

Feeding patterns and gonadal maturation of zooplankton in the Indian Sector of the Southern Ocean

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Zooplankton form a pivotal link in Southern Ocean ecosystems, linking primary producers with higher trophic levels, modulating the fate of biogenic carbon and ultimately influencing whether the ocean acts as a source or sink of greenhouse gases like CO₂. If we are to understand how changes at the base of the food web impact the entire ecosystem we need to address some pressing knowledge gaps in our understanding of lower trophic level organisms. For example, there is little information available concerning grazing rates of key zooplankton species other than Antarctic krill. This is especially true of the Indian Sector of the Southern Ocean, where there have been only limited attempts to undertake systematic grazing experiments. Zooplankton grazing is an important energy pathway in the Southern Ocean, and is highly influenced by size-based predator-prey interactions. Our understanding of these complex, lower trophic interactions is limited due to a lack of quantitative information on zooplankton ingestion rates and the influence of behavioural selection of prey. Establishing robust feeding rates is important for assisting ecosystem modellers to represent zooplankton grazing parameters in their models.

In January 2015, Australian students joined a voyage of the *Umitaka-maru* (TUMSAT) to sample zooplankton along the 110°E meridian from Fremantle to ~65°S. Shipboard incubation experiments were used to examine grazing rates and prey selectivity of key zooplankton taxa at five stations along the transect. Eleven species were tested in the experiments (some at multiple sites), enabling a picture to be developed of how their feeding rates and food selection varied with latitude. Species found north of the Polar Front actively selected diatoms as food, in spite of the fact that diatoms represented a smaller fraction of potential prey items in northern waters and dinoflagellates were dominant. South of the Polar Front little size-based selectivity was shown by the grazers, and phytoplankton were in very high abundance, especially at the two southern-most stations. The diatom *Fragilariopsis kerguelensis*, which is heavily silicified, was ingested by all copepod species used in the experiments. Results from the ship-board grazing experiments were supported by the examination of the gut contents of field-caught specimens of four dominant copepod species (*Calanoides acutus*, *Calanus propinquus*, *Calanus simillimus* and *Rhincalanus gigas*). Diatoms were shown to be the key dietary item, representing 96% of identifiable items in the guts. Fifteen diatom taxa were common to all four copepods, with three being particularly prevalent: *Fragilariopsis kerguelensis*, *Thalassiosira* spp. and *Trichotoxon reinboldii*. These direct observations of ingested food will aid the interpretation of forthcoming results from $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ analyses of key species of plankton that were also collected during the *Umitaka-maru* voyage.

Maturation of the ovaries is an important aspect of the life cycle strategies of copepods, yet quantitative information on gonad maturation stages is lacking for many species in the Southern Ocean. Adult females of the four dominant copepods collected - *C. acutus*, *R. gigas*, *C. propinquus* and *C. simillimus* - were examined in detail in the laboratory and classed into one of five reproductive maturation stages: Immature, Party Mature, Semi Mature, Mature and Spent. Gonad maturation increased along the transect from north to south, with few mature females of any species found north of the Polar Front. Increased food availability at the southernmost stations probably accelerated sexual maturation of females in those waters, potentially increasing overall fecundity and directly influencing recruitment in the high latitude waters.