



Vegetation and Permafrost Return to Drained Lake Basins

Terrestrial Vegetation Vital Sign 2022

Who/What/Where

The NPS Arctic Inventory and Monitoring Network (ARCN) monitors vegetation and landscape change in the five National Park units of northern Alaska (Figure 1). The northern coastal plain of Bering Land Bridge National Preserve (BELA) lost lakes at an alarming rate over the first two decades of this century, including four lakes over 100 ha in size in 2018-2019 alone (Figure 2). To document vegetation growth in drained lake basins, we sampled vegetation in 2019 and 2021 and installed permanent vegetation monitoring plots. We also compared the vegetation in recently drained lake basins to the basins of lakes that drained centuries ago, and estimated the effect of the lake loss on available loon habitat.

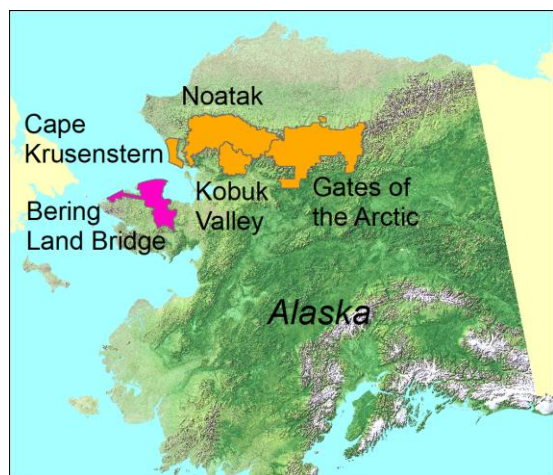


Figure 1. The National Park Service's Arctic Inventory and Monitoring Network

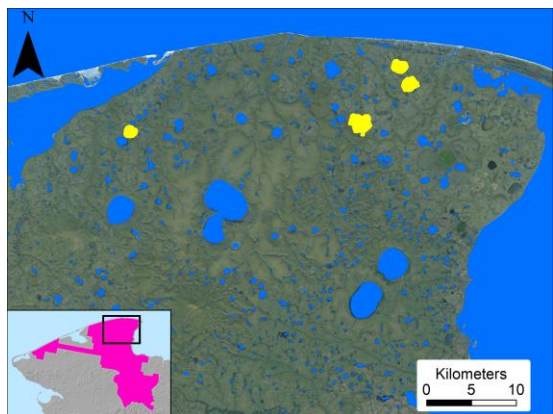


Figure 2. Location of the four study lakes (in yellow) in Bering Land Bridge National Preserve that drained in 2018-2019

Key Findings

- The four study lakes drained in early summer, before the end of June. Drainage was probably triggered by record warm weather in 2014-2019, and above-normal snowfall in 2018-2019.
- Lake drainage in 2018-2019 eliminated about 2% of the potential nesting habitat for Yellow-billed loons and 0.6% of the potential nesting habitat for Pacific loons in northern BELA. In contrast, nesting habitat for Red-throated loons probably increased, because the residual ponds that remain after lake drainage can potentially support multiple pairs of loons.
- The moist loamy sediment of the lake bottoms was colonized rapidly by plants. In one lake, most of the former lake bottom was covered with plants by the end of the summer when it drained. The other lake basins developed vegetation more gradually over the two following summers.
- The first plant communities consisted of just one or two dominant plant species (Figure 3). These species were present but not abundant in the land surrounding the lakes. Some of these plants probably sprouted from seeds stored in the lake-bottom mud, while *Equisetum* (horsetail) probably sprouted from spores that blew into the lake basin soon after drainage.
- By year three after drainage, more diverse plant communities dominated by lush stands of tall wetland grasses and sedges developed (Figure 4).
- We observed permafrost in the lake bottoms in 2021 (2 or 3 years post-drainage), and some of the plants present then were ones that dominate old drained lakes in the region. This suggests that the new basins are evolving to be like older drained lake basins in the region, but the transition is likely to take centuries. The old drained lake basins in our area have permafrost, acidic peaty soils, and plant communities dominated by *Sphagnum* moss and sedges.
- We will continue to monitor the vegetation and permafrost in these drained lake basins in the future to see how they evolve and learn if climate change will cause them to follow a path that differs from older drained lakes.

How do we monitor drained lake basins?

We have 16 plots in the basins of lakes that drained in 2018 and 2019 in BELA, and 30 more plots in the basins of lakes in BELA and elsewhere in ARCN of unknown age (they drained before any historical records or aerial photographs). We make repeated measurements of the cover by each plant species and the depth to frozen ground at these plots. In addition, we study satellite images to determine when the lakes drained, how fast they were colonized by vegetation, and where the different plant communities occur (Figure 5).



Figure 3. The plant communities that developed in the first year or two after lake drainage were dominated by just one or two species that were not common in the surrounding tundra.

Management Implications

- The loss in potential Yellow-billed loon nesting habitat due to lake drainage (2% in just two years) could become significant over time if lakes continue to drain. However, Red-throated loon nesting habitat does not appear to be threatened by lake drainage.
- The evolution of plant communities and permafrost in drained lake basins from 2018 to 2021 appeared to be following the historical trends, but this could change with future climate warming.



Figure 4. By the third summer after the lakes drained, a lush stand of tall wetland grasses and sedges had developed in most areas.

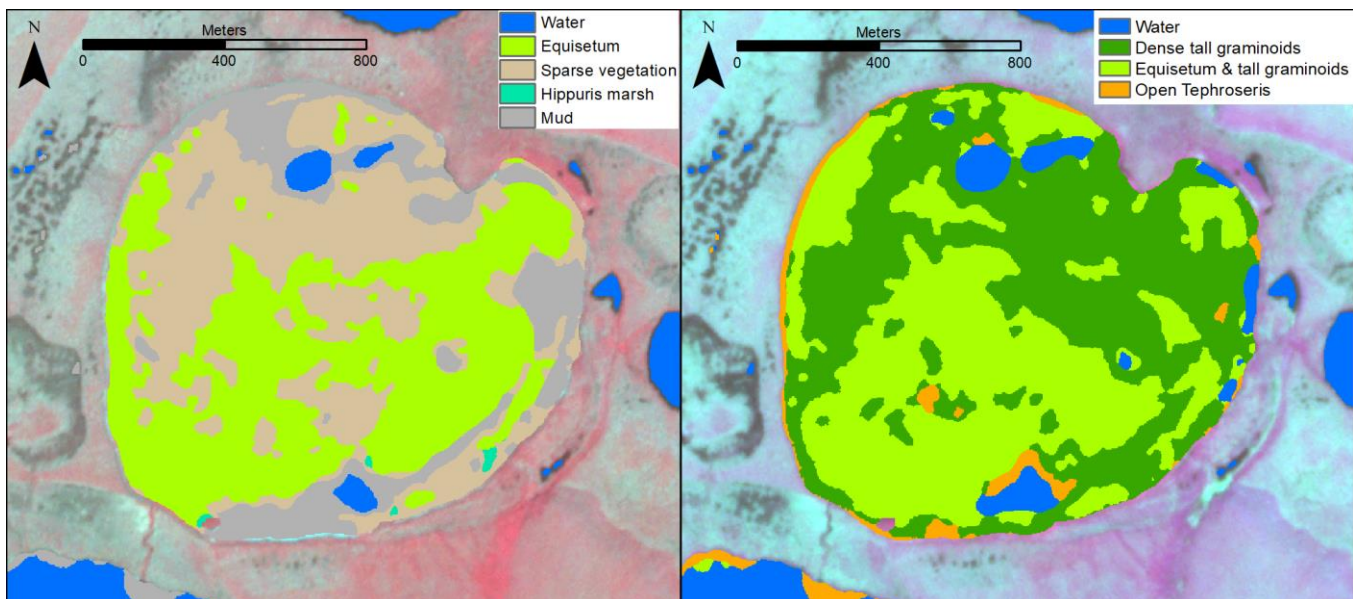


Figure 5. Maps of vegetation in one of the study lakes in the first (left) and third (right) year after drainage.

For more information

Read the full NPS Natural Resources Report about drained lake vegetation and loon habitat at:
<https://irma.nps.gov/DataStore/Reference/Profile/2296593>

See also our report about lake drainages in ARCN at:
<https://irma.nps.gov/DataStore/Reference/Profile/2272062>

Our report on recent warming at:
<https://doi.org/10.1080/15230430.2020.1859435>

And our vegetation monitoring program brief:
<https://irma.nps.gov/DataStore/Reference/Profile/2229859>

Or contact Dave Swanson, 907-455-0665,
david_k_swanson@nps.gov.