



Contribution to the Lepidopterans of Visakhapatnam Region, Andhra Pradesh, India

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General Note



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ABSTRACT

The butterflies *Byblia ilithyia* (Nymphalidae), *Pieris canidia* (Pieridae) and *Azonus jesous* (Lycaenidae) and the day-flying moth, *Nyctemera adversata* (Erebidae) are oligophagous. Previously, only *B. ilithyia* has been reported to be occurring in this region while the other three species are being reported for the first time from this region. The larval host plants include *Jatropha gossypifolia* and *Tragia involucrata* for *B. ilithyia*, *Brassica oleracea* var. *oleracea* and *B. oleracea* var. *botrytis* for *P. canidia*, and *Acacia auriculiformis* for *Azonus jesous*. The nectar plants include *Tragia involucrata*, *Euphorbia hirta* and *Jatropha gossypifolia* for *B. ilithyia*, *Premna latifolia* and *Cleome viscosa* for *P. canidia*, *Lagascea mollis*, *Tridax procumbens* and *Digera muricata* for *A. jesous* and *Bidens pilosa* for *N. adversata*. The study recommends extensive field investigations to find out more larval plants and nectar plants for each lepidopteran species now reported.

Key words:

Byblia ilithya, *Pieris canidia*, *Azonus jesous*, *Nyctemera adversata*, oligophagy, nectar plants.

1. INTRODUCTION

The occurrence and abundance of butterflies and moths are good indicators of the health of any given natural habitat or ecosystem, form an essential part of the food chain by providing prey for their predators such as birds, bats and other insectivorous animals, and by providing pollination and pest control services. Many ecologists used butterflies as model organisms to study the impact of habitat loss, fragmentation and climate change as well. Since butterflies and moths are integral elements in natural ecosystems, their conservation and management is inevitable for which accurate and up to date information on their occurrence, abundance and distribution is required. For this information, continuous field studies in each natural and urban area are imperative to assess the status of Lepidopteran species from time to time to revise or add species of lepidopterans that have not been reported so far and at the same time frame measures for their conservation and management.

Different authors provided checklists of butterflies for Visakhapatnam region from time to time. Subba Reddi and Meera Bai (1985) documented the occurrence of 46 butterfly species in Visakhapatnam. Ramana et al. (2001) added 3 more butterfly species to the list provided by Subba Reddi and Meera Bai (1985). Subba Reddi et al. (2002) reported the occurrence of 54 butterfly species in Andhra University Campus alone, which is in Visakhapatnam city. Solomon Raju and Purnachandra Rao (2003) documented a total of 68 butterfly species from Andhra University Campus. Later, there were no studies from this region to update the checklist of Lepidopterans either for Andhra University Campus or for Visakhapatnam city or region. In this paper, three butterfly species, *Byblia ilithya* (Nymphalidae), *Pieris canidia* (Pieridae), *Azonus jesous* (Lycaenidae) and one moth species, *Nyctemera adversata* (Erebidae) have been reported and discussed in the light of pertinent literature.

2. MATERIALS AND METHODS

In Visakhapatnam region, the remnant habitats of the city, the foothills and the areas outside the city were surveyed for research work on different aspects of plant-animal interactions for three full years 2017, 2018 and 2019. In the course of this survey, we recorded three butterfly and one moth species in this entire region. The period of their occurrence, larval and the nectar host plant species used by them were recorded. The life form, flowering season and the abundance of the plant species in addition to floral traits and nectar characters were observed to evaluate their importance as nectar source for butterflies and moths.

3. OBSERVATIONS

Byblia ilithya Drury (Family Nymphalidae: sub-family Biblidinae) commonly called "Spotted Joker" has wet and dry season forms but they are slightly distinguishable. Male and female adult butterflies are identical in wet season form while they show slightly different black markings on their wings in dry season form. This butterfly was found to use the small deciduous shrub, *Jatropha gossypifolia* L. (Euphorbiaceae family) as its larval host plant. The leaf is 3-lobed with gland-tipped hairs along the margins; these glandular hairs may provide protection to the eggs deposited on the leaf of this plant species by the adult female butterfly. *J. gossypifolia* thrives well during wet season during which the female butterfly uses this plant as larval host. The adult butterflies used *Croton bonplandianum*, *Euphorbia hirta*, *Jatropha gossypifolia* (Figure 1a,b) and *Tragia involucrata* as nectar plants in this area. Individual flowers of these plant species produce traces to minute volume of nectar. All these plant species are commonly available in dense populations providing ample nectar for both male and female butterflies. These plants grow seasonally during rainy season but also grow if the soil has sufficient moisture throughout the year. The butterfly appears frequently during wet season coinciding well with the availability of dense populations of its larval host plant in the same season.

Pieris canidia Sparrman (Family Pieridae: sub-family Pierinae) commonly called "Indian Cabbage White" show slight difference between male and female adult butterflies. Males show 1 black spot while females show 2 black spots on their forewings. It has wet and dry seasons forms. The only difference between these forms is that the dry season form is heavily dusted with dirty yellow to green scales when compared to the wet season form. This species is not available within Visakhapatnam city but it is frequently found in the areas outside this city where its larval host plant species, *Brassica oleracea* var. *oleracea* L. (Cabbage) and *B. oleracea* var. *botrytis* L. (Cauliflower) are cultivated as commercial vegetables throughout the year. Previously, no one has ever reported the occurrence of this butterfly species in this region. Nectar plant species utilized by this butterfly included a tree species, *Premna*

latifolia L. (Lamiaceae) with flowering during June–November and a herb species, *Cleome viscosa* L. (Cleomaceae) (Figure 1c) with flowering during August–November. However, *P. latifolia* shows sporadic flowering throughout the year while *C. viscosa* also flowers throughout the year in areas where soil is sufficiently wet consistently. The nectar in individual flowers of these two plant species is in moderate volume and sufficient to meet the requirement of the butterfly.

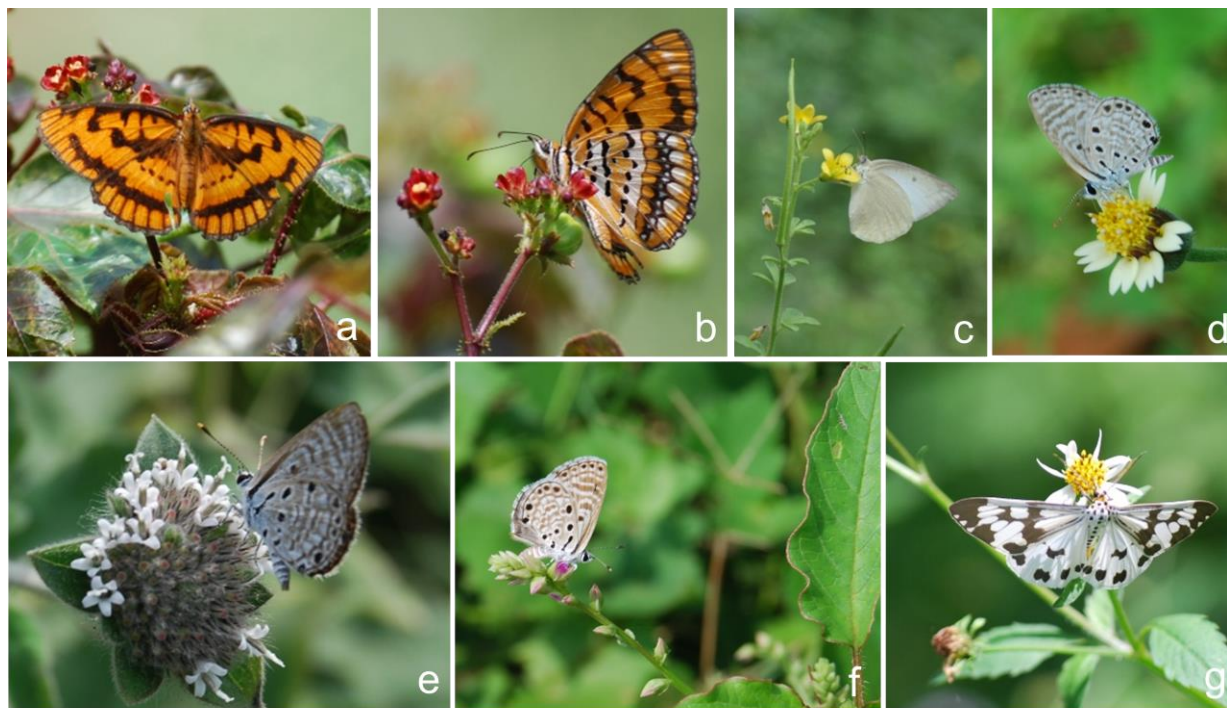


Figure 1. a. & b. *Byblia ilithya* collecting nectar from *Jatropha gossypifolia*, c. *Pieris canidia* collecting nectar from *Cleome viscosa*, d-f. *Azanus jesous* collecting nectar from *Tridax procumbens* (d), *Lagascea mollis* (e) and *Digera muricata* (f) and g. *Nyctemera adversata* collecting nectar from *Bidens pilosa*. @Prof. A.J. Solomon Raju and Dr. K. Venkata Ramana.

Azanus jesous Guerin-Meneville (Family Lycaenidae: sub-family Polyommatainae) commonly called "Topaz Babul Blue" exhibits almost identical forms during wet and dry season but the dry season forms are paler than wet season forms. It uses the evergreen tree, *Acacia auriculiformis* A. Cunn. ex Benth. (Fabaceae family) as its larval host in this area. This was frequently sighted at the flowers of *Tridax procumbens* L. (Figure 1d) and *Lagascea mollis* Cav. (Asteraceae) (Figure 1e) and *Digera muricata* (L.) Mart. (Amaranthaceae) (Figure 1f). All the three species show prolific growth and form mats of populations in open areas during rainy season and occur in vegetative growth and flowering throughout the year in open areas where the soil is sufficiently wet. This butterfly uses these plant species as important nectar sources. In *T. procumbens*, the inflorescence type is a heterogamous capitulum with white ray and yellow disc florets; the ray florets are female and nectarless while disc florets are bisexual and nectariferous. The butterfly lacks the ability to distinguish these two florets with reference to nectar availability and visits both ray and disc florets. In *L. mollis*, the inflorescence type is synflorescence with numerous 1-floreted capitula; all florets are white with bluish tinge, bisexual and nectariferous. In *D. muricata*, the inflorescence type is spicate raceme with numerous flowers, at each point, 3-flowers are produced consisting of one central fertile flower and two lateral infertile flowers. The fertile flowers are nectariferous, bisexual and tri-coloured with green, white and pink. The nectar is produced in traces in the disc florets of *T. procumbens*, *L. mollis* and in the fertile flowers of *D. muricata*. The inflorescence in all these species presents flowers in aggregated form and a single visit by the butterfly enabled it to collect nectar from as many as florets/flowers as possible.

Nyctemera adversata Schaller (Family Erebiidae: Sub-family Arctiinae) commonly called "The Marbled White Moth" is day-flying and sighted occasionally at the capitula of *Bidens pilosa* L. (Asteraceae) (Figure 1g). The plant is a herb that shows vegetative growth, flowering and fruiting throughout the year but it shows peak flowering during September–November only. The inflorescence type is a heterogamous capitulum with white, sterile, nectarless ray florets and yellow, fertile, bisexual nectariferous disc florets. The disc florets produce traces of nectar but all florets in a capitulum collectively provide ample nectar for the visiting individuals of this moth.

4. DISCUSSION

Butterflies occupy all possible habitats, even those with scanty habitats but their diversity depends on the plant diversity in the habitats where they occur (Solomon Raju and Purnachandra Rao 2003). In butterflies, the food and mode of feeding aspects are different in the larval and adult stage indicating their stages are functionally different. During larval phase, most caterpillars feed on leaves and show strict preference to specific host plants. These preferences are dictated by the chemical composition of leaves that the caterpillars eat. Based on the preferences displayed by caterpillars for specific host plants, three types of specialization have been identified - monophagy, oligophagy and polyphagy. Monophagy involves the use of only a few plant species in one genus by a particular caterpillar species. Oligophagy involves the use of several plant species in different genera of the same or a few closely related families by a particular caterpillar species. Polyphagy involves the use of many plant species in a number of unrelated plant families by a particular caterpillar species. Of these three types, oligophagy and polyphagy are most common types employed by caterpillar species. These feeding specializations are flexible facilitating caterpillars to feed on different host plant species according to their availability and nutritional value (Opler and Krizek 1984; Kunte 2000). The caterpillars consume a large amount of carbohydrates and accumulate energy sufficient to lead life during adult stage. But, the adults also require proteins and salts from floral nectar, rotting fruits and tree sap for a longer life span, for acquiring suitable mates and producing a greater number of eggs in each brood or generation (Opler and Krizek 1984). Therefore, the larval stage is intimately associated with plant leaf matter while adult stage is inevitably and largely dependent on floral nectar.

Gunathilagaraj et al. (1998) reported that *Byblia ilithya* is an inhabitant of dry, open, grassy plains throughout the drier parts of South India. Prasanna Kumar et al. (2011) reported that *B. ilithya* is distributed in southern Andhra Pradesh. Suryanarayana et al. (2016) noted that *B. ilithya* is distributed in Seshachalam Bio-reserve Forest in southern Eastern Ghats of Andhra Pradesh. Woodhall (2005) and Ravikanthachari et al. (2018) noted that *B. ilithya* utilizes *Tragia involucrata*, *T. plukenetii*, *T. dubanensis*, *T. glabrata*, *T. cannabina* and *Dalechampia capensis* - all belonging to Euphorbiaceae, as its larval host plants. In this study, it is found that this butterfly utilizes *Jatropha gossypifolia*, another Euphorbiaceae species as its larval host plant. This plant is largely seasonal in occurrence and flourishes well during rainy season. *T. involucrata* also occurs in this area. In this area, *J. gossypifolia* and *T. involucrata* act as larval host plants for *B. ilithya*. The larval host plants reported by previous workers and in the present study indicate that oligophagy is functional in *B. ilithya* since it is utilizing plant species belonging to Euphorbiaceae family only. Bhupathi Rayalu et al. (2011) reported that *B. ilithya* utilizes *Tridax procumbens* (Asteraceae) and *Croton bonplandianum* (Euphorbiaceae) as its nectar plants. The present study adds the plant species such as *Tragia involucrata* (Asteraceae), *Euphorbia hirta* and *Jatropha gossypifolia* (Euphorbiaceae) as nectar plants of *B. ilithya*. These plant species are common and form dense populations during rainy season ensuring sufficient flow of nectar for this butterfly species. Further, if the soil is wet and charged with nutrients, these plant species show vegetative growth and flowering continually and provide nectar to this butterfly. Since previous information on the nectar plants of this butterfly is lacking, it is not possible to define this butterfly as a generalist or specialist in utilizing different plant species as nectar sources.

Suryanarayana et al. (2016) reported that *Pieris canidia* occurs in Seshachalam Bio-reserve Forest in the southern Eastern Ghats of Andhra Pradesh. The present study reports the occurrence of *P. canidia* in Visakhapatnam region for the first time. Previous workers (Subba Reddi and Meera Bai 1985; Ramana et al. 2001; Subba Reddi et al. 2002; Solomon Raju and Purnachandra Rao 2003) have not listed *P. canidia* in the checklist of butterflies for this region. Joshi et al. (2016) reported that *P. canidia* utilizes species of Brassicaceae family such as *Brassica oleracea* var. *oleracea* (cabbage), *B. oleracea* var. *botrytis* (cauliflower), *Rorippa dubia*, *Sisymbrium* sp. and *Tropaeolum majus* as its larval host plant species. In this study also, cabbage and cauliflower plants serve as larval hosts for *P. canidia*. Since these larval plants are commercially cultivated as vegetables throughout the year, it is possible that *P. canidia* is multivoltine. Further, *P. canidia* is oligophagous because it utilizes species of different genera of only one family, Brassicaceae as reported by Joshi et al. (2016) and as evidenced in the present study. Kunte (2000) noted that the nectar plants of *P. canidia* are species of *Impatiens* (Balsaminaceae), *Leucas* (Lamiaceae), *Crepis* and *Vicoa* (Asteraceae). Of these, the flowers of *Impatiens* are blue, purple, red, orange, white, pink and yellow display either distinctly or in combination with any of these colours, those of *Leucas* are white and those of *Crepis* and *Vicoa* are yellow. Sengupta and Ghorai (2013) reported that *P. canidia* utilizes plant species from different families as nectar plants. The list provided by them include *Kaempferia ellipticum*, *Hedychium ellipticum* (Zingiberaceae), *Celogyne corymbosa*, *Dendrobium candidum*, *D. densiflorum* (Orchidaceae), *Rhododendron falconeri* (Ericaceae), *Cyananthus incanus* (Campanulaceae), *Gentiana capitata* (Gentianaceae) and *Magnolia campbelli* (Magnoliaceae). Of these, *D. densiflorum* flowers are yellow, *C. incanus* purplish blue and *R. falconeri* whitish-pink while all others are white. Dileepu Kumar et al. (2018) reported that *P. canidia* utilizes creamy-white flowered *Premna latifolia* (Lamiaceae) as its nectar plant. In the present study also, *P. latifolia* has been found to be an important nectar source for *P. canidia* for a long period during rainy season. *Cleome viscosa* with yellow flowers is also an important nectar plant during rainy season for *P. canidia*. Further, *P. latifolia* flowers sporadically while *C. viscosa* shows

moderate flowering throughout year; *P. canidia* utilizes these species as nectar sources where they are available. This butterfly is very actively forages at the flowers around noon and also in the early afternoon (Kunte 2000). With the information thus far available, it can be stated that *P. canidia* is a generalist and collects nectar from many species with variously coloured flowers, especially white ones belonging to widely different plant families.

Sengupta et al. (2014) reported that *Azanus jesous* utilizes small trees, *Acacia gageana* and *A. pennata* (Fabaceae family: Mimosoideae Clade) as larval hosts in the eastern Himalayan landscape, West Bengal. Williams (2018) reported that *A. jesous* utilizes different life forms representing different species in Fabaceae which include *Adenopodia spicata*, *Dichrostachys* spp., *Entada* spp., *Medicago* spp., *Senegalia caffra*, *Vachellia abyssinica*, *V. hockii*, *V. pseudofistula* and *V. seyal* and *Acacia stenocarpa*. In this study, it is found that *A. jesous* utilizes *Acacia auriculiformis* (Fabaceae), especially the growing and low height individuals as its larval host plant. Previous studies and the present study indicate that *A. jesous* exhibits oligophagy since it utilizes species of different genera in the same family as larval host plants. Mallikarjuna Rao and Solomon Raju (2017) reported that *A. jesous* utilizes *Lagascea mollis* (Asteraceae) as its nectar plant throughout the year if available. The present study also found that *L. mollis* serves as one of the nectar host plants for *A. jesous* in this area. Further, another Asteraceae member, *Tridax procumbens* and Amaranthaceae member, *Digera muricata* also serve as nectar host plants for this butterfly species. These three species form extensive mats of populations in open areas during rainy season and flower profusely providing ample nectar for this butterfly during this season. These species also occur year-long in areas where soil has sufficient moisture and accordingly provide nectar for this butterfly throughout the year. In *L. mollis* and *T. procumbens*, the florets are produced in capitula; it is synflorescence with numerous capitula, each with a single bluish tinge, bisexual and nectariferous floret while it is a heterogamous capitulum with white female and nectarless ray florets, and yellow bisexual and nectariferous disc florets. This suggests that all florets of *L. mollis* and only disc florets of *T. procumbens* provide nectar for *A. jesous*. In *D. muricata*, the spicate raceme type inflorescence with 3-flowers at each point also presents a unique situation in which only the central flower is fertile, bisexual, nectariferous and displays a combination of three colours - green, white and pink which serve as attractants. These three species with prolific growth and flowering, especially during rainy season, and individual inflorescences producing numerous nectariferous flowers are indeed promising nectar sources for *A. jesous*. With the information so far available on the nectar plants of *A. jesous*, it can be stated that it is not a generalist and utilizes a few plant species as nectar hosts.

Spitsyn et al. (2015) reported that *Nyctemera adversata* utilizes species of *Erechtites*, *Erigeron*, *Gynura*, *Picris* and *Senecio*, all belonging to Asteraceae family as its larval plants. Smetacek and Smetacek (2011) reported that *N. adversata* utilizes *Debregeasa longifolia*, *Girardinia diversifolia* and *Urtica dioica* (Urticaceae), *Gynura bicolor* and *Crassocephalum crepidioides* (Asteraceae) as its larval host plants. Since this moth utilizes plant species belonging to two different families, it can be said that it is oligophagous. In the present study, *N. adversata* has been sighted very occasionally at the capitula of an Asteraceae member, *Bidens pilosa* for the first time. This plant is not very common but in areas where it occurs shows prolific growth and flowering throughout the year but robust vegetative growth and flowering intensity are confined to rainy season only. The inflorescence type is a heterogamous capitulum with white, sterile and nectarless ray florets and yellow, bisexual nectariferous disc florets. As a result, only disc florets provide nectar and the moth profitably utilizes this plant as a promising nectar source. As a day-flying moth, *N. adversata* shows its activity mainly around noon time to collect nectar from *B. pilosa*. The larval host plants of this moth in this area have not been observed due to its occasional sightings only.

5. CONCLUSIONS

Previous information supplemented by the present study indicate that the butterflies, *Byblia ilithyia*, *Pieris canidia* and *Azanus jesous*, and the day-flying moth, *Nyctemera adversata* are all oligophagous as they use a few plant species of the same or closely related families as their larval hosts. Previously, only *B. ilithyia* has been reported to be occurring in this region while the other three species are being reported for the first time from this region. In this study, the larval host plants are *Jatropha gossypifolia* and *Tragia involucrata* for *B. ilithyia*, *Brassica oleracea* var. *oleracea* and *B. oleracea* var. *botrytis* for *P. canidia*, and *Acacia auriculiformis* for *Azanus jesous*. The nectar plants are *Tragia involucrata*, *Euphorbia hirta* and *Jatropha gossypifolia* for *B. ilithyia*, *Premna latifolia* and *Cleome viscosa* for *P. canidia*, *Lagascea mollis*, *Tridax procumbens* and *Digera muricata* for *A. jesous* and *Bidens pilosa* for *N. adversata*. The study warrants for extensive field investigations to define whether the lepidopterans now reported are really oligophagous or not, and also to define whether these lepidopterans are really generalist or specialist nectar feeders in utilizing widely different or specific plant species in the habitats where they occur.

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Authors contributions

Both authors contributed equally.

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REFERENCES AND NOTES

- Bhupathi Rayalu, M., Tarakeswara Naidu, M., Atluri, J.B. and Subba Reddi, C. 2011. Life history and larval performance of the Joker butterfly, *Byblia ilithya* (Lep: Nymphalidae). *J. Entomol. Soc. Iran* 31: 71-85.
- Dileepu Kumar, B., Sandhya Deepika, D. and Solomon Raju, A.J. 2018. On the reproductive ecology of *Premna latifolia* L. and *Premna tomentosa* Willd. (Lamiaceae). *J. Threatened Taxa* 10: 11105-11125.
- Gunathilagaraj, K., Perumal, T.N.A., Jayaram, K. and Ganesh Kumar, M. 1998. Some South Indian Butterflies. Nilgiri Wildlife and Environment Association, Nilgiri, Tamilnadu.
- Joshi, R.K., Kapkoti, B. and Rawal, R.S., Bhatt, I.D. and Dhyani, P.P. 2016. Diversity of butterflies in Surya-Kunj (Contribution to Nature Interpretation and Learning). GBPIHED, Kosi-Katarmal, Almora, Uttarakhand, India.
- Kunte, K. 2000. India, a Lifescape: Butterflies of Peninsular India. Universities Press, Hyderabad. pp. 254.
- Mallikarjuna Rao, M. and Solomon Raju, A.J. 2017. Secondary pollen presentation, psychophily and anemochory in *Lagascea mollis* Cav. (Asteraceae). *Biotropia* 24: 202-211.
- Prasanna Kuma, V., Harinath, P. and Venkata Ramana, S.P. 2011. Life cycle larval performance of the Joker *Byblia ilithya* (Lepidoptera: Rhopalocera : Nymphalidae) from southern Andhra Pradesh. *Bull. Pure and Applied Sci.* 31A: 1-6.
- Ramana, S.P.V., Atluri, J.B. and Subba Reddi, C. 2001. New additions to the butterflies of Visakhapatnam. *Insect Environ.* 6: 187.
- Ravikanthachari, N., Balakrishnan, V.C., Paresh, V.C., Satya Prakash and Kunte, K. 2018. Larval host plants of the butterflies of the Western Ghats, India. *J. Threatened Taxa* 10: 11495-11550.
- Sengupta, P. and Ghorai, N. 2013. On the plant-butterfly interaction in the surroundings of the upper Neora Valley National Park, a sub-tropical broad leaved hill forest in the eastern Himalayan landscape of West Bengal, India. *NeBio.* 4: 21-30.
- Sengupta, P., Banerjee, K.K. and Ghorai, N. 2014. Seasonal diversity of butterflies and their larval food plants in the surroundings of upper Neora Valley National Park, a sub-tropical broad-leaved hill forest in the eastern Himalayan landscape, West Bengal, India. *J. Threatened Taxa* 6: 5327-5342.
- Smetacek, P. and Smetacek, R. 2011. Additions to the known larval host plants of Indian Lepidoptera. *J. Threatened Taxa* 3: 2272-2276.
- Solomon Raju, A.J. and Purnachandra Rao, S. 2003. Andhra University Campus: A prize or a peril for butterflies? *J. Natcon.* 15: 341-350.
- Spitsyn, V.M., Bolotov, I.N., Gofarov, M.Y., Vikhrey, I.V. and Bolotov, N.I. 2015. First record of *Nyctemera adversata* (Schaller, 1788) and *N. carissima* (Swinhoe, 1891) (Lepidoptera, Erebidae, Arctiinae) from Myanmar. *Check List* 11: 4, doi: 10.15560/11.4.1687.
- Subba Reddi, C. and Meera Bai, G. 1985. Butterflies of Visakhapatnam, their seasonality, relative abundance. *Kingfisher Special Issue*, pp. 1-3, Andhra Pradesh Natural History Society, Visakhapatnam.
- Subba Reddi, C., Atluri, J.B., Ramana, S.P.V., Samatha, B., Ramesh, L. and Jyotsna, U.V.V. 2002. Andhra University Campus - A butterfly paradise. *Bulletin of Andhra University Research Forum* 8: 26-28.
- Suryanarayana, K., Harinath, P., Appala Naidu, S. and Venkata Ramana, S.P. 2016. Checklist of butterflies in Seshachalam Bio-Reserve Forest - Eastern Ghats of Andhra Pradesh - India. *European Acad. Res.* IV: 4872-4882.
- Williams, M.C. 2018. Afrotropical butterflies. <http://www.lepsofcafrica.org>
- Woodhall, S. 2005. *Field Guide to Butterflies of South Africa*, Struik, Cape Town, South Africa.