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Arctic puzzle: pioneering a shrimp habitat model in topographically complex Disko Bay (West Greenland)

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Our study focuses on the geologically, topographically, and oceanographically complex region of Disko Bay in West Greenland. Disko Bay is also considered a marine biodiversity hotspot in Greenland. Given the impact of commercial fishing on seafloor integrity in the area, seafloor habitats studies are crucial for sustainable use of marine resources. One of the key fishery resources in Greenland, as well as in the North Atlantic Ocean, is northern shrimp.

In this study we analyzed multiple (1) monitoring datasets from 2010 to 2019, including data from shrimp and fish surveys, commercial shrimp fishery catches, satellite chlorophyll data, and (2) seafloor models, encompassing high-resolution (25 x 25 m) multibeam data with a low-resolution (200 x 200 m) IBCAO grid. Using multivariate regression analysis and spatial linear mixed-effect model we assessed the impact of physical (water depth, bottom water temperature, sediment type), biological (chlorophyll a, Greenland halibut predation), and anthropogenic factors (shrimp fishery catch and effort) on shrimp density in the area. The resulting high-resolution predictive model of northern shrimp distribution in Disko Bay is the first model of this kind developed for an Arctic area.

Our findings reveal that shrimp density is significantly associated with static habitat factors, namely sediment type and water depth, explaining 34% of the variation. The optimal shrimp habitat is characterized by medium-deep water (approximately 150-350 m) and mixed sediments, primarily in the north-eastern, south-eastern, and north-western Disko Bay. This pioneering study highlights the importance of seafloor habitat mapping and modeling, providing fundamental geophysical knowledge necessary for long-term sustainable use of marine resources in Greenland.

The developed high-resolution model contributes to a better understanding of detailed patterns in northern shrimp distribution in the Arctic, offering valuable insights for stock assessments and sustainable fishery management. This novel approach to seafloor habitat mapping supports the broader goal of ensuring the responsible utilization of marine resources, aligning with principles of environmental conservation and fisheries management. Our work serves as a foundation for ongoing efforts to balance economic interests with the preservation of marine ecosystems, fostering a harmonious coexistence between human activities and the fragile Arctic environment.