Lake Malawi is an ancient, deep lake situated at the southern end of the western branch of the East African Rift System (EARS). Like other extant lakes in the EARS and several paleolakes that occupied rift basins in the EARS before, Lake Malawi provides habitats for an extraordinary diversity of freshwater biota ranging from vertebrates, like the adaptive radiations in cichlid fish (e.g. Kocher, 2004), to the phytoplankton communities that provide nutrients to the benthic and pelagic ecosystems (e.g. Van Bocxlaer et al., 2012 and references therein). Major environmental changes in the Malawi Basin since the Middle Pleistocene, including fluctuations in the water level of Lake Malawi, are recognized in the sediments of drill cores and are considered to be a driving force for organismal evolution (Cohen et al., 2007), including the diversification of amphilid gastropods of the genus Lanistes (Schultheiß et al., 2009). In the latest revisions of the Lanistes from the Malawi Basin (Mandahl-Barth, 1972; Berthold, 1990) five species (L. ellipticus Martens, 1866, L. ovum Troschel, 1845, L. solidus Smith, 1877, L. nyassanus Dohrn, 1865 and L. nasutus Mandahl-Barth, 1972) were recognized mainly based on anatomical traits and shell morphology, but further revision is required (Schultheiß et al., 2009). In any case, the extant Lanistes fauna of the Malawi Basin is a monophyletic, endemic clade (Schultheiß et al., 2009). The onset of molecular diversification in this clade is much younger (~0.6 Ma) than the first Lanistes fossils recorded in the basin, which are preserved in Unit 3A of the Chiwondo Beds (~3.75-1.80 Ma; Kullmer, 2008). However, the mechanisms of this young diversification event are poorly understood, as is the relation between molecular diversity and disparity in shell morphology. In this study we aim to get a better insight into the heritability of shell morphology.

In order to evaluate the heritability of morphological variation, we collected living specimens of three Lanistes morphospecies (‘L. ovum’, ‘L. solidus’ and ‘L. nyassanus’) from the South of Lake Malawi and transferred these to the Research Unit Palaeontology of Ghent University for a Common Garden Experiment. These three morphospecies are regularly found in the diverse groups have equal multivariate means.

In total, 242 first generation (F1) juveniles were bred in the Common Garden Experiment. Substantial differences were observed in fecundity between morphospecies and replicate experiments. Fecundity appears to be inversely proportional to the parent population size. Consistent shifts in morphospace occupation from the parent generation to the F1 generation were obtained in replicate experiments for the same morphospecies, suggesting that our study design was robust. Except for L. nyassanus, the parent and F1 offspring groups of each experiment were significantly different. However, the respective morphospecies underwent different shifts in morphospace occupation from the parent to the offspring generation. Statistical tests demonstrated that the morphological differences between two morphospecies pairs (L. nyassanus-L. solidus; L. nyassanus-L. ovum) remained in the F1 generation whereas the difference in the third morphospecies pair (L. solidus-L. ovum) disappeared at F1. Our results indicate that much of the morphological disparity in the Lanistes morphospecies from the South of Lake Malawi relates to inherited differences even though gene-flow between these morphospecies may occur. This suggests that some isolation by adaptation has occurred in these Lanistes morphospecies. However, plastic responses to environmental differences also add to the variability in shell shapes observed in the Lanistes from the South of Lake Malawi. The hybrid experiment indicated that, at least in the lab, hybridization between live-collected L. ovum and L. nyassanus is possible and a handful hybrid parent couples produced 419 viable F1 hybrids, although hybrid parent couples differed in reproductive success. It remains yet to be documented how the morphology of F1 hybrids relates to that of the parents, and how variable the offspring of a single couple is. In some tanks copulation has been observed between F1 hybrids (brothers-sisters), and in four tanks egg clusters were produced. Some of these eggs did not grow and appear to have been sterile, but a limited number of eggs hatched. The viability of these juveniles remains to be documented, but the observations in any case suggest that some F1 hybrids are fertile and capable of reproduction with other F1 hybrids. Currently we are still working on the F1 hybrids, after which we hope to design an F2 hybrid experiment.
References.


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