

## TELOSTICTA, A NEW DAMSELFLY GENUS FROM BORNEO AND PALAWAN (ODONATA: ZYGOPTERA: PLATYSTICTIDAE)

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**ABSTRACT.** — *Telosticta* new genus is described from Borneo and Palawan, with genotype *Protosticta feronia* Lieftinck. Other previously named species transferred to *Telosticta* are *Drepanosticta dupophila* Lieftinck, *Protosticta paruasia* van Tol, and *P. tubau* Dow. Eleven new species are described: *T. belalangensis*, *T. berawan*, *T. bidayuh*, *T. janeus*, *T. dayak*, *T. gading*, *T. kajang*, *T. longigaster*, *T. santubong*, *T. serapi*, and *T. ulubaram*. The relationships of *Telosticta* within the Platystictidae are discussed.

**KEY WORDS.** — Odonata, Zygoptera, Platystictidae, *Telosticta*, Borneo, Palawan

### INTRODUCTION

The platystictid genera *Protosticta* Selys and *Drepanosticta* Laidlaw include respectively 41 and 126 species (Schorr & Paulson, 2012; van Tol, 2005b) distributed throughout tropical Asia, with members of the latter genus reaching New Guinea and New Britain (van Tol et al., 2009). Most species inhabit forest streams and everywhere are noted for their high levels of endemism, with, for example, no species shared between any of the major land areas of Sundaland. The genus *Drepanosticta* was erected by Laidlaw (1917) on the basis of a minute venational difference, the presence of an anal bridge vein, absent in *Protosticta*. This character has since proved highly problematical. Occasionally specimens exhibit the *Protosticta* condition on one side and the *Drepanosticta* condition on the other (Dow & Orr, unpublished data). Moreover the distinction is obviously artificial, as it separates species that are clearly closely related on the basis of structural characters. The inadequacies and inconsistencies of the current venation based classification of the Old World Platystictidae have been discussed by several authors (e.g., Orr, 2003; van Tol et al., 2009; Dow, 2010). It seems clear that with further taxonomic research many species will be transferred to new genera, so that both *Protosticta* sensu stricto and *Drepanosticta* sensu stricto will have much reduced distributions and numbers of species.

This problem first became evident when Lieftinck (1933), describing two new species of Platystictidae from northwest Kalimantan, *Protosticta feronia* and *Drepanosticta dupophila*,

noted that they were very similar to each other, but needed to be placed in separate genera because of the minute differences in wing venation. In the last 25 years, fieldwork in Brunei, Sabah, and Sarawak conducted by various workers has yielded an abundance of specimens of Platystictidae. Many of them, particularly those from Brunei and Sarawak, have been found to be new species that are closely related to the two aforementioned species named by Lieftinck (1933; e.g., Orr, 2001, 2003; Dow & Reels, 2008, 2009, 2010; van Tol et al., 2009; Dow, 2010; Dow & Ngiam, 2012). To date only one of these, *Protosticta tubau* Dow, 2010, has been described from Borneo. Recently, van Tol (2005a) described a new species from Palawan, *Drepanosticta paruasia*, and also noted its affinity to *D. dupophila* and *P. feronia*. As with *P. feronia* and *D. dupophila*, the two recently described species mentioned above were placed in *Protosticta* and *Drepanosticta* respectively, based on the presence or absence of the anal bridge vein which has traditionally been used to separate the genera (e.g., Laidlaw, 1917; Fraser, 1933). *P. feronia*, *P. tubau*, *D. dupophila*, and *D. paruasia* are clearly more closely related to each other than to any other members of the family and should be placed in the one genus. In particular they share a distinctive and almost unique character in the form of the posterior lobe of the male pronotum, and a number of other diagnostic characters, namely: head with narrow vertex, synthorax with antehumeral markings, penis of distinctive form and anal appendages conforming to the same general plan. Clearly the present classification is untenable, as noted by Orr (2003), who informally included *P. feronia* and *D. dupophila* in his Group 1 of the Bornean

Platystictidae. Here we describe *Telosticta* new genus to accommodate *P. feronia* and its allies.

At present 15 species are included in *Telosticta*, of which 11 are described here. Of these, 14 occur in Borneo, and one in Palawan. Within the genus some species groups can be recognised: the *dupophila*-group consisting of four species from western Borneo; the *feronia*-group consisting of seven species from northwest Kalimantan, Sarawak, Brunei, and Palawan; the *tubau*-group consisting of one highly atypical species. The affinities of the three remaining species are uncertain and are not assigned to any group(s) at present. The *feronia*-group is further subdivided into the *feronia*-subgroup, consisting of two species from western Borneo, and the *dayak*-subgroup, containing the remaining species. It should be noted that, because the species of the *dupophila*-group and those of the *feronia*-group and -subgroup occur sympatrically, for the convenience of the user they are treated together in the species accounts and illustrations following the key to species below.

## MATERIAL AND METHODS

All material collected by the first author and his associates, treated with acetone, and initially assimilated into the first author's collection, has a unique reference code; this code is only stated for type material. Material collected by the same, but placed in ethanol for DNA analysis is deposited in RMNH (see below), where it receives an RMNH number; this number is stated for type material if available at time of publication. In lists of specimens, the authors' names are initialised as RAD and AGO, as are those of other collectors who appear more than once: Chee Yen Choong (CYC), Graham T. Reels (GTR), Luke Southwell (LS), Mibang Kibi (MK), Ollince Tateh (OT), and Stephen Butler (SB).

Codes for institutional repositories of specimens are as follows:

BMNH – Natural History Museum, London  
RMNH – National Museum of Natural History Naturalis, Leiden, the Netherlands  
ZRC – Raffles Museum of Biodiversity Research, Singapore

## TAXONOMY

### *Telosticta*, new genus

**Type species.** — *Protosticta feronia* Lieftinck, 1933 by present designation

**Diagnosis.** — A genus of slimly built platystictids ranging in body length from medium to long. Ground colour generally dark, always with pale antehumeral markings and some pale markings on at least one of abdominal segments 8–10. Males are readily distinguished from all other members of the Platystictidae by the combination of a narrow vertex, ventrally projecting, flattened lateral processes on the posterior pronotal

lobe, pale antehumeral markings and terminal segment of penis with a well-developed convex tongue-like structure between the horns. The superior anal appendages are typically down-turned in apical one half to one third, with a process or bulbous swelling arising dorsally and interiorly from the basal one-quarter to one half, and another, often poorly developed, arising dorsally at the down-turn. Inferior anal appendage with an internal subapical spine and its apical part modified into a dorsal-ventrally flattened structure that is typically upwardly concave and scoop-like in appearance.

**Etymology.** — *Telosticta* a feminine noun, compounded from the Greek *τελος*, meaning toll, named for Jan van Tol, whose surname originates from the Dutch word of the same meaning, in honour of his contributions to our knowledge of the Platystictidae, and the suffix *-sticta*, a common generic ending in the family.

**Description.** — Head (e.g., Fig. 1A): mostly black, with much of the labrum, the anteclypeus and part of the mandible bases pale. The dorsum of the head is narrow, with the ratio of the width of a compound eye measured at the narrowest part of the vertex to the distance between compound eyes at the same point typically around 9/10 (ca. 0.85–0.96 in specimens measured, including at least one example of each species included in the genus). The transverse anterior carina is typically well developed, with its lateral extremities angulated and often prominent.

Thorax: prothorax typically mostly pale, darker to the rear of the propleuron and the middle pronotal lobe. The posterior pronotal lobe is black; its hind margin is normally simple in both sexes. In the male the posterior lobe bears at each side a flattened lateral process, the “remarkable pending appendages of the posterior lobe of the pronotum” of van Tol (2005), directed downwards beside the rear margin of the propleuron and typically expanding slightly from its origin to the tip, which is normally rounded (e.g., Figs. 3, 9, 17A, B). The lateral process is variably developed in females even of the same species, and sometimes absent in that sex. The synthorax (e.g., Figs. 1B, 4, 10, 16A, B) bears pale antehumeral markings on the mesepisternum, which is otherwise bronzy black. The mesepimeron is typically black and the metepisternum is dark with a large pale marking. The metepimeron is largely or entirely pale and the venter of the synthorax is pale. The legs are mostly pale. The wings are falcate, with the arculus distal to Ax2 and its sectors not separated until some distance from origin. The quadrilateral is long and narrow and nearly rectangular. The anal bridge (ab) is variably present, in some species it is absent (e.g., traditional *Protosticta* venation), in others present (e.g., traditional *Drepanosticta* venation), and while each species typically has ab either present or absent, it is not uncommon to find individuals which have the other form in from one to all four wings. In one species (*T. belalongensis*) even the anal crossing (ac) is absent or vestigial in three wings of the single specimen available. When ab is present ac typically arises at ca the level of Ax2, when ab is absent ac typically arises proximal to Ax2, but closer to Ax2 than Ax1. R<sub>4</sub> arises at or distal to the subnodus, IR<sub>3</sub> well distal

to the subnodus. The pterostigma typically covers slightly more than one underlying cell, and is dark brown or black in mature individuals, often with a pale border.

**Abdomen:** Slender, mostly dark dorsally with variably developed basal annuli on S2–7. Always with some pale markings on at least one of S8–9. **Penis:** with a row of prominent setae on shaft. Internal fold well developed. Terminal part with a pair of long distal horns, curved downwards and then upwards at tip; between these horns is a prominent convex tongue like structure (e.g., Fig. 1C). **Male anal appendages** (e.g., Figs. 2, 6–8, 12–14, 17C, D, 18A–D) with short setae over much of their surfaces, not mentioned further unless of diagnostic importance and normally omitted from the illustrations. Superior appendage moderately broad at base, becoming narrower shortly afterwards, in lateral view with the upper margin running straight until turning down at one-half to two-thirds length; lower margin bent sharply upwards shortly after base, then running straight to the down-turn, giving an arched appearance to the whole. There is a structure visible in dorsal and sometimes lateral view, situated from one-quarter to slightly less than half the length in dorsal view, arising from the interior of the appendage, and referred to as the interior projection of the superior appendage hereafter. The interior projection is usually strongly developed, and variously shaped, from a mere bump or ridge to a simple spur or a blade like structure with dorsal and/or ventral spurs. At or around the level of the down-turn there is a dorsal interior structure, referred to as the

dorsal projection of the superior appendage, usually poorly developed and visible as a slight bulge in dorsal view and sometimes as a distinct angled peak in lateral view, but usually best seen from a interior view. However the dorsal projection is better developed in a few species. The apical section from down-turn to tip is typically expanded and variously shaped. In *T. tubau* the interior projection is absent and the dorsal projection is just a slight bump placed somewhat interiorly and not visible in the illustrations in Dow (2010).

Inferior appendage broad at base but immediately tapering, with a complex membranous articulation close to the base, after which cylindrical (this part referred to here as the stem) until about the level of the down-turn of the superior appendage, where dorsal-ventrally flattened and expanded laterally to a greater or lesser degree in most species, this section usually hollowed dorsally to form a scoop-like structure, and referred to here as the scoop of the inferior appendage. The concave surface of the scoop typically has a clump of setae at its base (not shown in illustrations) and normally faces upwards, but in some species it is twisted so that it faces outward or inwards in its terminal part. A spine, directed inwardly and typically at least slightly upwards and rearwards, originates dorsal-interiorly behind the scoop, and is often continued dorsally as a ridge behind it.

**Female anal appendages and ovipositor** (Fig. 1D): Superior appendages shorter than S10, approximately triangular in profile. Inferior appendages short, rounded and unremarkable.

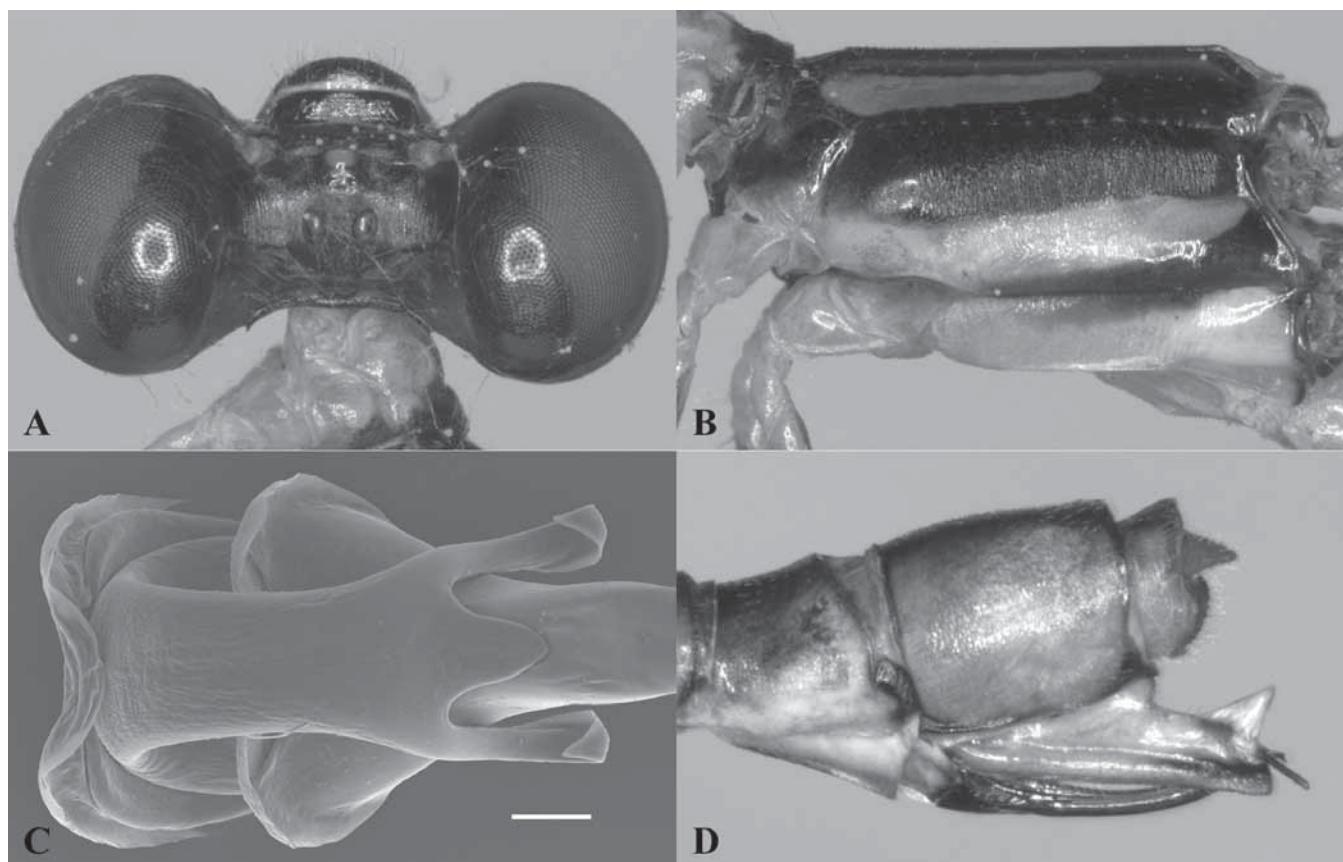


Fig. 1. A, head of *T. feronia* holotype; B, lateral view of synthorax of *T. feronia* holotype; C, penis of *T. dupophila* (SAR06\_PST135), scale bar = 50  $\mu$ m; D, anal appendages and ovipositor of *T. serapi* paratype female (SAR06\_PST61).

Ovipositor typically long, extending well beyond the tips of the superior anal appendages.

**Remarks.** — The nearest allies of *Telosticta* spp. appear to be three Bornean species: *Drepanosticta actaeon* Laidlaw, *D. rufostigma* (Selys) (which are clearly closely related to each other), and *D. dulitensis* Kimmins. None of these species bear the distinctive lateral processes on the pronotal hind lobe that are present in *Telosticta*, or a tongue-like structure between the horns of the terminal segment of the penis. *D. actaeon* and *D. rufostigma* also lack antehumeral marks and dorsal blue markings on the terminal abdominal segments; these characters are variably present in *D. dulitensis*. *D. actaeon* and *D. dulitensis* have a significantly wider vertex than *Telosticta*, but *D. rufostigma* is very variable in this character and overlaps the range seen in *Telosticta*. There are similarities in the general form of the anal appendages of *Telosticta* and *D. actaeon*, *D. dulitensis*, and *D. rufostigma*, but the scoop of the inferior appendage is modified into a strap like structure in these species (a condition approached in the inferior appendages of *T. gading*). In *D. dulitensis* the interior projection of the superior appendage is present, in a basal position, and there is also a dorsal projection. In *D. actaeon* and *D. rufostigma* a dorsal spine is present on the superior appendage, in the position of the interior projection of *Telosticta* and *D. dulitensis*; this is likely to be homologous with the interior projection of *Telosticta*. There is also a small dorsal projection close to the tip in *D. actaeon* and *D. rufostigma*. Orr (2003: 69) included *D. dulitensis* with the species here placed in *Telosticta* in his group 1 of the Bornean Platystictidae; it certainly appears to be closest relative of *Telosticta* but is distinctive enough to merit a genus of its own which would be the sister of *Telosticta*. *D. actaeon* and *D. rufostigma* form a separate clade.

The lateral processes of the posterior pronotal lobe in *Telosticta* are almost unique in the Platystictidae. Some

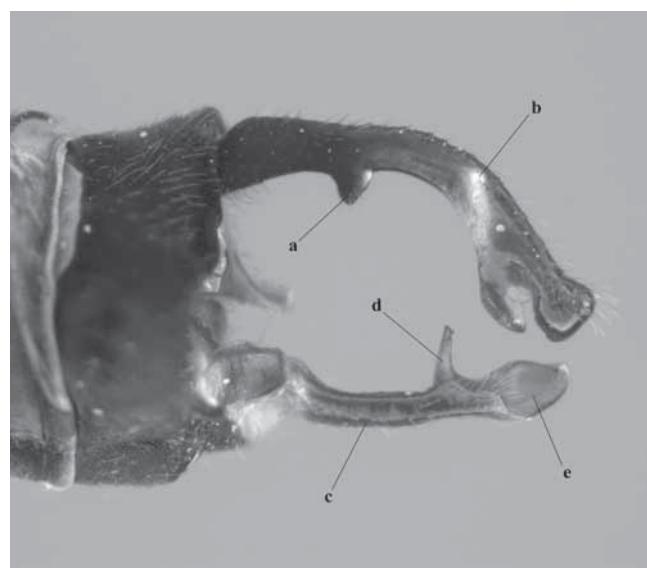


Fig. 2. Dorsal lateral view of male anal appendages of *T. dayak* paratype (SAR05\_PST17), right superior and left inferior appendage removed: a – interior projection; b – dorsal projection; c – stem; d – spine; e – scoop.

other species, for instance *Drepanosticta sbong* Dow and *D. hamadryas* Laidlaw and its allies from Peninsular Malaysia, have the lateral extremities of the posterior pronotal lobe produced into short downwards-directed processes. In *D. sbong* these processes are directed rearwards and slightly outwards, different from any species placed in *Telosticta*; *D. sbong* differs considerably in many other characters and is not likely to be closely related to *Telosticta*. In *D. hamadryas* and its allies, the lateral processes are very small and it is questionable if they are homologous to those of *Telosticta*.

The tongue-like structure, or at least a slight convexity between the horns of the head of the penis, is present in some other species groups within the Sundaland clade, for instance in *D. barbatula* Lieftinck and its allies, where it is very poorly developed. *Drepanosticta elongata* Wilson & Reels, 2001 has a very long tongue-like structure in the same position as *Telosticta* (Wilson & Reels, 2001: Figs. 52, 53).

There are similarities in the anal appendages of *Telosticta* with not just *D. actaeon*, *D. dulitensis*, and *D. rufostigma*, but many other species occurring in Sundaland and further afield. Spines or tubercles likely to be homologous to the interior or dorsal projections of *Telosticta* are present on many species. The general plan of the inferior anal appendages, with an articulated basal area, narrow stem and sub apical dorsal-internal spine followed by a modified apical section is repeated in many species, including species from China (*D. elongata*) and the Philippines (*Drepanosticta lestooides* (Brauer)). This form of anal appendages differs from that in species such as *Protosticta foersteri* Laidlaw from Peninsular Malaysia and its allies from further north, or *Drepanosticta forficula* Kimmins from Borneo, or most species from the Philippines and further south and east.

In the molecular phylogenies of the Platystictidae presented in van Tol et al. (2009) the one species included that is here placed in *Telosticta* (*Protosticta* aff. *feronia*, = *T. dayak*, new species) forms a monophyletic group with *D. rufostigma* and *D. lestooides*; *D. actaeon* and *D. dulitensis* were not included in these results. It appears likely that *Telosticta* falls together with a number of other species in a larger clade, comprising a number of as yet unnamed genera. This group can, for convenience, be called the “Sundaland” clade, although it includes species occurring well beyond Sundaland, and certainly does not include every species occurring in Sundaland. The Sundaland clade can be characterised in terms of similarities in the structure of the anal appendages, and in turn falls within the West Malesian clade of van Tol et al. (2009). Conversely, *P. foersteri* and its allies fall within the West Malesian clade but not the Sundaland clade, and most Philippine species are outside the West Malesian clade.

Within *Telosticta* provisional species groups can be recognised, here named either after the first described species, or the most widespread species, in each group. The atypical *T. tubau* is considered to form a group of its own, characterised by S10 with long dorsal setae and superior anal appendages without interior projection. The *dupophila*-group consists of four species (*T. dupophila*, *T. gading*, *T.*

*santubong*, and *T. serapi*) from western Borneo, all bearing short to moderate length lateral processes on the posterior pronotal lobe, vein ab typically present, superior anal appendages with a weakly developed dorsal projection and apical part expanded, flattened but not folded and without a notch or cleft in the tip, and inferior appendages with the stem relatively robust and the spine placed dorsally and directed strongly rearwards, so only partially or not at all visible in a ventral view. The *feronia*-group consists of species with moderate to long lateral processes on the posterior pronotal lobe, vein ab present or absent, superior anal appendage with a weakly developed dorsal projection and its apical part expanded, flattened but not strongly folded and with a small notch to a deep cleft in its tip. This group can be further divided into the *feronia*-subgroup (*T. bidayuh* and *T. feronia*) with a western distribution, moderate length lateral

processes and only a small notch in the tip of the superior appendage, and the *dayak*-subgroup (*T. berawan*, *T. dayak*, *T. kajang*, *T. paruati*, and *T. ulubaram*) with a more eastern distribution, long lateral processes and a conspicuous cleft in the tip of the superior appendage. The affinities of the remaining species are unclear, although *T. longigaster* may actually belong with the *feronia*-group and the remaining two species (*T. belalongensis* and *T. janeus*) may form a distinct group.

The anal appendages of *Telosticta* are of major diagnostic importance, but are structurally complex and must be examined very carefully when identifying species. In particular the shape of the terminal parts of both superior and inferior appendages can look very different depending on the angle from which they are viewed. The articulation of

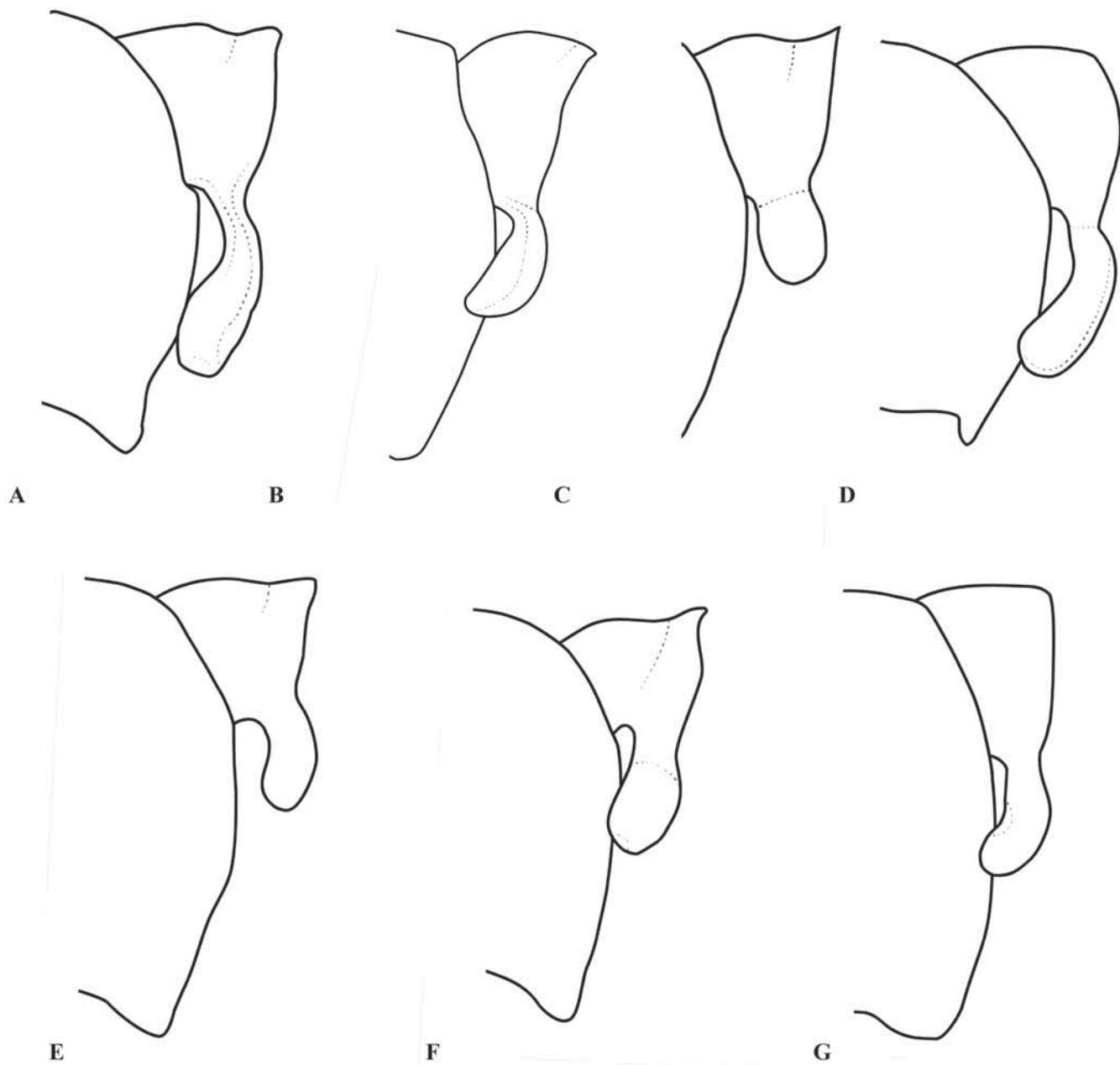


Fig. 3. Western species (holotypes unless noted otherwise), lateral processes of male posterior pronotal lobe: A, *T. bidayuh*; B, *T. dupophila* holotype; C, *T. dupophila* Bako (SAR05\_PST49); D, *T. feronia*; E, *T. gading*; F, *T. santubong*; G, *T. serapi*.

the inferior appendage is also complex, but does not appear to be of diagnostic value within the genus, and is frequently distorted or obscured; for this reason the illustrations give only a general impression of this structure.

Of the 15 named species included in the genus, 12 occur in Sarawak and Brunei. By comparison with Sarawak and Brunei, relatively little sampling of Odonata in habitats suitable for *Telosticta* has been conducted in Kalimantan and Sabah and more species from the genus can certainly be expected from these areas, and from Palawan.

The key below is organised for convenience of use rather than by species groups. Within the *feronia*-group, the *feronia*-subgroup and the *dayak*-subgroup appear to have allopatric distributions, but the *feronia*-subgroup species can occur sympatrically with species from the *dupophila*-group; for this reason all of the western species are treated together in the text following the key and in the illustrations. Similarly some species of the *dayak*-subgroup are known to occur allopatrically with *T. longigaster*, so these species are illustrated together. *T. belalongensis* also occurs allopatrically with *T. longigaster*, but is probably more closely related to *T. janeus* and is illustrated with that species.

### Key to males of *Telosticta*

1. S10 with a clump of long setae dorsally, interior projection of superior appendage absent ..... *T. tubau*
- S10 without a clump of long setae dorsally, interior projection of superior appendage present ..... 2
2. Lateral processes of posterior pronotal lobe longer than half the distance from their origin to the lower margin of the propleuron (Figs. 3A, D, 9, 17A, B) ..... 6
- Lateral processes of posterior pronotal lobe shorter than half the distance from their origin to the lower margin of the propleuron (Fig. 3B, C, E, F) ..... 3
3. Antehumeral stripes longer than half the length of the mesepisternum (Fig. 4E, F). Large species: abdomen 40 mm or more ..... *T. gading*
- Antehumeral stripes clearly less than half of the length of the mesepisternum (Fig. 4B, C, G, H). Smaller species: abdomen less than 40 mm ..... 4
4. S8 black dorsally, superior appendage with interior projection barely developed but with a conspicuous clump of long setae originating on and around the projection (Fig. 6E) ..... *T. santubong*
- S8 with at least some blue dorsally, superior appendages with the interior projection better developed but without a clump of long setae originating on and around the projection (Fig. 6B, F) ..... 5
5. Superior appendage with interior projection as in Fig. 6F, in lateral view abruptly down-turned apically at level of dorsal projection (Fig. 7F) ..... *T. serapi*
- Superior appendage with interior projection as in Fig. 6B, in lateral view only slightly down-turned apically (Fig. 7B) ..... *T. dupophila*
6. Interior projection of superior appendage nearly as long as the distance from the margin of S10 to the base of the projection (Fig. 12D) ..... *T. paruasia*
- Interior projection of superior appendage much shorter than the distance from the margin of S10 to the base of the projection ..... 7
7. Tip of superior appendage with a conspicuous deep cleft or excision in lateral view (e.g., Fig. 13A–E) ..... 8
- Tip of superior appendage variously shaped but without such a cleft or excision (Figs. 13F, 18C, D), or at most a small notch, difficult to see from most angles (Fig. 7A, C) ..... 11
8. Lower arm of the cleft in end of superior appendage clearly shorter than upper arm in normal lateral view (Fig. 13A, D, E) ..... 9
- Lower arm of the cleft of superior appendage ca same length as upper arm in normal lateral view (Figs. 13B, C)... *T. dayak*
9. Arms of tip of superior appendage protruding interiorly, and continued as prominent ridges above the cleft, forming a deep groove between them, clearly visible in dorsal view (Fig. 12E) ..... *T. ulubaram*
- Arms of tip of superior appendage only weakly expanded interiorly, so that only a shallow or no groove is visible in dorsal view (Fig. 12A, C) ..... 10
10. Pale dorsal marks on S8 and S9 (Fig. 11D), cleft in tip of superior anal appendage 'V' shaped (Fig. 13D) ..... *T. kajang*
- Pale dorsal marks only on S8 (Fig. 11A), cleft in tip of superior anal appendage 'U' shaped (Fig. 13A) ..... *T. berawan*
11. Superior anal appendages with dorsal projection well developed and prominent in either lateral (Fig. 13F), or dorsal (Fig. 18A) view ..... 12
- Superior anal appendage appendages with dorsal projection small and inconspicuous ..... 13
12. Superior appendage conspicuously expanded from ca half length in both dorsal and lateral views (Figs. 12F, 13F), the dorsal projection large and directed dorsally, clearly visible in lateral view (Fig. 12F) ..... *T. longigaster*
- Superior appendage only expanded in apical ca one quarter to one third (depending upon angle viewed from), the dorsal projection inwardly directed (Fig. 18A), not visible in lateral view (Fig. 18C) ..... *T. belalongensis*
13. Tip of superior appendage flattened, expanded and strongly folded over on its self to almost form a tube (Fig. 18D) ..... *T. janeus*
- Tip of superior appendage flattened laterally, but not strongly folded ..... 14
14. Interior projection of superior appendage placed at the point where the basal part of the appendage contracts (Fig. 6C), labrum only blue narrowly at base, blue markings on S8 and S9 dorsally (Fig. 5C) ..... *T. feronia*
- Interior projection of superior appendage placed well distal to the point where the basal part of the appendage contracts (Fig. 6A), labrum mostly blue, blue marking only on S9 dorsally (Fig. 5A) ..... *T. bidayuh*

### *T. tubau*-group

#### *Telosticta tubau* (Dow, 2010), new combination (Fig. 22)

*Protosticta tubau* Dow, 2010: 66–67, Figs. 8–12  
*Protosticta* ?*tubau* – Dow & Ngiam, 2012: 11

**Material examined.** — Holotype: male (SAR09\_10\_PST1), Malaysia, Sarawak, Bintulu Division, Sarawak Planted Forest Project (SPFP), Tubau area, in disturbed forest in block E2K, ca 156 m, 16 Aug. 2009, coll. RAD, in RMNH.

Others: male, Malaysia, Sarawak, Kapit Division, Hose Mountains, Gunung Kajang area, at side of stream 900–1000 m in disturbed forest, 6 Apr. 2011, coll. RAD.

**Remarks.** — This species meets the definition of *Telosticta*, but judging by the absence of the interior projection on the superior anal appendage it may be only remotely related to the other known species of the genus. The clump of long setae on abdominal S10 of this species are remarkable (Dow, 2010: Fig. 10), but as short setae typically occur on the abdomen and anal appendages of the Platystictidae, perhaps it should not be too surprising that they become highly modified in some species.

The male from the Hose Mountains is teneral and very shrivelled. It bears the distinctive patch of setae on the dorsum of S10 found on the holotype of *T. tubau*, but the condition of the appendages and other potentially diagnostic features of the specimen are such that it is not possible to determine if it is *T. tubau* or some closely related but un-described species. The female of this species is unknown.

***T. dupophila*-group; *T. feronia*-group: *T. feronia*-subgroup**

***Telosticta bidayuh*, new species**

(Figs. 3A, 4A, 5A, G, 6A, 7A, 8A, 19)

*Protosticta feronia* — Lieftinck, 1954: 31 (part); Orr, 2003: 38, 69 (part); Donnelly, 1997: 124, 126

*Protosticta* sp. cf. *feronia* — Dow & Reels, 2010: 15, 18

**Material examined.** — Holotype: male (SAR06\_PST16), Malaysia, Sarawak, Kuching division, near Indonesian border, Annah Rais, small high gradient stream in highly disturbed forest, 26 Jan.2006, coll. RAD, to be deposited in RMNH.

Paratypes (all from Sarawak, all from Kuching Division and all currently in coll. RAD unless otherwise noted, examples to be deposited in BMNH and ZRC): male (SAR06\_PST97), location as holotype, 26 Jan.2006; 2 males (SAR07\_8\_PST245–246), Gunung Singgai, small forest stream, ca 250 m, 2 Oct.2008; 4 males (SAR09\_10\_PST365, 378–380), Kubah National Park, stream at ca 650–700 m on Gunung Serapi, 3 Jun.2010; male (SAR11\_12\_PST138), same location, 3 Sep.2011; male (SAR05\_PST79), same national park, small streams on Gunung Serapi below 500 m, 13 Apr.2005; female (SAR07\_8\_PST348), same location, 3 Oct.2008; 2 males (SAR09\_10\_PST39–40), female (SAR09\_10\_PST41), same location, 13 Jul.2009; male (SAR09\_10\_PST54), same national park, small stream near Main Trail, 28 Oct.2009; female (SAR06\_PST9), same national park, Waterfall Trail, apparently ovipositing into the mid-rib of a leaf growing from a dripping wet cliff face, 14 Apr.2006; male (in ethanol, RMNH\_INS\_500006), same location, 21 Aug.2008; male, female (both teneral, SAR09\_10\_PST52–53), same area, main stream above waterfall, 16 Sep.2009; male (SAR07\_8\_PST115), Kubah National Park, Belian Trail, small high gradient forest stream, ca 80 m, 29 Nov.2007; male (SAR07\_8\_PST302), same location, 15 Sep.2008; 2 males (SAR09\_10\_PST389–390), same location, 25 Apr.2010; male (SAR11\_12\_PST137), Semenggoh Nature Reserve, small stream in arboretum, 7 Oct.2011; male (JvT 26584), Samarahan division, Serian area, Tapuh, 4–9 Jul.1958, coll. T.C. Maa, in RMNH; male (JvT 28069), no location information apart from “Sarawak”, 30 Sep.1950, coll. M. A. Lieftinck, in RMNH.

**Diagnosis.** — The male of *T. bidayuh* is distinguished from all other species of *Telosticta* except *T. feronia* by the combination of moderate length antehumeral stripes and long lateral pronotal processes and superior appendages with poorly developed dorsal projections and a flattened but not strongly folded apical part with at most a small notch in the tip as seen in normal lateral view. It is distinguished from *T. feronia* by the markings of the labrum and terminal abdominal segments and by the position of the internal projection of the superior anal appendage, placed at the point where the basal part of the appendage contracts in *T. feronia* but well distal to this point in *T. bidayuh*.

**Etymology.** — *bidayuh*, a noun in apposition. Named for the Bidayuh people; the known range of the species falls within the Bidayuh heartland.

**Description of holotype male.** — Head: Labium pale. Basal 3/4 of labrum blue, black along free margin. Anteclypeus blue, postclypeus shining black. Mandible bases blue in corner by clypeus, black below. Vertex and frons bronzy black, occiput shining black. Ratio of width of compound eye to width of vertex measured at level of lateral ocelli slightly over 9/10. Transverse occipital carina with lateral extremities angulated and prominent. Ocelli yellowish. Antenna with scape pale yellowish, remainder missing.

Thorax: Prothorax, largely pale cream except to rear of propleuron where there are irregular dark markings, a few brown patches at rear of middle pronotal lobe and whole posterior pronotal lobe, where black, becoming dark greyish white on lateral process, which is of moderate length (Fig. 3A) with the tip well above the level of the lower margin of the propleuron. Synthorax: Mesepisternum bronzy black, with a pair of blue antehumeral stripes, occupying ca 2/3 of the length (Fig. 4A). Antealar triangles blue. Mesepimeron bronzy black. Metepisternum largely occupied by a pale band, becoming blue towards wing bases, with a bronzy black wedge below, this extending from the wing bases to just before the spiracle. Metepimeron almost entirely pale. Venter of synthorax pale. Legs: each with coxa and trochanter cream, femur cream with dark stripe on extensor surface and some obscure dark markings at side, with obscure grey markings, black above tibia. Tibia black immediately below femur, then pale, black just above tarsus, which is pale with some black areas and brown claws. Wings: 13 Px in Fw, 12 Px in Hw. Vein ab absent. Arculus slightly distal to Ax2. R<sub>4</sub> arising at or distal to subnodus, IR<sub>3</sub> joined to it by a short stalk. Pterostigma with costal side slightly shorter than anal side, dark brown with white border, covering slightly more than one underlying cell.

Abdomen: Largely pale brown, darkening to rear. S1 whitish, brown behind posterior carina and narrowly before it. S2 with a pale basal annulus, just divided dorsally, laterally this extending to the posterior carina as a pale wedge, otherwise brown. S3–6 brown above, pale laterally with a well defined boundary between the two shades on S3–4, becoming less clear after this. A narrow pale basal annulus, narrowly interrupted dorsally on S3 but complete on S4–6,

this continued narrowly as a pale stripe along the lower margin of each segment, becoming indistinct apically. S7 similar but black dorsally, with the basal annulus broadly interrupted dorsally. S8–10 black with a pale blue dorsal bilobed marking on S8, this extending laterally at the segment base, becoming cream coloured halfway down the side and continued narrowly along the lower margin of the tergite for the length of the segment (Fig. 5A, G). Anal appendages (Figs. 6A, 7A, 8A) largely brown. Superior appendage slightly less than 2.5 times the length of S10, with interior projection at slightly less than half length, directed inwards at base so just visible in lateral view and then upwards with a sharp tip. Dorsal projection a small but well defined rounded knob directed inwards and slightly upwards (Fig. 6A). Expanded dorsal-ventrally in distal 1/3, with a notch at tip, difficult to see in normal lateral view. Inferior appendage ca same length as superior, scoop only slightly expanded, in ventral view turning rather abruptly inwards and then straightening in terminal part, where concave surface up and slightly outward, the spine large and directed inwards, upwards and to the rear (Fig. 8A).

Measurements (mm): abdomen without anal appendages 33.5, superior appendage ca 1.25, Hw 18.

**Description of female paratype.**—Based on (SAR06\_PST9); as male except as noted.

Head: blue on labrum with a narrow triangular excision centrally.

Thorax: lateral process of posterior pronotal lobe less pale than in male.

Wings:  $R_4$  arising distal to subnodus in all wings. 12 Px in Fw, 10–11 Px in Hw. Pt brown.

Abdomen: pale basal annulus on S7 broad, not interrupted dorsally. S8 mostly pale blue, S9 dark brown with obscure paler areas basally and laterally. Superior anal appendages shorter than S10. Ovipositor mottled dark brown and cream, long, valves extending well beyond tips of superior anal appendages.

Measurements (mm): Abdomen without anal appendages or ovipositor 31, Hw 19, ovipositor slightly less than 2.

**Variation in paratypes.**—Males: there is some slight variation in the length of the antehumeral stripes, and in the

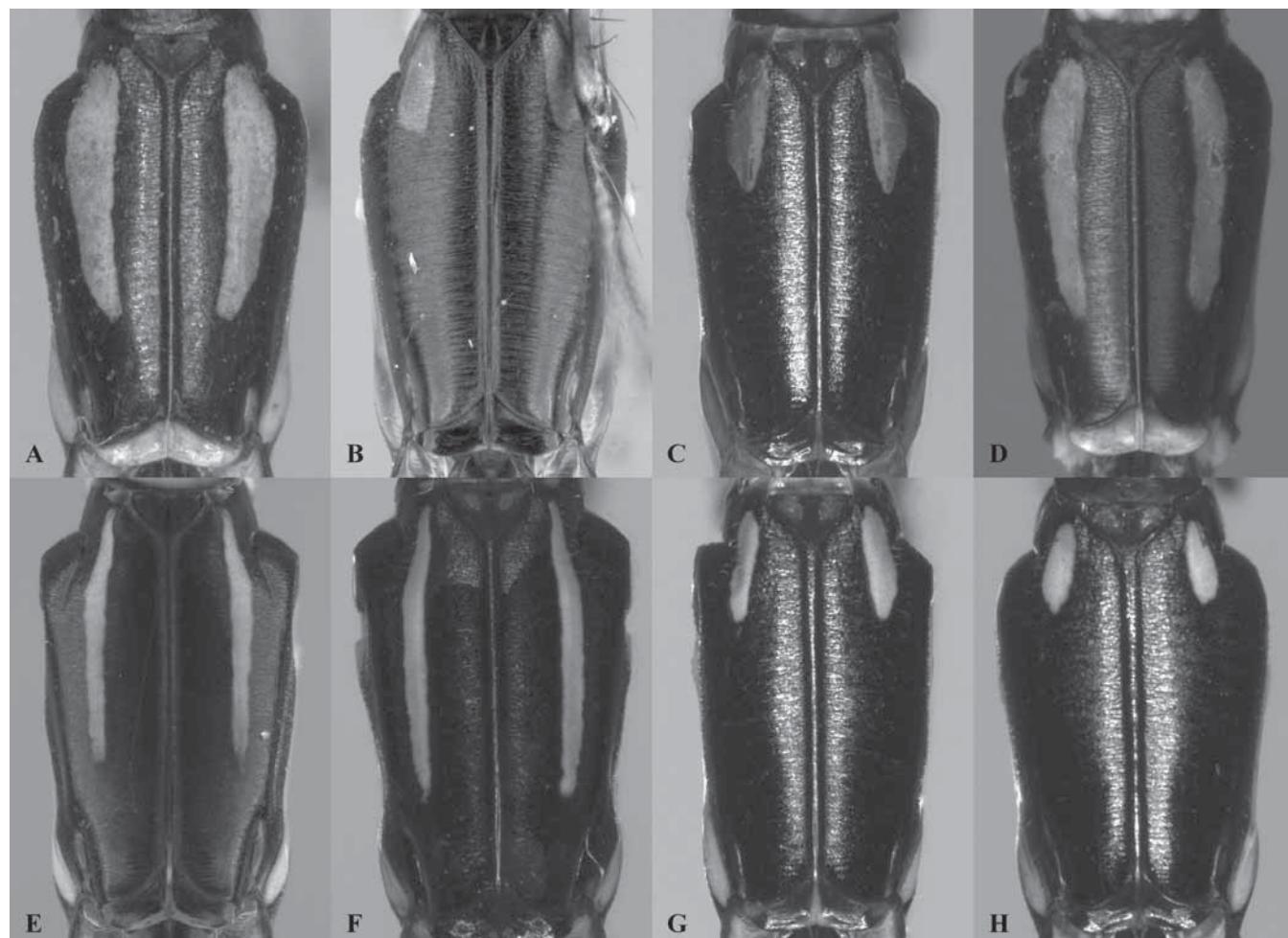


Fig. 4. Western species (holotypes unless noted otherwise), male antehumeral markings: A, *T. bidayuh*; B, *T. dupophila*; C, *T. dupophila* Bako (SAR05\_PST49); D, *T. feronia* paratype (JvT 13481); E, *T. gading*; F, *T. gading* paratype (SAR06\_PST21); G, *T. santubong* paratype (SAR05\_PST59); H, *T. serapi*.

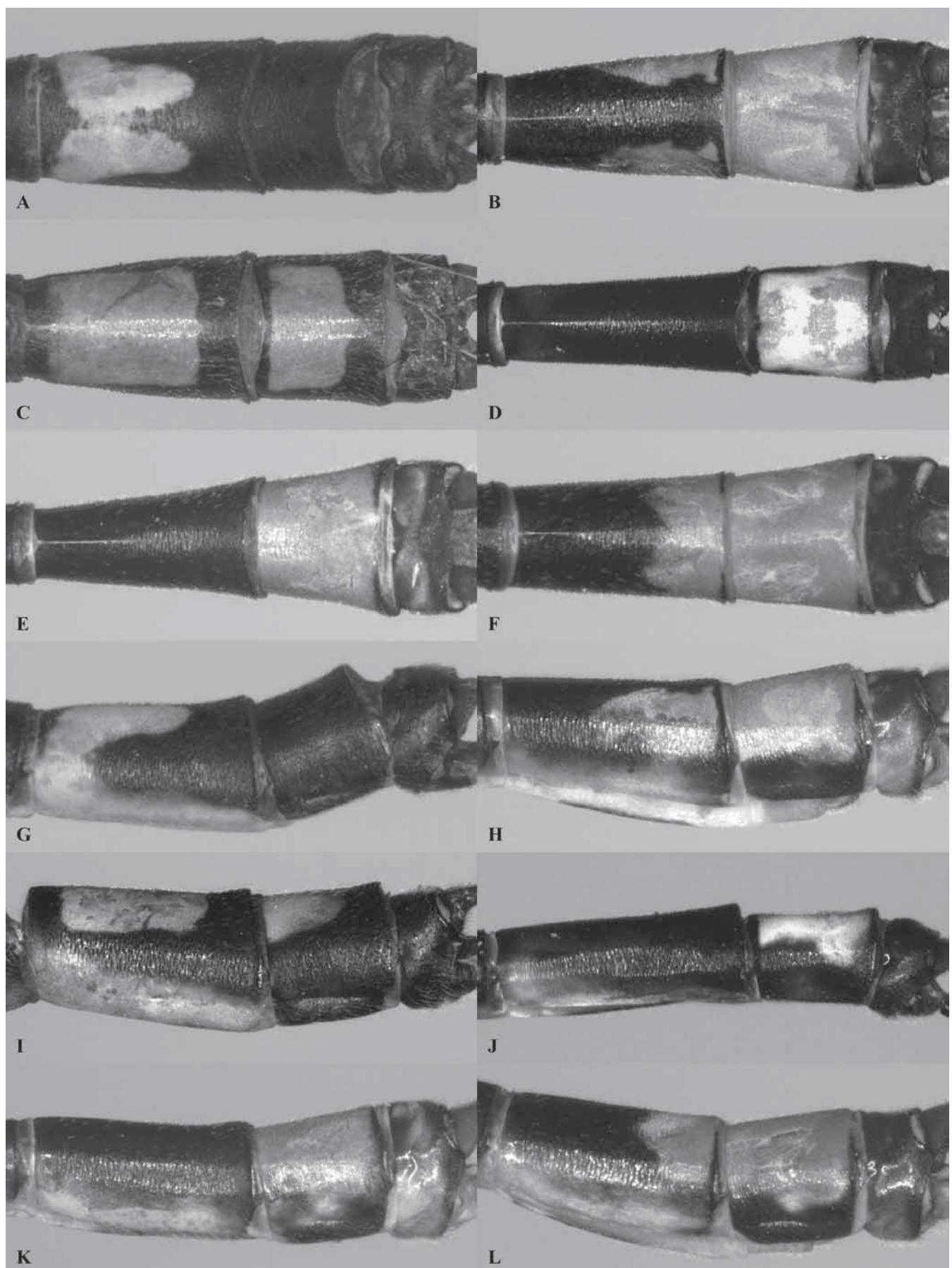


Fig. 5. Western species (holotypes unless noted otherwise), male terminal abdominal segments. Dorsal view: A, *T. bidayuh*; B, *T. dupophila* Bako (SAR05\_PST50); C, *T. feronia*; D, *T. gading*; E, *T. santubong*; F, *T. serapi*. Lateral view: G, *T. bidayuh*; H, *T. dupophila* Bako (SAR05\_PST50); I, *T. feronia* paratype (JvT 13481); J, *T. gading*; K, *T. santubong*; L, *T. serapi*.

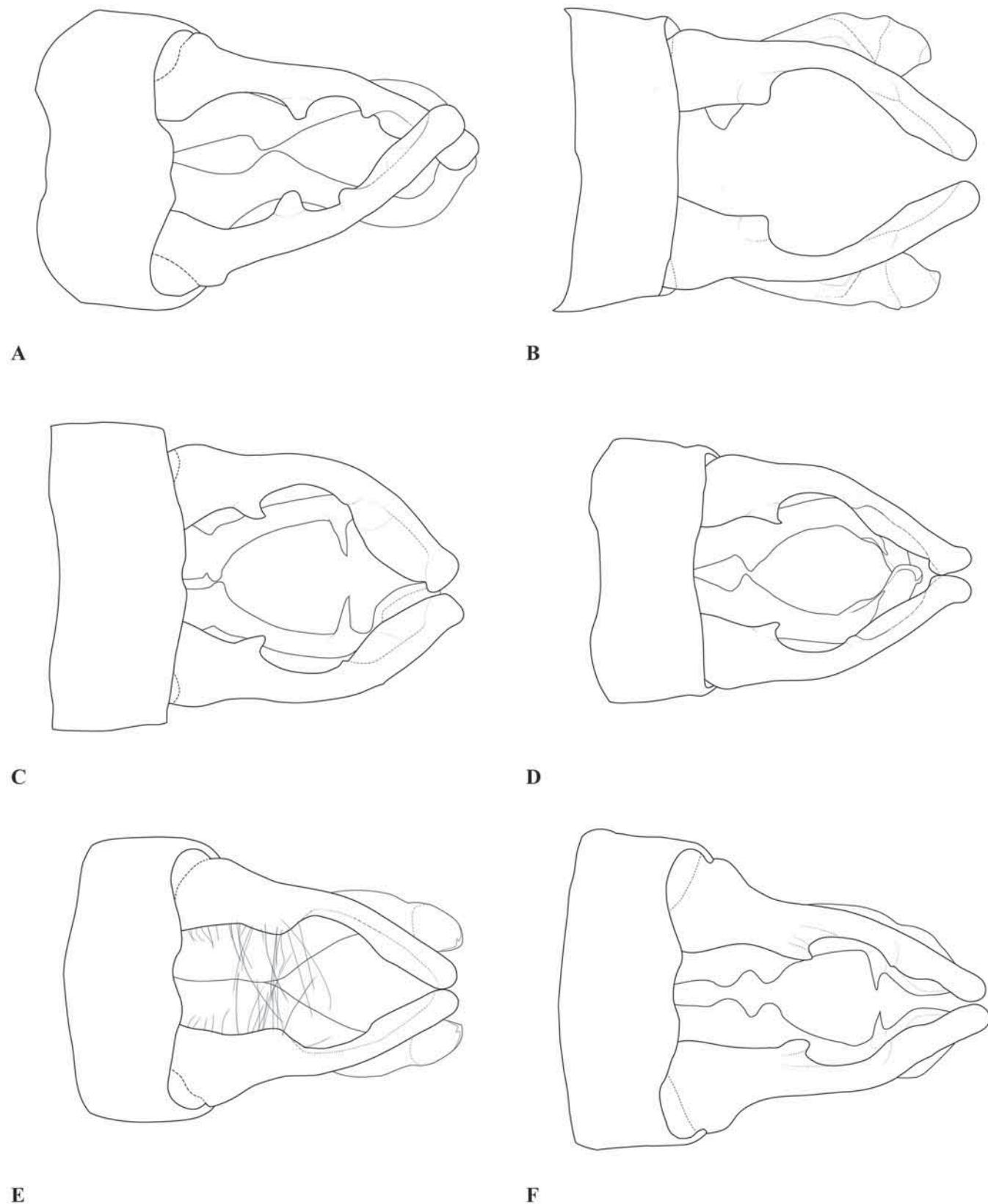


Fig. 6. Western species (holotypes unless noted otherwise), male anal appendages, dorsal view: A, *T. bidayuh*; B, *T. dupophila* Bako (SAR05\_PST49); C, *T. feronia*; D, *T. gading*; E, *T. santubong*; F, *T. serapi*.

shape of the lateral processes of the pronotal posterior lobe. In some individuals the pale mark on the dorsum of S8 is not bi-lobed, in the specimen collected by Lieftinck without a specific location there are a pair of tiny widely spaced basal dorsal lateral spots on S9. The notch in the tip of the superior appendage appears slightly deeper and/or wider in a few specimens, but to a large extent this is due to the way that the appendages are laying in the individual specimen.

Females: Little variation except in size is apparent, but in one individual from Kubah there is a pair of tiny blue dorsal spots on S9.

Measurements (mm): Males: Abdomen without anal appendages 31–36.5, Hw 17.5–20.5. Wings with 11–13 Px in Fw, 10–12 in Hw. Females: Abdomen without appendages or ovipositor 31–33, Hw 19–21. Wings with 12–13 Px in Fw, 10–11 in Hw.

**Biological notes.** — This species is found at high gradient forest streams, usually small but teneral individuals have been found beside a larger torrential stream at Kubah National Park. At Kubah National Park it occurs together with *T. serapi* at many locations, but typically occurs at lower densities.

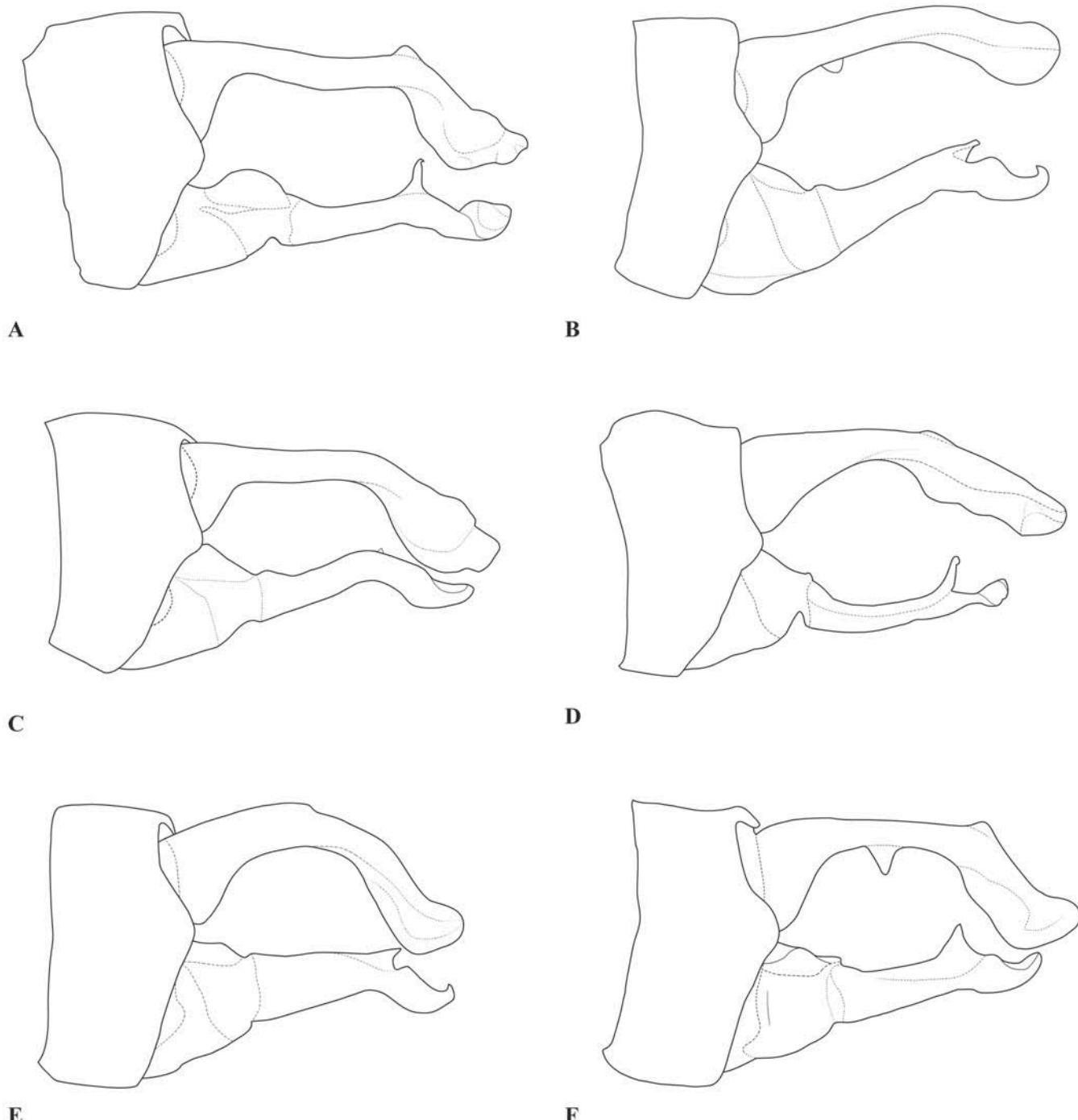


Fig. 7. Western species (holotypes unless noted otherwise), male anal appendages, lateral view: A, *T. bidayuh*; B, *T. dupophila* Bako (SAR05\_PST49); C, *T. feronia*; D, *T. gading*; E, *T. santubong*; F, *T. serapi*.

Females have been found perched on vegetation at wet cliff faces beside waterfalls on several occasions.

**Distribution.** — Known from Sarawak west of the Lumar River, with records from Serian in Samarahan division, and in Kuching division from the Matang Range (including Kubah National Park), Semenggoh Nature Reserve, and Annah Rais (Fig. 19). Although the specimen collected by Lieftinck has no location information with it other than “Sarawak”, Lieftinck’s 1950 visit to the state was confined to Sarawak west of the Lumar and his specimen probably comes from somewhere close to Kuching.

***Telosticta dupophila* (Lieftinck, 1933), new combination**  
(Figs. 1C, 3B, C, 4B, C, 5B, H, 6B, 7B, 8B, 21)

*Drepanosticta dupophila* Lieftinck, 1933: 286–288, Fig. 2; 1954: 34; 1971: 85; Orr, 2003: 38, 69; van Tol, 1992: 23, 88, 99, 241; van Tol et al., 2009: 8, 18, 36  
*Drepanosticta ?dupophila* — Dow & Reels, 2010: 15, 18

**Material examined.** — Holotype: male (JvT3034), Indonesia, Kalimantan, Montrado, between Pakmongtheo and Pandjaoa, 3 Apr.1932, coll. L. Coomans de Ruiter, in RMNH.

Others (all from Malaysia, Sarawak, Kuching Division, currently in collection RAD unless noted otherwise): 2 males, Kubah National Park, Matang Wildlife Centre, tiny swampy low gradient forest stream on the Matang Wildlife Centre trail system, ca 75 m, 17 Mar.2005, coll. RAD; male, same location, 25 Jan.2006, leg RAD; male, same location, 13 Sep.2009, leg RAD; 2 males, same location, 2 Sep.2011, coll. RAD; male, Bako National Park, forest stream just below heath, 26 Aug.1980, coll. D. R. Paulson, in coll. Paulson; male, same national park, small streams in Kerangas forest, ca 120 m, 23 Mar.2005, coll. RAD, in RMNH; male, same location, 24 Mar.2005, coll. GTR; 2 males, same location and date, coll. RAD; 2 males, same location, 25 Mar.2005, coll. RAD; 2 males, 25 May.2005, coll. RAD; 2 males, Kuching city, Sama Jaya Nature Reserve, small stream in highly disturbed Kerangas forest, 4 Oct.2011, coll. RAD.

**Diagnosis.** — Readily distinguished from all other species of *Telosticta* except *T. santubong* and *T. serapi* by its very

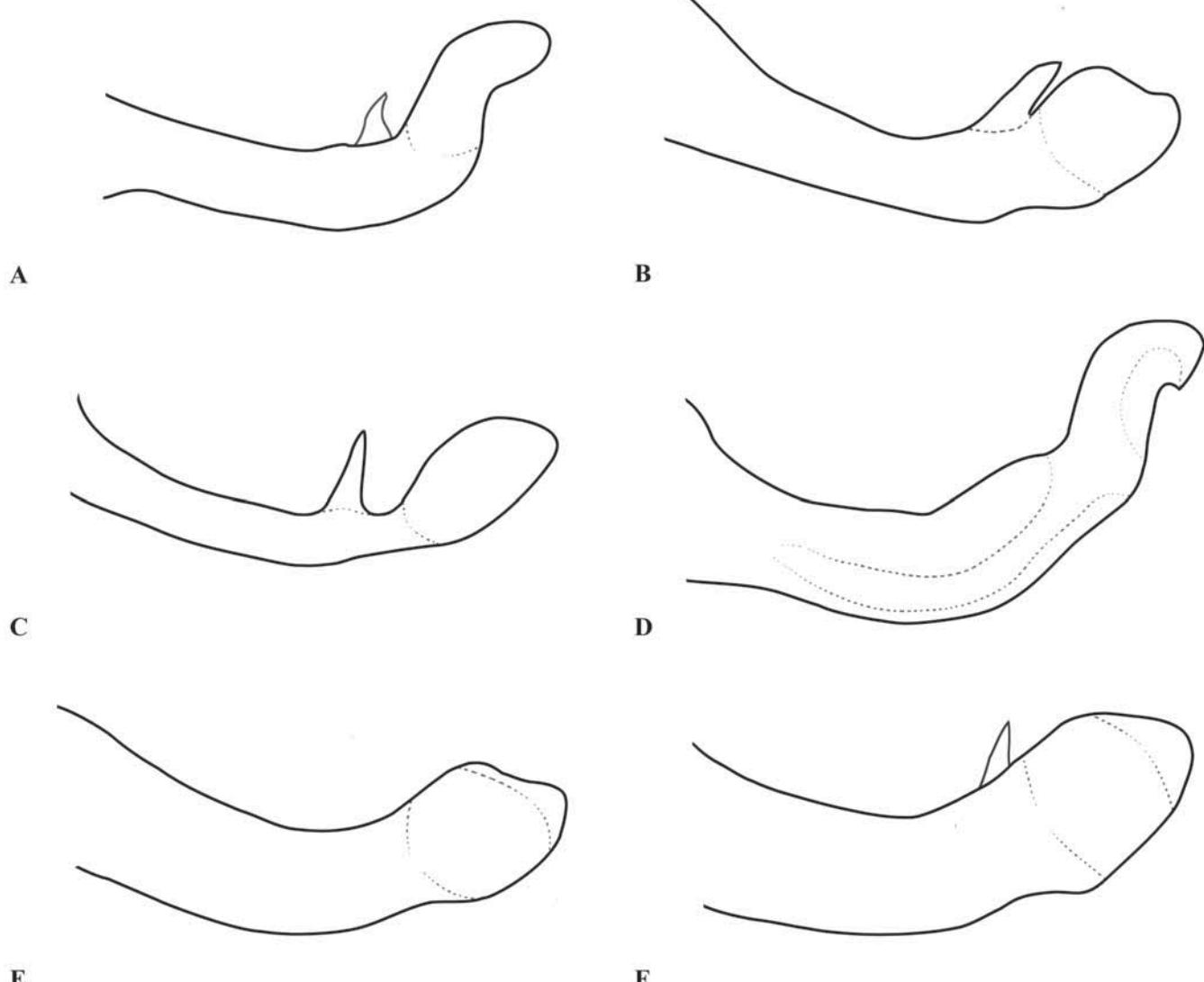


Fig. 8. Western species (holotypes unless noted otherwise), male right inferior anal appendage, ventral view: A, *T. bidayuh*; B, *T. dupophila* Bako (SAR05\_PST49); C, *T. feronia*; D, *T. gading*; E, *T. santubong*; F, *T. serapi*.

short antehumeral stripes and short lateral processes of the posterior pronotal lobe. Separated from *T. santubong* and *T. serapi* by the basal position of the interior projection of the superior anal appendages.

**Descriptive notes.** — *Telosticta dupophila* was previously only known from the holotype male. The female remains unknown. Lieftinck (1933) failed to mention the lateral processes of the posterior pronotal lobe; in the holotype of *T. dupophila* these are relatively short, reaching less than half the distance from their origin to the lower margin of the propleuron (Fig. 3B). The ratio of the width of compound eye to width of vertex measured at level of lateral ocelli is over 9/10. Lieftinck's description of the colouration of abdominal

segment 8 is possibly a little misleading, he states "Segm. 8–9 wholly blue, save for a transverse, black stripe along the base of 8, confined to the dorsum, and produced a little behind in the middle"; most of the basal half of the dorsum of S8 is now missing in the holotype, but what remains suggests a broad black rearwards spur reaching to ca one third of the length of the segment. Individuals from Sarawak typically differ from the holotype in the shape of the lateral process of the posterior pronotal lobe (e.g., Fig. 3C) and in the extent of the blue markings on S8 (Fig. 5B, H), which are present laterally but only extend onto the dorsum in the apical half or one third, if at all, and normally remaining broadly separated there, although in a few individuals they meet just before the end of the segment. However the lateral

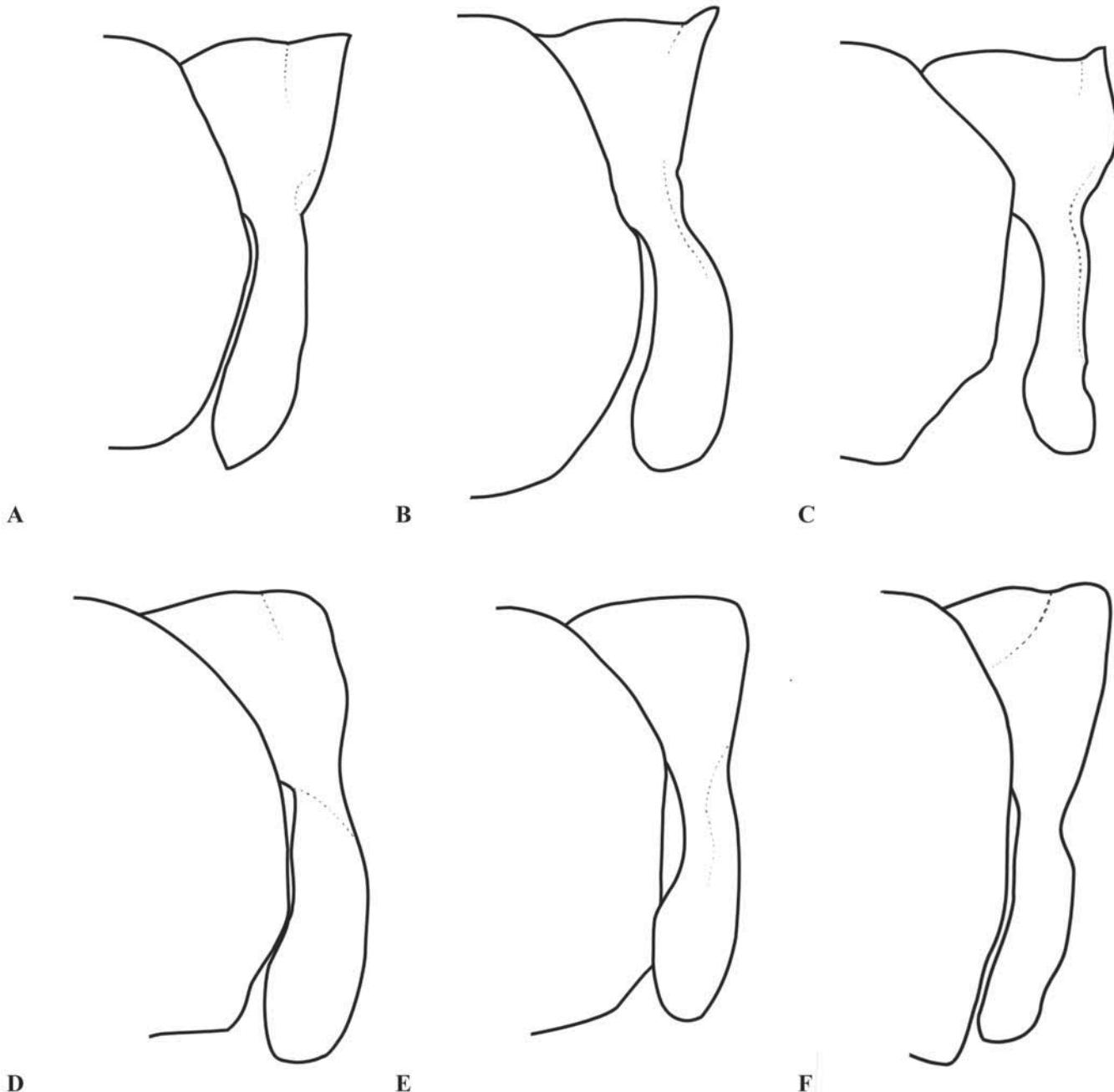


Fig. 9. *T. dayak*-group plus *T. longigaster*, lateral processes of posterior pronotal lobe of holotype males: A, *T. berawan*; B, *T. dayak*; C, *T. kajang*; D, *T. paruati*; E, *T. ulubaram*; F, *T. longigaster*.

processes are variable in shape in the Sarawak specimens, in one individual agreeing with those of the holotype and very reduced or even absent in some individuals. The lateral extent of the blue S8 marking is also variable, running the whole length of the segment in some specimens but only present in the apical one third in others. There are small differences in the shape and length of the antehumeral markings between the holotype and individuals from Sarawak (e.g., Fig. 4B, C) but these markings also show some variation within individual populations. The anal appendages of the Sarawak specimens are identical to those of the holotype; the small and variable differences noted above do not appear to be sufficient to warrant even subspecies status for the Sarawak populations.

Measurements (mm): Holotype: Abdomen without appendages ca 36.5, Hw 21.5. Wings with 12 Px in Fw, 11–12 in Hw. Sarawak specimens: Abdomen without appendages 31–36, Hw 18–21.5. Wings with 11–13 Px in Fw, 10–12 in Hw.

**Remarks.** — Van Tol et al. (2009: 36), writing about *Protosticta* aff. *feronia* (= *T. dayak*), stated that “it is morphologically very similar to *Drepanosticta dupophila*... Based on the fact that both nominal species are syntopic and share all morphological characters except wing venation, we predict that both names are synonyms”. However, with detailed study and more material available than van Tol had, it is clear that *T. dupophila* is a distinct species from both *T. feronia* and *T. dayak*, with consistent differences in structural characters and markings from both of these species.

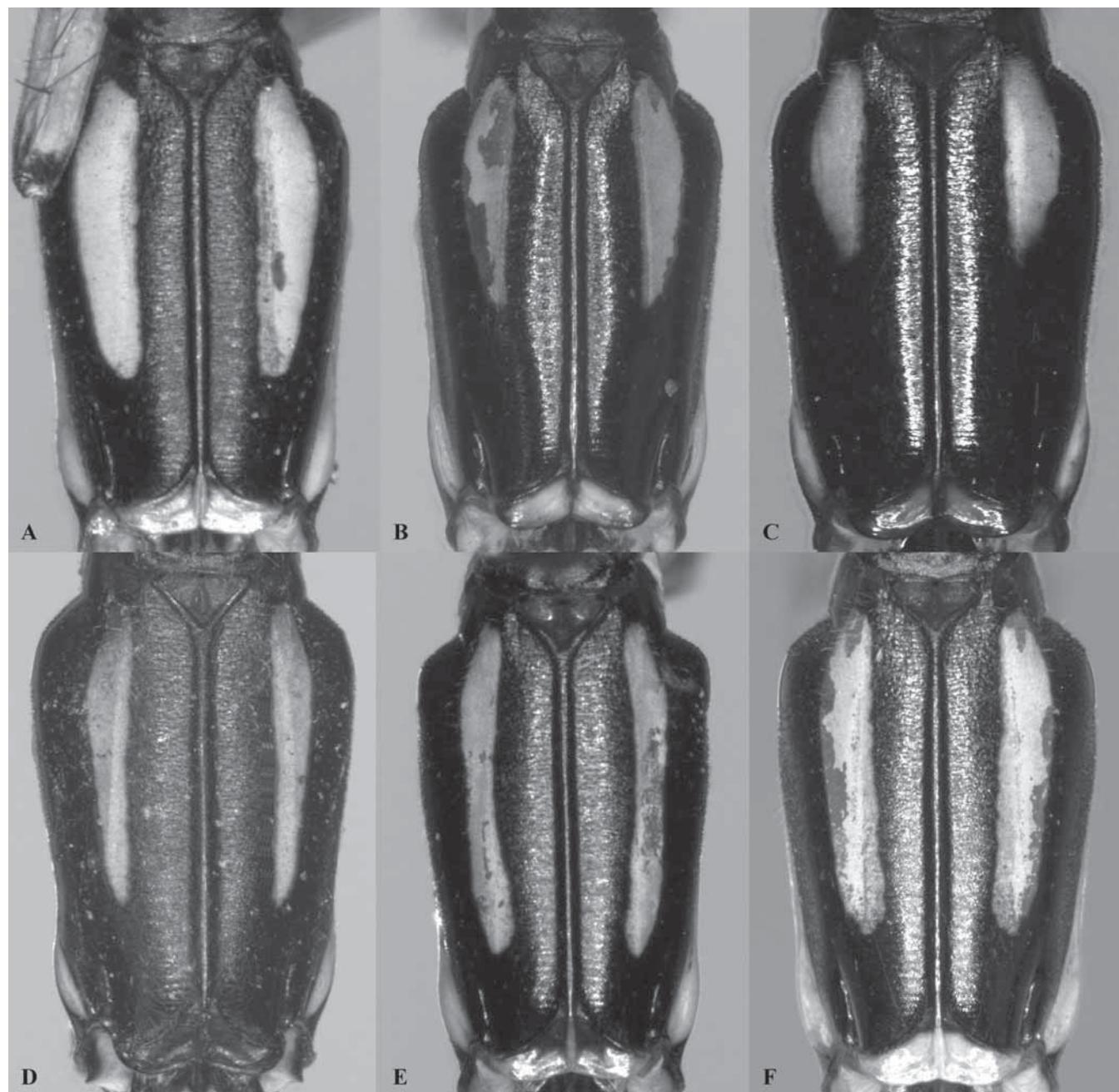


Fig. 10. *T. dayak*-group plus *T. longigaster* (holotypes unless noted otherwise), male antehumeral markings: A, *T. berawan*; B, *T. dayak*; C, *T. dayak* paratype, Brunei (JvT 5062); D, *T. kajang*; E, *T. ulubaram*; F, *T. longigaster*.

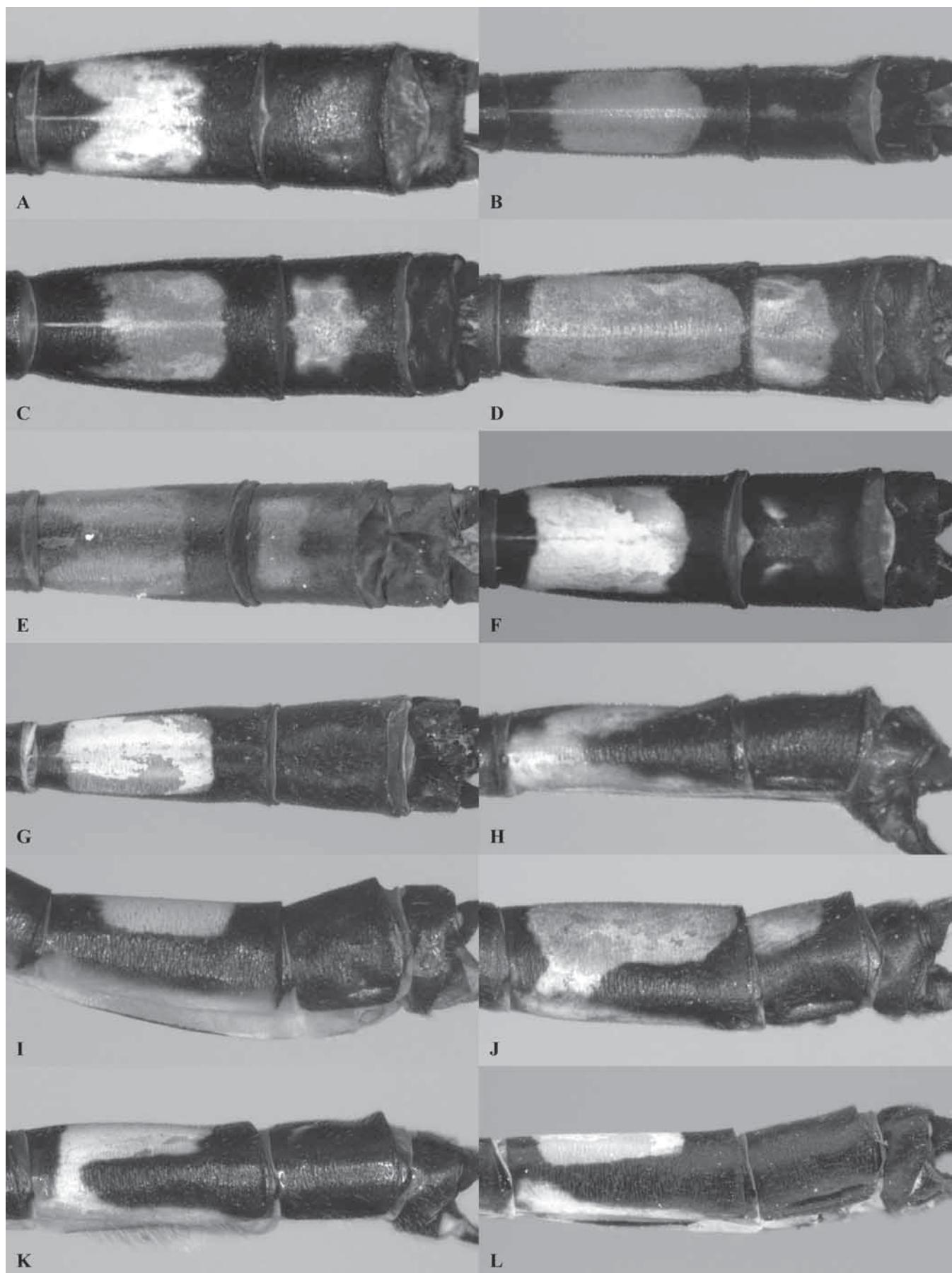


Fig. 11. *T. dayak*-group plus *T. longigaster* (holotypes unless noted otherwise), male terminal abdominal segments. Dorsal view: A, *T. berawan*; B, *T. dayak*; C, *T. dayak* Mount Dulit (SAR09\_10\_PST68); D, *T. kajang*; E, *T. paruasia*; F, *T. ulubaram*; G, *T. longigaster*. Lateral view: H, *T. berawan*; I, *T. dayak*; J, *T. kajang*; K, *T. ulubaram*; L, *T. longigaster*.

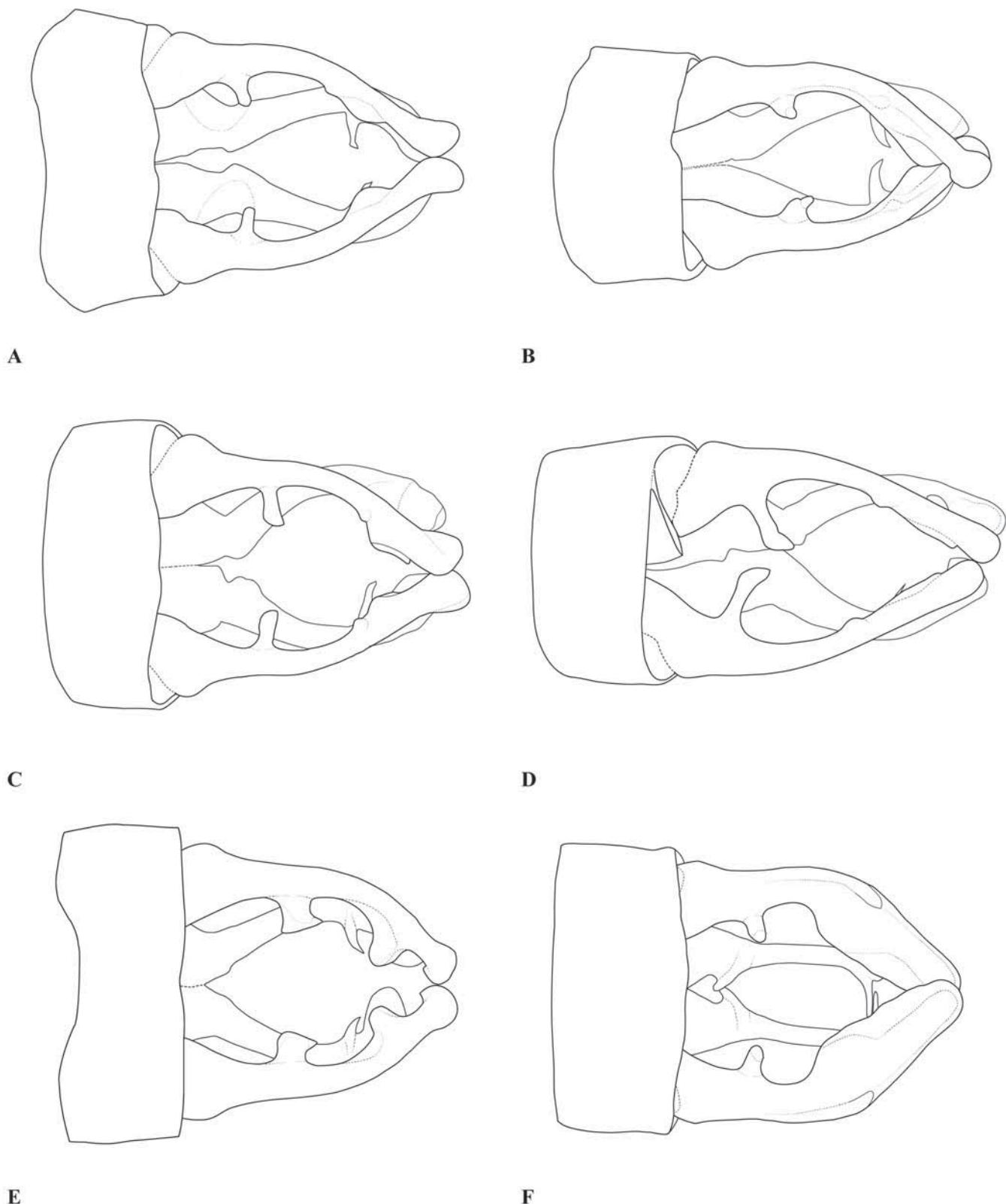


Fig. 12. *T. dayak*-group plus *T. longigaster*, anal appendages of holotype males, dorsal view: A, *T. berawan*; B, *T. dayak*; C, *T. kajang*; D, *T. paruati*; E, *T. ulubaram*; F, *T. longigaster*.

**Biological notes.** — The habitat at the type locality is described as “swampy forest” in Lieftinck (1933) and on the label as “strook vochtig bosch”: a “strip of moist forest”. At Bako National park in Sarawak it is found at small streams in Kerangas forest; in places this could be described as swampy. At Sama Jaya Nature Reserve it has been found on one tiny swampy stream in disturbed Kerangas forest. At Kubah National park it has been found on small low gradient streams in semi-alluvial forest; again this could be described as swampy. It appears to favour lower gradient streams than

the closely allied *T. serapi*; at Kubah they occur within 100 m of each other but on streams differing by gradient. At Bako it is quite a common species, males are found perched at the side of streams.

**Distribution.** — Fig. 21; *T. dupophila* is known from north west Kalimantan in the vicinity of Singkawang and from west Sarawak, where populations are known at Bako and Kubah National parks and at Sama Jaya Nature Reserve within the city limits of Kuching.

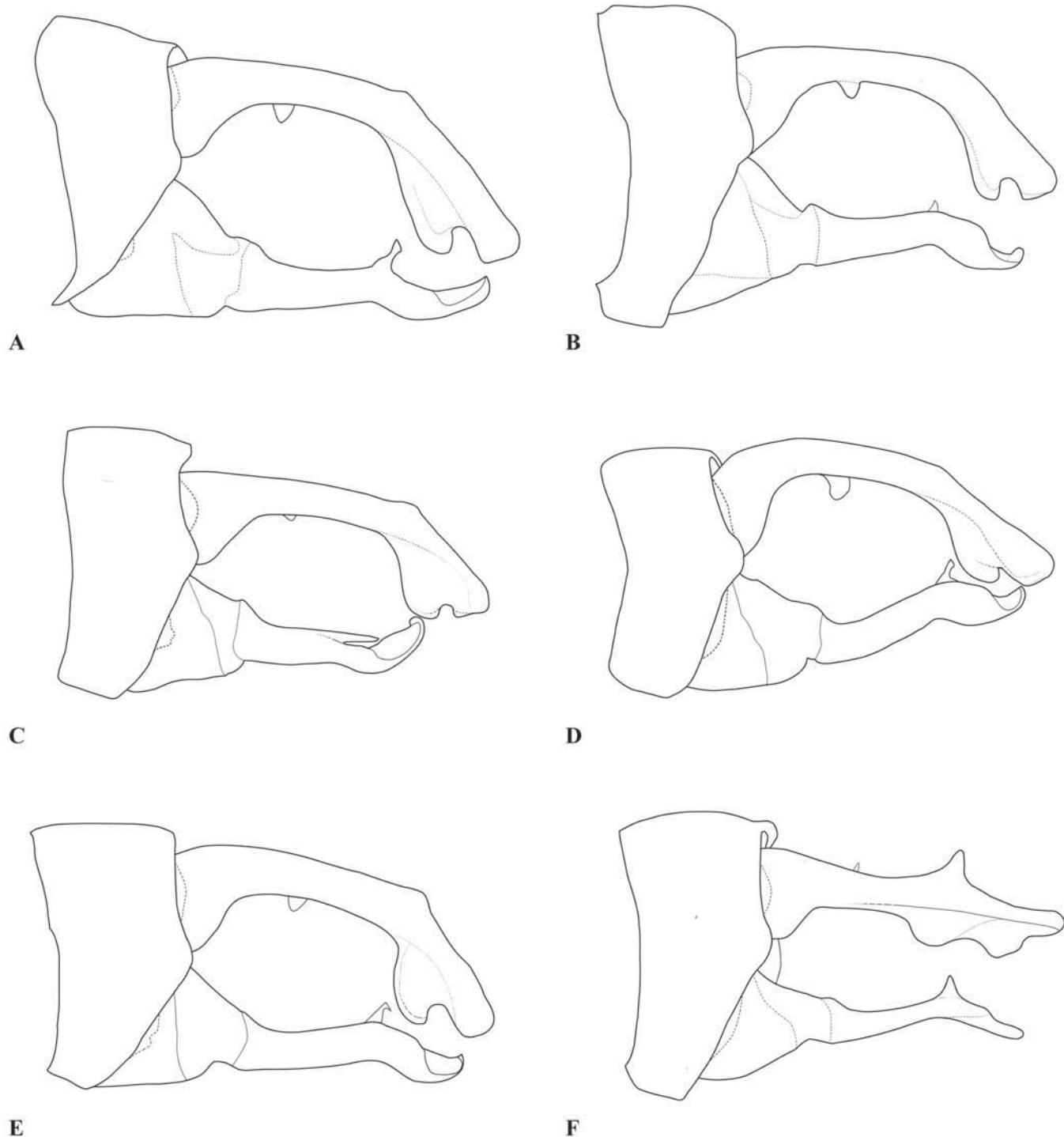


Fig. 13. *T. dayak*-group plus *T. longigaster* (holotypes unless noted otherwise), male anal appendages, lateral view: A, *T. berawan*; B, *T. dayak*; C, *T. dayak* paratype, Brunei (JvT 5062); D, *T. kajang*; E, *T. ulubaram*; F, *T. longigaster*.

***Telosticta feronia* (Lieftinck, 1933), new combination**  
(Figs. 1A, B, 3D, 4D, 5C, I, 6C, 7C, 8C, 19)

*Protosticta feronia* Lieftinck, 1933: 281–285, Fig. 1; 1954: 31 (part, west Borneo); 1971: 88; Orr, 2003: 38, 69 (part); van Tol, 1992: 23, 88, 99, 247; van Tol et al. 2009: 8, 18, 36

**Material examined.** — Holotype: male (JvT 3072), together with female (JvT 17087), Indonesia, Kalimantan Barat, Singkawang, Gunung Poteng, 1 Nov. 1931, coll. L. Coomans de Ruiter, in RMNH.

Paratypes (all with same data as holotype except as noted, all in RMNH): male (JvT 13481), 31 Jan. 1932; female (JvT 28062), 13 Mar. 1932.

Others (all from Indonesia, Kalimantan Barat, Singkawang area, all coll. L. Coomans de Ruiter): male, 1[?] Jan. 1932, Gunung Poteng; female, 28 Feb. 1932, Gunung Poteng; male, 19 Jun. 1932, Gunung Poteng; male, female, 14 Jul. 1932, Gunung Poteng; male, 21 Aug. 1932, Gunung Poteng; male, 16 Oct. 1932, Gunung Poteng; male, Bajak, 10 Jun. 1933; male, Gunung Mandor, Tjapkala, 24 Aug. 1933.

**Diagnosis.** — The male of *T. feronia* is distinguished from all other species of *Telosticta* except *T. bidayuh* by the combination of moderate length antehumeral stripes and long lateral processes on the posterior pronotal lobe, superior appendages with poorly developed dorsal projections and a flattened but not strongly folded apical part with at most a small notch in the tip as seen in normal lateral view. It is distinguished from *T. bidayuh* by the markings of the labrum and terminal abdominal segments and by the position of the internal projection of the superior anal appendage, placed at the point where the basal part of the appendage contracts in *T. feronia* but well distal to this point in *T. bidayuh*, and by the generally more robust build of the superior appendage in *T. feronia* compared to *T. bidayuh*.

**Measurements (mm):** Males: Abdomen without anal appendages 34–36, Hw 20–21. Wings with 11–13 Px in Fw, 10–12 in Hw. Females: Abdomen without appendages or ovipositor 29–31.5, Hw 20.5–22. Wings with 11–12 Px in Fw, 10–12 in Hw.

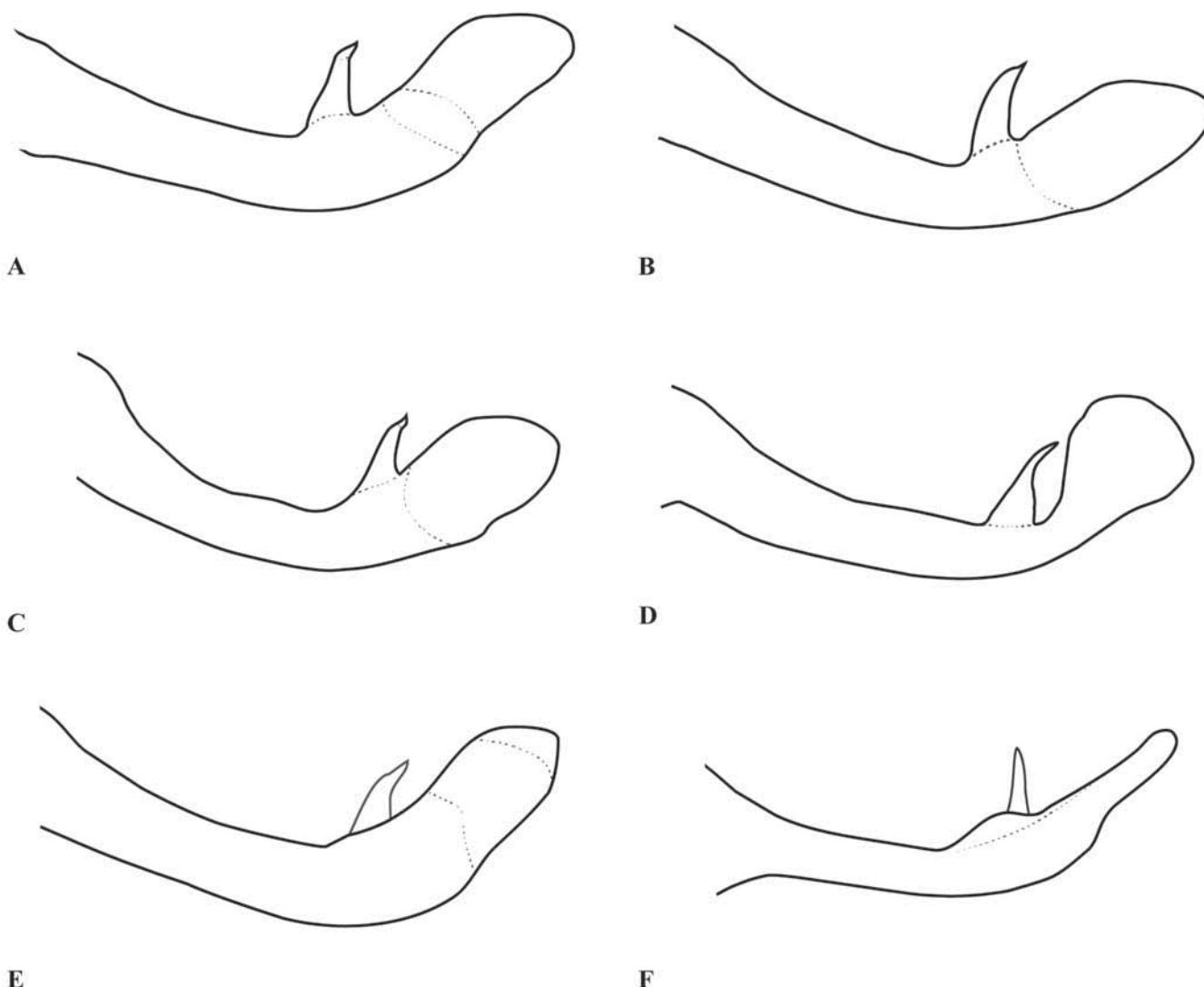


Fig. 14. *T. dayak*-group plus *T. longigaster*, right inferior anal appendage of holotype males, ventral view: A, *T. berawan*; B, *T. dayak*; C, *T. kajang*; D, *T. paruati*; E, *T. ulubaram*; F, *T. longigaster*.

**Remarks.**—As with *T. dupophila*, Lief tinck (1933) failed to mention the lateral processes of the posterior pronotal lobe. The ratio of the width of compound eye to width of vertex measured at level of lateral ocelli is over 0.9. Aside from small differences in markings and size, no significant variation was found in the type series and other old topotypical material. In the absence of fresh material little can be added about this species.

**Biological notes.**—All that has been recorded on the habitat of this species is that the type series were collected at a “forest-brook” at 325 m.

**Distribution.**—Fig. 19; known only from the Singkawang area in west Kalimantan.

***Telosticta gading*, new species**  
(Figs. 3E, 4E, F, 5D, J, 6D, 7D, 8D, 20)

**Material examined.**—Holotype: male (SAR07\_8\_PST247), Malaysia, Sarawak, Kuching division, Gunung Gading National Park, trailside on Gunung Gading, 100–200 m, 1 Oct. 2008, coll. RAD, to be deposited in RMNH.

Paratypes (all from same location as holotype at small streams or by trail up Gunung Gading, all coll. RAD): 5 males (SAR06\_PST18–22), 9 Jan. 2006; male (SAR08\_PST248), 1 Oct. 2008. Paratypes currently in collection RAD, examples to be deposited in BMNH and ZRC.

**Diagnosis.**—The male of *T. gading* is distinguished from all other species of *Telosticta* except *T. dupophila*, *T. santubong* and *T. serapi* by the short lateral processes of the posterior pronotal lobe. From the other species with short lateral processes it is easily separated by its much longer antehumeral stripes.

**Etymology.**—*gading*, a noun in apposition. Named for the type locality, Gunung Gading in the National Park of the same name.

**Description of holotype male.**—Head: Labium pale except for end hooks of labial palps, which are brown. Labrum pale blue except narrowly along free margin, where shining black. Anteclypeus pale blue, postclypeus shining black. Mandible bases pale blue in corner by clypeus, dark below, genae black except narrowly beside mandible bases, where obscurely pale. Vertex and frons bronzy black, occiput shining black. Ratio of width of compound eye to width of vertex measured at level of lateral ocelli over 9/10. Lateral extremities of transverse occipital carina angulated and prominent. Ocelli whitish. Antennae with scape dark brown, greyish at top, and pedicel greyish, brown at top, flagella missing.

Thorax: Prothorax with propleuron pale with a large almost square dark brown mark in upper rear part. Pronotum with anterior lobe pale except for a small dark marking dorsally just behind the anterior carina, median lobe brown, becoming paler laterally. Posterior lobe mostly black, hind margin

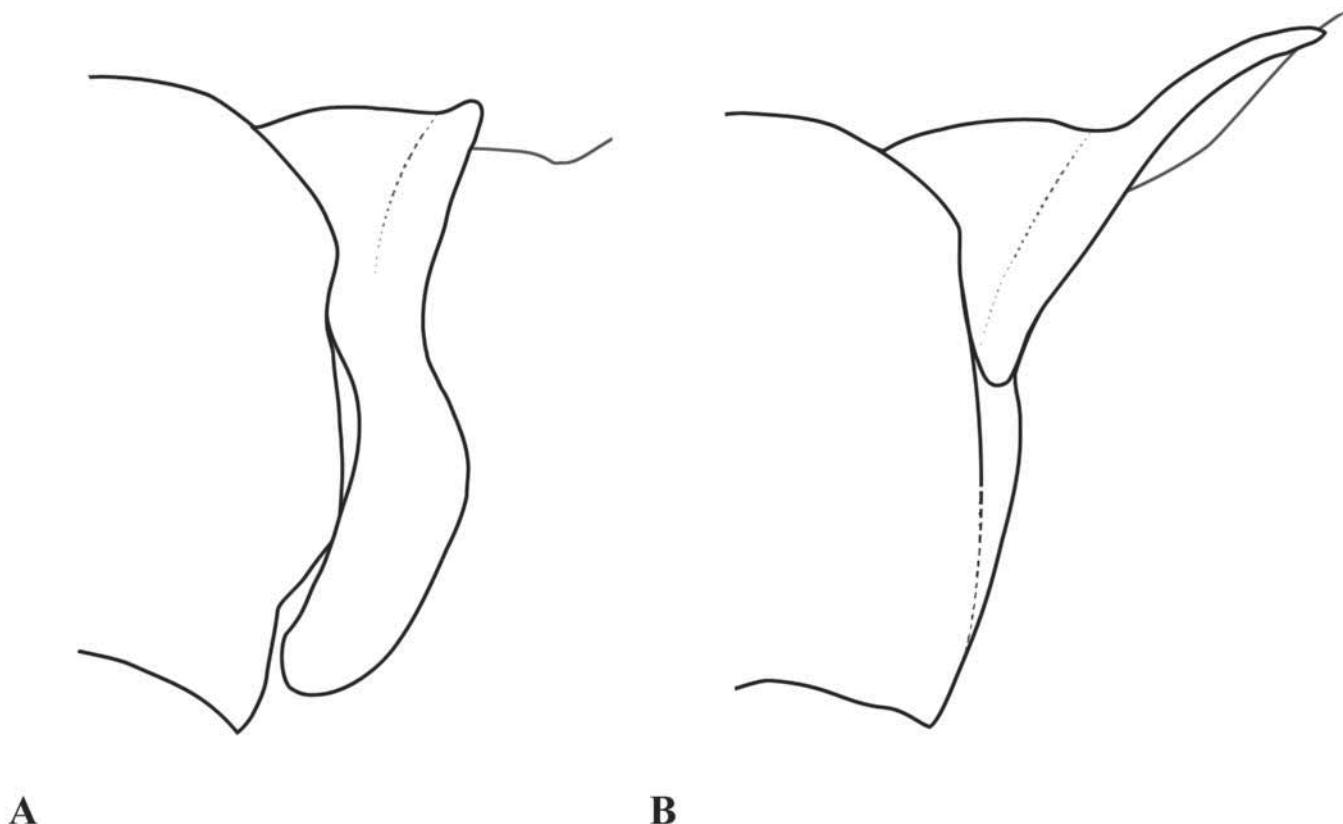


Fig. 15. *T. longigaster* female pronotal hind lobe, lateral view: A, Gunung Mulu (SAR07\_8\_PST118); B, Hose Mountains (SAR09\_10\_PST305).

simple, lateral processes very short, rounded with a narrow stalk (Fig. 3E). Synthorax: Mesepisternum black, with a pair of narrow pale blue antehumeral stripes, occupying ca 3/5 of the length (Fig. 4E). Antealar triangles black. Mesepimeron black. Metepisternum largely yellowish cream with a black

band extending from the antealar carina to just before the spiracle. Metepimeron largely pale, but black below metepleural suture for much of its length. Venter of synthorax pale. Legs: each with coxa and trochanter pale, femur pale with extensive grey and black markings, black above tibia.



Fig. 16. Markings of *T. belalongensis* and *T. janeus*. *T. belalongensis* holotype: A, antehumeral markings; C, terminal abdominal segments, dorsal view; E, terminal abdominal segments, lateral view. *T. janeus* holotype: B, antehumeral markings; D, terminal abdominal segments, dorsal view; F, terminal abdominal segments, lateral view.

Tibia dark immediately below femur, becoming pale brown lower. Tarsi brownish. Wings: 15 Px in Fw, 14 Px in Hw. Arculus distal to Ax2. Vein ab present.  $R_4$  arising at subnodus in Fw, distal to subnodus in Hw,  $IR_3$  joined to it by a short stalk. Pterostigma approximately trapezoidal with costal side slightly shorter than anal side, and proximal side slightly shorter than distal side, greyish brown with narrow white border, covering slightly more than one underlying cell.

Abdomen: Largely dark brown, darkening to rear. S1 brown above and behind posterior carina, pale below. S2 with a pale basal annulus, broadly interrupted dorsally, laterally this extending towards, but not quite reaching, the posterior carina as a pale wedge. S3–6 with a narrow pale basal annulus, broadly interrupted along the dorsal midline, S7–8 similar, but basal annulus absent, replaced by an obscure yellowish brown basal lateral marking. S9 largely pale blue above, this expanded laterally in apical half, otherwise dark brown and black below (Fig. 5D, J). S10 black. Anal appendages (Figs. 6D, 7D, 8D) largely dark brown and black. Superior appendage ca 2.5 times the length of S10, slender and slightly expanded outwards at tips in dorsal view, with interior projection at just over one-quarter length, dorsal projection present as a rounded interior swelling (Fig. 6D), not visible in lateral view. In lateral view bent downwards abruptly but gently in apical half, slightly dorsal-ventrally expanded just after the down-turn and hollowed on the exterior surface (Fig. 7D). Inferior appendage shorter than superior, with the scoop long, strap-like in ventral view (Fig. 8D), and the spine directed inwards, upwards and strongly to the rear, not visible in ventral view.

Measurements (mm): Abdomen without anal appendages 43.5, superior anal appendages ca 1.25, Hw 23.

**Female.** — Unknown

**Variation in paratypes.** — The only significant variation in the paratypes is in the length of the antehumeral stripes; in

most of the paratypes they are longer than in the holotype (e.g., Fig. 4F), but in some cases they are interrupted near their ends, with the terminal part irregular and/or indistinct. The abdomen of the holotype is a little longer than that of any of the paratypes.

Measurements (mm): Abdomen without anal appendages 40–43, Hw 21.5–23.5.

**Remark.** — *T. gading* is the largest of the species with short lateral processes on the posterior pronotal lobe of the male.

**Biological notes.** — Males have been found at low densities at small high gradient streams in mixed dipterocarp forest, or perched at the side of a trail near such streams.

**Distribution.** — Known only from Gunung Gading in west Sarawak (Fig. 20).

***Telosticta santubong*, new species**  
(Figs. 3F, 4G, 5E, K, 6E, 7E, 8E, 22)

**Material examined.** — Holotype: male (SAR05\_PST65), Malaysia, Sarawak, Kuching division, Damai Peninsular, Gunung Santubong National Park, small streams on Gunung Santubong, 100–400 m, 28 May 2005, coll. RAD, RMNH.

Paratypes (all from same location and date as holotype, all coll. RAD): 6 males (SAR05\_PST59–64). Paratypes in RMNH and coll. RAD.

**Diagnosis.** — Readily distinguished from all other species of *Telosticta* except *T. dupophila* and *T. serapi* by its very short antehumeral stripes and short lateral processes of the posterior pronotal lobe. Separated from *T. dupophila* and *T. serapi* by having the interior projection of the superior anal appendage reduced to a ridge bearing a clump of long setae.

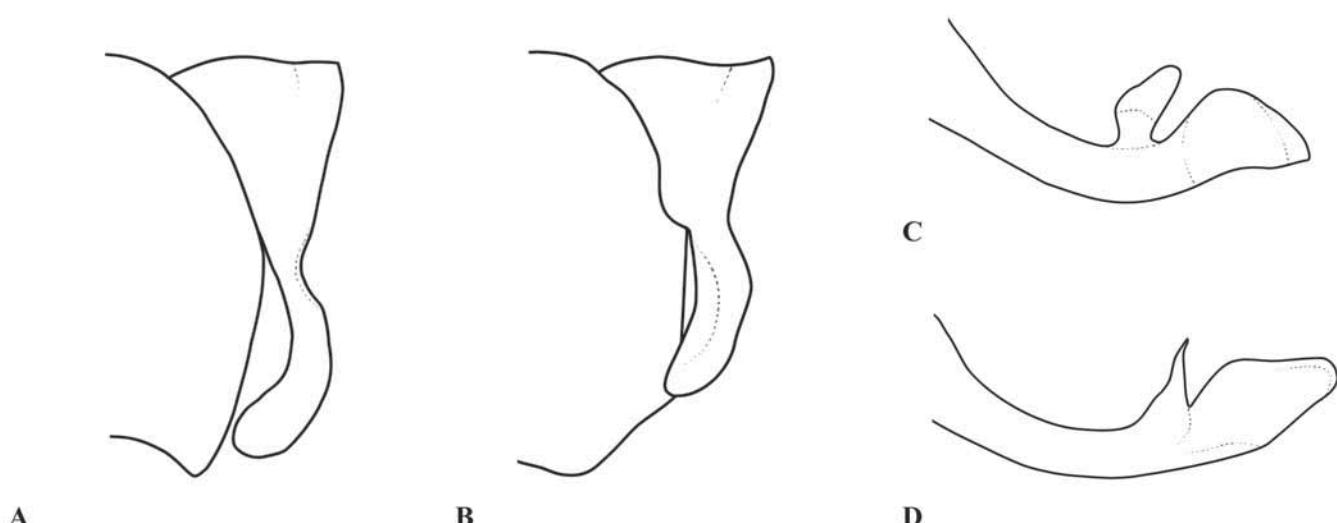


Fig. 17. *T. belalongensis* and *T. janeus*. *T. belalongensis* holotype: A, posterior pronotal lobe, lateral; C, right inferior anal appendage, ventral view. *T. janeus* holotype: B, posterior pronotal lobe, lateral; D, right inferior anal appendage, ventral view.

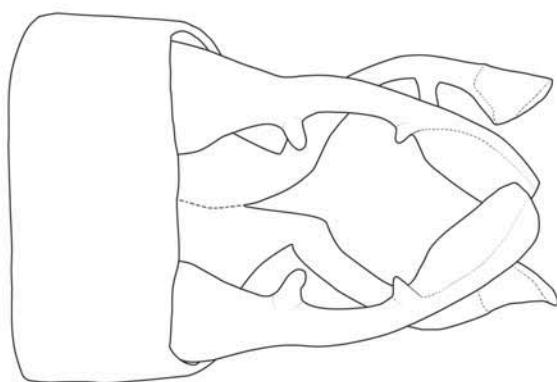
**Etymology.** — *santubong*, a noun in apposition. Named for the type locality, Gunung Santubong in the National Park of the same name.

**Description of holotype male.** — Head: Labium pale cream except for end hooks of labial palps, which are brown. Labrum pale blue except narrowly along free margin, where shining black. Anteclypeus pale blue, postclypeus shining black. Mandible bases pale blue in corner by clypeus, black otherwise. Vertex and frons shining metallic greenish-black, occiput shining black. Ratio of width of compound eye to width of vertex measured at level of lateral ocelli just over 9/10. Lateral extremities of transverse occipital carina not angulated. Ocelli yellowish. Antennae with scape greyish, pedicel cream, brown at top, rest black.

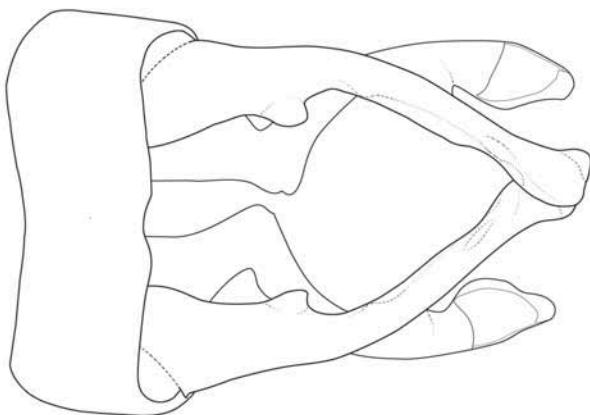
Thorax: Prothorax with propleuron pale cream, except to rear where obscurely mottled with dark brown. Pronotum with anterior lobe pale blue dorsally to cream laterally, except for a small black transverse stripe placed centrally just behind the anterior carina, median lobe pale blue dorsally to cream laterally, except at rear, where narrowly black. Posterior lobe black, hind margin simple, lateral process (Fig. 3F) short, reaching ca halfway to the lower margin of the propleuron. Synthorax: Mesepisternum black, with a pair very short pale

blue antehumeral stripes occupying ca 1/4 of the length (as in Fig. 4G which shows a paratype). Antealar triangles black, but mid-dorsal carina pale between them. Mesepimeron largely bronzy black. Metepisternum with a pale blue stripe in upper part, extending to lower margin of spiracle, tapering towards antealar carina and extending slightly above the mesepleural suture, otherwise brown. Metepimeron cream, obscurely brown around mid-length below metepleural suture. Venter of synthorax pale. Legs: each with coxa and trochanter cream, femur cream, with obscure dark markings and a black stripe along extensor surface, black above tibia. Tibia cream, black below femur and with black stripes on flexor surface. Tarsi cream, black towards claws, which are brown. Wings: 13 Px in Fw, 11 Px in Hw. Arculus slightly distal to Ax2. Vein ab present except in right Hw. R<sub>4</sub> arising distal to subnodus, IR<sub>3</sub> joined to it by a short stalk. Pterostigma trapezoidal, pale brown with white border, covering slightly more than one underlying cell.

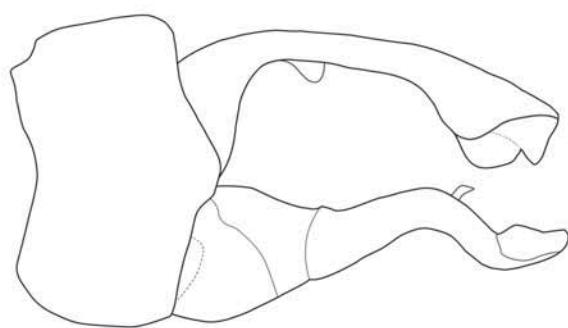
Abdomen: Dark brown above, paler to sides. S1 cream, brown behind posterior carina. S2 with a pale basal annulus, interrupted dorsally, laterally this extending towards, but not quite reaching, the posterior carina as a pale wedge. S3–S7 with a narrow pale basal annulus, interrupted dorsally and becoming less distinct on successive segments. S8 very dark



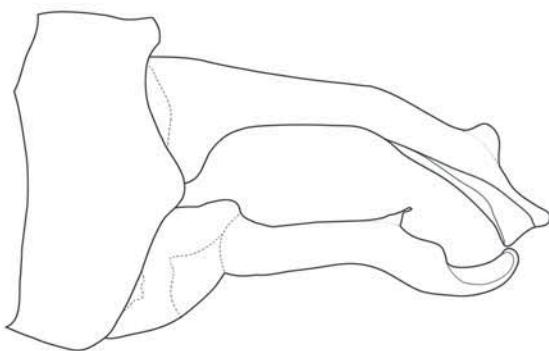
A



B



C



D

Fig. 18. *T. belalongensis* and *T. janeus*. *T. belalongensis* holotype: A, anal appendages dorsal; C, anal appendages lateral. *T. janeus* holotype: B, anal appendages dorsal; D, anal appendages lateral.

brown dorsally, cream laterally. S9 largely pale blue dorsally, obscurely cream and brown laterally. S10 obscurely pale mottled with brown over much of dorsum, black to rear, pale to sides. In dorsal view abdomen expanding evenly laterally from S8 to base of S10 (Fig. 5E, K). Anal appendages (Figs. 6E, 7E, 8E) largely dark brown and black. Superior appendage ca 2.5 times as long as S10, interior projection reduced to an inwardly and upwardly oriented ridge, reaching its highest point at just before half the length of the appendage, clear visible in lateral view, then abruptly running down, a distinctive clump of long setae originating on and around the ridge and directed mostly inwards and upwards (Fig. 6E). Dorsal projection barely developed, just visible as a bump in dorsal-lateral view. Appendage down curved in rear half, suddenly straightening at just before rounded tip (Fig. 7E). Inferior appendage with stem very robust, broad in ventral view, scoop only slightly expanded, rounded, upturned terminally and with its concave face orientated somewhat inwardly, spine directed inwards and rearwards (Fig. 8E).

Measurements (mm): Abdomen without anal appendages 37, superior anal appendages ca 1.25, Hw 21.

**Female.** — Unknown

**Variation in paratypes.** — In two of the paratypes the interior projection of the superior appendage is produced into a sharp point at its highest point. In some of the paratypes the dorsal projection is slightly more apparent than in the holotype and the pale marks on the dorsum of S10 are reduced in some.

Measurements (mm): Abdomen without anal appendages 35–37.5, Hw 19.5–22. Wings with 11–13 Px in Fw, 9–11 Px in Hw.

**Biological notes.** — Males were found at small streams in steep terrain in mixed dipterocarp forest.

**Distribution.** — *T. santubong* is known only from the mountain of the same name, on the Damai peninsular in west Sarawak (Fig. 22).

***Telosticta serapi*, new species**  
(Figs. 1D, 3G, 4H, 5F, L, 6F, 7F, 8F, 20)

*Drepanosticta ?dupophila* — Dow & Reels, 2010: 15, 18 (part)

**Material examined.** — Holotype: male (SAR07\_8\_PST343), Malaysia, Sarawak, Kuching division, Matang Range, Kubah National Park, small stream on Gunung Serapi, 100–400 m, 3 Oct.2008, coll. RAD, to be deposited in RMNH.

Paratypes (all from Kubah National Park or just outside the park boundary, all coll. RAD unless otherwise noted, currently in collection RAD unless otherwise noted, examples to be deposited in BMNH and ZRC): 5 males (SAR09\_10\_PST381–385), female (SAR09\_10\_PST386), stream at ca 650–700 m on Gunung Serapi, 3 Jun.2010; 2 males (SAR09\_10\_PST368–369), same location, 6 Jun.2010; 3 males (SAR09\_10\_PST392–394), female (SAR09\_10\_PST395), same location, 28 Jul.2010; 5 males (SAR05\_PST84–88), small streams on Gunung Serapi below 500

m, 13 Apr.2005; male (SAR05\_PST96), same location, 14 Apr.2005; 8 males (SAR06\_PST57–60, 157–160), female (SAR06\_PST61), same location, 21 Jan.2006; 4 males (SAR07\_8\_PST344–347), data as holotype; 2 males (SAR09\_10\_PST77–78), same location, 7 Sep.2009; female (SAR09\_10\_PST76), same location and date, coll. SB; male (SAR09\_10\_PST134), same location, 8 Sep.2009; 5 males (SAR07\_8\_PST171–174, RMNH\_INS\_229022 in ethanol), small streams near Main Trail, 23 Feb.2008; 3 males (SAR09\_10\_PST59–61), female (SAR09\_10\_PST62), same location, 28 Oct.2009; 10 males (SAR05\_PST69–72, 74–78, 89), female (SAR05\_PST73), small streams near Ulu Rayu Trail, 1 Jun.2005; 6 males (SAR07\_8\_PST303–308), small streams on Belian Trail, 15 Sep.2008; male (SAR09\_10\_PST387), same location, 25 Apr.2010; 2 males (SAR09\_10\_PST45–46), small tributary to Sungai Rayu crossed by Matang Wildlife trail system, 13 Sep.2009.

**Diagnosis.** — Readily distinguished from all other species of *Telosticta* except *T. dupophila* and *T. santubong* by its very short antehumeral stripes and short lateral processes of the posterior pronotal lobe. Separated from *T. dupophila* by having the interior projection of the superior appendage less basal and from *T. santubong* by its well developed interior projection without a clump of long setae.

**Etymology.** — *serapi*, a noun in apposition. Named for the type locality, Gunung Serapi in the Matang Range.

**Description of holotype male.** — Head: Labium pale cream except for end hooks of labial palps, which are brown. Labrum pale blue except along free margin, where shining black. Anteclypeus pale blue, postclypeus shining black. Mandible bases pale blue in corner by clypeus, dark below. Vertex and frons shining metallic greenish-black, occiput shining black. Ratio of width of compound eye to width of vertex measured at level of lateral ocelli ca 9/10. Lateral extremities of transverse occipital carina poorly developed. Ocelli whitish. Antennae with scape brown, grey at top and pedicel pale, brown at top, flagella missing.

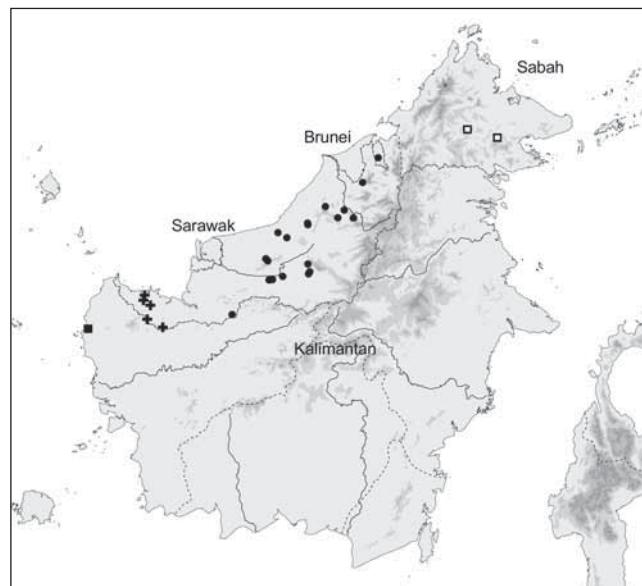


Fig. 19. Distribution of *T. bidayuh* (cross), *T. janeus* (open square), *T. feronia* (black square), and *T. longigaster* (circle).

Thorax: Prothorax with propleuron pale cream below, black above and along part of the rear margin. Pronotum with anterior lobe pale blue dorsally to whitish laterally, except for a black transverse stripe placed centrally just behind the anterior carina, median lobe pale blue dorsally to whitish, black at rear behind level of central pit. Posterior lobe black, hind margin simple, lateral process (Fig. 3G) reaching less than halfway to the lower margin of the propleuron, with a rounded head after a narrow stem. Synthorax: Mesepisternum black, with a pair of very short pale blue antehumeral markings occupying just less than 1/4 of the length (Fig. 4H). Metepisternum with a broad pale blue stripe in upper part, extending to lower margin of spiracle, tapering towards antealar carina, brown below this. Metepimeron dirty cream, brown below metapleural suture. Venter of synthorax pale. Legs: each with coxa and trochanter pale cream, femur also pale greyish cream, with extensor surface largely black. Tibia with a dark streak on extensor surface below joint and along whole length of flexor surface. Tarsi mostly pale but black before claws, which are brown. Wings: 13 Px in Fw, 12 Px in Hw. Arculus slightly distal to Ax2. Vein ab present. R<sub>4</sub> arising distal to subnodus, IR<sub>3</sub> joined to it by a short stalk. Pterostigma approximately trapezoidal with costal side slightly shorter than anal side, and proximal side slightly shorter than distal side, greyish-brown with prominent white border, covering slightly more than one underlying cell.

Abdomen: Largely pale brown, darkening to rear. S1 white, dark brown behind posterior carina, this intruding dorsally towards base, but poorly defined. S2 largely brown, with a yellowish lateral marking not quite reaching the base of the segment. S3–7 dark brown above, brown to sides, with a narrow pale basal annulus broadly interrupted on dorsum and becoming less well defined on each segment. S7 pale along tergal margin. S8 black above with the apical ca one third blue dorsally and pale along tergal margin, S9 black with the dorsum blue, this extending laterally, S10 largely black (Fig. 5F, L). Appendages (Figs. 6F, 7F, 8F) largely dark brown except ventrally basally on inferior appendage, where cream. Superior appendage slightly more than 2.5 times the length of S10, with interior projection at ca 4/10 length (Fig. 6F), the appendage narrowing abruptly immediately afterwards, the projection, which is short and robust, with a broad downwards spur that is clearly visible in lateral view (Fig. 7F) and a whitish upper spur directed rearwards (Fig. 6F). Dorsal projection at the point where the appendage turns down strongly, small and upwards directed. Upper margin of appendage after dorsal projection running straight at ca. 45 degrees to basal section until shortly before the tip which is expanded to rear, the whole down-turned section somewhat expanded and flattened, the tip broad and rounded in lateral view (Fig. 7F). Inferior appendage almost as long as superior, robust, the scoop not much expanded, only slightly broader than the stem in ventral view (Fig. 8F), turned up slightly at the tip, the spine robust and directed inwards, upwards and slightly rearwards.

Measurements (mm): Abdomen without anal appendages 37.5, superior anal appendages ca 1.25, Hw 21.5.

**Description of female paratype.** — Based on SAR06\_PST61, as male except as noted.

Head: basal half of labrum blue, rest black.

Thorax: posterior pronotal lobe without lateral process. Synthorax very similar to holotype male, but ground colour of sides brown rather than black and antehumeral marking slightly longer. Wings almost identical to holotype male, with 13 Px in Fw, 12 in Hw, but pterostigma darker.

Abdomen: S8 dark above with a small, poorly defined, blue dorsal-lateral mark, S9 dark dorsally, brown laterally, with large but poorly defined blue patch dorsal-laterally in the apical half, S10 dark above, pale at sides. Superior anal appendages ca same length as S10. Valves of ovipositor mostly pale, their tip only a little beyond the level of the tips of the superior anal appendages.

Measurements (mm): Abdomen without appendages or ovipositor 30.5, Hw 20.5, ovipositor ca 1.5.

**Variation in paratypes.** — Males: The extent of dark colouration on the propleuron and middle pronotal lobe is somewhat variable and there is a small amount of variation in the length of the antehumeral stripes and the lateral processes of the posterior pronotal lobe. The blue marking on S9 is often reduced compared to the holotype and in one paratype it is almost circular. The dorsal projection of the superior appendage is frequently more prominent in lateral view, but this is largely a matter of how the appendages are lying. In one specimen the upper spur of the interior projection of the superior appendage is only developed on one side, and is not directed rearwards; in the smallest paratype the upper spur is minute.

Females: In two of the paratypes there are rudimentary lateral processes on the posterior pronotal lobe.



Fig. 20. Distribution of *T. dayak* (circle), *T. gading* (triangle), and *T. serapi* (square).

Measurements (mm): Males: Abdomen without anal appendages 32.5–39, Hw 19–23.5. Wings with 12–14 Px in Fw, 11–12 in Hw. Females: Abdomen without appendages or ovipositor 30–35, Hw 20–22.5. Wings with 13–14 Px in Fw, 11–13 in Hw.

**Remarks.** — The female is associated with the male by reasonable supposition based on its co-occurrence with males and similarity of markings and colouration.

**Biological notes.** — *T. serapi* is a common species where it occurs. Males are found at small, high gradient streams, where they perch at the streamside. On Gunung Serapi it is frequently found at forest edge drains running beside the road that runs up the mountain, and which divert small streams that would otherwise run across the road. It frequently occurs together with *T. bidayuh* and *Drepanosticta rufostigma*.

**Distribution.** — *T. serapi* is known only from the Matang range in Kuching Division, west Sarawak (Fig. 20).

#### *T. feronia*-group: *T. dayak*-subgroup

##### *Telosticta berawan*, new species

(Figs. 9A, 10A, 11A, H, 12A, 13A, 14A, 22)

*Drepanosticta* new species – Dow & Reels, 2008: 3

*Drepanosticta* ?new species – Dow & Reels, 2009: 14, 16

**Material examined.** — Holotype: male (SAR06\_PST40), Malaysia, Sarawak, Miri Division, Gunung Mulu National Park, high gradient forest stream on lower slopes Gunung Mulu, ca 500 m, 19 Feb. 2006, coll. RAD, to be deposited in RMNH.

Paratypes: 2 females (SAR07\_8\_PST199–200), same location as holotype, 5 Jan. 2008, coll. LS; female (SAR07\_8\_PST124), same location, 12 Jan. 2008, coll. RAD; female (SAR07\_8\_PST233), same location, 11 Sep. 2008, coll. RAD; male (SAR07\_8\_PST236), Miri Division, Gunung Dulit, steep forest steam, ca 750–800 m, 27 Aug. 2008, coll. RAD. Paratypes currently in collection RAD.

Others: teneral male, Miri Division, Gunung Dulit, steep forest steam, ca 750–800 m, 30 Aug. 2008, coll. RAD, excluded from type series because of condition of specimen.

**Diagnosis.** — The male of *T. berawan* is readily distinguished from other species of *Telosticta* except for *T. ulubaram*, *T. dayak*, *T. paruati*, and *T. kajang* by the form of its superior anal appendage, with a distinct deep cleft in the tip, easily visible in lateral view. It is easily distinguished from *T. paruati* by having a much shorter interior projection on the superior appendage. It is distinguished from *T. dayak* by having the arms of the cleft in the tip of the superior anal appendage of unequal length in typical lateral view, and by having longer antehumeral stripes. It is distinguished from *T. ulubaram* by size and orientation of the interior projection of the superior anal appendage, and by the depth of the inner groove above the cleft in the tip of the superior appendages as seen in dorsal view, very deep in *T. ulubaram* with the bases of the two arms appearing as large rounded knobs in dorsal view, compared to shallow in *T. berawan*, with the

tip of the appendage appearing narrow in dorsal view. It is separated from *T. kajang* by having a slightly shorter and more basal interior projection on the superior anal appendages and a ‘U’ shaped rather than ‘V’ shaped cleft in their tip, a shorter interior projection, and pale dorsal markings only on abdominal segment 8.

**Etymology.** — *berawan*, a noun in apposition; named for the Berawan people, who live in the Mulu area.

**Description of holotype male.** — Head: Labium pale. Labrum yellow except narrowly along free margin, where shining black. Anteclypeus yellow, postclypeus shining black. Mandible bases yellow in corner by clypeus, indistinctly coloured below, genae black except narrowly beside mandible bases, where obscurely pale. Vertex and frons bronzy black, occiput shining black. Ratio of width of compound eye to width of vertex measured at level of lateral ocelli ca 9/10. Transverse occipital carina with lateral extremities angulated and prominent. Ocelli whitish-yellow. Antenna (that on left missing) with top of scape and all of pedicel pale, rest black.

Thorax: Prothorax, except for the posterior pronotal lobe, yellow. Posterior lobe black, becoming obscurely pale on the lower two-thirds of the lateral processes, which are long (Fig. 9A) with the tip at the level of the lower margin of the propleuron. Synthorax: Mesepisternum black, with a pair of broad dull yellow antehumeral stripes, occupying ca 2/3 of the length (Fig. 10A). Antealar triangles pale. Mesepimeron largely black. Metepisternum almost entirely yellow, a black wedge in lower corner by antealar carina, this extending narrowly along metepleural suture for some distance. Metepimeron entirely yellow. Venter of synthorax pale. Legs: each with coxa and trochanter yellow, femur same, with obscure grey markings, black above tibia. Tibia black below femur, then yellowish cream, brown just above tarsus, which is mostly pale but brown at either end and with brown claws. Wings: 11 (right) to 12 (left) Px in Fw, 11 Px in Hw. Vein ab present. Arculus slightly distal to Ax2.  $R_4$  arising distal to subnodus,  $IR_3$  joined to it by a short stalk. Pterostigma approximately trapezoidal with costal side slightly shorter than anal side, and proximal side slightly shorter than distal side, black with narrow white border, covering slightly more than one underlying cell.

Abdomen: Largely pale brown, darkening to rear. S1 yellowish cream, dark brown behind posterior carina, and a black basal dorsal mark. S2 with a pale basal annulus, laterally this extending to the posterior carina as a pale wedge, otherwise brown. S3–6 brown with a narrow pale basal annulus and a becoming darker apically, S7 mostly black dorsally, brown and black laterally, becoming whitish near tergal margin. S8–10 black with a whitish dorsal-lateral marking on S8 (Figs. 11A, 13A). Anal appendages (Figs. 12A, 13A, 14A) largely black except interiorly towards the tips. Superior appendage nearly three times the length of S10, with interior projection at ca 1/3 length directed inwards and downwards, large, blunt ended, dorsal projection barely developed as a rounded inward directed swelling. Expanded

dorsal-ventrally in distal 1/3, with a 'U' shaped cleft at tip, with the lower arm of the cleft shorter than upper, on interior side a shallow groove above the cleft between the bases of the two arms. Inferior appendage almost as long as superior, stem robust, scoop only slightly expanded, in ventral view curved inwards and then rearwards in terminal part, spine directed inwards, upwards and slightly to rear, its tip turned more to rear.

Measurements (mm): Abdomen without anal appendages 37, superior anal appendages ca 1.25, Hw 20.

**Description of female paratype.** — Based on SAR07\_8\_PST124. As male except as noted.

Head: Labrum with a small black central spot in the pale marking. Antenna with scape and pedicel almost entirely pale.

Thorax: Lateral processes absent on posterior pronotal lobe. Dark mesepisternal stripe extending narrowly to the spiracle. Wings with 12 Px in Fw, 11–12 Px in Hw.

Abdomen: S7 with a broad pale basal annulus, S8 largely occupied by a pale bluish marking, S9–10 black. Ovipositor with valves mostly pale, extending well beyond the tips of the superior anal appendages. Superior anal appendages clearly shorter than S10.

Measurements (mm): Abdomen without anal appendages or ovipositor 32.5, ovipositor ca 2, Hw 21.

**Variation in paratypes.** — The male from Dulit has the lateral processes of the posterior pronotal lobe slightly longer than in the holotype, reaching just beyond the lower margin of the propleuron. The colour of the pale markings on the synthorax is bluish green rather than yellow. The female paratypes are very similar to one another, except that the size of the central black spot on the labrum is larger in two specimens and entirely absent in another. One female has lateral processes on the posterior pronotal lobe, very similar to the male, but slightly more slender.

Measurements (mm): Male: Abdomen without anal appendages 37.5, Hw 21. Wings with 13 Px in Fw, 12 in Hw. Females: Abdomen without appendages or ovipositor 32–34, Hw 20–22.5. Wings with 12–13 Px in Fw, 11–12 in Hw.

**Remarks.** — The female is associated with the male only by supposition based on occurrence at the same site as the males on Gunung Mulu and similarity of colouration and markings. In life the pale markings of both sexes of the Gunung Mulu population present a strong yellow colouration. The teneral male from Dulit, excluded from the type series, questionably belongs to this species, agreeing with it in the few details that can be reliably examined given its condition; the anal appendages are shrivelled and no conclusions can be drawn from them.

The closest relative of *T. berawan* appears to be the very

similar *T. kajang*, from which it differs morphologically only in small details. However the known populations of the two are isolated from one another, and in the absence of concrete evidence to the contrary, it appears better to treat them as distinct species.

**Biological notes.** — *T. berawan* is known from small high gradient streams in mixed dipterocarp forest on mountains from 500–800 m. The holotype male was perched well above head height when caught; the paratype from Mount Dulit was perched some way back from the top of a steep stream bank. At the site on Gunung Mulu the supposed female is encountered with some regularity and has been observed apparently ovipositing into the midrib of broad leaves overhanging the stream, but the only male that has been observed is the holotype; it appears that the male of this species is secretive in its habits and does not spend much time close to the supposed larval habitat.

**Distribution.** — Fig. 22; so far only known from two mountains in north-east Sarawak Gunung Mulu in Miri Division and Mount Dulit which straddles the border of Miri and Kapit Divisions; *T. berawan* has been found only on the Miri side of the range to-date.

#### *Telosticta dayak*, new species

(Figs. 9B, 10B, C, 11B, C, I, 12B, 13B, C, 14B, 20)

*Protosticta feronia* — Thompson & van Tol, 1993: 59, 64, 69; Orr, 2001: 190; 2003: 38, 69 (part)

*Protosticta* species cf. *feronia* — Dow & Reels, 2010: 16–18 (note)

*Protosticta* aff. *feronia* — van Tol et al., 2009: 26–28, 30–33, 64, 67

**Material examined.** — Holotype: male (SAR07\_8\_PST20), Sarawak, Miri division, Lambir Hills National Park, tributary to stream crossed by Inoue Trail, 22 Dec. 2007, coll. RAD, to be deposited in RMNH.

Paratypes. Sarawak (all coll. RAD and in collection RAD unless otherwise noted, examples to be deposited in BMNH and ZRC): 7 males (SAR07\_8\_PST133–135, 137–140), Bintulu Division, Similajau National Park, small stream on Circular Trail, ca 20–30 m, 2 Feb. 2008; 2 males (SAR07\_8\_PST206–207), same location and date, coll. GTR; male (SAR07\_8\_PST192), same location, 4 Feb. 2008, coll. GTR; male (SAR07\_8\_PST53), same national park, small stream on Selunsur Trail, 3 Feb. 2008; 5 males (SAR09\_10\_PST8–12), Bintulu Division, SPFP, Kakus district, Bukit Jugam, small stream in disturbed Kerangas forest, ca 90 m, 24 Aug. 2009; male (SAR09\_10\_PST15), same location and date, coll. OT; 2 males (SAR09\_10\_PST14, other in ethanol), same district, tributaries to stream at Camp C acacia nursery, ca 50 m, 25 Aug. 2009; male (SAR09\_10\_PST397), same location, 20 Jun. 2010; 2 males (SAR09\_10\_PST314–315), same location, 21 Jun. 2010; 12 males (SAR09\_10\_PST324–325), same location, 25 Jun. 2010; 9 males (SAR09\_10\_PST338–346), female (SAR09\_10\_PST347), same district, steep tributary to stream 'A' in block K2L, ca 100 m, 26 Jun. 2010; male (SAR09\_10\_PST310), same location and date, coll. S. Stone; 3 males (SAR09\_10\_PST311–313), same district, tributary to stream 'B', ca 130 m, 23 Jun. 2010; 2 males (SAR09\_10\_PST320, other in coll. OT without number), same district, stream at Kapur Camp, ca 90 m, 29 Jun. 2010; male (SAR09\_10\_PST308), same

location, 1 Jul.2010; 5 males (SAR05\_PST19–23), Miri Division, Lambir Hills National Park, small steep trickles in vicinity of Pantu waterfall, 11 May 2005; 2 males, same location, 15 May 2005; 6 males (SAR06\_PST42, 112–116), female (SAR06\_PST165, in tandem with male SAR06\_PST42), same location, 1 Feb.2006; 3 males (SAR06\_PST87–89), same location and date, coll. GTR; 2 males, same national park, small stream in Latak valley, 13 May 2005; 2 males (SAR06\_PST117–118), same national park, tributaries to stream crossed by Main Trail beyond Pantu waterfall stream, 2 Feb.2006; 2 males (SAR06\_PST90–91), same location and date, coll. GTR; male (SAR07\_8\_PST21), same national park, tributary to stream crossed by Inoue Trail, 22 Dec.2007; 6 males (SAR11\_12\_PST30–35), same national park, small hill stream, 21 Apr.2011; 3 males, 2 females (SAR11\_12\_PST5–9), same national park, stream on Oil Well Trail, 22 Apr.2011; 3 males (SAR07\_8\_PST163–165), Gunung Mulu National Park, foot of Gunung Mulu, small stream near Camp 1, ca 200 m, 4 Jan.2008; female (SAR07\_8\_PST125), same area, trailside on Summit Trail near Camp 1, 11 Jan.2008; 1 female (SAR07\_8\_PST267), same area, stream on old trail to Sarawak Chamber, ca 80 m, 13 Jan.2008; 2 males, same national park, Sg. Putut, tributary of Sg. Melinau, 10 Oct.2009, coll. SB. Brunei (all in RMNH, all coll. D. Thompson): 4 males (JvT 5062–5), female (JvT 5074), Ulu Belait, between Ingai and Topi rivers, stream in tropical heath forest, 28 Sep.1992; male, female (in tandem, JvT 5027–8), same area, tributary of Ingai river with stony substrate in mixed dipterocarp forest, 30 Sep.1992.

Others: male, Sarawak, Kapit division, Dulit Range, western face of main Dulit ridge, side of broad rocky stream, ca 965 m, 29 Sep.2009, coll. RAD; female, same area, in forest by steep tributary to broad rocky stream, 29 Sep.2009, coll. RAD; 2 males, same area, near head of rocky stream, ca 1020 m, 30 Sep.2009, coll. RAD.

**Diagnosis.** — The male of *T. dayak* is readily distinguished from other species of *Telosticta* except for *T. berawan*, *T. kajang*, *T. ulubaram*, and *T. paruati* by the form of its superior anal appendage, with a distinct cleft in the tip, easily visible in lateral view. It is easily distinguished from *T. paruati* by having a much shorter interior projection on the superior appendage. It is distinguished from *T. berawan*, *T. kajang*, and *T. ulubaram* by the having the arms of the cleft of the tip of the superior appendage of the same length in typical lateral view.

**Etymology.** — *dayak*, a noun in apposition; named for all the Dayak races. Dayak is a collective term used for Borneo's indigenous inhabitants.

**Description of holotype male.** — Head: Labium pale. Basal 1/2 of labrum blue, black along free margin. Anteclypeus blue, postclypeus shining black. Mandible bases blue in corner by clypeus, black below. Vertex and frons bronzy black, occiput shining black. Ratio of width of compound eye to width of vertex measured at level of lateral ocelli ca 9/10. Transverse occipital carina with lateral extremities angulated and prominent. Ocelli whitish. Antenna with top of scape and basal 3/4 of pedicel greyish, rest dark brown, flagella missing.

Thorax: Prothorax, largely yellowish white except in upper rear of propleuron, rear part of middle pronotal lobe and whole posterior pronotal lobe, where black. Lateral pronotal

processes well formed, smoothly rounded and moderately long (Fig. 9B) with the tip falling short of the level of the lower margin of the propleuron. Synthorax: Mesepisternum bronzy black, with a pair of pale blue antehumeral markings, occupying ca 1/2 of the length (Fig. 10B). Antealar triangles largely blue. Mesepimeron bronzy black. Metepisternum largely occupied by a pale band, becoming blue towards wing bases, with a bronzy black wedge below, this extending from the wing bases to the metinfraepisternum but only well defined over the upper ca 1/3 of this distance. Metepimeron mostly pale, with an indistinct brownish area below the metepleural suture. Venter of synthorax pale. Legs: each with coxa and trochanter cream, femur dirty cream with a dark stripe along extensor surface, another on flexor surface of anterior femur only, black above joint. Tibia black immediately below femur, then mostly pale, brown just above tarsus, which is mostly pale but dark at joints end and with pale brown claws. Wings: 11 Px in Fw, 10 Px in Hw. Vein ab absent. R<sub>4</sub> arising distal to subnodus in Fw, at subnodus in Hw, IR<sub>3</sub> joined to it by a short stalk. Pterostigma approximately trapezoidal with costal side shorter than anal side, and proximal side slightly shorter than distal side, greyish brown with prominent white border, covering slightly more than one underlying cell.

Abdomen: Largely brown, darker dorsally after S1 and darkening to rear. S1 yellowish cream, dark brown behind posterior carina. S2 with a pale basal annulus, broadly interrupted dorsally, laterally this extending to the posterior carina as a pale wedge, otherwise brown. S3–7 brown with a narrow pale basal annulus interrupted dorsally, becoming less distinct on successive segments; each segment becoming darker apically. S8–10 black with a large sub rectangular pale blue dorsal marking centrally on S8 (Fig. 11B, I) and a tiny pale mark dorsally on S9. Appendages (Figs. 12B, 13B, 14B) brown, this dark basally and towards tip of superior pair. Superior appendage ca 2.5 times the length of S10, with interior projection at just over 1/3 length directed inwards and downwards so clearly visible in lateral view, but with a sharp upward and distally directed spur. Dorsal projection poorly developed as a rounded upward directed swelling. Expanded dorsal-ventrally in distal ca 1/3, with a 'U' shaped cleft at tip, with the lower arm of the cleft the same length as the upper, the two arms separated by a hollow after the cleft on the interior side. Inferior appendage almost as long as superior, stem robust, scoop expanded and upturned at tip, spine robust and directed inwards, upwards and to rear.

Measurements (mm): Abdomen without anal appendages 36, superior appendage ca 1, Hw 20.

**Description of female paratype.** — Based on SAR06\_PST165. As male except as noted.

Head: antenna with top of scape and most of pedicel cream coloured.

Thorax: Antehumeral stripes slightly longer than in male, extending more than half the length of the mesepisternum. Dark mesepisternal stripe better defined than in male. Wings: 12 Px in Fw, 11 in Hw.

Abdomen: brown colouration generally slightly lighter than in male. Dorsum of S8 largely occupied by pale blue mark, S9–10 entirely dark brown and black. Superior anal appendages shorter than S10. Ovipositor long, valves extending well beyond tips of superior appendages, mottled cream, dark brown and black.

Measurements (mm): Abdomen without appendages or ovipositor 33.5, Hw 20.5, ovipositor ca 2.

**Variation in paratypes.** — There is quite considerable variation in size in both sexes. There is significant variation in the male paratypes in the pale marking on the dorsum of S9; in some individuals it is larger than in the holotype, in others it is smaller and in many, especially in the western part of the species range, it is entirely absent. The S8 mark is also variable in shape, sometimes triangular with apex pointing to the base of the segment, sometimes rather irregular, and occasionally joined to the segment base by a narrow stalk. Some individuals have antehumeral stripes that are slightly shorter or longer; in one individual from Lambir Hills the antehumeral markings are reduced to a pair of faint asymmetrically placed patches. The lateral processes of the posterior pronotal lobe are longer in many individuals, reaching the level of the lower margin of the propleuron. The dorsal projection of the superior appendage is more evident in many of the paratypes. There is some small variation in the depth and openness of the cleft in the tip of the superior appendage; this does not appear to be correlated with populations across most of the known range of the species. The orientation of the interior projection is constant. The spine on the inferior appendage frequently has a short distally directed spur near the tip.

The known population in Brunei appears to differ consistently from the norm in having a shallower cleft in the tip of the superior appendages (Fig. 13C) and shorter antehumeral stripes (Fig. 10C). The short antehumeral stripes are shared with specimens from Sungai Putut at Gunung Mulu National Park, the closest of the Sarawak populations to the Brunei population, but the Sungai Putut specimens have typical superior appendages. The intermediate nature of the Sungai Putut population suggests that the Brunei population merely represents an extreme of geographical variation.

Females show variation in the lateral processes of the posterior pronotal lobe, in the female taken in tandem in Brunei the lateral processes are entirely absent, as they are in females from Mulu; however in another female from Brunei they are present. The ovipositor is also shorter in the females from Gunung Mulu, reaching barely beyond the tips of the superior anal appendages.

Measurements (mm): Males: Abdomen without anal appendages 32–39, Hw 18–21. Wings with 10–14 Px in Fw, 10–12 in Hw. Females: Abdomen without appendages or ovipositor 30–35, Hw 18–23. Wings with 12–14 Px in Fw, 11–13 in Hw.

**Remarks.** — The material from Mount Dulit excluded from the type series differs in a number of respects: they are longer (male abdomen without anal appendages 40.5–44, Hw 23–25; female abdomen 39.5, Hw 25) with a more robust build, vein ab is present and the males all have a large blue marking on the dorsum of S9 (Fig. 11C). The male anal appendages do not differ in any significant way, suggesting that these specimens represent a local, montane form of *T. dayak*. However the female specimen, associated with the males by reasonable supposition based on near co-occurrence and similarity of markings, does differ from typical female *T. dayak* in the length of its ovipositor, the tip of which barely extends beyond the tips of the superior appendages, as in females from Gunung Mulu also associated with *T. dayak* by reasonable supposition, compared with well beyond in typical *dayak* from Lambir Hills.

**Biological notes.** — *T. dayak* has been found in a variety of forest types, at small streams usually, but not always, in hilly terrain. At Lambir Hills and one of the sites at Gunung Mulu it is found in mixed dipterocarp forest; at most other locations the habitat can be classified as kerangas forest but the Gunung Dulit population occurs in montane forest. At Similajau, a coastal location, it occurs on low gradient streams. Males perch at the side of the stream and are often plentiful.

**Distribution.** — This species is quite widely distributed in Brunei and Sarawak as far west as Bintulu Division (Fig. 20).

#### *Telosticta kajang*, new species (Figs. 9C, 10D, 11D, J, 12C, 13D, 14C, 21)

*Drepanosticta* new species — Dow & Ngiam, 2012: 11

**Material examined.** — Holotype: male (SAR11\_12\_PST22), Malaysia, Sarawak, Kapit Division, Hose Mountains, Gunung Kajang area, at side of stream at 900–1000 m, 6 Apr. 2011, coll. RAD, to be deposited in RMNH.

**Diagnosis.** — The male of *T. kajang* is readily distinguished from other species of *Telosticta* except for *T. berawan*, *T. dayak*, *T. paruatia* and *T. ulubaram* by the form of its superior anal appendage, with a distinct, deep, 'V' shaped cleft in the tip, easily visible in lateral view. It is easily distinguished from *T. paruatia* by having a shorter interior projection on the superior appendage, much shorter than the distance from S10 to the base of the projection. It is distinguished from *T. ulubaram* by the depth of the inner groove above the cleft in the tip of the superior appendages as seen in dorsal view, very deep in *T. ulubaram* with the bases of the two arms appearing as large rounded knobs in dorsal view, compared to shallow in *T. kajang*. It is distinguished from *T. dayak* by having the arms of the cleft in the tip of the superior anal appendage of unequal length in typical lateral view. It is separated from *T. berawan* by having a slightly longer and less basal interior projection on the superior anal appendages, the shape of the cleft in the tip of the superior appendages and pale dorsal markings on abdominal segment 9.

**Etymology.** — *kajang*, a noun in apposition. Named for the area of the type locality.

**Description of holotype male.** — Head: Labium pale. Basal 2/3 of labrum blue, black along free margin. Anteclypeus blue, postclypeus shining black. Mandible bases blue in corner by clypeus, black below. Vertex and frons bronzy black, occiput shining black. Ratio of width of compound eye to width of vertex measured at level of lateral ocelli ca 9/10. Transverse occipital carina with lateral extremities angulated and prominent. Ocelli whitish. Antenna with top of scape and basal 3/4 of pedicel greyish, rest black, flagella missing.

Thorax: Prothorax, largely creamy white except in upper rear of propleuron, a central black diamond shape mark on anterior lobe, rear half of middle pronotal lobe and whole posterior pronotal lobe, where black, except the lateral processes which are grey. Lateral pronotal processes well formed and long (Fig. 9C) with the tip falling short of the level of the lower margin of the propleuron. Synthorax: Mesepisternum bronzy black, with a pair pale blue antehumeral stripes, occupying ca 2/3 of the length (Fig. 10D). Antealar triangles black. Mesepimeron bronzy black. Metepisternum largely occupied by a pale band, becoming blue towards wing bases, with a bronzy black wedge below, this extending from the wing bases to the metinfraepisternum. Metepimeron mostly pale, narrowly black below the metepleural suture. Venter of synthorax pale. Legs: each with coxa and trochanter cream, femur dirty cream with a dark stripes along extensor and flexor surfaces, black above joint. Tibia black immediately below femur, then mostly pale, black just above tarsus, which is mostly pale but dark at joints and with pale brown claws. Wings: 14 (left) to 15 (right) Px in Fw, 14 Px in Hw. Vein ab present. R<sub>4</sub> arising distal to subnodus in both wings, IR<sub>3</sub> joined to it by a short stalk, ab present in all wings. Pterostigma approximately trapezoidal with costal side shorter than anal side, and proximal side slightly shorter than distal side, black with white border, covering slightly more than one underlying cell.



Fig. 21. Distribution of *T. belalongensis* (black circle), *T. dupophila* (open circle), *T. kajang* (square), and *T. ulubaram* (triangle).

Abdomen: Largely very dark brown to black with some paler lateral markings. S1 mostly very dark brown, dirty cream at sides basally. S2 with a pale basal annulus, broadly interrupted dorsally, laterally this extending to the posterior carina as a pale wedge, otherwise dark brown. S3–7 brown with a narrow, poorly developed pale basal annulus interrupted dorsally, becoming less distinct on successive segments; each segment becoming darker apically. S8–10 black with a large sub rectangular pale blue dorsal marking on S8 and another on S9 (Fig. 11D, J). Appendages (Figs. 12C, 13D, 14C) mostly black. Superior appendage nearly 3 times the length of S10, with interior projection at ca 1/3 length directed inwards and downwards so clearly visible in lateral view, but with a sharp upward and slightly distally directed spur. Dorsal projection barely developed as a rounded inwards directed swelling, not apparent in lateral view. Expanded dorsal-ventrally and slightly laterally in distal ca 1/3, with a narrow 'V' shaped cleft at tip, with the lower arm of the cleft just shorter than the upper, but flattened and gently curved in profile, the upper branch robust and blunt ended, on interior side a shallow groove above the cleft between the bases of the two arms. Inferior appendage almost as long as superior, stem moderately robust, scoop expanded and up- and out-turned at tip, spine robust and directed inwards, upwards and to rear.

Measurements (mm): Abdomen without anal appendages 40, superior appendage ca 1.25, Hw 23.5.

**Female.** — Unknown

**Remarks.** — See under *T. berawan* for a discussion of the similarity of the two species.

**Biological notes.** — The unique male of *T. kajang* was found perched high and slightly back from a steep stream in disturbed forest at 900–1000 m.

**Distribution.** — Known only from the Gunung Kajang area of the Hose Mountains in Sarawak's Kapit division (Fig. 21).

***Telosticta paruata* (van Tol, 2005), new combination**  
(Figs. 9D, 11E, 12D, 14D, 23)

*Drepanosticta paruata* van Tol, 2005a: 201, 204, 242, 255–257, 280, Figs. 71–73, 107; 2009: 17

*Drepanosticta* sp. n. 19 — Hämäläinen & Müller, 1997: 258, 277

*Drepanosticta* sp. n. — Hämäläinen & Müller, 1997: 304

**Material examined.** — Holotype: male (JvT 20337), Philippines, Palawan, San Vicente, Port Barton, waterfall, 28 May 1991, coll. R.A. Müller, in RMNH.

**Diagnosis.** — The male of *T. paruata* is easily distinguished from that of other *Telosticta* species, except *T. berawan*, *T. dayak*, *T. kajang*, and *T. ulubaram*, by the form of the superior anal appendages, with a conspicuous cleft in the tip. It is distinguished from the species named above by the relatively basal position of, and the length of the interior process of the superior anal appendage, nearly as long as the distance

from the base of the appendage to the base of the projection in *paruasia* but much shorter in the others.

**Remarks.** — The ratio of width of compound eye to width of vertex measured at level of lateral ocelli is just below 9/10 in *T. paruasia*. The illustration in van Tol (2005a: Fig. 72) of the superior anal appendages of *T. paruasia*, shows the interior projections with tips more bulbous than they actually are (Fig. 12D).

**Distribution.** — Only known from the type locality on Palawan (Fig. 23).

***Telosticta ulubaram*, new species**

(Figs. 9E, 10E, 11F, K, 12E, 13E, 14E, 21)

**Material examined.** — Holotype: male (SAR07\_8\_PST15), Upper Baram, stream near Merawa Timber camp, ca 1010 m, 12 Dec. 2007, coll. RAD, to be deposited in RMNH.

Paratypes: All from Miri division, Sarawak all coll. RAD unless otherwise noted and currently in collection RAD, examples to be deposited in BMNH and ZRC: male (SAR05\_PST1), Tama Abu Range, Bario area, tributary to Bario's water catchment stream, ca 1100 m, 3 Apr. 2005; male (SAR05\_PST15), same location, trailside, 19 May 2005; male (SAR05\_PST25), same area, trailside on way to "the Gap", 20 May 2005; male (SAR07\_8\_PST14), data as holotype; 2 males (SAR07\_8\_PST84–85), Upper Baram, Long Banga water catchment area, tributary to Sungai Aro Lano, ca 900 m, 16 Dec. 2007; 2 males (SAR07\_8\_PST62–63), same data, coll. G.T. Reels.

**Diagnosis.** — Readily distinguished from other species of *Telosticta* except for *T. berawan*, *T. dayak*, *T. paruasia*, and *T. kajang* by the form of its superior anal appendage, with a distinct deep cleft in the tip, easily visible in lateral view. It is easily distinguished from *T. paruasia* by having a much shorter interior projection, shaped like the head of an axe, on the superior appendage. It is distinguished from *T. dayak* and



Fig. 22. Distribution of *T. berawan* (triangle), *T. santubong* (circle), and *T. tubau* (cross).

*T. kajang* by the shape of the tip of the superior appendage, and from the former by having longer antehumeral stripes. It is distinguished from *T. berawan* by the depth of the inner groove above the cleft in the tip of the superior appendages as seen in dorsal view, very deep in *T. ulubaram* with the bases of the two arms appearing as large rounded knobs, compared to shallow in *T. berawan*, with the tip of the appendage appearing narrow in dorsal view.

**Etymology.** — *ulubaram*, a noun in apposition, compounded from the Malay *ulu* (= upper) + *baram*, a place name. Named for the upper parts and headwaters of the Baram river: all the known sites for this species are in the watershed of the river, in the upper Baram area.

**Description of holotype male.** — Head: Labium pale. Basal 2/3 of labrum blue, black along free margin. Anteclypeus blue, postclypeus shining black. Mandible bases blue in corner by clypeus, black below. Vertex and frons bronzy black, occiput shining black. Ratio of width of compound eye to width of vertex measured at level of lateral ocelli ca 9/10. Transverse occipital carina with lateral extremities angulated and prominent. Ocelli whitish. Antenna with scape and basal 3/4 of pedicel greyish brown, rest dark brown.

Thorax: Prothorax, largely pale cream except small dark marks to rear of propleuron, a small central diamond shaped marking on the anterior pronotal lobe, a dark brown and black mark at the rear of the middle of the pronotal lobe and whole posterior pronotal lobe, which is black except for the lateral processes, which are grey, becoming paler towards tips, and long (Fig. 9E) with the tip almost at the level of the lower margin of the propleuron. Synthorax: Mesepisternum bronzy black, with a pair long blue antehumeral markings, occupying ca 2/3 of the length (Fig. 10E). Antealar triangles largely bluish-white near wing bases, black elsewhere. Mesepimeron bronzy black. Metepisternum largely occupied by a pale band, becoming blue towards wing bases, with a bronzy black wedge below, this extending from the wing bases to the metinfraepisternum but interrupted below the spiracle. Metepimeron mostly pale. Venter of synthorax pale. Legs: each with coxa and trochanter pale cream, femur yellowish cream, dark along extensor surface, with obscure grey markings, black above tibia. Tibia black below femur, then yellowish cream, black just above tarsus, which is mostly pale but black at either end and with brown claws. Wings: 13 Px in Fw, 12 Px in Hw. Arculus slightly distal to Ax2. Vein ab present. R<sub>4</sub> arising distal to subnodus, IR<sub>3</sub> joined to it by a short stalk. Pterostigma approximately trapezoidal with costal side slightly shorter than anal side, and proximal side slightly shorter than distal side, black with thin pale border, covering slightly more than one underlying cell.

Abdomen: Largely brown, darkening to rear. S1 whitish at side, dark brown and black above and behind posterior carina. S2 with a pale basal annulus broadly interrupted dorsally, laterally this extending to the posterior carina as a pale wedge, otherwise brown. S3–7 brown, becoming darker apically, with a narrow pale basal annulus. S8 black above, with a large pale blue ca rectangular marking occupying much of

the dorsum (Fig. 11F), pale along the tergal margin except apically, this extended narrowly upwards basally to meet the dorsal marking (Fig. 11K). S9–10 black. Anal appendages (Figs. 12E, 13E, 14E) largely black except interiorly towards the tips and at the articulation of the inferior appendage. Superior appendage nearly 5/2 times the length of S10, with interior projection at just over 1/4 length (Fig. 12E) directed inwards and downwards so clearly visible below in lateral view (Fig. 13E), shaped like the head of an axe and forward slanted, with a sharp spur on the outer upper corner. Dorsal projection moderately developed as a rounded upward directed swelling, whole appendage bent strongly downwards from this point. Expanded dorsal-ventrally in distal 1/3, with a 'U' shaped cleft at tip, with the lower arm of the cleft shorter than the upper (Fig. 13E), on interior side above this cleft a deep groove separating the arms, with the tip of the upper arm appearing bulbous and strongly in-turned in ventral view (Fig. 14E). On the outer side the tip of the lower arm extended slightly outwards. Inferior appendage almost as long as superior, robust in lateral and ventral views, scoop only slightly expanded and tapering quite sharply towards tip, where upturned (Fig. 14E), with spine basally broad, directed inwards, upwards and to rear, the tip of this sharp and directed more to rear.

Measurements (mm): Abdomen without anal appendages 48, superior anal appendages ca 1.25, Hw 25.

**Female.** — Unknown

**Variation in paratypes.** — The antehumeral stripes are a little longer in some specimens.  $R_4$  arises at or only just distal to the subnodus in a few specimens. Occasionally the pale marking along the tergal margin of S8 is completely separated from the dorsal marking. The pale dorsal markings on S9 are frequently absent, but in one individual from Long Banga, they are fused into a narrow basal transverse stripe.

Measurements (mm): Abdomen without anal appendages 48–50, Hw 24–26. Wings with 13–15 Px in Fw, 12–13 in Hw.

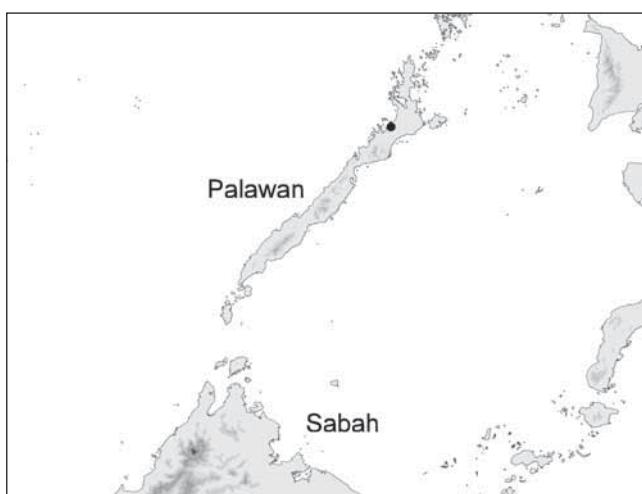


Fig. 23. Distribution of *T. paruata* (circle).

**Biological notes.** — *T. ulubaram* is found at small high gradient streams in mixed dipterocarp forest in mountainous terrain and has not been found below ca 900 m. Males perch at the stream edge at low densities.

**Distribution.** — Known from northeast Sarawak, from the upper Baram area of Miri Division and in the vicinity of Barito in the Tama Abu range (Kelabit Highlands; Fig. 21).

### Ungrouped species

#### *Telosticta longigaster*, new species

(Figs. 9F, 10F, 11G, L, 12F, 13F, 14F, 15A, B, 19)

*Protosticta* sp. A – Orr, 2003: 38, 69–70, 148–149, pl. 6c

*Protosticta* sp. B – Orr, 2001: 191

*Protosticta* species – Dow & Reels, 2008: 3

*Protosticta* new species – Dow & Reels, 2009: 14, 16; Dow & Ngiam, 2012: 11

**Material examined.** — Holotype: male (SAR07\_8\_PST210), Malaysia, Sarawak, Miri Division, Gunung Mulu National Park, steep tributary stream to Sungai Long Lansat, 26 Dec. 2007, coll. RAD, to be deposited in RMNH.

Paratypes. Sarawak (all coll. RAD and currently in collection RAD unless otherwise noted; examples to be deposited in BMNH and ZRC): 8 males (SAR07\_8\_PST1–8), Sri Aman Division, Batang Ai National Park, steep tributary to Sungai Bebiong Besar, ca 300–400 m, 4 Dec. 2007; female (SAR07\_8\_PST193), same national park, tributary to Sungai Bebiong Mit, 5 Dec. 2007; male (SAR07\_8\_PST110), same location, 6 Dec. 2007; male (SAR07\_8\_PST103), same national park, Sungai Nanga Beredik, 8 Dec. 2007; 2 males (SAR07\_8\_PST218–219), Bintulu Division, SPFP, Bukit Mina Wildlife Corridor, small forest stream on Bukit Mina, ca 90 m, 23 Jan. 2008; 3 males (SAR07\_8\_PST249–251), same location, 23 Oct. 2008; male (SAR11\_12\_PST27), same location, 1 May 2011, coll. L. Joseph; 2 males (SAR11\_12\_PST28–29), same location, 1 May 2011, coll. OT; 3 males (SAR09\_10\_PST16–17, one in ethanol), Bintulu Division, SPFP, Samarakan area, steep streams in disturbed forest in block T1F, ca 80 m, 21 Aug. 2009; 2 males (SAR07\_8\_PST311–312), Bintulu Division, SPFP, Tubau area, steep trickles in unplanted steep ground in block E2N, ca 150 m, 19 Oct. 2008; male (SAR09\_10\_PST93), same location, 31 Aug. 2009; male (SAR09\_10\_PST398), same location, 15 Jun. 2010; male (in coll. OT), same location and date, coll. OT; female (SAR07\_8\_PST293), same area, stream in unplanted steep ground in block E2N, 19 Oct. 2008; 4 males (SAR09\_10\_PST26–29), female (SAR09\_10\_PST30), same area, steep streams in highly disturbed forest in block E2N, ca 60–70 m, 17 Aug. 2009; male (SAR09\_10\_PST367), same location, 16 Jun. 2010; 3 males, Kapit Division, Lanjak Entimau Wildlife Sanctuary, 18 Jun. 2008, coll. CYC and Y. F. Ng, in coll. CYC; 2 males (SAR07\_8\_PST41–42), Kapit Division, Kapit town area, Sebabei Recreational Park, tiny tributary to Sungai Sebabei, 7 Feb. 2008, coll. GTR; 2 males, female (SAR11\_12\_PST82–84), same location, 2 Apr. 2011; male (SAR07\_8\_PST43), same area, Small tributary to Sungai Kapit above Rumah Bundong, 9 Feb. 2008; 2 males (SAR07\_8\_PST35–36), same location and date, coll. GTR; 2 male (SAR07\_8\_PST216–217); same area, steep tributaries to Sungai Sbong, 10 Feb. 2008; 4 males (SAR07\_8\_PST54–57), female (SAR07\_8\_PST58), same location, 11 Feb. 2008; male (SAR07\_8\_PST33), same location and date, coll. GTR; 2 males (SAR09\_10\_PST122–123), 2 females (SAR09\_10\_PST124–125), same area, second and third order tributaries to Sungai Ulu Yong, 21 Oct. 2009;

8 males (SAR09\_10\_PST183–190), same location, 12 May 2010; 4 males (SAR09\_10\_PST225–228), female (SAR09\_10\_PST229), Kapit Division, Hose Mountains, high gradient stream 920–1020 m, 17 May 2010; 3 males (SAR09\_10\_PST 197, 202–203), female (SAR09\_10\_PST198, in tandem with SAR09\_10\_PST197) same location and date, coll. GTR; 3 males (SAR09\_10\_PST285–287), same mountains, stream at ca 1070–1170 m, 19 May 2010, coll. GTR; female (SAR09\_10\_PST288), same location and date; 3 males (SAR09\_10\_PST302–304), female (SAR09\_10\_PST305), steep stream at foot of Hose Mountains, 21 May 2010, coll. M. Budi & RAD; 2 males (SAR11\_12\_PST56–57), same mountains, Gunung Kajang area, small stream at foot of mountains, 7 Apr. 2011, coll. L. Southwell; male (SAR\_11\_12\_PST54), same area, stream at ca 741 m, 6 Apr. 2011, coll. MK; 2 males (SAR11\_12\_PST103–104), same location, 13 Apr. 2011, coll. MK; male, female (SAR11\_12\_PST71–72), same area, streams between 660 and 840 m, 9 Apr. 2011; 6 males (SAR06\_PST43–45, 47–49), female (SAR06\_PST46), Miri Division, foot of Gunung Dulit, high gradient streams in disturbed forest, 30 Mar. 2006; male (SAR06\_PST23), same area, steep tributary to Sungai Long Aton, 31 Mar. 2006; male (in ethanol, RMNH\_INS\_500008), female (SAR07\_8\_PST299), same area, small stream in disturbed forest near Long Aton, 25 Aug. 2008; male (SAR07\_8\_PST294), same location and date, coll. GTR; 3 males (SAR07\_8\_PST226–228), Gunung Dulit, steep stream at ca 780–850 m, 28 Aug. 2008; male (SAR07\_8\_PST238), same location, coll. GTR; 2 males (SAR07\_8\_PST295–296), 2 females (SAR07\_8\_PST297–298), same area, stream ca 700–800 m, 29 Aug. 2008, coll. S. Malit; 2 males (SAR07\_8\_PST95–96), Miri Division, north Tinjar area, high gradient stream in disturbed forest, 22 Dec. 2007; male (SAR07\_8\_PST270), Miri Division, northern mid Baram area, tributary to Sungai Suan, 11 Dec. 2007, coll. GTR; 3 males (SAR09\_10\_PST348–350), mid Baram area, small streams on lower slopes of Gunung Kalulong, 14 Jul. 2010; male (SAR09\_10\_PST230), same mountain, stream at 700–800 m, 17 Jul. 2010; 2 males (SAR09\_10\_PST242–243), female SAR09\_10\_PST244), same area, streams in disturbed forest at foot of Gunung Kalulong, 21 Jul. 2010, coll. MK; 2 males (SAR09\_10\_PST252–253), female (SAR09\_10\_PST254), same location and date, coll. LS; male (SAR09\_10\_PST336), same area, steep stream on Batu Uro' (a peak adjacent to Gunung Kalulong), 15 Jul. 2010, coll. W. Kebing; female (SAR09\_10\_PST316), same location, 16 Jul. 2010; female (SAR05\_PST100), Miri Division, Gunung Mulu National Park, steep tributary stream to Sungai Long Lansat, 19 Apr. 2005; male (SAR07\_8\_PST211), same location, 26 Dec. 2007; 4 males (SAR07\_8\_PST183–186), female (SAR07\_8\_PST187), same location, 9 Jan. 2008; male (SAR07\_8\_PST117), female (SAR07\_8\_PST118), in tandem, same location and date, coll. SB. Brunei (all from Temburong, Kuala Belalong Field Studies Centre); female, 23 Jan. 1995, coll. AGO, in collection AGO; male (from canopy fogging sample), 11 Jul. 1997, coll. R.L. Kitching, in collection AGO.

**Diagnosis.**—The male of *T. longigaster* is easily distinguished from all other species of *Telosticta* by the distinctively expanded distal half of the superior appendages and the narrow finger-like ends of the inferior appendages. Although variable, the abdomen is always unusually long in proportion to the hindwing, and on this character could be confused only with *T. gading* and *T. ulubaram*.

**Etymology.**—*longigaster*, a noun in apposition. A common neognostic compound of Latin roots used in zoology to denote a long abdomen.

**Description of holotype male.**—Head: Labium pale except end hooks of labial palps, where brown. Basal 3/4 of labrum creamy white, black along free margin. Anteclypeus creamy white, postclypeus shining black. Mandible bases whitish in corner by clypeus, black below. Vertex and frons bronzy black, occiput shining black. Ratio of width of compound eye to width of vertex measured at level of lateral ocelli ca 9/10. Transverse occipital carina with lateral extremities angulated and prominent. Ocelli yellowish. Antenna scape and basal 3/4 of pedicel yellowish, flagella missing.

Thorax: Prothorax, almost entirely yellowish cream except for obscure dirty patches to the rear of the propleuron, to rear of middle pronotal lobe where dark brown, and whole posterior pronotal lobe, which is bronzy black becoming brownish grey on lateral processes, which are long (Fig. 9F) with the rounded tip just above the level of the lower margin of the propleuron. Synthorax: Mesepisternum bronzy black, with a pair of long broad pale greenish blue antehumeral markings, occupying ca 7/10 of the length (Fig. 10F). Antealar triangles largely bluish cream. Mesepimeron bronzy black. Metepisternum largely occupied by a pale band, with a bronzy black wedge below, this extending from the wing bases to just before the spiracle. Metepimeron almost entirely pale. Venter of synthorax pale. Legs: each with coxa and trochanter cream, femur and tibia mostly the same colour, with obscure dark grey marks on the upper part of middle and posterior femur, a narrow black stripe along the extensor surface of anterior femur and black around the joint of femur and tibia, brown just above tarsus, which is mottled cream and brown. Wings: 12 Px in Fw, 11 Px in Hw. Vein ac closer to Ax2 than Ax1, ab absent. Arculus slightly distal to Ax2, sectors separating at 1/4 to 1/3 of length of quadrilateral. R<sub>4</sub> arising slightly distal to subnodus, IR<sub>3</sub> joined to it by a short stalk and arising well distal to the subnodus. Pterostigma approximately trapezoidal with costal side slightly shorter than anal side dark brown with prominent white border, covering slightly more than one underlying cell.

Abdomen: Largely brown, darkening to rear. S1 cream, dark brown behind posterior carina. S2 with a white basal annulus interrupted narrowly dorsally, laterally this extending to the posterior carina as a pale wedge, otherwise brown. S3–7 brown, becoming darker apically, with a narrow pale basal annulus interrupted dorsally, and slightly extended laterally, this more extensive and better defined on S6–7, where the mark does not extend dorsally. S8 mostly black, with a large pale blue ca rectangular marking occupying much of the dorsum (Fig. 11G), pale along the tergal margin, this extended upwards basally to almost meet the dorsal marking (Fig. 11L). S9–10 black. Anal appendages (Figs. 12F, 13F, 14F) black basally, becoming brown towards tips. Superior appendage ca 5/2 times the length of S10, with interior projection at ca 1/3 length directed inwards and then upwards to a sharp tip, not visible in lateral view. Dorsal projection directed upwards, and slightly inwards and forwards as a broad-based rounded spike, very prominent. Broadly expanded in distal 1/2 so broad in dorsal view (Fig. 12F), with the inner part folded downwards with a sinuous lower margin, the fold terminating before the rounded tip (Fig. 13F). Inferior

appendage only slightly shorter than superior, stem narrow and in lateral view down-turned at level of the spine, which is long and directed straight inwards (Fig. 14F). The scoop is barely developed and no wider than the stem, so that the whole appendage after the articulation looks thin and finger like in ventral view (Fig. 14F).

Measurements (mm): Abdomen without anal appendages 43.5, superior anal appendages ca 1.25, Hw 20.

**Description of female paratype.** — Based on SAR07\_8\_PST118, Gunung Mulu. As male except as noted.

Head: Pale markings on labrum, clypeus and mandible bases blue. Antenna with pale parts cream.

Thorax: Prothorax almost identical to male, including the lateral processes. Antehumeral stripes blue. Wings with ab present in left Hw. 12 Px in Fw, 11 (left) or 12 (right) Px in Hw. Pt with costal side shorter relative to anal side than in male.

Abdomen: Coloured similarly to male, but with basal pale annuli better defined and fused dorsally on S5–6 and a broad cream basal annulus on S7. S8 pale blue above except for a narrow black basal band, becoming cream laterally, dark behind posterior carina. Superior anal appendages shorter than S10, very dark brown. Ovipositor mostly dark brown and black with obscure paler areas, especially on the upper apical part, extending well beyond the tips of the superior appendages.

Measurements (mm): Abdomen without appendages or ovipositor 34.5, Hw 19.5.

**Variation in paratypes.** — There is considerable variation in size within this species (see the measurements below), with an apparent trend for smaller size in the more western populations (e.g., those at Batang Ai and Lanjak Entimau and some populations in Kapit and Bintulu Divisions). There is little variation in markings; apart from small variations in size and shape, in some populations a small to tiny pale mark is apparent on the extreme upper part of the mesepimeron immediately below the mesepleural suture on some individuals of either sex. As with size, there is an apparent trend for the mesepimeral marking to be present with greater frequency in the more western populations, although it is present on a male from Brunei. In one female from the Sebabai Recreational Park the antehumeral stripes are almost full length. The antehumeral markings vary from blue to green and the pale parts of the prothorax, lateral synthorax and legs in the male are more intensely yellow in some populations. It is not uncommon for individuals to have ab present in 1–2 wings, and in specimens from above 700 m in the Hose mountains in Kapit Division ab is typically present in all wings.

The most remarkable variation in *T. longigaster* is in the posterior pronotal lobe of the female. In some examples it is like the female described (Fig. 15A), with lateral

processes as in the male, in others the lateral processes reduced to a tiny stump; in these individuals the free corners are typically produced into flattened finger-like processes directed rearwards and that vary from very short to longer than the body of the posterior pronotal lobe (Fig. 15B). On Mount Dulit females with lateral processes and females with short horns occur in the same population. There is some variation in shape in the lateral processes of the male, but they are almost invariably as long as in the holotype; the only exception is one individual with a malformed lateral process on one side.

Measurements (mm): Males: Abdomen without anal appendages 36–48, Hw 18–23. Wings with 10–14 Px in Fw, 9–13 in Hw. Females: Abdomen without appendages or ovipositor 31–38, Hw 20–23. Wings with 11–15 Px in Fw, 11–13 in Hw.

**Remarks.** — The variation in the posterior pronotal lobe of the female of this species is so great that, if examples of both extremes had not been taken in tandem, it would be difficult to believe that they represented the same species. In contrast, no notable variation in the male anal appendages has been detected. With this degree of variation, the role of the female posterior pronotal lobe in a 'lock-and-key' arrangement with the male anal appendages during tandem formation appears unlikely.

**Biological notes.** — It is found on small streams and seepages in steep terrain in mixed dipterocarp forest, and is tolerant of disturbance to its habitats by logging activities. It occurs from near sea level up to at least 1200 m. Females have been observed apparently ovipositing, unaccompanied by any male, into the midrib of leaves at the side of streams and seepages. The first male specimen was collected during a canopy fog in the vicinity of a marshy seepage, at least 100 m from any stream.

**Distribution.** — On present evidence this is the most widely distributed species of *Telosticta* (Fig. 19), occurring from Brunei and adjacent parts of Sarawak to Batang Ai in Sri Aman Division.

***Telosticta belalongensis*, new species**  
(Figs. 16A, C, E, 17A, C, 18A, C, 21)

*Protosticta* sp. A – Orr, 2001: 190  
*Protosticta* sp. B – Orr, 2003: 38, 70, 148–149, pl. 6f

**Material examined.** — Holotype: male, Brunei, Temburong, Kuala Belalong Field Studies Centre, 21 Jan. 1995, coll. AGO, to be deposited in RMNH.

**Diagnosis.** — Distinguished from all other species of *Telosticta* except *T. janeus* by the strongly folded tips of the superior anal appendages. Separated from *T. janeus* by the longer lateral processes of the posterior pronotal lobe, the well developed dorsal projection and absence of a dorsal crest near the end of the superior anal appendages and the shape of the spine and scoop of the inferior anal appendage.

**Etymology.** — *belalongensis*, a feminine adjective, originating from Belalong, a place name. Named for the type locality at the Kuala Belalong Field Studies Centre in Brunei.

**Description of holotype male.** — Head: Labium pale except for end hooks of labial palps, which are brown. Labrum pale blue except narrowly along free margin, where shining black. Anteclypeus pale blue, postclypeus shining black. Mandible bases pale blue in corner by clypeus, dark below. Vertex and frons bronzy black, occiput shining black. Lateral extremities of transverse occipital carina angulated and very prominent. Ocelli whitish. Antennae with scape and most of pedicel pale brown, becoming darker towards top, flagella missing.

Thorax: Prothorax with propleuron dull yellow except along rear margin, where brown. Pronotum with anterior and middle lobes dull yellow except at extreme rear of middle lobe dorsally, where very dark brown. Posterior lobe mostly black, hind margin simple, lateral processes long, reaching almost to the lower margin of the propleuron, rounded and curved with a narrow stalk (Fig. 17A), becoming greyish towards tips. Synthorax: Mesepisternum black, with a pair of narrow pale greenish antehumeral stripes, occupying ca 3/4 of the length (Fig. 16A). Antealar triangles pale greenish. Mesepimeron black. Metepisternum almost entirely occupied by broad yellowish cream stripe with just a black triangular area in the upper lower part. Metepimeron largely pale. Venter of synthorax pale. Legs: each with coxa and trochanter pale, femur pale with a narrow dark stripe along the extensor surface, black above tibia. Tibia dark immediately below femur, then brownish. Tarsi brownish. Wings: veins ac and ab absent except in left Hw, where ac is present; in both Fw there is a tiny stub originating on CuP, only visible on close scrutiny. 10 Px in Fw, 10 (left) or 9 (right) Px in Hw. Arculus distal to Ax2. R<sub>4</sub> arising distal to subnodus in both wings, IR<sub>3</sub> at ca half distance between subnodus and Px1, joined to R<sub>4</sub> by a short stalk. Pterostigma approximately trapezoidal with costal side slightly shorter than anal side, as deep as it is long, brown, covering slightly more than one underlying cell.

Abdomen: Largely brown, darkening to rear. S1 mostly brown with a pale basal area laterally. S2 with a pale basal annulus, interrupted dorsally, laterally extended towards, but not quite reaching, the posterior carina as a pale wedge. S3–6 with a narrow pale basal annulus, interrupted along the dorsal midline on S3 but just meeting on S4–6, on S3 this marking extended laterally as a pale streak along the margin of the tergite for most of its length, but becoming indistinct apically, S4–6 similar but the pale streak less well defined on each. S7 without the basal annulus but with an indistinct pale basal mark S8 black with a pair of narrowly separated pale dorsal markings placed centrally (Figs. 16C). S9 black with a basal dorsal pale marking (Fig. 16C, E). S10 black. Anal appendages (Figs. 17C, 18A, C) largely dark brown and black. Superior appendage slightly more than twice the length of S10, slender but strongly expanded in apical third, with interior projection at ca one third length, dorsal projection well developed and directed inwards (Fig. 18A) so not visible in lateral view (Fig. 18C). In lateral view almost

straight along upper margin, slightly down-turned towards tip, strongly dorsal-ventrally expanded in the apical third, the upper inner margin folded down as a triangular flap (Fig. 18C). Inferior appendage ca the same length as superior, stem relatively narrow in ventral view but robust basally in lateral view and down-turned at level of spine (Fig. 18C), scoop abruptly expanded on interior margin and then immediately contracting (Fig. 17C), running roughly straight along outer edge to a sharp tip, the concave surface turned outwards (Fig. 18C), the spine broad and flattened, directed inwards and rearwards, but only slightly upwards (Fig. 17C, 18C).

Measurements (mm): Abdomen without anal appendages 33.75, superior appendage ca 1.2, Hw 20.

**Female.** — Unknown

**Remarks.** — The markings of the holotype were pale green in life, and the eyes were apple green, dark dorsally.

**Biological notes.** — The unique holotype was collected flying in a sunspot in dense primary mixed dipterocarp forest about 3 m above the ground, some 50 m from the nearest stream. It is evidently very rare and/or fugitive as this locality, close to the KBSFC field station, was surveyed regularly by AGO for nearly five years.

**Distribution.** — *T. belalongensis* is known only from the Kuala Belalong Field Studies Centre in Brunei, where the habitat has been well documented (Cranbrook & Edwards, 1994), (Fig. 21; but also see under *T. undetermined A* below).

#### *Telosticta janeus*, new species

(Figs. 16B, D, F, 17B, D, 18B, D, 19)

**Material examined.** — Holotype: male (JvT 19977), Malaysia, Sabah, Danum Valley, 19 Mar.1987, coll. J. v. Tol, in RMNH.

Paratypes (all from Malaysia, Sabah): 4 males (JvT 19975–9), data as holotype, RMNH; 3 males (JvT 19980–2), same area, brooklet at “West 5”, 160 m, 20 Mar.1987, coll. J. v. Tol, RMNH; 4 males, Imbak Canyon, Ridge Trail, sub camp B, 2 Dec.2010, coll. CYC, in collection CYC; male, same area, “small river”, 3 Dec.2010, coll. CYC, in collection CYC.

**Diagnosis.** — Readily distinguished from all other known *Telosticta* species except *T. belalongensis* by the form of the superior appendages, with the terminal part flattened and folded over on its self. Separated from *T. belalongensis* by its shorter lateral processes of the posterior pronotal lobe; superior anal appendages without a well-developed dorsal projection, but with a dorsal crest near the end, and the shape of the spine and scoop of the inferior anal appendages.

**Etymology.** — *janeus*, a noun in apposition; a Latinised form of Jan, named for Jan van Tol.

**Description of holotype male.** — Head: Labium pale. Basal 4/5 of labrum blue, black along free margin. Anteclypeus

blue, postclypeus shining black. Mandible bases blue in corner by clypeus, black below, genae black. Vertex and frons bronzy black, occiput shining black. Ratio of width of compound eye to width of vertex measured at level of lateral ocelli ca 9/10. Transverse occipital carina with lateral extremities prominent. Ocelli whitish. Antenna with scape and top ca 1/4 of pedicel brown basal 3/4 of pedicel greyish pale, flagellum dark brown (missing on right).

Thorax: Prothorax, largely creamy white with blue patches dorsally on middle pronotal lobe, except to rear of propleuron and the rear part of middle pronotal lobe where black and dark brown with paler areas, and whole posterior pronotal lobe which is black, becoming brown towards tips of lateral pronotal processes, which are moderately long. (Fig. 17B). Synthorax: Mesepisternum bronzy black, with a pair of long pale blue antehumeral markings, tapering to rear and occupying ca 4/5 of the length (Fig. 16B). Antealar triangles mostly black, except at rear where pale. Mesepimeron mostly bronzy black. Metepisternum largely occupied by a pale band, spilling over onto the lower part of the mesepimeron, becoming blue towards wing bases, with a bronzy black wedge below, this extending from the wing bases to the metinfraepisternum. Metepimeron mostly pale, with a dark brown area below the metepleural suture centrally. Venter of synthorax pale. Legs: each with coxa and trochanter cream, femur dirty cream with a narrow dark stripe long the extensor surface, and obscure grey and dark markings elsewhere, black immediately above joint. Tibia similar but more extensive dark stripe on extensor surface and another on flexor surface. Tarsus dirty cream, black around joints, claws pale brown. Wings: 13 Px in Fw, 12 Px in Hw. Vein ab absent.  $R_4$  arising distal to subnodus in Fw, very slightly distal to subnodus in Hw,  $IR_3$  joined to it by a short stalk. Pterostigma approximately trapezoidal with costal side shorter than anal side, and proximal side shorter than distal side, dark brown with slightly paler border, covering slightly more than one underlying cell.

Abdomen: Largely brown, darkening to rear. S1 brown above and to rear laterally, white otherwise. S2 brown with a pale basal annulus (possibly pale blue in life), narrowly interrupted dorsally, laterally extending to the posterior carina as a pale wedge. S3–7 brown with a narrow pale basal annulus interrupted dorsally and extended laterally near lower margin of tergite for a distance, each segment becoming darker apically. S8–10 black with a pair of pale blue dorsal-lateral markings on S8, very narrowly separated dorsally, and a basal dorsal marking on S9 (Fig. 16D, F). Appendages (Figs. 17D, 18B, D) largely dark brown with obscure paler areas interiorly and dorsally. Superior appendage ca 2.5 times the length of S10, with robust but blunt interior projection at ca 1/3 length directed inwards. Dorsal projection a small rounded swelling only narrowly separated from the basal projection, but there is a thin subapical ca semicircular crest, prominent in lateral view. Expanded in distal 1/2 but folded under itself to nearly form an open-mouthed tube with the outer corner produced in a distinctive manner (Fig. 18B). Inferior appendage almost as long as superior, stem robust and scoop strongly expanded

then tapering to tip, up- and out-turned almost immediately, spine directed inwards, slightly upwards and to rear.

Measurements (mm): Abdomen without anal appendages 33, superior appendage ca 1.2, Hw 20.5.

**Female.** — Unknown

**Variation in paratypes.** — There are small variations in the markings of the head and thorax in the paratypes; in particular the extent of the intrusion of the pale stripe on the metepisternum onto the mesepimeron is greater than in the holotype. In one of the Imbak Canyon specimens the antehumeral stripes are shorter, ca 2/3 of the length of the metepisternum. In one paratype the lateral extremities of the transverse carina are much less prominent. There is some variation in the length of the lateral processes of the posterior pronotal lobe, in one case they are longer than in the holotype, in another they are shorter and poorly developed. The colour of the pterostigma varies from deep chestnut brown to almost black and the paler border is often only partially present and varies from just paler than the central part to considerably paler; in one paratype no border is apparent. The S8 dorsal markings are sometimes fused and sometimes more widely separated than in the holotype, and the dorsal part appears to fade somewhat with increasing maturity. The extent of the S9 marking varies considerably, and it is sometimes divided into two. The Imbak Canyon specimens are slightly larger on average than those from the Danum Valley, and have S1 paler dorsally and slightly more extensive pale colouration along the lower margins of S3–7.

Measurements (mm): Abdomen without appendages 31–35, Hw 19.5–22.5. Wings with 11–13 Px in Fw, 10–12 in Hw.

**Biological notes.** — Little has been recorded on the biology of this species, but all specimens have been collected at small streams in mixed dipterocarp forest in hilly or mountainous terrain.

**Distribution.** — Known only from the Danum Valley and Imbak Canyon in Sabah (Fig. 19).

### Identity uncertain

#### *Telosticta* undetermined A

**Material examined.** — 2 males, Malaysia, Sarawak, Miri Division, mid Baram, foot of Gunung Kalulong, small stream in disturbed forest, 20 Jul. 2010, coll. RAD; 1 female, same data but 21 Jul. 2010.

**Remarks.** — The males were freshly emerged when caught and the condition of the specimens does not allow definite identification. However the superior appendages of one of them are in good enough condition that the interior and dorsal projections can be examined, and the general shape of the appendage; it bears a strong resemblance to *T. belalongensis*. The markings, as far as they can be made

out, also broadly agree with *T. belalongensis*. The female is a mature specimen from the same location as the males, taken late in the afternoon and associated with the males only by supposition; its markings are also similar to that of the holotype of *T. belalongensis*. Although these specimens may belong to *T. belalongensis*, they might equally well belong to some other, unnamed species of *Telosticta* and their placement awaits more material.

### *Telosticta* undetermined B

**Material examined.** — 2 females, Malaysia, Sarawak, Miri Division, upper Baram, Lio Matu area, small high gradient stream in disturbed lowland forest, 13 Oct. 2009, coll. RAD.

**Remarks.** — These female specimens might belong to *T. berawan*, but differ in subtle details from the females supposed to be *T. berawan* from Gunung Mulu.

### *Telosticta* undetermined C

**Material examined.** — 1 male, Malaysia, Sabah, Mount Kinabalu National Park, Silau Silau stream, 28 Apr. 2005, coll. unknown.

**Remarks.** — A large sized teneral male, although the condition of the specimen prohibits description, enough of one of the superior anal appendages is intact to show that it is clearly an unnamed species.

### *Telosticta* undetermined D

**Material examined.** — 1 female, Malaysia, Sabah, Mount Kinabalu National Park, Poring Hot Springs, trailside in forest, Mount Kinabalu National Park, Sabah, Malaysia, 29 Apr. 2005, coll. unknown.

**Remarks.** — A mature specimen, possibly the female of *T. janeus*, but equally likely to be that of *T. undetermined C* above or of some other species for which no male specimen has yet been found.

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