

Carabids (Coleoptera : Carabidae) as Potential Predators on Major Crop Pests in South India

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ABSTRACT

Field investigations in south India revealed the occurrence of six species of carabids viz., *Omphra pilosa* Klug and *Oxylobus dekkanus* Andrewes on termites, *Calosoma maderae* Fabricius on maize cutworm, *Chlaenius panagaeoides* Laferte on cowpea aphids, *Casnoidea indica* Thunberg on paddy brown plant hopper and an arboreal predator, *Parena nigrolineata* Chaudoir on coconut black headed caterpillar as potential predators. Their morphological characters, seasonal activity, distribution, feeding potential and longevity were studied.

KEY WORDS : Carabid predators, termites, distribution, caterpillars

Carabids are known to prey upon caterpillars, pupae, grubs, aphids, termites etc. They are found in almost all habitats like agricultural fields, orchards, plantations, forest etc. Many species of carabids were recorded earlier as predators of crop pests. In India, *Calosoma maderae* Fabricius, *Cal-leida splendidula* Fabricius, *Parena nigrolineata* Chaudoir, *Casnoidea indica* (Thunberg) and *Omphra pilosa* Klug were reported attacking crop pests (Fletcher, 1919; Ramachandra Rao, 1924; Samal and Mishra, 1978; Rajagopal, 1984). *Calosoma sycophanta* L. was imported in large numbers from Europe into Northern America for the control of gypsy moth *Lymantria dispar* L. on forest trees (Burgess, 1911). Carabids are commonly associated with several crop pests under field conditions but information on their distribution, seasonal abundance and feeding potential is lacking. Therefore, the present study has been focussed to understand their association with crop pests and their role as potential predators under south Indian conditions.

MATERIALS AND METHODS

Observations were made in the different agroclimatic regions of South India during

1987-90 for the occurrence and distribution of various species of carabid beetles in various crop fields. The seasonal activity of a few species was studied at G.K.V.K. campus of the University of Agricultural Sciences, Bangalore, at fortnightly intervals. The seasonal activity was correlated with maximum and minimum temperature, total rainfall and relative humidity. The feeding potential of the carabids was studied under laboratory conditions by providing daily, known number of prey and recording the consumption rate of each beetle. The prey preference was studied by providing different preys and also morphs based on the predator and prey association under field conditions. Observations were also made on their daily rhythmic activity, burrowing behaviour, adult longevity, larval habits etc both in the field and laboratory. The size of each species was measured by using a (Wild) stereoscopic microscope attached with camera lucida and ocular micrometer.

RESULTS AND DISCUSSION

The study revealed six carabid species as potential predators of different crop pests. The morphological descriptions and

predatory behaviour of each species is presented in Table 1.

1. *Calosoma maderae* Fabricius var. *indicum* Hope

This species was found distributed in Karnataka (Bangalore, Dharwad, Mysore and Raichur) and Andhra Pradesh (Tirupati and Bapatla), where maize crop is being predominantly grown. The grubs and adults were found to be active during July to November. These are nocturnal in their activity and make burrows in the soil to hide during daytime.

Adults are medium sized, black coloured beetle, the grub is also black with a robust body and well developed legs and projected mouth parts (Fig. 1A). Both adults and grubs were found to feed on larvae and pupae of the cutworm, *Mythimna separata* (Walker) in the maize fields. The beetle fed 3 to 5 caterpillars and 4 to 6 pupae/day and lived for 127.0 to 132.0 days with food and 30.0 to 46.0 days without food. This species was earlier reported feeding on *Plusia* sp. and *Spodoptera* sp. in maize fields from northern India (Fletcher, 1919).

Table 1. Carabid species (subfamily : Carabinae) with their morphological characters

Name of the species	Mean size (mm)		Morphological characters
	Length	Maximum width	
Tribe Carabini			
<i>Calosoma maderae</i> F. var. <i>indicum</i> Hope	29.9 ± 0.5 (27.0 - 32.0)	11.0 ± 0.3 (9.0 - 12.5)	Black beetle; Prothorax much wider than head; elytral surface imbricate and wider at base
Tribe Scaritini			
<i>Oxylobus dekkanus</i> Andrewes	18.6 ± 0.3 (17.5 - 20.3)	5.6 ± 0.1 (5.1 - 6.2)	Black with shiny body surface, elytra convex, oval, the mandibles with 3 or 4 strong teeth, protibiae flattened and outwardly digitate
Tribe Chlaenini			
<i>Chlaenius panagaeoides</i> Laferte	14.7 ± 0.4 (11.7 - 15.7)	5.2 ± 0.2 (4.1 - 6.0)	Head green with coppery reflections; elytra black with four distinct yellow patches; pronotum and elytra punctate
Tribe Helluonini			
<i>Omphra pilosa</i> Klug	20.1 ± 1 (16.0 - 26.0)	7.2 ± 0.1 (6.6 - 7.8)	Uniformly black, pronotum densely punctate; elytra flat with deep striae and small hairs
Tribe Lebini			
<i>Parena nigrolineata</i> Chaudoir	8.7 ± 0.1 (8.3 - 8.9)	3.2 ± 0.03 (3.1 - 3.4)	Red; pronotum and elytra finely punctate, elytra with black longitudinal bands on lateral sides
Tribe Odacanthini			
<i>Casnoidea indica</i> (Thunberg)	7.1 ± 0.2 (6.0 - 8.0)	1.9 ± 0.05 (1.5 - 2.0)	Head narrowed behind a condyliform neck, elytra deep brown with two pairs of transverse black bands.

Data in paranthesis are ranges

2. *Oxylobus dekkanus* Andrewes

This was found distributed in Karnataka (Bangalore, Mysore, Mandya, Hassan, Tumkur, Dharwad and Kolar) in finger millet and maize fields, mulberry gardens, eucalyptus plantations and mango orchards and also in Kerala (Trichur, Trivandrum), Tamil Nadu (Palni, Madurai, Coimbatore and Mutlur) and Andhra Pradesh (Tirupati).

The emergence of beetles began soon after the onset of monsoon and peak activity was observed during May to November under Bangalore conditions and these have overlapping generations in nature. Beetle is crepuscular, black, shiny and grub is brown, head projected with long and pointed mandibles (Fig. 1B). Both adults and grubs were found associated with different species of termites viz., *Odontotermes horni* (Wasmann), *O.obesus* (Rambur), *O.redemanni* (Wasmann), and *Microtermes obesi* Holmgren. They are capable of entering into the foraging patches constructed by the termites by breaking the earthen sheetings with the help of modified forelegs.

The mean daily consumption rate of adults ranged from 9.9 to 38.2 worker termites. The beetles usually preferred the workers more than the soldiers, mainly because of the less sclerotised body. The adults lived for 303 to 437 days with food and 30 to 109 days without food. The activity of the beetle showed significant positive correlation with rainfall ($r = + 0.693$, $P < 0.05$) and minimum temperature ($r = + 0.623$, $P < 0.01$). This indicated that the soil moisture is playing an important role in the predatory activity of the beetle.

3. *Chlaenius panagaeoides* Laferte

It was found distributed in Karnataka (Bangalore, Chikmagalur, Kolar and Bijapur). The adults were active runners and observed to migrate from forest to the cultivated fields to feed on cowpea aphid, *Aphis craccivora* Koch. They often climbed the cow-

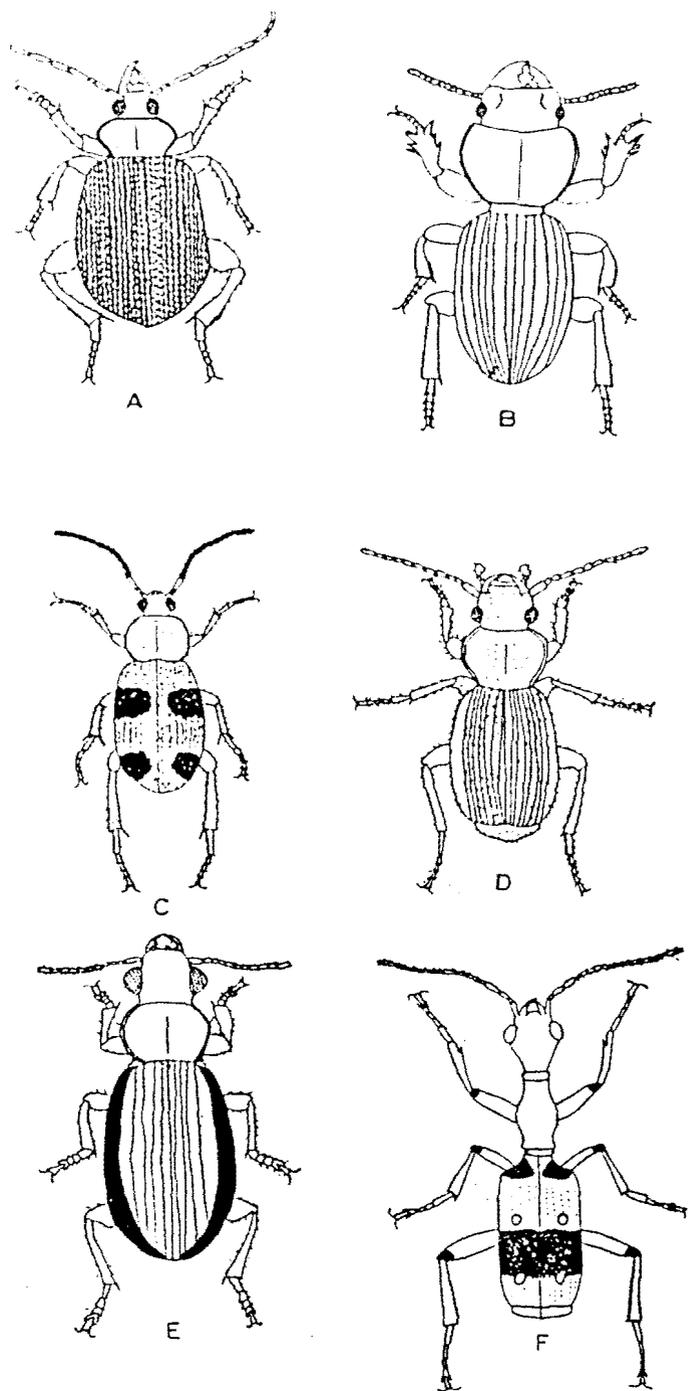


Fig 1. Carabid predators of crop pests in South India

- A. *Calosoma maderae* B. *Oxylobus dekkanus*
 C. *Chlaenius panagaeoides* D. *Omphra pilosa*
 E. *Parena nigrolineata* F. *Casnoidea indica*

pea plants and seen preying on aphids (more on nymphs) in the field. The adults were diurnal, black beetles, medium with four yellow spots on elytra (Fig. 1C). They were inactive during high temperature. Beetles were found to occur throughout the year with maximum population during the rainy season (May to September) and had overlapping generations. The activity of the beetle showed significant positive correlation with rainfall ($r = + 0.61$, $P < 0.05$). The mean daily consumption rate ranged from 1.4 to 6.9 aphids. The adults lived for 207.0 to 341.0 days with food and 14.0 to 73.0 days without food under laboratory conditions. Bhat and Rajagopal (1988) recorded *Dioryche colembensis* Nietner on cowpea aphids from Bangalore.

4. *Omphra pilosa* Klug

It was found widely distributed in almost all agro-forest eco- systems of south India. The adults were uniformly black in colour (Fig. 1D). The grub was very attractive, the dorsal surface of first six abdominal segments of grub was black and the head, thorax and remaining abdominal segments were reddish-brown in colour. Both grubs and adults were found to feed exclusively on termites. These were found normally under foraging patches of termites or any weed stubbles which are infested by termites. They were also found to feed on alate forms near the lights during their emergence.

The sturdy beetles survived even in dry conditions. The adults were nocturnal and active throughout the year with maximum population during April to October. The beetles were found to live beyond this period feeding on termites. The activity of the beetles showed a significant positive correlation with minimum temperature ($r = + 0.7796$, $P < 0.05$). The grubs were diurnal and active only during May to November and found moving freely on the roads and open grounds during morning hours. They had the habit of collecting termites and storing them in the burrows. Sometimes they heaped the

paralysed termites under the dried leaves or stubbles before carrying them to their burrows. Rajagopal (1984) recorded this species for the first time feeding on sterile and reproductive castes of termites from Karnataka.

The mean rate of consumption ranged from 9.8 to 20.4 termites. They preferred to feed on workers than soldiers as the former is soft bodied than the latter. These beetles can be cultured under laboratory conditions by providing termites as food and had a life cycle period of 50.0 to 85.0 days. Each female was observed to lay 4 to 6 batches of eggs with an interval of 39 days during its life span. This species was found to have overlapping generations in nature.

5. *Parena nigrolineata* Chaudoir

It was found distributed in coconut growing areas of Karnataka (Bangalore, Mandya and Mysore), Kerala (Kottayam), Tamil Nadu (Coimbatore) and Andhra Pradesh (Bapatla). It can be recognised by the red elytra with black longitudinal bands on lateral sides (Fig. 1E). Grub was brown with robust body. Both grubs and adults are arboreal on coconut palms by feeding on the larvae of coconut black headed caterpillar *Opisina arenosella* Walker. The predatory activity was recorded on the pest from April to September under Bangalore conditions.

The mean daily consumption rate of the grub and adults was observed to be 0.3 to 0.4 and 0.3 to 0.5 fourth instar caterpillar respectively under laboratory conditions. This data is almost similar to that of Gulagannavar (1984). Beetles preferred later instars while grubs preferred early instars. Adults were capable of living upto 450 days with food. This can be successfully reared in the laboratory by providing larvae. It took 30.0 to 60.0 days to complete its life cycle. *P.nigrolineata* has been recorded from south India by earlier workers on *O.arenosella* (Rao, 1924; Rao *et al.*, 1924; Nirula, 1956). Its

biology, feeding potential and seasonal activity were also studied by earlier workers (Gulagannavar, 1984; Pillai and Kesava Bhat, 1987).

6. *Casnoidea indica* (Thunberg)

Beetles were found distributed in south India especially in paddy growing areas. Adult can be recognised by its head, which narrowed behind a condyliform neck (Fig. 1F). The adults prey upon nymphs and adults of brown plant hopper, *Nilaparvata lugens* (Stal.). They are active fliers and observed throughout the year with a peak activity from June to December. About 200-300 beetles/light trap/night were collected during peak periods. Samal and Mishra (1978) have also reported the predator to feed on brown plant hopper in the paddy fields of Orissa.

In conclusion, these predatory carabids are almost specific with high searching ability. Some of these can be cultured easily under laboratory conditions. The feeding rate of these beetles is quite high and these are capable of surviving even under dry conditions. Adult longevity was quite high and the insects can withstand stress of starvation. The activity of these beetles is mainly influenced by soil moisture. It is necessary to monitor the predatory population in the crop fields as many of these are nocturnal. Hence the management and conservation of these predators is necessary for effective utilization in the integrated pest management programme.

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