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REDESCRIPTION AND POSTEMBRYONIC DEVELOPMENT OF *Paralisarda malabarica* Miller (Reduviidae: Salyavatinae)

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Paralisarda malabarica Miller is redescribed. It is a potential predator on termites. In this study it laid oval, brown eggs singly, 26 days after emergence. Females deposited 126.4 ± 20.1 eggs, during the adult life span of 110.9 ± 12.4 days. The eggs hatched in 11 to 12 days. The egg and five nymphal instars are also described and illustrated. A female-biased sex ratio was recorded. The females lived longer (110.9 ± 12.4 days) than males (82.3 ± 10.3 days).

***Paralisarda malabarica*, assassin bug, redescription, termite predator, postembryonic development.**

D. P. AMBROSE, & B. RAVICHANDRAN: Ponovni opis i postembrionalni razvoj *Paralisarda malabarica* Miller (Reduviidae:Salyavatinae): Entomol. Croat. 2007, Vol. 11. Num. 1-2:53-61.

Paralisarda malabarica Miller ponovno je opisana. Ona je potencijalni predator na termitima. U članku je opisano kako odlaže pojedinačno ovalna smeđa jaja 26 dana nakon pojavljivanja. Ženka odlaže 126,4 ± 20,1 jaja kroz životni vijek odraslog od 110,9 ± 124 dana. Ličinke su se razvile za 11 do 12 dana. Jaja i pet ličinačkih stadija opisani su i ilustrirani. Utvrđeno je da je broj ženki veći od broja mužjaka. Ženke žive dulje (110,9±12.4 dana) nego mužjaci (82,3±10,3 dana).

***Paralisarda malabarica,* ponovni opis, predator termita, postembrionalni razvoj**

Introduction

The reduviids are valuable predators in situations where diverse pest species occur (Ambrose, 1999). Killing more prey than they need to satiate themselves, reduviids are important mortality factors and should be conserved and augmented for utilization as biological control agents in integrated pest management programmes. Conservation and augmentation of reduviids can be achieved only by understanding their systematics and natural history. It is necessary to know not

only what the insect is, but also what its relatives and what its phylogenetic relationships are; such knowledge broadens and deepens the biological information and thereby makes it more useful (Schaefer, 1988; Ambrose, 2000).

Paralisarda malabarica Miller is a multivoltine salyavatine assassin bug that feeds only on termites and is found in concealed microhabitats such as underneath stones nearer to the termitaria. The description available in *Paralisarda malabarica* Miller (Miller, 1957) is inadequate and the biology of Oriental salyavatine species is little understood except that of *Petalocheirus brachialis* Stål (Ambrose, 1999). Hence, the authors attempt to redescribe and study the biology of *P. malabarica*. This paper presents the redescription and the postembryonic development of *P. malabarica*.

Materials and Methods

Adults of *P. malabarica* were collected from Muppandal Scrub Jungle (altitude 60 ± 6.43 MSL; latitude 77°31' E and 8° 22' N) of Kanyakumari District, Tamil Nadu, South India. An adult male was redescribed. They were reared in the laboratory at 30 ± 1° C temperatures, 70 ± 5 % relative humidity and 12 ± 1 hr photoperiod on termites. Adults were paired and placed in 15 x 7.5 cm plastic containers with screened lids for aeration. The bottom of each container was provided with fine sand granules and lined with a paper towel to simulate the natural concealed microhabitats. The eggs were transferred daily to 10 x 1.5 cm petri dishes for hatching. Moist cotton balls were provided to maintain optimum humidity (80 %) and removed periodically to prevent fungal attack. The newly hatched nymphs were reared in isolation in plastic containers (5 x 5 cm) on *O. obesus*. Observations were made of oviposition, fecundity, hatchability, incubation and stadial periods, nymphal mortality, adult longevity and sex ratio. The morphometric analysis and camera lucida illustrations were made from 70 % ethanol-preserved specimens.

Results and Discussion

Redescription

Adult

Dark testaceous; sulcate areas of nota, elevated parts of metanotum, connexival spots, annulations in legs, black; pleura, coxae and abdominal spots piceous; anteocular and postocular areas, elevated areas of nota, scutellum, hemelytra and

metathoracic wings sparcely setose; males smaller than females (male: 7.86 mm long, 1.19 ± 0.08 mm and 1.44 ± 0.05 mm pronotal length and width; female: 8.70 mm long, 1.23 ± 0.09 and 1.58 ± 0.1 mm pronotal length and width (Table 1 & Figures 1 to 3).

Table 1. Morphometry of adult male and female *Paralisarda malabarica* in mm.

Region		Male	Female
Head	AOL	0.486 ± 0.05	0.573 ± 0.02
	POL	0.623 ± 0.04	0.687 ± 0.04
	WBE	0.532 ± 0.03	0.582 ± 0.06
	DE	0.350 ± 0.02	0.360 ± 0.01
	L	1.459 ± 0.07	1.638 ± 0.09
Antennal length	SC	0.554 ± 0.03	0.628 ± 0.06
	PE	1.101 ± 0.05	1.178 ± 0.08
	F_1	0.989 ± 0.02	0.809 ± 0.05
	F_2	0.642 ± 0.03	0.669 ± 0.05
	E	3.093 ± 0.09	3.279 ± 0.1
Rostral length	B	0.637 ± 0.06	0.696 ± 0.04
	M	0.419 ± 0.04	0.432 ± 0.04
	T	0.337 ± 0.04	0.343 ± 0.05
	E	1.392 ± 0.11	1.471 ± 0.09
Prothorax	L	1.187 ± 0.08	1.232 ± 0.09
	W	1.436 ± 0.05	1.579 ± 0.10
Tibial length	F	1.832 ± 0.04	1.882 ± 0.05
	M	1.968 ± 0.06	2.132 ± 0.10
	H	2.805 ± 0.07	3.014 ± 0.20
Abdomen	L	4.173 ± 0.25	4.834 ± 0.37
	W	2.986 ± 0.25	3.714 ± 0.32

(AOL - anteocular, POL - postocular, WBE - width between eyes, DE - diameter of eye, L -length, SC - scape, PE - pedicel, F_1 - first flagellar, F_2 - second flagellar, E - entire, B - basal, M - medial, T - terminal, F - fore, M - mid, H - hind, W - width)

Head oval, granulose medially extending into an acute but somewhat recurved spine and also possesses lateral spines in front of the eyes, a cylindrical and narrowly rounded apically transverse sulcus on vertex as wide as the eye divides slightly shorter anteocular area from transverse postocular area (1: 1.24), vertex obliquely depressed from the base of median spine to eyes with a median wide and deep sulcus in the postocular area extending up to one third of its length; small, black, lateral, compound eyes prominently protruded; ocelli absent; fili-

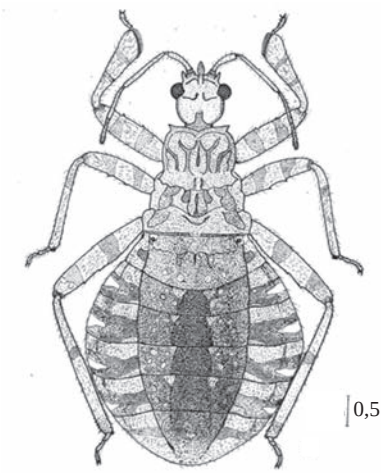


Figure 1. Adult female *Paralisarda malabarica*.

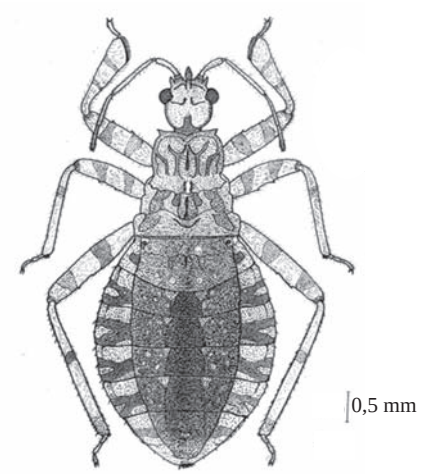


Figure 2. Adult male *Paralisarda malabarica*.

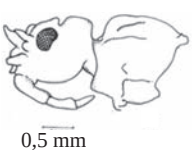


Figure 3. Lateral view of head.

form antennae, robust scape basally deflexed and longer than anteocular, pedicel moderately thick, cylindrical about twice longer than scape (1.93: 1), the first and second flagellar segments longer than the scape but shorter than pedicel separately (scape: pedicel: first flagellar: second flagellar: 1: 1.93: 1.53: 1.11); rostrum stout, basal segment the longest and the terminal segment the shortest; pronotum wider than longer (1: 0.80), the discal areas of pronotum granule, anterolateral angles produce a prominent collar, posterolateral margins well pronounced; apex of scutellum elevated; microptersous, apices of hemelytra and metathoracic wings acute; legs paler, femora incrassate particularly the forefemora with a spine on the lower surface, foretibiae incrassate apically and possess two black apical broad annulations, anterior and median femora with three black annulations, posterior femora with four black annulations, fossula spongiosae well developed on

foretibiae and less developed in midtibiae, fore- tibiae the shortest and hind tibiae the longest (fore-, mid- and hind tibial lengths: 1: 1.10: 1.56 mm); abdomen dorsally and ventrally suffused with piceous spots; connexivum well developed and connexival segments possess irregular median and apical black spots (Table 1).

Postembryonic development:
Oviposition and eclosion

The preoviposition period of *P. malabarica* from adult emergence was 26.3 ± 1.90 days (Table 2), which was longer than that of another salyavatine reduviid *P. brachialis* (Ambrose, 1999). The eggs were laid singly and loosely, scattered in the soil as reported among the members of subfamilies such as Ectrichodiinae, Reduviinae, Stenopodainae, Triatominae and Tribelocephalinae (Ambrose, 1999). A female on an average laid 126 ± 20.1 eggs whereas its close relative *P. brachialis* laid on an average 87.2 eggs. The mean incubation period was 11.8 ± 0.04 days, shorter than that of *P. brachialis* (16.4 days) and 92.3 % of the eggs hatched in the laboratory (Table 2), which was higher than the equivalent figure for *P. brachialis* (75.6 %). On average eclosion lasted for 15 minutes. Newly

Table 2. Biological parameters of *Paralisarda malabarica*
(Numbers in the parentheses indicate the number of observations).

Parameters		
Longevity of males (days)	82.3 ± 10.3	(18)
Longevity of females (days)	110.9 ± 12.4	(21)
Preoviposition period (days)	26.3 ± 1.90	(19)
Total no. of eggs/female	126.4 ± 20.1	(21)
Incubation period (days)	11.8 ± 0.40	(100)
Hatchability (%)	92.3 ± 0.00	(1132)

hatched first instars took their first feed nearly 8 hr after eclosion. Eclosion took place throughout the day and it was not restricted to certain hours as reported for other reduviids (Ambrose, 1999).

Ecdysis and stadia

The duration of each nymphal stadium and the percentage of stagewise nymphal mortality are presented in the Table 3. The 1st nymphal stadium was the shortest (6.9 ± 0.3 days) whereas the 2nd nymphal stadium was the shortest in another Oriental salyavatine *P. brachialis* of which the biology is known. The 5th

nymphal stadium was the longest (15.5 ± 1.1 days), as in *P. brachialis*. The total mortality recorded during nymphal development was 65.5 % whereas 66.4% mortality was observed in *P. brachialis*. The nymphs emerged to adults in 51.1 ± 4 days (Table 3).

Table 3. Stadial period and nymphal mortality of *Paralisarda malabarica* (Numbers in parentheses indicate the number of observations).

Instar	Stadial period (days)		Nymphal mortality (%)
1st	6.9 ± 0.3	(116)	30.2
2nd	7.0 ± 0.6	(81)	20.9
3rd	7.2 ± 0.7	(64)	17.2
4th	11.8 ± 0.8	(53)	24.5
5th	15.5 ± 1.1	(40)	7.2

Adult longevity and sex ratio

The average longevity of adult males (82.3 ± 10.3 days) was significantly ($P < 0.05$) shorter than that of females (110.9 ± 12.4 days) (Table 2) as observed in *P. brachialis* (Ambrose, 1999). The sex ratio of field-observed as well as laboratory-emerged adults of *P. malabarica* was significantly female biased. The laboratory emerged male:female ratio for 30 adults was 1.0: 1.5. However, the sex ratio of *P. brachialis* was male-biased (Ambrose, 1999).

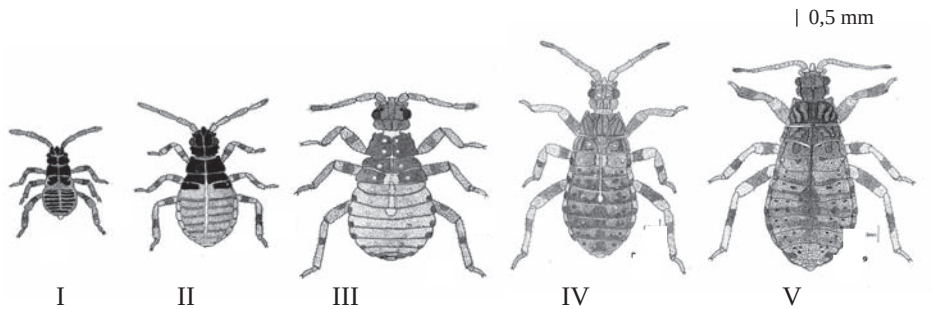
Eggs

The eggs of *P. malabarica* were pale brown at the time of laying and gradually turned dark maroon red and resembling those of the reduviine reduviid *Acanthaspis siva* Distant (Ambrose, 1999). The operculum is transparent and pale yellow in colour. Both the operculum and chorion are faintly sculptured and the chorion immediately behind the operculum forms a chorionic collar, as a fluffy rim around the operculum. The chorion has a dark spherical spot just behind the mouth of the egg. The egg is 0.82 mm long and 0.64 wide. The operculum is 0.48 mm long and 0.07 mm wide (Figure 4).

Figure 4. Egg

Nymphs

Testaceous; antennae, legs and abdomen paler in 1st to 3rd nymphal instars; antennae with the shortest scape, the longest and almost equal or subequal flagellomeres; compound eyes round, black; anteocular and postocular areas subequal in length; basal rostral segment the shortest and terminal segment the longest in early instars (1st to 3rd) whereas basal segment is the longest and terminal segment the shortest in older instars (4th and 5th); prothorax broader than longer except in 1st instar and devoid of sculpturations in early nymphal instars (1st to 3rd); hind leg the longest, the midtbia and foretibia almost equal in length in early instars (2nd and 3rd) and midtibia slightly longer than the foretibia in older instars (3rd to 5tha), all femora and tibiae highly mottled and banded, light brown tibial pads developed in the fore- and midtibiae in all the five stages with differential development of hairs, the tarsi two segmented with a pair of claws; abdomen longer than broader in all instars (Figures 5 to 9). Morphometry of the nymphal instars is given in Table 4.



Figures 5 – 9: I – V nymphal instars.

Key for identification of nymphal instars

1. Scape length equals to width of eye; medial rostral segment as long as pedicel; terminal rostral segment as long as prothorax; prothorax longer than broader ..... I instar
   Scape shorter than width of eye medial rostral segment shorter than pedicel; terminal rostral segment, shorter than prothorax; prothorax broader than longer 2

Table 4. Morphometry of head, cephalic appendages, prothorax, thoracic appendages and abdomen of nymphal instars of *Paralisarda malabarica* in mm.

Region		Nymphal instars				
		1st	2nd	3rd	4th	5th
Head	AOL	0.19 ± 0.24	0.201 ± 0.02	0.23 ± 0.01	0.32 ± 0.03	0.44 ± 0.05
	POL	0.18 ± 0.00	0.197 ± 0.01	0.22 ± 0.01	0.03 ± 0.07	0.34 ± 0.03
	WBE	0.23 ± 0.01	0.27 ± 0.01	0.32 ± 0.00	0.43 ± 0.03	0.56 ± 0.02
	DE	0.12 ± 0.02	0.14 ± 0.00	0.18 ± 0.00	0.24 ± 0.02	0.28 ± 0.02
	L	0.49 ± 0.02	0.53 ± 0.02	0.64 ± 0.01	0.86 ± 0.09	1.06 ± 0.06
Antennal length	SC	0.12 ± 0.02	0.16 ± 0.00	0.17 ± 0.01	0.25 ± 0.03	0.37 ± 0.03
	PE	0.17 ± 0.01	0.22 ± 0.01	0.28 ± 0.03	0.38 ± 0.02	0.67 ± 0.03
	F_1	0.21 ± 0.02	0.32 ± 0.00	0.35 ± 0.02	0.53 ± 0.02	0.67 ± 0.05
	F_2	0.27 ± 0.03	0.33 ± 0.01	0.34 ± 0.00	0.44 ± 0.04	0.55 ± 0.04
	E	0.77 ± 0.05	1.02 ± 0.03	1.13 ± 0.05	1.59 ± 0.07	2.27 ± 0.11
Rostral length	B	0.14 ± 0.00	0.18 ± 0.00	0.20 ± 0.00	0.37 ± 0.06	0.46 ± 0.07
	M	0.17 ± 0.17	0.18 ± 0.00	0.23 ± 0.00	0.27 ± 0.00	0.36 ± 0.04
	T	0.18 ± 0.00	0.19 ± 0.03	0.26 ± 0.01	0.25 ± 0.02	0.29 ± 0.02
	E	0.47 ± 0.01	0.55 ± 0.04	0.69 ± 0.02	0.88 ± 0.08	1.12 ± 0.09
Prothorax	L	0.18 ± 0.00	0.24 ± 0.01	0.42 ± 0.02	0.54 ± 0.04	0.86 ± 0.11
	W	0.14 ± 0.00	0.55 ± 0.02	0.87 ± 0.04	0.99 ± 0.11	1.52 ± 0.12
Tibial length	F	0.32 ± 0.05	0.43 ± 0.04	0.44 ± 0.04	0.72 ± 0.08	0.98 ± 0.08
	M	0.32 ± 0.04	0.42 ± 0.02	0.540.03	0.77 ± 0.03	1.05 ± 0.11
	H	0.47 ± 0.05	0.66 ± 0.03	0.73 ± 0.01	1.26 ± 0.06	1.83 ± 0.09
Abdomen	L	0.59 ± 0.08	1.12 ± 0.07	1.49 ± 0.11	2.15 ± 0.13	3.03 ± 0.16
	W	0.52 ± 0.03	0.98 ± 0.06	1.39 ± 0.16	1.72 ± 0.05	2.55 ± 0.34

(AOL - anteocular, POL - postocular, WBE - width between eyes, DE - diameter of eye, L -length, SC - scape, PE - pedicel, F_1 - first flagellar, F_2 - second flagellar, E - entire, B - basal, M - medial, T - terminal, F - fore, M - mid, H - hind, W - width)

2. Interocular distance equals to twice the width of eye; scape length equals to twice the length of first flagellar segment; basal rostral segment as long as medial rostral segment ..... II instar
   Inteocular distance shorter than twice the width of eye; scape length not equals to twice the length of first flagellar segment; basal rostral segment shorter than medial rostral segment 3
3. Anteocular length as long as medial rostral segment; basal rostral segment the shortest..... III instar
   Anteocular length not as long as medial rostral segment; terminal rostral segment the shortest 4

4. Scape as long as terminal rostral segment; prothorax length equals to twice the length of medial rostral segment ..... IV instar
   Scape longer than terminal rostral segment; prothorax length exceeds twice the length of medial rostral segment ..... V instar

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