Increased sea ice cover disrupts food web structure in Antarctic coastal benthic ecosystem

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Antarctica currently undergoes strong and contrasted impacts linked to climate change. While the West Antarctic Peninsula is one of the most rapidly warming regions in the world, resulting in sea ice cover decrease, the sea ice cover of East Antarctica unexpectedly tends to increase. Here, we studied shallow (0-20 m) benthic food web structure on the coasts of Petrels Island (Adélie Land, East Antarctica) during an event of unusually high spatial and temporal (two successive austral summers without seasonal break-up) sea ice cover. Using time-tested integrative trophic markers (stable isotope ratios of carbon, nitrogen and sulfur) and state-of-the-art data analysis tools (Bayesian ecological models), we studied the structure of the food web associated to benthic macroinvertebrates communities. In total, 28 taxa spanning most present animal groups (sponges, sea anemones, nemerteans, nematods, sipunculids, sessile and mobile polychaetes, gastropods, bivalves, pycnogonids, crustaceans, sea stars, sea urchins, brittle stars and sea cucumbers) and functional guilds (grazers, deposit feeders, filter feeders, predators, scavengers) were investigated.

Our results indicate that the absence of seasonal sea ice breakup deeply influences coastal benthic food webs. We recorded marked differences from literature data, both in terms of horizontal (i.e. primary producers and resources supporting animal populations) and vertical (i.e. trophic level of the studied consumers) structure of the food web. Overall, sympagic algae dominated the diet of many key consumers, and the trophic levels of invertebrates were low, suggesting omnivore consumers relied less on predation and/or scavenging than in normal environmental conditions. Surprisingly, few animals seemed to feed on the extremely abundant benthic biofilm, whose exceptional development was also presumably linked with the peculiar sea ice conditions. Comparison of data obtained in the austral summers of 2013-2014 (first year without seasonal breakup) and 2014-2015 (second year without seasonal breakup) clearly showed that the observed trends were linked to actual temporal changes in invertebrate feeding habits rather than with other potential ecological drivers. Our results provide insights about how Antarctic benthic consumers, which have evolved in an extremely stable environment, might adapt their feeding habits in response to sudden changes in environmental conditions and trophic resource availability. They also show that local and/or global trends of sea ice increase in Antarctica have the potential to cause drastic changes in food web structure and therefore impact benthic communities.

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