



Nearshore Ecosystem Response to Deglaciation



Aialik Glacier, currently a tidewater glacier, is showing increasing amounts of underlying bedrock at its terminus, indicating that it is nearing the point that it will retreat out of the marine environment and become land-terminating. NPS Photo/D. Kurtz

Teasing Out the Role of Glaciers in Coastal Ecosystems

“It’s complicated,” explains Deb Kurtz, one of the principal investigators, about a newly launched study of coastal habitats in Kenai Fjords National Park. Fjord ecosystems are complex and multilayered and are continuously being influenced by a host of ever-changing factors from both land and sea. The Nearshore Ecosystem Response to Deglaciation Study (NERD for short) is an effort to tease out the role glaciers play in this scenario. And if all this complexity weren’t enough of a challenge, the study is under the added pressure of a ticking clock.

Glaciers are receding the world over, and Kenai Fjords National Park’s glaciers are no exception. In Alaska, glaciers have experienced rapid and increasing rates of retreat during the 20th century and are predicted to shrink considerably by the end of this century. Tidewater glaciers, those that terminate in the sea, are particularly vulnerable. According to Esler and Kurtz, the study’s authors, “Many (of the park’s tidewater glaciers) are on the cusp of receding above sea level.”

These crushing rivers of ice have, for millennia, dominated the landscape and made their mark on every facet of the environment, living or dead. But their influence may be waning, along with their girth. How

exactly have they shaped Alaska’s nearshore zones? What will their absence mean for these rich coastal ecosystems, and for Kenai Fjords National Park’s famed marine wildlife? This expansive endeavor is no less than a glimpse into the nearshore marine ecosystem in a glacier-free future.

Proposed by a team of researchers from the National Park Service and U.S. Geological Survey, and launched in the summer of 2018, the NERD study poses three basic questions. How do glacial inputs affect the physical attributes of fjords? How do these inputs, such as ice, fresh water and sediment, affect the nearshore food web? And, how will the loss of glaciers change these communities? These are questions that have rarely been addressed. While more is known

about glacial effects on the pelagic food web, according to Kurtz and Esler, their influence on the specialized residents that make up the nearshore community are surprisingly murky.

Kenai Fjords National Park was selected for the study due to its variety of fjord types in close proximity, and because these fjords span the gradient from ocean to freshwater within a relatively short distance. Additionally, background information, such as oceanographic, and marine plant, bird and mammal data, already exist for the region.



Little is known about the impacts of increasing amounts of glacial meltwater on nearshore residents such as the harlequin duck. NPS Photo/D. Kurtz



Map of Kenai Fjords National Park showing the six fjords that are the focus of the study.

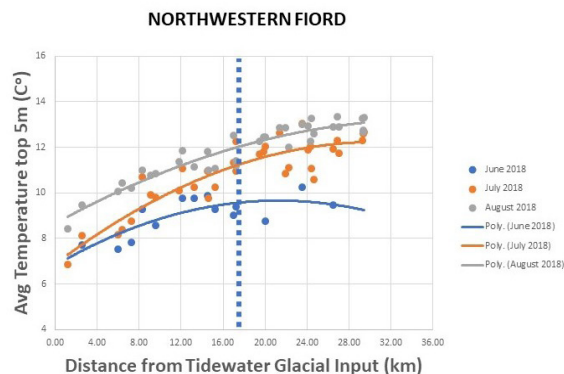
How is the Study Being Conducted?

The NERD study consists of a series of activities focusing on both the physical and biological attributes of three different types of fjords. Researchers will sample six fjords with varying degrees of glacial input – those with tidewater glaciers, those with glaciers that no longer reach the ocean, and fjords with little or no glacial input.

Large amounts of ice, cold freshwater, and sediment flow from glaciers into the marine environment. Such input presumably has a significant, but poorly described, effect on nearshore physical and chemical properties. To document this influence, researchers will take physical oceanographic measurements at multiple sites within each fjord. A Conductivity-Temperature-Depth (CTD) instrument will be deployed into the water 50 meters from shore, to measure temperature and salinity at various levels of the water column. A secchi disc (a black-and-white circular plate), lowered into the water in the same location, will document surface turbidity.

Measures of physical oceanography began in the summer of 2018. Data were collected in tidewater glacier fjords only, during June, July and August to study effects of seasonally increasing glacial melt on marine surface water. Findings so far indicate that surface water clarity, temperature and salinity all increased with distance from the glacier. The data also indicate considerable seasonal variability in the measurements, presumably as input progressed from primarily precipitation, to snow

melt, to glacial melt. Oceanographic data were also collected from March to August 2019 in all fjord types, and these are currently being analyzed. Future data collection will help reveal both seasonal and annual variation in physical conditions and, subsequently, will be linked to biological data to shed light on how these factors influence intertidal communities.



Example of physical data (temperature in the top 5m of the water column) and spatial and temporal variation in Northwestern Fjord throughout a single melt season. The vertical dashed line indicates the location of the underwater moraine or sill.

Researchers will conduct detailed studies to document biodiversity of intertidal communities within each fjord to determine how physical inputs from glaciers translate into variation in marine life. This research will focus, in particular, on diversity and abundance of marine flora and fauna such as macroalgae (i.e., seaweed), bivalves and marine birds and mammals.

A Matter of Time

Even in its initial stages, the study's authors acknowledge the complexity and magnitude of this research. It is, they surmise, the reason such questions haven't already been asked. "But," says Kurtz, "being complicated doesn't mean it's not worth studying." She has a point. Alaska's rich and complex fjord habitats are highly valuable to wildlife and humans, alike. It is prudent to begin tackling the questions of whether glaciers contribute to their productivity, and how climate change may affect conditions now, while glaciers still meet the sea.



A researcher uses a fishing rod to deploy a CTD unit in McCarty Fjord. NPS Photo/D. Kurtz

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