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COMPETITION AMONG PENGUINS AND CETACEANS REVEALS TROPHIC CASCADES IN THE WESTERN ROSS SEA, ANTARCTICA

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In the western Ross Sea during summer, compared to adjacent areas, the diatom assemblage is minimally grazed, coincident with relatively low zooplankton abundance and the development of cannibalism in Antarctic silverfish (*Pleuragramma antarcticum*), a major predator of the main diatom grazer, crystal krill (*Euphausia crystallorophias*). On the basis of field work at Ross Island, we suggest that these patterns, indicative of food depletion, are part of a trophic cascade stemming from foraging by unusually numerous Adélie penguins (*Pygoscelis adeliae*), minke whales (*Balaenoptera bonaerensis*) and fish-eating killer whales (*Orcinus orca*), all preying, with other top predators, on the krill and the silverfish. Aided by one 'natural experiment,' in which large, grounded icebergs altered the seasonal pattern of change in sea-ice cover in the region but not the previously detected (pre-icebergs) seasonal change in penguin diet, and another experiment in which a short-term opening in the ice (polynya) brought penguins and whales together in a large, but confined area, this time altering penguin diet and foraging behavior, we conclude that the foraging of penguins and whales, and not a formerly hypothesized seasonal decrease in sea-ice cover, explains the annual switch in the penguins' prey from krill to silverfish, the subsequent lengthening of penguin chick-provisioning trips and a marked, and ultimately the seasonal decline of cetaceans in the area. The reduction in the middle-trophic level prey is expressed, as well, in the grazing pressure on phytoplankton.