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International Dragonfly Fund - Report Journal of the International Dragonfly Fund

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Published: 15.02.2018

112

ISSN 1435-3393

The International Dragonfly Fund (IDF) is a scientific society founded in 1996 for the improvement of odonatological knowledge and the protection of species.
Internet: <http://www.dragonflyfund.org/>

This series intends to publish studies promoted by IDF and to facilitate cost-efficient and rapid dissemination of odonatological data..

Editorial Work/Reviewing:	Vincent Kalkman, Albert G. Orr, Martin Schorr
Layout:	Martin Schorr
IDF-home page:	Holger Hunger
Printing:	Colour Connection GmbH, Frankfurt
Impressum:	Publisher: International Dragonfly Fund e.V., Schulstr. 7B, 54314 Zerf, Germany. E-mail: oeslq@online.de
Responsible editor:	Martin Schorr
Cover picture:	<i>Drepanosticta johncanni</i> sp. nov., Lake Kutubu, PNG
Photographer:	Stephen J. Richards

Three new damselflies from Lake Kutubu, Papua New Guinea (Zygoptera: Argiolestidae, Coenagrionidae, Platystictidae)

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Abstract

We describe three new species of damselflies from streams draining into Lake Kutubu in Southern Highlands Province, Papua New Guinea. They are *Drepanosticta johncanni* sp. nov. (Platystictidae), *Pseudagrion parafarinicolle* sp. nov. (Coenagrionidae) and *Wahnesia kutubuensis* sp. nov. (Argiolestidae). Diagnostic characters of the males and, where available of the females, are illustrated and the probable affinities of the new species are discussed.

Key words: Odonata, Dragonflies, Zygoptera, *Drepanosticta johncanni* sp. nov., *Pseudagrion parafarinicolle* sp. nov., *Wahnesia kutubuensis* sp. nov., Papua New Guinea.

Introduction

Recent surveys for odonates along the southern fringe of Papua New Guinea's central cordillera (Oppel 2005, Kalkman et al. 2011, Richards & Theischinger 2015) have revealed a species-rich fauna and numerous species that are new to science (Michalski & Oppel 2010, Orr & Kalkman 2010, Orr et al. 2014, Theischinger & Richards 2011, 2014a, 2015a, b, Gassmann et al. 2016). However the odonate fauna of one of the most biologically significant, and visually spectacular, aquatic ecosystems of this region, Lake Kutubu, remains poorly documented.

Lake Kutubu is a large (>4,900 ha) perched lake located at an altitude of about 820 m a.s.l. in Southern Highlands Province. It is home to numerous species of endemic fishes and an endemic crayfish, and the entire lake and substantial areas of surrounding rainforest are contained within the Lake Kutubu Wildlife Management Area (WMA). Although comprehensive surveys of odonates have not been conducted in

the Lake Kutubu area, Polhemus (1995) collected damselflies from a number of streams that drain into the lake. That study documented 18 species of damselflies at altitudes of ~800–1,000 m a.s.l. in the general area and provides a useful baseline against which to compare future studies. During May 2017 two of the authors (SJR, PST) conducted a comprehensive survey of odonates at the western edge of Lake Kutubu. Here we describe three new species of damselflies encountered during that survey.

Material and methods

Descriptive terminology largely follows Watson & O'Farrell (1991). Colouration is given as assessed from the preserved material, supplemented with photographs of the new species taken in life. Measurements are given in millimeters (mm). All illustrations were done with the aid of a camera lucida and are not to scale. Coordinates are presented using the GPS datum WGS 84.

For comparative purposes we examined type material of *Wahnesia kirbyi* (RMNH) and of *Pseudagrion farinicolle* (RMNH).

Abbreviations used are: SAMA for South Australian Museum, Adelaide, Australia; RMNH for Museum Naturalis, Leiden, Nederland; S for abdominal segment(s).

Drepanosticta johncanni sp. nov.

Figures 1, 3-7

Material

Holotype: ♂ (SAMA 07-001504), Papua New Guinea, Southern Highlands Province, Tigibu Ck at western edge of Lake Kutubu (6.321°S, 143.265°E; 850 m a.s.l.), 06-v-2017, S.J. Richards & P.S. Toko. Deposited in the South Australian Museum.

Paratype ♂ (SAMA 07-001505), same data as holotype.

Etymology

The species is named for John Cann, in recognition of his work on freshwater turtles of Australia and New Guinea, his many years of friendship to GT and on the occasion of his 80th birthday on January 15, 2018.

Diagnosis

A small, very slender damselfly that can be distinguished from all congeners in the New Guinea region by the following suite of characters: body of male almost completely black except for a well-defined narrowly oval whitish patch dorsal of metathoracic spiracle (Fig. 1), superior anal appendages with apical half widely leaf-shaped, and inferiors very slim, curved and minimally armed (Figs 5-7).



Fig. 1. *Drepanosticta johncanni* sp. nov., male, in life. Photograph by SJR.

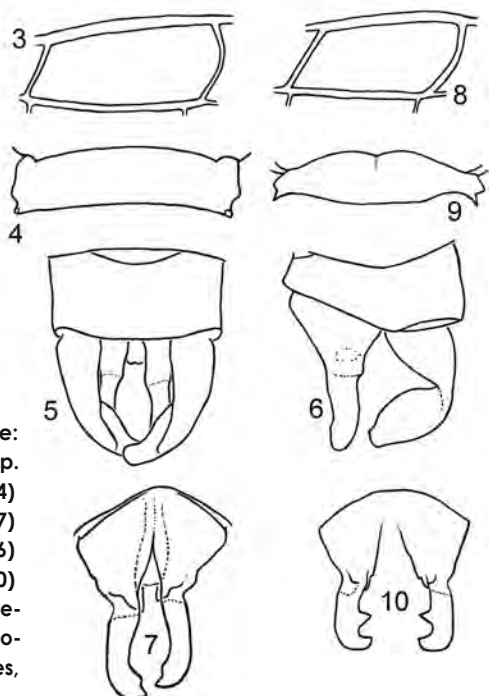
Holotype – Male (Figures 1, 3-7)

Head – Labium greyish to brownish black; anterior half of labrum and ventral portion of mandibles black, most of mandible base, posterior half of labrum, anteclypeus and anterior portion of postclypeus bluish white to pale yellow, posterior portion of clypeus, frons and scape black; top of head greyish to brownish black, only an ill-defined patch between antennal bases and median ocellus and some small ill-defined blotches along occipital margin slightly lighter; pedicel yellowish brown, flagellum missing, most probably black; genae pale next to mandibular base, dark adjacent to eye, postgenae brown in dorsal half, black in ventral half.

Prothorax – Anterior lobe of pronotum largely yellow, darkened along much of anterior margin; median and posterior lobe with back broadly blackish-brown and sides only narrowly pale to dull yellow; posterior lobe almost rectangular, its posterior edge almost completely straight, flanked by a small up-raised point each side; propleura black.



Fig. 2. *Drepanosticta dendrolagina*, male, in life. Photograph by SJR.



Figs 3-10. *Drepanosticta* spp., male:
(3-7) *Drepanosticta johncanni* sp. nov., holotype: (3) pterostigma; (4) posterior lobe of pronotum; (5-7) anal appendages: (5) dorsal; (6) lateral; (7) inferiors, ventral; (8-10) *Drepanosticta dendrolagina*: (8) pterostigma; (9) posterior lobe of pronotum; (10) inferior anal appendages, ventral.

Synthorax – Shining black with well-defined elongate bluish-white patch extending about 1/7 length of metanepisternum from subalar ridge to metathoracic spiracle, and metapostepimeron except for the black top largely pale greyish yellow. Mesopostcoxa brown and yellow, metapostcoxa yellow, poststernum largely black. Legs with coxae and trochanters yellow except for black outer face of procoxa and half of outer face of mesocoxa; femora pale to dark yellow except for black outer face of procoxa and half of outer face of mesocoxa largely greyish yellow to yellowish grey with upper edge and apex black and a subapical oval patch taking between 1/5 and 1/4 length bright yellow; tibiae greyish yellow to brownish yellow; tarsi greyish brown to blackish brown, claws somewhat paler than tarsi. Entire wing membrane slightly suffused with pale greyish brown, venation black; postnodals 15/14; pterostigma dark brownish grey, about twice as long as its greatest width, generally overlying slightly more than one cell, proximal border straight, distal border distinctly convex.

Abdomen – Slim, S7 to S10 wider than preceding segments, largely black with rather small ill-defined brownish-yellow ventro-lateral patch at base of S3-S8, smallest on S3 and S8; intersegmental membrane between S8 and S9 and a minute dorsal double-spot at base of S9 bright blue in life; S9 otherwise and S10 entirely black. Anal appendages (Figs 5-7) with superiors greyish brown and widely leaf-shaped in apical half; inferiors greyish yellow to yellowish brown, slim with medially curved short rather obtuse apex and barely detectable medially directed subapical elevation.

Measurements. – Hindwing 21.5 mm, abdomen + appendages 32.6 mm.

Female unknown

Variability

The paratype agrees well with the holotype except it has 15/15 postnodals. Its measurements are: Hindwing 22.2 mm, abdomen + appendages 34.5 mm.

Habitat

Both specimens were collected in moderately disturbed rainforest from low foliage along heavily shaded sections of a small (< 5 m wide), shallow (< 50 cm deep) clear-flowing stream that drains into the western edge of Lake Kutubu. Two additional specimens were seen on a nearby stream at slightly higher altitude (~950 m a.s.l.; Fig. 23). This species is known only from the vicinity of the type locality which is located within the Lake Kutubu Wildlife Management Area in Southern Highlands Province, Papua New Guinea.

Differential diagnosis

Thirty species of *Drepanosticta* have been described from New Guinea and its nearby satellite islands (including Misool and the Moluccas), by Selys (1878), Martin (1909), Fraser (1926), Lieftinck (1932, 1938, 1949), Theischinger & Richards (2005, 2014a, b, 2017) and Kovacs et al. (2015). However only three of these, *D. dendrolagina* Lieftinck, 1938, *D. moluccana* Lieftinck, 1938, and *D. obiensis* van Tol, 2007 share with the new species a combination of lack of antehumeral markings (Fig. 2), occiput with transverse ridge not developed laterally into two acute points, posterior lobe of pronotum with lateral extremities short and undeveloped (Fig. 9) and male inferior appendages with medial apical and subapical tooth/elevation (Fig. 10). The latter two species, which are known only from the remote Moluccan islands off western New Guinea (van Tol 2007) can be distinguished from *D. johncanni* sp. nov. (Fig. 1) by their bulkier superior and slimmer inferior anal appendages with markedly smaller medial teeth/elevations. The new species' closest ally is probably *D. dendrolagina*; however this species can be readily distinguished from the new species by having the dorsal surface of abdominal segment 10 blue (Fig. 2) (versus black in *D. johncanni* (Fig. 1)) and by the strongly armed inferior anal appendages (Fig. 10) (versus minimally armed in *johncanni* (Fig. 7)).

***Pseudagrion parafarinicolle* sp. nov.**

Figures 11-13

Material

Holotype: ♂ (SAMA 07-001506), Papua New Guinea, Southern Highlands Province, forest stream adjacent western edge of Lake Kutubu (6.323°S, 143.267°E; 835 m a.s.l.), 08-v-2017, S.J. Richards & P.S. Toko. Deposited in the South Australian Museum.

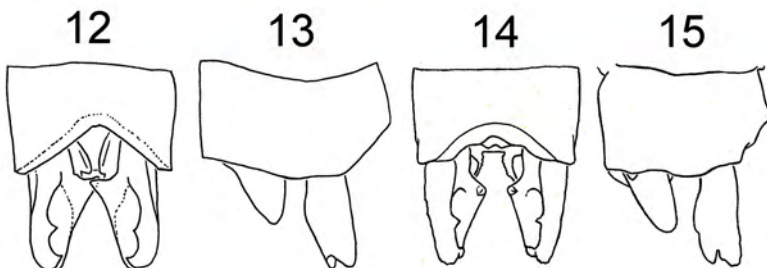
Paratype ♀ (SAMA 07-001507), same data as holotype.

Etymology

The specific name refers to the striking similarity of this species to its apparently closest ally *Pseudagrion farinicolle*.

Diagnosis

A rather large (abdomen 32.6 mm in male, 24.0 mm in female) *Pseudagrion*, male largely black, developing strong pruinosity when mature (Fig. 11), inner lobe of superior anal appendages subtriangular with apex angular and flat (Fig. 12); female largely yellow to brownish yellow, abdomen dorsally almost completely black (Fig. 11).



Figs 11-15. *Pseudagrion* spp: (11-13) *Pseudagrion parafarinicolle* sp. nov.: (11) holotype male and paratype female in copula. Photograph by SJR; (12, 13) holotype male, anal appendages: (12) dorsal; (13) lateral; (14, 15) *Pseudagrion farinicolle*, male, anal appendages: (14) dorsal; (15) lateral.

Holotype – Male (Figures 11-13)

Head – Labium yellow, lobes brownish black; mandible base brownish yellow; remainder of mandibles, labrum, postclypeus, frons and antennae black; anteclypeus pale yellow; top of head yellowish brown with sutures between postocular lobes and vertex, a ring around each lateral ocellus and occipital margin black; genae black and yellow, postgenae largely black, margin along eye brown.

Prothorax – Pronotum black and slightly pruinose, propleura black.

Synthorax – Front and pleura black, largely pruinose; postcoxae and poststernum black. Legs largely black, femora with incomplete narrow yellowish-brown sub-basal ring. Wing membrane hyaline, venation black; postnodals 13/12; pterostigma dark greyish brown, slightly longer than wide, generally overlying less than one cell, proximal border straight, distal border slightly convex, proximal and distal angle approximately 50°.

Abdomen – Almost completely black with only ventral margin of tergites brownish grey. Anal appendages (Figs 12, 13) black in profile; superiors with triangular notch between dorsal and ventral lobe, almost twice as long as inferiors which are apically rounded; in dorsal view dorsal lobe of superiors with apical medially turned hook and with triangular medially directed tooth at about 2/3 length, ventral lobe largely bluish grey, flat, triangular with inner basal corner not particularly pointed and not raised (Fig. 13).

Measurements – Hindwing 21.5 mm, abdomen + appendages 32.6 mm.

Female (Figure 11)

Head – Labium including lobes pale yellowish grey; labrum and clypeus mottled with various shades of brown, base of mandibles, remainder of face and top of head brownish yellow, only antennal flagellum, ring around each lateral ocellus, between vertex and postocular lobes and narrow rim along eye margin black.

Prothorax – Largely brownish yellow, grooves on pronotum black. Processes of posterior lobe approximately parallel to each other, slim, finger-like, distinctly longer than height of posterior lobe at point of attachment.

Synthorax – Largely brownish yellow to greyish yellow; most of collar, antecular ridge and margins of antecular sinus, most of subalar ridge, dorsal margin of metapostepimeron and an almond-shaped spot close to the dorsal end of meso- and metapleural suture black; postcoxae and poststernum pale yellow. Legs including coxae, trochanters, ca half of profemur, basal 3/4 of mesofemur and almost all of metafemur pale to dark brownish yellow; apex, a narrow wedge on outer surface of femora and much of remainder of legs black; much of metatibia brownish yellow to yellowish brown. Wings much as in male, but postnodals 13/11-12 and pterostigma brownish yellow to greyish yellow.

Abdomen – Dorsal and most of lateral surface of S1-S8 shining black, remainder of lateral and ventral surface pale yellow; S2-S5 with thin pale yellow basal line each side of mid-dorsum; intersegmental membrane between S8 and S9 merging into brown and yellow; S9 and S10 dorsally shining black, laterally largely bright yellow. Valves pale yellow; anal appendages and styli black.

Measurements – Hindwing 23.9 mm, abdomen 24.0 mm.

Habitat

This species occurred in the same area of forest as *Drepanosticta johncanni* sp. nov. and the new species described below. However the stream habitat that it occupied was quite different from those species. The types were encountered at a narrow (< 2 m wide) and shallow (<20 cm deep) stream with a silty substrate where it crossed a trail used for accessing the forest to extract timber for the construction of canoes. The forest canopy at this site had been opened by a large treefall and strong sunlight reached the forest floor. The holotype and paratype were in copula in full sunlight on a branch approximately 0.5 m high overhanging the stream. The distribution of *P. parafarinicolle* requires further documentation; it is possible that previous records of *P. farinicolle* in southern Papua New Guinea also refer to this species.

Differential diagnosis

Pseudagrion parafarinicolle can be distinguished from 15 of the 17 *Pseudagrion* species described by Rambur (1842), Brauer (1869), Tillyard (1906), Lieftinck (1932, 1936, 1937, 1949), Polhemus et al. (2008), Gassmann (2011) and Gassmann & Richards (2016), that are known to occur in New Guinea and nearby islands including Misool, the Moluccas, New Britain and Woodlark by having a largely black thorax partly covered with pruinosity (vs yellow-brown or blue with black markings). Only two species known from the region have this colour pattern, *P. farinicolle* Lieftinck, 1932, and *P. fumipennis* Polhemus, Michalski & Richards, 2008, and *P. fumipennis* can be readily distinguished from the new species by its distinctly darkened wing tips. Only *P. farinicolle* shares with *P. parafarinicolle* sp. nov. (Fig. 11) a black pruinose thorax and abdomen and hyaline wing tips, and is probably its closest ally. The male of *P. parafarinicolle* can be distinguished from *P. farinicolle* by the flat triangular ventral lobe of the superior anal appendages (Figs 12, 13) versus ventral lobe of the superior anal appendages with mediobasal angle sharply pointed and raised dorsally (Figs 14, 15). In the only available female of *P. parafarinicolle* the collar appears slightly less strongly developed than in females of *P. farinicolle*, but at the present this is not considered as a diagnostic character.

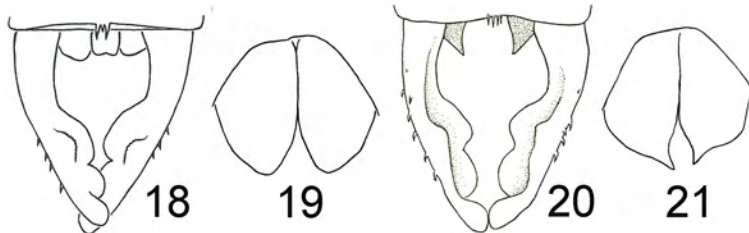
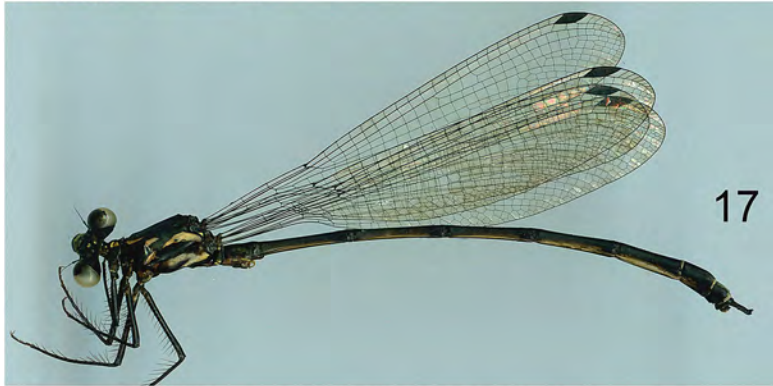
Wahnesia kutubuensis sp. nov.

Figures 16-19

Material

Holotype: ♂ (SAMA 07-001508), Papua New Guinea, Southern Highlands Province, forest stream adjacent western edge of Lake Kutubu (6.323°S, 143.272°E; 950 m a.s.l.), 09-v-2017, S.J. Richards & P.S. Toko. Deposited in the South Australian Museum.

Paratype ♂, Papua New Guinea, Southern Highlands Province, Tigibu Ck at western edge of Lake Kutubu (6.321°S, 143.265°E; 850 m a.s.l.), 08-v-2017, S.J. Richards & P.S. Toko. Deposited in Museum Naturalis, Leiden, Nederland (RMNH).



Figs 16-21. *Wahnesia* spp., male: (16-19) *Wahnesia kutubuensis* sp. nov., holotype: (16) in life. Photograph by SJR; (17) habitus, lateral; (18, 19) anal appendages: (18) dorsal; (19) inferiors: ventral; (20, 21) *Wahnesia kirbyi*, anal appendages: (20) dorsal, modified from Liefstinck (1935); (21) inferiors: ventral.

Etymology

The specific name refers to the type locality, Lake Kutubu, a feature of great importance to the local Foi people and home to a number of other endemic animal species.

Diagnosis

A medium-sized damselfly that can be distinguished from all congeners by the following combination of characters: largely black, including inner surface of femora and tibiae, pale markings restricted to moderately well-defined small yellowish markings on head and thorax (Figs 16, 17) and on abdomen; dorsum of S10 of male with three spines near posterior rim and apex of inferior anal appendages rounded (Figs 18, 19).

Holotype – Male (Figures 16-19)

Head – Labium including lobes pale brownish yellow to blackish brown; labrum, base of mandibles, anteclypeus and small areas on anterior frons between antennal base and eye greenish yellow; margins of labrum and posterior margin of postclypeus and most of mandibles darkened to blackened; postclypeus otherwise marbled black and yellowish green; remainder of frons, antennae, vertex, postocular lobes and occipital area largely black, only extreme margin of antennal base and scape narrowly pale greenish and a patch lateral to lateral ocellus and a smaller one posterior to it along occipital margin pale brownish yellow; genae and postgenae variably brown to black.

Prothorax – Pronotum largely brown to black, anterior and posterior lobe with small yellowish lateral patch, median lobe with much larger yellowish lateral patch; prothoracic pleura shining black.

Synthorax – Largely shining black with yellow marks and patches as follows: narrow wedge-shaped antehumeral stripes about 1/3 as long as mesanepisternum; postero-ventral corner of mesokatepisternum; a small patch on mesepimeron just anterior to metathoracic spiracle; a large curved wedge-shaped patch across approximately dorsal half of interpleural suture and a much smaller patch across part of ventral half of interpleural suture including anterior end of metathoracic spiracle, and a large approximately y-shaped patch across most of metepimeron. Postcoxae and poststernum blackish brown. Legs with coxae and trochanters greyish brown merging into yellow, particularly along base and posterior margin; remainder brown to black, lightened up slightly to significantly at base and near apex of femora and tibiae and very narrowly at about mid-length of metafemur. Wings with membrane hyaline and venation brownish black; postnodals 21/21; pterostigma with proximal and distal angle narrow (less than 45°), overlying approximately 2 cells, black; up to two rows of cells between anal vein and wing margin in Fw, up to three rows in Hw.

Abdomen – Largely shining black. S1 with large yellow dorsal patch and 2 smaller ill-defined yellowish lateral spots; S2 almost greenish black with 2 ill-defined lateral patches along ventral edge; S3-S8 with the dorsal shining black merging toward ventral for much of their length into greyish brown to brownish yellow; Intersegmental membrane between S7 and S8, S8 and S9 and S9 and S10 bright pale yellow. S9 dorsally broadly yellow; S10 black, posterior margin bearing three spines arranged

close together, middle spine slightly shorter than laterals. Anal appendages black; superiors evenly convergent with apex rounded, two mesal lobes, the basal markedly larger than the subapical; inferiors broadly oval.

Measurements – Hindwing 30.8 mm; abdomen + appendages 37.2 mm.

Female unknown.

Variability

The paratype closely agrees with the holotype but, being the less mature specimen, its colouration is generally somewhat lighter. In particular the postclypeus lacks black, there is a stronger trend to a narrow pale median patch/line on the inner surface of the femora and the pterostigma is brown. There are 22-23/20-21 postnodals. Measurements: Hindwing 29.6 mm; abdomen 35.5 mm.

Habitat

This species occurred in microsympatry with *Drepanosticta johncanni*, described above. It was found on low foliage in dappled sun and shade along sections of small (< 5 m wide), shallow (< 50 cm deep) clear-flowing streams (Figure 23) that drain into the western edge of Lake Kutubu. This species is known only from the vicinity of the type locality which is located within the Lake Kutubu Wildlife Management Area in Southern Highlands Province, Papua New Guinea.

Differential diagnosis

We include this species in the genus *Wahnesia* on the basis of dorsum of S10 (of male) bearing (a bundle of) three spines near posterior rim following the generic definitions of argiolestid damselflies provided by Kalkman and Theischinger (2013). *Wahnesia kutubuensis* sp. nov. can be distinguished from all 12 species included in the genus and described by Förster (1900), Lieftinck (1949, 1956) and Kalkman (2008), except *W. kirbyi* by not having S8 and S9 broadly expanded laterally and by the posterior margin of S10 not bearing a single or bifid raised central spine. It can be distinguished from *W. kirbyi* by smaller and better-defined pale pattern elements on the synthoracic pleura, almost completely dark legs (including inner surface of femora and tibiae) (Figs 16, 17), the posterior margin of S10 bearing only three central spines (Fig. 18) and apically well-rounded inferior anal appendages (Figs 18, 19) versus larger, less well-defined pale pattern elements on the synthoracic pleura, the inner surface of femora and tibiae being bright yellow (Fig. 22), the posterior margin of S10 bearing a tightly-packed cluster of spines and the inferior anal appendages apically distinctly pointed (Figs 20, 21).

Acknowledgements

Field work was approved by the Lake Kutubu WMA Management Committee and supported by ExxonMobil PNG Limited, and we are particularly grateful to Jane Mogina, Anita Mosby, Rebekah Ilave, Laura Ann Dresser and the Moro EMPNG team

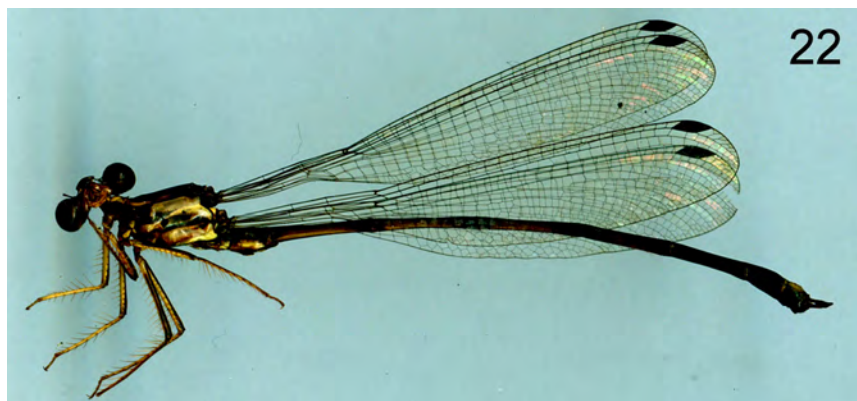


Fig. 22. *Wahnesia kirbyi*, paratype male, habitus, lateral.



Fig. 23. Habitat of *Drepanosticta johncanni* sp. nov. and *Wahnesia kutubuensis* sp. nov. near the western edge of Lake Kutubu, 9.v.2017. Photograph by SJR.

for their assistance. We also express our gratitude to The PNG National Research Institute who assisted with SJR's Research Visa, and the PNG Conservation and Environment Protection Authority for approving export of specimens. Peter Hudson at the South Australian Museum kindly provided registration numbers for the type

material and Wendy van Bohemen, Max Caspers and Vincent Kalkman provided loans of type material in their care. GT is grateful for ongoing support by the management of the NSW Office of Environment & Heritage and the Australian Museum.

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- idae, Agrionidae and Libellulidae (Genera *Podopteryx*, *Argiolestes*, *Papuagrion*, *Teinobasis*, *Huonia*, *Synthemis*, and *Procordulia*). *Nova Guinea* 17: 203–300.
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