# An illustrated and annotated checklist of *Arhopala* BOISDUVAL, 1832, taxa occurring in North Maluku and Maluku, Indonesia (Lepidoptera: Lycaenidae) — Part 7: Summary, including corrigenda, new information and biogeography

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Abstract: This paper is the 7<sup>th</sup> and final part in the series covering the species and subspecies of the lycaenid genus *Arhopala* BOISDUVAL, 1832 that occur in the Indonesian provinces of North Maluku and Maluku. All the *Arhopala* taxa found in North Maluku and Maluku are listed along with their known ranges there. The biogeography of *Arhopala* in the region is discussed, noting the areas of highest biodiversity and endemism. This paper recognises a total of 69 taxa, comprising **38 species**, as occurring there. 47 taxa (68%) and 7 species (18%) are endemic to the region. Two new locality records are reported. A map shows the islands discussed in the text. Some errors in the previous *Arhopala* papers are corrected, including the locations of some types.

**Keywords:** Lepidoptera, Lycaenidae, Theclinae, *Arhopala*, *Arhopala* species-groups, range, biodiversity, endemism, Indonesia, North Maluku, Maluku.

Illustriertes und kommentiertes Verzeichnis der Arhopala-Arten (Lepidoptera: Lycaenidae, Theclinae), die in den Nordmolukken und Molukken (Indonesien) vorkommen – Teil 7: Zusammenfassung mit Korrekturen, neuen Informationen und bniogeografischen Anmerkungen

Zusammenfassung: Dies ist die siebte und letzte Publikation einer Serie über die Arten und Unterarten der Lycaenidengattung Arhopala BOISDUVAL, 1832 aus den indonesischen Provinzen Nordmaluku und Maluku. Alle bekannten Arhopala-Taxa aus den besprochenen Provinzen Nordmaluku und Maluku werden zusammenfassend aufgelistet, mit ihren jeweiligen Verbreitungsarealen. Die Biogeographie der Arhopala-Taxa aus der Region wird diskutiert, zusammen mit Anmerkungen über Areale höchster Biodiversität und Endemismus. Insgesamt sind dort 69 Taxa, die zu 38 Spezies gehören, bekannt. 47 Taxa (68%) und 7 Arten (18%) sind in der Region endemisch. Zwei neue Fundangaben werden nachgetragen. Eine Karte zeigt die im Text erwähnten Inseln. Einige Fehler und Irrtümer aus den vorherigen 6 Teilen werden korrigiert, einschließlich von Angaben über einige Typenverbleibe.

#### Introduction

Arhopala BOISDUVAL, 1832 (Lycaenidae, Theclinae, Arhopalini) is the 5<sup>th</sup> genus to be published in NEVA in this series on the lycaenid genera of the Indonesian provinces of North Maluku (Maluku Utara) and Maluku. As *Arhopala* is a large group, the genus has been split into sections for publication. The previous six parts (RAWLINS et al. 2018a, 2018b, 2018c, 2019a, 2019b, RAWLINS et al. 2019c) covered an introduction to the genus and all the *Arhopala* species-groups (*sensu* Evans 1957) found in North Maluku and Maluku.

One new species and eight new subspecies of Arhopala were described in the previous parts.

In this 7<sup>th</sup> and final part, all the *Arhopala* taxa found in North Maluku and Maluku are listed, along with their known ranges there. The biogeography of *Arhopala* in the region is discussed, noting the areas of highest biodiversity and endemism. A total of 69 taxa, comprising 38 species are recorded there. 47 taxa (68%) and 7 species (18%) are endemic to the region.

Some errors from the previous papers are corrected and 2 new locality records are introduced.

A Map shows the islands of Maluku and North Maluku discussed in the text. The Indonesian western half of the Island of New Guinea along with its associated offshore islands (previously variously known as Irian, Irian Jaya, West Irian, Irian Barat) now consists of two political provinces: West Papua and Papua. The term "New Guinea" is used in its geographical sense to mean the whole island including these two Indonesian Provinces along with the mainland part of the country of Papua New Guinea.

In producing the *Arhopala* series, the collections of the Natural History Museum, London (NHMUK) and specimens and photographs from some other public and private collections, have been examined.

#### Abbreviations used

- CARR Collection Andrew RawLINS, Rainham, Kent, U.K.
- CMNH Carnegie Museum of Natural History, Pittsburgh, USA.
- CSSK Collection Stefan Schröder, Köln, Germany.
- FwL Forewing length.
- HT Holotype.
- ICZN International code of zoological nomenclature.
- MGCL McGuire Center for Lepidoptera and Biodiversity, Gainesville, FL, USA.
- NHMUK The Natural History Museum, London, U.K.
- RMNH Naturalis Biodiversity Center, Leiden, The Netherlands (formerly Rijksmuseum voor Natuurlijke Historie).
- PT Paratype.
- ssp. subspecies.

#### Corrections from previous Arhopala papers

I am very grateful to Gerardo LAMAS for pointing out some of the mistakes that are corrected below.

#### Location of types

• In *Arhopala* part 3, RAWLINS et al. (2018c: 92) recorded that the HT ♂ of *A. lata detanii* was deposited in the NHMUK. This is amended to the RMNH. On page 94 we stated that one PT ♀ of *A. philander ladysueae* was in the NHMUK. This is corrected to CARR.

In a separate paper not in this series, RAWLINS, SCHRÖDER & CASSIDY (2018) described a new subspecies of Arhopala admete (HEWITSON, 1863) from Sorong, West Papua. On page 40 we noted that the HT ♂ & 1 PT Q (ex CSSK specimens) of Arhopala admete cora were deposited in the NHMUK. This is changed to the RMNH.

#### Arhopala Part 4 (RAWLINS et al. 2019a)

- On p. 124 we discussed the names *admetina* and *hellava*. They are *nomina nuda* and should be attributed to TALBOT (1923) as they were never published by FRUHSTORFER.
- On p. 125 we listed *A. fulla prasiae* as a synonym of *A. fulla fulla*, noting that *prasiae* was an emendation for the original spelling *prasiä*. This name cannot be emended to "*prasiae*", as it is not based on a German word (see ICZN, Art. 32.5.2.1). Therefore, the correct emendation is "*prasia*".

#### Arhopala Part 5 (RAWLINS et al. 2019b)

- On p. 130 we stated: "Then HERBST (1800), in Latin and German, introduced the name *Papilio esra* to replace CRAMER's second *Papilio helius*, noting that the name had already been used for another butterfly." This action meant that CRAMER's second *Papilio helius*, became a junior primary homonym of his first *Papilio helius*. It should also be noted that *Papilio esra* HERBST, 1800 is a junior primary homonym of *Papilio esra* FABRICIUS, 1798 (a junior subjective synonym of Junonia evarete CRAMER, 1779).
- On p. 133 we listed Arhopala helius latimarginata STRAND, 1912 and A. interniplaga STRAND, 1912, as synonyms of A. thamyras phryxus. The correct date of publication was February 1913.

#### Arhopala Part 6 (RAWLINS et al. 2019c)

- In the Abstract on p. 1, the sentence "After the Maluku checklist, we provide notes and taxonomic suggestions for some taxa, respectively phenotypes found in the New Guinea region" should read: "After the Maluku checklist, we provide notes and taxonomic suggestions for some taxa and phenotypes found in the New Guinea region." In the abstract of *Arhopala* part 6, we also stated that the HT ♂ of *A. fowlerorum* was deposited in the NHMUK. This is amended to the RMNH. We also stated that the HT ♂ of *A. tyrannus jheae* was in the RMNH. This corrected to the NHMUK.
- The form name *leoesque* is misspelt as *leosque* on p. 20 and in the plate key for figs. 28–30.

#### New locality records of Arhopala taxa in Maluku

#### Arhopala sorena

In *Arhopala* part 3 (RawLINS et al. 2018c: 96) we gave the range for *A. sorena* as Aru, Waigeo and New Guinea, without specifying any specific Aru islands. The Aru pair figured had data labels stating "Aru Is., Dobo". Dobo is the capital of the Aru Islands and is situated on Wamar Island. A new record from Wokam Island (1  $\Im$ , x. 2006; 1  $\Im$ , iv. 2007; 2  $\Im \Im$ , vi. 2008, all CARR) is also added.

#### Arhopala eridanus padus

Obi (1  $\circlearrowleft$ , II. 2019, CARR). This species was covered in *Arhopala* part 1 (RAWLINS et al. 2018a: 194). This specimen is typical of *A. eridanus padus* except it is much smaller (FwL 22 mm) than northern Maluku *padus* (FwL usually 27–29 mm).

### Summarised checklist of North Maluku and Maluku *Arhopala* taxa and their ranges there

The anthelus species-group (covered in part 1)

Arhopala eridanus eridanus (C. Felder, 1860)

Endemic to Maluku: central Maluku (Buru, Manipa, Kelang, Seram, Ambon, Haruku, Seram Laut) and Gorong Islands (Gorong).

#### Arhopala eridanus padus C. & R. Felder, 1865

Endemic to Maluku: northern Maluku (Morotai, Halmahera, Bacan, Kasiruta), Obi.

#### Arhopala eridanus elfeta (HEWITSON, 1869)

Endemic to the Sula Islands (Taliabu, Mangole, Sanana).

Arhopala viola harmonica RAWLINS, CASSIDY & SCHRÖDER, 2018a

Endemic to the Sula Islands (Taliabu, Mangole).

Arhopala annulata (C. Felder, 1860)

Central Maluku (Buru, Ambon, Saparua).

The *theba* species-group (covered in part 1)

#### Arhopala argentea verityae Tennent & RAWLINS, 2010

Endemic to the Sula Islands (Taliabu).

The *democritus* species-group (covered in part 2)

Arhopala ate (Hewitson, 1863)

Endemic to Maluku: northern Maluku (Halmahera), central Maluku (Kelang, Seram, Ambon).

Arhopala cleander cleander (C. Felder, 1860)

Endemic to central Maluku (Buru, Seram, Ambon).

Arhopala cleander scoreyorum Rawlins, Cassidy & Schröder, 2018b

Endemic to northern Maluku (Halmahera).

Arhopala aruana (Evans, 1957)

Kei (Kei Kecil), Aru (Wokam).

#### Arhopala athada minor (Evans, 1957)

Endemic to northern Maluku (Halmahera, Bacan, Kasiruta).



Map: Provinces of North Maluku and Maluku showing the island names used in the text.

Arhopala phaenops phaenops Felder & Felder, 1865 Sula Islands (Taliabu, Sanana).

Arhopala phaenops buruensis Holland, 1900 Endemic to Maluku: Obi, central Maluku (Buru).

Arhopala alitaeus alitaeus (HEWITSON, 1862) Sula Islands (Taliabu).

The eumolphus species-group (covered in part 2)

Arhopala nobilis nobilis (C. FELDER, 1860) Endemic to Maluku: Obi, central Maluku (Seram,

Ambon), Kei.

Arhopala nobilis alce (HEWITSON, 1862) Endemic to northern Maluku (Morotai, Halmahera, Bacan, Kasiruta).

Arhopala nobilis alcestis GROSE SMITH, 1902 Gebe, Aru (Kobroor). Arhopala critala (C. FELDER, 1860) Central Maluku (Kelang, Seram, Ambon), Kei.

Arhopala wildei neva (Evans, 1957) Northern Maluku (Morotai), Aru (Wokam).

Arhopala halma (Evans, 1957) Endemic to northern Maluku (Halmahera).

Arhopala halmaheira Ветниме-Вакев, 1904 Endemic to northern Maluku (Morotai, Halmahera Kasiruta).

Arhopala irma irma FRUHSTORFER, 1914 Endemic to Obi.

Arhopala irma kotaroi Rawlins, Cassidy & Schröder, 2018b

Endemic to northern Maluku (Halmahera).

Arhopala acetes (HEWITSON, 1862) Sula Islands (Taliabu). Arhopala tephlis tephlis (HEWITSON, 1869) Endemic to northern Maluku (Morotai, Halmahera).

Arhopala tephlis mulleri Rawlins, Cassidy & Schröder, 2018b

Endemic to the Sula Islands (Taliabu).

Arhopala chamaeleona susyae TENNENT & RAWLINS, 2010 Endemic to northern Maluku (Morotai, Halmahera, Bacan).

*Arhopala chamaeleona rileyi* Joicey & Talbot, 1922 Endemic to central Maluku (Seram).

The *centaurus* species-group (covered in part 3)

Arhopala araxes araxes Felder & Felder, 1865 Sula Islands (Taliabu, Mangole, Sanana).

Arhopala araxes onetor FRUHSTORFER, 1914 Southwest Maluku (Wetar, Moa, Leti, Kissar, Sermata).

Arhopala eupolis eupolis (Мізкін, 1890) Kei, Aru (Wokam, Maikoor).

Arhopala adherbal GROSE SMITH, 1902 Northern Maluku (Halmahera), Aru (Kobroor, Maikoor).

Arhopala lata lata (Evans, 1957) Endemic to northern Maluku (Morotai, Halmahera).

Arhopala lata detanii RAWLINS, CASSIDY & SCHRÖDER, 2018c

Endemic to Gebe.

Arhopala madytus FRUHSTORFER, 1914 Aru (Wamar, Wokam, Kobroor, Maikoor, Trangan).

Arhopala philander philander FELDER & FELDER, 1865 Endemic to Maluku: northern Maluku (Morotai, Halmahera, Ternate, Bacan), Obi.

Arhopala philander ladysueae RAWLINS, CASSIDY & SCHRÖDER, 2018c

Endemic to Gebe.

Arhopala sorena Schröder, 2015 Aru (Wamar, Wokam).

Arhopala leander (Evans, 1957) Aru (Wokam, Kobroor).

Arhopala aexone aexone (HEWITSON, 1863) Aru (Wamar, Wokam, Kobroor, Maikoor, Trangan).

Arhopala aexone chrysoana FRUHSTORFER, 1914 Endemic to northern Maluku (Halmahera).

#### Arhopala micale superba (Röber, 1887)

Endemic to northern Maluku (Morotai, Halmahera, Ternate, Bacan, Mandioli).

Arhopala micale obina (Evans, 1957) Endemic to Obi.

Arhopala micale ssp. Endemic to Gebe.

Arhopala micale acerba (HEWITSON, 1863) Endemic to the Gorong Islands (Gorong, Manawoka).

Arhopala micale leptines FRUHSTORFER, 1914 Endemic to Kei (Kei Kecil).

Arhopala micale ribbei (Röber, 1886) Endemic to Aru (Wamar, Wokam, Kobroor, Maikoor, Trangan).

The fulla species-group (covered in part 4)

#### Arhopala admete admete (HEWITSON, 1863)

Endemic to Maluku: northern Maluku (Morotai, Halmahera, Bacan, Kasiruta), Obi, central Maluku (Kelang, Seram, Ambon).

Arhopala acron (HEWITSON, 1862)

Endemic to northern Maluku (Morotai, Halmahera, Bacan).

Arhopala azenia azenia (Hewitson, 1863)

Aru (Wokam).

Arhopala azenia patsyae TENNENT & RAWLINS, 2010 Endemic to Obi.

Arhopala disparilis (C. FELDER, 1860) Endemic to Maluku: northern Maluku (Morotai), central Maluku (Seram, Ambon, Haruku).

Arhopala fulla fulla (HEWITSON, 1862) Endemic to central Maluku (Buru, Ambon).

Arhopala fulla canulia (HEWITSON, 1869) Endemic to northern Maluku (Morotai, Halmahera, Ternate, Bacan).

Arhopala fulla sosias FRUHSTORFER, 1914 Endemic to Obi.

Arhopala fulla babsi JOICEY & TALBOT, 1917 Aru (Wamar, Wokam).

The thamyras species-group (covered in part 5)

Arhopala thamyras thamyras (LINNAEUS, 1758) Endemic to central Maluku (Buru, Kelang, Seram, Ambon, Saparua.

#### Arhopala thamyras anthore (Hewitson, 1862)

Endemic to northern Maluku (Morotai, Halmahera, Ternate, Bacan, Mandioli).

Arhopala thamyras potidaea FRUHSTORFER, 1914 Endemic to Obi.

Arhopala thamyras phryxus BOISDUVAL, 1832 Gebe.

Arhopala thamyras anthelius STAUDINGER, 1888 Endemic to Aru (Wokam).

#### Arhopala thamyras calaureia FRUHSTORFER, 1914

Watubela Islands (Kasiui).

Arhopala thamyras zfiae ssp. n. RAWLINS, CASSIDY & SCHRÖDER, 2019b

Endemic to Kei (Kei Kecil).

#### The hercules species-group (covered in part 6)

Arhopala hercules (Hewitson, 1862)

Sula Islands (Taliabu).

Arhopala tyrannus tyrannus C. & R. Felder, 1865 (f. tyrannus & f. stymphelus)

Endemic to northern Maluku (Morotai, Halmahera, Ternate, Bacan, Kasiruta, Mandioli).

Arhopala tyrannus sophilus FRUHSTORFER, 1914 Endemic to Obi.

Arhopala tyrannus herculina Staudinger, 1888 (f. herculina & f. leoesque)

Gebe.

Arhopala tyrannus jheae RAWLINS & CASSIDY, 2019

Endemic to Aru (Wokam, Kobroor).

#### Arhopala fowlerorum RAWLINS & CASSIDY, 2019

Endemic to Aru (Wamar, Wokam, Kobroor, Trangan).

In total: 38 species (7 are endemic to Maluku) and 69 taxa (47 endemic).

### Biogeography of *Arhopala* species in North Maluku and Maluku

As with all the papers in this series, the term Maluku is used to include both the Indonesian political provinces of North Maluku (= Maluku Utara) and Maluku – see below.

The biogeography of the region was discussed in detail by VANE-WRIGHT & PEGGIE (1994) and briefly by RAW-LINS et al. (2014: 5–8). VANE-WRIGHT & PEGGIE focused on northern Maluku (excluding the Sula Islands but including Gebe), Obi and central Maluku. They recorded 385 species, including 82 (21.3%) endemics and noted that endemism by butterfly family ranged from 5% in Hesperiidae to 50% in the Pieridae. The high figure for the Pieridae is largely because of the narrow range of many montane *Delias* HÜBNER, 1819 species. Since their paper, some new species have been described and many island records added, particularly for Morotai and Gebe.

In *Arhopala* part 1, RAWLINS et al. (2018a: 192) discussed the currently accepted definition of the genus *Arhopala* and its species-groups, *sensu* EVANS (1957). Eight of the 15 species-groups are represented in Maluku. RAWLINS et al. (2018a: 193) also discussed the number of species and the range of the genus. In brief, there are approximately 220 species of *Arhopala* distributed throughout the Indo-Australian Region from Afghanistan in the west, to Japan in the northeast and through S.E. Asia to Australia and the Solomon Islands. The genus reaches its peak diversity in Sundaland with species numbers decreasing both westwards and eastwards.

This paper recognises 69 Arhopala taxa (species and subspecies – the two additional forms in the *hercules* species-group are excluded) in Maluku. Forty-seven (68%) of these are endemic to the region. This is comparable to other lycaenid genera. RAWLINS et al. (2014: 8) reported that 41 of the 55 *Jamides* HÜBNER, 1819 taxa recorded from Maluku (almost 75%) were restricted to the region and RAWLINS & CASSIDY (2016: 146) noted that 12 of the 16 (75%) Maluku *Philiris* RÖBER, 1891 taxa were endemic.

At the species level, I record 38 Arhopala species in Maluku here. About 17% of all Arhopala species are represented in Maluku. Just seven of the 38 species (18%) found in Maluku are endemic to the region – Arhopala ate, halma, halmaheira, lata, acron, disparilis and fowlerorum. All are monotypic except A. lata which comprises two subspecies within Maluku. Three of these species – halma, halmaheira and acron – are endemic to northern Maluku and all occur in Halmahera. Three others are found in northern Maluku (2 of the 3 occur in Halmahera) as well as other parts of Maluku. One – the recently described A. fowlerorum – is endemic to Aru.

RAWLINS et al. (2014: 8) found that three (14%) of the 21 species of *Jamides* found in Maluku were endemic and RAWLINS & CASSIDY (2016: 146) recorded that three of the eight (37.5%) *Philiris* species recorded from Maluku were endemic.

For comparison, here are a few examples of endemism in Maluku in genera in other butterfly families.

There are six species of the danaine genus *Danaus* KLUK, 1802 (including the almost cosmopolitan *D. plexippus* LINNAEUS, 1758 as well as both *D. chrysippus* LINNAEUS, 1758 and *D. petilia* STOLL, 1790) known from Maluku. None of the species are endemic to the region. These six species comprise 18 taxa, 15 (83%) of which are endemic to Maluku. Six species (1 endemic = 17%), comprising 12 taxa (10 endemic = 83%) of the satyrine genus *Elymnias* Hübner, 1818 are known from Maluku.

Six species (no endemics), comprising about 20 (some undescribed) taxa, of the nymphaline genus *Junonia* HÜBNER, 1819 are recorded from Maluku. We consider 15 (75%) of the taxa are endemic.

Amongst the Pieridae, this paper recognises 39 species, comprising 60 taxa, of the genus *Delias* occurring in Maluku. Thirty-two (82%) of the species and 59 (an 98%) of the taxa are endemic. The only *Delias* taxon found in Maluku that is not endemic to Maluku is *D. gabia gabia* BOISDUVAL, 1832, recorded from Gebe. However, as noted above and by PEGGIE et al. (1995: 24), *Delias* includes many narrowly distributed species. The figures are very different for the other pierid genera present in Maluku. For example, 10 species (1 endemic = 10%), comprising 28 taxa (20 endemics = 71%) of the genus *Eurema* HÜBNER, 1819 occur there.

Twenty-two species (4 endemic = 18%), comprising 54 taxa (45 endemic = 83%) of the papilionid genus *Papilio* LINNAEUS, 1758 are reported from Maluku.

For the family Papilionidae, PEGGIE et al. (2005: 41) noted a total of 38 species with nine endemics (24%) present in northern Maluku (they included the Sula Islands, Obi and Gebe) and central Maluku. They did not include the islands they termed "South Maluku" (which include the Gorong, Watubela, Banda, Kei, SW Maluku, Tanimbar and Aru Islands).

RAWLINS et al. (2014: 5–8) separated the provinces of North Maluku and Maluku into 11 areas (island or island groups). The same categories are used here to briefly discuss the biogeography of *Arhopala* taxa within Maluku.

#### **The political province of North Maluku comprises:** The Sula Islands

The Sulas consist of Taliabu, Mangole and Sanana and lie midway between Sulawesi and the rest of Maluku and represent a distinct biogeographical entity within Maluku. Although politically part of North Maluku, their fauna is generally typical of the Sulawesi Region, and the *Arhopala* taxa recorded from the Sulas reflect this Sulawesi link. Of the nine *Arhopala* taxa recorded from the Sulas (all are found on Taliabu), none are found in the rest of Maluku.

Four taxa (all subspecies) (44%) are endemic. Two of these four -A. viola harmonica and A. argentea verityae - represent the eastern-most subspecies of species restricted to the Sulawesi Region. The other two -A. eridanus elfeta and A. tephlis mulleri - are Sula endemic subspecies of species that occur in both Sulawesi and Maluku. There are five non-endemic Arhopala taxa found in the Sulas -A. phaenops phaenops, A. alitaeus alitaeus, A. acetes, A. araxes araxes and A. hercules. All five also occur elsewhere in the Sulawesi Region but not

in other parts of Maluku. However, different subspecies of *A. phaenops* and *A. araxes* are distributed in other regions of Maluku.

#### Northern Maluku

The term "northern Maluku" is used to mean the following islands: Morotai, Halmahera, Ternate, Bacan, Kasiruta and Mandioli and some associated smaller islands. PEGGIE et al. (1995, 2005) included Obi and Gebe. However, they both have distinctive fauna and we treat them separately.

Northern Maluku and central Maluku (see below) are considered the biogeographical heart of Maluku.

Across all butterfly families, VANE-WRIGHT & PEGGIE (1994: 216) recorded 262 species from northern Maluku, including Gebe, of which 15 (5.7%) were endemic to the area. They noted the most species rich islands as Bacan (207 species, 0 endemic species) and Halmahera (200 species, 5 endemics = 2.5%). As with the rest of Maluku, the proportion of endemic subspecies is much higher.

Most butterfly species found on more than one of the islands of northern Maluku, occur in the same subspecies. However, there are many exceptions – for example, *Graphium batjanensis* OKANO, 1984, *Delias waterstradti* ROTHSCHILD, 1915 (both montane species), *Delias candida* VOLLENHOVEN, 1865, *Pantoporia mysia* FELDER & FELDER, 1860 and *Euthaliopsis aetion* HEWITSON, 1862 (not montane) occur in three distinct subspecies in Morotai, Halmahera and Bacan. In other cases, Bacan and Halmahera share the same subspecies, whilst the Morotai population is distinct, for example *Papilio ulysses* LINNAEUS, 1758. There are fewer examples where Morotai and Halmahera share the same taxon but the Bacan population is distinct – one is *Hebomoia glaucippe* LINNAEUS, 1758.

In the Lycaenidae, subspeciation within Maluku seems relatively rare, however *Jamides titei* TENNENT & RAWLINS, 2012 occurs in two distinct subspecies — one in Morotai and Halmahera, the other in Bacan and the neighbouring island of Mandioli.

The *Arhopala* in northern Maluku have not subspeciated, but it seems that the Morotai and Bacan populations of *A. tyrannus tyrannus* (see RAWLINS et al. 2019c: 13) may be diverging from that of Halmahera.

Twenty-two Arhopala taxa (representing 22 species) are recorded from northern Maluku, of which 15 (68%) are endemic. At the species level, three -halma, halmaheira,*acron* - are endemic to northern Maluku. The other 19 species are also found in one or more of: the Sulawesi Region including the Sulas (3 species), Gebe (6), New Guinea (13), Obi (7), central Maluku (8), Gorong & Watubela (3), Kei (3) and Aru (7). Three of these species are also widely distributed in S. E. Asia. With regard to *Arhopala* species, northern Maluku has stronger ties to the New Guinea Region than to central Maluku and preliminary analysis indicates this pattern applies across most butterfly groups.

Twenty taxa are recorded from Halmahera (the largest island in northern Maluku). Four are endemic -A. *cleander scoreyorum*, *A. halma*, *A. irma kotaroi* and *A. aexone chrysoana*. It is likely that one or more of these taxa also occur on other northern Maluku islands. Fifteen *Arhopala* taxa are recorded from Morotai (0 endemics) and 11 from Bacan (0 endemics).

#### Obi

Obi lies between northern and central Maluku, but it has usually been grouped with northern Maluku, e.g. by PEGGIE et al. (1995, 2005). Here it is treated separately. Obi shares some faunistic ties with both, but mainly with northern Maluku. There are very few butterfly species that are found in central Maluku and Obi but not in northern Maluku – two examples include *Pareronia jobaea* BOISDUVAL, 1832 (also occurs in Gebe and New Guinea) and *Melanitis amabilis* BOISDUVAL, 1832.

Across all butterfly families, VANE-WRIGHT & PEGGIE (1994: 216) recorded 171 species from Obi, of which three (1.8%) were endemic to the area. However, there are now five known endemic species on Obi (almost 3%) including 1 lycaenid: *Philiris moluccana* TITE, 1963.

There are no endemic Arhopala species on Obi. RAWLINS et al. (2014: 6) noted the generally high level of endemism at the subspecies level in Obi (over 50% of Papilionidae, Pieridae and Nymphalidae) and this is comparable for Arhopala taxa. Eleven Arhopala taxa occur on Obi and six (55%) are endemic – A. irma irma, A. micale obina, A. azenia patsyae, A. fulla sosias, A. thamyras potidaea and A. tyrannus sophilus. There are other subspecies of A. irma, A. micale, A. fulla, A. thamyras and A. tyrannus in both northern Maluku and New Guinea. Only Arhopala azenia is absent from northern Maluku (where it is replaced by its sister species A. acron), but it also occurs in Aru and New Guinea as the nominotypical subspecies.

Only *A. fulla* and *A. thamyras* have subspecies present in central Maluku, and only *A. fulla* (distributed from mainland S. E. Asia to New Guinea) is also found to the west of Maluku.

The five non-endemic Obi Arhopala taxa (all subspecies) also occur in other parts of Maluku – A. eridanus padus (northern Maluku), A. phaenops buruensis (Buru in central Maluku), A. nobilis nobilis (central Maluku and Kei), A. philander philander (northern Maluku) and A. admete admete (northern and central Maluku). There are other subspecies of A. nobilis, A. philander and A. admete present in New Guinea. Only A. phaenops (another wide-ranging species found from Thailand to the Philippines) occurs to the west of Maluku.

The Obi *Arhopala* taxa clearly demonstrate a strong Obi-northern Maluku-New Guinea connection, with a weaker link to central Maluku.

#### Gebe

Gebe lies between Halmahera in northern Maluku and Waigeo, with New Guinea beyond. Across all butterfly families, no endemic species are known from Gebe but there are many endemic subspecies. Most butterfly species found on Gebe are widespread species also found in northern Maluku and New Guinea, though usually in distinct subspecies. Many other species are found in Gebe and New Guinea but not in northern Maluku. Very few are found in northern Maluku and Gebe but not New Guinea. Two examples are *Appias placidia* STOLL, 1790 and *Danaus ismare* CRAMER, 1780.

VANE-WRIGHT & PEGGIE (1994: 216) recorded 32 species from Gebe, but they noted "The island of Gebe is undoubtedly under-recorded". I estimate at least 100 species will be found there.

Six Arhopala taxa are recorded from Gebe, of which three are endemic (50%) – A. lata detanii, A. philander ladysueae and A. micale ssp. The three non-endemic taxa – A. nobilis alcestis, A. thamyras phryxus and A. tyrannus herculina – are also recorded from the New Guinea Region but are not found in northern Maluku. At the species level, all six Arhopala known from Gebe also occur in northern Maluku and New Guinea. Only two of the six species – A. nobilis and A. thamyras – also occur in central Maluku (in distinct subspecies). This pattern clearly demonstrates the affinity of Gebe fauna with the New Guinea Region to the east and less strongly to northern Maluku to the west.

#### **The political province of Maluku comprises:** Central Maluku

The term "central Maluku" is used to mean the islands of Buru, Ambelau, Manipa, Kelang, Buano, Seram, Ambon, Haruku, Saparua, Nusa Laut, Geser and Seram Laut. This corresponds with the definition given by PEGGIE et al. (1994, 1995, 2005), but with the addition of Ambelau, a small island about 15 km off southeastern Buru. I have seen no *Arhopala* records from Ambelau. Interestingly, despite its proximity to Buru, Ambelau does have some endemic taxa. For example, the Pierid species *Hebomoia leucippe* CRAMER, 1775 occurs on Buru (as *H. leucippe leucogynia* WALLACE, 1863), Seram and other central Maluku islands, yet on Ambelau it is replaced by an endemic subspecies of *H. glaucippe* LINNAEUS, 1758 – *H. glaucippe* kazukoae SAMUSAWA, 1991.

Across all butterfly families, VANE-WRIGHT & PEGGIE (1994: 216) recorded 288 species from central Maluku, of which 44 (15%) were endemic.

12 Arhopala species from central Maluku are recognised, although none are endemic to the area.

Including subspecies, 12 Arhopala taxa occur in central Maluku, four (33%) of which are endemic – A. cleander cleander, A. chamaeleona rileyi, A. fulla fulla, A. thamyras thamyras. Arhopala cleander and A. fulla are wide-ranging

species found from the Southeast Asian mainland to New Guinea. Two further subspecies of *A. chamaeleona* occur in northern Maluku and New Guinea and *Arhopala thamyras* is found in several subspecies across Maluku, in the New Guinea Region and the Solomon Islands.

Of the eight Arhopala taxa present in, but not endemic to central Maluku, only two are also found outside Maluku -A. annulata (Sulawesi Region and Philippines) and A. critala (in New Guinea and within Maluku, in Kei). The remaining six are also found in one or more of: northern Maluku (3 taxa), Obi (3 taxa), Gorong (1 taxon) and Kei (2 taxa).

This suggests a link through Obi to northern Maluku and a weaker link southeast through Gorong to Kei.

Within central Maluku, Seram and Buru are the largest and most mountainous islands. Across all butterfly families, VANE-WRIGHT & PEGGIE (1994: 216) recorded 225 species (5 endemics, 2.2%) in Seram and 189 (13 endemics, 6.9%) in Buru. The level of species endemism in Buru was higher than for any other island in northern or central Maluku. They recorded 214 species (1 endemic) in Ambon.

Nine Arhopala taxa are recorded from Seram. However, it is likely that at least two further taxa known from Ambon -A. annulata and A. fulla fulla – occur there. Only one taxon – A. chamaeleona rileyi – is endemic to Seram. Ten taxa are known from Ambon (none are endemic), a much smaller island, adjacent to Seram. This almost certainly reflects the fact that more collecting has been done on Ambon than anywhere else in Maluku. Buru is the second largest island of central Maluku but only 6 Arhopala taxa are recorded and none are endemic to the island.

#### The Gorong, Watubela and Tayandu Islands

These island groups lie in a chain to the southeast of central Maluku, beyond Seram, Geser and Seram Laut. The Kei Islands are the next group further southeast.

Two Arhopala taxa are recorded from the Gorong Islands. One, A. eridanus eridanus is also widespread in the islands of central Maluku. The other is an endemic subspecies A. micale acerba. Arhopala micale ranges from Maluku through the New Guinea Region to Australia. Within Maluku it occurs in 6 subspecies across the region – in northern Maluku, Obi, Gebe, Gorong, Kei, Aru – but it is absent from central Maluku. This species seems to be centred in the New Guinea Region with two connections to Maluku. A northern link from New Guinea, through Gebe and northern Maluku to Obi. A southern link through Aru and Kei as far as Gorong.

One Arhopala taxon -A. thamyras calaureia (TL: Misool) - is recorded from the Watubela Islands, which lie between Gorong and Kei. This taxon is restricted to Watubela and Misool. The species ranges across Maluku through the New Guinea Region as far as the Solomon Islands.

I have seen no records of *Arhopala* from the Tayandu Islands.

#### The Banda Islands

The Bandas are a group of about 10 small volcanic islands, with a total land mass of only about 180 km<sup>2</sup>, situated about 120 km south of Seram. They formed in situ within the Banda arc. I have not seen any records of *Arhopala* from there.

#### The Kei Islands

The Kei Islands fauna shares a weak link with central Maluku fauna to the northwest and a stronger connection to that of Aru and New Guinea to the southeast. There are no endemic butterfly species in Kei, but as with other regions of Maluku, many endemic subspecies.

Six Arhopala taxa are recorded from the Kei Islands. Just 2 (33%) of these are endemic -A. micale leptines and A. thamyras zfiae. At the species level, both are widely distributed across Maluku to New Guinea and beyond, although A. micale is absent from central Maluku.

Two of the other Kei Arhopala taxa – A. aruana and A. eupolis eupolis – exhibit the Kei-Aru-New Guinea axis. Arhopala nobilis nobilis (TL: Ambon) is restricted to central Maluku and Kei (but only known from  $1 \mathcal{Q}$  in the NHMUK). Other nobilis subspecies are found in northern Maluku, Gebe, Aru and New Guinea. The final Kei taxon – A. critala – has an unusual disjunct distribution, being found only in central Maluku, Kei and New Guinea.

### The Southwest Maluku Islands = Western Daya Islands

These are the islands that extend beyond the Lesser Sunda Islands and Timor, from Wetar to Babar.

The fauna here is more akin to that of the Lesser Sundas than to other areas of Maluku. The only *Arhopala* taxon found here -A. *araxes onetor* – reflects that, ranging from Sumatra and Java along the Lesser Sunda Islands to the Southwest Maluku Islands. The other three subspecies of *Arhopala araxes* are restricted to the Sulawesi Region.

#### The Tanimbar Islands

These lie to the east of Babar and occupy the end of the island chain from Sumatra, through Java, the Lesser Sundas and the Southwest Maluku Islands. Three endemic butterfly species are known – *Troides riedeli* KIRSCH, 1885, *Neptis gracilis* KIRSCH, 1885 and *Holochila zita* GROSE SMITH, 1895. As with much of Maluku, there is a high level of endemism at the subspecies level. The Tanimbars' chief faunal link is with the Southwest Maluku Islands, and the Tanimbars represent the eastern limit of a number of species that occur from Timor eastwards, for example *Papilio pericles* WALLACE, 1865 and *Delias timorensis* BOISDUVAL, 1836. The Tanimbars also share some faunal links with Kei, for example, *Pachliopta polydorus* LINNAEUS, 1763 (present in Kei and Tanimbar Islands, but not in the Southwest Maluku Islands), but little with Aru and New Guinea. I have seen no records of *Arhopala* from the Tanimbars.

#### The Aru Islands

The Aru Islands sit on the New Guinea continental shelf and share much of their fauna with mainland New Guinea. Fifteen Arhopala taxa are found on Aru. Only 4 (27%) are endemic: A. micale ribbei, A. thamyras anthelius, A. tyrannus jheae and A. fowlerorum. The first three species are represented in northern Maluku and New Guinea in other subspecies. Arhopala thamyras also has a subspecies (the nominotypical) in central Maluku. Arhopala fowlerorum is a recently described Aru endemic species in the hercules species-group, however, further DNA sequencing of related New Guinea taxa may demonstrate there are conspecific taxa there.

The 11 non-endemic *Arhopala* taxa found on Aru also occur in New Guinea. Of these, two are also recorded from northern Maluku, one from Gebe and two from Kei.

#### In summary

There are varying faunas in the different biogeographical areas of Maluku. Amongst *Arhopala* (and other butterfly groups examined) there is a high level of endemism at the subspecies level, throughout most of Maluku. Northern Maluku has the highest level of endemism at both the species and subspecies level. The islands with the highest number of *Arhopala* species, are Halmahera (20 species), Morotai (15), Bacan (11) (all islands in northern Maluku), Aru (15), Obi (11), Ambon (10), Seram (9) and Taliabu (9). Note that Aru is not a single island, but a group of islands. However, the islands are separated by narrow sea channels, which in most cases are only 50 m to 1.5 km wide.

Ideally *all* the biogeographical areas of Maluku discussed, should be regarded as key zones for conservation. Regarding *Arhopala* diversity, Halmahera must be considered of prime importance, but if considering diversity and endemism (species and subspecies) in *Arhopala* and across all butterfly families, Seram, Buru, Obi, Aru and Taliabu are also critical.

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