

BIOLOGICAL CONTROL OF SCHISTOSOME TRANSMISSION
IN FLOWING WATER HABITATS OF RIO GRANDE, PUERTO RICO

Wiliam

?Angel Laracuento

CENTER FOR ENERGY AND ENVIRONMENT RESEARCH

---Page Break---

CEER #16

Biological control of schistosome transmission

in flowing water habitats of Rio Grande, Puerto Rico.

by

William R. Jobin

and

é Angel Laracuenta

April 1979 .

Environmental Health and Impact Division

---Page Break---

Abstract

Little attention has been given to the effectiveness of

Marisa cornuarietis for controlling *Biomphalaria glabrata* in

; flowing water. Furthermore the impact of this ampullarid

Snail in interrupting schistosome transmission has not been

evaluated previously in an endemic community. Thus it was

the purpose of this study to evaluate the role of *M. cornu.*

Tietis as the sole agent for schistosomiasis control in an

endemic community in Puerto Rico where transmission was occurring in flowing water. Two similar endemic communities on the northeastern coast of Puerto Rico were studied for 4 years. Populations of *B. glabrata* and their schistosome infections were monitored before and after introduction of 20,000 *H. cornuarteris* into the downstream community. After

tr

tment (addition of the anpullarid snail) very few *B. glabrata* were found and none were infected. In the untreated community the *B.*

B. glabrata population remained stable and the mean schisto-

infection rate increased. The entire control effort for the community of 3000 people cost \$260 for over a year of

» Protection, considerably less expensive than any other known method of control.

---Page Break---

Introduction

Although there are several reports on the successful control of *Gionphalaria glabrata* by *Marisa cornuarietis* in ponds and reservoirs, little attention has been given to the efficiency of this biological control agent in flowing waters such as streams or irrigation canals. Studies in ponds and reservoirs are easier to organize in similar replicates, thus the initial selentic evaluations of *M. cornuaretis* were in various sets of ponds, leaving the impression that this pullarid snail was not effective in flowing water. Furthermore the replicate ponds and reservoirs were chosen on the basis of similar ecology, not because they were important in schistosome transmission. Thus no information was published on the impact of in interrupting transmission of the

parasite. Some have taken this to mean that *M. cornuarietis* is not effective in controlling transmission.

As it appeared to us that the anpullarid was effective in many flowing water habitats and that evidence has accumulated showing an additional "decoy" effect in which *M. cornuarietis* protects *B. glabrata* from schistosome infections, it was the purpose of this study to evaluate *M. cornuarietis* as the sole

agent for control of schistosome transmission, in a representative endemic community in Puerto Rico. This simple 4-year study was di

igned to evaluate the effectiveness of biological control by monitoring the direct biological changes in the

infections.

snail population? and their schistosom

---Page Break---

Matert. hods

Two similar endemic communities on the northeastern coast of Puerto Rico were studied for & years. In addition to monitoring the snail populations, the schistosome infections

in *B. glabrata* were also determined. The two communities were

in the watershed of the Herrera River, along a system of small streams which flow all year. The streams are subject to flooding and rapid flows, due to the steep slope of the watershed and the high rates of rainfall, especially from July to December. A second shorter rainy season usually occurs in

April and May.

The untreated community, Halpica, was located along Angela Creek upstream of Montebello, the community where the *Marisa gornuarietis* were placed, in the municipality of Rto Grande (Figures 1 and 2). Housing in Malpica was slightly better than Montebello, but both communities were relatively poor by

pri

ent standards in Puerto Rico. About 3000 people lived in each community and most children attended nearby public schools. The streams in Montebello were rocky but bordered with heavy vegetation. The rocks formed many deep pools which sheltered snails and offered attractive bathing sites for children who were often seen in the relatively clean water (Figure 3). In Malpica the streambeds were mostly clay with heavy vegetation. The water was turbid and filthy but children played in it (Figure 4), In both communities the streams were contaminated by direct sewage discharges from latrines and septic tanks.

---Page Break---

FIGURE I, LOCATION OF MONTEBELLO AND MALPICE ON NORTHEAST COST

OF PUERTO RICO

RIO_ GRANDE

TOWN

"= To FAvARDO

(KILOMETER

??<???????

---Page Break---

Figure 2.

Montebello consists of a compact community of single-family houses constructed in the flood plain of Angela Creek. The creek is delineated by the row of trees

in the foreground and right-hand side of the photo.

---Page Break---

Figure 3. Angela Creek near Montebello contains many pools formed by large rocks and surrounded by heavy vegetation.

---Page Break---

Very simple techniques were used in the biological control effort; *M. cornuarietis* were collected from Lake Guayo tn

central Puerto Rico by walking the lake shore, collecting the snails with wire dippers and placing them in plastic buckets (Figure 5). Four men each collected about 1000 snails per hour, The snails were transported the same day and placed in the streams at 10 different sites in the treated community of

Nontedello. About 13,000 ampullarids were placed in October 1977 and 7,300 in February 1978.

Monitoring of schistosome infections in the planorbid snails from both communities began in May 1975, over 2 years prior to treatment, and continued after treatment until March 1979. Snails were collected quarterly by 2 man-days of inspection in all water-bodies of the two communities, and examined for parasitic infections. The individual snails were crushed in a press-slide preparation and examined under low power microscope for presence of schistosome sporocysts and cercariae, as well as other cercaria which occasionally occur in Puerto Rico.

---Page Break---

Figure 4. Angela Creek in Malpica contained high levels of human and animal wastes and heavy vegetation.

---Page Break---

Table 1

Number of *Biomphalaria glabrata* collected and
number infected with *Schistosoma mansoni*
in Malpica and Montebello of Rio Grande,

Puerto Rico from 1975 to 1979,

ene re rae Re ee ae

7 Walpica-Untreated Wontebello-Treated

Date Total Number Total Number

: *S. ghabrate* ?rnfectes slabrate infects

3275

may 33 ° 29 °

dune Be 50 3

1976

August 323 ° 2s 5

September 19 2 1

3277

Maren 7 1? a 2

dune 5 ° 3 2

September 15 ° 2 1

December ? 1 ° °

2s 1 ° °

° ° °

ie 6 1 oO o

+. 126 52 1 °

October 37 ? 0 °

December = a é °

? 1272

January 52 7 ° °

March oa 4 1 °

Apri

Marisa cornuarietis added (a total of 20,000).

No survey.

---Page Break---

10

Results

Previous to addition of the ampullarid snails, both

communities had stable populations of *S. glabrata*, with low

Fates of schistosome infections occurring in the snails in all months of the year (Table 1). The mean infection rate

with *S.*

Mansoni was 9% in Montebello and 10% in Malpica,

before treatment. Occasional infections with *Cercaria* *arini* were found, but the large majority were *S. mansoni*.

In the year and a half after the first group of *Me* *gornuarietis* were placed in Montebello very few planorbid snails were found despite intensive searching. None were infected. The ampullarid population declined somewhat but continued to reproduce. Since the small streams were

frequently scoured by floods, the smaller *B. glabrata* was

expected to survive better than *M. cornuarietis*, but apparently

the ampullarid reduced *B. glabrata* to minimal levels.

In the untreated community of Malpica the *B. glabrata*

Population remained stable at pretreatment levels and the mean

Schistosome infection rate increased to about 28% during 1978,

demonstrating that the decreases in snails and schistosom

infections in Montebello were not due to general ecological

trends in the area. Since Malpica is directly upstream of

Montebello, planorbid snails were probably being continually

washed down to Montebello but were not establishing colonies,

apparently due to the effect of *M. cornuarietis*.

---Page Break---

uu

Figure 5. Large numbers of *Marisa cornuarietis* were collected

in a single scoop from Lake Cuayo, including all ages and sizes.

---Page Break---

ae

Uaseussion

Previous field surveys showed that schistosome transmission had been occurring in this area for over 15 years!??, In Addition studies in 1963, 1964 and 1965 showed that cercariae could be recovered from the water entering Montebello during every month of the year. Continuation of transmission was further documented in 1976 when this municipality was found

to have the second highest skin test positivity on the island[®],
There is thus no doubt that this was an endemic zone for some
time and provided a representative site for testing the
amphibian snail.

Due to the large decrease in the planorbid population it
was not possible to measure the decoy effect of *M. cornuarietis*,
but this may have been protecting the planorbids from infection.
Previous pond studies showed that this ratio should be 6:1 or

Greater to block schistosome infection[®], The 20,000 *M. cornu*,

1s may have been in excess of the number needed for the
decoy effect. Although they were being continually washed out
by floods, the large number of *M. cornuarietis* eggs laid in
protected places seemed to replenish the population, keeping

Bs glabrata at a disadvantage.

The entire control effort for one year in this community
of 3000 people involved 2 days of work for 4 men. The daily
wages of these 4 averaged US \$30 and transportation of the

snails Involved 2 trips of 100 miles each, costing an additional

\$20. The total control cost of \$260 protected 3000 people

---Page Break---

13

for over a year, and ts about 10% of the cost for chemical

control of snails in Puerto Rico. In most endemic countries,

wages for unskilled labor are closer to \$3 per day Instead

3 of \$30, thus use of this technique in the Dominican Republic

< or Brazil would be another order of magnitude cheaper. It is

undoubtedly much cheaper than any other method of control

available, and should be investigated on a larger scale.

---Page Break---

1s

References

Kagan, I., Negron, H., Arnold, J. and Ferguson, F., 196.

A skin test survey for the prevalence of schistosomiasis

in Puerto Rico. Public Health Service Publication 1525,

Washington, D.C.

Rowan, W. B., 1965. The ecology of schistosome transmission

fact. Bull. WHO, 33: 63-71.

Butler, 3., Ferguson, F., Palmer, J. and Jobin, W., 1978.

Observations on schistosome infections of *Bionphalaria*

Alabrata and an invading population of *Tarebla granifera*

in a small stream in Puerto Rico. CEER Report #8,

Caparra Weights Station, Puerto Rico.

Negrón, H., and Jobin, W., Schistosomiasis control in

Puerto Rico: 25 years of operational experience. Am. 3.

Trop. Med. yg. accepted for May 1979,

Laracuenta, A., Brown, R. and Jobin, W., 1979. Comparison

of four species of snails as potential decoys to intercept

schistosome miracidia. Am. J. Trop. Hyg. Neds, 28: 99-105.

---Page Break---