Prey value of selected gastropod species, *Bulinus globosus*, *Bulinus nyassanus* and *Melanoides virgulata*, to the cichlid fish *Trematocranus placodon* in Lake Malawi

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The problem

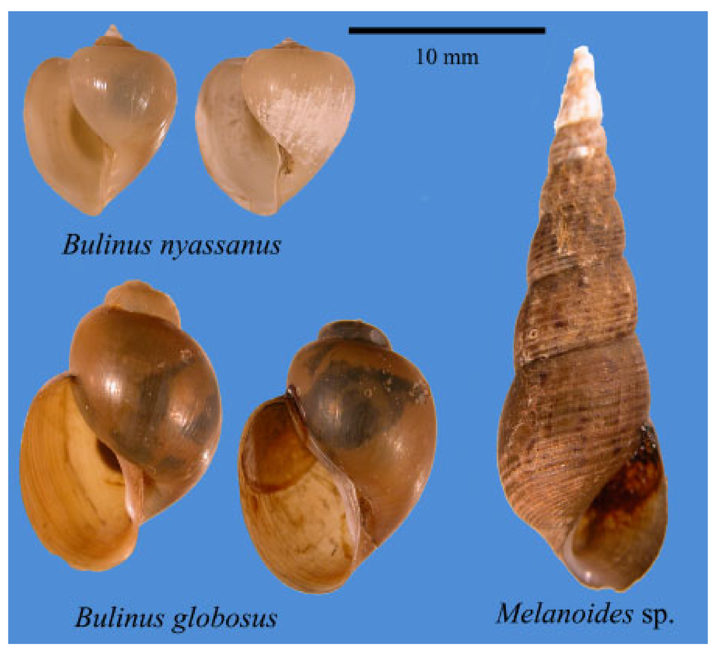
Schistosome transmission has increased in Lake Malawi over recent years and it has been suggested that this is a direct consequence of a decline in density of certain snail feeding cichlid species caused by seine-net fishing from the shoreline. This decline in fish density appears to have resulted in an increase in density of schistosome intermediate host snails. We suggest that reducing seine net fishing in the near shore areas of the lake would result in an increase in density of molluscivorous fishes and possibly a decline in schistosome transmission.

This, however, would require that the molluscivores would include a substantial fraction of *Bulinus* spp. in their diet. *B. nyassanus*, which is the primary intermediate host along open sandy shorelines of Lake Malawi, has a very thick shell and it is not the dominating species in the gastropod fauna. *Melanoides* species are much more common than *B. nyassanus.*

The snails

Bulinus nyassanus

B. nyassanus is an intermediate host of *S. haematobium* (Madsen *et al.* 2001). *B. nyassanus* is endemic to Lake Malawi and is found on open sandy areas without macrophytes. It is usually found buried 2-3 cm into the gravel.



Melanoides virgulata

Melanoides spp is the most abundant snail in Lake Malawi and is not an intermediate schistosome host. *M. virgulata* is thought to be a good representative for the majority of *Melanoides* as most *Melanoides* are very similar in shell morphology (Eldblom & Kristensen 2003).

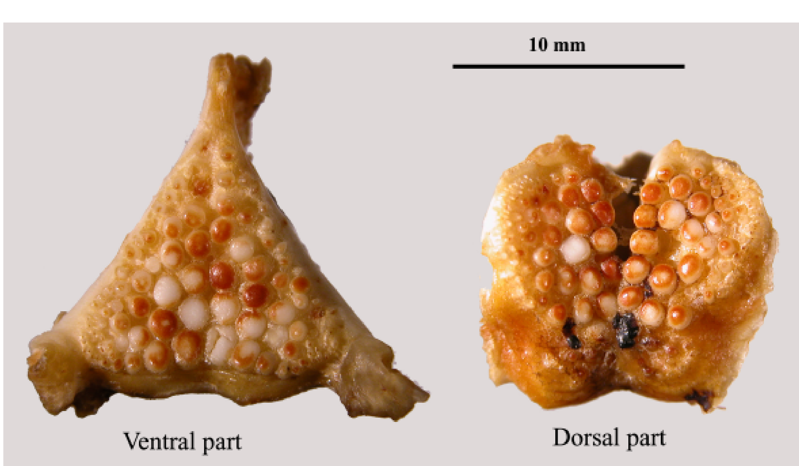
Bulinus globosus

B. globosus is an intermediate host of *S. haematobium*. The snail is most common among aquatic plants. *B. globosus* is uncommon in Lake Malawi, but has been reported at several sites in the lake, especially near inflowing streams and in sheltered areas (Madsen *et al.* in press).

The molluscivore cichlid: *Trematocranus placodon*

The molluscivore cichlid *Trematocranus placodon* is common in shallow waters on sandy bottoms where it forages mainly on gastropods. *T. placodon* has a very well developed pharyngeal jaw apparatus and ingested snails are moved to the pharynx where they are crushed.

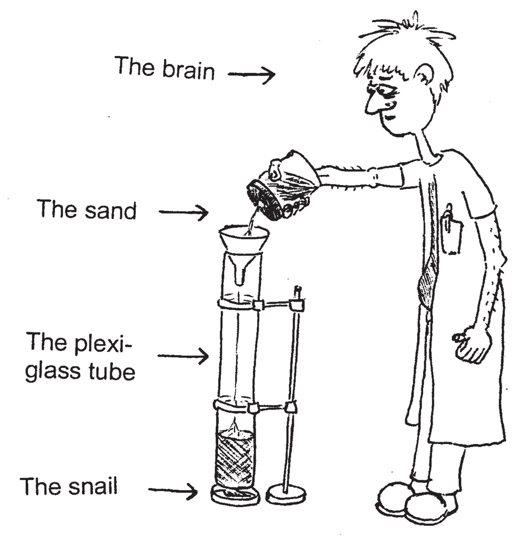
The pharyngeal jaws of *Trematocranus placodon*



The crushing experiment

Molluscivore foraging can often be explained by an optimal foraging model where prey is added to the diet in decreasing order of energetic benefit value of prey, divided by the handling time for that prey. Energetic benefit of a snail species can be estimated as its tissue mass and handling time has been shown to be proportional crushing resistance of the shell.

Dried specimens of field collected *Bulinus nyassanus*, *B. globosus* and *Melanoides virgulata* were shell height measured and placed underneath a plexi glass cylinder closed at the bottom. This tube was gradually filled with sand until the shell crushed (see Figure). The snail pieces were weighed (=total dry weight) and the plexi-glass tube, including the sand, was weighed (=crush weight). The snail pieces was placed in an oven at 500ºC for 1.5 hours, and weighed again (=inorganic dry weight).



The organic weight of the individually snails were determined by subtracting the inorganic dry weight from the total dry weight. Prey values were estimated as organic weight divided by crush weight.

For the three species, the best fitted models describing the relationship between crush weight and shell height (Fig 1) and ash free dry weight and shell crush weight (Fig 2) were determined. The linear relationship between prey value and shell height was determined for the three species (Fig 3).

Fig 1.

The graph shows that *B. nyassanus* has a higher crush weight than both *B. globosus* and *M. virgulata* in their entire shell height overlap interval. *B. globosus* has the lowest crush weight of the three.

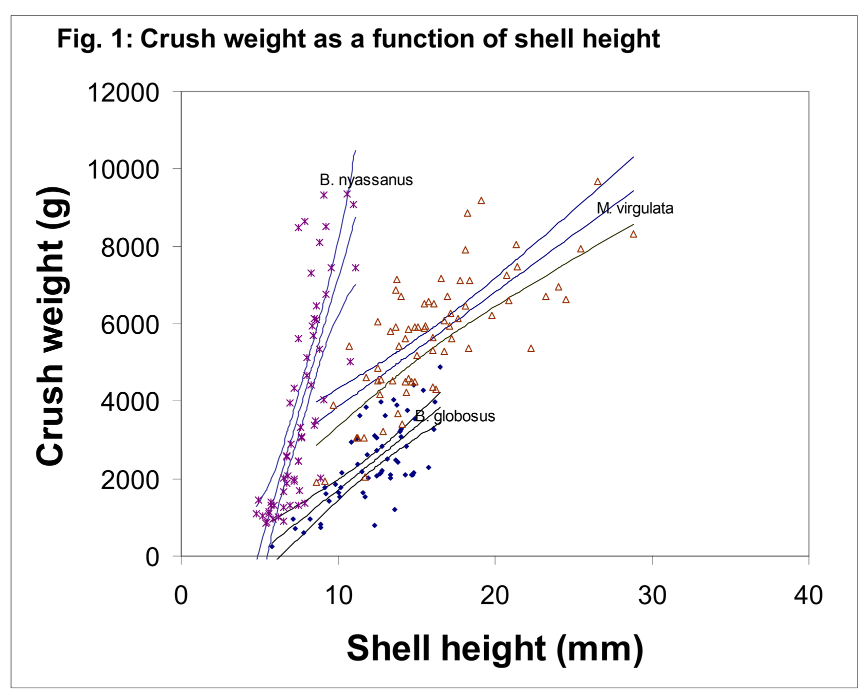


Fig 2.

B. globosus has a higher organic weight at a given crush weight than both other species. Only when the crush weight exceeds app. 6400 g does *M. virgulata* have a larger organic weight than *B. nyassanus*. This means, as seen from Fig.1, that the organic weight at a given shell height is higher for *M. virgulata* when the shell height exceeds app.13.5 mm for *M. virgulata* or 8.5 mm for *B. nyassanus*.

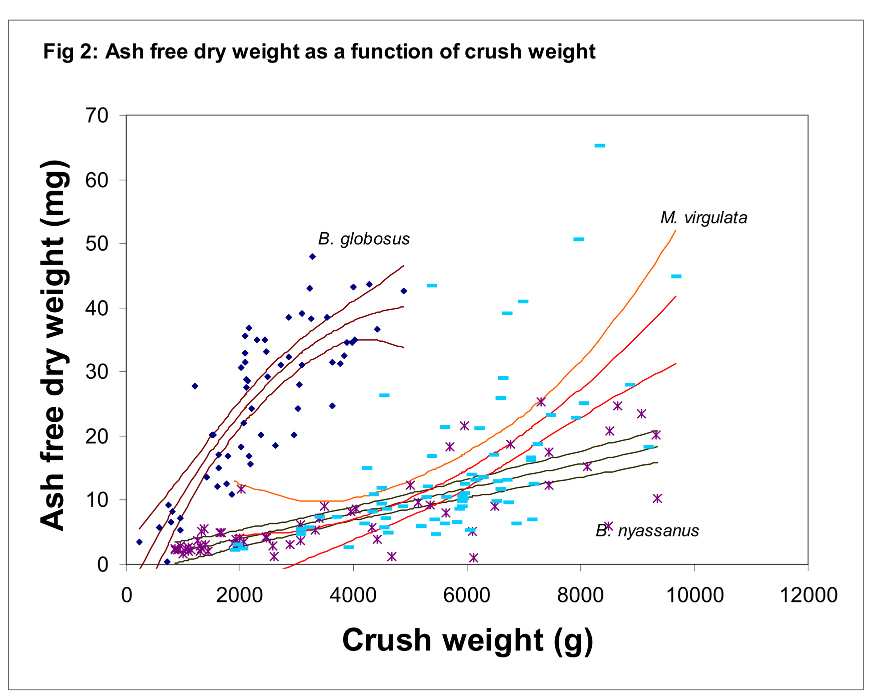
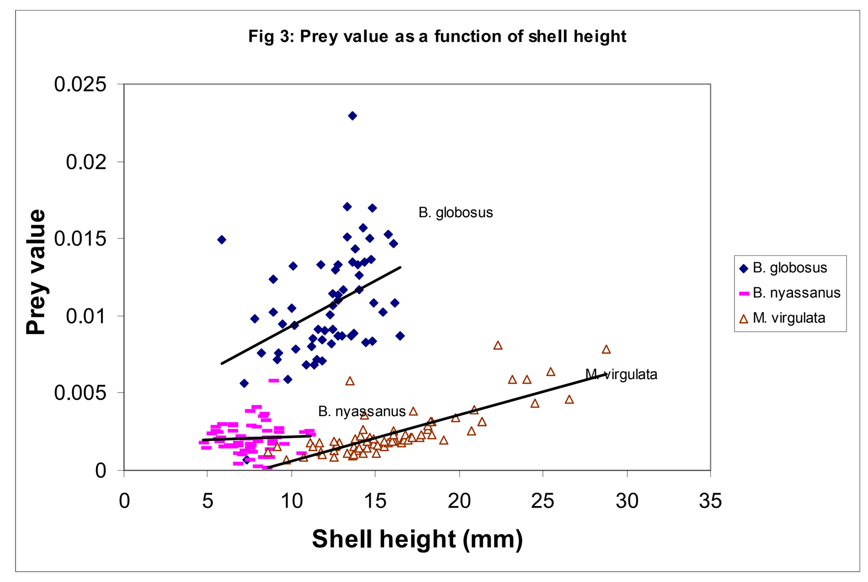


Fig 3.

Only for *B. globosus* and *M. virgulata* were the regression lines found to be significant ($p<0.05$). The figure shows that *B. globosus* is the most profitable prey of the three species. The prey value of *B. nyassanus* seems higher than for *M. virgulata* until *M. virgulata* gets fairly large (exceeding a shell height of app. 15 mm).



Stomach content of wild caught *T. placodon*

The proportion of the different snail species in the stomachs of wild-caught *T. placodon* specimens were compared to the proportion of these snail species found in the lake by transects (Table 1).

Table 1: Distribution of snail species in the *T. placodon* diet and in transects.

	Stomach/intestines		Field transects	
Species	No. of snails	Percentage to all snails	No. in field sampling	Percentage to all snails
Melanoides spp.	1042	72.3	4444	94.8
B. nyassanus	354	24.6	165	3.5
Other snails	45	3.1	77	1.6

Stomach content of *T. placodon.* Note both *Melanoides* and *Bulinus nyassanus* present.

Stomach content of *T. placodon. Bulinus nyassanus* shells are remarkably intact.

The conclusion

This study shows that *B. globosus* is the most profitable prey for *T. placodon* followed by *B. nyassanus* and *M. virgulata*. This might be part of the explanation why *B. globosus* is uncommon in Lake Malawi compared to the other two species. Until *M. virgulata* gets fairly large (>15 mm), *B. nyassanus* seems the most profitable catch of the two. Our *T. placodon* stomach content analysis supports this finding. Our results support the suggestion that *T. placodon* can be a useful biological control agent of *B. nyassanus*.

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