THE OCCURRENCE OF DIGENEAN LARVAE IN FRESHWATER SNAILS AT MBEZI-TEMBONI POND, DAR ES SALAAM

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ABSTRACT

The abundance of digenean larvae in snails at a pond in Mbezi -Temboni, Dar es Salaam, was investigated from July 1996 to June 1997. A total of 2,112 snails belonging to three species, Bulinus globosus *Morelet 1866,* Bulinus forskalii *Ehrenberg 1869, and* Melanoides tuberculata *Müller 1774 were examined, and 28 (1.3%) were found infected by four species of digenean trematodes. Trematodes were recovered only from* Bulinus *species; none of the examined* M. tuberculata *was infected.* B. globosus *was infected by* Schistosoma haematobium *Bilharz 1852 (1.14%), unidentified furcocercous cercariae (0.4%), and echinostome cercariae (0.76%).* B. forskalii *was infected by echinostome cercariae (0.25%) only. Generally, prevalence of digenean larvae in their host snails was very low and varied with the seasons. Variation of prevalence with the seasons was probably influenced by factors such as rainfall, population dynamics of host, and temporal availability of definitive hosts. Furthermore,* S. haematobium *and echinostome cercariae from* B. globosus *occurred alternately but not concurrently, suggesting a possible presence of intramolluscan competition.*

INTRODUCTION

Digenean trematodes are of significant economic importance as they can cause severe diseases in humans and domestic animals. Genera such as *Fasciola, Schistosoma, Clonorchis* and *Echinostoma* are renown for their pathogenicity in their hosts. In humans, schistosomiasis is the most important due to its high debilitating effects. The World Health Organisation (WHO) estimates that world wide 250 million people suffer from schistosomiasis, and 600 million are at risk. In Tanzania, about 19% of the population are believed to be affected by schistosomiasis (Iarotski & Davis 1981).

The increasing human population in developing countries has led to increased demand for food and energy. This has, sometimes, necessitated the construction of water reservoirs for various purposes including hydroelectric power production, irrigation, and domestic use and watering of animals. These reservoirs provide favourable habitats for snails, the first hosts of digeneans. Consequently, in Tanzania, for example, the distribution of snail-borne diseases has expanded (Rugemalila 1991). The permanence of such reservoirs, also, ensures year round transmission. In theory, other digeneans may also have been affected similarly. However, studies on the occurrence and distribution of the other digeneans are scarce.

Studies on the population biology of digenean larvae are useful in assessing the prevalence of snail-borne diseases (Baalawy & Moyo 1970) and could provide a more realistic understanding of the ecological setting from which snail-borne diseases originate (Loker *et al.* 1980). Studies carried out in areas where smail-borne diseases are endemic, may divulge existence of species that could be useful as biological agents in the control of such diseases. For instance, it has been reported that the prevalence of *Schistosoma haematobium* in *Bulinus* species may be reduced drastically by antagonist larval digeneans, which are naturally present in an endemic area (McCullough 1981).

In Tanzania, with the exception of Loker *et al.* (1980), studies of digenean larvae using a holistic approach are lacking. The present paper reports on a study to determine the abundance and population dynamics of digenean trematodes in an area where snail-borne diseases are endemic.

METHODS

The study was carried out in a 100 m^{2}. oval shaped pond at Mbezi-Temboni area, which is about 18 west of the city centre along the Morogoro road, Dar es Salaam, Tanzania. At the time the study was conducted, the water appeared clear all the time and short grasses, sedges and water lilies flourished on the edges of the pond. A large area of the pond was free of vegetation. The pond serves for watering domestic animals, and is visited by aquatic birds throughout the year. The snail fauna collected comprised of *Bulinus globosus* Morelet, 1866, *Bulinus forskalii* and *Melanoides tuberculata* Müller, 1774.

Snails were collected monthly from July 1996 to June 1997. A scoop and a pair of long forceps were used to collect snails from the deep habitats and from the shallow habitats, respectively. Snails were packed in plastic containers containing fresh water plants and transported to the laboratory in the Department of Zoology and Marine Biology of the University of Dar es Salaam. In the laboratory each snail was kept singly in a 10 mls beaker filled with conditioned tap water and exposed to strong artificial light (60 watts at one metre) for six to twenty four hours to induce shedding of cercariae. The beakers were inspected twice in 24 hours under a dissecting microscope for presence of cercariae. All the snails regardless of whether they were shedding or not shedding cercariae were also examined for sporocysts, rediae and metacercariae Snail shells were removed and their bodies crushed between two glass slides and examined under a compound microscope for infection. For the calculation of prevalence, snails harbouring sporocysts or rediae containing cercariae insufficiently developed to permit identification were classified as "infected". Snails and cercariae were identified with the help of keys prepared by the Danish Bilharziasis Laboratory (1987), and Frandsen and Christensen (1984).

RESULTS

The overall prevalence of digenean larvae in snails was low and fluctuated over the study period. Out of 2112 snails examined, only 28 (1.3%) were infected by digenean trematodes. High values were recorded during the dry period (September to November 1996) and low values during the rain season (March to June 1997). In fact, prevalence fell to zero from April through June 1997 (Fig. 1).

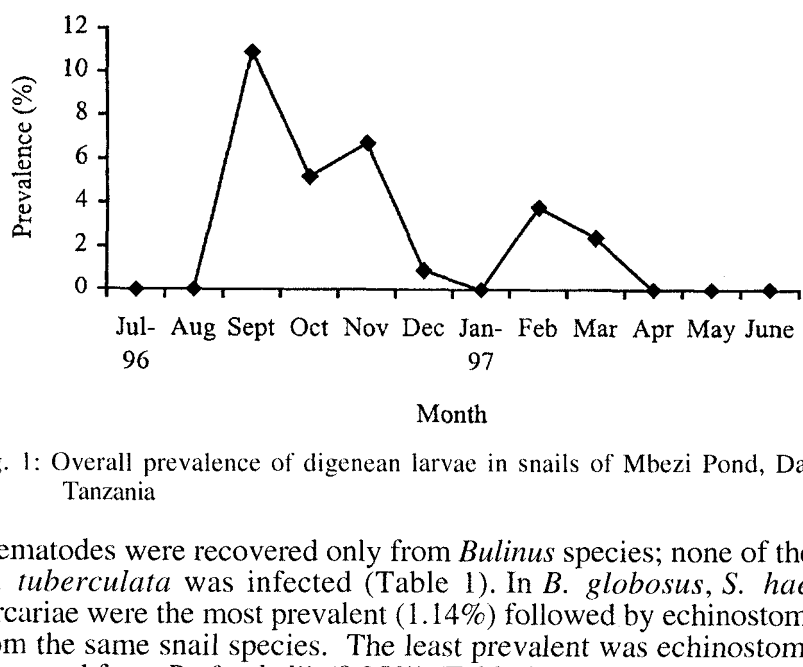

Fig. 1: Overall prevalence of digenean larvae in snails of Mbezi Pond, Dar es Salaam, Tanzania

Trematodes were recovered only from *Bulinus* species; none of the examined *M. tuberculata* was infected (Table 1). In *B. globosus*, *S. haematobium* cercariae were the most prevalent (1.14%) followed by echinostomes (0.76%) from the same snail species. The least prevalent was echinostome cercariae recovered from *B. forskalii* (0.25%) (Table 2).

Table 1: Occurrence of digenean larvae in snails from a Mbezi pond, Dar es Salaam, Tanzania

Snail species	Number examined	Number infected	Prevalence (%)
Bulinus globusus	1312	27	2.0
Bulinus forskalii	397	1	0.25
Melanoides turbeculata	403	0	0
Total	**2112**	**28**	**1.3**

Table 2: Prevalence of digenean larvae in snails from a Mbezi pond, Dar es Salaam, Tanzania

Cercarial type	Snail host	No. of snail examined/infected	Prevalence (%)
S. haematobium	*Bulinus globosus*	1312(15)	1.14
Echinostome	*Bulinus globosus*	1312(10)	0.76
Echinostome	*Bulinus forskalii*	397(1)	0.25
Brevifurcate arpharygeate monostome	*Bulinus globosus*	1312(2)	0.4

Multiple infections (i.e. two or more species of digenean larvae concurrently infecting an individual snail) were not recorded. However, *B. globosus* population harboured three species of digenean larvae (*S. haematobium*, echinostome and brevifurcate apharyngeate monostome cercariae). The prevalence of *S. haematobium* and that of the echinostome cercariae exhibited temporal variation, the two larvae were never observed concurrently but alternately over the study period. Maximum prevalence of echinostome cercariae was recorded in November 1996 (10.9%) and that of *S. haematobium* cercariae in February 1997 (3.8%) (Fig. 2).

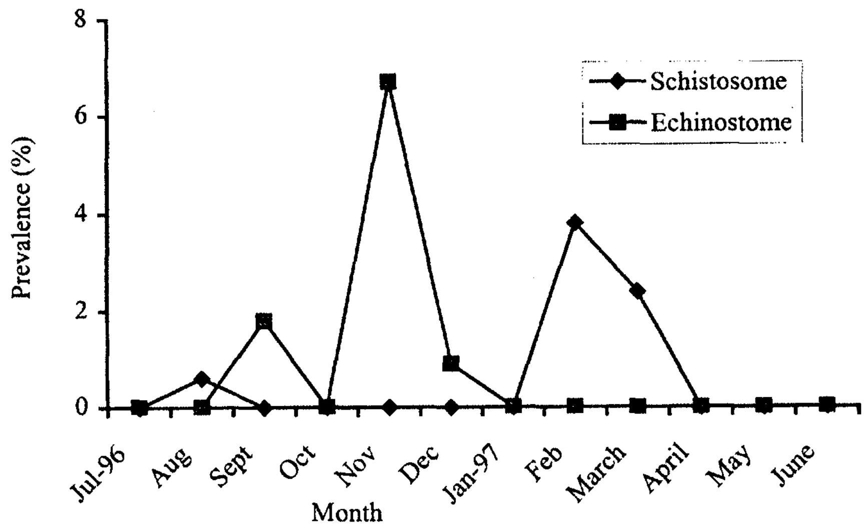

Fig. 2: Temporal variation in the occurrence of schistosome and echinostome cercariae in *Bulinus globosus* at a Mbezi pond, Dar es Salaam, Tanzania

DISCUSSION

Generally, the results of the present study show low prevalence (1.3%) of digenean larvae in snail hosts. This is typical of infection by digenean larvae in snails (see Loker *et al.* 1980). Anderson and May (1979) attributed the low levels of prevalence in natural populations as a direct consequence of high rates of parasite induced host mortality. On the other hand, Esch and Fernandez (1993) have argued that low prevalence is characteristic of parasites in short-lived hosts.

Other workers (Chandiwana *et al.* 1987) have reported the seasonal variation of prevalence noted in the present study. High prevalence during the dry season has been attributed to the reduced water volume accompanied by increased density of snail hosts and intensified use of the habitat by definitive hosts (Jordan *et al.* 1980, Loker *et al.* 1980). Also, the population dynamics of the host snails in conjunction with climatic factors such as temperature and rainfall are known to influence prevalence (Sapp & Esch 1994).

The effects of flooding on snails, their habitats and the infective stages (miracidia) could probably explain the low prevalence during the rainy season. Flooding resulting from heavy rainfall could have catastrophic effects on numbers and distribution (spatial and temporal) of snail hosts. Snails could be flushed out of their habitats, thus, affecting prevalence of digenean larvae (see Jordan *et al.* 1980). Snail habitats could be obliterated by floods and increased velocity of water current might sweep away the infective stages (miracidia).

The absence of multiple infections of digenean larvae in snails (infra-community level) reported in the present study is a common phenomenon (Probert 1966, Brown 1985). Probert (1966) has argued that once an infection has been established the chemo-attractiveness of the snail disappears. In addition, subsequent chemical changes in the infected digestive gland of the snail produce unfavourable conditions for successful establishment of another miracidium. Multiple infections, however, are a common occurrence within a snail population (compound community level). This is confirmed by the results of the present study as multiple infections were encountered at the host population level.

The temporal variation in the occurrence of two or more digenean species infecting the same host species has been reported before (Farley 1967, Sousa 1992). Farley (1967) reported that when two species infect a snail, a severe intramolluscan competition ensues, and the two species will tend to replace each other over a single season resulting in a temporal variation of occurrence. The sequence of replacement is hierarchical; species with large rediae dominate over intermediate sized rediae and sporocysts. Large sporocysts, in turn dominate over small sized sporocysts and rediae (Sousa 1992). Rediae are known to prey upon sporocysts and rediae of subordinate species, and can lead to substantial or complete elimination of such species from snails (Heynman *et al.* 1972). This behaviour of digenean larvae precludes concurrent occurrence of two or more species of Digenea in the same individual snail. The results of the present study, therefore, could be explained as above. Caution must be exercised, however, as the study was of short duration (one year).

Thus, the prevalence of digenean larvae in snail hosts is typically low and intramolluscan competition appeared to preclude multiple infections. While the elements of weather e.g. rain and temperature, have a strong influence on prevalence; host snail dynamics may also play a part. The limited period over which the study was carried out calls for caution to be exercised on the interpretation of some of the findings, and hence underlines the need for long term studies. Echinostome larvae are known to inhibit the establishment and development of schistosome larvae when they occur in the same individual snail. Since both these larvae were encountered in the present study, it may be expedient to investigate the potentiality of echinostomes in the control of schistosomiasis in Tanzania.

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