

Diversity of Odonata along an elevation gradient of the San Marcos River in Mexico

Josué D. Silva-Hurtado^{1,4}, Ana P. Martínez-Falcón¹, Juan Márquez²,
Jaime A. Escoto-Moreno³ & Julián Bueno-Villegas²

¹Laboratorio de Ecología de Comunidades, Centro de Investigaciones Biológicas, Universidad Autónoma del Estado de Hidalgo, Mineral de la Reforma, Hidalgo, México

²Laboratorio de Sistemática Animal, Centro de Investigaciones Biológicas, Universidad Autónoma del Estado de Hidalgo, Mineral de la Reforma, Hidalgo, México


³Colección Zoológica, Departamento de Biología, Centro de Ciencias Básicas, Universidad Autónoma de Aguascalientes, Aguascalientes, México

⁴Corresponding author, jodsilhur@hotmail.com

ORCID:

JDS-H:  <https://orcid.org/0000-0003-0422-6528>

APM-F:  <https://orcid.org/0000-0003-3307-3989>

JM:  <https://orcid.org/0000-0001-5423-3545>

JAE-M:  <https://orcid.org/0000-0003-1400-5518>

JB-V:  <https://orcid.org/0000-0003-0477-8373>

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Abstract. The diversity of odonates was analyzed along an elevation gradient from 100 to 2450 m of the San Marcos River within the states of Hidalgo and Puebla, Mexico, through systematic collections from July to October 2019, and March to June 2020. Adult individuals belonging to nine families, 38 genera, and 87 species were recorded. The completeness of the inventory was obtained with the estimator bootstrap and ranged between 90 and 93 %. The elevational pattern observed was an increase in species richness and diversity with decreasing elevation. Beta diversity was 81 %, replacement 47 %, and nestedness 33 %. The highest beta diversity was found when comparing the site located at the highest elevation to the other four sites and the lowest diversity values were found between medium and low elevation sites.

Further key words. Dragonfly, completeness, inventory, Hidalgo, Puebla

Urban dragonfly fauna of a Mediterranean city in south-western Europe: How suitable are artificial habitats for thermophilic species?

Manuel Ferreras-Romero¹ & Joaquín Márquez-Rodríguez²

¹ C/ Gerona 9, 41003 Sevilla, Spain;
corresponding author, mferrerasrsp@gmail.com

² Laboratorio de Zoología, Facultad de Ciencias Experimentales,
Universidad Pablo de Olavide, A-376 km 1, 41013 Sevilla, Spain

ORCID:

MF-R:  <https://orcid.org/0000-0002-6268-3869>

JM-R:  <https://orcid.org/0000-0003-4139-8492>

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Abstract. The Odonata fauna of three different artificial habitats in the Seville urban area, southern Spain, was analysed and compared: a channel with concrete walls, two ponds located inside a public park, and the old watercourse of the Guadalquivir River, a dead arm lacking water flow. Invasive animal species were common at these sites. No restoration or conservation measures or management practices to facilitate the development of autochthonous fauna have been undertaken. *Ischnura graellsii*, *Anax parthenope*, *Crocothemis erythraea*, and *Trithemis annulata* were observed repeatedly and consistently. Other frequent species were *Sympetrum fons-colombii* and *Trithemis kirbyi*. Odonata diversity of the four urban water bodies was poor and the spectrum of species trivialised. More than 90% of the Anisoptera records pertain to thermophilic species with a wide African distribution. Only one European endemic, *Platycnemis latipes*, was found. Several species exhibited multivoltine life cycles in these artificial habitats.

Further key words. Dragonfly, thermophilic species, Iberian Peninsula, Andalusia, Seville, multivoltinism

Check-list of the Odonata of Belarus

Denis Kitel¹, Aleh Sinchuk², Semion Levyj³ & Asmus Schröter⁴

¹Chavchavadze Avenue 7, 0179 Tbilisi, Georgia; kitelden@gmail.com

²Chkalava street 45, 225863 Verkhaless, Brest region, Belarus;
aleh.sinchuk@gmail.com

³Trusava street 337-155, 222511 Barysau, Minsk region, Belarus;
levysemion@gmail.com

⁴Tsulukidse street 18, 0190 Tbilisi, Georgia; asmus.schroeter@gmx.de

ORCID:

DK:  <https://orcid.org/0000-0002-5298-2611>

ALS:  <https://orcid.org/0000-0003-2845-1180>

AsS:  <https://orcid.org/0000-0002-3655-2304>

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This article is dedicated to Reinhard Jödicke on his 75th anniversary, honouring Reinhard's lifelong achievements in odonatology and his passionate interest in the East European dragonfly fauna.

Abstract. An updated check-list of 69 species of Odonata occurring in the territory of the Republic of Belarus is presented in tabular form, indicating the presence of each species on the level of administrative regions (*voblasts*). The data set for the check-list was created by compiling original data, records retrievable from available publications and databases, and those from museum collections. Contrary to current literature, due to a lack of reliable records, four Odonata species previously claimed for Belarus are not considered as being part of the Belarusian fauna, viz. *Coenagrion ornatum*, *C. scitulum*, *Aeshna caerulea*, and *Somatochlora alpestris*. Hitherto known records of *Aeshna soneharai*, a recently described new member of the European dragonfly fauna, are outlined. The history of discovery of rare species is critically reviewed. The flight period of each species is given in tabular form.

Further key words. Dragonfly, damselfly, Europe, conservation

Check-list of the Odonata of the Republic of Moldova

Galina Buşmachiuc¹ & Oxana Munjiu

Institute of Zoology, Moldova State University, Academiei str.1, MD 2028,
Chişinău, Republic of Moldova; bushmakiu@yahoo.com; munjiu_oxana@mail.ru

ORCID:

GB:  <https://orcid.org/0000-0002-9724-2414>

OM:  <https://orcid.org/0000-0001-6701-3920>

¹ Corresponding author

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Abstract. An annotated check-list of Odonata species occurring in the Republic of Moldova is presented. The check-list is based on an evaluation of literature published from 1903 onwards and the authors' own collections between 2013 and 2023, based on research conducted on Odonata larvae and adults. In total, 46 species records are currently considered credible and are included in the check-list. Eight additional species are considered as potentially occurring in Moldova, but at present lack any reliable record, and six species implausibly recorded have been rejected. *Chalcolestes parvidens* and *Sympetrum fonscolombii* are recorded for the first time for Moldova.

Further key words. Dragonfly, damselfly, diversity, distribution, *Chalcolestes parvidens*, *Sympetrum fonscolombii*

Contrasting female colour morph frequencies between *Ischnura genei* and *I. saharensis* populations (Odonata: Coenagrionidae)

Adolfo Cordero-Rivera¹ & Rosa Ana Sánchez-Guillén^{1,2}

¹ Universidade de Vigo, ECOEVO lab, E.E. Forestal, Campus Universitario, 36005 Pontevedra, Spain; adolfo.cordero@uvigo.gal; rosa.ana.sanchez.guillen@uvigo.es

² Present address: Instituto de Ecología A. C., Xalapa 91070, Veracruz, México; rosa.sanchez@inecol.mx

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Abstract. We describe the immature and mature morphs of *Ischnura saharensis*, based on individuals from Gran Canaria (Canary Islands, Spain), and report population morph frequencies for this species from Gran Canaria and Morocco, and for *I. genei* from the Mediterranean islands of Sardinia and Sicily. We found that *I. saharensis* has a wide range of colour variation in females, resulting from the combination of three colour morphs with ontogenetic colour changes. Mature androchrome females have a bright green thorax, very similar to males, but some are bluer than males when immature. Gynochrome females are either greenish-brown when mature (infuscans morph) or ochre-brown (aurantiaca morph). *Ischnura saharensis* from Morocco showed a preponderance of androchromes in one population and aurantiaca in the remaining three. The infuscans morph was the rarest. In contrast, androchromes were slightly more frequent than the other morphs (34–40%) in Gran Canaria, and the proportion of infuscans and aurantiaca was very similar (30–34%). In the case of *I. genei*, the aurantiaca morph was the most common in all populations (58–77%). No infuscans females were found in Sicily, but these represented 8–23% of females in Sardinia. Even when the infuscans morph was the rarest in *I. saharensis*, this morph was in all cases over-represented among mating pairs (significantly in one population). In *I. genei*, the aurantiaca morph was the commonest and the most frequently found mating (significantly in one population). Our results suggest that *I. saharensis* and *I. genei* resemble *I. elegans* in their wide variation of population frequencies between regions, supported by the fact that androchrome females mate at low frequencies.

Key words. Dragonfly, damselfly, Zygoptera, sexual conflict, colour polymorphism, mating frequency

Diel pattern of flight activities in *Anax imperator* under a cool temperate climate (Odonata: Aeshnidae)


Reinhard Jödicke¹, Angelika Borkenstein² & Asmus Schröter³

¹ Am Liebfrauenbusch 3, 26655 Westerstede, Germany;
reinhard.joedicke@magenta.de

² Lebensborner Weg 5, 26419 Schortens, Germany;
angelikaborkenstein@t-online.de

³ Tsulukidze street 18, 0190 Tbilisi, Georgia; asmus.schroeter@gmx.de

ORCID:

AS:  <https://orcid.org/0000-0002-3655-2304>

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Abstract. Visits by *Anax imperator* to breeding ponds were recorded in north-western Germany from dawn to dusk. On warm and windless sunny days, the species flew in three clearly defined time periods: before sunrise, from morning to afternoon, and from sunset to nightfall. Feeding flight over the water was only observed during both twilight periods, with both sexes foraging. Males patrolled not only in the diurnal period, but also at dusk and occasionally at dawn. Females oviposited during the diurnal period and on average flew one hour later than the males. The latest-flying vespertine males cruised close to the water surface during the last minutes of daylight, losing their aggression towards other males and finally leaving the pond when minimum light intensity reached 4 lx. Our observations confirm that mating is not initiated at the breeding ponds, although patrolling males and egg-laying females encounter each other there for hours during the diurnal period. The rendezvous site of the species is obviously away from the water. Overall, given its general abundance there are relatively very few records of mating wheels, which is why we assume that females mate rarely, perhaps even only once in their lifetime. Thus, the purpose of the long-lasting patrol flight remains a mystery.

Further key words. Dragonfly, Anisoptera, diel activity pattern, crepuscular behaviour, matutinal, diurnal, and vespertine activity, patrol flight, feeding flight, oviposition, copulation frequency

Sparsely reeded areas as main reproductive habitat of *Sympecma paedisca* at Lake Constance (Odonata: Lestidae)

Linda Keil¹, Holger Hunger¹ & Alexandra-Maria Klein²

¹ Institut für Naturschutz und Landschaftsanalyse – INULA,
Basler Landstraße 49e, 79111 Freiburg, Germany;
linda.keil@inula.de, holger.hunger@inula.de

² Chair of Nature Conservation and Landscape Ecology, University of Freiburg,
Tennenbacher Straße 4, 79106 Freiburg, Germany;
alexandra.klein@nature.uni-freiburg.de

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Abstract. This study investigates the reproductive habitat of *Sympecma paedisca* at Lake Constance, a region of special importance for the conservation of the species in Germany, focussing on vegetational characteristics. The reproductive activity of *S. paedisca* was analysed by sampling active individuals along transects, distinguishing between males, females, and tandems. Sixty-eight plots, including controls, were defined according to the *S. paedisca* observations, and vegetation surveys were conducted on each plot. Additionally, an analysis of the relationship between long-term *S. paedisca* monitoring data and the expanse of flooded reedbeds and reed meadows (*i.e.*, traditional litter meadows used to produce bedding for the stables) was conducted. The results suggest that the reproductive habitat description for *S. paedisca* at Lake Constance needs to be revised. The importance of sparse *P. australis* vegetation for *S. paedisca* was highlighted and the plant community of low sedge swamps was identified as additional reproductive habitat. Overall, the results indicate that plant community composition is not the main cue for *S. paedisca* habitat selection. Whilst the reed meadows are significant reproductive habitats for *S. paedisca*, this is not the case for the reedbeds.

Further key words. Dragonfly, damselfly, Zygoptera, habitat choice, habitat management, oviposition

**A riddle wrapped in a mystery inside an enigma:
notes on an enigmatic larva collected in Nepal,
with a reappraisal of Fraser's so called
'*Caliphaea confusa*' larva
from Meghalaya, India
(Odonata: Calopterygidae)**

Albert G. Orr¹ & Stephen G. Butler²

¹ Environmental Futures Research Institute, Griffith University, Nathan, Australia;
corresponding author: agorr@bigpond.com

² Heighways Lane, All Stretton, Shropshire, SY6 6HN, UK

ORCID:

AGO:  <https://orcid.org/0000-0003-3699-2745>

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Abstract. A late instar larva of an unknown calopterygid species, here termed 'species Q', was collected at Godawari, Nepal, in 1992 by SGB. It resembles, but appears to differ fundamentally from a larva described erroneously as *Caliphaea confusa* by F.C. Fraser from Meghalaya, Assam, in 1943. Fraser's description seems to contain impossible discrepancies but the original specimen may pertain to *Echo margarita*, which occurs in the same locality. However, there are no records of this genus from Nepal, from where just three species of the family, *Caliphaea confusa*, *Neurobasis chinensis* and *Vestalis gracilis*, are known. None of these three genera have larvae matching that of 'species Q'. The mystery larva is described and compared with that described by Fraser. Fraser's description is analysed and critiqued. The larva is concluded to be related to the genera *Mnais*, *Echo* and *Psolodesmus* but its specific identity and that of the larva described by Fraser remain uncertain, with the possibility of 'species Q' representing a new species or even a new genus with an unknown adult being suggested.

Further key words. Zygoptera, damselfly, Himalaya, nymph, Oriental region, *Echo*, *Mnais*, *Psolodesmus*

**The larva of the endangered
Heterophaea barbata (Martin, 1902),
from Luzon Island, the Philippines
(Odonata: Euphaeidae)**

Albert G. Orr¹ & Matti Hämäläinen²

¹Environmental Futures Research Institute, Griffith University, Nathan, Australia;
corresponding author, agorr@bigpond.com

²Naturalis Biodiversity Center, Leiden, The Netherlands;
matti.hamalainen@helsinki.fi

ORCID:

AGO:  <https://orcid.org/0000-0003-3699-2745>

MH:  <https://orcid.org/0000-0003-4919-534X>

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Abstract. The final instar larva of the large, spectacular Philippine and Luzon endemic euphaeid damselfly *Heterophaea barbata* (Martin, 1902) is described and illustrated for the first time, based on field collected exuviae of both sexes. Identification is by supposition, but larvae of the only other euphaeid on the island, *Euphaea refulgens* Hagen in Selys 1853, have been previously described and illustrated and can be confidently ruled out. The specimens are exceptionally large for the family and present several novel structural features not recorded in other euphaeid genera. The antennae of the principal specimen studied were asymmetric in length and numbers of segments, suggestive of a possible teratological event caused by genetic load or environmental factors during development. This and other specimens exhibited up to 14 antennomeres, more than hitherto recorded for any odonate larvae.

Further key words. Damselfly, Zygoptera, naiad, nymph, exuviae, Roland A. Müller, larval taxonomy, fluctuating asymmetry, flagship species

Name-bearing types of Zygoptera preserved at the Senckenberg Naturmuseum Frankfurt/Main (Odonata)

Malte Seehausen¹ & Massimo Terragni²

¹Zoologisches Museum der CAU zu Kiel, Hegewischstr. 3, 24105 Kiel, Germany; mseehausen@zoolmuseum.uni-kiel.de

ORCID:  <https://orcid.org/0009-0000-6718-1078>

²Senckenberg Forschungsinstitut und Naturmuseum Frankfurt, Senckenberganlage 25, 60325 Frankfurt am Main, Germany; massimo.terragni@senckenberg.de

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Abstract. The name-bearing types of Zygoptera preserved at the Senckenberg-Museum Frankfurt/Main (SMF), Germany are catalogued. There are 464 name-bearing types of 104 taxa deposited at the SMF. Of these taxa there are 68 additional paratypes and paralectotypes. The holotype male of *Disparocypha biedermanni* and both syntypes of *Acanthagrion lindneri* are missing. The type status of *Chalcopteryx radians*, *Cora irene*, *C. notoxantha*, *Euthore leroii*, *Bayadera melanopteryx*, *Calopteryx melli*, *Vestalis smaragdina velata*, *Platycnemis agrioides*, *Acanthagrion adustum*, *A. kennedii*, *Enallagma fractum*, and *Pseudagrion pontogenes* is investigated. All types of these taxa are considered syntypes, because their lectotype designations were invalid. In addition, 222 secondary types of 69 other taxa are listed. A supplementary list of name-bearing types of Zygoptera of 39 taxa described by Friedrich Ris and deposited in collections other than the SMF is provided. Evidence that *Aciagrion feuerborni* is a junior synonym of *A. approximans* is discussed.

Further key words. Damselfly, Friedrich Ris, taxonomy, nomenclature, collection, *Aciagrion feuerborni*, *Selysioneura bacillus*