

Baseline Inventory of Papilionoidea in Buxa Tiger Reserve, West Bengal, India (Insecta: Lepidoptera)

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Abstract

A comprehensive survey of Papilionoidea fauna in and around Buxa Tiger Reserve, Alipurduar district, West Bengal, revealed a total of 138 species spanning 6 families and 55 genera. Nymphalidae (43%) dominated the recorded species, followed by Lycaenidae (23%), Hesperidae (11%), Pieridae (10%), Papilionidae (9%), and Riodinidae (4%). Notably, 23 species are protected under the Wildlife (Protection) Amendment Act (2022), including 22 species listed in Schedule-II, and one in Schedule-I. The abundance of Papilionoidea species varied across different habitats. The highest number of species was recorded in HF (Hill Forest)-N22 (November 2022) (81 species), followed by RT (River trail)-N22 (68 species), and RT-A22 (April 2022) (50 species) and HF-A22 (47 species). This study contributes significantly to our understanding of the diversity in the region and informs conservation efforts aimed at protecting these vital pollinators and ecosystem indicators.

Keywords: Insecta, Lepidoptera, Papilionoidea, diversity, Wildlife Protection Act, conservation, Buxa Tiger Reserve, West Bengal, India.

Inventario de referencia de Papilionoidea en la Reserva de Tigres de Buxa, Bengala Occidental, India (Insecta: Lepidoptera)

Resumen

Un estudio exhaustivo de la fauna de Papilionoidea en la reserva de tigres de Buxa y sus alrededores, en el distrito de Alipurduar (Bengala Occidental), reveló un total de 138 especies de 6 familias y 55 géneros. Nymphalidae (43%) dominaba el número de especies registradas, seguida de Lycaenidae (23%), Hesperidae (11%), Pieridae (10%), Papilionidae (9%) y Riodinidae (4%). En particular, 23 especies están protegidas por la Ley de Protección de la Fauna y Flora Silvestres (Enmienda de 2022), 22 de las cuales figuran en la Lista II y una en la Lista I. La abundancia de especies de Papilionoidea varió entre los diferentes hábitats. El mayor número de especies se registró en HF (Hill Forest)-N22 (noviembre, 2022) (81 especies), seguido de RT (River trail)-N22 (68 especies), y RT-A22 (abril, 2022) (50 especies) y HF-A22 (47 especies). Este estudio contribuye significativamente a nuestra comprensión de la diversidad en la región e informa los esfuerzos de conservación dirigidos a proteger estos polinizadores vitales e indicadores del ecosistema.

Palabras clave: Insecta, Lepidoptera, Papilionoidea, diversidad, Ley de Protección de la Vida Silvestre, conservación, Reserva del Tigre de Buxa, Bengala Occidental, India.

Introduction

Lepidoptera, specifically Papilionoidea, represent one of the most extensively taxonomically investigated insect orders. The world's Papilionoidea fauna comprises more than 28,000 species, and India is home to a notable 1,504 species, showcasing the region's exceptional biodiversity (Triple, 2012). This vast array is neatly categorized into six families including Hesperidae, Papilionidae, Pieridae, Nymphalidae, Riodinidae, and Lycaenidae, providing a framework for understanding their intricate relationships (Braby, 2004). Faunal diversity is a key metric for assessing forest ecosystem health, as it contributes significantly to the resilience, stability, and sustainability of the forest's ecological processes (Bregman et al. 2016). The use of ecological indicator species has become a widespread practice globally, enabling effective monitoring and evaluation of ecosystem biodiversity (Thomas, 2005). Indicator species serve as valuable tools for informing forest management policies and assessing their subsequent impact on ecosystem structure and function (Fleishman & Murphy, 2009).

Lepidoptera are widely recognized as ideal bio-indicators due to their distinctive wing patterns, high diversity, short life cycles, specific host plant preferences, and sensitivity to environmental changes (Kotze et al. 2011; Lee et al. 2016). Contribute to ecosystem stability as herbivores, prey, and hosts, while also serving as pollinators and indicators of fauna and floral diversity, thereby maintaining community structure (Nicholls & Altieri, 2013; Oliver et al. 2015; Rusman et al. 2016; Chowdhury & Chowdhury, 2020).

The Northeastern region of India, extending from Sikkim through Assam to North Myanmar and up to Shan state, is one of the world's richest Papilionoidea areas (Kunte et al. 2012). This region's unique combination of flowering plants, habitats, topography, and climates supports an astonishing array of species (Rawal et al. 2013). Notably, 58% of the Papilionoidea found in the Indian subcontinent and Myanmar are concentrated in the Eastern Himalayan part and Northeastern region of India (Saikia et al. 2009). Papilionoidea species diversity, composition, and distribution patterns in the Northeastern region, particularly in Dooars and Terai plains of Northern Bengal, remains scarce (Rakshit, 2003). Conservation efforts have primarily focused on charismatic species, overlooking the importance of less glamorous taxa like Papilionoidea, which play vital roles in the ecosystem.

To address knowledge gaps, a survey was conducted to develop a comprehensive checklist of Papilionoidea species in the Dooars, a hilly region of Northern Bengal. The region is bounded by Bhutan and Assam to the north and east, and tea gardens and agricultural fields to the west and south (Pradhan & Khaling, 2020). The Buxa Tiger Reserve, situated in the foothills of the Eastern Himalayas, features the Sinchula hill range and peaks at 1800 m (Rai, 2002). Eight major rivers flow through the area, giving rise to ten distinct types of forests (Champion & Seth, 1968). The region hosts a diverse plant flora, including trees, shrubs, herbs, grasses, orchids, and ferns, alongside notable vertebrate populations such as the tiger, Asian elephant, Himalayan black bear, and gaur. With 68 mammalian species, 246 bird species, 41 reptile species, 103 fish species, and over 500 insect species (NTCA, 2022), Buxa Tiger Reserve boasts exceptional biodiversity. However, invertebrate diversity, particularly Papilionoidea diversity, remains understudied. Few studies have explored the diversity in the Himalayan foothills of West Bengal (Roy et al. 2012; Pal et al. 2015).

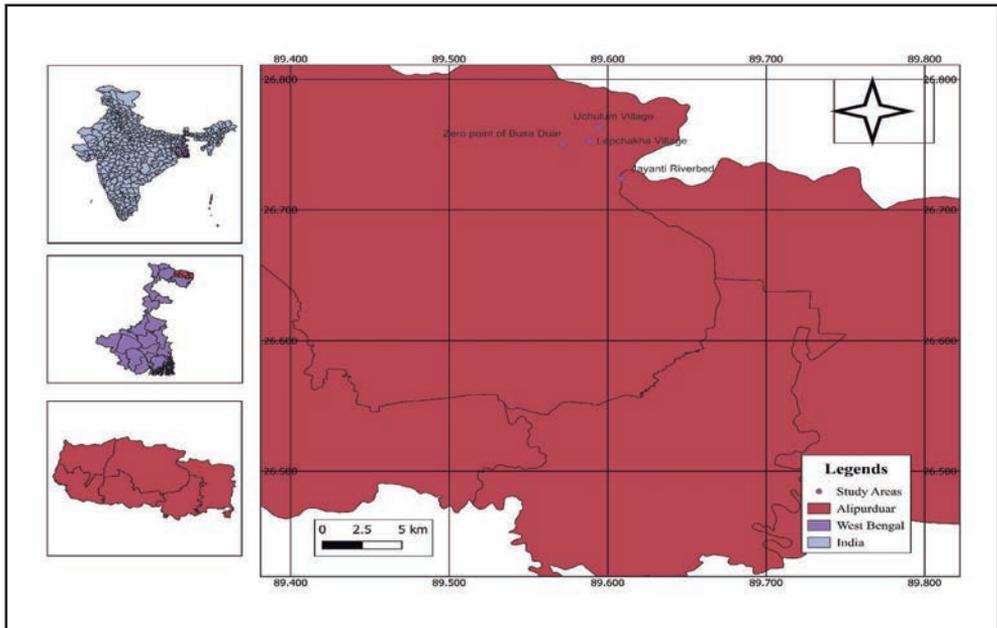
Buxa Tiger Conservation Foundation (2020) reported over 400 Papilionoidea species inside the reserve. The current investigation examines Papilionoidea diversity in Buxa Tiger Reserve, driven by three objectives. These objectives include compiling a preliminary checklist, assessing abundance and diversity.

Methodology

STUDY AREAS

The present study was conducted inside the Buxa Tiger Reserve of West Bengal, India. The first study was performed in April 2022, and the final study was performed in November 2022. In this study, two specific trails were selected for monitoring Papilionoidea, and in both of our visits, each of the trails was explored. The first trail ran from Zero Point of Buxa Duar (26.749939, 89.571548) to Uchulum Village (26.763242, 89.594472) via Sadar Bazar, Buxa Fort, Cataline Village, and Chetedara. The second trail ran from Lepchakha village (26.752903, 89.588454) to Jayanti Riverbed (26.723986, 89.608794) via Katlum, Boro Mahakal, Sachi Chu, Doban, and Choto Mahakal. The QGIS software was used to produce area maps (Figure 1).

Figure 1. Map of Study Areas.



METHODS

For getting better diversity of Papilionoidea, two different times, post-monsoon and spring, were chosen from a calendar year, 2022. The first study was performed between 10 and 12 April 2022, and the final study was performed between 15 and 17 November 2022. In every visit, we started our fields at 8:00 in the morning and completed them before 4:00 in the afternoon using a modified “Pollard Walk” technique (Pollard, 1977; Pollard & Yates, 1997). We performed the survey of the first trail, Hill Forest, on the first dates (10-IV and 15-XI of 2022) of our visit, and the very next day remained as an off day. On the last day of our visit (12-IV and 17-IV of 2022), we used to perform our river trail survey which was the second trail. In these studies, no Papilionoidea were harmed or collected. Only photographic documentation was performed using digital cameras. Species were identified on the field using Kehimkar (2016), and the photographic documentation was used to confirm the actual species identity.

Results and Discussion

A comprehensive survey of Papilionoidea fauna in and around Buxa Tiger Reserve, Alipurduar district, West Bengal, yielded a total of 138 species belonging to 6 families (Table 1, Plates 1-18). The species composition revealed that Nymphalidae was the dominant family, accounting for 43% (59 species) of the recorded species, followed by Lycaenidae (23%, 32 species), Hesperidae (11%, 15 species), Pieridae (10%, 14 species), Papilionidae (9%, 13 species), and Riodinidae (4%, 5 species) (Figures 2-3). Notably, 23 species recorded in the study area are protected under the Wildlife (Protection) Amendment Act (2022). Of these, 22 species are listed in Schedule-II, and 1 species in Schedule-I (Table 1). The abundance of Papilionoidea species varied across different habitats. The highest number of species was recorded in HF-N22 (81 species), followed by RT-N22 (68 species), RT-A22 (50 species) and HF-A22 (47 species) (Figure 4). Hierarchical clustering Paired group (UPGMA) in the study area were also shown in Figure 5.

The Buxa Tiger Reserve’s diverse ecosystem, comprising forest trees, herbs, shrubs and grasses supports a rich Papilionoidea community. The combination of habitats provides an ideal environment for

Papilionoidea, offering food and shelter. Nymphalidae was the dominant family, consistent with previous studies in India and North Bengal (Kumar et al. 2007; Verma, 2009; Sing, 2010; Kunte et al. 2012; Sengupta et al. 2014; Samanta et al. 2017). Wing size and feeding habits distinguished Papilionoidea groups, with non-herb feeders having larger wingspans in forested habitats. Mud-puddling and basking behavior were observed, particularly among male seeking essential nutrients. Also gathered on over-ripe fruits, elephant dung, and carnivore feces. The reserve’s unique climate, diverse flora, and water sources support a rich Papilionoidea diversity.

Figure 2. Family-wise Abundance of Papilionoidea species in study area.

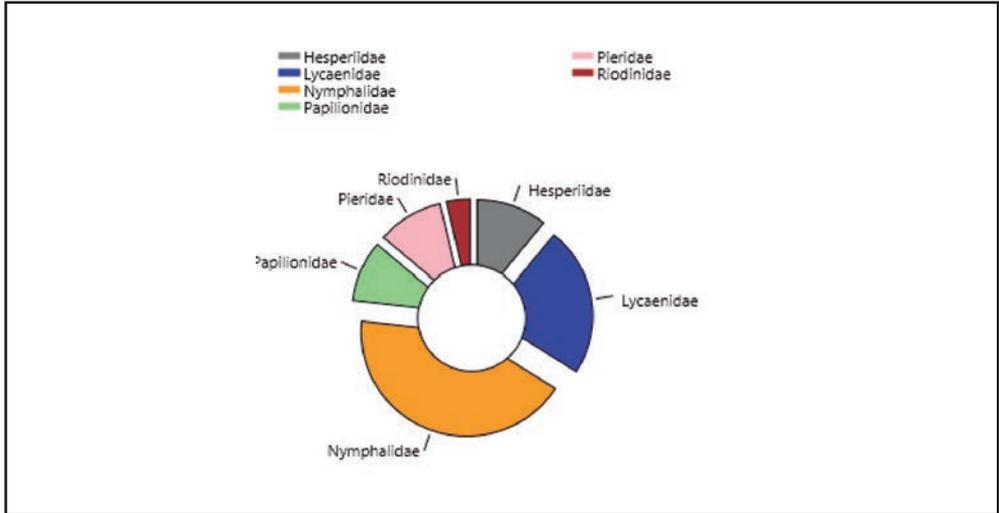


Figure 3. Family-wise abundance model of Papilionoidea species in study area. Note: X-axis numerical are Papilionoidea families; 1 = Nymphalidae, 2 = Lycaenidae, 3 = Hesperidae, 4 = Pieridae, 5 = Papilionidae, and 6 = Riodinidae.

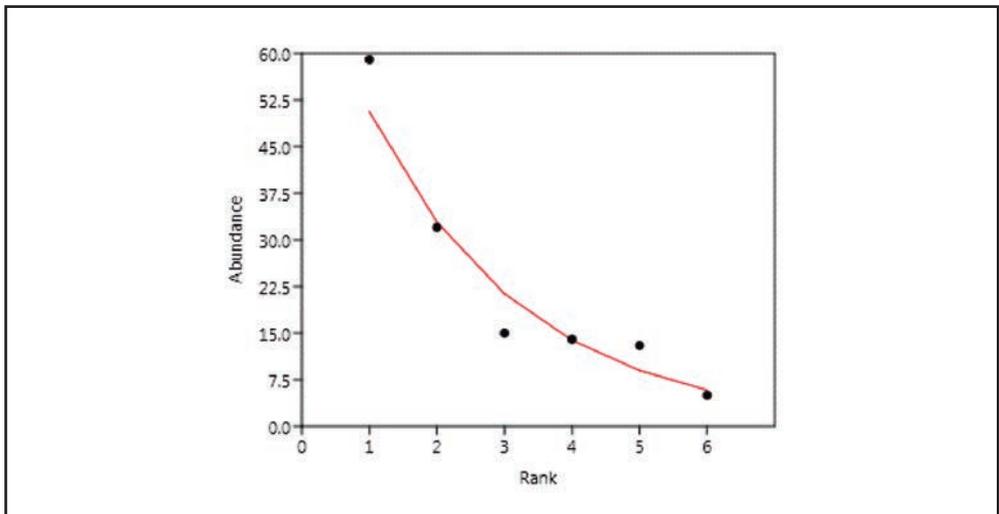


Figure 4. Abundance of Papilionoidea species in different habitats. Note: HF-A22 = Hill Forest - April; HF-N22 = Hill Forest - November22; RT-A22 = River Trail - April22; RT- N22 = River Trail - November 22.

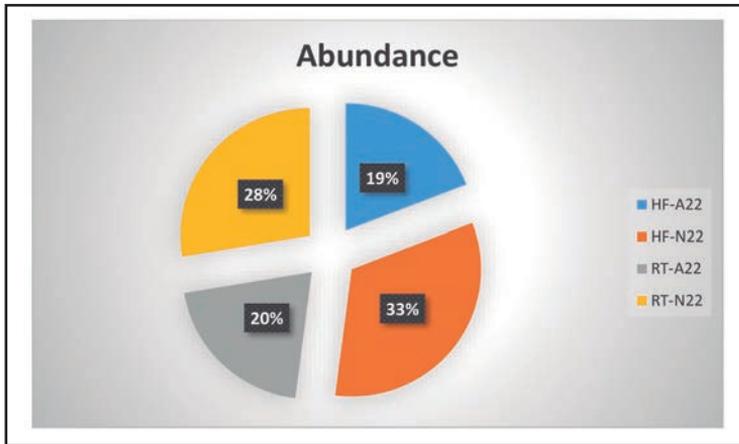
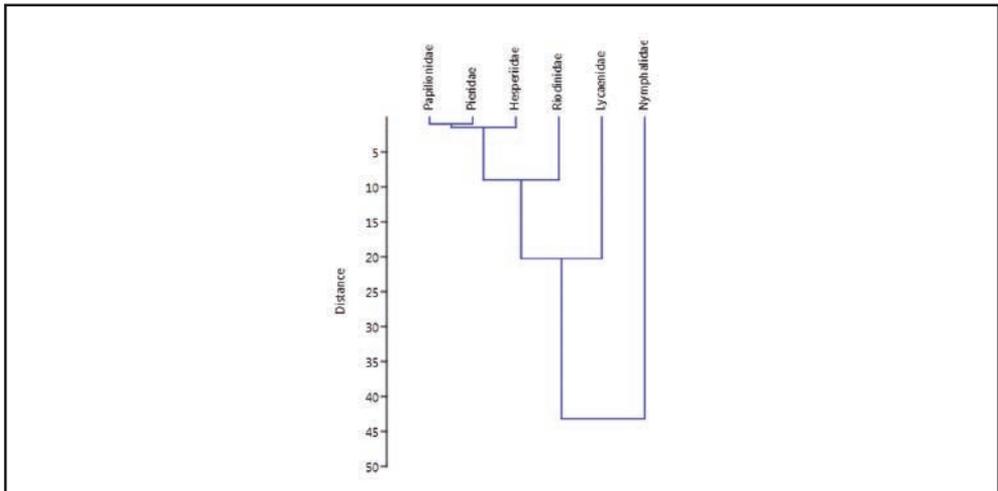


Figure 5. Hierarchical clustering Paired group (UPGMA) of Papilionoidea.



Conclusion

This preliminary study revealed that Papilionoidea were more abundant in the post-monsoon season than in spring in Buxa Tiger Reserve. Probably the prolonged monsoon boosts plant growth, and the availability of more fresh leaves helps the Papilionoidea larvae to thrive. Papilionoidea were more abundant in the hill forest habitat than on the river trail. Hill forest was rich with native flora, and the presence of many slow-to moderate-flowing streams inside the forest created different microhabitats, and the presence of versatile microhabitats contributed to the diversity.

This preliminary study recommends further long-term surveys to capture the complete picture of the Papilionoidea community in its different microhabitats. Future research should focus on seasonal variations, host plants, and environmental factors to conserve these pollinators. Anthropogenic disturbances, such as deforestation, tourism pressure, and, of course, global warming, pose threats, emphasizing the need for regular surveys and conservation strategies.

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Conflict of Interest

The authors declare that they have no financial interest or personal relationship that could influence the work presented in this article.

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Table 1: List of species found in the study area. Note: HF-A22 = Hill Forest - April; HF-N22 = Hill Forest - November22; RT-A22 = River Trail - April22; RT- N22 = River Trail - November 22; R= Recorded; N = Not Recorded; NA = Not Assigned; WLPAA 2022 = The Wildlife (Protection) Amendment Act, 2022.

Scientific Name	WLPAA 2022 Status	HF- A22	HF- N22	RT- A22	RT- N22
Hesperiidae					
<i>Badamia exclamationis</i> (Fabricius, 1775)	NA	R	N	N	N
<i>Burara oedipodea</i> (Swainson, 1820)	NA	N	R	N	N
<i>Burara jaina</i> (Moore, 1866)	NA	R	R	N	R
<i>Burara amara</i> (Moore, 1866)	NA	N	R	N	N
<i>Tagiades menaka</i> (Moore, 1866)	NA	N	R	N	R
<i>Celaenorrhinus leucocera</i> (Kollar, 1844)	NA	N	R	N	N
<i>Sarangesa dasahara</i> (Moore, 1866)	NA	R	N	R	N
<i>Odontoptilum angulatum</i> (Felder & Felder, 1868)	NA	N	N	N	R
<i>Iambrix salsala</i> (Moore, 1866)	NA	R	R	R	R
<i>Notocrypta feisthamelii</i> (Boisduval, 1832)	NA	R	R	N	N
<i>Cupitha purreea</i> (Moore, 1877)	NA	N	R	N	N
<i>Zographetus satwa</i> (de Nicéville, 1884)	NA	N	R	N	R
<i>Pelopidas assamensis</i> (de Nicéville, 1882)	NA	N	N	N	R
<i>Oriens goloides</i> (Moore, 1881)	NA	N	R	N	N
<i>Telicota ancilla bambusae</i> (Moore, 1878)	NA	N	R	N	N
Lycaenidae					
<i>Curetis bulis</i> (Westwood, 1851)	NA	R	N	N	N
<i>Poritia hewitsoni</i> (Moore, 1866)	Schedule II	N	R	N	N
<i>Spindasis lohita</i> (Horsfield, 1829)	Schedule II	R	R	N	N
<i>Anthene lycaenina</i> (Felder & Felder, 1868)	NA	R	N	R	N
<i>Nacaduba pactolus</i> (Felder & Felder, 1860)	NA	N	N	R	N
<i>Prosotas aluta</i> (Druce, 1873)	Schedule II	N	N	R	R
<i>Prosotas nora</i> (Felder, 1860)	NA	N	N	R	N
<i>Nacaduba kurava</i> (Moore, 1858)	NA	N	N	N	R
<i>Prosotas dubiosa</i> (Semper, 1879)	NA	N	R	N	R
<i>Neopithecops zalmora</i> (Butler, 1870)	NA	N	N	N	R
<i>Caleta elna</i> (Hewitson, 1876)	NA	N	R	N	N
<i>Jamides alecto</i> (Felder & Felder, 1860)	Schedule II	R	R	R	N

<i>Catochrysops strabo</i> (Fabricius, 1793)	NA	R	R	R	R
<i>Lampides boeticus</i> (Linnaeus, 1767)	NA	R	R	N	N
<i>Castalius rosimon</i> (Fabricius, 1775)	NA	N	R	N	N
<i>Tarucus ananda</i> (de Nicéville, 1884)	NA	N	R	N	R
<i>Zizina otis</i> (Fabricius, 1787)	NA	N	R	N	N
<i>Udara dilecta</i> (Moore, 1879)	NA	N	R	N	R
<i>Lestranicus transpectus</i> (Moore, 1879)	NA	N	R	N	N
<i>Heliophorus brahma</i> (Moore, 1858)	NA	N	R	N	R
<i>Heliophorus epicles</i> (Godart, 1824)	NA	R	R	R	R
<i>Arhopala bazalus</i> (Hewitson, 1862)	NA	N	N	R	N
<i>Surendra quercetorum</i> (Moore, 1858)	NA	N	R	N	N
<i>Amblypodia anita</i> (Hewitson, 1862)	NA	N	N	N	R
<i>Hypolycaena erylus</i> (Godart, 1824)	NA	R	R	R	R
<i>Chliaria othona</i> (Hewitson, 1865)	Schedule I	N	R	R	R
<i>Zeltus amasa</i> (Hewitson, 1865)	NA	N	R	N	N
<i>Remelana jangala</i> (Horsfield, 1829)	Schedule II	N	N	N	R
<i>Loxura atymnus</i> (Stoll, 1780)	NA	N	R	N	N
<i>Horaga onyx</i> (Moore, 1858)	Schedule II	N	R	N	N
<i>Cheritra freja</i> (Fabricius, 1793)	NA	N	R	N	R
<i>Rapala pheretima</i> (Hewitson, 1863)	NA	N	R	N	R
Nymphalidae					
<i>Libythea lepita</i> (Moore, 1858)	Schedule II	N	R	N	N
<i>Parantica aglea</i> (Stoll, 1782)	NA	N	R	N	R
<i>Parantica melaneus</i> (Cramer, 1775)	NA	N	R	N	R
<i>Tirumala septentrionis</i> (Butler, 1874)	NA	N	R	N	N
<i>Danaus genutia</i> (Cramer, 1779)	NA	N	N	N	R
<i>Danaus chrysippus</i> (Linnaeus, 1758)	NA	N	N	N	R
<i>Euploea mulciber</i> (Cramer, 1777)	NA	N	R	N	R
<i>Polyura athamas</i> (Drury, 1770)	Schedule II	N	N	R	R
<i>Charaxes eudamippus</i> (Doubleday, 1843)	NA	N	N	R	N
<i>Charaxes arja</i> (Felder & Felder, 1867)	NA	N	N	R	R
<i>Charaxes bernardus hierax</i> (Felder & Felder, 1867)	Schedule II	N	N	N	R
<i>Charaxes marmax</i> (Westwood, 1847)	Schedule II	N	R	N	R
<i>Charaxes psaphon imna</i> (Butler, 1870)	NA	N	R	N	R
<i>Elymnias hypermnestra</i> (Linnaeus, 1763)	NA	N	N	N	R
<i>Elymnias vasudeva</i> (Moore, 1858)	Schedule II	N	R	N	N

<i>Orinoma damaris</i> (Gray, 1846)	NA	N	R	N	N
<i>Lethe confusa</i> (Aurivillius, 1898)	NA	R	N	R	N
<i>Lethe verma</i> (Kollar, 1844)	NA	N	R	N	R
<i>Mycalesis heri</i> (Moore, 1858)	NA	N	R	N	N
<i>Mycalesis visala</i> (Moore, 1858)	NA	N	R	N	N
<i>Ypthima baldus</i> (Fabricius, 1775)	NA	R	R	R	R
<i>Calinaga gautama</i> (Moore, 1902)	NA	R	N	R	N
<i>Acraea issoria</i> (Hübner, 1819)	NA	N	R	N	N
<i>Cethosia biblis</i> (Drury, 1773)	Schedule II	N	R	N	R
<i>Cethosia cyane</i> (Drury, 1773)	NA	N	R	N	R
<i>Vindula erota</i> (Fabricius, 1793)	NA	R	N	R	N
<i>Cirrochroa aoris</i> (Doubleday, 1847)	NA	R	R	R	R
<i>Moduza procris</i> (Cramer, 1777)	NA	N	R	N	R
<i>Auzakia danava</i> (Moore, 1858)	Schedule II	N	N	R	N
<i>Athyma ranga</i> (Moore, 1858)	Schedule II	N	R	N	N
<i>Athyma selenophora</i> (Kollar, 1844)	NA	R	R	N	R
<i>Athyma cama</i> (Moore, 1858)	NA	N	N	R	N
<i>Athyma inara</i> (Westwood, 1850)	NA	R	N	R	N
<i>Lebadea martha</i> (Fabricius, 1787)	NA	N	N	N	R
<i>Pantoporia hordonia</i> (Stoll, 1790)	NA	R	N	R	N
<i>Pantoporia sandaca davidsoni</i> (Eliot, 1969)	NA	N	R	N	R
<i>Neptis clinia susruta</i> (Moore, 1872)	Schedule II	N	R	R	R
<i>Neptis hylas</i> (Linnaeus, 1758)	NA	R	N	R	N
<i>Neptis soma butleri</i> (Eliot, 1969)	Schedule II	R	R	N	R
<i>Neptis nata adipala</i> (Moore, 1872)	NA	R	N	R	R
<i>Euthalia monina</i> (Fabricius, 1787)	NA	N	R	N	R
<i>Euthalia phemius</i> (Doubleday, 1848)	NA	N	R	N	R
<i>Euthalia aconthea</i> (Cramer, 1777)	Schedule II	R	R	R	R
<i>Tanaecia lepidea</i> (Butler, 1868)	Schedule II	N	R	N	R
<i>Tanaecia julii</i> (Lesson, 1837)	NA	N	R	N	R
<i>Cyrestis thyodamas</i> (Doyère, 1840)	NA	N	N	R	N
<i>Pseudergolis wedah</i> (Kollar, 1844)	NA	R	R	N	R
<i>Stibochiona nicea</i> (Gray, 1846)	NA	N	R	R	R
<i>Mimathyma ambica</i> (Kollar, 1844)	NA	N	N	R	N
<i>Rohana parisatis</i> (Westwood, 1851)	NA	R	R	R	R
<i>Symbrenthia hypselis</i> (Godart, 1824)	NA	N	R	N	R

<i>Symbrenthia lilaea</i> (Hewitson, 1864)	NA	N	R	R	R
<i>Vanessa indica</i> (Herbst, 1794)	NA	N	R	N	N
<i>Vanessa cardui</i> (Linnaeus, 1758)	NA	R	R	N	R
<i>Aglais caschmirensis</i> (Kollar, 1844)	NA	R	R	N	N
<i>Junonia iphita</i> (Cramer, 1779)	NA	N	R	N	R
<i>Junonia lemonias</i> (Linnaeus, 1758)	NA	N	R	N	R
<i>Kallima inachus</i> (Boisduval, 1836)	NA	N	R	R	R
<i>Doleschallia bisaltide indica</i> (Moore, 1899)	Schedule II	N	R	R	R
Papilionidae					
<i>Graphium sarpedon</i> (Linnaeus, 1758)	Schedule II	N	N	R	R
<i>Graphium agamemnon</i> (Linnaeus, 1758)	NA	N	R	N	R
<i>Meandrusa payeni</i> (Boisduval, 1836)	NA	N	N	N	R
<i>Byasa polyeuctes</i> (Doubleday, 1842)	NA	N	R	N	R
<i>Pachliopta aristolochiae</i> (Fabricius, 1775)	NA	R	R	R	R
<i>Troides helena</i> (Linnaeus, 1758)	NA	R	R	R	R
<i>Papilio polytes</i> (Linnaeus, 1758)	NA	R	R	R	R
<i>Papilio castor</i> (Westwood, 1842)	NA	R	N	N	N
<i>Papilio helenus</i> (Linnaeus, 1758)	NA	R	R	R	R
<i>Papilio nephelus</i> (Boisduval, 1836)	NA	N	N	R	N
<i>Papilio agenor</i> (Linnaeus, 1758)	NA	N	R	N	N
<i>Papilio alcmenor</i> (Felder & Felder, 1864)	NA	R	N	R	N
<i>Papilio paris</i> (Linnaeus, 1758)	NA	R	R	R	R
Pieridae					
<i>Eurema hecabe</i> (Linnaeus, 1758)	NA	N	R	N	R
<i>Colias fieldii</i> (Ménétriés, 1855)	NA	R	R	N	N
<i>Ixias pyrene</i> (Linnaeus, 1764)	NA	R	R	R	R
<i>Hebomoia glaucippe</i> (Linnaeus, 1758)	NA	R	R	R	R
<i>Appias olferna</i> (Swinhoe, 1890)	NA	R	R	R	R
<i>Appias lyncida</i> (Cramer, 1777)	Schedule II	N	R	N	N
<i>Pieris canidia</i> (Linnaeus, 1768)	NA	R	N	N	N
<i>Cepora nerissa</i> (Fabricius, 1775)	NA	R	R	R	R
<i>Cepora nadina</i> (Lucas, 1852)	Schedule II	R	R	N	R
<i>Prioneris thestylis</i> (Doubleday, 1842)	NA	N	R	R	R
<i>Prioneris clemathe</i> (Doubleday, 1846)	NA	N	N	N	R
<i>Delias acalis</i> (Godart, 1819)	NA	R	R	N	R
<i>Delias descombesi</i> (Boisduval, 1836)	NA	N	R	N	R

BASELINE INVENTORY OF PAPILIONOIDEA IN BUXA TIGER RESERVE WEST BENGAL INDIA

<i>Delias agostina</i> (Hewitson, 1852)	NA	N	R	N	R
Riodinidae					
<i>Abisara fylla</i> (Westwood, 1851)	NA	R	R	R	R
<i>Abisara bifasciata</i> (Moore, 1877)	NA	N	R	N	N
<i>Abisara neophron</i> (Hewitson, 1861)	NA	R	N	N	N
<i>Zemeros flegyas</i> (Cramer, 1780)	NA	R	R	R	R
<i>Dodona eugenes</i> (Bates, 1868)	NA	N	R	N	N



Plate 1. 1. *Badamia exclamationis*. 2. *Burara oedipodea*. 3. *Burara jaina jaina*. 4. *Burara amara*. 5. *Tagiades menaka*. 6. *Celaenorrhinus leucocera*. 7. *Sarangesa dasahara*. 8. *Odontoptilum angulatum*.



Plate 2. 9. *Iambrix salsala*. 10. *Notocrypta feisthamelii*. 11. *Cupitha purreea*. 12. *Zographetus satwa*. 13. *Pelopidas assamensis*. 14. *Oriens goloides*. 15. *Telicota ancilla bambusae*. 16. *Curetis bulis*.



Plate 3. 17. *Poritia hewitsoni*. 18. *Spindasis lohita*. 19. *Anthene lycaenina*. 20. *Nacaduba pactolus*. 21. *Prosotas aluta*. 22. *Prosotas nora*. 23. *Nacaduba kurava*. 24. *Prosotas dubiosa*.



Plate 4. 25. *Neopithecops zalmora*. 26. *Caleta elna*. 27. *Jamides alecto*. 28. *Catochrysops strabo*. 29. *Lampides boeticus*. 30. *Castalius rosimon*. 31. *Tarucus ananda*. 32. *Zizina otis*.



Plate 5. 33. *Udara dilecta*. 34. *Lestranicus transpectus*. 35. *Heliophorus brahma*. 36. *Heliophorus epicles*. 37. *Arhopala bazalus*. 38. *Surendra quercetorum*. 39. *Amblypodia anita*. 40. *Hypolycaena erylus*.



Plate 6. 41. *Chliaria othona*. 42. *Zeltus amasa*. 43. *Remelana jangala*. 44. *Loxura atymnus*. 45. *Horaga onyx*. 46. *Cheritra freja*. 47. *Rapala pheretima*. 48. *Libythea leptia*.

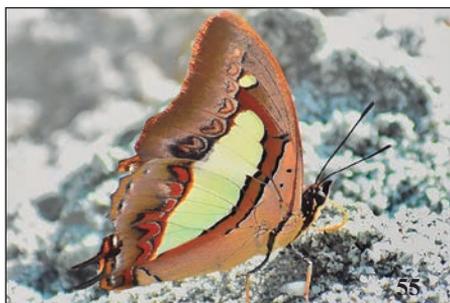


Plate 7. 49. *Parantica aglea*. 50. *Parantica melaneus*. 51. *Tirumala septentrionis*. 52. *Danaus genutia*. 53. *Danaus chrysippus*. 54. *Euploea mulciber*. 55. *Polyura athamas*. 56. *Charaxes eudamippus*.



Plate 8. 57. *Charaxes arja*. 58. *Charaxes bernardus hierax*. 59. *Charaxes marmax*. 60. *Charaxes psaphon imna*. 61. *Elymnias hypermnestra*. 62. *Elymnias vasudeva*. 63. *Orinoma damaris*. 64. *Lethe confusa*.



Plate 9. 65. *Letho verma*. 66. *Mycalesis heri*. 67. *Mycalesis visala*. 68. *Ypthima baldus*. 69. *Calinaga gautama*. 70. *Acraea issoria*. 71. *Cethosia biblis*. 72. *Cethosia cyane*.



Plate 10. 73. *Vindula erota*. 74. *Cirrochroa aoris*. 75. *Moduza procris*. 76. *Auzakia danava*. 77. *Athyma ranga*. 78. *Athyma selenophora*. 79. *Athyma cama*. 80. *Athyma inara*.



Plate 11. 81. *Lebadea martha*. 82. *Pantoporia hordonia*. 83. *Pantoporia sandaca davidsoni*. 84. *Neptis clinia susruta*. 85. *Neptis hylas*. 86. *Neptis soma butleri*. 87. *Neptis nata adipala*. 88. *Euthalia monina*.



Plate 12. 89. *Euthalia phemius*. 90. *Euthalia aconthea*. 91. *Tanaecia lepidea*. 92. *Tanaecia julii*. 93. *Cyrestis thyodamas*. 94. *Pseudergolis wedah*. 95. *Stibochiona nicea*. 96. *Mimathyma ambica*.



Plate 13. 97. *Rohana parisatis*. 98. *Symbrenthia hypselis*. 99. *Symbrenthia lilaea*. 100. *Vanessa indica*. 101. *Vanessa cardui*. 102. *Aglais caschmirensis*. 103. *Junonia iphita*. 104. *Junonia lemonias*.

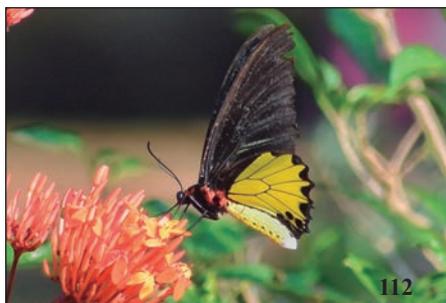
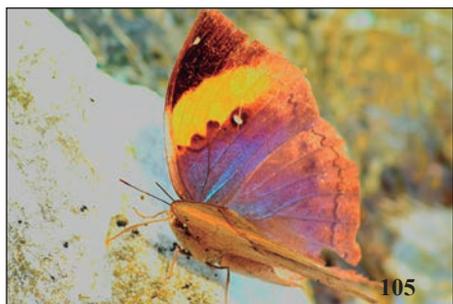


Plate 14. 105. *Kallima inachus*. 106. *Doleschallia bisaltide indica*. 107. *Graphium sarpedon*. 108. *Graphium agamemnon*. 109. *Meandrusa payeni*. 110. *Byasa polyeuctes*. 111. *Pachliopta aristolochiae*. 112. *Troides helena*.

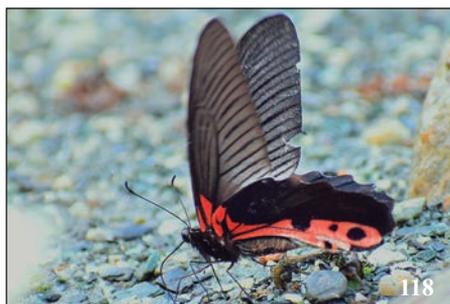


Plate 15. 113. *Papilio polytes*. 114. *Papilio castor*. 115. *Papilio helenus*. 116. *Papilio nephelus*. 117. *Papilio agenor*. 118. *Papilio almenor*. 119. *Papilio paris*. 120. *Eurema hecabe*.



Plate 16. 121. *Colias fieldii*. 122. *Ixias pyrene*. 123. *Hebomoia glaucippe*. 124. *Appias olferna*. 125. *Appias lyncida*. 126. *Pieris canidia*. 127. *Cepora nerissa*. 128. *Cepora nadina*.

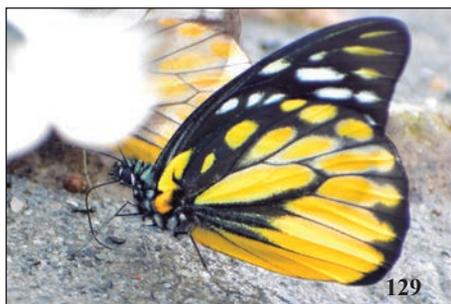


Plate 17. 129. *Prioneris thestylis*. 130. *Prioneris clemathe*. 131. *Delias acalis*. 132. *Delias descombesi*. 133. *Delias agostina*. 134. *Abisara fylla*. 135. *Abisara bifasciata*. 136. *Abisara neophron*.



Plate 18. 137. *Zemeros flegyas*. 138. *Dodona eugenes*.