

**A molecular phylogeny of geotrochus and trochomorpha species (gastropoda: trochomorphidae) in Sabah, Malaysia reveals convergent evolution of shell morphology driven by environmental influences**

**ABSTRACT**

There are currently eleven *Geotrochus* and four *Trochomorpha* species in Sabah. The primary diagnostic character that separates the two genera is the intensity of sculpture on the shell upper surface. All *Trochomorpha* species have a coarse nodular sculpture while *Geotrochus* species has a non-nodular sculpture or smooth shell. However, it is known that shell characters are often evolutionary labile with high plasticity in response to environmental factors. Hence, identifying the phylogenetic and ecological determinants for the shell characters will shed light on the shell-based taxonomy. This study aims to estimate the phylogenetic relationship between *Geotrochus* and *Trochomorpha* species in Sabah based in two mitochondrial genes (COI, 16S) and one nuclear gene (ITS) and also to examine the influence of temperature, elevation and annual precipitation on the coarseness of shell upper surface sculpture and shell sizes of the species of both genera. Additionally, we also investigated the phylogenetic signal of the shell characters. The phylogenetic analysis showed that *Geotrochus* and *Trochomorpha* species are not reciprocally monophyletic. The phylogenetic signal test suggested that shell size and upper surface sculpture are homoplastic, and these shell traits are strongly influenced by elevation and annual precipitation, particularly at the cloud zone of Mount Kinabalu. The highland species of both genera have a coarser shell surface than lowland species. The shell and aperture width decrease with increasing elevation and annual precipitation. In the view of finding above, the current taxonomy of *Geotrochus* and *Trochomorpha* in this region and elsewhere that based on shell characters need to be revised with sufficient specimens throughout the distribution range of the two genera.