

**Contribution to the knowledge
of the Moroccan Odonata,
with first records of *Orthetrum sabina*,
and an overview of first and last dates for all species**

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Abstract. Several field surveys between 2007 and 2014 were undertaken in Morocco. Altogether 54 species were observed during our studies, representing 86 % of the odonate fauna of the country. *Orthetrum sabina* is new for Morocco, increasing the number of species to 63. The species was found at Oued Ez-Zahar near Akhfenir, about 1 700 km off its nearest known locality at Ouargla in Algeria. Two small populations of *Erythromma viridulum* were found for the first time in the Rif, bridging the gap between populations in the Middle Atlas and the Iberian Peninsula. The third observation of *Sympetrum sinaiticum* for Morocco was recorded and we were able to significantly increase the known number of localities of the threatened Moroccan endemic *Cordulegaster princeps*. We further can show that several species (e.g., *Boyeria irene*, *Pyrrosoma nymphula*) are more widely distributed than believed and occur also at low altitudes in the country. On the other hand, *Calopteryx exul*, *Calopteryx virgo meridionalis*, *Lestes dryas*, *Coenagrion mercuriale*, *Aeshna isocoles* and *Libellula quadrimaculata* are very rare in Morocco and their populations should be monitored to assess their potential decline. Finally, for all Moroccan dragonfly species the first and last observation dates are listed. For 17 of them we provide the earliest observation date and for seven species we prolong the observation period.

Key words. Dragonfly, damselfly, distribution, North Africa, range expansion, phenology, conservation.

***Cordulegaster heros* and *Somatochlora meridionalis*
in Ukraine: solving the zoogeographical puzzle
at their northern range limits
(Odonata: Cordulegastridae, Corduliidae)**

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Abstract. The first records of *Cordulegaster heros* and *Somatochlora meridionalis* in Ukraine completed their distribution picture, thereby allowing the zoogeography of Balkan Odonata species at their northern range limit in Eastern Europe to be better understood. Five localities of *C. heros* in the Khotyn and Chernivtsi Uplands showed the eastern colonisation route to have proceeded north through the eastern Subcarpathians and adjacent hilly areas in Romania and southern Ukraine. A habitat and zoogeographical analysis mostly solved the *Cordulegaster*-puzzle in Ukraine and drew a picture of a northern *C. boltonii*-zone divided from a southern *C. heros*-zone by the extensive Podolian Upland. The population of *S. meridionalis* found in the extreme southwestern Ukraine completed the northernmost range limit in Eastern Europe between the known Slovakian and Romanian localities. It occurs in the Transcarpathian Lowland, i.e., the northernmost part of the Great Hungarian Plain in the direct foreground of the Carpathian foothills. Thus, it perfectly follows the species distribution pattern largely based on an extensive border zone of great basins and low foothills of the adjacent mountain ranges of the Carpathians and Alps. The situation and habitat of Ukrainian and eastern Slovakian localities suggest the Tisa River system as the main colonisation route of *S. meridionalis* for Central and Eastern Europe. Clear differences in the population sizes between streams suggested the optimal, acceptable, and marginal habitats of *C. heros*, which differed in the grain size of the bottom sediments, the stream morphology, and water current. *Somatochlora meridionalis* occurred in a several-metre-broad slow flowing and largely shaded canal-like river where specific habitat conditions were responsible for the concentration of species activity near the levee and pipe culvert.

Key words. Dragonfly, Anisoptera, Balkan fauna, Eastern Europe, zoogeography, habitat selection.

Update of the Odonata fauna of Georgia, southern Caucasus ecoregion

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Abstract. A total of 63 odonate taxa were recorded in Georgia during nationwide surveys in June–July 2014, and June and July–August 2015, corresponding to at least 85% of the country's Odonata fauna. For the majority of species information from Georgia is provided in English language for the first time. *Selysiothemis nigra* is a new addition to the country's list. The occurrence of *Chalcolestes parvidens* is confirmed and previous records from Georgia listed as *Lestes viridis* are doubted and believed to pertain to *parvidens*. The second and third records only for *L. macrostigma* are presented. Individuals intermediate between *Enallagma cyathigerum cyathigerum* and *E. c. risi* are reported from Georgia for the first time. As to Georgian *Lestes virens*, the infraspecific taxonomy is critically discussed, with special reference to Central Asian forms described as ssp. *marikovskii*. It is recommended to avoid any further splitting into inadequately defined subspecies, as the variability of eastern forms from Central Europe towards Central Asia can be better described as clinal variation within the ssp. *vestalis*. In consequence, the name *marikovskii* is regarded as a junior synonym of *vestalis*: *Lestes virens vestalis* Rambur, 1842 = *L. virens marikovskii* Belyshev, 1961, syn. nov. The diversity of taxa within the *Calopteryx splendens* complex in the Caucasus region is considered to comprise in fact three subspecies in Georgia: ssp. *intermedia*, ssp. *tschaldirica*, and ssp. *mingrelica*. Despite of transition zones and hybridisation each subspecies represents *in toto* a spatially clearly delimited unit. In ssp. *intermedia* androchrome females frequently occurred in the Kakheti region in the east of Georgia. The distinct female colour form 'feminalis' of *Calopteryx virgo* is illustrated for the first time and the availability of the name *Calopteryx virgo* var. *feminalis* Bartenev, 1910 is critically discussed. For a number of species the

first information from Georgia is provided since their discovery over a century ago, such as *Coenagrion armatum*, *Aeshna serrata*, and *Onychogomphus assimilis*; for *Coenagrion lunulatum* and *C. scitulum* the first data since over 75 years are presented. *Coenagrion ponticum* was recorded throughout the country and at least at two sites found to reproduce syntopically with *C. puella*. New information is provided for the little known *Coenagrion vanbrinkae*, including a formerly unknown pink colour morph of reproductive females. The infraspecific taxonomy of *Ischnura elegans* is critically discussed, with special reference to the taxa *pontica* Schmidt, 1938 and *ebneri* Schmidt, 1938. In addition, new records of *Pyrrhosoma nymphula* and *Coenagrion pulchellum*, both being rare in the Caucasus region, are given. The presence of distinct *Gomphus schneiderii* in Georgia is confirmed as well as the continuous presence of *Gomphus ubadschii* at the Rioni River over 80 years after its description under the homonym »*Gomphus flavipes* var. *lineatus* var. n.«. *Onychogomphus assimilis* and *O. flexuosus* were found to be abundant in the eastern half of the country suggesting that Georgia is an important global stronghold for both threatened species. Males of *Caliaeschna microstigma* exhibited a distinctive tendency for reduced ante-humeral stripes, leaving only a small bluish patch at the posterior part in some males. Vital populations of *Libellula pontica*, endemic to the East Mediterranean, were found and the species is assumed to be well established in the Kakheti region in the East of the country.

Key words. Dragonflies, damselflies, Anisoptera, Zygoptera, new records

**Abdomen or wings?
Comparing two body places for marking in
Mesamphiagrion laterale
(Odonata: Coenagrionidae)**

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Abstract. To assess a marking technique that avoids alteration of wing aspect and thereby reduces the effect of marking on the organisms' behavior, adult individuals of *Mesamphiagrion laterale* (Selys, 1876) were marked on two body regions and their probability of resighting (PR) was estimated. Marks were placed as irregular spots of turquoise, magenta, lime, and orange color. The PR of wing-marked individuals and abdomen-marked individuals was compared. A total PR of 80% was detected. PR was higher when the marks were placed on the abdomen (PR=0.72) than on the wings (PR=0.62), but no significance was found between these recapture rates ($\chi^2 = 0.413$). This exercise should be implemented in other odonate species to see the widespread nature of our results.

Key words. Dragonfly, damselfly, Zygoptera, South America, Colombia

Contrasting life-history patterns between vernal pond specialists and hydroperiod generalists in *Lestes* damselflies (Odonata: Lestidae)

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Abstract. The aim of our study was to identify life-history mechanisms enabling typical inhabitants of vernal ponds to complete their larval development under the time constrained conditions of their temporary larval habitats. For that reason we compared both hatching phenology and larval development of vernal pond specialists *Lestes barbarus*, *L. dryas*, and *L. macrostigma* with those of the closely related hydroperiod generalists *L. sponsa*, *L. virens*, and *L. viridis* under seminatural conditions. As hypothesized, we found vernal pond specialists of the genus *Lestes* to cope with the short water coverage of their typical larval habitats by the following developmental traits: a) an early hatching date in *L. dryas* and *L. barbarus*, b) large second-stadium larvae, which have to grow less and with fewer larval stadia than the hydroperiod generalists *L. dryas* and *L. macrostigma*, c) a short larval development time in *L. macrostigma* and d) higher growth rates in *L. dryas* and *L. barbarus* than in the other species. Degree day sums in vernal pond specialists were significantly lower than in their less specialized counterparts. This means, that they would have grown faster than hydroperiod generalists, if thermal conditions during larval development were identical in all species. Due to these developmental adaptations, larvae of *L. dryas* and *L. barbarus* emerged significantly earlier in the course of year than both *L. macrostigma* and the three hydroperiod generalists. Unexpectedly, none of the three studied vernal pond specialists has evolved all of these particular adaptations. This may be because of the close ecological relationship within the genus *Lestes*, and the studied species being generally characterized by univoltine life cycles and fast larval development, which enables all of the European species to reproduce in temporary ponds.

Key words. Dragonfly, damselfly, Zygoptera, hatching phenology, larval development, number of larval stadia

The daily food intake of *Pantala flavescens* females from foraging swarms estimated by the faeces excreted (Odonata: Libellulidae)

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Abstract. *Pantala flavescens* migrates to Japan every spring, where the population rapidly increases until autumn. Adults often form swarms above open grasslands for foraging. Little has been reported on the daily food intake in *P. flavescens*, probably due to the difficulty of observing foraging behaviour. We captured females from foraging swarms and kept them alive in the laboratory, and the faeces excreted were collected each 24-hour-period after capture. Faeces excreted within 24 hours after capture were typically dark brown, formed in oval pellets, including a lot of fragments of cuticle, which must have been derived from the prey. The total dry weight of faeces was 8.00 mg on average. The size of the subsequent faeces decreased, and the colour changed to reddish brown and detectable cuticle fragments were no longer present, suggesting that most of the indigestible parts had been excreted within 24 hours after feeding. When a female was handfed a single sheep blowfly, 4.51 mg of faeces were excreted within 24 hours after feeding, while a starved female excreted 2.23 mg. The daily food intake of a female was estimated to be about 14 mg, corresponding to about 185 small prey insects. Therefore, the mass flight of *P. flavescens* might affect populations of small insects in the open landscape in Japan.

Key words. Dragonfly, Anisoptera, feeding activity, flier, foraging flight, hand-feeding method, metabolism, percher, swarming

***Heteragrion thais* sp. nov.**
from the Atlantic Forest of Brazil
(Odonata: Heteragrionidae)

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Abstract. A new *Heteragrion* damselfly species, *Heteragrion thais* sp. nov. (Holotype deposited in ABMM) from Brazil, Minas Gerais State, Municipality of Barroso, is described and illustrated. This species is most similar to *H. beschkii*, *H. gracile*, and *H. luizfelipei*, from which it can be distinguished by the shape of the cercus and the colour of the posterior lobe of the prothorax.

Key words. Dragonfly, damselfly, new species, Zygoptera

Four new species of *Calvertagrion* St. Quentin from South America (Odonata: Coenagrionidae)

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Abstract. Four new species of *Calvertagrion* are described from the upper Amazon region of South America east of the Andes foothills, namely *C. albatum* sp. nov. (holotype male, Madre de Dios Department, Peru), *C. charis* sp. nov. (holotype male, Loreto Department, Peru), *C. declivatum* sp. nov. (holotype male, Santa Cruz Department, Bolivia), and *C. mauffrayi* sp. nov. (holotype male, Orellana Province, Ecuador). These additions bring the total number of species in the genus to five. Differences in thoracic and abdominal color pattern, morphology of the pronotum and male appendages are presented as characters in a key separating the known species. The male genital ligula is remarkably uniform within the genus, which is unusual within coenagrionid genera with multiple species.

Key words. Dragonfly, damselfly, Zygoptera, new species, Amazon Basin, Bolivia, Ecuador, Peru

**New species of damselflies
from the Hindenburg Wall region
of western Papua New Guinea
(Odonata: Coenagrionidae, Platycnemididae)**

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Abstract. Two new species of *Teinobasis* and one new species of *Nososticta* from the Hindenburg Wall region of western Papua New Guinea are described and illustrated. They are *Teinobasis cuneata* sp. nov. (Holotype SAMA 07-001421), *Teinobasis flavolineata* sp. nov. (Holotype SAMA07-001422), and *Nososticta oculata* sp. nov. (Holotype SAMA 07-001424). The new *Teinobasis* species are both moderately large, slender species with predominantly yellow/orange faces and black abdomens and they are most similar to *T. angusticlavia* Ris from the Aru Islands and *T. albula* Ris from the Lorentz River. The new *Nososticta* species is most similar to *N. finisterrae* Förster, a species that is widespread in south-eastern New Guinea, but differs from it in having the blue inter-ocular bar that is typical of *finisterrae* reduced to two widely separated pale blue spots on the anterior frons.

Key words. Dragonfly, damselfly, Zygoptera, new species, *Nososticta*, *Teinobasis*