

Variation in the Guano-Derived Resources for Marine Producers Below Seabird Colonies in Svalbard

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1. INTRODUCTION

Seabirds play a vital role in Arctic coastal ecosystems by delivering large quantities of organic matter and nutrients of marine origin, primarily in the form of guano, to the areas around their nesting sites. A significant proportion of these ornithogenic nutrients are absorbed by terrestrial producers, which stimulates the growth of exceptionally lush and rich tundra. However, the remainder returns to the sea through percolation, leaching and/or runoff from the ground. These nutrients are easily soluble, which increases their short-term bioavailability in coastal waters near seabird colonies, providing an important local resource for the marine food web. The greater the waves and the more open the sea, the more nutrients are dispersed in the water and lost from the area. However, the precise role and importance of seabird-derived nutrients in the marine ecosystem remains unclear.

2. MATERIALS AND METHODS

Here, we present the results of studies carried out in the marine coastal zones directly beneath bird cliffs and compared with nearby reference areas, at the south-east Bjørnøya (2022) and west Spitsbergen (Midterhuken in the Bellsund area; 2023 and 2024). We followed changes in the concentrations of resources for marine producers (ammonium, nitrate, phosphate, and silicate ions) along the distance from the cliffs (from 50 to 200 metres) and the depth (from the surface down to about 20 metres), as well as the nitrogen and carbon stable isotope ratio ($\delta^{15}\text{N}$)

and $\delta^{13}\text{C}$) values in suspended particulate organic matter (POM), which serves as a proxy for ornithogenic enrichment of pelagic producers.

3. RESULTS AND DISCUSSION

We found that seabird colony inputs affected the nutrient concentrations in seawater, though the trends were not always uniform. This variability was likely due to the location of the colonies (on the cliffs facing the open sea versus those exposed to the fjord) and the timing of the sampling (before or after the spring phytoplankton bloom). Higher $\delta^{15}\text{N}$ values for POM were recorded below the bird cliffs and decreased with distance from the coast in 2022 and 2023, indicating clear ornithogenic enrichment at both location. However, in 2024, the opposite trend was observed between the seabird and reference areas, with much lower values recorded throughout compared with previous years. This suggests that other factors, such as large-scale water movement or seasonal variations related to phytoplankton blooms and nutrient turnover, may be overlapping with the impact of seabirds and must be considered when analysing trophic dynamics within the Arctic coastal zone.

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