Restoration notebook

June 1999 *Exxon Valdez* Oil Spill Trustee Council

Photo Jay Andrews

Bald Eagle

Haliaeetus leucocephalus

By Tim Bowman
U.S. Fish and Wildlife Service

Bald eagles (*Haliaeetus leucocephalus*) occur only in North America and are widely distributed along coastlines and inland waterways throughout the United States, Canada, and northwest Mexico. Their habitats include everything from arctic tundra to arid deserts to mangrove swamps. Currently, highest densities are along the coasts of Alaska and British Columbia and may reach up to about one nest per mile of shoreline in some areas.

Bald eagles were once perceived as competitors with people for fish and game and subjected to widespread persecution. For example, claims by fox farmers and fishermen of eagle depredations prompted the Alaska Territorial legislature to impose a bounty system on eagles in 1917. From 1917 until the bounty system was removed in 1953, bounty hunters tallied 128,000 eagles in Alaska and probably many more were shot but never recovered.[1]

Bald eagles also were subject to the effects of contaminants, most notably the pesticide DDT, which was used in some Lower 48 states from 1947 to 1972 to control mosquitoes. DDT bioaccumulated in the food chain. Eagles foraging on contaminated

Vital Statistics

Population Size (Estimated)
45,000 in Alaska
11,000 in the spill area
6,000 in Prince William Sound

Population Trend
Increasing

Lifespan
20-30 years, perhaps longer

Adult size
weight 4-7 kg; wingspan 6.5 to 8 feet; females are about 1/3 larger than males.

Breeding Season
Egg-laying from mid-April to late May. Chicks fledge in August.

Clutch Size
1-3 eggs, usually 2.

Incubation/Chick-rearing
Incubation 35 days. Both sexes incubate eggs. Chicks fledge when 10-12 weeks old.

Chick Weights
4-5 kg at fledging

Maturity
Sexually mature at 4-5 years

Plumages
First-year eagles are uniformly dark brown, immatures have variable mottled plumage with increasing white on head and tail through 4th year; white head and tail when 5-6 yrs old.

Diet
Opportunistic: fish, carrion, birds, marine invertebrates, small mammals

food were themselves contaminated with DDT and failed to lay eggs or produced eggs with thin eggshells, which broke during incubation.[2]

Consequently, eagle populations plummeted in the Lower 48 states. Populations there were listed as endangered in 1967 and afforded additional protection under the Endangered Species Act in 1973. "Endangered" means a species is considered in danger of extinction throughout all or a large part of its range, whereas "threatened" means a species is considered likely to become endangered but is currently not in danger of extinction. They have made a remarkable comeback in the past two decades due to reintroduction programs, intensive management, the ban on DDT use in the U.S., and habitat protection. Bald eagles were reclassified from endangered to threatened in 1995. Unlike bald eagles in the Lower 48 states, bald eagles in Alaska were never listed under the Endangered Species Act , and their populations have remained relatively healthy, despite the fact that they were hunted for bounties until 1953.

The bald eagle was so named because of its conspicuous white head and tail. The distinctive plumage, however, is not attained until they are at least 5 years old. Juveniles have an all-brown plumage, which takes on a blotchy appearance as the birds mature and gradually replace feathers during molt each summer. By the time an eagle is four years old, it is almost indistinguishable from an adult, but retains some brown spots on the tail and head. Young eagles often seem larger than adults, and in fact, they are. Although their skeletal size is similar, young eagles have longer wing and tail feathers than adults, which gives them different aerodynamic properties more conducive to soaring on thermal air currents and to a nomadic lifestyle. Unlike adults, which hold territories, juveniles are not tied to a particular area and wander more. As an eagle matures, its wings become shorter and narrower, and its tail becomes shorter with each successive molt.

As is typical of most raptors, the female bald eagle is larger than the male. This is known as *sexual dimorphism.* Females are larger so that they can better defend themselves against other aggressive eagles, especially when tending young. This also reduces competition for food because females can target prey that are either too large or strong for the male to deal with.

Breeding

Bald eagles nest almost exclusively in trees in Prince William Sound (PWS) and southeast Alaska, but may nest on the ground, cliffs, or on rock pinnacles in treeless areas of Kodiak Island, the Alaska Peninsula, or the Aleutian Islands. Nearly all nests are close to water and are often in large, old-growth timber. Along the coast, bald eagles prefer to nest in Sitka spruce, western hemlock, and yellow or red cedar. In interior Alaska, they typically nest in cottonwoods and white spruce near rivers and lakes. Bald eagles use and rebuild the same nest for many years, adding sticks, moss, and grass each year. Tree nests may eventually become enormous, sometimes 10 feet across and as deep as 20 feet. Breeding pairs sometimes have an alternate nest site, usually in the vicinity of the primary nest, and will use the alternate site if the other one is damaged.

Photo by Daniel Zatz

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Nest building or maintenance begins in March and April. Both the male and female gather sticks as nest material and line the nest bowl with grass and moss. In southeast and southcentral Alaska, egg laying peaks in mid-to-late April. Eagles lay 1-3 eggs, usually 2, several days apart. The eggs are elliptical, dull white, and measure about 78 mm long by 58 mm wide. By mid-May, incubation has begun in all areas of Alaska.[3] Both sexes will incubate eggs, but the female assumes most of the responsibility. Incubation lasts 35 days and begins when the first egg is laid and, consequently, chicks hatch on different days. The chicks are covered with grayish down, and feathering begins at about 30 days. The female broods and tends the nest closely for the first few weeks while the male brings most of the food during this period.

Photo by Tim Bowman

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The first chick to hatch is fed by the parents for several days before its sibling hatches, at which time it may be considerably larger and stronger than its sibling. When food is limiting and parents cannot provide enough food for both chicks, the larger chick may outcompete the smaller chick for food, or may push it out of the nest, until it dies of starvation. This behavior ensures that at least one chick will survive in years that food is scarce.

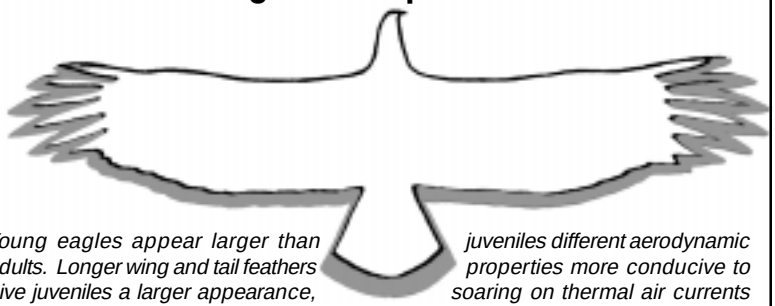
Chicks fledge when they are 10-12 weeks old. They often can be seen testing their wings at the nest or while perched on nearby branches about this time. They remain near the nest site for several weeks and the parents continue to provide them with some food while they learn to hunt and obtain food on their own. Juveniles disperse in September and October and lead a mostly nomadic life for the next few years.[2]

Eagles perform an elaborate aerial courtship display in which a pair flies leisurely in circles, the female flips upside down locking talons with its mate in mid-air, and the pair tumbles toward the ground, releasing their grip on each other and flying off in different directions before reaching the ground. This spectacular display lasts only a few seconds. It is often mistaken for aggression, but it is not. Nor does copulation occur during this ritual, as some people believe. Copulation occurs on a large limb or the nest, where the male mounts the female by standing on her back. Eagles usually breed each year, and they unite for life or until the death of a mate. After the death of a mate, the remaining bird finds a new mate and usually keeps the same nesting territory.

Feeding

Bald eagles are opportunistic feeders. In Alaska, salmon are a particularly important food for eagles. Salmon are most readily available to eagles during the nesting season, when eagles must provide food for themselves as well as for the chicks they raise. Although primarily fish eaters, bald eagles will hunt or scavenge a variety of prey. Bald eagles also are notorious pirates and will harass and intimidate other birds, including gulls and ospreys, until they surrender what food they have caught. They will kill snowshoe hares, ducks, geese, gulls, kittiwakes, and young sea otters and seals. On the Copper River Delta,

Adult Bald Eagles Compared to Juveniles



Young eagles appear larger than adults. Longer wing and tail feathers give juveniles a larger appearance, as shown by the gray outline in the illustration above. The longer feathers give juveniles different aerodynamic properties more conducive to soaring on thermal air currents and to a nomadic lifestyle. Wingspan can reach eight feet.

Photos by Tim Bowman

The distinctive plumage of a bald eagle (above left) is not attained at least 5 years of age. Juveniles have an all-brown plumage (above right), which takes on a blotchy appearance as the birds mature and gradually replace feathers during molt each summer. By the time an eagle is four years old, it is almost indistinguishable from an adult, but retains some brown spots on the tail and head.

eagles have learned to raid Canada goose nests and may eat both the adult and the eggs. Carrion, including starved deer and dead whales, can be important sources of food during winter when fish are less abundant. Eagles also will take advantage of road-killed animals, refuse at municipal dumps, fish offal from fish processing plants, and gut piles from harvested game.

Bald eagles are often seen perched atop tall trees where they have commanding views of their surroundings and can locate prey efficiently. Once an eagle spots its prey, it swoops down in a shallow glide and throws its feet forward to grasp the prey in its talons, sometimes reaching several inches below the surface of the water. Eagles typically carry the prey back to a favorite perch where they eat it. Sometimes eagles will attempt to carry off a fish too large to lift and end up in the water themselves. Eagles can swim fairly well, however, and may tow a fish back to shore rather than lose their catch. Eagles are capable of carrying fish up to four pounds.

Eagles have four toes per foot and each toe is equipped with sharp talons and spiny scales on the soles that are designed for gripping fish. Three toes face forward and one, the *hallux*, faces backward to aid in gripping prey. They have a large, heavy bill that is hooked and can readily tear off flesh from carrion or other prey. Bald eagles have supraorbital ridges, bony extensions over each eye, that help protect them from injury when catching and handling prey and shield the eyes from sun glare. Their eyesight is extraordinary — about 4-6 times sharper than a human's. They can spot even small prey as far as one mile away.

There are distinct differences in foraging behavior between juveniles and adults. Immatures apparently develop hunting skills slowly and must learn to locate reliable food sources and master feeding techniques. Consequently, young eagles are wanderers, foraging over wide areas, and often feed upon easily acquired foods, such as carrion, spawning salmon, and fish found in abundance at the mouths of streams. Adults lead a more predatory lifestyle, hunting live prey in localized territories.

Distribution, Movements, and Habitat Use

In Alaska, highest densities of eagles are found along the coasts of southeast Alaska, the Gulf of Alaska, PWS, the Kenai and Alaska Peninsulas, and the Aleutian Islands. Lesser numbers occur along Alaska's major river systems in the Interior and along the Bering Sea coast north to the Noatak River. Bald eagles from the interior of Alaska typically migrate to southeast Alaska and the lower 48 states during winter.

Young eagles and nonbreeding adults experience far more wanderlust than breeding adults. Juvenile bald eagles radio-tagged in PWS as fledglings flew as far as the Petersburg area in southeast Alaska, a distance of about 1,000 miles, during their first winter.[4] Adult bald eagles radio-tagged in Washington during winter traveled the following spring, mostly as nonbreeders, to the Copper River Basin, Susitna River, and Fairbanks area.[5]

Bald eagles establish territories around nest sites and will defend these territories vigorously; they may even kill another eagle in defense of their site. Territory size varies with the density of eagles and quality of habitat (e.g., food supply, suitable nesting and perching trees, and isolation from human activity). Adult eagles may defend nesting territories year-round in areas that stay ice-free and where food remains adequate.

Map courtesy of U.S. Fish and Wildlife Service

This is typical of eagles nesting in coastal areas of Alaska. These "resident" eagles usually stay within a mile of their nest sites, but will occasionally make long distance movements to feed on temporally abundant food sources, such as at herring, salmon and eulachon (hooligan) spawning areas, and even at artificial feeding stations like the one on the Homer Spit, where fish carcasses have been provided for eagles during winter for several years. Inland-nesting eagles that migrate to southern areas do not establish a territory during winter, but usually use the same areas each winter.

Bald eagles, because of their great mobility and capacity to fast, are better able to move about in response to local food conditions than most other birds. Bald eagles gather in great numbers at some areas when salmon, exhausted or dead after swimming upstream to spawn, are abundant and afford an easy meal for these opportunistic birds. More than 3,000 eagles may concentrate in late fall and early winter in the Chilkat Valley. Up to 1,500 eagles may congregate on the Copper River Delta when eulachon are spawning, and several hundred regularly congregate at herring and salmon spawning areas in PWS and on the Kenai Peninsula.[4]

Conservation and Management

Eagles have been systematically counted about every five years in southeast Alaska since 1967 and in PWS in 1982, 1989-91, and 1995. Both populations have continued to increase and are believed to be approaching carrying capacity.[6,7] Only during the 1990s has the southeast Alaska population shown signs of stabilizing. The increase in eagle numbers is believed to be a result of greater protection of birds and habitat, and probably also reflects recovery from the days when bounty hunting reduced population size. Today, bald eagle populations in Alaska remain healthy and may be as large as during pre-bounty days.

Protection of areas critical to eagles is increasingly in conflict with demands for natural resources, recreation, and development. Currently, the greatest threats are from logging, which may destroy nest and perch sites or degrade salmon spawning streams. Activities associated with resource development and recreation can cause eagles to abandon their nests, particularly during the early part of the nesting season. Characteristics of these activities, such as size, noise intensity, location, persistence, and timing, may influence how eagles are affected by a particular activity. Further, individual nesting pairs vary greatly in their sensitivity to human activities. Human activities may cause the adults to leave the eggs or young unattended and susceptible to overheating or hypothermia. Excessive human activity in areas used by nesting bald eagles can interfere with feeding and cause problems if the eagles do not have other, undisturbed, productive feeding sites nearby. Management that incorporates an awareness of bald eagle habitat needs is essential to the maintenance of Alaska's eagle population.

The bald eagle is afforded protection under the Bald Eagle Protection Act of 1940, which makes it illegal to kill, harm, harass, or possess bald eagles, alive or dead, or any part of an eagle, including eggs and feathers. The U.S. Fish and Wildlife Service recommends a 330-foot buffer zone around eagle nest trees. The U.S. Forest Service, some Alaska Native corporations, and the State of Alaska have adopted policies to avoid cutting timber within 330 feet of eagle

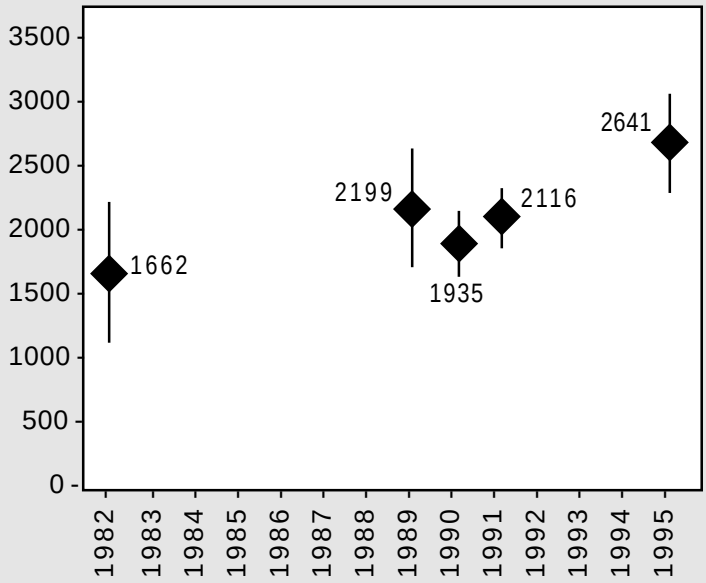
Photo by Tim Bowman

Bald eagles are opportunistic feeders. Although primarily fish eaters, bald eagles will hunt or scavenge a variety of prey, such as this deer carcass on a PWS beach.

Population Trend of Bald Eagles in Prince William Sound

Photo courtesy U.S. Fish and Wildlife Service

Following the spill, 151 eagle carcasses were recovered from the entire spill area. These carcasses represented only a fraction of the total mortality because some carcasses were overlooked, scavenged, not reported, drifted out to sea, or were otherwise lost. After accounting for these biases, it was estimated that about 250 eagles (about 5% of the PWS population) died in PWS as a result of the spill.



The size of the bald eagle population in PWS was estimated by aerial survey in 1989-91 and again in 1995. A survey using similar methods was conducted in 1982 and provided long term trend information. Survey results indicated that the population had returned to its pre-spill size by 1995, with a total population of about 6,000 eagles. In September 1996, the bald eagle was classified as fully recovered from the effects of the Exxon Valdez oil spill.

nest trees, although additional measures may be necessary in certain circumstances to protect bald eagles or their habitats.[8] Of particular importance are old-growth beach-fringe forests that fulfill eagles' needs for primary and alternate nest sites, as well as for perch and feeding sites.

Bald eagles have few natural enemies. Mortality may result from starvation, disease, shooting, accidental capture in traps, or injuries sustained during territorial disputes with other eagles. About half of all the identifiable causes of mortality of adult radio-tagged eagles in PWS were attributed to aggressive encounters between eagles.[9] Although an uncommon occurrence, black bears have been known to climb into bald eagle nests to eat eggs or chicks.

Bald eagles from Alaska have been used to bolster populations in the Lower 48 states through a process called *hacking*. Hacking is a procedure adapted from the sport of falconry. Eaglets are removed from nests when they are about eight weeks old and transported to manmade towers located in remote areas in other states where bald eagle populations are low or nonexistent. From 1982 to 1990, 279 eaglets were translocated from nests in southeast Alaska and have contributed greatly to the recovery of eagle populations in New York, Tennessee, Missouri, North Carolina, Indiana, and California.[10]

Effects of the Oil Spill

Following the spill, 151 eagle carcasses were recovered from the entire spill area. These carcasses represented only a fraction of the total mortality because some carcasses were overlooked, scavenged, not reported, drifted out to sea, or were otherwise lost. After accounting for these biases, it was estimated that about 250 eagles (about 5% of the PWS population) died in PWS as a result of the spill, but estimates of mortality for other areas affected by the spill were less certain.[11] Productivity was reduced in oiled areas of PWS in 1989, and only 30% of occupied nests produced young.[3] Low occupancy rates and nest failures were directly related to the extent and intensity of oil near nest sites, but the exact mechanism remains uncertain. [3] Reduced productivity may be attributed to the death of one or both adults, embryonic mortality due to oil being transferred to eggs from feathers of incubating adults, or disturbance by shoreline cleanup crews. Production apparently returned to normal in 1990 and 1991.[3,12] Logistical constraints incurred immediately after the oil spill in 1989 delayed surveys and precluded an accurate measure of reproductive success in other areas affected by the spill. Using the available data, however, detrimental effects were not readily apparent.[3]

Restoration Activities

Biologists radio-tagged 159 bald eagles in PWS from 1989 to 1992 and monitored these eagles to look for differences in survival between oiled and unoiled areas. Survival was about 71% for first-year eagles and 88% for adults, but there were no differences between oiled and unoiled areas. Researchers concluded that any effects on survival occurred immediately after the oil spill and before eagles were radio-tagged, which was more than four months after the spill.[9]

Photo courtesy U.S. Coast Guard

A bald eagle is released into the wild after treatment following the Exxon Valdez oil spill.

The size of the bald eagle population in PWS was estimated by aerial survey in 1989-91 and again in 1995.[6] A survey using similar methods was conducted in 1982 and provided long term trend information. During these surveys, biologists flew at tree-top level along shorelines and counted all adult eagles. The number of adults seen was an index to breeding population size, which was then adjusted to account for eagles not seen and for immatures.[13] Results of surveys indicated that the population had returned to its pre-spill size by 1995, with a total population of about 6,000 eagles.

It seems that the bald eagle population in the spill area was able to withstand the injury it sustained from the spill with no apparent long-term problems. Its resiliency, relative to other species, can be attributed to the fact that the population was healthy and increasing when the spill occurred, and that a temporary drop in reproductive success is fairly inconsequential to a long-lived species like the bald eagle.

In September 1996, the bald eagle was classified as fully recovered from the effects of the oil spill. No additional work has been carried out since 1995 to specifically assess the status of the bald eagle.

Bald eagles have benefited enormously from the habitat protection program. Much of the 650,000 acres protected is ideal bald eagle habitat. Old-growth forests and nonforested areas include many hundreds of nesting sites and secondary perching sites, usually along the 1,200 miles of shoreline and more than 300 salmon streams that were part of the protection effort. The majority of acreage protected included good bald eagle habitat.

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The Restoration Notebook series is published for educational purposes. Persons wishing to cite this material in scientific publications should refer to the technical reports and literature listed at the end of each account.

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