BIOLOGICAL EVALUATION

EVALUATING EFFECTS ON LISTED AND SENSITIVE SPECIES

from

ISSUANCE OF WINTER SEASON SPECIAL USE PERMITS ON THE

SKAGIT WILD AND SCENIC RIVER SYSTEM

Mount Baker-Snoqualmie National Forest

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I. INTRODUCTION

This document evaluates potential effects on Endangered, Threatened, Proposed, and USDA Forest Service (USFS) Sensitive species (ETP&S), and Critical Habitat from issuance of special use permits as described in the proposed action. This assessment complies with requirements of the Endangered Species Act (16 U.S.C. 1531 et seq) for listed species and Critical Habitat, and USFS policy for Sensitive species (FSM 2672.4).

II. PROPOSED ACTION

The Mt. Baker-Snoqualmie National Forest proposes to issue special use permits to commercial outfitter and guide operations on the Skagit Wild & Scenic River System (SW&SRS) (Figure 1). The permits would be effective for one year, and would provide for use of the surface waters of the Skagit system between November 1 and March 31. No timing restrictions on use would be placed on the permittees, and non-commercial uses would not be placed under permit.

Based on current use, it is anticipated that 12 rafting permits for the Skagit River between Rockport and Marblemount would be issued, five fishing permits from Hamilton to Bacon Creek on the Skagit River, and an unknown number on the Sauk River between the confluences of the Suiattle and the Skagit. The actual number of permits would depend upon the amount of commercial interest in use of the river. No limit on the number of permits is proposed.

The USFS is directed to issue commercial permits by the Wild and Scenic River Management Plan (USFS 1983), and by federal regulation (36 CFR 261.1(a)(4) & 36 CFR 261.58(z)). The USFS does not currently have a permit system in place on the Skagit River segment of the SW&SRS. Permits for summer use by commercial users are in place on the Sauk, Cascade and Suiattle Rivers, tributaries to the Skagit.

III. AFFECTED ENVIRONMENT

A. The Physical Setting:

The SW&SRS encompasses nearly 158 miles of river in the Skagit Basin above the town of Sedro Woolley, Washington (Figure 1, Map 1). The Skagit River drains approximately 3,105 square miles, originating in Canada and flowing southwesterly into Skagit Bay. It falls 1,570 feet from its source to the town of Marblemount, where it turns primarily westward and falls another 300 feet over the lower 92 miles. Above Marblemount, water fluctuations are controlled by three Seattle City Light dams. Below Marblemount, the Cascade and Sauk Rivers are major tributaries that contribute to natural fluctuations of the Skagit River.

Above the confluence with the Sauk River, the Skagit remains relatively clear throughout the year. Below the Sauk, the Skagit may become cloudy due to glacial runoff depending on the time of the year. The Sauk River also runs cloudy during peak flow periods when toe slopes of blue clay are eroded by the swift waters.

The Cascade River originates in wilderness areas and is fed by glacial runoff. The SW&SRS portion of the Cascade River travels from near the confluence of the North Fork and the South Fork of the Cascade northwesterly to where it drains into the Skagit River system, at the town of Marblemount. Approximately 3/4 of the upper Cascade flows through minimally developed National Forest lands, and 1/4 of the upper Cascade, and all of the lower Cascade flows through State and private lands which have been harvested and developed. The Cascade River has extensive areas of white-water.

The Sauk and Suiattle Rivers are major southern drainages of the Skagit River system. These rivers originate in the upper slopes of the N. Cascades, and drain to the west, northwest, and north into the Skagit River system at the town of Rockport. The Sauk River collects waters from the North and South Fork Sauk drainages, as well as the White Chuck River. The North and South Forks of the Sauk have their origins in wilderness areas and traverse through primarily remote and minimally developed National Forest lands. The White Chuck is a glacial river which runs milky in the summer from glacial melt and silt runoff, while in the winter the waters are clear. This river runs through mostly forested wilderness and undeveloped National Forest lands.

The Suiattle is another glacial river which carries a heavy load of glacial silt during summer melt season, late June through beginning of September. The Suiattle River also has its origin in the wilderness and approximately half of its length is within wilderness designation. Another quarter of the river's length is through National Forest with minimal development. As the Suiattle approaches the Sauk, it passes through State and private forest lands where recent timber harvest is evident along the corridor.

The North Fork of the Stillaguamish River, although not part of the SW&SRS does provide bald eagle (Haliaeetus leucocephalus) forage areas within three air miles of the Sauk River, and is therefore evaluated in this assessment. The upper portion of the N.F. Stillaguamish River between river miles 22 and 35 flows through a wide valley, where the gradient is gentle with numerous riffles and pools. This river segment flows through State and private ownership, so the surrounding land uses include residential, agricultural, grazing and forestry.

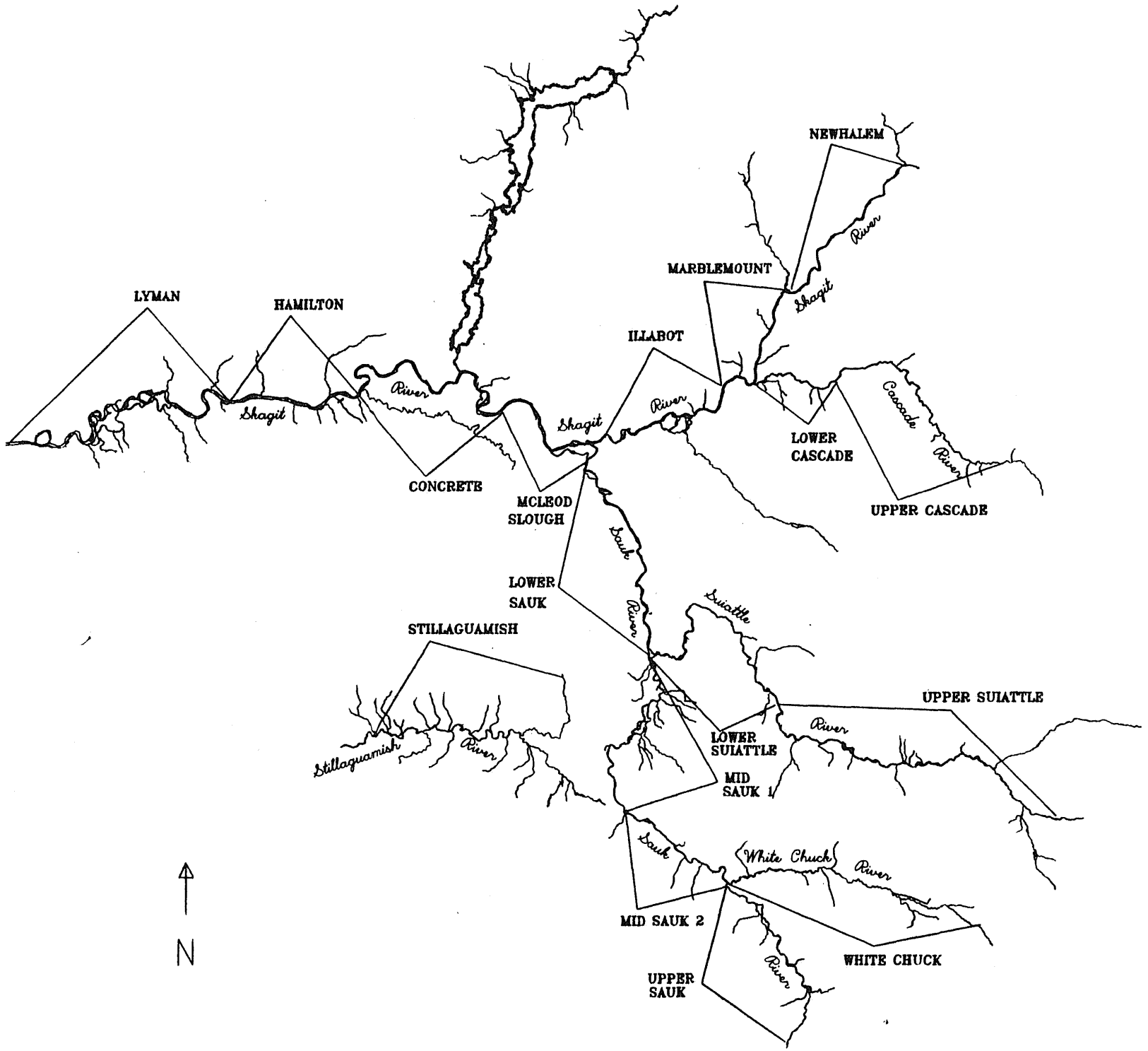


Figure 1. Vicinity Map

The Skagit River system, as referred to in this assessment, refers to the area encompassed by these river drainages.

Within the SW&SRS corridor, approximately 44% of the land is managed by the USFS, 50% is in non-federal ownership, and 6% is in State, county, or other federal ownership. While the USFS has no authority to control uses on non-federal lands within the SW&SRS, the USFS is given authority to manage the surface waters of the SW&SRS (USFS, 1983). The Skagit Wild and Scenic River Management Plan (USFS 1983) describes the area in detail.

B. Recreational Use:

Most recreational use of the waters in the Skagit River system occurs during the winter season, from October 1 through March 31. Winter steelhead fishing and float trips to view the wintering bald eagle population account for the majority of use. From a fixed sampling point (Washington Eddy), Stalmaster et al. (1991) data indicates that of the total river use (recreational events during the winter period), 53% were fishing boats, 41% viewing boats, and 6% was foot traffic.

Fishing on the Skagit is variable throughout the year and between years, depending on the species of salmon returning, water level, water clarity, and the number of fish. In odd numbered years, when pink salmon return to spawn, use increases, particularly on the Skagit between Lyman and Marblemount. This increased use generally occurs in the fall (October), and not during the winter period.

Washington Department of Wildlife (WDW) information suggests a decline from the 1986/87 season to the 1990/91 season in total angler hours spent between December and March (WDW 1992b). Fishing for winter run steelhead accounted for 90% of the sport fishing harvest from 1962 to 1991. Angling success rates have declined by 33% from 1986 to 1991.

The number of professionally guided fishing trips has declined over time possibly due to the decrease in the number of steelhead caught by sport anglers (Jost pers. comm.). Currently four guides book trips on the Skagit, down from forty in the 1960's.

Fishing access for bank or bar fishing is available at nine public boat launch areas. This access is very limited, as most of these sites are actually old ferry landings with the narrow right-of-way providing public access. Access to other bank fishing areas requires crossing private property.

Commercial and private floating on the Skagit is increasing. The majority of commercial rafting occurs December through January between Marblemount and Rockport. Data collected at the Marblemount boat launch indicate that 213 commercial rafts put in during the 1991-92 season, and 223 rafts put in during the 1992-93 season (Sotnik, pers. comm. 1993). The attraction is viewing wintering bald eagles. Private non-motorized boat use occurs mainly during the winter bald eagle season between Marblemount and Rockport. A low amount of private floating primarily occurs below Rockport throughout the year.

In the 1985/86 and 1986/87 winters, Stalmaster et al. (1991) studied recreational use patterns during the eagle season on the SW&SRS. The authors calculated that an average of 5,212 recreational events per year occurred from December through February on 155km of the SW&SRS. They estimated 18,774 persons visited the area in each of these years.

Winter recreational use during this period was highest between Marblemount and Van Horn, accounting for 72% of the total use. The authors rated recreational use of the Sauk as moderate, and use on the Suiattle as low.

Of the total recreational use, two thirds occurred on weekends. The number of fishing boats was similar between weekends and weekdays, but viewing boats were much more common on weekends (92%) than on weekdays (8%). Motorboat use was most frequent on the Skagit River from Rockport downstream, while dories were most prevalent on the Sauk. Highest levels of foot traffic occurred from Marblemount to Rockport.

On the average, 68% of the recreational activity in the area between Marblemount and Rockport occurred between 11:00 am and 3:00 pm. However, the presence of fishing boats was similar between morning and afternoon periods. Activities on weekdays tended to peak at earlier times of the day, probably due to the lack of viewing boats which are typically there later. Recreational use levels tended to increase as the season progressed, peaking in early February.

C. River Segments:

The SW&SRS has been divided into segments to aid in the analysis of the effects of recreational use on listed and sensitive species. The analysis area was divided into 16 river segments ranging in length from 5 to 19 miles (Table 1, Map 1, and Figure 1). Appendix A provides a detailed description of these segments, and additional information on recreational use within the segments. This information is summarized in Table 3.

TABLE 1. RIVER SEGMENT NAMES, LENGTH, AND LAND OWNERSHIP, SKAGIT RIVER SYSTEM.

Segment Name	River	River Miles	Length (mi)	Non-Federal Ownership (%)
Lyman	Skagit	23-40	17	100%
Hamilton	Skagit	40-47	7	100%
Concrete	Skagit	47-61	14	97%
McLeod Slough	Skagit	61-68	7	98%
and	Sauk	0-1	1	98%
Illabot	Skagit	68-76	8	97%
Marblemount	Skagit	76-83	7	94%
Newhalem	Skagit	83-93	10	0%
Lower Cascade	Cascade	0-5	5	100%
Upper Cascade	Cascade	5-17	13	0%
Lower Sauk	Sauk	1-13	12	95%
Mid Sauk 1	Sauk	13-25	12	99%
Mid Sauk 2	Sauk	25-32	18	0%
Upper Sauk	Sauk	32-40	8	0%
and	SF Sauk	1-3	3	0%
Lower Suiattle	Suiattle	0-12	12	100%
Upper Suiattle	Suiattle	12-31	19	0%
White Chuck	White Chuck	0-15	15	0%
NF Stillaguamish	Stillaguamish	22-35	13	100%

IV. LISTED AND SENSITIVE SPECIES OCCURRENCE

A. Species Assessed

All ETP&S species and Critical Habitat known or suspected of occurring on the Forest were evaluated for this project (Table 2).

B. Species Potentially Affected

Based on review of available records of species observations, and a lack of habitat, the wolverine is not expected to occur in the project area. This species will not be affected by the project.

All other animal species have a potential to occur in or adjacent to the area and have a potential of being affected. These species are evaluated further in this document.

TABLE 2. LISTED AND SENSITIVE SPECIES CONSIDERED IN THIS ASSESSMENT.

Species or Critical Habitat	Classification
Northern spotted owl (Strix occidentalis caurina)	Threatened
Bald eagle (Haliaeetus leucocephalus)	Threatened
Marbled murrelet (Brachyramphus marmoratus)	Threatened
Grizzly bear (Ursus arctos horribilis)	Threatened
Gray wolf (Canis lupus irremotus)	Endangered
Peregrine falcon (Falco peregrinus anatum)	Endangered
Critical Habitat, Northern spotted owl	Critical Habitat
Lynx (Lynx canadensis)	Sensitive
Wolverine (Gulo gulo)	Sensitive
Common loon (Gavia immer)	Sensitive
Townsend's big-eared bat (Plecotus townsendii)	Sensitive
Bull trout (Salvelinus confluentus)	Sensitive
Agoseris elata	Sensitive
Aster sibericus v. meritus	Sensitive
Botrychium ascendens	Sensitive
Botrychium lanceolatum, and B. lunaria	Sensitive
Botrychium minganense, and B. montanum	Sensitive
Botrychium pinnatum, and B. simplex	Sensitive
Calmagrostis crassiglumis	Sensitive
Campanula lasiocarpa	Sensitive
Carex buxbaumii and C. stylosa	Sensitive
Carex comosa and C. interrupta	Sensitive
Carex macrochaeta and C. pauciflora	Sensitive
Carex paupercula and C. pluriflora	Sensitive
Carex saxatilis v. major	Sensitive
Carex scirpoidea v. scirpoidea	Sensitive
Carex scopulorum v. prionophylla	Sensitive
Cassiope lycopodioides	Sensitive
Chaenactis thompsonii	Sensitive
Cimicifuga elata	Sensitive
Coptis asplenifolia	Sensitive
Dodecatheon pulchellum	Sensitive
Dryas drummondii	Sensitive
Fritillaria camschatcensis	Sensitive
Galium kamtschaticum	Sensitive
Gentiana douglasiana	Sensitive
Gentiana glauca	Sensitive
Lobelia dortmanna	Sensitive
Loiseleuria procumbens	Sensitive
Luzula arcuata	Sensitive
Lycopodium dendroideum	Sensitive
Lycopodium inundatum	Sensitive
Montia diffusa	Sensitive
Platanthera chorisiana	Sensitive
Platanthera obtusata	Sensitive
Platanthera sparsiflora	Sensitive
Pleuricospora fimbriolata	Sensitive
Poa grayana	Sensitive
Ranunculus cooleyae	Sensitive
Saxifraga debilis	Sensitive
Tillaea aquatica	Sensitive

Many of the USFS Sensitive plant species are not suspected in the analysis area because of specific habitat requirements and ecozones. The species that may occur are: Botrychium lanceolatum, Botrychium minganense, Botrychium montanum, Botrychium pinnatum, Carex interrupta, Carex pluriflora, Cimicifuga elata, Fritillaria camschatcensis, Galium kamtschaticum, Lycopodium dendroideum, and Montia diffusa. These plant species are further evaluated in this document.

C. Field Reconnaissance

Survey information is available for the bald eagle, peregrine falcon, bull trout and sensitive plant species:

Bald Eagle. Numerous censuses and surveys have been undertaken for this species in the area. A summary of USFS and other data is shown in Appendix B, with results discussed in subsequent sections of this analysis.

Peregrine falcon. Nest surveys were conducted by helicopter each year from 1986 to 1988 in and adjacent to the Skagit System. These surveys were conducted by the National Park Service in conjunction with the USFS, the U.S. Fish and Wildlife Service (USF&WS), and the WDW. No nests have been located in the analysis area. No major surveys have been conducted in the area since then.

Bull Trout. Bull trout have been documented in the Skagit River by WDW. Survey methods include hook and line sampling, creel survey and angler interviews. A lack of information on bull trout abundance and distribution currently exists for the Skagit River.

Occurrence of bull trout in the Skagit River Basin is known for specific areas, but all potential habitat has not been surveyed. Known bull trout locations include the Cascade River, Ross Lake, the Sauk drainage, and Goodell Creek.

Sensitive Plant Species. Field surveys for sensitive plant species were done in 1993 by qualified botanists along the Sauk River in the area were there is a boat launch. This area is the only National Forest land that will have any ground disturbing activity (use of the boat launch).

No surveys have been conducted in the SW&SRS corridor for any other ETP&S species, primarily due to the majority of non-federal lands in the corridor.

D. Habitat Conditions and Listed/Sensitive Species Use

1. Bald Eagle

a. Status.

The bald eagle's historic and present distribution covers much of North America. Declining populations of eagles up to the 1970's resulted in the listing of the species as endangered in 43 of the 48 contiguous states, and threatened in Oregon, Washington, Michigan, Minnesota, and Wisconsin (USFWS 1986). Causes for the declines were attributed to pesticide contamination, shooting, poisoning, habitat loss, and possible disturbance to nesting and wintering birds.

The Pacific Bald Eagle Working Team (Steenhof 1990) has reported nesting pair increases for most of the zones in the Pacific Northwest. Recovery from effects of DDT, educational efforts to reduce persecution, and increased survey effort have influenced the increasing number of reported breeding pairs. In 1992, seven of the eleven recovery zones within the State of Washington had met recovery goals for occupied breeding territories.

One parameter used in assessing whether the eagle population reaches recovery goals is a requirement that no significant declines in winter populations occur (USFWS 1986).

b. Relationship of the Skagit System to Regional Winter Habitat.

The Skagit system is one component of a larger network of winter habitat for bald eagles in the Puget Sound area. Factors influencing the availability of food throughout the region can be expected to influence eagle abundance in any of the major river systems and the Sound at any one time (Hunt et al. 1992).

Hunt et al. (1992) speculated that the low numbers of eagles in the early part of the winter may be due to more abundant food supplies in other areas. Chum salmon spawn earlier in Alaska and northern British Columbia than in the Puget Sound area, and therefore there areas may retain eagles longer in the early part of winter.

Hunt et al. (1992) summarized results of previous studies that followed the movements of 25 radiotagged eagles on the Skagit and Nooksack Rivers. As food supplies diminished, eagles left the upper Skagit and Nooksack Rivers. Seven eagles flew to other areas within the drainage, including the Sauk and lower Skagit, while others used the Snoqualmie and Fraser rivers. At least seven birds eventually flew westward to Puget Sound (San Juan Islands, Deception Pass, the Straight of Georgia, and coastal flats and estuaries).

Both census and telemetry data support the contention that as eagle numbers declined in the major river systems, eagle use of Puget Sound increased. Food supplies in the Sound included ducks, geese, fish, rabbits, and seabirds.

In the winter of 1978-79, Skagen (1979) found uncommonly high numbers of eagles on the Skagit. During this same winter, chum salmon (Oncorhynchus keta) escapement was 56% of normal on the Nooksack River (Hunt et al. 1992), and moderately high on the Skagit River (Appendix C). This suggests a shift in distribution due to food availability.

Biosystems, Inc. (1981) tracked two subadult eagles from the Skagit River to British Columbia and southeast Alaska in April. Birds captured on the Nooksack generally remained within the Nooksack River drainage during mid-late February, until the birds started dispersing to the San Juans, the Fraser River valley, and to the west coast of British Columbia. Some use of both the Nooksack and Skagit drainages by individual eagles was observed.

Eagles are often seen flying over the town of Darrington, apparently moving between the Sauk and Stillaguamish Rivers (Reed pers. comm.).

c. Number of Eagles on the Skagit System.

Estimates

Bald eagles frequent the Skagit River system primarily during the winter months of November through late February and into early March (Stalmaster et al. 1991; Hunt et al. 1992). The high winter use is due to the availability of food that results from large numbers of chum and, to a lesser extent, coho salmon that return to the river system to spawn and die. Stalmaster et al. (1991) estimated a peak eagle count in a portion of the Skagit system at 501 birds, the largest population in Washington, and one of the largest in the western United States. This attests to the importance of the Skagit River system to northwest bald eagle populations.

Hunt et al. (1992) estimated that 22,743 eagle-use-days occurred on the Skagit system in the 1980/81 winter season. Approximately 41% occurred on the Skagit between the Sauk mouth and Gorge dam, 30% in the lower Skagit River, 16% on the Sauk River between Darrington and the mouth, 4% upriver on the Sauk from Darrington, 5% on the Suiattle, and another 4% in the remaining tributaries of the system. These data were collected in a year of low chum salmon abundance.

Stalmaster et al. (1991) reported an average of 25,805 eagle-use-days over a three year period from 1987 to 1989. The authors reported a similar distribution in eagle numbers to Hunt et al. (1992). They found that approximately 44% occurred on the Skagit between the Sauk mouth and Gorge dam, 28% in the lower Skagit, 19% on the Sauk River between Darrington and the mouth, 6% on the Suiattle, and 3% on the Cascade River. The authors reported this distribution remained relatively consistent. These data were collected during years with both low and high chum salmon escapements.

A precise measure of total bald eagle numbers on the Skagit is unavailable, due to a lack of complete census data for the system. We evaluated trends in eagle numbers and eagle use of the Skagit system by examining two different estimators. First, we developed an estimate of eagle-use-days, and second we used census data from two areas of the Skagit system to serve as an index of eagle numbers.

We used the method employed by Hunt et al. (1992) and Stalmaster et al (1991) in estimating eagle-use-days, using data for the winter periods of 1982/83 through 1992/93. By summarizing eagle-use-days on the Newhalem to Rockport segment, and then extrapolating expected numbers in remaining segments based on the percent distribution shown in Hunt et al (1992), eagle-use-days for the Skagit system were calculated for each year. Since the distribution of eagles measured by Stalmaster et al (1991) and Hunt et al. (1992) were similar despite variations in food abundance, use of this technique appears reasonable. The method may be a conservative estimator of actual eagle use, due to less frequent surveys in the early (October and November) and late (March) survey efforts. Results of this estimate suggest an increasing trend in eagle use of the Skagit system, at least over the past seven winter seasons (Figure 2).

Figure 2a. Observed (Extrapolated) Eagle-Use-Days based on Census Data and Expected Eagle-Use-Days based on Chum Escapement for Skagit River

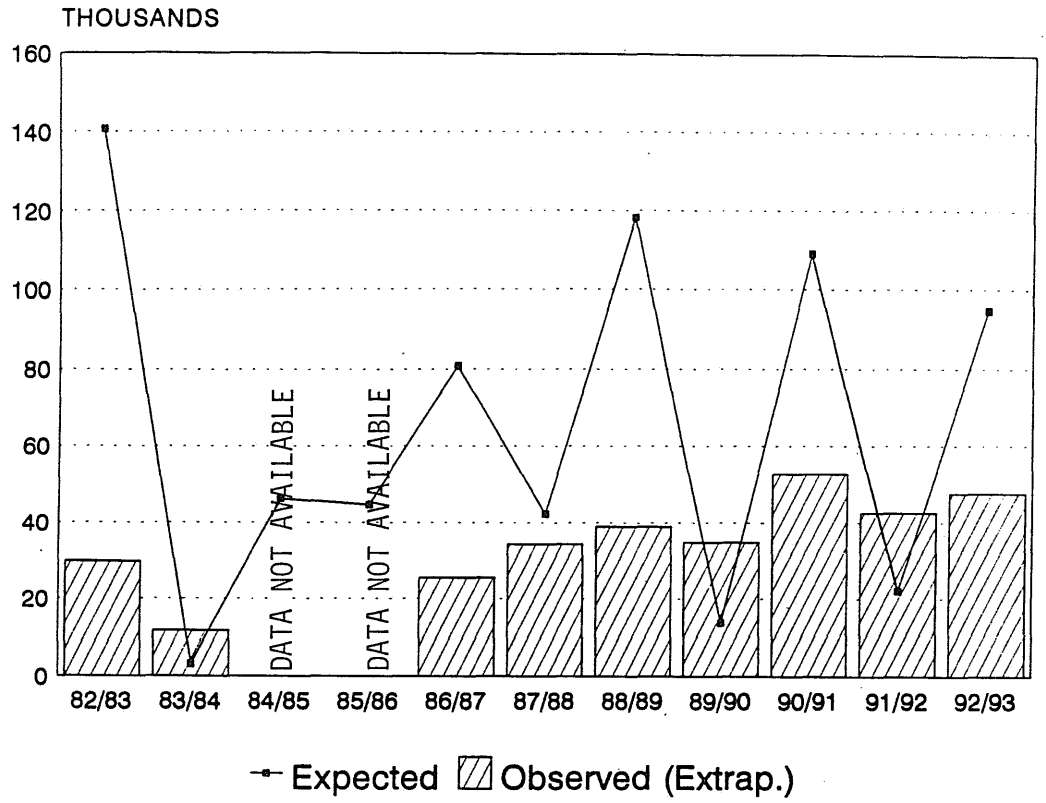
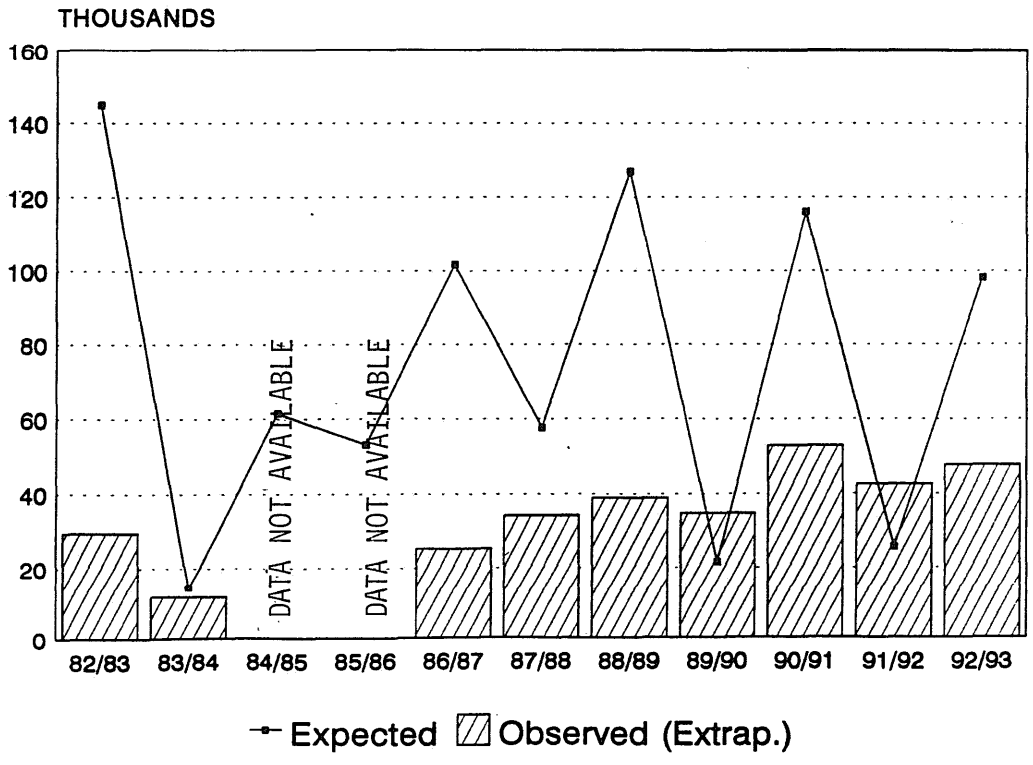


Figure 2b. Observed (Extrapolated) Eagle-Use-Days based on Census Data and Expected Eagle-Use-Days based on Chum and Coho Escapement for Skagit River



The second estimator used in assessing eagle trends was developed using census data from two areas within the system, and using them as index areas which are assumed to reflect trends in eagle numbers system wide. The first index area is the Newhalem to Rockport segment on the Skagit. Data collected by The Nature Conservancy and the National Park Service (Glesne, unpublished data 1993) on eagle observations from 1982 through 1993 was used as an index to numbers of eagles on the Skagit River.

The second index used was the summary of night roost count data from the Sauk and North Fork Stillaguamish drainages, since foraging area census data in these drainages are lacking. While it is possible that eagles foraging in other river segments might occupy roosts in these drainages, eagles have been observed to use roosts closest to foraging areas (Stalmaster and Gessaman 1984).

The results suggest that eagle use of the Sauk and NF Stillaguamish River drainages were relatively stable between 1990 and 1993 (Figure 3b). Numbers of eagles observed in the Newhalem to Rockport segment of the Skagit system appear to be increasing (Figure 3a).

This index method has many inherent limitations, including the possibility that some eagles may remain in forage areas overnight and hence would not be counted in night roosts, that not all night roosts may be known, and that the potential for eagles to use the Sauk drainage but roost outside of the area occurs.

In recognition of the limitations of the two methods, we felt that in combination both estimators reasonably reflect trends in eagle use and numbers of eagles in the Skagit system. Both estimators indicate trends of increasing eagle use of the Skagit system.

Relationship to Food Supply

The number of eagles present on the system appears to be closely related to food supply. Stalmaster et al. (1983) developed a model which predicted the number of eagles occurring based on chum salmon escapement estimates. Hunt et al. (1992) found a correlation between predicted chum salmon escapement and the number of bald eagles present on the Skagit, and concluded that eagle numbers on the Skagit, at least in years of low salmon carcass availability, are closely linked to food availability. Glesne (unpublished data 1993, Appendix B Graph 5) examined eagle census data for the Newhalem to Rockport segment since 1982 and found a close correlation between chum salmon escapement and numbers of bald eagles observed.

Age Ratios

Stalmaster et al. (1991) found that approximately 40% of the eagle population on the SW&SRS was comprised of subadult birds. Age ratios, usually expressed as a percentage of young eagles seen, are an indication of the demographic structure of the eagle population.

A population that is increasing will have more young birds than a population that is declining (Stalmaster 1987). Much variability has been reported in wintering population age ratios, and while age ratios do provide a rough estimate of population structure, long-term trends are considered more consequential (Stalmaster 1987).

Figure 3a. Average Number of Observed Bald Eagles Per Day from Rockport to Marblemount, 1989 - 1993

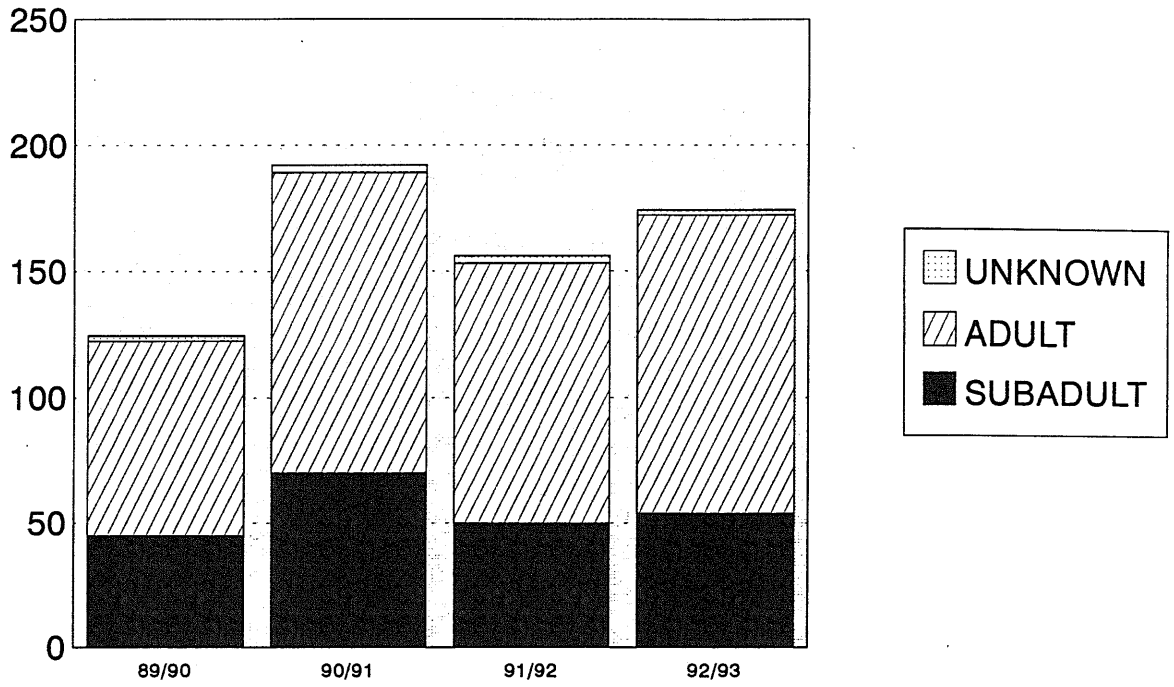


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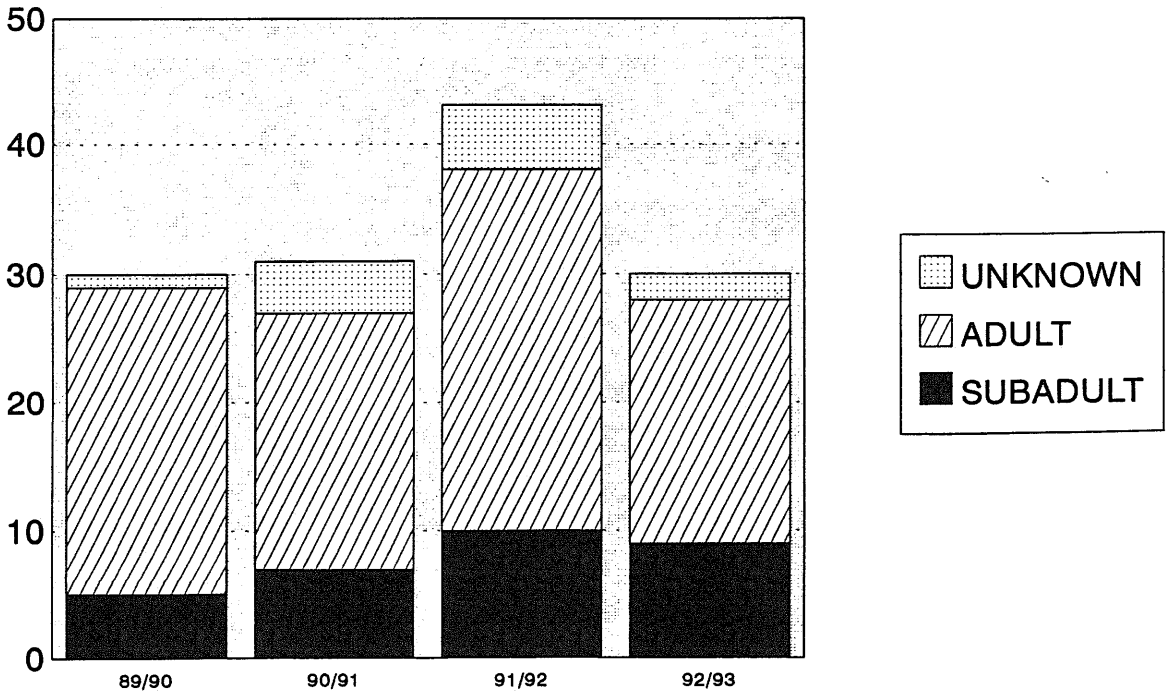
Figure 3b. Average Number of Observed Bald Eagles Per Day at Night Roosts in the Sauk & NF Stillaguamish Drainages, 1989 - 1993



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In discussions of influences on age ratios, Stalmaster (1987) reports that the proportion of young eagles was high where food was particularly easy to find and exceptionally abundant. The Nooksack River was used as an example where in the 1970's the age ratio of subadults to adults was about 34% of the population. In the early 1980's, after increases in the salmon runs, over 50% of all birds observed were young.

Census takers have plotted age ratios for other areas with eagle concentrations and found a rough average of approximately a third of the populations within the juvenile or subadult age class (Stalmaster 1987).

d. Bald Eagle Food Availability.

Numerous studies on the Skagit and adjacent river systems have demonstrated the importance of chum salmon as a food source for bald eagles (Biosystems Analysis Inc. 1981; Bjorklund 1981; Hunt et al. 1992; Russell 1980; Servheen 1975; Skagen 1979; Stalmaster et al. 1991). Chum salmon spawn from mid-November through December in the Skagit and Sauk River drainages, providing a supply of post-spawned carcasses during this period, until high waterflows wash them downstream or they are consumed by wildlife.

Using tagged fish (n=214), Hunt et al. (1992) estimated the rate at which post spawn salmon carrion became available to bald eagles. About 13.5% of the total chum salmon become available to eagles as carcasses, based on surveying carcasses every other week. There was no significant difference between recovery rates of those spawning in tributaries or in the main stem of the Skagit. Spawning areas such as shallow sloughs, because of their physiography, are more likely than other habitats to accumulate carcasses.

While chum salmon are the primary food source of eagles, coho salmon (Oncorhynchus kisutch) spawning in tributaries may serve as a principal food for eagles after mid January (Hunt et al. 1992). The number of coho salmon needed to furnish food for the eagles during the late winter period of 1980-81 amounted to 1,132 carcasses, or 13% of the estimated non-hatchery escapement (Hunt et al. 1992). This estimate was based on a small sample size of fish (n=10). Overall, food availability declines substantially in late winter (mid-January through March) (Stalmaster et al. 1991).

The quality of habitat for wintering bald eagles is tied to food sources and the characteristics of the area which promote foraging. Key factors are spawning habitat for fish and gravel bars for carcasses to catch or beach on. Night roosts are considered important for periods when thermal regulation is needed by eagles, and as part of the social interaction and foraging strategies of the birds. Tree cover along the river provides perches for eagles between feeding periods. Perch site availability is not believed to be a limiting factor on eagle abundance or forage use in the system.

Hunt et al. (1992) examined relationships between the number of bald eagles on the Skagit River and waterflow in the system during the winter period. In a 41 km study site on the upper Skagit, they concluded that eagles were negatively correlated to flowrates and flooding. They believe this was due to the influence these factors have on carcass availability. Higher flows and flooding tended to wash carcasses away and make them less available to eagles in the upper portion of the Skagit. It is unknown the degree to which these carcasses were subsequently deposited downstream.

The abundance of other food sources (ungulate carrion, waterfowl, etc.) in the Skagit system is relatively low, and is likely to be of low importance to eagles (Stalmaster et al. 1991; Hunt et al. 1992).

Temporal foraging patterns of eagles were described by Stalmaster et al. (1991). Most feeding activity was concentrated in the morning hours (63%), primarily between the hours of 9:00 am and 11:00 am. While feeding occurred throughout the day, significant declines in these activities occurred as the day progressed.

For this evaluation, we attempted to rate the various river segments as to their capability of providing available salmon carcasses (results shown in Table 3 and Map 1). This rating (High, Moderate, Low) was developed in part with the use of Washington Department of Fisheries (WDF) spawning survey data for chum and coho salmon, which is taken on a regular basis on selected index streams, and in other areas on an irregular basis (See Appendix C for details.)

Table 3 shows ratings, by river segment, of bald eagle food availability, eagle use patterns, and winter recreation levels. Within the entire Skagit River system, the river segment that has the highest food availability and eagle foraging use is the Illabot segment. The McLeod Slough segment also has high eagle use, with moderate food availability. The Concrete, Marblemount, Middle Sauk 1, and NF Stillaguamish segments were also rated as having "high" forage use, although the peak counts for these segments have been substantially lower than those for the Illaobt and McLeod Slough segments (Table 3). Appendix A provides a more detailed account of eagle use by river segment.

The Illabot, Marblemount, and McLeod Slough segments experience high levels of recreational activity (primarily boat use), while the Middle Sauk 1 and NF Stillaguamish segments receive moderate levels of recreational use (primarily fishing, with both drift boat and bank use). The Newhalem segment has a moderate level of food availability, eagle use, and recreational use. Areas with high eagle use and high recreational use have the highest potential for recreation/eagle conflicts.

Several anomalies can be found in Table 3. Data for the Lower Cascade segment indicate high food availability (reflected in both the carcass counts and the catchability) but low eagle use. It is not known why eagle use is not more significant in this area, as recreational use is low, and perch sites do not appear to be limiting.

TABLE 3. BALD EAGLE FOOD AVAILABILITY, HABITAT AND USE PATTERNS, AND RECREATIONAL USE BY RIVER SEGMENT, SKAGIT SYSTEM AREA.

River Segment Name	1 Eagle Forage Availability			2 Bald Eagle Occurrence and Habitat				3 Winter Recreation Levels	
	Chum	Coho	Catchability*	Perch Sites	Roosts	Peak Count	Forage Use	Boat**	Foot Traffic
Lyman	M	M	H	M	1	31	M	L	L
Hamilton	L	L	M	L	0	10	L	M	L
Concrete	L	L	H	M	1	65	H	M	L
McCleod Slough	M	L	H	M	1	90	H	H	H
Illabot	H	L	H	H	6	325	H	H	H
Marblemount	H	L	L	M	1	50	H	H	L
Newhalem	M	L	M	H	0	40	M	M	M
Lower Cascade River	H	M	H	H	0	4	L	L	L
Upper Cascade River	L	L	L	H	1	23	L	L	L
Lower Sauk	L	H	H	L	0	13	L	L	L
Middle Sauk 1	H	H	H	M	2	44	H	M	M
Middle Sauk 2	L	L	M	H	0	4	L	L	M
Upper Sauk	M	M	H	H	1	10	L	L	M
Upper Suiattle	L	M	H	H	3	14	L	L	L
Lower Suiattle	L	M	M	M	0	25	L	L	L
White Chuck	U	U	L	H	0	U	L	L	L
NF Stillaquamish	H	H	H	H	1	49	H	L	L

1/ Chum and Coho Salmon carcass production ratings of H=High, M=Moderate, L=Low, and U=unknown. Ranking based on professional judgement following review of carcass count data (WDF 1993), consultation with WDF personnel (Hendricks, pers. comms.), and knowledge of the segments.

*/ Catchability refers to the inherent ability of the river segment to allow accumulation of carcasses. Segments with a large number of gravel bars, high braiding, meandering channels, and relatively low water velocities received a high ranking.

2/ Perch Sites (column 1) is a subjective rating of perch site availability in the river segment (H=High, M=moderate, L=low). Perch sites are not believed to be limiting in the system. Column 2 shows number of known roost sites. Column 3 is the highest reported number of eagles seen in the segment based on USFS, NPS and/or TNC survey data. Foraging Use is a rating based on the level of existing bald eagle use (H= > 5 eagles on a somewhat regular basis over 2 or more years, M= 1 - 5 eagles over 2 or more years on a somewhat regular basis -or- >5 intermittently or for a limited period, L= 1 - 5 eagles intermittently).

3/ Subjective rating of winter recreational use based on USFS data, information from Stalmaster et al. (1991), and knowledge of the segments (Sotnik, pers. comm.)

**/ Boat use estimates: H= above 1000 river craft/year, M= 501-1000 river craft/year, L= 0-500 river craft/year.

The Concrete segment, on the other hand, appears to have low forage availability but high eagle use. The high eagle use in this segment is primarily concentrated within one area (Van Horn bend), with the rest of the segment receiving relatively low to moderate use. Carcass counts may average out as low for the entire segment, but the high catchability at Van Horn bend may cause this one location within the segment to be a high-use forage area for eagles. Although Table 3 reports this segment to have moderate recreational use, eagle surveyors have noted considerable disturbance (flushing of foraging eagles) at this location on several occasions during the winter (i.e., overall recreational use is moderate for this segment, but intermittent, local disturbances occur at this location).

e. Chum and Coho Salmon Population Trends.

Cursory examination of fish escapement data for chum salmon since 1968 for the Skagit reveals a cyclic change in numbers of fish. Chum salmon exhibit higher and lower escapement for even and odd years, respectively (Sprague pers. comm.). There also exists a stock-recruitment relationship between the parent and recruitment year classes, four years apart (Appendix C). The chum salmon population in the Skagit system appears to be relatively stable, although cyclic variations occur. Escapement goals developed by WDF for chum salmon in even and odd years (116,000 and 40,000, respectively) are not consistently met.

Currently, coho salmon are exhibiting a strong decline in populations (Parkhurst pers. comm.). Recently, coho salmon stocks have been petitioned for listing and protection under the Endangered Species Act.

Many of the tributaries to the Skagit are identified as watersheds in an unacceptable condition due to water quality and fish habitat concerns (USFS 1990). Habitat conditions for these species are hampered by channel instability and sediment loading. Appendix C details habitat requirements and environmental needs for chum and coho salmon, in addition to escapement numbers for these species.

f. Energetics and Carrying Capacity.

Since birds of prey often appear to be at population levels commensurate with food supplies (Newton, 1979; Stalmaster and Gessaman, 1984), the bald eagle carrying capacity of the Skagit River is likely dependent on salmon carcass availability. Estimates of carrying capacity need to consider the energetics of the species involved, intake rates, foraging strategies, caloric content of food supplies, and climatic conditions, among other parameters. Some of that information can also provide insight into the overall understanding of the possible effects of disturbance on wintering eagles and is presented here.

Stalmaster and Gessaman (1984) examined foraging behavior and energetics of wintering eagles on the North Fork Nooksack River. Time budgets based on tracking of radiotelemetered birds showed that they were sedentary most of the day (99% of 24 hours). They traveled an average of 6.1 km/day, 2.6 of which was the flight to and from the night roost. According to their model, the energy savings outweighed the cost of that flight. Regardless of location on the river, when eagles left the Nooksack at dusk they always selected the nearest roost, presumably maximizing energy conservation.

According to the above authors, inactivity is described as an important strategy for winter survival. Sit-and-wait hunting and especially food-stealing (kleptoparasitism) are the preferred foraging strategies. Juveniles and subadults spent more time at feeding sites and less time feeding than adults. This was presumably due to being less adept at foraging, and adults being more successful at stealing food from younger eagles. On average, young birds did not meet their energy needs at the feeding station observed by the authors; it was suspected they were meeting their needs feeding elsewhere. Gorging is also an important strategy. Eagles were observed to gorge up to 886g of salmon during a feeding. This amount can meet the energy requirements by feeding every 1.8 days. A food-deprived juvenile (Stewart 1970, as reported in Stalmaster and Gessaman 1984) gorged 924g in its first meal after 16 days, enough to meet energy requirements for 1.9 days. The availability of food is highly variable in time and space and eagles have been shown to withstand long periods of deprivation. The juvenile that was food-deprived demonstrated a 28% loss of body mass, but no apparent permanent harm.

Three estimates of carrying capacity are presented here. Two investigations have been conducted to examine carrying capacity in the area (Stalmaster 1981a and 1983, Hunt et al. 1992) and we applied the techniques from these investigations to available census information on the Skagit since 1982 (Figures 2a & 2b, Appendix B Graph 7). The carrying capacity can be described for a given point in time or for any period of time. Both techniques attempt to predict the carrying capacity for a season based on chum escapement. The models make assumptions for the energy requirements of the "average" eagle and the energy that becomes available and usable from chum salmon. Both models ignored the contribution of coho, but recognize that they contribute a small amount especially to late season food availability. In our application of the techniques we found that the addition of coho to the assessment had little effect (see the differences between Figure 2a and 2b).

Stalmaster (1981a) and Stalmaster and Gessaman (1982) described food consumption and energy requirements based on studies of captive bald eagles. Information from these studies and others (Biosystems Analysis Inc. 1981 [later in Hunt et al. 1992], Stalmaster and Newman 1978) was used to develop an energetics simulation model (Stalmaster 1981b and 1983). By evaluating the needs of an eagle relative to the value and availability of food, the model attempts to predict the seasonal carrying capacity of a river system based on escapement of chum salmon. Some of this information was also used to assess the carrying capacity of wintering bald eagles on the Skagit system (Hunt et al. 1992).

The model assumes that chum salmon are the primary food source and that an eagle requires 486 g of fish/day. Fourteen percent of salmon carcasses are assumed to drift to areas accessible by eagles. Eagles consume 94% of carcasses available to them (6% is lost to competition). Calculations are incorporated to account for: energy loss due to carcass decomposition; energy costs of the effects of the wind, long-wave radiation, ambient temperature, body temperature and energy costs of various other activities.

The verification of the energetics model on the North Fork Nooksack River suggested an error factor of less than 19% and appeared to show that the river was at or near carrying capacity on a season-long basis (Stalmaster 1983).

The second effort at defining a carrying capacity was conducted by Hunt et al. (1992). Their model was essentially a simplification of the Stalmaster model using salmon weights from the Skagit and ignoring losses due to competition and

decomposition. The authors recognized that losses occur due to competition but excluded them from the model. While they noted that the energetic content of tissue samples from carcasses did not decline with age, it is likely that some loss in total tissue can be expected from decomposition.

While the above study was conducted in an even numbered year, chum salmon escapement that year was in the range normally found during odd numbered years. The authors estimated that the amount of carcasses available to bald eagles from November to early January in the 1980-81 season was above that required by the number of eagles present. However, in the latter half of winter this was reversed until mid-February, when eagle numbers declined (Hunt et al. 1992).

Hunt et al. (1992) speculated that the presence of eagles at numbers below their carrying capacity in the early part of winter may be due to more abundant supplies in other areas. As stated earlier, chum salmon spawn earlier in Alaska and northern British Columbia than in the Puget Sound area, and therefore these areas may retain eagles longer in the early part of winter.

There is considerable variability between the two techniques for assessing bald eagle carrying capacity based on salmon escapement. This leads to variability in results and must be considered in evaluating the conclusions of these studies as they relate to the current discussion.

Different assumptions were used for these techniques. As previously stated, one model accounted for carcass losses from competition with other species and decomposition, while the other did not. By applying the assumptions of one to the results of the other the variability becomes evident. As an example, by applying Stalmaster's (1981, 1983) model to the results of Hunt et al. (1992), the predicted eagle-use-days would be 18,019 as opposed to the 21,073 reported by the authors. Of course, the opposite situation would occur if Hunt's model were applied to Stalmaster's results.

Hunt et al. (1992) used escapement predictions from WDF. Predictions are made prior to the season. Escapement estimates are made by WDF after the season, based on sampling conducted during the season. The escapement estimate for the 1980-1981 season was 19,425, 9% less than predicted.

The combination of application of Stalmaster's model to Hunt's results and the use of escapement estimates instead of predictions provides a low-end estimate of 16,395 eagle-days, 22% less than predicted and 28% less than observed by Hunt et al. (1992). If this estimate were accurate it would suggest that the eagles on the river system were well above the carrying capacity. On the other hand, applying Hunt's assumptions to Stalmaster's results would suggest that eagles on the North Fork Nooksack were well below carrying capacity.

Recognizing the limitations of the techniques, we also estimated season-long carrying capacity of the Skagit system (excluding the Stillaguamish) using fish weights from Hunt et al. (1992) and eagle needs from Stalmaster (1981, 1983). We then compared those predictions to actual eagle-use-days estimated from weekly census' from Rockport to Marblemount (NPS & TNC) that were extrapolated to a SW&SRS population using distribution estimates of Hunt et al. (1992). Our technique was essentially the simplified version used by Hunt with the difference that we used escapement estimates instead of predictions (Figure 2a). In addition, we incorporated coho escapement in a separate calculation (Figure 2b).

Our calculations indicate that based on chum escapement, carrying capacity was exceeded in 1983, 1989, and 1991 (Figure 2a) (data for 1984 & 1985 were unavailable). The addition of coho to the calculations make only slight differences and raise the expected slightly above the observed (extrapolated) for 1983 (Figure 2b). Keeping in mind the limitations of the models, these calculations are not taken to represent actual carrying capacities. Rather, the information has been used to give indications of when there may be a potential for food to be limiting.

An additional factor that may influence carrying capacity, but was not considered in the models, is group size. Based on observations on the North Fork Nooksack River, Stalmaster and Gessaman (1984) noted a relationship between group size and rates of interactions between eagles. Social foraging has advantages for eagles but there appear to be diminishing returns as eagle numbers increase above a certain level. As interaction frequencies increase, foraging efficiency should be expected to decrease. The authors found an optimum group size to be three to five. Interaction frequency increased exponentially in groups greater than 5. Groups greater than 20 were rare.

2. Northern spotted owl:

One portion of the analysis area (Suiattle River) is located within a spotted owl Habitat Conservation Area (HCA, W-28), and within a USF&WS-designated Critical Habitat Unit (CHU, WA-27). This HCA has an estimated population of 8 pairs of spotted owls (ISC, 1990). Surveys through the 1990 season identified 6 pairs, and 4 single birds within the HCA. No nest sites are known to occur within the analysis area of the Skagit W&SR corridor.

3. Marbled murrelet:

Surveys on some of the tributaries within the Skagit River system have found forest stands occupied by marbled murrelets (indicating probable nesting in these stands), and other areas of marbled murrelet presence in the Skagit River drainage. However, it is unlikely that marbled murrelets nest within the SW&SRS corridor, due to a lack of suitable nesting habitat. Marbled murrelets may fly over the river corridor on their way to and from nesting habitat, even during the winter, as murrelets have been detected in some forests in the winter (Ralph et al., 1993).

4. Grizzly bear:

Verified grizzly bear tracks have been detected approximately 10 miles north of the analysis area, in the Noisy-Diobsud Wilderness. An old grizzly carcass was found within 1 1/2 miles of the northeastern end of the SW&SRS, in the Ross Lake National Recreation Area. There was also a possible sighting in the upper Cascade River drainage. There are historical records (Sullivan, 1983) of grizzly bear sightings within the Suiattle drainage. Suitable habitat for this species is determined mainly by availability of foraging habitat, suitable winter den sites, and access to large areas away from human influence zones. The analysis area is located within the Highway 20, Highway 530, and Mt Loop Scenic By-way corridors. In addition, the analysis area contains much human development and is proposed to be managed for developed and dispersed recreation (Management Situation 3). Because of a lack of security habitat within most of the analysis area, it is highly unlikely that grizzly bears occur there.

5. Gray wolf:

Gray wolves have been verified in the North Cascades, on National Park Service lands northeast of the analysis area. Other possible detections have been reported in the Baker Lake basin. Suitable habitat for this species is determined mainly by availability of prey, water, cover, and areas away from human influence zones. Because of the presence of human development and high human use, it is unlikely that gray wolves occur within the analysis area.

6. Peregrine falcon:

Areas along the Skagit River system may be used as feeding habitat for peregrines, where waterfowl, a preferred peregrine food, occur. In addition, the Skagit River may be an important migration corridor for raptors, including peregrine falcons (Eric Cummins, pers. comm.). Available information on peregrine occurrence in the Skagit Valley indicates that a few peregrines winter in the Skagit Flats, and migrate north in the spring to nest in Canada. There is no information to suggest that any peregrine nesting habitat occurs in the SW&SRS corridor, or that peregrines use it to any extent.

7. Lynx (Sensitive)

Lynx sightings have been reported in the North Fork Nooksack drainage and also in the Baker Lake basin. Lynx are known to occur above 4000 feet elevation in Washington, although they have been located at higher elevations during the summer than in the winter in Washington. (WDW, 1993).

8. Common loon (Sensitive)

Common loons have been sighted on Baker Lake in the summer. It is possible that loons may use the SW&SRS corridor as a flyway. Wintering loons are more likely to be found on coastal waters than inland.

9. Townsend's big-eared bat (Sensitive)

Two Townsend's big-eared bats were detected on the Mt. Baker District during a survey in 1988 (Perkins, 1988). No Townsend's bats were detected on the Sauk and Suiattle rivers on the Darrington District, but one was detected on the Skykomish District, south of Darrington, so it is feasible that Townsend's bats also use areas on the Darrington District. The two detections on the Mt. Baker District were both day-roosts under bridges. No surveys were conducted on the Skagit River itself, but it is possible that they occur on a river of this size, as one of the detection locations was just off of the North Fork Nooksack River. As with many bats, Townsend's have been found to utilize open areas of standing water along streams for feeding on insects.

10. Bull Trout (Sensitive):

Until 1978, the bull trout (Salvelinus confluentus) was considered to be a form of Dolly Varden (S. malma), both native char of western Washington. Since then, these forms have been separated into two species, based on morphometric and meristic characteristics. A method exists to distinguish the two by Haas (1988). However, in coastal and northern Puget Sound drainages which are within the expected zone of co-existence, the Haas method does not appear to separate the species (WDW 1992). Of the coastal Washington native char populations examined to date which were previously believed to be Dolly Varden, all indicate a predominance of bull trout when examined with Haas' methodology.

Four life forms of native char are generally recognized. The adfluvial form matures in lakes or reservoirs and spawns in tributaries where juveniles rear for one to three years. Fluvial stocks have a similar life history except that they move between mainstem rivers and smaller tributaries. Bull trout have been found to be anadromous in coastal and Puget Sound drainages. Resident bull trout spend most of their lives in small, high elevation streams.

Most of the information on habitat requirements presented here was derived from information gathered from eastside drainages. Dolly Varden and bull trout share virtually the same habitat requirements in freshwater habitats. Young-of-the-year (YOY) have specific habitat requirements. Small bull trout (< 100 mm) are primarily bottom dwellers, and fry are found in shallow, slow backwater side channels or eddies, often in association with fine woody debris, and sand and gravel substrates. Age 1+ and older juveniles are found in deeper and faster water than YOY, often in pools with organic debris or clean cobble substrate. In larger rivers, the highest abundance of juveniles was found in rocks along the stream margin or in side channels. Limitations in juvenile rearing habitat may form an "ecological bottleneck", which would affect the overall population levels of bull trout (McPhail and Murray 1979).

Bull trout are strongly influenced by temperature, seldom occurring in streams with summer temperatures exceeding 18 degrees C, and are often found near cold perennial springs.

Adult char habitat is described by Goetz (1989) in a literature summary. Adult bull trout prefer deep pools of cold water rivers, lakes and reservoirs. Instream cover is essential to providing adequate habitat. Overhanging and undercut banks also provide good cover for adults.

11. Sensitive plant species

Botrychium lanceolatum, Botrychium minganense, Botrychium montanum, Botrychium pinnatum, Carex interrupta, Carex pluriflora, Cimicifuga elata, Fritillaria camschatcensis, Galium kamtschaticum, Lycopodium dendroideum, and Montia diffusa can be found in the western hemlock ecozone in the riparian or mixed deciduous-coniferous forest. Montia diffusa has been found in a gravel bar near the launch on the Sauk River. Many of these species have a specific habitat requirement or are at the edge of their range.

V. ASSESSMENT OF EFFECTS

This evaluation focuses on the issuance of permits to commercial operators on the SW&SRS, and the non-issuance of permits to other recreational users, which is incorporated in the proposed action.

A significant amount of variation exists in the methods and level of sampling involved in the studies cited in this document. Since it is not possible to fully report these here, all cited documents are hereby incorporated by reference. The reader should review the original citation for methodology.

A. Bald Eagle.

1. Potential Effects

The focus of concern regarding the bald eagle relative to the proposed action is the extent to which existing and projected recreational use of the Skagit system will impair winter foraging activities of eagles, and whether this effect could alter eagle survivability or reproductive success.

The degree to which recreational activities will influence bald eagle behavior depends upon several factors, including the characteristics of the winter habitat, temporal relationships, individual eagle behavior, the type of disturbance and its intensity or frequency, and food availability.

Disturbance of bald eagles by human activity has been discussed in many of the studies on wintering bald eagles. The sensitivity or tolerance of birds to human activity is often reported with references to amount of activity and to amount of forage. Steenhof (1976) reported that eagles may be more tolerant of people when foraging in preferred areas of abundant prey.

Conclusions about responses to disturbance are complicated by observations of individual birds. Some birds react more readily than others. Another factor in determining the response to disturbance may be the potential habituation of birds to disturbance (or lack of habituation). Stalmaster and Newman (1978) documented the interruption of eagle feeding and perching by human activity on the river system, and the apparent displacement of eagles to areas of less human activity. Eagles appeared to be more tolerant of disturbance when they were physically screened from human activity. A 300 meter buffer was suggested as an effective zone to eliminate eagle flushing to human activities on the Nooksack River.

The distance at which a disturbance elicits a response from an eagle has also been widely described. Buehler, et al. (1991) reported effects of human activity on bald eagle distribution in the N. Chesapeake Bay. Eagles flushed at boat approaches of 40-475 meters. The flushing distance was reported as being at the farther distance during winter. McGarigal et al. (1991) also reported on interactions of humans and bald eagles. During spring and summer in the Columbia River estuary, eagles were found to avoid foraging within 400 meters of the experimental stationary boat. Avoidance areas were reported in a range of 200-900 meters among pairs. A buffer zone of 400-800 meters around high-use foraging areas was recommended. Eagle feeding was greatest during early hours (<10 am) and McGarigal et al. (1991) suggested that the buffer zones would be most effective before 10 am and not needed following that period each day.

While most studies have documented wintering eagle response to human activities in rural settings, Spahr (1990) investigated wintering eagle response to human activities in the urban setting of Boise, Idaho. Spahr reported that eagles were more likely to flush when persons approached slowly and focused on the eagles. Walkers, especially when stopping to look at the eagles, were found to represent the most disturbing human activity (human activity was represented by: bicycler, vehicle, walker, fisherman and jogger). Spahr (1990) also found that eagles allowed disturbance activities at a closer distance (less than or equal to 100 meters) before flushing than what was reported in northwest Washington. These results suggested to Spahr (1990) that eagles in the Boise study area may have habituated to human activity.

This conclusion was also supported by the observations of higher flushing distance in Zone 1 (upriver from Boise) vs. Zone 2 (within Boise).

Disturbance distance of human activity on the rivers may be directly influenced by the river width. River segments which are narrow have greater potential for human activity on the river to pass within close proximity of foraging or perching eagles. Isaacs et al. (1992) reported that on the lower Grande Ronde and Wallowa Rivers, both characterized as "narrow", 84% of the eagles perched adjacent to the river flushed by boats floating the river during observations made in November through March.

While various distances of flushing response are reported, Fraser (1985) sums up the difficulty that exists in distinguishing between the fact of disturbance and the effects of disturbance. While modeling portrays potential consequences of disturbing wintering eagles, there is little documentation of declining population trends from the current population census or natality and mortality rates. Fraser (1985) concludes that what does seem clear is that chronic disturbance of eagles by human disturbance can lead to discontinued use of the areas.

The consequences of chronic disturbance on the individual or population as a whole is difficult to measure. Some wintering bald eagle populations are food-limited (Stalmaster and Gessaman, 1984). Winter food shortages may inhibit egg-laying and result in depressed the breeding rates (Hansen and Hodges 1985 in Stalmaster et al. 1991). Recruitment into the adult population would be lowered if subadult survival is reduced. These consequences could detract from recovery rates of the population as a whole.

2. Measured Effects, Results of Studies on the Skagit River System

Since the early 1970's concern was expressed as to the effects of human disturbance on the status of the wintering population of bald eagles on the Skagit river. The SW&SR Management Plan (USFS 1983) identified the need to further investigate the relationship between wintering bald eagles and winter recreational activities. Various studies have been during the last two decades to investigate the ecology of wintering bald eagles and effects of human disturbance on the Skagit and Nooksack rivers (Servheen 1975; Russell 1980; Skagen 1979 and 1980; Stalmaster and Newman 1978; Stalmaster et al. 1991; Wiley 1977, 1978; TNC 1976; Ralph 1980; Knight et al. 1980; Biosystems Analysis 1980; Bjorklund 1981; Hunt et al. 1992; Knight and Knight 1984; Stalmaster 1989).

These studies documented movement of eagles from human activity (flushing behavior related to distance and type of disturbance) and impacts to eagle feeding periods, and correlated numbers of eagles to levels of human disturbance.

Stalmaster et al. (1991) found that feeding activity exponentially declined in relation to the number of recreational events. Eagles were observed to feed 30% less on weekends than on weekdays when recreation was lower. Subadult foraging declined faster than foraging by adult birds, and subadults were slower to resume feeding following disturbance. The authors suggest this may be the result of limited exposure to humans and higher energy stress. More eagles were flushed by foot traffic than by motorboats (on a per-event basis), but more eagles were influenced by motorboats (due to more encounters with motorboats).

The data collected found that 63% of the eagle feeding activity occurred between 9 am and 11 am, with eagles tending to move off of the river as the day progressed. Recreational activities were found to increase the rate at which eagles moved off the river. Where eagles that moved off the river went, and whether or not they fed elsewhere, was not directly assessed by the study. As previously stated overall feeding activity was strongly dependent on the number of recreational events. When more than 40 recreational events occurred per day, few eagles were observed feeding.

The first few recreational events had the most effect on eagle behavior. For example, the first 17 events had the same net effect as the next 98 boating events in a 115 event day. Feeding activity increased on Mondays and Tuesdays following reduced use on the weekends due to recreational activities. The authors felt this occurred due to food stress on weekends.

Although the authors documented that recreationists were impairing foraging time by eagles on the main river, the proximate consequence to the population as a whole, or to individuals, was not evaluated as part of the study.

Response to recreational use was highly variable. Some eagles adapted well while others had very high sensitivity. Biosystems Analysis, Inc. (1980) reported that their data supported the hypothesis that bald eagles were more tolerant, or less likely to leave the foraging area due to human disturbance, when food is limited. They indicated that eagles disturbed at preferred feeding areas were observed returning to feed, usually in less than one hour from time of disturbance. This observation was also reported by Stalmaster (1975), who found that eagles foraging in areas of high human use appeared to be easier to approach than eagles in low human use areas.

Russell (1980) discussed her observations of eagles wintering on a river with little human activity (Suiattle) as being more sensitive to human activity than eagles on a river with high human activity (Sauk). Skagen (1980) observed a decrease in eagle feeding when human activity was within 200 meters of the eagle feeding area.

Hunt et al. (1992) speculated that territoriality among some adult eagles may ensure availability of carcasses to an individual over the winter period, and by definition, to the detriment of other individuals. During periods of low food availability therefore, other factors such as human disturbance could exacerbate declines in available food for subadult or subdominant eagles. Hunt et al. (1992) estimated that salmon on gravel bars were available to eagles, and did not consider the influence of human disturbance factors on carcass availability.

3. Cumulative Effects

Given that the Skagit system is one part of a wider network of winter habitat for bald eagles in the Puget Sound area, factors influencing the wintering habitat quality throughout the region can be expected to influence eagle abundance and long term productivity of the population. This makes the winter population susceptible to a variety of cumulative effects which could occur throughout the region, most of which cannot be quantitatively assessed.

Regulation of the salmon fishery, changes in habitat quality and occurrence of catastrophic events (e.g., wildfire which degrades water quality, oil spills in the Sound, declines in estuarine habitats, volcanic events, etc.) could all influence the population as a whole.

In the Puget Sound, actions which promote the conservation and retention of estuaries and other areas upon which shorebirds and waterfowl depend, and water quality as related to fish abundance can all positively influence food availability for eagles. The fishery regulations which affect the conservation and abundance of chum and coho salmon, in addition to habitat conditions, will directly influence the carrying capacity of the Skagit for bald eagles. While chum populations appear to be relatively stable over time, coho populations are in decline (Appendix C).

Dam operations as they relate to flowrates can directly effect food supplies of eagles. The numbers of eagles present on the Skagit were negatively correlated to river flowrate and the number of flood events (Hunt et al. 1992). The authors believed that eagles were negatively correlated to flowrates and flooding due to the influence these factors have on carcass availability. Higher flows and flooding tended to wash carcasses away and make them less available to eagles.

Consequently, management of flows through the Ross Lake, Gorge, and Diablo dams will influence food availability for eagles on the Skagit, and directly influence carrying capacity. Flowrates and dam management strategies are currently being investigated by Seattle City Light in cooperation with a number of agencies and groups. Final recommendations and agreed upon management strategies are yet to be finalized.

Degraded watershed conditions can be expected to improve over time. Currently, interagency efforts are underway to restore the system. The USDA Forest Service has implemented a sizable restoration program aimed at improving watershed stability and water quality. The program is likely to continue. Adoption of stricter management strategies are currently under examination by the federal government (Pacfish, President's Forest Plan). Recovery rates will likely be slow and occur over a long timeframe.

Subsequent development of sport fisheries in the system could directly influence eagle food supply, and indirectly influence levels of recreational activities. Currently, the State of Washington is proposing to enhance steelhead production from enhancement and additions to the hatchery facilities in the Skagit system. Resulting increases in steelhead abundance could increase the attractiveness of the area for recreational and commercial fisher, as well as expanding the area influenced by these activities in the system. Recreational use of the Skagit system is expected to continue to increase over time with or without changes in steelhead production.

While the USDA Forest Service has authority to manage use of the surface waters in the SW&SRS, management practices and use of the non-federal lands is largely up to the private landowner as guided by state and local regulation. The degree to which persons afoot on the banks disturb bald eagles cannot be controlled, and is anticipated to remain at existing levels or increase. Stalmaster et al. (1991) found that foot traffic had the greatest influence on eagle disturbance.

Public perceptions and recreational activities will greatly influence the future of bald eagle habitat on the river. Stalmaster et al. (1991) conducted a non-scientific study to determine public perceptions about eagles. A questionnaire was given to recreational users on the river to examine their perception of human-eagle interactions. A total of 803 questionnaires were given out; 52% were returned. Based on returned questionnaires, most recreationists underestimated their effect on eagles. Resistance to, and the reduced effectiveness of, restrictive measures for the management of bald eagles will continue without additional educational activities.

The Skagit Eagle Festival, for example, provides a tremendous opportunity to provide viewing ethics information to the recreational users, but also has the potential to attract (increase) use levels in an uncontrolled fashion. The last festival, which was over a two weekend period, drew hundreds of visitors to the river during the period of highest eagle density, potentially increasing conflicts with eagles. The 1993/94 Skagit Eagle Festival is planned for just one weekend in response to the disturbance to the bald eagles.

Many parts of the Skagit system are bordered on one or both sides by main thoroughfares (Hwys 20 & 530, South Skagit Highway, Cascade River Road, etc.). Traffic in proximity to foraging areas is an ongoing disturbance. Passing motorists are often attracted by the sight of eagles and stop to approach and/or photograph them.

Ongoing land exchange programs could facilitate higher levels of bald eagle management through the acquisition of non-federal lands by federal agencies or conservation groups. From 1992 to 1993, 1,894 acres have been purchased for the protection of bald eagle habitat. The Nature Conservancy, Inc. manages the Skagit Bald Eagle Natural Area, and is active in land acquisitions. Acquisition of lands is expected to continue in the SW&SRS, favorably influencing foraging, roosting, staging area protection and fish habitat.

Disturbances to roost and staging areas on non-federal lands have the potential to influence eagle habitat. Current Washington Forest Practice Act regulations (Wa. Dept. Nat. Res. 1993) contain protective measures when operations occur near roost sites, which should continue to provide a degree of protection. Timber harvest on private lands can be expected to continue. Due to less restrictive guidelines for water quality protection relative to federal guidelines (i.e., stream management zones, etc.), continued supplies of sediments above natural rates, and hazards from slumping can be expected.

B. Northern spotted owl

No direct effects are expected to the northern spotted owl as a result of the proposed action. The analysis area contains very little suitable spotted owl habitat (no large contiguous stands), and it is highly unlikely that nesting spotted owls occur within the river corridor. The proposed action would not remove critical habitat or other suitable spotted owl habitat, nor would it alter it so as to make it unsuitable, nor would it affect the ability of unsuitable habitat to become suitable. No indirect or cumulative effects are expected as a result of the proposed action.

C. Marbled murrelet:

A potential direct effect of permitted activities would be human disturbance to murrelets visiting forest stands in the winter. However, such effects are not expected, since fly-overs occur far above the recreational activities to be permitted, and it is unlikely that there is suitable nesting habitat within the analysis area for murrelets to be visiting in the winter. No indirect or cumulative effects are expected as a result of the proposed action.

D. Grizzly bear:

No direct effects are expected as the result of the proposed action, particularly during the winter months, when grizzlies are denning. No indirect or cumulative effects are expected.

E. Gray wolf:

No direct, indirect, or cumulative effects are expected as the result of the proposed action.

F. Peregrine falcon:

High recreational use of the Skagit River may cause waterfowl to avoid areas of concentrated human use, but it is not likely to completely eliminate them. Displaced waterfowl would likely move to the Skagit Flats, where wintering peregrines more commonly occur, anyway. No direct effects are expected as the result of the proposed action.

Recreational opportunities on the SW&SRS may attract more birders to the area, and result in increased concentrations of birders in the Skagit Flats. This could result in potential harassment (i.e., disturbance) of wintering peregrine falcons. However, it is likely that recreational birders would be attracted to the area anyway, regardless of recreational opportunities on the Skagit W&SR. No cumulative effects are expected.

G. Lynx (Sensitive)

No direct, indirect, or cumulative effects are expected as the result of the proposed action, as lynx tend to avoid areas of high human disturbance, and are not likely to occur within the analysis area.

H. Common loon (Sensitive)

No direct, indirect, or cumulative effects are expected in the analysis area in the winter.

I. Townsend's big-eared bat (Sensitive)

A potential direct effect of permitted activities would be human disturbance to roosting bats. Townsend's big-eared bats are extremely sensitive to disturbance, especially during winter hibernation. However, it is not likely that Townsend's big-eared bats roost or hibernate along the Skagit in the winter, as they tend to avoid areas with frequent disturbance. It is possible that they could use caves or cave-like structures for hibernacula on less-disturbed tributaries of the SW&SRS. However, it is not expected that continued existing recreational activities would affect hibernating Townsend's big-eared bats. If activities were to increase in previously undisturbed

tributaries, human disturbance could cause thermoregulatory stress that has been found to lead to population declines (Perkins, 1988). No indirect or cumulative effects are expected.

J. Bull Trout (Sensitive):

Bull trout/Dolly Varden are known to be caught on the Skagit River, mostly as incidental catch in the pursuit of steelhead. Often they are below the mandatory 20 inch limit, so are released. Information on delayed mortality or other effects of incidental catch is not known. Some anglers do target char in known "hot spots", above Baker Lake in Eagle Creek. No direct, indirect or cumulative effects are expected as a result of this proposed action.

K. Sensitive plant species

A potential direct effect would be the trampling of a known Montia diffusa subpopulation. This trampling could be from fishers or eagle watchers. No indirect or cumulative effects are expected.

VI. EFFECT DETERMINATION

This evaluation is based on available information regarding species ecology and habitat requirements, as documented in species accounts and literature summaries on file at the Mount Baker Ranger District office, in addition to the information presented in the previous section of this document. This information is hereby incorporated by reference.

1. Bald Eagle:

It is apparent from investigations conducted on the Skagit system that the existing levels of recreational use (and levels anticipated under the proposed action) are having an effect on the bald eagle. Numerous studies have documented flushing of eagles from foraging areas as a result of recreational activities (Skagen 1979; Russell 1980; Biosystems Analysis, Inc. 1980; Stalmaster et al. 1991). Flushing of eagles is a direct effect on the bald eagle resulting from human disturbance.

It is clear that recreational use (and issuance or nonissuance of permits) has and will affect the bald eagle. However, the significance of the effect is uncertain. While studies conducted in the Skagit system have documented modification of foraging behavior, none have been completed to determine the consequential effect this may have on eagle survivability or reproductive success.

To arrive at a determination of whether the effects of the proposed action can be discounted due to a level of non-significance (not likely to adversely affect), or whether the action has the potential to cause a significant adverse effect (likely to adversely affect), we examined the arguments which could be made for each case. We then considered many of these arguments in the context of the definition of "take" ("The Issue of Take"), discussed the merits of the remaining arguments ("Further Considerations"), and arrived at an effect determination ("Determination").

A case for "not likely to adversely affect".

The proposed action is not likely to adversely affect the bald eagle, based on several factors:

There is a lack of physical evidence to determine that the disturbance is resulting in biological harm to individual birds or the species. There have been no known mortalities of eagles on the Skagit system resulting from starvation (Keeney, pers. comm.). Stalmaster et al. (1991) suggested that winter food shortage may inhibit egg-laying and result in depressed breeding rates. In the Pacific Region, however, numbers of breeding bald eagle pairs are meeting recovery goals and even surpassing those goals set several years ago (Steenhof 1990). The eagle population in the region continues to show positive growth (Appendix B Graphs 6a and 6b).

Inadequate food intake, whether due to unavailability or disturbed accessibility, is reported by Stalmaster et al. (1991) as compromising the fitness of individual birds, and could adversely affect the health of the population. Population health is often determined by evaluating trends of breeding animals and recruitment of young into the population, with an appropriate mix of adults and subadults. The regional trends of increasing population and high subadult to adult ratios (40%) support the argument that the current level of recreational activities does not appear to be adversely affecting eagle viability. (See discussion in Affected Environment, Habitat Conditions and Listed/Sensitive Species Use.)

The proportion of young eagles has been reported to be higher where food was particularly easy to find and exceptionally abundant (Stalmaster 1987). In Appendix B Graph 4 the ratio of subadults to adults for Skagit River segments from Marblemount to Newhalen, and Rockport to Marblemount (SRBENA) average over 40% to 50% for the last 6 years. This concentration of subadults could indicate that the food supply is adequate.

Stalmaster et al. (1991) reports that the consequences of disrupted feeding also depend on the availability of alternate foraging areas. Graphs showing higher numbers of eagles in the Illabot Slough on the weekends (periods of high recreational activity) (Stalmaster et al. 1991) indicate that off-river areas such as this provide alternate foraging/roosting areas for eagles more sensitive to disturbance.

Other portions of the Skagit River system, such as the lower segment of the Cascade River, support fish runs which appear not to be be fully utilized (see Table 3). This area is reported to have high chum and coho fish spawning, gravel bars for catching carcasses, but low eagle forage use. Not all factors are well understood as to selection of eagle foraging areas, but if eagles are food-limited, then some explanation is needed for the unexploited foraging opportunity provided by this river segment. Other areas on the Suiattle and Sauk are not well surveyed and may represent unknown alternate feeding areas.

Fish escapement numbers have been used with energetics models by Stalmaster (1983) and Hunt et al. (1992) to determine carrying capacity on a season long basis. Hunt et al. (1992) determined that in 1980-81, with an escapement of 21,350 chum, there would be potential food for 21,073 eagle-use-days. This number was compared to the 22,743 eagle days calculated as occurring on the Skagit, and the river system was thought to be near carrying capacity for wintering eagles. A similar conclusion was reached by Stalmaster (1983) for the Nooksack drainage. The conclusion of Hunt et al. (1992) was that the

overall number of eagles present during the winter is a function of the availability of salmon carcasses.

If the above hypothesis is correct, and the predictions from Stalmaster et al. (1991) of a 35% overall reduced feeding time per season is also correct, then there should be a recreation-induced reduction in fish available to eagles (due to carcasses being washed away or lost to competition when they're not being fed on), and a subsequent reduction in eagle numbers during the winter. Eagle census data for the Skagit does not indicate any such reduction; see Figures 2a, 2b, 3a, and Appendix B Graph 5. A 35% reduced feeding time per season should also result in a noticeable increase in the number of unused carcasses and/or an increase in other scavenger populations. There have been no indications of increases in carcasses or other scavenger populations.

Stalmaster et al. (1991) observed high feeding activity by eagles on Mondays. This was interpreted as adaptative feeding to a cycle of low feeding on weekends (during high recreational activity), high feeding on Monday and Tuesday, lesser feeding on Wednesday and Thursday, and high feeding again on Friday. If adaptative feeding periods are meeting eagle needs, as demonstrated by increasing occupancy of breeding territories, and a strong subadult/adult ratio, then fitness of individuals and recruitment into the population appears to not be adversely affected.

The number of recreational events during the high feeding period of 9 am to 11 am, when viewed over the season, is primarily of concern during the weekends (based on interpretation of percent of recreational activity by day of the week, and percent frequency of recreational activity by hour of day (Stalmaster, 1990)). The majority of the recreational activity already occurs outside of the critical hours for eagle feeding.

A case for "likely to adversely affect"

Eagles are likely to be adversely affected from disturbance that prevents them from feeding during times when food is limited. Such disturbance could affect the overwinter survival and/or reproductive fitness of individual birds.

Winter is a period of survival for bald eagles (Stalmaster and Gessaman 1984, Stalmaster 1987). Many investigators have shown that eagles are flushed by recreational events (Buehler et al. 1991, Spahr 1990, Isaacs et al. 1992, Fraser 1985, Steenhoff 1976, Stalmaster et al. 1991). In addition to reduced feeding opportunities, this also results in increased energy expenditures. According to Stalmaster (1983) flapping flight consumes 12.5 times the energy consumed during inactivity (Basal Metabolic Rate, BMR). The increased energy expenditure results in an increased need for energy uptake (greater quantities of food).

Modeling has suggested that eagles are at times food-limited on the Skagit and Nooksack Rivers (Stalmaster 1983, Hunt et al. 1993, Figures 2a and 2b). If eagles are food-limited, or the carrying capacity exceeded, information on eagle movements (see section titled "Relationship of the Skagit System to Regional Winter Habitat") also suggests that adequate food resources are not available on other river systems within the range of the individuals. Put another way: even if food is not adequate, it must still be more available here than elsewhere, otherwise eagles would be likely to move to areas of adequate food.

The latter part of the season is more critical since individuals are more likely to be stressed from the previous rigors of the winter. It is also the latter part of the season that Hunt et al. (1992) found to be food-limited in 1980-1981, and Stalmaster et al. (1991), finding lower quantities of food per eagle, suspected to be food-limited between 1986 and 1989. In addition, it is the latter part of the winter when recreation on the river increases (Stalmaster et al. 1991)

Odd numbered years are more likely to be food-limiting than even numbered years due to depressed chum salmon runs (Figure 2a, Appendix B Graph 3, Appendix C). However, random events play an important and unpredictable role in food availability. For example, chum runs in 1980/81, an even year, were equivalent to those normally found in an odd year. Also, major flood events in 89/90, and 90/91 washed away large numbers of chum carcasses early in the season.

Daily and weekly food availability is largely the result of random events (e.g. floods, runoff, interspecific competition) over which we have little or no control. Recreational disturbance events, while somewhat predictable, are presently not controlled. When periods of high frequency of such disturbance events coincide with periods of low food availability, eagles are likely to lose opportunities to feed.

Stalmaster et al. (1991) observed substantial feeding reduction on weekends (30% less than weekdays) and gorging on the days immediately preceding and following the weekend. Stalmaster and Gessaman (1984) reported observing eagles gorging a maximum of enough food to supply energy needs for 1.8 days. This suggests that some eagles aren't feeding for 3 days (from Friday to Monday) over the weekend, and that they are in some degree of energy deficit after the weekend. Individuals that cannot obtain adequate food to recover from this deficit will be adversely affected. In times of limited food availability the likelihood of recovery will decrease. Unpredictable events can bring about food shortages that will reduce the ability of individuals to recover from this deficit.

As stated above, Stalmaster et al. (1991) reported a 30% reduction in feeding on weekends as opposed to weekdays. The reported 30% is, however, an average. It does not reflect the fact that his data indicates that weekends of peak recreation use (mostly later in the season) show reductions approaching 90% from what would be expected without disturbance.

Stalmaster et al. (1991) reported that the consequences of disrupted feeding partly depend on the availability of alternate foraging areas. It's been suggested that alternate foraging areas may exist in the Skagit system. If eagles that are driven off the river are going somewhere else to feed, assuming there is somewhere else to feed, some of the consequences of that are:

1. to cause a larger group size to develop in refuge areas with the potential to develop a greater than optimum group size (Stalmaster and Gessaman 1984) and a resultant reduction in ability of individuals to feed;
2. the potential to cause saturation in refuge areas, such that the food wouldn't be adequate to support the number of eagles;

3. the food they would have been feeding on in the disturbed area is now:
    a. more available for competing species; and
    b. more susceptible to loss through flooding events or other water fluctuations (Hunt et al 1993).

(A reduction in available food will lower the seasonal carrying capacity of the system (Stalmaster 1983, Hunt et al. 1993).)

Observations of reduced weekend feeding and pre- and post-weekend gorging (Stalmaster et al. 1991) suggest, however, that they do not go somewhere else to feed.

Subadults appear to be at greater risk during food shortages than adults. They appear to be less tolerant of disturbance than adults (Stalmaster et al. 1991), are less efficient foragers, require more energy to acquire food, lose food more to food-stealing by adults, and appear to not meet their energy needs in a social feeding environment (Stalmaster & Gessaman 1984).

The Skagit W&SRS plays an extremely important role in eagle wintering in the region. It supports the largest wintering population in the state of Washington and the second largest in the Puget Sound and southwestern British Columbia area. What affects this river, therefore, affects the regional population. Knowledge of eagle movements (Hunt et al. 1992) as well as general knowledge of the system as a whole, suggests that fluctuating food supplies result in frequent changes in the distribution of eagles. Disturbance that causes alterations in eagle use of one of the most significant feeding areas in the region, resulting in further losses of food and/or feeding opportunities, increase the risk of a significant reduction in carrying capacity of the region as a whole.

In summary, the available information (recorded data, scientific study, models and direct observations) indicates the following:

1. As a result of human disturbance from recreational activities
    a. there is a reduction in feeding opportunities (Stalmaster et al. 1991);
    b. there is an actual reduction of feeding during periods of high numbers of recreational events (based on observations of pre- and post-weekend gorging) (Stalmaster et al 1991); and
    c. there is an increased energy expenditure associated with being flushed (Stalmaster 1983) and a subsequent increased need for food.
2. Eagles are at times food-limited on the Skagit W&SRS (Stalmaster et al. 1991, Hunt et al. 1993, Figures 2a and 2b), as well as on other river systems (Stalmaster 1983);
3. Food-limited periods are unpredictable, but are more likely to occur in odd numbered years due to depressed chum runs (Stalmaster 1983, Stalmaster et al. 1991, Figures 2a & 2b, Appendix B Graph 3, Appendix C);
4. Interruption or prevention of feeding during times when food is limited has a higher likelihood of adversely affecting an individual than when food is not limited;
5. The likelihood of adversely affecting increases with the length of the food-limited period;
6. Subadults are more likely to be adversely affected than adults (Stalmaster et al. 1991).

Given the above, the proposed action would be likely to adversely affect individual bald eagles (in those areas of the system where human/eagle conflicts occur) at unpredictable times, resulting in a decreased ability of individuals to survive the winter, potentially affecting recruitment into the adult population and/or dampening population increases.

Summary Effect Determination, Bald Eagle

As previously stated, the following discussion considers some of the above arguments in the context of the definition of take. The section titled "Further Considerations" attempts to conclude discussion of items not discussed under take. The final "Determination" discussion summarizes the determination.

The Issue of Take:

Section 9 of the Endangered Species Act prohibits the taking of listed species. Take is defined to mean "harass, harm, pursue, hunt, shoot, capture, or collect, or to attempt to engage in any such conduct". Incidental take refers to takings that occur from, but are not for the purpose of, carrying out an otherwise lawful activity conducted by a federal agency or applicant (50 CFR 402.02).

Harass, in the definition of take, is any intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to breeding, feeding, or sheltering.

Harm, in the definition of take, means an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering.

Take is usually addressed in terms of an individual, breeding pair, or pairs of animals, rather than populations as a whole. Therefore, while the northwest population of bald eagles is moving towards attainment of recovery goals, take of an individual is still possible. By definition, take is considered as an adverse effect.

To assess whether harassment (as defined in the Act) might occur, it must be shown that the proposed action results in a significant modification of behavioral patterns, and further that this behavioral modification creates a likelihood of injury to the bald eagle.

Available information suggests that foraging behavior of wintering eagles is being disrupted to a significant degree in portions of the Skagit system. Stalmaster et al. (1991) estimated that eagle feeding time was reduced by 32% in areas with higher recreational events (6 to 20 per day) as compared to areas which received lower (0 to 5 per day) recreational use. When recreational events exceeded 40 per day, an 89% reduction in bald eagle feeding time was predicted. When data from the winter months were compiled and used in a predictive model, a negative and exponential relationship was predicted between eagle feeding time and recreational events on portions of the Skagit River. It was unknown whether eagles displaced from feeding areas relocated to alternate feeding sites, or whether individuals were not able to feed.

It is more difficult to ascertain whether a significant disruption in foraging behavior results in an increased likelihood of injury to the bird. While flushing of eagles from foraging areas has been shown, the degree to which this results in individual eagles not meeting their biological needs is not clear. If studies could be designed to answer this question they would be lengthy, costly, and likely pose great risks to individual eagles. No studies have been undertaken here to examine whether human activities are resulting in a biologically significant effect on eagles. Therefore, the potential of these actions to be significant can neither be dismissed, nor absolutely proven.

Due to the variation in response shown by eagles to recreational activities, the degree to which disturbances adversely affect birds will depend on the individual bird in question. Russell (1980) found that eagles occupying river segments with low recreational activity responded more readily to disturbances when they occurred.

Stalmaster et al. (1991) found that subadult eagles were more susceptible to disturbance than adults, and were slower to recover from disturbances than adult birds. Subadults are generally less able to compete with adults for food supplies, particularly when food is limited. Adult, or dominant eagles can limit accessibility to food supplies for subadult eagles by aggressive defense of salmon carcasses, or by stealing carcasses from subadult birds.

Hansen (1986) found that the number of eagles fighting amongst themselves (intraspecific competition) was inversely related to resource availability. The data collected in this study suggested that aggression is a mechanism of density dependant population regulation. Resource shortages bring increased escalation of intraspecific competition, which may force low-status individuals to emigrate or die (Hansen 1986).

Subadult, or subdominant eagles may be particularly susceptible during those years when chum salmon escapement, and hence food supplies, are limiting (Appendix C), or during the latter half of winter when food supplies diminish (Hunt et al. 1992; Stalmaster et al. 1991).

Bald eagles tend to be opportunistic feeders and can adapt to periods of low food availability. Stalmaster et al. (1991) speculated that compensatory behavior by eagles might occur on the Skagit to minimize the effects of food not being available for periods of time. Eagles were observed to gorge on Mondays and Tuesdays following high levels of recreational activity on weekends, and eagles were also observed gorging on Fridays.

The degree to which compensatory behavior offsets reductions in foraging opportunities is unknown. Stalmaster and Gessaman (1984) found eagles on the Nooksack River capable of gorging enough salmon in one feeding to sustain them for 1.8 days. A laboratory experiment conducted by Stewart (as reported by Stalmaster and Gessaman 1984) demonstrated that an eagle withstood deprivation of food for a 16 day period, without evidence of permanent harm. The eagle subjected to this trial did suffer a short term weight loss.

While this may be the case in the laboratory, environmental conditions for eagles in the wild can vary dramatically and can have a cumulative effect on an eagle's physical condition as the winter season progresses and food supplies decline. Subadult, or subdominant birds, could be prevented from feeding, or have reduced foraging efficiency, for longer periods due to intraspecific competition, particularly in late winter.

Since raptors tend to occupy areas at levels commensurate to food supplies (Newton, 1979), and our data (Figures 2a and 2b) as well as that of Hunt et al. (1992), Stalmaster et al. (1991), and Glesne (Unpublished data 1993, Appendix B Graphs 3 and 5) show the numbers of eagles are correlated to chum salmon escapement, it is unlikely that a substantial surplus of food occurs in all years to accomodate shifts in eagles from other areas. It is conceivable, therefore, that losses of foraging opportunities to individuals could become significant.

The combination of these factors could be construed as significantly disrupting normal foraging behavior to the extent that there is a likelihood of injury to individual eagles. It is likely that disturbance can result in increased energy expenditure during a period when concern for energy consumption is high (Stalmaster et al. 1991; Steenhof 1978). Generally, individuals of the subadult age class would be placed at a greater risk due to competition with adult birds in times of limited food supply (Stalmaster et al. 1991; Hunt et al. 1992). Available food declines as the winter season progresses (Stalmaster et al. 1991; Hunt et al. 1992). Potentially exacerbating this decline by reducing feeding opportunities increases the risk that harassment, as defined in the Act, occurs.

The degree to which existing and projected recreation levels could result in the actual killing of individual eagles and therefore harm (as defined in the Act) is unknown. While no eagle mortalities due to starvation have been reported (Keeney pers. comm.), no complete survey has been undertaken. There is a potential for birds to be lost and not reported, for carcasses to be scavanged prior to discovery, and for eagles to leave the system and experience mortality elsewhere. Actions which limit foraging efficiency and potentially reduce foraging times of individual eagles would have a higher risk of approaching harm.

Further Considerations:

We have stated that the population as a whole appears to be healthy and increasing. While effects on population changes are considered here, our current and past census techniques do not allow for the detection of such changes. No census technique is currently in place to adequately evaluate regional eagle population levels, let alone rates of change. Even if those tools were available, evaluating the effects of various activities on rates of population change would require years of costly study. The primary issue of effect, therefore, lies in whether or not there is likely to be an effect on individuals. Central to this issue is whether or not food is limiting and, if it is, whether or not eagles are prevented from feeding during those times.

High subadult to adult ratios have been used to support the idea that the population is healthy and that food might not be limited in areas of high ratios. While the evidence suggests that the population is healthy and growing, ratios shown for the Skagit are by no means conclusive. The 40% reported by Stalmaster et al. (1991) is not much greater than the 1/3 reported for other areas (Stalmaster 1987). In addition, the areas in which these ratios have been measured are those with the highest food abundance and should, therefore, show proportions higher than those expected for the population as a whole (Stalmaster 1987). Areas that have a higher proportion of subadults cannot be assumed to have abundant food, only that food might be more abundant there than elsewhere (Stalmaster 1987).

While the two estimates of carrying capacity (Stalmaster 1983, Hunt 1992) have limitations, their data do suggest that the number of eagles occurring in the system are closely linked to forage availability. This is further supported by our application of these techniques (Figures 2a & 2b) as well as preliminary work of the National Park Service (Appendix B Graphs 3 and 5). It should be noted that goals for the level of chum escapement are established by the State and are, to some extent, under human control.

The numerical estimations of carrying capacity (Stalmaster 1983, Hunt et al. 1992, Figures 2a & 2b) should not be taken too literally. They are useful for comparison between different times to determine when the most likely food-limited periods might be and to give an indication of whether or not there is a potential for food to be limited. We cannot determine from these estimates whether eagles are actually above or below their carrying capacity at any given point in time. As previously stated, the information suggests a potential for food to be limiting, especially in odd numbered years and during the latter part of the winter.

Observations of reduced feeding over weekends (Stalmaster et al. 1991) suggests that fewer eagles are feeding in disturbed areas of the mainstem of the river. As previously stated, the study did not address the disposition of displaced birds. Observations of increased use of areas such as Illabot Slough, however, indicate that some displaced birds appear to be finding alternate areas, and may be foraging there. Observations of increased foraging (gorging) on days immediately preceding and following the weekend would suggest, however, that alternate foraging areas are not meeting the needs of all eagles on the river.

With respect to alternate foraging areas the Lower Cascade segment continues to be an anomaly. Given its proximity to high use areas and other known attributes we believe that it would be used if it contained all the characteristics of suitable habitat. As previously stated not everything is known about eagle habitat needs, nor about eagle habitat on the SW&SRS.

It has been suggested that, outside of weekends, Stalmaster et al. (1991) data indicates that the majority of recreational events already occur outside the critical hours for eagle foraging of 9 am to 11 am. While it is true that most activity occurs outside these hours, the data must be considered in the context of what does occur during those hours. As an example, interpretation of the data indicates that weekday boating events in mid-January occur at the rate of approximately 10 per day. Between 9 am and 11 am they would be expected to occur an average of approximately one per hour. Based on the rate and type of activity, average recovery time is estimated at 15 minutes. This suggests an average of approximately a 25% reduction from normal feeding during those hours.

Increases in energy requirements directly attributable to the costs of flight due to flushing are expected to be minimal. There is only a small amount of time spent engaged in such flights. Evidence from Stalmaster et al. (1991) indicates that flight distances are generally short, and that eagles tend to leave the river under conditions that would elicit repeated flushing.

Trends in coho salmon populations, which may be important in later portions of the winter season, show a decline (WDF data). Chum salmon populations, while more stable, are not meeting escapement objectives consistently (Appendix C). At the same time, there are increasing trends in the amount of recreational use

of the river, portions of which (bank related activities) cannot be regulated. This combination could exacerbate existing conditions, further increasing conflicts and risks to bald eagles.

Given that the Skagit system is but one component of a larger winter habitat for bald eagles, the consequence of reducing food availability because of recreational disturbance activities could be at least in part compensated by the availability of other winter areas. Conversely, knowledge of eagle movements (Hunt et al. 1992, Skagen 1979, Biosystems Inc. 1980) suggests that food supplies in the region already result in frequent re-distribution of eagles, and therefore further losses of food can increase the risk of a significant reduction in carrying capacity.

Under existing conditions, the proposed action increases the risk of adversely affecting individuals of the species by reducing foraging efficiency and potentially exacerbating limited forage availability. While the population as a whole may continue to recover, individuals of the species may continue to be placed at increased risk.

Determination:

Based on the discussion in the previous two sections ("The Issue of Take" and "Further Considerations"), the proposed action, as well as no action, is likely to adversely affect the bald eagle. An average seasonal reduction of eagle feeding opportunities was calculated at 35% based on observations in the Washington Eddy area of the Illabot section. The actual reduction at a given point in time and space is dependent on many factors and is certainly sometimes much less and sometimes much greater. The significance of such reductions, however, is dependent on the remaining availablility of food, as well as the degree of access to that food that is afforded to eagles. Evidence indicates that the Skagit is likely to be food-limited at times. During such times when food availability is low, any action that limits an eagle's access to that food exacerbates the already limiting condition.

During times of limited food, disturbance can result in eagles losing feeding opportunities, food being lost from the system, and the carrying capacity of the system being lowered. The overwinter survivability and/or reproductive fitness of individuals may be at risk. The risk is highest for subadults. While the risk of effect is primarily to individuals, any effect on individuals also has the potential to affect the population by dampening any observed population increases.

When food is not limited (probably most of the time) the potential for effect is quite low. Food-limited periods are more likely to occur during the latter part of the season in odd numbered years. They may, however, happen at any time due to random and/or catastrophic events. Since these periods are largely unpredictable the "likely to adversely affect" determination cannot be limited to certain time periods and must be applied to the entire time that they are possible.

Certain river segments have a higher potential for conflict than other segments. Under existing fish, eagle, and recreational use patterns (Table 3) the Illabot segment is clearly the highest conflict area, followed by McLeod Slough, then Marblemount. Middle Sauk 1 and Concrete segments both have fairly high eagle use but moderate recreation use. Eagle/human conflicts in other segments are thought to be relatively minor.

2. Northern spotted owl: NO EFFECT

No removal or alteration of suitable habitat would occur, and no disturbance during the nesting season would be expected. The proposed project is consistent with the Conservation Strategy for the Northern Spotted Owl (Thomas et al. 1990), and with the Interpretation and Application of the ISC Strategy as disclosed in a document distributed on 4 January 1991 from the Regional Forester. No modification of Critical Habitat would occur, and therefore will not be effected by the project.

3. Marbled murrelet: NO EFFECT

Activities to be permitted would not occur during the murrelet nesting period. Murrelets are unlikely to occur in the analysis area during the winter, at least in areas that would be susceptible to human disturbance during this time.

4. Grizzly bear: NO EFFECT

The project occurs in an area of existing high recreational use (an existing disturbance zone), and would primarily occur when grizzly bear are denning.

5. Gray wolf: NO EFFECT

Wolves are unlikely to occur in the analysis area, as it is in an area of existing high recreational use (an existing disturbance zone).

6. Peregrine falcon: NOT LIKELY TO ADVERSELY AFFECT

Wintering peregrines are more likely to occur on the Skagit Flats than on the SW&SRS. There is potential for indirect effects of disturbance by recreational birders that are attracted to the area by recreational opportunities on the SW&SRS. However, recreational birding is an existing activity, and is expected to occur regardless of the recreational opportunities on the river.

7. Townsend's Big eared bat (Sensitive):
NOT LIKELY TO CAUSE A TREND TOWARD FEDERAL LISTING

The existing level of recreational activities on the SW&SRS are not expected to cause disturbance to hibernating bats, as they tend to avoid areas with frequent disturbance. If permitting commercial recreational activities results in an increase of activities in previously undisturbed tributaries, there is a chance for disturbance to occur. Such an increase is not currently expected.

8. Bull Trout (Sensitive): NOT LIKELY TO CAUSE A TREND TOWARD FEDERAL LISTING

The project is likely to affect individuals, but is not likely to cause a trend toward federal listing (e.g., will not jeopardize the continued existence of the species).

9. Sensitive plant species: NOT LIKELY TO CAUSE A TREND TOWARD FEDERAL LISTING

The project is likely to affect a subpopulation, but is not likely to cause a trend toward federal listing (e.g., will not jeopardize the continued existence of the species).

10. Other Sensitive Species: NOT LIKELY TO CAUSE A TREND TOWARD FEDERAL LISTING

This project is expected to have no impact on any other sensitive species known or suspected to occur in the area.

VII. MANAGEMENT RECOMMENDATIONS

1. In 1993, the Forest Service formulated a working group comprised of several agencies, groups, and individuals to attempt to identify management actions which might minimize adverse effects to bald eagles while providing for recreational interests. This working group identified the following measures which could be considered for implementation:

   Alt. A Bring all commercial operations under permit. A code of conduct would be developed. Continue public contact and education efforts along the river banks and on the river during peak periods. Continue to encourage voluntary compliance with the no put-in before 10:00 a.m. limitation.

   Alt. B Bring all commercial operations under permit. Implement a CFR restriction on boat traffic on the river between Rockport and Marblemount from 0500-1000 each day, between December 7 and February 1. Increase public contact and education with eagle watchers on the banks and people out on the river bars. Develop and distribute educational materials on a river use eagle code of conduct.

   Alt. C Bring all commercial operations under permit. Close the river to all boat traffic on Mondays and Thursdays from December 7 to February 1 between Marblemount and Rockport. Increase public contact and education with eagle watchers on the banks and people out on the river bars. Develop and distribute educational materials on a river use eagle code of conduct.

   Alt. D Bring all commercial operations under permit. Close the river to all boat traffic on three (3) days each week, Monday, Wednesday, and Friday (except on holiday weekends when it would be open on Friday and the holiday) from Marblemount to Rockport. Increase public contact and education with eagle watchers on the banks and people out on the river bars. Develop and distribute educational materials on a river use eagle code of conduct.

   Alt. E Bring all commercial operations under permit. Close the river one weekend day and one weekday (Sunday and Wednesday) to all boat traffic. Closure will be in effect between Marblemount and Rockport. Increase public contact and education with eagle watchers on the banks and people out on the river bars. Develop and distribute educational materials on a river use eagle code of conduct.

2. Our analysis suggests that eagles are placed at risk primarily in winter seasons when food supplies are limited. Generally, this occurs in odd years, when chum salmon numbers are down. A potential mitigation strategy would be to restrict activities on the SW&SRS from prior to 11:00 am in odd numbered years, in anticipation of restricted food availability. Monitoring systems could be implemented to adjust restrictions as

necessary. This, in combination with use of variable restrictions in the latter half of winter could potentially reduce effects to a level of non-significance.

3. Any mitigation strategy should consider each segment in relation to its relative concern for potential human/eagle conflicts.

4. Increase educational efforts on viewing and river use ethics as they relate to bald eagle protection. Continue support of the bald eagle festival as a conduit to provide this information, and coordinated educational and interpretive efforts through the Puget Sound Eyes on Wildlife Program.

5. Increase efforts on conducting coordinated, interagency surveying of bald eagles, and continue to monitor eagle and recreational relationships.

6. Work closely with the Washington Department of Fisheries, the Skagit System Co-op, and other agencies and cooperators to improve fish habitat and population management for chum and coho salmon. Continue and expand watershed restoration activities in the Skagit and NF Stillaguamish river systems.

7. Coordinate with Seattle City Light in creating favorable flows to support carcass availability and spawning conditions for chum and coho salmon.

8. Provide public educational materials regarding proper practices for avoiding contact and/or conflicts with bears (particularly for the upper Skagit area).

9. Provide information and education regarding avoiding disturbance to potential bat hibernacula. Conduct more surveys for Townsend's big-eared bats, to gain better knowledge of occurrence within the SW&SRS, as well as information on potential situations for disturbance for this species.

VIII. PERSONS CONSULTED

Cummins, Eric. 1993. Research Program Manager, WDW, Olympia, WA.

Cole, Wendy. 1993. Fisheries Biologist, Mount Baker Ranger District, Mount Baker-Snoqualmie National Forest.

Fuchs, Tony. 1993. Biologist, Puget Power and Light, Co., Concrete, WA.

Glesne, Reed. 1993. Aquatic Ecologist, North Cascades National Park, Sedro Woolley, WA.

Haas, Jeffery. 1992. Wildlife Biologist, USFWS, Olympia, WA.

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Mendenhall, Thomas. 1993 Fisheries Biologist, Darrington Ranger District, Mount Baker-Snoqualmie National Forest.

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Reed, P. 1993. District Wildlife Biologist, Darrington Ranger District, Mount Baker-Snoqualmie National Forest.

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Sprague, Gary. 1993. Fisheries Biologist, WDF.

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X. APPENDICES

APPENDIX A

DESCRIPTIONS OF THE RIVER SEGMENTS

Lyman Segment

A. Stream and Bank Characteristics

The Skagit river has numerous gravel bars all along this segment, some of which are very long. There are two major side channels and three braided areas in this segment, providing a lot of rearing habitat and cover for salmon. The river bank has deciduous trees along the edge of the river. The north side of the river has more human development than the south side, and has a patchy arrangement of deciduous trees.

There is one known night roost within this segment which is a deciduous roost in a black cottonwood. It is unlikely that there is any more potential night roost habitat within 3-4 miles of the river corridor in this segment, as it is heavily developed and receives a high amount of recreational use.

B. Food Availability

There are several indexed tributaries in this river segment but the river segment itself is not regularly surveyed. There are moderate levels of chum and coho carcass counts found.

C. Eagle numbers

Night roost surveys from 1991 to 1993 found 3-31 eagles feeding or perched in trees in the vicinity of the above night roost. This night roost was used throughout the winter, but received relatively less use during the early part of the season, and more use during the late part of the season. It also had relatively higher numbers of eagles near the end of the season, compared to many of the other roosts on the upper portion of the Skagit. Surveys in 1988-1989 found one high activity site for foraging eagles within this segment. Results from driving censuses in more recent years suggest that this area receives higher foraging activity earlier in the season. This area may not be used at all if existing gravel bars are immersed during periods of high water.

During the 1991-92 season, surveys found more adults than subadults during mid-season, and more subadults than adults during the late part of the season, during the 1992-93 season, the proportion of adults to subadults was either equal or higher throughout the season showing no obvious pattern.

D. Recreational Use

In comparison with those segments of the river above Rockport, there is low to moderate winter recreational use of the Lyman, Hamilton, and Concrete segments. While some fishing does occur in these segments, limited access, fluctuating water levels, and sediment-laden water lessen the quality and quantity of fishing activity. There is virtually no rafting and very little canoeing and kayaking in these segments during the winter.

Stalmaster (1991) recorded 486 recreation events and 1,215 river visitors per winter (Dec. 1-Feb.28) in this segment. Data were averaged over a two year sampling period (1985-86 and 1986-87). Relative amounts of use by 7 different user-groups for the same sampling period is depicted below.

Lyman:	Motorboat	46%
	Dory	2%
	Raft	0%
	Canoe	0%
	Kayak	0%
	Bank angler	50%
	Hiker	2%

It appears that there is very little eagle viewing activity in this section. Fishing is the predominant activity.

Hamilton Segment

A. Stream and bank characteristics

This segment has several gravel bars but little rearing habitat. There are no side channels or braiding in this area. The riparian zone has primarily deciduous trees with a small number of large coniferous trees where there haven't been any clear cuts or developments. There are no known night roosts within this segment. Surveys or censuses have been limited within this segment, due to inaccessibility (private property and development). Because most of the south side of this segment has been harvested, and most of the north side is developed, it is unlikely that there is any potential roosting habitat in the corridor associated with this segment. There is one stand of coniferous trees on the north side that may provide at least perching or staging habitat, and could possibly provide roosting habitat if it did not receive high human activity.

B. Food Availability

Carcass index areas are limited to one of the tributaries found in this segment. Information indicates low carcass availability throughout this segment for both chum and coho.

C. Eagle Numbers

A driving census in 1991-92 found a site in this segment that receives low to moderate foraging activity by eagles. Observations were made of 1-10 eagles feeding or perched in trees near Cement Island during the early part of the season. However, by late January, there was either just one adult or no eagles seen at this site. Incidental observations in 1992-93 showed a similar trend through the season. All but one observation saw more adults than subadults. In December the ratio was as skewed as 9:1, but in early January it was 3:4 and 3:1, changing to 1:0 or 0 from late January through February.

D. Recreational Use

This segment was not surveyed by Stalmaster (1991) but general recreational use is described in the narrative for the Lyman segment.

Concrete Segment

A. Stream and Bank Characteristics

There are several large gravel bars found in this segment of the Skagit river, and the channel meanders in places. Along the north side of the river, there are sections of highly developed farmland and housing tracts. The south side has some clear cuts. Where there is standing vegetation, it is primarily a mixed deciduous/coniferous stand. There is one known night roost on the south side of this segment, which is a coniferous roost located less than 1/4 mile from the river. Extensive development and harvesting make it unlikely that there is other suitable roosting habitat within 3-4 miles of this segment, but National Forest lands beyond 4 miles to the south (in the Finney watershed) may provide other roosting habitat. Eagles have been seen flying in that direction, but no surveys have been conducted in that area to determine potential roost location.

This segment also includes the Baker River basin, which is located north of Concrete. The Baker River flows into Baker Lake, which was created by the upper Baker River dam. This dam flows into Lake Shannon, which was created by the lower Baker River dam. The Baker River continues from below the lower dam. There is foraging, perching, and potential roosting habitat located along the shores of both lakes.

Eagles have been seen flying northward from Concrete up the Baker River at dusk, but it has not been determined where these eagles are going to roost. It is possible they may be going as far as Baker Lake, or they could be stopping near the lower Baker River Dam, where some eagles have been observed around dusk. During intermittent winter surveys by Puget Power biologists, two to three eagles have been observed that may have been roosting in the lower Baker Lake area (Fuchs, pers. comm.). An actual night roost has not been confirmed.

B. Food Availability

There are no index tributaries along this segment but portions of the mainstem of the Skagit are regularly surveyed. Carcass availability for both chum and coho are low.

There is a minimal run of chum in the Baker River basin, and a small run of coho that is transported above and below the dams by Puget Power, to rearing ponds.

C. Eagle numbers

Night roost surveys at Van Horn Bend since 1986 have found high eagle foraging activity, as well as large numbers of eagles flying by, perching, and roosting in the vicinity. As many as 65 eagles have been counted from the survey site, although many of those were fly-by's. It is not unusual to see an average of 15-20 eagles foraging and perching in the area during early to mid-season. The numbers have consistently declined to 0-3 by the end of the season. There are often more adults than subadults, throughout the season. Many of the birds observed have been recorded as "unknown" age, due to the fact that a long expanse can be viewed from this survey site, and it becomes difficult to identify age at long distances, especially around dusk.

Roost use at this site is variable. At times the majority of the eagles have been seen perching/roosting along the river. Some eagles have been seen flying to an area east of the night roost. Others have been seen flying further southward, possibly to the Finney drainage. Censuses and surveys at this site have observed much flushing of eagles at times, during periods of high boat activity.

A driving census in 1992-93 found high daytime foraging/perching activity just west of the roost area at Van Horn Bend. As many as 10-19 eagles were seen at this site in early December, with even higher numbers (30-42) from late December through mid-January. By February, the numbers dropped considerably (3-4). Generally, there were 3-7 times (or more) more adults than subadults, throughout the season.

There are a few other foraging/perching areas within this segment that receive a low amount of eagle use (Cape Horn, mouth of Baker River), and one area east of Concrete that can have a moderate amount of use, depending on the river level and gravel bar exposure. During surveys from 1990-93 at the mouth of Baker River, up to 9 eagles have been seen foraging and perching at this site, but it has been more common to see 2-3. Eagles have been seen at this site throughout the season, with a moderate increase in numbers during mid-season. This site usually has more adults than subadults.

Up to 15-20 eagles have been seen during the daytime in the Baker Lake basin, but a few observations near dusk have indicated that most left prior to dusk, to roost elsewhere (Fuchs, pers. comm.). These eagles may be flying to the Skagit or Nooksack, or upstream within the Baker River basin. Intensive night roost surveys have not been conducted in the Baker Lake basin.

D. Recreational Use

The narrative description of recreational use under the Lyman segment applies to the Concrete segment, as well. Stalmaster (1991) observed 611 recreational events and 1,695 river visitors per winter in 1985-86 and 1986-87. In comparison with the rest of the river, this segment had 11.7% of the recreational events and 11.5% of river visitors.

The majority of use along the Baker River occurs in the reservoirs created by the upper and lower Baker River dams. Lake Shannon (rm 1.0 to rm 9.4) created by the lower dam receives high motorized fishing use between April and October. The majority of use occurs on weekends. Fishers prefer early morning and early evening fishing. Bank fishing is limited due to lack of access. Very low winter fishing occurs on Lake Shannon. Recreational non-motorized use of Lake Shannon is low because of lack of access and recreational facilities.

Baker Lake (RM 9.4 to RM 19.3), the reservoir created by the upper dam, receives the highest use within the Baker River system. Easy access, eight boat launches, six campgrounds, and a private resort, all contribute to the popularity of the lake. Recreational use is high in the summer (April-October) and low in the winter (December-March). Motorized lake fishing represents seventy-five percent of the use and recreational boating twenty-five percent. Ninety percent of recreational boating on the lake is motorized and ten percent non-motorized. Weekend use is high (75%), with the remaining use evenly distributed throughout the week. Bank fishing is a highly popular activity on Baker Lake. The majority of use occurs on the south end of the lake. Easy access along the west side of the lake provides numerous bank fishing opportunities.

Use along the free-flowing segments of Baker River is limited. A boat launch at the confluence of Baker River and the Skagit provides access for bank fishing. A fish ladder within the first quarter mile of the Baker River precludes any boat activity. At RM 19.4 above Baker Lake the river regains its free-flowing characteristics. No motorized use occurs in the upper Baker River due to low water. Non-motorized use is limited to the few adventurous kayakers willing to portage up the river and negotiate through the low water. A low amount of bank fishing occurs along the river as fishers hike up the Baker River trail to fish for native trout.

One eagle viewing area is located within this segment, at the mouth of Baker River. This location receives relatively low viewing activity.

McLeod Slough Segment

A. Stream and Bank Characteristics

The McLeod Slough is a large area with numerous gravel bars throughout. The riparian vegetation consists of red alder and cottonwood with a few conifers on both sides of the streambank. The stream does a lot of meandering through this area, providing high forage use potential. There is one known night roost within this segment, which is primarily a deciduous roost, with some patches of conifers. Other potential roosting habitat occurs to the north of this roost, in Rockport State Park, and on National Forest land, approximately two miles from the river, south of Sauk Mountain. Most of the rest of the land to the south and directly north of this segment is private forest land that does not contain suitable roosting habitat at the present time.

B. Food Availability

This segment has a few carcass index tributaries as well as the mainstem of the Skagit and Sauk. On average this segment rates moderate for chum. Most of this segment has a low coho count except for the first river mile of the Sauk which has a moderate number of coho.

C. Eagle Numbers

Night roost surveys from Rockport State Park since 1986 have found as many as 50-100 eagles using the known roost. Eagles have been seen foraging, perching, and roosting at this location throughout the season, with large concentrations (averages in the 60's to 70's) seen from late December through January. Some of these birds have remained perching on the Skagit river, while others have been seen flying up the Sauk River.

Very high counts were made in 1986-87 and 1988-89, with early peak counts in 1988-89 (by mid-December, ending early, by mid- to late-January). Many fewer eagles were seen during the winter of 1989-90, but "average" numbers have been seen in subsequent years. There have usually been many more adults than subadults at this location, which has been especially noticeable during peak counts.

D. Recreational Use

Most of the recreational use of the McLeod Slough occurs during the winter season, October 1 through March 31. Stalmaster (1991) found this segment had the highest recreational use of any segment on the river. During December, January, and February, of 1985-86 and 86-87, he observed an average of 2,403 recreational events per year, or 46.1% of total river use, occurring in this segment. Also during that period, there were an average of 6,277 river visitors per year, or 42.5% of total river visitors. Use was especially high at the confluence of the Skagit and Sauk Rivers (Howard Miller Steelhead Park).

The relative amounts of recreational use by user-type is broken into percentages below.

Motorboat use	64%
Dory	16%
Raft	1%
Canoe	0%
Kayak	0%
Bank angler	15%
Hiker	4%

Two eagle viewing areas are located within this segment, at Howard Miller Steelhead Park (with high use), and along trails in Rockport State Park (with low use).

Illabot Segment

A. Stream and Bank Characteristics

This segment of the Skagit River provides a long section of braided side channel, called Barnaby Slough. This slough contains a lot of pools, riffles and gravel bars, as well as a large fish hatchery. There are several other side channels and gravel bars, caused by the confluence of the Illabot River meeting the Skagit. The surrounding vegetation is mostly deciduous trees mixed with some conifers. There are also patches of farmlands and clearcuts.

There are six known night roosts and one identified staging area within this segment. Four of the roosts are conifers, with three located 1/4 to 1/2 mile from the river, and one located approximately 3 miles from the river. Two of the roosts are deciduous, located adjacent to the river. One of the deciduous roosts is located near a major fish hatchery. There is a considerable amount of potential roosting habitat all along the northern side of the segment, on National Forest land within 1/4 to 1 mile of the river.

B. Food Availability

This segment has numerous index areas, is heavily surveyed and contains high concentrations of chum. While the Illabot and Barnaby sloughs contain the highest counts, Illabot and O'Brien creeks also have moderate levels of chum. The Skagit river itself is rated low by carcass surveys but the overall area is rated high for chum. This area is one of the two highest chum areas, the other being the Marblemount segment. Coho counts for this segment are quite low.

C. Eagle Numbers

There have been a number of sites in this segment that were used for night roost surveys. The Nature Conservancy (TNC) has also conducted a weekly census in this segment since 1982, as this segment contains the Skagit River Bald Eagle Natural Area (SRBENA), which was acquired by TNC.

One of the coniferous roosts has received sporadic, low use as determined by surveys in 1985-87. Another coniferous roost has received low to moderate use, which has been unpredictable throughout the season. The other four roosts are generally high-use roosts, with up to 30-40 eagles using two of them, as many as 100+ eagles using the other two. Census counts from TNC are typically in the 200-300 range during the height of the season.

There are many high activity foraging and perching areas within this segment, as well as the known roosts. Information regarding eagle numbers from USFS surveys are as follows: One area (at Rockport) has had as many as 50 eagles foraging there, as well as much soaring activity. Such concentrations have generally been limited to January, with much lower numbers seen in the early and late season.

Another high activity area is located near a roadside rest area (Sutter Creek), which also attracts many viewers. Night roost surveys since 1985 have counted over 100 eagles at one time, with an average peak of approximately 40. The largest concentrations have generally been seen from late December through January. In the winter of 1988-89, the peak count was unusually early (mid-December). There have almost always been more adults than subadults throughout the season in this area. Birds foraging at this site may remain to roost in trees along the river, or may fly to one of three roosts in the area. Much soaring has been seen in this vicinity, as well.

It was in the nearby Illabot Creek area that Stalmaster (1991) reported the highest concentrations of foraging eagles. A mean density for this area was 54 eagles per river kilometer. Stalmaster also found this area to have the highest proportion of subadults. During USFS night roost surveys since 1985, many of the eagles that forage in this area have been seen flying up Illabot Creek to a staging area approximately 1 mile from the river, and a roost approximately 3 miles from the river. Peak counts from these surveys have generally been from late December through January, often dropping significantly during the second half of January. Ratios of adults to subadults have been highly variable during these surveys, with no apparent trend or correlation with time of season.

D. Recreational Use

This area attracts much human activity, due to the fact that it is easily accessed by a boat launch at a state park, and easily viewed from Highway 20. The data collected at Howard Miller Steelhead Park for the 1991/92 winter commercial season indicate 212 commercial rafts took out at the park, 1992/93 data show 225 commercial rafts took out at the park (indicating high use of the Illabot segment, upriver from this park).

Data from 1985-1987 (Stalmaster 1991) show the majority of recreational use occurs on weekends between 10:00 am and 2:00 pm. Eagle viewing craft were much more common on weekends (92%) than weekdays (8%), and use was low in the morning (11%) and high in the afternoon (89%). Half of the fishing boat occurrences were on weekends and half were on weekdays. Fishing boats were equitably distributed throughout the day, with fifty-one percent recorded in the mornings (7:00 to 12:00) and forty-nine percent in the afternoons (12:00 to 5:00) (Stalmaster 1991).

This segment had 1,307 recreational events and 4401 river visitors per winter in 1985-86 and 1986-87 (Stalmaster 1991). Overall percentages of use by user-type is displayed below.

WEEKDAYS		WEEKENDS	
MOTORBOAT	28%	MOTORBOAT	17%
DORY	15%	DORY	16%
RAFT	4%	RAFT	10%
BANK ANGLER	38%	CANOE	10%
HIKER	15%	KAYAK	4%
		BANK ANGLER	23%
		HIKER	70%

There are five eagle viewing areas within this segment. One (Cascadian Farm area) receives moderate levels of viewing activity, while the other four receive high levels of activity. These areas are located at the Highway 530 bridge in Rockport; at a pull-out 1/4 mile east of Highway 530 on Highway 20; at Washington Eddy, M.P. 99 (SRBENA1); and at Sutter Creek, M.P. 100 (the Wash. Dept. of Transportation rest area). The latter two locations have interpretive displays that encourage viewing at these locations.

Marblemount Segment

A. Stream and Bank Characteristics

The Skagit River in this segment has a few gravel bars, found at the confluence of Bacon Creek and Cascade River. There is very little meandering in the segment and the river increases in velocity in places. The surrounding vegetation has a large conifer component. In the town of Marblemount, there are farmlands adjacent to the river bank.

There is one known night roost within this segment, which is in a coniferous stand located approximately 2 1/2 miles from the river (up Bacon Creek drainage). There is a considerable amount of potential roosting habitat within this segment, primarily on the north/west side of the river, with some also to the east in the upper half of this segment. This habitat consists of mature and old-growth coniferous stands on National Forest lands.

B. Food Availability

The mainstem of the Skagit receives regular and frequent surveys and a few of the tributaries have been less frequently surveyed. This area is highly variable with some areas being very high while others are very low. Tributaries contribute considerably to the chum ratio. This segment along with the Illabot segment has the highest chum availability in the analysis area. The overall rating for the area is high for chum and low for coho.

C. Eagle Numbers

Counts from a combination of driving censuses and intermittent and standard night roost surveys since 1985 have found up to 19 eagles using the Bacon Creek area. The average peak count has been 6-7 in January, with exceptionally high peak counts in 1987-88 and 1992-93 (19 and 18, respectively), and low peak counts in 1988-89 and 1991-92 (4, both seasons). In the 1992-93 season, there was a higher number of eagles observed during the late part of the season than had been observed during this time in previous years. There were more eagles seen in February than in December in this area, and relatively more eagles at this site in February than at some other survey sites that generally have higher counts earlier in the season.

The location of the roost was just verified in 1992-93, and limited observations so far indicate low use of this roost. Many of the eagles seen during the surveys have either flown up or downstream near dusk. It has been difficult to determine where these birds have stopped to roost, as visibility and access is limited in this drainage.

Data from censuses conducted by the National Park Service (NPS) from Marblemount to Newhalem have shown an apparent increase in total numbers of eagles within this segment during the last 5 years of the census effort (compared to the first 5 years, beginning in 1982). Bjorklund (1991) has also reported an apparent increase in the proportion of subadults during this time, but this was not statistically significant. These censuses have identified an area at the confluence of Diobsud Creek that has high foraging activity by eagles.

D. Recreational Use

During the 1992/93 season Skagit County had fourteen outfitter/guide rafting operations under permit. The County permit required the outfitters to access the river on the West side of the Cascade River road bridge (RM 78.2) and prohibited launching of rafts before 10:00 am. See the Illabot section for numbers of rafting trips that took place. Private non-motorized use occurs mainly during the winter bald eagle season between Marblemount and Rockport. Access is the WDW launch site on the east side of Cascade River road bridge (RM 78.2). The majority of use is private rafts with a low number of canoes and kayaks being used. Use occurs mainly during weekends between the hours of 10:00 am and 6:00 pm.

In the winters of 1985-86 and 1986-87 there were an average of 34 recreational events per winter (0.6% of the total), and 101 visitors per winter (0.7% of the total). Percentages of use broken out by user-type are described below.

MOTORBOAT	17%
DORY	17%
RAFT	0%
CANOE	9%
KAYAK	5%
BANK ANGLER	52%
HIKER	0%

There are two eagle viewing areas located within this segment, both of which receive low use. These are located at the Good Food Restaurant and the Cascade River Bridge, in Marblemount.

Newhalem

A. Stream and Bank Characteristics

This segment has a low number of gravel bars in it, the river bank is heavily forested, with an even mixture of coniferous and deciduous trees. The channel is split by one large gravel bar.

B. Food Availability

There are regular index surveys on two of the tributaries. One of the tributaries provides a high contribution of chum and the mainstem is moderate to low.

C. Eagle Numbers

The National Park Service conducts weekly census surveys in this segment. Forage use is moderate to low with peak counts for the segment typically in the 30's. There are no known night roosts in this segment.

D. Recreational Use

A moderate amount of commercial and private non-motorized boat use occurs on the upper Skagit between Newhalem and Copper Creek during the months July through September. National Park Service data for 1986 shows a total of 177 river craft used the Newhalem segment between July and September. The data from 1992 shows 423 river craft for the same months. Winter use is low, 1986 data for December through February show 25 river craft used the segment. Data for 1992 show 74 river craft using the river during the same time period. No motorized use occurs on the Newhalem segment due to low water conditions.

Lower Cascade River

A. Stream and Bank Characteristics

This segment is very braided and has gravel bars throughout. The area around the fish hatchery has a lot of open vegetation areas including farmlands. The riparian vegetation has both deciduous and coniferous trees in close proximity to the river bank.

One known staging area is located within this segment, which consists of large coniferous trees on a hillside located on private land. It is unknown where the eagles seen in this area go to roost. There is some potential roosting habitat 1/2 to 2 miles northeast of the river, on some private and some National Forest land. Most eagles seen in this area have been observed flying northward. Eagles foraging in this area might also fly southwest to the roost in the Illabot Creek drainage, or southeast to the roost in the upper Cascade.

B. Food Availability

This area is regularly surveyed for chum as well as coho. The lower 2 miles provide a high contribution of chum and moderate coho.

C. Eagle Numbers

Only one to four eagles were observed within this segment a few times during the winter of 1990-91. One surveyor noted that there were large numbers of fish (chum) carcasses in the vicinity of the Cascade River bridge near Marblemount, but there were not corresponding large numbers of eagles.

D. Recreational Use

Use on the lower Cascade River is low and is found near the confluence with the Skagit. No boat fishing occurs on the Cascade River. Bank fishing is low, limited by lack of access, water conditions, and occurs mainly below the Cascade-Rockport Road bridge.

According to Stalmaster (1991), there were an average of 60 recreational events and 100 river visitors per winter in 1985-86 and 1986-87.

Upper Cascade River

A. Stream and Bank Characteristics

This whole segment is a high energy stream. It has no gravel bars and has large boulders for river substrate. The river banks are wooded primarily with conifers, there is a small component of deciduous trees. There are some clear cuts in the area.

There is one known staging area/night roost within this segment, which is a coniferous roost located 1/4 to 1/2 mile from the river, on National Forest land. There is other potential coniferous roosting habitat on the surrounding National Forest land, particularly in the Irene, Marble, and Sibley Creek drainages.

B. Food Availability

There are no chum index streams in this area, but the availability of chum is thought to be low. There are several index areas for coho with very low numbers.

C. Eagle Numbers

Night roost surveys from December 1986 to December 1988 found relatively sporadic and low use (1-2 eagles) of the known night roost, although as many as 11 eagles were seen roosting in it in February 1987. Although the USFS felt that gathering information on the use of this roost needed to be continued, surveys in this area were discontinued in January 1990 due to inaccessibility caused by avalanches and bridge failure.

Peak counts always occurred in January, ranging from 6 in the winter of 1988-89 to 23 in the winter of 1986-87. Numbers of eagles seen in this segment were much higher in the winter of 1986-87 than in any of the following years. One foraging area was identified within this segment that apparently received an intermittent and low level of activity (1-4 eagles).

D. Recreational Use

Recreational use on the Upper Cascade is limited, due to rough terrain and lack of access. One commercial raft permit is in effect. Due to Class 5 white-water, inconsistent water levels, and the requirement by the permittee that the clients have previous white-water experience, only one guided float trip has taken place the past three years. That trip constituted 25 user-days out of a total 300 user days allotted to the permittee (100/yr). Private use in this segment is low and limited to highly skilled kayakers.

Lower Sauk

A. Stream and Bank Characteristics

The Lower Sauk (RM 13 to RM 0) encompasses the portion of the Sauk into which the Suiattle River flows. The banks along the lower stretch are primarily in hardwoods, alder and cottonwood, with second growth conifer stands. Even with steep banks of composed of glacial till which are susceptible to undercutting, the primary source of sediment in this segment of the river is from the glacial melt in the Suiattle River system. Much of this river segment meanders, with numerous side channels and splits in the main channel. The lower 4 miles of this segment is reported by Russell (1980) as having a good rifle to pool ratio for fisheries production. The river is bordered by Hwy 530 on the east bank. On the lower portion of the river, RM 9 and below, the river has parallel road systems. This segment has scattered homes along the river and Hwy 530. Agriculture, grazing, and forestry are the main land uses along this portion of the river valley. The community of Rockport is located at the confluence of the Sauk and Skagit Rivers and the Howard Miller Steelhead Park is an attraction to the camping and day-user public.

There is no known night roost within this segment. There is not much potential roosting habitat located along the river in this segment, but there may be potential coniferous roosting habitat within 2-3 miles on National Forest land located on both sides of the upper 3/4 of this segment. There may be more deciduous roosting habitat at the lower portion of this segment, near the known roost in the McLeod Slough segment, if it is not too disturbed by human developments and roads in the vicinity.

B. Food availability

This area is rated low for chum. Chum and coho utilize the lower end of Rinker Creek. Other coho spawning areas are reported by Russell (1980) as the lower portion of Hilt Creek, and White Creek.

C. Eagle numbers

Few surveys have been conducted on the Lower Sauk River, due to a lack of surveyors, and an apparently low number of eagles, as determined by surveys in the winters of 1986-87 and 1987-88. Surveys by the USFS have been limited to the lower portion of the Lower Sauk, near Hilt Creek and at "Government Bridge" or Sauk River Park, located approximately 1/2 mile north of White Creek. A driving census in 1992-93 included observations at the Government Bridge location.

Surveys in 1986-87 resulted in a peak count of nine in late December at Hilt Creek, and four in early December at Government Bridge. Only two, three, and five birds were seen at the Hilt Creek site on three other occasions, spread throughout the season. At Government Bridge, one eagle was seen twice, and two were seen twice. The Government Bridge site was not surveyed again. Hilt Creek was surveyed only six times in 1987-88, with a peak count of two once, and only one observation one other time. However, this site was not surveyed in January or February of that year.

During the peak count at Hilt Creek in 1986-87, two were adults, and seven were "unknown". All but one eagle observed throughout the rest of the surveys was an adult.

The census in 1992-93 found a peak count of three eagles on two occasions. Eagle observations were spread throughout the season. Most observations were of adults, although subadults were observed on two occasions (once in late December, and once in late February).

An area in the vicinity of Hilt Creek has been identified as a foraging area with low eagle use.

D. Recreational use

Use along the lower Sauk is low. No commercial rafting occurs on this segment. A low amount of private non-motorized boat use to fish or view bald eagles occurs in the winter. The majority of use occurs on weekends. Motorized fishing is low. If the water level is high enough and the water is clear, some fishers will fish the lower Sauk near the confluence of the Skagit. Summer use is limited to the occasional river floater. A low amount of bank fishing and eagle viewing occurs during the winter months.

Stalmaster (1991) observed 145 recreational events and 448 river visitors per winter in 1985-86 and 86-87. In comparison with the rest of the river, this segment had 2.8% of the recreational events and 3.0% of river visitors.

The relative amounts of recreational use by user type is broken into percentages below (Stalmaster 1991).

MOTORBOAT	9%
DORY	35%
BANK ANGLER	53%
HIKER	3%

Mid Sauk 1

A. Stream and Bank Characteristics

From Clear Cr. (RM 25) to the bridge near the Sauk/Suiattle River confluence, (RM 13), the tree cover along the banks is dominated by alder and cottonwoods, with much of this portion of the river along the Sauk Prairie. The area between Clear Cr. and Darrington has numerous residential developments scattered along the west banks of the river. The town of Darrington is the only major community along the Sauk River. The majority of this segment (RM 21 to RM 13) flows through a broad valley with agriculture, grazing and forestry practices. This segment of the river is characterized by multiple, braided

channels and frequent switches in channels as was evident following the 1990 fall floods. The broad riffles and pools of Mid Sauk 1 were described by Russell (1980) as having exceptional spawning gravels.

B. Food availability

This river segment includes the one WDW index area for chum counts (RM 16 to RM 19), and two coho index areas, a tributary near RM 21, and tributaries near RM 19. This river segment has the highest chum and coho production sites known on the Sauk River system. Coho counts in the hundreds and chum counts in the thousand are not unusual for this area (Hendricks 10/13/93). This area was also reported by Russell (1980) as an excellent spawning and rearing area for coho and chum salmon.

C. Eagle numbers

Eagle use of the this area is based on the night roost surveys for the Gold Hill area and observations of the Bennetville foraging/river roost area. Peak day counts for eagles entering the Gold Hill night roost are displayed in Appendix B Graph 1. The Gold Hill night roost had a peak count of 37 eagles in 1986/87. Lower counts in years following 1988/89, led to another observation station being established on this river segment at Bennetville. Following the 1990 floods, the river had switched channels, and the Bennetville site provided views of eagles foraging and staying on the river during the 1991/92 season and the 1992/93 season. The trend of eagle numbers detected at the Gold Hill roost has been down from the highs in 1986/87 and 1988/89, but comparable to what was observed in 1987/88. The 1990 floods may have made shifted forage opportunities toward the north, with eagles staying on the river (USFS observations 1991-1993) instead of using the Gold Hill roost (graphs of Bennetville eagle counts 1991/92 and 1992/93, Appendix B Graph 1). A rating of high eagle numbers (>15 eagles over 2 years) is given to this river segment, with key foraging areas noted between RM 13 and RM 19.

D. Recreational use

The Mid Sauk has a number of qualities which make it a unique river for white water boating including easy access, scenic quality and a variety of rapids. Commercial rafting is the major use on this segment. The normal season is May-August. Currently four commercial rafting permits are issued on the Sauk. Most use occurs on the weekends between 9:00 am and 3:00 pm. Private kayaking along the Sauk is a popular sport. Fishing is mainly bank fishing in the spring and fall. Weekend use is distributed throughout the day. Because of numerous access points, use is distributed along the whole segment. A small amount of drift fishing occurs if the water conditions are right. Some trapping of beaver may occur during the winter months depending on pelt prices.

Mid Sauk 2

A. Stream and Bank Characteristics

Downstream from the White Chuck River confluence with the Sauk, much of the bank area includes large conifers along with alder patches in areas of recent channels shifts (RM 32 to RM 25). Remnant old growth along the Old Sauk trail is primarily Douglas fir, western hemlock and western red cedar. The Mt. Loop Scenic By-way borders the south west side of the river, while the old Sauk road

borders the river on the north east side. At approximately RM 26, the road has been washed out on the north east side (1990) and has not been repaired. The road is used on either side of the washout for access to portions of Gold Hill (USFS rd 2210 and Rd 24). This segment of the river is characterized with a narrower channel and steeper gradient, fast flowing waters, and fewer gravel bars.

B. Food availability

This stretch of river also lacks any index streams for chum or coho counts by the state biologists. In this river segment, the production of chum and coho are thought to be spotty, with some spawning in the tributaries. A recent rearing pond excavation (1991) at Constant Channel (RM 28) has seen approximately 80 chum and 150 coho during the 1992/93 season return to the area to spawn. Additional rearing ponds excavated in the riparian area near RM 25 are used by coho with a single count (within the last 5 years) of 152 fish in the Hyachuck system. The ponds were designed to provide both spawning habitat and rearing area for young fish during the high water events in the main river.

C. Eagle numbers

One to five eagles have often been seen in the vicinity of the rearing ponds during the winter season. A possibility that the eagles may be beating the fish counters to the spawning grounds was brought up in discussions between USFS and WDW. The lack of numerous gravel bars and an increasing gradient may result in a lower catchability of fish carcasses for bald eagles. Eagles have been noted along this stretch of the river and perched above Constant channel, taking advantage of the forage. Not more than 2 eagles at a time were noted within the channel area.

D. Recreational use

The stretch of river from the White Chuck to Clear Cr. is frequented by rafters, since this portion of the river is characterized by swift water and rapids. The majority of the use is in the summer months with commercial rafters putting in at the White Chuck boat launch and taking out near Clear Cr., Backman Park, Darrington, or near the Sauk/Suiattle confluence. During the winter months, low flows and snowed-in roads make this stretch less attractive for rafters or boaters, but some kayak use occurs, primarily between the White Chuck and Clear Cr. There is no motorized use in this segment.

Upper Sauk

A. Stream and Bank Characteristics

Along the upper Sauk (RM 32 to RM 3 of the S.F. of the Sauk) , a mix of conifers and hardwoods flank the river. From Bedal (RM 39) to White Chuck River, (RM 32), much of the riparian area is in red alder (Alnus rubra) with black cottonwood (Populus trichocarpa), and some conifers of western red cedar (Thuja plicata), Douglas-fir (Psudotsuga menziesii), and western hemlock (Tsuga heterophylla). This stretch of the river has a number of side channels near Skull Cr., Lyle Cr., and Falls Cr. (RM 34 to RM 38) which have coho and chum spawning habitat. This portion of the river has a wide channel and frequent gravel bars, which is in contrast with the upper 3 miles where the channel narrows and the current is swift amongst large boulders. The Upper Sauk drainage includes stream banks with blue clay deposits which are active during high water events, often resulting in heavy silt suspension during winter months.

B. Food availability

The Upper Sauk has both coho and chum spawning sites along the river and in tributaries. Known sites include the Falls Cr, drainage, and tributaries in the stretch from RM 34 to RM 38. Consultation with Don Hendricks, state fisheries biologist (10/13/93) provided additional information on fish survey efforts and numbers. This segment of the river has no index streams so information on spawning areas and numbers is dependent on time and resources of the state biologists, and other sources such as the Skagit System Cooperative fisheries biologists. Both chum and coho production was rated as moderate for river miles 33 to 38, with 5 year average that rated low for carcass numbers detected in the area.

C. Eagle Numbers

Eagle use of the Upper Sauk is consistent from year to year of at least 5 to 10 eagles seen perched along the river. A night roost area has been identified in the Beaver Lake area with use by 1 to 8 eagles. Eagle use appears spread along the river segment from Bedal to the confluence with the White Chuck River (USFS surveys 1989 - 1992).

D. Recreational use

The Upper Sauk may have some kayak use during the summer months, but has only limited use by rafts or kayaks during the winter due to low flows and exposed large boulders. This river segment is not easily accessible for boating, and is more likely to have foot traffic to favorite fishing sites along the river bank. We estimate 100 river craft/yr and 200 bank anglers/yr in this segment.

Upper Suiattle

A. Stream and Bank Characteristics

The upper segment is primarily within the National Forest from RM 12 to RM 31. The Suiattle River varies from a meandering river channel as found from near Sulphur Cr. (RM 26) to a narrower channel where the river gathers the waters of Big/Grade Creeks (RM 9). The upper drainage of the Suiattle has a conifer/hardwood mix. The river edges and gravel bars are often hardwoods (alder/cottonwood) with large diameter conifers a part of the adjacent stands. The river often switches channels in this river segment, as was evident following the 1990 flood. The river banks are mix of sandy glacial till and volcanic ash, with the primary sediment source the silt from glacial melt during summer months. A USFS road (#26) parallels the north bank of the river; portions of the road on the south side of the river (USFS rd #25) are currently under obliteration (2550 and 2540). Several summer residences are located east of RM 10. The upper Suiattle River drainage is primarily forested with little development, outside of four campgrounds (Buck, Downey, Sulphur and the Suiattle).

B. Food availability

There are no Suiattle River coho or chum index streams checked by the state fisheries biologists. The Suiattle has no known chum spawning areas, but does have a number of tributaries with known coho spawning. The major coho spawning and rearing area is at All Creek swamp, near RM 12, other coho tributaries are in the vicinity of RM 14 to 16, and 18 to 21. Coho production was rated as

high at All Cr. swamp (RM 12) and moderate elsewhere on this river segment. The upper segment is characterized by a moderate coho production and numerous gravel bars to catch carcasses.

C. Eagle numbers

Few surveys have been accomplished on the Upper Suiattle River due to access difficulty during the winter months. Areas with known eagle use include a portion of the river near RM 16, and within the All Cr. swamp area, RM 12. Eagles were observed flying to three different night roost from the swamp, as well as perching within the swamp as dusk fell (USFS files 1989 to 1992). There have been peak day counts of at least 10 eagles using this area over the 3 years of surveys. Known eagle use for most of the river segment is low, with a moderate rating for the one river mile adjacent to All Cr. swamp.

D. Recreational Use

Little boating or rafting is known in the upper Suiattle drainage. Bank fishing is facilitated by the road which runs parallel to the Suiattle. Commercial and private rafters use the bridge site at RM 12 to put in for rafting the lower portion of the river. A limited number of kayakers will scout this segment and if conditions are safe will float the upper segment. It is estimated that fewer than 80 kayaks used this segment in 1993.

Lower Suiattle

A. Stream and Bank Characteristics

This segment of the river includes the portion from the confluence with the Sauk to the bridge over the Suiattle, near the boundary of the Mt. Baker-Snoqualmie National Forest (RM 0 to RM 12). Downstream from All Cr., the Suiattle narrows as it flows through the lower valley until approximately 3 miles from the Sauk River. Here the valley broadens and the river again has a more sinuous character. River gradient and flow decreases from the confined portions of the valley to a more moderate or gentle gradient in the lower few miles of the river. Bottom material is reported (Russell, 1980) as mostly boulders and cobble. The number of gravel bars increase as the river reaches the lower few miles. This river segment flows entirely through state and private ownership. The river bank vegetation is dominated by hardwoods and second growth conifers. Recent timber harvests have been conducted in the vicinity of the river between river miles 4 and 9. Russell (1980) reports that the general uses of the land in this segment are confined to forestry and recreation. There were 34 recreation subdivision lots reported by Russell (1980) in this segment.

B. Food availability

The lower 12 miles of this river segment are reported by Russell (1980) as providing spawning and rearing habitat for coho salmon. Little additional information was available from the WDW data base on productivity of this river segment for chum or coho. Scattered spawning was again reported by Russell (1980) in Tenas Creek, and lower Big Creek. D. Hendricks, state fisheries biologist explained how the lower portion of the Suiattle (RM 0 to 3) provided a moderately productive arena for coho rearing with sloughs and off river channels.

C. Eagle numbers

Eagle use of the Lower Suiattle is based on reports by Russell (1980) and Stalmaster (1991). Russell reported eagle counts of 11, 25, and 8 during float surveys in the months of December and January from R.M 12 to RM 0. Russell (1980) reports eagles as being thinly distributed with more eagles being viewed near the gravel bars adjacent to All Cr. or near the mouth of the river. Eagle use was thought to be correlated to gravel bars that catch fish carcasses. Stalmaster(1991) reports eagle density (mean number for river Km) as 1.6 eagles for the Suiattle River on a census route from RM 17 to RM 0.
Eagle use of the Lower Suiattle is rated as low.

D. Recreational use

The Lower Suiattle has commercial rafting activity during the summer months, but little rafting activity occurs during winter months. According to Stalmaster (1991), winter recreational use was divided evenly between dories and rafts only. There were only 15 recreational events and 66 river visitors in the winters of 1985-86 and 1986-87. Winter recreational use usually includes occasional drift boats for fishing. Due to log jams, rocks and low water, motorized boating is non-existent. Rafters and boaters often put in near the bridge at RM 12 and float to the confluence of the Suiattle and Sauk Rivers.

White Chuck Segment

A. Stream and Bank Characteristics

The White chuck River from RM 0 to RM 15 is being evaluated for eagle use due to the anadromous fish use of this river system. This river segment is within a narrow valley and is characterized by swift currents and steep gradients. The river banks are primarily forested with hardwoods and conifers, much of the length of the river has large diameter trees within the riparian corridor. River banks are often steep sandy, glacial till materials with volcanic ash deposits, and or sorted sedimentary layers. The principle sediment material in the river is silt from glacial melt during the summer months, when the river runs milky white. USFS road #24 runs adjacent to the White Chuck from the mouth to RM 12.

B. Food availability

Coho are suspected to use this segment of the river, but little is known of actual use areas. Tributaries such as Dead Duck and Pugh Creek do have suitable habitat for spawning fish.

C. Eagle Use

While the White Chuck River is reported to have an anadromous fish run, no concentrations of foraging eagles have been reported on this river which runs into the Sauk. There are a number of possible reasons: 1. the river runs in a relatively narrow channel, and is a swift flowing stream so fish carcasses may not catch on the gravel bars as in other areas, and 2. the fish runs are not predominately chum, the fish more commonly fed on by the eagles, 3. limited surveys since access during the winter is often limited due to snow.

D. Recreational use

No rafting or boating on the White Chuck is known by this author (P. Reed). Bank fishing is facilitated by the road which runs parallel to the river.

North Fork Stillaguamish River

The North Fork of the Stillaguamish River, although not part of the SW&SRS does provide bald eagles forage areas within three air miles of the Sauk River.

A. Stream and Bank Characteristics

The upper portion of the N.F. Stillaguamish River from RM 22 to 35 is within a wide valley. The gradient is gentle with numerous riffles and pools. This river segment flows through state and private ownership, so the surrounding land uses include residential, agricultural, grazing and forestry. The river banks are primarily hardwoods, alder and cottonwood with second growth conifers in some areas.

B. Food availability

This river segment is a very productive for a number of fish species including chum. Chum carcass numbers were rated as moderate for the main river from RM 22 to 33. The tributaries of Aston Cr., Snow Gl., and Squire and Brown's Creeks are considered high chum producers by D. Hendricks, state fisheries biologist. These creeks are index areas for the state for both chum and coho. Fish in the thousands was reported by D. Hendricks (10/13/93) from pint counts taken in the last 5 years.

C. Eagle numbers

Eagle use of this river segment is derived from night roost counts of eagles detected flying to the Whitehorse Roost. A peak day count in 1988/89 yielded 48 eagles. In 1989/90, eagle use of the roost average 10 eagles over the season, in the years 1990/91 to 1992/93, there were more bell shaped curves of eagle use. Eagle counts in the upper teens and twenties were common. These figures do not include eagles which stayed on the river or used the French Point Roost. No census of eagles on this river segment has been conducted by the USFS since the river segment is not within National Forest or is designated Wild and Scenic River system. Additional eagle numbers are suspected from the observations of eagle use of staging areas such as the Ashton Cr. area for alternate roosts sites, and eagles staying on the river as dusk fell. This river segment is rated as high in eagle numbers.

D. Recreational Use

There is little information on rafting or fishing by boat in this section. There are bank anglers and fishing with "waders" on this river segment. Overall recreational use is low.

APPENDIX B

BALD EAGLE CENSUS DATA AND DESCRIPTIONS

Census surveys: Census surveys have been conducted during foraging periods on a weekly basis by The Nature Conservancy (TNC) from RM 66 to RM 78 and the National Park Service (NPS) from RM 78 to RM 93 for the last eleven years. The surveys were conducted by driving and stopping at fixed locations that provided views of eagle habitat along the river. This survey technique provides a fairly accurate representation of eagles foraging and perching along the river on each survey day. Effort is made to count all eagles and not count the same bird(s) twice. Due to the nature of the river and the mobility of eagles this is, of course, not fully possible. Other factors that influence the accuracy of the counts include visibility and accessibility due to weather conditions, and changes over time in observer ability to detect eagles. Observer consistency has been relatively high during the last several years.

Eighty three percent of the surveys during the last four years were conducted by the two organizations on the same dates. To more accurately represent the information, and to improve consistency in representation of the two surveys, only surveys from November 10 to February 28 were used. Surveys outside of those dates were intermittent and usually not conducted for the entire stretch of the river. In addition, the numbers obtained from those surveys were consistently quite low and, as such, do not represent the eagle use season. The graph assumes that all sites were surveyed on each survey day. There were, however, some sites that were occasionally not surveyed due to inaccessibility.

Night Roost Surveys: Night roost surveys are designed to observe eagles entering night roost habitat in the evening. Most surveys are conducted near foraging habitat so that birds can be observed leaving the foraging area and visually followed to the roost. This technique does not provide a census but can give an indication of use at a particular site over time. All surveyors are provided with training but there is a mixture of inexperienced and experienced, amateur birders and professional biologists. Surveyor consistency between surveys is moderately low. Night roost survey results are also influenced by visibility and accessibility due to weather conditions.

METHODS FOR ESTIMATING BALD EAGLE USE TRENDS

Nearly all bald eagle surveys conducted on the Skagit system are done on a weekly basis. The significant daily fluctuations in numbers due to weather, water flow, condition of other river systems, etc. affect the accuracy of all estimates. The NPS has also evaluated trends and their graphs are included. The three methods used were as follows.

1. Peak day counts are the greatest number of eagles observed at a site for a specified period. They provide an estimate of how many eagles have occurred in a surveyed area at any one point in time. They can be used to estimate the maximum population on the river or as an index of what the

area could support relative to other areas. Since at any point in time the number of eagles in an area could exceed the carrying capacity peak, counts should not be taken to mean that the area can support that many eagles.

2. Average eagles per day provides a basis for comparing from year to year but is highly sensitive to the number of days surveyed on each end of the season when numbers were low. The total number of eagles observed is divided by the number of survey dates. This technique was applied to the Skagit from Rockport to Newhalem (TNC and NPS census surveys) (Figure 3a), and to night roost surveys on the Sauk River (Figure 3b). To more accurately represent the information on the Skagit, and to improve consistency in representation of the two surveys (NPS and TNC), only surveys from November 10 to February 28 were used. Surveys outside of those dates were intermittent and usually not conducted for the entire stretch of the river. In addition, the numbers obtained from those surveys were consistently quite low and, as such, do not represent the eagle use season.

3. Eagle-use-days estimate the total use for the season based on weekly census'. These estimates are essentially the areas under the graphs in Appendix B Graph 7. Each day that an eagle spends on the river counts as one eagle-use-day. This estimate is somewhat sensitive to whether or not surveys begin before eagles start to arrive and end after they leave. Many of the surveys did not cover the extremes of the season and, as such, will provide slightly low estimates.

   Based on the work of Hunt et al. (1992), the area covered by the census accounts for 41% of the eagle-use-days in the system. We, therefore, extrapolated the data to estimate eagle-use-days for the entire system for each year (figure 2).

Graphs are also included in Appendix B (Graphs 6a & 6b) depicting results of midwinter bald eagle surveys and data from WDW nest searches and surveys.

Due to the variability and biases introduced by the various survey techniques, it is impossible to say how much of the increase in numbers observed with each survey type is due to actual increases in numbers of eagles or increases in survey effort, surveyor ability or other elements of bias. Individual sites show much variation in peak counts and average number of eagles per day. With the small amount of data shown, sites on the Sauk and Stillaguamish appear to be fluctuating but stable, while most sites on the Skagit appear to be increasing. Based on the available information, however, it appears reasonably certain that eagle populations on the Skagit system, as well as statewide, are increasing but at unknown rates. Of greater interest to the issue of disturbance is the question of whether or not increases on the Skagit system are reflective of increases in productivity. In the absence of reliable information on rates we have not attempted to answer this question.

METHODS FOR ESTIMATING FORAGE USE LEVELS

Eagle use of the Skagit Wild and Scenic River corridor is due to the foraging opportunities provided to the wintering birds by the anadromous fish which spawn and die. Quality habitat for foraging is thought to include not only the areas with high counts of spawning fish, but also area with gravel bars for the fish carcasses to catch on. These areas are often characterized by the braided

channels where there is the appropriate sized cobble for the fish to prepare redds and the gravel bars to catch the fish carcasses following the spawning.

Areas which the USFS has noted as high activity sites for foraging eagles have been delineated on 1"/mi maps. Since eagles are thought to travel large distances to forage, the whole Skagit River system as well as the upper N.F. Stillaguamish River, and the Nooksack River system is thought to potentially be used by the same wintering eagle population. The N.F. of the Stillaguamish River flows within 2 miles of the Sauk River near the town of Darrington. Eagles are often seen flying over Darrington, apparently moving between the two river systems (Reed 1993).

To get an indication of relative abundance of food availability, average densities of carcasses were calculated for surveyed areas using all survey dates from 10/6/87 to 2/26/92 (5 seasons). Only dead fish were included in the calculations since this gives a better indication of locations where spawned fish end up as available food for eagles.

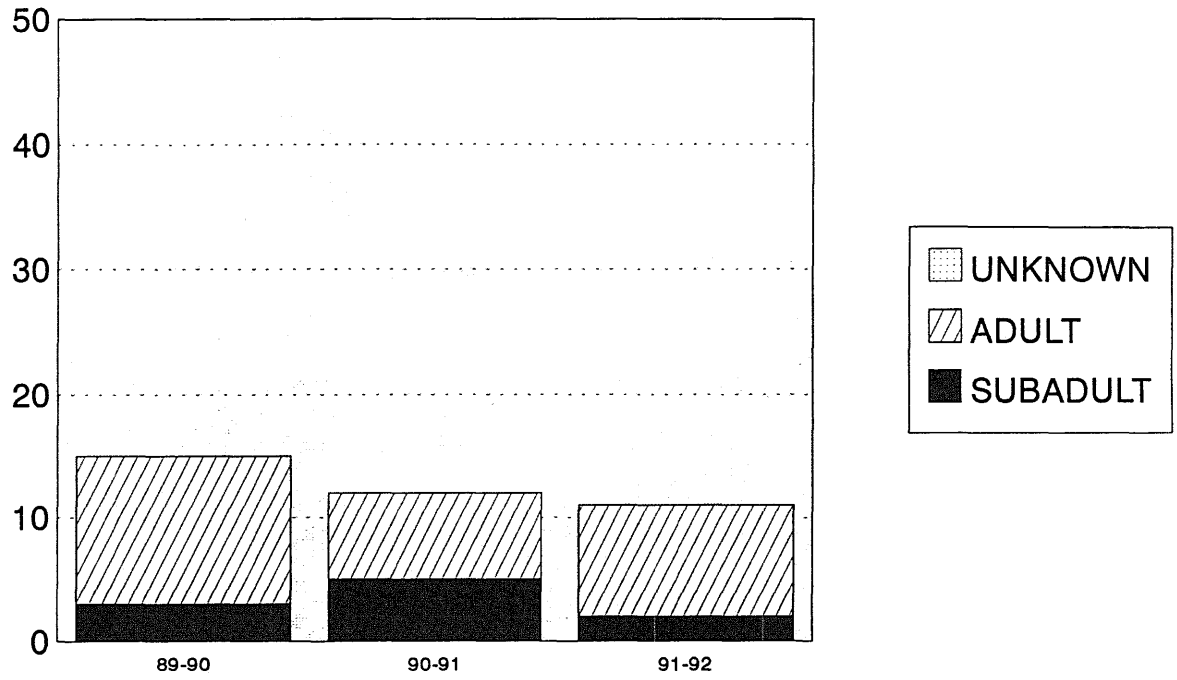
For display purposes, carcass density ratings were mapped (Map #1) by river mile for mainstem rivers or by whole tributary (e.g. only a small portion of a tributary may have been surveyed but the entire tributary is shown with the same density). Each river segment was then summarized by average density per mile surveyed within that segment. Since not all segments have index areas or comparable quantities of areas surveyed, not all streams have been surveyed, and not all surveyed areas have been surveyed to the same intensity, local knowledge, consultation with WDF personnel, and professional judgement has been used to adjust the maps as well as the ratings for each segment.

Areas not designated on map #1 as low, moderate or high either had no information or had an average density of fewer than 10 chum (or 26 coho). The intent was to show known concentrations and provide a range of food. Since the parameter of interest is food availability, different ranges of densities were used for coho and chum. One chum was taken to be equivalent to 2.6 coho (Stalmaster 1983). Other estimates have been offered and may be equally valid. Hunt et al. (1992) estimated 2.1 and Hendricks (pers. comm.) stated 2.6 may be valid but so might 1.5 coho.

LIST OF GRAPHS

PEAK DAY OF EAGLE COUNT PER YEAR

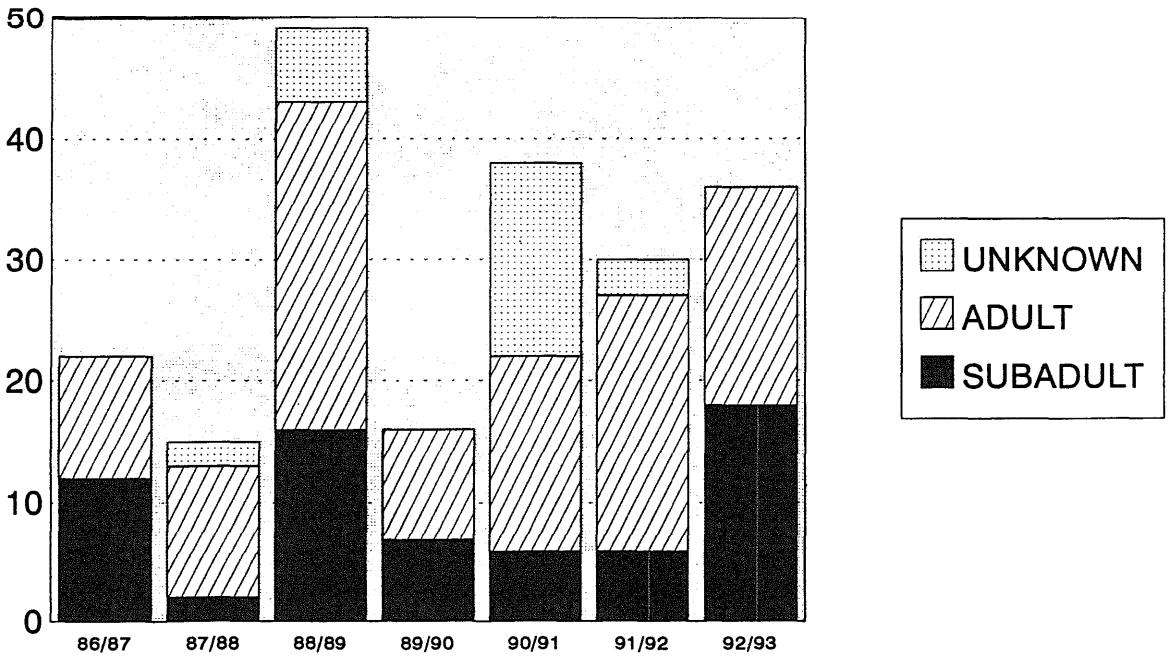
SUIATTLE SWAMP ROOST



LOWER SUIATTLE RIVER SEGMENT

PEAK DAY OF EAGLE COUNT PER YEAR

WHITEHORSE (ASHTON CREEK) ROOST

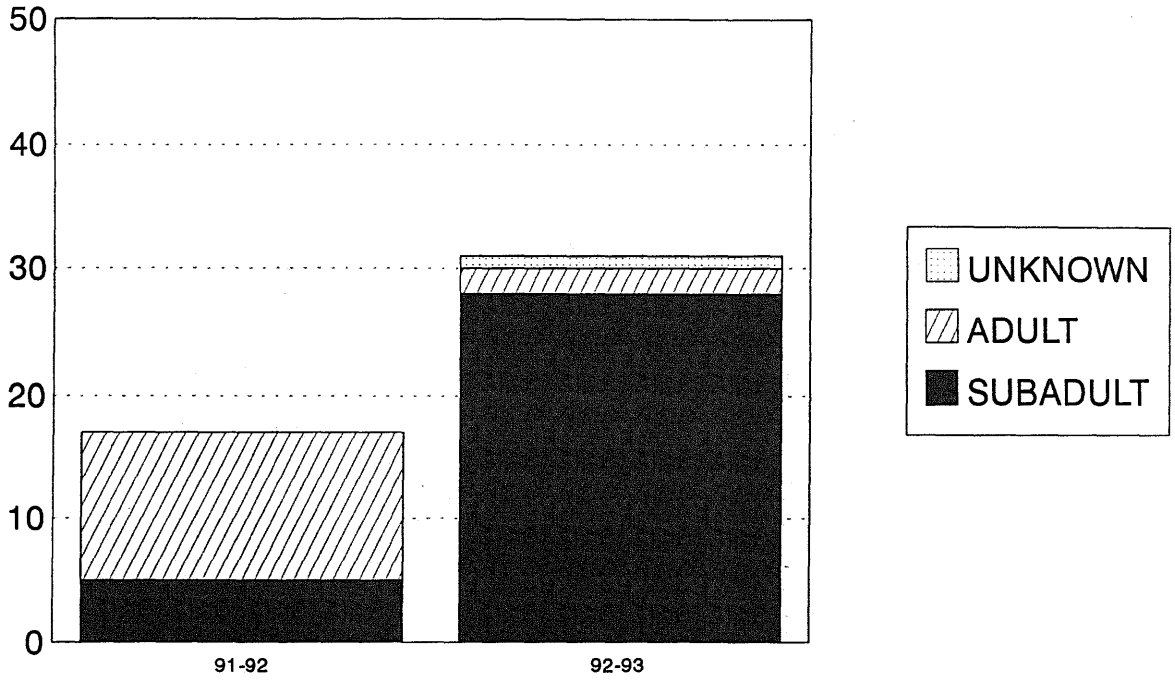


NORTH FORK STILLAGUAMISH RIVER

Graph 1. Peak Day of Eagle Count Per Year - Sauk/Stilliguamish (USFS data)
a. Lower Suiattle
b. NF Stilliguamish

PEAK DAY OF EAGLE COUNT PER YEAR

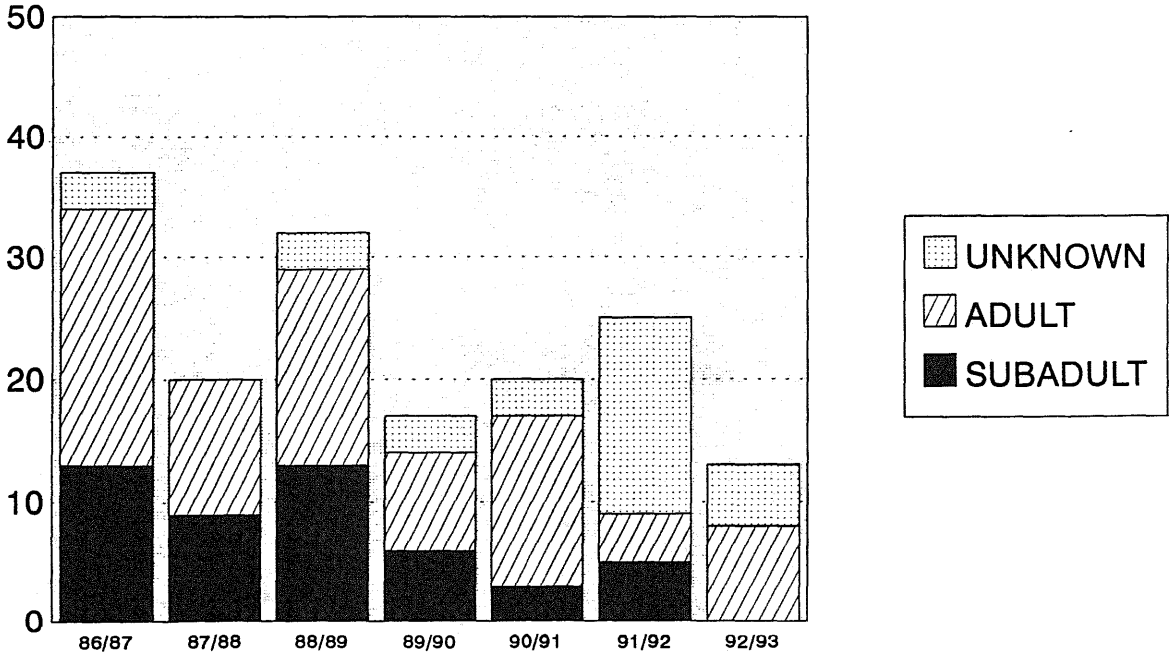
BENNETTVILLE FORAGE



MID SAUK 1 RIVER SEGMENT

PEAK DAY OF EAGLE COUNT PER YEAR

GOLD HILL ROOST

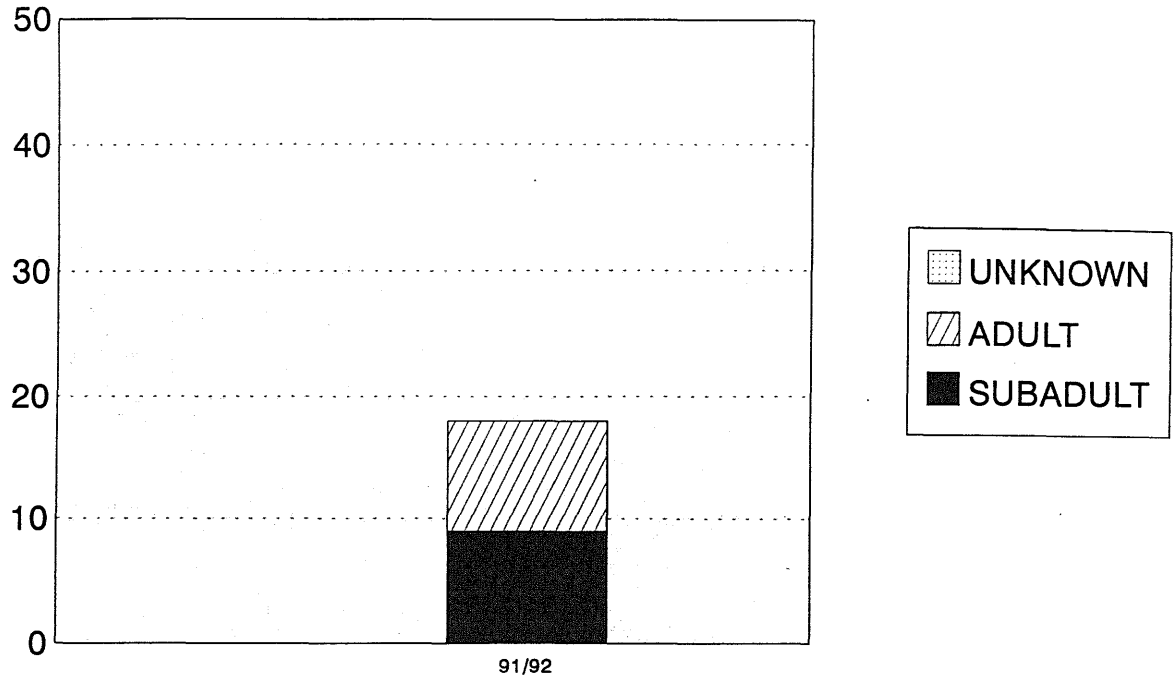


MID SAUK 1 RIVER SEGMENT

Graph 1. Peak Day of Eagle Count Per Year - Sauk/Stilliguamish (USFS data)
c. Mid Sauk 1 - Bennettville Forage
d. Mid Sauk 1 - Gold Hill

PEAK DAY OF EAGLE COUNT PER YEAR

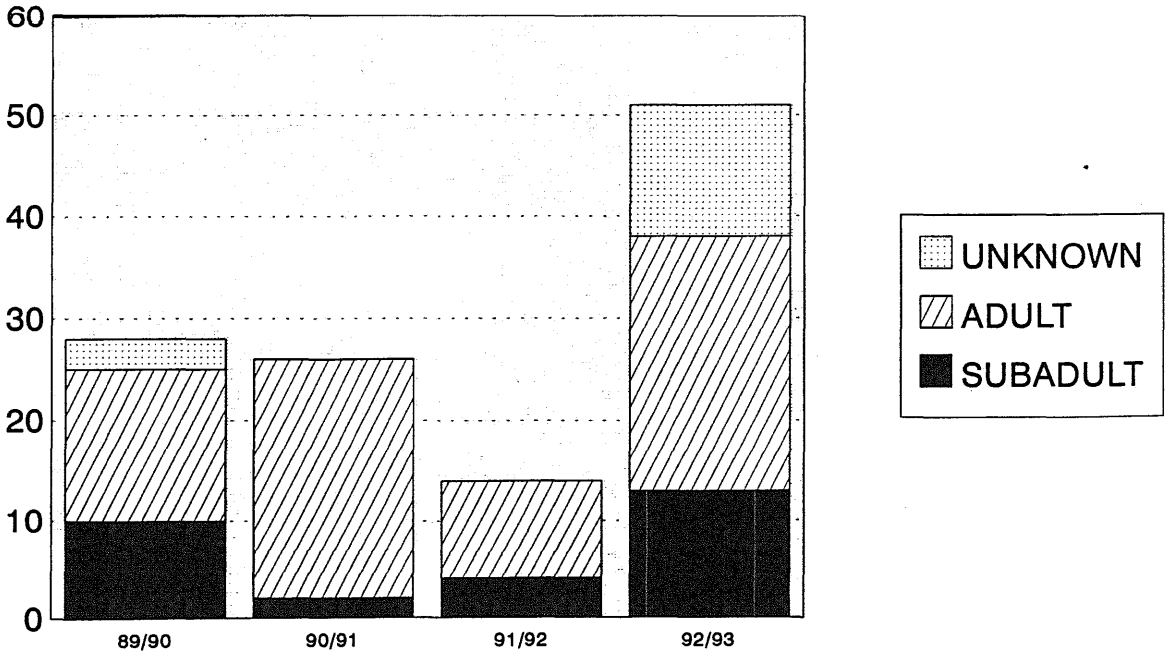
UTOPIA RD, LYMAN, FINNEY CUMBERLAND CENSUSES



LYMAN RIVER SEGMENT

PEAK DAY OF EAGLE COUNT PER YEAR

BIG EDDY OSPREY ROOST AND BAKER RIVER

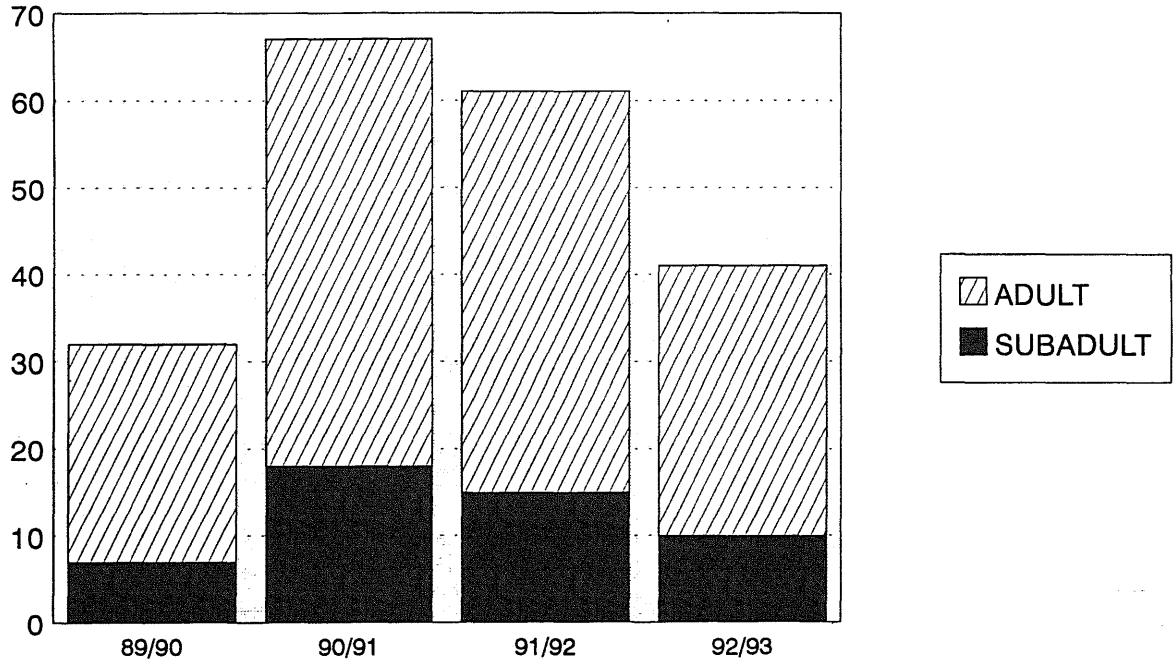


CONCRETE RIVER SEGMENT

Graph 2. Peak Day of Eagle Count Per Year - Skagit (USFS data)
a. Lyman
b. Concrete

PEAK DAY OF EAGLE COUNT PER YEAR

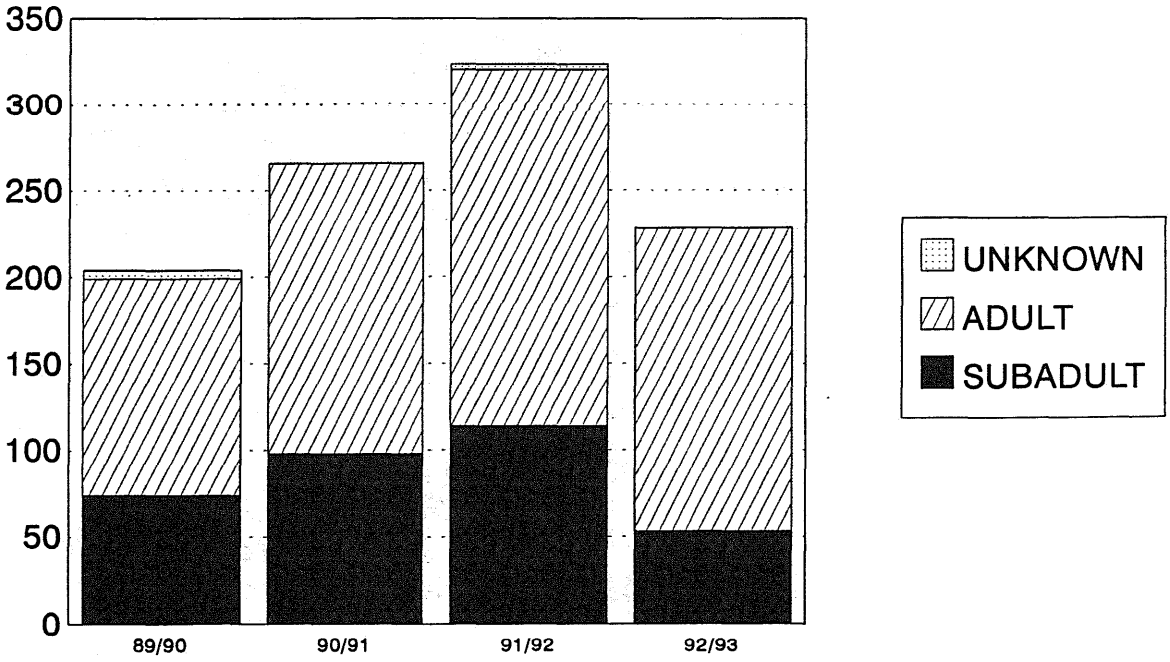
ROCKPORT STATE PARK (MCLEOD SLOUGH)



MCLEOD SLOUGH SEGMENT

PEAK DAY OF EAGLE COUNT PER YEAR

THE NATURE CONSERVANCY CENSUS

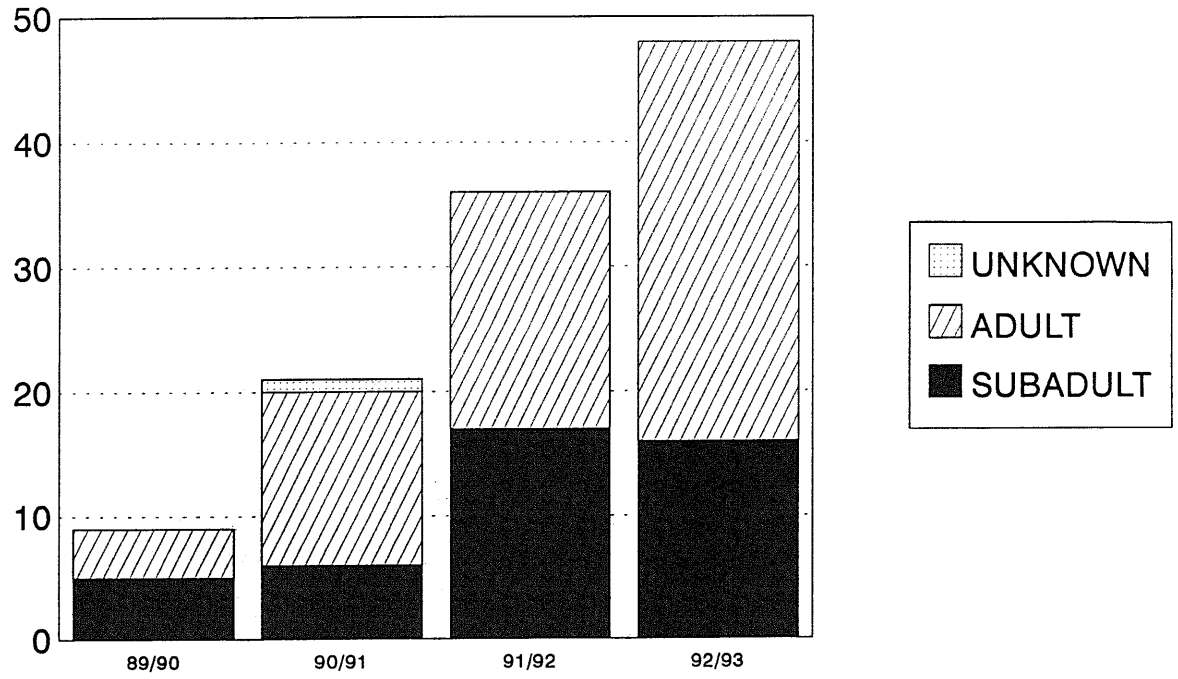


ILLABOT RIVER SEGMENT

Graph 2. Peak Day of Eagle Count Per Year - Skagit (USFS data)
c. McLeod Slough
d. Illabot

PEAK DAY OF EAGLE COUNT PER YEAR

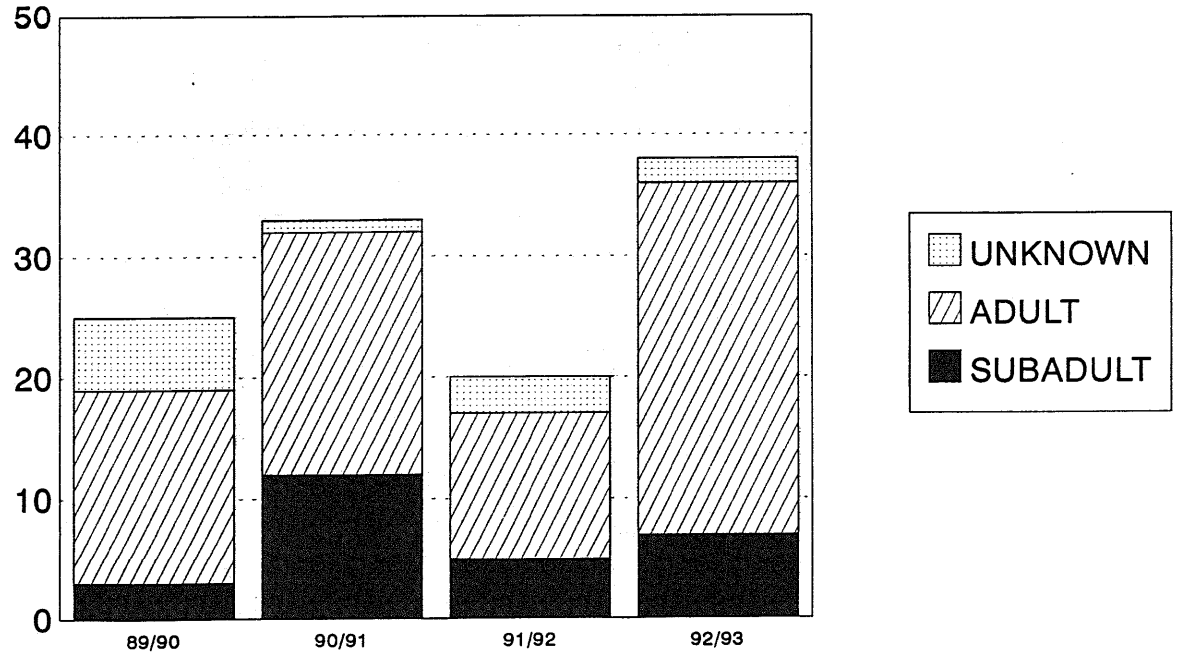
THE NATURE CONSERVANCY/NATIONAL PARK SERVICE CENSUS



MARBLEMOUNT RIVER SEGMENT

PEAK DAY OF EAGLE COUNT PER YEAR

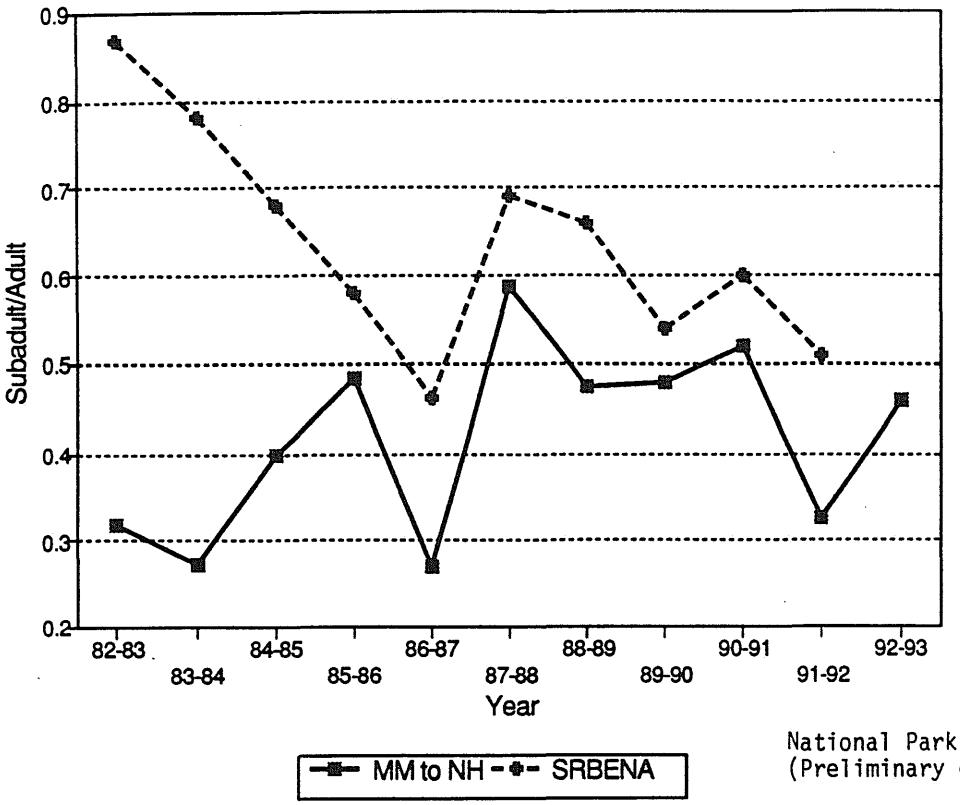
NATIONAL PARK SERVICE CENSUS



NEWHALEM RIVER SEGMENT

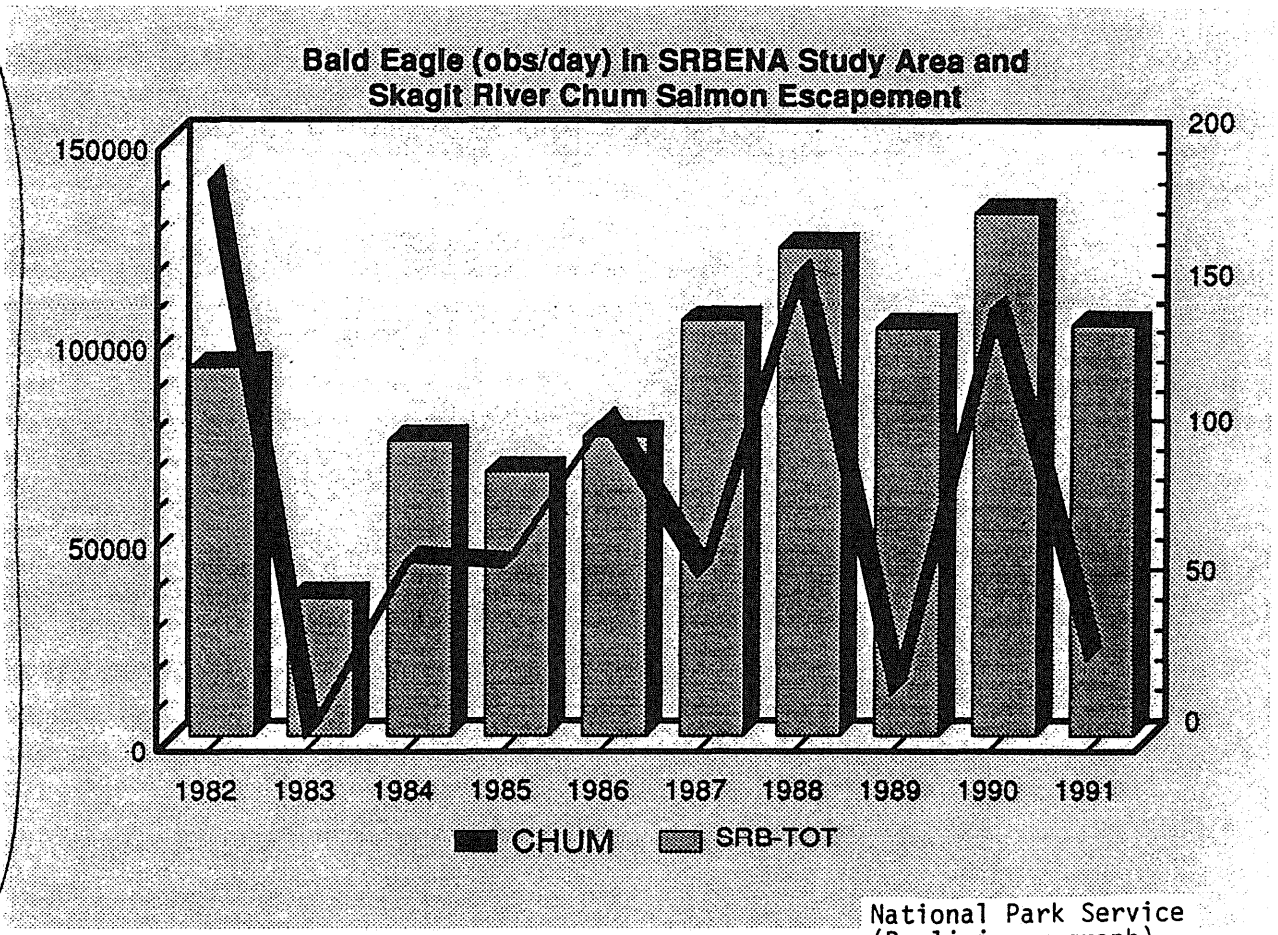
Graph 2. Peak Day of Eagle Count Per Year - Skagit (USFS data)
e. Marblemount
f. Newhalem

Graph 3. Average Eagles Per Day - Rockport to Marblemount, Compared to Chum Escapement (NPS graph)



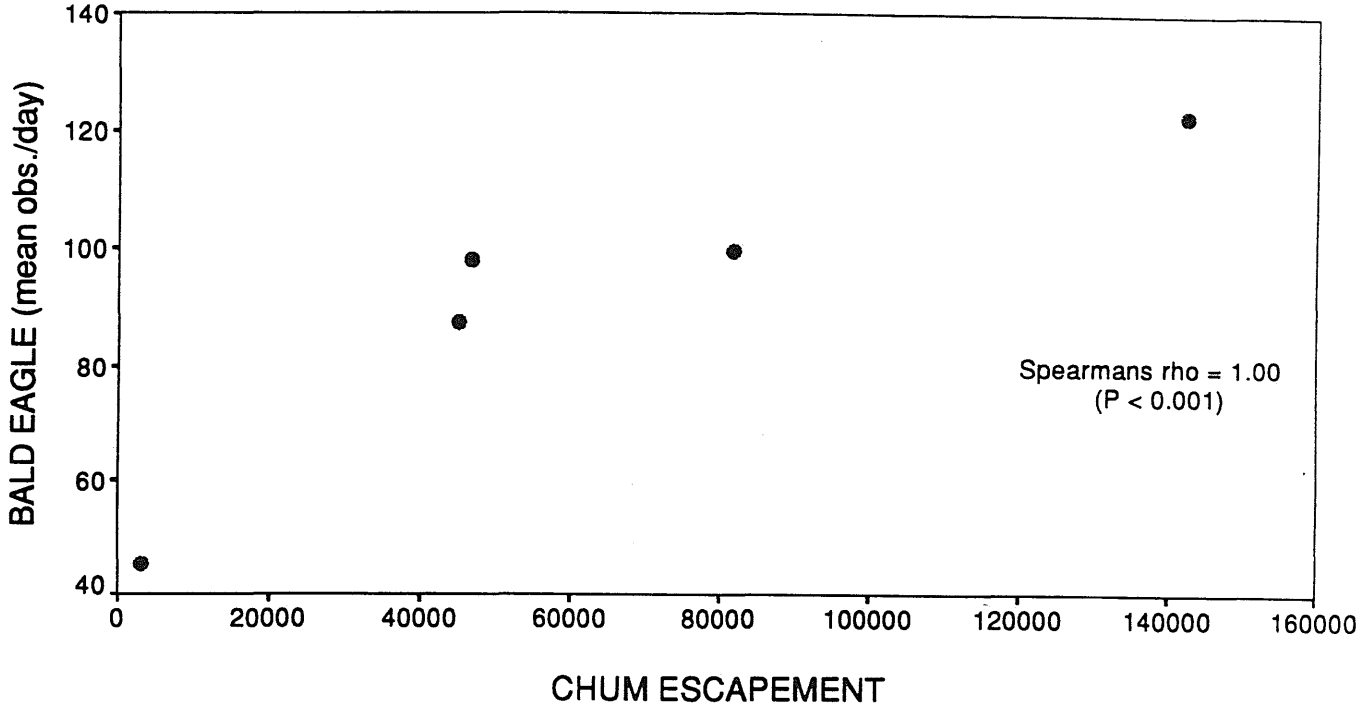
National Park Service
(Preliminary graph)

Graph 4. Subadult:adult ratios over time (NPS graph)

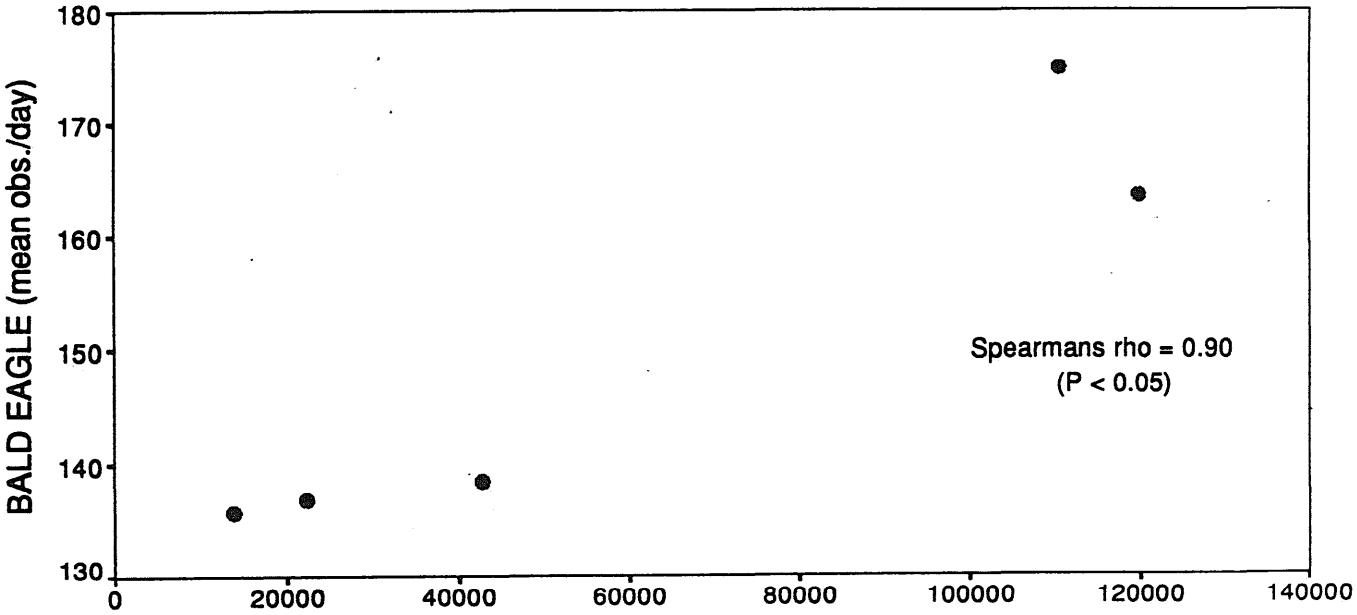


National Park Service
(Preliminary graph)

Relationship between relative abundance of bald eagles and chum salmon escapement, 1982-1986, SRBENA.



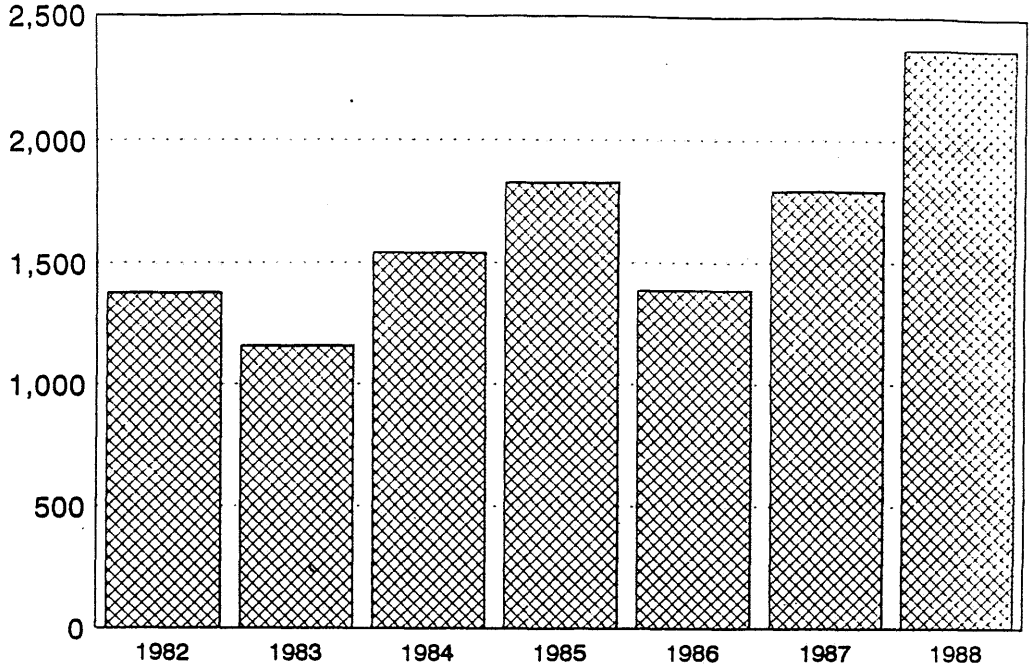
Relationship between relative abundance of bald eagles and chum salmon escapement, 1987-1991, SRBENA.



National Park Service
(Preliminary graphs)

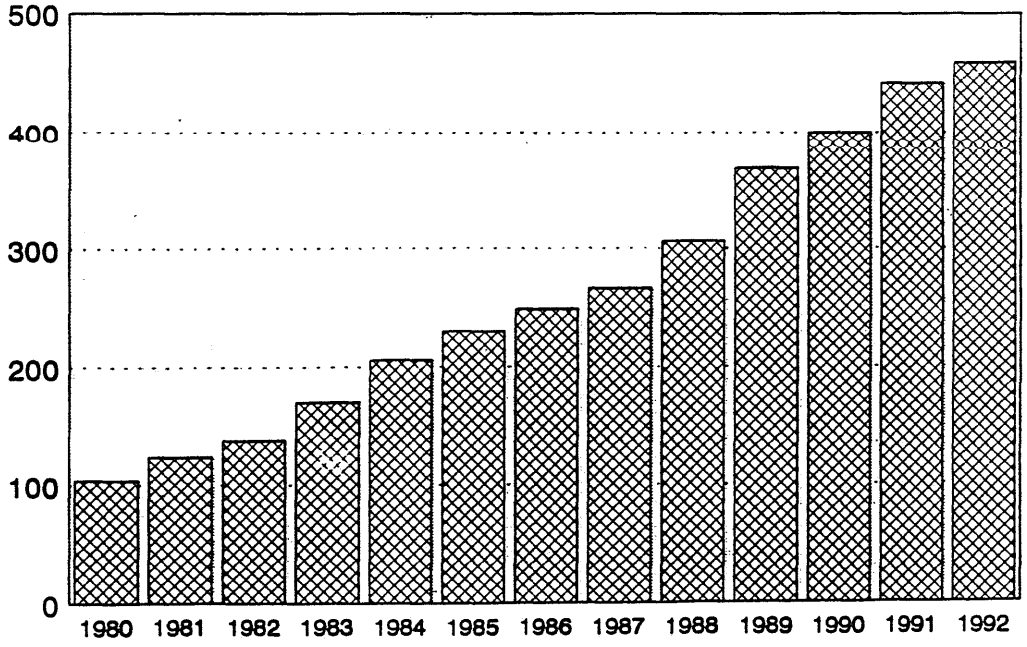
Graph 5. Correlation of Relative Eagle Abundance to Chum Escapement (NPS graph)

MIDWINTER BALD EAGLE SURVEYS



STATE OF WASHINGTON
(WASHINGTON DEPT OF WILDLIFE)

OCCUPIED BREEDING TERRITORIES

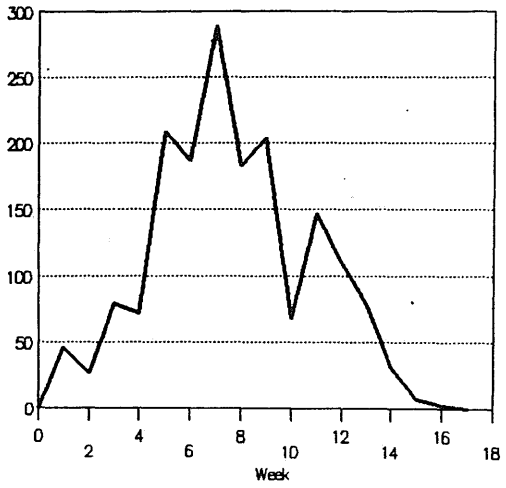


Graph 6. Statewide Surveys (WDW data)
a. midwinter
b. occupied breeding territories

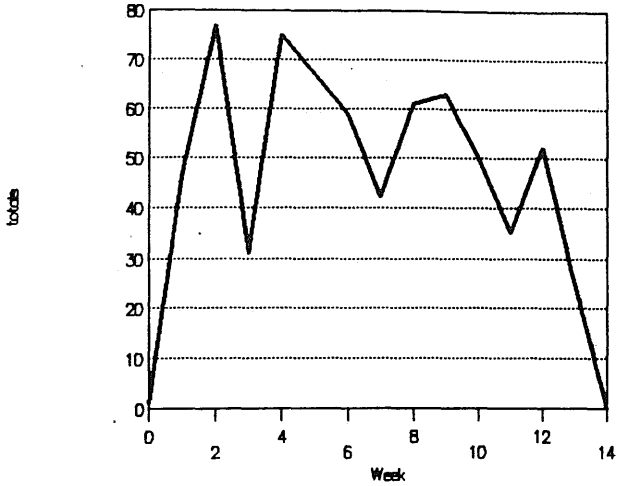
STATE OF WASHINGTON
(WASHINGTON DEPT OF WILDLIFE)

Graph 7. Weekly Eagle Census - Rockport to Newhalem (NPS & TNC data)
1982-1993 (page 1)

1982-83



1983-84



1984-85

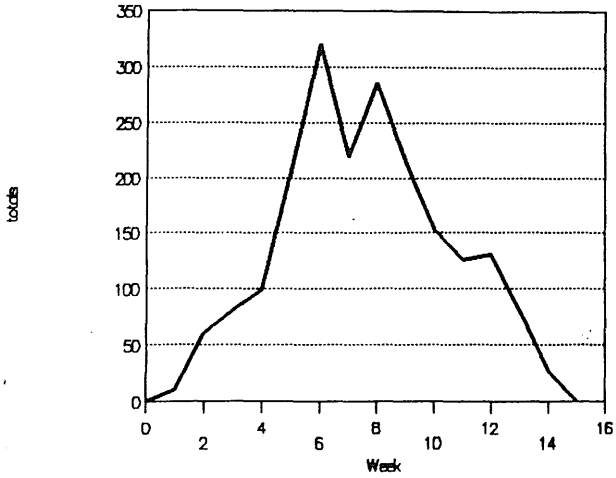
Data Not Available

1985-86

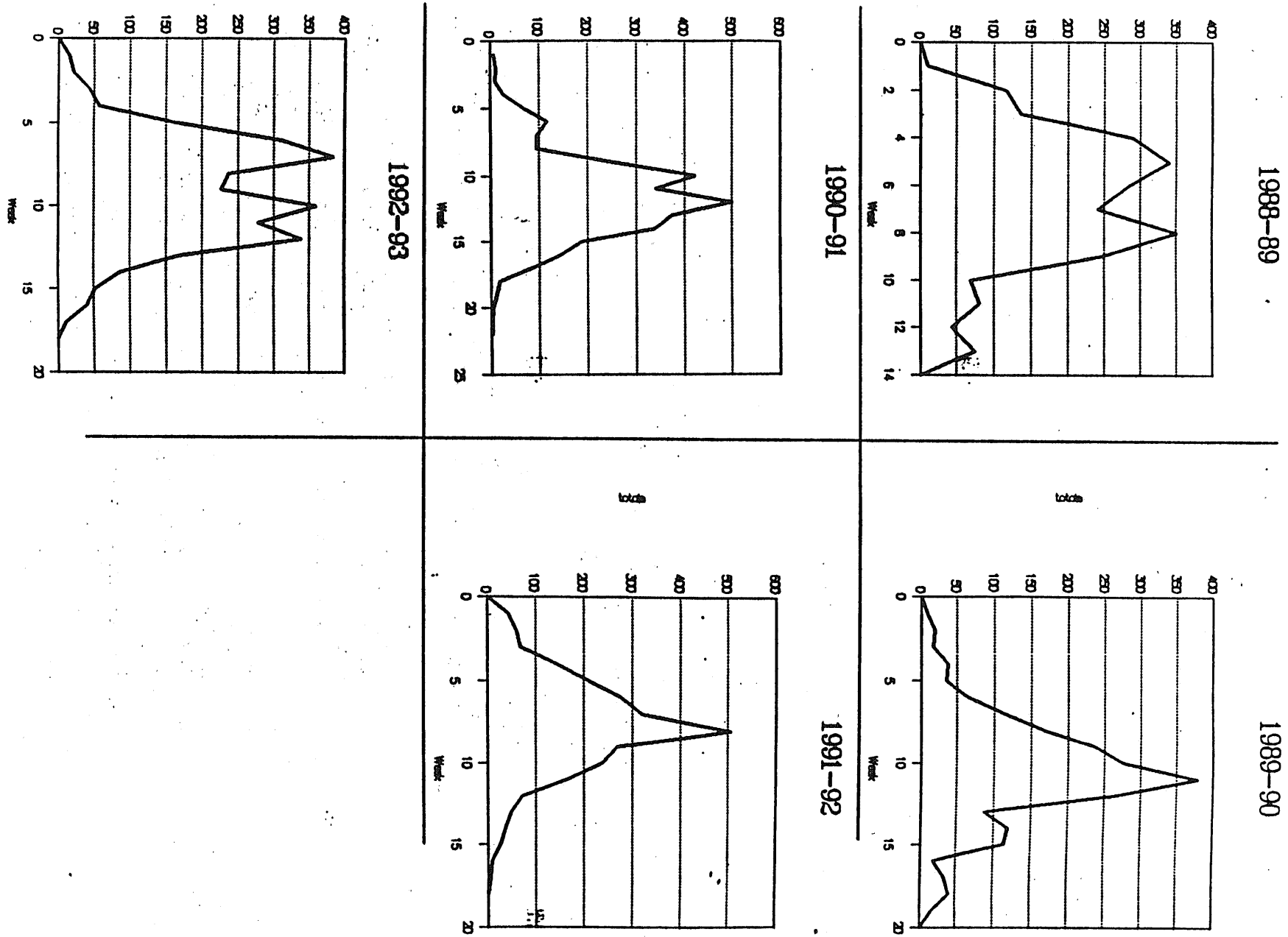
Data Not Available

1986-87

1987-88



Graph 7. Weekly Eagle Census - Rockport to Newhalem (NPS & TNC data)
1982-1993 (page 2)



APPENDIX C

CHUM AND COHO SALMON AND HABITAT NEEDS

CHUM AND COHO SALMON ESCAPEMENT NUMBERS

SKAGIT RIVER CHUM AND COHO SALMON

This section addresses habitat requirements and environmental conditions of Skagit River coho (Oncorhynchus kisutch) and chum (O. keta) salmon.

CHUM SALMON, Oncorhynchus keta

Water depth must be adequate to enable adult salmon to migrate upstream to spawn. Chum are large and strong swimmers, capable of swimming in currents of moderate to high velocities; however, they are not leapers. Extremely low water levels, high turbidity, long-span fish ladders, and physical barriers often inhibit upstream adult migration. Thus, they are generally found below the first barrier of any significance in a river. Adults enter the Skagit system primarily in October and November, and spawn from October through December (Anon. 1990). They tend to select spawning sites in areas with upwelling spring water and in relatively constant water temperature (Heard 1991), or immediately above turbulent areas (Salo 1991), or in areas of accelerating water flow, such as that encountered at pool-riffle interchanges (Pauley et al. 1988). Selection of the nest site by the female involves searching for preferred features, such as water odor, depth and velocity, gravel size composition, and cover. Primary spawning occurs in mainstem areas from Lyman, at river mile (RM) 34 upriver to Newhalem (RM 93), with frequent use of braided side-channels and sloughs (FERC 1992). Some tributary spawning also occurs throughout the basin, including Day Creek and the lower Cascade River (Williams et al. 1975).

Factors which influence egg survival include: superimposition of redds by later spawners, sedimentation, dissolved oxygen, stream discharge, water velocity, water temperature, erosion of streambeds caused by flooding, and drought. Weather and climate can often override other effects in determining egg-to-fry survival (Salo 1991).

Skagit chum stocks exhibit definite and quite regular even- and odd-year variations in behavior, age at maturity, size, marine survival, and abundance. These patterns appear to be related to the presence of pink salmon, which have strong biennial cycles of abundance. These cycles, in turn, seem to be brought about by oceanic phenomena (Salo 1991). Chum and pink salmon often spawn in the same reaches of the river. During years of pink salmon dominance, feeding and growth rates of juvenile chum salmon are lower. Chum salmon put more reproductive effort into even-numbered "non-pink" years than into odd-numbered "pink" years. Although it appears that both environmental and genetic factors influence odd-even year cycles, the main determinant in chum-pink relative abundances appears to be competition (Salo 1991, cited in Halbert 1992).

Nearly all of the basin chum salmon originate from natural stocks (Cole, pers. comm.). Between 1980 and 1990, the average odd-year and even-year escapements have fallen 34 and 15 percent short, respectively, of the escapement goals of 40,000 and 116,500 (Cole, pers. comm.)

COHO SALMON, O. kisutch

Coho have often been described as "opportunistic" in terms of their choice of spawning sites, and in their apparent determination to reach the small headwater creeks of larger rivers to spawn. Adult coho enter the river from July through December. Coho generally begin their upstream migration in the fall when there is a large increase in flow, particularly when combined with a high tide. They normally migrate in water temperatures from 7.2 to 15.6 C (Sandercock 1991). Spawning occurs from October through March, and is concentrated from November to January (Williams et al. 1975; Anon. 1990). Within the Skagit River system it is estimated that approximately 225 linear miles of stream are utilized by spawning coho (Williams et al. 1975). Nearly all accessible streams and tributaries within the Basin are utilized by spawning coho salmon, and they tend to spawn in the smaller tributary streams. The minimum depth required for spawning is .18 m. A substrate gravel size range of 1.3 to 10.2 cm is necessary.

There is a tendency for coho that migrate early to move further upstream than those that migrate later. If conditions (flow, temperature, etc.) in the stream are unsuitable, the fish will often mill about in the vicinity of the stream mouth, sometimes waiting weeks or even, in the case of early-timing fish, months for conditions to change. Since coho are vulnerable to predation while they are migrating through shallow riffle areas, they move through these areas as quickly as possible and seek the deeper, quieter pools. Coho migrate further upstream than pink and chum salmon, but usually not as far as sockeye and chinook (Sandercock 1991).

Survival of eggs and alevins to emergence is dependent upon flow, temperature, and streambed conditions. Generally, the small headwater streams in which coho spawn provide cool, clear, well-oxygenated water, with stable flows that are ideal for incubation and subsequent rearing. Groundwater seepage in small natal streams moderates temperatures to sustain a stable environment. Juvenile coho prefer a temperature range of 12-14 degrees C. Survival is decreased if a high concentration of sediment and sand in the gravel bed exists; this is also true for rearing juveniles. Silt loads of less than 25 mg/l are best for egg and fry survival. High water velocities reduce deposition of fine sediment. However, winter flooding may cause eggs to be dislodged and moved downstream. Low winter flows can result in dessication of redds or exposure of eggs to freezing temperatures.

Optimum rearing habitat for coho consists of a mixture of pools and riffles, abundant instream and bank cover, water temperatures that average between 10 and 15 degrees C in the summer, dissolved oxygen near saturation, and low amounts of fine sediments. 25.8 degrees C is the upper lethal limit.

Aquatic insects are prime food source for juvenile coho. Coho pick off food in suspension or on the surface; thus, the most productive coho areas are small streams rather than large rivers. There has been shown to be a positive correlation between the amount of terrestrial insect material found in coho stomachs and the extent to which the stream was overgrown with vegetation.

Riffles are one of the best habitat types for aquatic insect production. Pools with large riffles upstream have been documented as having higher coho production than pools downstream of small riffles, because of a greater food supply (Laufle et al. 1986). The most productive streams are those with alternating pools and riffles about equal in area. Pools generally occur in

lower gradient reaches where deposition is going on. Obstructions in the channel cause the stream to scour around them, or dam the flow, creating pools. Riffles are created in higher gradient reaches, and have swifter flowing water over completely or partially submerged obstructions.

Cover has been directly linked to salmon abundance in a stream. The more structurally complex a stream is, the more fry it can generally support, as abundance is limited by the number of available suitable territories. Pools that are 10 - 80 cubic meters, or 50 - 250 square meters surface area were found to be optimum for coho production in some studies, provided there was enough streamside vegetation for shading. If the canopy is very dense, however, then coho biomass will be reduced.

Mortality of juveniles is lowest in systems that have good winter habitat; creeks that remain clear and stable during winter, with good cover. Groundwater-fed smaller tributaries, spring-fed ponds adjacent to the mainstem, beaver ponds, sloughs, and side channels are often used for overwintering.

Juvenile coho generally reside in the stream for a year or more. Coho smolts migrate to sea during high flows mainly between mid-March and mid-July, early in their second year. Coho usually spend 2 summers in the ocean, returning to spawn during their third year of life.

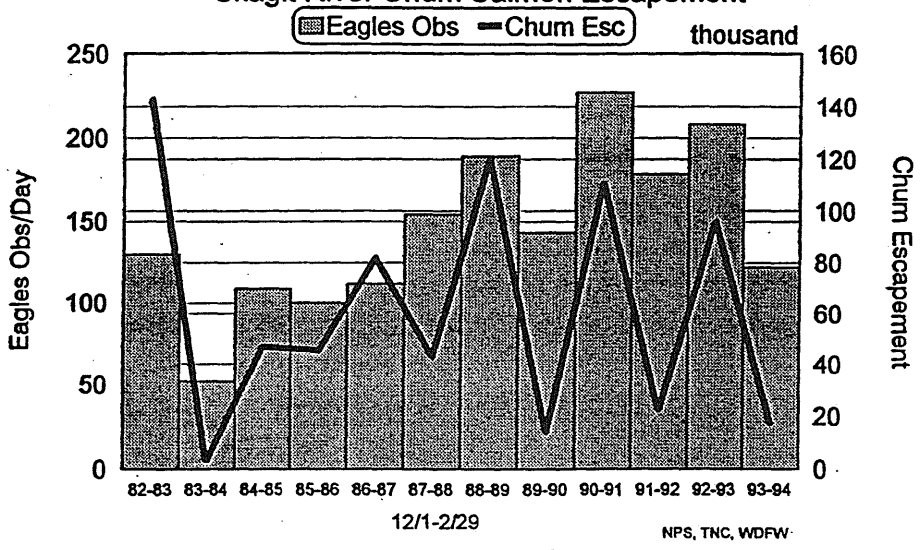
North Puget Sound Salmon Escapement

	Chum		Coho	
Year	Skagit	Stillaguamish	Skagit	Stillaguamish
1968	44049	18105	21000	24000
1969	22393	23510	10000	9000
1970	127588	46285	21000	26000
1971	48827	11734	14000	18000
1972	144732	21708	14000	8000
1973	83497	10757	15000	14000
1974	160248	35216	31000	22000
1975	15762	3718	10000	18000
1976	93000	28225	16000	23000
1977	36000	11637	30000	25000
1978	132895	72566	9000	16000
1979	23513	3520	33000	36000
1980	19425	14618	25000	24000
1981	16939	7775	15000	9000
1982	142541	34685	9000	9000
1983	3193	3283	24000	15000
1984	46817	48455	33000	18000
1985	45190	75069	18000	15000
1986	81869	90623	45000	23000
1987	42853	29291	33000	16000
1988	119791	65676	19000	18000
1989	13904	6499	17000	6000
1990	110567	33423	15000	15000
1991	22364	9200	7800	4000
1992	95940	36372	7500	12500

Errata
for
Environmental Assessment
and
Biological Evaluation
Regulating Surface Water Use on the Skagit Wild and Scenic River

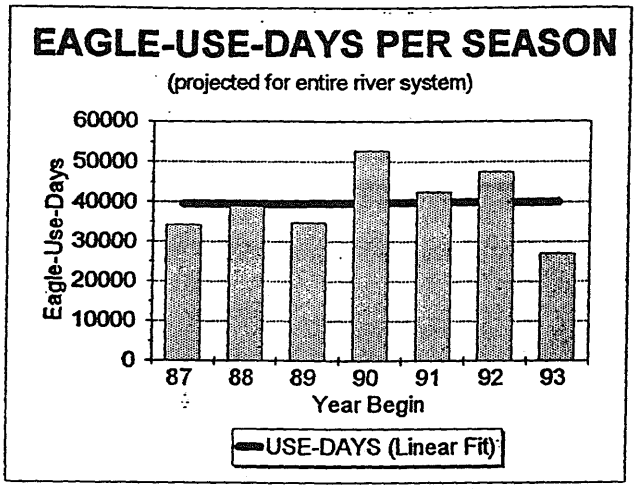
1. Figure 4, page 9 of the EA is corrected below. The 1993-94 eagle numbers were 122 instead of 200.

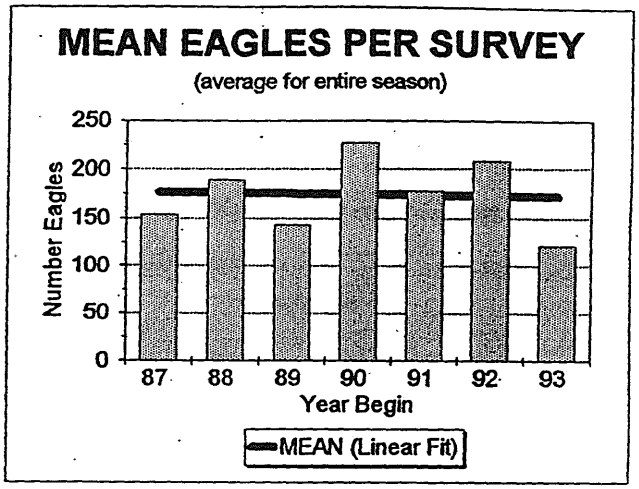
Figure 4
Bald Eagle (obs/day) RM 66 to RM 93 and
Skagit River Chum Salmon Escapement

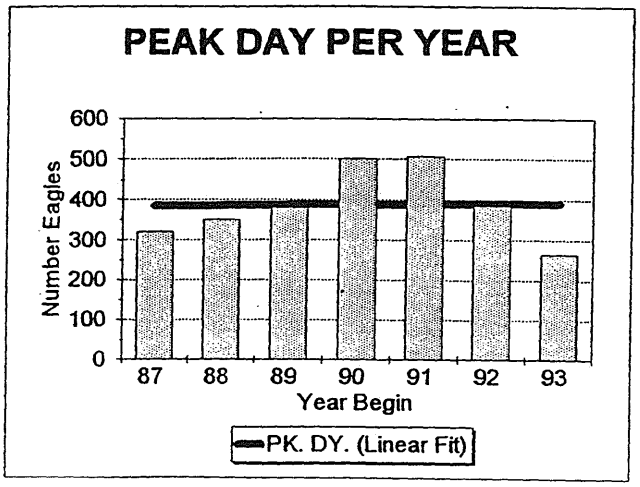


2. Table 1, page 26 of the EA should include Cascade RM 0-1 in the spatial restriction for alternative 3.

3. The Biological Evaluation and the EA concluded that the wintering population of eagles on the Skagit has been increasing. As a result of the correction to EA figure 4 (above), and in response to public comments (#29, 45) we reexamined the available data. While increases certainly occurred from 1982 to 1987, the graphs below indicate that during the last seven seasons there has been no trend for increasing or decreasing wintering populations. The graphs evaluate three different ways of looking at the census data during the last seven seasons. Each method is discussed in the Biological Evaluation. The bold line through each graph represents a linear fit regression line (Borland Quattro Pro for Windows, version 5.0). (Census data from National Park Service and The Nature Conservancy.)







ADDENDUM

to

BIOLOGICAL EVALUATION

EVALUATING EFFECTS ON LISTED AND SENSITIVE SPECIES

from

ISSUANCE OF WINTER SEASON SPECIAL USE PERMITS ON THE

SKAGIT WILD AND SCENIC RIVER SYSTEM

Mount Baker-Snoqualmie National Forest

May 4, 1994

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I. INTRODUCTION

The primary purpose of this addendum is to evaluate the effects of additional alternatives on the species and Critical Habitats addressed in the original Biological Evaluation (BE) dated October 28, 1993. Some additional background information is also presented here that was not incorporated in the original BE.

Errata: Page 15 discusses an apparent anomaly on the Cascade River where carcass counts are high but eagle use is nearly nonexistent. Data from Stalmaster (1989) indicates moderate eagle use of the first mile of the Cascade River and occasional use of the next 2 miles (see discussion of this citation later in this document). All discussions of this anomaly are no longer applicable. Maps should also be revised to show moderate use of the first mile, and Table 3 should be revised to show moderate use for the Lower Cascade River segment. In addition, Skagit River miles 58-59 and 76-77 should also be illustrated as moderate eagle use on the BE map.

Page 16, table 3. Winter Recreation Levels for Boat currently display M (for Moderate) for Hamilton, Newhalem, and Middle Sauk 1 segments. All of these should be changed to read L (for Low). The footnote **/ currently reads "Boat use estimates: H= above 1000 river craft/year, M= 501-1000 river craft/year, L= 0-500 river craft/year." This should be changed to read "Boat use estimates: H= above 750 river craft/season, M= 301-750 river craft/season; 0-300 river craft/season." All of these changes should also be made to the recreation use overlay for the map.

Page 16, table 3 shows "0" eagle roosts in the Newhalem segment. This should be changed to "1" (Jonathan Bjorklund, National Park Service, personal communication).

Page 25 states "The data collected found that 63% of the eagle feeding activity occurred between 9 am and 11 am...". 63% in this statement should be changed to 39%. While 64% of feeding activity occurs in the morning, only 39% occurs between 0900 and 1100 (Stalmaster 1989, Stalmaster et al. 1991).

Page 40, Section VII Management Recommendations, Item 1 purports to display the alternatives proposed by the Skagit River working group. Alt. E was not proposed by this group. An additional alternative was proposed that was not included in this list. Alternative 4 in this Addendum is essentially that alternative. This item was also inappropriately included as a "management recommendation". It was intended to display options that had been put forward at that time. Item 1 should be deleted.

Page 42, Section IX Literature Cited includes a citation for Bernatowitcz et al. 1992. This citation is not used in the text and should be removed from this section.

Appendix A, page A8 shows 70% of the recreational activity on the weekends in the Illabot segment is attributed to hikers. This should be corrected to read 20%.

Appendix A, page A10, Newhalem segment, C. Eagle Numbers states "There are no known night roosts in this segment". This should be changed to read "There is one known night roost in this segment" (Jonathan Bjorklund, National Park Service, personal communication).

II. PROPOSED ACTION

Five additional alternatives are evaluated in this addendum, and compared with the alternative presented in the original BE (shown here as alternative 2). All six alternatives are summarized here:

1. No Action. No permits issued.
2. Commercial permits, no new restrictions.
3. Commercial permits, timing restrictions for everyone, Marblemount to Rockport.
   River closed to all boat traffic from the Highway 530 bridge at Rockport to the Cascade Road bridge at Marblemount (Skagit River Mile (RM) 68 to 78), and Cascade River closed to all boat traffic from its confluence with the Skagit to the bridge at the State fish hatchery (Cascade RMs 0-1), from 0500 to 1100 each day, from 12/26 through 2/28.
4. Commercial permits, 4 day closure for everyone.
   River closed to all boat traffic from Rockport bridge to Marblemount bridge (RMs 68-78) on Monday, Tuesday and Thursday; and from Howard Miller Steelhead Park to the confluence of Baker River (RMs 57-68) on Wednesday each week from 12/7 through 2/1.
5. Commercial permits, 2 day closure for everyone.
   River closed to all boat traffic from Rockport bridge to Marblemount bridge (RMs 68-78) on Tuesday and Thursday each week from 12/7 through 2/1.
6. Commercial permits, timing restrictions for everyone, all eagle areas.
   Skagit River closed to all boat traffic for one mile in the vicinity of Van Horn (Skagit RMs 59-60), from a few miles below the Highway 530 bridge at Rockport to the Cascade Road bridge at Marblemount (Skagit RMs 66-78), and Cascade River closed to all boat traffic from its confluence with the Skagit to the bridge at the State fish hatchery (Cascade RMs 0-1), from 0500 to 1100 each day, from 12/26 through 2/28.

None of the alternatives limit bank use as this is outside of the jurisdiction of the USDA Forest Service. None of the alternatives limit American Indian fishing as these are treaty rights guaranteed by law. For additional information see the Environmental Assessment for the proposed action.

III. ASSESSMENT OF EFFECTS

Due to the nature and timing of the alternatives, effects on Critical Habitats and all species other than the bald eagle are expected to remain the same under all alternatives. The only change since the original Biological Evaluation (BE) has been the publication in the Federal Register (1/27/94) of Proposed Critical Habitat for the marbled murrelet. Due to the nature of the alternatives, none of them would destroy or adversely modify Proposed Critical Habitat for the marbled murrelet. Therefore, the remainder of this document is devoted to effects on bald eagles.

The original BE cited information from Stalmaster et al. (1991). That document was a draft manuscript for publication, and was a condensed version of the final report of the study (Stalmaster 1989). Besides containing modeling tools and information valuable in the formulation and assessment of alternatives, the earlier version also contains more detailed survey information not found in the condensed version.

All survey information cited in the original BE was collected using land-based surveys (auto/foot). Eagle and recreational use levels and distribution used for the analyses in this addendum are based primarily on information collected by Stalmaster (1989) which includes results of water-based surveys (raft) conducted during three seasons from 1985 to 1988. The reasons for using primarily the information from the water-based eagle surveys in this addendum are the following:

1) Water-based surveys are considered to be more thorough than land-based surveys since a much better view of eagle habitat on and adjacent to the river is provided.
2) Surveys reported by Stalmaster (1989) were more complete than any other surveys, covering a large portion (62%) of the Skagit Wild & Scenic River System (SW&SRS) miles. Approximately 88% of eagle use was included in the survey areas (see discussion under Evaluation Criteria #1, pg 3).
3) Distributions from Stalmaster (1989) raft censuses were loosely compared to census information collected by The Nature Conservancy, the National Park Service, and the Forest Service using land-based methods. Differences appear to be explainable by access limitations of land-based methods. No statistical comparisons were performed.
4) On the larger scale, as stated in the initial BE, distributions by reach reported by Stalmaster et al. (1991) were supported by the similar distributions reported by Hunt et al. (1992).
5) While the raft surveys are 6-9 years old, subsequent land-based eagle surveys do not demonstrate significant changes in spatial distribution patterns of eagles on the river.

As stated above, land-based surveys since 1988 have not shown significant changes in the spatial distribution patterns of eagles on the river. There have, however, been substantial changes in river topography since 1988 which may have caused changes in use patterns that may not have been detected by subsequent surveys. As discussed in the original BE there have also probably been changes in population and, hence, use levels. If such changes have occurred and are relevant to any implemented alternative, it is anticipated they will be detected through monitoring of the implemented alternative. Appropriate adjustments, if warranted, will be implemented at that time.

Available information on recreation use also does not indicate substantial changes in use patterns within user groups. As stated in the original BE fishing use on the SW&SRS has probably declined since the 1987-88 season but it is not possible to quantify these changes. Non-fishing use has probably increased during the same time period but it is also not possible to quantify these changes. It is anticipated that any changes as they relate to any implemented alternative will be detected through monitoring, and any appropriate adjustments made at that time.

EVALUATION CRITERIA:

Based on the information evaluated in the original BE there are a number of factors that are important considerations in mitigating the effects of the existing situation. The following evaluation criteria were established based on those factors. They are intended to evaluate to what extent each alternative reduces the significance of the existing effects. Each alternative was evaluated as to how well implementation would meet each of the following criteria, and effect determinations were based on whether or not the effects were reduced to a level of insignificance. These criteria are based on eagle biology and available information regarding eagle and recreational use of the SW&SRS. The criteria are briefly described below, followed by more detailed explanations of each in the remainder of this section.

To what degree does the alternative:

1. provide mitigation that benefits the largest portion of the eagle population of the river system;
2. provide an increase in feeding opportunities;
3. allow undisturbed feeding on a daily basis;
4. provide mitigation that is timed to cover the portion of the season with the largest number of eagles (by river segment);
5. allow adequate feeding opportunities when food is most likely to be limited.

Each of these criteria represents only one aspect of this highly complex issue. No single criterion can be used alone as an adequate measure or comparison of the expected mitigative effects of alternatives. The results of application of these criteria must be used in concert with each other to gain an adequate understanding of the expected effects.

These criteria are established solely for the purpose of evaluating expected changes in effects on eagles. Evaluating how each alternative affects recreational users is outside the scope of this Biological Evaluation and will be addressed separately in an Environmental Assessment.

1. **Proportion of the river population benefited**

   Based on two years of census data from raft trips (Stalmaster 1989) we calculated the proportion of the SW&SRS winter eagle population expected to occur in each river mile and, hence, the proportion expected to be affected by a given alternative. Stalmaster's surveys were conducted on 62% of the SW&SRS miles. Based on distributions estimated by Hunt et al. (1992) and Stalmaster et al. (1991) we estimate the area of these surveys to cover approximately 88% of the SW&SRS eagle use. These factors were considered when calculating the overall distribution for the SW&SRS.

Only a portion of the river population is currently being significantly affected by recreational activities. To adequately evaluate expected changes resulting from alternative mitigations, only that portion of the population should be considered. To determine impacted areas we started with criteria developed by Stalmaster (1989). Those criteria were primarily areas where: 1) eagles occur ($\geq$ 4 eagles/census); 2) there is a relatively high likelihood of an eagle encountering a recreational event; and 3) "intense" eagle feeding has been observed. (Data on recreational events in #2 did not distinguish between different types of activities.)

Impacts to eagles are predicated primarily on a reduction of feeding opportunities resulting from recreational activities. As discussed in the original BE an exponential decrease in feeding opportunities was observed by Stalmaster et al (1991) in response to increasing recreational events. An average reduction of 35% was reported. Feeding opportunity reductions were modeled by Stalmaster (1989) using observations of recreational impacts between RM 68 & 75. The average recreational activity index (Table A1) for this portion of the river was 10.5/mile. Assuming similar distribution of events through time, areas with less recreation than the study area should exhibit less of a decrease in feeding opportunity than that predicted by modeling. This would also result in a smaller increase from any mitigation than that predicted by the model. We have not attempted to model these differences but, while recognizing the nonlinear relationship between recreational events and eagle disturbance, feel it is reasonable to conclude that areas exhibiting less than 1/4 the average recreational activity of the study area are not significantly impacted. In these areas the likelihood of an interaction between eagles and a recreational event, as well as the reduction in feeding opportunity, are deemed insignificant.

The Illabot Slough was included by Stalmaster et al. (1989) as an area warranting protection. We have not, however, included it here as an impacted area since the entrances are already posted as no access. In addition, access is extremely difficult for most watercraft. Enforcement of this closure will continue to be monitored.

"Impacted" areas are shown in table A1 and can be located on the attached map. Approximately 25% of eagle use of the river occurs in areas determined to be impacted by recreational use. The proportion of this "impacted" portion of the population affected by each alternative was calculated and is shown in tables A1 and A2.

2. Increase in feeding opportunities.

Stalmaster (1989) modeled the reduction in seasonal average feeding opportunities that resulted from the observed recreational use in the study area (RM 68-75). He concluded that feeding opportunities at the time of the study were 65% of the level expected in the absence of disturbance from recreation (0-5 events per day). He also modeled the effects of several management scenarios and predicted the levels that would be achieved under each scenario. Those predictions are applied here to each alternative and shown in Table A2 as "Feeding Opportunity" (FO). Also shown is the predicted percent increase over current levels (Feeding Opportunity Increase - FOI). All values are based on observations between River Miles 68 and 75 (roughly Rockport to Marblemount). Each value is based on the <u>timing</u> of mitigation, not the location. Regardless of where the mitigation is applied, the expected values apply equally to all areas mitigated.

The FOs modeled by Stalmaster were averages for the entire season (12/1-2/28). Using Stalmaster's data, McClure (unpublished data) recalculated the current FO based on the seven weeks of the season that received the highest eagle use. A current FO level of 49% was calculated for this period.

This alternative way of looking at the data demonstrates the variability of impacts through the season and highlights a greater impact during the peak part of the season than may otherwise be evident. For our analysis we have used the full-season averages used by Stalmaster (1989). While these don't show the periods of greatest depression of FO, they provide an adequate means for comparison between alternatives. In addition, of greatest concern for the action alternatives is the resultant effect. Since the mitigation in alternatives 3 through 6 consist of providing disturbance-free periods, the resultant FOs for a given alternative should be similar whether calculated for 7 weeks or the entire season (the greater the restriction the more similar they should be). The increase (FOI), however, should be substantially greater during the seven week period of highest eagle use.

Stalmaster (1989) considered a 95% feeding opportunity level to be optimal, and a 90% level to be adequate. He recognized, however, that there were no data to support either level. For our analysis, as with the other criteria, an adequate level is partly dependent on the levels achieved with other criteria. For example if daily undisturbed feeding is achieved, 80% may be adequate; but if daily undisturbed feeding is not achieved 90 to 95% may be needed to be considered adequate. As with Stalmaster, there is no data to support these levels.

3. Undisturbed feeding on a daily basis.

Based on energetics modeling eagles on the North Fork Nooksack were observed to gorge a maximum during one feeding of enough salmon to meet their energy needs by feeding every 1.8 days (Stalmaster and Gessaman 1984). Mean consumption, however, was only slightly greater than that needed for one day. While eagles are capable of gorging food and, hence, not needing to feed every day, gorging is not necessarily the standard routine. On average eagles feed enough to support their energy needs for about one day, implying that on average eagles feed each day. While it is also likely that not all eagles employ the same feeding strategy each day, providing adequate feeding opportunities on a daily basis may be important to maintaining the health of some eagles and, therefore, is important to any mitigation strategy. The following formula provides an index for comparing the ability of each alternative to meet this need.

$$I_F = \left(\frac{Y}{7 \text{ days/week}}\right) 1.8 = .257\ Y$$

where: 1. I_F = Undisturbed Feeding Frequency Index
2. Y^F = number of periods per week between undisturbed feeding periods
3. the number of periods (Y) is not greater than one per day
4. undisturbed feeding periods on consecutive days are considered to have one period between each regardless of feeding period length.

This is intended as an indication (or index) of how well an alternative meets this criterion, not as a measure. I_F values can range from 0 to 1.8. An I_F value of 1.8 would indicate daily undisturbed feeding periods (Y=7). An I_F value of 1 would indicate undisturbed feeding periods every 1.8 days (Y=3.89), the minimum feeding frequency if each eagle gorged adequate salmon for 1.8 days.

4. **Timed to cover the portion of the season with the largest number of eagles (by river segment).**

Using census data from two years of raft trips (Stalmaster 1989) we calculated the percent of eagle use that would fall within the proposed restriction dates for each alternative. Since the distribution of eagles on the river system changes through the course of the season this was done by river segment and weighted by the proportion of the population affected by each alternative. Since the likelihood of conflict prior to 12/15 was rated as quite low (Stalmaster 1989) only census data from 12/15 through 2/28 was considered.

5. **Adequate feeding opportunities when food is most likely to be limited.**

Food is most likely to be limited late in the season when chum and coho carcasses are dwindling. This period also has the highest potential to have adverse effects if eagles are already in a weakened condition from limited food and the high energetic demands of the winter season. Based on carcass counts conducted by WDF, and for the purposes of this index, this is assumed to be the month of February. While some eagles remain on the river during early March, fish carcasses are virtually gone, eagles appear to be more evenly distributed throughout the SW&SRS so are less likely to impacted by recreational activity (or benefit from restrictions) on a particular stretch. The index is the proportion of the month of February to which the mitigation in an alternative is applied.

Late Season Feeding Opportunity Index:

$$I_L = \frac{\text{Number of Mitigation Days in February}}{\text{Number of Days in February (28)}}$$

COMPARISON OF ALTERNATIVES:

Results of application of the evaluation criteria to the alternatives are presented in Table A2 and discussed below. Alternative 1 has the same effect as the proposed action (alternative 2) evaluated in the original BE.

1. **Proportion of the impacted river population benefited.**

Since alterntives 1 and 2 lack mitigation, the proportion of the population benefited is zero. Alternatives 3 through 5 are similar in the proportion of the impacted population that a given restriction is expected to benefit -- mostly 60-70% (table A2). Alternative 4, however, would be expected to have some benefit, at different times, on a total of approximately 92%. Areas not benefited under alternatives 3, 4, and 5 are discussed below under "Increase in feeding opportunities". Alternative 6 would benefit all of the current impacted population.

2. Increase in feeding opportunities.

The predicted increase in feeding opportunity would be highest with alternatives 3 and 6, intermediate with alternative 4, lowest for alternative 5, and none for alternatives 1 and 2.

Feeding opportunity values cannot be applied equally to all river miles. As previously stated, feeding opportunities were modeled by Stalmaster (1989) using observations of recreational impacts between RM 68 & 75. Since the average recreational activity index (Table A1) for this portion of the river was 10.5/mile, areas with lower values should exhibit a commensurately higher existing feeding opportunity and a smaller increase from any mitigation than that predicted by the model (keeping in mind, however, that the relationship is not linear -- that an exponential decline in feeding is observed in response to increased recreational events). As previously stated we have not attempted to model these differences but they are worth consideration when evaluating alternatives and are discussed below for alternatives 3, 4 and 5.

Alternative 3. Of the impacted areas we've identified, river miles not included in this alternative are Skagit RMs 59-60 and 66-68. As illustrated in Table A1 RM 59-60 shows a little more than half the recreation activity of the study area (RMs 68-75). As stated above, in areas with less recreational activity than the study area, existing effects should be somewhat less than the model predicts and, if restrictions were imposed the actual feeding opportunity increases would be less than those predicted by the model.

RM 66-67 on the other hand, exhibits the highest concentration of eagle use (outside of Illabot Slough) as well as the highest concentration of recreational use (1.5 times that shown for the study area).

Alternative 4. All impacted miles other than Cascade RM 0-1 are included in some form of restriction under this alternative. The only scientific data available (Stalmaster 1989) indicates that Cascade RM 0-1 received high recreation use and moderate eagle use. According to Jim Chu (SW&SRS manager) the lower mile of the Cascade was regularly used by a rafting guide during the period of the Stalmaster study, and that that guide no longer uses this site. It is his belief that there is currently little, if any, recreational use of this section of the river. Data used in the recreational activity indices do not distinguish between types of use, and there is no additional data to support or refute Mr. Chu's contention of little or no recreational use.

The stretch that would only benefit from a one day/week closure, however, contains the river mile (66-67) with the highest concentration of eagle use outside of Illabot Creek.

Alternative 5. Miles not included in this alternative include Skagit RMs 59-60 and 66-68 (discussed above for alternative 3), as well as Cascade RM 0-1 (discussed above for alternative 4). As stated above in the discussion of alternative 4 Skagit RM 66-67 shows the highest concentration of eagle use outside of Illabot Creek.

3. **Undisturbed feeding on a daily basis.**

As previously stated here and in the original BE, eagles on the North Fork Nooksack were observed to gorge a maximum of enough salmon to meet their energy needs by feeding every 1.8 days (Stalmaster and Gessaman 1984). Mean consumption, however, was only slightly greater than that needed for one day. Applying that information to the Skagit, alternatives that allow some undisturbed feeding on a daily basis are more effective than those that don't. Alternatives 3 and 6 allow daily morning feeding opportunities on the stretches of river to which they apply. Alternatives 4 and 5 allow progressively less daily undisturbed feeding. Alternatives 1 and 2 provide no undisturbed feeding.

4. **Timed to cover the portion of the season with the largest number of eagles (by river segment).**

As shown in Table A1 alternatives 3 through 6 are reasonably similar (76-86%) with respect to how well the dates include the most eagles for that river stretch. This criterion cannot be applied to alternatives 1 and 2 since there is no mitigation.

5. **Adequate feeding opportunities when food is most likely to be limited.**

As identified in the original BE the latter part of the season is the most likely period for food to be limited due to decreasing carcass numbers. This essentially amounts to the month of February. The closure dates of alternatives 1, 2, 4 and 5 do not provide mitigation during this month. Alternatives 3 and 6 provide restrictions during the entire month of February.

Additional considerations:

Refuge concept: Some of the alternatives are based in part on the concept of providing a refuge where eagles can go to feed undisturbed. Stalmaster (1981 and 1983) and Hunt et al. (1992) have noted that eagle numbers are closely correlated to fish carcass numbers (food availability). Comparison of census data to carcass counts (NPS data, see original BE) supports this conclusion. Eagles are expected to distribute themselves on the river based primarily on a combination of carcass distribution and eagle density factors such as those described by Stalmaster and Gessaman (1984). Since carcass distribution is not expected to change significantly, and because eagle density will likely be high in the refuge area, continued use by eagles of areas outside the refuge area is fully expected. Since recreation use would continue at it's present or an increased rate, this would result in continued or increased disturbance to the birds outside the refuge.

Enforcement: Some form of enforcement is expected to be necessary, especially during the early stages of implementation of alternatives 3 through 6. This need is expected to decrease through time until a lower maintenance level is reached. Due to the consolidated areas and limited access points, alternatives 3, 4, and 5 lend themselves to the ability to monitor compliance without constant boat presence on the closed portion of the river. Alternative 6, on the other hand, would require substantially more presence. A jet boat would be used for river patrols. In the beginning approximately 6-8 passes per day are expected during the restricted period for alternative 6. At a maintenance level only an occasional pass on some days is anticipated. For alternatives 3 through 6 response to reports of violations would be required. This is expected to require only occasional trips.

Monitoring: A monitoring plan will be developed prior to implementation of any alternative. Several techniques are being considered to arrive at the most effective means of answering the monitoring questions. At this time the only technique being considered that has the potential to adversely affect eagles is helicopter flights to census eagles. If such flights are implemented they would likely be biweekly (one flight every other week), would occur during the restricted period (if one is implemented), and may cover the entire SW&SRS at a low elevation to enable the counting of eagles. Such low level flights have caused flushing of 37-68% of eagles on the Nisqually River (Stalmaster, personal communication). The highest flushing rates occurred with ground-feeding birds. Given the frequency of such flights, however, the effects are deemed insignificant.

Shift to bank use: Creel census records from WDW (1993) indicate that at present bank fishing predominates on the lower portions of the river while boat fishing is more prevalent on the upper river. In the event of implementation of some type of restriction on boat use there may be some shift from boat fishing to bank fishing. The number of anglers choosing to do this would likely be small, since boat-angling and bank-angling are very different user experiences and require different equipment and technique. In addition, nearly all of the banks of reaches proposed for restrictions are privately owned. Privately owned property is not legally accessible by the public without permission from the property owner. Assuming compliance with trespass laws and only limited landowners granting access, only limited areas could be accessed for bank fishing. Shifts in recreational use of this nature will be monitored.

Shift of boat use to other areas: Restrictions imposed on certain areas will likely cause some shifts of recreational use, during the restricted periods, to areas outside the restricted area. Depending on the amount of eagle use in these areas, such shifts may result in additional impacts not assessed here. The most likely areas of increased recreational use under alternatives 3 through 6 are shown below and in table A1. Relative eagle use of these reaches is also shown in table A1 by river mile and discussed below for each alternative.

Alt. #3: Most likely area of increase due to shift: Skagit RM 56 to 68. RMs 57-59 currently receive fairly high eagle use, but due to low recreation use are currently not considered impacted. Shifts of recreational use to this area may increase disturbance to a level of significance. RM 66-67 currently receives the highest eagle use of any single river mile outside of the Illabot Slough and also receives the highest recreation use of any river mile. Shifts to this area will increase this impact.

Alt. #4: Most likely areas of increase due to shift: Skagit RM 56 to 68 on Mondays, Tuesdays and Thursdays, and 68 to 78 on Wednesdays. RMs 57-59 currently receive fairly high eagle use, but due to low recreation use are currently not considered impacted. Shifts of recreational use to this area three days per week may increase disturbance to a level of significance. RM 66-67 currently receives the highest eagle use of any single river mile outside of the Illabot Slough and also receives the highest recreation use of any river mile. Shifts to this area will increase this impact. Skagit RMs 68 to 73 (Rockport bridge to Illabot Creek) is a very high eagle use area and also already receives significant recreational use. A shift to this area one day per week may also result in a significant increase in disturbance.

Alt. #5: Most likely areas of increase due to shift: Skagit RM 56 to 68. RMs 57-59 currently receive fairly high eagle use, but due to low recreation use are currently not considered impacted. Shifts of recreational use to this area may increase disturbance to a level of significance. RM 66-67 currently receives the highest eagle use of any single river mile outside of the Illabot Slough and also receives the highest recreation use of any river mile. Shifts to this area two days per week will increase this impact.

Alt. #6: Most likely areas of increase due to shift: Skagit RM 56 to 59 and 60 to 66. RMs 57-59 currently receive fairly high eagle use but low recreation use. Shifts of recreational use to this area may increase disturbance to a level of significance.

Actual shifts will need to be monitored. Evaluation of monitoring results will determine the need for management adjustments and/or reinitiation of Section 7 consultation.

American Indian Use: None of the alternatives will restrict American Indians from their treaty rights to fish the Skagit River. Recent use of the Skagit by tribal anglers, however, has been in the lower portions of the river, below Concrete (RM 57) and primarily below Hamilton (RM 40), outside of the areas considered impacted in this analysis. Changes to this pattern are not expected. Disturbance to eagles from tribal fishers is expected to be insignificant.

Retaliation: Due to the highly controversial nature of this issue, restrictions may spark retaliatory action by people affected by such restrictions. These actions may take the form of harming eagles. It is not possible to assess the risk of this happening, only to recognize that the potential exists.

IV. EFFECT DETERMINATIONS

The following effect determinations apply to bald eagle only. None of the determinations made in the original BE for other species and Critical Habitat are changed by any of the alternatives.

Determinations assume compliance with restrictions and insignificant shifts in recreational use. Compliance cannot be predicted but some discussion of enforceability is included here with each alternative that includes restrictions. Compliance and shifts in recreational use will be monitored. Evaluation of monitoring results will determine the need for management adjustments and/or reinitiation of Section 7 consultation.

Alternatives 1 and 2: MAY EFFECT, LIKELY TO ADVERSELY AFFECT

As previously stated, alternative 1 would have the same effect as the proposed action evaluated in the original BE (alternative 2). The average seasonal feeding opportunity is currently calculated at 65%, 35% below that predicted in the absence of disturbance. No relief from this reduction is provided. No undisturbed feeding is provided during any part of the season.

Alternative 3: MAY EFFECT, LIKELY TO ADVERSELY AFFECT

This alternative provides uninterrupted feeding opportunities on a daily basis during the time of day when a large proportion of feeding activity (53%) normally occurs. It is predicted to increase the feeding opportunities 28% over current levels in the area of the restriction to 83% of the level predicted without disturbance. It also provides an 11 mile refuge area during the restriction period (see earlier discussion of refuge concept).

The restriction period extends through February, increasing feeding opportunities during the time when food is most likely to be limiting.

The mitigation in this alternative reduces the effects to a level of insignificance in the areas where the mitigation is applied. While mitigation is provided for a significant portion of the population, as well as most of the population currently sustaining the highest impact, it does not mitigate for the effects of recreational activities in all areas where significant effects are currently occurring. One of these is the area of greatest current impact on the SW&SRS (RM 66-67). This alternative continues to allow existing or increased recreational impacts to eagles on RMs 59-60 and 66-68 where, based on the survey results of Stalmaster (1989), significant disruption of normal feeding behavior has been occurring (table A1), creating a likelihood of take of individuals and, therefore, a likelihood of adverse effect.

Due to the location of the restricted area relative to access points, and the consistency of the restricted area and time, enforceability of this alternative is expected to be relatively high with little impacts to eagles resulting from enforcement efforts.

Alternative 4: MAY EFFECT, LIKELY TO ADVERSELY AFFECT

This alternative provides uninterrupted feeding for full day periods, 3 full days on one stretch of the river and 1 full day on another stretch. It provides some mitigation for a large portion of the impacted population (92%: 29% one day/week and 63% three days/week). It also increases the predicted feeding opportunities by a reasonable amount (21%) to 78% of the level predicted without disturbance. It also provides a 10 mile refuge area three full days per week and an 11 mile refuge area one day per week (see earlier discussion of refuge concept).

The mitigation in this alternative reduces the effects to a level of insignificance on the days and in the areas where the mitigation is applied. This alternative does not, however, allow uninterrupted feeding on a daily basis. It provides a 3 day span each week with no mitigation. It also provides no relief in the latter part of the season when food is most likely to be limiting. This alternative also continues to allow recreational impacts to eagles on Cascade RM 0-1 where, based on the survey results of Stalmaster (1989), significant disruption of normal feeding behavior has been occurring (table A1). These factors create a likelihood of take of individuals and, therefore, a likelihood of adverse effect.

The location of the restricted area relative to access points facilitates enforcement of this alternative. Inconsistencies between days and areas of restriction, however, is expected to be confusing to the public, likely reducing compliance and complicating enforcement, hence increasing the potential for increased impacts to eagles resulting from enforcement efforts.

Alternative 5: MAY EFFECT, LIKELY TO ADVERSELY AFFECT

This alternative provides uninterrupted feeding for 2 full day periods each week. It increases the predicted feeding opportunities by a small amount (11%) to 72% of the level predicted without disturbance.

While this alternative doesn't provide mitigation for the entire impacted portion of the population, it does include a large portion as well as most of the population currently sustaining the highest impact. It also provides a 10 mile refuge area (see earlier discussion of refuge concept).

The mitigation in this alternative reduces the effects to a level of insignificance on the days and in the areas where the mitigation is applied. This alternative does not, however, allow uninterrupted feeding on a daily basis. It provides a 4 day span each week with no mitigation. It also provides no relief in the latter part of the season when food is most likely to be limiting. This alternative also continues to allow recreational impacts to eagles on Cascade RM 0-1 and Skagit RM 59-60 and 66-68 where, based on the survey results of Stalmaster (1989), significant disruption of normal feeding behavior has been occurring (table A1). RM 66-67 is the area of greatest current impact on the SW&SRS. These factors create a likelihood of take of individuals and, therefore, a likelihood of adverse effect.

Due to the location of the restricted area relative to access points, and the consistency of the restricted area, enforceability of this alternative is expected to be relatively high with little impacts to eagles from enforcement efforts.

Alternative 6: MAY EFFECT, NOT LIKELY TO ADVERSELY AFFECT

This alternative provides uninterrupted feeding opportunities on a daily basis during the time of day when a large proportion of feeding activity (53%) normally occurs. It is predicted to increase the feeding opportunities 28% over current levels in the area of the restriction to 83% of the level predicted without disturbance.

The restriction period extends through February, increasing feeding opportunities during the time when food is most likely to be limiting.

This alternative provides adequate mitigation that reduces the effects to a level of insignificance for all areas currently considered impacted.

Due to the location of the restricted areas relative to access points, and the disjunct nature of the restricted areas, enforceability of this alternative is questionable. If compliance is low, enforcement attempts are likely to increase impacts to eagles, potentially creating a likelihood of adverse effect.

V. MANAGEMENT RECOMMENDATIONS

Monitoring of eagle and recreational use will be essential to determining whether or not the assumptions used here are, and continue to be, valid. Of particular concern during monitoring will be those areas identified as "impacted", but where restrictions are not imposed, and areas used by eagles that currently receive little recreation use. If restrictions were not imposed because present impacts were not considered significant, shifts in recreational use that cause greater impacts to these areas should initiate reconsideration of the management scheme and/or reinitiation of Section 7 consultation.

VI. PERSONS CONSULTED

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VII. LITERATURE CITED

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Table A1. Eagle use and recreational activity in selected parts of the SW&SRS (derived from Stalmaster 1989) compared to proposed alternatives.

River Segment	River Mile	Impacted Areas	Eagle Distribution: % of SW&SRS pop'n	Eagle Distribution: % of SW&SRS impacted pop'n	Recreational 1/ Activity Index	Proposed Restrictions & Likely Boat Shifts 2/: Alternative 3	4 M-T-Th	4 W	5 T-Th	6
	Skagit:									
Lyman	29-30		1.8		0.5					
	30-31		0.7		1.5					
	31-32		2.1		1.2					
	32-33		1.3		2.5					
	33-34		1.3		2.7					
	34-35		0.6		8.2					
	35-36		0.4		7.0					
	36-37		0.5		2.5					
	37-38		0.1		3.2					
	38-39		0.6		2.5					
	39-40		0.2		7.2					
Hamilton	40-41		0.0		10.0					
Concrete	47-48		0.1		7.5					
	48-49		0.2		2.0					
	49-50		0.2		3.0					
	50-51		0.2		2.0					
	51-52		1.2		3.0					
	52-53		2.0		2.5					
	53-54		0.2		6.5					
	54-55		0.2		0.5					
	55-56		0.1		2.0					
	56-57		0.7		3.5	0	0		0	0
	57-58		1.7		2.5	:	:	X	:	:
	58-59		1.8		2.5	:	:	:	:	0
	59-60	XX	1.9	7.6	7.0	:	:	:	:	X
	60-61		0.6		6.5	:	:	:	:	0
McLeod Slough	61-62		0.2		6.5	:	:	:	:	:
	62-63		0.0		5.0	:	:	:	:	:
	63-64		0.3		4.0	:	:	:	:	:
	64-65		0.5		10.0	:	:	:	:	:
	65-66		0.5		9.0	:	:	:	:	0
	66-67	XX	4.8	19.3	15.0	:	:	:	:	X
	67-68	XX	0.5	2.0	18.3	0	0	X	0	
Illabot	68-69	XX	1.4	5.6	17.9	X	X	0	X	
	69-70	XX	2.3	9.2	7.8			:		
	70-71	XX	3.0	12.0	11.1			:		
	Illabot Cr:							:		
	0-1.5		15.5		2.0			:		
	Skagit:							:		
	71-72	XX	3.1	12.4	10.3			:		
	72-73	XX	1.9	7.6	9.9			:		
	73-74		0.3		10.4			:		
	74-75		0.4		6.5			:		
	75-76		0.5		3.8			:		
Marble-mount	76-77	XX	2.6	10.4	4.0			:		
	77-78	XX	1.4	5.6	4.0	X	X	0	X	X
	78-79		0.1		2.0					
	79-80		0.8		2.0					
	80-81		0.6		3.0					
	81-82		0.5		2.0					
	82-83		0.7		5.0					
Newhalem	83-84		0.3		1.0					
	Cascade									
Lower Cascade	0-1	XX	2.0	8.0	16.0	X				X
	1-2		0.3		0.0					
	2-3		0.2		0.0					

1/ From Stalmaster et al. (1989). Average number of events per year recorded on weekly surveys over 2 years. These numbers are useful only as an index to recreational activity distribution.

2/ Proposed restrictions are designated by solid lines and X's: X | X

Most likely shifts of boat use are designated by dotted lines and 0's: 0 : 0

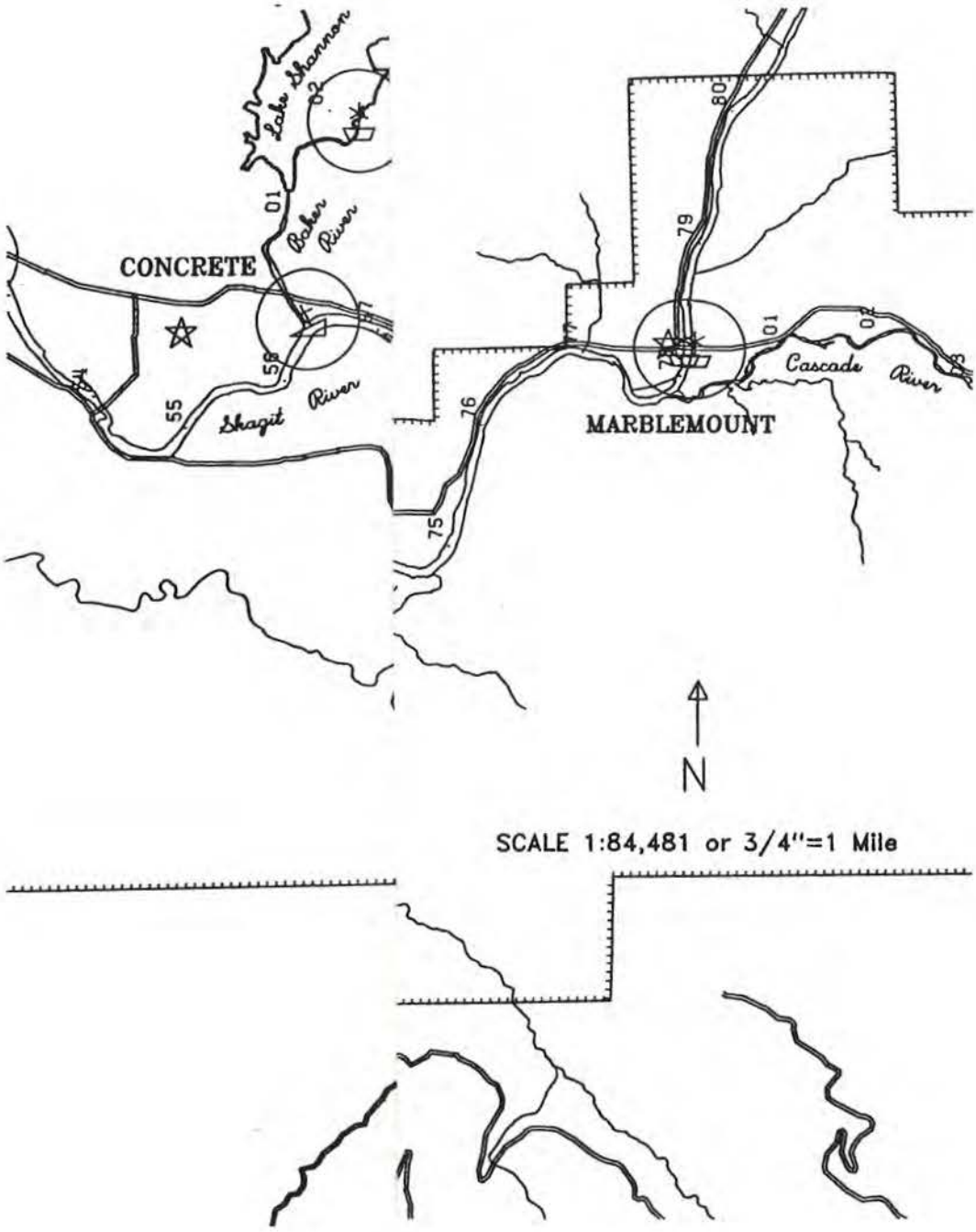
Table A2. **Comparison of Alternatives.** Evaluation criteria values assume full compliance with restrictions and no resultant shifts in recreational use patterns. (See text for explanations of evaluation criteria.) No single evaluation criterion is intended to be used alone as a measure of the effectiveness of any mitigation. All criteria should be used in concert with each other to adequately evaluate mitigation.

Evaluation Criteria	Alternative	1	2	3	4		5	6
	Restrictions	none	none	7 days/wk 0500-1100	3 days/wk M-T-Th All day	1 day/wk Wed All day	2 days/wk T-Th All day	7 days/wk 0500-1100
	Restriction dates	--	--	12/26-2/28	12/7-2/1		12/7-2/1	12/26-2/28
	River miles affected by restriction	--	--	68-78 Cascade 0-1 (11 miles)	68-78 (10 miles)	57-68 (11 miles)	68-78 (10 miles)	59-60 66-78 Cascade 0-1 (14 miles)
1.	Percent of impacted pop'n benefited by restriction	0%	0%	71%	63%---> 92%* <---29%		63%	100%
2.#	Feeding Opportunity (FO)	65%	65%	83%	75%---> 78%** <---68%		72%	83%
	Feeding Opportunity Increase (FOI)	0%	0%	28%	16%---> 21%** <--- 5%		11%	28%
3.	Undisturbed Feeding Frequency Index - I_F	0.00	0.00	1.80	0.77	0.26	0.51	1.80
4.	Percent of river segment eagle use occurring within restriction dates	--	--	83%	83%	76%	83%	86%
5.	Late Season Feeding Opportunity Index - I_L	0.0	0.0	1.0	0.0		0.0	1.0

* - These values represent the combined effect of both aspects of alternative 4. (This proportion of the population will derive some benefit at some time during the course of the week.)

** - These values represent the combined effect of both aspects of alternative 4. (A cumulative benefit, but to different segments of the population.)

\# - FO and FOI are based on timing of mitigation. The results are not affected by the location of that mitigation.


Lake Shannon
02
01
Baker River
CONCRETE
58
55
Skagit River
76
75
80
79
01
02
Cascade River
MARBLEMOUNT
N
SCALE 1:84,481 or 3/4"=1 Mile