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The Nature Conservancy®
OF ALASKA
Saving the Last Great Places

Ecoregion-Based Conservation in the Bering Sea

Identifying Important Areas for Biodiversity Conservation

Contents

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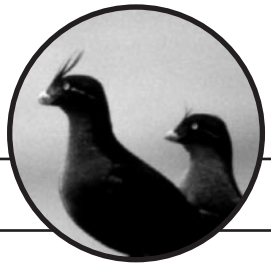


Executive Summary

For centuries, the Bering Sea has shaped the lives and cultures of the diverse people who live near the sea and depend upon it. At the heart of their communities lies the Sea's extraordinary abundance and productivity. The area supports North America's largest concentration of breeding waterfowl and shorebirds, the highest concentrations of Pacific walrus on earth, the world's largest eelgrass beds, over 80% of the world's population of breeding female polar bears, and 70% of the world's northern fur seals concentrated in just a few sites. It is the only sea harboring red-legged kittiwakes. And unlike many of our once great seas, it still maintains one of the most productive fisheries remaining on Earth.

In recent years, however, the residents of these Bering Sea communities have noticed marked changes in the sea. They and others- scientists and visitors, resource managers and users, have begun to express concern over the health of the Bering Sea.

Around the world, from the Grand Banks to the southern reaches of Chile, the health of marine ecosystems is seriously at risk. Fisheries have collapsed. Economies have been disrupted, and communities transformed. Yet the Bering Sea is only beginning to exhibit such trends. In the Bering Sea, we have the opportunity to prevent further losses associated with human activities.

While we understand that we cannot control the changing nature of the marine environment, we can make decisions about our own behavior that make for healthier oceans and seas, more resilient to stress. In making such choices in the Bering Sea, we give ourselves a greater chance for building long-term, sustainable human economies, for conserving the incredible richness and variation of marine life, and for ensuring the continuity of the region's vibrant cultures.

Recognizing the present opportunity in the Bering Sea and the immediate need for a strategic plan for the future, The World Wildlife Fund (WWF) and The Nature Conservancy's Alaska Field Office (TNC) joined in a conservation initiative to evaluate the Bering Sea for habitat conservation.

This document outlines the results of the first part of that initiative -æ a workshop co-sponsored by WWF and TNC in Girdwood, Alaska, March 20-23, 1999. The workshop was designed to identify the key biological features and ecological processes that define the sea and contribute to its unique richness and productivity

The report from this workshop has several components:

- an overview of the ecoregion-based conservation approach, as defined by WWF and TNC;
- a description of the process used in the Girdwood workshop to identify key areas for biodiversity in the ecoregion;
- a discussion of threats to Bering Sea biodiversity;
- maps outlining the areas important for each major taxa group of Bering Sea species;
- a map presenting the results of our collective discussion about priority areas for biodiversity conservation;
- and finally, detailed descriptions of these priority conservation areas.

In preparation for the workshop, TNC and WWF collaborated with the Institute of Marine Science of the University of Alaska-Fairbanks, as well as many other organizations and institutions in the U.S. and Russia, to compile existing ecological information and databases from both sides of the Bering Sea.

At the workshop, participants incorporated this data into their analyses, while also drawing on their own knowledge and field experience to identify the Bering's key biodiversity features æ habitats, species concentrations and unique ecological phenomena. Experts identified the unique polynyas south of

St. Lawrence Island and south of the village of Sireniki in the Gulf of Anadyr. They identified numerous important seabird colonies such as those on the Pribilof, Commander and Aleutian Islands. Experts discussed and mapped high plankton concentrations in the Bering Straits. Mammal experts mapped irreplaceable concentrations like the walrus haulouts on the north side of Bristol Bay and beluga feeding areas within the Anadyr Delta. Experts also identified unique waterfowl and fish habitat like the eel grass beds of Izembek Lagoon and wetlands of the Yukon-Kuskokwim Delta.

A wide range of experts from both sides of the Bering Sea participated in the workshop, including scientists, local fishermen, community members, resource managers, conservationists, and educators. For two days, experts worked across disciplines and regional specializations to highlight key features in the region and create maps of the special areas of the Bering Sea. Their work has helped to create a picture of the Bering Sea's most important conservation areas and processes (See Map 8).

This report provides a foundation on which WWF and TNC, with others, will develop more detailed strategies for biodiversity conservation in the Bering Sea. Additional information will be added over time to demonstrate changes in the sea, such as shifts in species distributions, or changes in conditions of the ice edge. Information about threats to biodiversity and human health, such as toxic contamination of wildlife, may also be added.

TNC and WWF will use the report to guide our own conservation efforts in the Bering Sea, and to contribute to the greater body of Bering Sea knowledge. It is our hope, however, that this report will serve not only as a useful public informational resource, but also as a catalyst to more widespread, coordinated and focused conservation of this unique marine and coastal environment.

◆ *Coastal sand dunes, Nunivak Island*

Dave Cline

Part One – Background

1.1 Introduction

The mission of the World Wildlife Fund is the conservation of nature. Using the best available knowledge and advancing that knowledge where we can, we work to preserve the diversity and abundance of life of Earth by protecting natural areas and wild populations of plants and animals, including endangered species; promoting the use of renewable natural resources; and promoting more efficient use of resources and energy and the maximum reduction of pollution.

The mission of The Nature Conservancy is to preserve the plants, animals, and natural communities that represent the diversity of life on Earth by protecting the lands and waters they need to survive.

Historically TNC and WWF focused efforts on species, then looked toward protecting their habitats in larger ecosystems. However, more recently we have concluded that in order to achieve success in conservation, we need to work on even broader scales, considering ecological processes and threats that occur across many ecosystems. We call this approach ecoregion-based conservation.

Ecoregions are relatively large areas delineated by biotic and environmental factors that regulate the structure and function of ecosystems within them. For the purposes of this report, we defined the Bering Sea ecoregion as the area enclosed to the south by the Aleutian Chain and to the north by the Bering Strait; the waters and coastal fringe of the Bering Sea; and the southern Chukchi Sea.

1.2 Why conduct Ecoregion-based conservation?

Several beliefs drive the shift towards ecoregion-based conservation. First, conservation planning at scales higher or broader than specific sites will more effectively conserve the full range of biodiversity and promote its persistence.

Second, many significant threats to biodiversity operate at the scale of multiple sites. Third, coordinated regional efforts can facilitate the creation of new partnerships and alliances and can help to avoid redundancy among groups working independently. Fourth, this approach can more accurately define an area for conservation, remediation, restoration or other management regimes than those primarily based on connecting sites or tailoring plans to political boundaries or agendas. Finally, comprehensive ecoregion-based strategies will have a greater leveraging effort, creating more political impact and donor interest and support than initiatives focused solely on sites.

Ecoregion-based conservation also helps us:

- Understand how local actions fit into regional and global conservation strategies;
- Ensure that there are clear and strong linkages between all conservation activities and biodiversity conservation objectives;
- Assess how well conservation strategies represent the full range of distinctive biodiversity, conserve larger intact ecosystems, and maintain ecological processes and species populations within their natural range of variation;
- Determine the range and limits of natural variability of marine and coastal ecosystems and to distinguish phenomena and processes effected by natural forces from those effected by anthropogenic impacts;
- Tailor conservation analyses and activities to the particular patterns of biodiversity, ecological dynamics, and responses to disturbance of different major habitat types, such as coral ecosystems or upwelling areas; and
- Understand the tradeoffs of different actions in terms of achieving different conservation targets.

1.3 Description of the Bering Sea Ecoregion

One of the most productive marine ecosystems in the world, the Bering Sea is a large, enclosed sub-arctic sea bounded by Alaska's southwest coast, Russia's Chukotka and Kamchatka Peninsulas, and the Aleutian archipelago (Map One, inside front cover).

The Bering Sea ecosystem includes both Russian and U.S. waters as well as international waters (i.e., beyond the 200 mile Exclusive Economic Zone).The Bering Sea is influenced by the neighboring waters of the North Pacific Ocean, in particular the Gulf of Alaska. Additionally, the physical processes occurring in the Chukchi Sea make this water body a critical component of the Bering Sea ecoregion. The region sustains over 100,000 people, including the Aleut, Yup'ik, Cup'ik and Iñupiat peoples who live along the Alaska coast, as well as Koryak, Yup'ik and Chukchi peoples along the Russian coast and Aleut people on the Commander Islands. U.S. commercial fisheries in the Bering Sea approach $1 billion per year and account for more than half of all annual domestic fish landings. In the 1990s, Russian catches of fish and invertebrates in the Bering Sea comprised a third of the country's commercial harvest. These fisheries generated approximately $600 million per year.

USFWS

◆ *Yupik child*

1.4 Biological Significance

The Bering Sea supports a wealth of biological diversity, including more than 450 species of fish and shellfish, 50 species of seabirds, and 26 species of marine mammals. The coastal fringe, including eelgrass beds, extensive coastal lagoons, deltas, wetlands, and estuaries, supports a similar abundance and diversity of waterfowl. Alaska's Yukon-Kuskokwim Delta, one of the world's largest wetland complexes, serves as breeding and feeding grounds for 750,000 swans and geese, two million ducks, and 100 million shorebirds and seabirds. The islands that punctuate the Bering Sea, such as the Pribilof Islands, St. Lawrence and St. Matthew, the Aleutians, and the Commander Islands provide critical breeding grounds for millions of seabirds, Steller sea lions, and northern fur seals.

At sea, much of the biological activity focuses on areas of nutrient upwelling along the Aleutian Arc, the edge of the continental shelf, across the northern shelf and along the Russian coast from the Kamchatka Peninsula to Cape Navarin.

Additionally, open waters associated with ice-covered seas (areas known as polynyas) are highly productive areas critical to the region's biota. Passes in the Aleutian Islands (such as Unimak Pass) and the Bering Strait further focus migrating species in key, sensitive areas.

1.5 Changes in the Bering Sea

Throughout the last century, commercial whaling and fishing, introduced species, and possibly pollution have caused severe ecological changes throughout the Bering Sea. Over the last few decades, these human-caused stresses have exacerbated the natural fluctuations caused by climate change.

Signs of stress are present throughout the trophic food web. For example, the once lucrative king crab fishery is virtually gone. Herring, a previously dominant fish, has declined in the eastern Bering Sea, creating a shortage of preferred food for top predators and seabirds. Fishermen report travelling further and further as local stocks are depleted. The apparent collapse of the snow crab population (once ranked as the third most valuable fishery in the region) in 1999 is another sign of significant change in the sea.

There are other signs of significant change in the ecoregion, such as declines of a number of wildlife species. For example, today, of the 26 species of marine mammals that use the Bering Sea:

- Seven great whales are listed as endangered under the Endangered Species Act;
- The endangered Steller's sea lion has declined by 80 percent in the past twenty years;
- The northern fur seal is listed as "depleted" by the Marine Mammal Protection Act; and,
- Sea otters are declining dramatically on several Aleutian Islands: Adak, Little, Kiska, Amchitka, and Kagalaska.

Of bird species:

- The short-tailed albatross is endangered; the spectacled eider is threatened according to the under the Endangered Species Act;
- Steller's and king eiders are proposed as "threatened" species under the Endangered Species Act;
- Red-faced cormorants have declined on St. Paul Island by 70 percent since the mid 1970s; and
- Red-legged kittiwakes, an endemic species, have declined by 40 to 60 percent throughout the Pribilof Islands during the same period.

The complexity of addressing such issues in a marine ecosystem is especially challenging because of the international nature of the Bering Sea. Added to this are the problems of a boundary dispute between Russia and the United States, and less than ideal collaboration across shared borders, creating difficulties for joint management efforts.

1.6 Conservation Opportunities

TNC and WWF agree that a critical part of protecting marine resources, and the sustainable economies that depend on them, is protecting biological diversity. This means protecting the full array of species that use the Bering Sea. Conservation and management plans also must take into consideration the need for populations to fluctuate, to respond to the pronounced natural variability of the ecosystem, and to maintain resiliency in the face of human-induced change.

A number of challenges to finding this balance between conservation and resource use have already presented themselves. Researchers have been unable to provide an unequivocal basis for resource management decisions or conservation action. Second, residents of Bering Sea communities have not been sufficiently included in research, management, policy development, public education and law enforcement. Third, a lack of coordination between Russia and the U.S. on research and management has caused fragmented ecological understanding and management. Finally, at the cost of habitat and species in the Bering Sea, large vested economic interests are working to assure fisheries management regimes that will proved the maximum economic return on their investment.

TNC and WWF recognize the importance of developing a strategy that:

- Focuses conservation activities on the most important places and processes for maintaining representative biodiversity in the Bering Sea;
- Integrates research, management, and policy across political boundaries;
- Ensures collaboration between and participation of key stakeholders, especially residents of Bering Sea communities;
- Improves the state of knowledge and builds research capacity;
- Manages for multiple species and desired ecosystem condition, rather than for single-species, short-term commodity outputs; and
- Employs adaptive approaches to management to test ecological hypotheses.

Vision for the Bering Sea

Based on what TNC and WWF have learned from this biodiversity analysis and the Girdwood workshop, we have formulated some common overarching goals for conservation in the Bering Sea ecoregion. Our vision is that the Bering Sea be managed in a truly integrated ecosystem-based manner. Our vision includes:

- The U.S. and Russia sharing information, expertise and capacity;
- Focused research to tease out ecological complexities and understand the linkages between human activities and species declines;
- Fishing interests, conservationists, governments, and Bering Sea residents collaborating to reach jointly developed and shared goals;
- Residents of the Bering Sea involved intimately in the issues that affect them, with full participation in decision-making, research, negotiation, and management;
- Communities with the tools, knowledge, and stewardship ethic needed to affect positive change;
- A multinational coalition of communities with a strong voice in decisions; and
- A carefully regulated fishery in both Russian and U.S. waters, with full participation by Bering Sea residents and other stakeholders and economic benefits accruing locally as well as to the larger Bering Sea absentee commercial interests.

To achieve this vision WWF and TNC should work with partners at global, ecoregional, and local levels, using a variety of strategies to address threats and conserve biodiversity. These strategies include:

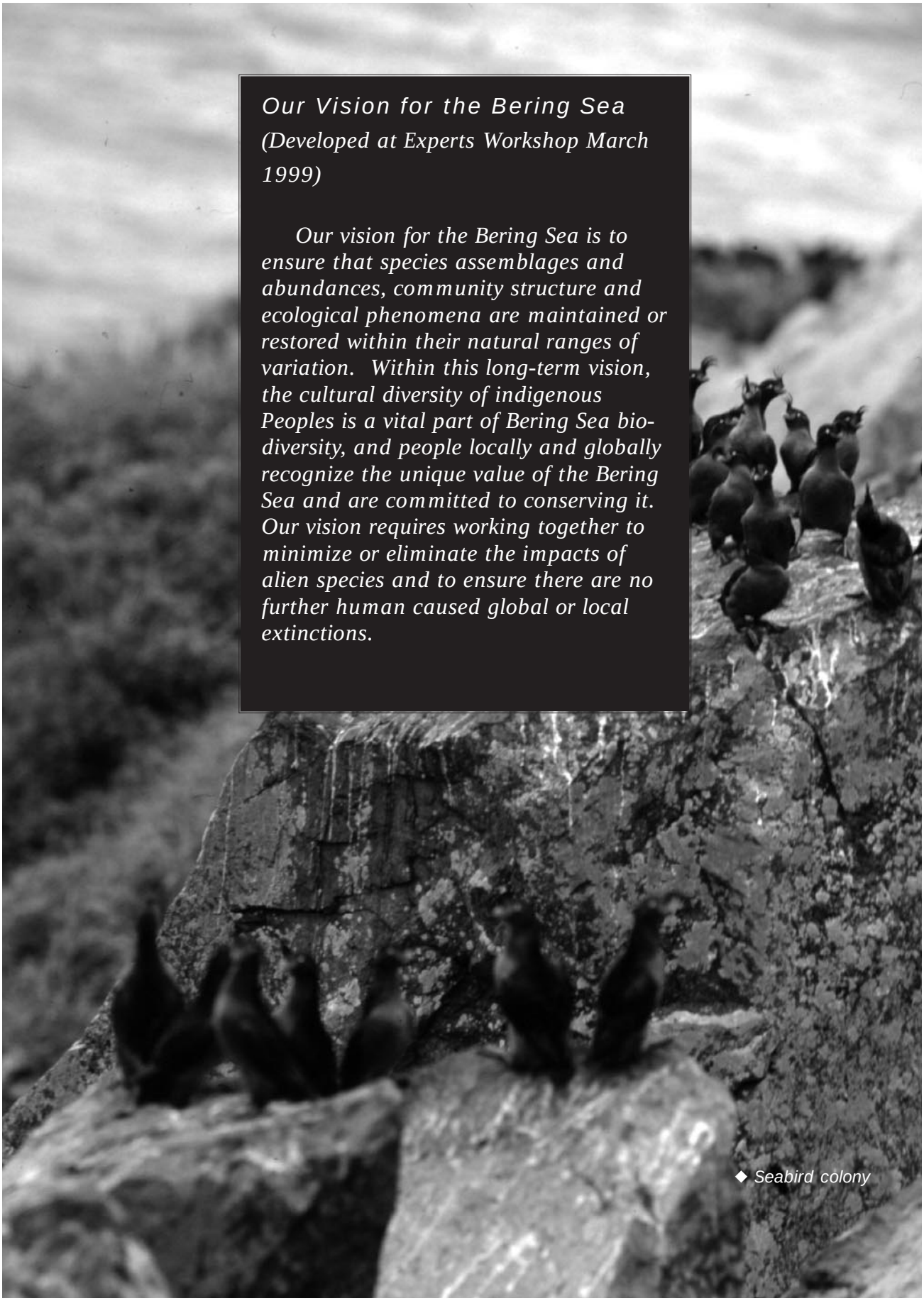
<u>At the global level,</u>

- Reducing greenhouse gas emissions;
- Banning production of persistent organic pollutants, which can migrate to the Bering Sea;
- Providing incentives to stop overboard dumping of plastics, netting and other debris;
- Promoting international awareness about the unique and valuable biological and cultural resources of the Bering Sea;

<u>At the ecoregional level,</u>

- Engaging Russia in a joint agreement for conservation of marine resources;
- Strengthening Russian enforcement of fisheries regulations in Russia and on the high seas;
- Promoting sustainable fishing practices on both sides of the Bering Sea, including the reduction of by-catch;
- Supporting species monitoring programs and the development of recovery plans for threatened marine species;
- Restoring depleted populations and damaged or polluted habitats
- Eradicating non-native species and preventing new species introductions;
- Establishing community-based monitoring programs to detect, document and monitor contaminants in marine organisms
- Supporting subsistence use by local people as a priority use of Bering Sea resources, consistent with sound conservation principles and practices;
- Defining marine conservation areas to provide buffer zones for populations of marine organisms; to maintain intact and sensitive communities; to build resiliency of marine organisms.

In an effort to better understand the unique biodiversity features that drive the Bering Sea, and to better define our conservation targets, TNC and WWF undertook this Bering Sea biodiversity assessment. The following chapters present the methodology used and the results of this work.



Our Vision for the Bering Sea

(Developed at Experts Workshop March 1999)

Our vision for the Bering Sea is to ensure that species assemblages and abundances, community structure and ecological phenomena are maintained or restored within their natural ranges of variation. Within this long-term vision, the cultural diversity of indigenous Peoples is a vital part of Bering Sea bio-diversity, and people locally and globally recognize the unique value of the Bering Sea and are committed to conserving it. Our vision requires working together to minimize or eliminate the impacts of alien species and to ensure there are no further human caused global or local extinctions.

◆ *Seabird colony*

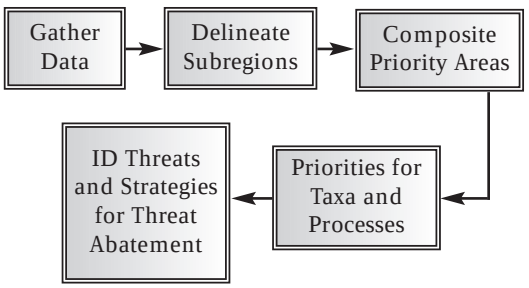
Nicolai Konyukov

Part Two: Workshop Report

2.1 Methodology: Assessing Biodiversity

The general conservation principles and analytical approach guiding this assessment have been derived from our work in other ecoregions of the world. It involves a step-wise process whereby we collect and analyze ecological data, define conservation targets and goals, identify a network of sites to meet the goals, evaluate ecoregion-wide threats, and explore possible strategies for achieving our goals in the ecoregion. (Please see Figure 1). This process is highly focused on biology: the species, natural communities, and processes have driven the final network of areas and associated strategies. Although the focus of this plan is on conserving biodiversity, we recognize the importance of the communities and economies that live and work in the Bering Sea ecoregion. We also recognize that these human communities are heavily dependent on the species this plan attempts to conserve.

Fig. 1 Assessing Biodiversity: Key Steps



2.1.1 Gathering Background Data on Biodiversity

The major part of the planning process involved synthesizing and compiling available information on species abundance and distribution; biological features such as kelp beds, breeding colonies; staging areas, etc.; physical factors such as bathymetry, upwellings, and polynyas. A Geographic Information System (GIS) was used as a tool to manage, compile and present this information. The GIS was also used to record the information provided by participants in the Girdwood workshop. By compiling individual data layers (maps of one particular feature or species) and then overlaying them in various combinations, we were better able to understand where certain groups of species congregate throughout the Bering Sea ecoregion. It also helped us understand what the relationships are between species distributions, communities, and biophysical parameters, as well as the natural variability of these features.

The first step in the information collection stage was to create basic data layers to provide the background for the biodiversity assessment. These layers included:

- Bathymetry
- Currents
- Typical upwelling areas
- Polynyas and seasonal ice edge
- Marine ecosystem classification (proposed approaches to stratify the Bering Sea ecosystem)
- Existing protected areas (state and national parks, refuges, critical habitat areas, including wilderness designations)
- Marine regulatory areas (e.g., no-trawl zones, crab closure areas, sea lion buffers, etc.)
- Seabird colonies
- Marine mammal haul-outs and rookeries
- Known concentration areas for birds or mammals (shorebird or waterfowl migratory stopovers)
- Important migratory corridors (whales, other marine mammals, birds, fish)
- Distribution of numerous species of fishes and invertebrates of both ecosystem and economic importance
- Known important or sensitive habitats (eelgrass beds, coastal lagoons, wetland complexes, estuaries.)
- Geographic features (coastline, major rivers, communities place names, latitude/longitude)

Much of the spatial information was available for the eastern Bering Sea. However, it was scattered among various agencies and organizations. WWF, TNC and Dr. Alan Springer of the University of Alaska contacted many organizations in an effort to gather and synthesize such databases. A number of informational resources were provided for this assessment. (Fig. 2).

There exists much useful reference material on marine mammals, benthic organisms, physical processes such as the role of ice in the Bering Sea and other topics (Hood and Calder 1981, Loughlin and Ohtani 1999, Continental Shelf Research 1986 and 1993, Moiseev, 1970).

Figure 2: DATA SOURCES FOR BERING SEA GIS COMPILATION

Existing spatial data:

- US Fish and Wildlife Service: Seabird Colonies of the Bering Sea
- National Oceanic Atmospheric and Atmospheric Administration: Coastal and Ocean Zones Strategic Assessment Data Atlas
- Alaska Marine Conservation Council: Essential Fish Habitat (Halibut)
- Wild Salmon Center: Habitat of Pacific Salmon (in prep.)

Additional sources of expertise:

- Particular Alaska Native organizations in the Bering Sea (such as regional non-profit organizations) which coordinate natural resource management activities, and serve as key links to Bering Sea communities
- User groups such as the Society of Native Hunters of Chukotka and others in Alaska and Russia
- International North Pacific Halibut Commission
- Kamchatrybvod
- Kamchatka Institute of Ecology and Natural Resources Use
- North Pacific Anadromous Fish Commission
- National Marine Fisheries Service: Alaska Fisheries Science Center and National Marine Mammal Laboratory
- National Oceanic and Atmospheric Administration: Pacific Marine Environmental Laboratory
- Pacific Institute for Scientific Research on Fisheries and Oceanology
- Shirshov Institute of Oceanology
- State of Alaska: Department of Fish and Game, Department of Environmental Conservation, Department of Community and Regional Affairs
- University of Alaska Fairbanks: Institute of Marine Science
- University of Colorado: Colorado Center for Atmospheric Research
- University of Washington: Fisheries Research Institute

2.2 Experts Workshop

Based on previous experiences, WWF and TNC believe that one of the most effective ways of gathering information in a large and remote ecoregion is to bring together experts from that particular area to solicit intensively and interactively their input on conservation priorities. Although we had initially gathered substantial information, the hands-on involvement of Bering Sea experts was essential in our identification and discussion of conservation priorities. Thus, the Girdwood workshop was convened in March, 1999.

Working first in taxonomic groups, then by regional expertise, experts "ground truthed" the maps of the Bering Sea's biological features, added their own information and expert opinions, and defined priority sites for conservation.

An important element of this project was the involvement of a wide variety of experts. Experts from resource management agencies, conservation organizations, universities, research institutes, boroughs and local communities participated. Especially valuable was the participation in the workshop by a team of Russian experts. Our Russian colleagues shared new information and perspectives from the western Bering Sea, answered questions, and completed information gaps about biodiversity and threats to the ecoregion. This broad range of expertise was important to contribute to the whole "picture" of the Bering Sea. We recognize that there are many other experts with important knowledge of the Bering Sea and we invite their comments and additions to this process.

2.3 Selecting Conservation Priorities: The Approach

2.3.1 Step 1- Delineating Subregions

Experts were first asked to delineate subregions within the Bering Sea ecoregion for the purposes of a representation analysis of species assemblages and habitat types. In other words, this step will help us to understand whether a conservation strategy adequately incorporates all of the ecoregion's diverse habitats and ecosystems. Subregions also help us to understand the relative importance of biodiversity features at different biogeographic scales. To determine these subregions, we reviewed existing subregional maps developed by Ford (1998) as well as those provided by the National Research Council (1996). Based on these maps and expert knowledge we mapped the following subregions in the Bering Sea (See Map 2, page A2).

Subregion I: Bering Strait and Southern Chukchi Sea

This area includes the northern portion of the continental shelf between Russia and the U.S., and encompasses St. Lawrence Island, Anadyr Bay, Norton Sound, and the Diomede Islands.

This subregion is distinct in that it is covered by sea ice for a significant part of each year. A variety of habitat types are found within the larger areas, including the shallow, seasonally warm, low-salinity environment of Norton Sound in the east where the Yukon River flows into the sea; the shallow but comparatively cold Gulf of Anadyr at the same latitude to the west at the Anadyr River delta; and the highly productive region between St. Lawrence Island and the Bering Strait, where strong currents flow north into the Chukchi Sea.

Subregion II: Bering Sea Shelf

This area includes the extensive continental shelf and shelf break in the eastern Bering Sea, and encompasses the Pribilof Islands, St Mathew Island, Bristol Bay and Nunivak Island.

Four marine habitat types are found here that correspond to the nature of the physical processes and depth: the inner shelf, middle shelf, outer shelf, and shelf edge domains. The shelf subregion is influenced by sea ice, but to a lesser extent than the Bering Strait subregion, and has weak current systems.

Subregion III: Kamchatka Shelf and Coast

This area includes the western Bering Sea and the coast of the Kamchatka Peninsula stretching out to encompass the Commander Islands and the shelf break off of the Russian mainland. The continental shelf is narrow and much of the subregion is dominated by the southward-flowing Anadyr and Kamchatkan currents.

Subregion IV: Aleutian Islands

This subregion includes all of the Aleutian chain and surrounding waters as well as the shallow submarine ridge, Bower's Ridge, extending into the Aleutian Basin. The region of the arc is physically dynamic because of strong tidal energy and currents flowing in either direction on the two sides - the westerly North Aleutian Flow on the north side the easterly Alaska Stream on the south side. Deep passes between the islands channel currents across the arc in several locations. Very little shallow water surround any of the islands.

Subregion V: Aleutian Basin

This area, with no landmasses, is a deep-water marine system with bottom depths of 3000 to 4000 m. It provides habitat for numerous fish, invertebrates, and marine mammals. It is located north of the Aleutian chain and southwest of the shelf break and occupies about half of the total area of the Bering Sea.

2.3.2 Step 2 – Selecting Special Areas for Major Wildlife Taxa

While working in taxa breakout groups (birds, fish, invertebrates and mammals), participants considered several criteria to determine the importance of particular areas. These criteria include:

1. The presence of distinct or unique species assemblages, habitat or habitat complexes (such as the groups of species in Russia's Commander Islands, representing several biogeographic zones)
2. Species richness or endemism (for example, the Pribilof Islands, where millions of seabirds nest each summer)
3. Outstanding abundances or aggregation areas (including Norton Sound, an area of high summer concentrations of beluga whales)
4. Critical area for sustaining important ecological phenomena (the Bering Strait for example, is a critical migratory corridor for Pacific walrus and bowhead, beluga, and gray whales)

Based on these criteria, the selected areas were then rated for the relative significance of their biodiversity. Additionally, participants discussed whether these areas were outstanding at the level of the Northern Hemisphere, the Bering Sea Ecoregion, or the Subregion within the Bering Sea.

The groups also listed known threats to the areas and noted the current management regime, if any.

These preliminary areas for each taxonomic breakout group were then presented to the larger group for review and discussion.

What did this tell us about why the Bering Sea is so special? From a biodiversity perspective, the Bering Sea is an amazing amalgam of habitats that provide a wide range of niches for diverse flora and fauna to occupy. Moreover, the base of the food web of the Bering Sea is highly productive, supporting great abundances of many species. Among the denizens of the Bering Sea are several endemic species, Arctic and sub-Arctic species typical of many regions of the Northern Hemisphere, and species that migrate from around the world to take advantage of its bounty. Some of the particularly notable features for different taxa are presented below.

2.3.2i Birds of the Bering Sea (Map 3)

From the bald eagle with its eight-foot wing span, to the diminutive least auklet, the birds of the Bering Sea are numerous, diverse, and occupy an important part of the food web in this northern region. For many birds, the Bering Sea provides unique habitat that is available nowhere else in the world. Seabirds of thirty-five species numbering nearly 20 million nest in the Bering Sea ecoregion. Only in the Antarctic is such a comparable diversity and abundance found. In addition, 27 species of waterfowl (ducks, geese) and 31 species of shorebirds nest on islands and in coastal areas of the mainland.

On St. George Island in the middle of the Bering Sea, flocks of kittiwakes, murres, auklets, gulls and puffins fill the sky as the birds vie for sites to make their nests in the crowded island cliffs. One of four

Pribilof Islands, St. George Island exemplifies the rich seabird life that for a short period each year, congregates in time and place.

In winter, even the harsh environment of the Bering Sea polynyas, or openings in the pack ice, offers a refuge to some species. For example, a recent discovery showed that in mid-winter, thousands of spectacled eiders (most of the world's population) gather in the open water areas of Bering Sea ice southwest of St. Lawrence Island.

The rich marine life that feeds so many birds attracts them across astounding distances. The vast number of resident seabirds doubles in summer with the influx of migrant shearwaters escaping the austral winter on their nesting grounds in the Southern Hemisphere. Shorebirds such as sandpipers and plovers, godwits and curlews make their way from Asia, Africa, Australia and the Americas to the Bering Sea ecoregion. Tens of thousands of snow geese fly from their wintering areas in California north to the Chukchi Sea each year, to breed on Wrangel Island. In the fall migration, many stop at the Yukon-Kuskokwim delta to feed. Spoonbill sandpipers move along the coast of the Russian Far East from their wintering areas in Southeast Asia to nest in northern Bering Sea wetlands. Sandhill cranes fly 10,000 miles from their wintering areas in Mexico to nesting areas on the Chukotka and Seward Peninsulas.

2.3.2ii Mammals of the Bering Sea (Map 4)

Like the avian diversity of the ecoregion, marine mammal life in the Bering Sea is exceptionally rich. With representatives from north temperate regions (harbor seals), the sub-Arctic zone (Dall's porpoises) and Arctic regions (polar bears), marine mammals are diverse and numerous. They include the pinnipeds, whales and dolphins, as well as the sea otter and polar bear.

The Bering Sea provides essential habitat for several species that are found nowhere else in such high concentrations. During winter months, for example, the bulk of the world's walrus population can be found in the Bering Sea. Nearly all of the northern fur seals are concentrated in one site in the Bering Sea, the Pribilof Islands, during their breeding period. Just north of the Bering Strait, the world's largest onshore polar bear denning area can be found on Wrangel and Herald Islands.

Of the 26 marine mammal species identified in the Bering Sea, eight are listed as federally endangered in the United States. One species, the northern fur seal, is designated as "depleted" under the Marine Mammal Protection Act and the status of many species is yet unknown. The Steller sea lion is listed as endangered according to the Endangered Species Act, and is recognized in Russia as a threatened species. Another species, the sea otter, has also exhibited signs of decline. Populations in some areas in the Aleutian archipelago have decreased sharply.

The Bering Sea provides critical habitat for some of the world's largest mammals. The blue, bowhead, humpback, northern right whale, and other baleen and toothed whales make their way to the Bering Sea to feed and breed in the ecoregion, or to migrate through the Bering Sea for points north in the Chukchi and Beaufort Seas. Each year the gray whale migrates north from wintering areas in Mexico to feed on the rich benthic crustaceans in the Bering Sea. Cetaceans are found throughout the ecoregion, from the deep waters of the basin (sperm whale and Dall's porpoise), at the continental slope (minke and fin whales, and Stejneger's beaked whale) and in the rich waters of the productive shelf and coastal zones (gray, northern right, humpback, beluga, and bowhead whales).

Fur seals, harbor and spotted seals are more common in the southern parts of the Bering Sea, while ribbon, ringed, and bearded seals – whose life cycles are closely tied to the ice pack – are found in northern waters. The dwindling populations of endangered Steller sea lions, also found in the Gulf of Alaska, occur throughout the Aleutian chain, Commander Islands, and western Bering Sea.

2.3.2iii Fish of the Bering Sea (Map 5)

A cornerstone of the Bering Sea food web, fish in the ecoregion exceed 400 species. Not surprisingly, the best-studied species are those that are used commercially. Indeed, the commercial fishery in the Bering Sea is one of the world's largest. For the United States, this resource is extraordinarily

important as it provides more than half of all fish and shellfish caught in our waters. Thirty species of groundfish, including 11 species of flatfish and 15 species of rockfish, are targeted. Of these, walleye pollock is the most dominant species, accounting for about half of the biomass of groundfish in the Bering Sea. Pollock sustains the largest single-species commercial fishery in the world, with peak harvests of between 4-6 million metric tons per year during the height of the fishery in the 1980s. Annual economic benefits of the pollock fishery to the US and other Pacific Rim nations exceed a billion dollars.

Among the list of marine species is the Pacific halibut. A fish with a naturally long life span, it can grow to several hundred pounds. Its seasonal migrations are striking: halibut can travel up to 800 km between spring feeding areas and the deeper waters where they spawn and winter. Halibut provide great adventure to sport fishers and is a lucrative commercial target.

The Bering Sea supports five species of salmon: chinook, coho, sockeye, chum, and pink. In both Russia and Alaska, these fish provide an important source of subsistence, support recreation, and generate income to residents and tourists alike. The run of sockeye salmon in Bristol Bay is the largest in the world, with an average return over the past twenty years of nearly forty-five million fish. Many terrestrial species, such as brown bears along the coast of southwest Alaska, depend heavily on salmon for food. On the Kamchatka Peninsula (a sparsely populated area roughly two-thirds the size of California), hundreds of free-flowing rivers fill with salmon each year. Kamchatka's robust brown bear population, Steller sea eagles, and other wildlife are intricately tied to the Bering Sea by these salmon.

Forage fish such as herring (also of commercial importance), sandlance, capelin, and lanternfish are a critical part of the Bering Sea's biodiversity, supporting birds such as kittiwakes, gulls, terns, and marine mammals.

2.3.2iv Invertebrates of the Bering Sea (Map 6)

For a northern sub-polar ecoregion, invertebrates are exceptional diverse in the Bering Sea. In areas such as the "Golden Triangle," the large marine area between the Pribilof Islands, Bogoslof Island and Izembek Lagoon (See Area #9 on Map 8, page A12), tidal mixing and ocean currents contribute to high levels of primary productivity, which in turn supports large concentrations of invertebrates such as squid. Similarly, in the western Bering Sea the nutrient-rich waters off the Kamchatka Peninsula support high numbers of zooplankton species. They, in turn, provide the basis for one of the most productive wildlife communities in the ecoregions, the Commander Islands, where representatives of North American and Asian marine benthos can be found. Among the commercially important invertebrate species of the Bering Sea are the crabs (king, tanner, and hair), and shrimp. The Korean hair crab is found primarily around the Pribilof Islands, while Tanner crabs range throughout the region. Bristol Bay historically has been rich in tanner, snow, and blue crabs.

One of the richest pockets of invertebrate life is found near St. Lawrence Island (See Area #12 on Map 6, page A9), where extremely productive benthic communities, including bivalve mollusks, and amphipods support a huge biomass of walruses, gray whales, and eiders during the year.

2.3.3 Step 3 – A Broader Strategy: Selecting Priority Areas for Conservation (Map 7)

Having examined biodiversity within these four taxa, the next step was to consider areas of common value among the taxa. Maps from each of the four taxonomic groups were then combined to identify areas of concentration and importance common among all groups (See Map 7, page A11). Consideration also was given to habitat types and ecological processes needed for sustaining the biodiversity of these areas. Conservation priorities (ranks) were then set for each identified area within each subregion. Thus, these combined areas encompass sites where multiple taxa exist as well as the habitat and processes that sustain them (See Map 8, page A12). Detailed descriptions of these areas (Appendix B), including potential threats, conservation status, resources use and managing agencies were also compiled during the workshop using available literature and other sources identified by workshop participants.

2.4 Threat Assessment Summary

Process

To better evaluate our potential for success in the areas highlighted as priorities for conservation, we asked participants to evaluate threats to Bering Sea biodiversity based upon their knowledge of the ecoregion. Individuals listed threats and then ranked them according to the following four criteria:

- Severity, (the level of degradation in the area from the threat)
- Scope (the scale of the threat or how large the area that is currently or could be impacted)
- Duration (how long the impact of the threat will persist)
- Urgency (a measure of how soon action is needed to address the threat)

We then listed all of the highest ranked threats to Bering Sea biodiversity and grouped threats that were similar in nature (e.g. discarded rubbish and toxic contamination were both listed in the "pollution" category). We then asked participants to vote on the four most critical threats.

As a result of these votes, four factors were highlighted as the most critical threats to biodiversity in the Bering Sea:

- Mismanagement of fisheries
- Global climate change
- Alien species introductions
- Pollution

Subsequently, the experts broke into four groups to discuss these threats and possible strategies to reduce or address them.

The following threats are listed in order of rank as voted by participants in the experts' workshop. (For a summary of the discussion on possible strategies to mitigate these threats, please see Table 1 on page 16).

2.4.1 Fisheries Management

This threat includes overfishing and overcapacity of the fleet, waste from bycatch, habitat destruction, benthic disturbance, poaching, bottom trawling, whaling, poor regulations, inappropriate subsistence harvest, drift nets, and inappropriate seasons for certain species. Mismanagement of the fishing industry within the Bering Sea was listed as a threat by 75% of the participants.

Fisheries mismanagement has received the most attention as a threat to Bering Sea resources in the past. Discussion of whether the depletion of some species is impacting the survival of other species is a topic of debate among researchers, the fishing industry and conservationists working on Bering Sea issues. Although the exact impact of fishing on specific fish stocks and mammal populations is still unclear, there are some facts that are clear.

For example:

- Fishing causes direct mortality to target fish species as well as other fish, mammals and birds through bycatch.
- Bottom trawling disturbs habitat structure and causes direct mortality to bottom dwelling fish, mollusks, corals, and other invertebrates (Jones 1992; Vining and Witherell 1997; Bergman and Hup 1992).
- Trawling leads to a large, rapid removal of biomass from critical areas of the Bering Sea.
- Fishing vessels carry rats, can spill oil and fuel, and are a source of nets and other debris known to cause direct mortality to birds and mammals.
- Fisheries policy development and regulation setting area heavily biased in favor of large commercial fishing interests.

Table 1: Key Threats and Potential Abatement Strategies

Source of Stress	Stress to Targets and Site	Threat
Fisheries Mismanagement	✶ Direct impact to and death of marine species ✶ Disturbance of benthic environment ✶ Excessive removals resulting in disruption to food web ✶ Disturbance to biological community structure ✶ Cumulative impact on species and communities through disruption of normal travel and distribution patterns ✶ By-catch and waste of marine species ✶ Sport harvest effects ✶ Local extinction	✶ Conduct management in larger context to protect important habitat ✶ Strengthen enforcement capabilities, particularly in Russia (observer programs, vessel tracking systems) ✶ Develop better research and monitoring of long-term ecological effects ✶ Stop destructive, short-term fishing/dredging practices in important areas ✶ Improve catch reporting from Russian side of the Bering Sea ✶ Compensate for the needs of birds and mammals in fisheries management decisions
Global Climate Change	✶ Warmer ocean temperatures ✶ Changes in currents ✶ Inundation of coastal habitat ✶ Changes in ice edge ✶ Changes in habitat structure due to changes in ice and snow structure in fall and spring ✶ Alteration of prey movement within the Bering Sea. ✶ Loss of near shore habitat due to hydrologic shifts	✶ Reduce greenhouse gas emissions globally ✶ Protect representative marine reserves that allow for variation in water temperatures and climate change and the resulting movement of species ✶ Raise public awareness about connections between Bering Sea and Lower 48 actions
Alien Species Introductions	✶ Competition, genetic pollution and disease from mariculture ✶ Introduced organisms from bilge water and ballast pumping ✶ Predation and disease from rats and mice accidentally introduced to islands ✶ Predation and habitat destruction from purposeful introductions of foxes and ungulates ✶ Accidental escaped aquaculture species ✶ Stock transfers and loss of local genetic adaptations	✶ Discourage mariculture for wide-ranging species such as salmon ✶ Use local seed stock for sessile invertebrates ✶ Implement treatment of ballast water for microbes and other organisms ✶ Encourage ballast pumping laws to avoid new introductions of species from other water bodies ✶ Create harbor defense networks similar to Pribilofs ✶ Establish shipwreck response teams near important sites ✶ Work with shippers to reduce rats on ships ✶ Remove rats from critical islands ✶ Allow no new introductions ✶ Remove foxes ground squirrels and other aliens from key sites
Pollution	✶ Plastic debris causing direct harm to species ✶ Point source pollution from coastal cities causing poor water quality ✶ Small gas and oil spills from shipping ✶ Sedimentation and chemicals from mining causing direct harm to species ✶ Nuclear-powered navigation lights (along the coast of Chukotka) ✶ Atmospheric transportation of pollution ✶ Contaminant bio-accumulation	✶ Firm solution on plastic debris ✶ Inspection of vessels for safety measures ✶ Safe transfer facilities ✶ Location and remediation of military bases ✶ International efforts to prevent oil, other spills ✶ Collect more information on magnitude of pollution and impact on species ✶ Increase education of general public on pollution issues ✶ Promote international treaty to eliminate production of Persistent Organic Pollutants

2.4.2 Anthropogenic Global Climate Change

A number of sources indicate climate change is affecting life in the Bering Sea: the average surface temperature across Arctic Siberia, Alaska, and Northwestern Canada has risen about 1 degree Celsius during the last thirty years, exceeding the rate predicted for the greenhouse effect (Center for Global Change and Arctic Systems Research, 1998).

Other indicators such as thawing permafrost and melting glaciers (an estimated 80 percent of Alaska's glaciers are receding) support evidence of this dramatic change. The extent of sea ice in the Bering Sea has shrunk as much as 5 percent in the last thirty years.

Diminishing ice cover alone has vast implications for the region: declining abundance of micro-algae, primary producers in the food chain that have adapted to the Arctic seas by living in the ice itself or on the underside of ice; loss of critical habitat for polar bears, seals, walrus, and other marine mammals who depend on the ice edge environment for food and protection from predators; an increase in severe weather events such as the frequency and power of storm surges that cause coastal erosion and inundation; subsistence lifestyle changes as altered sea ice conditions make hunting on the ice more dangerous.

Scientists have already demonstrated a link between unusually warm water temperatures in the Bering Sea in 1997 and 1998 and altered ocean currents and atmospheric conditions, rare algae blooms, drastically low salmon runs, and extensive die-offs of seabirds. Research so far has yet to conclude whether these warm water changes are passing anomalies, such as those associated with El Nino, or whether they are indications of long-term, large-scale changes.

But given the present rate at which carbon dioxide is accumulating in the Earth's atmosphere, computer models predict that temperatures in high northern latitudes, including Alaska, could rise as much as 4 to 6 degrees Celsius (about 10 degrees Fahrenheit) in the next 80 to 100 years. The resulting physical changes would have repercussions throughout the world's oceans by influencing circulation patterns, climate, and the productivity of food chains, including valuable fisheries.

2.4.3 Alien Species Introductions

The introduction of alien species such as rats, foxes, ungulates and marine organisms to the Bering Sea's islands and waters was, respectively, recognized to be one of the gravest threats to the local communities and native species populations. Girdwood workshop participants rated the prevention of alien introductions as one of highest priorities for action within the Bering Sea.

Alien species can have a devastating effect on biodiversity. In other marine regions, alien species traveling on ships' hulls, anchors, and in ballast water, have displaced and out-competed native species. Around the world, other regions have been adversely impacted by alien species, such as the Baltic Sea, where 60 introduced species have been found.

In an example closer to home, the rate of invasion into San Francisco Bay, is estimated to be one species every three to four months. One species that was introduced here is the green crab *(Carcinus maenas)*, which has been steadily moving northward. It has been found in locations as far north as British Columbia, and poses a threat to Bering Sea's native crab species, such as dungeness crabs. Researchers are even beginning to find exotic marine species here in Alaska. Last year a survey of Kachemak Bay in Cook Inlet turned up several non-native invertebrate species within the vicinity of the Homer Spit.

Mariculture poses additional threats to biodiversity in the Bering Sea. Competition from non-native hatchery species could impact native species, and there may be some level of genetic pollution from non-native stocks of fish. Diseases introduced from mariculture could be another significant threat associated with mariculture.

Bilge water pumping could introduce microbial organisms and mussels into the Bering Sea that are not present now. Ballast water from ships moving into the Bering Sea from other regions often carries organisms not found in the Bering Sea. Once this water is released into the Bering, the organisms can

persist and out-compete native species. This has occurred in the Great Lakes area with zebra mussels and may have caused the lack of microbial diversity within the Barents Sea.

Accidental and intentional introductions of rats, foxes and dogs have had a serious impact on bird and small mammal diversity on Bering Sea Islands. The main cause of species declines has been predation by foxes: Arctic foxes were introduced to 78 islands in the Aleutian chain and red foxes were introduced to at least 20 islands in the 1800s and early in the 20th century. Although they have died out or been removed from many islands, they persist on many large islands today. Predation by rats and other introduced rodents and habitat destruction by introduced large mammals have also had serious local effects.

2.4.4 Pollution

In the Bering Sea, pollution includes impacts from spilled or discharged petroleum or fuel oils, heavy metals, PCBs, and other synthetic organic chemicals such as pesticides, nuclear wastes, plastics and other debris lost and dumped from ships, and lost and discarded fishing nets. Some of these chemical pollutants are being discovered in the tissues of marine mammals and indigenous peoples whose diet in many parts of the Bering Sea relies on fish and marine mammals. Elevated levels of contaminants have also been discovered and reported for marine birds and invertebrates (Estes et al., 1997, Bacon et al., 1999, Anthony et al., 1999)

Other sources of pollution include toxic waste sites and military remnants from World War II and the Cold War. For example, in the western Aleutian Islands the Adak Naval Air Station has been included by the Environmental Protection Agency on the National Priorities List as a hazardous substance site.

There were several recurring concerns regarding pollution as a threat to Bering Sea species. One of the most serious concerns was related to point source pollution from expired and now leaking nuclear generators on the Chukotka Peninsula. Once used to power a network of approximately 80 navigation lights along the Chukchi and Arctic seacoasts, the generators are outdated yet are no longer maintained by the Russian government. The generators are a major health and safety hazard. Additional sources of pollution are military wastes in the such as the sites on Adak and St. Lawrence Islands.

Transportation and associated pollution from discarded debris and minor oil or chemical spills is another critical threat. The presence of cargo vessels has dramatically increased within the Bering Sea as new shipping routes are established. Because of rough weather and ocean conditions, relatively small spills are frequent within this area. The recent push by the government of the Russian Federation to open a northern shipping route through the Bering Strait is especially alarming, considering the current weakened state of Russia's coast guard and law enforcement capabilities.

2.5 Additional Issues of Concern

Girdwood workshop participants discussed a number of other factors that threaten biodiversity in the Bering Sea, or that impede processes to resolve conservation issues. For instance, potential oil development in the ecoregion directly threatens marine organisms. Other problems include the lack of inclusion of Russian and Alaskan communities in planning and strategizing for conservation in the region.

2.5.1 Oil Development

Oil development, which includes exploration, development, transport, pipelines, and associated activities, represented a threat for a total of 10 participants who considered oil and the associated impacts on the Bering Sea area's landscape to be serious. The major threat in this case revolves around the potential for an oil spill and the destruction of habitat associated with oil exploration and production. Russian experts expressed apprehension about the proposed opening of a northern sea route through the Bering Strait, a move which would introduce many new sources of pollution from shipping traffic.

2.5.2 Lack of involvement from the local community in resource management decisions

One of the other issues articulated during the workshop was that the local communities of the Bering Sea have not been adequately consulted on decisions affecting the resources they rely on to live.

Local communities have noticed significant changes in species numbers and the extent of unique natural processes in the Bering. These opinions and insights are not always considered, consulted, or incorporated during planning and implementation of research or conservation. Unless the public around the Bering Sea is involved, unless the local communities have a stake in developing their own conservation goals and plans, as a collective conservation community, we will be able to make little progress.

2.6 Data Gaps and Necessary Research

Another challenge to conservation in this ecoregion is the absence of a full understanding of how this dynamic natural system functions. For example, we still do not understand the links between human use and the status of wildlife and fisheries. We still lack sufficient information about particular species and species groups in the Bering Sea, such as benthic biodiversity patterns in the western Bering Sea. We have yet to understand how pollock utilize the entire Bering Sea, not only the Russian and U.S. Exclusive Economic Zones. Additional questions include the role species and processes in the basin play in the broader Bering Sea ecosystem; the abundance and importance of non-commercial fish and other species in the Bering Sea that have yet to be inventoried; the amount and kind of valuable physical and biological information contained in records of fisheries and oceanographic exploration in the Bering Sea by Russia and Japan in past decades that might help us understand changes of concern today.

◆ *Bering Sea ice pack*

Kevin Schafer

Part III: Beyond Maps, toward Conservation

3.1 Lessons from Girdwood Workshop

The Girdwood workshop helped to highlight not only the rich diversity of habitats across the immense expanse of the Bering Sea but the variety of factors which could or already do undermine biodiversity here. It is clear that in working on a scale as large as an ecoregion, and in addressing the variety of human activities in the Bering Sea, a combination of strategies will be necessary for biodiversity conservation. This mapping and prioritization exercise gives us a better understanding of where conservation strategies will be particularly important in the Bering Sea.

A strategy for biodiversity conservation should entail actions which help to conserve the full array of species, habitats, and processes in the Bering Sea. In some places it may be necessary to preserve some undisturbed, representative habitats that can serve as refugia for species and allow for restoration and resiliency. The conservation community is increasingly recognizing the value of marine protected areas as a tool for biodiversity conservation. (Table 2, page 20)

A portion of the workshop was devoted to a discussion of strategies that could be used to mitigate current and potential threats as well as more pro-active measures for conservation. Participants proposed a number of possible actions that could be taken in the near term (within the next five years) and over the long term (within the next fifty years) to address the major threats to biodiversity.

While discussing actions that are needed within the more immediate future, participants suggested measures that could be applied on the global scale (for example, reducing greenhouse gas emissions), the regional scale (aggressively preventing introductions of rats and other organisms to islands and waters of the Bering Sea), and the local scale, such as removing point sources of contaminants. (Table 1, page 15).

In considering how we can protect biodiversity over the long term, workshop participants hypothesized about creating a network of conservation areas which support critical Bering Sea ecosystems and processes. Working in small groups, participants theorized about how to create a range of areas that would meet conservation objectives in the ecoregion. Each team produced potential approaches, laying out a network of areas -- varying in size and status -- which might be given special status or conservation management strategies. The exercise was aimed more at facilitating a process for thinking about and discussing concepts for biodiversity conservation in this diverse and dynamic marine region than prescribing a specific plan for implementation.

The priority zones outlined in this report represent areas and processes which are significant for conservation of biodiversity and may be important as core protected areas in future proposals. Indeed the information here is intended to provide guidance for conservation strategies in the future.

One strategy to be considered is the creation of marine "safety areas," conservation areas, or low intensity use areas. These areas can take a variety of forms. Most importantly, these areas are designated for three major purposes: 1) to provide a refuge and buffer zone for populations; 2) to allow for a sufficient abundance and diversity of resources needed by species 3) to maintain intact and sensitive communities and 4) to enhance reproduction in exploited populations (Bohnsack, 1993, Hastings and Botsford, 1999). By setting aside populations of fish, marine conservation areas can help to ensure a secure spawning population even in a variable environment where estimating stock sizes is difficult. Such areas can protect species assemblages from the effects of fishing and other human activities. They can serve essentially as nursery grounds, propogating adult fish for spillover into exploited areas. Safety areas could be used as a preventative measure to mitigate against population losses, or to reverse the trend in declining species. The areas might be designated "subsistence use only" zones, where traditional and customary uses of marine resources would continue while intensive commercial exploitation would be limited.

Table 2: A Tool for Protecting Our Marine Ecoregions

One tool used to help conserve and restore marine ecosystem health and in many places used as an effective fisheries management tool is the marine protected area (MPA). The goals of marine protected areas have been defined by the World Conservation Union (IUCN) and the World Wildlife Fund as:

- To maintain the biodiversity and ecological processes of marine and coastal ecosystems
- To ensure that any use of marine resources is both sustainable and equitable
- To restore marine and coastal ecosystems where their functioning has been impaired

The main objective of most legally designated MPAs is biodiversity conservation, including protection or restoration of depleted populations, endangered species, and critical habitats. However, MPAs also have other roles. Large, zoned, multiple-use areas can play a role in reducing conflict between different uses of the marine environment. As human uses of the environment expand and intensify, the aims, definitions, and management approaches of MPAs are becoming increasingly flexible.

The experience of the conservation community has provided some important lessons that will be important to consider as the concept of MPAs is discussed in the Bering Sea:

1. MPAs must be tailored to local conditions, attitudes, and needs, and designed to achieve specific objectives, which should evolve according to changing circumstances if necessary.
2. Stakeholders must be involved at all stages of MPA planning and management.
3. MPAs need a sound legal basis.
4. All MPAs need a management plan.
5. Local communities have a role in enforcing MPAs.
6. MPAs require sufficient, well-trained personnel.
7. MPAs must be financially sustainable.
8. MPAs management effectiveness should be monitored and evaluated.

(This text has been taken from Marine Protected Areas: WWF's Role in their Future Development. WWF International Discussion Document. 1998)

For example, such a conservation strategy might be particularly desirable in regions of the Bering Sea where local people are concerned about declines in fish. The creation of a "safety" area if planned according to a given species' biological patterns and movements, could help fish populations to be replenish themselves. Increasingly scientists are noting that setting aside such areas can be beneficial to marine species. Not far from the Bering Sea in Puget Sound, for example, the creation of a marine park, Edmonds Underwater Park, twenty years ago has proven successful today in securing healthy lingcod and rockfish to populations. Around the world, communities are gaining positive experience with marine protected areas, learning that this tool can be beneficial to enhancing the long-term viability of their resources and environment.

Networks of protected areas may consist of permanent low intensity use zones around critical biodiversity conservation areas such as keystone islands or highly intact habitats. Such areas could be complemented with temporary "safety" areas that are opened and closed in important biodiversity areas at different times of the year or under particular conditions These could be strategically located based on known patterns of species movements and resource availability, or adjusted to current conditions of biophysical parameters such as sea ice extent. Temporary safety areas may be useful in providing buffers for species and populations in the predictably variable temperature, ice, and productivity conditions of the Bering Sea.

We recognize that much more work is needed to identify the appropriate scale and target of such a network in the Bering Sea. Indeed, the requirements of scale and design of special conservation areas will likely vary among species groups.

Additionally, in order to catalyze the creation of marine protected areas in the Bering Sea, public support will be needed. Education, outreach, and public participation in planning and discussions on this subject will be critical to building such support.

The priority areas highlighted here should serve to help the public to understand and further discuss areas where important biodiversity values are present. Additionally the report should serve as a conceptual framework around which a variety of conservation programs can be built. For instance, within the priority areas certain features such as critical species aggregations may require special attention, whether in the form of temporal protection, or with designation of a buffer zone around them. Some of the priority areas may require management alternatives, for instance a decrease in extraction activities such as oil exploration during seasonal occurrences such as whale migrations. Other alternatives also might include subsistence-only areas, where local communities were involved in managing areas for subsistence use. In other words, the priority areas shown on this map indicate areas where higher standards for human activities should be applied if we are to maintain the biodiversity in the Bering Sea.

3.2 Next Steps

With a better understanding of the key areas and processes supporting biodiversity in the Bering Sea, The Nature Conservancy of Alaska and the World Wildlife Fund will proceed in developing their respective conservation programs. Working with each other as well as with local, regional and other national partners, TNC and WWF envision the development of more refined action plans for particular areas highlighted within this report. Additionally, we will work with international partners to address ecoregional and global issues that affect biodiversity beyond these areas. We believe that in order to make progress in preserving the long-term viability of the Bering Sea the conservation community – defined in the broadest sense to include communities and resource users must join forces to develop an ecoregion-wide action plan. This plan will serve as a strategy setting forth goals and targets, the methods to achieve them, and the players who will be engaged in working toward these goals.

TNC and WWF will continue to work with communities and partners to begin focusing on some of the priorities and to address some of the threats identified in the workshop. We are both committed to this region, and hope to encourage many other players who will commit funds, expertise, and

support for efforts in the Bering Sea. In summary form below, we present the plans of our organizations in this ecoregion:

3.3 The Nature Conservancy and the Bering Sea

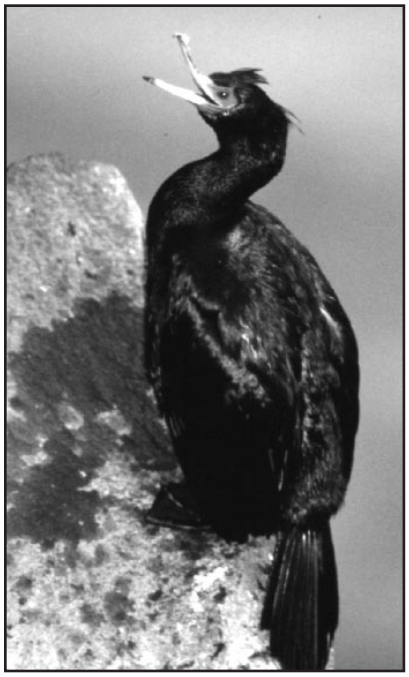
With over eight years of involvement in conservation in the Bering Sea, The Nature Conservancy of Alaska realizes the importance of working collaboratively with diverse partners towards shared conservation goals. With that in mind we have decided to build on lessons we have learned to implement a two pronged approach to our future work in the Bering Sea:

- ➢ We will first focus our efforts on ecoregional planning to define the important sites where we will deepen our conservation involvement.
- ➢ We will then work with local partners to abate critical threats at 2 to 5 sites within the Bering Sea over the next 10 years.

Conservation staff will further refine the ecoregional priorities identified in the Girdwood expert workshop. By early winter, 1999, we will refine our priorities and better evaluate how well priority sites meet the conservation goals for species and communities in the Bering Sea. Preliminary work indicates that TNC will initially (within five years) invest in abating key threats on the Pribilof Islands, Alaska Peninsula Lagoons, and in several aquatic sites associated with Bristol Bay. Future site-based strategies (over 10 years) may be initiated within the Bering Strait, on St Lawrence Island, the Commander Islands and the Yukon Delta.

With partners, the Conservancy will complete a site conservation plan for the Pribilof Islands. This will guide our work at that site and clarify how we can best support our local partner's work over the next five years. Possible strategies include:

- ➢ Helping to control exotic species introductions,
- ➢ conserving critical habitat, and
- ➢ building a strong conservation ethic among local youth through our support of the Pribilof Islands Stewardship Program



Kevin Schafer

◆ *Red-faced cormorant*

TNC will also complete an ecoregional plan for the Bristol Bay Lowlands that will further clarify site-based priorities within the terrestrial area of the Bristol Bay watershed.

3.4 WWF and the Bering Sea

WWF is committed to working with partners throughout the Bering Sea ecoregion to promote and implement conservation action on the ground. To date we have supported a number of projects in both the eastern and western Bering Sea that have helped us to become better aquainted with the region.

We will continue to pursue the following overarching goals in the ecoregion:

- ➢ Conserve the Bering Sea's unique and rich marine and coastal ecosystems;
- ➢ Raise awareness about the ecoregion and threats facing it, and build public support for Bering Sea conservation;
- ➢ Improve stewardship of Bering Sea resources;
- ➢ Work with partners to develop a comprehensive conservation strategy.

WWF works at the international, ecoregional, and local scales in the Bering Sea. Our program has several components, the goals of which are listed in the bullet points below.

1. Addressing Global Threats to Biodiversity

(a) Toxics and Contaminants

➢ Promote UNEP-sponsored treaty to eliminate Persistent Organic Pollutants (POPs) such as PCBs and dioxins that are harmful to wildlife and people

➢ Provide technical and financial support to community-based monitoring projects designed and implemented by local people

(b) Climate Change:

➢ Reverse the trend of increasing greenhouse gas emissions in industrialized nations by increasing energy efficiency and accelerating the transition away from coal and oil towards renewable forms of energy such as wind and solar power.

➢ Raise public awareness on the national level about links between consumer behavior and effects in the Bering Sea.

(c) Marine and Fisheries

➢ Promote implementation of the Magnuson-Stevens Fisheries Conservation Act, particularly in habitat protection and by-catch reduction

➢ Support and promote efforts to improve law enforcement of fisheries regulations in Russia

➢ Facilitate community involvement in fisheries conservation

➢ Work with communities to build support for marine protected areas

2. Develop education and outreach programs

➢ Provide support for Bering Sea educators through workshops on biodiversity, curriculum development and partnerships with educational institutions

➢ Increase national awareness about the Bering Sea through mass media

➢ Support two-way information flow to and from coastal communities through bulletins and radio programs such as "Alaska Coastal Currents"

3. Support species conservation and research, including

➢ Efforts to prevent and/or eradicate non-native species such as the Norway rat

➢ Community monitoring networks, including a walrus haul-out monitoring program in Chukotka (Russia) and

➢ Through partnerships with local organizations and agencies to monitor declines in species such as the sea otter

In May of 1999, WWF's Russia Program Office convened a meeting of 60 marine biologists, representatives from NGOs and government agencies from the Russian Far East. Together they have developed a comprehensive strategy to address conservation goals in the Seas of Japan and Okhotsk and in the Bering Sea. In general Russia's marine program will be active in the following areas:

➢ Development of marine protected areas

➢ Conservation of species of special concern

➢ Legislation: promoting a legal framework to support marine biodiversity conservation

➢ Sustainable economies

➢ Environmental Education

➢ Preventing and reducing impacts of industrial development and pollution

In the western Bering Sea, WWF has already developed strong partnerships with several organizations including the Russian Association for Indigenous Peoples of the North, the Chukotka Society for

Marine Mammal Hunters, the Fund for Pacific Salmon, Kamchatrybvod, the Kaira Club, scientists from the Chukotka branch of the Pacific Scientific Research Fisheries Center, and the Department of Protected Areas in Russia's Committee for Environmental Protection.

Through small grants WWF is supporting projects in environmental education, public awareness, protected areas planning, collection of traditional knowledge, and a field guide to marine birds and fish of the Russian Far East. In a project jointly funded by WWF and the US Fish and Wildlife Service, a network of Russian Native hunters are working with biologists in a program to monitor walrus populations. Other partners in our Russian projects include the Wild Salmon Center, and the Pacific Environment and Resources Center

In the coming year we will support further development of conservation planning and action in Chukotka, the Autonomous Region of Koryakia (particularly in the Karaginsky Bay area), the coastal areas of the Kamchatka Peninsula, and the Commander Islands. All of these areas are shown on Map 8 in the Appendices.

Conclusion

The compilation of data provided during the Girdwood workshop represents an important step in the effort to conserve biodiversity in the Bering Sea. This report is the second edition of a report that was reviewed by many of the Girdwood workshop participants. These experts provided invaluable comments, edits, and additional information which has enhanced the entire publication. The information has already been useful to WWF and TNC as we further develop our respective programs in the Bering Sea ecoregion. We hope that this document will also be useful to other organizations and individuals who share these goals and will serve to catalyze their interest in and support for conservation in the ecoregion.

We are committed to making this information available to the larger public, and more importantly, to promoting conservation action in the region. We believe that in order to achieve success in achieving this vision for the Bering Sea we must work with many partners – communities, research institutes, resource managers and resource users. We invite others to join in our efforts to conserve one of the world's most important seas and its resources for the future.

◆ *Steller sea lions*

Dave Cline

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Appendices

A. Maps 1-9

1 Bering Sea Ecoregion
2 Subregions of the Bering Sea
3 Priority Bird Areas
4 Priority Mammal Areas
5 Priority Fish Areas
6 Priority Invertebrate Areas
7 Overlapping Priority Areas for all Taxa
8 Priority Areas for Bering Sea Biodiversity
9 Existing Protected Areas of the Bering Sea

B. Priority Area Descriptions

C. Literature Cited in Appendix B

D. List of Participants in the Girdwood Workshop on Bering Sea Biodiversity, March 20-23, 1999

Appendix A:

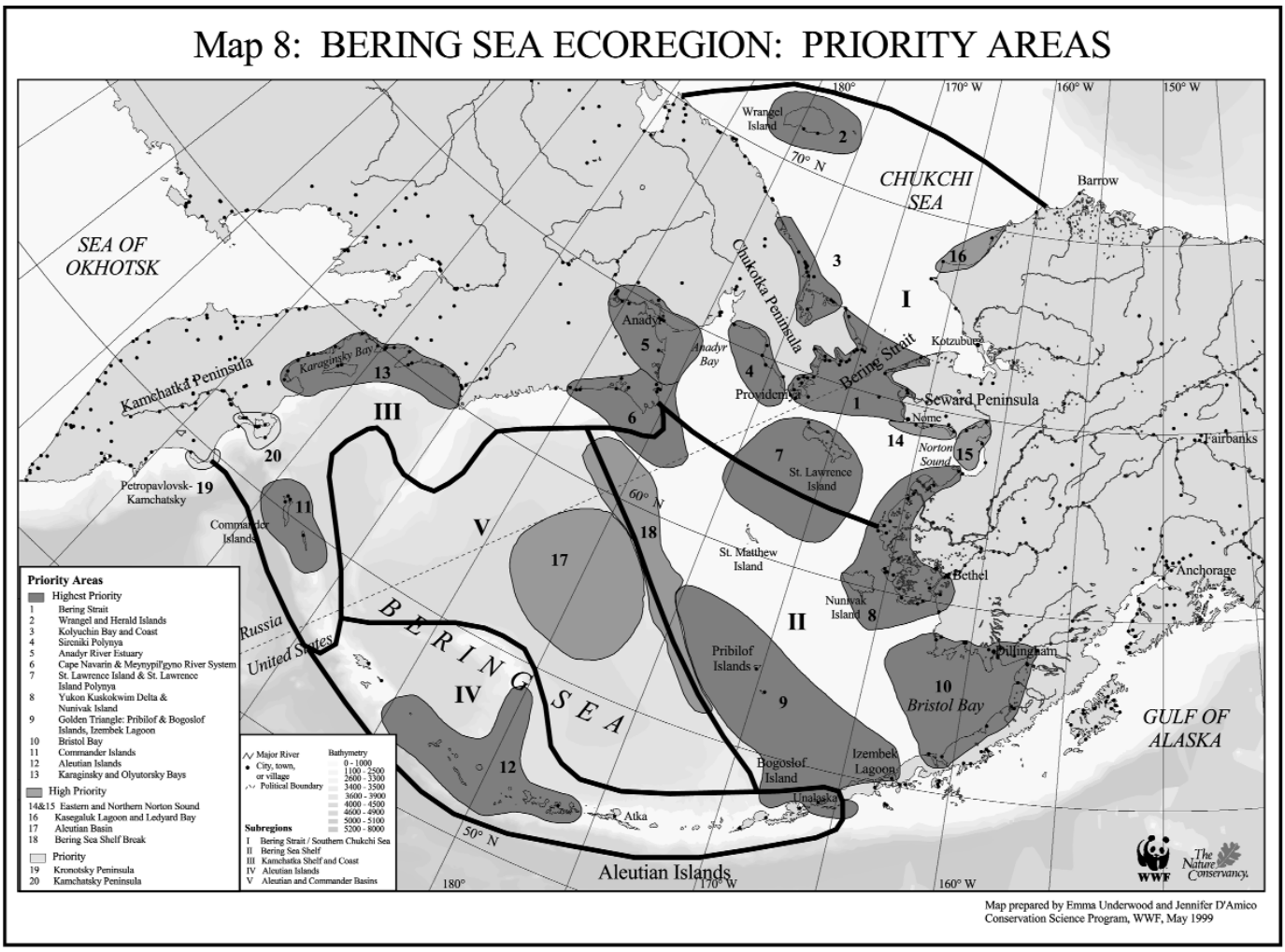
Maps from Girdwood Workshop, March 20-23, 1999 and Priority Area Descriptions

Maps 1-9

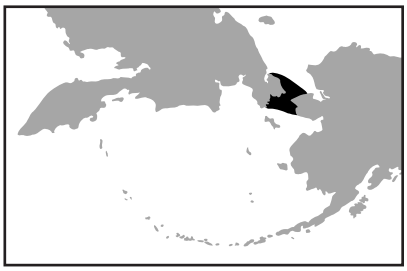
◆ *Snowy Owl*

McGill Adams

Appendix B:
Description of Priority Areas



I. Highest Priority Areas



Name: Bering Strait
Map ID number: 1
Subregion I: Bering Strait/Southern Chukchi Sea
Location: Ocean and coastal areas north of St. Lawrence Island, Alaska between the eastern edge of the Chukotka Peninsula, Russia and the western edge of the Seward Peninsula, Alaska.
Approximate Size: 69,009 km2
Ownership: Russian Federation and the United States

Description of area: The Bering Strait is a 85 km-wide ocean pass between the Chukotka Peninsula, Russia and the Seward Peninsula, Alaska that connects the North Pacific Ocean and Bering Sea to the Chukchi Sea and Arctic Ocean. The bathymetry of the area is a smooth underwater shelf, averaging less than 40 m in depth (Sharma 1977). Sea ice covers the area for 6 to 7 months out of the year. The Bering Strait provides the only connection and exchange of water between the Pacific and Atlantic Oceans in the northern hemisphere. Mean northward transport of water, and thus nutrients through Bering Strait is the result of a sea level difference between the Bering Sea and Arctic Ocean. Two ocean currents (the Anadyr Stream of the northwestern Bering Sea and the Alaskan Coastal Current in the northeastern Bering Sea) flow northward through the Bering Strait (Coachman et al. 1975). Coastal waters of the eastern side near Alaska originate on the shallow southeastern shelf and are relatively warm with low salinity. Waters of the western side, along the coast of Russia originate in deep oceanic water at the edge of the continental shelf and is cold and of higher salinity. Coastal areas on both sides of the strait are composed of cliffs, mountains, shorelines, bays, river deltas, lagoons and estuarine systems. Eelgrass *(Zostera marina)*, an important habitat and food item for numerous invertebrate and vertebrate marine species (Orth 1992) is found within several of the coastal lagoon areas. Big and Little Diomede Islands, belonging to Russia and the U.S. respectively, are situated within the Bering Strait and are rocky islands with numerous cliffs and sparse vegetation.
Outstanding Biological Features: A dominant feature of the Bering Sea ecoregion is the ice pack, which covers the Bering Strait for 6 to 7 months of the year. The seasonal spatial and temporal dynamic of the pack ice (over 1,700 km from the Arctic Ocean in summer to the Alaska Peninsula in winter, with high interannual variability in advance, extent, and retreat) (Niebauer 1980), is important in determining wildlife distribution, migration routes and feeding areas within the Bering Strait. Ice conditions affect the timing of spring melt and initiation of plant growth of coastal terrestrial areas. The pack ice edge possesses a significant abundance of micro-algae, which contributes to annual primary production during the spring ice-edge bloom. Typically, this is a small proportion of the total annual production (McRoy and Goering 1974). However, because cold water temperatures in spring preclude the development of herbivorous zooplankton populations, the bulk of the ice-edge primary production sinks to the bottom and is incorporated into benthic food webs (Coyle and Cooney 1988).

Concentrated nutrients carried in the flow of oceanic water from the shelf edge southeast of Cape Navarin (Priority area #6 – see Map 8, page A12), north around the Gulf of Anadyr, and through western Bering Strait (the Anadyr Stream) fuel the highest levels of primary production in the Bering Sea, and indeed some of the highest levels anywhere in the world (Springer et al. 1993). This prolific summer-long bloom of phytoplankton has a vastly greater role in the regional production budget than does primary production at the receding ice edge. The Anadyr Stream also advects a huge biomass of zooplankton onto the northern shelf that provides a major energy source to a diversity of species (Springer et al. 1989). According to Coyle et al. (1996), all four faunistic groups of zooplankton (comprising up to 56 species) that exist within the Bering Sea, are found within Bering Strait. In spite of their diversity and abundance, they are unable to control the prodigious phytoplankton production or biomass, and a heavy

rain of phytodetritus to the bottom leads to highly productive benthic invertebrate communities in the Bering Strait region that are critical to many marine birds and mammals (Grebmeier et al. 1988a).

The Bering Strait is a focal point for the migration and summer foraging of thousands of migratory birds. Many migrate through the Bering Strait from wintering grounds in the Americas, Asia, and Europe to breed in arctic regions. Large numbers of sea ducks, such as the spectacled eider *(Somateria fischeri)*, threatened in North America, undergo their annual flightless molt within Mechigmenskaya Bay, along the eastern coast of the Chukotka Peninsula (Petersen et al. 1999a). Numerous seabirds nest on cliffs along both Russian and U.S. coasts and on the Diomede Islands. Konyukhov et al. (1999) estimated that nearly 3.3 million seabirds nest on the eastern coast of the Chukotka peninsula and estimates of breeding seabirds on the Diomede Islands approach 2 million (Hunt et al. 1981a). Breeding seabirds species of Bering Strait include the common *(Uria aalge)* and thick-billed *(U. lomvia)* murre, black-legged kittiwake *(Rissa tridactyla)*, parakeet *(Cyclorrhynchus psittacula)*, crested *(Aethia cristatella)*, and least *(Aethia pusilla)* auklet, tufted *(Lunda cirrhata)*, and horned *(Fratercula corniculata)* puffin, northern fulmar (Fulmarus glacialis), pelagic cormorant *(Phalacrocorax pelagicus)*, herring gull *(Larus argentatus)* and glaucous gull *(Larus hyperboreus)*.

The Bering Strait is also a major migratory pathway and summer foraging and breeding area for marine mammals (Sobolevsky and Mathisen 1996). Gray whales *(Eschrichtius robustus)* and Pacific walrus *(Odobenus rosmarus)* depend on the productive benthic communities to support their populations. Bowhead whales *(Balaena mysticetus)* migrate north in the spring with the retreating ice pack through Bering Strait to summer feeding grounds in the Beaufort Sea. Other whales, such as the beluga *(Delphinapterus leucas)*, minke *(Balaenoptera acutorostrata)*, killer *(Orcinus orca)*, and humpback *(Megaptera novaeangliae)* also occur in the area. Ice-associated seals, the spotted *(Phoca largha)*, ringed *(P. hispida)*, ribbon *(P. fasciata)*, and bearded (Erignathus barbatus) seals; Steller sea lion *(Eumetopias jubatus)*, and polar bear *(Ursus maritimus)* are found along the pack ice edge during the year and use the pack ice as a foraging and breeding area.

Current Conservation Status: Approximately 1.12 million hectares of coastal and interior areas north of Nome on the Seward Peninsula (Bering Land Bridge National Preserve) and north of Kotzebue, Alaska (Cape Krusenstern National Monument, Kobuk Valley National Park, and Noatak National Preserve) are managed by the National Park Service. However, most of the marine communities are not protected. The managed areas are proposed to be included within an international park and preserve that would include a comparable terrestrial area on Russia's Chukotka Peninsula. A marine buffer zone is also proposed for the Russian side of the preserve. At this time, feasibility studies are still underway for designating the Russian portion of the preserve and it is unlikely that a marine component of this system will be included.

On the western coast of the Bering Strait, the regional Beringia Ethnological-Natural Park, established in 1993 by local authorities, encompasses more than three million hectares. Russia's Arakamchechin Island, on the eastern coast of the Chukotka Peninsula, world-class walrus haul-out areas receive some protection from the regional government. Big Diomede Island is a Russian border post and as human activity is limited, it may therefore receive some incidental protection by the military.

Current Resource Use: Russian and Alaska natives rely on terrestrial and marine mammals for subsistence. In Alaska and Chukotka, marine mammals such as the bowhead whale, beluga whale, walrus, bearded seal, and spotted seal are taken by subsistence hunters (Stoker and Krupnik 1993, Small and DeMaster 1995). Native commercial fishing for salmon and crab takes place in Alaska, but locations and species of subsistence and commercial harvest in Russia is not known.

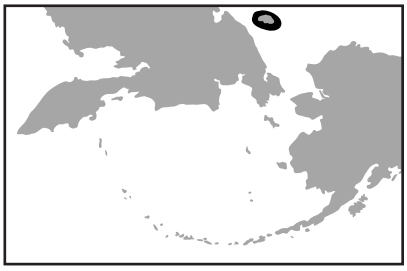
Description of Threats: Disturbance or pollution could arise from transportation traffic through the Bering Strait and along a new northern sea route which has been proposed by the Russian government.

Oil and gas exploration of Russian coastal areas near the Gulf of Anadyr, southwest of the Bering Strait, has been proposed in recent years (Newell et al. 1999). The release of oil or other pollutants from coastal processing of oil could cause impacts to biological resources (Khlebovich 1994, Melnikov et al. 1994). Accidental introduction of rats to islands or coastal areas from shipping traffic, either by running aground off shore or regular port docking, would have drastic consequences for seabirds as most nest in colonies and lay only one or two eggs each year. Global climate change could alter the distribution of pack ice in the Bering Strait area and disrupt biological processes that take place at the ice edge or influence the ice as a habitat for numerous species.

Conservation and Management Agencies: Union of Marine Mammal Hunters, Alaska Eskimo Whaling Commission, Alaska Nanuuq Commission, Union of Marine Mammal Hunters, U.S. National Park Service, U.S. Fish and Wildlife Service, National Marine Fisheries Service, Goskomchukotekologia (Chukotka Government Ecological Committee), Pacific Institute of Geography (Vladivostok), the Far Eastern Branch of the Russian Academy of Sciences (Magadan and Vladivostok), TINRO (Pacific Research Institute of Fisheries and Oceanography), Kaira Club, Government of the Chukotka Autonomous Region

Area Description Contributors: S. Belikov, V. Byrd, A. Golovkin, Y. Gerasimov, J. Grebmeier, M. Petersen, R. Small, G. Smirnov, A. Springer

Information Sources: U.S. National Park Service, U.S. Fish and Wildlife Service, National Marine Fisheries Service, Goskomchukotekologia (Chukotka Government Ecological Committee), Pacific Institute of Geography (Vladivostok, Russia), the Far Eastern Branch of the Russian Academy of Sciences (Magadan and Vladivosktok, Russia).



Name: Wrangel and Herald Islands
Map ID Number: 2
Subregion I: Bering Strait/Southern Chukchi Sea
Location: An area that extends west from the northeast tip of the Chukotka Peninsula (western Bering Strait) to Cape Schmidt and north to Wrangel and Herald Islands.
Approximate Size: 38,507 km2 and 40,729 km2 respectively
Ownership: Russian Federation

Description of area: Wrangel Island (aproximately 796,000 hectares) is located 170 km north of the Chukotka Peninsula, northwest of the Bering Strait. The entire island and a twenty-five mile marine zone surrounding it comprise one of Russia's Arctic nature reserves. This federally designated area is known as a Zapovednik, or strict scientific nature reserve. The island is divided latitudinally by a range of mountains that rise to 1,100 m, with an average elevation of about 500 m. To the north lies an extensive tundra and wetland complex known as the Tundra Academy that gently slopes to the sea. The tundra to the south of the mountains is drier, narrower, and higher in elevation, but includes the island's largest lake, Jack London Lake. The perimeter of the island consists of a series of coastal spits and barrier islands (Ward et al. 1993). The much smaller Herald Island (approximately 12 km2) is situated 60 km northeast of Wrangel Island. It consists of granite and gneiss mountains that rise to 364 m. The only vegetation on the island is patchy alpine tundra above the rocky coastal cliffs. Wrangel and Herald islands are surrounded by pack ice for most of the year and only briefly in late summer does the ice cover around the islands become sparse (Ovsyanikov 1996).

Outstanding Biological Features: Isolated off the north coast of the Chukotka Peninsula, Wrangel and Herald Islands are home to a vast diversity of plant and animal species. Over 380 species of plants have been recorded on the islands and several are found nowhere else in the world and believed to be relics from the time of the Bering Land bridge (10,000 to 12,000 years ago). Recent radiocarbon data suggests that wooly mammoths *(Mammuthus primigenius)* existed on Wrangel Island as recently as 4,000 to 7,500 years ago (Vartanyan 1995). One unique aspect of the island is the composition of species that are representative of distant regions, such as the steppes of Mongolia and Central Asia. The island boasts a number of endemic species, too: 24 vascular plants, 16 insects, and 2 lemmings (one of which is a subspecies) are endemic.

Fifty species of birds nest on Wrangel Island. A major breeding colony of snow geese *(Chen caerulescens)* is located on the island (Bousfield and Syroechkovskiy 1985, Cooch et al. 1995), as well as several Pacific black brant *(Branta bernicla)* (Ward et al. 1993). Thousands of black brant fly to Wrangel Island in late summer from North American breeding grounds to undergo a period of flightless molt. Approximately 500,000 seabirds, comprising eight species, nest on the islands. The large number of seabirds points to a rich abundance of marine fish and invertebrate life in the ocean surrounding the islands.

Nearly 80% of Bering and Chuckchi Sea populations of breeding female polar bears *(Ursus maritimus)* den and give birth to cubs on Wrangel and Herald islands (Ovsyanikov 1996). The area is also a hunting area for polar bears during winter since some of the highest densities of ringed *(Phoca hispida)* and bearded *(Erignathus barbatus)* seals are found on the islands. Nearly half the world's population of Pacific walrus *(Odobenus rosmarus divergens)* (over 100,000 animals) use the island for foraging and raising their offspring during summer months. Bowhead *(Balaena mysticetus)* and gray *(Eschrichtius robustus)* whales are found in the Chukchi Sea around Wrangel Island. These whales also occur with humpback whales *(Megaptera novaeangliae)* along the northern coast of the Chukotka Peninsula. The northern coast of the Chukotka Peninsula contains numerous coastal lowlands of tundra and wetlands used by breeding and migrating shorebirds and waterfowl. Polar bears use coastal mountains for denning and the area is a migratory and summer and fall feeding area for walrus, seals, whales, and seabirds.

Current Conservation Status: Wrangel and Herald Islands are designated as a strict nature reserve (zapovednik) currently administered by the Department of Protected Areas of the federal Committee of Environmental Protection of Russia. The protected area also includes a 25-50 km marine buffer zone around the islands. While protected on paper, Wrangel Island's remote location makes it an extremely expensive and difficult area to manage. Russia's economic crisis in the last several years has nearly crippled the country's nature reserve system which is in great need of technical and financial assistance. The Chukotka Coast has little formal protection.

Current Resource Use: Resource use is prohibited within the area of the Wrangel Island Nature Reserve (Zapovednik). Locations and species of subsistence and commercial harvest along the northern Chukotka coast is not known.

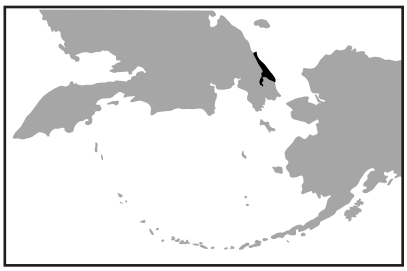
Description of Threats: Disturbance or pollution from transportation traffic through the Bering Strait and possibly along a newly proposed northern sea route (see Khlebovich 1994, Melnikov et al. 1994). Global climate change could alter the distribution of pack ice in the Bering Strait area and disrupt biological processes that take place at the ice edge or influence the ice as a habitat for numerous species.

Conservation and Management Agencies: Wrangel Island Reserve, Russian Institute of Nature and Conservation, Goskomchukotekologia (Chukotka Government Ecological Committee), the Far Eastern Branch of the Russian Academy of Sciences (Magadan and Vladivosktok), Government of the Chukotka

Autonomous Region

Area Description Contributors: S. Belikov, D. Cline, A. Golovkin, M. Petersen, S. Schliebe

Information Sources: Wrangel Island Reserve



Name: Kolyuchin Bay and Coast
Map ID Number: 3
Subregion I: Bering Strait/Southern Chukchi Sea
Location: An area that extends west from the northeast tip of the Chukotka Peninsula (western Bering Strait) to Cape Schmidt and north to Wrangel and Herald Islands.
Approximate Size: 69,009 km2
Ownership: Russian Federation

Description of area: This is an area that encompasses the Kolyuchin Bay on the northern coast of Chukotka, an enclosed bay protected by a series of spits and barrier islands. The highlighted area extends northwest along the coast of Chukotka, including marine and coastal habitats.

Outstanding Biological Features: This area is significant for its contributions of key habitat that support avian life in the Bering Sea. It is equally important for marine mammals. Kolyuchin Bay in particular is a site of importance for breeding, migrating and moulting waterfowl and shorebirds. It is one of only two sites in Russia where emperor geese *(Chen canagica)* are known to breed. The coastal area is rich in marine mammal life, fed by the nutrient-rich Anadyr Stream, which fuels prodigious primary production and also transports large volumes of zooplankton to the area. The coastal area is a key part of the migration route and foraging area of a number of cetacean species, particularly the bowhead whale *(Balaena mysticetus)*, as well as lesser numbers of fin (Balaena physalus) and humpback *(Megaptera novaeanliae)* whales. Killer whales *(Orcinus orca)* are common and even narwhals *(Monodon monocerus)* appear on occasion. In summer, gray whales *(Eschrichtius robustus)* and belugas *(Delphinapterus leucas)* are abundant. On shore, some of the Bering Sea's highest concentrations of ringed seals *(Phoca hispida)* are found along with other seals.

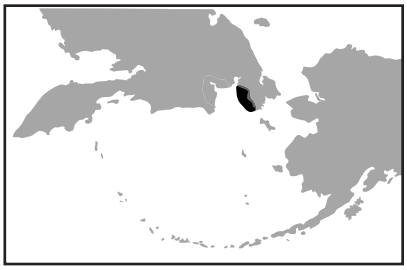
Conservation Status: None

Description of Threats: Threats to the region include the possible opening of a northern shipping route, which would increase marine traffic and associated human activities along the shore, including oil pollution.

Current Resource Use: Unknown

Relevant Conservation or Management Agencies: Goskomchukotekologia (Chukotka Government Ecological Committee), the Far Eastern Branch of the Russian Academy of Sciences (Magadan and Vladivosktok), ChukotNIRO (Chukotka Branch of the Pacific Research Institute of Fisheries and Oceanography)

Area Description Contributors: A. Golovkin, Y. Gerasimov, S. Belikov, A. Springer



Name: Sireniki Polynya
Map ID Number: 4
Subregion I: Bering Strait/Southern Chukchi Sea
Location: An open water, offshore area south and west of the village of Sireniki along the south side of the Chukotka Peninsula.
Approximate Size: 22,511 km2
Ownership: Russian Federation

Description of area: A coastal ice-free area in winter, this polynya is created by prevalent northerly winds (Smith et al. 1990). Located along the northeastern coast of the Gulf of Anadyr, the polynya extends westwards from St. Lawrence Island, Alaska to Meechkin Spit at the southern portion of Krest Bay, Russia. The area is biologically diverse and abundant during all times of the year primarily because of the Anadyr Stream that sweeps nutrients and plankton into the area. As a result, the area provides abundant primary and secondary production, which feeds populations of higher trophic species, such as fish, marine mammals, and sea ducks.

Outstanding Biological Features: An area of outstanding species abundance throughout the year. In winter months, thousands of birds, such as common murres *(Uria aalge)*, glaucous gulls *(Larus hyperboreus)*, oldsquaw *(Clangula hyemalis)*, eiders *(Somateria spp.)*, including specatacled eiders *(S. fischeri)* congregate in the forage-rich waters of the polynya. Pacific walrus *(Odobenus rosmarus divergens)* are found here, also, in winter. In spring, fall and winter, many beluga whales *(Delphinapterus leucas)* can be found here.

In summer months the area is very important for the Anadyr population of Pacific walrus. Two coastal areas in this section of the Gulf of Anadyr (Meechkin Spit and Rudder Spit) form the only large haul-outs and breeding areas for Pacific walrus in the entire Bering Sea. These populations may be non-migratory and thus part of an isolated population during summer and winter (G. Smirnov, pers. comm.). Ringed seal *(P. hispida)*, spotted seal *(P. largha)*, bearded seal *(Erignathus barbatus)*, gray whale *(Eschrichtius robustus)*, bowhead whale *(Balaena mysticetus)*, and beluga whale use the area as a breeding and foraging site as well as a migratory corridor to the Bering Strait. More rare, but occasionally sighted are the humpback whale *(Megaptera novaeangliae)* and fin whale *(Balaenoptera physalus)*. Colonies of breeding seabirds cover the cliffs and total numbers of birds exceeds a million (Konyukov et al. 1999).

Current Conservation Status: None.

Current Resource Use: The commercial fish harvest for this area is rather limited. In 1993-1995, a small-scale fishery (two-three vessels) was open for Polar cod and capelin, however conditions were variable and the fishery was unsuccessful. The total annual harvest here did not exceed 63 thousand tons on the Anadyr Gulf area.

Description of Threats: Disturbance or pollution from transportation traffic through the Bering Strait (see threats described for Wrangel Island, above) could result if and when the northern sea route is opened. Oil and gas exploration of Russian coastal areas near the Gulf of Anadyr, upstream from Sireniki Polynya, has been proposed in recent years (Newell et al. 1999). The release of oil or other pollutants from coastal processing of oil could cause impacts to biological resources (see Khlebovich 1994, Melnikov et al. 1994). There is concern that pollution from now-decrepit nuclear reactors that were established to power navigation lights along the coast of Russia are being released into the environment. Global climate change could disrupt the distribution of pack ice in the Bering Strait area and disrupt biological processes that take place at the ice edge or influence the ice as a habitat for numerous

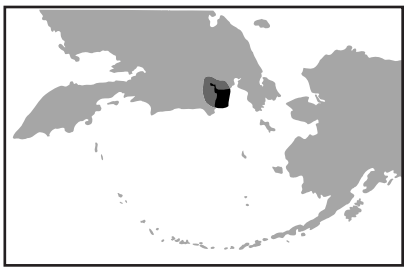
species. Unregulated hunting, overfishing and entanglement of marine mammals in ocean debris are continual concerns in this area.

Relevant Conservation and Management Agencies: Kaira Club, Goskomchukotekologia (Chukotka Government Ecological Committee), the Far Eastern Branch of the Russian Academy of Sciences (Magadan and Vladivosktok), ChukotNIRO (Chukotka Branch of the Pacific Research Institute of Fisheries and Oceanography)

Area Description Contributors: S. Belikov, A. Golovkin, G. Smirnov, A. Springer, V. Radchenko

Information Sources: Kaira Club (Chukotka), Goskomchukotekologia (Chukotka Government Ecological Committee), the Far Eastern Branch of the Russian Academy of Sciences (Magadan and Vladivosktok), Pacific Scientific Research Fisheries Center (TINRO-Center)

Name: Anadyr River Estuary
Map ID Number: 5
Subregion I: Bering Strait/Southern Chukchi Sea
Location: A large estuary and bay in northeastern Russia near the capital city of Anadyr.
Approximate Size: 45,198 km2
Ownership: Russian Federation



Description of area: The lower reaches of the Anadyr River are a dense network of river channels, and marine wetlands, comprising a rich estuary system that supports abundant wildlife. Vegetation is characteristic of coastal marine wetlands with areas of shrub, tussock, upland, and polygonal tundra further interior (Newell et al. 1999).

Outstanding Biological Features: Waterfowl and shorebirds are particularly numerous in the Lower Anadyr Delta. Large numbers of Pacific black brant *(Branta bernicla)*, white-fronted geese *(Anser albifrons)*, and emperor geese *(Chen canagica)*, are found in the area. (Petersen et al. 1994). In fact, the area is one of the main nesting areas in Russia for the species. The Anadyr River is a spawning area for salmon *(Oncorhynchus spp.)* and large numbers of capelin *(Mallotus villosus socialis)* (Naumenko 1996).

Current Conservation Status: Four special purpose preserves (zakazniks) are located within the Anadyr River estuary. The total area is 1,050 km2 of terrestrial habitat and 33,700 km2 of marine habitat. However, as a rule, zakazniks are not particularly well-enforced, especially with current budget cuts in the Russian environmental field. Zakazniks have no permanent staff; they are typically the management responsibility of the local game management department. Large expanses of territory identified within this priority area currently have no designation whatsoever for conservation.

Current Resource Use: The lower Anadyr River area is the most highly populated region of Chukotka, with a population of 8,000 in Anadyr, the capital of the region, and some 6,000 people living in surrounding villages. The largest commercial harvest of fish in Chukotka occurs in this area. Primary targets of the fishery are salmonid species: chum salmon *(Onchorhynchus keta)* pink salmon *(Onchorynchus gorbuscha)*, silver salmon *(Onchorhynchus kisutch)* and *Salvelinus alpinus*. Smelt *(Osmerus sp.)* and whitefish *(Coregonus sp.)* are also fished commercially here. Additionally, the area sees intensive sport hunting of waterfowl in the spring. (The chum fishery is only conducted in this area by beach and river seine with an annual harvest of 11,200 37,000 to tons in 1990s).

Description of Threats: Pollution from the town of Anadyr (pop. 8,000) appears to be the most likely threat currently. According to the National Research Council (1996), all sewage waste from Anadyr was dumped directly to the sea without treatment. Pollution from mining operations along interior section of the Anadyr River could also cause harmful discharge. Oil and gas exploration of Russian coastal areas near the Gulf of Anadyr, southwest of the Bering Strait, has been proposed in recent years (Newell et al. 1999). The release of oil or other pollutants from coastal processing of oil could cause impacts to biological resources (see Khlebovich 1994, Melnikov et al. 1994). Disturbance or pollution from transportation traffic through the Bering Strait and along the northern sea route (estimated at 1,000 vessels annually) is a potential. Global climate change could disrupt the distribution of pack ice in the Bering Strait area and disrupt biological processes that take place at the ice edge or influence tidal flows and thus vegetation and forage patterns for coastal species.

Relevant Conservation and Management Agencies: Naukan Association of Natives, Kaira Club (Chukotka), Union of Marine Mammal Hunters, Goskomchukotekologia (Chukotka Government Ecological Committee), TINRO (Pacific Research Institute of Fisheries and Oceanography), Kamchatrybvod, the Far Eastern Branch of the Russian Academy of Sciences (Magadan and Vladivosktok), Government of the Chukotka Autonomous Region

Area Description Contributors: S. Belikov, G. Smirnov, V. Radchenko

Information Sources: Goskomchukotekologia (Chukotka Government Ecological Committee), the Far Eastern Branch of the Russian Academy of Sciences (Magadan and Vladivosktok), Government of the Chukotka Autonomous Region

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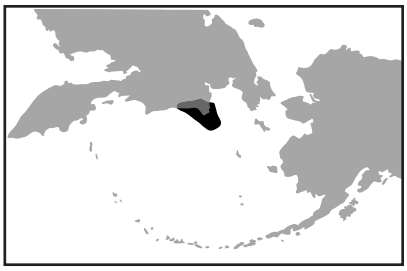
Name: Cape Navarin and Meynypil'gyno River System
Map ID Number: 6
Subregion III: Kamchatka Shelf and Coast
Location: Cape Navarin is approximately 200 km south of the mouth of the Anadyr River. Meynypil'gyno Lagoon is approximately 100 km west of Cape Navarin.
Approximate Size: 27,840
Ownership: Russian Federation



Outstanding Biological Features: The Anadyr Stream current that flows past Cape Navarin, is highly productive as a result of nutrient cycling and ocean upwelling from deep water areas along the Bering Sea continental shelf (Springer et al. 1993, 1996). This nutrient-rich current flows into and out of the Gulf and creates a very productive ocean area that supports great numbers of pelagic and benthic fauna (Springer et al. 1996). From Cape Navarin south to Cape Olyutorsk, ocean bottom temperatures are 0.5—3.0 °C colder than inner regions of the Gulf of Karaginskiy. Circulation brings nutrients from these cold water reservoirs up to the uppermost layers where photosynthesis takes place. This process contributes to high levels of primary and secondary production and elevated biomass of phytoplankton and zooplankton (Springer et al. 1996).

Cape Navarin is the site of one of the largest seabird colonies in northeastern Russia. Predominant marine life in the area includes the gray whale *(Eschrichtius robustus)*, killer whale *(Orcinus orca)*, humpback whale *(Megaptera novaeangliae)*, and fin whale *(Balaenoptera physalis)* (Sobolevsky and Mathisen 1996). Bowhead whales *(Balena mysticetus)* over winter in the area and beluga whales *(Delphinapterus leucas)* migrate through the area in conjunction with seasonal movements of the ice pack. Ice-associated seals [ringed *(Phosa hispida)*, spotted *(P. largha)*, ribbon *(P. rasciata)* and bearded *(Erignathus barbatus)*]

breed in the area. Haul-outs of Pacific walrus *(Odobenus rosmarus)* and Steller sea lion *(Eumetopias jubatus)* are found along the coast. Pacific walrus and beluga whales *(Delphinapterus leucas)* are found in the area during winter.

Meynypil'gyno Lagoon is a lake and riverine system of coastal wetlands. Numerous species of waterfowl and shorebirds nest in the area. Sockeye salmon *(Oncorhynchus nerka)* spawn in the rivers. Large numbers of beluga whales spend the winter near Meynypil'gyno Lagoon, as do smaller numbers of bowhead whale, Pacific walrus, and seals.

Current Conservation Status: No special protection measures are in place for Cape Navarin and the Meynypil'gyno River System.
Current Resource Use: A commercial fishery for sockeye salmon, pollock, cod and other groundfish is located in adjacent waters.

Description of Threats: Pollution from the town of Anadyr (pop. 8,000-12,000) appears to be the most likely threat currently. According to the National Research Council (1996), all sewage waste from Anadyr was dumped directly to the sea without treatment. Pollution from mining operations along interior section of the Anadyr River could also cause harmful discharge. Oil and gas exploration of Russian coastal areas near the Gulf of Anadyr, southwest of the Bering Strait, has been proposed in recent years (Newell et al. 1999). The release of oil or other pollutants from coastal processing of oil could cause impacts to biological resources (see Khlebovich 1994, Melnikov et al. 1994). Disturbance or pollution from transportation traffic through Bering Strait and along the northern sea route (estimated at 1,000 vessels annually) is a potential. Global climate change could disrupt the distribution of pack ice in the Bering Strait area and disrupt biological processes that take place at the ice edge or influence tidal and thus vegetation and forage patterns for coastal species.

Relevant Conservation and Management Agencies: Naukan Association of Natives, Kaira Club (Chukotka), Union of Marine Mammal Hunters, Goskomchukotekologia (Chukotka Government Ecological Committee), TINRO (Pacific Research Institute of Fisheries and Oceanography), Kamchatrybvod, the Far Eastern Branch of the Russian Academy of Sciences (Magadan and Vladivosktok), Government of the Chukotka Autonomous Region

Area Description Contributors: S. Belikov, G. Smirnov

Information Sources: Goskomchukotekologia (Chukotka Government Ecological Committee), the Far Eastern Branch of the Russian Academy of Sciences (Magadan and Vladivosktok), Government of the Chukotka Autonomous Region

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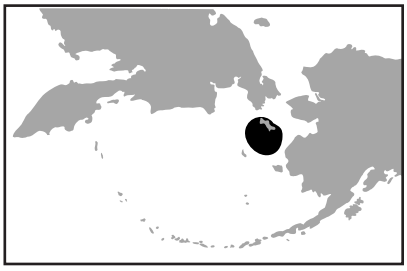
Name: St. Lawrence Island
Map ID number: 7
Subregion I: Bering Strait/Southern Chukchi Sea
Location: South of the Bering Strait in the northern Bering Sea.
Approximate Size: 106,437 km2
Ownership: Sivuqaq Native Corporation



Description of area: St. Lawrence island is a landmass of 2,000 square miles. As a result of its position and historic contact with both Asia and North America during the time of the Bering Land Bridge, flora and fauna of the island is particular to both palearctic and nearctic regions. Biotic communities are similar to mainland areas, but are somewhat modified due to the isola-

tion of the island and its unique climate (Fay and Cade, 1959). Tundra vegetation is the predominant type and most plants grow very close to the ground due to the high and frequent winds. The vast majority of wildlife, primarily birds, is concentrated along the coast where sea cliffs and talus hillsides provide nesting habitat for seabirds and shallow near shore areas form marine foraging habitat for sea ducks.

Outstanding Biological Features: Ocean areas surrounding the island exhibit high concentrations of benthic invertebrates, including bivalve mollusks *(Nuclea radiata, N. buloti, and Macoma calcarea)*, polychaetes, amphipod communities, blue king crabs *(Paralithodes platypus)*, and snow crabs *(Chionoecetes opilio)* (Grebmeier et al. 1988a, b, Grebmeier and Cooper 1995). The area hosts a large concentration of halibut *(Hippoglossus stenolepis)*. Ocean areas around St. Lawrence are also important foraging sites for wintering and breeding Pacific walrus *(Odobenus rosmarus)*, ice-associated seals [spotted *(Phoca largha)*, ringed *(P. hispida)*, and ribbon *(P. fasciata)*, and bearded *(Erignathus barbatus)*], and bowhead *(Belaena mysticetus)*, beluga *(Delphinapterus leucas)*, minke *(Balaenoptera acutorostrata)*, and gray *(Eschrichtius robustus)* whales.

South of St. Lawrence Island, ice free areas associated with the St. Lawrence Island polynya provide winter habitat for the spectacled eider *(Somateria fischeri)*, a threatened sea duck in North America (Petersen et al. 1999a). During the winter, these sea ducks forage on rich benthic invertebrate communities, primarily bivalves, at depths that may exceed 40 m (Petersen et al. 1999b). King *(S. spectabilis)* and common *(S. mollissima)* eiders and oldsquaw *(Clangula hyemalis)* are found along the southern coast of St. Lawrence Island during summer months and in open water areas along the pack ice edge in winter. Polar bears *(Ursus maritmus)* hunt in these areas during the winter. In the spring and fall, the island is in a major migration corridor for birds and marine mammals.

Approximately 2.7 million seabirds breed on St. Lawrence Island (Hunt et al. 1981a, Fay and Cade 1959). Species include the pelagic cormorant *(Phalacrocorax pelagicus)*, glaucous gull *(Larus hyperboreus)*, black-legged kittiwake *(Rissa tridactyla)*, common *(Uria aalge)* and thick-billed *(U. lomvia)* murre, pigeon guillemot *(Cepphus columba)*, parakeet *(Cyclorrhynchus psittacula)*, crested *(Aethia cristatella)* and least *(A. pusilla)* auklets, as well as horned *(Fratercula corniculata)* and tufted *(Lunda cirrhata)* puffin.

Current Conservation Status: None.

Current Resource Use: Subsistence hunting by village residents of Gambell and Savoonga for whales, walrus, seabirds, and waterfowl.

Description of Threats: An old U.S. military site on the northeast cape of St. Lawrence Island (approximately 9 square miles) contains at least 23 contaminated sites. According to contractors for the Army Corps of Engineers, these sites require environmental investigation and cleanup. Contamination includes fuel spills totaling over 220,000 gallons, solvents, heavy metals, dioxins and furans, asbestos, and PCBs. One of the several barrel dumps contains approximately 29,500 drums (Alaska Community Action on Toxics, Anchorage, Alaska). Oil and gas exploration of Russian coastal areas near the Gulf of Anadyr, southwest of the Bering Strait, has been proposed in recent years (Newell et al. 1999). The release of oil or other pollutants from coastal processing of oil could cause impacts to biological resources (see Khlebovich 1994, Melnikov et al. 1994). There is also a potential for spills of radionuclides from Russian nuclear generators used to power navigation lights along the coast of the Chukotka Peninsula. Global climate change could disrupt the distribution of pack ice in the Bering Strait area and disrupt biological processes that take place at the ice edge or influence the ice as a habitat for numerous species.

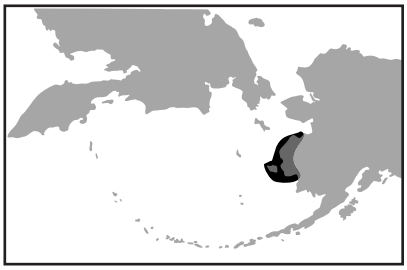
Relevant Conservation and Management Agencies: Sivuqaq Native Corporation, U.S. Fish and Wildlife Service, Eskimo Walrus and Whaling Commissions, Alaska Nanuuq Commission, Alaska Marine

Conservation Council, Alaska Community Action on Toxics

Area Description Contributors: C. Johnson, M. Petersen, J. Grebmeier, A. Springer

Information Sources: Sivuqaq Native Corporation, U.S. Fish and Wildlife Service, Alaska Community Action on Toxics

Name: Yukon-Kuskokwim Delta and Nunivak Island
Map ID number: 8
Subregion II: Bering Sea Shelf
Location: Along the west coast of Alaska in the eastern Bering Sea.
Approximate Size: 53,361 km2
Ownership: Native Corporations, the United States



Description of area: The Yukon and Kuskokwim Rivers meander through a vast expanse of treeless marsh and wetland that forms the Yukon-Kuskokwim Delta. Coastal vegetation is composed of salt tolerant marsh plants, whereas more interior areas are characterized by tundra and upland plant communities. Large tidal fluctuations near the coast, along with occasional storm tide surges, flood coastal areas with salt water creating invertebrate rich coastal marshes used by waterfowl and shorebirds. Nunivak Island, approximately 50 km southwest of the Yukon-Kuskokwim Delta comprises 445,000 hectares of coastal and interior wetland complexes and upland tundra with rocky sea cliffs along the coasts. The southern 243,000 hectares is designated as wilderness.

Outstanding Biological Features: The elaborate maze of lakes, ponds, and rivers that cover the Yukon-Kuskokwim Delta creates habitats for the largest concentrations of breeding waterfowl (King and Dau 1981) and shorebirds (Gill and Handel 1981) in North America. Over 20 species of waterfowl and 10 species of shorebirds breed on the delta. Common goose species include the Pacific black brant *(Branta bernicla)*, white-fronted goose *(Anser fabalis)*, cackling Canada goose *(Branta canadensis minima)*, and the sole North American breeding population of the Bering Sea endemic emperor goose *(Chen canagica)*. Diving duck species include the oldsquaw *(Clangula hyemalis)*, scaup *(Aythya spp.)* common eider *(S. mollissima)*, and the spectacled eider *(Somateria fischeri)*, a threatened species in North America (Stehn et al. 1993, Ely et al. 1994). Dabbling ducks include northern pintail *(Anas acuta)*, green-winged teal *(A. crecca)*, and northern shoveler *(A. clypeata)*.

Coastal littoral and wetland areas of the Yukon-Kuskokwim Delta are used by hundreds of thousands of migrating shorebirds during spring and fall (Gill and Handel 1981). Common breeding shorebird species include the black-bellied plover *(Pluvialis squatorola)*, bar-tailed godwit *(Limosa lapponica)*, ruddy *(Arenaria interpres)* and black *(A. melanocephala)* turnstone, red-necked phalarope *(Phalaropus lobatus)*, long-billed dowitcher *(Limnodromus scolopaceus)*, red knot *(Calidris canutus)*, semipalmated sandpiper *(C. pusilla)*, western sandpiper *(C. mauri)*, and dunlin *(C. alpina)*. Bearded *(Erignathus barbatus)* and harbor *(Phoca vitulina richardsi)* seals, Steller sea lions *(Eumetopias jubatus)*, Pacific walrus *(Odobenus rosmarus divergens)*, and beluga whales *(Delphinapterus leucas)* are found in coastal waters of the delta and occasionally near river mouths where they feed on salmon *(Oncorhynchus spp.)* and white fish *(Coregonus sp.)*.

Nunivak Island supports introduced herds of muskox *(Ovibos moschatus)* and reindeer *(Rangifer tarandus)*. The muskox herd is used as a breeding stock to establish herds elsewhere in Alaska and Russia. The reindeer herd is a major source of food and income for island residents. Approximately 85% of seabird colonies on Nunivak Island are comprised of common murres *(Uria aalge)* (Hunt et al. 1981a).

Other species include the black-legged kittwake *(Rissa tridactyla)*, thick-billed murre *(U. lomvia)*, pigeon guillemot *(Cepphus columba)*, parakeet auklet *(Cyclorrhynchus psittacula)*, pelagic cormorant *(Phalacrocorax pelagicus)*, and horned puffin *(Fratercula corniculata)*. The abundance of wildlife has made the Yukon-Kuskokwim Delta the heart of Yupik Eskimo culture for thousands of years. The delta encompasses 42 Eskimo villages whose residents depend on the coastal and interior wildlife resources of the area for subsistence.

Current Conservation Status: Although a large portion of this site falls within a National Wildlife Refuge, Native individuals or corporations own biologically significant tracts within the Refuge. The marine portion of this site is not in any formal conservation status.

Current Resource Use: Grazing activity by reindeer on the southern half of Nunivak Island began prior to Wilderness designation and will be allowed to continue as provided for in the Alaska National Interest Lands Conservation Act and the legislation designating these lands as Wilderness. Subsistence harvest of muskox occurs on Nunivak Island. Subsistence hunting of seals, migratory birds, and collection of plants occurs on Nunivak Island and on the Yukon-Kuskokwim Delta. Commercial and local subsistence fishing of salmon and white fish also takes place on the Yukon-Kuskokwim Delta.

Description of Threats: Heavy metal or radionuclide contamination can become incorporated into marine mammals, fish, and birds that are then caught and consumed by village populations (see Khlebovich 1994, Melnikov et al. 1994). Mismanagement of fisheries resources, upon which many seabirds, marine mammals, and native subsistence and commercial users depend, is of concern. Disturbance or pollution from transportation traffic through Bering Strait and from barge traffic along smaller rivers on the delta to access inland villages. Additionally, oil spills coincident with a storm surge tide in early fall could have drastic impacts to coastal habitats (Gill and Handel 1981). Lead poisoning of bottom feeding waterfowl comprises another threat.

Relevant Conservation or Management Agencies: Association of Village Council Presidents, Alaska Department of Fish and Game, U.S. Fish and Wildlife Service, Clarence Rhode (Yukon Delta) National Wildlife Refuge

Area Description Contributors: C. Lensik, M. Petersen

Information Sources: Association of Village Council Presidents, Alaska Department of Fish and Game, National Marine Fisheries Service, U.S. Fish and Wildlife Service, University of Alaska, Fairbanks

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Name: The Golden Triangle
Map ID Number: 9
Subregion II: Bering Sea Shelf
Location: A triangle-shaped area that encompasses areas in the Aleutian Islands, east of Bogoslof Island to Izembek Lagoon on the Alaska Peninsula and north to the Pribilof Islands.
Approximate Size: 202,474 km2. Within this area, Izembek National Wildlife Refuge encompasses 1.2 million hectares of land and water: Izembek Refuge (170,000 hectares); the Pavlof and North Creek Units of the Alaska Peninsula Refuge (610,000 hectares); and Unimak Island in the Alaska Maritime Refuge (400,000 hectares). Total area within the triangle of Bogoslof Island, Izembek Lagoon, and the Pribilof Islands is 202,474 km2.
Ownership: Coastal seabird colonies are managed by the U.S. Fish and Wildlife Service and are part of

the Alaska Maritime National Wildlife Refuge. Fur seal rookeries are managed by the National Marine Fisheries Service in cooperation with the Ecosystem Conservation Office of the Tribal Government of St. Paul. Remaining land is either owned by the State of Alaska or by Native Corporations.

Description of area: The ocean area within the Golden Triangle of Bogoslof Island, Izembek Lagoon, and the Pribilof Islands is situated at the southeast corner of the Bering Sea. This area is partitioned into biophysical domains that delineate habitats for many species. The ocean area within the Golden Triangle is unique in having four types of shelf domain within a limited space. These domains include the inner shelf (< 50 m in depth), the middle shelf (50-100 m in depth), the outer shelf (100 – 200 m in depth), and the continental slope (> 200 m in depth). Characteristics such as currents, temperature, salinity, timing of spring bloom, community structure of plankton, and carbon flux differ among these domains (Iverson et al. 1979, Cooney 1981, Walsh and McRoy 1986, Schumacher and Stabeno 1998, Springer et al. 1996). Part of the area can be covered by sea ice during winter months. The three points that comprise the Golden Triangle are described in the following paragraphs.

Bogoslof Island is a small (approximately 70 hectares and 100 m in elevation) rocky island 80 km west of Dutch Harbor, Alaska. The island was created during a suboceanic eruption in May of 1796 and has changed size and shape a number of times since it first rose out of the Bering Sea. Volcanic events have occurred at Bogoslof at least six times this century, including a major dome building event in the summer of 1992. The island now provides rocky cliff habitat for thousands of breeding seabirds and beaches for thousands of fur seals and hundreds of sea lions. The Aleutian North Slope Current bathes this region with Alaskan Stream water and then flows toward and then along the continental slope of the Golden Triangle (Stabeno et al., in press a Reed and Stabeno, in press). This current intimately links the biology along the Aleutian Islands to that of the outer shelf.

Izembek Lagoon contains one of the world's largest beds of eelgrass *(Zostera marina),* a marine grass that is an important substrate used by numerous invertebrate and vertebrate species during various life cycle stages. The landscape surrounding Izembek Lagoon includes volcanoes, glaciers, valleys, and tundra uplands sloping down to lagoons of the Bering Sea and North Pacific Ocean. The 370,000 hectare Unimak Island Wilderness comprises habitats that vary from low coastal wetlands to ice fields of the island's volcanic peaks. Much of the area is characterized by low-growing sedge and grass tundra, extensive ash flats and old lava flows, and permanent ice fields at the higher elevations. On the west side of Unimak Island is Unimak Pass, a 25 km ocean pass that is the first main entrance for North Pacific Ocean waters into the Bering Sea.

The Pribilof Islands (St. Paul, St. George, Walrus, and Otter) are located in the central Bering Sea 300 km north of the Aleutian Islands chain and 500 km west of the mainland. St. George has hills and ridges with steep cliffs rising up to 300 m, whereas St. Paul has a rolling plateau with some extinct volcanic peaks (National Research Council 1996). The islands are treeless and vegetation is comprised of tundra meadow communities. Waters from the continental slope interact with island bathymetry to create potentially trapped circulation around St Paul Island and also provide a source of nutrients and planktonic material (Stabeno et al, in press b).

Outstanding Biological Features: Bogoslof Island provides nesting habitat for nearly 100,000 seabirds, including red-legged kittiwakes *(Rissa brevirostris)*, which breed at only four sites in the world—all in the Bering Sea (Byrd 1978). Bogoslof Island contains a rookery of threatened Steller sea lions *(Eumetopias jubatus)* and a rapidly growing breeding population of northern fur seals *(Callorhinus ursinus)*.

The most outstanding feature of Izembek Lagoon is the large amount of eelgrass. Eelgrass is used as forage and a breeding and wintering habitat for numerous invertebrate and vertebrate species (Orth 1992). Izembek Lagoon is a critically important habitat for migrating and wintering waterfowl. Hundreds of thousands of waterfowl, including nearly the entire population of Pacific black brant geese *(Branta bernicla)*, most of the world's emperor geese *(Chen canagica)*, and the vast majority of the world's Pacific

population of Steller's eider, a threatened species in North America, use the lagoon during spring and fall migration. Black brant feed almost exclusively on eelgrass during the fall staging period before migrating to wintering areas on the Baja Peninsula of Mexico. Izembek Lagoon provides the final opportunity for many migrating shorebirds to feed and rest before their long over-water flights to wintering areas as far away as South America, Polynesia, and New Zealand. Numerous species of seabirds and marine mammals inhabit the surrounding marine environment. Harbor seals *(Phoca vitulina)* and sea otters *(Enhydra lutris)* frequent lagoon waters and congregate at haul-outs along sand and rock beaches. Steller sea lions are seen occasionally in the lagoon and use offshore rocky islands for haul-outs and rookeries. Gray *(Eschrichtius robustus)*, killer *(Orcinus orca)*, and minke *(Balaenoptera acutorostrata)* whales migrate along the coastline.

The Unimak Pass region is physically dynamic and highly productive. Immense numbers of shearwaters *(Puffinus spp.)* feed there in summer, and many other species of seabirds migrate through the area during spring and fall. This is also a major wintering area for auklets *(Cyclorrhynchus spp. and Aethia spp.)*.

The Pribilof Islands (and St. Matthew Island to the north) exhibit an extraordinary abundance and diversity of marine life (Hood and Calder 1983) as they comprise a rare island habitat, situated on the Bering Sea shelf. This location provides breeding space and access to a variety of feeding habitats, such as middle domain, outer domain, shelf-edge and oceanic. Seabird colonies on the islands are among the largest in the northern hemisphere, comprising nearly 2.5 million birds (Hunt et al., 1981a). Breeding colonies of more than one million thick-billed murres *(Uria lomvia)* occur here. Other breeding seabirds include the black-legged kittiwake *(Rissa tradactyla)*, parakeet auklet *(Cyclorrhynchus psittacula)*, crested auklet *(Aethia cristatella)*, least auklet *(Aethia pusilla)*, northern fulmar, and red-faced cormorant *(Phalacrocorax urile)*. Well over 80% of the world's population of the endemic red-legged kittiwake breeds on the Pribilof Islands (Byrd et al. 1997). Large numbers of short-tailed *(Puffinus tenuirostris)* and sooty *(P. griseus)* shearwaters forage in the area during summer months before returning to the southern hemisphere to breed during the austral summer (Hunt et al. 1981b). The Pribilof Islands are home to approximately 800,000 northern fur seals *(Callorhinus ursinus)*, approximately 80% of the world's population (NMFS 1993). Large concentrations of blue king crab *(Paralithodes platypus)*, snow crab *(Chionoecetes opilio)*, and hair crab *(Erimacrus isenbeckii)* are found in offshore waters (National Research Council 1996).

Due to the presence of the four biophysical domains in the area, the Golden Triangle supports diverse assemblages of species. Furthermore, physical processes such as tidal mixing, eddy pumping, and currents contribute to high levels of primary and secondary production that support higher trophic levels (Springer et al. 1996). For instance, the concentration of squid *(Berryteuthis spp. and Gonatus spp.)* along the shelf edge attracts chinook salmon *(Oncorhynchus tshawytscha)*, a squid specialist found along the shelf during the summer feeding period. A number of other species are attracted by the rich food source at the shelf edge and elsewhere in the region including the commercially valued walleye pollock *(Theragra chalcogramma)*, Pacific Ocean perch *(Sebastes alutus)*, Pacific cod *(Gadus macrocephalus)*, sablefish *(Anoplopoma fimbria)*, Greenland turbot *(Reinhardtius hippoglossoides)*, arrowtooth flounder *(Atheresthes stomias)*, Pacific halibut *(Hippoglossus stenolepis)* herring *(Clupea harengus)*, and large concentrations of capelin *(Mallotus villosus)* (Naumenko 1996, National Research Council 1996, Springer et al. 1996). The shelf edge also plays a central role in the life cycle of marine mammals, such as northern fur seals and fin *(Balaenoptera physalus)* and sperm whales *(Physeter macrocephalus)*. Like the chinook salmon, sperm whales are squid specialists and congregate at the shelf edge for feeding. Other whales, such as the blue *(Balaenoptera musculus)*, minke *(B. acusorostrata)*, Stejneger's beaked *(Mesoplodon stejnegeri)*, and Dall's porpoise *(Phocoenoides dalli)* are also shelf edge species (Lowry et al. 1982).

Current Conservation Status: Bogoslof Island is a wilderness area within the Aleutians Islands unit of the Alaska Maritime National Wildlife Refuge. The majority of Unimak Island and Izembek National

Wildlife Refuge are designated as Wilderness. (The Izembek Wilderness area is 300,000 acres in area, while the Unimak Wilderness area is 910,000 acres). Izembek Lagoon and coastal wetlands are protected within the state-run Izembek Game Refuge, while the adjacent watershed is ecompassed by the federally designated Izembek National Wildlife Refuge. Izembek Lagoon is also a Wetland of International Importance (Ramsar Convention). Rocky cliff areas of the Pribilof Islands are managed as the Bering Sea unit of the Alaska Maritime National Wildlife Refuge (U.S. Fish and Wildlife Service). Aiktak Island, a large seabird colony near Unimak Pass and other nearby islands are part of the Alaska Maritime NWR. There is no specific conservation designation within the marine area of the Golden Triangle. Many terrestrial areas with critical coastal habitat remain unprotected. Some of these areas are privately owned or could be subject to incompatible resource use.

Current Resource Use: Commercial fishing and crabbing operations are located around the Pribilof Islands. Other fisheries, based out of Dutch Harbor, Unalaska and Bristol Bay fish the area for salmon, halibut, pollock, and other groundfish. Subsistence use of seabirds, fur seals, sea lions and fish is important on the Pribilofs and elsewhere in the Golden Triangle area.

Description of Threats: Mismanagement of fisheries resources, upon which many seabirds, marine mammals, and native subsistence and commercial users depend, is of concern. Disturbance or pollution from transportation traffic through Unimak Pass, the terminus for the Alaska Peninsula and one of the first points of contact between the Bering Sea and Northern Gulf of Alaska. The U.S. Coast Guard estimated that 3,000-4,000 ships pass through Unimak Pass each year (Louis Berger and Associates 1984). Oil spills in any of these areas would have devastating impacts to wildlife habitats and fisheries resources. Accidental introduction of rats to Bogoslof Island or Pribilof Islands from shipping traffic, either by running aground off shore or regular port docking, would have drastic consequences for seabirds as most nest in colonies and lay only one or two eggs each year. Entanglement of marine mammals in ocean debris, especially for fur seals, is a continual concern.

Relevant Conservation or Management Agencies: Aleutian Islands East Borough, Pribilof Partners (King Cove, Alaska), National Marine Fisheries Service, U.S. Fish and Wildlife Service, Alaska Department of Fish and Game, Central Bering Fishermen's Association, Native Corporations, State of Alaska

Area Description Contributors: V. Byrd, M. Petersen, A. Sowls

Important information Sources: Izembek National Wildlife Refuge, Alaska Maritime National Wildlife Refuge

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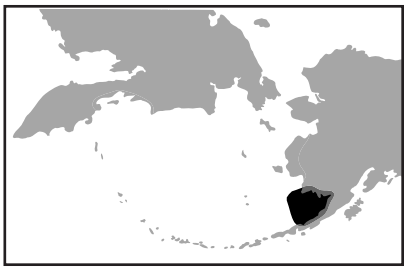

Name: Bristol Bay
Map ID number: 10
Subregion II: Bering Sea Shelf
Location: An ocean area in the eastern Bering Sea of southwestern Alaska. The area described here encompasses all areas north and east of Port Moller on the Alaska Peninsula, north and west to Cape Newenham.
Approximate Size: 98,716 km2
Ownership: U.S. Fish and Wildlife Service, State of Alaska, Native Corporations

Description of area: A large ocean area that contains two biophysical oceanic domains or habitats: the coastal domain (< 50 m in depth) and a middle shelf domain (50 – 100 m in depth). These domains

differ in regard to their currents, temperature, salinity, timing of spring bloom, community structure of plankton, and carbon flux (Schumacher and Stabeno, 1998). The break between these two domains winds its way along the north side of the Alaska Peninsula and through the central portion of Bristol Bay generally following the 50 m isobath (Schumacher et al. 1979). Much of Bristol Bay can be covered by sea ice during winter months. Bristol Bay is bordered to the north, west and south by often rugged, mountainous shorelines, as well as sand and gravel beaches, lagoons, estuaries, and river mouths. Hagemeister and Walrus Islands (approximately 60 and 20 square miles, respectively), are located in the northern portion of Bristol Bay. Coastal areas are vegetated by ryegrass *(Elymus spp.)*, cotton grass *(Eriophorum spp.)*, mosses, and succulents.

Outstanding Biological Features: Bristol Bay contains some of the largest populations of ground fish, crabs, and marine mammals in the world, especially in the eastern portion of the bay and along the north side of the Alaska Peninsula (Bakkala 1993). Large concentrations of sockeye salmon *(Oncorhynchus nerka)*, walleye pollock *(Theragra chalcogramma)*, Pacific cod *(Gadus macrocephalus)*, Pacific halibut *(Hippoglossus stenolepis)*, yellowfin sole *(Pleuronectes asper)*, rock sole *(P. bilineatus),* and flathead sole *(Hippoglossoides elassodon)* are found in the area. Red king crab *(Paralithodes camtschatica)*, tanner crab *(Chionoecetes bairdi)* and snow crab *(C. opilio)* are abundant.

Several haul-outs and breeding areas of Pacific walrus *(Odobenus rosmarus)* are located within the Bristol Bay region. These include those of the Round Island State Game Sanctuary near Togiak, Alaska. Spotted seals *(Phoca largha)* and six species of whale [beluga *(Delphinapterus leucas),* gray *(Eschrichtius robustus)*, humpback *(Megaptera novaeangliae)*, minke *(Balaenoptera acutorostrata)*, and right *(Eubalaena glacialis)* whale] use the off-shore waters for migration and foraging (Lowry et al. 1982). Sea otters *(Enhydra lutris)* are also found in the area, especially in the coastal lagoons of the southern portion of Bristol Bay.

The large abundance and diversity of fish in the area is an important component to the Bristol Bay and eastern Bering Sea ecosystem as these fish provide forage for other fishes, marine mammals, and birds (Bakkala 1993). Coastal areas of Bristol Bay are used by breeding and migrating waterfowl and shorebirds returning from wintering areas in Russia, Japan, Mexico, South America, New Zealand, and the South Pacific. There are several seabird colonies scattered along coastal areas of Bristol Bay, such as Cape Newenham and Cape Peirce. Bristol Bay contains the only substantial colonies of double-crested cormorant *(Phalacrocorax auritus)* in the Bering Sea (Hunt et al. 1981a). Other breeding seabird species include the pelagic *(P. pelagicus)* and red-faced *(P. urile)* cormorant, glaucous-winged gull *(Larus glaucescens)*, black-legged kittiwake *(Rissa tridactyla)*, Aleutian tern *(Sterna aleutica)*, common murre *(Uria aalge)*, pigeon guillemot *(Cepphus columba)*, parakeet auklet *(Cyclorrhynchus psittacula),* and horned *(Fratercula corniculata)* and tufted *(Lunda cirrhata)* puffin. Large numbers of short-tailed *(Puffinus tenuirostris)* and sooty *(P. griseus)* shearwaters forage in the area during summer months before returning to the southern hemisphere to breed during the austral summer (Hunt et al. 1981b). Coastal littoral and wetland areas of Bristol Bay are used by thousands of migrating shorebirds during spring and fall (Gill and Handel 1981). Common breeding shorebird species include the black turnstone *(Arenaria melanocephala)*, western *(Calidris mauri)* and rock *(C. ptilocnemis)* sandpiper, and dunlin *(C. alpina)*. Waterfowl, such as the emperor goose (*Chen canagica),* spend winter months in coastal lagoons. Large numbers of Steller's eiders *(Polysticta stelleri)*, threatened in North America, undergo their annual flightless molt and spend the winter in lagoon areas along the north coast of the Alaska Peninsula. Canada geese *(Branta canadensis)*, several species of dabbling duck, and songbirds also forage in coastal areas of Bristol Bay during spring and fall migration.

Current Conservation Status: Several coastal areas are within state or federal wildlife areas. These are the Togiak National Wildlife Refuge, Alaska Maritime National Wildlife Refuge, Alaska Peninsula National Wildlife Refuge, Cape Newenham State Game Refuge, Walrus Islands State Game Sanctuary, and the

State Critical Habitat Areas of Egegik, Pilot Point, Cinder River, Port Heiden, and Port Moller. Significant areas of private or non-conservation status lands exist within critical habitat, and there is little formal marine protection in this area.

Current Resource Use: Bristol Bay is home to the world's largest commercial sockeye salmon fishery, where 10 to 30 million sockeye salmon may be caught each year during only a few weeks time. Subsistence harvest of salmon and walrus (Fall et al. 1991) also takes place in the area. Harbor seals are also taken for subsistence.

Description of Threats: Mismanagement of fisheries resources, upon which many seabirds, marine mammals, and native subsistence and commercial users depend, is of concern. Oil spills in any of these areas would have devastating impacts to wildlife habitats and fisheries resources. There is also a potential for disturbance or pollution from transportation traffic through Unimak Pass, the terminus for the Alaska Peninsula and one of the first points of contact between the Bering Sea and Northern Gulf of Alaska. The U.S. Coast Guard estimated that 3,000-4,000 ships pass through Unimak Pass each year (Louis Berger and Associates 1984). Entanglement of marine mammals in ocean debris is a continual concern. Proposed commercial dredging for clams threatens bottom habitat in this area.

Relevant Conservation and Management Agencies: State of Alaska, Alaska Department of Fish and Game, U.S. Fish and Wildlife Service, National Marine Fisheries Service, Bristol Bay Native Association, Quassiq Walrus Commission

Area Description Contributors: V. Byrd, A. Sowls, J. Grebmeier

Information Sources: Alaska Department of Fish and Game, U.S. Fish and Wildlife Service, Bristol Bay Native Association, National Marine Fisheries Service

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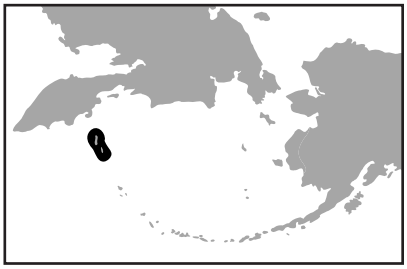


Name: Commander Islands
Map ID Number: 11
Subregion III: Kamchatka Shelf and Coast
Location: Situated approximately 125 miles (200 km) east of the Kamchatka Peninsula in the southwestern Bering Sea.
Approximate Size: 24,301 km2. The terrestrial area of Commander Islands Nature Reserve is 3,648,000 hectares; its marine protective zone (30 km zone around the islands) is 3,463,000 hectares.
Ownership: Russian Federation

Description of area: The Commander Islands (Bering, Medniy, and several smaller islands) are situated at the boundary between the Eurasian and North American continents and serve as a bridge for migrating species between these two continents. The area is therefore very diverse and interesting from a biogeographical standpoint. The islands are an above water portion of an underwater mountain ridge that rises nearly 4,000 m above the surrounding Kamchatka and Aleutian Basins. Several short and shallow rivers are located on the islands. Lakes are mostly of lagoon origin and there are no trees on the islands. Vegetation consists of upland tundra meadows and small bushes along the coasts. Nearly 500 species of plants have been identified on the islands (Newell et al. 1999).

Outstanding Biological Features: As a result of ocean upwelling from deep water areas of the surrounding Kamchatka and Aleutian basins, waters near the islands contain a rich diversity and abundance of invertebrate species. Coyle et al. (1996) found that ocean areas surrounding the Commander Islands

contained two distinct faunistic groups of zooplankton representing nearly 30 species.

Ocean areas surrounding the islands are feeding grounds for the humpback whale *(Megaptera novaeangliae)*, fin whale *(Balaenoptera physalus)*, sperm whale *(Physeter macrocephalus)*, killer whale *(Orcinus orca)* (Sobolevsky and Mathisen 1996), sea otter *(Enhydra lutis)*, and the threatened and declining Steller sea lion *(Eumetopias jubatus)* (Boltnev and Mathisen 1996). Steller sea lion rookeries are located in the area (National Marine Fisheries Service 1992). The islands contain approximately 15% of the world's breeding population of northern fur seal *(Callorhinus ursinus)* (National Marine Fisheries Service 1993).

Nearly 60 species of birds breed on the islands and several large seabird colonies are present. These include the horned puffin *(Fratercula corniculata)*, common murre *(Uria aalge)*, red-faced cormorant *(Phalacrocorax urile)*, and the endemic red-legged kittiwake *(Rissa brevirostris)*, which breeds at only four sites in the world—all in the Bering Sea (Byrd 1978). Wintering waterfowl are common and include the emperor goose *(Chen canagica)*, Steller's eider *(Polysticta stelleri)*, and oldsquaw *(Clangula hyemalis)*. Five endemic subspecies of birds, including one marine subspecies of the ancient murrelet *(Synthliborampus antiquus mycrorhynchos)* and the rock sandpiper *(Calidris ptilocnemis quarta)* (Tomkovich, 1987).

For a period of forty years, the shelf surrounding the Commander Islands was off limits to fishing. As a result of this lack of resource use, bottom communities have been little affected by commercial fisheries, particularly bottom trawling. The upper shelf is characterized by diverse macroalgal flora, which includes some 150 species. (Selivanova and Zhigadlova, 1997). Dense kelp forests of *Laminaria spp.* and *Alaria spp.* are found in the littoral zone. (Ivanjushina et al, 1991).

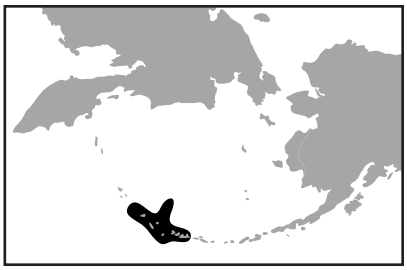
Current Conservation Status: A strict nature reserve (zapovednik) was established to incorporate the entire island group. This protective area includes a 30 mile zone around the islands for conservation of marine habitats. However, the reserve's protection regime is poorly enforced (see below). Poor communication capacity, lack of transportation, budget cuts by the federal government, loss of staff and deteriorating socioeconomic conditions on the islands are among some of the main obstacles to conservation.

Current Resource Use: There is an annual commercial harvest for northern fur seals on the island that consists of about 5,000 animals (Boltnev 1996). According to Newell et al. 1999, the economic collapse of the former Soviet Union has pushed local villagers to subsist on virtually every marine and terrestrial organism that occurs on Bering Island.

Description of Threats: Mismanagement of fisheries resources, upon which many seabirds, marine mammals, and native subsistence and commercial users depend, is of concern. Due to economic collapse of the former Soviet Union and resulting poverty in village communities, there is illegal harvest of just about every terrestrial and marine animal on the islands (Newell et al. 1999). Poaching by large and small fishing vessels within the rich waters of the protected marine zone is increasingly a problem, as the reserve staff has little capacity to address this pressure. Invasion by non-native species is another threat; currently 17 percent of the avifauna are alien species (Newell et al, 1999).

Relevant Conservation and Management Agencies: Kommandorsky Zapovednik, Kamchatrybvod (Kamchatka Territorial Board for the Preservation and Reproduction of Fish Resources and Regulation), Kamchatka Institute of Ecology and Natural Resources, Aleutian Pribilof Islands Association

Area Description Contributors: M. Williams, V. Burkanov
Information Sources: Kamchatrybvod (Kamchatka Territorial Board for the Preservation and Reproduction of Fish Resources and Regulation), Department of Nature Reserve Management of the Russian Federation's Committee on the Environment



Name: Aleutian Islands
Map ID number: 12
Subregion IV: Aleutian Islands
Location: Eastern, Central, and Western Aleutian Islands from Attu Islands east to Unimak Island.
Approximate Size: 92,508 km2
Ownership: United States, State of Alaska, Aleut Native Corporations

Description of area: The Aleutian Islands are comprised of over 200 islands that total about 1.1 million hectares. Volcanic in origin, the Aleutian Islands continue to experience frequent volcanic and seismic activity. Fifty-seven volcanoes (13 over 1,500 m high) are visible in the chain and many are active. The chain of islands is 30-100 km wide and extends more than 1,800 km from Attu Island east to Unimak Island. Most of the islands are mountainous with numerous lakes, ponds, and streams. The flora is rich and diverse, with a mix of plants from both North America and Eurasia. Grasses, sedges, lichens, mosses, and heath plants cover the landscape. Large beds of kelp and eelgrass *(Zostera marina)*, important habitats for many invertebrate and vertebrate species, are found along shorelines and within lagoons and bays.

Outstanding biological features: Few ocean areas are as productive as those surrounding the Aleutians. The Bering Sea's rich marine diversity is closely related to a phenomenon known as the Green Belt, a highly productive habitat along the edge of the continental shelf and throughout the Aleutian Arc (Springer et al. 1996). Processes of tidal mixing and circulation bring nutrients from reservoirs at greater depths up to the uppermost water layers where photosynthesis takes place. This process contributes to high levels of primary and secondary production and elevated biomass of phytoplankton and zooplankton (Springer et al. 1996).

The cold, turbulent waters of the Aleutian Islands produce some of the most abundant fishery stocks in the world. Walleye pollock *(Theragra chalcogramma)*, Pacific Ocean perch *(Sebastes alutus)*, Pacific herring *(Clupea harengus pallasi)*, Pacific cod *(Gadus macrocephalus)*, halibut *(Hippoglossus stenolepis)*, pelagic and demersal rockfish *(Sebastes spp.)*, Atka mackerel *(Pleurogrammus monopterygius)*, and salmon *(Oncorhynchus spp.)* are plentiful. Dolly varden *(Salvelinus malma)* and salmon spawn in streams throughout the chain. Pink salmon are the most abundant, but chum, coho, and sockeye salmon are also found in the area.

The islands and coastal waters are home to many marine mammals, such as the harbor seal *(Phoca vitulina richardsi)*, sperm whale *(Physeter macrocephalus)*, Baird's beaked whale *(Berardius bairdii)*, killer whale *(Orcinus orca)*, Dall's porpoise *(Phocoenoides dalli)*, and Stejneger's beaked whale *(Mesoplodon stejnegeri)* (Small and DeMaster 1995). Nearly half of Alaska's threatened Steller sea lion *(Eumetopias jubatus)* population is found in the Aleutian Islands. (Small and DeMaster 1995). Sea otters are abundant throughout the western and central Aleutians. Arctic *(Aloplex lagopus)* and red *(Vulpes vulpes)* foxes are present on some islands after being introduced by Russian fur traders from the 1830s to the 1930s (Bailey 1993). However, due to severe depredation on breeding seabirds, many foxes have or are being removed from islands where they were introduced.

The Aleutian Islands are an important resting and feeding stop for many migratory birds. About 40% of Alaska's seabirds (about 10 million birds among 25 species) are found on the islands (U.S. Fish and Wildlife Service). Outstanding examples of seabird diversity and abundance are found on Buldir Island, which supports the most diverse seabird breeding area in the northern hemisphere (Byrd and Day 1986). Kiska Island contains the largest auklet colony in the southern Bering Sea. Some birds also winter almost exclusively throughout the Aleutian Islands, such as the whiskered auklet *(Aethia pygmaea)*, and the emperor goose *(Chen canagica)*.

Besides the threatened Steller sea lion, two additional endemic species of concern occur along the Aleutian Islands. The threatened Aleutian Canada goose *(Branta canadensis leucopareia)* breeds on fewer than five islands (U.S. Fish and Wildlife Service 1991) and the endangered Aleutian shield-fern *(Polystichum aleuticum*) is found only on Adak Island. Though some are of debatable classification, several endemic subspecies have been identified throughout the Aleutian Islands, such as the green-winged teal *(Anas crecca nimia)*, rock sandpiper *(Calidris ptilonemis couesi)*, rock ptarmigan *(Lagopus mutus spp.)*, winter wren *(Troglodytes troglodytes spp.)*, song sparrow *(Melospiza melodia maxima)*, and rosy finch *(Leucosticte arctoa spp.)*. The majority of the world's population of whiskered auklets *(Aethia pygmaea)* occurs in the Aleutian Islands.

Current Conservation status: Commercial fishing occurs in the area for bottom fish, but is prohibited near sea lion rookeries. Much of the land mass is designated for conservation purposes. About 610,000 hectares of the Aleutian Islands are designated as wilderness and much of this area is also within the Alaska Maritime National Wildlife Refuge.

Current Resource Use: Commercial fishing and native subsistence harvest.

Description of threats: Accidental introduction of rats to Aleutian Islands from shipping traffic, either by running aground off shore or regular port docking, would have drastic consequences for seabirds as most nest in colonies and lay only one or two eggs each year. Entanglement of marine mammals in ocean debris is a continual concern. Mismanagement of fisheries resources, upon which many seabirds, marine mammals, and native subsistence and commercial users depend, is of concern. Predation by introduced foxes continues to limit seabirds and land birds on many islands.

Relevant Conservation or Management Agencies: U.S. Fish and Wildlife Service, National Marine Fisheries Service, Alaska Department of Fish and Game, Aleut Native Corporations

Area Description Contributors: V. Byrd, A. Springer, A. Sowls

Information Sources: U.S. Fish and Wildlife Service, National Marine Fisheries Service, Alaska Department of Fish and Game, Aleut Native Corporations

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Name: Karaginsky and Olyutorsky Bays
Map ID number: 13
Subregion III: Kamchatka Shelf and Coast
Location: Approximately 50 km east of the northeastern portion of the Kamchatka Peninsula.
Approximate Size: 200,000 hectares
Ownership: Russian Federation

Description of area: The area encompasses the waters and coast of the northern Kamchatka Peninsula, including two adjacent bays, Karaginsky and Olyutorsky Bays. Also included in this area are Karaginsky Island and the Govena Penisnsula. Karaginsky Island is comprised of both flat and more mountainous terrain, reaching 920 m at its highest elevation. There are numerous lakes and interior and coastal wetlands. Vegetation consists primarily of willow *(Salix spp.)*, stone birch *(Betula ermani)*, and dwarf shrub and tussock tundra (Newell et al. 1999). The Govena Peninsula is a mountainous coastal area, reaching 1,300 m at its highest elevation. Vegetation of the area is primarily upland tundra, but forests of Siberian stone pine *(Pinus pumila)* also occur. Parapolsky Dol is an interior wetland area with many lakes and bogs (Zabelina et al., 1998).

Outstanding Biological Features: The marine realm of this priority region is the broadest and most shallow section of the continental shelf in the western Bering Sea. It provides important habitat for groundfish (yellow fin sole) and herring and it is the major spawning area for walleye pollock in the western Bering Sea. The Kamchatka Current influences the area, facilitating the exchange of nutrient-rich waters between onshore areas and the ocean basin.

Karaginsky Island is home to a rich flora and fauna characteristic of coastal habitats of the region. A total of 120 species of have been recorded for the area, of which as many as 91 breed on the island. Many of these species also use the area during migration and molting periods (Newell et al. 1999). Wetland habitats are used by several species of waterfowl, including some of the largest breeding densities of harlequin duck *(Histrionicus histrionicus)* in the Russian Far East.

The island is a breeding area for the southernmost population of Pacific walrus *(Odobenus rosmarus)* in the western Bering Sea and the surrounding Karaginsky Gulf is an important walrus feeding area. Other marine mammals found within Karaginsky Gulf are ice-associated seals [spotted *(Phoca largha)*, ringed *(P. hispida)*, and ribbon *(P. fasciata)*, and bearded *(Erignathus barbatus)*], the gray whale *(Eschrichtius robustus)*, fin whale *(Balaenoptera physalus)*, and humpback whale *(Megaptera novaeangliae)*. Substantial Steller sea lion *(Eumetopias jubatus)* rookeries are found on Karaginsky Island and to the north on Verkhoturova Island (National Marine Fisheries Service 1992, Boltnev and Mathisen 1996). The abundance of marine mammals and seabirds indicates a high concentration and diversity of marine invertebrates and fishes. Coyle et al. (1996) describe two faunistic groups of zooplankton, including nearly 30 species, for the region. Salmon *(Oncorhynchus spp.)* spawn within nearly all of the streams on the island and walleye pollock *(Theragra chalcogramma)* spawn in areas around the island and to the north near Cape Olyutorsk (Balykin 1996).

Parapolsky Dol is one of the greatest waterfowl reserves in northeast Asia, with the number of birds reaching 700,000 during the breeding season. The area is an important crossroads in the migration routes of waterfowl breeding in Yakutia (Central Siberia), Chukotka, and the Parapolsky Dol and wintering in China, Korea, Japan and other Asian countries. Approximately 180 species of birds occur here, of which 28 are waterfowl species and another 50 are wetland-dependent at various periods in their life cycles. Among the species that breed here are the black scoter *(Melanitta nigra)*, oldsquaw *(Clangula hyemalis)*, green-winged teal *(Anas crecca)*, Eurasian wigeon *(Anas penelope)*, Northern pintail *(Anas acuta)*, tufted duck *(Anas fuligula)*, greater scaup *(Aythya marila)*. Some of Russia's rare and endangered species, such as the white-tailed eagle *(Haliaeetus albicilla)*; gyrfalcon *(Falco gyrfalco)* and Osprey *(Pandion haliaetus)* breed here.

Nearly 30 seabirds colonies are scattered along the rocky coast of the Govena Peninsula (Zabelina et al. 1998). Steller sea lion *(Eumetopias jubatus)* rookeries and Pacific walrus (Odobenus rosmarus) haul-outs are also located along the Govena Peninsula (Boltnev and Mathisen 1996). Ocean areas are inhabited predominantly by gray whales *(Eschrichtius robustus)*, but killer *(Orcinus orca)* and minke *(Balaenoptera acutorostrata)* whales also occur (Sobolevsky and Mathisen 1996). The abundance of marine mammals and seabirds indicates a high concentration and diversity of marine invertebrates and fishes. Fish here include Arctic grayling *(Thymallus arcticus)*, five species of cisco *(Coregonus sp)*, pike *(Esox sp.)*, burbot *(Lota lota)* and gobs *(Gobiidae)*.

Current Conservation Status: Karaginsky Island was designated as a regional-level special purpose preserve (zakaznik) to protect the numerous rocky cliff areas along the coasts that are used by breeding seabirds. However, this status means little for the conservation of the area. For instance, no permanent staff are assigned to manage, monitor, or protect the territory. The area is remote and little funds are available for local organizations and agencies to implement conservation programs here. An additional 5-km buffer zone surrounds the island for protection of marine resources but again, enforcement of this regime is unlikely given current economic conditions in the region. Coastal areas on Karaginsky Island have been recognized as a Wetland of International Importance (Ramsar Convention). An additional

zakaznik surrounds the neighboring Verkhoturova Island for the protection of marine mammals, notably Steller sea lion rookeries. This smaller island is also surrounded by a 3-km protective zone.

The Govena Peninsula and Parapolsky Dol, a wetland area, are encompassed by the Koryaksky Zapovednik (strict nature reserve). The Zapovednik, created in 1995, covers a territory of 327,200 ha., 83,000 of which are adjacent to the Bering Sea. While the Zapovednik does receive some international financial support, the reserve is still very young and not fully functioning as a conservation organization. Parapolsky Dol is also a Wetland of International Importance (Ramsar Convention). A 3-km marine buffer zone was established in the area from Vigenstiten Point to Khatyrka Point for the protection of marine mammal haul-outs. Despite this formal designation, a lack of enforcement may be allowing some violations of this conservation status. A temporary zakaznik (special purpose preserve) was established on the Belaya River in Parapolsky Dol.

Current Resource Use: Local Koryak people use Karaginsky Island for mushroom and berry picking and some historical seabird egg collecting may still take place. Some commercial fishing reportedly takes place in the area, and violations of the reserve and buffer area may be more frequent with inadequate enforcement. Resource use is not permitted within Parapolsky Dol, as the area is protected as a federal nature reserve. Both in Olyutorsky and Karaginsky Bays are important for the Russian commercial fishery, which targets pollock, herring, Pacific cod, saffron cod, salmon, halibut, and other flatfishes.

Description of Threats: Poaching of the valuable fisheries resources of this region is a threat to the fish themselves, as well as the many species that depend upon them. Restrictions on commercial catches are intended to conserve stocks, but enforcement in recent years may be problematic. In 1996, gold mining in the interior that could have adversely influence the watersheds of the region were halted as a result of public opposition

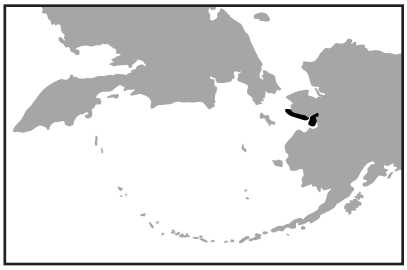
Relevant Conservation or Management Agencies: Koryak Environmental Committee for Nature Protection, Kamchatka Institute of Ecology and Natural Resources, Kamchatrybvod (Kamchatka Territorial Board for the Preservation and Reproduction of Fish Resources and Regulation), TINRO (Pacific Research Institute of Fisheries and Oceanography)

Area Description Contributors: V. Burkanov, M. Williams

Information Sources: World Conservation Union (IUCN), Russia Program Office of World Wide Fund for Nature, Kamchatka Institute of Ecology and Natural Resources

II. High Priority Areas

Map ID#	Area Name
14 & 15	Eastern and Northern Norton Sound
16	Kasegaluk Lagoon and Ledyard Bay
17	Aleutian Basin



Name: Eastern and Northern Norton Sound
Map ID number: 14 & 15
Subregion I: Bering Strait/Southern Chukchi Sea
Location: Coastal and ocean areas of the southern Seward Peninsula and Eastern Norton Sound. The area includes coastal and ocean areas east to Cape Darby and south to Stuart Island.
Approximate Size: 16,867 km2
Ownership: State of Alaska, United States, Native Corporations

Description of area: Norton Sound is an eastern extension of the broad, shallow Bering Sea shelf that averages less than 50 m in depth. The coastline of the sound consists of cliffs, lagoons, and coastal wetlands. Beach environments range from rocky to muddy and attract intertidal fauna that are food sources for migrating and breeding shorebirds and marine mammals. Eelgrass *(Zostera marina)*, an important habitat and food item for numerous invertebrate and vertebrate marine species (Orth 1992), is found within several of the coastal lagoon areas.

Outstanding Biological Features: Norton Sound is an important foraging area for many species. Coastal littoral and wetland areas are used by thousands of migrating shorebirds during spring and fall (Gill and Handel 1981), as well as by breeding birds of the area. Several species of shorebird also breed in these habitats, such as the red-necked *(Phalaropus lobatus)* and red *(P. fulicarius)* phalarope, western sandpiper *(Calidris mauri)*, and dunlin *(C. alpina)*. The coastal cliffs at Bluff and Square Rock west of Golovin Bay provide nesting habitat for about 150,000 seabirds. Northern Norton Sound is considered an important spawning area for red king crab *(Paralithodes camtschatica)*, hair crab (*Erimacrus isenbeckii)*, Pacific cod *(Gadus macrocephalus)*, capelin *(Mallotus villosus)* and for harbor seal *(Phoca vitulina)* pupping. Areas of eastern Norton Sound are known for their abundances of beluga whale *(Delphinapterus leucas)*, salmon *(Oncorhynchus spp.)*, Pacific herring *(Clupea harengus pallasi)*, and sand lance *(Ammodytes hexapterus)*. Offshore areas of eastern Norton Sound are critical habitat in the fall for molting and foraging by spectacled eiders *(Somateria fischeri)*, a threatened sea duck in North America, after their departure from breeding grounds on the Yukon-Kuskokwim Delta (Petersen et al. 1999a).

Current Conservation Status: Some of the land is owned by Native corporations and individuals, but much of the coastal area of Norton Sound as well as Square Rock and Sledge Island are managed by the Alaska Maritime National Wildlife Refuge (U.S. Fish and Wildlife Service). Marine areas have no formal protection here.

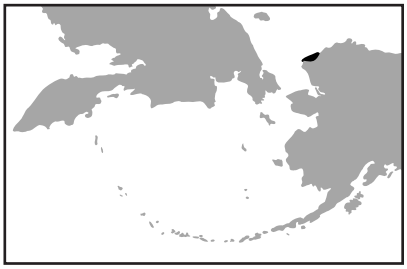
Current Resource Use: Native subsistence harvest of fish and marine mammals. Commercial harvest of herring, salmon, crab and halibut.

Description of Threats: Mismanagement of fisheries resources, upon which many seabirds, marine mammals, and native subsistence and commercial users depend, is of concern. Disturbance or pollution from transportation traffic through the area. Oil spills in any of these areas would have devastating impacts to wildlife habitats and fisheries resources.

Relevant Conservation and Management Agencies: Marine Mammal Commission, Kawerak Natural Resources, Eskimo Walrus Commission, Alaska Nanuuq Commission, Norton Sound Economic Development, U.S. Fish and Wildlife Service

Area Description Contributors: M. Petersen, V. Byrd, A. Sowls

Information Sources: U.S. Fish and Wildlife Service, Alaska Biological Science Center (U.S. Geological Survey, Biological Resources Division)



Name: Kasegaluk Lagoon and Ledyard Bay
Map ID number: 16
Subregion I: Bering Strait/Southern Chukchi Sea
Location: Along the northeastern coast of Alaska, northwest of Bering Strait in the Arctic Ocean.
Approximate Size: 8,931 km2
Ownership: State of Alaska, United States, Native corporations

Description of area: Kasegaluk Lagoon is a 200-km long lagoon that is protected from the Chukchi Sea by a series of sparsely vegetated barrier islands and shoals. The Lagoon varies considerably in width and depth, with shallow water areas and mudflats in the southwesterly portion with deeper water (nearly 4 m) in the northeastern portion (Johnson et al. 1993). The Lagoon is ice covered for about 7 months of the year.

Outstanding Biological Features: This is an area of major summer concentrations of beluga whales *(Delphinapterus leucas)* which also has among the world's largest concentrations of spotted *(Phoca largha)*, ringed *(P. hispida)*, and bearded *(Erignathus barbatus)* seals. Gray whales feed in Ledyard Bay in summer and bowhead whales migrate through it in spring. Polar bears *(Ursus maritimus)* hunt for seals in the area and some females den along the coast. Johnson et al. (1993) found that the richness and diversity of bird species using Kasegaluk Lagoon were greater than in other lagoon systems in the Chukchi or Beaufort Sea. The seabird colony at Cape Lisburne which contains more than 270,000 Kittiwakes and murres is the largest in arctic Alaska. The majority of female and juvenile spectacled eiders from arctic Alaska molt in Ledyard Bay. Large numbers of Pacific black brant *(Branta nigra)* also stage in the lagoon during late August.

Current Conservation Status: Kasegaluk Lagoon and the seabird colonies at Cape Lisburne are part of the Alaska Maritime National Wildlife Refuge, but most of the buffer area around this site is private or state owned.

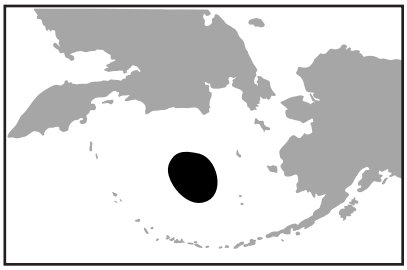
Current Resource Use: Traditional subsistence harvest of seabird eggs occurs at Cape Lisburne; walrus are often along the coast of Ledyard Bay, and beluga whales and spotted seals at Kasegaluk Lagoon.

Description of Threats: Development around the lagoon is a potential threat to this site.

Relevant Conservation or Management Agencies: Nanuuq Commission, Beluga Whale Committee, U.S. Fish and Wildlife Service

Area Description Contributors: A. Springer

Name: Aleutian Basin
Map ID number: 17
Subregion V: Aleutian and Commander Basins
Location: South central Bering Sea
Approximate Size: 135,645 km2
Ownership: Joint Treaty



Description of area: The abyssal Aleutian Basin lies at a depth of 2,800 to 3,600 m. Reeburgh and Kipphut (1986) and others suggest that the deep, nutrient-rich waters of the Bering Sea must originate from the deep ocean and move north onto the continental shelf, by large and possibly chaotic processes (Reed and Stabeno 1990), where they are mixed upward to supply the nutrients required for high productivity. Dynamic physical processes create numerous oceanic eddies in the southeastern region and along the edge of the continental shelf: the role of eddies in the ecosystem is poorly understood, but they are known to be important to distribution and perhaps productivity of larval fishes such as pollock (Schumacher and Stabeno 1994).

Outstanding biological features: The basin is a high quality deep, pelagic habitat area. The Bering Sea is the terminus for the circulation of the world's deep ocean currents. Deep water formed in other high-latitude regions of the North Atlantic and Southern Ocean reaches the Gulf of Alaska and Bering Sea after traveling for centuries. These waters are therefore some of the oldest waters in the world's oceans and have very high nutrient concentrations (National Research Council 1996).

Large and little understood populations of mesopelagic fishes and squids, such as the northern lanternfish *(Stenobrachius leucopsarus*), perhaps the most abundant single species of fish in the Bering Sea. Lanternfish, other mesopelagic fish speceis, and squids are key prey of pollock *(Theragra chalcogramma)* and salmon especially in late autumn and winter and of great numbers of sperm whales *(Physeter macrocephalus*) and Dall's porpoises *(Phocoenoides dalli)* in summer. Most of the pollock stocks of the eastern and western Bering Sea spend summer feeding periods in the Basin.

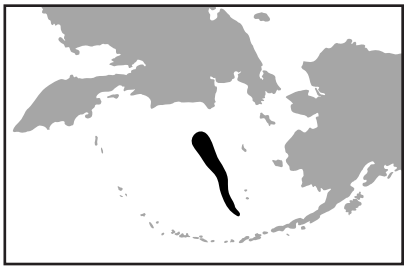
Conservation status: A bilateral treaty between the US and Russia, but this does not provide formal protection for this area, and it mainly addresses how the fishery should be managed.

Description of threats: Overfishing, including illegal fishing, particularly in international waters of the basin known as the Donut Hole, and changing physical oceanographic conditions as a result of climate change (National Research Council 1996, Steele 1991), especially within the top 100 m (National Research Council 1996) are threats to biodiversity here.

Relevant Conservation or Management Agencies: National Marine Fisheries Service

Area Description Contributors: A. Springer

Information Sources: National Marine Fisheries Service



Name: Bering Sea Shelf Break
Map ID number: 18
Subregion II: Bering Sea Shelf
Location: South central Bering Sea
Approximate Size: 78,670 km2
Ownership: Russian Federation and the United States
Approximate Size:

Desription: The Bering Sea Shelf Break region includes the area between the 200 m and 2000 m isobaths. It varies in width from about 10 km to 100 km, depending on the steepness of the shelf edge, and contains three canyons-Pribilof, Zemchug, and Navarin. The Bering Slope Current flows along the shelf edge from the southeast to the northwest: it is a complex current that includes numerous eddies (Kinder et al. 1975; Kinder and Coachman 1977; Natarov 1963; Schumacher and Reed 1992). The eddies are clearly visible in modern satellite imagery. Most of the flow apparently diverges fron the shelf edge at about 58ºN and spreads across the basin (Stabeno and Reed 1994). Flow intensifies as a western boundary current off Cape Navarin and joins the southward flowing Kamchatka Current that returns water to the North Pacific Ocean. A portion of the current splits off near Cape Navarin and flows to the north, becoming the Anadyr Current that exits the Bering Sea through Bering Strait (Coachman et al. 1975). An oceanographic front extending some 1000 km overlies the continental slope year round (Kinder and Coachman 1978) and marks the transition between basin and shelf physics.

Outstanding Biological Features: This region, referred to as the Bering Sea Green Belt, is an area of enhanced biological activity important to the overall production budget of the Bering Sea (Springer et al. 1996). Annual primary production is elevated throughout summer and is approximately 60% higher than estimates for the adjacent continental shelf region and 270% higher than the basin. This in turns supports a high production and biomass of zooplankton, squids, and fishes. In winter, water temperatures at depth along the shelf edge are much warmer than bottom waters over the shelf, which attracts many species of fishes to the winter time thermal refuge.

Fishes that concentrate at the shelf edge for all or part of the year include chinook salmon *(Oncorhynchus tschawytscha)*, salmon sharks *(Lamna ditropis)*, Pacific Ocean perch *(Sebastes alutus)*, sablefish *(Anoplopoma fimbria)*, Pacific cod *(Gadus macrocephalus)*, Greenland turbot *(Reinhardtius hippoglossoides)*, arrowtooth flounder *(Atherestes stomias)*, and halibut *(Hippoglossus stenolepis)* (Bakkala et al., 1981; Best, 1981; Natarov and Novikov, 1970). The zooplankton, squids, and fishes attract large numbers of marine birds *(Shuntov 1993)* and mammals, including fur seals *(Callorhinus ursinus)*, ribbon seals *(Phoca fasciata)*, sea lions *(Eumetopias jubatus)*, sperm whales *(Physeter macrocephalus)*, blue whales *(Balaenoptera musculus)*, fin whales *(B. physalus)*, minke whales *(B. acutorostra)*, Stejneger's beaked whales *(Mesoplodon stejnegeri)*, and Dall's porpoises *(Phocoenoides dalli)* (Kajimura and Laughlin, 1988; Lowry et al. 1982; Lucas 1899; Nishiwaki 1966; Nasu 1974; Okutani and Nemoto 1964; Omura 1955).

Conservation Status: None

Current Resource Use: Important region for the commercial groundfish fishery, where Pacific Ocean perch and other rockfish, Greenland turbot, sablefish, Pacific cod, and Pacific halibut are the chief targets.

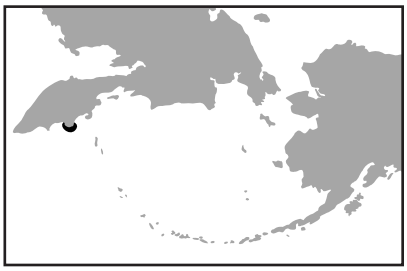
Description of Threats: Over fishing.

Relevant Conservation or Management Agencies: National Marine Fisheries Service.

Area Description Contributors: A. Springer.
Information Sources: National Marine Fisheries Service, U.S. Geological Survey, U.S. Fish and Wildlife Service, University of Alaska Fairbanks.

III. Priority Areas

Map ID Number	Priority Area Name
19	Kronotsky Peninsula
20	Kamchatsky Peninsula



Name: Kronotsky Peninsula
Map ID number: 19
Location: Northeastern coast of the Kamchatka Peninsula
Approximate Size: 3,591 km2
Ownership: Russian Federation

Description of area: This area, dominated by 11 active volcanoes, (the highest reaching 3,528 m, that flank Lake Kronotsk), is covered by a large network of rivers, lakes, and active geysers. There is a diverse array of habitats, such as ocean coastline, interior wetlands and riparian areas, meadow, and alpine and upland tundra.

Outstanding Biological Features: The area contains a rich abundance of flora and fauna. Approximately 750 plant species, including 16 endemic species, have been recorded in the area. Two hundred and sixty species of birds have been recorded for the area, including the Steller's sea eagle *(Haliaeetus pelagicus)* and numerous seabirds that breed in colonies along the rocky coastline during summer. Nine species of cetaceans have been observed in coastal waters of the area, including Steller sea lion *(Eumetopias jubatus)* (National Marine Fisheries Service 1993).

Current Conservation Status: Site of Kronotsky Zapovednik (strict nature reserve), recognized as a UNESCO World Natural Heritage Site. The Zapovednik, established is one of Russia's oldest nature reserves. It covers an area of 1,142,000 hectares.

Current Resource Use: According to Newell et al. (1999), resource use in the area is basically non-existent due to the isolated location of the reserve from any roads or human habitation. However, ecotourism opportunities are available and "tourists," particularly foreigners, may pay a fee to local private firms for access to the reserve to hunt, fish, hike, etc. As in other reserves, the reserve lacks the technology and transportation to adequately manage, monitor, and protect the biodiversity here.

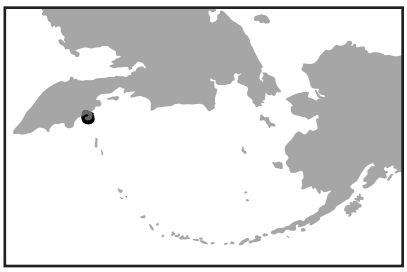
Description of Threats: Weakened management and protection capacity in Koryaksky Zapovednik.

Relevant Conservation or Management Agencies: Kronotsky State Nature Reserve, World

Conservation Union (IUCN), Kamchatka Institute of Ecology and Natural Resources, Kamchatrybvod (Kamchatka Territorial Board for the Preservation and Reproduction of Fish Resources and Regulation)

Area Description Contributors: M. Williams, Burkanov

Name: Kamchatsky Peninsula
Map ID Number: 20
Location: Northeastern Kamchatka Peninsula, including Nerpichye Lagoon, Azabachiye Lake, and the lower part of the Kamchatka River.
Approximate Size: 10,479 km2
Ownership: Russian Federation



Description of area: Coastal lagoons and wetlands.

Outstanding Biological Features: The Azabachiye Lake watershed is an important area for sockeye salmon *(Oncorhynchus nerka)*. Steller sea lion *(Eumetopias jubatus)* rookeries are located along coastal areas.

Current Conservation Status: A 6-km protective zone exists around Steller sea lion haul-outs along coastal areas, but is poorly enforced.

Current Resource Use: Unknown

Description of Threats: Mismanagement of fisheries resources, upon which many seabirds, marine mammals, and native subsistence and commercial users depend, is of concern. Pollution from mining activity in interior areas discharged into the Elovka River, a tributary of the Kamchatka River. Disturbance or pollution from transportation traffic along the coast of the Kamchatka Peninsula. Ocean debris frequently washed ashore and into areas of contact with marine mammals or seabirds.

Relevant Conservation or Management Agencies: Kamchatka Institute of Ecology and Natural Resources, Far Eastern Branch of the Russian Academy of Sciences (Vladivostok), Kamchatrybvod (Kamchatka Territorial Board for the Preservation and Reproduction of Fish Resources and Regulation)

Area Description Contributors: M. Williams, V.. Burkanov

Information Sources: Kamchatrybvod (Kamchatka Territorial Board for the Preservation and Reproduction of Fish Resources and Regulation)

Appendix C:

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Appendix D:

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