



International Dragonfly Fund - Report

Journal of the International Dragonfly Fund

1 -23

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Armenia and Azerbaijan

Published: 11.09.2019

135

ISSN 1435-3393

The International Dragonfly Fund (IDF) is a scientific society founded in 1996 for the improvement of odonatological knowledge and the protection of species.
Internet: <http://www.dragonflyfund.org/>

This series intends to publish studies promoted by IDF and to facilitate cost-efficient and rapid dissemination of odonatological data.

Editorial Work: Bernd Kunz, Oleg Kosterin, Holger Hunger, Rory A. Dow,
Milen Marinov, Martin Schorr

Layout: Martin Schorr

IDF-home page: Holger Hunger

Printing: Colour Connection GmbH, Frankfurt

Impressum: Publisher: International Dragonfly Fund e.V., Schulstr. 7B,
54314 Zerf, Germany. E-mail: oestlap@online.de

Responsible editor: Martin Schorr

Cover picture: ***Ischnura fountaineae*, female**

Photographer: Eric Durand

Dragonfly species new or rare to the Odonata fauna of Georgia, Armenia and Azerbaijan

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Abstract

During four field trips in Georgia, Armenia and Azerbaijan from 2010 to 2018, the author collected data of a total of 55 species (see Tab. 2 in Appendix). This study provides first insights into new or rare species in this ecoregion. *Ischnura fountaineae* and *Cordulia aenea* were found for the first time in Armenia. We also highlight the rediscovery of some species that were mentioned in the older literature but had not been confirmed since. An autochthonous population of *Lestes macrostigma* was discovered in Azerbaijan sixteen years after the single previous record by Dumont (2004). Original information is provided on the distribution of some rare species encountered in these countries. Finally, the identification of a puzzling *Cordulegaster* sp. observed in south Armenia is discussed briefly.

Key words: Distribution, southern Caucasus ecoregion, *Lestes macrostigma*, *Ischnura fountaineae*, *Cordulia aenea*, *Leucorhina pectoralis*, *Aeshna cyanea*, *Sympetrum danae*, *Selysiothemis nigra*, *Gomphus schneiderii*, *Onychogomphus assimilis*, *Cordulegaster insignis*, *Cordulegaster* sp., new records

Introduction

Southern Caucasus (Georgia, Armenia and Azerbaijan are here summed as Southern Caucasus) is one of the most biologically rich regions on Earth. Located at a biological crossroads, this area is characterized by huge species richness (Williams et al. 2006). Due to its geographical position, the remarkable diversity of climate and the role of refuge during the climatic oscillations of the Late Quaternary, a high percentage of post-glacial relicts occurs in this region (Habel & Assmann 2009). These considerations make South Caucasus an outstanding place to investigate the distribution of biodiversity and in particular dragonfly communities. As indicated by Tailly et al. (2004), Skortsov & Snegovaya 2015, the South Caucasus odonatofauna was firstly discovered during the Soviet period with mainly old data (Bartenev 1924, 1929a,b, 1930a,b; Bogachev 1937, 1951; Akramowski 1939, 1948, 1964, 1975; Shengelia 1953, 1964, 1975; Akramowski & Shengelia 1967; Kasymov 1972; Beutler 1987; Reinhardt 1992). For the last 30 years - although the knowledge of the dragonfly fauna of this region has been updated significantly - considerable large gaps have been remaining with regard to range and abundance

of most species. Recently, several major works have been published including a series of papers focusing on Azeri odonata (Dumont 2004; Skvortsov 2010; Skvortsov & Snegovaya 2014, 2015, Snegovaya 2019). A significant update on the Odonata fauna of Georgia is given in the frame of a national odonatological project (Schröter 2010; SCHRÖTER et al. 2015, Seehausen et al 2016). In Armenia, the results of numerous field works were compiled in recent papers (Taily & Ananian 2004; Taily et al. 2004; Taily & Tabarroni 2006; Ananian 2012; Ananian & Taily 2012, 2013; Durand & Rigaux 2015) and in the online atlas of dragonflies & damselflies in Armenia (Ananian & Taily 2016). Finally, Schneider et al (2018) provide an extensive overview and update of the odonatan fauna in Iran. During four surveys carried out between 2010 and 2018, the author collected plenty of local odonate data with the aim of improving knowledge on the dragonfly fauna from Southern Caucasus. This paper compiles a selection of records of rare taxa encountered in the three countries considered.

Material and Methods

The current study was carried out during four field trips in 2010 (from 04 to 17 August), 2014 (from 02 to 20 June), 2015 (from 07 to 17 July) in Armenia and Georgia and 2018 (from 28 April to 07 May) in Azerbaijan. Data collected in the first country comprises records throughout the country and numerous aquatic habitats at any altitude for dragonflies were explored. The Georgia's and Azeri surveys were less intense and only sporadic observations were made. The selection of the sites visited was firstly based on former bibliography but largely completed by additional locations selected with topographical satellite images analysis in search of suitable biotopes (about 400 sites pre-selected in Armenia and Georgia). All sampled locations were recorded by hand-held GPS and later adjusted via Google Earth. Adult insects were recorded by sight or temporarily caught with a hand-net and released after identification. Most of the species listed here were photographed in natural conditions or in hand. Coordinates were recorded by Garmin eTrex H personal GPS or by Obsmapp application. The elevations above sea level were revised using Google Earth. Locations are given as angle degrees in the WSG84 geodesic system and altitudes are given in meters above sea level (m a.s.l.) and below sea level (m b.s.l.).

Sampling sites

For each locality (Fig.1; Tab. 1 in Appendix) the identifier number, country, a description of the locality, coordinates and altitude in meters are listed.

Loc. 1. Armenia. Wetland between Vardaghbyur and Karmravan, 40.9958°N, 43.8891°E, 2010 m a.s.l.

Loc. 2. Armenia. Rivulet near Marmashen monastery, 40.8441°N, 43.7559°E, 1545 m a.s.l.

Loc. 3. Armenia. Lake north of Tachir, 41.1415°N, 44.2803°E, 1520 m a.s.l.

Loc. 4. Armenia. Lori wetlands, north of Stepanavan, 41.0510°N, 44.3092°E, 1480 m a.s.l.

Loc. 5. Armenia. Lake north of Urasar, 41.0234°N, 44.3018°E, 1565 m a.s.l.

Loc. 6. Armenia. Dsoraget river near Dsoragyugh, 40.9541°N, 44.6013°E, 1020 m a.s.l.

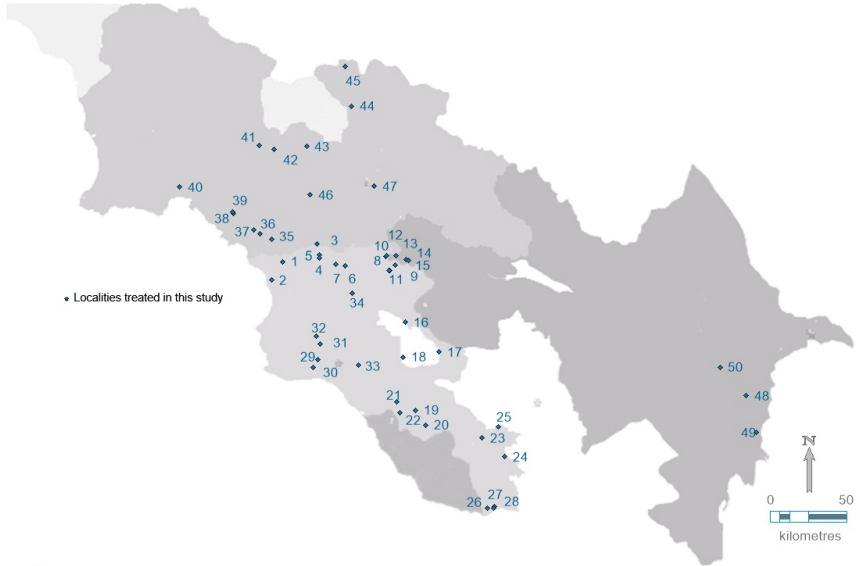


Figure 1. Distribution of the sampled localities presented in this study. All collecting locations are indicated by numbers. The disputal territory of Nagornyi Karabakh is not included as it is currently inaccessible.

- Loc. 7.** Armenia. Pond on the shore of the Dzoraget river, south-west of Vardablur, 40.9673°N, 44.4947°E, 1320 m a.s.l.
- Loc. 8.** Armenia. Pond near Khachaghbyur river at Yenokavan, 40.9076°N, 45.1035°E, 870 m a.s.l.
- Loc. 9.** Armenia. Irrigation network near Aghstev river, Aknaghbyur, 40.9555°N, 45.1677°E, 570 m a.s.l.
- Loc. 10.** Armenia. Artificial lake in forest, Acharkut, 41.0297°N, 45.0648°E, 805 m a.s.l.
- Loc. 11.** Armenia. Khachaghbyur river gorge, 40.9085°N, 45.0928°E, 00 m a.s.l.
- Loc. 12.** Armenia. Samson river near Acharkut, 41.0331°N, 45.0746°E, 780 m a.s.l.
- Loc. 13.** Armenia. Artificial lakes near Bentonite mining, Sevkar, 41.0317°N, 45.1769°E, 704 m a.s.l.
- Loc. 14.** Armenia. Rivulet northeast of Vazashen, 40.9985°N, 45.2979°E, 730 m a.s.l.
- Loc. 15.** Armenia. Isolated pond, east of Vazashen, 40.9920°N, 45.3172°E, 875 m a.s.l.
- Loc. 16.** Armenia. Artanish peninsula, 40.4715°N, 45.2774°E, 1910 m a.s.l.
- Loc. 17.** Armenia. Drying peat deposit also called "lake" Gilli, Vanevan, 40.2169°N, 45.6565°E, 1920 m a.s.l.
- Loc. 18.** Armenia. Lakes north of Martuni. 40.1774°N, 45.2500°E, 1905 m a.s.l.

- Loc. 19.** Armenia. Arpa river near Malishka, 39.7299°N, 45.3884°E, 1130 m a.s.l.
- Loc. 20.** Armenia. Lake near Martiros, 39.6011°N, 45.4993°E, 1930 m a.s.l.
- Loc. 21.** Armenia. Rivulet north of Chiva, 39.8043°N, 45.1716°E, 1604 m a.s.l.
- Loc. 22.** Armenia. Noravank gorge, 39.7103°N, 45.2073°E, 1155 m a.s.l.
- Loc. 23.** Armenia. "Devil bridge" on Vorotan river, 39.4846°N, 46.1400°E, 1375 m a.s.l.
- Loc. 24.** Armenia. Shallow stream near Verin Khotanan, 39.3262°N, 46.3968°E, 1535 m a.s.l.
- Loc. 25.** Armenia. Peatland north of Akner, 39.5790°N, 46.3282°E, 2100 m a.s.l.
- Loc. 26.** Armenia. Dry valley near Meghri, 38.9091°N, 46.2737°E, 645 m a.s.l.
- Loc. 27.** Armenia. Meghri pond, 38.8943°N, 46.2652°E, 515 m a.s.l.
- Loc. 28.** Armenia. Small river near Karchevan, 38.8931°N, 46.1905°E, 852 m a.s.l.
- Loc. 29.** Armenia. Pond, west of Etchmiadzin, 40.1692°N, 44.2755°E, 870 m a.s.l.
- Loc. 30.** Armenia. Armenia, Jrarbi wetlands, 40.1017°N, 44.2243°E, 840 m a.s.l.
- Loc. 31.** Armenia. Rivulet and pond near Agarak, 40.2963°N, 44.3017°E, 1050 m a.s.l.
- Loc. 32.** Armenia. Rivulet near Antarut, 40.3627°N, 44.2636°E, 1775 m a.s.l.
- Loc. 33.** Armenia. Canyon of river Azat, Garni, 40.1151°N, 44.7420°E, 1350 m a.s.l.
- Loc. 34.** Armenia. Wet grasslands south of Margahovit, 40.7238°N, 44.6746°E, 1700 m a.s.l.
- Loc. 35.** Georgia. Madatapa lake, 41.1888°N, 43.7606°E, 2115 m. a.s.l.
- Loc. 36.** Georgia. Wetland between Katinatu and Spasovka, 41.2361°N, 43.6291°E, 2020 m a.s.l.
- Loc. 37.** Georgia. Shore of the Khanchali lake, Ninotsminda, 41.2666°N, 43.5572°E, 1930 m a.s.l.
- Loc. 38.** Georgia. Tsundli lake near Nakalakewi, 41.4101°N, 43.3279°E, 1240 m a.s.l.
- Loc. 39.** Georgia. Kura river near Tmogvi, 41.4208°N, 43.3208°E, 1185 m a.s.l.
- Loc. 40.** Georgia. Lake south of Amkheri, 41.6390°N, 42.7198°E, 1580 m a.s.l.
- Loc. 41.** Georgia. Kura river near Chaschuri, 41.9797°N, 43.6356°E, 686 m a.s.l.
- Loc. 42.** Georgia. Lake north of Imerkhevi, 41.9414°N, 43.8038°E, 960 m a.s.l.
- Loc. 43.** Georgia. Artificial ponds north of Kvakhvrel, 41.9642°N, 44.1725°E, 570 m a.s.l.
- Loc. 44.** Georgia. Aragvi river near Buchaani, 42.2985°N, 44.6895°E, 985 m a.s.l.
- Loc. 45.** Georgia. Tergi river near Pansheti, 42.6333°N, 44.6245°E, 1755 m a.s.l.
- Loc. 46.** Georgia. River Khrami gorge near Trialeti, 41.5541°N, 44.2075°E, 955 m a.s.l.
- Loc. 47.** Georgia. Kura river near Gachiani, 41.6200°N, 44.9410°E, 352 m a.s.l.
- Loc. 48.** Azerbaijan. Saline soils in lowland Salyan district near Yolüstü, 39.807°N, 49.156°E, 26 m b.s.l.
- Loc. 49.** Azerbaijan. Neftçala district north of the city of Banka, 39.496°N, 49.271°E, 29 m b.s.l.
- Loc. 50.** Azerbaijan. Hacıqabul district, ancient fishponds west of the city of Hacıqabul, 40.050°N, 48.862°E, 21 m b.s.l.

Results

This article presents a selection of dragonfly records collected during four field trips between 2010 and 2018 in south Caucasus. 150 findings of 23 rare or uncommon species are detailed. *Cordulia aenea* and *Ischnura fountaineae* are new in the checklist of the dragonfly of Armenia. In addition, original localities of *C. aenea* and *Leucorrhinia pectoralis* were found in Georgia and *I. fountaineae*, *Lestes macrostigma* in Azerbaijan.

A significant discovery also is the new record of *Sympetrum danae* in Armenia. Furthermore, the author added new localities of some uncommon species (*Coenagrion scitulum*, *Coenagrion lunulatum*, *Coenagrion ornatum*, *Aeshna cyanea*, *Aeshna isoceles*, *Sympetrum pedemontanum*, and *Selysiothemis nigra*).

Records on selected species

Capital letters indicate the following abbreviations: A = adult; C = copula, tandem; O = ovipositing; T = teneral, emergence; U = exuviae, indicated only if not collected. Symbols are given to the relative abundance rating: +++ = very abundant in the locality; ++ abundant; +moderately abundant; r=rare

Lestidae

Lestes virens (Charpentier, 1825)

Loc. 4 – 07.VII.2015 (T, r)

Lestes macrostigma (Eversmann, 1836)

Loc. 48 – 06.V.2018 (A, T, U, ++)

Sympetma paedisca (Brauer, 1877)

Loc. 22 – 13.VIII.2010 & 19.VI.2014 (A, r); **Loc. 32** – 06.VIII. 2010 (A, r)

Coenagrionidae

Coenagrion armatum (Charpentier, 1840)

Loc. 1 – 05.VI.2014 (A, T, C, r); **Loc. 35** – 05.VII.2015 (A, T, C, +)

Coenagrion lunulatum (Charpentier, 1840)

Loc. 1 - 05.VI.2014 (A, T, C, r); **Loc. 20** – 19.VI.2014 (A, T, C, +); **Loc. 25** – 14.VI.2014 (A, T, C, U, ++); **Loc. 35** – 05.VII.2015 (A, T, C, U, +++); **Loc. 36** – 05.VII.2015 (A, +); **Loc. 37** - 05.VII.2015 (A, T, C, U, ++)

Coenagrion ornatum (Selys, 1850)

Loc. 2 – 04.VI.2014 (A, r); **Loc. 19** – 13.VI.2014 (A, r); **Loc. 29** – 02.VI.2014 (A, C, r); **Loc. 38** – 03.VII.2015 (A, r); **Loc. 43** – 30.VI.2015 (A, C, +); **Loc. 44** – 28.VI.2015 (A, C, r); **Loc. 45** – 29.VI.2015 (A, r)

Coenagrion pulchellum (Vander Linden, 1825)

Loc. 4 – 07.VII.2015 (A, T, ++); **Loc. 5** – 08.VI.2014 (A, T, +); **Loc. 6** – 10.VI.2014 (A, r);
Loc. 7 – 10.VI.2014 (A, +); **Loc. 17** – 12.VI.2014 (A, T, ++); **Loc. 18** – 12.VI.2014 (A, C, +);
Loc. 37 – 05.VII.2015 (A, +); **Loc. 42** – 30.VI.2015 (A, r)

Coenagrion scitulum (Rambur, 1842)

Loc. 7 – 10.VI.2014 (A, C, r); **Loc. 27** – 16.VI.2014 (A, C, +)

Ischnura fontaineae Morton, 1905

Loc. 13 – 10.VII.2015 (A, T, C, U, +); **Loc. 48** – 06.V.2018 (A, T, C, +); **Loc. 49** –
 03.V.2018 (A, T, C, +); **Loc. 50** – 02.V.2018 (A, T, C, +)

Pyrrhosoma nymphula (Sulzer, 1776)

Loc. 44 – 28.VI.2015 (A, r)

Aeshnidae

Aeshna isocetes (Müller, 1767)

Loc. 27 – 16.VI.2014 (A, r); **Loc. 30** – 02.VI.2014 (A, r)

Aeshna cyanea (Müller, 1764)

Loc. 8 – 09.VII.2015 (A, r); **Loc. 10** – 12.VII.2015 (A, r)

Gomphidae

Gomphus schneiderii Selys, 1850

Loc. 12 – 12.VII.2015 (A, r); **Loc. 46** – 06.VII.2015 (A, r)

Onychogomphus assimilis (Schneider, 1845)

Loc. 11 – 09.VII.2015 (A, C, U, ++); **Loc. 12** – 12.VII.2015 (A, r); **Loc. 41** – 01.VII.2015 (A, r)

Onychogomphus flexuosus (Schneider, 1845)

Loc. 26 – 15 & 16.VI.2014 (A, T, +); **Loc. 47** – 17.VII.2015 (A, T, C, ++)

Cordulegastridae

Cordulegaster insignis Schneider, 1845

Loc. 11 – 09.VII.2015 (A, r); **Loc. 12** – 12.VII.2015 (A, r) ; **Loc. 14** – 10.VII./2015 (A, r);
Loc. 15 – 10.VII./2015 (A, r); **Loc. 21** – 19.VI.2014 (A, +); **Loc. 22** – 13.VIII.2010 (A, C, U, +);
Loc. 23 – 17.VI.2014 (A, r); **Loc. 28** – 16.VI.2014 (A, C, +); **Loc. 33** – 20.VI.2014 (A, r);
Loc. 39 – 03.VII.2015 (A, r); **Loc. 46** – 06.VII.2015 (A, T, r)

Cordulegaster sp

Loc. 24 – 15.VI.2014 (A, r)

Corduliidae

Cordulia aenea (Linnaeus, 1758)

Loc. 10 – 12.VII.2015 (A, r); **Loc. 40** – 02.VII.2015 (A, C, +); **Loc. 42** – 30.VI.2015 (A, C, +);
Loc. 46 – 17.VII.2015 (A, r)

Libellulidae

Leucorrhinia pectoralis (Charpentier, 1825)

Loc. 4 – 07.VII.2015 (A, T, C, U, ++); **Loc. 5** – 08.VI.2014 (A, T, C, ++); **Loc. 40** – 02.VII.2015 (A, T, C, ++)

Pantala flavescens (Fabricius, 1798)

Loc. 16 – 11.VIII.2010 (A, r); **Loc. 47** – 17.VII. 2015 (A, r)

Selysiothemis nigra (Vander Linden, 1825)

Loc. 13 – 10.VII.2015 (A, C, ++); **Loc. 27** – 14.VIII.2010,16.VI.2014 (A, T, C, r); **Loc. 47** – 17.VII.2015 (A, r)

Sympetrum danae (Sulzer, 1776)

Loc. 4 – 07.VII.2015 (T, +)

Sympetrum pedemontanum (Müller in Allioni, 1766)

Loc. 9 – 09.VII.2015 (A, T, C, ++); **Loc. 31** – 05.VIII.2010 (A, r) ; **Loc. 34** - 10.VIII.2010 (A, T, C, ++)

Comments on selected species

Lestes macrostigma

In Azerbaijan, *Lestes macrostigma* was previously reported from the Masalli district by Dumont (2004). Our record represents the confirmation of *L. macrostigma* in Azerbaijan territory. Freshly emerged individuals (Fig. 2) were found in saline swamps colonized by salt-tolerant chenopods (Chenopodiaceae) (*Suaeda* cf *microphyllum* and *Salicornia europaea*) in the Kur-Araz lowland (Fig. 5). This area is widely occupied by saline steppe temporary flooded following spring rainfalls which supports the assumption that *L. macrostigma* is less rare than believed.





Figure 2a, b. Female and male of *Lestes macrostigma*, Salyan district, Azerbaijan, 06-v-2018.



Figure 3. Peatland north of the village of Akner (Loc.25). Habitat of *Coenagrion lunulatum*, Armenia, 14 vi-2015.

Coenagrion lunulatum

The Caucasus populations are isolated from the core of the European population (Boudot & Kalkman 2015). Its main range is located in the Javakheti plateau at the border triangle between Georgia, Armenia and Turkey where it was reported as "very common" on the Armenian side (Akramowski 1948). It was recently rediscovered and found in high abundance in Georgia (Schröter et al 2015). Our records confirm its occurrence on the volcanic plateau and suggest metapopulation structures where the strong populations of some Georgian wetlands (Madatapa, Tabaskuri, Khanchali lakes in particular) may play a key role in local conservation of this species. Furthermore, in Armenia where the previous records are rare (Akramowski 1948; Ananian & Taily 2013), its current distribution now includes the provinces of Vayots Dzor and Syunik (Fig. 3 and 5). All data compiled here are located between 1930 and 2115 m a.s.l. which confirms that *C. lunulatum* is confined to high mountains in south Caucasus.

Coenagrion pulchellum

Until the end of the 20th century, *C. pulchellum* was considered as rare in the Transcaucasian region with a handful of reliable and scattered mentions in each country (Bartenev 1924; Akramowski 1948; Kasymov 1972; Skvorstov & Snegovaya 2015). More recently, distribution of this species has improved through systematical surveys and expeditions and it is now treated as "a rare species" in Armenia (Ananian & Taily 2013), "common on some places" in Azerbaijan (Skvorstov & Snegovaya 2015) and "confined to higher altitudes of the Samtskhe-Javakheti region and mountain ranges of adjacent Autonomous Republic of Adjara" in Georgia (Schröter et al. 2015, Seehausen et al 2016). The findings presented here show that its range in this ecoregion is larger than it was previously known. A strong population was found in the relict ponds of Lori Highland, linking up two core populations known of the Samtskhe-Javakheti region (Georgia) and in the Sevan basin (Armenia). The distribution of the closely related species *Coenagrion ponticum* remains still unclear in Armenia, with no data at the moment. Nevertheless, this species is reported from Azerbaijan (Dumont 2004; Skvorstov & Snegovaya 2015) and now assumed to be well established throughout Georgia (Schröter et al. 2015, Seehausen et al 2016) with several reports from the Javakheti plateau at close range of the Armenian border. Thus, further studies are needed to clarify if *C. ponticum* is present in the Lori and Shirak provinces.

Coenagrion scitulum

This damselfly is currently considered rare in Caucasus with a discontinuous occurrence and a low number of populations in the Western Palaearctic region (Schröter & Borsov 2010, Schröter et al. 2015, Seehausen et al 2016) with the exception of the Shemakha and Gedabek districts (Azerbaijan) where it is respectively reported as very abundant and not infrequent (Skvorstov & Snegovaya 2015). Two additional records in Armenia, where *C. scitulum* was previously known from only four localities (Ananian & Taily 2013, Ananian com. pers), are remarkable. Regional distribution of this species is still uncertain and it is assumed to be more regular in Armenia and Georgia.

Ischnura fontaineae

This species occurs from the Mediterranean through Middle East and Central Asia (Boudot & Kalkman 2015). Akramowski (1948) considered the occurrence of this species as possible in the eremic areas of Armenia due to the scattered previous records in Caucasus confined to Azerbaijan (Bartenev 1912a) and later confirmed by Haritonov 1988, Dumont 2004; Skvortsov & Snegovaya 2014, 2015 then in Georgia (Seehausen et al 2016). The record documented here constitutes the first mention of *I. fontaineae* for Armenia (Fig. 4) and confirms Akramowski's hypothesis. In adjacent Azerbaijan, at least four localities were known previously (Fig. 5). The present findings of three new autochthonous sites during a non-specific prospection show the species to occur more widely than the hitherto known distribution suggested. *I. fontaineae* and *I. elegans* coexist in several sites.



Figure 4. Male and immature female of *Ischnura fontaineae*, Sevkar, Tavush, Armenia, 10-vii-2015.

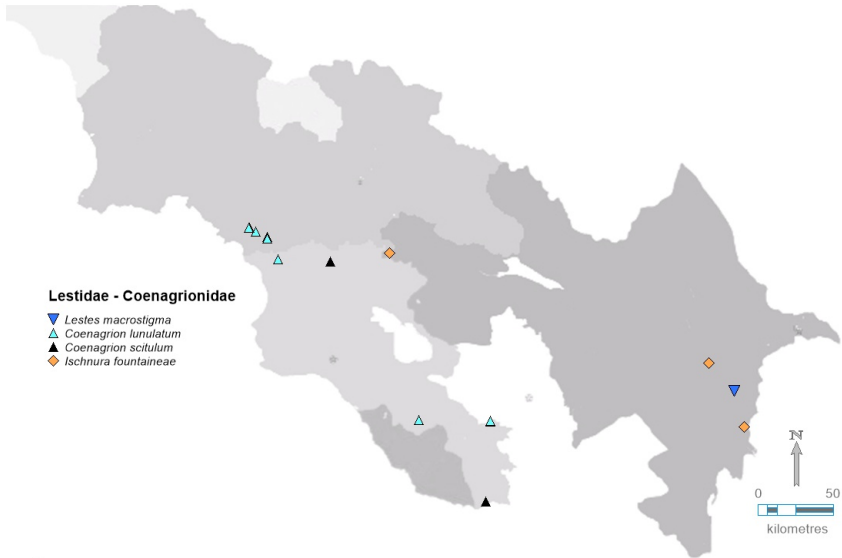


Figure 5 - Localization of selected species of Lestidae and Coenagrionidae

Cordulegaster insignis

The distribution of this *Cordulegaster* species is centered in Turkey with extensions in Balkans, Caucasus and Iran (Boudot & Kalkman 2015). In the eastern part of its range, it seems to be found regularly in Armenia and in southern Georgia in its preferred habitats (different types of rivers and streams with riparian vegetation). This result has been well supported by our findings and is consistent with Akramowski (1948), Shengelia (1975) and Taily & Ananian (2004) (Fig. 8). As mentioned by Dumont (1976) and Boudot (2014, 2015), *C. insignis (charpentieri)* is characterized by huge variation in size, shape of its yellow pattern, but also in anal appendages. The presence of strong basal teeth given by Hagen's re-description of *C. insignis* (Selys & Hagen 1850) appears to be an unreliable feature within the Transcaucasian population (21% without basal teeth, 15% with reduced basal teeth; n=33 males examined).

***Cordulegaster* sp.**

In June 2014, a puzzling male *Cordulegaster* was captured and released at Verin Khotanan in Syunik province, Armenia in the same village where *Cordulegaster vanbrinkae* was discovered in 2010 (Ananian & Taily 2012). This specimen could not be clearly assigned to one of the four valid species present in the Transcaucasus ecoregion (*Cordulegaster insignis*; *C. (insignis) mzymtae*; *C. picta*; *C. vanbrinkae*). The validity of the two newly described *C. plagionyx* and *C. nakhitschevanica* is not considered here due to the complex taxonomic situation of *C. insignis* and the need of reexamination by more systematic and cladistic studies. In most stable morphological

characters conventionally used for *Cordulegaster* identification (Boudot 2001, 2014), our specimen relates to the *boltonii* species-group and shows combined features of *C. picta* and *C. vanbrinkae* (Fig. 7). The superior anal appendages are long (as S10), slender and the apices are not convergent in accordance with the *C. vanbrinkae* descriptions (Lohmann 1993). The presence of a basal tooth doesn't fit the current descriptions of Iranian and Armenian *C. vanbrinkae*; (Ananian & Taily 2012; Schneider et al. 2014). Nevertheless, the review of pictures of an Azeri specimen of *C. vanbrinkae* provided by V. Skvortsov shows a distinctive basal tooth which suggests



Figure 7. Male of *Cordulegaster* sp. with intermediate characters between *C. picta* and *C. vanbrinkae*. Vorotan, Syunik, Armenia, 15-vi-2014.

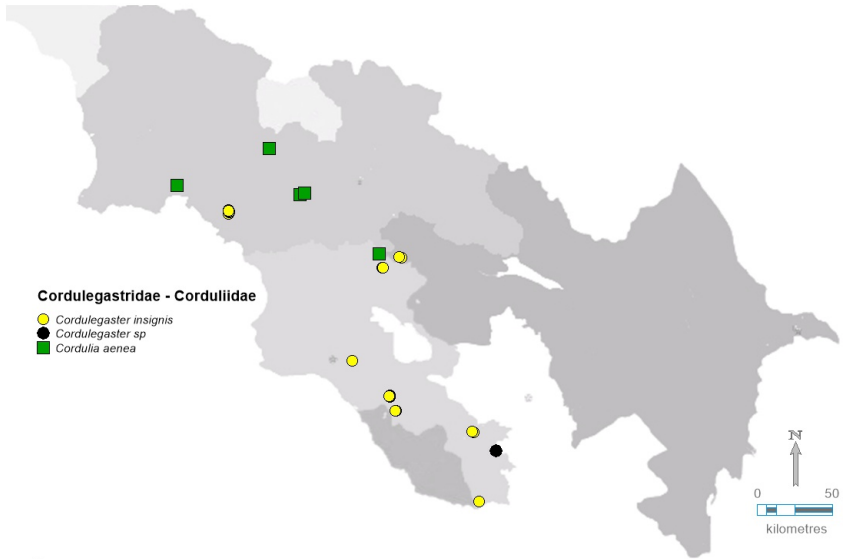


Figure 8. Localization of of selected species of Cordulegastridae and Corduliidae.

the variability of this character. The identification of our specimen is complicated by the pattern of the abdomen which differs from typical *C. vanbrinkae* and reminds one of some north-Anatolian *Cordulegaster picta* (Boudot 2014). A DNA sample was collected but lost in the lab and so could not be integrated in the current project of revision of the genus *Cordulegaster* in Western Palearctic.



Figure 9. Male of *Cordulia aenea* along the Khrami river. East of Trialeti, Kvemo Kartli, Georgia, 17-vii-2015.

Cordulia aenea

C. aenea is apparently rare in the South Caucasus with scattered known localities in the Turkish part of the Pontic mountains (Kalkman & van Pelt 2006; Boudot & Kalkman 2015), and in Georgia (Bartenev 1923, Shengelia 1975, Seehausen et al 2016). This species was found in three new localities in Georgia (Samtskhe-Javakheti, Kverno Kartli and Shida Kartli districts). It was also reported in Armenia for the first time with a single male observed around a forest lake in the Kirants-Samson gorge (Fig. 9). The species was mainly found in typical habitats (lake, pond or bog with emergent and submerged vegetation in woodland areas), but individuals from a population in the Khrami valley (Trialeti, Georgia) are constantly found in riverine ecosystem characterized by low-water periods with an alternation of pools and riffles over gravel or silt bottom and without significant aquatic vegetation (Fig. 9).

Leucorrhinia pectoralis

Until the 2000s, *L. pectoralis* was known from old records from two localities in the southern Caucasus (Akramowski 1948; Bartenev 1924; Shengelia 1964). The handful of records made during recent field surveys in south Caucasus (Durand & Rigaux 2015, Schröter et al. 2015, Seehausen et al 2016) and the new site presented here (Fig. 10 and 11) suggest a widespread distribution in the region.



Figure 10. Forest lake south of Amkheri. Habitat of a population of *Leucorrhinia pectoralis* and *Cordulia aenea*, 02-vii-2015.

Selysiothemis nigra

In the area considered, *S. nigra* has a patchy distribution from the arid Lori tableland in Georgia to the dry and rocky lowlands of the Ararat valley in south of Armenia passing by Azerbaijan – including the Nakhichevan Autonomic Republic. It was recently discovered in Georgia (Schröter et al. 2015) and in Armenia (Ananian & Taily 2006) although the first reliable record in Azerbaijan was published at the beginning of the 20th century by Bartenev (1912a&b in Skvorstov & Snegovaya 2015); others followed (Akramowski 1958b; Dumont 2004; Skvorstov & Snegovaya 2015, Snegovaya 2019). The status of the species is now confirmed in Armenia with reproductive behaviors observed at Meghri in 2010 and 2014 and Sevkar in 2015.

Sympetrum danae

The record of *S. danae* is the first documented observation in Armenia since the only mention by Akramowski (1948) who considered it as not uncommon. Surprisingly, while several dozens of wet peatlands were prospected in Armenia and Georgia during its flying period, *S. danae* was discovered in only one locality (Fig. 11). This species is considered absent in Azerbaijan and has been recorded only once in Turkey at the eastern part of the Black sea region (Miroglu 2011). In Georgia, *S. danae* was identified in two sites based on old data (Samtskhe-Javakheti, Mtskheta-Mtianeti districts) (Akramowski 1948). It has recently been rediscovered near the Khanchali lake, in the Javakheti plateau (Schröter et al. 2015). Available information, as of today, suggests that this species is rare in the Transcaucasus region with only one known stable breeding population at Lori marshes (Armenia), constituting the southernmost locality in Europe and Western Asia (Skvorstov 2010; Boudot & Kalkman 2015).



Figure 11. Localization of of selected species of Libellulidae.

Acknowledgements

The author is grateful to Jean-Pierre Boudot, Otakar Holuša, Asmus Schröter, Thomas Schneider, Vladimir Skvortsov and Marc Tailly for sharing taxonomic status and chorology information and valuable comments on the manuscript. I also thank Cindy Castelle for the endless English corrections.

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Appendix

Tab. 1: Localities sampled between 2010 and 2018.

ID- locality	Date1	Country	Localities	X - DD	Y - DD	Alt. (meters)
1	05.06.2014	Armenia	Wetland between Vardaghybur and Karmravan	40,996	43,889	2010
2	04.06.2014	Armenia	Rivulet near Marmashen monastery	40,844	43,756	1545
3	07.07.2015	Armenia	Lake north of Tachir	41,142	44,280	1520
4	07.07.2015	Armenia	Lori wetlands, north of Stepanavan	41,051	44,309	1480
5	08.06.2014	Armenia	Lake north of Urasar	41,023	44,302	1565
6	10.06.2014	Armenia	Dsoraget river near Dsoragyugh	40,954	44,601	1020
7	10.06.2014	Armenia	Pond on the shore of the Dzoraget river, south-west of Vardablur	40,967	44,495	1320
8	09.07.2015	Armenia	Yenokavan pond near Khachaghbyur river	40,908	45,104	870
9	09.07.2015	Armenia	Irrigation network near Aghstev river, Aknaghbyur	40,956	45,168	570
10	12.07.2015	Armenia	Acharkut pond	41,030	45,065	805
11	09.07.2015	Armenia	Khachaghbyur river gorge	40,909	45,093	900
12	12.07.2015	Armenia	Samson river near Acharkut	41,033	45,075	780
13	10.07.2015	Armenia	Lake near Bentonite mining, Sevkar	41,032	45,177	704
14	10.07.2015	Armenia	Rivulet north-east of Vazashen	40,999	45,298	730
15	10.07.2015	Armenia	Isolated pond, east of Vazashen	40,992	45,317	875
16	11.08.2010	Armenia	Artanish peninsula	40,472	45,277	1910
17	12.06.2014	Armenia	Former lake Gillis, Vanevan	40,217	45,657	1920
18	12.06.2014	Armenia	Lakes north of Martuni	40,177	45,250	1905
19	13.06.2014	Armenia	Arpa river near Malishka	39,730	45,388	1130
20	17.06.2014	Armenia	Martiros pond	39,601	45,499	1930
21	19.06.2014	Armenia	Rivulet north of Chiva	39,804	45,172	1604
22	13.08.2010; 19.06.2014	Armenia	Noravank gorge	39,710	45,207	1155
23	17.06.2014	Armenia	"Devil bridge" on Vorotan river	39,485	46,140	1375
24	15.06.2014	Armenia	Shallow stream near Verin Khotanan	39,326	46,397	1535
25	14.06.2014	Armenia	Pitland north of Akner	39,579	46,328	2100

ID-locality	Date1	Country	Localities	X - DD	Y - DD	Alt. (meters)
26	15.06.2014; 16.06.2014	Armenia	Arid gorge near Meghri	38,909	46,274	645
27	16.06.2014	Armenia	Meghri pond	38,894	46,265	515
28	16.06.2014	Armenia	Karchevan river	38,893	46,191	852
29	02.06.2014	Armenia	Pond, West of Etchmiadzin	40,169	44,276	870
30	02.06.2014	Armenia	Jarbi wetlands	40,102	44,224	840
31	05.08.2010	Armenia	Rivulet and pond near Agarak	40,296	44,302	1050
32	06.08.2010	Armenia	Rivulet near Antarat	40,363	44,264	1775
33	20.06.2014	Armenia	Canyon of Azat, Garni	40,115	44,742	1350
34	10.08.2010	Armenia	Wet grasslands south of Margahovit	40,724	44,675	1700
35	05.07.2015	Georgia	Madatapa lake	41,189	43,761	2115
36	05.07.2015	Georgia	Wetland between Katinatu and Spasovka	41,236	43,629	2020
37	05.07.2015	Georgia	Shore of the Khanjali lake	41,267	43,557	1930
38	03.07.2015	Georgia	Tsundli lake near Nakalakewi	41,410	43,328	1240
39	03.07.2015	Georgia	Kura river near Tmogvi	41,421	43,321	1185
40	02.07.2015	Georgia	Lake south of Amkheri	41,639	42,720	1580
41	01.07.2015	Georgia	Mtkvari (Kura) River near Chaschuri	41,980	43,636	686
42	30.06.2015	Georgia	Lake north of Imerkhevi	41,941	43,804	960
43	30.06.2015	Georgia	Artificial ponds north to Kvakhvrel	41,964	44,173	570
44	28.06.2015	Georgia	Aragvi river near Buchaani	42,299	44,690	985
45	29.06.2015	Georgia	Tergi river near Pansheti	42,633	44,625	1755
46	06.07.2015	Georgia	Khrami gorge near Trialeti	41,554	44,208	955
47	17.07.2015	Georgia	Kura river near Gachiani	41,620	44,941	352
48	06.05.2018	Azerbaijan	Salyan district near Yolüstü	39,807	49,156	-26
49	03.05.2018	Azerbaijan	Neftçala district north of the city of Banka	39,496	49,271	-29
50	02.05.2018	Azerbaijan	Ancient fishponds west of the city of Hacıqabul	40,050	48,862	-21

Tab. 2: Checklist of odonate species recorded between 2010 and 2018.

Species	Family	Armenia			Georgia	Azerbaijan
		2010	2014	2015	2015	2018
<i>Aeshna affinis</i>	Aeshnidae		√	√	√	
<i>Aeshna cyanea</i>	Aeshnidae			√		
<i>Aeshna isoceles</i>	Aeshnidae		√			
<i>Aeshna mixta</i>	Aeshnidae	√				
<i>Anax ephippiger</i>	Aeshnidae					√
<i>Anax imperator</i>	Aeshnidae	√	√	√	√	
<i>Anax parthenope</i>	Aeshnidae	√	√	√	√	
<i>Callaeschna microstigma</i>	Aeshnidae	√	√	√	√	
<i>Calopteryx splendens</i>	Calopterygidae	√	√	√	√	
<i>Coenagrion armatum</i>	Coenagrionidae		√		√	
<i>Coenagrion lunulatum</i>	Coenagrionidae		√		√	
<i>Coenagrion ornatum</i>	Coenagrionidae		√		√	
<i>Coenagrion puella</i>	Coenagrionidae		√	√	√	
<i>Coenagrion pulchellum</i>	Coenagrionidae		√	√	√	
<i>Coenagrion scitulum</i>	Coenagrionidae		√			
<i>Cordulegaster insignis</i>	Cordulegasteridae		√	√	√	
<i>Cordulegaster spec. (prob picta x vanbrinkae)</i>	Cordulegasteridae				√	
<i>Cordulegaster vanbrinkae</i>	Cordulegasteridae		√	√		
<i>Cordulia aenea</i>	Cordulidae			√		
<i>Crocothemis erythraea</i>	Libellulidae	√	√	√	√	√
<i>Enallagma cyathigerum</i>	Coenagrionidae	√	√	√	√	
<i>Epallage fatime</i>	Euphaeidae	√	√	√	√	
<i>Erythromma viridulum</i>	Coenagrionidae	√	√	√	√	
<i>Gomphus schneiderii</i>	Gomphidae			√	√	
<i>Ischnura elegans</i>	Coenagrionidae	√	√	√	√	√
<i>Ischnura fontaineae</i>	Coenagrionidae			√		√
<i>Ischnura pumilio</i>	Coenagrionidae	√	√		√	
<i>Lestes barbarus</i>	Lestidae	√			√	√

Species	Family	Armenia			Georgia	Azerbaijan
		2010	2014	2015	2015	2018
<i>Lestes dryas</i>	Lestidae	√	√	√	√	
<i>Lestes macrostigma</i>	Lestidae					√
<i>Lestes sponsa</i>	Lestidae	√		√	√	
<i>Lestes virens</i>	Lestidae			√		
<i>Leucorrhinia pectoralis</i>	Libellulidae		√	√	√	
<i>Libellula depressa</i>	Libellulidae	√	√	√	√	
<i>Libellula quadrimaculata</i>	Libellulidae		√	√	√	
<i>Onychogomphus assimilis</i>	Gomphidae			√	√	
<i>Onychogomphus flexuosus</i>	Gomphidae		√		√	
<i>Onychogomphus forcipatus</i>	Gomphidae	√		√	√	
<i>Orthetrum albistylum</i>	Libellulidae		√	√	√	√
<i>Orthetrum brunneum</i>	Libellulidae	√	√	√	√	
<i>Orthetrum cancellatum</i>	Libellulidae		√	√	√	√
<i>Orthetrum coerulescens</i>	Libellulidae	√	√	√	√	
<i>Pantala flavescens</i>	Libellulidae	√			√	
<i>Platycnemis dealbata</i>	Platycnemididae	√	√	√	√	
<i>Platycnemis pennipes</i>	Platycnemididae	√	√	√	√	
<i>Pyrrhosoma nymphula</i>	Coenagrionidae				√	
<i>Selysiothemis nigra</i>	Libellulidae	√	√	√	√	
<i>Sympecma fusca</i>	Lestidae	√	√	√	√	√
<i>Sympecma paedisca</i>	Lestidae	√	√			
<i>Sympetrum danae</i>	Libellulidae			√		
<i>Sympetrum flaveolum</i>	Libellulidae	√		√	√	
<i>Sympetrum fonscolombii</i>	Libellulidae	√	√	√	√	
<i>Sympetrum meridionale</i>	Libellulidae	√		√	√	
<i>Sympetrum pedemontanum</i>	Libellulidae	√		√		
<i>Sympetrum sanguineum</i>	Libellulidae	√		√	√	
<i>Sympetrum striolatum</i>	Libellulidae	√	√		√	
<i>Sympetrum vulgatum decoloratum</i>	Libellulidae	√				

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While preparing the manuscript authors should consider that, although the journal gives some freedom in the style and arrangements of the sections, the editors would like to see the following clearly defined sections: Title (with authors names, physical and e-mail addresses), Abstract, Introduction, Material & Methods, Results, Discussion, Acknowledgments and References. This is a widely used scheme by scientists that everyone should be familiar with. No further instructions are given here, but every author should check the style of the journal.

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Reference cited in the text should read as follows: Tillyard (1924), (Tillyard 1924), Swezey & Williams (1942).

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Swezey, O. & F. Williams, 1942. Dragonflies of Guam. Bernice P. Bishop Museum Bulletin 172: 3-6.

Tillyard, R., 1924. The dragonflies (Order Odonata) of Fiji, with special reference to a collection made by Mr. H.W. Simmonds, F.E.S., on the Island of Viti Levu. Transactions of the Entomological Society London 1923 III-IV: 305-346.

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The manuscript should end with a list of captions to the figures and tables. The latter should be submitted separately from the text preferably as graphics made using one of the Microsoft Office products or as a high resolution picture saved as a .jpg .tif or .ps file. Pictures should be at least 11 cm wide and with a minimum 300 dpi resolution, better 360 dpi. Line drawings and graphics could have 1200 dpi for better details. If you compose many pictures to one figure, please submit the original files as well. Please leave some space in the upper left corner of each picture, to insert a letter (a, b, c...) later. Hand-made drawings should be scanned and submitted electronically. Printed figures sent by the post could be damaged, in which case authors will be asked to resubmit them.

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