Environmental drivers of sea stars feeding ecology in the Southern Ocean

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The Antarctic continent and the surrounding Southern Ocean undergo strong and contrasted impacts of climate change. In the Western Antarctic Peninsula, sea ice cover and ice season duration are decreasing, presumably in relation with increased air and water temperature and northwesterly winds originating from the also warming subtropical Pacific. In contrast, despite increased air and deep water temperatures, sea ice cover and ice season duration are increasing in other Antarctic regions. This is possibly linked with ocean stratification due to freshwater inputs from the melting continental ice. These changes are likely to impact marine communities and food webs of the Southern Ocean.

Sea stars (Echinoderms: Asteroidea) are an important group of the Southern Ocean benthos. Compared to other organisms, they seem to have relatively high physiological tolerance to warming. However, they could be indirectly affected by climate change, notably through quantitative and qualitative modifications of food availability.

In this context, the aim of this study was to infer the trophic diversity of sea stars of the Southern Ocean to assess their potential trophic plasticity regarding food web changes. Thanks to collaborative networking and valorization of museum samples, Sea stars samples taken in summer in various regions around the Antarctic continent with different types of environment (Antarctic or Subantarctic, deep-sea or coastal, presence of sea ice or not) were obtained. Stable isotopes ratios of C (denoted δ13C) and N (denoted δ15N) were then analysed in the tegument of sea stars in order to investigate their trophic ecology. Isotopic niches metrics were also computed to assess differences of trophic diversity between regions.

Variability in stable isotope ratios and isotopic niche metrics revealed strong differences in sea star feeding ecology between and within locations, possibly in relation with differences in environmental conditions, notably sea ice coverage and dynamics. For example, on the continental shelf of Antarctic South Shetland Islands, small isotopic niches could indicate that sea stars exploit a food web based on a common basal food source and exhibit a "trophic continuum". In this context, absence of sea ice before and during the sampling period could have limited the number of available food sources. By contrast, on the continental shelf of the Antarctic Marguerite Bay or in the Subantarctic South Georgia Island, sea stars had large isotopic niches that suggest that they could exploit one or several food webs based on more than one food source, and exhibited strong trophic segregation. In Marguerite Bay, this could be linked with progressive sea ice melting, which allows export of both sea ice materials and blooming phytoplankton to the benthic compartment. In South Georgia, on the other hand, oligotrophic conditions and thus reduced availability of phytoplankton are more likely to explain this pattern. Ultimately, this project helps us understanding which ecological processes determine how an ecologically important animal group copes with environmental modifications linked to climate change.

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