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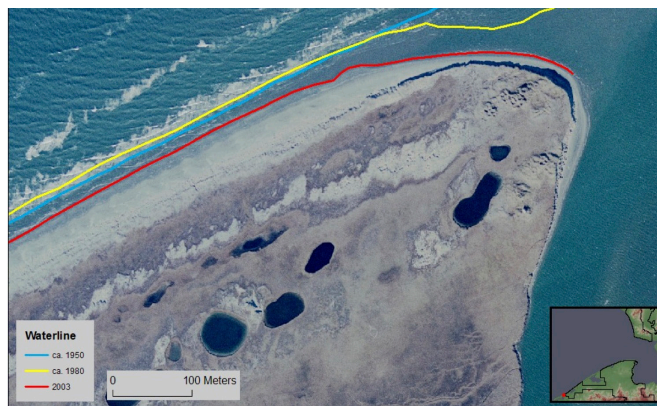
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Shifting Lines in the Sand: Coastal Erosion in Western Arctic Parklands

The fifth largest block of coastline that the NPS manages is vulnerable to climate change. The coastlines of Bering Land Bridge National Preserve (BELA) and Cape Krusenstern National Monument (CAKR) extend for over 550 miles (880 km), and include critical habitats, sensitive ecosystems, and cultural resources. Longer ice-free seasons leave the coastline exposed to wave action, increased seasonal permafrost thaw, rising sea level, and a potential increase in storm magnitude or frequency. Such effects are predicted to occur with climate change.

Vulnerable to coastal erosion are a variety of near-shore marine, terrestrial, and freshwater habitats—sub tidal zones, sandy shores, barrier spits and islands, lagoons, bays and inlets, tundra bluffs, deltas, and wetlands. Such areas provide critical habitat for plant communities, nesting birds, seal haul-outs, den sites (furbearers, wolves, fox, bears) freshwater and anadromous fish, and migratory stopover sites for marine mammals and birds. Changes in the coastal zone will impact human activities and cultural resources such as travel routes, subsistence fishing, egg gathering, and hunting, as well as altering or destroying archaeological sites. For some communities, like Shishmaref, it will affect their very infrastructure.

Most of the coast has experienced erosion since 1950. Where erosion does occur, rates are higher for BELA than



A close-up view of high-resolution imagery from 2003 showing detailed mapping of the coastline as it existed in 1950 (blue), 1985 (yellow), and 2003 (red). This point has eroded over 330 ft (100 m) in five decades.

for CAKR, and have averaged 1.7ft/yr (0.5 m/yr), reaching more than 10 ft/yr (3 m/yr) —with shoreline retreat of tens to hundreds of meters (or feet) since the 1950s. We monitor erosion in both parks with the help of Louise Farquharson at University of Alaska Fairbanks, Geophysical Institute, recipient of the NPS George Melendez Wright Climate Change Fellowship. Currently, she is evaluating new satellite imagery and will update coastal erosion rates this year.

What we need to know:

- 1) Are coastlines experiencing rapid rates of erosion? Is erosion accelerating?
- 2) Why do coastal-change rates vary so much from one location to another?
- 3) Are rates of erosion related to beach structure and orientation, nearshore water depth, etc.?
- 4) Is erosion or sediment deposition disproportionately affecting certain landforms or vegetation types? What effect does inlet migration or inlet closures have on lagoons?

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Arctic Network Inventory and Monitoring Program (ARCEN)

Our mission is to collect scientifically sound information through natural resource monitoring to contribute to park management and facilitate park preservation for future generations. We work in Bering Land Bridge National Preserve (BELA), Cape Krusenstern National Monument (CAKR), Gates of the Arctic National Park and Preserve (GAAR), Kobuk Valley National Park (KOVA), and Noatak National Preserve (NOAT).

<http://science.nature.nps.gov/im/units/arcn/>



Dall's Sheep Decline



Dall's sheep populations steeply declined in 2013 and 2014 in the Brooks Range of Alaska, affecting populations across the largest, contiguous span of National Park Service lands— Noatak National Preserve (NOAT) and Gates of the Arctic National Park and Preserve (GAAR). Following aerial surveys conducted last July across NOAT, NPS and Alaska Department of Fish and Game biologists estimated a 70% decline in total sheep numbers (all age categories and both ewes and rams) since 2011 and very low lamb productivity and survival. This prompted an emergency closure of hunting seasons for both state—and federally—managed hunts in the western Brooks Range. In GAAR, sheep numbers were stable from 2009 to 2012 but declined 62% by 2014 in the northeastern portion of the park. Very few lambs were observed in 2013 and 2014, and the decline here predominantly affected lambs, yearlings and ewes.

Low lamb numbers were reported elsewhere in Alaska as well as the Yukon Territory and Northwest Territories of Canada in 2013. Additionally, for a few areas in the state, 2014 marked the second or third year of low lamb productivity and survival.

Western Arctic Caribou Herd Migrated Further West Than Usual This Winter

Bering Land Bridge National Preserve preserve has seen four years of consecutive increased use by the Western Arctic Caribou Herd (WAH). The National Park Service has tracked the winter distribution of WAH cows since 2010-2011. In that winter, about 7% of collared cows utilized Bering Land Bridge National Preserve. The following winter (2011-2012), usage doubled to 16%. Use of the Preserve amazingly doubled again in 2012-13 (30%) and again in 2013-2014 (60%). Already this winter, use of the Preserve has exceeded 75%. Moreover, cows are further west and north within the Preserve than usual.

Use of these new ranges may be due, in part, to declining lichen abundance in winter ranges to the east and south. Lichens are the primary forage for caribou during winter, often accounting for more than 60% of their diet and sometimes reaching as much as 90%. Incursions of caribou onto the Seward Peninsula have had dramatic impacts on the reindeer herding industry.

Weather events like the cold May in 2013 and deep snow and icing events can dramatically reduce over-winter survival, particularly for lambs, yearlings and old sheep. Winter and spring weather and snow conditions can also affect lamb productivity. The low number of lambs seen in 2013 and 2014 may be due to low birth rates and/or low newborn survival from May (when lambs are born) to July (when most surveys are conducted).

This lag in lamb productivity and survival will lead to fewer mature sheep later and slow recovery of populations in NOAT and GAAR. We will continue annual population surveys in these park units and use those data to inform harvest management decisions while working with local residents and other agencies for sheep conservation and management.

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Thin-horned cousins of the west's iconic bighorn, Dall's sheep in the central and western Brooks Range are at the northwestern most extent of their range, and comprise 10-13% of the world's Dall's

sheep. Multiple factors can affect Dall's sheep populations including weather events, environmental change, nutrition, predation, hunting, development, parasites and disease. To see how we conduct population surveys to monitor Dall's sheep within these parklands watch *Counting Sheep in Alaska* on Alaska NPS YouTube.



Andy Greenblatt

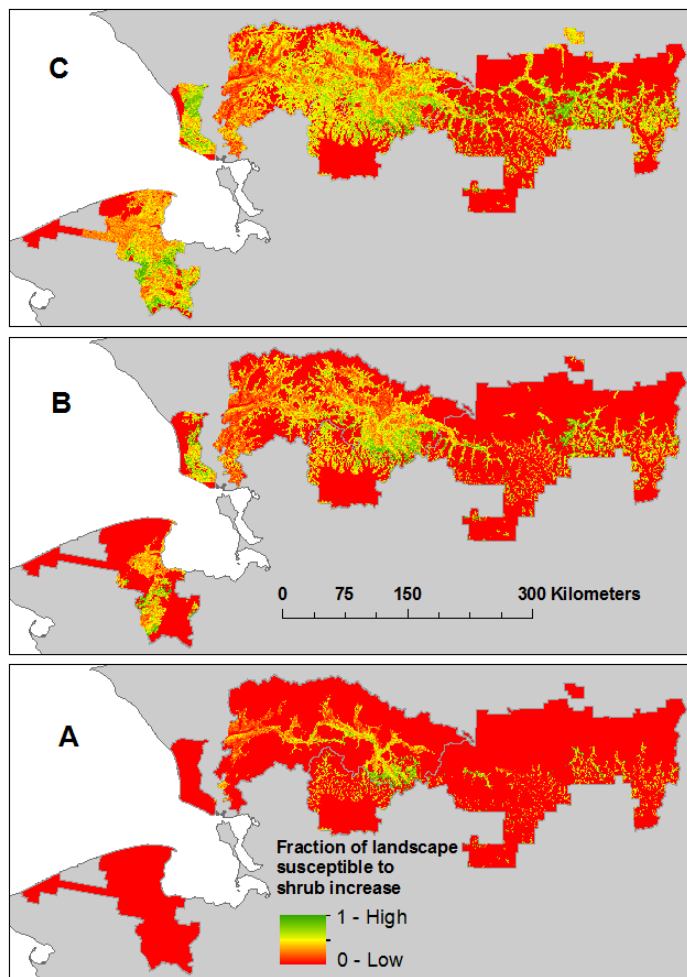
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Modest Increase in Tall Shrubs Expected for Arctic Network Parks in Coming Decades

Much of the Arctic Network is near the temperature threshold for tall shrub expansion. We mapped susceptibility to tall shrub expansion by overlaying areas that would become warm enough for tall shrub thickets after 2 or 4 °F of warming on ecotypes with suitable soils (from Jorgenson et al. 2009). About 46% of ARCN was estimated to have mean July temperatures in the ideal range for multiple tall shrub species (54 °F or higher). Two degrees of warming, the amount predicted to occur in ARCN by mid-century (IPCC 2013) would bring most of region into the optimal temperature range for multiple, tall shrub species. Areas that stand out as likely to experience shrub expansion include inland portions of Bering Land Bridge National Preserve and Cape Krusenstern National Monument, parts of the Noatak basin in Noatak National Preserve, and the mountain valleys of central Gates of the Arctic National Park and Preserve.

Nevertheless, soil conditions substantially restrict the environments where tall shrub thicket form, and would continue to do so under warming climate. Soil conditions would limit felleaf willow and balsam poplar expansion to river floodplains and certain well-drained calcareous upland areas. Soil acidity should also prevent dense thickets of the other, more acid-tolerant species from forming over large areas of lowland tundra and tussock tundra, even if warmth and wetness conditions were to improve. With warming, we expect alder to move into well-drained uplands and probably some wet diamond leafwillow stands. Thaw of permafrost would probably bring about a modest increase in tall shrub area in the coming decades. Stay tuned for the full report *Tall Shrub Environments and the Potential for Shrub Expansion in Alaska's Arctic National Parks*, available later this winter.

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Susceptibility map for tundra shrub expansion in ARCN. Susceptibility refers to the proportion of the landscape with soils favorable to the formation of high-volume shrub canopies, and ranges from 1.0 ("High", green) to 0 ("Low", red). The maps portray the proportion of soils with high susceptibility in areas of mean July temperature of 54 to 56°F (A, bottom), 53 to 56°F (B, middle), and 51 to 56°F (C, top). These simulate the areas favorable to shrub expansion at the present time and with one and two degrees of additional summer warming.

Story in a Stream: Looking at Water Chemistry to Understand Permafrost Thaw



Recent climate change at high-latitudes is altering watershed hydrology, stream chemistry, and aquatic habitats. For instance, groundwater inputs to river flow have increased in recent decades in response to permafrost thaw. New research by Jon O'Donnell and colleagues shows that as permafrost thaws, subsurface flow paths in streams get deeper, modifying the chemical quality of dissolved organic carbon (DOC) transported from soils to streams. Using DOC chemistry, we can detect watershed-scale permafrost thaw. We plan to use this technique, tested in Interior Alaska, to detect permafrost thaw in watersheds of northern parks.

To learn more about this study (O'Donnell et al. 2014) see publications page or contact: [Jon O'Donnell, jonathan_a_o'donnell@nps.gov](mailto:jonathan_a_o'donnell@nps.gov), 907.644.3696

Photo: Ken Tape

Youth: Learning, Experience, and Adventure

Connecting Youth to Yellow-Billed Loon Conservation Through Videography

Reaching next-generation scientists, policy makers, teachers, story-tellers, and resource stewards is critical to resource conservation and an important NPS mission. In 2013 and 2014, we brought together youth from rural and urban Alaska and a Student Conservation Association Media Intern to 1) experience firsthand the conservation and science of Yellow-Billed Loons (YBLO) in northern Alaska and 2) use digital media—the hallmark of today's youth—to share their experience.

The group produced two videos that are available on AlaskaNPS YouTube: 1) *Alaska's Yellow-billed Loons* (2014) highlights the long-term monitoring of the species, including conservation issues and concerns, and 2) *Telling a loon story: An Alaskan youth filming expedition in Bering Land Bridge National Preserve* (2013) depicts the students' experience. Both videos will be highlighted this January on the Alaska Ocean Observing System website and shown at Alaska Forum on Environment Film Festival in February. Spirit of Youth Radio interviewed Max Dan and Sam Tocktoo about their experience in 2013. Listen to their interview at www.spiritofyouth.org.

These young filmmakers also experienced:

- 1) hands on YBLO Science by swabbing eggs for contaminants sampling
- 2) new perspectives by connecting and collaborating with other students from rural and urban communities
- 3) geography and land use by visiting Bering Land Bridge National Preserve, Kotzebue, National Petroleum Reserve-Alaska, Deadhorse, the Helmericks' Homestead on the Colville River Delta
- 4) career possibilities by working alongside professionals in aviation, digital media production, homesteading, natural history, and wildlife biology



Last year, the US Fish and Wildlife Service considered listing Yellow-billed Loons under the Endangered Species Act. The Service concluded the species did not warrant listing at this time. Photo: BLM



Andrew Kennedy (2014), age 16, from Effie Kokrine Early College Charter School in Fairbanks. Andrew produced *Generation Games* (YouTube), a video highlighting the importance of games in Alaska Native culture.

Max Dan (2013), age 19, graduated West High School in Anchorage. While with Alaska Teen Media Institute, Max produced: *Tour of Anchorage 2013* and *The Mushroom Maven* of the Chugach National Forest. (Vimeo)



Sam Tocktoo (2013, 2014), age 16, from Shishmaref School in Shishmaref. Sam is working with Alaska Teen Media Institute on a polar bear safety video for the Alaska Nanuuq Commission.

Sam Bernitz (2014), age 16, from West High School in Anchorage. is a reporter and producer for Alaska Teen Media Institute's *In Other News* radio show on KNBA 90.3 FM. He is currently working with Sam Tocktoo on a polar bear safety video for the Alaska Nanuuq Commission. He produced: *Off the Chain Bicycle Collective and International Migratory Bird Day at the Alaska Zoo* (Vimeo).



Dev Dharm Khalsa (2014), a Student Conservation Association Media Intern with Fairbanks Public Lands Information Center who mentored the students on this project in photography and videography.

Field notes from Inigok, National Petroleum Reserve-Alaska: "The weather doesn't look so good up there. Inigok's webcam is fogged over and looks as if the camp was hit by a Category 4 hurricane. My heart sank. Trips always seemed to start out with bad weather. Three duffels, two pelican cases, two backpacks, one massive 50lb tripod and a gopro bag later (that's just my stuff), we're off to catch our flight with 45 minutes to spare. Soon we are soaring above the dark ominous storm clouds cloaking Fairbanks. The clouds break as we pass over the Brooks Range to the north. Then the mountains drop away and a single, thick pancake cloud blankets the land as far as the eye can see. We dip lower and lower—the altimeter reads 1200, 1000, then 800. For minutes, I can see nothing. Then, a lake becomes visible, and another. As we dip below the last layer of fog, I see many small lakes dotting the land all around us. We have reached the North Slope." -Dev Dharm

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Youth: Learning, Experience, and Adventure

Putting 'Place' and 'Practical' in Education

Last November, NPS staff delivered a weeklong education program at Nunamiut School in Anaktuvuk Pass. The K-12 program included lessons and exercises in ungulate anatomy, wildlife ecology, and archaeology. Life, long ago in northern Alaska was also covered during the program.



Sean Tevebaugh

Above, Timothy Ahgook, a high-school student, follows village elder Rachel Riley's instruction for cutting a caribou quarter during subsistence lesson. Reflecting back on the experience, he says, "I really enjoyed cutting the meat with elder Rachel Riley. She taught me a lot [about] the caribou, and my favorite part was giving the meat out to the elders!"

The program included a student exchange, with Effie Kokrine Early College Charter School in Fairbanks—two students journeyed from Fairbanks with their Early College Coordinator Sue McCullough to Anaktuvuk. Nunamiut students (all juniors and seniors) will travel to Fairbanks this March to help NPS archaeologists prepare a caribou skeleton for later use in an analysis of artifacts from a 7,000 year-old archaeological site at Lake Matcharak and other sites in Gates of the Arctic National Park and Preserve. While in Fairbanks, they will visit the University of Alaska Fairbanks mammalogy and archaeology labs at the museum and meet with students, faculty, and staff with the Rural Student Services, Financial Aid, Wildlife Firefighting and EMT programs.



Sean Tevebaugh



Sean Tevebaugh

"I learned how to use an Ulu and how to cut the skin of the caribou hoof. We took off all the meat from the caribou, and cleaned the bones as much as we could. We cut all the meat and delivered the meat to elders who didn't have caribou meat for the winter. They were really excited to see us bring the meat to them." - Suleymi Juarez (pictured above).



Dev Dharm Khalsa

Park archaeologist Jillian Richie (pictured left) demonstrates the basics of a hands-on archaeological dig with 1st grade students at Nunamiut School in Anaktuvuk Pass (pictured above).

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Migrating Shorebirds

Each spring, shorebirds—the long-distance athletes of the animal world—make marathon flights between hemispheres to coastal areas in Alaska to raise young. Their reliable, annual journeys connect us to other communities, cultures, and countries far away. Shorebird migration is an awesome natural phenomenon.



Important along their flight routes are staging areas—places to rest and refuel. Alaska's nearshore environments are staging areas for many arctic breeding shorebirds making trips between their overwintering areas and breeding grounds. The 550 miles (880 km) of coastline of Bering Land Bridge National Preserve (BELA) and Cape Krusenstern National Monument (CAKR)—extensive salt marsh and tidal flat habitat—lie at the convergence of three major flyways of migratory birds: The East Asian-Australasian, Central Pacific, and Pacific Americas.

Migration is a dangerous undertaking, and birds face numerous threats throughout their journeys. Coastal areas in the Bering and Chukchi Sea are increasingly vulnerable to heightened industrial activity in conjunction with a rapidly changing climate. NPS is mandated "to protect habitat for internationally significant populations of migratory birds". These parks are important areas for many bird species and we need basic information about their use of coastal habitats to make informed conservation decisions.

We know very little about the ways in which shorebirds use coastal areas over the course of the migration period in these parks. Lack of baseline information in the Gulf of Mexico and Prince William Sound hindered scientists' ability to quantify the impacts of North America's largest oil spills on their populations, ultimately fueling controversy about their recovery.

To better understand the use of coastal areas in BELA and CAKR by shorebirds and other waterbirds during the postbreeding migration period, starting in 2013 we began collaborating with shorebird biologists from the Universities of Alaska Anchorage (UAA) and Alaska Fairbanks (UAF); and the Wildlife Conservation Society Beringia Program.

In 2013, at Ikpek and Arctic lagoons in BELA we found that roughly 3,400 Western and Semipalmated Sandpipers used 3 km² of salt marsh habitat each day, indicating these areas are important stopover sites for migrating

shorebirds. Our surveys were conducted over 15 days from late July through early August.

Last year, Dr. Audrey Taylor (UAA) took to the air with Kotzebue pilot Eric Sieh in late July and August and counted over 26,000 shorebirds during a 2-week period, the majority of which were found at Cape Espenberg, Lopp Lagoon, Kotzebue Sound, and Arctic and Ikpek Lagoons.

During the same period, UAF, PhD student Megan Boldenow was staged at Sisualik Spit. There she found 19 shorebird species (on average 11 species per day and approximately 10,300 individual shorebirds) stopped over on their migrations. Western Sandpiper, Semipalmated Sandpiper, Dunlin, and Red-necked Phalarope were the most abundant species (over 500 observations made over three weeks) and Least Sandpiper, Pectoral Sandpiper, and Long-billed Dowitcher were the most common (5-10 individuals sighted per day). She even recorded the Stilt Sandpiper, an uncommon migrant along the Chukchi Sea coast that breeds on the North Slope.

What's next in 2015:

We plan to conduct large-scale, photographic aerial surveys to estimate shorebirds populations staging along BELA and CAKR coasts during postbreeding migration.

On the ground, in BELA, we plan to survey portions of Cape Espenberg to provide more detailed species composition counts, like those completed for Sisualik, and to document the timing of shorebird use of this area.

Finally, we will work with students at Shishmaref School to learn about shorebird migration through timelapse photography. Together we will test the method as a way to document the timing of migration at Shishmaref lagoon and provide an index of shorebird use to supplement ongoing survey work in BELA.

Alaska Shorebird Marathoners



Bar-tailed Godwit (left): record holder for longest nonstop migration of any bird—8 days non-stop, Alaska to New Zealand or Australia, over 7,000 miles

Red Knot (right): Alaska to Tierra del Fuego, South America 9,300 miles

American Golden Plover: Alaska to southern South America, over 7,000 miles

Pacific Golden Plovers: Alaska to Hawaii, non-stop 3,019 miles

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Publications and Reports Now Available

Locate reports at <http://science.nature.nps.gov/im/units/arcn/> or at Integration of

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<https://irma.nps.gov/>

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Dev Dharm Khalsa

Word On Weather- 2014

Warmest Year on Record for NW Alaska

Last year was the warmest year on record for both Kotzebue and Nome, the two locations in Northwest Alaska that we use as index sites for the Arctic parks. Extremely warm temperatures were recorded in January, May, November and December of 2014. Using these locations as proxies for weather in the parks, along with data from two weather stations in Noatak National Preserve (NOAT) with 10 plus year records, we conclude that it was a warm year for Cape Krusenstern National Monument, Bering Land Bridge National Preserve, and NOAT. Gates of the Arctic National Park and Preserve (GAAR), in northern interior Alaska, was also warm, but broke no records. It was the 5th warmest year on record for Bettles, located just south of the park.

November Warmer than October in the Brooks Range

A warm inversion was present across much of interior Alaska during November. The mountain climate sites in GAAR and eastern Noatak National Preserve were on average ~3° warmer in November than in October! These upland sites were ~15° warmer than valley bottom sites. At Norutak Lake (elevation 800') the average monthly temperature for November was ~19° cooler than October, quite normal as we head into winter and lose the sun. On the other hand, at Ram Creek high in the Brooks Range (elevation 4100'), the November average temperature was ~4° warmer than October. Local climatologists say

this is uncommon.

Bare Ground on the Seward Peninsula in January 2014



The image above was captured from the camera at the Serpentine Hot Springs weather station on January 27, 2014.

Winter Temperatures Above Freezing, High in the Brooks Range

During the warm spell in January 2014, the temperatures rose above freezing at all weather stations between the 24th and 29th. On January 27, the maximum temperature at Imelyak, a site high in the Brooks Range in southeastern NOAT, was 51° F— higher than the July 2013 average temperature of 46°F.

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Science for the stewardship of Arctic Parklands

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