

## A review of *Delias rileyi* (Lepidoptera: Pieridae) in Papua, Indonesia

Henk van Mastrigt

Kelompok Entomologi Papua, Kotakpos 1078, Jayapura 99010, INDONESIA  
Email: hevamas@gmail.com

Suara Serangga Papua: **8**(1): 17 - 39

*Abstract:* The taxonomic history of *Delias rileyi* Joicey & Talbot (1922) is presented with some comments. A comparison of diagnostic features of the various subspecies results in a new synonym.

*Rangkuman:* Sejarah taksonomi *Delias rileyi* Joicey & Talbot (1922) disajikan dengan komentar. Perbandingan ciri-ciri diagnosis dibuat antara subspecies-subspecies yang menghasilkan satu sinonim baru.

*Key-words:* West New Guinea, **syn. nov.**, *ssp. extremus*, *ssp. erici*.

### Introduction

*Delias rileyi* is under-represented in most musea and private collections. Both *D. rileyi* and *D. rileyi yofona* were described from single male specimens and until recently females of both taxa were unknown. The more recently described *D. r. nishizawai* from the Ilaga-Mulia-Sinak area and *D. r. erici* from Korupun are relatively common in their respective ranges. *D. rileyi* was not recorded by the Archbold III Expedition to the Baliem Valley in 1938-1939 (see Roepke, 1955) however it has since been found in three separate localities within the valley. Specimens from the Baliem area appear similar to *ssp. yofona* originally described from the Paniai Lakes area and also commonly found at Tembagapura in the Snow Mts.

Specimens similar to *yofona* have been collected at Homeyo and occasionally at Kanggime and Tiom, two well-known locations for *D. rileyi nishizawai*. The scattered occurrence of *yofona*-like phenotypes raises questions about the status and range of some subspecies.

The taxon *D. rileyi extremus* Tuzov & Churkin (1998) is based on an incorrect species identification and is synonymised with *D. langda watlangku* below. Additionally, the key diagnostic characteristics used by Gotts & Ginn (2005) to separate *ssp.*

*erici*. have been measured and compared with a broad sample of neighbouring populations in the KSP.

## Abbreviations

dc – discocel(lular)

GG – Private collection of G. (Fred) Gerrits, Brisbane, Australia.

HT – holotype

KSP – Koleksi Serangga Papua (Collection of Papuan Insects), Jayapura, Indonesia.

ssp. – subspecies

## Taxonomic history

*Delias rileyi* was originally described by Joicey & Talbot (1922), based on a single male from the Menoo Valley, 6,000 to 8,000 feet, January, 1921. The authors considered the new species to be allied to *jordani* Kenrick and compared both species in the description.

Talbot in his Monograph of the Pierine Genus *Delias* (1928, 1929) listed *D. rileyi* and figured the genitalia of the holotype (in part IV, 1929). Based on similarities in genitalia, Talbot placed *rileyi* in his *geraldina* group of species rather than the superficially more similar *cuningputi* group. Recent DNA analysis by Muller *et al.* (2012) has confirmed that *rileyi* (and some other species of Talbot's *geraldina* group) are members of the *aroeae-cuningputi* clade.

Sibatani & Nishizawa (1982) compared three populations of *D. rileyi* (from Ilu-Mulia, Ilaga and the Paniai Lakes area) with the holotype from the Kobowre Mts finding that the upperside and underside of forewing resembles the Ilaga population; the upperside of hindwing resembles Paniai population and the underside of the hindwing resembles Ilu population. The authors conclude that "Populations of various regions are probably all continuous to one another, forming a cline."

In 1992 Schröder & Treadaway described *Delias yofona* based on a single male collected by Ray Straatman at Tuguwai near Wissel Lake in May 1980. The authors overlooked the existence of *D. rileyi* and instead suggested that the new species might be related to *Delias lecerfi* Joicey & Talbot 1922, though differing in nearly all details.

D'Abrera (1971, 1977, 1990) did not mention *D. rileyi*, perhaps by oversight. Sibatani (1988) regarded *D. yofona* "a local population (or plausibly a good subspecies) of *D. rileyi*".

In 1991 van Mastrigt & Sibatani published the description of *Delias rileyi nishizawai* based on 41 males from Ilaga and 14 males from the Ilu-Mulia area.

Parsons (1999) mentioned *D. rileyi* in his Checklist of New Guinea Butterflies (including species occurring only in Irian Jaya, Indonesia) – Appendix XI.

Yagishita (1993) established the currently recognised classification with three subspecies: *rileyi* (Menoo Valley), *yofona* (Wissel Lake) and *nishizawai* (Ilaga River). For the first time a female of *D. rileyi nishizawai* was pictured and a new allied species was described as *Delias hikarui*, based on a single female from Ilu, July 1991.

In his checklist Tuzov (1995) mentioned besides the three subspecies of *D. rileyi* and *D. hikarui* as mentioned by Yagishita (1993) a new un-described subspecies from the Baliem Valley. Tuzov & Churkin (1998) later described *Delias rileyi extremus*, based on 14 males from "Balim valley, Seg River, Watlangku, 1800 m, 7-10.I.1995".

Gotts & Pangemanan (2001, 2010) mention, besides *Delias rileyi yofona* from Tembapapura, a possible fourth subspecies from Korupun (named as *erici* in the revised edition of 2010) and stated that all races are endemic to the southern parts of Papua. They also published a picture of a female from Tembapapura.

In 2005 Gotts & Ginn described a new subspecies, *Delias rileyi erici*, based in six males from the Asso River at Korupun and also mentioned two males from Wesi River, Baliem Valley (in GG) suggesting that other unnamed subspecies of this species may exist. The paper also includes a useful key to the subspecies of *Delias rileyi*.

Van Mastrigt [2011] published the first records of *D. rileyi* from the Baliem Valley (32 males from 3 localities).

Van Mastrigt (2012) proposed to treat *hikarui* as a hybrid of *D. rileyi* and *D. argentata* (now revised as *D. hypomelas* f. *argentata*).

### **Some notes on taxonomic history**


When Schröder & Treadaway described *Delias yofona* as new species, they overlooked *Delias rileyi*. Later realizing their mistake, Treadaway sent a picture of the holotype to the author appended with the name '*Delias rileyi yofona*'.

*Delias rileyi extremus* Tuzov & Churkin, 1998 clearly represents the previously described *D. langda watlangku* Gerrits & van Mastrigt [1993]. Herewith, *D. rileyi extremus* is formally recognised to be a junior synonym of *D. langda watlangku*.

In his publications (1982 & 1988) Sibatani emphasized that the varieties found among series of *D. rileyi* could not easily be described as subspecies. He preferred

**Table 1.** Differences in frequency of features between different localities of *D. rileyi* ssp. ♂

wing	locality		Modio-Kamu		Kobowre-Magoda		Homeyo		Kanggime		Tiom		Tembagapura		Habbema		Welesi-Wesi		Musatfak		Silakma-Ninya		Korupun		
	features / number of specimens		6		18		5		18		29		25		5		13		8		4		26		
1	f.w.r.	1a	border absorbed dc-bar	2	33.3%	7	38.9%	0	0.0%	2	11.1%	1	3.4%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		1b	narrow greyish area between border and dc-bar	3	50.0%	10	55.6%	3	60.0%	10	55.6%	16	55.2%	1	4.0%	0	0.0%	0	0.0%	0	0.0%	1	25.0%	0	0.0%
		1c	dc-bar clearly separate	1	16.7%	1	5.6%	2	40.0%	6	33.3%	12	41.4%	24	96.0%	5	100.0%	13	100.0%	8	100.0%	3	75.0%	26	100.0%
2	f.w.r.	2a	border reaching tornus broadly and curving into inner margin	3	50.0%	9	50.0%	0	0.0%	1	5.6%	1	3.4%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		2b	border reaching tornus but not curving into inner margin	3	50.0%	9	50.0%	5	100.0%	14	77.8%	21	72.4%	10	40.0%	5	100.0%	13	100.0%	8	100.0%	4	100.0%	25	96.2%
		2c	border not reaching tornus	0	0.0%	0	0.0%	0	0.0%	3	16.7%	7	24.1%	15	60.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	3.8%
3	f.w.r.	3a	border with five clear subapical - terminal spots	0	0.0%	0	0.0%	0	0.0%	1	5.6%	0	0.0%	2	8.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	8	30.8%
		3b	border with 1-4 poor developed subapical - terminal spots	4	66.7%	13	72.2%	2	40.0%	6	33.3%	15	51.7%	23	92.0%	5	100.0%	11	84.6%	8	100.0%	4	100.0%	17	65.4%
		3c	border with only 1-2 very vague or no spots at all	2	33.3%	5	27.8%	3	60.0%	11	61.1%	14	48.3%	0	0.0%	0	0.0%	2	15.4%	0	0.0%	0	0.0%	1	3.8%
4	h.w.r.	4a	black broad border continue till tornus	0	0.0%	0	0.0%	0	0.0%	12	66.7%	15	51.7%	0	0.0%	0	0.0%	2	15.4%	0	0.0%	0	0.0%	0	0.0%
		4b	black border undulate	0	0.0%	0	0.0%	0	0.0%	3	16.7%	7	24.1%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		4c	black border till M3 followed by black dots at vein ends	6	100.0%	18	100.0%	5	100.0%	3	16.7%	7	24.1%	25	100.0%	5	100.0%	11	84.6%	8	100.0%	4	100.0%	26	100.0%
5	f.w.v.	5a	dc-bar broadly connected with black border	0	0.0%	2	11.1%	0	0.0%	7	38.9%	7	24.1%	0	0.0%	1	20.0%	3	23.1%	3	37.5%	4	100.0%	18	69.2%
		5b	dc-bar just connected with black border or in one wing only	6	100.0%	10	55.6%	3	60.0%	7	38.9%	16	55.2%	4	16.0%	4	80.0%	6	46.2%	3	37.5%	0	0.0%	8	30.8%
		5c	dc-bar not connected with black border	0	0.0%	6	33.3%	2	40.0%	4	22.2%	6	20.7%	21	84.0%	0	0.0%	4	30.8%	2	25.0%	0	0.0%	0	0.0%
6	f.w.v.	6a	yellow in dc less than 30%	6	100.0%	18	100.0%	5	100.0%	2	11.1%	6	20.7%	25	100.0%	5	100.0%	13	100.0%	8	100.0%	4	100.0%	10	38.5%
		6b	yellow in dc 30-75%	0	0.0%	0	0.0%	0	0.0%	4	22.2%	1	3.4%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	16	61.5%
		6c	dc (almost) totally yellow	0	0.0%	0	0.0%	0	0.0%	4	22.2%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		6d	yellow extended and passing cobitus	0	0.0%	0	0.0%	0	0.0%	8	44.4%	22	75.9%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
7		length of forewing	30.2		29.5		29.2		29.3		29.2		29.2		29.0		29.8		29.5		29.8		29.8		

 50 - 75% of individuals

 75 - 100% of individuals

to use the term 'populations' which include some individual varieties and finally agreed (pers. comm.) to publishing ssp. *nishizawai* only because of the large yellow area on the underside of forewing which is absent in the other known subspecies. The populations from the Baliem Valley and Homeyo show some differences in comparison with the holotypes (and other specimens from the type-localities) of the described subspecies, however following Sibatani's criteria, they are treated for the time being as distinct populations rather than valid subspecies.

## Material in KSP

Material of *D. rileyi* in KSP consists of 193 males and 6 females from various areas: the Kobowre Mts (type locality of nominate *rileyi*) in the west ( where most recent material originates from Magoda), via Tuguwai on the edge of the Paniai Lakes (type locality of *D. rileyi yofona*), Homeyo and Tembapapura to the Ilaga and Mulia-Sinak area (type locality of *D. rileyi nishizawai*); from there via the Kanggime and Tiom areas to the Baliem Valley (where the species is present in three separate localities). In the south east part of Papua, some specimens have been recorded at Soba and Ninya and at the most eastern locality of Korupun. As far as is known the KSP contains material from all known localities of *D. rileyi* apart from the Menoo Valley, and so provides a comprehensive resource for further investigation. The female of *D. rileyi nishizawai* is not represented in the KSP therefore the specimen depicted by Yagishita (1993) is used for comparison.

Based on the existing classification and the key of Gotts & Ginn (2005), the KSP holdings comprise the following:

### 1. *Delias rileyi rileyi* (24 ♂♂)

- a. Modio – Kamu (6 ♂♂): Modio (1 ♂), Kamu Valley (5 ♂♂)
- b. Kobowre Mts – Magoda (18 ♂♂)

### 2. *Delias rileyi nishizawai* (71 ♂♂)

- a. Ilaga population: Ilaga (11 ♂♂) = HT locality
- b. Sinak-Mulia-Ilu population (23 ♂♂): Sinak-Mulia (15 ♂♂), Sinak (1 ♂), Kembruk-Sinak (1 ♂), Mulia (4 ♂♂), Ilu (2 ♂♂)
- c. Kanggime population: Kanggime (12 ♂♂), Kayuwagi (1 ♂), Karubaga (1 ♂)
- d. Tiom population (21 ♂♂)

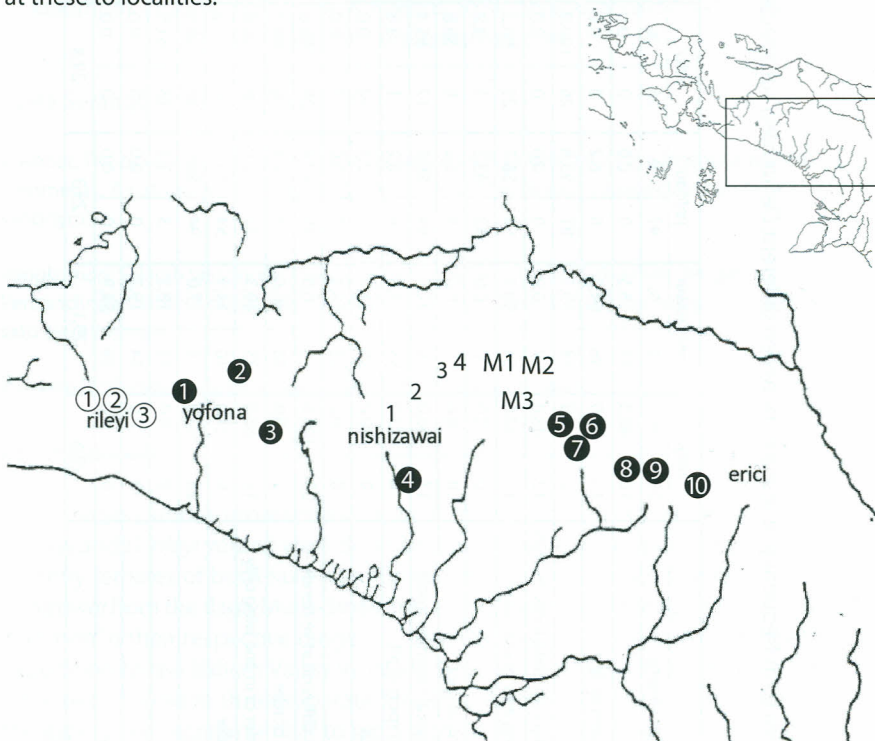
### 3. *Delias rileyi yofona* (68 ♂♂ + 1 ♀)

- a. Paniai Lake population: Tuguwai (1 ♂) = HT locality, Homeyo (5 ♂♂)
- b. Tembapapura population: Tembapapura (24 ♂♂+ 1 ♀), Jila (1 ♂)
- c. Karubaga population: Karubaga (1 ♂)
- d. Kanggime population: Kanggime (4 ♂♂), Tiom (4 ♂♂), Mapinduma (5 ♂♂)
- e. Baliem Valley population: Habbema River (5 ♂♂, Wesi River (13 ♂♂), Musatfak (8 ♂♂)

#### 4. *Delias rileyi erici* (30 ♂♂ + 5 ♂♂)

- Silakma-Ninya population: Silakma-Ninya (4 ♂♂): Silakma (2 ♂♂), Ninya (♂♂)
- Korupun population: Korupun (26 ♂♂ + 5 ♂♂) = HT locality

It should be noted that the localities Kanggime and Tiom are mentioned below both *Delias rileyi nishizawai* and *D. rileyi yofona*, implying that they are sympatric at these to localities.



Distribution map of *Delias rileyi* ssp. in Papua

#### Explanation:

- ① ② etc. Distribution *D. rileyi yofona*, including *erici* **syn. nov.**
- ① ② ③ Distribution of *D. rileyi rileyi*
- 1 2 etc. Distribution of *D. rileyi nishizawai*
- M Localities with *yofona* and *nishizawai*

**Table 2.** Differences in frequency of features between different *Delias rileyi* subspecies ♂

	subspecies	<i>rileyi</i>		<i>nishizawai</i>		<i>yofona</i>		<i>erici</i>		TOTAL/specim		TTL/ssp.
		character/number of specimens	25	%	71	%	97	%	26	%	219	%
1a	border absurbed dc-bar	10	40,0	11	15,5	0	0,0	0	0,0	21	9,6	13,9
1b	narrow greyish area between border and dc-bar	13	52,0	46	64,8	6	6,2	0	0,0	65	29,7	30,7
1c	dc-bar clearly separate	2	8,0	14	19,7	91	93,8	26	100,0	133	60,7	55,4
2a	border reaching tornus broadley and curving into inner margin	12	48,0	7	9,9	0	0,0	0	0,0	19	8,7	14,5
2b	border reaching tornus but not curving into inner margin	13	52,0	64	90,1	55	56,7	25	96,2	157	71,7	73,7
2c	border not reaching tornus	0	0,0	0	0,0	42	43,3	1	3,8	43	19,6	11,8
3a	border with five clear subapical - terminal spots	0	0,0	0	0,0	5	5,2	8	30,8	13	5,9	9,0
3b	border with 1-4 poor developed subapical - terminal spots	17	68,0	16	22,5	84	86,6	17	65,4	134	61,2	60,6
3c	border with only 1-2 very vague or no spots at all	8	32,0	55	77,5	8	8,2	1	3,8	72	32,9	30,4
4a	black broad border continue till tornus	0	0,0	58	81,7	2	2,1	0	0,0	60	27,4	20,9
4b	black border undulate	0	0,0	13	18,3	0	0,0	0	0,0	13	5,9	4,6
4c	black border till M3 followed by black diffusion at veinends	25	100,0	0	0,0	95	97,9	26	100,0	146	66,7	74,5
5a	dc-bar broadly connected with black border	2	8,0	26	36,6	12	12,4	18	69,2	58	26,5	31,6
5b	dc-bar just connected with black border or in one wing only	17	68,0	35	49,3	31	32,0	8	30,8	91	41,6	45,0
5c	dc-bar not connected with black border	6	24,0	10	14,1	54	55,7	0	0,0	70	32,0	23,4
6a	yellow in dc less than 30%	25	100,0	5	7,0	94	96,9	10	38,5	134	61,2	60,6
gb	yellow in dc 30-75%	0	0,0	13	18,3	3	3,1	16	61,5	32	14,6	20,7
6c	dc (almost) totally yellow	0	0,0	14	19,7	0	0,0	0	0,0	14	6,4	4,9
6d	yellow extended and passing cobitus	0	0,0	39	54,9	0	0,0	0	0,0	39	17,8	13,7
	length of forewing - average	29,6		29,1		29,3		29,8		29,3		29,4

## Key to subspecies of males

By comparing six different features and the size of the forewing (see table 1) the author intends to establish if the four recognised taxa are consistent and soundly based and if further subspecies as suggested by (Gotts & Ginn, 2005) can be identified.

### Character 1.

The position of the dc-bar at the upperside of the forewing is a fairly reliable characteristic for separating *yofona* and *erici* from *rileyi* and *nishizawai* as in all specimens of *erici* and in nearly all of *yofona* (93.8%) the dc-bar is clearly separate from the border. However this feature is also present in some *rileyi* (8.0%) and *nishizawai* (19.7%).

### Character 2.

The connection of the border with the tornus shows that in the majority of subspecies the border reaches to tornus but does not curve into the inner margin.

### Character 3.

The number of subapical and terminal spots/dots is quite variable. In *rileyi* and *nishizawai* no specimens are found with five terminal spots. Specimens with vestigial or no spots are more common in *nishizawai* (77.5%) than in *rileyi* (32.0%). In *yofona* and *erici* the spots are much clearer than in the other subspecies, however only 30.8% of *erici* and 5.2% of *yofona* have five clearly defined spots.

### Character 4.

Differences in the border on the upperside of the hindwing are quite clear. A narrow black border extending to M3 followed by black diffusion at the vein ends is common in all subspecies except *nishizawai* which has a broad continue border till tornus, sometimes undulate (in 18.3% of specimens).

### Character 5.

The broad dc-bar on the underside of the forewing is broadly or just connected with border in *erici* (69.2% + 30.8%), in *nishizawai* (36.6% + 49.3%), in *rileyi* (8.0% + 68.0%) and in *yofona* (12.4% + 32.0%). Only in *yofona* are a majority of specimens (55.7%) with the dc-bar separated from the border.

### Character 6.

The yellow coloration on the underside of forewing is much extended in *nishizawai* with (75% of specimens having the dc is nearly completely filled with yellow or extending and passing the cubitus. However in a significant minority, 18.7%, only 30-75% is yellow and in 8% less than 30% is yellow. In the other subspecies the yellow area is restricted: in *rileyi* all individuals have less than 30%; in *yofona* 96.9% have less than 30% and just 3.1% have 30-75% yellow; in *erici* these percentages are respectively 38.5% and 61.5%.



**The length of the forewing** shows no significant difference. It varies between 26-27 mm to 31-32 mm, with an average between 29.1 (*nishizawai*) and 29.8 (*erici*).

It is possible to divide the *rileyi* specimens in two groups, the *rileyi*-like (including *nishizawai*) and the *yofona*-like (including *erici*). The *yofona*-like species are characterised by a clearly separate dc-bar (1c), better developed white subapical spots (3a-b), on the upperside of the forewing and on the upperside of the hindwing a short black border followed by black dots at the vein-ends (4c) and a very reduced yellow area in the base of dc (6a). The *rileyi*-like specimens have less features in common, but no subapical spots or poor developed ones (3b-c), a dc-bar not clearly separated from the border; in many cases a broader border on the upperside of hindwing and more yellow on underside of forewing. Subspecies *nishizawai* can normally be recognized by the extended yellow area on the underside of the forewing although this is not present in 18% of the specimens. Subspecies *erici* can be recognised by its larger and brighter subapical and terminal spots on the forewing upperside. However a few individuals of other subspecies show the same feature.

Subspecies can be defined only by a combination of features and there are many exceptions!

The following key is proposed:

1. a. On upperside forewing dc-bar not or poorly separate from black border and poor developed subapical and terminal dots, if they are any. .... 2
  - b. On upperside forewing dc-bar clearly separate from black border and subapical and terminal spots quite till good developed ..... 3
2. a. On underside forewing yellow in dc less than 30% and on underside hindwing black border not continue: only till M3 followed by black diffusion at vein-ends. .... *rileyi*
  - b. On underside forewing yellow filling (nearly) whole dc or even extending and passing cobitus and on underside hindwing black border continue till tornus, mostly broad. .... *nishizawai*
3. a. On upperside of forewing better developed white spots and on underside forewing yellow 30-75% and dc-bar broadly or just connected with black border ..... *erici*
  - b. On upperside forewing developed white spots (but less than in *erici*); on underside forewing yellow less than 30% and broad dc-bar poorly or not connected with black borde ..... *yofona*

The use of at least two features in the key above is a need to reduce the number of exceptions. Even with this provision, key 1 is invalid for 8% of individuals; key 2 invalid for 7% and key 3 for about 30% of individuals.

The keys used by Gotts and Ginn (2005) to separate *erici* from *yofona* are debatable; (1) "Forewing upperside with five defined white subapical spots" is only true for 30.8% of the Korupun specimens in KSP (65.8% has 2-4 spots and a single specimen has only one spot); (2) "the black discocellular bar touching or broadly joined to outer apical black area" is found in 100% of the Korupun population, but also in 44.4% of *yofona* (12.5% for the Tembagapura population); (3) "the hindwing upperside with dark margin bold and heavily beaded at apices of veins" is confirmed in nearly all Korupun specimens, however a few *yofona* also show the same feature although generally the black diffusion at the vein-ends is reduced *yofona*.

Specimens from the Baliem Valley and its environment, River Habbema, River Wesi, Musatfak, Silakma and Ninya, show affinities to the Tembagapura population of *yofona* in the yellow area on underside forewing and to the Korupun population (*erici*), in the connection of the dc-bar with the black border.

The weakly defined characteristics and the frequency of individual exceptions, together with the intermediate forms found in the Baliem Valley, provide little evidence of a discontinuity between *yofona* and *erici*, that would justify subspecific status for the latter. As a consequence, it is proposed to treat *D. rileyi erici* as a **syn. nov.** of *D. rileyi yofona*.

## Females

The females of *Delias rileyi* are very rare in collections which makes it difficult to judge the variation in regional forms. Comparison of five females from Korupun, a single female from Tembagapura (+ the figure of the upperside in Gotts & Pangemanan) and the picture in Yagishita (upperside and underside) leads to the conclusions that the *D. rileyi nishizawai* ♀ differs from all others on the forewing upperside by the absence of subapical and terminal spots (four in all other females) and on the upperside of the hindwing by a broad black border without white spots. The female from Tembagapura differs from all others on the underside of forewing where the broad dc-bar is separated from the black border.

## Genitalia

Dissected genitalia of male specimens of *D. rileyi rileyi* (from Magoda), *D. rileyi yofona* (from Tembagapura) and *D. rileyi nishizawai* (from Mulia) are shown in figs 49-54. These show little difference between populations and are therefore discounted as a means of separating subspecies.

## Discussion

The sympatry of *Delias rileyi nishizawai* and *D. r. yofona* at both Kanggime and Tiom is curious.

It is unsatisfying to conclude that there are three subspecies; *Delias rileyi rileyi*, *D. r. nishizawai* and *D. r. yofona* (including *D. r. erici* **syn. nov.** and the Baliem Valley and Homeyo populations), without suggesting a plausible reason for the sympatry at Kanggime and Tiom.

Roepke presented the idea that various species and subspecies may have evolved from shared ancestors in separate valleys which, as tectonics shaped the mountain ranges, became isolated and resulted in different genetic constitutions. More recent geological movement and other changes allowed previously geographically isolated populations to become mingled by interbreeding or – if they have become genetically too different, they remained separate, forming the "species duplex" of Toxopeus.

A recent study of Saturnidae in Costa Rica, Central America (Janzen, Daniel H. *et al.*) revealsthrough genetic analysis that some traditional species are actually composed of several 'cryptic' species, often with near-identical genitalia. Examination of DNA barcodes of 32 previously recognised Saturnid species lead to the identification of 49 biological entities that are may be considered separate species. This implies, according to the authors, that standard biological information about each traditional species may be an unconscious mix of interspecific information, and begs renewed DNA bar-coding, closer attention to so-called intraspecific variation, and increased museum collection and curation of specimens from more individual and ecologically characterised sites – as well as eventually more species descriptions. Simultaneously, this inclusion of sibling species as individual entities in biodiversity studies, rather than pooled under one traditional name, reduces the degree of ecological and evolutionary generalisation perceived by the observer.

The relationship between *rileyi* and *yofona* may be an example sibling species or a 'species-duplex' and further genetic analysis will be required to confirm their affinities and status.

## Acknowledgements

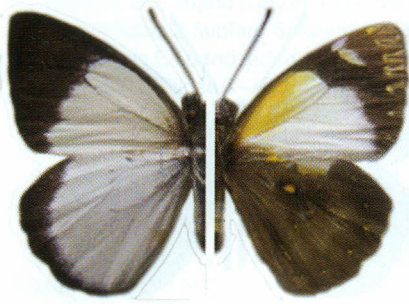
Thanks are due to many local people who assisted the author on various trips in the interior of Papua over many years. I gratefully acknowledge Rob de Vos (RMNH) who did the dissection of three *rileyi* ssp. males, which pictures are presented in this paper. Also thanks to Chris Davenport for his comments and proof reading.

## Literature

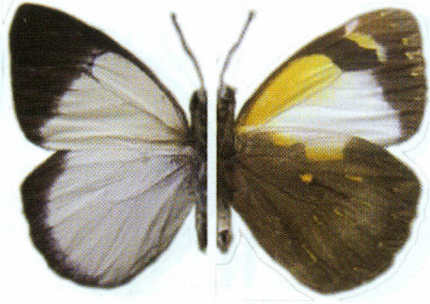
- D'Abrera, B. 1971, 1977, 1990 (revised). *Butterflies of the Australian Region*, 3rd ed.: 1-416. ISBN 0 947352 02 3, Hill House, Melbourne & London.
- Gerrits, F. & H. van Mastrigt. [1993]. New results on *Delias* from the central Mountain range of Irian Jaya (Lepidoptera: Pieridae) – *Treubia*, Vol. **30**, 1992 Part 3: 381-402.
- Gotts, Robert & Norris Pangemanan. 2010. *Mimika Butterflies – A Guide to the Butterflies of the Mimika Region of Papua*. PT Freeport Indonesia, PT Indonesia Printer. ISBN 978-979-97503-6-5: 1-287 (pp. 102-103).
- Janzen, Daniel H. *et al.* 2012. What happens to the traditional taxonomy when a well-known tropical saturniid moth fauna is DNA barcoded? – *Invertebrate Systematics* 26(6): 478-505, Published: 19 December 2012.
- Joicey J. & G. Talbot, 1922. New Forms of the Genus *Delias* (Pieridae) from New Guinea, Ceram and Buru – *Bull. Hill Mus.* 1, pt. 3 (14 Sept) (306).
- Muller C., Matos-Maravi P.F. & Beheregaray L. B. Delving into *Delias* Hübner (Lepidoptera Pieridae): fine scale biogeography, phylogenetics and systematics of the worlds largest genus. *Journal of Biogeography* 2012,
- 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. (p. 307).
- Roepke, W. 1955. The Butterflies of the genus *Delias* Hübner (Lepidoptera) in Netherlands New Guinea – *Nova Guinea*, Vol.6 (2): 185-260 (pp. 188-189).
- Schröder, H. & C.G. Treadaway. 1982. Neue *Delias*-Formen aus West-Irian, Neuguinea (Lep.: Pieridae) – *Ent. Z., Frankf.a.M.* 92. Jahrg. No. 23 (1. Dez. 1982): 334-338 (pp. 335 - 336).
- Sibatani, A. 1988. A note on *Delias rileyi* Joicey & Talbot (Lepidoptera: Pieridae) from Irian Jaya – *Tyô to Ga*, 39(1): 81-82.
- Sibatani, A. & T. Nishizawa, 1982. *Delias rileyi* Joicey & Talbot (Lepidoptera: Pieridae) from Irian Jaya – *Tyô to Ga*, 32(3,4): 179-181.
- Talbot, 1928. A Monograph of the Pierine Genus *Delias*, 1: 1-56. John Bale, Sons & Danielson, Ltd., London. June 2nd, 1928 (pp. 26, 46).
- Talbot, 1929d. A Monograph of the Pierine Genus *Delias*, 2: 57-116, pls. i-vii. John Bale, Sons & Danielson, Ltd., London. April 30th, 1929 (pp. 168-170).
- Tuzov, V.K. 1995. Checklist of the genus *Delias* Hübner, 1819 (Lepidoptera, Pieridae) – *Actias* 2 (1-2): 111-113 (p. 133).
- Tuzov, V.K. & S.V. Churkin. 1998. New subspecies of *Delias* Hübner, 1819 (Lepidoptera, Pieridae) from Irian Jaya (Indonesia) – *Nachr. Entomol. Ver. Apollo, N.F.* 19(1): 43-49.
- 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.
- Yagishita, A. in A. Yagishita, S. Nakano & S. Morita. [1993a]. An illustrated list of the Genus *Delias* Hübner of the World <text>. i-xiv; 1-384. Ed. Yasusuke Nishiyama; Khepera Publishers Sinapora, Tokyo 1993 (p. 100).
- Yagishita, A. in A. Yagishita, S. Nakano & S. Morita. [1993b]. An illustrated list of the Genus *Delias* Hübner of the World. i-ix; 1-409. Ed. Yasusuke Nishiyama; Khepera Publishers Sinapora, Tokyo 1993 (p. 90-91).



**Figs 1-6.** *Delias rileyi* ♂ : 1-2. *D. r. rileyi*: 1. From Modio (KSP 5468),  
2. From Magoda (KSP 5488); 3-6: *D. r. nishizawai* from Ilaga  
(KSP 5492, 5502, 5498, 5497).



7



8



9



10



11

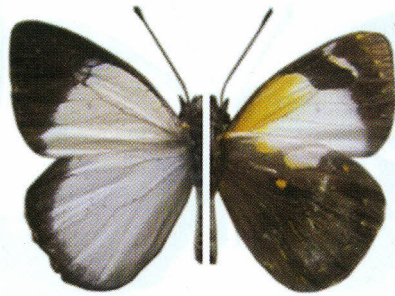


12

**Figs 7-12.** *Delias rileyi nishizawai* ♂ : 7-9. From Sinak (KSP 5506, 5512, 5513); 10. From Mulia (KSP 5519); 11-12. From Kanggime (KSP 5529, 5535).



13



14



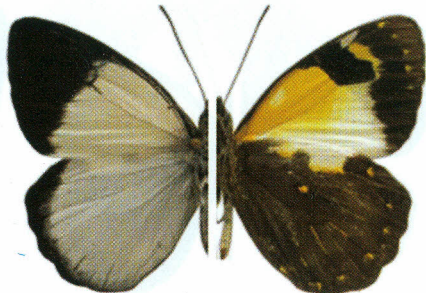
15



16



17



18

**Figs 13-18.** *Delias rileyi nishiozawai* ♂ : 13-14. From Kanggime (KSP 5537, 5538);  
15-18. From Tiom (KSP 5548, 5561, 5551, 5555).



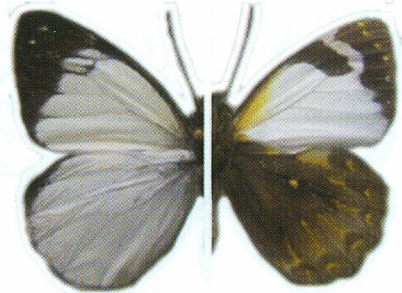
19



20



21



22



23



24

**Figs 19-24.** *Delias rileyi yofona* ♂ : 19. From Tuguwai, HT-locality (KSP 5563);  
20-24. From Tembagapura (KSP 5567, 5570, 5574, 5575, 5584).





25



26



27



28

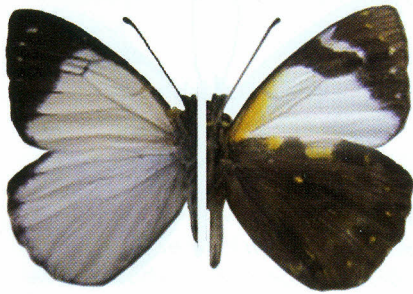


29



30

**Figs 25-30.** *Delias rileyi yofona* ♂ : 25. From Jila (KSP 5586),  
26-27. From Homeyo (KSP 5584, 5591), 28. From Mapinduma (KSP 5602),  
29-30. From Kanggime (KSP 5593, 5594).



31



32



33



34



35



36

**Figs 31-36.** *Delias rileyi yofona* ♂ : 31-32. From Tiom (KSP 5595, 5597), 33. From Habbema (KSP 5605), 34-36. From R. Wesi, Welesi (KSP 5607, 5613, 5614).



37



38



39



40



41



42

**Figs 37-42.** *Delias rileyi yofona* ♂ : 37-38. From Musatfak (KSP 5624, 5627), 39. From Silakma (KSP 5629), 40. From Ninya (KSP 5632), 41-42. (= *D. rileyi erici* **syn. nov.**) From Korupun (KSP 5633, 5643).



43



44



45



46



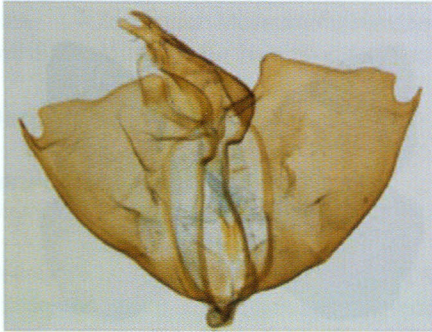
47



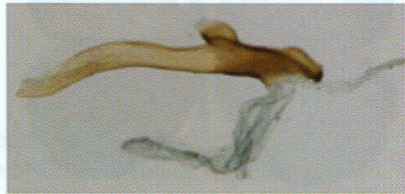
48

**Figs 43-45.** *Delias rileyi yofona* ♂ (= *D. rileyi erici* **syn. nov.**)  
from Korupun (KSP 5644, 5648, 5658);

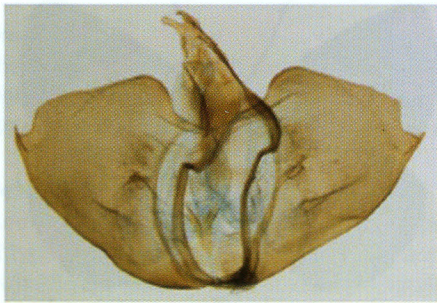
**Figs 46-48.** *D. rileyi* ssp. ♀: 46. From Tembagapura (KSP 5585),  
47. From Mulia (see Yagishita), 48. From Korupun (KSP 5659).



49



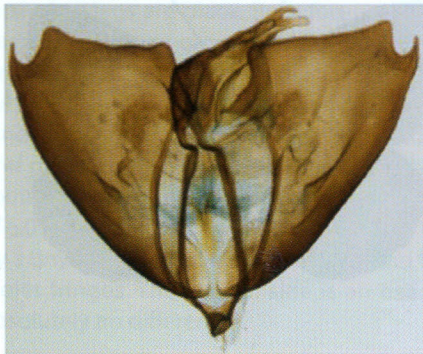
50



51



52



53



54

**Figs 49-54.** Male genitalia of *Delias rileyi* ssp. (left: habitus; right: aedeagus):  
49-50. *D. rileyi rileyi*; 51-52. *D. rileyi nishizawai*; 53-54. *D. rileyi yofona*.