THE SEASONALITY OF BUTTERFLIES IN A SEMI-EVERGREEN FOREST: GIBBON WILDLIFE SANCTUARY, ASSAM, NORTHEASTERN INDIA

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Abstract: A study spanning 3.7 years on the butterflies of Gibbon Wildlife Sanctuary GWS (21km²), a semi-evergreen forest, in Jorhat District of Assam, northeastern India revealed 211 species of butterflies belonging to 115 genera including 19 papilionids and seven ‘rare’ and ‘very rare’ species as per Evans list of the Indian sub-continent (Great Blue Mime Papilio paradoxa telearchus; Brown Forest Bob Scobura woolletti; Snowy Angle Darpa pteria dealbatahah; Constable Dichrorhaga nesimachus; Grey Baron Euthalia anosia anosia; Sylhet Oakblue Arhopala silhetensis; Branded Yamfly Yosoda tripunctata). The butterflies showed a strong seasonality pattern in this forest with only one significant peak during the post monsoon (September-October) when 118 species were in flight inside the forest which slowly declined to 92 species in November-December. Another peak (102 species) was visible after winter from March to April. Species composition showed least similarity between pre-monsoon (March-May) and post-monsoon (October-November) seasons. The number of papilionid species were greater from July to December as compared from January to June. The findings of this study suggest that the pattern of seasonality in a semi-evergreen forest in northeastern India is distinct from that of the sub-tropical lowland forest in the Himalaya. Favourable logistics and rich diversity in GWS points to its rich potential in promoting ‘butterfly inclusive ecotourism’ in this remnant forest.

Keywords: Conservation, eco-tourism, endemic, Papilionidae, rainfall, rare, semi-evergreen forest.
INTRODUCTION

The northeastern region of India, that lies south of the Brahmaputra River, is part of the Indo-Burma biodiversity hotspot on the globe. It is located at the tri-junction of Indo-Chinese, Indo-Malayan and Palaearctic biogeographic realms exhibiting a profusion of habitats characterized by diverse biota with a high level of endemism (http://www.biodiversityhotspots.org/xp/hotspots/indo_burma/Pages/default.aspx).

More than 50% of the butterfly species found in India occur in the northeast, also called the “Papilionidae-rich zone” in the ‘Indo-Burma hotspot’ as per IUCN (New & Collins 1991). The high species richness and endemism make this an important region for conservation of biodiversity in India.

Study Area

The Gibbon Wildlife Sanctuary (GWS) 26°40’–26°45’N & 94°20’–94°25’E, lies in Jorhat District in upper Assam in northeastern India. It is today an isolated forest patch covering approximately 21km² of mainly lush green ‘tropical semi-evergreen forest’ sparsely interspersed with ‘wet evergreen forest’ patches, classified as ‘Assam plains alluvial semi-evergreen forests (2B/C1a)’ (Champion & Seth 1968). Dipterocarpus retusus (Hollong) is the predominant element in the forest. The associated species are Allantus integrifolia, Altingia excelsa, Artocarpus chama, Castanopsis purpurella, Cinnamomum bejolgheta, Dysoxylum gobara, Mesua ferrea, Michelia champaca and Vatica lanceafolia (Barua & Khatri 2010) with most of the tree species being utilized by the Western Hoolock Gibbon Hoolock hoolock here (Barua & Gogoi 2012). The altitudinal range of GWS varies between 100–120 m above sea level, while the average temperature ranges from 18.95–27.9 °C, the average humidity varies between 64.5% and 94.5% and the annual rainfall of the study area being ~250cm. The sanctuary was carved out of Hollongapar Reserve Forest set aside in 1881 named after the dominant tree species - Hollong (Dipterocarpus retusus). Subsequently, more forest areas were added to this RF and by 1997 the total area of the Hollongapar RF increased to 2098.62ha. The Government of Assam declared this entire RF area as the Gibbon Wildlife Sanctuary in 1997. GWS is surrounded by mostly tea gardens and small villages. The Bhogdoi River flows from Nagaland (south) to Assam (north-west) and distinctly demarcates the eastern boundary of this sanctuary as a permanent physical barrier (Image 1). GWS was once contiguous with a large forest tract that extended to Dissoi Valley Reserve Forests of Nagaland in the south and are now separated by a vast stretch of tea gardens presenting a barrier in the effective migration of wildlife such as elephants (Bhattacharjee 2012). GWS today is still a home to many species of animals of global concern namely, Hoolock Gibbon Hoolock hoolock (Endangered; Brockelman et al. 2008); Capped Langur Trachypithecus
pileatus (Vulnerable; Das et al. 2008), Slow Loris Nycticebus bengalensis (Vulnerable; Streicher et al. 2008), Pig-tailed Macaque Macaca fuscata (Vulnerable; Boonratana et al. 2008), Stump-tailed Macaque Macaca arctoides (Vulnerable; Htun et al. 2008), Assamese Macaque Macaca assamensis (Near Threatened; Boonratana et al. 2008), Malayan Giant Squirrel Ratufa bicolor (Near Threatened; Walston et al. 2008), Asian Elephant Elephas maximus (Endangered; Choudhury et al. 2008), Leopard Panthera pardus (Near Threatened; Henschel et al. 2008), Large Indian Civet Viverra zibetha (Near Threatened; Duckworth, et al. 2008), Chinese Pangolin Manis pentadactyla (Endangered; Challender et al. 2014), as recorded by the author. Besides, many other species have also been listed in the sanctuary’s catalogue (Bordoloi 2010).

The published literature on the butterflies of the GWS is scanty. Senthilkumar et al. (2006) recorded 37 species from GWS. A blog by Abhijit Narvekar (http://butterflyinggibbonwls.blogspot.in/) lists 31 species from GWS, recorded in May 2013. Besides these, there are no other published records of butterflies from GWS. The authors hereby report the results of a three and a half year study carried out by them in the GWS.

**METHODS**

**Sampling**

Twenty-eight sampling surveys covering all the months were carried out in Gibbon WS from 4 August 2010 to 26 April 2014. Sampling was carried out along forest trails up to 5m on both sides along a stretch of 3.5km from the village Melang Grant to the Gibbon Forest Rest House (FRH) and along the two parallel trails that goes from the FRH towards river Bhogdoi in the east (Fig. 1). The ‘Pollard walk’ (Pollard & Yates 1993) method was used for sampling butterflies. Sampling was carried out between 08.00hr to 15.00hr mostly on sunny days, but the sampling hours varied in different samplings from 1.5–3 hours. The taxa encountered were recorded in each sampling. The data on abundance, however, could not be recorded for each survey, but species occurring in exceptionally high numbers (peak abundance) were noted. A total of ~65 hours of sampling was carried out.

Butterflies were identified from photographs and using field guides (Evans 1932; Wynter-Blyth 1957; Haribal 1992; Smith 1989 & 2006; Kehimkar 2008; Sondhi et al. 2013 and websites: www.flutters.org/ and www.ifoundbutterflies.org/).
Data Analysis

Data for the number of species recorded in each survey was pooled. Species accumulation curve was then plotted from the first to the last sampling to see the rate of species accumulation during the study period. The Sorensen’s similarity index or $\beta$ was calculated to see the species similarity in butterflies between four different seasons meeting different seasons [pre-monsoon (March–May), monsoon (June–Sept), post-monsoon (October–November) and winter (December–February)] in this semi-evergreen forest.

$$\beta = \frac{2c}{(S1+S2)}$$

where, $S1 =$ the total number of species recorded in one season/site
$S2 =$ the total number of species recorded in different season/site
$C =$ number of species common to both seasons/sites

The Sorensen’s similarity index (Sorensen 1948) is a very simple measure of beta diversity, ranging from a value of zero, where there is no species overlap between the communities to a value of one, when exactly the same species are found in both communities.

The seasonality of butterflies in GWS was then compared with trends available in other studies in other forest habitats in the Himalaya and the northeast to see the variation in this forest type.

RESULTS AND DISCUSSIONS

Species richness

Amongst the 211 species belonging to 115 genera recorded during 28 sampling surveys (Appendix 1), 19 species were of the family Papilionidae. This suggests that species richness of the area could be as high as 257 species based on the family proportion model (Singh & Pandey 2004), by taking Papilionidae’s proportion as 7.4% of the total for northeastern India (Wynter-Blyth 1957). The present sampling thus represents about 82% of the species found in the study area. Families Lycaenidae and Hesperiidae proportions are less than those of the northeastern region, these two families are thus under-represented (Table 1) in the present surveys and there is a need to look for more species among these two families in GWS.

Species accumulation

An increasing trend in the species accumulation curve shows that new species were added during every sampling up to the last sampling at a prominently higher rate just after the monsoon rains (Aug–Sep) until pre-monsoon (March), every year (Fig. 2). The trend obtained during the last six samplings suggests that new species were still being discovered until the end (mainly Lycaenidae and Hesperiidae).

Seasonality

Maximum number of species were recorded during the ‘post monsoon’ season in the region (Fig. 3). The first peak in species richness (102 species) during March and April was smaller than the second peak in September to October (118) when most of the species are in flight in GWS. The two peak seasonal trends in butterflies is very typical of the Himalaya and northeastern India. In GWS, which is a semi-evergreen forest, the second peak is higher than the first peak, however. This pattern differs considerably from the sub-tropical lowland forests in Bhutan (Fig. 4; Singh 2012) lying between 100–220 m,
where both the peaks are high but the first peak in April is slightly greater than the second peak in December (Fig. 4). The reason for the first peak being smaller than the second peak in GWS may be related to the pattern of rainfall here. The reason for the first peak being smaller than second peak higher in GWS may be related to the pattern of rainfall here. In GWS the onset of early rains is early in spring (from April), monsoons are less severe, there is short dry (moderate) winter in comparison to rains arriving relatively late in May–June, severe monsoon and a longer winter season in Bhutan.

Species similarity among seasons
Sorensen’s similarity index between seasons varied from 0.25–0.55. This suggests that, the species composition varied in GWS all over the seasons of the year. However, the highest similarity was noticed between post-monsoon and autumn, post-monsoon and spring, winter and spring, spring and autumn, respectively. In other words from post-monsoon to spring the species composition in GWS showed much similarity. The similarity index was least between spring and pre-monsoon followed by monsoon and winter, respectively (Fig. 5). This suggests that major changes in species composition in the semi-evergreen forests occurs between these seasons, which may be related to the life history patterns of these butterflies. The number of species in flight during rainy season were few in comparison to the dry season.

Papilionidae species similarity of GWS with other semi evergreen forest areas in the region
GWS, a small forest, recorded 19 species of Papilionidae as compared to the other large forest tracts like in Jeypore-Dehing RF where 21 species of Papilionidae have been reported (Gogoi 2013). Four species (Great Zebra Graphium xenocles; Common Peacock Papilio polyctor; Common Windmill Atrophaneura polyeuctes and Lesser Batwing Atrophaneura aidoneus) found in Jeypore-Dehing RF (Gogoi 2013) were absent in GWS. This could be due to proximity and continuity of Jeypore RF with Himalayan foothills of Arunachal Pradesh from where these species come down and non-connectivity of GWS forest with the nearest hills in Nagaland and no freshwater mountain streams inside the GWS. Besides, 30 papilionids have been recorded in Garo Hills (Sondhi et al. 2013) of which 10 have not been recorded at GWS, but Garo Hills have diverse habitats under at least three forest types and a large altitudinal gradient when compared to GWS.

The Papilionidae species similarity between these three forests (Table 2) all having semi-evergreen forest component in common also have at least 53 percent papilionid species common among them.

Significant records
A dead female of the Great Blue Mme Papilio paradoxa telearchus, a rare species (Evan 1932), crushed by a vehicle on the forest road was recorded on 25
August 2012 on the road and later identified (Image 2). The female of this species are very rarely photographed as they mimic the female of the Magpie Crow *Euploea radamanthus* and thus overlooked. A male *P. p. telearchus* was photographed (Image 3) on 10 July 2013 feeding on the wet ground on the trail. This species also feeds on the nectar of *Syzygium* sp. flowers in September–October 2011 along with Great Archduke *Lexias dirtea* (Image 4), Blue-spotted Crow *Euploea midamus*; Stripe Blue Crow *Euploea mulciber*; Yellow-spot Jezebel *Delias agostina*; Red-spot Jezebel *D. descombesi* and Red-base Jezebel *D. pasithoe*. Brown Forest Bob *Scobura woolletti* woolletti Riley (Image 5), a rare species, was recorded on 20 February 2011 and 27 March 2011 was also a species with a distribution in the Naga Hills, Siam and Borneo (Evans 1932). Norman (1956), however, had recorded *S. w. woolletti* Riley from Sibsagar District of Assam that was previously also known from Manipur. The record of Snowy Angle, *Darpa pteria dealbata* on 4 August 2012 (Image 6), is the second photographic record of this species from India. Earlier, it had been recorded from the forests of Jeypore-Dehing in Assam between April 24 and 29, 2011, the distribution of the species being further south through Burma, Thailand, Laos, Malay Peninsula, Tioman, Borneo, Sumatra, Java, and Palawan, Phillipines in South-east Asia (Karthikeyan & Venkatesh 2011). The Constable, *Dichorrhagia nesimachus* (Image 7) a very rare species (Evans 1932) was recorded on three occasions, 15 April 2012, 7 December 2013 and 4 March 2014 and a male of Grey Baron, *Euthalia anosia anosia* (Image 8) another rare species (Evans 1932), on 15 April 2012 and 4 March 2014, both basking in the sunshine and on wet mud inside the forest. Sylhet Oakblue *Arhopala silhetensis* (Images 9,10) is another rare species (Evans 1932) that was recorded on several occasions (6 February 2011, 24 January 2013; 13 May...
2013; April 2014), the species being found from Sikkim to North Myanmar. Tamil Oakblue *Narathura bazaloides* also a rare species was photographed on 9 October 2010 (Image 11) and April 2014 while Spotless Oakblue *Arhopala fulla ignara* Riley, a rare (Evans 1932) on April 2014. Branded Yamfly *Yasoda tripunctata tripunctata* (Image 12) is yet another rare species, which is also distributed from Sikkim to Myanmar, was recorded once on 25 October 2011.
CONCLUSION

Being a remnant forest of 21 km², GWS supports a rich diversity of butterflies found in northeastern India. The seasonality and diversity of butterflies of a ‘semi evergreen forest’ is unique from that of lowland subtropical forests of the lower Himalaya. Barua et al. (2010) have also found that rainfall has a strong correlation with the abundance of some papilionids in northeastern India besides a strong seasonality in continental South-east Asian butterfly assemblages. GWS, besides supporting butterfly diversity, also needs to be preserved as a gene bank biodiversity of flora and fauna (birds, mammals, herpetofauna, orchids, canes, bamboos, etc.) unique to northeastern India and functions as an island habitat for movement of large mammals and birds between larger protected areas in the landscape. Also, better accessibility and location of GWS with the national highway in the region, proximity to Jorhat town, lying in the plains and having a rest house, increases its potential for attracting tourists for - butterfly-inclusive eco-tourism in a natural semi-evergreen forest habitat. Using local villagers as guides to generate livelihood for communities involved thereby reducing biotic pressure on one hand and conserving this magnificent forest on the other along with, the researchers and students, GWS can easily be taken up as a role model in conservation biology.

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Appendix 1. Checklist of butterflies recorded in Gibbon Wildlife Sanctuary, Assam, India (110–120 m; August 2010–April 2014).

| Common name | Scientific name | Season |
|-------------|----------------|--------|
|             |                | Jan-Feb| Mar-Apr| May-Jun| Jul-Aug| Sep-Oct| Nov-Dec |
| Papilionidae |                |        |        |        |        |        |        |
| 1 White Dragontail | Lamproptera curius curius Fabricius |        |        |        |        |        |        |
| 2 Common Blue Bottle | Graphium sarpedon sarpedon Linnaeus | * | * |        |        |        |        |
| 3 Common Jay | Graphium dosonaxiion Felder | * | * | * |        |        |        |
| 4 Great Jay | Graphium eurypylus cheronus Fruhstorfer |        |        |        |        |        |        |
| 5 Tailed Jay | Graphium agamemnon agamemnon Linnaeus | * | * | * | * |        |        |
| 6 Five Bar Swordtail | Graphium antiphates pomplius Fabricius | * | * | * |        |        |        |
| 7 Lesser Zebra | Graphium macareus indicus Rothschild | * |        |        |        |        |        |
| 8 Common Mormon | Papilio polytesromulus Cramer | * | * | * | * |        |        |
| 9 Common Raven | Papilio castorcastor Westwood |        |        |        |        |        |        |
| 10 Red Helen | Papilio helenushelenus Linnaeus | * | * | * | * | * |        |
| 11 Yellow Helen | Papilio nepheuschaon Westwood | * | * | * | * | * | * |
| 12 Great Mormon | Papilio menmonagenor Linnaeus | * | * | * | * | * | * |
| 13 Spangle | Papilio proteroneproruntror Fruhstorfer | * | * | * | * | * | * |
| 14 Redbreast | Papilio alcmenor alcmenor C.R. Felder | * |        |        |        |        |        |
| 15 Blue Peacock | Papilio arcturus arcturus Westwood | * |        |        |        |        |        |
| 16 Great Blue Mime | Papilio paraadoxa telearchus Hewitson | * |        |        |        |        |        |
| 17 Common Batwing | Atrophaneura varunaasiatorian Westwood | * | * | * | * | * | * |
| 18 Common Rose | Atrophaneura aristolochiae aristolochiae Fabricius | * | * | * | * | * | * |
| 19 Common Birdwing | Troides helenacerberus Felder & Felder | * | * | * | * | * | * |
| Pieridae |                |        |        |        |        |        |        |
| 20 One-spot Grass Yellow | Eurema andersamjordani Corbet & Pendlebury | * |     | * |        |        |        |
| 21 Three-spot Grass Yellow | Eurema blandasilhetana Wallace | * | * | * | * | * | * |
| 22 Common Grass Yellow | Eurema hecabehecabe Linnaeus | * | * | * | * | * | * |
| 23 Tree Yellow | Gandaca harinoassamica Moore | * | * | * | * | * | * |
| 24 Common Emigrant | Catapsila pomona pomona Fabricius | * | * | * | * | * | * |
| 25 Great Orange Tip | Hebomoia glaucippeglaucippe Linnaeus | * | * | * | * | * | * |
| 26 Pale Wanderer | Pareronia avator Moore | * | * | * | * | * | * |
| 27 Chocolate Albatross | Appias lycida Cramer | * | * | * | * | * | * |
| 28 Indo-Chinese Chocolate Albatross | Appias lycida elenora Boisduval | * | * | * | * | * | * |
| 29 Common Albatross | Appias albinadarada Felder & Felder | * | * | * | * | * | * |
| 30 Eastern Striped Albatross | Appias alfera alfera Swinhoe | * | * | * | * | * | * |
| 31 Indian Cabbage White | Pieris candiaindica Evans | * | * | * | * | * | * |
| 32 Lesser Gull | Cepora nadinanadina Lucas | * | * | * | * | * | * |
| 33 Common Gull | Cepora narissh phryne Fabricius | * | * | * | * | * | * |
| 34 Red Base Jezebel | Delias pasithopasithoe Linnaeus | * | * | * | * | * | * |
| 35 Red Spot Jezebel | Delias descombesidescombes Boisduval | * | * | * | * | * | * |
| 36 Red Breast Jezebel | Delias thyse pyramus Wallace | * | * | * | * | * | * |
| 37 Yellow Jezebel | Delias agoagostina Hewitson | * | * | * | * | * | * |
| 38 Psyche | Leptosia ninanina Fabricius | * | * | * | * | * | * |
| Lycaenidae |                |        |        |        |        |        |        |
| 39 Bright Sunbeam | Curetis buls Westwood | * |        |        |        |        |        |
| Common name                          | Scientific name                                      | Season   |
|-------------------------------------|------------------------------------------------------|----------|
| Jan-Feb                             | Mar-Apr                                              | May-Jun  | Jul-Aug   | Sep-Oct  | Nov-Dec |
| Centaur Oak blue                    | Arhopala centaurusbrisinus Moore                     |          | *         | *        |         |
| Aberrent Oakblue                    | Arhopala abeus indicus Riley                         | *        |           |          |         |
| Sythet Oakblue                      | Arhopala silhetensisilhetensis Hewitson             | *        | *        |          |         |
| Tamil Oakblue                       | Narathura bazioides (Hewitson) [IWPA-Schedule-II]   |          | *        |          |         |
| Hooked Oakblue                      | Arhopala paramutaparamuta de Niceville #            | [IWPA-Schedule-II] |          | *        |         |
| Spotless Oakblue                    | Arhopala fula ignara Riley #                         |          | *        |          |         |
| Green Oakblue                       | Arhopala eumolpus eumolhus Cramer                   | *        |           |          |         |
| Yellow Disc Tailless Oakblue        | Arhopala perimuta perimuta, Moore #                 |          | *        |          |         |
| Common Acacia Blue                  | Surendra quercetorumquercetorum Moore                | *        |           |          |         |
| Branded Yamfly                      | Yasoda triphutatatriphutata Hewitson                | [IWPA-Schedule-II] |          | *        |         |
| Yamfly                              | Loxura atymnuscontinentalis Fruhstorfer             |          | *        | *        |         |
| Blue Imperial                       | Ticherra acteacte Moore                              | *        | *        | *        | *       |
| Common Imperial                     | Cheritra freja evansi Cowan                         | *        |           |          |         |
| Banded Royal                        | Rachana jalinda indra Moore                         | *        |           |          |         |
| Chocolate Royal                     | Remelana jangala ravana (Horsfield) #               | *        |           |          |         |
| Broad Spark                         | Sinthusa chandrama gretel Moore #                    |          |           |          |         |
| Common Tip                          | Hyppolycaena erylishovantis Fruhstorfer             |          | *        | *        |         |
| Fluffy Tip                          | Zetus amosa amosa Hewitson                          | *        | *        | *        | A       | *       |
| Copper Flash                        | Rapala phremitmapetisinsis Hewitson                 | [IWPA-Schedule-II] |          | *        |         |
| Indian Red Flash                    | Rapala iarbussiarbus Fabricius                      |          |           | *        |         |
| Long banded Silverline             | Spindasis lohitahimalayanus Moore                   | [IWPA-Schedule-II] |          | *        |         |
| Common Tinsel                       | Catapaeclima major anais Fruhstorfer #              |          |           |          |         |
| Golden Sapphire                    | Heliophorus brahmamajor Moore                       | *        |           |          |         |
| Purple Sapphire                    | Heliophorus epides latilimbata Fruhstorfer         | *        | *        | *        | *       | *       |
| Common Ciliate Blue                 | Anthene emolusemolus Godart                         | *        |           |          |         |
| Pointed Ciliate Blue                | Anthene lycanenlycaenina Felder & Felder           |          | *        |           |         |
| Elbowed Pierrot                    | Caleta ehanalitea Fruhstorfer                       | *        |           | *        |         |
| Common Pierrot                     | Castalus rosinrosonim Fabricius                     | *        |           | *        |         |
| Banded Lineblue                    | Prosotas alita coelests Wood-Mason & de-Niceville  |          |           |          |         |
| Pale 4-Lineblue                    | Nacaduba hermsnababo Fruhstorfer                    | [IWPA-Schedule-II] |          | *        |         |
| Opaque 6-Lineblue                  | Nacaduba beroegythion Fruhstorfer                   |          | *        |           |         |
| Transparent 6-Lineblue             | Nacadubakurava euplea Fruhstorfer                   |          | *        |           |         |
| Common Lineblue                    | Prosotas norordates Moore                           | *        | *        |          |         |
| Tailless Lineblue                  | Prosotas dubiosa indica Evans                      | *        |           | *        |         |
| Bhutta Lineblue                    | Prosotas bhutea de Nicewile                         | *        |           |          |         |
| Pointed Lineblue                   | Ionalyce helcon mguana Moore                        | *        |           |          |         |
| Common Cerulean                    | Jamides celeno celeno Cramer                        | *        | *        | *        |         |
| Metallic Cerulean                  | Jamides aleoalocina Swinhoe                        | *        |           | *        |         |
| Dark Cerulean                      | Jamides bochus bochus (Stoll)                       | *        |           |          |         |
| Silver Forget-me-not               | Catachrysops panormsexigius Distant                 | *        |           |          |         |
| Forget-me-not                      | Catachrysops straboStrabo Fabricius                 | *        |           |          |         |
| Pale Grass Blue                    | Pseudatzeeria mahamahla Kollar                     | *        |           | *        |         |
| Common name          | Scientific name                                      | Season     |
|----------------------|------------------------------------------------------|------------|
| Dark Grass Blue      | Zizeera karsandra Moore                              | *          |
| Quaker               | Neopithecops salmosalmona Butler                     | * * * *    |
| Malayan              | Megisa malayasiakima Moore                          | * *        |
| Common Hedge Blue    | Acytolepis puspagica Fruhstorfer                    | * *        |
| Pale Hedge Blue      | Udara diletadicta Moore                              | * *        |
| Lime Blue            | Chilades lajosulasjus Stoll                         | *          |
| Punchinello          | Zemeros flagyasindicicus Fruhstorfer                 | * * * * * * |
| Tailed Judy          | Abisara neophran neophran Hewitson                  | *          |
| Plum Judy            | Abisara echerius paloea Fruhstorfer                 | * *        |
| Nymphalidae          |                                                      |            |
| Striped Tiger        | Danaus genutigenutia Cramer                         | * * *      |
| Plain Tiger          | Danaus chrysippus chrysippus Linnaeus                | *          |
| Glassy Tiger         | Parantica aglea melanoides Moore                    | * * * *    |
| Chestnut Tiger       | Parantica sitasita Kollar                           | *          |
| Striped Blue Crow    | Eupheoa mucumberculber Cramer                       | * A        |
| Blue-spotted Crow    | Eupheoa midamus rogenhoferi Felder & Felder         | IWPA-Schedule-II |
| Maggie Crow          | Eupheoa radamuthusradamanthus Fabricius             | * * * *    |
| Common Indian Crow   | Eupheoa core core Cramer                            |            |
| Common Nawab         | Polyura athamas athamas Drury                       | * * *      |
| Pallid Nawab         | Charaxes arja arja Felder & Felder #                |            |
| Tawny Rajah          | Charaxes bernardushierax Felder & Felder            | * * * *    |
| Yellow Rajah         | Charaxes marmax marmax Westwood                     | IWPA-Schedule-II |
| Variegated Rajah     | Charaxes kahruba kahruba Moore                       | IWPA-Schedule-II |
| Common Faun          | Faunis canensarcesilas Stichel                      |            |
| Common Duffer        | Discophora sondaicaeval Westwood                    |            |
| Great Duffer         | Discophora timora timora Westwood                   | *          |
| Longbranch Bushbrown | Mycalesis visala visala Moore                       |            |
| Common Evening Brown | Melonitis ledaleo Linnaeus                          | * *        |
| Dark Evening Brown   | Melonitis phebimabla Moore                          | * *        |
| Great Evening Brown  | Melonitis ziteniuszitenius Herbst                    |            |
| Bamboo Treebrown     | Lethe europa niladona Fruhstorfer                   | *          |
| Banded Treebrown     | Lethe confusaconfuse Aurivillius                   |            |
| Straightbanded Treebrown | Lethe verma sintica Fruhstorfer                       | * *        |
| Common Palmfly       | Elymnias hypermnestra undularis Drury               | * *        |
| Tiger Palmfly        | Elymnias nesaethimandra Wallace                     |            |
| White-bar Bushbrown  | Mycalesis anoxiaoxamate Fruhstorfer                 |            |
| Lilacine Bushbrown   | Mycalesis franciscasanatana Moore                   | * * *       |
| Chinese Bushbrown    | Mycalesis gotamacharsaka Moore                      | * *        |
| Common Bush Brown    | Mycalesis perseusblasius Fabricius                  | * * * *    |
| Dark-brand Bushbrown | Mycalesis mineusmineus Linnaeus                    | * *        |
| Long brand Bushbrown | Mycalesis visala visala Moore                       | *          |
| Nigger               | Orsatrioena medusmedus Fabricius                    | *          |
| Common Fiver-ring    | Ypthima baldusbaldis Fabricius                      | * * * *    |
| Common name               | Scientific name                        | Season   |
|--------------------------|----------------------------------------|----------|
| 124 Large Three-ring     | Ypthima nareda nareda Kollar           | *        |
| 125 Common Four-ring     | Ypthima huebnerihuebneri Kirby         | *        |
| 126 Himalayan Five-ring  | Ypthima sakraausteni Moore             | *        |
| 127 Red Lacewing         | Cethasia biblis tisamena Fruhstorfer   | *        |
| 128 Leopard Lacewing     | Cethasia cyane cyane Drury             | * * *    |
| 129 Cruiser              | Vindula eroterata Fabricius            | *        |
| 130 Large Yeoman         | Cirochroa aorisaoris Doubleday         | *        |
| 131 Green Commodore      | Sumalia daraoxadarao Doubleday         | *        |
| 132 Commander            | Moduza procrisprocrisCramer            | *        |
| 133 Unbroken Sergeant     | Athyma pravara acutipennis Fruhstorfer | *        |
| 134 Common Sergeant      | Athyma periusperius Linnaeus           | *        |
| 135 Dot-Dash Sergeant     | Athyma kanwaphorkys Fruhstorfer        | * * * *  |
| 136 Black-vein Sergeant   | Athyma rangaranga Moore                | * *      |
| 137 Small staff Sergeant  | Athyma zeroa zeroca Moore              | *        |
| 138 Staff Sergeant       | Athyma selenopharselenophora Kollar    | * *      |
| 139 Colour Sergeant      | Athyma nefte inana Westwood            | * *      |
| 140 Common Lascar         | Pantoporia hardoniahardonia Stoll      | * * *    |
| 141 Perak Lascar          | Pantoporia paraka paraka Butler        | *        |
| 142 Yellow Jack Sailer    | Neptis viraj viraj(Moore)              | *        |
| 143 Common Sailer         | Neptis hullakamarupa Moore             | * * * *  |
| 144 Clear Sailer          | Neptis clinia susruta Moore            | *        |
| 145 Creamy Sailer         | Neptis soma soma Linnaeus              | *        |
| 146 Sullied Sailer        | Neptis nata adipala Moore [IWPA-Schedule-II] | * * * |
| 147 Great Yellow Sailer   | Neptis radha Moore                     | *        |
| 148 Plain Sailer          | Neptis cartica Moore                   | *        |
| 149 Dingy Sailer          | Neptis pseudovikasi Moore              | *        |
| 150 Dingiest Sailer       | Neptis harlia Moore                    | *        |
| 151 Broad-banded Sailer   | Neptis sankara amba Moore              | *        |
| 152 Knight                | Lebadea marthamartha Fabricius         | *        |
| 153 Powdered Baron        | Euthalia monina kesava Moore           | *        |
| 154 White-edged Blue Baron| Euthalia phemius phemius Doubleday    | *        |
| 155 Baron                 | Euthalia acothhea garuda Moore         | * * *    |
| 156 Grey Baron            | Euthalia anosaanasiad Moore [IWPA-Schedule-II] | *    |
| 157 Gaudy Baron           | Euthalia lubentina indica Fruhstorfer  | *        |
| 158 Grey Count            | Tanaecia lepidoelepidia Butler         | * * *    |
| 159 Common Earl           | Tanaecia juli appiadius Ménétries     | * *      |
| 160 Plain Earl            | Tanaecia jahnjahunu Moore              | *        |
| 161 Great Archduke        | Lexias cyanipardus cyanipardus Butler  | * * * *  |
| 162 Common Map            | Cyrestis thydamaosthydama Boisduval    | *        |
| 163 Common Maplet         | Chersonesia risarisa Doubleday         | *        |
| 164 Constable             | Dichrorhagia nesimachusnesimachus Doyere | *        |
| 165 Indian Purple Emperor | Mimathyma ambica Kollar               | *        |
| 166 Common Castor         | Ariadne merionetapesstri Moore         | *        |
| Common name                  | Scientific name                                      | Jan-Feb | Mar-Apr | May-Jun | Jul-Aug | Sep-Oct | Nov-Dec |
|------------------------------|------------------------------------------------------|---------|---------|---------|---------|---------|---------|
| 167 Common Jester            | Symbrenthia lilaea khasiana Moore                    | *       | *       | *       | *       |         |         |
| 168 Blue admiral             | Kaniska conaceanae Linnaeus                         | *       |         |         |         |         |         |
| 169 Indian Red Admiral       | Vanessa indica indica Herbst                        |         |         |         | *       |         |         |
| 170 Chocolate Pansy          | Junonia iphitaiphita Cramer                         | *       | *       | *       |         |         |         |
| 171 Grey Pansy               | Junonia atites atites Linnaeus                       | *       | *       | *       | *       | *       |         |
| 172 Peacock Pansy            | Junonia almana almanac Linnaeus                     | *       |         |         |         |         |         |
| 173 Lemon Pansy              | Junonia lemonias lemonias Linnaeus                   | *       | *       |         |         |         |         |
| 174 Great Eggfly             | Hypolimnas bolinojacintha Drury                     | *       | *       |         |         |         |         |
| 175 Orange Oakleaf           | Kalima inachusinachus Boisduval                      | *       |         |         |         |         |         |
| 176 Autumn Leaf              | Doleschalia bisaltheindica Moore                     | *       | *       | *       |         |         |         |
| Hesperiidae                  |                                                      |         |         |         |         |         |         |
| 177 Indian Awking            | Choaspes benjaminii japonica Murray                  |         | *       | *       | *       |         |         |
| 178 Common Awl               | Hasara badra Moore                                  |         |         |         |         |         | *       |
| 179 Plain Ace                | Halpe kumara kumara de Niceville #                  | *       |         |         |         |         |         |
| 180 Common Spotted Flat      | Calaenorrhinus leucocera leucocera Kollar           | *       | *       | *       |         |         |         |
| 181 Fulvous Pied Flat        | Pseudocolodenia danfobia Evans                       | *       | *       | *       | *       |         |         |
| 182 Brown Pied Flat          | Coladenia agni de Niceville #                        |         |         |         |         | *       |         |
| 183 Dusky Yellow Breasted Flat | Gerossis phasaphisarora Moore                     |         |         |         |         | *       |         |
| 184 Suffused Snowflat         | Togiades gana othos Plötz                          |         | *       | *       |         |         |         |
| 185 Common Snowflat           | Togiades japetusravi Moore                          | *       | *       | *       |         |         |         |
| 186 Snowy Angle              | Darpa pteria dealbata Distant                       | *       |         |         |         |         |         |
| 187 Common Dartlet           | Oriens goloides Moore                               | *       | *       | *       | *       |         |         |
| 188 Common Dart              | Potanthus pseudoaesa Moore                          | *       |         |         |         |         |         |
| 189 Straight Swift           | Parnara badaboda Moore                              |         | *       | *       | *       |         |         |
| 190 Blank Swift              | Calthor's kumara (Moore)                            | *       |         |         |         |         |         |
| 191 Rice Swift               | Barbos cinnara Wallace                              | *       |         |         |         |         |         |
| 192 Small branded Swift      | Pelopidas mathias Fabricius                         | *       | *       | *       |         |         |         |
| 193 Large Branded Swift      | Pelopidas sinensis sinensis Mabille                 | *       |         |         |         |         |         |
| 194 Paint-brush Swift        | Boans farri (Moore) [IWPA-Schedule-II]              | *       |         |         |         |         |         |
| 195 Colon Swift              | Calthor's cahira austeni Moore                      | *       |         |         |         |         |         |
| 196 Brown Forest Bob         | Scobura woolletti Riley #                           | *       | *       |         |         |         |         |
| 197 Chestnut Bob             | Iambrix salala salala Moore                         | *       | *       |         |         |         |         |
| 198 Small Indian Palm Bob    | Suastus gremius Fabricius                           | *       |         |         |         |         |         |
| 199 Grass Bob                | Suada swerga swergade Niceville #                   | *       |         |         |         |         |         |
| 200 Dark Velvet Bob          | Koruthalos butleri butleri de Niceville #           | *       |         |         |         |         |         |
| 201 Common Redeye            | Matapa ario Moore                                   | *       |         |         |         |         |         |
| 202 Coon                     | Psilos fuliga subfasciatus Moore                    | *       | *       | *       |         |         |         |
| 203 Chocolate Demon          | Ancistrodes nignita diocles Moore                   | *       | *       | *       |         |         |         |
| 204 Common Banded Demon      | Notocrypta paraylos asawa Frusthofer               | *       |         |         |         |         |         |
| 205 Restricted Demon         | Notocrypta curv(fascia Felder & Felder             | *       |         |         |         |         |         |
| 206 Tiger Hopper             | Ochus subivittatussubradiatus Moore                 | *       |         |         | *       |         |         |
| 207 Bush Hopper              | Ampitia dissorides Fabricius                        | *       |         |         | *       |         |         |
| 208 Scarce Bush Hopper       | Ampitia maroides de Niceville                       | *       |         |         |         |         |         |
| 209 Veined Scrub Hopper      | Aeromachus stigmatoabsoletus Takeuchi               | *       |         |         |         |         |         |
Butterflies in Gibbon Wildlife Sanctuary

| Common name                  | Scientific name                               | Season               |
|------------------------------|-----------------------------------------------|----------------------|
| Grey Scrub Hopper            | Aeromachus jhoracreta Nicéville               | Jan-Feb, Mar-Apr, May-Jun, Jul-Aug, Sep-Oct, Nov-Dec |
| Pygmy Scrub Hopper           | Aeromachus pygmaeus Fabrictius                | *                    |

IWPA-Indian Wildlife Protection Act, 1972; *-peak season for the species; #-Recorded by Monsoon Jyoti Gogoi

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