Notes on *Graphium eurypylus* Linnaeus, 1758 (Lepidoptera: Papilionidae) with descriptions of two new subspecies from Papua, Indonesia

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Abstract: *Graphium eurypylus magnificus* **ssp.nov.** is described from Japen Island, Papua Province, Indonesia, and *Graphium eurypylus argenteus* **ssp.nov.** described from Misool Island, West Papua Province, Indonesia. The general ecology and taxonomy of *Graphium eurypylus* is discussed, in addition to the relationships of the new subspecies to geographically proximate populations of the same species.

Rangkuman: Graphium eurypylus magnificus **ssp.nov.** dideskripsikan dari Pulau Yapen, Provinsi Papua, Indonesia dan *Graphium eurypylus argenteus* **ssp.nov.** dideskripsikan dari Pulau Misool, Provinsi Papua Barat, Indonesia. Ekologi dan taksonomi umum *Graphium eurypylus* didiskusikan, di samping itu sebagai hubungan subspesies baru dengan populasi yang dekat secara geografis dari spesies yang sama.

Keywords: Graphium eurypylus, Lauraceae, Misool Island, Papua, West Papua, Japen Island.

Introduction

The papilionid butterfly *Graphium eurypylus* Linnaeus, 1758, frequently referred to as the Great Jay or Pale Green Triangle, is widely distributed as numerous described subspecies within tropical and subtropical zones of Indo-China, South-East Asia and Indo-Australia. Adults of *G. eurypylus* express virtually no appreciable sexual dimorphism with respect to wing patterning or colouration; females of the species lack elongated androconial filaments which are concealed within a fold present along the upper surface of the inner margin of the male hindwings. This insect constitutes a conspicuous representative of the insect fauna of its biotopes, which include tropical rainforests, areas of secondary growth and adjacent open spaces from sea level to 1200 metres or more in elevation. Small and relatively isolated tropical islands have been colonised by *G. eurypylus*, situations in which highly distinctive phenotypes may arise; the taxon also prospers within habitats which have been disturbed as a result of human activity.

The type locality of *G. eurypylus* was originally designated as the "Indiis" (Linnaeus, 1758); however, the provenance of the holotype was subsequently clarified by Corbet (1949) as being the island of Ambon, located in the central Moluccas of present day Indonesia. Page and Treadaway (2014) divided *G. eurypylus* into three regional sub-groupings, those being taxa occurring within the northern Moluccas and Papuan region, subspecies of the island of Sulawesi and surrounding sub-region, and those of continental Asia, the Philippines and Sundaland. Within the broader context of its distribution, *G. eurypylus* is typically uncommon to rare in occurrence, or present in low population densities; however, as is

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characteristic of many species within the Leptocircini, adults may at times occur in great seasonal abundance.

The life history of *G. eurypylus* has been well documented; preferred larval foodplants fall principally within the plant family Annonaceae, including *Annona*, *Artabotrys*, *Desmos* and *Rauwenhoffia* (Vane-Wright & de Jong, 2003). In captivity, larvae may also accept *Cinnamomum camphora* (Lauraceae), and *Magnolia* (Magnoliaceae). *G. eurypylus* will breed readily upon plants grown for ornamental or horticultural purposes within urban gardens, including species of custard apple such as *Annona muricata* and *Annona reticulata*. Eggs are deposited upon young foliage of the larval foodplant on the underside of the leaf near the petiole, or at times on its upper surface. The larvae of *G. eurypylus* feed openly upon the upper surface of leaves of the hostplant; earlier instars are coloured in shades of brown, changing to a highly cryptic green in later instars. Pupation typically occurs upon the foodplant; the green pupa is attached to a leaf or other suitable support by the cremaster and a thoracic silken girdle.

As is typical of numerous species of Papilionidae, adult males of *G. eurypylus* actively imbibe moisture from dampened earth or other water sources; however, adults of this species are typically active in the forest canopy. Females of *G. eurypylus* are more retiring in their habits, and most usually observed whilst actively seeking out and ovipositing upon larval foodplants; both sexes will take nectar at flowers at ground level. As is characteristic of *Graphium*, the flight behaviour of adult *G. eurypylus* is both rapid and erratic, with the wings remaining in constant motion while the insects feed at blossoms, a favourite being *Lantana*.

The author recently examined examples of *G. eurypylus* which were collected on Japen Island, a mountainous island approximately 170 kilometres in length, which lies off the north-west coast of the Indonesian province of Papua. The butterfly fauna of Japen Island expresses a considerable level of sub-specific differentiation in relation to species which are also distributed on the mainland of New Guinea; recent descriptions of Papilionidae from Japen Island include *Papilio albinus yapenensis* (Goode, 2012) in addition to distinctive subspecies of *Ornithoptera* including *Ornithoptera* (*Schoenbergia*) *goliath ukihidei* (Hanafusa, 1994) and *Ornithoptera (Schoenbergia) tithonus elizebethae* (Schäffler, 2006). The pierid genus *Delias* also expresses unique subspecies on Japen Island, including *Delias ennia jobiana* (Oberthűr, 1894), in addition to the recently described taxa *Delias lara hideyoae* (Nakano, 1994), *Delias gabia naokoae* (Nakano, 1995), and *Delias ladas yapenensis* (Yagashita, 1998). Additional examples of *G. eurypylus*, recently collected from Misool Island, have also been analysed by the author. Misool, one of the four main islands which constitute the Raja Ampat Islands of West Papua Province, is positioned in the Ceram Sea between the Vogelkop Peninsula of West Papua and the Moluccan island of Ceram. The entomological fauna of Misool is of predominantly Papuan origin, including endemic subspecies of large butterflies such as *Ornithoptera tithonus misoolana* (Deslisle, 1985); at present, Misool remains rather poorly prospected entomologically-speaking, with intensive future exploration likely to reveal a multitude of discoveries within its resident butterfly and other insect populations.

Specimens of the populations of *G. eurypylus* from Japen and Misool Islands were carefully compared by the author with examples of the same taxon from several localities on the island of New Guinea, collectively constituted by the subspecies *Graphium eurypylus lycaonides* (Rothschild, 1895) (Fig.5), in addition to individuals of *Graphium eurypylus extensus* (Rothschild, 1895) (Fig.6) from the Bismarck Archipelago of Papua New Guinea.

The examples of *G. eurypylus* from Japen and Misool were both positively confirmed as being consistently distinctive with respect to their wing colouration and patterning from each other in addition to specimens of *G. eurypylus* of neighbouring geographical affinity, and are described herein as *Graphium eurypylus magnificus* **ssp.nov.** from Japen Island, and *Graphium eurypylus argenteus* **ssp.nov.** from Misool Island.

Depositories and abbreviations
MG - (Collection of) Mark Goode, Tettenhall, United Kingdom
NHM(UK) - Natural History Museum, London, United Kingdom

Description of the new subspecies:

Graphium eurypylus magnificus ssp.nov. (Figs 1-2)

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Holotype: ♂ NHM(UK): Japen Island, Papua Province, Indonesia, i.2016, leg. Mark Goode.
Paratypes: 1 ♂ NHM(UK): Japen Island, Papua, Indonesia, i.2016, leg. Mark Goode; 6 ♂ MG: Japen Island, Papua, Indonesia, i.2016 leg. Mark Goode.

Diagnosis: *Graphium eurypylus magnificus* is clearly divergent with respect to its colouration and wing patterning from its biological counterpart of closest geographical proximity, *G. e. lycaonides*, the latter occurring widely on the mainland of New Guinea. The bluish-green median forewing spotting of *G. e. magnificus* is consistently narrower in extent when compared with *G. e. lycaonides*; the said colouration is richly tinted with bluish tones, in opposition to the lighter, whitish-blue present in *G. e. lycaonides*. The blue submarginal spotting which runs down both surfaces of the forewings and hindwings is slightly reduced in magnitude when compared to the same markings in *G. e. lycaonides*. The ground colouration of *G. e. magnificus* is a rich and intense black, whereas that of *G. e. lycaonides* is blackish-brown; the hindwings of the new subspecies tend to be broader and/or more rounded in shape, as opposed to the more typically narrow and tapered hindwings of *G. e. lycaonides*. The black pigmentation of the recto wing surfaces and dark brownish-black colouration on the verso wing surfaces is greater in width from the wing margins to the median areas of both pairs of wings in *G. e. magnificus* than *G. e. lycaonides*.
The male forewing length is also statistically larger in *G. e. magnificus*, averaging 49.5 mm in a random sampling of 5 males, as compared to 46.6 mm from a like grouping of 5 males of *G. e. lycaonides* originating from several localities upon the island of New Guinea.

Description: Male – Length of forewing 49.5 mm. The antennae and eyes are greyish black; the head is covered in dark greyish hairs. The thorax and abdomen are covered laterally with fine white hairs. The abdomen is greyish dorsally, more intensely so toward the thorax; a line of black pigmentation runs along each side of the abdomen laterally. The legs are black dorsally and white ventrally. Ground colour of the recto surfaces of both pairs of wings is deep velvet black. A median row of bluish-green spotting is present on the recto forewing surfaces and also within the discal and submedian areas of the hindwings. Space 7 of each hindwing is coloured in clear white. Small submarginal spots are present adjacent to the margins of both pairs of wings. Bluish-green spots are also present adjacent to the costal margin of each forewing between the median and postmedian areas. A bluish-green

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marking is also evident within each forewing cell, adjacent to space 4; a vestigial dash of the same colour is situated toward the centre of the forewing cells. Androconial scales are concealed within a fold which extends along the inner margin of recto surface of each hindwing; when extended, the androconia are long, white and plume-like.
The ground colour of the verso wing surfaces is deep brownish-black. The configuration of bluish-green patterning of the recto wings surfaces is repeated virtually identically upon the verso wing surfaces; however, upon the verso surfaces, the former colour is replaced with whitish colouration which is delicately infused with a deep pinkish lustre. Deep crimson red spots are present as one dash along the costal margin of each hindwing, adjacent to the base, with single crimson spots also present within the postmedian area of each hindwing in spaces 1b, 2 and 4 respectively. The inner margin of each hindwing is edged with crimson adjacent to where the androconial folds are situated. Space 7 of each hindwing is coloured in clear white within the discal/discoidal area, and infused with a pinkish lustre. The submarginal spotting on both pairs of wings is slightly reduced in magnitude from the like-configurations present upon the recto wing surfaces.

Distribution: Recorded from Japen Island, Papua Province, Indonesia.

Etymology: The specific latin name *magnificus* refers to the larger and more richly coloured appearance of the new subspecies when compared to the closest geographical population of the same taxon, *G. e. lycaonides*.

Discussion: Given its overall distinctiveness, *G. e. magnificus* represents an interesting taxonomic addition to the *G. eurypylus* subspecies grouping within the Papuan region. The new taxon appears to be a closely related to *G. e. lycaonides*, the population from the New Guinea mainland; however the former expresses clear and consistent differences with respect to increased richness of colour which contrasts strongly against its darker ground colouration.

Graphium eurypylus argenteus ssp.nov. (Figs 3-4)

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Holotype: ♂ NHM(UK): Misool Island, West Papua, Indonesia, i.2016, leg. Mark Goode.
Paratypes: 1 ♂ NHM(UK): Misool Island, West Papua, Indonesia, i.2016, leg. Mark Goode; 5 ♂ MG: Misool Island, West Papua, Indonesia, i.2016, leg. Mark Goode.

Diagnosis: *Graphium eurypylus argenteus* is also clearly divergent with respect to its colouration and wing patterning from its biological counterpart of closest geographical proximity, *G. eurypylus lycaonides* (Rothschild, 1895) which occurs widely on the mainland of New Guinea. The median forewing spotting of *G. e. argenteus* is slightly wider in extent when compared with the like character in *G. eurypylus lycaonides*, with the said colouration of the former tinted with a lighter, pale-greenish tone, in opposition to the whitish-blue patterning present in *G. e. lycaonides*. The blue submarginal spotting which runs down both surfaces of the forewings and hindwings of *G. e. argenteus* are close to replicating the like markings in *G. e. lycaonides*. Greenish-white spotting situated within the forewing cells of *G. e. argenteus* is consistently more extensive than in both *G. e. lycaonides* and *G. e. magnificus*. The hindwings of *G. e. argenteus* are typically narrower in width than those of

the latter two subspecies, being more processed tornally; the greenish-white markings in hindwing spaces 1B and 6 are more extensive in *G. e. argenteus* than in *G. e. lycaonides*, with the colouration in space 6 extending to approximately the subtornal area. The black pigmentation of the recto wing surfaces and the dark, brownish-black colouration of the verso wing surfaces closely approximates that of *G. e. lycaonides*. Verso wing spotting is conspicuously scaled with an intensely silvery iridescence which is lightly infused with pinkish tones; many of the spots, particularly those located upon the forewings are fused, or virtually fused together; the shimmering nature of the latter character is more intense than that evident in both *G. e. lycaonides* or *G. e. magnificus*, and was immediately perceptible by the author through the translucent papers in which the specimens were originally received.

The male forewing length of *G. e. argenteus* is also statistically reduced in comparison to both *G. e. magnificus* and *G. e. lycaonides*, averaging 42.5 mm in a random sampling of 5 males, as opposed to 46.6 mm resulting from a like sampling of 5 males of *G. e. lycaonides* originating from several localities upon the island of New Guinea, and 49.5 mm in a random sampling of 5 males of *G. e. magnificus*.

Description: Male – Length of forewing 42.5 mm. The antennae and eyes are greyish black; the head is covered with downy dark greyish hairs. The thorax and abdomen are covered laterally with fine white hairs. The abdomen is whitish-grey dorsally, more intensely so toward the thorax; a line of black pigmentation runs along each side of the abdomen laterally. The legs are black dorsally and white ventrally. Ground colour of the recto surfaces of both pairs of wings is deep velvet black. A median row of bluish-green spotting is present upon the recto forewing surfaces and within the discal and submedian areas of the hindwings. Space 7 of each hindwing is coloured in clear white. Small submarginal spots are present adjacent to the edges of both pairs of wings. Bluish-green spotting is also present adjacent to the costal margin of each forewing between the median and postmedian areas. A bluish-green marking is also present within each forewing cell adjacent to space 4; a vestigial dash of the same colour is present toward the centre of the forewing cell. Androconial scales are concealed within a fold which extends along the inner margin of each hindwing; when extended, the androconia are long, white and plume-like.

The ground colour of the verso wing surfaces is rich brownish-black. The greenish-white patterning of the recto wing surfaces is virtually identically repeated upon the verso surfaces, however upon the latter surface the former colour is replaced with silvery-white colouration which is delicately infused with a deep pinkish lustre. Crimson red spotting is present as one dash along the costal margin of each hindwing, adjacent to the base; a single crimson spot is also present in spaces 1b, 2 and 4 respectively within the postmedian area of each hindwing. The inner margin of each hindwing is edged with crimson adjacent to where the anal folds are situated. Space 7 of each hindwing is coloured in clear white, and infused with a pinkish lustre. The verso submarginal spots upon both pairs of wings are slightly reduced in magnitude from the like-configurations present upon the recto wing surfaces.

Distribution: Recorded from Misool Island, West Papua Province, Indonesia.

Etymology: The specific Latin name *argenteus* refers to the richly silvered appearance of the verso wing patterning of this new subspecies when compared to the same character in the closest geographical population of the same taxon, *G. e. lycaonides*.

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Discussion: *G. e. argenteus* represents an interesting taxonomic addition to the Moluccan/Papuan subspecies grouping of *G. eurypylus*, and fits comfortably within the latter assemblage on the basis of its structure and wing-patterning. Based upon its colouration and pattern characters, It would appear that *G. e. argenteus* manifests a westward diversification of the Papuan subspecies *G. e. lycaonides*.

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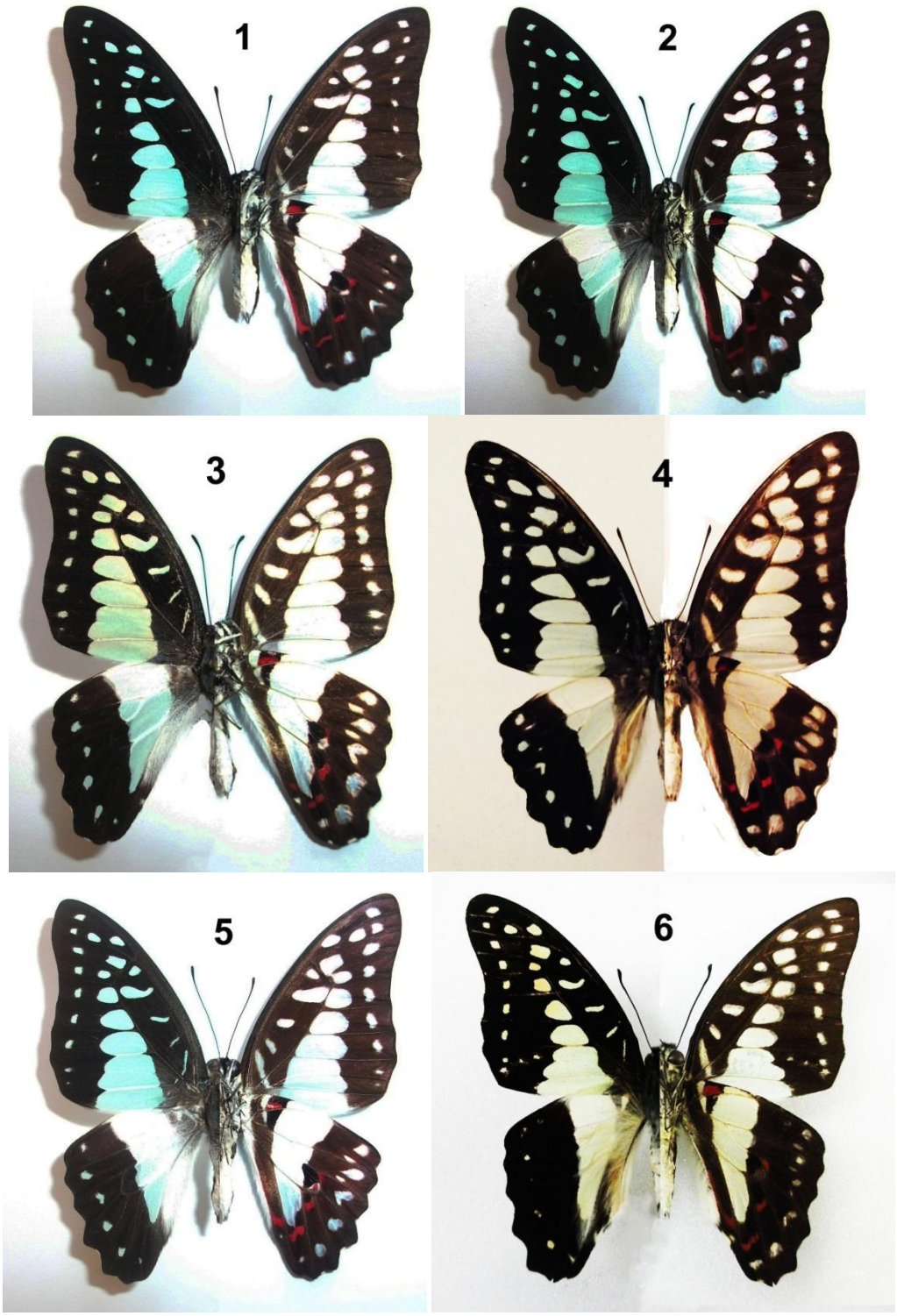

Figs. 1-6. *Graphium eurypylus* subspecies with at each picture upperside (left) and underside (right): **Fig. 1.** *Graphium eurypylus magnificus* **ssp.nov.** holotype ♂, Japen Island, Papua, Indonesia; **Fig. 2.** *Graphium eurypylus magnificus* **ssp.nov.** paratype ♂, Japen Island, Papua, Indonesia; **Fig. 3.** *Graphium eurypylus argenteus* **ssp.nov.** holotype ♂, Misool Island, West Papua, Indonesia; **Fig. 4.** *Graphium eurypylus argenteus* **ssp.nov.** paratype ♂, Misool Island, West Papua, Indonesia; **Fig. 5.** *Graphium eurypylus lycaonides* ♂, Manokwari, West Papua, Indonesia; **Fig. 6.** *Graphium eurypylus extensus* ♂, Kavieng, New Ireland, Papua New Guinea.

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