ANALYSIS SPECIES ASSESSMENT:
Bald Eagle (*Haliaeetus leucocephalus*)

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Baker River Project Terrestrial Working Group Analysis Species

Bald Eagle (*Haliaeetus leucocephalus*)

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**Habitat Type:** Generalist Species

**Species Biology and Population Status:**

***For general information on the biology of bald eagles refer to The Birds of North America, no. 506.***

- The Pacific Northwest region has the largest population of both nesting and wintering bald eagles within the species’ range (Knight et al. 1990). In Washington, bald eagles have increased from about 105 nesting pairs in 1980, to about 664 in 1998. Up to 80% of Washington’s wintering population breed in Alaska and British Columbia and migrate to Washington for the winter to feed on spawned salmon. It is estimated that over 3,000 bald eagles may reside in Washington during winter (Stinson et al. 2001, WDFW 2001).

- Since the early 1980’s Washington’s bald eagle population has grown 10% annually. This current growth trend is expected to slow as the population reaches an estimated carrying capacity of 733 nesting pairs. Nesting habitat in western Washington is limited and there are indications that the carrying capacity of this region has already been met, especially around Puget Sound and other marine coasts. Populations in northeastern Washington and along some western Washington rivers, however, continue to grow (Stinson et al. 2001).

- In Washington, bald eagles nest primarily west of the Cascade Mountains, with scattered breeding areas along major rivers in the eastern part of the state. Wintering populations are found throughout the Puget Sound region, the San Juan Islands, Hood Canal, the Olympic Peninsula, and the upper and lower Columbia River and its tributaries. Major wintering concentrations are often located along rivers with salmon runs (Watson and Rodrick 2001).

- In Washington, a small portion of eagle nests are in parks and other protected public lands, but 2/3 of nests are located on private lands (WDFW 2001).

- Bald eagles in Washington are migratory. Eagles that nest in Washington typically move north after nesting in late summer or early fall to spend several weeks feeding on early salmon runs in coastal British Columbia and southeast Alaska (Watson and Rodrick 2001, WDFW 2001). Fledglings also disperse northward, but may remain there for several months before returning to Washington (Stinson et al 2001). Many of the eagles that concentrate along rivers in Washington during winter are birds that nest in Alaska, British Columbia, and Montana. Washington nesters begin arriving at
their traditional wintering grounds in late October through late January (Watson and Rodrick 2001, WDFW 2001).

- Spring migration for eagles wintering on the Skagit River generally occurs from the end of January through mid-April. In one study, the straight-line distance traveled between wintering and breeding territories averaged about 700 miles and took about 3 weeks to reach (Stinson et al. 2001).

- From 1980-98, Washington’s bald eagle population had a productivity rate of 0.95 young per occupied territory. During this period nest success in western Washington reached 65% with an increasing trend. An average of 35% of active nests produced no young, 1 young fledged at 35% of nests, 2 young at 29% and 3 young at 1% of nests (Stinson et al. 2001).

- Recent population studies in Washington have found lower adult survival. Despite this, the Washington breeding population has increased. It has been suggested that higher juvenile survival and adult immigration from adjacent regional populations may account for increasing bald eagle populations (Stinson et al. 2001).

- In addition to well-documented cases of harassment of other birds by bald eagles, eagles engage in other, unusual, interspecific relationships. In Washington, at least two instances of bald eagles rearing red-tailed hawk nestlings have been reported (Stinson et al. 2001).

- Ospreys and peregrine falcons are known to harass bald eagles, especially in defense of their nests (Stagner pers. comm., Stinson et al. 2001). In fact, adult bald eagles have been known to die in combat with peregrine falcons. Ospreys are also known to use nests that had been occupied by eagles only a few weeks earlier. In such cases, it is doubtful that an osprey(s) displaced the original eagle occupant but rather took over use of the nest when one of the eagles died (Stinson et al. 2001).

- Ongoing satellite telemetry studies in Washington found breeding eagles died from gunshot wounds, intraspecific aggression, and lead poisoning. Wintering bald eagles died from electrocution and vehicle collisions (Stinson et al. 2001).

- The bald eagle is a state threatened species in Washington. It is vulnerable to loss of nesting and winter roost habitat and is sensitive to human disturbance, primarily from development and timber harvest along shorelines. However, bald eagle populations are recovering and have exceeded most target levels established by the Pacific States Bald Eagle Recovery Plan. Because of its recovery nationwide, the bald eagle is under review for removal from the Federal Threatened species list. In the Pacific recovery region numeric delisting goals have been met since 1995; in at least 80% of managed zones a minimum of 800 nesting pairs with an average reproductive rate of 1.0 fledged young/occupied breeding area, an average success rate of at least 65% over a 5 year period, as well as wintering populations that are stable or increasing. In the event of Federal de-listing, the bald eagle’s status as a State Threatened species in Washington will also be reviewed (USDI 1999, Watson and Rodrick 2001).
Nesting/Reproductive Behavior:

*** For general information on nesting/reproductive behavior of bald eagles refer to The Birds of North America, no. 506. ***

- In Washington, breeding and nest building typically occurs in January and February. Egg-laying begins at the end of February, with most pairs incubating their eggs by the third week in March (Watson and Rodrick 2001). Young eaglets hatch by late April and fledge at 11 to 13 weeks of age, usually during early to mid-July (Stinson et al. 2001).
- Bald eagles exhibit a high year-to-year site fidelity to nest territories and wintering grounds. A study of eagles breeding along the Skagit River found that all eagles returned to the same geographic location occupied for breeding the previous year and 65% returned during the winter (Stinson et al. 2001).
- In addition to its primary nest, an eagle’s nest territory can contain up to 8 alternate nests. In western Washington alternate nests were an average of 1,050 ft (315 m) from the occupied nest (Stinson et al. 2001).
- There is some evidence that several generations may use the same nests, or at least the nests are reused past the lifetime of the original nesting pair. Also, there is some interesting behavior in which the eagle pair will dismantle the nest after the fledglings have left the nest and rebuild it in the same place the following year (Stagner pers. comm.).

Habitat Requirements:

*** For general information on the habitat requirements of bald eagles refer to The Birds of North America, no. 506. ***

- Bald eagles are found in all forested areas of Washington, but they are considerably more abundant in the cooler maritime region west of the Cascade Mountains than in the more arid eastern half of the state. The only area of the state in which nesting bald eagles are largely absent is the dry shrub-steppe habitat of the Columbia Basin away from large rivers and large trees (Stinson et al. 2001).
- Bald eagle nests are most often located near marine shorelines, however nests are also found near the shorelines of lakes and reservoirs and along rivers in Washington (Stinson et al. 2001).
- In Washington, 97% of bald eagle nests are within 914 m (0.5 mi) of a marine, lake or river shore (WDFW 2001).
- In Washington, bald eagle breeding territories include mature coniferous and hardwood upland forests and lowland riparian stands (Watson and Rodrick 2001).
- In Washington, wintering bald eagles are concentrated at salmon spawning streams and waterfowl wintering areas. In eastern Washington, the majority of wintering bald
eagles congregate at the reservoirs and major tributaries of the Columbia River. (Stinson et al. 2001).

- Bald eagle nesting territories in western Washington average 2.5 km² (0.96 mi²) in radius. Home ranges are considerably larger averaging 6.8 km² (2.6 mi²) in Puget Sound. To the east, bald eagle home ranges are considerably larger averaging 22 km² (8.5 mi²) along the lower Columbia River, with an average distance of 7.1 km (4.4 mi) separating nests. Defended territories represent core areas of intense use, which average 1.5 km² (0.58 mi²) in size, while ranges include areas occasionally occupied by bald eagles, outside of defended territories. The distance between adjacent territories may be important for productivity when food resources are limited (Watson and Rodrick 2001).

- In areas of high quality habitat, adjacent active bald eagle nests may be spaced every few miles. In Clallam and San Juan counties, individual nests encompass an average 4-5.6 mi (6.4-9.0 km) of shoreline (Stinson et al. 2001).

- Winter home ranges of bald eagles are considerably larger and more variable than breeding ranges. A study conducted over 24 winter seasons on the Skagit river found that winter ranges for 15 eagles averaged 17,450 mi² (45,370 km²) and ranged from 89-113,365 mi² (231-294,749 km²). Some birds moved relatively short distances to distinct areas while others regularly traveled longer distances to new locations throughout the winter (Stinson et al. 2001).

- In 1998, 26 bald eagle roosts were counted on major tributaries of Puget Sound. Roost trees were larger in diameter and taller than other random trees in the area. Territories averaged 9 ha (22.2 ac) in size and were located <1.1 km (0.68 mi) from foraging areas (Watson and Rodrick 2001).

- Over 130 communal bald eagle night roosts, characterized by large, old trees, have been found throughout Washington and some of these roosts are used in successive years. Many of these older roost trees (i.e. western red cedar, black cottonwood, western hemlock, and Douglas-fir) have broken crowns, and an open branching structure and while these roosts do not always meet strict definitions for old growth, an old growth component is usually present and the oldest trees are used most frequently by roosting eagles (Dellasala et al. 1998, Stinson et al. 2001).

- Communal night-roosts are generally found adjacent to foraging areas and their location is largely a function of prey abundance and distribution. Roosts vary widely in area and may be used by a single pair of eagles or congregations as large as 500 individuals. Studies from the Klamath Basin measured roosts varying from 3.7-627 ac (1.48-251 ha). Many roosts also provide protection from harsh environments. Studies have shown that communal roosts provide a more favorable microclimate, with higher air temperatures, lower direct precipitation and lower wind speeds, than areas outside the vicinity (Stinson et al. 2001).

- Bald eagles, while not old growth obligates, do require trees large enough to support their weight and that of their massive nests (Stinson et al. 2001).

- In western Washington, bald eagles will typically nest in old growth Douglas-fir and sitka spruce near the coast, and mature grand-fir and black cottonwood around Puget Sound. Nests in eastern Washington are found in ponderosa pine and black cottonwood (Stinson et al. 2001).
• Habitat surrounding nest trees in Washington range from old growth forests along coasts and islands, patches of forest along rural-residential shorelines, to small patches of trees in residential areas (Stinson et al. 2001).
• Snags are the preferred perch trees of bald eagles wintering along the Nooksack River in Washington. Big-leaf maples, black cottonwood and sitka spruce are preferred over the much more abundant red alder. Wintering eagles along the mid-Columbia River choose the tallest, largest in diameter perch trees with the most open crowns. Deciduous trees are preferred perch trees in winter because the absence of foliage improves visibility and provides an unobstructed flight path through the tree crowns. The distribution of perch trees had a greater influence on the distribution of wintering eagles on the mid-Columbia River than did food abundance (Stinson et al. 2001).

Food Resources and Foraging Behavior:

• Bald eagles are opportunistic hunters and scavengers, using their keen eyesight to search for food (Stinson et al. 2001).
• Eagles, also acquire food by inter- and intraspecific food robbery. Food piracy is common while feeding on salmon carcasses along Pacific Northwest rivers (Knight and Knight 1986).
• Eagles will often steal prey from osprey and gulls, and have been observed stealing marine invertebrates from sea otters and fish from river otters (Stinson et al. 2001).
• The ability to obtain food increases with age and eagles forage by methods for which their age class is most suited based on morphology (i.e. size and wing loading) and experience (Bennetts and McClelland 1997).
• Foraging tactics such as stooping and aerial piracy require not only detection of prey, but also agility and precise timing. In contrast, scavenging primarily requires detection. Ground piracy probably requires more skill than does scavenging, but the host is usually stationary on the ground, often enabling even a juvenile’s awkward approach to be successful (Bennetts and McClelland 1997).
• Foraging tactics and ability of bald eagles are influenced by age, phenotype, and prey availability. Stooping is the most successful tactic and is more frequently used by older birds. The relative use of stooping increases with age and the use of ground piracy generally decreases with age. The relative use of different foraging tactics also reflects changing prey availability. Younger birds often resort to ground tactics (i.e. piracy and scavenging) as a result of lesser skill at aerial tactics (aerial piracy and stooping), however when prey availability (i.e. salmon carcasses) is limited juveniles have been observed obtaining food by aerial piracy. A study conducted at Glacier National Park, Montana, found that eagles of all age classes used aerial foraging tactics when lower numbers of salmon precluded accumulation of carcasses but when salmon carcasses accumulated in large numbers, all age classes used ground tactics (Bennetts and McClelland 1997).
• A study on inter- and intraspecific piracy behavior of wintering bald eagles along the Mississippi River found that although immature eagles made more robbery attempts than adults, no age-specific differences in the ability to rob or retain fish was detected. Eagles possessing large fish were more often attacked by pirates than birds
with smaller fish. Immature eagles showed no preference for robbing a particular age class, but adults were more likely to rob other adults than immature birds. Opportunistic piracy appeared to be the optimal feeding method of immature bald eagles (Fischer 1985).

- Because eagles use their talons when attacking birds, injury to food holders is possible. Vigilant behavior may allow a feeding eagle to detect a pirating attempt and thereby increase its likelihood of keeping food and avoiding injury. Aggression among conspecifics increases with increasing group size (Knight and Knight 1986).

- An individual bird may learn locations of food sources through local enhancement, in which the searcher is attracted to actively foraging birds. Social learning of food location by local enhancement occurs intraspecifically and interspecifically in bald eagles (Knight and Knight 1983).

- Bald eagles may prefer feeding with other eagles because of the ease of consuming salmon torn open by others. This behavior may be adaptive, because it eliminates time and energy needed to rip open skin, and a partially eaten carcass may indicate food suitable for ingestion (Knight and Knight 1983).

- Eagles may feel more secure when feeding with other eagles due to a greater ability to detect disturbance or possible danger (Knight and Knight 1983). In addition, individuals in flocks can spend less time looking for predators and more time feeding without reducing their level of safety (Knight and Knight 1986).

- Foraging success and habitat use of bald eagles were found to be strongly dependent upon fluctuating river flows from Glen Canyon Dam along the Colorado River in Grand Canyon National Park, Arizona. Foraging in river, shore and isolated pool habitats decreased to 0% at flows >568 m³ sec⁻¹, whereas foraging in adjacent creek habitat increased to 100%. Low river flows were associated with increased eagle habitat use and prey capture, whereas high river flows reduced eagle foraging habitat diversity, lowered foraging success in river habitat, and restricted foraging opportunities (Brown et al. 1998).

- Foraging rates and strategies of bald eagles at the Columbia River estuary are strongly influenced by tidal cycles, with foraging and scavenging most common at low tide and first daylight (Watson et al. 1991, Brown et al. 1998). Hourly fluctuating river flows below hydroelectric dams mimic tidal cycles and may have similar influences on eagle foraging behavior (Brown et al. 1998).

- A study examining aspects of food location by wintering bald eagles along the Nooksack River, Washington found eagle numbers increased along the river after flooding, which caused a widespread elimination of salmon (Knight and Knight 1983).

- The bald eagle regularly preys upon injured or grounded waterfowl; as well, it is capable of capturing or knocking down avian prey in flight, including ptarmigan, ducks and geese. One account describes the capture of a goose in mid-air by an eagle that swooped under the prey, turned upside down, and grasped the breast of the prey with its talons (Nero 1987).

- On land, bald eagles approach avian prey close to the ground. On water avian hunting methods observed, include flying low between ocean swells, diving from a high altitude, and returning to the surface from an underwater dive to take sitting birds (Nero 1987). Diving ducks are taken by circling above and diving upon the
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• Duck, causing it to dive repeatedly until it is so out-of-breath that it is easily taken (Stinson et al. 2001).

• Bald eagles use a variety of methods to capture seabirds including team-hunting, excavating nesting burrows, surprise and pirating (Knight et al. 1990). In Washington, bald eagles have been observed raiding gull and seabird colonies to prey on adults, nestlings or eggs (Stinson et al. 2001).

• Bald eagles also prey upon mammals, including rabbits, raccoons, muskrats, opossums, deer and cattle carrion, sheep, and seals (Stinson et al. 2001).

• Bald eagles have been observed team-hunting while preying on jackrabbits and cattle egrets (Stinson et al. 2001).

• Bald eagles are also effective scavengers and will feed on well decayed flesh and garbage (Stinson et al. 2001).

• In winter, spawned salmon on riverbanks and bars become the most important food source for much of the wintering bald eagle population (Stinson et al. 2001).

• Wintering bald eagles concentrate on and move between several Washington rivers (Skagit, Nooksack, Stillaguamish, Skykomish, Nisqually, Okanagan, upper Columbia and Spokane) from September to January to feast on salmon carcasses. The Skagit River attracts the highest concentration of bald eagles that gather to feed primarily on chum but also coho and steelhead (Stinson et al. 2001).

• In late winter bald eagles move from the Skagit River to its tributaries to feed on late spawning coho salmon (USFS 2000).

• Of 1198 items collected at bald eagle nests from three regions in Washington: San Juan Islands, Olympic Peninsula and Puget Sound, 53% were birds, 34% were fish, 9% were mammals, and 4% were invertebrates. Seabirds, including grebes, murres, gulls, cormorants and scoters were the principal bird prey. Fish, including rockfish, ling-cod, walleye pollock, starry flounder and pacific hake, were more abundant at nests in the San Juan Islands and Puget Sound than at nests in the Olympic Peninsula. Overall, mammals were not an important food source in these regions; however, the European hare was a common food species for eagles in the San Juan Islands (Knight et al. 1990).

• In a more recent study, a collection of 380 prey remains under 67 nest trees in the Puget Sound and San Juans was 67% birds, 19% fish, 6.8% mollusks and crustaceans, and 6% mammal. Birds, including gulls (especially glaucous-winged), ducks (at least 15 species, especially scoters, mallards and mergansers), western grebe, common murre, great blue heron, and pelagic cormorant were among the most common prey remains in the two studies. Fish remains included flounder, plainfin midshipman, dogfish shark, sculpin, rockfish, ling-cod, walleye pollock, Pacific hake, Pacific cod, cabezon, red Irish lord, salmon (unidentified salmonids) and channel catfish (Stinson et al. 2001).

• Eagles in Puget Sound suburbs are known to prey on northwestern crow nestlings and fledglings (Stinson et al. 2001).

• In general, coastal nesting bald eagles feed more on birds than on other taxa, while the diets of eagles nesting near lakes and rivers have a higher proportion of fish (Knight et al. 1990, Stinson et al. 2001).
A study of bald eagle diet in the Columbia River estuary found 90% of prey remains belonged to fish, 7% birds, and 3% mammals. Waterfowl were the most common avian prey in nests, while suckers, American shad, and carp were the most common fish (Stinson et al. 2001).

A study of nesting birds at Lake Roosevelt (Columbia River) in eastern Washington reported that prey delivered to nests was 83% fish, 13% birds, and 2% mammal. In the same study, prey remains below the nests were 71% fish, 27% birds, and 6% mammals. Suckers were the most frequently recorded prey items in remains, and largescale suckers were the most abundant fish in the lake. Hatchery reared rainbow trout and kokanee accounted for 23% of prey observed during deliveries to nests. Other commonly eaten fish included walleye and carp, but black crappie, small-mouthed bass, yellow perch and whitefish were also recorded. Birds that occurred as prey included coots, ducks, pigeons, and northern flickers (Stinson et al. 2001).

Conversely, coots, mallards and chukars were the most frequent prey of wintering eagles recorded from a study on the mid-Columbia River, and fish comprised only 8% of prey taken. Similarly, wintering eagles on the free-flowing Hanford Reach of the Columbia River were reported to feed more frequently on waterfowl and coots (53% of biomass) than on fish (48% of biomass). In this study, the relative proportions of fish and waterfowl, changed during the season, because chinook carcasses were only available from November to mid-December, and waterfowl became the chief prey by late winter (Stinson et al. 2001).

In the Harney Basin, Oregon, bald eagles foraged primarily on waterfowl from November to December, on mammal carrion from December to February, and again on waterfowl from February to April (Isaacs and Anthony 1987).

Fish remains collected from bald eagle nests in western Washington contained few vertebrae but a large number of skulls. This suggests eagles fed on fish heads discarded by fisherman (Knight et al. 1990).

Because wintering eagles often depend on dead or weakened prey, their diet may vary locally. In Washington, various types of carrion are important food items during fall and winter (specifically spawned salmon (primarily chum)). Cattle carcasses and afterbirths, road-killed deer, and crippled waterfowl are important food sources where salmon carcasses are unavailable (Watson and Rodrick 2001).

Introductions of European hare, and chukar and pheasant to eastern Washington have provided new prey sources for bald eagle (Stinson et al. 2001).

Adequate prey resources are most critical during the brooding period when young grow rapidly to fledging size. An insufficient prey base may result in the starvation of one or all of the nestlings (Stinson et al. 2001).

Effects of Human Disturbance and Habitat Alteration:

It has been estimated that prior to human settlement, the early summer population of bald eagles in Washington State may have been around 6,500. However, years of persecution, timber harvest, commercial exploitation of salmon runs and the use of DDT severely reduced Washington’s eagle population and the carrying capacity of the region. Fortunately, a ban on DDT use (after 1972) and increased protection for
eagles and their habitat has undoubtedly led to their recovery. In addition, the construction of over 1000 dams and the introduction of various species of warm water fishes have added winter and nesting habitat. In the past twenty years, Washington’s nesting bald eagle population has grown 10% annually. In 1980, 105 known nesting pairs were recorded in the state of Washington and by 1998 664 occupied nests were found (Stinson et al. 2001).

- Human activities that permanently alter bald eagle habitat (i.e. removal of nest, roost and perch trees, and removal of buffers without regeneration of trees of adequate size and structure) and activities provoking reproductive failure or reduced vigor (i.e. construction, logging, boating) are the greatest threat to nesting and wintering eagles in Washington State (Watson and Rodrick 2001).

- Bald eagles have no known natural predators. Despite legal protection, however, eagles continue to be persecuted by humans throughout their range. Bald eagles exhibit avoidance behavior in response to people, suggesting that eagles perceive humans as a potential threat (Knight and Knight 1986).

- In areas that are highly disturbed by humans, feeding efficiency declines because eagles spend more time scanning as the possibility of human encounters increases (Knight and Knight 1986).

- Although fixed wing aircraft have posed little threat of disturbance to nesting bald eagles, their limited maneuverability may compromise the accuracy of data collected for occupancy and productivity surveys. Helicopters are often used for nest surveys however, their ability to remain stationary and move relatively close to eagle nests may be more disturbing. Studies in western Washington found eagles flushed more frequently at encounter distances >120 m (394 ft). Eagles with young or those spotted close to their nests would generally allow helicopters to approach at closer distances before flushing, this may indicate a form of nest defense. A lack of immediate response to human activity should not be interpreted as inconsequential as regular disruptions of nesting activities may reduce time designated to brooding and feeding of eaglets and could possibly lead to nest failure. Watson (1993) suggests researchers follow a protocol for helicopter surveys that includes hovering for <10 seconds at distances of at least 60 m (197 ft) from nests, on calm dry days as late in the season as possible to minimize the chance of adult presence (Watson 1993).

- Along with aircraft, pedestrian activity creates the highest active disturbance response in bald eagles. Research has shown pedestrian traffic to affect eagle behavior (i.e. flushing, agitation responses and reduced incubation time) up to 991 m (3,251 ft) from nests (Watson and Rodrick 2001).

- Investigations evaluating factors affecting the productivity and behavior of nesting bald eagles in rural residential areas in western Washington found non-audible activity (i.e. walkers) caused the highest eagle disturbance responses of any human activity (Watson and Pierce 1998).

- Management of temporal activities to reduce human impacts on bald eagle nest success should include minimizing home construction out to 400 m (1312 ft) from nests, and promoting growth of tall nest trees that are well screened from human activity (Watson and Roderick 1998).

- Nest screening significantly reduces response rates of nesting bald eagles. In rural areas of western Washington, the presence of partial or total vegetative screening
reduced the distance at which eagles were disturbed by 26-42 m (85-138 ft). However, partial screening also increased the incidence of surveillance flights compared to open nests. Watson and Pierce (1998) suggest that maintaining high levels of nest screening and restricting pedestrian activity <120 m (394 ft) from nests, provide buffering that will significantly reduce disturbance.

- Wintering adult eagles feeding along the Nooksack River were more vigilant when feeding near intense human activity than at isolated sites, yet vigilant behavior by immatures did not differ between sites. This interaction of age of eagle and level of human activity at the feeding site suggests that adult eagles have learned to associate humans with danger (Knight and Knight 1986).

- Human invasion of eagle nests during incubation normally causes abandonment of the eggs, and the birds do not re-nest in the same season. A similar invasion when young are in the nest is usually tolerated and the young are not deserted, however this may result in relocation of the breeding pair to a new nest some distance away the following year (Blood and Anweiler 1994).

- Studies have found that eagles spend considerably less time (average of 14 minutes/hour less) incubating when nests are situated close to residential areas (within 60m [197 ft]). A reduction in incubation time negatively affects nesting success (Stinson et al. 2001).

- Continued nesting by bald eagles in settled areas suggests considerable tolerance of human activities. Young eagles raised in nests overlooking subdivisions and other developments are expected to accept similar nest sites when of breeding age, provided that a secure nest tree and adjacent foraging areas remain (Blood and Anweiler 1994).

- An investigation of bald eagle behavior at an active nest adjacent to home construction in rural western Washington failed to reveal any adverse impacts from human activity during the post-brood season. Juvenile feeding behavior, adult presence, and prey delivery rates were uncorrelated to human activity levels. Flushes were all in response to pedestrian activity outside the home. The nest was located 20 m (66 ft) from, and at eye-level to, a residential construction site. These finding demonstrate that unusually tolerant eagles can nest successfully, for at least 2 seasons, in very close proximity to dramatic habitat alteration and new residential construction (Watson and Pierce 1998).

- In Craig, Arkansas during the mid 1980s, an area was cleared for a trailer park and a nest tree was almost cut completely down before the nest was located. The eagle pair actually fledged one young that same year. They successfully used the nest at least two more years before the tree blew down. During these two years the trailer park was being used by long term residents and also short term RV parking (Stagner pers. comm.).

- Disturbance investigations in rural areas of western Washington found increased primary and secondary roads ≤200 m (656 ft) from nests were positively correlated with nest success. Furthermore, the number of vehicles ≤800 m (2,624 ft) from nests was also positively correlated with nest success. Watson and Pierce (1998) conclude that high volume, constant vehicle traffic on paved roads has little affect on eagle nest success. Close vehicle activity (≤60 m [197 ft]) however, was of concern during courtship when eagles engaged in pair-bond establishment, nest building, and copulation (Watson and Pierce 1998).
Changes to habitat have significantly reduced foraging opportunities in many areas throughout the bald eagle’s historical range. Since the early 1800’s, the Puget Sound has lost an estimated 47% of its estuarine wetlands and 76% of its marshlands and there has been a considerable decline in mudflats and sandflats. Washington’s remaining coastal and riparian wetlands are continually threatened by contaminants, dredging, over-enrichment from residential and agricultural fertilizers and sewage, application of pesticides to oyster beds, the introductions of spartina, reed canary grass and purple loosestrife (Stinson et al. 2001).

Half of Washington’s 5.4 million people are concentrated near the shores of Puget Sound, Hood Canal and the Pacific Ocean, the same areas inhabited by a majority of the state’s bald eagle population. Although bald eagle populations have recently increased, continued shoreline development will further reduce the number of large trees available for nesting habitat and confine eagles to smaller areas. Only 1% of the Puget Sound Douglas-fir zone has been protected and 80% of land within 0.8 km (0.5 mi) of shores is privately owned (Watson and Rodrick 2001).

Outside of national forests, only 3% of forests in western Washington are late seral. These remaining stands occur in small patches and are highly susceptible to blow-down and development. Most of these remaining old growth patches are above 600m (1, 968 ft) in elevation, and too far from shorelines to be useful to nesting bald eagles (Stinson et al. 2001).

In southeast Alaska, the density of active bald eagle nests decreased with increasing proximity to clearcuts, although nesting success (number of chicks per nest) did not vary with density and proximity to clearcuts. The authors of this study suggest buffer zones, at least 300m (984 ft) wide, should be established around eagle nests to maintain nesting density (Gende et al. 1998).

Large trees, particularly Douglas-fir, western hemlock, western red cedar and sitka spruce, over 100 years old, used as nesting, perching and roosting habitats are a diminishing resource, particularly near shorelines that are valuable for residential development. Declining roosting habitat and riparian perch trees may be limiting the number of wintering eagles in the lower Snohomish and Skykomish River basins. (Stinson et al. 2001).

In addition to logging, the loss of habitat to linear developments, such as highways, transmission lines, and pipelines, which frequently follow valley bottoms or parallel rivers, further reduce the number of potential nest trees (Blood and Anweiler 1994).

The distribution of wintering bald eagles has been greatly altered by the creation of dams, reservoirs and waterfowl refuges along major river systems. These manipulated environments have created a number of nesting and wintering sites for bald eagles as a result of increased foraging opportunities. Fish that are killed or stunned when passing over spillways or through turbines, and those that congregate below dams, as their upstream movement is impeded, are potential food for eagles. Because rivers are ice free for some distance below these dams, eagles may be/ in some instances able to find food and over-winter in interior areas where they were formerly rare. However, this valuable winter habitat has been created at the expense of prime nesting riparian habitat (Blood and Anweiler 1994).

The presence and density of eagle territories are highly dependent on the abundance and availability of prey. Many dams block access to spawning salmon. In eastern
Washington, the Grand Coulee and Chief Joseph dams block access to over 550 miles of the Columbia River watershed. The impact that salmon declines may have on eagles may be somewhat mitigated by the presence of several species of introduced fishes many man-made reservoirs supply (Stinson et al. 2001).

- The distribution of wintering and post-breeding bald eagles in Washington is threatened by dwindling and increasingly unpredictable salmon runs (Watson and Rodrick 2001). Declining salmon stocks in the Puget Sound and Columbia River have been attributed, in part, to over-fishing, habitat deterioration due to impacts of flood control, logging, agriculture and urbanization and poorly designed hatchery programs. Fortunately, many of the large and medium spawning populations in Washington have been rated healthy (Stinson et al. 2001).

- Wetland and salmonid enhancement projects, such as spawning channels and passage facilities have increased the availability of eagle food in some areas (Blood and Anweiler 1994).

- Between 1980-87, high levels of dichloro dephenyl dichloroethylene (DDE), polychlorinated biphenyls (PCB’s) and 2, 3, 7, 8-tetrachlorodibenzo-p-dioxin (TCDD) were found in eggs, blood from adults and 2 eagle carcasses in the Columbia River estuary. Detectable levels of DDE and PCB’s were found in blood of nestlings indicating they were exposed to these contaminants in early life. Increasing concentrations of DDE and PCB’s with age also indicated accumulation of these contaminants. Adult eagles also had higher levels of mercury (Hg) in blood than subadults or young indicating accumulation with age. The high levels of DDE and PCB’s were associated with eggshell thinning and with productivity that was lower than that of healthy populations. DDE and PCB’s had a deleterious effect on reproduction of bald eagles in the estuary. Potential sources of DDE include avian prey that winter in Central or South America where DDT is still being used and/or DDE present in sediments, water and food chains of the Columbia River estuary. PCB’s are likely entering the Columbia River system from plastics, coolants, and electrical transformers used on hydroelectric dams and remain persistent in the environment from historic exposures. Dioxins are discharged to the Columbia River from both point and non-point source pollution. Sources of dioxins include leaded and diesel fuels, bleached wood pulp, wood preservatives, sewage chlorination, petroleum refinement, hazardous waste incinerators and forest fires (Anthony et al. 1993).

- Although DDT was banned in 1972, a recent study in the Columbia Basin of eastern Washington found appreciable amounts of DDT in 94% of fish samples (Stinson et al. 2001).

- Organophosphate and carbamate pesticides were responsible for almost 150 recorded eagle mortalities from 25 states between 1982 and 1994. Eagle poisonings occurred largely due to human carelessness or as a result of illegal use in bait for predator control (Stinson et al. 2001).

- Lead poisoning as a result of incidental ingestion of lead shots while feeding on hunter-crippled or lead poisoned waterfowl and from lead residues in waterfowl tissues has been a significant source of mortality in bald eagles. The use of lead for waterfowl hunting has been illegal since 1991 in the United States. Nevertheless, in 1996-97, 25% of pellets available to ducks were lead, indicating a substantial number
of lead shots spent before the 1991 ban are still deposited in many wilderness areas (Stinson et al. 2001).

**Studies Conducted in the Baker River Watershed:**

- There are currently two occupied bald eagle nests around Baker Lake. One of the nests is located just south of Panorama Point while the second nest is situated around the confluence of Baker River and the full pool reservoir level (USFS 2002).
- Although winter foraging is concentrated along the Skagit River and its tributaries, bald eagles do fish in the Baker and Shannon reservoirs, particularly just below the dams (USFS 2002).
- Bald eagle nesting habitat has improved around Baker Lake with the expansion of the lake’s surface area and a more dependable summer food source (USFS 2002).
- Winter bald eagle distribution and abundance along the Skagit is highly associated with chum salmon abundance. Reductions in these salmon runs could severely reduce winter bald eagle habitat quality and bald eagle abundance (USFS 2002). Baker River Project load following operations may affect chum salmon spawning and emergence; however, mainstream Skagit River fall chum stocks are currently healthy and production levels are consistent with available habitat (WDFW et al. 1994).
- Chinook spawning surveys were conducted in 2000 by the Washington Department of Fish and Wildlife (WDFW) on the Skagit River between river mile 15.5 and 67.2. It was estimated that about 80% of the total estimated number of spawning fish spawned in the Skagit River below the Baker River. Based on observations by WDFW biologist Pete Castle, an estimated 20% of redds were lost due to decreased flows after the Thanksgiving weekend. With a total return for the lower Skagit chinook of 3,262, this would be a loss production from about 16% of the spawners (Sprague 2002).
- Puget Sound Energy (PSE) conducted bald eagle boat surveys on Shannon and Baker Lakes from January 1990 to January 1999. During each survey outing, a PSE boat was used to travel the length of each lake starting at the south end. In areas of the lakes to wide to view all suitable habitat from the middle, the boat would also travel east to west. Boat surveys covered both reservoirs once per outing. A total of 445 adults, 84 juveniles, and 15 bald eagle chicks were observed during this period. The largest number of bald eagles observed during one survey (a total of 31 birds) occurred on Lake Shannon in February 1996; 24 adults and 7 juveniles were counted. The month and year of each bald eagle count is available. Geographic locations of all bald eagle nest sites were mapped for each year they were active, and the number of chicks produced was noted. This data is also available in tabular and graph form. Data was compiled separately for Shannon and Baker Lakes as total number of bald eagle sittings per year, and the total number of sittings for each month for all years of the study. Wildbird data is available from Puget Sound Energy, Tony Fuchs, tfuchs@puget.com.
- The Washington Department of Fish and Wildlife, Priority Habitat and Species polygon report documents the locations of 5 bald eagle nest sites within the Baker River watershed. Nest records were made from 1984 to 1997, with each nest site recorded only once. Two of the nest sites occur in the same geographic location as bald eagle nests recorded in the PSE bald eagle database. There is also 1 record of a
bald eagle nest from 1997 on the Skagit River near the town of Concrete. A total of 3 bald eagle communal night roosts were located on the Skagit River within 2 miles of the mouth of Baker River. The data contains the month, year, observer, and the township range geographic location. Survey methods are not available. The geographic location of each bald eagle nest and communal night roost is provided on 1: 24,000 scale habitat and species map. This data is available from WDFW, Priority Habitats and Species, Lori Guggenmos- GIS Programmer.

- The North Cascades National Park Service NPSpecies Database contains 23 observation records of bald eagles from 7/29/69 to 9/27/92. The observations were made in an area of the North Cascades National Park Service Complex located on the west side of the Cascade Mountains. This area of the National Park is located in sections of both Whatcom and Skagit Counties. The NPSpecies Database includes the date, observer’s name, UTM coordinates and a behavioral description of each bald eagle observation. This database is available at NPSpecies, Ronald Holms, Ecologist/Data Manager, North Cascades NPS Complex, 810 State Route 20, Sedro-Woolley, WA 98284-1239.
Literature Cited:


**Literature Review:**


Figure 1. Confirmed, probable, and possible breeding evidence of the bald eagle in Washington State (Washington Gap Analysis Project 1997).
Bald eagle *Haliaeetus leucocephalus*

Figure 2. Breeding Bird Survey (BBS) map of bald eagle distribution throughout breeding season. Distribution is based on counts estimated over the interval 1982-1996 (US Geological Survey Patuxent Wildlife Research Center 2002).