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Effects of seasonal resource input on the architecture of Antarctic food webs: implications for biodiversity persistence under climate change

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In the Ross Sea, long-term environmental stability and absence of anthropogenic pressure resulted in a high biodiversity level, mainly represented by benthic invertebrates. In turn, marked seasonality in light and sea-ice coverage control biological productivity in the region. This forced benthos to adapt to pulsed resource inputs. Disentangling mechanisms of trophic niche modification following changes in food availability will improve our understanding of Antarctic biodiversity organisation. This will provide insights on potential effects of climate change on nutrient transfer, food web stability and vulnerability to biodiversity loss.

Based on stable isotope analyses, we described benthic food webs along a gradient of seasonal sea-ice persistence (i.e. from early to late sea-ice break up) in medium-depth waters at Terra Nova Bay, Ross Sea. Species' isotopic distribution varied across locations, suggesting that assimilation of sympagic algae by benthos increased were sea-ice break up occurred earlier. Mean number of feeding links, number of potential competitors, and intraguild predation all decreased where assimilation of sympagic algae was higher. In turn, as a consequence of reduced connectance between species, the robustness of the food web to biodiversity loss due to secondary extinctions was lower. Independently by the availability of sympagic resource inputs, food webs were more vulnerable to a top-down (e.g. fishing) than to a bottom-up (e.g. ocean acidification) spread of perturbations.

The architecture of biodiversity at Terra Nova Bay was reshaped by the pulsed sympagic input in early summer. Such dynamic stability of the food web could be a key factor promoting the high biodiversity in the Ross Sea. Potential climate-driven mismatch between the timing of nutrient inputs and consumer demand, together with anthropogenic pressure, may produce unprecedented ecological changes affecting Antarctic food web architecture, with increased risk of secondary species extinction and competitive exclusions as a consequence.