MALACOLOGICAL OBSERVATIONS BEARING ON THE EPIDEMIOLOGY
OF SCHISTOSOMIASIS IN A RURAL BAHIAN COMMUNITY

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SUMMARY

Malacological observations concerning with epidemiology and transmission
of schistosomiasis have been performed in the rural community of Castro Alves,
State of Bahia. The types and nature of aquatic habitats and the sites of contact
with household water, as well as the distribution and level of snail hosts are
presented. Both B. glabrata and B. straminca were found in the area, although only
the first was infected with proportions till 22.8%. The reproduction of snails
seems to occur during all the year, but the period of highest fecundity occurred
in October, reaching January or February. It was observed that B. glabrata is
able to resist occasional periods of dryness in the area and quickly recover
the original population. These observations could be useful for planning control
programs in that area.

INTRODUCTION

Schistosomiasis in Brazil was first recognized in the State of Bahia by Pirajá da Silva in
1908, and the epidemiology of the disease in Bahia, including malacological aspects, has
been regularly studied thereafter. Most investigations have been concerned with the transmis-
sion of the disease in urban localities, principally Salvador and its environs, but few studies
have focused on rural locales. The present study, therefore, was designed to complement the
efforts of the Harvard/Wellcome/Federal University of Bahia Project investigating the
epidemiology of the disease in a small, rural, Bahian community — Castro Alves.

Although Pirajá da Silva (1912) first noted the snail Planorbis bahiensis (= Biomphala-
ria glabrata) shedding furcocercous cercariae which he designated as Cercaria blanchardi
and which were subsequently identified as cercariae of Schistosoma mansoni, the first defini-
tive study of the snail intermediate hosts of schistosomiasis in Brazil and Bahia was that
of Lutz (1918). Subsequent observations have been made on the snail hosts of Bahia by many
investigators, including those of Coutinho 4,5,6, Lucena 6, Penido et al. 7, Travassos 8,
Barretto 3, and Michelson & Dubois 9.

STUDY AREA AND HABITATS

Studies and observations were made in the municipal district of Castro Alves, a rural area
situated approximately 140 km west of Salvador, the capital of Bahia, at 12°45’S. latitude and 29°25’
W. longitude. The area of the municipal district is 1827 km² and has an estimated population,
according to the 1970 census, of 46,727. About a fourth of the population resides in the town, with
the remainder living in the more rural farms. The rural area is characterized by a hilly topo-
graphy, with roads and houses on the crests of the hills and the water sources located in
the small valleys separating the “fazendas”. Eleven “fazendas” comprised the study site
and these were mapped, censused, and the prevalence of schistosomiasis in the population
determined by fecal examination (Lehman et

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al. The occurrence of schistosomiasis in Castro Alves was first reported by LOBO and subsequently by PELGON & TEIXEIRA (1950) and by COUTINHO. Recent studies (LEHMAN et al.), suggest that the overall prevalence for the region is in the order of 68%, considerably higher than the 19.2% rate cited by ARCOVERDE for the State of Bahia.

Aquatic Habitats — The aquatic habitats in the region which serve as actual or potential habitats for the snail hosts and as sites of disease transmission may be classified as follows: 1) small, temporary or semi-permanent pools (tuniques) which are used by the population for the collection of household water for drinking and cooking and less often serve as sites for washing clothes or bathing (Figs. 1 and 2). These sites originate from natural depressions, at times are intentionally constructed, or are the remains of borrow pits. They are filled by rain water, ground run-off, or, on occasion, by springs. The water levels are subject to extreme fluctuations, dependent on the amount of rainfall, and smaller ponds frequently approach dryness if droughts occur. Vegetation is sparse if the site is used regularly; however, abandoned ponds become overgrown with lilies and water hyacinths and, if they become dry, may disappear by encroachment of the surrounding vegetation. 2) A second type of habitat is the artificial impoundment designated primarily for animal use. These are usually muddy, covered with scum, low in oxygen, and rarely, if ever, support snail populations. 3) Marshes created by run-off from the surrounding hills are found in several of the valleys. These often contain small rivulets which have been formed as a consequence of the slope of the land and snails have been found in them. This type of habitat is difficult to sample with any degree of confidence, and the importance of such a reservoir for snails and in disease transmission requires further study. 4) Another category of habitat is the “bica”, an area usually fenced for privacy and used for bathing and/or washing of clothes (Fig. 3). Water is supplied to the “bica” via a bamboo pipe, which collects run-off from a small stream, nearby marsh, or ground water from surrounding hills. The bamboo pipe is frequently oriented so as to form a shower. We have never found host snails in a “bica” proper, but have noted their occurrence in nearby drainage ditches. In one such ditch, over 100 B. glabrata were collected.

The local populace is hesitant to identify sites of the “bicais” and many probably have not been detected in our survey. 5) The last category consists of the small streams and rivulets which criss-cross the countryside (Fig. 4). The two main streams in the area are the Rio Riacho Seco and the Rio do Mocambo from which many of the smaller streams drain. These streams are abundantly stocked with host and other snail species and probably serve as reservoirs from which snails are transported to other sites.

Snail Survey — A total of 37 aquatic habitats have been identified in the 11 “Fazendas” of the study area (Figs. 5 and 6). In addition, four sites in Castro Alves proper and one in Fazenda Lagoa were investigated. The sites were visited approximately three to four times per year over a six-year period from 1974-1979. For each site, water temperature, pH, type and abundance of vegetation present, species of snails, and the infection rate of host snails were recorded. Six species of snails were identified by morphologic criteria as set forth by PARAENSE and included the following: Biomphalaria glabrata, B. straminea, Drepanotrema cimex, D. lucidum, Plesiophysa ornata, and Aplexa marmorata. It should be noted that this is the first report of B. straminea in the Castro Alves region and, also, the first record of P. ornata from the State of Bahia. The latter species has been known previously only from Paraiba, Pernambuco, Espirito Santo, and Minas Gerais. We found it at site 21, a small pond in Fazenda Morro do Afonso. Snails identified as Aplexa marmorata have been designated in the earlier Brazilian literature as A. brasiliensis; however, as CLENCH noted this species appears to be a synonym for A. marmorata. Anatomical and conchological comparison of our specimens from Castro Alves with A. marmorata from Puerto Rico confirm their identity. No snails were recovered from 9 of the 37 sites (24.3%) situated in the study area. Twenty sites harbored B. glabrata and 2 B. straminea. Infection rates for B. glabrata ranged from 0 to 22.5%; B. straminea have not yet been found infected. In an earlier study, MICHELSON & DUBOIS reported that the snails of this area were quite variable with respect to susceptibility to an allopatric strain of parasite with a few populations being entirely refractory to infection.
DYNAMICS OF A SMALL POND

The dynamics of the snail population in a small pond typical of the area was followed for one and a half years. The site, designated Tanque Charqueada 32, was in located in the backyard of a house in the poorer section of Castro Alves. This was an old borrow pit which filled with rain water during the rainy season and measured when full 7.5 x 10 m in diameter. The predominant vegetation was water hyacinths, which at times covered most
Fig. 3 - A "Rica" where people bathe and do their laundry. Snails are not found in the "Rica" proper, but in the drainage ditches.

Fig. 4 - The Rio Ranco Seco, a site in which snail infection rates may reach 22%.

of the surface area. Members of the adjacent house used the pond as the primary source of water for drinking and cooking. On five occasions, fecal boil were found near the edge of the pond. Only a single snail species, B. glabrata, inhabited the site and the snail population was found to have infection rates ranging from 0 to 22.8% (mean 11.7%) during the period of observation.
Fig. 5 — Map showing small habitats in Fazendas Cajueiro, Maracaju, Coqueiro, Morro do Genipapo, and Moro. Habitats are indicated by stars and numbers, roads are solid black lines.

Fig. 6 — Map showing small habitats in Fazendas Boa Pox, Caco, Alto, Ribeira Seco, Gravel, and Morro do Afonso. Fazenda Lagos was not in the study area.
Samples were taken every two weeks, by the same collector, at three stations situated equidistant around the pond's periphery. Each sampling consisted of making dips with a small scoop for five minutes at each station. Collected snails were counted, measured to the nearest 0.5 mm, and then returned to the pond. At selected intervals (approximately every three months) an aliquot of the total sample was examined for the presence of snails shedding cercariae. All collections were made between 0830 and 1100 hours AM and prior to sampling the water temperature and, at times, the pH determined. In addition, chemical and physical attributes were determined on three separate occasions by use of a Hach DR-EL/2 Engineer's Laboratory and the methodology designed for the apparatus (Hach Chemical Co., Ames, Iowa). The results of these analyses are as follows:

dissolved oxygen, 15-18 mg/l; total hardness as CaCO₃, 140 mg/l; turbidity by the absorptometric method, 65; specific conductance, 300 μM/cm or 150 mg/l NaCl; pH 6.5-6.9; temperature 18-24°C; no detectable nitrates or sulphates.

The results of the snail collections are illustrated in Fig. 7. The extended period of drought which began in April, 1976, and continued until October of that year was unprecedented. Sampling was not conducted during May through July or in September as the water level was so low that we feared undue damage to the habitat. Early rains in August caused a rapid onset of reproduction as it did later in October. Examination of young snails collected in both August and in October revealed that approximately 27% showed the presence of lamellae in the shell aperture. This characteris-

![Graph indicating the dynamics of a snail population in a small semi-permanent pond in the Castro Alves area. The mean number of snails collected bi-monthly, the size composition of the population, and the mean size of the snails in the population are illustrated.](image)

Since collections from the three stations were found consistently comparable and the area of the pond was small, we made the assumption that the snails in this instance could be considered to be randomly distributed. Consequently, we initiated, during January and February of 1976 and 1977, a series of mark-release-recapture experiments in which 150 marked snails were released and then 4, 7, and 14 days later the po-
pulation was re-sampled. On the basis of recaptured snails, we estimated that the total population of the pond ranged between 2500 and 5200 snails. Thus, our biweekly samples represented only 2 to 6% of the total snail population at any one time.

DISCUSSION

The Castro Alves region, situated in the fertile Reconcavo, is subjected to 130 to 180 cm of rainfall yearly, and contains numerous water bodies suitable for supporting snail populations. The rainy and dry seasons are not as sharply demarcated as in other portions of northeastern Brazil and snail reproduction probably occurs year round with peak fecundity from October through January. Two potential snail hosts, B. glabrata and B. straminea, occur in the region, and although the latter has yet to be found infected, its potential role must not be discounted. The area has been shown to be highly endemic for schistosomiasis (LEHMAN et al. 1) and recent surveys conducted during the course of these observations (Mota, unpublished) suggest that, in the 11 “fazendas” of the study area, the prevalence is in the order of 55%. Although indiscriminate detection and fecal pollution of water bodies are not commonly observed, it does occur and sites of deposition have been noted both in and near snail habitats. The rugged topography of the area forewarns of the difficulties that may be associated with snail control and it is imperative that snail habitats utilized by the population be identified and kept under surveillance.

It is axiomatic that the control of a disease, such as schistosomiasis, depends on a sound knowledge of epidemiology; this implies an intimate knowledge of the biology of the intermediate snail hosts. To this end, we have attempted to present an overview of the habitats, distribution, bionomics, and level of infection of the snail hosts in the Castro Alves region. Hopefully, this information may be of value in the proposed national program (MACHADO 11), which is oriented toward the control of schistosomiasis with a combined approach of chemotherapy and snail control.

RESUMO

Observações malacológicas relacionadas à epidemiologia da esquistossomose em comunidade baiana rural

Observações malacológicas relacionadas à epidemiologia e transmissão de esquistossomose foram feitas na comunidade rural de Castro Alves, Estado da Bahia. São apresentados os tipos e natureza dos habitats aquáticos e os lugares de contacto com água da população, assim como a distribuição, bionômica e nível de infeccão de planorbídeos hospedeiros. Ambos B. glabrata e B. straminea foram encontrados na área, apesar de que somente o primeiro tenha sido encontrado infectado, com proporções de até 22,8%. A reprodução de planorbídeos parece ocorrer durante todo o ano, porém o período de maior fecundidade ocorreu em outubro continuando até janeiro ou fevereiro. Foi observado que B. glabrata é capaz de resistir a períodos ocasionais de seca que ocorrem na área e refazer rapidamente a população original de seus habitats após esses períodos. Essas observações podem ser úteis para o planejamento de programas de controle da esquistossomose nessa área.

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