Distribution and habitats of *Biomphalaria pfeifferi*, snail intermediate host of *Schistosoma mansoni*, in South Africa

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Abstract

As intermediate host for *Schistosoma mansoni*, *Biomphalaria pfeifferi* plays a major role in the transmission of intestinal bilharziasis in the endemic areas of South Africa. This article focuses on the geographical distribution and habitats of this species, as reflected by the 1 639 samples on record in the database of the National Freshwater Snail Collection of South Africa. This snail is well represented in the Northern Province, Mpumalanga and the coastal areas of KwaZulu-Natal, that represent the bilharzia endemic areas of South Africa. Details of each habitat, as well as mean altitude and mean annual temperature and rainfall of each locality, were processed to determine chi-square and effect size values and to construct an integrated decision tree that makes a selection of those variables that could maximally discriminate between this snail and all the other species in the database. The results indicated that temperature and type of water-body are the major factors determining the distribution of *B. pfeifferi* in South Africa. These findings support the results of demographic studies reported by several authors that led them to the conclusion that *B. pfeifferi* does best under warm stable conditions. The importance of four isolated and persistent foci occurring further west than the western arm of its range of distribution and far removed from the bilharzia endemic areas, is discussed. Two of these localities are popular holiday resorts and the fact that specimens from both these localities showed a high compatibility with a local strain of *S. mansoni* is cause for concern.

Keywords: geographical distribution, habitat preferences, experimental infection, epidemiology of schistosomiasis, *Biomphalaria pfeifferi*

Introduction

Biomphalaria pfeifferi is the most important intermediate host in tropical Africa for *Schistosoma mansoni*, the parasite causing intestinal bilharzia in man (Brown,1994). It was first described from specimens collected in the Umgeni Valley, KwaZulu-Natal. The oldest sample of this species on record in the National Freshwater Snail Collection (NFSC) of South Africa, dates back to 1952. This report focuses on the geographical distribution and habitats of this snail as reflected by the samples on record in the NFSC. The ecological implications of the range of values reported by various authors for the demographic parameter *r* (intrinsic rate of natural increase) are also discussed. Attention is drawn to four persistent populations of this species occurring in isolated foci outside the bilharzia endemic areas in South Africa. Details are given of snail habitats as described by the collectors at the time of collection and also of the mean altitude and mean annual rainfall and mean annual air temperature of the loci ($^1/_{16}$ square degree) in which the collections were made.

Materials and method

Data pertaining to the geographical distribution and habitats of *B. pfeifferi* were extracted from the database of the NFSC. Only those samples for which the collection sites could be pinpointed on the 1:250 000 topo-cadastral map series of South Africa, were included in the analysis. The majority of these samples were collected during surveys conducted by staff of government and local health authorities and then sent to the former Snail Research Unit at the Potchefstroom University for identification and to be added to the NFSC. Details of the habitats were documented by collectors during surveys by selecting the relevant options on forms compiled by the staff of the Snail Research Unit. The number of loci in which the collection sites were located was distributed in intervals of mean annual rainfall and air temperature, as well as intervals of mean altitude, and the results tabled to illustrate the frequency of occurrence in specific intervals. Rainfall, temperature and altitude data were obtained from the Computing Centre for Water Research, University of Natal. A temperature index was calculated for all mollusc species in the database from their frequencies of occurrence in the selected temperature intervals and the results used to rank them in order of association with low to high climatic temperatures. This was done by allocating numeric values, ranging from one for the coolest to five for the warmest, to five selected temperature intervals. The proportion of the total number of loci of each species falling in a particular temperature interval was then multiplied by the value allocated to that specific temperature interval. This was done for each temperature interval in which the species was recorded and the sum of these scores was then taken as the temperature index for that particular species ($I = \sum_{i=1}^{5} ip_i$) and the results presented in a table. This analysis was recommended by Brown (2002). Chi-square values were calculated to determine the significance of the difference between the frequency of occurrence in, on, or at the different options for each variable, such as type of water-body, type of substratum and temperature interval. Furthermore, an effect size was calculated for all the different variables discussed in this paper.