THE LAND OF ALASKA

Alaska is the largest state in the United States, almost twice the size of Texas. Because of its size, Alaska encompasses many habitats and has a diverse landscape. Alaska is often divided into six land regions: the Alaska Panhandle (the southeastern coastal strip of land), the southwest and Aleutian Islands, interior, southcentral, western/Bering Sea coast and the **Arctic** (including the Brooks Mountain range and North Slope).

The Pacific Mountain system extends through the southern and southeastern regions. These mountains, forming two parallel arcs across southern Alaska, are the northern extent of the Pacific Coast Range and the Cascade Mountains. The Saint Elias, Chugach, Wrangell, Kenai and Alaska mountain ranges make up this region of volcanic mountains and glaciers. Forests of western hemlock, Sitka spruce, white spruce, Alaska yellow cedar, and red cedar cover the land while Dall sheep, mountain goats, black bears, brown bears, Kodiak bears (a subspecies of brown bear), foxes, squirrels and grouse inhabit this **montane** region. This area is punctuated by the tallest mountain in North America, Mt. McKinley, which looms over Denali National Park. Mt. McKinley, at 20,320 feet (6,194 m), is often referred to as Denali, an Athabaskan Indian name meaning "great one."

Glaciers cover nearly 29,000 square miles (75,110 sq km) of Alaskan land – almost 5% of the state's total area! In fact, about three-fourths of Alaska's freshwater supply is in the form of glacial ice. Most of Alaska's 100,000 glaciers are concentrated in the panhandle. The largest glacier in Alaska, and in all of North America, is Malaspina, in the Saint Elias Range. Malaspina glacier covers 850 square miles (2,202 sq km) (Heinrichs, 1991).

In the southwestern portion of the state, the Aleutian Islands lie between the Bering Sea and the Pacific Ocean, stretching beyond the Alaskan Peninsula and mainland nearly 1,100 miles (1760 km). The Aleutian Islands join Japan, the Philippines, New Zealand, southern and central America, the Andes, Mexico and the west coast of the United States in making up the Pacific ring of fire – volcanoes circling the entire Pacific Ocean.

The Aleutian Islands region is wet and windblown, taking the brunt of coastal climates. Tall grasses, instead of trees, are the primary vegetation. Whales, salmon, halibut, sea otters, fur seals, walruses and seabirds such as loons, gulls, petrels, puffins and plovers inhabit the waters and beaches surrounding the Aleutian Islands and the western Alaskan coast. On Alaska's west coast the Bering Land Bridge National Preserve is the nesting site for millions of migratory birds. This Preserve is an International Peace Park with Russia only 55 miles (89 km) away.

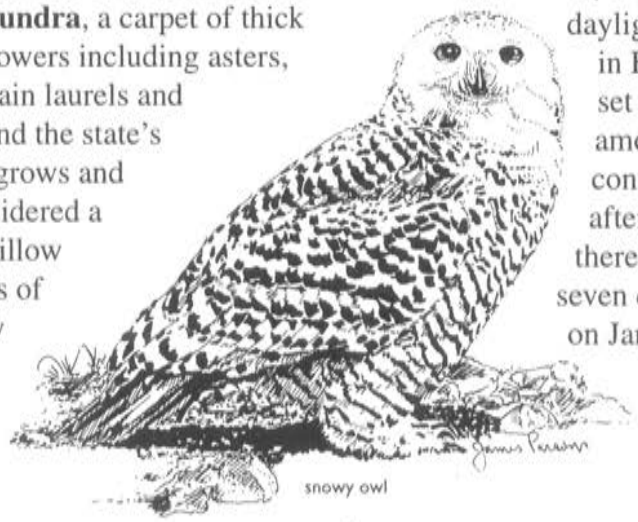
montane

The interior of Alaska is made up of gently rolling hills and wide, swampy river valleys often referred to as the lowlands and uplands region. Covering much of the state's interior between the Brooks Mountain Range to the north and the Alaska Range to the south, this central plateau is home to Alaska's longest river, the Yukon – the fourth longest river in the United States. Paper birch and black cottonwood trees line the valleys. **Muskeg bogs** support mosses, lichens, cranberries and bog laurel as well as animals such as moose, elk, beavers and muskrat. This region also provides nesting habitat to over 80% of the world's emperor and Canada geese.


porcupine

Heading north from the interior, one encounters the Brooks Mountain Range. Home to elk, wolves, porcupine, Dall sheep and grizzly bears, the Brooks Range is the northern extent of the Rocky Mountains that stretch north through the U.S. and Canada from Mexico.

North of the Brooks Range lies the Arctic Coastal Plain, often called the North Slope. Here the land gradually drops off from the mountains to the Arctic Ocean. The entire Arctic Coastal Plain lies within the Arctic Circle and is above the northern extent of treeline. This "Land of the Midnight Sun" boasts long days of light during the summer but months of darkness during its harsh winters. When the surface layer of ground thaws each summer on this treeless region called **tundra**, a carpet of thick mosses, grasses and wildflowers including asters, larkspurs, fireweed, mountain laurels and varieties of lichen, sedge and the state's flower, the forget-me-not, grows and blooms. The tundra is considered a year-round home for the willow ptarmigan, arctic fox, herds of musk oxen, wolves, grizzly bears, lemmings as well as millions of migratory birds. It is a summer home for snowy owls and caribou as well as a winter denning site for polar bears. However, because the arctic has unusually harsh weather conditions it is home to relatively few species. For example, only 50 of the earth's 4,000 mammal species live in arctic regions. In the far northeast corner of Alaska lies the Arctic National Wildlife Refuge, an important home and sanctuary for many of these species, and the last great open range to preserve the few numbers that remain.


snowy owl

SEASONS IN THE NORTH

If you look at a globe, you will notice that Alaska lies between the 50th and 72nd parallel, with the majority of the state above the 60th parallel. During the earth's annual rotation around the sun, each pole of the earth alternately tilts toward or away from the sun. Since Alaska is relatively close to the North Pole, it annually experiences a drastic variation in seasonal light and temperatures. For example, in June and July regions near the North Pole experience almost 24 hours of daylight per day. On the summer solstice (June 20th or 21st) the sun does not set for an entire day. As the earth spins on its daily cycle, these regions never move out of reach of the sun's rays. The opposite is true in December and January, when these northern regions experience close to 24 hours of darkness per day, because the sun's rays then cannot reach that part of the earth. In Antarctica, the seasons are reversed and the long days of summer are in December and January, while long nights of winter are in June and July (Sayre, 1994).

"Barrow, the Alaskan city nearest to the North Pole, experiences the most drastic daylight extremes. After the sun rises in Barrow on May 10, it does not set again until August 2. That amounts to eighty-four days of continuous daylight! In the winter, after the sun sets on November 18, there is no more daylight for sixty-seven days. The sun finally rises again on January 24" (Heinrichs, 1991).

Spring in Alaska does not always mean glorious warm days, even with summer approaching, cold still grips much of the state. North of the crest of the Brooks Range, true arctic climate prevails. Winters are long, dark and cold. Despite the cold however, there is little snowfall in this region of Alaska. Drier continental air masses produce limited, dry snowfall. Barrow Alaska receives only an average of 1.1 inches (3 cm) of precipitation from November through March (National Climatic Data Center, NESDIS, NOAA, U.S. Department of Commerce). Summer, in comparison, is short in duration, but long in daylight and warmth, especially in interior areas. In this region, a typical day in winter is more than 100° Fahrenheit (38° C) colder than a typical day in summer.

TAIGA, TUNDRA AND MONTANE ENVIRONMENTS

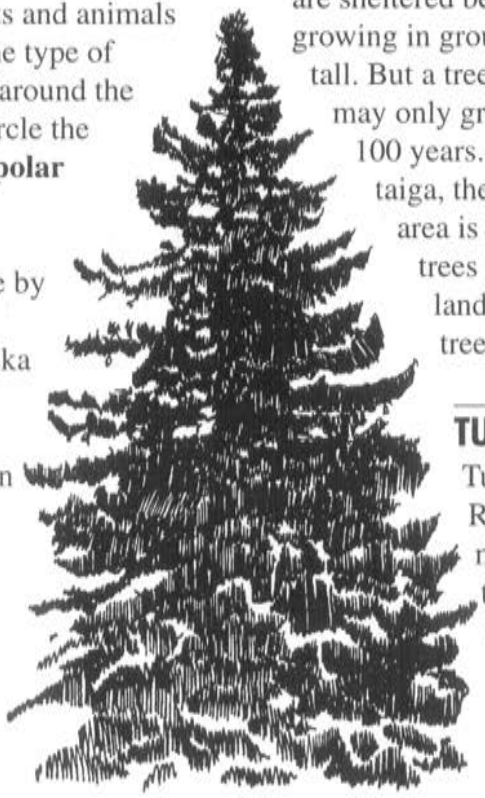
Above the latitudes of the **temperate forests** in the Northern Hemisphere lie the **taiga** and tundra **bioclimatic zones.** These zones span around the northern hemisphere in a continuous belt. From south to north, taiga forests, tundra and arctic ice encircle the North Pole across Alaska, Canada, Greenland, northern Europe (Iceland, Norway, Sweden, Finland and western Russia) and northern Asia (Siberia and far eastern Russia). There are different species of plants and animals in different parts of this belt, but the type of habitat is similar at these latitudes around the world. Because these habitats encircle the north pole, they are called **circumpolar** regions. Montane habitats are also found throughout the circumpolar region. Montane regions vary more by their elevation, than their latitude. Therefore montane regions of Alaska share many of the same characteristics of other montane regions, such as here in Washington state.

TAIGA

The taiga, a Russian word that means "land of little sticks," is the northern or **boreal** forest that lies between the temperate zone (forests of the Pacific Northwest for example) and the far northern tundra. Boreal forests are made up of spruce and other **coniferous** trees like the temperate forest, but boreal forests also have an extensive amount of **deciduous** trees, primarily aspen.

Trees in the taiga are smaller in size compared to those in temperate forests due to a shorter growing season and nutrient-poor soils. In most forests, decomposition is the primary source of nutrients in the soil. However, in the far northern regions, soils tend to be nutrient-poor since the process of decomposition is restricted to only the few warm months of the year. Growth in these soils can also be affected by **permafrost**, permanently frozen soil. Permanently frozen soils prevent root penetration. Trees are not able to grow very tall if their root structures cannot reach far into the earth for stability. Lightening-caused fires are one of the greatest forces of change in this ecosystem – recycling nutrients, helping to melt permafrost and clearing areas for other plants to grow. In fact, cones of black spruce trees only open up and disperse seeds when heated by fire.

On the far northern limits of the taiga, within the Brooks Range, trees are often stunted due to the colder temperatures and harsh climate. Trees that are sheltered behind a ridge, in a valley or by growing in groups, might grow to 20 feet (6 m) tall. But a tree exposed to the winds and snow may only grow to 4 feet (1.2 m) in as much as 100 years. The farther north you travel in the taiga, the more sparse trees become. This area is known as tree line. Gradually the trees disappear altogether and the landscape changes into a gently rolling treeless plain called tundra.



white spruce

TUNDRA

Tundra ecosystems, derived from a Russian word meaning "treeless marshy area," are found as one travels to the northern latitudes of North America, Europe or Russia. Trees do not grow in this area because of three climatic factors. First, trees need to manufacture

large amounts of food through **photosynthesis** and the speed of this reaction and the tree's ability to grow is dependent upon temperatures being above 50° F (10° C). Therefore the tree line generally exists where the average temperature of the warmest month (July) is 50° F (10° C). Temperatures are not that warm on the tundra. The second reason why trees do not exist on the tundra is the blasting wind and snow. Fine bits of blowing sand, snow and ice damage the tips of growing trees. Trees growing at the northern reaches of the taiga forest usually grow only as high as the snow is deep during the winter. Thus, the trees stay protected under a blanket of snow during harsh winter storms. The third reason why trees do not exist on the tundra is the presence of permafrost. The farther north one travels, the closer the permafrost is to the earth's surface leaving only a shallow layer of unfrozen soil which is unable to support the root systems of a tree. Plants that do grow in the tundra are small, with shallow but far reaching root systems. They also grow close to the ground, huddling for warmth and escaping from the wind (Fuller, 1972).

In winter, the tundra is completely iced over and snow is limited because evaporation ceases when temperatures reach -40° F (-40° C). Without evaporation, precipitation cannot occur. The tundra is a very dry region receiving 12-20 inches (31-51 cm) of snow per year with very little additional precipitation in the form of rain. By some definitions, this limited amount of precipitation classifies the arctic tundra as a desert.

brown bears

In the short spring and summer months, only a few inches of the top **"active layer"** of soil thaws. The land then becomes swampy because the lower layers of permafrost prevent the snow melt from draining away. The great pools of standing water resulting from these summer thaws are important seasonal wetlands serving as nesting areas for large flocks of waterfowl such as geese, swans and ducks.

In the spring, migrating caribou will return from the south to graze on these plants. Sandpipers will search ponds and streams for insects, while arctic terns hover then swoop to grab fish. Grizzly bears, black bears, and people feast on the summer abundance of berries, while billions of mosquitoes feast upon the blood of the bears, people and caribou (Sayre, 1994).

About one-third of the tundra is covered with woody shrubs, dwarf willows, grasses and sedges and the rest of the tundra is coarse gravel covered with lichen and bare soil. **Eskers** are also prominent features of the tundra. Eskers, long ridges of gravel, occur where rivers once flowed and deposited gravel. Other eskers were formed when retreating glaciers dropped gravel they were carrying. The porous soils and high banks of eskers are important for arctic foxes and wolves, which use them for their tunnels and dens.

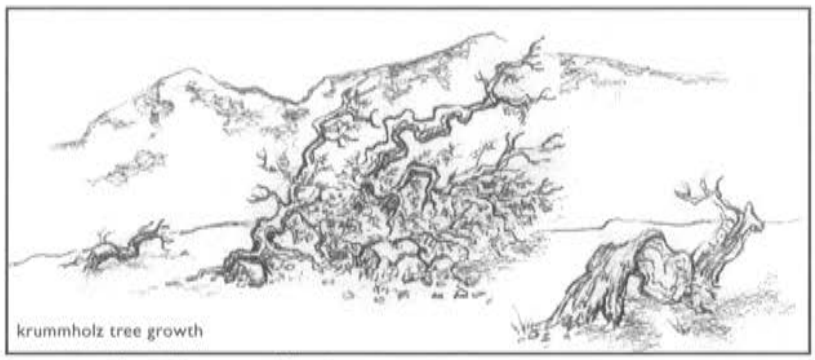
When looking at a globe, the arctic region is considered to be any area above the Arctic Circle, which is at 66° latitude. Biologists however, consider the boundary of the arctic as a place where the average monthly temperature never exceeds 50° F (10° C). You may remember that the area where the treeline meets the southern limits of tundra is the region where average temperatures begin to dip below 50° F (10° C). Using this definition, the true arctic begins at the crest of the Brooks Range, considerably north of the geographic Arctic Circle.

Because the distance between continents is relatively small around the north pole, it is easy for animals to move from one land mass to another by swimming or hopping icebergs. Seeds also travel these short distances, carried by wind, or by birds and thus easily populate other areas. This global exchange of plants and animals means all tundra regions are similar and are home to characteristic flora and fauna.

MONTANE

Montane simply means mountain. Montane habitats are found throughout the world and share very similar characteristics. Montane habitats are characterized by increased elevation.

Mountains act as dividers or barriers between bioclimatic zones. When mountain ranges are located near coastal areas, such as the Coast Mountains or the Cascade Range, they form a natural precipitation barrier. Precipitation in the form of rain and snow falls in greater quantities on the seaward, or ocean-facing side, with considerably less precipitation on the **leeward**, or protected side. Vegetation growth patterns reflect this moisture difference. Forests on the seaward side of mountain ranges are characterized by moisture-dependent trees such as spruce and cedar with a thick **understory**. Forests on the leeward side consist of drought-tolerant trees with an open understory.


krummholz tree growth

For more information on montane regions see Woodland Park Zoo's Washington Wildlife teacher packet.

ARCTIC TUNDRA, ALPINE TUNDRA

Another possible origin of the word tundra may have been a Finnish word, "tunturi," meaning "completely treeless heights." By this definition, tundra is the treeless area found at high elevations (alpine tundra) as well as high latitudes (arctic tundra).

The upper elevation of mountainous, or montane, areas have tundra conditions similar to those in the arctic. **Alpine tundra** is found in elevations above the treeline, but below the permanent snow and ice of high mountain peaks. Alpine tundra is found in isolated patches on the slopes of Mt. McKinley in Alaska and on the highest peaks of the Cascades and Olympic mountains in Washington state and elsewhere, while arctic tundra occurs close to sea level in the arctic regions of the world. Both the arctic and alpine tundra have cold and windy weather with characteristic low-growing vegetation. Alpine regions however, receive more precipitation and there is more direct sunlight on mountains at lower latitudes than the far northern arctic plains. Also, because of the steep topography and lack of permafrost, soils in the alpine tundra tend to be better drained than in the arctic, thus enabling a greater diversity of plants to grow.

Alpine treeline is the upper elevational limit of forest where the tundra zone begins on a mountain. The further north one travels from the equator, the lower one will find the elevation of this treeline. This is due to the lower mean annual temperatures, varying length of daylight hours and shorter growing seasons. In the Pacific region, for example, treeline is found near 9,000 feet (2,743 m) in northern California; at 6,000 feet (1,829 m) in northwestern Washington; 3,500 feet (1,067 m) in Juneau, Alaska; and at only 1,000 feet (305 m) at Seward in southcentral Alaska. Mountain ranges located further inland, with drier, continental, weather patterns, have treelines located at higher elevations than those of maritime mountain ranges. Southern Colorado's alpine treeline develops near the 12,000 foot (3,600 m) level; southern Alberta's is at 7,500 feet (2,286 m); treeline in central Alaska is found at 3,500 feet (1,050 m), sometimes lower — in Denali National Park it can be 2,000 to 3,800 feet (608 to 1,155 m).

During the last glacial period, which ended approximately 10,000 years ago, there were large ice sheets covering all of Canada and the northern U.S. These ice sheets were similar to those now covering Antarctica. The glaciers covered Alaska's montane region, but due to the limited snow fall in the lowlands, ice sheets did not form. This resulted in vegetative and geological differences between the arctic and alpine tundra. In the harsh conditions of the alpine tundra, relatively few species of plants and animals can survive.

PERMAFROST

One of the defining characteristics of Alaska's ecosystems is the soil. Affected by the extreme temperatures of the northern regions, much of Alaska's soil is continuously or discontinuously frozen. This frozen soil is called permafrost. "Much of the Interior and parts of southcentral Alaska are underlain by discontinuous permafrost." (Thompson, 1991) While the surface layers of soil go through cycles of freezing and thawing, lower layers may remain frozen year round. Southern exposure slopes with well-drained soils have very little permafrost, while north-facing slopes or poorly drained soils could have nearly continuous permafrost. The farther north one travels in this zone, the more permafrost one tends to encounter. On the North Slope of Alaska, near the community of Barrow, the permafrost is 1,300 feet (396 m) thick and thousands of years old (Brown, 1972). Deep lying frozen ground may persist for centuries as a remnant of much colder times.

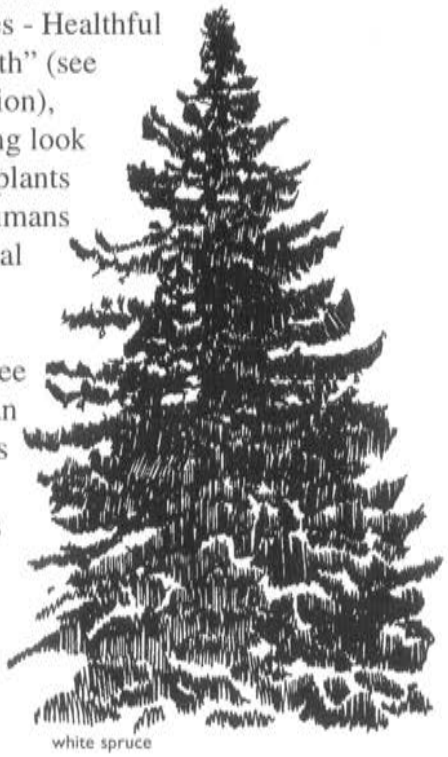

black spruce

The depth of the permafrost helps determine the types of vegetation that will grow. Plants such as white spruce, cottonwood, birch and certain willows need a significant amount of room for their roots and therefore thrive in areas where the permafrost layer starts at a greater depth. For example, these trees grow well near Fairbanks where the permafrost starts at least four feet below ground level. Other plants, such as black spruce, may have much shallower roots and need only a foot and a half of soil to grow. These trees can therefore survive in areas where the permafrost begins closer to the surface. The vast area of the northern regions of Alaska has so little unfrozen topsoil that low lying bushes such as wild cranberries, lichens and mosses are the characteristic forms of vegetation in these completely frozen lands.

As described before, the permafrost layer does not permit water to drain through the soil. Therefore, when the upper layers thaw in the summer, the water has no place to drain. Additionally, due to constant thawing and freezing of this saturated soil layer, the ground sometimes buckles as it thaws and refreezes, or the soil may slide during periods of saturation. Either scenario sometimes causes trees to grow at an angle, thus giving a slanted appearance to many wooded areas of Alaska.

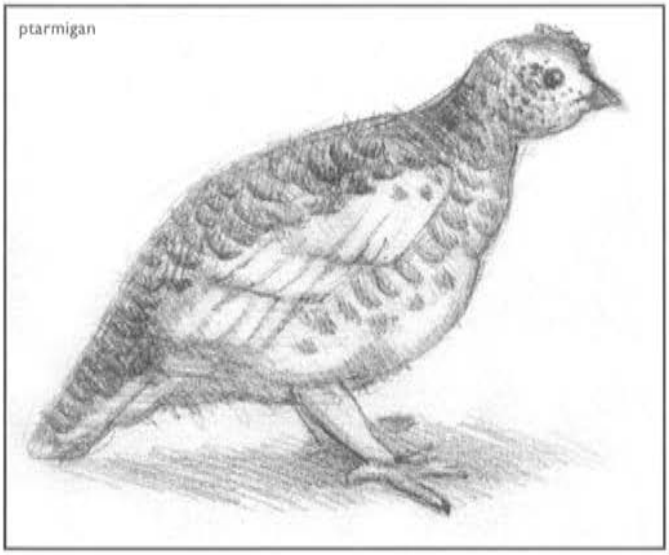
PLANTS OF THE TAIGA AND TUNDRA

As is true with any ecosystem, plants are, directly or indirectly, the life source for all animals that share the ecosystem. Although the growing conditions in Alaska are harsh, many plant species manage to persist and thrive. These plants provide food and shelter for humans and other animals. The following information is about only a few plants found in Alaska. Eleanor G. Viereck's book, "Alaska's Wilderness Medicines - Healthful Plants of the Far North" (see the "Resources" section), provides an interesting look at several species of plants which are used by humans for food and medicinal uses.


white spruce

The most common tree in the North American taiga, white spruce, is also the most important in the lives of its native people. For thousands of years the Athabaskans have used spruce to

make houses, boats, sleds, spoons and hundreds of other items. See the insert in this packet titled "Athabaskan Utilization of the White Spruce" for more information about uses of this plant. During the summer a white spruce grows almost continuously, thus providing food and shelter for many species. In the winter, a variety of animal species relies on white spruce, including spruce grouse, which survive by eating the buds and needles of the spruce. White spruce can be seen lining the entrance to the zoo's Northern Trail bioclimatic zone.



Soapberry is a berry-producing shrub found on the taiga and is a favorite food source of brown bears. Brown bears also utilize shrubby cinquefoil. Shrubby cinquefoil, also known as tundra rose, grows on both the taiga and the tundra. Brown bears use its branches to line their dens.

Birches are also common food sources for Alaskan wildlife. The bark of paper birch provides winter food for animals such as moose and snowshoe hares. A close relative of the tree-sized paper birch, the dwarf birch rarely gets as tall as a full-grown person. Caribou take advantage of the dwarf birch's small size and browse on the leaves during the summer. Ptarmigan eat the buds and twigs in the winter.

The hips (fruit) of prickly rose contain vitamin C. These fruits cling to their stems long into the winter and are therefore an excellent food source for many birds.

When you visit Woodland Park Zoo's Northern Trail, you will have an excellent opportunity to learn about plants of Alaska. More than 80% of the plants found in this part of the zoo are native to Alaska.

PLANT SURVIVAL STRATEGIES

The variation in length and intensity of light and the long stretches of cold weather make for a very short growing season in Alaska and throughout similar areas around the top of the globe. Although extremely long hours of daylight during the summer extend the short growing season, conditions are nonetheless very harsh in most areas of Alaska.

As mentioned previously, cold temperatures and limited precipitation, often in the form of snow which is unusable by plants except for the brief period of time when it melts in the spring, are deterrents to plant growth and survival.

The following is a chart showing the average monthly temperature and precipitation for four cities in very different parts of Alaska. Anchorage lies on the coast in the southcentral area of the state, Barrow is on the far northern tip, Fairbanks is slightly east of the center of the state and finally, Juneau is on the southeastern panhandle, near British Columbia.

In order to survive the harsh conditions presented by life in the far north, plants must have a wide variety of **adaptations** to help them survive.

TEMPERATURE AND PRECIPITATION

Average daily temperatures in degrees Fahrenheit

	Anchorage (Southcentral)	Barrow (Northern tip)	Fairbanks (Central)	Juneau (Southwest)
January	15°	-13°	-10°	22°
February	19°	-18°	-4°	28°
March	26°	-15°	11°	31°
April	36°	-2°	31°	39°
May	47°	19°	49°	46°
June	54°	34°	60°	53°
July	58°	39°	63°	56°
August	56°	38°	57°	55°
September	48°	31°	46°	49°
October	35°	14°	25°	42°
November	21°	-2°	3°	33°
December	16°	-11°	-7°	27°
Average	35.9°	9.5°	27°	40°

Average monthly precipitation in inches

	Anchorage (Southcentral)	Barrow (Northern tip)	Fairbanks (Central)	Juneau (Southwest)
January	0.8	0.2	0.5	3.7
February	0.8	0.2	0.4	3.7
March	0.7	0.2	0.4	3.3
April	0.7	0.2	0.3	2.9
May	0.7	0.2	0.6	3.4
June	1.1	0.3	1.4	3.0
July	1.7	0.9	1.9	4.1
August	2.4	1.0	2.0	5.0
September	2.7	0.6	1.0	6.4
October	2.0	0.5	0.9	7.7
November	1.1	0.3	0.8	5.2
December	1.1	0.2	0.9	4.7
Total	15.8	4.8	11.1	53.1
Average	1.32	0.4	.93	4.43

National Climate Data Center

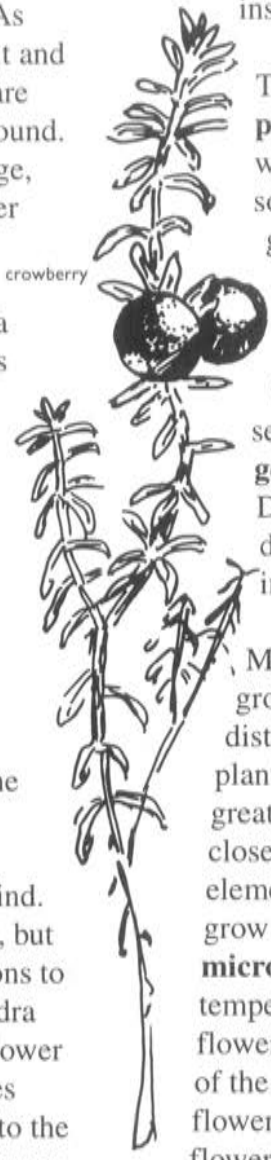
Plant Life on the Tundra

Plants on the tundra survive the harsh winter buried under a blanket of snow or as seeds underground. As the snow melts, plants prepare for a flurry of activity. They have only 10-14 weeks, from June through August, in which to grow, flower and seed before winter begins to fall again. During this short summer, plants on the tundra receive as much solar energy as plants in the tropics because of the 24 hours of sunlight. As temperatures start to drop in the fall, pigment and fluid drain out of the leaves and shoots and are stored in the plant's roots and bulbs underground. The dying leaves cover the tundra with orange, yellow and red hues before the coming winter snows.

In order to succeed in the north, many tundra plants are adapted to carry on photosynthesis quickly and at cooler temperatures than plants in lower latitudes. In fact, many tundra plants grow best between 27°-36° F (-2.7°-2.2° C). With this adaptation, plants are able to make better use of the short growing seasons. Despite this ability, however, tundra plants are still not able to grow as fast as plants in warmer climates. Some plants in Alaska may take many years to achieve the same amount of growth their warm climate counterparts achieve in just one year.

Another harsh factor of the weather is the wind. Wind in this region not only aids in freezing, but also drying whatever is in its path. Adaptations to beat the windchill are also important for tundra plants. Due to friction, wind speed is much lower close to the ground than it is just a few inches above the earth's surface. By growing close to the ground, low lying bushes, mosses and lichens are more protected. Many plants, such as cotton grass, grow in clumps, huddling their leaves together for warmth. Other plants form mounds called **tussocks**. This shape helps to break the wind and allows more leaves to be warmed by the sun. Finally, as was mentioned earlier, taller shrubs protect themselves by growing only as high as the snow is deep, thus new shoots and buds won't get damaged in the wind.

Some tundra plants have waxy leaves to help retain water. The waxy coating prevents rapid water loss through evaporation. This is vital for plants since, although there is a lot of water in the tundra, it is usually in frozen form, except during the brief summers in areas where the snow and/or permafrost melt. Some plants also have dark colored leaves which trap and retain heat to insulate the leaves from the freezing cold. Some plants also grow hair on their buds for extra insulation.



The vast majority of plants on the tundra are **perennial**, with their buds surviving the winter at or just below the surface of the soil. **Annual** plants sometimes use two growing seasons to set their seeds. The seeds in berries (such as crowberry, blueberry and cranberry) are eaten by birds and mammals and dispersed across the tundra in the animals' waste. Other seeds may be dispersed by the wind, or **germinate** where they fall from the plant. During the harsh winters the seeds will lay dormant under the snow and then germinate in the spring.

Many plants have adapted to northern growing conditions by evolving into distinctive shapes and forms. For example, plants growing on the tundra are exposed to greater amounts of wind and therefore grow close to the ground for protection from the elements. Some plants, such as moss campion, grow in tight mats forming their own **microenvironment**, which increases the temperature of the plant. Parabolic-shaped flowers, like the Alaska poppy, follow the path of the sun each day. The bowl shape of these flowers reflects light back to the center of the flower, creating a warm spot that attracts insects for pollination. Many trees in Alaska's interior are also shaped for the winter with narrow tops and wide bottoms. They have downward sloping, flexible branches which allow the snow to fall off the tree, rather than gathering on the tree and weighing down or breaking the branches.

Some trees and shrubs keep their leaves throughout the winter, giving them a head start on the growing season of the following year. During the spring and summer, these **evergreens** will then lose their leaves (not all at once though, like deciduous plants) and grow new ones. Other trees and shrubs are deciduous, meaning they'll lose their leaves before each winter. Due to low levels of sunlight during the winter months, many plants are unable to photosynthesize the energy they need to grow. These plants will often enter a state of dormancy, similar to that of some animals, in which many of their functions slow down to conserve energy during the winter months. During these periods of **dormancy**, plants will cease to grow or grow at a very slow rate.

Tamarack	Deciduous, needle-leaf
Black spruce	Evergreen, needle-leaf
Alaska yellow cedar	Evergreen, needle-leaf
Black cottonwood	Deciduous, broadleaf
Quaking aspen	Deciduous, broadleaf
Kinnikinnick (common bearberry)	Evergreen, broadleaf

Plants also have unique ways to reproduce in the tundra environment. Some plants, such as crowberry, spread out their shallow roots above the permafrost, shooting new stems in all directions. These stems will sprout a new plant identical to the first. Sedges, grasses and arctic willows reproduce in this way under the protection of the ground.

The tundra also is home to some beautiful flowers such as larkspur and monkshood. At first glance, it seems remarkable that these can grow here at all. On closer investigation, these plants are probably growing where the soils have been fertilized by droppings from a snowy owl, a lemming or a fox. Wildflowers often grow near the dens and burrows of animals where the soil has been disturbed, the nutrients are rich and the location may be better protected from the weather. While the stems and leaves of tundra plants are often smaller than temperate relatives, flowers tend to be about the same size, making them appear more prominent.


snowy owl

Winter Survival Strategies of Animals

Many plants and animals have physical adaptations which help them survive seasonal changes, changes which affect food availability, day length, snow cover and temperature. In addition to these physical adaptations, animals may also develop behavioral patterns linked to seasonal changes.

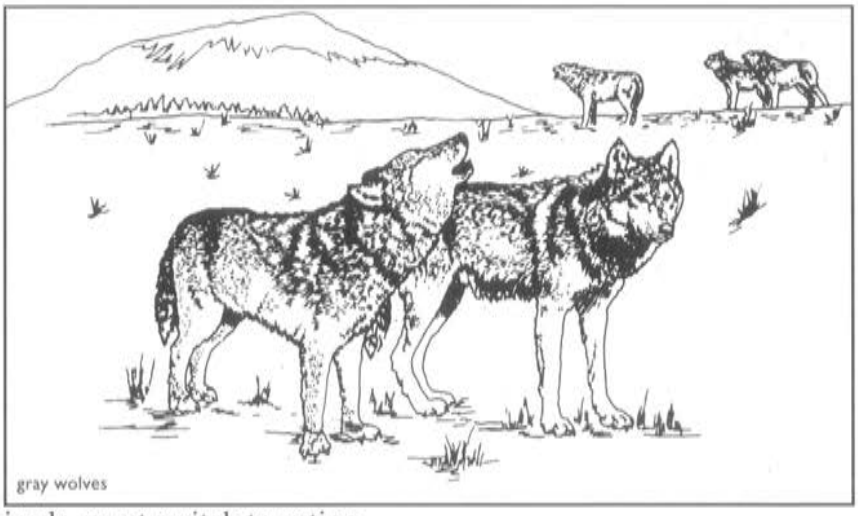
During the next several pages we will be examining several strategies that animals employ for surviving the changes brought about by the onset of long cold winters in the north. A few of these methods are: remaining active (out and about) or escaping winter through **hibernation/ torpor, migration** or **subnivean** survival.

OUT AND ABOUT IN ALASKA'S WINTER

Animals remaining active for the long Alaskan winters must be adapted to survive the shortage of food. Most animals, whether they remain active or not, will eat highly nutritious food throughout the late summer and fall in order to build up their fat storage. By eating large amounts of food during the time it is plentiful, they are better prepared for the sparse winters. As winter comes on, food sources, such as vegetation, begin to wane: some plants lose their leaves while grasses and many other small plants are covered with snow. The shortage of food forces many **herbivores** (plant-eating animals) to migrate to other areas or to sleep through the winter. This in turn causes a shortage of food for many **carnivores** (meat-eating animals) who must also seek an alternate means of survival during the long winter months.

Animals remaining active during the winter often must resort to eating less nutritious foods. For example, moose spend the summer months feeding on rich aquatic plants but during the winter they must be satisfied with less nutritious and more

difficult to digest foods such as bark or willow branches. While wintering in the forests of the taiga, caribou survive on nothing but lichen they dig up from under the snow. The gyrfalcon, which spends its summers dieting on lemmings and squirrels, must switch to eating ptarmigans, hares and snow buntings all winter long. Brown bears fatten themselves through the summer and fall on berries and salmon but in winter, if they wake from their torpor, they have to be satisfied with digging up roots and eating seaweed along the coast.


gray wolves

In the summer when the weather is mild and food is abundant, members of a wolf pack fan out in one or twos to hunt small animals like ground squirrels and hares. When the harsh winter weather sets in, food becomes sparse. Wolf packs come together to hunt as a group to find and kill large animals such as moose and caribou.

Animals remaining active for winter also have physical adaptations to help them find food in order to survive. Caribou and other deer have sharp-edged hooves which allow them to dig beneath the snow in search of food. Wolverines have large, broad feet with webbing between the toes. These feet act as snowshoes, allowing wolverines to run across the snow in search of food, such as deer or wild sheep. Ptarmigans do not have snowshoes year round but instead grow stiff, densely matted feathers on their feet each fall to help them walk on the snow. In addition to these feathers, ptarmigans have sharp claws to grip when they are walking on ice.

Some animals, such as arctic foxes and snowshoe hares, adapt to winter by growing a long white coat and shedding this coat by summer to show the short gray or brown hair underneath. This "changing" of a hare's or fox's coat serves as **camouflage**, enabling it to protect itself from **predators** or giving it the ability to hide itself when sneaking up on its **prey**. The longer hairs of the winter coat also help to insulate the animal from cold temperatures and protect it from the wind.

For many animals, summer on the tundra is a time for mating, laying eggs or giving birth, and raising their young. In order to accomplish this safely and protect their young from predators, some animals change color so they are camouflaged for the summer season. When the snowshoe hare or arctic fox looses their winter coat, the shorter coat beneath is brown or gray. These colors help the animal blend into its surroundings when the snow melts. Female snowy owls have feathers that are white, speckled with brown. Since this animal nests on the ground, the flecks of brown and white on her feathers will camouflage the owl against the patches of melting snow and bare ground as she sits on her nest. This camouflage will protect her from predators such as weasels, gyrfalcons and foxes. A pair of snowy owls can be observed at Woodland Park Zoo's Northern Trail. Unlike the fox and hare however, the color of the snowy owl's feathers do not change with the seasons.

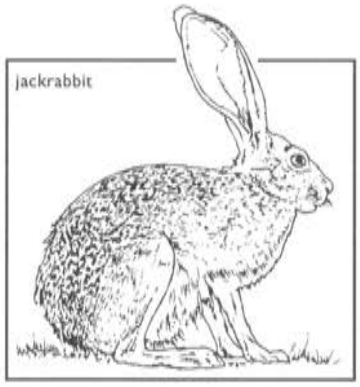
BODY SHAPE: A SURVIVAL TOOL

Throughout the world of animals, one can identify many different body shapes. The shape of an animal's body includes its torso and appendages. Different body shapes have evolved to help animals survive in a wide variety of habitats. Large appendages, such as long ears and long legs, tend to release heat rapidly, whereas smaller appendages help the animal conserve heat.

In the frozen areas of the northern hemisphere, a round torso with comparatively small appendages would be considered the ideal body shape for maintaining body heat. A round body has a smaller surface-area-to-volume ratio than a long,

or oblong body. In simpler terms, the round body is more compact: there is less skin (or surface area) exposed to the air and there is also less body mass close to the body's surface, therefore, the animal can retain heat for longer periods of time. To illustrate this, imagine if you went outside in the cold of winter, what parts of your body would get cold first? Your fingers, toes, ears and nose would feel the cold first. What would you do with your body to keep warm? Maybe you would wrap your arms around yourself and hunch your shoulders. Or if you were lying down, you might roll up into a ball. When it's cold, we tuck in our arms and legs trying to reduce the number of body parts exposed to the cold. But what if it was very hot outside? Would you roll up in a tight ball? No, you would probably stretch out. When it is hot, we tend to spread our body out. When more of our body is exposed to the air, it can help us cool down.

Let's look at an example of body shape. A jackrabbit is a large rabbit often found living in desert regions. A snowshoe hare is an arctic species. Jackrabbits have long thin bodies, long legs and very large ears. This body shape makes jackrabbits well suited to warm desert climates because these animals can easily release body heat through their long appendages. Snowshoe hares, on the other hand, have round, compact bodies, short ears and short, stocky legs. These small appendages aid snowshoe hares in heat retention. Thus snowshoe hares are well suited to the cold climate of Alaska.


jackrabbit

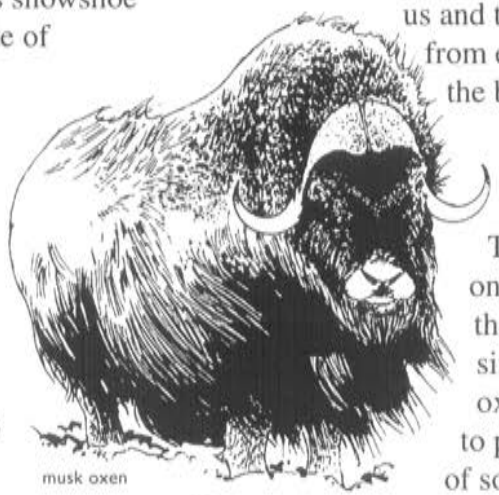
Although the round body and small appendages are ideal for winter survival, not all northern animals are short and plump. If you were to look at pictures of arctic animals, you would notice many body shape variations. For example, wolves have very long legs for their body size. This adaptation allows them to run quickly and move easily through deep snow while hunting prey. To help them stay warm, wolves have thick warm coats of fur.

INSULATION

In addition to its body shape, an animal may have other adaptations to help it survive the cold northern weather. One such adaptation is insulation. Insulation is something that minimizes heat exchange between the animal's body and the environment, similar to insulation in our homes. Animals use two primary means of insulation: body coverings, such as fur or feathers, and fat.

Fur: Most cold weather animals have two types of fur. One is a short, densely packed fur close to the skin called **underhair**. The other layer consists of long outer hair, often referred to as **guardhair**. The long guardhairs lay over the short underhairs so that rain runs off the animal, without soaking in next to the skin. Any water that does manage to penetrate this first layer of fur is repelled by the underhair. Furthermore, both types of hair are coated with natural body oils which also help to repel rain and keep the animal dry.

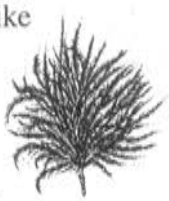
In addition to keeping the animal dry, the combination of underhairs, guardhairs and oil help to keep the animal warm. The fur helps protect the animal from the wind, just like a jacket or blanket would protect us. Fur also helps by trapping a layer of air near the animal's skin. This air, circulating near the animal's body, is warmed by the animal's body heat and acts as a cushion against cold air. Think about what happens when we get under a blanket in the winter. It's cold when we first get into bed, but our bodies soon warm the air around us and the blanket keeps the warm air from escaping. An animal's fur, like the blanket, helps hold the warmth in and protect the animal from the elements.


musk oxen

The musk oxen is one animal on the tundra which can survive the blasting wind and bitter cold simply by standing still. Musk oxen have small, stocky bodies to preserve their warmth, a layer of soft underhair and a full layer of

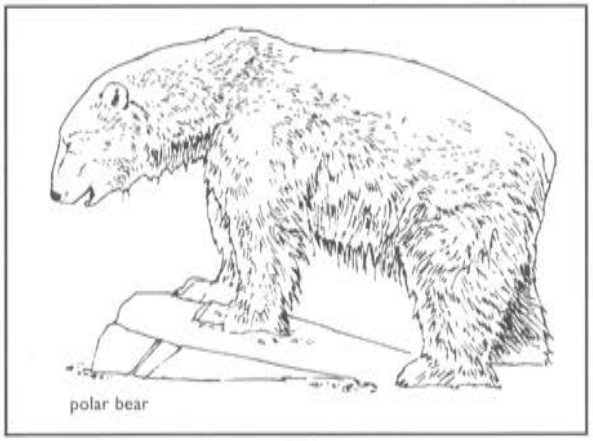
long, black protective hair that can be up to 3 feet (almost 1 meter) long! Each spring, the underhair is shed. Many arctic tribes collect this fur and weave it into winter clothing to help keep them warm during the winter.

Feathers: A bird's outer feathers, or **flight feathers,** are similar to a mammal's guardhairs. These feathers are long and layered to help the rain roll off the animal's body. Like mammals, birds have natural body oils covering their feathers to further protect themselves from the rain and keep dry. Sometimes you can see a bird rub its beak under its tail feathers and then rub its other feathers. The uropygial gland, which secretes oil, is located at the base of the bird's body, under the tail feathers. When you see a bird doing this activity, called preening, the bird is spreading the natural oils over its feathers, thus "waterproofing" itself.



Underneath the flight feathers, birds have small, fluffy feathers called **down feathers.** Like the short underhairs on mammals, down feathers are designed to trap air next to the bird's skin. On cold days, you may notice birds puffing themselves up, an adaptation which traps even more air next to their bodies. In this way, some birds can keep their body temperatures over 100° F (38° C), even when the air temperature is below zero!

Fat: Fur or feathers aren't always enough to keep an animal warm in the far north. Many animals also have a layer of fat under their skin as an additional barrier against the cold. Polar bears have more than 3 inches (7.5 cm) of fat on their backs and sides. Fat is such a good insulator that some animals, such as whales, use only fat, without fur to keep warm. In many marine mammals, like whales, this fat is called **blubber**. Wolves have fat in their feet as an extra insulator for walking through snow.



polar bear

ESCAPING WINTER'S WEATHER

Not all animals living in the extreme northern hemisphere are physically adapted to remain active. Some are unable to find enough food to survive during the harsh winters of this region. Many animals, therefore, use another means of winter survival such as: hibernation/torpor or migration.

HIBERNATION/TORPOR

marmot

Due to severe temperatures or lack of vegetation and other food sources during the winter months, many arctic and subarctic species survive winter by hibernating or going into a state of torpor. Hibernation is characterized by long periods of inactivity coupled with a significant reduction in the animal's body temperature, heart rate and respiration. An active arctic ground squirrel has a heart rate of 200-400 beats per minute, a body temperature of 97° F (38° C), and a respiration rate of 60 breaths per minute. During hibernation, these body functions are reduced to 7-10 heartbeats per minute, 62° F (17° C) body temperature and three breaths per minute (Quinlan, 1988).

True hibernating animals cannot be woken easily, if at all. If they are awoken, they may use so much of their stored energy returning their body functions to normal and then returning to a hibernating state that they won't have enough remaining energy stored to survive the rest of the winter.

The subject of hibernation versus torpor is greatly debated. Torpor is often referred to as a state of semi-hibernation. Animals passing the winter in torpor will frequently wake up for periods lasting from a matter of hours to a matter of days. Although body temperature will decrease somewhat, the physiological changes during torpor are not as dramatic as those during hibernation. By this definition, very few animals are true hibernators. Among the true hibernators are arctic ground squirrels and

marmots. Although often referred to as hibernators, black bears and brown bears instead go into torpor, also called dormancy.

Torpor and hibernation both serve to reduce the level of energy used by an animal. By reducing its body functions, an animal does not require as much energy to survive. Therefore an animal can endure the winter by using stored body fat instead of having to continuously expend and intake new energy during the search for food.

MIGRATION

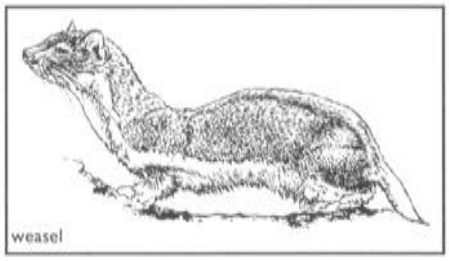
Migration is another means by which animals from the cold northern regions avoid harsh winters. Primarily a behavioral adaptation, migration refers to a movement from one place to another, often for purposes of finding food or breeding. Generally when people refer to migration, they are discussing the seasonal movement of animals, such as birds, between a northern region and a more southerly region during the fall and spring. However, migration refers to any movement of animals from one location to another. Zebras and wildebeest on the African savannas migrate each year, following the rains in search of food. Wildlife living in mountainous areas adapt to variable weather conditions by migrating to different elevations. Some animals, like mountain goats, migrate to higher elevations in the summer when food sources are available, and return to lower elevations in the winter when snow and cold temperatures make mountain life more difficult.


mountain goat

Migration generally occurs as a solution to a change in food availability or climate during certain seasons. For example, each fall thousands of caribou leave the open tundra and migrate a total of 1,350 miles (2,200 km) to spend the winter in the more protected boreal forests of the taiga. Some packs of wolves, although not generally a migratory species, may follow the migrating caribou herds in order to have this continued food source. Snow geese take advantage of summers on the tundra where they nest and raise their young on the bounty of insects and plants. Come winter, they fly south to such areas as the Skagit River Valley here in Washington state. The arctic tern flies almost 22,000 miles (35,400 km) on an annual round-trip migration between the Arctic and the Antarctic. By traveling to both the Arctic and Antarctic for each region's summer season, this tern takes advantage of each area's almost 24-hour sunlit days and abundant food sources.

LIFE UNDER THE SNOW

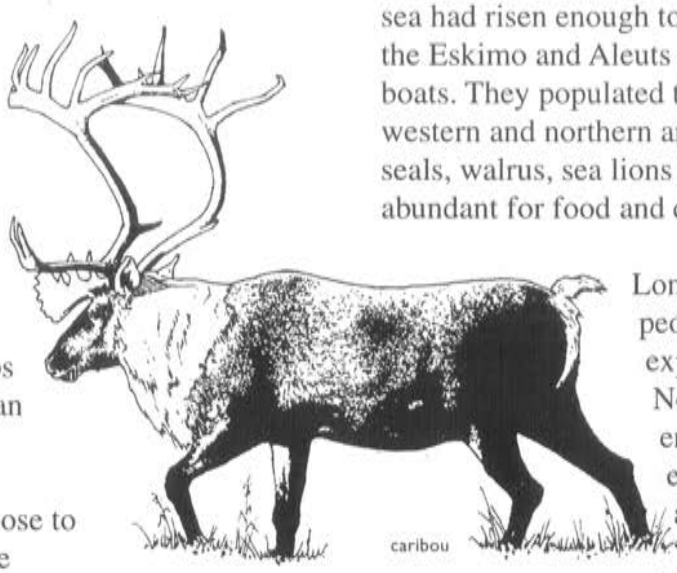
Migration for some species is simply a movement underground. Certain animals, such as voles, mice, weasels, lemmings and shrews, use tunnel systems and spend the winter under deep snow, close to the ground. At this level, the temperatures remain fairly constant (approximately 32° F, 0° C) due to the heat radiating from the earth and the insulating properties of snow. Lemmings have even been known to line their tunnels with grass for a more cozy home. Living under the snow close to the ground, these animals are able to avoid the severe temperatures and wind chill of the surface and they can find food throughout the winter, such as grass or plant seeds. Many also give birth and raise their young during this time. Life under the snow is referred to as subnivean. "Sub" means beneath or below and "nivis" is Latin for snow. Subnivean animals do not go into torpor or hibernation, but remain active throughout the winter.


weasel

If the snow becomes iced over due to rain or a thaw and quick refreeze, the ice prevents air from getting through the snow. Therefore, tunneling animals dig vent shafts to the surface in order to provide themselves with air. However, these air shafts make it easier for predators, such as foxes, to hear and therefore hunt burrowing animals.

Humans in the Winter

Unlike other species of animals, humans do not tend to adapt to their environment as much as they adapt their environment to suit their needs. Through use of modern technology such as heating and cooling units we are able to live comfortably in many different environments. Additionally humans have the ability to easily change their body coverings/insulation through the use of clothing. Due to these factors, humans can live in a wide variety of climates and do not need to rely on the same survival methods as other animals. However, we do occasionally use some of the same strategies.


caribou

For example, humans have been known to migrate. Nomadic tribes of Athabaskan Indians, like the wolves, sometimes follow migrating herds of caribou for a continuous source of food. Other groups move to areas where they can find more abundant food sources. There are also, of course, those of us who choose to "migrate" south to areas like Florida, thus escaping cold winters of the north.

People may also store food for the winter. Hunters and gatherers still gather and preserve plants or dry meat products for use in times of shortage. Many communities now have access to stores or some form of trading area where they can purchase foods otherwise not available during lean times. Canning food products is another means of storing food for times of shortage or when foods are "out of season."

People of Alaska

ALASKA'S HUMAN HISTORY

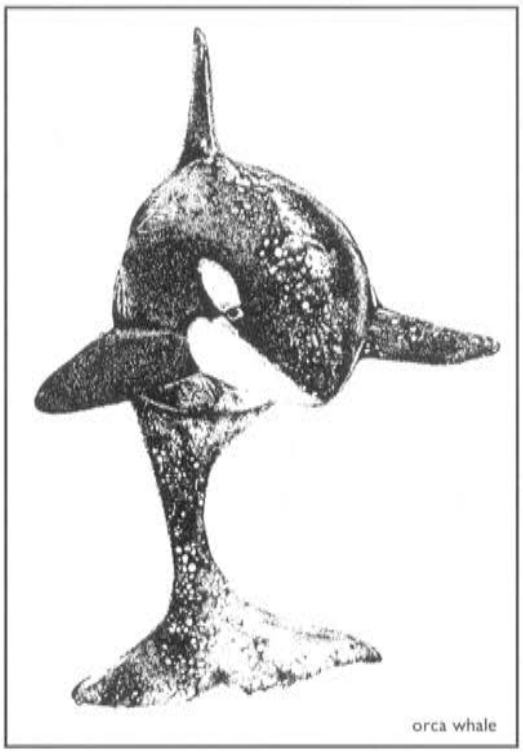
At one time, a land bridge connected the Asian continent with North America. It's been estimated that this land bridge was approximately 1,000 miles (1,610 km) wide and stretched between today's Alaska and the Russian area known as Siberia. From between 15,000 and 40,000 years ago, native people from Asia followed herds of animals who used this land bridge to cross onto the North American continent. These people, known today as Native Americans, continued south and populated much of the area of today's United States. Other tribes of people such as the Haidas and Tlingits came across the land and populated the coastal forests of today's Alaskan Panhandle. The Athabaskan people settled in the interior of today's Alaska and became adept at gathering berries, catching fish and hunting caribou, moose, and mountain sheep with snares and bows and arrows. It is believed that by 14,000 years ago, the sea had risen enough to cover the land bridge so the Eskimo and Aleuts came to this continent by boats. They populated the Aleutian Islands and the western and northern arctic coast where whales, seals, walrus, sea lions and sea otters were abundant for food and clothing.

Long before these native people saw the European explorers who settled eastern North America, they encountered Russian explorers who traveled across the sea to claim the "new land." When Vitus Bering was exploring the self-named Bering Strait in 1741, tales of the land's natural bounty brought Russian fur trappers who settled the area and trapped the seals, walrus and otters until populations of these animals suffered severe declines. By 1867, Russia was no longer interested in the land and sold it to the United States for $7.2 million dollars — approximately two cents per acre. European settlers headed to Alaska for entrepreneurial reasons, first the boom of salmon canneries and then the discovery of gold in 1896. By the 1930s, approximately 65,000 people called Alaska their home. Most had come by ship since there were no roads connecting this land with Canada or the U.S. During World War II, the 1,397 mile (2,248 km) Alaska Highway was built and in 1959 Alaska became the 49th state of our Union. The name Alaska is derived from an Aleut name, "Alyeska," meaning "great land."

There are approximately 550,043 people living in Alaska, a state of 570,374 square miles (1,477,269 sq km). Over half the population, 226,338 people, live in the 1,732 square mile (4,486 sq km) Anchorage Borough (The World Almanac, 1995). Out of the total human population of Alaska, native people make up 15.6% of the state's population, approximately 85,698 people. The majority of native people are Athabaskan Indian, Inuit and Aleut (Thompson, 1991).

ATHABASKANS

Athabaskans are the most culturally varied of any of the native people of Alaska. There are 11 Athabaskan languages in Alaska and almost 20 more in Canada (Nelson, 1983). Athabaskan Indians traditionally inhabited interior Alaska and were **nomadic** groups. Over the past century, they have settled into more permanent villages, however, they do still frequently migrate to summer fishing camps. The use of modern vehicles, such as snowmobiles and trucks allow Athabaskans to travel great distances for hunting, while still maintaining more permanent homes.


orca whale

The culture of the Athabaskan people is based on hunting and trapping game animals and fishing, as well as gathering available plant foods. (Stop by the Tundra Center at the zoo's Northern Trail to see a video on Athabaskan people and a model of a fish-drying rack.) Many plants in Alaska are inedible, but edible berries are heavily utilized. Goods from community stores help to supplement the diet of these hunter-gatherers, but subsistence living is still their primary focus. See the enclosed information sheet, "Athabaskan utilization of the white spruce."

INUITS

Inuits used to be known as Eskimos, a word that means "eaters of raw meat." Most members of these tribes prefer, however, to be called Inuits. These people traditionally had villages along the Bering Sea, along the Arctic Ocean and along a strip on the Gulf of Alaska. Inuits have inhabited this region for around 2,000 years.

When people think of Inuits (Eskimos), they may think of igloos. However, research has shown that these people often built permanent sod homes and used igloos as temporary homes when hunting and traveling between hunting camps. In order to build a sod home in the arctic, a hole had to be dug on the hottest day in the summer when the top few feet of the permafrost would be melted and the digging was easier. A 5-foot (1.5 m) deep hole was dug as the floor of the house. A house half buried in this manner would be better protected from the arctic winds and therefore stronger and insulated. The walls and archways of the house would be made from whale ribs or jaw bones while driftwood and stones would be utilized for floor and wall planking. Sod would then cover the house to further insulate the inside from the cold.

Inuits' primary food source was marine mammals such as walrus, seals and whales. Salmon, waterfowl, berries, ptarmigan and occasionally caribou were also used to supplement their diets. Their meat, clothing, tents, boats, tools, oil for heat, light and fuel all came from seal, salmon and walrus. Subsistence hunters, like the Inuits, traditionally used all parts of the animal, wasting little, if anything. For example, when a giant bowhead whale was harpooned, 100,000 pounds (50 tons) of blubber would be shared between relatives and friends. The rest of the animal would be used to make some of the items mentioned above. They traveled year-round by dogsled or boat, in one-person kayaks or 10-person umiaks

covered with stretched seal or walrus skin. Today, hunting is still a primary means of obtaining food for many Inuits, however, additional food supplements, clothing and other items can be purchased at village stores. Dog sleds and kayaks are still used, however, three- and four-wheeled overland vehicles and motorized boats are often utilized as well.

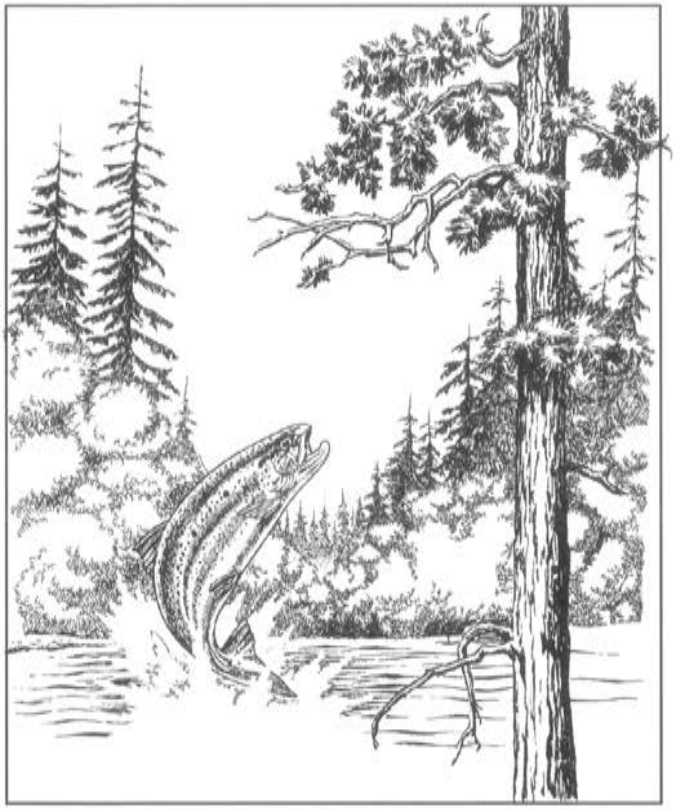
ALEUTS

The Alaskan peninsula and Aleutian Islands are home to the Aleuts. They have always lived in permanent villages; their original structures were large communal structures housing up to 40 families. The Aleuts utilized plants and animals from the sea and land animals as their primary food source. Today many Aleuts are commercial fishermen.

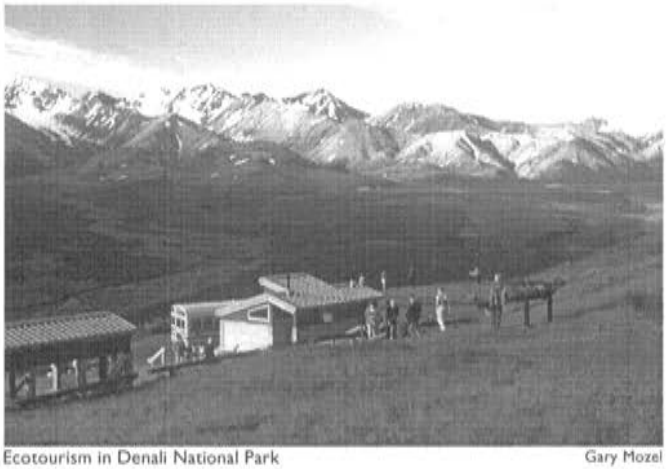
ECONOMY

Alaska's economy is primarily driven by mining, timber, fishing and tourism. The oil and gas industry is by far the biggest contributor to Alaska's income. For example, in 1991 approximately 2 billion dollars was generated by taxes and royalties on North Slope crude oil. That figure means that 85% of every state dollar is generated from this source (Thompson, 1991).

The predominance of the oil and gas industry is due in part to the discovery of oil in Prudoe Bay and the completion of the Alaskan Pipeline during the 1970s. Oil is shipped via the pipeline from Prudoe Bay on Alaska's north coast to its southern coast at Valdez, on Prince William Sound, where ships then transport the oil to the **Lower 48**. Prince William Sound is the location where the oil tanker, Exxon Valdez, hit a reef off the coast of southern Alaska in 1989. Eleven million gallons of oil were spilled into the bay, killing an estimated 300,000 sea birds, sea otters and seals. This was the largest oil spill in North American history.



Alaska's second largest industry is tourism. Tourism has been growing at a rate of 4% annually; over one-half million people visited Alaska during 1991 and that number has continued to rise (Facts About Alaska, 1991). The increasing interest in outdoor vacations such as camping, hiking, fishing, hunting and visiting national parks, has resulted in the increase to Alaska's tourism industry. This type of tourism is generally referred to as **ecotourism** and is beneficial to both the state's economy and its natural environment. Ecotourism brings hundreds of millions of dollars into Alaska each year. Part of that money is then put into protecting Alaska's natural resources, for without those resources, the tourist industry would decline.



Ecotourism in Denali National Park — Gary Mozel

Ecotourism is an oft-debated subject. There are many people on both sides of the argument when the question is raised as to whether ecotourism is beneficial or harmful to a habitat and its plants, animals and people. On the one hand, as was previously mentioned, ecotourism

pours large sums of money into regions rich in natural habitats, like Alaska or east Africa. However, increases in tourism require hotels, restaurants, roads and other facilities to be built. More people come to an area, placing added pressure on the habitat. Also, more natural resources are needed to feed and entertain visitors. No absolute verdict has been reached about ecotourism but, like most things in life, everything should have its limits and balance is the optimal goal. The topic of the benefits and downfalls of ecotourism would be an excellent topic for debate among older students.

Agriculture is a minor source of income since nutrient-poor soils and minimal moisture makes it difficult to grow crops in most of the Alaskan region. However, there are two very fertile valleys, Matanuska and Tanana, near Anchorage and Fairbanks, where many crops including wheat, hay, barley, cabbages, potatoes and carrots are grown in the cool arctic soils. Sixty percent of farming is done in Matanuska Valley with farms raising beef and dairy cattle, chickens, pigs and sheep. The cold temperatures throughout most of Alaska restrict the growth of crops to these few lowland areas of the interior where long, sunny summer days are combined with relatively long frost-free seasons.

Other Alaskan industries include mining for coal, lead, silver, tin and zinc. Salmon, crabs, halibut, herring and shrimp are the mainstay of the fishing industry while paper and wood products round out the economy. Trapping is also a common profession for many Alaskans. Wolves, beaver, wolverines, lynx, marten and mink are popular and legal to trap.

EXXON VALDEZ — THE ALASKAN OIL SPILL

The 1989 Exxon Valdez oil spill caught the attention of the world. This spill sent 11 million gallons (41.8 million liters) of crude oil into Prince William Sound. This spill was catastrophic to the natural environment of this fragile ecosystem, affecting aquatic and terrestrial animals alike. This spill was tragic and harmful, but what many people don't realize is that there are oil spills almost every single day around the world. This fact does not diminish the seriousness of the Valdez spill. However, it is important for us to be aware that it is not only the spills that make world headlines that are devastating to the environment. Every time oil, or for that matter any pollutant, enters an ecosystem, the future of the habitat and its inhabitants is put at risk.

Each of us, through our action or inaction, help to determine the future of our world. The more we are aware of what is happening in different habitats and in our own backyard, the better able we are to make informed decisions that can help improve our natural environment not only for future generations, but for our own.

For more information on the Exxon Valdez oil spill, see the "Resources" section of this packet.

CONSERVATION OF THE NORTHERN BIOCLIMATIC REGION

The taiga, tundra and montane bioclimatic zones are relatively intact around the world because of their inaccessibility and harsh weather conditions. But as consumption increases in the United States, Europe and Japan and the search for natural resources to feed that consumption continues, these zones will come under greater development pressures.


caribou

Habitat conservation is vital to the survival of many species inhabiting Alaska. Some birds that breed and nest at higher latitudes in the summer migrate long distances to wintering areas at lower latitudes around the world, including here in Washington. For birds and other animals, habitat protection of breeding grounds, migration routes and wintering areas is critical to their conservation. Due to the great distances some animals travel, the protection of habitats needs to span large areas.

OIL THREATENS ALASKA'S WILDLIFE

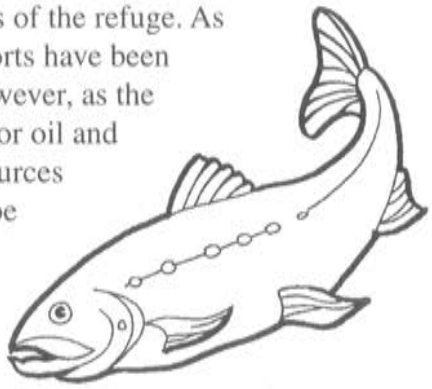
Oil exploration and development are prominent issues relating to the survival of tundra ecosystems. Due to our great dependence on oil, the search for new oil resources sometimes comes in conflict with conservation of these northern ecosystems and human cultures. For example, the Arctic National Wildlife Refuge in Alaska is home to large caribou herds, and numbers of polar bears, grizzly bears, wolves, migrating birds and musk oxen. This area along with the delta of the Mackenzie River in Yukon Territory (Canada) and the Russian Far East (Russia) are areas of potential oil development. Finding a balance between the needs of people for oil resources and protecting the environment for plants, animals and our own benefit, are vital when examining these types of issues.

THE ARCTIC NATIONAL WILDLIFE REFUGE

The Arctic National Wildlife Refuge (ANWR) was created in 1960 by President Eisenhower. Comprising of 19 million acres (7.7 million h), this vital sanctuary for wildlife is located in the north-east corner of Alaska. The ANWR is home to 180 species of birds as well as many species of plants and mammals. Millions of birds migrate to and from the ANWR every year. This refuge is also the site of the annual migration of the Porcupine River caribou herd. One hundred and fifty-two thousand caribou migrate hundreds of miles between their wintering grounds and their spring birthing area.

Unfortunately, the most northern portion of the Arctic National Wildlife Refuge lies along Alaska's North Slope. Currently, 95% of Alaska's North Slope has been drilled, developed, leased or explored by oil corporations. According to Alaska Wilderness League, 800 square miles (2,072 sq km) of Alaska's North Slope is home to "1,500 miles (2,410 km) of roads and pipelines, more than 150 drilling pads, 1,400 production wells, numerous pumping stations and three jet airports."

Oil drilling threatens the future of the ANWR on several fronts. First, oil pipelines run close to the refuge, carrying millions of gallons of oil yearly. A break in one of these pipelines can threaten wildlife living on the refuge. Furthermore, for many years, oil companies have been lobbying Congress to allow drilling to occur within the borders of the refuge. As of 1999 these efforts have been unsuccessful. However, as the world's demand for oil and other natural resources continue, it may be only a matter of time before such drilling is permitted. The irony of this situation is that, according to the Alaska Wilderness League, if the oil companies succeed in gaining access to the refuge, U.S. Geological Survey's estimates say that they will only gain about eight months worth of oil.



FURTHER THREATS TO ALASKAN WILDLIFE

Commercial fishing is another economic source for Alaska which faces a difficult future. There is growing concern that the over-exploitation of Alaska's fisheries may result in the extinction of certain aquatic species. Salmon is the primary commercial fishing source in Alaska. Currently, Alaskan salmon populations do not appear to be at great risk, however, habitat destruction and overfishing can lead to population depletion, therefore it is always important to keep an eye on the future as well as their present status. Although Alaska's salmon populations are not presently at risk, there is ongoing controversy between Alaska's fishing industries and fishing industries of Canada and some of the lower United States. Many fishermen in areas south of Alaska feel that Alaskan fishing habits are reducing populations that would be available to the lower 48 states and Canada.

Logging is a controversial issue around the world. In Alaska the timber industry provides a valuable economic contribution to the state's income as well as thousands of jobs. On the other hand, depletion of these natural resources poses both environmental and economic problems. Logging removes trees holding literally tons of soil in place; the soil often ends up running into streams and other waterways during times of rain or snow melt.

bald eagle

This soil runoff then clogs waterways, affects aquatic ecosystems and may even affect other industries, such as fishing. Timber removal may also have negative effects on ecotourism, since the beautiful areas tourists come to visit are often the ones that are easily accessible for industry.

Around the world northern boreal forests cover more land region than Brazil's rain forest. Because the taiga is one of the most intact forest types in the world, many scientists believe it may be even more critical for countering the effects of global warming than the tropical rain forest. The forests of eastern interior Russia (Siberia) represent almost 60% of the world's coniferous forest volume. (See attatched opinion piece by Tom Brokaw.)

The tundra is a delicate system susceptible to damage from disturbances. Vehicular tracks made in permafrost-prone soils leave marks that may take centuries to disappear. Development activities (oil and gas exploration, road construction and mining) can significantly damage these fragile areas unless care is taken to protect tundra vegetation. Any structure built on tundra must be shielded to prevent the transfer of heat from the structure into the ground. Otherwise, heat from the structure causes the permafrost to melt which can result in unstable soil and structural damage to the building. Construction projects in the arctic need to be well-planned to minimize damage to the surrounding tundra and impact on wildlife. Any human-initiated change in this environment is likely to be permanent.

Alpine tundra is also vulnerable to human activity. Due to the short growing season and harsh conditions similar to arctic tundra, it is very difficult to restore the landscape once damage occurs. This is illustrated in the alpine regions in Washington state. The National Park Service at Olympic, Mt. Rainier and North Cascades National Parks has been involved for the last 20 years in alpine restoration projects at higher elevation campsites and trails. Despite this length of time, many of the scars on the land have yet to heal. Development and use of alpine tundra areas must be carefully planned and monitored to minimize damage.

Awareness of environmental and economic issues and knowledge about how our individual behaviors affect our environment can help us make decisions which will benefit, rather than destroy, our environment. Supporting sustainable logging and fishing practices by carefully selecting the products we buy, or participating in noninvasive activities, such as responsibly reducing our demand for nonsustainable products, such as oil, are just a few of the many things we can do to help protect our environment and ultimately our species.

WOODLAND PARK ZOO AND CONSERVATION

The Northern Trail exhibit at Woodland Park Zoo provides zoo visitors with the experience of Alaskan taiga, tundra and montane regions. This experience helps people to develop an appreciation for Alaska's habitats and wildlife. In addition, visitors acquire an understanding of conservation issues surrounding Alaskan wildlife. Many species of plants and animals that inhabit Alaska are also found in Washington state. Some animals, such as birds of prey, waterfowl, sea lions and whales migrate between Alaska and Washington state and depend on healthy habitats in both states. For this reason, many conservation efforts in Washington state also benefit Alaskan species.

Alaska is home to the largest population of bald eagles in the United States. However, human activities in Alaska, such as logging and hunting, have affected bald eagle populations. Bald eagle nests, such as the one in the Northern Trail exhibit, are large and heavy. Thus, bald eagles rely on the presence of large, sturdy trees in which to build their nests. In Alaska prior to 1959, when legislation which outlawed the possession or killing of bald eagles was passed, thousands of bald eagles were killed by humans. The eagles were killed due to the belief, later disproved, that eagles were depleting wildlife resources important to the human economy of Alaska by eating large numbers of animals, such as foxes and fish. Bald eagles in Washington state, some of which are residents and some of which may migrate south from Canada and Alaska, have faced similar threats. Since the 1970s, Woodland Park Zoo has conducted a program to rehabilitate and release bald eagles and other birds of prey that have been injured in the wild. Some of these injuries are due to humans. Woodland Park Zoo has successfully released more than 70 rehabilitated birds of prey back into the wild.

Depending on winter conditions in the north, snowy owls may migrate as far south as Washington state. During the winter of 1996-97, a snowy owl became trapped in a parking garage near SeaTac Airport. Keepers from Woodland Park Zoo were called to capture the animal in order to release it back into natural habitat. The owl was captured and keepers checked its physical condition. The keepers determined that the owl was faring well and released it back into the wild.

Woodland Park Zoo is also involved in efforts to maintain populations of wolves and grizzly bears in Washington state. Scientists of the Center for Wildlife Conservation (CWC), a consortium of government agencies and universities housed at Woodland Park Zoo, have recently honed techniques for extracting and examining DNA from animal feces. This technology is being used to monitor populations of wolves and grizzly bears in Washington state as well as other locations in the Pacific Northwest. By locating and mapping where populations of these animals are found, CWC scientists aid government agencies in the management of wildlife habitats.

CONCLUSION

The taiga, tundra and montane ecosystems of Alaska are representative of the taiga, tundra and montane ecosystems found across the Northern Hemisphere. In many ways these habitats are not as threatened as many of the world's ecosystems due to the remoteness of the northern regions and the inhospitable climate. Nonetheless, the habitats of Alaska are at risk due to some of the valuable resources found there. As is true throughout the world, it is vital that people work together to balance the needs of the human race with the conservation of the world's natural resources, including its plants and animals.

Our personal actions, such as the conservation of paper, paper recycling, purchasing of products made from recycled materials and reducing our personal consumption of fossil fuels, especially oil, can have a significant influence on the future of Alaska's wildlife, as well as wildlife and humans around the globe.

As individuals, our conservation efforts do make a difference and when we work together in groups or as a community, we strengthen our commitment to conservation, both locally and worldwide. Make a difference...get involved.

Plants and Animals of Alaska

(* indicates species found at Woodland Park Zoo's Northern Trail
The following list is only a sample of animals and plants found in Alaska and arctic regions.

Mammals:

brown bear* - *Ursus arctos*
grizzly bear* - *Ursus arctos horribilis*
polar bear - *Ursus maritimus*
North American black bear - *Ursus americanus*
grey wolf* - *Canis lupus*
Arctic fox - *Alopex lagopus*
red fox - *Vulpes vulpes*
Canadian lynx - *Lynx canadensis*
Dall's sheep - *Orvis dalli*
mountain goat* - *Oreamnos americanus*
snowshoe hare - *Lepus americanus*
snow hare - *Lepus timidus*
collared pika - *Ochotona collaris*
sperm whale - *Physeter catodon*
killer whale - *Orcinus orca*
gray whale - *Eschrichtius robustus*
Steller sea lion - *Eumetopias jubatus*
walrus - *Odobenus rosmarus*
northern fur seal - *Callorhinus ursinus*
sea otter - *Enhydra lutris*
North American river otter* - *Lutra canadensis*
moose - *Alces alces*
caribou - *Rangifer tarandus*
musk ox - *Ovibos moschatus*
Brower's marmot - *Marmota broweri*
hoary marmot* - *Marmota caligata*
red squirrel - *Tamiasciurus hudsonicus*
Arctic grey squirrel – *Spermophilus parryii*
beaver - *Castor canadensis*
meadow jumping mouse - *Zapus hudsonius*
collared lemming - *Dicrostonyx groenlandicus*
bog lemming - *Synaptomys borealis*
true lemming - *Lemmus sibiricus*
meadow vole - *Microtus pennsylvanicus*
muskrat - *Ondatra zibethicus*
North American porcupine* - *Erethizon dorsatum*
ermine (large weasel) - *Mustela erminea*
American mink - *Mustela vison*
common (least) weasel - *Mustela nivalis*
American pine marten - *Martes americana*
fisher* - *Martes pennanti* (very restricted area of northern panhandle)
wolverine - *Gulo gulo*

Birds:

gyrfalcon - *Falco rusticolus*
(found at Woodland Park Zoo's Raptor Center)
peregrine falcon - *Falco peregrinus*
(found at Woodland Park Zoo's Raptor Center)
osprey - *Pandion haliaetus*
northern harrier - *Circus cyaneus*
sharp-shinned hawk - *Accipiter striatus*
red-tailed hawk - *Buteo jamaicensis*
rough-legged hawk - *Buteo lagopus*
golden eagle - *Aquila chrysaetos*
bald eagle* - *Haliaeetus leucocephalus*
Steller's sea eagle - *Haliaeetus pelagicus*
northern hawk-owl - *Surnia ulula*
snowy owl - *Nyctea scandiaca*
northern pygmy owl - *Glaucidium gnoma*
common loon - *Gavia immer*
Arctic loon - *Gavia arctica*
Pelagic cormorant - *Phalacrocorax pelagicus*
double-crested cormorant - *Phalacrocorax auritus*
tundra swan - *Cygnus columbianus*
trumpeter swan - *Cygnus buccinator*
spruce grouse - *Dendragapus canadensis*
ruffed grouse - *Bonasa umbellus*
willow ptarmigan - *Lagopus lagopus*
rock ptarmigan - *Lagopus mutus*
white-tailed ptarmigan - *Lagopus leucurus*
common ringed plover - *Charadrius hiaticula*
semipalmated plover - *Charadrius semipalmatus*
snow bunting - *Plectrophenax nivalis*
McKay's bunting - *Plectrophenax hyperboreus*
tufted puffins - *Fratercula cirrhata*
horned puffin - *Fratercula corniculata*
Cassin's auklet - *Ptychoramphus*
rhinoceros auklet - *Cerorhinca monocerata*
eider - *Somateria* spp.

Reptiles and Amphibians:

garter snake - *Tham nophis*
wood frog - *Rana sylvatica*

Trees and Shrubs

Alaska yellow cedar - *Chamaecyparis nootkatensis*
bearberry - *Arctostaphylos uvaursi*
black cottonwood - *Populus trichocarpa*
black spruce - *Picea marina*
blueberry - *Vaccinium* spp.
bush cinquefoil - *Potentilla fruticosa*
crowberry - *Empetrum nigrum*
devils club - *Oplopanax horridus*
dwarf arctic birch - *Betula nanna*
hooker willow - *Slix ookeriana*
quaking aspen - *Populus tremuloides*
mountain cranberry - *Vaccinium vitisidaea*
Nutka rose - *Rosa nutkana*
prickly rose - *Rosa acicularis*
resin birch - *Betula glandulosa*
Scouler's willow - *Salix scouleriana*
tamarack - *Larix - laricina*
white spruce - *Picea glauca*
wood rose - *Rosa woodsii*
wildflowers, grasses and ferns

FASCINATING FACTS

- There are 128 species, 54 genera and 19 families of woody plants in Alaska. Woodland Park Zoo's Northern Trail has 59 native Alaskan species of plants.
- Of the 128 woody plant species native to Alaska, approximately two-thirds, or 90, of these are in the willow *(Salicaceae)*, rose *(Rosaceae)* or heath *(Ericaceae)* families.
- Although Alaska is the largest of the United States, it is home to only 33 native tree species. Most other states have more than twice as many tree species.
- Alaskan state records: Port Walker on Alaska Panhandle receives 220 inches (559 cm) of precipitation per year. Record high and low temperatures have occurred in Alaska's interior region. June 27, 1915, Fort Yukon set the record high temperature at 100° F (38° C). Prospect Creek set the lowest record at -80° F (-62° C) on January 23, 1971 (Heinrichs, 1991).
- A wolf pack may travel up to 30 miles (48 km) or more per day in the winter.
- On hard snow or ice, otters may reach speeds of up to 15 mph (24 kph) by alternately running and sliding.
- Porcupines and their immediate ancestors have roamed the earth for almost 30 million years.
- Arctic terns migrate farther than any other bird on earth. Each year they travel from the North Pole to the South Pole and then back again. The tern's round trip is almost 22,000 miles (35,400 km) every year!
- Sea otters have no blubber but keep warm because of their dense fur. A square inch of sea otter fur has more hair follicles than an average person's head.
- Sea otters eat up to half their weight each day to maintain their body weight.
- Polar bears have black skin and hollow hairs (the original solar heating unit).
- Polar bears have hair on the bottom of their feet to give them traction on the ice.
- A polar bear's den may be as much as 40° warmer than the outside air.
- At birth a polar bear weighs only 16-32 ounces (448-896 g).
- A grizzly bear can sprint as fast as a horse for over 300 feet (91 m).
- Killer whales can weigh over 13,000 pounds (6.5 tons; 5,850 km).
- Transient killer whales generally hunt seals and sea lions, but shrinking populations of their food sources have caused killer whales to start hunting sea otters as well. This is having a negative impact on sea otter populations.
- Killer whale calves can be up to 6+ feet (1.8+ m) long at birth.
- Wolverines may travel 30 miles (48 km) per night searching for food.
- Wolverines and sea otters are the second heaviest and heaviest members of the weasel family, respectively.
- Northern bald eagles may migrate over 1,200 miles (1,920 km) south for the winter.
- Bald eagles have wing spans of up to 8 feet (2.4 m).