

## THE BUTTERFLY FAUNA OF PU HOAT NATURE RESERVE, NGHE AN PROVINCE

**Bui Van Bac**

*Vietnam National University of Forestry*

### SUMMARY

Pu Hoat Nature Reserve (NR) is the part of the Western Nghe An Biosphere Reserve (Nghe An province, central Vietnam), and identified as an important area for biodiversity conservation in the North Central Coastal Vietnam. This nature reserve hosts various ecosystems and landscapes with four main formations including closed forests, sparse forests, scrubs and grass vegetation. It is well known that butterflies with their high diversity and abundance are one of the most important players in many ecosystem processes. The loss of butterfly diversity may lead to negative cascading effects across whole communities. Therefore, conservationists have often taken the advantage of butterfly diversity as an indicator for forest planning and management in the tropics. Between April and December 2020, we sampled butterflies over three consecutive collection trips throughout Pu Hoat NR. In total, 155 butterfly taxa were recorded during the dedicated surveys of this study, in addition to 12 species-level records from previous studies. The main aim of this paper is to give a first report of all butterfly species known to date in Pu Hoat NR. Additionally, the study identified butterfly species as potential bio-indicator species for different forest types in Pu Hoat NR. This information may be useful for monitoring biodiversity in Vietnam forests where have witnessed the high relative rate of habitat loss and degradation.

**Keywords:** bioindicator species, Lepidoptera, Rhopalocera, Western Nghe An Biosphere Reserve.

### 1. INTRODUCTION

Butterflies (Lepidoptera: Rhopalocera) have an important role in the forest ecosystems, providing the stability in the food webs, as herbivore, pollinator and host of parasitoids (Dahelmi, 2000; Atmowidi et al., 2007). Butterflies are often used to assess the impact of forest deforestation on biodiversity, as they are closely associated with habitat structure and ecosystem characteristics (Brown & Freitas, 2000). About 19,445 butterfly species have been recorded so far (Schappert, 2000). The Vietnamese butterfly fauna was described for the first time by Metaye (1957) with 454 recorded species. Recently, Monastyrskii & Devyatkin (2003, 2015) provided a butterfly list of 1,124 species throughout Vietnam. Particularly, butterfly assemblages have been investigated in several natural protected areas. For example, Ikeda et al. (1999-2002) recorded 251 butterfly species distributed across 11 families: Papilionidae: 25 species, Pieridae: 22 species, Danaidae: 16 species, Satyridae: 24 species, Amathusiidae: 6 species, Acraeidae: 1 species, Nymphalidae: 56 species, Libytheidae: 1 species, Riodinidae: 3 species, Lycaenidae: 50 species and Hesperidae: 47 species. There were 72 species in Hang Kia – Pa Co Nature Reserve and 98 species in Ba Be National Park

(Dang Thi Dap & Hoang Vu Tru, 2003), 174 species in Phia Oac – Phia Den National Park (Pham Hong Thai et al., 2013), 175 species in Hon Ba Nature Reserve (Vu Van Lien, 2005) and 188 species in three protected areas including Dakrong and Ba Na – Nui Chua nature reserves and Bach Ma National Park (Vu Van Lien et al., 2014). Recently, Vu Van Lien (2015) has reported 156 species in Pu Mat National Park.

Pu Hoat Nature Reserve (NR) is located in the northwest of Nghe An province, 180 km from Vinh City. Pu Hoat NR is one of the three protected natural areas of the Western Nghe An Biosphere Reserve recognized by UNESCO since 2007. With a total area of over 85,000 hectares, Pu Hoat NR with the recognised high biodiversity value contains various ecosystems and landscapes (Pu Hoat Nature Reserve, 2013). Under Decision No 118/QĐ-SNN.QLKTKHCN of the Nghe An Department of Agriculture and Rural Development of 6 March 2020 on Research on insect biodiversity and conservation measures at Pu Hoat Nature Reserve, we conducted comprehensive surveys of the insect fauna in Pu Hoat NR and recorded a total of 155 butterfly taxa including two rare species. This paper provides a first list of butterflies and

biological indicator species for different forest types in Pu Hoat NR. These findings may be further used for conservation decisions.

## **2. RESEARCH METHODOLOGY**

### **2.1. Butterfly sampling and identification**

The butterfly sampling was conducted in Pu Hoat Nature Reserve, Nghe An province (Vietnam) over three consecutive collection trips between April and December 2020. Four localities were surveyed, including Thong Thu, Tien Phong, Hanh Dich and Nam Giai communes (Que Phong district). At each locality, four 2×2 km sampling squares, equalling an 8 km long transect was established with the intention to cover different habitats along the established transects. Butterflies were surveyed in four levels of forest disturbance including: forest edges, mixed forests comprising bamboo and broad-leaved trees, forest light gaps and closed forests. At each locality, three surveyors walked along the selected transect for recording butterflies. Recording took place during sunny weather, and monitoring was conducted between 10 am and 5 pm. All monitored transects were divided into segments of approximate 100 m length with an accompanying description for the habitat surrounding transects. Recordings were made of the butterfly adults, as seen within an “invisible box” of 10 m in front of the recorders, 5 m to each side and 10 m above (Videvall et al., 2016). Observations were aided with butterfly nets and cameras. The pace of walking depends on habitat, accessibility and butterfly density, but in general is approximately 3 km/h.

The collected butterflies were identified mainly according to the field guide of Monastyrskii & Devyatkin (2001, 2003, 2015).

### **2.2. Data analysis**

Venn diagrams were generated using the VennDiagram package v. 1.6.18 (Hanbo, 2017) to show the number of butterflies common to four spatially separated areas. An indicator value analysis (IndVal) was carried out using the indicpecies package v. 1.7.6

(Caceres & Jansen, 2016) in order to identify the characteristic species of specific areas (Dufrene & Legendre, 1997).

## **3. RESULTS**

### **3.1. Species composition of butterflies in Pu Hoat Nature Reserve**

A total of 167 taxa of butterflies were recorded in the Pu Hoat NR (Table 1). Of which, 155 taxa were sampled during the three dedicated surveys of the current study (April 2020 – December 2020), 12 species-level records were from the previous surveys. Of the 155 taxa collected in this study, 148 were identified to species level. The remaining 7 taxa were assigned to the following genera, and could not be reliably named to species: *Appias* Hübner, 1819; *Euploea* Fabricius, 1807; *Ideopsis* Horsfield, 1857; *Arhopala* Boisduval, 1832; *Yasoda* Doherty, 1889; *Lethe* Hübner, 1819 and *Parnara* Moore, 1881. In the case of these genera, I assigned taxa to morphospecies, but further taxonomic work would be required to name species with confidence, but such taxonomic uncertainty did not affect the analyses.

The family Nymphalidae dominated the butterfly assemblages at the Pu Hoat NR with 45 recorded species (and morphospecies), followed by the families Papilionidae (37 species), Pieridae (22 species), Satyridae (19 species), Danaidae (14 species), Lycaenidae (11 species). Relatively minor representation was afforded by the Amathusiidae (nine species), Hesperidae (six species, *Cephrènes acalle* Hopffer, 1874, *Halpe porus* Mabille, 1876, *Halpe wantona* Swinhoe, 1893, *Iambrix salsala* Moore, 1865, *Parnara bada* (Moore, 1878) and *Parnara* sp1.), Riodinidae (two species, *Abisara echerius* Moore, 1901 and *Zemeros flegyas* Cramer, 1780) and Acraeidae (two species, *Acraea violae* Fabricius, 1775 and *Acraea issoria* Hübner, 1816).

The butterfly species were generally widespread across a number of spatially separated areas, with 43 of the 167 species being occurred in all four areas (Fig. 1).

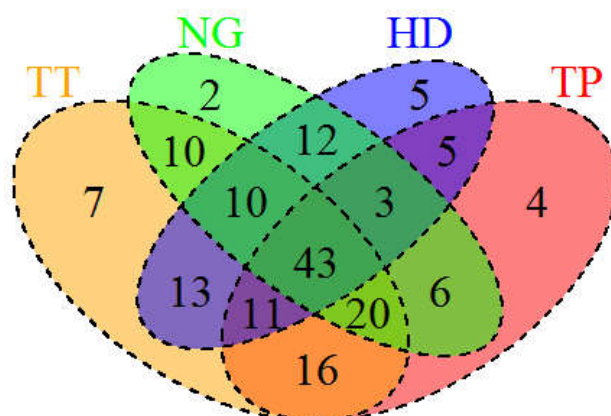


Figure 1. Venn diagrams showing the number of butterflies occurring in uniquely and in common in four study areas (Thong Thu Commune: TT; Hanh Dich Commune: HD; Nam Gai Commune: NC and Tien Phong Commune: TP) at Pu Hoat NR

Table 1. Species composition of butterflies recorded in Pu Hoat NR

(1) <b>Papilionidae</b>	36	<i>Troides aeacus</i> (Felder & Felder, 1860) (**)
1 <i>Atrophaneura varuna</i> (White, 1842)	37	<i>Troides helena</i> (Linnaeus, 1758) (**)
2 <i>Byasa crassipes</i> (Oberthür, 1879) (*)	(2) <b>Pieridae</b>	
3 <i>Byasa polyeuctes</i> (Doubleday, 1842)	38	<i>Appias albina</i> (Boisduval, 1836) (**)
4 <i>Chilasa agestor</i> (Gray, 1831)	39	<i>Appias galba</i> (Wallace, 1887)
5 <i>Chilasa clytia</i> (Linnaeus, 1758)	40	<i>Appias indra</i> (Moore, 1858)
6 <i>Graphium agamemnon</i> (Linnaeus, 1758) (**)	41	<i>Appias libythea</i> (Fabricius, 1775)
7 <i>Graphium agetes</i> (Westwood, 1843)	42	<i>Appias lycinda</i> (Cramer, 1779)
8 <i>Graphium antiphates</i> (Cramer, 1775) (**)	43	<i>Appias pandione</i> (Geyer, 1832)
9 <i>Graphium aristeus</i> (Stoll, 1780) (*)	44	<i>Appias</i> sp.1.
10 <i>Graphium doson</i> (Felder & Felder, 1864) (**)	45	<i>Artogeia canidia</i> (Sparman, 1768) (*)
11 <i>Graphium eurous</i> (Leech, 1893)	46	<i>Catopsilia pomona</i> (Fabricius, 1775) (**)
12 <i>Graphium eurypylus</i> (Linnaeus, 1758)	47	<i>Catopsilia pyranthe</i> (Linnaeus, 1758) (**)
13 <i>Graphium evemon</i> (Boisduval, 1836)	48	<i>Cepora nadina</i> (Lucas, 1852)
14 <i>Graphium macareus</i> (Godart, 1819)	49	<i>Cepora nerissa</i> (Fabricius, 1775)
15 <i>Graphium phidias</i> (Oberthür, 1896)	50	<i>Delias hyparete</i> (Linnaeus, 1758) (*)
16 <i>Graphium sarpedon</i> (Linnaeus, 1758) (*)	51	<i>Delias pasithoe</i> (Linnaeus, 1758) (**)
17 <i>Lamproptera curius</i> (Fabricius, 1787)	52	<i>Delias</i> sp.1. (*)
18 <i>Lamproptera meges</i> (Zincken, 1831)	53	<i>Eurema hecabe</i> (Linnaeus, 1758) (*)
19 <i>Pachliopta aristolochiae</i> (Fabricius, 1775)	54	<i>Eurema laeta</i> (Boisduval, 1836)
20 <i>Papilio alcmenor</i> Felder & Felder, 1864	55	<i>Eurema sari</i> (Horsfield, 1829)
21 <i>Papilio arcturus</i> Westwood, 1842 (**)	56	<i>Hebomoia glaucippe</i> (Linnaeus, 1758) (**)
22 <i>Papilio bianor</i> Cramer, 1777 (**)	57	<i>Ixias pyrene</i> (Linnaeus, 1764) (**)
23 <i>Papilio bootes</i> Westwood, 1842	58	<i>Leptosia nina</i> (Fabricius, 1793)
24 <i>Papilio castor</i> Westwood, 1842	59	<i>Pieris brassicae</i> (Linnaeus, 1758) (*)
25 <i>Papilio demoleus</i> Linnaeus, 1758 (**)	(3) <b>Danaidae</b>	
26 <i>Papilio dialis</i> (Leech, 1893)	60	<i>Danaus genutia</i> Cramer, 1779 (**)
27 <i>Papilio elephenor</i> Doubleday, 1845 (**)	61	<i>Euploea core</i> Cramer, 1780 (**)
28 <i>Papilio helenus</i> Linnaeus, 1758 (**)	62	<i>Euploea eunice</i> (Godart, 1819) (**)
29 <i>Papilio memnon</i> Linnaeus, 1758 (**)	63	<i>Euploea klugii</i> Moore & Horsfield, 1857
30 <i>Papilio nephelus</i> Boisduval, 1836	64	<i>Euploea modesta</i> Butler, 1866
31 <i>Papilio noblei</i> de Nicéville, 1889 (**)	65	<i>Euploea mulciber</i> Cramer, 1777
32 <i>Papilio paris</i> Linnaeus, 1758 (**)	66	<i>Euploea</i> sp.1.
33 <i>Papilio polytes</i> Linnaeus, 1758 (**)	67	<i>Ideopsis similis</i> Linnaeus, 1758
34 <i>Papilio protenor</i> Cramer, 1775 (**)	68	<i>Ideopsis vulgaris</i> Butler, 1874
35 <i>Papilio xuthus</i> Linnaeus, 1767	69	<i>Parantica aglea</i> Stoll, 1781 (**)

70	<i>Parantica melaneus</i> Cramer, 1775 (*)	121	<i>Faunis canens</i> Hübner, 1820-1826
71	<i>Parantica sita</i> Kollar, 1844 (*)	122	<i>Faunis eumeus</i> Drury, 1770
72	<i>Tirumala limniace</i> (Cramer 1775) (**)	123	<i>Stichophthalma fruhstorferi</i> Rober, 1903
73	<i>Tirumala septentrionis</i> Butler, 1874	124	<i>Stichophthalma mathilda</i> Janet 1905
<b>(4) Nymphalidae</b>		125	<i>Thaumantis diores</i> Doubleday, 1845
74	<i>Argyreus hyperbius</i> Linnaeus 1763	126	<i>Thauria lathyi</i> Fruhstorfer, 1905
75	<i>Ariadne ariadne</i> Linnaeus, 1763	127	<i>Zeuxidia masoni</i> Moore, 1879
76	<i>Ariadne merione</i> Cramer, 1779	<b>(6) Lycaenidae</b>	
77	<i>Athyma perius</i> (Linnaeus, 1758)	128	<i>Acytolepis puspa</i> (Horsfield, 1828)
78	<i>Athyma pravara</i> Moore 1857	129	<i>Anthene emolus</i> (Godart, 1824)
79	<i>Calinaga buddha</i> Moore, 1857	130	<i>Arhopala agaba</i> (Hewitson, 1862)
80	<i>Calinaga funeralis</i> Monastyrskii & Devyatkin 2000	131	<i>Arhopala aida</i> De Nicéville, 1889
81	<i>Cethosia biblis</i> Drury, 1770	132	<i>Arhopala amantes</i> (Hewitson, 1862)
82	<i>Cethosia cyane</i> (Drury, 1770)	133	<i>Arhopala</i> sp.1.
83	<i>Charaxes kahruha</i> Moore, 1895	134	<i>Curetis bulis</i> (Westwood, 1851)
84	<i>Charaxes marmax</i> Westwood, 1848	135	<i>Flos abseus</i> (Hewitson, 1862)
85	<i>Chersonesia intermedia</i> Martin, 1895	136	<i>Hypolycaena othona</i> Hewitson, 1865
86	<i>Chersonesia risa</i> Doubleday, 1848	137	<i>Yasoda</i> sp.1.
87	<i>Cirrochroa tyche</i> C. & R. Felder, 1861	138	<i>Zeltus amasa</i> (Hewitson, 1865)
88	<i>Cyrestis thyodamas</i> Boisduval, 1836	<b>(7) Riodinidae</b>	
89	<i>Dilipa morgiana</i> Westwood, 1850	139	<i>Abisara echerius</i> Moore, 1901
90	<i>Elymnias malelas</i> Hewitson, 1863	140	<i>Zemeros flegyas</i> Cramer, 1780
91	<i>Elymnias patna</i> Westwood, 1851	<b>(8) Satyridae</b>	
92	<i>Euthalia phemius</i> Doubleday, 1848	141	<i>Coelites nothis</i> Westwood, 1850
93	<i>Hypolimnas bolina</i> Linnaeus, 1758	142	<i>Elymnias malelas</i> Hewitson, 1863
94	<i>Hypolimnas misippus</i> (Linnaeus, 1764)	143	<i>Lethe chandica</i> Moore, 1857
95	<i>Junonia almana</i> Linnaeus, 1758	144	<i>Lethe confusa</i> Aurivillius, 1897
96	<i>Junonia atlites</i> Linnaeus, 1763	145	<i>Lethe europa</i> Fabricius, 1775
97	<i>Junonia orithya</i> (Linnaeus, 1758)	146	<i>Lethe mekara</i> Moore, 1857
98	<i>Kalima alicia</i> Joicey & Talbot, 1921	147	<i>Lethe minerva</i> Fabricius, 1775
99	<i>Kallima inachus</i> (Doyère, 1840) (*)	148	<i>Lethe</i> sp.1.
100	<i>Kaniska canace</i> (Linnaeus, 1763)	149	<i>Lethe</i> sp.2.
101	<i>Lasippa heliodore</i> Fabricius, 1787	150	<i>Melanitis leda</i> Linnaeus, 1758
102	<i>Lasippa tiga</i> Moore, 1858	151	<i>Melanitis phedima</i> Cramer, 1782
103	<i>Lexias dirtea</i> (Fabricius, 1793)	152	<i>Mycalesis annamitica</i> Fruhstorfer, 1906
104	<i>Lexias pardalis</i> Moore 1878	153	<i>Mycalesis inopia</i> Fruhstorfer, 1908
105	<i>Mimathyma ambica</i> Kollar, 1844	154	<i>Mycalesis intermedia</i> Moore, 1892
106	<i>Neptis hylas</i> (Linnaeus, 1758)	155	<i>Mycalesis malsara</i> Moore, 1857
107	<i>Orsotriaena medus</i> Fabricius, 1775	156	<i>Mycalesis mineus</i> Linnaeus, 1858
108	<i>Pantoporia sandaka</i> (Butler, 1892)	157	<i>Mycalesis perseoides</i> Moore, 1890
109	<i>Penthema michallati</i> Janet, 1894	158	<i>Mycalesis sangaica</i> Butler, 1877
110	<i>Phaedyma columella</i> Cramer 1782	159	<i>Ypthima baldus</i> Fabricius, 1775
111	<i>Phalanta alcippe</i> Cramer, 1782	<b>(9) Hesperiidae</b>	
112	<i>Phalanta phalantha</i> Drury, 1773	160	<i>Cephrenes acalle</i> Hopffer, 1874
113	<i>Polygonia caureum</i> Linnaeus, 1758	161	<i>Halpe porus</i> Mabille, 1876
114	<i>Polyura athamas</i> Drury, 1773	162	<i>Halpe wantona</i> Swinhoe, 1893
115	<i>Rohana parisatis</i> (Westwood, 1850)	163	<i>Iambrix salsala</i> Moore, 1865
116	<i>Rohana tonkiniana</i> Fruhstorfer, 1906	164	<i>Parnara bada</i> (Moore, 1878)
117	<i>Stibochiona nicea</i> Gray, 1846	165	<i>Parnara</i> sp.1.
118	<i>Symbrenthia hypselis</i> Godart, 1823	<b>(10) Acraeidae</b>	
<b>(5) Amathusiidae</b>		166	<i>Acraea issoria</i> Hübner, 1816
119	<i>Amathuxidia amythaon</i> Doubleday, 1847 (*)	167	<i>Acraea violae</i> Fabricius, 1775
120	<i>Discophora sondaica</i> Boisduval, 1836		

(\*) denote species recorded only in (Department of Science and Technology of Nghe An, 2017); (\*\*) denote species recorded in both the current study and (Department of Science and Technology of Nghe An, 2017).

### 3.2. Butterflies as potential bioindicators for forest disturbance in Pu Hoat NR

The indicator value analysis indicated that, nine butterfly species had a significant preference for one habitat type (IndVal > 70%,  $p < 0.05$ ) (Table 2). Of which, four species including *Zemerus flegyas*, *Zeltus amasa*, *Melanitis leda* and *Melanitis phedima* were

identified by high indicator values as true specialists in forest edges. *Euploea mulciber*, *Lamproptera curius* and *Papilio polytes* were bio-indicator species of forest light gaps. *Kallima inachus* was bio-indicator species of closed forests, while *Stichophthalma mathilda* was indicator of the mixed forests comprising bamboo and broad-leaved trees.

**Table 2. The indicator value test results of butterfly species with significant preference ( $p^* < 0.05$ ) for the four habitat types. Species were ordered according to the value of IndVal.**

Species	Forest type	IndVal	$p^*$ value
<i>Zemerus flegyas</i>	Forest edges	82.6	<0.001
<i>Zeltus amasa</i>	Forest edges	79.5	0.002
<i>Stichophthalma mathilda</i>	Mixed forests comprising bamboo and broad-leaved trees	78.3	0.003
<i>Euploea mulciber</i>	Forest light gaps	77.7	0.006
<i>Melanitis leda</i>	Forest edges	76.2	0.008
<i>Melanitis phedima</i>	Forest edges	75.3	0.01
<i>Lamproptera curius</i>	Forest light gaps	74.4	0.02
<i>Papilio polytes</i>	Forest light gaps	73.1	0.03
<i>Kallima inachus</i>	Closed forests	72.6	0.04

## 4. DISCUSSIONS

The number of butterfly species found in this study area was 167 species or about 15% of the approximately 1,124 species described in Vietnam (Monastyrskii & Devyatkin, 2003, 2015). One hundred and twenty-nine species were found in Pu Hoat Nature Reserve for the first time.

The Pu Hoat NR has a relatively high number of butterflies, compared to other nature reserves/ national parks in Vietnam, although these differences might be related to different size of the area, sampling efforts and differences in environmental conditions (Ramos, 2000). For example, there were 72 species in Hang Kia – Pa Co and 98 species in Ba Be National Park (Dang Thi Dap & Hoang Vu Tru, 2003), 156 species in Pu Mat National Park (Vu Van Lien, 2015), 174 species in Phia Oac – Phia Den National Park (Pham Hong Thai et al., 2013), 175 species in Hon Ba Nature Reserve (Vu Van Lien, 2005) and 188 species in three protected areas including Dakrong and Ba Na – Nui Chua nature reserves and Bach Ma National Park (Vu Van Lien et al., 2014).

The butterfly fauna in Pu Hoat Nature Reserve was dominated by Nymphalid butterflies (The family Nymphalidae). This family was also dominant in other Asian areas (Panjaitan, 2008; Nimbalkar et al., 2011, Rusman et al., 2016), commonly found in the road, edges, and disturbed areas (Ramos 2000). Meanwhile, the family Acraeidae was rarely observed with only two individuals of the species *Acraea violae* and *A. issoria* being recorded. This family was found commonly in African areas. In Vietnam, only two species (*Acraea violae* and *A. issoria*) of this family have been recorded (Monastyrskii & Devyatkin, 2003, 2015).

Among the recorded butterflies, two golden birdwing butterflies including *Troides aeacus* and *Troides helena* have been assessed as Least Concern by the IUCN Red List. The two golden birdwings are large tropical butterflies belonging to the swallowtail family, Papilionidae. Both species have a wide extent of occurrence, being found across South and Southeast Asia. Although these two butterflies do not qualify for a higher extinction risk at the

species-level, they are threatened in parts of their range by habitat loss and degradation. Particularly, the birdwing populations are rapidly declined in Vietnam as consequences of tropical forest degradation, unsustainable harvesting of forest resources for livelihood and expansion of settlements and specimen collection for trades and craftwork (Vu Van Lien, 2014). Currently both species are listed in the Decree No. 06/2019/ND-CP dated January 22, 2019 of the Vietnamese Government on management of endangered, precious and rare species of forest fauna and flora and observation of convention on international trade in endangered species of wild fauna and flora), Red Data Book of Vietnam and the Appendix II of CITES. The further determination of potential threats that the birdwings and their larval food plants are facing is crucial for conserving the two globally important butterflies.

## 5. CONCLUSION

The list containing 167 butterfly taxa in Pu Hoat NR was officially provided for the first time. Of which, the two rare butterfly species (*Troides helena* and *T. aeacus*), that are present on both the Convention on International Trade in Endangered Species of wild fauna and flora (CITES) and the Vietnamese Red List 2007 were recorded. Nine butterfly species were determined as potential bio-indicator species for different forest types in Pu Hoat NR. These findings will be useful for monitoring biodiversity in Vietnam forests where have witnessed the highest relative rate of habitat loss and degradation.

## Acknowledgment

The results of this research are among outputs of the project: Examining the insect diversity and reviewing solutions for insect conservation in Pu Hoat Nature Reserve according to the Decision 118/QĐ-SNN.QLKTKHCN dated on 06/3/2020 of the Nghe An Department of Agriculture and Rural Development.

## REFERENCES

1. Atmowidi, T., Buchori, D., Manuwoto, S., Suryobroto, B. & Hidayat, P., 2007. Diversity of pollinator insects in relation of seed set of Mustard (*Brassica rapa* L.: Cruciferae). *HAYATI J Biosci*, 14:155e61.
2. Pu Hoat Nature Reserve, 2013. Planning for conservation and sustainable development of special-use forests of Pu Hoat Nature Reserve in the period of 2013-2020. Pu Hoat, Que Phong, Nghe An.
3. Brown, K.S.Jr. & Freitas, A.V.L., 2000. Atlantic forest butterflies: Indicators for landscape conservation. *Biotropica*, 32, 934-956.
4. Caceres, M.D. & Jansen, F., 2016. Indicspecies: Relationship between species and groups of sites. R package version 1.7.6. URL <https://cran.r-project.org/web/packages/indicspecies/>.
5. Dahelmi, 2000. Inventarisasi tumbuhan inang kupu-kupu Papilionidae di kawasan Cagar Alam Lembah Harau, Sumatera Barat. *J Matematika IPA*, 9:19e21.
6. Dang Thi Dap & Hoang Vu Tru, 2003. Results of the butterflies (Lepidoptera, Rhopalocera) surveys in Hang Kia – Pa Co Natural Reserve and Ba Be National Park. Science and Technics Publishing House. Hanoi.
7. Dufrene, M. & Legendre, P., 1997. Species assemblages and indicator species, the need for a flexible asymmetrical approach. *Ecol. Monogr.*, 67(3), 345-366.
8. Hanbo, C., 2017. VennDiagram: Generate High-Resolution Venn and Euler Plots. R package version 1.6.18. URL <https://cran.r-project.org/web/packages/VennDiagram>.
9. Ikeda, K., Nishimura, M. & Inagaki, H., 1999. Butterflies of Cuc Phuong National Park in Northern Viet Nam (2). *Butterflies*, 23, 50-63.
10. Ikeda, K., Nishimura, M. & Inagaki, H., 2001. Butterflies of Cuc Phuong National Park in Northern Vietnam (5). *Butterflies*, 30, 58-66.
11. Ikeda, K., Nishimura, M. & Inagaki, H., 2002. Butterflies of Cuc Phuong National Park in Northern VietNam (6). *Butterflies*, 32, 34-38.
12. Metaye, R., 1957. Contribution à l'étude des Lépidoptères du Viêt Nam (Rhopalocères). *Annl's Fac. Sci. Saigon*, 69-106.
13. Monastyrskii, A.L. & Devyatkin, A.L., 2001. Common Butterflies of Vietnam. Field Guide. Labor and Social Publishing House, Hanoi.
14. Monastyrskii, A.L. & Devyatkin, A.L., 2003. A system list of butterflies of Vietnam. Thong Nhat Publishing House, Hanoi.
15. Monastyrskii, A.L. & Devyatkin, A.L. 2015. Butterflies of Vietnam (an illustrated checklist). Planorama Media, Vietnam.
16. Nimbalkar, R.K., Chandekar, S.K. & Khunte, S.P., 2011. Butterfly diversity in relation to nectar food plants from Bhor Tahsil, Pune District, Maharashtra,

India. *J Threat Taxa*, 3:1601e9.

17. Panjaitan, R., 2008. Distribusi kupu-kupu (Superfamili Papilionoidea: Lepidoptera) di Minyambou, Cagar Alam Pegunungan Arfak Manokwari, Papua Barat. *BIB*, 7:11e6.

18. Pham Hong Thai, Ta Huy Thinh, Hoang Vu Tru, Tran Thieu Du, Cao Thi Quynh Nga, Le My Hanh, 2013. The preliminary result of the insect survey in Phia Oac-Phia Den Nature Reserve (Nguyen Binh, Cao Bang). *Proceedings of the 5<sup>th</sup> National conference on Ecology and Biological resources*, Hanoi.

19. Ramos, F.A., 2000. Nymphalid butterfly communities in an Amazonian forest fragment. *J Res Lepid*, 35:29e41.

20. Rusman, R., Atmowidi, T. & Peggie, D., 2016. Butterflies (Lepidoptera: Papilionoidea) of Mount Sago, West Sumatra: Diversity and Flower Preference. *HAYATI Journal of Biosciences*, 23, 1- 6.

21. Schappert P, 2000. *Butterflies*, Firefly Books.

22. Department of Science and Technology of Nghe An, 2017. Report on the results of the project on biodiversity investigation in Pu Hoat Nature Reserve,

Nghe An, and propose solutions for biodiversity conservation. Pu Hoat, Que Phong, Nghe An.

23. Videvall, E, Öckinger, E. & Pettersson, L.B., 2016. Butterfly monitoring using systematically placed transects in contrasting climatic regions – exploring an established spatial design for sampling. *Nature Conservation*, 14, 41-62.

24. Vu Van Lien, 2005. The composition and abundance of butterflies (Lepidoptera, Rhopalocera) in Hon Ba forest, Khanh Hoa. *Agriculture Publishing House*, Hanoi.

25. Vu Van Lien, 2015. Butterfly species list (lepidoptera: rhopalocera) of natural forest on mountain of Pu Mat National Park, Nghe An Province. *Proceedings of the 6<sup>th</sup> National conference on Ecology and Biological resources*, Hanoi.

26. Vu Van Lien, Vu Quang Con, Pham Viet Hung & Tran Thi Thanh Binh, 2014. Results of butterflies (Lepidoptera: Rhopalocera) in three protected areas in central Vietnam: Dakrong, Bach Ma and Ba Na – Nui Chua (survey in April-May 2013). *Proceedings of the 8<sup>th</sup> Vietnam National Conference on Entomology*, Hanoi.

## **KHU HỆ BƯỚM NGÀY TẠI KHU BẢO TỒN THIÊN NHIÊN PÙ HOẠT, TỈNH NGHỆ AN**

**Bùi Văn Bắc**

*Trường Đại học Lâm nghiệp*

### **TÓM TẮT**

Khu Bảo tồn thiên nhiên Pù Hoạt (KBTTN) thuộc Khu Dự trữ sinh quyển miền Tây Nghệ An là khu vực quan trọng trong bảo tồn đa dạng sinh học vùng Duyên hải Bắc Trung Bộ Việt Nam. Khu Bảo tồn thiên nhiên Pù Hoạt có nhiều hệ sinh thái và cảnh quan khác nhau với bốn dạng chính bao gồm rừng kín, rừng thưa, cây bụi và thảm cỏ. Bướm ngày với sự đa dạng và phong phú cao là một trong những mắt xích quan trọng nhất của nhiều quá trình sinh thái. Sự suy giảm tính đa dạng của các loài bướm ngày có thể dẫn đến hiệu ứng tiêu cực cho toàn bộ quần xã. Do đó, các nhà sinh học bảo tồn thường dựa vào sự đa dạng của nhóm bướm ngày như một chỉ số quan trọng cho việc lập kế hoạch và quản lý các khu rừng nhiệt đới. Trong khoảng thời gian từ tháng 4 đến tháng 12 năm 2020, chúng tôi đã thu thập các loài bướm ngày trong ba đợt điều tra thực địa xuyên suốt Khu Bảo tồn thiên nhiên Pù Hoạt. Tổng cộng, 155 đơn vị phân loại bướm ngày đã được ghi nhận trong các cuộc khảo sát, cùng với 12 loài đã được ghi nhận từ các nghiên cứu trước đó. Bài báo cung cấp danh lục loài đầu tiên về tất cả các loài bướm được ghi nhận đến nay tại KBTTN Pù Hoạt. Bên cạnh đó, nghiên cứu đã xác định các loài bướm có tiềm năng làm sinh vật chỉ thị sinh học cho các kiểu rừng khác nhau ở KBTTN Pù Hoạt. Các thông tin này có thể được sử dụng cho việc giám sát đa dạng sinh học ở các khu rừng Việt Nam, nơi có tỷ lệ mất và suy thoái rừng cao.

**Từ khóa:** Khu dự trữ sinh quyển miền Tây Nghệ An, Lepidoptera, Rhopalocera, sinh vật chỉ thị.

**Received** : 13/10/2021

**Revised** : 15/11/2021

**Accepted** : 03/12/2021