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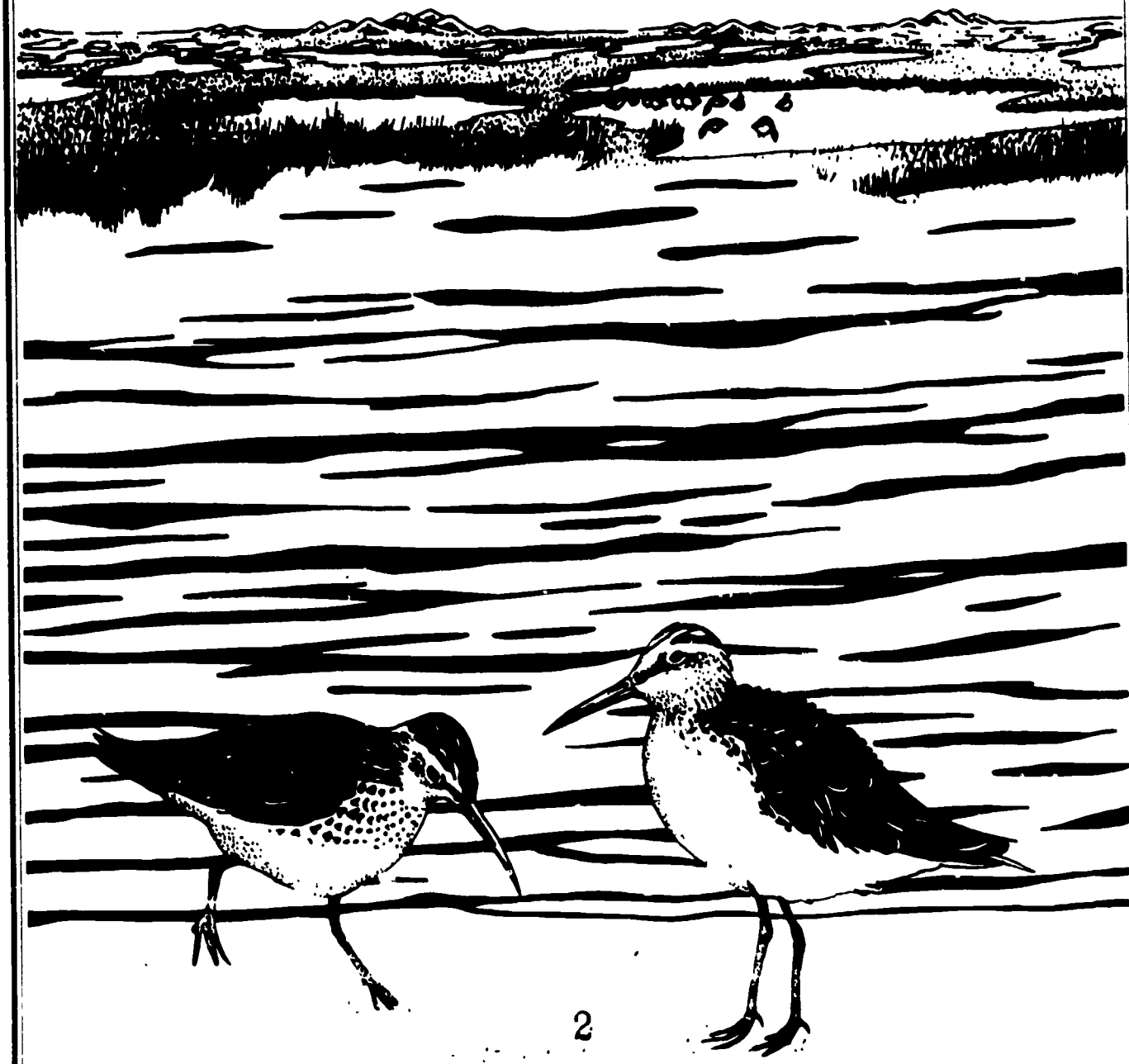
ABSTRACT

This document consists of a teacher manual and a set of information cards. The teacher manual is designed to educate Alaskan students about the important functions of Alaska's wetlands and about the fish and wildlife that live there. Part I of the manual explores Alaska's wetland habitats, the plants and animals that live there, and the relationships between human activities and wetlands as ecosystems. The appendices include a description of wetland types that may be found in some habitat complexes, animal adaptations for living in wetlands, and a reference list. Part II focuses on bird species which are Alaskan summer residents and includes aspects of individual bird species and bird population dynamics. Year-round habitats of migratory birds are discussed in addition to detailed accounts of six species and two sub-species of migratory birds that nest in Alaska. Also discussed is conservation of migratory birds. The appendices include information on bird migration, laws concerning wetlands and migratory birds, and a reference list. These materials contain illustrations and maps. The wetland cards contain over 100 illustrations of plants, invertebrates, fish, birds, and mammals found in Alaska's wetlands. Each illustration is accompanied by text describing the organism's traits, habitats, food habitats, and what eats it. (LP)

WETLANDS & WILDLIFE

Alaska Wildlife Curriculum
Teacher Information Manual, Part I



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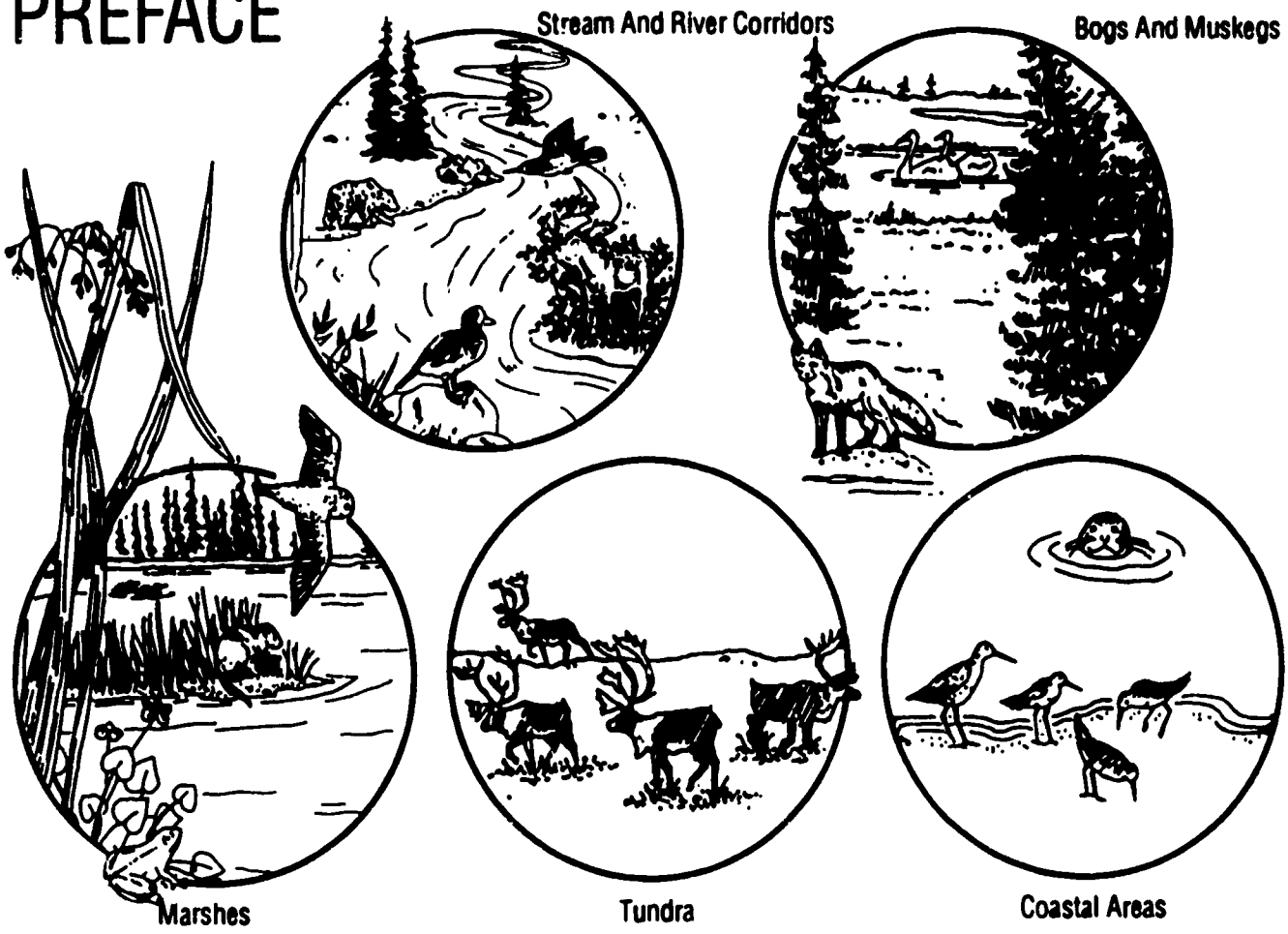
PREFACE



In 1984, the Alaska Department of Fish and Game introduced a curriculum on "Water, Wetlands, and Wildlife" with the following words:

Each long winter, we Alaskans wait, as native Alaskans have waited each year for centuries, for melting snow, thawing ice, and the honking of wild geese returning.

Every year, as they have for centuries, the wild geese return, their V-shaped flocks soaring high across our skies to wedge spring away from winter. The geese, ducks, and shorebirds that pour into our state each spring have traveled great distances to reach Alaska. They have flown from the continental United States, Mexico, Central and South America, Polynesia, and Asia.

Nearly one-half of Alaska is wetlands and over 20 percent of the state is suitable habitat for breeding waterfowl. Most of the 16 national wildlife refuges and 1.2 million acres of state game refuges and critical habitat areas were set aside to protect waterfowl habitat. This habitat base supports 37 species of waterfowl, including thirteen populations of geese and 30 populations of ducks. Alaska is the primary breeding grounds for 80 percent of the world's trumpeter swans, 50 percent of tundra swans, and also for six of the 11 sub-species of Canada geese. Generally, Alaska habitats support 20-50 percent of the pintails, 25 percent of the wigeon, and 20 percent of the scaup and canvasbacks in North America. Annually, Alaska yields a fall flight of approximately 80,000 swans, 750,000 geese, and 10-12 million ducks to all four U.S. flyways, Canada, Mexico, and Asia. About 17 percent of all geese and 11 percent of all ducks harvested in North America are from Alaska. In addition to waterfowl production, Alaska provides molting, staging, and wintering habitat for several hundred thousand ducks and geese that breed in Canada and the Soviet Union.

Why do these birds come here each spring, and where are the flocks going as they pass overhead? In a sense, they come to Alaska for water. All living things — plants and animals — need water. But many species, like the geese, are adapted for living in, on, and around water. They come to Alaska to feed, nest, and live in our wetlands.

Over the past several decades, the public's view of wetlands has shifted. In the past, many people believed that wetlands were wastelands to be filled and put to good use. People are now beginning to consider their value to

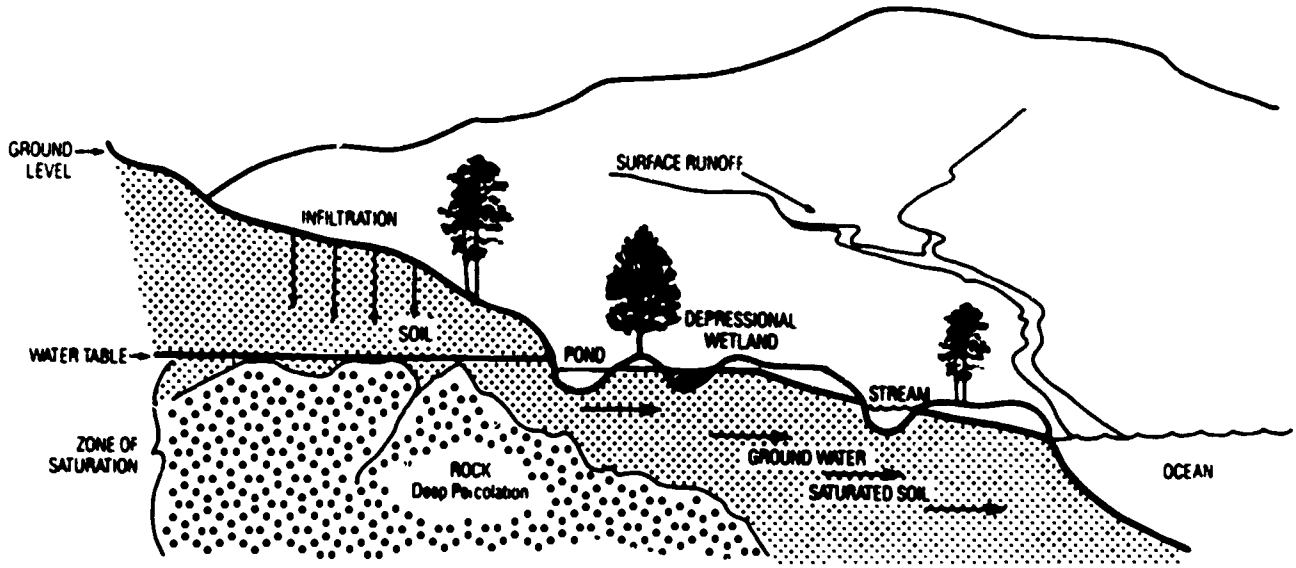
humans often in terms of "goods" well beyond the reach of traditional economics. We are just beginning to appreciate the important functions wetlands perform beyond their well-documented values as habitat for fish and wildlife. Meanwhile, as wetlands losses mount, declines in some fish and wildlife populations have highlighted the importance of wetlands as habitat. Among many fish and wildlife species that depend on wetlands, waterfowl are among the most visible and most closely managed because of their importance to many people across North America who are either recreational hunters, subsistence hunters, scientists, or birdwatchers.

Teacher Information Manual, Part I explores Alaska's wetland habitats, the plants and animals that live there, and the relationships between human activities and wetlands as ecosystems. Part II focuses on the management of the migratory birds that depend on wetlands.

Two agencies, the Alaska Department of Fish and Game and the U.S. Fish and Wildlife Service, have joined forces to develop these curriculum materials. The Department of Fish and Game had targeted 1990 as the year to update and revise the Alaska Wildlife Week curriculum packet entitled "Alaska's Water, Wetlands, and Wildlife," distributed in 1984. The U.S. Fish and Wildlife Service also embarked in 1990 on a statewide information and education program about waterfowl management. They planned to adapt materials from the "Teach About Geese" curriculum developed in 1988 that addressed topics related to the decline of populations of geese nesting on the Yukon-Kuskokwim Delta. This curriculum packet combines, adapts, and extends many activities from the earlier curriculum packets.

This reference manual is designed to give you a resource "at your fingertips" to answer the biological, ecological, and management questions about Alaska's wetlands and the wildlife that depend upon them. The curriculum will help you educate Alaska's children about these topics important to Alaska's economic, cultural, and recreational well-being. Educated children will ensure a sound future for the wetlands and wildlife of Alaska.

SETTING THE STAGE: WHAT IS A WETLAND?



So what, exactly, is a wetland? Because some people are apparently keeping track of wetlands, it would seem that there would be a common definition. Not so — the definition is different depending on your perspective.

If you're trying to travel, wetlands are places where you may bog down or find yourself mired. Bog, quagmire, muskeg, tundra, swamp, fen, marsh, pothole, pond . . . these are just some of the many names for areas that people recognize as definitely land, but also definitely wet.

If you're a hydrologist, someone who studies the water cycle, then the wetness of a specific area depends on how much water falls on it in the form of rain or snow or which flows across it from "upstream." Water flow can be a matter of torrents down steep mountainsides or trickles down the sides of tussocks or the slow drop-by-drop percolation of groundwater. More importantly, how long an area stays wet and how wet it stays depend on the type of soil or plants there and how steeply it slopes to the next "downstream" area. Thus, water disappears down into cracks and crevices and holes between rocks or soil particles, is taken up by thirsty plants, or quickly streams off steep cliff faces. However, some water remains on the surface in areas where a subsurface layer of rock or permafrost won't let it continue down into the ground or where it enters an existing pond or stream. Wetlands are areas where water remains ponded or near the surface and saturates the soils, leaving no room for oxygen.

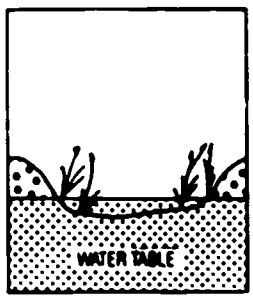
If you're a biologist, wetlands are places where plants and animals that live there must have adaptations for both terrestrial life, or life on land, and for aquatic life, or life in the water. Also, the soil has limited or no oxygen, and organisms which live in the soil and plants that have their roots in the soil must have adaptations to these anaerobic, or low oxygen, conditions.

If you're a regulator, charged with protecting the important functions of wetlands recognized by the Clean Water Act, wetlands have a specific legal definition that currently recognizes the hydrological and ecological conditions described above. However, because the water cycle is dynamic and the wetness of an area varies accordingly, determining whether the legal definition is met by a specific area is often very difficult.

WETLAND AREAS

FACTORS USED TO IDENTIFY WETLANDS

WETLANDS HYDROLOGY



TYPICALLY WET SOILS

PLANTS THAT GROW IN WET SOIL
1 Sedges
2 Cattail
3 Bulrushes

KEY CHARACTERISTICS

1. Wetlands hydrology (water regime): area periodically flooded
2. Soils retain water and are generallly saturated
3. Presence of plants adapted for growth in wetland conditions

INFORMATION ON TECHNICAL WETLAND DEFINITIONS

Alaska has an abundance of areas that are wet during the period of the year that they are not frozen or covered with snow. The question "What is a wet area?" has a common sense answer based on when it's time to don rubber boots or hip boots to walk across an area. But the question "What is a wetland?" has a complicated answer when a technical definition is sought as required by regulations that carry out the Clean Water Act which protects wetlands. Under a definition used by the U.S. Army Corps of Engineers and the Environmental Protection Agency, three factors are used to define an area as a wetland: the **hydrology**, or **water regime**, of the area; the **type of soil (hydric, or water-retaining)**, and the **type of plants that grow there (dependent on wetland conditions, specifically adapted to growth in soils with low oxygen or no oxygen at all)**. With some specific exceptions, human activities that would dredge or fill areas that meet all three criteria require wetland permits under existing laws and regulations.

While federal agencies that manage various wetland resources agree on the basic elements that identify wetlands, the agencies do not always agree that the regulatory definition is accurate for differing purposes and mandates. The *Federal Manual for the Delineation of Wetland Jurisdiction* contains different definitions by three agencies. For example, the U.S. Fish and Wildlife Service, with responsibility for managing migratory bird populations, has adopted a definition that considers the ecological role of areas. Thus, they classify unvegetated areas, such as intertidal sand and mud flats and unvegetated gravel bar islands in rivers or streams, which are important habitat for birds probing for buried invertebrates as wetlands. They classify all areas as wetlands that have predominantly wetland soils, predominantly wetland plants, or where the substrate is not soil, but is saturated with water or covered by shallow water at some time during the growing season. In contrast, the Soil Conservation Service of the U.S. Department of Agriculture, which assesses the eligibility of farmers for U.S. Department of Agriculture program benefits that are no longer provided if wetlands are converted to agriculture (the "Swampbuster" provision of the Food Security Act of 1985), uses a different definition. They exempt permafrost wetlands in Alaska from the penalties of the Swampbuster provision if they have been identified as having a high potential for agriculture (see discussion of permafrost under Tundra Wetlands below).

FACTORS WHICH INFLUENCE WETLAND CRITERIA

The water regime has to do with how much water is present and where the water is in relation to the surface. How much water depends on water cycle processes and patterns. Along the edge of the oceans, the tides dominate the dynamics of surface water flow. Inland, the amount of water present is a result of precipitation, water flowing from "upstream," and loss of water through evaporation or run-off downhill or downstream.

The water regime includes run-off: where the water is in relation to the surface. Saturated surface soils, and thus wetlands, occur where the water table remains near the surface. In many areas, the sheer amount of water that falls or gathers as a result of gravity keeps the water table shallow or higher than the ground surface. In other areas, certain types of substrates (for example, permafrost or clay) which do not allow the water to pass through are present below the surface, so the water table remains "perched" above the layer. If water flow or precipitation continues, water stands on the surface. While the specific patterns of water flow are unique to

every wetland, the presence of standing water or water at or near the soil surface is the key characteristic of a wetland.

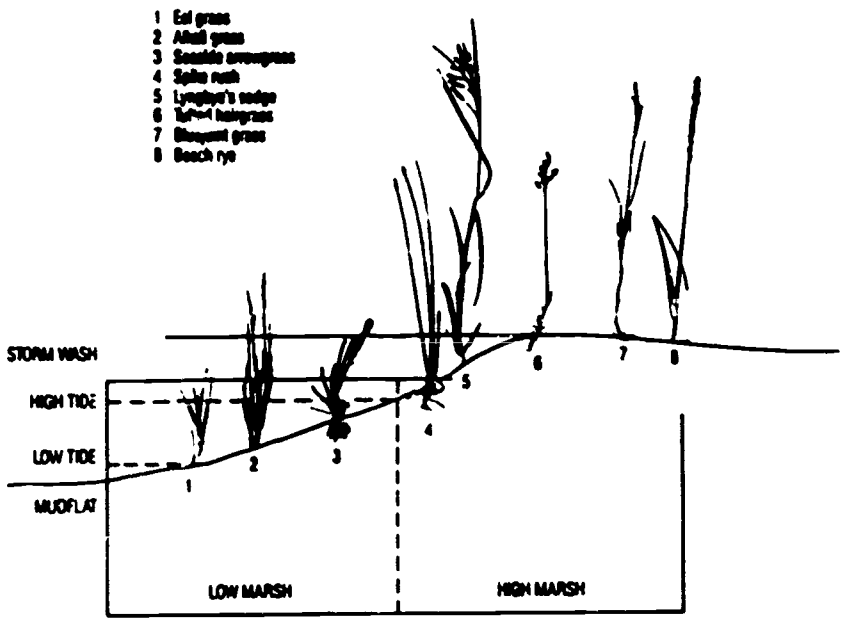
Classifying areas as wetlands also involves determining whether soil saturation is frequent or only occasional. However, because it may be difficult to observe areas for long periods of time, people often observe instead whether wetland soils or wetland plants are present. Certain soil types or certain plants serve as indicators that areas are typically wet. A list of the hydric soil types that indicate wetlands and a list of wetland plants has been compiled for Alaska (see Resources section).

WHAT KINDS OF WETLANDS OCCUR IN ALASKA?

Many people think of wetlands in terms of areas like ponds, lakes, marshes, or bogs. Ecologists and land managers distinguish a much larger number of Alaska wetland types which they describe with technical terms that are likely unfamiliar to you and your students. Thus, these materials provide Alaska wetland descriptions using the commonly-used terms for relatively distinct kinds of areas which generally contain several wetland types.

If you are interested in more detailed information about Alaska wetland types, these terms are cross-referenced with the wetland types identified through the National Wetland Inventory project of the U.S. Fish and Wildlife Service (see Appendix). Please note that this system does not classify areas in the center of ponds, lakes, or stream channels where the water is too deep to support plants as wetlands (they are classified as "deep-water habitat"). Wetland areas such as bogs, saltwater wetlands, and tundra are mosaics of different wetland types and may also contain areas that are not classified as wetlands.

COASTAL AREAS



KEY CHARACTERISTICS

1. Salt or brackish (part salt water, part fresh water) water
2. Productive "edge" area between land and sea
3. Often important or crucial habitat for migratory birds, juvenile fish, and invertebrates
4. Diversity of types: estuaries, salt marshes, mudflats, sandflats, lagoon/barrier island and lagoon/spit systems

All wetland plants are adapted to life in a wet environment. The presence of salt water is the factor distinguishing coastal wetlands from inland wetlands. This factor adds an additional challenge for plant growth. Thus, saltwater wetlands along Alaska's coast have different vegetation than inland, freshwater wetlands. They are extremely productive "edge" areas where nutrients from the land flow down to the sea and nutrients from the sea are brought inland by the tides. Many are important feeding, resting, and nesting habitats for astonishing numbers of migratory birds. They are the nursery for many juvenile fish and invertebrates. For example, the young salmon, bottomfish, crabs, and shrimp get their start in the rich feeding zones of shallow coastal wetlands.

Some of the biologically richest areas in the state are the many estuaries where streams and rivers meet the sea and fresh and salt water mingle. As streams reach low flat areas along the coast, sediment and detritus drop out in delta deposits. At the same time, nutrients dissolved in the water column are shunted back and forth by tidal action. Thus, estuaries are relatively shallow and well-fertilized by constant flows of fresh and sea water that circulate nutrients several times daily.

River deltas support extensive stands of salt grasses and salt-tolerant sedges. These salt marsh communities provide staging areas for migrating swans, geese, and other waterfowl which graze on tender spring shoots and nutritious fall seeds of sedges and arrowgrass. Nearly half of Alaska's salt marsh habitat is along the coastline of western Alaska. The Yukon-Kuskokwim Delta area in western Alaska is one of the most productive coastal wetlands in the world. Wet tundra on the inland delta merges with rich coastal estuaries, where salt water may surge with storms as far as ten miles inland.

This delta alone is the nesting grounds for nearly 2 million waterfowl and an estimated 100 million shorebirds. Nearly the entire world population of emperor geese, many of the black brant, most of the cackling Canada geese, and most of the western population of tundra swans nest in this area. The Delta is also important habitat for two of Alaska's most rare and beautiful ducks, the Steller's and spectacled eiders. Most of the western sandpipers, dunlin, and black turnstones in North America also nest in this rich delta. The Delta was also a vital staging habitat for the Eskimo curlew, now thought to be extinct, and the bristle-thighed curlew, which once numbered in the millions.

Southcentral Alaska has approximately 1/3 of Alaska's salt marsh habitat. More than 20 million shorebirds, including the entire world population of western sandpipers and most of the red knots and dunlin in North America, stop to rest and feed in the Copper River Delta. These birds use their long bills to probe deep in the estuary mud for tiny clams, worms, and other invertebrates; the life found in estuary mud also provides important food sources for herons and other shorebirds, dabbling waterfowl, and juvenile bottomfish and salmon. Once rested, the flocks push farther north and west to nest in other Alaska wetlands. The entire population of dusky Canada geese remain to nest there, along with a large proportion of the trumpeter swans that migrate to Alaska to breed.

Though the state's salt marshes are important and even critical in many cases to the well-being of many species of migratory birds, they make up a small percentage (1.7%) of Alaska's coastal wetlands; Alaska's long coastline has only 7% of the salt marsh habitat along the entire U.S. coastline. Every small delta and salt marsh is an important link in the chain of wetlands that enable birds to migrate from as far away as South America and Polynesia to arctic Alaska. Most migratory water birds must stop over on wetlands to rest and eat in preparation for the next leg of their journey. They also need wetlands all along their route to find shelter during storms. All of Alaska's saltwater wetlands, large or small, are important to migratory birds, but some wetlands are particularly important to large numbers of birds. For example, the delta at the mouth of the Stikine River in Southeast Alaska is a migration stopover for tens of thousands of snow geese, trumpeter swans, ducks, and shorebirds.

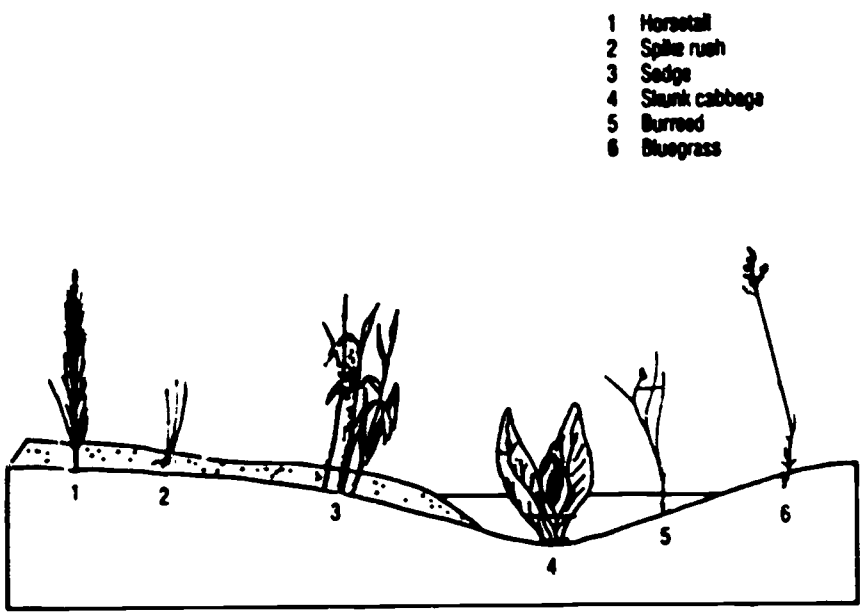
Nutrient-rich water draining into coastal wetlands enriches seawater and provides a rich nursery ground for marine fish and invertebrates in mudflats and shallow-water areas. Subtidal muddy areas may support extensive eelgrass beds which are the nursery areas for flounders, halibut, other juvenile fish, and young crabs.

Many coastal areas from Yakutat to the Beaufort Sea have shallow lagoon systems behind spits or barrier islands that blunt the force of icy winds, rough seas, or the harsh scouring action of pack ice in the north, and which restrict the flow of cold water into the lagoons. The sheltered lagoons are rich in nutrients because of the continuous deposit of silt and detritus by rivers and streams, but remain shallow-water habitat as the ebb and flow of seawater in and out of the lagoon prevents the lagoons from filling up with silt. These protection and enrichment processes permit the development of salt marshes. In summer, the lagoons are relatively warm and brackish and support dense concentrations of marine and anadromous fish close to the shore.

Lagoon/salt marsh areas are important habitat for migratory birds. For example, nearly all of the Pacific Coast population of black brant stop to rest and feed at Izembek Lagoon before making a nonstop flight across the Gulf of Alaska and Pacific Ocean to the West Coast and Mexico. Nearly the entire world population of Steller's eiders and emperor geese gather in Alaska Peninsula lagoons during fall; these birds remain in Alaska throughout the winter. The lagoons also provide shelter from storms and food for molting, flightless waterfowl. Simpson Lagoon in arctic Alaska is crowded each summer by more than 100,000 oldsquaws that gather there and along the rest of the Beaufort Sea coastline to molt. Oldsquaw ducks feed on mysid shrimp, amphipods, and small clams that eat the rich detrital material on the lagoon bottom. Juvenile phalaropes, brant, and eiders crowd the beaches during fall, and migrating pintail, wigeon, and brant use the lagoons and adjoining brackish ponds.

Invertebrates of lagoon mud are also food for fish and gray whales. In lagoons that are deep enough, beluga whales and ringed and spotted seals spend much of every summer preying on fish that live in the lagoons. Some lagoon channels remain open during winter, providing overwintering areas for fish.

STREAM AND RIVER CORRIDORS



KEY CHARACTERISTICS

1. Zone influenced by rivers or streams
2. Nutrients are moved downstream by way of channelled flows
3. Water levels change as stream flows change in response to precipitation, freeze-up, and break-up conditions
4. Plant and animal distributions are in zones in relation to distance from main channels
5. Important movement corridors for fish and wildlife; "corridors of productivity"

The stream and river channels are arteries that thread throughout Alaska. They nourish, and are nourished by, more extensive wetland areas within the riverine zone, defined as the area influenced by the flooding regime of the stream or river. Spring floods bring a rich load of organic debris and nutrients down rivers, overflowing banks and depositing the load into adjacent wetlands. However, during most of the year, rivers steadily receive nutrients from numerous small streams and from the drainage of areas within the stream or river corridor. Nutrients are slowly released from wetlands to the rivers, but rivers store few nutrients, eventually carrying them to estuaries.

The seasonal cycle of ice formation, ice cover, break-up, and alternating storms and dry periods during the period of open water results in major changes in water levels within the riverine zone. The riverine zone of large rivers often includes ponds, oxbow lakes, gravel bars with tall willow stands, and marsh areas. All of these areas are affected seasonally by flooding or are hydrologically connected to the main channels.

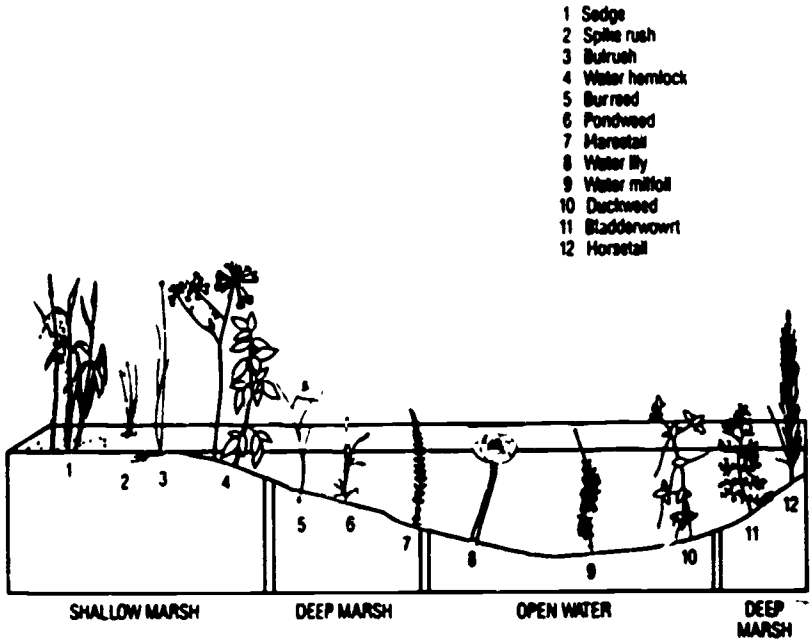
The many plant and animal species that occur in floodplains depend upon the nutrients spread by flood waters. In fact, the frequency with which ponds are connected to stream or river systems is one of the key factors determining the amount of food and subsequently determining the productivity of fish and birds using the ponds to rear their young.

Conditions along the edges of streams, in slowly-moving stretches, and in riverine wetlands are similar to those found in the shallow areas of ponds, lakes, and marshes. Plants and animals have adapted to live in wet areas, depending on their needs and tolerances to being flooded. Their distribution reflects a gradient of adaptation to submersion or exposure to water.

Shrubby wetlands with stands of willows, birches, and alders are particularly important to Alaska's wildlife. A walk through a floodplain willow stand during the summer is a birdwatcher's delight. Tracks of moose and bears are common, usually along with the pellets that indicate that moose spent many winter days browsing on the willows. As the river rises and deposits more silt in the stand, a rich substrate is provided for showy flowering plants such as Jacob's ladder and monkshood and for berry-producing plants. Corridors can include forested wetlands where trees can grow which tolerate temporary flooding. For example, cottonwood forests grow along braided glacial rivers of southeastern Alaska and spruce forests grow among a maze of channels on alluvial fans and gravel bars.

Riverine zones are particularly important to fish because the wetland plants and plants which grow on less-frequently flooded sites provide habitat for their insect and crustacean foods. Plants also slow water currents, and their detritus fuels the aquatic food chain.

MARSHES



KEY CHARACTERISTICS

1. Shallow water areas that support plants
2. Plant and animal distributions are in zones related to depth of water and/or slope of basins
3. Wetland plants provide food and cover for birds, mammals, and fish
4. May provide important nesting habitat for water birds

Depressions that collect water exist as a result of variety of geological processes. Many Alaska lakes and ponds were formed as glaciers receded and gouged holes in the landscape, while others occur where river channels cut across oxbow meanders. Movements of the earth's crust along fault lines created large, deep lakes. The extensive networks of ponds and lakes in permafrost (perenially frozen soil) areas are the result of a complex pattern of freezing, thawing, and filling which alternately creates basins as ice-formed polygons thaw and subside; these basins drain as outlet channels form or they fill with organic matter. Ponds and lakes occur as isolated basins, but many are connected seasonally or permanently to streams or wetlands.

A pond or lake is likely near your home anywhere in Alaska; however, a glance at a map of the state reveals that some areas are dominated by these waterbodies. Ponds and lakes cover the Arctic Coastal Plain; large river deltas such as that of the Yukon-Kuskokwim and smaller deltas such as those of the Colville, Noatak, Kobuk, Selawik, Susitna, and Copper Rivers; the lowlands around Bristol Bay; and inland river "flats" such as the Yukon, Minto, Kanuti, and Dulbi.

While some ponds and lakes are unsuitable places for plants to grow, many are encircled or covered by plants which provide food and cover for fish and wildlife. Shallow marshes, including the vegetated shorelines of ponds and lakes, are wetlands which display different zones with characteristic plant and animal communities. The factors affecting which plants will thrive in a given zone are the depth of the water (sunlight penetration diminishes with depth) and the plants' adaptations to having roots or leaves submerged. In basins, water depths depend upon the depth of the basin and the slopes of the sides of the basin.

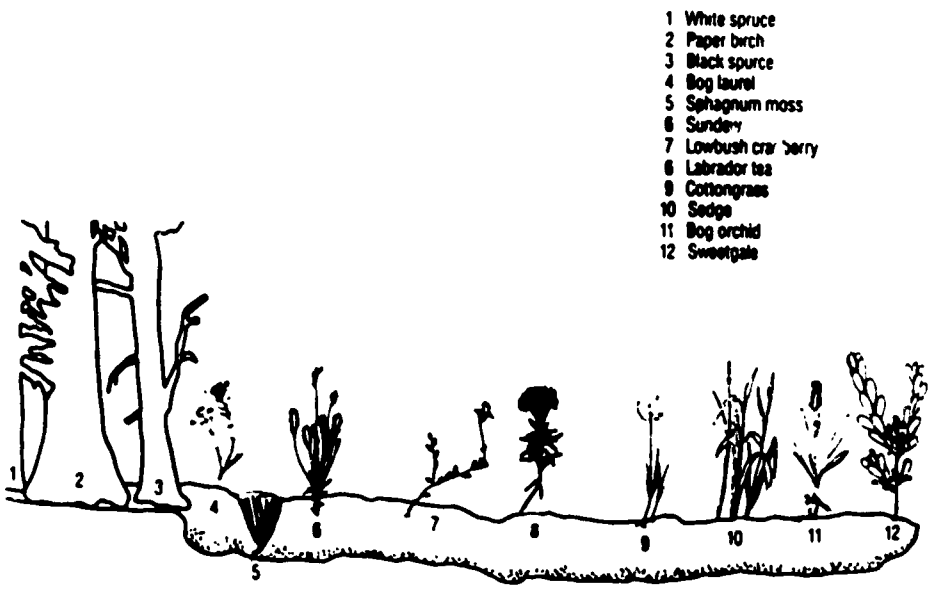
Adaptations to life in shallow water include floating leaves and flowers (pond lily, buttercups), entire plants that float (bladderwort), an "emergent" growth form that allows the plant to live with roots submerged and stems partially covered by water (horsetails, some sedges), and adaptations to photosynthesize when totally submerged (aquatic mosses).

The marsh plants encircling ponds, lakes, and in stands of other shallow water areas provide important cover and food sources for fish and wildlife. Here, young fish, such as grayling and sticklebacks, and ducklings forage on the abundant aquatic invertebrates. Larger fish depend on aquatic invertebrates and the terrestrial insects which drop from plants into the water. Many species of loons, diving ducks, and other waterbirds nest in or near lakes, ponds, and marshes and depend on the plants, invertebrates, or fish in these wetlands. Many animals depend on different plant and animal food sources at different stages of their life cycle. Plants also provide nesting materials for loons and cover for ducks who lead their broods into tall sedge areas at the first hint of trouble.

Some ponds, lakes, and marshes have deep, open water areas without plants. These areas are important habitat for fish and are crucial to overwinter survival when shallow areas freeze. During winter, these areas are also critical to the survival of aquatic mammals such as otters and beavers.

Marsh habitats can be among the richest and most productive for fish, waterfowl, and mammals in Alaska from the sedge marshes of interior Alaska frequented by blackbirds, muskrats, and northern harriers to the vast network of ponds and lakes on the Arctic Coastal Plain dotted with scattered contingents of loon and pintail broods and wading shorebirds.

BOGS AND MUSKEGS



KEY CHARACTERISTICS

1. Usually acidic waters with lush sphagnum moss growth
2. Drainage slow or lacking
3. Slow and incomplete decomposition of plant material which causes peat build-up
4. Plants have specialized adaptations
5. May support trees adapted to wet soils (black spruce, lodgepole pine)

Bogs, often called muskegs in Alaska, are common in the glacially-carved landscape of southeastern and southcentral Alaska and above most of the patches of discontinuous permafrost in interior Alaska. They are a unique type of landform which occurs only in high latitudes, and they are distinguished by a lush growth of moss (usually sphagnum) and thick, organic, acidic soils.

Bogs form in places where drainage is slow or lacking and soil and water temperatures are low. They often form when ponds and lakes are covered by floating plants and eventually filled in by accumulating dead plant materials. In contrast to the rapid decay and export of dead plants from other wetlands, the slow and incomplete decomposition of dead plant matter (mostly moss and sedges) in bogs results in the slow build-up of peat. In interior and northern Alaska, bogs form where low temperatures restrict the activity of decomposer organisms. In southeastern Alaska, bogs form where the wet climate results in waterlogged soils that lack oxygen, limiting the number of decomposer organisms to a low number. In areas with permafrost, slowly-decomposing peat layers and surface mosses insulate the soil and prevent thaw and slumping of ice-rich permafrost. Not all bogs are in low-lying areas; in coastal southcentral Alaska and southeastern Alaska, "perched" bogs may occur in bedrock depressions on slopes or wherever conditions favor development of thick moss carpets.

Certain peat mosses, once established, help retain water and can actually speed up the formation of bogs. The small stems of these mosses have leaf-like projections that contain gas-filled cells. These cells can fill with water and allow the moss to hold 200 times its weight, like a sponge. When dry, the moss can wick water up the stem from groundwater. Finally, the peat mosses release acids which poison bacteria that cause decomposition.

Treeless moss bogs occur in southcentral, interior, southwestern, and southeastern Alaska. Few tree species can grow in these waterlogged soils because their root systems accumulate toxic substances during anaerobic, or low oxygen, respiration. A few tree species have adapted to wet bog conditions and especially to underlying permafrost by developing a broad surface net of roots rather than a deep root system. They are often unstable and lean eventually, creating "drunken forests." Black spruce and tamarack are able to grow new roots as lower roots are "drowned," sprouting roots from lower branches or stems or forming new stems when the tree falls over or is wind-thrown. The indiscriminate trees can grow well on fallen logs. In southeastern Alaska, scattered lodgepole pines grow in many bogs, often in a stunted form.

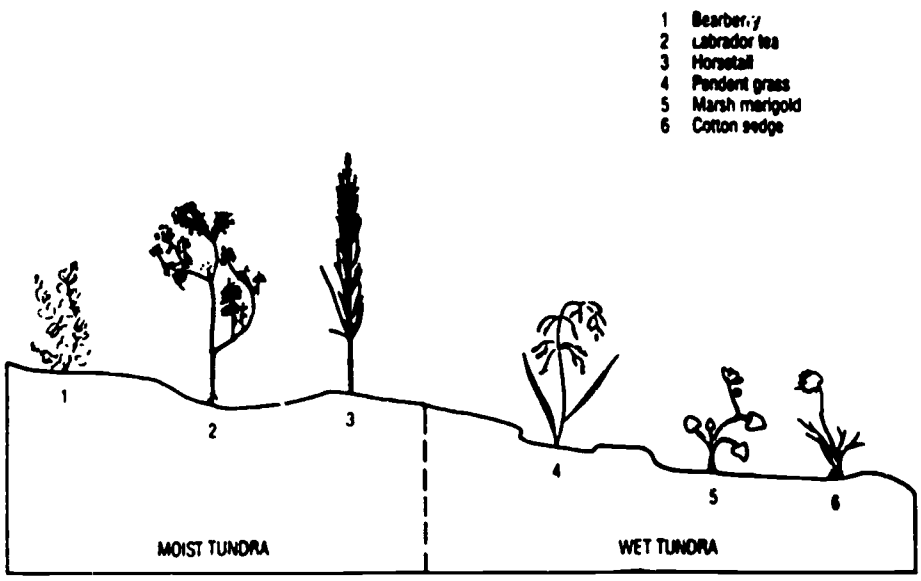
Many plants are common to the soggy soils in all regions; pungent Labrador tea and several spring-blooming plants such as bog laurel, bog rosemary, and shooting stars nestle in the sphagnum mat. Black spruce bogs may also have dwarf birch, willow, and leatherleaf shrubs, horsetails, grasses, and sedges in the understory. Lodgepole pine bogs in southeastern Alaska may include skunk cabbage and various orchid species. Insectivorous plants thrive in otherwise low-nutrient soils.

Due to slow decomposition and thus slow cycling of nutrients, bogs are generally areas of low productivity for

insect foods for fish or birds. The acidic water which slows plant decomposition and nutrient cycling also inhibits growth of algae and bacteria. Thus, plants and animals on lower levels of the food chain are less abundant than in other types of habitats, and fewer animals can be supported at higher levels of the food chain. But wildlife use exists during all seasons. Birds that graze (swans), capture airborne insects (songbirds), or prey on other animals (hawks) use bogs as feeding areas. Aquatic or semi-aquatic mammals such as beavers, mink, and otter often find their preferred foods in bogs. Moose probe during spring and summer for the succulent plants that contain needed minerals.

Because bogs are treeless or support only scattered, stunted trees, they serve as important open areas in forests. They are used by different wildlife species during different seasons. Deer use southeastern Alaska muskegs for courting during fall. During spring and summer, bird songs fill the air above Alaska bogs and muskegs as birds engage in aerial displays. Hawks and owls perch along the edge, keeping watch for the lemmings and voles that venture out of mossy nests. Bogs are certainly one of the most unique habitat types in Alaska.

TUNDRA



KEY CHARACTERISTICS

1. Combination of periodic severe cold, short growing seasons, persistent wind, and no trees
2. Includes many wetlands, but uplands also
3. Elevation most important factor determining where plants grow
4. Some tundra wetlands are extremely productive during thaw period, particularly for migratory water birds and some mammals (for example, lemmings)

Tundra describes all areas that have periodic severe cold, short growing seasons, persistent winds, and no trees. In Alaska, these conditions are met in the western and northern portions of the state where flat or gently-sloping areas have poor drainage and are often underlain by permafrost. Large portions of these tundra areas are wetlands, and tundra areas are found further south and east where permafrost is intermittent. Tundra is also found in alpine areas statewide, but only a small portion of alpine tundra is flat or wet enough to be considered a wetland. Most of lowland tundra remains wet or moist throughout the short season of thaw because water cannot seep through the permafrost and it flows slowly over flat ground. Lowland tundra has peat deposits as a result of the slow decomposition of matter under arctic or subarctic conditions.

Tundra is a mosaic of many different landforms and plant communities. Elevation, which affects the degree of wetness of an area, is an important factor determining where different plants can grow. Often only a matter of inches separates very different plant communities. The wettest tundra areas typically have shallow standing water throughout the summer. Sedges such as cottongrass thrive in this type of environment. In somewhat drier patches (gravel bars, river banks, hummocks, and tops of ice-wedge polygons) where surface water drains by late summer, grasses and dwarf willows can become established. The diminutive flowers of mountain avens (*Dryas* spp.), saxifrages, and taller poppies are found in these areas. Where conditions are dry enough for tussock-forming cottongrasses to establish themselves, these plants create their own mini-uplands. Although only several inches higher than the surrounding tundra, the tussocks provide a roothold for dwarf and shrub birches, Labrador tea, lichens, and many berry-producing plants such as lingonberry, cloudberry, and bearberry which are adapted to drier sites.

Some tundra wetland areas are very productive during the brief arctic summer. Migrations of millions of shorebirds, waterfowl, and other water birds return to the tundra to nest from wintering grounds as far south as Antarctica and South America. They spread out over the variety of tundra micro-habitats. In general the deep and shallow tundra ponds, lakes, and streams near the coast are heavily used by a wide variety of nesting birds. Further inland, fewer species and lower densities of water birds are supported by wetland habitats.

Fish and invertebrates move into flooded wetlands near stream courses where they grow and reproduce. Sticklebacks swarm in wetland complexes where they are preyed upon by loons and other fish-eating waterfowl. Caribou calve and find the summer foods that will allow them to survive the lean winter. Lemmings graze green growth and stockpile "haystacks" for the coming winter. Grizzly bears, arctic foxes, jaegers, and snowy owls are among the predators that roam the tundra, searching for small mammals or bird eggs and nestlings.

After the brief summer ends, many fish and birds migrate to more southern areas, while polar bears and arctic foxes head north with the ice pack. Bears dig dens, and arctic ground squirrels dig burrows and then sleep away the long winter. Insect larvae go dormant and fish find deep, spring-fed holes in rivers. Still, some wildlife are adapted to the harsh winter conditions. Lemmings and voles, muskoxen, ravens, and caribou remain active year-round.

The seasonal ecological importance and ecology of arctic tundra wetlands to fish and wildlife is described in more detail in the articles "The Summer Pageant" (*Alaska Fish and Game* magazine,) and "Arctic-Tundra Wetlands: Values and Management" in the March-April, 1990, edition of the *Alaska Fish and Game* magazine included in this curriculum packet. Tundra is the theme of Alaska Wildlife Week Unit 6 ("Alaska's Living Tundra"). Please refer to this unit for further background information on this type of habitat.

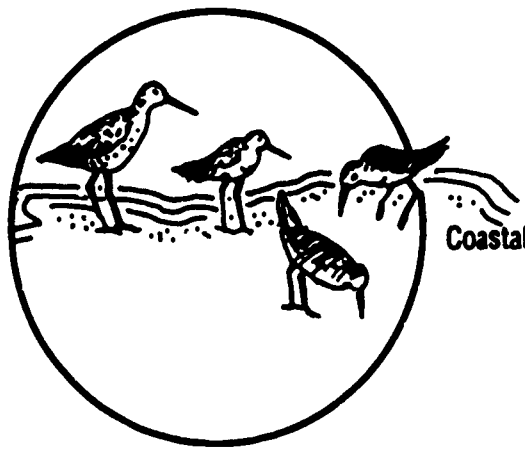
SUMMARY

Wetlands are diverse and productive. Saltwater wetlands line Alaska's long coastline, and freshwater wetlands abound along drainages or where the land is flat and drainage is poor. The next section of the manual describes the fish and wildlife residents of the wetlands.

THE CAST OF CHARACTERS: ANIMALS OF THE WETLANDS

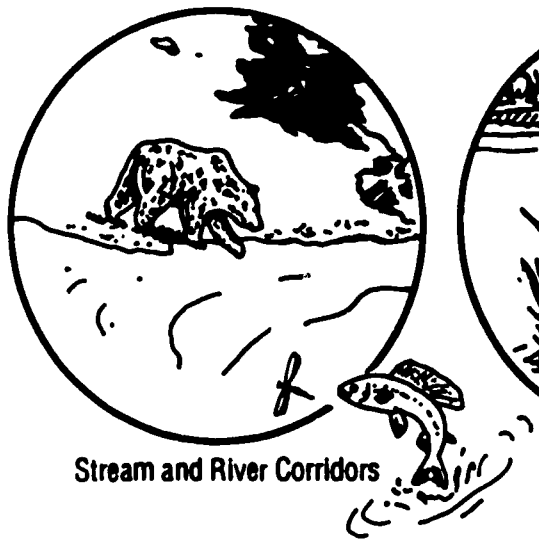
Knowing the natural history of animals helps in making wise decisions affecting their futures. This section introduces the birds and mammals of Alaska's wetlands and then focuses on migratory birds, detailing the identification, status, and annual migration cycle of species that represent unique wildlife management challenges.

Tundra



Coastal Areas

Bogs & Muskegs



Stream and River Corridors

Marshes

WATERBIRDS

Waterbirds are those species found around fresh water or salt water. These birds get their food from the water and can be found in Alaska wetlands.

THE WATERFOWL FAMILY

Ducks, geese, and swans together are called waterfowl. The world's 145 waterfowl species have several characteristics in common. For example, all are web-footed swimming birds with a row of tooth-like serrations along the edges of their broad bills that they use tear vegetation, grasp small fishes, or strain edibles from pond water. All have downy young that, unlike the naked, helpless young of most other birds, are able to see, walk, eat, and run within hours of hatching.

Waterfowl are an order of birds that can be divided into several groups, two of which are found in Alaska: ducks in one group, and both geese and swans in the other. Ducks can be further sub-divided into diving ducks or "divers," puddle ducks or "dabblers," seaducks, and mergansers.

Geese and Swans

Geese and swans are like other types of waterbirds (loons, grebes, shorebirds) in that the males and females have similar plumages and have the same call. Geese and swans mate for life; they molt (replace their feathers) only once a year; and the male guards the nest and helps the female care for the young. Because swans and geese are generally large and conspicuous, they rely more on aggression to protect their nests than on secrecy and concealment. They are adapted for walking on land and for grazing on vegetation.

Five species of geese are common migrants and breeders in Alaska: Canada goose, black brant, greater white-fronted goose, snow goose, and Emperor goose. Three species of swans occur in Alaska: tundra, trumpeter, and whooper swans, although the latter species is a rare visitor from Asia. For more information about several sub-species of Canada goose and on tundra swans, see the next section of this guide.

Ducks

Ducks differ from other types of waterbirds in that female and male ducks have different plumages and voices. They mate only for a single season, each year going through elaborate courtship rituals. During the breeding season, the male's feathers are flashy to attract a mate and to show off in front of other males. Female ducks wear drab feathers to help them hide from predators while sitting unguarded on their nests. The male leaves the female once she begins to sit on the eggs and, thereafter, has nothing to do with her or her young.

Diving ducks dive for clams, insects, crustaceans, fish, and deep plants. They nest at or over water, preferring large marshes and lakes. Their feet are large and webbed, and their legs are set way back on their body for underwater swimming. Thus, they waddle on land, walking awkwardly, but use their large feet and broad webs to propel them through the water and to dive. Some divers can go down to 150 feet. When they take off from the water, their short pointed wings require that they build up speed in a long pattering run along the water surface (loons and grebes also take off this way). Diving ducks that nest in Alaska include the bay ducks, also known as inland divers (canvasback, redhead, ring-necked duck, and scaup), sea ducks (eiders, scoters, oldsquaw, harlequin ducks, goldeneyes, and bufflehead), and mergansers.

Most sea ducks spend their winters at sea, although many move to freshwater wetlands during the breeding season. They have bold black-and-white plumage, compact bodies, and fat layers under the skin. Eider down is well-known for its value as insulation from the cold. For example, in Iceland, the down is collected from nests and used to make warm clothing and sleeping bags

Mergansers are specialized sea ducks that resemble loons and grebes. Like loons and grebes, they dive for fish and carry their young on their back. Common mergansers nest in holes in tree trunks near streams and have slender bills with sharp, teeth-like structures to better catch and hold fish. Red-breasted and hooded mergansers also occur in Alaska.

Dabbling ducks feed on insects and crustaceans on the surface of the water by walking through the water. They feed on bottom-dwelling animals and plants by "tipping up" so that only their bottom and wagging tail can be seen in areas of shallow water. Their necks are longer and their legs are more centrally placed than those of divers. Thus, they walk better on land, often nesting away from water on the ground among grasses and later moving their brood relatively long distances to water. Because their broad wings allow dabblers to fly quickly off the water when taking off, they can nest and feed on smaller ponds and escape predators. As they take off, they flash an iridescent speculum (patch on the trailing edge of the wing). Mallards, pintails, teal species, American wigeon, and northern shovelers are common dabbling ducks that migrate through and breed in Alaska (the mallard is the most common duck in North America). The life history of the northern pintail is described in Teacher Information Manual Part II.

LOONS

Loons are striking birds with black and white spots and stripes. They sit low in the water and often sink straight down like a submarine. In flight, they hold their heads lower than their body. Webbed feet and sharply pointed bills are other characteristics of this excellent diver that feeds on fish or aquatic invertebrates. The common loon, Pacific loon, and red-throated loon are Alaska loons which use both freshwater wetlands for nesting and brood-rearing and marine waters for wintering.

GREBES

Grebes have long, skinny necks and are smaller than loons. Both red-necked grebes and horned grebes can be seen swimming and diving in freshwater lakes, ponds, and slow-moving rivers. Grebes have lobed toes instead of webbed ones.

SHOREBIRDS AND WADERS

This diverse grcup includes cranes, herons, and shorebirds. Some shorebirds are upland birds in the sense that they feed and nest in drier areas away from wetlands; but, as a group, these birds are among the most abundant users of Alaska wetlands where they find food, stage along their migration route, or nest. Alaska wetlands are particularly important for some shorebird species because it is the only place in the world that they nest. Shorebirds are most identifiable during spring when they are in breeding plumage; during fall and winter, they have only brown, black, and white feathers.

Shorebirds, in general, have long legs for wading, short tails, and sharp, pointed wings such as falcons and other fast flyers. Dowitchers, godwits, plovers, turnstones, sandpipers, curlews, snipe, phalaropes, and yellowlegs make up the many whirling flocks which migrate through Alaska, staging in areas like the Copper River Delta by the millions. Dowitchors and curlews probe the mud and sand of tidal and riverine flats for insects, crustaceans, and mollusks; yellowlegs and herons wade into shallow water on long legs. Plovers patter their feet on loose sand or mud causing the small organisms on which they feed to rise to the surface. As shorebirds reach their nesting grounds, they spread out into a diversity of habitats.

SEABIRDS

A wide variety of birds fit into the category of "seabird." Several seabirds spend the summer in inland wetlands, although a larger variety of seabirds nest on the coast. All seabirds spend most of the year (September through April) along the coast or at sea. Many seabirds of the wetlands nest in colonies on islands, which protects them from predators such as foxes.

Seabirds have webbed feet, and their bills are sharp for snatching up fish and invertebrates. Seabirds that spend the summer in Alaska wetlands include gulls, terns, and cormorants. Mew gulls and arctic terns nest in colonies in many marshes and lakes. Bonaparte's gulls nest in trees near lakes in interior Alaska. Larger gulls, especially glaucous-winged, glaucous, and herring gulls, visit lakes and rivers to feed. Some arctic terns and gulls nest on gravel bars along rivers. Double-crested cormorants breed at a few lakes in southcentral Alaska. Uncommon seabirds of the wetlands include Aleutian terns (near the coast) and Sabine's gulls (on marshy arctic tundra). Many seabird species such as puffins, murres, and murrelets nest only on coastal cliffs along rocky coastlines.

BIRDS OF PREY

Birds of prey, or "raptors," include those species of birds that capture and eat birds, fish, or mammals. This group includes the eagles, hawks, falcons, and owls that perch around the perimeter of freshwater wetlands or soar in the openings searching for voles or nesting birds. All birds of prey have acute vision for spotting prey over long distances.

Bald eagles are common along the coast of Alaska where they feed on fish. Ospreys are also specialized to prey upon fish and nest regularly in Alaska along lakes, rivers, and coastlines soutn of the Brooks Range. The northern harrier is a medium-sized hawk formerly known as the marsh hawk because of its characteristic low-flying, gliding behavior over marshy areas in quest of small mammals. Buteos (soaring hawks) and hawk owls often perch on dead trees to spot prey. Rough-legged hawks, kestrels, snowy owls, short-eared owls, and peregrine falcons are other raptor species commonly spotted over open marshes or tundra wetlands. Hawks hunt during the day while most owls are nocturnal hunters.

PASSERINES AND OTHER BIRDS

Passerines are perching birds, with feet designed for grasping a perch, they are sometimes called songbirds. This group includes flycatchers, swallows, jays, chickadees, thrushes, warblers, finches, sparrows, and many other birds. Many species are true forest birds; others are most common in forest openings or at the edges of forest stands where they can perch, find cover and nesting places, and keep a sharp eye out for insects over ponds, marshes, or muskegs. Flycatchers, swallows, warblers, and sparrows are common throughout Alaska in wetlands or along wetland edges, and the dipper is a specialized year-round inhabitant of springs that stay open during winter. Riverine shrub thickets are especially rich areas for a variety of passerines. Other birds that may be found in Alaska wetlands include woodpeckers, swifts, belted kingfishers, and hummingbirds.

WETLAND MAMMALS

Many different mammal species use Alaska wetlands during part or all of the year. The lush, early spring plant growth attracts deer and bears to the tidal salt marshes. Grizzly bears of interior Alaska seek the green growth on the broad floodplains as spring spreads northward. Further north on the tundra, caribou seek tender sedge shoots as a welcome change from a winter diet of

lichens, dwarf willow, and birch shrubs. As floodplain shrub thickets green up, moose and muskox nibble tender willow leaves in the same areas where they crunched on branches and sought shelter from winter winds and deep snows. The aquatic plants of ponds, stream edges, and marshes are the foods of beaver and muskrats. The amphibious land otter and mink hunt on both land and in the water, feeding on a variety of plants and animals such as small fish, crustaceans, and mollusks.

Throughout the summer, moose feed in ponds and marshes. They often submerge their heads in ponds to obtain the mineral-rich aquatic plants that help replace the calcium lost through nursing cows or to antler development. Caribou feed in tundra wetlands. The late summer berries of bogs attract black bears. Small mammals scurry among tussocks or along the shores of ponds and streams, sometimes pursued by foxes or weasels. Bats may emerge at dusk, hunting insects over ponds and bogs.

Beaver and muskrat are year-round residents of ponds and lakes, continually travelling during winter between the shallow waters that support the plants whose roots and stems they eat and moving into deeper waters as shallow areas freeze. Beavers are the architects of wetlands, creating deep-water habitats by their damming activities and opening clear areas by cutting down trees. While beaver are found throughout the state, the highest populations of muskrats are found in the broad floodplains and deltas of major rivers and in marshy areas dotted with small lakes in the "flats" areas of Alaska such as Yukon Flats, Minto Flats, Northway-Tetlin Flats, the Yukon-Kuskokwim Delta, and the Selawik-Kobuk-Noatak Flats. Muskrats feed on aquatic plants such as the roots and stems of cattails, lilies, sedges, and grass and occasionally feed on mussels, shrimp, and small fish. Living below the ice in ponds during winter, they create "push-up" holes where they push up piles of the grasses collected during summer and keep an air-hole open to access their cache. As shallow ponds freeze, they move to deeper ponds. Small amounts of available food and long, cold winters result in high mortality among the muskrats. Land otters (also known as river otters) forage on land and in fresh or salt water. Mink prefer streams, ponds, beaches, and marshes, but will move inland to take advantage of an abundance of mice or hares.

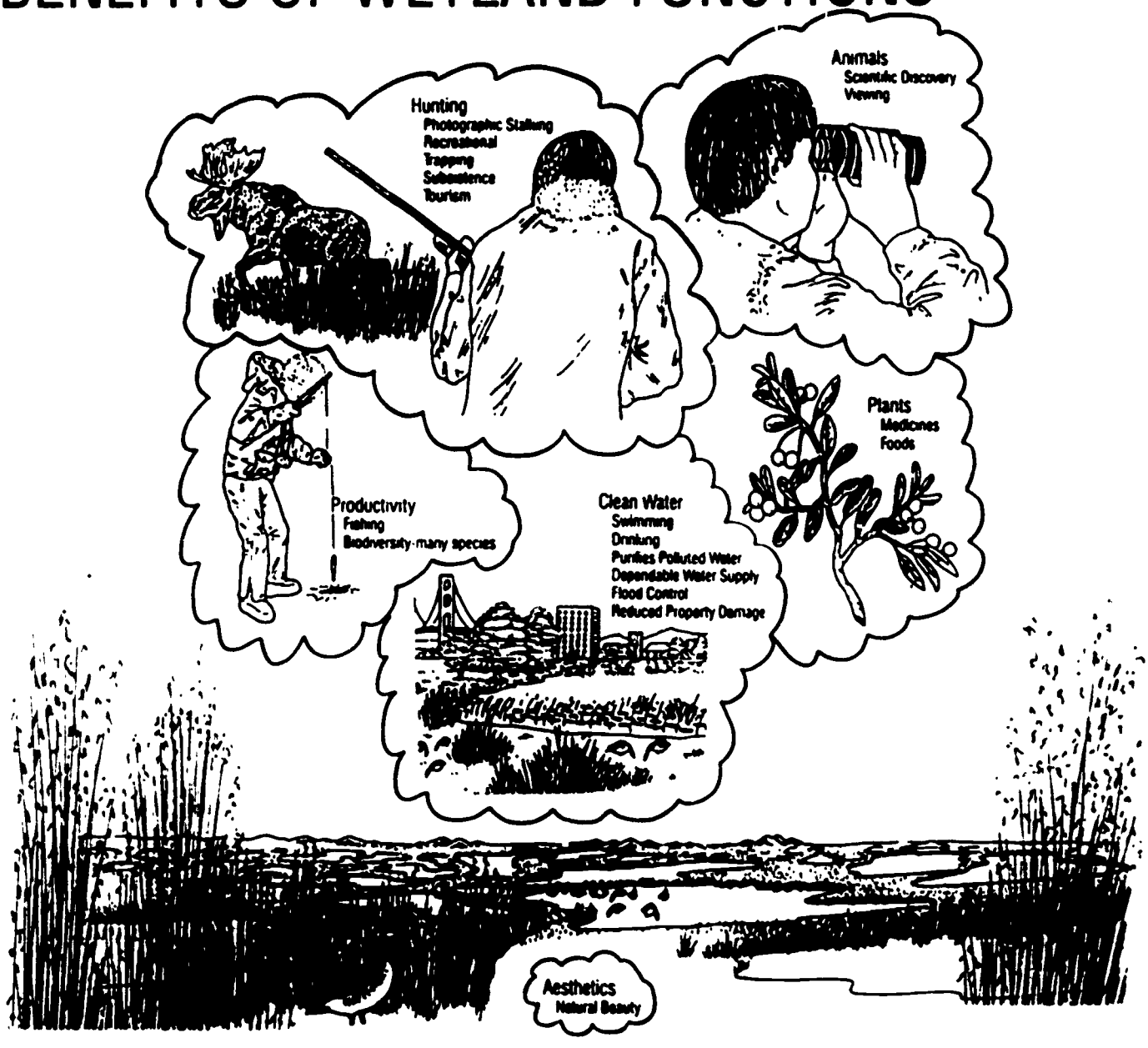
Other mammals reside year-round in tundra wetlands. One of the most characteristic groups is the lemmings. Brown, Siberian, black-footed and northern bog lemmings are year-round tundra inhabitants. They are herbivores, storing cut plants in "hay piles" that they feed upon throughout the winter. When lemmings are particularly abundant, weasels may move to lowland tundra areas to hunt them. Wide-ranging predators such as wolves, coyotes, and wolverine include wetlands in their hunting ranges, often using river corridors for travel during both summer and winter.

FISHES OF THE WETLANDS

Alaska's wetlands are nursery areas for many fish species. The streams, rivers, and riverine wetlands produce the millions of salmon upon which the large Alaska commercial fishery depends. Saltwater estuaries are critical to the successful transition of smolts and juvenile salmon from their freshwater birthplace to their adult life in the ocean. The estuaries are nurseries for other important commercial fish species: halibut, sole, crab, and shrimp. Wetlands also provide habitat for fish caught by sportfishers and for subsistence use.

The emergent plant communities at the shallow edges of streams and rivers, in areas of slow-moving water, and in riverine wetland areas are especially important to small fish such as sculpins, young freshwater fish, and coho salmon. Here, they find cover, an abundance of invertebrate food, and shelter from strong currents.

BENEFITS OF WETLAND FUNCTIONS



The following table, "How Wetland Functions Benefit Humans," extends the article "Alaska Wetlands" in the Alaska Department of Fish and Game magazine (included in this packet) which describes the different wetland functions. Examples of benefits to humans and economic benefits can be used as a reference to lead activities and discussions related to teaching activities in Units 4 (Wetland Worth) and issue-related activities in Unit 5.

While all wetlands have one or more of these functions to some degree, it is rare that a wetland will have all of the possible functions and benefit humans in all possible ways. People who regulate human uses that could disturb wetland functions try to assess the relative degree of the function present and how a proposed change in the wetland (for example, diverting water by using ditches, or placing fill materials in the wetland) will diminish the function. They also consider ways to minimize the loss of functions and to restore wetlands whose function has been impaired by human actions.

A regulator would take into account the value of the wetland as habitat for fish and wildlife when assessing its function as habitat. All wetlands do not have the same value as habitat from the standpoint of individual fish or wildlife species. The habitat requirements of each species differ. Because of these differences, the overall diversity of the species supported by a specific type of wetland or specific wetland can vary considerably. Some wetlands support an astonishing variety of species and others support only a few species. This relativity of value for various wetland functions is important background for the issues that arise in relation to decisions to alter wetlands or leave them in their natural state.

HOW WETLAND FUNCTIONS BENEFIT HUMANS

WETLAND FUNCTION(S)	BENEFITS TO HUMANS	ECONOMIC BENEFITS
FISH & WILDLIFE HABITAT	Hunting - food, recreation Fishing - food, recreation Trapping - furs Wildlife Photography Viewing/Enjoyment Scientific Study	Hunting & Fishing Guiding Industry Subsistence Economy Commercial Fishing Industry Tourism Industry Recreational Equipment Industry
HYDROLOGY • Groundwater Recharge • Groundwater Discharge	Dependable water supplies	Business or industrial use of water Savings on wells and transportation of water
• Maintain Stream Flows	Dilution and transport of pollutants	Less expensive sewage treatment Maintenance of fisheries
• Flood Storage	Safe, dry sites for homes and commercial development Recreation/Open Space	Savings in flood insurance, damage costs, public services
WATER QUALITY	Water supplies suitable for drinking water Swimming	Business or industrial use of water requiring high-quality water, e.g., mariculture, seafood processing. Savings in water treatment for domestic use. Savings in disease control and treatment.
• Sedimentation	Aesthetics (streams, reservoirs)	
• Erosion Protection	Absence can result in property damage	Avoids cost of erosion control structures
• Nutrient Transformation	Purification of polluted water	Less expensive treatment of pollutants.
WETLAND PLANTS	Provide foods (e.g., berries, greens) and medicines	Subsistence economy

HUMANS AND WETLANDS

Wetland Losses

Historically, wetland areas were often thought of as wastelands and thus were developed in order to be put to use. Many human activities required that the wetlands be drained or filled with gravel. Wetlands development has been followed by actions to preserve and restore altered wetlands.

In Alaska, proper or improper land uses in support of agriculture, oil and gas development, community expansion, timber harvest, and mining can alter wetlands in a variety of ways. These land uses may entail clearing vegetation, dredging, filling, changing flow patterns by ditching, diversion, or channelizing, building structures and roads, applying chemicals, and discharging pollutants.

The overall record on conversion of wetlands in North America has been grim from the standpoint of maintaining important fish and wildlife habitat values and other values such as flood control and water quality. It has been estimated that approximately 1/2 of the wetlands in the lower 48 states were lost between the time of European settlement and the mid-1970s. Wetland loss in individual states has been as high as 90% during that period.

In Alaska, the overall losses of wetlands are relatively small in proportion to the large size of the state. These losses have been concentrated in urban areas (Anchorage, Fairbanks, Juneau, etc.), around villages in tundra areas, around communities in the narrow strip of land between mountains and coastal areas of southeastern and southcentral Alaska, and in areas of large industrial development such as oilfields, transportation corridors, and industrial sites. In urban areas particularly, rates of wetland loss are similar to those nationwide. By 1990, the Anchorage Bowl had lost over 1/2 of its freshwater wetlands, and the Juneau area had lost approximately 1/3 of its freshwater wetlands.

Wetland Protection and Restoration

As people throughout the United States began to accumulate information about the importance of wetlands, the protection of many wetland areas was accomplished by creating national and state wildlife refuges, parks, and public recreation areas. The proceeds of sales from state and federal Duck Stamps, a required purchase for waterfowl hunters, are used to help acquire private wetlands for waterfowl habitat. In addition, several organizations concerned with the conservation of wildlife and wildlands (Ducks Unlimited, National Audubon Society, The Nature Conservancy) acquire lands and manage them to avoid further loss of habitat values for fish and wildlife.

Restoration of degraded wetland areas has occurred, but a nationwide wetlands gain of two million acres between the mid-1950s and the mid-1970s was overshadowed by a loss of 11 million acres over the same period. Restoration is required of private developers as mitigation for habitat destruction, and state and federal agencies undertake projects to restore wetlands. However, restoration or creation of new wetlands is difficult, expensive, and not always successful. In Alaska, where wetland systems are often fragile and sensitive to change, very few attempts at restoration have been made.

Regulation of Development Activities

In addition to laws setting aside wetland areas and attempting to restore degraded wetlands, a variety of laws and regulations were passed in the late 1970s that provided for a review of some types of development projects on private or public lands which may result in environmental impacts to wetlands. The most specific legislation is Section 404 of the Clean Water Act which governs activities that require the dredging or fill of wetlands. As implemented by regulations of the Army Corps of Engineers, development projects that would dredge or fill wetland areas are reviewed by state and federal fish and wildlife managers and the public. The purpose of the review is to avoid or minimize adverse impacts to the habitat. However, recommendations on how to accomplish this are weighed against other public factors such as economic benefits that may result from development, whether the projects need to be sited in a wetland or wet area, public needs for facilities and transportation, and whether alternatives that will not affect wetlands exist.

The National Environmental Policy Act (NEPA) also requires reviews of the environmental impacts of development projects on federal lands or which involve major federal actions. A national Coastal Zone Management Act directs attention to the protection of coastal wetlands in land use planning at the state and local level; but again, the need for protection versus development is often reviewed in a trade-off context with societal values. Key concepts of regulating activities in wetlands mitigation include attempting to avoid negative impacts, minimizing impacts that can not be avoided, and restoring and rehabilitating areas that are damaged.

Current Issues in Wetland Policy Development

In 1987, the U.S. Environmental Protection Agency established a National Wetland Policy Forum which attempted to draw in as many perspectives about wetlands protection and management as possible. The Forum included representatives of state governors (including Alaska), federal agencies, conservation groups, oil companies, the logging industry, and wetland scientists. The group held public workshops in several states. Their report (The Conservation Foundation 1989) includes a summary of "the wetland issue" from a national perspective.

In 1988, the Forum recommended that the federal government pursue a policy of "no net loss" of the nation's remaining wetland base, as defined by acreage and function, and to restore and create wetlands where feasible to increase the quality and quantity of the nation's wetlands resource base. ("No net loss" by acreage and function meant that unavoidable losses of wetlands should be mitigated by restoring or enhancing functions on degraded or lower-quality wetlands; wetland losses and gains should be equal in the short run and gains more than offset losses in the long run.)

The recommended policy was vigorously opposed by the oil industry, some local governments, and others in Alaska who believed that the policy would severely restrict development in the state. They argued that Alaska's wetland losses were insignificant and that if development activities continue, losses will continue to be insignificant. Because few alternatives to wetlands development existed in many areas of Alaska (such as tundra wetland areas) and because no technology had been developed for wetland restoration in arctic tundra areas, wetlands policy opponents felt that restoration should not be required in Alaska. They also believed that the large amounts of land already protected in Alaska assured that there will never be a problem similar to that seen in the lower 48 states. Thus, a wetlands issue in Alaska involved the trade-offs of maintaining habitat and other public values of wetlands versus their development for economic benefits to individuals and society as a whole.

President Bush has made the protection of our nation's wetlands a major priority in his environmental program. In an address to the Ducks Unlimited Sixth International Waterfowl Symposium in June, 1989, the President said, "It's time to stand the history of wetlands destruction on its head." He also said he hoped people could report that by 1989 a new policy would be applicable "... a policy summed up in three simple words: 'no net loss'."

In early 1990, President Bush directed the Domestic Policy Council Task Force on wetlands to solicit public input on appropriate strategies for working toward the national goal of "no net loss." The Task Force included representatives from the White House, the Departments of Agriculture, Commerce, Defense, Energy, Housing and Urban Development, Interior, Justice, and Transportation, the Environmental Protection Agency, and the Council on Environmental Quality.

The Task Force has been charged with providing recommendations on wetland policy to the Domestic Policy Council. The Task Force review of wetland policy will consider recommendations for revisions in existing presidential executive orders on wetland protection and flood plain management. For example, Executive Order No. 11990 on the Protection of Wetlands directs federal agencies to minimize the loss of wetlands but does not address the broader issue of working toward the achievement of "no net loss." The Task Force will also examine other methods to work toward "no net loss" of wetlands, including regulatory and non-regulatory approaches such as market-based incentives. Additionally, the Task Force will consider how the aggressive pursuit of the "no net loss" goal may affect farmers, public works projects, businesses, and private landowners.

The following questions cover some of the issues that the Task Force will explore in developing a recommended policy for the president in 1991.

- What should be the appropriate federal, state, and local government roles in working toward the national goal of "no net loss" of wetlands?
- What regulatory and non-regulatory mechanisms now in place offer the best and most effective means of helping achieve the goal?
- What new or revised regulatory and non-regulatory approaches, including market-based incentives, should be considered?
- How effective are current federal, state, and local laws in protecting wetlands?
- At what level should the "no net loss" goal be applied— on an individual property basis, locally within the state or region, or at the national level?

- To what extent can wetlands effectively be created or restored? What tools or approaches should be used to ensure that creation of restoration projects are successful, especially over the long term?
- What role should mitigation banking play in working toward the "no net loss" goal?
- Should wetlands be indexed according to their functions and values in applying the "no net loss" goal? If so, what criteria should be used to determine the index?
- How do we balance the need to protect wetlands against the potential effects on farmers, businesses, and public works projects?
- What research or data collection is necessary in working toward the "no net loss" goal?
- How should the federal government manage its wetlands? How should the existence of wetlands be addressed prior to disposal of federal properties?
- What can be done to encourage public awareness of the value of wetlands?

The U.S. Fish and Wildlife Service responded to President Bush's statements about a national "no net loss" policy with a national wetlands action plan "Wetlands Meeting the President's Challenge."

RESOURCES FOR ISSUE IDENTIFICATION AND PROBLEM-SOLVING

The problem statement developed by the National Wetland Policy Forum summarizes the issues related to wetland loss, protection, and restoration. The problem statement is included as reference material for you and your class and is followed by a brief summary of the regulatory process for wetlands and some aspects of the issue unique to Alaska. Finally, a list of resources to allow your students to explore different opinions about the issue is included.

The National Perspective:

A problem statement from *Protecting America's Wetlands : An Action Agenda*, the final report of the National Wetlands Policy Forum (1989):

In recent years, dramatic changes have occurred in the nation's appreciation of the many values wetlands provide as integral elements of ecological and economic landscapes. Wetlands used to be viewed chiefly as sources of disease and pestilence. The earliest government wetlands programs simply gave them away on condition that they be drained and converted to purposes considered more useful. In this century, well-intentioned public and private efforts to provide flood protection, greater agricultural protection, better highways, and other valued societal benefits have often led to the drainage or filling of wetlands for farming. In 1983, the U.S. Fish and Wildlife Service estimated that over 200 million acres of wetlands existed in the lower 48 states at the time of European settlement, but by 1975, the number had decreased to 99 million acres.

An acre of wetlands is lost every minute. At the same time, some new wetlands are being created. Private hunting clubs and organizations such as Ducks Unlimited have intentionally established or improved many wetlands to provide waterfowl habitat. (Ducks Unlimited in 1989 had 3,788 projects in Canada, 272 in the U.S., 76 in Mexico; 5 million acres were reserved and managed. Ducks Unlimited buys wetlands, fences them from livestock, dredges potholes and basins, digs ditches, and controls predators.) However, the new wetlands may be of different types and provide different functions than those being lost.

The nation is now coming to realize that wetlands have great value in their natural state. Their biological productivity can exceed that of the best agricultural lands. A broad array of wildlife, fisheries, and other aquatic resources depends on them. Wetlands sustain nearly one-third of the nation's endangered and threatened species. They provide breeding and wintering grounds for millions of waterfowl and shorebirds every year. Coastal wetlands provide nursery and spawning grounds for 60 to 90 percent of U.S. commercial fish catches.

Wetlands also play key roles in regional hydrologic cycles by lessening flood damage, reducing erosion, recharging groundwater, filtering sediment, and abating pollution. Within a landscape, wetlands are linked to both upstream and downstream ecosystems, and their functional values may extend well beyond their own boundaries. At an extreme, as in the case of some migratory birds, habitat functions can extend even to other continents.

At the same time, property containing wetlands is valuable for other purposes as well. Facilities such as ports and marinas need to be adjacent to water. In some metropolitan areas, the only large, flat, open, and centrally located parcels of available land contain wetlands, making them prime sites for shopping centers, industrial parks, airports, parks, highway and utility crossings, and other large developments. Wetlands may overlie important oil, gas, and other mineral deposits or support valuable stands of timber. In agricultural areas, they may provide the only land that individual farmers can readily make use of to expand their cropped acreage.

Wetlands can be altered physically, chemically, or biologically by human activities. Physical alterations can include the placement of fill and other materials in wetlands, excavation, drainage or flooding, or the disruption of natural supplies of sediment needed to maintain their elevation. Chemical alterations are caused by water pollutants. These may include petroleum products, heavy metals, pesticides and herbicides, or a host of other substances that are toxic to some wetland plants and animals. Clearing wetland vegetation results in biological alterations.

Alterations can occur at different rates. While filling wetlands is usually a relatively rapid event, the construction of a dam and other flood control structures can reduce the amount of sediment that flows downstream over a long period of time and eventually cause permanent submersion of downstream wetlands.

The effects of some changes are more temporary than others. Harvested forests may grow back. The effects of filling wetlands are likely to be permanent.

Landowners receive most of the economic benefits resulting from wetlands use and conversion. In contrast, the benefits resulting from wetlands protection as well as the costs of their degradation tend to accrue mostly to the general public. Often, the landowner may not be aware of these public benefits and, therefore, may resist efforts to restrict the use of the land. The fact that protection of wetlands makes good economic as well as environmental sense for society is central to much of the conflict over wetlands protection policies.

Description of Wetlands Regulation

In 1972, the federal government enacted the first nationwide wetlands regulatory program in Section 404 of the Clean Water Act and focused increased attention on coastal wetlands by enacting the Coastal Zone Management Act. These laws require that anyone planning to dredge or fill a wetland must apply for a permit. The permit application is then reviewed by the public and by state and federal agencies who identify the wetland values. The Army Corps of Engineers, with guidance from the Environmental Protection Agency, must then weigh the information and decide whether it is in the best interests of the public to allow the activity to occur. The "Swampbuster" provision of the 1985 Food Securities Act (Farm Bill) discourages agricultural drainage of wetlands — farmers are to be denied farm program benefits if they drain wetlands and plant crops. The federal law covers only dredging and fill activities and does not regulate clearing or draining.

Critics of regulatory programs say they have only reduced the rate of wetland loss in the nation, but have not stopped it. They say the current systems are inconsistent, unpredictable, slow, and ineffective. They are concerned about "loopholes" that exempt many farming and timber harvest operations from regulation. They advocate no further net loss of wetlands and that any permit to destroy wetlands must be accompanied by a commitment to create or restore the same amount of acreage.

Another approach to the wetlands controversy is requiring mitigation that reduces the loss of wetlands but which does not always require creation or enhancement of wetlands. Mitigation means to avoid or reduce the negative impacts that a proposed project may have on the environment. Obviously, the least possible impact would be to move the project and its impacts to an area that is not a wetlands. If that is not a possibility, then possible measures to reduce the impact would be to move a project from a wetland with high values to a wetland area with lower values, to make the project smaller, or to require treatment of pollutants before allowing them to be discharged into a wetlands. Mitigation measures often increase the cost of developing a project, but maintain a larger share of the societal values.

The Alaska Situation

Wetland losses in Alaska are relatively small compared to the vast acreage of the state and the large number of acres that are wetlands. However, many of the losses are localized to industrial sites, such as the Prudhoe Bay oilfield, and to the vicinity of communities, especially along the coast. The creation of new wetlands has occurred only in a few instances. The technology to create new wetlands and to restore the functions of degraded wetlands in Alaska's harsh climate is a subject of current research.

Approximately 45% of the land in Alaska is wetlands; therefore, any type of development usually requires draining or filling in some wetlands. In other areas of Alaska where undeveloped, flat land is scarce, community expansion or industrial development puts pressure upon wetlands. Also, locations on lakeshores or along the coast are often highly desired places to live or places for tourist facilities.

In Alaska, much of the land is publicly-owned through local, state, and federal governments. Government land owners such as the Bureau of Land Management and the Alaska Department of Natural Resources seek to optimize many uses of their lands, including those uses producing economic returns. Conflicts occur in Alaska between the economic desires of private land owners and the "societal good." Conflicts also exist between economic benefits to society from the development of wetlands and environmental and economic costs to society that result from the loss of their functions. Flood control is performed year after year and its absence is only noticed after it is lost. The dams and other types of structures needed to replace it can cost millions of dollars.

In Alaska, filling is one of the most common ways wetlands are altered to provide foundations for buildings, roads, and airports. Wetlands have been filled along the coast to provide platforms for transferring materials to shore, for transfer of logs, minerals, and other resources to market, and for developing waterfront residences and businesses. In tundra areas of Alaska, all development necessarily occurs in wetlands. In these and other permafrost areas, thicker layers of fill are needed for insulation. Gravel fill covers fish and wildlife habitat and eliminates cover, food, and water sources. Wildlife may still make some use of these areas if higher, dry sites are preferred and if the animals can tolerate the human activity associated with the fill. Fill in permafrost areas may also result in the damming of shallow surface water drainage. Without proper culverts and bridges to maintain cross-drainage, areas upstream of the fill become flooded while those downstream dry up.

The challenges associated with considering Alaska wetlands and mitigating wetland losses during the economic development of communities and oil and gas, mineral, and timber resources result in controversial issues. People promoting the benefits of economic development point out that jobs will be created, that a relatively small percentage of the state wetlands has been altered compared to that of other states, and that there is a lack of alternatives and techniques to restore Alaska's wetlands following development. It is likely that you can find a local wetland issue and involve "both sides" of the issue in a unit for your classroom. Articles in the Alaska Department of Fish and Game magazine on wetlands and the following additional resources will help your students frame the issues and research the "pros" and "cons" of development versus protection of wetlands.

Teacher Resources

The *Alaska Public Affairs Journal*, Summer, 1990 issue contains articles representing the viewpoints of the Army Corps of Engineers, a wetlands ecologist, an oil company representative, and a logging company representative on wetland regulatory issues in Alaska.

The *CLASS PROJECT Wetlands in Alaska* unit, 1986, includes the activity "Developing a Wetland: a Conflict of Values" and a role-play about a wetlands issue. Available from the Wildlife Federation of Alaska, 750 W. 2nd Avenue - Suite 200, Anchorage, AK 99501.

Groups likely to have a position on Alaska wetlands issues:

Landowners: Native Corporations, state and federal land management agencies, oil companies

Industry groups: Alaska Forest Association, American Oil and Gas Association, etc.

The Wildlife Society, Alaska Chapter

Municipalities or Borough governments (contact planning departments)

Adopting a Wetland: a Northwest Guide. 1990. *Adopting a Stream: a Northwest Handbook.* 1988. University of Washington Press. These two books provide practical information about gathering information about streams and wetlands and taking action to improve them or protect them.

America's Wetlands: Our Vital Link Between Land and Water. 1988. U.S. Environmental Protection Agency. EPA-87-016. Describes wetland functions, EPA involvement in wetland resources, and regulatory measures. Available from EPA Public Information Center, 401 M Street SW, Washington, D.C. 20460.

Our Nation's Wetlands. 1978. U.S. Government Printing Office 0-329-527. Summarizes wetland functions, the impacts of different types of land use on wetlands, and laws regulating wetlands. Excellent diagrams illustrate the concepts.

A Citizen's Guide to Protecting Wetlands. 1989. The National Wildlife Federation. Provides a step-by-step guide to the Clean Water Act 404 permit process for the layman. Available from NWF, 1400 16th St., N.W., Washington, D.C. 20036-2266.

Protecting America's Wetlands: An Action Agenda. Final report of the National Wetlands Policy Forum. 1989. The Conservation Foundation. A review of issues related to wetland management in the U.S. and specific changes in laws and programs needed to protect wetlands. Available from The Conservation Foundation, 1250 24th St., N.W., Washington, D.C. 20037. Send $2.00 for shipping.

Wetlands: Meeting the President's Challenge. 1990. A wetlands Action Plan for the U.S. Fish and Wildlife Service. Includes a discussion of the application of a no net loss policy to Alaska's North Slope wetlands. Available from U.S. Fish and Wildlife Service - Habitat Enhancement Division, 1011 East Tudor Road, Anchorage, AK 99503.

APPENDIX A

WETLAND TYPES THAT MAY BE FOUND IN SOME HABITAT COMPLEXES

WETLAND TYPES

A wetland type describes the general appearance of the habitat in terms of either the dominant life form of the vegetation or the composition of the substrate. These are features that can be recognized without the aid of detailed environmental measurements. Life forms are characteristically used to describe habitats because they are relatively easy to distinguish, do not change distribution rapidly, and have traditionally been used as criteria for classification of wetlands.

Of the eleven wetland types recognized, five are vegetated and six are non-vegetated. For the purpose of this text, the six non-vegetated wetland types (for example, mudflats, gravel bars) will be considered as one type and called non-vegetated wetlands. The five vegetated wetlands, in order of descending life form are 1) Forested wetlands, 2) Scrub-Shrub wetlands, 3) Emergent wetlands, 4) Moss-Lichen wetlands, and 5) Aquatic Bed.

Forested wetlands are characterized by woody vegetation that is six meters tall or taller. They include mature trees as well as some recognized shrubs that may attain tree height. Tree species typically found in a Forested wetland type may include black cottonwood, tall willow, balsam poplar, alder, black spruce, and tamarack.

The **Scrub-Shrub wetland** type includes areas dominated by woody vegetation less than six meters in height. The species include true shrubs, matted or decumbent shrubs, young trees and saplings, and trees and shrubs that are small or stunted because of environmental conditions. This wetland type may represent a successional stage leading to Forested wetland or they may be relatively stable communities. Shrub vegetation may include alder, willow, sweetgale, Labrador tea, prickly rose, cinquefoil, dwarf birch, crowberry, lowbush cranberry, bog blueberry, bog rosemary, red currant, and those species listed for Forested wetlands which may be saplings or stunted due to environmental conditions.

The **Emergent wetland** type is characterized by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. This vegetation is present for most of the growing season in most years. These wetlands are usually dominated by perennial plants. Emergent wetlands in an estuarine environment may contain many different sedges (primarily Lyngby sedge), arrowgrass, plantain, alkaligrass, milkwort, saltbush, spurry, glasswort, silverweed, and bluejoint grass. Within the freshwater areas may be found various sedges and grasses, horsetail, marestail, dock, Jacob's ladder, peavine, buckbean, buttercups, cottonsedge, sundew, arrowgrass, and numerous other non-woody flowering plants.

The **Moss-Lichen wetland** type includes areas where mosses or lichens cover substrates other than rock and where emergents, shrubs, or trees make up less than 30% of the area. Mosses and lichens are important components of the flora in many wetlands, but large or extensive areas of "pure" moss or lichen are rare. They usually form a ground cover under a dominant layer of trees, shrubs, or emergents.

The **Aquatic Bed** includes wetlands and deepwater habitats dominated by plants that grow principally on or below the surface of the water. Aquatic Beds represent a diverse group of plant communities that require surface water for optimum growth and reproduction. They are best developed in relatively permanent water or under conditions of repeated flooding. The plants are either attached to the substrate or float freely in the water above the bottom or on the surface. Aquatic Beds include algae (both freshwater and saltwater), eelgrass, seagrass, pondweed, water milfoil, waterweed, water lilies, duckweed, and bladderwort.

WETLAND HABITAT COMPLEXES

A wetland habitat complex is a mixture of two or more wetland types which together form a more general category or description of an area. The categories used for these complexes are the everyday terms known to us as marsh, bog, tundra, or forested wetland. The emphasis in describing these wetland habitat complexes is to direct the students' attention to the fact that any large habitat type is actually a "complex" made up of smaller, more technically "pure" types. Thus, a bog can be considered a complex with several integral parts; it is composed of emergents, shrubs, possibly trees, moss, and may have small pools of aquatics.

Marsh — A periodically wet or continually flooded, but non-peat forming, ecosystem supporting predominantly herbaceous plants such as sedges, rushes, marestail, and other hydrophytes. Woody plants, sphagnum moss and lichen are absent or rare. Marshes may be either freshwater or estuarine. In Alaska, marshes are characteristically flooded with 15 cm or more of water, may have no standing water late in the summer, but soils remain saturated.

Marshes are among the most productive of all wildlife habitats. They are important in controlling flood surges, in water purification, and in water recharge. Marshes are distinguished from swamps by the noted absence of woody plants and from bogs by the absence of moss and heath-type shrubs. Marshes are a complex of several wetland types including Emergent wetland, Aquatic Bed, and non-vegetated wetlands.

Bog/Muskeg — A peat-forming ecosystem influenced solely by water which falls directly on to it as rain or snow and generally dominated by sphagnum moss. The water table is generally near the surface, but there is little or no standing water. The peat (semi-decomposed moss or sedge) may be up to 12 meters thick. Vegetation may include trees, heath-type shrubs, and herbaceous plants (mostly sedges and other grass-like plants). The surface terrain may be hummocky with standing water in small depressions.

Bogs (or muskegs in Southeast Alaska) are composed of many wetland types including Forested wetland, Scrub-shrub wetland, Emergent wetland, Moss/Lichen, and small pools of Aquatic Bed.

Moist Tundra — A cold climatic landscape having a substrate that is generally frozen and underlain by permafrost. The vegetation communities are characterized by short-stemmed perennial herbaceous plants, stunted or prostrate shrubs, lichens, and mosses. Trees are conspicuously absent. Tundra has a short growing season and low summer temperatures resulting in low primary productivity and low decomposition rates.

The presence of permafrost enables the thin mineral soil to remain saturated during the non-frozen summer period. In some areas, permafrost may be only 3-4 cm below the surface. The permafrost itself may be over 1000 feet thick.

Moist tundra is a complex of the Scrub-Shrub, Emergent, and Moss/Lichen wetland types.

Forested Wetland — An area with saturated soil or periodic inundation which is covered primarily by broadleaf deciduous (cottonwood, alder) or coniferous (spruce, tamarack) trees. Forested wetlands may occur within the active floodplains of major rivers or as forested areas in slight depressions or on toe-slopes of mountains. The majority of Forested wetlands occur in Southeast Alaska and the southcentral coastal fringe and on Kodiak Island. Forested wetlands in interior and southcentral Alaska are usually associated with bog areas (spruce bog).

Forested wetlands are composed of the Forested wetland vegetation types along with an understory of the Scrub-Shrub and Emergent wetland types. Forested wetlands within floodplains may lack the shrub and emergent understories.

WETLAND TYPES THAT MAY BE FOUND IN SOME HABITAT COMPLEXES

WETLAND HABITAT COMPLEXES

WETLAND TYPES	Marsh	Bog/Muskeg	Moist Tundra	Forested
Forested		X		X
Scrub-Shrub		X	X	X (understory)
Emergent	X	X	X	X (understory)
Moss-Lichen		X	X	
Aquatic Bed	X	X (small pools)		

APPENDIX B

ANIMAL ADAPTATIONS FOR WETLANDS LIVING

An adaptation is an anatomical, physiological, or behavioral attribute which enhances an animal's ability to live in a specific environment. Adaptations may improve an animal's ability to live in one environment yet reduce its ability to survive in other, different environments.

PROBLEMS	SOLUTIONS	
OXYGEN REQUIREMENTS— All animals require oxygen to break down carbon chains and release the energy needed for their metabolism, growth, capture of food, reproduction, and escape from predators. Air-breathing animals must be able to temporarily survive underwater without air. Air-breathing animals must have a means of keeping water out of their respiratory system. Aquatic animals must obtain oxygen from water. Even water saturated with dissolved oxygen contains 30-40 times less oxygen than an equivalent volume of air.	**Invertebrates** OXYGEN STORAGE — Some air-breathing invertebrates (like predaceous diving beetles) entrap a bubble of air and carry it with them as they swim underwater. The air bubble, in addition to being a store of oxygen, serves as a gill. When the oxygen in the bubble is depleted by the insect's respiration, oxygen diffuses from water into the bubble, and the insect is thus supplied with more oxygen than it carried underwater. In most insects, oxygen is carried to cells in gas form through open tracheae, rather than by blood. A few aquatic insects, however, have hemoglobin to store oxygen. MEANS OF EXTRACTING OXYGEN FROM WATER — Aquatic invertebrates, including fairy shrimp, water fleas, bivalve mollusks, flatworms, and others extract oxygen from water by diffusion. Some (like flatworms and some insects) have a body covering that is permeable to oxygen. Others have specialized membranes, called gills, which are permeable to oxygen and other gases. Gills are found on legs, the abdomen, thorax, or other parts of the body. Many invertebrates maintain a flow of water, and thus a renewed oxygen supply, by stirring the water with waving motions of their legs, antennae, or the gills themselves. SIPHONS AND SNORKELS — Some invertebrates are able to breath atmospheric oxygen through a tube to the water surface (for example, mosquito larvae). Some insects have special respiratory tubes to tap into air spaces of aquatic plants.	**Amphibians** MEANS OF EXTRACTING OXYGEN FROM WATER — Adult amphibians are able to extract oxygen from water by diffusion through their moist skin. They also have lungs to breathe the air. Juvenile amphibians have gills.

Fish	Birds	Mammals
HIGH TOLERANCE FOR CO2 — Some fishes are able to live in water with low oxygen levels because they can tolerate high levels of CO2 in the blood. CLOSED RESPIRATORY SYSTEM — Fish absorb oxygen across gill membranes only. MEANS OF EXTRACTING OXYGEN FROM WATER — All fish have specialized membranes or gills for extracting oxygen from water through diffusion. Fish maintain an adequate flow of freshwater over their gills by continually pumping water with specialized muscles, and in some species by living in running water or water with high levels of dissolved oxygen. Fish gills are able to extract 4/5 of the oxygen dissolved in water.	REDUCED USE OF OXYGEN — Birds that dive are able to reduce their heart rate by as much as 50% when underwater, thus greatly reducing their rate of oxygen use. Dippers, and perhaps other diving birds, can reduce the supply of blood to non-vital organs and tissues. HIGH TOLERANCE FOR CO2 — Diving birds (dipper, loons, grebes, diving ducks) have the ability to tolerate high levels of CO2 in the blood and thus are able to stay underwater for longer periods than other birds that dive. OXYGEN STORAGE — Diving birds have nearly two times as much blood and greater concentrations of hemoglobin (and thus a greater capacity for oxygen storage) than land birds of equivalent size. MEANS OF CLOSING OPENINGS TO RESPIRATORY SYSTEM — Dippers have special nasal flaps which they close before going underwater.	REDUCED USE OF OXYGEN — Some aquatic mammals (seals, beaver, whales, porpoises) can reduce their heart rate and the supply of blood to certain organs and tissues and thus reduce their rate of oxygen use. HIGH TOLERANCE FOR CO2 — Diving mammals (whale, otter, beaver, muskrat, seal) can tolerate high levels of CO2 in their blood and are thus able to stay underwater without breathing for longer periods of time than other mammals. OXYGEN STORAGE — River otters have relatively larger lungs than other mammals and can store more air for underwater use. Marine mammals have high hematocrit and hemoglobin levels and big blood volumes which increase their capacity for oxygen storage and transport. MEANS OF CLOSING OPENINGS TO RESPIRATORY SYSTEM — Most diving mammals have special flaps or specially shaped nostrils so they can close these openings when underwater. The anatomy of the beaver's respiratory system prevents them from breathing through the mouth. Thus, they can open their mouth underwater to carry sticks. Muskrats can close their lips behind their incisors, so they can gnaw while underwater.

PROBLEMS	SOLUTIONS	
MAINTAINING OR ATTAINING A DESIRED POSITION IN THE WATER; MOVING IN WATER — Water is denser than air and thus provides more resistance; animals need specialized appendages to propel themselves through water and a body shape that reduces the resistance of water (particularly important for animals in running water). A fusiform shape, narrow about both ends and widest part of body one-third of the distance between each end, offers the least resistance. Air-breathing animals that float on the surface, but dive underwater, need a means to overcome the buoyancy of water. Aquatic animals need a means of staying at the desired depth. Animals that live in running water need ways of staying in a desired spot. Animals that live on the water surface must have adaptations to stay afloat.	**Invertebrates** METHODS OF PROPULSION — cilia (paramecium). — fringes of hairs to increase the surface area of appendages (water mites). — wide, flattened appendages (water boatmen). AIR BLADDER — Some phantom midge larvae have a gas sac at each end of their body and can rise or sink in water by regulating the amount of air in these sacs. AVOIDANCE OF CURRENT — Some invertebrates that live in running water avoid the water current by living in the boundary layer between the water and the bottom. Within a few millimeters of the bottom, friction reduces the water current to almost zero. Some mayflies have very flattened bodies and flattened appendages that stick out to the side rather than down, so the animals can keep out of the current. CLASPING APPENDAGES — Mayflies, caddisflies, and other aquatic insects have claws on their legs and/or anal hooks to hang onto the bottom. Dipteran larvae do not have true legs, but have developed "prolegs" for hanging onto plants and stones. ANCHORS — Aquatic caterpillars, leeches, and blackfly larvae have groups of tiny spines to attach themselves to the bottom. Bivalve mollusks, hydra, rotifers, aquatic caterpillars, midge larvae and some other invertebrates anchor themselves to the bottom or to plants with sticky threads or glue-like secretions. BALLAST — Caddisfly larvae have hooks to hold onto their cases; the weight of their cases helps keep them on the bottom. SURFACE TENSION — Tiny animals are able to stay afloat by spreading their weight over a larger area, so that the surface tension of water remains unbroken. Water mites, water boatmen, and other invertebrates have long fringes of hairs; water striders have very long legs.	**Amphibians** METHODS OF PROPULSION — webbed feet (frogs, salamanders). — strong leg muscles and their swimming legs are placed far back on the body (diving ducks). ANCHORS — Frogs and salamander egg masses are anchored to underwater sticks or plants by sticky, mucous-like surfaces.

Fish METHODS OF PROPULSION — fins (bony rays with skin stretched over them) common to all fish. STREAMED-LINED SHAPE — Most fish have fusiform body shapes to minimize the resistance of moving in water or remaining stationary in running water. AIR BLADDER — Some bony fish have a special air bladder located in the middle of their body. By regulating the amount of air and gases in this bladder they can control the depth at which they float. ANCHORS — Lamprey have a powerful sucker which they use to move against the current and hold themselves in place, in addition to holding on to animals they parasitize.	**Birds** METHODS OF PROPULSION — webbed feet (ducks, loons, gulls, terns, geese, swans). These increase the surface area of the feet and allows the bird to propel itself through the water. Swimming birds also have large, strong leg muscles and legs placed far back on their body to increase the propulsion provided by moving their feet. —lobed feet (grebes, phalaropes). STREAM-LINED SHAPE — Loons, grebes, mergansers, and diving ducks have bodies that are flattened horizontally, have smaller wings, and short, vertically-flattened legs placed toward the rear of the body. All of these factors streamline the bird for underwater swimming. AIR-BLADDER — Swimming birds can regulate the amount of air in the air sacs in their abdomen and the amount of air entrapped by their waterproof feathers; thus they make themselves buoyant for floating on the surface or less buoyant for diving underwater. CLASPING APPENDAGES — Dippers have long toes for clasping the bottom. BALLAST — Diving birds (loons, grebes, and diving ducks) have marrow-filled bones and few air sacs (while other birds have hollow bones and many air sacs as adaptations for flight). These birds are also able to tightly compress their feathers to expel the air trapped between them.	**Mammals** METHODS OF PROPULSION — webbed feet (beaver, muskrat, otter). — fringes of hairs (water shrews, muskrats). — flippers and flukes (seals, sea lions, porpoises, and whales). STREAM-LINED SHAPE — Diving mammals in general have smaller appendages (ears, legs, tails) than similar sized land mammals. Also, swimming mammals have a fusiform shape. SURFACE TENSION — Water shrews have long fringes of hair on their hind feet. Surface tension against these hairs allow the tiny shrew to run across the water surface.

PROBLEMS	SOLUTIONS	
FEEDING ON ANIMALS that live in water or along the shore.	**Invertebrates** FILTERS TO CAPTURE FOOD — Invertebrates have the greatest variety of adaptations for filtering edible materials from water. Some, like hydra, move tentacles through the water. A wide variety (including bivalve mollusks, rotifers, water fleas, and others) have hair-like filters. Several insects (some mayflies, caddisflies) have fringes of hairs on their appendages which filter out food. Some caddisflies spin web-like nets which they hold out in the water current to capture food particles.	**Amphibians**

Fish	Birds	Mammals
METHODS OF GRASPING SLIPPERY FISH — Predaceous fish, like northern pike, have long jaws and many sharp teeth for grasping their prey.	FILTERS TO CAPTURE FOOD — Mallards, pintails, shovelers, wigeon, and some other ducks have tiny lamellae (stiff hair-like fringes) on their bills which they use to strain detritus, insects, mollusks, and other food from water. They also have more touch-sensitive nerve endings per square millimeter in their bill than humans have in a finger tip. LONG, PROBING BILLS — Shorebirds have specialized bills adapted for probing deep in the mud. The bills of many are packed with touch-sensitive nerve ending so the birds can distinguish food from mud or sand. LONG LEGS — Most birds that feed along the shore have long legs for wading in water without getting their feathers wet. METHOD OF GRASPING SLIPPERY FISH — Fish-eating birds that capture fish with their bills have sharply pointed bills (loons, grebes, and kingfishers). Many of these fish-eating birds also have backward-slanting projections on their tongue, roof of their mouth, or throat to help in holding and swallowing slippery fish. Eagles and osprey which catch fish with their feet have long, sharp talons. Osprey also have special spiny tubercules on the bottom of their feet which help to hold on to slippery fish. Mergansers have bills with saw-tooth edges which help hold slippery fish.	FILTERS TO TRAP FOOD — Some whales have stiff, hair-like baleen instead of teeth. They use the baleen to strain organisms from water. METHODS OF GRASPING SLIPPERY FISH — Fish-eating mammals like the river otter have sharp claws and razor sharp teeth for grasping and ripping fish flesh.

PROBLEMS	SOLUTIONS	
SURVIVING PERIODS OF FROZEN WATER — Animals that live in water or obtain food from water must have a means of surviving periods when water freezes. Problems include 1) avoiding freezing and (warm-blooded animals) keeping warm, and 2) obtaining sufficient oxygen since the oxygen in water covered by ice may be used up by respiration of the animals living under the ice, and 3) obtaining food.	**Invertebrates** LIFE CYCLE ADAPTATIONS -- Insects that live in water bodies that freeze solid in winter survive by entering a period of dormancy, called diapause, during winter. During diapause, growth, development and reproduction cease and the animal's metabolic rate is reduced. Insects may pass through diapause in the egg, larvae, or adult stage. Other invertebrates also survive periods of cold by entering periods of dormancy or in life stages that can tolerate freezing. USE OF SHELTER — Many invertebrates burrow into the mud, move into gravel interstices, deep water, or into piles of decaying vegetation. These locations provide protection from freezing.	**Amphibians** LIFE CYCLE ADAPTATIONS — Frogs require open water for eggs and tadpoles to develop. Wood frog eggs and tadpoles develop more quickly than those of other frogs. This fast development allows wood frogs to survive at northern latitudes where ponds are frozen solid for 7 months of the year. Only the air-breathing adults overwinter. USE OF SHELTER — Most amphibians overwinter as adults. They bury themselves in mud or soil to avoid freezing. Wood frogs, the northernmost amphibians, burrow into the humus layer of a dry site. Snow, leaf litter, and soil insulate the frog. Wood frogs seek dry sites for burrowing, as these provide better protection against freezing. FOOD STORAGE — Wood frogs and perhaps other amphibians put on an extra layer of fat before winter. This fat reserve provides energy for the metabolism of the hibernating animal. REDUCTION OF ENERGY REQUIREMENTS — Wood frogs reduce their winter food requirements by remaining inactive and reducing their heart rate and other metabolic functions while hibernating.

Fish

LIFE CYCLE ADAPTATIONS — Most Alaska freshwater fish lay eggs in late summer or fall. The eggs and the alevins (embryos) have a food supply in the yolk and can survive in small amounts of flowing water on the bottom and in gravel interstices of stream bottoms.

MIGRATION — Most Alaskan freshwater fish migrate downstream to overwinter in deep rivers and lakes that do not freeze solid and have sufficient open water or water movement to provide adequate oxygen supplies. Some fish (like Dolly Varden) overwinter at sea.

USE OF AIR HOLES — Blackfish, capable of breathing air with their specialized esophagus, gulp air from holes or breaks in the ice. They are known to gather around muskrat push-ups, holes in the ice that remain open throughout winter.

Birds

LIFE CYCLE ADAPTATIONS — Water birds nest as early in spring as possible so that eggs are hatched early and young are full grown and capable of migrating by fall.

MIGRATION — Almost without exception, Alaska's wetland birds migrate to more hospitable areas for winter. Many move out to sea or to the sea coast (phalaropes, loons, diving ducks, emperor geese, shorebirds). Others migrate to areas where open fresh water occurs throughout winter (dabbling ducks, most geese, sparrows, swallows, northern harrier, bald eagles, osprey). Some birds migrate short distances downstream or to the coast, while others make global journeys to reach areas of open water and plentiful food.

Mammals

USE OF SHELTER — Beaver, muskrat, foxes, otters, mink, and water shrews use dens and burrows during winter. The dens provide protection from winter cold and winds.

FOOD STORAGE — In fall, beavers store large quantities of branches underwater near their den or lodge. These provide a winter food supply.

USE OF AIR HOLES — Muskrats maintain air holes in the ice by poking holes in the ice when it is thin and then pushing vegetation up through the holes. These plants cover the hole and insulate it so the hole does not refreeze. Muskrats use their "push-ups" to get air when the pond is frozen over. This allows them to swim under the ice and feed on aquatic plants throughout winter. Ringed seals also maintain breathing holes in sea ice by digging and scraping the ice with their front claws.

INSULATION — Alaskan mammals grow a much heavier fur coat for winter. The thick white fur coat of the arctic fox can keep this animal warm at -40°F. Marine mammals also grow a thicker layer of blubber for winter.

PROBLEMS	SOLUTIONS	
KEEPING WARM — Water conducts heat more quickly than air, so warm-blooded animals lose heat 10-100 times more quickly in water than in air. Evaporation of water takes heat, so an animal that gets wet and is exposed to air will lose heat more quickly than an animal that is dry.	**Invertebrates** COLD-BLOODED	**Amphibians** COLD-BLOODED

Fish	**Birds**	**Mammals**
COLD-BLOODED	INSULATION AND WATERPROOFING — Birds that swim or dive (loons, grebes, mergansers, waterfowl) have thicker layers of down and fat and a higher total number of body feathers than other birds. When cold, birds can fluff out their feathers to entrap a layer of air which helps to insulate the body. The preen glands of swimming birds are larger and produce more oil than those of land birds. The birds frequently preen this oil on to their feathers to maintain waterproofing. SPECIALIZED CIRCULATION — The webbed feet of ducks and geese have no capillaries (the arteries flow directly to veins) which allows more rapid blood circulation and reduces heat loss through the feet.	INSULATION AND WATERPROOFING — Most mammals that live in water or swim have thick waterproof fur coats that entrap a layer of air which helps insulate the animal (beaver, water shrews, mink, otter, sea otter, polar bear, muskrat). Whales and seals that have little or no hair have thick layers of blubber (over 25% of their body weight). REDUCED BLOOD FLOW TO EXTREMITIES — Beaver, seals, and porpoises can reduce the amount of blood flowing to their extremities and thus reduce the amount of heat lost from these. Marine mammals also have relatively smaller limbs than terrestrial mammals, so they have less surface area from which to lose heat. GREATER HEAT PRODUCTION — Some mammals, like porpoises, have a higher basal metabolic rate than terrestrial mammals of the same size. Others, like the muskrat, are able to increase their metabolic rate, and thus increase heat production before and while swimming.

APPENDIX C

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MORE WETLAND TEACHING ACTIVITIES

Wading into Wetlands. Naturescope. National Wildlife Federation, 1400 Sixteenth St. N.W., Washington, D.C. 20036-2266.

Sea/River Week Series:
Discovery - Volume I.
Animals of the Seas and Wetlands - Volume II.
Shells and Insects - Volume III.
Birds and Wetlands - Vol. IV.
Available from Sea Grant Program, 138 Irving II, University of Alaska Fairbanks (write for ordering information).

Aquatic Project WILD Western Regional Environmental Education Council. Contact Coleen Matt, Alaska Department of Fish and Game - Division of Wildlife Coordination, 333 Raspberry Road, Anchorage, AK 99503 to arrange a teacher workshop.

Habitat Pacs: Estuaries and Tidal Marshes, Freshwater Marshes, Rivers and Streams, Migratory Birds, Wetlands Conservation and Use. Available from U.S. Fish and Wildlife Service, 1011 East Tudor Road, Anchorage, AK 99503.

Western Education Development Group Series:
The Pond Book, The Lake Book, The Estuary Book, The Creek Book, The Pond Book, The Snow Book, The Rain Book. Pacific Education Press, Education Department, University of British Columbia, Vancouver, B.C. Canada V6T 1W5.

Wild Fish and Hatchery Fish: a six-lesson unit. Available from Jon Lyman, Division of Sport Fish, Alaska Department of Fish and Game, Box 3-2000, Juneau, AK 99801. Includes a stream survey form and instructions.

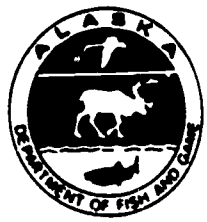
CLASS Project. Classroom Learning Activities for Science and Social Studies Project. Units include Wetlands and Wildlife Habitat Management, both of which have been adapted for Alaska. Wildlife Federation of Alaska, P.O. Box 103782, Anchorage, AK 99510.

RECORDINGS OF BIRD SOUNDS

Audible Audubon - sound plates and player. Living Sound Society, Box 3529, Torrance, CA 90510.

Dawn in Duckblind - record. Crow's Nest Bookshop, Laboratory of Ornithology, Cornell University, 159 Sapsucker Woods, Ithaca, N.Y. 13850.

Field Guide to Western Bird Songs. Available as records or cassettes. Follows Roger Tory Peterson's Field Guide to Western Birds. Houghton-Mifflin Co.



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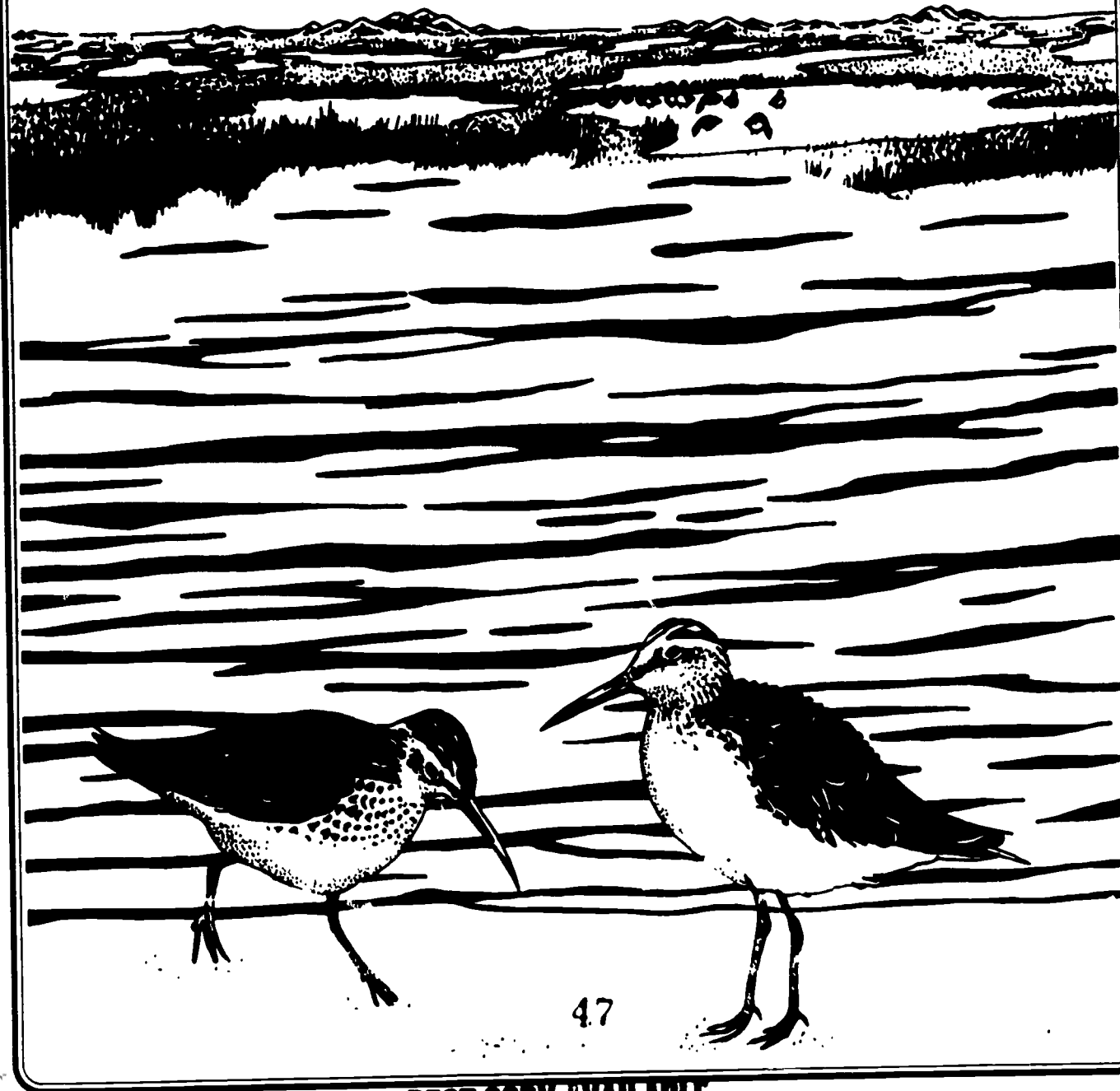
WETLANDS & WILDLIFE

Alaska Wildlife Curriculum
Teacher Information Manual, Part II



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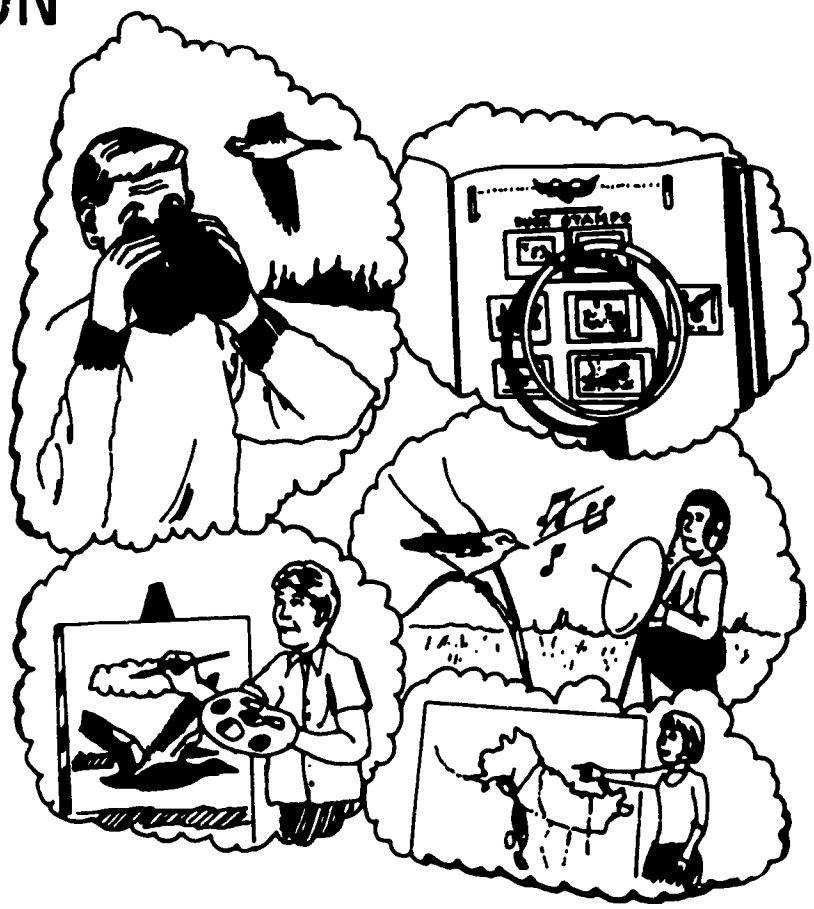
INTRODUCTION



While Alaska contains the breeding grounds of more than 400 species of birds, only a few of these species are year-round residents. Once Alaska's abundant summer food supply begins to dwindle in the fall, most birds migrate thousands of miles to areas where a warmer climate assures winter food. Certainly such long flights are hazardous. But the birds' metabolic rates are very high and large amounts of food are necessary for survival. For most species, the increased food supply in the south is worth the risk of migration. Only a few birds (such as ptarmigan, ravens, and chickadees) have adapted to the limited winter food supply and remain throughout the winter.

All of North America and several other continents are reached by migratory birds that breed in Alaska. Through the centuries their flights south in the fall and return in the spring have served to enrich the lives of people along their routes. Some people hunt these birds for food during the birds' migration. Native American people traditionally travelled to migration and nesting areas to take birds for food and feathers and some groups continue to do so today. Many hunters from all cultures eagerly await fall hunting seasons and may travel thousands of miles for an opportunity to hunt a species unavailable in their home area. Migratory birds are valued for more than hunting: Native Alaskan tales, like those of other Native American people, include many stories about birds that have strong cultural and religious significance. For many people today, watching and learning about birds has become a major recreation. The annual migrations provide excellent opportunities to see birds that are rare visitors in certain areas.

As human populations have grown and as both hunting and travel methods have become more mechanized, some bird populations have been seriously depleted. Consequently, the migrations are carefully monitored and studied to help find methods to preserve a healthy population of the species. This acquired knowledge has led to the establishment of a variety of management programs and to the enactment of treaties, laws, and regulations to control consumption. These conservation efforts require cooperation at local, state, and national levels.

Of all the migratory birds, waterfowl have been hunted the most, providing food and recreation for many. Therefore, they are the most intensively studied and managed, and our knowledge of them is more enriched and expanded than of other species. What we know of ducks, geese, and swans has also broadened our knowledge of the factors that affect all bird populations and has helped wildlife managers of all migratory birds.

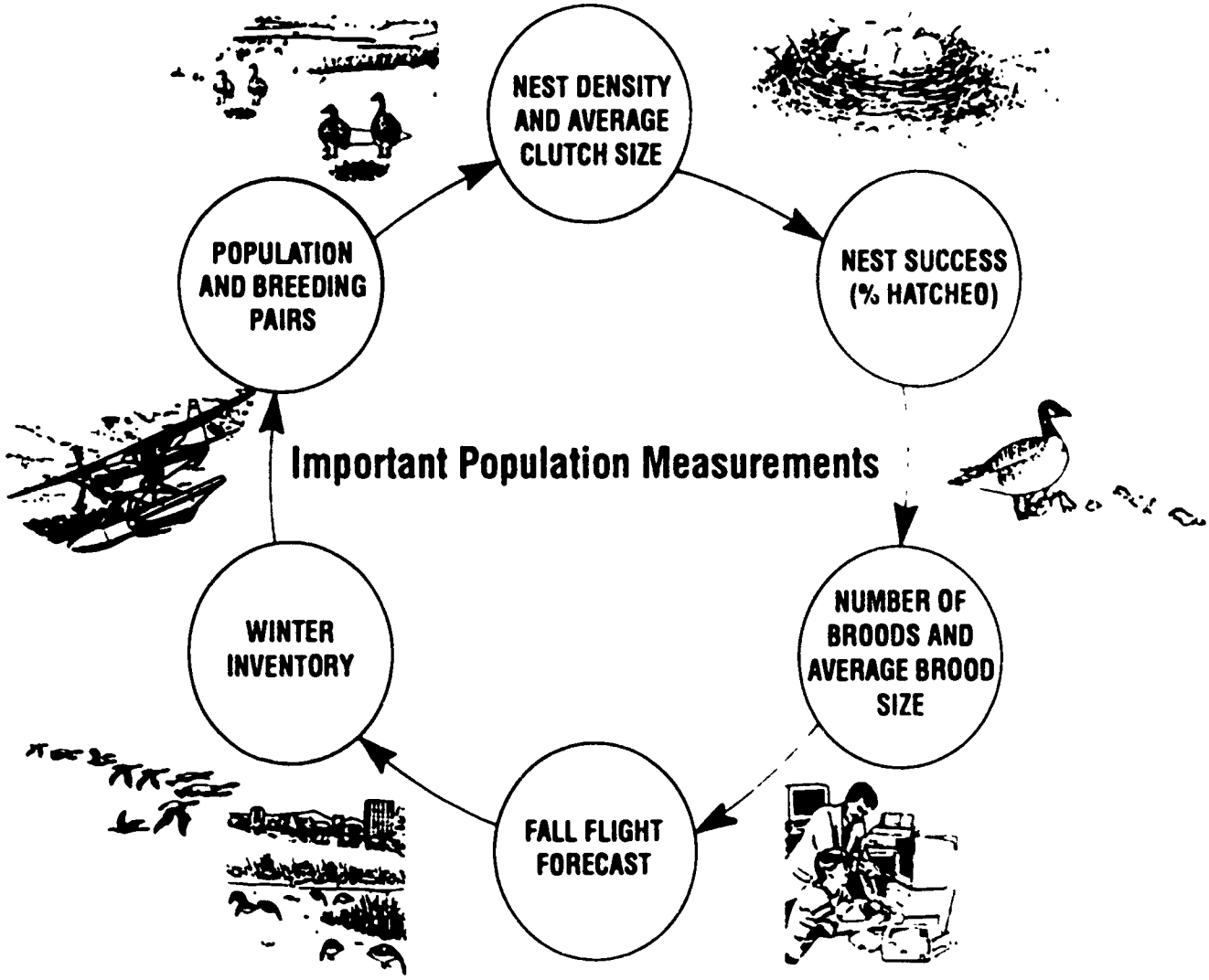
As we begin our study of waterfowl, it is important to understand two terms used by wildlife biologists and managers.

The first term is **species**. A species is a group of animals which breeds only among themselves. There are many different migratory bird species. They are distinguished by unique characteristics which result from evolutionary separation. Often, geographic barriers such as mountain ranges and oceans isolate one species from other species. However, migratory bird groups often mix during their travels. In this instance, the differences between species have been maintained over time by several factors: strong traditional migratory patterns, the use of specific breeding and wintering areas, and specialized instinctual behaviors. For example, the thirty-three duck species in North America all mingle on their wintering grounds. But each species has developed specialized feeding habits and social signals—such as male plumage colors—that ensure mating within the same species.

The second important term is **populations**. Within a species with a broad geographic distribution, there are often several populations of birds that occupy only certain parts of the entire species' range. A population may (and sometimes does) mix with members of other populations. But generally, a population associates only with its own members and breeds within the population. For example, six distinct populations of Canada geese nest in different parts of Alaska and generally winter in specific areas of Washington, Oregon, and California. Some of these populations overlap during winter, but still maintain their group identities. Alaska tundra swans are another example of a species that forms two populations—one that breeds in northern Alaska and winters on the Atlantic coast, and one that breeds in western Alaska and winters in California. These populations remain distinct.

Studies have shown that wetlands are absolutely vital to migratory birds' survival. In this manual, we concentrate on species which are Alaskan summer residents. The following pages outline the year-round habits of migratory birds and give detailed accounts of six species and two sub-species. Also discussed are population dynamics, bird migration, migratory bird management, and laws concerning migratory birds.

ASPECTS OF POPULATION DYNAMICS



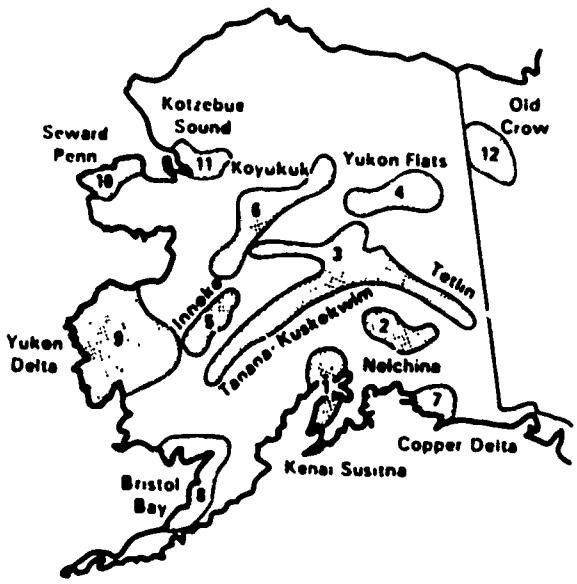
Understanding the dynamics of individual species and populations permits management of waterfowl by geographic breeding stocks. The following section examines critical characteristics that scientists and managers measure in waterfowl populations, the factors that affect populations, and typical activities of biologists involved in waterfowl management throughout the year. It is intended to illustrate the dynamics of waterfowl populations and provide background to allow you and your students to construct a simple population model for one yearly cycle.

Spring Arrival Period

Reproduction, the addition of offspring to a population, begins when birds arrive on the nesting grounds. The number of young that can be added depends on the number of pairs of birds that breed that year and how many young each pair produces. Thus, Alaska biologists and biologists in other nesting areas first count the number of **adult breeding pairs** that arrive in the spring.

The number of breeding pairs which arrives depends on the overall survival rate of the population through winter and the hazards of spring migration. Not all of the arriving birds will reproduce; the number of breeding pairs also depends on the proportion of birds in the population that are old enough to reproduce. This proportion varies. Ducks generally mature within their first year, except some seaducks, such as eiders, that take up to three years to mature. Ducks choose new mates each year during winter or spring migration. In contrast, most geese and swans mature at three years of age or older and usually mate for life. Consequently, among waterfowl arriving in Alaska in spring, ducks have formed their pairs for the season and nearly all are capable of nesting, but goose and swan populations contain immature birds that will not nest for one or more years into the future. As discussed later, age structure of a

Waterfowl Spring Surveys



population not only affects potential production in a given year, but also indicates a population's ability to maintain itself by replacing losses from natural mortality, hunting, and years of poor nesting conditions.

In spring, biologists conduct breeding bird surveys from aircraft over the most productive nesting areas across North America to assess an annual outlook for waterfowl production. There are twelve major breeding areas sampled in Alaska and Yukon Territory each year (see illustration). The crews record birds as singles, pairs, or flocks, and by species. Weather and habitat conditions are also recorded in each survey area. The product of these intensive survey flights is a **breeding pair index** derived from the actual counts of birds, adjusted for the habits of each type of bird (every lone female duck is assumed to be paired; flocks often contain young or unmated birds and are disregarded as pairs) and total area sampled. The breeding pair index is not a total census of all waterfowl, but is a relative measure of potentially productive birds to compare with other years or to show long-term trends for a given area or region. Because waterfowl are widely dispersed over the expansive northern regions of the continent for nesting, it is neither possible nor practical to measure population sizes during the breeding season. This is accomplished when they are more concentrated on fall staging areas (where birds stop to rest and sometimes eat) and wintering grounds.

Nesting Period

Not all breeding pairs nest successfully, so the next important statistic is the number of nests that are built into which eggs are layed. The actual nesting effort of a population is usually measured in terms of **nest density** (number of nests per unit area) or the number of nests in colonies for birds like snow geese and brant that nest together on traditional sites.

The timing of breeding and egg-laying in birds is controlled by hormones that are triggered well before their arrival in Alaska; thus, the availability of suitable habitat and spring weather conditions on the nesting grounds can strongly influence the number of breeding pairs that successfully establish nests. A late break-up can keep preferred nest sites covered with snow and ice, limit the availability of plant foods for grazers like geese, or make travel easier for predators like foxes. On the other hand, a rapid break-up can cause extensive flooding along river systems and lakes where waterfowl nest, eliminating preferred nest sites.

Spring weather can also affect the number of eggs layed, or the **clutch size**, due to the relationship between weather and female fat reserves. Cold spring weather drains energy reserves of female birds who need them for development of eggs. Geese have adopted a strategy of nesting early in spring, so they feed heavily in late winter and on spring migration, arriving with most of the fat and protein needed to lay eggs as soon as the snow melts. If snow and cold weather persist, they begin consuming those reserves and, in very poor years, they may resorb developing eggs or abandon nesting entirely. In contrast to geese, ducks count on arriving later on the nesting grounds and getting protein for eggs by feeding intensely on insects and crustaceans in newly thawed marshes and ponds. A delayed spring limits food availability for ducks and has the same effect on egg production as described for geese. To measure the effect of spring weather on nesting conditions, biologists make counts of the number of eggs laid in nests on nest plots to estimate the **average clutch size per nesting pair** as another important measure of annual waterfowl production.

Another factor influencing reproductive effort in waterfowl is their social behavior during the nesting season. Swans, ducks, and most geese have developed pair territories that are defended against other birds. Territorial defense ensures that each breeding pair has its own area for mating, a reserved food supply, and a suitable area for raising young. In most instances, only a fixed number of good territories exist in an area, naturally limiting the number of pairs that can be accommodated, and thus limiting the potential productivity of the population. Territorial behavior results in the most experienced and productive pairs getting the best breeding sites, young and inexperienced pairs pioneering marginal habitat, and nonproductive birds often being driven out of areas where they would compete with breeders for food and other resources.

The establishment of nests occurs rapidly and is nearly synchronized for each species in a given region. As soon

as nests are built and eggs are laid a number of factors begin to operate that will determine **nest success**, the proportion of nests that produce at least one hatched egg. During the nesting period biologists can determine when nest losses occur and the causes of nest failures by periodically observing or revisiting nests.

Because northern-nesting waterfowl nest as soon as possible, spring snow storms, flooding from spring thaw, and cold rain are all threats to eggs that must be kept warm. Under these conditions, birds must remain on their nests and use their energy reserves to keep their eggs alive. Usually, a small percentage of eggs do not survive because they are either pushed out of the nest, get too cold at some time, or are infertile.

As soon as a pair of birds selects a nest site, the nest site becomes a target for a variety of bird and mammal predators. Ducks, geese, and swans lay one egg every 1-2 days. They cover their nests and leave after each egg is laid until the entire clutch is completed. This minimizes the risk of attracting predators to their activities or to their scent around the nest.

Once all the eggs are laid, the females begin incubating them nearly constantly except for short breaks (some male swans help by taking shifts with their mates). Incubation takes at least 20 days for ducks and as long as 37 days for trumpeter swans. During incubation, both the eggs and the female are at risk from predators. The drab brownish plumage of female ducks is an adaptation for concealment while they are on their nests and their mates have left them for the season. Swan and goose males remain with their mates and help defend the territory and nest from intruding neighbors and predators.

Over the entire nesting period many eggs and entire nests may be lost depending on the number of predators and the abundance of other foods for those predators. In Alaska, if lemmings or mice are scarce, bird predators and foxes take more waterfowl eggs. Bird predators, like gulls and jaegers, and small mammals like mink, take single eggs and eat them nearby which allows the nesting birds to incubate the remaining eggs. Foxes usually take most or all of the eggs away, burying them one at a time as food caches (storage) for use in winter. Coyotes and bears tend to eat all the eggs in a nest and tear up the nest itself. These clues help biologists determine which predators are causing nest losses. Foxes, coyotes, bears, and eagles also prey on some adult birds on or near their nests.

Although nest predation is probably the most important factor in the production of young waterfowl in Alaska each year, nest failures also occur if prolonged adverse weather or disturbance of breeding birds is enough to cause nest abandonments. Nesting waterfowl are particularly sensitive to disturbances by people, vehicle traffic, noise, and other animals during the egg-laying period. As incubation progresses, birds are increasingly attached to their nests. If weather, disturbance, or predation causes abandonment during early nesting, ducks can often start a new nest when their reproductive systems develop new eggs. Geese and swans, however, usually do not have enough energy reserves or time to start over and raise young during the short Alaskan summer.

Brood Rearing And Molt Period

In waterfowl, all the eggs in a nest hatch within 24 hours of each other and the down-feathered young are ready to travel within one or two days. Hen ducks and both swan and goose parents lead their young (called a **brood** for each family) away from the dangerously scent-filled nest to the safety of ponds, lakes, or rivers. The first week in a young bird's life is the most perilous because they may become separated from their parents and predators like gulls and foxes can easily catch them. During the 8-10 weeks until they are able to fly, broods need water where they can swim away or dive from danger and plant cover where they can hide. Young waterfowl instinctively peck at moving things and feed almost continuously on insects and crustaceans during their rapid growth.

All waterfowl lose the worn out flight feathers on their wings and regrow new ones in mid-summer. Male ducks and non-breeding geese and swans begin this wing **molt** by late June. Geese, swans, and female ducks with families molt later. Nonbreeding birds usually gather together to seek safe molting areas, sometimes migrating hundreds of miles to special places. Safety from predators and disturbances as well as abundant food are important needs for the birds during the 3-5 weeks it takes to grow new feathers and regain the ability to fly.

Biologists are particularly interested in broods in late summer when they are nearing the flying, or "fledging," stage. At this time, annual production in an area can be estimated by counting the **number of broods** and **average brood size**. By this time most losses to predators have occurred and the remaining young will likely be added to the **fall flight** of all birds in the population. In addition, molting adults and their flightless young may be easily captured and banded in August before they can fly. By July, biologists can use breeding population and production information to produce a **fall flight forecast** that is used to adjust hunting regulations for the coming fall hunting season.

Fall Migration Period

During August, waterfowl in Alaska begin to gather in flocks on large lakes and along the coast in preparation for the fall migration. Among most species there is some difference in the timing of departures of different

sex or age groups (e.g., male ducks may precede females with broods, nonbreeding geese precede family groups). Waterfowl consume a large amount of food energy to successfully complete their long migrations, relying on stored fat accumulated on the breeding grounds in late summer and "refueling" at a series of stopover places. Geese and swans especially need food and resting spots, called **staging areas**, where large numbers of birds traditionally gather each year.

Concentrations of geese on staging areas provide biologists an opportunity to make population estimates from aerial counts. During these counts, young birds can be distinguished from adults by their immature plumage (Canada geese lack the white cheek patch, white-fronted geese lack black barring on the breast, and young swans have dirty gray plumage in their first fall). Calculated **age ratios** (young per adult) from these surveys provide good estimates of the number of young produced that year. The age ratio also tells biologists what proportion of young may have survived to flight stage since they were hatched on the nesting grounds.

Waterfowl face a wide variety of hazards during their migration, including inadequate energy (fat) reserves to make the flight, bad weather, and hunting along their flyways. A substantial number of young birds are lost during their first migration, usually because they lack experience and stamina for the rigorous journey, but also because they are more susceptible to hunting. Young birds, unaccustomed to hunting, are not very wary when going into fields and marshes, and they are more easily attracted to the decoys set out by hunters.

The high death rate of young birds due to natural causes and hunting are important concepts in managing waterfowl populations and regulating hunting. For the most part, hunting removes many young birds that would not survive their first year in any case. This substitution of hunting for natural mortality has little effect on the populations. In addition, the harvest of mostly young birds results in greater survival of the older, more productive adults that will return to the breeding grounds in the next spring.

Because of the importance of measuring and controlling the effects of hunting on waterfowl, the U.S. Fish and Wildlife Service and the Alaska Department of Fish and Game conduct **harvest surveys** by asking a predetermined number of hunters to keep track of and report the number and kind of birds they take during the open season, as well as the places they hunted and the number of days they spent hunting. Also during the fall hunting season, biologists receive many reports of birds that are marked with neck collars or leg bands. Hunters often give metal leg bands from birds they've shot to biologists. These reports and observations will be gathered throughout the winter and analyzed later to determine patterns of bird migration, hunting activity, and many other kinds of information (see the "Tagging Birds" and "Migratory Mapping" activities). Particularly in the lower 48 states, biologists and wildlife managers spend considerable time at hunter check stations and on law enforcement patrols to gather information and ensure compliance with hunting regulations.

Winter

By late November or December, most waterfowl are on their wintering grounds. Without the protein requirements of the nesting season and territorial behavior of breeding pairs, wintering waterfowl are very social and flocks travel to find abundant food. Nowadays, most of the major wintering areas have been converted from wetlands and grassy plains to agricultural uses and urban expansion. This has not been all bad for waterfowl because most ducks, geese, and swans have adapted and become dependent on abundant corn, rice, and winter wheat crops, as well as livestock pastures for food. Of course, this sets up conflicts with farmers that may experience damage to their crops from large concentrations of waterfowl.

The primary problem with winter waterfowl habitat is the loss of wetlands needed by birds for resting and feeding on natural wetland foods. Crowding, spread of diseases, and poor water quality on the remaining wetlands are serious problems. Over the years, a network of state and federal waterfowl refuges has been established to both preserve critical wetland habitats and draw waterfowl away from agricultural crops on the wintering grounds (see section on the Conservation of Migratory Birds). Management and restoration of wintering grounds is becoming critical as evidence shows that the condition of waterfowl throughout winter affects how productive they are the following spring.

During winter, waterfowl populations that cannot be estimated on fall staging areas (ducks, swans, some geese) are counted in wintering concentrations on **midwinter inventory** surveys. These surveys are conducted from the ground and from airplanes by many people across the major wintering areas of the U.S. and Mexico. For most waterfowl populations, either a fall or **midwinter population index** is used as an annual measure of population size over time, but these are estimates and are not total counts of all birds.

By late winter and spring, after the hunting seasons have closed in January, biologists and managers have gathered a great deal of information on the size, distribution, and welfare of waterfowl populations. From hunter harvest survey reports they can estimate the number of hunters that hunted waterfowl, the level of effort (days) spent by hunters, their average success in taking ducks and geese, and the locations of hunting activity. These figures are used to calculate estimated **total harvest** and other statistics, nationally, by flyway, by state, and even for some local areas. When compared with past informa-

tion, these data indicate changes in waterfowl harvests and hunter behavior.

Other information is gathered from examining wings of ducks and tails of geese taken by hunters. Duck wing samples provide the composition of duck species in the harvest, the proportions of males and females (**sex ratio**), and the proportions of young and adult ducks (**age ratio**). Goose tails show the number of each species and the proportion of young geese in the harvest. Computerized records of metal leg band reports and observations of marked birds may be used to estimate survival rates for groups of birds and to plot the harvest distribution for birds from a particular breeding area or population segment.

As early as February, waterfowl begin trickling northward, feeding more intensively for their long spring flights to Alaska in April and May. Experienced adults are anxious to reach the nesting grounds and lead the way, followed by maturing birds with new mates and young birds learning the traditional flyways and rest stops. Once again, staging areas are critical to their survival and the pace of spring in Alaska will strongly influence the annual success of the populations.

Applications For Students

North American waterfowl populations face increasing problems, from the vagaries of continental droughts to the continued loss of wetland habitats and complexities of human impacts. The species accounts following this section illustrate some of the problems of the individual waterbird populations and the wildlife management efforts underway to address them. We hope this background material will help you convey the principles of population dynamics and the variety of factors influencing populations in many of this curriculum's activities.

By necessity, the art and science of managing migratory bird resources has advanced rapidly in the last 50 or more years. The methods of early naturalists with their notebooks and cameras and their prosaic accounts of bird observations have been largely overshadowed by modern technology and highly trained scientists. We can now reach every corner of the earth with airplanes, we can track individual birds or map their habitats on a large scale from satellites, and we use computers to make more accurate population estimates and harvest forecasts.

Certainly, ornithologists and wildlife managers need technical skills in mathematics, chemistry, physics, and biological sciences to understand wildlife resources. But they also need to know the sociological, economical, and legal issues associated with the conservation of wildlife in our complex society. Hopefully, some of your students will become fascinated with these migratory birds that touch so many lives and will take an interest in wildlife science as a profession. At the very least, we hope all students will appreciate the natural world and become informed citizens capable of making better decisions that affect the future of migratory birds.

Simple Model Of Annual Waterfowl Population Data

This example may serve to integrate lessons on factors affecting waterfowl populations and waterfowl management activities. In reality, many different kinds of surveys are conducted to gather information on many of the specific populations of swans, geese, and ducks. The model illustrates only the main measurements that are taken, and the numbers were made for a relatively healthy goose population unit from a small breeding area.

<u>May Breeding Population Survey (by airplane)</u>

A. Total Population (estimate) = 250 birds
B. Breeding Pairs (observed) = 100 pairs (200 birds)

We now know: most of the population (80%) is adult breeding birds in pairs, with 50 immature or unmated birds. This can be compared to previous years.

<u>Early June Nesting Surveys (ground surveys)</u>

C. Nests Found = 90 — B - C = 10 (10%)
D. Average Clutch Size = 5 eggs — C x D = 450 eggs

We now know: about 10% of the pairs did not nest and there are potentially 450 eggs produced by the population. Nest numbers and clutch size can be related to this year's weather conditions and previous data.

<u>Late June Nest Survey (ground)</u>

E. Nests Hatched = 60 — E ÷ C = 67% nest success
E x D = 300 potential young

We now know: about 30 of the nests did not hatch and we can estimate how many were lost to predators from signs at the nest sites. The population may have produced as many as 300 young birds, a loss of 150 eggs from the starting total of 450.

<u>July Brood Survey (by airplane)</u>

F. Number of Broods = 40
G. Average Brood Size = 3 young
H. Production Estimate = F X G = 120 young

We now know: over half the young birds that may have hatched have been lost by this time, and from an average of 5 eggs per family only 3 young have been produced.

Fall Population Forecast (calculations)

I. Fall Flight = A + H = 370 birds
J. Percent Young = H ÷ I = .32 (32%)

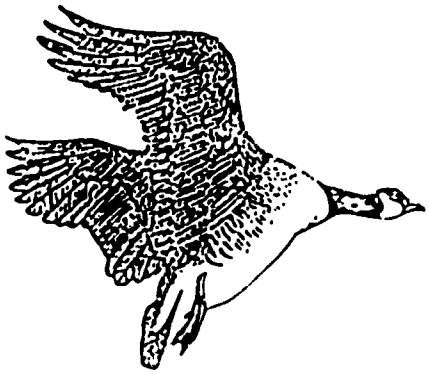
Biologists estimate the size of the fall population by adding the estimated number of young produced to the population size measured prior to the nesting season. The fall flight forecast is usually given in terms of change from previous years; in this case the population has increased by 48% (H ÷ A). A high percentage of young in fall indicates a growing population. Special airplane surveys on fall staging areas provide more accurate estimates of the proportion of young surviving to migration.

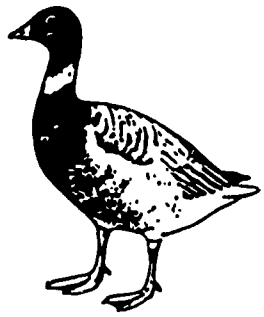
Winter Inventory (by airplane and ground counts)

K. Total Population = 300
L. Total Young = 75 L ÷ K = 25% Young

We now know: the population decreased by 45 young and 10 adults since fall migration. The estimated number of young have survived their most difficult life stages and are likely to represent lasting additions to the population (called "recruitment"). Thus, if we take into consideration all of the adults and young that have survived since we first started counting birds, we show a 20% increase of the total population. When information is gathered from hunter surveys and banding reports, a fairly detailed picture of this population can be drawn for the entire year.

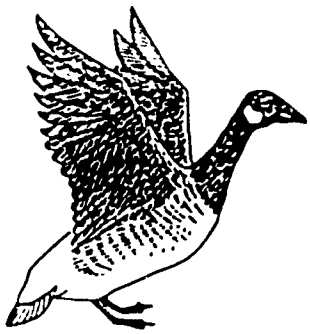
SPECIES ACCOUNTS

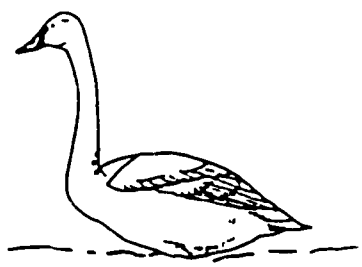


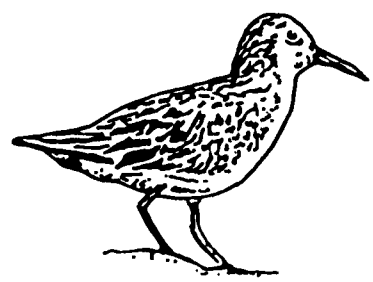


The following pages contain profiles (accounts) of six species and two sub-species of migratory birds that nest in Alaska. These **accounts** provide background for several of the activities in this curriculum. Certainly there are many more migratory birds in Alaska than are listed here; these species accounts should serve as examples of the diversity of waterfowl that use wetland habitats. The summaries include important facts about breeding and molt cycles, migration routes, nesting areas, and wintering locations. Each account also outlines the factors which influence the population dynamics and the management efforts to maintain or restore these groups of birds.

As you will note in your reading of the sections called "Factors Affecting Populations...," several important societal issues are raised concerning human actions which are needed to maintain or increase waterfowl populations. These issues can form the basis of units or action projects that focus on conflict resolution and the development of critical thinking skills.







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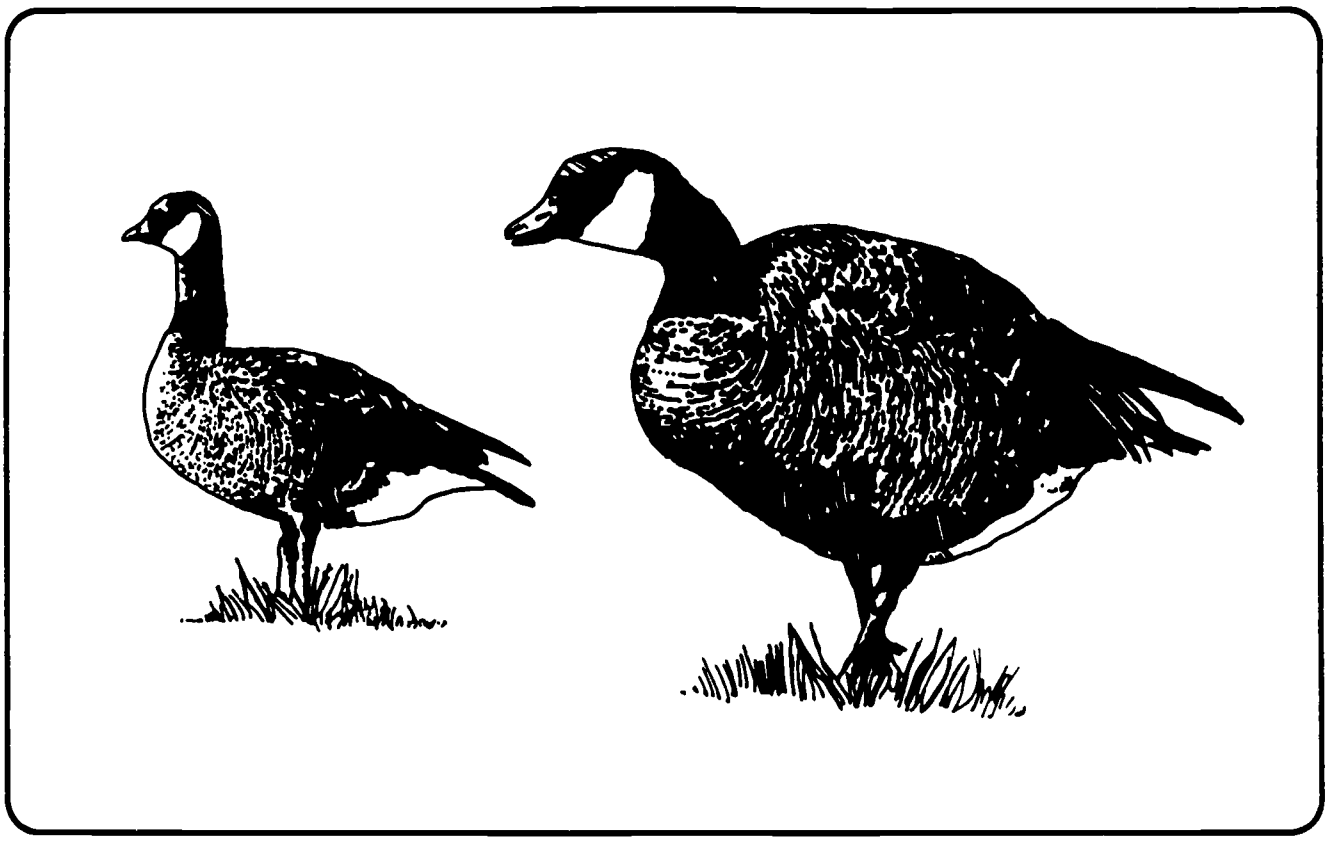
CANADA GEESE (*Branta canadensis*)
Igsragutilgich (Inupiat)
Midhalzin, dits'in, vidhal zring (Athabascan)



There are six kinds, or sub-species, of Canada geese that nest in Alaska. Two of the sub-species, the Aleutian Canada goose and the dusky Canada goose, present unique management situations. While Canada geese populations throughout North America have generally been increasing, these two sub-species are in trouble; the Aleutian Canada geese are on the threatened species list and duskies are at low population levels compared to historical numbers. These two types of Canada geese nest in different areas of Alaska and remain separate sub-species because the populations do not interbreed in the wild. However, they mingle with other types of Alaska nesting Canada geese when the geese are on their wintering areas.

Identification

Canada geese have black heads and necks, white "chinstraps" stretching from ear to ear, black bills, legs, and feet; grayish-brown backs and wings, gray or brown sides and breasts, and white bellies and flanks.

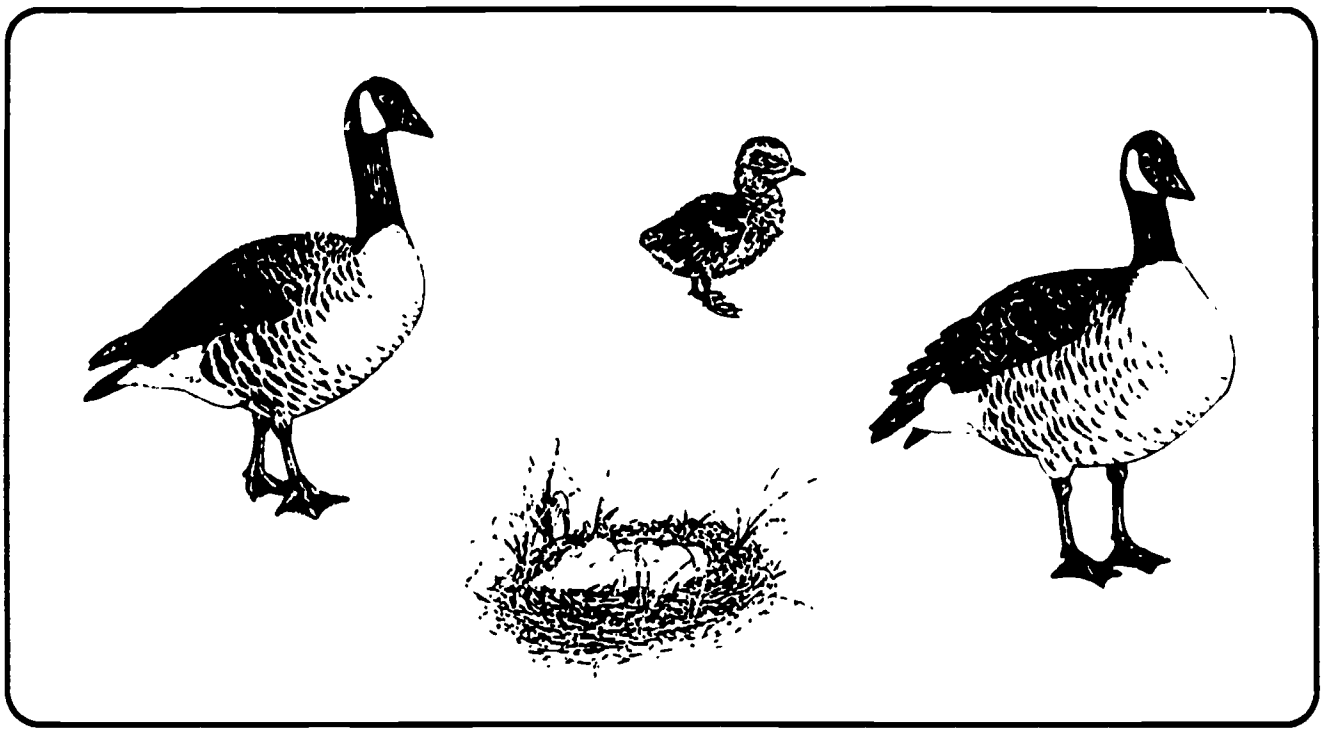
Breeding Habits

Canada geese mate for life and generally nest at three years of age (occasionally at two years). Vegetation is their primary food and they construct their nest with vegetation, usually close to the water. The two sub-species featured in this section nest on the ground; other sub-species sometimes nest in trees (Vancouver Canada geese), or occasionally on cliffs (interior and northern Alaska geese). Canadas lay 4-5 eggs per nest. Predators on eggs and goslings include gulls, foxes, coyotes, wolves, bears, wolverines, jaegers, eagles, and ravens.

Molt Cycle

Canada geese molt each summer, losing all of their flight feathers simultaneously. Geese are flightless for about a month, while new feathers grow.

Aleutian Canada Goose (*Branta canadensis leucopareia*)



Identification

Aleutian Canadas are nearly the smallest of Canada geese, weighing four to six pounds. They have a broad white ring at the base of the neck and a light breast. No one characteristic distinguishes these from the other small Canada goose sub-species, thus a combination of characteristics is needed for identification. Their size and high-pitched voices are similar to cackling Canada geese that nest on the Yukon-Kuskokwim Delta.

Breeding Grounds and Migration Routes

Until recently, scientists thought that Aleutian Canadas were nesting on only a few of the Aleutian Islands, a remnant of their former range which included the Aleutian Islands and the Kurile and Commander Islands of the Soviet Union. In 1984, sophisticated genetic techniques have confirmed that the geese on Kiliktagik Island in the Semidi Island group south of the Alaska Peninsula were, in fact, Aleutian Canada geese.

Aleutian Canadas are seldom seen in Alaska outside their Semidi and Aleutian Islands nesting areas. Their migration route is thought to be across the Gulf of Alaska and through remote coastal areas of the state.

Wintering Areas

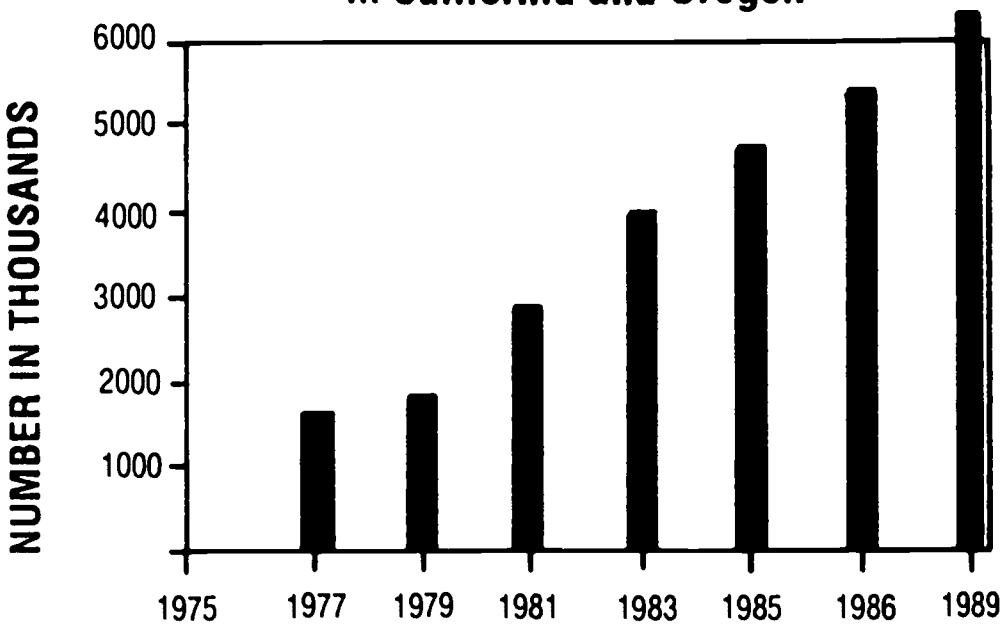
The geese that nest in the Aleutians winter primarily in California's Central Valley, making landfall in the Crescent City area and wintering in the Sacramento Valley and south to the San Joaquin River in the Modesto/Los Banos area. In spring, they again stage at Crescent City and travel along the Oregon and lower Washington coast on their way to Alaska. The birds nesting on Kiliktagik Island winter in the Pacific City/Woods area of Oregon.

Population Status

The Aleutian Canada goose is one of only a few species of Alaska wildlife that are presently classified as threatened or endangered (by both the Alaska Department of Fish and Game and the U.S. Fish and Wildlife Service). The U.S. Fish and Wildlife Service has now reclassified the sub-species threatened since its population has a lower level of potential for extinction. The decline of the species began in the mid-1800s, with the introduction of arctic foxes to the Aleutian Islands. Farmers released foxes on the islands and harvested them later for their furs. The foxes fed primarily on defenseless ground-nesting geese and seabirds who had no similar natural predator. (Geese respond to dogs, which have been used to herd them for banding or capture, by freezing in place and acting as if hypnotized.)

In 1967, managers could account for fewer than 800 birds in the population. The only known nesting area was Buldir Island in the western Aleutians and migration routes and wintering areas were not known. In 1989-90, 6200 birds were estimated in the California wintering areas, and breeding birds occupied Kiliktagik Island and Chagulak, Agattu, and Nizki Islands in the Aleutians. The group nesting on Kiliktagik Island was estimated at 100 birds on its Oregon wintering grounds in 1988-89.

ALEUTIAN CANADA GEESE
Fall/Winter Population Index
in California and Oregon



Factors Affecting the Population on the Nesting Grounds

Wherever foxes remain, they continue to be a major cause of mortality for Aleutian Canada geese and an obstacle to reestablishing them on islands where they formerly nested. Bald eagles, found on islands east of Buldir, are also an effective predator on young birds and may be a barrier to establishment of new populations through transplants of young or captive-reared birds. More than 90% of the population nests on Buldir and managers remain concerned that a single catastrophic event such as a severe storm could decimate the population.

Management Efforts on the Nesting Grounds

In 1975, managers implemented a Recovery Plan for the sub-species under the requirements of the Endangered Species Act. Foxes were eradicated from several Aleutian Islands with a combination of trapping and controlled use of the poison "1080" in small tallow baits. No effects of the poison on bald eagles were noted, although some glaucous-winged gulls and ravens are believed to have died due to ingestion of the poison. The Environmental Protection Agency has banned the use of the poison except in specially-permitted and carefully monitored applications such as those necessary to provide secure nesting habitat for the Aleutian Canada goose.

Biologists reared geese in captivity from eggs removed from the nests. However, when captive-reared goslings or adults were released directly onto islands, these failed to survive and did not breed with wild birds. The best success followed the capture of wild male geese in northern California which were then bred with captively-reared females. The resulting family groups were then transplanted to Buldir and many survived. Production on Buldir has increased to the point where captive-rearing was no longer necessary; however, some captive-reared flocks still remain in zoos and in Japan where birds have also been released to try to restore birds to the western-most area of their historic breeding range.

Wild birds have been captured and relocated to islands that are either fox-free historically, or from which foxes have been eradicated. In 1989, the efficiency of the biologists' round-up of flightless, molting geese in tall grass on steep slopes was greatly improved by the use of border collies to locate and "herd" the geese. Once transplanted, young birds have suffered high predation by bald eagles; the most successful transplants of wild birds have been of families nearing the end of their flightless period. The adults serve as guides to winter areas and the young return to the transplant site the following year, where hopefully they will nest at two years of age.

Factors Affecting the Population on Migration Routes and Wintering Areas

On staging and wintering areas, hunting was a major mortality factor until 1975.

Some portions of the wintering areas are privately-owned and the habitat is not necessarily managed by landowners to ensure long-term feeding areas and high-quality water sources for the birds. In general, the Central Valley wintering grounds are frequently affected by shortages of water and poor water quality. Agricultural interests control much of the water supply, and only the remainder (which in some cases is polluted with fertilizers and chemicals) is left for wildlife refuges and waterfowl management areas. These areas are small which results in crowding of many kinds of waterfowl into remaining wetlands. Disease outbreaks can occur and severely affect many birds under these conditions.

Management Efforts on the Wintering Areas and Migration Routes

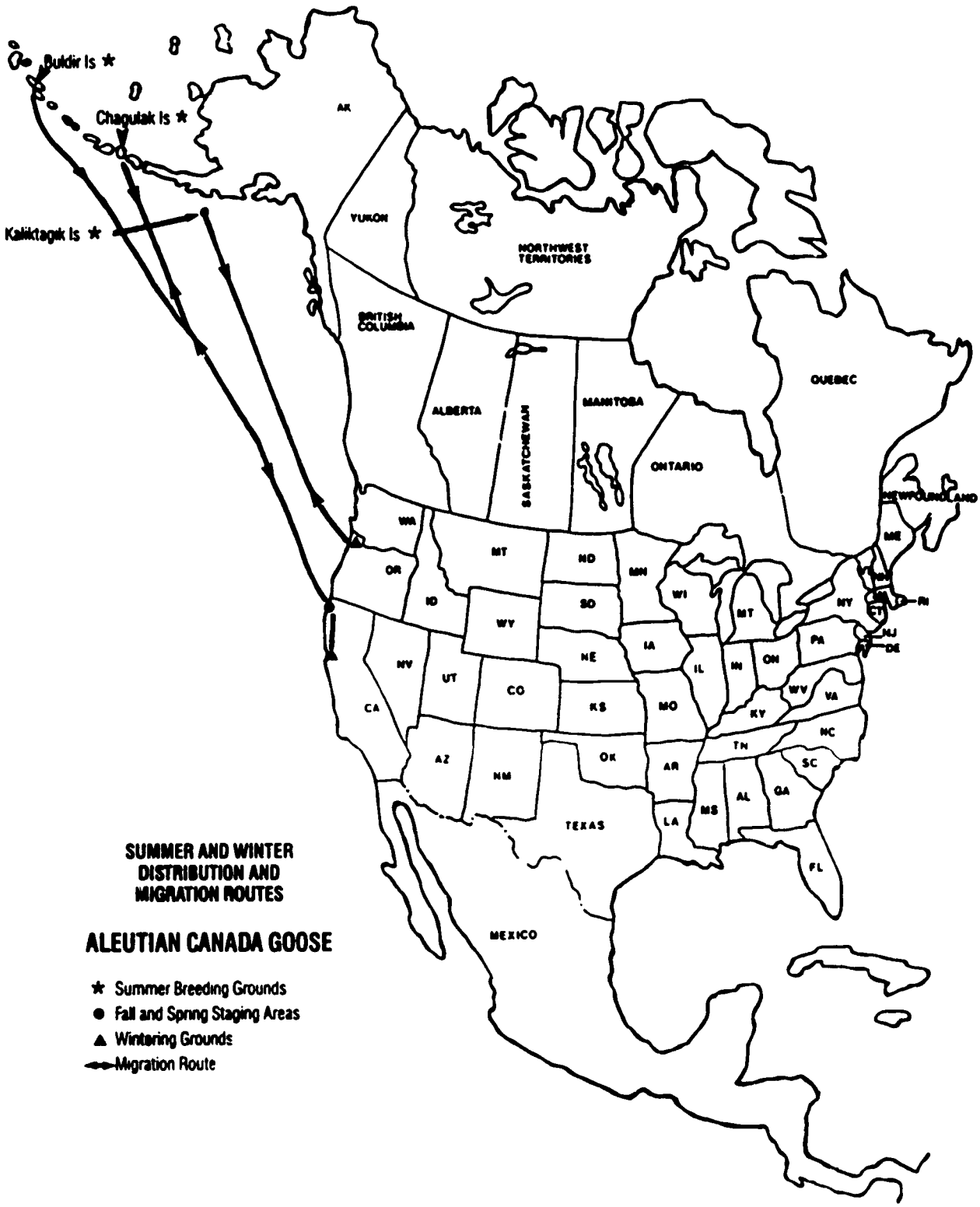
When the sub-species was listed as endangered in 1967, migration routes and wintering areas had not been identified yet. Managers used band returns and observations of color-banded birds and intensive winter surveys in Washington, Oregon, and California to trace the routes.

Canada goose hunting has been closed in areas used by Aleutian Canada geese to ensure that this small population survives and grows. Canada goose hunting is closed west of Unimak Pass in Alaska and has also been closed since 1975 on three important staging and wintering areas in northern and central California. During fall and winter, biologists carefully monitor the numbers and the movements of Aleutians to prevent accidental shooting of these birds during hunting seasons for ducks and other kinds of geese. A major education program for hunters and non-hunters has emphasized identification of seven different kinds of Canada geese in the Pacific Flyway and the need to protect Aleutian, cackling, and dusky Canada goose populations.

As part of the 1986 North American Waterfowl Management Plan, efforts have intensified to protect and increase the California grasslands and wetlands vital to Aleutian Canada geese. The U.S. Fish and Wildlife Service, California Department of Fish and Game, and many private conservation groups have joined forces to buy and lease land, create wetlands, and manage pastures and rice fields for ducks and geese. Their goal is to restore and enhance 90% of the original wetlands that have been lost in the region.

Summary

The Aleutian Canada goose is a success story in terms of its continuing recovery from a point where it was in imminent danger of extinction. However, efforts are still needed to expand their use of nesting areas in the Aleutian Islands and provide long-term security for both staging and winter habitat.


Buldir Is ★
Chagulak Is ★
Kaliktagik Is ★
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NORTHWEST TERRITORIES
BRITISH COLUMBIA
ALBERTA
SASKATCHEWAN
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ONTARIO
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PA
NY
ME
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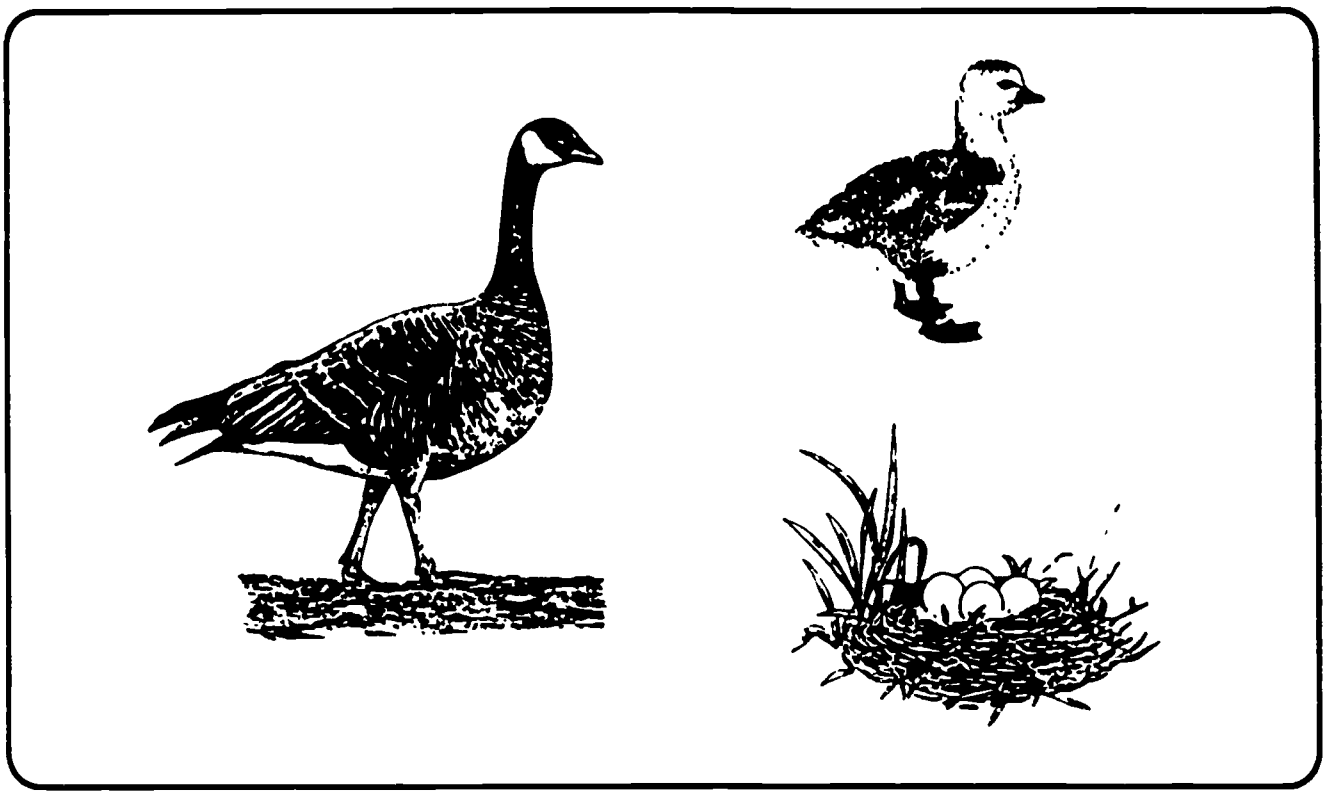
MEXICO
SUMMER AND WINTER DISTRIBUTION AND MIGRATION ROUTES
ALEUTIAN CANADA GOOSE
★ Summer Breeding Grounds
● Fall and Spring Staging Areas
▲ Wintering Grounds
Migration Route

Dusky Canada Goose (*Branta canadensis occidentalis*)



Identification

Duskies, as their name implies, are some of the darkest colored Canada geese in Alaska. In the fall, they weigh five to eight pounds, but males in spring can weigh ten or more pounds. They are closely related to the Vancouver Canada goose that is found from Southeast Alaska south to Washington state.

Nesting Areas and Migration Routes

Dusky Canadas nest only on the Copper River Delta near Cordova. In fall, duskies migrate from Cordova across the Gulf of Alaska. Some stop in the Queen Charlotte Islands of British Columbia. Most land in southwest Washington then follow the Columbia River to Portland, turning south to spread out through the Willamette Valley. The spring migration route is the reverse.

Wintering Areas

The primary wintering areas for this population are the Willamette Valley in western Oregon and the lower Columbia River floodplain. Small numbers winter in other areas from British Columbia to California.

Population Status

Fall numbers of dusky geese declined during the period 1979-1990, from 25,500 in 1979 to between 10,000 and 12,000 in 1990.

Factors Affecting the Population on the Nesting Grounds

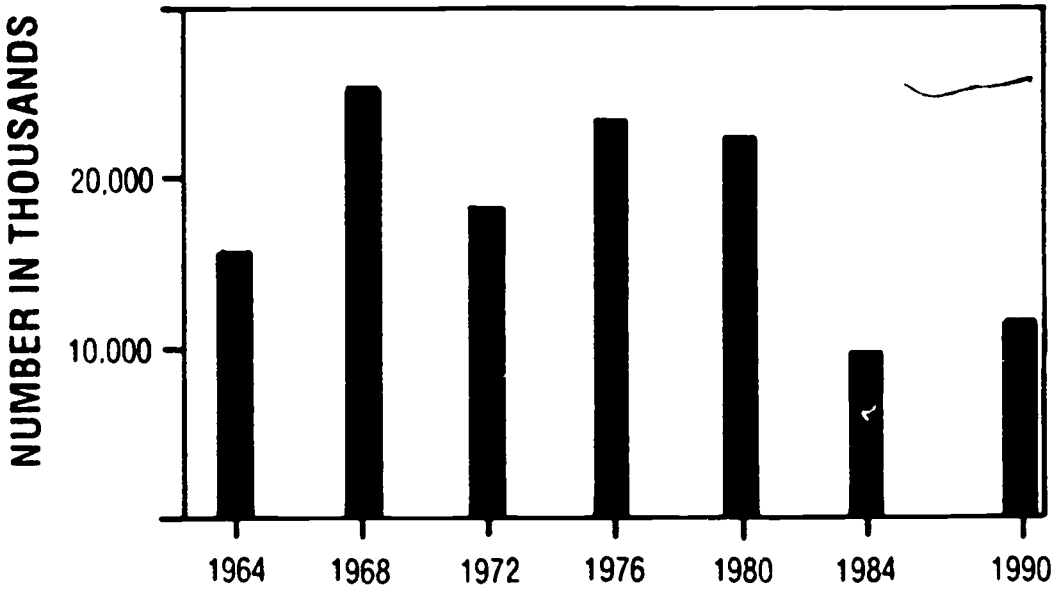
In 1964, the nesting area in the Copper River Delta was uplifted by the "Good Friday" earthquake. Following the uplift, some portions of the wetland habitat on the Copper River Delta began to dry out. Shrubs grew much better than the wetland plants in the drier areas. (The area is expected to follow a successional pattern that will eventually transform the shrubs into forest stands.) Although nesting habitat was still abundant, the shrubs provided habitat in the form of food and cover for animals that prey on eggs and goslings. As the activity of brown bears, coyotes, glaucous-winged gulls, and parasitic jaegers increased in nesting areas following the earthquake, nest success dropped dramatically.

Nests also fail if flooding occurs in June. Heavy rains can combine with high levels of beaver activity damming streams to reduce the availability of elevated, dry nesting sites.

Management Efforts on the Nesting Grounds

Attempts to stabilize the population of dusky geese in the face of a dramatic ecological change is one of Alaska's

DUSKY CANADA GEESE
Fall/Winter Population Index
in Oregon and Washington



most difficult waterfowl management problems.

Researchers have been studying changes in the selection of nest sites and nest success as the plant communities are changing on the Delta. Since 1984, artificial nest islands have been built by the U.S. Forest Service and Ducks Unlimited to discourage predators from reaching nests. A variety of designs have been tried, and floating fiberglass platforms are being used successfully by the geese.

In 1987, the brown bear population was temporarily reduced by 40-60% by capturing and moving bears a long distance from the nesting areas when geese began laying eggs. Researchers did not observe an increase in nest success that they could attribute to the reduced bear population. Weather conditions were cold and rainy in 1987 and predation by glaucous-winged gulls and jaegers increased over previous years. Researchers also observed that coyote predation on nes' as high in a year that their rodent prey base was low. e to the effects of several types of predators, the researchers concluded that all three types of predators affected goose nest success and would have to be considered together in any management program to increase the dusky population.

Beginning in 1987, goslings and adult dusky Canada geese were transplanted to Middleton Island in the Gulf of Alaska. There are no foxes or other mammalian predators which would prey on the geese on the island. As of 1990, the production of geese on Middleton is increasing and may help to stabililize the dusky population.

Factors Affecting the Population on Their Migration Route and Wintering Areas

Dusky Canada geese stop at several places in Southeast Alaska and British Columbia during fall migration. Most of these places are in their natural condition on protected publicly owned lands. However, further south they use agricultural lands and other areas that are susceptible to conversion into unusable habitat (residential or commercial development, etc.). Changes in agriculture and establishment of wildlife refuges have attracted 80,000 Canada geese to the Willamette Valley during winter. The geese feed on winter wheat, grass sod farms, and other crops, creating conflicts with farmers who want to be paid for damages.

Historically, dusky Canada geese were heavily hunted in Oregon, and hunting controlled the size of the population. This situation has changed and production on the breeding grounds is now the major limiting factor. When hunting was heavy, high annual production of young sustained the population.

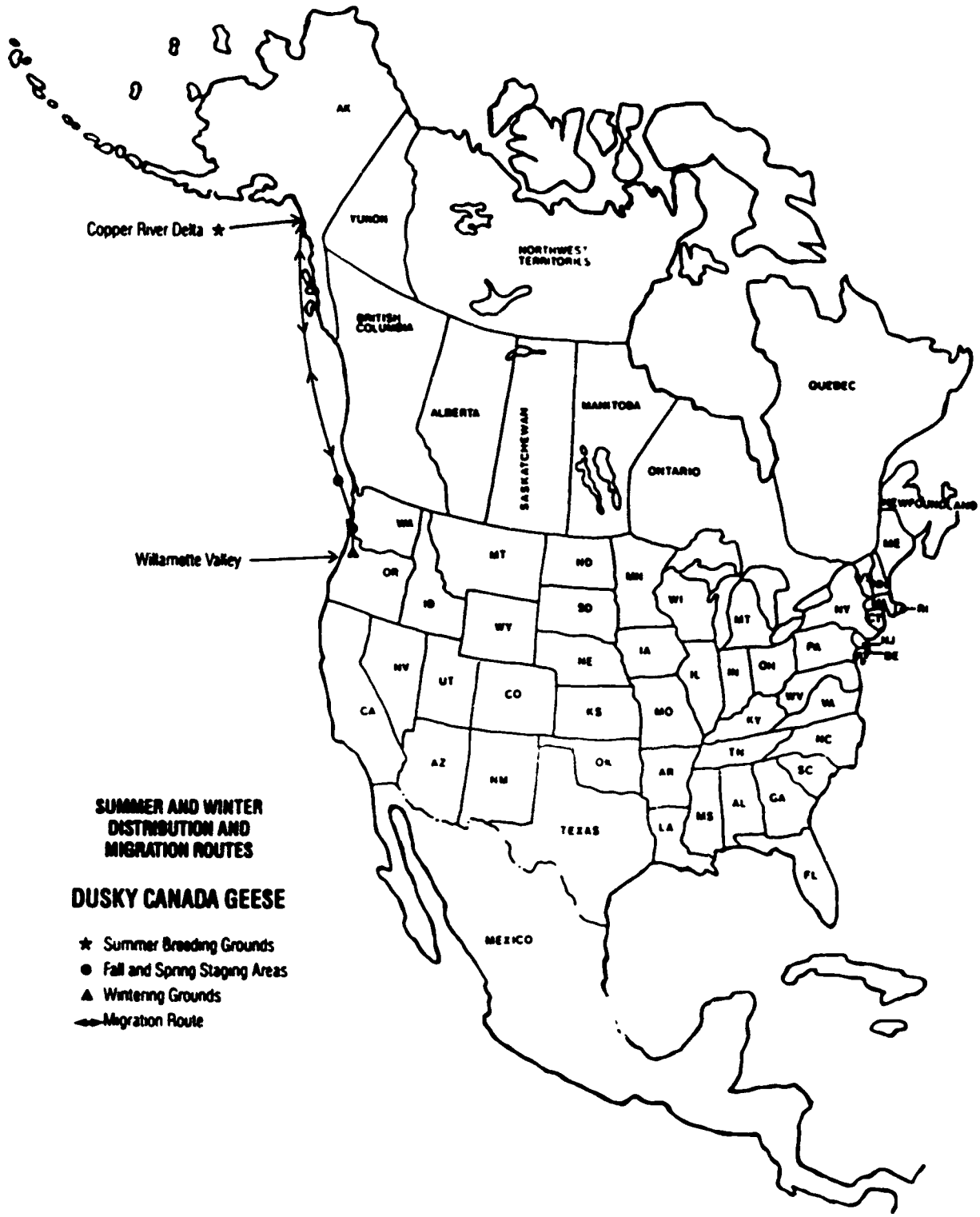
In addition to recreation and food provided by hunting, the hunting season discouraged geese from using

farmers' fields and limited the total number of all kinds of geese on the wintering grounds. But now that the threatened dusky Canada and cackling Canada geese have begun to winter in Oregon together, there are more protective measures needed to restore their populations. Hunting is increasingly restricted despite the large numbers of other Canada goose subspecies available to hunters and feeding on crops.

Management Efforts on Their Migration Route and Wintering Areas

In 1964 and 1965, three National Wildlife Refuges were established in the Willamette Valley to provide sanctuary, food, and water for duskies during winter. Creation of the refuges has helped safeguard winter habitat, and the vegetation on the refuges is managed to keep the geese on the refuges.

There is a limited number of tools that biologists can use to safeguard migratory birds. Controlled goose hunts are now used in Oregon to minimize the harvest of dusky geese. There is also a major education effort to help hunters tell the sub-species of Canada geese apart. And scientists are conducting research to find ways to better census goose populations and more accurately measure survival rates.


Copper River Delta
Willamette Valley
AK
YUKON
NORTHWEST TERRITORIES
BRITISH COLUMBIA
ALBERTA
SASKATCHEWAN
MANITOBA
ONTARIO
QUEBEC
NEWFOUNDLAND
WA
OR
CA
NV
ID
MT
WY
UT
AZ
CO
NM
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SD
NE
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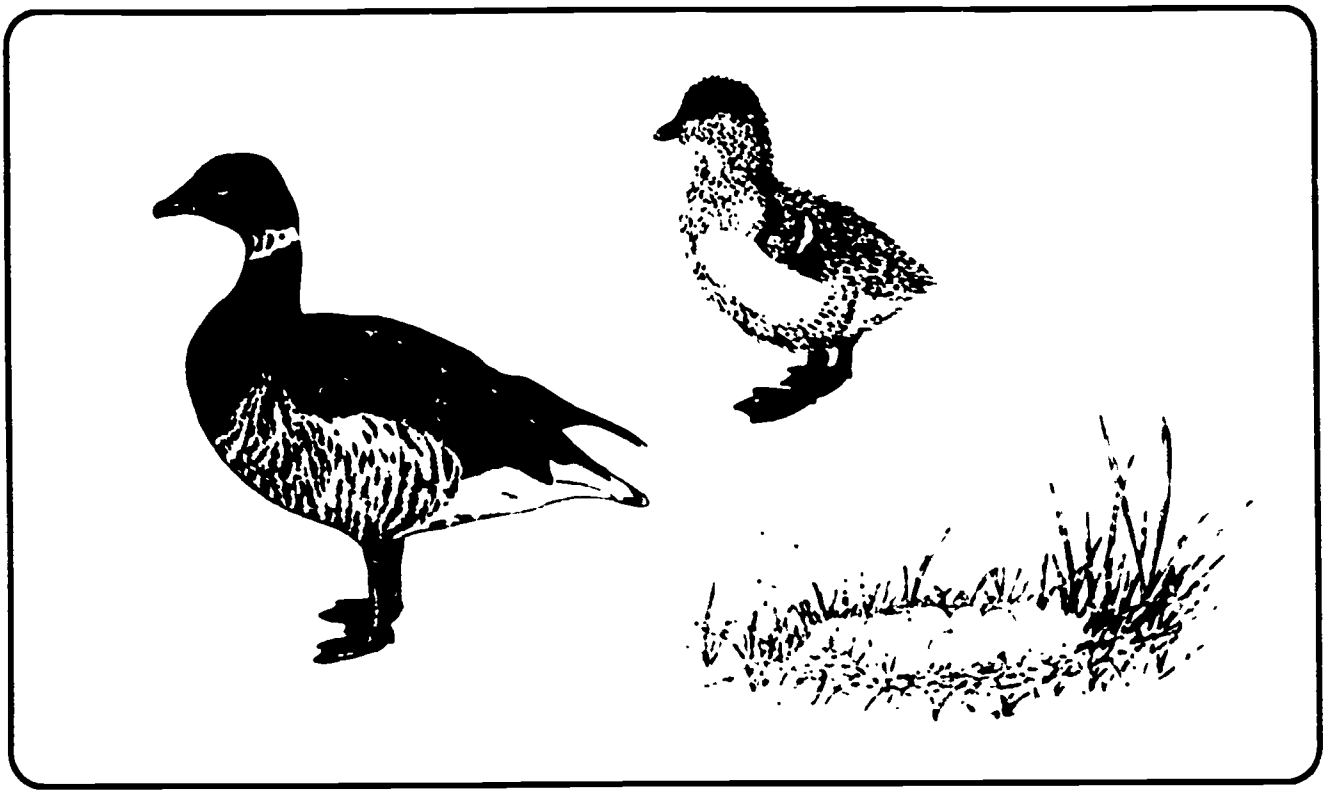
MEXICO
SUMMER AND WINTER DISTRIBUTION AND MIGRATION ROUTES
DUSKY CANADA GEESE
★ Summer Breeding Grounds
● Fall and Spring Staging Areas
▲ Wintering Grounds
Migration Route

Pacific Black Brant (*Branta bernicla nigricans*)
Neqlernat, 'Leqlernat (Yup'ik)
Niglingaq, Niglingak, Niglingat (Inupiat)
Novoghhigidits'in (Athasbascan)
Chyornaya Kazarka (Russian)



The Yup'ik and Inupiat names for brant sound like the b·ant's call while the scientific names *bernicla* means ·ark-bellied and *nigricans* means black, both of which describe its color.

Identification

Brant are small geese, 22-26 inches long and weigh approximately three pounds. They are stocky in silhouette and dark in color with black heads and necks. White feathers make a "necklace" high on their necks. Their breasts and bellies are a uniform dusky brown to blackish color as far back as the legs, and the sides and flanks are strongly barred grey and white. Their bills, legs, and feet are black.

Goslings are slate grey and fluffy. Immature or juvenile geese are very similar to breeding adults, lacking only the white neck markings and with white edging on the feathers of the middle wing.

In flight, brant are fast, easily-maneuvering, dark birds with a conspicuous expanse of white feathers under their tails. They often travel in wavering lines low over the water.

Breeding Cycle

Black brant are social birds, preferring to nest in large groups or "colonies" instead of in scattered pairs. They nest on small islands in freshwater tundra lakes, usually within three miles of the coast. Birds return year after year to the same traditional nesting areas on the Yukon-Kuskowkim Delta, in the Canadian Arctic, and Siberia. Brant usually arrive on their nesting grounds after mid-May, but do not arrive on their farthest north colonies until June. Here they graze on sedges and grasses, establish nests with three to five eggs, and cooperatively defend their nests from predators.

Brant mate for life and first nest when they are two years old. They are known for depositing large amounts of dark gray down in their nests. Brant usually raise their young in coastal saltmarshes, often forming large communal family flocks. Two to three goslings usually survive from each nest and make the fall migration.

Molt Cycle

Birds that do not breed and those whose nests have failed migrate long distances to traditionally-used tundra

lakes to summer and molt during June and July. While some non-breeders congregate in large flocks near nesting areas, most birds travel to the Teshekpuk Lake area on the central portion of Alaska's North Slope. Teshekpuk Lake and nearby lakes and ponds are a very important molting area for 30-50,000 geese each year. A large percentage of Alaska's summer brant population molts there, joining molting white-fronted, snow, and Canada geese. Scientists have estimated that up to 20-25% of the population of Pacific brant molt there each year; banding returns have documented that brant come to Teshekpuk Lake from the Mackenzie and Anderson River Deltas of Canada as well as from Siberia. The brant molt on large lakes with grassy meadows along the shores. The meadows provide feeding areas and the large lakes provide escape habitat from land predators. These areas are very important because brant are flightless while they grow new wing feathers.

Migration Routes

Brant move to coastal wetlands and stream deltas after the molt in August. When the black brant leave their tundra molting and nesting areas at the end of summer, they migrate westward and southward along the coast of Alaska to Izembek Lagoon at the western end of the Alaska Peninsula by Cold Bay. They stage in several lagoons along the way near Chagvan Bay, Pilot Point, the mouth of the Cinder River, Port Heiden, and Port Moller. The brant that nested on the Yukon-Kuskokwim Delta and the North Slope of Alaska join the birds that nested in Siberia and Canada — making Izembek one huge family reunion site for almost all of the world's black brant during September and October.

The brant stay at Izembek between four and six weeks to fatten up on a highly nutritious marine grass called eelgrass (*Zostera maritima*) which grows abundantly in the shallow waters of the lagoon. The brant gain about one pound, or about one-fourth to one-third of their body weight. Accumulated fat supplies critical energy for their non-stop transoceanic flight south when the birds leave Izembek.

Their departure from Izembek is a spectacular event. Near the first of November when a weather system gives them tail winds, the social brant climb together higher and higher into the sky and begin their migration en masse. Since they usually leave between sunset and midnight, radar at the nearby military site has been used to track their departure. Within a day or two, the lagoon is quiet and almost empty. A few thousand brant will stay the winter at Izembek if the weather remains mild.

The migrating brant fly over the Pacific Ocean west of the Gulf of Alaska and most of the flocks go straight to Mexico, settling in Baja or the mainland west coast of Mexico.

In February, brant start moving back northward on their long journey up the Pacific Coast, concentrating enroute in bays of California, Oregon, Washington, and British Columbia. In April the geese push north, a few stopping at Kodiak, but most returning directly to Izembek Lagoon. After a few weeks spent feeding on the eelgrass, the birds fly along the coast, stage again in bays on the north side of the Alaska Peninsula, and then fly on to their breeding areas.

Wintering Areas

Over 90% of the population winters in Mexico along the Baja and mainland coast. Approximately half of the Mexico-wintering birds stay in San Ignacio Lagoon. Scattered small groups winter north of Mexico in British Columbia, Washington, Oregon, and California. A group of 15,000 to 20,000 brant, mostly from the farthest north nesting areas in Canada, stay in Puget Sound near Anacortes, Washington. Brant prefer saltwater for wintering, again feeding primarily on eelgrass.

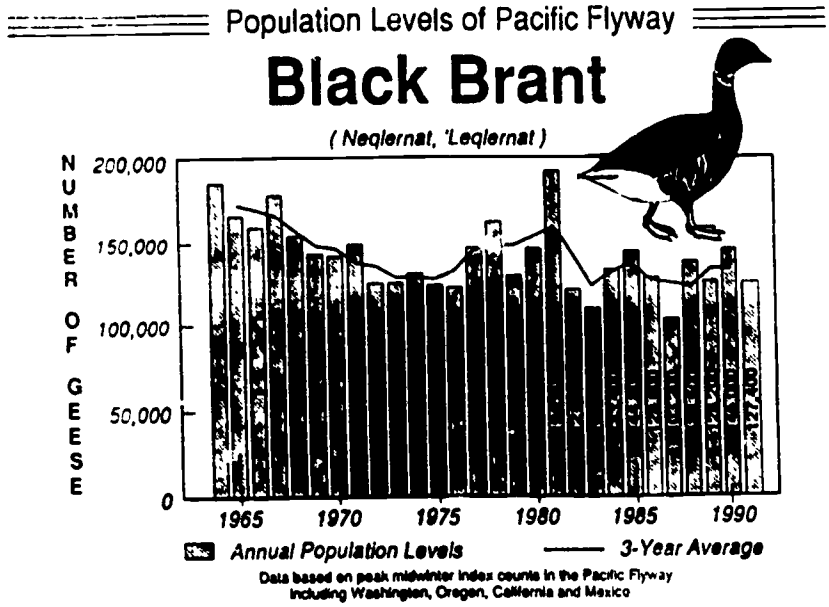
Population Status

The number of black brant in the population is measured each year in January when the birds are concentrated on their wintering areas. These annual counts indicate considerable fluctuations from year to year, but the long-term stable average is around 140,000 birds. In species that nest in the arctic, it is not unusual for years of good and bad spring weather to cause a "boom or bust" pattern of population changes.

Over the past 25 years, the two major changes in the numbers of Pacific brant have been the shift to more southern wintering grounds and a dramatic decline in the number of birds nesting on the Yukon-Kuskokwim Delta.

Factors Affecting the Population on the Nesting Grounds

Between 1981 and 1984, the number of birds nesting on the Yukon-Kuskokwim Delta decreased by more than 75%. Large expansive colonies that were nearly continuous along portions of the coast before the decline were reduced to three small colonies with empty habitat between them after the decline occurred. In 1990, the causes of the decline had not been explained and the effect of the decline on the total brant population was unclear. Scientists did not have enough information to determine if brant that formerly nested in western Alaska shifted to more northern nesting areas or if they died at higher rates than birds that nested in other areas. The total population did not show a major decrease in the size of the wintering population during the 1981-84 period.



There are two major causes for concern about the brant population: 1) vulnerability of the small remaining colonies on the Yukon-Kuskokwim Delta to predators and to catastrophic events such as storms; and 2) limited knowledge of the productivity of colonies in the Canadian arctic and the Soviet Union. In addition, Yup'ik people on the Yukon-Kuskokwim Delta have traditionally hunted brant during the spring and also removed eggs from nests for food. This harvest adds to the harvests that have historically occurred along the fall migration route and wintering areas. Hunting and egg-gathering, with associated disturbance, can affect local nesting colonies.

Like other waterfowl, delayed nesting because of a late spring or flooding results in lower productivity. Flooding in combination with high predation by arctic foxes may compound population reductions particularly in the small remnant colonies on the Yukon-Kuskokwim Delta. In one nesting colony on the Yukon-Kuskokwim Delta, foxes were removed by trapping prior to the nesting season. Nesting success increased from 2% in 1985 and 7% in 1984 to 83% in 1986, 87% in 1987, and 79% in 1988. Colonially-nesting birds are especially vulnerable to predation.

While most nesting areas are largely unaltered by development, the potential for habitat degradation and disturbance could affect the population on some breeding and molting areas. Yukon-Kuskokwim Delta nesting habitat is almost totally within the boundaries of the Yukon Delta National Wildlife Refuge, but over 50% of the habitat is privately owned. Nesting areas on the Delta and on the arctic coast of Alaska and western Canada are adjacent to areas already leased for oil and gas development or scheduled for lease sales. The critical Teshekpuk Lake molting area, managed by the Bureau of Land Management, is within National Petroleum Reserve-Alaska, where oil and gas exploration has occurred and where interest remains high.

Factors Affecting the Population on Migration Routes and Wintering Grounds

Hunting has historically been an important concern for the population along its fall migration route, especially its potential to prematurely move birds out of stopover areas from Washington south to California. Most brant harvested by recreational hunters are taken by American hunters at San Quintin Bay in Mexico. Careful management of brant hunting requires close cooperation between the U.S. and the government of Mexico. Young birds are especially vulnerable to hunting, and when they are numerous in years of high production, the harvest in Mexico increases markedly.

Between the mid-1960s and the mid-1970s, the majority of brant shifted their wintering grounds from coastal Washington, Oregon, and California to Baja Mexico. This shift is one of the major factors affecting the numbers of Pacific brant, but the reasons for this dramatic change in tradition is not known. Wildlife managers believe it is likely related to increased development and human activity in bays preferred by the brant for wintering and the degradation of important eelgrass habitat areas. A general decline in the population corresponds to this period of winter redistribution.

Continuing threats from changing land use exist for the staging and wintering brant concentrations. Izembek Lagoon could be affected by oil and gas exploration and development in the St. George Basin or North Aleutian areas as part of the Outer Continental Shelf leasing program. The lagoon lies in the path of transportation corridors and is adjacent to areas suitable for port development and siting of other support facilities.

Disturbance and degradation of habitat through development and human activities in coastal areas of Washington, Oregon, and California are continuing. Offshore and coastal resource development threatens Mexican wintering areas where tourism and resort development is increasing. People come to beaches and lagoon areas for warm weather, whale-watching in the lagoons, and other recreational activities.

Many of the staging areas critical to brant have been placed in a protective land status. Izembek Lagoon has been officially designated as a wetland of international importance. The shallow lagoon is a State Game Refuge and the surrounding land is a National Wildlife Refuge. Cape Newenham (Chagvan Bay) is a State Game Refuge adjacent to Togiak National Wildlife Refuge, and Pilot Point, the mouth of the Cinder River, Port Heiden, and Port Moller are State Critical Habitat Areas. Scammon and San Ignacio Lagoons are Wildlife Sanctuaries in Mexico.

Cooperative Management Efforts

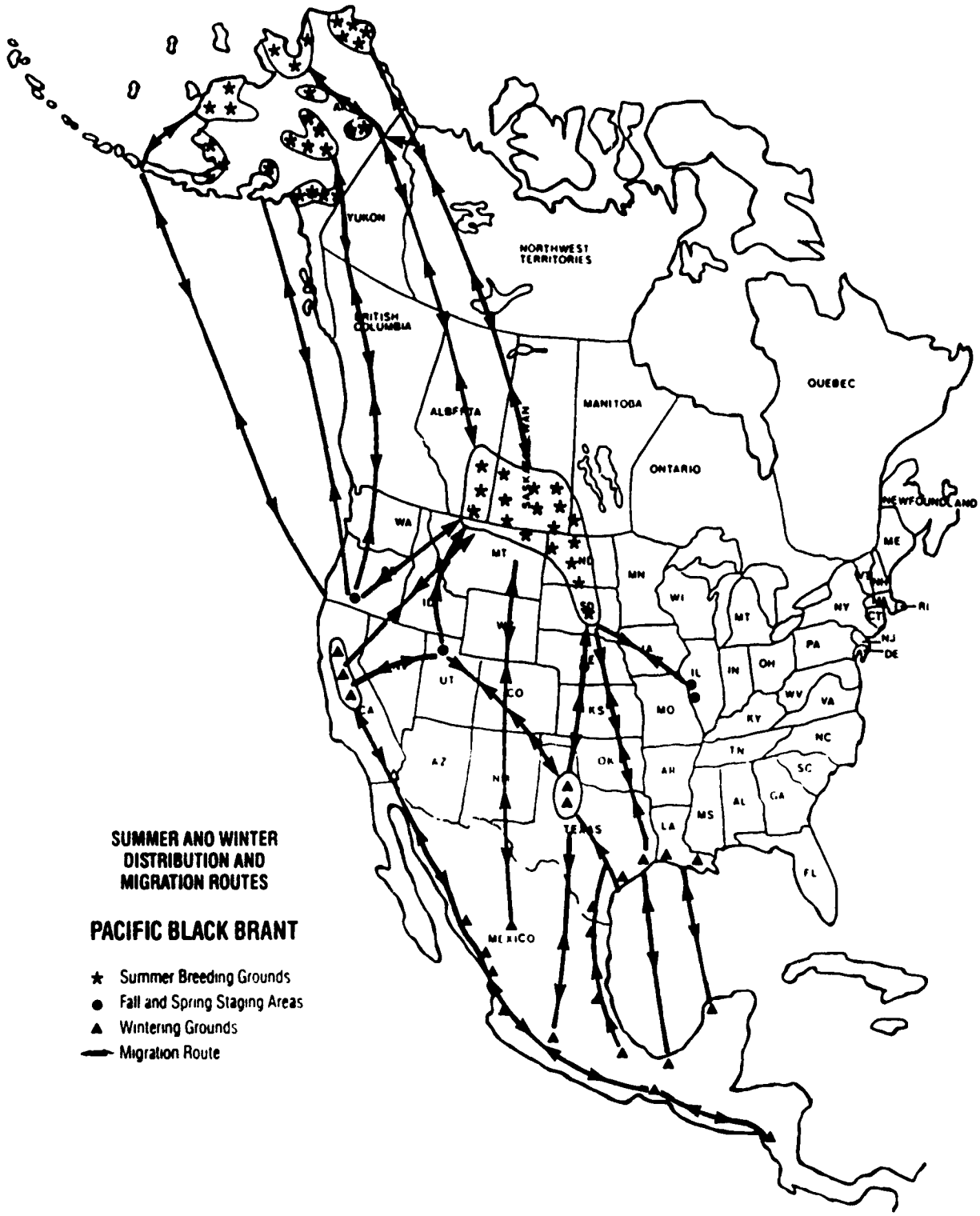
Pacific brant are one of four species of geese nesting in western Alaska that have experienced serious population declines or changes in recent years. As these species of geese began declining in numbers, people throughout the range of the geese became concerned and were brought together to craft a set of solutions to problems facing the birds. In 1984, the Yukon-Kuskokwim Delta Goose Management Plan (YKDGMP) was adopted by the people of the Yukon-Kuskokwim Delta, people from all the other states along the migration route of the geese, and the state and federal agencies responsible for wildlife management. This unique conservation program involved education and information exchange to promote understanding among very different interest groups from Alaska to Mexico. It also required sacrifices on everyone's part to achieve what was needed to restore goose populations.

All users agreed to reduce hunting of the four species of geese. Hunting for black brant was not to occur on the Yukon-Kuskokwim Delta during nesting, brood-rearing, or molting periods and there was to be no egg-gathering from brant nests. Spring waterfowl hunts are traditional in rural Alaska, but they are prohibited by the international treaties signed by the United States with other countries. Efforts have been on-going to amend the treaties or to find a means to legally permit and regulate a spring harvest which is an important source of food for Alaska Natives and other rural residents at a time of year when fresh game is scarce. Recreational hunters in the Pacific Flyway states agreed to additional restrictions on seasons and bag limits during fall. Recreational harvests of black brant were reduced by 50% in California and Alaska and carefully controlled in Washington and Oregon. The government of Mexico has shortened the brant season, reduced bag limits, and conducted harvest surveys since the goose management plan was adopted.

In 1985, population goals were established and minimum population levels were identified for all four species of geese. The minimum population level was the level below which more intensive actions were needed and no hunting would occur. For brant, the population goal is 185,000 birds; the minimum population level is 120,000 (based on 3-year running averages of January index counts).

Since 1984, the YKDGMP has been modified and updated to efficiently address concerns of everyone involved, and it remains a major source of direction for management of brant and the other goose populations nesting in western Alaska. Other conservation provisions of the plan include increased efforts to protect more habitat on the wintering grounds, to reduce disturbance on nesting, molting, and staging grounds, and to improve scientific research into factors affecting goose populations. For brant, this has meant new management programs for coastal habitats, studies of brant colonies and predators on the Yukon-Kuskokwim Delta, and the beginning of cooperative surveys and research with the Soviet Union and Mexico.

The plan recognizes the need to share information from research studies on the geese and to expand the cooperative information and education program among peoples that value Pacific brant and other migratory birds. The school curriculum package "Teach About Geese" is one result of that effort and the source of many activities in this expanded " Wetlands and Wildlife" curriculum.



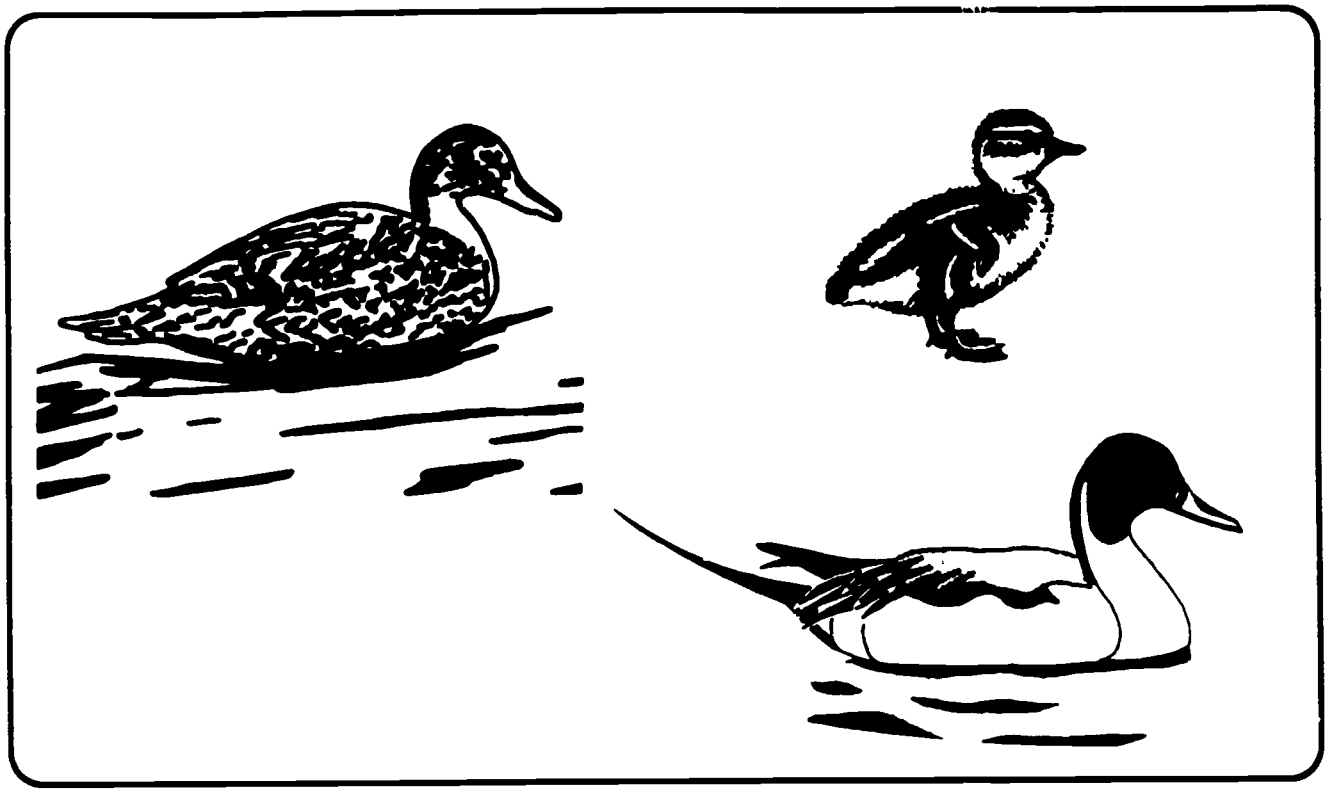
SUMMER AND WINTER DISTRIBUTION AND MIGRATION ROUTES

PACIFIC BLACK BRANT

★ Summer Breeding Grounds
● Fall and Spring Staging Areas
▲ Wintering Grounds
Migration Route

72

Northern Pintail (*Anas acuta*)
Kurugaq, kurukkak, kurukkat (Inupiat)
K'enlathgi, gidrangidh, gidrongedh (Athabascan)
Shilokhvost (Russian)



Identification

Male pintails have a chocolate-brown head atop a slender white neck, the white extending in a thin line onto the head. The other easily-distinguishing characteristic is the long, black central tail feathers that extend far beyond the end of the wedge-shaped tail. Females are difficult to identify due to their resemblance to other brownish female ducks, but they have a longer, more pointed tail and longer neck than other ducks. The silhouette of a flying pintail is distinctive, with a long neck, slender body, and long, pointed wings. The dark green/bronze speculum (trailing edge of the secondary wing feathers) bordered in white can sometimes be observed.

Breeding Cycle

Pintails begin leaving their winter grounds in late January or early February. Pintails are among the first waterfowl to return to Alaska. They arrive on nesting areas in late spring: in late April in Fairbanks and in mid-May on the Yukon-Kuskokwim Delta. Female pintails feed heavily on invertebrates before and during egg-laying, then switch to a primarily vegetarian diet. Females select open areas for their nests where vegetation is low or sparse. They lay an average clutch of six eggs (range of one to 12) with an incubation period of 22-24 days. The females lead the ducklings to water, sometimes over long distances.

Young pintails feed almost exclusively on animal matter, with the percentage of plant material increasing as the ducklings grow. Pintail ducks breed at the age of one year.

Molt Cycle

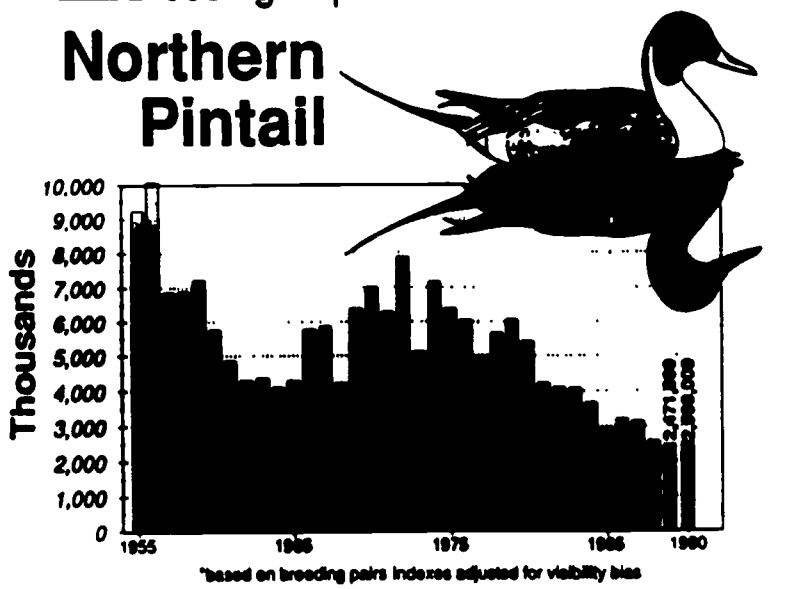
Male pintails begin flocking by mid-June while females are incubating eggs or tending the young. The males molt and are flightless by late June and early July. Flight feathers are generally regained by early August. The wing molt of females is delayed to coincide with the development of the young. Pintails build up into spectacularly large molting concentrations along the coastline of the Bering and Chukchi Seas.

Breeding Grounds and Migration Routes

Pintails are widely distributed during the breeding season. They nest both in Alaska and in northeastern Asia but are most abundant in the prairie pothole region of northcentral U.S. and Canada.

In the fall, pintails stage in saltmarsh areas where they

Breeding Population Estimates*



feed heavily on seeds of saltmarsh plants. The seeds are an important part of the diet because their high carbohydrate content helps to provide the energy necessary for migration.

Pintails usually leave Alaska in late August or early September. An important migration corridor stretches from near the tip of the Alaska Peninsula to the Klamath Basin in northern California. Pintails gather at Izembek Lagoon and nearby concentration areas on the Alaska Peninsula before using this corridor. A second corridor extends from the base of the Alaska Peninsula along the Pacific Coast to Puget Sound; smaller migration corridors extend from interior Alaska to the interior of British Columbia and to northern Alberta.

Wintering Areas

The majority of pintails that breed in Alaska winter in California or further south in Mexico and northern South America. Small numbers remain to winter in the Aleutian Islands and Southeast Alaska.

Population Status

Pintails range further over the earth's surface than any other type of waterfowl, being circumpolar in their breeding range and wintering as far south as Hawaii, the Philippines, India, Columbia, and central Africa. The pintail is the most abundant nesting dabbling duck in Alaska and is the second or third most abundant duck in North America behind mallards, and, depending on annual production, lesser scaup. It is also the most abundant duck in the Pacific Flyway, with a significant portion raised in Alaska.

On the North American continent, pintail breeding populations declined from 6.3 million in the 1970s to 3.8 million in 1985. The decline continued to a low of 2.5 million in 1989, the lowest since breeding ground surveys began in 1955.

Factors Affecting Populations on the Nesting Grounds

The major factor affecting pintail populations continent-wide is loss and degradation of habitat—both winter and breeding habitat. While most of the breeding habitat in Alaska remains relatively productive, the draining and filling of California Central Valley wetlands and farming practices which drain prairie pothole habitat continue.

Unprecedented drought in the mid-continental prairies throughout the 1980s dried up large numbers of ponds and made it easy for farmers to cultivate formerly wet areas. This long-term habitat loss has been particularly devastating to pintails which prefer shallow, temporary wetlands which are vulnerable to drought.

Lack of rainfall in the prairie pothole area has historically been a factor in reducing duck populations. Drought in this region results in migrant pintails which "overfly" the area and continue on to Alaska. However, managers suspect that many of these birds do not breed successfully because their fat reserves have been exhausted.

Widespread drought occurred in the prairie potholes in the late 1980s. In 1986 and 1988, 46% and 61%, respectively, of the continent's surveyed pintail population was found in Alaska on the nesting grounds compared to 25% in an average year. However, the total number of pintails in Alaska that arrived on the nesting grounds remained fairly constant. These two statistics taken together imply that while a greater percentage of the population came to Alaska during those drought

years, the total population continued to get smaller and smaller. Production of young birds in Alaska did not appear to increase to compensate for the overall population losses.

In Alaska, a late spring and break-up can prevent ducks from foraging in the shallow waters of small lakes and ponds. Early cold weather and accompanying ice conditions can eliminate the fall food resources in freshwater areas.

Because they nest in open areas, the nests are vulnerable to predation from birds (gulls, crows, ravens, jaegers) and from mammals (foxes, coyotes).

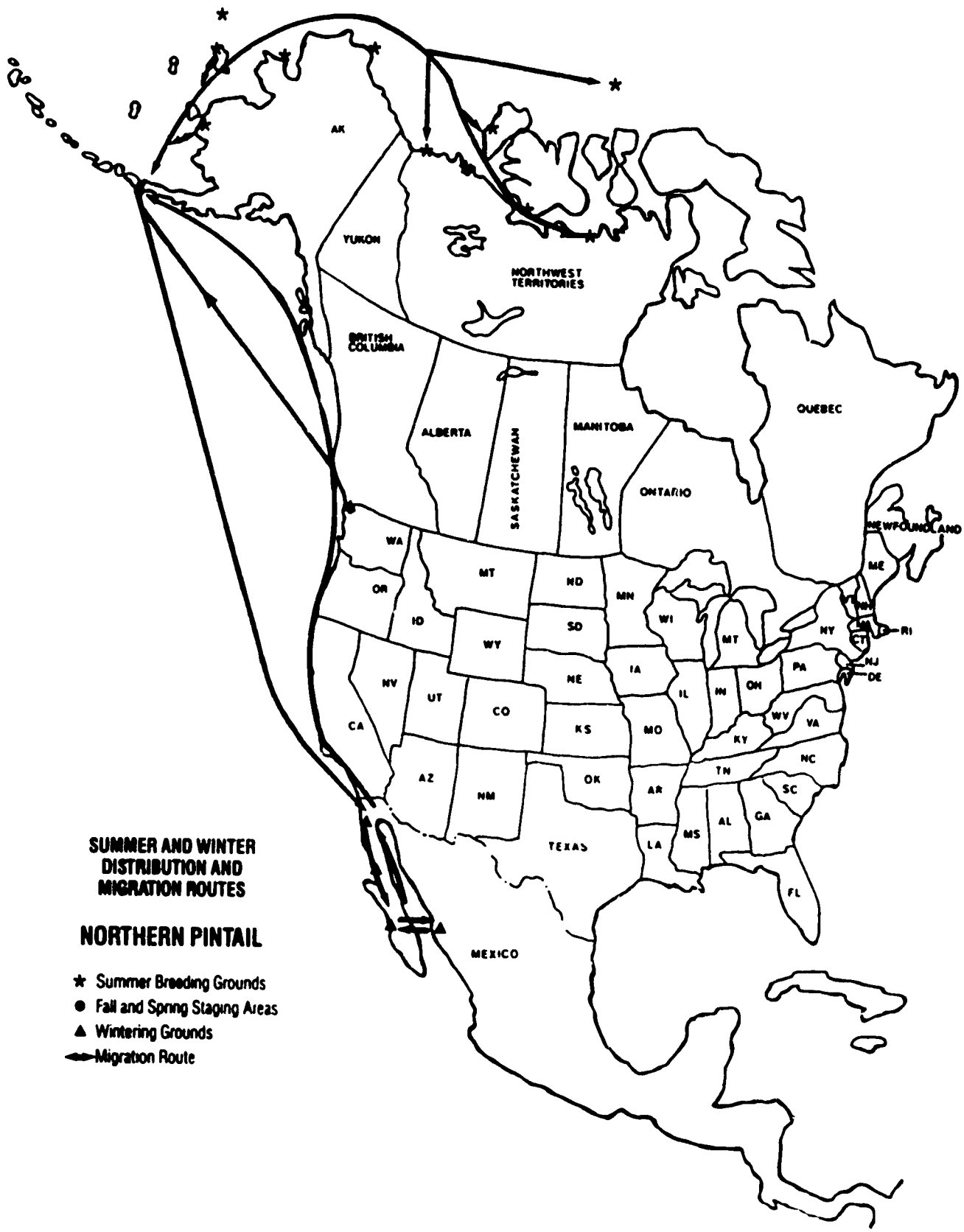
Management Efforts on the Nesting Areas

Ten species of dabbling ducks are included in the North American Waterfowl Management Plan. The Plan states that "continuing habitat degradation and loss since the early 1960s have diminished the likelihood of these populations recovering to former abundance without innovative and intensive management on public and private lands, greater efforts to preserve existing habitat, and changes in land use and agricultural practices on private lands." While the most severe impacts on nesting habitat are occurring in the prairie pothole region, maintenance of breeding habitat in Alaska is also critical. In the plan, several areas of Alaska have been identified as waterfowl habitat areas of major concern for the United States and Canada.

Government agencies are seeking partnerships with private landowners and private organizations (such as Ducks Unlimited) to set aside wetland habitats for waterfowl production. They are seeking to protect migration and wintering habitat by acquiring discrete areas of critical importance for long-term use by waterfowl. They are also trying to influence land-use practices to benefit waterfowl.

Factors Affecting Populations on Their Migration Route and Wintering Grounds

As described above, loss and degradation of winter habitat is part of the reason for the decline of pintails nationwide. The crowding of birds onto shrinking winter habitat areas has contributed to mortality from disease outbreaks and lead poisoning.

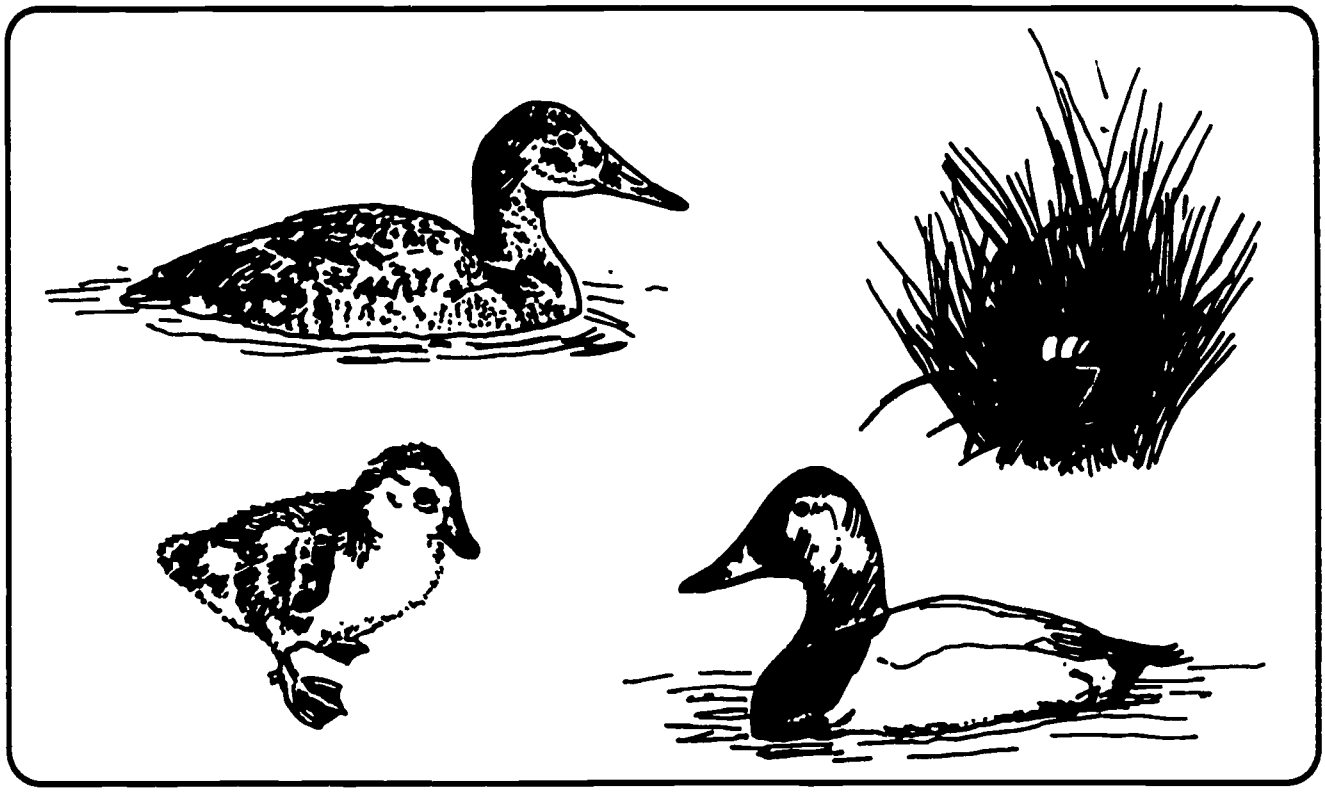


SUMMER AND WINTER DISTRIBUTION AND MIGRATION ROUTES

NORTHERN PINTAIL

★ Summer Breeding Grounds
● Fall and Spring Staging Areas
▲ Wintering Grounds
Migration Route

Canvasback (*Aythya valisinera*)



Identification

Male canvasbacks are large diving ducks with an unmistakable coloration of chestnut head and neck, black chest, and whitish sides and belly. Their coloration is similar to that of a redhead duck, which is less common, but the male canvasback has a sloping forehead and upper bill profile, and the bill is black (in contrast to the rounded head of the redhead and multi-colored bill). The female canvasback has the same profile and bill color as the male and has a pale brown head and neck and pale brownish-gray back and sides.

Canvasbacks often feed in large flocks. Like other diving ducks, canvasbacks dive for their food, to depths of 6 to 30 feet, and feed while submerged.

Migrating flocks are fast-flying and form Vs or lines. On feeding grounds, they move in small compact flocks, their wings creating a loud whirring noise.

Breeding Cycle

Courtship begins in mid-February, with pair formation occurring in late winter or during migration in early spring. The birds usually breed at the age of two years and find a new mate each year. Most diving ducks arrive on their nesting areas by mid to late May in southwest and southcentral Alaska. They use larger, more permanent ponds for feeding, resting, and courting and use the smaller, shallower, and less permanent ponds for nesting.

Canvasbacks nest in beds of bulrushes and reeds in sloughs and marshes just above the surface of the water. Their clutch averages 7-9 eggs and the incubation period ranges from 24 to 28 days. Nesting females and young ducklings feed primarily on animal matter such as fish, insects (e.g., caddisfly larvae), and mollusks. Females move the ducklings to different water bodies or through marshes to obtain the animal foods needed.

In contrast, adult male canvasbacks feed on plants. As soon as the females begin incubating, the males withdraw into flocks by themselves and take no role in rearing the young. The young fledge at about 80 days in late August in Alaska. Young birds may or may not migrate with their parents.

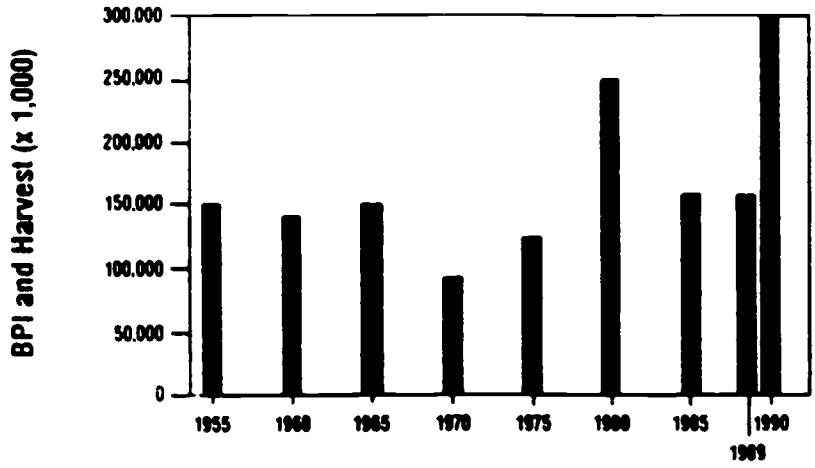
Molt Cycle

The male canvasbacks molt in flocks on larger lakes and are flightless for about two weeks during mid-summer.

Breeding Areas

Canvasbacks are managed as two populations: an eastern population winters on the mid-Atlantic coast around Chesapeake Bay, and a western population winters in California and Nevada. Birds that breed in Alaska belong to both populations.

CANVASBACK POPULATION INDEX (BPI)
May survey, Western Population



Canvasbacks breed throughout southwestern, southcentral, and interior Alaska near the larger and deeper inland water bodies. Most of the canvasbacks that winter in the Pacific Flyway breed in Alaska or Alberta. The largest breeding population in Alaska occurs on the Yukon Flats. This area and the Old Crow Flats in Yukon Territory contribute an estimated 90% of the western population of canvasbacks. The Tanana-Kuskokwim area is another important breeding area.

Fall Migration and Wintering Areas

During fall migration, adult females and young switch to plant foods in the fall. Like males, they feed on the roots, tubers, and the basal portions of underwater plants. Pintails favor the tubers of pond lilies and the seeds of sedges and grasses, which they strain out of pond mud.

Adult males and young congregate in large flocks during migration, but females migrate in a more dispersed fashion and are not common at any particular location.

Western canvasbacks overwinter along the coast in shallow, enclosed estuaries. Some overwinter in Kodiak and the Aleutian Islands, in Cook Inlet (especially in Kachemak Bay), and in Prince William Sound. Important migration stops for those migrating further south include Great Salt Lake marshes, Malheur National Wildlife Refuge (Oregon), Klamath Basin (Oregon), and the Carson Sink area in Nevada. San Francisco Bay is a major overwintering area; smaller winter concentrations occur along the Pacific from British Columbia through Mexico. Eastern canvasbacks from interior Alaska migrate across the continent to the Atlantic coast, though some winter along the Texas and Louisiana coasts.

Population Status

Despite their extensive distribution, canvasbacks have never been very abundant. Populations have declined since the settlement of the western United States. The western breeding population fluctuated between 76,000 in 1961 and a high of 308,000 in 1990. The eastern population peaked at 589,000 in 1975, but has generally declined to 285,000 in 1990.

Factors Affecting Populations on the Nesting Grounds

Similar to its effect on production of dabbling ducks, the timing of break-up in Alaska affects productivity of diving ducks. Late springs can delay nesting, and flooding can destroy eggs and young. However, the flooding in river valleys is also beneficial because it fertilizes ponds and produces more food for waterfowl. Dry conditions can also reduce productivity.

The loss of prairie pothole wetlands habitat to agriculture, draining, and fill is believed to be a major factor, if not *the* major factor, causing declines in canvasback populations nationwide. Also, where the nesting grounds of canvasbacks and redhead ducks overlap, redhead ducks are nest parasites, inserting their eggs into canvasback nests for the canvasbacks to raise—much to the detriment of canvasback ducklings!

A major factor affecting canvasback populations is the drought conditions which have recurred in recent years over much of their breeding range outside of Alaska. The number of ponds declines, and larger wetlands are reduced in size during drought conditions. Canvasbacks are particularly vulnerable to dry habitat conditions

because the availability of overwater nesting cover is reduced and the nests are accessible to predators.

When drought conditions occur in the prairie region, canvasback migrants overfly the area and continue on to Alaska. Alaska breeding grounds remain a last stronghold for prairie-nesting duck species that are vulnerable to recurrent drought and reduced breeding habitat elsewhere in their range.

In the North American Waterfowl Management Plan, several areas of Alaska have been identified as canvasback habitat areas of major concern for the United States and Canada.

Factors Affecting Populations on Their Migration Route and Wintering Areas

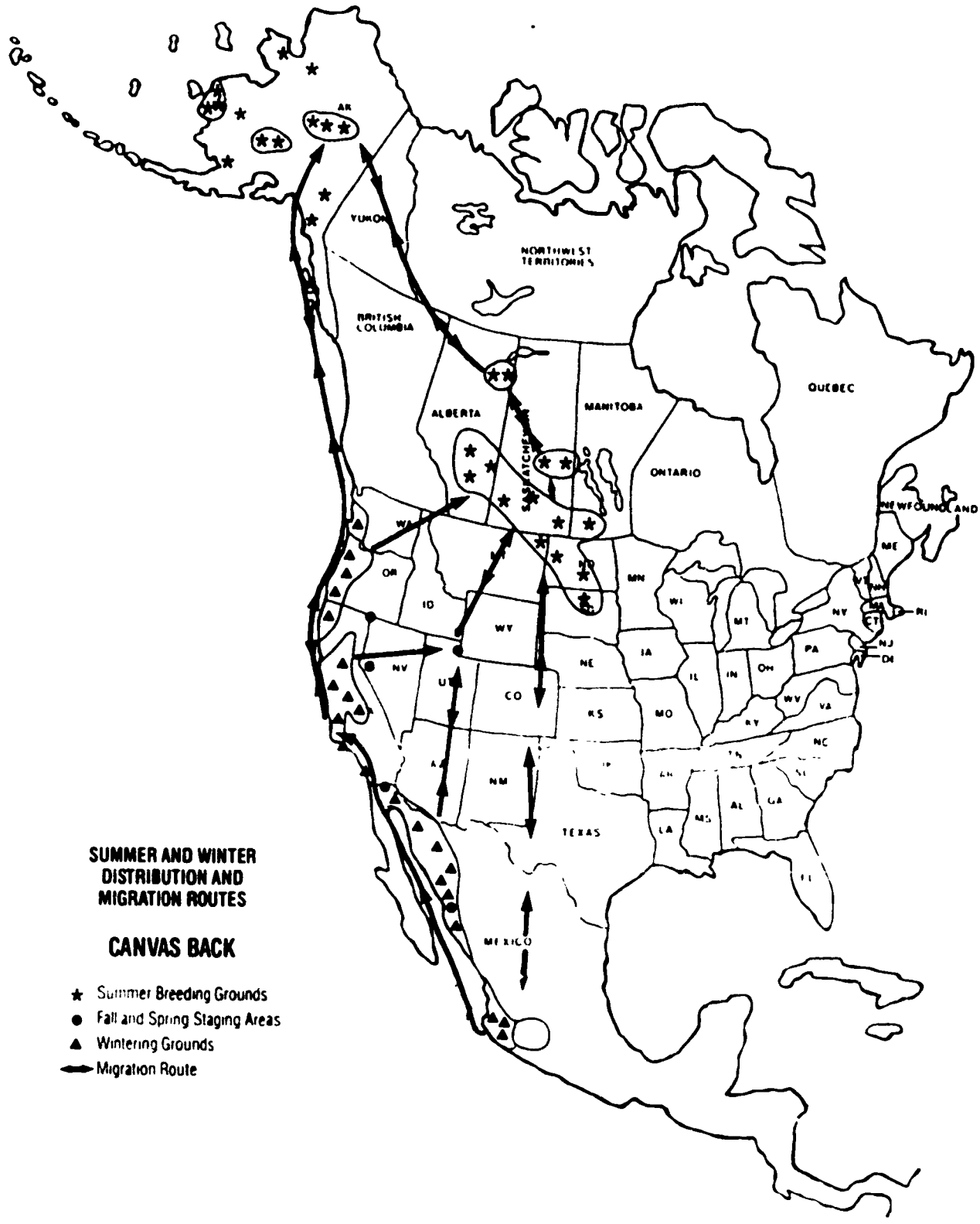
Canvasbacks have historically been a very sought-after game species. They were the prime target on the prairies at a time when they were hunted for profit in the late 1800s, largely because of their habit of gathering in large concentrations. Regulated hunting has reduced the harvest to a level which allows the population to sustain itself.

Wintering areas are being affected by wetland filling, pollution, and human disturbance.

Management Efforts on the Migration Route and Wintering Areas

Hunting regulations have been restrictive on canvasbacks since the late 1950s.

Canvasbacks are addressed in the North American Waterfowl Management Plan. Measures to improve the quality and quantity of wintering habitat in the Central Valley of California would benefit the Pacific Flyway canvasback population.



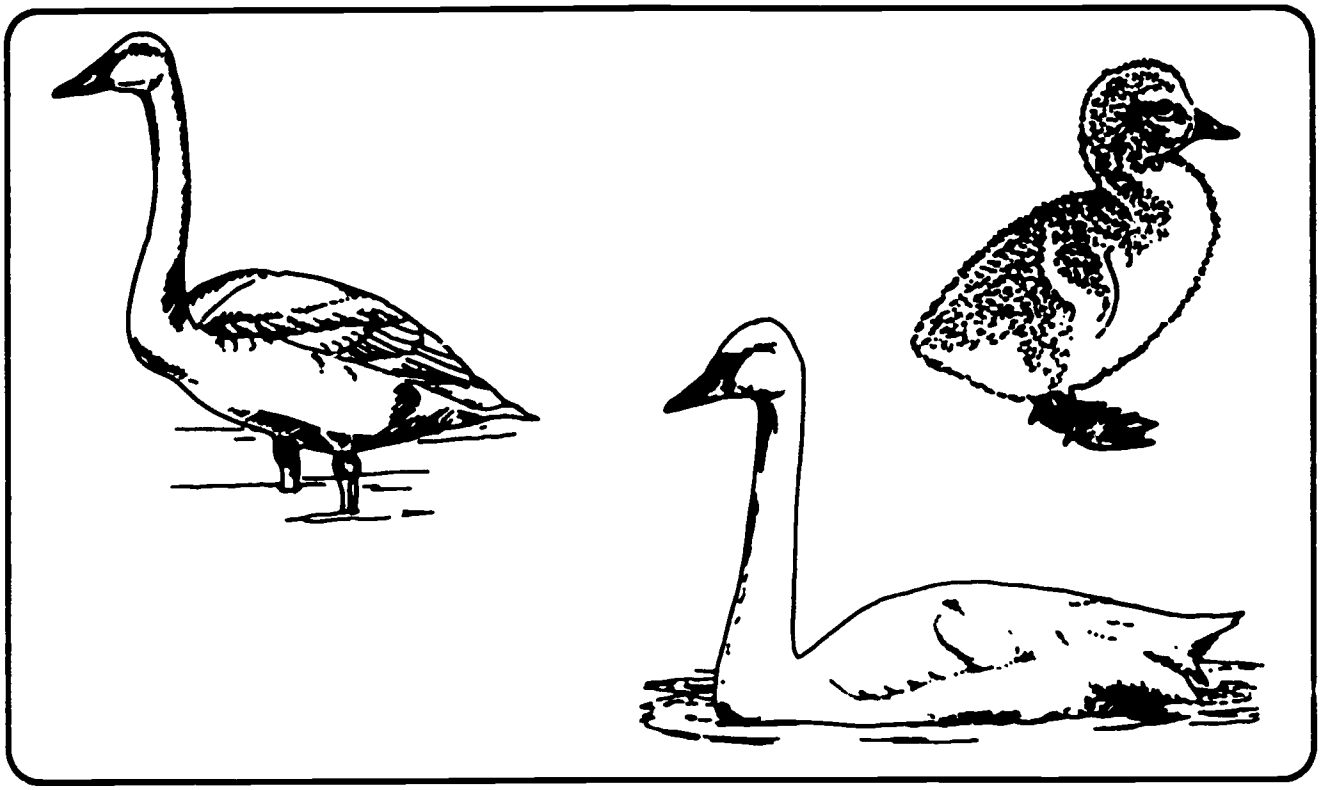
SUMMER AND WINTER DISTRIBUTION AND MIGRATION ROUTES

CANVAS BACK

★ Summer Breeding Grounds
● Fall and Spring Staging Areas
▲ Wintering Grounds
⟷ Migration Route

81

Tundra Swan (*Cygnus columbianus*)
Tavo (Athabascan)



Identification

Tundra swans were formerly called whistling swans. Like other swans, both male and female adult tundra swans have identical all-white feathers, while the young are an ash-grey color. Although less than 2/3 the size of the trumpeter swan (the world's largest member of the waterfowl family), tundra swans are often difficult to distinguish from their close relative. Adult tundra swans frequently, but not always, have a yellow spot between their black bill and eye. Their voice is different than the trumpeter's deep horn-like note. Tundra swans have a higher pitched, bark-like call, and they call more frequently than trumpeters.

Breeding Cycle

Tundra swans often arrive on the nesting grounds before the snow has melted and begin nesting as soon as the spring thaw permits. They often return to traditional nesting sites, selecting tundra areas and preferring hummocks on peninsulas and islands near water. Both the male and female uproot plants in an area up to 15 feet in diameter and form a nest mound 12 to 18 inches high from moss, grasses, and sedges in which the female lays an average of three to five eggs.

The male defends a territory around the nest. Unlike the pattern in ducks, both male and female parents share incubation, nest care, and rearing of the young. During incubation the male (called a cob) molts and is flightless for approximately one month. The young (called cygnets) hatch after 31-35 days, and the pair guard the cygnets for the next 8 to 12 weeks until they are ready to fledge. During this period, the female (called a pen) molts her feathers.

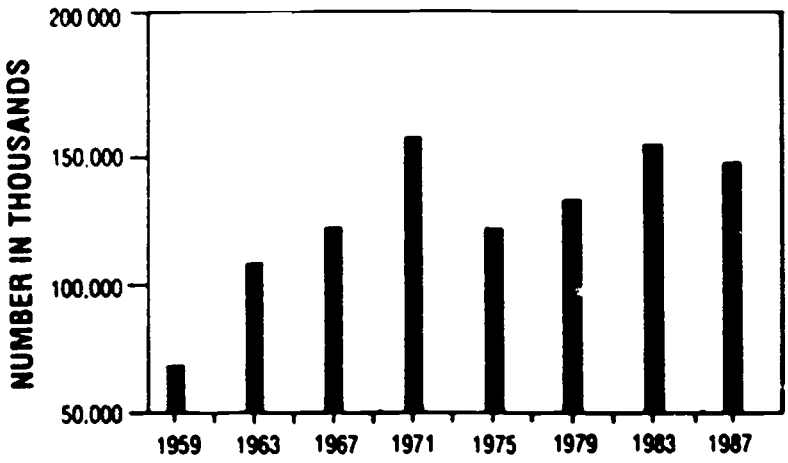
Summer foods for the adult swans are leaves, seeds, and tubers of marsh plants such as horsetail, pondweeds, sedge, bulrush, and pond lily. They feed in shallow water, immersing their head and neck. They also graze the margins of lakes and ponds. Like most young waterfowl, the growing cygnets require aquatic invertebrates during the first few weeks then gradually shift to a plant diet.

Swans mate for life, usually as two-year-olds, but delay breeding until their third, fourth, or even fifth year. If one of a pair is lost, a new mate will be found before the next breeding season.

Alaska Nesting Areas and Migration Routes

Two different populations nest in Alaska. These populations nest and winter in different areas and little interchange occurs between them. The western population nests along the west coast of Alaska from Kotzebue Sound to the Alaska Peninsula, arriving from California with an important staging stop at the Naknek River near King Salmon. The major breeding areas are the Yukon-Kuskokwim Delta, which they reach in late April to mid-June, and the Bristol Bay area. The eastern population

TUNDRA SWANS
Mid-Winter Population Index
Total United States



nests primarily on the North Slope in Alaska and eastward into the Canadian Arctic. They also nest westward to the Seward Peninsula.

Fall Migration and Wintering Areas

As the tundra begins to freeze in late September or October, the swans begin their fall migration to their wintering area, migrating as family groups or small flocks. In the fall, they feed on lowbush cranberries and blueberries on the tundra.

The western population travels via two routes to the Central Valley of California to spend the winter. One route is along the Pacific Coast, while a second route heads inland through western Alberta, western Montana, and Utah before reaching California. Some non-migratory swans remain to winter offshore of Unimak Island in the Aleutian Islands; small numbers winter all along the Pacific Coast south to Baja California. The eastern population migrates across the continent through the Canadian prairie provinces, eastern Montana, and the Dakotas to winter on the east coast of the United States in Maryland, Virginia, and North Carolina. Major concentrations occur in Chesapeake Bay and the farm fields of North Carolina. Tundra swans stop over in most provinces and northern states. Thus, tundra swans use all four of the flyways in North America!

Population Status

The western population of tundra swans has fluctuated markedly since the late 1960s but has increased during the late 1980s. The 1990 population estimate was significantly lower at 40,000 birds, compared to 79,000 in 1989. The eastern population continued to slowly increase, a trend it has followed since the 1940s. The eastern population numbered about 90,000 in 1990. The only decline in wintering populations occurred in Maryland, but populations increased further south in coastal North Carolina.

Factors Affecting Populations on the Nesting Grounds

Timing of snow melt is a major factor influencing productivity of tundra swans.

Survival of young to fledging is affected by severe weather, predator populations, and possibly diseases.

The breeding range of tundra swans is large, but within that range the breeding habitat is specific. For example, some birds select certain kinds of lakes with the right combination of aquatic plants. These specific habitats may be vulnerable to degradation due to their scarcity.

Management Efforts on the Nesting Grounds

Wildlife managers in Alaska are working to identify traditional tundra swan breeding areas and protect them from human activities with the potential to alter habitat and limit productivity. In western and northern Alaska, concern exists for the impacts of offshore and onshore petroleum and mineral development. Onshore oil development in the Prudhoe Bay/Kuparuk areas and National Petroleum Reserve-Alaska are occurring in key breeding areas for the eastern tundra swan population.

Factors Affecting the Population during Migration and on the Wintering Grounds

A subsistence harvest of swans occurs in Alaska and in

northern Canada. Since 1961, a limited recreational harvest has been permitted in Utah, Nevada, Montana, and North Carolina. An experimental hunting season opened on the Seward Peninsula in Alaska for the first time in 1988. Permits were issued for the hunt and only one swan could be harvested per permit.

The subsistence harvest of swans occurs in western Alaska and in Canada although the harvest is not legally permitted. Other swans are killed by vandals. Wildlife managers estimate that 6,000-10,000 swans are killed annually in this unregulated harvest.

Population shifts have occurred in the wintering areas of the eastern population of swans, with fewer swans wintering in Chesapeake Bay and more swans wintering in coastal North Carolina. Threats to eastern wintering habitat include the pollution of Chesapeake Bay and growing concern about damage to wheat crops in North Carolina, to seeded oyster beds in Virginia, and to cranberry crops in New Jersey. Loss of traditional wintering habitat may have contributed to the learned behavior of feeding on crops. Lead poisoning and oil spills have caused mortalities in eastern wintering areas.

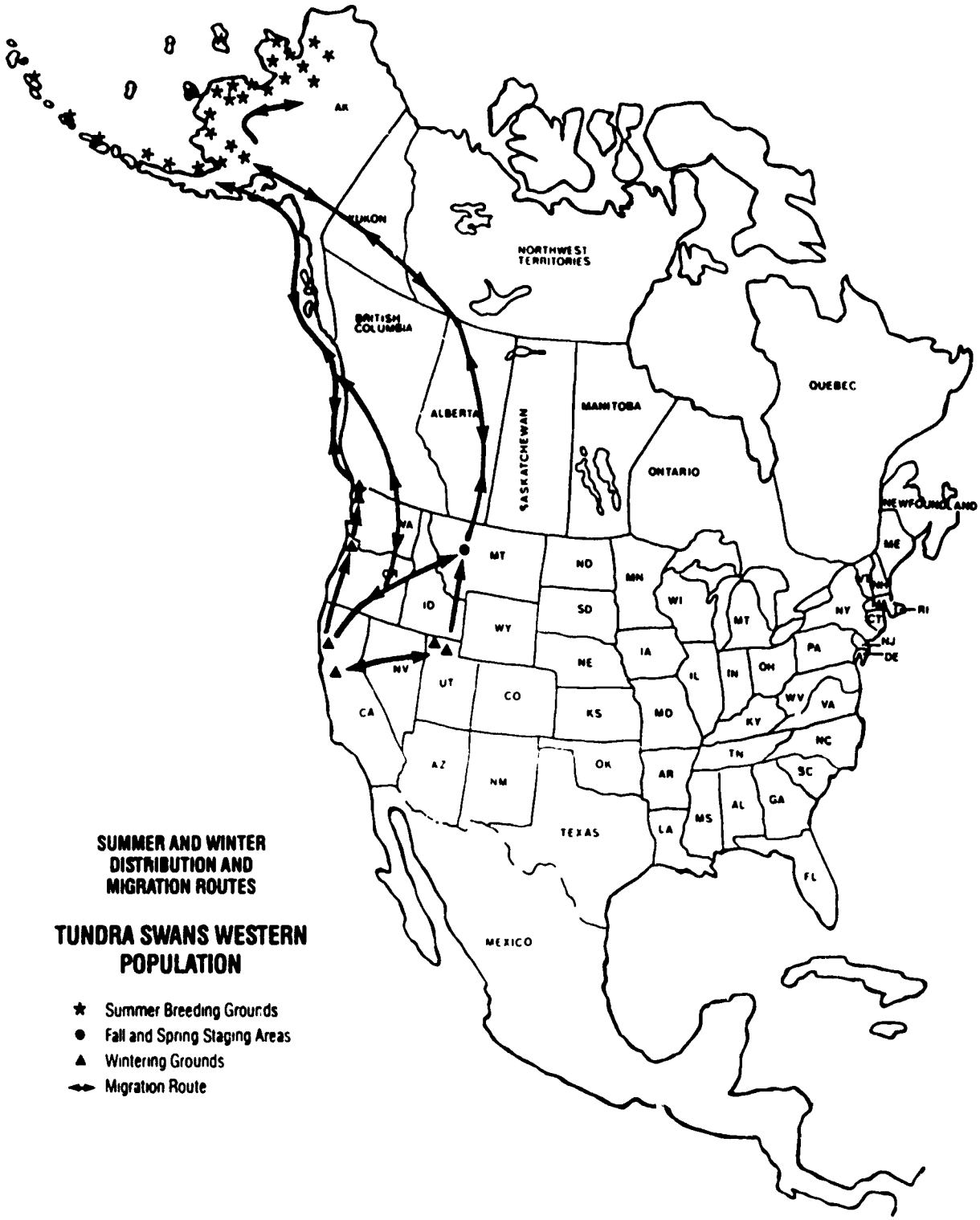
Loss and degradation of wetland habitat in the Central Valley of California is a concern for the western population. Swans are also subject to die-offs from avian cholera in the western wintering areas. Wintering populations in Nevada, Utah, Idaho, and Washington are more variable than those in California. Populations may fluctuate in response to harsh winters and fluctuating water levels. Water allocations that provide priority for agriculture or other human uses can threaten wintering populations during periods of drought.

Lead poisoning, mainly from spent hunting shot, is a chronic cause of mortality that affects both populations in migration and wintering areas. Swans ingest the lead when they dig for roots and tubers of aquatic plants.

SUMMER AND WINTER DISTRIBUTION AND MIGRATION ROUTES

TUNDRA SWANS EASTERN POPULATION

- ★ Summer Breeding Grounds
- ● Fall and Spring Staging Areas
- ▲ Wintering Grounds
- ◂▸ Migration Route

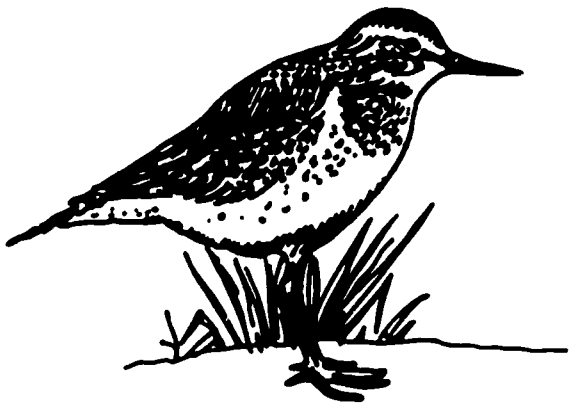


SUMMER AND WINTER DISTRIBUTION AND MIGRATION ROUTES

TUNDRA SWANS WESTERN POPULATION

- ★ Summer Breeding Grounds
- ● Fall and Spring Staging Areas
- ▲ Wintering Grounds
- ◂▸ Migration Route

WESTERN SANDPIPER (*Calidris mauri*)
Pereponchatopaly Pesochnik (Russian)



Identification

Sandpipers are a group of shorebirds which have long, slender bills and legs, short tails, and relatively long, pointed wings adapted for fast flight. Several sandpiper species nest in Alaska and, while they vary in size, they are generally difficult to tell apart. They are most easily identified during spring and early summer when each species displays its somewhat distinctive breeding plumage and engages in distinctive courtship displays and calls.

At approximately 6 1/2 inches long and weighing 20-40 grams, the western sandpiper is among the smallest of the shorebirds. It is closest in appearance to the least sandpiper, but is more often observed with semipalmated sandpipers in coastal and tundra habitats in Alaska. In breeding plumage, the heavily-patterned wings and back of the western sandpiper are chestnut-tinted with rusty highlights, and the crown of the head is rusty. The black legs of the western sandpiper are the major feature distinguishing the species from the least sandpiper which has yellowish-green legs. The western sandpiper has distinct, arrow-shaped flank spots. While the plumages vary seasonally, they are the same for male and female birds.

Breeding Grounds and Migration Routes

Western sandpipers are highly migratory. While the entire world population of western sandpiper migrates to breed in Alaska during summer, they occur during other seasons on both coasts and at many interior sites in temperate areas of North America and at coastal locations in Central and South America.

The birds arrive in Alaska from their nearest major staging area in Vancouver Island, British Columbia in late April and early May. The long, rocky coastline provides few feeding opportunities until they reach the Copper River Delta area in Alaska. Here, they make a critical fueling stop to replenish their fat supplies after the long flight. The stop is especially important to these small birds.

Western sandpipers often arrive at the Copper River Delta in mixed flocks with other sandpipers and shorebirds and are among the some 20 million birds that use this important staging area each year. The migration stop on the delta and tideflats between Controller Bay and Orca Inlet is short, however, and the entire migration occurs within a five-week period. The birds feed during both rising and falling tides along the tideline, probing for clams and other invertebrates.

The birds continue along the coast of Alaska on to the Yukon-Kuskokwim Delta and to northwestern Alaska. Some of them make intermediate stops at Fox River Flats and Kachemak and Kamishak Bay wetlands in Lower Cook Inlet.

Western sandpipers nest during late May and early June. The majority of the birds nest primarily from the Alaska

Peninsula at Nelson Lagoon northward to the Yukon-Kuskokwim Delta. Other smaller numbers nest along the coasts of the Seward Peninsula, the coasts of the Bering and Chukchi seas to Barrow and Atkasook, and 50 miles inland along the Meade River. They also nest in northeastern Siberia (northwest Chukchi Peninsula) and on Nunivak, St. Matthew, and St. Lawrence Islands. Western sandpipers select mainly drier, shrubby tundra areas (where they have some cover from predators) close to marsh or mudflat feeding areas. A majority of birds are faithful to nesting sites and use the same territory and even the same nest cup in subsequent years.

While many larger sandpipers are polygamous and display a variety of breeding patterns, most small sandpipers such as the western sandpiper are monogamous. A male attracts a female by performing displays over areas he claims and defends as his territory. The female lays four eggs. The young are precocial, born downy (vs. without feathers), and are able to mature quickly. Both the male and the female incubate the eggs for 20-22 days. They both tend the young birds; however, the female leaves the young before they fledge and the male stays only until shortly after fledging.

Hatching coincides with the peak abundance of adult insects, which provide the first foods for the young. The young leave the nest within a few hours of hatching. As they grow, the young sandpipers forage for themselves and shift to feeding on insect larvae. During the nesting period, adult birds probe the wet soil and muddy margins of ponds, marshes, and sloughs in tundra areas, foraging for insect larvae (especially cranefiies and midges). They also capture spiders and beetles and feed in nearby intertidal areas for oligochaetes (marine worms), small clams, crustaceans, insect larvae, and marine zooplankton.

Flocks of adults begin to form in late June as nonbreeding birds gather. Flocks grow as birds which fail to breed join them. These flocks move from tundra areas to coastal mudflats, saltmarshes, sloughs, lakes, and rivers during July and begin migration southward. The first southbound migrants may reach the "lower 48" states by July 4. Juveniles remain in tundra nesting areas while adults are forming flocks, then flock up later as they move to coastal areas. The juvenile birds remain on the coast until mid or late August and migrate south separately from the adults. Juveniles also probe shallow-water wet mud and sand habitats for a variety of insect larvae, worms, crustaceans, and mollusks.

Birds from the eastern U.S.S.R. join Alaska birds on fall staging areas on the extensive mudflat/saltmarsh areas of Kotzebue Sound, the northern Seward Peninsula, and Norton Sound. Two migration routes are followed: 1) birds nesting on the Bering Sea coast stage on mudflats of the Yukon-Kuskokwim Delta and Alaska Peninsula, then migrate southeastward along the Pacific Coast of North America; and 2) birds nesting farther north move inland from the Chukchi Sea coast then eastward along the Beaufort coast and down the MacKenzie River drainage south to the central plains and Gulf of Mexico. The fall migration lasts longer than the spring migration and not all migrants use the same staging areas they used during spring. In fall, large staging concentrations occur in southwestern Alaska and a large percentage of the fall migrants overfly or bypass the northern coasts of the Gulf of Alaska used during spring.

Wintering Areas

Western sandpipers winter in coastal mudflats and beaches along both the west and east coasts of North and South America. They winter along the Pacific Coast from southern Alaska south to the coastal wetlands of northern California and as far south as Peru. The sandpipers also winter along the Atlantic and Gulf of Mexico coasts from North Carolina south to Mexico, Columbia, Venezuela, and Surinam, in the West Indies. They feed on foods similar to those on their staging areas.

Population Status

Compared to waterfowl species which have traditionally been hunted, other migratory birds are rarely actively managed so their populations are not closely monitored. Scientists estimate the population of western sandpipers to be several million birds. As far as is known, the population is relatively stable.

Factors Affecting the Population on the Nesting Grounds

A variety of predators (including foxes, weasels, jaegers, and gulls) feed on eggs, young, and even adults on the breeding grounds. Sandpipers and other shorebirds have evolved a variety of defenses to distract the attention of predators from nests, including feigning a broken wing or crouching to simulate the movement of a rodent. Groups of birds also "mob" predators that move into nesting areas. When family groups feed away from the nest, the cryptically-colored chicks respond to alarm calls from adults by squatting motionless in low-growing plants where they are difficult to see. Feeding in dense flocks also makes it more difficult for aerial predators to pick off a single bird.

Managers and conservationists are concerned about the effects of oil development in arctic tundra habitats on a variety of birds that depend on wetland habitats for breeding. The Yukon Delta National Wildlife Refuge includes a major portion of the breeding habitat for western sandpipers and is especially critical for this species. Western sandpipers are susceptible to offshore oil spillage that could contaminate intertidal feeding areas or oil the birds directly.

Development of facilities for oil exploration and development or for other purposes in tundra wetlands generally requires dredging, filling, or diking of wetlands. Such alterations would reduce the habitat available to western sandpipers for breeding and foraging. Tundra wetlands of the Yukon-Kuskokwim Delta are of particular concern to this species because such a high percentage of its breeding occurs there.

Factors Affecting the Population During Migration

The major type of problem facing this species and other shorebird species was summarized by Joseph Jehl, Jr., at the symposium "Shorebirds in Marine Environments" held in 1979: "Consider a bird programmed by 10,000 years of postglacial evolution to hit a specific staging area after a flight of hundreds of miles. It arrives exhausted, fat reserves nearly gone, only to find what was a slough a few months ago is now a parking lot. And no alternate sloughs are available."

While staging areas along the Atlantic and Pacific coasts south of Alaska are in much greater danger of becoming altered, another type of threat does exist for the Copper River Delta, a critical "bottleneck" during migration. The birds arrive at the Delta with few fat reserves and with no alternative staging areas nearby. The population literally has "all of its eggs in one basket," even though the eggs, at this time of year, have yet to be layed. The Copper River Delta is one of only five sites in North America that support more than a million shorebirds each year (Gray's Harbor, Washington; the Bay of Fundy, Canada; Cheyenne Bottoms, Kansas; and the beaches of Delaware Bay, New Jersey and Delaware are the other four).

The major marine shipment of oil from Alaska occurs in Prince William Sound south from the port of Valdez. The effects of an oil spill contaminating the Copper River Delta could have a very serious effect on the species, particularly if it occurred while the entire population was concentrated there during spring migration. The 1989 Exxon Valdez oil tanker spill was carried by currents away from the Copper River Delta, but had winds shifted, the oil would have reached the staging area a few weeks or days before the birds arrived.

If birds come into contact with oil, the oil destroys the insulative value of their feathers. As birds preen to clean their feathers, they ingest the highly toxic oil and are poisoned. Oil which is stranded on beaches can smother intertidal invertebrates or poison them through chronic contact. Stranded oil can persist for many years in intertidal mudflats and marsh habitats. Scientists have studied what western sandpipers eat on the Copper River Delta and found that a small intertidal bivalve clam, *Macoma balthica*, is a very important food item. These clams occur very near the surface of mudflats, accessible to the short bills of the small birds. The clam is thus vulnerable to smothering or poisoning by spilled oil which comes ashore; experimental oilings have resulted in high mortality which increased with increasing length of exposure. An oil spill which killed this important food source could result in high mortality among the sandpipers. But even levels of toxic oil compounds that didn't kill food items outright could cause harmful effects to the birds over time as the birds consumed them.

The sandpipers are also vulnerable to oil spills or other types of pollution at other staging areas along their migration route.

Factors Affecting the Populations on the Wintering Areas

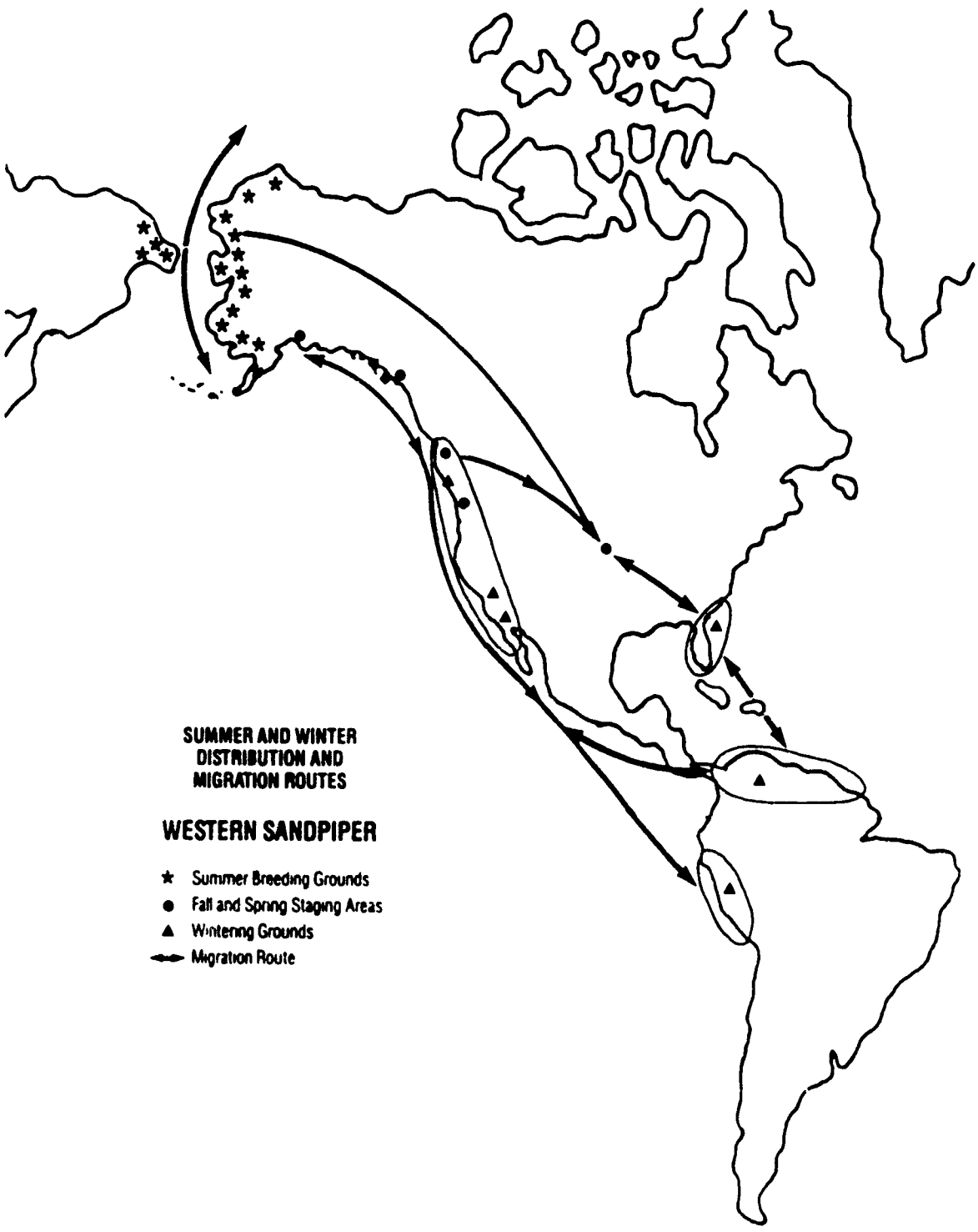
Destruction or pollution of coastal wetlands would reduce the habitat available for wintering birds.

Management Efforts on the Breeding Areas and Migration Routes

The tideflats and wetlands of the Copper River Delta and Fox River Flats in Cook Inlet have been designated state Critical Habitat Areas which are managed to protect the habitat. The value of the Copper River Delta for wildlife also received special recognition in the Alaska National Interest Lands Act (ANILCA). Therefore, the Forest Service, which manages the lands above the intertidal zone, manages these lands with a priority for wildlife over other uses.

In 1990, the Copper River Delta was recognized internationally as a Western Hemisphere Shorebird Reserve due to its critical nature as shorebird habitat. Cheyenne Bottoms, Kansas, an important staging area, and San Francisco Bay, California, an important wintering area, have the same designation. Designation as a site in the network is a means for scientists and conservationists to encourage landowners to protect and manage the land for shorebirds and to communicate with the landowners and land managers of other important sites for the same species of shorebirds. Areas in Panama which provide wintering habitat for western sandpipers have been nominated as Ramsar sites, another protective designation for wetlands of international importance.

Wildlife managers are beginning to actively manage National Wildlife Refuge wetlands for shorebirds as well as waterfowl. In those areas where water levels are manipulated for irrigation and habitat, water levels can be drawn down at critical times during migration to provide suitable habitat.


SUMMER AND WINTER
DISTRIBUTION AND
MIGRATION ROUTES
WESTERN SANDPIPER
★ Summer Breeding Grounds
● Fall and Spring Staging Areas
▲ Wintering Grounds
Migration Route

CONSERVATION OF MIGRATORY BIRDS

The management and conservation of migratory birds requires information about habitats used all along their migratory routes. These activities also require considerable cooperation among people. The long migratory routes of many bird species cross political lines of states and countries. The birds depend on habitat areas managed by private landowners and public land managers who manage lands for a variety of purposes.

Scientists throughout the world have worked together in researching the life cycles and routes of migratory birds. They have also cooperatively monitored changes in the size of populations. All bird species have not received equal attention. Species that are difficult to study and are not currently used by people in some way or threatened by human actions have received less study. Finally, people have managed certain bird populations cooperatively to avoid foreseeable declines or initiate action when major declines occurred that could be reversed by human actions.

People have acted to conserve migratory birds in five major ways.

1) habitat preservation and enhancement
2) regulation of development activities
3) control of toxic pollutants
4) harvest regulation
5) propagation

In 1986, the United States and Canada adopted a North American Waterfowl Management Plan. This document is a comprehensive blueprint for the application of conservation measures to increase waterfowl populations to the higher levels that have existed historically. Wetland habitat maintenance and improvement are the key elements of the plan. Commonly used conservation measures as well as new innovative measures will be needed if the goals of the plan are to be realized.

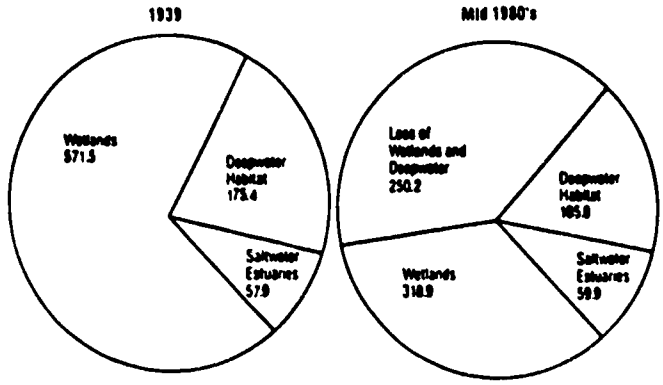
Habitat Preservation and Enhancement

The section on Humans and Wetlands in Teacher Information Manual I generally describes the situation of wetland habitat loss and the measures being taken to restore or protect wetland habitats. Many state and federal refuges and state Critical Habitat Areas have been established in Alaska specifically to protect habitat for migratory birds and other wetland-dependent wildlife. The passage of the Alaska National Interests Land Conservation Act in 1980 placed several million acres in national wildlife refuges. Birds that breed in Alaska stage and winter in many of the more than 400 national wildlife refuges outside Alaska.

Wetland losses have been substantial in some localized areas of Alaska. Restoration of wetlands following development has rarely been attempted. However, some efforts have been made to enhance habitat quality for wildlife. For example, artificial nest structures have been constructed on the Copper River Delta. Nesting dusky Canada geese now use the nest structures. Chicks from artificial nests boost the declining productivity. In another case, Ducks Unlimited and the Alaska Department of Fish and Game have built artificial nesting islands in Palmer Hay Flats State Game Refuge. And, a pond system was excavated in Creamer's Field State Game Refuge, Fairbanks, to provide habitat for migrants and nesting birds.

Because of the critical nature of Alaska's wetlands as the breeding grounds for many migratory species, these wetlands require protection. However, wetlands elsewhere must be protected as well. One of the most significant problems facing waterfowl populations that breed in Alaska is the loss of wetland habitat in the lower 48 where these populations winter. For example, by 1984, California had less than 10% of the wetlands it had in 1850. An average of 5.4 thousand acres were destroyed each year in the Central Valley of California between 1939 and the mid-1980s. Over 60% of the ducks, geese, and swans of the Pacific Flyway and many other migrants to Alaska wintered in the Central Valley. Thirty-one and one-half percent of the Valley's wetlands were lost during this period to agriculture and urban and industrial development.

CALIFORNIA WETLAND LOSS
WETLANDS, THOUSANDS OF ACRES



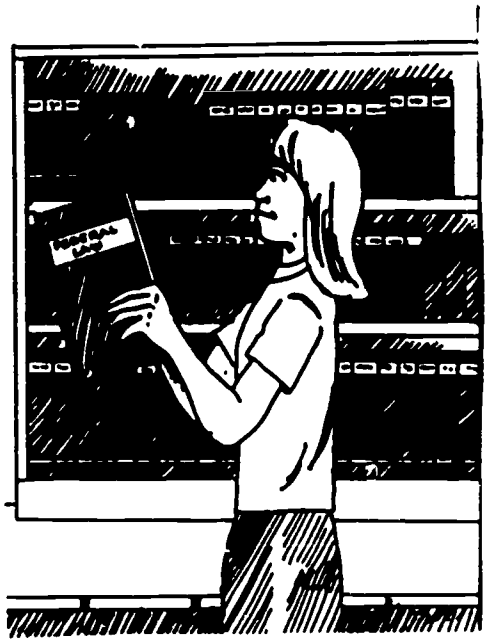
The North American Waterfowl Management Plan identifies actions to restore and maintain habitats needed to achieve specific population goals for 29 species of ducks, five species of geese, and four species of swans. All but four of these duck species breed in Alaska. The plan identifies priorities for habitat acquisition, maintenance, restoration, and rehabilitation. Seven habitat areas in Alaska are described as "of major concern": Izembek Lagoon, upper Alaska Peninsula, Yukon-Kuskokwim Delta, Upper Cook Inlet, Copper River Delta, Yukon Flats, and Teshekpuk Lake. The plan concludes with the following call to action:

> The major requirement for waterfowl conservation in North America is to influence land-use practice on extensive areas across the continent . . . . The effort required to maintain and enhance waterfowl habitat in North America is beyond the capability of public natural resource agencies alone. Long-term solutions will require the coordinated action of governments, private organizations, landowners, and other citizens.

Regulation of Development Activities

Besides habitat loss or alteration that results from the filling of wetlands, development activities can affect wildlife negatively in a variety of other ways. These include disturbance or harassment by people or by vehicles such as motorboats, airplanes, and helicopters; displacement; mortality due to accidents; entrapment in impoundments or excavations; entanglement in fishing nets or debris; or collision with vehicles or structures. Migratory birds are especially vulnerable to harassment by airplanes or helicopters flying over staging or breeding areas and to collisions with powerlines or large antenna systems placed perpendicular to their migration route. Diving ducks and seabirds are vulnerable to entanglement and drowning in submerged gillnets.

Knowledge about migratory birds and their habitats improved in large part due to programs designed to study the likely environmental impacts of proposed development projects. For example, in Alaska, after potential offshore oil and gas leasing areas were identified, researchers studied the migration routes, productivity, and life histories of many shorebird and seabird species that use saltwater wetlands as part of the Outer Continental Shelf Environmental Assessment Project. Researchers gathered similar types of information as part of baseline studies related to oil and gas leasing in the Arctic National Wildlife Refuge. Information from the Outer Continental Shelf studies provided a basis for response measures to protect key habitat areas following the Exxon Valdez oil spill. Studies also document negative impacts and provide a basis for measures to avoid or minimize impacts in the future. Examples of such studies in Alaska are those in the Prudhoe Bay area where oil and gas development continues to occur and in the area affected by the Exxon Valdez oil spill.



Federal laws (the National Environmental Policy Act, the Fish and Wildlife Coordination Act) and Alaska state laws (Anadromous Fish Stream Protection Act, Alaska Coastal Management Act) require the involvement of fish and wildlife management agencies in the permitting of many development projects. These fish and wildlife management agencies, including the Alaska Department of Fish and Game and U.S. Fish and Wildlife Service, review proposed development projects and sometimes recommend that developers move projects to avoid important wetland habitats or redesign them to avoid or minimize negative impacts to wildlife. In some cases, they recommend that a project should not occur due to the potential for negative impacts to outweigh any positive benefits the project might provide.

In most cases, the fish and wildlife management agencies advise the regulatory agencies responsible for permitting the projects. When projects are proposed on state or federal refuges or other protected areas managed by fish and wildlife agencies, these agencies play a regulatory role.

Control of Toxic Pollutants

Some chemicals used by humans for one purpose can have unfortunate side effects on migratory birds. The most dramatic example is that of DDT, a pesticide used to control mosquitoes and other insect "pests." Its widespread use contributed to the decline of bald eagle populations in all states (except Alaska) to endangered status. Other raptors, including the endangered subspecies of peregrine falcon that nests in Alaska, also declined. DDT is a substance that "bio-accumulates," reaching more concentrated levels as it is incorporated at higher levels of the food chain. At higher concentrations, it causes thinning of bird egg shells which shatter during incubation. Use of DDT has been banned in North America, but its use continues in South America where some of Alaska's birds spend the winter.

Other agricultural chemicals that control undesirable weeds or insects have poisoned migrating waterfowl: dieldrin, aldrin, and parathion pesticides have been used in the rice fields of Texas; heptachor and lindane insecticides coat winter wheat seeds and have been fed upon by migrating geese in Oregon and Washington; and diazinon pesticide has been used on golf courses. Geese are especially vulnerable to chemical poisoning because they are attracted to farm fields and golf courses for feeding. Many farmers have quit using these chemicals or reduced their use, but in some areas no alternatives exist that will allow similar high levels of agricultural production to continue.

The death of wetland birds also results from encounters with petroleum and petroleum products. The transport and accidental spills of these substances pose a threat to migratory birds who have no adaptive mechanisms to avoid spilled oil. Birds that encounter spilled oil die either when they lose buoyancy and drown, when they lose insulation and die of hypothermia in cold waters, or when they preen to remove the oil and ingest the toxic oil. Birds which dive for their food are most vulnerable to marine oil spills. Thus, deaths of diving seabirds–loons, grebes, and seaducks–dominate the known mortality of birds that encountered oil spilled from the Exxon Valdez tanker. Migrants adapted for long flights, such as the small sandpipers, are less vulnerable to even large spills because they fly over miles of open water between staging areas without landing on the water. Spills that contaminate wetland staging areas could be devastating to a variety of bird species. Because clean-up technology is poorly developed, realistic regulation of oil transportation that focuses on prevention of spills is best for migratory birds.

In addition to the relatively rare events of catastrophic spills, numerous small spills and routine operations in oil-related facilities may result in chronic, low-level contamination of nearby wetlands. Chronic pollution also enters the food chain and may reduce productivity in the area. In addition, oil drilling requires the use of drilling muds that include highly toxic compounds. Disposal of toxic drilling muds into reserve pits in the tundra wetlands at Prudhoe Bay has reduced invertebrate populations that are a food source for waterbirds. In some areas such as Prudhoe Bay, reinjection of the muds back into the hole is an option that avoids contaminating wetlands. In other areas, reinjection would contaminate the groundwater and pose health hazards in drinking water supplies for humans.

A final class of pollutants that has caused die-offs in waterfowl populations are heavy metals. Heavy metal contamination in downstream run-off of agricultural irrigation waters has resulted in sharply-reduced productivity on refuges in California and severe deformities in young birds. Researchers traced the cause to selenium that was in high concentrations in upstream farmland soils. Agricultural practices have been restricted to end this contamination; however, the problem will continue in areas with similar types of soils or soils with other types of heavy metal concentrations. Birds also die when they encounter mining tailing waste ponds with high heavy metal concentrations.

Lead is another lethal pollutant that results from the use of lead-based shotgun ammunition by waterfowl hunters. In 1989, lead poisoning was estimated to kill as many as 1 1/2 to 3 million waterfowl every year. Because shotgun loads consist of many small pellets, many of which miss the bird, thousands of lead pellets end up in the bottoms of wetlands and waterfowl hunting areas every year. Diving ducks (scaup, canvasback, and ring-necked ducks) are more likely to swallow lead pellets than dabblers. Ducks that feed on plants and invertebrates in the water or on the surface of the bottom are less likely to pick up lead shot that has settled to the bottom than snow geese, swans, and ducks such as the pintail that dig into the bottom for food. Bald eagles also suffer from lead poisoning when they feed on ducks and geese that have been poisoned by the shot.

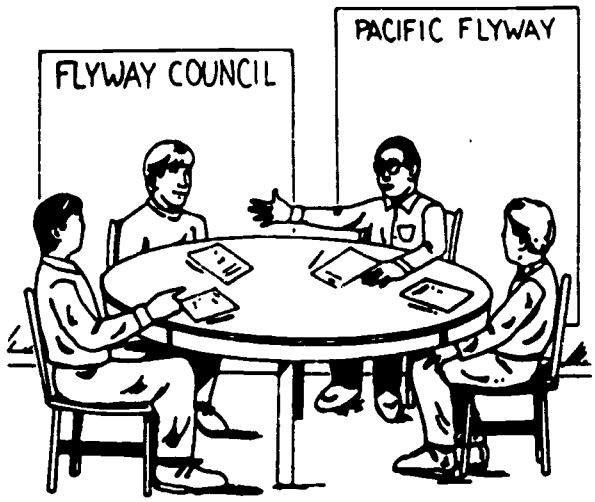
Even after research established the link between the use of lead shot to losses of waterfowl from lead poisoning, changing the use of lead ammunition by hunters has been a slow process. The Pacific Flyway Council adopted criteria for monitoring and reducing lead poisoning in waterfowl in 1980. In 1985 and 1986, the Alaska Department of Fish and Game collected livers and gizzards from mallards and pintails harvested by hunters in Upper Cook Inlet and detected high levels of lead shot. A federal regulation bans the use of lead shot for waterfowl hunting nationwide after September 1, 1991. An efficient non-toxic steel shot substitute has been developed and an education effort is underway to help hunters switch their hunting techniques to compensate for the less dense metal.

One mysterious case of waterfowl die-offs in Alaska remained unsolved in 1990. Biologists saw birds dying in the Eagle River Flats area near Anchorage in 1980. Over several years thousands of ducks and swans died. The area had been used by the military as an artillery range since World War II, but no similar die-offs were noted at other artillery ranges. Through studies, biologists eliminated disease as a likely cause. When scientists fed plants, water, or mud from the area to mallard ducklings, some of them died. When they placed birds in pens on the flats, some of these also died. The birds first became disoriented, stumbling and walking in circles. Then they went into convulsions, arching their heads and necks over their backs and doing somersaults before dying. Yet, scientists were unable to pinpoint any toxic substance in the blood or flesh of birds that died. They now suspect that very low levels of chemical residues from bomb compounds are somehow the culprit in the deaths. They believe these toxic substances are in the water and the mud.

Waterfowl Regulations

Waterfowl have traditionally been harvested for food. As human populations have grown, breeding, migration, and wintering habitats have diminished. As the technology for harvest has improved, it has become increasingly necessary to monitor numbers of breeding birds and production and regulate harvests all along the birds' migration path to ensure maintenance of healthy populations.

In North America since 1952, states and provinces have participated in flyway councils to cooperatively manage waterfowl harvests. Four flyway councils manage four regions of the U.S. Each council management area includes several states and Canadian provinces with common boundaries. Areas managed by a council include the entire migration route of species that migrate in a north-south direction. Species that follow east-west routes may cross flyway boundaries and receive management attention and coordination from one or more councils. Alaskan representatives of the Alaska Department of Fish and Game and the U.S. Fish and Wildlife Service participate as members of the Pacific Flyway Council. However, because the waterfowl that breed in Alaska migrate in all four flyways, Alaskan researchers and managers provide information to all four flyway councils. Information on production in Alaska is especially important to the Central Flyway Council during drought years for the prairie-pothole area.



Flyway councils meet annually to review population information and to agree on a strategy for managing the following year's harvest. They agree on the times and lengths of harvest seasons, the size of bag limits, and the methods hunters will be allowed to use. The migration route of each species is divided into several management units that correspond with different populations.

Council members base their recommendations on a review of information gathered by research biologists who census waterfowl on the breeding grounds in May and June (to determine the number of birds returning from wintering areas), on the breeding grounds in July (to determine the number of young produced), and on the wintering grounds following the hunting season. Most surveys are aerial surveys of specific "index" areas that are counted year after year to provide a historical comparison. Some areas are also surveyed from the ground (on foot) to correct aerial counts that may miss some birds or to measure productivity. When other types of information are needed, researchers band birds on the breeding grounds. Band returns provide additional information about migration routes, use of specific areas, and causes of mortality.

Transect Surveys, N.A.

The illustration shows the areas and transect lines where aerial surveys of adult birds (nesting pairs and non-nesting flocks) are conducted each year in Alaska. Brood, or productivity, surveys have also occurred in recent years in Alaska, using low-level helicopter surveys in low-density nesting areas and on-the-ground surveys in high-density nesting areas. Major banding efforts occur on many Alaska refuges to provide information on specific management situations. These surveys indicate that the timing of snow-melt and break-up in Alaska is one of the major determining factors of annual productivity for the species that nest in the state. Short summer seasons prevent renesting if a nest fails and can mean that late nesting birds cannot successfully fledge their young by freeze-up.

Researchers combine information about adult breeders and non-breeders and the estimated rate of production (young fledged/pair) to project the number of birds that will make up the "fall flight" between nesting and wintering areas. Members of the flyway councils use these projections to recommend hunting regulations to the Secretary of Interior who has the authority to adopt them into law. The Alaska Board of Game also adopts the regulations. Both state and federal enforcement officials are responsible for enforcing the laws.

Flyway council members also exchange information on waterfowl research and management needs, law enforcement problems, and overall coordination among agencies, private groups, and citizens. Technical committees that are part of the councils coordinate waterfowl census, banding, migration, and harvest studies. Finally, the councils develop management plans for individual species of waterfowl as needed. For over a decade, all four councils have worked together to develop the North American Waterfowl Management Plan adopted by the U.S. and Canada in 1986. Regulation of harvests is the second key element of this plan after habitat preservation and enhancement.

Control of Disease

Several diseases result in large-scale die-offs of waterfowl because they spread rapidly in areas where birds are concentrated. The number of diseases and disease-breeding conditions are increasing due to the loss of wetland habitat and the crowding of larger numbers of birds into smaller and smaller areas. Although millions of waterfowl die of disease each year, it may be relatively unnoticeable because sick and dying birds seek cover and predators and scavengers consume the carcasses.

Avian cholera and avian botulism are two lethal diseases that are caused by bacteria. Viruses, fungi, and parasites also cause diseases and loss of waterfowl. Some viruses, in particular, are extremely deadly to waterfowl.

Managers seek to control disease by removing diseased

carcasses from the environment and disposing of them properly, manipulating water levels, using scare devices to keep healthy birds out of disease "hot spots," and using insect control to slow the spread of diseases such as avian pox which is spread by mosquitoes and flies. Plowing under unharvested grains and peanuts that are likely to become moldy eliminates a source of fungi and mycotoxins.

Propagation

Propagation is a means to enhance or restore waterfowl populations that are at low levels. In Alaska, one example of propagation has been the captive-rearing of Aleutian Canada geese, an endangered species that was reduced to only a few remnant populations on remote islands until recovery efforts were begun.

Since 1986, trumpeter swan eggs have been transferred to Minnesota, Michigan, and Wisconsin to help reintroduce the species. Careful studies have ensured that removal would not reduce production in Alaska and that abandonment of nesting areas would be minimized. The eggs have been hatched and the cygnets reared in captivity in Minnesota and Michigan. In Wisconsin, young swans have been raised in natural wetland areas with use of a swan surrogate mother (which is actually a person in flotation waders inside a swan-like structure that leads the cygnets around the lake to feed)! These states hope to reestablish breeding pairs that migrate with natural populations. The eggs of peregrine falcons and bald eagles have also been removed from Alaska nests to hatch in captivity so that young birds can be reintroduced into areas where the species was formerly plentiful in the northeast United States.

APPENDIX A

BIRD MIGRATION

In spring and autumn, the sky can become dark with countless birds flying between their breeding grounds and wintering grounds. This seasonal or periodic movement, called migration, is not unique to birds. Various wildlife species ranging in size from butterflies to whales are migratory. While most birds migrate, many, such as the raven and chickadee, do not. The reasons for migration, the problems surrounding it, and the management of migratory birds will be explored here.

Why Do Birds Migrate?

The reason birds migrate can be explained only partially at this time. Several theories for migration have been identified, and it is probably a combination of factors that stimulates birds to migrate.

One theory suggests that seasonal changes in weather which affect the availability of food and water cause birds to migrate. Waterfowl obviously cannot feed in frozen lakes, and many insect-eating birds leave the north to winter in Central America after feeding on the abundant arctic insects all summer.

A second theory links migration to genetic or inherited characteristics by suggesting that migration is an instinctive return to ancient habitat areas.

How Do Birds Migrate?

During migration, birds accomplish remarkable feats. For instance, the golden plover from Alaska flies across 3,000 miles of open ocean to find tiny land spots of Hawaii; a ruby-throated hummingbird can fly as high as 21,000 feet; geese attain speeds of 50 mph; and greater shearwaters migrate 8,000 miles annually. The destinations of migratory birds are as amazing as their flights. After a journey of 3,000 miles, the Tennessee warbler has been known to return to the same tree in which it nested the previous year.

Migratory methods are varied and fascinating. In addition to flying, some seabirds migrate by swimming; mountain quail migrate down mountain slopes in the winter to warmer altitudes (instead of flying to warmer latitudes).

Several senses and adaptations enable birds to migrate. Most migratory birds have very powerful flight muscles. They also have a highly developed respiratory system, hollow bones, internal air sacs, and specialized body shapes. All of these features enable them to fly high, fast, and for long periods of time.

In addition, most birds have very sharp vision. This enables them to use distinct landmarks and the sun or stars as directional cues. Other helpful aids include an ability to see ultraviolet light, hear low-frequency sounds (like surf against a distant beach), detect the magnetic and gravitational fields of the earth, and sense weather frontal systems and changes in barometric pressure. One or several of these aids may be used depending upon the species and the route traveled.

When Do Birds Migrate?

Times of annual migrations vary. For instance, while many shorebirds begin their fall migration in early July, other species, such as geese, do not begin until late fall. And while some birds have a leisurely migration schedule, others fly swiftly to their destinations. In general, however, migrations in the fall are less hurried than in the spring. It is believed that spring migrations are faster because of the stimulus to breed and nest.

The time of day when migration occurs also varies. In general, most small birds migrate by night. Ducks and geese may migrate both day and night. Observations made with telescopes focused on the full moon have shown birds migrating over one area at a rate of 9,000 birds per hour! Travel by night enables some of the small birds to avoid their enemies. In addition, by traveling at night, birds can spend the day feeding and resting.

Day migrants include loons, cranes, gulls, hawks, and vultures. Soaring birds such as broad-winged hawks migrate only during the day because they are dependent upon updrafts created by the sun.

Where Do Birds Migrate?

Migration can take birds from the arctic to Antarctica. While most species' journeys are not that long, many birds, even small songbirds, do travel impressive distances. This makes bird migration an international concern. The availability of food, water and shelter are the most important factors which determine where birds migrate. Many species of birds will seemingly travel several thousand miles out of their way but actually take that route because of the availability of food sources.

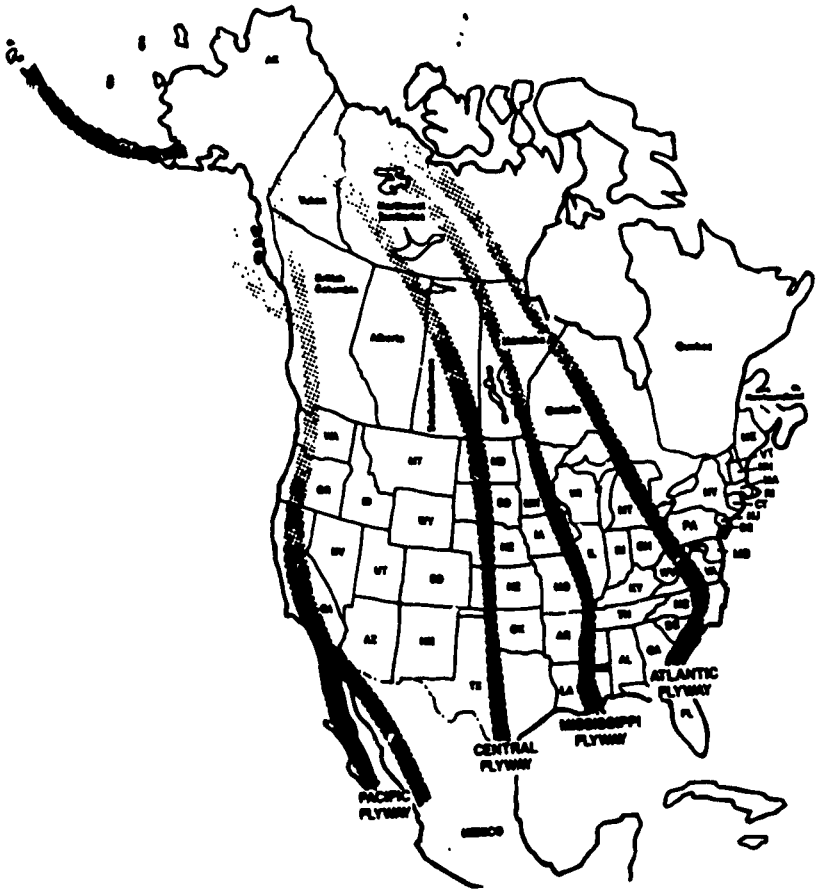
While general directions of flight are consistently followed by migrating birds, it is important to remember that the term "migration route" does not mean an exact, specific route between wintering and breeding grounds. Routes tend to follow major habitat types, avoid crossing obstacles like mountain ranges, and provide the necessary food, water, and shelter. Migration routes tend to follow a north-south path, but routes can also include east-west movements.

There appear to be four broad migration routes in North America. For research and management purposes these routes are depicted as four distinct flyways: the Atlantic Flyway, the Mississippi Flyway, the Central Flyway and the Pacific Flyway. Of these, the Mississippi route is the most used.

Difficulties Along the Way

Despite the many benefits of seasonal movement, a number of problems can occur during migration. Migrating birds are under considerable stress and use up a great deal of energy in sustained flight. A sudden storm that blows them off course or unusually cold weather that reduces their food supply can have disastrous results. Stress also makes them more susceptible to disease, and some birds migrate in large flocks where disease can spread easily. Another problem for migratory birds is collisions with skyscrapers, picture windows, radio towers, and power lines.

Map of North American Flyways



Alteration of habitat along the flyways offers potential benefits as well as problems for migrating birds. Many marshlands and other resting places for the traveling birds have been converted to farmland. The birds must feed and rest to survive, so they often take advantage of wheat or corn fields along the way.

These crops are a good food source, but many birds have begun to delay their migrations, feeding for long periods in areas with prime supplies. This not only presents a problem for the farmer but also for the birds which may suffer a higher incidence of disease or face severe weather as the seasons change. The conversion of land for many other uses such as housing or commercial development reduces the amount of food available during migration.

Migratory bird populations can also be seriously affected by contact with pesticides. For many years DDT was used to kill insects. Through the food chain process, DDT accumulates in the bodies of birds and mammals. For birds, this can result in thin-shelled eggs, infertility, and sometimes death. While DDT is now banned in the United States, it is still used extensively in other parts of the world. Therefore, birds migrating to these areas are still exposed to it.

Research and Management

A variety of research is currently being conducted to increase our knowledge of bird migrations. Methods used to collect migration data include direct observation, recordings of calls, bird banding, radio tracking, radar observation, and laboratory studies involving orientation, navigation, and the physiology of migrating birds.

Of all these methods, however, bird banding has probably yielded the most information. Bird banders trap or net birds and place a metal band on each bird's leg. Each band has a different number on it. This number, along with a description of the species of bird, its age, sex and date of banding, is sent to the U.S. Fish and Wildlife Service. After the banded bird is released, it may be caught again by banders, die of accident, disease, natural causes, or be shot by hunters. Information about the recapture or the band from the dead bird is then sent to the U.S. Fish and Wildlife Service.

By analyzing the reported bands, wildlife professionals can tell where birds breed and winter, how long they live, and the times, lengths, and routes of their migration. Band recoveries provide valuable data for the biologists to use when estimating the relative abundance of a particular species in an area or population. The public can play a valuable role in this research by sending any bird band found to the address on the band: U.S. Fish and Wildlife Service Bird Banding Laboratory. The information obtained from research provides valuable contributions to the management of migratory birds. Some examples of how research data are used by wi fe experts include how to combat disease outbreaks, change feeding patterns that are damaging to crops, and set harvest limits for migratory bird hunters.

Much of migratory bird management consists of making sure that adequate habitat exists along the migration routes so birds can rest and feed. Hundreds of private, state, and federal wildlife refuges have been established to help meet these needs. Similar efforts are also conducted in other countries. This international effort is crucial to the survival of migratory birds.

Research, habitat preservation and management, and international treaties ensure that migratory birds will be here for future generations.

From: U.S. Fish and Wildlife Service Issue Pac, Migratory Birds.

APPENDIX B

IMPORTANT LAWS CONCERNING WETLANDS

Clean Water Act

Section 401 of the Clean Water Act requires states to develop water quality standards for all uses of the state's waters that benefit society, such as public drinking water, maintenance of fish and aquatic life, and recreation. States must establish minimum levels of various water quality characteristics necessary to maintain these uses. States review federal permits required under Sections 402 and 404 of the Act and certify that the activities will not result in violations of the state water quality standards. The Alaska Department of Environmental Conservation is responsible for determining appropriate water quality standards and for reviewing permit applications for the purpose of certification.

Section 402 created the National Pollutant Discharge Elimination System (NPDES) through which the Environmental Protection Agency regulates pollutant discharges such as industrial wastes and sewage to wetlands, streams, and other waters.

Section 404 regulates activities that would place dredged or fill materials in all "waters of the United States," which include most wetlands. A permitting system is administered by the Army Corps of Engineers and overseen by the Environmental Protection Agency. Examples of the types of activities which may require permits include road fills, bank and shoreline protection projects, utility line crossings, and shoreline structures such as bulkheads and piers requiring fill.

Rivers and Harbors Act of 1899

Section 10 of the Rivers and Harbors Act regulates activities that alter the navigability of waterways, including oceans, rivers, streams, and lakes. A permitting system is administered by the Army Corps of Engineers.

The Coastal Zone Management Act and Alaska Coastal Management Program

The Coastal Zone Management Act requires that states review and certify that proposed activities affecting the coastal zone, including many activities in wetlands, will be consistent with environmental requirements imposed under state law. The Alaska Coastal Management Program establishes the standards against which activities are reviewed and includes standards for the maintenance of wetland functions.

Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act requires consultation with the U.S. Fish and Wildlife Service and the state agency which manages fish and wildlife for all water use projects that might affect fish and wildlife populations or habitats. As a result, these agencies review all Environmental Impact Statements, Corps of Engineers permit applications, and other federal permits that affect wetlands and provide recommendations to mitigate the impacts to fish and wildlife.

Fish Habitat Protection Permit Required (A.S. 16.05.870)

A permit from the Alaska Department of Fish and Game is required for activities that would affect streams, lakes, and rivers that are important for the spawning, rearing, or migration of anadromous fish. Activities which require permits

are those which would divert or use water; obstruct, pollute, or change the natural flow or bed; or use of certain types of equipment in the bed. The department reviews permit applications and assures protection of fish and wildlife before issuing the permit.

Emergency Wetlands Resource Act of 1986

The Emergency Wetlands Resource Act of 1986 provides for the collection of fees at national wildlife refuges. These fees and funds from the Lands and Water Conservation Act are deposited into the Migratory Bird Conservation Fund for use in the acquisition of privately-owned wetlands. The act also directs the development of priority conservation plans to provide the framework, criteria, and guidance for identifying wetlands warranting priority attention for acquisition and to address wetlands as an important outdoor recreation resource.

Food Security Act of 1985

The Food Security Act of 1985, or Farm Bill, has several sections that promote acquisition of wetlands for protection of fish and wildlife habitat. Easements and deed restrictions can be obtained for conservation purposes on lands owned by the Farmers Home Administration prior to resale. Wetlands on private lands can also be set aside in conservation easements in exchange for debt relief to landowners.

IMPORTANT LAWS CONCERNING MIGRATORY BIRDS

Migratory Bird Treaty Act

The Migratory Bird Treaty Act and its amendments between the U.S. and foreign governments –1916 U.S. and Great Britain (for Canada), 1936 U.S. and Mexico, 1973 Convention U.S. and Japan, and 1976 U.S. and U.S.S.R.– provide mandates for protecting and managing species and critical habitats for species that migrate between the U.S. and foreign countries. The Act also provides the authority to control the taking, selling, transporting, and importing of migratory birds, their nests, eggs, parts, and products.

Convention on Wetlands of International Importance Especially as Waterfowl Habitat - 1972

This convention, known as the Ramsar Convention adopted in Ramsar, Iran, includes criteria for designating wetlands in this international category.

National Wildlife Refuges Act

The National Wildlife Refuges Act established the refuge system in 1903 primarily to conserve valuable habitat for migratory birds (especially waterfowl), large game animals, and endangered species. The national refuge system includes more than 430 units of land in 50 states, including 16 in Alaska.

North American Waterfowl Management Plan (1986)

The North American Waterfowl Management Plan provides general guidelines for waterfowl habitat protection and management actions for 29 species of ducks, 27 populations of geese, and four species of swans. Waterfowl habitat areas of major concern are identified in the U.S. and Canada, including seven in Alaska (Izembek Lagoon, Upper Alaska Peninsula, Yukon-Kuskokwim Delta, Upper Cook Inlet, Copper River Delta, Yukon Flats, Teshekpuk Lake). The plan has been signed by the United States and Canada.

APPENDIX C

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Gill, Robert Jr. U.S. Fish and Wildlife Service.
Senner, Stan. Alaska Department of Fish and Game.

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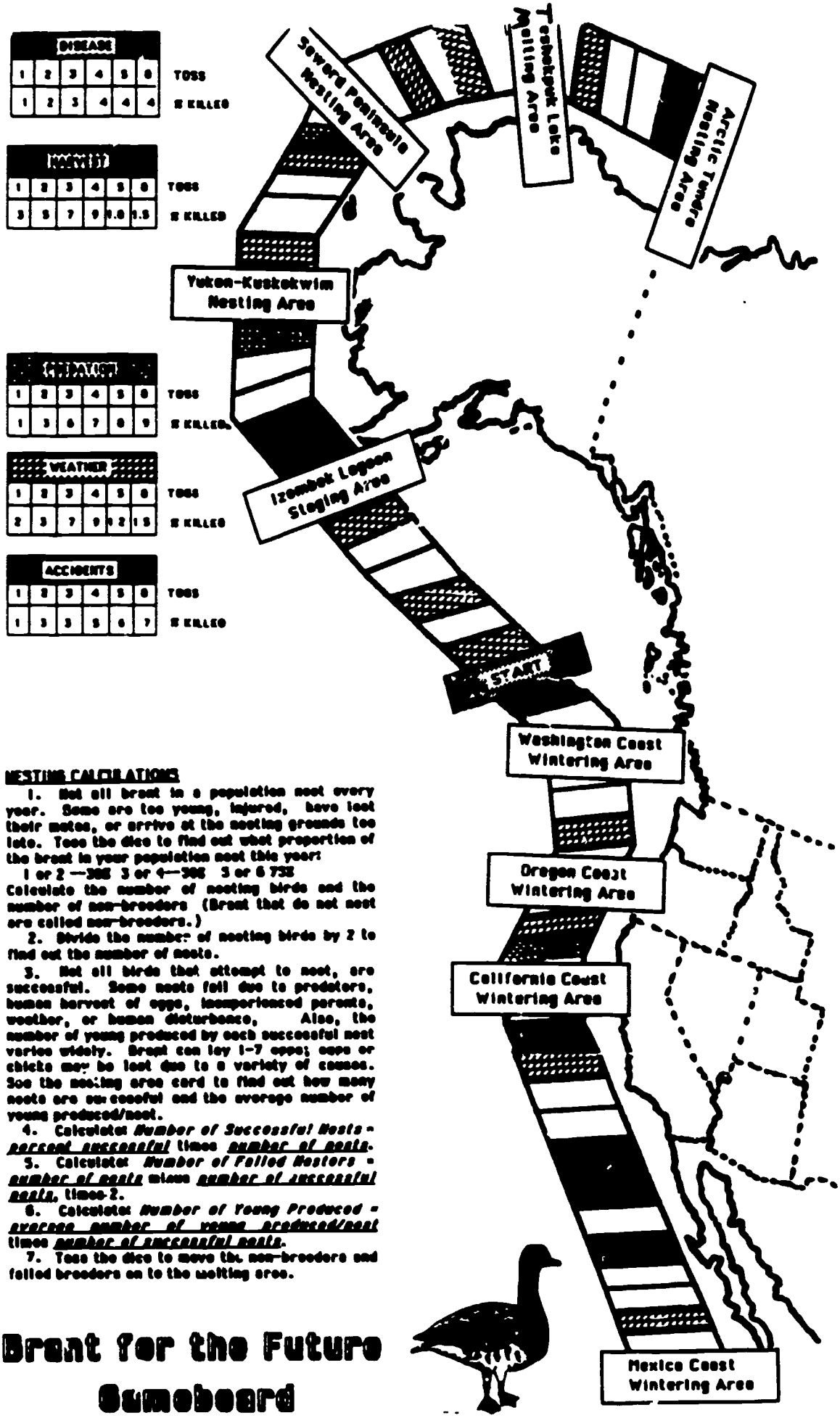
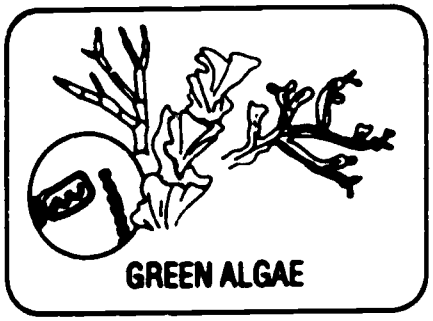
Office of Resource Support
1011 Tudor Road
Anchorage, Alaska 99503
(907) 786-3351



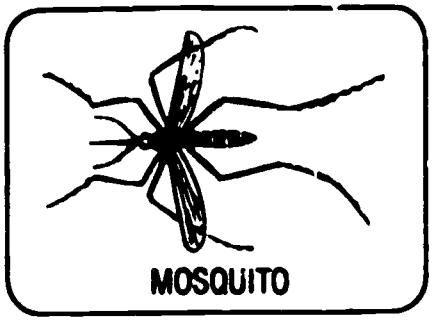
NESTING CALCULATIONS

1. Not all brant in a population nest every year. Some are too young, injured, have lost their mates, or arrive at the nesting grounds too late. Toss the dice to find out what proportion of the brant in your population nest this year:
   1 or 2 — 30% 3 or 4 — 20% 5 or 6 75%
   Calculate the number of nesting birds and the number of non-breeders. (Brant that do not nest are called non-breeders.)
2. Divide the number of nesting birds by 2 to find out the number of nests.
3. Not all birds that attempt to nest, are successful. Some nests fail due to predators, human harvest of eggs, inexperienced parents, weather, or human disturbance. Also, the number of young produced by each successful nest varies widely. Brant can lay 1-7 eggs; eggs or chicks may be lost due to a variety of causes. See the nesting area card to find out how many nests are successful and the average number of young produced/nest.
4. Calculate: *Number of Successful Nests* = *percent successful* times *number of nests*.
5. Calculate: *Number of Failed Nesters* = *number of nests* minus *number of successful nests*, times 2.
6. Calculate: *Number of Young Produced* = *average number of young produced/nest* times *number of successful nests*.
7. Toss the dice to move the non-breeders and failed breeders on to the molting area.

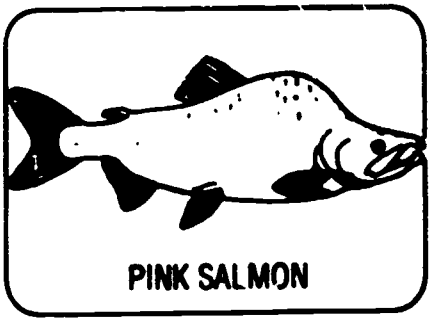
Brant for the Future Gameboard



GREEN ALGAE



MOSQUITO



PINK SALMON

WETLAND CARDS

The following pages contain over 100 illustrations of plants, invertebrates, fish, birds, and mammals found in Alaska's wetlands. Each illustration is accompanied by text describing the organism's traits, habitat, food habits, and what eats it.

Upper elementary, junior high, and senior high school teachers can use the cards as is, or photocopy them. Primary teachers may choose to enlarge and use only the illustrations for handouts, and use the information for reference and simplify it for young students.

WOOD FROG

BALD EAGLE

MOOSE

Writers/Editors: Marilyn Sigman, Susan Jordan
Writers — Wetland Cards: Susan Quinlan and Matt Graves
Editors: Janet Ady, Beverly Farfan, Colleen Matt, Karen McKibbin, Cathy Rezabeck
Production by Connie Allen, Beverly Farfan, Cathy Rezabeck, Rick Turner, Fineline Graphics
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EQUAL EMPLOYMENT OPPORTUNITY STATEMENT

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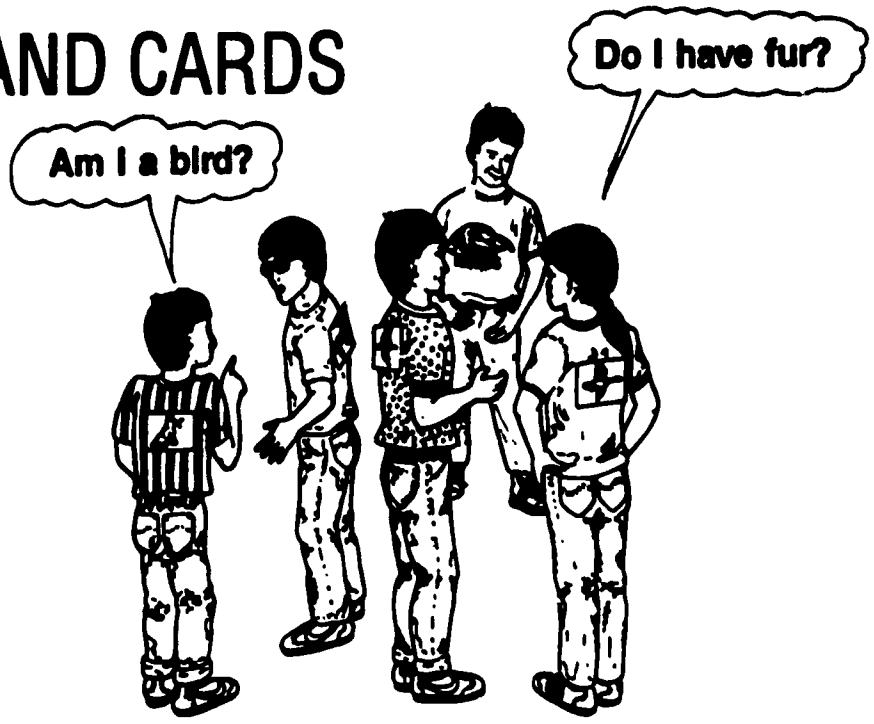
1849 C Street NW
Washington, D.C. 20240

WETLAND CARDS



Objectives

Students will:
1. Become familiar with wetland species and their habitats

2. Learn interrelationships among species

Method

Students use Wetland Cards for activities to become familiar with wetland species and habitat.

Background

On the back of the Wetland Cards are a description of the size, physical description, habitat, predators and food for each species. Younger students may use fewer cards for the activities.

Materials

- Wetland Cards
- Contact paper to cover cards

Procedure

Choose enough cards to equal the number of students. Choose cards that relate to each other. For instance, you might choose a duck species, its food, and its predators. Give each student a Wetland Card. Each student should then learn about his/her species. For younger students, learning the name is sufficient. Each student then introduces their species and tells some information about it. Older students should tell only facts about their species, to see if the other students can guess the species. (Several activities in each Teacher's Guide require the use of the Wetland Cards.)

Evaluation

Can students identify a species by its picture? Can students identify food and habitat for main species? Can students identify wildlife species and their habitats, foods and predators?

Extensions

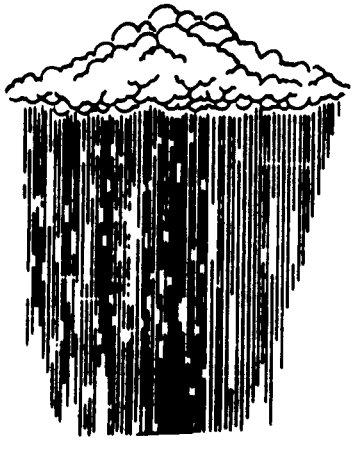
1. Tape or pin a card to each student's back. The student cannot look at the cards on their back, but can ask other students 'yes' or 'no' questions about their species until they guess correctly. Or pin a card to one student at a time and have them ask questions of the class as a group.

2. Make 2 sets of cards to play the game 'concentration.' One set should be drawings of wildlife; the other set should be corresponding cards with the name and information about the wildlife species. All cards are laid face down. Students alternate turning two cards over at a time. When a match is made (card with the name and the card with the correct picture) the student keeps the pair.

3. Play food chain rummy. This game has the same rules as rummy, but students must make a food chain (of three or four cards, depending on the level of the students) to lay down. (Example: eelgrass, goose and fox - fox eats goose, goose eats eelgrass; information about feeding habits is on the cards). When all the cards are gone, the student with the most sets wins.

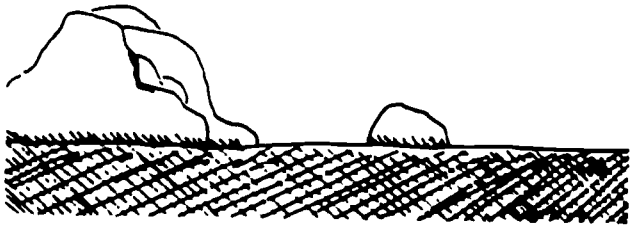
1. Air

Traits: Air is made up of several gases, including nitrogen (78%), oxygen (21%), rare gases ((0.9%), and carbon dioxide (0.03%).
Occurrence: Air surrounds us, but we rarely notice it.
Values: The thin layer of air that blankets the earth makes the earth suitable for life, by providing the oxygen and carbon dioxide needed by living things, by trapping heat from the sun, and by blocking out high intensity (ultraviolet) light rays that are harmful to living things.
Conservation Problems: Burning of wood and fossil fuels (oil, gas, and coal), and other activities of people, can pollute the air. Pollution may be changing the earth's atmosphere and could thus harm climates and living things.
"Gee Whiz": Although the sky above us looks endless, the earth's atmosphere is actually very thin. On a scale model of the earth the size of an apple, the atmosphere would be the same thickness as an apple skin.



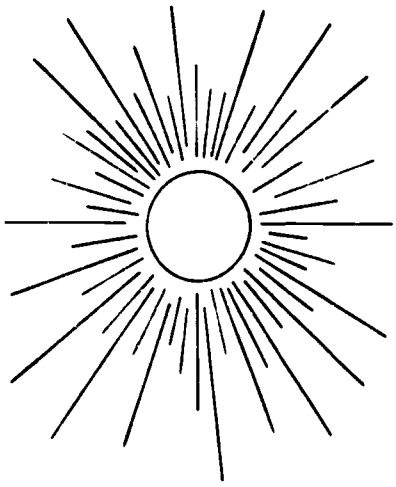
2. Water

Traits: Water molecules are made up of two atoms of hydrogen and one atom of oxygen. Water is a solid (ice) at temperatures below freezing (32 F, 0 C), a liquid above this, becomes a gas at temperatures above 212 F (100 C).
Occurrence: Water occurs in the air as clouds, rain, and snow. It forms lakes, streams, rivers, and oceans. It also occurs in the soil and deep underground in the water table.
Values: All living things need water for most life processes. Most living things are made up of 70% water.
Conservation Problems: Disposal of wastes in or near water supplies, or in the air, can pollute water and make it poisonous to living things.
"Gee Whiz": Water cycles continuously from clouds to rain or snow to rivers, lakes, and oceans, then back to clouds. Today we are using the same "recycled" water that dinosaurs used thousands of years ago.



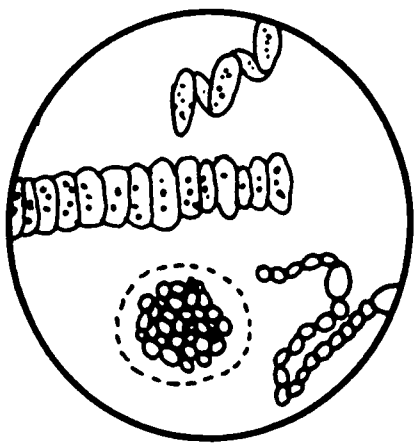
3. Soil

Traits: Rocks are made up of elements and compounds that form solids under most of the conditions on earth. Wind and water erosion change rocks into fine sand and clay particles, the basis of soils. Some soils are enriched by nutrients from decomposed plants, animals, and other living things.
Occurrence: The earth is made of solid and (in its core) molten rock. Much of the land on earth is covered by soil, but different kinds of soil occur; e.g. desert soils are mostly sand.
Values: Most plants require soil to grow. It provides them a place to anchor, and is their source for minerals and water.
Conservation Problems: Soil takes thousands of years to form from rocks and decomposition, but can be quickly washed or blown away by rains and wind.
"Gee Whiz" A teaspoon of soil may contain 3-10 billion microscopic organisms, as well as, hundreds of tiny invertebrate animals.



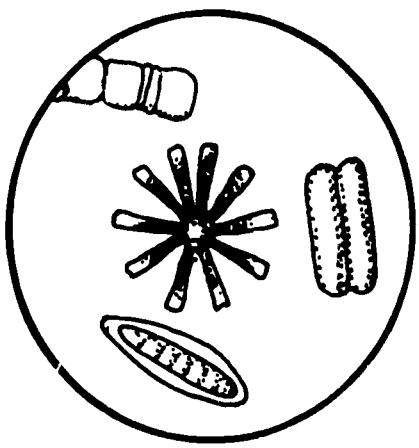
4. Sun

Traits: The sun is a dwarf, yellow star, essentially a very dense ball of gases and dust. Thermonuclear reactions in the sun give off tremendous amounts of heat and light energy. The sun is about 109 times the size of the earth.
Occurrence: The sun is located in the center of out solar system, 93 million miles from out planet, Earth. It takes light from the sun eight minutes to reach earth.
Values: Plants, and other producers, capture the energy in sunlight and, through photosynthesis, store it in the form of sugar. They, and all other living things, use this "stored sunlight energy" to grow and reproduce.
Conservation Problems: Pollution of the earth's atmosphere with chemicals made by people may change the amount and kinds of solar energy reaching the earth. This could change the earth's climates, or allow more ultraviolet light (which harms living things) to reach the earth's surface.
"Gee Whiz": The amount of solar energy striking the earth every day is about 1.5 billion times greater than the amount of electricity generates each year in the United States.



5. Blue-Green Algae

Traits: Microscopic to several inches in length, single celled or in colonies of cells, can appear blue-green, brown, red, or yellow depending on pigments.
Habitats: common in small ponds, lakes, estuaries, or in open ocean. can occur in floating masses or attached to submerged rocks.
Food: Make their own by photosynthesis.
Eaten by: Protozoans, roundworms, segmented worms, springtails, mites.
"Gee Whiz": The Red Sea gets its name from the occasional abundance of blue-green algae which is red. Blue-green algae, once considered a primitive plant, is now considered to be more like bacteria and is classified with these simple organisms in a separate kingdom of living things, called "Monerans."

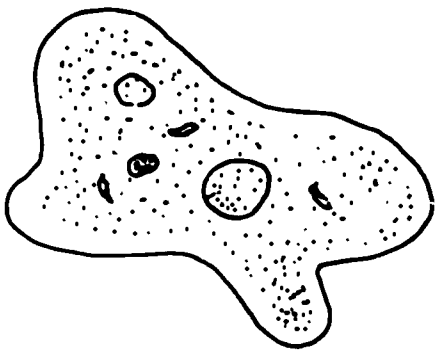


6. Diatoms

Traits: Microscopic, single-celled organisms that occur individually or in colonies. These organisms are encased by two lens-like shells made of silica (a component of glass).
Habitat: Diatoms are the most abundant producers (photosynthetic organisms) in both fresh and salt water. Many are free-floating in water, while some live attached to submerged rocks or sticks, often giving these a very slick or slimy surface.
Food: Make their own by photosynthesis.
Eaten by: Amoeba, small crustaceans, larvae of invertebrates, and fish.
"Gee Whiz": When these organisms die, their shells fall to the bottom of the sea. Large deposits formed over centuries are now mined and the collected shells are used in industry as filtering agents, insulators, in soundproofing, and in the manufacture of some paints and varnishes.

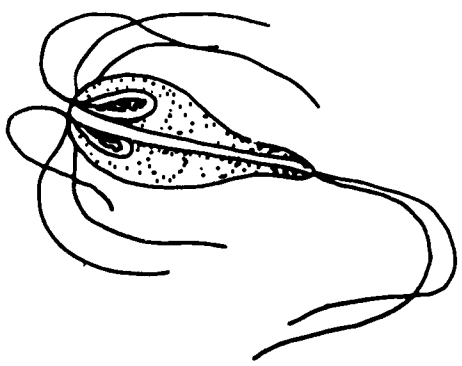
7. Green Algae

Traits: Single-celled organisms capable of photosynthesis. They occur individually, in filaments, and in colonies. The cells store food in the form of starch.
Habitat: Often occur wherever water occurs. Some grow in damp or moist soil or in tree bark.
Food: Make their own by photosynthesis.
Eaten by: Protozoans, roundworms, small crustaceans, certain mollusks, other aquatic invertebrates, fish, geese ducks, and other water birds.
"Gee Whiz": Green algae were once considered a kind of plant, but they did not have the same kinds of cells and do not have specialized conducting tissues to move water and food from one part of the organism to another. Today, most biologists classify green algae in the kingdom "Protista" - a group that includes manu microscopic organisms.



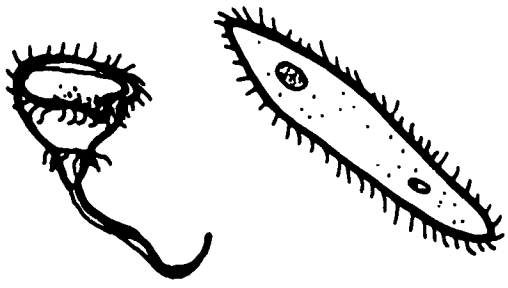
8. Amoebas

Traits: Microscopic organisms that move and capture prey by "pseudopodia," or flowing extensions of their bodies.
Habitat: Amoebas occur in both freshwater and saltwater habitats.
Food: Amoebas prey on small organisms including other protozoans, bacteria, algae and diatoms.
Eaten by: Other protozoans.
"Gee Whiz": certain kinds of amoebas cause diseases in people, such as amoebic dysentery. "pseudopodia" means "false feet".



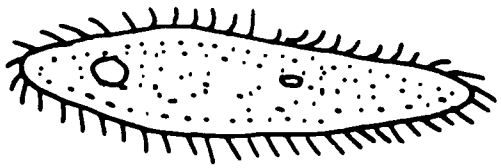
9. Flagellates

Traits: Microscopic, single-celled organisms with long, whip-like structures called flagella. Flagellates are a variety of shapes and may be attached or free living. Phytoflagellates contain pigments necessary for photosynthesis while zooflagellates do not.
Habitat: Common free-living organisms in fresh and salt water. Some are parasites on other organisms.
Food: Phytoflagellates produce their own food through photosynthesis, but zooflagellates feed on other microscopic organisms
Eaten by: Zooplankton, small crustacea, larvae of invertebrates, fish larvae.
"Gee Whiz": Red tides, which occasionally cause the death of thousands of fish, are caused by vast swarms of certain kinds of flagellates.



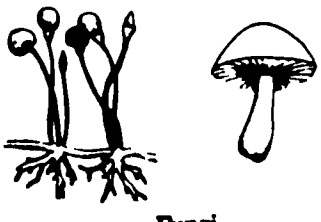
10. Ciliates

Traits: Microscopic single-celled organisms that have cilia (short, hair-like structures) which they use to move around and to capture food. Most ciliates have a cell mouth, and all have two kinds of cell nuclei.
Habitat: Most ciliates are free swimming and live in fresh or saltwater. Some kinds live inside of or attached to other organisms.
Food: Other small organisms including rotifers, protozoans, bacteria, algae, detritus, and diatoms. Some are parasites on other organisms.
Eaten by: Protozoans, roundworms, segmented worms, and fish larvae.
"Gee Whiz": Certain ciliates live in the digestive tracts of hoofed mammals, like moose and caribou. The ciliates help these animals digest their foods. Up to 400,000 ciliates may live in a teaspoon (1 ml) of the digestive fluid of these mammals.



11. Bacteria Protist

Traits: Microscopic protist that may be round, rod-shaped or spiral.
Habitat: Some types of bacteria occur in every moist environment; a tablespoon of tundra soil may contain 1 billion or more bacteria.
Food: Mainly dead plant, fungi, and animal materials; some kinds of bacteria live as parasites of living things, and some are able to make their own food.
Eaten by: Protozoans, some fungi.
"Gee Whiz": Some bacteria are parasites and cause diseases of plants, animals, or fungi; others live in the digestive tracts of animals and aid in digestion. Bacteria can survive long periods of inactivity and unfavorable conditions. They are a major decomposer in most ecosystems.



Fungi

Lichens

12. Fungi and Lichens

Traits: Fungi are an entire kingdom of living things which includes mildews, morels, truffles, mushrooms, toadstools, shelf fungi, yeasts and molds. Lichens are made up of a fungi living together with an algae or cyanobacteria. All fungi obtain food by absorbing it. Many are extremely important as decomposers. Microscopic to 12 inches.
Habitat: Molds, mildews, and rusts: dead plants or waste materials, on living plants or insects. Mushrooms: soil and litter of tundra and other habitats.
Food: Many feed on dead plant materials, while others live as parasites on plants or insects. Lichens make their own food.
Eaten by: Springtails, bacteria, squirrels, lemmings, fungus gnats, nematodes, people eat several types of mushrooms.
"Gee Whiz": Many fungi can stop functioning, then begin activities when conditions are favorable to allow them to survive in harsh environments. some lichens have revived after 100 years of dormancy.

13. Horsetails

Traits: Ground cover with distinctly jointed stems that grow from an underground rhizome. 2 to 8 inches (5-20 cm) high.
Habitat: Wet, moist, and dry soils in forests, tundra and wetlands.
Feed: Make their own by photosynthesis.
Eaten by: Bears, moose and grouse.
"Gee Whiz": Horsetail stems contain silica (the element in sand) so they can be used like a scouring brush to clean pots and pans. Horsetails were among the dominant plants when dinosaurs roamed the earth; many kinds grew to tree size then. Today, only one species grows over 6 1/2 feet (2 m) tall.

14. Burreed

Traits: Long, flat leaves; flowers and seeds in round burr-like clusters, 6 to 20 inches tall.
Habitat: Deep or shallow water from alpine to lowland areas.
Feed: Make their own by photosynthesis.
Eaten by: Ducks, swans, sandhill cranes, common snipe, and muskrats.
"Gee Whiz": The shape of the flower heads give this plant its name. Male and female flowers occur in separate burs on the same plant.

15. Eelgrass

Traits: A marine (salt water) plant with slender, branched, green stems and leaves up to 39 inches (1.0 m) long with parallel veins. Separate male and female flowers grow on the same plant. Stems up to 6 1/2 feet (2m) long.
Habitat: Shallow estuaries and lagoons around the world.
Food: Make their own by photosynthesis.
Eaten by: Ducks, geese, fish, and a variety of marine invertebrates including mollusks and crustaceans; also people.
"Gee Whiz": Eelgrass is the primary food source of black brant on their staging areas and wintering grounds.

16. Sedges

Traits: Herbs with long, narrow leaves, with parallel veins, and solid, usually triangular stems. Vary from 1 to 39 inches (2.5-99 cm) in height. The tiny inconspicuous flowers grow in clusters.
Habitat: Grows in shallow water, mud, or moist soil of fresh or salt water wetlands.
Feed: Make their own by photosynthesis.
Eaten by: Caribou, muskoxen, ground squirrels, lemmings, voles, geese; also seed-eating birds such as snow buntings,longspurs, and rosy finches.
"Gee Whiz": The long, narrow leaf shape of sedges reduces fraying by strong winds.

17. Pendent Grass

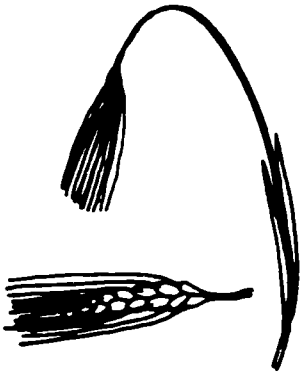
Traits: Aquatic grass with long, narrow leaves. Small, red-brown flowers occur in 1-7 tight clusters (spiklets) at the top of a tall stalk. Up to 36 inches (91 cm) tall.
Habitat: Grows in shallow water of wet tundra and along lake shores and stream banks.
Feed: Make their own by photosynthesis.
Eaten by: geese, ducks, certain insects, snails, and other aquatic invertebrates that eat plants. A major spring forage for brown and black bears.
"Gee Whiz": Loons and grebes use the leaves and hollow stems of this grass to build nests that float on the water. Pendent grass also provides important cover for molting ducks and geese.

18. Cotton Grass

Traits: Herbaceous plants with long, narrow leaves, and solid stems. Tiny, inconspicuous flowers grow in tight clusters. This mis-named sedge has tufts of white cotton-like bristles on the seeds.
Habitat: Wet tundra, muskegs, coastal wetlands, and stream or lake margins.
Feed: Make their own by photosynthesis.
Eaten by: Caribou, muskoxen, lemmings, voles, geese, and seed-eating birds such as longspurs, redpolls, and snow buntings.
"Gee Whiz": The cotton-like seeds of these sedges are dispersed by the wind. Tussocks formed by cottongrass provide shelter and nest sites for small tundra birds and mammals.

19. Rushes

Traits: Aquatic plants with round leaves that have parallel veins. The tiny flowers have three greenish petals and grow in clusters along the sides of leaves.
Habitat: Marshes, wet tundra, riverbanks, estuaries, bogs, and ponds in cool temperate, subarctic, and arctic regions.
Feed: Make their own by photosynthesis.
Eaten by: Some aquatic invertebrates; seeds are eaten by seed-eating birds.
"Gee Whiz": Rushes compete with other aquatic plants and sometimes crowd out other species.

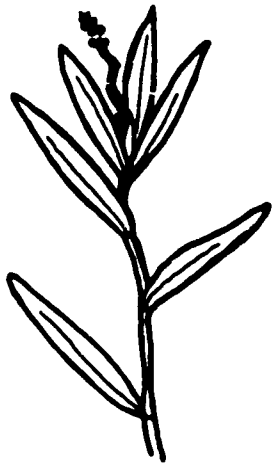


20. Agriculture Grains

Traits: Wheat, rice, milo, oats, barley, pasture grasses and other grains are actually types of grasses that once grew wild. They have narrow leaves, small green flowers, and round, hollow stems. Grains have larger seeds than wild grasses due to centuries of selection by farmers for the largest seeds and fastest growth.
Habitat: Grown by people in large agriculture fields throughout the world in regions of moderate climates.
Feed: Make their own by photosynthesis.
Eaten by: Many waterfowl, including Pacific White-fronts and cackling Canada geese eat shoots and seeds, especially during migration and wintering. People world-wide depend upon grains for bread, cereal and other food.
"Gee Whiz": Some National Wildlife Refuges grow special crops of grains just for waterfowl to eat during winter.

21. Arrowgrass

Traits: An aquatic plant with long, narrow round leaves that rise from a horizontal root. The rounded fruits are loosely arranged along the stem. Maybe 4 to 35 inches tall, but they are usually small. This plant contains small amounts of cyanide.
Habitat: Fresh or saltwater wetlands.
Feed: Make their own by photosynthesis.
Eaten by: Ducks, geese, and some aquatic invertebrates.
"Gee Whiz": The same species of arrowgrass that occur in Alaska also grow in Canada, Europe, Asia and Siberia.

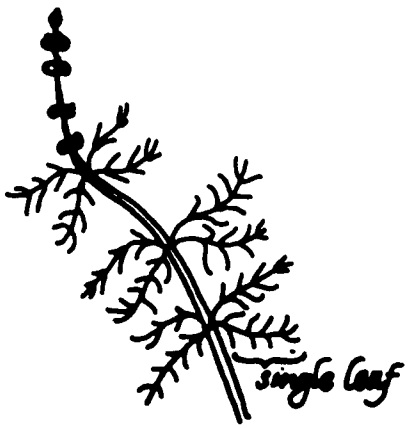


22. Pondweed

Traits: Aquatic plant with floating leaves, parallel veins, leaves submerged on young plants, long and narrow in most species. Flowers in spike, 2 to 12 inches (5-30.5 cm) tall.
Habitat: Shallow to deep water in lakes and ponds throughout Alaska.
Feed: Make their own by photosynthesis.
Eaten by: Insect larvae, snails, muskrat, waterfowl.
"Gee Whiz": There are about 40 species of pondweed in North America, almost all of which are important either as food or shelter for animals.

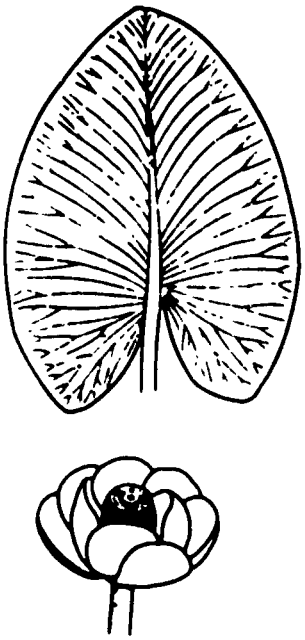
23. Mare's Tail

Traits: Aquatic plants with 6 to 12 pale green leaves in a whorl (circle) around the stem, flowers grow between stem and leaf.
Habitat: In Alaska, one species grows in shallow running water, one in mountain streams, one kind grows in estuaries.
Feed: Make their own by photosynthesis.
Eaten by: Ducks, certain sandpipers, and some aquatic invertebrates.
"Gee Whiz": Only a few species of mare's tail exists. They occur in wetlands worldwide.



24. Water Milfoils

Traits: Aquatic plant with finely divided leaves that form a circle around the stem. Flowers grow on a spike that sticks above water. Up to 6 inches (15cm) tall.
Feed: Make their own by photosynthesis.
Habitat: Grows in shallow, slow-moving or still waters.
Eaten by: Muskrats, ducks, and some shore birds.
"Gee Whiz": the male flowers have larger petals than the female ones. Both male and female flowers occur on the same plant.



25. Yellow Pond Lily

Traits: Grows in water. A large plant with large, long-stemmed, heart-shaped floating leaves. Flowers large, 3 to 4 inches, and yellow. Flowers have 7 to 9 petals.
Habitat: Ponds and slow streams throughout most of Alaska. Bogs and muskegs except in western Alaska and north of the Brooks Range.
Feed: Make their own by photosynthesis.
Eaten By: Root eaten by muskrats, ducks, and traditionally by Alaska Natives.
"Gee Whiz": Seeds may be popped like popcorn, and served as a cereal or snack.

26. Water Smartweed

Traits: Aquatic plant with long petioles (small stem that attaches leaf to main stem) on oblong, smooth edged leaves; net patterned veins. Leaves often tinged with red; pink flowers grow in dense spikes (upright cluster). Leaves 3 inches (7.6 cm) long, stem 15 inches (38 cm) or more. The bases of the leaf petioles (called stipules) are paper-like, and wrap around the stem.
Habitat: Wetlands, ponds, and bogs.
Feed: Make their own by photosynthesis.
Eaten by: Muskrats, moose, ducks, some aquatic invertebrates.
"Gee Whiz": This plant grows in wetlands of northern areas around the world.

27. Bladderwort

Traits: Aquatic plant with finely divided underwater leaves. The small flowers stick out of the water.
Habitat: Ponds and lakes throughout Alaska.
Feed: Make their own by photosynthesis. Also feeds on small insects.
Eaten by: Ducks
"Gee Whiz": Small air sacs (or bladders) on the underwater leaves are traps for insects. When an insect touches the sensitive hairs outside the trap, the air sac pops open. Water then rushes in, carrying the unsuspecting insect into the trap. The bladderwort then digests the insect and uses the nutrients from its body to grow flowers and new leaves.

28. Cattail

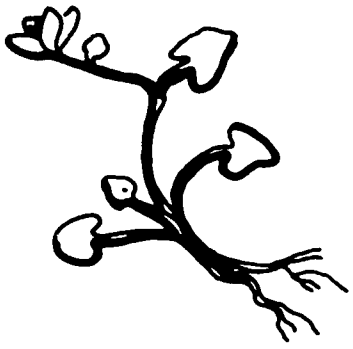
Traits: Tall plant with broad leaves and central reddish-brown spike.
Habitat: Shallow water and marshes in Interior Alaska
Food: Makes their own by photosynthesis
Eaten by: Muskrats
"Gee Whiz": Called "the supermarket of the marsh," all parts can be eaten by humans.

29. Sphagnum Moss

Traits: A primitive kind of plant, this soft-stemmed moss, has feather-like leaves that soak up and hold water. These mosses vary in color from white to green to pink.
Habitat: Wet sites in coastal wetlands, muskegs, wet tundra, and forests. Often forms thick, spongy mats that cover large areas.
Food: Make their own by photosynthesis.
Eaten by: Certain small invertebrate animals and microscopic organisms.
"Gee Whiz": Sphagnum mosses have been used as a substitute for gauze in surgical dressings, and as diaper lining by the Eskimos. White-fronted geese use sphagnum mosses to build nests. Its anti-bacterial property makes it valuable for treating wounds.

30. Sundew

Traits: Small plant with leaves covered with sticky glands. The flowers are small with five petals; up to 1 inch (2.5 cm) tall.
Habitat: Common in muskeg bogs.
Food: Make their own by photosynthesis. Also feeds on insects. **Eaten by:** Unknown
"Gee Whiz": Sundew plants trap insects on their sticky leaves. The leaves close around the trapped insect and digest it. The nitrogen and phosphorus in an insect's body are valuable nutrients that the sundew needs to produce its flowers.



31. Marsh Marigold

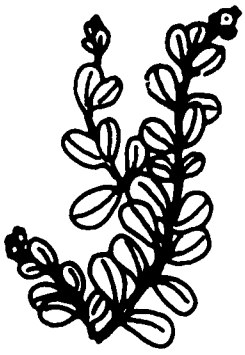
Traits: A herbaceous plant with shovel-shaped, net veined leaves and showy yellow flowers. They grow 3-5 inches (8-13cm) tall.
Habitat: Grows in wet and moist places.
Feed: Make their own by photosynthesis.
Eaten by: Moose, muskrats, and some aquatic invertebrates.
"GEE Whiz": Marsh marigolds are poisonous when raw, but are edible after careful boiling.

32. Marsh Fivefinger

Traits: A sprawling plant with woody rootstalk. Leaves are toothed and in groups of 5 to 7 separate leaflets. Flowers purplish-brown with 5 pointed petals.
Habitat: Very wet meadows, marshes, shallow water, and along streams.
Feed: Make their own by photosynthesis.
Eaten By: Unknown
"Gee Whiz": Also called Marsh Cinquefoil.

33. Wild Iris

Traits: 12 - 24 inches (25 - 30 cm) tall with broad, grass-like leaves; parallel veins; thick, round flower stalk. Flowers have 3 large purple violet petals.
Habitat: Bogs, meadows, shorelines, and riverbanks.
Feed: Make their own by photosynthesis.
Eaten By: Unknown, may be poisonous to most animals.
"Gee Whiz": This plant is poisonous and causes vomiting.



34. Bearberry

Traits: Low-growing shrub with evergreen or persistent deciduous leaves. Small, bell-shaped flowers. The fruit is an edible berry. A member of the heath or leather family. Height to 2-3 inches (5-7.5 cm).
Habitat: Grows on dry and moist soil in alpine and lowland tundra, forests, and muskegs.
Feed: Make their own by photosynthesis.
Eaten by: Bears, voles, lemmings, ptarmigan, geese, plovers, and other birds.
"Gee Whiz": Bearberry plants depend on fungi to help them obtain nutrients from the soil. They provide sugars to the fungi in exchange.

35. Dwarf Birch

Traits: A low shrub with small, round deciduous leaves. Male and female flowers are on the same plant and are in catkins. Up to 2 1/2 feet (0.8 cm) tall.
Habitat: Moist and wetalpine and lowland tundra.
Feed: Make their own by photosynthesis.
Eaten by: Ptarmigan, caribou, muskoxen, and seed-eating birds such as redpolls, longspurs, and snow buntings.
"Gee Whiz": The low growth form of this shrub allows it to avoid the wind and take advantage of warm soil temperatures. Its perennial growth allows it to survive and reproduce despite the short growing season in tundra regions.

36. Willow

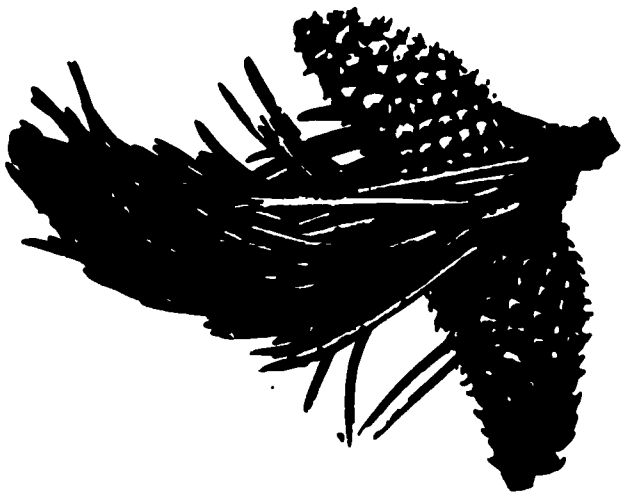
Traits: Willows are low to tall shrubs with deciduous leaves. Most have long, narrow leaves. There are separate male and female plants.
Habitat: In wetlands, forests and tundras throughout northern regions of the world. Most willows prefer moist or wet sites.
Feed: Make their own by photosynthesis.
Eaten by: Musk oxen, caribou, moose, snowshoe hares, ptarmigan, redpolls.
"Gee Whiz": Willow bark contains salicylic acid, the active ingredient in aspirin. Willow bark was used as a painkiller at least 2400 years ago.

37. Alder

Traits: Smooth, gray bark with horizontal lines (lenticels). Usually with groups of 3 - 9 slender-stalked, black or dark brown cone-like fruits. Leaf blades sometimes finely toothed.
Habitat: Grows on disturbed areas; gravelly slopes, flood plains, landslides, and along streams and marshes.
Food: Make their own by photosynthesis.
Eaten By: Deer and moose browse the twigs and leaves. Some birds eat the buds and seeds.
"Gee Whiz": Alder roots usually have root nodules which fix nitrogen from the air and enrich the soil. Excellent wood for smoking fish, also carving, particularly spoons and masks.

38. Tamarack

Traits: A small to medium size tree from 30 to 60 feet tall. Leaves are needles and are deciduous (shed in fall). Needles are in clusters of 12 - 20 and turn yellow before falling off. Dark-gray bark.
Habitat: Muskegs throughout central and parts of western Alaska. Found with black spruce, white spruce, alder, and paper birch.
Food: Make their own by photosynthesis.
Eaten By: Porcupines eat inner bark, red squirrels cut cones and seeds. Voles and some birds eat seeds.
"Gee Whiz": The only Alaska conifer shedding its leaves in winter.

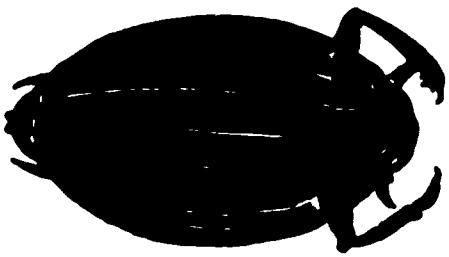


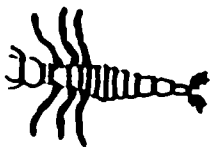
39. Shore Pine (Lodgepole)

Traits: A low spreading or scrubby tree 20 to 40 feet tall. Trunk 8 to 12 inches in diameter. Needles 1 to 2 inches long, 2 per bundle. Sometimes grows as a shrub in poor soil.
Habitat: Open muskegs and along open lake shores in Southeast Alaska. Intolerant of shade.
Food: Make their own by photosynthesis.
Eaten By: Seeds eaten by pine grosbeaks and squirrels. Porcupines eat bark. Deer browse younger trees.
"Gee Whiz": The shore pine, along with its close relative, the lodgepole pine, are the only true pines naturally found in Alaska.

40. Black Spruce

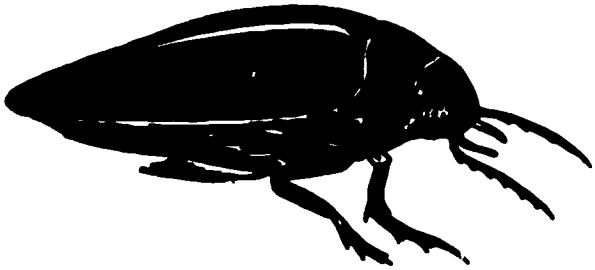
Traits: Small evergreen tree 15 - 30 feet. Often shrub-like. Short sparse branches often drooping. Needles are long, pointed, stiff, blue-green, and on all sides of twig. Twigs covered with very short reddish hairs.
Habitat: Cold wet bogs, muskegs, and lake margins throughout central, eastern, and southern Alaska.
Food: Make their own by photosynthesis.
Eaten By: Moose and snowshoe hares will feed on the twigs under starvation conditions. Red squirrels cut cones and eat seeds.
"Gee Whiz": Popular for Christmas trees.





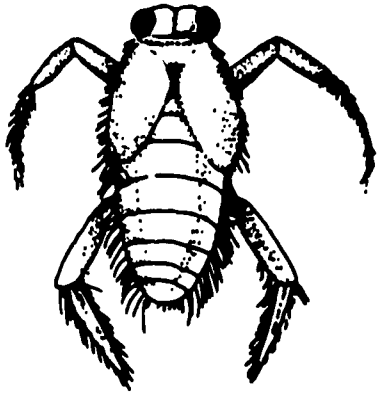
41. Diving Beetle

Traits: Predaceous, aquatic insect. Larvae have a large head, long mandibles, and eight to ten abdominal segments. Adults are oval-shaped and have legs with hair-like fringes. Length: 1/32 to 1 3/4 inches (0.1-4.5 cm) long.
Habitat: Common in ponds, lakes, streams, rivers, and, estuaries.
Food: Adults and larvae prey on aquatic insects, small fish, and tadpoles.
Eaten by: Fish, water birds, and water shrews.
"Gee Whiz": Diving beetles obtain air at the surface of the water but can remain submerged for long periods of time by carrying an air bubble underwater with them.



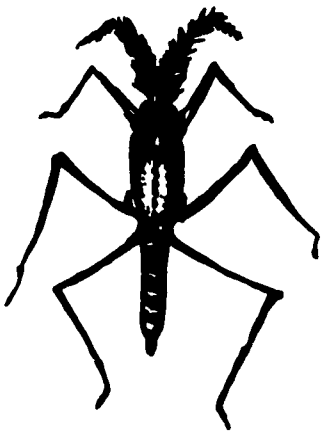
42. Whirligig Beetle

Traits: Aquatic insect. Adults are flat, oval-shaped and have two eyes on top of the head and two on the bottom. They are black or greenish and often swim in circles together.
Length: 1/8 to 1/3 inch, (0.3-0.8 cm).
Habitat: Common in ponds, lakes, and streams.
Food: Insect larvae, small fish, tadpoles.
Eaten by: Fish and waterbirds.
"Gee Whiz": Whirligig beetles can see underwater and above water at the same time.



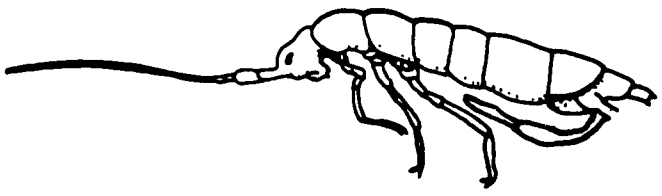
43. Water Boatman

Traits: Aquatic insect with front legs modified to form scoops and two long pairs of legs used for swimming. The larvae and adults look alike.
Habitat: Margins of lakes, ponds and estuaries.
Food: Algae, insect and crustacean larvae, detritus.
Eaten by: Diving beetles, frogs, fish, waterfowl, and shore birds.
"Gee Whiz": Water boatmen are like scuba divers They trap an air bubble under their wings at the water surface then use this "air tank" to breathe while diving underwater.



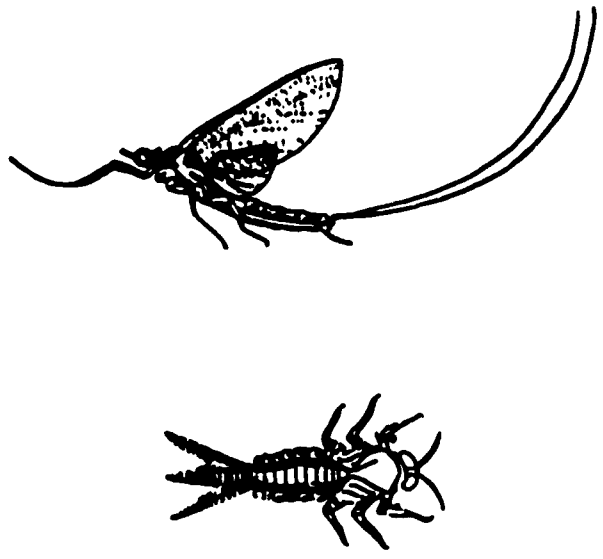
44. Water Strider

Traits: Insect with body and long legs covered with stiff waterproof hair that allows the insect to "skate" across the water surface. Length: 1/8 to 3/4 inch (0.3-1.9 cm).
Habitat: Common in ponds and streams.
Food: Small living or dead insects on the water surface.
Eaten by: Fish, water birds, and water shrews.
"Gee Whiz": A water strider will sink and drown if the hairs on its legs become wet and it cannot reach a place to dry out.



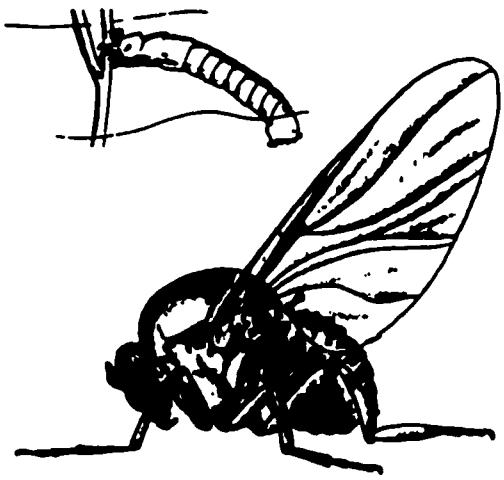
45. Springtail

Traits: Small, wingless insect with chewing mouth parts, a tube on the underside of the first abdominal segment, and a tail-like forked organ (called a furcula) on the last abdominal segment. The furcula is folded down under the body and released, springing the animal into the air.
Habitat: Lives in soil, litter, decaying logs, and moss; a few species live in trees.
Food: Decaying materials, algae, lichens, pollen, and fungal spores.
Eaten by: Centipedes, ground beetles, spiders, shrews, birds.
"Gee Whiz": A springtail, 1/4 inch (6mm) in length, can jump 3 to 4 inches (7.6-10.2 cm).



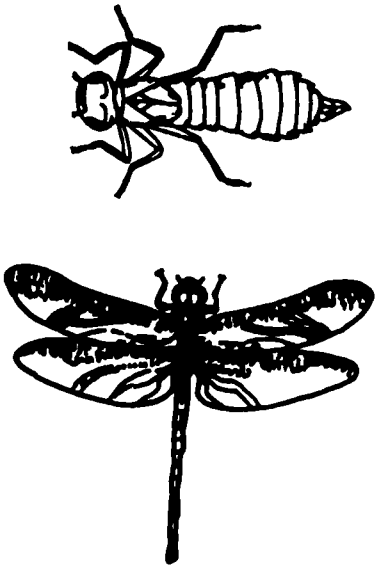
46. Mayfly

Traits: Insect with two to three hair-like structures at the end of the abdomen. Adults hold their two pairs of wings upright over their body when at rest. Rear wings are smaller than forewings.
Habitat: Larvae are common in clear, fast-flowing streams, lakes, and ponds.
Food: Larvae feed on diatoms, algae, and detritus; adults cannot feed because their mouth parts do not function.
Eaten by: Diving beetles, frogs, fish, waterfowl, and shore birds.
"Gee Whiz": Most adult mayflies live for only two to three days; some live for just one to two hours.



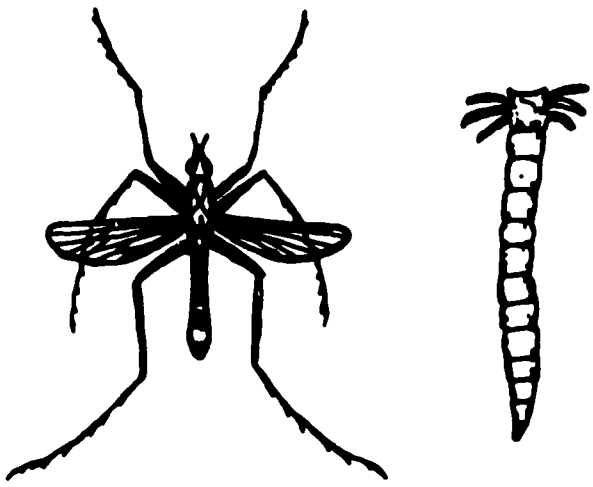
47. Blackfly

Traits: 1/12 - 1/8 inches long. Adults have 3 pairs of legs and are dark colored flies with broad wings and short legs. Larvae are worm-like with a sucker at the end of their abdomen.
Habitat: Larvae live underwater attached to rocks and plants in streams. Adults live around water.
Food: Larvae feed on detritus (decaying plant and animal matter). Adults feed on flower nectar and adult females suck blood from birds, mammals, and other animals.
Eaten By: Adults are eaten by swallows and dragonflies. Larvae eaten by fishes such as blackfish and dippers.
"Gee Whiz": Female blackflies are vicious biters; males don't bite.



48. Dragonfly

Traits: Adults 3/8 - 2 1/2 inches long. Long, narrow abdomen. They hold their wings at right angles to their body. Hind wings broader at base than forewings. Three pairs of legs, large eyes, and four wings. Larvae have no visible gills at the base of the abdomen.
Habitat: Larvae live on the bottom of streams and ponds or on aquatic plants. Adults live near water.
Food: Larvae prey on mosquito larvae, snails, tadpoles and small fish. Adults prey on small flying insects including mosquitos and blackflies.
Eaten By: Slimy sculpin and other fishes. Swallows eat adults. Dippers feed on larvae.
"Gee Whiz": Adults catch mosquitos in the air with their basket-like legs.

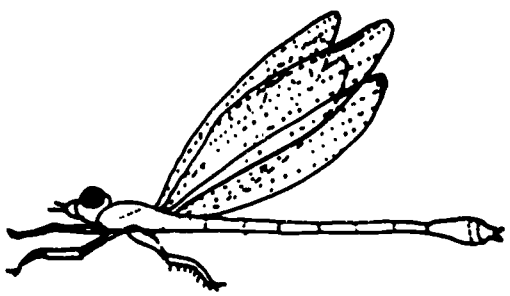


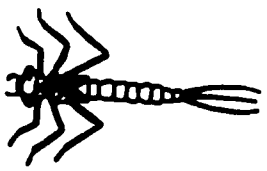
48. Cranefly

Traits: Long-legged insect that resemble a huge mosquito. They have one pair of clear wings and a small pair of knobs (called halters) on the back.
Habitat: Larvae live in moist soil and decaying plants in forests. Some species live in the water.
Food: Larvae feed on algae and detritus; some prey on larvae of other insects. Some adults feed on flowers.
Eaten by: Bats, shrews, insect-eating birds, including shore birds and some waterfowl, centipedes, spiders, and other insect-eating invertebrates.
"Gee Whiz": Cranefles are able to develop slowly and resume development after long periods of cold and inactivity. Although cranefles look like giant mosquitos, they do not bite. They do, however, eat mosquitos.

50. Caddisfly

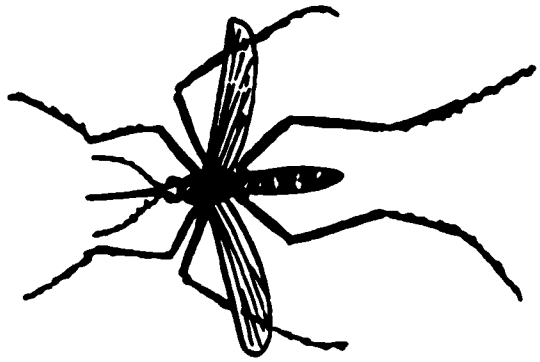
Traits: Insect with aquatic larvae. Larvae have hook-like structures at the end of their abdomen, tiny antennae, and some have feather-like gills. Adults have wings covered with hairs, long antennae, and when at rest hold their wings over their body like a roof.
Habitat: Larvae live in ponds, lakes, and streams.
Food: Larvae feed on aquatic plants, algae, diatoms, small crustaceans, and aquatic insect larvae. Adults feed on flower nectar.
Eaten by: Diving beetles, frogs, fish, waterfowl, and shore birds.
"Gee Whiz": Many larvae build cases in which to pupate. These cases may be made of leaves, twigs, sand grains, pebbles, or entirely of silk which the larvae produce from modified salivary glands.

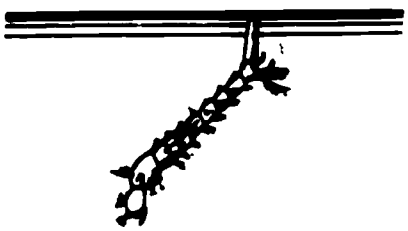




51. Damselfly

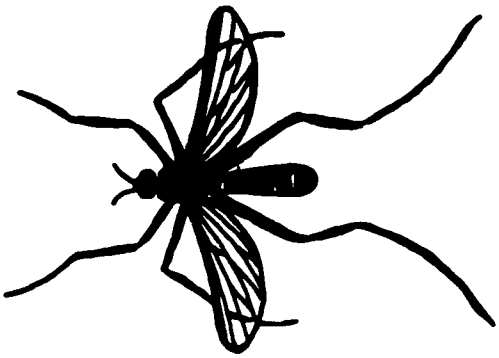
Traits: Insect with aquatic larva. Adults have four wings of the same size. They hold their wings in a raised position when resting. Larvae have three visible gills at the base of the abdomen.
Habitat: Larvae live on aquatic plants or on the bottom of streams and ponds. Adults live near water.
Food: Larvae eat mosquito larvae, tadpoles, and small fish. Adults prey on flying insects including midges and mosquitos.
Eaten by: Diving beetles, frogs, fish, waterfowl, and shore birds.
"Gee Whiz": Fossil records indicate that some prehistoric relatives of damselflies had wingspreads of 27 inches (68.6 cm).

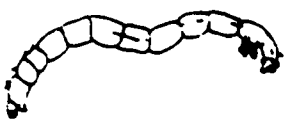




52. Mosquito

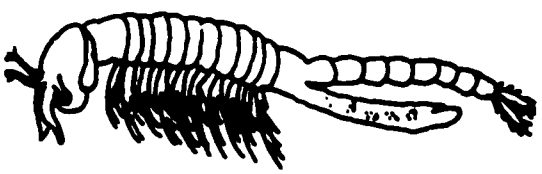
Traits: Insect that have worm-like larvae and adult forms with scales and a long, tubular mouthpart (proboscis) for sucking.
Habitat: Most larvae are aquatic and live in ponds, lakes, puddles, and still water along rivers and streams.
Feed: Larvae feed on algae, protozoans, and detritus. Adult males feed on flower nectar. Adult females suck blood from birds and mammals.
Eaten by: Larvae are food for other aquatic insects, fish, and waterbirds. Adults are eaten by dragonflies, fish, frogs, swallows shore birds, warblers, and bats.
"Gee Whiz": Male mosquitos pollinate flowers. Female mosquitos can carry certain microscopic organisms that cause diseases in mammals and birds.





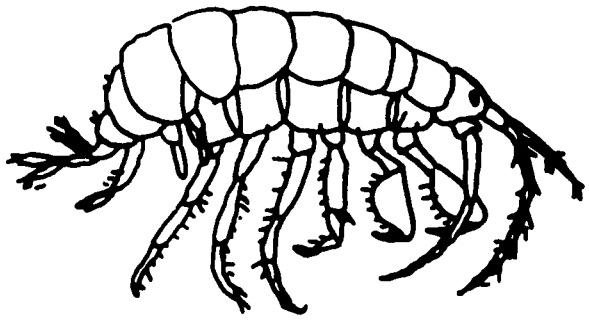
53. Midge

Traits: Insect with aquatic larvae. Adults have six long legs, a long narrow abdomen, and one set of wings that are narrow at the base. Mosquito-like appearance. Length: 3/8 to 1 1/2 inches (1.0-3.8 cm).
Habitat: Larvae live in water or wet moss; adults occur in swarms over these habitats.
Feed: Some larvae feed on algae and plant material. Others filter microscopic organisms from the water, and some prey on other insects. Some adults feed on flower nectar and pollen.
Eaten by: Fish and other aquatic animals, birds, shrews, ground beetles.
"Gee Whiz": Adults often occur in huge swarms in the evening. Adults live for only 5-10 days. They do not bite.



54. Fairy Shrimp

Traits: Crustacean that swim upside down; 20 segments in body with appendages on the first 11-12 segments, eyes on stalks, no hard shell covering body. Length: 3/8 to 4 inches (1-10 cm).
Habitat: common in small ponds, springs, and meltwater pools.
Feed: Detritus, small crustaceans, rotifers, protozoans, algae, diatoms, and other plankton.
Eaten by: Ducks, phalaropes, water shrews, diving beetles, other predaceous aquatic invertebrates, and fish.
"Gee Whiz": Females are often more abundant than males, and in some types no males are known and develop from eggs that have never been fertilized.



55. Amphipod

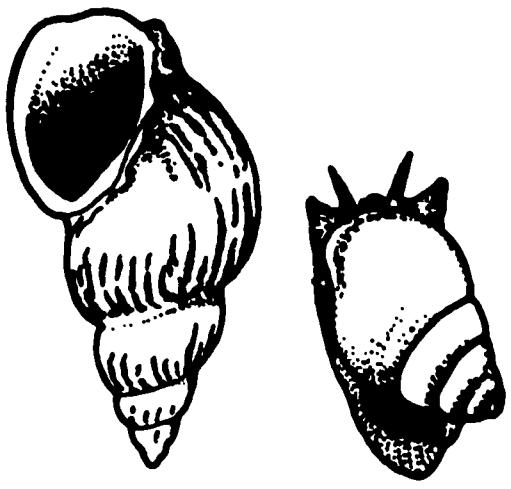
Traits: Crustacean with many legs, a hard exoskeleton, and a body compressed from side to side. The eyes of amphipods are not on stalks (unlike shrimp).
Habitat: Most live in saltwater, but many kinds occur in freshwater lakes and ponds.
Food: Detritus, and small invertebrates.
Eaten by: Fish, water birds, whales, and other aquatic predators.
"Gee Whiz": Beach amphipods, sometimes called sand fleas, are only 2 cm long, but they can leap 1.1 yards (1 m). That is farther than any other organism of their size.

56. Copepod

Traits: Crustacean with short, cylindrical bodies of ten segments. The first few segments behind the head have appendages but none on the other segments. Length: 1/64 to 1/8 inch (0.3-3.1 mm).
Habitat: Common in both fresh and saltwater wetlands and at sea.
Food: Most filter detritus or algae from the water, but some capture small zooplankton. Some copepods are parasites on the gills of fish and large crustaceans.
Eaten by: Fish and other aquatic animals including whales.
"Gee Whiz": Although they are tin, copepods and other small crustaceans are the chief food of the largest animals on earth, blue whales.

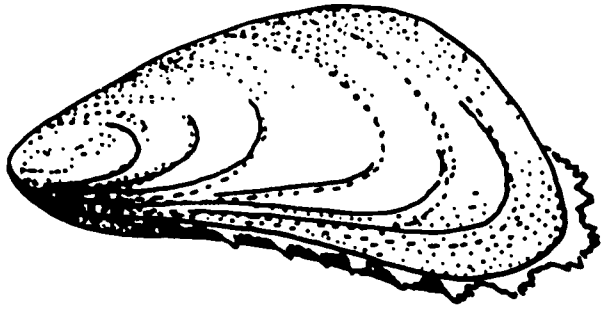
57. Water Flea

Traits: Crustacean with body compressed side to side, hard shell covering body but not head, uses second set of antennae to swim. Microscopic to 1/8 inch (3mm).
Habitat: Common in lakes, ponds and streams.
Food: Filters detritus, protozoans, rotifers, small crustaceans, algae, diatoms, and other plankton from the water.
Eaten By: Ducks, shore birds, diving beetles, other predaceous aquatic invertebrates and fish.
"Gee Whiz": Females produce two kinds of eggs; thin-shelled eggs in the summer which develop without fertilization, and thick-shelled ones in winter which are fertilized by males.



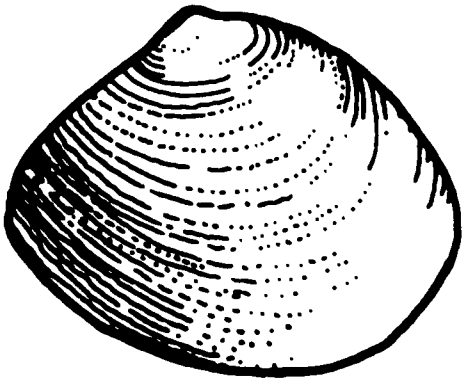
58. Snail

Traits: Mollusk with flat creeping foot, one-piece shell, and well-developed head. Length: 1/2 to 5 inches (1.3-12.7 cm).
Habitat: Snails live on land as well as in water. Most aquatic snails live on rocks on sandy or silty bottoms, or on aquatic plants in either fresh water or salt water.
Feed: Most freshwater snails graze on algae, aquatic plants, detritus, and fungi. Some marine forms prey on other marine animals, including other mollusks.
Eaten by: Crustaceans, fish, birds, and mammals.
"Gee Whiz": There are over 35,000 living species of snails.



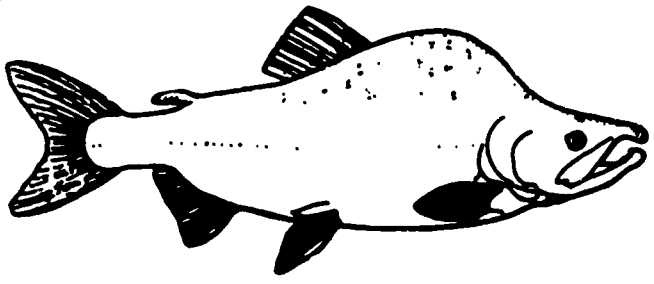
59. Mussel

Traits: Mollusk with two-valved shells hinged on one side, small head, compressed body. They attach themselves to a surface with "byssal threads" Length: 1/2 to 8 inches (1.3-20.3cm)
Habitat: Attatched to rocks or wharf pilings in saltwater.
Feed: Filter food particles including detritus, algae, protozoans, small crustaceans, and insect larvae from the water.
Eaten by: Snails, sea stars, certain fish, diving ducks, emperor geese, shore birds, sea otters, and people.
"Gee Whiz": Mussels are edible.



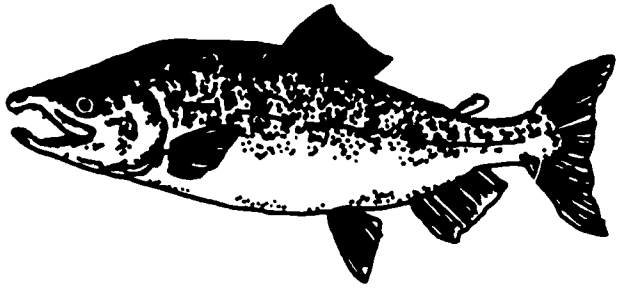
60. Clam

Traits: Mollusk with two-valved shells hinged on one side, small head, compressed body. Length: 1/2 to 8 inches (1.3-20.3 cm).
Habitat: Varies by species. Some burrow in sand of smooth beaches, or mud of bays and inlets; certain species burrow in rocks.
Feed: Filter food particles including detritus, algae, protozoans, small crustaceans, and insect larvae from the water.
Eaten By: Snails, sea stars, certain fish, diving ducks, emperor geese, shore birds, sea otters, and people.
"Gee Whiz": Clams can burrow very rapidly by extending their "foot" into the sand or mud, expanding the tip to act as a anchor, and pulling themselves down.



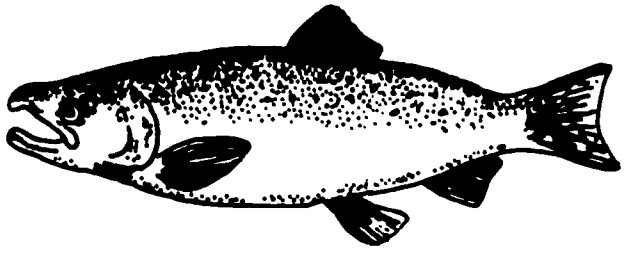
61. Pink Salmon

Traits: Fish with an adipose fin, very large spots on back and caudal fin. Up to 30 inches (76 cm) long and 6 pounds (2.7kg).
Habitat: Adults live at sea but move into freshwater to spawn. They spawn in rivers and river mouths. Young go to sea shortly after leaving gravel spawning areas.
Feed: Copepods, squid, insects, amphipods, and small fish.
Eaten By: Larger fish, seals, sea lions, certain whales, bears, bald eagles, osprey, people.
"Gee Whiz": Pink salmon are the smallest salmon. They are also called humpback salmon because the breeding males have large humps on their backs.



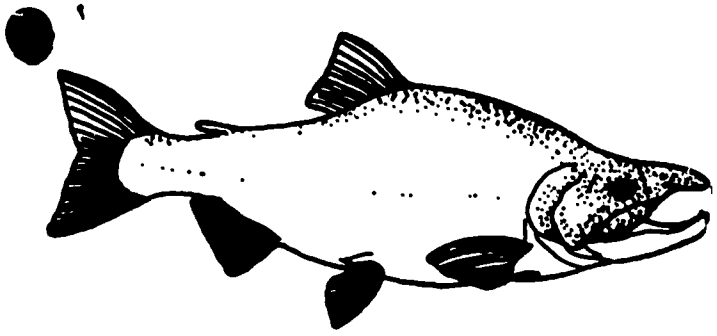
62. Coho Salmon

Traits: A large salmon reaching 24 - 35 inches (63 - 90 cm) and 6 - 12 lbs.(2.7 - 5.4 kg). Adipose fin, small black spots on the back and upper caudal fin. No spots on lower lobe of tail. Have grey gums.
Habitat: Adults live at sea but return to freshwater to spawn. They spawn in fast-flowing streams with gravel bottoms. The fry remain in freshwater streams for 1 - 2 years.
Feed: Adult coho salmon prey on herring, sandlance, crustaceans, and other invertebrates. Young feed mostly on insect adults and larvae.
Eaten By: Eggs are eaten by grayling. Young are eaten by other salmon, grebes, and loons. Adults are eaten by orca and beluga whales, eagles, bears, and humans.
"Gee Whiz": Young coho salmon may spend up to five years in fresh water before going to sea.



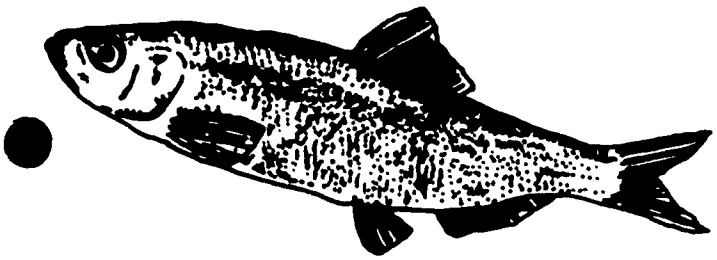
63. Chum Salmon

Traits: This salmon species is 24 - 28 inches (60 - 70 cm) and 10 - 13 lbs. (4.5 - 6 kg). Adipose fin, absence of spots on body and fins; all fins, except dorsal, have dark tips.
Habitat: Adults live at sea but move into fast-flowing freshwater streams to spawn. Young to sea shortly after leaving the gravel and mature in estuaries.
Feed: At sea, chum salmon feed on small crustaceans including copepods, euphausiids, amphipods, squid, crab larvae, young herring, and other fishes. During migration out to sea the fry eat insects (including midge larvae and water fleas) and copepods.
Eaten By: Eggs are eaten by Arctic grayling. Young are eaten by other salmon. Adults are eaten by orca and beluga whales, eagles, bears, and humans.
"Gee Whiz": Known as "dog salmon" and are a traditional source of dried food for winter use as dog food. Some Chum Salmon swim 2,000 miles up the Yukon River to spawn.



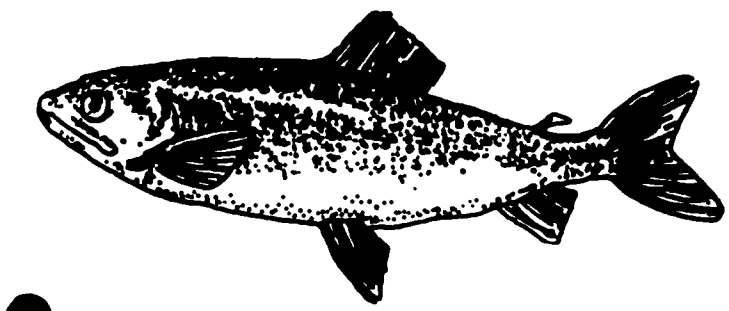
64. Sockeye Salmon

Traits: Fish with an adipose fin that lacks definite spots on back and tail. Length to 25 inches (63.5 cm), weighs 4 to 8 pounds (1.8-3.6 kg).
Habitat: Adults live at sea but return to fresh water streams to spawn. Spawning is in streams with fine gravel bottoms. After hatching, young, or the fry, move into lakes where they remain for one or two years before migrating to the sea.
Feed: At sea sockeye salmon eat squid, copepods, crustaceans, insects, and other small fish. Fry eat water fleas, insect larvae, copepods, and other invertebrates.
Eaten by: Seals, whales, larger fish, bears, bald eagles, and people. Fry are eaten by fish-eating birds, such as mergansers and loons.
"Gee Whiz": Sockeye Salmon are the most abundant salmon in Alaska. They are also called red salmon.



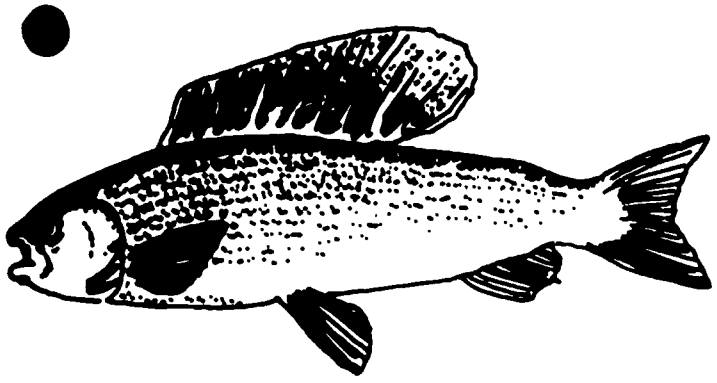
65. Herring

Traits: A medium-sized fish that grows 10 - 15 inches (25 - 38 cm). No lateral line, large mouth, no teeth or jaws, no adipose fin.
Habitat: Lives mainly at sea and in estuaries. Spawns in shallow waters over eelgrass, kelp, or rocks. Young live in shallow bays, inlets, and channels before moving out to deeper waters.
Feed: Adults feed on copepods, amphipods, euphausiids, mollusks, larvae, and small fish. Young feed on copepods, invertebrate eggs, and diatoms.
Eaten By: Chum salmon, loons, porpoises, beluga whales, and humans.
"Gee Whiz": A very important part of the food web!



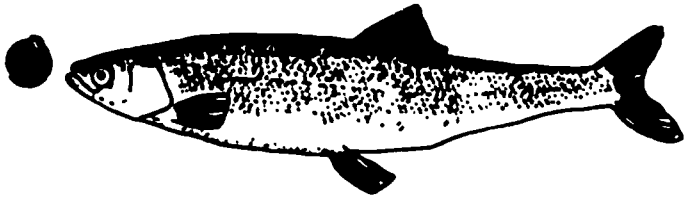
66. Arctic Char

Traits: A medium-sized fish up to 16.5 inches (42 cm) and 2.2 -4.4 lbs. (1 - 2 kg). Adipose fin, small scales, large pink to red spots on sides and back.
Habitat: Lives in lakes. Spawns in gravel of lake margins or shallow, quiet stream pools.
Feed: Insects, young fish, crustaceans, mollusks.
Eaten By: Young are eaten by other fishes. Adults eaten by humans.
"Gee Whiz": Adults feed on salmon smolts migrating to the sea.



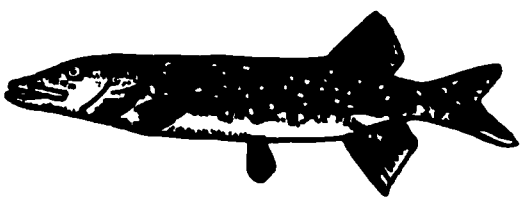
67. Arctic Grayling

Traits: Graylings reach 12 - 14 inches (30 - 35 cm) and 1 - 1.5 lbs. (0.5 - 0.7 kg). Adipose fin; large sail-like dorsal fin; small mouth. Dorsal fin dotted with large iridescent red or purple spots.
Habitat: Cold, clear streams, lakes, and ponds. Spawns in streams with sandy gravel bottoms.
Feed: Mayflies, stoneflies, caddisflies, salmon eggs, salmon smolts. Voles or shrews that fall into the water.
Eaten By: Young eaten by larger fish, loons, grebes, and mergansers. Adults are eaten by humans.
"Gee Whiz": Grayling make long migrations upstream to spawn in freshwater streams in Alaska.



68. Eulachon

Traits: Grows to 8 inches (20 cm). Lower jaw longer than upper and curves upward, narrow body, forked tail, 18 - 23 rays in anal fin, dorsal fin starts behind base of pelvic fins.
Habitat: Adults live at sea but return to freshwater streams to spawn. They spawn in streams with coarse sand and gravel bottoms. The fry are swept out to sea and live in estuaries and nearshore waters.
Feed: Feed on copepods, phytoplankton, mysid shrimp, barnacle larvae, water fleas, worm larvae, and euphausids.
Eaten By: Young eaten by salmon, seals, sea lions, and beluga whales. Spent bodies of spawned out eulachon eaten by gulls, eagles, and bears. Adults eaten traditionally by Alaska Natives.
"Gee Whiz": Also known as the candlefish because of its traditional use as a candle when dried and fitted with a wick

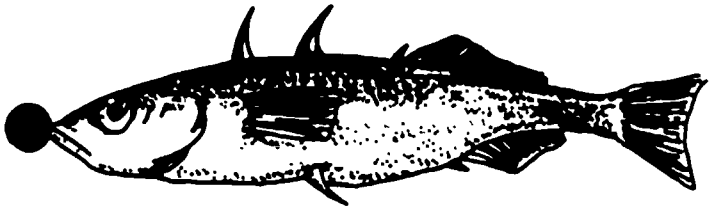


69. Northern Pike

Traits: A fish with a long, flat snout; rear placement of dorsal and anal fins; large mouth with many sharp teeth. Elongated body and head. Up to 52 inches (133 cm) and 48 lbs. (22 kg).
Habitat: Adults live in deep freshwater lakes and rivers in winter, but spawn and spend summers in shallow nearshore waters with dense emergent aquatic plants.
Feed: Adults eat fish including sticklebacks, blackfish, burbot, and young pike. They also feed on waterfowl, frogs, water shrews, and insects. Young eat copepods, water fleas, and insects.
Eaten By: Young eaten by adult pike and Alaska blackfish. Adults eaten by humans.
"Gee Whiz": A 12 lb. pike was found with a 4 lb. pike in its stomach.

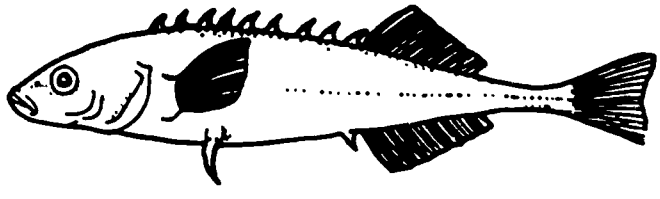
70. Burbot

Traits: A fish up to 60 inches (152 cm) long and 15 1/2 lbs. (34 kg). Large head, wide gill openings, 2 dorsal fins (second one long), small barbel on chin; rounded tail, no spines in fins.
Habitat: Burbot live in deep waters of lakes and rivers. They spawn in moderately deep water with clean gravel and sand bottoms.
Food: Adults feed mostly on fish but may also eat insect larvae, mollusks, copepods, fish eggs, shrews. Young feed on stonefly and mayfly larvae, other insects, and small fish.
Eaten By: Young eaten by other fishes and humans.
"Gee Whiz": A single female Burbot can lay 1,000,000 eggs!



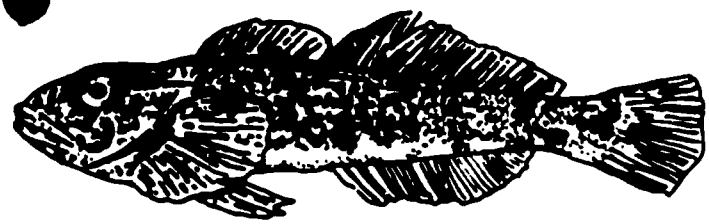
71. Three-spine Stickleback

Traits: Grows up to 4 inches (10 cm). Three sharp spines on back, pelvic fin is a sharp spine, and spine in front of the anal fin.
Habitat: Some adults overwinter in deep water of lakes and rivers, but move into shallow water with aquatic plants to spawn and feed during summer. Others live at sea and return to estuaries and river mouths to spawn.
Food: Copepods, water fleas, midges, rotifers, seed shrimp, aquatic worms, mollusks, amphipods, leeches, planaria, and water mites.
Eaten By: Salmon, Dolly Varden, loons, grebes, and mergansers. Adult sticklebacks will eat young sticklebacks.
"Gee Whiz": Sticklebacks migrate to deep pools in streams and ponds to prevent being frozen in the ice during the winter. They also have a high tolerance to low oxygen levels in shallow frozen lakes enabling them to survive where other fish cannot.



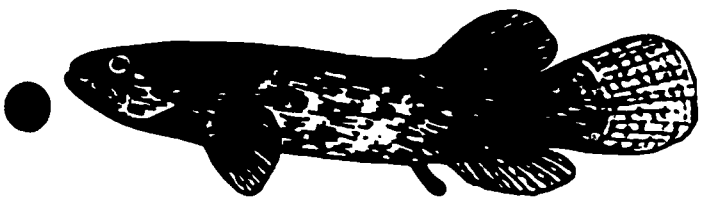
72. Nine-spine Stickleback

Traits: Fish with nine spines in its dorsal (back) fin.
Habitat: Found in lakes and rivers; spends the winter in deep water, then migrates to shallow water and tributaries to spawn.
Food: Midges, water fleas, copepods, crustaceans, and aquatic insects.
Eaten By: Arctic char, lake trout, grayling, loons, grebes, terns, gulls, mink, river otters, and people.
"Gee Whiz": Sticklebacks can survive underneath the ice in winter because they migrate to deep water, and can tolerate water with a very low oxygen content. They can lock their spines upright to prevent predators from swallowing them.



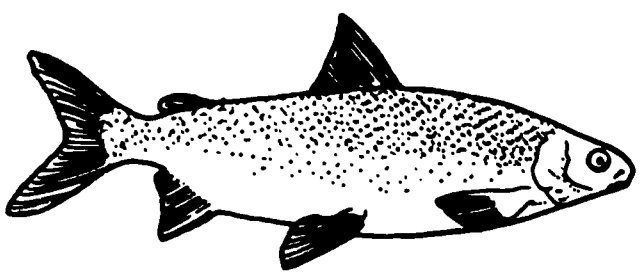
73. Slimy Sculpin

Traits: A small fish that grows to 3 - 5 inches (7.5 - 12 cm). They have a large head, short lateral line ending below the second dorsal fin.
Habitat: Adults live in lakes and fast-moving streams. They move into shallow water to spawn.
Food: Eat larvae of flies, mayflies, caddisflies, dragonflies, amphipods, some eggs, and young fish.
Eaten By: Grebes, loons, mergansers, and other fishes.
"Gee Whiz": Male builds nest and defends eggs against predators.



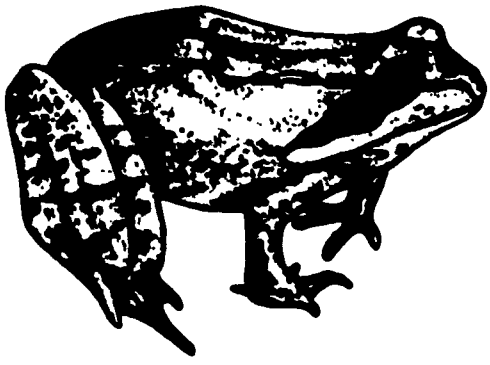
74. Blackfish

Traits: Fish with broad, flat heads, large dorsal and anal fins placed far back on body, rounded tail, three rays in pelvic fin. Up to 12 inches (30.5 cm).
Habitat: Heavily vegetated lowland ponds and streams; moves upstream to spawn and into deep water for overwintering.
Food: Copepods, water fleas, larvae of stoneflies, mayflies, midges, and dragonflies. Also mollusks, segmented worms, and algae.
Eaten By: River otters, mink, loons, grebes, terns, and people.
"Gee Whiz": Blackfish are able to breathe air for short periods of time and have antifreeze in their blood that allow them to tolerate icy cold water and survive partial freezing.



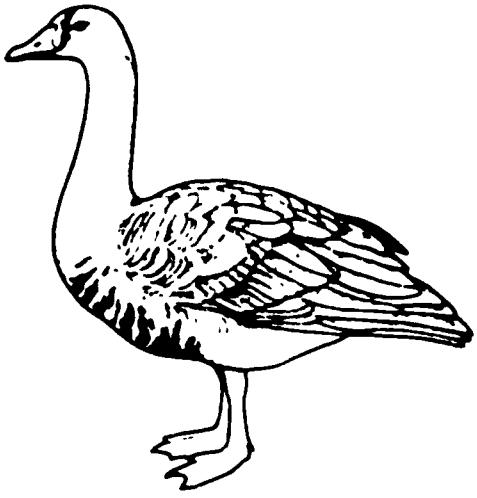
75. Whitefish

Traits: Fish with slender, rounded bodies, large scales, forked tails, and small mouths with the upper jaw overlapping the lower jaw.
Habitat: Lakes, streams, and estuaries.
Food: Mainly insects, including larval mayflies, stoneflies, midges, dragonflies, and mosquitoes; also eggs and larvae of other fish.
Eaten by: Lake trout, burbot, arctic char, and people. Fry are eaten by fish-eating birds, such as mergansers and grebes.
"Gee Whiz": Most whitefishes migrate long distances up and down rivers between feeding and spawning grounds. Some migrate to saltwater feeding areas, but spawn and overwinter in freshwater.



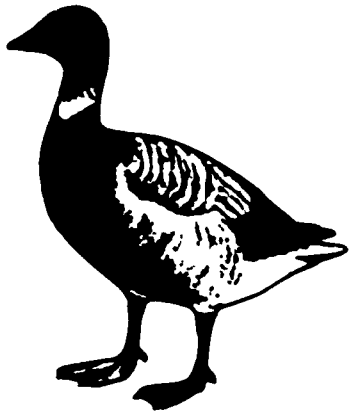
76. Wood Frog

Traits: Small amphibian with moist skin, no scales or claws, long hind legs, short forelegs, large mouth.
Habitat: Forests, muskegs, tundra, eggs and larvae live only in winter.
Feed: Adults eat insects, including flies, true bugs, lacewings, dragonflies; larvae feed on algae and small aquatic plants.
Eaten by: Larvae are eaten by predaceous diving beetles, dragonfly larvae, and by some fish. Adults are eaten by pike and other predatory fish, sandhill cranes, jays, crows, grebes, loons, and other birds, and by mink and river otters.
"Gee Whiz": Wood frogs range further north than any other amphibian. They have antifreeze in their blood that allow them to survive temperatures below freezing.



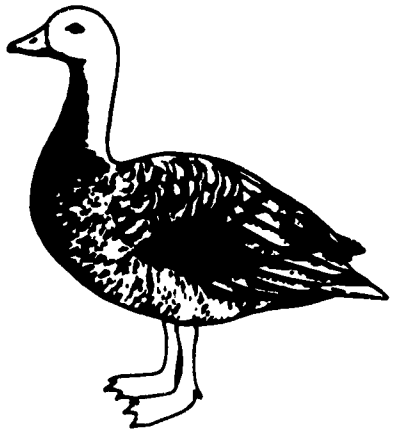
77. Greater (Pacific) White-fronted Geese

Traits: Medium-sized, grey-brown goose with orange legs and feet. Named for the white band at the base of the bill.
Habitat: Nests in coastal and inland wetlands and tundra. Winters in wetlands and agricultural fields in central California.
Feed: Summer: feeds on grasses, sedges, leaves, berries, seeds, and roots of may aquatic plants. Winter: seeds of rice, water grass, milo, barley, and marsh plants such as reshes and cattails.
Eaten by: Foxes, gulls, jaegers, ravens, and people.
"Gee Whiz": White fronts are also called "speckle-bellies" or "tiger bellies" because of the dark brown bars on their undersides.



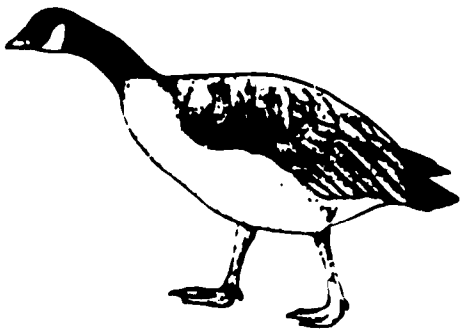
78. Black Brant

Traits: Small, dark, stocky goose with black head and neck and whitish patches on both sides of upper neck. The breast and belly are a uniform dusty brown.
Habitat: Nests on islands in salt bays and estuaries, and on small islands in tundra lakes and ponds near the coast.
Feed: In spring and summer Brant feed on short annual grasses, sedges, algae, larval insects, and small crustaceans. Eel grass is their major food during migration and in winter.
Eaten by: Foxes, gulls, jaegers, ravens, and people.
"Gee Whiz": Most winter along the coast of Mexico, but some winter along the coast of California, Washington, and Oregon.



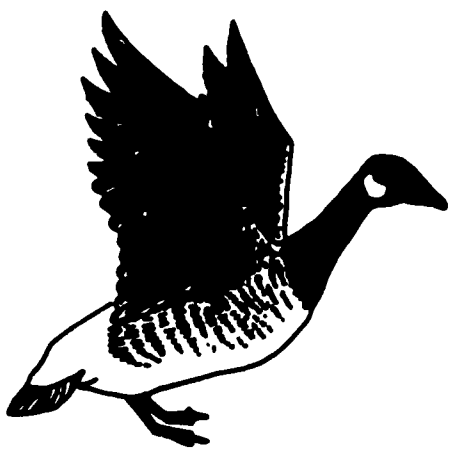
79. Emperor Goose

Traits: Blue-gray geese with round body, rounded head, and short, thick neck. The head and back of neck are white. The gray feathers on the back and wings are edged with bands of white and black. The face is often stained a rust color in the summer.
Habitat: Most nest in loose groups in wetlands within 5-15 miles (8-24km) of the Bering Sea coast. They winter in the nearshore waters and intertidal areas of the Aleutian Islands.
Food: Grasses, sedges, and aquatic vegetation in summer and fall. In winter their foods include small invertebrate animals such as mussels, and some eelgrass and algae.
Eaten by: Foxes, gulls, jaegers, ravens, and people.
"Gee Whiz": Most emperor geese spend their entire life in Alaska. Most winter in the Aleutians, but a few winter near Kodiak Island.



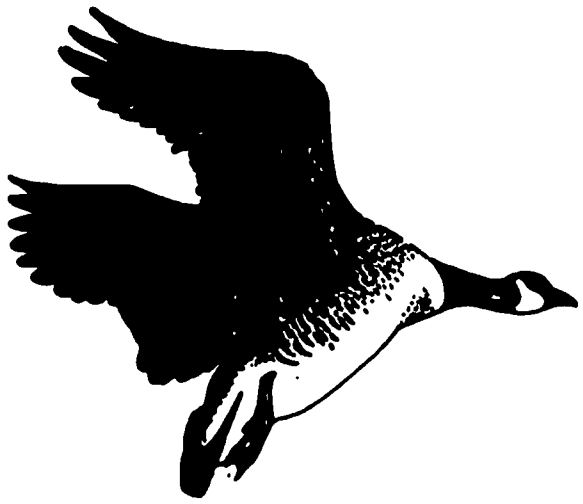
80. Cackling Canada Goose

Traits: Large bird with webbed feet, black head and neck with distinctive white "chin strap." Cacklers have black bills, legs, and feet. This subspecies, the size of a mallard duck, is the smallest type of Canada goose.
Habitat: Nests in the coastal wetlands of the Yukon-Kuskokwim Delta. Winters in Oregon and California in wetlands and agricultural areas.
Food: During spring and summer cacklers feed on grasses and sedges. In late summer and fall they also eat berries. During winter, wildgrasses and agricultural grains are their main foods.
Eaten by: Foxes, gulls, jaegers, ravens, and people.
"Gee Whiz": The call of the cackler is a short high-pitched cackle. This is why it is called the 'cackling' Canada goose.



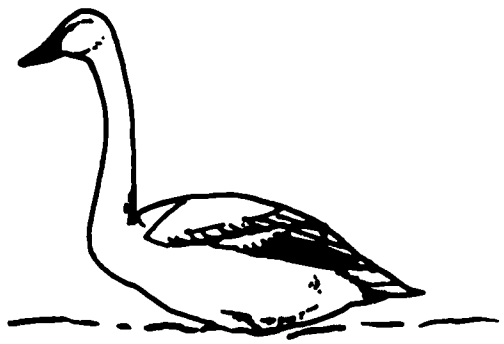
81. Aleutian Canada Goose

Traits: Small goose with black head and neck marked with white "chin strap" from ear to ear. Broad white ring at base of neck. Grey body.
Habitat: Nests on grassy slopes in Aleutian islands in summer. Winters in western Oregon and northern California.
Food: Eats shoots, roots, and seeds of grasses and sedges, bulbs, grain, berries, also insects, crustaceans, and mollusks.
Eaten By: Foxes, bald eagles.
"Gee Whiz": Rarest of all Canada geese. Were endangered due to foxes that were released for fur farming, but are recovering.



82. Dusky Canada Geese

Traits: A medium-sized goose with black head and neck marked with white "chin strap" from ear to ear. Dark breast.
Habitat: In summer, found in one great colony in sedge marshes of the Copper River delta. Winters in Oregon along Willamette River Valley.
Food: Shoots, roots, and seeds of grasses and sedges; bulbs, grain, berries; also insects, crustaceans, and mollusks.
Eaten By: Gulls, jaegers, bald eagles, brown bear, coyotes, mink.
"Gee Whiz": Nests only on the Copper River delta and winters only in Oregon.

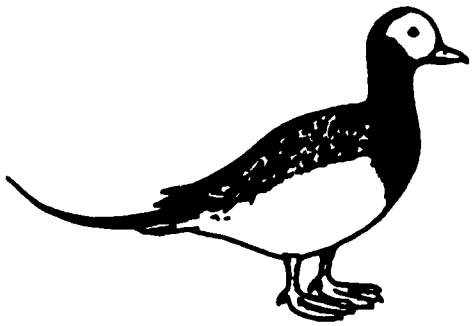


83. Tundra Swan

Traits: Large aquatic bird (6 - 7 ft. wingspan) with all-white plumage and very long neck. Bright yellow spot on black bill.
Habitat: Lowland tundra, small islands, ponds, lakes, rivers during summer. Winters mainly in California, Maryland, North Carolina, and Virginia.
Food: Leaves, seeds, and underground roots of horsetails, pondweed, sedges ,rushes, pond lily, and water milfoil. Young eat invertebrates, then switch to plants.
Eaten By: Adults eaten by foxes. Young eaten by foxes, minks, and gulls.
"Gee Whiz": Once paired, mates tend to stay together for life.

84. Pintail

Traits: A large slender duck. Male has white breast and brown head with long pointed tail.
Habitat: In summer, grasslands, tundra, sandy flats, lakes, ponds, and marshes. Winters in salt and brackish waters along coast.
Food: Eats 90% plant foods including: seeds of sedges, grasses, pondweeds, smartweeds, and grain. Will eat aquatic invertebrates, insects.
Eaten By: Adults eaten by foxes, eagles, minks, and humans. Young eaten by gulls, jaegers, and foxes.
"Gee Whiz": Most widely distributed duck in North America.



85. Oldsquaw

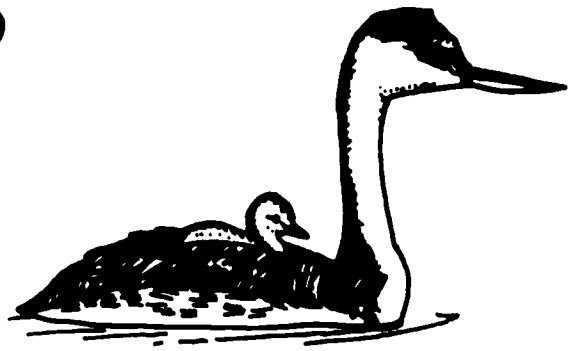
Traits: Stocky, diving duck with black and white plumage.
Length: Male is 22 inches (56 cm) and female is 16 inches (41 cm). The long tail of the male is noticeable during flight.
Habitat: Ponds and lakes of lowland and alpine tundra in summer, at sea in winter.
Food: Mussels, clams, snails, and crustaceans are their main foods. In fresh water they also eat larvae of midges, cranefiles, caddisflies, and other insects.
Eaten by: Eggs and young eaten by foxes, weasels, gulls, jaegers, and ravens.
"Gee Whiz": Oldsquaw may dive deeper than any other duck. They have been recorded at depths of 72-240 feet (73 m).

86. Canvasback

Traits: A medium-sized duck with a forehead that slopes to a long black bill. Male has dark reddish head and neck with whitish back and sides. Females are light brown.
Habitat: In summer, found in marshes, sloughs, and lakes with shoreline plants. Winters in lakes, rivers, and saltwater bays.
Food: Pondweeds and seeds of sedges, and burreeds, aquatic invertebrates (especially small clams).
Eaten By: Adults eaten by foxes, falcons, eagles, and humans. Young eaten by foxes, weasels, and gulls.
"Gee Whiz": Typical diving ducks: legs are located far back on the body and wide apart, which is good for diving but poor for walking.

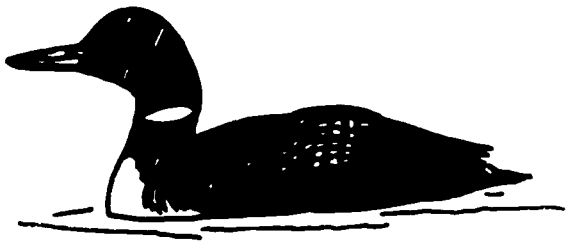
87. Merganser

Traits: 16 - 27 inches (40 - 67.5 cm) and 1.75 - 3.5 lbs. (0.8 - 1.6 kg). Long bill with saw-tooth edges; hooked tip; webbed feet; most have a crest on head; unable to take off from land.
Habitat: Nests on ground (red-breasted) or in hole in tree near river, lake, or estuary. Winters along coast and on large inland lakes and rivers of lower 48.
Food: Sticklebacks, sculpins, eels, eulachon, herring, blackfish, frogs, crustaceans, snails, insects, and leeches.
Eaten By: Foxes eat adults on the nesting grounds. Young eaten by foxes, weasels, and gulls.
"Gee Whiz": Mother mergansers will sometimes carry young from nest to water in her bill.



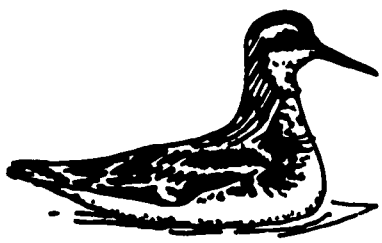
88. Grebe

Traits: 12 - 22 inches (30 - 55 cm) and 15 - 32 ounces (0.4 - 0.9 kg). Sharp, pointed bill; lobed feet; dives underwater; unable to take off from land. Rarely seen on land or in flight.
Habitat: Nests on lakes and estuaries. Winters along coast of North America in bays and estuaries.
Food: Sticklebacks, sculpins, herring, dragonflies, damselflies, water striders, water boatmen, caddisflies, diving and whirligig beetles, crustaceans, frogs.
Eaten By: Young are eaten by foxes, mink, weasels, and gulls. Adults eaten by foxes and sometimes eagles.
"Gee Whiz": Grebes eat feathers! This if thought to protect stomach and intestines from sharp fish bones.



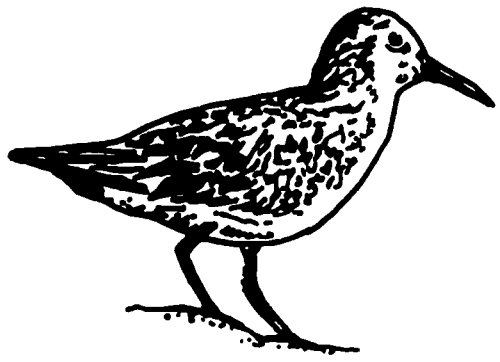
89. Loon

Traits: 23 - 36 inches (57.5 - 90 cm) in length and 4 - 15 lbs. (1.8 - 6.8 kg). Sharp, pointed bill; webbed feet; large heavy body; dives underwater; unable to take off from land. Males and females look the same. Five species in Alaska.
Habitat: Nests on freshwater lakes. Winters along coast to Mexico.
Food: Sticklebacks, sculpins, herring, sandlance, young salmon, rockfish, flounders, and codfish. Also eat leeches, snails, frogs, shrimp, amphipods, and aquatic insects.
Eaten By: Young eaten by gulls, jaegers, and foxes. Adults sometimes eaten by foxes.
"Gee Whiz": Loons can dive to 240 feet and fly up to 60 miles per hour.



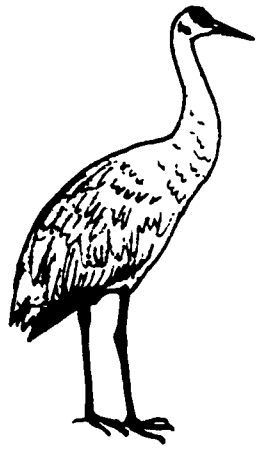
90. Phalarope

Traits: 6 - 9 inches (15 - 22.5 cm) long and 1 - 2.5 oz. (28 - 63 grams). A small dainty bird; straight thin bill (longer than width of head); 4 lobed toes; often sits duck-like in water and spins in circles.
Habitat: Nests amidst grasses and sedges in wetlands. Both red and red-necked phalaropes winter at sea, mainly in southern hemisphere.
Food: Eats plankton, mosquitoes, midges, blackflies, craneflies, tiny mollusks, amphipods, copepods, fairy shrimp, and other crustaceans.
Eaten By: Adults eaten by foxes. Young eaten by foxes, gulls, and weasels.
"Gee Whiz": Their native name "Nimishuruk" means "spins in a circle" after the spinning motions that phalaropes use while feeding. Males incubate eggs and stay with the young.



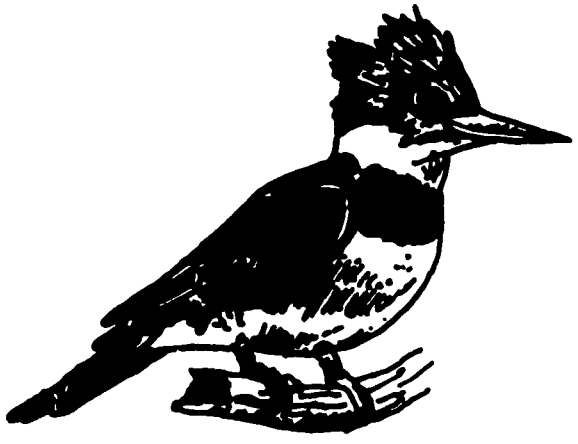
91. Western Sandpiper

Traits: A small shorebird with black legs, longer bill, and reddish markings on the head.
Habitat: In summer, found on drier tundra. Winters along coast on tideflats.
Food: Amphipods, small clams, worms, larvae of craneflies and midges.
Eaten By: Adults eaten by foxes, falcons, and jaegers. Young eaten by foxes, gulls, jaegers, falcons, owls, and weasels.
"Gee Whiz": Travels as far south as Peru to spend the winter!



92. Sandhill Crane

Traits: Large gray bird with long neck and legs, red skin on crown, whitish chin, cheek and upper throat.
Habitat: Lowland tundra, muskeg, and river bottoms in summer; migrates to plains and coast of Lower 48 during winter.
Food: Shoots, roots, and seeds of wetland plants, lemmings, voles, insects, and frogs.
Eaten by: Foxes, wolves; eggs eaten by jeagers, gulls and people.
"Gee Whiz": Some radio tagged sandhill cranes in Tennessee traveled 363 miles (584 km) non-stop in 9.5 hours.



93. Belted Kingfisher - Ceryle alcyon

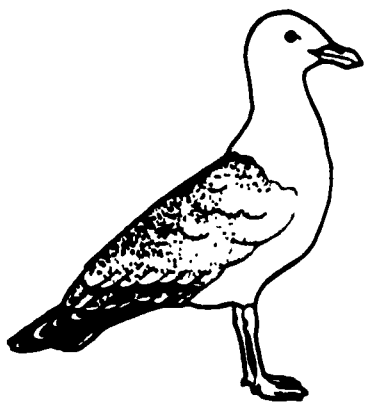
Traits: Small chunky body; large head with crest; long sharply pointed bill; small legs and feet; two front toes joined together; long tail.
Habitat: Found along coast, rivers, lakes, ponds.
Food: Sticklebacks, sculpin, blackfish, young salmon, herring, eulachon, minnows, frogs, crustaceans, mollusks, and aquatic insects.
Eaten By: Unknown
"Gee Whiz": Digs burrow in bank above water.

94. Dipper

Traits: 5 1/2 - 7 1/2 inches (14 - 19 cm); 1 5/8 oz. (50 gm). Plump, all-gray bird, short neck, short bill, short tail, and long toes.
Habitat: Found along clear, fast-moving streams throughout Alaska.
Food: Larvae of caddisflies, stoneflies, mayflies, mosquitoes, midges, water striders, water boatmen, predaceous diving beetles; also clams, snails, small fish fry and eggs.
Eaten By: Sharp-shinned hawk, mink, marten, weasel, wolverine, and occasionally large fish.
"Gee Whiz": Able to walk underwater by grasping bottom with long toes.

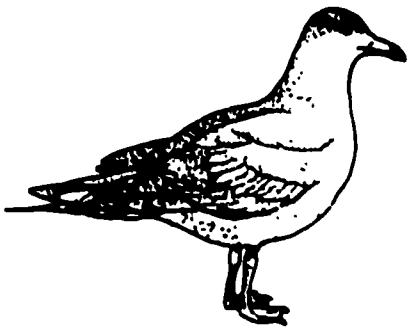
95. Swallow

Traits: 4 3/4 - 6 1/2 inches (12 - 16 cm); 3/8 - 2/3 oz. (12 - 22 gm). Slender body; long pointed wings; tiny bill; short legs and small feet; moderately long tail - square, or slightly to deeply forked.
Habitat: Varies by species, but most live in open areas around lakes, ponds, and rivers.
Food: Blackflies, mosquitoes, craneflies, mayflies, dragonflies, damselflies, aphids, beetles, wasps, bees, water boatmen.
Eaten By: Hawks and falcons.
"Gee Whiz": Catch almost all their food in flight.



96. Glaucous Gull

Traits: Large bird with pale grey wings and mantle. Light can be seen through the white wing tips.
Habitat: Wetlands in tundra, forest, and coastal areas.
Food: Mainly dead animals, eggs and young of other birds; also crustaceans, insects, and fish; gulls are scavengers.
Eaten by: Foxes, weasels, bears, jaegers, and falcons.
"Gee Whiz": Gulls can stand on ice and still keep warm because of a special arrangement of the blood vessels in their legs. The arteries surround the veins, so that the cold blood returning from the feet is warmed before reaching the gull's body.



97. Parasitic Jaeger

Traits: Seabird with strongly hooked bill and long, pointed, angled wings; long central tail feathers.
Habitat: Alpine and lowland tundra throughout Alaska: pelagic (at sea) in winter.
Food: During summer, jaegers prey on lemmings and small birds and eat the eggs and young of geese, ducks, and shore birds. In other seasons, they prey on small sea birds and steal fish from large sea birds.
Eaten by: Eggs and young may be eaten by foxes, bears, and gulls.
"Gee Whiz": Jaegers migrate from tundra nesting areas to wintering areas at sea in both the northern and southern hemispheres.

98. Snowy Owl

Traits: Sharply hooked bill, talons, large forward-facing eyes, and large, broad wings and tail. Snowy owls are the only all-white owl; they have varied amounts of black speckling. 20-27 inches, 3.5 - 4.5 lbs.
Habitat: Coastal Lowland Tundra
Food: Mainly lemmings and other small mammals, such as moles, shrews, ground squirrels, hares, and weasels.
Eaten by: Humans
"Gee Whiz": Snowy owls nest only when lemmings are abundant and migrate south only when lemmings are scarce.

99. Northern Harrier

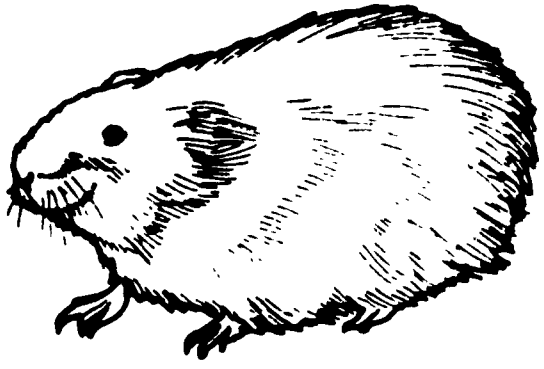
Traits: 20 inches (50 cm); 12 - 20 oz (336 - 560 grams). Large eyes; sharply hooked bill; talons; long tail; long wings; white rump patch.
Habitat: Found in open areas, particularly coastal and fresh-water wetlands. Nests throughout Alaska and winters from Lower 48 south to northern South America.
Food: Voles, lemmings, frogs, dragonflies, sparrows, and sandpipers.
Eaten By: Great horned owl
"Gee Whiz": Locates prey by sound using curved, sound-reflecting facial ruff.

100. Bald Eagle

Traits: 30 -43 inches (75 - 107 cm); 8 - 13 lbs. (3.6 - 5.9 kg). Large body, sharply hooked bill; large curved talons; rounded tail; broad wings. Adults have a white head and tail.
Habitat: Forested areas along coast, lakes, and rivers; also along coast in some treeless regions.
Food: Waterfowl, small mammals, salmon, herring, dead and dying fish, mammals, or birds washed up along shorelines.
Eaten By: Young occasionally eaten by ravens and magpies.
"Gee Whiz": Abundant in Alaska; endangered or threatened everywhere else in the United States.

101. Vole

Traits: Small mouse-like mammal with rounded nose, short tail and legs, and long front teeth (incisors) for gnawing.
Habitat: Forests, shrublands, wetlands, and tundra.
Food: Fresh green vegetables, seeds, roots, berries, mushrooms, and other fungi.
Eaten by: Coyotes, foxes, marten, weasels, hawks, owls, jaegers, sandhill cranes, gulls, and other predatory birds.
"Gee Whiz": These animals are important to many plants because they help scatter seeds and spores of mycorrhizal fungi. The tunnels they dig in leaf litter and soils help allow the soil to absorb water and air and provide crevices in which small soil animals can live.



102. Lemming

Traits: Small mouse-like animal with thick neck and short tail; two gnawing teeth (incisors) on upper and lower jaw separated by a space from cheek teeth.
Habitat: Alpine and lowland tundra and muskegs.
Food: Shoots and leaves of grasses and sedges and bark, twigs and buds of willow and dwarf birch. Insects, berries, and fungi are occadionally eaten.
Eaten by: Owls, jaegers, gulls, arctic foxes, and weasels.
"Gee Whiz": Collared lemmings turn white in the winter and grow shovel-like claws for digging through snow and ice.

103. Shrew

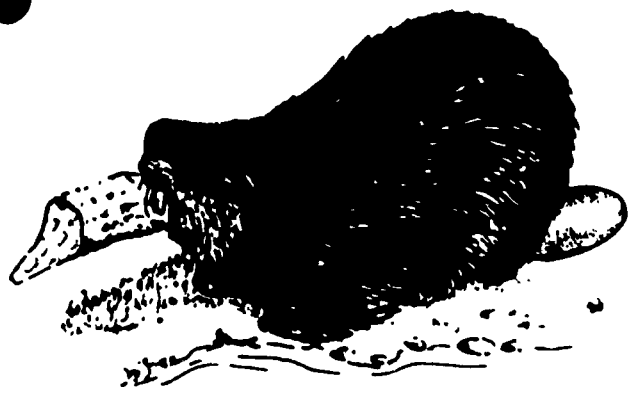
Traits: Small mammal with long, pointed nose, sharp teeth, short legs, and long tail.
Habitat: Forests, shrublands, wetlands and tundra.
Food: Insects such as springtails, beetles, and fly larvae; also centipedes, mites, worms, spiders, roundworms, eggs and young of small ground nesting birds, and young voles.
Eaten by: Weasels, marten, foxes, owls, kestrels, jaegers, and shrikes.
"Gee Whiz": Shrews live under the snow and remain active throughout the winter.

104. Mink

Traits: Mammals with large canine teeth, a long, slender body, short legs, and long round tail covered with dense brown fur. Feet not webbed. Length: 17 to 26 inches (43.2-66 cm). Weight: 1 1/4 to 3 pounds (0.5-1.4 kg).
Habitat: Streams, lakes, marshes, inlets, estuaries.
Food: Muskrats, voles, lemmings, eggs, and young of ducks, geese and shorebirds, fish, frogs, mussels, and aquatic insects.
Eaten by: Hawks, owls, lynx, foxes, coyotes, and wolves.
"Gee Whiz": Like all other weasels, mink have an anal scent gland which produces a strong odor.

105. Muskrat

Traits: Brownish rat-like mammal, 16 to 25 inches (40.6- 63.5 cm) in length; long, naked tail, flattened side to side with short hairs, hind feet webbed. Two gnawing teeth (incisors) on upper and lower jaw separated by space from cheek teeth. Weight: 1 3/4 to 3 1/2 pounds (0.8-1.6 kg).
Habitat: Ponds, lakes, marshes, estuaries.
Food: Mainly aquatic plants including bulrushes, water lilies, and pondweeds; occasionally mussels, frogs and fish.
Eaten by: Hawks, owls, and occasionally foxes, coyotes and mink.
"Gee Whiz": During winter, muskrats spend much of their time under the ice. They maintain holes through the ice, called "pushups" for breathing and as feeding sites.

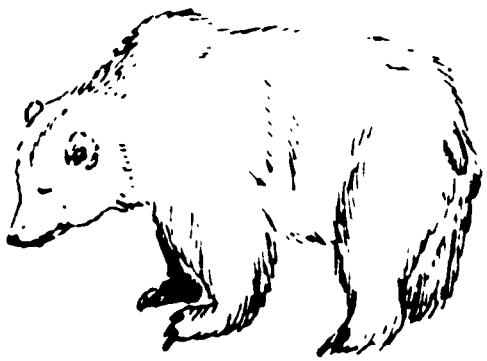


106. Beaver

Traits: Small mammal with long incisors, webbed feet, and long flat tail.
Habitat: Slow-moving streams or lakes, usually near willow, aspen or other deciduous trees and shrubs.
Food: The cambium (inner bark) of willow, aspen, cottonwood trees, and shrubs; also aquatic plants.
Eaten by: Wolves, lynx, wolverines, bears, and people.
"Gee Whiz": Beavers change their environment to suit their needs by constructing large dams and by building lodges. People are the only animals that make greater changes in their environment.

107. River Otter

Traits: Furbearing mammal with large canine teeth, long slender body, short legs, four webbed feet, and a long tail covered with dense fur.
HAbitat: Streams, rivers, large lakes, and along sea coasts.
Food: Fish including rockfish, blackfish, sculpins, suckers; also frogs, aquatic inertebrates, and occasionally birds and small mammals.
Eaten by: Occasionally taken by lynx, coyotes, and wolves.
"Gee Whiz": River otters can dive 60 feet (18.3 m) below the water surface and can stay underwater for up to 4 minutes.

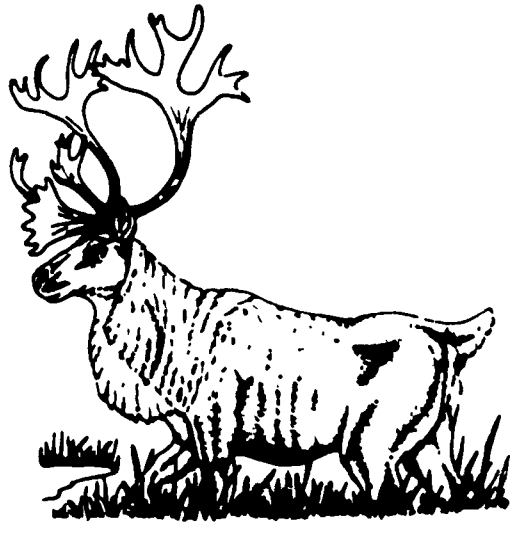


108. Brown Bear

Traits: Heavy-set mammal with short tail, long snout, canine teeth, large hump on shoulders, long claws on forefeet; walks on heels rather than toes; brown fur. 6-7ft., 300-1,153 lbs.
Habitat: Tundra and forests throughout Alaska.
Food: In spring, over-wintered berries, roots, and fresh grasses and herbs; during summer and fall berries are important. Brown bears also kill and eat small mammals, caribou, moose, salmon and feed on carrion.
Eaten by: Other brown bears
"Gee Whiz": Brown bears survive winter by remaining dormant in an underground den.

109. Moose

Traits: Large hoofed mammal, long legs, drooping nose, large palmate antlers on male in fall.
Habitat: Prefers tall shrub thickets that grow 10 to 20 years after a fire or other disturbance and thickets along rivers; also seeks shelter in forests, particularly during winters with heavy snowfall.
Food: Browses on woody vegetation, especially willow, birch, and aspen. In spring, grasses, sedges, horsetails, and aquatic plants.
Eaten by: Wolves, brown bears, and people.
"Gee Whiz": A moose depends upon bacteria and other microscopic organisms that live in its digestive tract to help it get energy and minerals from its foods.

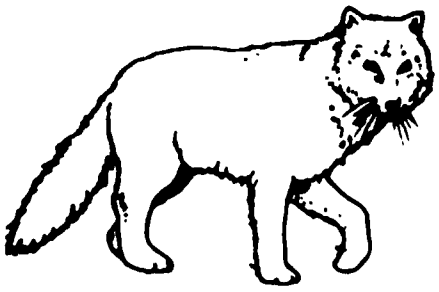


110. Caribou

Traits: Moderately sized hoofed mammal, ears and tail short, mane on neck, antlers large and variable with forward projecting brow tines.
Habitat: Tundra and open coniferous forest.
Food: Grasses, sedges, lichens, mosses, leaves of willow and birch.
Eaten by: Wolves, bear, lynx, people.
"Gee Whiz": Both male and female caribou have antlers.

111. Red Fox

Traits: 35 - 44 inches (900 - 1,117 mm); 8 - 15 lbs. (3.6 - 6.8 kg). Dog-like mammal; 5 toes on front, 4 on hind feet; canine teeth; red to black fur; holds tail straight out when running.
Habitat: Muskegs, shrub areas, wet tundra, river and stream corridors.
Food: Voles, lemmings, snowshoe hares, muskrats, berries, insects, carrion from kills by larger carnivores, nesting/molting ducks, geese and other birds, and young birds.
Eaten By: Wolves, coyotes, lynx, wolverines. Eagles prey on young foxes.
"Gee Whiz": Foxes cache excess food when hunting is good.

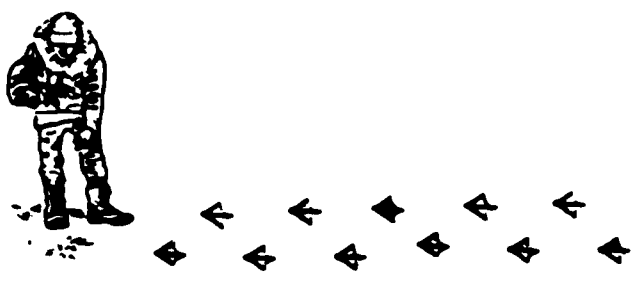


112. Arctic Fox

Traits: Dog-like mammal, five toes on front, four on hind feet, blue-gray to yellow/brown fur in summer, white in winter; tail held straight out when running.
Habitat: Wetlands, dry tundra, and pack ice in winter.
Food: Lemmings, voles, hares, birds and their eggs, black brant, cackling Canada goose, emperor goose, Pacific white-fronted goose, fish, including burbot, char and arctic cod, and carrion from kills of larger animals.
Eaten by: Occasionally taken by wolves, wolverines, and bears. Snowy owls may take young foxes.
"Gee Whiz": Arctic foxes were introduced to the Aleutian Islands by people for fur harvest. These introduced predators caused declines in the populations of several seabirds, and the Aleutian Canada Goose. These birds did not have the adaptations necessary to avoid nest predation by foxes.

113. Little Brown Bat

Traits: 3 - 3.5 inches (79 - 93 cm); 1/4 - 1/3 oz. (5.5 - 12 gm). Simple snout, large ears; skin membrane stretched between forelegs, hind legs, and tail; tail does not extend beyond membrane connecting tail and hind legs. Dark brown.
Habitat: Feeds at dusk over wetlands and forest openings north to interior Alaska. Roosts by day in caves, hollow trees, or buildings.
Food: Moths, beetles, and other flying insects.
Eaten By: Merlins
"Gee Whiz": A colony of 500 little brown bats can eat up to 500,000 insects in a single night. Bats have excellent eyesight, despite the phrase "blind as a bat." Scientists believe many bats spend the winter in Alaska but they do not know where.



114. People

Traits: Large mammals that walk erect on two legs and have forelimbs with opposable thumbs. Have little hair in comparison to other mammals.
Habitat: People use tools to make clothing, build shelters, catch or grow food, and thus are able to live in a wide variety of environments around the world.
Food: Moose, caribou, salmon, geese, many plants and domesticated animals.
Eaten by: Bears and other large, wild animals kill people on rare occasions, but people have no true predators.
"Gee Whiz": People have the ability to cooperate together to accomplish big jobs. People can work together to ensure there will be wildlife in the future.

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