

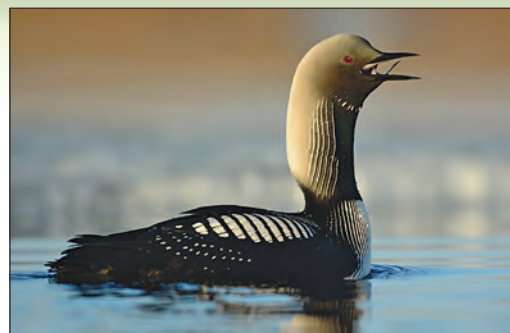


# Changing Arctic Ecosystems

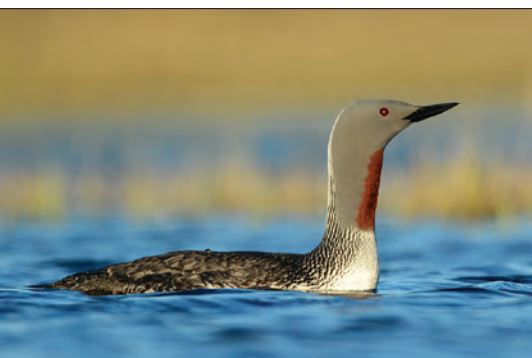
## Ecology of Loons in a Changing Arctic

### Why Study Loons in the Arctic?

The U.S. Geological Survey (USGS) Changing Arctic Ecosystems (CAE) initiative informs key resource management decisions for Arctic Alaska by providing scientific information on current and future ecosystem response to a changing climate. From 2010 to 2014, a key study area for the USGS CAE initiative has been the Arctic Coastal Plain of northern Alaska. This region has experienced rapid warming during the past 30 years, leading to the thawing of permafrost and changes to lake and river systems. These changes, and projections of continued change, have raised questions about effects on wildlife populations that rely on northern lake ecosystems, such as loons. Loons rely on freshwater lakes for nesting habitat and the fish and invertebrates inhabiting the lakes for food. Loons live within the National Petroleum Reserve-Alaska (NPR-A) on Alaska's northern coast, where oil and gas development is expected to increase. Research by the USGS examines how breeding loons use the Arctic lake ecosystem and the capacity of loons to adapt to future landscape change.



Populations of Pacific Loons on the Arctic Coastal Plain are stable or slightly increasing. (Photograph taken by Ryan Askren, U.S. Geological Survey.)



Red-throated Loons breeding on the Arctic Coastal Plain of Alaska exhibit population fluctuations that may be related to ocean conditions. (Photograph taken by Ryan Askren, U.S. Geological Survey.)

### Which Loons Are in Northern Alaska?

Three species of loon breed on the Arctic Coastal Plain of Alaska: the Yellow-billed Loon, Pacific Loon, and Red-throated Loon. These species differ in size, habitat use, and diet. Loons select breeding lakes that provide suitable habitat for nesting and raising young. Yellow-billed Loons nest on large, deep connected lakes that sustain year-round fish populations, whereas Pacific Loons often nest on smaller lakes that freeze solid in winter, which limits fish abundance. Red-throated Loons nest on even smaller lakes and typically fly away from nesting lakes to gather fish in the ocean. Research by the USGS on loon nest site characteristics suggests that the best habitats for nesting loons are lakes with islands and peninsulas. These habitat characteristics reduce nest predation by terrestrial predators, such as foxes, and provide sheltered shorelines for nest sites.

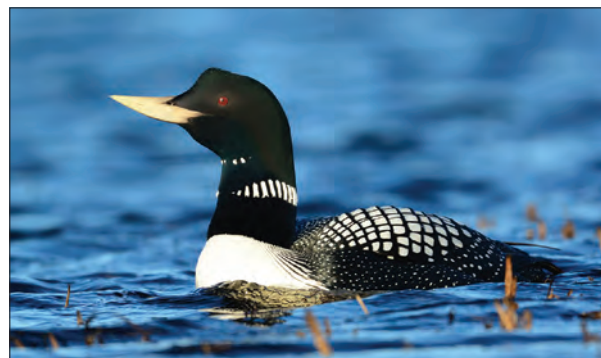
### Is There Competition Among Loon Species?

Loons are highly territorial and will aggressively defend their nesting lake, which suggests that nest sites and food are limited on the breeding grounds. Yellow-billed Loons are the largest loon species and use their size to exclude Pacific and Red-throated loons from breeding lakes. The USGS has determined the size of loon territories to define appropriate

buffer zones around nest sites necessary to accommodate industrial development in the NPR-A. Research by the USGS suggests that future changes to water levels and freezing patterns of lakes, due to increased air temperatures, will influence fish distribution, shoreline shape, and thus the pattern of space use and competition among loon species. The USGS also is evaluating how such changes will influence future populations of loons in the Arctic.

### Where Do Loons Go in Winter?

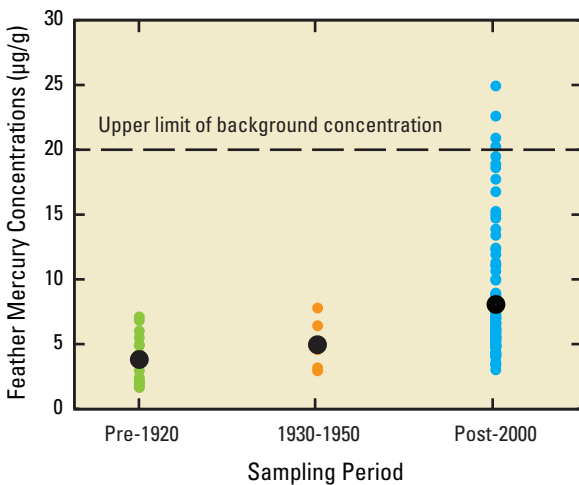
To understand year-round effects on loons, the USGS has identified migratory patterns, key stopover locations, and overwintering areas of the three loon species that breed in northern Alaska. Based on satellite telemetry, Yellow-billed Loons that breed on the Arctic Coastal Plain of Alaska migrate through the Bering Strait to wintering areas off the coast of Asia, mostly near northern Japan. Although satellite telemetry studies have determined that Yellow-billed and Red-throated loons have high annual survival rates (>90 percent), other USGS research determined that birds migrating to Asia for winter were more likely to have elevated levels of mercury and polychlorinated biphenyl (PCB) contamination.



The Yellow-billed Loon is one of the rarest breeding birds in North America and is being considered for listing under the Endangered Species Act. (Photograph taken by Ryan Askren, U.S. Geological Survey.)

## Are Contaminants an Issue for Loons?

Mercury exposure in the Arctic is increasing in fish-eating birds, including loons. Thawing of permafrost and melting of Arctic sea ice has increased natural levels of mercury in the environment. Increases from anthropogenic sources are also likely. To determine risks posed by mercury to loons, the USGS examined contemporary and historical samples from Yellow-billed Loons. Although blood mercury concentrations from most Yellow-billed Loons breeding in Alaska were within natural background levels, individuals that wintered farther west in Asia exhibited elevated concentrations of mercury in feathers. Analysis of historical and more contemporary samples indicates a two-fold increase in mercury levels in Yellow-billed Loons, suggesting that mercury levels in Yellow-billed Loons are elevated.



Mercury concentrations of historical and contemporary feather samples of Yellow-billed Loons in the Arctic from different periods. Colored circles show individual samples within the period and black circles show the average value.

## Publications

Evers, D.C., Schmutz, J.A., Basu, N., DeSorbo, C.R., Fair, J.S., Gray, C.E., Paruk, J., Perkins, M., Regan, K., Uher-Koch, B.D., and Wright, K.G., 2014, Historic and contemporary mercury exposure and potential risk to Yellow-billed Loons breeding in Alaska and Canada: *Waterbirds*, v. 37, p. 147–159, doi: 10.1675/063.037.sp117.



Adult Yellow-billed Loon with chick awaits the hatch of the remaining egg in its nest. (Photograph taken by Ken Wright, U.S. Geological Survey.)



General migration paths of Yellow-billed Loons from breeding areas on the Arctic Coastal Plain of Alaska to wintering areas in Alaska and Asia.

## What Is Next?

The Yellow-billed Loon is being evaluated for listing as a threatened species within the framework of the Endangered Species Act, and USGS research will provide important information for this decision. Planned USGS research will evaluate how other environmental factors may influence the breeding and migration of loons and how these factors may affect the characteristics of lakes (size, shape, and present fish species) used by loons. These studies will help to forecast loon population sizes and distributions relative to anticipated climate warming in the Arctic.

Haynes, T.B., Schmutz, J.A., Lindberg, M.S., and Rosenberger, A.E., 2014, Risk of predation and weather events affect nest site selection by sympatric Yellow-billed and Pacific loons in Arctic habitats: *Waterbirds*, v. 37, p. 16–25, doi: 10.1675/063.037.sp104.

Haynes, T.B., Schmutz, J.A., Lindberg, M.S., Wright, K.G., Uher-Koch, B.D., and Rosenberger, A.E., 2014, Occupancy of Yellow-billed and Pacific loons—Evidence for interspecific competition and habitat mediated co-occurrence: *Journal of Avian Biology*, v. 45, p. 296–304, doi: 10.1111/jav.00394.

Schmutz, J.A., Wright, K.G., DeSorbo, C.R., Fair, J.S., Evers, D.C., Uher-Koch, B.D., and Mulcahy, D.M., 2014, Size and retention of breeding territories of Yellow-billed Loons in Alaska and Canada: *Waterbirds*, v. 37, p. 53–63, doi: 10.1675/063.037.sp108.

Schmutz, J.A., 2014, Survival of adult Red-throated Loons (*Gavia stellata*) may be linked to marine conditions: *Waterbirds*, v. 37, p. 118–124, doi: 10.1675/063.037.sp114.

Schmutz, J.A., Trust, K.A., and Matz, A.C., 2009, Red-throated Loons (*Gavia stellata*) breeding in Alaska, USA, are exposed to PCBs while on Asian wintering grounds: *Environmental Pollution*, v. 157, p. 2,386–2,393. doi: 10.1016/j.envpol.2009.03.020.

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