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TITLE: Environmental Gradients, Fragmented Habitats, and Microbiota of a Northern Ice Shelf Cryoecosystem, Ellesmere Island, Canada

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ABSTRACT:

Over the course of the last century, the 9000-km2 Ellesmere Ice Shelf (82?83°N, 64?90°W) fragmented into six main ice shelves now totaling 1043 km2. This ensemble of thick ice environments lies along the northern coast of Ellesmere Island in the Canadian High Arctic and provides a cryohabitat for microbial communities that occur in association with eolian and glacially entrained sediments on the ice surface. We undertook a comparative analysis of physical, chemical, and biological characteristics of five of the remnant ice shelves including geographic information system (GIS) mapping of ice types. Each of these remnants is a thick (>20 m) mass of ice with substantial sediment overburden that promotes the formation of oligotrophic meltwaters in the summer. Microbiota occurred in all sampled sediment, forming a continuum of abundance from sparse to loosely cohesive and pigmented microbial mats. Using digital images from over-flight transects we determined that 8% of the combined ice-shelf area was suitable microbial mat habitat, and contained an estimated 34 Gg of organic matter stocks for the entire system. A gradient of increasing chlorophyll a, organic content, and conductivity was found from west to east. This is likely related to the surface ice type (meteoric versus marine) and to the relative availability of sediment. Our results indicate that differences in phototrophic community structure (microalgae and cyanobacterial morphotypes) were associated with different ice and microbial mat types. In addition, the relative abundance of dominant taxa was significantly associated with environmental gradients of conductivity, soluble reactive phosphorus, and nitrate and ammonium concentrations. There were distinct differences between each ice shelf with regards to ice type and sediment availability but no differences in taxonomic richness or diversity, indicating little effect of habitat fragmentation on these community attributes. However, the ensemble of ice shelves that compose this unique cryoecosystem remains vulnerable to habitat attrition and complete loss with ongoing climate warming.

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