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Habitat and altitude preferences of butterflies in Aralam Wildlife Sanctuary, Kerala

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Butterflies are essential part of any natural ecosystem as their adults perform pollination and larvae enact as primary herbivores thereby transferring radiant energy trapped by plants to the next trophic level; rendering dual roles as pollinators and as energy transferors. The holometabolus life history of butterflies exposes them to a wide range of environmental influences. They are highly sensitive to changes in temperature, humidity and light; parameters that are easily influenced by habitat deterioration (Murphy *et al.* 1990). Therefore, butterflies are good indicator species to monitor ecological changes in a habitat.

Among insects, butterflies are the most studied group. Larsen (1987a,b,c, 1988) made a detailed survey of butterflies of Nilgiri mountains and recorded nearly 300 species including endemics. In Kerala, butterflies of Silent Valley National Park (Mathew & Rahamathulla 1993) and Parambikulam Wildlife Sanctuary (Sudeendrakumar *et al.* 2000) have been carried out. The present paper deals with the occurrence and diversity of butterfly populations in different altitude levels in a tropical rain forest ecosystem of Aralam Wildlife Sanctuary in Kerala, South India.

Aralam Wildlife Sanctuary (11°50′ - 11°52′ N and 75°57′ - 75°59′ E), the northern most conservation area in Kerala, has an area of 55 km^2. This Sanctuary lies in Aralam and Kottiyoor villages of Kannur District. The Brahmagiri Wildlife Sanctuary of Karnataka State, reserve forests of Wyanad and Central State Farm, Aralam adjoin the sanctuary on the northern, eastern and the western borders (Fig. 1). More than 90% of the sanctuary is mountainous, with altitude varying from 50 m at the foot hills to about 1145 m a.s.l.

Climatic conditions in Aralam are typical of south Indian forest areas. Temperature varies from 11° to 40°C. The hottest months are April and May. The period from December to February is comparatively cool. The maximum rainfall (south-west monsoon) is received during the months of June to August. Average annual rainfall is around 3,000 mm as recorded at the meteorological station of the Aralam State Farm.

The natural vegetation comprises of west coast tropical evergreen and semi-evergreen types. Evergreen forests are seen at the higher reaches of the sanctuary. *Palaquium ellipticum* Engl., *Mesua ferrea* L., *Machilus macrantha* Nees., *Calophyllum elatum* Bedd., *Artocarpus hirsuta* Lam. and *Dipterocarpus indicus* Bedd. are the major floral elements in this type. Common trees of semi-evergreen forest are *Xylia xylocarpa* Taub., *Vitex altissima* L., *Eugenia* sp. and *Terminalia* spp., though *Hopea parviflora* Bedd. and *Dipterocarpus indicus* Bedd. occur frequently. Monocultures of teak and *Eucalyptus* occur in 488.7 ha in this sanctuary.

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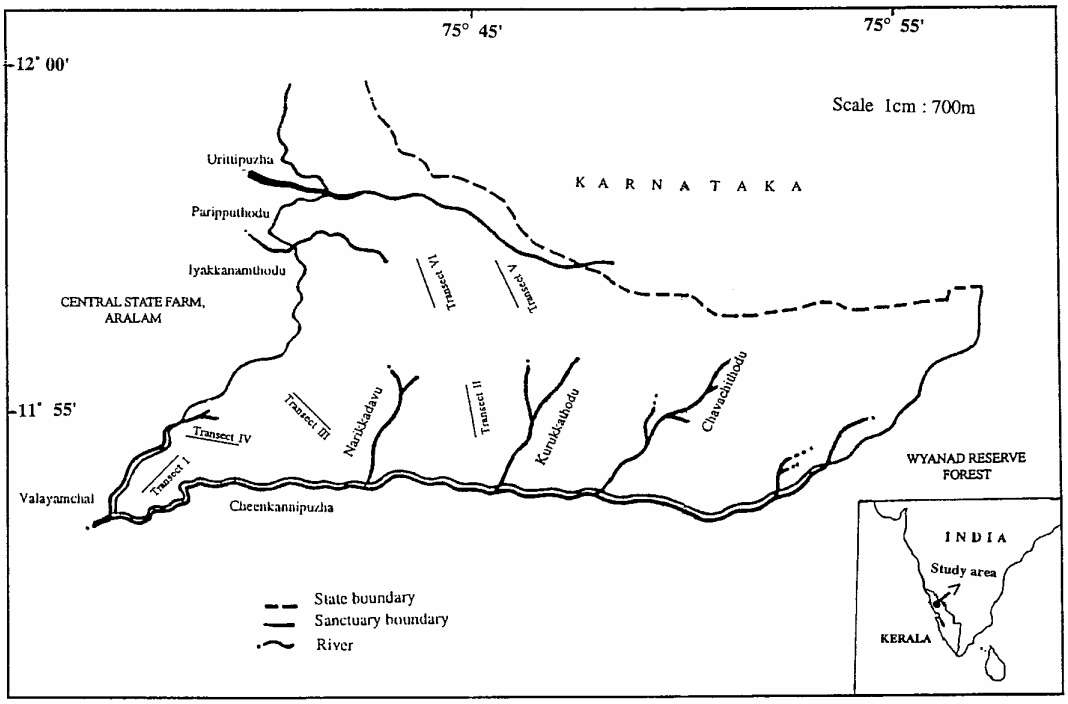

Fig. 1. Map of Aralam Wildlife Sanctuary showing transects of the present study.

Six transects, each of 600 m long and 10 m width marked at varying altitudes (see Fig. 1), viz. low elevation (<250 m), middle elevation (251-700 m) and high elevation (>700 m). There were two transects in each altitude zone. Observations were carried out in the morning between 08.00-11.00 h during August-December, 1995. Each transect was monitored 10 times. Butterflies observed in each habitat were individually recorded. Unfamiliar species were collected for identification. To find out habitat preferences, the nearby agricultural area owned by the Central State Farm was also monitored. Species observed outside the transects and forest edges were noted separately.

Butterflies observed along the transects alone were considered for statistical analyses. Data were analysed using a statistical package SYSTAT. Variation in abundance of butterflies in three altitude zones and differences in abundance among butterfly species irrespective of considering altitude were computed by ANOVA. For data analysis, number of transects selected in each altitude zone was considered as a replication. Species abundance (the ratio between total number of individuals of a species in all study plots and total number of sample units in which the species observed) was computed for each elevation gradient to find out the most dominant species in each zone and for the whole study area (Trivedy *et al.* 1987). Biodiversity index was computed using a statistical program SPDIVERSE. BAS.

Seventy one species of butterflies were recorded during the current investigation in Aralam Wildlife Sanctuary. Nearly 97% of them were representatives of the Oriental region while few species such as *Leptosia nina* and *Catopsilia* sp. were African forms. The family Nymphalidae had maximum number of species (Fig. 2).

Eight species such as *Papilio helenus, P. budha, Idea malabarica, Melanitis phedima, Mycalesis anaxias, Cyrestis thyodamas, Kallima, philarchus* and *Matapa aria* were habitat specific being restricted to evergreen forests and bamboo thickets only, while 24 species were seen in evergreen, semi-evergreen and in plantations. Nine species were located in evergreen and semi-evergreen forests, and the rest were in plantations and in open forests. Species such as *Idea malabarica, Papilio budha, Cyrestis thyodamas, Mycalesis anaxias* and *Kallima philarchus* were frequent in undisturbed evergreen forests. *Papilio*

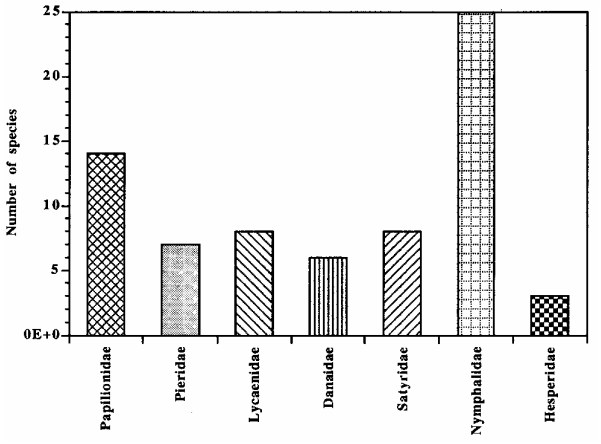

Fig. 2. Dominant butterfly families observed during the present study.

budha, and *Papilio helenus* were occasionally found in plantations and in open places.

Species such as *Eurema hecabe, Catopsilia* sp., *Pachliopta aristolochiae, P. hector, Precis iphita, Junonia atlites, J. orithyia, J. lemonias, Vanessa cardui, Polyura athamas, Euploea core, Acraea terpsicore* and *Celaenorrhinus ambareesa* were common either at the edges or in open plains showing the light loving proclivity.

Mud puddling was common during the sunny hours in post-monsoon months. Both mixed and occasionally single species assemblages were formed at wet soil patches. Several species such as *Graphium sarpedon, Eurema hecabe, Catopsilia* sp., *Polyura athamas, Pathysa antipathes, Euploea core, Caleta caleta* and *Graphium doson* were present in mixed puddling group. But on most of the occasions, the yellows (pierids) dominated the assemblages.

Nine endemics, namely *Troides minos, Pachliopta hector, Idea malabarica, Mycalesis patnia, Cirrochroa thais, Celaenorrhinus ambareesa, Papilio polymnestor, P. budha* and *Acraea terpsicore* were recorded from Aralam Wildlife Sanctuary.

Among the recorded butterflies, 21 species were common to all elevation gradients, 45 occurred only in low to medium altitude areas, three preferred medium and high elevations (*Hypolimnas bolina, Papilio helenus* and *P. budha*) and two (*Kallima philarchus* and *Cyrestis thyodamas*) preferred only high elevation areas. Significant difference was observed in abundance among butterfly species irrespective of transects ($F = 7.29$, $df = 54$, $P<0.001$). Similarly, the abundance of individual butterfly species between transects of different altitudes were significant ($F = 53.13$, $df = 2$, $P<0.001$). Again, the interaction between parameters such as altitude and number of species was also highly significant ($F = 2.42$, $df = 108$, $P<0.001$). Shannon index also vary between transects with maximum in the middle zone ($H' = 3.75$), followed by low zone ($H' = 3.62$) and minimum in high zone ($H' = 2.94$).

Among the identified butterflies, *Eurema hecabe* was the most abundant species in all the three altitude gradients with a cumulative index value of 5.5. Abundant species recorded at different elevation gradients are shown in Fig. 3.

Being one of the biodiversity hot spots, the Western Ghats harbour nearly 331 species of butterflies in its diverse habitats of varying climatic conditions. Larsen (1987a,b,c, 1988) reported 299 species of butterflies including several rare and endemics from the Nilgiri region. Mathew & Rahamathulla (1993) recorded the presence of 100 species of butterflies in Silent Valley National Park. Wynter-Blyth (1957) reported that March-April and October were the two peak seasons for Indian butterflies. Kunte (1997) reported that butterflies in all habitats showed a highly seasonal trend but, there was no evidence of peak in sum-

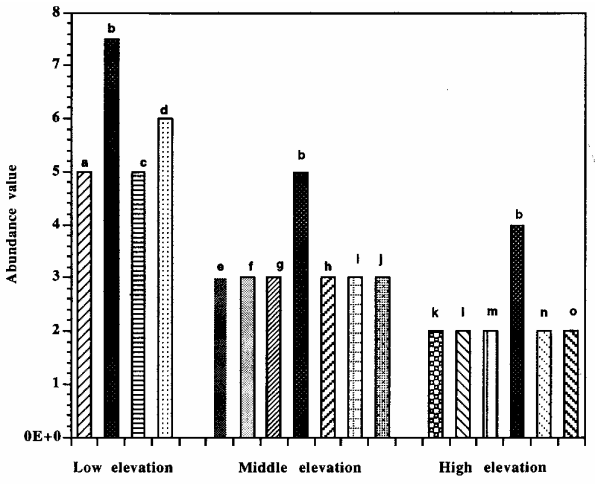

Fig. 3. Abundant butterflies in different elevation gradients. (a) *Troides minos;* (b) *Eurema hecabe*; (c) *Caleta caleta*; (d) *Jamides celeno*; (e) *Junonia orithyia*; (f) *Ypthima huebneri*; (g) *Euploea core*; (h) *Catopsilia* sp.; (i) *Papilio demoleus*; (j) *Pachliopta hector*; (k) *Graphium sarpedon*; (l) *Papilio polymnestor*; (m) *Leptosia nina*; (n) *Idea malabarica*; (o) *Kallima philarchus*.

mer in his study site in Pune, northern Western Ghats.

Habitat specificity of butterflies can be directly related to the availability of food plants (Thomas 1995). Each habitat has a specific set of micro environment suitable for a species. For example, species such as *Idea malabarica* and *Papilio budha* were observed only in evergreen forests. However, about 34% of the species recorded during the present study were not habitat specific. Such general occurrence would help them to have a wider distribution and to maintain larger population size. Nymphalidae was the dominant family in the present study area. This is one of the largest families of butterflies in Silent Valley National Park (Mathew & Rahamathulla 1993) and in Parambikulam Wildlife Sanctuary (Sudheendrakumar *et al.* 2000). Many members of this family are polyphagous which would help them to live in all habitats and in different elevation gradients.

Maximum number of species was observed at low and middle elevations as reported earlier (Larsen 1988; Sparrow *et al.* 1994). However, the low diversity levels observed at the low elevation when compared to the mid elevation ranges may be due to cattle grazing, fuel wood collection and related man-made activities which affect larval food plants. It is also evident that most of the low and middle zone dwelling species prefer light gaps in forests or edges. Species observed at high elevation (>700 m) alone are seen in undisturbed evergreen forests.

The Western Ghats area is unique in endemism. Nine endemic species of butterflies were recorded during this investigation which is less compared to Parambikulam Wildlife Sanctuary (23 species) (Sudheendrakumar *et al.* 2000), and Silent Valley National Park (13 species) (Mathew & Rahamathulla 1993). Holloway (1974) pointed out that most of the endemic species of this region have diverged from the Oriental stock in ecological isolation. He added that several species colonized in South India were species of South East Asian countries but few species such as *Leptosia nina* and *Eurema hecabe* were derived from African savannas. The Oriental species in South India contain a high proportion of widespread species of dry and low land and associated plains.

Mud puddling behaviour is common in some tropical butterflies (Beck *et al.* 1999). In summer, several species of pierids were seen mud puddling on soggy places. This is a mechanism which help them to fulfill their salt and protein deficiency (Beck *et al.* 1999).

Like amphibians, butterflies are also sensitive to changes in their environment and hence regarded as ecological indicators (Kremen 1992). Species such as *Idea malabarica, Papilio budha, Melanitis leda* and *Mycalesis anaxias* choose habitats with least disturbances. As reported by Sparrow *et al.* (1994), individual butterfly species might not be adequate ecological indicators by themselves, but together the selected butterfly species may constitute an indicator group for assessing habitat quality and changes affecting the local diurnal Lepidoptera. The polyphagous nature of *Eurema hecabe* may be responsible for their abundance in the present study area. This would help them to multiply in large numbers.

Acknowledgements

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