ORIGINAL RESEARCH PAPER

Zoology

FOOD AND FEEDING BEHAVIOUR OF FRESH WATER LEECH, *ASIATICOBDELLA BIRMANICAS*

KEY WORDS:

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INTRODUCTION

The blood sucking mode of feeding on the buffalo is common among the South East Asian species of leeches specially *Piscillobdella manilensis, Poicilobdella granulosa* (Moore, 1927; Bhatia, 1973; Sawyer, 1984). It was observed that the leech species even pierce the skin of elephant too. The adults use their denticular half jaws and the juveniles use their pointed proboscis, which is similar to niddle of a syringe. (Sawyer 1984).

In the process of cutting the skin surface, anaesthetising the skin surface, piercing the jaws and the complex pharyngeal actions are most important. The phylogenetic development of the mouth parts of *Asiaticobdella birmanica* are Euthylaematus – Pharynx (Hirudinaeformes), Gnathus, Sanguivorous, Trignathus, Pharynx partially Protectile.

During feeding behaviour, '**Searching**' is the first behaviour observed in all leeches display irregular movement of some or all of the body in a manner reminiscent of 'searching'. Searching may be expressed in response to a variety of stimuli including water disturbance, changes in light intensity and presence of dissolved foodstuffs. This behaviour functions to orient the animal with respect to the immediate environment and sometime proceeds as total reversal in direction of locomotion. Searching is particularity directed towards potential food and according, is most readily and aggressive behaviour expressed by 'hungry' leeches conversely its expression is depressed following feeding (sawyer, 1974).

In practice two types of searching can be recognized in the *Asiaticobdella birmanica* these are '**head movement and body waving'.** Although these two movements are for the most part distinguishable. It is likely they constitute a continuous dependent to some extent on body size and state of excitation. This being the case body waving would be specialized form of head movement. In *Haementeria ghilianii* body wavering is replaced by head movement during post-embryonic development.

Observations in the aquarium and on the soft tiles fixed platform about searching behaviour of *A. birmanica* for its locomotion was observed as two different behaviours.

Firstly, when the adult and larval leeches are released on a concrete built platform with soft surface tiles fixed on it then it was observed that, the leech species randomly move in any direction, it move forward in direction by alternate attachment and release of the anterior and posterior sucker on the soft platform. When it release the anterior sucker from the attached soft surface, then for the next forward move upto 6-8 cm in a well grown adult leech of this species, it raise its head in the air up to 2-3 cm and swings in left, right, up and down directions or all around the head to all directions and settles its oral sucker on the platform and establish the attachment for the next creeping cycle of forward movement. In this sort of creeping movement, the leech species doesn't care about the obstacles, live or dead objects in its way, it indicates that, it doesn't have any sense of attaining a specific directed or planned route for the forward creeping.

Secondly, when the leech species *A. birmanica* is in water, the body movements can be good observed in the aquarium. The waving movements of the leech are **sucker locomotion and sucker attachment.**

The use of suckers or sucker like structure located especially at the posterior end of the body is widespread among segmented worms. As the oral sucker released its attachment to the substrate a wave of contraction passes over the circular muscles from anterior to posterior. This causes body elongation which acting against an anchored caudal sucker extends the body forward over the substrate. The oral sucker attaches as the caudal sucker release and a wave of contraction passes over the longitudinal muscles which acting against the anchored oral sucker draws the body forward. During this forward progression a tension of about 1.2 – 1.8 gm is normally exerted by the oral sucker in a well grown adult leech of this species.

The mechanism of sucker attachment of the caudal sucker elicits a reflex inhibition of the longitudinal muscle in the blood sucking species. Suckers are so fundamental to the biological make-up of leeches that leech behaviour cannot be understood fully without some knowledge of the sucker and its various roles in the life of the leeches. One must make a clear distinction between two independent mechanisms which contribute to sucker attachment to the substrate, namely adhesion via glandular secretion and negative pressure (suction) relive contribution of these two mechanisms vary with species.

In most *Asiaticobdella birmanica* adhesive gland cells are numerous but not especially prominent in keeping with the more advanced locomotory role for the sucker. Each cell opens individually on to the inner surface of the sucker where it secrets an acid mucopolysuccharide therefore when the leech move forward a mucous strip results on the soft surface of the dry substratum indicating the secretion of mucous sticky secretion. Following processes observed in sucker attachment.

In suction most leech species employ the caudal sucker as a finely tuned suctorial device for rapid efficient dipole locomotion. *Asiaticobdella birmanica* can be taken as representative of this group. Its caudal sucker is nearly circular. Highly muscular disc broadly attacked to the posterior end of the body.

This juncture allows a remarkable flexibility movement of the body about a fixed point spontaneous rotation of 90^0 to 120^0 about the vertical axis is common and up to 360^0 occurs occasionally during 'searching' . Furthermore it is possible to rotate the body manually through 450^0 without causing release of the sucker.

METHODOLOGY

To study the food and feeding habit of the leech species *Asiaticobdella birmanica* selected for the study, direct observation method on the field was used to understand the fact. A pond where the domestic buffalo enter in the water frequently, such water body was selected for the study and the details of the leech behaviour for the selection of the host, approaching the host, attachment to the host body and making the jaw wound to host skin, time required to suck the blood and other details of feeding behaviour are recorded. Different kind of body movements were seen in the leech species during blood sucking and after the feeding is over, what is the next move of the leech species; all these details are recorded at the habitat site. All the observations are clear and easy to observe hence no any laboratory experimentations were carried. The methodology is based on the 'Direct observation method' (Sawyer, 1984, 1986).

In the present investigation was carried out on leech species, *Asiaticobdella birmanica.* The role of posterior sucker in the locomotion, especially for suction action was studied. To study the locomotion on the ground on the wet soil, on the soft tiles coated platform and on the glass surface was studied. The well fed leech was used as a control and of the same size another adult leech was starved for one week and released on the surfaces. The locomotion in both the experimental and control were observed.

RESULTS AND DISCUSSION

Asiaticobdella birmanica is a sanguivorous leech (Siddal *et al.,* 1995, 1996), sucking blood mainly from the lower-lateral region of the body of domestic buffalo. The leech species is found to stick to the hip region, near the vulva, posterior part of udder, ventral to the neck near the large jugular vein and near the base of ear pinna of host buffalo. Generally the cows enter the shallow water of depth less than 1 ft for drinking but not for dipping, therefore, the leech does not stick to their body; but buffalo was the most preferred host by this leech species for sanguivorous feeding; When the pig or dog enters the stream water then very few number of leeches are found stick to these hosts. Occasionally the leech species is found stuck to the unprotected human feet during the netting of this species. *Hirudo birmanica* is found stuck to the site of wound in the feet of cow-boys and commonly in the ankle region when they enter the pond water to clean the buffaloes (Cow boys told their experience). Only one leech was found attached to the site of wound and non-wounded normal foot but not in a cluster. The time taken by the leech to stick the human body was shorter in water than on land. A hungry individual of this leech species may take 05-10 min to establish firm attachment with the human body when experimented outside the water. Once the attachment is firm to the part of human body, it may take 03-04 minutes for the jaw injury or skin cut on the host body to suck the blood. An adult individual of *A. birmanica* sucks 20-22 ml blood from any host and only after fully gorging the attached leech leave the host body within 20 minutes if not removed forcefully. The leech of any length requires 18-20 min for one full attempt of sucking blood from the host body. When the host buffalo enters the water of leech habitat, usually take rest and bath for 30-40 min time, it may be called as host bathing time (HBT), which was naturally the sufficient time for *A. birmanica* to complete the blood sucking process. If by any certain reason when the host of this leech leaves the habitat then the leech leave the host and get dropped in to the water. It is the best blood letting strategy adopted by this leech species (Siddal *et al.*, 1996). Only during monsoon season (June- September) the leech comes out of aquatic habitat along with the host buffalo and remains stuck to the host till it gets fully gorged with blood meal. In the process the leeches are carried with the host buffalo and thus are spread away from the habitat, this is the most common way of distribution of this species. The leeches distributed through the host mediation later on get hibernated in the wet soil or swimming free if dropped in the water. During the rest of the seasons (winter and summer) the leeches are found detached from the host body and dropped into the habitat water hence the distribution of this species through attachment to the host body is very poor or none during the winter and the summer. During the late summer season in the month of May, the bite (entry of sharp proboscis in to host skin) of 3-5 mm long leeches freshly released from the cocoons and 2-5 cm long young leeches of thread size living in the pools in the stream most probably produces small knots (inflammation due to larval leech bite) of pale reddish colour on the skin of host buffalo, therefore, the herd of buffalo escapes from the ponds and pools in the stream with rapid speed within 10-15 min. The itching in the host body due to larval leech bite is the most probable reason behind escape before HBT. Generally the fasted or freshly collected or most hungry leech take nearly 08-10 min to fix its oral sucker on human body when experimented in-vitro in its aquatic habitat. It is not sure that it will make wound at the site of attachment with the human body. As the leech starts the process of sucking the blood, the sensation of biting is like a pin pricking in the body. During the process of sucking the blood from the host body there is a continuous minor irritation, however there is no loss of blood from the site of attachment but when leech is removed from the host body during the sucking of blood and after, there is a continuous flow of blood from the wound caused by the leech bite. Generally the bleeding didn't stop up to 05 minutes. There was a characteristic tri-radiate, inverted 'Y' shaped (Mercedes car Logo) wound mark of leech bite found on the skin of buffalo in a freshly leech bite case. The leech sticks to the host skin by way of using its both suckers. The action of sucking blood is similar to suction pump thus, gorging the stomach compartments were from posterior to anterior end of the body. A few leeches stuck to the body of buffaloes in the process of sucking of blood were found picked-up and swallowed by the large size aquatic bird species like Gray Herons (*Ardea cinerea*) and Cattle Egrets (*Bubulcus ibis*) waiting on the banks of the pond or the stream and few sitting on the back of the host buffalo.

The experimental leech was fast in movement on the all surfaces. The grip of the posterior sucker on the ground in both the experimental and well fed leech was very poor. The attachment and release of the posterior sucker for the forward progression of the body was comparatively fast in the starved leech than the fed leech. The starved leech take 5 seconds to make the firm grip on the soft surface while the well fed leech take 10-12 seconds during locomotion. The starved leech release the posterior sucker grip when it makes the anterior sucker attachment and contrast the body by forward propulsion nearer to the anterior sucker, for this event the time required in the starved leech was less as compared to the fed leech. This indicates the starved leech is more active in the sucker mode of locomotion.

The sucker mode of locomotion takes two forms; first, Vermiform crawling and second Inchworm crawling. Both inchworm and vermiform crawling share body elongation as the initial phase of crawling sequence, they differ in subsequent movement of the caudal end of the body and in the relative position of caudal sucker attachment. Vermiform crawling was probably derived phylogenetically from the oligochaete mode of locomotion. Whereas, inchworm crawling is an advanced behaviour involving the skilful use of the caudal sucker as a suctorial device. (Sawyer, 1986).

Whether vermiform crawling or inchworm crawling is employed by a leech is to a great extent characteristic of the taxonomic group to which the species belongs. *Erpobdelliform* species, e.g. *Erpobdella octoclata*, display only vermiform crawling (with a characteristic lateral looping of the head). On the other hand the *Branchiobdelida* and *Acanthobdelid*a crawl exclusively in inchworm fashion. Similarly, most Rhynchobdellida, e.g. *piscicola geometra* and probably *Glossiphonia complinata*, display only inchworm crawling however, a few glossiphonild species display vermiform crawling occasionally e.g. *Helobdella stagnalis* and *Hemiclepis marginata* or routinely example of adult *Haementeria ghilianii*. In the case of the latter species there is a progressive ontogenetic change from inchworm to vermiform crawling.

Hirudiniform species, including *Hirudo medicinalis*, *Haemopis sanguisuga* and *Haemadipsa zeylanica*, are capable of employing either vermiform crawling or inchworm crawling. Precisely which form of crawling is used at any given moment is dependent on poorly understood exteroceptive and proprioce privet factors, for example. *Hirudo medicinalis* crawls exclusively in inchworm fashion on a vertical surface same is the case found in *Asiaticobdella birmanica*, *Poicilobdella granulose* when these species move from the bottom of aquarium to surface of aquarium along the aquarium glass wall by using the anterior and posterior sucker, but usually in vermiform fashion on a horizontal surface.

Also inchworm Crawling is hardly ever expressed on a soft substrate such as sand. In the land leech *Haemadipsa zeylanica* vermiform crawling is very infrequently expressed and then nearly always on a soft or unstable substrate (personal observation). **In vermiform crawling,** the individual extends its whole body and then with or without firm attachment of the oral sucker, pull up the caudal end of the body without executing an exaggerated loop. During this sequence the annuli are often erected, presumebly affording the animal better traction with the substrate. Vermiform crawling would appear to be more efficient than inchworm crawling when moving on an unstable substrate such as mud or sand. The resemblance of vermiform crawling to Oligochaeata locomotion is probably not coincidental in the leeches.

Although leech crawling consist of a well defined sequence of simple movements. Some of which have been discussed in the earlier descriptions. The neural basis of the crawling cycle is poorly understood.

It is possible to analyze the crawling cycle in a freely suspended leech by the provision of suitable attachments e.g. cover slips. For each sucker in turn. When the caudal sucker attaches itself in such a freely suspended preparation a wave of activity at once passes down the circular muscles while the longitudinal muscles simultaneously relax. When the oral sucker is allowed to attach itself. As soon as a wave of circular contraction has expended over the whole body. The caudal sucker detaches itself spontaneously and a wave of contraction passes down the longitudinal muscles of the whole body. Reattachment of the caudal sucker provide detachment of the oral sucker and the cycle is repeated.

Attachment of the caudal sucker requires full isotonic contraction of the longitudinal muscles isometric contraction of these muscles. Even in brainless animals leads to tremendous tension (up to 80g) which can last for prolonged period (e.g. 60s) under such isometric conditions the crawling cycle is abolished but reappears as soon as the longitudinal muscles are allowed to shorten freely to their normal extent. Frequency of crawling depends on the rate at which the longitudinal muscles undergo complete isotonic contraction thus, altering the rate of contraction e.g. by attaching a load to the hind end of the animal decreases the frequency of crawling.

Although the suckers clearly play an important role in the normal execution of the crawling cycle removal or enervation of the suckers does not abolish crawling as long as the animal is in contact with the ground (Ventral stimulation) (Gee, 1913), (Gray, *et al.,* 1938). Similarly stimulation to the dorsal surface does not elicit longitudinal relaxation and if applied during a phase of longitudinal relaxation leads to contraction of these muscles. Under some conditions dorsal tactile stimulation leads to swimming. The absence of all extero-stimulation to the body also leads to swimming but never to crawling.

In inchworm crawling, the individual extends its whole body and attacks its oral sucker firmly to a solid substrate almost instantly the caudal sucker release and executing a distinct loop with the body is attached close to and virtually touching the oral sucker, the latter quickly released. The typical inchworm crawling sequence outlined above should appear to be more efficient than vermiform crawling when moving on a solid (smooth) substrate such as a rock or plant. This observation can be interpreted as evidence that inchworm crawling and vermiform crawling are distinct behaviours and do not represent two extremes of the same.

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