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

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

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

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

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

No.	Species	Halimun	Salak	other locations in Java *
140	<i>Appias pandione</i> (Geyer, [1832])	1	0	was not obtained at other locations
141	<i>Catopsilia pomona</i> (Fabricius, 1775)	0	1	a, b, c, f, h, j, m, o
142	<i>Catopsilia pyranthe</i> (Linnaeus, 1758)	1	0	a, b, c, h, j
143	<i>Cepora iudith</i> (Fabricius, 1787)	1	1	a, b, c, f, h, i, k
144	<i>Delias belisama</i> (Cramer, [1780])	1	1	b, c, e, f, i, j, k
145	<i>Delias crithoe</i> (Boisduval, [1836])	1	1	f
146	<i>Delias dorylaea</i> (Felder & Felder, [1865])	1	0	was not obtained at other locations
147	<i>Delias hyparete</i> (Linnaeus, 1758)	0	1	b, c, f, h
148	<i>Eurema alitha</i> (Felder & Felder, 1862)	1	0	a, b, c, h, j
149	<i>Eurema beatrix</i> (Toxopeus, 1939)	1	0	was not obtained at other locations
150	<i>Eurema blanda</i> (Boisduval, 1836)	1	1	a, b, c, f, h, i, j, k
151	<i>Eurema brigitta</i> (Stoll, [1780])	1	0	f, j, r
152	<i>Eurema hecabe</i> (Linnaeus, 1758)	1	1	a, b, c, e, f, h, i, j, k, m, o, s
153	<i>Eurema lacteola</i> (Distant, 1886)	0	1	f
154	<i>Eurema sari</i> (Horsfield, [1829])	1	0	a, b, c, h, j, o
155	<i>Gandaca harina</i> (Horsfield, [1829])	1	1	a, c, f, h
156	<i>Leptosia nina</i> (Fabricius, 1793)	1	1	a, b, c, e, f, h, i, j, m, o, s
157	<i>Prioneris autothisbe</i> (Hübner, [1826])	1	1	f
Riodinidae (no. 158 – 161)				
158	<i>Abisara kausambi</i> Felder & Felder, 1860	1	0	a, h
159	<i>Stiboges nymphidia</i> Butler, 1876	0	1	was not obtained at other locations
160	<i>Taxila haquinus</i> (Fabricius, 1793)	0	1	was not obtained at other locations
161	<i>Zemeros flegyas</i> (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
<i>Cyrestis lutea</i> (Zinken, 1831)	Nymphalidae	Endemic Java & Bali	Halimun & Salak
<i>Euploea gamelia</i> (Hübner, [1823])	Nymphalidae	Endemic Java	Salak
<i>Elymnias ceryx</i> (Boisduval, 1836)	Nymphalidae	Endemic Java	Salak
<i>Mycalopsis nala</i> Felder & Felder, 1859	Nymphalidae	Endemic Java	Halimun
<i>Mycalopsis moorei</i> Felder & Felder, [1867]	Nymphalidae	Endemic Java	Halimun & Salak
<i>Mycalopsis sudra</i> Felder & Felder, [1867]	Nymphalidae	Endemic Java & Bali	Halimun & Salak
<i>Ypthima nigricans</i> Snellen, 1892	Nymphalidae	Endemic Java & Bali	Halimun
<i>Zeuxidia dohrni</i> Fruhstorfer, 1893	Nymphalidae	Endemic Java	Halimun
<i>Appias lucasii</i> (Wallace, 1867)	Pieridae	Endemic Java	Halimun
<i>Delias dorylaea</i> (Felder & Felder, [1865])	Pieridae	Endemic Java	Halimun
<i>Eurema beatrix</i> (Toxopeus, 1939)	Pieridae	Endemic Java	Halimun
<i>Prioneris autothisbe</i> (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 Hesperidae 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 Hesperidae. 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.

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REFERENCES

- Ackery, P.R. & R.I. Vane-Wright 1984. *Milkweed Butterflies. Their Cladistics and Biology*. British Museum (Natural History), Comstock Publishing, Cornell University Press, Ithaca, New York, 425 pp.
- Aduse-Poku, K., E. Vingerhoedt & N. Wahlberg 2009. Out-of-Africa again: A phylogenetic hypothesis of the genus *Charaxes* (Lepidoptera: Nymphalidae) based on five gene regions. *Molecular Phylogenetics and Evolution* **53**: 463–478.
- Amir, M., W.A. Noerdjito & S. Kahono 2003. Kupu (Lepidoptera). In: Amir, M. & S. Kahono (eds.), *Serangga Taman Nasional Gunung Halimun, Jawa Bagian Barat*. Biodiversity Conservation Project LIPI – JICA – Departemen Kehutanan, Bogor, pp. 123-146.
- Aoki, T., S. Yamaguchi & Y. Uemura 1982. Satyridae. Libytheidae. In: Tsukada, E. (ed.), *Butterflies of the South East Asian Islands*. III. Plapac Co. Ltd., Japan, 500 pp.
- Brower, A.V.Z. 2012. *Charaxes* Ochsenheimer 1816. Version 12 March 2012 (under construction). [Online] <<http://tolweb.org/Charaxes/70521/2012.03.12> in The Tree of Life Web Project, <http://tolweb.org/>> [Accessed 15 January 2013].
- Colwell, R.K. 2009. EstimateS: Statistical estimation of species richness and shared species from samples. Version 8.2. User's guide and application. [Online] <<http://purl.oclc.org/estimates>> [Accessed 9 August 2013].
- Corbet, A.S. & H.M. Pendlebury 1992. *The Butterflies of the Malay Peninsula*. 2nd edition. Oliver & Boyd, London, 595 pp.
- D'Abbrera, B. 1985. *Butterflies of the Oriental Region*. Part 2. Nymphalidae, Satyridae & Amathusiidae. Hill House, Melbourne, p. 245-534.
- D'Abbrera, B. 1986. *Butterflies of the Oriental Region*. Part 3. Lycaenidae & Riodinidae. Hill House, Melbourne, 672 pp.
- de Jong, R. & C.G. Treadaway 2007. HesperIIDae of the Philippine Islands. *Butterflies of the World*, Supplement 15. Goecke & Evers, Keltern, Germany, 72 pp.
- Dephut 2013. Halimun National Park. [Online] <http://www.dephut.go.id/INFORMASI/TN%20INDO-ENGLISH/halimun_NP.htm> [Accessed 1 February 2013].
- Direktorat PJLKK/HL 2013. Map of Halimun-Salak National Park. [Online] <<http://ekowisata.org/galeri/taman-nasional/tn-gunung-halimun-salak/>> [Accessed 31 December 2013].
- Harmonis 2013. Butterflies of lowland East Kalimantan and their potential to assess the quality of reforestation attempt. Unpublished PhD thesis at Faculty of Environment and Natural Resources, Albert-Ludwigs-Universität, Freiburg im Breisgau, Germany, 167 pp.

- Häuser C.L., C.H. Schulze & K. Fiedler 1997. The butterfly species (Insecta: Lepidoptera: Rhopalocera) of Kinabalu Park, Sabah. *The Raffles Bulletin of Zoology* **45** (2): 281–304.
- Kahono, S. & W.A. Noerdjito 2002. Fluctuation of rainfall and insect community in Gunung Halimun National Park, West Java. In: Kahono, S., T. Okayama & A.J. Arief (eds.), *Research and Conservation of Biodiversity in Indonesia*. Vol. IX. *Biodiversity of the Last Submontane Tropical Rain Forest in Java: Gunung Halimun National Park*. Part 1. Biodiversity Conservation Project in Indonesia LIPI, PHPA and JICA, Bogor, pp. 157-169.
- Kahono, S. & M. Amir 2003. Ekosistem dan khasanah serangga Taman Nasional Gunung Halimun. In: Amir, M. & S. Kahono (eds.), *Serangga Taman Nasional Gunung Halimun, Jawa Bagian Barat*. Biodiversity Conservation Project LIPI – JICA – Departemen Kehutanan, Bogor, pp. 1-22.
- Kartawinata, K. 2013. *Diversitas Ekosistem Alami Indonesia: Ungkapan Singkat dengan Sajian Foto dan Gambar*. LIPI Press & Yayasan Pustaka Obor Indonesia, Jakarta, 124 pp.
- Lewis, O.T., R.B. Wilson & M.C. Harper 1998. Endemic butterflies on Grande Comore: habitat preferences and conservation priorities. *Biological Conservation* **85**: 113-121.
- Maruyama, K. 1991. *Butterflies of Borneo. Hesperidae*. Vol. 2, No. 2. Tobishima Corp., Japan, 84 pp. (English version), 89 pp. (Japanese version), 39 pls.
- Morishita, K. 1981. Danaidae. In: Tsukada, E. (ed.), *Butterflies of the South East Asian Islands*. II. Plapac Co. Ltd., Japan, pp. 439-628, pls. 85-162.
- Noerdjito, W.A. 2001. Serangga (Insects). In: Noerdjito M & I. Maryanto (eds.), *Jenis-jenis Hayati yang Dilindungi Perundang-undangan Indonesia*. Bidang Zoologi (Museum Zoologicum Bogoriense), Puslit Biologi LIPI, The Nature Conservancy & USAID. Cibinong, pp. 127–131.
- Peggie, D. & M. Amir 2006. *Practical Guide to the Butterflies of Bogor Botanic Garden / Panduan Praktis Kupu-kupu di Kebun Raya Bogor*. Puslit Biologi, LIPI & Nagao Natural Environment Foundation Japan, Bogor, 126 pp.
- Peggie, D. 2008. Inventory surveys of nymphalid butterflies in Java, Indonesia. Report on Insect Inventory Project in Tropical Asia (TAIV): 111-122. Also in Japanese language: 2009. Inventory surveys of nymphalid butterflies in Java, Indonesia. *The Nature & Insects* **22** (13): 11-13.
- Peggie, D. 2011. *Precious and Protected Indonesian Butterflies / Kupu-kupu Indonesia yang Bernilai dan Dilindungi*. Bidang Zoologi (Museum Zoologi Bogor), Pusat Penelitian Biologi & Nagao Natural Environment Foundation Japan, Cibinong, 72 pp.
- Peggie, D. & W.A. Noerdjito 2011. Kupu-kupu Gunung Ciremai dan Sekitarnya. In: Peggie, D. (ed.), *Fauna Serangga Gunung Ciremai: Kumbang Sungut Panjang, Capung, Kupu-kupu*. LIPI Press, Jakarta, pp. 53-103.
- Peggie, D. 2012. A list of the butterflies of Ujung Kulon National Park, Java, Indonesia. *Treubia* **39**: 67-76.
- Seki, Y., Y. Takanami & K. Otsuka 1991. *Butterflies of Borneo. Lycaenidae*. Vol. 2, No. 1. Tobishima Corp., Japan, 114 pp. (English version), 139 pp. (Japanese version), 69 pls.
- Sola, E., I.K. Widyaningrum & S. Mulyati 2005. *A Photographic Guide to the Common Insects of Gunung Halimun-Salak National Park / Serangga di TNGHS*. VSO, JICA, TNGHS, pp. 66-85.
- Tsukada, E. & Y. Nishiyama 1982. Papilionidae. In: Tsukada, E. (ed.), *Butterflies of the South East Asian Islands*. I. (Translated into English by Morishita, K), Plapac Co. Ltd., Japan, 457 pp.
- Tsukada, E. 1985. Nymphalidae (I). In: Tsukada, E. (ed.), *Butterflies of the South East Asian Islands*. IV. Plapac Co. Ltd., Japan, 558 pp.

- Tsukada, E. 1991. Nymphalidae (II). In: Tsukada, E. (ed.), *Butterflies of the South East Asian Islands*. V. Azumino B.R.I., Japan, 576 pp.
- Ubaidillah, R., M.R. Sofyan, H. Kojima, S. Kamitani & M. Yoneda 1998. Survey on butterflies in Gunung Halimun National Park. In: Simbolon, H., M. Yoneda & J. Sugardjito (eds.), *Research and Conservation of Biodiversity in Indonesia*. Vol. IV. *Gunung Halimun: the Last Submontane Tropical Forest in West Java*. Biodiversity Conservation Project in Indonesia LIPI, PHPA and JICA, Bogor, pp. 155-161.
- Vane-Wright, R.I. & R. de Jong 2003. The butterflies of Sulawesi: annotated checklist for a critical island fauna. *Zoologische Verhandelingen* **343**: 1-267.
- Whitten, A.J. 1994. Conservation of Java's flora. Strategies for flora conservation in Asia. The Kebun Raya Bogor Conference Proceedings, Bogor.
- wikipedia.org. 2013a. List of national parks of Indonesia. [Online] <http://en.wikipedia.org/wiki/List_of_national_parks_of_Indonesia> [Accessed 1 February 2013].
- wikipedia.org. 2013b. Gunung Salak. [Online]. <http://id.wikipedia.org/wiki/Gunung_Salak> [Accessed 22 July 2013].
- Wiriadinata, H. 1997. Floristic study of Gunung Halimun National Park. In: Yoneda, M, H. Simbolon & J. Sugardjito (eds.). *Research and Conservation of Biodiversity in Indonesia*. Vol. II, *The Inventory of Natural Resources in Gunung Halimun National Park*. Biodiversity Conservation Project in Indonesia, LIPI, PHKA and JICA, Bogor, p. 7-12.
- Wiriadinata, H. 2002. Kekayaan jenis tumbuhan Taman Nasional Gunung Halimun. *Berita Biologi* **6** (1): 137-143.
- Yata, O. 1981. Pieridae. In: Tsukada, E. (ed.), *Butterflies of the South East Asian Islands*. II. Plapac Co. Ltd., Japan, pp. 205-438, pls. 1-84.
- Yoneda, M., H. Simbolon & J. Sugardjito 2001. Research and conservation of biodiversity in Gunung Halimun National Park, West Java Indonesia. *Tropical Biodiversity* **7** (2-3): 103-120.

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