Friends of the Sea Otter
Founded in 1968 by Margaret Owings & James Mattison, Jr.
and dedicated to protect and defend a rare and threatened species

**Animal Protection Institute**
**Center for Marine Conservation**
**Defenders of Wildlife**
**Friends of the Sea Otter**
**Humane Society of the United States**
**International Marine Mammal Project of the Earth Island Institute**

November 30, 2000

The Honorable Jamie R. Clark
Director, U.S. Fish and Wildlife Service
U.S. Department of the Interior
Room 3256
1849 C Street, NW
Washington, DC 20240

**Re: Petition for Rulemaking to Protect Southern Sea Otter Population/Supplemental Notice of Intent to Sue Under The Endangered Species Act**

Dear Director Clark:

Pursuant to 5 U.S.C. § 553(e), the Animal Protection Institute, Center for Marine Conservation, Defenders of Wildlife, Friends of the Sea Otter, Humane Society of the United States, and International Marine Mammal Project of the Earth Island Institute hereby petition the United States Fish and Wildlife Service ("FWS") to undertake rulemaking on either an interim or expedited basis to amend its regulations governing the southern sea otter experimental population. 50 C.F.R. § 17.84(d). Specifically, this rulemaking petition requests that FWS revoke or suspend the provisions in the experimental population regulations dealing with the capture and removal of sea otters from the so-called "management zone." Id. § § 17.84(d)(1)(ii), (d)(5), (d) (6). In addition, this letter serves as a supplemental notice of intent to sue pursuant to § 11(g) of the Endangered Species Act ("ESA"). 16 U.S.C. § 1540(g).

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**Rulemaking Petition**

The so-called "containment" provision of 50 C.F.R. § 17.84(d)(6) needs to be suspended for six reasons: 1) Public Law 99-625 envisioned a successful translocation as a prerequisite for capture and removal; 2) the Point Conception zone is unlawful because it is inconsistent with recovery; 3) containment is not feasible and violates the prohibition on lethal take; 4) capture and removal will cause jeopardy; 5) capture and removal violates the Secretary's affirmative duty to conserve this species; and 6) a supplemental National Environmental Policy Act ("NEPA") review of the underlying translocation plan must be completed. Each of these issues will be discussed separately.

<u>The Need for a Successful Translocation</u>. In 1986, Congress passed Public Law 99-625 to clarify and define the authority held by FWS to translocate southern sea otters from their then-current range to another location. The primary purpose of Public Law 99-625 was to allow FWS to apply the principles established under section 10(j) of the ESA, 16 U.S.C. § 1539(j), to the sea otter recovery program. Under section 10(j), Congress created a procedure to authorize FWS to translocate members of a species listed under the ESA from their existing range to other locations for the purpose of addressing the threats to their continued existence and promoting recovery. *Wyoming Farm Bureau Federation v. Babbitt*, 199 F.3d 1224, 1234, 1235 (10th Cir. 2000) (flexibility created by section 10(j) "allows the Secretary to better conserve and recover endangered species;" section 10(j) reflects paramount objective of the ESA to conserve and recover species); *United States v. McKittrick*, 142 F.3d 1170, 1174 (9th Cir. 1998). <u>See</u> <u>also</u> H.R. Rep. No. 97-567 at 33 (1982), reprinted in 1982 U.S.C.C.A.N. 2807, 2833; H.R. Conf. Rep No. 97-835 at 30 (1982), reprinted in 1982 U.S.C.C.A.N. 2860, 2871.

As stated in H.R. Report 99-124, "[t]he legislation is intended to allow the Fish and Wildlife Service to use the process they have begun under section 10(j) of the Act." H.R. Rep. No. 124, 99th Cong., 1st Sess. 14 (1985). Thus, it was the clear intent of Congress that Public Law 99-625 be used, like section 10(j), as the mechanism for achieving recovery of the species.

In enacting Public Law 99-625, Congress defined the clear relationship between the successful establishment of the experimental population within the translocation zone and the concept of a management zone from which sea otters would be captured and removed under appropriate circumstances. Congress acknowledged the relationship between these two zones in stating that "[t]he delineation of the translocation and management zones are [sic] critical to the success of the translocation plan." Id. at 16.

Clearly, in enacting the translocation law, Congress envisioned a scenario under which a successful translocated populated would thrive at San Nicolas Island. A successful, breeding population at San Nicolas would advance the recovery goals of this species and allow for the implementation of a management zone where capture and removal would take place under appropriate circumstances without risk to the species or individual animals. In effect, Congress recognized the existence of a "quid pro quo" – the establishment of a successful translocated population in exchange for a sea otter management zone. This principle is reflected in the statement made in conjunction with the enactment of Public Law 99-625 by Senator Cranston:

> The translocation that the Fish and Wildlife Service has proposed is an important step in this direction [the designation of additional sites within the species historic range for restoration and protection of sea otters and the designation of areas where otters would not be allowed]. In addition to establishing zones where sea otters would and would not be maintained, the proposed action calls for important research to be conducted on the relationship between sea otters and the nearshore ecosystems. This information is likely to be crucial to eventual determinations under the Marine Mammal Protection Act of the optimum sustainable population level for the California sea otter. *This determination should, in turn, make it possible for the Service, in cooperation with other interested parties, to chart a course for sea otter protection and management that will satisfy the goals of the Endangered Species Act and the Marine Mammal Protection Act while reducing the potential for conflict between sea otter protection actions and other resource uses.*

132 Cong. Rec. S 17323 (Oct. 18, 1986) (emphasis added).

Thus, it is clear that successful implementation of the translocation zone and enforcement of the management zone goes hand-in-hand. One cannot exist without the other. In the absence of a thriving and successful population in San Nicolas Island, there is no reason or justification for capture and removal of animals from the management zone. Indeed, to proceed with containment of sea otters from the zone when the population at San Nicolas Island is anything short of fully successful flies in the face of the very purpose and objective of Public Law 99-625.

Any question about the need for balance between a successful translocation and the implementation of the management zone is further dispelled by reference to statements made in the administrative record developed by FWS regarding the translocation. For example, the EIS states: "As required by P.L. 99-625, maintenance of the management zone would continue indefinitely, even after the sea otter is delisted, unless the translocation fails." 1987 EIS at B-20 (emphasis added).

As this history demonstrates, the essential "quid pro quo" envisioned by Congress in 1986 and FWS in developing its regulations has failed to materialize. The translocation to San Nicolas Island has been a dismal failure. By now, the San Nicolas population should number 150 or more animals. As stated in the 1987 EIS:

> It is conceivable that, under ideal conditions, nearly all of the 15 adult females and some of the 40 females translocated as immatures could be reproducing within the first 2-3 years of the initial growth and reestablishment stage; however, the new population could not be deemed established until a minimum estimated population size of 150 animals had been achieved, in combination with attainment of an annual recruitment for 3 of the preceding 5 years of no less than 20 animals. Conceivably, this could occur five years after the translocation was initiated. If reproduction and population growth did not occur at this rate, the period of initial growth and reestablishment would simply continue until the criteria were met, or until it was determined that the experimental population had failed.

1987 EIS at B-26. As stated further in the EIS: "Occupation of all the habitat could be expected within five years after translocation begins, and a viable breeding colony could be established as early as five years after the initial group of otters is moved to the new site." 1987 EIS, Executive Summary at 4.

The San Nicolas Island population has clearly failed to meet this test. Not only is the population well below carrying capacity, it meets the failure criteria of the experimental population regulations. For example, under section 17.84(d)(8)(ii), if within three years from the initial transplant, fewer than 25 otters remained in the translocation zone and the reasons for emigration or mortality could not be identified or remedied, the translocation is deemed a failure. That criterion has been met. As of 1990, (three years after the initial transplant) there were only 15 otters at San Nicolas Island. The same test was met for the next ten years, confirming many times over that the population has been a failure. Reasons for this failure remain unclear and are not being remedied.

The need for range expansion to achieve recovery remains as strong as ever. Unfortunately, the San Nicolas Island population is not advancing the purposes originally envisioned when Public Law 99-625 was enacted or the zonal management concept was developed. As a result, it is at odds with the concept underlying Public Law 99-625 to expect that sea otters would be captured and removed from the management zone considering the absence of a successful population at San Nicolas Island. To proceed with any type of containment under these circumstances would fly in the face of the clear intent of Congress and the long-standing principles that served as the basis for the zonal management proposal.

<u>The Point Conception Boundary Is Invalid</u>. In addition to this fundamental principle – that there should be no attempt to proceed with zonal management of sea otters in the absence of a successful translocated population – Congress also set forth specific requirements that would govern the establishment and implementation of the management zone. One of these requirements is the mandate that the management zone be established so as to "not include the existing range of the parent population <u>or adjacent range where expansion is necessary for the recovery of the species</u>." Pub. L. No. 99-625, § 1(b)(4)(B), 100 Stat. 3500 (1986) (emphasis added). As explained in the legislative history, in creating the zone to provide sufficient room for range expansion, FWS "must accommodate, among other important biological needs, the feeding behavior of the sea otter." 132 Cong. Rec. S 17322 (statement of Senator Cranston). Thus, foraging as well as all other biological needs of the sea otter must be taken into account in establishing this zone.

The management zone now clearly violates that requirement. It has become increasingly clear in recent years that removing sea otters that migrate south of Point

Conception is fundamentally inconsistent with the recovery of the species. This point is made clear in the current draft revised recovery plan for the southern sea otter. There are four fundamental reasons why the southern sea otter management zone is not a viable option. 2000 Draft Recovery Plan, at 23-24.

• The Southern Sea Otter Recovery Team believes that any future translocations, which are similar to the concept of forcible removals and relocations of remaining sea otters in the management zone, "are not a useful means of recovering the southern sea otter population, in large measure because of their high cost and low probability of success". The Team goes on to say, " [h]owever, whereas recovery of a growing population without the use of translocations was anticipated until about the mid-1990's, the presently declining population calls for a fundamentally different strategy for recovery."

• Based on what the experts learned about the trajectory of the Exxon Valdez oil spill, the "safeguarded" population at San Nicolas Island would not be protected from a single catastrophic event. The southern sea otter population would need a range which greatly exceeds the present distribution.

• The translocation has not been successful. Out of the 140 sea otters moved to the Island between 1987-1990, only small numbers have been observed since 1990, and there has been no recruitment.

• Large groups of sea otters have seasonally migrated into the management zone in 1998 and 1999. FWS has stated that they do "not have the capability to capture and translocate this number of sea otters annually."

Thus, the expert group of sea otter biologists assembled by FWS to determine what actions are necessary for recovery of the species has determined that the Point Conception management zone boundary is a serious impediment to recovery and is, therefore, in violation of Public Law 99-625.

In addition to the expert analysis contained in the draft revised recovery plan, leading experts in the field recently issued a report that implementation of the management zone will interfere with species recovery. This report explores the potential population level impacts of translocating sea otters from the management zone. Numerous population dynamic simulations were run to calculate the effect on the population of such capture and removal operations. Virtually all simulations resulted in a decreased population size, and hence negative impacts on recovery, as a result of capture/removal. See Exhibit 1.

Finally, other documents prepared by FWS relative to this species indicate the serious problems that enforcement of the Point Conception zonal management boundary will have for recovery of the species. For example, the biological opinion recently issued by FWS confirms this problem. As the Service concluded: "the translocation program has not been as successful as was desired and . . . cessation of the containment program is considered the primary action for promoting the recovery of the southern sea otter." Biological Opinion, at 29. The Service also states that, "our analysis indicates that the capture of large numbers of southern sea otters in the management zone and their release into the parent range would likely have substantial adverse effects on the ability of this subspecies to survive and recover. We are unable to define the exact number of southern sea otters that could be moved from the management zone into the parent range before such substantial adverse effects are likely to occur. Id. at 36.

In addition, in the 1999 draft report on the "Evaluation of the Southern Sea Otter Translocation Program" FWS made the following observation regarding the Point Conception zone: Given that the southern sea otter population has declined in four out of the last five years, "members of the Recovery Team cautioned that the capture and relocation of a large number of sea otters could result in the deaths of animals, disrupt the existing social structure of resident groups, increase competition for resources, and very possibly exacerbate the observed population decline." Draft Evaluation, at 19.

This information and expert analysis makes a compelling case as to why the containment provisions of the translocation regulations can no longer be enforced. There is no credible evidence in the record, or argument that has been advanced, that the Point Conception boundary can be enforced to capture and remove sea otters without interfering with species recovery. As a result, FWS should take immediate action to rescind or suspend the requirements of the translocation regulations that would call for animals to be captured and removed from this no longer properly designated zone.

Containment Violates Public Law 99-625 Because It Is Not Feasible and Will Result In Lethal Take. It is equally clear that capture and removal of sea otters cannot be undertaken by either feasible or non-lethal means. The death of many sea otters is certain to occur as a result of capture and removal. The FWS' biological opinion notes that "the stress of being captured, held in captivity, and (for some individuals) undergoing surgery to implant tracking devices resulted in a mortality rate that was higher than anticipated, even though a mortality rate of three to five percent (Benz, pers. comm. in Service 1987b) had been expected to result from handling of southern sea otters during translocation." Biological Opinion, at 13.

The biological opinion also states that, "[b]y the time of the 1993 draft evaluation, seven southern sea otters had died at Monterey Bay Aquarium while waiting to be translocated to San Nicolas Island or after surgery to implant radios, three died at San Nicolas Island while waiting to be released, one died after being captured in the parent range for translocation and released at the point of capture, and four died within two weeks of being released after being captured during containment activities". Id. at 13. This level of mortality is far higher than what was anticipated when the program was developed. For example, the 1987 biological opinion estimated a mortality rate of no more than 3-5% from the actual translocation (two to four otters lost). See 1986 Biological Opinion, at 14. The current estimate of expected mortality, 17%, is orders of magnitude higher. Under no reasonable interpretation can mortality of 17% be considered "nonlethal."

In addition, given the current circumstances, containment is not "feasible." The FWS' biological opinion contains a section entitled "Previous Reviews of the Translocation Program." In this section, FWS confirms that continuing the enforcement of the management zone is not a feasible option. In 1992, FWS drafted a document for a meeting with the California Department of Fish and Game. The biological opinion describes this document as follows: "As stated in the draft document, in 1992, the major issues the Service viewed as affecting the recovery of the southern sea otter were the existence of the management zone and the feasibility of non-lethal containment techniques." Biological Opinion, at 11 (emphasis added).

In 1995, the Service again raised concerns about the viability of maintaining the management zone for southern sea otters using non-lethal techniques. In a status report for the translocation program, the Service stated that "containment activities were labor intensive and that, over the long-term, existing techniques were inadequate to maintain a management zone free of southern sea otters." Id. at 15.

In addition, the following points on the feasibility of containment were made in the technical consultant meeting convened by FWS on September 26, under the heading, "Difficulties Encountered with Sea Otter Containment":

• Capture operations were labor intensive and frequently unsuccessful.

• Coordination of transport and release of otters was often very challenging.

• Some otters were found dead shortly after they were released in the parent range.

• Some otters returned to the management zone after being moved hundreds of miles away.

In addition, FWS' 1999 report on the translocation program made the following observations:

• Detection and confirmation of sea otters in the management zone is difficult and, upon confirmation and attempts to organize a capture, the animal had left the zone.

• The inherent difficulty with non-lethal containment was evident from attempts to capture sea otters in the vicinity of San Miguel Island. Efforts to capture otters near the island proved to be very difficult due in large measure to the unfavorable environmental conditions experienced and inaccessibility of target animals.

Taken together, this evidence clearly demonstrates containment is infeasible and will result in lethal take. Such action violates Public Law 99-625 and should not be allowed.

Section 17.84(d)(6) Violates Section 7(a)(2) of the ESA. FWS' recent biological opinion confirms that capture and removal of sea otters from the management zone will cause jeopardy to the species. As concluded in the opinion: "After reviewing the current status of the southern sea otter, the environmental baseline for the action area, the effects of the continuation of the containment program, and the cumulative effects, it is the Service's biological opinion that continuing the containment program and restricting the southern sea otter to the area north of Point Conception (which marks the current legal boundary between the parent range and the management zone, with the exception of the translocation zone at San Nicolas Island) is likely to jeopardize its continued existence." Biological Opinion, at 37.

The Service determined that reversal of the southern sea otter's population decline is essential to its survival and recovery. Continuation of the containment program will result in the capture, transport, and release of large numbers of southern sea otters from the management zone into the parent population. These actions may result in the direct deaths of individuals and disrupt social behavior in the parent population to the degree that those affected individuals will have reduced potential for survival and reproduction. As the Service determined, "[t]hese effects will exacerbate the recent decline of the southern sea otter population." Id. at 37.

This conclusion necessarily means that section 17.84(d)(6) itself, and the translocation plan it implements, violate the ESA. When FWS promulgated this regulation, it did so on the basis of a biological opinion which concluded that containment would not cause jeopardy. Now, due to changed circumstances and improved information, it is clear that there is no way to implement section 17.84(d)(6) and the underlying translocation plan without causing jeopardy. Thus, the capture and removal provisions of the FWS translocation regulations are per se unlawful and a violation of the ESA.

Section 17.84(d)(6) Violates the Secretary's Affirmative Duties Under Section 7(a)(1) of the ESA. As described above, there is overwhelming evidence that containment of sea otters under section 17.84(d)(6) and the current translocation plan will be contrary to the best interests of this species. Section 7(a)(1) of the ESA imposes an affirmative duty of the Secretary to "utilize such programs [under his jurisdiction] in furtherance of the purposes of this chapter." 16 U.S.C. § 1536(a)(1). The purposes of the ESA include providing "a program for the conservation" of listed species. Id. at § 1531(d). The term "conservation" is, in turn, defined to mean "the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this chapter are no longer necessary." Id. § 1532(3).

The courts have construed this authority to impose upon the Secretary of the Interior a strong mandate. *See Carson-Truckee Water Conservancy Dist. v. Clark*, 741 F.2d 257, 262 (9th Cir. 1984)(duty to conserve requires federal agencies to affirmatively and "actively pursue a species conservation policy" and to dedicate "all means at their disposal" in doing so). This means that the Secretary cannot carry out programs adverse to sea otter recovery and conservation. There is no question that, under FWS' own analyses as well as the overwhelming weight of expert opinion, that enforcement of the management zone will be adverse to the best interest of this species.

FWS has now initiated a procedure to review the status of the San Nicolas Island translocation. This review is likely to lead to a determination that the translocation has failed. The issues set forth previously in this letter will be taken into account as part of that decisionmaking process. The very reason FWS has initiated this proceeding is because the translocation has not gone as expected, with numerous problems for the species presented by the failure of the population at San Nicolas Island and the threat for containment being enforced through litigation by certain shellfish organizations. In light of this ongoing review, it is clearly inappropriate for FWS to leave in effect a regulatory requirement that could be construed, and has been argued by certain shellfish groups to mean, that sea otters must be captured and removed from the management zone.

On the basis of the factors described above, FWS should take immediate and prompt action to amend the provisions of section 17.84 so as to revoke or suspend implementation of the containment requirement until the decisionmaking process on failure of the translocation has been completed. There is clear authority for such action in Public Law 99-625. As stated in section 1(b), "the Secretary may develop and implement . . . a plan for the relocation and management of the population of California sea otters . . ." (Emphasis added). There is no requirement that every aspect of the plan be implemented at every point in time. Clearly, FWS has been provided with the discretion to develop a plan that could, in circumstances such as those presented here, call for a suspension or revocation of the containment requirement during a period when the program itself is under review and when so many factors indicate that it would be in violation of law, as well as at odds with the principles underlying the experimental population program, for sea otters to be captured and removed from the management zone.

NEPA Review. By letter of January 21, 2000, Friends of the Sea Otter advised FWS of its legal duty to undertake additional NEPA compliance on the translocation plan and regulations. A copy of that letter is attached to this petition as Exhibit 2. As explained in the letter, FWS cannot proceed with any capture and removal actions until this NEPA obligation has been fulfilled. FWS has now reinitiated its NEPA review, apparently conceding the points raised in the January 21 letter. As a result, FWS must also take the necessary steps to withdraw from application the regulatory provisions that address the capture and removal requirement. Failure to do so causes the translocation regulations to be in violation of NEPA.

## Notice of Intent

By letters of August 4, 1998 and September 14, 1999, FSO served notice on FWS that any action to enforce the management zone would be in violation of the ESA and result in litigation. Exhibits 3, 4. Those letters, and the grounds for legal challenge set forth therein, are incorporated by reference herein. In addition, as described above, various provisions of section 17.84 of the translocation regulations and the translocation plan are themselves per se violations of the ESA. Unless FWS takes immediate action to suspend, rescind, or amend those provisions, we intend to file a lawsuit challenging those regulations.

For these reasons, the organizations signing onto this petition request FWS to undertake appropriate regulatory measures to revoke, suspend, or amend the containment requirements of the translocation regulations to ensure that no sea otters are captured and removed from the management zone until the translocation decisionmaking has been concluded. Failure to take this step now will cause the above-referenced organizations to sue FWS under the ESA and other applicable law. On behalf of all of the organizations submitting this letter, thank you for considering this request.

Sincerely,

Cindy Lowry

Cindy Lowry
Executive Director
Friends of the Sea Otter

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# Development of a spatially explicit population model to assess potential population impacts associated with translocation of sea otters from south of Pt. Conception

## *Final Report for Friends of the Sea Otter*

October 2000

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## Executive Summary

We developed a simulation model with which to explore potential population level impacts of translocating southern sea otters from the "Management Zone" south of Pt. Conception, California. Available data on demographic rates were compiled; however, all data were collected prior to 1994 when the population was increasing (1986-1994 mean $\lambda$=1.05), and were thus unlikely to reflect recent negative population trends (1995-1999 mean $\lambda$=0.97). We employed Maximum Likelihood Estimation (MLE) techniques to adjust baseline vital rates to better fit the age-at-death distribution from the 1990's, as measured by tooth-age estimates from collected carcasses. We used the modified rates to parameterize an age-structured, deterministic matrix model, which we incorporated into a spatial population framework simulating growth within and movement between sub-populations, as well as population expansion into currently unoccupied habitat (i.e. south of Pt. Conception). A suite of simulations was run projecting population dynamics 20 years into the future, both with and without capture/translocation from the Management Zone; for each run, model parameters were randomly selected from a broad range of values above and below MLE best-fit values. Virtually all model scenarios (98.2 % of 20,000 simulations) resulted in decreased population size associated with translocation, and approximately half resulted in a decrease of 5 % or more from the final population size without translocation. The principle impact of translocation in most scenarios was indirect, resulting from curtailment of population growth at the edge of the range or from negative effects to animals in the recipient population, rather than direct effects to the translocated animals themselves, and would likely prove difficult to measure.

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Figure 10. Results from first suite of 5000 simulations, showing frequency distribution of percent differences in population size (after 20 years) between simulations with vs. without translocation. In this scenario, capture intensity was low and growth was depressed ($\lambda$=0.99) in the center of the range (sub-population M). Values to the left of 0 indicate an increase in final population size with

translocation, while values to the right indicate a reduction due to translocation. A solid red vertical line indicates the median value, while a brown dashed line indicates the 75th percentile. .................. 37

Figure 11. Results from second suite of 5000 simulations, showing frequency distribution of percent differences in population size (after 20 years) between simulations with vs. without translocation. In this scenario, capture intensity was high and growth was depressed ($\lambda$=0.99) in the center of the range (sub-population M). Values to the left of 0 indicate an increase in final population size with translocation, while values to the right indicate a reduction due to translocation. A solid red vertical line indicates the median value, while a brown dashed line indicates the 75th percentile. .................. 37

Figure 12. Results from third suite of 5000 simulations, showing frequency distribution of percent differences in population size (after 20 years) between simulations with vs. without translocation. In this scenario, capture intensity was low and growth rate was constant ($\lambda$=1.03) throughout the range. Values to the left of 0 indicate an increase in final population size with translocation, while values to the right of 0 indicate a reduction due to translocation. A solid red vertical line indicates the median value, while a brown dashed line indicates the 75th percentile. ........................................................ 38

Figure 13. Results from fourth suite of 5000 simulations, showing frequency distribution of percent differences in population size (after 20 years) between simulations with vs. without translocation. In this scenario, capture intensity was high and growth rate was constant ($\lambda$=1.03) throughout the range. Values to the left of 0 indicate an increase in final population size with translocation, while values to the right of 0 indicate a reduction due to translocation. A solid red vertical line indicates the median value, while a brown dashed line indicates the 75th percentile. ........................................................ 38

Figure 14. Results of a sensitivity analysis of the simulation model parameters: sensitivity is represented as the proportion of variance in a model response variable attributable to each model parameter, measured by the coefficient of partial determination. A) Response variable is final population size after a 20-year simulation run, assuming no translocation ($N_{t=20}$). B) Response variable is decrease in final population size (due to translocation) after a 20-year simulation run ($\Delta N_{t=20}$). The relative sensitivity is shown for the movement parameters (*M, k, md, cd, rd, fmr*) and for the parameters determining direct effects of translocation on animals: *pk, ps* and *effect* (*e*). ....................................... 39

Figure 15. Sample model results from a single simulation run of 20 years. Top: entire population, with and without translocation. Middle: 4 sub-populations without translocation. Bottom: 4 sub-populations with translocation. These results were obtained under scenario 2, in which capture intensity was high and growth was depressed ($\lambda$=0.99) in the center of the range (sub-population M). Model parameters were set to the best fit or "most likely values", as listed in Table 4. .................................................... 40

# Introduction

### *Background*

In 1987, the US Fish and Wildlife Service (FWS) initiated a program to reestablish sea otters at San Nicolas Island in the southern California Bight. Because of concerns by shellfishery interests over conflicts with sea otters in southern California, legal authority to reestablish sea otters at San Nicolas Island also required establishment of a policy dictating than any sea otters located elsewhere between Pt. Conception and the Mexican border (the "Management Zone") must be captured and removed by FWS. Beginning in 1998, more than 100 sea otters dispersed southward from central California to the area between Pt. Conception and Santa Barbara, prompting shellfishery interests to demand their removal. FWS has been reluctant to do this because of 1) high costs and other difficulties associated with the removal of so many animals; 2) concerns over incidental mortality associated with the capture and relocation of these animals; and 3) concerns over possible negative impacts of these activities on the already-declining and legally Threatened population. However, to-date there has been no rigorous evaluation of the nature or magnitude of these potential impacts. Friends of the Sea Otter (FSO) has requested the development of a technical report containing an explicit and quantitative evaluation of the population-level risks associated with translocation of sea otters from the "management zone" south of Point Conception.

There are two general reasons for concern over the proposed capture and translocation activities. The first reason for concern is simply the likelihood of the translocation actually achieving it's stated goals. Previous attempts at capture and translocation of animals within the California population have met with limited success, and it is possible that the proposed capture and translocation from south of Pt. Conception will suffer from the same negative effects as past such efforts, namely a) unavoidable risk of mortality during the capture and transportation to a new area, b) low survival rates of translocated animals after their release to a new area, and c) the tendency of translocated sea otters to return (or attempt to return) to the area from which they were initially captured, even when this involves travelling hundreds of kilometers.

The second reason for concern is the Threatened status of the California sea otter, and uncertainly over a) current trends in sea otter numbers and spatial/temporal patterns in these trends, b) the underlying demographic dynamics leading to the recent population decline (1995-99) and to fluctuations in the rate of recovery in general, and c) how translocation of animals from the southern portion of the range will impact factors a and b. Annual range-wide census data collected over the past 20 years suggest that range expansion to the south has been important to overall population growth: in fact, during the past 7-8 years sea otter numbers in the southern periphery of the range have increased while numbers in the center and northern half of the range have remained constant or decreased (USGS unpublished data; Figure 1). Given this observation, it is very possible that curtailing population expansion to the south of Pt. Conception will affect future population dynamics, and thus the rate of recovery of the sea otter population as a whole. The current study attempts to explore and quantify potential population-level effects using a simulation model approach, incorporating what data there are on population dynamics and demographics.

***Objectives and General Approach***

The principal objectives defined by FSO were 1) to discuss the risks associated with containment and translocation of sea otters, including likely mortality levels; and 2) to evaluate the potential population-level impacts of translocation. The first objective was achieved through a review of all previous efforts to contain and relocate sea otters, placing emphasis on those involving southern sea otters. Based on these data we estimated the likely range of mortality rates of translocated sea otters, both during capture/transportation and after release. The second objective was achieved through the development of a spatially-explicit population model for the California sea otter at the south end of it's range, and by use of this model in a suite of simulations designed to evaluate projected sea otter population dynamics with and without translocation activities.

# Part 1: Summary of Past Translocation and Re-release Activities

### *Summary of sea otter translocations outside of California*

Translocation of sea otters was first attempted in the early 1950s in the Aleutian Islands, Alaska, with experimental attempts at sea otter capture, captivity and transport from Amchitka Island to the Pribilof Islands and Attu Island. The first attempts were entirely unsuccessful, with 100% mortality of 35 otters transported by ship in 1951 and 31 otters in 1955 (Kenyon 1969). Later attempts had more success, with lower mortality levels during transport: 3 out of 10 animals died in a 1959 translocation from Amchitka to the Pribilofs, and 12 out of 35 in a 1965 translocation from Prince William Sound to SE Alaska. However, the survival of the animals after release was largely unknown, due to lack of suitable techniques for monitoring and tracking sea otters at that time; it seems likely that few of these animals survived more than one or two years, based on tag re-sightings (Kenyon 1969).

Between 1965 and 1972, a total of 708 sea otters captured in Alaska were translocated to other locations in Alaska (467), British Columbia (89), Washington (59), and Oregon (93). Jameson et al. (1982) provide a review of these translocations and their relative degree of success. In general, the mortality of the otters during capture and transport was much lower than earlier attempts, while the survival of the animals after release varied dramatically from location to location: for example, at the Pribiloff Islands all animals died within a few years, while at SE Alaska the population grew rapidly. In Washington, at least 16 out of 29 otters died within 2 weeks of release in 1969 (Jameson et al. 1982, Jameson et al. 1986). In general, translocation of sea otters throughout this time period entailed mortality levels during capture and transport of 10 to 100% (with a trend towards decreasing mortality as methods improved) and highly variable levels of survival after release.

After the *Exxon Valdex* Oil Spill (EVOS) in 1989, many sea otters were treated for oil contamination, rehabilitated in captivity and subsequently released. Monnet et al. (1990) report on the post-release survival of radio-instrumented otters. Survival was generally very low (only 65% survived first 8 months): this was attributed to 1) stress during capture, 2) stress during captivity, 3) disease contracted during captivity, 4) separation of mother-pup pairs, and 5) disruption of normal learning processes of young animals. Bodkin and Weltz (1990) reviewed the captures during EVOS, summarized problems and recommended a number of alternatives to post-contamination capture, including pre-emptive translocation. Based on available evidence and the history of past translocations, they predicted a 10% mortality level for pre-emptive translocation.

***Summary of sea otter translocations in California***

A number of attempts at sea otter translocation have been made in California. Wild and Ames (1974) describe a translocation experiment of male otters in 1969 from Cambria to Big Creek. Out of 29 captured, 5 were released on site and 4 died during capture: the remaining 17 were transported to Big Creek. This translocation was considered unsuccessful at achieving its intended goal, as most of the animals returned to the original sight. There were 2 known mortalities post release, and 3 mortalities during the captures (Wild and Ames 1974). In 1979, another translocation experiment was attempted. First, 8 animals were captured of which 5 underwent a simulated translocation; one of these died 6 days after release, and another died 10 months after release. Secondly, 24 males were captured of which 10 were transferred to a holding pen for 4-5 days: of these, one died immediately post-release.

Using radio-tagged otters, another experiment was conducted in 1986 to evaluate the degree to which translocated otters would return to their point of capture (K. Ralls and D. Siniff, pers. comm.). Four otters were captured in the vicinity of Morro Bay and implanted with radio transmitters: one was then released at Point Sur and three at Big Creek. One otter died immediately after release and another died 10 days later, upon which the experiment was discontinued. The two otters that did not die quickly returned to their capture location; the otter that died after ten days was apparently attempting to return, and had already made it as far south as Pico Creek.

The most well documented translocation of sea otters in California began in August of 1987 when sea otters were translocated to San Nicolas Island from the mainland (US-FWS 1988). A total of 124 otters were captured for translocation during the first year, of which 4 died in captivity and 51 were released: thus mortality during initial capture and transport was 5%. By the end of the first year after the program started, only 14 of the 69 animals translocated still remained at the Island: 10 others had died, 14 had returned to the mainland (1 of which was recaptured in the management zone and 13 had returned to the central coast), and 31 were unaccounted for (Rathbun et al. 1990). Results were similar in subsequent years (1988-90): mortality rate of animals during capture and transport was about 5%, 22% returned quickly to the mainland, the confirmed mortality rate after release was 6%, and approximately 58% of the animals were missing as of 1990 (US-FWS 1990) – these animals had either died or returned to the mainland unobserved. Only 11% of the translocated animals remained at the Island.

To summarize, past translocation of sea otters has yielded both variable and unpredictable results. Although there has been a clear trend towards lower mortality levels during the capture and transport of animals, it is still not unusual to expect 10% mortality at this stage. After release at the new site, the fate of translocated animals is very difficult to monitor, and past estimates of post-release mortality range anywhere from 5 -100%. In California it seems that 50% mortality during the first year post-release is not unusual, and it is also to be expected that a significant number of translocated animals (20-50%) will return (or attempt to return) to their original range.

# Part 2: Modification of Existing 2-Sex Matrix Model

### *Introduction and Explanation*

In the mid 1980's an intensive study of sea otter population biology in California was undertaken: this study utilized radio-telemetric methods to monitor survival, reproduction, movements and behavior of marked and radio-tagged individuals, and provided detailed data on sea otter demographics (Siniff and Ralls 1988). A. Brody fitted these data to a "proportional hazards model" (PHM, following Eberhardt and Siniff 1988) to obtain smoothed age-specific survival ($s_x$) and fecundity ($m_x$) values, and used these values to parameterize a matrix. The resulting 2-sex, age-structured, deterministic matrix model represents the best available model for the California sea otter population in the 1980's, and was used as a baseline population matrix for the current study.

During the approximately 14 years since the Siniff and Ralls study there have been significant changes in the population growth rate ($\lambda$): from 1983 through the early 1990's the mean population growth rate was positive, about 5% per year ($\lambda$=1.05), while from 1995-1999 the mean population growth rate was negative, about -3% per year ($\lambda$=0.97; USGS-BRD, unpublished data). Unfortunately, there are very limited data available on survival/reproductive rates of sea otters for this latter period, making it difficult to discern the underlying demographic changes responsible for the observed fluctuations in population growth rate. Two sources of data that are available include bi-annual range-wide surveys of distribution and abundance, and age-at-death data obtained from beach-cast carcasses (age estimates from carcasses are obtained by cementum analysis of tooth sections). Monson et al. (2000) provide a method for adjusting age-specific survival ($s_x$) values, employing a maximum likelihood approach to fit a modifying function using observed age-at-death distributions. We utilized a similar approach to "update" or adjust the baseline matrix model to fit the observed age-at-death data. Additionally, we use a modified version of this approach that also incorporates the available survey data.

## *Methods*

### *Baseline Matrix*

First, we used PHM-type functions to initialise baseline vital rates (for a detailed description of the derivation and biological interpretation of these functions, see Eberhardt and Siniff 1988). For each age-class, $x$, we calculated female and male survivorship ($l_x$) values using equations 1 and 2:

$$\text{females: } l_{xf} = \exp[-a_{1f} \times (1-\exp(-b_{1f}(x))] - [a_{2f}(x)] - a_{3f} \times [\exp(b_{3f}(x)) - 1)] \quad 1$$

$$\text{males : } l_{xm} = \exp[-a_{1m} \times (1-\exp(-b_{1m}(x))] - [a_{2m}(x)] - a_{3m} \times [\exp(b_{3m}(x)) - 1)] \quad 2$$

where parameter $a_1$ specifies the magnitude of early mortality risks, $b_1$ determines the rate of approach to maturity, $a_2$ specifies the magnitude of adult mortality risks, $a_3$ specifies the magnitude of late mortality risks, and $b_3$ determines the rate of approach to senescence. For the purpose of this model, age-specific female fecundity rates ($m_x$) were defined as the probability of a female giving birth to *and successfully weaning* a female pup. The decision to include pup survival within the $m_x$ term, rather than within the survivorship functions, was made for practical rather than biological considerations: because the purpose of this exercise was to up-date survival rates to better fit current data, and because there were no current data with which to update pup survival rates, it was necessary to effectively separate pup survival from juvenile survival. Age-specific $m_x$ values were calculated for each age-class, $x$, using equation 3:

$$m_x = \alpha \times \beta \times \theta \times [1-\exp(-b_4(x) - C)] \times \exp[-a_5\{\exp(b_5(i))\} - 1)] \quad 3$$

where $\alpha$ represents the maximum reproductive rate (pups born per female per year), $\beta$ represents the maximum weaning success rate (probability of a pup surviving from birth to weaning), $\theta$ is the ratio of female to male pups, $C$ is the age of first reproduction – 1, $b_4$ determines the rate of approach to prime reproductive age, $a_5$ specifies the magnitude of reproductive senescence, and $b_5$ determines the rate of approach to reproductive senescence.

The parameter values for male and female survival functions were set to equal those provided by Sinnif and Ralls (1988), which represent best-fit values for the raw survival data collected during their 1984-87 field study. Parameter values for the fecundity function were modified from those used by Siniff and Ralls (1988) in order to better-fit data on reproductive rates and pup survival collected more recently. Annual female reproductive rates reported for southern sea otters vary between 0.89 (Eberhardt and Schneider 1994) and 1.07 (Riedman et al. 1994), with intermediate values of 0.92–0.94 (Siniff and Ralls 1988, Jameson & Johnson 1993). Published pup survival rates range from 0.58 (Siniff and Ralls 1988) to 0.65 (Riedman et al. 1994) and weaning success appears to be age-dependent: Riedman et al. (1994) found that pups of young females had a survival rate as low as 0.40, increasing to 0.75 for mid-aged females and to 1.0 for older (10-14 yr old) females. We adjusted the fecundity function parameters to obtain an $m_x$ curve consistent with these reported rates. The resulting baseline values for all PHM parameters are presented in Table 1, along with a summary of the biological interpretation of each parameter.

**Table 1** Summary of parameters used in "Proportional Hazards Model" (see text, equations 1-3) to generate baseline values for male and female age-specific survival and fecundity.

| PHM Parameter | Biological Interpretation of Parameter | Baseline value |
|---|---|---|
| o $a_{1f}$ | –log of juvenile female survival rate from early hazards | –log(.80) |
| o $b_{1f}$ | "shape parameter", determining rate of approach to maturity for females | 1.0 |
| o $a_{2f}$ | –log of adult female survival rate from adult hazards | –log(0.93) |
| o $a_{3f}$ | –log of female survival from additional senescence-related hazards | –log(0.998) |
| o $b_{3f}$ | "shape parameter", determining rate of approach to senescence for females | 0.41 |
| o $a_{1m}$ | –log of juvenile male survival rate from early hazards | –log(1.0) |
| o $b_{1m}$ | "shape parameter", determining rate of approach to maturity for males | 1.0 |
| o $a_{2m}$ | –log of adult male survival rate from adult hazards | –log(0.87) |
| o $a_{3m}$ | –log of male survival from additional senescence-related hazards | –log(0.93) |
| o $b_{3m}$ | "shape parameter", determining rate of approach to senescence for males | 0.286 |
| o $\alpha$ | maximum number of pups per female per year at age of prime reproduction | 1.0 |
| o $\beta$ | maximum pup survival rate (wean success rate) at age of prime reproduction | 1.0 |
| o $\theta$ | sex ratio at birth (ratio of female to male pups) | 0.5 |
| o C | age of first reproduction – 1 | 2 |
| o $b_4$ | "shape parameter", determining rate of approach to age of prime reproduction | 0.275 |
| o $a_5$ | –log of reproductive senescence effect | 0.996 |
| o $b_5$ | "shape parameter", determining rate of approach to reproductive senescence | 0.15 |

Values for $l_x$ and $m_x$ were calculated using the PHM functions and used to calculate matrix elements for the baseline 2-sex matrix model. For each age class, *x*, from 0 to 20 years, we calculated:

$$s_{xf} = l_{(x+1)f} / l_{xf} \quad (4)$$

$$s_{xm} = l_{(x+1)m} / l_{xm} \quad (5)$$

$$f_x = s_{xf} \times m_x \quad (6)$$

The $s_x$ and $f_x$ values were used to parameterize a 44 row × 44 column matrix (Table 2). Baseline values for population growth rate (λ), stable age distribution (ω), age-specific female reproductive values ($v_x$) and matrix elasticities ($\varepsilon_x$) were calculated following Caswell (1989).

**Table 2**. Layout of the 2-sex matrix used to model southern sea otter demographics.

| | | FEMALE | | | | | MALE | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | … 21 | 22 | 23 | 24 | 25 | … 43 | 44 |
| F | 1 | $f_{x(0)}$ | $f_{x(1)}$ | $f_{x(2)}$ | … $f_{x(20)}$ | 0 | 0 | 0 | 0 | … 0 | 0 |
| E | 2 | $s_{xf(0)}$ | 0 | 0 | … 0 | 0 | 0 | 0 | 0 | … 0 | 0 |
| M | 3 | 0 | $s_{xf(1)}$ | 0 | … 0 | 0 | 0 | 0 | 0 | … 0 | 0 |
| A | 4 | 0 | 0 | $s_{xf(2)}$ | … 0 | 0 | 0 | 0 | 0 | … 0 | 0 |
| L | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ |
| E | 22 | 0 | 0 | 0 | … $s_{xf(20)}$ | 0 | 0 | 0 | 0 | … 0 | 0 |
| | 23 | $f_{x(0)}$ | $f_{x(1)}$ | $f_{x(2)}$ | … $f_{x(20)}$ | 0 | 0 | 0 | 0 | … 0 | 0 |
| M | 24 | 0 | 0 | 0 | … 0 | 0 | $s_{xm(0)}$ | 0 | 0 | … 0 | 0 |
| A | 25 | 0 | 0 | 0 | … 0 | 0 | 0 | $s_{xm(1)}$ | 0 | … 0 | 0 |
| L | 26 | 0 | 0 | 0 | … 0 | 0 | 0 | 0 | $s_{xm(2)}$ | … 0 | 0 |
| E | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ |
| | 44 | 0 | 0 | 0 | … 0 | 0 | 0 | 0 | 0 | … $s_{xm(20)}$ | 0 |

*Raw Data Used to Update Baseline Matrix*

Sea otter carcasses have been collected throughout their range in California as part of a long-term program supported by CDFG, USGS-BRD, and others. Since 1991, teeth have been extracted from all collected beach-cast carcasses and sent to G. Matson for sectioning and cementum analysis, from which age estimates are obtained (Bodkin et al. 1997). Age-at-death distributions, as calculated from beach-cast carcasses (n=156 known-sex and known-age carcasses), were inspected for temporal trends through the 1990's. Insufficient data existed to compare distributions on a year-by-year basis, so data were grouped into two periods (1991-94 and 1995-97) and a Kolmogorov-Smirnov Goodness of Fit Test was used to test the null hypothesis that the age-at-death distribution was similar between these periods. The test was repeated with data grouped into three periods, 1991-93, 1994-95 and 1996-97, to ensure that results were not spurious.

Range-wide censuses of the California sea otter population have been made twice annually since 1982: once in the spring and once in the fall of each year. The counts are made primarily from the ground, with the exception of a few areas of poor shoreline access, which are made from a plane. Observers count numbers of independent otters (i.e. all juveniles, sub-adults and adults) and dependent pups; various other data are also recorded, including each otter's location. A database of all these census data is maintained by USGS-BRD, allowing spatial and temporal analyses of sea otter population trends over the past 18 years.

*Modifying the Baseline Matrix*

We modified the baseline matrix using a logit-type multiplier that adjusted age- and sex-specific survival ($s_x$) values to best-fit available carcass (age-at-death) and survey data for a given period. All analyses were conducted twice, first with raw data grouped into two periods (1991-94 and 1995-97) and then again with raw data divided into three periods (1991-93, 1994-95 and 1996-97) to ensure consistency of results. For each age-class, *i*, and time period, *j*, two functions were calculated:

$$f_{F(i,j)} = a + b(j) + c(i) + d(i)(j). \quad 7$$

$$f_{M(i,j)} = e + f(j) + g(i) + h(i)(j). \quad 8$$

where equation **7** is the modifying function for female survival, equation **8** is the modifying function for male survival, and letters a – h are parameters to be fitted. A series of functional forms were evaluated, in which the number of parameters ranged from 1 (a constant with no age/time effects) to 4 (constant, age effect, time effect, age-time interaction), for a combined total of 1 to 8 parameters (Table 3). The functions were used to adjust male and female survival for each age-class, *i*, and time period, *j*, using the equation:

$$\text{mod}\{s_{(i,j)}\} = s_{(i)} \times Logit_{(i,j)}, \text{ where } Logit_{(i,j)} = \exp(f_{(i,j)}) / [1 + \exp(f_{(i,j)})] \quad 9$$

Values for the function parameters were fitted using Maximum Likelihood Estimation (MLE). The likelihood (***L***) associated with a particular set of parameter values was calculated based on the predicted carcass distribution at time *j*, using the multinomial probability distribution:

$$L = \frac{N!}{dx_{1,j}!dx_{2,j}!dx_{3,j}!\ldots dx_{i,j}!} px_{1,j}^{dx_{1,j}} px_{2,j}^{dx_{2,j}} px_{3,j}^{dx_{3,j}} \ldots px_{i,j}^{dx_{i,j}} \quad 10$$

where $N$ is the total number of observed carcasses, $dx_{i,j}$ is the number of observed carcasses in age class *i* at time *j*, and $px_{i,j}$ is the predicted proportion of all carcasses in age class *i* at time *j*. ***L*** was calculated for both males and females, and for all years of data, and the combined sum of the negative log likelihoods ($\Sigma$-***LL***) was minimized using a non-linear searching routine (the computer program *MATLAB* was used for all calculations). "Akaike's Information Criterion", or *AIC* values (Akaike 1973), were calculated and used to select the best forms of the modifying functions.

A second suite of MLE analyses were run in which the parameters were fit to both the age-at-death data and the survey data simultaneously. To achieve this an additional negative log likelihood term was added to the negative log likelihood sum already described, which fit the function parameters to the survey data. For each time period, *j*, the negative log likelihood for this additional term was calculated as:

$$-\boldsymbol{LL} = \log(s_{(j)}) + \tfrac{1}{2}\log(2\pi) + (\boldsymbol{D}_{(j)}^{2})/(2\, s^{2}_{(j)}) \qquad \mathbf{11}$$

where $\boldsymbol{D}$ is the deviation between observed and expected counts of independent otters at time *j*, and $s^2$ is the variance of the deviations between observed and expected counts (following Hilborn and Mangel 1997). It was assumed that deviations were normally distributed and resulted from observation error only (and not process error).

**Table 3.** Functional forms used to modify baseline female and male survival rates. Analyses were conducted for all possible combinations of female and male functions, and with data grouped into 2 and 3 time periods, and with MLE values fitted to the carcass data and to the carcass and survey data together, for a total of 96 combinations: the results are presented in Appendix 1.

| Female Modifying Function | Male Modifying Function | Effect of Function |
|---|---|---|
| $f_F(i,j) = a$ | $f_M(i,j) = e$ | Adjusts by a constant |
| $f_F(i,j) = a + b(j)$ | $f_M(i,j) = e + f(j)$ | Adjusts varying by time |
| $f_F(i,j) = a + c(i)$ | $f_M(i,j) = e + g(i)$ | Adjusts by age-class |
| $f_F(i,j) = a + b(j) + c(i) + d(i)(j)$ | $f_M(i,j) = e + f(j) + g(i) + h(i)(j)$ | Adjusts by time & age-class |
| *Null Model* | *Null Model* | *Does not adjust baseline* |

## *Results*

### *Baseline Matrix and Raw Data*

The baseline population model resulted in age-specific $s_x$ and $m_x$ curves as shown in Figure 2, and an expected rate of population increase of approximately 5 % per year ($\lambda$=1.045), consistent with the observed rate of population increase observed throughout most of the 1980's and the early 1990's. Female survival increased from 0.8 for juveniles to 0.91 for adults between 3 and 10 years, while male survival declined from a maximum value of 0.87 for juveniles. Net fecundity (successfully weaned pups per female per year) increased from 0.39 for females aged 3-5, to 0.75 for females aged 6-9, to 0.9 for females aged 10-14, for an overall rate of 0.64. Together, these data resulted in a peak reproductive value for 5-year-old females ($v_x$=0.39; Figure 2). Age-specific elasticity values ($\varepsilon_x$), representing the proportional change in $\lambda$ given a proportional change in a demographic rate, indicate that $\lambda$ is far more sensitive to changes in survival than to changes in fecundity, and is most sensitive to changes in juvenile and early adult survival (Figure 2).

A Comparison of carcass age distributions indicated that the distribution of female age-at-death changed significantly between 1991 and 1997 (Figure 3). The difference was found to be significant with data grouped into two periods (K.S.=19.39, P=0.035) or three periods (K.S.=11.68, P=0.040). No significant temporal changes were found in male age-at-death distributions.

*Modifying the Baseline Matrix*

The MLE analysis results differed slightly depending on whether or not the survey data were included in the negative log likelihood calculation; however, results were similar irrespective of whether data were divided into two or three time periods. A complete summary of all forms of the modifying function, the best-fit parameter values and the associated AIC values is provided in Appendix 1: hereafter we will refer to specific functional forms using the "Modifying Function Identification" number (MFID) as listed in the Appendix. When only age-at-death data were included in the analysis the best functional form (AIC=116.834) was one that included a constant and an age term for females; this function resulted in a decrease in female survival at all ages but with the greatest decrease occurring in older age classes (Figure 4; MFID#1). Male survival was not modified. Using this function, the modified matrix produced an expected $\lambda=0.96$, as compared to the baseline $\lambda=1.05$.

When the survey data were included in the analysis along with the age-at-death data, two functional forms provided equally good fit (AIC=173.548). The first (MFID#49) included a constant and a time term for females, resulting in a decrease in survival for all ages but with a greater decrease in 1995-97 than 1991-94 (Figure 5). This function also included a constant for males, which resulted in an increase in survival for all male age classes. Using this function, the modified matrix produced an expected $\lambda=1.03$ for 1991-94 and $\lambda=0.99$ for 1995-97, as compared to the baseline $\lambda=1.05$. The second functional form (MFID#50) included a constant and an age term for females, and resulted in no change for males: this function was very similar to the first best-fit function described above (MFID#1; Figure 4). Another functional form with an AIC value only marginally larger (AIC=173.767) was one that included both age and time terms for females, resulting in a decrease in survival for all ages but with a greater decrease for older females and a greater decrease in 1995-97 than 1991-94 (MFID#51).

The modified matrices described above were used to model demographic processes in the population simulations described in *Part 3*.

# Part 3: Simulations of Spatially-Explicit Population Dynamics

### *Introduction and Explanation*

To investigate the effect of the proposed translocation of otters from south of Pt. Conception, we took the general approach of simulating future population dynamics both with and without translocation. This was a daunting task for a number of reasons:

1) The nature of current and future population dynamics in any part of the sea otters range is far from clear at the present. Annual census data from the past 5-10 years suggest a pattern of slow or negative growth in the center part of the range and positive growth at the southern end of the range (Figure 1), however without a better understanding of the causes of these patterns it is impossible to extrapolate them into the future with any confidence. The modified matrix model (as explained in *Part 2*) represents the best starting point for a model to predict future population dynamics.
2) The simulations had to be made spatially explicit, due to the spatial nature of the problem: that is, a proposed translocation from a specific portion of the range (which happens to be an area of current range expansion).
3) A spatially explicit model requires careful consideration of sea otter movement patterns and range expansion dynamics. The dynamics of sea otter movements and range expansion are not fully understood, although past studies in both California and Alaska (e.g. Garshelis and Garshelis 1984, Garshelis et al. 1984, Gelatt 1996, Jameson 1989, Lubina and Levin 1988, Ralls and Siniff 1990, Siniff and Ralls 1988, Siniff 1991, Wild and Ames 1974) highlight certain commonalities:
   a) juvenile and sub-adult males tend to make the longest and most frequent movements.
   b) males are the first to move into unoccupied areas, and may often move regularly between the new area and the previously occupied range.
   c) for a certain period of time after initial colonization, a newly occupied area often contains only males: the initial rate of colonization by these males may vary from quite rapid in some cases to very slow in others
   d) eventually females will begin to move in to the new area, although such immigration may be slow at first and it may take a number of years before the female:male ratio of the new area equals that of previously occupied range.
   e) juvenile and sub-adult females tend to move farther, more frequently, and occupy new areas more readily than adult females.

We developed a simulation model accounting for all the above-mentioned factors. Spatial dynamics were incorporated by modeling net movement of animals between sub-populations, and a modified matrix model (see *Part 2*) was used to initialize demographic rates and age distributions within sub-populations. To allow for the many uncertainties we ran a suite of simulations that included different assumptions about population growth and movement patterns. Rather than relying on the results of any single model simulation, we instead focus on the distribution of results from many simulations. This approach results in more general and robust predictions, and also serves to highlight those particular aspects of sea otter biology or life history that need to be better understood in order to achieve more precise forecasts of future population growth and impacts of translocation.

### *Methods*

Population dynamics were simulated in a spatially explicit way by dividing the whole population into arbitrary sub-units, and modeling the population dynamics within, and movement between, these sub-populations. The sub-populations were defined by boundaries designated along the 5 fathom line (also known as the "ATOS" or "As The Otter Swims" line): the location of these boundaries and the areas they enclose are shown in Figure 6. Area M, corresponding to the "main" population, extends 135 km along ATOS from Santa Cruz (Natural Bridges Park) in the north to Pt. Estero in the south. Area N, corresponding to the population "near the management boundary", extends from Pt. Estero south to Pt. Conception. Area O, corresponding to the population "over the management boundary", extends from Pt. Conception south to Santa Barbara, and Area P, corresponding to currently unoccupied but potential range, extends south of Santa Barbara. Area L represents the area of range expansion to the north. Areas L, N, O and P each extended approximately 125 km along the 5 fathom line, corresponding to the maximum distance regularly traveled within a year by sea otters in California (Siniff and Ralls 1988); this ensured that movement need only be modeled between adjacent areas (Figure 6). The most recent survey data (Spring 2000 census) were used to initiate the population sizes in each of the areas, and the age/sex distributions for areas L, M and N were set to equal the stable age distribution of the appropriate modified matrix model (see below). Area O was initially assumed to contain only male otters, and the initial age distribution was set to the male stable age distribution of the appropriate modified matrix model.

Movement of animals between Areas was modeled as the net movement ($N_M$) of animals of each sex ($k$). The direction and net rate of movement was dictated by the relative difference in densities in adjacent areas (in all cases density is measured as # otters per km of ATOS), with net movement always going from an area of higher density to areas of lower density, following the equation:

$$N_{M(k)} = M/2 \times [(N_{1(k)} / A_1) - (N_{2(k)} / A_2)] \qquad \textbf{12}$$

where $A_1$ is the size of Area 1, $N_{1(k)}$ is the number of animals of sex $k$ in Area 1, $A_2$ is the size of Area 2, $N_{2(k)}$ is the number of animals of sex $k$ in Area 2, and $M$ is the movement coefficient. The last parameter, *M*, scales the net rate of movement and can be thought of as the distance along ATOS in Area 1 in which population density could equalize in one year with the same distance in the adjoining Area 2 (Doak 1995). The net rate of movement for a particular sex was assumed to depend on the relative densities of animals *of that sex only*: thus if male density is equal in two adjacent areas but female density is not, there will be *no* net movement of males but there will be a net movement of females. For both female and male sea otters, the majority of long distant movements are made by juveniles and sub-adults (Siniff and Ralls 1988). To account for this, ¾ of all movement was assigned to age-classes 0-3, while the remaining ¼ was assigned to older age classes; within these two groups the age distribution of moving animals was set to equal the current age distribution of the source population.

A limited number of other assumptions and parameters were added to the model in order to simulate, as realistically as possible, the patterns of movement and range expansion observed previously in California. In the case of a newly occupied Area (e.g. Area O to the south of Pt. Conception), the population had to grow to some "required density" (*rd*) before movement into another adjacent unoccupied area (i.e. Area P) could occur. When the density of animals in a new area was below some minimum density, *md*, the net movement of males into the new area was adjusted by multiplying the "normal" net movement ($N_{M(i,k)}$) by a constant, *k*, thus allowing for a modified rate of movement into new area (either greater or lower than the "regular" rate of movement). The parameter *md* also represented the minimum density required in a new area before female movement into that area was allowed to occur. Once the density had further increased to some critical density (*cd*), female movement was allowed to occur at its "normal" rate: between *md* and *cd* the net rate of female movement into a new area was modified (scaled down) using the equation:

$$\mathrm{mod}\{N_{M(k)}\} = N_{M(k)}^{\,1-\left[\frac{cd-D_t}{cd}\right]^2} \qquad \mathbf{13}$$

where $N_{M(k)}$ is the "normal" net rate of movement and $D_t$ is the current density of the new area. This equation resulted in an initially slow but accelerating rate of movement of females into a new area. Finally, the normal rate of female movement between areas was reduced as compared to that of males by a "female reduction factor" (*fmr*), to simulate the fact that the movements of juvenile males tend to exceed the movements of juvenile females in both distance and frequency (Siniff and Ralls 1988). Thus, the magnitude and dynamics of movement between adjacent areas in the simulation model were determined by the relative densities of the two areas and by 6 user-defined parameters: *M*, *rd*, *md*, *k*, *cd*, and *fmr* (Figure 7). When the density of a newly occupied area was less than *cd*, movement dynamics were density dependent: that is, they changed with density. Once the density exceeded *cd*, movement dynamics were effectively density independent: they occurred at a constant rate determined only by the relative difference in densities between adjacent areas. At each time step (assumed to be a year), movement was assumed to occur first, followed by survival and reproduction. In this way, movement depended on the end conditions of the previous year: the matrix multiplication determining survival and reproduction was performed on the starting population vector minus the animals moving out of the area plus the animals moving in to the area. At the end of each year, the total population was calculated as the sum of the population vectors from all sub-populations.

In the case of translocation, a number of other assumptions and user defined parameters had to be introduced. The "proportion killed", *pk*, specified the proportion of all captured animals that were killed during capture, captivity, transport and release to a new area. A second parameter, *ps*, specified the rate of survival of the remaining animals for their first year after release to the new area. A final parameter, *e*, was added to simulate possible negative effects to the recipient population. For the purpose of this model, *e* was defined as the number of female mortalities in the recipient population for each additional male introduced (e.g. 0.1 females die for every male translocated and introduced into the recipient location). This was prompted in part by recent occurrences in the Monterey region of female mortalities caused by aggressive male mating behavior (J. Ames, M. Chechowitz, pers. comm.). This abhorrent behavior may or may not be associated with an abnormally high male:female ratio; in any case, it is conceivable that introducing males to an existing population may have some negative effect on that population. Other possible effects (e.g. negative effects associated with adding additional females) were not considered for this simulation.

Capture and translocation of otters was assumed to occur only in Area O, and all translocated animals were assumed to be released into Area M (the main population to the north). At each time step in Area O the captures were assumed to occur first, followed by movement between Areas (i.e. net movement into Area O from Area N and, if density in O exceeded *rd*, net movement out of O into P), followed by survival and reproduction of the remaining animals. For the translocated animals released into Area M, survival for the remainder of the year was determined by parameter *ps*, rather than by the matrix multiplication in Area M (it was also assumed that translocated females would not reproduce during the year of translocation or, if they did, that their pups would not survive). After the first year, survival and reproductive rates were assumed to equal that of other animals in Area M.

A Maximum Likelihood Analysis approach was used to select an appropriate range of values for the six movement parameters. For this exercise, previous range expansion and growth of the sea otter population to the north of Santa Cruz (from 1982 to 2000) was used as a "model" for future sea otter range expansion and population growth to the south of Pt. Conception. With the starting conditions set from the 1982 spring census (1278 otters in the Main population, Area M, and 0 otters in Area L), simulations were allowed to run from 1983 to 2000, with movement into area L determined by the six movement parameters. Parameter *rd* was set to 2 (corresponding to the density in Area M at which sea otters actually began to expand into new habitat to the north and south), while the other 5 parameters were allowed to vary over a wide range. For each combination of parameter values, Negative log Likelihood (***-LL***) values were calculated based on the deviation between observed and expected numbers of adults and pups in Areas L and M, using Equation 11 (see Part 2). The ***-LL*** values were then summed for each year of the simulation. A searching routine in MATLAB was used to find the combination of parameter values providing the minimum ***-LL*** (and thus the best fit). For this set of simulations the underlying matrices for both sub-populations were set as follows: the Siniff and Ralls (1988) baseline matrix was used for the years 1982-1994, while the best-fit modified matrix model (calculated using function MFID#1; Figure 4) was used for subsequent years.

After calculating the MLE values for the movement parameters (the "most likely values"), a lower limit was defined as ½ the MLE value and an upper limit was defined as 2× the MLE value: these limits bounded the range of parameter values used for subsequent simulations. For each of the translocation parameters a range of likely values was also specified, based on prior translocations (summarized in *Part 1*) whenever possible.

Simulations of future population dynamics were conducted under two alternate assumptions about population growth in the California sea otter population and two alternate assumptions about the intensity of capture and translocation activities, for a total of four scenarios:

Scenario 1. Low translocation intensity, depressed growth in the center of the range. For this scenario, the intensity of capture and translocation effort was low to moderate: each year, 40 % of animals south of Pt. Conception were captured for translocation, up to a maximum of 75 animals. The demographic rates for all sub-populations were calculated using a best fit, modified matrix model (MFID#49): for sub-population M the matrix parameter values for 1995-97 were used, resulting in $\lambda=0.99$, while for all other sub-populations the matrix parameter values for 1991-94 were used, resulting in $\lambda=1.03$.

Scenario 2. High translocation intensity, depressed growth in the center of the range. For this scenario, the intensity of capture and translocation effort was high: each year, 80 % of animals south of Pt. Conception were captured for translocation, up to a maximum of 150 animals. The demographic rates for all sub-populations were calculated as in Scenario 1.

Scenario 3. Low translocation intensity, constant growth rate throughout the range. For this scenario, the intensity of capture and translocation effort was low to moderate (see Scenario 1). The demographic rates for all sub-populations were calculated using a best fit, modified matrix model (MFID#49): for all sub-populations the matrix parameter values for 1991-94 were used, resulting in $\lambda=1.03$.

Scenario 4. High translocation intensity, constant growth rate throughout the range. For this scenario, the intensity of capture and translocation effort was high (see Scenario 2). The demographic rates for all sub-populations were calculated as in Scenario 3.

These four scenarios were by no means intended to represent an exhaustive set of conditions: rather, they were intended to provide some indication of how differing assumptions about spatial patterns of population growth and translocation intensity affected the simulation results. For each of these four scenarios a suite of 5000 simulations was run, with movement and capture parameter values for each simulation selected randomly from the range of possible values. A simulation consisted of a pair of 20-year runs, one with no translocation and the other allowing translocation. The distributions of results from all 20,000 simulations – population trajectories, final population sizes, and differences between translocation and no-translocation simulations – were tabulated and summarized.

Finally, the relative sensitivity of the simulation model to the movement and translocation parameters was gauged by comparing the proportion of variance in the simulation results explained by each parameter (following Wisdom et al. 2000). Coefficients of Partial Determination were compared for each parameter: this statistic was calculated using multiple linear regression analysis and measured the variance in a response variable explained by the addition of a parameter when all other parameters were already in the model (Neter et al. 1996). Two response variables were used for the analysis: a) the final population size assuming no translocation ($N_{t=20}$) and b) the difference in final population size between simulations with and without translocation ($\Delta N_{t=20}$). The first response variable was used to determine sensitivity of the model to movement parameters only, while the second reflected the sensitivity of the model to both the movement and the capture parameters.

## *Results*

By fitting the movement model to observed population dynamics associated with past range expansion to the north, the MLE analysis provided a set of "most likely" values for the movement parameters (Table 4). These values resulted in good agreement between expected and observed population trajectories in Areas M and L (Figure 8). The close match between observed and predicted population dynamics at the northern area of range expansion suggests that the general form of the model was sufficient to capture the most important aspects of population growth and movement dynamics, at least for the past 18 years. Unfortunately it was impossible to directly evaluate the success of the model at predicting female vs. male movement into new range, because the annual censuses do not distinguish between males and females. However, we were able to evaluate this aspect of the model indirectly by using pup density as a surrogate for female density, and comparing expected vs. observed pup density in Areas M and L for 1982-2000 (Figure 9). This comparison suggests that the model was generally successful at predicting both the pattern and the rate with which females moved into a recently colonized area.

**Table 4**. Ranges of values used for model parameters in simulations. Values highlighted in bold in the center column indicate Maximum Likelihood Estimation (MLE) best-fit values.

| Parameter | Lower Value | "Likely" Value | Upper Value |
|---|---|---|---|
| *M* | 4.17 | **8.333** | 16.67 |
| *k* | 1.98 | **3.950** | 5.93 |
| *md* | 0.08 | **0.164** | 0.33 |
| *cd* | 0.11 | **0.328** | 0.98 |
| *fmr* | 0.19 | **0.385** | 0.77 |
| *rd* | 1.00 | 2.00 | 3.00 |
| *pk* | 0.00 | 0.1 | 0.20 |
| *ps* | 0.25 | 0.5 | 0.75 |
| *e* | 0.00 | 0.1 | 0.20 |

The results of 20,000 model simulations projecting population dynamics into the future, with or without translocation of animals, varied as a function of assumptions about population growth rates and capture intensity (Scenarios 1-4) and as a function of the values selected for the user-defined model parameters. Figures 10-13 show the distribution of simulation results under scenarios 1-4. Under scenario 1, where capture intensity was low and population growth was depressed in the center of the range, the median decrease in final population size due to translocation was 5%, and ¼ of the simulations resulted in a decrease of 8% or more (Figure 10). A very small number of simulations (<2%) actually showed an increase due to translocation. The distribution of results did not change greatly under scenario 2, where capture intensity was high and growth was depressed in the center of the range (Figure 11). The median decrease in final population size was slightly larger (6%) and the right tail of the distribution was much longer, reflecting the small number of simulations in which translocation caused very substantial decreases (2% of the simulations resulted in decreases of 20% or more). Under scenario 3, where capture intensity was low and growth was constant and positive throughout the entire range, the distribution of results was much tighter than scenarios 1 and 2, and the median decrease in final population size was only 2% (Figure 12). Approximately 5% of simulations increased slightly (1%) as a result of translocation, however ¼ of simulations still showed a decrease of 3% or more. Scenario 4, in which capture intensity was high and growth was constant and positive throughout the entire range, showed a skewed distribution of results with a long right tail, similar to scenario 2 (Figure 13). Under scenario 4, the median decrease due to translocation was 3%; however, ¼ of simulations resulted in a decrease of 5% or more, and for some simulations the decrease over 15%. Taken together, virtually all the simulation results from the 4 scenarios indicated a decrease in final population size as a result of translocation (98.2 % of 20,000 simulations), and approximately half resulted in a decrease of 5 % or more. The variability of the results tended to increase with intensity of translocation effort, although all scenarios showed considerable variance attributable to the effects of the model parameters for movement dynamics and translocation effects.

Not all the model parameters contributed equally to variation in the simulation results (Figure 14). Parameter *M* was the most important movement parameter in the model, contributing disproportionately to variation in final population size ($N_{t=20}$). The model was also sensitive to parameter *fmr*, which scaled female vs. male movement. The other movement parameters contributed little to variation in $N_{t=20}$. A sensitivity analysis of decrease in final population size due to translocation ($\Delta N_{t=20}$) produced a slightly different pattern: parameter *M* still contributed much of the variance, however *fmr* was much less important while parameter *k* (which scaled male movement during early stages of range expansion) contributed significantly to variance in $\Delta N_{t=20}$. The model showed low sensitivity to parameter *pk* (proportion of animals killed during capture) but was more sensitive to *ps* (survival of translocated animals after release), and parameter *e* (effect of translocated animals on recipient population) explained a great deal of variance in $\Delta N_{t=20}$, second only to parameter *M*.

# Part 4: Summary and Discussion of Results

Previous attempts at sea otter translocation in California and elsewhere have had very mixed levels of success. In all cases, the number of animals remaining at the re-location site has declined substantially in the year following the translocation, due to the combined effects of emigration and mortality. Certain levels of mortality are to be expected during initial capture, handling, and transportation of animals. In general, however, the level of mortality experienced in such operations has dropped over time, reflecting improved capture and holding techniques; nonetheless, 5-10% mortality at this stage is certainly possible. Paradoxically, differences in the rate of mortality during capture and transportation explained a relatively minor amount of variation in the results of the simulation model, suggesting that this factor would have a much lower impact on the population-level impact of translocation than other factors such as survival after release or effect on animals at the recipient location. The fate of translocated animals post-release has traditionally been difficult to quantify in past translocations, due to the difficulties inherent in obtaining reliable follow-up data from individual animals. The simulation results presented here indicate that a reliable estimate of survival rates of released animals, at least for the first year, will be required in order to accurately gauge the impacts of translocation. In addition, no attempts have ever been made to measure (or even look for) potential effects on the recipient population of introduced translocated animals. The high sensitivity of the simulation results to the simple male-female effect modeled here suggests that such effects could contribute greatly to the negative effects of translocation, resulting in a far more significant population-level impact than a substantial increase in mortality among the translocated animals themselves. A variety of additional potential effects could be envisioned, such as the impact of introduced males on male survival or introduced females on female survival at the recipient location: while not treated in the current model, it is clear that addition of any of these effects would lead to greater overall impacts of translocation.

Other common observations and conclusions from past translocations include: a) animals will very frequently return to the location from which they were captured, even if this involves traversing great distances (this has been especially true in California); b) animals will tend to have higher survival post-release when the trauma during capture and handling is minimized (this means reducing holding time as much as possible); and c) the survival rate of translocated animals tends to be significantly lower than other animals for the first year after release.

There is a currently a great degree of uncertainty as to the status of the California sea otter population, particularly regarding the nature and cause of current population trends. *Part 2* of this study attempts to determine how underlying demographic rates have changed since the mid 1980's (at which time there were fairly good data available), making use of available data from the carcass and census databases (USGS-BRD/CDFG, unpublished data). The results of the Maximum Likelihood Analysis suggest that the principle demographic change since the 1980's has been a decrease in survival of prime age (4-8 year old) and older females, and that this decreased survival was more pronounced after 1995. This approach provides a more up-to-date matrix model for conducting simulations of future population dynamics.

The spatial population model we devised was relatively simple, and yet was able to model with reasonable accuracy the dynamics of range expansion and demographic changes for the past 18 years at the northern end of the range. While the nature and rates of sea otter movements and range expansion will undoubtedly be very different south of Pt. Conception, we believe that the survey data from north of Santa Cruz represented the best available independent data set with which to parameterize the model. The use of the northern data may in fact have resulted in conservative estimates of the movement parameters, because Monterey Bay is believed to have acted as a barrier to expansion north of Santa Cruz (B. Hatfield, personal communication). If so, this would have caused the model to underestimate the potential growth rate of the population south of Pt. Conception, and thereby underestimated the net impacts of a translocation program. It would be a useful exercise to attempt to fit this model to other sea otter populations where suitable long-term survey data exist (e.g. Washington, SE Alaska), to see how the parameter estimates vary for different populations.

The simulation model was used to project future dynamics with and without the translocation of animals from south of Pt. Conception to the main population in the north. The results of these simulations varied substantially depending on assumptions about population growth in different parts of the range, intensity of translocation efforts, rates of movement between different areas, and male/female differences in the rate of colonization of unoccupied range. In spite of this variation, a common feature of the simulations conducted was the overwhelming tendency of simulations with translocation to result in a decreased rate of population growth over a 20-year period. The results of a typical simulation can be used to illustrate some of the common features of most simulations run (Figure 15). This sample simulation was conducted under scenario 2 (low growth in the centre of the range and more rapid growth at the south end of the range) with a medium intensity of translocation efforts and model parameters set to the "most likely" values presented in Table 4. The general effect of translocation was to depress overall population growth over the 20-year projection: in this case the final population size without translocation was 6.3% higher than the final population size with translocation. The chief reason for this difference was the lack of significant population growth in Area O. There was virtually no difference in population growth for Area N, while the final number in Area M actually *increased* with translocation: this resulted from the additional animals added to area M from Area O, and reflects the assumptions of high survival of translocated animals and limited effect on the recipient population ($e$ = 0.1 for this simulation). Relaxing these assumptions would reduce the subsidization to Area M and result in a greater net impact of translocation.

Simulations were run under different assumptions about the intensity of translocation efforts and about future rates of population growth. Surprisingly, doubling the intensity of translocation activity (capturing 80% of animals in the management zone each year vs. 40%) did not substantially change the results of the most simulations, only slightly increasing the median impact of translocation (e.g. compare Figure 10 with Figure 11). The right tail of the distribution did increase with increased capture intensity, however, indicating that under some sets of conditions a high translocation effort could result in a very high impact to the population: these were simulations with higher values of $e$ (effect on the recipient population). Varying the assumptions about future population growth affected the magnitude of translocation impacts, but not the shape of the distribution of simulation results (e.g. compare Figure 11 with Figure 13). The assumption of lower growth in the center part of the range resulted in a greater impact of translocation (measured as percent decrease in final population size due to translocation) than did the assumption of a constant growth rate throughout the range, primarily because the latter assumption resulted in greater final population sizes for all simulations – the absolute magnitude of the translocation effect (in terms of number of animals lost) was similar under either assumption. The former scenario provides a more conservative picture of potential impacts and, given observed trends over the past decade, is probably more realistic.

Overall, the simulation results presented here suggest that translocation of sea otters from south of Pt. Conception would likely have a negative impact on population growth rates over the next 20 years. Unfortunately, due to uncertainty about the general population biology of the southern sea otter (including important limiting factors, demographic rates in different parts of the range, spatial dynamics of range expansion and individual movement patterns), it is currently impossible to predict with much precision the magnitude of this impact. For this reason it is necessary to consider the full distribution of simulation results, rather than any single scenario. Our sensitivity analysis of the model parameters provides some hope that the model we present here can be improved upon. Only four parameters ($M$, $k$, $ps$ and $e$) were responsible for most of the variance in the simulation results (Figure 14). The first two of these parameters could be quantified with greater certainty by careful long term monitoring of many tagged individuals: such a population study is currently being initiated in the southern portion of the range. The second two parameters will be more difficult to quantify: potential opportunities to do so may be provided by future pre-emptive translocations of sea otters in response to oil spill threats, if monitoring programs are in place to monitor the survival of such animals and their behavioral interactions with other otters.

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# Appendix 1.

Summary of results from Maximum Likelihood Estimate (MLE) analyses conducted to select the optimal functional form and best-fit parameter values for a modifying function used to adjust the Siniff and Ralls (1988) baseline matrix model. The best-fit values for each parameter are shown for 24 different functional forms, sorted in order of ascending AIC values (functional forms at top provide better fit than those at bottom). Four suites of MLE analyses were conducted, as described in the text and indicated in column 1. Each modifying function is uniquely identified by the MF ID#.

| | MF | AIC | Parameter | | | | | | | | # |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MLE Analysis Description | ID# | value | a | b | c | d | e | f | g | h | params |
| Fit to age-at-death data only | 1 | 116.834 | 2.284 | | -0.073 | | | | | | 2 |
| Two periods (91-94, 95-97) | 2 | 117.032 | 1.790 | | | | | | | | 1 |
| | 3 | 118.195 | 1.296 | | | | 2.037 | | | | 2 |
| | 4 | 118.222 | 2.435 | -0.599 | | | | | | | 2 |
| | 5 | 118.844 | 2.202 | | -0.069 | | 2.833 | | | | 3 |
| | 6 | 119.573 | 1.488 | | | | 0.021 | | 0.090 | | 3 |
| | 7 | 120.143 | 1.653 | -0.198 | | | 2.284 | | | | 3 |
| | 8 | 120.303 | 1.502 | | | | 2.599 | -0.199 | | | 3 |
| | 9 | 120.541 | 1.667 | | -0.033 | | 0.432 | | 0.073 | | 4 |
| | 10 | 121.410 | 1.722 | | -0.037 | | 1.845 | 0.431 | | | 4 |
| | 11 | 121.493 | 1.667 | -0.178 | | | 0.556 | | 0.070 | | 4 |
| | 12 | 121.494 | 1.831 | 0.512 | -0.135 | 0.043 | | | | | 4 |
| | 13 | 122.229 | 1.667 | -0.430 | | | 1.667 | 0.237 | | | 4 |
| | 14 | 123.148 | 1.667 | 0.178 | -0.092 | 0.035 | 2.407 | | | | 5 |
| | 15 | 123.154 | | | | | 9.979 | | | | 1 |
| | 16 | 124.043 | 1.667 | | | | 0.556 | 0.400 | 0.167 | -0.083 | 5 |
| | 17 | 124.664 | 1.667 | | -0.031 | | 0.556 | 0.104 | 0.164 | -0.083 | 6 |
| | 18 | 124.738 | 1.708 | 0.198 | -0.093 | 0.034 | 1.667 | | 0.029 | | 6 |
| | 19 | 125.153 | | | | | 9.815 | | 0.189 | | 2 |
| | 20 | 125.154 | | | | | 9.815 | 0.578 | | | 2 |
| | 21 | 125.456 | 1.708 | 0.020 | -0.093 | 0.043 | 1.708 | 0.474 | | | 6 |
| | 22 | 125.775 | 1.667 | -0.296 | | | 1.667 | 0.356 | 0.100 | -0.083 | 6 |
| | 23 | 128.915 | 1.667 | 0.400 | -0.126 | 0.050 | 1.543 | -0.207 | 0.144 | -0.078 | 8 |
| | 24 | 129.152 | | | | | 8.333 | -0.533 | 0.167 | -0.083 | 4 |
| Fit to age-at-death data only | 25 | 150.215 | 2.257 | | -0.076 | | | | | | 2 |
| Three periods (91-93, 94-95, 96-97) | 26 | 150.657 | 1.743 | | | | | | | | 1 |
| | 27 | 151.897 | 1.255 | | | | 2.037 | | | | 2 |
| | 28 | 152.228 | 2.202 | | -0.070 | | 2.942 | | | | 3 |
| | 29 | 152.386 | 2.037 | -0.260 | | | | | | | 2 |
| | 30 | 153.321 | 1.502 | | | | 0.062 | | 0.093 | | 3 |
| | 31 | 153.707 | 1.543 | | | | 3.354 | -0.568 | | | 3 |
| | 32 | 154.021 | 0.556 | 0.400 | | | 1.667 | | | | 3 |
| | 33 | 154.022 | 1.667 | | -0.033 | | 0.185 | | 0.085 | | 4 |
| | 34 | 154.251 | 1.749 | | -0.033 | | 3.354 | -0.599 | | | 4 |
| | 35 | 154.903 | 1.722 | 0.469 | -0.079 | -0.001 | | | | | 4 |
| | 36 | 155.319 | 1.626 | -0.198 | | | 0.514 | | 0.070 | | 4 |
| | 37 | 155.798 | 1.667 | -0.044 | | | 3.519 | -0.578 | | | 4 |
| | 38 | 157.223 | | | | | 9.979 | | | | 1 |
| | 39 | 157.378 | 1.667 | | | | 0.556 | 0.178 | 0.196 | -0.083 | 5 |
| | 40 | 157.728 | 1.667 | | -0.031 | | 0.432 | 0.504 | 0.167 | -0.083 | 6 |
| | 41 | 158.251 | 1.667 | 0.469 | -0.086 | 0.001 | 3.519 | -0.593 | | | 6 |
| | 42 | 158.276 | 1.667 | 0.198 | -0.099 | 0.029 | 1.667 | | 0.027 | | 6 |
| | 43 | 158.334 | 1.667 | 0.400 | 0.051 | -0.083 | 3.395 | | | | 5 |
| | 44 | 159.220 | | | | | 9.815 | | 0.189 | | 2 |
| | 45 | 159.222 | | | | | 9.815 | 0.578 | | | 2 |
| | 46 | 159.506 | 1.667 | -0.133 | | | 1.667 | -0.578 | 0.189 | -0.083 | 6 |
| | 47 | 162.685 | 1.790 | 0.385 | -0.079 | 0.001 | 3.765 | -0.207 | 0.110 | -0.078 | 8 |
| | 48 | 163.073 | | | | | 9.444 | 0.311 | 0.100 | -0.128 | 4 |

(Appendix 1, continued)

| MLE Analysis Description | MF ID# | AIC value | Parameter a | b | c | d | e | f | g | h | # params |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Fit to age-at-death & survey data | 49 | 173.548 | 3.272 | -0.600 | | | 5.741 | | | | 3 |
| Two periods (91-94, 95-97) | 50 | 173.548 | 2.791 | | -0.098 | | | | | | 2 |
| | 51 | 173.767 | 5.000 | -0.598 | -0.047 | -0.133 | 9.938 | | | | 5 |
| | 52 | 173.888 | 3.395 | | -0.138 | | 8.951 | | | | 3 |
| | 53 | 174.724 | 2.154 | | | | | | | | 1 |
| | 54 | 175.142 | 2.407 | | | | 4.218 | | | | 2 |
| | 55 | 175.466 | 3.272 | -0.600 | | | 5.864 | -0.600 | | | 4 |
| | 56 | 175.595 | 3.130 | -0.600 | | | | | | | 2 |
| | 57 | 175.737 | 3.395 | | -0.144 | | 6.111 | -0.600 | | | 4 |
| | 58 | 176.189 | | | | | 9.979 | | | | 1 |
| | 59 | 176.346 | 5.000 | -0.578 | -0.053 | -0.128 | 9.815 | | 0.196 | | 6 |
| | 60 | 176.347 | 5.000 | -0.578 | -0.053 | -0.128 | 9.815 | -0.600 | | | 6 |
| | 61 | 176.933 | 2.407 | | | | 4.835 | -0.600 | | | 3 |
| | 62 | 177.124 | 2.901 | -0.148 | -0.144 | 0.045 | | | | | 4 |
| | 63 | 177.139 | 2.449 | | | | 2.229 | | 0.111 | | 3 |
| | 64 | 177.388 | 2.572 | | -0.031 | | 2.284 | | 0.090 | | 4 |
| | 65 | 178.187 | | | | | 9.691 | -0.600 | | | 2 |
| | 66 | 178.187 | | | | | 9.815 | | 0.189 | | 2 |
| | 67 | 179.306 | | | | | 5.000 | -0.400 | 0.167 | -0.128 | 4 |
| | 68 | 180.107 | 2.654 | | | | 6.481 | -0.533 | 0.122 | -0.123 | 5 |
| | 69 | 180.179 | 5.000 | -0.593 | -0.079 | -0.083 | 5.000 | -0.578 | 0.100 | -0.083 | 8 |
| | 70 | 180.531 | 2.778 | | -0.031 | | 6.111 | -0.193 | 0.125 | -0.128 | 6 |
| | 71 | 180.983 | 3.889 | -0.600 | | | 9.444 | | 0.189 | | 4 |
| | 72 | 199.430 | 5.000 | -0.600 | | | 8.333 | 0.400 | 0.167 | 0.183 | 6 |
| Fit to age-at-death & survey data | 73 | 223.801 | 3.642 | -0.600 | | | 9.938 | | | | 3 |
| Three periods (91-93, 94-95, 96-97) | 74 | 225.666 | 4.959 | -0.464 | -0.073 | -0.077 | 9.979 | | | | 5 |
| | 75 | 226.174 | 3.519 | -0.600 | | | 9.815 | -0.600 | | | 4 |
| | 76 | 226.931 | 3.889 | -0.267 | 0.025 | -0.083 | 9.815 | -0.600 | | | 6 |
| | 77 | 228.678 | 3.765 | -0.600 | | | 6.481 | 0.089 | 0.078 | -0.078 | 6 |
| | 78 | 228.747 | 3.395 | | -0.138 | | 9.650 | | | | 3 |
| | 79 | 228.882 | 5.000 | -0.400 | -0.092 | -0.083 | 9.444 | | 0.189 | | 6 |
| | 80 | 229.156 | 3.889 | -0.600 | | | 9.444 | | 0.189 | | 4 |
| | 81 | 229.597 | 3.583 | -0.600 | | | | | | | 2 |
| | 82 | 230.569 | 3.395 | | -0.139 | | 6.728 | -0.600 | | | 4 |
| | 83 | 230.618 | 3.025 | | -0.115 | | | | | | 2 |
| | 84 | 230.998 | 2.531 | | | | 5.658 | | | | 2 |
| | 85 | 231.863 | | | | | 9.979 | | | | 1 |
| | 86 | 232.003 | | | | | 8.333 | -0.400 | 0.033 | -0.083 | 4 |
| | 87 | 232.576 | 2.298 | | | | | | | | 1 |
| | 88 | 232.582 | 2.531 | | | | 5.329 | -0.600 | | | 3 |
| | 89 | 232.700 | 3.889 | -0.267 | 0.025 | -0.083 | | | | | 4 |
| | 90 | 232.882 | 5.000 | -0.400 | -0.092 | -0.083 | 9.444 | 0.400 | 0.167 | 0.183 | 8 |
| | 91 | 232.963 | 2.503 | | | | 2.942 | | 0.066 | | 3 |
| | 92 | 233.100 | 2.695 | | -0.033 | | 3.189 | | 0.066 | | 4 |
| | 93 | 233.781 | | | | | 6.193 | -0.600 | | | 2 |
| | 94 | 233.861 | | | | | 9.815 | | 0.189 | | 2 |
| | 95 | 237.064 | 2.531 | | | | 2.572 | -0.296 | 0.051 | 0.086 | 5 |
| | 96 | 237.755 | 2.778 | | -0.027 | | 3.148 | -0.222 | 0.063 | 0.109 | 6 |

## Report Figures

(Attached, following pages)

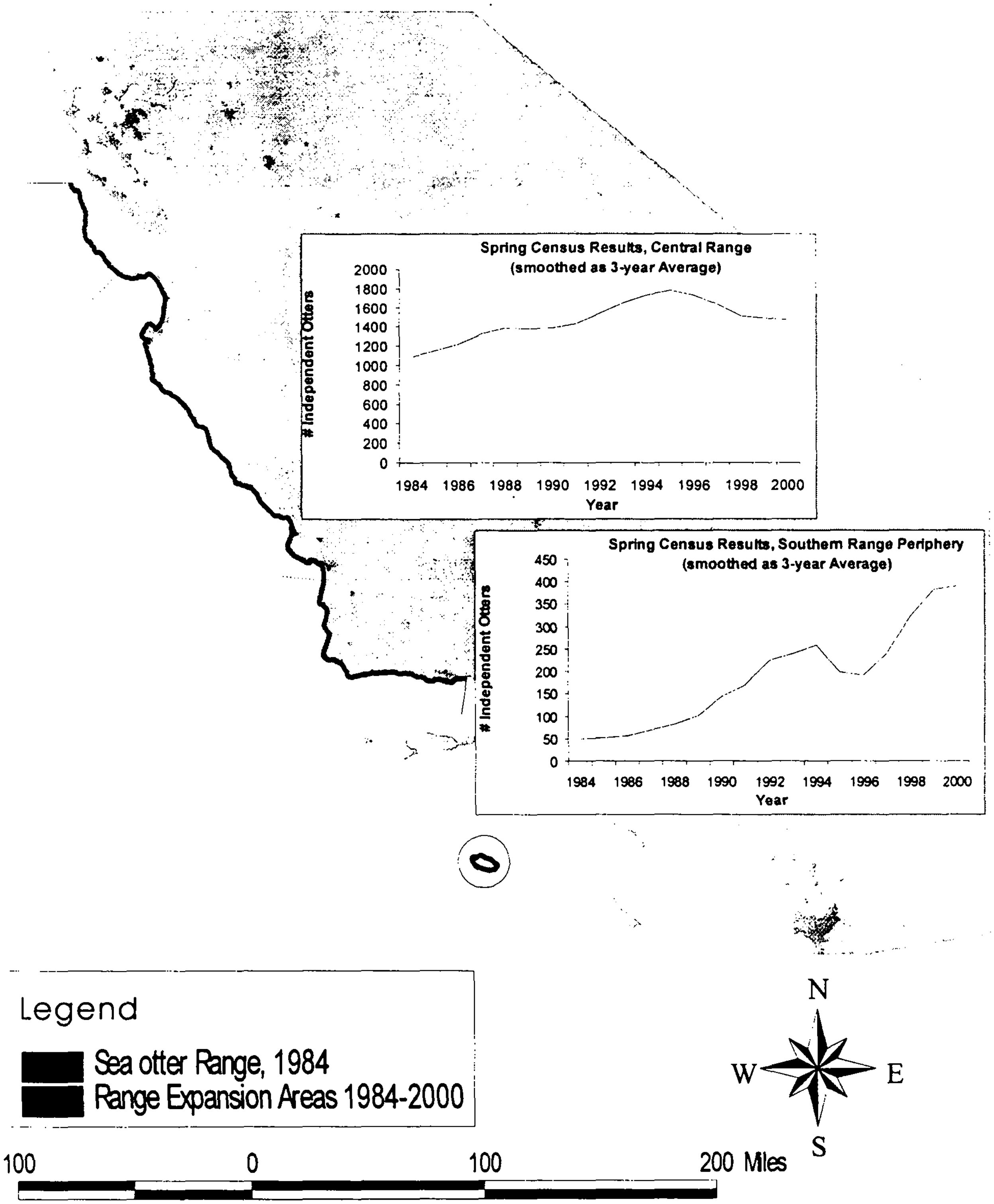


**Figure 1.** Map of central-southern California showing sea otter range in 1984 and areas of range expansion over the period 1984-2000. Annual survey counts of independent otters (smoothed to 3-year average) are shown plotted against time for the centre portion of the range (Top) and the southern range periphery (Bottom).

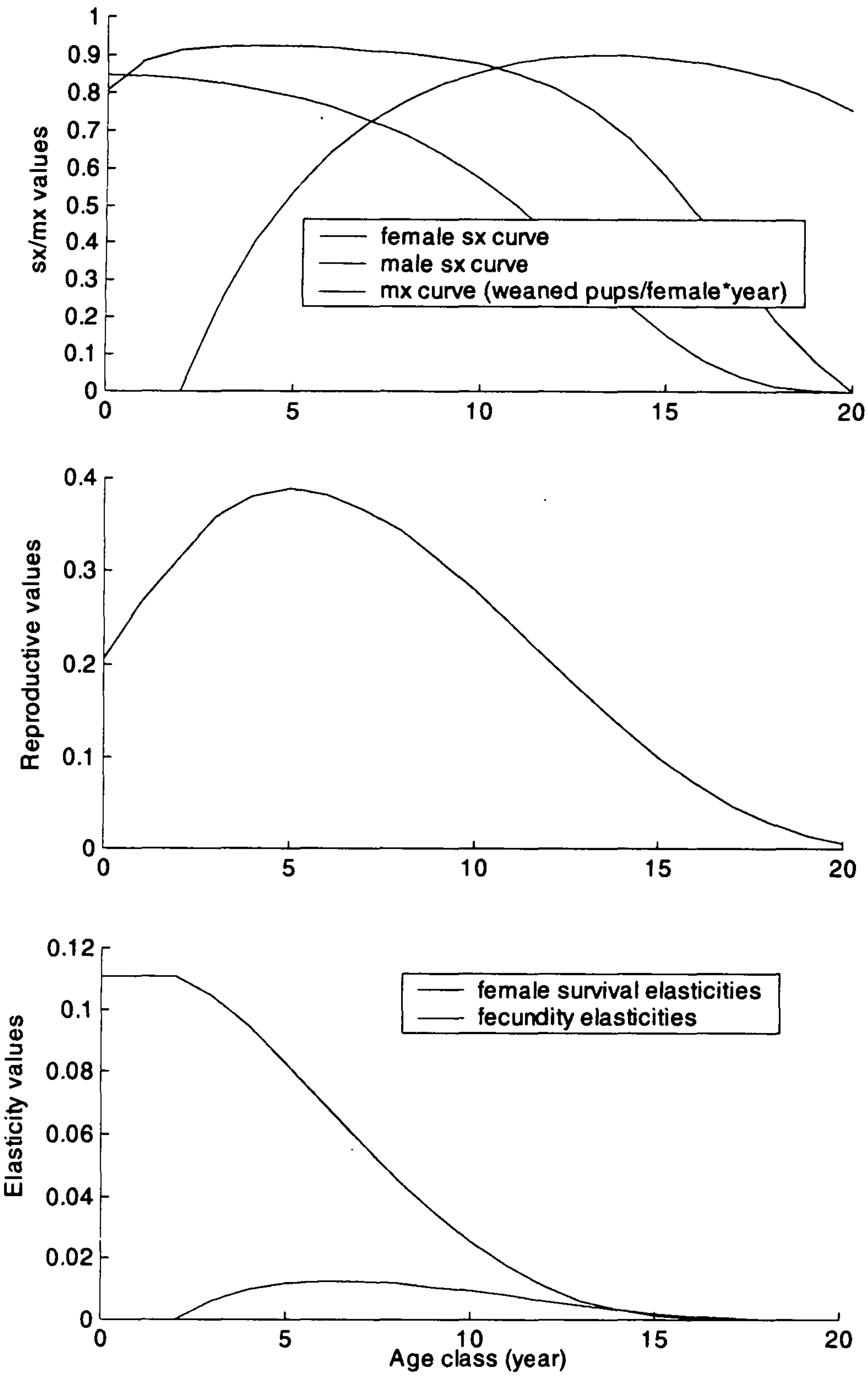


**Figure 2** Baseline matrix model for southern sea otters, generated using the "proportional hazards model" with parameter values as indicated in Table 1. Top: age-specific survival rates ($s_x$) for males and females, and age-specific fecundities ($m_x$ = the number of pups of either sex successfully weaned per female per year). Middle: age-specific female reproductive values ($v_x$). Bottom: age-specific elasticities ($\varepsilon_x$) for female survival and fecundity.

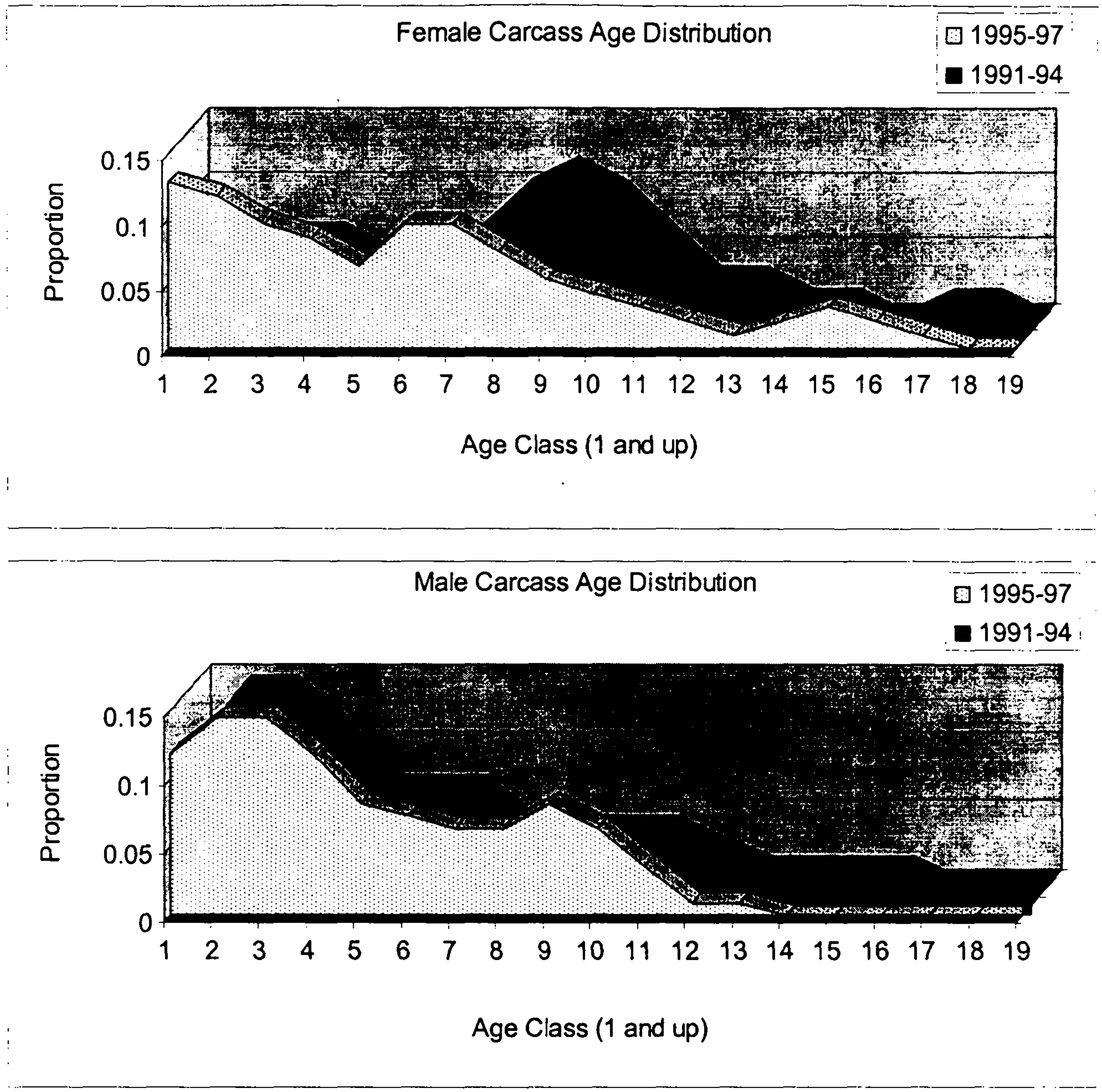


**Figure 3** Carcass age distributions for female (Top) and male (Bottom) southern sea otters during 2 time periods: 1991-94, and 1995-97. Age estimates were obtained by cementum analysis of tooth sections collected from beach-cast carcasses (n=156 known-sex carcasses), and raw data have been smoothed as 3-year running averages. USGS-BRD & CDFG, unpublished data.

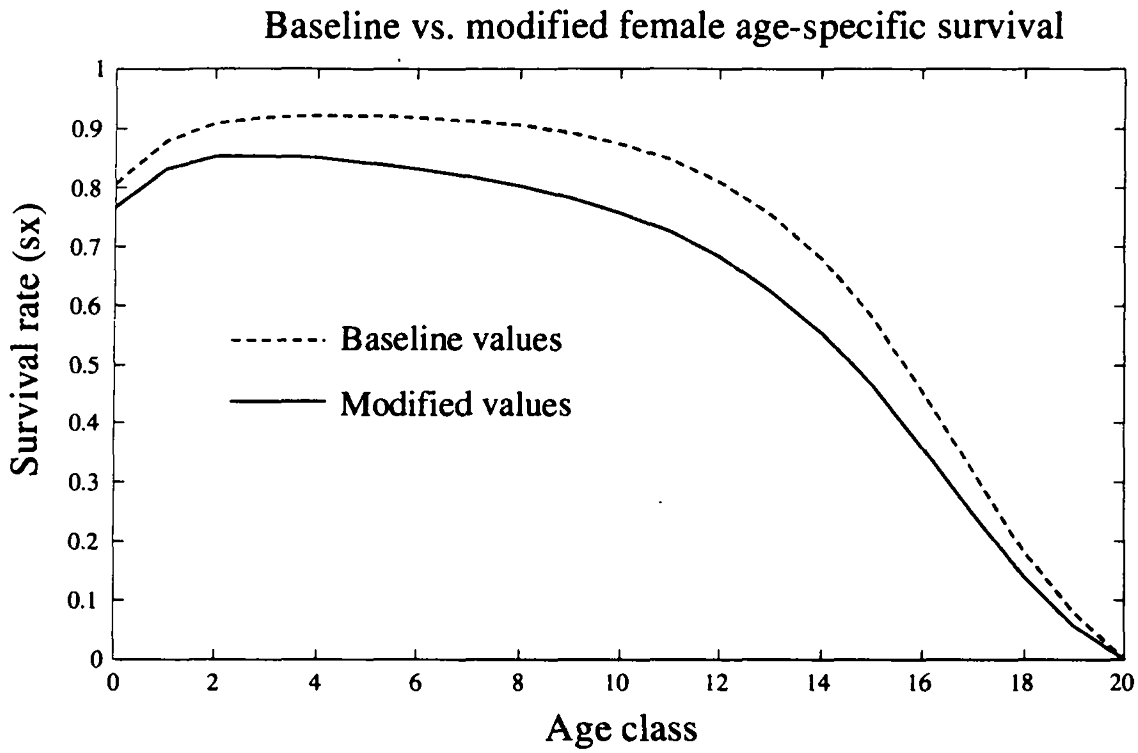


**Figure 4.** Age-specific survival curves for female sea otters, showing baseline values (blue dashed line) and modified values (red solid line) as estimated by a Maximum Likelihood Analysis based on age-at-death data only, with data grouped into two time periods. Data are shown for the functional form with the lowest associated AIC value. Modifying function parameters include a constant and an age term, resulting in a decrease in survival for all ages but with the greatest decrease occurring in older age classes. The baseline model produced an expected $\lambda=1.05$, while the modified model produced an expected $\lambda=0.96$.

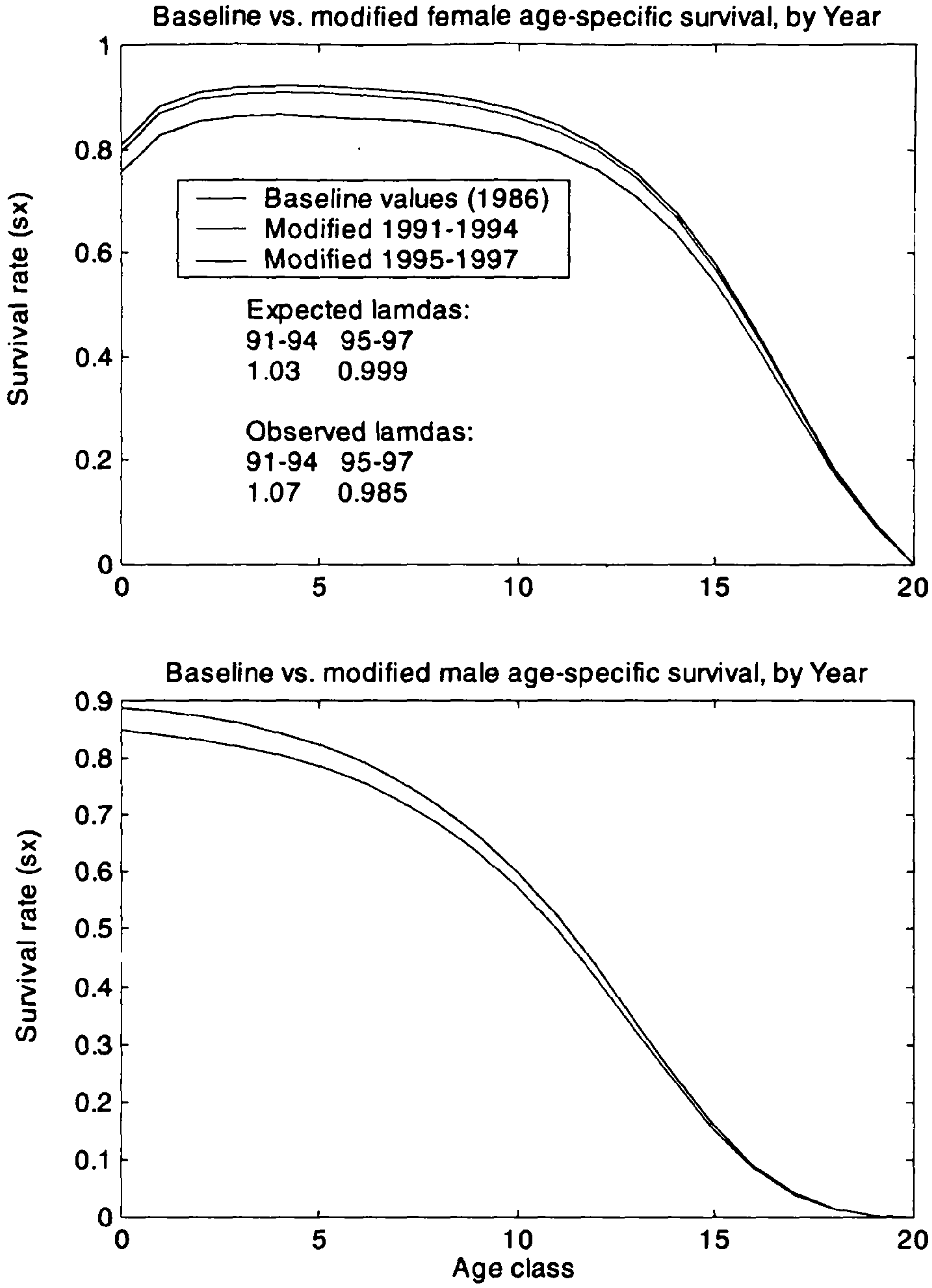


**Figure 5.** Age-specific survival curves for female sea otters (top) and male sea otters (bottom), showing baseline values (blue line) and modified values (red and green lines) as estimated by a Maximum Likelihood Analysis based on age-at-death data and survey data, with data grouped into two time periods. Data are shown for the functional form with the lowest associated AIC value. Female modifying function parameters include a constant and a time term, resulting in a decrease in survival for all ages but with a greater decrease in 1995-97 than 1991-94. Male modifying function parameters include a constant only, resulting in an increase in survival for all ages. The baseline model produced an expected $\lambda=1.05$, while the modified model produced an expected $\lambda=1.03$ for 1991-94 and $\lambda=0.99$ for 1995-97.

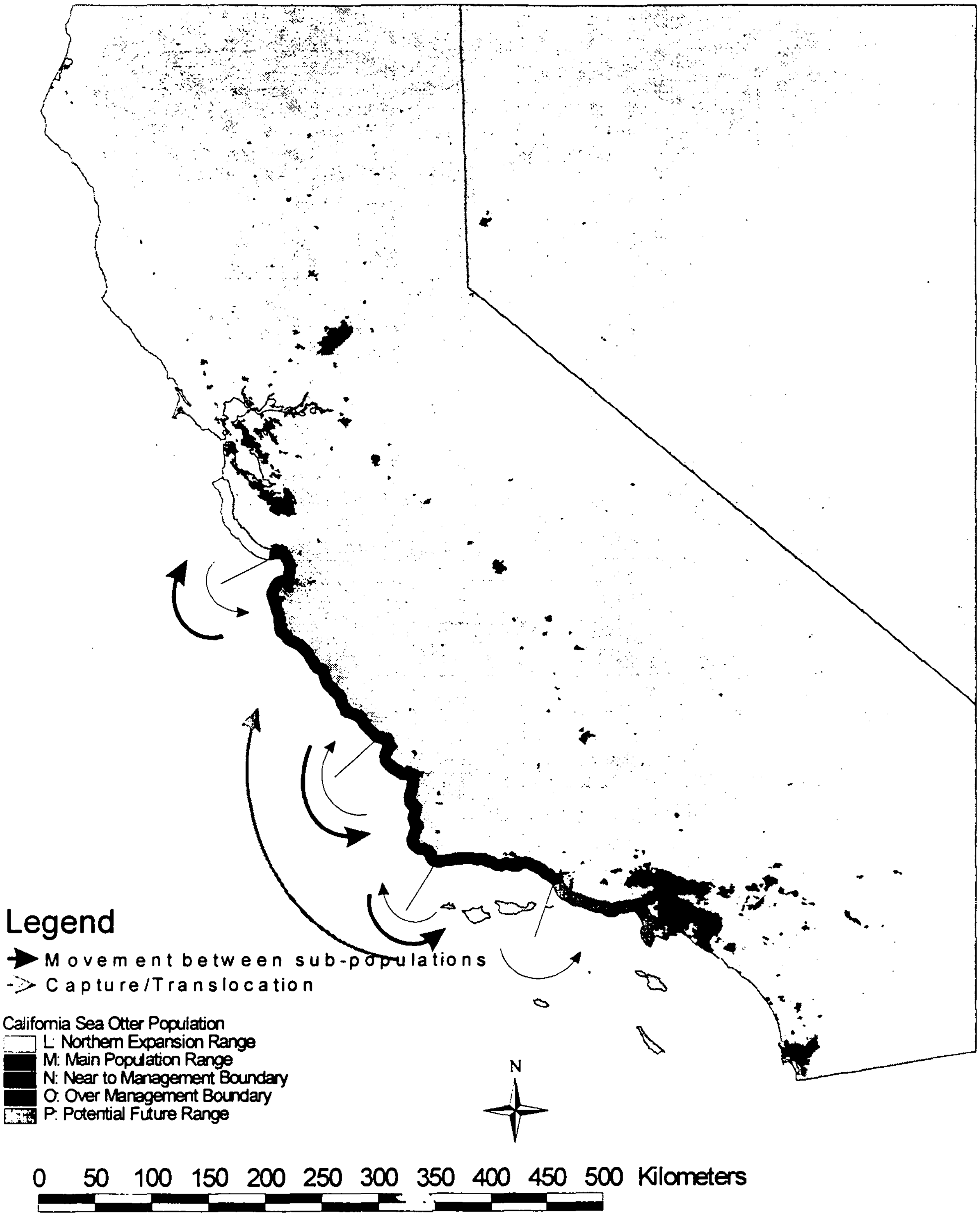


**Figure 6** Map of sea otter range in California, showing division into sub-populations L, M, N, O and P. Black arrows designate net movement between areas and the light arrow designates translocation from area O, as simulated in model. See text for explanation.

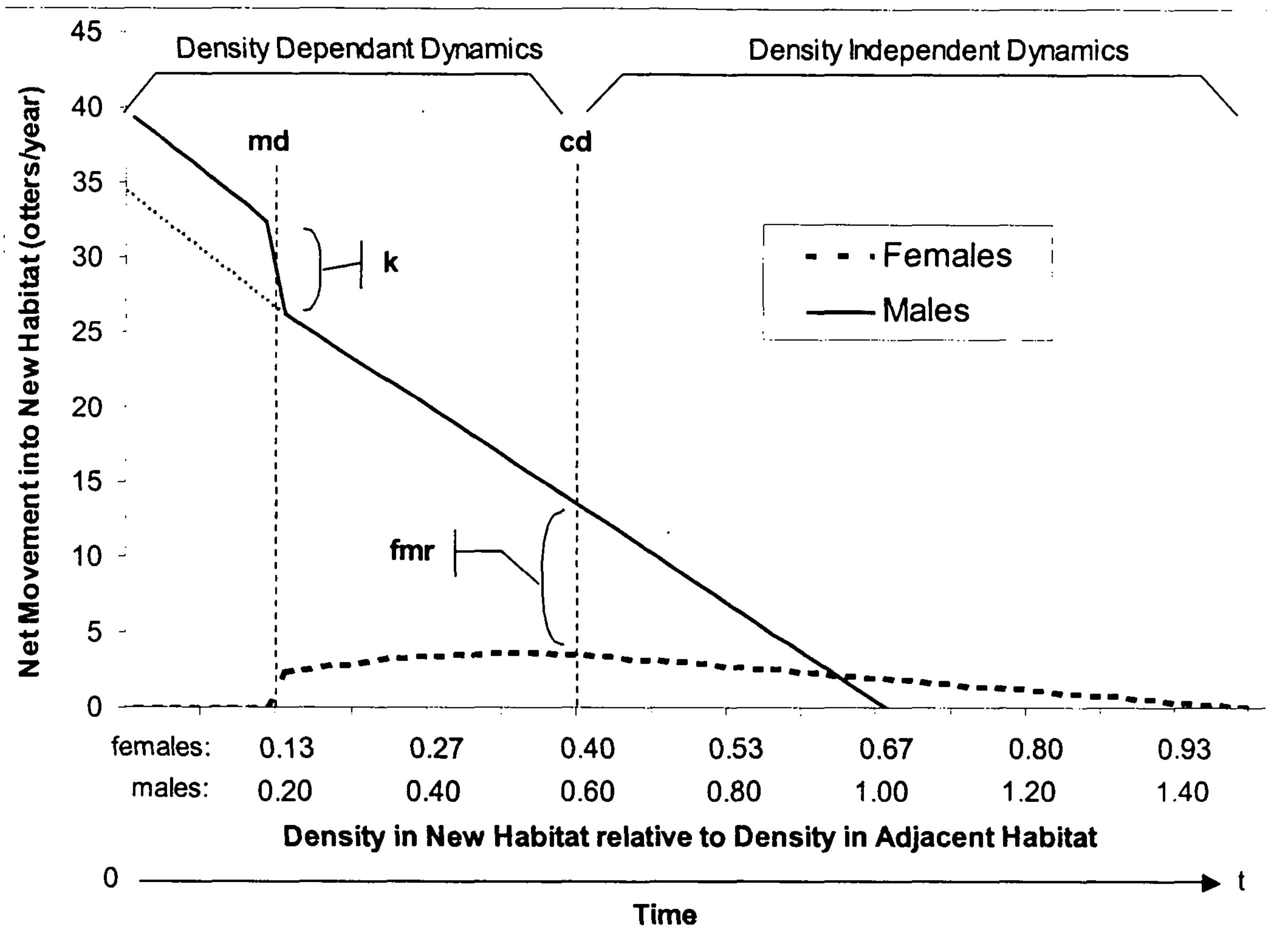


**Figure 7** A schematic representation of the dynamics of sea otter population expansion into new habitat as modeled in the simulations, illustrating the effects of the model parameters. The X-axis shows sea otter density in the newly occupied habitat relative to the density in the adjacent habitat (which is assumed to have a density of 5 otters/km). The Y-axis shows the net rate of movement of otters into the new habitat from the adjacent habitat. Relative densities and movement rates are tracked separately for male and female otters. As the density of males or females in the new habitat approaches equilibrium with the adjacent habitat, the net rate of movement for that sex approaches zero. Parameter *md* determines the minimum density at which female movement into the new area can occur: below *md* only males move into new habitat, and their net rate of movement is adjusted from the baseline rate by parameter *k*. The baseline movement rate of females is lowered relative to male movement by parameter *fmr*. Parameter *cd* determines the density at which female movement reaches its baseline rate: when density is between *md* and *cd* female rate of movement increases gradually. When density in the new habitat is above *cd*, net movement of both males and females is density independent with magnitude determined by parameter *M* (movement of individuals between habitats is assumed random, such that net movement depends only on *M* and the relative difference in densities between areas, reaching zero when densities are equal).

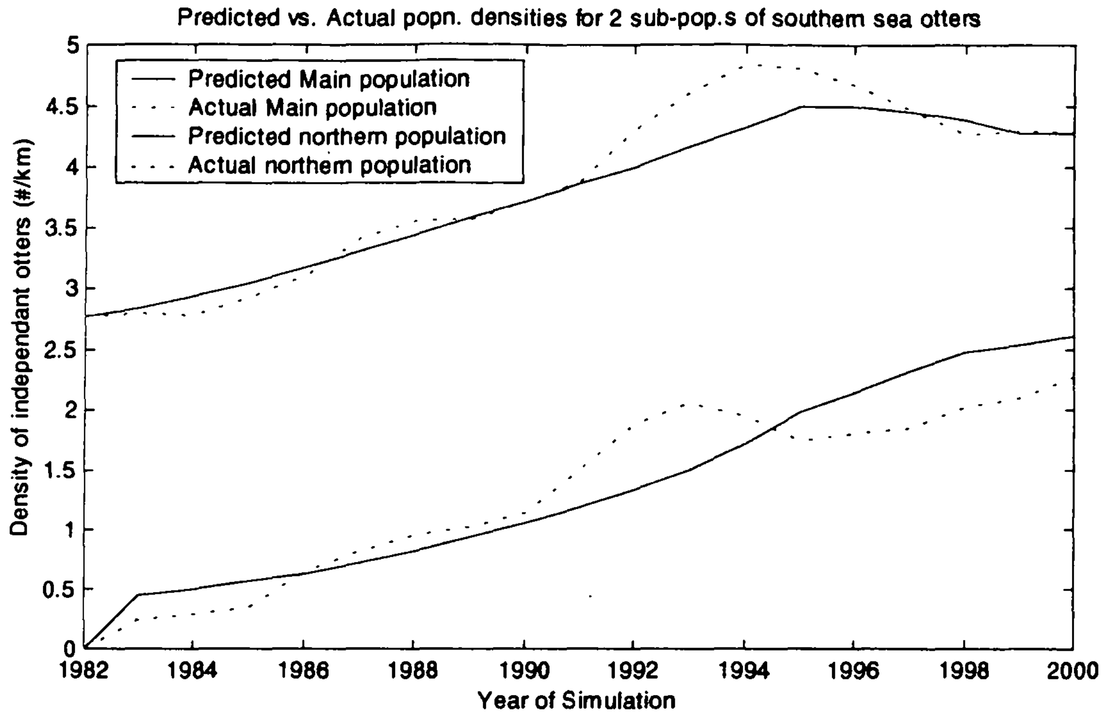


**Figure 8**. Trajectories for sea otter sub-populations from 1982-2000, showing observed numbers of independent otters (spring survey data; dashed lines) vs. numbers predicted from simulation model (solid lines). Data are shown for the area north of Santa Cruz (newly occupied in 1982) and the main population. Colonization of the northern area from the main population, and movement between the areas, was modeled as described in text: parameter values for this model were selected by Maximum Likelihood Analysis to fit the observed data. See text for explanation.

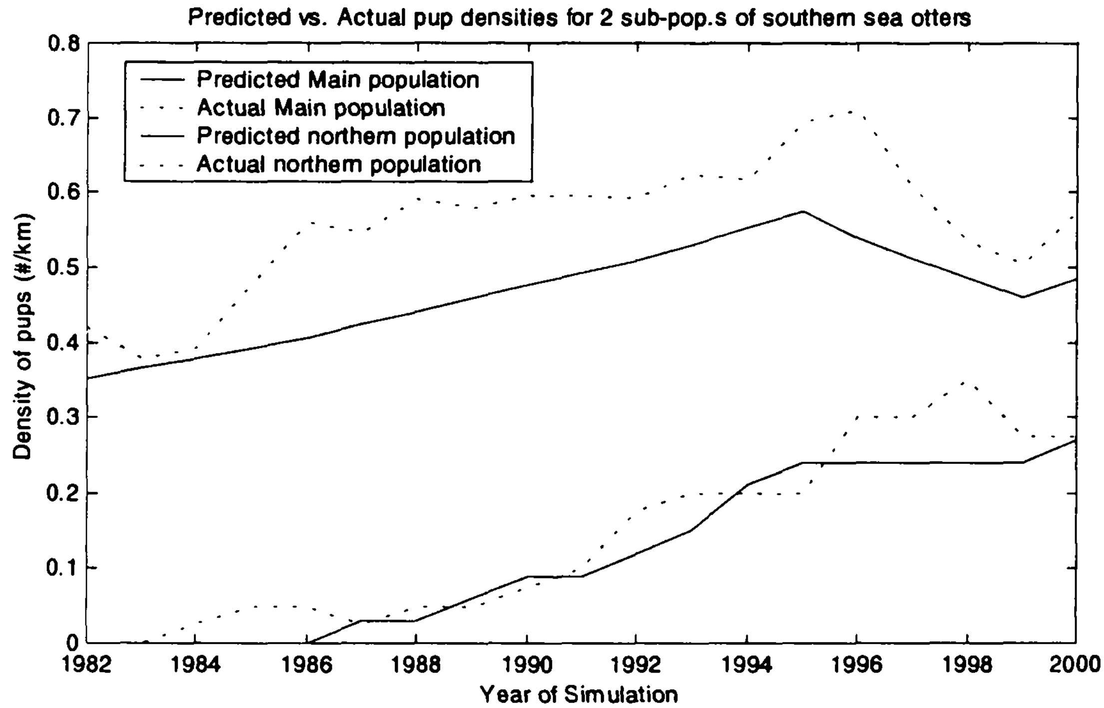


**Figure 9**. Comparison of simulated (solid lines) vs. observed (dashed lines) pup densities between 1982 and 2000. Data are shown for the area north of Santa Cruz and the main population. Colonization of the northern area from the main population, and movement between the areas, was modeled as described in text: parameter values for this model were selected by Maximum Likelihood Analysis to fit the observed data. See text for explanation.

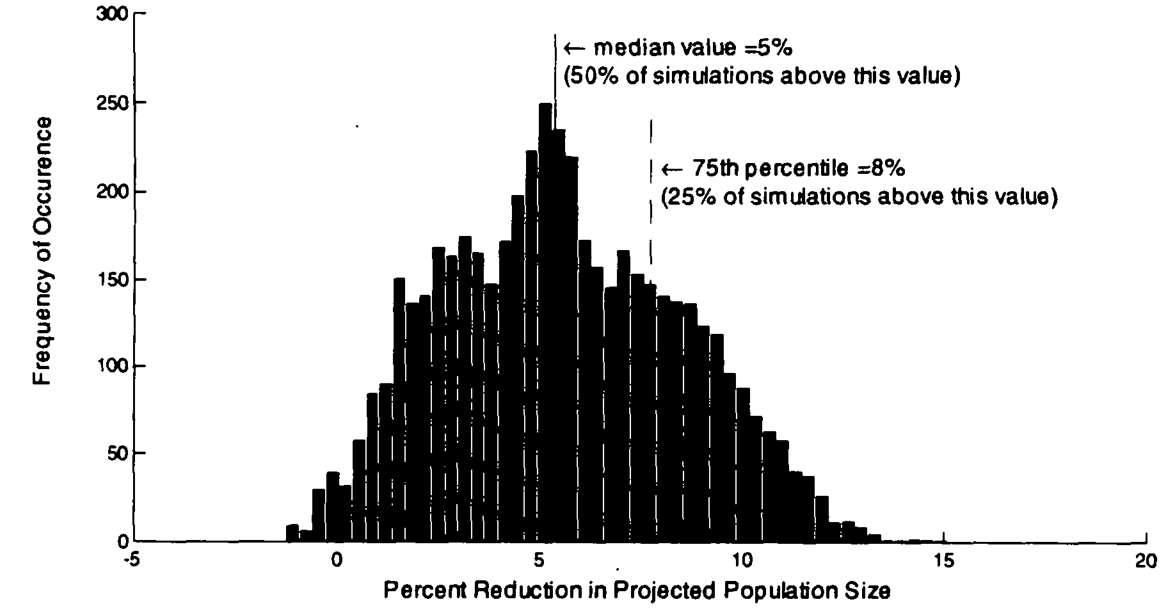


**Figure 10.** Results from first suite of 5000 simulations, showing frequency distribution of percent differences in population size (after 20 years) between simulations with vs. without translocation. In this scenario, capture intensity was low and growth was depressed ($\lambda$=0.99) in the center of the range (sub-population M). Values to the left of 0 indicate an increase in final population size with translocation, while values to the right indicate a reduction due to translocation. A solid red vertical line indicates the median value, while a brown dashed line indicates the 75th percentile.

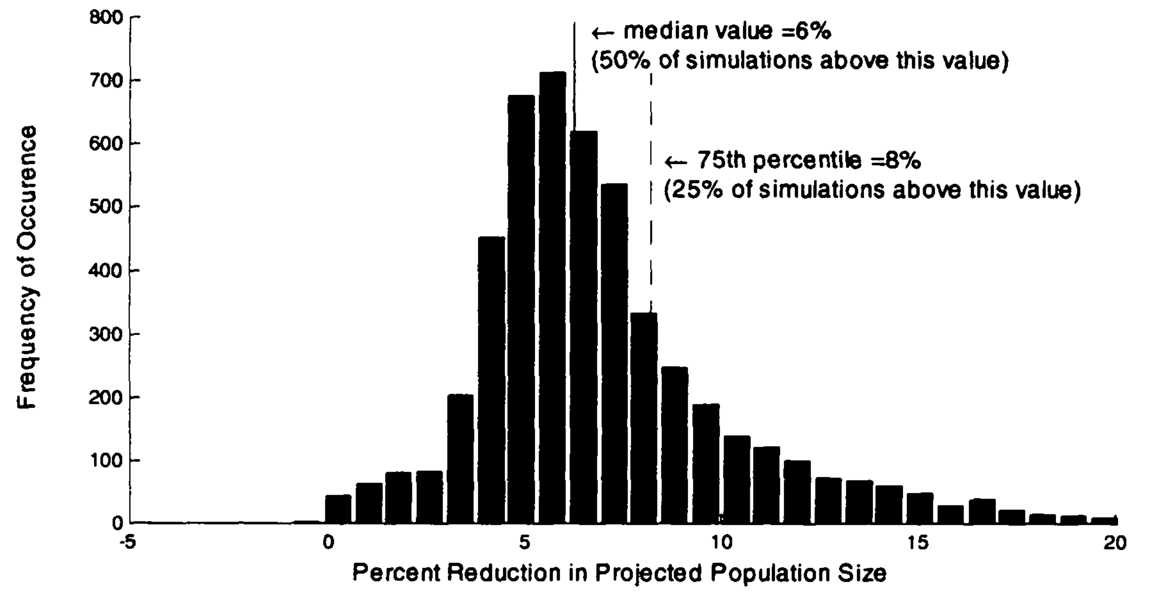


**Figure 11.** Results from second suite of 5000 simulations, showing frequency distribution of percent differences in population size (after 20 years) between simulations with vs. without translocation. In this scenario, capture intensity was high and growth was depressed ($\lambda$=0.99) in the center of the range (sub-population M). Values to the left of 0 indicate an increase in final population size with translocation, while values to the right indicate a reduction due to translocation. A solid red vertical line indicates the median value, while a brown dashed line indicates the 75th percentile.

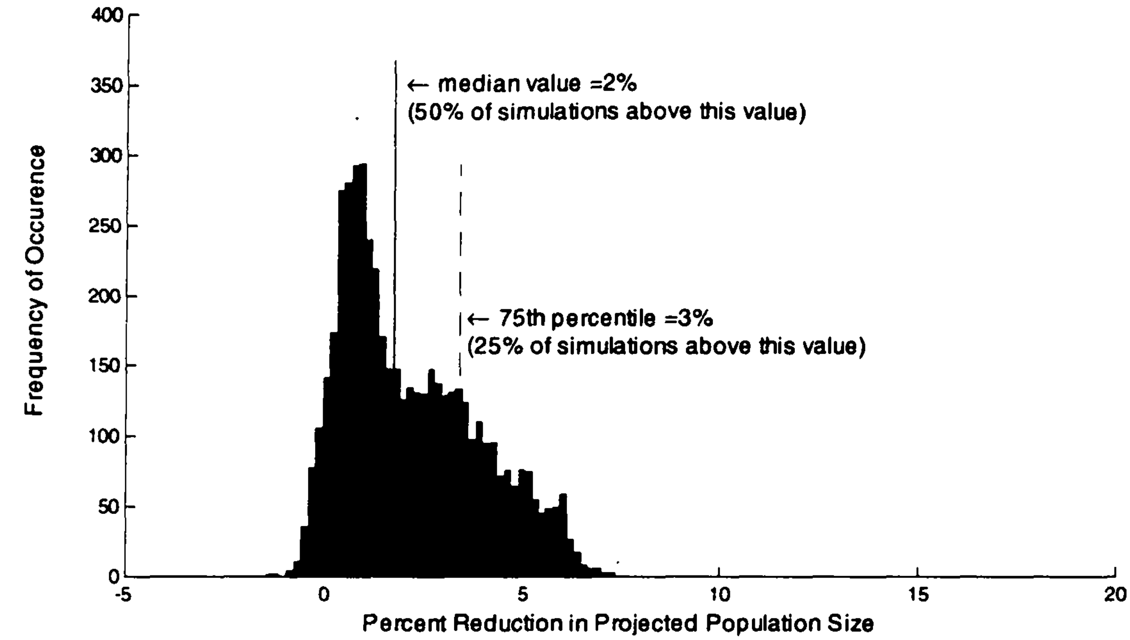


**Figure 12.** Results from third suite of 5000 simulations, showing frequency distribution of percent differences in population size (after 20 years) between simulations with vs. without translocation. In this scenario, capture intensity was low and growth rate was constant ($\lambda$=1.03) throughout the range. Values to the left of 0 indicate an increase in final population size with translocation, while values to the right of 0 indicate a reduction due to translocation. A solid red vertical line indicates the median value, while a brown dashed line indicates the 75th percentile.

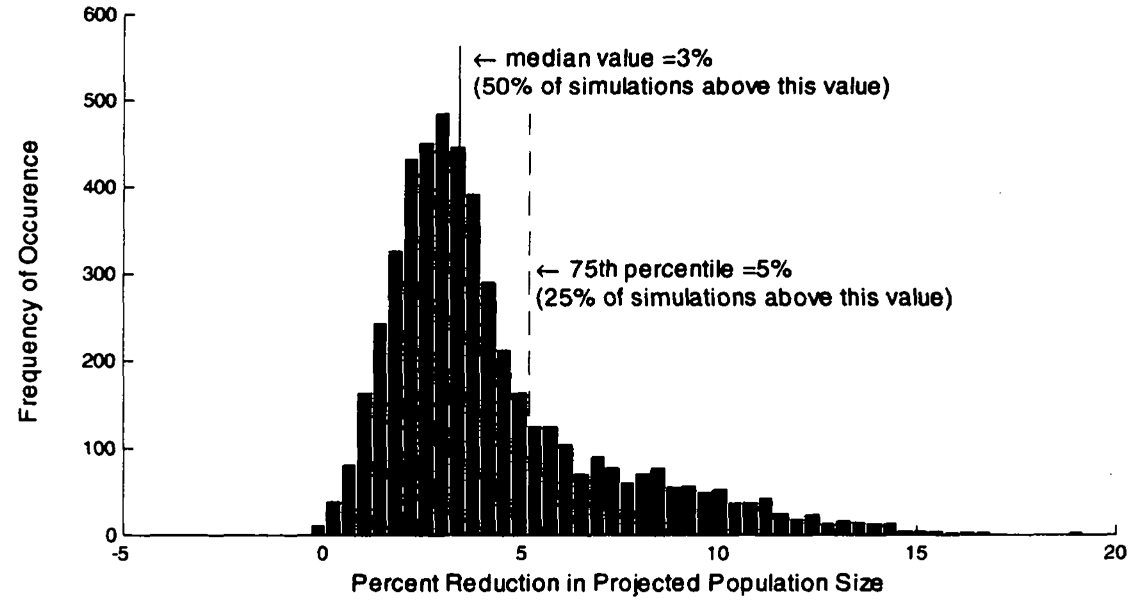


**Figure 13.** Results from fourth suite of 5000 simulations, showing frequency distribution of percent differences in population size (after 20 years) between simulations with vs. without translocation. In this scenario, capture intensity was high and growth rate was constant ($\lambda$=1.03) throughout the range. Values to the left of 0 indicate an increase in final population size with translocation, while values to the right of 0 indicate a reduction due to translocation. A solid red vertical line indicates the median value, while a brown dashed line indicates the 75th percentile.

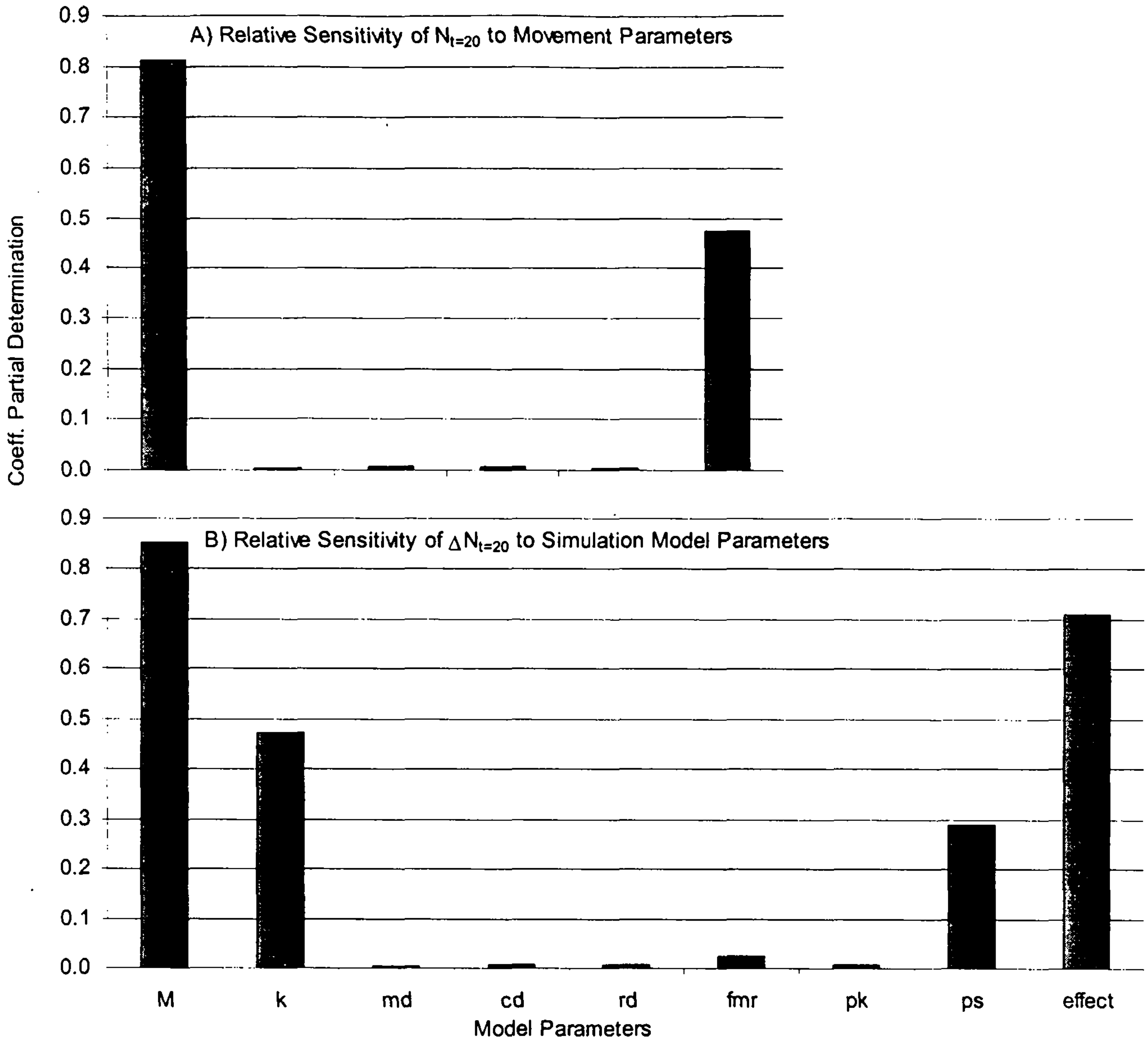


**Figure 14.** Results of a sensitivity analysis of the simulation model parameters: sensitivity is represented as the proportion of variance in a model response variable attributable to each model parameter, measured by the coefficient of partial determination. A) Response variable is final population size after a 20-year simulation run, assuming no translocation ($N_{t=20}$). B) Response variable is decrease in final population size (due to translocation) after a 20-year simulation run ($\Delta N_{t=20}$). The relative sensitivity is shown for the movement parameters (*M, k, md, cd, rd, fmr*) and for the parameters determining direct effects of translocation on animals: *pk, ps* and *effect* (*e*).

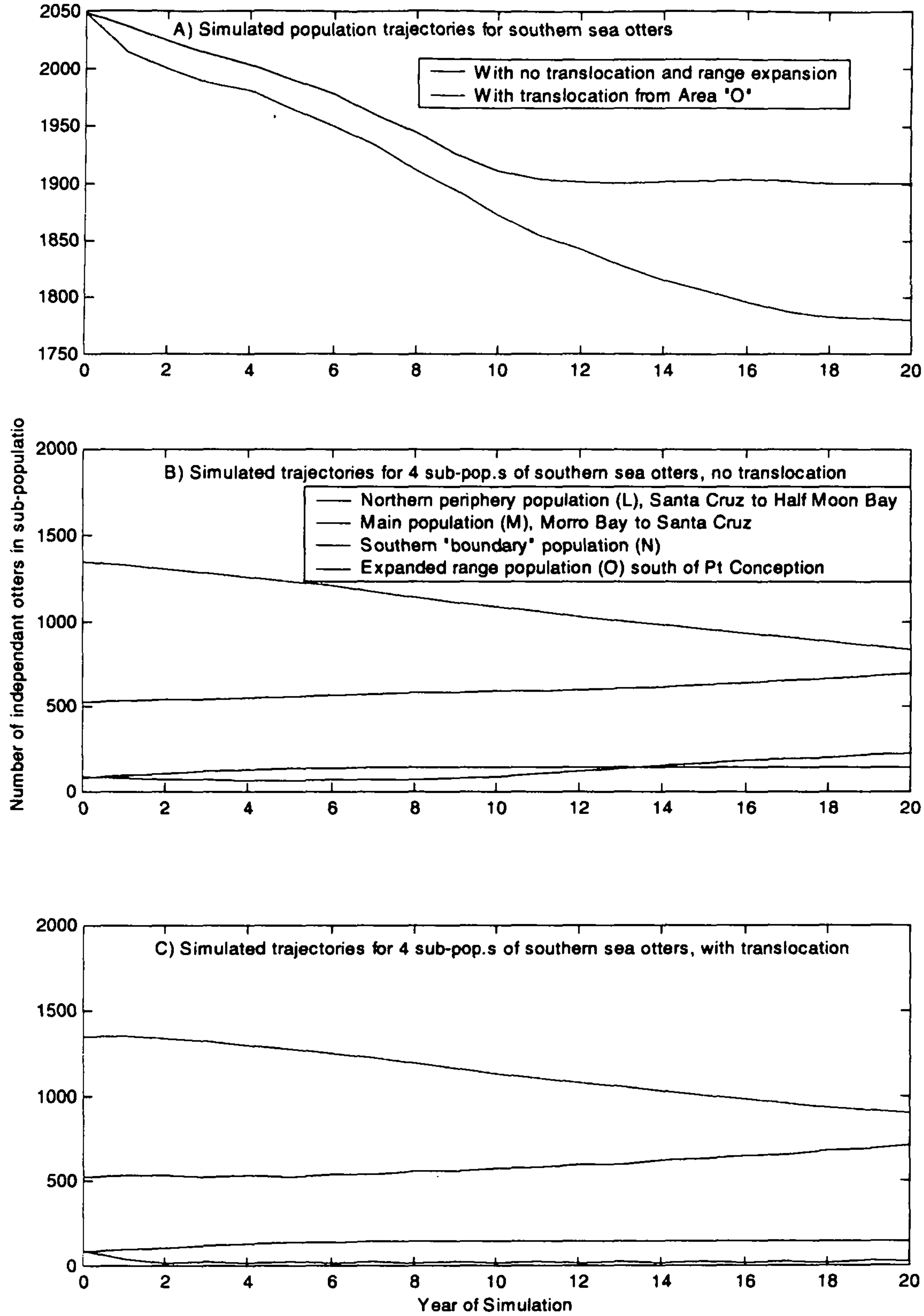


**Figure 15.** Sample model results from a single simulation run of 20 years. Top: entire population, with and without translocation. Middle: 4 sub-populations without translocation. Bottom: 4 sub-populations with translocation. These results were obtained under scenario 2, in which capture intensity was high and growth was depressed ($\lambda$=0.99) in the center of the range (sub-population M). Model parameters were set to the best fit or "most likely values", as listed in Table 4.

2

PERKINS COIE LLP

607 FOURTEENTH STREET, N.W. · WASHINGTON, D.C. 20005-2011
TELEPHONE: 202 628-6600 · FACSIMILE: 202 434-1690

January 21, 2000

Mr. Michael Spear
Manager
California/Nevada Operations Office
U.S. Fish and Wildlife Service
2800 Cottage Way, Room W-2606
Sacramento, CA 95825

**Re: NEPA Compliance for Southern Sea Otter Conservation**

Dear Mr. Spear:

On behalf of Friends of the Sea Otter, we are writing to express concern over the status of National Environmental Policy Act ("NEPA") compliance for southern sea otter conservation efforts and to respond to the Service's letter of January 11, 2000.

As discussed in our letter of September 14, 1999 (see attached), the severe problems confronting this species require supplemental NEPA compliance before any action can be taken that might place sea otters at risk. In particular, capture and removal of sea otters from the so-called management zone south of Point Conception is impermissible because, among other legal deficiencies discussed in our previous letter, such action has not been subjected to the required NEPA analysis taking account of current circumstances and analyzing environmental impacts that would occur now should such action occur. As a result of the Service's January 11 letter, we understand that additional NEPA compliance will occur with respect to the review of the status of the San Nicolas Island translocation. We appreciate that information and the Service's response, but request confirmation that no action will be taken to implement zonal management because, among the other legal problems identified in our prior correspondence, the NEPA review for such action is no longer adequate.

The southern sea otter is experiencing a serious, sustained and unexplained decline that threatens its continued existence. At the same time, the translocation to San Nicolas Island has not succeeded, and the species is demonstrating the need for

[09901-9700/DA003670.170]

range expansion to the south. This combination of factors puts the southern sea otter in a precarious situation, one about which there is insufficient biological knowledge and a lack of understanding regarding environmental consequences.

FSO and other organizations previously commented on the failure of the zonal management program as implemented pursuant to the 1986 translocation law and that the capture and removal of sea otters from the management zone would present a serious threat to this species. Indeed, the zonal management program is now a serious impediment to sea otter conservation in accordance with the mandates of the Endangered Species Act and the Marine Mammal Protection Act.

We have previously commented to you that any action to capture and remove sea otters for zonal management purposes would be unlawful under the ESA, MMPA and the translocation law and opposed by our organization. The purpose of this letter is to reiterate our point that any action to capture and remove sea otters also would violate NEPA.

The zonal management program is a continuing agency action for purposes of NEPA compliance. See, e.g., Greenpeace v. National Marine Fisheries Serv., 55 F. Supp. 2d 1248 (W.D. Wa. 1999) (amendments to fishery management plans for North Pacific fisheries are ongoing federal actions); Fund for Animals v. Clark, 27 F. Supp. 2d 8 (D.D.C. 1998) (bison and elk feeding programs are ongoing actions), appeal dismissed without op., 1999 U.S. App. LEXIS 33866 (D.C. Cir. 1999); Morris County Trust for Historic Preservation v. Pierce, 714 F.2d 271 (3d Cir. 1983) (urban renewal project over which federal agency retained authority deemed ongoing action). As such, FWS has a duty to ensure that it remains in compliance with the environmental review requirements of NEPA until such time as zonal management is rejected and the management zone eliminated. See Stop H-3 Ass'n v. Dole, 740 F.2d 1442, 1463 (9th Cir. 1984), cert. denied, 471 U.S. 1108 (1985).

NEPA compliance for the southern sea otter zonal management program derives from the 1986 EIS for the translocation. That EIS was prepared on the basis of information that is now outdated and based upon assumptions and policy objectives that no longer apply. Since that EIS was published, the southern sea otter population has entered a severe, sustained decline. Incidental take, thought to have been controlled, now appears to be a problem. Sea otters now show a significant susceptibility to disease. The habitat range north of Pt. Conception, once thought to be sufficient for recovery, is now known to be inadequate. Capture and removal, believed in 1986 to be capable of implementation on a nonlethal basis, is now known to result in unacceptably high mortality. The consequences of an oil spill for sea otters, as evidenced by Exxon Valdez, are now understood to be more severe than was understood in 1986. And, unfortunately, the San Nicolas Island translocation has not been successful.

All of these, and other, factors are developments that have emerged since 1986 when the EIS was prepared. Had this information been available then, it is doubtful zonal management would have been undertaken at all. Clearly, with this new information at FWS' disposal, no basis exists to undertake sea otter containment south of Pt. Conception based upon the outdated 1986 EIS.

As the courts have made clear, an action agency's NEPA responsibilities continue even after an EIS has been issued. As stated by the Supreme Court: "NEPA does require that agencies take a "hard look" at the environmental effects of their planned action, even after a proposal has received initial approval." Marsh v. Oregon Natural Resources Defense Council, 490 U.S. 60, 373-74 (1989). The current situation confronting the southern sea otter readily meets the test for new NEPA review before any containment action could be taken. In the Supreme Court's formulation of the test, 'if the information is sufficient to show that the remaining action will "affect the quality of the human environment" in a significant manner or to a significant extent not already considered a supplemental EIS must be prepared.' Id. See also Price Rd. Neighborhood Ass'n, Inc. v. Dep't of Transp., 113 F.3d 1505 (9th Cir. 1997); Enos v. Marsh, 769 F.2d 1363 (9th Cir. 1985); Stop H-3 Ass'n, 740 F.2d at 1463-64. For the reasons noted above, the 1986 EIS is now insufficient to support continuation of the zonal management program as it relates to capture and removal of animals in the management zone.

FWS is now conducting decisionmaking on whether to declare the translocation a failure and terminate zonal management. While FSO opposes the removal of sea otters from San Nicolas Island, an action clearly contrary to the recovery needs of the species, we urge FWS to proceed promptly with decisionmaking on the termination of the management zone. In the meantime, FWS is not legally authorized to undertake any containment action for the reasons discussed in this letter and our previous correspondence.

As discussed in the Service's January 11 letter, we understand that NEPA compliance will be undertaken in connection with the decision whether to declare the translocation a failure. Such a review must account for all of the factors discussed in this letter, and provide an updated and accurate assessment of the environmental consequences associated with zonal management. FWS should promptly publish a Notice of Intent to undertake this NEPA compliance, 40 C.F.R. § 1506.6, and in doing so make clear that the environmental consequences of maintaining the now discredited and inappropriate translocation zone at Pt. Conception will be fully assessed.

Thank you for your considering these concerns. If we can be of assistance to FWS in carrying out the actions discussed in this letter, please contact any of us.

Sincerely,

Donald C. Baur

Stuart L. Somach
Decuir & Somach
The Wells Fargo Center
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Attachment

cc: The Honorable Donald J. Barry
The Honorable Jamie R. Clark
The Honorable Robert Hight
Elizabeth H. Stevens
John R. Twiss, Jr.

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August 4, 1998

The Honorable Jamie R. Clark
Director, U.S. Fish and Wildlife Service
Department of the Interior
Room 3256
1849 C Street, N.W.
Washington, D.C. 20240

Re: Sea Otter Recovery; Statement of Legal Concerns Pursuant to Section 11(g) of the Endangered Species Act

Dear Director Clark:

We are writing to express the concerns of Friends of the Sea Otter ("FSO") over the current status of the southern sea otter (Enhydra lutris nereis). Only a few years ago, the southern sea otter population was growing and appeared to be on the road to recovery. Unfortunately, this population is now experiencing a sustained and serious decline that threatens to cancel the progress that has been made in prior years. This decline, combined with the presence of threats caused by human activities, could very well place the southern sea otter at risk of slipping from ESA "threatened" to "endangered" status. Immediate action is necessary to reverse this course and implement meaningful measures that will once again make recovery of the subspecies a realistic possibility. The purpose of this letter is to advise you of the steps FSO considers necessary for this purpose.

**Status of the Southern Sea Otter (Enhydra lutris nereis)**

Before discussing the measures that must be taken to protect and recover the southern sea otter, the current status of the population is reviewed.

The spring 1998 southern sea otter population survey resulted in a total count of 2114 animals, down from a high of 2377 in spring 1995. This count dropped 4.2% between 1995-96, 2.2% between 96-97, and 5.2% between 97-98.

If this decline continues, the population may be listed as "endangered" by the year 2001. This is a most alarming trend.

The population is currently found along the mainland California coast from just north of Pt. Año Nuevo to Purisima Pt. A small group of about 14-16 otters remains at San Nicolas Island as a result of the translocation effort authorized by Public Law No. 99-625 ("the Translocation Law"). As part of that Law, a zone was established south of Pt. Conception within which sea otters would not be provided with the full protections otherwise extended to the subspecies by the Endangered Species Act ("ESA") and the Marine Mammal Protection Act ("MMPA"). Recently, a group of up to 100 sea otters have moved into this zone.

Although the southern sea otter has been listed under the ESA since 1977, the principal threats to the subspecies have not been removed. Chief among these is the risk of a spill of oil or other substance from vessels transiting the California coast. Recently (summer 1998) the U.S. Coast Guard ("USCG") and NOAA announced voluntary measures for a Vessel Traffic Agreement that will help keep tankers and similar vessels a safe distance off the central California coast. The policies in this agreement still have, at least, another year before they are approved by the International Maritime Organization. Even if approved by then, it is unlikely the vessel routing improvements could be fully implemented before the year 2002. The measures outlined in the USCG/NOAA Vessel Traffic Agreement are a step in the right direction. But until then, there is a conspicuous absence of measures for reducing the risk of oil spills—measures which could help protect otters and other sensitive biological resources. Other threats continue to exist, including entrapment in fishing gear, pollution, malicious taking, disease, and loss of food biomass. These threats, combined with ongoing population decline, place the southern sea otter in a truly precarious situation. Immediate action is needed.

## Status of the San Nicolas Island Translocation

The southern sea otter translocation to San Nicolas Island was undertaken pursuant to a special law enacted by Congress in 1986 (the Translocation Law). The purpose of the translocation was to promote sea otter recovery by establishing a second population remote from the mainland range to ensure that an oil spill would not impact the entire subspecies, threatening it with extinction.

Two factors have come into play to demonstrate that the translocation has not been successful. First, after eleven years, the number of otters at San

Nicolas is far below expectations. Between 1987 and 1990, 139 otters were translocated to the island. Now, as of spring 1998, only 14-16 otters are evident (it was originally expected there would be over 500 otters by this time). Although this small population may eventually thrive, it is clear that the criteria for a successful translocation has not been met.

Second, the Exxon Valdez oil spill demonstrated that a spill of similar size in California could cover all the current sea otter range and habitat (including San Nicolas Island). We are now aware that the existence of even a thriving population of otters at San Nicolas would not be sufficient to justify delisting.

Because of these developments, FSO believes that the San Nicolas translocation must be considered a failure pursuant to two sections of the Translocation Law, and pursuant to one condition of the U.S. Fish and Wildlife Service ("FWS")/California Department of Fish and Game ("CF&G") MOU:

1.) Under 50 C.F.R. § 17.84(d)(8)(ii), the translocation has failed because fewer than 25 otters were present in the translocation zone within three years from the initial transplant and the reason for emigration/mortality has not been determined. Indeed, fewer than 25 otters have been present at San Nicolas since 1992.

2.) Under 50 C.F.R. § 17.84(d)(8)(v) the translocation has failed because the health and well-being of this population is seriously in question due to its small size and apparent inability to increase.

3.) Condition 5 of the FWS/CF&G MOU provides for a determination of failure if sea otters have been established in the management zone (i.e., south of Pt. Conception) in "numbers that exceed the ability of cooperative efforts to capture and remove" them. Such a situation has occurred.

FSO requests that FWS promptly proceed with the steps necessary to declare the translocation a failure.

## Range Expansion

FSO considers the movement of sea otters to areas south of Pt. Conception a positive and natural development. It was originally believed that an increased otter population was the primary key to recovery. Now, it seems that additional range (habitat) may be needed. When the Translocation Law was established, it made it clear that a sea otter management zone (areas south of Pt. Conception) cannot include "the existing range of the parent population or adjacent range where expansion is necessary for the recovery of the species" (emphasis added). If a healthy and thriving population were migrating into the management zone, there may be justification (under the Translocation Law) for relocating the otters. However, currently the population appears unhealthy, and its numbers are declining Therefore, range expansion may be necessary for recovery, and the otters should not be relocated to another area.

FSO is aware that the FWS is considering whether to capture these animals and move them elsewhere. This consideration is being given because, pursuant to the Translocation Law, FWS established a so-called management zone south of Pt. Conception within which ESA/MMPA protections are relaxed and sea otters are to be captured by non-lethal measures and removed. FSO believes that, given the current declining status of the subspecies, such action is ill-advised and contrary to the intent of the Translocation Law and the ESA. These otters should be left in place for the following reasons:

1.) Capture and removal is high risk for the otters. Based on previous translocation experience, it is known that otters, especially males, are very likely to die in such an effort. For this reason, such capture/relocation would violate the requirement of the Translocation Law for non-lethal containment. Public Law No. 99-625, § l(b)(4); 50 C.F.R. § 17.84(d)(6)(i).

2.) In addition, it is not known to what location the captured animals should be moved. Despite decling numbers in other parts of the sea otter range; if otters are moved back north, into their current range, there may be increased: i) competition for food, ii) compression of existing habitat, iii) territorial male competition for space, and iv) vulnerability to disease and pollution that apparently is affecting otters to the north.

3.) It is clear that range expansion of this nature may be necessary for conservation of the subspecies, including recovery. The Translocation Law requires that a management zone be established in such a way so as to accommodate conservation of the subspecies, including recovery through range expansion. Although establishing a management zone south of Pt. Conception may have seemed reasonable 12 years ago, current knowledge demonstrates that this artificial line is now inappropriate. H.R. No. 124, 99th Congress, 1st Session, 16 (1985).

4.) The management zone concept was based on the premise that sea otters would successfully establish at San Nicolas Island. In effect, this was a quid pro quo arrangement. The San Nicolas population has not been successful; therefore, the necessary precondition for maintaining the management zone does not exist. Indeed, Congress made clear that in the event the subspecies experiences a serious decline, as now very well may be occurring, "this provision [the Translocation Law] would not prevent the Secretary from exercising his authority to list the California sea otter as endangered and accord both the parent and experimental populations the full protection of the Act." Id. at 14. Thus, Congress has envisioned a situation where otters would be left at San Nicolas and along the mainland coast, notwithstanding the provisions of the Translocation Law.

5.) The cost of capturing and relocating so many sea otters is sure to be prohibitive, both in dollars and resources invested. FSO believes those funds would be much better spent on other sea otter priorities, such as investigations into the cause(s) of the current decline, rather than to move otters away from a location where they should be present in any event.

6.) There is no question that this range expansion is in the best interests of the southern sea otter. For FWS to undertake containment, an action clearly contrary to conservation of this subspecies, would violate the agency's affirmative duty under section 7(a)(1) of the ESA. 16 U.S.C. § 1536(a)(l). Especially in light of its effects on the donor population, such action also would trigger section 7(a)(2), requiring consultation and a jeopardy determination. Id. § 1536(a)(2). Indeed, the current population decline has already triggered the duty to reinitiate consultation as a result of the availability of new information and changes in circumstances. 50 C.F.R. § 402.16(b). This reinitiated consultation should be undertaken now. FSO hereby requests FWS to undertake such a consultation at this time. Such an effort should include discussions with the Southern Sea Otter Recovery Team, which has considerable expertise on the key biological issues.

FSO is aware that FWS is now engaged in a public review of some of these questions. In large part, this review is intended to gather information pertinent to the containment question. FSO supports this dialogue and FWS's careful approach to decision making, but we believe it is necessary to consider the containment issue in the broader context of translocation failure and recovery of the subspecies. FSO is willing to participate in discussions on these issues with all affected interest groups. To focus principally on containment, however, ignores the underlying problems. FWS and the affected parties need to look at the big picture presented by the change in the status of the southern sea otter and the invalidation of the assumption that served as the basis for the translocation, the management of boundaries, and the containment concept. Hopefully, such a review will lead to a conservation program for the southern sea otter that has a broad base of support.

In summary, FWS should immediately initiate a public review process to declare the Translocation a failure and devise an alternative conservation program for the southern sea otter. At a minimum that program should include leaving all otters in their current locations subject to full protection of the ESA and MMPA, taking steps to halt the population decline and initiate a positive growth trend and eliminating the continuing threats to recovery.

## Recovery Plan

FWS has invested considerable effort in developing a revised Southern Sea Otter Recovery Plan ("the Plan"). FSO greatly appreciates this effort, and the hard work of the recovery team members. The issuance of a revised blueprint for sea otter recovery will be of great value in guiding future recovery actions.

Although FSO is anxious to see this Plan issued, we have some remaining concerns. Foremost among these is the need to ensure that the final Plan is developed only after additional input is obtained from affected parties. The final Plan should not be approved until an additional draft has been released for review and comment.

An additional concern relates to the content of the Plan. The Plan appears to contemplate delisting criteria based exclusively on population size. As discussed in our comment letters to FWS of September 20, 1996 and January 7, the delisting threshold of 2650 sea otters is far too low and is not in line with the accepted ESA principle of erring an the side of protecting the subspecies. Moreover, the Plan should not rely on population growth alone to signal recovery; management measures to address threats also must be identified. It is not sufficient to state that achieving a population milestone will itself constitute the sum and substance of the ESA recovery plan and leave the assessment of the recovery criteria to occur at that time. The Plan itself must consider these criteria and include specific measures to address, or state why such measures are not necessary or feasible. Particularly important is the linkage of recovery to resolving the oil spill risk to sea otters, and to understanding and mitigating what appears to be elevated mortalities due to disease, habitat degradation, and entrapment.

FSO is willing to work closely with FWS to address these recovery issues. To do so, FWS must agree to maintain the open dialogue on recovery planning that has worked so well in the past. And FWS must accept that the final plan will call for action-forcing mechanisms to truly address the risks that confront this threatened subspecies. The Recovery Team has done an excellent job in gathering and analyzing the relevant information and FSO hopes to have the opportunity to continue to work with the Team to bring about a final plan to guide future southern sea otter conservation efforts.

## Oil Spill Risk Reduction

Notwithstanding the recently-proposed USCG/NOAA Vessel Traffic Agreement, the risk of an oil spill still is a major threat to the continued existence of the southern sea otter, and the most significant obstacle to its recovery. As noted above, while vessel routing improvements have been proposed, they could not, even if fully approved, be fully implemented before the year 2002. The sea otter population could slip to endangered status by then if immediate corrective action is not taken.

FSO appreciates the hard work FWS has invested in the vessel traffic review process. The same is true for NOAA and the USCG. We encourage the FWS to continue to play an active role in this process. The USCG must follow through with a proactive approach to achieve these vessel traffic restrictions. It remains to be seen whether these actions will be taken. The importance of doing so is underscored by the fact that numerous actions pertaining to vessel traffic safety and routing appear to not have been reviewed under section 7(2) (a) of the ESA.[1]

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[1] Examples of these actions include:

1.) The development of the United States position before the International Maritime Organization with respect to vessel transit routes off the coast of California.

2.) The designation of the Traffic Separation Schemes ("TSS") for San Francisco and Santa Barbara Channel.

3.) Implementation of oil spill vessel response plans under the Oil Pollution Act of 1990, 33 U.S.C. §2701 et seq. ("OPA"), with specific reference to the California coast.

4.) Implementation of the requirements of Regulation 26 of the International Convention for the Prevention of Pollution from Ships ("MARPOL") (Annex I), requiring vessel response plans.

5.) Approval of individual vessel response plans under OPA 90 and Regulation 26.

6.) Approval of area contingency plans for the California coast under section 4202 of OPA 90. Id. § 1321(j)(4).

7.) Development and implementation of the May 19, 1993, Memorandum of Agreement on Marine Environmental Protection between USCG and the State of California.

In addition to oil spills, there are other threats to the southern sea otter. Over the past few years, sea otter mortalities have increased. There is evidence these mortalities are related to disease, pollutants, and possibly accidental catch in gill and trammel nets, fish traps, and shellfish traps. Nearly 40% of new otter deaths appear due to infectious disease. Also, recent tests of tissues of dead otters revealed high concentrations of heavy metals and a variety of contaminants. The potential for sea otters interacting with gill and trammel nets is becoming more of a concern. Recent data are showing that sea otters are diving more frequently to the depths of these nets. A new live-rockfish fishery, using wire cages (traps), has developed along the central California coast. These cages are unregulated, and some designs are capable of drowning otters. Sea otters are being found with classic drowning symptoms; net and trap entanglement may be responsible. FSO requests that the FWS play a significant role in resolving these threats to the southern sea otter.

## Research

Long-term conservation of the southern sea otter, as well as recovery itself, will require research on several key issues:

1.) Diseases: Determine infection rates, and how and to what degree infections are communicable.

2.) Pollutants: Determine impact and source of contaminants and toxins (heavy metals). Determine impacts of non-point-source runoff.

3.) Entrapment: Monitor incidental take of sea otters in gill and trammel nets, live-rockfish traps, and shellfish traps. Identify regulatory measures needed.

4.) Population numbers: Investigate the methodology used in arriving at a delisting number of 2650 animals.

5.) San Nicolas translocation: Compile data for declaration as a failure.

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8.) The promulgation of regulations implementing the International Safety Management Code (IMO Resolution A.647(16) requiring vessels to manage operations with regard to pollution prevention and reduction in environmental damage. 33 C.F.R. Part 96.

6.) Commercial shellfisheries: Determine impacts of abalone, urchin, crab, and lobster fisheries, on otters. Determine sustainability of shellfisheries.

7.) Squid fishery: Determine impact of nets and strong lights used (at night) in proximity to kelp beds inhabited by otters. Determine importance of squid as a food source for otters, and impacts of commercial squid fishing on food availability.

8.) Kelp harvesting: Evaluate impacts, on otters and fish populations, of hand-harvesting of kelp. Determine if current harvesting operations are sustainable.

9.) Food biomass: Determine availability of food biomass, including overfishing and contamination of food resources.

10.) Human disturbances: Evaluate impacts of human nearshore water users on distribution and behavior of otters.

11.) Municipal discharge: Evaluate as source of disease and toxins.

12.) Captive and rehabilitation programs: Evaluate in terms of otter population recovery.

To further investigate the causes of mortality in the southern sea otter population, the following recommendations have been proposed (Thomas and Cole 1996): [2]

1.) Completion of the 5-year intensive necropsy study through the National Wildlife Health Center (NWHC).

2.) Analysis of the population data through further investigation into the recent necropsy data.

3.) Identification of the key factors in the disease cycles.

4.) Development of comparative data with more vigorous sea otter populations.

5.) Continuation of a mortality monitoring system.

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[2] Thomas, N.J., and R.A. Cole. 1996. The risk of disease and threats to the wild population. Endangered Species Update. Special Issue: Conservation and Management of the Southern Sea Otter 13(12):23-27.

6.) Evaluation of the rates of disease exposure.

7.) Assess immune function.

8.) Assess research needed on several key southern sea otter issues as well as the recommendations for further investigations into the causes of mortality in the otter population.

FSO encourages the FWS to give these research initiatives high priority. We intend to follow up, with appropriate agency staff, on pursuing these priorities.

In summary, FSO believes there is strong justification for the FWS to pursue the following steps:

1.) Reinitiate consultation on the San Nicolas translocation.

2.) Devise, through an open dialogue with affected parties, an alternate conservation program for the southern sea otter. FSO believes that this program should include leaving all otters in their current locations subject to full protection of the ESA and MMPA.

3.) Take steps to halt the population decline, and initiate a positive growth trend.

4.) Develop a comprehensive research program, actively support necessary legislation and funding for research, and take the lead in research follow through.

5.) Update the most recent draft of the second southern sea otter recovery plan. The plan should provide more definitive oil spill protection, reflect the new concerns over sea otter population health, and address fisheries impacts on sea otters. Additional public review should be provided.

6.) Move forward with the implementation of vessel traffic restrictions through both domestic and international procedures.

FSO looks forward to working with FWS to address these high priority issues. If you have any questions about the recommendations in this letter, please contact FSO's Science Director, Jim Curland, at 831-373-2747.

Sincerely,

Jeffrey Calder
Executive Director, Friends of the Sea Otter

Ronald Stevens
President, Friends of the Sea Otter

cc: John Twiss, Robert J. Hofman (**Marine Mammal Commission**)
LaVerne Smith, Carl Benz, Diane Noda, Wayne White, Mike Spear (**U. S. Fish & Wildlife Service**)
Secretary Bruce Babbitt, Assistant Secretary Don Barry, Steven Alcorn (**U. S. Department of Interior**)
Jacqueline Shaffer, DeWayne Johnston (**California Department of Fish & Game**)
Dave Jessup, Pete Bontadelli (**OSPR**)
James Baker (**NOAA**)
Captain Harlan Henderson, Captain Larry Hall, Vice Admiral Thomas H. Collins (**U. S. Coast Guard**)
Doug Demaster, Jim Estes (**Sea Otter Recovery Team**)
Vicki Nichols (**Save Our Shores**)
Rachel Saunders, Warner Chabot (**Center For Marine Conservation**)
Armando Nieto (**Environmental Defense Center**)
David Phillips (**Earth Island Institute**)
Toni Frohoff (**Humane Society of the U.S.**)
William Douros (**Monterey Bay National Marine Sanctuary**)
Michelle Staedler, Andy Johnson (**Monterey Bay Aquarium**)
Brian Hatfield (**Biological Survey, USGS**)
The Honorable Sam Farr, The Honorable Lois Capps, The Honorable Elton Gallegly, The Honorable Bruce McPherson, The Honorable Jack O'Connell, The Honorable Fred Keeley, The Honorable Barbara Boxer, The Honorable Dianne Feinstein, The Honorable Brooks Firestone, The Honorable Tom Bordanaro
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September 14, 1999

The Honorable Bruce Babbitt
Secretary, U.S. Department of the Interior
1849 C Street, N.W., Room 6151
Washington, D.C. 20240

The Honorable Jamie R. Clark
Director, U.S. Fish and Wildlife Service
Department of the Interior
1849 C Street, N.W., Room 3256
Washington, D.C. 20240

**Re: Statement of Legal Concerns Pursuant to Section 11(g) of ESA**

Dear Secretary Babbitt and Director Clark:

On behalf of Friends of the Sea Otter (FSO), we are writing to you to reaffirm our strong objection to any containment action to be undertaken under Public Law 99-625 to remove southern sea otters from the so-called management zone south of Point Conception in California. Recently, the Commercial Fishermen of Santa Barbara, Inc. and the California Abalone Association, Inc. wrote to you expressing their intent to file a lawsuit to force such containment. The purpose of this letter is to advise strongly against taking such action and to encourage the U.S. Fish and Wildlife Service (FWS) to proceed promptly with a declaration of translocation failure and elimination of the management zone.

By letter of August 4, 1998 (copy enclosed), FSO wrote to you giving notice under section 11(g) of the Endangered Species Act, 16 U.S.C. § 1382(g), that undertaking taking containment would violate the Act. Such action also would violate the non-lethal containment requirement of Public Law 99-625, the translocation law. FSO further put the FWS on notice that the zonal management program undertaken by FWS violates Public 99-625 because the Point Conception management zone line fails to provide the territory required for the mainland sea otter population to grow and achieve recovery. Finally, FSO explained the numerous reasons the so-called zonal management program should be abandoned.

[10581-0001/DA992500.041]

Since FSO's letter, FWS has undertaken a comprehensive and commendable public review process to address the biological, legal, and policy issues associated with the southern sea otter translocation program. Although the two California fishing organizations that have sent you a notice of intent to sue now argue stridently for containment, we note that apparently neither organization bothered to submit written comments during that review. As the Service nears the completion of the initial phase of its decision-making process on the containment/translocation failure issue, we hereby reiterate that any action to carry out containment will be in violation of law and compel legal action by the environmental community. The grounds for such legal actions are stated in FSO's August 4, 1998 letter, and would include the section 7(a)(2) jeopardy prohibition, 16 U.S.C. § 1536(a)(2), and section 9(a)(1) take prohibition of the ESA, Id. § 1538(a)(1), and the take prohibition of sections 101(a)(1) and 102(a) of the Marine Mammal Protection Act. Id. §§ 1371(a)(1), 1372(a). Moreover, it is clear that the translocation plan itself as set forth in the regulations violates these provisions.

In addition, we note that the National Environmental Policy Act (NEPA) compliance for the translocation plans, especially any action taken with respect to containment, is seriously out-of-date and does not reflect the current factual situation or the resulting environmental impacts of such an activity. As a result, if the Service were to proceed with any containment action in the absence of preparing a supplemental EIS, it would be in violation of NEPA.

As discussed in FSO's August 4, 1998, letter, the quid pro quo for containment under Public Law 99-625 – the establishment of a successful southern sea otter colony at San Nicolas Island – has not come about. In addition, containment would imperil the animals to be moved, as well as those within the parent population. On account of the declining status of this seriously at-risk species, containment cannot be justified on any basis. In addition, containment cannot be rationalized on economic grounds. It is clear that the translocation must be declared a failure under 50 C.F.R. § 17.84. When this is done, hopefully in the very near future, there will be no basis for containment. Considering the expense and administrative burdens involved, it would be wasteful and inefficient to capture and remove sea otters. Indeed, the sea otter sighted in the management zone have been there only periodically, and it is not at all clear that containment would be appropriate under any circumstances for animals that have not become established in that zone. Clearly, the zonal management program envisioned by Public Law 99-625 has not worked and must be discontinued as a result of the commercial fishing groups' strident call for containment. Undertaking containment now therefore would be a futile and wasteful action, as well as one that is biologically unsound and unlawful.

Thank you for your attention to this matter. Please feel free to contact us if you have any questions.

Sincerely,

Donald C. Baur

Donald C. Baur

Stuart L. Somach

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Enclosure

cc: The Honorable Donald J. Barry
The Honorable Robert C. Hight
The Honorable John Leshy
The Honorable Mary Nichols
Michael J. Spear
John R. Twiss, Jr.