ISSN : 0082 - 6340
E-ISSN : 2337 - 876X
Accredited : No. 523/AU2/P2MI-LIPI/04/2013

LIPI

TREUBIA

A JOURNAL ON ZOOLOGY
OF THE INDO-AUSTRALIAN ARCHIPELAGO

Vol. 41, pp. 1–90 **December 2014**

MUSEUM ZOOLOGICUM BOGORIENSE
IN SOLITUDINE FORS
1894

Published by

RESEARCH CENTER FOR BIOLOGY
INDONESIAN INSTITUTE OF SCIENCES
BOGOR, INDONESIA

ISSN : 0082 - 6340
E-ISSN : 2337 - 876X
Accredited : No. 523/AU2/P2MI-LIPI/04/2013

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Subscription and Exchange

TREUBIA
RESEARCH CENTER FOR BIOLOGY - INDONESIAN INSTITUTE OF SCIENCES (LIPI)
Jl. Raya Jakarta-Bogor Km 46, Cibinong-Bogor 16911, Indonesia
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VOL. 41, DECEMBER 2014

CONTENT

TREUBIA

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

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

Date of issue: DECEMBER 2014

UDC: 597.82(594)

Nia Kurniawan

Genetic divergence and geographic distribution of frogs in genus *Fejervarya* from Indonesia inferred from mitochondrial 16S rRNA gene analysis

TREUBIA, December 2014, Vol. 41, pp. 1–16.

The Indonesian archipelago is an ideal setting for the study of speciation and biogeography. This archipelago is divided into three island groups based on zoogeography: Sundaland, Wallacea and the Australian region. In this paper we used frogs in genus *Fejervarya* (Bolkay) to study biogeography and examine patterns of gene flow across proposed zoogeographic boundaries. Several molecular studies on *Fejervarya* species from Indonesia have been carried out, but comparative studies among members of the genus *Fejervarya* have yet to be performed. In order to elucidate genetic divergence and geographic distribution of these frogs, we conducted a molecular analysis of the mitochondrial 16S rRNA gene using 179 frogs from five *Fejervarya* species. In total we collected from 32 localities in Sumatra, Kalimantan (Indonesian part of Borneo), Java, Bali, Sulawesi and Lesser Sunda Islands in Indonesia. Molecular phylogenetic analysis recovered 35 haplotypes and showed that frogs in the genus *Fejervarya* were divided into two well-supported clades. The first group were of three species, *F. limnocharis*, *F. iskandari* and *F.* cf. *verruculosa* and the other group clade consisted of *Fejervarya cancrivora* and *Fejervarya* sp. (Sulawesi-type). The average sequence divergence among these four species ranged from 1.09 to 16.03% (mean = 11.29± 2.83%). The present results clearly show that there are five *Fejervarya* species in the Indonesian archipelago. *Fejervarya limnocharis* and *F. cancrivora* are widely distributed and sympatric in Sumatra, Borneo and Java. *Fejervarya iskandari* is not endemic to Java and also occurs in the Lesser Sundas. *Fejervarya* cf. *verruculosa* and *Fejervarya* sp. (Sulawesi-type) are endemic to Lesser Sunda and Sulawesi Island, respectively.

(Nia Kurniawan, Tjong Hon Djong, Tesri Maideliza, Amir Hamidy, Mahmudul Hasan, Takeshi Igawa and Masayuki Sumida)

Key words: *Fejervarya*, genetic divergence, geographic distribution, 16S rRNA gene

UDC: 595.78(594.53)

Djunijanti Peggie

Butterflies of Gunung Halimun-Salak National Park, Java, Indonesia, with an overview of the area importance

TREUBIA, December 2014, Vol. 41, pp. 17–30.

Data on the occurrence of butterfly species at Gunung Halimun-Salak National Park is presented based on collections and observations obtained in 2004, 2007, 2009 and 2010. In total, 161 butterfly species (10 Hesperiidae, 23 Lycaenidae, 86 Nymphalidae, 17 Papilionidae, 21 Pieridae, and 4 Riodinidae) were recorded. Of the total number of species, 133 were recorded from Gunung Halimun and 82 were recorded from Gunung Salak. The occurrence of butterflies at this national park was compared with data known from other localities in Java. The significance of Gunung Halimun-Salak NP in terms of the butterfly diversity is discussed.

(Djunijanti Peggie and Harmonis)

Key words: butterflies, endemic species, Gunung Halimun-Salak National Park, Java, occurrence

UDC: 595.34

Mulyadi

Taxonomic problems on four species of *Pontella* (Copepoda, Calanoida) described by A. Scott (1909) in Indo-Malayan waters

TREUBIA, December 2014, Vol. 41, pp. 31–50.

Four species of *Pontella,* i.e., *P. alata, P. cerami, P. denticauda*, and *P. forficula*, which were originally described by A. Scott (1909) were found from Indo-Malayan waters. Some misidentifications resulting in wrong species identity were discovered on *P. cerami* and *P. forficula. Pontella cerami* A. Scott, 1909, described based on two male

specimens from the Banda Sea, Indonesia is here recognised as the male of *P. alata.* Similarly, *P. forficula,* also known from two male specimens from the Sulu Sea, Philippine must be reassigned as the male of *Ivellopsis elephas* (Brady, 1883). Another Indo-Malayan *Pontella*, *i.e.*, *P. denticauda* A. Scott, 1909 must also be moved to the genus *Ivellopsis* Claus 1893, as *Ivellopsis denticauda* (A. Scott, 1909) by its having posterior corners of Pdg5 produced into rounded lobes in both sexes; particularly in the female, by (1) the genital double -somite with a large lateral process, (2) the CR asymmetrical with the right ramus longer than the left, and (3) the Re of P5 with 3 apical spines and with an acuminate Ri. The male has, (1) the CR asymmetrical with right ramus slightly longer than the left, and (2) the thumb of Re2 of right P5 is elongated, and (3) the Re2 of the left P5 bifurcate at apex.

Descriptions, measurements and figures of the four species are given, along with a review of their distribution and that of their species groups over Indo-West Pacific waters, together with taxonomic remarks and synonymies in each case.

(Mulyadi)

Key words: Copepoda, Indo-Malayan, *Pontella*, small islands, taxonomy

UDC: 599.323.4(594.2)

Anang Setiawan Achmadi

New records of two rarely encountered, endemic rats (Rodentia: Muridae: Murinae) from Gunung Gandangdewata, West Sulawesi Province

TREUBIA, December 2014, Vol. 41, pp. 51–60.

We collected specimens of Sommer's Sulawesi shrew-rat, *Sommeromys macrorhinos*, at three sites (1600, 2200, and 2600 m) and the Sulawesi small-bodied shrew-rat, *Crunomys celebensis*, at one site (1600 m) on Gunung Gandangdewata in the western block of the central core of Sulawesi during November 2011 and May 2012. Prior to 2011, *S. macrorhinos* was known only from the holotype, which was taken on 2 August 1973 at 2400 m near the summit of Gunung Tokala (upper montane forest). Previously, *C. celebensis* was known only from tropical lowland evergreen rain forest in the Danau Lindu valley and nearby upper drainage of the Sungai Miu in the northern portion of the west-central mountain block in Sulawesi's central core. The new specimens of *S. macrorhinos* and *C. celebensis* extend their known range of habitats to include the transition between lowland and montane forest. Because the original description of *S. macrorhinos* was based on a single specimen, we describe some external morphological features and provide measurements of new specimens as a supplement to the original description.

(Anang Setiawan Achmadi, Kevin C. Rowe and Jacob A. Esselstyn)

Key words: *Crunomys celebensis,* morphology, shrew-rat, *Sommeromys macrorhinos*

UDC: 598.2(594.25)

Frank E. Rheindt

New and significant island records, range extensions and elevational extensions of birds in eastern Sulawesi, its nearby satellites, and Ternate

TREUBIA, December 2014, Vol. 41, pp. 61-90.

The Wallacean Region continues to be widely unexplored even in such relatively well-known animal groups as birds (Aves). We report the results of an ornithological expedition from late Nov 2013 through early Jan 2014 to eastern Sulawesi and a number of satellite islands (Togian, Peleng, Taliabu) as well as Ternate, providing details on numerous first records of bird species outside their previously known geographic or elevational ranges observed or otherwise recorded during this expedition. We also document what appears to be a genuinely new taxon, possibly at the species level, of kingfisher from Sulawesi that has been overlooked by previous ornithologists. Our results underscore our fragmentary knowledge of the composition of the avifauna of eastern Indonesia, and demonstrate that there continues to be a high degree of cryptic, undescribed avian diversity on these islands.

(Frank E. Rheindt, Dewi M. Prawiradilaga, Suparno, Hidayat Ashari and Peter R. Wilton)

Key words: birds of eastern Sulawesi, elevational extensions, new island records, range extensions

BUTTERFLIES OF GUNUNG HALIMUN-SALAK NATIONAL PARK, JAVA, INDONESIA, WITH AN OVERVIEW OF THE AREA IMPORTANCE

Djunijanti Peggie*[1] and Harmonis[2]

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Received: 30 October 2013; Accepted: 14 May 2014

ABSTRACT

Data on the occurrence of butterfly species at Gunung Halimun-Salak National Park is presented based on collections and observations obtained in 2004, 2007, 2009 and 2010. In total, 161 butterfly species (10 Hesperiidae, 23 Lycaenidae, 86 Nymphalidae, 17 Papilionidae, 21 Pieridae, and 4 Riodinidae) were recorded. Of the total number of species, 133 were recorded from Gunung Halimun and 82 were recorded from Gunung Salak. The occurrence of butterflies at this national park was compared with data known from other localities in Java. The significance of Gunung Halimun-Salak NP in terms of the butterfly diversity is discussed.

Key words: butterflies, endemic species, Gunung Halimun-Salak National Park, Java, occurrence

INTRODUCTION

Gunung Halimun-Salak National Park is one of twelve national parks in Java (wikipedia 2013a). The national park preserves several ecosystem types, including lowland rain forest, sub-montane forest and montane forest (Dephut 2013), and is considered the largest remaining sub-montane forest area in Java (Whitten 1994). The national park is located in three administrative districts: Bogor, Sukabumi and Lebak. It covers 113,357 ha of land, making it the second largest national park in Java, after Ujung Kulon NP which has approximately 120,600 ha of land. Initially in 1992, Gunung Halimun was a national park with 40,000 ha of land located at 6°37'–6°51' S and 106°21'–106°38' E (Kahono & Amir 2003). Gunung Salak was a nature reserve located at Bogor and Sukabumi districts with elevation ranges from 400–2,200 m asl. and the geoposition of the highest peak is located at 6°43' S and 106°44' E (wikipedia 2013b). In 2003, Gunung Salak was incorporated into the Gunung Halimun NP and the combined area became known as Gunung Halimun-Salak NP – the two are currently connected by a forest corridor of about 11 km long. The national park is of great importance because of its hydrological function for many surrounding towns and cities, and other ecosystem services yet to be fully realised.

Despite its close vicinity to Jakarta and Bogor, our knowledge of Gunung Halimun-Salak NP is still rather limited and fragmentary. The area is relatively difficult to access. The trip to reach Cikaniki, the research station at Gunung Halimun, can take about four hours by car from the park entrance Kabandungan with some difficulties due to poor road conditions. Similarly, the steep and often confusing climb to Gunung Salak also added to difficulties to reach the forest area. This relative inaccessibility partly explains the paucity of information on the biodiversity of the area.

The need to obtain data on biodiversity of Gunung Halimun-Salak NP for conservation management has led to a major initiative. A comprehensive study of the flora and fauna of Gunung Halimun was conducted through JICA programs for the Biodiversity Conservation Project (Phase I from 1995 to 1998, and Phase II from 1998 to 2003), as well as for the construction of facilities for biodiversity conservation in 1997 (see Yoneda *et al*. 2001).

An initial survey at Cikaniki area and Gunung Botol of Gunung Halimun NP by Ubaidillah *et al*. (1998) reported 77 species of butterflies. As a part of a publication on the insects of Gunung Halimun, Amir *et al*. (2003) reported 41 species of butterflies, and mentioned that there were probably more than 100 species. Sola *et al*. (2005) mentioned 20 common butterfly species found at Gunung Halimun. There is no previously published report on the butterflies of Gunung Salak. Surveys were therefore conducted to gain a better understanding of the butterfly fauna of Gunung Halimun-Salak NP.

MATERIALS AND METHODS

We conducted field surveys of butterflies at Gunung Halimun-Salak NP (Fig. 1) between July 2004 and June 2010 with standard method of scan sampling. Sampling periods at localities of Gunung Halimun and Gunung Salak were comparable: two persons for a total of 30 days each were allocated. Fieldwork at Gunung Halimun was conducted at Cikaniki area in July 2004 with support from Indonesian government project DIPA, and in August 2004 through collaboration with German-IPB student excursion program. A survey to cover Pameungpeuk area, which is located southwest of Kabandungan, was conducted in July 2007 with support from Indonesian government project DIPA. In June–July 2009 and June 2010, we conducted field surveys at several locations at Gunung Salak with support through Indonesian Ristek PKPP program: the 2009 Gunung Salak location included Cidahu to Kawah Ratu area, and the 2010 Gunung Salak location included Sukamantri, Curug Nangka

and Gunung Bunder. These locations were selected primarily because they were accessible. Some other routes were available, but were considered too risky to take especially during the wet season of 2010.

Figure 1. Map of Gunung Halimun-Salak National Park (Direktorat PJLKK/HL 2013). Gunung Halimun-Salak is located at three districts: Bogor, Sukabumi and Lebak, the borders are indicated by black bold lines. Prior to 2003, Halimun was a national park by itself (indicated by blue line). With the inclusion of Gunung Salak in 2003, the area of NP was extended considerably (indicated by light blue area).

Specimens were obtained using insect nets, killed by pressing the thorax, put in a glassine envelope and stored in a sturdy plastic box. Upon returning from the field, the specimens were mounted at the Entomology laboratory of Museum Zoologicum Bogoriense (MZB)-LIPI. Specimens were identified using Morishita (1981), Yata (1981), Aoki *et al*. (1982), Tsukada & Nishiyama (1982), D'Abrera (1985, 1986), Tsukada (1985, 1991), Maruyama (1991), and Seki *et al*. (1991). Additional references such as Ackery & Vane-Wright (1984) and Corbet & Pendlebury (1992) were also consulted. Recent changes in butterfly classification and nomenclature, such as those proposed by Aduse-Poku *et al*. (2009) on the synonymy of *Polyura* with *Charaxes*; Brower (2012) on the higher classification of Nymphalidae; Yata (pers. comm. – October 2013) on the revised status of *Appias leptis* (Felder & Felder, 1865) are followed. All specimens are deposited at MZB-LIPI.

Beta diversity "Sørensen index" was used to analyse the relationship between Halimun and Salak. This index was calculated by using EstimateS 8.2 (Colwell 2009).

RESULTS

In total, 161 butterfly species were recorded at the two localities combined: 133 species at Halimun and 82 species at Salak (Table 1).

Table 1. List of butterfly species at Gunung Halimun-Salak National Park compared to other locations in Java

No.	Species	Halimun	Salak	other locations in Java *
	Hesperiidae (no. 1 – 10)			
1	*Ancistroides nigrita* (Latreille, [1824])	1	0	b, h
2	*Celaenorrhinus inaequalis* Elwes & Edwards, 1897	1	0	was not obtained at other locations
3	*Erionota thrax* (Linnaeus, 1767)	1	0	a, b, e, h, m
4	*Gangara lebadea* (Hewitson, 1868)	1	0	was not obtained at other locations
5	*Isma umbrosa* (Elwes & Edwards, 1897)	1	0	was not obtained at other locations
6	*Notocypta feisthamelii* (Boisduval, 1832)	1	0	f
7	*Parnara guttatus* (Bremer & Grey, [1852])	1	0	a
8	*Pirdana distanti* Staudinger, 1889	1	0	h
9	*Tagiades gana* (Moore, [1866])	1	0	a
10	*Zela onara* (Butler, 1870)	1	0	was not obtained at other locations
	Lycaenidae (no. 11 – 33)			
11	*Arhopala eumolphus* (Cramer, [1780])	1	0	was not obtained at other locations
12	*Arhopala overdijkinki* Corbet, 1941	1	0	was not obtained at other locations
13	*Arhopala paraganesa* (de Nicéville, 1882)	1	0	was not obtained at other locations
14	*Austrozephyrus absolon* (Hewitson, 1865)	1	0	was not obtained at other locations
15	*Dacalana vidura* (Horsfield, [1829])	1	0	was not obtained at other locations
16	*Heliophorus epicles* (Godart, [1824])	1	1	f, i, k
17	*Hypolycaena amasa* Hewitson, 1865	1	1	a, h
18	*Hypolycaena erylus* (Godart, [1824])	0	1	a
19	*Jamides alecto* (Felder, 1860)	0	1	a, b, c, f, j
20	*Jamides caerulea* (Druce, 1873)	1	0	was not obtained at other locations
21	*Jamides celeno* (Cramer, [1775])	1	0	a, b, c, h, j
22	*Jamides pura* (Moore, 1886)	1	0	a, b, c, h
23	*Lampides boeticus* (Linnaeus, 1767)	0	1	a, b, c, f
24	*Miletus boisduvali* Moore, [1858]	1	0	a, b, c, o
25	*Miletus zinckenii* Felder & Felder, [1865]	1	0	was not obtained at other locations
26	*Nacaduba kurava* (Moore, [1858])	0	1	was not obtained at other locations
27	*Poritia erycinoides* (Felder & Felder, 1865)	1	0	was not obtained at other locations

No.	Species	Halimun	Salak	other locations in Java *
28	*Prosotas dubiosa* (Semper, [1879])	1	0	a, b
29	*Prosotas nora* (Felder, 1860)	0	1	a
30	*Prosotas pia* Toxopeus, 1929	1	0	was not obtained at other locations
31	*Surendra vivarna* (Horsfield, [1829])	1	0	a
32	*Udara dilecta* (Moore, 1879)	1	1	f
33	*Yasoda pita* (Horsfield, [1829])	1	1	c
	Nymphalidae - Charaxinae (no. 34 – 35)			
34	*Charaxes* (*Polyura*) *athamas* (Drury, [1773])	1	1	a, f, h, j
35	*Charaxes* (*Polyura*) *moori* Distant, 1883	1	0	h
	Nymphalidae - Cyrestinae (no. 36 – 38)			
36	*Chersonesia rahria* (Moore, [1858])	1	0	a, c, h, q
37	*Cyrestis lutea* (Zinken, 1831)	1	1	c, d, f
38	*Cyrestis nivea* (Zinken, 1831)	1	1	c, f
	Nymphalidae - Danainae (no. 39 – 55)			
39	*Danaus genutia* (Cramer, [1779])	1	1	a, c, f, j
40	*Danaus melanippus* (Cramer,[1777])	1	0	c, g, h, j
41	*Euploea algea* (Godart, [1819])	1	1	a
42	*Euploea climena* (Stoll, [1782])	0	1	b, c, p
43	*Euploea corinna* (MacLeay, [1826])	1	0	was not obtained at other locations
44	*Euploea eunice* (Godart, 1819)	1	1	a, b, c, f, g, h, i, j, k, q, s
45	*Euploea eyndhovii* Felder & Felder, [1865]	1	0	f
46	*Euploea gamelia* (Hübner, [1823])	0	1	f
47	*Euploea mulciber* (Cramer, [1777])	1	1	a, b, c, e, f, g, h, i, j, k, l, m, n, o, p, q, s
48	*Euploea phaenareta* (Schaller, 1785)	0	1	a, c, g, h
49	*Euploea radamanthus* (Fabricius, 1793)	1	1	a, c
50	*Euploea sylvester* (Fabricius, 1793)	1	0	f, h, l
51	*Idea hypermnestra* (Westwood, 1848)	1	0	c
52	*Ideopsis gaura* (Horsfield, [1829])	1	0	h
53	*Ideopsis vulgaris* (Butler, 1874)	1	1	a, c, f, j
54	*Parantica albata* (Zinken, 1831)	1	1	f, j
55	*Parantica pseudomelaneus* (Moore, 1883)	1	1	c
	Nymphalidae - Heliconiinae (no. 56 – 61)			
56	*Acraea issoria* (Hübner, [1819])	0	1	d, e, f, r
57	*Cethosia hypsea* Doubleday, [1847]	1	0	a, c, h
58	*Cirrochroa clagia* (Godart, [1824])	1	0	c, f, h, i
59	*Cirrochroa emalea* (Guérin-Méneville, 1843)	1	0	a, h
60	*Vagrans egista* (Cramer, [1780])	1	0	c, d, f, k
61	*Vindula dejone* (Erichson, 1834)	1	0	a
	Nymphalidae - Limenitidinae (no. 62 – 77)			
62	*Athyma asura* Moore, [1858]	1	0	was not obtained at other locations
63	*Athyma nefte* (Cramer, [1780])	1	0	a, b, c, f, h, j
64	*Athyma perius* (Linnaeus, 1758)	1	0	was not obtained at other

No.	Species	Halimun	Salak	other locations in Java *
				locations
65	*Athyma pravara* Moore, [1858]	1	1	a, c
66	*Athyma reta* Moore, 1858	1	0	was not obtained at other locations
67	*Athyma selenophora* (Kollar, [1844])	1	1	f
68	*Bassarona teuta* (Doubleday, [1848])	1	0	was not obtained at other locations
69	*Dophla evelina* (Stoll, [1790])	1	0	a, b, c
70	*Euthalia agnis* (Vollenhoven, 1862)	1	0	f
71	*Euthalia monina* (Fabricius, 1787)	0	1	b, f, h
72	*Moduza procris* (Cramer, [1777])	1	0	a, b, c, g, h
73	*Neptis clinioides* de Nicéville, 1894	1	0	c, q
74	*Neptis hylas* (Linnaeus, 1758)	1	1	a, b, c, e, f, g, h, j, k, l, m, o, p, q, r, s
75	*Neptis vikasi* Horsfield, [1829]	0	1	a, c, f, h, k, p
76	*Tanaecia trigerta* (Moore, [1858])	1	0	a, c, f, h, p
77	*Tanaecia iapis* (Godart, [1824])	1	1	a, c, f, g, h, i, p, q
	Nymphalidae – Nymphalinae (no. 78 – 87)			
78	*Doleschallia bisaltide* (Cramer, [1777])	1	0	a, b, c, h, i
79	*Hypolimnas bolina* (Linnaeus, 1758)	1	1	a, b, c, f, g, h, j, l, m, o, p, q, r, s
80	*Junonia almana* (Linnaeus, 1758)	1	1	a, b, c, f, g, h, i, j, q
81	*Junonia atlites* (Linnaeus, 1763)	1	1	a, b, c, f, g, h, l, q, r
82	*Junonia iphita* (Cramer, [1779])	0	1	a, b, c, d, f, g, h, j, l, q
83	*Junonia orithya* (Linnaeus, 1758)	1	1	b, c, s
84	*Kaniska canace* (Linnaeus, 1763)	1	1	f
85	*Rhinopalpa polynice* (Cramer, [1779])	0	1	was not obtained at other locations
86	*Symbrenthia hypselis* (Godart, [1824])	1	1	a, c, f, j
87	*Symbrenthia lilaea* (Hewitson, 1864)	1	1	d, e, f, g, i, j, r
	Nymphalidae – Pseudergolinae (no. 88)			
88	*Amnosia decora* Doubleday, [1849]	1	1	c, f, i
	Nymphalidae – Satyrinae (no. 89 – 119)			
89	*Amathusia phidippus* (Linnaeus, 1763)	1	0	a, b, f, g
90	*Discophora celinde* (Stoll, [1790])	1	0	g
91	*Discophora necho* Felder & Felder, [1867]	0	1	f
92	*Elymnias casiphone* Geyer, [1827]	0	1	c, f, h, j
93	*Elymnias ceryx* (Boisduval, 1836)	1	1	f
94	*Elymnias dara* Distant & Pryer, 1887	0	1	was not obtained at other locations
95	*Elymnias hypermnestra* (Linnaeus, 1763)	1	1	a, b, c, f, g, h, l, m, p, q
96	*Elymnias kamara* Moore, [1858]	0	1	c
97	*Elymnias nesaea* (Linnaeus, 1764)	0	1	a, b, f, q
98	*Erites medura* (Horsfield, [1829])	1	0	a, c, p, q
99	*Faunis canens* Hübner, [1826]	1	1	a, b, c, d, f, g, h, i, k
100	*Lethe confusa* Aurivillius, 1897	1	1	a, c, d, f, g, i, j, k
101	*Melanitis leda* (Linnaeus, 1758)	1	1	a, b, c, e, f, h, j, q

No.	Species	Halimun	Salak	other locations in Java *
102	*Melanitis phedima* (Cramer, [1780])	1	1	a, b, c, f, i
103	*Melanitis zitenius* (Herbst, 1796)	0	1	a, b, c, f, h, k, p
104	*Mycalesis horsfieldi* (Moore, [1892])	0	1	a, b, c, f, h, j, k
105	*Mycalesis janardana* Moore, 1857	1	1	a, b, c, f, g, h, i, j, k, l, q
106	*Mycalesis mineus* (Linnaeus, 1758)	0	1	a, b, c, n, s
107	*Mycalesis moorei* Felder & Felder, [1867]	1	1	c, g, i, k
108	*Mycalesis nala* Felder & Felder, 1859	1	0	was not obtained at other locations
109	*Mycalesis sudra* Felder & Felder, [1867]	1	1	c, e, f
110	*Neorina crishna* (Westwood, 1851)	1	0	a, c, f, g
111	*Orsotriaena medus* (Fabricius, 1775)	1	0	a, c, g, h
112	*Ragadia makuta* (Horsfield, [1829])	1	0	c, i
113	*Taenaris horsfieldii* (Swainson, [1820])	1	1	was not obtained at other locations
114	*Thaumantis odana* (Godart, [1824])	1	1	c, h
115	*Ypthima nigricans* Snellen, 1892	1	0	c, d, g
116	*Ypthima pandocus* Moore, [1858]	1	1	c, d, e, f, h, i, j, k, q, r
117	*Ypthima philomela* (Linnaeus, 1763)	1	1	a, b, c, h, j, q
118	*Zeuxidia dohrni* Fruhstorfer, 1893	1	0	was not obtained at other locations
119	*Zeuxidia luxerii* Hübner, [1826]	1	0	c, h
	Papilionidae (no. 120 – 136)			
120	*Atrophaneura nox* (Swainson, 1822)	0	1	a
121	*Graphium agamemnon* (Linnaeus, 1758)	1	0	a, b, c, f, h, j, m, o, r, s
122	*Graphium antiphates* (Cramer, [1775])	1	0	a, h, s
123	*Graphium bathycles* (Zinken, 1831)	1	0	c
124	*Graphium doson* (Felder & Felder, 1864)	0	1	a, b, c, h, m, o, s
125	*Graphium evemon* (Boisduval, 1836)	1	0	was not obtained at other locations
126	*Graphium sarpedon* (Linnaeus, 1758)	1	1	a, b, c, e, f, h, j, m, o, s
127	*Lamproptera meges* (Zinken, 1831)	1	0	was not obtained at other locations
128	*Pachliopta aristolochiae* (Fabricius, 1775)	0	1	a, b, c, f, h, j, k
129	*Papilio demoleus* Linnaeus, 1758	1	0	b, c, f, m, o, s
130	*Papilio demolion* Cramer, [1776]	1	1	a, b, c, i, j, m, o, s
131	*Papilio helenus* Linnaeus, 1758	1	1	a, b, c, f, h, i, k
132	*Papilio karna* Felder & Felder, 1864	1	1	was not obtained at other locations
133	*Papilio memnon* Linnaeus, 1758	1	1	a, b, c, f, h, i, j, k, m, o, r
134	*Papilio paris* Linnaeus, 1758	1	0	c, f, i
135	*Papilio polytes* Linnaeus, 1758	1	0	a, b, c, f, h, j, m, o, s
136	*Troides helena* (Linnaeus, 1758)	1	0	a, c, f, h, o
	Pieridae (no. 137 – 157)			
137	*Appias leptis* (Felder & Felder, 1865)	1	0	a, c, h, i
138	*Appias lucasii* (Wallace, 1867)	1	0	was not obtained at other locations
139	*Appias nero* (Fabricius, 1793)	1	0	a, b, h

No.	Species	Halimun	Salak	other locations in Java *
140	*Appias pandione* (Geyer, [1832])	1	0	was not obtained at other locations
141	*Catopsilia pomona* (Fabricius, 1775)	0	1	a, b, c, f, h, j, m, o
142	*Catopsilia pyranthe* (Linnaeus, 1758)	1	0	a, b, c, h, j
143	*Cepora iudith* (Fabricius, 1787)	1	1	a, b, c, f, h, i, k
144	*Delias belisama* (Cramer, [1780])	1	1	b, c, e, f, i, j, k
145	*Delias crithoe* (Boisduval, [1836])	1	1	f
146	*Delias dorylaea* (Felder & Felder, [1865])	1	0	was not obtained at other locations
147	*Delias hyparete* (Linnaeus, 1758)	0	1	b, c, f, h
148	*Eurema alitha* (Felder & Felder, 1862)	1	0	a, b, c, h, j
149	*Eurema beatrix* (Toxopeus, 1939)	1	0	was not obtained at other locations
150	*Eurema blanda* (Boisduval, 1836)	1	1	a, b, c, f, h, i, j, k
151	*Eurema brigitta* (Stoll, [1780])	1	0	f, j, r
152	*Eurema hecabe* (Linnaeus, 1758)	1	1	a, b, c, e, f, h, i, j, k, m, o, s
153	*Eurema lacteola* (Distant, 1886)	0	1	f
154	*Eurema sari* (Horsfield, [1829])	1	0	a, b, c, h, j, o
155	*Gandaca harina* (Horsfield, [1829])	1	1	a, c, f, h
156	*Leptosia nina* (Fabricius, 1793)	1	1	a, b, c, e, f, h, i, j, m, o, s
157	*Prioneris autothisbe* (Hübner, [1826])	1	1	f
	Riodinidae (no. 158 – 161)			
158	*Abisara kausambi* Felder & Felder, 1860	1	0	a, h
159	*Stiboges nymphidia* Butler, 1876	0	1	was not obtained at other locations
160	*Taxila haquinus* (Fabricius, 1793)	0	1	was not obtained at other locations
161	*Zemeros flegyas* (Cramer, [1780])	1	0	h
		133	82	

0 = absence of species, 1 = presence of species.

* a = Ujung Kulon, b = KRB, c = Bodogol Gede-Pangrango, d = Selabintana Gede-Pangrango, e = Patuha, f = Ciremai, g = Pangandaran, h = Nusa Kambangan, i = Baturraden, j = Wonosobo, k = Turgo Merapi, l = Wonogiri, m = Lawu-Magetan, n = Pacitan, o = Alas Purwo, p = Sempu, q = Meru Betiri, r = Ijen, s = Baluran (see Peggie & Amir 2006, Peggie 2008, 2012, Peggie & Noerdjito 2011) .

The Sørensen index showed that the difference in the species proportion between the two localities was 50%. According to the result of Harmonis (2013), the similarity threshold of butterfly habitats for Sørensen index is 40%, so our finding of 50% indicates that the two localities are similar.

The butterfly species in Halimun-Salak represents 26% of the total number of species known from Java (Table 2). The proportions of the butterfly families in Halimun-Salak were in the ranges of 8–46%, with the families Hesperiidae and Lycaenidae lowest in proportions.

Table 2. Proportional representation of families relative to the total number of species known from Java

Family	Number of species in Halimun-Salak	Number of species in Java*	Proportion of Java (%)
Hesperiidae	10	120	8
Lycaenidae	23	189	12
Nymphalidae	86	217	40
Papilionidae	17	37	46
Pieridae	21	49	43
Riodinidae	4	12	33
Total	**161**	**624**	**26**

***Sources :** Peggie (in prep.), based on compilation of Morishita (1981), Yata (1981), Aoki *et al*. (1982), Tsukada & Nishiyama (1982), D'Abrera (1985, 1986), Tsukada (1985, 1991), Maruyama (1991), Seki *et al*. (1991), de Jong & Treadaway (2007)

Regarding the status, twelve species recorded at Gunung Halimun-Salak NP are endemic to Java and Bali (Table 3). They reach 31% of 39 endemic species for Java (see Morishita 1981, Yata 1981, Aoki *et al*. 1982, Tsukada & Nishiyama 1982, D'Abrera 1985, 1986, Tsukada 1985, 1991, Maruyama 1991, Seki *et al*. 1991, Peggie in prep.). In relation to the conservation value, *Troides helena* was found at Halimun. This species is one of five butterfly species in Java, which are threatened by trade and thus regulated by CITES (included as Appendix II) and protected under Indonesian law (Noerdjito 2001, Peggie 2011).

Table 3. Occurrence of butterflies endemic to Java (or Java and Bali) in Gunung Halimun-Salak NP

Species	Family	Status	Localities of Occurrence
Cyrestis lutea (Zinken, 1831)	Nymphalidae	Endemic Java & Bali	Halimun & Salak
Euploea gamelia (Hübner, [1823])	Nymphalidae	Endemic Java	Salak
Elymnias ceryx (Boisduval, 1836)	Nymphalidae	Endemic Java	Salak
Mycalesis nala Felder & Felder, 1859	Nymphalidae	Endemic Java	Halimun
Mycalesis moorei Felder & Felder, [1867]	Nymphalidae	Endemic Java	Halimun & Salak
Mycalesis sudra Felder & Felder, [1867]	Nymphalidae	Endemic Java & Bali	Halimun & Salak
Ypthima nigricans Snellen, 1892	Nymphalidae	Endemic Java & Bali	Halimun
Zeuxidia dohrni Fruhstorfer, 1893	Nymphalidae	Endemic Java	Halimun
Appias lucasii (Wallace, 1867)	Pieridae	Endemic Java	Halimun
Delias dorylaea (Felder & Felder, [1865])	Pieridae	Endemic Java	Halimun
Eurema beatrix (Toxopeus, 1939)	Pieridae	Endemic Java	Halimun
Prioneris autothisbe (Hübner, [1826])	Pieridae	Endemic Java	Halimun & Salak

DISCUSSION

This research shows that Gunung Halimun-Salak National Park is an important conservation area within Java in terms of the butterfly diversity. Gunung Halimun-Salak NP with the coverage area of 113,357 ha, is less than 1% of the total area of Java of over 13,200,000 ha. Yet, the national park supports at least 26% of the butterfly diversity of Java. The relatively high proportions of Papilionidae (46%), Pieridae (43%), and Nymphalidae (40%) at Gunung Halimun-Salak NP (Table 2) indicate that these families are well represented in the national park. These numbers at Gunung Halimun-Salak NP are slightly higher than those for Ujung Kulon NP, with 16 spp. (43%) of Papilionidae, 18 spp. (37%) of Pieridae, and 78 spp. (36%) of Nymphalidae (see Peggie 2012). Variation in ecosystem types of lowland rain forest, sub-montane forest, and montane forest (Dephut 2013; Kartawinata 2013) may contribute to this high diversity of butterflies. The differences of butterfly numbers between Gunung Halimun-Salak NP and Ujung Kulon NP are possibly also due to the different sampling efforts allocated.

About 189 species of Lycaenidae are reported from Java (D'Abrera 1986, Seki *et al*. 1991, Vane-Wright & de Jong 2003, Peggie in prep.), but only very few were found during fieldwork at Gunung Halimun-Salak NP. There were only 18 species from Halimun, and 9 from Salak. Only four species: *Heliophorus epicles*, *Hypolycaena amasa*, *Udara dilecta* and *Yasoda pita* were found at both locations, so the total lycaenid species from Gunung Halimun-Salak NP was only a mere 23 species, which compares poorly with the 189 species recorded from Java. Thirteen species out of the total 23 species were previously recorded from other locations in Java (Table 1, see Peggie & Amir 2006, Peggie 2008, 2012, Peggie & Noerdjito 2011). This finding indicates that the Lycaenidae of Java is still poorly known.

At least 120 species of Hesperiidae are reported from Java (Maruyama 1991, Vane-Wright & de Jong 2003, de Jong & Treadaway 2007, Peggie in prep.), but only ten species were obtained during fieldwork at Gunung Halimun-Salak NP. This low number should not be taken as the disappearance of most species, but reflects undersampling. It should be noted that sufficient efforts were not dedicated to obtain Hesperiidae. When we started our inventory in 2004, the main objective was to record the nymphalid butterflies. However, we collected all other families as well but the efforts of collecting the smaller and easily missed lycaenids and hesperiids were obviously not adequate.

The different species compositions of butterflies found at Halimun and Salak (Table 1) may be related to variation of habitats. As suggested by Häuser *et al.* (1997), variation in

habitats is positively related to species diversity. About 500 plant species were initially recorded from Gunung Halimun (Wiriadinata 1997), and subsequent surveys revealed an additional 345 species (Wiriadinata 2002).

Estimating the beta diversity using Sorensen index indicated that Halimun and Salak are similar. Halimun and Salak are adjacent to each other and the climate conditions are also very similar, with many wet days all year long (Kahono & Noerdjito 2002). The similarity is possibly also due to the relatively similar vegetation type and the fact that the localities are adjacent and connected by a forest corridor.

The importance of Gunung Halimun-Salak NP is also reflected from the presence of a significant number of species endemic to Java. As many as 31% or 12 Javan endemic species were found out of 39 endemic species recorded from Java (Peggie in prep.). The island of Java does not support many endemic species compared to other islands of Indonesia because of the shared distribution with Sumatra, Kalimantan, and the Lesser Sundas, so the presence of these 12 endemic species in the national park is of great significance. These endemic species include five species (*Appias lucasii*, *Delias dorylaea*, *Eurema beatrix*, *Mycalesis nala* and *Zeuxidia dohrni*) which are of special importance because based on our surveys in Java from 2004 – 2010 they were found only at Halimun and no where else in Java. The high level of endemism at Gunung Halimun-Salak NP may be due to the pristine condition of the forest and the high altitude, as suggested by Lewis et al. (1998), that many endemic species occur in forests above 500 m asl.

Various species of butterflies may be useful as an indicator of habitat quality. For instance, 33 species were found only at Gunung Halimun-Salak NP (see Table 1), including five endemic species mentioned above, which constitutes 20% of the total 161 species reported from the national park. Therefore, we would suggest monitoring these indicator species as part of the conservation management programs of the national park.

The findings of this research show the importance of Gunung Halimun-Salak NP. It is possible that additional species may be revealed because many areas of Gunung Halimun-Salak NP have yet to be surveyed.

ACKNOWLEDGMENTS

This research was supported by Research Center for Biology-LIPI (Indonesian Institute of Sciences) through Indonesian government project DIPA 2004, 2007 and by Indonesian incentive project of Ristek PKPP program 2009–2010. We are very grateful to

colleagues and technicians at Entomology laboratory who have been cooperative in the field and in the laboratory. Thanks are due to staff of the Ministry of Forestry who allowed access to the national park. We would like to thank the reviewers who kindly read and made improvement to the manuscript. The manuscript of this paper was prepared during the first author's visit to the Hokkaido University Museum, Sapporo, Japan, and the first author would like to express gratitude and appreciation especially to Dr. Masahiro Ohara for the opportunity and facilities provided.

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For example:

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

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