

U.S. Geological Survey (USGS) Western Region: Alaska Coastal and Ocean Science

The U.S. Geological Survey (USGS), a bureau of the Department of the Interior (DOI), is the Nation's largest water, earth, and biological science and mapping agency. The bureau's science strategy "Facing Tomorrow's Challenges—U.S. Geological Survey Science in the Decade 2007–2017" describes the USGS vision for its science in six integrated areas of societal concern: Understanding Ecosystems and Predicting Ecosystem Change; Climate Variability and Change; Energy and Minerals; Hazards, Risk, and Resilience; Environment and Wildlife in Human Health; and Water Census of the United States.

USGS has three Regions that encompass nine geographic Areas. This fact sheet describes examples of USGS science conducted in coastal, nearshore terrestrial, and ocean environments in the Alaska Area.



ALASKA: COASTAL FACTS

- Alaska has more coastline than the combined coastline of the rest of the United States.
- Reductions in Arctic sea ice along Alaska's shores have accelerated rapidly in the past 10 years.
- Rates of shoreline erosion along Alaska's coasts are among the highest in the world.
- Alaska has more than 40 active volcanoes, most along the Aleutian Islands Arc "ring of fire."
- Alaska is the most earthquake-prone state; the epicenter of the largest recorded earthquake in the United States was in Prince William Sound on March 28, 1964.
- The oil field of Prudhoe Bay on the northern Alaskan coast accounts for 25 percent of the oil produced in the United States. Millions of gallons of oil travel daily through the Trans-Alaska Pipeline to the coastal community of Valdez, where the oil is pumped into tankers for marine transport.
- The 1989 Exxon Valdez oil spill is widely considered to be the largest spill worldwide in terms of damage to the environment with effects lingering today after 20 years.
- More than one-half of the Nation's seafood comes from Alaskan waters, and Alaska leads the Nation in the value of its catch, including salmon, crab, shrimp, halibut, herring, and cod.
- More than 90 percent of the migratory shorebird species in the Western Hemisphere have breeding populations in Alaska.

Understanding Ecosystems and Predicting Change

Top to Bottom, Ocean to Shore

From seafloor mapping to studies of animals such as ocean-feeding pelagic seabirds, benthic-feeding walrus, and nearshore-dependent sea otters, USGS science informs resource management and broader public policy discussions with a marine ecosystem-



based approach. The USGS studies many of the nearly 70 seabird species that reside around Alaska's marine waters. Research by the USGS on population dynamics and feeding of this diverse assemblage provides key insights into ecological consequences of changes in pelagic ocean environments.



For example, walrus feed on the ocean bottom consuming about 45 kilograms of clams per day, which provides a tool to understand changes in the benthic portions of the marine community. The USGS' satellite telemetry, population models, and genetic methods identify critical habitats, help define potential

influences of sea ice changes, and inform Continental Shelf oil and gas development planning. The USGS' seafloor mapping technologies and geologic studies are used to develop habitat models for benthic communities and for species such as halibut, crabs, and walrus. The USGS studies linkages between the dynamic sedimentary system and marine benthos of many marine systems such as Kachemak Bay and Glacier Bay. Closer to land, USGS scientific studies on sea otters identify continued consequences of the 1989 Exxon Valdez oil spill and inform nearshore ecological restoration approaches. The USGS coastal monitoring protocols are now used by the National Park Service's Vital Signs Program in Alaska to establish a solid foundation for tracking nearshore marine health.

Climate Variability and Change in Coastal and Marine Environments



Status of Sea Ice-Dependent Species into the Future

Populations of several key DOI-managed species are strongly affected by characteristics of the declining sea ice environment. USGS research helps define and constrain the consequences of projected sea ice loss to species such as the polar bear, listed as 'Threatened' under the Endangered Species Act, and the Pacific walrus, which is under status review. USGS research on the sea duck spectacled eider, listed as 'Threatened', indicates that populations can be affected by extended periods of dense sea-ice concentrations. Continuing research using satellite transmitters will help researchers monitor these population changes. The USGS continues to develop new models, forecasting approaches, and technologies to reduce uncertainty about the complex relationships of species of interest to changing sea ice conditions.



Coastal Erosion

The USGS helps better forecast future shorelines and potential infrastructure and ecological consequences of patterns of erosion. Findings show that present-day rates of coastal erosion are high and accelerating along segments of the Arctic coast of Alaska. Average annual erosion rates along parts of the coast have climbed from 20 feet per year during 1950–80 to 45 feet per year during 2002–07. These recent rates of erosion may be a result of declining sea ice and of increases in storm power on a coastline underpinned by warming permafrost.



Energy and Minerals

Energy Assessments

The USGS assessment strategy provides estimates of the volumes of undiscovered petroleum resources that are technically recoverable. The Arctic Basin has high resource potential, but limited assessment information to help constrain overall estimates of potential oil and gas resources. The USGS' recent assessment provides a methodologically consistent snapshot of oil and gas potential onshore and offshore across the World's circumpolar region. Through these methods, the USGS estimates that about 90 billion barrels of oil and 1,669 trillion cubic feet of natural gas may remain to be found in the Arctic. On the unconventional energy front, USGS' investigations of onshore and offshore gas production from gas hydrates—gas trapped with water in ice-like structures—shows them to be a major untapped resource; 85.4 trillion cubic feet of gas on Alaska's North Slope could heat 100 million homes for a decade.

Circumpolar Bedrock Geology

The USGS partnered with the Geological Survey of Canada, Geological Survey of Greenland and Denmark, Geological Survey of Norway, Geological Survey of Sweden, Geological Survey of Finland, Geological Survey of Iceland, and the Russian Geological Research Institute to develop and publish "The International Polar Year Circumpolar Geologic Map." The map shows the bedrock geology of the northern Circumpolar region. This effort provides a comprehensive and methodological consistent view of the bedrock geology of coastal, marine, and interior reaches covering as far south as 60 degrees north latitude or just south of Anchorage, Alaska.



Natural Hazards

Monitoring Volcanoes and Their Effects

Alaska's some 40 active volcanoes, most located along the Aleutian Islands Arc "ring of fire," influence associated coastal ecosystems, and pose a hazard to North Pacific Air Routes where some 25,000–30,000 passengers pass through daily. The Alaska Volcano Observatory (AVO) monitors the hazard status of about 33 volcanoes in partnership with the USGS, the University of Alaska Fairbanks Geophysical Institute, and the State of Alaska Division of Geological and Geophysical Surveys. The U.S. Fish and Wildlife Service and the USGS are studying the ecological effects of the 2009 eruption of the Kasatochi Volcano in the Aleutians that destroyed much of the maritime ecosystem of the island and seabird nesting areas to better understand the importance of volcanic events on the sustainability of such Aleutian systems.



Kasatochi Volcano in July 2008 (left) and then in October 2008 (right). The volcano erupted in August 2008.

Earthquakes and Tsunami Generation

Three of the six largest earthquakes ever recorded occurred in Alaska. The USGS is a major partner in the Advanced National Seismic System (ANSS) that informs the Nation of seismic events. ANSS seismic monitoring in Alaska is a partnership of the USGS, the National Weather Service, and the University of Alaska. The effect of earthquakes on coastal areas can be devastating, largely because of the tsunamis they can generate. For example, the M9.2 1964 earthquake centered in Alaska's Prince William Sound caused tsunamis that impacted the U.S. west coast. Subsequent submarine landslide-generated tsunamis caused destruction along the south-central coast of Alaska. The USGS develops seamless digital elevation models—most recently for northern Resurrection Bay, a site of major destruction in 1964, and for Port Valdez, the TransAlaska Oil Pipeline terminus—to define submarine landslide tsunami generation models to improve hazard notification and mitigation.

Role of the Environment in Human Health

Working Together

The USGS facilitates the Alaska Interagency Ecosystem Health Work Group that brings together and leverages diverse missions, skills, and capacities of Federal and State entities for a greater understanding of the relationships among wildlife, human health, and ecosystems including coastal and marine systems. One successful component of this effort has been the USGS and Alaska Native Tribal Health Consortium collaboration to investigate the relationships among earth and natural resource patterns and Alaska Native health records throughout Alaska. One topic of research is to better understand the potential transport of naturally occurring toxics, such as mercury, that are increasingly appearing in the natural ecosystem. These toxics persist and may eventually accumulate in Alaska Native subsistence foods, such as halibut and salmon, creating potential health threats to the native community.

Water Resources



Freshwater from Alaska's many rivers and glaciers eventually discharges into coastal waters and accounts for more than one-third of the Nation's average annual runoff. This large volume is a key component of circulation patterns in the marine environment and strongly affects productivity of fish, seabirds, and marine mammals in near-shore ecosystems. The USGS continuously monitors water flow parameters in cooperation with local, State, and Federal agencies. The USGS provides photographic monitoring of many of Alaska's coastal glaciers and quantitative information on glacier mass-balance, including a 40-year record of changes in glacier volume. These long-term records allow analyses of climate change influences on water supplies and sea-level rise.

Data Integration and Evolving Technologies

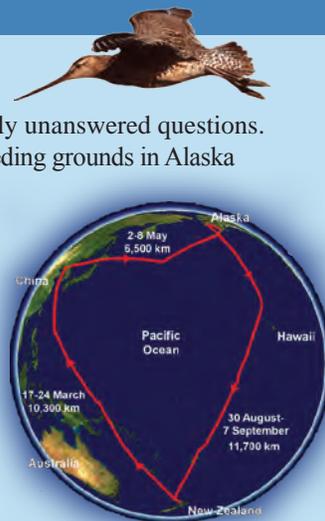
Satellite Telemetry to "See"

Using satellite telemetry, the USGS can "see" animals as they travel the globe and gain insights into previously unanswered questions. The USGS documented the extraordinary nonstop migration of a shorebird, the Bar-tailed Godwit, from its breeding grounds in Alaska to its wintering grounds in New Zealand and then the trip back to Alaska by way of Korea. The researchers are investigating how these birds select 'perfect storms' that provide energy-saving wind assistance to their nonstop transpacific flights. This research is part of a larger effort to understand the potential transmission of avian influenza viruses from Asia to North America.

The USGS continues to pioneer new satellite remote sensing methods to detect sea ice changes and to determine the underlying mechanisms of change. Using these new methods, the USGS can now "see" how climate variability is affecting the habitats of Arctic wildlife species such as polar bears and walrus even in the winter months of 24-hour darkness.

Molecular Ecology

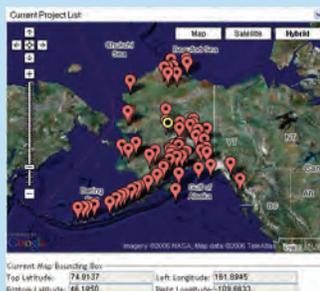
USGS' molecular genetics techniques developed for species such as polar bears, walrus, sea otters, sea ducks, seabirds, and eelgrass characterize breeding populations and help assess the response of species populations to natural and human-induced changes. These results help managers who are responsible for conserving species in Alaska and globally. Genetic analyses provide evidence that some birds from Asia and North America freely interbreed and thus improve our understanding of the role of migratory birds in the dissemination of avian influenza amongst continents.



Making Alaska Coastal Information Available

<http://alaska.usgs.gov/portal>

This portal is a searchable, web map-based tool to facilitate public and partner access to information about USGS studies in Alaska. It also promotes access to information in numerous USGS web pages across the Nation.



For more information:

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