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Observations on butterflies of non-protected areas of Titabar, Assam, India

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Abstract: This paper depicts the result of two years study from 2014 to 2016 in non-protected areas on butterflies of Titabar (26.588° N & 94.187° E), Assam, India. During the study period, a total of 158 species of butterflies distributed in six families were recorded, out of which 29 belong to the family Hesperiidae, 17 to Pieridae, 11 to Papilionidae, 38 to Lycaenidae, two to Riodinidae, and 61 to Nymphalidae. Fourteen ‘rare’ species were recorded during the survey as per Evans (1932) such as Athyma ranga, Arhopala paraganesa, Caltoris cormasa, and Appias nero. This indicates the importance of the study and the need for conservation of butterflies of non-protected area of Titabar subdivision in upper Assam.

Keywords: Conservation, diversity, Jorhat District, Lepidoptera, northeastern India, species.

Upper Assam, a biodiversity rich zone of the northeastern region is well known for butterflies, having over 400 species of which 1/3rd are endemic and 1/7th are protected under various schedules of the Wildlife (Protection) Act 1972 in India (Singh 2017). Notable works have been done in Panbari Reserve Forest (RF), Kaziranga-Karbi hills (Gogoi 2013b, 2015), Jeypore RF, Dehing-Patkai (Gogoi 2013), Gibbon Wildlife Sanctuary (WS) (Singh et al. 2015), Dangori RF (Boruah & Das 2017), and floodplains of Dibru Soikhuwa NP (Das et al. 2017) in upper Assam. Along with the protected areas (PA), other non PAs like different forests and village woodlands of Assam also provide habitat for different butterfly species. But due to anthropogenic pressures these non PAs are declining in number thus affecting tiny creatures like butterflies.

Doubleday (1865) worked on the butterflies of Jorhat District. Recently, Singh et al. (2015) and Neog (2015) listed the butterflies of Gibbon WS which is the only PA of Titabar subdivision, and Bhuyan et al. (2005) documented the butterflies of the Regional Research Laboratory Campus of Jorhat. Again Saikia et al. (2014) studied the butterfly diversity of the Sericultural Training Institute Campus of Titabar and Dutta (2013) recorded 40 species from Titabar Town area. Our study hasn’t included the Gibbon WS. Emphasis has been made to document the butterfly diversity of non PAs of Titabar subdivision to show the significance of non PAs especially in upper Assam and their importance in butterfly conservation in the region.
Methods

Study Area

Titabar subdivision (26.588 N & 94.187 E) is located in Jorhat District of Upper Assam. To the north of Titabar lies the Jorhat subdivision, the south is bordered by Nagaland, Sivasagar District is located in the east, and the west is bordered by Golaghat District. Titabar subdivision consists of two revenue circles: Titabar and Mariani. The altitude of Titabar is 172m above sea level, while the average temperature ranges from 17–28°C, the average humidity is in the range of 66.5–89.9% and the annual rainfall of the study area is 250cm. The climate here is humid in summer and dry and cold in winter. Titabar has one wildlife sanctuary, the Hollongapar Gibbon WS under Mariani revenue circle. The survey was conducted in 10 different places in Titabar-Nanda Nath Saikia College Campus (26.588 N & 94.177 E), Sericultural Training Institute (26.592 N & 94.172 E), Bebejia (26.586 N & 94.173 E), Kachari Gaon (26.595 N & 94.175 E), Kasojan (26.58 N & 94.17 E), Mejenga Grant (26.597 N & 94.164 E), Bekajan (26.384 N & 94.162 E), Panjan (26.495 N & 94.21 E), Jalukonibari (26.645 N & 94.188 E), Rangajan (26.646 N & 94.223 E).

Survey methods

The survey of butterfly species was conducted in all the major seasons, i.e., pre-monsoon, monsoon, post-monsoon, and winter. The survey involved walking through different sites and visual search and photography were conducted on different forest trails, hill streams, village woodlands, grasslands, croplands, and tea gardens between 08.00 and 14.00 hr from May 2014 to June 2016. Some species were also recorded in the early mornings and evenings. The species were...
photographed with a digital camera whenever possible.

Identification of all encountered butterflies was done to the species level. Though a few species were identified in the field, most of the species were identified from digital images taken with the camera in the field. The identification of butterflies was done by using the identification guides of Watson (1897), Evans (1932), Kehimkar (2008), research papers of Gogoi (2013b), Gogoi (2015), and Singh et al. (2015). No butterflies were caught with net or other equipment for identification.

RESULTS AND OBSERVATIONS

During the study period, a total of 158 species of butterflies were identified belonging to six families from the non PAs of Titabar subdivision. Out of the 158 species identified, Nymphalidae showed the maximum species richness, comprising 38.60% with 61 species, followed by Lycaenidae 24.05% with 38, Hesperiidae 18.35% with 29, Pieridae 10.75% with 17, Papilionidae 6.96% with 11, and Riodinidae 1.26% with two species (Table 1, 2).

Twenty species found during the survey are new records for Titabar subdivision as they have not been recorded earlier by either Singh et al. (2015) or Neog (2015) from Gibbon WS. These are Tirumalaseptentronics, Elymnias malelas, Lexias pardinis, Pseudergolis wedah, Eurema brigitta, Appias nero, Curetis saronis, Iraota timoleon, Charana mandarinus, Arhopala paraganesa, Arhopala oenea, Caleta roxus, Taraka hamada, Bibasis jaina, Tagiades menaka, Pseudoborbo bevani, Halpe porus, Potanthus ganda, Telicota colon, and Caltoris cormasa.

The species which have not been recorded by Singh et al. (2017) from eastern Assam found during the survey are Elymnias malelas, Lexias pardinis, Pseudergolis wedah, Eurema brigitta, Appias nero, Charana mandarinus, Iraota timoleon, Arhopala paraganesa, Arhopala oenea, Caleta roxus, Tagiades menaka, and Telicota colon.

Findings like Arhopala oenea, Arhopala paraganesa, Appias nero, and Telicota colon are significant as these species have not been recorded in recent times from the PAs of upper Assam by Gogoi (2013b, 2015), Neog (2015), Singh et al. (2015), Baruah & Das (2017), Singh (2017), and Das et al. (2017).

Fourteen species found during the survey are “rare” in occurrence as per Evans (1932). These are Mycalesis malasarida, Athyma ranga, Neptis namba, Euthalia anosia, Appias albino, Appias libythea, Appias nero, Arhopala silhetensis, Arhopala bazaloiase, Arhopala paraganesa, Arhopala oenea, Caltoris cormasa, Doleschalia bisaltide, and Iraota timoleon. Twenty-two species found during the study are protected under various schedules of the Indian Wildlife (Protection) Act, 1972 (Schedule I—1 species, Schedule II—17 species, Schedule IV—4 species); however, results indicate poor habitat of butterflies in non PAs of Titabar as only 11 papilionids were recorded during the survey whereas 19 species of papilionids were recorded by Singh et al. (2015) from Gibbon WS.

Notes on ‘rare’ (Evans 1932) occurrence of the species

Plain Bushbrown Mycalesis malsarida Butler, 1868
One individual was encountered in a dense woodland in Bebejia on 28 October 2014 in the morning. In India, it is found only in the northeastern region. Except India it is recorded from Bangladesh (Larsen 2004), Bhutan, and Myanmar (Kehimkar 2016). We also encountered one individual from Gibbon WS in September, 2015. The species is protected under Schedule II of IWPA, 1972.

Yellow Sailer Neptis namba Moore, 1858:
Two individuals were encountered during the study period. One was recorded from Bebejia on 26 August 2014 in the morning and the other from Rangajan on 10 July 2015 in the afternoon. Both the individuals were encountered on a village road.

Blackvein Sergeant Athyma ranga Moore, 1858:
One individual of this species was encountered from the Sericulture Training Institute campus on 15 March 2015 in the morning. The species ranges from Nepal to northeastern India, northeastern Bangladesh, and Myanmar. It is protected under Schedule II of IWPA, 1972.

Grey Baron Euthalia anosia Moore, 1858:
One individual was encountered mud puddling on a road surrounded by woodland in Jalukonibari on 28 October 2014. Protected under Schedule II of IWPA, 1972. In India the species is restricted to the northeastern region.

Table 1. Overview of taxonomic diversity of butterflies of the Titabar subdivision.

| Family          | Number of subfamily | Number of genera | Number of species |
|-----------------|---------------------|------------------|------------------|
| Nymphalidae     | 10 (43.47%)         | 38 (35.18%)      | 61 (38.60%)      |
| Papilionidae    | 1 (4.34%)           | 4 (3.70%)        | 11 (6.96%)       |
| Pieridae        | 2 (8.69%)           | 9 (8.33%)        | 17 (10.75%)      |
| Lycaenidae      | 6 (26.08%)          | 30 (27.77%)      | 38 (24.05%)      |
| Riodinidae      | 1 (4.34%)           | 2 (1.85%)        | 2 (1.26%)        |
| Hesperiida      | 3 (13.04%)          | 25 (23.14%)      | 29 (18.35%)      |
| TOTAL:          | 23 (100%)           | 108 (100%)       | 158 (100%)       |
Table 2. List of butterflies recorded in Titabar, Jorhat, Assam during the study period (May 2014–June 2016).

| Common name | Scientific name | Status (Evans, 1932) | IWPA, 1972 |
|-------------|-----------------|----------------------|------------|
| Family Nymphalidae | | | |
| Subfamily Danainae | | | |
| 1. Striped Tiger | Danaus genutia Cramer, 1779 | VC | |
| 2. Plain Tiger | Danaus chrysippus Linnaeus, 1758 | VC | |
| 3. Glassy Tiger | Paranta aglea Stoll, 1782 | C | |
| 4. Common Crow | Euploea core Cramer, 1780 | C | |
| 5. Dark Blue Tiger | Tirumala septentrionis Butler, 1874 | NR | |
| 6. Striped Blue Crow | Euploea mulciber Cramer, 1777 | C | Schedule IV |
| 7. Magpie Crow | Euploea radamanthus Fabricius, 1793 | NR | |
| Subfamily Morphinae | | | |
| 8. Common Duffer | Discophora sondaica Boisduval, 1836 | C | |
| 9. Common Faun | Founis canens Huebner, 1826 | C | |
| 10. Jungle Glory | Thaumantis diore Doubleday, 1845 | NR | |
| Subfamily Charaxinae | | | |
| 11. Tawny Rajah | Charaxes bernardus Fabricius, 1793 | C | |
| 12. Common Nawab | Polypura athamas Drury, 1773 | C | |
| Subfamily Satyrinae | | | |
| 13. Angled Red Forester | Lethe chandica Moore, 1858 | NR | |
| 14. Bamboo Treebrown | Lethe europa Fabricius, 1775 | NR | |
| 15. Common Fivering | Ypthima boldus Fabricius, 1775 | VC | |
| 16. Common Bushbrown | Mycalesis perseus Fabricius, 1775 | VC | |
| 17. Plain Bushbrown | Mycalesis malisida Butler, 1868 | R | Schedule II |
| 18. Whitebar Bushbrown | Mycalesis anaxias Hewitson, 1862 | NR | Schedule II |
| 19. Dark Brand Bushbrown | Mycalesis mineus Linnaeus, 1758 | VC | |
| 20. Common Evening Brown | Melanitis leda Linnaeus, 1758 | VC | |
| 21. Dark Evening Brown | Melanitis phedima Cramer, 1780 | C | |
| 22. Common Palmfly | Elymnias hypermnestra Linnaeus, 1763 | C | |
| 23. Spotted Palmfly | Elymnias maleas Hewitson, 1863 | NR | |
| 24. Tiger Palmfly | Elymnias nesae Linnaeus, 1764 | NR | |
| Subfamily Heliconinae | | | |
| 25. Common Leopard | Phalanta phalantha Drury, 1773 | C | |
| 26. Cruiser | Vindula erota Fabricius, 1793 | NR | |
| 27. Large Yeoman | Cirrochroa aoris Doubleday, 1847 | NR | |
| 28. Vagrant | Vagrans egista Cramer, 1780 | NR | |
| Subfamily Acraeinae | | | |
| 29. Leopard Lacewing | Cethosis cyane Drury, 1773 | NR | |
| 30. Tawny Coster | Acrasio violae Fabricius, 1793 | C | |
| Subfamily Limenitinae | | | |
| 31. Common Sailer | Neptis hylas Linnaeus, 1758 | VC | |
| 32. Yellow Sailer | Neptis namba Tytler, 1915 | R | |
| 33. Grey Count | Tanaecia lepidea Butler, 1868 | NR | Schedule II |
| 34. Commander | Moduza prachis Cramer, 1777 | NR | |
| 35. Knight | Lebadea martha Fabricius, 1787 | NR | |
| 36. Common Sergeant | Athyma perius Linnaeus, 1758 | C | |

| Common name                  | Scientific name          | Status (Evans, 1932) | IWPA, 1972 |
|-----------------------------|--------------------------|----------------------|------------|
| 37. Blackvein Sergeant      | Athyma ranga Moore, 1858 | R                    | Schedule II|
| 38. Staff Sergeant          | Athyma selonaphora Kollar, 1844 | NR                   |            |
| 39. Colour Sergeant         | Athyma nefte Cramer, 1780 | NR                   |            |
| 40. Common Lascar           | Pantoporia hardonora Stoll, 1790 | C              |            |
| 41. Archduke                | Lexias pardalis Moore, 1878 | NR                   |            |
| 42. Dark Archduke           | Lexias dirtea Fabricius, 1793 | NR                   | Schedule II|
| 43. Gaudy Baron             | Euthalia lubentina Cramer, 1777 | C                    | Schedule IV|
| 44. Powdered Baron          | Euthalia monina Fabricius, 1787 | NR                   |            |
| 45. Common Baron            | Euthalia acantha Cramer, 1777 | NR                   | Schedule II|
| 46. Grey Baron              | Euthalia anasia Moore, 1858 | R                    | Schedule II|
| 47. Common Earl             | Tanaecia julii Lesson, 1837 | C                    |            |
| **Subfamily Cyrestinae**    |                          |                      |            |
| 48. Common Map              | Cyrestis thyodamas Boisduval, 1846 | C              |            |
| 49. Common Maplet           | Chersonesia risc Doubleday, 1848 | NR                   |            |
| 50. Tabby                   | Pseudergalis wedah Kollar, 1848 | C                    |            |
| **Subfamily Biblidinae**    |                          |                      |            |
| 51. Common Castor           | Ariadne merione Cramer, 1777 | C                    |            |
| 52. Angled Castor           | Ariadne ariodne Linnaeus, 1763 | C                   |            |
| **Subfamily Nymphalinae**   |                          |                      |            |
| 53. Peacock Pansy           | Junonia almana Linnaeus, 1758 | C                    |            |
| 54. Yellow Pansy            | Junonia hierta Fabricius, 1798 | C                    |            |
| 55. Grey Pansy              | Junonia attles Linnaeus, 1763 | NR                   |            |
| 56. Lemon Pansy             | Junonia leonias Linnaeus, 1758 | C                    |            |
| 57. Chocolate Pansy         | Junonia iphita Cramer, 1779 | C                    |            |
| 58. Great Eggfly            | Hypolimnas bolina Linnaeus, 1758 | C              |            |
| 59. Orange Oakleaf          | Kallima inachus Boisduval, 1846 | NR                   |            |
| 60. Common Jester           | Symbrenthia ilaoa Moore, 1875 | C                    |            |
| 61. Autumn Leaf             | Daleschalia bisaltrde Cramer, 1777 | R              |            |
| **Family Papilionidae**     |                          |                      |            |
| **Subfamily Papilioninae**  |                          |                      |            |
| 62. Common Jay              | Graphium dason C&R. Felder, 1864 | C                    |            |
| 63. Tailed Jay              | Graphium agamonmnon Linnaeus, 1758 | C              |            |
| 64. Common Mormon           | Papilio polytes Linnaeus, 1758 | VC                   |            |
| 65. Great Mormon            | Papilio memnon Linnaeus, 1758 | C                    |            |
| 66. Lime Butterfly          | Papilio demoleus Linnaeus, 1758 | VC                   |            |
| 67. Common Bluebottle       | Graphium sarpedon Linnaeus, 1758 | C                    | Schedule II|
| 68. Common Mime             | Papilio clytia Linnaeus, 1758 | NR                   |            |
| 69. Yellow Helen            | Papilio nephelus Boisduval, 1836 | NR                   | Schedule II|
| 70. Red Helen               | Papilio helenus Linnaeus, 1758 | C                    |            |
| 71. Common Raven            | Papilio castor Westwood, 1842 | NR                   |            |
| 72. Golden Birdwing         | Troides aeacus C&R. Felder, 1860 | NR                   |            |
| **Family Pieridae**         |                          |                      |            |
| **Subfamily Coliadinae**    |                          |                      |            |
| 73. Small Grass Yellow      | Eurema brigitta Stoll, 1780 | VC                   |            |
| 74. Common Grass Yellow     | Eurema hecabe Linnaeus, 1758 | VC                   |            |
| Common name                          | Scientific name                  | Status (Evans, 1932) | IWPA, 1972 |
|-------------------------------------|----------------------------------|---------------------|------------|
| Three Spot Grass Yellow             | Eurema blanda Boisduval, 1836    |                     | C          |
| Tree yellow                         | Gandaca harina Horsfield, 1829   |                     | NR         |
| Common Emigrant                     | Catopsilia pomona Fabricius, 1775|                     | C          |
| Mottled Emigrant                    | Catopsilia pyranthe Linnaeus, 1758|                     | C          |
| **Subfamily Pierinae**              |                                  |                     |            |
| Indian Cabbage White                | Pieris canidia Linnaeus, 1768    |                     | VC         |
| Green Veined White                  | Pieris melete Menetries, 1857    |                     | NR         |
| Common Albatross                    | Appias albina Boisduval, 1836    |                     | R          |
| Chocolate Albatross                 | Appias lyncida Cramer, 1777      |                     | C          |
| Striped Albatross                   | Appias licythe Fabricius, 1775   |                     | R          |
| Orange Albatross                    | Appias nero Fabricius, 1793      |                     | R          |
| Red Base Jezebel                    | Delias pasithoe Linnaeus, 1767   |                     | NR         |
| Red-Spot Jezebel                    | Delias descombesi Boisduval, 1836|                     | NR         |
| Lesser Gull                         | Cepora nadina Lucas, 1852        |                     | NR         |
| Great Orange Tip                    | Hebomaia glaucippe Linnaeus, 1758|                     | C          |
| Psyche                              | Leptosia nina Fabricius, 1793    |                     | C          |
| **Family lycaenidae**               |                                  |                     |            |
| Common Gem                          | Poritia hewitsoni Moore, 1866    |                     | NR         |
| **Subfamily Poritinae**             |                                  |                     |            |
| Apefly                              | Spalgis epius Westwood, 1852     |                     | NR         |
| **Subfamily Curetinae**             |                                  |                     |            |
| Burmese Sunbeam                      | Curetis saronis Moore, 1877      |                     | NR         |
| **Subfamily Lycaeninae**            |                                  |                     |            |
| Purple Saphire                       | Helioptorus epicles Godart, 1824 |                     | C          |
| **Subfamily Theclinae**             |                                  |                     |            |
| Fluffy Tit                          | Zeltus amosa Hewitson, 1865      |                     | NR         |
| Common Tit                          | Hypolycaena erylus Godart, 1824  |                     | C          |
| Orchid Tit                          | Chlaria othana Hewitson, 1865    |                     | NR          |
| Yamfly                              | Luxura atymnus Stoll, 1780       |                     | C          |
| Common Imperial                     | Cheritra freja Fabricius, 1793   |                     | NR         |
| Common Acacia Blue                  | Surenda quercetorum Moore, 1858  |                     | C          |
| Common Onyx                         | Haraga onyx Moore, 1858          |                     | NR          |
| Copper Flash                        | Rapala pheretima Hewitson, 1863 |                     | NR         |
| Sylhet Oakblue                      | Arhopala silhetensis Hewitson, 1862|                     | R          |
| Tamil Oakblue                       | Arhopala bazaloides Hewitson, 1878|                     | R          |
| Yellow Disc Tailess Oakblue         | Arhopala perimuta Moore, 1858    |                     | R          |
| Silverstreak Blue                   | Iraota timoleon Stoll, 1790      |                     | R          |
| Mandarin Blue                       | Charana mandarinus Hewitson, 1863|                     | NR         |
| Dusky Bush Blue                     | Arhopala paraganesa de Niceville, 1882|                     | R          |
| Centaur Oakblue                     | Arhopala centaurus Fabricius, 1775|                     | NR         |
| Hewitson’s Dull Oakblue             | Arhopala oenee Hewitson, 1869    |                     | R          |
| **Subfamily Polyommatinae**         |                                  |                     |            |
| Common Hedge Blue                   | Acytolepis puspa Horsfield, 1828 |                     | C          |
| Common name               | Scientific name               | Status (Evans, 1932) | IWPA, 1972 |
|---------------------------|-------------------------------|----------------------|------------|
| 111. Plain Hedge Blue     | Celastrina lavendularis Moore, 1877 | NR                   |            |
| 112. Malayan              | Megista malaya Horsfield, 1828 | NR                   |            |
| 113. Common Cerulean      | Jamides celeno Cramer, 1775   | C                    |            |
| 114. Dark Cerulean        | Jamides bochus Stoll, 1782    | C                    |            |
| 115. Pale Grass Blue      | Pseudaloezeeria maha Kollar, 1844 | VC                   |            |
| 116. Lesser Grass Blue    | Zizina ots Fabricius, 1787    | C                    |            |
| 117. Lime Blue            | Chilades lajus Stoll, 1780    | C                    |            |
| 118. Tailless Lineblue    | Prosotas dubiosa Semper, 1879 | C                    |            |
| 119. Common Lineblue      | Prosotasa nora C.Felder, 1860 | C                    |            |
| 120. Common Ciliate Blue  | Anthene emolus Godart, 1824   | C                    |            |
| 121. Zebra Blue           | Leptotes pimplius Fabricius, 1793 | C                     |            |
| 122. Pea Blue             | Lampides boeticus Linnaeus, 1767 | C, Schedule II      |            |
| 123. Common Pierrot       | Castalus rosmon Fabricius, 1775 | C                     |            |
| 124. Elbowed Pierrot      | Coleta elna Hewitson, 1876   | NR                   |            |
| 125. Straight Pierrot     | Coleta roxus Godart, 1824    | NR                   |            |
| 126. Forest Pierrot       | Taraka hamada Duce, 1875     | NR                   |            |
| 127. Quaker               | Nepoithedops zalmora Butler, 1870 | C                   |            |
| **Family Riodinidae**     |                               |                      |            |
| 128. Punchinello          | Zemeros flegyas Cramer, 1780  | VC                   |            |
| 129. Tailed Judy          | Abisara neophrum Hewitson, 1861 | NR                  |            |
| **Family Hesperiidae**    |                               |                      |            |
| 130. Common Awl           | Hasora badra Moore, 1858     | NR                   |            |
| 131. Common Banded Awl    | Hasora chromus Cramer, 1780   | NR                   |            |
| 132. Orange Awlet         | Bibasis jaina Moore, 1866    | NR                   |            |
| **Subfamily Pyrginae**    |                               |                      |            |
| 133. Common Small Flat    | Sarangesa dasahara Moore, 1866 | C                    |            |
| 134. Fulvous Pied Flat    | Pseudocoladenia dan Fabricius, 1787 | C                  |            |
| 135. Indian Skipper       | Spialia galba Fabricius, 1793 | C                    |            |
| 136. Common Spotted Flat  | Celaenorrhinus leucocera Kollar, 1844 | C                  |            |
| 137. Suffused Snow Flat   | Tagiades japetus Stoll, 1781 | NR                   |            |
| 138. Spotted Snow Flat    | Tagiades menaka Moore, 1866   | C                    |            |
| 139. Common Snow Flat     | Tagiades parra Fruhstorfer, 1910 | C                  |            |
| **Subfamily Hesperinae**  |                               |                      |            |
| 140. Tiger Hopper         | Ochus subvittatus Moore, 1878 | C                    |            |
| 141. Common Redeye         | Motapa aria Moore, 1866      | C                    |            |
| 142. Giant Redeye         | Gangara thyris Fabricius, 1775 | NR                  |            |
| 143. Grass Demon          | Udaspes fulus Cramer, 1775   | C                    |            |
| 144. Chocolate Demon      | Ancistrodes nigris Lattreille, 1824 | C                |            |
| 145. Restricted Demon     | Notoctyra curvifascia C.R. Felder, 1862 | C            |            |
| 146. Bevan’s Swift        | Pseudaloezeeria bevani Moore, 1878 | NR                  |            |
| 147. Small Branded Swift  | Pelopidas mohias Fabricius, 1798 | C                  |            |
| 148. Moore’s Ace          | Halpe porus Mabille, 1877    | NR                   |            |
Orange Albatross *Appias nero* Fabricius, 1793: One individual was encountered on the bank of Kasojan sub-tributary in Kasojan Village on 10 August 2014 in the afternoon. The right forewing of the individual recorded was worn off (image 66). The species is found in northeastern India and Myanmar. The species was recorded from Lumding, upper Assam by Parsons & Cantile (1948) and protected under Schedule IV of IWPA, 1972.

Common Albatross *Appias albina* Boisduval, 1836: One individual was encountered in a muddy patch on the boundary between Nanda Nath Saikia College and Kachari Gaon on 11 June 2014 in the morning. The species is protected under Schedule II of IWPA, 1972.

Striped Albatross *Appias libythea* Fabricius, 1775: Two individuals were encountered during the study period. One was from a roadside in Bebejia feeding on the nectar of *Lantena camera* on 09 July 2014 and the other individual was encountered in the flower garden of Nanda Nath Saikia College on 12 August 2014. This species is protected under Schedule IV of IWPA, 1972.

Sylhet Oakblue *Arhopala silhetensis* Hewitson, 1862: Two individuals were encountered on 14 March 2015 and 09 July 2015 in a forest in Rangajan. This species is distributed in the northeastern region of India, Bangladesh, and Myanmar. It is protected under Schedule II of IWPA, 1972.

Tamil Oakblue *Arhopala bazaloides* Hewitson, 1878: Two individuals were encountered during the study period. One was encountered from Rangajan on 15 March 2015 and the other from Bebejia on 02 August 2015. Both the individuals were encountered in a woodland in the morning. The species is protected under Schedule II of IWPA, 1972.

Centaur Oakblue *Arhopala centaurus* Fabricius, 1775: Two individuals were encountered during the survey, one from Bebejia on 12 June 2015 and the other from Kachari Gaon on 30 May 2016. Both the individuals were encountered from village woodlands. In India this species is found in Uttarakhand, Western Ghats, northeast, and West Bengal. The status of occurrence of this species is not rare (Evans 1932).

Hewitson’s Dull Oakblue *Arhopala oenea* Hewitson, 1869: The species was encountered four times in a woodland in Bebejia Gaon on 30 May, 02, 09, & 18 June 2016. One individual was found laying eggs on *Castanopsis indica* plant and most probably it is the first record of its egg laying on this plant. The species is distributed from Garhwal to northeastern India (Khasi Hills and Nagaland), northeastern Bangladesh, and Myanmar. It is protected under Schedule II of IPWA, 1972.

Dusky Bushblue *Arhopala paraganesa* de Niceville, 1882: Only one individual was encountered in a woodland in Bebejia on 18 June 2016 in the morning. The species is restricted to the northeastern region in India. It’s protected under Schedule II of IWPA, 1972. Except for this species and *A. oenea*, we observed all other *Arhopala* spp. recorded during the study period in Gibbon WS.

Autumn Leaf *Doleschallia bisaltide* Cramer, 1777: This species was encountered two times during the study period. One individual from Bebejia on 14 July 2015 and the other from Jalukonibari on 13 April 2016. Both the individuals were encountered near a bamboo patch puddling on stone and sand.

Full Stop Swift *Caltoris cormasa* Hewitson, 1876: One individual of this species was encountered in Bebejia on 05 April 2016 puddling on bird droppings in a small
open area between a bamboo patch and a woodland. It is restricted to the northeastern region of India.

**Silverstreak Blue Iraota timoleon Stoll, 1790:** One individual was encountered sitting on a dry leaf of *Dioscorea* sp. in a vegetable garden surrounded by a woodland in Bebejia on 25 February 2015.

**Tabby Pseudergolis wedah Kollar, 1848:** Though a common species as per Evans (1932), it was encountered only once in Panjan on 24 December 2014, found puddling on stones near a hill stream. The species is found in the north-east, Uttarakhand, and Himachal in India.

**Forest Pierrot Taraka hamada Druce, 1875:** One individual was encountered in a tea garden surrounded by village woodland in Mejenga Grant on 05 January 2015. The species is distributed from eastern Nepal to northeastern India, southeastern Bangladesh, and Myanmar. It is not rare as per Evans (1932).

**Straight Pierrot Caleta roxus Godart, 1824:** One individual was encountered near a hill stream in Bekajan on 18 January 2015 in the morning. The surrounding area of the spot where the individual was encountered was heavily disturbed by illegal coal mining and saw mills. The species is not rare as per Evans (1932).

**Sumatran Dart Potanthus ganda Fruhstorfer, 1911:** One individual of this species was encountered in a woodland in Rangajan on 15 March 2015 sitting on a fern in the morning. The species is considered extralimital in Evans (1932). It was identified on the basis of subapical spot. The subapical spot in space 8 is slightly smaller than that of the space 7 and 6 (Corbet et al. 1992; Ek-Amnuay 2012). It is distributed in the northeastern region in India and in Myanmar, Thailand, Laos, Vietnam, Malaysia, Sumatra and Java.

**DISCUSSION**

Titabar subdivision is rich in its biodiversity due to the edge effect of both plain and hilly areas and being located at the foothills of Nagaland. Gibbon WS is already well known for its floral and faunal diversity including butterflies. Singh (2015) recorded 211 species of butterflies from the sanctuary. Our study added 20 more species of butterflies from the non PAs to the total butterfly diversity of Titabar subdivision. The village woodlands with rich bamboo plantations serve as ideal habitat for the majority of animals, including butterflies. Though during the present survey a total of 158 species were recorded in the non PAs of Titabar subdivision, the final number of butterfly species occurring in the non PAs is more likely to be between 200–250 as some places of Titabar are still unexplored.

The significance of the area from the lepidopteran viewpoint lies in the fact that it harbors one species belonging to Schedule I, 17 species to Schedule II, and four species to Schedule IV of IWPA, 1972. Fourteen rare species, according to Evans (1932) were also recorded here. Again, many species listed as common by Evans (1932) were actually found to be uncommon or rare in this survey. This is probably because of different anthropogenic pressures. The major threat to the butterfly population in this area is the conversion of village woodlands to small and micro tea gardens. Pesticides, herbicides, and other chemicals used in these tea gardens may directly affect the number of butterflies by reducing their habitats. A number of illegal coal mining stations and saw mills in the Titabar-Nagaland border pose a big threat to the biodiversity, as well as the butterfly diversity of this area.

Still more work on the butterflies of this area regarding the host plants, habitat, and ecology are required. The results of our study form a baseline for future work on the diversity and conservation of butterflies in Titabar subdivision.

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Butterflies of non-protected areas of Titabar, Assam

1. Cethosia cyane
2. Mycalesis anaxias
3. Euthalia lubentina
4. Euthalia monina
5. Athyma nefte
6. Moduza procris
7. Chersonesia risa
8. Danaus chrysippus
9. Discophora sondaica
10. Lebadea martha
11. Dolchallia bisaltide
12. Tanaecia julii
13. Phalanta phalantha
14. Neptis hylas
15. Vindula erota
16. Tirumala septentrionis
17. Parantica aglea
18. Mycalesis mineus
19. Acraea violae
20. Cirrochroa aeris
21. Kallima inachus
22. Pseudergolis wedah
23. Neptis ananta
24. Euthalia anosia
Butterflies of non-protected areas of Titabar, Assam

Image 25. Mycalesis malasarida
Image 26. Cyrestis thyodamas
Image 27. Elymnias malelas
Image 28. Caleta elna

Image 29. Castalius rosimon
Image 30. Caleta roxus
Image 31. Taraka Hamada
Image 32. Lampides boeticus

Image 33. Spalgis epius
Image 34. Curetis thetis
35. Acytolepis puspal
Image 36. Prosotas dubiosa

Image 37. Charana mandarinus
Image 38. Zeltus amasa
Image 39. Loxura atymnus
Image 40. Iraota timoleon

Image 41. Chliaria othona
Image 42. Rapala pheretima
Image 43. Arhopala silhetensis
Image 44. Arhopala perimuta

Image 45. Arhopala centaurus
Image 46. Arhopala oenea
Image 47. Arhopala paraganesa
Image 48. Heliophorus epicles
Butterflies of non-protected areas of Titabar, Assam

Image 73. Delias descombesi
Image 74. Catopsilia Pomona
Image 75. Hasora badra
Image 76. Hasora chromus
Image 77. Halpe porus
Image 78. Telicota colon
Image 79. Potanthus ganda
Image 80. Oriens goloides
Image 81. Tagiades gana
Image 82. Tagiades japetus
Image 83. Tagiades menaka
Image 84. Suoda swerga
Image 85. Iambrix salsola
Image 86. Notocrypta curvifascia
Image 87. Ochus subvittatus
Image 88. Ampittia dioscorides
Image 89. Gangara thyrsis
Image 90. Aeromachus pygmaeus
Image 91. Udaspes folus
Image 92. Ancistroides nigrita
**Butterflies of non-protected areas of Titabar, Assam**

Konwar & Bortamuly

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Articles

Spatiotemporal movement pattern of Asian Elephants Elephas maximus Linnaeus, 1758 in Sindhudurg District, Maharashtra, India
– Milind Dangarb Patil, Vinayak Krishna Patil & Nirdin Avinash Mungi, Pp. 18109–18119

Conservation ecology of birds in Mt. Hilong-hilong, a Key Biodiversity Area on Mindanao Island, the Philippines
– Arturo G. Gracia Jr., Alma B. Mohagan, Janezel C. Burlat, Welfredo L. Yu Jr., Janine Mondal, Florfe M. Acma, Hannah P. Lumista, Riah Calising & Krizfer Cezuela Talangko, Pp. 18110–18121

Nesting and hatching behaviour of Olive Ridley Turtles Lepidochelys olivacea (Eschscholtz, 1829) (Reptilia: Cryptodira: Chelonidae) on Dr. Abdul Kalam Island, Odisha, India
– P. Poornima, Pp. 18122–18131

Feeding ecology of Walia ibex Capra walia (Mammalia: Artiodactyla: Bovidae) in Simien Mountains National Park, Ethiopia
– D. Ejigu, A. Bekele & E. Powell, Pp. 18132–18140

Assessment of crop and property damage caused by Semnopithecus vetulus nestor (Bennett, 1833) (Mammalia: Primates: Cercopithecidae) in Gampaha District, Sri Lanka
– Sunil Wijethilaka, Lakshani S. Weerasekara, Saumya Bandara & Kithsiri B. Ranawana, Pp. 18141–18147

Habitat preference of the Indian Pangolin Manis crassicaudata inhabiting Margalla Hills National Park, Islamabad, Pakistan
– Tarig Mahmood, Shaista Andleeb & Faraz Akram, Pp. 18148–18155

The endangered Himalayan Red Panda: first photographic evidence from its westernmost distribution range
– Saroj Shrestha, Sony Lama, Ang Phuri Sherpa, Sonam Tashi Lama & Dinesh Ghale, Pp. 18156–18163

Ecological niche modelling predicts significant impacts of future climate change on two endemic rodents in eastern Africa
– Aditya Srinivasulu, Alembrhan Assefa & Chelmala Srinivasulu, Pp. 18164–18176

Avian diversity in a fragmented landscape of central Indian forests (Bhopal Forest Circle)
– Amit Kumar, Yogesh Dubey & Adwait Edgaonkar, Pp. 18177–18188

Nest tree preference shown by Ring-necked Parakeet Aratinga finschi (Aves: Psittaciformes: Psittacidae) in northern districts of Tamil Nadu, India
– M. Pandian, Pp. 18189–18199

Two new species of Euphasia Selys, 1840 (Odontona: Zygoptera: Euphaeidae) from northern Western Ghats, India
– Shriram Dinkar Bhakare, Vinayan P Nair, Pratima Ashok Pawar, Sunil Hanmant Bhoite & Milind Digambar Patil, Pp. 18200–18214

Trichaleurina javanica
First report of the fleshy mushroom Trichaleurina javanica (Rehm) M. Carbone et al. (Ascomycota: Pezizales: Chorioactidaceae) from southern India
– Lalita Saini, Archasvi Tyagi, Inam Mohammad & Vijai Malik, Pp. 18215–18226

Two new light attracted rove beetle species of Astenus Dejean, 1833 (Coleoptera: Staphylinidae: Paederinae) from Kerala, India
– Poovoli Amina & K. Rajmohana, Pp. 18249–18254

A new distribution record of an endangered and endemic rare Rein Orchid Habenaria rariflora from Gujarat, India
– Mital R. Bhatt, Pp. 18353–18357

Glimpse of climber diversity in Saharanpur District, Uttar Pradesh, India
– Lalita Saini, Archasvi Tyagi, Inam Mohammad & Vijai Malik, Pp. 18387–18389

First report of the fleshy mushroom Trichaleurina javanica (Rehm) M. Carbone et al. (Ascomycota: Pezizales: Chorioactidaceae) from southern India
– Munuswamy Kumar, Sekar Nithya & Antony Agnes Kayalvizhi, Pp. 18398–18402

Notes

Photographic record of Tragopan tragopan temminckii (Gray, 1831) (Aves: Galliformes: Phasianidae) from eastern Bhutan: an evidence of its westward range expansion
– Thshering Dorji, Kinley Kinley, Letro Letro, Dawa Tshering & Prem Nanda Maidali, Pp. 18403–18405

The Malay Cardamom Meistera arculata (Roxb.) Škorničk. & M.F. Newman (Zingiberaceae: Alpiniaeae) from the Palghat gap: a new record to Kerala, India
– Vadakkevedu Jagadesh Aswani, Manjakulam Khadhersha Jabeena & Maya Chandrashekar Nair, Pp. 18406–18410