

# The butterflies of the Genus *Delias* Hübner (Lepidoptera: Pieridae) in the Baliem Valley

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*Abstract:* The records of *Delias* species encountered by the Archbold III Expedition (1938-1939) in the area of the Baliem Valley and upwards are reviewed and comparison is made with more recent collecting results presented in this paper. Additionally, some notes and comments are made on individual species, including a stat. nov. and three comb. nov.

*Rangkuman:* Hasil Expedisi Archbold II (1938-1939) lagi disajikan, sejauh mana menyangkut *Delias* dan terfokus pada daerah Lembah Baliem ke atas. Perbandingan dibuat dengan hasil yang lebih baru yang disajikan di sini. Akhirnya sejumlah catatan dan komentar diberikan, termasuk satu stat. nov. dan tiga comb. nov.

*Keywords:* Archbold III Expedition, *luteola*, comb. nov., stat. nov.

## **Introduction**

The Archbold III Expedition (1938-1939) to the Lake Habbema and Mt Wilhelmina ( now known as Mt Trikora) regions of central Papua collected 46 different taxa of the Genus *Delias* Hübner, at altitudes ranging from about 60 m above sea level at the Bernard Camp on the River Mamberamo to about 3,300 m in the vicinity of Lake Habbema.

This publication updates and compares records of the *Delias* species from the Baliem Valley (1,600 m) extending to Lake Habbema at the foot of the Mt Trikora (3,300 m). It combines the results of the Archbold III Expedition with the findings of later collectors, mainly by the author in the period 1987-1993, and especially from 1989 till 1991.

In addition, the taxonomical status of species and forms described by Roepke (1955) and subsequently revised by later authors are presented.

## Results of the Archbold III Expedition

Roepke (1955) published a summary of all known *Delias* in Netherlands New Guinea (now the Indonesian provinces Papua and Papua Barat). Particular attention was paid to the recent results of the Archbold III Expedition to Mt Trikora and the Le Roux Expedition (1939) in the environment of the Wissel Lakes. Roepke's treatment of new *Delias* forms collected on these expeditions was based on an unfinished manuscript by the entomologist Toxopeus who took part in the expedition and initially studied the collections but died before being able to publish his findings.

The following taxa of *Delias* were recorded by Roepke (1955) as having been collected during the Archbold III Expedition from the Mamberamo River to the environment of Lake Habbema:

1. \**D. ladas ladas* Grose Smith, 1894 (Fig. 1)  
Sigi Camp, 1,350 m (a large series of ♂♂)  
*D. ladas* f-♀ *sulfurata* Roepke, 1955 (Fig. 2)  
Araucaria Camp, 800 m (4 ♀♀), Mist Camp, 1,500 (1 ♀)
2. \**D. lecerfi cyclosticha* Roepke, 1955  
Rattan Camp 1,200 m (12 ♂♂), Sigi Camp 1,350 m (1 ♂)
3. \**D. geraldina sidera* Roepke, 1955 (Figs 3-5)  
Araucaria Camp 800 m (a large series of ♂♂, 1 ♀), Rattan Camp 1,200 m (1 ♂)  
*D. geraldina sidera* f-♂ *flavescens* Roepke, 1955 (Figs 6-7)  
Araucaria Camp 800 m (3 ♂♂)
4. (1) *D. microsticha microsticha* Rothschild, 1904 (Figs 9-10)  
Slopes of Mt Wilhelmina, and Ibele Camp 2,200-2,300 m (a large series of ♂♂)
5. (2) *D. hypomelas fulgida* Roepke, 1955 (Figs 11-12)  
Sigi Camp 1,500 m (several ♂♂), Lower Mist Camp 1,700 m (1 ♂)  
*D. hypomelas lieftincki* Roepke, 1955 (Fig. 13; Figs 14-15?)  
Ibele Camp, 2,250 m (only 1 ♂)
6. (3) *D. argentata* Roepke, 1955 (Figs 16-18)  
Ibele Camp, 2,500 m (a series of ♂♂; only 1 ♀)  
*D. argentata* f. *sanguinea* Roepke, 1955 (Figs. 19-20)  
Ibele Camp, 2,500 m (a large series ♂♂; 4 ♀♀)
7. \**D. sphenodiscus* Roepke, 1955  
Araucaria Camp, 800 m (16 ♂♂; 3 ♀♀)
8. (4) *D. cuningputi ibelana* Roepke, 1955 (Figs 21-22)  
Most Forest Camp, 2,600-2,700 m), Ibele Valley, 2,220-2,300 m (a large series of ♂♂; 3 ♀♀)

9. (5) *D. pheres approximata* Joicey & Talbot, 1922 (Figs 23-26)  
Moss Forest Camp 2,600 m (a rather large series of ♂♂, Ibele Camp 2,200-2,250 m (many ♂♂), Baliem Valley, 1,700 m (1 ♂)
10. (6) *D. aroa* (sic!) *yabensis* Joicey & Talbot, 1922  
Including 6 ♂♂ from Sigi Camp 1,350-1,500 m, and Lower Mist Camp, by Toxopeus described as *D. aroa brumalis*. (Figs 28-29)  
*D. aroa* (sic!) *balimensis* Roepke, 1955 (Fig. 27)  
Baliem Valley 1,650-1700 m, (8 ♂♂)
11. (7) *D. eichhorni antara* Roepke, 1955 (Figs 30-31)  
Moss Forest Camp, 2,700 m, Ibele Camp 2,300-2,850 m (a series of 15 ♂♂, 2 ♀♀)
12. (8) *D. eichhorni germana* Roepke, 1955 (Figs 32-33)  
Moss Forest Camp, and Ibele Camp 2,250-2,850 m (9 ♂♂)
13. (9) *D. carstensziana alcornis* Roepke, 1955 (Figs 34-36)  
Lake Habbema, 3,300 m, Moss Forest Camp, and Ibele Camp 2,300-3,300 m (a large series of ♂♂; 5 ♀♀ all Lake Habbema)
14. (10) *D. leucobalia ericetorum* Roepke, 1955 (Figs 37-38)  
Lake Habbema, 3,300 m (6 ♂♂, 2 ♀♀)
15. (11) *D. catisa aurostriga* Roepke, 1955 (Figs 39-40)  
Moss Forest Camp, 2,700 m, and Ibele Camp 2,250 m (4 ♂♂),  
Top Camp 2,100 m (1 ♂)
16. (12) *D. toxopei toxopei* Roepke, 1955 (Fig. 41)  
Moss Forest Camp, 2,600-2,700 m, and Ibele Camp 2,250 m (32 ♂♂)
17. (13) *D. nais holophaea* Roepke, 1955 (Figs 42-43)  
Rattan Camp, 1,200 m, Mist Camp, 1,800 m, and Lower Mist Camp, 1,700 m,  
and Sigi Camp 1,500 m (5 ♂♂; 1 ♀ from Sigi Camp)  
*D. zebra* Roepke, 1955 (Figs 44-45)  
Ibele Camp 2,200-2,300 m (a long series of ♂♂; 6 ♀♀), Baliem Camp 1,700 m  
(several ♂♂, 1 ♀)  
*D. zebra* var. *reducta* Roepke, 1955  
Baliem Camp 1,700 m (2 ♂♂, 1 ♀)
18. (14) *D. mesoblema flavistriga* Roepke, 1955 (Figs 46-47)  
Forest Moss Camp and Ibele Camp (a large series of ♂♂); Moss Forest Camp  
(4 ♀♀), and Ibele Camp (1 ♀), Lake Habbema, 2,850, (2 ♀♀)
19. (15) *D. luctuosa archboldi* Roepke, 1955 (Figs 48-49)  
Forest Moss Camp, 2,700-2,800 m (a good series of ♂♂), Habbema Lake  
(1 ♂ + 4 ♀♀)

- D. luctuosa archboldi* f-♂ *butyracea* Roepke, 1955 (Figs 50-51)  
Forest Moss Camp, 2,700-2,850 m (several ♂♂; 1 ♀)
20. (16) *D. callista callipareia* Roepke, 1955 (Figs 52-54)  
Forest Moss, 2,600-2,700 m, Ibele Valley 2,200-2,300 m, Top Camp (many) and Mist Camp (1 ♂), (numerous ♂♂; a smaller series of ♀♀)  
*D. callista callipareia* f-♂ *luteola* Roepke, 1955 (Fig. 54)  
Top Camp 2,100 m, Moss Forest Camp, 2,600 m, and Ibele Valley, 2,200 m (6 ♂♂ and 2 intermediate ♂)
21. (17) *D. hapalina amoena* Roepke, 1955 (Figs 55-56)  
Ibele Valley 2,250 m (4 ♂♂, 1 ♀)  
*D. hapalina amoena* var. *adjuncta* Roepke, 1955 (Fig. 57)  
Mist Camp, 1,800 m, and Ibele Valley 2,250 m (4 ♂♂)
22. \**D. campbelli microleuca* Roepke, 1955  
Lower Mist Camp, 1,450-1,600 m, Sigi Camp, 1,350-1,500 m, Rattan Camp 1,150-1,200 m, Araucaria Camp 800 m (a large series of ♂♂, 4 ♀♀)  
*D. campbelli microleuca* f-♂ *subflavescens* Roepke, 1955  
Lower Mist Camp, 1,600 m (1 ♂)
23. (18) *D. leucias* Roepke, 1955 (Figs 58-59)  
Ibele Valley 2,200-2,500 m (a large series of ♂♂; 1 ♀)  
*D. leucias* f-♂ *lutescens* Roepke, 1955 (Fig. 60)  
Ibele Valley 2,200-2,500 m (1 ♂)
24. (19) *D. rosamontana* Roepke, 1955 (Figs 61-62)  
Ibele Valley 2,200-2,300 m, and Forest Moss, 2,600-2,700 m (a large series of ♂♂), Forest Moss, 2,600-2,700 m (4 ♀♀)
25. \**D. kummeri fumosa* Roepke, 1955  
Araucaria Camp (3 ♂♂)
26. \**D. ligata interpolata* Roepke, 1955 (Figs 63-64)  
Sigi Camp 1,450-1,500 m, Lower Mist Camp, 1,450 m, Rattan Camp, 1,450 m, Araucaria Camp, 800 m (10 ♂♂, 1 ♀ - Sigi Camp)
27. (20) *D. alepa orthobasis* Roepke, 1955 (Figs 65-67)  
Mist Camp, 1,800 m, Sigi Camp, 1,800 m (2 ♂♂)
28. \**D. ornytion* Godman & Salvin, 1880  
Araucaria Camp 800 m (1 ♂), Bernard Camp, 600 m (2 ♂♂)
29. (21) *D. wollastoni bryophila* Roepke, 1955 (Figs 68-69)  
Moss Forest Camp, 2,700-2,800 m (a nice series of 18 ♂♂)
30. \**D. discus apodicus* Roepke, 1955  
Araucaria Camp (15 ♂♂, 3 ♀♀)



31. (22) *D. mariae walshae* Roepke, 1955 (Figs 70-71)  
Ibele Valley 2,250 (1♂), Top Camp (1♀)
32. (23) *D. mira autumnalis* Roepke, 1955 (Figs 72-73)  
Moss Forest and Ibele Valley 2,200-2,700 m, (a long series of ♂♂, 5 ♀♀ - from Moss Forest 2,600-2,850)
33. (24) *D. klossi chrysanthemum* Roepke, 1955 (Figs 74-76)  
Moss Forest, 2,600-3,000 m (many ♂♂), Ibele Valley 2,250 m (5 ♀♀), Moss Forest, 2,800-2,950 m (3 ♀♀)
34. (25) *D. meeki hypochrysis* Roepke, 1955 (Figs 79-80)  
A large series of males, from Moss Forest Camp, 2,600-2,850 m, Ibele Camp 2,200-2,800 m, Top Camp, 2,100 m (many) and Mist Camp (1 ♂), 3 females.  
*D. meeki hypochrysis* var. *insula* Roepke, 1955 (Fig. 81)  
3 Males, from Forest Moss Camp.  
*D. meeki hypochrysis* var. *peninsula* Roepke, 1955 (Fig. 82)  
10 Males, from Moss Forest Camp.  
*D. meeki hypoxantha* Roepke, 1955 (Figs 83-84)  
Baliem Valley, 1,700-2,000 m (7 ♂♂, 2 ♀♀)
35. \**D. aruna aruna* Boisduval, 1832  
Bernard Camp, 60 m (2 ♂♂)
36. \**D. mavroneria mavroneria* Fruhstorfer, 1914  
Araucaria Camp, 800 m (a large series of ♂♂)
37. \**D. ennia ennia* Wallace, 1867  
Bernard Camp (4 ♂♂), Araucaria Camp (13 ♂♂, 1 ♀)
38. \**D. parennia* Roepke, 1955  
Araucaria Camp (5 ♂♂, 1 ♀)
39. \**D. mysis lara* Boisduval, 1832  
Bernard Camp (1 ♂); Araucaria Camp (2 ♀♀)

The 43 taxa of species and subspecies listed by Roepke are currently considered to belong to 39 species, based on the following considerations:

*D. hypomelas fulgida* and *D. hypomelas lieftincki* belong to a single species. *D. eichhorni antara* and *D. eichhorni germana* are now known to be separate species. *D. meeki hypochrysis* (including the forms *insula* and *peninsula* together with *D. meeki hypoxantha* are now considered to belong to the species *D. niepelti*. *D. nais* and *D. zebra* (including its form *reducta*) were treated as two species, but they have recently been synonymised by Katsuyuki (2010). *D. aroae balimensis* is a very doubtful subspecies and is now considered to be a form of *D. yabensis*.

From these 39 species of *Delias* only 25 were recorded by the Archbold III expedition at an altitude between 1,650 and 3,300 m above sea level; these are numbered in parenthesis. The remaining 14 species (with \* in front of name) were recorded at lower altitudes outside the Baliem Valley.

We regret that it has not been possible to examine all of the type-material in RMNH, Leiden, as some specimens were not found, notably the holotype of *D. hypomelas lieftincki*, the holotype of *D. zebra* var. *reducta* and the allotype of *D. carstensziana alcicornis* ♀.

### **Creamy yellowish varieties**

Having compared a large number of specimens, within six species *Toxopeus* (ms) recognized varieties with a creamy or yellowish tinge ("buttery tint") on the upperside of both wings. Although *Toxopeus* (ms) considered some to be subspecies-all are treated by Roepke (1955) as forms, with the following names:

- a. *D. ladas* f-♀ *sulfurata* (based on 5 females) upperside with slightly yellowish tinge.
- b. *D. geraldina* f-♂ *flavescens* (based on 3 males) upperside decidedly yellowish.
- c. *D. luctuosa archboldi* f-♂ *butyracea* (based on several males) upperside male creamy instead of milky white, having a yellowish tinge; (based on 1 female) upperside female deep chrome yellow, the light spots at border of both wings creamy.
- d. *D. callista callipareia* f-♂ *luteola* (based on 8 males including 2 intermediates) upperside shows a same creamy yellowish coloration as in the male of *D. luctuosa archboldi* f-♂ *butyracea*.
- e. *D. campbelli microleuca* f-♂ *subflavescens* (based on 1 male) with the same buttery tint on upperside of both wings and underside of hind wing as in *D. luctuosa archboldi* f-♂ *butyracea*.
- f. *D. leucias* f-♂ *lutescens* (based on 1 male) with same upperside coloration as already described for *D. luctuosa archboldi* and other species.

### **Actual status and combinations**

From the 43 taxa mentioned by Roepke, nine subspecies are now considered to be full species: *D. cyclosticha*, *D. approximata*, *D. yabensis*, *D. antara*, *D. germana*, *D. flavistriga*, *D. walshae*, *D. autumnalis*, *D. lara*.

A further two subspecies are now considered to be races of alternative parent species: *D. fascellis ibelana*, and *D. yabensis balimensis* (if valid).

## Results of collecting by Henk van Mastrigt

From 1987 until 1993 the author lived at Wamena and had the opportunity to make one-day and longer collecting trips to surrounding areas with the help of two local guides who also collected extensively on their own.

These surveys resulted in an enormous quantity of specimens and many notes and observations. More than 11,000 specimens of *Delias* were recorded in 170 days during the period 1989-1991. These included four localities over 2,800 m (73 days); a single locality at 2,300 m (9 days); four localities at 2,000-2,100 m (83 days), and a single locality at 1,650 m (5 days). Table 1 summarises these collecting records.

Besides the 25 species recorded by Roepke, a further five species have been recently observed in the area between the Baliem Valley to Lake Habbema. These are *D. aruna inferna* (local, up to 2,000 m), *D. lara* (infrequent), *D. rileyi* (local), *D. arabuana* (only a single observation) and *D. ligata* (infrequent).

Seven of the known species were not recorded during the above mentioned 170 day period, but at other times and/or localities. These are *D. aruna inferna*, *D. lara lara*, *D. nais holophaea* (not f. *zebra*), *D. arabuana arabuana*, *D. ligata interpolata*, *D. alepa orthobasis* and *D. walshae walshae*.

In the close vicinity of the Baliem Valley, around the Pass Valley and elsewhere, another fourteen species of *Delias* have been recorded: *D. mavroneria*, *D. cyclosticha*, *D. geraldina*, *D. cambelli*, *D. kummeri*, *D. ladas* (also recorded during the Archbold III expedition), *D. gabia*, *D. oktanglap*, *D. langda*, *D. telefomensis*, *D. isocharis*, *D. roepkei* and *D. fioretti*. These species from outside the Baliem Valley will be reviewed in a future publication.

At all altitudes a trio species are dominant and form the majority of individual records:

- a. from 2,800 m upwards *D. luctuosa* (37.61%), *D. carstensziana* (23.52%) and *D. klossi* (21.55%), together 82.68%;
- b. at 2,000 - 2,300 m *D. niepelti* (28.38%), *D. flavistriga* (13.19%) and *D. approximata* (10.75%), together 52.17%;
- c. at 1,650 m *D. niepelti* (19.57%), *D. flavistriga* (19.15%) and *D. approximata* (16.17%), together 54.99%.

It is notable that at lower altitudes, the percentage of *D. niepelti* decreases and the percentages of *D. flavistriga* and *D. approximata* increase.

The highest number of species at a single location (25) was recorded at an altitude of 2,000-2,100 m (over a period of 83 collecting days). This number was recorded at only one of the four collecting localities at this altitude where the daily results of 55 specimens was far below the average of 70 specimens per day encountered elsewhere. At the other localities at this altitude, only 20 species or less were recorded. At the various locations at 2,800 m and at 1,650 m up to 20 species were recorded; the single locality at 2,300 m yielded only 18 species, however this altitude and locality provided the largest number of individual specimens, an average of 100 daily.

The collecting results show an enormous imbalance between male and female individuals. Among the 11,338 records, only 159 females (1.40%) belonging to 17 species are present; the females of eight species were not found at all although quite high numbers of males were encountered. Among these are *D. fascelis ibelana* (518 males), *D. rosamontana* (430 males) and *D. catisa* (192 males).

The highest percentages of females were found in *D. approximata* (15.79% = 3 individuals), *D. hapalina* (14.29% = 3 individuals), *D. callista* (12.00% = 18 individuals), *D. nais* f. *zebra* (7.84% = 21 individuals), *D. argentata* f. *sanguinea* (4.42% = 10 individuals), *D. argentata argentata* (2.78% = 1 individual) and *D. luctuosa* (2.29% = 42 individuals). Within all other species the percentage of females was lower than 2%, including the 18 females of *D. flavistriga* (1.38%) and the 17 females of *D. klossi* (1.55%).

To eliminate the bias of frequent visits to some localities, table 2 presents the daily averages per altitude, based on the daily averages at each locality. This table shows that the average daily record is 70 specimens: the highest daily records were made at 2,300 m (100 specimens), followed by 2,100 m (68) and on 2,800 m upwards (66) and the lowest daily result was at 1,650 m with only 47 specimens.

The figures of this table show also a high number of species with less than one specimen encountered daily. At 2,800 m, 14 species (of the 20 total) were not recorded daily; and 4 species have an even lower average than 0.1 equating to just one record in more than ten days of collecting. At 2,300 m, 4 of the 18 species were not recorded daily but no species have an average occurrence below 0.1. At 2,100 m, 10 of the 25 species were not recorded daily and a single species has an average below 0.1 (*D. hypomelas*). At 1,650 m, 6 of the 20 species were not recorded daily and no species has a lower average than 0.1.

## Some notes on individual species

Some species deserve further comment because of their questionable taxonomic status, inaccurate data in Roepke (1955) or because of new findings about their occurrence in the field.

### 01. *D. rileyi* (Fig. 8)

The presence of *D. rileyi* in the Baliem Valley and its higher environments is new to science. This species was not included in the results of the Archbold III Expedition, probably because it seems to be very local and its presence is restricted to two quite small areas, one in the middle of the valley (1,600 m), the other along a small river at about 2,100 m.

### 02. *D. hypomelas*

The Archbold results of several males of ssp. *fulgida* from the Sigi Camp 1,500 m (outside the Baliem Valley) and only a single male from the Lower Mist Camp 1,700 m and a single male of ssp. *lieftincki* from the Ibele Camp, 2,250 m, seem to indicate that *D. hypomelas* this is an extremely rare species in the Baliem Valley. The author's records confirm this rare status except for the vicinity of River Habbema, where 33 males were recorded during the years 1992-1993. Also four specimens are recorded from Welesi: 1 male from River Mil in 1986, and 3 males from River Wesi in 1991.

Toxopeus (ms) described the characteristic that separates ssp. *fulgida* from ssp. *rubrostriata* as "the red striped much reduced and mostly overload with blackish scales, obsolete or wanting in c4 and c5", a feature which is variable according to Roepke, who doubted that it was a solidly founded subspecies.

Among the 33 males recorded at the R. Habbema, 31 specimens look more or less the same, however 4 specimens have red subapical tips at the underside of forewing and 29 have yellow tips. The two other specimens are quite different, both because the much lighter ground colour at the underside of hind wing and one also because of a large white area on the underside of the forewing. Based on the variation found in specimens from the environment of Lake Habbema, the collection of only two specimens in the Baliem Valley during the Archbold Expedition, and the doubts expressed by Roepke about the validity of *D. hypomelas fulgida*, I propose that only *D. hypomelas lieftincki* occurs in the Baliem Valley and upwards. The identity of the specimens from the Sigi Camp will be the subject of a future study.

The similarities with *D. argentata* mentioned in the description of ssp. *lieftincki* are at least an indication of a close relationship between these species. (See below)

03. *D. argentata*, first recorded at the Ibele Camp, 2,500 m, consists of two forms: *D. argentata argentata* with yellow subapical tips on the underside of the forewing (a series of males; only 1 female) and *D. argentata* f. *sanguinea* with red subapical spots (a large series of males; 4 females). The reason why Toxopeus (ms) described the typical *argentata* based on the less common specimens with yellow subapical tips and used f. *sanguinea* for the much more common one with the red subapical tips, is not clear.

It is significant that many of the characteristics found in *D. hypomelas* are also found in *D. argentata*. [quotation from Roepke (1955) p. 199] "Toxopeus (ms) considers it (*D. hypomelas lieftincki*) as closely allied to his new *argentata*, whereas I think it rather belongs to *hypomelas rubrostriata*. As no *hypomelas* at all were caught near Ibele Camp, it may be a rare subspecies in the locality, perhaps having another time of appearance or frequenting localities not visited by the expedition."

There are further reasons to suppose a close relationship between *D. hypomelas* and *D. argentata* and the conclusion that the latter is only a form of the first one. These are as follows.

Within the Baliem Valley and some other areas *D. hypomelas* is very rare while *D. argentata* is frequent, but in various areas adjacent to the Baliem Valley the opposite is true; *hypomelas* is very common while *argentata* is extremely rare or absent.

*D. destrigata* van Mastrigt, 1995 is based on two males that are evidently closely related to *argentata*, but recorded at localities where *argentata* was not otherwise found. It is now thought that they may represent a form of *D. hypomelas* that is common in the type locality.

Material and data in the KSP, from inside and outside the Baliem Valley, will enable a more extensive study on the relationship between these taxa.

04. *D. approximata*, described from the Kobowre (Weyland) Mts, is also very common in the Baliem Valley as recorded by the Archbold III Expedition and the author. Roepke did not distinguish females within the material of *D. approximata* (p. 203) but mentioned that the form '*separata*', had been proposed by Toxopeus, based on two females (Figs 25-26). In the RMNH Leiden, besides the specimens mentioned above, a third female has been found, labelled as holotype of 'f. *designata*, Roepke' (Fig. 24). Neither of these taxa was published by Roepke. The differences between the specimens of f. *separata* (compare Figs 25 and 26) and the poor quality of the single example of f. *designata* (Fig. 24) may have led Roepke to omit the description of these provisional forms in his final publication. The sixteen females from the Baliem Valley in KSP show some individual variation which tends to confirm Roepke's decision.

05. *D. carstensziana alcicornis* is a common species on high altitudes as confirmed by the Archbold collection of a long series of males from Lake Habbema, 3,300 m, Moss Forest Camp, and Ibele Camp 2,300-3,300 m, and five females all Lake Habbema.

This subspecies differs from the typical *carstensziana* by having the colour of the forewing underside lemon chrome instead of bright orange. D'Abrera listed *alcicornis* as synonym for *carstensziana*. It has been found that the great majority of specimens for the western part of the central mountain range have an orange underside of forewing and that the majority of specimens from the Baliem Valley and its environment are yellow. However both forms are found in variable proportions in nearly all areas of central Papua between Korupun and the Star Mountains, from where *D. carstensziana starensis* is described. Specimens from PNG are bright yellow on the forewing underside.

Toxopeus recognized two forms within ssp. *alcicornis*, one with a pinkish or purplish hue on the underside of hindwing, and a second in which the underside of the hindwing is greenish grey.

06. *D. leucobalia ericetorum* was collected at the Lake Habbema, 3,300 m (6 males, 2 females). This species occurs only at the highest elevations only and is rarely collected as it tends to fly around the tops of trees rather than coming down to river banks. Weather conditions at such high elevations are often less favourable for collecting. See also Parsons (1999).

07. *D. toxopei toxopei* was collected at Moss Forest Camp, 2,600-2,700 m, and Ibele Camp 2,250 m, in total 32 males. No females were recorded. The preferred altitude for this species is not constant as ssp. *morosa* around Paniai is common at 1,400-1,500 m; ssp. *uranoi* in the central area of Ilaga and Mulia is very common at 1,700 m but is totally absent at 1,850 m upwards. In the Baliem Valley ssp. *toxopei* seems to prefer 2,000 m upwards and ssp. *nipsan*, the most eastern subspecies, is found at 1,650 m around Nipsan.

08. *D. nais holophaea* was recorded at Rattan Camp, 1,200 m, Mist Camp, 1,800 m, Lower Mist Camp, 1,700 m, and Sigi Camp 1,500 (5 males; 1 female from Sigi Camp) and was not thought by Roepke to overlap with *D. zebra* collected at higher elevations. Recent findings have shown that where they are sympatric, *nais* and *zebra* occur with a range of intermediate varieties including Roepke's form *reducta*. On this basis Katsuyuki (2010) recently synonymised *D. zebra* with *D. nais*, a step which had already been suggested by Parsons (1990) among others. *D. (nais f.) zebra* was common at the Ibele Camp 2,200-2,300 m, where a long series of males and 6 females were recorded and at the Baliem Camp 1,700 m

where several males and 1 female were collected. *Var. reducta* was found at the Baliem Camp 1,700 m (2 males, 1 female), the lowest collecting site and nearest to the range of *D. nais holophaea*.

09. *D. callista callipareia* was collected (numerous males; a smaller series of females) at Moss Forest, 2,600-2,700 m, Ibele Valley 2,200-2,300 m, Top Camp (many) and Mist Camp (1 female). *D. callista callipareia* f-♂ *luteola* was collected at Top Camp 2,100 m, Moss Forest Camp, 2,600 m, and Ibele Valley, 2,200 m (6 males and 2 intermediate males). Toxopeus was puzzled by the f-♂ *luteola*, which comprised one seventh, (not 70% as mentioned by Parsons, 1999) of all records, and the frequency of the orange female, which was comprised more than one third of the captures. This frequency is also found in recently collected material held in KSP consisting of 9 white females, 2 with orange forewing and white hindwing, and 2 with orange forewing and pale orange hindwing. Comparison of males from various areas show much variability in the ground colour of the hindwing underside, the most western forms are quite pale yellow to creamy white, in the Baliem Valley the ground colour is pale yellow, around Langda and the environment if Mt Goliath a suffusion of red scales cause the yellow to appear more orange and in the Star Mountains the ground colour is deep yellow. Individual exceptions to these general trends are found in all areas. Schröder & Treadaway (1982) described *D. callista raymondi* from the Weyland Mts. Yagishita (1993) treated *D. callista callipareia* f. ♂ *luteola* as a full species; placed *raymondi* as a subspecies of *D. luteola* and added *D. luteola miyashitai* from Ilu-Mulia. Morita (1996) described two further subspecies from the Weyland Mts as *D. luteora* [sic!] *shirahatui* and *D. luteora* [sic!] *ogawai*, both of which are clearly closely related to *D. callista raymondi*.

A review of the *callista-raymondi* complex has often been discussed but never published. The morphological differences between *callista* (sensu stricto) and *raymondi* are evident, however the western populations of *callista* between the Kobowre Mts (former Weyland Mts) and the Baliem Valley, have caused confusion because male specimens are very variable within each location however the female upperside is quite different to *raymondi* from the Kobowre Mts and *callista* from the Baliem Valley eastwards.

The raising of *luteola* to species level by Yagishita (1993) and extended by Morita (1996) is unjustified. As discussed earlier, butterfly-yellow aberrations are known to occur regularly in many *Delias* species. As far as nomenclature is concerned, the subspecific name *raymondi* has priority over *luteola* which is only the name of a form.

To update the taxonomy of the group, the following changes are proposed: *D. callista raymondi* is recognised as a separate species *D. raymondi* **stat. nov.**



*D. luteora* [lapsus!] *shirahatui* dan *D. luteora* [lapsus!] *ogawai* are proposed as *D. raymondi shirahatui* **comb. nov.** and *D. raymondi ogawai* **comb. nov.** *D. luteola miyashitai* is proposed as *D. callista miyashitai* **comb. nov.** Although this taxa was originally described as a member of the same species as ssp. *shirahatui* and ssp. *ogawai* it should be treated as a ssp. of *D. callista*, rather than of *D. raymondi*, because of the pattern and coloration on the underside of hind wing. The name *luteola* is restricted to the creamy upperside male-form of *D. callista callipareia* as described by Roepke.

More intensive studies are required to provide a better understanding of the various populations of *miyashitai*, particularly the many varieties occurring sympatrically in the environment of Ilu-Mulia-Ilaga, and the uncertain status of *ogawai* which may be synonymous with *raymondi*.

10. *D. alepa orthobasis* is a very rare species. Only two males were recorded, one at the Mist Camp, 1,800 m and the other at the Sigi Camp, 1,800 m. The author has recorded only a single male specimen from the Habbema area.
11. *D. wollastoni bryophila* was recorded by the Archbold Expedition at the Moss Forest Camp, 2,700-2,800 m (a series of 18 males). At high altitudes it is more common than *leucobalia*. Females were never recorded in the Baliem Valley. It appears that *D. wollastoni* is locally common as the author will never forget the day that one of his assistants returned with over 200 specimens of *Delias*, including 146 males and 9 females of *D. wollastoni bryophila*, collected on 20-21 December 1990, close to Tiom at about 2,300 m.
12. *D. walshae* was recorded at the Ibele Valley 2,250 m (1 male) in November 1938 and at the Top Camp (1 male) in February 1939. In KSP *walshae* is represented by five males, all from the environment of Makki, about 2,000 m altitude, collected in 1989 and 1991 in the months of October, November and December.
13. *D. niepelti*  
 Within the *niepelti* species group three species have been described: *D. niepelti* Ribbe, 1900, *D. meeki* Rothschild, 1904 and *D. anamesa* Bennett, 1956. The latter is generally accepted to be a synonym of *D. niepelti*, which can be separated from *D. meeki* by its semi-translucent mauvish-white upperside of forewing, instead of opaque creamy-white in *D. meeki* (Parsons, 1999). Parson's arrangement of the group means that a single species, *D. niepelti*, is present in Papua, with six subspecies, including:
  - *hypochrysis* recorded at Moss Forest Camp, 2,600-2,850 m, Ibele Camp 2,200-2,800 m, Top Camp (many) and Mist Camp (1 male), (numerous males; three

females) with var. *insula*, and var. *peninsula* recorded at Forest Moss, 2,600-2,700 m (var. *insula* 3 males; var. *peninsula* 10 males - not females as mentioned by Roepke)

- *hypoxantha*, recorded at Baliem Valley, 1,700-2,000 m (7 males, 2 females). The features that Roepke used to separate *hypoxantha* from *hypochrysis* (among others, slightly smaller size and yellow rather than orange underside forewing coloration in *hypoxantha*) are highly variable and of debatable diagnostic value, as are the same features mentioned by Jordan [1912] when describing *D. meeki neagra* from Mt Goliath and by Yagishita (1997) when he added *D. niepelti henki* from the Star Mts.

The recently recorded presence of a wide variety of intermediate forms at all localities has shown that the distinction between these supposed subspecies is groundless. In fig. 50 Parsons (1999) erroneously placed the subspecies *hypochrysis* and *hypoxantha* in quite separate areas, although they are found very close one to another, if not sympatrically. Further studies are needed to clarify this complex species.

14. *D. aruna aruna* was recorded at Bernard Camp, 60 m (2 males); however, no records were reported of *D. aruna inferna* (Figs 77-78) which is now a very common species in the Baliem Valley [at least since the 1980's]. The Baliem River Camp was located at a site where *inferna* is now often observed and is close to a location where *inferna* caterpillars have been seen feeding on mistletoes in the *Cassuarina* trees, beneath which pupae can be found in bushes and fences.

*D. aruna aruna* is generally found on the northern side of the central mountain ranges and *D. a. inferna* on the southern side. The recent records from the Baliem Valley suggest an expansion in the range of *D. a. inferna* possibly associated with the spread of *Casuarina*, a cultivated tree species found near human settlements.

It should be noted that *D. aruna irma* –the commonly used name for the *aruna* ssp. from the southern side of the central mountain range in New Guinea– has been synonymised by Parsons (1989) with *inferna*, agreeing with Talbot (1928-1937) who pointed out that the male of the taxon *irma* is hardly separable from that of the Australian *inferna*.

## Discussion

The occurrence of *Delias* species in the Baliem Valley and its higher surroundings has not changed very much from 1938 to 1990, although the habitat has suffered from deforestation and increasing population. The differences in collecting results

between the Archbold III Expedition and the author show some progress as the latter includes a larger number of species. The extended duration of the Archbold Expedition makes it surprising that some species were overlooked. The current presence of *D. aruna inferna* shows that changes have taken place in the composition of *Delias* in the Baliem Valley in past fifty years (1940-1990). The continued pressure on forest habitat, caused by the increasing population and the construction of roads, should be monitored by future surveys.

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## Literature

- Gerrits, F. & H. van Mastrigt. [1993]. New results on *Delias* from the central Mountain range of Irian Jaya (Lepidoptera: Pieridae) – *Treubia*, Vol. **30**, 1992 Part 3: 381-402.
- Katsuyuki Funakasih. 2010. A révision of *Delias nais* and *D zebra* (Lepidoptera, Pieridae) on the island of New Guinea – *Trans. lepid. Soc. Japan* **60**(4): 237-244.
- Küppers, P.V. 1978. Neue und wenig bekannte *Delias* (Lepidoptera, Pieridae) – *Beitr. naturk. Forsch. Sudw. Dtl.* Band 37: 181-191; Karlsruhe 1.12.1978.
- Morinaka, Sadaharu, 1993. Observations on the "puddling behavior" of *Delias* species (Lepodiptera: Pieridae) in the central highlands of Irian Jaya – *Tyô to Ga* Vol. 44 No. 3, November 5, 1993: pp. 89-96.
- Morinaka, Sadaharu, Henk J.G. van Mastrigt & Atuhiro Sibatani. 1991. A Review of *Delias eichhorni* Rothschild, 1904 and Some of Its Allies from Irian Jaya (Lepidopterae, Pieridae) – *Bull. Biogeogr. Soc. Japan* **46**(16), Dec. 20, 1991: pp. 133-149.
- Morinaka, Sadaharu, H.J.G. van Mastrigt & A. Sibatani. 1993. A Study of the *Delias eichhorni*-complex from New Guinea Island (Lepidoptera; Pieridae) (I) – *Bull. Biogeogr. Soc. Japan* **48**(1): pp. 17-26.
- Morinaka, Sadaharu & Tohru Nakazawa. 1997. A Study of the *Delias eichhorni*-complex from New Guinea Island (Lepidoptera; Pieridae) (II) – *Bull. Biogeogr. Soc. Japan* **52**(1): pp. 19-28.
- Morinaka, Sadaharu & Tohru Nakazawa. 1999. A Study of the *Delias eichhorni*-complex from New Guinea Island (Lepidoptera; Pieridae) (IV) – *Biogeography* **1** (Aug. 17, 1999): 69-80.

- Morinaka, Sadaharu, Tadashi Miyata & Kenji Tanaka. 2002. Molecular phylogeny of the Eichhorni group of *Delias* Hübner, 1819 (Lepidoptera: Pieridae) – Molecular Phylogenetics and Evolution Vol. **23**, No. 2 May 2002: 276-287.
- Nishiyama, Yasusuke & Hayami Arima. 1996. Notes on the Genus *Delias* Hüner (sic!) from Irian Jaya, Indonesia - Futao No. 21 (Jan. 16, 1996): 6-7, Pl. 1, figs. 1-6.
- Parsons, M. 1999. The Butterflies of Papua New Guinea: their Systematics and Biology, pp. I-XVI, 1-736, Pl. 1-162 (132 col.); HB. Academic Press, London. ISBN 0-12-545555-0. (pp. 296-322, 646-653, Pl. 117-118: figs 3086-3098).
- Roepke, W. 1955b. The Butterflies of the genus *Delias* Hübner (Lepidoptera) in Netherlands New Guinea - Nova Guinea, Vol. 6 (2): 185-260.
- Schmitt, O. 1992b. Revision de quelques *Delias* du groupe V: geraldina (Lepidoptera Pieridae) - Bull. Sciences Nat., France, 75 & 76 (Octobre 1992): p. 69-72, Pl. 10, figs 1-20, 24-25).
- Tuzov, V.K. 1995. Checklist of the genus *Delias* Hübner, 1819 (Lepidoptera, Pieridae) – Actias 2 (1-2): 111-123.
- Van Mastrigt, H.J.G. [1988]. Taxonomy of the *Delias mesoblema* subgroup from Irian Jaya (Lepidoptera Pieridae) – Ent. Ber., Amst. Deel **49** (1989)1:8-14.
- Van Mastrigt, H.J.G. 1990. New (Sub)species of *Delias* from the Central Mountain Range of Irian Jaya (Lepidoptera, Pieridae) – Tijdschrift voor Entomologie, **133**: 197-204.
- Van Mastrigt, H.J.G. 1996a. Review on "An illustrated list of Genus *Delias* Hubner of the World" (Lepidoptera: Pieridae) – NEN, Markt-leuthen 38. Band (April 1996):9-19.
- Van Mastrigt, Henk. 1996b. New species and subspecies of *Delias* Hübner, [1819] from the central mountain range of Irian Jaya, Indonesia (Lepidoptera: Pieridae) – NEN, Markt-leuthen 38. Band (April 1996):21-55.
- Van Mastrigt, Henk. 2000. A review of the *Delias clathrata* group from Irian Jaya and Papua New (Lepidoptera: Pieridae) - NEN, Markt-leuthen 48. Band (Mai 2000): 3-68, 72-93, incl. Colour Pl. I-XI: figs 1-189.
- Van Mastrigt, Henk. 2001. Study on *Delias* from lower montane forest in Irian Jaya, Indonesia (Lepidoptera: Pieridae) – Futao, No. 37 (April 21, 2001): 2-13.
- Van Mastrigt, Henk. 2002. Taxonomy of the *Delias fascelis* subgroup from New Guinea (Papua and Papua New Guinea) (Lepidoptera: Pieridae) – Futao, No. 41 (June 22, 2002): 2-23 (incl. 58 pictures).
- Van Mastrigt, Henk. 2003a. Some notes on *Delias weiskei* subgroup from mainland New Guinea (Lepidoptera: Pieridae) – Futao, No. 44 (June 30, 2003): 2-19 (incl. 82 pictures).
- Van Mastrigt, Henk. 2003b. Some notes on the *Delias aroae* Group (lepidoptera: Pieridae) – Atalanta (August 2003) **34** (1/2): 55-73, pl. II-IV.
- Van Mastrigt, H.J.G. & A. Sibatani, 1991. A study of *Delias rileyi* from Irian Jaya, Indonesia (Lepidoptera: Pieridae) – Ent. Ber., Amst. Deel **51**(1991)1:2-6.
- Worth, Richard A. & Richard J. Worth. 1997. A Gynandromorph of *Delias argentata* from Irian Jaya (Lepidoptera: Pieridae) – Tropical Lepidoptera, **8**(1): 38.
- Yagishita, Akira. 1994b. "An illustratated list of the Genus *Delias* Hübner of the World", Continued (3) – Futao No. 17 (Nov. 23, 1994); 6-7, Plate 1: figs 5-6.
- Yagishita, A. 1997. Notes on *Delias nipelti* [sic!] group (Lepidoptera, Pieridae) from New Guinea, with description of a new subspecies – Gekkan-Mushi 317 (July 1997):11-19.

Map of southern part of Archbold III Expedition, with collecting spots of Henk van Mastrigt c.s.



**Table 1.** Results on *Delias* by Henk van Mastrigt c.s. from Baliem Valley to Lake Habbema

No	Daerah	Totals (73 days)				Totals (9 days)				Totals Daela (36 days)				Wesi (44 days)					
		Lembah Baliem upwards				2,800 m upwards				± 2,300 m				2,000-2,100 m				2,000 m	
		M	F	M+F	%	M	F	M+F	%	M	F	M+F	%	M	F	M+F	%		
1	<i>aruna</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
2	<i>lara</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
3	<i>microsticha</i>	-	-	-	-	21	-	21	2.33	63	2	65	2.32	87	-	87	3.56		
4	<i>rileyi</i>	-	-	-	-	-	-	-	-	-	-	-	-	25	-	25	1.02		
5	<i>hypomelas</i>	-	-	-	-	-	-	-	-	-	-	-	-	2	-	2	0.08		
6	<i>argentata</i>	2	-	2	0.04	8	-	8	0.89	-	-	18	0.64	23	1	24	0.98		
7	<i>argentata f. sanguinea</i>	7	-	7	0.15	20	2	22	2.44	93	5	98	3.50	89	3	92	3.77		
8	<i>fascelis ibelana</i>	60	-	60	1.25	57	-	57	6.32	186	-	186	6.65	187	-	187	7.65		
9	<i>yabensis</i>	-	-	-	-	-	-	-	-	1	-	1	0.04	15	3	18	0.74		
10	<i>approximata</i>	17	1	18	0.38	95	2	97	10.75	269	3	272	9.72	349	-	349	14.29		
11	<i>antara</i>	11	-	11	0.23	12	-	12	1.33	42	-	42	1.50	8	-	8	0.33		
12	<i>germana</i>	92	2	94	1.96	9	-	9	1.00	34	-	34	1.22	41	-	41	1.68		
13	<i>carstensiana</i>	1,123	3	1,126	23.52	20	-	20	2.22	64	-	64	2.29	10	-	10	0.41		
14	<i>leucobalia</i>	66	-	66	1.38	-	-	-	-	3	-	3	0.11	3	-	3	0.12		
15	<i>catisa</i>	21	-	21	0.44	4	-	4	0.44	14	-	14	0.50	130	-	130	5.32		
16	<i>toxopei</i>	37	-	37	0.77	5	-	5	0.55	3	-	3	0.11	46	-	46	1.88		
17	<i>nais</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
18	<i>nais f. zebra</i>	25	1	26	0.54	37	3	40	4.43	144	14	158	5.65	40	3	43	1.76		
19	<i>arabuana</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
20	<i>flavistriga</i>	231	13	244	5.10	119	-	119	13.19	422	2	424	15.15	430	3	433	17.72		
21	<i>callista</i>	1	1	2	0.04	12	2	14	1.55	36	8	44	1.57	77	7	84	3.44		
22	<i>luctuosa</i>	1,760	41	1,801	37.61	-	-	-	-	16	1	17	0.61	10	-	10	0.41		
23	<i>hapalina</i>	-	-	-	-	-	-	-	-	-	-	-	-	14	2	16	0.65		
24	<i>leucias</i>	3	-	3	0.06	61	-	61	6.76	123	-	123	4.40	78	1	79	3.23		
25	<i>rosamontana</i>	55	-	55	1.15	65	-	65	7.21	209	-	209	7.47	78	-	78	3.19		
26	<i>ligata</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
27	<i>alepa</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
28	<i>wollastoni</i>	112	-	112	2.34	5	-	5	0.55	14	1	15	0.54	37	-	37	1.51		
29	<i>walshae</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
30	<i>autumnalis</i>	10	-	10	0.21	87	-	87	9.65	190	1	191	6.83	157	-	157	6.43		
31	<i>klossi</i>	1,015	17	1,032	21.55	-	-	-	-	32	-	32	1.14	26	-	26	1.06		
32	<i>niepelti</i>	60	1	61	1.27	256	-	256	28.38	781	4	785	28.06	455	3	458	18.75		
	Number of specimens	4,708	80	4,788	100.00	893	9	902	100.00	2,757	41	2,798	100.00	2,417	26	2,443	100.00		
	Number of species	20				18				22				25					

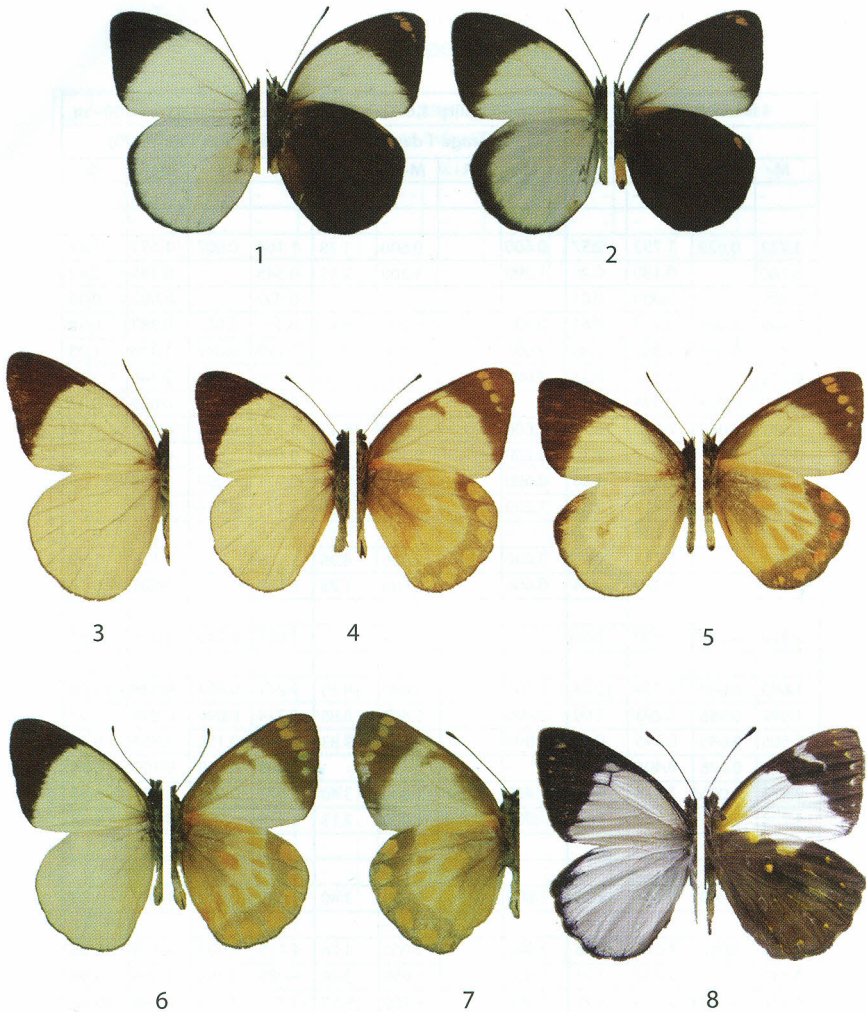
Welesi: Mil, Sigit (3 days)				Total All (83 days)				Musatfak/Siep (5 days)				Total All (170 days)				
2,000 m				2,000-2,100 m				1650 m				1,650-3,000 m				
M	F	M+F	%	M	F	M+F	%	M	F	M+F	%	M	F	M+F	%	% F
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x
4	-	4	2.11	154	2	156	2.88	3	-	3	1.28	178	2	180	1.59	1.11
1	-	1	0.53	26	-	26	0.48	6	-	6	2.55	32	-	32	0.28	-
-	-	-	-	2	-	2	0.04	-	-	-	-	2	-	2	0.02	-
1	-	1	0.53	24	1	25	0.46	1	-	1	0.43	35	1	36	0.32	2.78
2	-	2	1.05	184	8	192	3.55	5	-	5	2.13	216	10	226	1.99	4.42
10	-	10	5.26	383	-	383	7.08	18	-	18	7.66	518	-	518	4.57	-
-	-	-	-	16	3	19	0.35	-	-	-	-	16	3	19	0.17	15.79
20	-	20	10.53	638	3	641	11.84	38	-	38	16.17	788	6	794	7.00	0.76
1	-	1	0.53	51	-	51	0.94	1	-	1	0.43	75	-	75	0.66	-
1	-	1	0.53	76	-	76	1.40	3	-	3	1.28	180	2	182	1.61	1.10
-	-	-	-	74	-	74	1.37	6	-	6	2.55	1,223	3	1,226	10.81	0.24
-	-	-	-	6	-	6	0.11	-	-	-	-	72	-	72	0.64	-
13	-	13	6.84	157	-	157	2.90	10	-	10	4.26	192	-	192	1.69	-
1	-	1	0.53	50	-	50	0.92	3	-	3	1.28	95	-	95	0.84	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x
1	-	1	0.53	185	17	202	3.73	-	-	-	-	247	21	268	2.36	7.84
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x
43	-	43	22.63	895	5	900	16.63	45	-	45	19.15	1,290	18	1,308	11.54	1.38
4	-	4	2.11	117	15	132	2.44	2	-	2	0.85	132	18	150	1.32	12.00
-	-	-	-	26	1	27	0.50	9	-	9	3.83	1,795	42	1,837	16.20	2.29
4	1	5	2.63	18	3	21	0.39	-	-	-	-	18	3	21	0.19	14.29
5	-	5	2.63	206	1	207	3.82	7	1	8	3.40	277	2	279	2.46	0.72
18	-	18	9.47	305	-	305	5.63	5	-	5	2.13	430	-	430	3.79	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x
2	-	2	1.05	53	1	54	1.00	8	-	8	3.40	178	1	179	1.58	0.56
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x
16	-	16	8.42	363	1	364	6.72	10	-	10	4.26	470	1	471	4.15	0.21
2	-	2	1.05	60	-	60	1.11	8	-	8	3.40	1,083	17	1,100	9.70	1.55
39	1	40	21.05	1,275	8	1,283	23.70	46	-	46	19.57	1,637	9	1,646	14.52	0.55
188	2	190	100.00	5,344	69	5,413	100.00	234	1	235	100.00	11,179	159	11,338	100.00	
20				25				20				25				

**Table 2.** Results on *Delias* (as table 1) recalculated to one day at each altitude

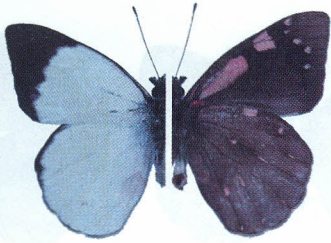
No	Daerah Baliem 1 day per altitude	4 localities 2,800-2,100 m				1 localities 2,300 m			
		average 1 day (73)				average 1 day (9)			
		M	F	M+F	%	M	F	M+F	%
1	<i>aruna</i>	-	-	-	-	-	-	-	-
2	<i>lara</i>	-	-	-	-	-	-	-	-
3	<i>microsticha</i>	-	-	-	-	2.333	-	2.333	2.33
4	<i>rileyi</i>	-	-	-	-	-	-	-	-
5	<i>hypomelas</i>	-	-	-	-	-	-	-	-
6	<i>argentata</i>	0.027	-	0.027	0.04	0.889	-	0.889	0.89
7	<i>argentata f. sanguinea</i>	0.096	-	0.096	0.15	2.222	0.222	2.444	2.44
8	<i>fascelis ibelana</i>	0.822	-	0.822	1.25	6.333	-	6.333	6.32
9	<i>yabensis</i>	-	-	-	-	-	-	-	-
10	<i>approximata</i>	0.233	0.014	0.247	0.38	10.556	0.222	10.778	10.75
11	<i>antara</i>	0.151	-	0.151	0.23	1.333	-	1.333	1.33
12	<i>germana</i>	1.260	0.027	1.288	1.96	1.000	-	1.000	1.00
13	<i>carstensziana</i>	15.384	0.041	15.425	23.52	2.222	-	2.222	2.22
14	<i>leucobalia</i>	0.904	-	0.904	1.38	-	-	-	-
15	<i>catisa</i>	0.288	-	0.288	0.44	0.444	-	0.444	0.44
16	<i>toxopei</i>	0.507	-	0.507	0.77	0.556	-	0.556	0.55
17	<i>nais</i>	-	-	-	-	-	-	-	-
18	<i>nais f. zebra</i>	0.342	0.014	0.356	0.54	4.111	0.333	4.444	4.43
19	<i>arabuana</i>	-	-	-	-	-	-	-	-
20	<i>flavistriga</i>	3.164	0.178	3.342	5.10	13.222	-	13.222	13.19
21	<i>callista</i>	0.014	0.014	0.027	0.04	1.333	0.222	1.556	1.55
22	<i>luctuosa</i>	24.110	0.562	24.671	37.61	-	-	-	-
23	<i>hapalina</i>	-	-	-	-	-	-	-	-
24	<i>leucias</i>	0.041	-	0.041	0.06	6.778	-	6.778	6.76
25	<i>rosamontana</i>	0.753	-	0.753	1.15	7.222	-	7.222	7.21
26	<i>ligata</i>	-	-	-	-	-	-	-	-
27	<i>alepa</i>	-	-	-	-	-	-	-	-
28	<i>wollastoni</i>	1.534	-	1.534	2.34	0.556	-	0.556	0.55
29	<i>walshae</i>	-	-	-	-	-	-	-	-
30	<i>autumnalis</i>	0.137	-	0.137	0.21	9.667	-	9.667	9.65
31	<i>klossi</i>	13.904	0.233	14.137	21.55	-	-	-	-
32	<i>niepelti</i>	0.822	0.014	0.836	1.27	28.444	-	28.444	28.38
	Number of specimens	64.493	1.096	65.589	100.00	99.222	1.000	100.222	100.00
	Number of species	20				18			



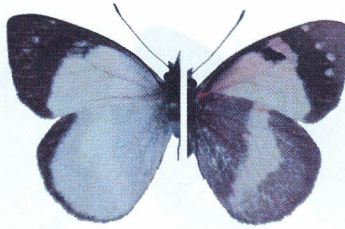
4 localities 2,100 m				1 locality 1,650 m				10 localities 1,650-2,800+ m			
av. 1 day (83)				average 1 day (5)				average 1 day (170)			
M	F	M+F	%	M	F	M+F	%	M	F	M+F	%
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
1.723	0.029	1.752	2.57	0.600	-	0.600	1.28	1.164	0.007	1.171	1.67
0.180	-	0.180	0.26	1.200	-	1.200	2.55	0.345	-	0.345	0.49
0.009	-	0.009	0.01	-	-	-	-	0.002	-	0.002	0.00
0.408	0.005	0.413	0.61	0.200	-	0.200	0.43	0.381	0.001	0.382	0.54
1.877	0.085	1.962	2.88	1.000	-	1.000	2.13	1.299	0.077	1.376	1.96
4.310	-	4.310	6.33	3.600	-	3.600	7.66	3.766	-	3.766	5.36
0.080	0.014	0.094	0.14	-	-	-	-	0.020	0.003	0.023	0.03
6.931	0.069	7.000	10.28	7.600	-	7.600	16.17	6.330	0.076	6.406	9.12
0.937	-	0.937	1.38	0.200	-	0.200	0.43	0.655	-	0.655	0.93
1.022	-	1.022	1.50	0.600	-	0.600	1.28	0.971	0.007	0.977	1.39
1.719	-	1.719	2.52	1.200	-	1.200	2.55	5.131	0.010	5.141	7.32
0.134	-	0.134	0.20	-	-	-	-	0.259	-	0.259	0.37
1.743	-	1.743	2.56	2.000	-	2.000	4.26	1.119	-	1.119	1.59
0.370	-	0.370	0.54	0.600	-	0.600	1.28	0.508	-	0.508	0.72
-	-	-	-	-	-	-	-	-	-	-	-
2.278	0.232	2.510	3.69	-	-	-	-	1.683	0.145	1.828	2.60
-	-	-	-	-	-	-	-	-	-	-	-
11.699	0.040	11.739	17.24	9.000	-	9.000	19.15	9.271	0.054	9.326	13.28
1.147	0.146	1.293	1.90	0.400	-	0.400	0.85	0.724	0.096	0.819	1.17
0.505	0.040	0.545	0.80	1.800	-	1.800	3.83	6.604	0.150	6.754	9.62
0.330	0.076	0.406	0.60	-	-	-	-	0.083	0.019	0.102	0.14
2.473	0.005	2.478	3.64	1.400	0.200	1.600	3.40	2.673	0.051	2.724	3.88
4.734	-	4.734	6.95	1.000	-	1.000	2.13	3.428	-	3.428	4.88
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
0.705	0.040	0.745	1.09	1.600	-	1.600	3.40	1.099	0.010	1.109	1.58
-	-	-	-	-	-	-	-	-	-	-	-
4.658	0.012	4.670	6.86	2.000	-	2.000	4.26	4.115	0.003	4.118	5.86
0.837	-	0.837	1.23	1.600	-	1.600	3.40	4.085	0.058	4.144	5.90
16.342	0.163	16.505	24.23	9.200	-	9.200	19.57	13.702	0.044	13.746	19.57
67.154	0.953	68.108	100.00	46.800	0.200	47.000	100.00	69.417	0.812	70.230	100.00
18				20				18			



**Figs 1-2.** *Delias ladas*: 1. ♂ 2. *f. sulfurata*: HT♀ upp./und.;  
**Figs. 3-6:** *D. geraldina siderea*: 3. HT upp. 4. PT upp./und. 5. AT upp./und.  
 6. *f. flavescens* HT upp./und. 7. *f. flavescens* PT und.;  
**Fig. 8.** *Delias rileyi yofona* upp./und. (KSP 5605).



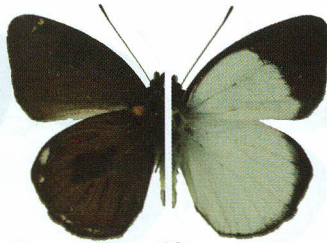
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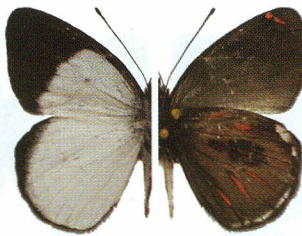
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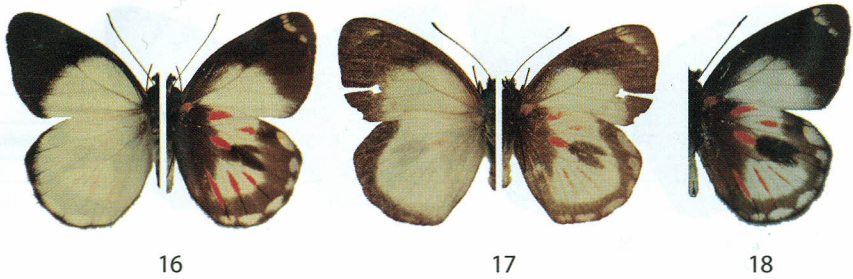


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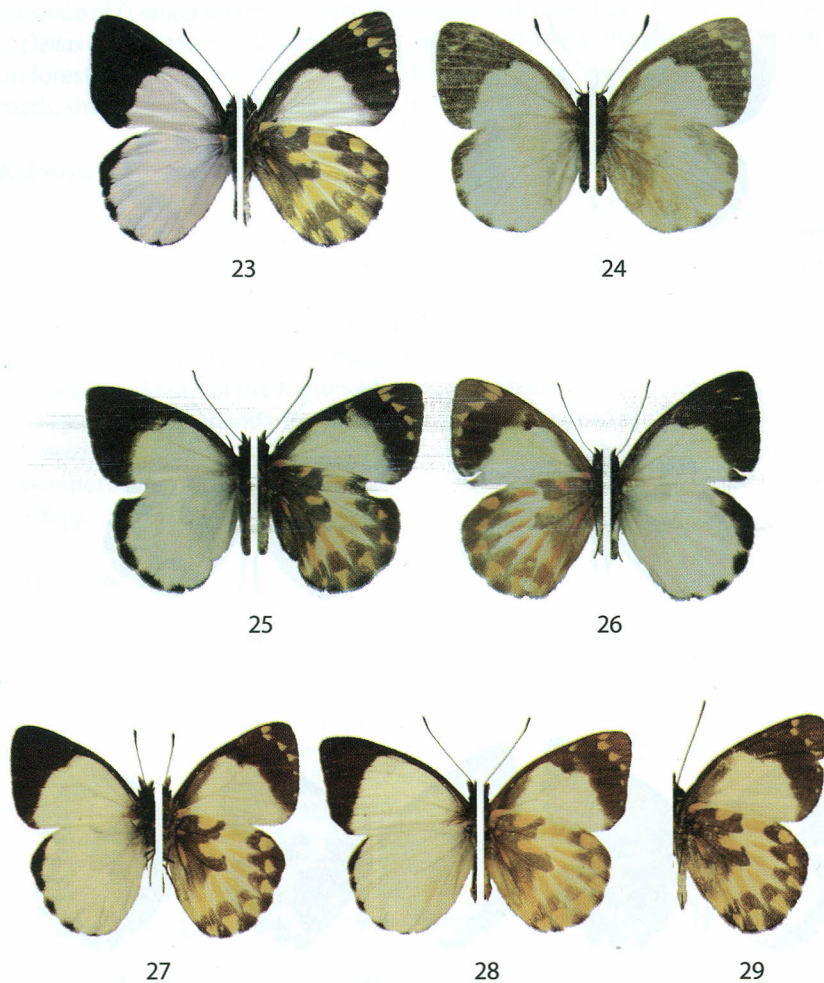
15

**Figs 9-10.** *Delias microsticha serratula*: 9. HT upp./und. 10. AT upp./und.;  
**Figs 11-12.** *D. hypolemas fulgida*: 11. HT upp./und. 12. PT und./upp.;  
**Figs 13-15:** *D. hypomelas* sp. 13. upp./und. (KSP 25950), 14. upp./und. (KSP 25966),  
15. upp./und. (KSP 25973).



**Figs 16-20.** *Deltias argentata*: 16. HT ♂ upp./und. 17. AT ♀ upp./und. 18. var. *sanguinea* AT ♀ upp./und. 19. var. *sanguinea* HT ♂ upp./und. 20. var. *sanguinea* AT ♀ upp./und.  
**Figs 21-22.** *D. fascelis ibelana*: 21. HT ♂ upp./und. 22. AT und./upp.

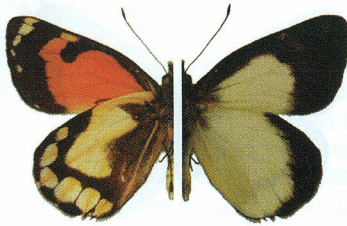




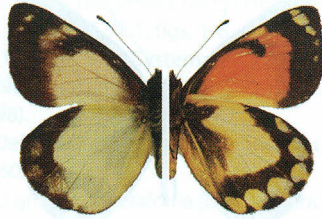
**Figs 23-26.** *Delias approximata*: 23. ♂ upp./und. (KSP 3735), 24. f. *designata* HT ♀ upp./und. 25. f. *separata* HT ♀ (in litt); 26. f. *separata* PT ♀ (in litt) und./upp.

**Fig. 27.** *D. aroae balimensis* HT ♂ upp./und.

**Figs 28-29.** *D. aroae brumalis*: 28. HT upp./und., 29. PT ♂ und.



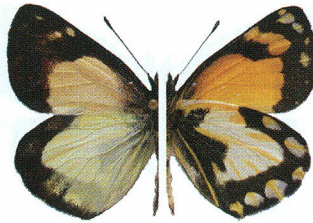
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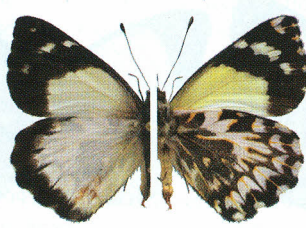
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**Figs 30-31.** *Delias antara*: 30. HT ♂ upp./und. 31. AT ♀ upp./und.  
**Figs 32-33.** *D. germana*: 32. HT ♂ upp./und. 33. ♀ upp./und. (KSP 6360);  
**Figs 34-36.** *D. carstensiiana alcicornis*: 34. HT ♂ upp./und. 35. ♀ upp./und.  
(KSP 6091); 36. ♀ und. (KSP 6092).



37



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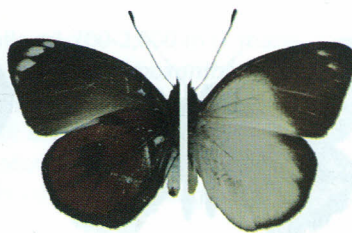


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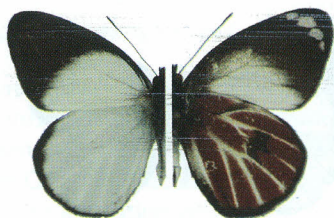
**Figs 37-38.** *Delias leucobalia ericetorum*: 37. HT ♂ upp./und. 38. AT ♀ upp./und.  
**Figs 39-40.** *D. catisa aurostriga*: 39. HT ♂ upp./und. 40. PT ♂ upp./und.;  
**Fig. 41.** *D. toxopei toxopei* HT ♂ upp./und.



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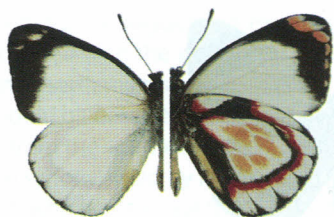
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**Figs 42-43.** *Delias nais holophora*: 42. HT ♂ upp./und. 43. AT ♀ und./upp.  
**Figs 44-45.** *D. nais holophora* f. *zebra*: 44. HT ♂ upp./und. 45. AT ♀ upp./und.;  
**Figs 46-47.** *D. flavistriga flavistriga*: 46. HT ♂ upp./und. 47. AT ♀ upp./und.





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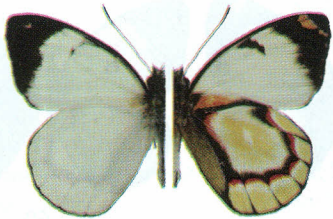
49



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51

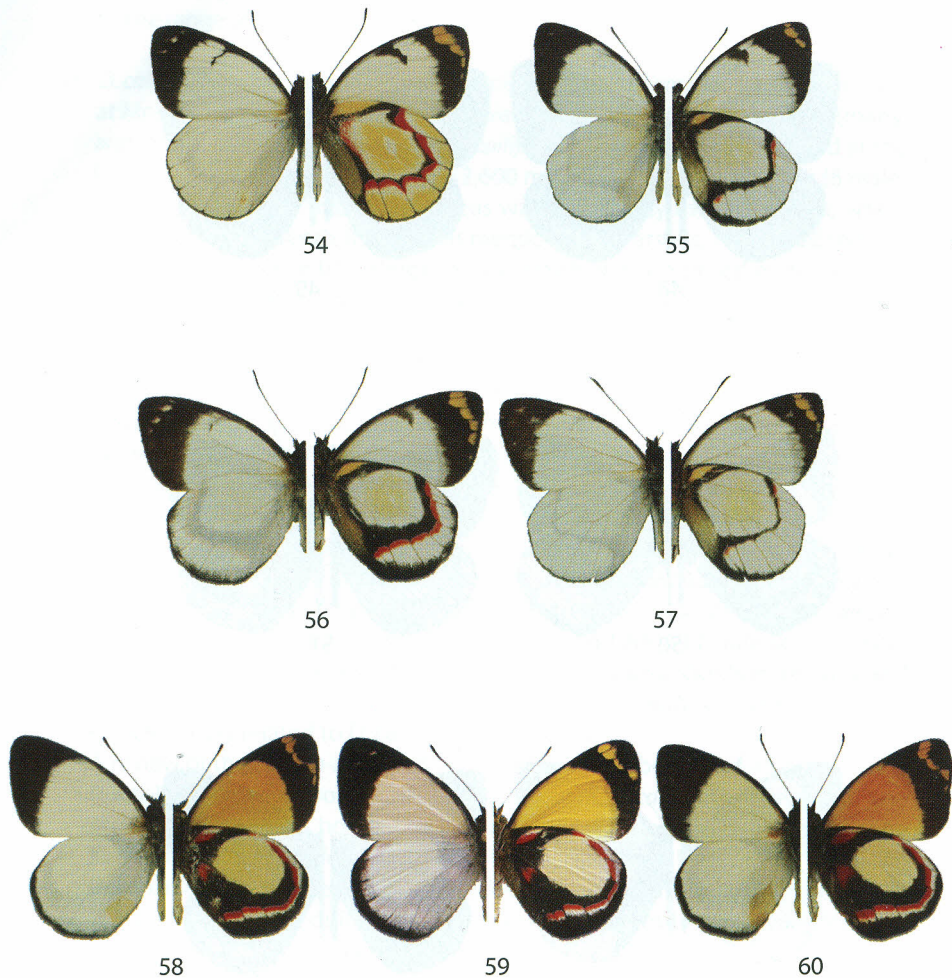


52

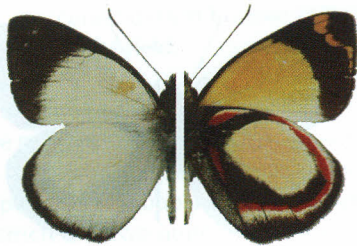


53

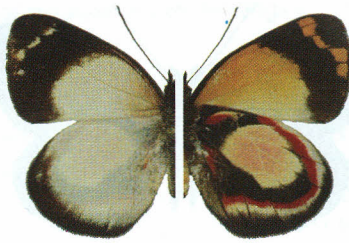
**Figs 48-51.** *Delias luctuosa archboldi*: 48. HT ♂ upp./und. 49. AT ♀ upp./und.  
50. *f. butyracea* HT ♂ und./upp. 51. *f. butyracea* AT ♀ upp./und.  
**Figs 52-53.** *D. callista callipareia*: 52. HT ♂ upp./und. 53. AT ♀ upp./und.



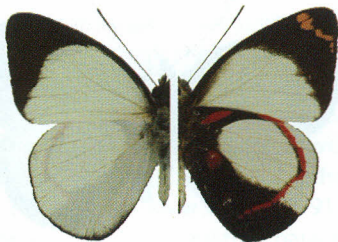
**Fig. 54.** *Delias callista callipareia* f. *luteola* HT ♂ upp./und.;  
**Figs 55-57.** *D. hapalina amoena*: 55. HT ♂ upp./und. 56. AT ♀ upp./und.  
 57. var. *adjuncta* HT ♂ und./upp.;  
**Figs 58-60.** *D. leucias* (= *Delias leucias rhodea* HT ♂, in litt.) upp./und.  
 59. ♀ (KSP 9553); 60. f. *lutescens* HT ♂ upp./und.



61



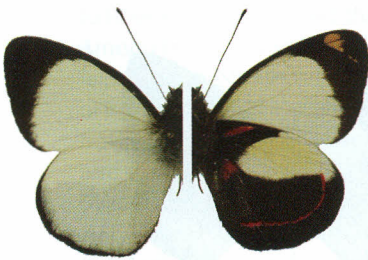
62



63



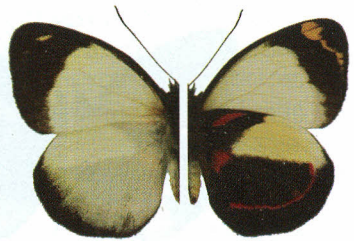
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67

**Figs 61-62.** *Delias rosamontana*: 61. HT ♂ upp./und. 62. AT ♀ upp./und.  
**Figs 63-64.** *D. ligata interpolata*: 63. HT ♂ upp./und. 64. AT ♀ und./upp.;  
**Figs 65-67.** *D. alepa orthobasis*: 65. HT ♂ upp./und. 66. PT ♂ upp., 67. AT ♀ upp./und.

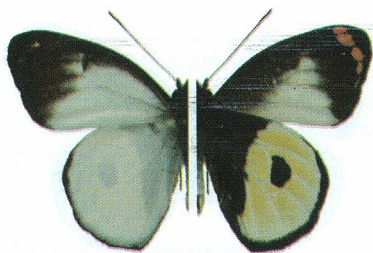




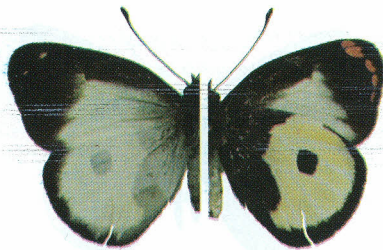
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**Figs 68-69.** *Delias wollastoni bryophila*: 68. HT ♂ und./upp. 59. ♀ (KSP 21804) und./upp.

**Figs 70-71.** *D. walshae walshae*: 70. HT ♂ upp./und. 71. AT ♀ upp./und.;

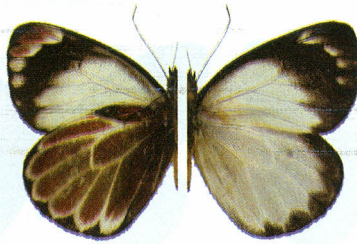
**Figs 72-73.** *D. autumnalis autumnalis*: 72. HT ♂ upp./und. 73. AT ♀ upp./und.



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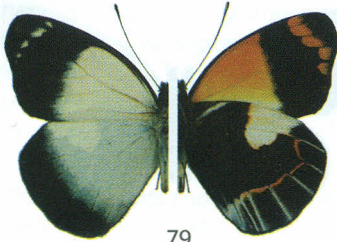


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**Figs 74-76.** *Delias klossi chrysanthemum*: 74. HT ♂ upp./und. 75. AT ♀ upp./und.

76. f. *deluna* HT ♀ (KSP 25729);

**Figs 77-78.** *D. aruna inferna*: 77. ♂ upp./und. (KSP 2473), 78. ♀ upp./und. (KSP 2477).



79



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**Figs 79-82.** *Delias meeki hypochrysis*: 79. HT ♂ upp./und. 80. AT ♀ upp./und.  
 81. var. *insula* HT ♂, 82. var. *peninsula* HT ♂; **Figs 83-84.** *Delias meeki hypoxantha*:  
 83. HT ♂ upp./und. 84. AT ♀ und./upp.