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LARVAL HOSTPLANT SPECIFICITY IN BUTTERFLIES: PATTERNS AND ECOLOGICAL IMPLICATIONS IN AND AROUND SOUTHERN ANDHRA PRADESH

K.S. VERONIKA[1] AND S.P. VENKATA RAMANA[2]

[1]*Research Scholar, Department of Zoology, Yogi Vemana University, Kadapa.*
[2]*Associate Professor, Department of Zoology, Yogi Vemana University, Kadapa, Andhra Pradesh, India.*

***Corresponding author**
S.P. Venkata Ramana

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ABSTRACT
In order to emphasize patterns of host specificity and their ecological implications, the current study examines larval host plant availability and usage among butterfly species throughout four study sites namely Nemaligundla, Seshachalam Bioreserve, Buggavanka and Nallamala forest area during April 2023 to March 2026. 53 species of butterflies from five families the Nymphalidae (14), Lycaenidae (11), Papilionidae (8), Pieridae (16) and Hesperiidae (4) as well as the host plants they were connected with were identified. The findings showed a high level of host specialization within the butterfly population, with monophagous species predominating, followed by polyphagous and oligophagous feeders. Important plant families that sustain a variety of butterfly species as larval resources include the Fabaceae, Capparaceae, Rutaceae, and Apocynaceae. The study also showed that host plant availability differed between study sites, with a number of plants being widely dispersed, including *Calotropis gigantea, Ficus racemosa, grasses, Ziziphus* spp. and *Pongamia pinnata*. Butterfly abundance and host plant availability were found to be strongly correlated, with species linked to widely accessible plants being more common and those reliant on scarce host plants being more uncommon. These results highlight how important host plant diversity and distribution are in determining butterfly assemblages. Overall, the study emphasizes how crucial it is to preserve native host plants in order to preserve butterfly variety and recommends that habitat management plans concentrate on protecting plant species that serve both specialist and generalist butterflies.

Keywords: *Butterflies, Host specificity, Larval ecology, Biodiversity, Conservation.*

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INTRODUCTION
Butterflies are one of the most researched insect groups due to their ecological significance, aesthetic appeal, and sensitivity to environmental changes. Host specificity, or the extent to which butterfly species depend on specific plant species for larval development and adult eating, is one of the most important aspects of butterfly ecology [1]. Butterfly larvae usually rely heavily on particular host plants that supply vital nutrients needed for development and survival. On the other hand, although the variety of nectar sources varies greatly between species, mature butterflies often get their energy from floral nectar.

The distribution, abundance and evolutionary relationships of butterfly species are significantly influenced by the uniqueness of their larval host plants [2, 3]. While some butterflies are polyphagous, using a wide variety of host plants, many exhibit monophagy, which involves feeding on a single plant species, or oligophagy, which involves feeding on a few closely related plant species. These feeding practices affect butterflies' interactions with plant ecosystems and predators in addition to their life cycle and reproductive success. Numerous factors including as plant chemical defenses, nutritional quality, habitat availability, and evolutionary history, influence the choice of host plants.

Recognizing the patterns of larval host specialization offers important insights into the ecology of butterflies, their co-evolution with plants, and the operation of ecosystems. Because habitat loss, climate change and

agricultural expansion can alter the availability of nectar supplies and larval host plants, this information is also crucial for conservation planning. Researchers can gain a better understanding of species distribution patterns and create successful methods for biodiversity conservation by studying the interactions between butterflies and their host plants.

In terrestrial ecosystems, butterfly-plant interactions are a prime illustration of coevolutionary connections. Herbivorous larvae rely on certain host plants and plants develop defensive mechanisms such inducible defenses, structural barriers, and secondary metabolites. Female oviposition behavior, which controls larval exposure to host plant characteristics and eventually, fitness outcomes is a key mediator of these interactions. According to the "preference–performance hypothesis," females choose hosts that enhance the survival of their larvae. However, recent empirical research reveals that the impacts of plant quality on larval growth and population viability vary greatly [4].

Furthermore, because plant-insect interactions are a part of larger ecological networks that include mutualists, parasitoids, and predators, the results rely on the environment [5]. Chemical ecology and molecular biology advances have revealed that larval detoxification systems and plant defense signaling pathways function at genetic and biochemical scales, emphasizing the multi-level intricacy of butterfly-plant interactions [6].

Evolutionary history, plant chemistry, sensory signals and ecological trade-offs all influence host specificity in butterflies, which ranges from stringent specialists (monophagous species) to generalists (polyphagous species). Adult choice, plant palatability and larval performance are some of the components of host specificity that are not necessarily aligned, according to a systematic analysis of the monarch butterfly [7]. Larval eating and survival are shaped by physical characteristics like trichomes and chemical cues like phagostimulants and deterrents, whereas host usage habits can be changed by environmental changes. According to recent research, depending on their nutritional appropriateness and interactions with other trophic levels, novel or exotic host plants may serve as alternative resources or as "ecological traps" [6]. As a result, host specificity is context-dependent and dynamic, which has significant effects on butterfly conservation, evolution and reactions to environmental change on a global scale.

Importance of Host Plants for Larval Development

The vital nutrients needed for growth and metamorphosis are supplied by the larval host plants. Plant tissues high in proteins, carbohydrates and secondary metabolites are consumed by caterpillars, which affects their growth and survival [8]. The choice of host plant by ovipositing females was crucial for larval success since larvae frequently have limited mobility.

According to the preference-performance hypothesis, mother butterflies choose host plants that will enhance their offspring's performance and survival. However, empirical research has demonstrated that because of plant defensive characteristics and environmental variability, oviposition preferences do not always precisely match larval performance.

Research on butterfly species like monarchs has demonstrated that physical characteristics like trichomes and the chemical makeup of plants have a significant impact on larval survival. For instance, even when adults prefer host plants with specific defense chemicals, larval survival may be decreased.

Chemical Ecology and Plant Defenses

In butterfly-plant systems, chemical ecology focuses on how host selection, herbivory and coevolutionary dynamics are mediated by plant secondary metabolites. Alkaloids, terpenoids, phenolics and cyanogenic glycosides are just a few of the many chemical defenses that plants manufacture to discourage herbivores or lessen their effectiveness. These substances are not dispersed at random; rather, they change in response to resource availability and herbivore pressure, influencing insect feeding niches as well as plant defense mechanisms [9]. These chemical cues have a significant impact on butterfly host plant selection, frequently superseding plant phylogeny. As a result, species with comparable chemical profiles typically host similar butterfly assemblages [10]. In addition, plants may use inducible defenses, which are triggered by herbivory, or constitutive defenses, which are always present, giving plant-insect interactions a dynamic aspect. According to recent research on chemical ecology, these interactions affect community assembly, specialization, and biodiversity patterns throughout ecosystems, going beyond mere deterrence [11].

In order to get past or even take advantage of plant chemical defenses, butterflies have developed a variety of physiological and behavioral adaptations. Many species are able to withstand or store poisonous substances from their host plants because they have detoxifying enzymes or sequestration mechanisms. For instance, monarch butterflies use the cardenolides they sequester from milkweed as chemical defenses against predators, although doing so can have negative physiological effects like oxidative stress and decreased signal quality [12]. According to Mattila et al. [13], certain butterflies, such as Heliconius species, biosynthesize or accumulate cyanogenic chemicals, with toxin levels frequently associated with environmental factors and life-history trade-offs. These adaptations serve as an example of a fundamental idea in chemical ecology: plant defenses stimulate evolutionary novelties including specialization, mimicry, and aposematism in addition to limiting herbivores. As a result, interactions between butterflies and plants are controlled by an ongoing chemical arms race in which insect counter-adaptations and plant defense diversity work together to dictate ecological consequences and evolutionary paths.

Conservation Implications

Butterflies are commonly utilized as bioindicators of environmental health because they react quickly to habitat changes. According to [14] species that rely on certain host plants are especially susceptible to habitat loss, agricultural intensification, and climate change. Specialized butterflies may become extinct locally as a result of host plant declines brought on by urbanization or changes in land use. Thus, conservation initiatives prioritize the preservation and rehabilitation of nectar sources and larval host plants in butterfly habitats. According to recent evaluations, butterfly populations and ecological interactions depend on host plant diversity being maintained.

METHODOLOGY

Study Areas:

Study area 1. Nemaligundla, a dense black forest area in the Giddaluru Zone of the Prakasam District, is renowned for its waterfalls, Nemaligundla Falls, and is situated in the center of the dense Nallamala forest. Latitude 15° 45' 19.9944" N and longitude 79° 57' 55.854" E is where the study area was situated. The natural environment of this study region is a dry deciduous woodland. Large trees cannot develop when there is insufficient water, and the typical vegetation is a dry deciduous forest with an abundance of *Terminalia, Hardwickia* and *Pterocarpus* trees. Except for small areas close to villages where subsistence farming is done, agriculture is essentially non-existent. It is distinguished by different sections of grasses, climbers, shrubs, and herbs.

Study area 2. Seshachalam Bioreserve is located in the Eastern Ghats 13° 30' to 14° 11' 15" N 79° 0' 30" to 79° 30' E and is rich in biodiversity. It covers parts of Chittoor and Kadapa districts with varied terrain and climate. The reserve includes dry deciduous forests, scrublands, and grasslands. These habitats support a high diversity of butterflies (~100+ species). Major butterfly families include Nymphalidae, Pieridae, Lycaenidae, Papilionidae, and Hesperiidae. The area is ideal for studying butterfly distribution and host plant relationships. Common host plants include *Calotropis gigantea, Cassia spp., Citrus spp., and Ficus spp*. Shrubs like *Lantana camara* and herbs provide nectar sources for adults. Seasonal vegetation changes influence butterfly abundance and life cycles. The reserve is important for conservation and ecological research on plant–insect interactions [15].

Study area 3. Buggavanka Area 14.2559.007"N 7852'51.841"E. Buggavanka is a seasonal stream ecosystem located in the semi-arid region of the Eastern Ghats. The area consists of riparian vegetation, scrub forests, and grasslands, creating diverse habitats. It supports butterfly diversity due to the availability of nectar and host plants. Seasonal water flow promotes the growth of herbaceous plants and flowering species. Common plant species include *Calotropis gigantea*, *Cassia spp.*, *Lantana camara*, and grasses. These plants serve as larval host plants and nectar sources for butterflies. Butterfly families observed include Nymphalidae, Pieridae, Lycaenidae, and Papilionidae. The mosaic habitat supports both generalist and specialist butterfly species. The area is suitable for studying butterfly–host plant interactions and seasonal variation. Buggavanka is an important microhabitat for conservation and ecological studies in the Kadapa region [16].

Study area 4. Nallamala forest area is situated in Andhra Pradesh and Telangana. This vast forest range stretches from north to south along the Eastern Ghats around 15°40'41"N 78°47'10"E. As a vast range covering over 140 km north-south, with notable sections passing through the districts of Kurnool, Prakasam, and Kadapa. Numerous butterfly species that rely on particular host plants for their larvae are found in the Nallamala forest region, which is a portion of the Eastern Ghats with dry deciduous flora. *Aristolochia indica* (for Crimson Rose and Common Rose), *Citrus* species and *Murraya koenigii* (for Lime Butterfly and Common Mormon), *Calotropis* and other milkweed family plants (for Danaid butterflies like Blue Tiger), and shrubs like *Barleria, Hygrophila*, and *Asystasia* (used by pansies and other nymphalids) are common host plants in this area. Larval hosts include trees like *Pongamia pinnata* and *Annona*, as well as forest species like *Wrightia tinctoria*. Native flora is vital for butterfly diversity in Nallamala because butterfly caterpillars are extremely host-specific and cannot survive without them [17].

The study was conducted in selected habitats representing different vegetation types such as forest edges, grasslands, agricultural fields, and gardens. These habitats were chosen because they support a diversity of butterfly species and host plants. The study areas were surveyed throughout different seasons to capture variations in butterfly abundance and plant availability.

Field observations were carried out over a period of several months covering different seasons, preferably during peak butterfly activity. Surveys were typically conducted between 08:00 AM and 04:00 PM, when butterflies are most active and nectar feeding behavior can be easily observed.

To determine larval host specificity, host plants were identified through:

1) Direct observation of oviposition by adult butterflies.
2) Observation of larvae feeding on plants in the field.
3) Rearing collected larvae in laboratory conditions to confirm host plant associations.

Plants were identified using regional floras and botanical references. Leaves, flowers, or fruits of host plants may be collected for proper identification when necessary. Photographic documentation was used to confirm butterfly hostplant species.

The following data was collected:

1) Plant species present
2) Abundance of host plants

RESULTS

The larval host specificity of butterflies was observed in the following study areas Nemaligundla, Seshachalam Bioreserve, Buggavanka, Nallamala forest area during the period April 2023 to March 2026 with research scholars' team and took photographs and noted the availability of hostplants in the study areas.

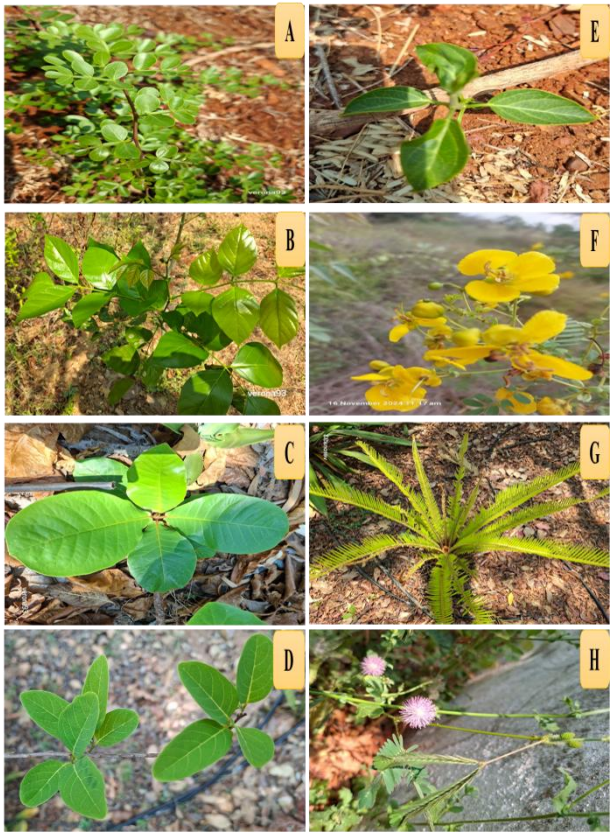
A total of 53 butterfly species were found to use a variety of larval host plants from various families in the current study, demonstrating significant heterogeneity in host plant specificity. Monophagous (M) species predominated among them, followed by polyphagous (P) and oligophagous (O) species, indicating a propensity for specific host plant associations in the research region.

While polyphagous species like *Hypolimnas bolina* and *Junonia spp.* used host plants from Acanthaceae and Malvaceae, monophagous species within the family Nymphalidae, such as *Danaus chrysippus, D. limniace leopardus* and *Phalantha phalantha* were mainly associated with plants of the families Apocynaceae and Salicaceae. Similarly, in the Lycaenidae family, species like *Tarucus nara* and *Spindasis vulcanus* relied on Rhamnaceae, while *Lampides boeticus* and *Talicada nyseus* used a wider range of hosts across Fabaceae and Crassulaceae.

A variety of specialization patterns were seen in the Papilionidae family, with species such as *Princeps demoleus* and *Graphium spp*. using multiple host plants within Rutaceae and Annonaceae, whereas *Pachliopta aristolochiae* and *P. hector* were exclusively connected with Aristolochiaceae. A number of species in the Pieridae family, including *Catopsilia, Colotis*, and *Cepora nerissa*, exhibited substantial correlations with the Capparaceae and Fabaceae plant families, underscoring their importance as larval resources. The primary food sources for Hesperiidae species were grasses (Poaceae) and plants such as *Pongamia pinnata* and *Ricinus communis.*

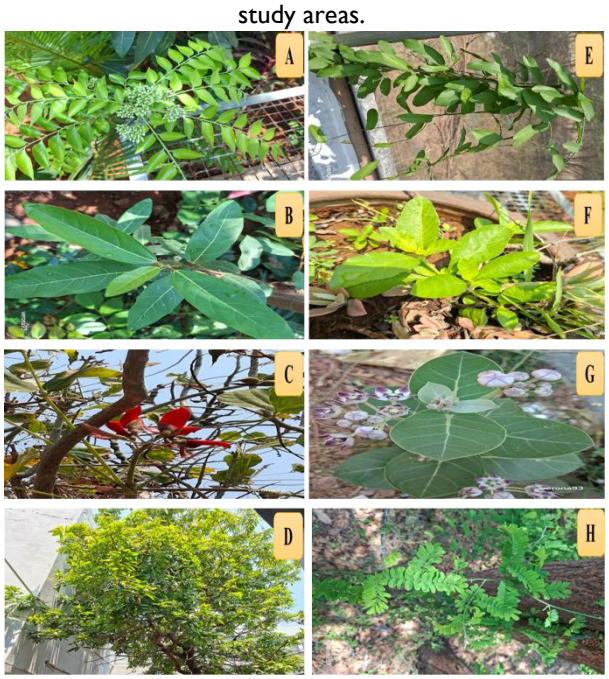
Several important plants, such as *Calotropis gigantea*, *Ficus racemosa, grasses, Asystasia gangetica, Ruellia tuberosa, Ziziphus spp., Mangifera indica, Terminalia spp., Cassia fistula,* and *Pongamia pinnata*, were widely distributed throughout all four study areas, according to an analysis of host plant availability. On the other hand, some host plants, such *Asclepias tuberosa, Kalanchoe spp., Magnolia champaca,* and *Oryza sativa*, had limited distribution and were only found in particular places.

According to the abundance data, species reliant on few or sparsely distributed plants tended to be rare (R), while butterflies connected with widely available host plants were typically abundant (A) or frequent (F). The distribution and number of butterflies appear to be strongly correlated with the availability of host plants. Overall, the study shows that the diversity and distribution of host plants significantly influence the formation of butterfly communities, with plant groups including the Fabaceae, Capparaceae, Rutaceae and Apocynaceae being important sources of larval nutrition in the area.



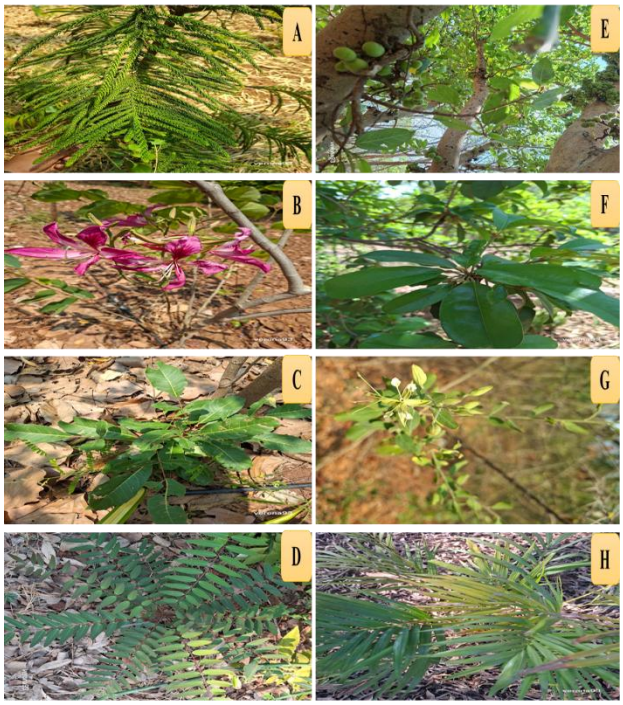
A. Limonia acidissima, B. Pongamia pinnata, C. Terminalia katappa, D. Annona squamosa, E. Dragea volubilis, F. Senna auriculata, G.Cycad, H. Mimosa pudica

Figure 01: Photographs of hostplants identified in the study areas.



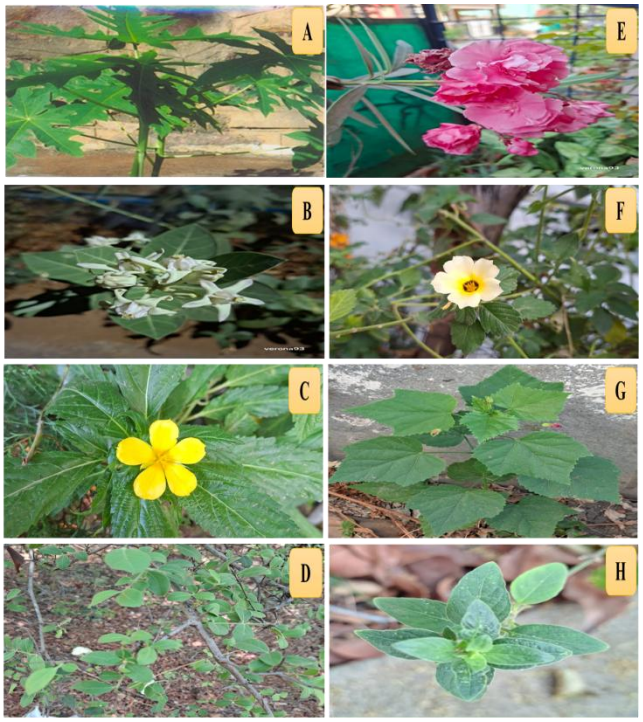
A. Murraya koenigii, B. Ficus racemosa, C. Butea monosperma, D. Mangifera indica, E. Aristolochia indica, F. Ruellia tuberosa, G. Calotropis procera, H. Abrus precatorius

Figure 02: Photographs of hostplants identified in the study areas.



A. Araucaria heterophylla, B. Bauhinia purpurea, C. Terminalia arjuna , D. Senna siamea, E. Ficus sycomorus, F. Manilkara zapota, G. Cadaba fruiticosa , H. Dypsis lutescens

Figure 03: Photographs of hostplants identified in the study areas.



A.Ricinus communis, B.Calotropis procera, C.Turnera ulmifolia, D.Capparis zeylanica, E.Nerium oleander, F.Turnera subulata, G.Urena lobata, H.Ruella repens

Figure 04: Photographs of hostplants identified in the study areas.

Table 01: Larval host plant usage: The range of host plants utilized by different butterfly species.

S. No.	Name of the butterfly	Host plant specificity	Host plant	Abundance	Plant family
Nymphalidae					
1	*Danaus chrysippus*	M	*Calotropis gigantea* *Calotropis procera*	A	*Apocynaceae*
2	*D. limniace leopardus*	M	*Dragea volubilis*	F	*Apocynaceae*
3	*D. plexippus*	M	*Asclepias tuberosa*	R	*Apocynaceae*
4	*Euploea core*	P	*Ficus racemosa* *Nerium oleander*	A	*Moraceae*
5	*Melanitis leda*	M	*Grasses*	A	*Poaceae*
6	*Hypolimnas bolina*	P	*Sida rhombifolia*	F	*Malvaceae*
7	*H. misippus*	P	*Asystasia gangetica*	F	*Acanthaceae*
8	*Junonia almanac*	P	*Ruellia tuberosa*	F	*Acanthaceae*
9	*Junonia hierta*	P	*Ruellia cordata*	F	*Acanthaceae*
10	*Junonia lemonias*	P	*Ruellia repens* *Ruellia tuberosa*	F	*Acanthaceae*
11	*Junonia orithyia*	P	*Justicia procumbens*	R	*Acanthaceae*
12	*Phalanta phalantha*	M	*Flacourtia indica*	R	*Salicaceae*
13	*Byblia ilithyia*	M	*Tragia plukenetii*	F	*Euphorbiaceae*
14	*Acraea terpsicore*	O	*Passiflora foetida* *Turnera ulmifolia* *Turnera subulata*	A	*Passifloraceae*
Lycaenidae					
15	*Tarucus nara*	M	*Ziziphus mauritiana*	A	*Rhamnaceae*
16	*Spindasis vulcanus*	M	*Zizyphus jujuba*	A	*Rhamnaceae*
17	*Talicada nyseus*	M	*Kalanchoe pinnata* *Kalanchoe laciniata* *Bryophyllum calycinum*	F	*Crassulaceae*

18	*Curetis thetis*	P	*Pongamia glabra* *Abrus precatorius*	A	*Fabaceae*
19	*Spindasis ictis*	M	*Senegalia catechu*	F	*Fabaceae*
20	*Chilades lajus*	P	*Limonia acidissima*	A	*Rutaceae*
21	*Zizeeria karsandra*	P	*Amaranthus spinosus*	A	*Amaranthaceae*
22	*Luthrodes pandava*	M	*Cycad*	F	*Cycadaceae*
23	*Rathinda amor*	P	*Mangifera indica*	A	*Anacardiaceae*
24	*Virachola isocrates*	P	*Manilkara zapota*	A	*Sapotaceae*
25	*Lampides boeticus*	M	*Butea* sps.	F	*Fabaceae*
Papilionidae					
26	*Graphium agamemnon*	P	*Polyalthia longifolia* *Annona squamosa* *Urena lobata*	A	*Annonaceae*
27	*G. doson*	P	*Polyalthia longifolia* *Desmos chinensis* *Magnolia champaca*	A	*Annonaceae* *Magnoliaceae*
28	*Pachliopta aristolochiae*	M	*Aristolochiae indica*	F	*Aristolochiaceae*
29	*P. hector*	M	*Aristolochiae indica*	F	*Aristolochiaceae*
30	*Papilio polymnestor*	M	*Citrus sps*	F	*Rutaceae*
31	*Papilio polytes*	M	*Murraya Korenigii*	A	*Rutaceae*
32	*Princeps demoleus*	P	*Citrus aurantifolia* *Citrus limon* *Citrus sinensis*	A	*Rutaceae*
33	*Arhopala amantes*	P	*Terminalia catappa* *Terminalia arjuna*	A	*Combretaceae*
Pieridae					
34	*Appias albina*	M	*Crateva adansonii*	R	*Putranjivaceae*
35	*Appias libythea*	M	*Crataeva magna*	R	*Capparaceae*
36	*Appias olferna*	O	*Cleome rutidosperma*	F	*Cleomaceae*
37	*Catopsilia crocale*	O	*Cassia fistula*	F	*Fabaceae*
38	*C. Pomona*	P	*Bauhinia species*	F	*Fabaceae*
39	*C. pyranthe*	M	*Senna occidentalis*	A	*Fabaceae*
40	*Colotis danae*	M	*Cadaba fruticosa* *Capparis zeylanica* *Maerua oblongifolia*	F	*Capparaceae*
41	*C. eucharis*	M	*Cadaba fruticosa* *Capparis zeylanica* *Maerua oblongifolia*	F	*Capparaceae*
42	*C. fausta*	O	*Cadaba fruticosa* *Capparis zeylanica* *Maerua oblongifolia*	F	*Capparaceae*
43	*C. amata*	M	*Cadaba fruticosa* *Capparis zeylanica* *Maerua oblongifolia*	F	*Capparaceae*
44	*Cepora Nerissa*	M	*Capparis zeylanica* *Capparis spinosa* *Cadaba fruticosa* *Capparis sepiaria* *Crateva adansonii*	F	*Capparaceae*
45	*Delias eucharis*	M	*Dendrophthoe falcata* *Dendrophthoe glabrescens*	R	*Loranthaceae*
46	*Eurema hecabe*	P	*Mimosa pudica* *Abrus precatorius*	R	*Fabaceae*
47	*Leptosia nina*	O	*Capparis zeylanica* *Capparis rheedei* *Crateva religiosa*.	F	*Capparaceae*

48	*Eurema blanda*	P	*Cassia fistula*	F	*Fabaceae*
49	*Eurema brigitta*	M	*Hypericum aethiopicum* *Chamaecrista mimosoides*.	A	*Hypericaceae, Fabaceae*
Hesperidae					
50	*Borbo cinnara*	M	*Oryza sativa*	A	*Poaceae*
51	*Hasora alexis*	P	*Ricinus communis* *Pongamia pinnata*	A	*Euphorbiaceae* *Fabaceae*
52	*Hasora chromus*	P	*Ricinus communis*	A	*Fabaceae* *Euphorbiaceae*
53	*Gangara Thyrsis*	P	*Dypsis lutescens*	A	*Arecaceae*
Host specificity: M- Monophagous, P- Polyphagous, O- Oligophagous, Abundance: A- Abundant, F- Frequent, R- Rare					

Table 02: Larval host plants availability in the study areas.

Name of hostplant	Study area 1 (Nemaligundla)	Study area 2 (Seshachalam Bioreserve)	Study area 3 (Buggavanka)	Study area 4 (Nallamala forest area)
Calotropis gigantea	+	+	+	+
Calotropis procera	_	_	+	_
Dragea volubilis	+	+	+	+
Asclepias tuberosa	_	_	+	_
Ficus racemosa	+	+	+	+
Grasses	+	+	+	+
Sida rhombifolia	+	+	_	+
Asystasia gangetica	+	+	+	+
Ruellia tuberosa	+	+	+	+
Ruellia cordata	_	_	+	_
Ruellia repens	+	+	_	_
Justicia procumbens	+	+	+	+
Flacourtia indica	+	_	_	+
Tragia plukenetii	+	+	+	+
Passiflora foetida.	+	+	_	+
Zizyphus jujuba	+	+	+	+
Ziziphus mauritiana	+	+	+	+
Kalanchoe pinnata	_	_	+	_
Kalanchoe laciniata	_	_	+	_
Bryophyllum calycinum	+	+	+	+
Pongamia glabra	+	+	_	+
Senegalia catechu	+	_	+	_
Limonia acidissima	+	_	+	_
Amaranthus spinosus	+	_	_	+
Cycad	+	+	+	+
Mangifera indica	+	+	+	+
Manilkara zapota	+	+	+	+
Butea monosperma	+	+	+	+
Annona squamosa	+	+	_	+
Polyalthia longifolia	+	+	_	+
Magnolia champaca	+	_	_	_
Aristolochiae indica	+	_	_	+
Desmos chinensis	+	+	_	+
Murraya Korenigii	+	+	+	+
Citrus aurantifolia	+	_	_	+
Citrus limon	+	+	_	+
Citrus sinensis	+	+	+	+
Terminalia catappa	+	+	+	+
Terminalia arjuna	+	+	+	+
Crataeva magna	+	+	_	+

Cleome rutidosperma	+	_	_	+
Bauhinia purpurea	+	+	_	+
Senna occidentalis	+	+	+	+
Cadaba fruticosa	+	+	_	+
Capparis zeylanica	+	+	_	+
Maerua oblongifolia	+	+	_	+
Crateva adansonii	+	+	+	+
Dendrophthoe falcata	+	_	+	+
Dendrophthoe glabrescens	+	_	+	+
Mimosa pudica	+	+	_	+
Abrus precatorius	+	+	_	+
Crateva religiosa.	+	_	_	+
Cassia fistula	+	+	+	+
Hypericum aethiopicum	+	+	_	+
Chamaecrista mimosoides	+	+	_	+
Oryza sativa	_	_	+	_
Pongamia pinnata	+	+	+	+
Ricinus communis	+	+	+	+
Dypsis lutescens	+	+	+	+
Turnera ulmifolia	_	+	+	+
Turnera subulata	+	+	+	+
Urena lobata	+	_	_	_
Nerium oleander	+	+	+	+

Discussion

The present study demonstrates that larval host plant usage among butterflies is strongly structured by both plant diversity and availability, reinforcing the ecological importance of plant–insect interactions in shaping butterfly communities. The dominance of monophagous species observed in this study indicates a high degree of host specialization, which is consistent with the idea that many butterflies evolve close physiological and chemical adaptations to specific host plants. Such specialization, while advantageous for efficient resource utilization, may also increase vulnerability to habitat disturbance and loss of host plants.

Within Nymphalidae (14), the association of species like *Danaus chrysippus* and *Danaus limniace* with Apocynaceae reflects the well-known dependence of danaine butterflies on plants containing toxic secondary metabolites, which are sequestered for defense. Similarly, the reliance of several *Junonia* species on Acanthaceae supports earlier findings that this plant family serves as an important larval resource for nymphalid butterflies in tropical regions. The occurrence of *Melanitis leda* on grasses highlights the role of Poaceae as a stable and widely available resource supporting generalist feeders.

In Lycaenidae (11), both specialization and polyphagy were evident. Species such as *Tarucus nara* and *Spindasis vulcanus* showed strong dependence on Rhamnaceae, while others like *Lampides boeticus* utilized multiple hosts within Fabaceae, suggesting adaptive flexibility. The association of *Talicada nyseus* with Crassulaceae further indicates niche specialization linked to succulent host plants. These patterns align with previous studies emphasizing the diverse feeding strategies within lycaenids, often influenced by plant chemistry and ecological conditions.

The Papilionidae (8) exhibited clear host specificity in species like *Pachliopta aristolochiae* and *P. hector*, which are restricted to Aristolochiaceae, reflecting co-evolutionary relationships. In contrast, species such as *Princeps demoleus* and *Graphium spp.* displayed broader host usage within Rutaceae and Annonaceae, indicating ecological adaptability. Such variation suggests that even within a single family, host plant usage can range from strict specialization to moderate generalization.

In Pieridae (16), the strong association with Capparaceae and Fabaceae highlights these families as key larval resources in the study region. The repeated use of plants like *Capparis zeylanica* and *Cadaba fruticosa* by multiple *Colotis* species suggests resource sharing and possible niche overlap. Similarly, the dependence of *Eurema* species on Fabaceae reflects the nutritional suitability and widespread distribution of legumes.

The significance of Hesperiidae (4) as the main larval resources in the research area was highlighted by their strong relationship with monocot plant families including Poaceae and to a lesser extent, Arecaceae. Widely dispersed grass species are frequently exploited by species in genera like *Borbo*, which reflects the ecological richness and nutritional sufficiency of Poaceae members. Furthermore, some skippers exhibit host specialization, as seen by their sporadic dependency on palms and allied plants. In general,

Hesperiidae's need on grasses highlights the ecological importance of grasslands and open environments for maintaining their numbers.

The analysis of host plant availability across study areas clearly indicates that plant distribution directly influences butterfly abundance and occurrence. Widely distributed plants such as *Calotropis gigantea*, *Ficus racemosa*, grasses, *Ziziphus spp.*, and *Pongamia pinnata* supported abundant butterfly populations, whereas species relying on restricted plants like *Asclepias tuberosa* and *Kalanchoe spp.* were comparatively rare. This finding supports the hypothesis that resource availability was a key determinant of butterfly population dynamics. Host specificity was a fundamental ecological trait influencing butterfly distribution, survival, and evolutionary relationships with plants. Many butterflies exhibit strong larval host specialization while adult butterflies often utilize a broader range of nectar resources. This life-stage difference reflects distinct ecological pressures related to growth, reproduction, and mobility [18].

Butterfly larvae typically feed on a limited number of plant species or closely related plant families. This specialization was primarily driven by plant chemical defenses and the ability of larvae to detoxify plant secondary metabolites. Studies continue to support the preference–performance hypothesis, which states that female butterflies often select host plants that maximize larval survival and development [7].

Host plant specialization plays a key role in butterfly diversification and speciation. Long-term co-evolution between plants and herbivorous insects has produced complex ecological relationships. Plant chemical defenses and insect detoxification mechanisms drive an evolutionary "arms race" that contributes to biodiversity [19]. Recent research suggests that host plant interactions may also influence sexual selection and reproductive dynamics in phytophagous insects, further shaping evolutionary processes [20].

Host shifts, ecological specialization, and adaptation to new host plants are therefore major drivers of insect diversification. The contrasting patterns of specialized larval feeding represent a dual ecological strategy in butterflies. Larval specialization ensures efficient growth and adaptation to host plants in tropical and forest areas [21]. Recent studies emphasize the importance of host plant diversity, ecological adaptation, and environmental change in shaping butterfly populations. Integrating knowledge of host plant interactions into conservation planning is therefore essential for maintaining butterfly diversity and ecosystem stability.

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AUTHOR CONTRIBUTIONS

K.S. Veronika contributed to the investigation, field data collection, documentation of butterfly species and larval host plants, and manuscript preparation. S.P. Venkata Ramana contributed to supervision, conceptualization, interpretation of findings, and critical revision of the manuscript. Both authors reviewed and approved the final manuscript.

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

ETHICAL APPROVAL

Ethical approval was not applicable to this study, as it involved field observations and documentation of butterfly species and their larval host plants without the involvement of human participants or experimental procedures involving vertebrate animals.

INFORMED CONSENT

Not applicable, as this study did not involve human participants.

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