PROGRESS REPORT August 1997

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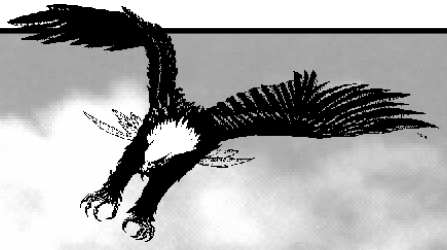
Movements, Origins, and Breeding Population Status



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SKAGIT RIVER BALD EAGLES: MOVEMENTS, ORIGINS, AND BREEDING POPULATION STATUS

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Abstract**:** *In the winter of 1996-97, a study was initiated to investigate the origins and breeding population status of bald eagles (Haliaeetus leucocephalus) wintering on the Skagit River, Washington. Eighteen eagles were trapped on river bars, including 9 adults that were affixed with satellite transmitters. Following capture, eagles spent from 1 to 52 days on the river. Northward migration was along coastal British Columbia, and through interior British Columbia. Most eagles arrived at breeding areas in April. Eagles originated from widely dispersed populations from southern British Columbia to northern Yukon territory, and east along the McKenzie River in Northwest Territories. As of mid-June, two adults had been observed on breeding areas. Satellite monitoring will continue into fall, 1997, with plans to deploy at least 6 additional transmitters in winter 1997-98.*

The Skagit River is one of the key wintering areas for bald eagles (*Haliaeetus leucocephalus*) in the Pacific northwest and Washington state. As many as 500 eagles are found on the upper reaches within the Skagit Wild and Scenic River System (SW&SRS) (Stalmaster 1989). Eagles are attracted to the river because of the spawned carcasses of chum salmon (*Oncorhynchus keta*) and coho salmon (*Oncorhynchus kisutch*) deposited in the backwaters and on the riverbanks. Wintering eagles are found on the river from late October through March.

The river also attracts recreationists, principally sport fishers, rafters, and bird watchers. Steelhead (*Salmo gairdnerii*) fishing, which lasts from November through spring, is particularly popular to bank and boat anglers. Up to 115 recreational events/day have been documented in the SW&SRS (Stalmaster 1989). Research in the late 1980's correlated recreational activity with reduced eagle presence and feeding in the SW&SRS (Stalmaster 1989).

In 1993, the U. S. Forest Service (USFS), which is in charge of managing the SW&SRS, submitted a Biological Evaluation to the U. S. Fish and Wildlife Service concluding that the existing recreational use and/or proposed permitting of existing commercial users of the SW&SRS was "likely to adversely affect" the bald eagle. A subsequent Environmental Assessment issued by the USFS proposed closing portions of the SW&SRS to surface water use during the morning hours as mitigation. The decision was very controversial and aggressively opposed by some recreationists. In 1996, voluntary river closures were enacted on the upper river between Rockport and Marblemount to ensure adequate feeding opportunities for bald eagles (Appendix, Figure 1). The USFS is analyzing the effects of that effort.

In order to understand the ultimate effects of recreational activity on eagle survival and reproduction of the wintering population of bald eagles on the Skagit River, it is necessary to identify the origins of these eagles. Telemetry studies of eagles from the Skagit River and southeast Alaska (Servheen and English 1979, Hunt et al. 1980, Hunt et al. 1981, Hodges et al. 1987) suggested wintering eagles in Washington and the Skagit River originate from northern latitudes, but were not conclusive. In the winter of 1996-97, a study was initiated to investigate the origins of Skagit River bald eagles. We report here on the preliminary results of that investigation, with specific objectives to: 1) describe local movements of eagles and their fidelity

to the SW&SRS; 2) determine population origins of the SW&SRS bald eagles; 3) determine the breeding status of the monitored eagles and summarize what is known about the history of their nesting populations; and 4) assess survival of marked eagles.

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STUDY AREA AND METHODS

We defined the limits of the study area as the Skagit River from Concrete to Newhalem, and the lower Sauk River (Appendix, Figure 1). These reaches of the SW&SRS included both relatively high and low levels of human activity (Stalmaster 1989). We identified gravel bars in reaches previously known to be used by feeding eagles. In late November, when adult eagles began to arrive in increasing numbers, we initiated trapping efforts on or near these bars testing a variety of methods. Padded leg-hold traps submerged in shallow water and on dry river bars were staked around steelhead, and chum, coho, and chinook salmon *(O. Tshawytscha*) carcasses (Hunt et al. 1980). Noose carpets (Watson 1985) with 25-50 lb. monofilament were placed on remains of black-tailed deer (*Odocoileus hemionus*) near upland perch sites. We also created noosed-salmon by constructing a wire frame work inside a carcasses on which the nooses were attached. Small carcasses were anchored to the ground to prevent captured eagles from carrying away baits. Pacific herring (*Clupea pallasii*) were used as bait in constructing floating, noosed-fish sets (Cain and Hodges 1989) in backwater areas. Remote noose snares (Jackman et al. 1994) set around salmon carcasses and on frequented perches were placed on river bars with good visibility and close ground or boat access.

Traps were placed prior to dawn before eagles flew from the roosts to the river. Captured eagles were sexed by the Bortolotti method using hallux length and beak depth (Bortolotti 1984). Vinyl, teal-blue band markers (McCollough 1990) were attached to USFWS leg bands. Markers were coded with three alpha-numeric digits identifying the general location of origin (S), trapping year (6 or 7), and sequential order of capture (a-z). Adult eagles were outfitted with backpack satellite transmitters from from *Microwave Telemetry, Inc* with piggy-backed VHF units from *Advance Telemetry Systems, Inc.* Most eagles were released at capture locations within 1 hour following capture.

Both transmitters were pre-programmed to transmit at varying diurnal and annual cycles in order to maximize battery life to last 3 winters. Satellite transmitters transmitted every 4th to 5th day during migration and winter, and once every 10 days during the nesting season; VHF transmitters transmitted during the 12-hour period between dawn and dusk every day during winter, and every 7th day thereafter. Satellite transmissions provided long-range movement information while VHF signals allowed for locating individuals on breeding areas.

Because the two NOAA satellites that retrieve data orbit the earth approximately every 2 hours at the latitude of the study area, a potential of eight, but most often three or four locations were obtained during a given transmission period. Each location was coded during during down-loading into one these of seven classes (Service Argos, Inc. 1994) based on the quality of the data received: location class 3 accurate<150m; 2<350m; 1<1000m; 0>1000m (i.e. no more accurate than 1000 m); A (no accuracy); B (no accuracy); Z (invalidated location). Field testing to estimate error of class 0 locations in northwestern Washington calculated error bias of 1.7±2.2 km for latitude coordinants, and 4.4±4.8 km for longitude coordinants (Watson et al. 1995). Thus, locations for classes 0-3 were considered useful for interpretation of movements, and probably described a geographic location <10 km of the actual location.

A secondary objective to the study was to collect salmon carcass distribution information throughout the winter for the USFS assessment of voluntary river closures and changes in bald eagle distribution. Salmon carcasses on river bars and in backwater areas <2 feet deep were counted weekly by volunteers in boats from Concrete to Marblemount (Appendix, Figure 1). Carcasses were tallied by species for each river mile on laminated air photos. Another secondary objective of the study was to collect movement and behavioral information on radio-monitored birds while they were on the Skagit River and relate them to carcass distribution and human activity levels (Appendix, Figures 2 and 3). Data collection protocol included documentation of eagle activity and disturbance responses.

In April, when satellite locations indicated eagle movements had stabilized following spring migration, regional biologists in Alaska, and the Canadian provinces were contacted to assist in locating telemetered birds at nest sites. Two search flights were conducted by a WDFW biologist in interior Alaska. In addition to locating nests and confirming nest status, historic nesting information was gathered for breeding populations where telemetered eagles from the Skagit River eagles were located. Requests for resighting information of marked birds was distributed to regional biologists and via the eagle communication network on the internet (eaglenet@unixg.ubc.ca).

RESULTS

Trapping Summary

We captured 18 eagles in winter 1996-97 including 9 subadults, and 9 adults (Appendix, Table 1). Eagles were captured at 6 of 12 trap stations located from Concrete to Newhalem (Appendix, Figure 1). Five adults were captured in relatively high human activity areas from Rockport and upriver about 3 miles, and 4 adults were captured at a more remote location at the confluence of the Skagit River with Bacon Creek above Marblemount.

Remote-controlled nooses and noosed-carcasses were most effective in capturing eagles with steelhead or chum salmon as bait (Appendix, Table 2). Leg-hold traps were largely ineffective because of freezing and flooding conditions which fouled dry-land sets, and eagles were reluctant to wade to open-water sets when carcasses were available on land. Seventeen eagles were not secured after being successfully ensnared after slipping out of traps or breaking nooses, resulting from the challenges of determining the correct combination of monofilament size and anchoring weights. Also, several birds were not secured on bars that were accessed by boat only because of increased time necessary to reach them.

Local Movements and Spring Migration

Adult bald eagles spent from 1 to 52 days on the Skagit River following their capture (Table 1). Six birds remained within a few river-miles of their capture location for the time they spent on the river. The other 3 birds (i.e. 25015, 24016, and 28010) remained in the capture vicinity for 1-14 days and then moved downriver from Concrete to Hamilton for up to 16 days. At least one bird used other rivers in western Washington following capture, including the Nooksack, Suiattle, Snohomish, Skykomish, and Nisqually. Eagle 28004 resided on the Yakima River for 44 days, which was the only extensive time spent in eastern Washington by a telemetered eagle.

Table 1. Summary of movements of adult bald eagles captured on the Skagit River in winter 1996-97

Eagle ID	Days on River	Local Movement Pattern	Spring Migration Pathway	Date Arrived on Breeding Area	Terminal[a] Location
24015	11	Samish R., Nooksack R. Vanc. Is., lower Skagit R.	Coastal B.C.	4/15/97	Gulkana R., AK
24016	10	lower Skagit R., Fraser R.	Interior B.C.	4/20/97	McKenzie R., NWT
28004	1	Nisqually R., Yakima R.	Interior B.C.	4/2/97	Columbia R., BC
28005	52	upper Skagit R.	Coastal B.C.	4/30/97	Smith R., BC
28006	41	Suiattle R., Snohomish R., Skykomish R., upper Skagit R.	Coastal B.C.	4/26/97	Porcupine R., YT
28007	6	upper Skagit R.	Interior B.C.	4/12/97	Copper R., AK
28008	14	upper Skagit R.	Interior B.C.	4/4/97	Williston L., BC
28009	10	upper Skagit R.	Coastal B.C.	3/13/97	Ballenas Is., AK
28010	30	Skagit R.	Coastal B.C.	4/15/97	Beaver Creek, AK

[a]Location at which satellite locations stabilized following migration.

Adult eagles migrated northward from the Skagit River along two general corridors (Table 1). Five eagles moved along coastal British Columbia to southeast Alaska before moving to breeding areas. Four eagles moved through interior British Columbia up the Skagit River, Fraser River,

and Columbia River.

Eight salmon carcass surveys were conducted between Concrete and Marblemount from 6 December through 30 January. One survey was cancelled due to high water on the river. About 6,000 carcasses were tallied (Appendix, Figure 4). River miles 66 and 77 (Appendix, Figure 1) held the greatest number of carcasses throughout the winter. Carcass counts peak in mid December and were markedly reduced by the beginning of February.

We did not conduct behavioral monitoring of telemetered birds the first winter intense monitoring would have required considerable expenditure of time and manpower that was needed to accomplish the primary objective of trapping and telemetering eagles.

We received no reports of resightings of subadult bald eagles captured during winter 1996-97.

Origins and Breeding Status

With the exception of one eagle, locations of telemetered adults stabilized following migration in the month of April (Table 1). These terminal locations were all north of the 48 degrees latitude and widely dispersed from southern British Columbia to north Yukon Territory, and east in the Northwest Territories (Fig. 1).

Air searches were conducted for 7 of the 9 eagles in spring, 1997. By mid-June three telemetered adults observed on nesting areas. The first was an adult female (28009) perched with another adult on a small island southwest of Craig, Alaska. No nest was located from the air, but the birds were believed to be nesting (P. Schempf, pers. comm.). The second bird (28010) was observed near a subadult eagle, feeding alone on a fish carcass (M. Bertram, pers. comm.). No nest was located in the vicinity, and the nearest known nest was about 7 km away. The third bird (28004) was observed on the upper Columbia River near an active nest with 2 chicks, but has not been confirmed as one of the breeding adults (T. Kinley, pers. comm.).

Assessment of breeding status based on the stability of spring satellite locations alone suggested 5 eagles were on breeding territories (i.e. 24015, 28004, 28005, 28006, and 28009). Of the remaining birds, spring locations either indicated nomadic movements (28007 and 28010), were too inaccurate to identify movements (24016), or were not received for several weeks (28008), indicative of a failed transmitter, or the demise of the bird.

Historic breeding information was being compiled from published and unpublished literature for populations where telemetered eagles resided in spring. Quality of information ranged from very specific (e.g. nest productivity parameters, population trends) to general (number of nests). Current population information trends will be available for southeast and interior Alaska, and Williston Lake in northcentral B.C., following this year's breeding season (P. Schempf, M. Woods, and C. Mitchell pers. comm.).

Figure 1. Spring locations of bald eagles captured on the Skagit River in the winter 1996-1997.

DISCUSSION

Preliminary results indicate Skagit River eagles originate north of the contiguous United States from broadly dispersed breeding populations in British Columbia, Alaska, Yukon Territory, and the Northwest Territories. This is signficant in that if the wintering population of eagles on the Skagit River consists of birds from different breeding populations, any impacts to the wintering population from human activity would be absorbed among many breeding populations. Furthermore, no telemetered individuals were from populations in the contiguous United States where there are known productivity concerns or downward population trends. Compilation of nesting history for breeding populations in Canada and Alaska will continue in order to describe their trends in future reports.

Data from winter 1996-97 suggest at least some of the bald eagles wintering on the Skagit River are highly mobile during the winter and visit other local rivers prior to migration. However, because we did not observe all birds throughout the entire winter period it is difficult to know if more stationary birds remained so throughout their entire stay in Washington. We suspect that the movement of wintering eagles depends on local prey abundance and other factors such as human activity levels. We plan to conduct local monitoring of newly captured and returning adult eagles in winter 1997-98, depending on trapping success and manpower needed to accomplish primary objectives. Carcass counts will be conducted again next winter. Carcass distribution information from winter 1996-97 will be analyzed by river mile to assess relationships to satellite locations.

Two general migration corridors were used by telemetered eagles. Servheen and English (1979) speculated that Skagit River eagles used the coastal and Fraser River pathways during northward migration. For eagles migrating up the coast, southeast Alaska was the crossroads for continuing northward into interior Alaska or breaking off to the east to the Northwest Territories or interior British Columbia.

Telemetered eagles will continue to be monitored into fall migration, 1997. During winter 1997-98, 6 additional satellite transmitters will be deployed on adult eagles. Additionally, we hope to secure funding to deploy and additional 5 transmitters to provide an overall sample of 20 individuals. This larger sample will more accurately describe the movement patterns and origins of adult bald eagles on the Skagit River. Also, we are in the process of creating a web page that will provide regular updates and tracking information on telemetered eagles over the internet.

LITERATURE CITED

Bortolotti, G. R. 1984. Sexual size dimorphism and age-related size variation in bald eagles. J. Wildl. Manage. 48:72-81.

Cain, S. L., and J. I. Hodges. 1989. A floating-fish snare for capturing bald eagles. J. Raptor Res. 23:10-13.

Hunt, W. G., J. B. Bulger, and C. Thelander. 1980. Impacts of a proposed Copper Creek dam on bald eagles. Rep. to Seattle City Light, Office of Environ. Affairs. BioSystems Analysis, Inc., San Francisco, Calif. 143pp.

_____, and B. S. Johnson. 1981. Impacts of a proposed Copper Creek dam on bald eagles: second winter study. Rep. to Seattle City Light, Office of Environ. Affairs. BioSystems Analysis, Inc., San Francisco, Calif. 113pp.

Jackman, R.E., W. G. Hunt, D.E. Driscoll, and F.J. Lapsansky. 1994. Refinements to selective trapping techniques: a radio-controlled bow net and power snare for bald and golden eagles. J. Raptor Res. 28:268-273.

McCollough, M.A. 1990. Evaluation of leg markers for bald eagles. Wildl. Soc. Bull. 18:298-303.

Service Argos, Inc. 1994. Animal Tracking. Argos Newsletter No. 48. Landover, Md. 28pp.

Watson, J.W. 1985. Trapping, marking, and radio-monitoring rough-legged hawks. North Am. Bird Bander 10:9-10.

_____, J.A. Bernatowicz, and D. John Pierce. 1995. Movements of bald eagles in and from Washington state. 1995. Washington Dept. of Fish and Wildl. Annual Prog. Report. 6pp.

APPENDIX

Table 1. Information on bald eagles captured on the Skagit River in winter, 1996-97.

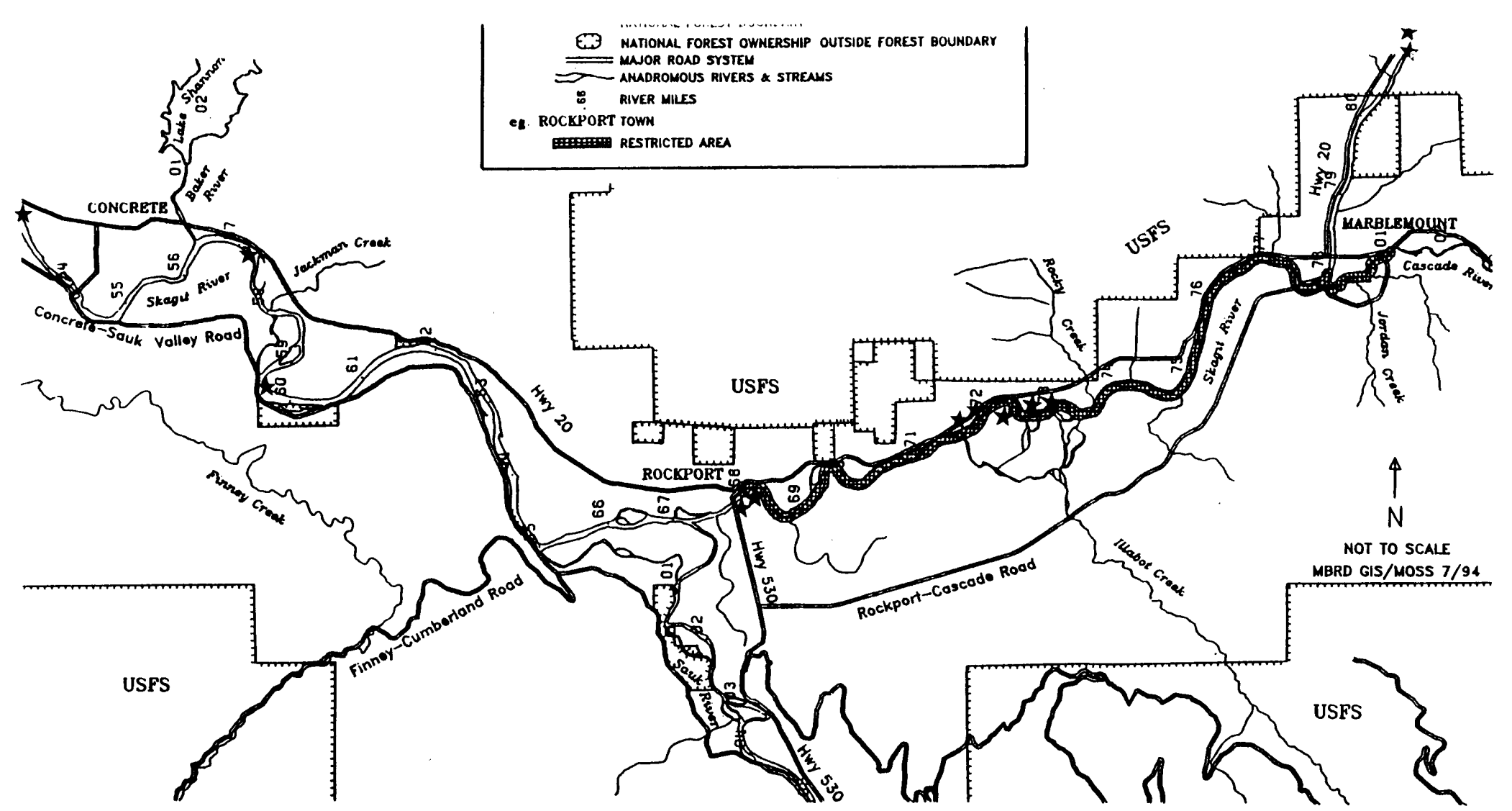
Date	Age (yr)	Hallux Length (mm)	Beak Depth (mm)	Sex[a]	Marker Code	Band Number	Satellite ID	VHF Frequency	Location
12/5/96	1.5	42.0	35.3	male	S6A	629-08976	n/a	n/a	Buehler Farm
12/9/96	4.5+	39.6	35.0	male	S6B	629-08977	24015	164.245	Rockport Bar
12/31/97	1.5	38.0	33.5	male	S6C	629-08979	n/a	n/a	Rockport Bridge
1/2/97	1.5	40.5	34.0	male	S7A	629-08980	n/a	n/a	Buehler Bar
1/2/97	3.5	39.4	32.0	male	S7B	629-08981	24016	164.203	Buehler Bar
1/3/97	1.5	40.0	31.5	male	S7C	629-08982	n/a	n/a	Buehler Farm
1/7/97	4.5+	40.5	33.6	male	S6D	629-08983	28006	164.293	Buehler Bar
1/10/96	4.5+	40.2	32.0	male	S7D	629-08984	28004	164.223	Buehler Bar
1/13/97	1.5	37.0	34.5	male	S7E	629-08985	n/a	n/a	Buehler Bar
1/14/97	1.5	40.7	33.6	male	S7F	629-08986	n/a	n/a	Buehler Bar
1/29/97	4.5+	43.0	34.5	female	S7G	629-08987	28005	164.215	Bacon Creek
1/31/97	1.5	45.5	40.5	female	S7H	629-08988	n/a	n/a	Buehler Bar
2/6/97	4.5+	40.3	32.5	male	S7I	629-08989	28007	164.354	Bacon Creek
2/6/97	4.5+	40.7	33.0	male	S7J	629-08990	28008	164.305	Rockport Bar
2/7/97	1.5	42.0	38.0	female	S7L	629-08991	n/a	n/a	Rockport Bar
2/12/97	4.5+	46.6	36.3	female	S7K	629-08992	28009	164.253	Rockport Bar
2/18/97	4.5+	44.4	36.0	female	S7M	629-08993	28010	164.263	Bacon Creek
2/21/97	1.5	46.0	36.0	female	S7N	629-08994	n/a	n/a	Bacon Creek

[a]Sex based on Bortolotti index (Bortolotti 1984) from hallux and beak measurements. Index determined from adult eagles; appropriateness of application to subadults is unknown.

Table 2. Trap effectiveness and success in capturing bald eagles on the Skagit River in winter, 1996-97.

Trap type	Captures		Misses[a]		Total
	Adults	Subadults	Adults	Subadults	
Leg-hold in water	0	0	0	0	0
Leg-hold on land	0	1	1	1	3
Floating Noosed Fish	0	0	0	0	0
Noosed Carcass (salmon)	1	5	4	6	16
Noose Carpet (deer)	0	0	0	0	0
Remote Snare	8	3	5	0	16
Total	9	9	10	7	35

[a]Situations where eagles slipped out of traps or broke away from nooses after being captured.



Appendix. Figure 1. Bald eagle study area on the upper Skagit River showing the voluntary restriction zone between Rockport and Marblemount. River miles are identified adjacent to the main channel. Stars identify locations of eagle trapping stations.

Appendix. Fig. 2.

SKAGIT RIVER BALD EAGLE STUDY

DATE __ __ __ __ __ WEEKEND/WEEKDAY PRE-11:00/POST-11:00 TIME (SURVEY BEGIN)_____ TIME (SURVEY END) ____

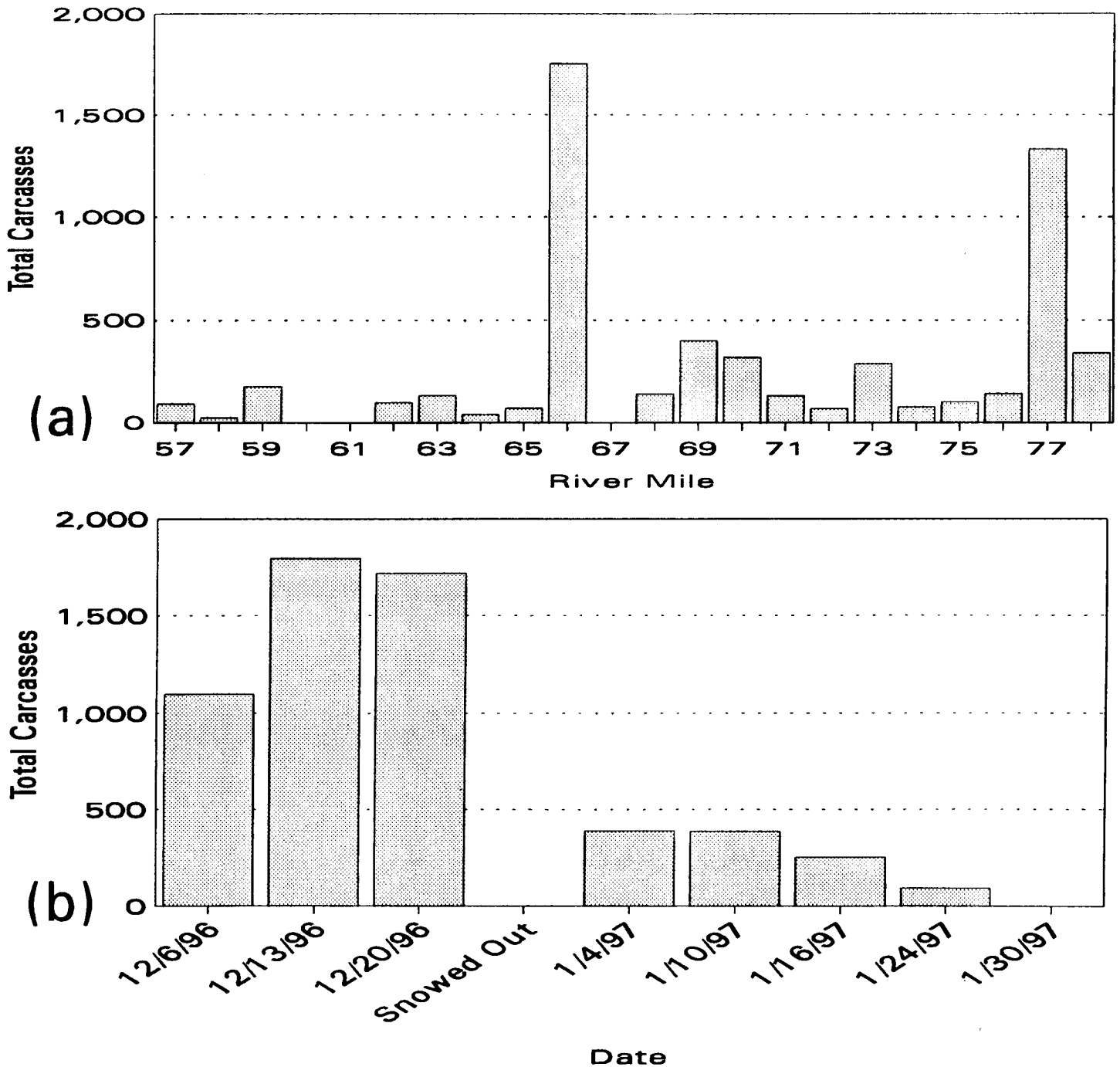
SURVEY DURATION (min)_____ SURVEYER INITIALS __ __ TEMP ___ WINDSPEED ___ SKY___ PRECIP___

BIRD ID (164.*)	ACT	MAP REF	RM	DIST TYPE	DISTURBANCE RESPONSE FLS	DIR	FD	AFD	COMMENT

Appendix. Fig. 3.

EAGLE SURVEY PROTOCOL

DATE: mmddy
WEEKEND/WEEKDAY: circle appropriate
PRE-11:00/POST-11:00: circle appropriate
TIME (beg/end): military time bout began and ended
SURVEY DURATION: total survey minutes
TEMP: ambient temperature
WINDSPEED: windspeed - 1=calm; 2=breeze; 3=brisk; 4=gust
SKY: sky cover - 1=clear; 2=5-25%; 3=26-50%, 4=51-75%; 5=76-95%; 6>95%
PRECIP: precipitation - 1=occ lt rain; 2=stdy lt rain; 3=occ hvy rain; 4=stdy hvy rain; 5= sleet/ice; 6=snow
BIRD ID: VHF frequency
ACT: eagle activity
1=perch off (roosting) - record roost type (conifer, deciduous) or name of roost in comments
2=perch off (any perch activity > 50 m from river, or river slough)
3=perch on, tree (perched in tree <50 m from river)
4=perch on, stand (perched on bar, driftwood <50 m from river, NO feeding activity)
5=perch on, feed (feeding)
6=avoidance flight (response to human activity, follow detailed protocol below)
7=other flight
MAP REF: reference no. of activity location on attached map
RM: river mile (from air photo)
DISTURBANCE TYPE: 1=running motorboat; 2=motorboat, engine off; 3=dory; 4=shore angler; 5= raft; 6=canoe; 7=kayak; 8=hiker
DISTURBANCE RESPONSE:
FLUSH: 1=yes; 2=no
DIR: 1=across river; 2=up river; 3=down river; 4=away from river
FD: flush distance- distance (m) of eagle to activity when flushed
AFD: avoidance flight distance- distance (m) eagle flew to avoid activity



Appendix. Fig. 4. Salmon carcass counts from surveys on the Skagit River from Marblemount to Concrete in winter, 1996-97. Figure (a) identifies total carcasses counted over 8 surveys per river mile (Appendix, Fig. 1.). Figure (b) describes carcass totals by date.