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The Role of *Gyraulus parvus* as an Intermediate Host for Avian Schistosomes[1]

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ABSTRACT: *Gyraulus parvus* was found to be the natural intermediate host for three species of avian schistosomes in southwestern Michigan. Of 5,635 snails examined for patent infections during the summers of 1979–1981, 143 (2.5%) shed cercariae. Snails 4–7 mm in diameter were more likely to be infected (17%) than smaller ones, 1–3 mm in diameter (0.8%). The highest overall infection rates occurred in July of 1980 and May of 1981. Patent infections of a fourth species were established in laboratory-reared *G. parvus*. This study shows that *G. parvus* does play a significant role as an intermediate host for avian schistosomes. Furthermore, at least three of the four species can cause swimmer's itch.

Schistosome cercarial dermatitis, commonly known as swimmer's itch, is currently a problem of increasing concern in Michigan (Wall, 1976). It is caused by cercariae of avian and rodent schistosomes that accidentally penetrate human skin. Three families of freshwater gastropods are known to serve as intermediate hosts for avian schistosomes: Planorbidae, Lymnaeidae, and Physidae. Members of the latter two families are more commonly infected in southern Michigan.

Gyraulus parvus is a small planorbid snail that based on the literature, appears quite insignificant as an intermediate host for avian schistosomes. Brackett (1940) found it to host two species in Wisconsin but did not determine their infection rate or seasonal prevalence of infections. Relationships between seasonal changes in snail size and infection rate have not been documented for *G. parvus* as they have for *Physa integra*, another intermediate host of avian schistosomes (Kulesa et al., 1982). This paper reports a comparable study of a large natural population of *G. parvus* at the Kellogg Bird Sanctuary of Michigan State University.

Materials and Methods

From June through August of 1979 and 1980 and from May through September of 1981, snails were collected at the Kellogg Bird Sanctuary of Michigan State University, in northeastern Kalamazoo County, Michigan. Wintergreen Lake and several adjacent ponds that support large and diverse populations of waterfowl were chosen as study areas. The major collection site was a small, cement-walled channel connecting Wintergreen Lake to the middle ponds. Snails of all sizes were randomly collected by hand from the wall, sticks, and filamentous algae.

After measuring the largest diameter of each snail, 10 large to 25 small ones were placed in 3-inch finger bowls of lake water. Each bowl was checked daily for cercariae for at least 3 days. If cercariae were present, snails from that bowl were isolated individually in small vials to identify the infected ones. Those not shedding cercariae were returned to the collecting site. Generally, two collections were made each week.

Cercariae were first examined alive and then fixed in 3–5% hot formalin and stained with neutral red and methylene blue. The different cercarial species were readily distinguished by differences in size, morphology, and behavior. In addition, all species were established in laboratory-reared snails exposed to miracidia from naturally infected birds.

Results

Of 5,635 *Gyraulus parvus* examined during the three summers, 143 (2.54%) contained patent infections of avian schistosomes. The overall infection rates for 1979, 1980, and 1981 were 1.56%, 6.52%, and 1.50%, respectively. The highest rate (33%) was found in 5-mm snails. Below 5 mm, it decreased in relation to snail size (Table 1).

Changes in infection rates during each of the three summers were varied. In 1979 and 1981, the highest infection rate was early in the season. In 1980, there was a peak in infection rate in mid-July (see Fig. 1). Overall, the highest infection rates (averaged over 2-wk periods) were in July of 1980 (13.6%) and May of 1981 (13.2%) with sample sizes of 243 and 38, respectively.

A comparison of mean snail size for collections made from May through September 1981 showed that the largest snails were found in May. Snail sizes in June and July were smaller but increased

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Table 1. Percent of *Gyraulus parvus* infected with schistosomes, shown by snail size and by year of collection.

Size (mm)	No. examined (no. infected)				% Infected
	1979	1980	1981	Total	
7	0 (0)	0 (0)	1 (0)	1 (0)	0.0
6	3 (0)	0 (0)	10 (2)	13 (2)	15.4
5	26 (4)	23 (6)	39 (19)	88 (29)	33.0
4	120 (11)	297 (48)	99 (15)	516 (74)	14.3
3	489 (7)	610 (20)	1,235 (9)	2,334 (36)	1.5
2	667 (0)	220 (1)	1,508 (1)	2,395 (2)	0.1
1	104 (0)	4 (0)	180 (0)	288 (0)	0.0
Total	1,409 (22)	1,154 (75)	3,072 (46)	5,635 (143)	
% Infected	1.56	6.52	1.50	2.54	

slightly in August and September. In 1979 and 1980, collections were only made from June through August, therefore, such a pattern was not apparent.

Cercariae obtained from naturally infected *G. parvus* represent three species of avian schistosomes. Of these, two possessed long tail-stems; one longer than the other. The third species was characterized by a short tail. Finally, a fourth type was recovered from laboratory-reared snails that were exposed to miracidia obtained from naturally infected ducks. It is interesting to note that no natural infections of the latter species were found.

Cercariae of three species of avian schistosomes isolated from *G. parvus* during this study were capable of eliciting a skin reaction in humans known as swimmer's itch. One of the authors (DLD) readily obtained lesions in the laboratory when exposed to cercariae of all but one species.

Discussion

The overall patent infection rate of 2.54% observed in this study is considerably higher than in a similar study on another intermediate host for avian schistosomes. Kulesa et al. (1982) reported only 0.19% of 26,775 *Physa integra* to be infected with bird schistosomes representing two species. The higher rate reported here for *Gyraulus parvus* may in part be due to the large number of birds that frequent the study area, particularly during spring and fall migrations. Brackett (1940) noted that larger *G. parvus* were more likely to be infected with schistosomes, but he did not monitor infection rates. The results of the present study support his observation.

Seasonal differences in snail size reflect the reproductive cycle of *G. parvus*. The average snail size is highest in May, before die-off of mature adults leaves the population dominated by young, hatching in late spring. Marked increases in size were not observed during the remainder of the summer. The life span of *G. parvus* in southwestern Michigan thus seems to be just over a year. This life cycle is very similar to that reported for *Lymnaea catascopium* (=*Stagnicola emarginata angulata*) and *Physa parkeri,* two other snails that serve as intermediate hosts for avian schistosomes in Michigan (Cort et al., 1940 and 1941, respectively).

Although the prevalence of infection differed considerably during each of the three summers, it is difficult to find a plausible explanation for these variations. Factors that may be important include: changing weather patterns and water levels and therefore fluctuations in the density of one or both host species.

A high percentage of the snails collected in May were found to be infected with schistosomes. It is not known whether these snails overwinter with the infection or become infected immediately after the ice melts (usually in March). However, it seems unlikely that infections found in early May could have resulted from exposure after the ice melted because cold temperatures would delay development of the sporocysts. It thus seems more likely that snails overwinter with infections.

Brackett (1940) described two species of avian schistosomes from *G. parvus* collected in Wisconsin: namely, *Cercaria elongata* and *C. gyrauli.* Based on morphological and behavioral features, the four species of avian schistosomes recovered from the same species of planorbid snail in Michigan are not similar to those de-

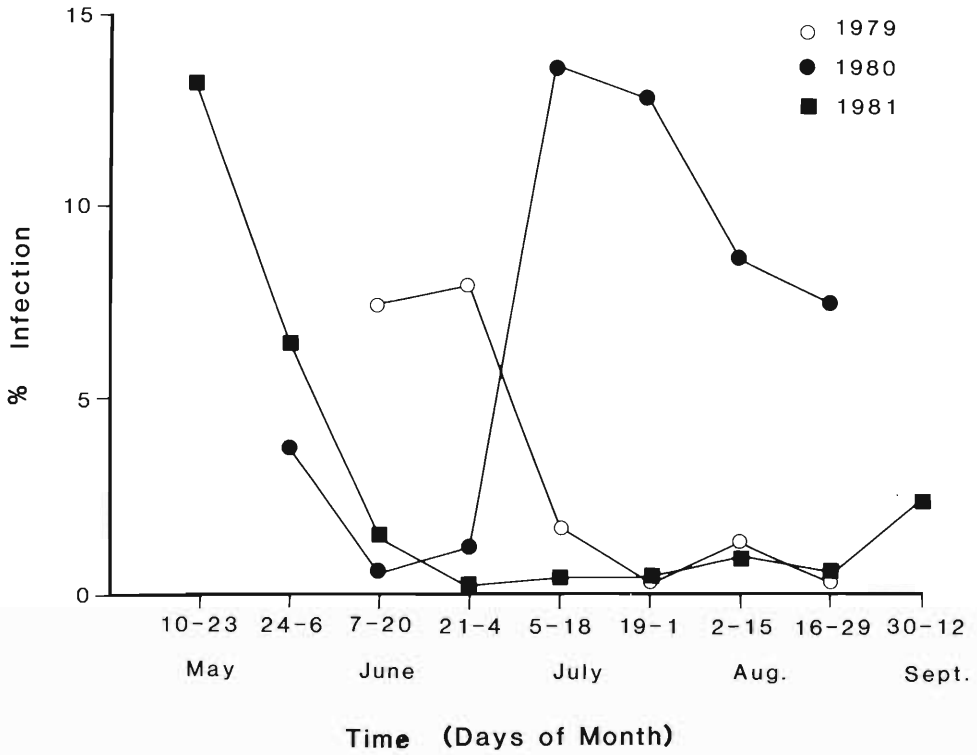

Figure 1. Changes in percent infection of *Gyraulus parvus* during each of the three summers (1979-1981).

scribed by him. Therefore, at least six species of avian schistosomes are now known to cycle through *G. parvus*.

Data from this study indicate that *G. parvus* plays a more significant role as intermediate host for avian schistosomes than has been previously recognized. Because this snail is common and widely distributed in many aquatic habitats and because it harbors dermatitis-producing cercariae, it must be more closely considered in the future as the causative agent for outbreaks of swimmer's itch.

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