

Two new species of *Candalides* Hübner, 1819 (Lepidoptera: Lycaenidae) from Papua New Guinea and Indonesia

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Abstract: Two new species of *Candalides* Hübner, 1819, in the *absimilis* Felder, 1862, species group, from mainland New Guinea, are described and figured: *Candalides brabyi* n. sp. (Upper Sepik, Papua New Guinea, and Papua, Indonesia) and *Candalides skotadi* n. sp. (Trans Fly, Papua New Guinea). Adults of both sexes are illustrated, as are the male genitalia, with *C. brabyi* compared to the related *C. limbata* (Tite, 1963) and *C. skotadi* to *C. ardosiaea* (Tite, 1963) and *C. margarita* (Semper, 1879).

INTRODUCTION

The lycaenid genus *Candalides* Hübner, 1819, is distributed within the Australian region, ranging from the Lesser Sunda Islands through mainland New Guinea and its satellite islands as far east as the Louisiade Group and throughout much of Australia (Tite, 1963; Parsons, 1998; Braby, 2000). There are 34 named species, some of which have been described or synonymised in recent years (Braby & Douglas, 2004; Tennent, 2005; Braby, 2008; Müller, 2013, 2014a). More than half of the known species occur in New Guinea.

The ‘*absimilis*’ group of *Candalides*, as defined by Braby (2000) and Braby & Douglas (2004), is comprised largely of species previously referred to the genus *Holochila* Felder, 1863 by Tite (1963). The group is separable from the remainder of *Candalides* by differences in the labial palpi, androconial scales and underside wing pattern (Braby, 2000). The ‘*absimilis*’ group is the largest within *Candalides*, comprising 23 described species (Parsons, 1998; Braby, 2000, 2008; Tennent, 2006; Müller, 2014a). Members of the ‘*absimilis*’ group are distributed predominantly in rainforest habitats of mainland New Guinea and its adjacent islands and the coastal areas of eastern Australia.

Müller (2014b) concluded, based on examination of several taxa and from the illustrations of Tite (1963), that species of the ‘*absimilis*’ group comprise two sub-groups, separated by the morphology of the valvae of the male genitalia. The majority of taxa have long appendages stemming from the apex of the valva, whereas members of the other, smaller, group possess relatively simple valvae, which may or may not be forked (Müller, 2014b). During an expedition by the first author to the Upper Sepik, Papua New Guinea, during early 2010, both sexes of a distinctive new *Candalides* taxon were collected. Two additional males, from Indonesian Papua, of the same undescribed species were recognised in the private collection of Chris Davenport, Scotland. In examining specimens for comparison in the ANIC, a series of another unusual, undescribed *Candalides* species, collected in the Trans Fly region of Papua New Guinea by William Brandt in the early 1960s, was seen by the first author. This taxon had been separated and labelled in the collection as ‘spec.’ but was overlooked by Parsons (1998) in his account of the butterflies of Papua New Guinea. These two new species from New Guinea are described here.

MATERIALS AND METHODS

Types and other specimens were examined and/or deposited in the following institutions: Australian Museum, Sydney, Australia (AMS), Australian National Insect Collection, Canberra, Australia (ANIC), the Natural History Museum, London, England (BMNH), reference collection of Chris Davenport, Inverness, Scotland (CDC), reference collection of Chris J. Müller, Sydney, Australia (CJMC), reference collection of Michael F. Braby, Canberra, Australia (MFBC), McGuire Center for Lepidoptera and Biodiversity, Gainesville, USA (MGCL) and the National Agricultural Research Institute, Port Moresby, Papua New Guinea (NARI).

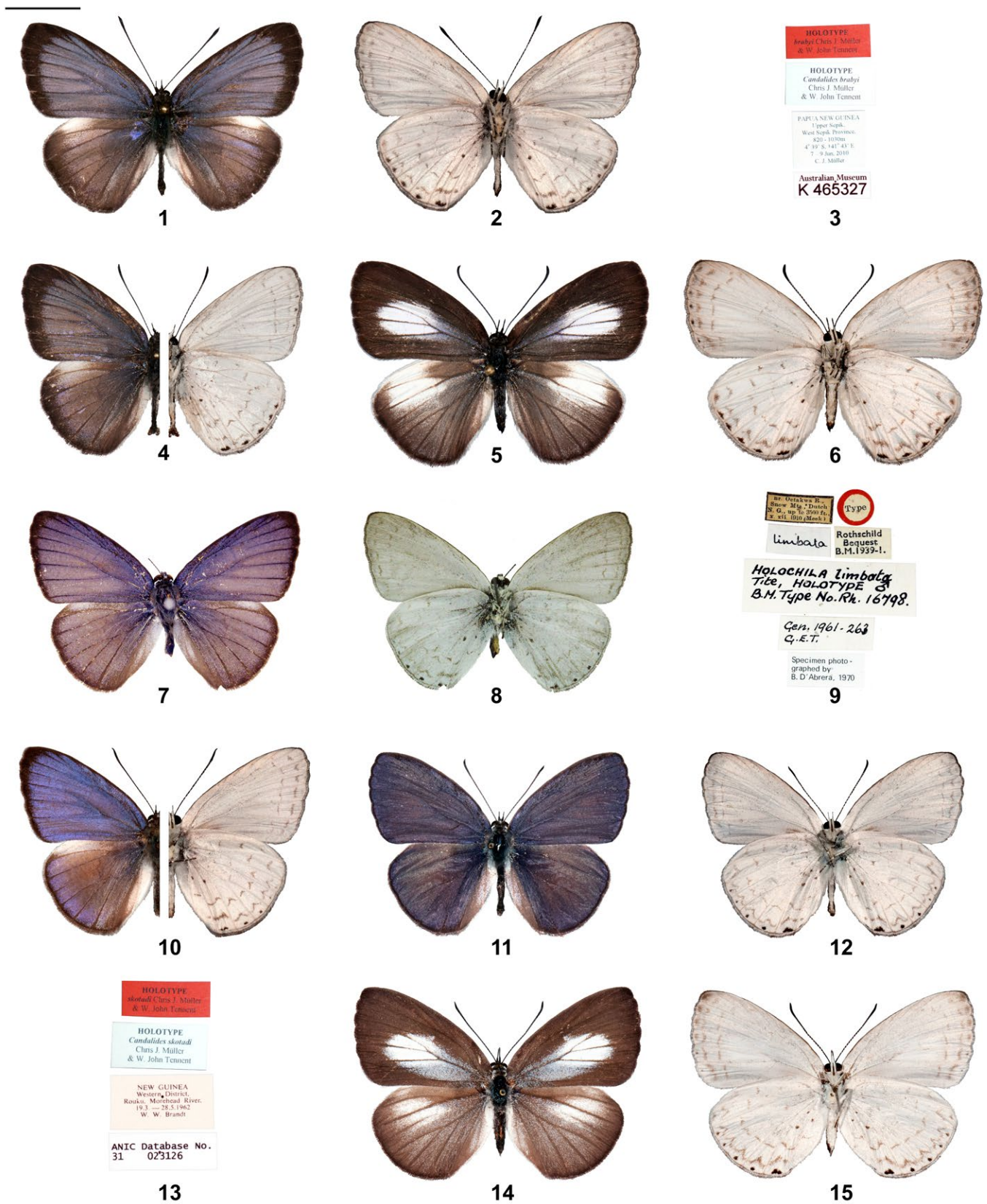
Pinned adults were photographed using a Nikon D300s Digital SLR Camera with a Nikon AF-S VR Micro-Nikkor 105 mm f/2.8G IFED Macro lens and Nikon R1C1 Close-up Kit Flashes Speedlights. Dissected and prepared male genitalia were photographed using the same camera with a Meiji Techno EMZ-5TR-P-FOI Trinocular Stereozoom Microscope, with OPTEK FL95E Fibreoptic Illuminator and twin arm optical fibre. Individual sliced genitalia images were aligned and meshed using the software Helicon Focus 6.0, then edited in Adobe Photoshop CS6. Genitalia slides were photographed using a Nikon CoolScan ED5000 with modified slide scanner. Plates were designed in Adobe InDesign CS6. Descriptions follow that of the numerical vein system (Corbet and Pendlebury, 1993).

RESULTS

Candalides brabyi Müller & Tennent, new species (Figs. 1 – 6, 31)

Adult Description. *Male* (Figs. 1, 2, 4). Forewing length 19.0 mm, antenna 10.2 mm (holotype). Head dark grey-black, clothed with dark grey hairs; labial palpus pale white-grey, eye ringed narrowly with white-grey; antennae black, ringed weakly with white ventrally. Thorax dark grey-black with grey hairs above, cream with white-grey hairs beneath. Abdomen dark grey-black above, white-grey beneath.

Forewing termen subtly serrated (indented at vein ends), inner margin nearly straight. Dorsal forewing ground colour lustrous medium slate blue-grey, darker blue-grey along veins in median area between veins 1b and 7 where veins are overlaid with androconia; termen broadly brown-black (2 mm wide at tornus, increasing to 4 mm in width at apex) and extending part way along veins; veins narrowly dark brown; cilia dark brown tipped with white. Ventral forewing background colour white-cream, subterminal row of dark brown spots



Figs. 1–15. Adults of *Candalides*. **Fig. 1,** *Candalides brabyi* n. sp., ♂ (Holotype), dorsal view; **Fig. 2,** *C. brabyi* n. sp. ♂ (Holotype), ventral view; **Fig. 3,** *C. brabyi* n. sp. (Holotype), label data; **Fig. 4,** *C. brabyi* n. sp. ♂ (Paratype), dorsal view at left, ventral view at right; **Fig. 5,** *C. brabyi* n. sp. ♀ (Paratype), dorsal view; **Fig. 6,** *C. brabyi* n. sp. ♀ (Paratype), ventral view; **Fig. 7,** *C. limbata* ♂ (Holotype), dorsal view; **Fig. 8,** *C. limbata* ♂ (Holotype), ventral view; **Fig. 9,** *C. limbata* (Holotype), label data; **Fig. 10,** *C. limbata* ♂ (Subitana), dorsal view at left, ventral view at right; **Fig. 11,** *C. skotadi* n. sp. ♂ (Holotype), dorsal view; **Fig. 12,** *C. skotadi* n. sp. ♂ (Holotype), ventral view; **Fig. 13,** *C. skotadi* n. sp. (Holotype), label data; **Fig. 14,** *C. skotadi* n. sp. ♀ (Paratype), dorsal view; **Fig. 15,** *C. skotadi* n. sp. ♀ (Paratype), ventral view. Scale bar = 10 mm.

in spaces 1b to 6 between veins, an indistinct row of elongated dark brown blotches and spots in submarginal area basad to subterminal spots; a very obscure band of brown postmedian spots in spaces 1b to 6; cilia white-cream except at apex where cilia are wholly dark brown.

Hindwing rounded but distinctly pronounced at apex. Dorsal hindwing ground colour lustrous medium slate blue-grey, appearing brown when viewed at some angles; termen and costa broadly dark brown (up to 4 mm nearer apex); white at apex, occupying distal half of space 7 and extending into space 6 where there is a dusting of pale blue-green scales, as well as pale blue-green scales in space 1b along vein 2; cilia brown tipped with white. Ventral hindwing background colour white-cream; a row of prominent black subterminal spots in spaces 1a to 5, a subterminal brown band basad to these spots, indented basally between veins, a postmedian band of brown markings grading from lines in space 1a to indistinct triangular markings in space 6, two small black spots in space 1a in basal area, one small black spot in space 1 in basal area and three minute black spots in cell and another in space 2, all in basal area; cilia white but black at vein ends.

Male Genitalia (Fig 31). Tegumen and vinculum ring roughly oval; sociuncus "U"-shaped dorsally, subrounded laterally, each sinus slightly pointed; saccus reduced, pointed upwards; brachium tapered apically; juxta bifurcated, with broad clubs that are serrated at margins;

valva broad, stepped abruptly along ventral margin near apex, developed into a short, sharp apical tooth that is bent in and upwards, valva adorned with a long, flat apical process that is widest near tip; aedeagus with pre-zonal section approximately equal to post-zonal section, with well developed bifurcated cornutus near base of post-zonal section.

Female (Figs. 5, 6). Forewing length 19.5 mm, antenna 10.3 mm. Head dark grey-black, clothed with dark grey hairs; labial palpus white, eye ringed narrowly with white; antennae black, ringed weakly with white ventrally. Thorax dark grey-black with grey hairs above, white-cream beneath. Abdomen dark grey-black above with grey scales, white-cream beneath.

Dorsal forewing brown, an oblong patch of white (approximately 8 mm long) centred at junction of cubital vein and veins 3 and 4 and occupying adjacent parts of cell, and spaces 1b, 2 and 3, this central patch bordered with pale blue-purple scales basal part of cell and proximal part of space 1b; cilia brown, marginally white at tornus. Ventral forewing as in male but subterminal spots are more prominent, paler brown.

Dorsal hindwing brown; an irregular white patch approximately 7 mm diameter in postmedian area of spaces 5, 6, 7 and costa as well as distal part of cell; remainder of cell dusted with pale blue scales and spaces 1b, 2, 3 and 4 dusted with white scales, inner margin and apex narrowly dusted with white; cilia brown, marginally white at apex. Ventral hindwing as in male but markings slightly more prominent and of a lighter shade of brown.

Types: HOLOTYPE ♂: PAPUA NEW GUINEA: labelled "Papua New Guinea, Upper Sepik, West Sepik Province, 820 – 1030m, 4°39'S, 141°43'E, 7 - 9 June, 2010, C. J. Müller"; genitalia dissected and held in vial pinned to specimen (AMS), deposited in AMS (AMS Registration No. K.465327).

PARATYPES: PAPUA NEW GUINEA: 2♂♂, labelled the same as holotype (deposited in BMNH); 1♀ labelled the same as holotype (deposited in AMS, AMS Registration No. K.465328), 2♂♂ labelled the same as holotype (deposited in MFB), 1♂ labelled "Papua New Guinea, Upper Sepik, West Sepik Province, 560m, 4°43'S, 141°47'E, 18 February, 2010, C. J. Müller"; genitalia dissected and held in vial pinned to specimen (deposited in NARI); 2♂♂, 1♀, labelled the same as holotype (deposited in CJMC); 2♂♂ labelled "Indonesia, Borne, Papua, 800 – 1200m, 2006, H. van Mastrigt (deposited in CDC).

Type locality. Papua New Guinea: Upper Sepik, West Sepik Province (4°39'S, 141°43'E, 820–1030 m).

Etymology. The species is named for Michael F. Braby, Canberra, for his continuing significant contribution to our knowledge of Australasian (and other) butterflies, including the tribe Candalidini.

Distribution and phenology. *Candalides brabyi* is known from the Upper Sepik Basin in Papua New Guinea and from Borne in Indonesian Papua, at altitudes from 560–1,200 m. These localities are both on the northern side of the central

cordillera in mainland New Guinea and are approximately 150 km apart. It is predicted that the taxon occurs in intervening localities at suitable elevations.

Diagnosis. The new species clearly belongs to the 'absimilis' group of *Candalides*, characterised by the presence of a 'trident' androconial mark in the median area of the dorsal forewing, by the underside wing pattern, and the characteristic ornate valvae of the male genitalia. *Candalides brabyi* appears closest to *C. limbata* (Tite, 1963) (Figs. 7 - 10), yet there are significant differences in wing shape, coloration, pattern and male genitalia.

In comparison to *C. limbata*, the male of *C. brabyi* has a subtly different wing shape, with the hindwing being more pronounced at the apex. Males of *C. brabyi* have a slate blue-grey ground colour, whereas the ground colour in *C. limbata* is a much brighter purplish blue with a more prominent red tinge when viewed at certain angles. The width of the upperside termen border in *C. brabyi* is about three times that of *C. limbata* on both wings, thus resembling *C. neurapacuna* Bethune-Baker, 1908, in upperside pattern. Ventrally, *C. brabyi* has a row of terminal spots on the forewing underside that are not present in any *C. limbata* specimen examined. Additionally, the forewing subterminal and postmedian bands are closer together in *C. limbata* than in *C. brabyi*.

The female of *C. brabyi* cannot currently be compared to *C. limbata*, since no females are known of the latter species. However, the unusual wing shape, in particular the pronounced hindwing apex, is also a feature of the *C. brabyi* female.

The male genitalia of *C. brabyi* (Fig. 31) and *C. limbata* (Figs. 32, 35) both have a similar morphology to those of several species in the 'absimilis' species group, in which the valvae bear long subapical processes. Those of *C. brabyi* and *C. limbata* can be separated by the morphology of the valvae and aedeagus. In the former, the main body of the valva is broader than that of the latter, particularly when viewed laterally. The apical hooks on the valva are more curved upwards in the new species; the aedeagus of *C. brabyi* also bears a darkened patch of cornuti in the centre, near the base of the post-zonal section, while in *C. limbata* a patch of cornuti is present at the apex, near the base of the vesica.

Candalides skotadi Müller & Tennent, new species (Figs. 11 – 15, 33)

Adult description. **Male** (Figs. 11, 12). Forewing length 18.5 mm, antenna 9.5 mm (holotype). Head dark grey-black, clothed with dark grey hairs; labial palpus white; eye narrowly ringed with white; antennae black, weakly surrounded with white ventrally. Thorax dark grey-black with grey hairs above, white beneath. Abdomen dark grey-black above, white beneath.

Dorsal forewing dull, dark slate grey-purple, with dull copper-green tints when viewed at low angles, lighter distinct sex scales in median area at junction of, and along, veins; terminal border very narrowly (hairline thickness) black; cilia dark brown, rimmed with white near tornus and along inner margin. Ventral forewing white; an indistinct row of subterminal spots in spaces 1b to 6; a further series of obscure bars basad; a further obscure series of narrow bars all close together (i.e., all three lines parallel to termen); a small brown patch at base in space 1b; cilia white, dark brown at apex.

Hindwing rounded. Dorsal hindwing as dorsal forewing; upperside dull, dark slate grey-purple, dull copper-green tints when viewed at low angles; termen narrowly (hairline thickness) black; inner margin brown, with white

scales near base; cilia dark brown, rimmed with white. Ventral hindwing white; a row of prominent terminal spots, that in space 1a larger than others (approx. 1 mm across) and roughly triangular; a subterminal band basad of these spots, indented basally between veins; a postmedian band occupying spaces 1a to 7, grading from irregular lines in space 1a to triangular marks nearer costa; one small black spot in space 1 in basal area and two basal black spots in space 1a; two indistinct brown spots in basal part of cell and another in basal part of space 7; cilia white.

Male Genitalia (Fig. 33). Tegumen and vinculum ring roughly oval; sociuncus deeply “U”-shaped dorsally, subrounded laterally, each sinus slightly pointed; saccus triangular in lateral view; brachium tapered apically; juxta bifurcated, with broad clubs; valva narrow and tapered towards apex, developed into a sharp apical tooth that is bent upwards, valva adorned with a long, flat and slightly twisted apical process of approximately uniform width; aedeagus with pre-zonal section approximately equal to post-zonal section, with arrow-like cornutus near tip, inside vesica.

Female (Figs. 14, 15). Forewing length 18.8 mm, antenna 9.7 mm. Head dark grey-black, clothed with dark grey hairs; labial palpus white, eye ringed narrowly with white; antennae black, ringed weakly with white ventrally. Thorax dark grey-black with grey hairs and scales above, beneath white. Abdomen dark grey-black above, white beneath.

Dorsal forewing brown; an oblong patch of white (approximately 5 mm long) centred at junction of cubital vein and veins 3 and 4 and occupying adjacent parts of cell, and spaces 1b, 2 and 3, this central patch connected to wing base with pale blue-grey scales in that part of cell and about half of space 1b; cilia brown. Ventral forewing as in male but subterminal spots are more prominent, lighter brown.

Dorsal hindwing brown; an irregular white patch approximately 5 mm across in postmedian area of spaces 5 and 6 and distal part of cell, remainder of cell and spaces 1b, 2, 3 and 4 dusted with grey scales; inner margin and apex narrowly dusted with white; cilia brown. Ventral hindwing as in male but markings slightly lighter shade of brown.

Types: HOLOTYPE ♂: PAPUA NEW GUINEA: labelled “NEW GUINEA, Western District, Rouku, Morehead River, 19.3. – 28.5.1962 W. W. Brandt”; genitalia dissected and held in vial pinned to specimen (ANIC), (ANIC: Registration No. 31 023126).

PARATYPES: PAPUA NEW GUINEA: 7 ♂♂, 6 ♀♀, data as holotype (all in ANIC).

Type locality. Papua New Guinea: Rouku, Morehead River, Western Province.

Etymology. The species name “skotadi” is a Greek word for dark, reflecting the external facies of both sexes, the male in particular.

Distribution and phenology. *Candalides skotadi* n. sp. is known only from the type series taken at Rouku, in the low-lying Trans Fly region of mainland New Guinea.

Diagnosis. The new species belongs to *Candalides*, as exemplified by its external morphology and characteristic male genitalia. Although different in wing shape and pattern, and very much darker than related species, *C. skotadi* shows some relationship to *C. ardosiaea* (Tite, 1963) (Figs. 16 – 21) and, superficially, to *C. margarita* (Semper, 1879) (Figs. 22 – 30). The latter species, described from Australia, is represented by subspecies *maria* (Bethune-Baker, 1908) (Figs. 28 – 30) in New Guinea and offshore islands in Indonesia (Tite, 1963).

Candalides skotadi males have an unusual ‘rounded’ shape to both wings, by comparison to the longer, narrower wings of the related *C. ardosiaea* (Tite, 1963) and those of *C. margarita* (Semper, 1879). The upperside ground colour of *C. skotadi* males is a very dark, slate grey-purple, unlike the bright, somewhat translucent blue of *C. ardosiaea* and *C. margarita*. Dorsally, in the male *C. skotadi* there is a copper-green

suffusion to both wings, not present in either *C. ardosiaea* or *C. margarita*. Ventrally, the subterminal black spot in *C. skotadi* is prominent and triangular, which is quite different to that of *C. ardosiaea*, which has a narrow line of black along the tornus, while in *C. margarita* the tornal spot is oval in shape and orientated obliquely to the tornus. In *C. skotadi*, the subterminal lines on the hindwing are narrower and with greater wavelength than in *C. ardosiaea*. In *C. skotadi*, the subterminal line on the forewing underside is formed from sub-triangular lines, whereas these lines are straight in *C. ardosiaea*.

The female of *C. skotadi* is very different from related species, with the white hindwing patch not reaching the costa. The extent of pale grey-blue on the forewing dorsally is extensive, occupying about half of space 1b. As in the male, the underside wing markings are distinct from related species.

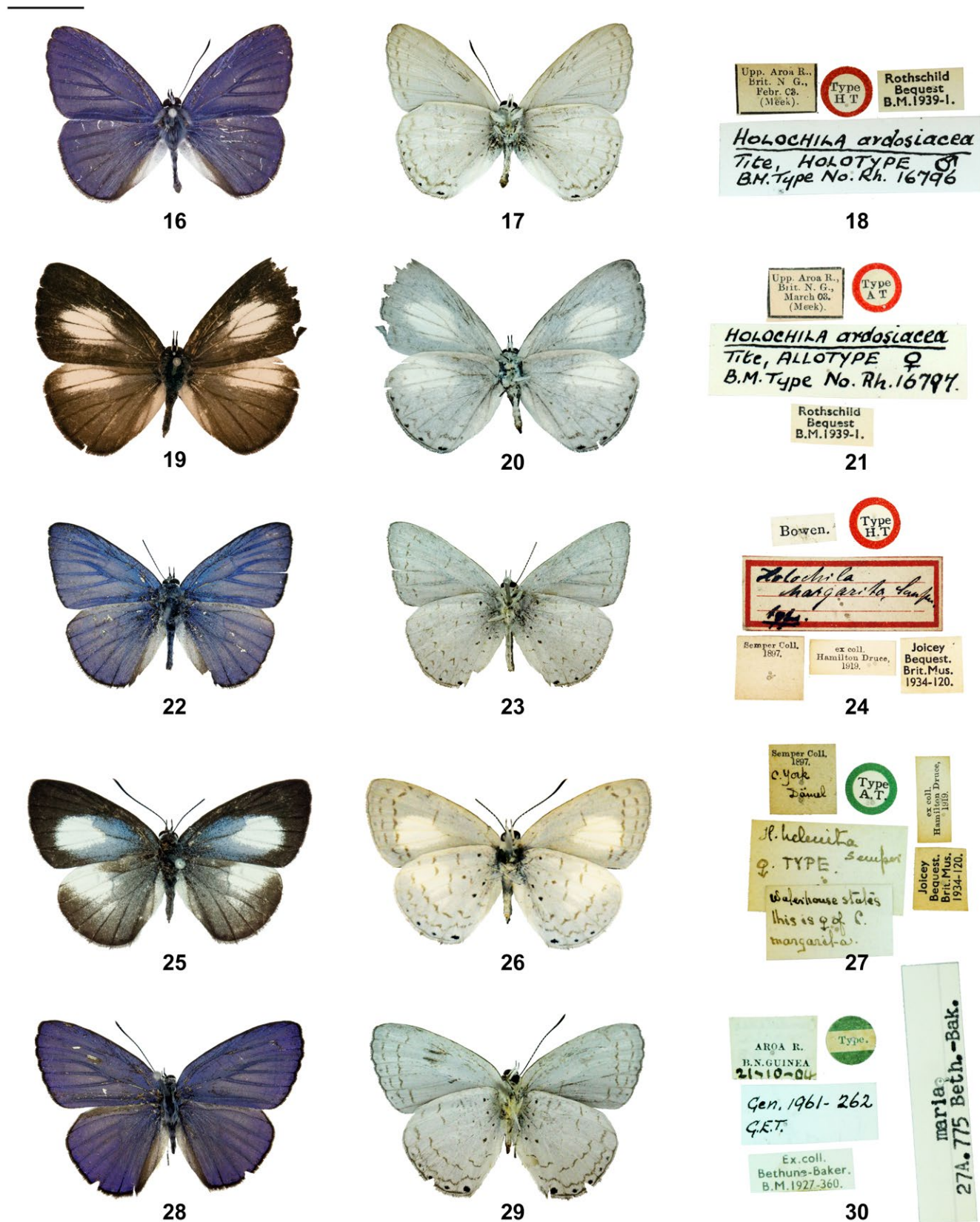
Candalides skotadi has similar male genitalia (Fig. 33) to *C. ardosiaea* (Fig. 34) in that they have ornate valvae very unlike those of the simple tubular form of *C. margarita* (Fig. 36). The valvae of *C. skotadi* are longer and more curved laterally in comparison to *C. ardosiaea*, and the apical spike is much longer in the former species. Additionally, the sociuncus of *skotadi* is more deeply incised. The aedeagus is also very different in the two species, with *C. skotadi* having reduced cornuti at the tip, whereas the cornuti of *C. ardosiaea* are conspicuous and set further back, towards the base of the post zonal section.

DISCUSSION

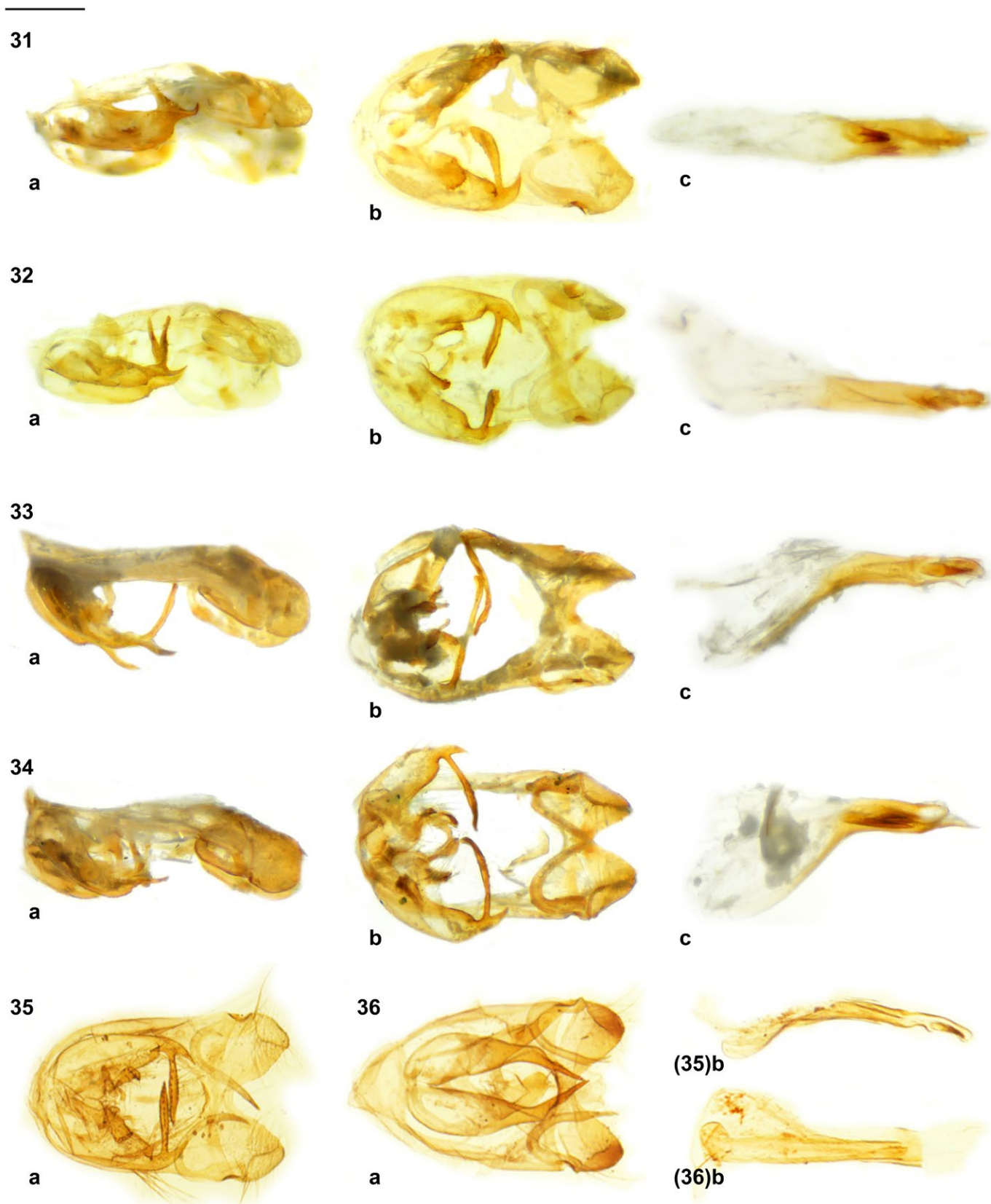
While the distribution of the two new *Candalides* species described here is imperfectly known, they each occupy very different biomes in mainland New Guinea. *Candalides brabyi* is recorded in upland primary rainforest on the northern slopes of the central cordillera, while the type (and currently the only known) locality for *C. skotadi* is in the centre of the Trans Fly lowland plains of southern New Guinea, characterised by narrow gallery forest amid dry savannah. Interestingly, another member of the genus, *C. afretta* Parsons, 1986, is also known only from the Trans Fly, and both species may be specialists restricted to this environment. The two occur at that locality with *C. margarita*, a species commonly encountered in such habitats in Australia.

It is unknown whether *C. brabyi* and the related *C. limbata* are sympatric in mainland New Guinea. Records for the former species are on the north of the cordillera, whereas those of *C. limbata* are primarily along the southern side (Oetakwa River type locality and Subitana, Central Province). A male of *C. limbata* was observed (but not captured) in the Star Mountains, near Tabubil, also on the southern slopes of the central cordillera; there is a male of *C. limbata* in the ANIC from near Mount Hagen, Western Highlands Province, approximately 250 km to the east of the type locality of *C. brabyi* and well within the central cordillera.

Males of *C. brabyi* occupied clearings in primary forest from 1330 hrs, initially defending territories about 6m above the ground but moving higher into the canopy later in the day, until eventually they retired to the tops of tall trees approximately 40 m above the ground in the late afternoon. Typical of other



Figs. 16–30. Adults of *Candalides*. **Fig. 16**, *Candalides ardosiaacea* ♂ (Holotype), dorsal view; **Fig. 17**, *C. ardosiaacea* ♂ (Holotype), ventral view; **Fig. 18**, *C. ardosiaacea* (Holotype), label data; **Fig. 19**, *C. ardosiaacea* ♀ ((allotype [=paratype])), dorsal view; **Fig. 20**, *C. ardosiaacea* ♀ ((allotype [=paratype])), ventral view; **Fig. 21**, *C. ardosiaacea* ♀ ((allotype [=paratype])), label data; **Fig. 22**, *C. margarita* ♂ (Type), dorsal view; **Fig. 23**, *C. margarita* ♂ (Type), ventral view; **Fig. 24**, *C. margarita* (Type), label data; **Fig. 25**, *C. margarita* ♀ (Cape York), dorsal view; **Fig. 26**, *C. margarita* ♀ (Cape York), ventral view; **Fig. 27**, *C. margarita* ♀ (Cape York), label data; **Fig. 28**, *C. margarita maria* ♂ (Holotype), dorsal view; **Fig. 29**, *C. margarita maria* ♂ (Holotype), ventral view; **Fig. 30**, *C. margarita maria* (Holotype), label data. Scale bar = 10 mm.



Figs. 31-36. Male genitalia of *Candalides*. **Fig. 31**, *Candalides brabyi* n. sp., (Holotype), a) lateral view, b) ventral view, c) aedeagus in lateral view; **Fig. 32**, *C. limbata* (Subitana), a) lateral view, b) ventral view, c) aedeagus in lateral view; **Fig. 33**, *C. skotadi* n. sp., (Holotype), a) lateral view, b) ventral view, c) aedeagus in lateral view; **Fig. 34**, *C. ardosiaacea* (Gulf Province), a) lateral view, b) ventral view, c) aedeagus in lateral view; **Fig. 35**, *C. limbata* (holotype), a) ventral view, b) aedeagus in lateral view; **Fig. 36**, *C. margarita maria* (holotype), a) ventral view, b) aedeagus in lateral view. Note: 35 and 36 are slide mounted. Scale bar = 0.5 mm.

members of the ‘*absimilis*’ species group, adult males rested on foliage with head downwards and wings partly spread. One male was collected as it drank from damp earth in a large clearing. Females were recorded in the same habitats as the males, flying among foliage several metres above the ground.

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