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FIELD NOTES ON EMERGENCE OF *PANTALA FLAVESCENS* (FABRICIUS) IN CENTRAL INDIA (ANISOPTERA: LIBELLULIDAE)

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A total of 611 exuviae were collected within a period of 45 days during April-May, 2004 from the walls of an open cement drain at Nagpur, India. The daily record of this collection revealed that 50% of the total emergence was completed by the 14th day and the sex ratio is considerably in favour of ♂♂ (1.4:1). The ♀♀ emerge earlier (protogyny) and the ME_{50} for ♀ and ♂ was observed on the 10th and 18th day, respectively. Protogyny probably provides adequate time for the ♀ to develop her ovaries. 194 exuviae (31.75%) were collected from the north wall, which was completely in shade, and 417 (68.25%) from the south wall, which receives sunlight throughout the day. On the north wall, 44.7% exuviae were collected at a height of 30-45 cm from the water level, while from the south wall, 57.2% exuviae were collected at a height up to 15 cm and 28.4% between 15-30 cm. The present findings indicate that sunlight and temperature not only determine the choice of direction of the emerging larva but also initiate an early commencement of Stage I of metamorphosis (shortening the time between the surfacing of the larva and splitting its thoracic cuticle), which results in the shorter distance climbed by the larvae on the south wall for the final moult.

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THE REPRODUCTIVE BIOLOGY AND DAILY ACTIVITY PATTERNS OF *ISCHNURA HETEROSTICTA* (BURMEISTER) IN EASTERN AUSTRALIA (ZYGOPTERA: COENAGRIONIDAE)

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The reproductive behaviour was observed at a pond in Fig Tree Pocket, Brisbane, Australia, from Oct. 2010 to Jan. 2011. In total, 769 individuals were marked in the field for observations pertaining to the daily activity patterns and reproductive cycle of this sp. Forty-one *I. heterosticta* pairs were collected and kept in the laboratory for detailed observations of the reproductive behaviours, copulation duration and oviposition, and to determine the duration of larval development. It started to form mating pairs from ca 5:00 to 9:00 am, foraged from ca 9:00 am to 13:00 pm, and finally ♀♀ oviposited mainly from ca 13:00 pm to 16:30 pm. Oviposition usually occurred in the following days after mating. Mating pairs formed the tandem position for about 13 s, then copulated in the wheel position on average for 195 min, and upon completion of insemination formed a tandem position again for about 12 s. On average, ♀♀ spent 145 min in actual oviposition, laying several hundred eggs on floating vegetation. Ovipositing ♀♀ were not guarded by ♂♂. The eggs hatched within 10 to 21 days, and the larvae took 3 to 5 months to develop into adults.

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PATTERNS OF MITOCHONDRIAL AND WING MORPHOLOGICAL DIFFERENTIATION IN TAIWANESE POPULATIONS OF *PSOLODESMUS MANDARINUS* McLACHLAN (ZYGOPTERA: CALOPTERYGIDAE)

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To investigate the patterns of molecular and morphological differentiation, the mitochondrial cytochrome oxidase I and 16S ribosomal DNA genes and wing morphology data were analyzed. Both phylogenetic and population genetic analyses revealed two lineages, an Eastern and a Western lineage existing on each side of the longitudinal Central Mountain Range. For wing traits, the latitudinal clines mainly altered across the populations in northern Taiwan and the transition zone was broad. For ♀ wing size, however, the latitudinal cline shifted at 24.19 degrees N latitude, which is close to the current criteria (24.33 degrees N latitude line) for dividing 2 geographical sspp., *P. m. mandarinus* and *P. m. dorothea*.

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WING SHAPE VARIATION IN *CALOPTERYX SPLENDENS* (HARRIS) POPULATIONS IN THE ZAGROS MOUNTAINS, IRAN (ZYGOPTERA: CALOPTERYGIDAE)

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C. splendens is found in most of Europe, large parts of Siberia and much of west and central Asia. There is great variation among ♂♂ in wing coloration. Traditionally, subspecific taxa have been distinguished by the size and position of the pigmented wing spot and by mating behaviour. About a dozen subspecies have been recognized, all of which are more or less geographically confined, but often with overlapping ranges and strong variation in wing spot size. Here, a geometric morphometrics is used to quantify morphological data and analyze the wing shape independent of wing spot size in 6 Zagros mountain populations, traditionally known as *C. s. intermedia*, based on wing spot size. 19 different points were digitized as landmarks on the left forewings of ♂♂, using GPA (Generalized Procrustes Analysis). The results reveal significant wing shape differences between all populations except Markazi and Lorestan on the one hand and Fasa and Kazeroon on the other hand. These observations confirm the role of geographic (here Dena, Oshtoran Kooh and Zard Kooh mountains of more than 4000 m altitude) and climatic barriers in population isolation, but also suggest that wing spot similarity does not necessarily reflect the full genetic similarity and evolutionary grouping of populations. Based on the wing shape analyzed, *C. splendens* is split into 2 distinguishable population groups in central and southern Zagros with 2 different gene pools, even though they show the same wing spot size, i.e., a long-term isolation among the groups investigated has occurred and the wing spot is not an infallible character for identifying *C. splendens* sspp.

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MORPHOFUNCTIONAL GROUPS OF ODONATA LARVAE IN THREE FRESHWATER ECOSYSTEMS FROM EASTERN CUBA

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Five morphofunctional groups were determined, based on the morphological characters of the exuviae and the behaviour of the larvae, in three freshwater habitats from Santiago de Cuba. The exuviae were collected weekly over a year, within an 8 m transect and 1 m wide. in the water-ground transition, directly on vegetation, rocks or ground. The most diverse group was the lamellates with 12 spp., followed by the epibenthonics with 11; the least diverse was the hidden group which included the only 2 Gomphidae known from Cuba, together with *Cannaphila insularis funerea* and *Orthemis ferruginea*, all gallery diggers. The Zygoptera were represented by over 25% of the spp. observed in each habitat, whilst the Aeshnidae always had less than 10% of the individuals. The Libellulidae, the most diverse family within the Anisoptera, accounted for the greatest diversity among the morphofunctional groups.

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OVIPOSITION BEHAVIOUR IN THE DRAGONFLY *SYMPETRUM INFUSCATUM* (SELYS) MISTAKING DRIED-UP RICE PADDY FIELDS AS SUITABLE OVIPOSITION SITES (ANISOPTERA: LIBELLULIDAE)

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Tandem oviposition behaviour of *S. infuscatum* was studied in rice paddy fields that were dried due to agricultural procedures in the cool temperate zone of Japan. Oviposition site selection is probably mainly visual because every tandem pair is attracted to structurally similar rice paddy fields without any water. Observations of flying behaviour of tandems was carried out on sunny days without winds. All pairs flew about to search for a suitable oviposition site in the rice paddy fields. They hovered to start oviposition while in tandem. ♀♀ of tandems flicked their abdomen while on the wing to aid egg release; each height of these oviposition flights was measured. They separated after completion of the oviposition bout. Vertical changes in the air temperature, relative humidities and light intensities above and below the top of the rice plants were measured. Oviposition site selection was related to the vertical decline of vapour pressure above the rice plants, suggesting that the horizontal surface of rice paddy fields horizontally reflects highly polarized light. Eggs that had fallen on dried-up rice paddy soil diapaused throughout the winter and started to develop the following spring when the field was filled with enough water for rice planting. Therefore, there is a mechanism for suitable habitat selection for larval development under seasonal changes in man-made water supplies for the cultivation of rice plants.

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MULTI-LEVELS, MULTI-SCALES AND MULTI-FUNCTIONS IN THE FINE STRUCTURE OF THE WING VEINS IN THE DRAGONFLY *PANTALA FLAVESCENS* (FABRICIUS) (ANISOPTERA: LIBELLULIDAE)

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The internal fine structure of the wing veins is explored and the relationships between the structures and the functions of dragonfly wing veins are revealed. SEM photographs of the cross-sections of dragonfly wing veins have shown that: (a) the micro/nano structures vary along the axis of a vein, i.e. different cross-sections have different micro/nano structures. – (b) In a given cross-section, the micro/nano structures are at multi-levels and multi-scales. – (c) At a large scale, the structures of the veins are of diversities and disorders. The larger the size scale, the more complicated the structures and the higher are the diversities and disorders. The smaller the size scale, the simpler are the structures, and the higher are the unifications and orders. – (d) At nano scale, we may induce an unified assembling mode for the vein's structures, i.e. "nano fibres → nano layers (or nano bunches)". – (e) Both the mechanical and the biological functions of the micro/nano structures of the veins are optimized.

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SHORT COMMUNICATION

DESCRIPTION OF FEMALE OF *NIHONOGOMPHUS SCHORRI* DO & KARUBE FROM HUU LIEN NATURE RESERVE, LANG SON PROVINCE, NORTH VIETNAM (ANISOPTERA: GOMPHIDAE)

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The ♀, collected from the type locality of the sp., Huu Lien Nature Reserve, Lang Son Province, North Vietnam, is described and illustrated in detail.