

Research Article

Larval Hostplants' specificity of butterflies in Garbhanga Reserve Forest (Proposed Wildlife Sanctuary) and Rani Reserve Forest, Kamrup, Assam, India

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ABSTRACT

Study has been carried out from 14th April 2021 to 14th September 2021 in Rani and Garbhanga Reserve Forest of Assam to gathered knowledge about the larval host plant specificity of butterflies in Pre-monsoon and monsoon seasons using line and point transect methods. Study found that altogether 31 butterflies of 25 species belonging to 4 families that were used 27 different species of plants belonging to 19 families. Certain butterflies were also observed to use larval host plants under the families of Fabaceae and Rutaceae. Again, *Graphium agamemnon* has utilized *Monoon longifolium*, *Eurema blanda* utilized *Calliandra haematocephala*, *Leptostia nina* utilized *Cleome rutidosperma*, *Pieris brassicae* utilized *Brassica juncea*, *Junonia lemonias* utilized only *Barleria cristata*, *Ariadne merione* utilized only *Ricinus communis*, *Acraea issoria* utilized only *Sarcochlamys pulcherrima*, *Elymnias malelas* utilized *Musa balbisiana*, *Ancistroides nigrata* utilized only *Curcuma longa*, *Burara harisa* utilized only *Heteropanax fragrans* and *Tagiades litigiosa* utilized only *Dioscorea alata*. Whereas certain butterflies used more than two plant species as their larval hostplants such as *Papilio clytia* utilized *Litsea deccanensis* and *L. monopetala*, *Pachliopta aristolochiae* utilized *Aristolochia indica* and *A. tagala*, *Elymnias hypermnestra* utilized *Areca catechu* and *Cocos nucifera* etc. Study also found that many butterflies used only one specific plant species as their larval host plant, such as the plant *Murraya koenigii* used by *Papilio polytes*, *P. Helenus*, *Citrus limon* used by *Papilio polytes*, *P. helenus*, *P. demoleus*, *Cocos nucifera* plant used by *Elymnias hypermnestra* and *E. nesaea* etc. The present observation has supported the views that most of the butterflies have species specific uses of larval host-plant in Rani & Garbhanga reserve forest and the study area is very important to support large numbers of butterflies through providing the valuable resources for butterflies' conservation.

Key words: : Butterflies, Larval host plant, hostplant specificity, Garbhanga RF, Rani Reserve Forest

INTRODUCTION

Butterflies are mostly phytophagous, serve as primary herbivores in the food chain. For example, many butterflies are foods for many predatory animals, bio-indicators of the environment, etc., they can be used to identify ecologically important landscapes for conservation purposes (Kumar *et al.*, 1999). Moreover, butterflies are the biological indicators of habitat features along with environmental health and several species are strictly seasonal and favour only particular places of habitats (Kunte, 1997). Butterflies and their caterpillars are dependent on specific host plants for food, thus the diversity of butterflies indirectly reflects the overall varieties and variabilities of plant species diversity especially herbs and shrubs and herbs in a particular area. Both the adults and caterpillars are highly reliable on specific plants for their life cycle and therefore, they also have been used as models to monitor temporal changes in plant-insect interactions (Padhye *et al.*, 2006). Recent studies highlight the diversity and spatial occurrence of butterflies in the northeastern region, but little information is available about their larval host plants and their life stages

(Wynter-Blyth 1957; Igarashi and Fukuda, 2000; Robinson *et al.*, 2001; Kunte *et al.*, 2018), which is crucial for ecological as well as conservation studies.

Larval host plants form an important aspect of a butterfly's life cycle (Bach, 1981; Faeth *et al.*, 1981), but scanty pieces of information are available on feeding habitats and food resources of adult butterflies when compared to that of caterpillars (Kunte, 2000). Caterpillars are primarily herbivorous and basically confined to a narrow range of host plants that are acceptable to them based on nutritional and other chemical requirements. So, the larval host plants are an important subject for the butterfly's life cycle generation and conservation of the species. The present study emphasizes the observations of larval host plants of various butterfly species as there is no such published information regarding the records of species-specific host plants and butterflies in the Rani-Garbhanga Reserve Forest of Assam. These pieces of information are important for the conservation of butterflies and their habitats. The main objective of the study is to find out the larval hostplants of certain selected butterflies found in the Rani-Garbhanga Reserve Forest of Kamrup district of Assam.

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MATERIALS AND METHODS

Study area

The study has been carried out in Garbhanga Reserve Forest (recently proposed as a wildlife sanctuary) and Rani Reserve Forest in Kamrup district of Assam situated within the coordinates between 91° 33' 16" E to 91° 55' 24" E longitude and 26° 06' 41" N to 26° 01' 15" N latitude, in Rani Reserve Forest and coordinates between 91° 36' 25" E to 91° 47' 45" E longitude and 26° 05' 31" N to 25° 54' 12" N latitude in Garbhanga Reserve Forest with a total area of 188.60 km² (Fig. 1). The

forests are mainly dominated by Sal (*Shorea robusta*), Bamboo (*Dendrocalamus hamiltonii*) and sub-type moist deciduous forests (Champion & Seth, 1968). Some other main vegetations of the forests are *Schima wallichii*, *Choisya sp.*, *Gmelina arborea* Roxburgh, *Lagerstroemia parviflora* Roxburgh, *Dillenia pentagyna* Roxburgh, *Phyllanthus emblica* Linnaeus, *Premna latifolia* Roxburgh, *Aporosa roxburghii* Bailon, *Garcinia sp.*, *Dendrocalamus hamiltonii*, *Eupatorium odoratum* Linnaeus, *Imperata cylindrical* (Linnaeus) Beauverd, *Zizyphus oenoplia* Miller, *Entada phaseoloides* Merrill, *Artocarpus chaplasha* Roxburgh, *Michelia champaca* Linnaeus, and *Amoora spectabilis* Miquel, etc.

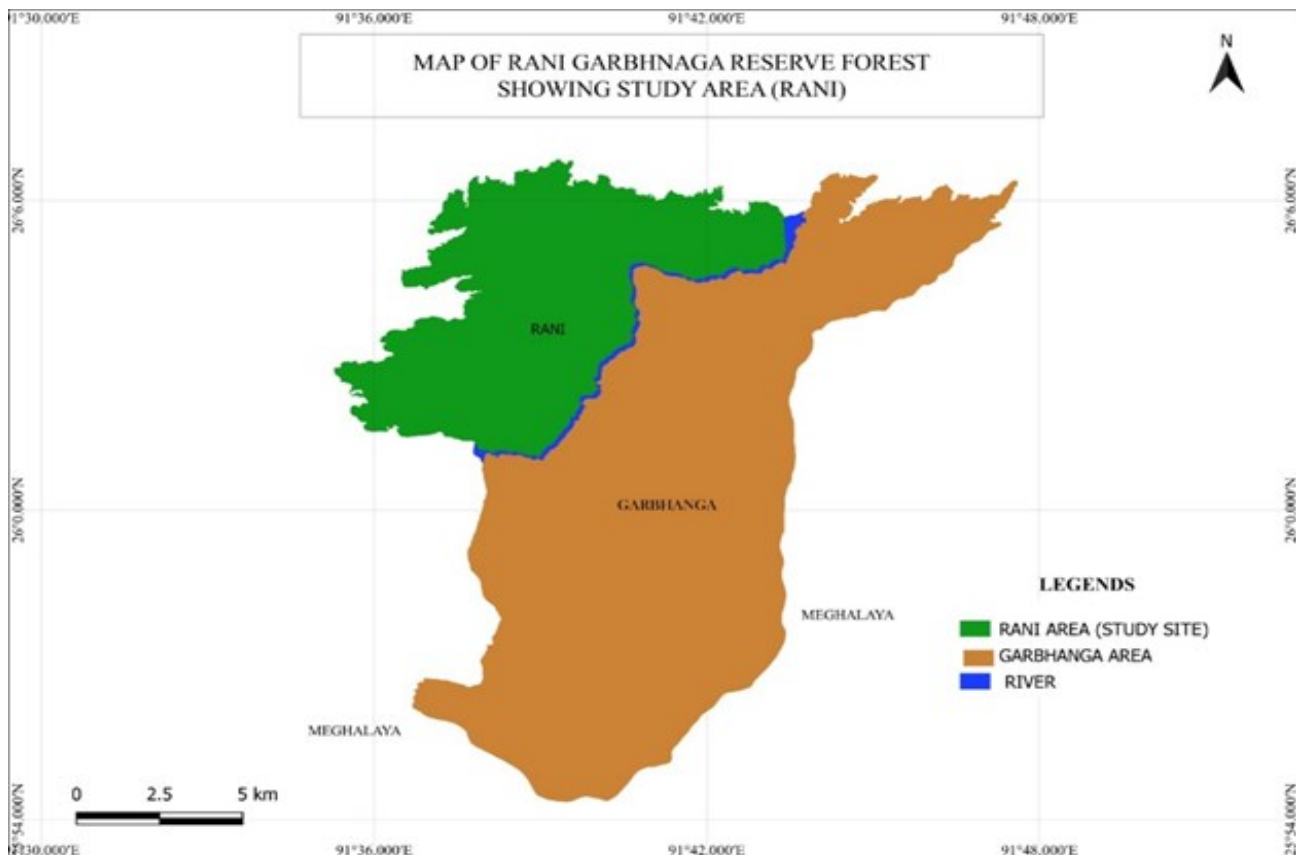


Figure 1. Showing the map of the study area (Garbhanga Wildlife Sanctuary and Rani Reserve Forest, Assam).

Methods of the Study

Field observations were initially carried out over a period of six months, extending from 14th April 2021 to 14th September 2021 in Garbhanga Wildlife Sanctuary and Rani Reserve Forest, Assam. All surveys and sampling data were planned to be collected during Pre-monsoon and monsoon seasons from the study area. The fieldwork and the data collection were done six hours a day, from 07:00 hours to 13:00 hours. A total of 252 hours were taken for data collection. For the study, the objectives can be studied in the field by applying Line Transect Method (Pollard, 1977), Visual Encounter Survey (Heyer *et al.*, 1994), and Quadrant Sampling Method (Weaver, 1918).

Study Design

a. Design for stratified habitat

The habitat of the study area is divided into seven

different types as per Champion and Seth (1968). The habitats include bamboo breaks, mixed deciduous forest, short grassland, agricultural land, human habitation, riparian fringing forest, and secondary forest. The criteria for dividing the study area into the above habitat types were based on the dominant vegetation type and topographical and structural characteristics.

b. Transect design

Altogether 38.15 km length of transect including 15 transects in Rani RF and 5 Transects were taken from Garbhanga RF. Apart from that 20 Quadrates were taken with a size of 20×20m in both the habitat to do the intensive survey of butterflies and their Host Plants.

Species identification

The species (both butterflies and host plants) were identified and classified by published journals or guides for

butterflies and their host plants, supplemented with personal data and expertise and also some host plants were identified with the help of the herbarium center of the Department of Botany, Gauhati University. Identification of the species was done using the keys in Nitin *et al.*, (2018), and Karmakar *et al.*, (2018). More information on early stages and larval host plants reported here is available on the Butterflies of India website (<http://www.ifoundbutterflies.org/lifecycles>), which is continually updated.

Data Collection and data analysis

An extensive field survey was carried out to find out the egg-laying and larvae observed in the habitat in the specified transect of the Rani-Garbhanga Reserve forest and the data were noted down in the field notebook. The host-plant species of butterflies were identified in the field and noted down in the notebooks and unidentified host plants were collected and carried to the Gauhati University Botanical laboratory and then identified in the Departmental Museum with the help of plant taxonomists present in the department. During data collection, the parameters such as the locality, date, time, and habitat of each individual butterfly were recorded in a field notebook. The data were collected randomly along foot trails, stream beds and grassland bordering them, and other locations known for butterflies. The photographic evidence of the butterflies and their larval hostplants were documented using Nikon D5600 with AF-P DX Nikon 18-55mm f/3.5-5.6G VR and AF-P DX Nikon 70-300mm f/4.5-6.3G ED VR lenses and ASUS Zenfone Max Pro M1 mobile camera. The statistical analysis of the data and simple graphs were prepared using Microsoft Excel software.

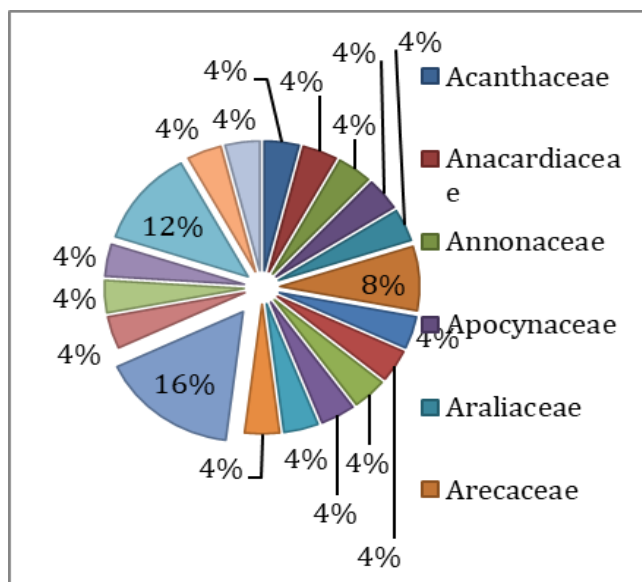


Figure 2. The % of larval hostplant species that observed 25 butterfly species in the study area

RESULTS AND DISCUSSION

The study recorded altogether 31 numbers of butterfly larvae belonging to 25 butterfly species of four different families, that feeds on 27 plant species of 19 families (Table 1). All 27 numbers of larval hostplant species were belongs to 19 families such as Lauraceae, Annonaceae, Aristolochiaceae, Rutaceae, Fabaceae, Caparaceae, Brassicaceae, Acanthaceae, Anacardiaceae, Euphorbiaceae, Apocynaceae, Urticaceae, Arecaceae, Musaceae, Zingiberaceae, Araliaceae, Poaceae, Dioscoreaceae and Costaceae (Table 1), Those larval host plants were used by 25 butterfly species of four butterfly families, namely Papilionidae, Pieridae, Nymphalidae, Hesperidae, whereas, Rutaceae and Fabaceae family were the most used plants by butterflies to achieve their life cycle (Table 1; Plate I-IV). The study also showed that the butterflies used mostly the *Citrus limon* species of the Rutaceae family to lay their eggs and complete their life cycle. There were three species of butterflies that used the same *Citrus limon* plant species in the forest as their larval host-plant, the species were such as *Papilio polytes*, *Papilio demoleus*, *Papilio helenus* (Figure 2; See Plate I-IV)

Habitat Used types

From the habitat used types, it was found that butterflies mostly prefer the Human Habitational area (42%) to perform their life cycle generation. The percentage of habitat used by butterflies was found to be the same in mixed deciduous forest and short grassland habitats (25%), whereas the agricultural land was used by very small number of butterflies with 8% (Figure 3).

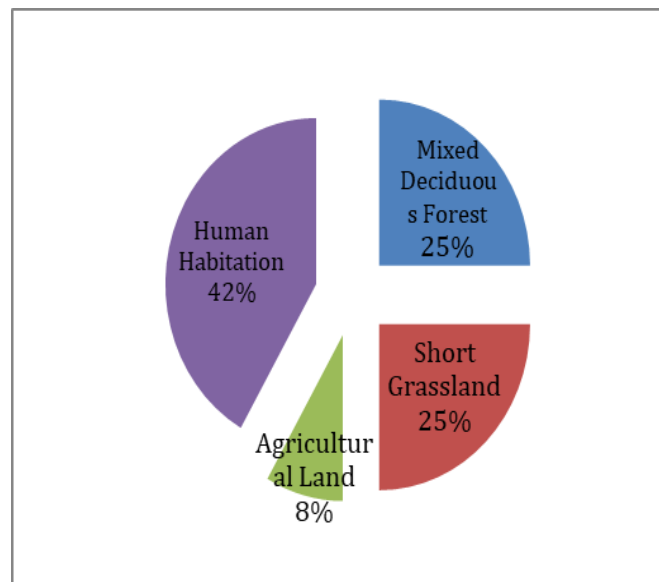


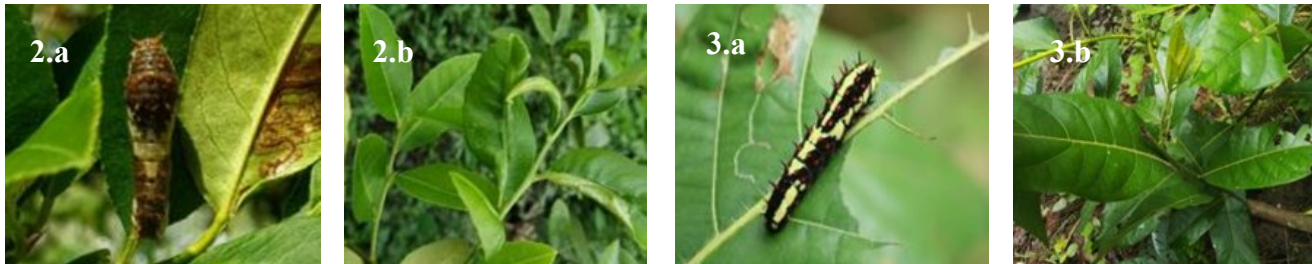
Figure 3. Habitat types used by butterflies in the study.

Table 1. Comprehensive list of Larval Host Plants used by the different Butterflies in Rani-Garbhanga Reserve Forest, Kamrup, Assam.

Sl. No.	Larvae of Butterfly Species	Larval Host Plants	Plant Family
01	<i>Papilio clytia</i>	<i>Litsea deccanensis</i>	Lauraceae
02	<i>Papilio clytia</i>	<i>Litsea monopetela</i>	Lauraceae
03	<i>Graphium agamemnon</i>	<i>Monoon longifolium</i>	Annonaceae
04	<i>Pachliopta aristolochiae</i>	<i>Aristolochia indica</i>	Aristolochiaceae
05	<i>Pachliopta aristolochiae</i>	<i>Aristolochia tagala</i>	Aristolochiaceae
06	<i>Papilio polytes</i>	<i>Murraya koenigii</i>	Rutaceae
07	<i>Papilio helenus</i>	<i>Murraya koenigii</i>	Rutaceae
08	<i>Papilio polytes</i>	<i>Citrus limon</i>	Rutaceae
09	<i>Papilio demoleus</i>	<i>Citrus limon</i>	Rutaceae
10	<i>Papilio helenus</i>	<i>Citrus limon</i>	Rutaceae
11	<i>Catopsilia pyranthe</i>	<i>Cassia sophera</i>	Fabaceae
12	<i>Catopsilia pomona</i>	<i>Cassia occidentalis</i>	Fabaceae
13	<i>Eurema blanda</i>	<i>Calliandra haematocephala</i>	Fabaceae
14	<i>Eurema hecabe</i>	<i>Senna alata</i>	Fabaceae
15	<i>Eurema hecabe</i>	<i>Caesalpinia pulcherrima</i>	Fabaceae
16	<i>Leptosia nina</i>	<i>Cleome ruidosperma</i>	Capparaceae
17	<i>Pieris brassicae</i>	<i>Brassica juncea</i>	Brassicaceae
18	<i>Junonia lemonias</i>	<i>Barleria cristata</i>	Acanthaceae
19	<i>Euthalia aconthea</i>	<i>Mangifera indica</i>	Anacardiaceae
20	<i>Ariadne merione</i>	<i>Ricinus communis</i>	Euphorbiaceae
21	<i>Euploea core</i>	<i>Hemidesmus indicus</i>	Apocynaceae
22	<i>Acraea issoria</i>	<i>Sarcochlamys pulcherrima</i>	Urticaceae
23	<i>Elymnias hypermnestra</i>	<i>Areca catechu</i>	Arecaceae
24	<i>Elymnias hypermnestra</i>	<i>Cocos nucifera</i>	Arecaceae
25	<i>Elymnias nesaea</i>	<i>Cocos nucifera</i>	Arecaceae
26	<i>Elymnias malelas</i>	<i>Musa balbisiana</i>	Musaceae
27	<i>Ancistroides nigrata</i>	<i>Curcuma longa</i>	Zingiberaceae
28	<i>Burara harisa</i>	<i>Heteropanas fragrans</i>	Araliaceae
29	<i>Matapa aria</i>	<i>Bambusa arundinacea</i>	Poaceae
30	<i>Tagiades litigiosa</i>	<i>Dioscorea alata</i>	Dioscoreaceae
31	<i>Udaspes folus</i>	<i>Costus spp.</i>	Costaceae



1. Common Mormon (*Papilio polytes*)



2. Common Lime (*Papilio demoleus*)

3. Common Mime (*Papilio clytia*)



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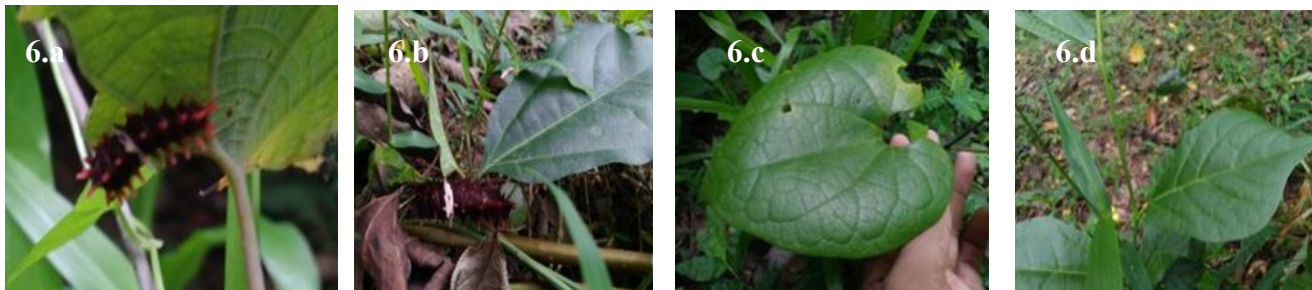
3.d. C. M. HP

4. Red Helen (*Papilio helemus*)



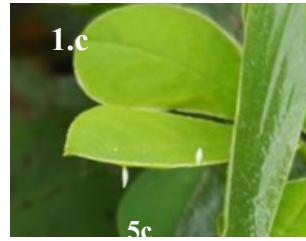
4. Red Helen Hostplant

5. Tailed Jay (*Graphium agamemnon*)



6. Larvae and host plants of Common Rose (*Pachliopta aristolochiae*)

Plate-I. Photographs shows the Life stages and the host plants of Papilionidae butterflies recorded in Garbhanga Wildlife Sanctuary and Rani Reserve Forest during the study period.

1. Common Grass Yellow-*Eurema hacabe*

Larvae & Host Plant



2. Larvae & Host-plant, Three spot Grass-Yellow

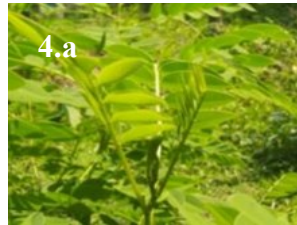
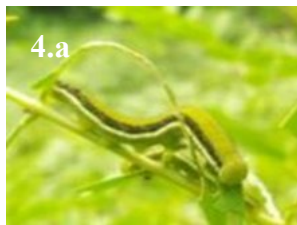
3. Host Plant of Common Emigrant-*Catopsilia pomona*4. Larvae, Mottled Emigrant *C. pyranthe* & Hostplant5. Larvae, Large Cabbage-white *P. brassicae* & *H.P.*6. Psyche (*Leptosia nina*)

Plate-II. Photographs shows the *Life stages and the host plants* of Pieridae butterflies recorded in Garbhanga Wildlife Sanctuary and Rani Reserve Forest during the study period.

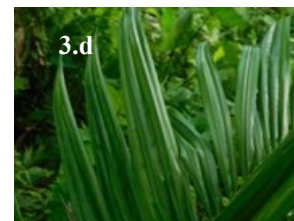
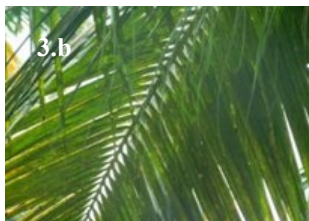
Study opined that the Garbhanga and Rani Reserve Forest is a resourceful habitat for all forms of butterflies that is evident from the present study. It is a fact that the existence of butterflies and their caterpillars are directly dependent on the specific host plants for food and nourishment which is also suggested by the earlier studies conducted by Padhye *et al.* (2006). The association of butterflies, their habitats and their immediate environmental status are always linked together for their survival that is evident from the present study. Bora *et al.*, (2014) also suggested that the association between butterflies and plants is always highly specific. During the present study, it is also evident that during the life cycle stages, 31 species of butterflies are specifically dependent on 27 host plant species. So, without the existence of species specific hostplants in a habitat butterfly cannot survive and never resides in that area. Again, most of the Pierid butterflies use the plant species that belong to the Fabaceae family as their host plant, such as *Catopsilia pyranthe* (*Cassia sophera*), *Catopsilia Pomona* (*Cassia occidentalis*),

Eurema blanda (*Calliandra haematocephala*), *Eurema hecabe* (*Senna alata*) and *Eurema hecabe* (*Caesalpinia pulcherrima*) etc. Study also revealed that two or three butterflies use one plant as their host plant, for example- *Papilio polytes*, *Papilio demoleus* and *Papilio helenus* use *Citrus limon* plant; *Papilio polytes* and *Papilio helenus* use *Murraya koenigii*; *Elymnias hypermnestra* and *Elymnias nesaea* butterflies use *Cocos nucifera* as their host plant. Apart from that single butterfly may use many plants as its host plant, for survival e.g. *Papilio polytes* and *Papilio helenus* both the butterfly use *Citrus limon* and also *Murraya koenigii* plant; *Papilio clytia* use *Litsea deccanensis* and *Litsea monopetala* plant; *Pachliopta aristolochic* use *Aristolochia indica* and *Aristolochia tagala* plant; *Elymnias hypermnestra* use *Areca catechu* and *Cocos nucifera* plant, etc. Thus present study has provided vital information for conservation-related work of butterflies and as well as the existence of diversified plant species in a particular habitat mosaic depending on the studies on butterfly diversity. The present statement is also supported by

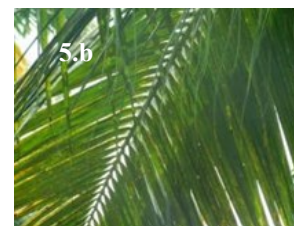
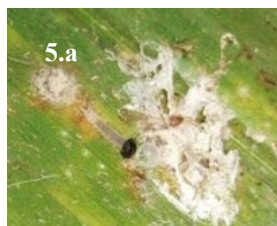
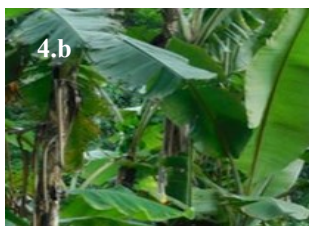


1. Larvae & Host plant of *Junonia lemonias*

2. Larvae and host plant of *Junonia iphi*



3. Larvae, Pupa and Host Plant of Common Palmfly-*Elymnias hypermnestra*

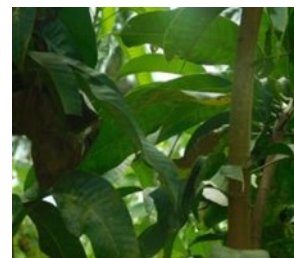


4. Larvae & host plant of Spotted Palmfly-*E. malelas*

5. Larvae & host Plant, Tiger Palmfly-*E. nesaea*



6. Larvae & host-plant of common Crow-*Euploea core*



7. Common Baron-*Euthalia aconthea* Pupa & hostplant



8. Yellow Coster (*Acraea issoria*)



9. Common Castor (*Ariadne merione*)

Plate-III. Photographs shows the *Life stages and the host plants of Nymphalidae butterflies* recorded in Garbhanga Wildlife Sanctuary and Rani Reserve Forest observed in study period.

Padhye *et al.*, (2006) in their work.

The present study also evident that, butterflies are mostly preferred anthropogenically modified habitats even also near large forested habitats are available to lay their eggs and also completed life cycles (42%), associated with other habitats like Short Grassland and Mixed Deciduous Forest (25%) respectively. But this result contradicts the findings of Choi and Kim (2012) that butterflies are mostly found in grassland habitat. Butterflies used the habitats of Human Habitational area to perform their life cycle because peoples are

unknowingly planted some butterflies host plant that are naturally rare in natural forest areas. According to Ghose and Saha (2016), pesticides uses, grazing pressure and change in land use pattern had a negative impact on butterfly population. Ghosh and Saha (2016) also suggested that availability of water resources also encourage the adult butterflies to mud puddle in large congregations on the sandy patches along the streams which results in high diversity of butterflies in the present habitat. Butterflies prefer this type of habitat for mud puddling to achieve various nutrients from soil that

1. Orange Awlet (*Burara harisa*)2. Chocolate Demon (*Ancistroides nigrita*)3. Grass Demon (*Udaspes folus*)4. Water Snow Flat (*Tagiades litigiosa*)5. Common Redeye (*Matapa aria*)

Plate-IV: Photographs shows the *Life stages and the host plants of Hesperidae butterflies* recorded in Garbhanga Wildlife Sanctuary and Rani Reserve Forest during the study period.

play various roles in their physiology, ethology, and ecology. The diverse plant species of Garbhanga RF and Rani RF provide a suitable nectar source and food for caterpillars and it can be presumed that the study area has a good diversity of butterflies. Again, the butterflies of Garbhanga RF and Rani RF are highly seasonal (Saikia *et al.*, 2010) as that is dependent on the availability of the larval and adult food is not available in all the seasons. The occurrence status of larval food plants indicates the availability of butterflies, so, further intensive studies covering all the seasons are also urgently be require to understand the detailed associations between butterflies and host-plants in order to gather concrete information for the conservation of butterflies and their larval stages and the plants species diversity as well.

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