A REVIEW ON STATUS OF VECTOR SNAILS OF URINARY SCHISTOSOMIASIS IN ZIMBABWE

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INTRODUCTION

The African freshwater snail genus *Bulinus* has long been the subject of intensive study because some of the species serve as intermediate hosts in the transmission of schistosomiasis in man and his domestic stock. A knowledge of the systematics of the intermediate host snails has thus been recognized as an important tool for understanding the epidemiology and control of this tropical parasitic disease (Kristensen 1991).

Extensive research has been done on the epidemiology and distribution of the parasite *Schistosoma haematobium* in Zimbabwe (Clarke 1977; Taylor & Makura 1985; Chandiwana 1987) and *S. mattheei* (Lawrence & Condy 1970), but not much has been devoted to the taxonomy and variability to infection of the *Bulinus* intermediate host, where the only known natural vector of *S. haematobium* in Zimbabwe is *B. globosus*. Intensive studies on the biology of this vector snail have been done by Schiff (1964a,b,c), and Woolhouse and Chandiwana (1990) reported on the population biology of *B. globosus* in the highveld region of Zimbabwe.

Bulinus *snails in Zimbabwe*

The national snail survey done by Makura and Kristensen (1991) revealed important information concerning the nature and distribution of the *Bulinus* snails in the country. *B. africanus* (a potential vector of *S. haematobium*) has been reported to be present in Zimbabwe (Hira 1970; Brown 1994). However, Brown (1994) stresses that the distribution of *B. africanus* in southern Africa is unclear and critical comparison with *B. globosus* is needed. The only character which seems to differentiate between the two species is the penis sheath where in *B. africanus* it is bigger, longer and/or thicker than the preputium (Mandahl-Barth 1957; Brown 1966). Differences with related species in some enzyme profiles in certain geographical areas have been reported by Jelnes (1979) and by Rollinson and Southgate (1979).

Because of the complexity of the *Bulinus* vector snails, a taxonomist requires a population genetics approach, and current discussions concerning the species status of these snails are the result of a lack of basic population genetic data. In contrast to taxonomy, population genetics characterizes genetic variation within and among populations of a species (Tabachnick & Black 1995). In a given region or locality, taxonomic studies are often carried out without information on the extent of gene flow among different populations. Before one starts to suspect a species complex when studying *Bulinus* snails, it is imperative to find out if the amount of genetic variation within populations is significantly less than variation among populations. This question can only be answered through sampling of different populations and an estimation of the amount of variation and gene flow among them which is a common practice in population genetics.

In recent years an increasing amount of information on the *Bulinus* vector snails in Africa has been acquired, but very few investigators have taken a population genetics approach (Rollinson & Wright 1984; Njiokou *et al.* 1993, 1994; Mukaratirwa *et al.* 1996a, 1996b). Another important issue is the study of their mating system (particularly selfing) because they naturally experience population crashes, extinction and recolonization due to adverse ecological factors.

Lately, extensive work has been done by Mukaratirwa (1995) on the population genetics and taxonomy of the genus *Bulinus* in Zimbabwe (see populations sampled in Figs. 1 and 2). From this study, the genetics and morphology investigations to verify the presence of *B. globosus* and *B. africanus* were compatible with that of a single species *i.e. B. globosus* and no specimen resembled that of *B. africanus*.

Apart from *B. globosus* and *B. africanus*, the other *Bulinus* species which have been reported in Zimbabwe are *B. natalensis* Küster, 1841 (Mandahl-Barth *et al.* 1976; Makura & Kristensen 1991); *B. tropicus tropicus* Krauss (Brown 1980; Makura & Kristensen 1991); *B. forskalii* Ehrenberg (Makura & Kristensen 1991); *B. scalaris* Dunker (Brown 1980; Makura & Kristensen 1991); *B. tropicus depressus* Haas 1936 (Makura & Kristensen 1991) and *B. succinoides* Smith (Makura & Kristensen 1991).

None of the above species has been reported to be a natural intermediate host of *S. haematobium* despite reports by Mandahl-Barth *et al.* (1976) on *B. natalensis* being susceptible to *S. haematobium* from Egypt. Makura & Kristensen (1991) noted an interesting observation of morphology variation in shells of the *B. tropicus/truncatus* complex snails collected from the southwestern region of the country. Recent studies by Mukaratirwa (1995) on this complex revealed important findings. Considering the genetic and shell morphology results, the hypothesis that the different shell phenotypes represent different species or subspecies was rejected in the study and these were considered as ecotypes within one single *B. tropicus* species. Furthermore, snails from this study were refractory to being challenged with *S. haematobium*.

Ecological factors and Bulinus globosus *habitats*

According to Minshull (1993), Zimbabwe possesses ten river systems as demarcated in Figure 3. Most of the river systems dry up completely during the dry season (June-September), while during the rainy season (April-May) they experience flash floods of short durations.

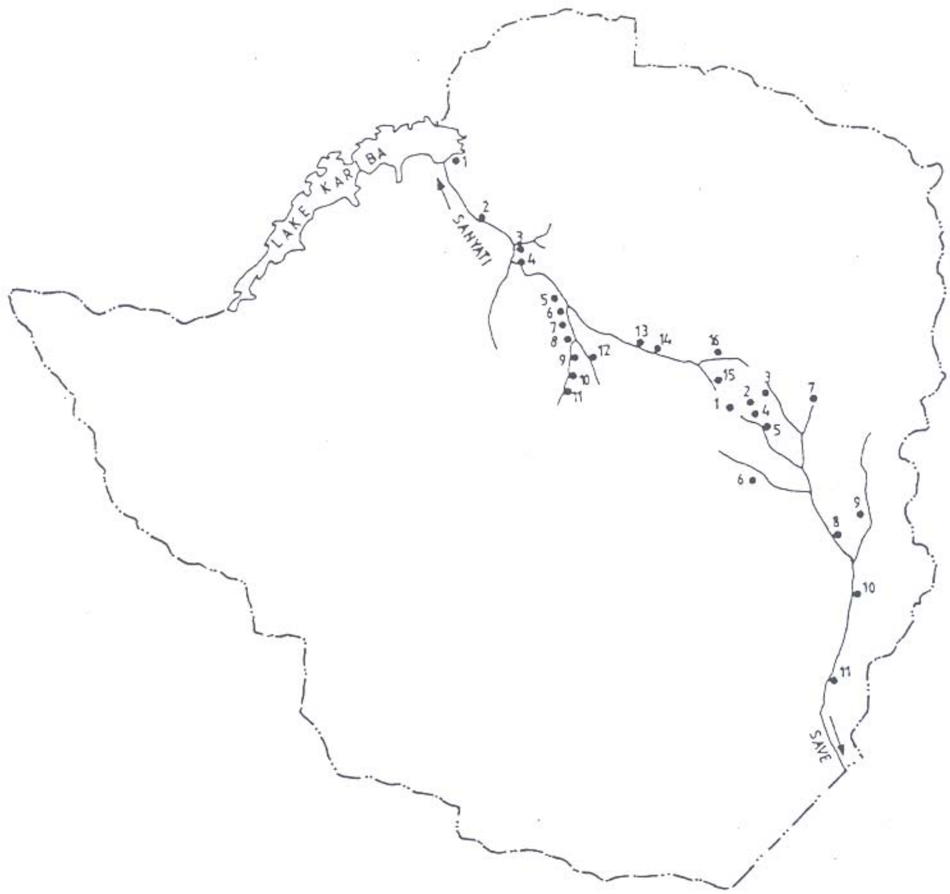

FIG. 1. Location of sampling areas of *Bulinus globosus* along the 2 Drainage systems in Zimbabwe (Mukaratirwa, *et al*. 1996a).

The Save and Sanyati rivers are among the largest rivers in Zimbabwe and are perennial, with a significant reduction in water level during the dry season, where they form ponds or water pools which are ideal as snail habitats. The tributaries to these large rivers commonly dry up during the dry season, forming isolated pools along their course, which persist during most of the dry season, although others might dry up completely towards the end of the dry season. *B. globosus* is commonly found in the temporary pools, and to a lesser extent in the small waterbodies formed along the banks of flowing rivers or streams, and fluctuations in water levels of these habitats influence the size and survival of *B. globosus* populations (Mukaratirwa *et al.* 1996a)

Heavy floods during the rainy season flush snail populations from the small streams and tributaries and the few that survive these catastrophies establish new populations and begin to increase in numbers at the end of the rainy season when water habitats become stable.

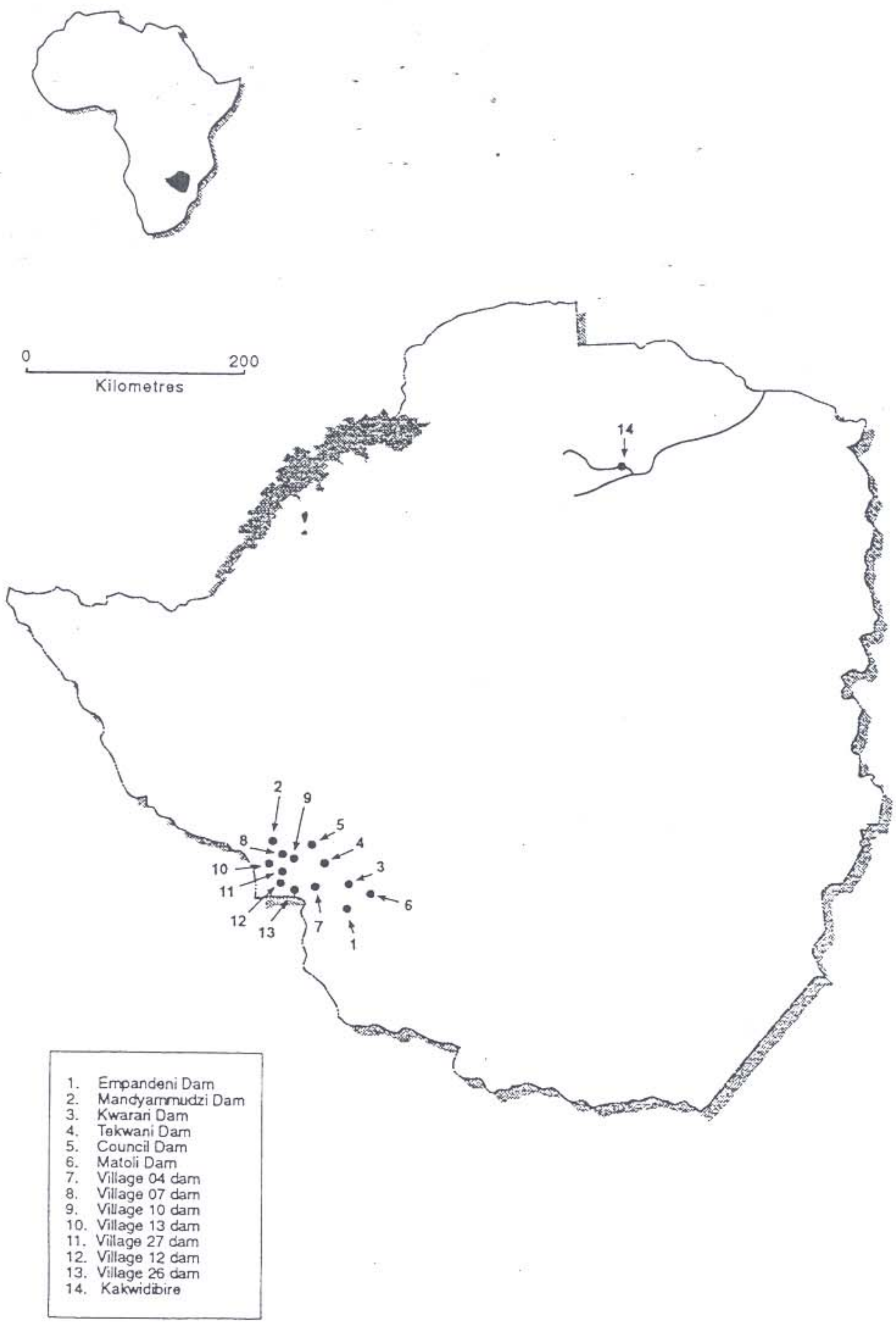

FIG. 2. Map showing sampling localities of *Bulinus tropicus/truncatus* complex in Zimbabwe (Mukaratirwa 1995).

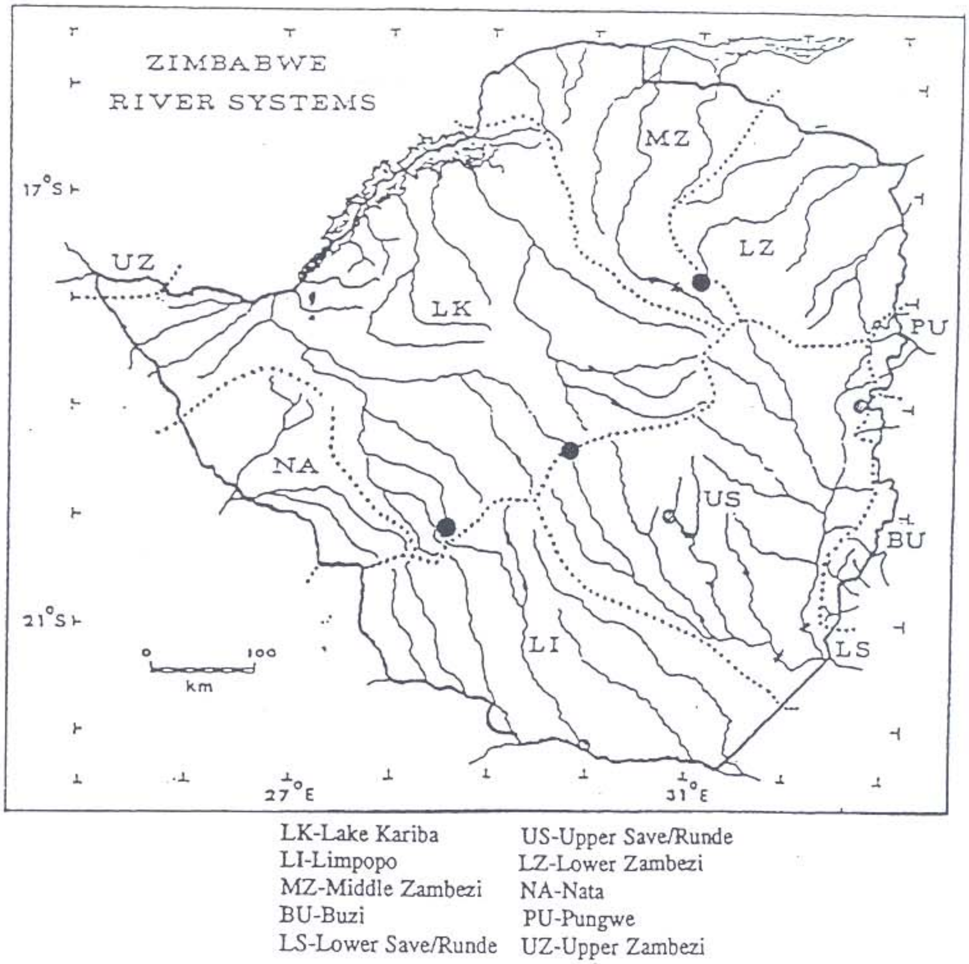

FIG. 3. Map showing demarcation of Zimbabwe river systems (Minshull 1993).

The effects of these ecological catastrophies on *B. globosus* populations, and the implications on schistosomiasis transmission, have been studied by Mukaratirwa *et al.* (1996a). Ecological and environmental factors (population bottlenecks, extinction and recolonization) were found to have influence in the genetic structure of *B. globosus*.

Susceptibility of Bulinus *species snails in Zimbabwe*

Zimbabwe's rainfall pattern divides the country into two distinct areas: the high rainfall areas of the north and the low rainfall areas of the south. *S. haematobium* is the main existing schistosome species with *B. globosus* as intermediate host and prevalence of the disease is well-defined in the two areas (Fig. 4). The heavy rainfall areas of the north have a high prevalence of the disease in comparison with the low rainfall areas of Matebeleland in the southern region (Taylor & Makura 1985).

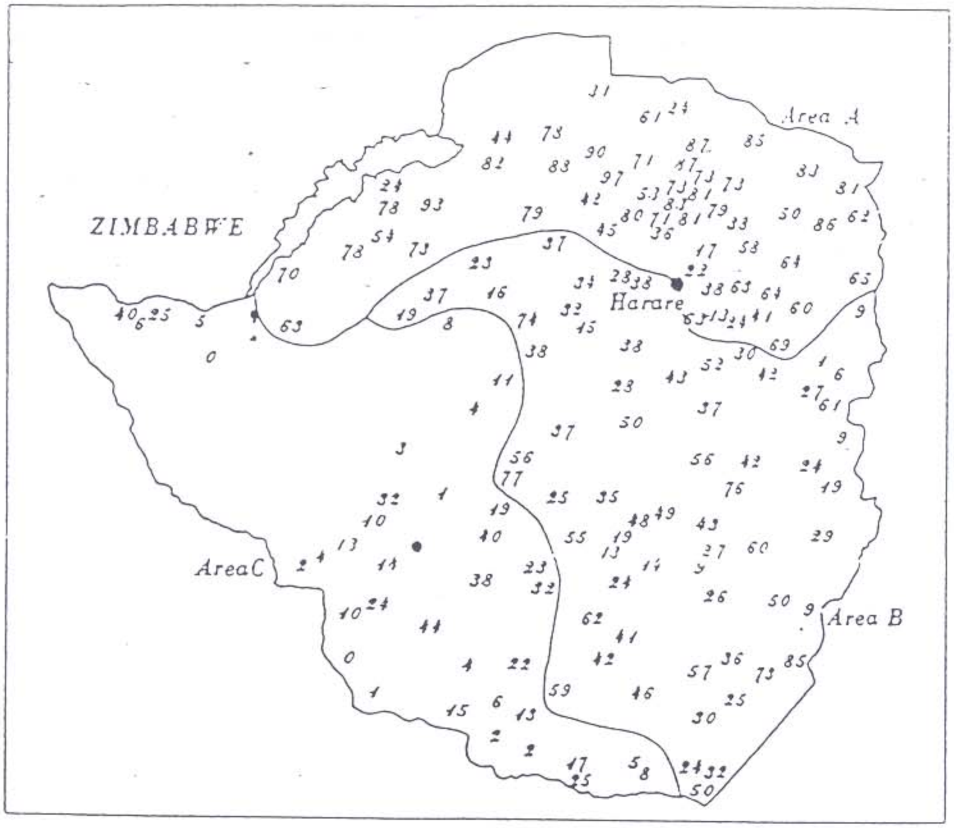

FIG. 4. Zones of different *S. haematobium* endemicity (Taylor & Makura 1985).

According to Brown (1994), vector snails of the same species in different geographical areas could be adapted to different parasite schistosome strains and such adaptation could be maintained in comparatively small areas. Studies to determine the presence or absence of this phenomenon in *B. globosus* vector snails in Zimbabwe have been done by Mukaratirwa *et al.* (1996b) and the authors went on to relate the genetic structure of different populations of *B. globosus* to susceptibility to *S. haematobium*. There was diversity in the patterns of susceptibility of *B. globosus* to different strains of *S. haematobium* which coincided with the heterogeneity in the genetic structure of *B. globosus* populations. The study revealed variation in compatibility towards three sympatric strains of *S. haematobium* on a local scale. The results are in concordance with Basch (1975) who postulates that migration of snails during floods or by any other means can mix originally separate populations and results in changes in allele frequency distributions which may give rise to abrupt alteration in the susceptibility pattern of the snail host.

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