

ISSN : 0082 - 6340  
E-ISSN : 2337 - 876X  
Accredited : 30/E/KPT/2018



# TREUBIA

*A JOURNAL ON ZOOLOGY  
OF THE INDO-AUSTRALIAN ARCHIPELAGO*

---

Vol. 47, no. 1, pp. 1-75

June 2020



Published by

RESEARCH CENTER FOR BIOLOGY  
INDONESIAN INSTITUTE OF SCIENCES  
BOGOR, INDONESIA



ISSN : 0082 - 6340  
E-ISSN : 2337 - 876X  
Accredited : 30/E/KPT/2018



# TREUBIA

*A JOURNAL ON ZOOLOGY  
OF THE INDO-AUSTRALIAN ARCHIPELAGO*

---

Vol. 47, no. 1, pp. 1-75

June 2020



Published by

RESEARCH CENTER FOR BIOLOGY  
INDONESIAN INSTITUTE OF SCIENCES  
BOGOR, INDONESIA

ISSN : 0082 - 6340  
E-ISSN : 2337 - 876X  
Accredited : 30/E/KPT/2018

## TREUBIA

A JOURNAL ON ZOOLOGY OF THE INDO-AUSTRALIAN ARCHIPELAGO  
Vol. 47, no. 1, pp. 1–75, June 2020

### Board of Editors:

Dr. Djunijanti Peggie, M.Sc. (Chief Editor)  
Prof. Dr. Dewi Malia Prawiradilaga, M.Rur.Sc.  
Dr. Daisy Wowor, M.Sc.  
Dr. Kartika Dewi  
Dr. Dhian Dwibadra  
Dr. Conni Margaretha Sidabalok, M.App.Sc.

### International Editors:

Dr. Paul Bates, M.A. Harrison Institute Bowerwood House 15 Botolph's Road Sevenoaks, Kent, TN13 3AQ, UK  
Dr. Thomas von Rintelen Museum für Naturkunde Leibniz - Institut für Evolutions und Biodiversität sforschung an der Humboldt-University zu Berlin, Invaliden straße 43, 10115 Berlin, Germany  
Dr. Alan T. Hitch University of California, Davis, CA 95616, USA

### Reviewers:

Dr. Ding Li Yong BirdLife International (Asia), 354 Tanglin Road, Tanglin International Centre Singapore, 247672 Singapore  
Dr. Willy Marthy Rombang Wildlife Conservation Society-Indonesia Program, Jl. Malabar I no. 11, Bogor 16128, Indonesia  
Dr. Chris J Müller Australian Museum, 6 College Street, Sydney, NSW 2010, Australia  
Dr. R.I. Vane-Wright Durrell Institute of Conservation and Ecology, School of Anthropology and Conservation, University of Kent, Canterbury, CT2 7NR, UK; Life Sciences, Natural History Museum, Cromwell Road, London SW7 5BD, UK  
Prof. Dr. Dewi Malia Prawiradilaga, M.Rur.Sc. Museum Zoologicum Bogoriense, Research Center for Biology, Indonesia Institute of Sciences (LIPI), Indonesia  
Muhammad Irham, M.Sc. Museum Zoologicum Bogoriense, Research Center for Biology, Indonesia Institute of Sciences (LIPI), Indonesia  
Dr. Michael Balke Zoologische Staatssammlung München, Münchhausenstraße 21, München, 81247 Germany  
Dr. Karol Szawaryn Museum and Institute of Zoology Polish Academy of Sciences, Wilcza 64, 00-679 Warszawa, Poland  
Pungki Lupiyaningdyah, S.Si., M.Sc. Museum Zoologicum Bogoriense, Research Center for Biology, Indonesia Institute of Sciences (LIPI), Indonesia  
Graham T. Reels 21 St. Anne's Close, Winchester SO22 4LQ, Hants., UK  
Dr. Djunijanti Peggie, M.Sc. Museum Zoologicum Bogoriense, Research Center for Biology, Indonesia Institute of Sciences (LIPI), Indonesia

**Managing Assistant:**  
Sri Wulan, S. Ikom.

**Layout:**  
Liana Astuti

**TREUBIA**  
RESEARCH CENTER FOR BIOLOGY - INDONESIAN INSTITUTE OF SCIENCES (LIPI)  
Jl. Raya Jakarta-Bogor Km. 46, Cibinong-Bogor 16911, Indonesia  
e-mail: [treubia@gmail.com](mailto:treubia@gmail.com)  
<http://e-journal.biologi.lipi.go.id/index.php/treubia>



CONTENT

<b>David J. Lohman, Sarino, and Djunijanti Peggie</b> Syntopic <i>Elymnias agondas aruana</i> female forms mimic different <i>Taenaris</i> model species (Papilionoidea: Nymphalidae: Satyrinae) on Aru, Indonesia .....	<b>1–12</b>
<b>Tri Haryoko, Oscar Johnson, Matthew L. Brady, Subir B. Shakya, M. Irham, Yohanna, Rusdiyan P. Ritonga, Dewi M. Prawiradilaga, and Frederick H. Sheldon</b> Recent ornithological expeditions to Siberut Island, Mt. Talamau and Rimbo Panti Nature Reserve, Sumatra, Indonesia .....	<b>13–38</b>
<b>Elize Y. X. Ng, Arya Y. Yue, James A. Eaton, Chyi Yin Gwee, Bas van Balen, and Frank E. Rheindt</b> Integrative taxonomy reveals cryptic robin lineage in the Greater Sunda Islands .....	<b>39–52</b>
<b>Arif Maulana, Tri Atmowidi, and Sih Kahono</b> A contribution to the taxonomy and ecology of little-known Indonesian <i>Afissa</i> ladybird beetles (Coccinellidae, Epilachnini) .....	<b>53–62</b>
<b>Ainun Rubi Faradilla, Mariza Uthami, Bella Andini, and Hening Triandika Rachman</b> The life history and microhabitat ecology of a phytotelm-breeding damselfly <i>Pericnemis stictica</i> in Jatimulyo forest, Yogyakarta .....	<b>63–75</b>





## TREUBIA

(A JOURNAL ON ZOOLOGY OF THE INDO-AUSTRALIAN ARCHIPELAGO)

ISSN : 0082 - 6340  
E-ISSN : 2337 - 876X

Date of issue: 30 JUNE 2020

This abstract sheet may be reproduced without permission or charge

UDC: 595.78(594.73)

David J. Lohman

**Syntopic *Elymnias agondas aruana* female forms mimic different *Taenaris* model species (Papilionoidea: Nymphalidae: Satyrinae) on Aru, Indonesia**

TREUBIA, June 2020, Vol. 47, No. 1, pp. 1–12.

Wing patterns of female *Elymnias agondas* (Boisduval, 1832) butterflies are highly variable, presumably to mimic different *Taenaris* species throughout New Guinea and surrounding islands. Labels on most *E. agondas* museum specimens lack precise locality information, complicating efforts to match *E. agondas* female wing patterns with presumed *Taenaris* model species. This paucity of data also makes it impossible to determine where different forms occur and whether they are strictly allopatric. During fieldwork on the Aru Archipelago, we found two distinct forms of *E. agondas* females occurring syntopically. The “light form” resembles *T. catops*, while the “dark form” seems to mimic *T. myops* and *T. artemis*. We discuss the significance of this finding and illustrate species in the *Taenaris* mimicry ring encountered on Aru.

(David J. Lohman, Sarino, and Djunijanti Peggie)

**Keywords:** adaptation, Batesian mimicry, butterfly, mimicry ring, polymorphism

UDC: 598.2:910.4(594.4)

Tri Haryoko

**Recent ornithological expeditions to Siberut Island, Mt. Talamau and Rimbo Panti Nature Reserve, Sumatra, Indonesia**

TREUBIA, June 2020, Vol. 47, No. 1, pp. 13–38.

Siberut Island, Mt. Talamau, Rimbo Panti Nature Reserve, and intervening locations in West Sumatra Province were visited during two expeditions in 2018-2019 by ornithologists from the Museum Zoologicum Bogoriense-Indonesian Institute of Sciences (LIPI), Louisiana State University Museum of Natural Science, and Andalas University. The main objective of these expeditions was to obtain data and tissue-subsample rich museum specimens for morphological and genetic studies of phylogeny and population genetics of Southeast Asian birds aimed at understanding the causes of avian diversification in the region. We also observed, photographed, and audio-recorded numerous bird species during the expeditions and archived these data. In total, 285 species were identified, and specimen material was collected from 13 species and 26 subspecies not previously represented in tissue resource collections. Here, we provide complete lists of birds found at each location, highlight distributional discoveries, and note cases of potential taxonomic, ecological, and conservation interest.

(Tri Haryoko, Oscar Johnson, Matthew L. Brady, Subir B. Shakya, M. Irham, Yohanna, Rusdian P. Ritonga, Dewi M. Prawiradilaga, and Frederick H. Sheldon)

**Keywords:** birds, distribution, diversity, conservation, West Sumatra

UDC: 598.813.063(59)

**Elize Y. X. Ng**

**Integrative taxonomy reveals cryptic robin lineage in the Greater Sunda Islands**

TREUBIA, June 2020, Vol. 47, No. 1, pp. 39–52.

Southeast Asian avifauna is under threat from both habitat loss and illegal poaching, yet the region's rich biodiversity remains understudied. Here, we uncover cryptic species-level diversity in the Sunda Blue Robin (*Myiomela diana*), a songbird complex endemic to Javan (subspecies *diana*) and Sumatran (subspecies *sumatrana*) mountains. Taxonomic inquiry into these populations has previously been hampered by a lack of DNA material and the birds' general scarcity, especially *sumatrana* which is only known from few localities. We demonstrate fundamental bioacoustic differences in courtship song paired with important distinctions in plumage saturation and tail length that combine to suggest species-level treatment for the two taxa. Treated separately, both taxa are independently threatened by illegal poaching and habitat loss, and demand conservation action. Our study highlights a case of underestimated avifaunal diversity that is in urgent need of revision in the face of imminent threats to species survival.

(Elize Y. X. Ng, Arya Y. Yue, James A. Eaton, Chyi Yin Gwee, Bas van Balen, and Frank E. Rheindt)

**Keywords:** bioacoustics, bird trade, passerines, songbird crisis, taxonomic neglect

UDC: 595.76:591.46(594.53)

**Arif Maulana**

**A contribution to the taxonomy and ecology of little-known Indonesian *Afissa* ladybird beetles (Coccinellidae, Epilachnini)**

TREUBIA, June 2020, Vol. 47, No. 1, pp. 53–62.

We collected the little-known ladybird beetle *Afissa incauta* in the mountainous region of Bandung, West Java. The beetle occurred sympatrically with the very similar species *A. gedeensis*. Here, we provide an update to the current knowledge for these two species. The *A. incauta* we collected have a slightly smaller and duller body compared to the previously known specimens of *Afissa incauta*, with convergent elytral maculation similar to *A. gedeensis*.

(Arif Maulana, Tri Atmowidi, and Sih Kahono)

**Keywords:** *Afissa gedeensis*, *Afissa incauta*, Coleoptera, Epilachnini, ladybird beetle

UDC: 595.733:574.2(594.57)

**Ainun Rubi Faradilla**

**The life history and microhabitat ecology of a phytotelm-breeding damselfly *Pericnemis stictica* in Jatimulyo forest, Yogyakarta**

TREUBIA, June 2020, Vol. 47, No. 1, pp. 63–75.

This study aims to understand the life history and microhabitat ecology of a phytotelmata-breeding species, *Pericnemis stictica*. Data was collected at 46 breeding sites in the Jatimulyo Forest, Kulonprogo. Several parameters were recorded from each breeding site, i.e. plant species, diameters, depth, water depth, water volume, water pH, and water turbidity. Naiads and imagoes of *P. stictica* were measured morphometrically. The data taken was analyzed descriptively using Minitab 19. The results showed that 17 naiads of *P. stictica* were found in 13 bamboo stumps. The bamboo species most commonly used by *P. stictica* as a breeding site was *Dendrocalamus asper*. Naiads of *P. stictica* were found in the same habitat as mosquito larva from genera *Toxorhynchites*, *Aedes*, *Armigeres*, and *Culex*. During the rearing process, it was recorded that *P. stictica* naiads can eat more than ten mosquito larvae a day. Four males and one female imagoes of *P. stictica* were found. The imagoes were mostly found in a secondary forest with shady ravine areas. Imago's average total length was 7.19 cm. Naiad's final instar average size was 16.7 mm. Water depth, water temperature, bamboo depth, bamboo volume, and humidity were all positively correlated to *P. stictica*'s phytotelmata-breeding behavior.

(Ainun Rubi Faradilla, Mariza Uthami, Bella Andini, and Hening Triandika Rachman)

**Keywords:** breeding, *Pericnemis*, phytotelm, Yogyakarta

**SYNTOPIC *ELYMNIAS AGONDAS ARUANA* FEMALE FORMS MIMIC DIFFERENT *TAENARIS* MODEL SPECIES (PAPILIONOIDEA: NYMPHALIDAE: SATYRINAE) ON ARU, INDONESIA**

**David J. Lohman<sup>\*1,2,3</sup>, Sarino<sup>4</sup>, and Djunijanti Peggie<sup>4</sup>**

<sup>1</sup>Biology Department, City College of New York, City University of New York, New York, NY, USA

<sup>2</sup>Ph.D. Program in Biology, Graduate Center, City University of New York, New York, NY, USA

<sup>3</sup>Entomology Section, National Museum of Natural History, Manila, Philippines

<sup>4</sup>Museum Zoologicum Bogoriense, Research Center for Biology, Indonesian Institute of Sciences (LIPI), Jl. Raya Jakarta-Bogor Km. 46, Cibinong, Bogor 16911, Indonesia

\*Corresponding author: dlohman@ccny.cuny.edu

Received: 27 January 2020; Accepted: 16 June 2020

**ABSTRACT**

Wing patterns of female *Elymnias agondas* (Boisduval, 1832) butterflies are highly variable, presumably to mimic different *Taenaris* species throughout New Guinea and surrounding islands. Labels on most *E. agondas* museum specimens lack precise locality information, complicating efforts to match *E. agondas* female wing patterns with presumed *Taenaris* model species. This paucity of data also makes it impossible to determine where different forms occur and whether they are strictly allopatric. During fieldwork on the Aru Archipelago, we found two distinct forms of *E. agondas* females occurring syntopically. The “light form” resembles *T. catops*, while the “dark form” seems to mimic *T. myops* and *T. artemis*. We discuss the significance of this finding and illustrate species in the *Taenaris* mimicry ring encountered on Aru.

**Keywords:** adaptation, Batesian mimicry, butterfly, mimicry ring, polymorphism

**ABSTRAK**

Pola sayap kupu-kupu betina *Elymnias agondas* (Boisduval, 1832) bervariasi tinggi, kemungkinan untuk menyerupai spesies *Taenaris* yang berbeda-beda di New Guinea dan pulau-pulau sekitarnya. Label pada kebanyakan spesimen museum dari *E. agondas* tidak memiliki informasi lokasi yang tepat, menambah rumit upaya untuk menyandingkan pola sayap betina *E. agondas* dengan terduga jenis model *Taenaris*. Kesenjangan data juga membuat tidak mungkin untuk menentukan di mana terdapat bentuk-bentuk yang berbeda dan apakah mereka sungguh-sungguh *allopatric*. Pada kerja lapangan di Kepulauan Aru, kami menemukan dua bentuk yang berbeda dari betina *E. agondas* yang terdapat secara *syntopic*. Bentuk yang terang menyerupai *T. catops*, dan bentuk yang gelap tampaknya menyerupai *T. myops* dan *T. artemis*. Kami mendiskusikan signifikansi temuan ini dan menunjukkan jenis dalam rantai mimikri *Taenaris* yang dijumpai di Aru.

**Kata kunci:** adaptasi, mimikri Batesian, kupu-kupu, rantai mimikri, polimorfisme

**INTRODUCTION**

Natural selection for visual mimicry among species is responsible for marked phenotypic diversity, including morphological divergence and convergence (Mallet & Joron, 1999). In sex-limited mimetic species, only females are Batesian mimics; males do not resemble any distasteful model. In such species, females are frequently polymorphic and mimic different model species in different areas (Kunte, 2009). The African Mocker Swallowtail, *Papilio dardanus* Yeats in Brown, 1776, is a well-studied example of this: males are monomorphic

and not mimetic throughout the species' range, but there are over 30 female forms mimicking a variety of model species in different locales (Thompson & Timmermans, 2014). Sexually dimorphic mimicry or “dual mimicry” in which males and females resemble different models is less common (Vane-Wright, 1971, 1975, 1976). Some populations of the Asian satyrine *Elymnias hypermnestra* (Linnaeus, 1763) exemplify dual mimicry. In some areas including India, Java, Bali, and Seram, the species is dimorphic and each sex mimics a different model: males mimic *Euploea* spp. and females mimic orange *Danaus* spp.—most likely *D. genutia* (Cramer, [1779]) and/or *D. chrysippus* (Linnaeus, 1758). However, in other locales, including Taiwan, Hainan, Borneo, Sumatra, and the Lesser Sundas east of Wallace's Line, males and females are monomorphic and mimic *Euploea* spp. (Wei et al., 2017; Panettieri et al., 2018).

Two or more chemically defended Müllerian mimics sometimes evolve to resemble each other and may be mimicked by one or more palatable Batesian mimic, forming a “mimicry ring” of multiple co-mimetic species that may vary in palatability (Punnett, 1915; Joshi et al., 2017). Phenotypic similarity among co-mimics can be so striking that it is difficult to distinguish species, particularly among Müllerian mimics. Frequently, many or all of the co-mimicking species adopt a different pattern in other locales, creating strong phenotypic matching within communities and marked polymorphism within species (Corbet, 1943; Parsons, 1998). *Heliconius* mimicry rings in South America are probably best known (Jiggins, 2017), but there are many examples in Asia that await further study (Punnett, 1911; Ackery & Vane-Wright, 1984; Parsons, 1998).

*Taenaris* comprises approximately 25 medium- to large-sized butterfly species, most of which have wings with a white and/or grey background and two conspicuous eyespots on the underside of each hindwing. Wing patterns are variable within each species and between sexes; however, sympatric species often have similar wing patterns (Parsons, 1998), suggesting Müllerian mimicry. Species in the genus *Taenaris* are often Müllerian mimics of their congeners where they co-occur. They form the basis of mimicry rings on New Guinea and its surrounding islands, where most *Taenaris* species are distributed (Brooks, 1950; Parsons, 1998). There is strong, indirect evidence that *Taenaris* species are chemically defended. Larvae of some species feed on cycads (Cycadaceae) and presumably sequester cycasin or related compound(s). Adults of species that do not feed on cycads as larvae imbibe cycad sap as adults (Parsons, 1998), which presumably imparts phytochemical protection. The conspicuous colors and gregarious habits of *Taenaris* larvae suggest that they are aposematic despite larval diets that may lack defensive compounds. Parsons (1998) postulated that *Taenaris* and *Faunis* are sister genera, and molecular phylogenomic data confirms this relationship (Lohman et al., unpublished data; Chazot et al., 2019). *Faunis* and most other amathusiines are smaller, cryptically colored, and crepuscular. The *Taenaris* lineage is more

conspicuous and diurnal, further suggesting that the taxon is aposematic (Parsons, 1998). The genus is placed in the tribe Amathusiini in the nymphalid subfamily Satyrinae based on molecular phylogenetic evidence (Wahlberg et al., 2009; Chazot et al., 2019), but the tribe has previously been regarded as a family (Amathusiidae; Brooks, 1950; Aoki et al., 1982), a subfamily (Amathusiinae; Ehrlich, 1958; Monastyrskii, 2011), or a tribe within Morphinae (Scott, 1984 (1985); Parsons, 1998).

Vane-Wright (1971) and Parsons (1984, 1998) enumerated butterfly taxa participating in the *Taenaris* mimicry ring. Presumed Müllerian mimics include all *Taenaris* species and the monotypic *Hyantis hodeva* Hewitson, 1862, together with some presumed palatable mimics including female *Elymnias agondas* (Nymphalidae: Satyrinae), some female forms of *Papilio aegeus* Donovan, 1805 (Papilionidae: Papilioninae), female *Hypolimnas deois* Hewitson, 1862 (Nymphalidae: Nymphalinae), and female *Mydosama drusillodes* (Oberthür, 1894) (Nymphalidae: Satyrinae). Some authors also regard *Hypocysta* (Nymphalidae: Satyrinae) of the New Guinea region as diminutive *Taenaris* mimics (Brower, 2009). Average forewing length in *Hypocysta* spp. is around 17-20 mm, but ranges between 44-59 mm in the *Taenaris* spp. encountered on Aru (Parsons, 1998).

Female *E. agondas* are highly polymorphic and mimic different *Taenaris* species throughout the species' range. The species is sexually dimorphic, and male *E. agondas* may resemble darker *Taenaris*, such as *T. onolaus* (Kirsch, 1877) (Parsons, 1998), or they might not be mimetic. Wei et al. (2017) illustrated 21 female *E. agondas* specimens with varying patterns but refrained from revising the taxonomy or indicating the distributions of subspecies on New Guinea because of the extreme variation and lack of detailed locality records. The dearth of precise locality information for most museum specimens (many labels simply state "New Guinea") complicates efforts to study mimicry of *E. agondas*. Existing locality information does not allow the ranges of different forms or subspecies to be determined, thwarts inference of putative model species for these taxa, and prevents determination of whether different female forms of *E. agondas* are strictly allopatric.

During the course of fieldwork on the Aru Archipelago we encountered two different female forms of *Elymnias agondas* that resemble different co-occurring *Taenaris* species. We describe the significance of these syntopic forms and characterize the *Taenaris* mimicry ring on Aru.

## MATERIALS AND METHODS

We collected butterflies from 18-23 June 2019 near the west coast of Wokam Island and from 23-25 June 2019 on Ujir Island using aerial nets and pop-up butterfly traps (cone type with 20 cm opening; bugdorm.com) baited with rotting bananas and pineapple sprinkled with

bourbon. Collection information including GPS coordinates was recorded for each specimen. Some specimens were papered in the field and subsequently spread; other specimens had their wings removed and stored in glassine envelopes before placing the bodies in a vial of pure ethanol to preserve DNA.

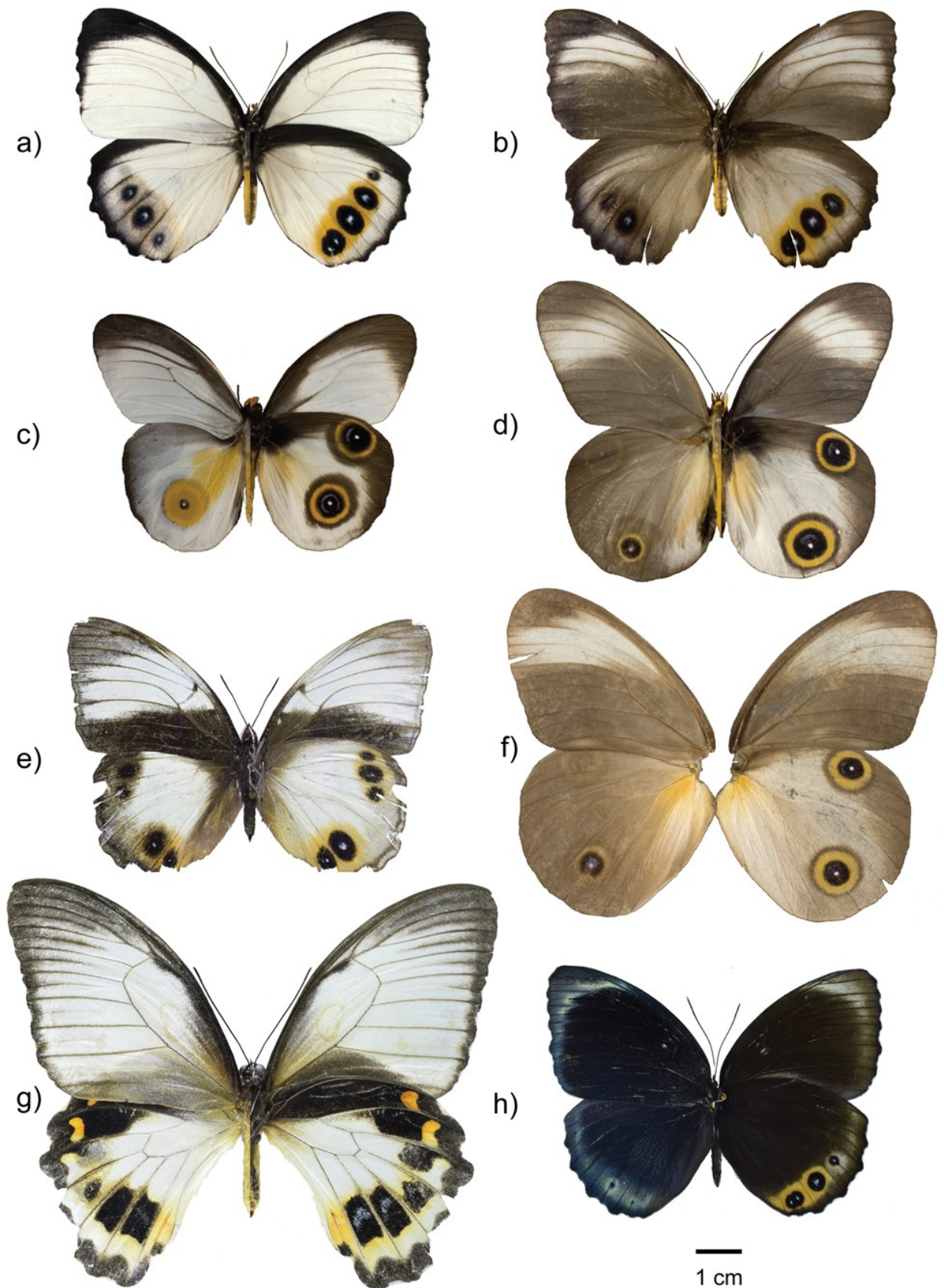
## RESULTS

We recorded over 100 butterfly species from Wokam and Ujir Islands, including several members of the *Taenaris* mimicry ring: *T. artemis myopina* Fruhstorfer, 1904, *T. catops catops* (Westwood, 1851), *T. myops myops* (C. & R. Felder, 1860), *Elymnias agondas aruana* Fruhstorfer, 1900, *Hypolimnas deois deois* (Hewitson, 1858), *Papilio aegeus ormenus* Guérin-Méneville, [1831] (Fig. 1), *Hypocysta osyris osyris* (Boisduval, 1832), and *Hypocysta haemonia haemonia* Hewitson, 1863. While male *E. agondas* were phenotypically invariant (Fig. 1h), females were variable and could be classified into a “light form” (Fig. 1a) resembling *T. catops* (Fig. 1c) and a “dark form” (Fig. 1b) resembling *T. artemis* and *T. myops* (Fig. 1d, f). Intraspecific taxa, including forms, are not recognized by the International Commission on Zoological Nomenclature (ICZN, 2000). Thus, our use of the term “form” is not meant to provide a new taxonomic designation, but rather to introduce descriptive terms to discuss distinctive phenotypes. Dark and light forms of *E. agondas* females were caught together in the same fruit trap on the same day, demonstrating no spatial or temporal separation between the forms. We collected too few females to determine the relative abundance of different forms, but note that both of these forms seemed to be variable. We sampled individuals that varied slightly from the specimens pictured in Figure 1.

## DISCUSSION

The discovery of two different mimetic female forms of *Elymnias agondas* coexisting in the same place at the same time appears to be novel. Apart from developmental aberrations, most intraspecific variability is between populations, not within them, because interbreeding within a population homogenizes phenotypic variability. Moreover, individuals within a single population coexist within the same environment and experience the same (or similar) selection pressures, and, thus, the evolution and/or maintenance of different phenotypes within a single panmictic population is unexpected. Extensive studies of inadequately labeled *Elymnias agondas* specimens at several museums did not suggest that any of the various female forms coexisted.

The discovery of these two syntopic forms prompts questions about how this polymorphism evolved, how it is maintained in sympatry, and why it persists. Aru is a land bridge island on the Sahul Shelf ~120 km south of New Guinea, and was intermittently



**Figure 1.** Members of the *Taenaris* mimicry ring on Aru. Each specimen image is a composite showing the upperside (dorsal) on the left and the underside (ventral) on the right. a) *Elymnias agondas aruana* ♀ “light form”; b) *Elymnias agondas aruana* ♀ “dark form”; c) *Taenaris catops catops* ♂; d) *Taenaris myops myops* ♂; e) *Hypolimnas deois deois* ♀; f) *Taenaris artemis myopina* ♀; g) *Papilio aegaeus ormenus* ♀; h) *Elymnias agondas aruana* ♂.



connected to New Guinea throughout the Pleistocene (Voris, 2000). These periods of connection and separation could have provided opportunities for the evolution of different forms in allopatry during periods of high sea stand, followed by secondary contact when sea levels were low. Studies on several mimetic butterfly species have found that tightly linked groups of wing patterning loci known as “supergenes” often control development of different forms (Kunte et al., 2014; Timmermans et al., 2014). The co-adapted loci are prevented from being dissociated by recombination because of their linkage and occasionally by chromosomal re-arrangements (Joron et al., 2011). Mimicry supergenes have been demonstrated in distantly related butterflies, and it is therefore plausible to hypothesize that a supergene is responsible for the dimorphism seen in *E. agondas aruana* females. The coexistence of two mimetic forms mimicking similar but distinctly different model species indicates that predators can visually discriminate the two forms and suggests that divergent mimics are more successful than a single phenotype intermediate between the dark and light forms.

One might also ask why two discrete female forms can co-exist without one becoming more advantageous and thus fixed in the population. This is similar to asking why male and female dual mimetic species mimic different models. A dominant hypothesis is that palatable mimics should be less abundant than their models in order for predators to learn to avoid the more common, unpalatable species (but see Ries & Mullen, 2008). When males and females each mimic a different model species, the theoretical maximum abundance of imagos increases because the abundance of each sex is now determined by the commonness of two different models rather than a single species. However, if birds and other predators are not duped by the taxon-specific mimicry of each *E. agondas* form, then the relative abundance of the two forms might be subject to negative frequency-dependent selection. In this scenario, the more common form is at a selective disadvantage because predators encounter and learn to detect it more readily, potentially leading to cycles of alternating commonness and rarity between the forms (Takahashi & Kawata, 2013).

While most *Taenaris* species including all found on Aru have two prominent underside hindwing eyespots, *E. agondas* and *H. deois* females have more eyespots than their model species, and the eyespots are noticeably smaller and in different positions on the wing. Moreover, *Papilio aegeus* female “eyespot” lack concentric rings (Fig. 1g). Although concentric ring patterns are known from the family Papilionidae (in the subfamily Parnasiinae), the developmental mechanisms seem to be different than in Nymphalidae (Shirai et al., 2012). The poor mimicry of the model species’ hindwing eyespots is particularly intriguing, as eyespot position and size affect detection by predators in satyrine butterflies (Ho et al., 2016). Vane-Wright (1971) notes that eyespots are atypical of butterfly warning patterns. Some insectivorous birds seem to have innate aversion to eyespots (Blest,

1957a, b), and—at least in *Taenaris*—large eyespots may serve as a second line of defense after their presumed unpalatability. In contrast to the eyespots, the colors and patterns of the two forms of *E. agondas* forewings more accurately resemble their models (Fig. 1). Birds learn color more quickly than shape or pattern (Osorio et al., 1999; Kazemi et al., 2014), which might explain why the mimics' color is more faithful to the model than eyespot number.

Each of the Batesian mimics in the *Taenaris* mimicry ring on Aru (Fig. 1) could be characterized as an imperfect mimic that can be readily distinguished from its model by human observers. Much has been written on how imperfect mimicry evolves, why it remains effective, and why mimetic perfection is not often achieved (Edmunds, 2000; Ruxton *et al.*, 2004; Wilson et al., 2013; Quicke, 2017). Predators are less likely to attack imperfect mimics when the models are particularly unpalatable and are more likely to learn to avoid imperfect mimics when the models are far more abundant than the mimics (Ruxton et al., 2004). Moreover, the visual acuity of avian and other predators differs from humans (Cuthill & Bennett, 1993; Su et al., 2015). Thus, differences between mimics and models obvious to humans might not be apparent to the butterflies' predators, particularly if they only use a subset of possible visual cues to associate with their learned aversion. Motion blur of the wings in flight may increase resemblance of the model species (Srygley, 1999). The abundance of *E. agondas* that we observed on Aru and their wide distribution across most of New Guinea and surrounding islands suggests that imperfectly mimicking a toxic model is sufficient for survival of the species in a wide array of environments. While behavioral mimicry (*e.g.*, flight height, wing beat patterns, diel activity, etc.) often accompanies wing pattern mimicry (Srygley, 1999; Elias et al., 2008), we observe that this is rarely the case with *Elymnias* mimics, which tend to fly in short, rapid bursts around their palm (Arecaceae) host plants. This mode of flight might provide potential predators with little opportunity to assess the fidelity of their wing pattern mimicry.

We encountered most of the species from the *Taenaris* mimicry ring previously recorded on Aru: *T. artemis*, *T. catops*, *T. myops*, female *Elymnias agondas*, female *Hypolimnias deois*, female *Papilio aegeus*, and the putative mimics *H. osyris* and *H. haemonia*. *Hyantis hodeva* and female *Mydosama drusillodes* are members of the mimicry ring elsewhere, but are not recorded from Aru. Brooks (1950) recorded an additional *Taenaris* species from the Aru Archipelago based on the extensive collection in The Natural History Museum, London: *T. dimona aruensis* Brooks, 1944. We did not encounter this species, which is a phenotypically variable and could resemble either the dark or light form of female *E. agondas* (Parsons, 1998). We also did not find *Hypocysta calypso aruana* Jordan, 1924, previously recorded from Aru.

Interestingly, none of the four *Taenaris* species recorded from Aru is known to feed on cycads or other host plants that might provide larvae with unpalatable phytochemicals. While there seem to be no larval host plant records for *Taenaris* from Aru, the species found on the archipelago have been recorded feeding on various monocots in Papua New Guinea and Australia. *Taenaris artemis* larvae feed on coconut (*Cocos nucifera*, Arecaceae), and various *Pandanus* spp. (Pandanaceae) including *P. odoratus* (Parsons, 1984; Merrett, 1996). *Taenaris catops* has been recorded from *Phaius tankervilleae* and *Spathoglottis* sp. (both Orchidaceae), *Cordyline fruticosa* (Asparagaceae) (recorded as *Cordyline terminalis* [Liliaceae]) (Parsons, 1984; Merrett, 1996), *Musa acuminata*, *M. balbisiana* (Musaceae), *Caryota rumphiana* and *Areca catechu* (Arecaceae) (D’Abrera, 1978). Larvae of *Taenaris dimona* have been recorded feeding on banana leaves (*Musa* sp., Musaceae) (Parsons, 1998), and *Taenaris myops* has been recorded feeding on oil palm (*Elaeis guineensis*), *Rhopalostylis baueri* (recorded as *Ptychosperma robusta*), *Cocos nucifera* (all Arecaceae), *Curculigo erecta* (Hypoxidaceae), *Tapeinochilos* sp., *Costus* sp. (both Costaceae) (Parsons, 1984; Merrett, 1996), *Musa acuminata*, and *M. balbisiana* (Musaceae) (Szent-Ivany & Barrett, 1956). We observed coconuts and other palms, bananas, spiral gingers (Costaceae), pandans (Pandanaceae), and cycads on Aru, and the cycad-feeding lycaenid *Luthrodes cleotas* was common. *Taenaris catops* has been observed imbibing cycad “juices” (Parsons, 1998), and this habit is presumably how the *Taenaris* species on Aru obtain noxious chemicals to warrant their aposematic coloration. It is also possible that these presumably aposematic butterflies obtain defensive compounds from endophytes infecting their otherwise chemically benign host plants. In Europe, the satyrine *Melanargia galathea* is defended by loline, a pyrrolizidine alkaloid derived from fungal endophytes infecting its grass (Poaceae) host plant (Rothschild, 2001; Rasooly et al., 2017).

With the possible exception of *P. aegaeus*, none of the Batesian mimics feeds on host plants that might impart chemical defense. *Elymnias agondas* larvae feed on palms (Arecaceae) including oil palm (*Elaeis guineensis*), rattan (*Calamus* spp.), and coconut (*Cocos nucifera*). In the wild, immature stages have been found on *Brassiophoenix schumanii*, *Caryota rumphiana*, *Calamus caryotoides* and *Ptychosperma* spp. (all Arecaceae). In captivity, banana species *Musa acuminata* and *M. balbisiana* (Musaceae) supported larval development until adulthood (Wood, 1984; Merrett, 1993). *Hypolimnas deois* larvae feed on *Elatostema* sp. (Urticaceae), and *Papilio aegaeus* larvae have been recorded eating tender foliage of *Micromelum minutum*, *Geijera salicifolia*, *Zanthoxylum megistophyllum*, and *Clymenia polyandra* (all Rutaceae) (Parsons, 1998).

Batesian mimics are frequently variable throughout their range, and this example of distinct co-occurring forms within a single species is not the first example from the genus *Elymnias*. Wei et al. (2017) synonymized *Elymnias kamara* into *E. casiphone* because multiple specimens sampled throughout the range of each “species” demonstrated that they

are a single species, as evidenced by strongly supported polyphyly at every locus in a six-locus molecular phylogeny. Both of the formerly separate species are sexually dimorphic, suggesting that a supergene underlies mimicry of sexually dimorphic male and female *Euploea mulciber* by males and females of the *casiphone* form (Aoki et al., 1982), and mimicry of male and female *Euploea modesta* (Butler, 1871) by respective sexes of the *kamara* form.

It seems likely that the unpalatable *Taenaris* on Aru and their palatable *Elymnias* mimics all feed on Arecaeae as larvae; a family that presumably lacks defensive compounds. Further study of the natural history and chemical ecology of these taxa, including the possible role of endophytes in their hostplants, will no doubt be interesting.

### ACKNOWLEDGMENTS

Fieldwork in Aru was conducted under an MoU between the City College of New York and the Research Center for Biology–LIPI with permits from RISTEKDIKTI (149/E5/E5.4/SIP/2019) and other pertinent authorities. This research was funded by grant WW-227R-17 from the National Geographic Society Committee for Exploration and Research and by NSF DEB-1541557. We thank Jade Astor T. Badon and Shen-Horn Yen and for their comments on an earlier version of this paper, and Richard I. Vane-Wright, and Chris Müller for their signed reviews of the manuscript.

### REFERENCES

- Ackery, P.R. & Vane-Wright, R.I. 1984. *Milkweed Butterflies*. London: British Museum (Natural History): 425 + iv pp.
- Aoki, T., Yamaguchi, S. & Uemura, Y. 1982. *Butterflies of the South East Asian Islands, Vol. III: Satyridae, Amathusiidae & Libytheidae*. Tokyo: Plapac Co. Ltd.: 498 pp.
- Blest, A.D. 1957a. The evolution of protective displays in the Saturnioidea and Sphingidae (Lepidoptera). *Behaviour*, 11: 257–309. <https://doi.org/10.1163/156853957X00146>
- Blest, A.D. 1957b. The function of eyespot patterns in the Lepidoptera. *Behaviour*, 11: 209–256. <https://doi.org/10.1163/156853956X00048>
- Brooks, C.J. 1950. A revision of the genus *Tenaris* [sic] Hübner (Lepidoptera: Amathusiidae). *Transactions of the Royal Entomological Society of London*, 101: 179–238. <https://doi.org/10.1111/j.1365-2311.1950.tb00451.x>
- Brower, A.V.Z. 2009. Tree of Life Web Project: *Taenaris* Hübner 1819. Available at: <http://tolweb.org/Taenaris/> Last accessed 10 December 2019.
- Butler, A.G. 1871. A monograph of the Lepidoptera hitherto included in the genus *Elymnias*. *Proceedings of the Zoological Society of London*, 1871: 518–525. <https://www.biodiversitylibrary.org/item/90542>
- Chazot, N., Wahlberg, N., Freitas, A.L.V., Mitter, C., Labandeira, C., Sohn, J.-C., Sahoo, R.K., Seraphim, N., de Jong, R. & Heikkilä, M. 2019. Priors and posteriors in Bayesian timing of divergence analyses: The age of butterflies revisited. *Systematic Biology*, 68: 797–813. <https://doi.org/10.1093/sysbio/syz002>

- Corbet, A.S. 1943. The biogeographic division of the Indo-Australian Archipelago. 4. Considerations based on the rhopalocerous fauna. *Proceedings Linnean Society London*, 154: 143–148. <https://doi.org/10.1111/j.1095-8312.1943.tb00312.x>
- Cuthill, I.C. & Bennett, A.T. 1993. Mimicry and the eye of the beholder. *Proceedings of the Royal Society of London. Series B: Biological Sciences*, 253: 203–204. <https://doi.org/10.1098/rspb.1993.0103>
- D’Abrera, B.L. 1978. *Butterflies of the Australian Region, 2nd Edition*. Sydney: Lansdowne: 415 pp.
- Edmunds, M. 2000. Why are there good and poor mimics? *Biological Journal of the Linnean Society*, 70: 459–466. <https://doi.org/10.1006/bjrl.1999.0425>
- Ehrlich, P.R. 1958. The comparative morphology, phylogeny and higher classification of the butterflies (Lepidoptera: Papilionoidea). *University of Kansas Science Bulletin*, 39: 305–370. <https://doi.org/http://hdl.handle.net/1808/7853>
- Elias, M., Gompert, Z., Jiggins, C. & Willmott, K. 2008. Mutualistic interactions drive ecological niche convergence in a diverse butterfly community. *PLoS Biology*, 6: e300. <https://doi.org/10.1371/journal.pbio.0060300>
- Ho, S., Schachat, S.R., Piel, W.H. & Monteiro, A. 2016. Attack risk for butterflies changes with eyespot number and size. *Royal Society Open Science*, 3: 150614. <https://doi.org/10.1098/rsos.150614>
- ICZN 2000. *International Code of Zoological Nomenclature*. <https://www.iczn.org/the-code/the-international-code-of-zoological-nomenclature/the-code-online/>: The International Trust for Zoological Nomenclature 16 February 2020.
- Jiggins, C.D. 2017. *The Ecology and Evolution of Heliconius Butterflies*. Oxford, UK: Oxford University Press: 288 pp.
- Joron, M., Frezal, L., Jones, R.T., Chamberlain, N.L., Lee, S.F., Haag, C.R., Whibley, A., Becuwe, M., Baxter, S.W., Ferguson, L., Wilkinson, P.A., Salazar, C., Davidson, C., Clark, R., Quail, M.A., Beasley, H., Glithero, R., Lloyd, C., Sims, S., Jones, M.C., Rogers, J., Jiggins, C.D. & French-Constant, R.H. 2011. Chromosomal rearrangements maintain a polymorphic supergene controlling butterfly mimicry. *Nature*, 477: 203–206. <https://doi.org/10.1038/nature10341>
- Joshi, J., Prakash, A., Kunte, K., Nuismer, S.L. & Bronstein, J.L. 2017. Evolutionary assembly of communities in butterfly mimicry rings. *The American Naturalist*, 189: E58–E76. <https://doi.org/10.1086/690907>
- Kazemi, B., Gamberale-Stille, G., Tullberg, Birgitta S. & Leimar, O. 2014. Stimulus salience as an explanation for imperfect mimicry. *Current Biology*, 24: 965–969. <https://doi.org/10.1016/j.cub.2014.02.061>
- Kunte, K. 2009. Female-limited mimetic polymorphism: A review of theories and a critique of sexual selection as balancing selection. *Animal Behaviour*, 78: 1029–1036. <https://doi.org/10.1016/j.anbehav.2009.08.013>
- Kunte, K., Zhang, W., Tenger-Trolander, A., Palmer, D.H., Martin, A., Reed, R.D., Mullen, S.P. & Kronforst, M.R. 2014. *doublesex* is a mimicry supergene. *Nature*, 507: 229–232. <https://doi.org/10.1038/nature13112>
- Mallet, J. & Joron, M. 1999. Evolution of diversity in warning color and mimicry: Polymorphisms, shifting balance, and speciation. *Annual Review of Ecology and Systematics*, 30: 201–233. <https://doi.org/10.1146/annurev.ecolsys.30.1.201>
- Merrett, P.J. 1993. Life history of *Elymnias agondas glaucopis* (Nymphalidae: Satyrinae), a pest of oil palm in Papua New Guinea. *Journal of the Lepidopterists' Society*, 47: 229–235.
- Merrett, P.J. 1996. Life histories of three *Taenaris* species (Nymphalidae: Amathusiinae) in Papua New Guinea. *Journal of the Lepidopterists' Society*, 50: 261–268.
- Monastyrskii, A.L. 2011. *Butterflies of Vietnam, Volume 3: Nymphalidae: Danainae; Amathusiinae*. Hanoi: Thien Ngan Galaxy Co., Ltd.

- Osorio, D., Jones, C.D. & Vorobyev, M. 1999. Accurate memory for colour but not pattern contrast in chicks. *Current Biology*, 9: 199–202. [https://doi.org/10.1016/S0960-9822\(99\)80089-X](https://doi.org/10.1016/S0960-9822(99)80089-X)
- Panettieri, S., Gjinaj, E., John, G. & Lohman, D.J. 2018. Different ommochrome pigment mixtures enable sexually dimorphic Batesian mimicry in disjunct populations of the common palmfly butterfly, *Elymnias hypermnestra*. *PLOS ONE*, 13: e0202465. <https://doi.org/10.1371/journal.pone.0202465>
- Parsons, M. 1984. Life histories of *Taenaris* (Nymphalidae) from Papua New Guinea. *Journal of The Lepidopterists' Society*, 38: 69–84.
- Parsons, M. 1998. *The Butterflies of Papua New Guinea*. San Diego: Academic Press: 736 pp. + 136 pls.
- Punnett, R.C. 1911. "Mimicry" in Ceylon butterflies, with a suggestion as to the nature of polymorphism. *Spoila Zeylanica*, 7: 1–24 + 22 pl.
- Punnett, R.C. 1915. *Mimicry in Butterflies*. Cambridge: Cambridge University Press: 188 pp.
- Quicke, D.L.J. 2017. *Mimicry, Crypsis, Masquerade and Other Adaptive Resemblances*. Oxford: Wiley Blackwell: xvii + 557 pp.
- Rasooly, R., Rothschild, M., Gov, Y., Wolferstan, P., Nash, R., Do, P. & Balaban, N. 2017. Butterflies extracts show antibacterial activity. *Advances in Microbiology*, 7: 467–479. <https://doi.org/10.4236/aim.2017.76036>.
- Ries, L. & Mullen, S.P. 2008. A rare model limits the distribution of its more common mimic: A twist on frequency-dependent Batesian mimicry. *Evolution*, 62: 1798–1803. <https://doi.org/10.1111/j.1558-5646.2008.00401.x>
- Rothschild, M. 2001. The Marbled White (*Melanargia galathea*), a toxic butterfly. *Antenna*, 25: 176–177.
- Ruxton, G.D., Sherratt, T.N. & Speed, M.P. 2004. *Avoiding Attack: The Evolutionary Ecology of Crypsis, Warning Signals, and Mimicry*. New York: Oxford University Press: 249 pp.
- Scott, J.A. 1984 (1985). The phylogeny of butterflies (Papilionoidea and Hesperioidea). *Journal of Research on the Lepidoptera*, 23: 241–281. <https://www.biodiversitylibrary.org/item/224814>
- Shirai, L.T., Saenko, S.V., Keller, R.A., Jeronimo, M.A., Brakefield, P.M., Descimon, H., Wahlberg, N. & Beldade, P. 2012. Evolutionary history of the recruitment of conserved developmental genes in association to the formation and diversification of a novel trait. *BMC Evolutionary Biology*, 12: 21. <https://doi.org/10.1186/1471-2148-12-21>
- Srygley, R.B. 1999. Incorporating motion into investigations of mimicry. *Evolutionary Ecology*, 13: 691–708. <https://doi.org/10.1023/A:1011046202928>
- Su, S., Lim, M. & Kunte, K. 2015. Prey from the eyes of predators: Color discriminability of aposematic and mimetic butterflies from an avian visual perspective. *Evolution*, 69: 2985–2994. <https://doi.org/10.1111/evo.12800>
- Szent-Ivany, J.J.H. & Barrett, J.H. 1956. Some insect pests of banana in the territory of Papua and New Guinea. *Papua New Guinea Agricultural Journal*, 11: 1–5.
- Takahashi, Y. & Kawata, M. 2013. A comprehensive test for negative frequency-dependent selection. *Population Ecology*, 55: 499–509. <https://doi.org/10.1007/s10144-013-0372-7>
- Thompson, M.J. & Timmermans, M.J.T.N. 2014. Characterising the phenotypic diversity of *Papilio dardanus* wing patterns using an extensive museum collection. *PLoS ONE*, 9: e96815. <https://doi.org/DOI:10.1371/journal.pone.0096815>
- Timmermans, M.J.T.N., Baxter, S.W., Clark, R., Heckel, D.G., Vogel, H., Collins, S., Papanicolaou, A., Fukova, I., Joron, M., Thompson, M.J., Jiggins, C.D., French-Constant, R.H. & Vogler, A.P. 2014. Comparative genomics of the mimicry switch in *Papilio dardanus*. *Proceedings of the Royal Society B: Biological Sciences*, 281: 20140465. <https://doi.org/10.1098/rspb.2014.0465>

- Vane-Wright, R.I. 1971. The systematics of *Drusillopsis* Oberthür (Satyrinae) and the supposed Amathusiid *Bigaena* van Eecke (Lepidoptera: Nymphalidae), with some observations on Batesian mimicry. *Transactions of the Royal Entomological Society of London*, 123: 97–123. <https://doi.org/10.1111/j.1365-2311.1971.tb00841.x>
- Vane-Wright, R.I. 1975. An integrated classification for polymorphism and sexual dimorphism in butterflies. *Journal of Zoology*, 177: 329–337. <https://doi.org/10.1111/j.1469-7998.1975.tb02236.x>
- Vane-Wright, R.I. 1976. A unified classification of mimetic resemblances. *Biological Journal of the Linnean Society*, 8: 25–56. <https://doi.org/10.1111/j.1095-8312.1976.tb00240.x>
- Voris, H.K. 2000. Maps of Pleistocene sea levels in Southeast Asia: Shorelines, river systems and time durations. *Journal of Biogeography*, 27: 1153–1167. <https://doi.org/10.1046/j.1365-2699.2000.00489.x>
- Wahlberg, N., Leneveu, J., Kodandaramaiah, U., Peña, C., Nylin, S., Freitas, A.V.L. & Brower, A.V.Z. 2009. Nymphalid butterflies diversify following near demise at the Cretaceous/Tertiary boundary. *Proceedings of the Royal Society B: Biological Sciences*, 276: 4295–4302. <https://doi.org/10.1098/rspb.2009.1303>
- Wei, C.-H., Lohman, D.J., Peggie, D. & Yen, S.-H. 2017. An illustrated checklist of the genus *Elymnias* Hübner, 1818 (Nymphalidae, Satyrinae). *ZooKeys*, 676: 47–152. <https://doi.org/10.3897/zookeys.676.12579>
- Wilson, J.S., Jahner, J.P., Williams, K.A. & Forister, M.L. 2013. Ecological and evolutionary processes drive the origin and maintenance of imperfect mimicry. *PLOS ONE*, 8: e61610. <https://doi.org/10.1371/journal.pone.0061610>
- Wood, G.A. 1984. The life history of *Elymnias agondas australiana* Fruhstorfer (Lepidoptera: Nymphalidae). *Australian Entomological Magazine*, 11: 41–42.

## INSTRUCTIONS FOR AUTHORS

TREUBIA is a peer-reviewed, scientific zoological journal with focus on biosystematic aspects of terrestrial and aquatic fauna in the Indo-Australian region. TREUBIA is published twice a year and accepts manuscripts within the scope of the journal. It is accessible online at <http://e-journal.biologi.lipi.go.id/index.php/treubia>.

The missions of TREUBIA are to: (1) promote sciences and disseminate information in animal systematics and on the biodiversity of the region; (2) participate in the effort of educating public through good quality of scientific media and available professional researchers; (3) establish linkages among zoologists particularly in the field of systematics.

TREUBIA accepts manuscripts based on original research, taxonomic review or short communication. The manuscript should not be offered for prior or simultaneous publication elsewhere. It must be written in English and should use the American English spelling. Manuscripts should be prepared in Microsoft Word, using Times New Roman font 12, A4 paper size. Template is available through e-journal. An electronic file of the manuscript along with a formal cover letter – indicating the importance, stating its originality and its approval by all co-authors – should be submitted to the editors of TREUBIA through <http://e-journal.biologi.lipi.go.id/index.php/treubia> or through email address: [treubia@gmail.com](mailto:treubia@gmail.com).

Concise writing is recommended. All numbers under 10 and any number forming the first word of a sentence must be spelled out, except in the Materials and Methods section of taxonomic papers. Year should be completely written. Names of genera and species should be in italic type. It is recommended to use metric measurements in abbreviation (for examples: kg, cm, ml). Please consult and refer to a recent issue of TREUBIA for an acceptable format. Please note that starting in 2018, we adopt Mendeley reference management application, with Harvard referencing style.

Manuscripts should be presented in the following order (with Conclusions and Appendices if necessary):

**Title section.** This includes the title of the paper (all capitalized), author's full name, author's institution and address (all with first letters capitalized), and e-mail address of the corresponding author. The title should be short, informative and without abbreviation.

**Abstract.** Except for short communications, articles should be accompanied by an abstract. The abstract consists of no more than 250 words in one paragraph which should clearly state the essence of the paper, with no references cited.

**Keywords.** Following the abstract, list up to 5 keywords, all typed in lowercase except a proper noun, separated by commas, presented in alphabetical order.

**Introduction.** The introduction must briefly justify the research and give the objectives. References related to the justification of the research should be cited in the introduction but extensive and elaborate discussion of relevant literature should be addressed in the Discussion section. References are to be cited in the text by the author's surname and year of publication. When citing multiple sources, place them in chronological order, for example: (Glaubrecht, 1999, 2006; Glaubrecht et al., 2009; Maaß & Glaubrecht, 2012). For two authors, both names should be cited. For three authors or more, only the first author is given followed by et al.



**Materials and Methods.** Provide a clear explanation of materials and methods used in the research. The place of specimen depository should be mentioned here.

**Results.** The results can be presented in the form of tables and figures when appropriate. The text should explain and elaborate the data presented. Captions of tables, figures, and plates should be inserted where you want them to be inserted. All line drawings, photographs and other figures should be submitted separately in JPEG format and the image size should be at least 1024 by 768 pixels.

**Discussion.** The discussion should interpret the results clearly and concisely, and should discuss the findings in relation with previous publications.

**Acknowledgments.** Acknowledgments of grants, assistance and other matters can be written in one paragraph.

**References.** List of references should be in alphabetical order by the first or sole author's surname. Journal references should include author's surname and initials, year of publication, title of the paper, full title of the journal (typed in *italic*), volume number and inclusive page numbers. Book references should include author's surname and initials, year of publication, title of the book (typed in *italic*) or/and title of the chapter and editor (if part of a book), publisher, city of publication, and page numbers.

For example:

Eaton, J.A., van Balen, B., Brickle, N.W. & Rheindt, F.E. 2016. *Birds of the Indonesian Archipelago: Greater Sundas and Wallacea*. 1st ed. Barcelona: Lynx Edicions.

LaSalle, J. & Schauff, M.E. 1994. Systematics of the tribe Euderomphalini (Hymenoptera: Eulophidae): parasitoids of whiteflies (Homoptera: Aleyrodidae). *Systematic Entomology*, 19: 235–258.

MacKinnon, J. & Phillips, K. 1993. *Field Guide to the Birds of Borneo, Sumatra, Java and Bali*. Oxford: Oxford University Press: 491 pp.

Natural History Museum 2013. Wallace100 - celebrating Alfred Russel Wallace's life and legacy. <http://www.nhm.ac.uk/nature-online/science-of-natural-history/wallace/index.html> 11 October 2013.

Higgins, P., Christidis, L., Ford, H. & Bonan, A. 2017. Honeyeaters (Meliphagidae). In: J. del Hoyo, A. Elliott, J. Sargatal, D.A. Christie & E. de Juana, eds. *Handbook of the Birds of the World Alive*. Barcelona: Lynx Edicions. <http://www.hbw.com>.

Upon receiving a manuscript, a Treubia editor will check the compliance with these instructions and will send the manuscript to two reviewers. Based on comments from the reviewers and the suitability of the manuscript, Treubia editors will decide the acceptance or rejection of the manuscript. The author will be notified of the decision and will receive the manuscript with reviewers' comments.

Following the process of reviewing and revising, a final proof will be sent to the first or sole author for correction and approval. Starting 2020, we will publish online only, without printed edition.



VOL. 47, NO. 1, JUNE 2020

CONTENT

<b>David J. Lohman, Sarino, and Djunijanti Peggie</b> Syntopic <i>Elymnias agondas aruana</i> female forms mimic different <i>Taenaris</i> model species (Papilionoidea: Nymphalidae: Satyrinae) on Aru, Indonesia .....	<b>1–12</b>
<b>Tri Haryoko, Oscar Johnson, Matthew L. Brady, Subir B. Shakya, M. Irham, Yohanna, Rusdian P. Ritonga, Dewi M. Prawiradilaga, and Frederick H. Sheldon</b> Recent ornithological expeditions to Siberut Island, Mt. Talamau and Rimbo Panti Nature Reserve, Sumatra, Indonesia .....	<b>13–38</b>
<b>Elize Y. X. Ng, Arya Y. Yue, James A. Eaton, Chyi Yin Gwee, Bas van Balen, and Frank E. Rheindt</b> Integrative taxonomy reveals cryptic robin lineage in the Greater Sunda Islands .....	<b>39–52</b>
<b>Arif Maulana, Tri Atmowidi, and Sih Kahono</b> A contribution to the taxonomy and ecology of little-known Indonesian <i>Afissa</i> ladybird beetles (Coccinellidae, Epilachnini) .....	<b>53–62</b>
<b>Ainun Rubi Faradilla, Mariza Uthami, Bella Andini, and Hening Triandika Rachman</b> The life history and microhabitat ecology of a phytotelm-breeding damselfly <i>Pericnemis stictica</i> in Jatimulyo forest, Yogyakarta .....	<b>63–75</b>