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The effect of habitat disturbance and altitudes on the diversity of butterflies (Lepidoptera: Rhopalocera) in a tropical forest of Vietnam: results of a long-term and large-scale study

Влияние нарушенности биотопа и высот на разнообразие дневных бабочек (Lepidoptera: Rhopalocera) в тропическом лесу Вьетнама: результаты многолетнего и широкомасштабного изучения

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КЛЮЧЕВЫЕ СЛОВА: бабочка, фауна, состав, сходство, нарушенность, распределение, высота, Вьетнам

ABSTRACT: The effect of habitat disturbance and altitudes on the diversity of butterflies was assessed in different habitat types and at different altitudes in a long-term and large-scale study of butterfly diversity in the tropical to subtropical forest of Tam Dao National Park, northern Vietnam from 2002 to 2009. Lowlands yielded more butterfly species than highlands. Species diversity increased along with forest disturbance rates, yet dropping both when the forest was heavily disturbed or transformed into agricultural land. The rarity of butterflies (the proportion of rare species) was the highest in natural closed forest, the lowest in agricultural lands. The rarity of butterflies decreased while the commonness (the proportion of common species) increased with growing forest habitat disturbance. The rarity of butterflies was also higher at higher altitudes. Species composition (363 species) varied between different habitat disturbance levels and altitudes; the highest faunal similarity being between agricultural lands at both altitudes considered, the lowest between the natural closed forest at high altitudes and agricultural lands at low altitudes. Species with small geographical ranges were most often found in forested habitats while species with wide geographical distributions occurred in non-forest biotopes.

РЕЗЮМЕ: Оценивался эффект нарушенности биотопа и высот на разнообразие дневных бабочек в разных типах биотопов и на разных высотах во время долгосрочного и широкомасштабного исследования в тропическо-субтропическом лесу Национального парка Там-Дао (Северный Вьетнам) в 2002–2009 годах. На низменности выявлено больше видов бабочек, чем в горах. Разнообразие бабочек росло со степенью нарушенности лесного биотопа, но падало при высокой степени нарушенности леса или превращения его в агроценоз. Редкость бабочек (процент редких видов) была максимальной в естественном сомкнутом лесу, а минимальная – в агроценозах. Редкость бабочек падала, а их обыкновенность (процент тривиальных видов) росла с ростом нарушенности биотопов. Редкость бабочек росла и с высотой. Видовой состав (363 вида) варьировал среди разных уровней биотопической нарушенности и высот, при этом самое высокое фаунистическое сходство обнаруживали агроценозы на обеих высотах, а самое низкое — естественный сомкнутый лес на больших высотах и агроценозы на низких высотах. Узкоареальные виды чаще всего находили в лесных биотопах, а широкораспространенные — в нелесных стациях.

Introduction

Insects, as well as plants and other animals, are unevenly distributed on the earth, most of their diversity being usually observed in the tropics. Tropical forest harbours a great diversity of plants and animals, with insects playing highly important roles in forest ecosystems. However, large portions of tropical forest are allocated in developing and undeveloped countries, currently being disturbed, fragmented and reduced both in quality and quantity. Large forested areas have been converted to agricultural lands and this problem is expected to continue from the present into the future. Negative impacts on natural forests lead to changes in composition and abundance of animals, including insects and butterflies [e.g. Bobo et al., 2006; Roy et al., 2001]. In general, insect diversity is the highest in habitats with the highest plant diversity, the lowest in shrub, grass and open areas [DeVries, 1992]. Different

insect groups show different diversity trends. Some groups such as beetles and moths tend to demonstrate high diversity levels in natural forest, versus low in secondary forest [Morse et al., 1988; Barlow, 1989]. However, butterflies show low diversity rates in natural forest, versus higher in disturbed forests [Brown, 1996; Blair & Launer, 1997; Schulze et al., 2004; Fermon et al., 2005; Bobo et al., 2006]. Some other studies have also indicated that the numbers of butterfly species and individuals are high in secondary and regenerating forests and low in natural forest [Spitzer et al., 1993; Vu & Yuan, 2003], being the highest at the forest edge, the lowest in agricultural lands [Vu, 2009]. When natural forests are disturbed, the species diversity and abundance of butterflies increase, but their diversity is at its highest in moderately disturbed forests, decreasing rapidly in urbanized forests [Brown, 1996; Blair & Launer, 1997]. There may also be large differences in species composition along disturbance gradients from forested landscapes to agricultural environments [Vu, 2009]. Natural forest supports fewer butterfly species, but most of them are endemic and show the most restricted distributions; these species decrease with increasing habitat disturbance and disappear when forests are urbanized [Brown, 1996; Blair & Launer, 1997; Vu, 2009].

The effect of habitat disturbance on butterfly communities and/or their diversity rates on small scales has already been studied in tropical forest [e.g. Spitzer et al., 1997; Vu & Yuan, 2003; Vu, 2009]. However, there have been no explorations in tropical forests of Southeast Asia concerning the diversity of butterfly species in different habitat types and at different altitudes on a large and long-term scale. Previous investigations in the area were usually conducted over short times of 2–3 years and in small areas [Spitzer et al., 1993, 1997; Vu, 2009]. Studies on different area and time scales are important because large-scale and long- term research may add more species and reveal more comprehensive results.

The study aims to examine how the rates of forest habitat disturbance and altitude affect the diversity, rarity and similarity of butterfly species in a long-term and large-scale study of a tropical forest in Vietnam. The project also focuses on the relationship between geographical distribution of species and habitat disturbance levels on a large scale. Even though some studies on short-term and small scales have been conducted and appear to support some of these issues, long-term large scale investigations are likewise needed to check and verify the obtained patterns.

Research methodology

Study area

Research was carried out in Tam Dao National Park, Vinh Phuc Province, Vietnam (21°21'–21°42'N, 105°–105°44'E), with an area of 36,883 ha of natural forest and a 15,515 ha buffer zone. The park is an isolated island of natural habitat surrounded by areas of agriculture. The park is a small ridge (80 km long and 10–15 km wide) with altitudes ranging from 100 m to 1591 m a.s.l. The vegetation is tropical to subtropical rain evergreen closed forest exposed to a seasonally wet tropical climate. The rainy season is from April to October when over 90% of the annual rainfall occurs. High altitude climate differs from that at lowlands. Highlands receive more rainfall and rainy days than lowlands; vegetation at higher altitudes is less diverse than that in the lowlands [Vu, 2008].

Altitudes of studied sites were divided into two altitudinal belts related to vegetation. Tropical forest was mostly found at low altitudes (below 700 m a.s.l.) while subtropical forest occurred at altitudes roughly above 700 m a.s.l. [Thai, 1978]. Plants were identified by Pham [1999, 2000].

Natural closed forest at high altitudes (NFh): forest canopy reaches up to 25 m and the vegetation cover is over 70%, consisting of natural forest with some small natural gaps, characterized by the presence of trees of various families in the climax forest. The forest canopy is uniform, almost without dominant canopy trees. The closed forest was only disturbed by illegal selective logging. Most of the common plant species are in the families Lauraceae, Fagaceae, Theaceae, Magnoliaceae, Hamamelidaceae, Ericaceae and other needle-leaf trees. On the mountain ridges and tops, trees are chiefly short and small, belonging to the families Magnoliaceae, Illiaceae and Ericaceae.

Disturbed forest at high altitudes (DFh): the forest was disturbed by illegal logging of timbers and bamboos, widening and improving the road in the forest and other human activities. Plant species are diverse, containing plants of the natural closed forest along with those grown in open areas such as *Litsea cubeba* (Lauraceae). The main plant species are in the families Fagaceae, Magnoliaceae, Rosaceae, Moraceae, Lauraceae, Theaceae, Euphorbiaceae and Aceraceae.

Shrub and grass at high altitudes (SGh): the habitat is characterized by the presence of shrubs and grasses. The main species are in the families Poaceae, Melastomaceae etc. Common plants are *Euphorbia thymifolia* (Euphorbiaceae), *Melastoma* spp. (Melastomaceae), *Centotheca* spp., *Saccharum* spp. and other grasses of the family Poaceae.

Agricultural lands at high altitude: the area is in the local tourist resort. The main vegetable plants are Chayote (*Sechium edule*), *Luffa operculata*, and *Cucurbita* spp. (Cucurbitaceae), and some kinds of vegetables such as *Brassica* spp. (Brassiceaceae). Grasses are also present, such as *Saccharum arundidinaceum, Imperata cylindryca*, *Thysannolena maxima* and *Eleusine indica.*

Natural closed forest at low altitudes (NFl): the forest canopy reaches 35 m and shows storeys with high vegetation diversity. The tallest are species of Dipterocarpaceae. Most of the species in the dominant layer are in the families Lauraceae, Fagaceae, Myrtaceae and Rubiaceae. Plants in the undercanopy are shade-preference species with most of them in the families Myristi-

caceae and Anonaceae. Forest cover is above 70%, with the diameter of trees from 20 cm to 80 cm. There are many plant species in the families Dipterocapaceae, Lauraceae, Fagaceae, Myrtaceae, Rubiaceae, Annonaceae, Myristicaceae, Magnoliaceae, Theaceae, Fabaceae etc.

Disturbed forest at low altitudes (DFl): vegetation consists of small trees and bamboo, with bamboo dominating in some places. The forests were heavily disturbed in previous years as large timbers were logged. Plant species are diverse in different families with many of the same species as the natural closed forest; in addition, more open area and flowering plant species are present in the openings.

Shrub and grass at low altitudes (SGl): the habitat is characterized by the presence of shrubs and grasses of the families Caesalpiniaceae, Melastomaceae, Myrtaceae, Acanthaceae, Poaceae, Asteraceae, Euphorbiaceae and Rubiaceae.

Agricultural lands at low altitudes (AGl): a variety of planted trees and crop plants from rice, vegetables and other cultivated plants in the families Euphorbiaceae, Fabaceae, Musaceae, Rutaceae, Cucurbitaceae. Common plants are *Brassica* spp., *Cucurbita* spp., *Luffa operculata* (Cucurbitaceae), *Manihot* sp. (Euphorbiaceae), *Musa* spp. (Musaceae).

Sampling methods

Individual butterflies were counted during surveys to provide both species presence and relative abundance in different habitat types and at different altitudes. Most of the butterflies were identified immediately by sight in the field. However, a number of individuals (ca 1000) were collected for identification, especially small butterflies of the families Lycaenidae and Hesperiidae. Sweep nets and baited traps were used to collect butterflies as well. Identification and nomenclature of butterfly species followed Chou (1994), D'Abrera [1982-86], Monastyrskii and Devyatkin [2003], Lekagul et al. [1977], Osada et al. [1999].

The study took place in several different areas (24 sites) of the park from the buffer zone to the core area, from lowland (100 m a.s.l.) to the mountain top (1,591 m a.s.l.), during the years 2002 to 2009. Each surveyed area was from 4 to 8 km in length and 1–2 sites could be surveyed on a given day. The study sites consisted of different habitat types, from maximally disturbed (agricultural lands) to undisturbed (natural closed forest). Typically, surveys took place from April to November, although occasionally sampling took place in other months as well. Sampling occurred on 4–6 days per month and between 8:00 am and 5:00 p.m. Bad weather was avoided. A total of more than 1000 person-day of surveying butterflies was implemented.

Data analysis

The similarity of species composition between different habitat types and altitudes (Bray-Curtis similarity) was analyzed with Cluster Analysis using Similarity Tree software [Primer, 2001].

Information on the geographical distribution of each species was taken from Chou [1994], D'Abrera [1982–1986], Devyatkin & Monastyrskii [2002], Hill & Monastyrskii [1999], Lekagul et al. [1977], Spitzer et al. [1993, 1997], Vu [2009]. The geographical distribution ranges (R) of species were categorized on a scale from 1 to 5 (smallest to largest): (R1) Endemic: East Himalayas, South China, North Indochina; (R2) Southeast Asian mainland; (R3) Indo-Malayan region; (R4) Indo-Malayan and Australasian regions; and Palaearctic, extending into the Indo-Malayan region; and (R5) Old World tropics, Holarctic, or Cosmopolitan.

The relative abundance of species was counted as rare species (up to 2 individuals), uncommon species (more than 2 to 4 individuals), and common species (more than 4 individuals). Individuals were counted for 10 survey days. This was used as an *ad hoc* measurement only.

Results

A total of 363 butterfly species in 11 families was recorded in Tam Dao National Park. The species list and their relative abundance are presented in Appendix. Six of these species are of special concern and are listed in IUCN or CITES. Among them, *Teinopalpus aureus* are listed in Appendix II of IUCN; in addition, this species and two *Troides* (*T. helena* and *T. aeacus*) are listed in Appendix II of CITES; species listed in IUCN as being in need of a study are *Meandrusa sciron, Byasa crassipes,* and *Papilio noblei* [New & Collins, 1991].

Butterfly distributions differed between habitat types as shown in Table. The distribution of butterfly species by habitat types depended on their habitat preferences. The disturbed forests (DFh and DFl) supported the greatest number of species (240 and 272, respectively), followed by shrub and grass habitats (SGh and SHl) with 168 and 196 species, respectively. The natural closed forests (NFh and NFl) ranked third. The agricultural lands (AGh and AGl) show the least number of species (88 and 97 species, respectively). Low-altitude species numbers were consistently higher than high-altitude ones for a given habitat. Almost all butterfly families contain species recorded in disturbed forests, as well as shrub and grass habitats, namely, Hesperiidae, Lycaenidae, Nymphalidae, Papilionidae and Pieridae. The families Amathusiidae, Satyridae and Riodinidae encompass most of their constituent species in the natural closed forests and in disturbed forests, as well at both altitudes delimited. High-altitude natural and disturbed forests contained 73% of species in the family Amathusiidae, 82% and 73% in the natural closed forest and in the disturbed forest at low altitudes, respectively. The family Satyridae contains 74% of its species diversity in the natural closed forest and in the disturbed forest at high altitudes, and 76% and 73% in the natural closed forest and in the disturbed forest at low altitudes, respectively. The family Riodinidae shows 75% of its species in the natural closed forest and in the

disturbed forest at high altitudes, and 62% and 75% in the natural closed forest and in the disturbed forest at low altitudes, respectively. Shrub and agricultural lands supported very few species from these three families.

Table. Species number in different habitat types and at different altitudes in Tam Dao National Park.
Таблица. Число видов в различных типов биотопов и на различных высотах в Национальном парке Там-Дао.

Butterfly family	High altitude				Low altitude			
	NFh	DFh	SGh	AGh	NFl	DFl	SGl	AGl
Acraeidae	0	1	1	1	0	2	2	1
Amathusiidae	8	8	1	1	9	8	1	1
Danaidae	10	14	13	8	9	14	13	9
Hesperiidae	24	46	30	18	29	51	38	19
Libytheidae	0	0	1	0	0	0	1	0
Lycaenidae	17	26	20	12	20	33	25	15
Nymphalidae	28	56	44	18	51	73	56	19
Papilionidae	18	29	19	10	18	31	22	11
Pieridae	9	24	22	13	17	24	20	15
Riodinidae	6	6	2	1	5	6	1	1
Satyridae	30	30	15	6	31	30	17	6
Total species	150	240	168	88	189	272	196	97

NOTE: NFh/NFl: the natural closed forest at the high/low altitude; DFh/DFl: the disturbed forest at the high/low altitude; SGh/SGl: the shrub and grass at the high/low altitude; AGh/AGl: agricultural lands at the high/low altitude.

Rare species make up the highest proportion of species richness (46.0%) in Tam Dao National Park. Common species (15.4% of the total) compose the lowest share. The proportion of uncommon species comprises 38.6% of the total species diversity. Species abundance levels (rare, uncommon, and common) are different in different habitat types and at different altitudes. Fig. 1 shows that the natural closed forests at both altitudes (NFh and NFl) support most of the rare species (59% and 52 %, respectively), their proportions being higher than in other habitats. The agricultural lands at both altitudes harbour the lowest proportion of rare species (20% and 16%, respectively). The natural closed forests at both altitudes reveal the lowest share of common species (6% and 7%, respectively). The agricultural lands at both altitudes support most of the common species (25% and 36%, respectively). The proportion of rare species tends to decrease from the natural closed forest to agricultural lands. That of common species tends to increase with a growing forest habitat disturbance (from natural closed forest to agricultural lands). Nevertheless, the share of uncommon species seems similar between habitats and altitudes (varying from 35% to 48%). A decreased proportion of rare species and an increased one of common species with increasing forest habitat disturbance was significantly related, amounting to $r^2 = 0.949$; $p < 0.01$ at high altitudes and $r^2 = 0.986$; $p < 0.01$) at low ones.

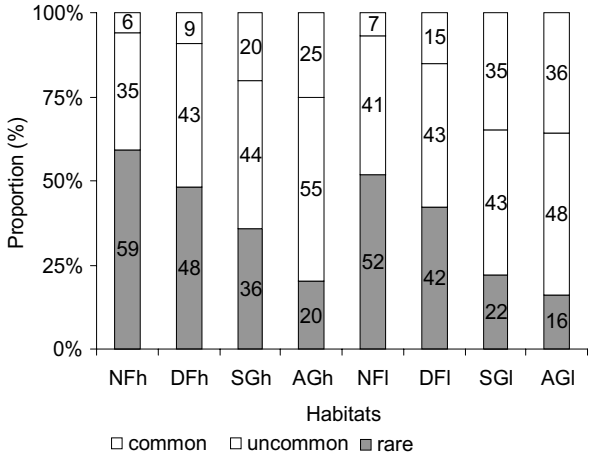

Fig. 1. Proportions of species abundance by habitats. Note: Habitats as in Table.

Рис. 1. Пропорции обилия видов по биотопам. NB: Биотопы как в Таблице.

Similarity of species composition between habitat types

Species composition similarity between habitats with different forest disturbance levels is shown in Fig. 2. The similarity of species composition in all habitats was rather low (43%) and divided into two groups. Natural closed forests and disturbed forests at both altitudes make up one group (61%) while the other habitats at both altitudes form the other (63%). The greatest similarity is observed between agricultural lands at low and high altitudes (89%), followed by shrub and grass habitats at low and high altitudes (81%). Disturbed forests of low and high altitudes were also similar (77%). The similarity of species composition in natural closed forests between

both altitudes considered is also rather high (66%). The largest difference in species composition was between the habitat types that were the most disparate, that is, the natural closed forest at high altitudes and the agricultural lands at low altitudes (22%). Species composition was similar between comparable habitat types (forested habitats versus non-forested habitats).

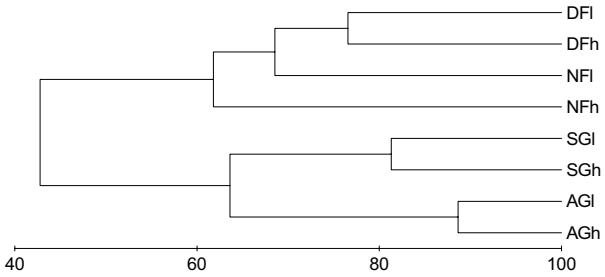

Fig. 2. Similarity of species composition between habitat types and altitudes. Note: Habitats as in Table.

Рис. 2. Сходство видового состава по типам биотопам и высотам. NB: Биотопы как в Таблице.

Geographical distribution of species in different habitat types and at different altitudes

The geographical distribution ranges of butterfly species from the smallest (R1) to the largest (R5) in different habitats with different disturbance levels and altitudes are shown in Figs 3 and 4. Consistent with both altitudes, butterflies with the smallest range (R1) decreased in proportion to increasing forest habitat disturbance. Species with the smallest range (R1) are absent from agricultural lands. The share of species distributed in the Southeast Asian mainland (R2) also decreases gradually with increasing forest habitat disturbance. The proportions of species with the most restricted (R1: Indochina) and larger geographical distribution range (R2: Southeast Asia mainland) decrease with increasing forest habitat disturbance: Indochina species ($r = –0.950$; $p < 0.05$ at high altitudes; $r = –0.960$; $p < 0.05$ at low altitudes) and Southeast Asian mainland species ($r = –0.948$; $p < 0.05$ at high altitudes; $r = –0.980$; $p < 0.05$ at low altitudes). The share of species distributed in the Indo-Malayan region is almost the same among habitats (from 41% to 72% at low altitudes and from 58% to 72% at high altitude). There was no significant difference in the proportion of species in the Indo-Malayan region ($r = 0.823$; $p = 0.20$ at high altitudes; $r = 0.673$; $p = 0.40$ at low altitudes). As species ranges increased (> Indo-Malayan region), the proportion grew with increasing forest habitat disturbance (e.g., species distributed in the Indo-Malayan and Australasian regions, and Palaearctic ($r = 0.997$; $p < 0.05$ at high altitudes; $r = 0.980$; $p < 0.05$ at low altitudes). The results indicate that there was a positive correlation between the size of species geographical distribution and the rate of increasing forest habitat disturbance.

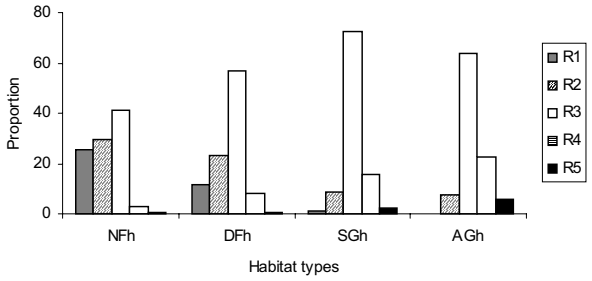

Fig. 3. Geographical distribution of species in different habitat types at high altitudes. Note: The smallest (R1) to the largest geographical distribution ranges (R5); habitats as in Table.

Рис. 3. Географическое распространение видов в разных типах биотопов в горах. NB: Самые узкоареальные (R1) до самых широкоареальных видов (R5); биотопы как в Таблице.

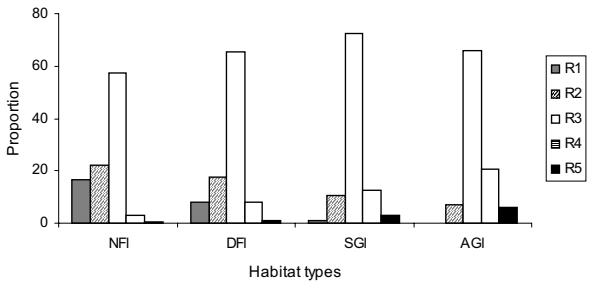

Fig. 4. Geographical distribution of species in different habitat types at low altitudes. Note: The smallest (R1) to the largest geographical distribution range (R5); habitats as Table.

Рис. 4. Географическое распространение видов в разных типах биотопов в низинных местах. NB: Самые узкоареальные (R1) до самых широкоареальных видов (R5); биотопы как в Таблице.

Discussion

Natural closed forest shows fewer butterfly species than disturbed forests. The latter support more species than shrub and grass habitats and agricultural lands. The agricultural lands yield the least number of species, a result consistent with previous observations [Vu & Yuan, 2003; Vu, 2009]. Unsurprisingly, disturbed forests harbour a greater diversity of plants than natural closed forest while the higher the diversity of plants, the greater that of insects [Price, 1975; Spitzer et al., 1987]. In addition, disturbed forests have more openings that provide more light and space to attract more butterfly species than natural closed forest [Hill et al., 2001; Spitzer et al., 1997]. Disturbed forests also show more flowering plants which obviously support more butterfly species than natural closed forest. Other studies have likewise indicated that the diversity both of species and individuals in butterfly communities increases when natural forests get disturbed; the diversity reaches the highest in moderately disturbed forests, but drops rapidly in urbanized forests; endemic species disappear when their habitats are urbanized [Brown 1996; Blair & Launer, 1997].

Natural forests are richer in abundance of rare species and this metric decreases with increasing forest habitat disturbance levels. Conversely, common species increase with growing forest habitat disturbance levels. Altitude also plays a role, with rare species abundance being greater at high altitudes compared to low ones. The greatest proportion of rare species is found in natural closed forest in high altitudes while more common species are yielded in agricultural lands at low altitudes. These results correspond well with those of Lewis et al. [1998] who found that most of the rare species are found in natural closed forest at high elevations; altitudes being equal, most of the rare species are confined to natural closed forest, their proportions getting lower in secondary forests to become the lowest in cultivated lands. Thus, high-altitude forest is particularly important for conservation of rare butterfly species.

Overall species diversity is higher at low altitudes than at high ones. This result corresponds well with theory and practice as well, since previous work indicated that the diversity of insects or butterflies alone decreases with increasing latitude or altitude [e.g. Price, 1975; Sparrow et al., 1994; Vu & Yuan, 2003]. High altitudes receive more rainfall and rainy days than lower elevations. In addition, vegetation at low altitudes is more diverse than that at high altitudes. All these factors support higher levels of species diversity of butterflies at low altitudes compared to higher ones.

The butterfly species composition differed between habitat disturbance levels and altitudes. This result is similar to those obtained by Steffan-Dewenter & Tscharntke [1997] and Vu [2009]. Nelson & Wydoski [2008] also showed that the butterfly community composition changed between different habitats. It was highly similar between comparable habitats (natural closed forest and disturbed forests; or shrubs and grass and agricultural lands). The greatest differences are those observed between natural closed forest at high altitudes and lowland agricultural lands. The species composition of forested habitats (natural forest and disturbed forests) differs from that of non-forested biotopes (shrub, grass and agricultural lands). Whether a habitat was forest or non-forest was a major factor while altitudes were a minor factor in deciding the similarity of butterfly species composition between habitats. Species composition is similar between forest habitats or between non-forest habitats. Hill et al. [2001] and Schulze et al. [2004] also showed that the species composition of butterfly communities is dissimilar between the natural forests and the agricultural lands, and between forest canopy and openings in the forests similar between natural forests and old secondary forests. Habitats influence the similarity of butterfly compostion between areas [Posa & Sodhi, 2006].

The proportion of species with the most restricted distributions is the highest in natural closed forest, dropping with increasing forest habitat disturbance. The most characteristic species of natural closed forest are endemics that show the smallest geographical ranges. They are forest species and many of them live under forest canopy. When forests are urbanized, the forest species tend to disappear due to the lost of their unique habitat [Brown, 1996; Blair & Launer, 1997]. They show low tolerance to forest destruction and a decreased ability to live in disturbed forests. Examples include *Stichphthalma howqua, Neope murrheadi,* and *Ragadia crilsida*. These are forest indicator species [Vu, 2007]. Thomas [1991] also indicated that butterfly species with small geographical ranges have less ability to live in modified habitats than species with wider distributions. Lewis et al. [1998] emphasized that most of the widespread species follow human-impacted habitats. The species found in agricultural lands tend to have the largest geographical ranges. They are open-land or non-forest opportunistic species. The high proportion of endemic species in natural closed forest shows this undisturbed forest habitat to be of high conservation value, although its species diversity is low compared to those in disturbed forest habitats and shrub and grass biotopes. This result also agrees with previous work [Spitzer et al., 1997; Vu, 2009].

The results of our long-term and large scale study support the earlier views derived from short-term surveys [Spitzer et al., 1997; Vu & Yuan, 2003; Vu, 2009]. However, we have detected many more species than did the previous short-term investigations conducted on a small scale, with less than 200 species involved, as in Spitzer et al. [1997], Vu [2009] and Vu & Yuan [2003].

More species live in lowlands than in the mountains. Some species appear to be restricted to lowlands, some others to high altitudes, some are being found only on mountain tops, such as the rare CITES species *Teinopalpus aureus* (found on mountain tops of more than 1,200 m elevations) [Vu, 2005]; a IUCN species restricted to lowlands is *Papilio noblei*. When temperatures at higher altitudes increase, lowland species could expand to higher altitudes, similar to some butterfly species of England extending northward due to global warming [Pollard & Yates, 1993]. Does global warming affect the vertical distribution of butterflies? Perhaps in the future more lowland species will expand to highlands and there result in greater species diversity levels. Global warming will likely threaten the existence of insects beyond butterflies. Can they adapt to global warming? Long-term monitoring of butterflies can perhaps shed some light on these questions.

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Appendix. Abundance of butterfly species in different habitat types in Tam Dao National Park
Приложение. Обилие видов чешуекрылых в различных местообитаниях вНациональном Парке Там Дао

No.	Species	DR	High altitude				Low altitude			
			1	2	3	4	5	6	7	8
	Papilionidae									
1	*Troides helena* (Linnaeus, 1758)	3	u	u	u		u	u	u	
2	*Troides aeacus* (C. Felder et R. Felder, 1860)	3	u	u	u		u	u	u	
3	*Atrophaneura varuna* (White, 1868)	2	u	u			u	u		
4	*Atrophaneura aidoneus* (Doubleday, 1845)	2	u	u			u			
5	*Atrophaneura polyeuctes* (Doubleday, 1842)	2	r	r			r	r		
6	*Byasa dasarada* (Moore, 1857)	2	r	r						
7	*Byasa crassipes* (Oberthür, 1879)	2	r	r			r	r		
8	*Pachliopta aristolochiae* (Fabricius, 1775)	3					r	u	u	
9	*Chilasa slateri* (Hewitson, 1857)	3		r				r	r	
10	*Chilasa clytia* (Linnaeus, 1758)	3			u			u	u	
11	*Chilasa paradoxa* (Zinken, 1831)	3						u		
12	*Papilio demoleus* Linnaeus, 1758	4		r	u	c		u	c	c
13	*Papilio noblei* de Nicéville, 1889	1					r	r		
14	*Papilio nephelus* (Boisduval, 1836)	3	r	r	r		r	r	u	u
15	*Papilio helenus* (Linnaeus, 1758)	4	u	c	c	c	c	c	c	c
16	*Papilio polytes* (Linnaeus, 1758)	3		r	u	u		u	c	c
17	*Papilio memnon* Linnaeus, 1758	3		u	c	u	u	c	c	u
18	*Papilio protenor* Cramer, 1775	2	c	c	c	c	c	c	c	c
19	*Papilio dialis doddsi* Janet, 1896	1	u	u			r	r		
20	*Papilio bianor* (Cramer, 1777)	4		r	u					
21	*Papilio paris* Linnaeus, 1758	3		r	c	r		u	c	u
22	*Papilio arcturus* Westwood, 1842	2	r	r						
24	*Meandrusa sciron* Leech, 1890	2	r	u						
25	*Meandrusa payeni* (Boisduval, 1836)	3	r	r			r	r		
26	*Teinopalpus aureus* Mell, 1923	1	r							
27	*Graphium sarpedon* (Linnaeus, 1758)	4		u	c	u		c	c	u
28	*Graphium doson* (C. Felder et R. Felder, 1864)	3		r		u		c	c	u
29	*Graphium eurypylus* (Linnaeus, 1758)	4						u	u	
30	*Graphium evemon* (Boisduval, 1836)	3						r		
31	*Graphium chironides (*Honrath, 1884)	3		u	r			r	r	
32	*Graphium agamemnon* (Linnaeus, 1758)	4			u	r			c	r
33	*Graphium agetes* (Westwood, 1843)	3		r	r			r		
34	*Graphium nomius* (Esper, 1799)	2						u		
35	*Graphium antiphates* (Cramer, 1775)	3	r	u	u		u	c	c	
36	*Graphium macareus* (Godart, 1819)	3	r	r			r	r		
37	*Graphium xenocles* (Doubleday, 1842)	3		u	u			c	u	
38	*Graphium megarus* (Westwood, 1844)	3	r	r			r	r		
39	*Lamproptera curius* (Fabricius, 1787)	3		u	c	u	u	c	c	u
40	*Lamprotera meges* (Zinken-Sommet, 1831)	3		r	r		r	u	c	
	Pieridae									
41	*Delias pasithoe* (Linnaeus, 1767)	3		u	c	c	c	u	c	c
42	*Delias acalis* (Godart, 1819)	2	u	u	u		r	r	u	u
43	*Delias agostina* (Hewitson, 1852)	2	r	r						
44	*Delias hyparete* (Linnaeus, 1758)	3	u	u	u		u	u	u	
45	*Prioneris thestylis* (Doubleday, 1842)	3	u	u	c	u	u	c	c	u
46	*Prioneris philonome* (Boisduval, 1836)	3	u	u			u	u		
47	*Pieris brassicae nepanlensis* Gray, 1846	2			u	u			u	u
48	*Pieris canidia* (Linnaeus, 1768)	4		u	c	c		u	c	c

Appendix. Continued. Приложение. Продолжение

No.	Species	DR	High altitude				Low altitude			
			1	2	3	4	5	6	7	8
49	*Pieris erutae* Poujade, 1888	4		r	r					
50	*Talbotia naganum* (Moore, 1884)	1	r	r			r	r		
51	*Appias albina* (Boisduval, 1836)	4	r	u	u	u	u	c	c	u
52	*Appias indra* (Moore, 1857)	2		u	u	r	u	u	u	r
53	*Appias lalage* (Doubleday, 1842)	3		u	u		r	r	u	
54	*Appias lyncida* (Cramer, 1777)	3		r	u	u	u	u	c	u
55	*Appias nero* (Fabricius, 1793)	3		u	u	u		r	u	u
56	*Appias pandione* (Geyer, 1832)	3		u	u					
57	*Appias paulina* (Cramer, 1777)	4						r	r	
58	*Ixias pyrene* (Linnaeus, 1764)	3		u	u		r	r	r	
59	*Hebomoia glaucippe* (Linnaeus, 1758)	3	r	u	u	r	r	u	c	r
60	*Pareronia avatar* (Moore, 1858)	3					r	r		
61	*Colias fieldii* Ménétriés, 1855	4			r					
62	*Dercas verhuelli* (van de Hoeven, 1839)	2		u			r	u		
63	*Catopsilia pomona* (Fabricius, 1775)	5		u	u	c		u	c	c
64	*Eurema hecabe* (Linnaeus, 1758)	4		u	c	c		u	c	c
65	*Eurema blanda* (Boisduval, 1836)	4			u	c		c	c	c
66	*Eurema andersonii* (Moore, 1886)	3		r	r			u	u	u
67	*Gandaca harina* (Horsfield, 1829)	3	r	r			r	u		
68	*Cepora nadina* (Lucas, 1852)	3		u	u	u	u	u	c	u
69	*Cepora nerissa* (Fabricius, 1775)	3		r	u		u	u	c	
	Danaidae									
70	*Danaus chrysippus* (Linnaeus, 1758)	4		r	u	u		r	u	u
71	*Danaus genutia* (Cramer, 1779)	4		u	c	u	u	u	c	c
72	*Tirumala limniace* (Cramer, 1775)	3					r	u	u	
73	*Tirumala septentrionis* (Butler, 1874)	4	u	c	c	c	u	c	c	c
74	*Parantica aglea* (Stoll, 1782)	4	u	c	c	c	u	c	c	c
75	*Parantica melaneus* (Cramer, 1775)	3	u	c	c	u	u	c	c	u
76	*Parantica swinhoei* (Moore, 1883)	3	r	u	u		r	r		
77	*Parantica sita* (Kollar, 1844)	3	u	c	u					
78	*Ideopsis similis* (Linnaeus, 1758)	3	c	c	c	u	c	c	c	c
79	*Euploea core* (Cramer, 1780)	3	u	u	u		u	u	c	
80	*Euploea sylvester* (Fabricius, 1793)	3		r	r			r	u	
81	*Euploea mulciber* (Cramer, 1777)	3	u	c	c	c	u	c	c	c
82	*Euploea tulliolus* (Fabricius, 1793)	4		r	r	u		u	u	u
83	*Euploea midamus* (Linnaeus, 1758)	3	r	r	u			u	u	
84	*Euploea eunice* (Godart, 1819)	3	r	r	u			u	u	r
	Satyridae									
85	*Melanitis leda* (Linnaeus, 1758)	5	c	c	c	c	c	c	c	c
86	*Melanitis phedima* (Cramer, 1780)	3	r	r	r		u	u	r	
87	*Elymnias hypermnestra* (Linnaeus, 1763)	3		u	u	u	u	c	c	c
88	*Elymnias patna* (Westwood, 1851)	3	r	r	r	r	r	r	r	r
89	*Elymnias malelas* (Hewitson, 1863)	1					r	r	r	
90	*Lethe europa* (Fabricius, 1787)	3	r	r	r		u	u	u	
91	*Lethe rohria* (Fabricius, 1787)	3	r	r	r					
92	*Lethe confusa* Aurivillius, 1897	3	u	c	u	u	u	c	c	u
93	*Lethe verma* (Kollar, 1844)	3	u	c	r	u	u	c	r	
94	*Lethe mekara* (Moore, 1858)	3					r	r	r	
95	*Lethe chandica* (Moore, 1858)	3	r	u	r		u	u		
96	*Lethe insana* (Kollar, 1844)	3	u	u	r		u	u	r	

Appendix. Continued. Приложение. Продолжение

No.	Species	DR	High altitude				Low altitude			
			1	2	3	4	5	6	7	8
97	*Lethe vyndhia* (C. Felder et R. Felder, 1859)	2	u	u			u	u		
98	*Lethe gulnihal* de Nicéville, 1887	1	r	r			r	r		
99	*Lethe kansa* (Moore, 1857)	2	r	r			r			
100	*Lethe sinorix* (Hewitson, 1863)	3	r	r			r	r		
101	*Lethe bhairava* (Moore, 1857)	1	r	r			r			
102	*Lethe naga* Doherty, 1889	2	u	r						
103	*Lethe philemon* Fruhstorfer, 1911	1	r	r						
104	*Lethe syrcis* (Hewitson, 1863)	1	c	c	u		c	c	u	
105	*Lethe gemina* Leech, 1891	1	u	u						
106	*Neope bhadra* (Moore, 1857)	1	r				r			
107	*Neope armandii* (Oberthür, 1876)	1	r							
108	*Neope muirheadi* (C. Felder et R. Felder, 1862)	1	c	c	r		c	c		
109	*Mandarinia regalis* (Leech, 1889)	1	u	u			u	u		
110	*Neorina patria* (Leech, 1891)	1	u	r			u	r		
111	*Ethope noirei* (Janet, 1896)	1	u				u			
112	*Penthema michallati* (Janet, 1894)	2	u	u			u	u		
113	*Mycalesis perseoides* (Moore, 1892)	2					u	u	u	
114	*Mycalesis mineus* (Linnaeus, 1758)	3						u	c	c
115	*Mycalesis intermedia* (Moore, 1892)	3						u	u	
116	*Mycalesis adamsonii* Watson, 1897	2					u	u	u	
117	*Mycalesis anaxias* Fruhstorfer, 1911	3		r	r			u	u	
118	*Mycalesis inopia* Fruhstorfer, 1908	1	r	r			r	r		
119	*Mycalesis misenus* de Nicéville, 1901	1	c	c	r		c	c		
120	*Coelites nothis* Westwood, 1850	1					u			
121	*Ragadia crisilda* Hewitson, 1862	2	c	c			c	c		
122	*Ypthima baldus* (Fabricius, 1775)	3		u	u	c		c	c	c
123	*Ypthima imitans* Elwes & Edwards, 1893	1		c			u	u		
124	*Ypthima tappana* Matsumura, 1909	1	r							
125	*Ypthima praenubila* Leech, 1891	1	r	r			r	r		
	Amathusiidae									
126	*Faunis canens* (Hübner, 1826)	2	r	r			u	u		
127	*Faunis eumeus* (Drury, 1773)	2					u	u		
128	*Faunis aerope* (Leech, 1890)	1	r	r			r			
129	*Aemona amathusia (*Hewitson, 1867)	2	r				u	u		
130	*Stichophthalma fruhstorferi* Röber, 1903	1	r	r						
131	*Stichophthalma howqua* (Westwood, 1851)	1	c	c			c	c		
132	*Thaumantis diores* Doubleday, 1845	1	r	r			u	u		
133	*Thauria lathyi* (Fruhstorfer, 1902)	1	r	r			u	u		
134	*Discophora sondaica* Boisduval, 1836	3		r	r	u	u	c	c	u
135	*Discophora deo* de Nicéville, 1898	2					r	r		
136	*Enispe euthymius* (Doubleday, 1845)	2	u	u						
	Acraeidae									
137	*Acraea issoria* (Hübner, 1819)	3		r	r	r		r	r	r
138	*Acraea violae* (Fabricius, 1793)	2						r	r	
	Nymphalidae									
139	*Ariadne ariadne* (Linnaeus, 1763)	3			u	u			u	u
140	*Argyreus hyperbius* (Linnaeus, 1763)	3			c	u			c	c
141	*Cupha erymanthis* (Drury, 1773)	3	r	r		u	u	u	u	u
142	*Phalanta phalantha* (Drury, 1773)	3							r	
143	*Vagrans egista* (Cramer, 1780)	4		u	c	u		u	c	c
144	*Vindula erota* (Fabricius, 1793)	3	u	u	u	u	u	c	c	u

Appendix. Continued. Приложение. Продолжение

No.	Species	DR	High altitude				Low altitude			
			1	2	3	4	5	6	7	8
145	*Cirrochroa tyche* C. Felder & R. Felder, 1861	3	u	c	c	u	u	c	c	u
146	*Terinos atlita* (Fabricius, 1787)	3	r				r	r		
147	*Cethosia biblis* (Drury, 1773)	3		u	c	u	u	u	c	c
148	*Cethosia cyane* (Drury, 1773)	2		r	r	r	r	r	u	
149	*Kanisca canace* (Linnaeus, 1763)	3	r	r	r		r	r	r	
150	*Vanessa cardui* (Linnaeus, 1758)	6			c	c			c	c
151	*Vanessa indica* (Herbst, 1794)	5			u	u			u	u
152	*Polygonia c-aureum* (Linnaeus, 1758)	3	r	r	r		r	r	r	
153	*Symbrenthia lilaea* (Hewitson, 1864)	3		u	u	u	u	c	c	c
154	*Symbrenthia hypselis* (Godart, 1824)	3	r	u	u		u	u	u	
155	*Hypolimnas bolina* (Linnaeus, 1758)	4		u	c	u	u	u	c	u
156	*Hypolimnas misippus* (Linnaeus, 1764)	4			r			r	r	
157	*Junonia iphita* (Cramer, 1779)	3						u	u	u
158	*Junonia atlites* (Linnaeus, 1763)	3		u	u			u	c	
159	*Junonia almana* (Linnaeus, 1758)	3			u	u		u	c	c
160	*Junonia orythia* (Linnaeus, 1758)	4		r	r	u		u	u	u
161	*Junonia lemonias* (Linnaeus, 1758)	3		r	r					
162	*Junonia hierta* (Fabricius, 1798)	3?		r	r	u				
163	*Kallima inachus* (Boisduval, 1846)	2	r	r			u	u		
164	*Doleschallia bisaltidae* (Cramer, 1777)	3					u	u		
165	*Cyrestis cocles* (Fabricius, 1787)	3					r	r		
166	*Cyrestis thyodamas* Boisduval, 1836	3	u	u	u	u	u	u	u	u
167	*Chersonesia risa* (Doubleday, 1848)	3	r	r			u	u		
168	*Pantoporia hordonia* (Stoll, 1790)	3		u	c			u	c	
169	*Lasippa tiga* (Moore, 1858)	3						r	r	
170	*Neptis hylas* (Linnaeus, 1758)	4		u	c	u		u	c	u
171	*Neptis clinia* (Moore, 1872)	3			u			u	u	
172	*Neptis soma* Moore, 1858	3		u				r	u	
173	*Neptis nata* Moore, 1858	3						r	u	
174	*Neptis harita* Moore, 1875	3		r	r			r	r	
175	*Neptis miah* Moore, 1858	2	u	u	u		u	u	u	
177	*Neptis magadha* C. Felder & R. Felder, 1867	3						r		
178	*Neptis nashona* Swinhoe, 1896	2		r				r	r	
179	*Neptis namba* Tytler, 1915	2	r	r			r	r		
180	*Neptis ananta* Moore, 1858	2	r	u				u	u	
181	*Neptis radha* Moore, 1857	2	r	u						
182	*Phaedyma columella* (Cramer, 1780)	3		r	r		u	u	u	
183	*Athyma perius* (Linnaeus, 1758)	3			r				r	
184	*Athyma asura* Moore, 1858	2	r	r	r		r	r	r	
185	*Athyma cama* Moore, 1858	3	r	u	c		r	r	c	
186	*Athyma nefte* (Cramer, 1780)	3		u	u			u	u	
187	*Athyma ranga* Moore, 1857	2		r	r			r	r	
188	*Athyma selenophora* (Kollar, 1844)	3	r	u	c		r	r	c	
189	*Athyma zeroca* Moore, 18725	2					r	r	u	
190	*Parthenos sylvia* (Cramer, 1776)	4		u	u			u	c	
191	*Lebadea martha* (Fabricius, 1787)	3		u			r	r		
192	*Sumalia daraxa* (Doubleday, 1848)	3		u						
193	*Parasarpa dudu* (Westwood, 1848)	3	r	u			u	u		
194	*Moduza procris* (Cramer, 1777)	3		r				r	r	
195	*Neurosigma siva* (Westwood 1850)	1	r				r			
196	*Tanaecia julii* (Lesson, 1837)	3		u	u		u	c	c	

Appendix. Continued. Приложение. Продолжение

No.	Species	DR	High altitude				Low altitude			
			1	2	3	4	5	6	7	8
197	*Tanaecia lepidea* (Butler, 1868)	3					c	c	u	
198	*Lexias dirtea* (Fabricius, 1793)	3					r	r		
199	*Lexias pardalis* Moore, 1878	3					c	c		
200	*Euthalia whiteheadi* Grose-Smith, 1889	3					r	r		
201	*Euthalia lubentina* (Cramer, 1777)	3			r		r	u	u	
202	*Euthalia malaccama* Fruhstorfer, 1899	3					r	r		
203	*Euthalia niepelti* Strand, 1916	2	r	r			r	r		
204	*Euthalia phemius* (Doubleday, 1848)	3					r	r	u	
205	*Euthalia eryphylae* de Nicéville, 1891	3					r	r		
206	*Euthalia evelina* (Stoll, 1790)	3					r	r		
207	*Euthalia monina* (Moore, 1859)	3					r	r	u	
208	*Euthalia sinkai* Yokochi, 2004	1								
209	*Pseudergolis wedah* (Kollar, 1844)	2		u	u			u	c	
210	*Stibochiona nicea* (Gray, 1846)	2	c	c	u	r	c	c	u	r
211	*Dichorragia nesimachus* (Doyere, 1840)	2	r	r			r	r		
212	*Rohana parisatis* Westwood, 1850	3						c	u	r
213	*Rohana tonkiniana* Fruhstorfer, 1906	1		u			u	u		
214	*Sephisa chandra* Moore, 1857	3		u			u	u		
215	*Eulacera osteria* (Westwood, 1850)	3	r				r	r		
216	*Herona marathus* (Doubleday, 1848)	3	r	r	r		r	r	r	
217	*Hestina nama* (Doubleday, 1844)	3		r	u			u	u	
218	*Euripus nyctelius* (Doubleday, 1845)	3		r	r			u	u	
219	*Polyura schreiber* (Godart, 1824)	3	r							
220	*Polyura jalysus* C. Felder & R. Felder, 1867	3		r			r		r	
221	*Polyura athamas* (Drury, 1773)	3		u	u		u	u	c	r
221	*Polyura nepenthes* (Grose-Smith, 1883)	2	r	r	r		r		u	
222	*Bhagadatta austenia* (Moore, 1872)	2	r	r			r	r		
223	*Charaxes bernardus* (Fabricius, 1793)	3					r	r		
224	*Charaxes aristogiton* C.Felder, 1867	2		u				u		
225	*Charaxes marmax* Westwood, 1848	2	r	r			r	r		
226	*Charaxes kahruba* (Moore, 1895)	2		u			r	u		
	Libytheidae									
227	*Libythea myrrha* Godart, 1819	3			r				r	
	Riodinidae									
228	*Zemeros flegyas* (Cramer, 1843)	3		u	u	c		u	c	c
229	*Dodona ouida* (Hewitson, 1865)	2	u	u			u	u		
230	*Dodona egeon* (Westwood, 1851)	3	r				+	+		
231	*Abisara fylla* (Westwood, 1851)	2	u	u				u		
232	*Abisara echerius* (Stoll, 1790)	3		r	r		r	r		
233	*Abisara neophron* (Hewitson, 1861)	2	r	r						
234	*Paralaxita dora* (Fruhstorfer, 1904)	1	r				r			
235	*Stiboges nymphidia* (Butler, 1876)	3	r	r			r	r		
	Lycaenidae									
236	*Miletus chinensis* C.Felder, 1862	3					r	u		r
237	*Miletus mallus* (Fruhstorfer, 1913)	2	u	u						
238	*Taraka hamada* (Druce, 1875)	3		u	r		u	u		
239	*Curetis bulis* Westwood, 1851	3					r	r	u	u
240	*Castalius rosimon* (Fabricius, 1775)	3		r	r	r		r	u	u
241	*Caleta roxus* (Godart, 1823)	3			u	r			u	r
242	*Caleta elna noliteia* (Fruhstorfer, 1918)	3					r	r		
243	*Everes lacturnus* (Godart, 1824)	3							u	u

Appendix. Continued. Приложение. Продолжение

No.	Species	DR	High altitude				Low altitude			
			1	2	3	4	5	6	7	8
244	*Megisba malaya* (Horsfield, 1828)	3					u	u		
245	*Udara dilecta* (Moore, 1879)	3		c				c	u	
246	*Udara placidula* (Druce, 1895)	3							u	
247	*Acytolepis puspa* (Horsfield, 1828)	3	u	u	u			r	c	
248	*Callenya melaena* (Doherty, 1889)	3	r				r	r	r	
249	*Celatoxia marginata* (de Nicéville, 1884)	3	u	u		r	u	u	u	u
250	*Celastrina argiolus* (Linnaeus, 1758)	2	r	u	u	r		u	u	u
251	*Zizina otis* (Fabricius, 1787)	3							u	u
252	*Zizeeria maha* (Kollar, 1844)	3			c	c			c	c
253	*Zizula hylax* (Fabricius, 1775)	5							u	u
254	*Chilades pandava* (Horsfield, 1829)	3		r	r	r			u	
255	*Lampides boeticus* (Linnaeus, 1767)	5			c	c			c	c
256	*Jamipes bochus* (Stoll, 1782)	3	u	u	u	r	u	u	u	
257	*Jamides celeno* (Cramer, 1775)	3		u	u	u		c	c	u
258	*Jamides alecto* (C.Felder, 1860)	3	u	u	u	u	c	c	c	c
259	*Nacaduba kurava* (Moore, 1857)	3			u	u		u		u
260	*Ionolyce helicon* (C. Felder, 1860)	3	u	u				u		
261	*Prosotas nora* (Waterhouse & Lyell, 1914)	3						u	u	
262	*Prosotas dubiosa* (Semper, 1879)	3						u	c	
263	*Anthene emolus* (Godart, 1823)	3					r	r		
264	*Heliophorus epicles* (Godart, 1823)	3		u	c	u		u	c	u
265	*Heliophorus delacouri* Eliot, 1963	3	r	u	r			r	r	
266	*Chrysozephyrus scintillans sinkaii* (Morita, 1998)	1	r							
267	*Arhopala opalina* (Moore, 1883)	3					r	r	r	
268	*Arhopala perimuta* (Moore, 1857)	3					r	r		
269	*Arhopala birmana* (Moore, 1883)	2	r	r			r			
270	*Iraota timoleon* (Stoll, 1790)	3		r				r		
271	*Amblypodia anita* Hewitson, 1862	3					r	r		
272	*Spindasis syama* (Horsfield, 1829)	3		u	u			u	u	
273	*Spindasis lohita* (Horsfield, 1829)	3		u	u			u		
274	*Loxura atymnus* (Cramer, 1782)	3	u	u			u	u		
275	*Yasoda androconifera* Fruhstorfer, 1912	2	u	u			u	u		
276	*Yasoda tripunctata* (Hewitson, 1863)	2	u	u			u	u		
277	*Ticherra acte* (Moore, 1857)	2	u	u						
278	*Ticherra* sp.						r			
279	*Tajuria* sp.		r							
280	*Ancema ctesia* (Hewitson, 1865)	3		r	r					
281	*Ancema blanka* (de Nicéville, 1895)	3	r	r	r		r	r		
282	*Sinthusa chandrana* (Moore, 1882)	3		r	r			r	r	
283	*Rapala rectivitta* (Moore, 1879)	2						r		
284	*Charana mandarina* (Hewitson, 1863)	3		r						
285	*Horaga onyx* (Moore, 1857)	3					r			
286	*Catapaecilma major* Druce, 1895	3			u				u	
	Hesperiidae									
287	*Bibasis vasutana* (Moore. 1865)	2	u	u	r	u	u	u	u	u
288	*Bibasis gomata* (Moore, 1865)	3		r	r			u	u	u
289	*Bibasis etelka* (Hewitson, 1867)	3					r	r	r	
290	*Hasora danda* Evans, 1949	3						r	r	
291	*Hasora taminatus* (Hübner, 1818)	3						u	u	
292	*Hasora badra* (Moore, 1857)	3		u	u	u		u	u	u
293	*Hasora vitta* (Butler, 1870)	3	u	c	u	u	u	c	u	u

Appendix. Continued. Приложение. Продолжение

No.	Species	DR	High altitude				Low altitude			
			1	2	3	4	5	6	7	8
294	*Hasora anura* (de Nicéville, 1889)	1	u	u						
295	*Badamia exclamationis* (Fabricius, 1775)	4			u	u			c	c
296	*Choaspes plateni* (Staudinger, 1888)	3		r				r		
297	*Choaspes benjaminii* (Guérin-Méneville, 1843)	3	u	u		r	u	c	u	r
298	*Choaspes hemixanthus* Rothschild & Jordan, 1903	3		r	r				r	
299	*Capila lineata* Chou et Gu, 1994	1	r	r			r	r		
300	*Capila penicillatum insulari* (Joicey et Talbot, 1921)	2	r	r			r	r		
301	*Capila pauripunetata tamdaoensis* Devyatkin, 1996	1	r							
302	*Celaenorrhinus pyrrha* de Nicéville, 1889	3		r	r			r	r	
303	*Celaenorrhinus leucocera* (Kollar, 1848)	3					r	r		
304	*Celaenorrhinus putra* (Moore, 1866)	3					r	r		
305	*Celaenorrhinus aspersa* Leech, 1891	2		r						
306	*Celaenorrhinus munda maculirnis* Elwes et Edwards, 1897	2						r		
307	*Celaenorhinus inexspectus* Devyatkin, 2000	1	u	u			u	u		
308	*Celaenorrhinus vietnamicus* Devyatkin, 1998	1	r	r			r	r		
309	*Odina decoratus* (Hewitson, 1867)	1								
310	*Satarupa gopala* Moore, 1865	3	r	r			r	r		
311	*Pintara bowringi colorata* Devyatkin, 1998	1	r	r			r	r		
312	*Gerosis phisara phisara* Moore, 1884	1	r	r			r	r		
313	*Tagiades parra* Fruhstorfer, 1910	3					r	r		
314	*Tagiades litigiosa* (Möschler. 1878)	3	u	u	u	u	u	u	u	u
315	*Tagiades menaka* (Moore, 1865)	2	r	r						
316	*Tagiades cohaerens* Mabile, 1914	3	r	r	r		r	r	r	
317	*Mooreana trichoneura* (C. Felder et R. Felder, 1860)	3	u	c			u	c		
318	*Odontoptilum angulata* (C. Felder, 1862)	3		r				r		
319	*Caprona alida* (de Nicéville, 1891)	2	r	r			r	r		
320	*Astictopterus jama* C. Felder et R. Felder, 1860	3		u	c	c			c	c
321	*Sovia eminens* Devyatkin, 1996	1	r							
322	*Thoressa monastyrskyi monastyrskyi* Devyatkin, 1996	1	r							
323	*Halpe homolea* (Hewitson, 1868)			r						
324	*Halpe zola zola* Evans, 1937	3						r	r	
325	*Halpe frontieri* Devyatkin, 1997	1	u	u						
326	*Isoteinon lamprospilus* C. Felder et R. Felder 1862	3		u	u	u				
327	*Iambrix salsala* (Moore, 1865)	3	r	u	u			u	u	
328	*Koruthaialos rubecula* (Plötz, 1882)	3						r	r	
329	*Koruthaialos butleri* (de Nicéville, 1884)	3						r	r	
330	*Koruthaialos sindu* C. Felder et R. Felder, 1860	3					r	r		
331	*Ancistroides nigrita* (Latreille, 1824)	3		r	r				u	
332	*Notocrypta paralysos* (Wood-Mason et de Nicéville, 1881)	3					r	r		
333	*Notocrypta curvifascia* (C. Felder et R. Felder, 1860)	3		u	u	u		c	u	u
334	*Notocrypta feisthamelii* Boisduval, 1832	3	u	u			u	u		
335	*Udaspes folus* (Cramer, 1775)	3		r	r			u	u	
336	*Scobura wollentti* (Riley, 1923)	3	r	r	r		r	r	u	
337	*Suada swerga suava* Evans, 1949	3							r	
338	*Gangara thyrsis* (Fabricius, 1775)	3		r				r		
339	*Erionota torus* Evans, 1941	3		u	u	u		u	c	c
340	*Matapa aria* (Moore, 1865)	3					r	r		
341	*Matapa druna* (Moore, 1866)	3					r	r		
342	*Matapa sasivarna* (Moore, 1866)	3		**r**	**r**			**r**	**r**	
343	*Potanthus ganda* (Fruhstorfer, 1911)	3		r	r	r			r	r
344	*Potanthus mara mara* (Evans, 1932)	3			r	r			r	r

Appendix. Continued. Приложение. Продолжение

No.	Species	DR	High altitude				Low altitude			
			1	2	3	4	5	6	7	8
345	*Telicota linna* Evans, 1949	2		r						
346	*Telicota ohara* (Plötz, 1883)	4		r	r			u	u	
347	*Cephrenes acalle* (Hopffer, 1874)	2		r				r		
348	*Parnara guttata* (Bremer et Gray, 1852)	3			c	c			c	c
349	*Parnara bada* (Moore, 1878)	4			u	c			c	c
350	*Parnara ganga* Evans, 1937	3			c	c		u	c	c
351	*Borbo cinnara* (Wallace, 1866)	3			r			r	r	
352	*Pelopidas sinensis* (Mabille, 1877)	3		r	u			u	u	u
353	*Pelopidas agna* (Moore, 1865)	4			c	c			c	c
354	*Pelopidas assamensis* (de Nicéville, 1882)	2		u	u	u	u		u	u
355	*Pelopidas conjuncta* (Herrich-Schäffer, 1869)	3		u	u			u	u	
356	*Polytremis lubricans* (Herrich-Schäffer, 1869)	3		r	r	r		u	u	r
357	*Baoris farri* (Moore, 1878)	3					r	r	r	
358	*Caltoris sirius* (Evans, 1926)	2					r	r		
359	*Caltoris cahira* (Moore, 1877)	3		r						
360	*Caltoris confusa* (Evans, 1932)	2		r				r		
361	*Carterocephalus christophi* Grum-Grshimailo, 1891	1					r			
362	*Parasovia perbella* (Hering, 1918)	1	r				r			