Living and Playing in the Kenai River Watershed

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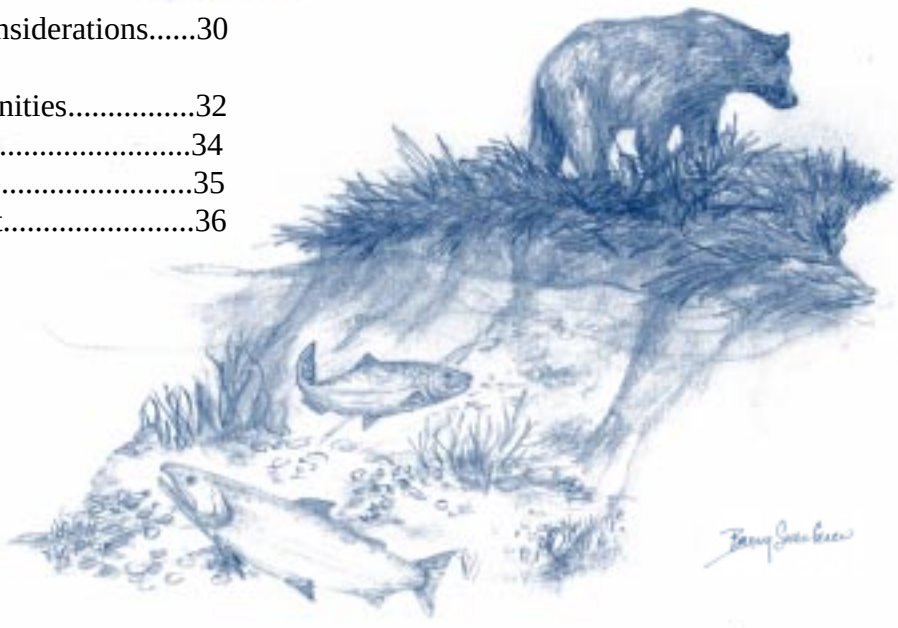
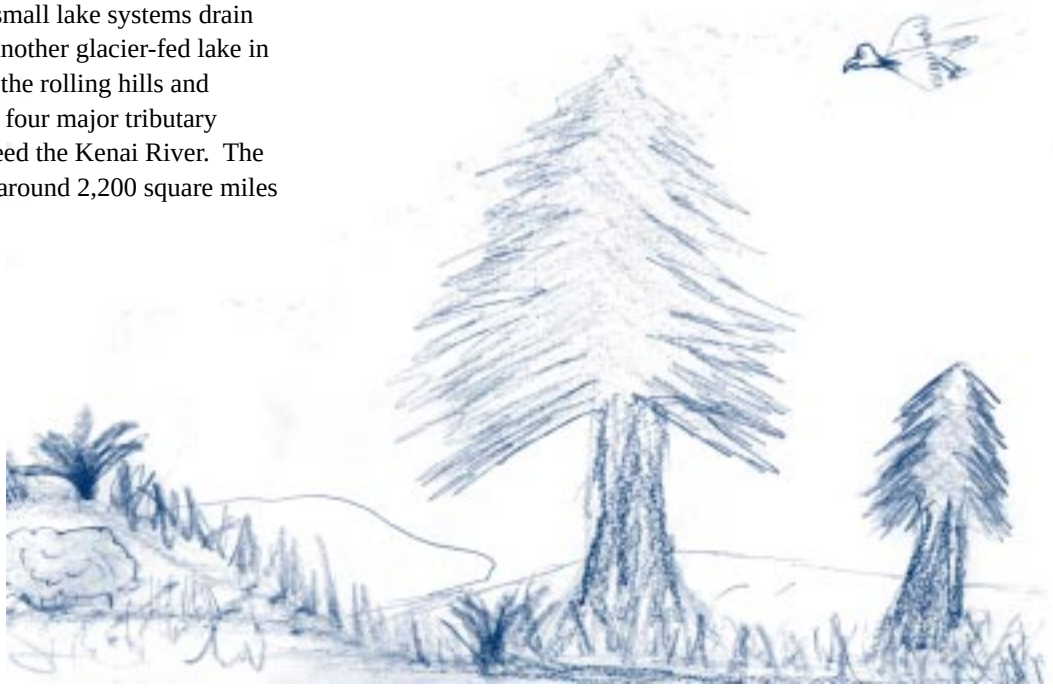
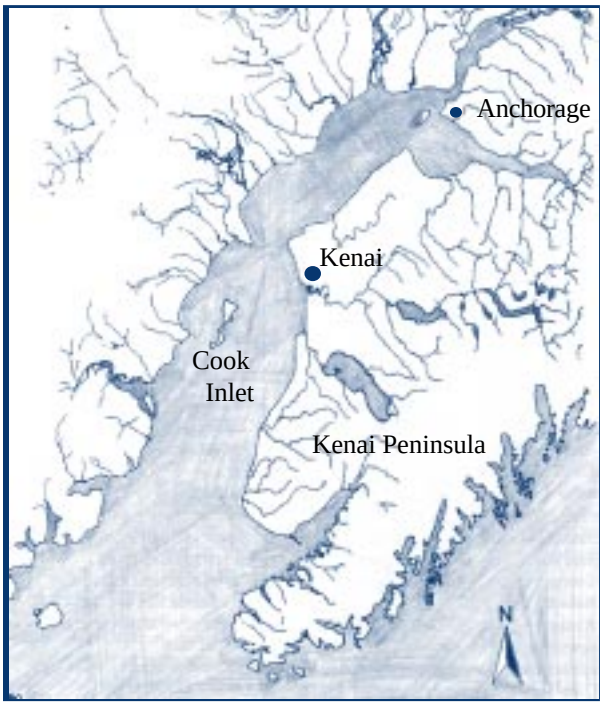


Overview

The Watershed: Deep in the Kenai Mountains, glaciers, numerous tributaries and several small lake systems drain into Kenai Lake. Skilak Lake is another glacier-fed lake in the foothills of the mountains. In the rolling hills and lowland areas below Skilak Lake, four major tributary systems and extensive wetlands feed the Kenai River. The total area within the watershed is around 2,200 square miles or 1.4 million acres.



"Living in the Kenai River Watershed" by Nathan McWilliams, age 14, Jabila'ina Dance Group, Kenaitze Indian Tribe.



Kenai Peninsula and Cook Inlet

What is a watershed? Glad you asked! A watershed, sometimes called a drainage or a basin, is an area of land where all the water drains toward a common body of water, in our case, the Kenai River system. Every lake and stream has its own watershed, and is usually part of a larger watershed. Both the Russian River and Soldotna Creek watersheds are part of the Kenai River watershed and the Kenai River watershed is part of the greater Cook Inlet watershed.

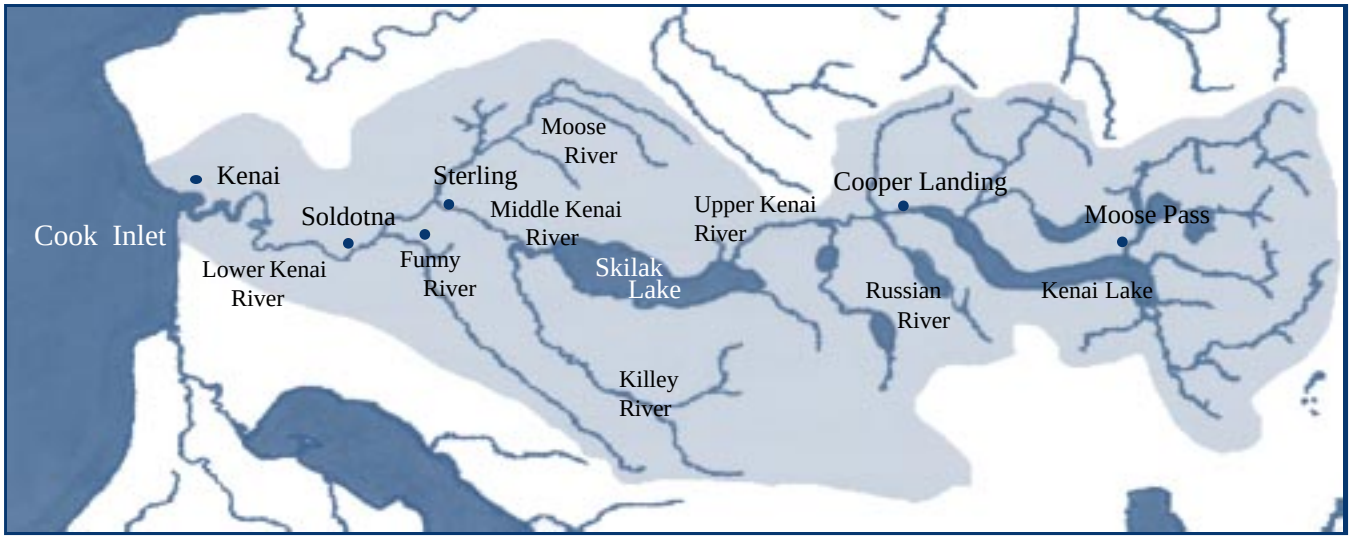
What's the point? The reason we look at a river in terms of its watershed is that everything that goes on in the watershed ultimately affects the river, because water flows downhill!

The River: The Kenai River begins in the outflow of Kenai Lake. The river flows 17 miles from Kenai Lake to Skilak Lake, and then another 50 miles from the outlet of Skilak Lake to Cook Inlet. Total length from the outlet of Kenai Lake to Cook Inlet is around 82 miles. Extreme tide variance in Cook Inlet brings saltwater as much as 12 miles up the Kenai River during high tides.

The section of river between Kenai Lake and Skilak Lake is referred to locally as the "upper" river. The section between Skilak Lake and the Sterling Highway bridge in Soldotna is often called the "middle" river, and below the bridge is the "lower" Kenai.

What is the purpose of this booklet? The Kenai River watershed is a very special place to very many people. Beautiful mountains, turquoise water, the biggest fish, wildlife common in our backyards that people come from all over the world to catch a glimpse of...

This booklet is designed to help residents and visitors navigate the watershed by providing basic information and an overview of the resource. It is also a guide to better understanding the river system so that we can continue to enjoy it without causing damage. The Kenai River is becoming special to so many people that the sheer numbers of us living, playing and working in the watershed are affecting it bit-by-bit. No one damages the river intentionally, but we all do it unintentionally when we don't understand the effects of our actions, or think the small things we do individually are too insignificant to matter.



Kenai River Watershed

The Communities: Two incorporated cities and four unincorporated communities are within the watershed. The cities are Kenai and Soldotna. The communities include Funny River, Sterling, Cooper Landing and Moose Pass. The entire watershed is within the Kenai Peninsula Borough.

The problem is that no one can predict when the sum total of tens of thousands of small, individually insignificant actions in the watershed will reach a critical mass that prevents the river from functioning normally. A local biologist has used the analogy of removing rivets from an airplane. You know that the airplane doesn't need all of its rivets to fly. However, as you remove them one-by-one you can't tell when the plane has lost its integrity until a wing falls off in mid-flight and then it is too late.

The Land

Alaska is made up of a variety of blocks (terranes) of land that accumulated here as a result of *tectonic* plate movement of the earth's crust over the last 200 million years. The block containing the Chugach Mountain Range and the Kenai Mountains migrated to Alaska around 65 million years ago. These mountains are primarily composed of metamorphic rock which was thrust upwards as a result of the block's collision with Alaska. Metamorphic rock is composed of sedimentary rock or igneous (volcanic) rock which has been changed under conditions of high temperature and pressure.

The active volcanoes on the west side of Cook Inlet and frequent earthquakes in this area are clear evidence that tectonic plates are converging here! The Pacific Plate is being forced under (*subducting* under) the Alaskan Plate along what is known as the Aleutian Trench in the Gulf of Alaska.

A south side view of Mt. Redoubt during an eruption of ash in 1990. Mt. Redoubt is one of four active volcanoes in the Cook Inlet watershed.

Photo by Bob Toll

Do the west side and east side of the Kenai Peninsula seem like totally different landscapes? They are! The Kenai Mountains are part of the Chugach Mountain Range. The rest of the Kenai Peninsula is part of a giant sedimentary basin which exists between the Kenai Mountains to the east and the Chigmit Mountains across Cook Inlet to the west. Cook Inlet and the lowlands of the western Kenai Peninsula are underlaid by thousands of feet of sediments accumulated during the *Tertiary Period* between 1 million and 65 million years ago as sediment-laden rivers flowed out from the interior. Changing climate and water levels allowed for periods of significant plant growth in the basin which today account for the oil, natural gas and coal deposits within the tertiary sediments.

Glaciers have advanced out of the Kenai Mountains across the Kenai Lowlands, and retreated again, at least 7 times in the last million years. At times, glacial ice was several thousand feet thick on the Peninsula. Because of this, glacial deposits of various depths are found on top of the Tertiary sediments.

What exactly *is* a glacier? When more snow accumulates in the winter than melts during the summer, such as at elevations above 4,000 feet in the Kenai Mountains, ice fields and glaciers result. As snow accumulates, it becomes compacted over several years into ice. The Harding Ice Field in the Kenai Mountains is an ice covered area of around 700 square miles. As the ice accumulates at the head of valleys, gravity starts pulling it down and it becomes a glacier. Glaciers move, or fall, at various (slow) rates, eroding and transporting rock and debris as they go. Today, the glaciers here are in retreat, meaning they are melting more in the summer than they are being added to in the winter with snowfall. The melting glaciers provide most of the water you see in the Kenai River.

Photo courtesy of KNWR

The Harding Ice Field. The mountain peaks poking up above the ice are called nunataks.

Glaciers are messy. They have littered the Kenai Peninsula lowlands with debris that is hundreds of feet deep and created the landscape, or *topography*, we see today. *Till* is unsorted glacial debris of all sizes from silt to boulders. It can be found in various depths all over the lowlands. *Moraines*, or mounds, of glacial till were dropped by melting ice. Moraines at the lower ends of Kenai Lake and Skilak Lake are responsible for a damming effect which created these lakes. Flowing melt water from the glaciers transported and deposited *outwash*, or clean sands and gravels. Glacial *erratics* are large boulders found randomly in till; these are often exposed as the sediments around them erode away. There are many erratics in the channel of the Kenai River between Soldotna and Morgan's Landing which boaters must avoid.

Erratics can easily be seen in Naptowne rapids in the spring when the river level is low. Naptowne was the original name given to the community of Sterling by homesteaders from Indianapolis. That name was also given to the most recent glacial advance. These rocks are part of a deposit left by that glacier.

Very fine silts and clay deposited by glacial rivers, lakes and the wind make up sediment layers which are relatively impermeable to water. Today we can see evidence of these deposits from the last period of glaciation in the form of lakes and wetlands, areas of poor drainage which are great habitat for moose and other wildlife!

The vast expanses of wetlands between Sterling and the Kenai Mountains are the result of glacial deposits.

Did You Know? Ice worms living in glaciers? Sounds like a good joke for visitors, but it is true! They are small (less than one inch long), thin, segmented black worms. They eat algae and are themselves a food source for several species of birds.

Recommended reading: *Roadside Geology of Alaska*; *Living Ice: Understanding Glaciers and Glaciation*; *A Field Manual for the Amateur Geologist*.

The Climate

Average temperatures at the City of Kenai range from 14˚ F in January to 55˚ F in July. So, why is it so warm here in the winter and cool in the summer?

What do you mean it's warm here?

The Kenai lowlands are in a transitional climate zone between the maritime climate of the eastern Kenai Peninsula and the continental climate typical of interior Alaska. The maritime climate is typified by mild temperatures all year because the weather is moderated by relatively warm ocean currents. The continental climate is typified by extreme temperature highs in summer and extreme lows in winter.

Photo courtesy of KNWR

A frosty winter morning near Sterling

That's not to say we don't experience any extremes... Temperatures measured at the Kenai airport have hit a low of -50˚ and a high of 86˚. Communities located inland, away from the moderating influence of Cook Inlet, experience somewhat different averages and extremes (it can get really cold in Sterling!).

Rain and Snow

The average annual precipitation in the lowlands of the western Kenai Peninsula is 18 inches. This includes an average winter snowfall of 65 inches (although the moisture content of snow varies, typically, 10 inches of snow is equal to one inch of rain). The Kenai Mountains capture much of the moisture from the air flowing over the Kenai Peninsula from the Gulf of Alaska, they get an average annual precipitation of over 40 inches (that is equal to over 30 feet of snow!).

Growing Season

The average growing season in the lowlands is 105 frost-free days. Plants which tolerate the cool summer weather get a boost from the long hours of sunlight.

Summer Solstice
June 21

18.5 hours Sun
(above the horizon)

5.5 hours Darkness

Winter Solstice
December 21

18.5 hours Darkness

5.5 Hours Sun
(above the horizon)

The Water

Where does all that water come from?

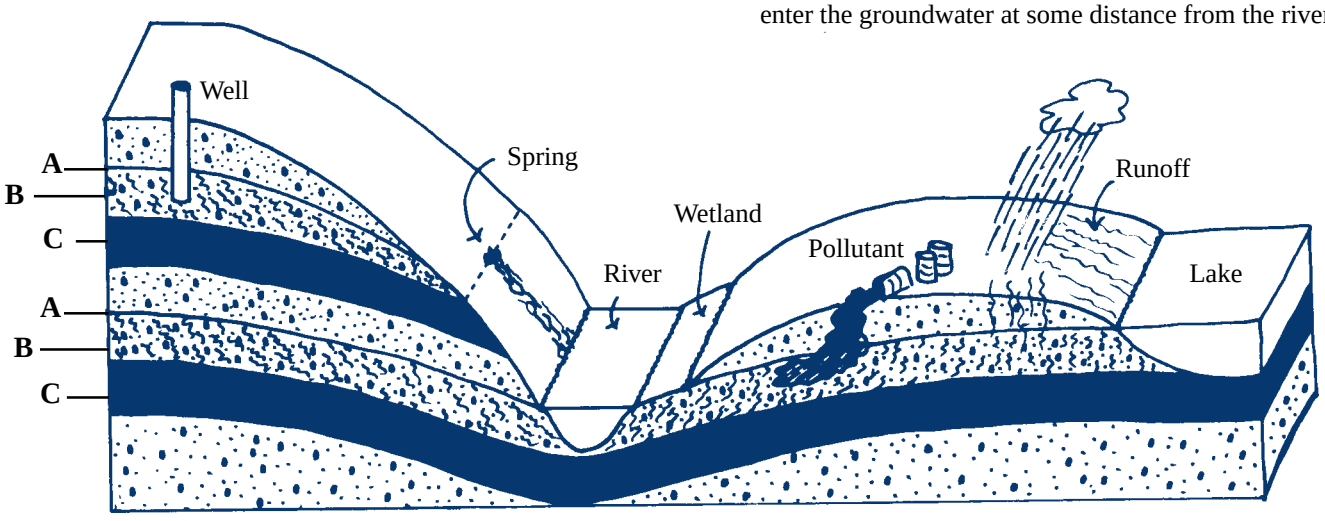
Glacial melt provides the majority of water for the Kenai River system. As a result, the volume of water in the river changes significantly during the year with the highest level occurring in August or September.

Lakes are reservoirs for river water. Kenai Lake, Skilak Lake, Grant Lake and Trail Lakes fill faster than they drain during the summer and their water levels increase. This stored water drains out during the fall and winter.

Surface water and runoff: Runoff includes the rain, melting snow and floodwater which is not absorbed into the ground but flows to the river or a tributary. This surface flow of water carries nutrients into the river system as well as woody debris. It can also erode soil which has been exposed by natural or man-made events such as land slides, logging or road building. When this eroded soil runs into streams and rivers, it can accumulate in fish spawning beds and prevent oxygen from reaching eggs and juvenile fish (see page 15). Runoff from developed or urbanized areas can also carry a variety of harmful substances from roads, parking lots, driveways, lawns and septic systems.

Groundwater provides nutrients to the river all year long and helps maintain water levels in the winter: When ground is covered with water from rain, snow or floods, a proportion of the water percolates downward through soil and rock until it reaches a layer which is impermeable to water. The amount of this *groundwater* depends on the permeability and porosity of the rock and the shape of the land. Groundwater flows, but very slowly. A spring is an outlet where groundwater is released onto the surface. The upper surface of the groundwater is called the water table. A wetland is an area where the water table is close to, or at, ground level. Below the water table, the rock is saturated with water. The height of the water table varies- in dry weather it is lower. The level of a lake or wetland is the same as the level of the adjacent water table.

Groundwater flows downhill in the same way as surface water, but more slowly. Layers which are not below the level of the Kenai River and its lakes and tributaries will usually end up in the river. This constant underground flow also makes the river vulnerable to pollutants which may enter the groundwater at some distance from the river.



A - Water table **B** - Groundwater in saturated layer **C** - Layer impermeable to water

The Water

Why does the Kenai River look turquoise? Tons of glacial sediment flow into Kenai Lake and Skilak Lake. The lakes give the sediment a chance to settle out and fall to the bottom. The very fine sediment which remains suspended in the water happens to reflect the blue-green portion of the light spectrum. Glacial sediment called *flour* can be so fine, the slightest movement of the water is enough to keep it suspended.

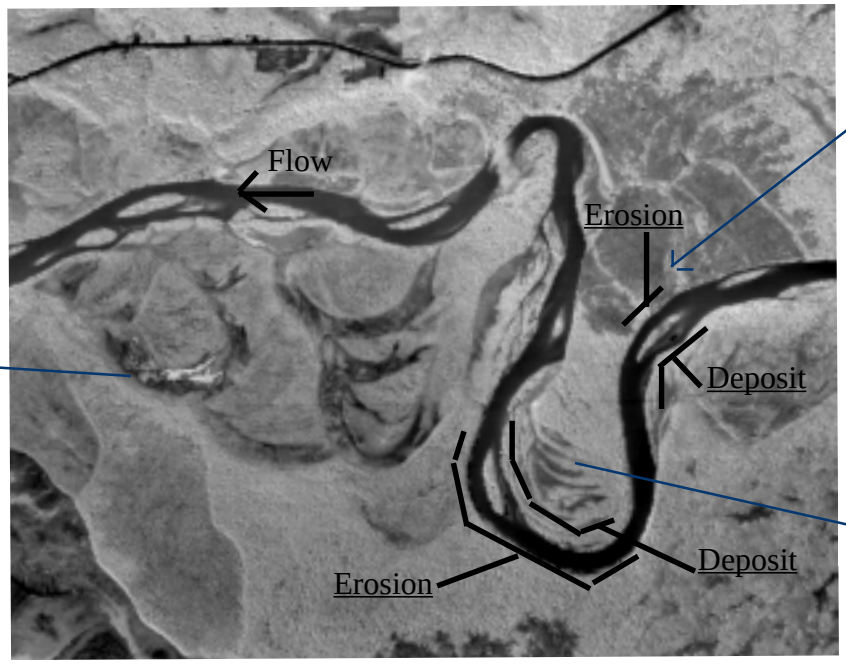
"The River within the River": Sediment is a constant stream of rock debris (from glacial flour to rocks) moved along by and generated by the water flow. A stream or river will constantly be picking up or dropping sediments depending on variables such as the shape of the water channel, the size of the sediments, and the water's speed or velocity.

Did You Know? It is possible to hear sediment in the Kenai "rasping" against the hull of your boat.

How does your river flow? **In a very complicated way!** A multitude of factors influence the "where" and "how" of river shape and flow. Rivers do three main things: they move water; they move sediments; and they shape their own channels. These three functions have a dynamic relationship which results in a constantly changing river channel. This is especially true in the middle and lower Kenai River where the river is flowing through glacial deposits which tend to be "loose" and easily eroded.

Erosion and deposition: Many factors influence how a river will erode and deposit sediment. Significant factors include the speed, or *velocity*, of the water and the type of materials the river is flowing through. The faster water flows, the more power it has to erode and to carry sediments. In general it is typical for rivers to erode the outside of bends and to deposit materials on the inside of bends and other places where the water slows down.

The Changing Face of the River



These are old *meander* bends which were cut off by the erosion occurring at the upstream side of the bend. Once the river channel of the bend is cut off from the river flow it is called an oxbow

The river will naturally continue eroding at this point until it cuts across the meander bend, creating another oxbow.

Within the bend you can see the old river bank lines which kept advancing outward as materials were deposited on the inside of the bend.

Floods are our friends. Say what? First of all, floods are normal and inevitable. The Kenai River system floods as a result of high storm runoff or rapid snow melt, the sudden release of a glacially damned lake or ice-jam flooding during breakup. We know where flood waters will go when it happens; the floodplains are mapped.

Floodplains act to disperse and slow flood waters and wetlands act like sponges, absorbing flood waters. Flood effects are considered bad when humans have filled in wetlands or built within floodplains without accounting for the inevitable. However, flood effects are good because they perform essential functions for our river and lake productivity.

A few of the benefits of floods include-

- Recharging the groundwater, replenishing wells and stabilizing long-term stream flows.
- Scouring fine sediments out of stream beds, thereby benefiting spawning, over-wintering fish and food sources.
- Replenishing water and nutrients into wetlands, increasing their productivity (see page 11).
- Replenishing sources of woody debris in streams and rivers, increasing habitat for fish and food sources; moving nutrients and food sources from the land into the water.
- Undercutting stream banks, increasing habitat for fish and food sources.

Did you know? A 100 year flood has a 1% chance of happening every year. In other words, having one this year wouldn't mean we couldn't have one next year also...

1995 flood waters at Bing's Landing State Recreation Area.

Saltwater: The area around the mouth of a river where the fresh water meets the ocean is called the estuary. Saltwater comes into the Kenai River, mixing with the fresh water, as far as 12 miles up river from the mouth. This is the result of the extreme tide variance in Cook Inlet and the relative flatness of that part of the river. The estuary gets the benefits of both freshwater and saltwater ecologies and is a very rich habitat for many creatures. The freshwater has lots of organic debris (food) and the saltwater brings in new minerals and other nutrients.

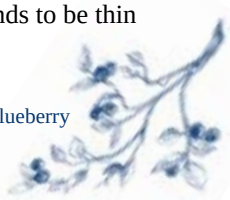
The mouth of the Kenai River where it flows into Cook Inlet, and the salt water of Cook Inlet flows into the river during rising tides. The estuary of the river begins here and extends up river as far as tidal affects are experienced.

Recommended reading: *At the Water's Edge*

The Plants and their Communities

Plant communities are groupings of plant species that are often found growing together because they are adapted to similar environmental conditions. The USDA's Natural Resources Conservation Service has distinguished and mapped 120 different plant communities along just the lower Kenai River (they can be found in the *Kenai River Landowner's Guide*). Here we'll just cover some general categories!

Alpine tundra occurs on the mountains of the watershed above 2,500 foot elevation. The soil here tends to be thin and dry and supports small herbaceous and woody plants (including several species of berries).



blueberry

Well-drained areas are known as uplands and support the typical mixed *boreal forests* of white spruce, birch, quaking aspen and cottonwood, as well as *shrub thickets* of alder and willow. The headwaters area above Kenai Lake is in a transition zone between the temperate rainforest of the Kenai Peninsula's eastern coast area and the boreal forest. As a result, hemlock trees and Lutz spruce trees (a hybrid of white spruce and Sitka spruce) are abundant. Uplands vary in location from mountainsides to floodplains. These communities, in all their diversity, provide food and shelter for most of the animals of the Kenai, from bugs to bears. (For information on the spruce bark beetle infestation see page 17.)

watermelon berry/ twisted stalk

Nootka rose

high-bush cranberry

Berries are an obviously useful plant. Many more plants in the watershed have medicinal, nutritional, cosmetic and other commercial uses.

***Wetlands:* So what *is* the big deal about wetlands?** It turns out that wetlands are not just swampy areas waiting to be drained, but fundamental components of a healthy watershed. A wetland is an area where the ground is wet enough that only certain water-tolerant plants will grow.

Depressional or *flats* wetlands are low areas which collect precipitation and runoff.

Lacustrine wetlands exist around the edges of lakes.

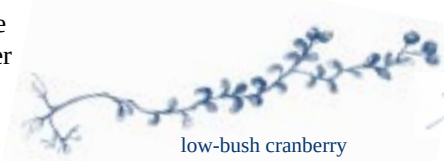
Estuarine wetlands exist around the edges of estuaries.

Slope wetlands occur where the water table intersects the surface of the land and groundwater emerges.

Riverine wetlands occur along rivers and streams in riparian areas and floodplains.

Black spruce, the trees designed by Dr. Seuss. These slow growing trees are adapted to wet soils and acidic soils where they don't have to compete with their faster growing relatives the white spruce.

Other familiar plants found in wetland communities include peat moss, cottongrass, Labrador tea, iris, horsetail and potentilla.



low-bush cranberry

mossberry/ crowberry

Some benefits provided by wetlands include:

Absorbing precipitation and runoff which replenishes (*recharges*) the supply of groundwater.

Releasing water to streams, rivers and lakes when water levels drop during the winter.

Trapping and removing sediments and pollutants including petroleum products spilled or leaked from vehicles and pesticides and fertilizers from yards and fields.

Stabilizing shorelines.

Providing food and habitat for wildlife.

Reducing flood peaks by absorbing and storing flood water.

Illustrations by Dorien Skye Coray, Age 14, Jabila'ina Dance Group, Kenaitze Indian Tribe

Freshwater and saltwater wetlands are also the nursery of life within the watershed. Sunlight works with the water, carbon dioxide and chlorophyll in the green plants, yielding water, oxygen and carbohydrates (starches and sugars) in the process of *photosynthesis*. Almost every living thing depends ultimately on the energy created through photosynthesis.

Wetlands in the estuary...busier than they look!

Wetlands which are connected to streams, rivers and lakes are vitally important to the food chain for salmon. Within them, algae and tiny plants grow, and feed insects and other invertebrates (worms, mites, snails, nematodes, rotifers, etc.). Dead plants become organic debris or *detritus* and still carry food energy which other creatures can use. Immature fish and invertebrates consume the plants, detritus and smaller organisms. All of this food produced in the wetlands flows with surface and groundwater into the rivers and lakes.

Dead plants are valuable too! Numerous birds and small mammals need dead trees to use for their homes and nests. Fallen dead trees and plants support and feed organisms in the bottom levels of the food chain and return nutrients to the soil. The dead remains of plants and trees in the water are a food source and habitat for bugs and microorganisms which in turn feed fish. Large woody debris in streams and rivers helps slow erosion and creates necessary resting and rearing areas for fish.

Did You Know? In a southeast Alaska study, the removal of logs and large woody debris from a small stream resulted in an 80% reduction in the Dolly Varden population in just one year!

Recommended reading: *Wetlands, The Web of Life*; *Field Guide to Alaskan Wildflowers*; *Tanaina Plantlore, Dena'ina K'et'una*; *Alaska Trees and Shrubs; Discovering Wild Plants; Alaska's Wild Plants; Collecting and Using Alaska's Wild Berries and Other Wild Products; Growing Alaska Natives; Kenai River Landowner's Guide*.

Wildlife: the Mammals

The watershed offers a great variety of habitats for the great diversity of mammals who make their home here for all or part of the year. Over thirty land mammals have been identified and three species of sea mammals visit the Kenai River.

Land Mammals

barren-ground caribou
beaver
black bear
brown bear
common (masked) shrew
coyote
Dall sheep
dusky shrew
ermine (short tail weasel)
hoary marmot
house mouse*
least weasel
little brown bat
lynx
marten
meadow vole
mink
moose
mountain goat
muskrat
northern bog lemming
northern flying squirrel
northern red-backed vole
Norway rat*
porcupine
pygmy shrew
red fox
red squirrel
river otter
snowshoe hare
tundra vole
wolf
wolverine

*introduced to Alaska by humans

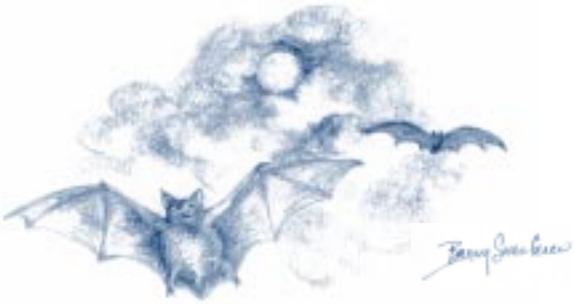
Marine Mammals

harbor seal
beluga whale
orca (killer) whale (rare)

least weasel

Did you know? Domestic dogs are one of the greatest threats to wildlife, particularly young moose and caribou. Even the mildest mannered pets will chase wild game. They don't understand that it is against the law to harass wildlife and that they may be destroyed by law enforcement personnel if they are caught..

Residents and visitors in Alaska appreciate the opportunity of seeing many of these beautiful creatures living in their natural environment. It is up to us to make sure we can continue to enjoy their presence by maintaining the habitats they need to feed, find shelter, nest, raise their young and overwinter successfully.



little brown bat

Viewing wildlife: The best way to see animals is to learn about their habitats and habits and then quietly be in the right place at the right time. A few species are common enough or predictable enough that they are relatively easy to observe.

Moose are plentiful and widely distributed throughout the watershed. They can often be seen browsing along roadsides, but more typically in the early morning or evening.

Caribou can frequently be spotted in the Kenai River Flats near the mouth of the river, and the muskeg areas along Marathon Road beyond the Kenai Airport.

Dall sheep and **mountain goats** hang out on mountain sides around Cooper Landing and can often be viewed from the roadside pull-off at mile 45.6 of the Sterling Highway (binoculars or a spotting scope are recommended!).

Beluga whales and **harbor seals** often swim up the Kenai River hunting fish in the spring, summer and fall. The best time to look for them near the mouth of the river is during an incoming tide or high tide period. Once in a great while **orca (killer) whales** are seen hunting beluga whales in the mouth of the river.

Wildlife viewing ethics

Give them space (especially mothers with young) and use binoculars or spotting scopes; prolonged or repeated disturbances may cause wildlife to avoid areas that offer the best food or nesting sites.

Avoid nests, dens and calving grounds; keep your pets restrained.

Do not feed wildlife - encouraging them to approach humans for food or depend on humans for food puts their lives in danger as well as yours.

Avoid running into wildlife with your vehicle! Road kills account for about 30% of moose killed by people. Slow down on dark mornings and evenings when moose and caribou are most active.

Report injured animals to State Troopers, Fish and Game or land managers - do not try to help or save them.

snowshoe hare in summer coat of brown

We tend to take wildlife for granted and assume that it will always be there. But human development can affect the ability of animals to meet their needs for long-term survival. For example, brown bears on the Peninsula depend on eating salmon in the fall to build up the fat reserves necessary for staying healthy through the long winters. Humans also like to harvest salmon and live near rivers. In a competition between bears and humans for fish, humans will win every time. By radio-tracking bears, scientists have learned that many bears will simply avoid humans even if they have to go without salmon. Bears which are willing to seek salmon near humans are vulnerable to being killed in defense of life and property.

Moose and humans also share the same habitat, preferring low-lying areas adjacent to rivers, lakes and streams. Woody plants are the primary food source for moose, they eat the twigs in winter and the leaves in summer. Although they are tolerant of people, they are less stressed if they have undisturbed places to rest and feed. Moose are important for their contribution to our larders, our family traditions, our economy and the plant and predator communities of our ecosystem The needs of moose and bears for food and space should be considered as we plan our own development.

Did You Know? When startled, caribou hop on their hind feet and release a scent which alerts other caribou that danger may be present.

Recommended reading: *Wildlife Notebook Series*; *Alaska Wildlife Viewing Guide; Backcountry Bear Basics.*

Wildlife: the Fish

Thirty-seven separate species of fish live in the watershed. Salmon tend to get most of the attention around here, but we also have a wonderful variety of other fish, including longnose sucker, slender eelblenny and slimy sculpin, enriching the system with their presence in the food chain and their fanciful names! Many of the fish live in the lower ten miles of the river (the estuary) and have primarily marine (saltwater) life cycles. Fifteen species can be found above Skilak Lake. (See page 34 for a list of species)

We have enough species! Four of the fish species are *exotic*, or not native to the Kenai River, but were brought here by humans. These are the arctic grayling, Alaska blackfish, northern pike and burbot. The northern pike may someday pose a serious threat to other species, including salmon, due to their effective predation on juvenile fish. There is no known way to control the spread of these fish once they are established.

Bobby Wilson

Ideal Riparian Habitat For Fish

Did You Know? Salmon aren't the only anadromous fish in the Kenai watershed. Two kinds of lampreys, hooligan (*eulachon*), longfin smelt, Bering cisco, Dolly Varden and even the little threespine stickleback migrate out to sea and back.

The Kenai River holds International Game Fish Association all-tackle world records for three of the five species of Pacific salmon. That is a clue about how well this watershed is adapted for salmon production. Salmon are *anadromous* fish which means they hatch in fresh water, migrate out to sea, and return to fresh water to reproduce or *spawn.*

The proper conditions in the areas where fish spawn and juveniles live are essential for the continued productivity of the system.

The water must be the correct temperature (around 55° F), be chemically balanced, be free of toxins and have sufficient oxygen.

Spawning gravels must be free of sediment so that water can flow through it bringing oxygen to the eggs and alevins.

Juveniles must have an adequate food supply of insects and other invertebrates.

Young fish need special river bank (*riparian*) habitat where the current is slowed by rough banks and woody debris, where overhanging plants or undercut banks provide shade and shelter from predators.

Juvenile king salmon live in the Kenai River for one year. Spring, summer and fall they spend along the banks of the river. Most of them spend the winter in Skilak Lake, so these tiny fish also need to be able to swim upstream to the lake without facing overpowering water velocity. The changes that human development brings to the watershed affect all of these essential habitat characteristics

Did You Know? The Dolly Varden, a beautiful char with pink spots, was named for a character in the Charles Dickens novel *Barnaby Rudge*. The character is Dolly Varden, who wears a pink polka-dotted dress.

The Pacific salmon, or, "Life Cycle of the Rich and Famous"

The life cycle begins when an adult female salmon lays eggs in fresh water. This can occur anytime between May and February in the Kenai River, depending on the specie and stock of the salmon.

(1) A female digs a *redd*, or nest, in the gravel bed of a freshwater stream, river or lake. After a male fertilizes the eggs deposited into the redd by the female, she will cover them with gravel. Soon after spawning the adult salmon die.

(2) Eggs hatch in 8 to 12 weeks. The newly hatched fish, *alevins*, stay in the gravel for several more weeks living off yolk sacs.

(3) Once they absorb their egg sacs the young fish are referred to as *fry*. At this stage they begin feeding on aquatic insects and detritus.

(4) King, silver and red salmon remain in fresh water for one to three years before heading out to sea. Pink and dog salmon remain for just a few days before heading downstream to the sea.

(5) Depending on the species, the fish will spend 1 to 7 years at sea growing to their adult size before returning to spawn.

(6) All the species of Pacific salmon are bright silver in color until they return to fresh water, then they start changing color and shape. The adult salmon return to the streams they came from and locate them by their sense of smell.

An average red salmon produces 3,500 eggs and only two may survive to spawn. In this way, salmon are contributing a great deal, in the form of food, to other creatures and humans. When the successful spawners die, they too become a vital part of the food chain. Many animals and birds feast on their rich remains and depend on the salmon to build up their own fat reserves to get them through the winter. The leftover carcasses decompose, adding nutrients back into the soil and water.

Salmon are an obvious example of the links between all aspects of a watershed - the right geology, the right surface and groundwater qualities and the right plants and plant communities provide a habitat for one type of creature which in turn is an essential part of many other living systems, including a human economy!

Recommended reading: *Alaska's Fish; Pacific Salmon, Alaska's Story*; *Reaching Home: Pacific Salmon, Pacific People*.

Wildlife: the Birds

Birds, besides being fun to watch, are another important piece of the overall watershed puzzle, providing insect control, recycling and seed distribution among other functions. Over 100 species can be seen here, some just seasonally as they pass through on migrations. Wonderful diversity is the rule, varying from jumbo-sized trumpeter swans to tiny rufous hummingbirds. (See page 35 for a species list.)

Viewing birds: In the summer **arctic terns** perform their fancy flying at (where else?) Tern Lake at the junction of the Seward and Sterling Highways. They share the lake with the **common loon**, **mallard**, **pintail** and **Barrow's golden-eye**.

Pairs of **swans** and loons can often be seen on other lakes, especially those that are less disturbed by human activity. **Mergansers** are more tolerant of people and are common on lakes and the Kenai River. **Double-crested cormorants** also enjoy the freshwater of the river and area lakes.

common loon

In the spring, the Kenai River flats near the mouth of the river and the Moose River flats provide a migratory stop-over for **snow geese**, **Canada geese**, **white-fronted geese** and **sandhill cranes**. Several pairs of sandhill cranes can usually be seen on the flats all summer. Big, beautiful **ravens** can be seen and heard throughout the watershed, throughout the year.

Your backyard: The type of plant communities around your home will determine the species of birds you are likely to see. Common types attracted to feeders with sunflower seeds and/or suet include black-capped and boreal chickadee, red-breasted nuthatch, common and hoary redpoll, pine siskin, pine grosbeak, hairy and downy woodpecker, gray jay and dark-eyed junco.

To attract birds to your yard provide:
Water - any shallow basin works;
Food - feeders or berry and seed plants;
Cover - shrubs and trees for perching and protection.

nuthatch

Bald eagles nest all along the river in the spring and summer and are even more abundant in the winter. One stock of coho salmon returns to the Kenai River much later than others and spawns as late as February, providing a special food source for the birds. "Warm" lake water and groundwater keeps some areas of the river from freezing over for much of the winter and allows the eagles access to the fish. As many as 600 eagles have been counted at one time on the river in winter.

Did You Know? Bald eagles can weigh up to 15 pounds and have 7 foot wing spans. They mate for life and may return to the same nest or area year after year. Their "eagle-eyes" can spot a fish a mile away! Eagles don't get their adult plumage until they are 4 or 5 years old. Juveniles have mottled brown and white plumage. Alaska has a total population of around 30,000 bald eagles, in spite of the bounty which the Territory of Alaska had on them for much of this century.

Recommended reading: *A Birder's Guide to the Kenai Peninsula; Alaska's Birds.*

Frogs, Bugs and Mushrooms

The only amphibian found in the watershed is the wood frog (*Rana sylvatica*). This smooth-skinned frog may grow up to three inches in length. They are generally light brown or gray with dark spots on top and creamy white underneath. Their habitat varies from forest to wetlands and they need shallow ponds for laying eggs and tadpole development.

Illustration by Larry Eiffert

They actually freeze while hibernating in winter in holes in the upper layer of the previous years' dead vegetation (*duff*). A special antifreeze chemical inside of their cells allows them to survive. They emerge in the spring and reproduce quickly. Taking advantage of the sun's warmth, they are active during the day, feeding primarily on insects. They, in turn, are preyed upon by birds and larger animals.

There are no reptiles found naturally in the watershed. Good news for hikers!

Bugs and fungi are more important than you think! Even though they don't get as much attention as salmon, moose, wildflowers or glaciers, we wouldn't be here without them. Insects fertilize plants and provide food for other creatures, like little brown bats which eat lots of mosquitoes. Both insects and fungi are very important to the process which decomposes organic material (*dead stuff*). A wide variety of both insects and fungi do much of the recycling of dead plants and animals into soil and nutrients.

Edible Mushrooms: Many wonderful edible mushrooms grow in the watershed, including boletus and morel (morchella esculenta). However, many extremely poisonous mushrooms thrive here as well, including amanita. Know what you are doing before you pick!

Spruce Bark Beetles: These tiny beetles are having a significant effect on the watershed at this time by killing great numbers of spruce trees. Spruce bark beetles are normally part of the decomposition crew of the Kenai Peninsula's forests, laying their eggs under the bark of spruce trees which have recently fallen over. When their population increases beyond the food supply available in fallen trees then they start laying their eggs under the bark of mature, standing trees. The eggs hatch into larvae which eat the living layer (*phloem*) and eventually kill the tree. While plant communities and wildlife distribution will change, the infestation is not expected to endanger fish or wildlife.

The reasons for the current population explosion of beetles are not entirely understood, although there is an apparent connection between warmer than average summer temperatures and beetle infestations. There is evidence of previous infestations on the Kenai Peninsula. Human concerns about the infestation include wildfire danger and the loss of the beautiful mature spruce forests. Steps are being taken to minimize fire danger to communities. Home owners should educate themselves about protecting their property. The death of the old trees will restart the natural succession of plant communities here and we will eventually have large stands of spruce trees to enjoy again.

Information about the spruce bark beetle and fire safety for landowners, and the simply curious, is available from the Alaska Division of Forestry (see page 33).

Did you know? Mushrooms are the "fruit" of fungi which live in the soil or other organic materials.

People of the Past

The Kenai River watershed has been a popular place for humans to settle for at least the last six thousand years. There may have been people here as much as ten thousand years ago, when the peninsula became habitable after the last major glaciation.

These earliest people belonged to what is known as the *Paleo-Arctic tradition* which is believed to be the first group of humans to migrate to Alaska from Siberia across the Bering Land Bridge. Paleo-Arctic people hunted mammoths, mastodons and saber-toothed tigers in the interior of Alaska with very distinctive stone tools (*microblades*). There is no sign that those fantastic creatures ever lived on the Kenai Peninsula, but Paleo-Arctic people lived along the Kenai River for some time and left their tools behind as evidence.

The next group of Kenai watershed people identified by archeologists, again by distinctive tools (*side-notched points*), belonged to the *Northern Archaic tradition*. They were here between 4,500 and 4,000 years ago.

Between one thousand and three thousand years ago the watershed was enjoyed by people who belonged to the *riverine Kachemak tradition.* Based on artifacts, scientists have determined that their main food source was salmon netted in fresh water. They left behind stone tools and artful stone and bone carvings.

The people who have lived in the watershed for the past two thousand years are Dena'ina Indians. They belong to a larger group of Indians, linked by similar language, called Athabaskan. Athabaskan Indians of Alaska are related to Navajo and Apache people of the Southwest. The Dena'ina moved into the Cook Inlet region from interior Alaska and were one of the only Athabaskan cultures to settle in a coastal area.

The Dena'ina of the Kenai River lived near the mouth in the spring and summer, harvesting salmon and other fish, sea mammals, clams, sea bird eggs, berries and other edible plants.

After freeze-up in the fall they would travel to the mouth of Skilak Lake and other areas up river to spend the winter. They hunted and trapped land mammals and caught late-running salmon in the river.

Dena'ina homes were dug several feet into the ground with wood construction above. Today, the remains of these single and multi-roomed houses can be found throughout the watershed as rectangular depressions in the ground, locally referred to as *barabaras* (bä rä' bä räs).

Captain James Cook was the first European to sail into Cook Inlet in 1778, but it was Russia that laid claim to Alaska in the late 1700's, and Russian fur traders who built the first European settlement in the Kenai watershed in 1791 at the present location of the City of Kenai. The Russians had a devastating effect on the Dena'ina people through the introduction of diseases to which they had no immunity and through oppression and exploitation which disrupted their way of life. As a people, the Dena'ina survived the Russian era and all of the following social, economic, and political changes that occurred on the central Kenai Peninsula, but at great cost.

Dena'ina names:

Kahtnu - Kenai River
Yaghanen (good land) - Kenai Peninsula
Yaghanen Dghili (good land mountains) - Kenai Mountains
Q'es Dudilen Bena (flows into outlet lake) - Skilak Lake
Tikahtnu (big water river) - Cook Inlet

America purchased Alaska from Russia in 1867. The late 1800's saw a small gold rush on the Kenai Peninsula and the beginning of the commercial salmon industry which brought the first cash economy to the area.

The community of Cooper Landing was started by miners around the turn of the century, about the same time that Seward was started by railroad entrepreneurs. Kenai, Seward and Cooper Landing were all gateway communities for big game hunters who came to the watershed for trophy moose and Dall sheep from the turn of the century until the 1940's. The community of Moose Pass started as a road-house and store for miners in 1909. It was on the railroad route and the transportation corridor between the port of Seward and the mining town of Hope. Kenai Lake and the Kenai River formed an important transportation corridor between Seward, Cooper Landing and the village of Kenai, especially in the winter.

Photo courtesy of McLane Collection

Dog team in Cooper Landing in 1920's

The waters of Cook Inlet and the river systems were the traditional "highways" for the Dena'ina and the handful of Caucasian homesteaders who lived here before World War II. The war caused the U.S. government to recognize Alaska's value in national defense. As part of a federal push to populate Alaska, roads were built on the Kenai Peninsula and veterans were given a special deal on homesteading.

The communities of Soldotna and Sterling were started by these new homesteaders who could acquire between 40 and 160 acres for minimal investment. Jobs were scarce and half the people who moved here did not stay. This would change in 1957 when the Swanson River oil fields began production. Statehood for Alaska followed and the oil industry boomed.

The new state outlawed the use of fish traps, thereby eliminating the salmon monopoly held by cannery owners from outside of Alaska. Opportunity for locals to benefit from the commercial salmon industry grew steadily, and in the late 1970's the tourism industry began.

The well-being generated by a good economy and the Federal Government's efforts to settle Alaska Native land claims prompted a cultural revival by the Dena'ina Indians (recognized as the Kenaitze Indian Tribe*, IRA) in the 1970's. Today, communal, educational fishing sites and children's programs help nurture and maintain cultural identity. Interpretive sites developed in collaboration with the Chugach National Forest are accessible during the summer months at mile markers 52 and 54 on the Sterling highway south of Cooper Landing. The Tribe also engages in public performances of storytelling, dance and drum-ming which allow others to share and learn about the Dena'ina culture.

* When the Russians came, they called the river Kenai, and the people Kenaitze, or "people of the Kenai".

Did You Know? Archeologists are still learning about the early peoples of the Kenai. If you come across artifacts, don't disturb them. They need to be analyzed in relation to where they are found in order to be useful to archeologists. Report your find to the land owner. It is illegal to disturb or collect any artifacts found on state or federal land.

Recommended reading: *A Dena'ina Legacy, K'tl'egh'i Sukdu: The Collected Writings of Peter Kalifornsky*; *A Larger History of the Kenai Peninsula*; *Once Upon The Kenai.*

People of the Present and the Future

Economy: Natural resources are still fueling the economy today. The oil and gas extraction industry, a small proportion of which occurs within the watershed, is currently the greatest single contributor to the local economy, and faces an uncertain future as local production declines. The salmon of the Kenai River contribute the next biggest portion. The local commercial salmon fishing and processing industry generates between $75 and $175 million annually. Forty percent of that is attributable to Kenai River stocks.

This is one of five seafood processing plants located in the mouth, or estuary, of the Kenai River. The first salmon cannery on the river was built on this location in 1888.

The tourism industry also depends on the salmon. The Kenai River system is the most popular salmon sport fishing area in the state. Over 350 fishing guides work on the river. People from outside of Alaska account for more than half of the total fishing trips, which has been around 350,000 per season for some years. Almost all of this sport fishing effort takes place between May and August — a short, but intense, visitor season.

The area's job base is well diversified with government, manufacturing, retail and services. However, natural resources (oil, gas & fish) are still the primary source of new dollars coming into the economy. There is also a timber industry, although the area's relatively small, slow-growing trees are not very valuable commercially.

Since the early 1980's, biologists have been increasingly concerned about the damage humans are causing to fish habitat in the river system. It would be a bleak future here without salmon.

Quality of life: The watershed provides its human residents with natural beauty, endless opportunities for recreation and bountiful natural resources available for personal use. There is a growing movement in the U.S. of people moving to rural communities which are "gateways" to nearby wilderness. But as we grow, will we be able to maintain the quality of life we experience now? Some people think we are already losing ground as a result of crowding on certain parts of the river and an increasing population of short term residents who aren't committed to the long term health of the community.

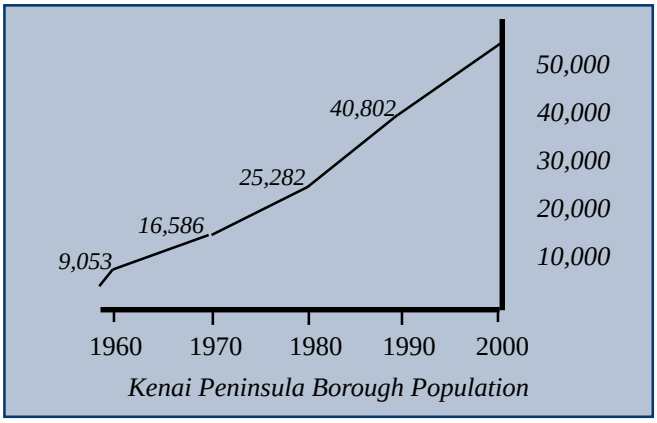
The Future/Stewardship: Wild salmon are a sustainable resource, although you would not think so from the fact that at least 106 stocks are extinct and 214 are at risk in California, Oregon, Idaho and Washington. Many people think Alaska is immune from the problems affecting watersheds and salmon stocks in other states, because of our vast open spaces and remoteness. However, when we compare the problems in the western U.S. and Canada with our own watershed the similarities are apparent.

Dams - A dam on the Kenai? Yes, it happens here. When the Cooper Lake Hydroelectric project was licensed in 1957, Cooper Creek was a large, clear water tributary of the Kenai River. The dam was built with no consideration for fish and it eliminated Chinook salmon and rainbow trout fisheries.

Logging - Poor logging practices are linked to increased sedimentation and the loss of fish spawning beds. Possible cumulative effects of logging in the watershed have not been examined.

Livestock - On the Kenai? The negative effects of improper livestock grazing include broken-down stream banks, damaged vegetation, increased erosion, soil compaction and pollution. Those are the exact effects we experience in the watershed from the thousands of bank anglers and wakes from improperly operated power boats.

Development - Around two-thirds of the river-front land in the lower 50 miles of the Kenai is privately owned and rapidly being developed. A recent inventory found 136 fixed docks or landings, 82 boat ramps, 36 canals or basins, 49 solid jetties, 5 bridges, 58 pile supported structures and 73 bank revetments (retaining walls) constructed of tires, logs, timbers, concrete rubble, cabled trees, cinder block, chain link fence or sheet pile. It has been estimated that at least 11% of the river bank has been impacted. That is the riparian habitat which is so critical for juvenile Chinook salmon (see page14). Development pressure also threatens wetlands which are essential for the productivity of the river system (see page11). In 1964, 101 river-front lots had been developed, by 1996 that number had jumped to 944; over 4,000 river-front lots are currently platted.



Kenai Peninsula Borough Population

Pollution - Increasing urbanization and rural development just naturally leads to potential water quality problems. More roads get built, increasing sedimentation and salt in runoff. Roads and parking lots get paved, increasing contaminated storm drain runoff water. Sewage treatment plants have to handle more and more. Additional septic systems get built; existing septic systems age and fail.

This is another area where individual actions accumulate. People's decisions about pumping their septic tanks, disposing of hazardous substances, treating lawns with herbicides and fertilizers and even washing cars where the run off ends up in a storm sewer, ultimately make a difference in our water quality.

A great deal is at stake. Negative impacts to salmon can be avoided or mitigated through vigilance and paying the price of protection, such as effective filtration systems on storm drains and keeping roads and fill out of wetlands. It would be great if everyone understood all the impacts of their actions and voluntarily did the right thing, but, human nature being what it is, some regulation is necessary. 35,000 acres of private land in the watershed have not yet been developed. Broad based land use planning could guide that future development so as to maintain the health of the watershed.


Photo courtesy of KNWR

Many people in the watershed feel a spiritual connection to the Kenai

Quality-of-life impacts are subtle and more difficult. It takes a community process to evaluate those factors which contribute to "high quality" and plan a future which maintains them.

Ongoing Stewardship Efforts: Both public and private efforts are focused on improving existing conditions and preventing further damage through regulation and incentives for voluntary changes. The Kenai River Habitat Protection Association recognizes and rewards landowners who protect and/or enhance salmon habitat. Lands providing valuable fish, wildlife and human habitat have been aquired through various funding sources so they can continue to benefit the entire community. Government agencies are working hard to gain a better understanding of the system, perform habitat restoration, provide responsible recreational access and to find funding sources for demonstration projects and for cost-sharing with private restoration projects. Many other organizations contribute to stewardship through public outreach programs and river clean-up and restoration projects.

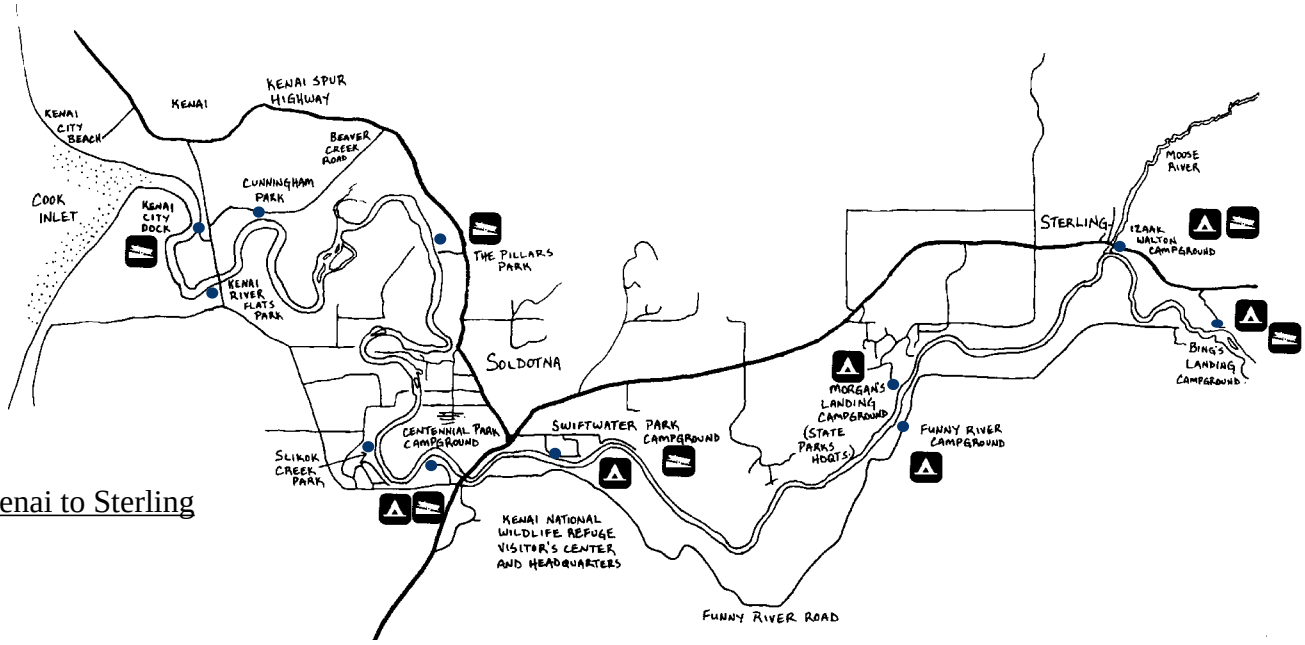
More and more people are recognizing the threats to the system and the stakes involved. This is one bandwagon we need everyone to jump aboard!

Recommended reading: *Entering the Watershed*

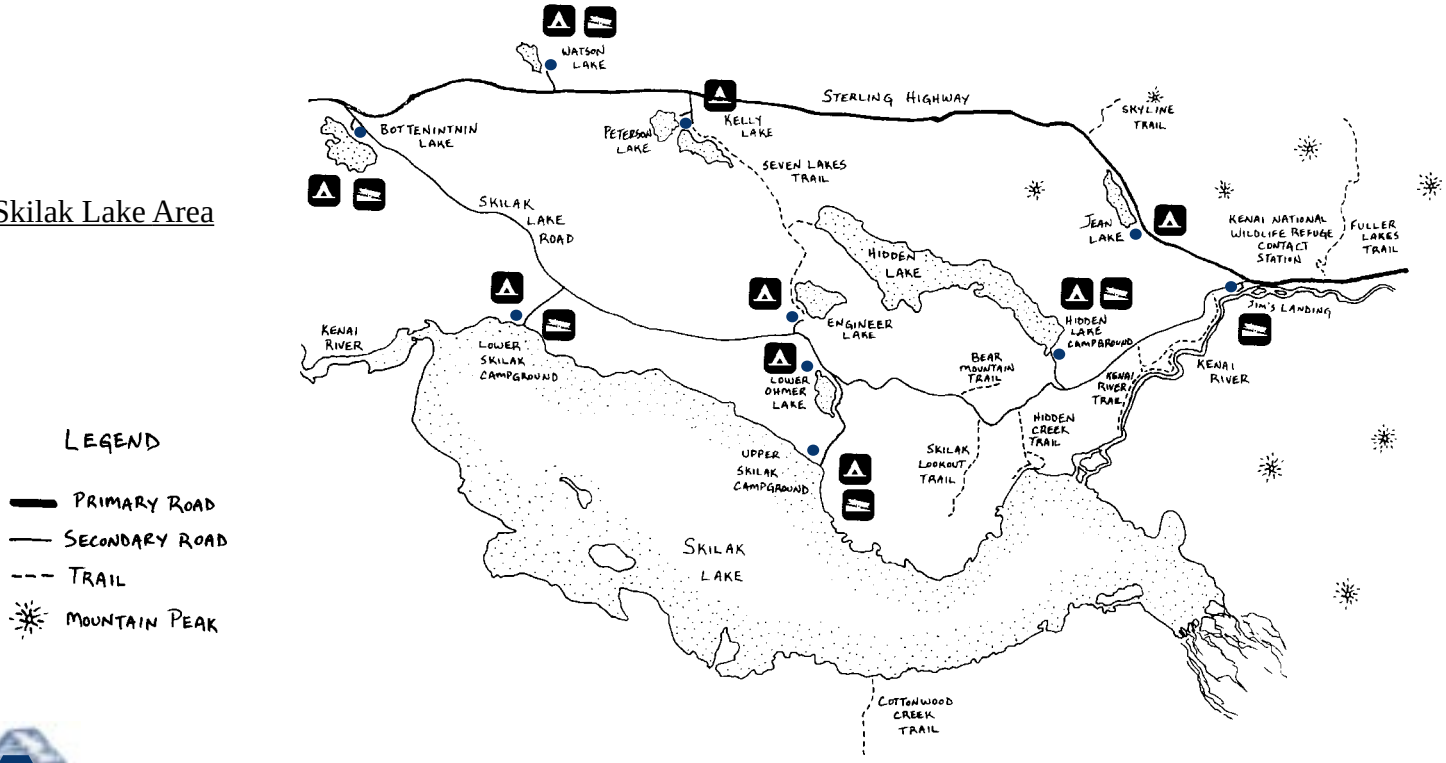
Playing in the Watershed

Public Facilities

Public access to recreational sites within the watershed is assisted by a great many facilities provided by the various public land managers. The following maps indicate the location of campgrounds, boat ramps and trails. Fees and regulations vary depending on agency and location, contact the indicated land manager for more information (see page 33).



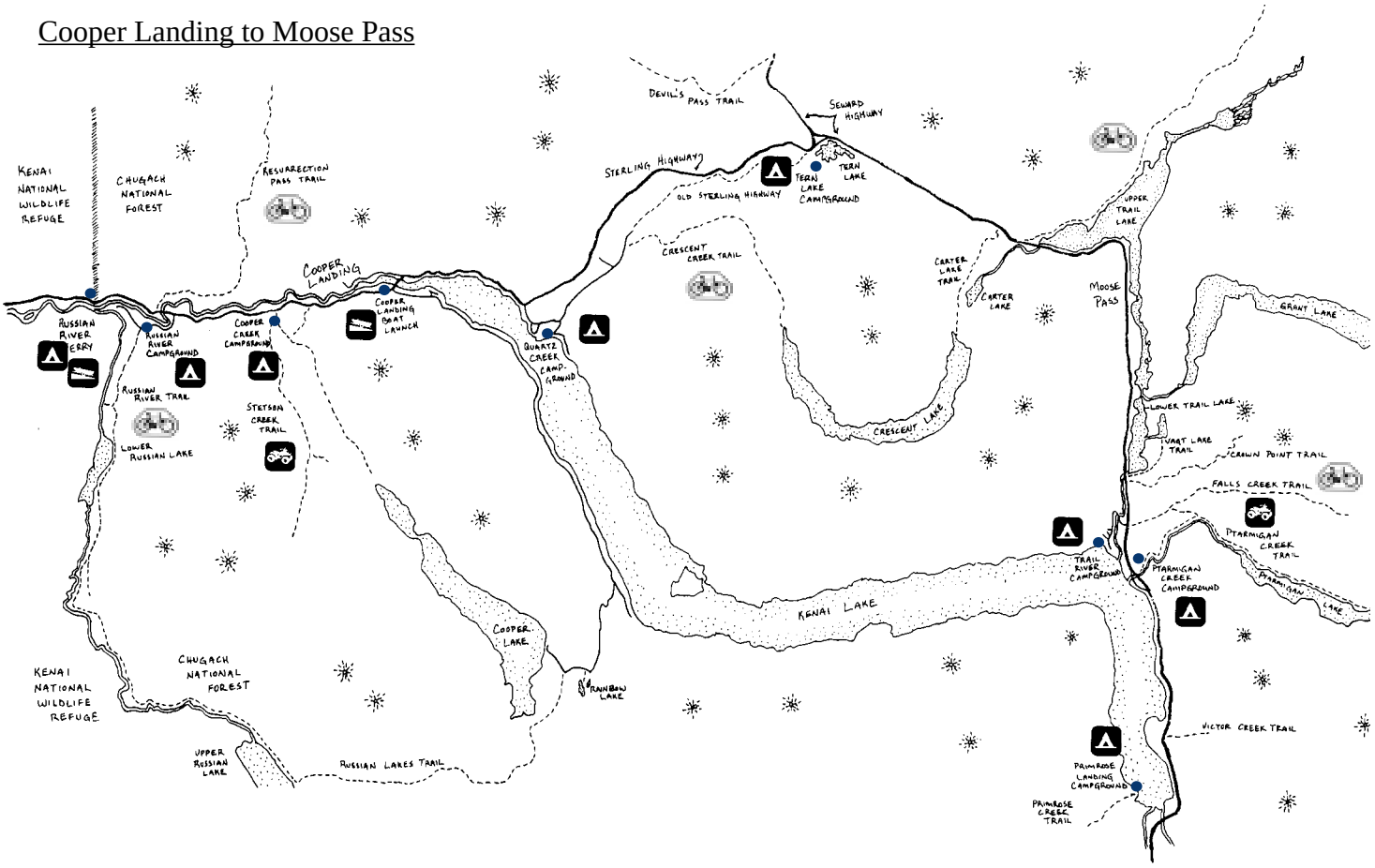
Kenai to Sterling



Skilak Lake Area

The water column (up to the ordinary high water level) of the river from approximately mile 4 upstream to, and including, Skilak Lake and Kenai Lake is designated as the Kenai River Special Management Area. This is managed as a unit of the Alaska State Park system and subject to regulations developed by the Alaska Department of Natural Resources. In the early 1980's, scientists started noticing declines in the availability and quality of essential fish habitat in the river. As a result, in 1984 the State of Alaska created the Kenai River Special Management Area with the recognition that "The river's fishery and wildlife are its most important resources. The highest priority uses of the river and its adjacent land derive from its fishery and wildlife resources which must be protected and preserved to ensure their renewability and continued usefulness." Some positive changes have occurred, but the Kenai River Special Management Area only covers the river. As we've learned, the whole watershed is important.

Cooper Landing to Moose Pass



The Kenai National Wildlife Refuge was originally established in 1941 as the Kenai National Moose Range to protect moose populations. Since then the purpose of the Refuge has been expanded to conserve all fish and wildlife populations and habitats in their natural diversity. The area is also managed for its wilderness, scientific, water quality, educational and recreational values.

Most of the headwaters of the watershed are in the **Chugach National Forest.** The forest is managed under a multiple-use concept which includes recreation, mining, logging, trapping and hunting.

Fishing

Fishing Regulations: This section is intended to give general advice about fishing in the watershed. The Alaska Department of Fish and Game manages fisheries very carefully to preserve stocks. As a result, fishing regulations tend to be complex, may change at any time, and are impossible to reproduce here. It is up to the angler to have a copy of the latest regulations and be aware of any changes. During the fishing season, Fish and Game monitors fish stocks and may make necessary changes in regulations by "Emergency Order". These are posted, broadcast on local radio stations and are available from the Department of Fish and Game.

Kenai River: Around thirteen percent of all the sport fishing in Alaska is done on the Kenai River! It is important to understand both the regulations and the local guidelines about fishing courtesy, safety and respect for the delicate river system which produces all those fish. (See page 14 for information on fish habitat.)

In general, king salmon fishing is done from boats, silver salmon fishing is done from boats and along the banks, and red salmon, pink salmon, rainbow trout and Dolly Varden fishing is done along the banks. If you are new to fishing and/or the Kenai River, it is a very good idea to hire a guide for your initial fishing trip, especially if you are boating. The Kenai River is fast, cold, dangerous and no place for an inexperienced boat operator.

Boating Guidelines -

The signal for a "fish on" is a raised landing net, give those boats lots of space, pull your lines in if you are nearby.

Always launch and retrieve boats at a developed launch site.

When beaching your boat, select a site which avoids crushing bank vegetation.

Reduce your boat wake whenever possible and travel in mid-channel.

Fuel your boat at a site where gas will not get into the river should an accident happen.

The Kenai River system has restrictions on the use of motors and maximum allowed horsepower. Fish and Game's Sport Fishing Regulations have information on these restrictions.

Summary of Kenai River's Major Recreational Fisheries

Species	Period of Availability	Fishing Style
King Salmon	First run - mid-May to early July Second run - early July to season closure on July 31	From boats
Red Salmon	First run - late May to mid-June Second run - Mid-July to early August	Along banks
Silver Salmon	First run - late July to late August Second run - early September to September 30	From boats and along banks
Pink Salmon	Late July through mid-August (even numbered years only)	Along banks and from boats
Rainbow Trout*	June 15 through October 31	Along banks
Dolly Varden*	Upstream of Upper Killey River - June 15 through April 14 Downstream of Upper Killey River - entire year	Along banks

*Certain sections of the Kenai River system are managed as catch-and-release areas for these species. If you are looking for a tasty trout for the frying pan, head for one of the many stocked lakes in the neighborhood (see page 26).

Bank Fishing Guidelines

Reduce your impact on precious fish habitat...

Use developed trails, ladders and boardwalks to access the water.

Avoid trampling and damaging vegetation along the water's edge.

Move well away from the water's edge when walking up and down stream.

Stand in the water or on graveled areas when fishing, not on the bank.

Avoid all steep banks and water-saturated soils.

Leave all vegetation and woody debris in place on the bank and in the water.

If no restrooms are available, relieve yourself at least 200 feet from fresh water sources and bury human waste at least 6 inches deep (add a plastic trowel to your fishing gear and pack out toilet paper).

Respect private property and areas closed to bank angling. (Fish and Game has the responsibility and authority to close publicly owned areas to fishing when the banks get trampled and damaged by anglers.)

Orange colored fences like this one mark areas where important habitat is being restored or protected. Please respect them!

This photo, taken in early spring, demonstrates erosion which occurs when a path beats down the vegetation along the river bank. High water erodes the path behind the bank edge. You can see how this accelerates the erosion along the entire bank.

Be courteous to anglers and fish....

Respect other anglers' space, even when they are busy landing a fish.

When someone is trying to land a fish nearby, pull your line in out of the way.

Avoid breaking lines and pick up your litter (monofilament is dangerous to birds and small fish).

Learn how to properly release fish which you don't intend to keep.

Avoid snagging fish, it is injurious to the fish (and illegal).

Photo courtesy of KNWR

Help spread the word by explaining these guidelines to newcomers in a friendly way.

Fish and Game offers additional "how-to" information in the pamphlets *Kenai River Recreational Fishery* and *Russian River Sockeye Salmon*. These pamphlets are available at no charge at Department offices.

Lake Fishing: Lake fishing is one of the best kept secrets in the watershed. If you are looking for serenity and/or some fresh fish to eat you have many options for lake fishing all year long.

Stocked lakes in the watershed: Fish and Game stocks rainbow trout and/or coho salmon in twelve lakes within the watershed, and many more lakes around the Peninsula. Stocked lakes within the watershed include:

Arc Lake	Carter Lake
Spirit Lake	Jerome Lake
Loon Lake	Long Lake
Longmere Lake	Meridian Lake
Rainbow Lake	Scout Lake
Sport Lake	Vagt Lake

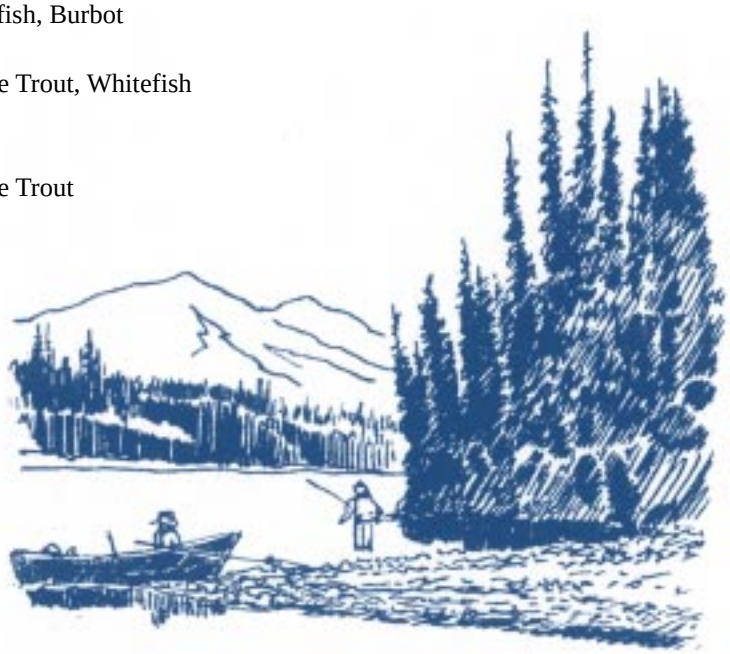
Photo courtesy of KNWR

Fishing is a year-round activity in the watershed. There is less competition from other people and bears in the winter. Fish and Game's pamphlet Fishes of Cook Inlet Lowland Lakes *includes ice fishing tips.*

Other lake fishing opportunities:

Cooper Lake	Rainbow Trout, Dolly Varden
Crescent Lake	Grayling, Dolly Varden
Hidden Lake	Rainbow Trout, Dolly Varden, Lake Trout, Kokanee
Jean Lake	Rainbow Trout, Dolly Varden
Juneau Lake	Rainbow Trout, Lake Trout, Whitefish, Burbot
Kelly & Peterson	Rainbow Trout
Kenai Lake	Rainbow Trout, Dolly Varden, Lake Trout, Whitefish
Ohmer Lakes	Rainbow Trout, Dolly Varden
Russian Lakes	Rainbow Trout, Dolly Varden
Skilak Lake	Rainbow Trout, Dolly Varden, Lake Trout
Watson Lake	Rainbow Trout

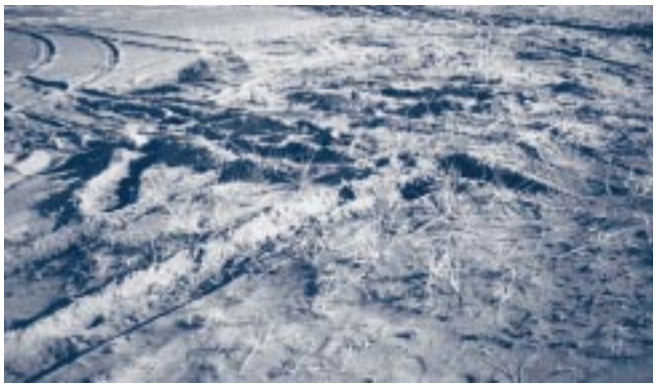
Be sure to follow the same habitat-protecting guidelines on the lakes as for the Kenai River. Fish and Game has two pamphlets handy for lake fishing: *Fishes of (and fishing tips for) Cook Inlet Lowland Lakes*; and *Kenai Peninsula Stocked Lakes* (includes access information). The U.S. Forest service also has a pamphlet, *Hooked on Fishing*, which is a guide to area lakes.



Larry Eiffert

Personal Use Fishing: Residents of the State of Alaska are eligible to participate in various types of fisheries known as "personal use." Personal use fisheries are opportunities for people to harvest fish for their own use with nets or dipnets. As in sport fishing, any harvested fish may not be sold or bartered. In our watershed there are personal use fisheries for salmon and hooligan (eulachon). The hooligan fishery occurs in spring (May-June). The personal use salmon fishery occurs in the mouth of the Kenai River during the height of the red salmon run in July. (These fisheries also occur in other places on the Peninsula.) A special permit is necessary from Fish and Game in order to participate in these fisheries.

The personal use salmon fishery is an activity which generates dense crowds in sensitive areas. The shorelines where the fishing is done are not impacted but the sandy, grassy dunes beyond the beaches are vulnerable to disturbance by trucks, all-terrain vehicles and foot traffic. These dunes protect uplands behind them from erosion by Cook Inlet's waves. It is very important to use established trails and keep vehicles and all-terrain vehicles on the hardened area of beaches only.



Grasses on this dune will die as a result of the disturbance to their roots. Wind erosion will start moving the sand away, and so prevent plants from re-establishing on the dune. Eventually the site level will lower until high tides can reach it.

Other Outdoor Recreational Opportunities

There is enormous opportunity for all kinds of recreation within the watershed since so much of it is in public land. The Chugach National Forest, the Kenai National Wildlife Refuge and the Alaska State Parks accommodate hiking, camping, boating, hunting, trapping, berry picking, biking, skiing, snowshoeing, dogsledding and snowmachining. With the large population of Anchorage so close and a growing population on the Peninsula, trails, recreation sites and the backcountry are being enjoyed more and more. We need to be increasingly sensitive about the impact we have on the land and take an active part in protecting the quality of our natural areas.

Hiking: For those using trails in their outdoor pursuits, many options are available (see public facilities map). Basic information on trails is available from the Refuge and National Forest (see page 32). The Alaska Natural History Association has published *Kenai Pathways*, a guide to all the trails on the Kenai Peninsula, with a corresponding map. These are available for sale at Refuge and National Forest visitors' centers. Whether you are on trails or in the backcountry the following guidelines will help you minimize the impact you have so that others will be able to enjoy their outings as much as you.

If there is a trail available, use it and stay on it. Cross muddy stretches and snowbanks directly so that you don't widen the trail. Short-cutting on switch backs causes erosion and gullying.

During rest breaks, try to find a spot well off the trail that is durable — like a rock or bare soil. This protects the feeling of solitude for you and other hikers and protects fragile vegetation.

Pack out your trash, even cigarette butts and toilet paper.

Camping

Take your pick! Improved campgrounds are available throughout the watershed (see public facilities map). Chugach National Forest has public recreation cabins available by reservation for those who like to travel light .

Backcountry camping can have you waking up in a spruce forest or in alpine tundra... Check with land managers for information on fees and length-of-stay restrictions. Camping on state lands in the Kenai River Special Management Area is restricted to developed campgrounds in order to protect important fish and wildlife habitat.

Happy Camping Guidelines:

In high-use areas, choose an established campsite. Using a hardened site which has already lost its vegetative cover will avoid damage to pristine areas.

If no established campsite is available, choose a naturally durable site (with rock, sand, gravel or snow) that is at least 200 feet from fresh water sources and out of sight and earshot of trails.

Choose a site with a slight slope so rain water can drain away without the use of soil disturbing trenching. Leave organic "litter" (leaves, spruce needles, etc.) in place on the ground.

Dispose of human waste responsibly. Carry a lightweight trowel for digging "catholes" around 6 inches deep and 6 inches wide for feces, disguise the hole when you are finished. Locate catholes at least 200 feet (70 adult steps) from water, trails and camp.

Minimize use and the impact of fire. Carry a camp stove. Be aware of fire restrictions. Use only small pieces of wood picked up off the ground so they will burn completely and leave the area looking natural. Use existing fire rings or a technique which will leave no sign of fire behind, such as a portable fire pan.

Pack out everything, even leftover food. Buried or partially burned food will attract bears, putting future campers and the bears in danger.

Leave your camp clean or cleaner than when you arrived. Dirty sites encourage future campers to choose new, undisturbed sites that may soon become trampled and left without vegetation

Biking

Off-road biking is allowed on certain designated trails in the Chugach National Forest. In the Kenai National Wildlife Refuge, bicycles are restricted to roads designated for vehicles.

All-Terrain Vehicles

Chugach National Forest has some trails designated for all-terrain vehicle use. Snowmachines may be used in both the national forest and the refuge with some restrictions on timing (related to snow cover) and areas. Some area restrictions are based on habitat protection, for example, the refuge does not allow snowmachining above tree line due to the vulnerability of arctic tundra and impacts to wintering wildlife. Other restrictions are based on sharing areas between snowmachiners and skiers. Contact the land managers for details.

Snowmachiners should avoid moose and other wildlife very carefully. Stressing animals in the winter can significantly affect their ability to survive.

Boating

Power boating: There are some restrictions regarding power boats, jet skis, hydroplanes and airboats on different water bodies in the watershed. For information check with land managers.

Other boating: There are obviously numerous possibilities for canoeing and kayaking in the watershed, not to mention extensive canoe trails in the nearby Swanson River watershed. The Kenai River is suitable for kayakers, rafters and very experienced canoe paddlers.

Navigation: Twelve miles downstream from Kenai Lake, just below Jim's Landing, the river enters Kenai Canyon for two miles of class II-III rapids. Naptowne Rapids (river mile 39, just below Bing's Landing) is a mile-long rocky stretch popular with white water kayakers.

General guidelines:

Always launch and retrieve boats at a developed launch site;

When beaching your boat, select a site which avoids crushing bank vegetation;

In lakes travel well off shore to avoid disturbing waterfowl;

Avoid disturbing wildlife, give them space. Prolonged or repeated disturbances may cause wildlife to avoid areas that might offer the best food or nesting sites.

In the river, reduce your boat wake whenever possible and travel in mid-channel;

Reduce your wake around canoes and kayaks;

Fuel your boat at a site where gas will not get into the water should an accident happen.

Photo courtesy of KNWR

Well equipped boaters on a calm day at Skilak Lake.

Did You Know? A 2 cycle outboard motor only burns around 75% of the gas and oil it uses. At least 25% passes through the engine and ends up in the water and air. When you count all the boats and fuel being used on the Kenai it starts adding up. Four cycle outboard motors are much less polluting.

General Safety

Bears: Most bear encounters are avoided by the bears' normal reluctance to encounter humans! General rules include making noise (so they can beat feet when they hear you coming), going the other way when you see one (don't try for that close-up photo) and storing food and trash in bear proof containers at least 200 feet away from camp, or in your vehicle at improved campgrounds. Take the time to learn more about bear avoidance before you hit the backcountry.

Drinking water: Surface water may have giardia, a parasite which causes dastardly intestinal problems (also known as "beaver fever"). Water needs to be filtered, treated or boiled before being used for drinking water.

Cold water, Cold weather: Be prepared! Don't even think about going on the river or lakes without a personal flotation device. Always take basic survival gear including extra clothing, the weather can change extremely quickly and unexpectedly.

Did You Know? Ice fields and glaciers can generate their own weather, including *katabatic* winds. The ice up in the mountains keeps the air temperature cool. As the air in the valleys warms during a sunny day, that warm air will rise and the colder, heavier air will flow down hill to replace it, creating a katabatic wind in the valley.

Recommended reading: *Leave No Trace, Outdoor Skills and Ethics: Alaskan Tundra*; *Soft Paths; Polluting for Pleasure; Backcountry Bear Basics; 55 Ways to the Wilderness in Southcentral Alaska.*

Property Development Considerations

Stewardship

Land owners in the watershed have a great responsibility for, and also a great stake in, a healthy future for the Kenai River system. Owners of the 4,000 platted river-front lots have tremendous potential for protecting or harming Kenai River fisheries. But every piece of property in the watershed is important. Water, and everything soluble in water, flows downhill to the river! Everyone, from the subdivision developer to the weekend cabin occupant, has an impact and an opportunity to help protect the future economy and quality of life here.

Make informed decisions. The Kenai River Landowner's Guide (available from the U.S.D.A. Natural Resources Conservation Service, see page 33) is a very comprehensive resource. It is targeted toward river-front property owners but most of the concepts are applicable to developing anywhere in the watershed. Other references and resources are available at the Kenai River Center.

"Living in the Kenai River Watershed" by Miles Geiser. Age 11, Jabila'ina Dance Group, Kenaitze Indian Tribe.

This bank is too steep and the material is too loose to be stabilized by vegetation or anything else. Erosion here is inevitable.

Most of the concepts are common sense. If you build in a floodplain, you will experience flooding. The outside bank of a meander curve in a river or stream will continue to erode and is usually not a wise place to build. If you remove all the vegetative cover from sloping ground, the soil will erode. Whatever you place on or in the ground (e.g. lawn fertilizer, motor oil) can end up in the groundwater and in the river. Every individual action we perform is accumulating with tens of thousands of other actions.

Remember to contemplate your development plans in the context of the other 4,000 river front lots on the Kenai River and the 35,000 acres in the watershed which haven't yet been developed.

Conservation Tools

Simply learning about the impact human activities have on the watershed, and modifying those activities to minimize impact, will make a difference. Understanding the environment also allows land owners to work with the system to reach a desired goal. For example, some erosion control strategies can improve fish habitat. The Kenai River Center is the source for more information along these lines.

Staff at the Kenai River Center can also direct landowners to sources of cost sharing for conservation-related projects like this bank restoration. Cut spruce trees are secured to the bank to slow water velocity and reduce erosion. This allows natural vegetation to return and provides fish habitat.

Another type of tool is a *conservation easement*. Like a protective covenant, a conservation easement allows a property owner to place restrictions on the future use of land to protect its values. The restrictions are permanent and can reduce property taxes. Local landowners have used conservation easements to control the type of development possible on river front property and in other sensitive areas like wetlands. For more information on this type of tool, contact the Kenai River Region of the Kachemak Heritage Land Trust (see page 33).

The owner of this river front property placed a conservation easement on it which restricts future use to single-family residence and recreation.

Regulatory Requirements

In an ideal world, everyone would be informed and do the right thing on their own. In our real world, regulations have been developed to try to prevent and mitigate damage to the natural resources upon which our economy and quality of life depend. The effects of actions on the environment tend to be site specific; therefore, a permitting process was designed to allow for flexible application of the regulations.

The bad news is there are multiple city, state and federal agencies which have jurisdiction over the Kenai River, adjacent lands and river-related resources (e.g. wetlands). The good news is that there is one place you can go to get help with the entire process. The Kenai River Center has representatives from multiple agencies. The staff there will work with landowners to help them figure out how to meet their needs within the protective regulatory parameters. The Kenai River Landowner's Guide is also an invaluable resource.

Here is a very general list of the types of activities which require permits:

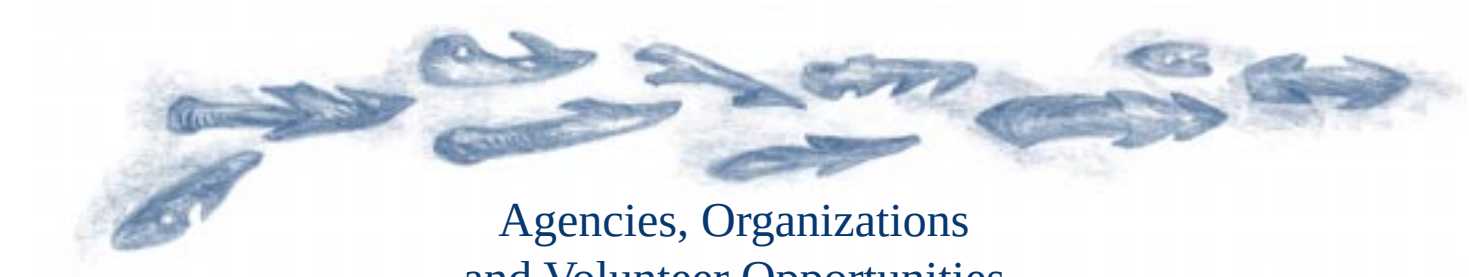
Any actions taking place within the Kenai River system and/or affecting fish habitat.

Any actions which may degrade the quality of surface or groundwater.

Any filling, dredging or clearing vegetation in wetlands, lakes or streams.

Developing land within the river's floodplain.

Within the City of Soldotna's "Kenai River Overlay District": development of land; extraction of natural resources; storage of hazardous materials; filling or excavating land.



Agencies, Organizations and Volunteer Opportunities

This list is intended as a general overview of groups and volunteer opportunities. (Omissions are unintended and details are subject to change!)

Organizations

Alaska Fly Fishers
P.O. Box 90011 ph 274-1288
Anchorage, AK 99509
Volunteer: Annual upper Kenai River clean-up, Board of Directors.

Kachemak Heritage Land Trust, Kenai River Region
P.O. Box 356 ph 260-1999
Soldotna, AK 99669 fax 260-5412
Membership organization.
Volunteer: numerous indoor and outdoor opportunities including Board of Directors.

Kenai Peninsula Resource Conservation and Development District
P.O. Box 800 ph 283-7493
Kenai, AK 99611 fax 283-8158
Assists communities with conservation and development.
Volunteer: Board of Directors

Kenai River King Salmon Fund
34824 Kalifornsky Beach Rd. ph 262-2492
Suite E fax 262-2898
Soldotna, AK 99669
Volunteer: Board of Directors

Kenai River Property Owners Association
P.O. Box 3070 ph 262-2305
Soldotna, AK 99669 fax 262-2115
Membership organization.
Volunteer: Board of Directors

Kenai River Sport Fishing Association
P.O. Box 1228 ph 262-8588
Soldotna, AK 99669 fax 262-8582
Membership organization, Kenai River Habitat Protection Program.
Volunteer: Board of Directors and Advisory Board.

Kenai Soil and Water Conservation District
P.O. Box 800 ph 283-8732
Kenai, AK 99611 fax 283-8158
Assists landowners and others in conservation and development. Arranged to have the *Kenai River Landowner's Guide* prepared.
Volunteer: Board of Directors

Kenai Watershed Forum
P.O. Box 2937 ph 260-5449
Soldotna, AK 99669 fax 260-5412
www.kenaiwatershed.org
Membership organization. Citizen's group focusing on health of Kenai River watershed.
Volunteer: water quality monitoring programs, Kenai River Festival, other activities, Board of Directors.

The Nature Conservancy of Alaska
Kenai River Project Office ph 262-6377
P.O. Box 1868 fax 262-6377
Soldotna, AK 99669
Membership organization
Volunteer: Board of Directors

Trout Unlimited
P.O. Box 3055 ph 262-9494
Soldotna, AK 99669 fax 262-5920
Membership organization
Volunteer: Board of Directors, special projects.

Local Government

City of Kenai
210 Fidalgo Ave., Suite 200 ph 283-7535
Kenai, AK 99611 fax 283-3014
Administers city facilities and land use regulations.

City of Soldotna
177 North Birch St. ph 262-9107
Soldotna, AK 99669 fax 262-1245
Administers city facilities and land use regulations.
Volunteer: Stream watch program, visitor center.

Kenai Peninsula Borough
144 N. Binkley St. ph 262-4441
Soldotna, AK 99669 fax 262-8618
Administers Kenai River development ordinance, property tax programs.

Agencies

Kenai River Center
36130 Spur Highway
Soldotna, AK 99669
ph 260-4882
fax 260-5992
www.borough.kenai.ak.us/KRiver.htm

Permits and development information from representatives of the Kenai Peninsula Borough, Alaska Dept. of Fish and Game, Alaska Dept. of Natural Resources' Division of Parks and Outdoor Recreation and other agencies.

Alaska Department of Environmental Conservation
Kenai District Office
35390 Kalifornsky Beach Rd.
Red Diamond Center
Soldotna, AK 99669
ph 262-5210
fax 262-2294

Regulates discharges to the Kenai River and water quality issues.

Alaska Department of Fish and Game
34828 Kalifornsky Beach Rd.
Soldotna, AK 99669
ph 262-9368

Fishing and hunting regulations and permits.

Alaska Department of Fish and Game, Division of Habitat & Restoration
333 Raspberry Rd.
Anchorage, AK 99518
ph 267-2466
fax 349-1723

Fish and wildlife habitat permits for protection and restoration.

Alaska Department of Natural Resources' Division of Parks and Outdoor Recreation
P.O. Box 1247
Soldotna, AK 99669
ph 262-5581
fax 262-3717

Regulates the Kenai River mainstem and other State Recreation Areas.

Volunteer: Annual river clean-up, Ranger assistant, campground host, campground speaker program.

Alaska Department of Natural Resources' Division of Forestry
HC1 Box 107
Soldotna, AK 99669
ph 262-4124
fax 262-6390

Administers burn permits and Forest Stewardship Program.

Kenai National Wildlife Refuge
P.O. Box 2139
Soldotna, AK 99669
ph 262-7021
fax 262-3599

Manages the Refuge, operates a year-round visitor center on Ski Hill Road just south of Soldotna and a seasonal visitor station at mile 58 on the Sterling Highway.

Volunteer: Trail maintenance, carpentry, assistance with biological surveys, campground hosts, visitor center.

Chugach National Forest, Seward Ranger District
334 4th Ave.
Seward, AK 99664
ph 224-3374
fax 224-3268

Manages the Seward District of the Forest, operates a year-round visitor center in Seward.

Volunteer: Streamwatch program, Backcountry Trail Ranger program and other activites.

U.S.D.A. Natural Resources Conservation Service
P.O. Box 800
Kenai, AK 99611
ph 283-8732
fax 283-8158

Works with landowners on conservation issues, administers water quality, soil and snow surveys.

U.S. Environmental Protection Agency
P.O. Box 1329
Kenai, AK 99611
ph 283-6608
fax 283-8158

Assists community based watershed, wetland and water quality conservation projects. Reviews national permits for waterway, wetland and other development.

U.S Fish & Wildlife Service, Kenai Fishery Resource Office
P.O. Box 1670
Kenai, AK 99611
ph 262-9863
fax 262-7145

Conducts fisheries management, participates in habitat restoration, Adopt-A-Stream and other community projects.

Volunteer: Adopt-A-Stream Program, seasonal fishery management assistants.

U.S. Army Corps of Engineers
Regulatory Branch
Alaska District
P.O. Box 898
Anchorage, AK 99506
ph (800) 478-2712
ph 753-2712
fax 753-5567

Administers permit program for waterway, wetland and other development.

Fish Species

Appendix A

Humpy/Pink Salmon

Dog/Chum Salmon

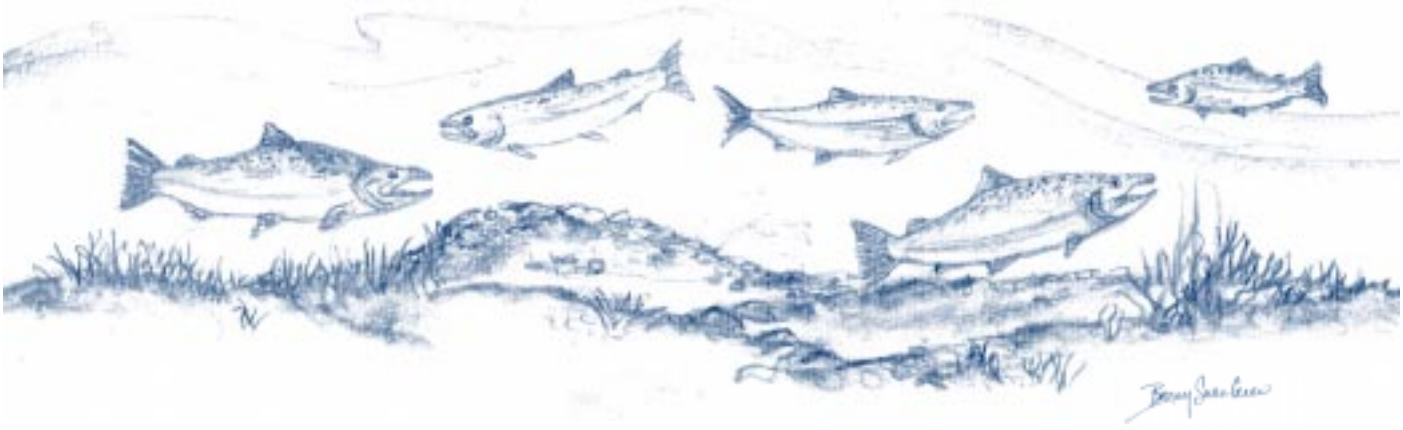
Red/Sockeye Salmon

Silver/Coho Salmon

King/Chinook Salmon

	Main Habitat*
Pacific Lamprey	River
Arctic Lamprey	River
Pacific Herring	Estuary
Chinook (King) Salmon	River
Sockeye (Red) Salmon	Lakes
Coho (Silver) Salmon	Tributaries
Pink (Humpy) Salmon	River
Chum (Dog) Salmon	River
Rainbow Trout	Lakes
Dolly Varden	Lakes
Lake Trout	Lakes
Arctic Grayling	Lakes
Round Whitefish	Lakes
Bering Cisco	Lakes
Eulachon (Hooligan)	River
Longfin Smelt	Estuary
Alaska Blackfish	Lakes
Northern Pike	Lakes
Longnose Sucker	Tributaries
Pacific Cod	Estuary
Burbot	Lakes
Pacific Tomcod	Estuary
Walleye Pollock	Estuary
Threespine Stickleback	River
Ninespine Stickleback	River
Pacific Sandfish	Estuary
Slender Eelblenny	Estuary
Pacific Sand Lance	Estuary
Rock Greenling	Estuary
Coastrange Sculpin	River
Slimy Sculpin	River
Pacific Staghorn Sculpin	Estuary
Sturgeon Poacher	Estuary
Snailfish	Estuary
Rex Sole	Estuary
Rock Sole	Estuary
Starry Flounder	Estuary

* Only one main habitat is presented here although most species depend on several habitat areas for survival.



Bird Species

Appendix B

Great-horned Owl
Northern Hawk-owl
Short-eared Owl
Boreal Owl
Bald Eagle
Golden Eagle
Marsh Hawk
Sharp-shinned Hawk
Red-tailed Hawk
Northern Harrier
Peregrine Falcon
Northern Goshawk
Merlin
Northern Shrike

Double-crested Cormorant
Trumpeter Swan
Tundra Swan
Canada Goose
Snow Goose
Greater White-fronted Goose
Green-winged Teal
American Widgeon
Barrow's Goldeneye
Common Goldeneye
Bufflehead
Oldsquaw
Harlequin Duck
Mallard Duck
Northern Pintail
Northern Shoveler
Greater Scaup
White-winged Scoter
Common Merganser
Red-breasted Merganser
Common Loon
Arctic Loon
Red-throated Loon
Horned Grebe

Sandhill Crane
Greater Yellowlegs
Lesser Yellowlegs
Semipalmated Plover
Lesser Golden Plover
Black-bellied Plover
Whimbrel
Common Snipe
Spotted sandpiper
Solitary Sandpiper
Wandering Tattler
Pectoral Sandpiper
Least Sandpiper
Dunlin
Short-billed Dowitcher
Western Sandpiper
Red-necked Phalarope
Glaucous-winged Gull
Bonaparte's Gull
Mew Gull
Herring Gull
Arctic Tern
Parasitic Jaeger
Belted Kingfisher

greater yellowlegs

willow ptarmigan

Rufous Hummingbird
Three-toed Woodpecker
Hairy Woodpecker
Downy Woodpecker
Olive Sided Flycatcher
Alder Flycatcher
Horned Lark
Violet-green Swallow
Tree Swallow
Bank Swallow
Cliff Swallow
Spruce Grouse
Willow Ptarmigan
Gray Jay
Steller's Jay
Black-billed Magpie
Common Raven
Boreal Chickadee
Black-capped Chickadee

Brown Creeper
Varied Thrush
American Robin
Hermit Thrush
Swainson's Thrush
Gray-cheeked Thrush
Golden-crowned Kinglet
Ruby-crowned Kinglet
Bohemian Waxwing
Pine Grosbeak
Yellow Warbler
Orange-crowned Warbler
Blackpoll Warbler
Wilson's Warbler
Yellow-rumped Warbler
Northern Waterthrush
Rusty Blackbird
Rosy Finch
Common Redpoll
Hoary Redpoll
White-winged Crossbill
Dark-eyed Junco
Pine Siskin
Water Pipit
American Dipper
Savannah Sparrow
American Tree Sparrow
Fox Sparrow
Lincoln's Sparrow
Song Sparrow
White-crowned Sparrow
Red-Breasted Nuthatch
Snow Bunting
Lapland Longspur

Recommended Reading

Appendix C

55 Ways to the Wilderness in Southcentral Alaska, Nienhauser & Wolfe, The Mountaineers, 1985

Alaska Wildlife Viewing Guide, Sydeman & Lund, Falcon Press Publishing Co., 1996

Alaska's Birds, Robert H. Armstrong, Alaska Northwest Books, 1994

Alaska's Fish, Robert H. Armstrong, Alaska Northwest Books, 1996

Alaska's Wild Plants, A Guide to Alaska's Edible Harvest, Janice Schofield, Alaska Northwest Books, 1993

Alaska Trees and Shrubs, L.A. Viereck E.L. Little, Jr., USDA Forest Service, Agriculture Handbook No. 410, 1972

At The Water's Edge, Alan M. Cvancara, Wiley Nature Editions, 1989

Backcountry Bear Basics, Dave Smith, The Mountaineers, 1997

A Birder's Guide to the Kenai Peninsula, Alaska, George C. West, The Pratt Museum and Birchside Studios, 1994

Collecting and Using Alaska's Wild Berries and Other Wild Products, Alaska Cooperative Extension, 1995.

A Dena'ina Legacy, K'tl'egh'i Sukdu: The Collected Writings of Peter Kalifornsky, ed. Kari & Boraas, University of Alaska Fairbanks, 1991

Discovering Wild Plants, Janice Schofield, Alaska Northwest books, 1989

Entering the Watershed, Doppelt et al, (The Pacific Rivers Council), Island Press, 1993

Field Guide to Alaskan Wildflowers, Verna E. Pratt, Alaskakrafts Publishing, 1989

A Field Manual for the Amateur Geologist, Alan M. Cvancara, Prentice Hall, 1995

Growing Alaska Natives, Richard L. Baldwin, 1997

Kenai River Landowner's Guide, Kenai Soil and Water Conservation District, USDA Soil Conservation Service, 1994

A Larger History of the Kenai Peninsula, Pederson, 1983

Leave No Trace, Outdoor Skills and Ethics: Alaskan Tundra, National Outdoor Leadership School, 1997

Living Ice: Understanding Glaciers and Glaciation, Robert P. Sharp, Cambridge University Press, 1988

Once Upon The Kenai, Kenai Historical Society, Walsworth Pub. Co., 1984

Pacific Salmon, Alaska's Story, ed. Angela Tripp, Alaska Department of Fish & Game, Albion Publishing Group, 1996

Polluting for Pleasure, Andre Mele, W.W. Norton & Co., 1993

Reaching Home, Pacific Salmon, Pacific people, Natalie Forbes, Alaska Northwest Books, 1994

Roadside Geology of Alaska, Connor & O'Haire, Mountain Press Publishing Co., 1988

Soft Paths, Hampton & Cole (National Outdoor Leadership School), Stackpole Books, 1995

Tanaina Plantlore, Dena'ina K'et'una, P.R. Kari, National Park Service, U.S. Department of the Interior, 1987

Wetlands, The Web of Life, Rezendes & Roy, Sierra Club, Verve Editions, 1996

Wildlife Notebook Series , Alaska Department of Fish and Game, 1994

A book is an "Information" Cache