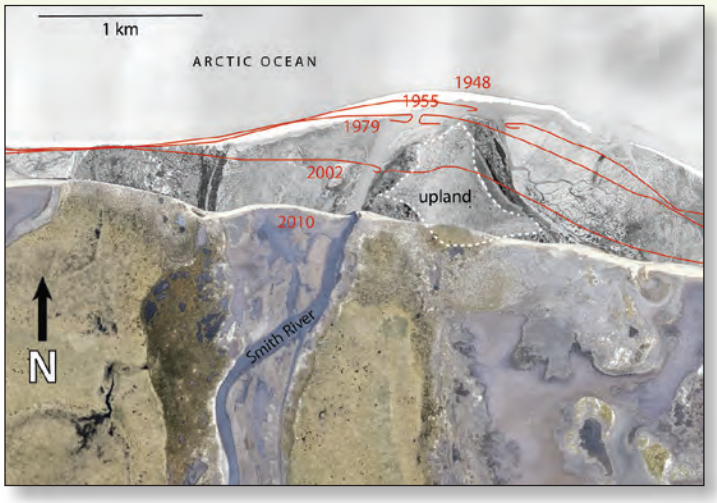
Changing Arctic Ecosystems

Sea Ice Decline, Permafrost Thaw, and Benefits for Geese

How Do Sea Ice and Permafrost Influence Geese?

Through the Changing Arctic Ecosystems (CAE) initiative, the U.S. Geological Survey (USGS) strives to inform resource management decisions for Arctic Alaska by providing scientific information on current and future ecosystem response to a warming climate. A key area for the USGS CAE initiative has been the Arctic Coastal Plain of northern Alaska. This region has experienced a warming trend over the past 30 years, leading to reductions in sea ice and thawing of permafrost. Loss of sea ice has increased ocean wave action, leading to erosion and salt water inundation of coastal habitats. Saltwater tolerant plants are now thriving in these areas and this appears to be a positive outcome for geese in the Arctic. This finding is contrary to the deleterious effects that declining sea ice is having on habitats of ice-dependent animals, such as polar bear and walrus.



Time series orthoimagery showing coastal erosion from 1948 to 2010 at the Smith River on the Arctic Coastal Plain of Alaska (from Tape and others, 2013).

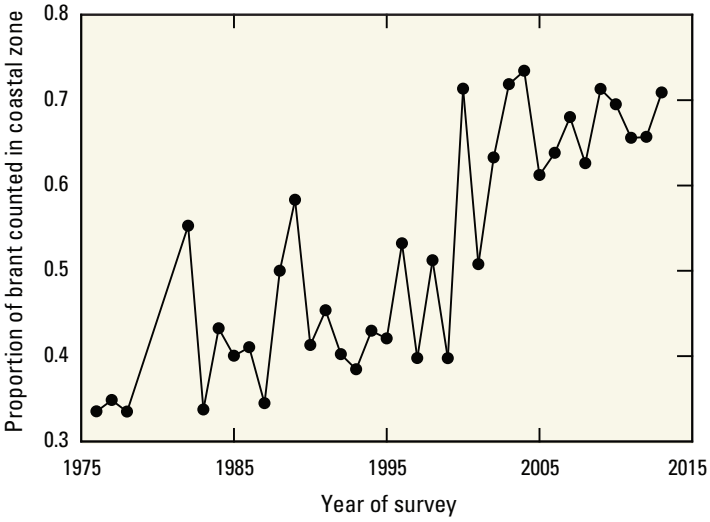
The Annual Cycle of the Pacific Black Brant

Many bird species that live on the Arctic Coastal Plain in summer are highly migratory. Birds migrate to Alaska each spring from wintering areas as far away as South America and Asia. The Pacific Black Brant migrates by the thousands each summer to Alaska and the Arctic Coastal Plain to breed and to undergo wing molt, an annual event in late summer during which the birds are flightless for 3–4 weeks. This molt allows them to replace worn flight feathers before their fall migration to wintering areas in British Columbia (Canada), California, and Mexico. The molt period requires high-quality food as well as open-water areas where birds can escape from predators.

Pacific Black Brant in flight. (Photograph taken by Kelly Warren, U.S. Fish and Wildlife Service.)

Changes in Brant Distribution in the Arctic

Since the 1970s, data collected by the U.S. Fish and Wildlife Service (USFWS) has indicated a shift in the distribution of molting Black Brant geese near Teshekpuk Lake, a large inland lake southeast of Barrow, Alaska. The USGS determined that Black Brant geese, and younger geese in particular, are using new molting areas on the coast, away from traditionally used large inland lakes. Subsequent surveys by the USFWS in the new coastal molting habitats documented a 50 percent increase in the population size of molting Black Brant along the Arctic Coastal Plain. This shift in distribution is due to an increase in high quality forage along the coast brought about by reduced sea ice.



Molting Black Brant have been shifting from inland lakes to coastal areas of northern Alaska where saltwater flooding has created new foraging habitat for the geese. Data provided by U.S. Fish and Wildlife Service Migratory Bird Management.

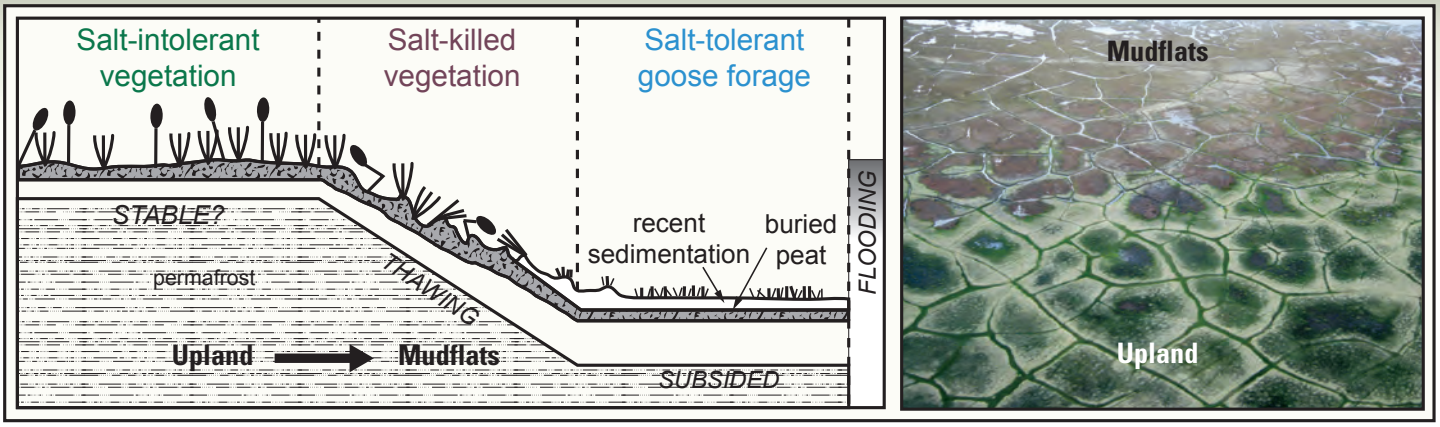


Diagram showing the process by which thawing permafrost, subsidence, salt water flooding, and sedimentation facilitate increased habitat conversion from upland to mudflats. The July 2012 photograph shows an aerial view of this habitat conversion. Black Brant are benefiting from the increase in new, high-quality forage plants on the mudflats. (Photograph by Ken Tape, University of Alaska, Fairbanks.)

Habitat Changes on the Arctic Coastal Plain

Time series imagery and soil analysis show a thawing of permafrost and subsidence of upland tundra. With a decrease in sea ice coverage, salt water moved farther inland through storm surges, causing non-salt tolerant vegetation to be buried. These new coastal mud flats provide a productive environment for salt-tolerant, goose-favored forage plants, thus facilitating redistribution of molting geese. Future reductions in sea ice and associated permafrost thaw may continue to alter coastal areas by creating more salt marshes and high-quality goose forage. Other species of geese also are responding to similar temperature driven changes in northern Alaska that have increased forage quantity. The population of White-fronted Geese on the Arctic Coastal Plain has increased since 1980, and in the past few years the population of Lesser Snow Geese has increased dramatically.

What Is Next?

Research by the USGS CAE in the area of terrestrial ecosystem change is assisting land management agencies, such as the Bureau of Land Management, in determining areas that may need special considerations when planning for potential industrial development on the North Slope of Alaska. The key finding is that as habitat conditions are altered, wildlife populations are responding with changes in both abundance and distribution. The USGS is developing forecasts of future habitat quality for geese that will assist management planning to account for future wildlife and habitat distributions when considering potential development scenarios. Understanding the process by which habitats are changing is critical for forecasting wildlife distributions. Thus, future USGS work will examine the potential for further habitat conversion on the Arctic Coastal Plain and determine if the sea ice and permafrost driven changes are resulting in an overall increase in the high-quality coastal vegetation used by geese or if habitat is being lost to coastal erosion, or both.

Coastal erosion on the North Slope of Alaska. (Photograph taken by John Pearce, U.S. Geological Survey.)

Publications

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