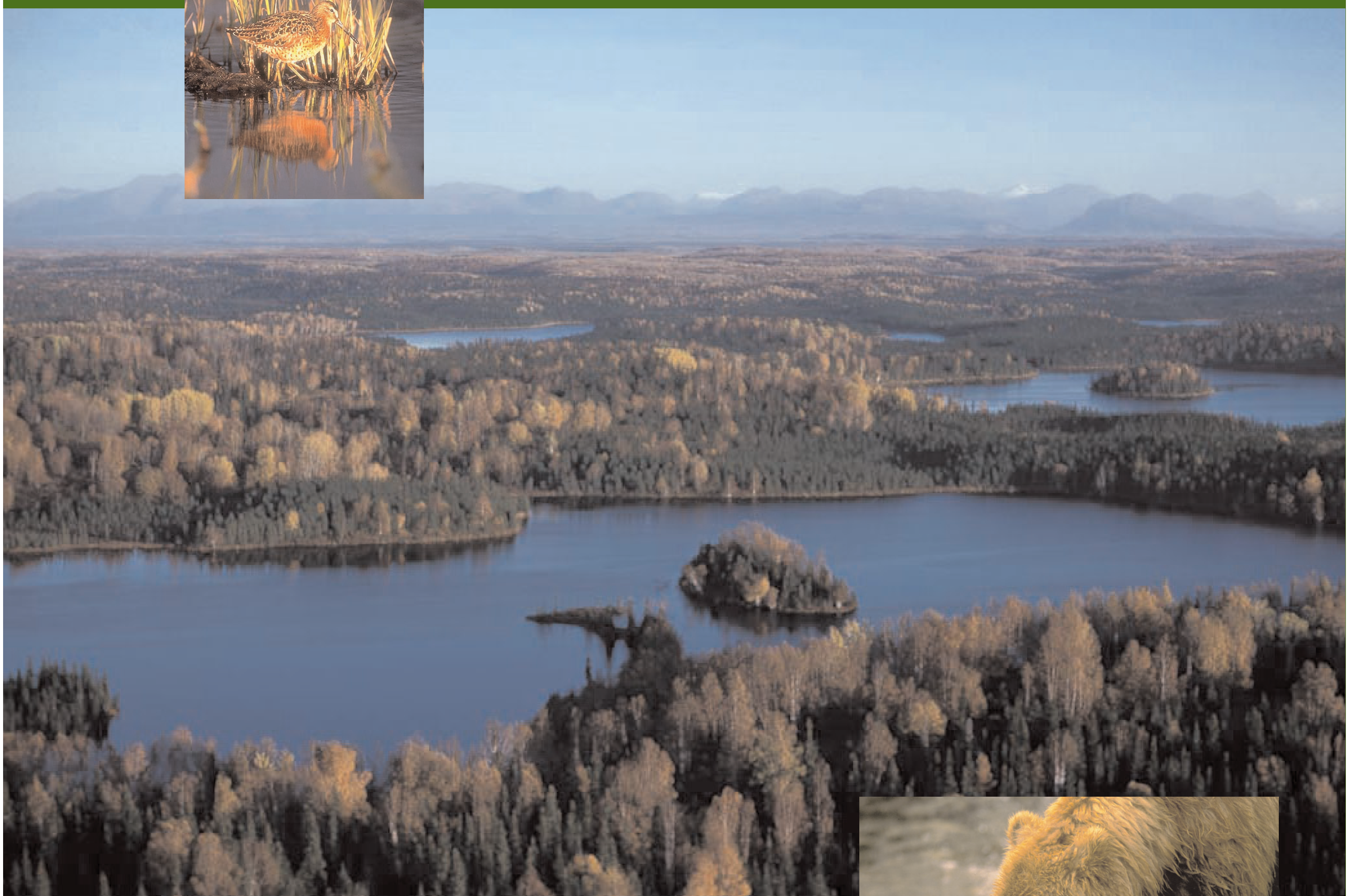
Cook Inlet Basin

ECOREGIONAL ASSESSMENT



The Nature Conservancy of Alaska

AUGUST 2003

The Nature Conservancy

SAVING THE LAST GREAT PLACES ON EARTH

Cook Inlet Basin Ecoregional Assessment

The Nature Conservancy of Alaska

August 2003

ACKNOWLEDGEMENTS

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READING THIS ASSESSMENT

Data sources for all figures may be found in Appendix 14. A number of agencies and organizations are referred to in the text by their acronym. The following is a list of frequently used acronyms in this assessment.

ADOT	Alaska Department of Transportation
ADFG	Alaska Department of Fish and Game
ADNR	Alaska Department of Natural Resources
AKNHP	Alaska Natural Heritage Program
DOD	Department of Defense
EPA	Environmental Protection Agency
KPBPC	Kenai Peninsula Borough Planning Commission
ISER	Institute for Social Research, University of Alaska Anchorage
NMML	National Marine Mammal Laboratory
NOAA	National Oceanographic and Atmospheric Administration
UAA	University of Alaska Anchorage
UAF	University of Alaska Fairbanks
USFWS	United State Fish and Wildlfe Service
USFS	United States Department of Agriculture, Forest Service
USGS	United States Geological Survey
WWF	World Wildlife Fund

A. EXECUTIVE SUMMARY

In 2000, The Nature Conservancy in Alaska and its partners assembled a team, working with over 50 scientists noted for their expertise in the Cook Inlet Basin ecoregion, to assess the ecoregion's biodiversity and identify areas of biological significance. The Cook Inlet Basin ecoregion is the first terrestrial ecoregion assessed by the Conservancy in Alaska. The team carried out the assessment guided by the methodology outlined in *Designing a Geography of Hope: A Practitioner's Handbook to Ecoregional Conservation Planning*, although certain modifications were required to adapt the framework to the unique characteristics of Alaskan ecoregions.

FIGURE 1: Location of Cook Inlet Basin ecoregion

The Cook Inlet Basin ecoregion is located in southcentral Alaska and is home to the greatest concentration of Alaska's human population (see Figure 1). Even so, most of the ecoregion's 2,906,110 ha of land are only lightly developed and many of its landscapes and ecological processes are relatively intact. The region is most notable for its healthy populations of top level and wide-ranging predators, such as black and brown bear, gray wolf, wolverine and lynx, and its important habitats for migratory species including waterfowl and shorebirds, marine mammals and Pacific salmon.

Conservation Targets

The team identified 299 conservation targets to represent the basin's biodiversity, including both coarse filter targets (ecological systems) and fine filter targets (species and species aggregations). Fine filter targets were selected based on their imperilment, vulnerability, endemism, declining status, and the inability of coarse scale targets alone to represent them. Aquatic, terrestrial and coastal ecological systems were used to represent a broader level of biological diversity across the ecoregion. The team assumed that a combination of fine filter and coarse filter target selection would be a robust way to capture the broadest array of biodiversity; however, significant gaps in information on species populations and occurrences as well as the location and extent of fine scale habitats necessitated crosswalking of many fine filter targets to associated systems. The assessment therefore represents largely a coarse scale analysis.

Portfolio Design

The portfolio assembly process consisted of several steps. Once conservation targets were selected and conservation goals were set for these targets, portfolio assembly began. A computer algorithm and software program called SITES was used to compare various portfolio "solutions" based on several criteria. As part of the process, a cost suitability index was applied to determine viability of targets, and a conservation lands assessment was completed to maximize the efficiency of the portfolio by building upon those areas already in protected status. The preferred result from SITES was used as a "strawman" portfolio that was then revised during expert workshops. Although certain preliminary steps for portfolio design were partially automated, it was the input of experts that essentially drove portfolio selection.

Portfolio of Areas of Biological Significance

The final portfolio reflects the character of northern landscapes and the migratory or wide-ranging nature of many of the species. Such species use a number of habitats at different seasons and life stages, including feeding areas, resting and staging areas, and areas for breeding and the care of young. The portfolio includes 10 terrestrial and 4 aquatic areas of biological significance that—if managed with an emphasis on biodiversity—will likely conserve the fish and wildlife of the basin over the long term. The portfolio, including marine environments, comprises 2,020,950 ha (approximately 5 million acres) or nearly 53% of the ecoregion (see Figure 2).

Public lands make up the majority (87%) of the portfolio, and of the public managers, the state of Alaska is the lead with nearly 48% of the land in state ownership. Nearly 43% of the portfolio is already managed at a high or medium conservation status (e.g. federal refuge or state critical habitat area), and 2% is managed at a low conservation status. Over 55% of the land is not managed for conservation.

Preliminary Threats Assessment

The primary objective of the threats assessment was to identify general threats to targets across the ecoregion. The most pervasive threats were identified as non-native species introduction, incompatible recreational use, incompatible residential development and incompatible resource development.

Information Gaps

Recognizing that our understanding of the biodiversity in the Cook Inlet Basin is characterized by significant uncertainties and gaps in data, a secondary goal of the assessment was to document these information gaps and research needs. While many data gaps exist for this ecoregion, two stand out:

1. the need for a comprehensive, fine-scale vegetation map to delineate natural community types and key habitats for species, and
2. better and more information on the habitat needs of wide-ranging species in the ecoregion.

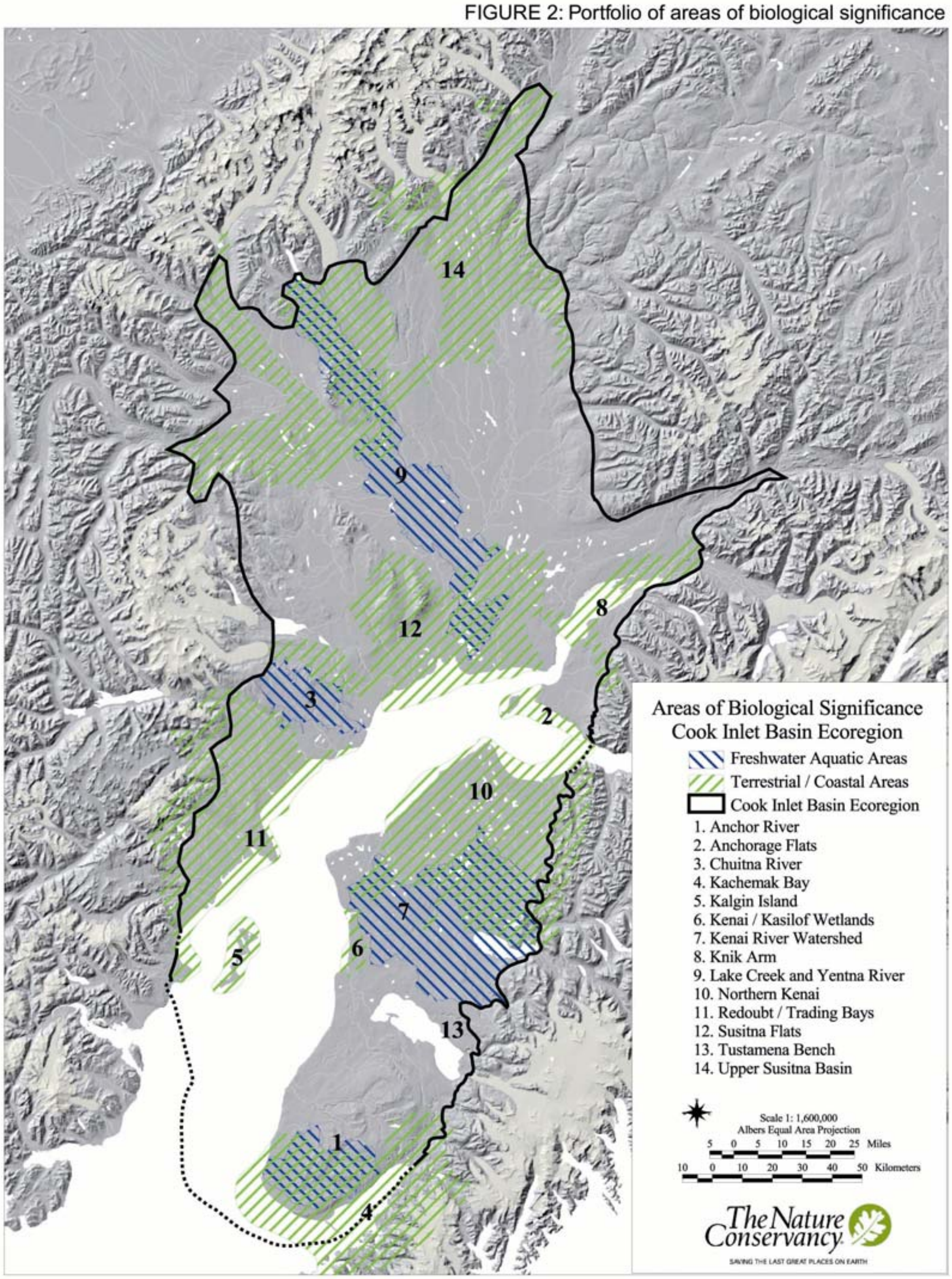
Conservation Blueprint

The primary product of this ecoregional assessment can be considered a conservation blueprint—a vision for conservation success—to guide the basin's public land managers, land and water conservation organizations, private landowners, and others in conserving natural diversity within this ecoregion. The goal is to conserve the entire portfolio of areas of biological significance. Balancing such conservation with the needs of our communities will require a combination of strategies, including on-the-ground and community-based action at specific areas and multiple-area strategies to address threats to targets across ecoregions.

It is certain that this initial identification of areas of biological significance will require further qualitative assessment as new information becomes available. This assessment is designed to focus conservation work in the immediate future, allowing conservation practitioners to quickly put emerging opportunities into the appropriate ecological context and to take actions that are scientifically defensible and result in the most biodiversity conserved.

Implementing careful strategies and filling gaps in our knowledge will require partnership and commitment between the many landowners, managers and stakeholders in the region. The Conservancy looks forward to working cooperatively with these individuals, agencies, businesses and organizations to translate this assessment and future iterations into long-lasting conservation success on the ground.

FIGURE 2: Portfolio of areas of biological significance



B. OVERVIEW OF THE COOK INLET BASIN ECOREGION

1. Landscape and Species

The Cook Inlet Basin ecoregion is composed of the low-lying basin surrounding Cook Inlet from the south side of the Alaska Range to Kachemak and Tuxedni Bays. It is bound on the east by the Kenai, Chugach and Talkeetna Mountains and on the west by the Alaska and northern Aleutian mountain ranges. The ecoregion includes the western half of the Kenai Peninsula, the Anchorage bowl, the western Cook Inlet lowlands, and the Susitna lowlands.

Connected to the mainland only by a narrow isthmus and further fragmented by a road, the Kenai Peninsula acts as an island. This "island effect" limits the exchange of genetic material; consequently, populations found on the peninsula may be disjunct from those in the rest of the ecoregion (e.g., Kenai brown bear). The size of the ecoregion including the marine environment is 3,792,310 ha. Of this, the terrestrial and freshwater portions comprise 2,906,110 ha.

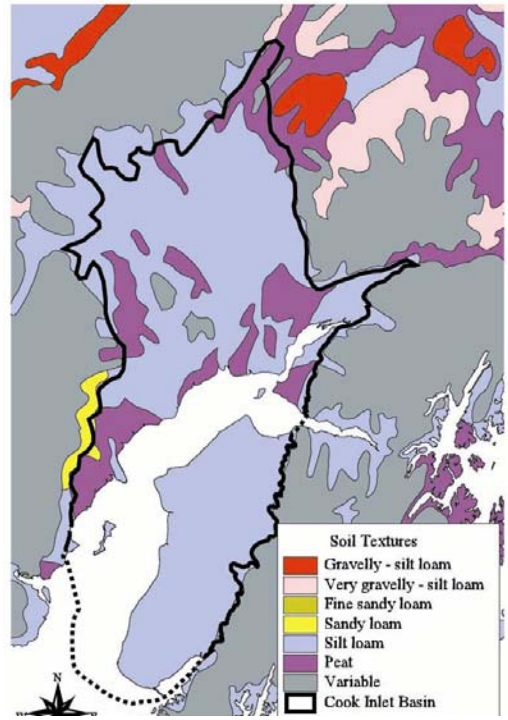


FIGURE 3: Soils of the Cook Inlet Basin

The lowlands of the ecoregion contain numerous lakes, estuaries and large river basins, including the drainages of the Kenai and Susitna rivers. These large rivers terminate in broad estuarine areas in Cook Inlet. The Susitna River provides the greatest amount of freshwater input into Cook Inlet within the ecoregion (ADNR 1999).

Past glaciation was extensive, leaving silty, fine-grained mudflats and numerous lakes. The basin is generally free from permafrost, and soils are mostly windblown loess and volcanic ash overlaying deep glacial deposits. Significant peat deposits are scattered throughout the region. Much of the shoreline of the ecoregion is characterized by mixed sand and gravel beaches and exposed tidal mud flats.

The ecoregion has a mild climate by Alaska standards, ranging from an average winter low of -15°C to an average summer high of 18° C. The average annual precipitation ranges from 77-200 cm (McNab and Avers 1994). The geographic position of the basin between the Gulf of Alaska and the Interior creates a transitional climate between maritime and continental (Figure 4). Ice forms heavily in the upper inlet and occasionally in the southern inlet due to air temperature, and is usually present from November through April (ADNR 1999).

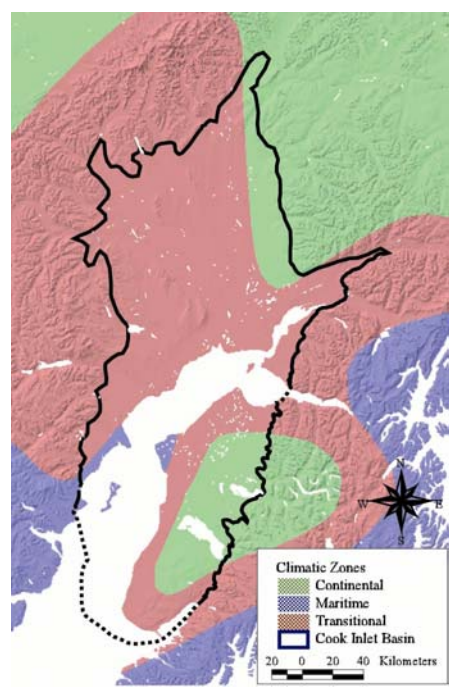


FIGURE 4: Climatic zones of the Cook Inlet Basin ecoregion

Due to low elevation and landscape position, wetlands—including bogs, fens, and swamps—are common in the Cook Inlet Basin. Bogs are one of the prominent features of the wet, peat-dominated lowlands, supporting black spruce and scrub communities. Wet to moderately wet sites often support bluejoint grass (*Calamagrostis canadensis*) communities. Many low scrub and wet graminoid community types are found throughout the ecoregion. Floodplains are dominated by tall scrub communities with alder and willows (*Alnus* and *Salix* spp.). Given the transitional climate of the ecoregion, forested areas range from coastal temperate rainforests in the south to interior taiga forests in the north. Forest types include coniferous, broadleaf and mixed forest types. White spruce (*Picea glauca*) and black spruce (*P. mariana*) dominate coniferous forested areas. In addition, forests of Lutz spruce (*P. lutzii*), a hybrid of white and Sitka spruce (*P. sitchensis*) are found on the Kenai Peninsula and in other isolated areas in southcentral Alaska. The Lutz spruce system is similar to the widely-dispersed, white spruce forest system except that it is found primarily on the Kenai Peninsula (DeVelice et al. 1999). Balsam poplar (*Populus balsamifera*), black cottonwood (*Populus balsamifera* subsp. *trichocarpa)*, paper birch (*Betula papyrifera*) and quaking aspen (*Populus tremuloides*) occur within broadleaf and mixed forests.

Healthy populations of many top-level predators exist in the ecoregion, including brown bear (*Ursus arctos*), black bear (*U. americanus*), gray wolf (*Canis lupus*), wolverine (*Gulo gulo*), lynx (*Lynx canadensis*), and coyote (*C. latrans*) (Ricketts et al. 1999).

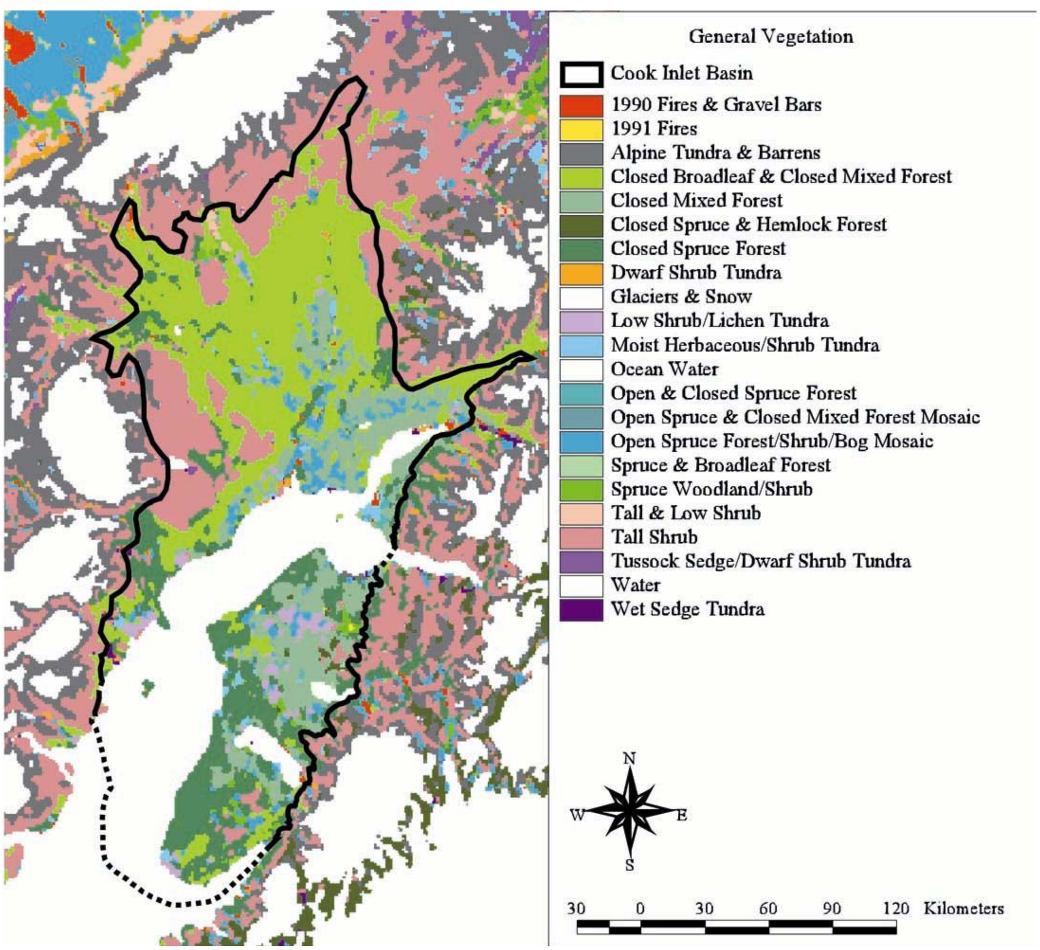


FIGURE 5: General vegetation classes of the Cook Inlet Basin ecoregion

Five species of Pacific salmon (*Oncorhynchus* spp.) are present in the waters of the ecoregion, as are other anadromous salmonids such as steelhead (*O. mykiss*), arctic grayling (*Thymallus arcticus*) and dolly varden (*Salvelinus malma* (Walbaum)). A unique stock of chinook salmon (*O. tshawytscha*) is found in the Kenai River watershed and consistently produces record-size fish. Eulachon (*Thaleichtys pacificus* (Girad)) are an important forage fish for many species.

Coastal wetlands and bays along the shores of Cook Inlet provide staging areas for large seasonal aggregations of waterfowl and shorebirds. A significant portion of the world population of the Wrangel Island snow goose (*Chen caerulescens* (Wrangel Island)) uses the upper Cook Inlet Basin ecoregion in spring. What may be the entire wintering population of the nominate form of rock sandpipers (*Calidris ptilocnemis* (Pribilof)) reside for a period of the year along the shores of Cook Inlet (Gill and Tibbetts 1999). Bays along the inlet also provide major spring stopover sites for western sandpipers (*C. mauri*), dunlin (*C. alpina*) and Hudsonian godwits (*Limosa haemastica*). Important molting and breeding areas for the Tule white-fronted goose (*Anser albifrons elgasi*) are found in the ecoregion as are high concentrations of overwintering bald eagles (*Haliaeetus leucocephalus*).

The Cook Inlet population of the beluga whale (*Delphinapterus leucas*), a genetically and geographically isolated stock, reside in the marine waters of Cook Inlet in summer, and perhaps year round (NMML 1999). Rookeries and haul-outs for other marine mammals are distributed primarily in the southern areas, although sightings of harbor seals (*Phoca vitulina*) have been reported in upper Cook Inlet. Pacific herring (*Clupea pallasi*) and Pacific halibut (*Hippoglossus stenolepis*) also occur in the lower marine portions of the ecoregion as do several shellfish species, such as scallops, crab and shrimp, and many species of groundfish.

Several mammal species are endemic to the Cook Inlet Basin ecoregion, including the Kenai red squirrel (*Tamiasciurus hudsonicus Kenai*), Kenai northern flying squirrel (*Glaucomys sabrinus* (Kenai subsp.)), and the Kenai wolverine (*Gulo gulo katschemakensis*). Several birds are also endemic to the ecoregion for all or parts of their life cycles, including the Kenai song sparrow (*Melospiza melodia kenaiensis*), the Tule white-fronted goose during breeding, and the Pribilof Island rock sandpiper (*Calidris ptilocnemis* (Pribilof)) during winter. Lutz spruce is also thought to be endemic to the Kenai Peninsula as are several plant species. There are 5 globally rare species in the ecoregion with Natural Heritage Program ranks of G1 or G2, all of which are plants.

2. Ecological Processes

Ecological processes are natural events that shape a landscape and its constituent biodiversity. Although ecological processes occur at many scales, natural disturbances such as flooding and fire are often most noticeable for their quick and significant impacts. Natural disturbance regimes affect biodiversity by maintaining heterogeneity of habitat patches (Pickett and Thompson 1978). The primary ecological processes driving the natural ecosystems of the Cook Inlet Basin ecoregion are climate, insect damage, flooding, fire, vulcanism, tectonic activity and tidal activity. The interaction of these natural ecological processes at varying intensities, frequencies, and spatial scales is fundamental to maintaining landscape heterogeneity and biotic diversity of ecosystems in this ecoregion.

The primary ecological driver across this ecoregion is climate. It shapes the land and influences the type of vegetation that occurs on the landscape. Evidence is growing that climate in Alaska is undergoing an unusual degree of change. Alaska is thought to have experienced the greatest regional warming of all states in the U.S. Records show that temperatures in Anchorage have increased approximately 2.2°C over the last 41 years and up to 4.5°C in winter months since the 1960s (EPA 1998, Alaska Regional Assessment Group 1999). It is estimated that in the coming years precipitation will increase slightly in the fall and winter and by up to 10% in the spring and summer (EPA 1998).

Observations in recent years suggest climate change is particularly affecting habitats on the Kenai Peninsula. There is some evidence of a drying cycle that may be affecting wetlands and lake levels. Spruce trees are establishing themselves in muskeg areas and treeline appears to be rising in the mountains on the eastern edges of the ecoregion (Berg 2001). Climate change may also be implicated in the recent spruce bark beetle (*Ips typographus)* infestation on the peninsula. Roughly 80% of the mature spruce stands in the region have been killed due to the infestation (Ricketts et al. 1999). Though the beetle occurs naturally here, the extent of the infestation may have been exacerbated by climate change. Recent reports indicate that spruce bark beetle activity may be declining in parts of the state, including the Kenai Peninsula and Western Cook Inlet, due to lack of host material, changes in structure of stands, and forest type conversion (Wittwer 2002).

Flooding is another significant ecological process in the Cook Inlet Basin ecoregion. Snowfall and corresponding melt in mountains surrounding the ecoregion send large quantities of water into the riverine and lacustrine systems of the ecoregion. Floods occur annually due to heavy precipitation in August and September. When flooding occurs within the Cook Inlet Basin ecoregion, it can greatly affect deposition and sedimentation processes as well as erosion. Irregular flooding may occur coincident with events such as volcanic eruptions (Brabets et al. 1999).

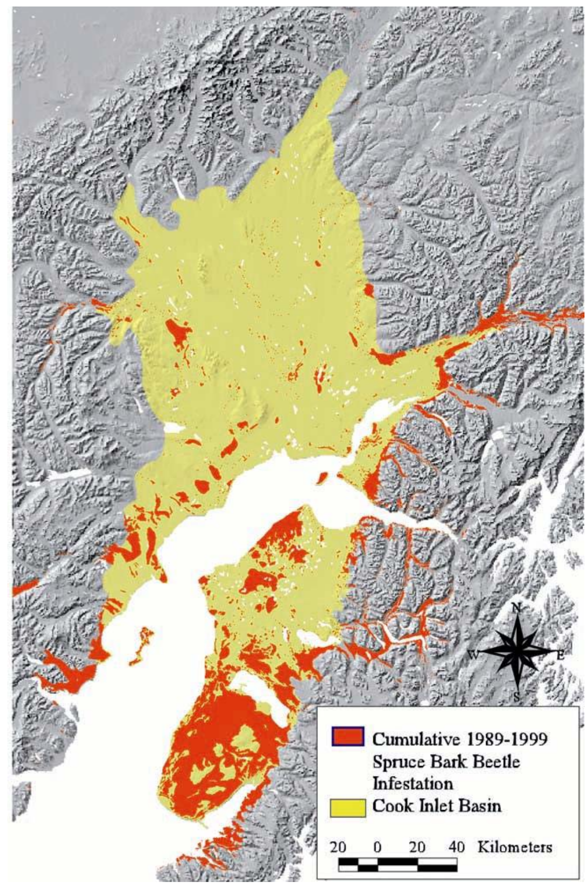


FIGURE 6: Cumulative spruce bark beetle infestation of the Cook Inlet Basin

Fires are generally common in the Susitna River drainage, and occasional on the Kenai Peninsula. The recent spruce bark beetle epidemic, however, has increased both the number of dead trees and the incidence of fire on the Kenai Peninsula. Currently, the Kenai Peninsula and Western Cook Inlet are considered to be at moderate to high level risks for large, catastrophic fires due to the concentration of dead wood, both standing and down, created by the spruce bark beetle infestation (Wittwer 2002).

Volcanos and earthquakes are sporadic natural disturbance regimes in the ecoregion. Along the western side of the inlet rise Mt. Augustine, Mt. Iliamna, Mt. Spurr, and Mt. Redoubt—all considered active volcanoes. Eruptions from these volcanoes can play a significant disturbance role due to ash deposition. Volcanic activity has occurred in the recent past, including several eruptions in the last century and significant eruptions of Redoubt and Spurr in the early 1990s. Regular tectonic activity also occurs in the ecoregion. Some of the largest earthquakes in the world have affected the Cook Inlet Basin, and coastal lands in the region have been known to rise or fall several feet. In 1964 the largest earthquake recorded in North America permanently changed the elevations of many coastal areas. Forested community types quickly transitioned to salt marsh due to flooding from subsidence of the ground (UAF Sea Grant 2002). Subsidence and uplift at this scale can dramatically change the landscape and character of associated surface waters.

Tides in Cook Inlet have among the highest ranges in the world, ranging up to 9.16 m in the upper inlet where bore tides are commonly observed. Rivers in the ecoregion deposit glacial sediment into the inlet and much of this is redistributed and deposited in extensive tidal flats (ADNR 1999). Mixing of freshwater and saltwater influence the high productivity found within the inlet. Erosion from moving ice can affect the surrounding coastline.

3. Trends in Biodiversity

The Cook Inlet Basin is generally considered an intact ecoregion with unimpeded natural ecological processes shaping the landscape; however, there are several notable negative trends in biodiversity, such as non-cyclical population declines, collapse of marine fish populations, and spatial isolation.

Aquatic ecological systems are mostly stable, but sport and commercial fisheries, as well as exotic species, place significant pressure on local fish populations. Experts have noted declining populations of pink and coho salmon, especially in the upper inlet. Declining chinook salmon populations have also been documented throughout the ecoregion.

Northern pike (*Esox lucius linnaeus*), a fish species not native to the Cook Inlet Basin, have recently been found in many lakes and streams in the ecoregion and are of great concern. Indigenous north and west of the Alaska Range, northern pike were introduced to the Cook Inlet Basin by humans and are rapidly spreading throughout southcentral Alaska. Northern pike can have severe impacts on the aquatic systems to which they are introduced, as they eliminate or greatly reduce the native species. Northern pike use habitat similar to that of salmon and trout, especially in shallow waters, and are voracious predators of salmon fry. Populations of coho salmon, arctic grayling, rainbow trout, and other salmonids have suffered from the introduction of northern pike.

Researchers have also documented declines in marine species. The Cook Inlet stock of beluga whales showed declines by up to 50% from 1994-1998 (NMML 1999). Heavy fishing pressure coupled with climatic shifts have resulted in the collapse of populations of herring and several crab species in and around Kachemak Bay, and fishermen have noted declines in the number of groundfish such as pacific halibut in the lower Cook Inlet. The Kachemak Bay commercial Tanner crab fishery, the Cook Inlet commercial shrimp fishery, and the Kachemak Bay personal-use dungeness fishery were each closed within the last 15 years, indicating long-term population changes.

Many landbirds are considered declining on a global scale, including the olive-sided flycatcher (*Contupus cooperi*), a “species of special concern” in Alaska according to ADFG. Sources of decline may be within or outside the Cook Inlet Basin. The flycatcher’s decline, for example, may be due to alterations in its wintering habitats in South America (Boreal Partners in Flight Working Group 1999). While not declining, black-capped chickadees (*Parus atricapillus)* in the ecoregion have shown increasing numbers of bill deformities. Most of the reports of deformed chickadees have come from the Matanuska-Susitna Valley (43%) and from Anchorage and Eagle River (39%) (USGS 2000). Experts studying these deformities believe that the cause for the deformities may be local.

Other birds in the Cook Inlet Basin showing declines in populations include the short-billed dowitcher (*Limnodromous griseus*), Hudsonian godwit, longtailed duck (*Clangula hyemalis*), and whimbrel (*Numenius phaeopus*). The Hudsonian godwit and whimbrel both occur in high concentrations in the ecoregion, and in turn, the Cook Inlet ecoregion is critical to supporting hemispheric populations of these birds (Alaska Shorebird Working Group 2000).

There are currently no known declines of terrestrial mammal populations in the ecoregion; however, little is known about population sizes of many species. While populations on the

Kenai Peninsula are currently stable, they are naturally isolated from populations on the mainland and may be therefore vulnerable to increases in habitat fragmentation. The Kenai Peninsula brown bear population has been identified as a "species of special concern" in Alaska by ADFG because the population "is vulnerable to a significant decline due to low numbers, restricted distribution, dependence on limited habitat resources, or sensitivity to environmental disturbance" (ADFG 2000). Due to its geography, the Kenai Peninsula acts as an island, limiting genetic exchange and travel of this population. Increase in human population on the Kenai Peninsula has likely contributed to the increased killing of bears for defense of life and property. Similarly, large predator populations are currently stable in the Susitna drainage and around Anchorage, but it is likely that the Anchorage and the Palmer/Wasilla areas are increasingly local sinks for these species.

Forests in the ecoregion continue to change due to the recent spruce bark beetle epidemic. There are concerns that future forest composition may not resemble the forests of the present or recent past because there is a lack of understory individuals for regeneration and there has been a significant loss of overstory seed sources. Future predictions for forest composition include increases in heavy grasses and/or hardwoods for several decades (Berg 2000b).

Changes in forest composition and structure may affect several species of landbirds. Though species such as the Townsend's warbler (*Dendroica townsendi*) and white-winged crossbill (*Loxia leucoptera*) may be negatively impacted, other species including the great gray owl (*Strix nebulosa*), gray-cheeked thrush (*Catharus minimus*) and northern shrike (*Lanius excubitor*) may actually benefit from moderate openings in the forests (Boreal Partners in Flight Working Group 1999). Several small mammal species and moose may also benefit from changes to early successional forests; whereas other mammal species, such as red squirrels, may show declines (Wittwer 2002). Changes to salmon habitat are likely as well. Streams bordered by affected trees may undergo changes in large woody debris availability, and such changes would likely affect spawning habitat.

Currently there are two species with populations listed as endangered or threatened under the Endangered Species Act. The western population of the Steller sea lion (*Eumetopias jubatus*) is listed as endangered, and the breeding population of the Steller's eider (*Polysticta stelleri*) is listed as threatened. The Cook Inlet Basin ecoregion is not primary habitat for either species; although they do occur in the ecoregion.

4. Socioeconomic Trends

The Cook Inlet Basin ecoregion hosts the majority of the state's population and related infrastructure. Even so, most of the Cook Inlet Basin is only lightly developed, with most heavy development and human population concentrated in a small number of areas, primarily Anchorage, the Matanuska-Susitna Valley (Mat-Su) and the Kenai Peninsula. Human population numbers, however, have been consistently increasing. Over the last 10 years, this ecoregion has seen some of the most rapid growth in the state. Two of Alaska's fastest growing boroughs are in the Cook Inlet Basin. The Kenai Peninsula Borough population increased by 22% from 1990 to 2000, and the Mat-Su Borough increased by 49% over the same time period (ISER 2001). Towns in these boroughs are growing at a faster rate than Anchorage; their combination of proximity to Anchorage and rural setting is likely stimulating the rapid growth (Brabets et al. 1999; ISER 2001).

Population in the Cook Inlet Basin ecoregion tends to increase seasonally. Tourism, one of the most rapidly growing industries in Alaska, is responsible for much of this seasonal increase. Expansion of residential subdivisions and the development of recreational homes in areas outside established communities is an increasingly common occurrence in the ecoregion, and has led to a proliferation of homes and cabins along major rivers and lakes. Second home development is particularly popular on the Kenai Peninsula, especially along the Kenai River and around the Kachemak Bay area, and in the Mat-Su Valley around Big

Lake. Job growth within the Mat-Su Borough increased by 66% from 1990-1999 and 18% in the Kenai Peninsula Borough over the same time period (ISER 2001).

The major industries of the region include commercial fishing, timber, oil and gas development, and tourism. Around four million salmon are harvested from streams in the Cook Inlet Basin annually (Brabets et al. 1999). Timber harvesting has increased on the Kenai Peninsula in response to the recent spruce bark beetle outbreak. Numerous logging roads are present on the Kenai, and some timber harvesting is occurring on the west side of Cook Inlet and within the Susitna drainage. Oil and gas development is concentrated on the northern part of the Kenai Peninsula and in the western portion of Cook Inlet Basin. This development and its attendant infrastructure may increase with current trends in energy policy. In Nikiski, an unincorporated town in the Kenai Peninsula Borough, oil refineries, a liquefied natural gas (LNG) plant, and a fertilizer factory are significant economic drivers. The port of Nikiski services offshore drilling platforms. Timber, commercial fishing, sport fishing, government, retail businesses and tourism-related services also provide employment.

Harvest of fish and wildlife for subsistence purposes in the Kenai Peninsula and Mat-Su regions is, on average, 12-18 kg annually per person; in Anchorage it is 7-16 kg per person (ISER 2001). Sport fishing is increasing on nearly all of the drainages in the ecoregion. Many major commercial species have shown declines in the last decade.

5. Land Management

The ecoregion falls in the jurisdictions of the Kenai Peninsula Borough, Mat-Su Borough and the Municipality of Anchorage. The majority of land in the Cook Inlet Basin is publicly managed (see Figure 7). State-managed lands constitute 51% of the ecoregion and federally-managed lands comprise 15%. The Kenai National Wildlife Refuge accounts for most of the federally-owned lands. A small fraction of state-managed lands are managed for conservation values. These include game refuges, critical habitat areas, state parks, and state recreation rivers. Much of the state-managed lands in Cook Inlet Basin (45%) are as yet undesignated, and thus not necessarily managed for conservation.

As elsewhere in the state, Native groups and individuals are among the most significant private landowners (see Figure 8). Cook Inlet Region, Inc. (CIRI) is the single regional for-profit Native corporation located within the ecoregion. In addition there are several Native communities, associations, or tribes located within the ecoregion: Chickaloon, Eklutna, Knik, Ninilchik, Salamatof, Tyonek, Kenaitze and Point Possession, Inc. Eight percent of the Cook Inlet Basin ecoregion is composed of Alaska Native Claims Settlement Act (ANCSA) lands. Of the ANCSA lands, CIRI predominantly owns subsurface rights, and the corporations for each of the villages own the surface rights. Village land statistics are unavailable. There are a total of 132 Native allotments in the ecoregion.

C. METHODS

The Nature Conservancy and its partners carried out this assessment guided by the methodology outlined in *Designing a Geography of Hope: A Practitioner's Handbook to Ecoregional Conservation Planning* (Groves et al. 2000). Certain modifications, however, were required to adapt the framework to the unique characteristics of the Cook Inlet Basin ecoregion. Modifications, as well as the specific applications of the planning framework to Cook Inlet Basin, are documented in the following sections of the report.

Ecoregional assessment is an iterative process built around five key steps:

1. **Select conservation targets** (e.g., species, communities, and ecological systems) to represent the ecoregion's biodiversity and to be the focus of conservation efforts within the ecoregion.

2. **Set conservation goals** in terms of number and distribution of the targets to be captured in the portfolio. These goals serve as initial hypotheses about the level of effort required to conserve biodiversity.

3. **Assess viability of individual target occurrences** to determine the likelihood of long-term persistence.

4. **Identify and design a portfolio of areas of biological significance** that effectively meets conservation goals.

5. **Identify preliminary threats to targets** at these areas and identify action steps to conserve the portfolio.

This type of rigorous analysis employs thousands of pieces of detailed information. It requires location-specific information for conservation targets as well as the past, current, and potential future status of lands where the targets occur. The team used the most up-to-date biological and physical data available for this assessment. However, given the quantity and quality of information involved—and the reality of ecological change—our knowledge will remain incomplete. We therefore approach this assessment with the intention of clarifying and filling information gaps over time, and periodically revisiting our analysis with new information that becomes available.

1. Selecting Conservation Targets

The vast number of species comprising any given area's biological diversity makes it impractical to assess and plan for each individual element of that diversity. The first step in an ecoregional assessment, therefore, is to identify a subset of species, communities and ecological systems that could best represent the relative biodiversity significance of an area. This "coarse filter/fine filter" approach to biodiversity conservation was developed by The Nature Conservancy and refined through experience and planning.

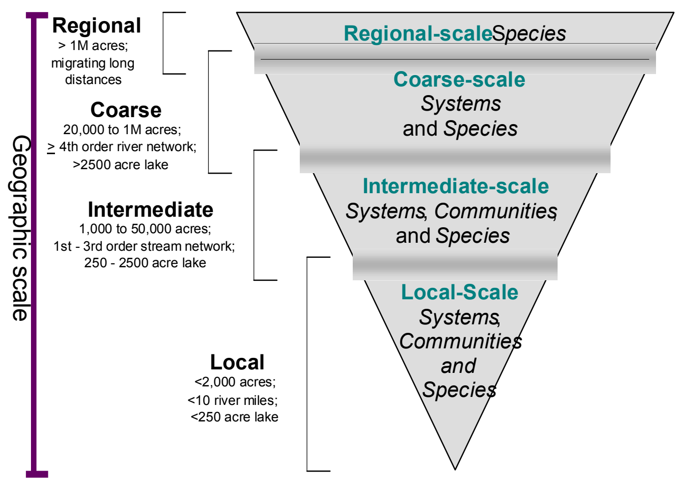
The coarse filter is a broad-level conservation strategy whereby ecological system types are used as conservation targets and assumed to represent 85-90% of species and many ecological processes, without having to inventory and manage each species individually. Given the status of our biological knowledge, however, this ecological systems approach cannot be counted on to maintain and protect all biodiversity. Some species, especially the rarest, will fall through the screen of the coarse filter. Therefore, a fine filter for certain species is needed as a complement to the coarse filter.

Fine filter targets include species—particularly those that are rare, endemic and/or in decline—and certain rare, small patch plant and animal community types. Some fine filter species may be adequately addressed as members of recurrent communities (or species aggregations, such as migratory bird stopovers, bear feeding areas, etc.); others require attention as individual species fine filters (such as species that are globally rare and imperiled, narrowly endemic, or wide-ranging).

In order to use the coarse filter, it is necessary first to name and describe (classify) the constituent terrestrial, freshwater, and coastal systems in an ecoregion. In order to match the level of detail available in most spatial data sets for the Cook Inlet Basin ecoregion, broad classification units were chosen instead of more detailed classifications.

FIGURE 9: Characteristic spatial patterns of conservation targets

Categories representing geographic scale of conservation targets. Areal ranges are approximate and overlapping (Poiani et al. 2000).



Once lists of conservation targets are developed and reviewed by experts, additional descriptive information is gathered for each target. Particularly important is the target's characteristic spatial pattern, which represents the typical range of a species, extent of a system type, or length of a stream (stream order can substitute as a preliminary estimate). Four spatial scales are used: *local, intermediate, coarse* and *regional*. Spatial scale is attributed to each target not necessarily as it occurs today, but as it has occurred in recent centuries without significant human alteration (*sensu* Poiani et al. 2000) (See Figure 9). To ensure that conservation is focused on all scales of biodiversity in the ecoregion, it is important that the final list of conservation targets include representatives from all four spatial scales.

2. Setting Conservation Goals

Goals provide the quantitative basis for identifying and prioritizing areas of biological significance and for evaluating the effectiveness of conservation action. Meaningful conservation goals are therefore measureable both quantitatively and spatially. The quantitatitve component defines the number of on-the-ground occurrences of targets necessary to adequately conserve the target in the ecoregion. The spatial component describes how target occurrences should be distributed across the landscape. For example, a conservation goal of five occurrences in the ecoregion may be further refined to require that at least one occurrence be located in each subregion of the ecoregion. As a general rule, multiple examples of each target, stratified across the target's geographic range, are necessary to represent the variability of the target and its environment, and to provide some level of replication. Replication is needed to ensure persistence in the face of environmental stochasticity and the likely effects of climate change.

A number of factors, including life history, key ecological processes and genetic or environmental variability of a target, contribute to the goal-setting process for each target. Ideally conservation goals should be based on a thorough and modern understanding of the population biology of targeted species and minimum population viability theory. Unfortunately, current, complete and specific data were not available for most of the targets within the Cook Inlet Basin ecoregion. Due to this lack of information, several assumptions were made during the goal-setting process. The first assumption was that in lieu of a specific number of populations by which to set a goal, conservation goals for species may be linked to specific habitat types. For example, instead of establishing a goal for a certain number of viable populations of Townsend's warbler, the goal would be a certain amount of the warbler's preferred habitats: open forest, forest gaps, and woodland and muskeg edges. Unfortunately, the terrestrial habitat information available for the Cook Inlet Basin could not reliably represent these fine-scale habitats. Thus, a second assumption had to be made—that coarse filter system targets could reliably represent finer-scale habitats. In the case of the Townsend's warbler, it was assumed that the preferred habitats could be represented by the following systems: floodplain/outwash plain forest and woodland, Lutz spruce forest and woodland, and white spruce/ black spruce forest and woodland. These assumptions magnify the possibility of error in targeting specific areas of biological significance, but they constitute a best attempt at using available information.

The science involved in setting conservation goals is still young, and appropriate guidelines for answering the inherent question "How much is enough?" are sparse, particularly in largely intact systems such as those in the Cook Inlet Basin. The assessment team relied upon a variety of resources to set conservation goals, from existing species management studies to existing conservation plans to expert opinion to default measures that must be refined in time through monitoring and observation.

Establishing conservation goals is a process rooted in the most difficult—and most important—scientific questions in biodiversity conservation. As some have pointed out (e.g. Noss 1996, Soule & Sanjayan 1998), these questions cannot be answered by theory alone, but require an empirical approach, target-by-target, and a commitment to monitoring and continual re-evaluation over the long term. Goals for the Cook Inlet Basin ecoregion, therefore, must be considered working hypotheses and should ideally be tested and refined over time in order not only to incorporate new information but also to measure the success of the assessment and its resulting conservation efforts.

3. Viability Assessment

It is important to set conservation goals based on *viable* species or populations that have a high probability of continued existence in a state that maintains vigor and potential for evolutionary adaptation over a specified period of time. Conservation goals should support the evolutionary pathway of target species in continually changing systems; in the case of this assessment, goals were therefore set based on a time horizon of 100 years or 10 generations.

In a conservation assessment context, viability of a species or system may be determined for any of several scales: the individual example, a group or population, or the entire species or system. In ecoregions where sufficient detail is available, the emphasis is on viability of populations of species, and occurrences (or examples) of ecological communities and systems. The purpose of conducting viability assessments in these ecoregions is to ensure that the portfolio of areas of biological significance is composed of targets of the highest viability and that the areas are of sufficient dimension to endure natural processes that maintain the viability of the conservation targets therein (in other words, that they are functional landscapes). In essence, viability assessment represents a risk analysis for making an investment decision.

In ecoregions lacking detailed information about viability of populations and occurrences, alternate measures of viability may be used. In this assessment, a cost suitability analysis was performed to identify areas in the ecoregion where the cost of conservation efforts was likely to be the greatest. High cost was associated with features that contribute to landscape fragmentation, such as dams, roads, and towns. Degree of fragmentation and viability of conservation targets have been shown to be inversely related. Consequently, areas in the ecoregion that showed a high conservation cost were avoided in the final portfolio, unless the conservation targets in a high-cost area did not occur anywhere else in the ecoregion.

4. Designing the Portfolio

The primary goal of an ecoregional assessment is to identify a portfolio of areas of biological significance. These areas, if managed properly, will likely ensure the long-term survival of the species, plant communities and ecological systems of the ecoregion.

The Cook Inlet Basin assessment team used the following principles, based on guidelines outlined in *Designing a Geography of Hope*, to assemble the portfolio:

1. **Coarse Scale Focus***: As a first step represent or "capture" a percentage of all coarse-scale targets in the ecoregion, followed by targets at finer spatial scales.*
2. **Representativeness***: Capture multiple examples of all conservation targets across the diversity of environmental gradients appropriate to the ecoregion (e.g., subregion, ecological land unit).*
3. **Efficiency:** *Give priority in the portfolio selection process to areas where multiple targets occur in order to meet conservation goals for targets in the least amount of area.*
4. **Integration:** *Give priority to areas that contain multiple types of coarse-scale systems (e.g., terrestrial, aquatic and coastal) or areas that have targets at multiple spatial scales and levels of biological organization.*
5. **Functionality:** *Areas should be ecologically functional or readily restorable to a functional condition.*
6. **Completeness:** *Ensure that goals for each target have been met using viable occurrences. If there are not enough viable occurrences in the ecoregion to meet the conservation goal, restoration objectives should be set.*
7. **Irreplaceability:** *Areas with irreplaceable occurrences, or those that have no substitutes, should be included in the portfolio. Irreplaceable occurrences include those where targets are endemic to a single area, an only-known area for a target, one of the best-known areas for any target, concentrations of elements, or high ecological integrity.*
8. **Complementarity:** *Favor areas that complement existing conservation areas, assuming that management plans on these lands are adequate for conserving the species and systems present.*

The portfolio was designed using both an automated computer function and manual delineation by teams of experts. The Cook Inlet Basin ecoregion is ecologically intact, and characterized by functional ecological systems and wide-ranging species. In ecoregions such as this, there may be several viable portfolio "solutions" that meet conservation goals. The assessment team judged the portfolio in this report to be the best first iteration based on existing data and the knowledge and decisions of the experts involved in the process.

5. Data Sources, Management and Limitations

5a. Data Sources

Information about conservation targets and the ecology of the ecoregion was assembled from existing data sources (maps, literature, data sets) and supplemented with expert opinion. Expert opinion was sought throughout the assessment process through individual interviews and group meetings (workshops) of experts. Assessment teams attempted to compile all pertinent available data sets regarding targets in the Cook Inlet Basin ecoregion.

A variety of GIS layers for assessment, analysis, and the production of maps were compiled for the Cook Inlet Basin ecoregion. Base data layers included transportation, hydrography, ecoregional boundaries, element occurrences, land status, surficial geology, digital elevation models and species data from many sources. Biological information on habitats, ranges and aggregations of targeted species were also compiled using published and unpublished literature and information from scientific experts. For several lesser-known, declining and endemic species, expert-generated spatial data and habitat descriptions were used. Due to time constraints, the objective during data assembly was to compile comprehensive ecoregional data sets from existing sources, rather than data sets from small areas within the ecoregion or collection of primary information.

5b. Data Management

In addition to assembling a GIS database, planning teams compiled information in an Access-based database created by The Nature Conservancy for ecoregional planning, called the Conservation Planning Tool (CPT). This relational database allows information on the ecoregion and its targets to be stored in a central location. The CPT and data layers that are not restricted under data sharing agreements are available upon request. For a complete list of data sources as they relate to targets, see Appendix 11.

A comprehensive land cover map was not available for the entire ecoregion; thus land-cover maps from differing scales and classification schemes were “crosswalked” and combined with other biophysical features to form a consistent terrestrial systems model. Aquatic systems were also modeled using existing hydrography data, elevation and surficial geology. For coastal systems, existing information from NOAA’s Environmental Sensitivity Index was used in lieu of modeling systems. A CD compilation of modeled information is available upon request.

5c. Data Limitations

The assessment and portfolio design were based on the most current and comprehensive data readily available; however, both comprehensive field inventories in the Cook Inlet Basin ecoregion and, in many cases, basic data on species distribution and on specific location of habitat are limited. These data gaps necessitated a number of working assumptions. First, because published data are limited for many targets, the assessment team assumed expert information to be a scientifically adequate substitute. Second, the assessment team assumed that models were accurate to provide sufficient information at the ecoregional scale, although they were not ground-truthed. Third, data from a wide variety of sources were compiled and used in the assessment; these data were collected at different times and at different scales. Finally, data for many targets are incomplete and thus assumptions were made based on modeled information.

The Cook Inlet Basin has many species that commonly range throughout the ecoregion and beyond. Mapping habitats for these wide-ranging species also presented a number of challenges. Wide-ranging species require large areas to meet habitat requirements and many habitats are not well known; thus habitat prioritization is difficult. For example, brown bears in the basin may have a home range of between tens and hundreds of square miles (ADFG 2000). Because population-level information and specific habitat area needs for many species that use large areas are not available, conservation goals for these species will need refinement over time and should be updated once area requirements and population dynamics are better understood.

A summation of the most significant data gaps and consequent methodological challenges is in itself an important product of the assessment process. Identification of data gaps provides salient research topics for biologists and conservation scientists. These gaps, as well as recommendations for future assessments, are documented in more detail in Section K of this report.

6. Ecoregional Assessment Team

The Cook Inlet Basin ecoregional assessment team, organized in January 2000, consisted of representatives from The Nature Conservancy in Alaska, the Alaska Natural Heritage Program, the Conservancy's Freshwater Initiative, the Conservancy's Coastal Waters program and the Conservancy's Western Conservation Science Center. Staff from the Conservancy's Alaska office led taxonomic teams, information management and data compilation. The Western Conservation Science Center and Freshwater Initiative led terrestrial and aquatic classification work.

A number of experts helped obtain information and provided input to the assessment. Scientists and land managers knowledgeable about the Cook Inlet Basin ecoregion reviewed assessment materials and attended the expert workshops. Several meetings were held with experts from distinct areas of taxonomic expertise (e.g. birds, mammals). Experts assisted with selecting appropriate conservation targets, setting conservation goals, and mapping habitats and occurrences of targeted species. Experts also assisted in the delineation of areas of biological significance.

Participating experts in the Cook Inlet Basin assessment included representatives from the Alaska Department of Fish and Game, U. S. Geological Survey Biological Resources Division, the Department of Defense, the U.S. Fish and Wildlife Service, the National Park Service, the National Marine Fisheries Service, the Alaska Natural Heritage Program, the Audubon Society, the Natural Resource Conservation Service and the University of Alaska. Appendix 1 provides a full list of participants and the agencies and organizations involved. We are endebted to all of these experts for their time, commitment and excellent advice.

The Conservancy looks forward to expanding such partnerships in the Cook Inlet Basin ecoregion in both conservation action and future iterations of this assessment.

D. IDENTIFYING CONSERVATION TARGETS

The Cook Inlet Basin conservation assessment began with the identification of conservation targets, using the coarse filter/fine filter approach. The team chose 299 conservation targets. All mappable terrestrial, aquatic and coastal systems were selected as conservation targets; whereas only select species—particularly those endemic to the ecoregion and those vulnerable and in decline—were selected. Certain important species aggregation areas were also selected as species targets, even if they were not in decline. Vegetation communities were assumed to be represented by system targets; too little is currently known about their distribution in the basin to make them meaningful targets.

The following table identifies the type and number of targets in the Cook Inlet Basin Ecoregion. Species targets from all spatial scales were selected (Figure 10).

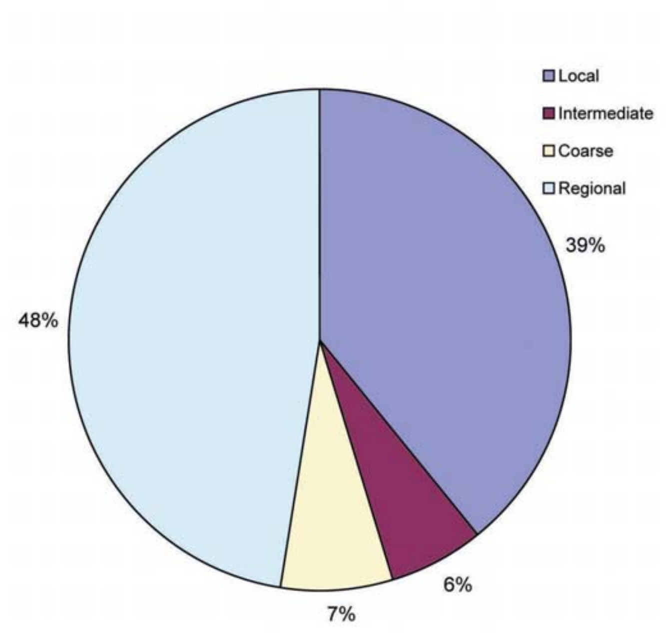


FIGURE 10: Spatial Scale of Target Species

TABLE 1: Conservation Targets in the Cook Inlet Basin Ecoregion

TYPE OF CONSERVATION TARGET	NUMBER OF TARGETS
ECOLOGICAL SYSTEMS	**207**
Terrestrial systems	13
ELU/system combinations	129
Aquatic systems	50
Coastal systems	15
SPECIES	**84**
Birds	28
Terrestrial mammals	12
Marine mammals	4
Crustaceans	2
Fish	10
Amphibians	1
Plants	27
SPECIES AGGREGATIONS	**8**
TOTAL	**299**

**Coastal mudflats and tidal marsh are considered coastal system targets.*

1. Coarse Filter Targets

1a. Terrestrial Ecological Systems Model

The Alaska Natural Heritage Program (AKNHP) describes 23 terrestrial ecological systems that are known to occur within the Cook Inlet Basin ecoregion (Appendix 5). Ideally, a detailed and ground-truthed vegetation map would be used to model these systems; however, no such map exists for the entire ecoregion. Several landcover datasets of adequate spatial resolution and appropriate thematic classification are available for *parts* of the ecoregion, but the Alaska interim land cover (LCI) data set, developed by USGS in the 1980s, is the only map at this time that provides both consistent coverage of the full geographic extent of the ecoregion and an adequate spatial resolution (50 m) for modeling system targets at the ecoregional level.

The LCI data was therefore chosen for modeling although its thematic classification is not sufficient to depict the spatial distribution of all terrestrial and palustrine targets. To address this limitation, a GIS model was developed in consultation with vegetation experts. The model uses the LCI vegetation data in combination with ancillary features of the landscape, including topography (e.g. “low flat” landform type), elevation zone (e.g. above vs. below treeline), proximity to tidewater, and floodplains. For a technical description of the model, including input data and the set of GIS decision rules, see Appendix 6.

The GIS model resulted in 14 terrestrial system surrogates for predicting the distribution of 15 of the 23 system types. The remaining 8 systems—shrub wetlands, lowland hemlock forest and woodland, bluejoint meadows, coastal sand dunes, active inland dunes, sagebush bluffs, eelgrass beds and aquatic/lake systems (e.g. emergent vegetation) —could not be modeled using the terrestrial system surrogates. These systems were identified when possible with expert-delineated polygons.

Table 2 lists the resulting modeled terrestrial systems used as conservation targets in this assessment of Cook Inlet Basin, along with the AKNHP-defined systems from which the models were derived. Though the modeled systems are named based on dominant vegetation, they represent an *integration* of vegetation and physical landscape features. Also included in the table is information on distribution and spatial pattern characteristics of each modeled system (for definitions see Appendix 3).

TABLE 2: Modeled Terrestrial Systems in Cook Inlet Basin

MODELED TERRESTRIAL SYSTEMS USED AS TARGETS	TERRESTRIAL SYSTEMS (DESCRIBED BY THE ALASKA NATURAL HERITAGE PROGRAM)	DISTRIBUTION WITHIN COOK INLET BASIN	SPATIAL PATTERN
Alpine Ericaceous Dwarf Shrubland	Alpine Ericaceous Dwarf Shrubland	Widespread	Small patch, large patch
Alpine Wet Herbaceous Meadow	Wet Herbaceous	Widespread	Small patch
Birch-Aspen Forest and Woodland	Birch-Aspen Forest and Woodland	Widespread	Large patch
Black Spruce and Open Peatland	Peatlands	Widespread	Small patch, large patch
	Black Spruce Peatlands	Widespread	Small patch, large patch
Coastal Mudflats*	Coastal mudflats	Widespread	Large patch
Exposed Bedrock / Sparse Vegetation	Exposed Bedrock / Sparse Vegetation	Widespread	Large patch
Floodplain / Outwash Plain Forest & Woodland	Floodplain / Outwash Plain	Widespread	Limited, large patch
Lutz Spruce Forest and Woodland	Lutz Spruce Forest and Woodland	Endemic	Large patch, matrix
Mesic Herbaceous	Mesic Herbaceous	Widespread	Small patch, linear

Subalpine Tall Shrubland	Subalpine Tall Shrubland and Avalanche Chutes	Widespread	Limited, large patch
Tidal Marsh*	Tidal Marsh	Widespread	Small patch
Upland Dwarf Shrub	Low Shrub	Widespread	Small patch
Upland Tall and Low Shrub		Widespread	Small patch
Wet Herbaceous Meadow	Wet Herbaceous	Widespread	Small patch
White Spruce / Black Spruce Forest & Woodland	White Spruce Forest and Woodland	Widespread	Large patch, matrix
	Black Spruce Forest and Woodland	Widespread	Matrix
TOTAL = 13*			

1b. Ecological Land Units and Terrestrial Ecological System Combinations

In order to describe the diversity of the physical environment and thus the full range of environmental gradients across which systems are distributed, a mapped classification of the abiotic environment was also developed. This abiotic classification identifies unique, spatially-discrete combinations of elevation zone, surficial geologic class and landform type. Each unique combination is called an Ecological Land Unit (ELU).

The development and use of abiotic units is based on the widely-recognized premise that the natural distribution of plant species is driven by environmental gradients, and that these gradients are determined by a complex of underlying abiotic factors, such as insolation, temperature, soil moisture and nutrients, operating at multiple scales. Under such a premise, the distributions of the key abiotic factors may therefore act as approximations, or "physical proxies," in a particular area for the spatial distribution of many species and ecological systems.

Ideally, a biophysical classification of the Cook Inlet Basin would be based on such abiotic variables as climatic zone, elevation, landform, slope, aspect, hydrologic regime, amount of exposed bedrock, and soil depth, texture, pH and salinity. Due to insufficient data, however, ELUs for the basin were developed from 3 key components: elevation zone, surficial geologic type and landform type.

ELUs were modeled across the ecoregion using a 30 m digital elevation model (DEM) resampled from the 60 m National Elevation Dataset (NED), and the State Surficial Geology Map of Alaska (1964)(1:1,584,000), digitized by NPS (2000). Variables and variable classes used to develop ELUs were derived from documented knowledge of driving ecological factors within the ecoregion (e.g., Viereck et al. 1992). Landforms, land position, and aspect were first derived from the digital elevation model, and then combined with surficial geology and elevation zone to form the ELUs. For a technical description of methods used to determine ELUs, see Appendix 7.

When used in combination with a biotic system classification, an abiotic landscape classification may have special utility in describing the environmental "envelope" of a system. The derived distribution of ELU types was therefore combined in a GIS with the modeled terrestrial systems layer. The result is a stratification of each modeled terrestrial system by its component ELUs, which describes the range of environmental conditions over which the system occurs.

After the terrestrial systems were stratified by ELU types across the ecoregion, minor combinations were eliminated. Unique ELU/system combinations with total areas of less than 10 ha or, in the case of matrix-forming and large-patch targets, less than 50 ha were considered erroneous and eliminated. After applying the minimum patch size filters, 129 ELU/system combinations then remained.

In order to represent the full range of ecological and genetic variation of each system, these remaining ELU/system combinations were considered conservation targets in and of themselves. For a complete list of the ELU/system targets see Appendix 4.

1c. Aquatic Ecological Systems Model

Freshwater aquatic systems are spatial units defined by distinct geomorphological patterns of stream and lake networks. They must share similar environmental processes (e.g., hydrologic and nutrient regimes) and gradients (e.g. temperature), occur in the same part of a drainage network, and form distinguishable spatial units (Higgins et al. forthcoming). These spatial units have characteristics potentially important for biotic assemblages, as well as for genetic and ecotype characteristics of species.

The classification of aquatic systems in the Cook Inlet Basin ecoregion yielded 50 system types. There were 4 main divisions among the systems: those that had a glacial origin, those with a non-glacial origin, those that contained lakes, and those that occurred on islands. While the uniqueness of lake and island stream systems may be apparent, the hydrologic patterns of glacial and non-glacial rivers are also distinct. Glacial-fed rivers have very high peak flows and sediment loads during glacial melt-off; whereas the peak flows and sediment loads of non-glacial rivers are much lower.

Following the initial division of systems into glacial, non-glacial, lake and island, subsequent classification was based on size, surficial geology, and connectivity to lakes, wetlands, sloughs and the inlet.

The 50 aquatic systems described in the Cook Inlet Basin ecoregion are nested within 3 ecological drainage units (EDUs): the West Cook Inlet EDU, the Anchorage-Kenai Peninsula EDU and the Susitna/Matanuska/Knik EDU. In order to account for the expected differences in freshwater biota between drainage units, similar system types in different EDUs were classified separately. For example, a glacial mainstem river in the West Cook Inlet EDU was classified separately from a glacial mainstem river in the Anchorage-Kenai Peninsula EDU. In essence, classification units were intersected with ecological drainage unit classification to obtain a classification framework that describes systems across broad-scale environmental gradients. These gradients were defined by precipitation patterns as well as patterns of geology, changes in elevation and density of glaciers. (See Appendix 8 for delineation of EDUs, a discussion of the process and the classification of aquatic systems by EDU).

The aquatic systems analysis was designed to highlight factors that are likely driving variables in distinguishing aquatic environmental patterns and processes, which in turn determine the types and distributions of natural communities. Rather than define the fine-scale differences within and between riverine and lacustrine systems, the analysis seeks to characterize the potential for these differences. For example, despite common knowledge that floodplain rivers may have main channels, lateral channels, riparian floodplains, oxbow lakes, and intermittently connected lakes, the classification will merely distinguish a floodplain river from other river types—not the components within them. The classification of aquatic systems for the Cook Inlet Basin appears in Table 3 below.

TABLE 3: Aquatic system targets

EDU	GENERAL TYPE	ID NUMBER	CLASSIFICATION (SHORT NAME)
WEST COOK INLET EDU	GLACIAL RIVERS	111	Glacial Mainstem River
		1111	Bedrock Tributaries to Glacial Mainstem
		11111	Glacial Mainstem River with Large Headwater Lake
		111111	Headwater Lake and Tributaries
		11112	Icefield Melt Dominated, Short River Mainstem
		1112	Moraine Tributaries to Glacial Mainstem

		1113	Lake Plain Tributaries to Glacial Mainstem
		1114	Marine and Alluvial Deposit Tributaries to Glacial Mainstem
		1115	Distributaries from Glacial Mainstem
	NON-GLACIAL RIVERS	112	Moderate Sized Non-Glacial River
		1121	Bedrock Tributaries to Non-Glacial Mainstem
		1122	Moraine Tributaries to Non-Glacial Mainstem
		121	Stream on Moraine
		131	Stream on Lake Plain
		141	Stream on Alluvium and Marine Deposits
	STREAMS & LAKES ON ISLANDS	411	Streams on moraine connected to lakes and wetlands. Empty into Inlet.
		413	Unconnected lakes and streams on islands on moraine.
SUSITNA / MATANUSKA EDU	**GLACIAL RIVERS**	211	Glacial Mainstem of Major Tributary of Susitna Complex
		212	Susitna River Delta
		213	Glacial River Flowing into Inlet-Non Susitna Complex
		2111	Bedrock Tributaries to Glacial Mainstem
		2112	Moraine Tributaries to Glacial Mainstem on Alluvial Terrace
		2113	Alluvial Floodplain Tributaries to Glacial Mainstem
		2115	Lake Plain Tributaries to Glacial Mainstem
	NON-GLACIAL RIVERS	221	Non-Glacial Stream on Moraine
		231	Non-Glacial Stream on Lake Plain
		251	Small Stream on Moraine Unconnected to Inlet
	LAKES	2611	Small Unconnected Lakes on Lake Plain
		2612	Small Unconnected Lakes on Moraine
		271	River on Alluvial Floodplain on Moraine
		2711	Moraine Tributaries to Rivers on Alluvial Floodplain on Moraine
		281	Very Short Streams on Sand Dunes in Susitna Delta
		282	Very Short Streams on Lake Plain in Susitna Delta
ANCHORAGE / KENAI EDU	**GLACIAL RIVERS**	311	Glacial Mainstem River
		312	Glacial Mainstem not on Outwash Channel
		313	Tributaries to Glacial Mainstem River
		3111	Bedrock Tributaries to Glacial Mainstem
		3112	Moraine Tributaries to Glacial Mainstem
		31121	Moraine Tributaries to Glacial Mainstem on Alluvial Outwash Plain
		3113	Lake Plain Tributaries to Glacial Mainstem
		321	Glacial Mainstem with Large Lake in Headwaters
		3211	Lake and Tributaries to Glacial Mainstem with Large Lake in Headwaters
	NON-GLACIAL RIVERS	331	Non-Glacial River Draining Steep Topography and Crossing Lake Plain and Moraine
		332	Stream on Moraine
		333	Stream on Lake Plain
	LAKES	3361	Unconnected Lake on Lake Plain
		3362	Unconnected Lake on Moraine
		337	Large Stream on Lake Plain in Alluvial Floodplain
		338	Large Stream on Moraine in Alluvial Fllodplain with Sections of Old Glacial Outwash
	STREAMS AND LAKES ON ISLANDS	414	Island Unconnected Lakes and Streams on Lake Plain
TOTAL			**50 AQUATIC ECOLOGICAL SYSTEMS**

1d. Coastal Ecological Systems Map

Coastal systems are generally areas of high productivity that provide critical habitats for a range of species. In the Cook Inlet Basin ecoregion, coastal systems were defined based on substrate and structural characteristics of the coastline. A typical substrate feature identified on a map might be a rocky intertidal zone; whereas important coastal marine vegetation might be eelgrass.

Like the terrestrial and aquatic systems described in previous sections, the identification and mapping of coastal system targets was dependent on available spatial data. For the coastal systems in the Cook Inlet Basin, the primary source of spatial data was the Environmental Sensitivity Index (ESI). This classification and associated map were developed by the U.S. Minerals Management Service and NOAA, and produced by the Exxon Valdez Oil Spill Research and Restoration Information Project. The ESI is a classification of shoretype (coastal morphology), and it was produced for use in analyzing vulnerability of the coastal environment to oil spills.

ESI shoreline types were used as surrogates for coastal system targets and for several of the coastal species targets in the ecoregion. Table 4 lists the coastal systems that were used as conservation targets in the ecoregional assessment, and Figure 11 shows their distribution in the ecoregion. For a full description of ESI shoreline types and sensitivity to oil spills, see Appendix 9.

In applying the ESI data in this assessment, several assumptions were made. For example, ESI-defined 'sheltered tidal flats' were used as a surrogate for "mudflats with *Macoma baltica*." Assessment teams also determined that "hard bottom intertidal," "spit/lagoon" and "subtidal shoals and reef systems" could not be adequately mapped. These system types were dropped from consideration as targets as their locations were unknown. They will need to be addressed in a future assessment as finer-scale data becomes available.

In addition to the ESI system types, several other system and community level targets in the ecoregion could be mapped from models, already existing data, or expert workshops. For example, mudflats and tidal marsh systems, both components of the terrestrial systems model, were incorporated in the coastal analysis. The Kachemak Bay Estuarine Research Reserve supplied locations for kelp forests and mussel beds. Experts mapped locations of estuaries, river mouths and eelgrass beds. A number of the coastal targets occur only in the southern part of the ecoregion.

TABLE 4: Coastal ecological system targets

COASTAL SYSTEM TARGET	
Coarse grained sand beaches	Kelp forests
Coastal mudflat	Mixed sand and gravel beaches
Eelgrass beds	Mussel beds
Estuaries / river mouths	Sandy beaches w/razor clams
Exposed rocky shores	Sheltered rocky shores
Exposed tidal flats	Sheltered tidal flats and mudflats with *Macoma baltica*
Exposed wavecut platforms	Tidal marsh
Gravel, cobble and boulder beaches	TOTAL = 15 COASTAL SYSTEM TARGETS

2. Fine Filter Targets

Species that are rare, have extremely restricted habitat requirements, are wide-ranging or migratory, or show high fidelity to a specific area year after year may not be adequately represented by the coarse filter. Such species may be included in the ecoregional assessment as fine filter targets.

In the Cook Inlet Basin assessment, fine filter targets were selected in consultation with experts familiar with the ecology and species in the basin. Species under the following categories were included as fine filter targets:

- *all species with Natural Heritage Program ranks of G1 to G3 or T1 to T3;*
- *all species listed as Threatened or Endangered under the Endangered Species Act;*
- *and species thought to be endemic to the ecoregion or disjunct.*

In addition, several species considered to be declining, keystone or vulnerable were selected as targets. Definitions of these categories are not, however, agreed upon universally and so selection was subjective. Table 5 outlines the definitions used in this assessment. Definitions for all other categories are found in Appendix 3.

TABLE 5: Criteria used for species target selection in the Cook Inlet Basin ecoregion

CRITERIA	DESCRIPTION
G1-G3 / T1-T3	Natural Heritage Program Global (G) and Subspecies (T) rarity rank
FEDERALLY-LISTED THREATENED OR ENDANGERED	U.S. Endangered Species Act
ENDEMIC TO THE ECOREGION	Species with >75% of total geographic distribution, populations, or individuals that fall within the ecoregion
DISJUNCT	Species does not occur in adjacent ecoregions
DOCUMENTED DECLINING	Species that exhibit significant declines in part of their range, are subject to a high degree of threat in multiple seasons, or have unique habitat or behavioral requirements that expose them to great risk
KEYSTONE	Species whose impact on a community or ecological system is disproportionately large for their abundance
VULNERABLE	Species with some aspect of their life history that makes them susceptible to species-level declines
SPECIES AGGREGATION	Species concentration areas that are unique, irreplaceable or critical to the conservation of a certain species or suite of species

2a. Birds

Bird targets were selected based on trends, status, and distribution in the Cook Inlet Basin ecoregion. In consultation with experts, targets were selected from landbirds, seabirds, seaducks, shorebirds, and waterfowl groups that spend some portion of their life cycle in the Cook Inlet Basin. Bird targets are listed below in Table 6.

TABLE 6: Bird targets in Cook Inlet Basin ecoregion

SCIENTIFIC NAME	COMMON NAME	G-RANK	WHY CHOSEN
LANDBIRDS			
Aegolius funereus	Boreal owl	G5	Vulnerable
Cinclus mexicanus	American dipper	G5	Vulnerable
Empidonax difficilis	Pacific-slope flycatcher	G5	Vulnerable
Dendroica townsendii	Townsend's warbler	G5	Vulnerable
Melospiza melodia kenaiensis	Kenai song sparrow	G5TU	Endemic
n/a	Olive-sided flycatcher - species mix nested within		Declining
n/a	Riparian landbird species mix		Special aggregations, many declining species
SEABIRDS / SEADUCKS			
Brachyramphus brevirostris	Kittlitz's murrelet	G3G4	Declining
Brachyramphus marmoratus	Marbled murrelet	G3G4	Vulnerable
Cepphus columba	Pigeon guillemot	G5	Vulnerable
Clangula hyemalis	Long-tailed duck	G5	Declining
Histrionicus histrionicus	Harlequin duck	G4	Declining
Polysticta stelleri	Steller's eider	G3	Declining
Somateria mollissima (Pacific)	Pacific common eider	G5	Vulnerable
Sterna aleutica	Aleutian tern	G4	Special aggregation, declining
SHOREBIRDS			
Calidris alpina	Dunlin	G5	Special aggregations
Calidris mauri	Western sandpiper	G5	Special aggregation
Calidris ptilocnemis (Pribilof)	Rock sandpiper (Pribilof Island)	G5	Special aggregation
Limosa haemastica	Hudsonian godwit	G4	Declining
Limnodromus griseus	Short-billed dowitcher	G5	Declining
Numenius phaeopus	Whimbrel	G5	Declining
Tringa flavipes	Lesser yellowlegs	G5	Special aggregation
WATERFOWL, CRANES AND LOONS			
Anser albifrons elgasi	Tule white-fronted goose	G5T3?	Endemic (breeding)
Chen caerulescens (Wrangel Island)	Wrangel Island snow goose	G5	Special aggregation
Cygnus buccinator	Trumpeter swan	G4	Disjunct
Gavia immer	Common loon	G5	Vulnerable

Gavia pacifica	Pacific loon	G5	Vulnerable
Grus canadensis	Sandhill crane	G5	Special aggregation
TOTAL = 28 FINE FILTER BIRD TARGETS			

Landbirds

Several landbirds were identified as potential targets from the Landbird Conservation Plan for Biogeographic Regions (Boreal Partners in Flight 1999). Many of these species were grouped by experts based on common habitat requirements. Other landbirds were targeted individually if their habitat needs differed substantially from those represented by the species groups and if they were considered vulnerable, endemic or declining. For example, bird species that depend on healthy riparian habitats were grouped together as the target 'riparian landbird species mix.' The American dipper, a bird that relies on healthy aquatic systems and that is often associated with intact riparian zones, was nevertheless considered a separate target because its populations in the Cook Inlet Basin are considered vulnerable and its habitat needs differ from the riparian group.

Seabirds and seaducks

Seabirds and seaducks are attracted to the unique environments that the Cook Inlet Basin provides, such as its shallow, nearshore marine waters and semi-protected bays. In summer seabirds are found along the coastline of Cook Inlet; although the larger colonies are found in lower Cook Inlet. Protected bays such as Kachemak Bay are important habitats for seaducks in winter. Several seabird and seaduck species that use Cook Inlet are considered declining or vulnerable in some or all of their ranges in Alaska and were therefore selected as fine filter targets. These include Steller's eider, which winter in the lower Cook Inlet Basin, Aleutian tern, harlequin duck, long-tailed duck, and Kittlitz's murrelet.

Seabirds were also included as species aggregation targets in the form of seabird colonies and seabird foraging areas. Colonial seabirds, except for gulls and terns, are mostly confined to lower Cook Inlet where foraging areas are more abundant (USFWS 1978).

Shorebirds

The intertidal habitats of the Cook Inlet Basin ecoregion provide important feeding and migratory stopover habitat for several species of shorebirds. For example, great numbers of western sandpipers and dunlins use Cook Inlet for migratory habitat. The nominate form of rock sandpiper winters primarily in this ecoregion. Significant numbers of Hudsonian godwits, and long- and short-billed dowitchers also use upper Cook Inlet (Alaska Shorebird Working Group 2000). Several shorebird species rely on breeding habitat in the Cook Inlet Basin as well.

Waterfowl, Cranes and Loons

Upper Cook Inlet was identified as an important waterfowl habitat area for North America in the 1998 update to the *North American Waterfowl Management Plan* (USFWS et al. 1998). Coastal salt marshes in particular are important for waterfowl. In this assessment, many waterfowl habitats were mapped using the terrestrial coarse filter. Several waterfowl species, however, were identified as fine filter targets because their exact habitats may not be sufficiently captured by the coarse filter alone. Common and Pacific loons and the long-tailed duck were singled out as fine filter targets due to their vulnerable or declining status. The only known breeding habitat of the Tule white-fronted goose is in the Cook Inlet Basin ecoregion. The special aggregation areas of sandhill cranes, trumpeter swans and Wrangel

Island snow geese were also considered fine filter targets. The trumpeter swan's use of important Cook Inlet breeding grounds, for example, may be affected by human disturbances (Timm and Wojeck 1978 in Conant et al 1995).

2b. Terrestrial Mammals

Twelve terrestrial mammals were chosen as targets for the reasons listed in Table 7. Several species were chosen because they are endemic or have qualities of keystone species. Of special concern is the Kenai Peninsula brown bear, an isolated and small population thought to number 250-300 bears and in danger of decline.

TABLE 7: Terrestrial mammal targets in the Cook Inlet Basin ecoregion.

SCIENTIFIC NAME	COMMON NAME	G-RANK	WHY CHOSEN
TERRESTRIAL MAMMALS			
Alces alces	Moose	G5	Keystone
Canis lupus	Gray wolf	G4	Keystone
Clethrionomys rutilus	Northern red-backed vole	G5	Keystone
Glaucomys sabrinus (Kenai subsp.)	Northern flying squirrel (Kenai subsp.)	G5	Disjunct
Gulo gulo katschemakensis	Kenai wolverine	G4T3	Endemic
Lontra canadensis	Northern river otter	G5	Vulnerable
Lynx canadensis	Lynx	G5	Keystone
Martes americana	American marten	G5	Keystone
Rangifer tarandus	Caribou	G5	Disjunct
Tamiasciurus hudsonicus Kenai	Kenai red squirrel	G5	Endemic
Ursus arctos	Brown bear	G4	Keystone
Ursus arctos (Kenai pop.)	Brown bear (Kenai pop.)	G4	Disjunct
TOTAL = 12 FINE FILTER TERRESTRIAL MAMMAL TARGETS			

2c. Aquatic and Amphibian Species

Although the coarse filter dominated the analysis of aquatic biodiversity in the ecoregion, fine filter targets were also used to provide conservation focus to certain aquatic species. Ten fish species, all salmonids, were chosen as conservation targets, as well as one amphibian (Table 8). The salmonids were selected primarily because there is some concern that their Cook Inlet populations are declining or vulnerable, and they are furthermore ecological drivers of aquatic systems in southcentral Alaska.

The wood frog is the only amphibian in the Cook Inlet Basin ecoregion. Recent reports of wood frogs with deformities have prompted the USFWS and the AKNHP to study the frog and inventory its habitats.

TABLE 8: Fish and amphibian targets in the Cook Inlet Basin ecoregion

SCIENTIFIC NAME	COMMON NAME	G-RANK	WHY CHOSEN
FISH			
Oncorhynchus gorbuscha	Pink salmon	G5	Declining
Oncorhynchus keta	Chum salmon	G5	Declining
Oncorhynchus kisutch	Coho salmon	G4	Vulnerable

Oncorhynchus nerka	Sockeye salmon	G5	Vulnerable
Oncorhynchus tshawytscha	Chinook salmon	G5	Vulnerable, declining
Oncorhynchus mykiss	Rainbow trout	G5	Vulnerable
Oncorhynchus mykiss	Steelhead	G5	Disjunct
Salvelinus alpinus	Arctic char	G5	Disjunct on Kenai Peninsula
Salvelinus malma	Dolly Varden	G5	Keystone
Thymallus arcticus	Arctic grayling	G5	Vulnerable
AMPHIBIANS			
Rana sylvatica	Wood frog	G5	Vulnerable
TOTAL = 10 FINE FILTER FISH SPECIES, 1 FINE FILTER AMPHIBIAN SPECIES			

2d. Coastal Species

Coastal fine filter targets were selected based on notable declines and vulnerability. Many marine mammals are important components of the ecological systems in lower Cook Inlet (e.g. Kachemak Bay); although their distributions are peripheral to the upper Cook Inlet. For example, harbor seals may be observed following summer runs of anadromous fish as far north as the Susitna River (Calkins 1979 in ADFG 1985a), but they are generally more abundant in the lower inlet. Similarly, although Steller sea lions normally range south of the ecoregion, they can be found in Kachemak Bay. Beluga whales, on the other hand, are more commonly found in the upper inlet in summer concentrations, especially at the mouth of the Susitna River and in Knik Arm. Species inhabiting the south side of Kachemak Bay and southward were considered to be outside of the ecoregion and thus were not considered ecoregional targets. Species found on the north side of Kachemak Bay, however, were considered in target selection.

TABLE 9: Coastal species targets in the Cook Inlet Basin ecoregion

SCIENTIFIC NAME	COMMON NAME	G-RANK	WHY CHOSEN
CRUSTACEANS			
Cancer magister	Dungeness crab	Not ranked	Declining
Paralithodes camtschaticus	King crab	Not ranked	Declining
MARINE MAMMALS			
Enhydra lutris	Sea otter	G4	Declining, keystone
Eumetopias jubatus	Steller sea lion	G3	Declining
Delphinapterus leucas pop 4	Beluga whale (Cook Inlet pop.)	G4T1T2	Declining, disjunct
Phoca vitulina	Harbor seal	G5	Declining
TOTAL = 2 CRUSTACEAN TARGETS, 4 MARINE MAMMAL TARGETS			

2e. Plants

Botanists from the AKNHP developed the target list for plant species. Most were chosen because they are globally rare species or subspecies.

TABLE 10: Plant fine filter targets

SCIENTIFIC NAME	COMMON NAME	G-RANK	WHY CHOSEN
PLANTS			
Aphragmus eschscholtzianus		G3	Rank
Arnica lessingii ssp. norbergii	Lessing arnica	G5T2Q	Rank
Artemisia campestris var. strutziiae		G5T2T3Q	Rank
Atriplex alaskensis	Alaska orache	G3G4Q	Rank
Botrychium ascendens	Upward-lobed moonwort	G2G3	Rank
Carex parryana	Dewgrass	G4	Rank
Carex lenticularis var. dolia	Goose-grass sedge	G5T3Q	Rank
Carex lyngbyei	Sedge (Inland)	G5	Rank
Cochlearia sessilifolia	Sessile-leaf scurvy grass	G1G2Q	Rank
Dodecatheon pulchellum ssp. macrocarpum	Dodecatheon (shooting star)	G5T2T4Q	Rank
Douglasia alaskana	Alaska rockjasmine	G2G3	Rank
Douglasia gormanii	Gorman's douglasia	G3	Rank
Draba ruaxes	Rainier Whitlow-grass	G3	Rank
Draba stenopetala	Anadyr whitlow-grass	G3G4	Rank
Gentianella propinqua ssp. *aleutica*	Aleutian four-parted gentian	G5T2T4	Rank
Isoetes truncata	Truncate quillwort	G1G2Q	Rank
Maianthemum stellatum	Starflower Solomon's plume	G5	Rank
Papaver alboroseum	Pale poppy	G3G4	Rank
Platanthera chorisiana	Choriso bog-orchid	G3G4	Rank
Poa laxiflora	Loose-flowered bluegrass	G3	Rank
Poa turneri		G3QS3	Rank
Puccinellia glabra		G2QS2	Rank
Puccinellia kamtschatica	Alaska alkali grass	G2Q	Rank
Puccinellia triflora		G3QS3	Rank
Stellaria alaskana	Alaska starwort	G3	Rank

Taraxacum carneocoloratum	Pink dandelion	G3Q	Rank
Thlaspi arcticum	Arctic pennycress	G3	Rank
TOTAL = 27 FINE FILTER PLANT SPECIES			

2f. Species Aggregations

Aggregations of species in the Cook Inlet Basin ecoregion include migratory concentrations and stopover areas. Seasonal staging areas for shorebirds and bear concentrations along salmon streams are two examples. Aggregation targets often represent critical life stages, such as staging and nesting, or important feeding areas.

TABLE 11: Species aggregation targets in the Cook Inlet Basin ecoregion

BIRD AGGREGATIONS (5)	MAMMAL AGGREGATIONS (2)
Seabird colonies	Brown bear concentration areas
Seabird foraging areas	Little brown bat (winter concentrations)
Seaduck wintering areas	**COASTAL SPECIES AGGREGATIONS (1)**
Shorebird migratory concentrations	Pacific herring spawning areas
Waterfowl migratory concentrations	

E. SETTING CONSERVATION GOALS

As part of the assessment, taxonomic teams set conservation goals for all species, systems and species aggregations identified as conservation targets (For a full listing of goals, data sources and justification, see Appendix 11). In setting goals, teams relied on existing literature, expert knowledge and existing spatial data pertaining to population size, life stages and habitat needs. The quality and availability of such information, however, varied greatly for many species. As a result, some goals were set using systems as surrogates for more specific habitats; others were set using mapped distribution data and numerical goals.

Four subregions were established in the ecoregion as part of the goal-setting process (see Figure 12). Subregional stratification accounted for adequate representation of heterogeneity across the ecoregion and maintained adequate separation distances between occurrences, in case of stochastic events such as disease or catastrophic disturbance.

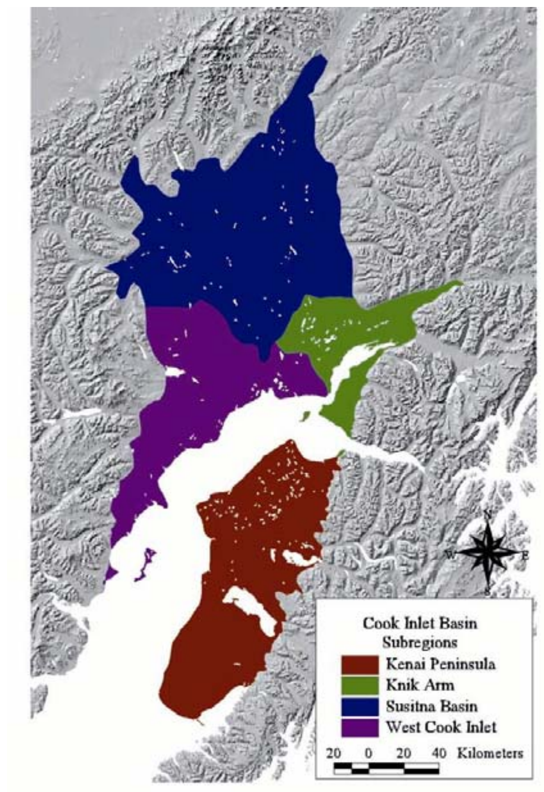


FIGURE 12: Subregions of the Cook Inlet Basin ecoregion

1. Conservation Goals for Coarse Filter Targets

1a. Terrestrial Ecological Systems

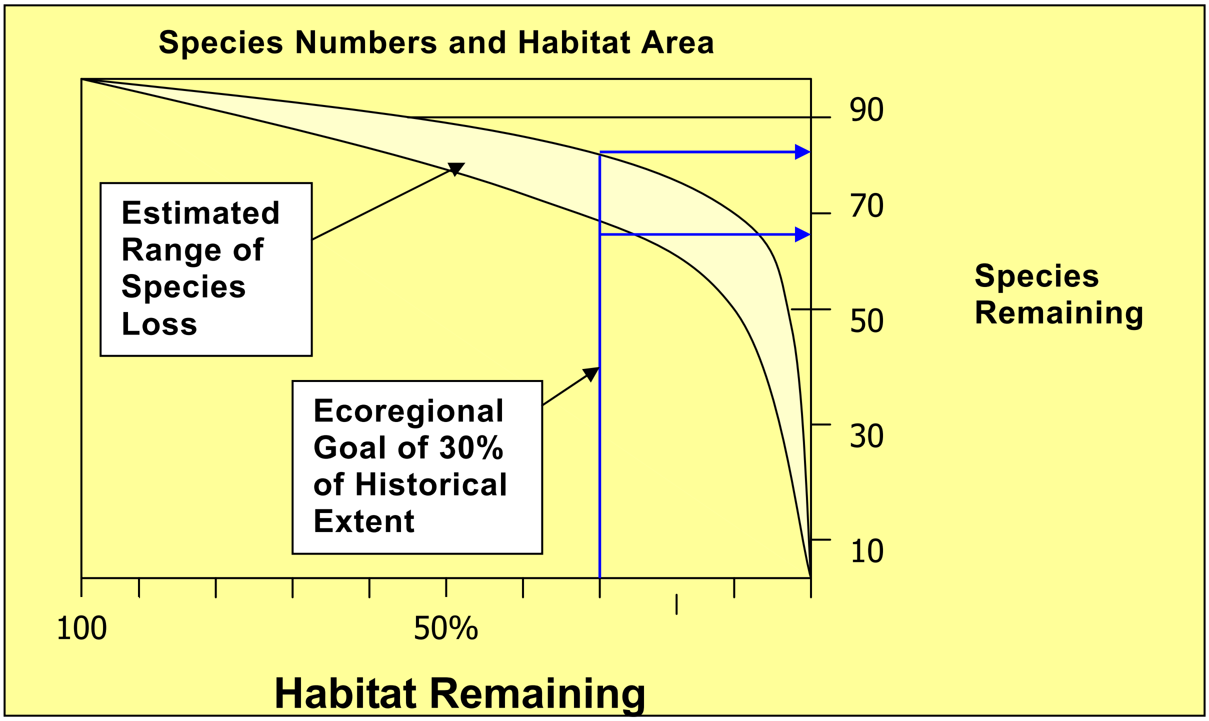
In consultation with regional experts, the assessment team assigned quantitative goals to each terrestrial system target, based on known spatial pattern, disturbance regimes, and inferred minimum dynamic area, or the amount of suitable habitat necessary for survival of a minimum viable population (Primack 2000).

Many terrestrial communities and systems maintain a characteristic landscape pattern as a result of disturbance regimes. It is assumed that for a system occurrence, or patch, to persist on the landscape, it must be large enough to contain by several fold the spatial extent of typical disturbance events. In its classification of the 23 ecological systems in the Cook Inlet Basin, the AKNHP recommends minimum dynamic areas or *mininum patch size* goals for several systems. In setting the goals for terrestrial systems, these minimum patch sizes were crosswalked from the AKNHP-defined systems to the modeled terrestrial system targets.

Matrix-Forming and Large-Patch Systems

Each matrix-forming and large-patch system was assigned a goal of 30% of the existing extent in each subregion where it occured. Several systems were also tagged with a minimum contiguous area requirement. The 30% area goal is based on the general correlation between the size of a sample area (island, lake or other habitat patch) and the number of native species supported (Dobson 1996, MacArthur and Wilson 1967). This relationship is expressed mathematically as a species-area curve, and it describes the expected rate of change in number of native species with a corresponding change in available habitat area (Figure 13). One interpretation is that by preserving 30% of the historical area of a particular system, one might expect to preserve 65% to 85% of the remaining native species. Lacking historical data and given the relative intactness of the Cook Inlet Basin ecoregion, assessment teams assumed that the current systems model would be a reasonable representation of conditions to which to apply this criteria.

FIGURE 13: Estimated species loss with percentage of habitat loss over time



Small Patch Systems

For small-patch systems, the goal was also expressed as 30% of extent in each subregion. Some small-patch systems goals also included a minimum patch size requirement. Application of the 30% area goal to small patch is not based on the species-area relationship, as teams interpreted this to apply to only matrix-forming systems. Instead, the 30% figure was chosen as an arbitrary but consistent means to compare representation of the varied array of targets.

ELU/System Combinations

The 30% area goal was also applied to each ELU/system combination. Subregional stratification was not applied to the ELU/system combinations because ELUs—by representing the range of physical landscape features—effectively stratify systems.

1b. Aquatic Ecological Systems

Conservation goals for aquatic systems were set at 30% of the current extent of each aquatic system in each ecological drainage unit. This goal was chosen to be consistent with that used for terrestrial matrix systems. The aquatics team assumed this would adequately represent the diversity of freshwater habitats, environmental gradients, and common and understudied elements of biodiversity present within the ecoregion.

1c. Coastal Ecological Systems

Another interpretation of the species-area curve is that species richness declines are greater when reserves fall below 20% of a particular region; this number has been used in marine reserve design (Beck 2003). The coastal team set a goal of 20% of each coastal system represented by the ESI data within the ecoregion and distributed among each subregion with a marine component. Because the size of marine reserves necessary for conservation is currently under debate (Ward et al. 1999; Roberts and Hawkins 2000), the coastal team set a more conservative goal (30%) for those small-patch systems or systems with limited distributions that were mapped using different methods (e.g., expert polygons).

2. Conservation Goals for Fine Filter Targets

As discussed in Section C "Methods," current, complete and specific data were unavailable for many fine filter targets in the Cook Inlet Basin ecoregion. In lieu of specific numbers of populations or known habitat locations by which to set a goal, the taxonomic teams first attempted to set conservation goals for species using specific habitat preferences. Unfortunately, these fine scale habitats were also not mappable and so many fine filter target goals had to be linked to modeled ecological system goals. As a result, despite its use of fine filter targets, the assessment is on the whole a coarse scale analysis.

2a. Birds

Setting conservation goals for bird species in the Cook Inlet Basin ecoregion required an investigation of general habitat requirements of many resident and migratory species. Existing bird conservation plans, relevant literature and expert knowledge were used as the basis for setting goals for birds (Boreal Partners in Flight 1999; Alaska Shorebird Working Group 2000; Gill and Tibbetts 1999; Byrd et al. 1998; USFWS 1999). In many cases goals were set differently for species based on the amount of information available. Where it was necessary to set goals based on ecological system types, goals were consistently set at 30% for each bird target to correspond to system types. For a complete list of bird conservation goals, see Appendix 11.

A network of areas for migration, nesting and molting was considered important for conservation of many migratory species. Shorebird migratory areas form such a network and removal of one area could potentially disrupt the entire system (Gill and Tibbetts 1999); therefore conservation goals for shorebirds aggregations were set at 100% of expert-delineated migratory areas.

Landbirds in the Cook Inlet Basin ecoregion were grouped into two distinct categories based on general habitat requirements. Conservation goals were linked to system targets that represented their predominant habitat requirements. Due to insufficient vegetation data, in many cases, teams were unable to delineate specific locations for the habitat of many landbirds and many birds. As a result, conservation goals for not only landbirds but all bird species were based on identifiable habitat and/or on a crosswalk of specific habitat to coarse-scale terrestrial systems when locations were not available.

2b. Terrestrial Mammals

Setting conservation goals for terrestrial mammals, many of which are wide-ranging, proved to be a significant challenge. There is little theoretical or empirical guidance on how much land needs to be under conservation management to retain biological diversity over the long term. Knowledge of disturbance regimes and home-range size of area-sensitive species, however, are useful in setting area goals for system targets associated with these mammal targets.

The example of brown bears is particularly relevant. Although the conservation goal (4,000 km^2 of intact systems) was successfully met for brown bears in the Kenai Peninsula subregion, brown bears may actually need additional acreage in more specific places to ensure viability over time. Bears are known to occur throughout the ecoregion, and they concentrate at different times at different locations (e.g. anadromous streams). As the population declines or as the suitable area declines, specific locations become even more important.

2c. Aquatic and Amphibian Species

Many of the fish targets are anadromous; they are wide-ranging species that use freshwater and marine habitats throughout their life histories. Successful conservation depends on consideration of their entire ranges of habitats. Due to the lack of information about important offshore marine habitats, this assessment considers only freshwater and estuarine habitats.

For fish species the conservation goal was set at 30% of all anadromous streams documented by the *Anadromous Waters Catalog* (2000) in order to account for anadromous fish targets. For other fish species, aquatic systems were used as surrogates when more specific information was not available.

No specific information was available for the wood frog to guide a conservation goal so no goal was set. Instead, it was assumed to be captured in coarse filter aquatic and terrestrial systems, such as forest/woodland habitats and edges of ponds and streams (Natureserve 2002).

2d. Coastal Species

In this assessment, consideration of marine species was limited to the coastal components of marine species' life histories. For example, the Cook Inlet beluga whale was a target in the assessment, but conservation goals and portfolio design only considered those nearshore areas known to be important feeding areas. Thus, some goals were based on known locations for certain life history stages, and other goals were based on habitat affinities, much like other species targets. For species with very limited distributions in the ecoregion (e.g. only occur in Kachemak Bay), goals were set higher.

2e. Plants

Conservation goals for individual plant species were set using a standard documented in *Designing a Geography of Hope*. The goal is to represent at least 2 viable populations of each target per subregion with a minimum of 10 viable populations rangewide. Information on locations of plant species, their viability and rangewide information was limited; rare plant information should therefore be considered a significant data gap in this assessment.

2f. Species Aggregations

Cook Inlet provides the last significant area of ice-free littoral habitat available to shorebirds migrating to Arctic breeding grounds (Gill and Tibbetts 1999). Cook Inlet is also special as a stopover area for large numbers of several bird species. Such aggregation areas are critical as staging, nesting and feeding occur here. Goals were set at 30% of known aggregation areas for most species aggregation targets. Exceptions include shorebirds, brown bear concentration areas and seabird colonies. A conservation goal of 100% of known shorebird aggregation areas was set for shorebirds. Experts directed the team to a specific set of brown bear concentration areas and seabird colonies.

F. PORTFOLIO DESIGN

The principal product of an ecoregional assessment is a map indicating areas of biological significance for the ecoregion. Referred to as a portfolio, this map is the outcome of an analysis of the distribution, goals, and viability of selected conservation targets, and it represents the areas that, if managed for biodiversity, will likely conserve the native species and ecological communities of the ecoregion. The assessment team assembled the portfolio for the Cook Inlet Basin ecoregion based on:

- *areas identified through output from a computer algorithm*
- *composite areas identified through expert workshops*
- *review of other published information on important areas within the ecoregion.*

For a discussion of general criteria used in portfolio selection, please see Section C "Methods."

1. Portfolio Selection Process

1a. Computer algorithm SITES

The computer algorithm called SITES (Andelman et al. 1999) was created to facilitate the selection of the portfolio. SITES generates various "solutions" to a problem, such as how to assemble the most viable examples of targets in the least area. SITES provides a suite of solutions that are then analyzed by experts familiar with the ecology of the ecoregion.

SITES analysis units can be watersheds (such as hydrologic unit codes (HUCs) of a given scale), road-bounded blocks, or they can be derived from an arbitrary grid, such as contiguous hexagons. The effectiveness of a contiguous set of hexagon units for defining natural variability, especially among spatially heterogeneous data sets, is well documented (White *et al*. 1992). Moreover, watersheds and road-bounded blocks would not provide meaningful SITES analysis units for the Cook Inlet Basin as the appropriate scale watershed data are not readily available and the landscape is mostly intact. Therefore, a hexagonal pattern was derived, with a 500 ha unit. The 500 ha size was specific enough for capturing species targets and still useful for aggregation into clusters to address system targets. The Cook Inlet Basin analysis units resulted in 7,516 SITES analysis units for the entire ecoregion. For more detailed information on SITES, see Appendix 10.

1b. First Experts Workshop

The Cook Inlet Basin Expert Workshops involved approximately 50 scientists, noted for their expertise in the ecoregion and willing to provide constructive feedback and supplement the existing biological data on targets for the ecoregion (see Appendix 1 for a full list of participants).

In the first workshop, working groups of these experts provided feedback on draft target lists, identified new habitat "occurrences" for targets and species aggregations, completed occurrence identification forms, and commented on long-term viability needs and threats to targets.

Working groups also delineated preliminary areas of biological significance for the species group or system on which their group was focused. Information was delineated on base maps at a scale of 1:375,000 showing elevation, hydrography, and land management status for the ecoregion. Base maps contained known locations of conservation targets if such data were available. Experts were asked to both supplement the information already depicted on maps and to provide boundaries of areas used by target species. Other existing maps were also available for reference, including among others ADFG Most Environmentally Sensitive Areas, ADFG Habitat Management Guides, NOAA ESI maps, AKNHP range maps, USFWS National Wetland Inventory and Seabird Colonies, and recent USGS satellite images of the ecoregion (Appendix 14).

Descriptive information such as target viability and status, important ecological processes and threats were entered onto forms that corresponded with the mapped locations. Finally, the spatial information was digitized into a GIS and the tabular data entered into an associated Access database. Many experts worked in teams when delineating and compiling information. Figure 14 shows the overlay of all expert delineated target locations.

1c. Development of the Cost Suitability Index

Viability assessment is a key component of portfolio design. Viability refers to the ability of a species to persist for many generations or the ability of an ecological system to persist over time (TNC 1996). In order to maximize the success of conservation efforts, it is important to identify areas that contain the most viable occurrences of species and systems. A viable population or system has a better chance of persisting through time than a population or system that is already showing signs of stress.

Viability assessments are generally based on determinations of size, condition, and landscape context of each target occurrence. This level of assessment requires detailed information on the landscape and target occurrences. In the Cook Inlet Basin ecoregion, this level of detail was unavailable. Therefore, a surrogate assessment—a suitability index—was used in place of detailed measurements of size, condition and landscape context.

A suitability index can be described as a compilation of spatial data relating to the current infrastructure and/or threats within the ecoregion (e.g., road density, polluted areas, dams, etc.). The expressed or anticipated effect of infrastructure or threat is ranked according to its severity and is identified as a cost when selecting portfolio areas. Areas with higher costs are then avoided, if possible, during portfolio area selection.

SITES selects areas to meet goals for conservation targets while balancing objectives of efficiency—that is, the greatest number of target goals met in the least amount of "suitable" land. The "cost suitability index" integrates land use factors for a given geographic area, and is used to help select among SITES analysis units that contain conservation targets. The suitability index is a mechanism for integrating economic, socio-political and biological factors in the portfolio design process.

The cost suitability index was developed for the entire ecoregion using available spatial data sets from the ADNR, U.S. Army Corps of Engineers and the Cook Inlet Keeper GIS Atlas. The index for the Cook Inlet Basin ecoregion was based upon numerous factors, including road density, presence of land converted to urban land uses, presence of railroads, pipelines, past pollution sites, etc. Factors were assigned a subjective rank (cost) according to the estimated severity of the factor to target viability. For example, trails and marine highways were considered less of a threat to target viability than contaminated or urban areas. Urban areas are not considered viable places for conservation, as they are generally associated with increasing development. Table 12 includes the factors and costs used in the index and applied to each SITES analysis unit. Figure 15 shows the index as applied to the Cook Inlet Basin ecoregion.

TABLE 12: Factors used in the cost suitability index for the Cook Inlet Basin ecoregion

FEATURE	COST	FEATURE	COST
Marine highway	2	Active gasfields	20
Trails	5	Dams	20
Department of Environmental Conservation wastewater permits (no National Pollutant Discharge Elimination System)	10	Department of Environmental Conservation contaminated sites	20
Air runways (asphalt and gravel)	10	Department of Environmental Conservation solid waste sites	20
Emergency response (reported spills) Environmental Protection Agency	10	Former military sites	20
Pipes (oil and gas)	10	Highways	20
Spills database (Department of Environmental Conservation '95-'98)	10	Oil platforms	20
Stormwater discharges	10	Resource Conservation and Recovery Act (RCRA) Large quantity generators	20
Toxic release inventory	10	Resource Conservation and Recovery Act (RCRA) Small quantity generators	20
Utility lines	10	Superfund sites (priority, no action required and not on National Priority list)	20
Railroad	12	Towns	30
Clean Water Act permits	15	Road density index	Varied

1d. Conservation Lands Assessment

An efficient portfolio makes use of land already in conservation status and avoids, when possible, areas of development associated with private lands. An assessment of conservation status for all land in the ecoregion was undertaken in order to create an efficient portfolio for the Cook Inlet Basin.

The conservation status of lands in the ecoregion was ranked based on general land management status, a task regularly done by GAP programs across the country. All lands were assigned to one of four distinct categories, modified from national GAP categories (Caicco et al. 1995). Modifications were finalized with input from experts at the workshops.

The categories used to assess conservation status were high, medium, low and none. Lands range from those that are managed as preserves and wilderness areas to those privately held and not managed for conservation (Table 13, Figure 16). High conservation status lands include those lands that have an active management plan in place and allow for natural disturbance events to occur, including Nature Conservancy preserves, national parks and preserves and federally designated wilderness areas. Many state specially-designated lands (e.g. state park, state critical habitat areas, etc.) as well as national forests and USFWS refuges garnered a medium rank. Such lands are generally managed for natural values, but activities are allowed that may degrade the natural quality of the habitat. Low conservation status lands include other state-designated lands (e.g. state public use and recreation areas). All other public or private lands were assigned no conservation status. While these ranks differ from previous GAP categories and from a recent landscape assessment for Alaska

(Duffy et al. 1999), there was agreement by experts involved that they accurately portrayed the management of the individual land units in the ecoregion.

TABLE 13: Conservation Status Ranking of Managed Lands

I. HIGH	II. MEDIUM	III. LOW	IV. NONE
• The Nature Conservancy Preserves • National Park and Preserve • Federal Wilderness Area	• National Wildlife Refuge • National Forest • State Park • State Critical Habitat Area • State Game Refuge • State Wildlife Refuge	• State Moose Range • State Public Use and Recreation Areas • State Special Management Area	• Private • Undesignated State • University of Alaska • BLM • Military • Native Lands • Municipal

Land status information (generalized to a minimum mapping unit of 640 acres) and state administrative boundaries data were compiled from the ADNR for the ecoregion (ADNR 2000). Additional data were also obtained from the USFWS Kenai National Wildlife Refuge. If conflicting information was encountered (e.g., more than one land management status was present), the lower conservation status value was chosen. For example, a privately owned parcel within a state critical habitat area may have been attributed as both state critical habitat management status and private ownership. In this case it would have been ranked no status due to the private ownership.

The results of the conservation lands assessment indicate that 43% of terrestrial lands in the ecoregion have high and medium conservation status, and 57% have low or no conservation status. This conservation lands assessment was completed only for the terrestrial lands within the ecoregion. Some federally-designated and state-designated areas reach into the marine waters of Cook Inlet; however, marine waters were not included in the assessment. The 1999 Cook Inlet areawide oil and gas lease sale was not taken into consideration in this assessment (ADNR 1999).

1e. First SITES Analysis: Development of a "Strawman" Portfolio

Before running a SITES analysis, the SITES program requires that each conservation target be assigned a quantitative *goal* (numbers of occurrences, area, or linear distance) and a *penalty value* for not meeting that goal. While goals varied for each target, the penalty value was equal for all targets. This value approximated the maximum values assigned to hexagons in the suitability index, which built in a strong incentive for the SITES program to meet stated conservation goals.

Explicit minimum patch size goals are also added to the SITES program (for example, minimum patch size goal of 10,000 ha for the white spruce/black spruce forest and woodland system type). SITES is then required to find contiguous hexagons that contain sufficient area (or length) of each system or species habitat to count towards the target's conservation goals. The Cook Inlet Basin portfolio design used "simulated annealing" so that a variety of alternative portfolios could be compared to one another to yield an optimal solution.

Simulated annealing works by randomly selecting a "seed" portfolio, (e.g., a randomly chosen set of hexagons). It then chooses another randomly selected alternative set and compares the two to determine which one is better at meeting target goals for the least cost. The better portfolio is kept and the process (the simulated annealing) is repeated a million times per run for a total of ten runs. If one portfolio meets the goal for one less target than an alternative portfolio, it is assigned a cost value of 1,000 points higher than the alternative portfolio, thus incurring the penalty. This process allows SITES to configure a portfolio which best meets our conservation goals while incurring the lowest possible conservation cost as defined by the suitability index.

Each SITES analysis unit was populated (by overlaying GIS layers) with target occurrences, in the forms of points (numbers), pixels (area), and lines (length). For the first run of the SITES tool, several fine filter targets (i.e. seals, center points of migratory bird concentrations, plants, Aleutian tern colonies, and river mouths) as well as systems were used as data inputs. The species targets used in this run of SITES were chosen mainly based on their data occurrence as point locations. While species targets were represented by points, systems were represented with pixels and lines. Many expert-delineated polygons were not used in this automated process because the large polygons were not easily attributed to the hexagon analysis unit. The SITES model ran through 10 runs of one million iterations each and selected the most efficient results.

In order to include expert "occurrences," expert polygons were then overlaid with the SITES output (Figure 17), and the portfolio that best captured these occurrences was chosen as a "strawman" portfolio. This strawman portfolio was then used as the basis for portfolio design at the second expert workshop where potential areas of biological significance were evaluated, discussed and modified.

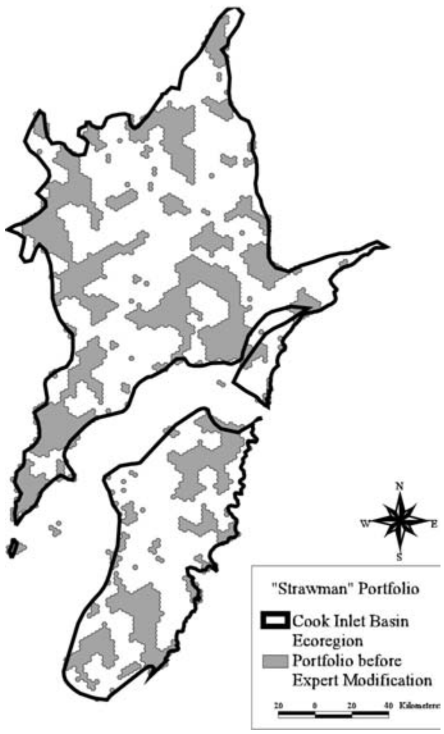


FIGURE 17: Strawman portfolio before expert modification

1f. Second Experts Workshop

At the second workshop, participants reviewed the work of the previous workshop and refined target lists. Teams worked together first reviewing the strawman portfolio, land management maps and conservation area maps, and then modifying the strawman portfolio for their specific taxonomic groups. The portfolio was modified, for example, to include, among other areas, known brown bear feeding areas, moose wintering areas and caribou calving areas.

The goal of this process was to develop a draft set of composite areas suitable for sustaining all conservation targets over the long term. The workshop resulted in the production of mylar overlays of recommended areas of biological significance for each taxonomic group. In the final stages of the workshop, participants identified threats to biodiversity at these areas and compiled a summary of data gaps for the ecoregion.

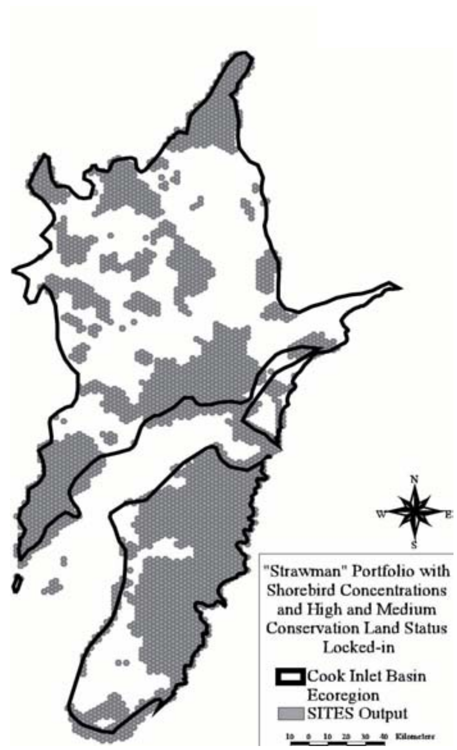


FIGURE 18 SITES: Output with shorebird migratory concentrations and high and medium status conservation locked in.

1g. Second SITES analysis and Final Portfolio Design

After the workshop, the assessment team ran SITES again, including several additional factors. First, the team locked in all expert identified shorebird migratory areas. Shorebird migratory areas form a seasonally-used network of areas and loss of even one area could potentially disrupt the entire system (Gill and Tibbetts 1999). Second, in order to create the most efficient portfolio possible, lands with high and medium conservation status were locked in so that conservation goals for species and systems were met first on lands already managed for conservation. All terrestrial, coastal and aquatic systems were also used in this second SITES run (Figure 18). Some fine filter targets were dropped for this iteration of SITES as they were to be picked up during modifications of the output.

As the second SITES run was based mostly on shorebird migratory areas and lands already conserved (high and medium), it was also necessary to modify the portfolio output based on the expert-delineated portfolios developed for each taxonomic group. This assured that those known areas important for many fine filter targets were included. The team made modifications to the draft portfolio in several steps. First, the team reviewed all portfolio areas and adjusted boundaries to integrate nearby targets where appropriate. Second, locations of targets with irreplaceable occurrences that weren't yet captured (e.g. Tule white-fronted goose molting and dispersed breeding areas) were integrated into the portfolio for each taxonomic group. Third, the resulting portfolio was assessed for adequacy in meeting conservation goals and then delivered to participants in the expert workshops for review and comments. Finally, after expert comments were incorporated, the terrestrial systems model was revised and the results for meeting conservation goals for terrestrial systems and ELU/system combinations (and those species whose goals were based on systems) assessed a final time. Throughout the process, the assessment team relied strongly on the knowledge and advice of the experts, and this expert knowledge ultimately drove the selection of the portfolio.

2. Selection of Aquatic Areas of Biological Significance

Conservation goals for aquatic systems (30% representation of each system) were assessed during the automated phases (SITES runs) of portfolio design. The genetic diversity of species across freshwaters was recognized as an important element of the assessment; however, this element was not addressed in the automated SITES selection process because little is known about specific patterns of genetic diversity. Instead the assessment team assumed that genetic diversity could be addressed by manually selecting aquatic areas of biological significance stratified across the ecological drainage units in the ecoregion.

The first step in this process was the prioritization of stream networks in terms of biodiversity significance. Stream networks with high biodiversity significance were assumed to have higher odds of containing unique or rare species assemblages, high species richness, and/or the most viable examples of such.

The assessment team began with a map of aquatic systems stratified by ecological drainage unit (EDU) and a map of the ADFG's anadromous stream and species data. Several criteria determined a stream network's ranking, including total number of anadromous species documented in the streams, presence or absence of barriers to fish passage, and a subjective ranking of the network's intactness. The following table summarizes ranking criteria.

TABLE 14: Criteria used to prioritize stream networks

PRIORITY	CRITERIA
HIGHEST (ASSIGNED TO ONLY 1 STREAM PER EDU)	• High species richness with more than five fish targets spawning, rearing or resident within the stream network and high system diversity • No major barriers to fish movement • Other aquatic species must be present within the stream system • The watersheds must be mostly intact and subject to little surface disturbance
HIGH	• At least four fish species targets spawning, rearing or resident and presence of more than one aquatic system • No major barriers to fish movement.
MEDIUM	Subjective, assigned to other streams based on interviews with experts
LOW	All other streams

Although the ranking of stream networks was subjective, the assessment team determined it adequate to prioritize aquatic areas of biological significance. It is important to note that all streams ranked "highest" within the ecoregion are not equal. For example, the Kenai River is ranked highest despite the development and disturbance on the lower Kenai River; whereas the Lake Creek and Chuitna river watersheds, also ranked as highest, do not share that level of disturbance. In this case, the Kenai River's irreplaceable runs of three species of salmon and unique resident fish populations justified the highest rank.

In the prioritization of stream networks, the stream, river, and lake waterbodies themselves were the focus of study; however, in the selection of the portfolio of aquatic areas, the health of the aquatic systems, dependent on the condition of the lands in the watershed, was also taken into account. Small-scale watersheds were delineated to encompass the highest ranked stream networks. An automated GIS process using a 90 m digital elevation model (DEM) was applied to determine flow accumulation and flow direction. These small watersheds were then grouped into final watersheds for use as boundaries for aquatic areas of biological significance (Figure 19).

Aquatic areas of biological significance may contribute to connectivity among terrestrial areas in the portfolio. Connectivity among areas at the ecoregional scale is important for the seasonal movement of terrestrial species as well as aquatic species and may also allow for immigration and emigration of species, thus permitting genetic exchange (Meffe and Carroll 1997). The specific use of corridors by species in the Cook Inlet Basin ecoregion was not studied, but the corridors created by the aquatic areas of biological significance may be one solution to maintaining connectivity in the future.

3. Portfolio Assembly Results

The total portfolio for the Cook Inlet Basin, including the marine environments, comprises 2,020,950 ha or 53% of the ecoregion, and it includes 10 terrestrial and 4 aquatic areas of biological significance (Figure 20). If managed well, these areas should greatly contribute to the maintenance of biological diversity in the ecoregion.

The size of the portfolio is the result of several factors. First, many species targeted in the Cook Inlet Basin, such as caribou, brown bear, lynx, wolf and wolverine, have large home-range sizes. Home range refers to that area traversed by an individual in its normal activities of food-gathering, mating and caring for young. Second, many species are migratory and require a network of areas for various life stages (e.g., migratory shorebirds). The large area requirements of these networks are reflected in the conservation goals that were set for each target. Third, larger areas have several advantages. Large areas are likely to contain a greater number of species than small areas, as well as larger populations of the species present (Meffe and Carroll 1997). Larger areas are more likely than small areas both to maintain genetic diversity through disturbance events and environmental stochasticities and to minimize edge effects (Primack 2000). Large areas also are more likely to contain heterogenous habitat patches.

Connectivity among isolated patches is important for the interchange of individuals among populations and may increase local and regional persistence of populations (Fahrig and Merriam 1994; Sjogren 1991 in Rosenberg et al. 1997). In the Cook Inlet Basin portfolio, the aquatic areas of biological significance offer some connectivity among terrestrial areas. Further study may reveal that other areas are indeed used as efficient corridors.

Finally, it is important to note that several of the areas of biological significance identified in the Cook Inlet Basin assessment lie partially in adjacent ecoregions, such as the Gulf of Alaska Mountains and Fjordlands and the Alaska Range ecoregions. These areas will be incorporated into adjacent ecoregional assessment efforts in the future. In the following analyses, results are reported only for elements *within* the Cook Inlet Basin ecoregion, except for Kachemak Bay. Because the delineation of the ecoregion was based on terrestrial attributes, Kachemak Bay was divided between two ecoregions. In this report, however, Kachemak Bay is treated as one unit for coastal and marine purposes; thus, coastal and marine targets that occur within Kachemak Bay (e.g. birds, marine mammals) are part of the ecoregional assessment for Cook Inlet Basin.

TABLE 15: Areas of biological significance in the Cook Inlet Basin ecoregion

AREA	TOTAL AREA (HA.)* (INCLUDING MARINE ENVIRONMENTS)	TERRESTRIAL OR AQUATIC
1. Anchor River	7,795**	Aquatic
2. Anchorage Flats	20,210	Terrestrial
3. Chuitna River	40,948**	Aquatic
4. Kachemak Bay	163,210	Terrestrial
5. Kalgin Island	22,521	Terrestrial
6. Kenai / Kasilof Wetlands	12,608	Terrestrial
7. Kenai River	42,577**	Aquatic
8. Knik Arm	63,331	Terrestrial
9. Lake Creek and Yentna River	84,932**	Aquatic
10. Northern Kenai Peninsula	302,697	Terrestrial
11. Redoubt / Trading Bay	198,010	Terrestrial
12. Susitna Flats	275,270	Terrestrial
13. Tustamena Bench	235,745	Terrestrial

14. Upper Susitna Basin	551,096	Terrestrial
TOTAL	**2,020,950 HECTARES**	

** Area sizes include only that portion of the area within Cook Inlet Basin ecoregion boundaries.*
***Includes watershed. These aquatic areas overlap spatially with terrestrial areas. The area size here is only for that portion of the area that does not overlap with a terrestrial area.*

G. ASSESSING THE PORTFOLIO

Once the portfolio of areas of biological significance was assembled, the team analyzed the portfolio to assess how well conservation goals were met for each target and to identify information gaps and future inventory and research needs. When summarizing results of targets based on multiple goals, the entire goal was considered unmet if any part of the goals was unmet. It is important to note that the aquatic areas of biological significance often overlap spatially with the terrestrial areas. In these cases, portfolio results (such as portfolio statistics and goal assessment) were assessed for the terrestrial area, and were not duplicated for the aquatic area

For the majority of species and system targets (73%), the conservation goals were met within the portfolio. The results by major target group show that 100% of the coastal system goals were met, as well as 93% of bird targets, 86% of aquatic systems, 70% of fish targets, and 50% of marine mammal targets. Conservation goals for all but one of the terrestrial systems (alpine wet herbaceous meadow) were met within the portfolio. Goals for 79% of the terrestrial ELU/system combinations were also met.

Although goals were met for all but one terrestrial system target, when terrestrial system targets were used as surrogates to represent species, the success rate at meeting goals declined to 25%. This is due to the addition of a minimum patch size filter. For example, a minimum patch size filter of 10,000 contiguous forested hectares was required for lynx representation in the portfolio. Meeting minimum patch size goals proved difficult to achieve.

Despite best attempts, some goals were not met. This may be the result of inappropriately set goals or lack of data to describe the locations of targets, or it may suggest that numbers of the target have declined past the point of the conservation goal. Only a few of the targeted species—mostly plants—were entirely unrepresented in the portfolio, and this was largely due to a lack of information about the location and distribution of the species.

On the other hand, some goals were exceeded by a large margin, signaling inefficiencies in the portfolio. Large patch sizes tended to sweep in many targets, especially systems, far beyond their minimum goals. Goals for certain birds and aquatic systems were substantially exceeded. Overrepresentation of certain targets is the by-product of conserving species with large area requirements (e.g., brown bear, gray wolf). Planners must allow portfolio design to be driven by these requirements. Efficiency of the portfolio will be affected by the large area needs of these wide-ranging species. For a full listing of results by target, see Appendix 12.

TABLE 16: Summary of Goals Met

TARGET GROUP	TOTAL NUMBER	# MEETING CONSERVATION GOAL	# NOT MEETING CONSERVATION GOAL*	% OF GOALS MET
Species Aggregations	8	5	3(1)	**63**
Amphibians	1	0	1(1)	**0**
Fish	10	7	3(2)	**70**
Aquatic Systems	50	43	7(0)	**86**
Crustaceans	2	1	1(0)	**50**
Marine Mammals	4	2	2(1)	**50**
Coastal Systems	15	15	0(0)	**100**
Plants	27	0	27(24)	**0**

Birds	28	26	2(1)	**93**
Terrestrial Mammals	12	6	6(0)	**50**
Terrestrial Systems	13	12	1(0)	**92**
ELU/system combinations	129	102	27(0)	**79**
*Terrestrial Systems with minimum patch size ***	*12*	*3*	*9(0)*	***25***
*ELU/ system combinations with minimum patch size ***	*81*	*54*	*27(0)*	***42***
TOTAL	**299**	**219**	**80(30)**	**73**

** For a number of targets there was no information with which to assess goals. The goal was therefore considered unmet. In parentheses is the number of the total for which there was no information. For example, out of 3 species aggregations not meeting goals, there was no information for 1 of the aggregations.*
***Not included in totals*

1. Goal Assessment for Coarse Filter Targets

1a. Terrestrial Systems

The following discussion addresses the portfolio representation, by area in hectares, of each of the 13 terrestrial system types that were modeled and used as targets. These systems are discussed in regard to the minimum patch size filter and spatial stratification by the four subregions. White Spruce/Black Spruce Forest and Woodland and Birch-Aspen Forest and Woodland are treated as one system type and explained together. In some cases, areas of biological significance with unique or disproportionate composition are identified.

As might be expected, the terrestrial systems best represented in the portfolio are those that enjoyed a high spatial correspondence with the fine filter targets that drove area selection. Because migratory shorebird concentrations, for example, were the first areas “locked in” during the portfolio selection process, portfolio design favored terrestrial systems associated with these targets. On the other hand, sub-alpine and alpine terrestrial systems spatially disjunct from shorebird area concentrations are generally underrepresented.

White Spruce/Black Spruce Forest and Woodland and Birch-Aspen Forest and Woodland

For application of the minimum patch size filter, Birch-Aspen Forest and Woodland and White Spruce/Black Spruce Forest and Woodland were treated as the same system type for several reasons. In the USGS Alaska interim land cover (LCI) data, Closed Broadleaf Forest is absent from the Kenai Peninsula, an obvious error which consequently prevents mapping Birch-Aspen there. The White Spruce and Black Spruce targets are both matrix-forming types, of which Birch forest is a significant matrix component, as are peatlands and, to a lesser degree, various herbaceous and shrub types. Nearly 50% of the ecoregional distribution of this type was captured by the portfolio, and entirely within patches greater than 10,000 ha in area.

Lutz Spruce Forest and Woodland

Approximately 50% of the ecoregional distribution of Lutz Spruce Forest and Woodland is captured in the portfolio, before and after application of the patch size filter, and almost exclusively in the Tustamena Bench and Kachemak Bay areas. Note that this system type was mapped based on an expert’s general delineation of the southern end of the Kenai Peninsula. Further investigation of the distribution of this system type is warranted.

Black Spruce and Open Peatland

Over 40% of the ecoregional distribution of Black Spruce and Open Peatland is contained within the portfolio. However, only 20% of that area (31,600 ha) is within patches larger than 1,000 ha, and these larger patches are limited to the Kenai Peninsula. This indicates that the typical patch size, according to the model, is smaller than the assigned minimum.

The model uses LCI shrub types and no forest vegetation to predict the distribution of this system type. Excluding forest cover may restrict the modeled distribution to smaller patches. It is also possible that many actual occurrences are mapped within the White Spruce/Black Spruce matrix.

Floodplain/Outwash Plain Forest and Woodland

The distribution of this system type is well represented in the portfolio, principally in the northern and western sections. This is largely due to the high spatial coincidence between this system type distribution and that of the aquatic systems, which were used to guide area selection. Since floodplains form continuous linear patches, both on the landscape and in the model, the 1,000 ha minimum patch size is not restrictive.

As a model component, this system type is unique in that its mapped distribution is based principally on linework from hydrography. There are two large floodplain areas on the west side of the Cook Inlet in the Redoubt/Trading Bay area. Verification of this model, because it is based on linework, is warranted.

Subalpine Tall and low Shrubland

Representation in the portfolio was dramatically reduced by the minimum patch size filter (1,000 ha minimum), from over 30% of available area to less than 10%.

Alpine Ericaceous Dwarf Shrubland

According to the model, Alpine Ericaceous Dwarf Shrubland is a minor system type in this ecoregion, occupying less than 6,000 ha, or 0.2%; 45% of which falls inside portfolio areas. Like Subalpine Tall and Low Shrubland, portfolio composition was dramatically reduced by the minimum patch size filter, though using a smaller minimum size of 100 ha.

As observed in the field, and according to the model output, these types are spatially contiguous and ecotonal; subalpine shrub communities give way to alpine dwarf shrub communities with increasing altitude or exposure. Given the spatial inter-digitization of these types on the landscape, and the underlying physical gradient, the assigned minimum patch sizes may be overly rigorous or inappropriate in separating these types at their transition.

Alpine Wet Herbaceous Meadow

This is a minor system type in this ecoregion, occupying less than 1,200 ha, (0.04% of the ecoregion), 23% of which falls inside portfolio areas.

Exposed Bedrock/Sparse Vegetation

Although the portfolio contains over 38% of this system type available in the ecoregion, the modeled system distribution is likely unreliable. The system type as described by the AKNHP occupies areas above the upper elevation limit of vegetation and on active talus only. The model output includes these areas *and* numerous occurrences in floodplains (mis-classified gravel bars) and at lake margins. This is a shortcoming of the current model rules.

Wet Herbaceous Meadow

This system type, and the LCI wet herbaceous and aquatic herbaceous on which it is based, are erroneously absent from the Kenai Peninsula. The remaining portfolio contains over 50% of the model distribution. No minimum patch size was applied, and over a quarter of occurrences are smaller than 1 ha. When considering only patches larger than 1 ha, portfolio representation is reduced to 14,280 ha, or 37% of what is available ecoregionally. Since the spectral signature of emergent vegetation in wet areas is relatively distinct, and because this is a known small-patch system, its model distribution outside the Kenai Peninsula is relatively reliable.

Mesic Herbaceous

Over half of the distribution of this system type is contained in the portfolio, but only 7 patches (equaling 1,200 ha) occur in areas larger than 100 ha, and these 7 patches all fall within the Northern Kenai area. Bluejoint meadow is a small-patch system target whose distribution is not addressed by the model. In the absence of known element occurrences of *Calamogrostis* communities, model occurrences of the Mesic Herbaceous system type deserve field inventory.

Upland Tall and Low Shrub and Upland Dwarf Shrub

These two system types were intended to capture the distribution of the AKNHP-defined Low Shrub terrestrial system. Together they describe close to 15% of the ecoregion land area and close to 15% of the portfolio as well. Portfolio representation of both is dramatically reduced by the patch-size filter. The Kenai Peninsula contains 87% of the ecoregional distribution of Upland Dwarf Shrub. Only two patches are larger than the 1,000 ha minimum; both are within the Tustamena Bench area and together account for just under 3,000 ha. Upland Tall and Low Shrub is more evenly distributed across the ecoregion; 54% of its area is captured inside portfolio areas. Nineteen percent, or 69,000 ha, of its portfolio-contained area is in patches larger than 1,000 ha.

The LCI source data makes a thematic distinction between Tall and Low Shrubland and Dwarf Shrub and Related Communities, which are floristically and structurally distinct but often difficult to separate spectrally. Distribution of these modeled system types would benefit from expert review and refinement. The distribution of Upland Dwarf Shrub includes several immediately apparent problems, specifically high-elevation occurrences in the Caribou Hills on the Southern Kenai Peninsula, which might be more accurately described as a subalpine dwarf shrub type; and low-lying occurrences on the northern Kenai which are more likely peatlands.

1b. ELU/System Combinations

Appendix 12 lists each major ELU/system combination and the area captured inside the portfolio and compares representation with and without application of the minimum patch size filter. Only the matrix and large patch systems were evaluated using a minimum patch size filter.

Of the 129 ELU/system combinations that were used as targets, 79% were captured at or above their 30% representation goals. The application of the minimum patch size criteria significantly decreases this representation from 79% to 42%.

The three systems that were best represented in the portfolio—White Spruce/Black Spruce Forest and Woodland, Lutz Spruce Forest and Woodland, and Floodplain/Outwash Plain Forest and Woodland—were also best represented in terms of their major component ELUs.

The ELU/system combinations that were underrepresented, relative to the 30% area goal, consisted primarily of subalpine surficial geologic types (i.e. mountain alluvium/colluvium and bedrock/coarse rubble) which occur above treeline and at the ecoregion periphery. Since these combinations are geographically peripheral to the ecoregion, they may also be considered to be less characteristic of the ecoregion.

Entirely absent from the portfolio are ELU/system combinations belonging to the following “parent” systems: Birch-Aspen Forest and Woodland, Foodplain/Outwash Plain Forest and Woodland, and Lutz Spruce Forest and Woodland. Since portfolio site selection was completed before the ELU/system combinations were available, these combinations could not influence site selection.

Ideally, for each target system, the portfolio would capture 30% of its ecoregional distribution, contained within patches above the minimum size, and these patches would collectively capture 30% of the ecoregional distribution of each ELU/system combination. The results presented here indicate that this can only be achieved by a deliberate area selection process that targets spatially contiguous occurrences of major ELUs as system components.

1c. Aquatic Systems

Of the 50 aquatic systems, conservation goals were met in the portfolio for 43. Forty-one systems exceeded the 30% goal by a significant margin. This is likely a result of the large areal requirements for terrestrial species such as brown bear. Four systems reached less than half of the goal, and 3 nearly reached the goal. These 3 systems, all in the West Cook Inlet EDU, are Stream on Lake Plain, Alluvial Floodplain Tributaries to Glacial Mainstem, and Lake Plain Tributaries to Glacial Mainstem.

1d. Coastal Systems

All coastal system goals were fully met in the portfolio. This is likely due to the fact that shorebird concentration areas, which occur along the coastline, were locked into the portfolio at the outset. In addition, estuary/river mouths, tidal marshes and coastal mudflats were identified as important habitats for a number of fine filter targets, thus increasing the odds that the systems would be represented in the portfolio.

2. Goal Assessment for Fine Filter Targets

2a. Birds

Goals for most birds were set using multiple data sets, expert delineations and/or system models. Because multiple data sets were used and because expert-delineated priority areas were considered one occurrence, some goals for birds were overmet. Only goals for 2 bird targets, the American dipper and the pigeon guillemot, were not met in the portfolio.

Location data for the American dipper was not available, nor was a reliable crosswalk to an aquatic system type, and so *all* aquatic systems together were chosen as the surrogate for the American dipper. Because not all aquatic system goals were met, the goal for the American dipper was considered unmet. In reality, aquatic systems on the whole were very well represented in the portfolio, and it is likely that the habitat for American dipper is similarly represented.

In the case of the pigeon guillemot, goals were set based on habitat. Most suitable habitat for the pigeon guillemot, however, is on the south side of Kachemak Bay, which is technically outside the ecoregion and was not included as part of this assessment. Pigeon guillemots will be more fully considered in the assessment for the adjacent ecoregion, the Gulf of Alaska Mountains and Fjordlands.

2b. Terrestrial Mammals

Fifty percent of the terrestrial mammal goals were met in the portfolio. Goals that were met tended to be those based on area requirements unassociated with system types. For example, one of the goals for lynx was based on areal extent (e.g., 4 examples of 259,000 contiguous ha). In fact, it was these area requirements that essentially drove the size of the portfolio.

For a number of wide-ranging species, there was not enough information on individual populations to assess the goal and so the goal was considered unmet. For many species, goals associated with system types were not met. This is particularly true of targets whose goals called for identification of *all* known habitat, such as caribou calving areas and moose wintering and post-rut areas. This suggests that setting goals of 100% of known habitat may not be feasible, or may result in an inefficient portfolio. Goals for some terrestrial mammals were not met because goals for surrogate targets were not met. For example, the goals for red-backed vole were based on minimum patch sizes of certain terrestrial systems. Because minimum patch sizes were not reached for those systems, the goals for red-backed vole were not met. It should be noted that minimum patch sizes are estimates that may need further refinement. Additional knowledge about patch sizes, habitat affinities and life-history locations for terrestrial mammal species will improve future iterations of this assessment.

2c. Aquatic and Amphibian Species

Goals for fish species were set at 30% of all the ecoregion's anadromous streams as represented in the *Anadromous Waters Catalog*. In the portfolio, anadromous streams were overrepresented by nearly twice their goal. Future iterations of this assessment would be improved by focusing on spawning and rearing areas, rather than entire anadromous streams. Although specific goals for spawning and rearing areas were not explicitly set, the presence of spawning and rearing areas is noted in the descriptions of each area of biological significance (see Section I).

The goal for the wood frog was unmet due to a lack of specific information about its distribution. The wood frog may have been adequately captured by coarse filter goals.

2d. Coastal Species

Fifty percent of the goals for coastal and nearshore marine species were completely met in the portfolio; the other half were nearly met. For example, the goal for beluga whales (100% of identified feeding areas) was nearly met (98%). The goal for king crab (100% of known spawning and rearing areas) was also nearly met (88%). The goal for the Steller sea lion was not assessed because they are peripheral to the ecoregion, but known to occur on the south side of Kachemak Bay.

2e. Plants

None of the goals for plants were met. There is sparse locational information available for these species in the ecoregion. Even though these targets were considered unmet, they may be captured through the coarse filter. A goal for the next iteration will be to improve information on plant species.

2f. Species Aggregations

Of 8 species aggregations, goals were met for 5. Of the 3 species aggregations whose goals were not met, 2—migratory shorebird concentration areas and brown bear concentration areas—were nearly met at 98% and 95% respectively. For the third aggregation, seabird foraging areas, no information was available; it is considered a data gap. Goals were substantially overmet for 4 of the aggregations, including migratory waterfowl concentrations, Pacific herring spawning areas, surrogate habitat for the little brown bat, and seabird colonies.

4. Goal Assessment by Subregion and EDU

General patterns emerged when assessing goals met by subregions and EDUs (Tables 17 and 18). Goals in the Knik Arm subregion were met less often than goals for other subregions. This is attributed to the fact that the Knik Arm subregion is the smallest of the 4 subregions in the Cook Inlet Basin; some of the goals—especially ones based on areal extent—were impossible to achieve in this small subregion. In addition the Knik Arm subregion is the most heavily populated of the subregions; therefore, the cost suitability index tended to avoid the developed areas around Anchorage and the Mat-Su valley. Unmet goals may reflect the methods used in portfolio design (i.e., a computerized selection process followed by manual adjustments), but they more likely indicate poorly designed goals.

TABLE 17: Goals met by subregion

TAXONOMIC GROUP	KENAI	KNIK	UPPER SUSITNA	WEST COOK INLET
Amphibians	0*	0*	0*	0*
Birds	100%	32%	94%	64%
Coastal Systems	93%	100%	N /A	100%
Marine Mammals	67%	100%	N /A	100%
Crustaceans	50%	N /A	N /A	N /A
Plants	0*	0*	0*	0*
Species Aggregations	71%	60%	25%	60%
Terrestrial Systems	100%	33%	100%	67%
Terrestrial Systems Considering Minimum Patch Size	55%	25%	45%	27%
Terrestrial Mammals	50%	14%	33%	43%
AVERAGE, EXCLUDING N/A AND DATA GAPS	**82%**	**43%**	**71%**	**63%**

** Goals for wood frogs and rare plants may be captured in the portfolio of areas of biological significance and subregions; however, goals were not met as data was inadequate for complete assessment. Information regarding these species should be considered gaps in knowledge.*

TABLE 18: Goals met by ecological drainage unit

TAXONOMIC GROUP	ANCHORAGE/ KENAI PENINSULA	SUSITNA / MATANUSKA / KNIK	WEST COOK INLET
Fish	88%	100%	100%
Aquatic Ecological Systems	86%	77%	75%
AVERAGE	**87%**	**88%**	**87%**

6. Land Management and Conservation Status of Portfolio

The total area encompassed by the terrestrial areas of biological significance in the portfolio is 1,617,370 ha, or approximately 43% of the total area of the ecoregion which includes its marine environments. Public lands make up the majority (87%) of the portfolio. Lands managed by the federal government constitute approximately 26% of the portfolio, and state-managed lands comprise approximately 48% (Table 19 and Figure 21). Native organizations own nearly 10%. Other private landowners and municipalities together manage over 16%. These land management statistics, based primarily on section-level data (640 acres), are generalized and do not include the marine waters of Cook Inlet, some of which are managed by the state. The 38 Native allotments in the portfolio are also not included in these totals.

The conservation status of the portfolio is shown in Table 20 and Figure 22. Forty-three percent of lands in the portfolio are currently managed as high or medium conservation status, and 2% are managed with a lower conservation status. Fifty-five percent of lands are not managed for conservation.

TABLE 19: Land management of the portfolio

LAND MANAGEMENT	TOTAL AREA IN ECOREGION (HA)	PERCENTAGE OF ECOREGION	TOTAL AREA IN PORTFOLIO (HA)	PERCENTAGE OF PORTFOLIO
FEDERAL				
BLM	10,716	.37%	3,676	0.23%
Military	13,374	0.46%	8,153	0.50%
NPS	30574	1.05%	30,161	1.86%
USFWS	380,067	13.08%	378,095	23.38%
STATE	1,468,516	50.53%	772,408	47.76%
STATE AND NATIVE	14,491	0.50%	5,330	0.33%
NATIVE	321,973	11.08%	155,512	9.62%
PRIVATE AND MUNICIPALITY	666,399	22.93%	264,014	16.32%
TOTAL	**2,906,110**	**100%**	**1,617,349**	**100%**

TABLE 20: Conservation status of the portfolio

CONSERVATION STATUS	TOTAL IN ECOREGION (HA)	PERCENTAGE OF ECOREGION	TOTAL IN PORTFOLIO (HA)	PERCENTAGE OF PORTFOLIO
High	270,310	9%	269,549	17%
Medium	446,369	15%	417,800	26%
Low	80,327	3%	31,729	2%
None	2,109,115	73%	898,291	55%
TOTAL AREA	**2,906,121***	**100%**	**1,617,370***	**100%**

**Total area numbers differ slightly from Table 18 due to rounding.*

H. DESCRIPTION OF AREAS OF BIOLOGICAL SIGNIFICANCE

The following section provides a brief introduction to each area of biological significance in the Cook Inlet Basin ecoregion. As a next step in its conservation process, the Conservancy will investigate each area in a focused and more detailed manner, establishing area conservation plans with specific strategies for conserving the targets in each area. This assessment is intended to simply identify, at a coarse scale level, areas of biological significance in the ecoregion.

In the following descriptions, area sizes include marine environments; however, they do not include portions of the area that fall outside the ecoregion boundaries. A number of the areas overlap with other ecoregions. The size of each area is also expressed as a percentage of the total acreage of the portfolio (2,020,950 ha), which includes marine environments. In order to avoid double-counting acreage, the total portfolio acreage is derived by adding the terrestrial acreage to only the aquatic area acreage that does not overlap with terrestrial areas.

1. Anchor River

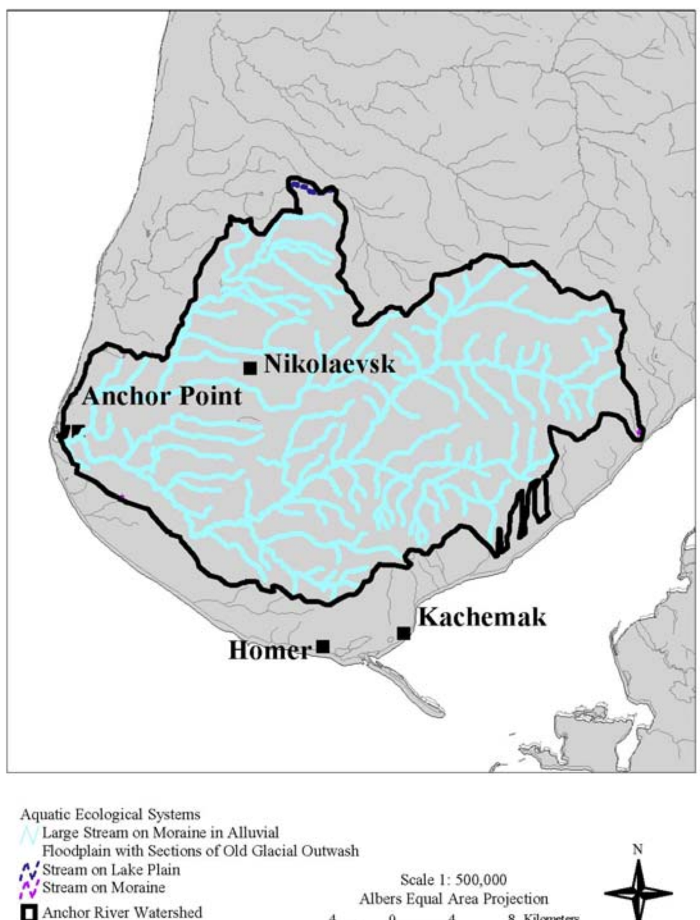
AQUATIC AREA

Size: 62,676 ha

SIZE OF AREA AS A PERCENTAGE OF PORTFOLIO: 3.10%

The Anchor River watershed supports strong runs of chinook and coho salmon and one of the northernmost runs of steelhead on the continent. The river's clear flow—free of glacial input—helps to support productive spawning gravel beds for much of the river's length. A very popular series of sport fisheries occurs at the mouth of the river and begins in May for chinook and continues through the fall for coho and steelhead. These anadromous fish also bring abundant nutrients into the watershed, and the nutrients form the basis for a complex and productive watershed and floodplain that is critical for nesting bald eagles, moose, brown and black bears, lynx, and many other species.

FIGURE 23: Anchor River aquatic area



One of the most sensitive—and heavily used—locations on the Anchor River is the estuary and barrier beach system at the mouth of the river where the waters drain into Cook Inlet. Here, salmon and steelhead rest before continuing upstream to spawn, and young fry spend time in the productive salt marshes before migrating to salt water.

Waterfowl and shorebirds numbering in the thousands use the estuary during annual migrations. In the winter, this protected estuary supports some of the highest densities of overwintering waterfowl in Cook Inlet.

TABLE 21: Targets at Anchor River

FISH	*Oncorhynchus gorbuscha*	Pink salmon spawning
	Oncorhynchus kisutch	Coho salmon spawning and rearing
	Oncorhynchus tshawytscha	Chinook salmon spawning and rearing
	Oncorhynchus mykiss	Steelhead spawning and rearing
	Salvelinus malma	Dolly varden rearing
AQUATIC SYSTEMS		Large Stream on Moraine in Alluvial Floodplain with sections of Old Glacial Outwash
		Stream on Moraine
		Stream on Lake Plain

2. Anchorage Flats

TERRESTRIAL AREA

SIZE: 20,120 ha

SIZE OF AREA AS A PERCENTAGE OF PORTFOLIO: 1%

Extensive tidal mudflats, coastal marshes, and mixed sand and gravel beaches characterize this area bordering Fire Island, the city of Anchorage and the Turnagain and Knik Arms of Cook Inlet. The area encompasses much of the Anchorage Coastal Wildlife Refuge, managed by the State of Alaska.

High numbers of shorebirds concentrate to feed and stage at the Anchorage Flats area and include thousands of Hudsonian godwits and short-billed dowitchers. The area is important for concentrations of waterfowl and includes nesting and staging habitat for thousands of ducks and geese in the spring and fall. There are moderate densities of breeding ducks, and urban Canada geese use the area. Sandhill cranes also occur here in the hundreds in spring and fall. There are likely 10 breeding pairs.

The Cook Inlet population of beluga whales is estimated to be around 357 individuals. The population is designated "depleted" under the Marine Mammal Protection act. The area is used by belugas in summer, and whales are seen sporadically here in the winter. Hunting, urban development and reduction in salmon are common threats to belugas.

FIGURE 24: Anchorage Flats land ownership

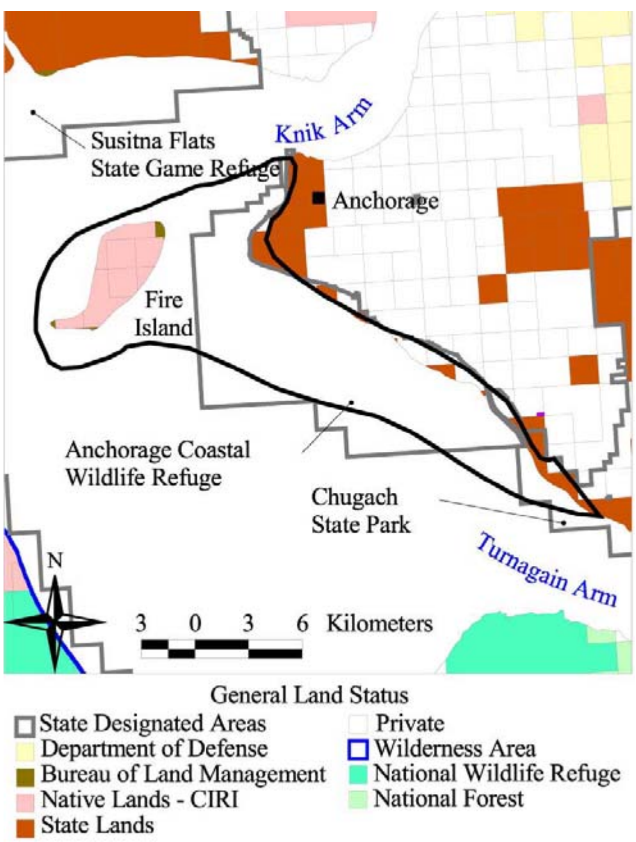


FIGURE 25: Anchorage Flats conservation status

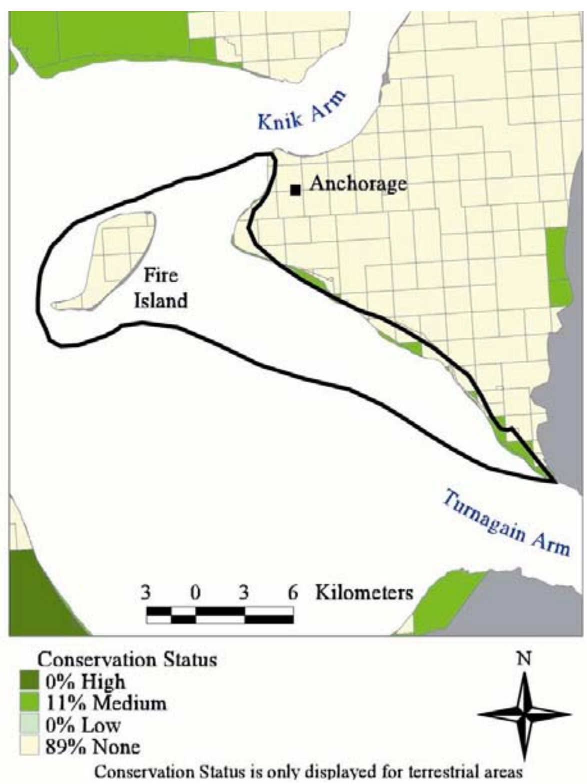


TABLE 22: Targets at Anchorage Flats

BIRDS	*Aegolius funereus*	Boreal owl*
	Anser albifrons elgasi	Tule white-fronted goose*
	Calidris alpina	Dunlin*
	Calidris mauri	Western sandpiper*
	Calidris ptilocnemis (Pribilof)	Rock sandpiper (Pribilof Island)*
	Chen caerulescens (Wrangel Island)	Wrangel Island snow goose*
	Contopus cooperi	Olive-sided flycatcher - species mix*
	Dendroica townsendii	Townsend's warbler*
	Empidonax difficilis	Pacific-slope flycatcher*
	Gavia immer	Common loon*
	Gavia pacifica	Pacific loon*
	Grus canadensis	Sandhill crane
	Limnodromus griseus	Short-billed dowitcher*
	Limosa haemastica	Hudsonian godwit*
	Numenius phaeopus	Whimbrel*
	Tringa flavipes	Lesser yellowlegs*
		Riparian landbird species mix*
COASTAL SYSTEMS		Coastal Mudflat
		Exposed rocky shores
		Exposed tidal flats
		Gravel, cobble and boulder beaches
		Mixed sand and gravel beaches
		Tidal Marsh
FISH	*Oncorhynchus gorbuscha*	Pink salmon spawning
	Oncorhynchusketa	Chum salmon
	Oncorhynchus kisutch	Coho salmon spawning and rearing

	Oncorhynchus tshawytscha	Chinook salmon spawning and rearing
	Oncorhynchus nerka	Sockeye salmon
	Salvelinus malma	Dolly varden spawning
AQUATIC SYSTEMS		Island unconnected lakes and streams on lake plain
		Non-glacial river draining steep topography and and crossing lake plain and moraine
PLANTS	*Puccinellia triflora*	*Puccinellia triflora*
SPECIES AGGREGATIONS	*Myotis lucifugus*	Little brown bat (winter concentrations)*
		Seabird colonies
		Shorebird migratory concentrations
		Waterfowl migratory concentrations
TERRESTRIAL SYSTEMS		Birch-aspen forest and woodland
		Black spruce and open peatland
		Exposed bedrock/sparse Vegetation
		Mesic herbaceous
		Upland dwarf shrub
		Upland tall and low shrub
		Wet herbaceous meadow
		White spruce/black forest and woodland
TERRESTRIAL SYSTEMS WITH MINIMUM PATCH SIZES		Exposed Bedrock/sparse vegetation patch
		Wet herbaceous meadow patch
TERRESTRIAL MAMMALS	*Alces alces*	Moose*
	Canis lupus	Gray wolf*
	Lontra canadensis	Northern river otter*
	Ursus arctos	Brown bear*

** Occurrence at area may be based on potential habitat.*

3. Chuitna River

AQUATIC AREA

SIZE: 44,011 ha

SIZE OF AREA AS A PERCENTAGE OF PORTFOLIO: 2.18%

The Chuitna River, a moderate-sized, non-glacial river, meanders through intact forested lands, and its floodplain hosts associated wetlands. The Chuitna watershed was chosen as a high priority aquatic area for its aquatic biodiversity. The river and its tributaries contains important spawning and rearing areas for chinook and coho salmon, and spawning areas for chum, pink and sockeye salmon.

Figure 26: Chuitna River aquatic area

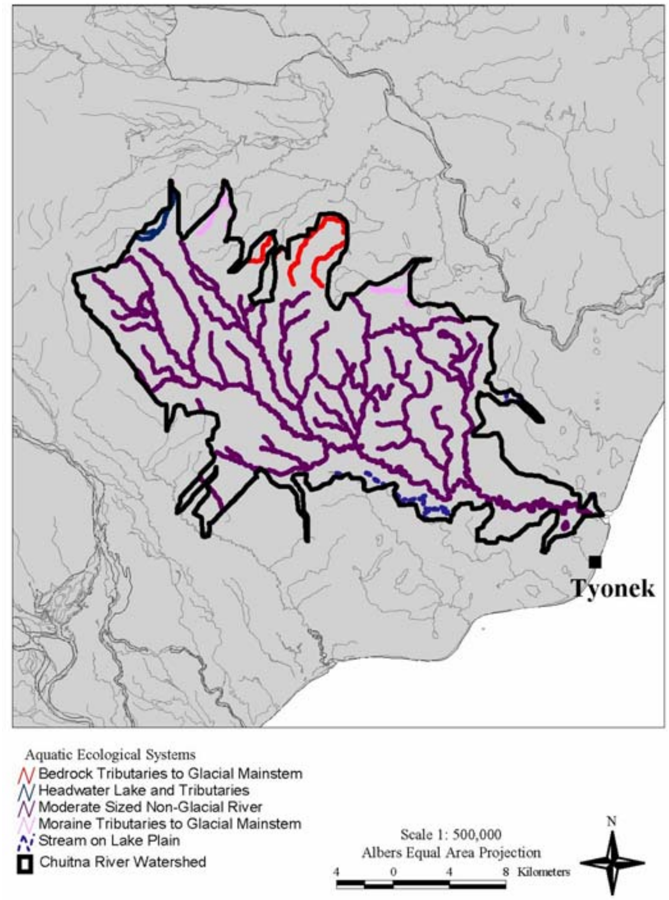
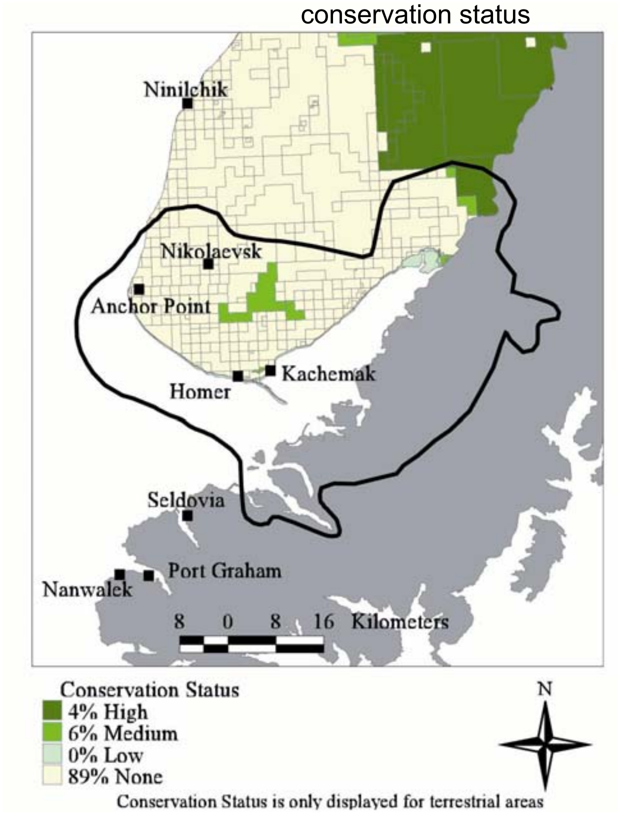


TABLE 23: **Targets at Chuitna River**

FISH	*Oncorhynchus gorbuscha*	Pink salmon spawning
	Oncorhynchusketa	Chum salmon
	Oncorhynchus kisutch	Coho salmon spawning and rearing
	Oncorhynchus tshawytscha	Chinook salmon spawning and rearing
	Oncorhynchus nerka	Sockeye salmon
AQUATIC SYSTEMS		Bedrock tributaries to glacial mainstem
		Headwater lake and tributaries
		Moderate sized non-glacial river
		Moraine tributaries to glacial mainstem
		Stream on lake plain

4. Kachemak Bay

FIGURE 28: Kachemak Bay conservation status



TERRESTRIAL AREA

Size: 163,210 ha

Size of Area as a Percentage of Portfolio: 8.08 %

The World Bank identified Kachemak Bay as one of two bodies of water in the United States meriting special attention for their extraordinary productivity. The bay's rich marine system is surrounded by productive coastal forests, salt marshes and other wetlands, alpine tundra and salmon-rich rivers.

The Kachemak Bay area contains the largest concentration of spits and embayments within the Cook Inlet Basin ecoregion as well as the only spawning and rearing areas for king and dungeness crab. Fox River Flats and China Poot Bay are two important estuaries. The salt marsh at Jakalof Bay contains one of the highest plankton counts in the area and so is very high in marine nutrients. Hard bottom intertidal communities are present in the area and include mussels and a diversity of other species. Kelp forests and eelgrass beds occur in the bay. There is a large harbor seal haulout where several hundred seals concentrate.

In spring and fall, thousands of waterfowl concentrate in the Kachemak Bay area and aggregations of up to 100,000 shorebirds also occur. There are 6 seabird colonies in the area (Grass Island, 60 Foot Rock, Grewingk Glacier, Cohen Island, Gull Island, Fox River Flats, Deepwater dock and Homer Airport). Colonial seabird species include black oystercatcher, arctic and Aleutian terns, pigeon guillemot, pelagic cormorant, common murre, tufted puffins and red-faced cormorants among others.

Kachemak Bay provides wintering habitat for several seaducks including harlequin duck (1,500 –2,000), long-tailed duck (approx. 5,000), and Pacific common eider (hundreds), and 3 species of scoters (>15,000). Steller's eiders (1,000-2,000) use waters offshore from Anchor Point south to the Homer Spit and occasionally Mud Bay. It is unclear whether the Steller's eiders that winter in Kachemak Bay are Alaska or Russian breeders.

Important terrestrial system targets include Lutz and Sitka Spruce forests. The Kachemak Bay area also hosts the only extensive patch of Sitka spruce forest in the ecoregion not yet significantly affected by spruce bark beetle infestation.

Because of its significant biodiversity, Kachemak Bay has been designated a Western Hemisphere Shorebird Network Site, a National Estuarine Research Reserve, and a State Critical Habitat Area. The area also includes part of Kachemak Bay State Park, and the Anchor River-Fritz Creek Critical Habitat Area (see Figure 27 for land ownership).

TABLE 24: Targets at Kachemak Bay

BIRDS	*Aegolius funereus*	Boreal owl*
	Anser albifrons elgasi	Tule white-fronted goose*
	Brachyramphus brevirostris	Kittlitz's murrelet
	Brachyramphus marmoratus	Marbled murrelet
	Calidris alpina	Dunlin*
	Calidris mauri	Western sandpiper*
	Calidris ptilocnemis (Pribilof)	Rock sandpiper (Pribilof Island)*
	Clangula hyemalis	Long-tailed duck
	Contopus cooperi	Olive-sided flycatcher - species mix*
	Chen caerulescens (Wrangel Island)	Wrangel Island snow goose*
	Cygnus buccinator	Trumpeter swan*
	Dendroica townsendii	Townsend's warbler*
	Empidonax difficilis	Pacific-slope flycatcher*
	Gavia immer	Common loon*
	Gavia pacifica	Pacific loon*
	Grus canadensis	Sandhill crane*
	Histrionicus histrionicus	Harlequin duck
	Limnodromus griseus	Short-billed dowitcher*
	Limosa haemastica	Hudsonian godwit*
	Melospiza melodia kenaiensis	Kenai song sparrow*
	Numenius phaeopus	Whimbrel*
	Polysticta stelleri	Steller's eider
	Somateria mollissima (Pacific)	Pacific common eider
	Sterna aleutica	Aleutian tern
	Tringa flavipes	Lesser yellowlegs*
		Riparian landbird species mix*

COASTAL SYSTEMS		Coastal mudflat
		Eelgrass beds
		Estuaries/river mouths
		Exposed tidal flats
		Kelp forests
		Mixed sand and gravel beaches
		Mussel beds
		Sandy beaches w/razor clams
		Sheltered rocky shores
		Sheltered tidal flats
		Tidal marsh
COASTAL MARINE MAMMALS	*Delphinapterus leucas pop 4*	Beluga whale (Cook Inlet population)
	Enhydra lutris	Sea otter
	Phoca vitulina	Harbor seal
CRUSTACEANS	*Cancer magister*	Dungeness crab
	Paralithodes camtschaticus	King crab
FISH	*Oncorhynchus gorbuscha*	Pink salmon spawning
	Oncorhynchus keta	Chum salmon spawning
	Oncorhynchus kisutch	Coho salmon spawning and rearing
	Oncorhynchus nerka	Sockeye salmon spawning
	Oncorhynchus tshawytscha	Chinook salmon spawning and spawning
	Oncorhynchus mykiss	Steelhead spawning and rearing
	Salvelinus malma	Dolly varden rearing
AQUATIC **SYSTEMS**		Bedrock Tributaries to Glacial Mainstem
		Glacial Mainstem River
		Large Stream on Moraine in Alluvial Floodplain with Sections of Old Glacial Outwash
		Moraine Tributaries to Glacial Mainstem

		Stream on Lake Plain
		Stream on Moraine
PLANTS	*Puccinellia glabra*	Puccinellia glabra
SPECIES AGGREGATIONS		Brown bear concentration areas
	Myotis lucifugus	Little brown bat (winter concentrations)*
	Clupea pallasi	Pacific herring spawning areas
		Seabird colonies
		Seaduck wintering areas
		Shorebird migratory concentrations
		Waterfowl migratory concentrations
TERRESTRIAL SYSTEMS		Black spruce and open peatland
		Exposed bedrock/sparse vegetation
		Floodplain/outwash plain forest and woodland
		Lutz spruce forest and woodland
		Mesic herbaceous
		Upland dwarf shrub
		Upland tall and low shrub
TERRESTRIAL SYSTEMS WITH MINIMUM PATCH SIZES		Exposed bedrock/sparse vegetation patch
		Floodplain/outwash plain forest and woodland patch
		Lutz Spruce forest and woodland patch
		Upland dwarf shrub patch
		Upland tall and low shrub patch
TERRESTRIAL MAMMALS	*Alces alces*	Moose
	Canis lupus	Gray wolf*
	Clethrionomys rutilus	Northern red-backed vole*
	Glaucomys sabrinus (Kenai subsp.)	Northern flying squirrel (Kenai subsp.)*

Lontra canadensis	Northern river otter*
Lynx canadensis	Lynx*
Martes americana	American marten*
Ursus arctos	Brown bear *

** Occurrence at area may be based on potential habitat.*

5. Kalgin Island

TERRESTRIAL AREA
SIZE: 22,521 ha
SIZE OF AREA AS A PERCENTAGE OF PORTFOLIO: 1.11%

Waterfowl concentrate in the Kalgin Island area in the spring and fall, and harbor seals haul out on the island's extensive mudflats. Coho and sockeye salmon spawn in the area and dolly varden and rainbow trout are also present.

Important targets include harbor seals, streams on moraine connected to lakes and wetlands, unconnected lakes and streams on islands on moraine, and gravel, cobble and boulder beaches.

Kalgin Island is mostly managed by the state of Alaska, with a portion designated as a state critical habitat area. There are also private lands, Native allotments and University of Alaska lands.

FIGURE 29: Kalgin Island land ownership

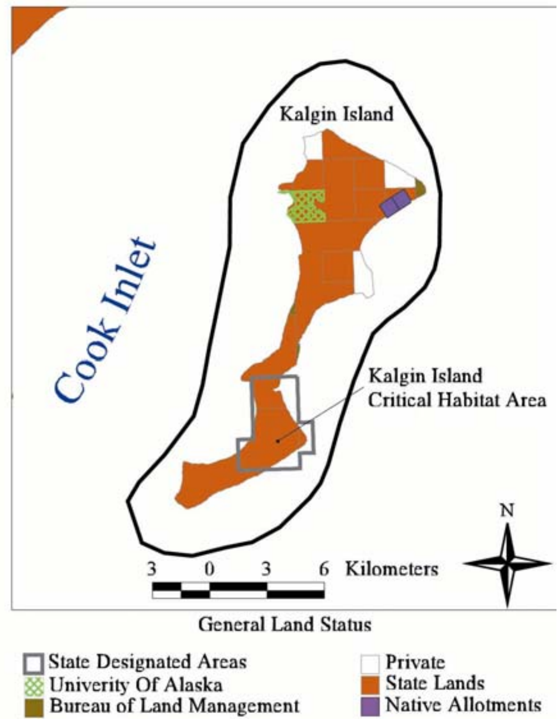


TABLE 25: Targets at Kalgin Island

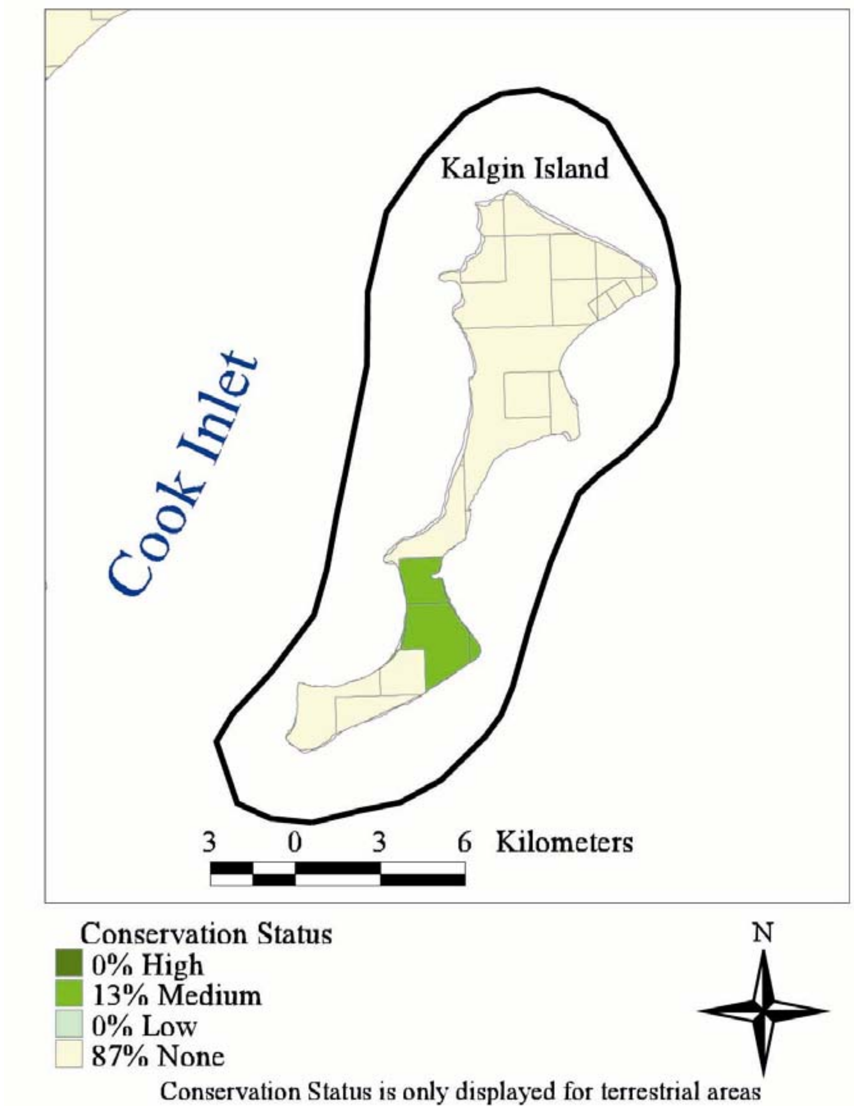
BIRDS	*Aegolius funereus*	Boreal owl*
	Anser albifrons elgasi	Tule white-fronted goose*
	Calidris alpina	Dunlin*
	Calidris mauri	Western sandpiper*
	Chen caerulescens (Wrangel Island)	Wrangel Island snow goose*
	Contopus cooperi	Olive-sided flycatcher - species mix*
	Cygnus buccinator	Trumpeter swan*
	Dendroica townsendii	Townsend's warbler*

	Empidonax difficilis	Pacific-slope flycatcher*
	Gavia immer	Common loon*
	Gavia pacifica	Pacific loon*
	Grus canadensis	Sandhill crane
	Limnodromus griseus	Short-billed dowitcher*
	Limosa haemastica	Hudsonian godwit*
	Numenius phaeopus	Whimbrel*
	Tringa flavipes	Lesser yellowlegs*
		Riparian landbird species mix*
COASTAL SYSTEMS	Exposed tidal flats	
	Gravel, cobble and boulder beaches	
	Mixed sand and gravel beaches	
	Sandy beaches w/razor clams	
	Sheltered tidal flats	
	Tidal Marsh	
COASTAL MARINE MAMMALS	Harbor seal	*Phoca vitulina*
FISH	Coho salmon spawning	*Oncorhynchus kisutch*
	Dolly varden	*Salvelinus malma*
	Sockeye salmon spawning	*Oncorhynchus nerka*
AQUATIC SYSTEMS		Streams on moraine connected to lakes and wetlands. Empty into Inlet.
		Unconnected lakes and streams on islands on moraine
SPECIES AGGREGATIONS	*Myotis lucifugus*	Little brown bat (winter concentrations)*
		Waterfowl migratory concentrations
TERRESTRIAL SYSTEMS		Birch-aspen forest and woodland
		Black spruce and open peatland
		Upland dwarf shrub

		Upland tall and low shrub
		Wet herbaceous meadow
		White spruce/black spruce forest and woodland
TERRESTRIAL SYSTEMS WITH MINIMUM PATCH SIZES		Wet herbaceous meadow patch
MAMMALS	*Canis lupus*	Gray wolf*
	Lontra canadensis	Northern river otter*
	Ursus arctos	Brown bear*

** Occurrence at area may be based on potential habitat.*

FIGURE 30: Kalgin Island conservation status



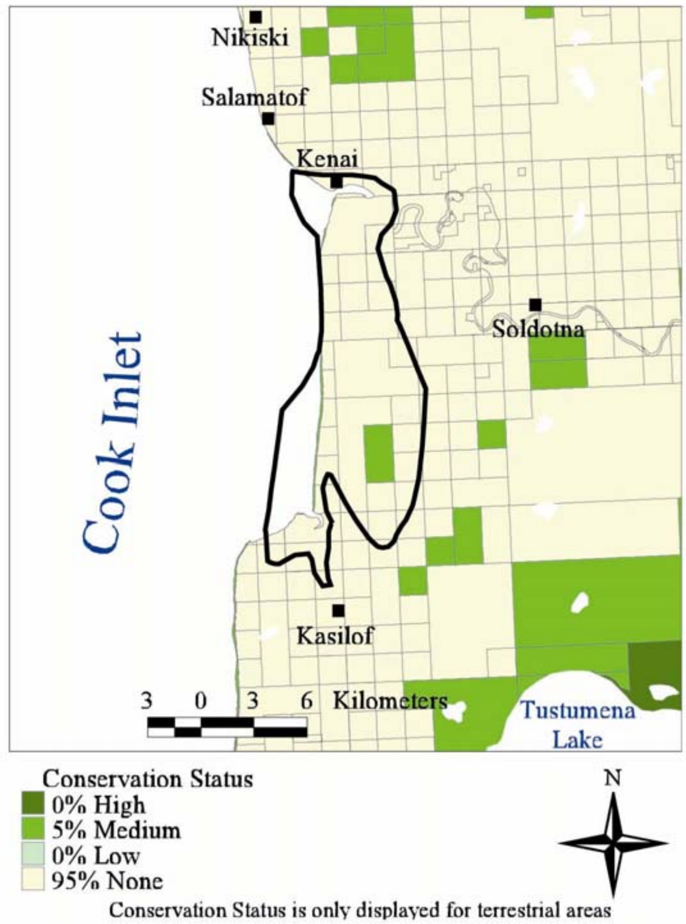
6. Kenai and Kasilof Wetlands

TERRESTRIAL AREA

SIZE: 12,608 ha

SIZE OF AREA AS A PERCENTAGE OF PORTFOLIO: 0.62%

FIGURE 32: Kenai and Kasilof Wetlands conservation status



The Kenai and Kasilof Wetlands area is made up of marine terrace wetlands and bogs, with coastal bluffs dominating the western border with Cook Inlet. The wetlands are relatively flat with tidal marsh communities in the floodplain area around the mouths of the Kenai and Kasilof Rivers. The tidal marshes present (both estuarine and freshwater marshes occur here) are extremely valuable habitat, with high diversity and biological activity.

Belugas concentrate for feeding at the estuaries and river mouths in summer. There are also mudflats with *Macoma baltica*, seabird colonies, and staging concentrations of sandhill cranes and Wrangel Island snow geese. There are 3 seabird colonies in the area where Aleutian terns were once present; although they may not use these colonies at present. The heaviest use by snow geese occurs when the west Cook Inlet marshes have a late snow melt. The area also contains significant portions of coarse-grained sand beaches and glacial mainstem rivers with large lakes in headwaters. Northern red-backed vole and lynx were associated with large patches of black spruce forests and open peatlands. Caribou calving areas are also an important target in this area.

The Kenai and Kasilof Wetlands area is mostly made up of state, Native and private lands as well as land managed by the Kenai Peninsula Borough (see Figure 31 for land ownership).

TABLE 26: Targets at Kenai and Kasilof Wetlands

BIRDS	*Aegolius funereus*	Boreal owl*
	Anser albifrons elgasi	Tule white-fronted goose*
	Calidris alpina	Dunlin*
	Calidris mauri	Western sandpiper*
	Calidris ptilocnemis (Pribilof)	Rock sandpiper (Pribilof Island)*

	Contopus cooperi	Olive-sided flycatcher - species mix*
	Chen caerulescens (Wrangel Island)	Wrangel Island snow goose*
	Dendroica townsendii	Townsend's warbler*
	Empidonax difficilis	Pacific-slope flycatcher*
	Gavia immer	Common loon*
	Gavia pacifica	Pacific loon*
	Grus canadensis	Sandhill crane*
	Limnodromus griseus	Short-billed dowitcher*
	Limosa haemastica	Hudsonian godwit*
	Melospiza melodia kenaiensis	Kenai song sparrow*
	Numenius phaeopus	Whimbrel*
	Sterna aleutica	Aleutian tern
	Tringa flavipes	Lesser yellowlegs*
		Riparian landbird species mix*
COASTAL SYSTEMS		Coarse-grained sand beaches
		Coastal mudflat
		Estuaries / river mouths
		Exposed tidal flats
		Mixed sand and gravel beaches
		Tidal marsh
COASTAL MARINE MAMMALS	*Delphinapterus leucas pop 4*	Beluga whale (Cook Inlet population)
FISH	*Oncorhynchus gorbuscha*	Pink salmon spawning
	Oncorhynchus keta	Chum salmon
	Oncorhynchus kisutch	Coho salmon rearing
	Oncorhynchus nerka	Sockeye salmon rearing
	Oncorhynchus tshawytscha	Chinook salmon spawning and rearing
	Oncorhynchus mykiss	Steelhead
	Salvelinus malma	Dolly varden

AQUATIC SYSTEMS		Glacial Mainstem with Large Lake in Headwaters
		Unconnected Lake on Lake Plain
SPECIES AGGREGATIONS	*Myotis lucifugus*	Little brown bat (winter concentrations)*
		Seabird colonies
		Waterfowl migratory concentrations
TERRESTRIAL *S*		Black spruce and open peatland
		Exposed bedrock/sparse vegetation
		Floodplain/outwash plain forest and woodland
		Lutz spruce forest and woodland
		Mesic herbaceous
		Upland dwarf shrub
		Upland tall and low shrub
		White spruce/black spruce forest and woodland
TERRESTRIAL SYSTEMS WITH MINIMUM PATCH SIZES		Black spruce and open peatland patch
		Exposed bedrock/sparse vegetation patch
		Mesic herbaceous patch
TERRESTRIAL MAMMALS	*Canis lupus*	Gray wolf*
	Alces alces	Moose
	Clethrionomys rutilus	Northern red-backed vole*
	Lontra canadensis	Northern river otter*
	Lynx canadensis	Lynx *
	Rangifer tarandus	Caribou
	Ursus arctos	Brown bear*

** Occurrence at area may be based on potential habitat.*

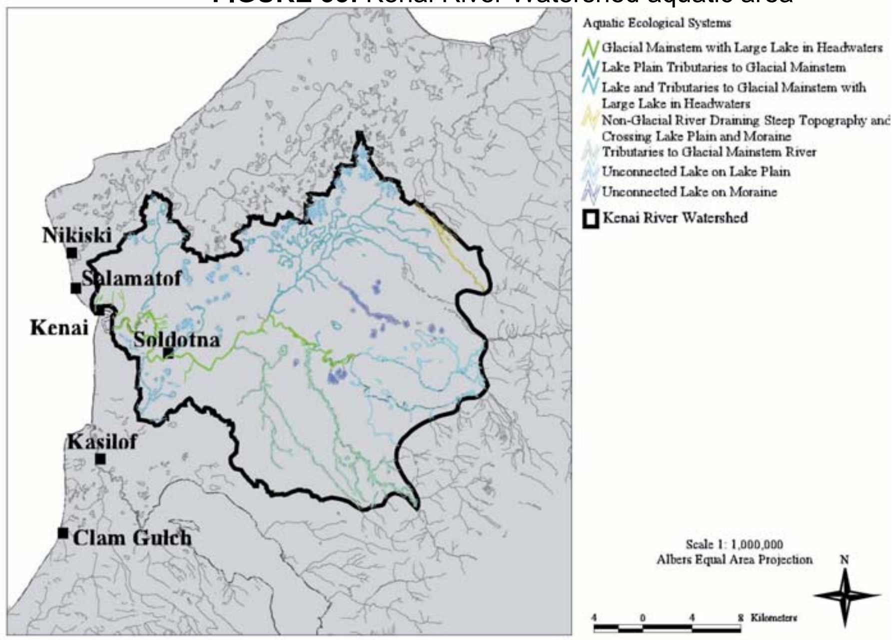
7. Kenai River Watershed

AQUATIC AREA

SIZE: 230,054 ha

SIZE OF AREA AS A PERCENTAGE OF PORTFOLIO: 11.38%

FIGURE 33: Kenai River Watershed aquatic area



The Kenai River is classified as a glacial mainstem river with a large lake in the headwaters. It is a very important river system due to its unique stocks of salmon and numerous aquatic invertebrates. The watershed supports 37 species of fish, 21 species of waterfowl, and numerous mammal species.

The river and its tributaries provide spawning and rearing habitat for chinook salmon, spawning habitat for pink salmon, and rearing habitat for sockeye and dolly varden. The Moose River, a large tributary watershed to the Kenai River, is one of the most important rearing areas for coho salmon in the watershed, contributing about 22% of the coho smolt that left the watershed in 1992-1994 (Palmer and Tobin 1996).

Portions of the Kenai River watershed fall in both the Cook Inlet Basin and Gulf of Alaska Mountains and Fjordlands ecoregions.

TABLE 27: Targets at the Kenai River Watershed

FISH	*Oncorhynchus gorbuscha*	Pink salmon spawning
	Oncorhynchus kisutch	Coho salmon spawning and rearing
	Oncorhynchus nerka	Sockeye salmon rearing
	Oncorhynchus tshawytscha	Chinook salmon spawning and rearing
	Salvelinus malma	Dolly varden rearing

AQUATIC SYSTEMS

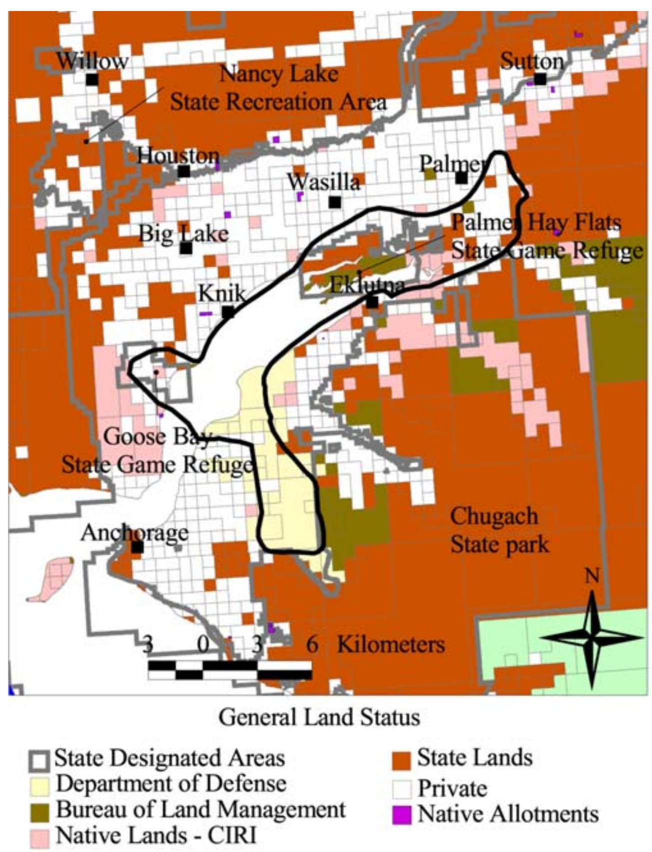
	Glacial Mainstem with Large Lake in Headwaters
	Lake Plain Tributaries to Glacial Mainstem
	Lake and Tributaries to Glacial Mainstem with Large Lake in Headwaters
	Non-Glacial River Draining Steep Topography and Crossing Lake Plain and Moraine
	Tributaries to Glacial Mainstem River
	Unconnected Lake on Lake Plain

8. Knik Arm

TERRESTRIAL AREA

SIZE: 63,331 ha
SIZE OF AREA AS A PERCENTAGE OF PORTFOLIO: 3.13%

FIGURE 34: Knik Arm land ownership



The Knik Arm area is especially important for migratory waterfowl and coastal systems. One of the largest concentrations of feeding beluga whales has been observed here in the summer (NMML 1999). Hundreds of sandhill cranes stage in the Palmer Hay Flats each spring and fall, and it is likely that 50-100 breed there. There are seabird colonies with mew gulls, herring gulls and arctic terns on islands along the Knik River fingers, at Duck flats, Coffee Point and Otter Lake. Three large tidal marshes provide feeding and staging habitat for tens of thousands of ducks, Canada geese and tundra swans during migration as well as nesting and brood rearing habitat for trumpeter swans.

The Knik Arm area hosts the only known occurrence of mixed deciduous forest with red-osier dogwood in the Matanuska Valley. There is also a small stand of sagebrush bluff on a steep southwestern facing slope and there may be other stands in the area. A large patch of coastal sand dunes is still actively forming in an area along the outwash plain.

The area has both glacial and non-glacial rivers. Wasilla Creek supports runs for sockeye, chinook, pink and coho salmon, and the Matanuska and Knik rivers support 5 species of salmon, but only limited spawning occurs at this area. Chinook spawning and rearing, chum spawning, coho spawning and rearing, and sockeye spawning and rearing all occur within streams in the Knik Arm area.

The Knik Arm area contains military, private, state and BLM lands.

FIGURE 35: Knik Arm conservation status

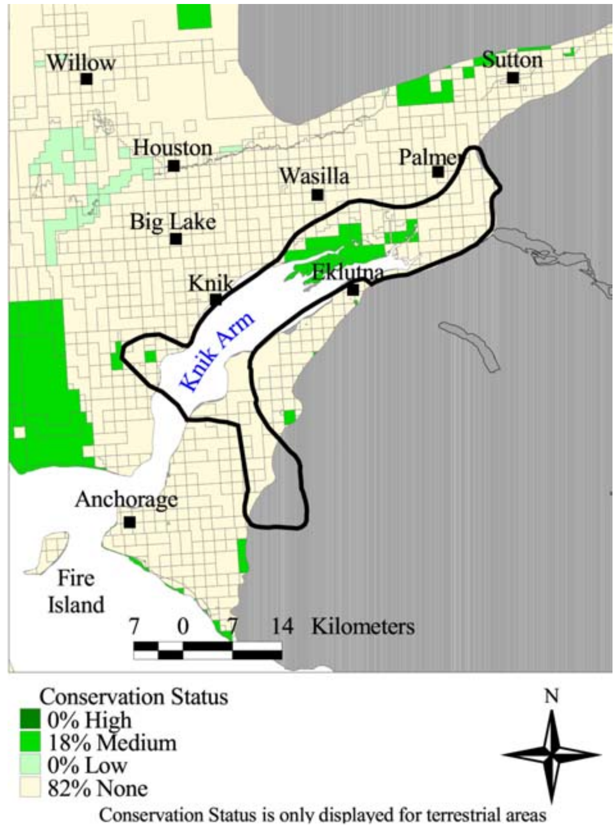


TABLE 28: **Targets at Knik Arm**

BIRDS	*Aegolius funereus*	Boreal owl*
	Anser albifrons elgasi	Tule white-fronted goose*
	Calidris alpina	Dunlin*
	Calidris mauri	Western sandpiper*
	Calidris ptilocnemis (Pribilof)	Rock sandpiper (Pribilof Island)*
	Contopus cooperi	Olive-sided flycatcher - species mix*
	Chen caerulescens (Wrangel Island)	Wrangel Island snow goose*
	Cygnus buccinator	Trumpeter swan*
	Dendroica townsendii	Townsend's warbler*
	Empidonax difficilis	Pacific-slope flycatcher*
	Gavia immer	Common loon*
	Gavia pacifica	Pacific loon*
	Grus canadensis	Sandhill crane*
	Limnodromus griseus	Short-billed dowitcher*
	Limosa haemastica	Hudsonian godwit*
	Melospiza melodia kenaiensis	Kenai song sparrow*
	Numenius phaeopus	Whimbrel*
	Tringa flavipes	Lesser yellowlegs*
		Riparian landbird species mix*
COASTAL SYSTEMS		Coastal Mudflat
		Estuaries / river mouths
		Exposed tidal flats
		Mixed sand and gravel beaches
		Sheltered tidal flats
		Tidal Marsh
COASTAL MARINE MAMMALS	*Delphinapterus leucas pop 4*	Beluga whale (Cook Inlet population)*
FISH	*Oncorhynchus gorbuscha*	Pink salmon

	Oncorhynchus keta	Chum salmon spawning
	Oncorhynchus kisutch	Coho salmon spawning and rearing
	Oncorhynchus tshawytscha	Chinook salmon spawning and rearing
	Oncorhynchus nerka	Sockeye salmon spawning and rearing
AQUATIC SYSTEMS		Glacial Mainstem not on Outwash Channel
		Glacial River Flowing into Inlet-Non Susitna Complex
		Moraine Tributaries to Glacial Mainstem
		Non-Glacial River Draining Steep Topography and Crossing Lake Plain and Moraine
		Non-Glacial Stream on Moraine
		Small Unconnected Lakes on Moraine
		Stream on Moraine
		Unconnected Lake on Moraine
PLANTS	*Puccinellia glabra*	Puccinellia glabra
	Puccinellia triflora	Puccinellia triflora
SPECIES AGGREGATIONS	*Myotis lucifugus*	Little brown bat (winter concentrations)*
		Seabird colonies
		Waterfowl migratory concentrations
TERRESTRIAL SYSTEMS		Birch-Aspen forest and woodland
		Black spruce and open peatland
		Exposed bedrock/sparse vegetation
		Floodplain/outwash Plain forest and woodland
		Mesic herbaceous
		Upland dwarf shrub
		Upland tall and low shrub
		Wet herbaceous meadow
		White spruce/black spruce forest and woodland
TERRESTRIAL SYSTEMS WITH MINIMUM PATCH SIZES		Exposed bedrock/sparse vegetation patch

		Floodplain/outwash plain forest and woodland patch
		Wet herbaceous meadow patch
TERRESTRIAL MAMMALS	*Alces alces*	Moose
	Canis lupus	Gray wolf
	Ursus arctos	Brown bear*
	Lontra canadensis	Northern river otter*

** Occurrence at area may be based on potential habitat.*

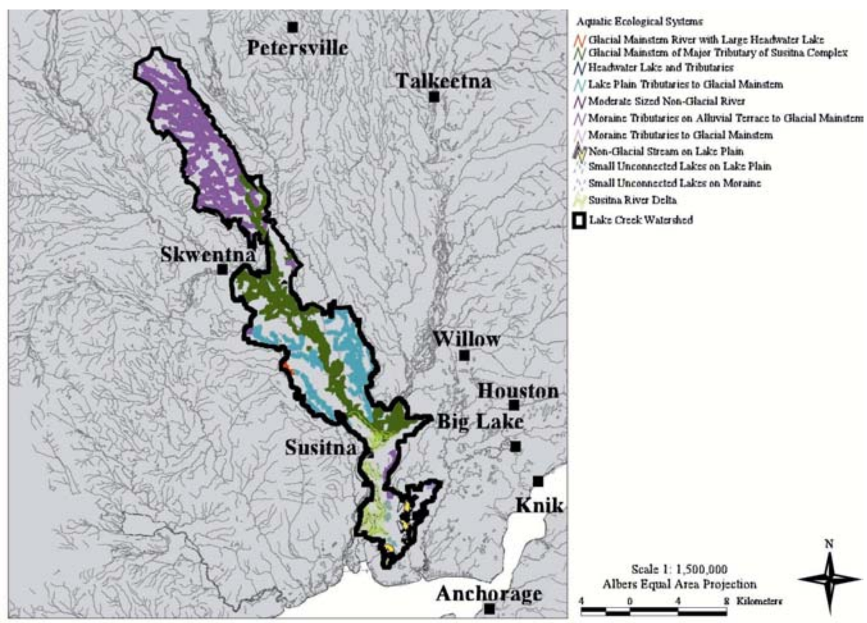
9. Lake Creek and Yentna River Watershed

AQUATIC AREA

SIZE: 181,444 ha

SIZE OF AREA AS A PERCENTAGE OF PORTFOLIO: 8.98%

Figure 36: Lake Creek and Yentna River Watershed aquatic area



Lake Creek and the Yentna River form major tributaries to the Susitna River. Flowing from the Alaska Range and glacially influenced, the Lake Creek and Yentna River watershed is diverse in its aquatic ecological system composition. Five species of Pacific salmon are present in these waters, with spawning habitat used by 4 species. Other important species known to depend on this watershed include brown bears and wolves, among others. There are also dispersed nesting grounds for the Tule white-fronted goose.

TABLE 29: Targets at the Lake Creek and Yentna Watershed

FISH	*Oncorhynchus gorbuscha*	Pink salmon
	Oncorhynchus keta	Chum salmon spawning
	Oncorhynchus kisutch	Coho salmon spawning and rearing
	Oncorhynchus nerka	Chinook salmon spawning and rearing
	Oncorhynchus tshawytscha	Sockeye salmon spawning and rearing
AQUATIC SYSTEMS		Bedrock Tributaries to Glacial Mainstem

	Glacial Mainstem of Major Tributary of Susitna Complex
	Lake Plain Tributaries to Glacial Mainstem
	Moraine Tributaries on Alluvial Terrace to Glacial Mainstem
	Non-Glacial Stream on Lake Plain
	Small Unconnected Lakes on Lake Plain
	Small Unconnected Lakes on Moraine
	Susitna River Delta

10. Northern Kenai

TERRESTRIAL AREA

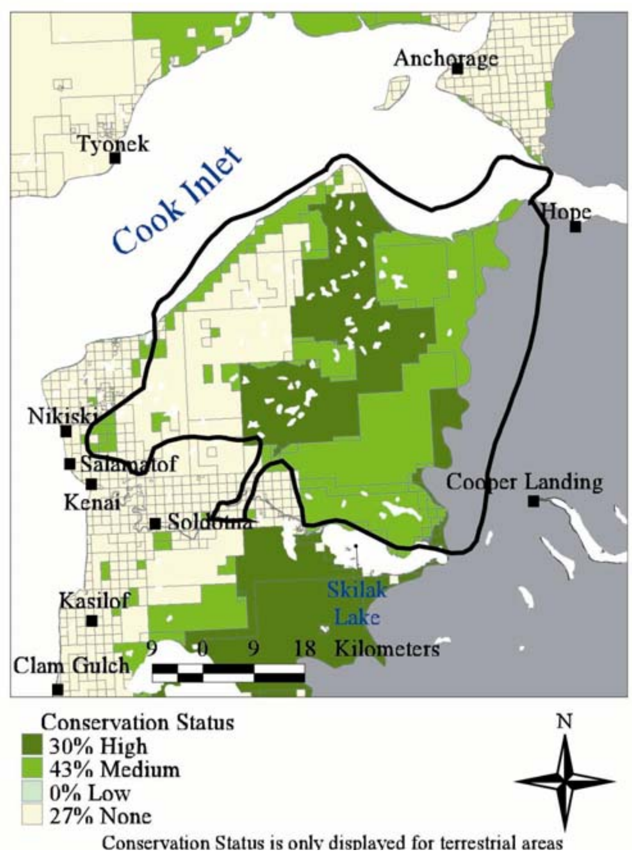
SIZE: 302,697 ha

SIZE OF AREA AS A PERCENTAGE OF PORTFOLIO: 14.98%

The Northern Kenai area is one of the largest areas in the portfolio and encompasses a large portion of the present day non-glaciated parts of the Kenai Peninsula. The Kenai Peninsula is connected to the mainland by only a narrow isthmus, creating a bottleneck for many terrestrial species. Birch-aspen forest occurs as part of a large mosaic of different terrestrial systems that covers much of the Northern Kenai lowlands. Black spruce peatlands occur in small patches in a forest/fire mosaic. There is a narrow band of active dunes.

The area is very important for the Kenai Peninsula brown bear, lowland caribou and other wide-ranging mammals. Territory for roughly 7 wolf packs is found in the area. The Northern Kenai area is part of the Kenai-Susitna area that was ranked by the USFWS as the 5th highest in biological importance for waterfowl in Alaska and considered vital to the maintenance of statewide and continental waterfowl populations (USFWS 1978). Pacific and common loons are present on many lakes; sandhill cranes (<100) stage at Chickaloon Flats with a lesser number nesting there. Thousands of shorebirds are recorded at Chickaloon Flats each spring and include short-billed dowitcher, lesser yellowlegs and least sandpiper. Chickaloon Flats and the greater northern Kenai area provide habitat for thousands of staging ducks and geese in both the spring and fall. Trumpeter swan adults/subadults (>180) are also known to occur here and use the area for nesting and brood rearing. There are thousands of small lakes in this area, and some of these lakes are unusual in that they have sand bottoms rather than the peat bottoms common to the area. The Chickaloon Flats are considered a high-use summer habitat for beluga whales (NMML 1999).

FIGURE 38: Northern Kenai conservation status



The dwarf longnose sucker (*Catostoms catostoms*) is found in Wolf Lake and 3 of the Finger Lakes (south of Wolf Lake). Landlocked pink salmon (same genus and species as anadromous pink salmon) are found in 3 lakes in the Moose River watershed.

In addition to Chickaloon Flats, the extensive flats at the mouth of the Kenai are the largest on the east side of Cook Inlet. Other potentially sensitive communities composing this area include the dune system and bluffs along the east side of Cook Inlet near the mouth of the Kenai, and extensive shallow wetlands north of the Kenai airport.

Much of the Northern Kenai area is composed of the Kenai National Wildlife Refuge, including a large federally designated wilderness area. There are also Native, borough and private lands. See Figure 37 for land ownership.

TABLE 30: Targets at Northern Kenai

BIRDS	*Aegolius funereus*	Boreal owl*
	Anser albifrons elgasi	Tule white-fronted goose*
	Calidris alpina	Dunlin*
	Calidris mauri	Western sandpiper*
	Calidris ptilocnemis (Pribilof)	Rock sandpiper (Pribilof Island)*
	Contopus cooperi	Olive-sided flycatcher - species mix*
	Chen caerulescens (Wrangel Island)	Wrangel Island snow goose*
	Cygnus buccinator	Trumpeter swan
	Dendroica townsendii	Townsend's warbler*
	Empidonax difficilis	Pacific-slope flycatcher*
	Gavia immer	Common loon*
	Gavia pacifica	Pacific loon*
	Grus canadensis	Sandhill crane*
	Limnodromus griseus	Short-billed dowitcher*
	Limosa haemastica	Hudsonian godwit*
	Melospiza melodia kenaiensis	Kenai song sparrow*
	Numenius phaeopus	Whimbrel*
	Tringa flavipes	Lesser yellowlegs*
		Riparian landbird species mix*
COASTAL SYSTEMS		Coarse-grained sand beaches
		Coastal Mudflat
		Estuaries / river mouths
		Exposed rocky shores
		Exposed tidal flats
		Exposed wavecut platforms
		Gravel, cobble and boulder beaches
		Mixed sand and gravel beaches

		Sheltered rocky shores
		Sheltered tidal flats
		Tidal Marsh
COASTAL MARINE MAMMALS	Delphinapterus leucas pop 4	Beluga whale (Cook Inlet population)
	Phoca vitulina	Harbor seal
FISH	Oncorhynchus gorbuscha	Pink salmon spawning
	Oncorhynchus keta	Chum salmon
	Oncorhynchus kisutch	Coho salmon spawning and rearing
	Oncorhynchus mykiss	Steelhead
	Oncorhynchus nerka	Sockeye salmon spawning and rearing
	Oncorhynchus tshawytscha	Chinook salmon spawning and rearing
	Salvelinus alpinus	Arctic char
	Salvelinus malma	Dolly varden
AQUATIC SYSTEMS		Glacial Mainstem with Large Lake in Headwaters
		Lake and Tributaries to Glacial Mainstem with Large Lake in Headwaters
		Lake Plain Tributaries to Glacial Mainstem
		Large Stream on Lake Plain in Alluvial Floodplain
		Non-Glacial River Draining Steep Topography and Crossing Lake Plain and Moraine
		Stream on Lake Plain
		Tributaries to Glacial Mainstem River
		Unconnected Lake on Lake Plain
		Unconnected Lake on Moraine
SPECIES AGGREGATIONS		Brown bear concentration areas
	Myotis lucifugus	Little brown bat (winter concentrations)*
		Seabird colonies
		Shorebird migratory concentrations
		Waterfowl migratory concentrations
TERRESTRIAL SYSTEMS		Birch-Aspen forest and woodland
		Black spruce and open peatland

		Dwarf shrub tundra
		Exposed bedrock/sparse vegetation
		Floodplain/outwash plain forest and woodland
		Mesic herbaceous
		Subalpine tall and low shrubland
		Upland dwarf shrub
		Upland tall and low shrub
		Wet herbaceous meadow
		White spruce/black spruce forest and woodland
TERRESTRIAL SYSTEMS WITH MINIMUM PATCH SIZES		Black spruce and open peatland patch
		Exposed bedrock/sparse vegetation patch
		Mesic herbaceous patch
		Upland dwarf shrub patch
		Upland tall and low shrub patch
		Wet herbaceous meadow patch
		White spruce/black spruce forest and woodland patch
TERRESTRIAL MAMMALS	*Alces alces*	Moose
	Canis lupus	Gray wolf
	Clethrionomys rutilus	Northern red-backed vole*
	Glaucomys sabrinus (Kenai subsp.)	Northern flying squirrel (Kenai subsp.)*
	Lontra canadensis	Northern river otter*
	Martes americana	American marten
	Lynx canadensis	Lynx*
	Rangifer tarandus	Caribou
	Ursus arctos	Brown bear*
	Ursus arctos (Kenai pop.)	Brown bear (Kenai pop.)*

** Occurrence at area may be based on potential habitat.*

11. Redoubt and Trading Bays

TERRESTRIAL AREA

SIZE: 198,010 ha
SIZE OF AREA AS A PERCENTAGE OF PORTFOLIO: 9.8%

Redoubt Bay is extremely important for shorebird and waterfowl concentrations. Several hundred thousand western sandpipers (>25 % of the global population) depend on the unvegetated intertidal habitats for feeding during spring migration. Around 100,000 dunlin stage here in spring. As much as 10% of the global population of Hudsonian godwits use the bay's intertidal areas for feeding and staging in spring, and nest in the spruce bog wetlands adjacent to the coast. The Pribilof Island rock sandpiper is a winter resident and uses the non-vegetated intertidal areas for feeding from October to April.

Redoubt Bay provides habitat for scattered nesting of trumpeter swans (high concentrations along the Kustatan River). Several hundred long-tailed ducks winter here, especially in the southern portion of the bay during late winter. Over 10,000 dabbling ducks nest at this area. Tule white-fronted geese were formerly more abundant, but likely abandoned the area after the Mt. Redoubt eruption that may have altered their habitat. Currently few (around 100) are found nesting and molting in this area, including small groups molting inland on the McArthur River (associated with late summer flooding). Up to 20% of the world's population of the Wrangel Island snow goose move around upper Cook Inlet in spring and use the outer coastal zone, depending on annual snowmelt pattern in Cook Inlet. Ten to twenty thousand birds rotate through the area feeding on rhizomes in the outer marsh fringe, as snow-free areas permit. The area also provides critical spring feeding habitat for the cackling Canada goose.

Rivers within the area support spawning and rearing habitat for 5 species of salmon. The area contains two separated coastal salt marsh complexes, and it contains small freshwater marsh/lake community complexes. Beluga whales feed in shallows

FIGURE 39: Redoubt and Trading Bays land ownership

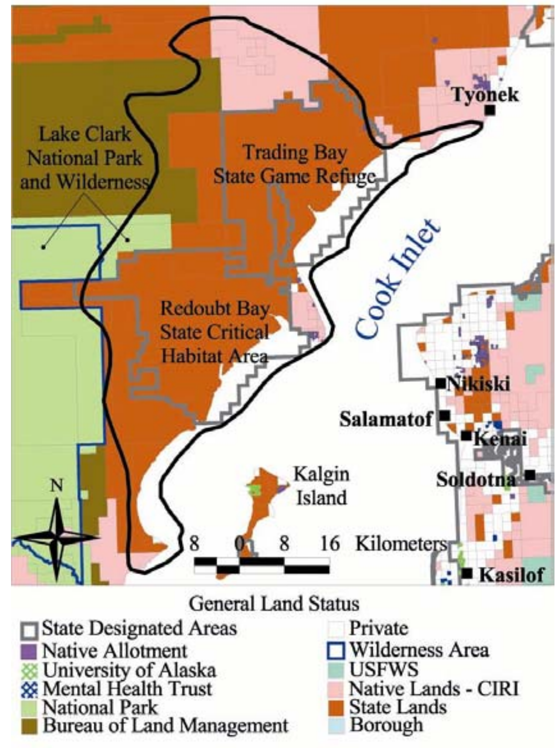
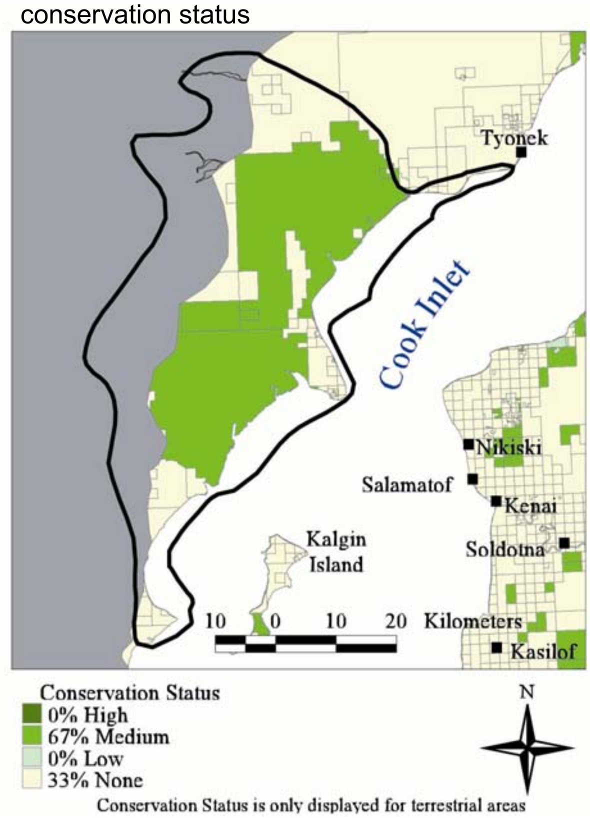


FIGURE 40: Redoubt and Trading Bays conservation status



within this area. Redoubt Bay is also an important staging and resting area for sandhill cranes. Moose wintering habitat and large spring concentrations of brown bear were also identified here.

Both Redoubt and Trading Bay qualify as hemispheric sites in the Western Hemisphere Shorebird Reserve Network for the rock sandpiper and as international sites for other species (Gill and Tibbetts 1999).

The Redoubt and Trading Bay area is primarily composed of state lands, including the Trading Bay State Game Refuge and the Redoubt Bay Critical Habitat Area. Native and BLM lands are also found within the area.

TABLE 31: Targets at Redoubt and Trading Bays

BIRDS	*Aegolius funereus*	Boreal owl*
	Anser albifrons elgasi	Tule white-fronted goose*
	Calidris alpina	Dunlin*
	Calidris mauri	Western sandpiper*
	Calidris ptilocnemis (Pribilof)	Rock sandpiper (Pribilof Island)*
	Clangula hyemalis	Long-tailed duck
	Contopus cooperi	Olive-sided flycatcher - species mix*
	Chen caerulescens (Wrangel Island)	Wrangel Island snow goose*
	Cygnus buccinator	Trumpeter swan*
	Dendroica townsendii	Townsend's warbler*
	Empidonax difficilis	Pacific-slope flycatcher*
	Gavia immer	Common loon*
	Gavia pacifica	Pacific loon*
	Grus canadensis	Sandhill crane*
	Limnodromus griseus	Short-billed dowitcher*
	Limosa haemastica	Hudsonian godwit*
	Melospiza melodia kenaiensis	Kenai song sparrow*
	Numenius phaeopus	Whimbrel*
	Sterna aleutica	Aleutian tern
	Tringa flavipes	Lesser yellowlegs*
		Riparian landbird species mix*

COASTAL SYSTEMS		Coarse-grained sand beaches
		Coastal Mudflat
		Estuaries / river mouths
		Exposed rocky shores
		Exposed tidal flats
		Gravel, cobble and boulder beaches
		Mixed sand and gravel beaches
		Sandy beaches w/razor clams
		Sheltered tidal flats
		Tidal Marsh
COASTAL MARINE MAMMALS	*Delphinapterus leucas pop 4*	Beluga whale (Cook Inlet population)
	Phoca vitulina	Harbor seal
FISH	*Oncorhynchus gorbuscha*	Pink salmon spawning
	Oncorhynchus keta	Chum salmon spawning and rearing
	Oncorhynchus kisutch	Coho salmon spawning and rearing
	Oncorhynchus mykiss	Steelhead rearing
	Oncorhynchus nerka	Sockeye salmon spawning and rearing
	Oncorhynchus tshawytscha	Chinook salmon spawning and rearing
	Salvelinus malma	Dolly varden spawning and rearing
AQUATIC SYSTEMS		Distributaries from Glacial Mainstem
		Glacial Mainstem River (West Cook Inlet)
		Glacial Mainstem River with Large Headwater Lake
		Icefield Melt Dominated, Short River Mainstem
		Marine and Alluvial Deposit Tributaries to Glacial Mainstem
		Moderate Sized Non-Glacial River
		Moraine Tributaries to Glacial Mainstem (West Cook Inlet)

		Moraine Tributaries to Non-Glacial Mainstem
		Stream on Alluvium and Marine Deposits (West Cook Inlet)
		Stream on Lake Plain (West Cook Inlet)
		Stream on Moraine (West Cook Inlet)
SPECIES AGGREGATIONS		Brown bear concentration areas
	Myotis lucifugus	Little brown bat (winter concentrations)*
		Seabird colonies
		Shorebird Migratory concentrations
		Waterfowl migratory concentrations
TERRESTRIAL SYSTEMS		Birch-aspen forest and woodland
		Black spruce and open peatland
		Exposed bedrock/sparse vegetation
		Floodplain/outwash plain forest and woodland
		Mesic herbaceous
		Upland dwarf shrub
		Upland tall and low shrub
		Wet herbaceous meadow
		White spruce/black spruce forest and woodland
TERRESTRIAL SYSTEMS WITH MINIMUM PATCH SIZES		Exposed bedrock/sparse vegetation patch
		Floodplain/uutwash plain forest and woodland patch
		Wet herbaceous meadow patch
TERRESTRIAL MAMMALS	*Alces alces*	Moose
	Canis lupus	Gray wolf*
	Lontra canadensis	Northern river otter*
	Ursus arctos	Brown bear*

** Occurrence at area may be based on potential habitat.*

12. Susitna Flats

TERRESTRIAL AREA

SIZE: 275,270 ha
SIZE OF AREA AS A PERCENTAGE OF PORTFOLIO: 13.62%

Within the ecoregion, Susitna Flats is an important area for staging and nesting waterfowl and shorebirds. The Flats area qualifies as a hemispheric site in the Western Hemisphere Shorebird Reserve Network for the Pribilof Island rock sandpiper and as an international site for other shorebird concentrations (Gill and Tibbetts 1999). The most important areas for shorebirds are the mouths of the Little Susitna and Ivan Rivers west to 3-Mile Creek. Shorebird species that use the area include the Hudsonian godwit, Pribilof Island rock sandpiper, short-billed dowitcher, and western sandpiper. Major use areas for the Pribilof Island Rock Sandpiper are around the Lower Susitna River and from the Ivan River west to 3-Mile Creek as well as the area between the Lewis and Beluga River. Birds in these areas number up to 20,000—100% of the population of winter residents from October to April. There is some movement south in particularly harsh winters.

Other birds also use the area in high numbers. Hundreds of sandhill cranes breed locally in low densities at the brackish marsh and shrub bog interface and thousands (3,000) stage during spring and fall. Low densities of trumpeter swans also breed and higher numbers (8,000) stage here in the fall. Tens of thousands of dabbling ducks and geese also use this area in both spring and fall concentrations. Approximately 10-20% of the population of the Wrangel Island snow goose stages at Susitna Flats in spring (April 15-May 15), with fewer present in the fall. Susitna Flats is the key staging site for the geese before they move on to the Yukon-Kuskokwim Delta and Russia. The area also provides habitat for 200-300 breeding Tule white-fronted geese, who use the coastal marshes, shrub zones, and

FIGURE 41: Susitna Flats land ownership

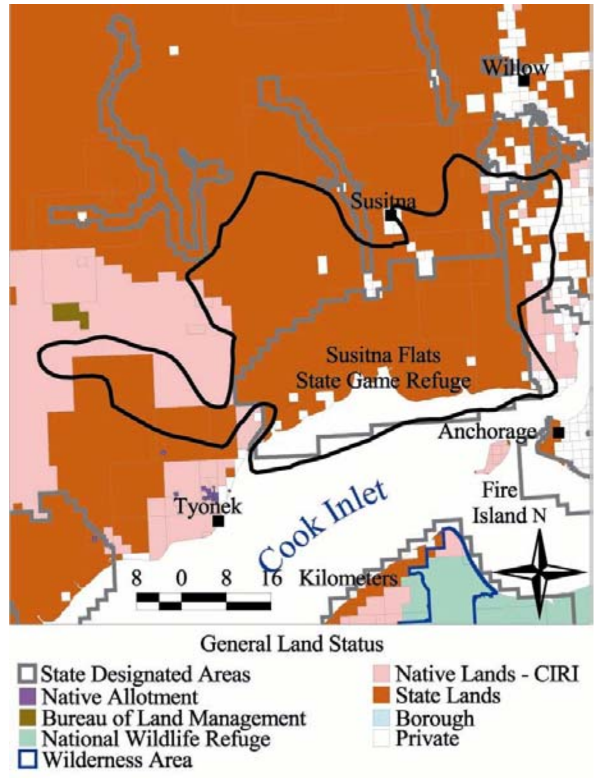
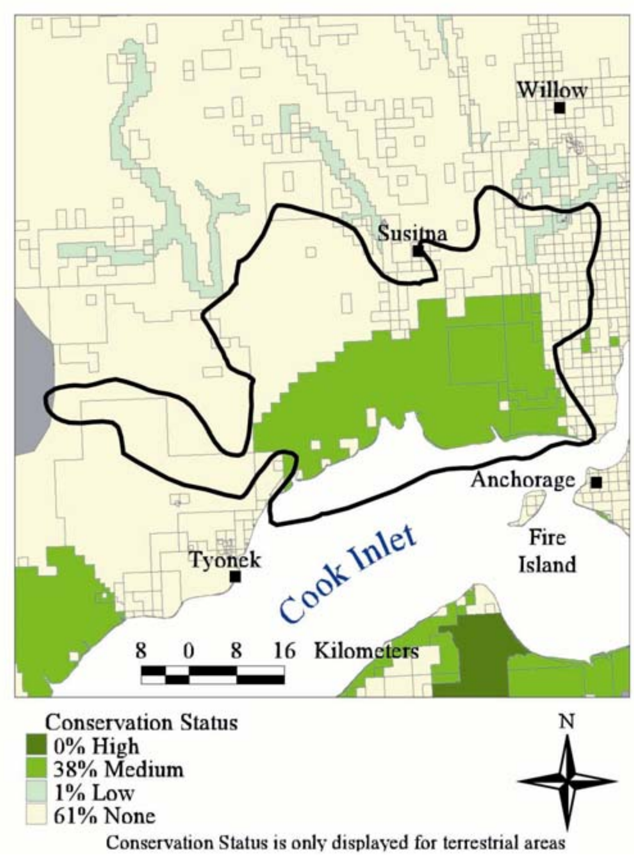


FIGURE 42: Susitna Flats conservation status



lower river corridors for staging, nesting, brood-rearing and molting. Dispersed pairs can be found in the marsh and shrub-bog zones. There are also several seabird colonies within this area with glaucous winged gulls, herring gulls, mew gulls, and arctic terns present.

Brown bears are found here in large concentrations in the spring. The Susitna River supports the second largest runs of salmon in Cook Inlet. Beluga whales follow forage fish here and feed at the mouth of the Susitna River. Several hundred belugas calve, breed and feed in the shallows offshore from the flats. In fact, this was one of the largest concentrations of feeding beluga whales in a recent summertime survey (NMML 1999). Rivers support 5 species of salmon, as well as steelhead and dolly varden.

Birch aspen forest and woodlands occur here, and in particular aspen forest on stabilized sand dunes with a sparse understory—unusual for the Susitna Valley. Black spruce forests and open peatlands are common and include the occurrence of a shrub fen that is one of several large string bog complexes in the area between the Beluga River and Mt. Susitna.

Much of the land within the Susitna Flats area is managed by the State of Alaska including the Susitna Flats State Game Refuge. Other lands include private, Native corporation, and undesignated state lands.

TABLE 32: Targets at Susitna Flats Area

BIRDS	*Aegolius funereus*	Boreal owl*
	Anser albifrons elgasi	Tule white-fronted goose*
	Calidris alpina	Dunlin*
	Calidris mauri	Western sandpiper*
	Calidris ptilocnemis (Pribilof)	Rock sandpiper (Pribilof Island)*
	Contopus cooperi	Olive-sided flycatcher - species mix*
	Chen caerulescens (Wrangel Island)	Wrangel Island snow goose*
	Cygnus buccinator	Trumpeter swan*
	Dendroica townsendii	Townsend's warbler*
	Empidonax difficilis	Pacific-slope flycatcher*
	Gavia immer	Common loon*
	Gavia pacifica	Pacific loon*
	Grus canadensis	Sandhill crane*
	Limnodromus griseus	Short-billed dowitcher*
	Limosa haemastica	Hudsonian godwit*
	Melospiza melodia kenaiensis	Kenai song sparrow*
	Numenius phaeopus	Whimbrel*
	Tringa flavipes	Lesser yellowlegs*

		Riparian landbird species mix*
COASTAL **SYSTEMS**		Coarse-grained sand beaches
		Coastal Mudflat
		Estuaries / river mouths
		Exposed tidal flats
		Mixed sand and gravel beaches
		Sheltered tidal flats
		Tidal Marsh
COASTAL MARINE MAMMALS	*Delphinapterus leucas pop 4*	Beluga whale (Cook Inlet population)
FISH	*Oncorhynchus gorbuscha*	Pink salmon spawning
	Oncorhynchus keta	Chum salmon spawning
	Oncorhynchus kisutch	Coho salmon spawning and rearing
	Oncorhynchus mykiss	Steelhead
	Oncorhynchus nerka	Sockeye salmon spawning and rearing
	Oncorhynchus tshawytscha	Chinook salmon spawning and rearing
	Salvelinus malma	Dolly varden rearing
AQUATIC SYSTEMS		Bedrock Tributaries to Glacial Mainstem (Susitna – Matsu)
		Bedrock Tributaries to Glacial Mainstem (West Cook Inlet)
		Bedrock Tributaries to Non-Glacial Mainstem
		Glacial Mainstem of Major Tributary of Susitna Complex
		Glacial Mainstem River with Large Headwater Lake
		Headwater Lake and Tributaries
		Lake Plain Tributaries to Glacial Mainstem (Susitna – Matsu)
		Moderate Sized Non-Glacial River
		Moraine Tributaries to Glacial Mainstem (West Cook Inlet)
		Moraine Tributaries to Glacial Mainstem on Alluvial Terrace
		Moraine Tributaries to Rivers on Alluvial Floodplain on Moraine
		Non-Glacial Stream on Lake Plain

		Non-Glacial Stream on Moraine
		River on Alluvial Floodplain on Moraine
		Small Stream on Moraine Unconnected to Inlet
		Small Unconnected Lakes on Lake Plain (Susitna – Matsu)
		Small Unconnected Lakes on Moraine (Susitna – Matsu)
		Stream on Lake Plain (West Cook Inlet)
		Susitna River Delta
		Very Short Streams on Lake Plain in Susitna Delta
		Very Short Streams on Sand Dunes in Susitna Delta
SPECIES AGGREGATIONS	*Myotis lucifugus*	Little brown bat (winter concentrations)*
		Seabird colonies
		Shorebird Migratory concentrations
		Waterfowl migratory concentrations
TERRESTRIAL SYSTEMS		Alpine wet herbaceous meadow
		Birch-aspen forest and woodland
		Black spruce and open peatland
		Dwarf shrub tundra
		Exposed bedrock/sparse vegetation
		Floodplain/outwash plain forest and woodland
		Mesic herbaceous
		Subalpine tall and low shrubland
		Upland dwarf shrub
		Upland tall and low shrub
		Wet herbaceous meadow
		White spruce/black spruce forest and woodland
TERRESTRIAL SYSTEMS WITH MINIMUM PATCH SIZES		Alpine wet herbaceous meadow patch
		Exposed bedrock/sparse vegetation patch
		Floodplain/outwash plain forest and woodland patch

		Subalpine tall and low shrubland patch
		Upland dwarf shrub patch
		Upland tall and low shrub patch
		Wet herbaceous meadow patch
		White spruce/black spruce forest and woodland patch
TERRESTRIAL MAMMALS	*Alces alces*	Moose
	Canis lupus	Gray wolf
	Clethrionomys rutilus	Northern red-backed vole*
	Lontra canadensis	Northern river otter*
	Lynx canadensis	Lynx*
	Martes americana	American marten*
	Ursus arctos	Brown bear*

** Occurrence at area may be based on potential habitat.*

13. Tustamena Bench

TERRESTRIAL AREA

SIZE: 235,745 ha
SIZE OF AREA AS A PERCENTAGE OF PORTFOLIO: 11.67%

Tustamena Lake is the largest lake on the Kenai Peninsula, at approximately 40 km long and 8 km wide, with a maximum depth of 290 m (Jones and Faurot 1991). There is a braided glacial river and outburst lake related to one of the largest outwash plains on the Kenai Peninsula. The plain is in various successional stages.

The Tustamena Bench area is key for brown bears and contributes greatly to brown bear conservation goals set for the ecoregion. It is also important for the Kenai wolverine and likely habitat for marten, lynx, red-backed vole, boreal owl, hudsonian godwit, olive-sided flycatcher, lesser yellowlegs, Pacific-slope flycatcher, Townsend's warbler, and sandhill crane.

The U.S. Fish and Wildlife Service manages the majority of this area as the Kenai National Wildlife Refuge, which includes a large

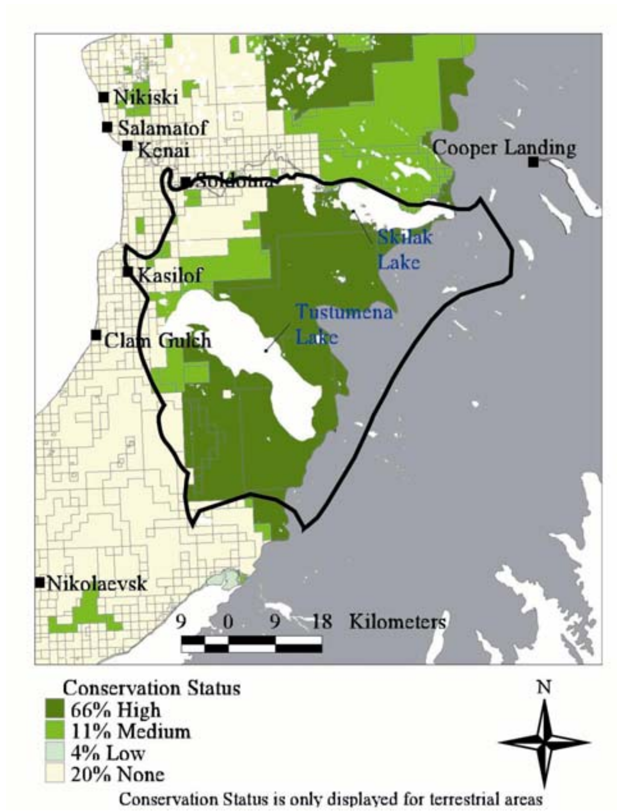


FIGURE 44: Tustamena Bench conservation status

federally designated wilderness area. See Figure 43 for land ownership.

TABLE 33: Targets at Tustamena Bench Area

BIRDS	*Aegolius funereus*	Boreal owl*
	Anser albifrons elgasi	Tule white-fronted goose*
	Calidris alpina	Dunlin*
	Calidris mauri	Western sandpiper*
	Calidris ptilocnemis (Pribilof)	Rock sandpiper (Pribilof Island)*
	Contopus cooperi	Olive-sided flycatcher - species mix*
	Chen caerulescens (Wrangel Island)	Wrangel Island snow goose*
	Cygnus buccinator	Trumpeter swan*
	Dendroica townsendii	Townsend's warbler*
	Empidonax difficilis	Pacific-slope flycatcher*
	Gavia immer	Common loon*
	Gavia pacifica	Pacific loon*
	Grus canadensis	Sandhill crane*
	Limnodromus griseus	Short-billed dowitcher*
	Limosa haemastica	Hudsonian godwit*
	Numenius phaeopus	Whimbrel*
	Tringa flavipes	Lesser yellowlegs*
		Riparian landbird species mix*
COASTAL SYSTEMS		Coastal Mudflat
		Estuaries / river mouths
FISH	*Oncorhynchus gorbuscha*	Pink salmon spawning
	Oncorhynchus keta	Chum salmon spawning
	Oncorhynchus kisutch	Coho salmon spawning and rearing
	Oncorhynchus mykiss	Steelhead rearing
	Oncorhynchus nerka	Sockeye salmon spawning and rearing
	Oncorhynchus tshawytscha	Chinook salmon spawning and rearing

		Dolly varden rearing
AQUATIC SYSTEMS		Glacial Mainstem River
		Glacial Mainstem with Large Lake in Headwaters
		Lake and Tributaries to Glacial Mainstem with Large
		Lake in Headwaters
		Lake Plain Tributaries to Glacial Mainstem
		Large Stream on Moraine in Alluvial Floodplain with Sections of Old Glacial Outwash
		Moraine Tributaries to Glacial Mainstem
		Moraine Tributaries to Glacial Mainstem on Alluvial Outwash Plain
		Stream on Lake
		Stream on Moraine
		Tributaries to Glacial Mainstem River
		Unconnected Lake on Lake Plain
	Myotis lucifugus	Unconnected Lake on Moraine
SPECIES AGGREGATIONS		Brown bear concentration areas
		Little brown bat (winter concentrations)*
		Seabird colonies
		Waterfowl migratory concentrations
TERRESTRIAL SYSTEMS		Black spruce and open peatland
		Dwarf shrub tundra
		Exposed bedrock/sparse vegetation
		Floodplain/outwash plain forest and woodland
		Lutz spruce forest and woodland
		Mesic herbaceous
		Subalpine tall and low shrubland
		Upland dwarf shrub

		Upland tall and low shrub
		White spruce/black Spruce forest and woodland
TERRESTRIAL SYSTEMS WITH MINIMUM PATCH SIZES		Black spruce and open peatland patch
		Dwarf shrub tundra patch
		Exposed bedrock/sparse vegetation patch
		Floodplain/outwash plain forest and woodland patch
		Lutz spruce forest and woodland patch
		Mesic herbaceous patch
		Upland dwarf shrub patch
		Upland tall and low shrub patch
		White spruce/black Spruce forest and woodland patch
TERRESTRIAL MAMMALS	*Alces alces*	Moose
	Canis lupus	Gray wolf
	Clethrionomys rutilus	Northern red-backed vole*
	Glaucomys sabrinus (Kenai subsp.)	Northern flying squirrel (Kenai subsp.)*
	Gulo gulo katschemakensis	Kenai wolverine
	Lynx canadensis	Lynx*
	Martes americana	American marten
	Ursus arctos	Brown bear*
	Ursus arctos (Kenai pop.)	Brown bear (Kenai pop.)*

** Occurrence at area may be based on potential habitat.*

14. Upper Susitna Basin

TERRESTRIAL AREA

SIZE: 551,096 ha

Size of Area as a Percentage of Portfolio: 27.27%

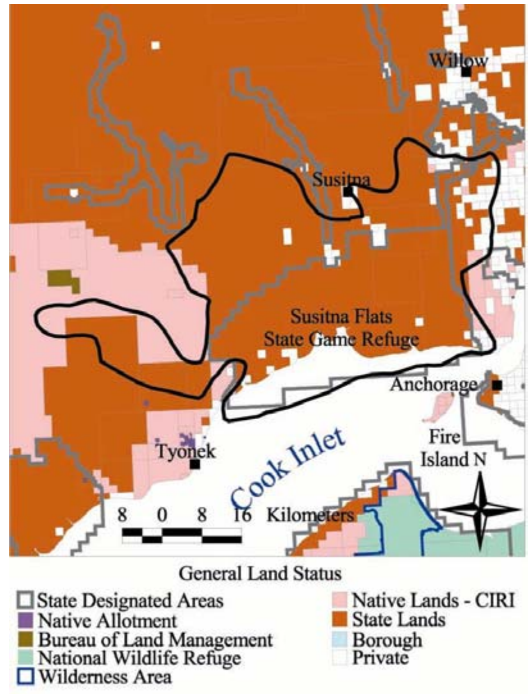


FIGURE 45: Upper Susitna Basin land ownership

The landscape of the Upper Susitna Basin is largely unfragmented and so provides the wide intact areas necessary to large carnivores, such as wolves. In the summer, brown bears concentrate in areas abundant with returning salmon. Moose winter along the river valleys and high densities of moose are recorded during all seasons.

The rivers of the basin provide extensive spawning and rearing areas for 5 species of salmon. The Susitna River stock of chinook salmon is considered to be the fourth most abundant in Alaska, after the Yukon, Kuskokwim, and Nushagak river stocks (Rutz and Sweet 2000).

The area is very important for the Tule white-fronted goose as approximately 20% of the population (1,500 birds) molt within this area. Approximately 80% (~ 4,000) of the breeding population are dispersed across the Kahiltna, Susitna and Yentna Valleys. This area also provides nesting habitat for Hudsonian godwits and other waterfowl and resting areas for sandhill cranes.

Most of the area is composed of undesignated state lands. There are also Susitna Basin State Recreation Rivers, a portion of Denali National Park, a small amount of BLM managed land and some private lands.

TABLE 34: Targets at Upper Susitna Basin

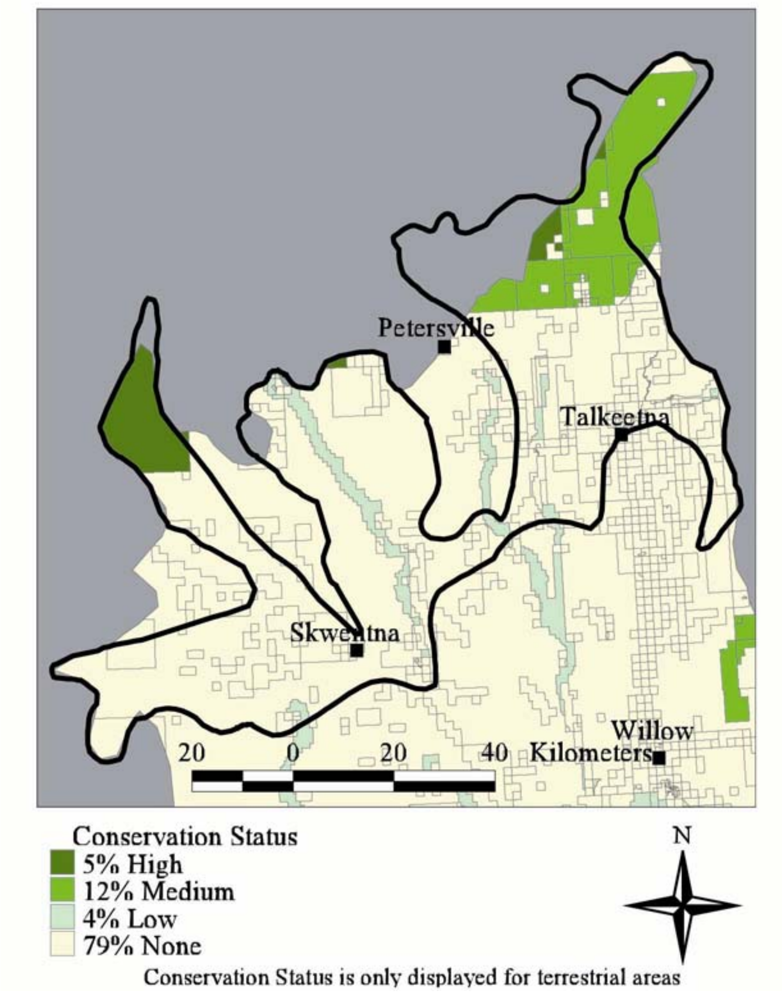
BIRDS	*Aegolius funereus*	Boreal owl*
	Anser albifrons elgasi	Tule white-fronted goose*
	Calidris mauri	Western sandpiper*
	Contopus cooperi	Olive-sided flycatcher - species mix*
	Cygnus buccinator	Trumpeter swan*
	Dendroica townsendii	Townsend's warbler*
	Empidonax difficilis	Pacific-slope flycatcher*
	Gavia immer	Common loon*
	Gavia pacifica	Pacific loon*
	Grus canadensis	Sandhill crane*

	Limnodromus griseus	Short-billed dowitcher*
	Limosa haemastica	Hudsonian godwit*
	Numenius phaeopus	Whimbrel*
	Tringa flavipes	Lesser yellowlegs*
		Riparian landbird species mix*
FISH	*Oncorhynchus gorbuscha*	Pink salmon spawning
	Oncorhynchus keta	Chum salmon spawning
	Oncorhynchus kisutch	Coho salmon spawning and rearing
	Oncorhynchus mykiss	Steelhead rearing
	Oncorhynchus nerka	Sockeye salmon spawning and rearing
	Oncorhynchus tshawytscha	Chinook salmon spawning and rearing
	Salvelinus malma	Dolly varden rearing
AQUATIC SYSTEMS		Alluvial Floodplain Tributaries to Glacial Mainstem
		Bedrock Tributaries to Glacial Mainstem
		Glacial Mainstem of Major Tributary of Susitna Complex
		Lake Plain Tributaries to Glacial Mainstem
		Moraine Tributaries to Glacial Mainstem on Alluvial Terrace
		Small Stream on Moraine Unconnected to Inlet
		Small Unconnected Lakes on Moraine
SPECIES AGGREGATIONS	*Myotis lucifugus*	Brown bear concentration areas
		Little brown bat (winter concentrations)*
TERRESTRIAL SYSTEMS		Alpine wet herbaceous meadow
		Birch-aspen forest and woodland
		Black spruce and open peatland
		Dwarf shrub tundra
		Exposed bedrock/sparse vegetation
		Floodplain/outwash plain forest and woodland
		Mesic herbaceous
		Subalpine tall and low shrubland

		Upland dwarf shrub
		Upland tall and low shrub
		Wet herbaceous meadow
		White spruce/black spruce forest and woodland
TERRESTRIAL SYSTEMS WITH MINIMUM PATCH SIZES		Alpine wet herbaceous meadow patch
		Exposed bedrock/sparse vegetation patch
		Floodplain/outwash plain forest and woodland patch
		Upland tall and low shrub patch
		Wet herbaceous meadow patch
		White spruce/black spruce forest and woodland patch
TERRESTRIAL MAMMALS	Moose	*Alces alces*
	Gray wolf	*Canis lupus*
	Northern red-backed vole*	*Clethrionomys rutilus*
	Lynx*	*Lynx canadensis*
	American marten*	*Martes americana*
	Brown bear*	*Ursus arctos*

** Occurrence at area may be based on potential habitat.*

FIGURE 46: Upper Susitna Basin conservation status



I. THREATS

Relative to the rest of the United States, Alaska seems only lightly affected by threats to the ecological integrity of its landscapes. The effects of human influence which are so severely and broadly manifested in the conterminous United States—such as high road densities, sprawling population centers, development and pollution—are much less noticeable in Alaska. Yet these and other threats to biodiversity and ecologically functional landscapes have been, and continue to be, expressed in Alaska. The region of Alaska probably most susceptible to human-made threats is the Cook Inlet Basin ecoregion, due primarily to the fact that half of the state's population is centered around Anchorage.

The following is a list of the broad-scale human impacts that currently exist or are expected to manifest in the near future in the Cook Inlet Basin ecoregion. In analysis of each area of biological significance, threats will be broken into two components: stress and source of stress. By identifying how a threat stresses a certain conservation target within an identified area of biological significance, and then identifying the particular source of that stress, we can better identify the appropriate method of ameliorating the negative impact of the stress at a particular place—rather than trying to eliminate the source altogether. For a more detailed discussion of these threats, see Appendix 15.

General Threats

1. **INCOMPATIBLE DEVELOPMENT OF TRANSPORTATION AND RELATED INFRASTRUCTURE.**
2. **INCOMPATIBLE RESIDENTIAL DEVELOPMENT.**
3. **INCOMPATIBLE RESOURCE DEVELOPMENT.**
4. **INCOMPATIBLE TOURISM AND RECREATION DEVELOPMENT.**
5. **INVASIVE SPECIES.**
6. **HYDROELECTRIC POWER DEVELOPMENT.**
7. **INCOMPATIBLE FISHERIES PRACTICES.**
8. **INCOMPATIBLE LOGGING PRACTICES.**
9. **ALTERED FIRE REGIMES.**
10. **CLIMATE CHANGE.**

J. GENERAL STRATEGIES

If The Nature Conservancy and its partners are to succeed in protecting the full range of native species and natural communities in the Cook Inlet Basin ecoregion, a suite of conservation strategies must be used to address the most pressing threats to the conservation. This must be done by working cooperatively with public and private landowners, industry, and others. Given the large number and wide range of areas, conservation strategies must be a mix of direct action at some places and broad conservation strategies across many areas. At some areas of biological significance, it will mean direct conservation action such as acquiring land on behalf of a private or public conservation organization, or acquiring conservation easements over key tracts. At other areas, it will require supplementing direct conservation action with community-based conservation programs. All the areas will require working with partners and promoting sound land stewardship.

While the Conservancy and its partners will work to achieve tangible lasting conservation results that go to scale at select priority areas within the ecoregion, it is clear that resource constraints limit our ability to pursue direct conservation action at all priority areas within the time frame necessary to address potential threats to conservation targets. The Conservancy and its partners must pursue conservation strategies that have the most impact over the greatest area.

A preliminary list of conservation strategies for the Cook Inlet Basin ecoregion was developed by the assessment team and input from experts. While these strategies attempt to address threats at an ecoregional scale, it is also recognized that conservation strategies must address specific threats to specific conservation targets at a local level. The next step in the conservation process employed by The Nature Conservancy is to develop strategies for individual areas of biological significance. These strategies are developed by taking a close look at a small set of species and systems at a particular place. Stresses and sources of stress are identified, and strategies are developed through work with partners. Measures of success are also developed in an attempt to measure the progress of conservation effort.

General conservation strategies for the Cook Inlet Basin ecoregion are described below:

1. Fee acquisition of priority tracts

Where the Conservancy or its partners pursue the acquisition of fee interests in key tracts, management strategies must produce the highest conservation leverage for the entire area.

2. Acquisition of conservation easements over priority tracts

Conservation easements are powerful, high-leverage tools for conservation in the Cook Inlet Basin ecoregion. While donations of conservation easements will be possible at some places, it is unlikely that donations of easements will be a viable strategy at most places. Instead, the Conservancy and its partners will have to seek private and public funding sources for the acquisition of conservation easements over priority tracts that will remain in private ownership. Private land tenure in the Cook Inlet Basin ecoregion can be a powerful force for conservation of natural diversity; if the Conservancy and its partners can make it economically feasible for private land managers to stay on the ground employing the best known stewardship practices, the result will be long-lasting, high-leverage conservation of natural diversity.

3. Land exchanges

While long-term protection of priority areas often presents the best hope for conserving areas within the Cook Inlet Basin, there are areas where creative win-win land exchanges between state and federal or federal and private entities makes the most sense. In some areas, land may be owned by the federal government that is more suitable for development than biologically important tracts owned by private or state interests. In these cases the Conservancy may want to help facilitate a land exchange to benefit all parties.

4. Protection of natural hydrologic regimes at priority aquatic areas

A number of areas of biological significance in the Cook Inlet Basin ecoregion harbor significant conservation targets that depend upon natural hydrologic conditions. Riparian forest communities, wetlands, and aquatic communities in particular depend upon a supporting hydrologic regime. Research is needed to help land managers understand these systems in order to effectively address the impacts of hydrologic alterations. The Conservancy and its partners must pursue strategies, such as ecologically sustainable water management to study and protect natural hydrologic regimes in the Cook Inlet Basin ecoregion (Richter et al. forthcoming).

5. State land designations

Some of the portfolio areas include large portions of critical habitat areas and state game refuges. Consideration should be given to expanding boundaries of these designated areas to adequately protect the species dependent upon them.

6. Strengthening public agency partnerships for conservation

Federal and state agencies have significant opportunities to contribute to conservation of natural diversity in the Cook Inlet Basin ecoregion. The Conservancy should work to encourage state and federal agencies operating within the ecoregion to develop and fund biodiversity conservation efforts. Special emphasis should be placed on further strengthening partnerships with the U.S. Fish and Wildlife Service, U.S. Forest Service, National Park Service, Alaska Department of Fish and Game, Alaska Department of Natural Resources, U.S. Geological Survey, U.S. Department of Defense, Bureau of Land Management, and the National Oceanic and Atmospheric Administration, among others.

7. Land use planning

Several of the threats identified could be addressed through better land use planning and enforcement. As a private property owner within the ecoregion, the Conservancy has great respect for private property rights and does not want to see state or local government burden property owners with unnecessary planning restrictions. The Conservancy recognizes nonetheless that some level of planning can provide significant benefits to biodiversity and actually increase property values. We should work with our local partners to advance thoughtful planning that leads to the greatest protection of biological diversity while still respecting the rights of private property owners.

8. Community-based conservation programs

Several portfolio areas are large-scale working landscapes, owned and managed by numerous private and public entities, and dependent upon large-scale natural ecological processes, such as flooding and fire. Conservation success at these large-scale areas will depend upon unprecedented cooperation, innovation and patience. Community support and engagement is a prerequisite for long-term conservation success. At these areas, the Conservancy in particular must make significant commitments to community-based conservation programs. Such programs may take forms ranging form local, on-the-ground staff presence to local community advisory boards to building the capacity of local partners for successful conservation.

K. INFORMATION GAPS AND RECOMMENDATIONS FOR FUTURE ASSESSMENT

In addition to the portfolio map of areas of biological significance and general conservation strategies, another valuable product of the ecoregional assessment process is a summation of the most significant data gaps and methodological challenges. Identification of data gaps provides salient research topics for conservation scientists, and documentation of methodological weaknesses provides a starting point to better the next iteration of an ecoregional assessment when more information becomes available. Both are excellent opportunities for partnership and collaboration between the Conservancy and its public and private partners.

Information Gaps

Conserving the biodiversity of an ecoregion requires comprehensive knowledge of the species and systems native to that ecoregion. Recognizing that our understanding of the biodiversity in the Cook Inlet Basin ecoregion is characterized by significant uncertainties, a goal of the ecoregional assessment was to document information gaps and research and inventory needs. The team documented data gaps throughout the assessment process.

While many data gaps exist for the Cook Inlet Basin ecoregion, two stand out as critical to the assessment process and must be better addressed for the next iteration of this assessment. First, a consistent, detailed, high-quality vegetation map for the ecoregion is necessary to delineate natural community types and key habitats for a number of species. Second, criteria to better assess the habitat needs of many wide-ranging species would be a tremendous asset to future iterations of ecoregional assessments here and elsewhere.

The following lists compiled at an expert workshop in November 2000 outline major data and information gaps for species and systems, impacts of threats to species and systems and research needs in the Cook Inlet Basin ecoregion. It should not, however, be considered a comprehensive list.

Cook Inlet Basin Ecoregion Data Gaps

Current Areas of Incomplete Information:

1. Species distribution maps
2. Rare species location data
3. Marine ecological system and species information
4. A high quality, consistent vegetation or ecological system map
5. Water-quality information
6. Genetic information on population units of fish, birds and mammals
7. Connectivity for species between ecoregions and conservation areas
8. Consistent, detailed land management/ownership data for ecoregion
9. Edge-matched hydrography data
10. Fine-scale watershed data
11. Important bird areas information
12. Increased information and locations important for amphibians and plants
13. Little brown bat habitat needs and winter concentrations

14. Comprehensive studies to expand biological and spatial data on macroinvertebrates and periphyton to document baseline conditions
15. Specific location data on endemic, declining, or disjunct species in the ecoregion
16. Biological and locational information on insects
17. Current range-wide data for mammal targets to inform conservation goals
18. Area habitat needs of wide-ranging species
19. Viability criteria for all target species in the ecoregion
20. Seabird foraging area locations
21. Wintering habitat for many migratory bird species that use the ecoregion

Suggested Research Areas:

1. Expand telemetry and banding studies to gain genetic information for fish, birds and mammals
2. Biodiversity assessment with focus on Kenai Peninsula using fine-scale data
3. Support of the USFWS/ADFG inventory of culverts/fish passage to prioritize and recommend needed retrofits to remedy fish passage problems
4. Study impacts of commercial harvest effects on escapement levels of salmon in northern ecoregion
5. Determine the extent of pike invasion
6. Expand 2000 wood frog study for deformities on Kenai NWR and in Mat-Su area
7. Investigate the effect of water level fluctuation on arctic char spawning in Cooper Lake
8. Study impacts of boat traffic on aquatic species, water quality, and riparian habitats
9. Investigate the extent of anadromous fish use and abundance of chinook, coho, steelhead and dolly varden on Anchor River, Deep Creek, Stariski and Ninilchik Creeks
10. Characterize flow, turbidity, contaminants, and sediment grading on Anchor River, Deep Creek, Stariski and Ninilchik Creeks
11. Estimate abundance of whitefish and characterize distribution in Fox River of salmon, dolly varden and whitefish
12. Obtain information on Kasilof late-run chinook salmon
13. Identify ecological processes operating within and threats to riparian and wetland ecological systems
14. Study impacts of sockeye fisheries on rainbow trout spawning success in the lower Russian River
15. Develop groundwater models for key riparian and wetland ecological systems
16. Increase understanding of how human communities influence the viability of wide-ranging species
17. Increase understanding of the role of patch size and fragmentation on viability
18. Identify key wintering habitat, areas, and stopover areas for migratory birds
19. Assess viability and develop range-wide conservation goals for species and communities to understand how the Cook Inlet Basin ecoregion contributes to the overall distribution and abundance of many species and systems
20. Increase understanding of the role, condition, and status of insects in the ecoregion
21. Study impacts of tourism on wildlife
22. Inventory areas of biological significance for high-quality examples of conservation targets not yet documented at the areas
23. Inventory, rank and monitor endemic and declining species

24. Obtain additional inventory data from state agencies and other sources
25. Study impacts of off-road vehicle use
26. Study long-term ecological impacts of spruce bark beetle infestation
27. Study impacts of human and natural disturbances to ecological systems
28. Investigate natal streams of salmon commercially harvested from the central district

Recommendations for adapting planning methods to functional landscapes

The Cook Inlet Basin ecoregion was the first terrestrial ecoregional assessment developed for an Alaskan ecoregion. The standards and methods for ecoregional planning as outlined in the document *Designing a Geography of Hope* have been widely applicable and met the Conservancy's large-scale planning needs within the continental United States. In Alaska, however, and likely in other places characterized by intact, functional landscapes with wide-ranging species, applying the current ecoregional standards and methods has presented special challenges. Below are described several of the methods outlined in *Designing a Geography of Hope* that have been difficult to apply in functional, intact ecoregions. Obvious methodological weaknesses discussed below represent major issues; other shortcomings may be present but not explicitly identified. Future assessments will need to address both as additional knowledge is gained and methods further refined.

Selecting Conservation Targets:

The outcome of a conservation assessment is highly dependent on the selection of target species and systems. The Conservancy's guidelines recommend selecting *all* terrestrial, freshwater and coastal systems, as well as a limited set of species, including among others rare, endemic, keystone and wide-ranging species. In the Cook Inlet Basin, few species are rare or endemic. There are, however, many species that may be considered keystone, wide-ranging or both. Unfortunately, these terms have no established and consistent definitions in scientific literature, and the assessment team could not find consistent criteria by which to assign species to these categories. Thus, determining a conservation target list for this ecoregion—according to the guidelines in *Designing a Geography of Hope*—was challenging. To overcome this challenge, the team did not include 'wide-ranging' as a justification for selecting targets. A number of wide-ranging species were assessed; however they were included not because they were wide-ranging but because they fell in other categories such as keystone.

To further complicate the matter of target selection, there was little documented locational information on many species targets, and experts were largely unable to compensate for these omissions. To overcome the lack of information about where targets occurred on the landscape, the assessment team applied the predictive systems models as surrogates for species habitats. Such an application, though the only recourse available in this case, has two fundamental drawbacks: first, it may propagate any errors in the systems models through to species, and second, due to the scale of the systems models, it most likely over-generalizes the locations of species. Finer scale data would be preferable. For subsequent iterations, the assessment team would advise that species lacking documented locational information not be selected as targets.

Reliance on Surrogate and Modeled Information:

The lack of data on species and community locations forced the assessment team to rely on expert data and surrogate models. This reliance represents the most significant methodological shortcoming of the assessment. None of the coarse filter systems modeled by the Conservancy (e.g., terrestrial or aquatic) have been ground-truthed or assessed for accuracy. Thus, the quality of the models is unknown, as is any information based on the models, such as some species information and goals. In subsequent iterations, the planning team recommends ground-truthing of the models or the use of fine-scale vegetation coverages as training sets.

Setting and Assessing Conservation Goals:

Although it is challenging in any ecoregion to set quantitative conservation goals for species, goal-setting for the Cook Inlet Basin species was particularly challenging. Current guidelines suggest that conservation goals be set as a number of occurrences, or populations, of a species. In the Cook Inlet Basin, a relatively unfragmented ecoregion characterized by wide-ranging species such as brown bear, occurrences or populations of many species are not clearly delineated. Moreover, because little information exists on what constitutes *an occurrence* of a wide-ranging species, goals were generally linked to habitat as portrayed by predictive system models. Unfortunately, the scale of the system models could not indicate fine scale habitats, and so goals were generalized to broad system types.

For systems, guidelines suggest a default goal of 30% of the historical area occupied by that system. This default is widely applied by the Conservancy in ecoregions in the western U.S. and although its basis is tenuous even there, it is all the more questionable in a landscape that is relatively intact and unfragmented. In future iterations, it may be worth experimenting with alternate goals and/or trying to quantify and qualify what might be lost from an ecoregion such as the Cook Inlet Basin if only 30% of each habitat type were to remain.

Most improvements in goal-setting will require general advances in our understanding of the ecology of the Cook Inlet Basin ecoregion and its species and systems. On the other hand, two improvements can be made to the process without this information. First, species that migrate or disperse beyond one ecoregion should be assigned rangewide goals rather than goals by ecoregion. Second, fine scale habitats should not be used to set conservation goals, unless the fine scale habitats are reliably mappable. Otherwise, information becomes generalized to the point of relative meaninglessness and the potential to replicate error is magnified.

Assessing Viability:

There is little data on the viability of species in the Cook Inlet Basin ecoregion. A limited number of population viability studies exist; however, most were done in areas outside the ecoregion and may not be applicable to the conditions characteristic of Cook Inlet Basin. To account for the shortage of viability information on species and systems, the assessment team created a cost suitability index to eliminate certain *areas* in the ecoregion as suitable areas for conservation. Although the cost suitability index attempts to focus conservation in the most promising areas, it does not reveal information about the condition of particular occurrences or populations of species.

Portfolio Assembly:

In assembling a portfolio, an assessment team attempts to identify the “best” set of areas that meet conservation goals for target species and systems. The most efficient assembly achieves these goals in the least amount of area and within areas already managed for conservation. In fragmented landscapes where *Designing a Geography of Hope* methods are applied, the best portfolio design is often quite clear—the portfolio is comprised of the remaining blocks of habitat nestled among developed areas. The best portfolio design is not quite as obvious in intact, unfragmented lanscapes such as the Cook Inlet Basin. Here, many species range widely across the landscape. Others seem to exist everywhere at once in low densities. Still others use different habitats in the ecoregion at different times of the year, and in some years, they use none of the habitats. Furthermore, the Cook Inlet Basin has a large share of land in medium and high conservation status. In this situation, where any spot may be inhabited by a target species at some point in its life cycle and where protected areas are well established, there is not a clear solution to the task of assembling the "best" set of areas to achieve conservation goals. More so than in fragmented landscapes, setting goals in intact landscapes is a decision about how much can be lost rather than how much should be "saved." Although it is a subtle shift in perspective, the ramifications of choosing how much can be lost are considerable. While there is no one "answer" for identifying areas of biological significance in intact ecoregions, the recommendation of the assessment team is to build outward from the following seeds: locations known for consistent use by species targets, areas of species aggregations, and areas of highest conservation status.

Aquatic System Models:

Although the aquatic systems model received high marks from reviewers for its accuracy, methods for using the model to identify important aquatic areas in intact landscapes need improvement. Further work is also needed to correlate specific salmon habitat with aquatic systems by developing finer-scale information.

Marine Assessment:

The species and systems assessed as coastal targets in the Cook Inlet Basin ecoregion were primarily assessed from a nearshore perspective. Much additional work could be done to identify areas of biological significance in the marine portions of the ecoregion.

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