Appendix D: Population Status of the Southern Sea Otter

Population Status of the California Sea Otter*

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INTRODUCTION

The geographical range of the sea otter (*Enhydra lutris*) extends across the North Pacific Ocean from about the central Pacific coast of Baja California, Mexico, to northern Japan. Prior to the Pacific maritime fur trade, which began with the discovery of Alaska and the Aleutian Islands by the Bering Expedition in the mid-1700s, high density sea otter populations probably occurred more or less continuously throughout this region, but the species was systematically hunted to the brink of extinction by the end of the 19th century. Sea otters were afforded protection from further take in 1911, at which time about a dozen remnant colonies survived. One of these remnant colonies occurred near Bixby Creek along the then remote Big Sur coastline.

With protection, the surviving colonies began to recover. While early records of recovery are necessarily sparse, the population in central California clearly has increased at a slower rate than all or most others (Estes 1990). For instance, a naturally reestablished population at Attu Island (in the western Aleutian archipelago) and populations reestablished through reintroductions in Washington State, Vancouver Island, and southeast Alaska, all increased at 17-20% yr^{-1}, which is about the theoretical maximum rate of population growth for the species. Other populations in Alaska and Asia seem to have recovered at about the same rate. The California sea otter population, in contrast, has recovered at about 4 to 6% yr^{--1} at best.

While records of initial population size and early growth are spotty because of a lack of information prior to World War II and varying survey methods thereafter, the data are sufficient to demonstrate that growth rate of the California sea otter population was always slow, even early in this century. Nonetheless, both the range and population size marched steadily upward until about the mid-1970s, at which time numbers began to decline. As information from field studies accumulated, it became evident that California sea otters were being lost to incidental entanglement in a coastal set-net fishery and there was increasing concern that this was the cause of the decline. Loss estimates to the fishery made by the California Department of Fish and Game added credence to that possibility (Wendell *et al.,* unpubl. CDF&G report). The State of California instituted a limited emergency closure of the set net fishery in 1982, followed by a range-wide 15 fathom closure in 1985, and the number of animals counted during annual surveys began to increase shortly thereafter (Riedman and Estes 1990, Estes 1990). A standardized survey method also was developed and put into use in 1982. Briefly, the new survey procedures involved counting animals twice annually (early autumn and late spring) from shore in accessible stretches of coastline, and from a fixed-wing aircraft in the remaining areas. The data from 1982 onward thus are not confounded by methodological change and have been used to assess population trends over the past 16 years. In addition to total population size, the number of dependent pups are noted in each survey. These data, in conjunction with findings from several more in-depth studies (Jameson and Johnson 1993, Riedman *et al.* 1994) are sufficient to assess female reproductive rates and changes in reproductive success of the California sea otter population through time.

During this same period, information has been obtained on sea otter mortality from beach-cast carcasses in a salvage program that has been variously organized and managed over the years by CDF&G, FWS, and BRD. As is the case with surveys of the living population, the methods and level of effort have varied through the years. Perhaps the most significant methodological change occurred in 1992 when necropsies of fresh otter carcasses were undertaken by trained veterinary pathologists from the National Wildlife Health Center in Madison, Wisconsin. This effort identified infectious disease as the ultimate cause of death in about 40 percent of the beach-cast carcasses for California--a significant finding because it helped explain the relatively low growth rate of the California sea otter population.

This White Paper was written at the request of the Ventura Field Office of the Fish and Wildlife Service following the movement of about 100 otters in spring of 1998 into the area near Government Point south of Point Conception. The redistribution was problematic because it created a management dilemma for the Fish and Wildlife Service. Government Point is in the "no-otter zone" established by Public Law 99-625, and the Service therefore is legally obligated to remove these animals. However, removal of so many otters might also have a detrimental effect on the parent population, listed as Threatened under the Endangered Species Act. Thus, compliance with one law would result in violation of the other. Our intent here is to provide Fish and Wildlife Service with an overview of the biological information needed to formulate a response plan. Specifically, we will 1) summarize the most recent data on distribution and abundance of the California sea otter population, from which we will assess current population status; 2) summarize data on numbers of beach-cast carcasses and cause of death in these animals; 3) discuss possible reasons for a recent change in population trends; 4) discuss the likely consequences of strict compliance with Public Law 99-625; and 5) identify future information needs. We will not analyze the data in detail, but rather identify what, in our judgement, are the high points and most relevant conclusions.

TRENDS IN POPULATION ABUNDANCE AND DISTRIBUTION

Information on the distribution and abundance of sea otters in California prior to 1990 is summarized by Riedman and Estes (1990). Although both range and numbers have increased during the 20th century, these variables are not well correlated. In particular, whereas population abundance has experienced several periods of decline, distribution evidently has not retracted during these periods.

Range delineation is somewhat arbitrary because individuals frequently wander well beyond the distributional limits of most of the population. Nonetheless, the geographic range of the California sea otter has expanded greatly since 1938, at which time most individuals occurred in the area between Bixby Creek in the north to Pfeiffer

Point in the south. As the population increased over subsequent decades, range expansion to the south was consistently more rapid than it was to the north. By the late 1980s, the California sea otter's range had increased to include the area between about Point Año Nuevo at the north and Point Sal at the south. Although the number of otters continued to increase through the mid 1990s, range expansion to the south slowed and to the north it essentially ceased during this period. By 1995, sea otters were commonly seen as far south as Point Arguello and in 1998 a substantial number of otters dispersed into the "no-otter zone" south of Point Conception.

Population abundance of the California sea otter has steadily increased through the twentieth century, except for two periods. By 1976 the population contained an estimated 1,789 individuals, but then declined to 1,443 by 1979 and to 1,372 by 1984. Standardized range-wide counts, undertaken in the spring and fall of each year, were initiated in 1982. The spring surveys have traditionally been used to assess population status since they are both consistently higher than the fall surveys in any given year and less variable among years. The number of animals counted during spring surveys remained essentially constant until 1985, increasing steadily thereafter until the mid-1990s (Fig. 1A & 1B). However, since 1996, the total number of animals counted in the spring surveys has progressively declined. This trend is evident in both the yearly counts (Fig. 1A) and in the same data plotted as 3-year running averages (Fig. 1B). Running averages were used to eliminate year-to-year vagaries in any given count, thus emphasizing overall trends. Trends in the spring counts thus indicate that the California sea otter population recently has declined. The fall counts show a similar pattern (Figs. 1C & 1D).

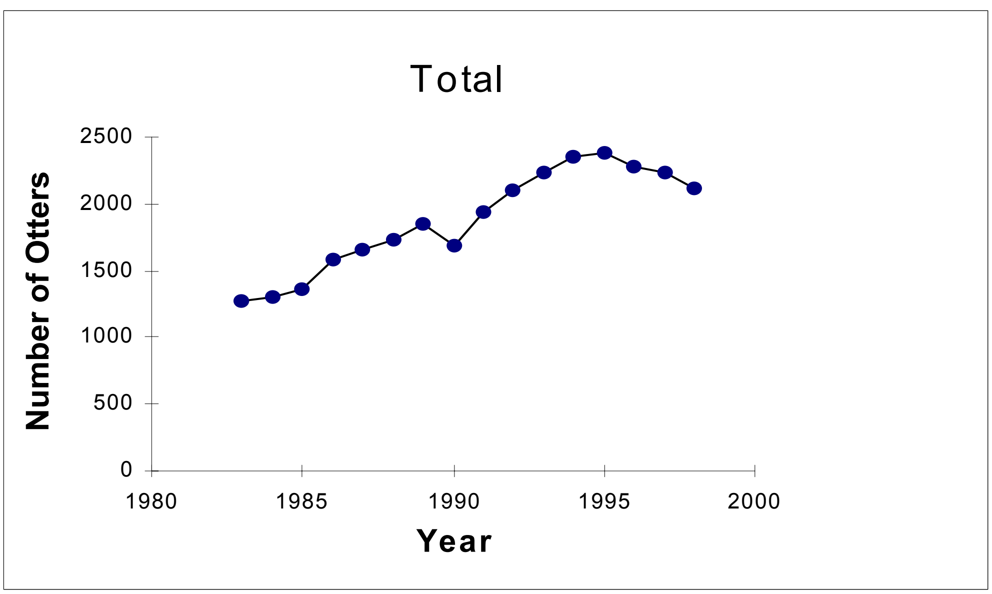

Figure 1A. The total number of sea otters counted from 1982 through 1998 during spring surveys.

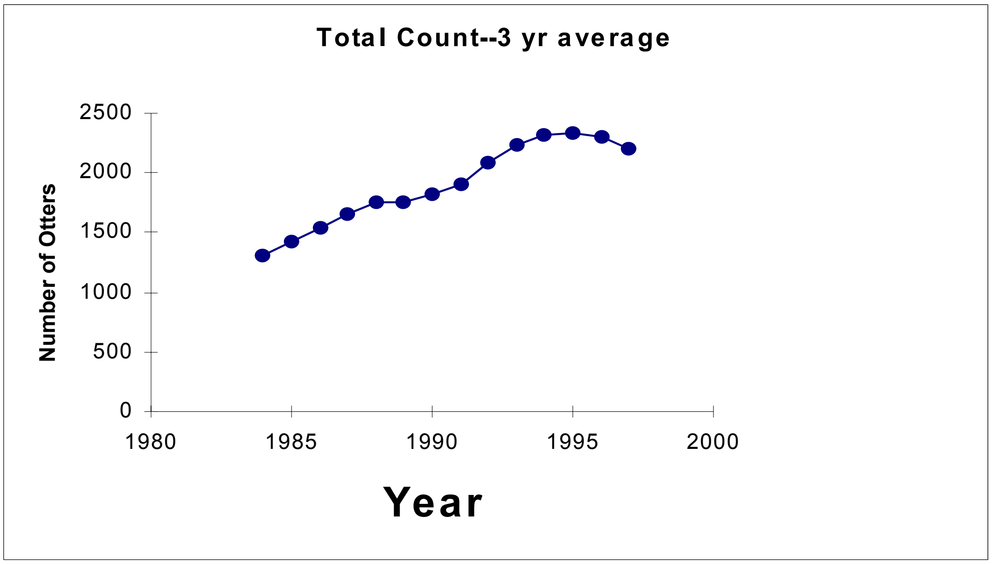

Figure 1B. Total number of sea otters counted during the spring surveys, plotted as 3-year running averages.

TRENDS IN MORTALITY

Our assessment of sea otter mortality in California is based on information obtained from beach-cast carcasses. Two measures are available: 1) the number of carcasses retrieved and 2) the cause of death in fresh carcasses. The number of carcasses recovered through time shows an overall pattern that is roughly consistent with population growth (Fig. 2). However, relative mortality patterns (measured by dividing the number of carcasses retrieved in a given year by the number of otters counted in the spring survey of that same year) indicate several departures from a time-constant relationship (Fig. 3). These data suggest further that mortality was roughly constant at about 5% yr^{-1} during the period of population increase (i.e., from about 1985 through 1994) but increased somewhat during periods of decline (i.e., the early 1980s and from 1995-1998). In sum, the available information suggests that the size of the California sea otter population has declined and mortality has increased over the past several years.

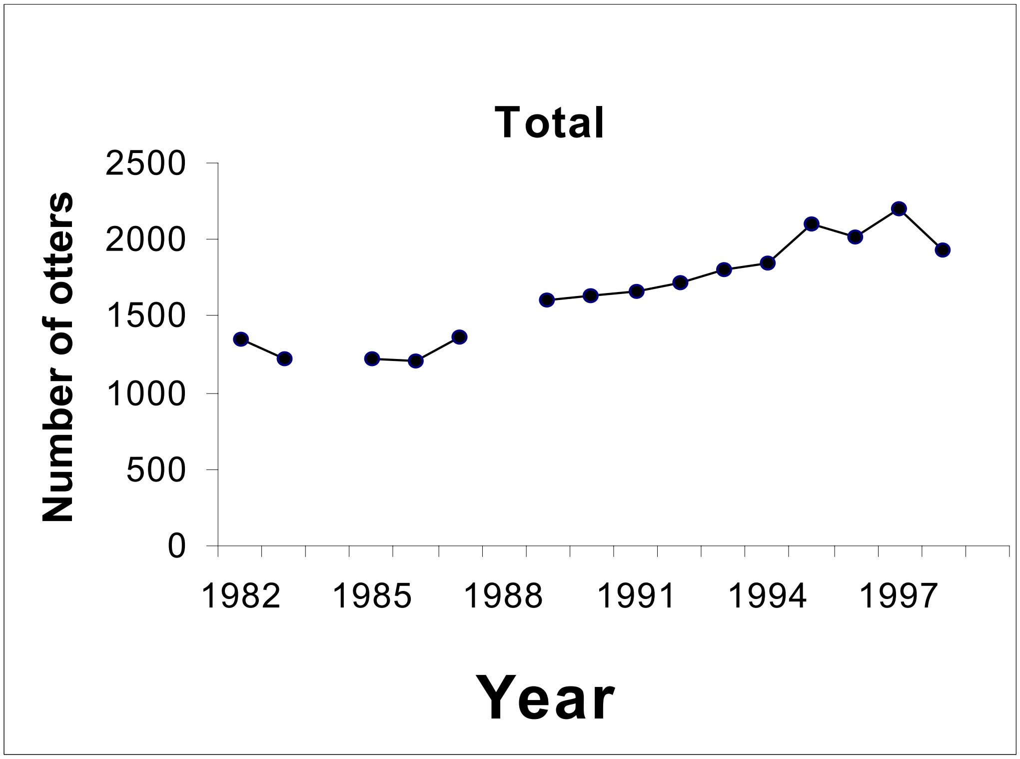

Figure 1C. Total number of sea otters counted from 1982 through 1997 in autumn surveys. Autumn surveys were not conducted in 1984 or 1988.

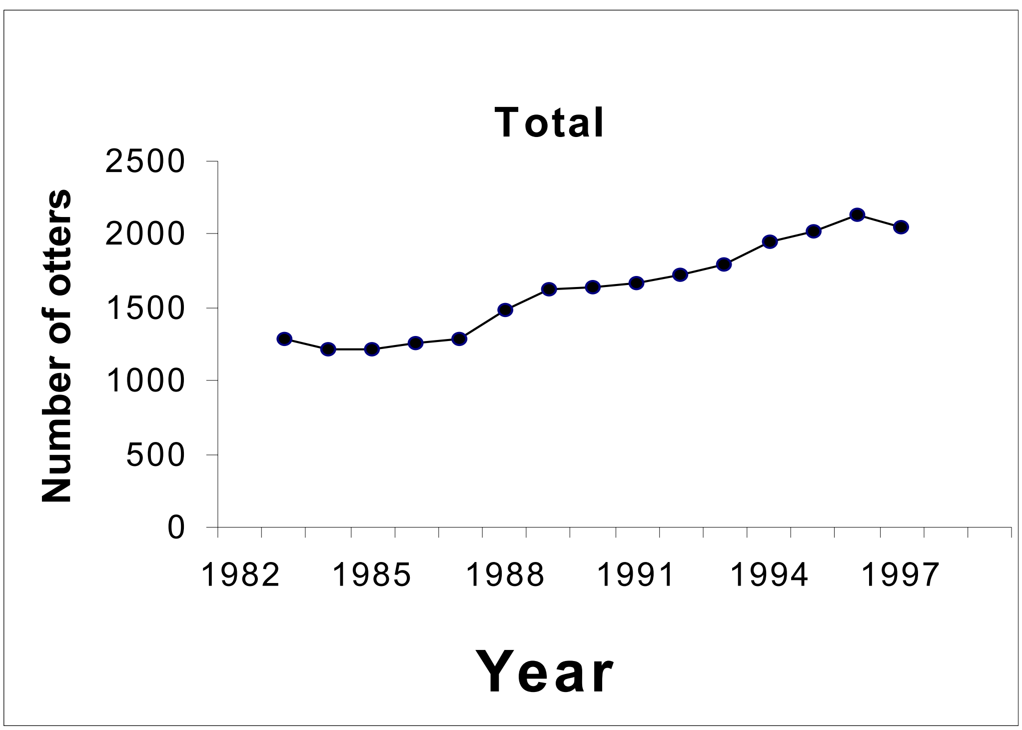

Figure 1D. Total number of sea otters counted in autumn surveys, plotted as 3-year running averages. No autumn surveys were conducted in 1984 and 1988; therefore years 1983-85 and 1987-89 are represented as 2-year averages.

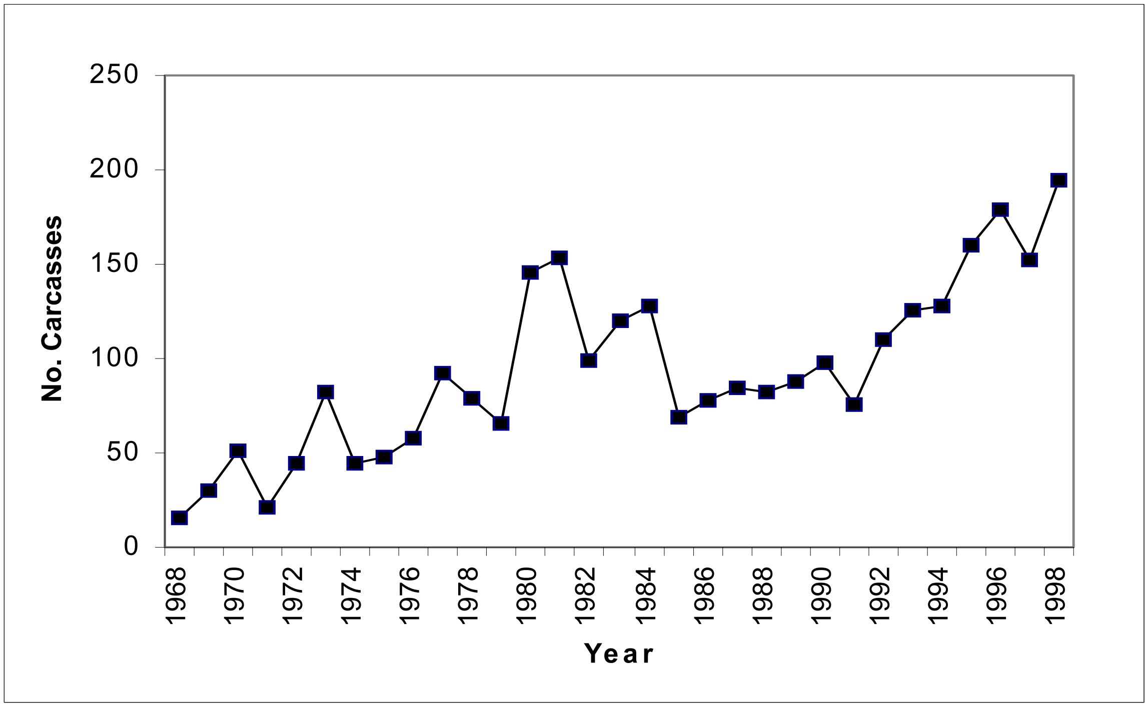

Figure 2. The number of beach-cast sea otter carcasses recovered by year from 1968 through 1998. Note that since 1998 is not yet over, the value was estimated by adding the number retrieved through September 1998 (172) to the most recent 10-year average number of carcasses recovered from October through December (22.9), for a total of 194.9.

Two explanations for increased mortality and reduced population abundance in the California sea otter have been suggested—infectious disease and incidental losses in coastal fishing gear. Because thorough necropsies have been done on fresh carcasses since 1992, it is possible to make a preliminary evaluation of the disease hypothesis. Inasmuch as the elevated mortality rate and declining abundance did not begin until about 1995, the incidence of infectious disease- induced mortality also should have increased concurrently if this were responsible for recent trend changes in the population. No changes in the rate of infectious disease are evident since 1992 (Fig. 4).

Nonetheless, two conclusions can be drawn about the influence of infectious disease on California sea otter populations. First, infectious disease must be an important factor in causing the slow growth rate, given that disease is responsible for roughly half of the deaths of animals obtained in the salvage program. Since the reproductive rate of California sea otters is comparable to that of other populations that are growing more rapidly, it follows that growth rate of the California population would be much higher in the absence of disease. The magnitude of this potential gain is unknown although it probably could be determined through population modeling. Second, the collective data suggest that the incidence of infectious disease may have been high throughout this century. The California sea otter population has never increased at more than about 5 % yr^{-1}, thus implying that mortality rate has not changed appreciably during the period of recovery. We also know that disease rate was high in the early 1990s, a time when the population was increasing at about 5 percent yr^{-1}. Therefore, if the rate of infectious disease has increased in recent years, some other source of mortality must have declined concurrently. Although such changes are conceivable, there is no reason to believe that they have occurred.

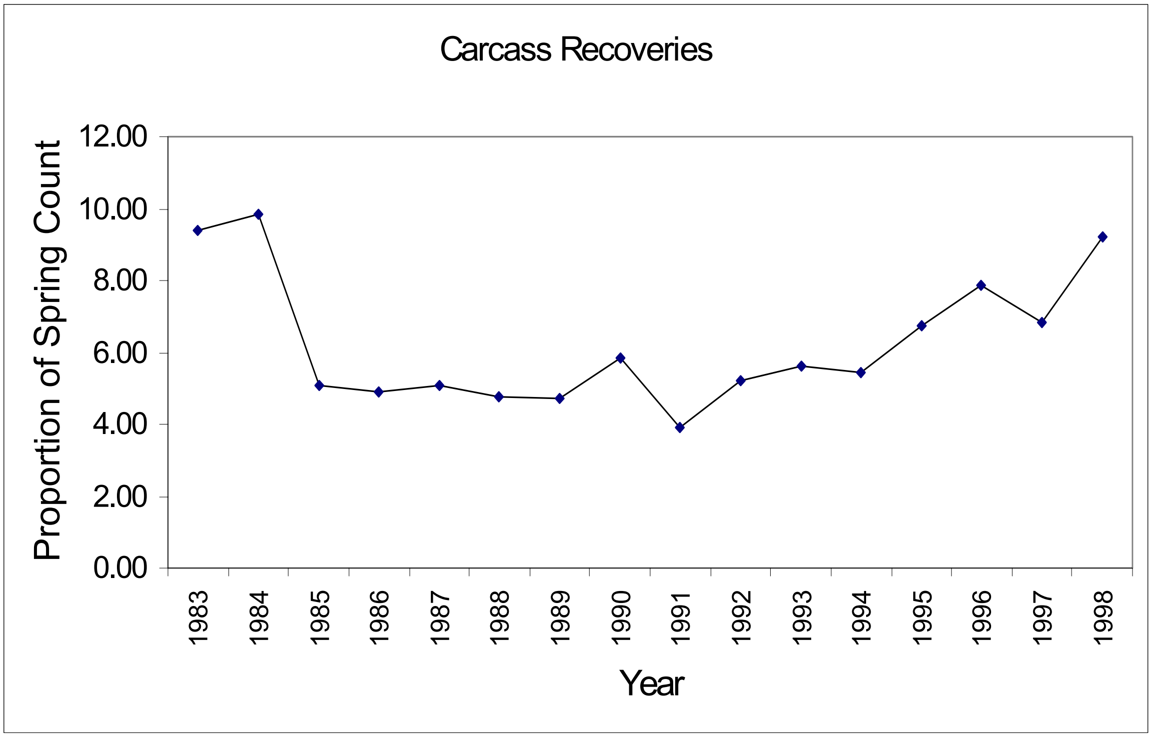

Figure 3. The relative number of sea otter carcasses retrieved by year. Proportions were determined by dividing the number of carcasses recovered by the number of otters counted in the spring surveys (x100).

While coastal pot fisheries are known to have intensified in recent years, and there are unconfirmed reports of otters having been killed by swimming into these pots for either their bait or targeted catch, we do not yet have sufficient information to evaluate this potential source of mortality. There is also a renewed concern about the incidental loss of sea otters in gill and trammel nets. The National Marine Fisheries has estimated the sea otter losses in central California have increased from near zero in 1995 to almost 50 individuals in 1998 (Karin Forney, NMFS, unpubl. data). Losses of this magnitude would significantly impact sea otter population trends.

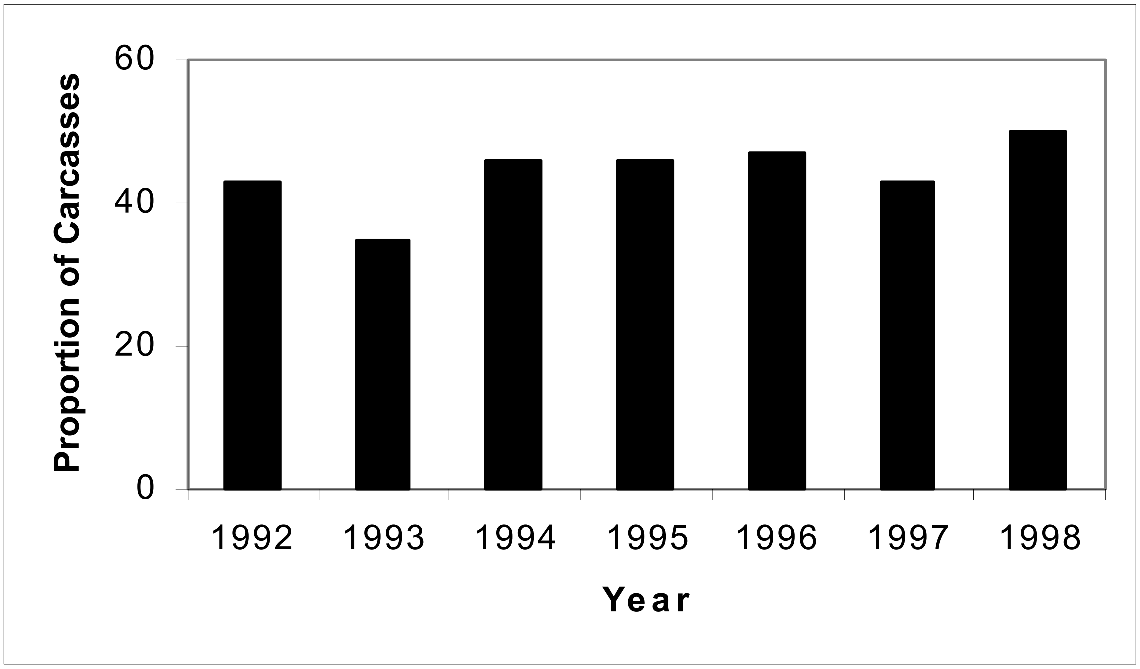

Figure 4. Proportion of sea otter carcasses necropsied at the National Wildlife Health Center that died of infectious or parasitic disease by year from 1992-1998. Two hundred and seventy one carcasses were examined, ranging from 65 in 1995 to 14 in both 1997 and 1998 (through July). These data should be treated as preliminary as diagnostic information on the most recent cases continues to be developed.

TRENDS IN REPRODUCTIVE SUCCESS

Reproduction has been studied in several sea otter populations (including California) by tagging known-age individuals and chronicling birth rate and pup survival rate from follow-up observations of the tagged animals. While the season of births and the probability of pup survival from birth to weaning vary by female age and population status, age-specific birth rates are virtually constant in all populations that have been studied. Several such studies, all completed prior to 1995, have been done on California sea otters (Siniff and Ralls 1989, Jameson and Johnson 1993, Riedman *et al.* 1994). There is no evidence for depressed reproduction from any of these studies.

A measure of reproductive success is also provided by the annual survey data, through the dependent pup counts. The pup to independent ratio varies considerably among years (Fig. 5). However, there is no obvious relationship between these measures and population trends.

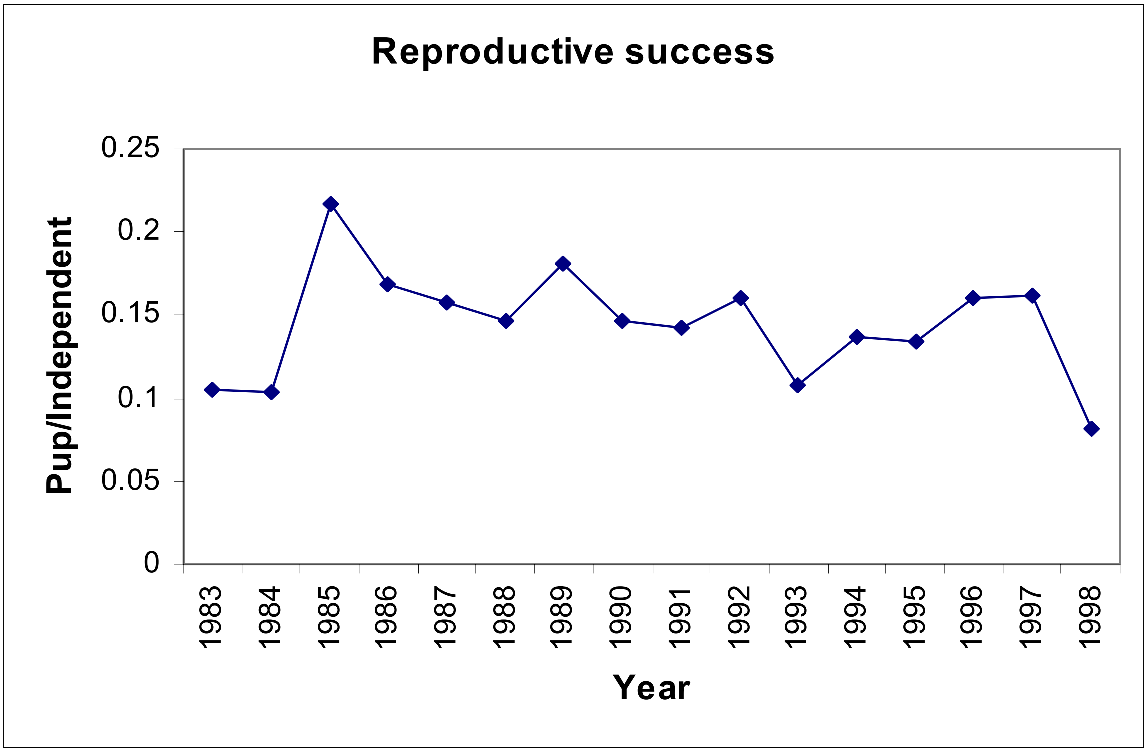

Figure 5. The ratio of dependent pups to independent sea otters as determined from the spring surveys done from 1983 through 1998.

Sea otters reproduce throughout the year and females typically come into estrous immediately after losing a pup (either from weaning or premature death). The low pup/independent ratios seen in the early 1980s probably were a lingering effect of the strong El Niño event that occurred in 1982-83. Intense winter storms caused an abnormally large number of females to lose their dependent pups, thus apparently resetting the annual birthing pattern for several more years. The same effect seems to have occurred in 1998. Even so, there is no indication of reproductive failure associated with the onset of the recent population decline.

ASSESSMENT OF CURRENT POPULATION STATUS

After at least 10 years of uninterrupted population growth, the California sea otter now appears to be in modest decline. There are three possible demographic explanations for the decline. One is that some of the otters have moved elsewhere. It is highly unlikely that the missing animals have moved to some other coastal area because the entire region is under almost constant surveillance by boaters and coastal observers. The distribution of otters may also have shifted offshore, thus decreasing the probability of an individual being observed during a survey. There is no evidence that distributional shifts of this nature occur in sea otters, nor have we noted any such change in the location of individuals during the surveys. We thus regard this possibility as unlikely, but worthy of further investigation. Another possibility is that the population has declined because of depressed reproduction. Again, the evidence both from past studies and the currently available data does not support this explanation. A third possibility is increased mortality. We regard this latter possibility as the most likely cause of the decline.

Mortality is difficult to study in wildlife populations. The only record of mortality patterns available for the California sea otter in recent years is the number and character of beached carcasses. At best, these materials provide a crude indicator of overall mortality because an unknown proportion of dead otters is recovered and it is uncertain that individuals found dead on the beach are representative of deaths in the population as a whole. While the number of carcasses recovered has increased in rough accordance with the population decline, there are no evident changes in cause of death in the freshly stranded animals. Since infectious disease has been shown to be the cause of death in almost half of the beached carcasses, any significant change in the incidence of this mortality source would be expected to appear as an increase in the proportion of diseased individuals among those that are necropsied. This pattern is not seen (Fig. 4) and thus we think it unlikely that an increase in infectious disease is responsible for the population decline. There are other possibilities, one of which is increased incidental take in fishing gear. In view of the recent growth of coastal pot fisheries, reports of otters being caught and killed in these pots, and high likelihood that incidental losses in fishing gear were responsible for an earlier population decline, the possibility of growing entanglement losses warrants further attention. Recent estimates of sharply increased sea otter losses in gill and trammel nets adds to this concern and the complexity of the issue.

Despite reasonably strong evidence for a recent population decline, the range of the California sea otter has continued to expand southward, thus resulting in about 100 individuals moving into the "no otter zone" south of Point Conception during late winter/spring of 1998. This situation raises the question of how compliance with Public Law 99-625 would affect the welfare of the California sea otter population. The easiest scenario to evaluate is that of removing these animals without placing them elsewhere. Inasmuch as the California sea otter population is in decline, such removals without replacement most likely would be additive to current losses, thus causing the population to decline even more rapidly. The potential consequences of removal with replacement are less certain, although several predictions are possible either from first principles of ecology or past experience. Relocations of these animals, either within the existing range north of Point Conception or outside the existing range, can be expected to cause the deaths of some of the relocated individuals. In addition, many of the relocated individuals almost certainly would return to the locations from which they were captured. There is also concern over how the relocated animals would interact with resident otters. The fact that these animals dispersed from the existing range makes it likely that their forced return would compromise the system in some manner, the two most likely mechanisms being via resource competition with the residents and disruption of the residents' social systems. Both processes would likely be detrimental to the residents. On the other hand, it is difficult to see how the residents might benefit from the intruders. In sum, regardless of exactly what is done with animals taken from the "no otter zone," removal of these animals would be detrimental to the California sea otter population. This issue may now seem moot because only a single sea otter was sighted south of Pt. Conception during the most recent (October) survey of the area. However, this is likely a seasonal pattern, and large numbers of otters should be expected to return the area south of Pt. Conception in late winter or spring of 1999.

There is little doubt that the California sea otter population would be best served by elimination of the "no-otter zone." This now appears essential for natural range expansion, and thus recovery, of the California sea otter. Disturbances to animals in this area will be detrimental to the population.

INFORMATION NEEDS

Conservation and management issues surrounding the California sea otter are complex and thus there are diverse needs for further information. Three specific problems require special attention. One is the issue of incidental losses of sea otters to fisheries. Further work is needed to assess whether such losses are of sufficient magnitude to be causing the population to decline. A second need is for basic information on sea otter demography and behavior. We have argued that reproductive failure is not responsible for the recent population decline, but in fact there have been virtually no data gathered since 1995 to assess that possibility. The same can be said of redistribution and mortality. A focused research program based on tagging and radio telemetry is needed to answer these questions. In view of the fact that a study of this kind was conducted during a time when the California sea otter population was growing (Siniff and Ralls 1989), similar information from the present would provide an illuminating contrast that would help clarify the reason for the current decline. A third need is to better understand the role of infectious disease in the population biology of California sea otters. Continued monitoring and detailed necropsies of fresh carcasses should receive high priority. The present policy of conducting detailed necropsies on every fourth otter is limiting our understanding of the decline but greatly reducing the power of the data to detect change. Although a reduced effort was justifiable while the population was still growing, it is no longer so now that the population is in decline. Further information on the history of disease and the ecology of the various parasites and disease organisms would also be of great value to understanding the status and trends of the California sea otter population.