Salps fertilize the Southern Ocean more effectively than krill

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Krill swarm. Photographer: Jamie Hall. Image source: NOAA. via Wikimedia Commons.

Experts at the Alfred Wegener Institute have, for the first time, experimentally measured the release of iron from the fecal pellets of krill and salps under natural conditions and tested its bioavailability using a natural community of microalgae in the Southern Ocean. In comparison to the fecal pellets of krill, Antarctic phytoplankton can more easily take up the micronutrient iron from those produced by salps. Observations made over the past 20 years show that, as a result of climate change, Antarctic krill are increasingly being supplanted by salps in the Southern Ocean. In the future, salps could more effectively stimulate the fixation of the greenhouse gas carbon dioxide in Antarctic microalgae than krill, as the team of researchers report in the journal *Current Biology*.

In many parts of the Southern Ocean, iron is the primary limiting resource for the growth of phytoplankton. Accordingly, the amount of available iron has a major impact on how much CO_2 the microalgae can fix and, in turn, how much biomass is available at the base of the food web. Studies clearly show that, as climate change progresses, Antarctic krill, the key species in the Southern Ocean, will increasingly be supplanted by salps.

"We investigated what a dominance shift from krill to salps would mean for primary production," explains Dr. Scarlett Trimborn from the Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research (AWI). As head of the AWI research group EcoTrace, during an expedition with the Research Vessel Polarstern she and her colleagues conducted experiments with natural phytoplankton populations in the Southern Ocean near Elephant Island. As a source of iron, the researchers offered the microalgae communities fecal pellets from krill and salps, since a dominance shift between the two species would mean higher feces production by salps in the future.

"We were surprised to find that, compared to krill, the fecal pellet material from salps released more iron per microgram of carbon. In addition, we determined that the iron released by the salps' fecal pellets was more bioavailable for phytoplankton than the iron from krill pellets," reports Sebastian Böckmann from the EcoTrace group and first author of the study. The phytoplankton communities were able to take up as much as five times more iron from the salps' fecal pellets than from the krill feces. This improved uptake could be due to ligands, which enhance the iron's bioavailability for the algae. This aspect could result in significantly increased CO_2 fixation among the phytoplankton.

The Southern Ocean is extremely important for the future of our climate, as its vast expanses of water can potentially absorb or release large quantities of CO_2 from or into the atmosphere. In some regions,

e.g. surrounding the Antarctic Peninsula, climate change is affecting the sea-ice cover. When the ocean is ice-free, more sunlight penetrates the upper water layers, providing an energy source for photosynthesis. That being said, the availability of the resource iron is what chiefly determines CO_2 uptake in microalgae. "Although we know from which sources iron is transported into the Southern Ocean, it's still completely unclear how much of the iron the microalgae can take up, especially with regard to its release through recycling on the part of grazers like salps and krill. Our study makes an important contribution to modeling biogeochemical cycles in the Southern Ocean of tomorrow," Trimborn summarizes.

More information: Sebastian Böckmann et al, Salp fecal pellets release more bioavailable iron to Southern Ocean phytoplankton than krill fecal pellets, *Current Biology* (2021). DOI: 10.1016/j.cub.2021.02.033

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