Odonata surveys 2010–2016 in the United Arab Emirates and the Sultanate of Oman, with emphasis on some regional heritage species

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Abstract. Six field trips were carried out in the United Arab Emirates (UAE) and the Sultanate of Oman in autumn 2010, late winter 2013, spring 2014, autumn 2014, spring 2015 and spring 2016. We recorded 37 species at 87 localities, including new localities for some species of regional interest. Information on all observed Odonata species was recorded including their life stage, behaviour, habitat and water characteristics. Exuviae were also systematically collected. *Urothemis thomasi* was discovered at several new sites in the Hajar Mountains, the Dhofar and the Al Wusta regions, filling in the gap between the Dhofar and the Muscat area. In addition, new localities for two Arabian endemics: *Arabianemis caerulea* and *Arabineura khalidi* were found, with their occurrence in the Dhofar region extending their known area and demonstrating that *A. khalidi* cannot be regarded as a strict Hajar endemic. Important differences were noticed in the species composition of formerly surveyed localities, which may be ascribed to habitat degradation through management directed towards human recreation. Lastly, the well-known and diverse zoogeographical influences of Omani and the Emirati odonatofauna are confirmed with a large set of species of African origin in the Dhofar and a smaller set of species of Indomalayan origin visiting both the

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Dhofar and the northeast of the region during migrations and establishing, at least temporary, reproductive localities.

Further key words. Dragonfly, damselfly, Anisoptera, Zygoptera, Arabian Peninsula, Hajar Mountains, Dhofar, Red List, *Arabicnemis caerulea, Arabineura khalidi, Azuragrion somalicum, Azuragion nigridorsum, Agriocnemis pygmaea, Paragomphus sinaiticus, Orthetrum ransonnetii, Tholymis tillarga, Urothemis thomasi, Macrodiplax cora.*

Matutinal mating in *Aeshna grandis* and *A. viridis* – a behavioural pair of twins prefers early-morning sex (Odonata: Aeshnidae)

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Abstract. We investigated the hitherto unknown matutinal mating behaviour of Aeshna grandis and found that matings basically occurred at dawn. With the first morning light males began performing a searching flight for females that roosted deep in terrestrial vegetation characterized by reed, rush and grass. Matutinal mating in the distinctive twistedwheel position is documented. Twisted wheels are unique as they are not formed in flight but while perching on vegetation and they show no readiness to escape. The twisted position, with the male hanging upside down and his appendages being obliquely slipped across the female's head, is the result of the formation of mating wheels with the female perched. Later in the morning we observed feeding flight at suitable sites and resting in low vegetation of a wet meadow. During this resting phase some males inspected the vegetation on the wing, described here as 'mid-morning searching flight'. In this situation and also when foraging individuals aggregated, we found untwisted, upright hanging couples, which we interpret as wheels formed in flight - an indication of alternative mating tactics. Aeshna viridis, also known to exhibit matutinal matings, occurred syntopically and behaved similarly. We interpret the energy-sapping searching flight at dawn as sexual selection: females select genetic quality by choosing only the fittest mates.

Further key words. Dragonfly, Anisoptera, mating behaviour, diel activity pattern, searching flight, twisted-wheel position, mating tactics, sexual selection

Altitudinal variation of wing length and wing area in *Libellula quadrimaculata* (Odonata: Libellulidae)

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Abstract. The area and length of the right fore and hind wings and the abdomen length were analysed in specimens from two Iberian populations of *Libellula quadrimaculata* Linnaeus, 1758, one on a plateau (782 m a.s.l.) and another in the mountains (1909 m a.s.l.), with a view to ascertaining whether their morphometric characteristics vary with altitude. Allometric relationships in terms of length and area of the fore and hind wings of both populations were found. The wings are longer and have a greater area in plateau specimens whereas the length of the abdomen did not vary between populations. Between the populations there was an overlap in the wing length measurements. The significance of these parameters in aiding the dragonflies' flight capacity and hence the effects on their lifestyle under different environmental conditions is discussed.

Further key words. Dragonfly, Anisoptera, wing morphology, mountains, plateau, Iberian Peninsula

Ultrastructure of spermatozoa of *Anax guttatus* (Odonata: Aeshnidae)

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Abstract. In Anax guttatus (Burmeister, 1839), the mitochondria accumulate at the base of the nucleus to form a single nebenkern during spermiogenesis. An electron dense matrix 'centriole adjunct' is formed at the base of the nucleus surrounding the nebenkern. The acrosomal vesicle migrates to the anterior end of the nucleus. The ultrastructure of the spermatozoa reveals that its elongated head lodges an apical inverted 'T' shaped, double-layered acrosome and a long, electron-dense nucleus, while the tail is composed of the axoneme, a pair of identical mitochondria derivatives, and the lateral/osmophilic bodies. The nucleus is displaced on one side by the axoneme. The axoneme consists of microtubules, and these are arranged into nine outer peripheral inter-singlets, nine peripheral doublets, and two central tubules (9+9+2 type). The mitochondrial derivatives and lateral bodies surround the axoneme at the tail region of the spermatozoon. A large number of cristae are evident in the longitudinal section of the derivatives. The spermatozoon of A. guttatus is therefore characterized by several unique features, such as the absence of a centriole, a spiked double layered acrosome, and a long nucleus with a sub-central axoneme running all along its length. The mitochondria derivative runs parallel to the axoneme, while a pair of lateral bodies is located parallel to the mitochondrial derivatives.

Further key words. Dragonfly, Anisoptera, mitochondria derivatives, axoneme.

Leptagrion lencioninetoi sp. nov. from the Serra da Mantiqueira of south-eastern Brazil (Odonata: Coenagrionidae)

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Abstract. *Leptagrion lencioninetoi* sp. nov. is described from two males, the holotype and a paratype, collected in Brazil: São Paulo, Campos do Jordão, Condomínio Paradise, alt. 1796 m a.s.l., 16-x-2005, F. Lencioni Neto leg., both deposited in the author's collection. The new species differs from all congeners by the elevated and bifurcated hind lobe of prothorax.

Further key words. Dragonfly, damselfly, Zygoptera, South America, Atlantic Forest, Araucaria Forest, *Leptagrion siqueirai*

Hetaerina dutati sp. nov. from Brazil with notes on *H. amazonica* Sjöstedt, 1918 (Odonata: Calopterygidae)

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Abstract. *Hetaerina dudati* sp. nov. is described and illustrated based on specimens collected in forest streams in the state of Para in Brazil. The new species is close to *Hetaerina amazonica* Sjöstedt, 1918 differing from it mainly by the structure of male appendages and female epiproct. Some notes are made on topotypes of *H. amazonica*.

Further key words. Dragonfly, damselfly, Zygoptera, new species, South America, taxonomic character

Heteragrion cauei sp. nov., a new damselfly from Minas Gerais, Brazil (Odonata: Heteragrionidae)

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Abstract. *Heteragrion cauei* sp. nov. (\mathcal{O} holotype and \mathcal{Q} allotype: Brazil, Minas Gerais, Catarina Mendes, Ouro Preto, 18-iii-2016, 20°19'54"S, 43°30'49"W, deposited in coll. MNRJ) is described and illustrated. Based on thoracic coloration, *H. cauei* sp. nov. is part of the group of species formed by *H. gracile, H. luizfelipei* and *H. beschkii*; however the new species differs from these species by the morphology of the medial process of the cercus.

Further key words. Dragonfly, Zygoptera, new species, South America

Micrathyria wasscheri sp. nov. from the coastal savannahs of French Guiana (Odonata: Libellulidae)

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Abstract. On July 2014, a teneral specimen of an unknown *Micrathyria* species was found during the survey of an open marsh in Trou-Poissons in the coastal savannah of French Guiana. Further specimens were subsequently collected at the same place and at two other localities in Kourou and Macouria. The male and female of this new species are described here. *Micrathyria wasscheri* sp. nov. seems to depend on open marshes vegetated with *Eleocharis intersincta* (Cyperaceae), which constitute a very specific ecosystem of limited extent. This discovery highlights biodiversity issues in the coastal marshlands ('pri-pri'), which are currently threatened by demographic trends.

Further key words. Dragonfly, Anisoptera, *Eleocharis interstincta*, Neotropics, pri-pri, South America.

Pseudagrion kamiranzovu sp. nov., a new flagship species of damselfly from Rwanda's Nyungwe Forest (Odonata: Coenagrionidae)

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Abstract. *Pseudagrion kamiranzovu* sp. nov. is described from streams in the montane rainforest of Nyungwe National Park in western Rwanda. The species belongs to the *Pseudagrion* A-group and is similar to *P. risi* Schmidt in Ris 1936 and *P. gamblesi* Pinhey, 1978 but is characterized by its unique combination of colours, the lack of blue markings on the abdomen, the male appendages and the short pterostigmata. The body size makes it one of the largest members of the genus in continental Africa.

Further keywords. Dragonfly, Zygoptera, Africa, Albertine Rift

Description of final instar larvae of Ecchlorolestes Selys spp. from South Africa (Odonata: Synlestidae)

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Abstract. The final instar larvae of two rare, endemic South African species, *Ecchlorolestes nylephtha* and *E. peringueyi*, are described. This first description illustrates important features in identification, and also gives differences between the genera *Chlorolestes* and *Ecchlorolestes*.

Further key words. Zygoptera, Western Cape, Eastern Cape, Cape Floristic Region endemics, habitat, distribution

Bironides ypsilon sp. nov. and Nannophlebia ballerina sp. nov., two new stream-dwelling dragonflies from southern Papua New Guinea (Odonata: Libellulidae)

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Abstract. Two new species of stream-dwelling libellulid dragonflies are described from Gulf Province, Papua New Guinea. *Bironides ypsilon* sp. nov. and *Nannophlebia ballerina* sp. nov. are both small black and yellowish green dragonflies that appear to be confined to the vicinity of clear forest streams where adults were found perched on low vegetation. Characters of both sexes are illustrated, and the affinities of the new species are discussed.

Further key words. Anisoptera, new species, Wau Creek, Kikori River Basin

The type material of Isostictidae, Dicteriadidae, Argiolestidae and Megapodagrionidae in the Museum für Naturkunde in Berlin (Odonata)

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Abstract. A catalogue listing all species-group names associated with type specimens of the families Isostictidae, Dicteriadidae, Argiolestidae and Megapodagrionidae (Odonata) currently housed in the entomological collection of the Museum für Naturkunde – Leibniz Institute for Evolution and Biodiversity Science in Berlin (Germany) – includes current status of the species-group names, transcriptions of data labels and references to the original descriptions.

Further key words. Dragonfly, damselfly, Zygoptera, catalogue, collection locality, collector, verbatim label, type