	0	0	2	2	20	54	21	1	0	0	0	0
O. (forcipatus) albotibialis	0	0	1	1	14	36	37	11	1	0	0	0
O. (forcipatus) forcipatus	2	0	0	6	2	35	39	12	2	0	2	0
Onychogomphus lefebvrii	0	0	3	4	17	44	27	3	1	1	0	0
Onychogomphus macrodon	0	0	0	0	44	44	9	3	0	0	0	0
Ophiogomphus reductus	0	0	0	2	31	35	17	15	0	0	0	0
Paragomphus genei	4	13	17	22	5	6	4	1	4	7	12	4
Paragomphus lineatus	0	0	6	14	13	29	30	6	2	0	0	0
Paragomphus sinaiticus	1	7	23	24	1	1	1	0	6	17	13	7
Stylurus ubadschii	0	0	0	5	38	33	14	10	0	0	0	0
Cordulegastridae												
Cordulegaster charpentieri	0	0	0	1	8	43	39	8	1	1	0	0
Cordulegaster coronata	0	0	0	7	13	27	53	0	0	0	0	0
Cordulegaster insignis	0	0	0	0	8	32	50	10	0	0	0	0
Cordulegaster mzymtae	0	0	0	0	0	3	47	50	0	0	0	0
Cordulegaster picta	0	0	0	0	6	25	57	12	0	0	0	0
Cordulegaster vanbrinkae	0	0	0	0	7	29	54	10	0	0	0	0
Neallogaster schmidti	0	0	0	0	0	40	60	0	0	0	0	0
Corduliidae												
Cordulia aenea	0	0	0	0	19	45	35	0	0	0	0	0
Somatochlora flavomaculata	0	0	0	0	27	36	24	11	2	0	0	0
Somatochlora meridionalis	0	0	0	0	4	33	56	4	4	0	0	0
Libellulidae												
Acisoma panorpoides	0	0	0	0	0	0	100	0	0	0	0	0
Acisoma variegatum	25	0	38	0	0	0	13	13	0	13	0	0
Brachythemis contaminata	0	0	0	67	33	0	0	0	0	0	0	0
Brachythemis fuscopalliata	0	0	1	8	20	37	21	6	4	3	0	0
Brachythemis impartita	0	0	2	10	21	28	9	8	10	10	4	0
Crocothemis erythraea	2	4	5	10	12	23	18	8	6	6	4	2
Crocothemis sanguinolenta	1	3	18	35	3	11	4	2	2	9	11	1
Crocothemis servilia	0	0	2	11	15	21	13	7	9	8	13	2
Diplacodes lefebvrii	3	8	8	15	14	12	6	7	7	9	8	3
Diplacodes trivialis	0	0	0	0	0	0	0	0	0	0	100	0
Leucorrhinia pectoralis	0	0	0	0	17	50	28	6	0	0	0	0
Libellula depressa	0	0	0	2	11	43	32	10	2	0	0	0
Libellula fulva	0	1	0	1	42	41	14	1	1	0	0	1
Libellula pontica	0	0	2	11	44	32	8	2	2	0	0	0

Species name	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Libellula quadrimaculata	0	0	0	0	20	34	33	14	0	0	0	0
Macrodiplax cora	6	12	18	26	0	1	0	4	7	8	18	1
Nesciothemis farinosa	4	2	14	10	4	26	0	4	8	16	12	0
Orthetrum abbotti	14	14	14	29	0	14	0	14	0	0	0	0
Orthetrum albistylum	0	0	1	1	8	37	35	15	1	1	0	0
Orthetrum brevistylum	0	5	0	12	24	17	5	0	2	15	17	2
Orthetrum brunneum	0	0	0	2	11	29	36	17	4	1	0	0
Orthetrum caffrum	3	7	10	0	21	31	3	3	3	14	3	0
Orthetrum cancellatum	0	0	0	2	12	41	30	13	1	0	0	0
Orthetrum chrysostigma	2	7	11	16	11	14	6	4	6	12	9	3
Orthetrum coerulescens	0	0	0	3	12	34	31	15	4	1	0	0
Orthetrum julia	0	22	11	0	0	33	0	0	0	11	22	0
Orthetrum luzonicum	0	0	0	14	29	14	43	0	0	0	0	0
Orthetrum pruinosum	0	0	0	50	0	0	50	0	0	0	0	0
Orthetrum ransonnetii	4	11	13	23	11	6	4	3	5	12	3	4
Orthetrum sabina	2	4	5	13	15	19	11	7	9	8	5	3
Orthetrum taeniolatum	0	0	1	9	20	30	17	10	7	4	2	0
Orthetrum triangulare	0	0	0	0	100	0	0	0	0	0	0	0
Orthetrum trinacria	0	0	3	12	21	21	9	3	3	29	0	0
Palpopleura deceptor	100	0	0	0	0	0	0	0	0	0	0	0
Palpopleura sexmaculata	0	0	0	0	100	0	0	0	0	0	0	0
Pantala flavescens	2	5	3	4	4	7	11	18	14	15	14	5
Rhyothemis semihyalina	1	3	14	29	6	6	2	6	6	11	14	3
Selysiothemis nigra	0	1	2	11	13	39	18	8	5	3	1	0
Sympetrum arenicolor	0	1	0	3	19	30	19	6	7	9	6	0
Sympetrum danae	0	0	0	0	0	0	27	55	0	9	9	0
Sympetrum depressiusculum	0	0	0	0	0	11	43	37	6	4	0	0
Sympetrum flaveolum	1	0	0	0	0	10	46	37	3	3	0	0
Sympetrum fonscolombii	1	1	2	8	11	18	24	18	10	5	3	1
Sympetrum haritonovi	0	0	0	0	0	4	38	48	10	0	0	0
Sympetrum meridionale	0	0	0	2	5	17	37	24	11	3	0	0
Sympetrum pedemontanum	0	0	0	0	0	13	35	46	6	0	0	0
Sympetrum sanguineum	0	0	0	1	2	21	48	23	4	1	0	0
Sympetrum sinaiticum	0	0	20	0	20	0	0	20	20	0	0	20
Sympetrum striolatum	1	0	1	3	12	27	26	13	7	9	2	1
Sympetrum tibiale	0	0	0	0	0	0	100	0	0	0	0	0
S. vulgatum decoloratum	0	0	0	0	1	4	36	37	15	5	0	1
Tholymis tillarga	0	0	0	0	0	0	33	0	33	0	33	0
Tramea basilaris	3	21	8	5	0	0	0	0	0	0	55	8
Tramea limbata	11	7	26	17	2	0	0	2	7	13	15	0
Trithemis annulata	2	1	6	11	14	24	14	6	8	10	4	2
Trithemis arteriosa	2	10	9	14	9	12	5	4	8	15	9	3
Trithemis aurora	0	0	0	100	0	0	0	0	0	0	0	0
Trithemis dejouxi	9	0	0	18	27	36	0	0	0	0	9	0
Trithemis festiva	0	0	0	8	19	33	22	7	6	4	2	0
Trithemis furva	0	11	11	4	25	29	4	0	11	0	7	0

Species name	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Trithemis kirbyi	2	4	14	22	11	11	6	3	3	11	7	7
Trithemis pallidinervis	0	0	0	33	0	0	0	0	0	0	33	33
Urothemis edwardsii	2	0	19	32	3	2	10	3	6	15	8	0
Urothemis thomasi	0	0	17	41	3	10	3	0	1	17	6	1
Zygonyx torridus	2	6	16	20	8	6	6	3	5	14	11	3

Appendix 3

The English names of the dragonflies and damselflies of West and Central Asia

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Today, books and websites provide over 4000 English names for almost 3000 of the world's 6300 known dragonfly and damselfly species, although the vast majority of these were only introduced since 1995. To serve those who prefer such names, an attempt was made to produce a consistent list of English names, with a single name per species, for all species found in West and Central Asia.

Twelve new species names are proposed, while seven existing names are adjusted slightly. Drafting the list benefitted from discussions with Jan Hermans and Dhirendra Singh in preparation of a forthcoming guide for northwestern India, in which names used in Europe (Dijkstra & Lewington 2006, Dijkstra et al 2020, Smallshire & Swash 2020), Africa (Dijkstra & Clausnitzer 2014, Dijkstra 2017) and various Australasian countries (Wilson 1995, 2003, Tsou 2005, Theischinger & Hawking 2006, Bedjanič et al. 2007, 2014, Subramanian 2009, Bun et al. 2010, Reels & Zhang 2015, Joshi et al. 2021) are reconciled as much as possible.

Below, comments on the proposed English names are provided for all species not listed by Dijkstra & Lewington (2006), Dijkstra & Clausnitzer (2014), and Schneider & Ikemeyer (2020), or where the proposed name differs from those used in these references.

Sympecma gobica Förster, 1900 — **Turkestan Winter Damsel**
New English name. Schneider & Ikemeyer (2020) proposed the name "Gobian Winter Damsel". "Gobi" would be simpler and grammatically more correct than "Gobian". Moreover, the Gobi Desert is largely peripheral to the species' range. A name better reflecting its actual occurrence is therefore suggested, translated from the Dutch name (Bos et al. 2020).

Calopteryx hyalina Martin, 1909 — **Clear-winged Demoiselle**
Calopteryx syriaca Gené in Rambur, 1842 — **Syrian Demoiselle**
The source of these two names available online has not been traced, but both seem appropriate.

Calopteryx samarcandica Bartenev, 1912 — **Samarkand Demoiselle**
Calopteryx waterstoni Schneider, 1984 — **Pontic Demoiselle**
New English names. These taxa are not always separated as full species from the Banded Demoiselle *C. splendens* (Harris, 1780). If they are, however, names indicative of their range seem most appropriate

Arabicnemis caerulea Waterston, 1984 — **Powderblue Damsel**
Amended English name. Walker & Pittaway (1987) called this "Powderblue Damselfly" and Feulner et al. (2007) "Powder Blue Damsel": the proposed shortening seems appropriate for this monotypic genus.

Arabineura khalidi (Schneider, 1988) — **Hajar Threadtail**
Amended English name. Feulner et al (2007) suggested the name "Hajar Wadi Damsel". The monotypic genus is very similar to other disparoneurine genera, so it would be appropriate to call this species a "Threadtail" too and drop one of the two prefixes. If the genus deserves a unique group-name in the future, "Hajar Wadi-damsel" would be a fitting species name.

Calicnemia eximia (Selys, 1863) — **Scarlet Oread**
The species-rich Asian genus *Calicnemia* was given the (rather generic) group-names "Openwing" in India (Subramanian 2009, Joshi et al 2021) and "Mountain Damsel" in Hong Kong (Wilson 1995, 2003), replaced with the shorter "Oread" by Reels & Zhang (2015). The name proposed for this species combines the latter group-name with the prefix "Scarlet" used in India, as was also done in a forthcoming guide for northwestern India (pers. com. D. Singh & J. Hermans).

Agriocnemis pygmaea (Rambur, 1842) — **Wandering Wisp**
This widespread species is known under various English names across Asia and Australia, of which "Wandering Wisp" is most prevalent.

Coenagrion australocaspicum Dumont & Heidari, 1996 — **Hyrcanian Bluet**
Amended English name. Schneider & Ikemeyer (2020) proposed the name "Australocaspian Azure Bluet". However, inserting "Azure" is superfluous if this species is considered distinct from the Azure Bluet *C. puella* (Linnaeus, 1758). *Coenagrion intermedium* Lohmann, 1990 and *C. syriacum* (Morton, 1924) belong to the same species complex and are simply called the "Cretan Bluet" and "Syrian Bluet" respectively. Furthermore, "Australocaspian" is an awkward translation of the rather technical scientific name: "Hyrcanian" has a similar meaning, but seems more accessible.

Coenagrion ornatum (Selys, 1850) — **Ornate Bluet**
Schneider & Ikemeyer (2020) suggested the name "Eastern Ornate Bluet" for C. vanbrinkae Lohmann, 1993. If this taxon is indeed separated from *C. ornatum* as a good species, the latter would become "Western Ornate Bluet".

Coenagrion persicum Lohmann, 1993 — **Persian Bluet**
Amended English name. Schneider & Ikemeyer (2020) proposed the name "Persian Azure Bluet", but inserting "Azure" is superfluous (see *C. australocaspicum* above), especially as the species recalls the Variable Bluet *C. pulchellum* (Vander Linden, 1825) more in general appearance.

Coenagrion ponticum (Bartenev, 1929) — **Pontic Bluet**
Amended English name. Schneider & Ikemeyer (2020) proposed the name "Pontic Azure Bluet", but see *C. australocaspicum* above.

Enallagma risi Schmidt, 1961 — **Ris's Bluet**
This taxon is not always separated from the Common Bluet *E. cyathigerum* (Charpentier, 1840), but the English name proposed by Schneider & Ikemeyer (2020) is appropriate when it is.

Erythromma lindenii (Selys, 1840) — **Blue-eye**
Schneider & Ikemeyer (2020) called this the "Blue- or Globlet[sic]-marked Damselfly" presumably an erroneous reference to the British name "Goblet-marked Damselfly" and European name "Blue-eye" introduced by Dijkstra & Lewington (2006) in allusion to its "red-eye" relatives.

Ischnura aralensis Haritonov, 1979 — **Kazakh Bluetail**
The English name was first used in Boudot & Kalkman (2015).

Ischnura forcipata Morton, 1907 — **Forked Bluetail**
Schneider & Ikemeyer (2020) called this species "Forked Bluetail", although in India "Forcipate Bluetail" has also been used (Joshi et al 2021, Subramanian 2009). The latter seems needlessly technical and "Forked Bluetail" will also be used in the forthcoming guide for northwestern India (pers. com. D. Singh & J. Hermans).

Ischnura intermedia Dumont, 1974 — **Persian Bluetail**
Schneider & Ikemeyer (2020) used both "Dumont's Bluetail" and "Persian Bluetail", but the latter is favoured in the European literature (Boudot & Kalkman 2015, Dijkstra et al 2020, Smallshire & Swash 2020).

Ischnura nursei Morton, 1907 — **Pixie Bluetail**
Known as "Pixie Dartlet" in India (Joshi et al 2021, Subramanian 2009), but named "Pixie Bluetail" here and in a forthcoming guide for northwestern India (pers. com. D. Singh & J. Hermans) in order to conform with the widely known group-name for *Ischnura*. Unfortunately, *I. nursei* is one of the few species of that genus without a blue tail-end.

Ischnura rubilio Selys, 1876 — **Golden Bluetail**
Called "Rubilio Bluetail" by Schneider & Ikemeyer (2020) and "Western Golden Dartlet" in India (Joshi et al 2021, Subramanian 2009). "Golden Bluetail" conforms with other *Ischnura* species by its group-name, while the extra prefix "Western" is not needed as alternative names not using "Golden" already exist for the presumed "Eastern Golden Bluet" *I. aurora* (Brauer, 1865). This adjustment is also applied in a forthcoming guide for northwestern India (pers. com. D. Singh & J. Hermans).

Pseudagrion arabicum Waterston, 1980 — **Arabian Sprite**
New and self-explanatory English name.

Pseudagrion decorum (Rambur, 1842) — **Azure Sprite**
Proposed names include "Elegant Sprite", "Three-lined Dart" and "Three-striped Blue Dart". In accordance with a forthcoming book for northwestern India (pers. com. D. Singh & J. Hermans), the name "Azure Sprite" from Sri Lanka is preferred (Bedjanič et al 2007, 2014).

Pseudagrion laidlawi Fraser, 1922 — **Dusky Sprite**
Schneider & Ikemeyer (2020) introduced the name "Laidlaw's Sprite". However, in an effort to avoid eponyms, this dark and dusty species is named "Dusky Sprite" in a forthcoming guide for northwestern India (pers. com. D. Singh & J. Hermans).

Pseudagrion syriacum Selys, 1887 — **Syrian Sprite**
The source of this name found online was not traced, but it is self-explanatory and appropriate.

Cephalaeschna klapperichi Schmidt, 1961 — **Western Harvest-hawker**
New English name. The group-name "Harvest-hawker" will be introduced in a forthcoming guide for northwestern India (pers. com. D. Singh & J. Hermans), as many *Cephalaeschna* species fly in late summer and autumn. This is the most western species of the genus.

Pinheyschna yemenensis (Waterston, 1985) — **Yemen Hawker**
The source of this name found online was not traced, but it is self-explanatory and suitable.

Anormogomphus kiritshenkoi Bartenev, 1913 — **Sallow Clenchtail**
New English name. The genus name refers to the male's terminal abdominal segment, which clenches the appendages like a fist. The prefix refers to the species' almost uniformly pale brownish yellow appearance.

Gomphus kinzelbachi Schneider, 1984 — **Zagros Clubtail**
New English name. Schneider & Ikemeyer (2020) called this species "Eastern Clubtail", but the group-name "Clubtail" is used widely in the family, which includes countless species found further east. The current proposal is deemed more informative for this regional endemic, limited to the Zagros Mountains and its southern slope.

Onychogomphus albotibialis Schmidt, 1954 — **Eastern Small Pincertail**
Amended English name. Schneider & Ikemeyer (2020) called this taxon "Small Eastern Pincertail". Whether it is considered a good species or a subspecies of the Small Pincertail *O. forcipatus* (Linnaeus, 1758), the correct word order would be "Eastern Small Pincertail".

Ophiogomphus reductus Calvert, 1898 — **Pale-green Snaketail**
The English name will be introduced in a forthcoming guide for northwestern India (pers. com. D. Singh & J. Hermans): the species appears very similar to the Green Snaketail *O. cecilia* (Geoffroy in Fourcroy, 1785), but often looks more faded.

Paragomphus genei (Selys, 1841) — **Common Hooktail**
Called "Common Hooktail" in Africa and "Green Hooktail" in Europe. However, much greener species exist in the genus. Furthermore, this mainly African species is much more common and widespread in Africa than any other *Paragomphus* species. The African name is therefore preferred: "Common Hooktail" has also been used for *Lamelligomphus formosanus* (Matsumura, 1926) in Taiwan (Tsou 2005) and *Paragomphus lineatus* (Selys, 1850) in India (Joshi et al 2021, Subramanian 2009), but the alternatives "Taiwan Clawtail" and "Lined Hooktail" exist for those species.

Cordulegaster charpentieri (Kolenati, 1846) — **Persian Goldenring**
Cordulegaster coronata Morton, 1916 — **Turkestan Goldenring**
Cordulegaster mzymtae Bartenev, 1929 — **Pontic Goldenring**
New English names. The taxonomy of the complex of species related to the Blue-eyed Goldenring *C. insignis* Schneider, 1845 is unresolved. For now, therefore, the English names should be considered provisional and based on distribution, where the proposals above probably reflect their occurrence in different western and central Asian mountain ranges best. Schneider & Ikemeyer (2020) called *C. coronata* "Eastern Goldring", although "Goldenring" is the prevalent spelling of the group-name. As that group-name is used widely in the family, and the family includes many more eastern species, a more specific name is proposed.

Cordulegaster vanbrinkae Lohmann, 1993 — **Hyrcanian Goldenring**
Amended English name. Schneider & Ikemeyer (2020) introduced the name as "Hyrcanian Goldring" and only the spelling of the group-name is corrected here to conform with that used elsewhere.

Neallogaster schmidti Asahina, 1982 — **Afghan Goldenring**
New English name for a species known so far with certainty from only Afghanistan.

Acisoma panorpoides Rambur, 1842 — **Asian Pintail**
While this species has been called "Trumpettail" in India and Singapore (Bun et al 2010, Joshi et al 2021, Subramanian 2009), "Asian Pintail" was applied elsewhere in Asia. The latter includes the group-name used for other members of the genus and is therefore preferred here and in a forthcoming book for northwestern India (pers. com. D. Singh & J. Hermans).

Brachythemis contaminata (Fabricius, 1793) — **Orange-winged Groundling**
Called "Common Amberwing" or "Asian Amberwing" in some Asian countries, alluding to the unrelated amberwings *Perithemis* in the Americas. Known as "Ditch Jewel" in India (Subramanian 2009, Joshi et al. 2021), although "Jewel" is used widely as group-name in Chlorocyphidae. A forthcoming guide for northwestern India (pers. com. D. Singh & J. Hermans) adopts the Sri Lankan name "Orange-winged Groundling" (Bedjanič et al. 2007, 2014), which conforms with the group-name used for the related species in the region, *B. fuscopalliata* (Selys, 1887) and *B. impartita* (Karsch, 1890).

Crocothemis erythraea (Brullé, 1832) — **Broad Scarlet**
The status of the taxon *chaldaeorum* Morton, 1920 either as a good species or a subspecies or synonym of *C. erythraea* is unresolved. If an English name would be needed, "Oasis Scarlet" and "Arabian Scarlet" are options.

Orthetrum coerulescens (Fabricius, 1798) — **Keeled Skimmer**
Schneider & Ikemeyer (2020) suggested "Eastern Keeled Skimmer" for *O. c. anceps* (Schneider, 1845), which seems appropriate if there is need to give that subspecies an English name.

Orthetrum pruinosum (Burmeister, 1839) — **Pink Skimmer**
This widespread species is known by various names in Asia. In accordance with a forthcoming book for northwestern India (pers. com. D. Singh & J. Hermans), the name "Pink Skimmer" (after the male's abdomen colour) from Sri Lanka is preferred (Bedjanič et al. 2007, 2014).

Orthetrum triangulare (Selys, 1878) — **Triangle Skimmer**
The alternative "Lesser Blue Skimmer" has also been published, which makes a nice pair with "Greater Blue Skimmer" for the similar O melania (Selys, 1883). The name "Triangle Skimmer" from Sri Lanka (Bedjanič et al. 2007, 2014) seems more attractive and has also been adopted for a forthcoming guide for northwestern India (pers. com. D. Singh & J. Hermans).

Palpopleura sexmaculata (Fabricius, 1787) — **Asian Widow**
While this species has been called "Blue-tailed Yellow Skimmer" in India (Subramanian 2009, Joshi et al. 2021), "Asian Widow" was applied elsewhere in Asia. The latter includes the group-name used for other members of the genus and is therefore preferred here and in a forthcoming book for northwestern India (pers. com. D. Singh & J. Hermans).

Sympetrum arenicolor Jödicke, 1994 — **Sandy Darter**
Schneider & Ikemeyer (2020) introduced the name "Prairie Darter", but overlooked that the more fitting "Sandy Darter" had already been proposed by Dijkstra & Lewington (2006).

Sympetrum tibiale (Ris, 1897) — **Steppe Darter**
New English name, translated from the Dutch name (Bos et al. 2020).

Tramea basilaris (Palisot de Beauvois, 1817) — **Keyhole Glider**
Schneider & Ikemeyer (2020) used the Indian name "Red Marsh Trotter" (Subramanian 2009, Joshi et al. 2021) but the African name "Keyhole Glider" conforms with the group-name used most widely in the Old World. The African name was also adopted in recent European guides (Dijkstra et al. 2020; Smallshire & Swash 2020).

Trithemis aurora (Burmeister, 1839) — **Crimson Dropwing**
This name conforms with the group-name "Dropwing" used throughout the range of the genus *Trithemis*, as well as with the prefix in the Indian name "Crimson Marsh Glider". Indeed, with that exception and "Dawn Dropwing" in Sri Lanka (Bedjanič et al. 2007, 2014), "Crimson Dropwing" is the generally preferred name across Asia.

Trithemis pallidinervis (Kirby, 1889) — **Dancing Dropwing**
This name conforms with the group-name "Dropwing" used throughout the range of the genus *Trithemis* and has been used throughout Asia. Only in India the species has been called the "Long-legged Marsh Glider" (Subramanian 2009, Joshi et al. 2021).

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Photographers

Species name	page	
Lestidae		
Chalcolestes parvidens	35	Jean-Pierre Boudot
Lestes barbarus	36	Jean-Pierre Boudot
Lestes concinnus	37	Dietmar Ikemeyer
Lestes dryas	38	Jean-Pierre Boudot
Lestes macrostigma	39	Jean-Pierre Boudot
Lestes pallidus	40	Tom Kompier
Lestes sponsa	41	René Manger
Lestes virens	42	Roy van Grunsven
Sympecma fusca	43	Jean-Pierre Boudot
Sympecma gobica	44	Vladimir Kazenas
Sympecma paedisca	45	Antoine van der Heijden
Calopterygidae		
Calopteryx hyalina	46	Johan van 't Bosch
Calopteryx samarcandica	47	Sergei Borisov
Calopteryx splendens	48	Geert De Knijf
Calopteryx syriaca	49	Paul Schrijvershof
Calopteryx virgo	50	Geert De Knijf
Calopteryx waterstoni	51	Johan van 't Bosch
Euphaeidae		
Epallage fatime	52	Robert Pieters
Coenagrionidae		
Agriocnemis pygmaea	53	Jean-Pierre Boudot
Agriocnemis sania	54	David Kotter
Azuragrion granti	55	Jaap Bouwman
Azuragrion nigridorsum	56	Jean-Pierre Boudot
Azuragrion somalicum	57	Geert De Knijf
Azuragrion vansomereni	58	Damian Pinguey
Ceriagrion georgifreyi	59	Jean-Pierre Boudot
Ceriagrion glabrum	60	Robert Ketelaar
Coenagrion armatum	61	Jean-Pierre Boudot
Coenagrion australocaspicum	62	Dietmar Ikemeyer
Coenagrion lunulatum	63	Geert De Knijf
Coenagrion ornatum	64	Paul Schrijvershof
Coenagrion persicum	65	Dietmar Ikemeyer
Coenagrion ponticum	66	Jörg Adelmann
Coenagrion puella	67	Jean-Pierre Boudot
Coenagrion pulchellum	68	Jean-Pierre Boudot
Coenagrion scitulum	69	Jean-Pierre Boudot
Coenagrion syriacum	70	David Kotter
Enallagma cyathigerum	71	Geert De Knijf
Enallagma risi	72	Oleg Kosterin
Erythromma lindenii	73	Jean-Pierre Boudot
Erythromma viridulum	74	Geert De Knijf

Species name	page	
Ischnura aralensis	75	Oleg Kosterin
Ischnura elegans	76	Jean-Pierre Boudot
Ischnura evansi	77	Jean-Pierre Boudot
Ischnura forcipata	78	Antoine van der Heijden
Ischnura fountaineae	79	Jean-Pierre Boudot
Ischnura intermedia	80	Geert De Knijf
Ischnura nursei	81	Mohsen Kiany
Ischnura pumilio	82	Antoine van der Heijden
Ischnura rubilio	83	Antoine van der Heijden
Ischnura senegalensis	84	Paul Schrijvershof
Pseudagrion arabicum	85	Henri Dumont
Pseudagrion decorum	86	Geert De Knijf
Pseudagrion hamoni	87	Lappies Labuschagne
Pseudagrion kersteni	88	Lappies Labuschagne
Pseudagrion laidlawi	89	Dietmar Ikemeyer
Pseudagrion niloticum	90	Phil Benstead
Pseudagrion sublacteum	91	Paul Schrijvershof
Pseudagrion syriacum	92	Paul Schrijvershof
Pseudagrion torridum	93	Jean-Pierre Boudot
Pyrrhosoma nymphula	94	Robert Pieters
Platycnemidae		
Arabicnemis caerulea	95	Geert De Knijf
Arabineura khalidi	96	Jean-Pierre Boudot
Calicnemia eximia	97	Tom Kompier
Platycnemis dealbata	98	Geert De Knijf
Platycnemis kervillei	99	Paul Schrijvershof
Platycnemis pennipes	100	Geert De Knijf
Aeshnidae		
Aeshna affinis	101	Geert De Knijf
Aeshna cyanea	102	René Manger
Aeshna isoceles	103	Jean-Pierre Boudot
Aeshna juncea	104	Vasil Ananian
Aeshna mixta	105	René Manger
Aeshna serrata	106	Gilles Jacquemin
Aeshna vercanica	107	Dietmar Ikemeyer
Anax ephippiger	108	David Kotter
Anax immaculifrons	109	Robert Pieters
Anax imperator	110	Jean-Pierre Boudot
Anax parthenope	111	David Kotter
Anax speratus	112	Damian Pinguey
Anax tristis	113	Katharina Reddig
Brachytron pratense	114	Jean-Pierre Boudot
Caliaeschna microstigma	115	David Kotter
Cephalaeschna klapperichi	116	*

Species name	page	
Pinheyschna yemenensis	117	Henri Dumont
Gomphidae		
Anormogomphus kiritshenkoi	118	Paul Schrijvershof
Gomphus davidi	119	Paul Schrijvershof
Gomphus kinzelbachi	120	Dietmar Ikemeyer
Gomphus schneiderii	121	Robert Pieters
Lindenia tetraphylla	122	Robert Pieters
Onychogomphus assimilis	123	Robert Pieters
Onychogomphus flexuosus	124	Asmus Schröter
Onychogomphus albotibialis	125	Geert De Knijf
Onychogomphus forcipatus	126	Jean-Pierre Boudot
Onychogomphus lefebvrii	127	Paul Schrijvershof
Onychogomphus macrodon	128	Martin Waldhauser
Ophiogomphus reductus	129	Oleg Kosterin
Paragomphus genei	130	Robert Ketelaar
Paragomphus lineatus	131	Antoine van der Heijden
Paragomphus sinaiticus	132	Jean-Pierre Boudot
Stylurus ubadschii	133	Asmus Schröter
Cordulegastridae		
Cordulegaster charpentieri	134	Jean-Pierre Boudot
Cordulegaster coronata	135	Dietmar Ikemeyer
Cordulegaster insignis	136	Jean-Pierre Boudot
Cordulegaster mzymtae	137	Jean-Pierre Boudot
Cordulegaster picta	4, 138	Robert Pieters
Cordulegaster vanbrinkae	139	Dietmar Ikemeyer
Neallogaster schmidti	140	**
Corduliidae		
Cordulia aenea	141	Jean-Pierre Boudot
Somatochlora flavomaculata	142	Jean-Pierre Boudot
Somatochlora meridionalis	143	Jean-Pierre Boudot
Libellulidae		
Acisoma panorpoides	144	Antoine van der Heijden
Acisoma variegatum	145	Dick Bekker
Brachythemis contaminata	146	Antoine van der Heijden
Brachythemis fuscopalliata	147	Paul Schrijvershof
Brachythemis impartita	148	Jean-Pierre Boudot
Crocothemis erythraea	149	Paul Schrijvershof
Crocothemis sanguinolenta	150	Paul Schrijvershof
Crocothemis servilia	151	Paul Schrijvershof
Diplacodes lefebvrii	152	Geert De Knijf
Diplacodes trivialis	153	Tom Kompier
Leucorrhinia pectoralis	154	René Manger
Libellula depressa	155	Jean-Pierre Boudot
Libellula fulva	156	Jean-Pierre Boudot
Libellula pontica	157	Geert De Knijf

Species name	page	
Libellula quadrimaculata	158	Jean-Pierre Boudot
Macrodiplax cora	159	Paul Schrijvershof
Nesciothemis farinosa	160	Jean-Pierre Boudot
Orthetrum abbotti	161	Dorit Bar-Zakay
Orthetrum albistylum	162	Geert De Knijf
Orthetrum brevistylum	163	Raoul Beunen
Orthetrum brunneum	164	Jean-Pierre Boudot
Orthetrum caffrum	165	Damian Pinguey
Orthetrum cancellatum	166	Jean-Pierre Boudot
Orthetrum chrysostigma	167	René Manger
Orthetrum coerulescens	168	Asmus Schröter
Orthetrum julia	169	Robert Ketelaar
Orthetrum luzonicum	170	Tom Kompier
Orthetrum pruinosum	171	Antoine van der Heijden
Orthetrum ransonnetii	172	Jean-Pierre Boudot
Orthetrum sabina	173	Robert Ketelaar
Orthetrum taeniolatum	174	Paul Schrijvershof
Orthetrum triangulare	175	Antoine van der Heijden
Orthetrum trinacria	176	René Manger
Palpopleura deceptor	177	Casper Zuyderduyn
Palpopleura sexmaculata	178	Antoine van der Heijden
Pantala flavescens	179	Paul Schrijvershof
Pantala flavescens	180	Antoine van der Heijden
Rhyothemis semihyalina	181	Jean-Pierre Boudot
Selysiothemis nigra	182	Geert De Knijf
Sympetrum arenicolor	183	Paul Schrijvershof
Sympetrum danae	184	Alex Rukhaia
Sympetrum depressiusculum	185	René Manger
Sympetrum flaveolum	186	Jean-Pierre Boudot
Sympetrum fonscolombii	187	Geert De Knijf
Sympetrum haritonovi	188	Jean-Pierre Boudot
Sympetrum meridionale	189	Jean-Pierre Boudot
Sympetrum pedemontanum	190	Jean-Pierre Boudot
Sympetrum sanguineum	191	Asmus Schröter
Sympetrum sinaiticum	192	Jean-Pierre Boudot
Sympetrum striolatum	193	Jean-Pierre Boudot
Sympetrum tibiale	194	Thomas Hallfarth
Sympetrum vulg. decoloratum	195	Jean-Pierre Boudot
Tholymis tillarga	196	Damian Pinguey
Tramea basilaris	197	Robert Ketelaar
Tramea limbata	198	Geert De Knijf
Trithemis annulata	199	Paul Schrijvershof
Trithemis arteriosa	200	Robert Ketelaar
Trithemis aurora	201	Antoine van der Heijden
Trithemis dejouxi	202	Christian Monnerat

Species name	page	
Trithemis festiva	203	Antoine van der Heijden
Trithemis furva	204	Jean-Pierre Boudot
Trithemis kirbyi	205	Jean-Pierre Boudot
Trithemis pallidinervis	206	Antoine van der Heijden
Urothemis edwardsii	207	Jean-Pierre Boudot
Urothemis thomasi	208	Jean-Pierre Boudot
Zygonyx torridus	209	Robert Ketelaar

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De NVL is op 1 maart 1997 opgericht en is ontstaan uit een fusie tussen het jeugdbondslibellenproject en de Nederlandse Libellen Onderzoekers (NLO). De vereniging heeft als doel het stimuleren van studie en bescherming van libellen, in het bijzonder in Nederland. Om dit te bereiken worden er studieweekenden en een jaarlijkse libellenstudiedag georganiseerd. De Nederlandse Vereniging voor Libellenstudie en de Libellenvereniging Vlaanderen brengen samen het tijdschrift Brachytron uit waarin artikelen betreffende de libellenfauna van Nederland, Vlaanderen en omstreken verschijnen.

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Libellenvereniging Vlaanderen vzw (LVV)

De LVV is op 10 november 2007 opgericht na een opsplitsing van de 24 jaar oude nationale Libellenwerkgroep *Gomphus* in een Vlaamse en Waalse groep. De vereniging stelt zich tot doel het verzamelen, verspreiden en delen van kennis over libellen en de bescherming van hun leefmilieu. We organiseren excursie's, workshops en een jaarlijkse libellenstudiedag en hebben een digitale nieuwsflits. Samen met de NVL geven we het tijdschrift Brachytron uit waarin artikelen betreffende de libellenfauna van Nederland, Vlaanderen en omstreken verschijnen.

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