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STATUS OF TRANSLOCATED SEA OTTERS AT SAN NICOLAS ISLAND, CALIFORNIA

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In the 1970s about 1,650 southern sea otters (*Enhydra lutris nereis*) were restricted to the central California coast (Riedman and Estes, 1990), and a high volume of oil was being shipped through the region. Because of the vulnerability of sea otters to contamination from oil (Costa and Kooyman, 1982; Williams and Davis, 1995) that would likely spread widely along the shore after a large spill (VanBlaricom and Jameson, 1982), the subspecies was listed as threatened in 1977 under the United States Endangered Species Act.

One of the principal actions called for in the first southern sea otter recovery plan (USFWS [United States Fish and Wildlife Service], 1981) was to establish a separate population of southern sea otters by translocation. This action was believed to be sufficient to significantly reduce risks to the population from catastrophic events, such as oil spills. In 1987, sea otters were moved to San Nicolas Island in southern California. In addition to being a conservation action, the translocation afforded an opportunity to evaluate prevailing models of sea otter/ecosystem interactions (VanBlaricom and Estes, 1988), and to better document and understand the process of moving sea otters, which was considered important in implementing their management in the state (Packard, 1982). In this paper, we present data on the status of sea otters at San Nicolas Island, and discuss concerns for their future.

San Nicolas Island (Fig. 1) was selected as the translocation site for several reasons (Ladd, 1986*a*, 1986*b*; USFWS, 1987*a*). Being about 110 km offshore of Los Angeles, San Nicolas Island was isolated and remote from the mainland sea otter population. The island was also considered ideal habitat within the historical range of the southern sea otter. In addition, San Nicolas Island had good logistical support for the translocation because the United States Navy owns and operates a missile testing facility, landing field, road network, and housing/dining facilities there. San Nicolas Island is 13.7 km long and 4.8 km wide, and is composed of a series of exposed sedimentary marine terraces that culminate 276 m above sea level (Vedder and Norris, 1963). The relatively steep sides of the island, especially above each terrace, would enable field personnel to effectively monitor numbers of sea otters and movements around the 35-km perimeter of the island.

The translocation plan (USFWS, 1987*b*), which was the guiding protocol for the project, took into consideration the best biological information available on sea otters (Riedman and Estes, 1990), and the best methods of capture, transport, husbandry, release, and monitoring that had been developed during other sea otter translocations and research projects (Ames et al., 1986). All this information, including strictly defined timing, sex ratios, and age-class distributions of sea otters destined for reintroduction, was part of the translocation plan. Criteria for determining the success or failure of the translocation were also part of the plan.

Sea otters were captured with tangle nets, dip nets, and Wilson traps (Ames et al., 1986) along the central California coast from Monterey Bay south to Point Buchon (Fig. 1). While onboard the capture boats, a subjective appraisal of each

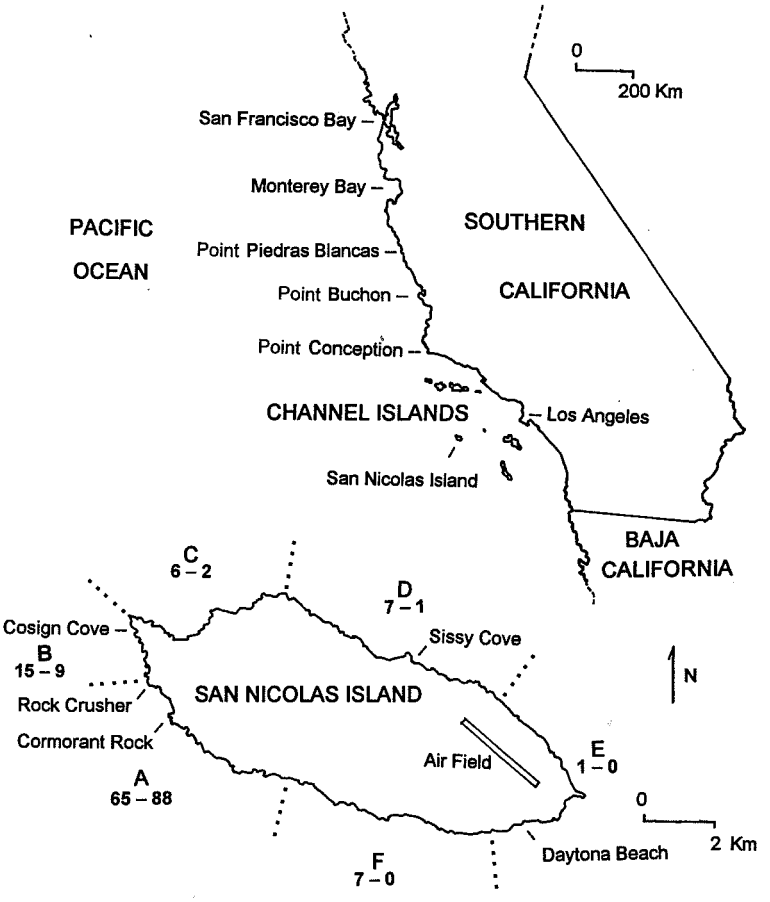

FIG. 1—Southern California and San Nicolas Island with important sea otter capture, release, and resighting locations. Hyphenated numbers in shore segment A through F around San Nicolas Island are the yearly mean percent independent and dependent sea otters counted per segment from 1990 through 1998.

sea otter's general health based on tooth wear, pelage condition, and behavior also was made and was used to assess each sea otter's suitability for translocation (Rathbun et al., 1990; Rathbun and Benz, 1991). Those sea otters rejected were tagged for individual identification with colored flipper tags (Ames et al., 1986) and a passive integrated transponder (PIT; Thomas et al., 1987) and immediately released at their capture site.

Sea otters kept for translocation were taken to shore within ca. 60 min of their capture. Once ashore, they were individually placed in airline-style kennels and transported in an air-conditioned van to the Monterey Bay Aquarium, where they were held in pools for 1 to 12 days (Rathbun et al., 1990). During this period, their health was further assessed based on blood chemistry and behavior. They also were tagged for individual identification with PIT and flipper tags, and one was successfully implanted with an intraperitoneal radiotransmitter (Ralls et al., 1989).

Sea otters were flown to San Nicolas Island from the Monterey Airport in a Convair 440 or Cessna 182 airplane. At the island, sea otters in their kennels were taken by pickup truck to their release sites. Those that were to be radiotracked were fitted with a flipper-mounted transmitter (Hatfield and Rathbun, 1996) just prior to release. Initially, sea otters where acclimated to the island for 48 hours in floating pens (Ames et al., 1986) off of Sissy Cove (Fig. 1) before being released into the ocean.

Although the road system on San Nicolas Is-

land allowed personnel to reach most locations at any time, Navy operations sometimes resulted in restricted access to sections of the island from several hours to several days. Although these restrictions, along with fog and frequent strong northwesterly winds, sometimes disrupted our monitoring routine, they did not significantly alter the quality of data we gathered.

One to four biologists at the island monitored numbers, identities, distribution, and behavior of sea otters with the aid of telescopes and binoculars. Monitoring was done weekly from 1987 through 1992 and every 2 to 3 months from 1993 through 1998. Total-island counts of sea otters within 1 day were done by one to three observers, using methods similar to those used to monitor the mainland sea otter population (Estes and Jameson, 1988; Jameson and Johnson, 1993). We also monitored the population at San Nicolas Island based on the individual identities of sea otters (radiotags, visual tags, and unique marks and behaviors) accumulated over a calendar month.

Unfortunately, all tagging methods that we used at San Nicolas Island had limitations, even though they continue to be the best techniques available. Transponders were only readable when sea otters were recaptured, radios had a 1 month to 2 year battery life, and flipper tags were gradually shed over several years (Hatfield and Rathbun, 1996).

To quantify the distribution of sea otters around San Nicolas Island, we arbitrarily divided the perimeter into six segments (Fig. 1). For each segment, we used the highest sea otter count for each month from 1990 through 1998 to calculate the mean percent counted per segment.

Sightings and individual identifications of sea otters at other Channel Islands and along the mainland coast were gathered by several methods. These included unsolicited reports of sightings from fishermen and citizens that were subsequently confirmed, identifications based on shore and aerial surveys dedicated to searching for dispersing radiotagged animals, identifications made during the biannual, range-wide sea otter survey conducted along the mainland coast in California (Estes and Jameson, 1988; Estes, 1990), and dead sea otters that were recovered and identified based on their PIT or flipper tags.

We released 139 sea otters at San Nicolas Island between August 1987 and July 1990 (Fig. 2). The female-biased sex ratio of 108/31 was intended to complement their polygynous mating system (Riedman and Estes, 1990), and the juvenile (<15.9 kg) to adult ratio of 76/63 was thought to be optimal for reproduction and limiting dispersal (USFWS, 1987*b*; Rathbun et al., 1990). To establish a large number of sea otters at the island as soon as possible, 51 of the 139 (37%) were released during August and September 1987, and another 49 (35%) by the end of the following year (Fig. 2). Because of difficulties in amending wildlife permits, only 79 of the 139 (57%) were radiotagged—three with previously implanted radios, one with a newly implanted radio, and 75 with flipper-mounted transmitters.

The first two shipments of sea otters (n = 45) to San Nicolas Island were held in the floating pens. We discontinued the use of pens, however, when three animals apparently died from stress while in the cages or just after release at the island (Table 1). Another factor was that moored pens could not withstand the rough seas at the island for more than a few weeks. All subsequent sea otters were released directly into the ocean from shore, and we did not document any further mortality at the island. During the first 3 years of the translocation, six dead sea otters were found or reported in California south of Point Conception and not at San Nicolas Island (Table 1), and some of these were suspected of being killed by people (Brownell and Rathbun, 1988).

The first 60 sea otters taken to San Nicolas Island were released at or near Sissy Cove, Daytona Beach, Rock Crusher, and Cosign Cove. When many of these animals took up residence along the western shore, we released the next 75 near Rock Crusher, except when the Navy closed the area and four animals had to be released at Daytona Beach (Fig. 1).

At least 36 sea otters released at San Nicolas Island eventually found their way back to the mainland range in central California (Table 1). Ten translocated animals (not including an orphaned animal that was rehabilitated and then released at San Nicolas Island; Hatfield et al., 1994) were captured in the no-otter management zone in southern California and returned to the mainland range. Most of the sea otters that disappeared from San Nicolas Is-

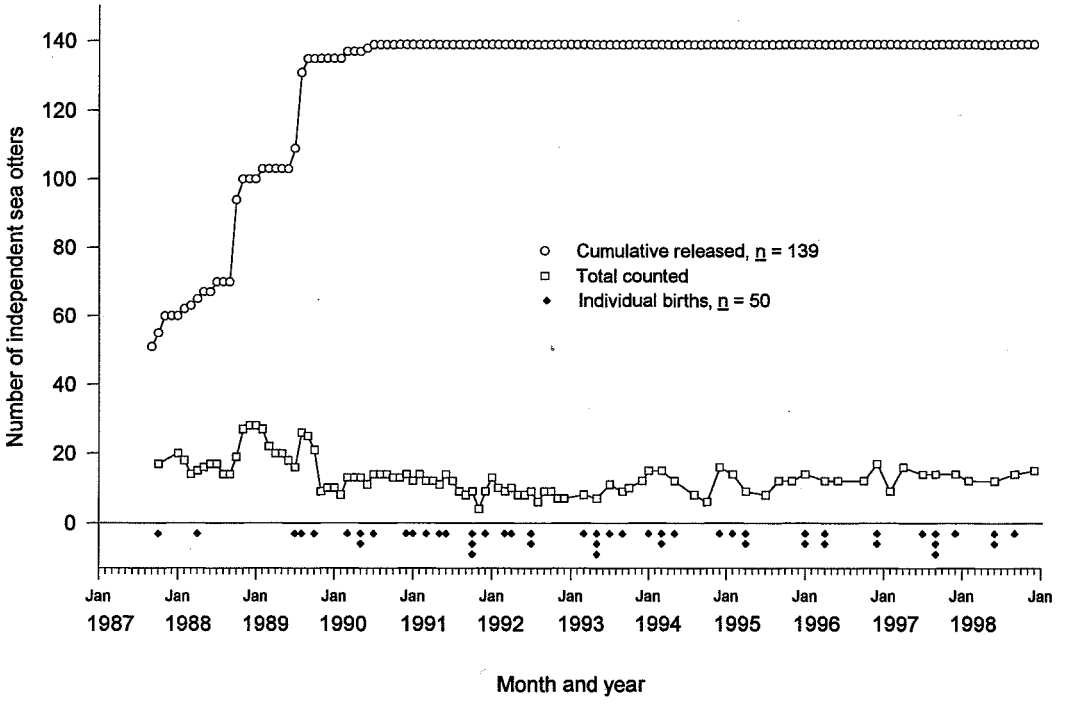

FIG. 2—Sea otters released and accounted for at San Nicolas Island each month, from 1987 through 1998. Sightings of new pups are shown below the X-axis.

land, however, have not been accounted for (Table 1).

We documented 50 births at the island from August 1987 through December 1998 (Fig. 2). Although the translocation plan stipulated that none of the sea otters taken to the island were to be pregnant, this was difficult to determine. At least two, and at most six, of the initial births were conceived before the females were captured along the mainland. One female at San Nicolas Island gave birth ≥7 times, and another ≥4 times.

An average of 5.0 pups per year (range from 3 to 8) was born at San Nicolas Island from 1990 through 1998, and during this time the number of independent animals counted or

TABLE 1—Status of sea otters released at San Nicolas Island (SNI) by calendar year, 1987–1997. In 1987 the year includes 12 August–31 December.

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	Total
Total released at SNI[a]	60	40	35	4	0	0	0	0	0	0	0	0	139
Total died[b]	6	0	3	0	0	0	0	0	0	0	0	0	9
Total removed management zone	1	0	1	1	1	5[c]	1	0	0	0	0	0	10
Total homed	1	13	13	3	3	2	1	0	0	0	0	0	36
Total born at SNI	1	1	3	5	8	4	6	5	3	6	5	3	50
Highest SNI count of adults	36	35	46	16	15	13	13	16	14	17	16	15	—

[a] Does not include one orphan pup raised by husbandry staff at the Monterey Bay Aquarium and released at SNI on 10 May 1988 (ID #FWS305, male).

[b] Does not include sea otters that died after homing. Three died at SNI in 1987, the rest in the management zone.

[c] One of these was observed back in the mainland range prior to being recaptured in the management zone, and also was counted in the number homed.

identified varied between 13 and 17 (Fig. 2). None of the sea otters remaining at San Nicolas Island have had flipper tags since January 1996, although we continue to see animals at the island that have lost their flipper tags. We also see adults at the island with no indication that they have ever been flipper tagged. These animals most likely were born at San Nicolas Island, although immigration from the mainland is also possible.

The sea otters at San Nicolas Island have always favored the southwestern shore (Fig. 1). Beginning in 1991, however, there was a trend for animals to become less aggregated and increase their use of the northern shore. By 1996, about a third of sightings were made along the northern side of the island (Segments C and D), and by 1998 they were being consistently seen on all sides of San Nicolas Island, although the majority were still sighted along the western shore.

In Alaska, Washington, and British Columbia, expanding sea otter populations increase by up to 17% per annum, while in California the growth rate has never exceeded about 5% (Estes, 1990). Based on assessments of the habitat at San Nicolas Island (J. Estes, in litt.) and population dynamics of sea otters, it was estimated that the carrying capacity of San Nicolas Island would be at least 280 sea otters, which was expected to occur in 11–30 years, depending on the growth rate (USFWS, 1987*b*). Obviously, growth has not occurred (Fig. 2). Initially, we documented considerable dispersal from the island (Table 1), and it is likely that additional sea otters escaped detection after returning to the mainland of California or even dispersing to Baja California (Gallo-Reynoso and Rathbun, 1997). Unfortunately, after the initial dispersals there has been little information to indicate why the San Nicolas Island population has not grown. Our data show that there are adequate births to support growth, and food availability, measured as the density of nearshore macroinvertebrates, has been and continues to be higher than in many locations within the mainland range of the sea otter (J. Estes and M. Kenner, pers. comm.). This leaves two main reasons for the lack of growth at San Nicolas Island: dispersal and death.

We believe, based on our field observations, that few if any long-term resident sea otters at San Nicolas Island leave the island. Unfortunately, there is no way of documenting this because none of the animals at San Nicolas Island are still flipper-tagged, and there has been no provision or effort to tag or re-tag sea otters at the island.

Hundreds of lobster pots are set in the nearshore waters around San Nicolas Island (authors' personal observations), and there has been speculation that sea otters at the island have been drowning in these traps. Others may have been shot (Brownell and Rathbun, 1988). However, we have documented no mortality at San Nicolas Island since 1987 (Table 1). This may be partly due to the likely low frequency of lobster pot entanglements (based on the average yearly birth rate, it would only require about 5 deaths a year from all causes to result in the relatively stable population at the island). A certain amount of cooperation from the fishermen who have been largely unsympathetic with the translocation effort, would help resolve these issues. In the absence of cooperation, documentation will require a focused effort similar to that which showed that sea otters were being killed in the nearshore gillnet fishery along mainland California in the 1970s and 1980s (Wendell et al., 1986).

Although translocations of northern sea otters (*E. l. lutris*) have occurred in Alaska, Canada, Washington, and Oregon, none were well documented and not all were successful (Jameson et al., 1982). Based on results from the successful translocation of sea otters from Alaska to Washington state (Jameson et al., 1986), we knew sea otter numbers at San Nicolas Island might initially decline, but expected them to start increasing after several years. The sea otter population at San Nicolas Island has not changed greatly from 1990 through 1998 (Fig. 2). Based on the Washington model, the San Nicolas Island population may still expand, especially with greater effort to identify limiting factors, and implementing corrective actions.

The required technical and public reviews associated with the translocation project were extensive and complicated (Ladd, 1986*a*, 1986*b*), and resulted in the Final Environmental Impact Statement (USFWS, 1987*a*) and federal and state permits. However, restrictions in these documents limited flexibility in implementing the translocation and understanding population dynamics of the sea otters remaining at the island. For example, our initial per-

mits did not allow for radiotagging all sea otters taken to San Nicolas Island, and no provision was made for tagging or re-tagging animals at the island.

Another problem was the concessions made to the various critics of the translocation. For example, sea otters can outcompete fishermen for food resources (VanBlaricom and Estes, 1988), and thus the USFWS agreed to implement zonal management of sea otters to win support for translocation from sport and commercial fishing interests (Ladd, 1986*a*, 1986*b*). This concession resulted in all of southern California south of Point Conception and outside of San Nicolas Island being designated as a no-otter zone (Public Law 99-625), and required the USFWS to implement the law by non-lethal means. The law continues to influence the fate of sea otters at San Nicolas Island.

The translocation plan (USFWS, 1987*b*) defines criteria for a successful or failed translocation. As long as the effort continues to be considered a success, the USFWS is required under the public law to maintain the no-otter zone. However, if the translocation is declared a failure by the USFWS, then the public law requires that an attempt be made to remove the sea otters remaining at San Nicolas Island. Unless Congress changes the public law to allow sea otters to remain at the island while at the same time abandoning maintenance of the no-otter zone, it seems to us that the sea otters are potentially the short-term losers. However, the real issues are long-term and broader than just San Nicolas Island: how many sea otters should there be in California and where should they be allowed to live? Is non-lethal zonal management workable? Commercial and sport fishing interests, conservation organizations, regulatory agencies, and the Southern Sea Otter Recovery Team are currently grappling with these complicated and emotionally charged issues (Ralls et al., 1996; Watson, 1996). The decisions on these broader, long-term topics will, in turn, determine what happens to the sea otters remaining at San Nicolas Island.

Resumen—Con el fin de disminuir la posibilidad de una reducción catastrófica de la población de la nutria marina meridional (*Enhydra lutris nereis*), clasificada por el gobierno de los Estados Unidos como amenazada se restableció una población en la Isla San Nicolás, California, U.S.A. Entre 1987 y 1990, se trasladaron 139 nutrias de la costa continental a la isla. Estas nutrias se monitorearon intensivamente aproximadamente cada semana entre 1987 y 1992 y alrededor de cada dos meses entre 1993 y 1998. Después de una pérdida inicial de individuos, principalmente por emigración, el número mínimo de nutrias independientes (sin incluir cachorros) en la isla ha oscilado entre 13 y 17, todos los años. Documentamos un mínimo de 50 nacimientos en la isla entre 1987 y 1998, y, en promedio, 5.0 cachorros nacieron cada año entre 1990 y 1998. No está claro por qué la población no ha incrementado. Las razones posibles incluyen mortalidad natural y asociada con actividades humanas, y emigración de la isla. El futuro de la población de nutrias en la Isla San Nicolás es incierto no sólo por su tamaño reducido, sino también por políticas administrativas referentes a la translocación de individuos que aún no han sido resueltas.

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