

The *Delias* HÜBNER, 1819 of the Bismarck Archipelago, Papua New Guinea, with description of a new species from New Britain Island (Lepidoptera, Pieridae)

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Abstract: *Delias elusiva* sp. n., a highly distinctive species from montane New Britain Island, Papua New Guinea, is described and figured; holotype male in Australian Museum, Sydney, Australia. It is compared in detail to related species in the subclade of *Delias nysa* (FABRICIUS, 1775), by phenotypic and molecular characters. The addition of this new taxon brings the total of *Delias* species in the Bismarck Archipelago to 12. Each, together with distinct subspecies, is illustrated and notes on their distribution are provided. Brief discussion is made on the divergence timing of the new species and on convergent evolution in Bismarck *Delias*.

Keywords: Lepidoptera, Pieridae, new taxa, *Delias*, *elusiva*, Bismarck Archipelago, Papua New Guinea, phylogenetics, Müllerian mimicry.

Die *Delias* HÜBNER, 1819 des Bismarck-Archipels, Papua-Neuguinea, mit Beschreibung einer neuen Art von Neubritannien (Lepidoptera, Pieridae)

Zusammenfassung: *Delias elusiva* sp. n., eine gut erkennbare Art aus den Bergen Neubritanniens im Bismarck-Archipel Papua-Neuguineas, wird beschrieben und abgebildet (Holotyp Männchen im Australischen Museum, Sydney, Australien). Die neue Art wird habituell und molekular verglichen mit verwandten Arten aus der Artengruppe von *Delias nysa* (FABRICIUS, 1775). Damit erhöht sich die Artenzahl der Gattung *Delias* im Bismarck-Archipel auf 12. Alle 12 Arten einschließlich einiger auffälliger Unterarten werden abgebildet und Angaben zu ihrer Verbreitung geliefert. Die Entstehungszeit der neuen Art und Gedanken zu konvergenter Evolution von *Delias*-Arten aus dem Bismarck-Archipel werden diskutiert.

Introduction

Delias HÜBNER, 1819 is currently recognised as the world's largest butterfly genus, comprising some 255 species (MÜLLER et al. 2013). Owing largely to their beauty and exceptional diversity, *Delias* butterflies are popular research and collection subjects.

The great majority of *Delias*, approximately 150 species, are confined to mainland New Guinea. Several of the New Guinean *Delias* clades represent more recent lineages that are highly species-rich, containing numbers of similar species (MÜLLER et al. 2013). Much fewer species are known from the satellite islands surrounding the New Guinea mainland. The Bismarck Archipelago hosts some of the most spectacular of all *Delias*, all of which are endemics.

All known Bismarckian *Delias* occur in either or both of the main islands, New Ireland and New Britain, and none are known from the Admiralty Islands. For those species occupying only one main island, a 'sister' species is present

on the other. The exception has been *D. brandti* MÜLLER, 2001 which is only known to inhabit mid-high montane New Ireland, and for which no related species was known from New Britain, although we suspected its presence. Despite much research in the Bismarck Archipelago by the authors over a 15 year period (MILLER et al. 2007, MÜLLER 1999a, 1999b, 2001a, 2001b, 2001c, 2002, 2003, MÜLLER & SANDS 1999, MÜLLER & TENNENT 1999, MÜLLER et al. 2008a, 2008b), only recently was the sister to *D. brandti* finally discovered and is here introduced in this paper. For geographical details, see Map.

Nomenclature follows that of MÜLLER et al. (2013). The description follows the venation according to the numerical notation.

Abbreviations

AM Australian Museum, Sydney, Australia.
ANIC Australian National Insect Collection, Canberra, Australia.
CJMC Reference collection of Chris J. MÜLLER, Sydney, Australia.

Systematics of Bismarck *Delias*

Delias elusiva sp. n.

(Figs. 1–4, 65.)

Holotype ♂: Papua New Guinea, Whiteman Range, West New Britain Province, 1100 m (5°59' S, 150°35' E), 13. xii. 2012, Chris J. MÜLLER, genitalia dissected and held in vial pinned to specimen (AM), Registration Number AM K310556, GenBank Accession Code KF153102 (COI partial gene fragment).

Paratypes (1 ♂, 1 ♀): 1 ♂ labelled the same as the holotype but dated 2. xi. 2012 (CJMC); 1 ♀ labelled the same as the holotype but dated 22. x. 2012 (AM), Registration Number AM K310557.

Etymology: The name '*elusiva*' reflects the elusive nature of this enigmatic taxon. This 'sister'-species of *D. brandti* was sought by us for more than a decade before it was discovered.

Diagnosis

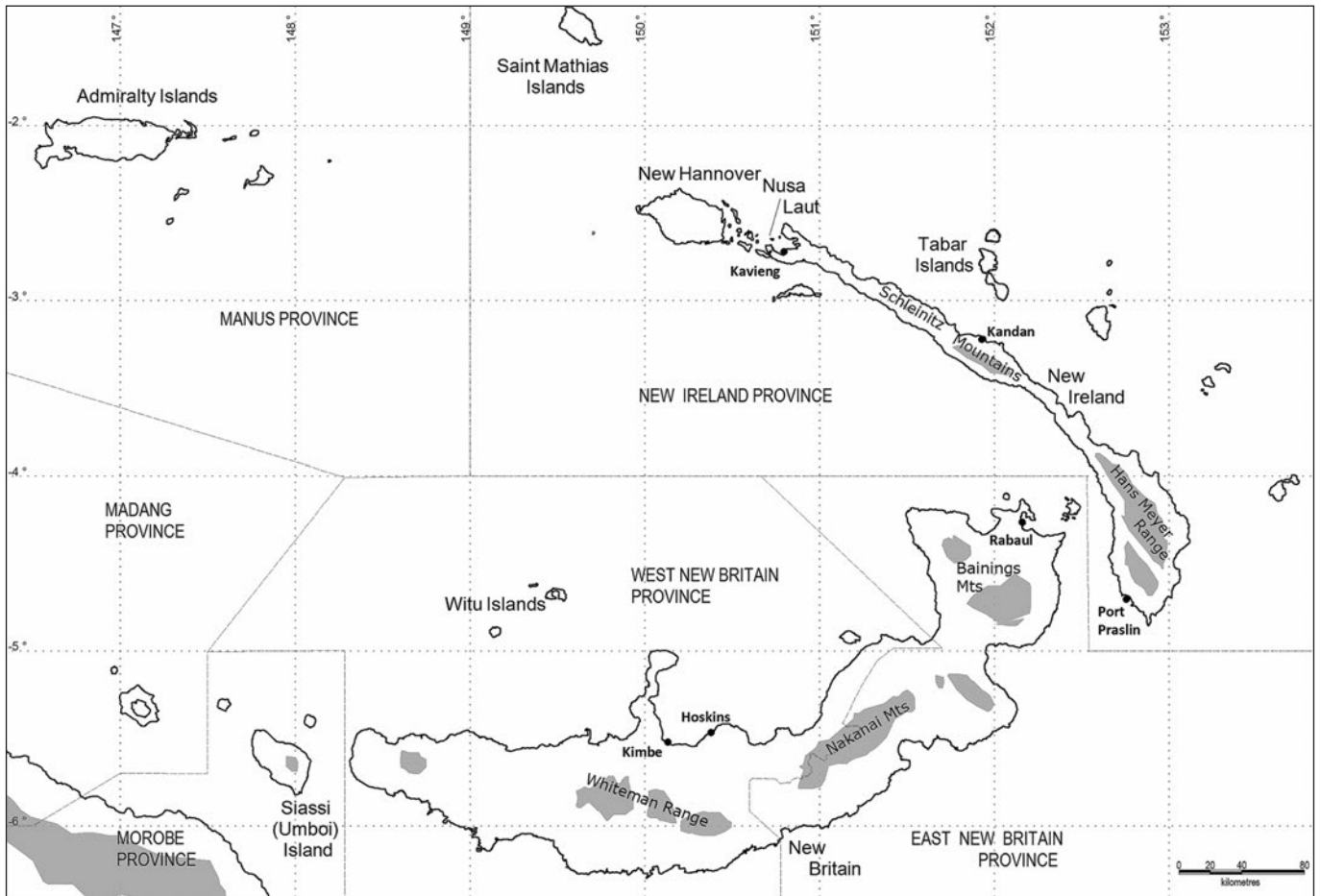
♂ (Figs. 1, 2). Forewing length 31 mm, antenna 15 mm (holotype). Head medium grey, clothed with dense, medium grey hairs; labial palpus white-grey, eye ringed with white-grey; antennae grey. Thorax medium grey with long grey hairs above, dorsally with long yellow hairs; legs white-grey. Abdomen, including claspers, white. Forewing with costa slightly bowed towards base; upperside pure white, black dusting narrowly along costa, broad black subapical area extending from costa at end of cell to termen between veins 1b and 2, relatively



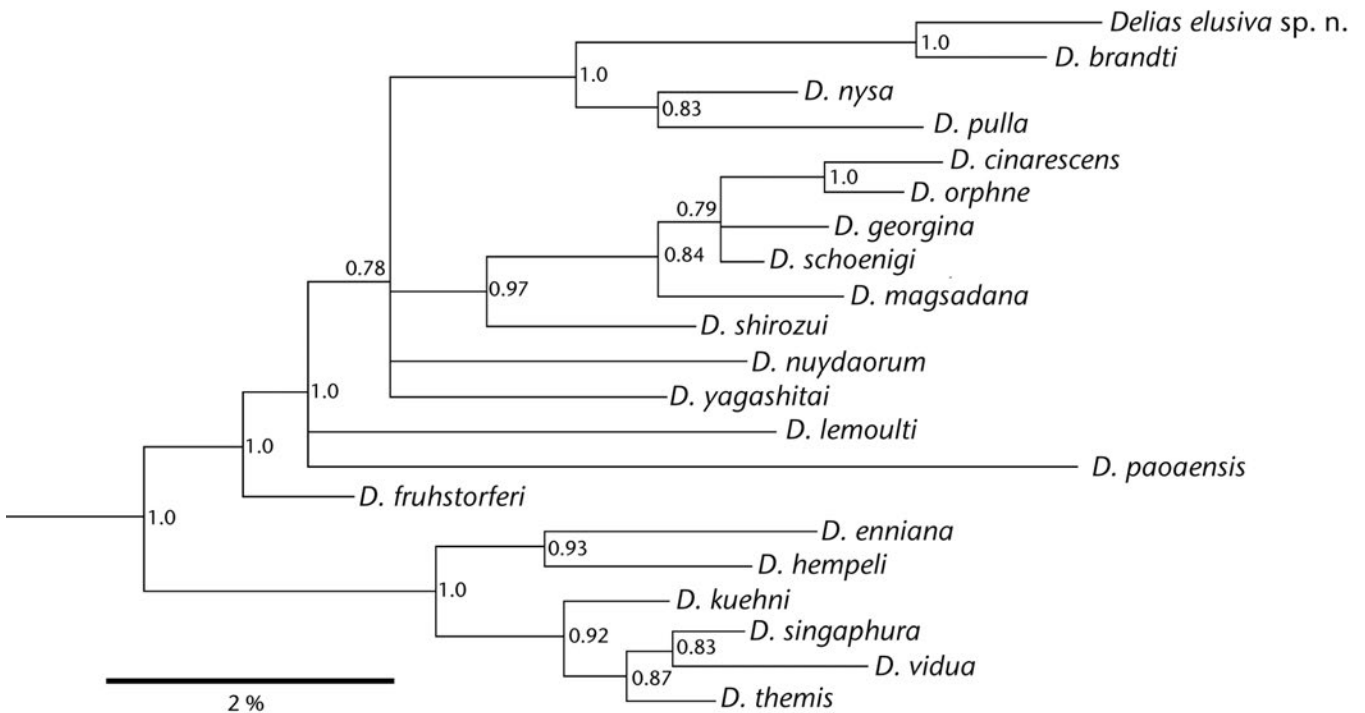
Figs. 1–64: Bismarckian *Delias* adults. Odd numbers upperside, even numbers underside. — Figs. 1–4: *Delias elusiva* sp. n. Figs. 1, 2: ♂, holotype. Figs. 3, 4: ♀, paratype. — Figs. 5–8: *D. brandti*. Figs. 5, 6: ♂. Figs. 7, 8: ♀. — Figs. 9, 10: *D. laknekei*, ♂. — Figs. 11–14: *D. lytaea*. Figs. 11, 12: ♂. Figs. 13, 14: ♀. — Figs. 15–20: *D. narses*. Figs. 15, 16: ♂ (New Ireland). Figs. 17, 18: ♂ (New Britain). Figs. 19, 20: ♀ (New Britain). — Specimens approximately at natural size, scale bar = 2 cm.

Figs. 21–28: *D. totila*. Figs. 21, 22: ♂ (New Ireland). Figs. 23, 24: ♀ (New Ireland). Figs. 25, 26: ♂ (New Britain). Figs. 27, 28: ♀ (New Britain). — Figs. 29–32: *D. bagoe*. Figs. 29, 30: ♂. Figs. 31, 32: ♀. — Figs. 33–36: *D. salvini*. Figs. 33, 34: ♂. Figs. 35, 36: ♀. — Figs. 37–44: Subspecies of *D. madetes*. Figs. 37–40: *D. m. madetes*: Figs. 37, 38: ♂. Figs. 39, 40: ♀. Figs. 41–44: *D. m. honrathi*: Figs. 41, 42: ♂. Figs. 43, 44: ♀. — Specimens approximately at natural size; scale bar = 2 cm.





Map: The Bismarck Archipelago (comprising all islands within Manus, New Ireland, East and West New Britain Provinces, as well as the Siassi Island group), showing localities mentioned in the text. Shading represents approximate expanse of land above 1000 m elevation. An example of the biotype of the Nakanai Range is shown in Fig. 69.



Phylogram: Fifty percent majority rule consensus phylogram for the *Delias nysa* group, from a Bayesian analysis of 650 base pairs of COI gene fragment, as per the LCO-HCO primers used in MÜLLER et al. (2013). Phylogenetic analytical protocol followed that of MÜLLER et al. (2013). Numbers at the nodes are the posterior probabilities of those nodes. The scale bar represents 2% genetic distance. *Leuciactria olivei* MÜLLER, 1999 (Pieridae) was used as an outgroup taxon. Sequence data for the taxa incorporated are accessible via Appendix S1 in MÜLLER et al. (2013). The COI sequence for *Delias elusiva* sp. n. can be located on GenBank, accession number KF153102.

straight but diffuse border with white ground colour and protruding into ground colour up to 3 mm along veins, black border narrow (< 1 mm) from midway between veins 1b and 2 and tornus, this border marked on basal side by a narrow grey strip (< 1 mm wide); discocellulars distinctly black between veins 4 and 5 at end of cell, cilia black; underside ground colour black with subtle purple-brown lustre, between costa and vein 12 plus basal one-third of wing and inner margin below vein 1b (excepting termen which is black) with heavy white dusting, within basal half of cell and between cell and between cell and vein 12 this dusting is bright yellow; subapical row of white elongated spots between veins, pointed basally and greyish towards termen where the spots are split by narrowly black subveins, the row of spots is continuous along subtermen where they are light grey, elongated parallel to the termen and less than 1 mm wide, all spots split by blackened subveins, cilia black. Hindwing rounded; upperside pure white, black terminal even yet diffuse border approximately 3 mm wide, narrowing at apex and at tornus and extending approximately 1.5 mm along veins, this black border rimmed with an approximately similar width of grey basally, diffuse, narrowing at apex and along inner margin close to tornus, cilia black; underside ground colour black with subtle purple-brown lustre, bright yellow basal area extending to middle of costa and centred over vein 8, from midway between vein 7 and 8 this yellow area is more diffuse and extends through the base of the cell and broadly two-thirds along the inner margin towards the tornus, between the inner margin and midway between vein 1b and 2; row of large (up to 4 mm) bright yellow subterminal spots between veins and meeting termen narrowly at between vein 7 and apex, the spot between veins 5 and 6 and that between vein 6 and 7 is oval-shaped, while those between vein 5 and vein 1b are more elongate parallel to the termen, the spot between veins 1b and 2 being split by a blackened subvein, cilia black.

♂ **genitalia** (Fig 65). Vinculum and tegumen ring broadly oval; uncus stout, with 5 short protrusions, middle and outer protrusions much longer and larger than remainder; valve hirstute, apex pointed, lateral margin strongly concave; saccus squat and rounded; phallus slender, tapered apically.

♀ (Figs. 3, 4). Forewing length 30.5 mm, antenna 15 mm. Shape and body colouration similar to ♂ but both wings more rounded. Forewing upperside with ground colour black, basal area grey from one-sixth along costa through basal one-third of cell and to postmedian area along inner margin, distinctly white in median area; forewing underside similar to ♂ but with white basal area restricted to inner margin below vein 1b excluding the terminal area, basal half of wing excluding costa and inner margin bright yellow, heavily dusted with black along veins and particularly discocellulars; white-grey subapical spots between vein 5 and costa similar to male but slightly smaller; subterminal grey spots restricted to between veins 2 and 5 and larger than in ♂. Hindwing

upperside with ground colour black, basal half of wing grey with yellow dusting throughout most of cell and basally between vein 1b and costa; hindwing underside similar to ♂ but with suffusion more purplish than brown, yellow dusting at base less extensive.

Distribution: New Britain Island, Papua New Guinea.

Delias brandti MÜLLER, 2001

(Figs. 5–8, 66.)

This species is known only from the type series and a small number of specimens taken since its description. All specimens originate from between 1300 and 1800 m in the Hans Meyer Range and Schleinitz Mountains in south and central New Ireland, respectively. A single female, included in the type series, taken by William W. BRANDT in the Schleinitz Mountains at '3000 ft' (900 m) is likely to have been collected at a higher altitude. The authors have spent much time in the Schleinitz Mountains, up to 1400 m, and have not seen the taxon below 1300 m. *D. brandti* appears to exhibit very little variation.

Although similar in colour and, to some degree, pattern to *D. narses* HELLER, 1896, *D. brandti* is positioned within a separate clade to *D. narses* (MÜLLER et al. 2013), see Phylogram. *D. brandti* is a more robust species, flying more rapidly and usually higher above the ground than adults of *D. narses*.

Delias laknekei MILLER, SIMON & WILLS, 2007

(Figs. 9–10.)

D. laknekei is only known from the type series taken in central New Ireland. The ♀ is unknown.

Since *D. laknekei* is sister to the next species, *D. lytaea*, they are doubtfully sympatric, suggesting that *D. laknekei* does not occur in New Britain and *D. lytaea* unlikely occurs in New Ireland (MÜLLER et al. 2013). Indeed, MILLER et al. (2007) considered that the few records of *D. lytaea* from New Ireland were dubious.

Delias lytaea GODMAN & SALVIN, 1878

(Figs. 11–14.)

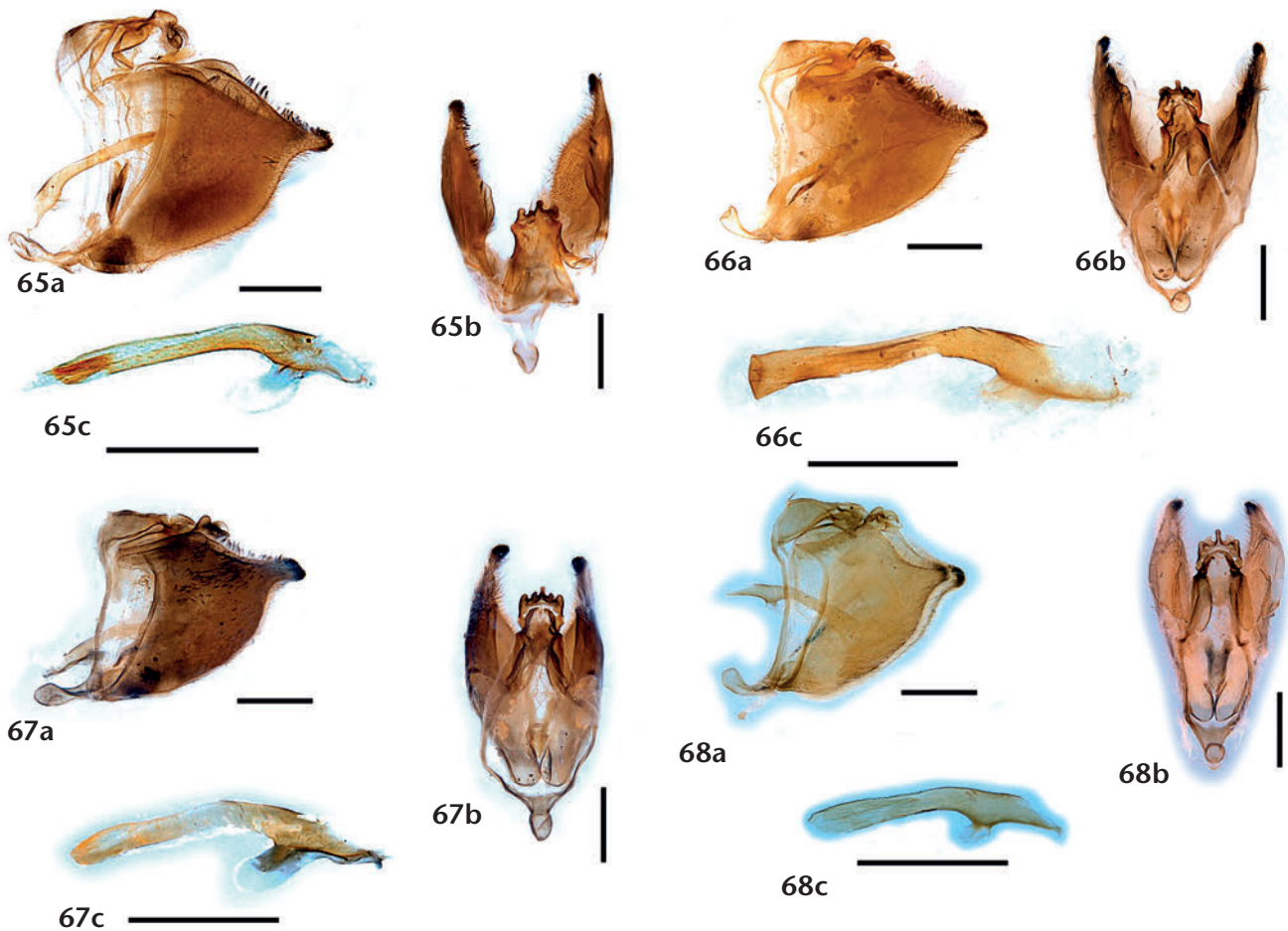
D. lytaea appears to be confined to New Britain. As outlined above, this species is not likely to occur on New Ireland, as was previously supposed (e.g. D'ABRERA 1971, 1978, 1990). The taxon *D. lytaea georgiana* GROSE SMITH, 1895 (= *smithi* TALBOT, 1929), from New Georgia, Solomon Islands, is almost certainly erroneous. TENNENT (2002) implied that the occurrence of this species in the Solomon Islands required confirmation.

This species flies from sea level to about 1000 m but is most common below 400 m. We have observed the species in East New Britain in the Rabaul/Kokopo district, Bainings Mts. and in West New Britain in the foothills of the Whiteman Range.



Figs. 45–56: Subspecies of *D. messalina*. Figs. 45–48: *D. m. vigasa*: Figs. 45, 46: ♂. Figs. 47, 48: ♀. Figs. 49–52: *D. m. lizae*: Figs. 49, 50: ♂. Figs. 51, 52: ♀. Figs. 53–56: *D. m. gerritsi*: Figs. 53, 54: ♂. Figs. 55, 56: ♀. — Figs. 57–60: *D. eximia*. Figs. 57, 58: ♂. Figs. 59, 60: ♀. — Figs. 61–64: *D. mayrhoferi*. Figs. 61, 62: ♂. Figs. 63, 64: ♀. — Specimens approximately at natural size, scale bar = 2 cm.

Figs. 65–68: *Delias nysa* subclade, ♂ genitalia; a: genitalia lateral view; b: genitalia dorsal view; c: phallus lateral view. — Fig. 65: *D. elusiva* sp. n. Fig. 66: *D. brandti*. Fig. 67: *D. pulla*. Fig. 68: *D. nysa*. — Scale bars = 1 mm, i.e., phalli approximately double the size as other parts of genitalia. — Fig. 69: Part of the western Nakanai Range, viewed towards the north — typical montane *Delias* habitat.



D. elusiva and *D. brandti* are readily separable in both sexes, with the new species being highly sexually dimorphic, while in *D. brandti* the ♂ and ♀ are similar. *D. elusiva* is larger, with more elongated, pointed forewings than in *D. brandti*. The body in *D. brandti* is black ventrally, with a white spot near the base of the hindwing, whereas in *D. elusiva* the body is covered with yellow hairs. The legs are black in *D. brandti* and white and yellow in *D. elusiva*. The upperside of both wings in the ♂ of *D. elusiva* have much narrower terminal borders than in *D. brandti* and

are predominantly white, while in the latter species they are predominantly black. ♀♀ of *D. elusiva* and *D. brandti* are fairly similar in pattern on the upperside, but the basal area is more bluish in *D. elusiva* and the forewing is reminiscent of that of the ♀ *D. totila*, with a whitish median area near the inner margin. On the underside of both sexes of *D. elusiva* the basal yellow is much more reduced than in *D. brandti* and the new species bears a row of white-grey subapical and subterminal spots, which are yellow and restricted to the subapical region in

***Delias narses* HELLER, 1896**

(Figs. 15–20.)

This taxon flies at 900–2200 m in much of upland New Ireland and New Britain. Populations from each island show certain minor, yet consistent differences. Notably, ♂♂ from New Britain have the hindwing cell above filled with white, whereas those from New Ireland are partly filled with black towards the discocellulars. Additionally, both sexes from New Britain essentially lack the white flecks in the subapical region of the forewing present in those from New Ireland. The number of subterminal spots on the forewing underside of ♀♀ is variable, as is the degree of yellow dusting on the hindwing upperside basal region. That depicted in Fig. 19 has pronounced yellow suffusion.

As previously stated, to some degree this species resembles the unrelated *D. brandti* and may represent convergent evolution of the two taxa through Müllerian mimicry.

MÜLLER et al. (2013) noted that *D. narses* was recovered as sister to *D. biaka* JOICEY & NOAKES, 1915, suggesting a possible Bismarck–Schouten Island connection.

***Delias totila* HELLER, 1896**

(Figs. 21–28.)

D. totila occurs from sea level to 2400 m but is most common at 800–1200 m on both New Ireland and New Britain. We have occasionally seen the species flying on the coast in Kimbe town and at Hoskins. As with *D. narses*, the population on New Ireland is quite distinct from that on New Britain. Both sexes from New Britain are generally slightly larger with more rounded wings than their New Ireland counterparts. The blue-grey on the forewing underside is more extensive in both sexes from New Britain, and ♂♂ generally have a well-defined single white subapical forewing patch which is either absent or obscure, and sometimes paired, in New Ireland ♂♂. The extent of yellow and blue-grey on the ♀ hindwing upperside is variable, with some specimens almost devoid of yellow and others with wholly yellow basal areas. This taxon appears to share a mimetic relationship with yellow ♀ forms of *Mynes katharina* RIBBE, 1898 (Nymphalidae), which flies in the same habitats.

In the Whiteman Range, a ♀ of this species was observed ovipositing on an unidentified tree with glossy, serrated leaves.

A Bismarck–Schouten Island connection, through a recovered sister-relationship of *D. totila* with *D. talboti* JOICEY & NOAKES, 1915, was postulated by MÜLLER et al. (2013).

***Delias bagoë* BOISDUVAL, 1832**

D. bagoë is the sister-species of *D. salvini* BUTLER, 1882, obvious through examination of its phenotype and also confirmed through molecular phylogenetic analysis (MÜLLER et al. 2013).

***D. bagoë bagoë* BOISDUVAL, 1832**

(Figs. 29–32.)

The type locality for *D. bagoë* is ‘Port Praslin’ in southern New Ireland and the nominate subspecies is restricted to New Ireland and Nusa Laut (TENNETT 2006). We have observed this species mostly at altitude, up to 1300 m, but also at sea level east of Kavieng.

***D. bagoë restricta* ROTHSCHILD, 1925**

This taxon was described from New Hannover and separated from the nominate *D. bagoë bagoë* based on its more restricted submarginal markings on the hindwing underside. We have only examined a small number of *D. b. restricta* specimens and can therefore make no comment as to its validity. However, assessment of series of *D. bagoë* from New Ireland implies that there is some degree of variation in the latter that probably also occurs in *D. b. restricta*.

***Delias salvini* BUTLER, 1882**

(Figs. 33–36.)

This species is fairly widespread in New Britain, ranging from sea level to approximately 1350 m (e.g., the summit of Mt. Otto, near Hoskins), although, typically of the genus in the Bismarcks, it is more common at higher altitudes.

Similar to *D. bagoë*, *D. salvini* is relatively variable in the extent of the red postmedian band on the underside of the hindwing. The male of *Mynes eucosmetos* GODMAN & SALVIN, 1879 (Nymphalidae) is a mimic for *D. salvini* in New Britain.

***Delias madetes* GODMAN & SALVIN, 1878**

This is the largest species in the Bismarcks. Three subspecies are recognised, as follows:

***D. madetes madetes* GODMAN & SALVIN, 1878**

(Figs. 37–40.)

This insect is predominantly montane, occurring in central and southern New Ireland. We have observed it at up to 1800 m in the north-western Hans Meyer Range. However, there are specimens in the ANIC collected by W. W. BRANDT labelled Kandan, central New Ireland, at sea level.

We have found the early stages of this taxon infesting various mistletoe species (Loranthaceae), which parasitize a number of different host trees. The larva and pupa were illustrated by PARSONS (1998) and are similar to those of *D. aruna* BOISDUVAL, 1832.

***D. madetes honrathi* MITIS, 1893**

(Figs. 41–44.)

This taxon occurs primarily from 600 to 2200 m in New Britain, although may occur at lower elevations, as does nominate *D. madetes* in New Ireland. *D. m. honrathi* is temporally sporadic, sometimes flying in numbers for short periods and then becoming rare for years at a time.

The ♀ of *D. m. honrathi* is mimicked by that of *Mynes eucosmetos* in New Britain, both flying high above the ground with extended periods of sailing through the air.

***D. madetes neohannoverana* ROTHSCHILD, 1916**

We have not examined any specimens of this subspecies, restricted to New Hannover.

***Delias messalina* ARORA, 1983**

PARSONS (1998) suggested that *D. messalina* was related more to *D. weiskei* RIBBE, 1900 than *D. nigrina* FABRICIUS, 1775, as supposed by ARORA (1983). A recent phylogenetic study recovered the species as part of the *D. kummeri* RIBBE, 1900 subclade within the *D. nigrina* species-group (MÜLLER et al. 2013).

Five subspecies are recognised, three of which occur in the Bismarck Archipelago, namely:

***D. messalina vigasa* PARSONS, 1989**

(Figs. 45–48.)

The type locality for this taxon is in the Upper Waran-goi River catchment between 1100 and 1300 m. We have taken this taxon at close to 2200 m in the southern Baining Mountains, East New Britain, and at 1100 m in the Whiteman Range, West New Britain. The single ♂ from the latter locality is much smaller than those from East New Britain. A small series of specimens taken in Siassi Island appear to most closely resemble *D. m. vigasa*.

***D. messalina lizae* MÜLLER, 1999**

(Figs. 49–52.)

One of the most striking members of the genus, this distinctive taxon is known solely from a short series of both sexes from the Hans Meyer Range, southern New Ireland. We have recorded *D. m. lizae* from 1400 to 2400 m. The taxon exhibits only minor variation.

***D. messalina gerritsi* MÜLLER, JAKUSCH & WILLS, 2008**

(Figs. 53–56.)

Separated by only a narrow strip of land from *D. m. lizae*, *D. m. gerritsi* is restricted to the Schleinitz Mountains in Central New Ireland where it occupies a very narrow altitudinal envelope between 1300 and the top of the range at under 1500 m. No significant variation has been noted in this taxon.

***Delias eximia* ROTHSCHILD, 1925**

(Figs. 57–60.)

This species was only known from the type series collected at an unknown locality in New Ireland, until M. J. PARSONS collected one ♀ from the Lelet Plateau, New Ireland. We have since collected long series of this exquisite taxon in the Schleinitz Mountains between 800 and 1300 m and one at the northwestern end of the Hans Meyer Range at 1700 m. Perhaps surprisingly, *D. eximia* was not collected by W. W. BRANDT during some months spent in the Schleinitz Mountains in 1959.

D. eximia is closely mimicked by *Mynes katharina*, which has both a white and yellow-orange morph for the ♂ and ♀ models of the former, respectively.

D. eximia appears to exhibit little variation.

***Delias mayrhoferi* BANG-HAAS, 1939**

(Figs. 61–64.)

Delias schunichii MORITA, 1996 is a synonym of *D. mayrhoferi*, as pointed out by HÄUSER et al. (2009). The type locality is the Baining Mts. where A. MAYRHOFFER collected 2 ♂♂ and 1 ♀. MORITA (1996) described the taxon *D. schunichii* from a single ♂ from an unspecified locality in New Britain that was collected during VII–IX. 1995. GOTTS & GINN (2003) described and illustrated the unknown ♀ of *D. schunichii*.

We have recorded *D. mayrhoferi* at altitudes from 650 – 1200 m in East and West New Britain Provinces. In the Whiteman Range, a ♀ of this species was observed ovipositing on a coarse-leaved mistletoe, cf. *Amyema scandens* (TIEGH.) DANS. (Loranthaceae) about 20 m above the ground. Some weeks later two green, hairy *Delias* larvae were observed through binoculars on the foliage of the same mistletoe but could not be reached due to extensive slippery moss on the host tree trunk and incessant rain. A batch of 40 yellow pierid eggs were located on the same mistletoe at a later date.

There is minor variation in the extent of the red on the hindwing underside in both sexes of *D. mayrhoferi*, though particularly so in the ♀, which also varies in the extent of yellow and grey scaling bordering the outer margin of the red postmedian band.

MÜLLER et al. (2013) confirmed a sister-relationship of this species with *D. eximia*, as implied by MORITA (1996).

Discussion

Delias elusiva sp. n. belongs to the *D. nysa* clade in a subgroup also comprising *D. pulla* TALBOT, 1937 and *D. brandti*, as demonstrated in the presented phylogeny (Text-Fig. 2). This is corroborated by the external facies and morphology of the ♂ genitalia, with adult ♂♂ having darkened discocellular patches on the forewing and compact, rugose and ornate genitalic socii, respectively. Within this group, adults of *D. elusiva* and *D. brandti* may be separated from *D. pulla* and *D. nysa* by the absence of extensive white on the forewing underside of ♂♂, which is present in the latter two taxa. Superficially, adults of *D. elusiva* bear some resemblance to *D. hempeli* DANNATT, 1904, an endemic to North Maluku, Indonesia, also in the *D. nysa* clade but recovered in a sub-clade with *D. singhapura* (WALLACE, 1867) (MÜLLER et al. 2013), although the new species lacks the forewing upperside subapical spots present in *D. hempeli*. However, despite this similarity, the new species is recovered as sister to *D. brandti* in the molecular phylogeny and this is in line with other sister-pairings in the Bismarcks, with allopatric taxa occurring on New Ireland and New Britain.

D. brandti. The hindwing undersides of both sexes of *D. elusiva* are similar, as they are in *D. brandti*. In *D. elusiva*, a full row of large subterminal yellow spots is present, whereas *D. brandti* bears only a single apical spot. The yellow costal patch at the base of the hindwing underside is much more extensive in *D. elusiva* than in *D. brandti*, and yellow dusting extends along the inner margin in the basal area of the former species that is not present in *D. brandti*. *D. brandti* bears a white spot in the discocellular region of the hindwing underside that is absent in the new species.

♂ genitalia of the *D. nysa* group are similar (Figs. 65–68). All possess squat, ornate socii that bear 5 thumb-like protrusions. The length and shape of these structures is diagnostic between the species, with *D. elusiva* having comparatively short structural processes. Although similar, the shape of the valva is also distinct among each of the *D. nysa* group members. That of *D. elusiva* is strongly pointed apically and the lateral posterior margin is evenly curved. The phallus is more sharply tapered apically in *D. elusiva* than in related species, being particularly distinct from that of *D. brandti*, which has a square-shaped apex.

Together with *D. brandti*, *D. elusiva* is one of the higher altitude *Delias* occurring in the Bismarck Archipelago and both species fly high, usually above the forest canopy. Several specimens, presumably of this species, were observed by the authors flying over the canopy at 2200 m in the Bainings Mts., East New Britain, in 2009. 2 ♂♂ of *D. elusiva* were seen about 20 m above the ground, feeding at small yellow flowers of cf. *Antirhea* COMM. ex JUSS sp. (Rubiaceae) in the Whiteman Range, during late x. 2012.

The timing of separation between *D. brandti* and *D. elusiva* is estimated to be approximately 3 million years ago (Mya), based on a numeric interpretation from the splitting of *D. brandti* and (*D. nysa* + *D. pulla*), within the calibrated tree of MÜLLER et al. (2013). This is inferred to be slightly older than other separations of sister-species in New Britain/New Ireland. Gene flow is likely reduced between higher elevation species as the gap between populations is greater and the ability to cross sea, or low elevation, barriers is reduced. This possibly also explains the significant phenotypic divergence between *D. elusiva* and *D. brandti*.

Within the Bismarck Archipelago, *Delias* are not known from the remote Admiralty Islands, nor were they recorded over a 2.5 years period endured by one of us (CM) in the Tabar Islands, from sea level to the tops of the highest hills at approximately 650 m on all the major islands. This illustrates the infrequent dispersal events and poor ability of *Delias* to disperse. For example, MÜLLER et al. (2013) noted that no representatives of the mainland-restricted subclades of New Guinea *Delias* are found in the d'Entrecasteaux Islands, just off the New Guinea mainland, except for one species, *D. ligata* JORDAN, 1904 (L. WILLS pers. obs.).

Convergent evolution (Müllerian mimicry) in *Delias* has been noted by several authors (e.g., DIXEY 1918, 1920, TALBOT 1928–1937) and was expanded by MÜLLER et al. (2013). It is particularly prevalent in the *Delias* of the Bismarck Archipelago, with several species bearing similar wing pattern and colouration to members of the genus *Mynes* BOISDUVAL, 1832 (Nymphalidae). Müllerian mimicry is also apparent within *Delias* of the Bismarck Archipelago, with the unrelated *D. brandti* and *D. narses* showing some superficial convergence.

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Entomologische Notiz

Schmetterlingssammlung des verstorbenen Dr. Lindfried Rudolf SCHELLBERGER an das Museum Senckenberg gelangt

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Ende 2012 gelangte die Schmetterlingssammlung von Dr. Lindfried Rudolf SCHELLBERGER an das Museum Senckenberg und wurde am 28. II. 2013 übereignet.

L. R. SCHELLBERGER wurde am 2. III. 1944 in Komotau (Sudetenland) geboren. Nach der Vertreibung 1946 lebte er zuerst in Klein-Felda im Vogelsberg. Seit 1950 verbrachte er seine Schulzeit in Gießen. Ab 1964 studierte er an der Justus-Liebig-Universität in Gießen für das Lehramt an Gymnasien die Fächer Biologie, Chemie, Physik und Psychologie. 1972 schloß er sein Studium mit der Promotion bei Prof. H. SCHERF in der Außenstelle Künanzhaus der Uni Gießen auf dem Hoherodskopf im Vogelsberg ab. Er arbeitete damals fast gleichzeitig und in Kooperation mit Werner THOMAS an Mikrolepidopteren (vergleiche NÄSSIG 1993), nur mit einer anderen Fragestellung; eine gemeinsame Arbeit über faunistisch bedeutsame Beifänge erschien in THOMAS & SCHELLBERGER (1971). [Zu ungefähr der gleichen Zeit war übrigens auch Uwe DRECHSEL, heute Paraguay, im Künanzhaus tätig.] Eine Kurzfassung seiner Promotion wurde 1973 veröffentlicht (SCHELLBERGER 1973). Weitere Publikationen von L. SCHELLBERGER sind bei JUNGBLUTH (2008) nicht verzeichnet; ich betrachte die hier aufgelisteten Arbeiten aber bisher nicht als überprüfte, komplette Bibliographie.

Nach der Promotion zog sich L. SCHELLBERGER aus der Lepidopterologie weitgehend zurück. Das Referendariat machte er am Hardenberg-Gymnasium in Fürth in Bayern. Er unterrichtete je nach Bedarf und Institution in den Fächern Biologie, Chemie, Physik, Mathematik und Psychologie. Er hatte Lehraufträge an

der Universität Erlangen-Nürnberg, an der Fachoberschule für Sozialpädagogik in Nürnberg und der Bundeswehrfachschule in Gießen. Schulunterricht erteilte er an den Gymnasien und Gesamtschulen mit gymnasialer Oberstufe in Vilshofen, Fürth, Erlangen, Nürnberg, Gießen und Grünberg, er war Studiendirektor und auch als Fachbereichsleiter für das mathematisch-naturwissenschaftlich-technische Aufgabenfeld in der schulischen Verwaltung tätig. Daneben trug er, soweit es die Gesundheit erlaubte, noch der künstlerischen Tradition seiner Familie (siehe NORBERT SCHELLBERGER – LEBEN UND WERK 2012) Rechnung und zeichnete und malte; daraus eventuell entstandene gedruckte Publikationen habe ich nicht recherchiert.

Im Jahr 2000 mußte er aus gesundheitlichen Gründen vorzeitig pensioniert werden; seit dem 2. III. 2007 war er neben den Medikamenten zusätzlich von permanenter maschineller Sauerstoffversorgung abhängig, was seine körperliche Leistungsfähigkeit erheblich einschränkte. Er verstarb am 23. XII. 2011 an den Folgen einer Lungenerkrankung in Feldatal-Kestrich im nordwestlichen Vogelsberg.

Die von ihm beziehungsweise später von Angehörigen aufbewahrte Sammlung umfaßt 28 eher locker gesteckte Insektenkästen mit insgesamt ca. 3868 Exemplaren. Gut zwei Drittel davon sind eine sehr schöne hessische Kleinschmetterlingssammlung aus seiner Promotionszeit aus dem Vogelsberg. Dazu kommen weitere Kästen mit hessischen Tag- und Nachtfaltern, letztere wohl Beifänge vom Lichtfang, und einige Schaukästen mit teils tropi-