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The Role of *Chaetogaster limnaei* in the Dynamics of Trematode Transmission in Natural Populations of Freshwater Snails

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Summary. *Chaetogaster limnaei*, an oligochaete was always found infesting *Bulinus* (*Phy.*) *globosus*, *B.*(*B.*) *forskalii* and *Lymnaea natalensis* in Bo, Sierra Leone, living below the shell or embedded in the mucus of the foot. The worms had no preference for snails with trematode infection. The population was highest in the dry season when fewer snails were infected by trematodes. This is suggested to be a result of the protection the worms give to snails against invading miracidia.

Introduction

In a recent study of freshwater snails of economic importance in the rice swamps of Bo, Sierra Leone, West Africa, several gastropods including *Bulinus* (*Physopsis*) *globosus* (Morelet), *Bulinus* (*Bulinus*) *forskalii* (Ehrenberg) and *Lymnaea natalensis* (Krauss) were found to be infested by an oligochaete annelid, *Chaetogaster limnaei*. The worm was first described by von Baer (1827) from the mantle cavity and renal organ of various Lymnaeidae and *Planorbis corneus*. Its potential role in the control of larval trematodes came to light in 1931 when Wagin found cercariae of trematodes in its gut. This observation was confirmed by Wesenberg-Lund (1934), Krasnodebski (1936), Backlund (1949), Ruiz (1951) and Shigina (1970).

The protective influence of *Chaetogaster* on infection of snails by miracidia was demonstrated by Khalil (1961) who was unable to infect *Lymnaea natalensis* infested with *Chaetogaster* with miracidia of *Fasciola gigantica*. A low infection rate (34%) was obtained by Michelson (1964) when he tried to infect *Biomphalaria glabrata* having *Chaetogaster* with miracidia of *Schistosoma mansoni* as compared to 76% in worm-free snails. It would seem from these reports that the association of *C. limnaei* with snails is purely commensal, the worm being given a measure of protection from enemies such as fish and physical hazards, such as excessive flooding and fast water current, while the worm protects the snails from infection by trematodes. Gruffydd (1965a, b) differentiated two, subspecies of *Chaetogaster limnaei*. The first *C. limnaei limnaei* lives on the outer surfaces of the snail as a harmless commensal while the other *C. limnaei vaghini* lives within the kidney and eats the tissues of this organ. The latter subspecies is predatory and capable of harming the host.

Reports of the worm on the African continent are extremely scanty and sketchy. Reference was made to it by Van Someren (1946) in Kenya as being commonly

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found inside the shells of living *Lymnaea caillaudi* as a harmless commensal. In South Africa, Bayer (1955) found an oligochaete, "probably *C. limnaei*" in the mantle cavity of several snails around Durban. A very brief reference was also made to the worm by McClelland (1964) who found few in his snail tanks. This exercise is, therefore, an effort to investigate under natural conditions the role of the worm on the life of the snail hosts and the trematodes which they transmit.

Materials and Methods

Bulinus (*Phy.*) *globosus*, *B.* (*B.*) *forskalii* and *Lymnaea natalensis* were collected twice a month from a very large rice swamp in the centre of Bo town near the Bo by-pass bridge. Each snail was put in a 3 × 1 cm glass specimen tube containing some filtered pond water and exposed to four 60 watt electric bulb illumination for 4–5 h. The water was then examined for cercariae of trematodes namely *Schistosoma haematobium*, *Echinostoma leonense* sp. nov., *E. porteri* sp. nov. and two undetermined species of Xiphidiocercariae (Fashuyi, 1976). *Chaetogaster* usually emerged from infested snails and crawled about the floor of the tube under such conditions. All worms found in water were counted under the binoculars. The foot and other surfaces below the shell of every snail were examined for *Chaetogaster*. Snails not shedding cercariae after exposure were dissected and examined for larval trematodes and *Chaetogaster*.

The gut contents of fifteen worms were examined every month under the microscope. As the body wall is transparent, each worm was examined whole either gently pressed, or squashed within slide and coverslip. Some worms were observed in Petri dishes containing cercariae to see if the latter would be eaten.

Results

Changes in Chaetogaster Population. All the three common species of snails in the rice swamp were infested with *Chaetogaster* (Fig. 1). There was a peak rise in worm population late in the dry season (Jan. and Feb.) with a sharp decline in March and April at the onset of 1973 rainy season.

Location of Chaetogaster in Snails. Most of the worms attached to the snails were found below the shell close to the collar ridge. The rest were found embedded in the mucus of the foot.

Gut Contents. The gut contents of *Chaetogaster* examined included partially digested remains of rotifers, ostracods and diatoms. Cercariae were not seen in the worm's gut even after both have been left together for several hours.

Incidence of Chaetogaster and Trematodes in Snails. The distribution of *Chaetogaster* among snails parasitized and not parasitized by trematodes have been plotted on a 2 × 2 contingency table (Table 1). There were few snails harbouring both trematode and *Chaetogaster* simultaneously than those with either of them. The number of snails with *Chaetogaster* correlates negatively with those infected by trematodes ($r = -0.084$, Fig. 2).

Distribution Among Snails. The distribution of *Chaetogaster* population among various snails is shown in Figure 3. *B.* (*Phy.*) *globosus* harboured more worms (64.9%) than *L. natalensis* and *B.* (*B.*) *forskalii* with 22.6% and 12.5% respectively of total worm population. The average number of *Chaetogaster* per snail examined was highest in *B.* (*Phy.*) *globosus* (Fig. 3).

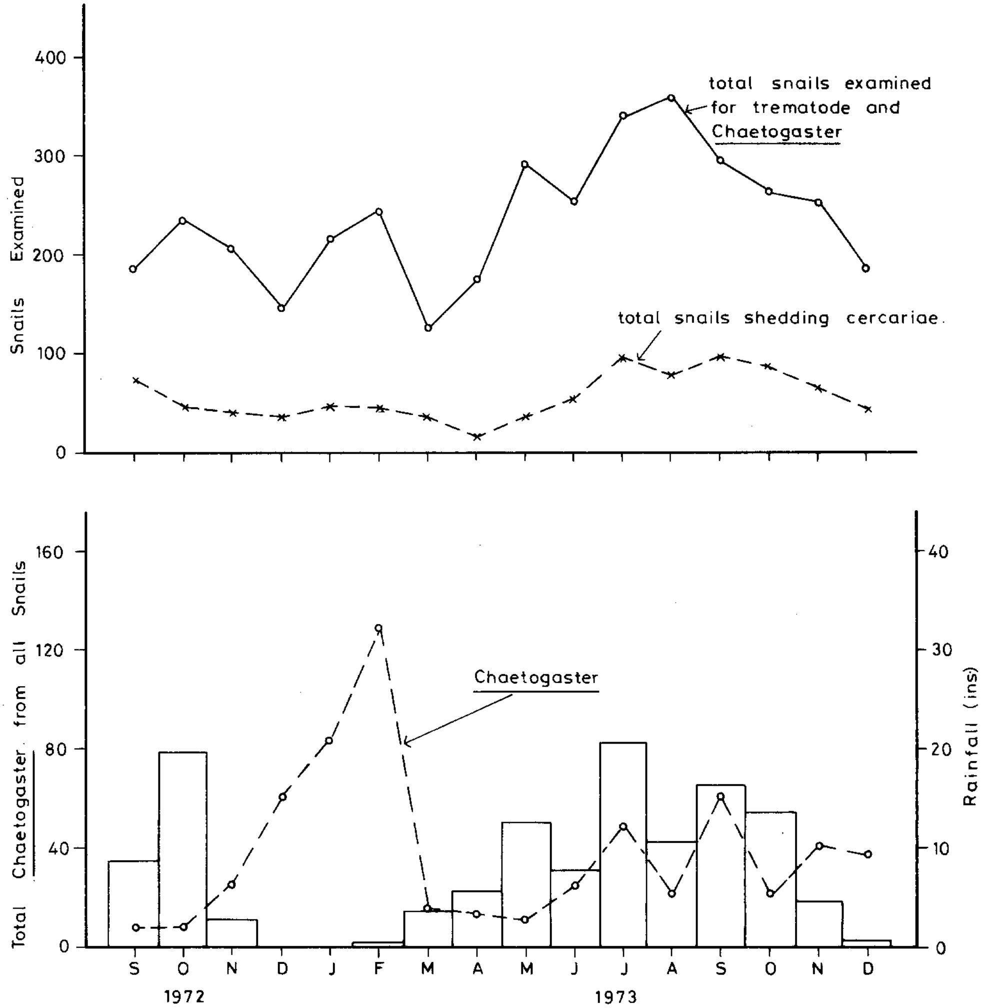

Fig. 1. Total number of snails examined monthly and total *Chaetogaster* recovered

Discussion

Following von Baer's first description of *Chaetogaster limnaei* as a free living worm in water inhabited by pulminate snails and in the kidney of snails, all other similar worms found in snails have often been called that name. Gruffydd (1965a, b) and Buse (1971) distinguished the body surface and kidney forms as subspecies of *C. limnaei.* The present form can, therefore, be said to be more related to the subspecies *C. limnaei limnaei* on the body surfaces of snails. The worm was not seen in the mantle cavity or kidney of all snails examined.

Studies carried out on populations of *C. limnaei* in Britain showed that they varied seasonally (Gruffydd, 1965b; Buse, 1971). In Bo, Sierra Leone, the worm was most

Table 1. The incidence of *Chaetogaster limnaei* in *Bulinus* (*Phys.*) *globosus*, *Bulinus* (*B.*) *forskalii* and *Lymnaea natalensis* on a 2 × 2 table

		Snails and *Chaetogaster*					
		B. (*Phys.*) *globosus*		*B.* (*B.*) *forskalii*		*L. natalensis*	
		+	−	+	−	+	−
Snails	+	82	343	16	513	54	608
Trematodes	−	168	813	16	572	65	472
X^2		0.7301		0.0046		46.352	
P		30%–50%		90%–95%		∠0.1%	
Trematodes		*S. haematobium*		Xiphidiocercaria A		Xiphidiocercaria B	
Parasites		*E. leonense*				*E. porteri*	

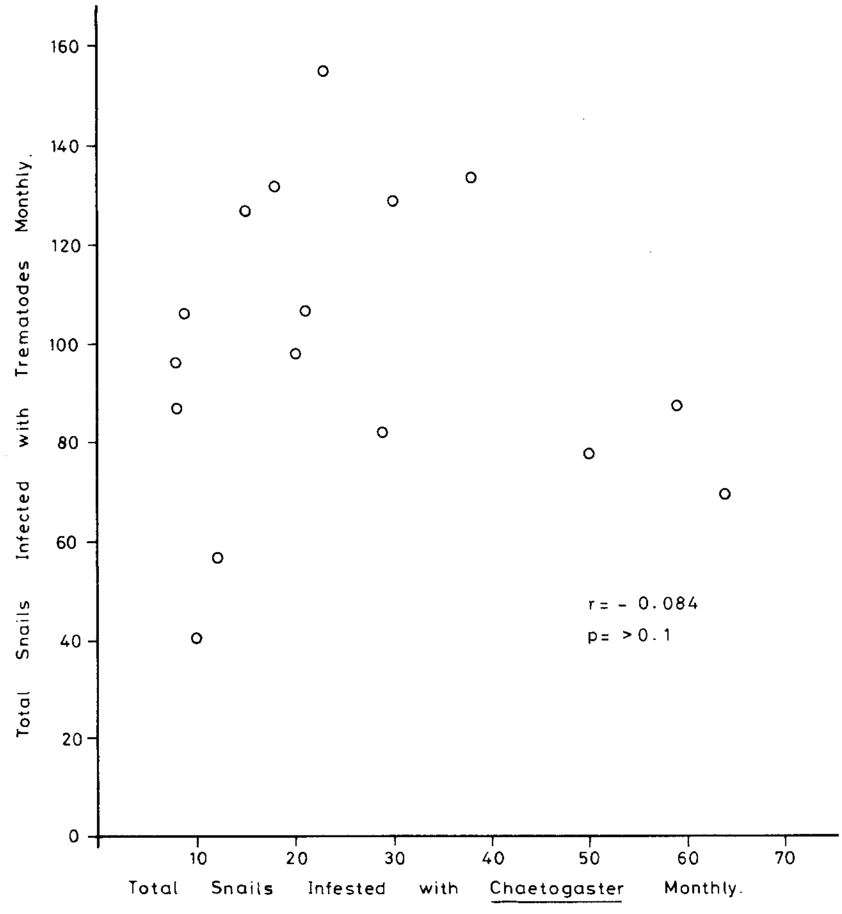

Fig. 2. Relationships between trematode infection in snails and infestation with *Chaetogaster*

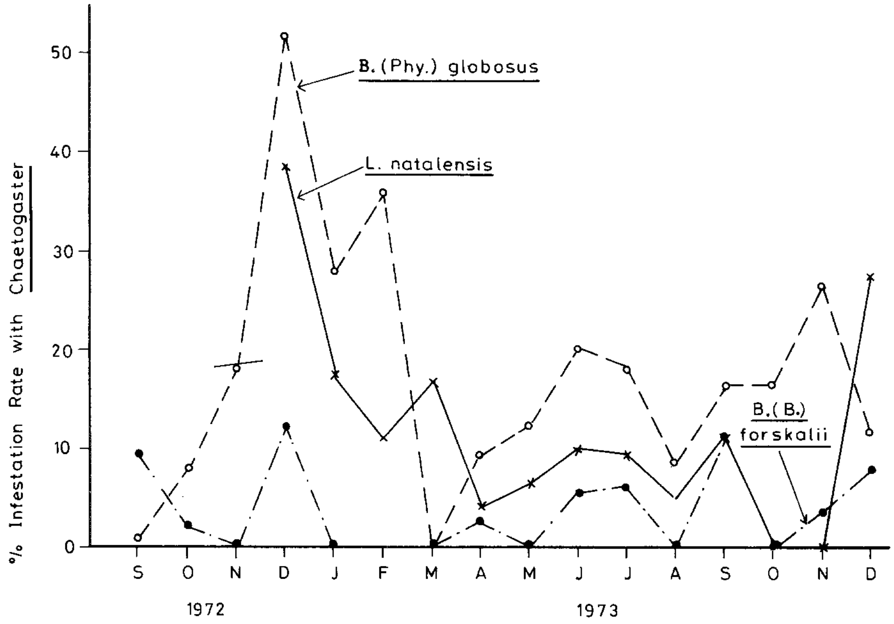

Fig. 3. Percentage infestation rates of snails with *Chaetogaster*

abundant in the dry season (Fig. 1). That was the time water in the area was more stable physically and the worms less likely to be swept away by flood.

The worm has been reported to show preference for some snails and discriminate against others (Khalil, 1961). Although all snails in the rice swamp were infested, it showed more preference for *B. (Phy.) globosus* than others. This can be explained by the behaviour and habitats of these snails. *B. (B.) forskalii* was always collected from temporary bodies of water which were muddy and less likely to be rich in decaying organic matter and microfauna which form the main food of rotifers and ostracods. This would mean substantial absence of food supply for *Chaetogaster* whose gut contents comprise mainly of rotifers and ostracods. *L. natalensis* on the other hand was often observed gliding on the water surface and not with quick reach of *Chaetogaster* which crawls or swims near the substrate. *B. (Phy.) globosus* was always seen attached to submerged weeds, pieces of wood or undersurfaces of floating aquatic leaves or crawling on the stream bed. The snail is, therefore, a surer source of shelter for *Chaetogaster* than all others in the environment.

It is difficult to assess the actual role of the worm in the dynamics of trematode transmission in Bo. There was a decrease in the number of snails shedding cercariae when *Chaetogaster* was abundant in the rainy season. The reverse was the case in the dry season (Dec.–Feb., Fig. 1). This inverse relationship could be a result of the protection against invading miracidia given by the worm (Khalil, 1961; Wajdi, 1964; Michelson, 1964), resulting in a highly significant negative correlation between the two. It could also be due to other factors. The arrival of the rains resulting in fast currents could sweep away the worms anytime they emerged from the snail. Consequently, the worm population remained low when conditions were quite favourable for rapid multiplication in snails and a resultant increase in trematode infection potential. Our results show that *C. limnaei limnaei* plays no part in reducing cercariae emitted by snails as the worm never fed on cercariae.

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