

# **MOVEMENTS OF REHABILITATED BALD EAGLES AND PROPOSED SEASONAL MOVEMENT PATTERNS OF BALD EAGLES IN THE PACIFIC NORTHWEST**

by

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## *Abstract*

Eleven rehabilitated Bald Eagle (*Haliaeetus leucocephalus*) that had been in captivity for various lengths of time were released on the Skagit River in western Washington. They were fitted with colored patagial markers for determining regional movements. Eagles were sighted in both interior and coastal British Columbia and in Puget Sound. A total of 30 reports were received from outside the Skagit Valley. The most distant report was 332 km from the release site, and at least one eagle was still wearing color markers one year after release.

Regional movement patterns of the Bald Eagles in the Pacific Northwest are discussed and a general theory of seasonal movements is proposed for coastal and interior eagle populations of the Northwest. The probable origins of the eagles that winter on the Skagit River and possible migration routes of this population are considered.

## *Introduction*

Continued pressure on the remaining Bald Eagle population, declared endangered in 1978 in 43 states and threatened in five others by the U.S. Fish and Wildlife Service (1978), emphasizes the need to return to the wild captive and rehabilitated eagles capable of survival. There has been concern that captive and rehabilitated eagles may have little or no chance of survival once returned to the wild because captivity and association with man might make them weak and unfit to compete again with wild eagles. This paper describes the movements of 11 rehabilitated and color-marked Bald Eagles that have returned to the wild. Data on regional movements are interpreted to give an indication of possible migratory patterns of Bald Eagles in the Pacific Northwest in general and of the Bald Eagle population which winters on the Skagit River in particular.

## *Methods*

Rehabilitation techniques for Bald Eagles prior to release have previously been described in detail (Servheen and English 1976). Eagles were released during January and February of each year from 1975 through 1978. All eagles were released in a Bald Eagle

wintering area on the Skagit River in northwest Washington. This area is currently being managed as a natural area by the Nature Conservancy and the Washington Department of Game. The area offers high food availability during the post-release period and protection from excessive human disturbance.

Released eagles were individually fitted with a patagial marker of Saflag material on each wing between the secondary and tertiary flight feathers. Each marker was fastened with two grommet-type fasteners placed in prepunched holes through four overlapping layers of Saflag material.

Marker colors used were yellow, pink, and orange. Eagles were not individually marked with specific colors or with lettering on the patagial markers. Different colors were used during different years. We found that most observers could not distinguish pink markers from orange at a distance. Eagles were not individually identified on the basis of color marker sightings because of the unreliability of untrained observers and the possible fading of markers.

### *Results and Discussion*

Eleven Bald Eagles have been released on the Skagit River near Rockport, Washington, since 1975 (table 1). All were brought to the Seattle Woodland Park Zoo for treatment of injury or starvation.

Table 1. Bald Eagles Released on the Skagit River, 1975-1978

Date of Release	Estimated Age <sup>1</sup>	Approx. Time in Captivity	Condition When Found	Site of Injury	Approx. Distance from Skagit <sup>2</sup>
01/03/75	3 yrs.	31 mo.	Shot	Wing	Unknown
02/25/75	5 yrs.	2 wk.	Shot	Body	0 km
01/05/76	Adult	49 mo.	Shot	Wing	Unknown
01/05/76	1 yr.	11 mo.	Shot	Wing	120 km
01/05/76	1 yr.	4 mo.	Shot	Wing	120 km
01/05/76	2 yrs.	9 mo.	Shot	Wing	96 km
01/04/77	4 yrs.	21 mo.	Shot	Wing	128 km
01/04/77	3 yrs.	21 mo.	Tendon Damage	Wing	120 km
01/04/77	1 yr.	1.5 mo.	Starving	—	88 km
01/05/78	3 yrs.	6 mo.	Shot	Body	120 km
01/05/78	1 yr.	2 mo.	Shot	Wing	289 km

<sup>1</sup>Age estimate based on plumage characteristics (see Servheen 1975).

<sup>2</sup>Distance from where eagle was originally found to Skagit release site.

*Local Movements.* Immediately after release, eagles spent varying amounts of time at the release site adjusting to the area and their sudden freedom. There was no definite relationship between time in captivity and time spent in the immediate area, although the bird captive for 49 months spent the most time at the release site.

Local movements were limited for the first three to four days by lack of muscle tone that resulted from long periods in captivity in a small flight cage (Servheen and English 1976). As muscle tone and flight ability increased, the eagles began to fly up and down the river and feed with local wintering eagles. Released eagles soon learned the best perching and feeding sites, possibly by observing and following local eagles. Within two weeks of release, activities, perching areas, and movements of released eagles were similar to those of the local wintering eagles. If released eagles had not been marked, it would have been difficult or impossible to distinguish them from wild eagles by their behavior.

*Regional Movements.* Reports of color-marked eagles can be divided into two categories: (1) those from coastal areas in Puget Sound and the Strait of Georgia; and (2) those from interior British Columbia. Thirty reports have been received from areas outside the Skagit Valley. Of these, twenty-three were from coastal areas and seven from the interior (fig. 1). A summary of distances moved by month is shown in figure 2. The most distant report was from Campbell River, British Columbia, on the west side of Vancouver Island, 332 km by air from the Skagit wintering area. No reports were received from locations south of the Skagit River. No color-marked birds were known to have returned to the Skagit in following years; it is possible, however, that they were not recognized as returning individuals because some colors were reused.

Although dispersal movements of rehabilitated and previously captive birds cannot be accepted per se to be the same as those of wild eagles, we feel that similar movement pathways would be used by all eagles dispersing from the Skagit area. The validity of the assumption that released and wild birds would have similar dispersal behavior is strengthened by the fact that most released eagles remained with the resident wild population for four to eight weeks and dispersed from the area at the same time as the wild birds. The social nature of wintering Bald Eagles in roosting and group soaring (Southern 1963, 1964; Edwards 1969; Shea 1973; Lish 1975; Servheen 1975; Stalmaster 1976; Steenhof 1976; Sherrod et al. 1976) suggests that movement patterns may be learned by inexperienced individuals partially by visual observations of other eagles and by participation in group activities. The existence of socially facilitated learning of movements in Bald Eagles would indicate that both released and resident eagles would tend to move in similar patterns and, thus, this extrapolation is valid.

The distribution of reports by month (table 2) shows that few sightings occurred from June through December. Several possible explanations exist for this lack of sightings: (1) most patagial markers do not remain intact for more than six to eight months; (2) eagles move into more remote northern British Columbia at this time; or (3) the color-marked eagles are not surviving more than six to eight months in the wild. The last explanation is unlikely as the critical period for survival would probably be the first few weeks after release because of their initial inability to fly well and compete successfully with wild eagles (Servheen and English 1976). The first explanation is possible although we do have one report of a color-marked eagle on the Nicola River on 11 January. This bird had to have been wearing patagial markers for at least one year, but it is conceivable that markers are not staying on every eagle.

Table 2. Reports of Color-marked Bald Eagles More Than 9.5 Kilometers from the Release Site by Month of Occurrence

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Total number of sightings <sup>1</sup>	4	4	15	2	6	1	2	3	0	0	0	0
Selected sightings <sup>2</sup>	4	4	11	2	3	1	2	2	0	0	0	0

<sup>1</sup>Includes sightings from within Skagit Valley but no sightings within 9.5 km of the release site. Probable resightings of same individuals are included. N = 37.

<sup>2</sup>Probable resightings of same individual at same location eliminated. N = 29.

The possibility that color-marked eagles are moving with much of the rest of the population into more northern remote areas where observers are few seems the most plausible explanation at this time. From Alaska to Washington, movement patterns of coastal Bald Eagles are probably keyed to time of spawning of Pacific salmon (*Oncorhynchus* spp.), the most abundant food resource from August through December. In general, salmon runs occur earliest in northern coastal areas of Alaska and latest in southern coastal areas of Puget Sound. The two most distant reports, from Campbell River and Kamloops Lake, both occurred in August. Beebe (1974) theorized that Puget Sound eagles move north in August to utilize early morning salmon runs (fig. 3) and then follow the runs southward, arriving in Puget Sound in November and December (fig. 4).

Eagle counts on the Skagit (Servheen 1975) and in the southern Gulf Islands, just north of the San Juan Islands (Hancock 1964), show that adults arrive in November and December while subadults do not arrive until mid to late January. If eagles are returning south to Puget Sound in November and December, we would expect some sightings of color-marked birds during this time. The lack of reports may be because adults are the first eagles to return south during this time. Since only one of the eleven eagles color-marked was an adult, this may explain the lack of November-December sightings.

Adults are first to arrive in winter in numbers in Puget Sound, possibly because they do not move as far north during the fall as subadults. This theory assumes that most adults seen in the Puget Sound-Gulf Islands area in winter are adults from the local population. Hancock (1964) lends support to this by saying, "Not only were the first birds to arrive (in the Gulf Islands) adults, but these adults in many cases appeared paired and were located in the vicinity of nest sites." Sherrod et al. (1976) state that adult eagles in the Aleutian Islands are less prone to wander than subadults. Similar attachment to the nesting site during the winter is noted by Hensel and Troyer (1964) on Kodiak National Wildlife Refuge, where most nest sites were defended by resident adults even after the young fledged. Thus, it seems possible that adult eagles nesting in coastal areas from the Aleutian Islands south to Puget Sound wander locally in the winter, but their movements are more limited than those of subadults. Adult eagles in Puget Sound tend to move north after the nesting season, but probably not as far as subadults. Adults return to their nesting areas in midwinter before subadults.

The movements and aggregations of wintering Bald Eagles are determined by food availability. Most subadults from Puget Sound probably move north with adults after leaving the nest to utilize early northern salmon runs. Sherrod et al. (1976) suggest that in the Aleutians adults rely less on carrion than subadults, and adults tend to utilize available food sources near nest sites during much of the winter, usually by catching live prey, whereas subadults depend mostly on carrion in areas away from nest sites. This results in a form of food resource partitioning which is maintained by some territorial defense around nest sites by resident adults even during the nonbreeding season. We propose a similar system of modified resource partitioning could exist between adult and subadult Bald Eagles throughout the coastal areas of the Pacific Northwest. Overlap of food resource utilization between adults and subadults can be expected at sites of excessive food concentration such as salmon spawning areas. Subadults are dependent on food concentration areas throughout most of the winter. Adults also utilize food concentrations, but for shorter periods. Many coastal adults move to breeding areas in mid to late winter where they catch live prey and use small local carrion concentrations. Territorial exclusion of other eagles by resident adults probably becomes more active as the nesting

season approaches, and subadults disperse from dwindling food concentrations. This resource partitioning is well adapted to the Pacific Northwest coast where weather conditions do not preclude winter food availability around nest sites and where a multitude of food concentrations exist at salmon spawning areas. Bald Eagles in interior North America face a different food resource distribution in winter, and such a modified food resource partitioning system probably does not and cannot exist in the interior.

*Possible origins of the Skagit Wintering Population.* Of the eleven eagles released to date, nine remained in the wintering area within 9.5 km of the release site for at least 45 days. They stayed in this area with the resident wintering birds until the food supply of dead salmon was depleted. With depletion of the food supply, the released eagles dispersed from the area with the local wintering population.

If the dispersal of color-marked eagles released on the Skagit is indicative of dispersal movements of the wild population, the Skagit eagles originate in both interior British Columbia and in coastal areas in Puget Sound and the Strait of Georgia (fig. 4). Adult eagles arrive on the Skagit (Servheen 1975) at the same time as adults at nesting sites in the Gulf Islands, British Columbia (Hancock 1964). No data are available on whether most coastal nesting territories have adults present in them during winter although adult eagles are certainly present in the general area throughout the winter. Grubb et al. (1976) found a total of 44 active nests in the San Juan Islands. If the resident adults are wintering around their nests, we would expect 80 to 90 adult Bald Eagles in the San Juans through the winter. On the other hand, if resident adults move locally in winter in response to local food concentrations, some of the San Juan adults could be on the Skagit.

Substantial numbers of Bald Eagles winter on lakes in southern British Columbia eating American Coots (*Fulica americana*) (Brooks 1922, Munro 1938). Many eagles also follow salmon runs far inland up the Fraser River (Beebe 1974). The interrelationships between coastal wintering populations and inland populations are probably complex. Eagles inhabiting inland areas in British Columbia are forced south and west during winter as lakes and rivers freeze (fig. 3). It is likely that most eagles wintering on southern British Columbia lakes are more northern birds that have been pushed south, but no banding data are yet available to confirm this likelihood. Eagles wintering on inland rivers of the Fraser system are probably mixtures of inland birds driven south and west and coastal birds moving upriver to utilize inland salmon runs (fig. 4). The Skagit probably falls into the category of a mixed inland and coastal population, and dispersal movements of color-marked eagles (fig. 1) seem to support this.

We propose that there are two general migration routes for the Skagit wintering population (fig. 5). The first route is over the mountains in a north and northeast direction toward interior British Columbia. The second route is down the Skagit Valley to the west, then north through Puget Sound and the Strait of Georgia.

There is ample evidence for the second route down the Skagit Valley to the west. We have 23 reports of color-marked eagles along the Skagit between Rockport and Puget Sound, and there are 18 reports of color-marked eagles in the San Juan Islands.

There is no direct evidence of the first route over the mountains other than six reports of color-marked eagles in British Columbia. Indirect evidence of such a high-altitude overland route is available, however. Wintering eagles on the Skagit River often soar in groups and ascend to several hundred meters above the valley floor (Servheen 1975, 1976). Soaring behavior among groups of wintering Bald Eagles has been reported in

other areas (Southern 1964, Grewe 1966, Edwards 1969, Jonen 1973, Lish 1975, Steenhof 1976, Platt 1976, Stalmaster 1976, Sherrod et al. 1976) and has often been attributed to pre-roosting behavior, pair-bond maintenance, food resource "signalling," or play. Vertical soaring in the Skagit may also be a means of using rising thermal air formations to gain altitude necessary to cross the rugged mountains to the north. Migrating eagles could use mountain ridgelines for lift and as travel routes for long distances. Such travel over mountains could provide rapid movement between drainages such as the Skagit and the Nooksack, relatively close together but separated by precipitous mountains. Large variances in daily counts on the Skagit (Servheen 1975) and the Nooksack (Stalmaster 1976) may be evidence of such rapid, high-altitude travel. High-altitude travel is not uncommon in other birds, and flights over mountains at altitudes of 6000 meters have been reported (Meinertzhagen 1955, Berger and Hart 1974). The social nature of soaring flights indicates that eagles may fly over mountainous terrain in groups like several other raptor species (Brown and Amadon 1968). Such group movements would be advantageous to first-year birds who could learn routes and of special advantage (Ward and Zahavi 1973) to subadults which are primarily dependent on randomly distributed but concentrated food sources during winter.

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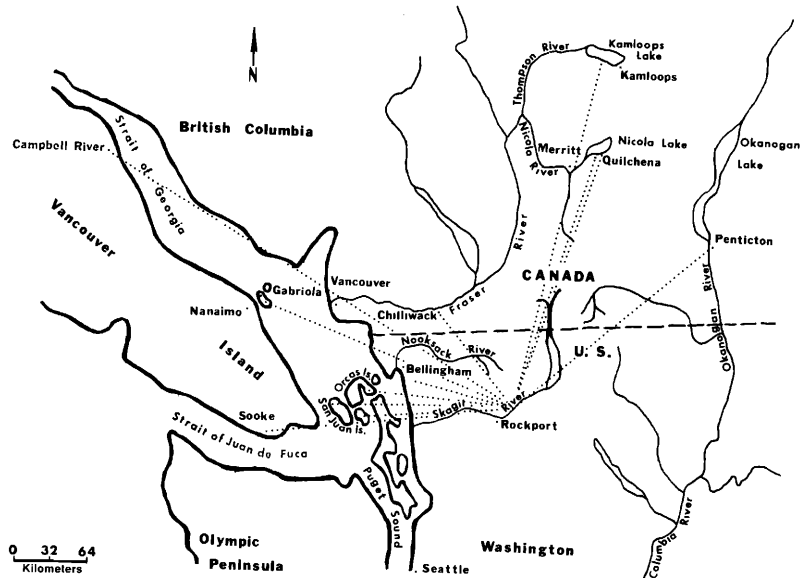


Figure 1. Sighting locations of color-marked Bald Eagles released on the Skagit River, 1975 through 1978. (Multiple sightings at individual sites not indicated.)

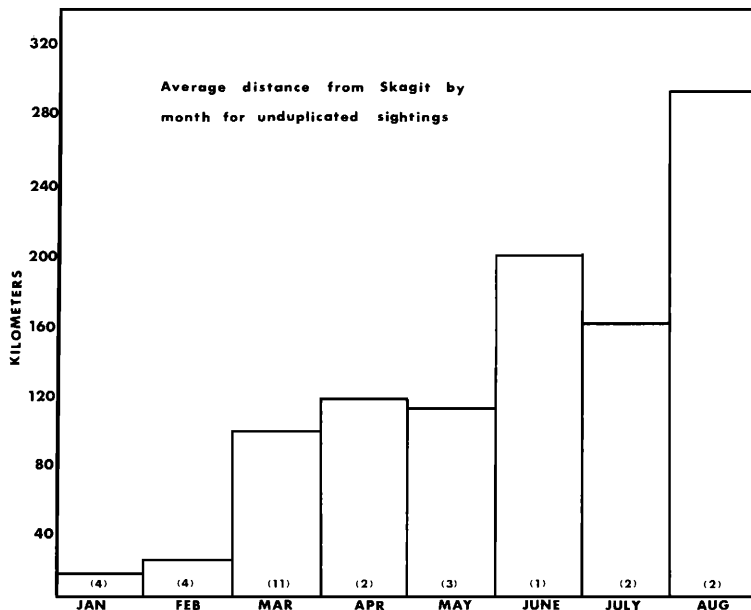


Figure 2. Average distance from Skagit release site by month for unduplicated sightings. No sightings included from within 9.5 kilometers of release site. Number of sightings per month in parentheses. N = 29.



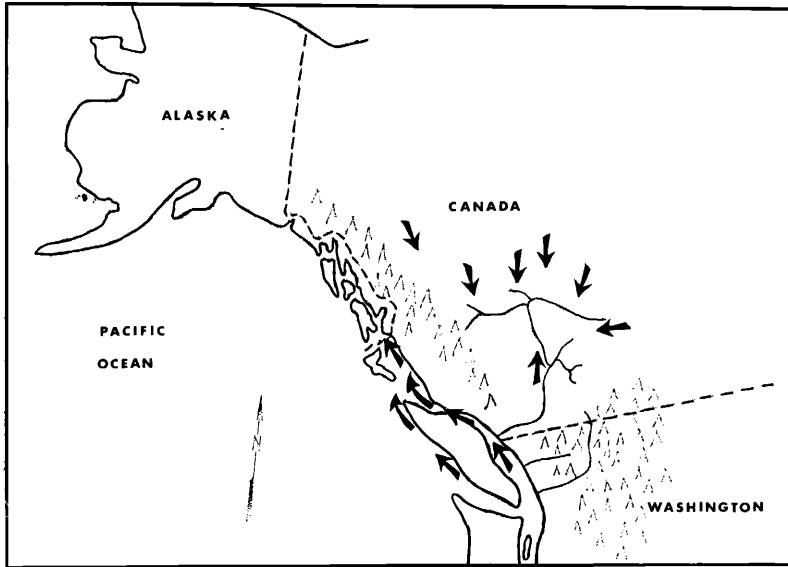


Figure 3. Hypothetical movement patterns of Bald Eagles during August and September in the Pacific Northwest.

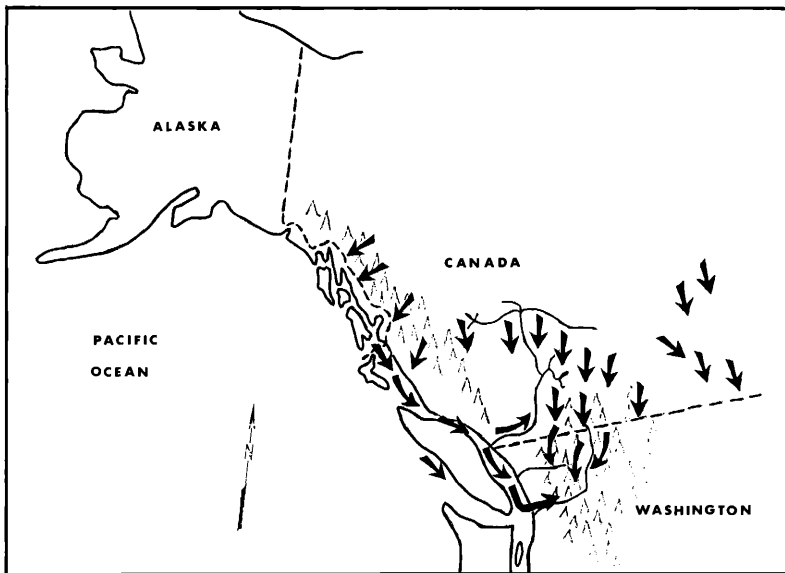


Figure 4. Hypothetical movement patterns of Bald Eagles during October, November, and December in the Pacific Northwest.

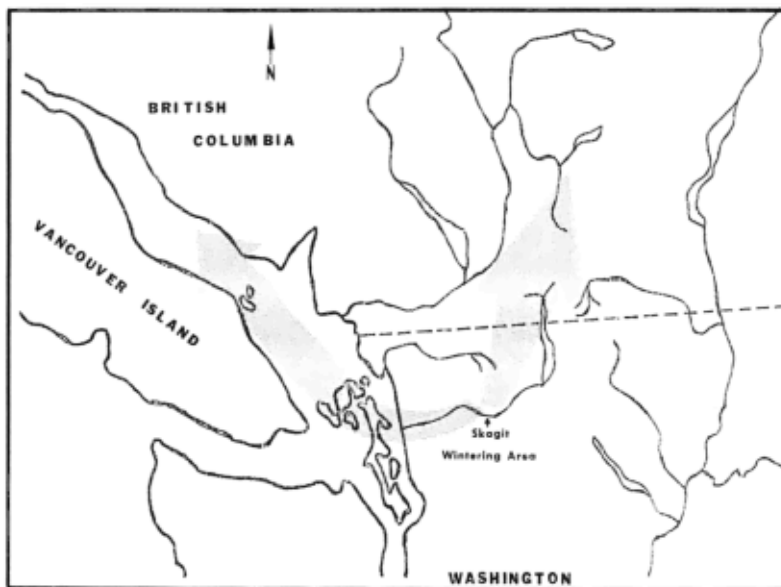


Figure 5. Hypothetical dispersal routes for Bald Eagles wintering on the Skagit River, Washington.

## SNOW GOOSE TAKEN BY PEREGRINE FALCON

by  
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While working with four companions near Rathbun Reservoir in south central Iowa on 1 October 1975, I heard geese calling and saw two large birds, presumably geese, flying in a rather erratic manner approximately 150 m above the ground and perhaps 0.4 km from our position. At that moment, a member of our party located the main flock, and everyone watched as 20 Snow Geese (*Chen caerulescens*) passed directly overhead. As I turned to relocate the two birds I had been watching, I saw an unidentifiable mass of wings and bodies tumbling rapidly toward the ground. At approximately 30 m above the ground, the tumbling ceased abruptly, and we observed a falcon, with cupped wings, struggling to support a weakly flopping goose. The raptor had a single talon fastened in the abdomen of the goose but seemed unable to support the weight of its prey. The pair continued down almost vertically and hit a low, brush-covered hill less than 200 m from our position. A similar aerial tumbling sequence involving a Peregrine Falcon (*Falco peregrinus*) and a crow (presumably *Corvus brachyrhynchos*) was reported by Hager (Bent 1938).