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REFERENCES

- MEGANATHAN, P. & B.V. DAVID (1994): Aleyrodidae fauna (Aleyrodidae: Homoptera) of Silent valley, a tropical evergreen rain-forest, in Kerala, India. *FIPPAT Entomological Series* 5: 1-66.
- REGU, K. & B.V. DAVID (1991): Two new species of *Asialeyrodes* Corbett (Aleyrodidae: Homoptera) from India. *J. Bombay Nat. Hist. Soc.* 88: 256-258.
- REGU, K. & B.V. DAVID (1993): *Asialeyrodes saklespurensis* sp. nov. (Aleyrodidae: Homoptera) from India. *Entomon* 18: 91-93.
- SUNDARARAJ, R. & B.V. DAVID (1991): On the genera *Asialeyrodes* Corbett and *Cockerelliella* n. gen. from India. *J. Bombay Nat. Hist. Soc.* 88: 415-424.

26. ADDITIONS TO KNOWN LARVAL HOST PLANTS OF INDIAN BUTTERFLIES¹

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Larval host plants of butterflies of the Western Ghats are well documented as compared to butterflies in other regions of India. This is due mainly to the efforts of T.R. Bell, J. Davidson, E.H. Aitken and other pioneer butterfly workers in India. However, their studies were concentrated more or less around Karwar (northwestern Karnataka, central Western Ghats) and the Nilgiri Mountains. Hence, host plant reports from other parts of the Western Ghats are either scanty or completely lacking. Earlier major records of use of larval host plants can be found in older original publications (Bell 1910-1927) or compilations (Pant and Chatterjee 1949; Wynter-Blyth 1957; Sevastopulo 1973). Some more recent but scattered records or incomplete species lists may be found in Gay *et al.* (1992), Haribal (1992) and Kunte (2000).

In this note I report previously unrecorded and site-specific host plants of 36 butterfly species from mainly three areas of the Western Ghats and adjoining localities: i) Pune city (western Maharashtra, northern Western Ghats), ii) Indian Institute of Science campus (Karnataka, Bangalore), and iii) Karian Shola and Varagaliar Shola in the Anamalai Hills (Tamil Nadu, southern Western Ghats). This includes 26 additions to the known 420 larval host plants of the Western Ghats butterflies. Larval host plants of two species, *Quedara basiflava* (Kunte, in press) and *Plastingia sala* (in prep.), whose early stages have not yet been reported are also presented.

In India, site-specific records of larval host plants are rare, as patterns in local host plant use have not been studied. Differences in host plant use in different areas can be due to individual- or population-based patterns in egg-laying preferences, which can be very complex and may lead to interesting ecological and evolutionary questions (e.g. see

work on *Euphydryas editha* butterflies, reviewed in Singer 1971). Secondly, species endemic to the Western Ghats, which have been considered monophagous, may actually be regionally oligophagous, as shown by discoveries of second host plants for *Papilio dravidarum* (see below) and *Idea malabarica* (Susanth 2005). Such observations lead to better understanding of regional patterns in host plant use. All the host plants reported here are based on successful rearing of caterpillars, not on mere observation of egg laying on those plants. Scientific names and authors of the larval host plant species were taken from floras (Cooke 1967; Saldanha and Nicolson 1976; Shetty and Pandey 1983; Chandrabose and Nair 1987; Vajravelu 1990; Deshpande *et al.* 1993; Sharma *et al.* 1993; Sasidharan 1997; Sivarajan and Mathew 1997).

Family Papilionidae

1. *Graphium sarpedon* (Linnaeus): *Cinnamomum malabattrum* Burm., Lauraceae. Small tree at a streamside in tall evergreen forest, Karian Shola, Top Slip, Anamalais. January 2000.

2. *Graphium agamemnon* (Linnaeus): *Goniothalamus cardiopetalus* (Dalz.) Hook f. & Thomson, and *Mitrephora heyneana* (Hook f. and Thomson) Thwaites, Annonaceae. Medium-sized trees in tall evergreen forest, Karian Shola. February 1999 and January 2000.

3. *Papilio helenus* Linnaeus: *Clausena heptaphylla* (Roxb.) Wt.&Arn., Rutaceae. Large shrub in tall evergreen forest, Karian Shola. January 2000.

4. *Papilio dravidarum* Wood-Mason: *Clausena heptaphylla* (Roxb.) Wt.&Arn., Rutaceae. Large shrub in tall evergreen forest, Karian Shola. October 2001. This butterfly was believed to be monophagous on *Glycosmis arborea*

(Roxb.) DC, on which I had previously reared a caterpillar in Karian Shola in December 1999. In 2001, I observed a female lay two eggs on *Clausena* and also found two caterpillars on the same plant. Later all these caterpillars fed on *Glycosmis*, but showed a marked preference for *Clausena*.

5. *Papilio polytes* Linnaeus: *Atalantia racemosa* Wt.&Arn., Rutaceae. Small tree in evergreen forest, Bhimashankar Wildlife Sanctuary (northern Western Ghats). December 1993.

6. *Papilio polymnestor* Cramer: *Atalantia racemosa* Wt.&Arn., and *Atalantia wightii* Tanaka, Rutaceae. Small trees in evergreen thickets at the edge of tall evergreen forest, Bhimashankar. December 1993, and Karian Shola. March 1999, respectively.

Family Pieridae

1. *Catopsilia pyranthe* (Linnaeus): *Gnidia glauca* (Fresen.) Gilg, Thymeleaceae. Large shrub in disturbed areas, Bhimashankar. December 1993.

2. *Eurema blanda* (Boisduval): *Cassia fistula* L. Small deciduous tree at the edge of Karian Shola. May 1999. *Caesalpinia mimosoides* Lam., straggling shrub in tree-fall gaps in tall evergreen forest, Karian Shola. January 2000. *Bauhinia purpurea* Lam.: small evergreen avenue tree. I.I.Sc. campus. March 2000. All plants of Family Caesalpiniaceae.

3. *Anaphaeis aurata* (Fabricius): *Capparis zeylanica* L., Capparaceae. Straggling shrub in scrub forest, Pachgaon Parvati, Pune. April 1993 through 1997.

4. *Leptosia nina* (Fabricius): *Capparis zeylanica* L., Capparaceae. I.I.Sc. campus, Bangalore. April 2000.

5. *Cepora nerissa* (Fabricius): *Capparis zeylanica* L., Capparaceae. Pune. 1992-94. *C. zeylanica* is already reported for this butterfly, as are several other *Capparis* spp. However, in Pune this species feeds exclusively on *C. zeylanica* although *C. grandis* L.f. and other *Capparis* spp. are commonly available.

6. *Appias indra* (Moore): *Drypetes oblongifolia* (Bedd.) Airy Shaw, Euphorbiaceae. Small tree in tall evergreen forest, Varagaliar Shola, Anamalais. January 2000. Earlier I had reported *Putranjiva roxburghii* Wall. for this butterfly from Pune (Kunte 1998), which is a synonym of *Drypetes roxburghii* (Wall.) Hurusava. This butterfly occurs in Bhimashankar and since its caterpillars feed on *Drypetes* spp., it probably feeds on *D. venusta* (Wt.) Pax. & Hoffm., which is the only species present at Bhimashankar.

7. *Appias albina* (Boisduval): *Drypetes oblongifolia* (Bedd.) Airy Shaw, Euphorbiaceae. Small tree in tall evergreen forest, Varagaliar Shola. January 2000. I found both *Appias indra* and *A. albina* caterpillars simultaneously on the same individual plant. Also, *Drypetes roxburghii* (Wall.) Hurusava,

a small, evergreen tree growing along moist stream banks in mixed deciduous forest, Yeoor, Thane, close to Mumbai. February 2000. As in *A. indra*, *A. albina* should be feeding on *D. venusta* (Wt.) Pax. & Hoffm. at Bhimashankar, as also reported by Bell from Karwar.

8. *Ixias marianne* (Cramer): *Capparis grandis* L.f., Capparaceae. Small tree in scrub forest, Law College Hill, Pune. 1992-94. The caterpillars refused to feed on *C. zeylanica* or other *Capparis* spp. present in this area.

9. *Pareronia valeria* (Cramer): *Capparis zeylanica* L., Capparaceae. Pune. Monsoon, 1992-99. The caterpillars do not accept any other *Capparis* as host plants in this area.

Family Nymphalidae

1. *Melanitis leda* (Linnaeus): *Oplismenus compositus* L., Poaceae. Short grass on open stream banks in tall evergreen forest, Karian Shola. February 1999.

2. *Melanitis phedima* (Stoll): *Ischaemum semisagittatum* Roxb. Poaceae. Small grass on open slopes near semi-evergreen forest. Castle Rock, Goa-Karnataka border. September 1999. The caterpillars subsequently fed in Bangalore on the following grass genera: *Andropogon*, *Apluda*, *Cymbopogon*, *Digitaria*, *Eragrostis*, *Pennisetum*, *Setaria* and also on the bamboo *Bambusa arundinacea* (Retz.) Roxb.; *Oplismenus compositus* L., in Karian Shola. January 2000.

3. *Melanitis zitenius* (Herbst): *Ochlandra* sp. Reeds along stream banks in Karian Shola. September 1999. Later, in Bangalore the caterpillars fed on *Bambusa arundinacea* (Retz.) Roxb. Both host plants belong to Poaceae. In October 2001, at Kozhikamudi in Anamalais, I saw a female lay two egg-clutches on an unidentified bamboo.

4. *Elymnias hypermnestra* (Linnaeus): Several palms (Family Arecaceae) are reported earlier. Here are some site-specific observations: *Calamus pseudo-tenuis* Beccari ex Beccari and Hook, *C. rotang* Beccari ex Beccari and Hook, and *C. thwaitesii* Beccari ex Beccari and Hook. Climbing palms in tall evergreen forest, Karian Shola. November 1998 to May 1999. *Phoenix loureirii* Kunth: dwarf palm in savannahs, Pandarvarai, Top Slip, Anamalais. December 1999. *Licuala chinensis*: ornamental palm, I.I.Sc. campus, Bangalore. Throughout 1999.

5. *Hypolimnas misippus* (Linnaeus): *Asystasia lawiana* Dalz., Acanthaceae. Small shrub in open spaces. Pune. August 1993.

6. *Hypolimnas bolina* (Linnaeus): *Sida rhombifolia* L., Malvaceae. Small herb in open spaces. Pune. October 1993.

7. *Phalanta phalantha* (Drury): *Xylosma longifolium* Clos, Flacourtiaceae. Small tree along water courses and in secondary thickets, Dehradun, north India. November 1998. Distribution of the plant extends to the Eastern Ghats and the

Nilgiris, and given the polyphagous nature of this butterfly, it probably feeds on *Xylosma* throughout its range. In Bangalore, the species feeds on both *Flacourtia indica* (Burm. f.) Merr. and *Salix* sp. (Family Salicaceae).

8. *Charaxes bernardus* (Kollar): *Aglaia lawii* (Wight) Sald. ex Rahmam., Meliaceae. Large tree in evergreen forest, Bhimashankar. January 2002.

Family Lycaenidae

1. *Abisara echerius* (Stoll): *Maesa indica* (Roxb.) DC., Myrcinaceae. Large shrub on the edge of tall evergreen forest, Karian Shola. March 1999.

2. *Leptotes plinius* (Fabricius): *Dyerophytum indicum* (Gibs. ex. Wight) Kuntze, Plumbaginaceae. Small shrub in dry deciduous forest, Pandupol, Sariska National Park. October 1997. The plant also occurs close to northern Western Ghats, where the larvae could be using it.

3. *Lampides boeticus* (Linnaeus): *Crotalaria pallida* Aiton, Fabaceae. Large herb in open spaces, I.I.Sc. campus. December 1999-January 2000.

4. *Zizula hylax* (Fabricius): *Hygrophila auriculata* (Schum.) Heine, Acanthaceae. Tall herb in marshes. Pune and I.I.Sc. campus. Used throughout the year except during the monsoon (June-September) when the plants may be partly submerged. Also *Phaulopsis dorsiflora* (Retz.) Sant., Acanthaceae: Small herb in mixed deciduous forest, Tiger Crossing Road, Top Slip, Anamalais. February 1999.

5. *Chilades laius* (Stoll): *Glycosmis arborea* (Roxb.) DC, Rutaceae. Large shrub in semi-evergreen forest, Castle Rock, northern Karnataka. August 2000.

6. *Freyeria trochylus* (Freyer): *Goniogyna hirta* (Willd.) Ali, Fabaceae. Small, prostrate herb in heavily grazed grassland. Malwadi, Pune. January 1993.

7. *Jamides bochus* (Cramer): *Millettia peguensis* Gillett, Fabaceae. Small avenue tree in I.I.Sc. campus. January-February 2000.

8. *Jamides celeno* (Cramer): *Atylosia albicans* (Wt.&Arn.) Benth., Fabaceae. Twiner on the edge of Karian Shola. January 2000.

Family HesperIIDae

1. *Celaenorrhinus leucocera* (Kollar): *Asystasia gangetica* (L.) T. And. Small, gregarious shrub in tall evergreen forest, Karian and Varagaliar Sholas. September 1999. *Nilgirianthus heyneanus* (Nees) Bremek., small gregarious shrub in semi-evergreen forest, Kudremukh National Park.

April 2000. *Nilgirianthus barbatus* (Nees) Bremek., large, often gregarious shrub on the rocky slope beside a perennial stream in semi-evergreen forest, Herinje stream, Kudremukh National Park. May 2000. *Carvia callosa* (Wall.) Bremek. and *Thelepaepale ixiocephala* (Benth.) Bremek., large gregarious shrubs on the edge of semi-evergreen and evergreen forests, Bhimashankar and Castle Rock. September 1999 and March 2000. All plants belong to Acanthaceae.

2. *Notocrypta curvifascia* (C & R Felder): *Costus speciosus* (Koen.) Smith, and *Hedychium* sp. Zingiberaceae. Tall herbs on stream banks in evergreen and semi-evergreen forests, Varagaliar Shola and Cheechalai, Anamalais. December 1998 to February 1999.

3. *Quedara basiflava* de Niceville: *Calamus pseudo-tenuis* Beccari ex Beccari & Hook, *Calamus rotang* Beccari ex Beccari & Hook, and *Calamus thwaitesii* Beccari ex Beccari & Hook, Arecaceae. Climbing palms in evergreen forests, Anamalais. Throughout 1999 and 2000.

4. *Plastingia sala* Hewitson: *Calamus pseudo-tenuis* Beccari ex Beccari & Hook, *Calamus rotang* Beccari ex Beccari & Hook, and *Calamus thwaitesii* Beccari ex Beccari & Hook, Arecaceae. Varagaliar Shola, Anamalais. January 2000.

5. *Gangara thyraxis* Fabricius: This is a highly polyphagous species. However, earlier reports mention the hosts merely as 'palms' (Arecaceae). Here I report some site-specific hosts: *Calamus pseudo-tenuis* Beccari ex Beccari & Hook, *Calamus rotang* Beccari ex Beccari & Hook, and *Calamus thwaitesii* Beccari ex Beccari & Hook, all from Karian Shola. *Phoenix loureirii* Kunth, dwarf palm in savannahs, Pandarvarai. *Cocos nucifera* L., planted in Erumapparai settlement, Top Slip, Anamalais. The above observations were made between November, 1998 and April, 1999. Throughout 1999 and most of 2000, I saw the caterpillars on the palms *Licuala chinensis* and *Phoenix humilis* Royle, at the I.I.Sc. campus. So far, I have seen neither caterpillars nor their bite-marks on *Caryota urens* L. on the campus. Therefore, this palm is probably not used as a larval host in Bangalore, although it is reportedly utilized elsewhere.

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REFERENCES

- BELL, T.R. (1910-1927): The common butterflies of the plains of India (including those met with in the hill stations of the Bombay Presidency). *J. Bombay Nat. Hist. Soc.* 19(1)-31(4).
 CHANDRABOSE, M. & N.C. NAIR (1987): Flora of Coimbatore. Bishan

- Singh Mahendra Pal Singh, New Delhi. 398 pp.
- COOKE, T. (1967): The Flora of the Presidency of Bombay. Botanical Survey of India. 2 vols., 1083 pp.
- GAY, T., I. KEHIMKAR & J.C. PUNETHA (1992): Common Butterflies of India. World Wide Fund for Nature-India. Oxford University Press. 67 pp.
- DESHPANDE, S., B.D. SHARMA & M.P. NAYAR (1993): Flora of Mahabaleshwar and adjoining, Maharashtra. Botanical Survey of India. 431 pp.
- HARIBAL, M. (1992): The Butterflies of Sikkim Himalaya and their Natural History. Sikkim Nature Conservation Foundation, Gangtok, Sikkim. 217 pp.
- KUNTE, K. (1998): The Plain Puffin (*Appias indra* Swinhoe): behaviour, life-history and distribution. *J. Bombay Nat. Hist. Soc.* 95: 137-139.
- KUNTE, K. (2000): Butterflies of Peninsular India (India: A Lifescape, Fascicle 1). Universities Press (Hyderabad) and Indian Academy of Sciences (Bangalore). 254 pp.
- KUNTE, K. (IN PRESS): Natural history and early stages of the Western Ghats endemic butterfly Golden Flitter *Quedara basiflava* (Hesperiidae, Lepidoptera) from southwestern India. *J. Bombay Nat. Hist. Soc.*
- PANT, G.D. & N.C. CHATTERJEE (1949): A list of described immature stages of Indian Lepidoptera, Part I: Rhopalocera. *Indian Forest Records (New Series): Entomology* 7: 213-255.
- SALDANHA, C.J. & D.H. NICOLSON (EDS) (1976): Flora of Hassan District, Karnataka, India. Amerind Publ. Co. Pvt. Ltd. 915 pp.
- SASIDHARAN, N. (1997): Forest Trees of Kerala: A Checklist including Exotics. KFRI, Peechi. 153 pp.
- SEVASTOPULO, D.G. (1973): The food-plants of Indian Rhopalocera. *J. Bombay Nat. Hist. Soc.* 70(1): 156-183.
- SHARMA, B.D., N.P. BALAKRISHNAN, R.R. RAO & P.K. HAJRA (EDS) (1993): Flora of India. Vol. 1-3. Botanical Survey of India.
- SHETTY, B.V. & R.P. PANDEY (1983): Flora of Tonk District, Rajasthan. Botanical Survey of India. 253 pp.
- SINGER, M.C. (1971): Evolution of food-plant preference in the butterfly *Euphydryas editha*. *Evolution* 25: 383-389.
- SIVARAJAN, V.V. & P. MATHEW (1997): Flora of Nilambur (Western Ghats, Kerala). Bishan Singh Mahendra Pal Singh. 900 pp.
- SUSANTH, C. (2005): *Parsonia spiralis*: New larval host plant of endemic butterfly Malabar Tree Nymph, *Idea malabarica* Moore (Danainae, Nymphalidae). *J. Bombay Nat. Hist. Soc.* 102(3): 354-355.
- VAIRAVELU, E. (1990): Flora of Palghat District. Botanical Survey of India. 646 pp.
- WYNTER-BLYTH, M.A. (1957): Butterflies of the Indian Region. Bombay Natural History Society, Mumbai. 523 pp.

27. NEW RECORDS OF MARINE MOLLUSCS FROM THE NORTHEAST COAST OF INDIA, BAY OF BENGAL¹

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Studies on molluscs in India and throughout the world are hindered by lack of up-to-date systematics and faunal lists. For the Indian subcontinent, however, contributions from the Zoological Survey of India are of utmost value from the extent of coverage made and species enlisted (Annandale 1922, 1924; Annandale and Kemp 1916; Annandale and Prasad 1919; Ray 1949; Rajagopal and Mookherjee 1978, 1982; Mookherjee 1985; Subba Rao *et al.* 1991, 1992, 1995; Subba Rao and Surya Rao 1993; Surya Rao and Subba Rao 1991; Surya Rao and Maitra 1998; Subba Rao and Dey 2000; Mohapatra 2001; Ramakrishna and Dey 2003; Subba Rao 2003). Nevertheless, in several cases the descriptions are based on empty shells obtained from old collections. There is a need, therefore, to focus on observations based on live material collected in recent years.

As a part of benthos productivity investigation for the northeast Indian shelf (1998-2002), a number of samples were collected that formed the chief source of material for this study. In addition, many short cruises were conducted off Visakhapatnam to study the littoral benthos. The main objective of this paper is to list 40 species of molluscs represented by 24 gastropods and 16 bivalves as new records

for the northeastern Indian coast, including the shelf sediments up to 200 m.

The study area (Fig. 1) includes five locations off the northeast coast of India at 1° intervals from Divi Point (16° 00' 50" N, 81° 09' 30" E) in the south to Paradeep

Table 1: Hydrographical conditions off northeast coast of India (January 1999 and July 2000)

Depth (m)	Salinity (%)	Dissolved Oxygen (ml/l)
30-50 (n=32)	28.75-34.23 (31.79 ± 0.23)	1.270-4.404 (2.847 ± 0.15)
51-75 (n=4)	29.17-33.61 (32.06 ± 1.02)	2.340-3.983 (2.935 ± 0.36)
76-100 (n=12)	30.31-35.19 (33.27 ± 0.37)	0.803-4.371 (2.303 ± 0.30)
101-150 (n=8)	32.97-34.84 (34.36 ± 0.23)	-0.01-3.848 (1.214 ± 0.49)
>150 (n=14)	32.27-34.86 (34.44 ± 0.29)	-0.03-1.557 (0.561 ± 0.15)

Mean ± standard error are in parenthesis;
n - sample size