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FOREST DAMSELFLIES OF THE PHILIPPINES, THEIR EVOLUTION AND PRESENT STATUS, WITH THE DESCRIPTION OF *DREPANOSTICTA MOOREI* SPEC. NOV. FROM LUZON (ZYGOPTERA: PLATYSTICTIDAE)

J. VAN TOL[1] and R.A. MÜLLER[2]

[1]National Museum of Natural History Naturalis, P.O. Box 9517, NL-2300 RA Leiden, The Netherlands
e-mail: tol@nnm.nl

[2]Rehetobelstrasse 99, CH-9016 St. Gallen, Switzerland

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D. moorei sp. n. (holotype ♂: Philippines, Luzon, Nueva Viscaya, Sta Fe, Atbo River, 550-800 m, 10-VI-1991, in RMNH) is described, and illustrated. It is closely related to *D. belyshevi* Hämäläinen from the Philippines. Some general remarks on the historical biogeography and the present status of the family are made. The current distribution of the family (SE Asia, Middle and northern South America) presumably dates back to the Upper Cretaceous.

INTRODUCTION

The family Platystictidae seems to be a well-established monophyletic taxon (e.g. JARZEMBOWSKI et al., 1998), based on the presence of a "basal post-cubital vein" (FRASER, 1957). BECHLY (1995) doubts the homology of the latter with the post--cubital vein in the 'ancient zygopteroid stock' (e.g. *Kennedya* Tillyard), and considers it the genuine CuP. The presence of this vein is a character that easily distinguishes this family from other Zygoptera, and is an apomorphy rather than a plesiomorphy in the Platystictidae (JARZEMBOWSKI et al., 1998). The family can also be identified by some other structural features, such as the groundplan of the anal appendages and the structure of the so-called gomphine-shaped lateral lobes of the labium. However, the diagnostic characters of, and the relationships between the genera are at present still unclear.

In the field, almost all SE Asian species are inconspicuous, brown and brownish black, confined to seepages and smaller streams. Most species move very little during

the day. With their cryptic coloration they are difficult to find among dense vegetation. The males of some species have a bright blue spot at the tip of the abdomen, which perfectly mimics the water drops at the tip of thin branches in the forest, the very sites where *Drepanosticta* Laidlaw and *Protosticta* Selys rest during the day.

The family occurs in southeastern Asia, from Sri Lanka over India, southern China and Malaysia, into the Indonesia up to the Solomon Islands. *Drepanosticta palauensis* Lieftinck is known from Palau (LIEFTINCK, 1962). Most species of SE Asia are assigned to the Platystictinae, but recently MATSUKI & SAITO (1996) and WILSON & REELS (2001) found two species for which the subfamily Sinostictinae was erected by WILSON (1997). Another subfamily, the Palaemnematinae, occurs in Middle America and in the northwestern part of South America. All New World species are assigned to the genus *Palaemnema* Selys. Several of these are remarkably similar to those of SE Asia, both in general appearance and in structural details, such as the anal appendages.

Although the historical biogeography of the family should be investigated in more detail, based on phylogenetic and preferably also molecular studies, our hypothesis is that its present geographic pattern goes back to the Late Cretaceous (ca 65 Ma). The family was at the time presumably distributed over Laurasia and northern North America. The climate was tropical, and Europe and America were still connected. After their separation, the climate became less favourable for tropical biota. Apparently, ancestors of the present Platystictidae moved southward, following the tropical conditions, in both North America and Laurasia. The presence of *Palaemnema* in South America is presumably rather recent in geological terms, following the emergence of the Isthmus of Panama, the connection of North and South America about 3 Ma (COATES, 1999).

Most of the Philippine *Drepanosticta* species are structurally more similar to those of the Moluccas (undescribed species) and New Guinea than to the mainland species. The characteristic structures include large processes posteriorly on the posterior lobe of the pronotum and relatively simple male anal appendages. They are also particularly dull in coloration. We hypothesize that this pattern is due to the presence of an island arc along the Pacific plate during the Oligocene and Miocene (20-30 Ma) (HALL, 1998).

DREPANOSTICTA OF THE PHILIPPINES

DIVERSITY. – *Drepanosticta* is a very large genus, with presently 87 valid species described and more than 20 awaiting description in the collection of the Leiden Museum alone, mostly from the Philippines, the Moluccas and New Guinea. Most species have small distributional ranges. The situation may prove even more complex, since many species show significant geographical variation (cf. e.g. VAN TOL, 1999, for Sulawesi *Protosticta*). Although the morphological differences between such populations may be rather small, it is not unlikely that these populations are separated for millions of years. Molecular studies by the first author to address this problem are in preparation.

A significant number of the undescribed species from the Philippines were collected by the second author and his collaborators in the 1980's and 1990's. General information of this collection, which is now housed in the National Museum of Natural History Naturalis, at Leiden, was published by HÄMÄLÄINEN & MÜLLER (1997), where also the history of the study of Odonata in the Philippines is adequately outlined. The first *Drepanosticta* species were described by BRAUER (1868), viz. *D. halterata* and *D. lestoides*. It is remarkable that Semper also collected such inconspicuous insects, which suggests that these must have been very common. The first species is still common indeed in the area studied by Semper, but *D. lestoides* is not common at all now. See also Table I for a list of the 13 nominal taxa, representing 12 species, described from the Philippines up to date. *D. septima* Needham & Gyger was considered by HÄMÄLÄINEN & MÜLLER (1997) a possible synonym of *D. myletta* Cowley.

Apart from the species described hereunder, more than ten new species will be described in a revision of the Philippine Platystictidae (VAN TOL, 2003).

CONSERVATION. – Like all biota confined to tropical forests and characterized by small distributional ranges, most Platystictidae are under serious threat. The Philippine forests rank high among the tropical forests of southeastern Asia, and they are under severe pressure of degradation and destruction. The total surface of the 7100 islands of the Philippines amounts to just over 300,000 km^2. The total forest cover is ca 20%, of which less than 3% primary forest. An FAO report suggests that less than 1 million hectares of "old growth" dipterocarp forest remain.

The human population amounts to ca 62 million, while the total surface of the archipelago is similar to Italy in Europe, or to New Mexico in the USA. According to a rough estimate, nearly 500 ha of secondary forest disappear daily. At present more than 90% of the forest is already destroyed; on some islands hardly any forest is left (e.g. less than 3% on the island of Negros). The best forest remnants can be found on Palawan, which is inhabited by a completely different flora and fauna and, biogeographically does not form a part of the Philippines.

Conservation International describes the Philippines as "the hottest of hotspots". Approximately 50% of the 8000 native plant species are endemic.

Table I

Nominal taxa of *Drepanosticta* from the Philippines (in chronological order)

Species-group name	Original genus	Author(s)
halterata	*Platysticta*	BRAUER, 1868: 551
lestoides	*Platysticta*	BRAUER, 1868: 552
annulata	*Platysticta*	SELYS, 1886: 156
myletta	*Drepanosticta*	COWLEY, 1936: 160
lymetta	*Drepanosticta*	COWLEY, 1936: 161
megametta	*Drepanosticta*	COWLEY, 1936: 163
trimaculata	*Drepanosticta*	LIEFTINCK, 1939: 149
aries	*Drepanosticta*	NEEDHAM & GYGER, 1941: 144
taurus	*Drepanosticta*	NEEDHAM & GYGER, 1941: 145
philippa	*Drepanosticta*	LIEFTINCK, 1961: 132
ceratophora	*Drepanosticta*	LIEFTINCK, 1974: 117
belyshevi	*Drepanosticta*	HÄMÄLÄINEN, 1991: 65

The number of named dragonfly species of the Philippines is ca 250 (HAMALAINEN & MÜLLER, 1997), of which more than 50% are endemic, including all *Drepanosticta* species. It is fortunate that none of the *Drepanosticta* species is under such an immediate threat as it is for example the platycnemidid *Risiocnemis seidenschwarzi* Hämäläinen (HÄMÄLÄINEN, 2000), confined to a stretch of 30 m of stream in the Tabunan forest of Cebu. On this island, with a total surface area of 1707 square mi (4400 km^2), not more than 145 ha of primary forest are left (pers. comm. Dr Hämäläinen, 2002).

We are honoured to be able to contribute this short paper to the *Festschrift* on the occasion of Dr Norman W. Moore's 80th birthday. Through Dr Moore's efforts, Odonata are high on the international agenda of invertebrate conservation and protection (e.g. MOORE, 1997). Naming one of the Philippine forest damselflies after him is more than appropriate.

DREPANOSTICTA MOOREI SP. NOV.

Figures 1-5

Platysticta annulata SELYS, 1886: 156
Drepanosticta sp., LIEFTINCK, 1961: 136 (specimen "588" in Selys collection, IRSN Brussels, a paralectotype of *Drepanosticta annulata* [Selys], not conspecific with lectotype).
Drepanosticta sp. n. note 7; HÄMÄLÄINEN & MÜLLER, 1997: 257, 276-277.

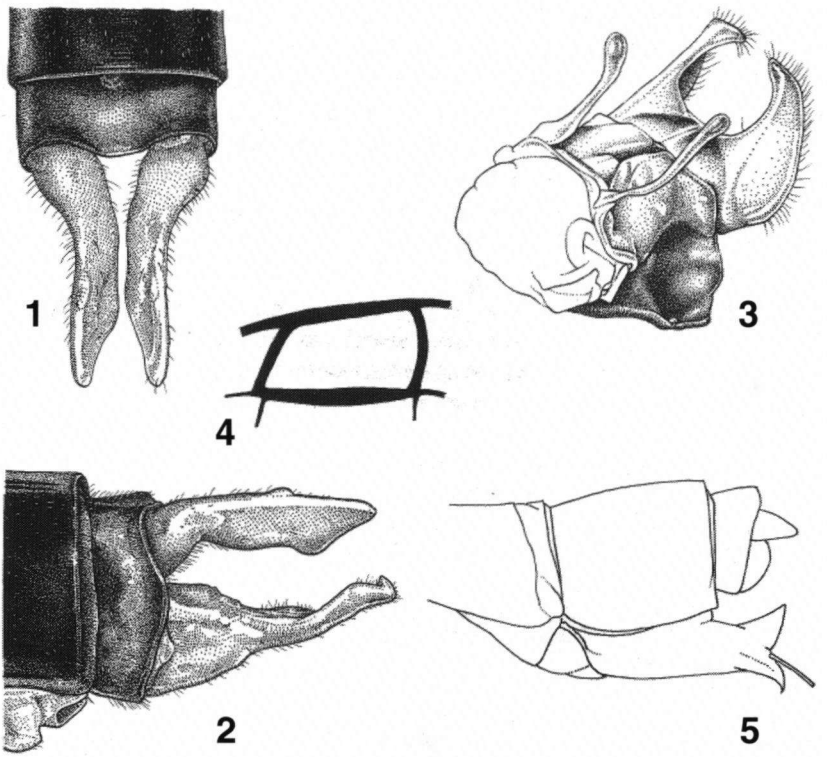
M a t e r i a l. – **Holotype** ♂, Philippines, Luzon, Nueva Viscaya, Sta Fe, Atbo River, 550-800 m, 10--VI-1991 / R.A. Müller leg. / coll. R.A. Müller [JvT 22225], coll. RMNH. – **Paratypes** (all ex coll. R.A. Müller, now in RMNH): Luzon, Nueva Viscaya, Dalton Pass, 850-900 m, 8/9-VI-1991, R.A. Müller, 1♂; – same site as holotype, 11♂ 10♀; – Luzon, Nueva Ecija, Caranglan, Batching River, 700-850 m, 11--VI-1991, R.A. Müller leg., 2♂; – Luzon, Aurora prov., Dilalongan, Sitio Biyak, Dibaraybay, 3/15-VII--1996, 300-500 m, Celso M. Nazareno leg.; – Luzon, Zambales Prov., Masinloc, Mt Coto, Tal-tal, 400--700 m, April 1/8-IV-1997, C.M. Nazareno leg.

E t y m o l o g y. – Named after Dr Norman W. M o o r e, for his contributions to the conservation of Odonata.

A remarkable and unmistakable species by the pronotum structure; the coloration of the synthorax is also different from that in most other Philippine congeners.

MALE [JvT 22225, Luzon, Nueva Viscaya]. – H e a d. – Labrum and anteclypeus very clear blue, anterior border of labrum with narrow black line; mandibles brown, but inner basal corner blue; rest of head bronze-black; parorbital carina distinct; postoccipital carina indistinct and lacking conspicuous extremities.

T h o r a x. – Pronotum (Fig. 3) with anterior and median lobe yellowish, lateral lobe brown, posterior lobe dirty yellow; anterior lobe approximately halfway each side with very long subcylindrical process, touching median lobe, and reaching virtually hind margin of central portion of posterior lobe; median and lateral lobes simple; hind lobe laterally with enormous collar, half-round, nearly twice as long as basal part of posterior lobe; lateral margin with long and thin setae. Synthorax bronze-black, but metepisternum nearly fully greenish yellow, and dorso-posterior third of metepimeron greenish yellow. Legs dirty yellow. Wings with 13 Px in fore wing, 13 Px in hind wing; origin of R4+5 just distal to nodus, R3 arises 6 cells distal to nodus in fore wing, 5 cells



Figs 1-5. *Drepanosticta moorei* sp. n.: (1) male anal appendages, dorsal view; – (2) same, left lateral view; – (3) male pronotum, oblique view; – (4) pterostigma right hind wing, male; – (5) female last abdominal segments.

in hind wing; Arculus just distal to Ax2, distinctly stalked; Ac and Ab forming a Y, hardly stalked; number of cells between distal end of quadrangle and place where CuP meets hind margin of wing in fore wing 5, in hind wing 7; pterostigma (Fig. 4) brown, with a narrow pale line against veins; ca 1.6 times longer than high, the proximal side oblique, the distal side rounded; veins distad to pterostigma undivided.

A b d o m e n. – Brown, but basal one-tenth of segment 3, basal one-sixth of segments 4-6, basal one-third of segment 7 dirty yellow; segments 8-10 tergites brown. Appendages (Figs 1-2) greyish brown, top of inferiors castaneous; superiors with basal one-fourth stout, rest narrow in dorsal view, actually strongly flattened dorso-ventrally, and broadly triangular in lateral view; inferiors in ventral view subparallel, the top bent outward, then inward in a semicircle, in lateral view the top bends in 90°.

M e a s u r e m e n t s (in mm). – Abdomen including appendages ca 37, hind wing 22.

FEMALE. – Very similar to male, including coloration, and structure of pronotum; segments 8-10 brown, anal appendage lightbrown, genital valves surpassing apex of

appendages (Fig. 5).

DIFFERENTIAL DIAGNOSIS. – This species differs from other species of the Philippine islands by the long processes on the anterior lobe of the pronotum. This character is present in both males and females. The only other Philippine species with long processes on the anterior lobe of the pronotum is *D. belyshevi* Hämäläinen (type locality Panaon Is.), characterized by the strongly curved, slender processes of the posterior lobe of the pronotum, and pale markings in the posterior thirds of metepisternum and metepimeron (in some specimens also of mesepimeron).

DISTRIBUTION. – Central Luzon (provinces Nueva Viscaya, Nueva Ecija, Aurora and Zambales). Apparently it occurs in low densities over a relatively large area. In larger numbers found at the type locality only.

RELATIONSHIPS. – Based on the highly characteristic processes of the anterior lobe of the pronotum, *D. moorei* sp. n. seems to be most closely related to *D. belyshevi* Hämäläinen. Although a direct link of these two species to most of the other Philippine congeners is not apparent, a close relationship to the mainland species-groups is also unlikely.

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