

On snail-borne hippo parasites: do artificial lakes and biological invasions pose a burden on *Hippopotamus amphibius*?

Ruben Schols^{a,b,*,+}, Hans Carolus^{c,*}, Cyril Hammoud^{a,d}, Kudzai C. Muzarabani^e, Maxwell Barson^{e,f,g} and Tine Huyse^a

^a Department of Biology, Royal Museum for Central Africa, Tervuren, Belgium

^b Laboratory of Aquatic Biology, KU Leuven Kulak, Kortrijk, Belgium

^c Laboratory of Molecular Cell Biology, KU Leuven-VIB center for microbiology, Leuven, Belgium

^d Limnology research unit, Ghent University, Ghent, Belgium

^e Department of Biological Sciences, University of Zimbabwe, Harare, Zimbabwe

^f Department of Biological Sciences, University of Botswana, Gaborone, Botswana

^g Lake Kariba Research Station, University of Zimbabwe, Kariba, Zimbabwe

* These authors contributed equally.

+ Lead Contact

Corresponding author: Ruben Schols (ruben.schols@africamuseum.be)

Abstract

Background

Humans impose a significant pressure on large herbivore populations in Africa through hunting, poaching and habitat destruction. Indirect anthropogenic disturbances such as artificial lake creation and the subsequent introduction of invasive species that alter the ecosystem have been less studied. Still, these events can lead to drastic changes in parasite diversity and transmission.

Results

In order to document and identify trematode parasites of hippopotami in artificial water systems of Zimbabwe, we applied an integrative taxonomic approach, combining molecular diagnostics and morphometrics on archived and new samples. In doing so, we provide DNA reference sequences of the hippo liver fluke *Fasciola nyanzae*, enabling us to construct the first complete *Fasciola* phylogeny. We describe parasite spillback of *F. nyanzae* by the invasive freshwater snail *Pseudosuccinea columella*, as a consequence of a cascade of biological invasions in Lake Kariba, one of the biggest artificial lakes in the world. Additionally, we report an unknown stomach fluke of the hippopotamus transmitted by the non-endemic snail *Radix* aff. *plicatula*, an Asian snail species that has not been found in Africa before, and the stomach fluke *Carmyerius cruciformis* transmitted by the native snail *Bulinus truncatus*. Finally, *Biomphalaria pfeifferi* and two *Bulinus* species were found as new snail host records for the poorly documented hippo blood fluke *Schistosoma edwardiense*.

Conclusions

Our findings indicate that artificial lakes are breeding grounds for endemic and non-endemic snails that transmit trematode parasites of the common hippopotamus. This has important implications, as existing research links trematode parasite infections combined with other stressors to declining wild herbivore populations. Therefore, we argue that monitoring the anthropogenic impact on parasite transmission should become an integral part of wildlife conservation efforts.