ALASKA'S CHANGING ARCTIC

COASTAL SECURITY AND INFRASTRUCTURE

UNIVERSITY of ALASKA

UAF UNIVERSITY OF ALASKA FAIRBANKS

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2024

ALASKA IN THE ARCTIC: ISSUES AND TRENDS FOR THE ALASKA STATE LEGISLATURE AND ITS CITIZENS

Contact Us

Send questions or comments about this report to uaf-iarc@alaska.edu.

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Read the report online
https://uaf-iarc.org/alaska-arctic-policy-trends

At the national level, Alaska has three members of Congress acting on the state's behalf. They receive information and support from the Congressional Research Service. In July 2023, the service released an updated report, *Changes in the Arctic: Background and Issues for Congress*. This nationally focused document outlined the biggest aspects of Arctic change likely to require federal government attention. However, the service is general and cannot provide detailed, real-time information with a sensitivity to the needs of Alaska's diverse population and suited to use by the Alaska Legislature.

Alaska, the state that makes the United States an Arctic nation and enables U.S. membership in the Arctic Council, can create and maintain policies that are state and regionally specific. Doing so can expand Alaska's Arctic role as well as address effects of environmental and developmental changes. Though there is not a routine suite of information for the Legislature in relation to Arctic issues, the Arctic Policy Act of 2015 directs the state to attend to its Arctic nature. This declaration of state Arctic policy was the result of several years of bipartisan efforts and community engagement of the Alaska Arctic Policy Commission. The AAPC was created by the Alaska Legislature in 2012, at the recommendation of the Alaska Northern Waters Task Force. Twenty-six commissioners, including 10 legislators and 16 experts from around Alaska, formed the effort.

The AAPC completed its work in 2015 and published a final report and implementation plan for Alaska's Arctic policy, framing its recommendations into four lines of strategic effort. Later that year the Alaska Legislature passed the Arctic Policy Act (44.99.105. Declaration of State Arctic Policy); see page 4.

UAF photo

Why create this report, and why the University of Alaska?

"Alaska's Changing Arctic: Coastal Infrastructure Issues and Trends" is the second University of Alaska report designed specifically for state government and Alaska citizens to contribute to policy making related to coastal security.

This report addresses the second of four priority lines of effort identified in Alaska's Arctic Policy, "addressing the infrastructure and response capacity gap in order to support the Arctic region," by assessing the state's Arctic coastal infrastructure and its impacts on the lives and livelihoods of Alaskans. The report recognizes the policy-making power of local and tribal governments and highlights key interactive trends in Alaska and the Arctic that are most likely to require legislative decision-making in the near future.

The authors are University of Alaska experts with local, national and international partnerships in both public and private sectors. They used scientific studies, historical and current policy analysis in combination with a close understanding of state, regional, federal and international governance to work collaboratively across the university. The shared result is a synthesis of the key trends that can assist the Alaska government as it seeks success in addressing Alaska's pressing challenges in the globalizing Arctic.

The University of Alaska serves as an information resource to the state government. This report is one way to serve the state. It aims to:

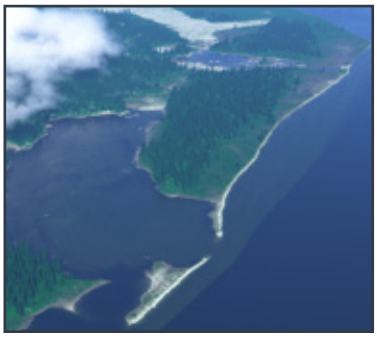
1. efficiently contextualize for the Alaska audience state concerns in relation to Arctic coastlines and their infrastructure, security, and connectivity;
2. serve as a timely resource for questions legislators, executive agencies or other government officials may have; and
3. highlight the unique opportunities of the State of Alaska to serve as a model for infrastructure and coastal resilience policies and practices serving cold climate, coastal, and rural areas in the United States and internationally.

These goals rest on the well-understood relationship between the university and state: the report seeks to inform, not advocate for any particular outcome. The report design facilitates state capacity to address the Arctic Policy Act, including concerns related to climate change and geopolitics without the pressure of advocacy or recommendations.

1. Alaska's Arctic Boundaries and Governance

This is a history of Alaska's boundaries and why changing conditions can alter future government decisions and planning for northern coasts.

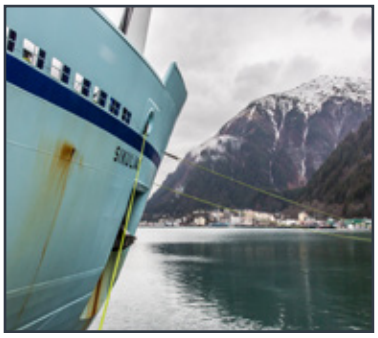
Policy implications p. 11



2. Alaska's Coastal Ecology and Infrastructure

This overview of the marine, shoreline and coastal eco-logical systems in Arctic Alaska helps understanding the nature of infrastructure in these locations, including the need for proactive change in design and use of coastal infrastructure.

Policy implications p. 19



3. Environmental and Human Security on Alaska's Coasts

Different geographic scales require specific security considerations. Here the role of the state in responding to different types of needs to keep its population safe, its environment healthy, and its vital nonliving assets protected is explained.

Policy implications p. 23

4. Alaska's Coastal Connectivity

Alaska's coastlines are not disconnected from the three major population centers in the state; rather, they provide vital economic, social and cultural connections from south to north and east to west. People living far from coasts are nonetheless affected by what happens in these places.

Policy implications p. 26

SEC. 44.99.105. DECLARATION OF STATE ARCTIC POLICY

a. It is the policy of the state, as it relates to the Arctic, to

1. uphold the state's commitment to economically vibrant communities sustained by development activities consistent with the state's responsibility for a healthy environment, including efforts to
   A) ensure that Arctic residents and communities benefit from economic and resource development activities in the region;
   B) improve the efficiency, predictability, and stability of permitting and regulatory processes;
   C) attract investment through the establishment of a positive investment climate and the development of strategic infrastructure;
   D) sustain current, and develop new, approaches for responding to a changing climate, and adapt to the challenges of coastal erosion, permafrost melt, and ocean acidification;
   E) encourage industrial and technological innovation in the private and academic sectors that focuses on emerging opportunities and challenges;
   F) maintain a strong, sustainable fisheries industry and increase fisheries research and monitoring;
   G) continue to prepare the residents of the state for emerging economic activities by using multiple education and training opportunities and implementing state workforce plans;

2. collaborate with all levels of government, tribes, industry, and nongovernmental organizations to achieve transparent and inclusive Arctic decision-making, including efforts to
   A) strengthen and expand cross-border relationships and international cooperation, especially bilateral engagements with Canada and Russia;
   B) sustain and enhance state participation in the Arctic Council;
   C) pursue opportunities to participate meaningfully as a partner in the development of federal and international Arctic policies, thereby incorporating state and local knowledge and expertise;
   D) strengthen support for and collaboration with Arctic Council Permanent Participant organizations that include Indigenous peoples of the state;

3. enhance the security of the Arctic region of the state and, thereby, the security of the entire state, including efforts to
   A) enhance disaster and emergency prevention and response, oil spill prevention and response, and search and rescue capabilities in the region;
   B) provide safe, secure, and reliable maritime transportation in the areas of the state adjacent to the Arctic;
   C) sustain current, and develop new, community, response, and resource-related infrastructure;
   D) coordinate with the federal government for an increase in United States Coast Guard presence, national defense obligations, and levels of public and private sector support; and

4. value and strengthen the resilience of communities and respect and integrate the culture, language, and knowledge of Arctic peoples, including efforts to
   A) recognize Arctic Indigenous peoples' cultures and unique relationship to the environment, including traditional reliance on a subsistence way of life for food security, which provides a spiritual connection to the land and the sea;
   B) build capacity to conduct science and research and advance innovation and technology in part by providing support to the University of Alaska for Arctic research consistent with state priorities;
   C) employ integrated, strategic planning that considers scientific, local, and traditional knowledge;
   D) safeguard the fish, wildlife, and environment of the Arctic for the benefit of residents of the state;
   E) encourage more effective integration of local and traditional knowledge into conventional science and research.

b. It is important to the state, as it relates to the Arctic, to support the strategic recommendations of the implementation plan developed by the Alaska Arctic Policy Commission and to encourage consideration of recommendations developed by the Alaska Arctic Policy Commission. Priority lines of effort for the Arctic policy of the state include

1. promoting economic and resource development;
2. addressing the infrastructure and response capacity gap in order to support the Arctic region;
3. supporting healthy communities; and
4. supporting existing and fostering new science and research that aligns with state priorities for the Arctic.

c. In this section, "Arctic" means the area of the state north of the Arctic Circle, north and west of the boundary formed by the Porcupine, Yukon, and Kuskokwim Rivers, all contiguous seas, including the Arctic Ocean, and the Beaufort, Bering, and Chukchi Seas, and the Aleutian Chain, except that, for the purpose of international Arctic policy, "Arctic" means the entirety of the state.

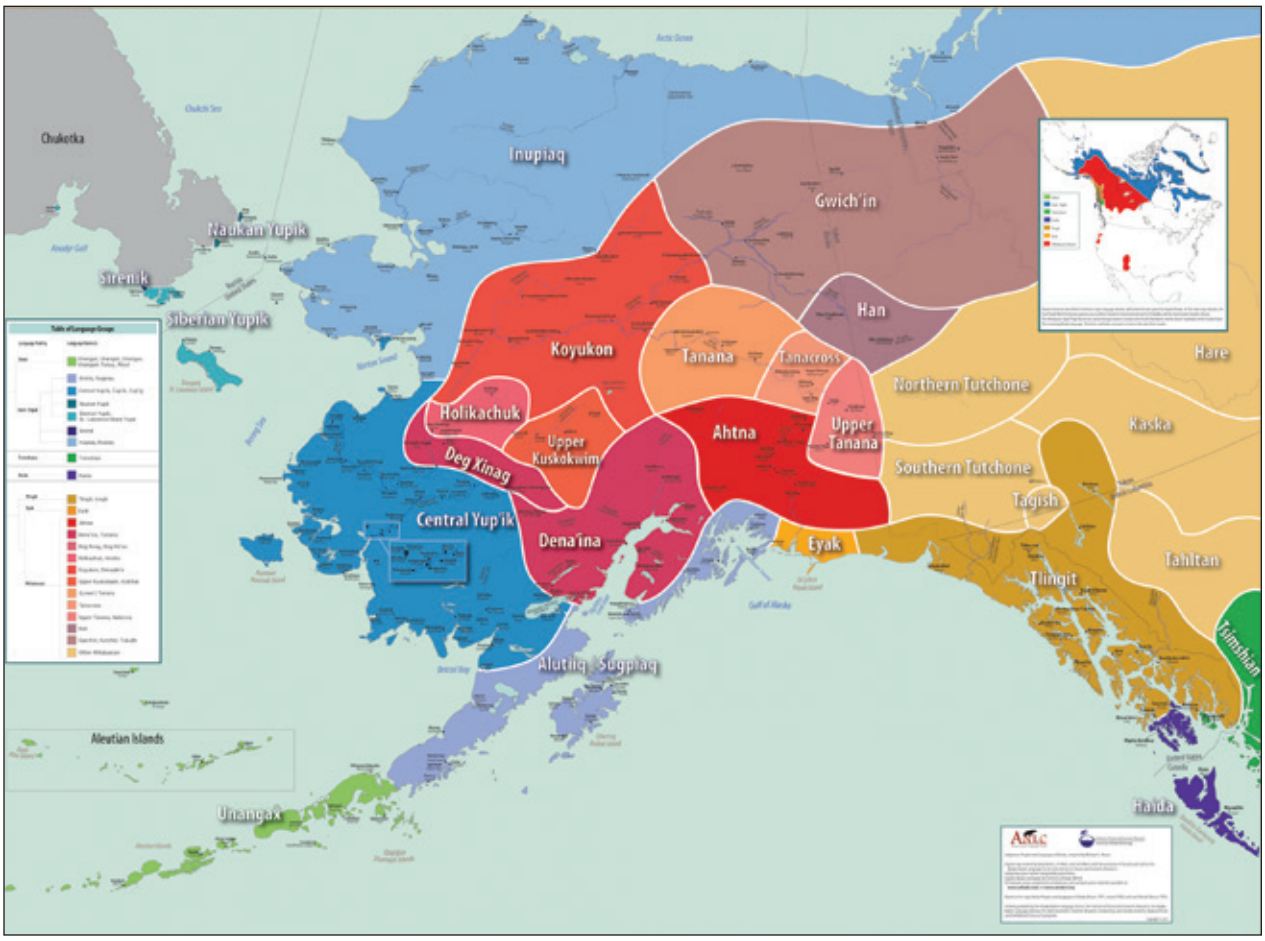
INDIGENOUS PEOPLES IN ALASKA

Alaska Native Peoples have thrived on the lands and waters of what is now the state of Alaska for more than 10,000 years, since before Russian and American exploitation and colonization. The map on this page shows the language groups by region of the Indigenous population. In 1942, when construction on the Alaska Highway began, there were 73,000 people in Alaska, about half of them Alaska Native. This percentage fell to 26% in 1950, and to 19% by the time of statehood in 1959. Today the population is approximately 20% of roughly 730,000 Alaska citizens. Looking to the future, the Alaska Department of Labor projects the Alaska Native population to increase by about 30,000 people by 2050. This would increase their proportion of Alaska's total projected population to 23%.

Alaska Native Claims Settlement Act

The Alaska Statehood Act of 1959 did not comprehensively address Indigenous land claims, noting only that the "State must disclaim all right and title to lands and other property not granted or confirmed to the State including right or title which may be held by any Indians, Eskimos or Aleuts (natives) or is held by the United States in trust for said natives."

In the 1960s the Alaska Federation of Natives was established to advocate for a land claims settlement. The Alaska Native Claims Settlement Act of 1971, known as ANCSA, extinguished aboriginal land title in Alaska. Its foundation was in Alaska Native corporate ownership. The state was divided into 12 regions creating private, for-profit Alaska Native regional corporations and over 200 private, for-profit Alaska Native village corporations. ANCSA also mandated that both regional and village corporations be owned by enrolled Alaska Native shareholders. Through ANCSA, the federal government transferred 44 million acres — land to be held in corporate ownership by Alaska Native shareholders — to Alaska Native regional and village corporations. The federal government also compensated the newly formed Alaska Native corporations a total of $962.5 million for land lost in the settlement agreement.



Indigenous Peoples

This map shows the Indigenous language regions of Alaska. The language boundaries represent traditional territories in approximately 1900. Alaska Native Peoples are those who are Indigenous to this place now called Alaska. https://www.uaf.edu/anla/collections/map/

UAF photo

LAND ACKNOWLEDGMENT

As a we build a more diverse, equitable and inclusive future, we acknowledge and honor the Alaska Native Peoples of the land on which we work and live.

University of Alaska Anchorage UAA recognizes and values the diversity of our unique location in Southcentral Alaska, the ancestral lands of the Dena'ina, Ahtna, Alutiiq/Sugpiaq, Chugachmiut and Eyak peoples. Dena'ina land acknowledgment: Dena'inaq ełnenaq' gheshtnu ch'q'u yeshdu. "I live and work on the land of the Dena'ina." Translation: Helen Dick, Sondra Shaginoff-Stuart, Joel Isaak.

University of Alaska Fairbanks We acknowledge the Alaska Native nations upon whose ancestral lands our campuses reside. In Fairbanks, our Troth Yeddha' Campus is located on the ancestral lands of the Dena people of the lower Tanana River.

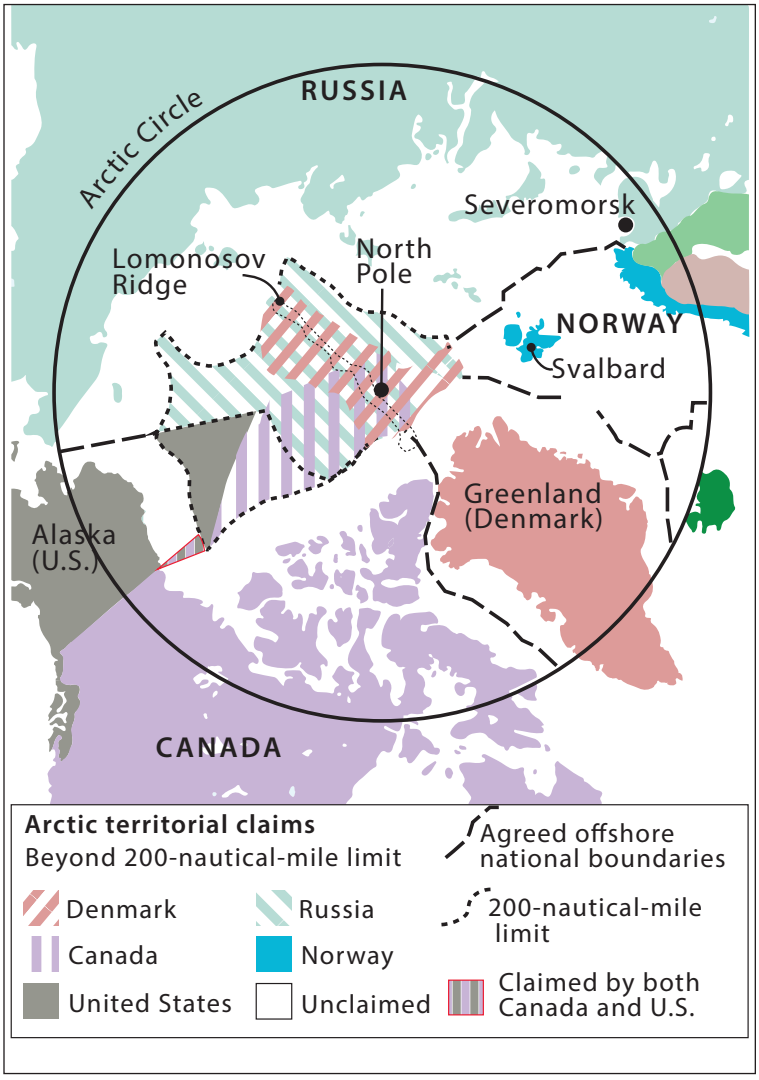
University of Alaska Southeast Our campuses reside on the unceded territories of the Áak'w Kwáan, Taant'á Kwáan and Sheetk'á Kwáan on Lingít Aaní, also known as Juneau, Ketchikan and Sitka, Alaska, adjacent to the ancestral home of the Xaadas and Ts'msyen peoples.

UAF photo

ALASKA'S ARCTIC BOUNDARIES AND GOVERNANCE

The boundaries of property, resource use areas, and jurisdictions in Alaska were formed by a mix of physical, cultural, political, and legal factors.

The Alaska coastline's unique physical features, such as its many bays, spits and barrier islands, are shaped over geologic time scales through processes like erosion, tectonic movement and volcanic activity. These features have long guided the use of the land for subsistence, transit, trade, recreational use, community location and migration, natural resource extraction and other economic opportunities. These coastal use patterns have, in turn, created complex political and legal boundaries.



Most contemporary political boundaries were solidified with the 1867 Alaska purchase from Russia. Subsequent treaties and agreements were made by drawing from a mix of geophysical boundaries such as the Canadian Coast Mountains and artificial divisions along longitudinal lines. These were used to form the official boundaries of the State of Alaska that we use today. More recently, the Alaska Native Claims Settlement Act of 1971 created additional internal shifts to jurisdictional boundaries and management.

The international border delineating U.S. and state jurisdiction for Alaska originated in the 1867 Alaska purchase from Russia, and remains broadly accepted aside from an ongoing dispute with Canada over the Beaufort Sea boundary, as well as one in the Dixon Entrance within the Inside Passage (see map). The state is bordered on the east by the 141st meridian and on all other sides by maritime features. Domestically, the formation of municipalities and transfers of land from federal to state ownership began with Alaska's ascension to statehood in 1959. Internal state boundaries for borough and city limits were determined by many variables including population densities, cultural and regional identities, and geographic features. These legal and political divisions serve as the scaffolding for our familiar federalist system, its rules of governance at the local, state and federal levels, and the rights of citizens. Subsequent divisions instigated by local activism and federal legislative action, including Alaska National Interest Lands Conservation Act conservation areas and private Alaska Native Claims Settlement Act lands, further complicated the land ownership and jurisdictional mosaic of the state. What happens on any given plot of land in Alaska depends on the rights and responsibilities

Territorial claims in the Arctic

This map shows ongoing territorial claims in the Arctic. The Arctic Ocean and surrounding seas are governed by the Commission on the Limits of the Continental Shelf. Except for the US, all parties are participating voluntarily in the process of determining Outer Continental Shelf boundaries. From the *Economist*, redrawn by Russ Mitchell.

of a range of government actors, natural resource access issues, and land use and tenure regimes. Understanding these jurisdictions and boundaries and how they have changed over time offers a glimpse of how future use patterns may drive policy needs, and how emerging changes may challenge longstanding or traditional use patterns.

JURISDICTIONAL BOUNDARIES

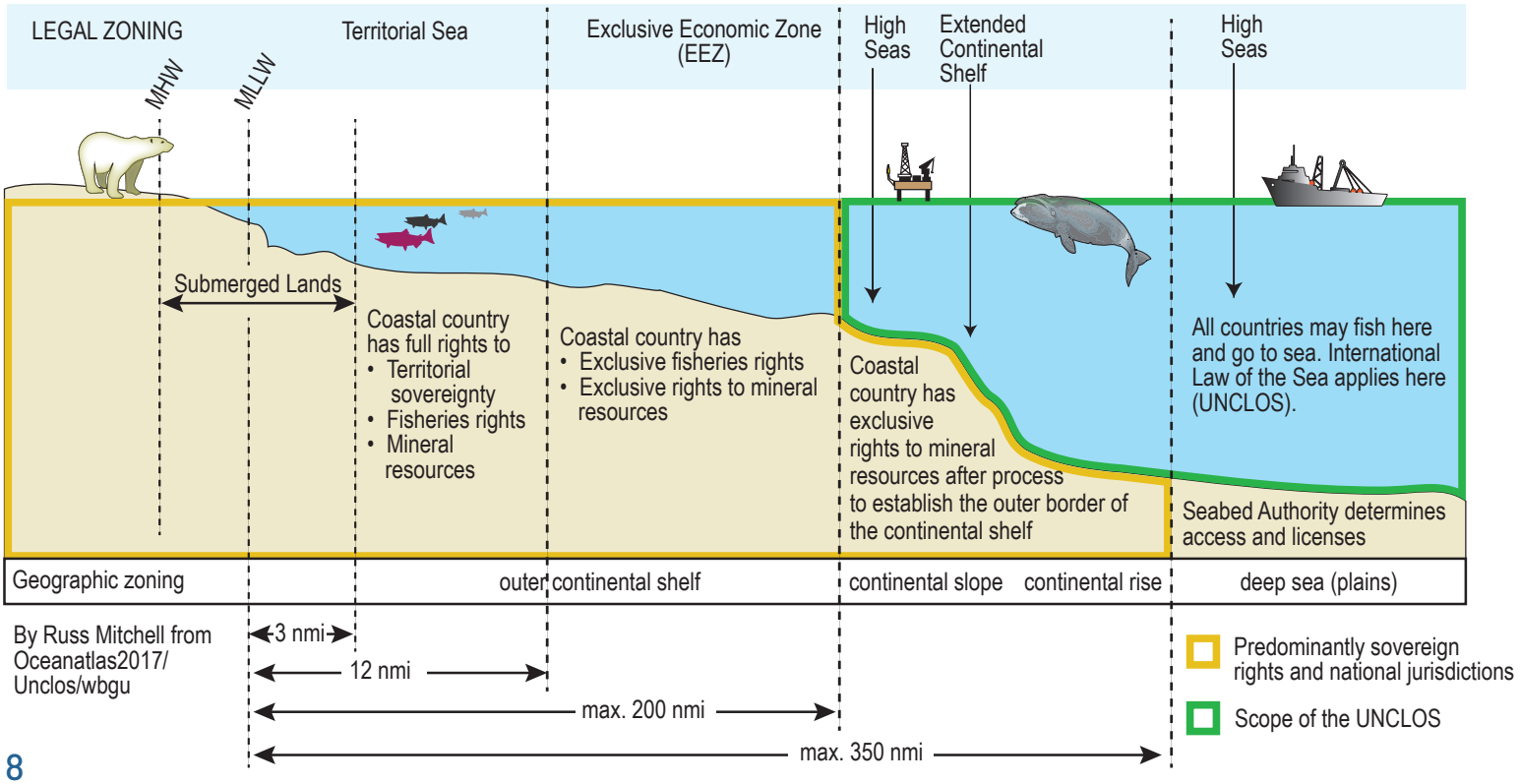
Alaska's vast coastline is not governed as a whole, but subject to a variety of legal and jurisdictional authorities across dozens of bounded areas and zones. Where jurisdictions overlap or multiple actors share responsibility, rules of governance and questions of responsibility become unclear. Jurisdictional overlap can happen horizontally (between two different agencies with coinciding missions) or vertically (between local, state, tribal or federal governments). Many of Alaska's jurisdictional boundaries were adopted with statehood, but some have continued to evolve since. These include jurisdictions onshore, offshore, and those straddling land and sea.

Offshore Jurisdiction

Alaska's primary offshore boundaries are governed by the 1953 Submerged Lands Act, the 1953 Outer Continental Shelf Lands Act, and guidance from the 1982 United Nations Convention on the Law of the Sea. While the U.S. has not ratified UNCLOS, we do honor many of the provisions of offshore boundaries established by the agreement, as defined by the following four jurisdictional categories: internal waters (such as ports, rivers, or inlets); territorial seas, which extend from shore low-water baseline to 12 nautical miles offshore; the contiguous zone, which extends up to 24 nautical miles from shore baseline; and the exclusive economic zone, which extends up to 200 nautical miles offshore from baseline.

The modern boundary for the U.S. exclusive economic zone stems from the Magnuson-Stevens Fishery Conservation and Management Act of 1976, sponsored by Alaska Senator Ted Stevens. The Magnuson-Stevens Act extended management of fisheries from 12 to 200 nautical miles in an effort to assert control over foreign fisheries operating within the U.S. exclusive economic zone. In 1983, the U.S. expanded upon the Magnuson-Stevens Act with Presidential Proclamation No. 5030, reasserting U.S. authority over fisheries within its exclusive economic zone and laying additional claims to authority over such things as mineral deposits and pollution regulation within the exclusive economic zone.

Alongside these definitions of federal offshore jurisdiction, under the 1953 Submerged Lands Act, most U.S. states, including Alaska, have jurisdiction over the first three nautical miles offshore from baseline. Motivated by states wishing to assert their



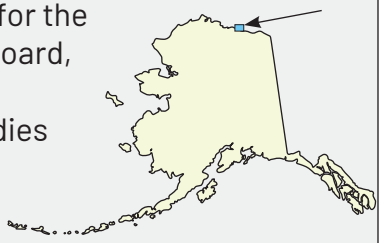
rights to coastal resources, but tempered by national security interests, the Submerged Lands Act grants the State of Alaska management authority and natural resource rights in those lands submerged within this jurisdictional boundary. These boundaries extend from both the main coastline as well as from islands within the state, but cannot be extended by the presence of partially or fully submerged features such as shoals. In some Gulf Coast states, these boundaries have shifted in the last decade, with certain forms of fisheries management extending to a 9 nautical mile offshore boundary. Generally, however, offshore natural resources and associated revenues beyond three nautical miles become the domain of the federal government under the 1953 Outer Continental Shelf Lands Act.

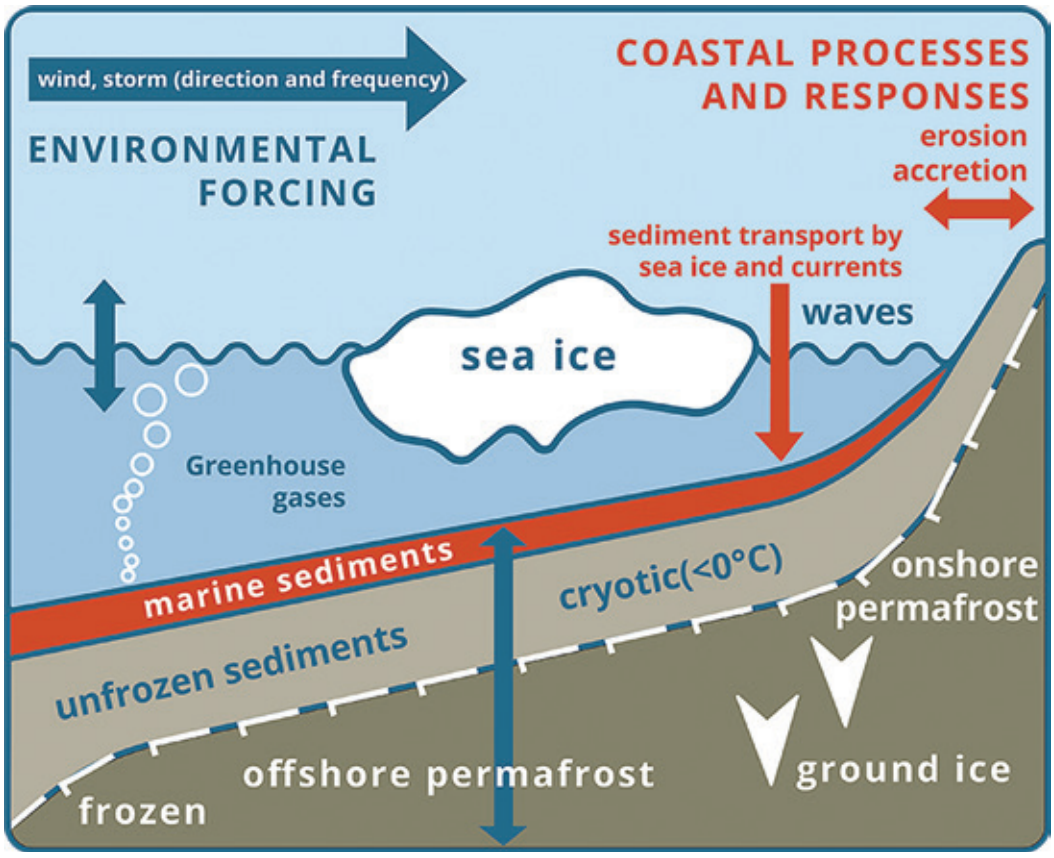
Onshore Jurisdiction

From the coastline inland, public and private lands are divided among a variety of agencies, corporations, and municipalities. This can create challenges for policymaking and management of coastal regions.

After the passage of statehood in 1959, Alaska's land ownership and responsibilities were further modified by the Alaska Native Claims Settlement Act in 1971. ANCSA established Alaska's unique tribal corporation system, transferring 44 million acres of federal lands into private ownership under Alaska Native

A notable example of complications caused by changing geophysical definitions and contested jurisdictional boundaries can be seen in the case of Dinkum Sands. Dinkum Sands is an offshore shoal that was previously identified as an island, until further geological surveys and a 1997 Supreme Court ruling shifted its status to a partially submerged shoal. This recategorization of Dinkum Sands led to a substantial loss of oil and natural resource rights for the State of Alaska, as well as a return of revenues to the federal side, under whose jurisdiction Dinkum Sands now falls. The federal government used these funds to create an endowment for the North Pacific Research Board, based out of Anchorage, that funds a range of studies relevant to Alaska.





Alaska's extensive, complex and dynamic coastline

Tidal forces, storms, and the accretion and erosion of sand create diverse near-shore and offshore landforms and habitats. People depend on these coastal zones for a wide range of uses. From Lantuit et al. (2012). The Arctic Coastal Dynamics database. A new classification scheme and statistics on arctic permafrost coastlines. *Estuaries and Coasts*, 35, 383–400. DOI 10.1007/s12237-010-9362-6.

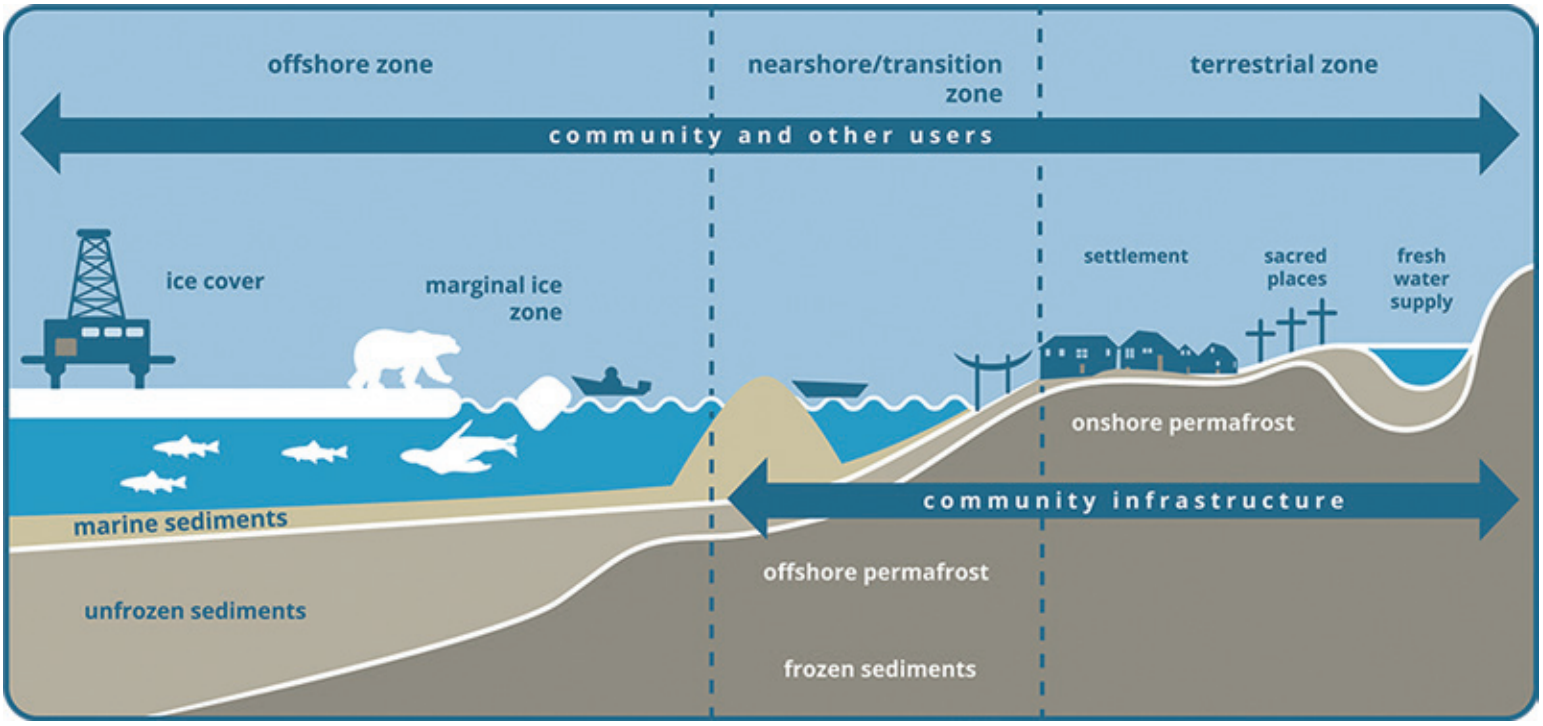
Corporations in exchange for the extinguishment of Native title. Only 10 years later, the Alaska National Interest Lands Conservation Act instigated a number of land swaps that radically altered the jurisdictional and land use makeup of the state. In some cases, federal ownership of coastal areas was relinquished to state management as old coastal defense installations, such as the Distant Early Warning-Line, or DEW-Line, were deemed obsolete, while other areas were claimed by the federal government for the purposes of resource and habitat conservation. As coastlines erode, some former military sites pose new contamination challenges caused by their prior uses. In others, repurposing allows subsistence activities and natural resource access to expand.

Federal ownership status determines a range of other legislative authorities that have a role in determining land use and management, presenting opportunities and challenges for state direction. When lands are transferred between entities, the management of those lands shifts, adding or removing responsibilities, changing values and management goals, and altering the composition of stakeholders.

Mixed Responsibilities

Many coastal areas are subject to mixed responsibilities among local, state, tribal and federal entities. Disaster response is a key example, where combined resources and action may be required to meet emergency needs, but limited capacity and ambiguous areas of responsibility for a given area hamper the effectiveness of response or reimbursement. Private infrastructure, although fundamental to local communities, may not qualify for federal recovery funding, requiring state intervention to restore necessary infrastructure or utilities. Additionally, municipalities lacking the capacity to develop hazard mitigation and emergency response plans often cannot access federal funds for coastal mitigation or recovery that require such plans as a prerequisite. In places where search and rescue responsibilities are split between local and federal partners, and likewise in the case of environmental impacts from ship traffic or transport of goods, cleanup and recovery often require state and federal partners with separate jurisdictional responsibilities to collaborate.

Alaska's fisheries provide another example of local, state, federal, and tribal mixed responsibilities. Federal fisheries are governed by the National Marine Fisheries Service and Department of Commerce (with significant input from the Magnuson-Stevens Act institution, the North Pacific Fishery Management Council) and the U.S. Fish and Wildlife Service with state, international, and tribal collaboration for some fisheries; state fisheries are governed by the Alaska Board of Fisheries in coordination with the Department of Fish and Game; tribal fisheries are operated by tribes, such as the Metlakatla Indian Community which manages the largest tribal fishery in the U.S. in coordination with



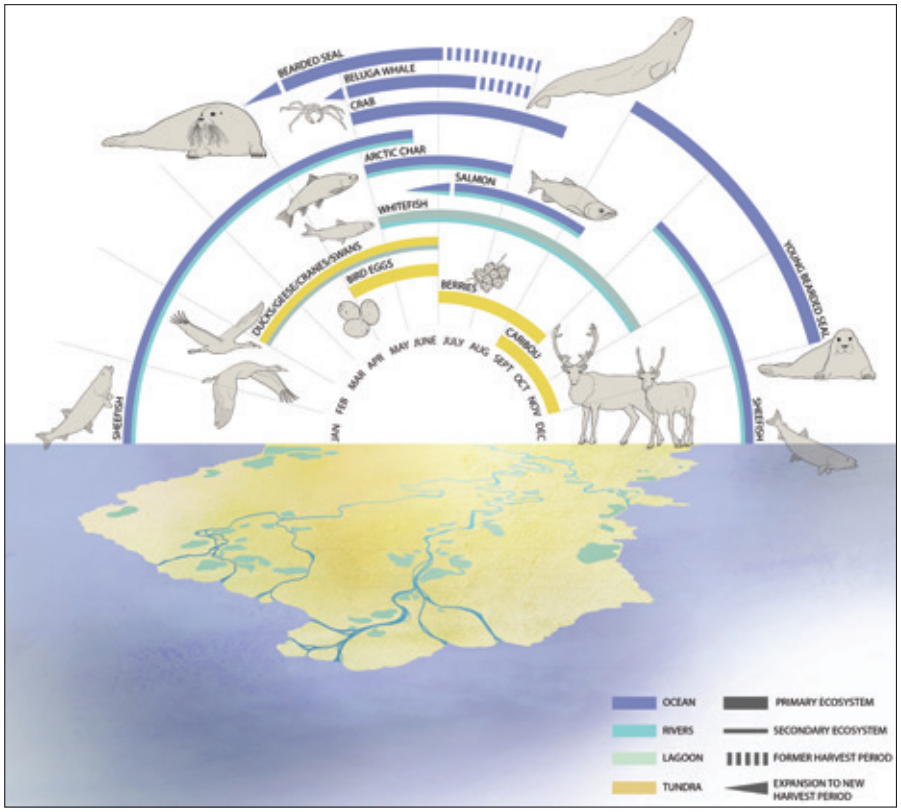
From Lantuit et al. (2012). The Arctic Coastal Dynamics database. A new classification scheme and statistics on arctic permafrost coastlines. *Estuaries and Coasts*, 35, 383–400. DOI 10.1007/s12237-010-9362-6.

the Bureau of Indian Affairs, and inter-tribal fish commissions such as the Kuskokwim River Inter-Tribal Fish Commission, which co-manages in-river salmon subsistence fisheries with the U.S. Fish and Wildlife Service in times of scarcity.

Indigenous peoples in the Yukon and Kuskokwim region have long drawn attention to the inequities of industrial fisheries over food fisheries. For example, there are currently no bycatch limits for some species, like chum salmon in the industrial trawl fleet, while subsistence salmon harvests — vital for cultural wellness, intergenerational knowledge transfer, and food security — have been closed or severely limited for years.

Many marine mammals are co-governed by Alaska Native Organizations and federal wildlife agencies. Under the U.S. Marine Mammal Protection Act, the federal government (NOAA Fisheries and the U.S. Fish & Wildlife Service) is responsible for marine mammal conservation. A provision of the 1994 amendments to the act allowed federal agencies to build cooperative agreements with hunters' organizations, especially with regards to subsistence harvest assessment. From there, Alaska Native Organizations such as the Alaska Eskimo Whaling Commission, the Eskimo Walrus Commission and others built co-management relationships and a broad expertise in analyzing potential impacts of resource development through their own meetings as well as participating in regulatory processes.

In particular there is ongoing conflict over trawl fishery bycatch in Western Alaska and how it affects subsistence fisheries. This is largely a problem of mismatch between jurisdiction and marine ecology. For example, if Pacific Salmon were governed by the North Pacific Fisheries Management Council under the Magnuson-Stevens Act, the council would be required to develop a management plan that would lead to recovery of overfished salmon species in no more than a decade. But because the council is not responsible for anadromous species, they have chosen to delay action on salmon bycatch — which, along with warming waters in the North Pacific and other factors, may be an important contributor to the declines and closures of several fisheries important for subsistence and personal use.



Changes in Seasonal Harvest

Seasonal changes in the harvest of coastal plants and animals in Northwest Arctic Alaska, from subsistence harvester interviews in Kotzebue, Alaska, in response to the question, "What months do you harvest coastal species now, and has that changed from the past?" Illustration by Cecil Howell and used with permission.

POLICY IMPLICATIONS of ARCTIC BOUNDARIES AND GOVERNANCE

Arctic amplification, the physical process through which the Arctic warms at two to three times the rate of the rest of the globe, is causing rapid and dramatic changes in Alaska's coastal regions. Increased traffic along Alaska's coast, retreating sea ice and coastal erosion may all warrant reassignments of jurisdiction, increased investments by state and private partners, and strategic pursuit of sustainable resource development. The development of new infrastructure depends on the ability of policy makers to adaptively address the emerging challenges of changing coastlines. Navigating the challenges facing Alaska's coastal regions and its boundaries requires a deliberative, multistakeholder approach to ensure the resilience of all Alaskans.

ALASKA'S COASTAL ECOLOGY AND INFRASTRUCTURE

2

UAF photo

The Arctic Ocean occupies a roughly circular basin and covers an area of about 5,427,000 sq mi, one and a half times larger than the United States.

Alaska's North Slope and northwestern Seward Peninsula border the Arctic Ocean via the Beaufort and Chukchi Seas. The state's extensive coastline totals approximately 34,000 miles — more than the rest of the United States' coasts combined.

Alaska's coastal systems are formed and reshaped through dynamic wave action in the open water period and sea ice formation in the winter. These forces redistribute sediment, carbon, nutrients and contaminants into the marine environment.

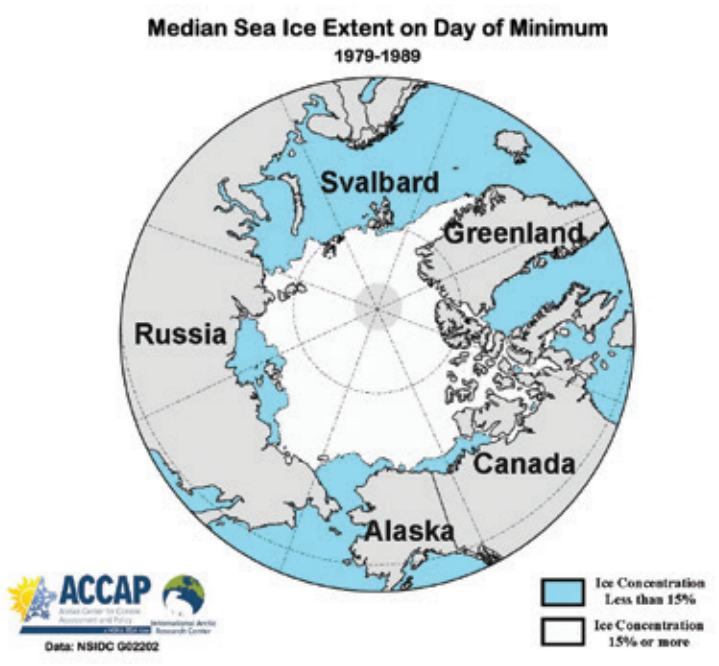
Alaska's Arctic coasts are defined by marine and terrestrial ice. Sea ice, particularly shore-fast sea ice, calms wave activity. Sea ice is significant to the people of Alaska as a habitat for animals, a platform for hunting and fishing, a hazard for ships, a traditional source of freshwater and a buffer to shorelines. As sea ice diminishes, it opens up marine areas for faster and safer transit, but also exposes thawing permafrost to the full force of wind and waves, increasing coastal erosion. This threatens infrastructure and community security along Alaska's northern shores.

Scientists categorize the state's coasts by type — deltaic and lowland plain, permafrost coastlines, rocky areas and Arctic coastal islands. Rocky shorelines are far less vulnerable to climate-change linked erosion. Coastline vulnerability varies regionally, as shown in the graphic on the next page.

The human relationship to coastlines ranges from small-scale subsistence regulated by millennia-old community practices, to large-scale industrial operations related to ship traffic and governed by the International Maritime Organization Polar Code. This can affect human and environmental security across several levels of governance. Decision-making depends on understanding the importance of the relationships between human uses, ecological dynamics, climate and infrastructure.

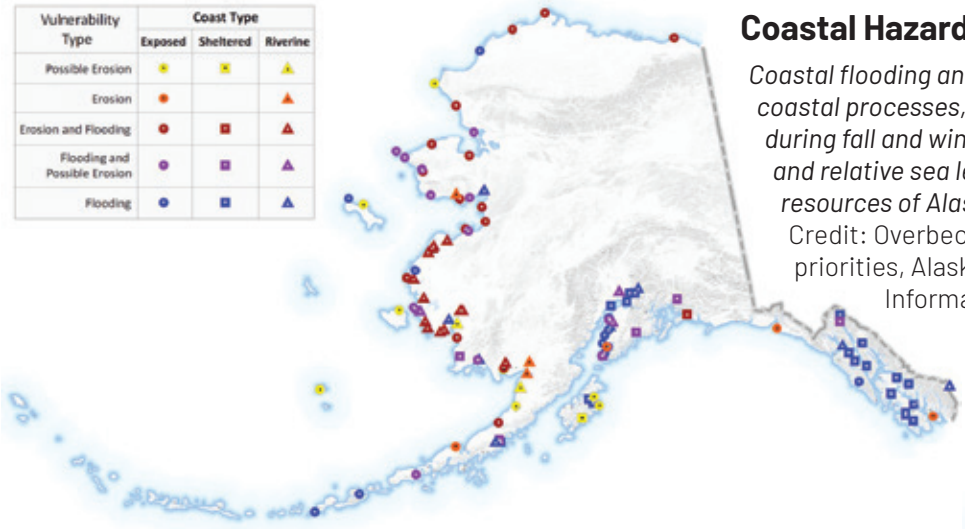
HUMAN COASTAL USES

People living on Alaska's northern coastlines face challenges of geographical isolation, limited transportation options, shifting seasonality, and the effects of ice and cold on equipment and infrastructure. Prior to the 20th century, Indigenous Alaskans generally practiced annual cycles of migration to and from coastlines. With colonization, forced relocation and settlement of Indigenous populations ended these practices. Numerous government-sponsored projects pushed Indigenous communities into sedentary patterns surrounding western infrastructure and institutions, often located coastally. It is important to note that the vulnerability of many coastal communities is less a product of their people and stewardship of natural resources and far more a result of colonial and state government and settler decisions.



Changes in Sea Ice Concentration North of Alaska

Arctic sea ice reaches its minimum concentration in September of each year. On September 19, 2023, Arctic sea ice reached its annual minimum extent of 4.23 million square kilometers (1.63 million square miles). The 2023 minimum is sixth lowest in the nearly 45-year satellite record. The last 17 years, from 2007 to 2023, are the lowest 17 sea ice extents in the satellite record. Data from the National Snow and Ice Data Center (NSIDC); Rick Thoman, Alaska Center for Climate Assessment and Policy.



Coastal Hazards

Coastal flooding and erosion resulting from naturally occurring coastal processes, changes in ocean conditions from reduced sea ice during fall and winter storm seasons, thawing coastal permafrost, and relative sea level rise impact coastal infrastructure and cultural resources of Alaska Native communities and other installations.
Credit: Overbeck, J.R., ed., 2018, Alaska coastal mapping gaps & priorities, Alaska Division of Geological & Geophysical Surveys Information Circular 72. http://doi.org/10.14509/30096

Alaska Shoreline Types

Alaska has a wide variety of shoreline types that are common along the coast of the contiguous U.S., as well as some unique Arctic shorelines. Alaska's cold climate results in permafrost coastlines as well as coastlines seasonally affected by Arctic sea ice.

Credit: Overbeck, J.R., ed., 2018, Alaska coastal mapping gaps & priorities, Alaska Division of Geological & Geophysical Surveys Information Circular 72. http://doi.org/10.14509/30096

Millennial Uses by Alaska Native Peoples

Coastal regions contribute heavily to uses and services that include cultural, spiritual and aesthetic heritage; food and raw materials; flood control, stabilization and storm protection; climate regulation and carbon sequestration; water supply, filtration and regulation; biodiversity; and recreation, education and tourism.

The patterns of Indigenous settlement, land use and trade along Alaska's Arctic coast and river basins were shaped by the region's unique plants and animals providing for a community's nutritional and cultural needs. A majority of Alaska's coastal communities continue to practice subsistence ways of life. Successful harvests depend on local knowledge of marine mammal habitats, avian flyways and the dynamic navigability of coastal waters. As Alaska's coasts have become subject to an increasing variety of uses — subsistence, transportation, resource development, large-scale fisheries — there is a growing need to ensure coordination and communication among all users. One long-standing example is the Open Water Season Conflict Avoidance Agreement between the Alaska Eskimo Whaling Commission, oil and gas interests and the National Oceanic and Atmospheric Administration, or NOAA. The Inuit Circumpolar Council has also begun planning an Arctic Council framework for monitoring Arctic subsistence species to support pan-Arctic monitoring networks. Thriving Arctic species provide food and cultural continuity for rights holders and others.

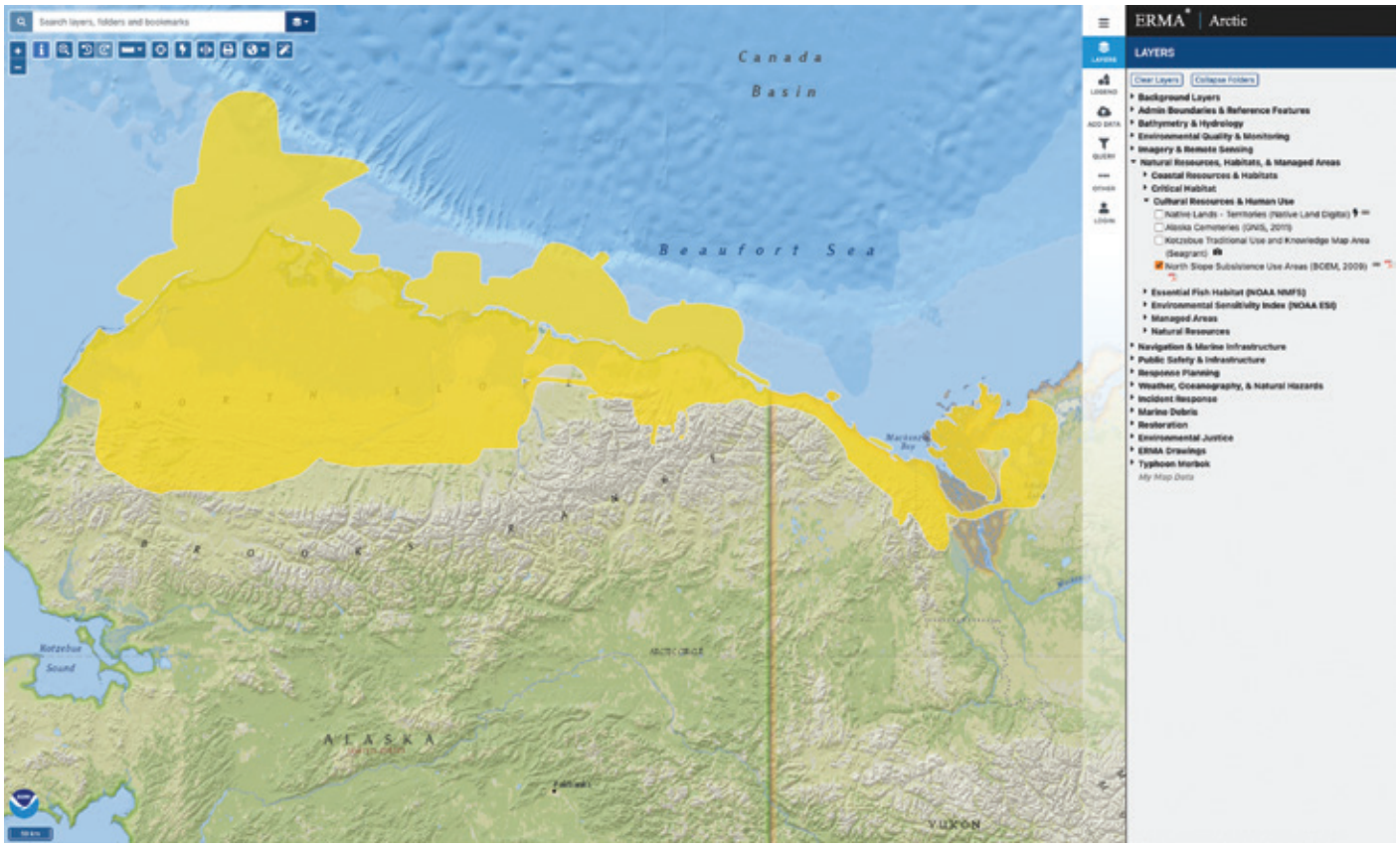
Complex and Competing Coastal Uses

Uses of the coastal regions are complex, interconnected and overlapping. Alaska's coastlines are the site of critical infrastructure for communities and industries, including wastewater plants, tank farms for storing fuel, and landfills, all of which are regulated by a range of authorities.

The federal agency responsible for much of the marine and coastal management in Alaska is NOAA, which has developed the Arctic Environmental Response Management system (https://erma.noaa.gov/arctic) an open access interactive web tool with dozens of data layers representing meteorological, environmental, ecological, structural and sociocultural factors.

Mapping Priorities in Emergencies

The ERMA Arctic online tool with subsistence areas selected and highlighted in yellow. This figure shows some of the primary categories within which many subsets of data are available. It highlights one selected layer, the North Slope Subsistence Use Area. This layer represents contemporary subsistence use patterns from Beaufort Sea communities over the last decade and incorporates traditional knowledge of subsistence harvest by species at a community level. NOAA ERMA Arctic online tool https://erma.noaa.gov/arctic



U.S. security policies are generating additional infrastructure and training activities along Alaska's coasts, such as the U.S. Air Force long range radar sites and the U.S. Army Corps of Engineers Alaska District $400 million Port of Nome expansion project. The Corps of Engineers has also analyzed coastal erosion and storm risk at Utqiaġvik, resulting in plans for a $600 million coastal protection (sea wall) project. Careful planning must take place so that sea walls do not accelerate erosion along adjacent coastal habitats and areas of community uses.

New uses of coastal areas, such as cruise ship tourism, can create economic and sociocultural conflicts, such as disagreement over the acceptability of using subsistence hunting, fishing and whaling activities as tourism attractions. Other challenges include highly variable and seasonal demand that may strain local populations and infrastructure.

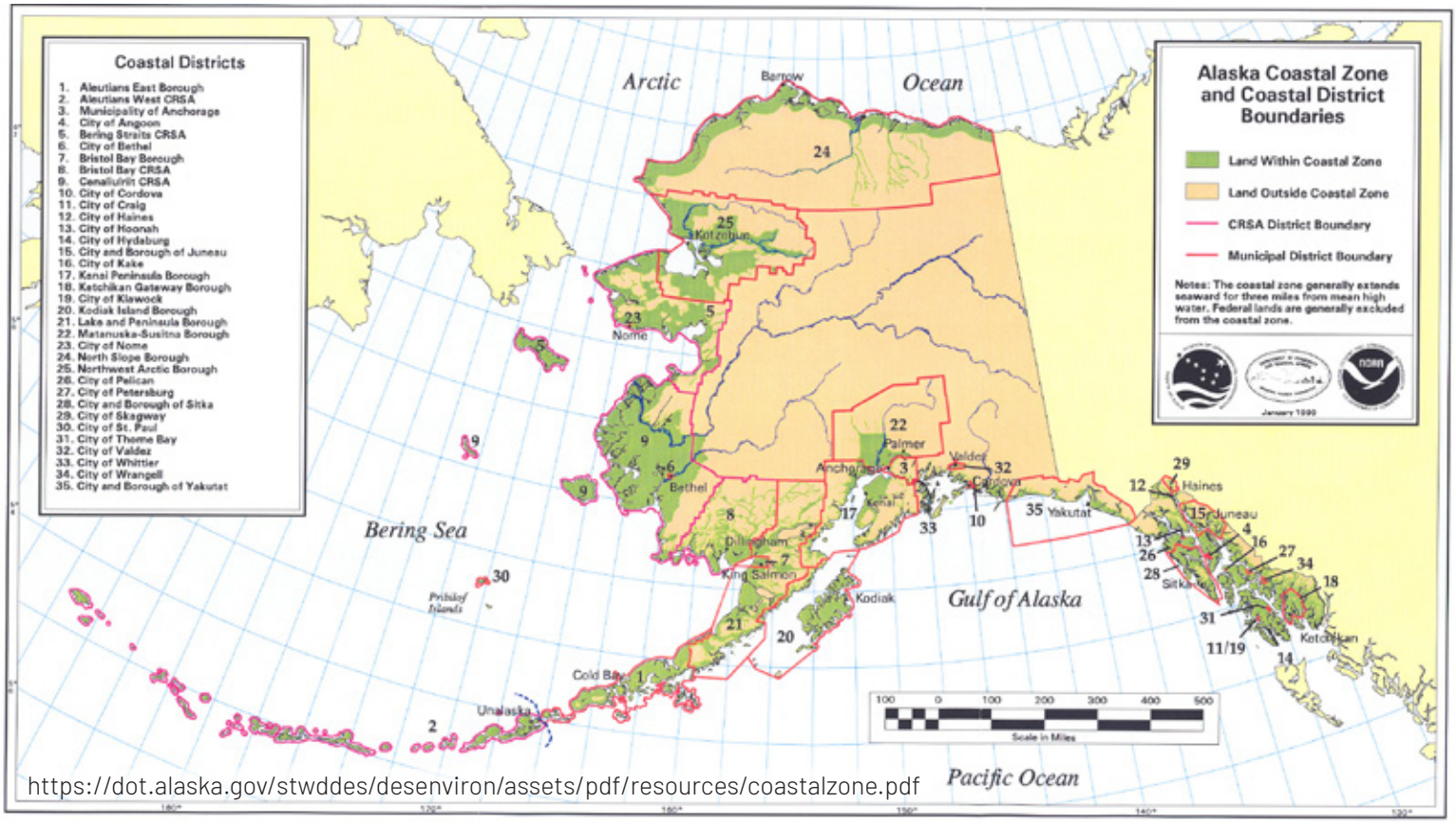
THE ALASKA COASTAL MANAGEMENT PROGRAM

In 1972, the federal government passed the Coastal Zone Management Act, encouraging coastal states to develop and implement coastal zone management plans under the National Coastal Management Program. Thus, Alaska established the Alaska Coastal Management Program, which gave the state greater authority over nearshore areas that would otherwise be managed exclusively by the federal government.

State programs involved all levels of government: NOAA, relevant state departments and agencies, and local governments, who were tasked with implementing Coastal Management Programs through land use regulations and other policy mechanisms. CMPs give state and local actors the advantage of participating in legally binding consistency reviews for federal actions that affect the coast. Participation further made both states and municipalities eligible for federal funding for staffing and implementation.

Of greatest urgency when the Alaska program was adopted were regulation of the newly operational North Slope oil complex, centered on Prudhoe Bay, and oil and gas exploration on the outer continental shelf in the Bering and Chukchi Seas. The North Slope Borough, Northwest Arctic Borough, City of Nome and the Bering Straits all had functional local input into coastal management through approved plans by 1989.

Alaska actively participated in the National Coastal Management Program until 2011. Discontinuation left it as the only coastal state in the nation that has opted out. As a result, Alaska does not qualify for some



https://dot.alaska.gov/stwddes/desenviron/assets/pdf/resources/coastalzone.pdf


UAF photo

funds, and struggles to effectively compete for other funding sources due to lack of proactive planning across jurisdictional boundaries. These limitations have reduced local coastal control.

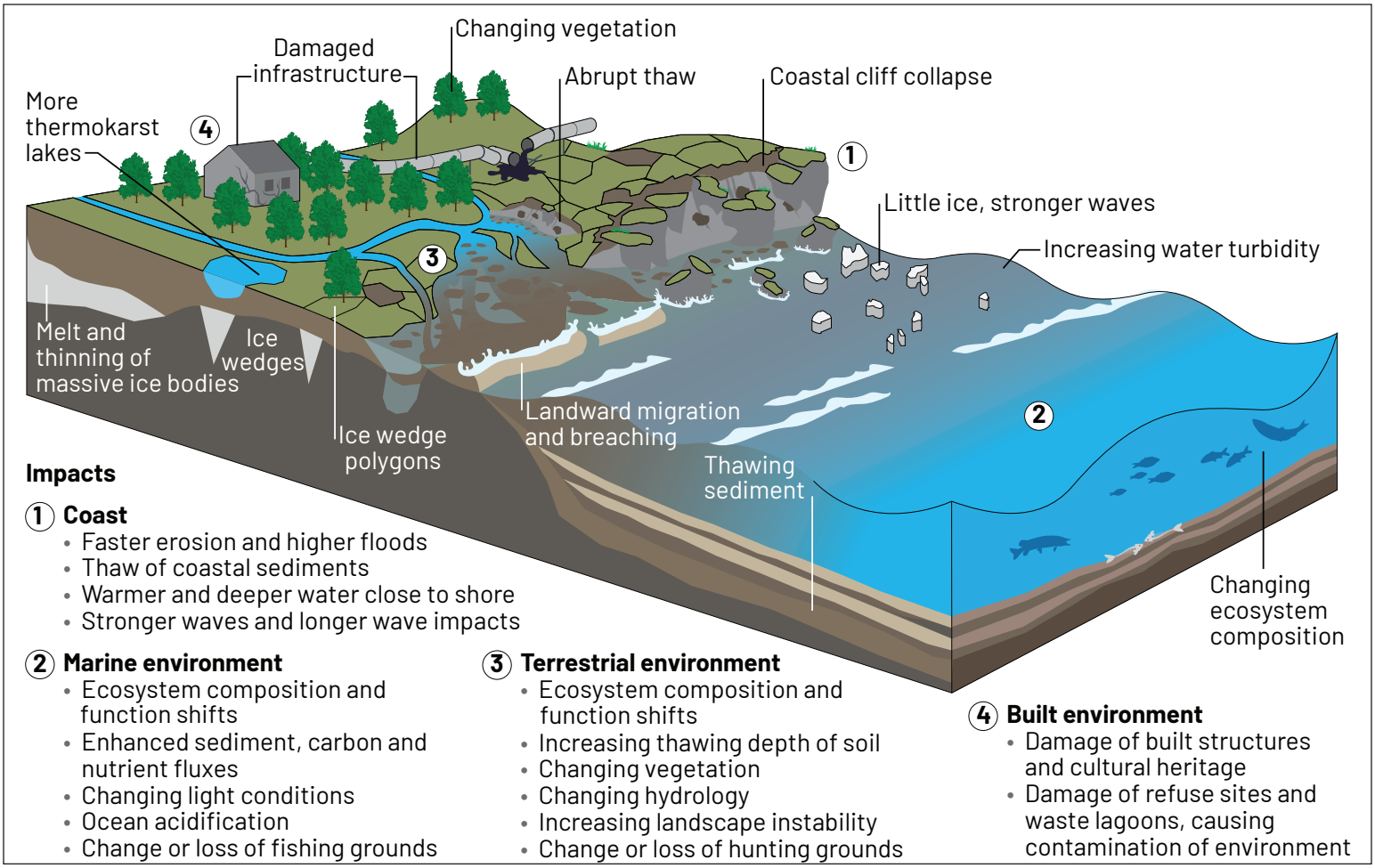
WHAT IS INFRASTRUCTURE?

Broadly speaking, infrastructure is the material basis that enables people, organizations, societies, cultures and communities to operate. It can be thought of as not only as fixed installations such as roads and bridges, but also as an interdependent network of physical and information assets, including logistics and communication technologies, data and information highways, and the skilled operators and engineers managing them. Infrastructure can be funded privately, publicly or as a shared private/public partnership.

Essential infrastructure is required to provide for the wellbeing of a society, including transportation systems, utilities, schools, power generation systems and communications hubs. The State of Alaska defines critical infrastructure as "systems and assets, whether physical or virtual, so vital to the state that the incapacity or destruction of the systems and assets would have a debilitating effect on security, state economic security, state public health or safety, or any combination of those matters" (AS 26.23.900), and is in alignment with federal policy that identifies 16 distinct critical infrastructure sectors. This definition plays an important role when aligning state policy with federal agencies, funding sources and regulations.

In Alaska coastal communities, natural infrastructure also plays an important role, providing necessary access to resources in the form of transportation routes (ice trails, snowmachine paths). It may protect archaeological sites and artifacts. Natural infrastructure may directly provide sources of food and water, or may offer means of preserving food, as in ice cellars (*siglauq*). It may also offer protection against threats. Barrier islands, for example, shelter coastlines, protect communities and ecosystems, and provide sites for communities themselves. Threats to infrastructure include coastal erosion, flooding, thawing permafrost and the Arctic climate. Coupled with remoteness, these threats contribute to the difficulty of building and maintaining infrastructure in the Arctic. Now-aging infrastructure was often sited and constructed before contemporary impacts to sea ice formation along the coast.

For late-season storms the lack of sea ice and hence lack of coastal protection can amplify the damage. In 2022, ex-Typhoon Merbok caused 11-foot storm surges, loss of coastline and an estimated $7.5 million dollars in damages. Such autumn storms require urgent repairs



Impacts of climate warming on Arctic coastal environments

Impacts on the Arctic coast,marine, terrestrial and built environments due to intensified physical processes driven by a warming climate. (1) Warmer water and air temperatures, as well as higher and more frequent extreme wave and high water-level events,lead to more rapid coastal erosion and destructive coastal flooding. (2) Increasing erosion rates and fluvial sediment delivery increase carbon and nutrient fluxes to the nearshore environment, altering ecosystem composition and services. (3) Higher air and water temperatures contribute to greater thaw depths, permafrost degradation, changes in surface and subsurface flows, an consequently changes in vegetation and ecosystem composition and services. (4) Eroding coasts and subsidence of the land surface destabilize built infrastructure, damage or cause the total loss of cultural artefacts andsites, and reroute surficial and subsurface hydrology that can potentially drain or contaminate drinking water supplies. Adapted from REF2.0• Springer Nature Limited. Irrgang, A.M., Bendixen, M., Farquharson, L.M. et al. Drivers, dynamics and impacts of changing Arctic coasts. Nat Rev Earth Environ 3, 39–54 (2022).

to prepare communities for winter. Materials may need to be brought in by air. Easily damaged critical infrastructure such as water and fuel tanks, power production and distribution, communications, and water/wastewater systems require outdoor repair that is challenging or impossible at certain times of the year. Damaging coastal storms are expected to continue under a changing climate. In some cases, this may require a strategic retreat or relocation of villages.

A 2019 Denali Commission Report "Statewide Threat Assessment: Identification of Threats from Erosion, Flooding, and Thawing Permafrost in Remote Communities" identifies 25 communities that have an immediate erosion threat to critical infrastructure and life-safety concerns requiring outside support in case of an event. All the communities damaged by Merbok are on this list. Unfortunately, many of the listed communities do not have access to local rock for shore protection. These communities also may not have the expertise to undertake required repairs.

Solutions must be developed on a case-by-case basis. Strategic retreat may allow expenditures over time rather than under emergency conditions. For example, Unalakleet is slowly moving the community to higher ground. Newtok, however, required a rapid retreat of individual structures. Shishmaref residents,

Deadhorse airport. Alaska DOT photo.

located on a barrier island, considered moving to a new location, partial retreat, or construction of erosion protection structures. The community agreed to move to the mainland, but a state survey showed that the proposed new site was suffering major permafrost degradation. Often, there is no single ideal solution.

Numerous coastal erosion protection systems, such as sandbags, have been tried with limited success. Sheet piles may be effective, provided they are driven deeply enough. Sheet pile is generally reserved for ports, where a wall is required for berthing ships. Large rock structures called rubble mounds, which serve to dissipate wave energy, are the most common type of shore protection.

ONGOING BIOGEOPHYSICAL CHANGES

The majority of Arctic permafrost coasts are already eroding. Projected intensification of wave and storm dynamics, coupled with loss of protective ice and frozen ground, will continue to test the ability of communities and the state of Alaska to plan and respond.

The offshore open water season in northern Alaska has lengthened by one to three months in recent decades. From 1979 to 2014, there was nearly a tripling of the number of wind events during open water conditions at Utqiaġvik. The rate of erosion is on the rise, and coastal erosion rates in the Arctic are already among the most extreme on earth: average rates of retreat are up to sixteen feet per year.

Landfills are a form of infrastructure vital to public health. Alaska's Department of Environmental Conservation, with consultants and tribal communities, are responsible for the state's solid waste management. Many remote landfills lack standard liners required by the Environmental Protection Agency due to exemptions. There are 184 unlined Class 3 sites, and 13 unlined Class 2 sites. The majority of Alaska Native tribal landfills are unlined. Without lining, a community is largely dependent on permafrost to prevent leaching. There was a big push with assistance from the Indian General Assistance Coordinators to modernize and permit many rural landfills in 2016, but for northern coastal communities this success must contend with both permafrost thaw and erosion. In addition, there are 364 Formerly Used Defense sites — legacy waste — in Alaska. Of these, 248 — many on northern coasts — are defined as having toxic, hazardous or radioactive waste. As of 2019 these FUDs have yet to be decontaminated and continue to pollute the waters that the Indigenous populations are forced to rely on as food and water sources.

The "Combined Threat" of Erosion, Permafrost Thaw and Floods

The 2019 Denali Commission report explains how these three hazards create a feedback loop. *Usteq*

is a subset of the combined threats, and represents the impacts flooding and erosion can have upon sites also subject to permafrost thaw such as the rapid crumbling in Newtok. Once ice-rich soils are battered by storms or otherwise exposed from erosion they can thaw very rapidly. The figure on page 17 highlights some of the complex interactions. Arctic coastal changes impact the human environment by threatening coastal settlements, infrastructure, cultural sites and archaeological remains. Changing sediment fluxes also impact the natural environment through carbon, nutrient and pollutant release on a magnitude that remains difficult to predict.

Future Modeled Coastal Changes

Coastal erosion along permafrost coasts is expected to continue at high rates or even accelerate in response to further climate warming. Coastlines are projected to change as they erode or islands are submerged, leading to linked changes in coastal geopolitical boundaries and Alaska's Exclusive Economic Zone. Typhoon Merbok, on its northward path, passed over North Pacific waters that were the warmest on record for that time of year — conditions likely to become more common. Coastal storms also lead to saltwater intrusions that contaminate water supplies.

New data and models are offering enhanced predictive capacity. Community-involved observation networks like the Sea Ice for Walrus Outlook sponsored by ARCUS and the Eskimo Walrus Commission have been adding to our knowledge of the ways in which climate warming is affecting parts of the coast, and will continue to be crucial.

Based on climate projections from a set of 13 global models, increased storm activity is likely in the Bering Sea and along the northeastern Alaska coast near Kaktovik. These future scenarios are consistent with recent data suggesting increases in high-wind events in Western and Northern Alaska.

Arctic winds can be expected to increase not only due to climate-driven increases in the frequency of low pressure centers, but also due to loss of sea ice, which tends to increase wind speeds due to changes in surface roughness and vertical mixing of air.

UAF photo by Todd Paris

POLICY IMPLICATIONS *for* COASTAL ECOLOGY AND INFRASTRUCTURE

Continuing to develop community-led vulnerability assessments will be important to plan for climate-driven changes such as permafrost thaw and erosion. Planning will rely on local knowledge, existing data on trends, geophysical data on the coastal sediments, and climate models. These assessments — and the implementation of their recommendations — cannot all follow the same template or rely on the same funding sources or agency support, because biophysical, economic, and social resources and challenges vary by location. For example, where erosion rates are high, FEMA disaster funding may not be available, since these funds require reestablishing prior conditions. Where planning suggests a need for altered siting or new construction materials or methods, state permitting will be necessary.

ENVIRONMENTAL AND HUMAN SECURITY ON ALASKA'S COASTS

3

Native village of Point Lay, Alaska. Credit: Andrea Medeiros/USFWS

The Alaska Arctic Policy Commission's 2015 final report and implementation plan in support of the declaration of state Arctic policy notes that environmental and human security are key elements of good policy for coastal domains. The AAPC links this security focus with its priority line of effort related to infrastructure.

WHAT IS SECURITY?

Security has many definitions. Broadly speaking, security can be viewed as the protection of people from threats, harm and violence, and the defense of territories from attack, invasion and takeover.

Although policy perspectives on security have historically focused on state sovereignty, national security and the military, the close of the Cold War ushered in a broadening of the concept to include human security. Human security focuses on people and communities, rather than states and nations. This demonstrates a fundamental shift in thinking to one in which national and global actors should not only respect governmental sovereignty but also promote the defense of individuals and their lives, livelihoods and communities.

Today's diverse security interests address a wide range of needs and actors. According to modern conceptions, security is multidimensional and multilevel. It includes physical, military, economic, environmental and cultural security. It exists at various scales: the individual, subnational community, nation-state and international. While the federal government uses a wide range of agencies (notably, but not exclusively, the military) to ensure national security, subnational governments and international actors also endeavor to protect security at their respective levels through a variety of policies and instruments.

Many security issues span multiple categories and levels. The figure on the facing page illustrates types of security issues at multiple scales for significant coastal infrastructure such as ports, extractive industrial projects, military installations, and community built capital such as sewer and water systems.

In Alaska, environmental change impacts military security. With melting sea ice comes new foreign military and commercial traffic to Alaska's coasts, which U.S. maritime security vessels are currently underprepared to address in the event of an emergency. Environmental change also impacts physical and cultural security. Coastal erosion has sparked relocation processes for villages like Newtok and Napakiak. Warming temperatures impact migratory patterns of a wide range of subsistence animals and affects hunting, whaling and fishing practices.

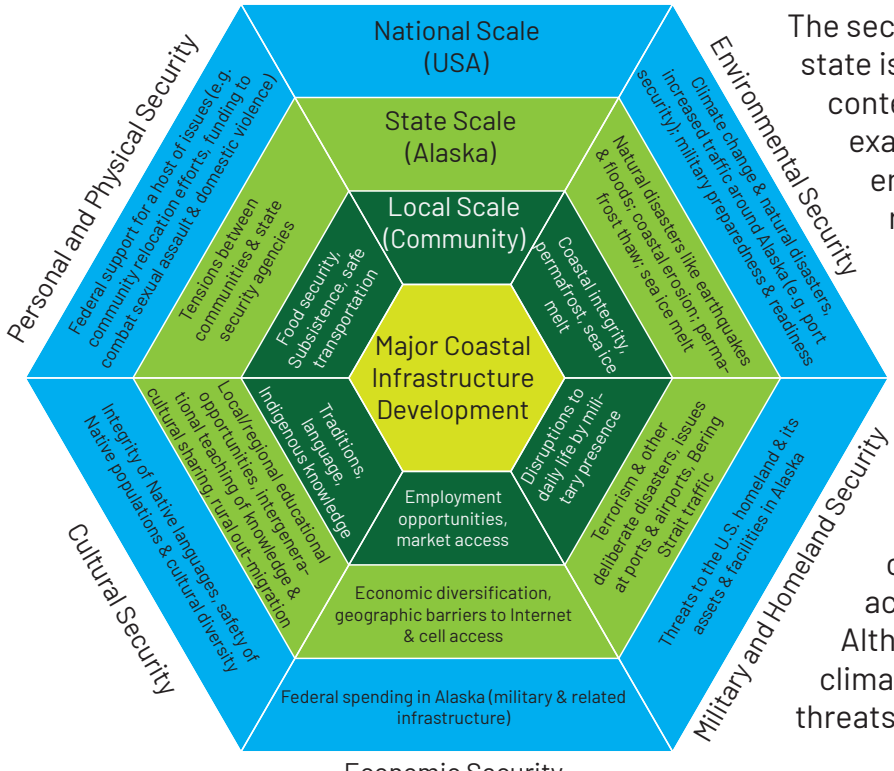
The security landscape thus ranges from military protection of the U.S. homeland to safeguarding Alaska-specific Indigenous food security and well-being. Security is a complex network of various actors attempting to protect individuals, communities, institutions, territorial integrity and the international community. Central to assuring the security of these entities is protection of vital infrastructure in Alaska's Arctic.

HOW DOES ALASKA ENSURE THE SECURITY OF ITS COASTS?

Coastal security in Alaska includes the protection of Indigenous and non-Indigenous people on Alaska's coasts and in near-coast communities. It also includes the defense of Alaska's coastlines to ensure state and national safety. These concerns are not simple to address, as they include a wide range of actors working to respond to coastal threats, increase protections and reduce risk. While Arctic security has traditionally fallen under the U.S. government's remit, federal agencies cannot and should not address all concerns. The federal government, State of Alaska, local communities, nongovernmental organizations, and private actors each contribute to Alaska's coastal security. While the federal government takes the lead on national security issues such as coastal patrol and port protection, the state government influences all levels of security from local to international. However, the state government may be most responsible for individual and community safety, including food security.

The Alaska government addresses coastal security as both a part of its general policy towards the entire state and as a geographic space with unique characteristics requiring targeted responses. Alaska security agencies include the Alaska National Guard, State Defense Force, Division of Homeland Security and Emergency Management, State Troopers, and Department of Fish and Game, among others.

Many state efforts focus specifically on the coastal regions. The Coastal Hazards Program of the Department of Natural Resources tracks flooding, erosion and permafrost degradation, and recently forecasted coastal infrastructure exposure to erosion. The Alaska Division of Spill Prevention and Response responds to oil spills on the coast, such as the tugboat diesel fuel spill near Sitka in 2022, in an effort to protect human health and the environment. The Alaska Department of Transportation and Public Facilities Ports and Harbors Section also focuses on the coast, and has partnered with the U.S. Army Corps of Engineers to evaluate potential deepwater port locations in light of the increase in maritime traffic. As a product of this work, Nome's port has been approved for expansion. Other state efforts with coastal region orientation include the Alaska Marine Highway System, the Alaska Naval Militia, and coastal-related subsistence programs and regulations.



B. Boylan, and J. Speight, designed by M. Biermann (2021). Modified by R. Mitchell.

HOW DOES A CHANGING ARCTIC IMPACT ALASKA'S COASTAL SECURITY?

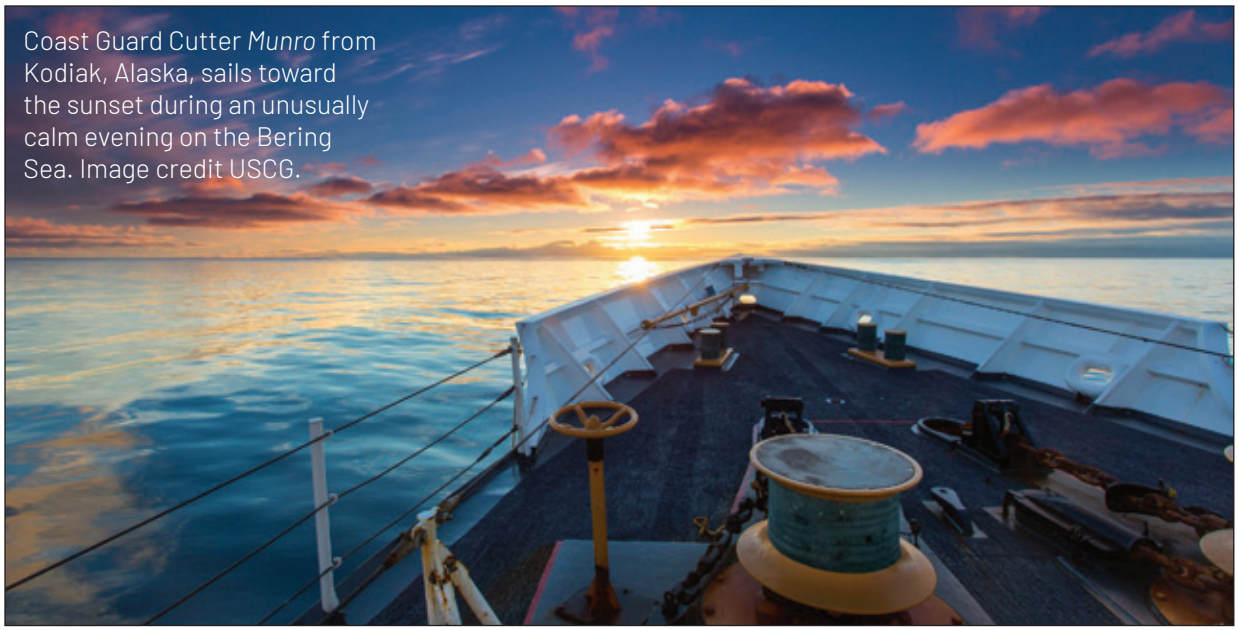
The security of individuals, communities, and the state is difficult to achieve even within a stable context. In Alaska, a rapidly changing climate exacerbates the challenges associated with ensuring coastal security. The Arctic region is now warming three to four times faster than the global average. As we see in Alaska, melting ice and snow exposes more surface area on land and sea. This exposed surface area absorbs more solar energy, which in turn furthers sea ice loss, glacier melt, permafrost thaw and loss of predictable seasonality. Autumn and spring "shoulder seasons" behave in unusual ways that create challenges for planning and subsistence activities and damage to infrastructure. Although not all coastal problems result from climate change, changing patterns present new threats to coastal communities and the state.

Photo by Seth LaCount,
Alaska National Guard Public Affairs

Climate change can threaten existing infrastructure. For example, subsistence communities rely heavily on ice cellars for storing and aging whale and walrus meat. Many of these are failing, owing to permafrost thaw, poor soil conditions and increasing urban development. Changing environmental conditions can also produce flooding, which the Department of Homeland security identifies as Alaska's most common disaster. Flooding repeatedly overwhelms water and sewer infrastructure in coastal villages that are considered "served" (with more than 55% of homes served by a piped septic tank and well, or covered haul system) and poses distinct health threats in the "unserved" communities such as those in Norton Sound and the Bering Strait (Wales, Stebbins, Shishmaref, Teller and the island of Diomede). For the coastal hub communities of Bethel, Dillingham, Kotzebue, Nome, Unalaska and Utqiaġvik, the Bureau of Indian Affairs estimates $833 million will be needed over the next 50 years to protect infrastructure from damage due to flooding, erosion, and permafrost degradation.

In other cases, climate change necessitates new infrastructure. U.S. security policies are leading to major infrastructure and training activities along the northern and western Alaska coasts. The U.S. Air Force operates many long range radar sites on Alaska's coastline. The U.S. Army Corps of Engineers Alaska District is planning a $400 million project to expand the Port of Nome.

The Corps of Engineers has also outlined the risks of coastal erosion and storms at Utqiaġvik. As a result, plans are underway for a $600 million coastal protection project, primarily a multilayered rock wall scheduled to begin construction in 2024 or 2025.



Coast Guard Cutter *Munro* from Kodiak, Alaska, sails toward the sunset during an unusually calm evening on the Bering Sea. Image credit USCG.

Most of Alaska's coast, however, will have no such seawall, leaving it vulnerable to erosion. Careful planning must also take place so that seawalls are not accelerating erosion along adjacent coastal habitats and areas of community uses. The high rate of coastal erosion in Utqiaġvik has prompted the study, engineering and design of a revetted berm (seawall) across nearly five miles of coastline to reduce risks to life, infrastructure and cultural heritage and to protect Naval Arctic Research Laboratory facilities. Past storm events in Utqiaġvik, documented since the 1950s, have caused severe damage to homes, roads, vehicles, waste storage facilities and electrical utilities, representing a significant threat to safety and mobility for the community.

Another example of the Arctic local and state security challenges facing Alaska can be seen in Point Lay's Comprehensive Plan (2017-2037). The plan links the area's changing environmental conditions to community security threats and provides examples of adaptation responses. Similar to other coastal communities' security concerns, failure of water and sewer is a threat to sanitation and health. Projects that address some security risks (such as loss of key infrastructure due to coastal storms, flooding and erosion) may also create new threats to coastal subsistence by introducing inappropriate building materials, processes and goals. This mismatch between infrastructure and community security has long been an expensive problem in the state and can be tied in part to the historical "boom and bust" cycle. Infrastructure projects with little community input often take place during economic booms and are completed in coastal communities when state coffers are flush, but then fail within decades due to poor design and implementation and lack of funding for upkeep during economic busts. Historically, Indigenous knowledge and subsistence practices have stabilized community well-being when infrastructure fails, but the latter is threatened by the magnitude and rapidity of recent change. Facing a rapidly changing environment, increasing pollution and rising fuel costs, the State of Alaska and local governments like boroughs and cities must also understand Arctic change and its impact on coastal security.

POLICY IMPLICATIONS *of* ENVIRONMENTAL AND HUMAN SECURITY ON ALASKA'S COASTS

While the federal government has primary authority over national defense and homeland security, Alaska's terrestrial and marine territory is critical to national security. In order to create effective human and environmental security from the international scale to small coastal communities, the State of Alaska must make appropriate partnerships with federal agencies. While some coastal issues are solely the purview of the state, such as local and statewide legal regimes, there will always be feedback between national and state actions — these must be attended to avoid costly duplication, promote equity, and find practical Alaska-based solutions.

ALASKA'S COASTAL CONNECTIVITY

In early June 2023, the Quintillion fiber-optic undersea cable providing internet and mobile phone service to North Slope and Northwest Alaska communities was severed by ice.

The communities that rely on this cable for phone and broadband services are in Alaska's roadless region, and serve as hubs for less accessible villages. Lost connectivity meant that people could not withdraw cash from ATMs, use food assistance cards in the market or receive their paychecks by direct deposit. Emergency and essential services like police, fire, search and rescue, and utilities were severely hampered. In some places, calling 911 was not possible. Doctors could not use online billing or scheduling software. While satellite connections were used to restore some of the connectivity, the level of service available was considerably degraded from the fiber optic service, and required significant expenditures on the part of communities and residents. The timeline of full cable repair was projected to be months.

Quintillion is a cautionary tale. The installation of the Quintillion cable on the North Slope was completed in 2017 and communities have since relied heavily on it for critical services across the region. While it opened up new communication opportunities to communities, it lacked redundancy, leading to fragility in the event of a system failure such as the one caused by the severed cable.

WHAT IS CONNECTIVITY?

Connectivity refers not only to remote communication via the internet and cell towers, but to all the infrastructure and services that allow people, goods and ideas to circulate across the diverse regions of the state, nation and planet.

Infrastructure connections can be contiguous (roads, seaways and trails), discontiguous (airports and ports), or virtual (broadband), but all facilitate flows between places. Connectivity infrastructure along Alaska's Arctic coasts is critical for commerce, education and governance, as well as human and geopolitical security and well-being. Part of what makes Alaska a modern economy and place where communities can thrive are the connections that overcome isolation and promote exchange.

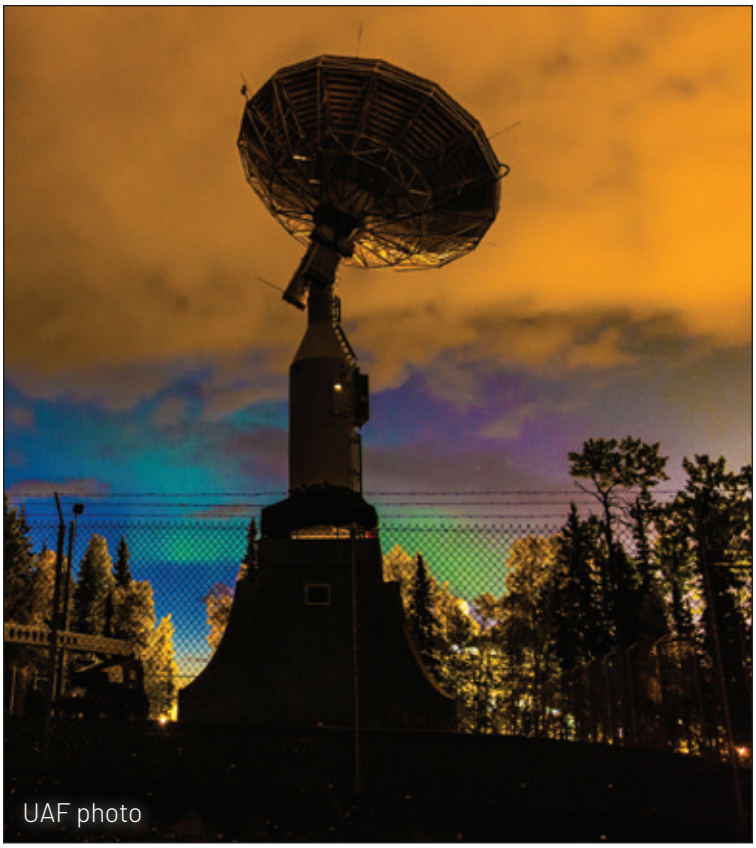
Simultaneously, higher levels of connectivity also open places to more diverse influences and risks, and certain forms of connectivity require stakeholder oversight, regulation and care. Infrastructure that supports connectivity can create unanticipated economic, social and cultural impacts.

The quality of and expectations for connectivity are rapidly changing. In the past 50 years, Alaska has gone from reliance on sporadic mail service (sometimes by dog sled) to high-speed internet,

illustration by Russ Mitchell

from little to no phone service to extensive cell coverage, and from seasonally limited river and tundra transport to year-round availability of flights. Connectivity continues to change as new satellite systems such as Starlink increase connectivity, and as new transportation hubs and routes are established across northern parts of the state.

For Indigenous community members and leaders in rural villages, all these modes of connectivity have become indispensable to their ability to participate regularly and equitably in decision-making that affects their homes and livelihoods. In the past, rural and Indigenous voices were sometimes absent from political and regulatory debates because of the difficulty of communicating with policy makers. Modern communications technology allows even the most remote communities to exercise their hard-earned right to be heard and included, but these rights can be threatened when technologies fail. Connectivity and connective infrastructures are thus the foundations not only for material well-being, but for the health of our political society and the preservation of free speech. As the previous section notes, Alaska is connected via the United States to other Arctic countries. In less than a decade the state will take the spotlight again when the U.S. chairs the Arctic Council 2031-2033.



UAF photo

WHY DOES ARCTIC COASTAL CONNECTIVITY MATTER FOR THE REST OF ALASKA?

Changes affecting Alaska's Arctic coasts have a direct impact on southern regions of the state. Alaska can promote resilience and prosperity by recognizing its interconnection with other regions of the Arctic, both north to south and east to west with our international neighbors. Coasts, rather than representing a barrier, represent a space of heightened connectivity and, therefore, increased responsibility.

The changes impacting coastal infrastructure of the Nome Census Area, Northwest Arctic Borough, and North Slope Borough include loss of landfast sea ice, accelerating erosion and intensifying floods. The impacts these have on connectivity and community well-being in the region are numerous and severe. Erosion and storms have washed away roads and boats, most notably during ex-typhoon Merbok. Changing coastal topography has created new risks for watercraft and barge landings. These events reverberate across the state. Any changes that affect the ability of North Slope oil operators to maintain, repair and protect key infrastructure could have dire consequences for the state's economy, and the city of Valdez in particular. Increases in vessel traffic along the Arctic coast, driven by sea ice loss, may impact migratory marine animal species and marine mammals that have cultural, subsistence and tourism value in other parts of Alaska.

For Alaska's northern coastal regions, some of the regionally distinct flows that people depend on include fuel and food delivery from large cities, trails through and to important hunting and fishing sites, and communication with industry, marine vessels and Search and Rescue services. Maintaining the ice roads that allow truck deliveries between the Railbelt and the Arctic has become more costly with irregular temperatures and shorter winters. On the North Slope, the Community Winter Access Trails program, run jointly by the Borough and the Department of Transportation, provides funding and oversight for critical trail maintenance between North Slope communities. Barges run by Crowley and Alaska Marine Lines carry tons of essential goods to communities across the Arctic coast. And the Department of Natural Resources' Alaska Strategic Transportation and Resources program seeks to

make regionally sourced gravel available for diverse infrastructure and repair projects across the north. The infrastructure required for all these connections creates benefits not only to northern coastal communities, but also to inland and southern coasts. The entire state will benefit from an expanded Port of Nome as America's only Arctic deep-draft port. The profit from oil production on the North Slope flows into Indigenous communities via ANCSA Treaty rights, as well as into the pockets of all citizens via the Permanent Fund Dividend. Zinc and lead mines in the Northwest Arctic Borough provide income to local community members — which helps support subsistence activities — as well as multiple benefits across the state. Lastly, each region's beauty draws tourists via marine-, air-, and land-based tourism.

Dutch Harbor runway. NOAA photo.

POLICY IMPLICATIONS *of* COASTAL CONNECTIVITY

Connectivity infrastructure along Alaska's Arctic coasts is critical for the well-being and security of Alaskan individuals and communities, as well as the entire nation. At the same time, with higher levels of connectivity come diverse influences and new risks. These may be mitigated with stakeholder oversight, regulation and care, so that infrastructure that supports connectivity does not create unanticipated economic, social and cultural impacts.

HOW TO CITE THIS REPORT

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front cover: top and bottom credit: UAF photos

ALASKA'S ARCTIC BOUNDARIES AND GOVERNANCE

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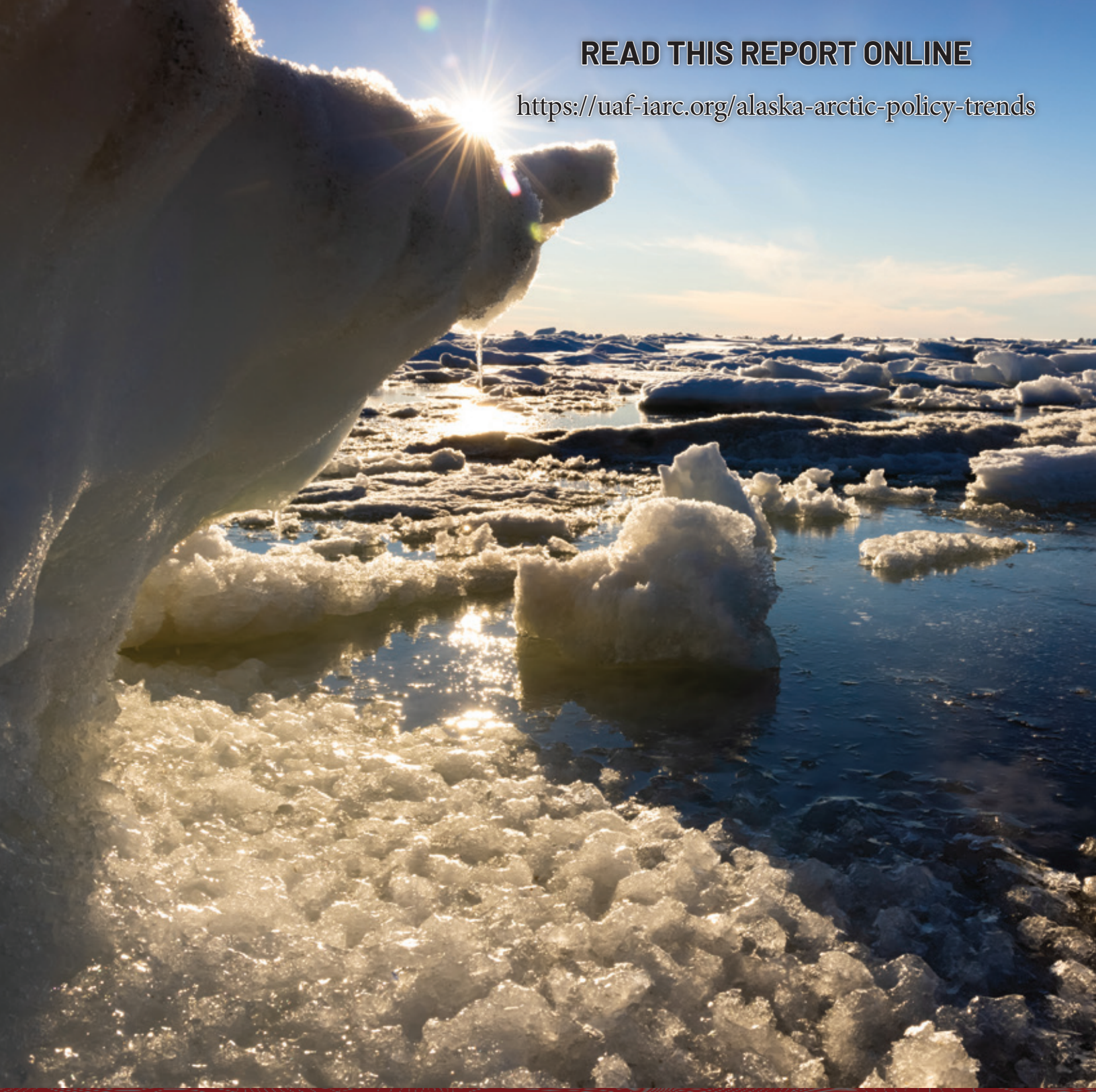

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