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REDESCRIPTION, POSTEMBRYONIC DEVELOPMENT AND BEHAVIOUR OF A HARPACTORINE ASSASSIN BUG *Sphedanolestes himalayensis* Distant (Hemiptera: Reduviidae)

S. Sam Manohar DAS, S.Sivarama KRISHNAN, V. JEBASINGH, Dunston P. AMBROSE

Entomology Research Unit, St. Xavier's College (Autonomous)
Palayankottai 627 002, Tamil Nadu - India.
e.mail: eruxavier@sancharnet.in

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A redescription of adult of *Sphedanolestes himalayensis* Distant is given. The immatures and adults of *S. himalayensis* were found to inhabit the shrubs of tropical evergreen forests. It lays single, elongate, pale reddish eggs, which adhered to the top of the rearing containers in the laboratory. The average number of eggs laid by a female was 74.8 ± 5.2. Incubation period was 9.6± 0.86 days. The total nymphal developmental period from I to V nymphal instar was 59.8± 8.6 days. The longevity of the adult female (71.6±3.4 days) was longer than that of the adult male (68.3±6.1 days). The preoviposition and postoviposition periods were 9.8± 0.76 and 4.6±0.03 days. The male and female sex ratio was 0.86: 1. Sequential events of predation and mating conform to those of other harpactorine reduviids.

***Sphedanolestes himalayensis*, assassin bug, redescription, postembryonic development, predation, mating**

S. Sam Manohar DAS, S.Sivarama KRISHNAN, V. JEBASINGH, Dunston P. AMBROSE: Ponovni opis, postembrionalni razvoj predatorske stjenice *Sphedanolestes himalayensis* Distant (Hemiptera: Reduviidae, Harpactorine)

Ponovno je opisana vrsta *Sphedanolestes himalayensis* Distant. Utvrđeno je da razvojni stadiji i odrasle stjenice *Sphedanolestes himalayensis* nastanjuju grmlje tropskih vazdazelenih šuma. One legu pojedinačna vitka blijedo crvenkasta jaja. U zaštitnom kontejneru u laboratoriju ona prijanjaju na samom vrhu. Prosječni broj jaja po ženki bio je 74,8 ± 5,2. Vrijeme je inkubacije 9,6± 0,86 dana. Ukupni razvojni period ličinki od I-V ličinačkog stadija bio je 59,8± 8,6 dana. Životni je vijek ženke (71,6±3,4 dana) dulji nego odraslog mužjaka (68,3±6,1 dana). Period prije ovipozicije i poslije ovipozicije bio je 9,8± 0,76 i 4,6±0,03 dana. Utvrđeno je da je omjer mužjaka i ženki 0,86:1. Naizmjenično hranjenje (predatorsko) i parenje slično je drugim stjenicama porodice Reduviidae)

Introduction

Reduviidae is the largest family of predaceous land Heteroptera. They are speciose, abundant, occur worldwide, and are voracious general predators. Being larger than many other predaceous land bugs and encompassing in their development a greater range of size, they consume not only more prey but also a wide array of prey (Schaefer, 1988; Ambrose, 2000). Since many of them are polyphagous predators they are valuable predators in situations where a variety of pests occur. However, life stages of some harpactorine species exhibit certain amount of host as well as stage preferences (Ambrose, 1999). Moreover, they exploit diverse microhabitats of the terrestrial ecosystem. Hence, they should be conserved in their natural habitats and/or augmented to utilize them effectively in Integrated Pest Management (IPM) (Ambrose, 1999; 2000; 2003; 2006; Ambrose et al., 2003; 2006). For instance, augmentative release of a harpactorine assassin bug *Pristhesancus plagipennis* (Walker) in Australia effectively suppressed the larvae of *Helicoverpa* spp. in cotton and the green mirid *Creontiades diluton* (Stål) and looper caterpillars *Chrysodeixis* spp. in soya bean (Grundy & Maelezer, 2000a, b; Grundy et al. 2000a,b). In India, augmentative release of another harpactorine assassin bug *Rhynocoris kumarii* Ambrose and Livingstone significantly reduced the population level of the red cotton bug *Dysdercus cingulatus* (Fabricius) (Claver & Ambrose, 2001a, b). Use of any biological control agent relies upon comprehensive knowledge of its ecology, physiology and behaviour.

Sphedanolestes is a predominant genus of oriental harpactorine reduviids inhabiting tropical rainforests, scrub jungles and semiarid zones bordering agroecosystems. Ambrose (2006) in his recent checklist on Indian Reduviidae included twenty species of *Sphedanolestes* Stål 1866. The available superficial morphological description on *S. himalayensis* without illustrations (Distant, 1910) does not allow the species to be diagnosed accurately and hence, a redescription is also included. Even though information on biology and behaviour of many reduviids is available no such information is documented for *S. himalayensis*. Hence, an attempt was made to study the postembryonic development and behaviour of *S.*

himalayensis. Such an understanding will provide baseline information on conservation and augmentation of the predator and thereby the use of its potential for the biocontrol of insect pests.

Materials and methods

Biology: Adults and immatures of *Sphedanolestes himalayensis* Distant were collected from Kodayar tropical evergreen forest (77º 22' 17" E and 8º 28' 9" N). They were reared on larvae of rice meal moth *Corcyra cephalonica* (Stainton) (Pyralidae) in plastic containers (5.5 x 6.5cm) under laboratory conditions (temperature 30- 35°C; 75- 85 % relative humidity and photoperiod 11- 13 hrs). The emerging virgin adults were allowed to mate. Only adults reared in the laboratory were used for the experimental studies. The number of batches of eggs and the total number of eggs laid were recorded for each female. Each batch of eggs was allowed to hatch in individual containers (5 x 4 x 3cm) covered with netted lids giving optimum humidity. The newly hatched nymphs were isolated soon after eclosion and reared individually in plastic containers (5 x 5.5cm) on the fifth instar (1.5cm long) larvae of rice meal moth *C. cephalonica*. The containers were examined at regular intervals for spermatophore capsules ejected after successful copulation as well as for eggs. Observations on eclosion, fecundity, hatchability, ecdysis, nymphal mortality, emergence and sex ratio and adult longevity for those adults that emerged in the laboratory were recorded.

Behaviour: The sequential acts of predation such as arousal, approach and capturing, piercing and sucking and postpredatory behaviour were recorded in one day-starved *S. himalayensis*.

The laboratory-emerged-sex starved virgin adult males and females were allowed to mate and their sequential acts of mating were observed. Camera lucida illustration and measurements of adults under microscope with micrometers were made with 70% ethanol preserved specimens. Measurements (no = 6) of adults from the laboratory culture are given in table 1.

Result

Microhabitat

Sphedanolestes himalayensis was found to inhabit shrubs in Kodayar tropical evergreen forests, Kanyakumari district, Tamil Nadu, South India under the large leaves of *Macaranga indica* Wight. We found other harpactorine reduviids

Table 1. Morphometrz of head, cephalic appendages, prothorax, thoracic appendages and abdomen of *Sphedanolestes himalazensis* (in mm; n=6; $\overline{X}$±SD)

	Head						Antennal length					Rostral length			
	AOL	**POL**	**WBE**	**DE**	**L**	**W**	**S**	**P**	**F_1**	**F_2**	**EA**	**B**	**M**	**T**	**E**
Adult male	0.63 ± 0.04	0.315 ± 0.028	0.45 ± 0.03	0.45 ± 0.02	1.395 ± 0.09	1.35 ± 0.43	1.935 ± 0.21	0.63 ± 0.07	1.575 ± 0.18	2.565 ± 0.32	6.705 ± 0.51	0.72 ± 0.06	0.9 ± 0.08	0.315 ± 0.024	1.935 ± 0.236
Adult female	0.675 ± 0.07	0.855 ± 0.06	0.54 ± 0.032	0.45 ± 0.03	1.98 ± 0.16	1.44 ± 0.09	2.025 ± 0.13	0.66 ± 0.05	1.648 ± 0.08	2.684 ± 0.32	7.017 ± 0.48	0.765 ± 0.08	0.945 ± 0.09	0.315 ± 0.036	2.025 ± 0.12

	Prothorax		**Tibial length**			**Wing**		**Abdomen**		**Insect length**
	L	**W**	**F**	**M**	**H**	**L**	**W**	**L**	**W**	
Adult male	1.665 ± 0.09	2.115 ± 0.16	2.835 ± 0.11	2.34 ± 0.26	3.51 ± 0.28	5.085 ± 0.42	1.755 ± 0.22	3.42 ± 0.42	2.205 ± 0.36	8.145 ± 0.6
Adult female	1.71 ± 0.12	2.34 ± 0.12	2.925 ± 0.19	2.475 ± 0.2	3.6 ± 0.32	5.265 ± 0.48	2.025 ± 0.18	4.32 ± 0.36	3.33 ± 0.46	8.955 ± 0.76

Head: AOL & POL - anteocular and postocular length, DE: diameter of eye, WBE: width between eyes.
Antenna: S - scape, P - pedicel, F_1 & F_2 - flagella 1 & 2
Rostrum: B, M, T - basal, mid- and terminal segments, E - entire.
Tibia: F, M & H - fore-, mid- and hind tibiae
L - length, W- width

with *S. himalayensis* such as *Irantha armipes* (Stål) and an unidentified species of *Coranus*.

Redescription

The superficial morphological description of *Sphedanolestes himalayensis* without illustrations (Distant, 1910) does not allow accurate diagnosis of the species, which has necessitated a redescription with measurements, illustrations and additional diagnostic features based on observations of specimens (Table 1, Figures 1 to 11).

Measurements (n = 6): Total length from head to abdomen 8.145 ± 0.6mm; width across eyes 0.45 ± 0.02mm; maximum width across prothorax and abdomen 2.115 ± 0.16mm and 2.205 ± 0.36mm.

Colouration: Head, anterior lobe of pronotum, femora, tibiae and abdominal apex deep ochraceous, eyes testaceous with reddish margin, posterior lobe of pronotum fuscous, hemelytra testaceous, membrane hyaline, abdomen dorsally fuscous, ventrally stramineous, connexivum dorsally piceously spotted on the fifth and sixth segments.

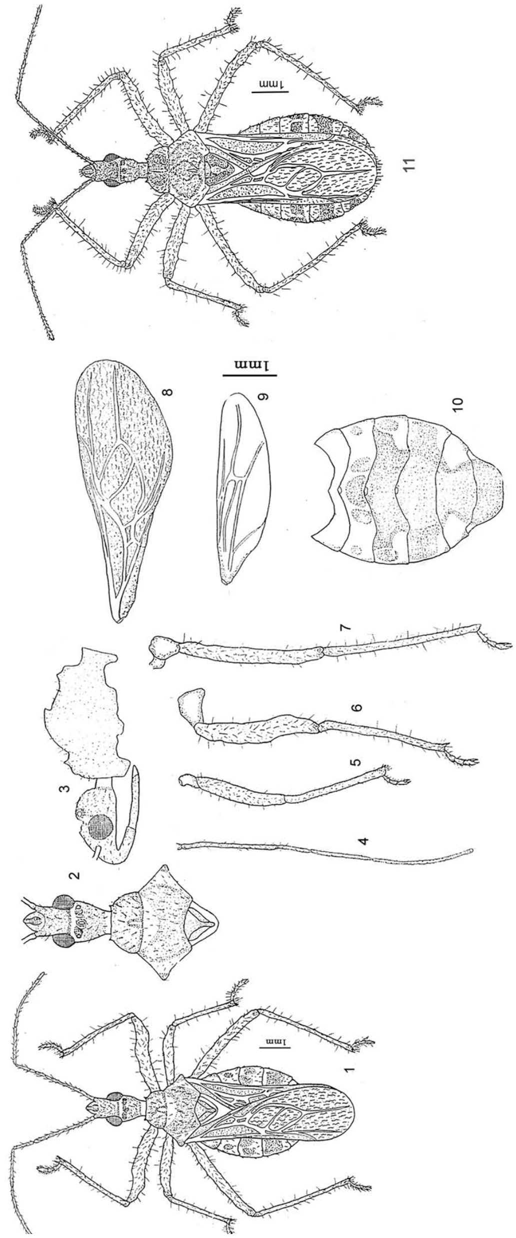
Structure:

Head: Head elongated, medially strongly impressed, pilose; eyes laterally protruding; longer anteocular (0.63mm) exarated from pulvinate and shorter postocular (0.32mm) (Figures 2 & 3); antennae long (6.705mm), four segmented, scape obscurely pilose, pedicel and flagellar segments richly pilose, distiflagellomere the longest (2.565mm) and pedicel the shortest (0.63mm); labium robust and longer (1.935mm) than head (1.845mm), midsegment the longest (0.9 mm) and terminal segment the shortest (0.315 mm) (Figure 4).

Thorax: Pronotum broader, pubescent, slightly longer (1.67mm) than head, laterally obtusely produced, posteriorly emarginate, smaller, bulbous anterior pronotal lobe sulcated from strigose, middorsally pulvinate posterior lobe; scutellum small, conical, scarcely acuminate (Figures 2 & 3).

Legs: Hind leg the longest and midleg the shortest, anterior femora incrassated longitudinally, femora and tibiae richly pilose, three segmented tarsi, midtarsi the longest and proximal tarsi the shortest (Figures 5 to 7).

Hemelytron: Corium moderately pilose, membrane passing abdominal apex (Figures 8 & 9).



Figures 1 - 11:
***Sphedanolestes himalayensis* :** 1.male, 2 & 3. head and thorax,dorsal and lateral views, 4. antenna, 5 – 7. fore -, mid- and hind legs, 8. forewing, 9. hind wing, 10. abdomen and 11. female.

Abdomen: Abdomen pulvinate and pubescent, third, fourth and fifth segments bear dorsomedial intersegmental scent gland orifices (Figure 10). Females are larger than males (Figures 1 & 11).

Egg

S. himalayensis adhered single, elongated, pale reddish eggs to the top of the rearing containers in the laboratory, suggesting arboreal habitats. The fertilized eggs became swollen with dark reddish chrion and reddish eye spots prior to hatching whereas the unfertilized eggs shrank after a few days.

Biology

Oviposition: The preoviposition period of *S. himalayensis* was 9.8 ± 0.76 days after emergence (Table 2). A female of *S. himalayensis* on average laid 7.27 ± 0.52 batches of eggs with a total number of 74.8 ± 5.2 eggs. A maximum 10.4 ± 1.1 and a minimum of 3.2 ± 0.24 eggs per batch were recorded (Table 2). The Index of oviposition period (percentage of egg laying days) was 14.1 ± 1.1 days.

Table 2. Oviposition pattern and hatchability of *Sphedanolestes himalayensis*.

Parameters	
Adult female longevity (days)	71.6 ± 3.4
Adult male longevity (days)	68.3 ± 6.1
Preoviposition period (days)	9.8 ± 0.76
Postoviposition period (days)	4.6 ± 0.032
Index of oviposition days	14.1 ± 1.1
Total number of batches of eggs laid	10.3 ± 0.82
Total number of eggs laid	74.8 ± 5.2
Average number of eggs per batch	7.27 ± 0.52
Minimum number of eggs per batch	3.2 ± 0.24
Maximum number of eggs per batch	10.4 ± 1.1
Total number of nymphs hatched	58.2 ± 4.4
Hatching percentage	77.81 ± 6.3
Frequency of 0% hatching	3.4 ± 0.03
Frequency of 100% hatching	5.1 ± 0.43
Incubation period (days)	9.6 ± 0.86
Nymphal mortality (%)	13.0%
Sex ratio (M : F)	0.86:1

Hatching: The fertilized eggs became swollen with dark reddish chorion and reddish eye spots prior to hatching whereas the unfertilized eggs shrank after a few days. The eggs hatched after 9.6 ± 0.86 days both during morning (5 to 10 am) and evening (2 to 6 pm) hours (Table 3). Both 100 % (5.1 ± 0.43) and 0 % (3.4 ± 0.03) hatchings were recorded in eggs batches with an average of 77.81 ± 6.3 % hatching (Table 2). The newly hatched nymphs were fragile and became tanned 3 to 6 hrs after emergence and thereafter started feeding, showing a preference for small and sluggish prey.

Moulting and duration of instars: The developmental durations of the first to fourth immature instars and the fifth immature instar to adult male and adult female *S. himalayensis* were 9.8 ± 0.62, 10.2 ± 0.85, 11.2 ± 0.9, 8.6 ± 0.96, 9.2 ± 0.72 and 10.8 ± 0.81 days respectively. The duration of the entire immature development was 52.8 ± 2.1 days (Table 3).

Table 3. Incubation and stadial periods of *Sphedanolestes himalayensis* in days ($\overline{X}$±SD)

Incubation period	Stadial period						
	I	II	III	IV	V - Male	V - Female	I - Adult
9.6 ± 0.86	9.8 ± 0.62	10.2 ± 0.85	11.2 ± 0.9	8.6 ± 0.96	9.2 ± 0.72	10.8 ± 0.81	52.8 ± 2.1
(8 - 10)	(8 - 11)	(9 - 11)	(10 - 12)	(8 - 10)	(8 - 10)	(8 - 11)	(43 - 55)
n = 16	16	15	14	14	6	8	14

(values in parentheses indicate the range)

Nymphal mortality: Abnormal hatching and moulting resulted in 2.1 ± 0.14, 3.6 ± 0.22, 3.3 ± 0.26, 1.6 ± 0.12 and 1.4 ± 0.11 % mortalities in I, II, III, IV and V nymphal instars. Thus, 13.0 ± 0.094 % of nymphs died during their postembryonic development and the survival rate was about 87 %.

Adult longevity and sex ratio: The females of *S.himalayensis* lived longer (71.6 ± 3.4 days) than the males (68.3 ± 6.1 days) (Table 2). The sex ratio (male:female) of *S. himalayensis* among the adults emerged from the laboratory was female biased (0.86:1).

Behaviour

Predatory behaviour: *Sphedanolestes himalayensis* exhibited a pin and jab mode of predation in a sequence of acts. The sequential pattern of predatory behaviour was observed in 24 hr prey-deprived predators on two different prey, viz., larva of rice meal moth *C. cephalonica* and the termite *Microtermes obesi* Holmgren as follows: arousal-approach-capturing-paralysing-labial probing and sucking and postpredatory behaviour (Table 4 , Figure 12).

Table 4. Chronology of predation of *Sphedanolestes himalayensis* on *Corcyra cephalonica* and *Microtermes obesi* in min. (n=6; $\overline{X}$±SD)

Prey	Time (in min.) taken for predatory acts				No. of piercing & sucking sites
	Capturing	Paralysing	Sucking	Total duration	
C. cephalonica	0.20 ± 0.65	0.79 ± 0.06	95.8 ± 7.6	96.79 ± 8.31	13.2 ± 1.15
M. obesi	0.13 ± 0.011	0.71 ± 0.06	88.7 ± 7.1	89.54 ± 5.7	10.6 ± 0.84

Arousal: The visual stimulus from the moving prey excited an arousal response in *S. himalayensis*.

Approach: *Sphedanolestes himalayensis* approached its prey, orienting towards the prey and remaining motionless until the prey came closer to the predator. The predator approached again if the prey was large or it escaped the predator. *S. himalayensis* approached the prey 0.23 ± 0.22 min. after sighting it.

Capturing: *Sphedanolestes himalayensis* first pinned and jabbed the lateral side of the prey with the extended labium. Thereafter, it firmly held the prey with its forelegs (Table 4).

Paralysing: After prey was pinned, jabbed and captured, the predator paralysed it by injecting toxic saliva (Table 4).

Prey transportation: After paralysing *S. himalayensis* transported the prey to a less lighted and more concealed place in the rearing container for feeding.

Probing and sucking: Once the prey was transported, *S. himalayensis* probed the prey by passing its labial tip over the prey and selecting suitable sites for sucking. Thereafter it frequently inserted and withdrew the stylets to suck the predigested body fluids of prey.

Postpredatory behaviour: After predation, *S. himalayensis* cleaned its antennae and labium with its foretibial combs to remove foreign materials such as defensive secretion, irritant exudation etc., of prey.

Impact of prey: Though the sequential acts of predatory behaviour of *S. himalayensis* on both the larva of *C. cephalonica* and *M. obesi* were similar, the prey type influenced predation. For instance, adults of *S. himalayensis* more quickly captured, paralysed and sucked a termite than a larva of *C. cephalonica*

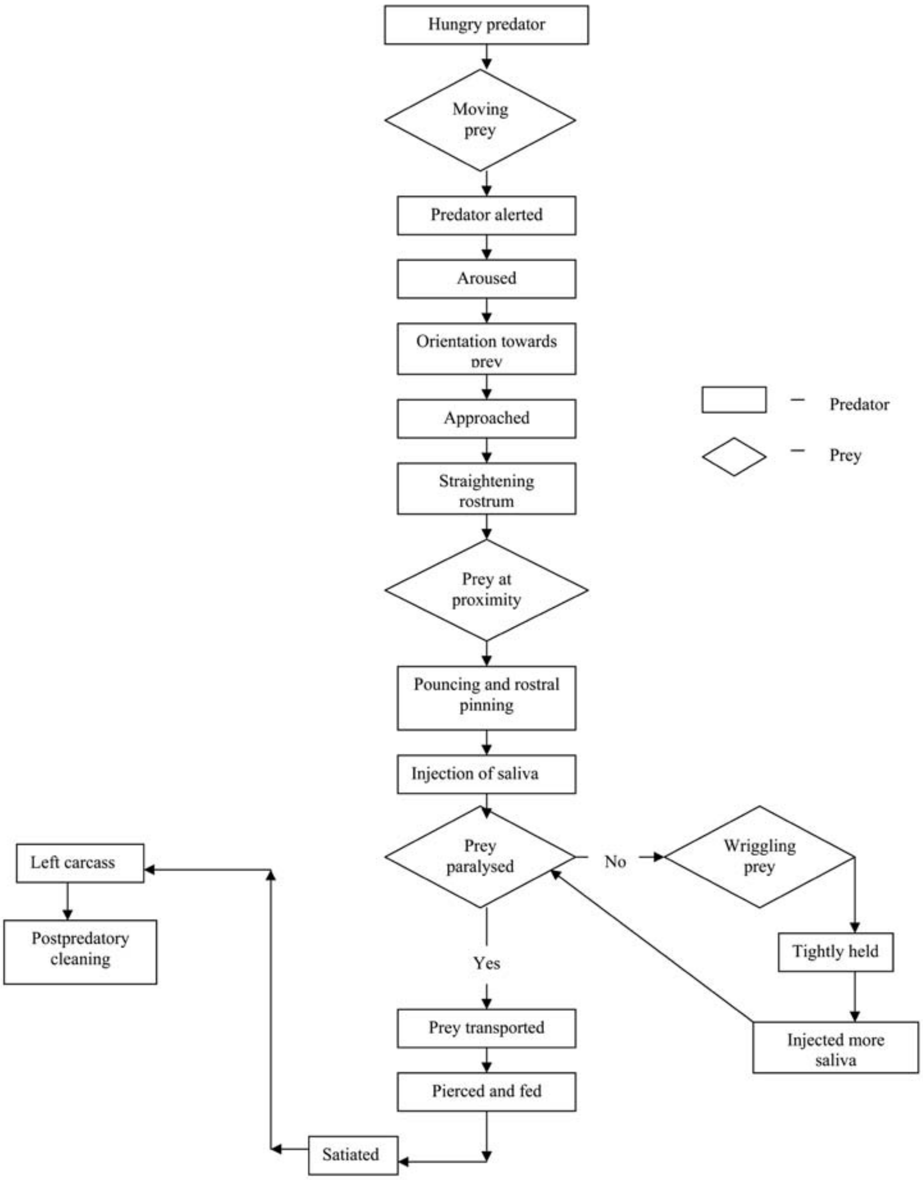


Figure 12. A flow chart on the predatory behaviour of *Sphedanolestes himalayensis.*

(Table 4). This could be attributed to the larger size of *C. cephalonica* larva when compared to *M. obesi*.

Mating behaviour: *Sphedanolestes himalayensis* is polygynous as well as polyandrous. The sequential acts of mating behaviour viz., excitation-approach-riding over-copulation-postcopulatory acts-ejection of spermatophore capsule were observed in laboratory reared sex-starved *S. himalayensis* (Table 5, Figure 13).

Table 5. Chronological analysis of mating in *Sphedanolestes himalayensis* in min. (n=6; $\overline{X}$±SD)

Arousal	**Approach**	**Riding over**	**Genitalia extension and connection**	**Copulation**	**Ejection of spermatophore capsule**
1.31 ± 0.12	1.86 ± 0.15	15.86 ± 1.2	0.16 ± 0.014	38.4 ± 3.1	62.4 ± 5.9

Excitation: Sight plays a very important role in the excitation of mating partners. The visually excited males of *S. himalayensis* started chasing the females. *S. himalayensis* got aroused quickly within 1.31 ± 0.12 min. and thereafter started briskly chasing the female.

Approach: The aroused males approached the females with their extended labium and antennae. The ready to mate females responded with antennal extension and labial stridulation. Thereafter, the motionless females submitted themselves to the males within 1.86 ± 0.15min. The approach response was completed once males touched the females with their antennae and placed their legs over females.

Riding over: The males of *S. himalayensis* rode over the females for 15.86 ± 1.2min. before achieving genital connection.

Copulation: At the culmination of riding over the male relaxed the characteristic pterothoracic labia pinning, assumed either the lateral or dorsolateral position and placed his legs over her pterothorax. Thereafter, the male extended its genitalia and achieved connection within 0.16 ± 0.014min. Retraction and reinsertion of genitalia were observed on rare occasions due to incompatibility of genital connection.

In copula mating partners remained motionless with intermittent vibration of antennae, tibial brushing against each other or against substrate, genitalia grooming etc., and these intermittent acts slowed down just prior to termination of co-

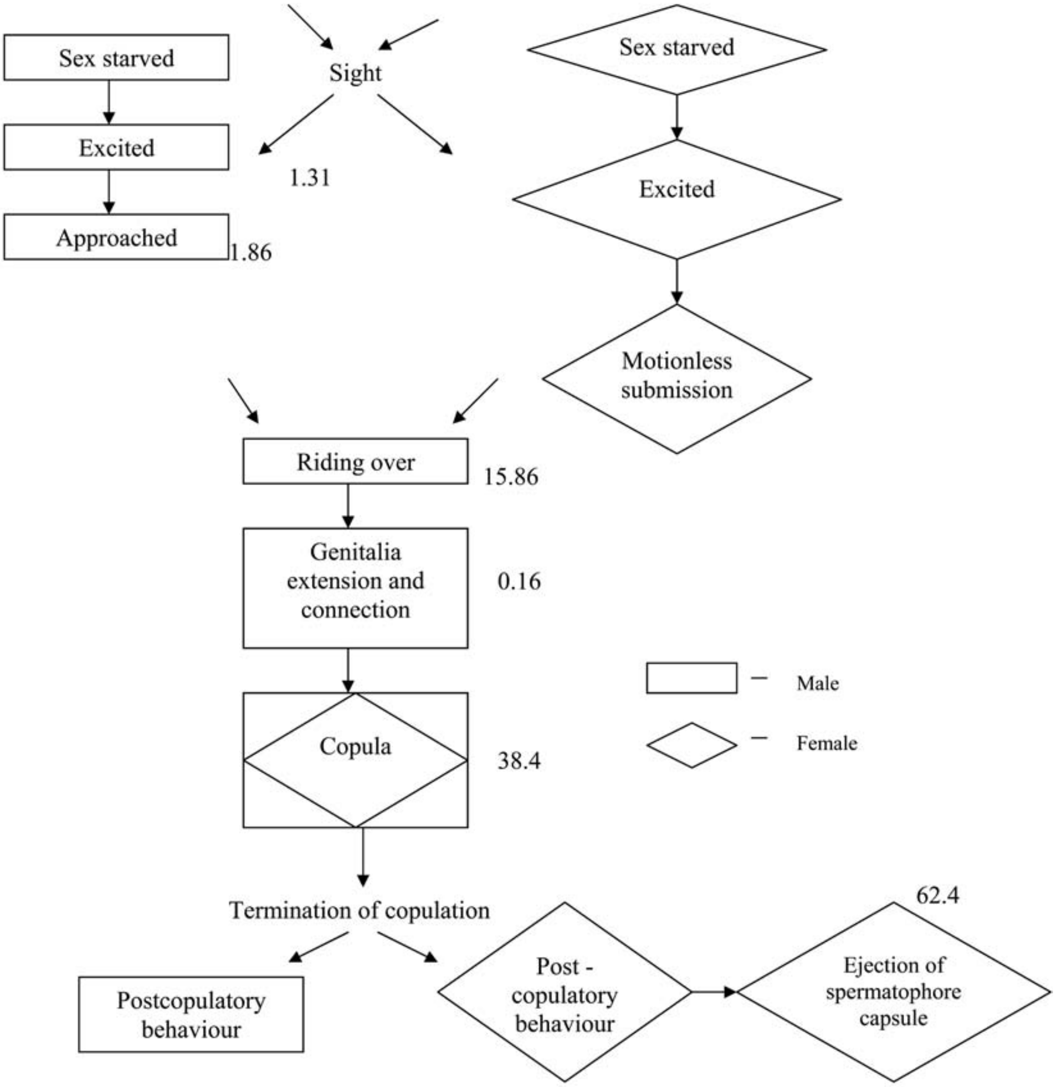


Figure 13. A flow chart on the mating behaviour of *Sphedanolestes himalayensis* (timings in minutes)

pulation. The copulation lasted for 38.4 ± 3.1min. The termination of copulation was indicated by the drooping of the antennae of both male and female followed by separation of mating partners. After separation the male moved away from the female where as the female remained motionless for a short period.

Postcopulatory acts: Antennal grooming, wing raising, hind legs cleaning, genitalia brushing etc., were observed in both partners. The successful completion of copulation was indicated by the ejection of spermatophore capsule 62.4 ± 5.9min. after the termination of copulation.

Discussion

The preoviposition period of *S. himalayensis* was longer than that of members of subfamilies Ectrichodiinae (7.0 days) and Salyavatinae (6.07 days) but shorter than that of members of subfamilies Stenopodainae (14.3 days) and Triatominae (30.4 days) (Ambrose, 1999). Among harpactorines it was much shorter than that of *Rhynocoris marginatus* (Fabricius) (33.3 days), *R. kumarii* Ambrose & Livingstone (26.0 days), *R. fuscipes* (Fabricius) (19.0 days) (Ambrose, 1999; George, 2000) and longer than that of *R. longifrons* (Stål) (8.0±0.0 days) (Ambrose et al., 2003). Among *Sphedanolestes* species, it was shorter than that of *S. pubinotum* Reuter (11.7±0.88 days) (Kumaraswami & Ambrose, 1993) and *S. minusculus* Bergroth (12.55±3.43 days) (Ambrose et al., 2006) and longer than that of *Sphedanolestes* sp. (8.6±0.52 days) (Ambrose, 1999), while it was closer to that of *S. signatus* Distant (9.33±1.19 days) (Vennison & Ambrose, 1990) and another harpactorine species *Irantha armipes* (Stål) (9.8±0.62 days) (Das & Ambrose, 2008). The fecundity in *S. himalayensis* was higher than that of congeneric species such as *S. signatus* (15.33 ± 6.41 eggs) (Vennison & Ambrose, 1990), *S. pubinotum* (54.0 ± 5.4 eggs) (Kumaraswami & Ambrose, 1993) and *S. minusculus* (63.33 ± 21.77 eggs) (Ambrose et al., 2006).

The incubation period observed in *S. himalayensis* (Table 2) was shorter than that of congeneric species *S. signatus* (12.3 days) (Vennison & Ambrose, 1990), *S. pubinotum* (10.2 days) (Kumaraswami & Ambrose, 1993) and longer than that of *S. minusculus* (7.8 ± 0.41 days) (Ambrose et al., 2006) and closer to that of *I. armipes* (9.1 ± 0.77 days) (Das & Ambrose, 2008). *S. himalayensis* eggs hatched both during morning and evening hours as observed by Kumar (1993) in *S. minusculus*. However, Ambrose et al., (2006) observed that hatching occurred mostly during morning hours in *S. minusculus*. The higher hatching percentage of *S. himalayensis* (77.81 ± 6.3%) is a diagnostic feature of tropical rainforest harpactorine reduviids such as *Scipinia* and *Sycanus* and congeneric species viz., *S. signatus* (76.29 ± 5.76%), *S. pubinotum* (81.48 ± 4.66%), *S. minusculus* (95%) and *Sphedanolestes* sp. (92.92 ± 7.8 %). The more frequent 100% hatching than 0% hatching observed in *S. himalayensis* as in many other harpactorine reduviids presumably ensures a relatively higher fecundity (Ambrose, 1999; Ambrose et al., 2006; 2007). However, the index of oviposition days for *S. himalayensis* (14.1 ± 1.1 days) was lower than that of congeneric species *S. pubinotum* (19.23 ± 3.51 days) (Kumaraswami & Ambrose, 1993) and *S. signatus* (36.67 ± 1.93 days) (Vennison & Ambrose, 1990) but higher than that of *S. minusculus* (13.7days) (Ambrose, 1999).

As observed in other harpactorines, the longest stadium in *S. himalayensis* was the fifth instar (fifth nymphal instar to adult female). But the shortest IV stadium observed in *S. himalayensis* was not recorded in other harpactorines, where it was generally either second or third stadium (Ambrose, 1999).However, first stadium was observed as the shortest in *Alcmena spinifex* Thunberg (Ambrose, 1999), *S. minusculus* (Ambrose et al., 2006) and *I. armipes* (Das & Ambrose, 2008). The nymphal mortality observed in *S. himalayensis* was moderate compared to nymphal mortalities observed among other harpactorines (Ambrose, 1999; Ambrose et al., 2006; 2007; Das & Ambrose, 2008).

Adult females of *S. himalayensis* living longer than males, as observed in congeneric species *S. minusculus* and *S. pubinotum,* is common in other harpactorines such as *Coranus* spp., *Endochus* spp., *I. armipes* and *R. kumarii*, a mechanism that promotes multiple mating with males of different age groups and subsequently facilitates enhanced fecundity (Kumaraswami & Ambrose, 1993; Ambrose, 1999; Ambrose et al., 2006; Das & Ambrose, 2008). The female biased sex ratio observed in *S. himalayensis* is not uncommon among the harpactorine reduviids (Ambrose, 1999; Ambrose et al., 2006).

The sequential pattern of the pin and jab mode of predation observed in *S. himalayensis* was similar to that of several other harpactorine reduviids. The importance of vision in prey location and subsequent arousal response in predation of S. *himalayensis* was proved by eye blinding experiments in many assassin bugs (Ambrose, 1999; Ambrose et al., 2007; Das & Ambrose, 2008). Moreover, it was further discussed that antennal contact of prey was not essential in reduviid predators such as *S. haimalayensis* as they do not touch any part of the prey's body before pinning and jabbing (Das, 1996). This was further shown by the fact that antennectomized reduviids successfully pinned and jabbed their prey (Ambrose, 1999). The approach of *S. himalayensis* to its prey was similar to that of any typical non-tibial pad reduviid. Though many harpactorines attack the prey laterally as observed in *S. himalayensis,* first attack sites such as antennal bases, leg joints, junction between head and thorax, rear end etc., were also reported for many reduviids (Ambrose, 1999; Ambrose et al., 2006; Das & Ambrose, 2008). Harpactorines such as *A. spinifex* normally attacked the prey from behind (Das, 1996).

Sphedanolestes himalayensis is able to paralyze the prey by haemolytic neurotoxins present in the salivary glands, especially in the anterior lobes as reported for several other reduviids (Ambrose, 1999). The transportation of the prey to a less lighted and more concealed place by *S. himalayensis* prior to sucking was similar to that observed in *Brassivola* spp. and *I. armipes* (Das, 1996; Das & Ambrose, 2008) whereas it is seldom observed in harpactorines such as *Vesbius sanguinosus* Stål (Das, 1996). Hence, it appears to be species-specific (Ambrose, 1999). The congregational feeding and cannibalism observed in many reduviids were not recorded in *S. himalayensis* as *I. armipes* when they were mass reared (Ambrose, 1999; Das, Ambrose, 2008).

The sequential acts of mating observed in *S. himalayensis* conformed to those of several other harpactorine reduviids. The primary role of vision in the excitation of mating partners was confirmed by eye blinding experiments in several reduviids. In addition, sensilla in the antennae of *S. himalayensis* also play a role in mating arousal as confirmed by antennectomy experiments in several other reduviids (Ambrose, 1999).

The male chasing the female and submission of motionless females to approaching males observed in the mating behaviour of *S. himalayensis* was also reported for many reduviids (Ambrose, 1999; Ambrose, et al., 2006; Das & Ambrose, 2008). The precopulatory female cannibalism over male reported in some species of reduviids was not observed in *S. himalayensis*. Though riding over prior to copulation is a diagnostic characteristic feature of harpactorine reduviids, the duration of riding over varied from a few minutes to 3 days in different species. Though harpactorines commonly copulate in the dorsolateral position *S. himalayensis* was observed copulating in either he lateral or dorsolateral. The slowing down of antennal vibration and tibial brushing prior to termination of copulation and ejection of spermatophore capsule after successful copulation observed in *S. himalayensis* were also recorded for several other reduviids. The postcopulatory cannibalism of female over male and seasonal variation in mating behaviour reported for certain harpactorine reduviids were not recorded in *S. himalayensis* (Ambrose, 1999).

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