# Preliminary study on the culture and breeding of *Bulinus nyassanus* (Mollusca: Pulmonata) under laboratory conditions

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**We successfully artificially cultured and bred *Bulinus nyassanus*, endemic to Lake Malawi and an intermediate host of *Schistosoma haematobium*. The laboratory culture of this snail species is essential in relation to further experiments on the feasibility of using facultative snail-eating fishes as biological control agents for intermediate hosts of *Schistosoma haematobium* in the open waters of Lake Malawi. The artificial culture of *B. nyassanus* will also enable us to collect important life history information including fecundity, egg development, hatchability, survival at varying temperatures and growth rates.**

**Key words:** **schistosomiasis, *Bulinus nyassanus*, Lake Malawi, breeding.**

Urinary schistosomiasis, caused by *Schistosoma haematobium,* occurs frequently in both the residents and tourists of Nankumba Peninsula, in the southeastern arm of Lake Malawi, Africa (Madsen *et al.* 2001). There has been a reported increase in the transmission of *S. haematobium* over the past decade (Cetron *et al.* 1996).

The Lake Malawi National Park (LMNP) at Cape Maclear is one of the most frequented tourist attractions in Malawi (Msukwa & Ribbink 1997). In addition to adversely affecting local human populations, the transmission of schistosomiasis infection will negatively impact the tourism industry in the country.

*Bulinus nyassanus* (Smith, 1877), an intermediate host of *S. haematobium,* is probably responsible for the majority of transmission in the open waters of Lake Malawi, along rather exposed shorelines, devoid of aquatic macrophytes, with a substratum of sand or gravel (Madsen *et al.* 2001). Previous attempts to culture *B. nyassanus* in the laboratory have not been optimal. In its natural habitat, the snail feeds on detritus within the sediment, and under laboratory conditions it will not feed on either fresh or boiled lettuce, which is used as a standard feed for many pulmonate snail species. In this paper we describe attempts to allow the snail to feed on artificial feed within the sediment.

*Bulinus nyassanus* is endemic to Lake Malawi and is particularly abundant along Chembe Beach, Cape Maclear. There is great variability in population size among sites, however, and this seems to be partially associated with sediment type and possibly the slope of the shoreline. The snail digs into the sediment, where it feeds on detritus. The snail populations undergo marked fluctuations in density, with very low numbers during the rainy season from about December to March/April. Population density increases from about April/May and at some sites such as Chembe village, this increase is particularly pronounced in shallow water (0.7–2 m) (Madsen *et al.* 2001). Cases where snails are distributed discontinuously across areas of seemingly similar ecological conditions are well known but difficult to explain (Appleton & Madsen 1997).

## SNAIL CAPTURE AND HOUSING

Snails were collected from Lake Malawi at Cape Maclear on the Nankumba Peninsula, and transported to Bunda College of Agriculture, University of Malawi, about 35 km south of Lilongwe. Kitchen wire sieves mounted onto long bamboo poles were used as scoops to collect the snails.

The snails were held in cement tanks before transportation. We transported snails using both wet and dry techniques. In the wet method, snails were transported in polythene bags with just enough lake water (about 10 l) to keep them afloat; the bags were filled with oxygen. In the dry method, 5 l plastic buckets were used. In both methods, no substrate was provided during trans-

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portation. However, sand from the snail habitat was collected in separate containers, which was later used as substrate in some of the tanks. Hundreds of snails were transported and no mortality occurred using either transportation method.

Upon reaching the laboratory, the snails were placed in 200 l fibreglass tanks in de-chlorinated tap water. The water was aerated and the snails were fed a fish feed consisting of 30% crude protein and comprised of fishmeal, maize bran, rice bran, soybean, wheat bran (binder), vitamin premix and mineral premix.

Snails were cultured in four 30 l circular tanks and two 200 l rectangular fibreglass tanks. Sand, which was collected from the snails' natural habitat, was placed on the bottom of the 30 l tanks as a substrate (2–3 cm). One hundred snails were stocked in each 30 l tank. One hundred and fifty snails were stocked in the 200 l tanks with no substrate. All tanks were aerated. During the first week, dead snails were replaced in all the tanks. The tanks were cleaned at least once a week by removing half of the water. The tanks were then refilled with de-chlorinated tap water. Room temperature ranged between 23° and 27°C.

Feed pellets were crushed with a mortar and pestle. The powdered form was then suspended in water and strained through a fine-meshed material to remove large fragments. The suspension was then fed to the snails every other day. One hundred millilitres of the strained liquid were fed in the 30 l tanks and 150 ml in the 200 l tanks. Later in the course of the study, snail shells (*Lanistes nyassanus*) were ground and added to the tanks as a calcium supplement.

## REPRODUCTION

Egg masses were observed both on sediment and tank walls two weeks after stocking all tanks. After about three weeks, newly hatched snails were observed in all the tanks. The small snails were then continuously removed from the tanks and kept separately. They were fed with the same feed under the same feeding regime. Mortality was high but a reasonable proportion (not quantified) reached maturity and was able to produce viable eggs.

## CONCLUSION

*Bulinus nyassanus* was successfully cultured and bred under artificial conditions and survived well on a locally formulated fish feed. The artificial culture of this snail species will permit the study of aspects of the biology and ecology of the species such as egg laying and hatchability, survival at varying temperatures, also growth rates in laboratory bred populations, and most importantly will provide a steady source of uninfected snails for predator (fish)-prey studies.

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## REFERENCES

APPLETON, C.C. & MADSEN, H. 1997. Are medical malacologists in danger of becoming an endangered species? In: *Proceedings of Workshop on Medical Malacology in Africa,* Zimbabwe, 22–26 September 1997, (eds) H. Madsen, C.C. Appleton & M. Chimbari, pp. 1–8. Danish Bilharziasis Laboratory, Charlottenlund.

CETRON, M.S., CHITSULO, L., SULLIVAN, J.J, PILCHER, J., WILSON, M., NOH, J., TSANG, V.C., HIGHTOWER, A.W. & ADDISS, D.G. 1996. Schistosomiasis in Lake Malawi. *The Lancet* **348**: 1274–1278.

MADSEN, H., BLOCH, P., PHIRI, H., KRISTENSEN, T.K & FURU, P. 2001. *Bulinus nyassanus* is intermediate host for *Schistosoma haematobium* in Lake Malawi. *Annals of Tropical Medicine and Hygiene* **95**: 353–360.

MSUKWA, A.V. & RIBBINK, A.J. 1997. The potential role of sanctuary areas for biological control of schistosomiasis in Lake Malawi National Park. In: *Proceedings of Workshop on Medical Malacology in Africa,* Zimbabwe, 22–26 September 1997, (eds) H. Madsen, C.C. Appleton & M. Chimbari, pp. 305–317. Danish Bilharziasis Laboratory, Charlottenlund.