

Population cycles of Antarctic krill

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Antarctic krill (*Euphausia superba*) is one of the most abundant species on Earth and is a key species in the Southern Ocean food web. In some regions of the Southern Ocean the krill biomass exhibits large-amplitude population cycles with a period of 5-6 years, which can strongly affect the whole ocean ecosystem. However, the underlying mechanisms of these cycles are still weakly understood. Previous studies suggest that these cycles are caused by periodical changes in climatological conditions. However, these studies show neither a consistent agreement nor are supported by quantitative models. Here, we compare field data with outcomes of an ontogenetic model of a krill population. We show that, although, external climatological factors can affect the phase and period of these cycles, the main driver is likely the resource competition between different developmental stages. We show that large biomasses of adult krill negatively affect larvae survival during autumn, giving rise to the oscillations with periods corresponding to the lifetime of a dominating krill cohort. Our findings explain the observed cycle period of 5-6 years, with 2 successive years of high recruitment and 3-4 years of low recruitment; the decrease in maximal recruitment with increasing krill biomass; and the potential synchronization with distinct climatological drivers in different regions. We also show that the presence of the cycles can be related with lack of krill predators (seals, penguins and whales), and a reduction in the biomass of krill predators can increase the oscillation amplitude and lead to drastic consequences for the whole ecosystem.

Keywords: *Euphausia superba*, population cycles, ontogenetic models

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