

DNA metabarcoding analysis of the early-stage diet of mesopelagic fishes and squids in the Southern Ocean

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Mesopelagic fishes and squids, high-trophic-level predators in the Southern Ocean ecosystem, undergo ontogenetic vertical migration. They move from shallow waters below 400 m to the mesopelagic zone, as they transform from larval to juvenile stages. However, little is known about their feeding habits as they undergo marked morphological transformation. This study analysed the stomach contents of two dominant fish species, *Notolepis coatsorum* (family Paralepididae) and *Bathylagus antarcticus* (Bathylagidae), and one squid species, *Galiteuthis glacialis* (Cranchiidae), in the seasonal sea ice zone of the Southern Ocean, using DNA metabarcoding to elucidate the feeding ecology of the early developmental stages. Samples were collected using an open/close multiple net-system (MOHT) and ring net from three stations at 110° E and 61°, 63.5°, and 65° S in January 2020 during voyages of the training ship *Umitaka-maru* (Tokyo University of Marine Science and Technology). The contents of *N. coatsorum* ($n = 20$, 27.9–76.0 mm in body length), *B. antarcticus* ($n = 33$, 14.1–154.7 mm), and *G. glacialis* ($n = 31$, 5.5–64.2 mm in mantle length) were examined under a binocular microscope, and then DNA was extracted for metabarcoding analysis. Although all three species fed mainly on copepods throughout the larval and juvenile stages, each species preferred different species at the order level. These results suggest differences in vertical distribution and feeding behaviour among the three species. In *G. glacialis*, jellyfish and diatoms were important items, suggesting that they feed on aggregates, such as sinking particles. In all species, the diet included more diverse taxonomic groups during the juvenile stage. These species likely change their diets to larger, more diverse prey as their swimming and feeding abilities improve via morphological transformation and their habitats change to a deeper water layer.

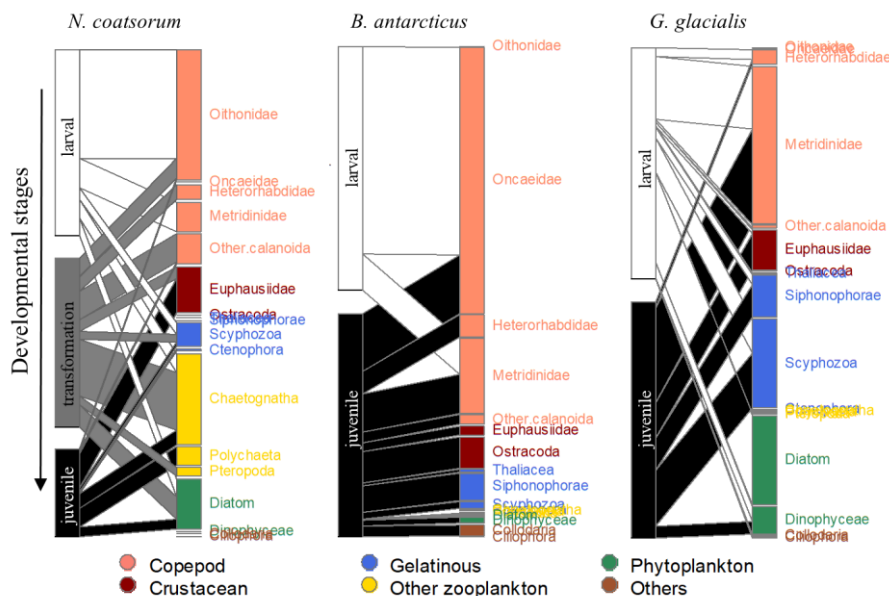


Figure 1. Changes in the diet of three mesopelagic species (*Notolepis coatsi*, *Bathylagus antarcticus*, and *Galiteuthis glacialis*) from larval to juvenile stages, as determined by DNA metabarcoding. Grayscale bars on the left show the developmental stages from larvae to juveniles. Coloured bars on the right show changes in prey composition with developmental stages. Line thickness indicates the relative dependence on prey.