

Models for the predatory behaviour of some reduviids from Southern India (Insecta—Heteroptera—Reduviidae)

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Abstract. The predatory behaviour of three reduviids, the millipede-feeding *Haematorrhophus nigroviolaceus* (Reuter) (Ectrichodiinae), the insectivorous *Pirates affinis* Serville (Piratinae) and the haematophagous *Triatoma rubrofasciata* (De Geer) (Triatominae), both under natural and laboratory conditions, is discussed. Visual stimuli elicited by the moving prey appear important for the initiation of feeding response. The olfactory stimuli from the defensive secretions of the prey appear to enhance the response and help in the continuation of feeding. In the haematophagous *Triatoma rubrofasciata*, while feeding responses are elicited only by the temperature gradient around their vertebrate hosts, the visual and olfactory senses play only a minor role. On the basis of observations on feeding behaviour, appropriate predatory behaviour models for the three reduviid species have been constructed.

Keywords. Reduviid bugs ; *Haematorrhophus nigroviolaceus* ; *Pirates affinis* ; *Triatoma rubrofasciata* ; predatory behaviour models.

1. Introduction

Reduviid bugs are characterised by their exclusive predatory habit, feeding on the blood of a variety of arthropods and rarely on avian and mammalian blood. Available information on their feeding behaviour appears meagre (Cachan 1952; Edwards 1962; Parker 1965, 1969, 1971, 1972), in spite of this being the largest group among the heteropterous insects. An attempt has been made to present a detailed study of the prey records, feeding habits, and the predatory behaviour of some representative types of reduviids collected from Southern India. The species *Haematorrhophus nigroviolaceus* (Reuter) (Ectrichodiinae), believed to be near the basal stock (Louis and Kumar 1973), *Pirates affinis* Serville (Piratinae), a generalised group, and *Triatoma rubrofasciata* (De Geer) (Triatominae), a highly specialised group with haematophagous habits (Miller 1971) were selected as type insects. These reduviids were found to feed on millipedes, carabid beetles, and mammalian blood, respectively. The present study involves an analysis of the units and sequences of the predatory behaviour and construction of suitable models depicting their predatory behaviour,

2. Materials and methods

Members of Ectrichodiinae and Piratinae were obtained from moist and humid places, from under stones and vegetation from Tambaram (Chingleput Dist.), Alagarkoil (Madurai Dist.), Walayar and Chandrapuram (Coimbatore Dist.) in Tamil Nadu during monsoon seasons (August–December), when alone these species appear in sizable numbers. *Triatoma rubrofasciata* were collected from cattle sheds and thatched huts as well as from inside brick houses when they come to feed on sleeping occupants. These insects were found to be distributed in Mayavaram, Kumbakonam (Tanjore Dist., Tamil Nadu), Trichur, Quilon (Kerala) and Bangalore (Karnataka). *H. nigroviolaceus* and *P. affinis* were reared in large fish tanks, the bottoms of which were filled with saw dust to a height of 5 cm and kept moist by sprinkling water regularly. During experimental starvation, the highly cannibalistic *P. affinis* were separately reared in plastic containers (8 cm × 4 cm, 15 cm × 10 cm) provided with wire-gauze for ventilation and a layer (2–3 cm) of moist sand and saw dust. *T. rubrofasciata* were reared in empty fish tanks and containers with sheets of thick paper longitudinally folded providing shelter. The thoracic and abdominal tergites of the insects were marked and numbered with paint for easy observation and recognition. All insects were maintained under laboratory conditions (temp. 29–32° C ; RH 70–90%). Laboratory colonies were fed with different preys on which they were found to feed under natural conditions. *H. nigroviolaceus* feed exclusively on millipedes ; young ones and adults of these were supplied with millipedes—*Trigoniulus* sp. ; *Xenobolus* sp. ; and *Paradesmus* sp. The insectivorous *P. affinis* exclusively predate on carabid beetles—*Omphora pilosa* Klug and *Omphora atrata* Klug. Newly emerged and early neanidal stages were fed with larvae of *Tribolium* sp., termites, house flies (after their wings were removed), small coleopterans and gryllids. Haematophagous *T. rubrofasciata* were fed on the blood of dog and rabbit. These insects were caged in 2–3 numbers in containers, the open ends of which were strapped on to the shaven abdominal surface of the hosts (after Ryckman 1952) to facilitate feeding. The amount of blood engorged was determined by weighing the insects before and after feeding and the difference was taken as the weight of the blood consumed. Smaller neanidal stages (I and II) were weighed in groups of 10 and the mean was determined. Metler's monopan balance was used for the determination of all weights.

Feeding behaviour of *H. nigroviolaceus*, *P. affinis* and *T. rubrofasciata* was observed when insects starved for 2 days were offered their natural preys. Several replications were made enabling sufficient data to be collected for construction of models for the predatory behaviour. With a view to assess the role played by the visual and olfactory stimuli in eliciting feeding responses and in helping the predator to discriminate their prey, different artificial baits were provided to *H. nigroviolaceus* and the insects' responses were observed. The different kinds of artificial baits offered were :

(i) Rectangular (3 × 2 cm) cardboard scented by placing it in a container having 15 millipedes for 5 days and dragged in front of the starved insect with a fine plastic thread.

(ii) Fine black cloth rolled into cylindrical shape (45 mm long and 3 mm wide) like that of a millipede and kept stationary in front of the starved insect (unscented and stationary bait).

(iii) Same as bait 2, but scented as in 1 and kept stationary in front of starved insect (scented and stationary bait).

(iv) Same as bait 2, but continuously dragged in front of the starved insect with a fine plastic thread (unscented and moving bait).

(v) Same as bait 3, but dragged in front of the starved insect with a fine plastic thread (scented and moving bait).

(vi) Live millipedes were offered as control.

Each starved individual was presented with each of the 5 baits, but at a time only one of these was given, and the second presentation was made to the same individual after an interval of 6 hr. Ten replicates were tried with each bait and the results obtained of the feeding responses are presented in figure 1. Starved individuals of *P. affinis* were offered two different species of carabid beetles to assess the variation in the predatory behaviour and to determine the direction of attack

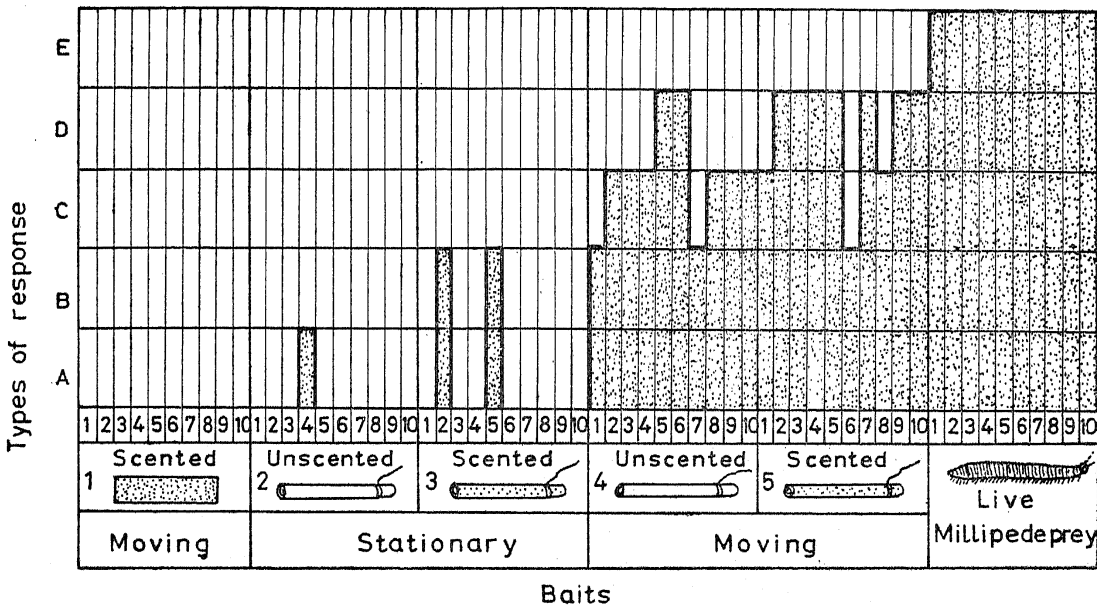


Figure 1. Feeding responses of *Haematorrhophus nigroviolaceus* (Reuter) to different artificial baits offered in the laboratory. A = Excitation (raising of the body from the ground). B = Extension of antennae (towards the direction of prey). C = Approach the prey (with raised legs). D = Pouncing on the prey and probing (with extended rostrum). E = Piercing (with stylets and injection of saliva).



= Black cloth rolled into a cylindrical form of the size of millipede.



= Same as above but scented by placing it for few days with a group of millipedes in a container.



= Card board piece (rectangular shape) but scented as above.

on these beetles. One hundred such observations were made as shown in table 1. The important role played by the visual, olfactory, and tactile sense organs in eliciting feeding responses in blood feeding *T. rubrofasciata* was also observed by blinding the insects' eyes with black paint, by removing their antennae and by the removal of their rostrum before they were allowed near the vertebrate hosts for feeding.

3. Observation and results

3.1. Feeding behaviour in *H. nigroviolaceus* and *P. affinis*

H. nigroviolaceus and *P. affinis*, though predatory, exhibit distinct variations in their feeding behaviour which differs considerably from that of the haematophagous *T. rubrofasciata*, the latter's feeding behaviour is discussed separately. *H. nigroviolaceus* is a crepuscular and lethargic insect and its different prey records are restricted to millipedes. Though there is no specificity in their feeding habits, there appears to be a preference for certain species of millipedes. In the field as well as in the laboratory, they predate on *Trigoniulus* sp., *Xenobolus* sp., and *Paradesmus* sp. in that order. When starved individuals are given these three millipedes, they prefer *Trigoniulus* sp., which produces the least irritating and pungent defensive secretions. Usually the giant *Spirostreptus* sp. is not attacked, but on a few occasions in the field, these were also predated. In spite of their smaller size, neanides of all stages readily attacked millipedes larger than their own body size, usually in groups of 2 or 3.

Under natural conditions the nocturnal and more aggressive *P. affinis* feed on carabid beetles—*Omphora pilosa* and *O. atrata*—and are able to capture and kill their prey almost instantaneously. This seems to be a general rule for all members of Piratinae, as revealed by field observations made on other members of this sub-family, viz., *Ectomocoris* spp. and *Catamiarus* sp. (Haridass 1978). Adults and neanides of these predators, under prolonged observation, readily exhibited canni-

Table 1. Direction of attack and site selection on carabid beetles by *Pirates affinis*.

Site of attack	Total number of attacks observed			
	<i>Omphora pilosa</i>		<i>Omphora atrata</i>	
	60 = (100%)		50 = (100%)	
	Number of attacks made from		Number of attacks made from	
	rear	side	rear	side
	42 = (70%)	18 = (30%)	23 = (46%)	27 = (54%)
Mandibular base	22 = 52.3%	Nil	11 = 47.8%	Nil
Antennal Base	10 = 23.9%	3 = 16.7%	7 = 30.4%	4 = 14.8%
Joints of leg	7 = 16.7%	9 = 50%	3 = 13.4%	14 = 51.95%
Nesk	3 = 7.1%	6 = 33.3%	2 = 8.3%	9 = 33.3%

balism. In both *H. nigroviolaceus* and *P. affinis*, the feeding behaviour consists of the following sequences: Sight of prey → approach to prey → pounce on prey → capture of prey → immobilise prey → drag prey to a safe place → feed; these can be categorised into distinct functional units as outlined below and this provides the framework for describing the behavioural sequences.

3.1a. *Prey location and discrimination*: *H. nigroviolaceus* on seeing a moving millipede becomes more active, raising the body from the ground, and with the antennae directed forwards, makes short, jerky movements towards the prey (figure 5A). Feeding responses of this insect using artificial baits (figure 1) show that stationary baits (figure 1, baits 1 and 2) invoke very little response, and if at all there is any, it stops with the raising of the body (figure 1, response A). In scented stationary bait (figure 1, bait 3), there is some response in the form of extension of antennae (figure 1, response B). Significant responses are seen in the cases of moving baits (figure 1, baits 4 and 5), both unscented and scented, when the predator not only extended its antennae but also attempted to pounce on the prey. The maximum response (figure 1, responses C and D) was evoked with the scented moving bait (figure 1, bait 5), when the predator pounced on the bait, at times probing with extended rostrum. Feeding responses were elicited by the moving bait and the chemical stimuli only enhance such responses. Since at no time the predator touched the bait before pouncing, it may be surmised that the chemical stimuli are responsible for the continuation of feeding responses, initiated first by the visual stimuli.

In *P. affinis* also as in other reduviids, visual stimulus plays a vital role in eliciting feeding behaviour. Unlike *H. nigroviolaceus*, olfactory stimuli play only a negligible role in this respect, as is evident when different insects were offered as prey to *P. affinis*. Starved adults and neanides readily fed on gryllids, click beetles, adults of Lepidoptera, and house flies. In all these cases the predators quickly attacked the prey and consumed them, showing the same kind of behavioural sequence. Moreover, exo-skeletons of dead beetles, piece of wood, painted black of the size of these beetles, also elicited the feeding behaviour and the predator pounced on them and probed for a suitable site. Especially, when exo-skeletons of beetles were offered, the predators even inserted the stylets, injected the saliva and carried these for some distance before dropping them. On seeing a moving prey these predators quickly run with extended antennae and rostrum and pounce on their prey (figures 5B ; 6A).

3.1b. *Prey immobilisation*: This unit of feeding behaviour involves immobilisation of the prey, whose movements and odour elicit the first unit behaviour. After location of the prey, the predator approached it with raised legs and pounced on it. In *H. nigroviolaceus* usually the posterior part of the long body of the millipede is selected for attack and the prey is held between the fore- and midlegs that encircle in a tight grip (figure 5C). Attempts to hold the prey in the anterior or middle region always resulted in the entwining of the free part of the millipede around the head, rostrum and legs, resulting in the complete arrest of any further movement of the predator. In this helpless condition the bug allows itself to be dragged for a considerable distance before it is finally released. Immediately

after its release, the predator starts with greater ferocity. The bug invariably grabs only the posterior part of the millipede in order to avoid the risk of being caught by the millipede. Once the prey is held in a tight grip the bug probes for a suitable site, always the soft cuticle between the sternum and the legs, inserts the stylets and instantaneously injects its saliva. Immediately the legs of the prey, adjacent to the point of attack, become paralysed and this effect spreads rapidly and progressively over the rest of the body of the millipede. In a matter of 12 to 15 sec, the entire body of the prey becomes limp and totally paralysed.

Immobilisation of carabid beetles by *P. affinis* differs considerably and the prey is attacked either from the rear or from the sides, in quick, aggressive manners (figure 6B and C). *O. pilosa* and *O. atrata*, like other carabid beetles, also produce defensive secretions of a phenolic odour; *O. pilosa*, the larger of the two, produces stronger defensive secretions. This prey is mostly attacked from the rear (table 1, 70% of the attack observed). When the attack is from the rear, the secretion of the beetle directed on to the under surface is avoided by the predator, which then runs over the dorsum of the prey to grip it. The antennae of the prey are held between the tibia and femora of the forelegs, while the mid- and hind-legs grip the prey from the sides. In such a position, the bases of the mandibles and the bases of the antennae are easily accessible to the predator for inserting the stylets and injecting the saliva. Sometimes, all the legs are used to grip the sides of the prey and in this position the neck region and the joints of the legs are also accessible to the predator for insertion of stylets (table 1, 16.7 and 7.1% of the attack observed). Sometimes, the prey is also attacked from the sides (table 1, 30% of the attack observed) and in such cases the predator is subjected to a spray of defensive secretions by the beetle. This does not deter the predator and it never lets loose the prey till it is finally killed. Attack of this kind calls for the cleaning of the predator's body before the prey is consumed. While attacking *O. pilosa* the smaller of the carabid beetles, which also emits defensive but less obnoxious, secretions, *P. affinis* exhibited a different kind of preference in its attack. Though 46% of the observed attacks were made only from the rear, it is significant that in 54% of the cases the prey was attacked only from the sides (table 1). Even when non-coleopteran insects like gryllids, lepidopterans, and house flies were offered, they were attacked mostly from the sides. The predator prefers to attack the prey only from the rear when it has to face the spray of defensive secretions. But in the absence of such secretions or when such secretions are less irritating, it attacks the prey from the sides. But there seems to be no selection of prey types based on olfactory stimuli offered by the prey. This observation is supported by the fact that in cases of prey with stronger secretions, number of attacks were from the sides (30% of attacks in *O. pilosa*). It is also true that many attacks were made from the rear (46% of attacks in *O. atrata*) when such defensive secretions had a weak effect or when insects did not emit any secretions at all, as in the case of Lepidoptera and Diptera. Whatever be the prey, after ensuring a firm grip, the extended proboscis probed and located a suitable site like the bases of the mandibles, bases of the antennae, joints of neck or legs and on selecting one, the stylets are instantaneously inserted injecting the saliva very rapidly. The prey stops all its twitching movements within 5-6 seconds and it hangs limp from the tip of the rostrum of the predator.

3.1c. *Prey transportation*: Transportation of the killed prey to a safe and secluded place for consumption is an important behavioural sequence of the predatory reduviids. Feeding does not commence immediately, instead these insects release their captured prey and spend considerable time in cleaning their own body. While the forelegs are used to clean the antennae and rostrum, the abdomen and the thorax are rubbed on the substratum. This is done by keeping the legs wide apart so as to make a flat contact with the ground or the body is held slantingly so as to make the lateral aspects of the body in contact with the ground. In such a position the body surface is repeatedly rubbed and cleaned (figure 5D). Three to five minutes are spent in such cleaning processes. This cleaning of the body is essential in view of the fact that millipedes and carabid beetles which are preys of these insects, discharge a variety of defensive repellent secretions. After cleaning, the predators return to their paralysed prey, insert the stylets and transport the cadaver to a safe and secluded place. After stylet insertion, *H. nigroviolaceus* walks backward dragging the millipede prey along with it (figure 5E). But in *P. affinis* the stylets are inserted mostly at the bases of the antennae and the insect prey is dragged and carried between the legs as the predator walks in search of a secluded place (figure 6D). This type of prey transportation appears to be the most common type as this has also been observed in several other reduviids.

3.1d. *Feeding*: Feeding, the longest of all units, is the terminal part of the predatory behaviour and starts only when the predators transport the prey to a safe place. In *H. nigroviolaceus* it lasts for 1–1½ hr. Since the cylindrical body of the millipede is long, the feeding sites are changed as and when one particular region is sucked out. During such changes, the predator never alters its stance, but manipulates with its fore- and midlegs, moving the prey horizontally from posterior to anterior (figure 5F). The entire contents of the millipede, except the rectal region, are emptied leaving behind only the exoskeleton. *P. affinis* takes 60–70 min for emptying the body contents of its carabid beetle prey and during ingestion, feeding sites are changed many times by the manipulation with the forelegs when a particular part of the prey is emptied. The entire contents of the insect, except the rectal parts, are consumed discarding the exoskeleton. Satiated *H. nigroviolaceus* and *P. affinis* show no interest in feeding for 4–5 days. While immature as well as adults of *H. nigroviolaceus* share a single prey on many occasions, this has never been the case with *P. affinis* where cannibalism is very frequent; starved neanides and adults feed on one another. Usually the smaller males and neanides fall prey to the larger females. The various units and sequences of feeding behaviour shown in figures 2 and 3 are the models of predatory behaviour in *H. nigroviolaceus* and *P. affinis*.

3.2. *Feeding behaviour in T. rubrofasciata*

This reduviid is the only species of the genus represented in India. Though the natural host of this haematophagous insect is said to be rats (Hoare 1972), the present study revealed their common occurrence in many houses, feeding on human and other vertebrates. They come mostly during night to feed and hide during day time in crevices or under mattresses or in places where cow dung cakes are stored. The feeding behaviour of *T. rubrofasciata* differs considerably and

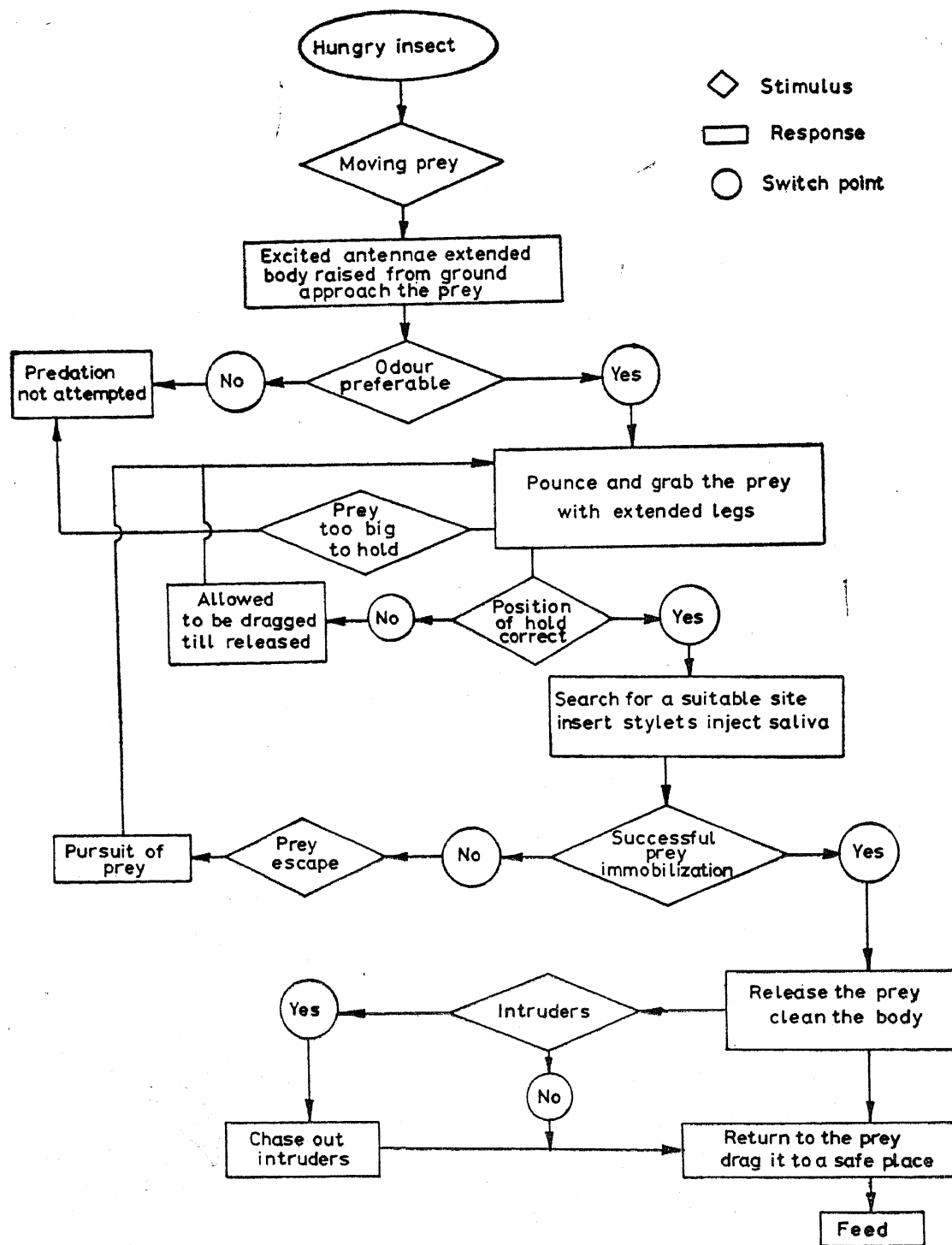


Figure 2. A model for the predatory behaviour in *Haematorrhophus nigroviolaceus* (Reuter).

does not involve many sequences and units as in other carnivorous reduviids, but it definitely shows a series of stimulus-response events. These may be briefly summarised as follows: Arousal of hungry insect → approach to host → host contact → site selection → feed. The following units of feeding behaviour can be distinguished, viz., (i) prey location; (ii) site selection; and (iii) feeding.

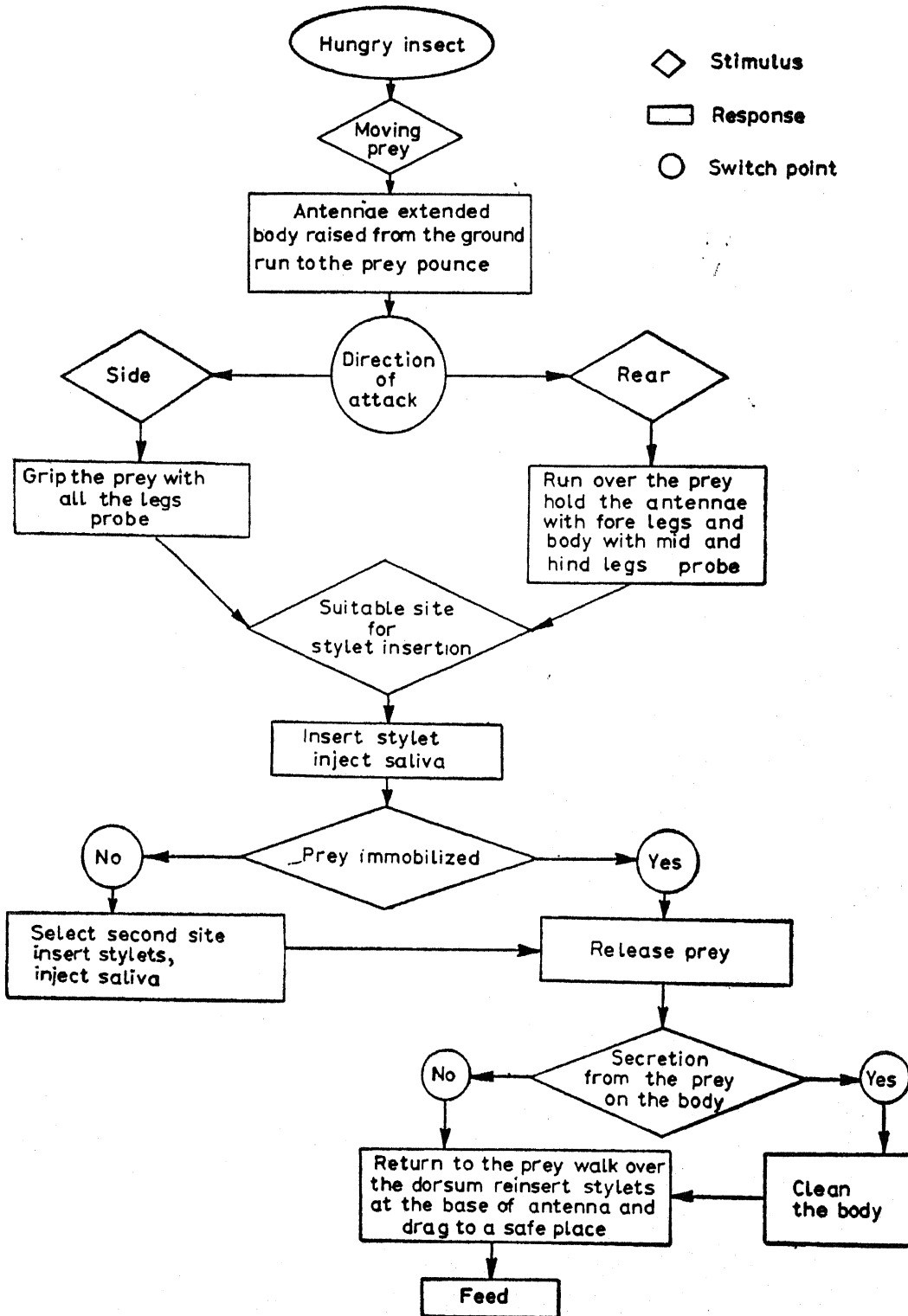


Figure 3. A model for the predatory behaviour in *Pirates affinis* Serville.

3.2a. *Prey location* : As in other blood feeding insects, the antennae appear to be the important sense organs in *T. rubrofasciata* that aid in the location of their hosts; and it is the gradient of air temperature, rather than radiant heat emitted by the host, that arouses the predator. Even when made blind, these

insects oriented successfully towards their hosts. But antennectomised bugs failed to orient towards the direction of the host and never located it. Bugs with their rostrum removed were still able to locate the host successfully. They readily feed on different vertebrates like man, rabbit, dog, rat, and cattle. Once an insect is aroused from a state of akinesis, it orients itself in the direction of the host and approaches it with extended antennae and rostrum (figure 6E).

3.2b. *Site selection*: After successfully locating a host, the next set of behavioural sequences involves selection of a proper site for stylet insertion. This begins with probing the host's surface with the rostrum. During such probings, the stylets were inserted and withdrawn 2-3 times. Such 'sampling' of the available feeding sites appears to provide the 'signal' for the successful location of proper blood meal. Once a site of blood meal is located, the bug commences sucking operation (figure 6F).

3.2c. *Feeding*: This last unit of the feeding sequences lasts for 18-24 min and the bug seldom changes the feeding site. Feeding activity is terminated only after the complete distension of the abdomen. Table 2 gives the volume of blood engorged by the adults and neanides of *T. rubrofasciata*. It is significant that 5th stage neanides consume more blood than both males and females. Adults feed every 3-4 days. Unlike adults, neanides exhibit 'cannibalism', where fully engorged 4th and 5th stage neanides attract unfed neanides of various stages. Such unfed neanides, numbering 2-3, pierce the abdomen of the fully fed neanide with their rostrum and engorge themselves. Victims of this type of feeding initially show some resistance, but remain quiet afterwards to allow being fed by others. Such individuals do not show any ill-effects of these neanidal assaults. Adults are never attacked because of the comparatively hard exoskeleton. This type of feeding differs very much from that of cannibalism of other reduviids and the term

Table 2. Volume of blood meal taken by neanides and adults of *Triatoma rubrofasciata* (volume determined by weighing the insects before and after the blood meals).

Stage of insect	Number of individuals weighed	Average volume of blood consumed in mg
Neanide		
I	42	4.76
II	30	12.77
III	25	52.76
IV	25	115.81
V—Male	20	289.68
V—Female	20	293.56
Adult		
Male	25	217.74
Female	25	255.78

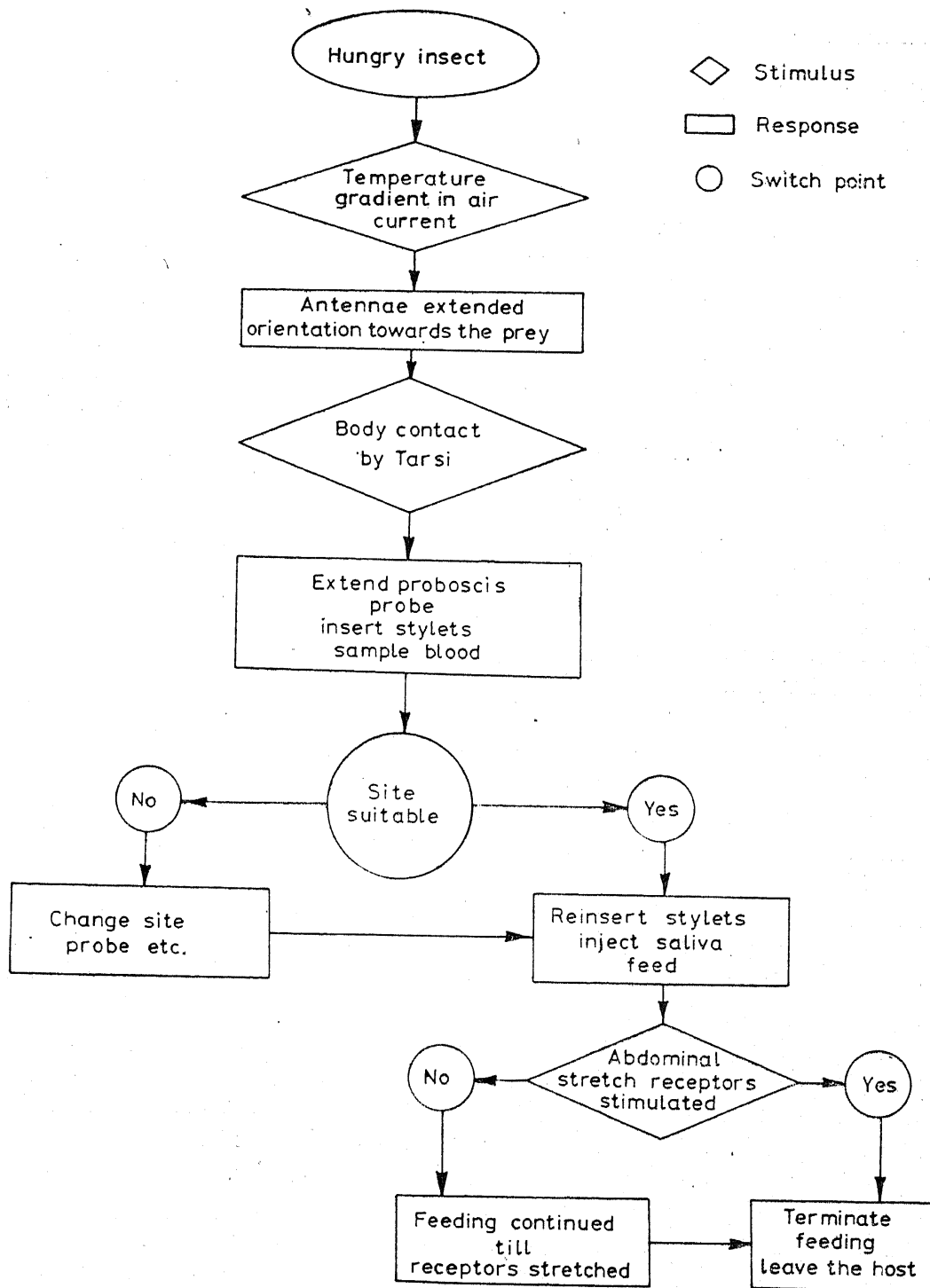


Figure 4. A model for the predatory behaviour in *Triatoma rubrofasciata* (DeGeer).

'kleptohemodeipnonism' is used for such feeding, meaning 'theft of a blood meal' (Ryckman 1951). The various units and sequences of the feeding behaviour are incorporated in figure 4, showing the model of predatory behaviour in *Triatoma rubrofasciata*.

4. Discussion

Analysis of the feeding behaviour of reduviids indicates that their predatory behaviour consists of a series of stimuli-response events. Studies on other predatory insects have shown that prey movement is an important stimulus in eliciting feeding response. Experiments conducted with *H. nigroviolaceus*, *P. affinis*, and *Ectomocoris* spp. using both natural prey and artificial baits showed that in reduviids also the visual stimuli are important for the predator-prey interactions. Observations to this effect have also been made on other reduviids (Odhiambo 1958; Edwards 1962; Parker 1965, 1969, 1971, 1972). Members of Ectrichodiinae are exclusive millipede feeders and the first record of their habit is provided by Green (1925) who reports the feeding of small *Physorhynchus linnaei* Stal on large *Spirostreptus* sp. Cachan (1952) also reports the feeding habits of *Ectrichodia gigas* H. Sch. on the millipede *Peridontopyge* sp. Miller (1971) also reports the feeding habits of *Ectrichodia* sp., *Maraenaspis* sp., and *Scadra* sp. Other Ectrichodiinae observed were *Ectrichotes pilicornis* (Fab.) and *Guionius nigripennis* (Fab.) also feed only on millipedes (Haridass 1978). Millipedes are known to discharge a variety of volatile repellent secretions like *p*-benzoquinones, hydrogencyanide, and benzaldehyde, from their segments of stimulation (Roth and Eisner 1962; Eisner *et al* 1963a, b). The spraying of these chemicals at the time of predation has necessitated the behavioural sequence of cleaning the body by the predatory reduviids, and they spend quite some time in this process. The very hard, chitinised exoskeletons of these millipede feeders enable them, not only to tolerate these irritating fluids, but also to withstand the rough treatment meted out to them at the time of prey attack, especially when they are entwined and dragged on the ground. The Ectrichodiinae show no specificity in their feeding habits, but they definitely exhibit distinct preferences for certain millipede species that emit less pungent and irritating defensive secretions. *H. nigroviolaceus* attacks *Trigoniulus* sp. in preference to the more obnoxious *Xenobolus* sp. and *Paradesmus* sp. Only under starvation, and in the absence of the first mentioned prey, this reduviid would predate on other millipedes.

Members of Piratinae are more aggressive predators and though the prey records include a variety of arthropods, *P. affinis* too, show a preference for less pungent ground beetle. They prefer to attack the prey mostly from the rear to avoid the repellent secretions. Only when the prey types produce more or less pungent secretions, these predators choose to attack from the sides. Since the carabid beetles also discharge phenolic compounds, formic acid, and *p*-benzoquinones as repellants and spray them from particular local segments rather than from all glands at once (Eisner 1958; Eisner *et al* 1962; Roth and Eisner 1962; Eisner *et al* 1963b). *P. affinis* also exhibits cleaning of the body as an important sequence of the predatory behaviour. They also show no specific selection of prey types based on their olfactory stimuli, and under starvation they freely predate on different beetles, gryllids, and on their own species. The present study suggests that in predatory reduviids like Ectrichodiinae and Piratinae, the complex stimulus-response events of feeding behaviour involves preferential selection of prey types, where the olfactory stimulus too plays a role and this only supplements the visual stimulus in prey capture. In both these insect groups it is interesting to observe

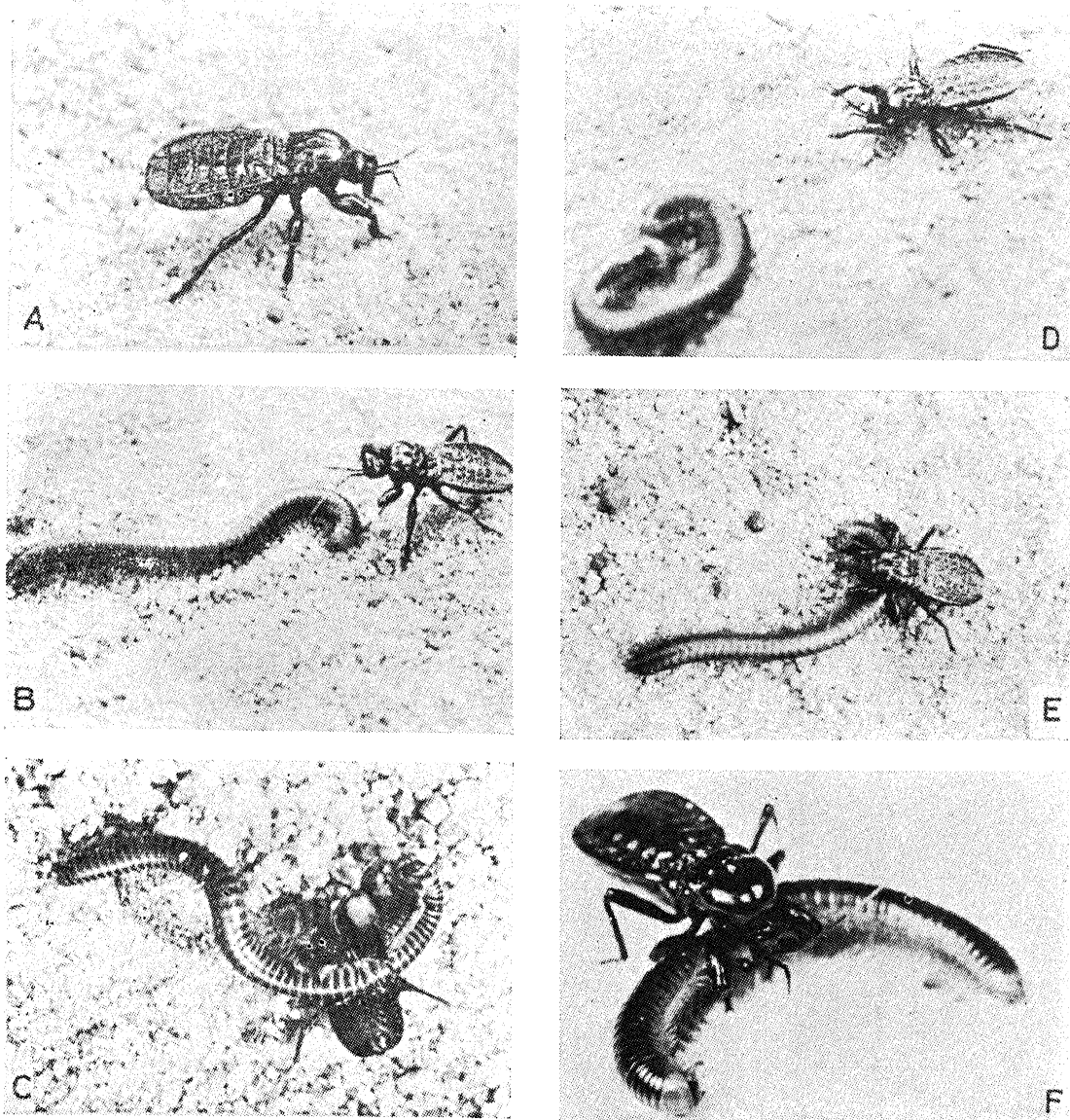


Figure 5. *Haematorrhophus nigroviolaceus*. A. Hungry insect, aroused by a moving prey, approaching the prey with raised body and extended antennae. B. Predator about to pounce on the millipede prey. C. Millipede is grabbed with fore- and mid-legs using the tibial pads, and saliva is injected into a suitable site between the legs. D. After complete paralysis of the prey, the predator cleans its body by rubbing it against the substratum. E. Dragging the paralysed prey to a safe place. F. Feeding of the killed prey.

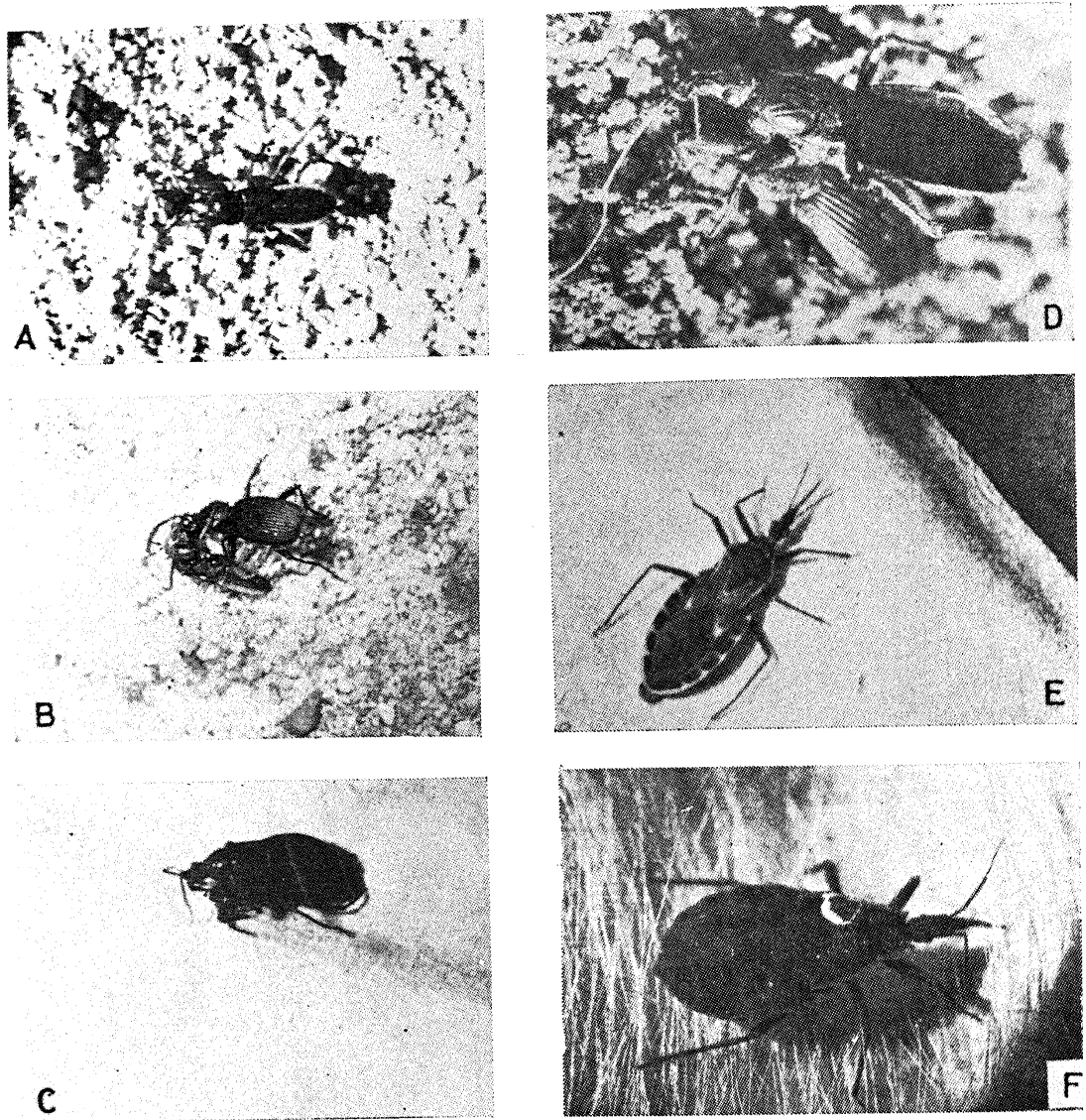


Figure 6. A-D. *Pirates affinis*. A. Hungry 5th Neanide aroused by a moving prey. B. Carabid beetle prey is attacked from the side and the stylets are inserted at the base of the neck. C. Attack of the prey from the rear with stylet insertion at the base of the mandibles. D. Adult female dragging the paralysed beetle prey. E and F. *Triatoma rubrofasciata*. E. Hungry adult male orienting towards the hand of a sleeping person. F. Fifth neanide on the body of a dog, engorging blood.

the presence of well-developed tibial pads, fossula spongiosa, that enhance the gripping ability, well-suited for the millipede and carabid beetle preys.

Unlike predatory reduviids, in the haematophagous *T. rubrofasciata*, feeding behaviour is elicited only by a temperature gradient arising from their vertebrate hosts, as is also the case with other blood feeding insects (Friend and Smith 1977). The failure of the antennectomised insects to orient properly towards their hosts and the successful orientation of the blinded *T. rubrofasciata* confirm the observation of Wigglesworth and Gillett (1934) that the antennae are the primary and 'perhaps the sole sense organs' that receive the temperature stimuli from the vertebrate hosts and aid in host location. Since these insects readily feed on a variety of mammals, from rat to man, their olfactory sense may be said to play a minor role in host location. Once the host is located, considerable time is spent in probing for a suitable site with the rostrum and sampling of the food. The sensory receptors of the rostrum of haematophagous Triatominae have been proved to be mechanoreceptors, rather than chemoreceptors (Pinet 1968; Bernard *et al* 1970), and the various nucleotides, especially ATP, are believed to, or at least to mimic, the signal for the proper food source (Friend and Smith 1977). On selecting a proper food source, *T. rubrofasciata* continues to engorge blood until it is fully satiated, and as suggested by Maddrell (1963) and Anuzel (1972) in *Rhodnius prolixus* Stal, the critical abdominal volume may also be controlled by abdominal stretch receptors. The feeding behaviour of the blood feeding *T. rubrofasciata* thus differs considerably from other predatory reduviids, and the complex of stimulus-response events involved in their feeding behaviour resembles those of phytophagous insects.

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