# Factors influencing nectar plant resource visits by butterflies on a university campus: Implications for conservation

**Article** *in* Nota Lepidopterologica · February 2006



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# Factors influencing nectar plant resource visits by butterflies on a university campus: implications for conservation

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**Abstract.** Floral attributes are well known to influence nectar-feeding butterflies. However, very little information is available on butterfly species and their nectar host plant relationships from north central India. The present study was carried out on Amravati University Campus from July 2004 to January 2005. A total of 48 butterfly species was recorded belonging to five families and included five species previously unrecorded on the campus. Nineteen nectar host plants were identified belonging to 12 plant families. Visits of butterflies were more frequent to flowers with tubular corollas than to non tubular ones, to flowers of herbs and shrubs rather than trees, to flowers coloured red, yellow, blue and purple than those coloured white and pink, and to flower sources available for longer periods in the year. Flower abundance, flowering period, flower colour and flower shape correlate significantly with plant habit, trees having sparser flowers generally with shorter flowering periods, less bright colours and non tubular flower shapes. A number of butterflies were observed to visit more (*Danaus chrysippus*, *Tirumala septentrionis*) or fewer flower (*Zizula hylax*) sources than expected and one plant (*Bauhinia purpurea*) had fewer visiting butterfly species than expected. The observations support the value of the university campus in providing valuable resources for butterflies.

Key words. India, Lepidoptera, Amravati University, resources, habitat, nectar plants, diversity, plant structure.

## Introduction

Amravati University Campus (area 190 ha) is situated at about 4 km north east of city Amravati (20°50'N 77°47'E) in the Pohara Forest Range (Maharashtra State of India). The east side of the campus is hilly and covered by the Pohara Malkhed Reserved Forest range. The campus, well known for its gardens, is occupied by tree plantations, ornamental plants in garden plots, a nursery and flowering plants around buildings; wild grasses and plants are spread over the campus. Many of the flowering plants are used by butterflies as nectar plants and support a rich diversity of butterflies. To determine the conservation value of the flowering plants for butterfly diversity a study has been carried out on nectar source visits by butterflies on the university campus based on previous checklists for both plants and butterflies (Palot 1998; Nair 2002). Earlier studies in the region have demonstrated the impact of larval host plants and nectar plants on the status of butterflies (Culin 2004; Solman Raju et al. 2004).
Within the region of Amravati, butterflies do not feed indiscriminately from any flower they find. They show preference for certain nectar flowers with specific chemical composition (Kunte 2000). But, very little information is available on feeding habits and food resources of adult butterflies compared to that of the larvae (Kunte 2000). The present study on the Amravati University Campus is a preliminary attempt to determine the link between characteristics of floral nectar plants and the butterflies using them as nutrient sources.

**Methods and Materials**

The findings presented here are based on a field survey and investigation carried out by the first author on a daily basis from July 2004 to January 2005 on the Amravati University Campus during the peak flowering period (tropical seasonal climate). Observations were made during a fixed daily transect carried out between 7.00 h to 10.00 h and 17.00 to 18.00 h outside teaching hours. Species were identified directly in the field or, in difficult cases, following capture or photography. Collecting was restricted to those specimens that could not be identified directly.

Butterflies were identified from Wynter-Blyth (1957), Gey et al. (1992) and Kunte (2000). Specific observations were made on each plant species visited by butterflies: plant habits, flowering period and floral characteristics such as colour and shape of corolla were examined. Specimens from the plant species visited by butterflies were photographed and/or collected and identified by the second author (VPD).

All scientific names follow Varshney (1983) and common English names are after Wynter Blyth (1957). Based on number of sightings butterfly species were categorized into very rare (< 2 sightings), rare (2–15 sightings), not rare (15–50 sightings), common (50–100 sightings) and very common (more than 100 sightings) and ranked from 1 (very rare) to 5 (very common). Availability of flowers (abundance of flowers) for flowering plants on the campus was placed into three categories, (1) sparse, (2) moderate and (3) dense, reflecting changes in abundance in orders of magnitude.

For analysis, plants were classed for habit, (tree, shrub, herb), corolla shape (tubular and non-tubular), flowering period (all year or restricted to less than half a year) and colour (white, pink, red, yellow, blue and purple with cream treated as white). Flower colour was also simplified into white/pink versus red/yellow/blue/purple. Number of flower visits by butterflies, number of flower categories visited by butterflies and number of butterfly species visiting flowers have been normalised ($sqrt_x$, $loge_x$); in all regression analyses the residuals have been tested for normality.

Four issues are investigated: (i) the relative dependence on nectar sources by butterflies, (ii) the range of nectar source use by butterflies; (iii) the size of the nectar feeding butterfly guild on flowering plants, and (iv) the influence of attributes of flowering plants (abundance, habit, colour, flowering period and corolla shape) on nectaring visits across species. For the second and third investigations, no assumption is made as to the form of the positive relationship between species making visits and visits observed beyond that it is linear following transformation for normality. This differs from the model used by Tudor et al. (2004) which assumes a strict logarithmic curve following Gleason's method of relating species number to area; although the transformations required supported a general fall off in species for increasing number of observations, this was not always found to follow a strict logarithmic model. In the second investigation, a butterfly species seen feeding frequently is likely to feed on more flower species than one seen rarely. Positive deviations from this pattern would indicate generalism, and negative deviations specialism in the feeding habits of the butterfly. In the third investigation, flower species more popular than expected will have more butterfly species feeding on them and those less popular than expected will receive fewer butterfly species than expected. The fourth investigation involves direct comparisons applying t tests and ANOVA and associations using Gamma, which accounts for tied values (Goodman & Kruskal 1972). All analyses have been carried out in STATISTICA (Statsoft 1999).

## Results

During the course of study 48 species of butterflies, belonging to 5 families, were recorded; five were new records for the university campus. These species were found utilizing the flower nectar of 19 plants species belonging to 12 families. Most butterflies recorded belong to the Nymphalidae (22 species) with two new records to the campus (i.e., *Tirumala septentrionis* (Dark blue tiger) and *Parantica aglea* (Glossy tiger)). Eleven Lycaenidae species were recorded with one new record (i.e. *Rapala larbus* (Indian red flash)). A further 10 Pieridae species were recorded with two new records (i.e., *Cepora nerissa* (Common gull) and *Pareronia valeria* (Common wanderer)). Only 1 species is recorded from the Hesperiidae and 4 species recorded from the Papilionidae. Among the 48 butterflies recorded three species come under the protection category of the Indian Wild Life (protection) Act 1972 (Kunte 2000). Among them *Hypolimnas misippus* came under schedule I of the act. The species recorded which come under schedule II of the wild life protection act 1972 are *Hypolimnas misippus, Pareronia valeria,* and *Lampides boeticus* (Gupta & Mondal 2005). The list of butterflies along with their common names, occurrence status, and nectar plants utilized by each butterfly species is provided in Tab. 1. The plant species utilized by each butterfly species along with habit, flowering period, colour, and corolla shape is given in Tab. 2. Each plant species included in the present study was utilized by more than one butterfly species.

**Observed versus expected nectaring events.** To determine whether species were observed visiting flowers as often as expected from their general abundance on the campus, the number of nectar visits by butterfly species has been regressed against their abundance coding. A significant correlation is found ($F_{1,46} = 34.18$, $R^2 = 42.6\%$, $P < 0.00001$, $N = 48$). Three distinctive outliers exist (>|2| standard errors): *Danaus genutia* and *Parantica aglea* were observed to be nectaring far more frequently than expected from their general abundance on the campus and *Melanitis leda* far less frequently from its observed abundance (Fig. 1).

**Range of nectar plants used by butterflies.** To determine the number of nectar plants used by butterflies, the number of flower groups has been regressed against number of observations (flower visits; Fig. 2). A significant relationship is found ($F_{1,46} = 51.19$, $P < 0.00001$, $R^2 = 52.7\%$, $N = 48$ butterfly species). Three outliers were found (>|2| standard errors); *Danaus chrysippus* and *Tirumala septentrionis* visit significantly more nectar sources than expected and *Zizula hylax* significantly fewer than expected. Other species also tend to have more (e.g., *Catopsilia pomona*, *Byblia ilithyia*) or fewer (e.g., *Zizeeria karsandra*, *Chilades laius*, *Catochrysops strabo*, *Lampides boeticus*) nectar visiting sources than expected.

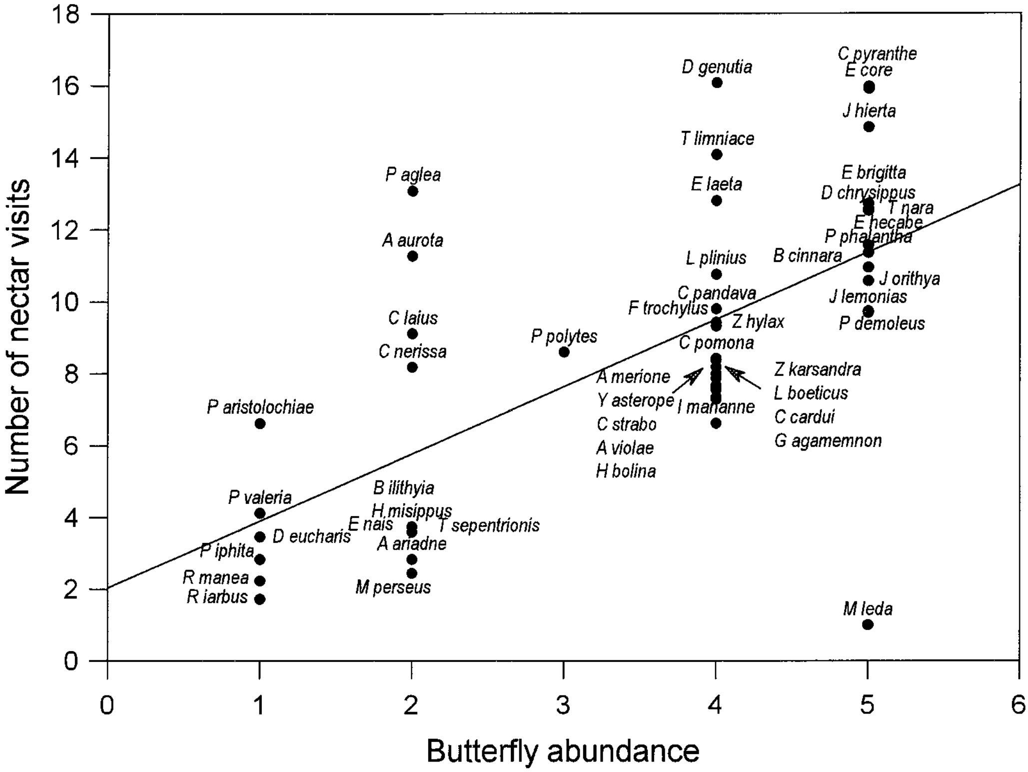


**Fig. 1.** Number of nectar visits by butterfly species in relation to butterfly abundance on the Amravati University campus. (nectar visits: square root transformed; butterfly abundance: 1 very rare (< 2 sightings), 2 rare (2–15 sightings), 3 Not rare (15–50 sightings), 4 common (50–100 sightings), 5 very common (> 100 sightings); for full names of butterfly species see Tab. 1).

**Number of butterfly species feeding on nectar sources.** To ascertain the size of the nectar feeding butterfly guild on flowering plants, the number of butterfly species has been regressed on number of observations (flower visits; Fig. 3). A significant relationship is found ($F_{1,17} = 79.74$, $P < 0.00001$, $R^2 = 82.4\%$, N = 19 plants). One outlier is found (>|2| standard errors), *Bauhinia purpurea*, which is visited by fewer butterfly species than expected. A number of other plants have more (e.g., *Jatropha gossypiifolia*, *Lantera camera*) or fewer (e.g., *Gaillardia* spp., *Tribulus terrestris*) butterfly species visiting them than expected.

**Factors influencing visits to flowers.** Visits to herbs and shrubs were more frequent than visits to flowering trees, but not significantly so ($F_{2,170} = 2.43$, P = 0.09). When shrubs and herbs are combined, this difference increases ($t_{171} = 1.85$, P = 0.07) and the ranked difference is significant (Mann-Whitney U, Z = 2.12, P = 0.03). Flowering period has a significant impact on visits for nectar ($t_{171} = 3.48$, P = 0.0006); plants flowering all year have more visits despite the fact that the survey was carried out for seven months. Flower shape also significantly influences visits for nectar ($t_{171} = 3.12$, P = 0.002); tubular shaped corollas have more visits than those that do not.

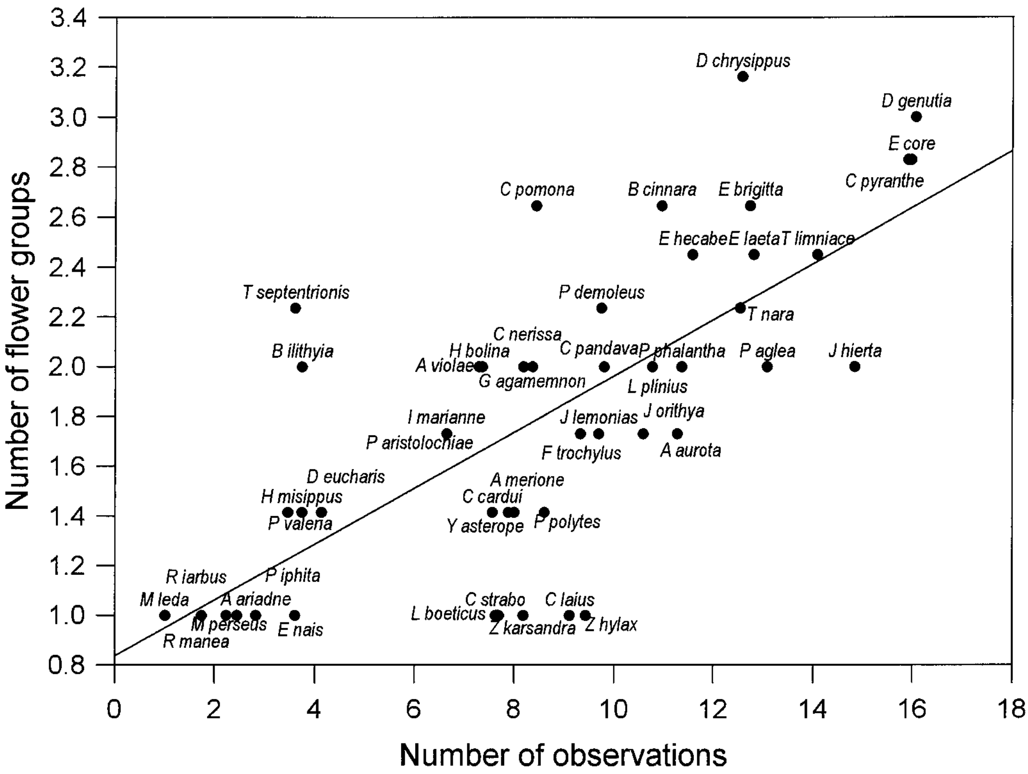


**Fig. 2.** Number of flower groups visited by butterflies in relation to the number of nectar visits observed (Both axes square root transformed; for full names of butterfly species see Tab. 1).

**Flower colour** has been tested individually, one flower colour at a time, as well as in a single test distinguishing white/pink flowers from others (red, yellow, blue and purple). White and pink flowers receive fewer visits than flowers of other colours, white flowers significantly so (white: t = 2.71, P = 0.007, pink: t = -1.16, P = 0.11, df = 171). Red, yellow and blue/purple flowers receive more visits than other colours, though not significantly for red flowers (red: t = -0.78, P = 0.44, yellow: t = -2.75, P = 0.007, blue/purple: t = -2.16, P =0.03; df = 171). When flowers are combined for colour, white/pink flowers receive significantly fewer visits than flowers of other colours (red/yellow/blue/purple) ($t_{171}$ = 3.89, P = 0.0001).

To determine the **main influences for across butterfly species visits to nectar sources**, number of visits (log transformed) have been regressed using forwards stepwise entry of variables against flower abundance (sparse, moderate, dense), habit (trees versus shrubs/herbs), flowering period (all year versus restricted period), flower shape (tubular/non-tubular) and flower colour (white/pink versus other colours). Three variables were found to significantly contribute to number of visits ($F_{3,169}$ = 14.52, $R^2$ = 20.5%, P < 0.00001, N = 173): flower abundance ($R^2$ = 12.9%), flower colour ($R^2$ = 4.1%) and

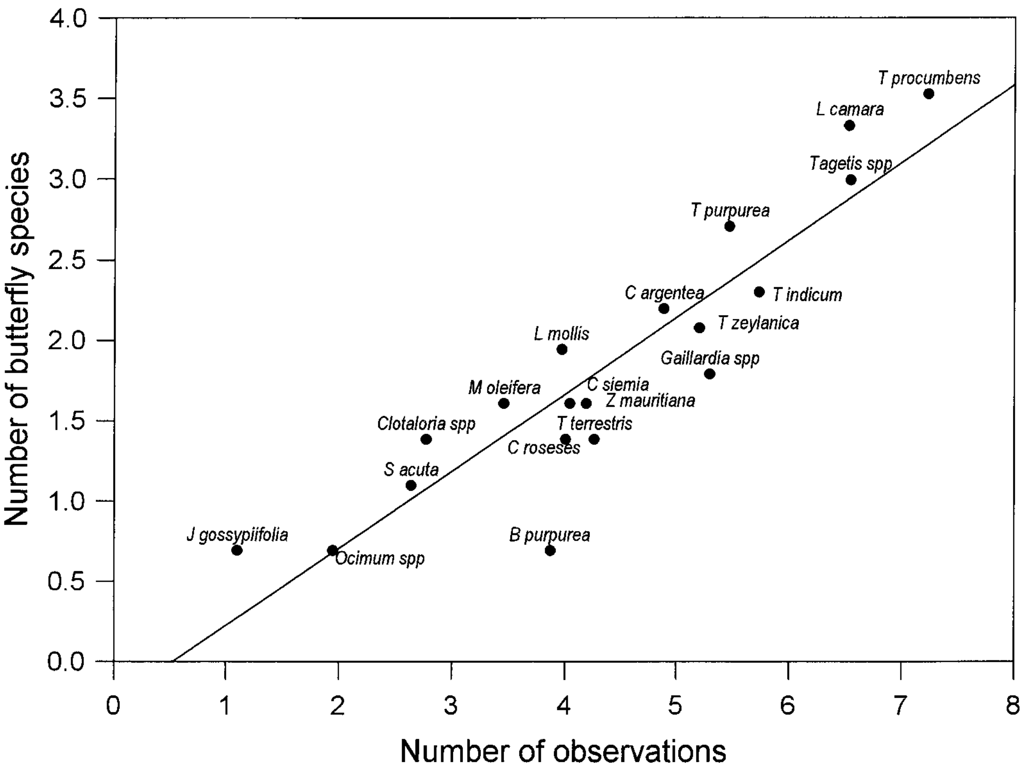


**Fig. 3.** Number of butterfly species visiting nectar flower groups in relation to the number of visits observed for each flower group. (Both axes log transformed; for full names of plant groups see Tab. 2).

flowering period ($R^2$ = 3.5%); beta coefficients for all three variables are significant at $P < 0.007$) though the overall explained variance is relatively low. However, habit is highly correlated with flower abundance (Gamma = -1.0), flowering period (Gamma = -0.94, $P < 0.0001$) and flower shape (Gamma = -0.82), and flower shape is highly correlated both with flowering period (Gamma = 0.92) and flower colour (Gamma = 0.95) ($P < 0.0001$ in both cases) (Tab. 3). Trees, which have significantly fewer nectar visits, also have a significantly sparser flowers, shorter flowering period, fewer tubular corollas and more typically have white/pink flowers rather than red, yellow or blue-purple.

## Discussion

Observations on nectar visits in butterflies on the Amravati University campus, in a tropical context, support four previous general findings on adult feeding in butterflies mainly from surveys of temperate butterflies (e.g., Faegri & van der Pijl 1979; Jennersten 1984; Porter et al. 1992; Corbet 2000; Tudor et al. 2004): (i) extensive variation in the range of dependency on nectar as a resource, (ii) varying degrees of generalism and

**Tab. 1.** Flower-visiting butterfly species of Amravati University Campus together with common name, status and nectar host plants. VC Very common (> 100 sightings), C Common (50–100 sightings), NR Not rare (15–50 sightings), R Rare (2–15 sightings), VR Very rare (< 2 sightings). For numbers in nectar host plant column, see Tab. 2.

| **Butterfly species** | **Common Name** | **Status** | **Nectar host plant** |
|---|---|---|---|
| Hesperiidae | | | |
| *Borbo cinnara* | Rice swift | VC | 4,5,6,7,16,18,19 |
| Papillionidae | | | |
| *Papilio polytes* | Common Mormon | NR | 2,18 |
| *Papilio demoleus* | Lime Butterfly | VC | 7,8,12,16,18 |
| *Pachliopta arstolochiae* | Common Rose | VR | 2,5,8 |
| *Graphium agamemnon* | Tailed Jay | C | 2,5,16,18 |
| Pieridae | | | |
| *Catopsilia pomona* | Lemon Emigrant | C | 2,3,5,7,12,15,18 |
| *Catopsilia pyranthe* | Mottled Emigrant | VC | 2,3,5,6,7,15,17,18 |
| *Eurema brigitta* | Small grass yellow | VC | 1,5,7,9,12,15,18 |
| *Eurema hecabe* | Common grass yellow | VC | 7,10,12,17,18,19, |
| *Eurema laeta* | Spotless grass yellow | C | 1,7,8,9,12,18 |
| *Delis eucharis* | Common Jezebel | VR | 12,18 |
| *Anaphaeis aurota* | Pioneer | R | 7,12,18 |
| *Ixias marianne* | White Orange Tip | C | 7,14,18 |
| *Cepora nerissa* | Common Gull | R | 5,7,12,18 |
| *Pareronia valeria* | Common Wanderer | VR | 5,11 |
| Lycaenidae | | | |
| *Zizula hylax* | Tiny Grass Blue | C | 7 |
| *Zizeeria karsandra* | Dark Grass Blue | C | 7 |
| *Freyeria trochylus* | Grass Jewel | C | 1,7,19 |
| *Lampides boeticus* | Pea Blue | C | 1 |
| *Chilades laius* | Lime Blue | R | 7 |
| *Leptotes plinius* | Zebra Blue | C | 1,7,17,18 |
| *Tarucus nara* | Rounded pierrot | VC | 6,7,12,17,18 |
| *Catochrysops strabo* | Forgot-me-not | C | 7 |
| *Chilades pandava* | Plains Cupid | C | 7,17,18,19 |
| *Rapala manea* | Slate Flash | VR | 5 |
| *Rapala iarbus* | Indian Red Flash | VR | 7 |
| Nymphalidae | | | |
| *Melanitis leda* | Common Evening Brown | VC | 7 |
| *Mycalesis perseus* | Common Bushbrown | R | 5 |
| *Ypthma asterope* | Common Three Ring | C | 5,7 |
| *Junonia hierta* | Yellow Pansy | VC | 7,8,12,18 |
| *Junonia lemonias* | Lemon Pansy | VC | 1,7,12 |
| *Junonia orithya* | Blue Pansy | VC | 7,8,18 |
| *Precis iphita* | Chocolate Pansy | VR | 12 |
| *Danaus chrysippus* | Plain Tiger | VC | 3,4,6,7,8,9,12,13,16,18 |
| *Danaus genutia* | Striped Tiger | C | 1,4,5,7,8,9,12,16,18 |
| *Tirumala limniace* | Blue Tiger | C | 5,7,8,9,13,18 |
| *Tirumala septentrionis* | Dark Blue Tiger | R | 5,7,9,13,18 |
| *Parantica aglea* | Glossy Tiger | R | 5,8,9,13 |
| *Phalanta phalantha* | Common Leopard | VC | 1,6,7,18 |
| *Euthalia nais* | Baronet | R | 7 |
| *Byblia ilithyia* | Joker | R | 5,7,14,18 |
| *Acraea violae* | Tawny Coster | C | 3,4,6,18 |
| *Ariadne merione* | Common Castor | C | 5,7 |
| *Ariadne ariadne* | Angled Castor | R | 5 |
| *Cynthia cardui* | Painted Lady | C | 7,18 |
| *Euploea core* | Common Indian Crow | VC | 4,5,6,7,8,9,11,18 |
| *Hypolimnas misippus* | Danaid Eggfly | R | 4,18 |
| *Hypolimnas bolina* | Great Eggfly | C | 1,5,10,12 |

**Tab. 2.** Nectar host plants and floral characteristics of butterfly species of Amravati University Campus. YL flowering all year: numbers indicate months of flowering; Corolla shape: T tubular, NT non-tubular; flower abundance: S sparse, M moderate, D dense.

| No | Plant species or group | Habit | Flowering period | Flower colour | Corolla shape | Flower abundance |
|---|---|---|---|---|---|---|
| | Amaranthaceae | | | | | |
| 1 | *Celosia argentea* | herb | YL | Pink/white | NT | M |
| 2 | *Cussia siemia* | tree | YL | yellow | T | S |
| | Apocynaceae | | | | | |
| 3 | *Catharanthus roseses* | shrub | YL | white | T | D |
| | Asteraceae | | | | | |
| 4 | *Gaillardia* spp. | shrub | YL | red | T | D |
| 5 | *Tagetis* spp. | shrub | YL | Red/yellow | T | D |
| 6 | *Lagasca mollis* | herb | 6–11 | white | T | D |
| 7 | *Tridax procumbens* | herb | YL | yellow | T | D |
| | Boraginaceae | | | | | |
| 8 | *Trichodesma indicum* | herb | YL | Blue/white | T | M |
| 9 | *Trichodesma zeylanica* | herb | YL | yellow | T | D |
| | Caesalpiniaceae | | | | | |
| 10 | *Bauhinia purpurea* | tree | 9–12 | purple | NT | S |
| | Euphorbiaceae | | | | | |
| 11 | *Jatropha gossypiifolia* | herb | 6–10 | red | NT | M |
| | Fabaceae | | | | | |
| 12 | *Tephrosea purpurea* | herb | YL | pink | NT | M |
| 13 | *Clotaloria* spp. | herb | YL | yellow | NT | M |
| | Lamiaceae | | | | | |
| 14 | *Ocimum* spp. | herb | 7–10 | White | T | D |
| | Malvaceae | | | | | |
| *15* | *Sida acuta* | herb | 7–11 | cream | T | D |
| | Moringaceae | | | | | |
| 16 | *Moringa oleifera* | tree | YL | white | T | S |
| | Rhamnaceae | | | | | |
| 17 | *Zizyphus mauritiana* | tree | 7–11 | cream | NT | S |
| | Verbenaceae | | | | | |
| 18 | *Lantana camara* | shrub | YL | yellow | T | D |
| | Zygophyllaceae | | | | | |
| 19 | *Tribulus terrestris* | herb | 6–10 | yellow | NT | M |

**Tab. 3.** Associations among nectar plant attributes and nectar visits (Gamma). Abundance: 1 sparse, 2 moderate, 3 dense; Habit: 1 herbs/shrubs, 2 trees; flowering period: 1 < half year, 2 all year; flower colour: 1 white/pink, 2 red/yellow, purple-blue; flower shape: 1 non tubular, 2 tubular. All coefficients are significant at $P < 0.0001$, except that between habit and flower colour with $P = 0.015$; $N = 173$.

| Variable | Visits | Flower abundance | Habit | Flowering period | Flower colour |
|---|---|---|---|---|---|
| Flower abundance | 0.50 | | | | |
| Habit | -0.66 | -1.0 | | | |
| Flowering Period | 0.69 | 0.83 | -0.94 | | |
| Flower Colour | 0.53 | 0.82 | -0.16 | 0.39 | |
| Flower shape | 0.49 | 0.96 | -0.82 | 0.92 | 0.95 |

specialism on flowering plants for nectar, (iii) the wide range in butterfly guilds on different nectar plants, and (iv) and the wide range of physical attributes used as cues for nectar quality or correlating with other (chemical) cues underlying nectar quality of flowering plants.

Butterflies differ in their dependency on nectar for somatic maintenance and reproductive potential (Gilbert 1981). In some species (e.g., *Euphydryas editha bayensis*) females emerge with a fixed number of oocytes in the ovaries, a relatively large proportion of which are chorionated and ready for deposition (Boggs & Nieminen 2004); other species (e.g., *Heliconius* spp.) display continual oogenesis and have no chorionated eggs on emergence (Gilbert 1973); the latter depend highly on adult acquired nutrition. Nutrition for egglaying may be obtained directly from adult feeding or from male reproductive investments as nuptial gifts (Boggs, 1995, Mevi-Schütz & Erhardt 2004). A relationship has previously been found between the abundance of butterflies and the diversity of nectar host plants utilized by them in India (Solman Raju 2004) as elsewhere (e.g., Feber et al. 1996, Swengel & Swengel 2001, Krauss et al. 2003). The current observations at the Amravati University campus suggest that some species (e.g., *Danaus genutia*, *Catopsilia pyranthe* and *Parantica aglea*) are greatly more dependent on nectar sources than other species (e.g., *Rapala iarbus*, *Ixias marianne*, *Mycalesis perseus* and *Melanitis leda*). The substantially fewer observations of nectar feeding in *Melanitis leda* than expected may largely owe to its crepuscular habit (Roberts 2001), but observations were carried out between 17.00 and 18.00h local time and cannot entirely explain the lack of nectar feeding in this butterfly and the closely related *Mycalesis perseus*. As grass feeders they may also be obtaining sustenance from other resources (e.g., ergot; Shreeve 1992) including rotting fruit or sap.

Butterflies have been found to differ in the range of available nectar sources used. In the parlance of host use, they are described as being generalists and specialists respectively. In a previous study in a temperate context, specialist nectar feeders were found to be species of conservation concern, having fewer broods, lower mobility and being associated with specific (taller) plant life forms; there was no relationship with wing size or proboscis length (Tudor et al. 2004). Linked with this it was also found that nectar plants have differently sized butterfly-feeding guilds on them. The present study confirms distinctions of nectar use generalism and specialism and range in guild size for plants, for a tropical context. In particular, *Danaus chrysippus* and *Tirumala septentrionis* use significantly more nectar sources than expected and *Zizula hylax* less sources than expected. Regarding butterfly nectar feeding guilds on plants, *Bauhinia purpurea*, despite being an attractive colour for butterflies, has a very limited guild of butterflies feeding on it. In a recent study of feeding by *Danaus genutia* on four nectar sources (*Crotalaria juncea*, *Nerium oleander*, *Barleria cristata* and *Bauhinia purpurea*) at the Kaziranga National Sanctuary, Assam, India, the fewest visits were also paid to *Bauhinia purpurea* (Bhuyan et al. 2005). The fact that it is a tree species with non-tubular flowers, and a flowering period restricted to a period between September and December, may form part of the reason, factors apparently not offset by flower colour. Unfortunately, biological data are unavailable for the Amravati species to determine underlying biological influences for these associations.

Nectar use has long been linked to flowering attributes, for instance, nectar concentrations (Watt et al. 1974, Pivnick & McNeil 1985), colour and pattern (Faegri & van der Pijl 1979, Jennersten 1984) and structure (e.g., corolla length) (Kingsolver & Daniel 1979) and butterfly morphology (e.g., proboscis length, wing loading) (Porter et al. 1992, Corbet 2000). Learned behaviour is also a feature of flower constancy (Goulson et al. 1997). The present study confirms the influence of flower colour and structure and adds plant habit (tree versus shrub/herb) and length of flowering time. A number of studies in temperate contexts have observed shifts in nectar flower use with emergence period and broods (Porter et al. 1992). In a tropical context flowering time is perhaps even more important than in a temperate context, as butterflies tend to be continuously brooded and require access to a continuous supply of flowering nectar-producing plants that may not be available. Shrubs and herbs provide this significantly more frequently than trees on the Amravati University campus.

The findings of the present study underline the importance of institutional estates, in this case a university campus, in providing resources for butterflies. Often, there are large open areas on college campuses and both ornamental and more functional areas can be diversified for the benefit of arthropods and other animals. Naturally, there has to be a balance between naturally grown, wild areas as well as mown grass areas. Increase in semi-natural vegetation has its dangers in a tropical context (e.g., poisonous snakes), particularly for staff and students on a university campus. There is considerable diversity of butterflies on the Amravati campus, to which five more species have been added; 32 species are common and a further 16 species relatively rare. The study not only confirms the importance of providing nectar resources for butterflies, but also reveals what kind and variety of resources are most appropriate for the butterfly fauna. Longer-lived trees provide fewer nectar resources than shorter-lived shrubs and herbs. The Botanical Garden, the University Garden and the University Dam at Amravati University are some of the rich butterfly areas on the campus and it follows that increasing these areas by planting additional nectar plants and increasing water resources would be valuable steps in the conservation of butterfly diversity on the campus. It is clear, from the specific associations of nectar visits to plants, that the obverse, a lack of flowering plants on the campus would have serious implications for the butterfly fauna and the maintenance of their populations.

Of course, this is but one aspect of resource use of butterflies on the university campus and a complete picture of habitat structure can only be obtained by research into all consumable and utility resources (Dennis et al. 2003). Butterfly populations would clearly benefit from planting indigenous, as opposed to exotic, nectar and larval host plants. In particular, attention should be paid to the seasonal availability of resources and to resources for less common butterflies on the campus. All in all, the campus provides rich ground not just for conservation but also for research into butterfly and arthropod biology for the students attending biology and ecology courses.

**Acknowledgements**

We are grateful to Prof. G. N. Vankhede, Head of the Department Zoology for providing facilities, J. S. Wadatkar for critical identification of rare butterflies and to Prof. Sarah Corbet and Prof. S.D.Bhusari for valuable suggestions. The first author is grateful to Dr. Sameer P. Narkhede for kind encouragement. Our grateful thanks to Martin Konvicka and an anonymous referee for their comments.

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