HISTORY AND STATUS OF TRANSLOCATED SEA OTTER POPULATIONS IN NORTH AMERICA

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Abstract: Seven hundred and eight sea otters (*Enhydra lutris*) captured in Alaska were translocated from 1965 to 1972 in efforts to reestablish this species in parts of its range from which it was extirpated during the fur hunting period in the 18th and 19th centuries. In Alaska, 467 sea otters were translocated to several locations from 1965 to 1969. During the period 1969–72, 89 sea otters were translocated to British Columbia; 59 otters were released in Washington in 1969–70. During 1970–71, 93 sea otters were released in Oregon. Results of surveys of translocated populations are: (1) at the Pribilofs no reproduction was observed and few, if any, otters now remain there; (2) the southeastern Alaskan population is established; 479 otters were counted in 1975; (3) 70 otters, including some pups, were observed in 1977 in British Columbia; (4) 36 otters, including 1 pup, were observed in Washington in 1981; and (5) reproduction was observed in Oregon, and a high count in 1973 indicated 23 otters, but in 1981 only 1 was found. It is expected that this colony will disappear.

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Intensive exploitation of sea otters began soon after the discovery of the Commander Islands by Vitus Bering in 1741 and continued for the next 170 years (Kenyon 1969). During this period sea otters were eliminated from much of their original range, which extended from the northern islands of Japan to the central Pacific coast of Baja California. Remnant populations survived only on the Kamchatka coast; in the Kuril, Aleutian, and Commander Islands of the north Pacific; in the Queen Charlotte Islands of British Columbia; near Point Sur, California; and near Cedros Island and San Benitos Island, Mexico. The Mexican and British Columbian populations disappeared by 1919 and 1929, respectively (Kenyon 1969).

Experimental translocations began in 1951. Translocations in 1951, 1955, 1956, and 1957 failed. Their failure was attributed primarily to inadequate knowledge of the role of sea otter pelage in thermoregulation. During the period between capture and release, the pelage, without special care, becomes soiled and matted, thus destroying its insulating qualities. This problem was eventually alleviated by minimizing transit time and holding captive otters in tanks containing circulating sea water, which allowed them to groom and condition their fur.

In 1956, 7 sea otters were successfully liberated at St. Paul in the Pribilof Islands. From 1965 to 1972, the Alaska Department of Fish and Game, in cooperation with state, federal, and provincial agencies, translocated 708 sea otters to unoccupied habitats in Alaska, British Columbia, Washington, and Oregon (Table 1, Fig. 1). All otters released at St. Paul were tagged; the majority of the others were not tagged. Eighty-nine percent of the otters released in southeastern Alaska were captured at Amchitka Island; 11% came from Prince William Sound. Thirty-three percent of the

[1] Deceased.

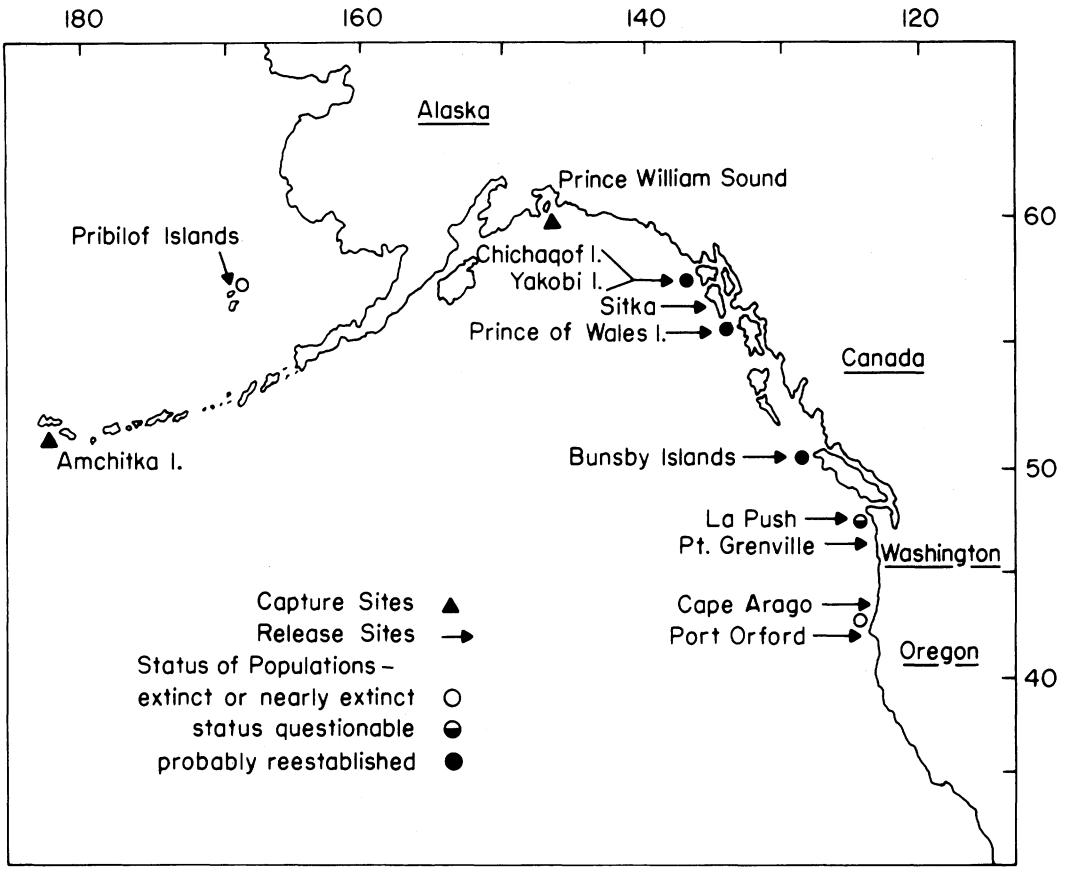

Fig. 1. General locations of capture sites and release sites and the status of translocated populations. Grid shown by latitude and longitude.

otters released in British Columbia were captured at Amchitka Island; 67% were from Prince William Sound. Otters released at all other sites were from Amchitka Island. The sex ratio of translocated otters was approximately 2:1, favoring females. Intensive post-release studies began in Oregon in 1971, but not until 1975 in Alaska, and 1977 in Washington and British Columbia were any intensive surveys conducted. This paper presents the results of our surveys in Alaska, Washington, and Oregon and reviews the status of all translocated sea otter populations. Interpretation of survey results also is presented. This information should provide some insight into the problems associated with translocation of sea otters and stimulate investigation of questions that remain unanswered.

K. B. Schneider and K. W. Pitcher of the Alaska Department of Fish and Game assisted during the 1975 southeastern Alaska survey. Schneider also provided us with data on the number, time, and location of releases in Alaska. E. Reutercrona assisted with boat surveys in Oregon and in Washington in 1977. K. Miles and R. Anthony assisted with the surveys in 1978. We thank the staff of William L. Finley National Wildlife Refuge, U.S. Fish and Wildlife Service, for allowing Jameson to assist in the aerial surveys of the Oregon coast

Table 1. Numbers of sea otters translocated from Amchitka Island and Prince William Sound, Alaska, 1965–72.

Release location	1965	1966	1967	1968	1969	1970	1971	1972	Total
St. George Island, AK				55					55
Southeastern Alaska[a]	23	30		301	58				412
Bunsby Islands, B.C.					29	14		46	89
Pt. Grenville, WA					29				29
La Push, WA						30			30
Port Orford, OR						29	24		53
Cape Arago, OR							40		40
Totals	23	30		356	116	73	64	46	708

[a] In southeastern Alaska, otters were released at several sites on the exposed west coasts of Yakobi, Chichagof, Baranof, and Prince of Wales islands. On the Alaska mainland otters were released at Yakutat Bay and Cape Spencer.

from 1972 to 1975, and pilot biologists B. Mate and J. Olterman for piloting aircraft used during other aerial surveys of the Oregon coast. J. A. Estes and G. R. VanBlaricom reviewed the manuscript and provided many helpful suggestions. G. Jameson, S. Jameson, and R. R. Jameson assisted in Oregon and Washington surveys. K. Balcomb and J. Nightingale assisted in the 1981 Washington survey.

METHODS

Survey areas in Alaska were searched from a small (5 m) boat from 30 April 1975 to 16 May 1975. Large pods of otters were counted from a nearby island or emergent rock with the aid of a 15–60× telescope or 10 × 50 binoculars. Otters were classified and recorded as independent or dependent (pups).

Survey techniques for Washington and Oregon were similar to those used in Alaska except that we made observations from shore whenever possible and used a 50–80× high resolution Questar telescope. The 1977 Washington survey included the coastline from the Bodelteh Islands to Destruction Island. In 1978, we surveyed the area from the Bodelteh Islands to the Giants Graveyard by boat. Weather precluded survey of Destruction Island by boat. In 1981 the entire coastline from Destruction Island to Neah Bay was surveyed by boat. Surveys in Oregon were conducted from small boats and from land-based observation points and included the area from Coos Bay to Pt. Saint George, California.

Aerial surveys were conducted annually in Oregon from 1971 to 1975. In 1971, only the coastline from Coos Bay to California was searched, but from 1972 to 1975 the entire coastline was surveyed. Altitude during flights varied between 100 and 200 m. All surveys were timed to correspond to sea otter activity cycles; therefore, most were conducted during midmorning when the majority of otters were at rest (Kenyon 1969).

RESULTS

Alaska

In 1972, A. Johnson circumnavigated St. George Island in the Pribilofs and observed only 3 sea otters. In 1976 and 1977 R. Gentry (Nat. Marine Mammal Lab., Seattle, WA, pers. commun.) saw 6 and 3 otters there, respectively. No pups have been reported since the 1968 release suggesting that little or no reproduction has occurred. Occasional sightings of single otters have been reported from St. Paul and Otter islands.

In 1971, 71 otters were observed at Surge Bay by Alaska Department of Fish and Game biologists (K. Schneider, Alaska Dep. Fish and Game, Anchorage, AK, pers. commun.). We observed 236 otters in the same area and a total of 479 sea otters at 7 locations in 1975 (Table 2). With the exception of the Coronation-Spanish Islands area otters had been released at or near all of the sites where groups were observed (within 20 km).

Reproduction appeared to be excellent in 1975 with an overall ratio of 15 pups : 100 independent animals observed. Between-site ratios varied considerably, reflecting differences in sex and age composition of the local populations (Table 2). For example, at Surge Bay the ratio was 10:100, but we know that the count included a single group of nearly 100 otters that were probably all or nearly all males. In contrast, the Khaz Bay ratio of

Table 2. Sea otter surveys of Alaska, Washington, and Oregon 1975–81. Numbers for Oregon during 1972–75 represent maximum for year, because frequent counts were made during the period. After 1975 only annual surveys were made.

Date and location	Distance from nearest release site (km)	Class		Total	Pup:Independent ratio
		Independent	Pups		
Alaska					
1975					
1 May/Coronation Island	40	35	4	39	11:100
2 May/Spanish Islands	40	25	10	35	40:100
3–4 May/Maurelle Islands	0	39	7	46	18:100
5–6 May/Barrier Islands	0	18	1	19	6:100
11–12 May/Necker Islands	0	3	1	4	33:100
14 May/Khaz Bay	0	79	19	98	24:100
15 May/Surge Bay	19	217	21	238	10:100
Total		416	63	479	15:100
Washington					
1977					
1 Jul/Destruction Island	33	3	3	6	
1 Jul/Giants Graveyard	9	3	1	4	
1 Jul/Bald Island	12	1	0	1	
4 Jul/Bodelteh Islands	31	8	0	8	
Total		15	4	19	27:100
1978					
27 Aug/Bodelteh Islands	31	1	0	1	
27 Aug/Sandy Islands	10	5	0	5	
28 Aug/Destruction Island	33	6	0[a]	6	
Total		12	0	12	0:100
1981					
14 Jul/Destruction Island	33	3	0	3	
15 Jul/Cape Johnson-Sandy Islands	9–10	10	1	11	
15 Jul/Sand Pt.	29	1	0	1	
15 Jul/Cape Alava-Bodelteh Islands	31	21	0	21	
Total		35	1	36	3:100
Oregon					
1972					
25 Feb/Simpson Reef	0	20	1	21	5:100
1973					
20 Jul/Blanco Reef	18	17	1	18	
20 Jul/Gull Rock	21	1	0	1	
20 Jul/Orford Reef	14	2	0	2	
20 Jul/Simpson Reef	0	1	1	2	
Total		21	2	23	9:100
1974–1981					
20 Jul 1974/Blanco Reef	18	16	5	21	31:100
29 Jul 1975/Blanco Reef	18	12	1	13	8:100
26 Jul 1976/Blanco Reef	18	11	1	12	9:100
21 Jun 1977/Blanco Reef	18	4	0	4	0:100
16 Aug 1978/Blanco Reef	18	3	1	4	33:100
7–8 Jul 1981/Blanco Reef	18	1	0	1	0:100

[a] Observation distance precluded seeing small pups.

24:100 reflects no obvious concentration of males.

Washington

At least 16 sea otters died within 2 weeks of the 1969 release. During the 1st 3 years after the 2nd release in 1970, reports were infrequent. In 1974, however, students from the University of Washington saw 7 independent otters and 2 pups near Destruction Island (D. Nysewander, Univ. of Wash., Seattle, WA, pers. commun.). Johnson and Kenyon conducted a survey by helicopter of part of the Washington coast on 3 May 1974 and observed only 1 otter near Cape Johnson. S. Jeffries (Wash. Dep. Game, Astoria, WA, pers. commun.) saw 10 otters near Cape Alava during an aerial survey on 14 June 1977 prior to our 1977 survey.

We conducted the 1st intensive survey of the Washington otter population in July 1977 and saw 19 sea otters including 4 pups (Table 2). Our 1978 survey was incomplete because of inclement weather and sea conditions. On 28 June 1978, R. L. Pitman (Eugene, OR, pers. commun.) sighted 11 sea otters near Bodelteh Islands, and on 29 June he saw 2 at Ozette Island. In the summer of 1978 S. M. Speich (Univ. of Wash., Seattle, WA, pers. commun.) reported 14 sea otters in the Bodelteh-Ozette Island area. We saw 36 sea otters including 1 pup during our 1981 survey.

Oregon

From 1971 to 1974 Jameson made frequent counts during all seasons. Beginning in 1975 we made annual summer counts. The maximum number of otters sighted during any survey was 23 in 1973 (Table 2). Counts remained fairly constant through 1974 but declined in 1975. Our 1978 and 1981 surveys were thorough and indicate that the downward trend has continued.

Results of aerial surveys were consistently lower than counts made from shore stations. These provided little information on otter numbers, but because all sightings were made near known concentrations of otters, they did provide information on otter distribution. Production of pups was good from 1972–74 (14 observed), but since 1975 we have seen only 3 pups (Table 2). Sea otters in Oregon continue to occur in the vicinity of Blanco Reef. In 1972, 1973, and 1974 otters were seen frequently near Cape Arago (Simpson Reef). During 1975–76, sightings near Cape Arago were infrequent and counts were low. No sightings were made in 1977, 1978, or 1981. We observed only 1 sea otter during our 1981 survey.

We are aware of 11 sea otter mortalities in Oregon: from 18 July 1970 to 3 August 1973, 8 otters were found dead (1 female, 2 males, 5 sex unknown). Since 1973, 3 additional carcasses have been recovered: 1 pregnant female, 1 stillborn pup, and 1 adult male. The female's stomach was empty, and about ⅓ of the mucosa was covered by shallow ulcers, probably induced by stress, the nature of which was not immediately apparent (R. Stroud, DVM, Clinical Necropsy Report). Kenyon found the adult male just north of Blacklock Point on 28 September 1976 and concluded that it was the victim of a shark attack. The animal was severely lacerated, but no shark tooth fragments were discovered.

DISCUSSION

The Pribilof Islands translocation probably has failed. Kenyon (1969) states that the northern limit of the sea otter's historical distribution was determined by the southern limit of sea ice in the Bering Sea. During the winters of 1971 and 1972 sea ice extended to the north side of Unimak Island. This abnormal southerly extension of the ice pack disrupted the distribution of the otter population on the north side of the Alaska Peninsula (Schneider and Faro 1975) and may have been partially responsible for the failure of

Table 3. Number of sea otters released and number sighted during recent surveys. The Yakutat Bay and Cape Spencer areas in southeastern Alaska were not surveyed and have not been included in this analysis.

Location	No. of otters released	No. of otters sighted during most recent survey (year)	Proportion of number released sighted in recent survey	Latitude of release site (° North)	Years from last release to most recent survey
Pribilof Islands	55	3 (1977)	0.05	57.0	9
S.E. Alaska, Sitka to Yakobi I.	223	336 (1975)	1.51	57.5	6
S.E. Alaska, Sitka to Prince of Wales I.	154	143 (1975)	0.93	56.5	6
British Columbia	89	70 (1977)	0.79	50.0	5
Washington	59	36 (1981)	0.61	47.5	11
Oregon	93	1 (1981)	0.01	42.5	10

the Pribilof translocation. Southeastern Alaskan populations are well established and should continue to grow. Bigg and MacAskie (1978) sighted 70 sea otters, including some pups, in British Columbia. The Washington population is growing, but because of its small size it would be premature to conclude that it is viable. The Oregon population has declined drastically since 1970, and its extinction appears inevitable.

In the following discussion we will examine several possible explanations for the variation in the success of these translocations, namely: (1) variation in the number of otters translocated; (2) high post-release mortality; (3) reproductive failure; (4) emigration of translocated animals resulting in small initial population size; and (5) variation in the suitability and quality of habitat at the release site.

There is a correlation ($r = 0.786$, $P < 0.12$) between the number of sea otters released, excluding the Pribilofs, and the number sighted during later surveys (Table 3). Based on this, the Oregon translocation should have been at least as successful as those in British Columbia and Washington (Table 3). Mortality soon after the Oregon release was relatively low (<10%) compared with Washington where >50% of the animals released in 1969 were found dead and British Columbia where Bigg and MacAskie (1978) speculated that many sea otters died after the initial transplant. Thus, immediate post-release mortality does not explain the failure of the Oregon translocation.

Since 1971 we have observed 17 sea otter pups in Oregon. Most were observed from January 1972 to August 1974. Reproduction first was observed in Washington in 1974, and pups have been sighted in all subsequent surveys. Thus, we suggest that reproductive failure be eliminated as the cause of the apparent failure of any translocation.

Emigration provides the most plausible explanation for translocation results. The Oregon population was the most intensively monitored and, therefore, provided the most information. During 1970, sea otters were sighted in Oregon at 9 locations ranging from 5–80 km from the nearest release site (Jameson 1975; B. Mate, Oreg. State Univ., Newport, OR, pers. commun.). All sightings but 1 were made north of the release site. During 1972 we received 2 reports, both well north of release sites, that appeared to be valid (Jameson 1975). Four to 5 otters were reported 204 km north of Cape Arago in June 1972 (C. Kebbe, Oreg. Dep. Fish and Wildl., Portland, OR, pers. commun.), and 3 sea otters were reported 290 km north of Cape Arago in August 1972 (C. Nelson, East Bay Reg. Park Dep., Oakland, CA, pers. commun.).

There is a significant correlation ($r = 0.931$, $P < 0.02$), excluding the Pribilofs, between the proportion of number released observed in recent surveys and the latitude of the release site (Table 3), suggesting that northward

emigrating otters were recruited into northern translocated populations. In 1969 the California Department of Fish and Game translocated 17 sea otters 72 km north of the capture site (Wild and Ames 1974). These otters were tagged, and at least 5 (30%) returned to the capture site within 9 months of being released. We suggest, therefore, that sea otters have an affinity for a particular home range (Jameson, unpubl. data; Kenyon 1969; Lensink 1962; Loughlin 1977), and some will attempt to return when released into unfamiliar habitat, resulting in a small initial population at the translocation site. Small populations below their "survival threshold" (Wilson and Bossert 1971) or "point of resistance" (Leopold 1933) have a higher likelihood of becoming extinct. The correlation between number released and number seen in surveys indicates that small initial population size could account for the failure of some translocations.

Subadults are the individuals most responsible for dispersal and range expansion in many mammalian species (Wilson 1975). The "natural dispersers" may more readily accept new environs and, therefore, be less likely to leave an unfamiliar location. The data on natality from Oregon offer some supportive evidence. Females without pups at time of release should have mated and pupped during the 1st year after the translocation (Schneider, unpubl. rep., Alaska Fed. Aid. Wildl. Rest. Proj. W-17-4, 1973), yet the 1st pup was not seen until February 1972 (Jameson 1975). Sightings of newborn pups during 1972 and 1973 ranged from 13 to 25 months after the 1971 release. Approximately 30% (19 of 64) of the translocated females were subadults when released. If these were the animals that remained at the site, the delay in reproduction would be accounted for.

An alternative to the homing hypothesis is that the translocated otters were better suited for survival in more northern waters. According to Ekman (1953), both capture sites as well as the British Columbia and southeastern Alaska translocation sites lie within the Aleutian zoogeographical province. However, Oregon and Washington lie within a transitional zoogeographic province that separates the Californian and Aleutian provinces. This information and the correlation between latitude of the release sites and translocation success suggests that the more southerly habitat may have been less suitable for sea otters from northern populations.

Failure of the Oregon, and possibly Washington, translocations probably resulted from emigration and mortality which resulted in populations too small to assure population growth. Conversely, the success of southeastern Alaska and British Columbia translocations could be attributed to larger initial numbers of otters (although Oregon had as many as British Columbia), immigration of otters from other populations, or more suitable or better quality habitat than available at the other sites, or a combination of these. It should also be noted that 69% of the sites where otters were observed during our surveys were not release sites (Table 2).

The establishment of a population above "threshold," thus assuring population growth, may require translocations to the same area of 25–50 otters/year for a period of 3–5 years. Translocated otters should be tagged. Subsequent observations of tagged individuals would greatly increase our understanding of the dynamics of translocated populations.

CONCLUSIONS AND MANAGEMENT IMPLICATIONS

Some tentative conclusions that can be drawn from our information on translocated populations are: (1) the number of sea otters at a transplant site decreases dramatically soon after release; (2) emigration appears to be an important factor in the initial decline of translocated populations; (3) small populations (<25–30 animals) are probably destined for extinction because they are incapable of re-

producing at a rate that is greater than the combined rates of mortality and emigration; (4) it is possible to select a general area to reestablish sea otters, but exact locations are difficult to predict; and (5) it is possible to reestablish sea otters in unoccupied habitat, but it appears to require a relatively large nucleus population.

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