PETITION TO THE CALIFORNIA FISH AND GAME COMMISSION TO LIST THE XANTUS'S MURRELET AS THREATENED UNDER THE CALIFORNIA FISH AND GAME CODE

Submitted by the Pacific Seabird Group

Based primarily on information contained and cited herein, the Pacific Seabird Group petitions the California Fish and Game Commission to list the Xantus's Murrelet (*Synthliboramphus hypoleucus*) under the pertinent sections of the California Fish and Game Code. We believe this colonial-nesting seabird should be listed because of: 1) small U.S. (2,500-2,800 breeding birds) and world population (5,000-11,500 breeding birds); 2) geographically restricted breeding range (12 nesting islands over 500 miles); 3) declines at the largest U.S. colony at Santa Barbara Island; and 4) abundant and increasing major threats to murrelets, including introduced mammals, oil pollution, native predators, and artificial light pollution, and several minor threats. Xantus's Murrelets breed on islands and forage in oceans adjacent to one of the most densely populated coastal regions in the U.S. (Los Angeles and San Diego metropolitan areas). This area is used extensively for commercial, military, industrial and recreational purposes that constantly threaten the marine environment, including murrelets. The many threats combined, or even a single event such as a catastrophic oil spill, could lead to the extirpation of the U.S. breeding population or even extinction of the species.

Beginning in 1994 (USFWS 1994), Xantus's Murrelet was listed as a federal category 2 candidate species before that category was abolished in 1996 (USFWS 1996). Currently, murrelets are a USFWS Species of Management Concern and are listed as a California Species of Special Concern by the California Department of Fish and Game (CDFG). The species is also listed as "Vulnerable" by the World Conservation Union (IUCN; Hilton-Taylor 2000; also see Sydeman and Nur 2000). By IUCN criteria, a taxon is Vulnerable when it is not "Critically Endangered" or "Endangered" but is facing a high risk of extinction in the wild in the medium-

term future, as defined by any of five criteria:
(http://www.redlist.org/info/categories_criteria.html).

This petition summarizes the most current information on the distribution, status, and threats to Xantus's Murrelets.

TAXONOMY, DISTRIBUTION, AND NATURAL HISTORY

The Xantus's Murrelet is relatively small (mean body mass 148-167 g; Drost and Lewis 1995) seabird (Family Alcidae) that occurs only along the west coast of North America. The species scientific name was formerly known as *Endomychura hypoleuca*, and the common name was formerly known as Xantus' Murrelet. Two subspecies, differing in facial plumage and range, are currently recognized: *S. h. scrippsi* breeds from the northern California Channel Islands (off southern California, U.S.A.) south to the San Benito Islands, Baja California Sur, Mexico; and *S. h. hypoleucus* breeds primarily at Guadalupe Island and the San Benito Islands off Baja California (Jehl and Bond 1975, Drost and Lewis 1995; Table 1; Figure 1). Records that may be extralimital include one nest of either Xantus's or Craveri's (*S. craveri*) murrelet at San Roque Island, Baja California Sur (Drost and Lewis 1995), and one nest of *S. h. hypoleucus* at Santa Barbara Island, California (Winnett et al. 1979). Single *S. h. hypoleucus* captured in dip nets at night while aggregating off potential colonies at Santa Cruz and San Clemente islands, California (H. R. Carter, pers. comm.), indicated small numbers may regularly breed in the U.S.

Xantus's Murrelets spend a majority of their lives at sea and come to shore only for a few months per year to breed. Following breeding, birds disperse northward and offshore, reaching as far north as northern British Columbia, Canada (Drost and Lewis 1995, Whitworth et al. 2000). It is uncertain where much of the population winters, although some observations indicate that many birds may winter in the Southern California Bight as well as the warmer

offshore waters of the California Current up to 200-300 nm off California, Oregon, and possibly Washington and Baja California (Briggs et al. 1987; Drost and Lewis 1995; K. D. Hyrenbach, unpubl. data). In winter (August to January), some murrelets occur off Baja California and possibly as far south as the state of Guerrero, Mexico (Howell and Webb 1995).

Most information on breeding biology has resulted from studies conducted at Santa Barbara Island, California (e.g., Hunt and Butler 1980, Hunt et al. 1981, Murray et al. 1983, Lewis and Gress 1988, Lewis et al. 1988, Ingram 1992, Drost and Lewis 1995, Ingram and Jory-Carter 1997, Martin and Sydeman 1998, Whitworth et al. 2000, Wolf et al. 2000, Sydeman et al. 2001). Murrelets are entirely nocturnal in their activities on shore. During the pre-egg and incubation periods, much social interaction occurs at night in near shore waters just off the breeding islands, where birds occur in loose aggregations and engage in vocal activity (birds infrequently vocalize on shore). The function of these aggregations is not well known, but they apparently include breeders and non-breeders (i.e., sub-adults and/or non-breeding adults; Whitworth et al. 1997, 2000) and likely include activities such as courtship and pair bonding. At Santa Barbara Island, murrelets begin arriving back at the breeding colony as early as mid- to late December, when the first birds may be heard calling on the water (Drost and Lewis 1995). During peak breeding at large colonies such as Santa Barbara Island and Los Coronados Islands, hundreds of birds may be heard calling through much of the night.

Murrelets nest mostly in natural rock crevices, caves, under shrubs, and less often, under man-made structures or earthen burrows dug by other species (Drost and Lewis 1995). Nesting habitats are often on steep slopes or cliffs, and occur from near the waterline to several hundred feet above the surrounding ocean. The timing of nesting is asynchronous and varies from year to year. At Santa Barbara Island, eggs have been laid as early as mid-February and as late as mid-June; peak clutch initiation usually occurs between mid-March and mid-April (Drost and Lewis 1995). Maximum and typical clutch size is two eggs, which are laid about eight days apart

(Murray et al. 1983). During the period between the laying of the first and second eggs, the parents do not attend the nest (at least during the day). Incubation begins after the second egg is laid, and lasts an average of 34 days (range 27-44 days; Murray et al. 1983). Murrelet chicks are precocial, and depart the nest to accompany the parents to sea at about two days of age. Since Xantus's Murrelets are rarely seen on the water with chicks, it is assumed that family groups disperse far to sea very quickly (Hunt et al. 1981, Murray et al. 1983).

Because of the murrelet chick's precocial behavior, productivity has been measured only as the number of chicks hatched per pair. At Santa Barbara Island between 1983-1995, productivity averaged 0.813 hatchlings/pair (range = 0.50-1.14; summarized by Sydeman et al. 1998). This productivity measure is low compared to the Xantus's congener, the Ancient Murrelet (*Synthliboramphus antiquus*), which averages 1.44 to 1.69 chicks/pair (Gaston and Jones 1998). Using linear regression, Sydeman et al. (2001) found that Xantus's Murrelet productivity on Santa Barbara Island declined significantly between 1985 and 1997.

Data on age of first breeding, adult survival, and longevity are lacking. Based on its congener the Ancient Murrelet, Sydeman et al. (1998) assumed that Xantus's Murrelets begin breeding at about 3-4 years of age and that annual adult survival is about 80%.

CURRENT STATUS

Because of their secretive nature at nesting colonies within habitats that are often treacherous to access, and their scattered and pelagic distribution at sea, estimating the breeding and total population sizes of Xantus's Murrelets is extremely difficult and there are no standardized techniques for making these estimates. Breeding population estimates have been based on direct nest counts, assessments of potential nesting habitat in coordination with either standardized or non-standardized assessments of occupancy of potential nest sites and nest

habitats, vocal detection surveys (call counts from birds on the water), or a combination of methods.

Known and suspected nesting populations of murrelets, along with methods used to determine the populations at the respective islands, are provided in Table 1. Murrelets are known to breed at five islands and suspected to breed at one island in the U.S. Breeding is known at four islands and suspected at two islands in Mexico. The current world breeding population estimate ranges between about 5,000 and 11,500 birds (2,500-5,750 pairs), including about 2,500-2,800 in the U.S. and 2,500-8,700 in Mexico. These estimates are considered to be rough, and most colony estimates are more likely overestimated than underestimated. In particular, the upper ends of estimates for several Baja California nesting islands appear to be over-inflated; these were based largely on potential nesting habitat as well as a longer breeding season than reported in the U.S., and were not highly based on nest or bird counts (Keitt 2000; B. S. Keitt, pers. comm.). The lower halves of population ranges likely are more reflective of actual breeding population sizes. A guess at total world population, including adults and subadults (excluding juveniles), is roughly between 8,000 and 15,000 individual birds.

Of particular note is the high degree of concentration of the murrelet breeding population. In the U.S., about 60% breed on only one island (Santa Barbara Island); in Mexico, about 90% breed on only three islands (Los Coronados, San Benito, and Guadalupe islands). Combined, about 80% of the world population breeds on these four islands. Nearly the entire subspecies *S. h. hypoleucus* breeds on Guadalupe Island. This level of concentration, along with small world population size, makes the species ever more vulnerable to localized catastrophes.

POPULATION TRENDS

Very few census data are available to assess population trends. Overall, however, evidence indicates that populations have declined considerably since the late 19th century. Much decline has been linked to predation and habitat degradation from introduced mammals, especially feral cats (*Felis catus*), black rats (*Rattus rattus*), and European rabbits (*Oryctolagus cuniculus*). Such declines have occurred at murrelet colonies in the U.S. at Anacapa and Santa Barbara islands, and at nearly all Mexican islands (Everett and Anderson 1991, Drost and Lewis 1995, McChesney and Tershy 1998, McChesney et al. 2000, Keitt 2000). Murrelets were believed to have been extirpated from Todos Santos, San Martin, and San Geronimo Islands by the mid-20th century (Jehl and Bond 1975), but surveys in 1999 (Keitt 2000) indicated that small colonies may persist on these islands at reduced levels (Table 1). Following the elimination of cats and rabbits, the Santa Barbara Island colony at least partially recovered in the mid- to late 20th century (Hunt et al. 1980, McChesney and Tershy 1998). At Los Coronados Islands, Howell (1910) considered murrelets abundant on all 4 islets, and an abundance of murrelet eggs collected by numerous observers (now mostly at the Western Foundation of Vertebrate Zoology, Camarillo, California) in the early- to mid-twentieth century also indicated a very large colony there. By 1989-1990, R. Pitman (pers. comm.) roughly estimated this colony was reduced to only 10% of potential because of feral cat predation. At Guadalupe Island in June 2000, Pitman and Everett (pers. comm.) estimated 1,000-2,000 breeding murrelets, compared to 2,400-3,500 estimated in 1968 (Jehl and Everett 1985, Drost and Lewis 1995). This difference in estimates on Guadalupe Island likely reflected, to some degree, different methodologies and may not reflect a major population decline.

The only colony where relatively systematic surveys are adequate to assess recent population trends is at Santa Barbara Island. Based on studies between 1975-1978, Hunt et al. (1981) estimated 2,000-4,000 breeding (1,000-2,000 pairs) Xantus's Murrelets at Santa Barbara

Island, or (presumably) an average of 3,000 breeding birds (Hunt et al. 1980). An additional 30 and 150 breeding birds were estimated at adjacent Shag Rock and Sutil Island, respectively, for a total of 3,180 breeding birds in the Santa Barbara Island area (Hunt et al. 1981). Based on these same studies, Murray et al. (1983) stated that as many as 10,000 birds may breed at Santa Barbara Island, but no explanation of methodology was provided for this estimate. In 1991, Carter et al. (1992) resurveyed the Santa Barbara Island area and estimated 1,402, 16, and 126 breeding murrelets on Santa Barbara Island, Shag Rock, and Sutil Island, respectively, or a total of 1,544 breeding birds. Combined estimates in 1991 were 51.4% lower than the 1975-1978 average (range = 22.8-61.4%), suggesting a substantial population decline, although the degree of decline is uncertain due to differences in survey and estimation techniques (Carter et al. 1992). After re-examining estimates by both Hunt et al. (1981) and Carter et al. (1992), Sydeman et al. (1998) modeled this decline as 2.5-5.3% per year from 1977 to 1991. Further evidence of substantial decline comes from annual nest monitoring as part of the Channel Islands National Park seabird monitoring program. This study has recorded declining occupancy rates (annual use) of monitored nest sites since the early 1990s (Wolf et al. 2000). Furthermore, several factors appear to be causing reduced adult survival and breeding success (see Population Threats, below).

If trends have continued following the 2.5-5.3% annual decline estimated by Sydeman et al. (1998), numbers at this colony may be reaching a low level at which natural recovery may not occur or may take decades or more. Using RAMAS/METAPOP to model population change, Sydeman et al. (1998) found that the Santa Barbara Island colony had a 30 to 80% chance of declining to 500 breeding birds or less within 20 years. From this assessment, it can be deduced that, in the longer-term, this decline likely will lead to extirpation of the colony. Given the importance of this island to the species, severe decline or loss of the Santa Barbara Island colony likely would reverberate throughout the remainder of the U.S. population, particularly if this

colony acts as a source for other colonies, and could lead to the eventual extinction of Xantus's Murrelets as breeders in the U.S.

POPULATION THREATS

Several colony- and population-level threats face the Xantus's Murrelet. Major threats include: non-native predators; oil pollution; native predators; and artificial light pollution. Minor threats include: human disturbance at colonies; oceanographic and prey changes; disturbance and mortality at sea from military operations; and bycatch in fisheries (reviewed in Drost and Lewis 1995, Carter et al. 2000, Roth and Sydeman 2000). We consider major threats to be those which available information suggests have caused, or have high potential to cause, population declines or lead to extinction. Minor threats are considered to have the potential to negatively effect murrelet populations, but current information does not indicate a major impact.

Major Threats

Non-native mammals

Several species of non-native mammals have been introduced onto Xantus's Murrelet nesting islands (reviewed in McChesney and Tershy 1998). Non-native mammals have been responsible for large declines and extirpations of seabirds worldwide (Moors and Atkinson 1984). In particular, feral cats, black rats, and European rabbits are believed to have caused major declines to several murrelet colonies. Feral cats are fierce predators of both adult and young seabirds; rats are primarily egg and chick predators, but are also capable of killing adults; and rabbits destroy habitat and may compete for crevice and burrow nest sites (Moors and Atkinson 1984, McChesney and Tershy 1998).

Many mammal introductions to Xantus's Murrelet breeding islands occurred between the mid-19th and mid-20th centuries. Thus, impacts from these introductions have occurred for about a century at most locations. As recently as 1994, feral cats occurred on at least 14 islands, rats on at least nine islands, and rabbits on at least five islands within the murrelet's breeding range (from McChesney and Tershy 1998; Table 2). Since 1994, several introduced mammals have been removed from the Baja California islands including: 1) cats from North Coronado, South Todos Santos, San Martin, San Geronimo, San Roque, and Asuncion Islands; 2) black rats from San Roque Island; and 3) rabbits from South Todos Santos Island, Middle, West, and East San Benito Islands (McChesney and Tershy 1998; Island Conservation and Ecology Group, unpubl. data). In addition, rabbits appear to have died off at San Martin Island (Keitt 2000). However, non-native mammals still threaten murrelets on several islands. Of these species, herbivorous mammals pose unique threats to murrelets by reducing shrub habitat and, for the larger species, crushing burrows. In the U.S., planned rat removal at Anacapa Island may result in the eventual restoration of a potentially large murrelet colony (McChesney et al. 2000).

Based on the low murrelet populations currently found at many islands, it appears that, over the years, impacts to murrelets have been great. Although recent and planned eradication efforts likely will lead to increases in murrelet numbers, the murrelet's low reproductive rate (mean = 0.813 hatchlings/pair at Santa Barbara Island; Sydeman et al. 1998) and high philopatry (if they are like most other alcids) likely will lead to slow natural recovery. Also, without strict management efforts, the threat of new introductions and reintroductions is high. In Baja California, most introductions have been from fishermen or other sea travelers (McChesney and Tershy 1998). Seasonal or permanent fishing encampments occur on nearly all western Baja California islands. Individuals from these groups often bring cats, dogs, or other animals to the islands, and allow them to roam free thereby increasing the potential for them to become feral. Rats have been introduced to several islands worldwide (including Anacapa Island) via shipwrecks. In addition, rats, mice and other rodents can easily be introduced through cargo.

Currently, there are no management plans to combat future introductions despite recommendations to the Channel Islands National Park in a letter from the Pacific Seabird Group in 1994.

Oil Pollution

Alcids are particularly vulnerable to oil pollution, accounting for large proportions of oil spill mortalities on the west coast of the U. S. where several spills have resulted in the deaths of from 1,500 to 400,000 birds (Burger and Fry 1993, Carter et al. 1998). In California oil spills between 1996-2002 Alcids have been the most commonly impacted family of birds (OWCN, unpublished data). In the Southern California bight, seabird mortality has been documented from offshore platforms, pipelines, on-shore oil facilities, tankers, and other military or commercial shipping (Anderson et al. 1993; Carter and Kuletz 1995; Carter et al. 2000). All of these sources pose a significant risk to murrelets through out the year, but especially during the breeding season (March-June) when nearly 90% of the Southern California Bight population occurs in the vicinity of Santa Barbara Island (Ford 1984) and lower concentrations of birds occur in the Santa Barbara Channel, off Point Conception, and along the northern Santa Rosa-Cortez Ridge (Carter et al. 2000). One oil spill incident, especially during this time of year, would have the potential to kill a large portion of this population (Carter et al. 2000) and possibly result in extinction. Even a small spill during this period could result in large-scale mortality from which the population might be unable to recover (Ford 1984).

Between 1960-1997, there have been at least 347 oil spills in excess of 10,000 gallons (Oil Spill Intelligence Report 1997) in California. The California Department of Fish and Game, Office of

Spill Prevention and Response (OSPR) documented over 500 marine spill incidents annually between 1992-1998. Between 1976-1997, four marine spills alone resulted in at least 1.77 million gallons of petroleum being released into Los Angeles Harbor and Santa Barbara Channel (habitat often occupied by Xantus's Murrelets) and 8 additional marine spills in the past 10 years have released at least 150,000 gallons of petroleum into murrelet habitat in other parts of California (D. Michaels, pers. comm.; Whitworth et al. 2000).

Over 3000 tankers pass along the California coast annually (S. Hampton pers. comm.) posing a significant recurring threat of oil pollution statewide and encompassing habitat used by murrelets all year. In 1995, California produced or imported a total of 642.2 million barrels of crude oil according to the California Energy Commission. Approximately half was produced in California and half was imported along west coast shipping lanes (Figure 2) that overlap with murrelets habitat. Two of three major marine shipping traffic lanes (Figure 3) in southern California are dangerously close (within 25 km) to most U.S. murrelet colonies (including the largest colony at Santa Barbara Island) and overlap substantially with murrelet foraging areas. The remaining marine shipping traffic lane (Figure 3) passes within 25 km of the largest Mexican colony at Los Coronados Islands (Carter et al. 2000). In addition to tanker and other large commercial vessel traffic, the southern California and northern Baja California coastal regions are frequented by thousands of military vessels, commercial cruise ships, fishing, diving, and recreational boats, all potential sources of oil pollution.

The geographic locations of some of the 35 offshore oil platforms (Figure 3) are between 12-30 kilometers of most U.S. murrelet colonies and are adjacent to murrelet foraging habitat. In addition,

offshore oil development in southern California has occurred since the 1960s and further exploration is currently (January 2002) being considered by the Bush administration thus perpetuating this potential risk to murrelets. Oil drilling, expansion of drilling, and transport of oil from drilling rigs to terminals on shore all pose further risks of oil spills, especially since these activities are being undertaken in a region known to be seismically active.

Between 1969-2000, 18 marine spills in southern California (between Avila Beach and San Diego) resulted in at least 6,000 marine bird carcasses being recovered (Figure 4). However, documentation of mortality usually was poor, and estimates of impacted birds may be closer to 60,000 based on standard extrapolations from other spill incidents (e.g., Ford 1984). These incidents undoubtedly impacted murrelets despite no carcasses being collected following these spills (Carter et al. 2000). Several other large spills in central and northern California have killed from a few hundred up to 15,000 birds per event. A few dead oiled Xantus's murrelets have been reported on beaches in central California (Carter et al. 2000). Low recovery rates of murrelets are attributed to their offshore habitat use and at-sea carcass loss due to sinking or scavenging following oil exposure far off shore. Between 1993-1999, biweekly or monthly beach surveys conducted from Bodega Bay to Pt. Año Nuevo by the Beach Watch Program recovered only 1 non-oiled Xantus' Murrelet emphasizing how rare it is to recover murrelets that die at-sea (Roletto et al. 1999). Furthermore, any murrelets washing ashore may also be scavenged by mammalian or avian predators prior to surveys for beach-cast birds making recovery of this small seabird highly unlikely, (Carter et al. 2000), even with high search efforts.

Murrelets have likely been impacted by past large and small oil spills, most notably by the 1969 Santa Barbara oil spill. During the fall and winter, murrelets are commonly observed in Monterey Bay and further north in central California. Therefore, winter oil spill incidents and mystery spills such as the 1997-1998 Point Reyes Tar ball Incident and the ongoing San Mateo County Mystery Spill may also be impacting over wintering murrelets. In 1997 and 1998, tar ball deposition on beaches in central California occurred repeatedly (Roletto et al. 1998; 1999) suggesting that chronic oil pollution poses a threat to over wintering murrelets, especially in central California (Ford 1984, Carter et al. 2000). This means that murrelets are at risk of oil contamination and mortality through out the entire year.

Native predators

Several native birds and mammals are significant predators of Xantus's Murrelet adults, chicks, or eggs, especially: deer mice (*Peromyscus maniculatus*); Barn Owls (*Tyto alba*); and Peregrine Falcons (*Falco peregrinus*). Barn Owls and Peregrine Falcons probably are the most significant predators of adult murrelets whereas deer mice are important egg predators (e.g., Murray et al. 1983, Drost and Lewis 1995, Sydeman et al. 1998). Western Gulls (*Larus occidentalis*) also have been known to take adults and chicks at sea and on land at Santa Barbara Island, but these occurrences are uncommon (Murray et al. 1983, Drost and Lewis 1995, Wolf et al. 2000). Overall levels of predation may be higher in the presence of bright lights (see Artificial Light Pollution, below).

Although murrelet mortality from native predators may be viewed as a "natural" situation, the impact of such mortality must be considered as a factor additive to such "unnatural" mortality from anthropogenic sources and non-native animals. The so-called "naturalness" of current predation levels from native predators also must be assessed carefully,

since long-term ecosystem changes (e.g., plant communities) likely have led to changes in predator populations and ecology. Thus, levels of predation may be much higher than they were historically. In these cases, predator management on certain islands may be necessary to restore murrelet populations.

Barn Owl. During a six-year study (1982-1987) on Santa Barbara Island, Drost (1989) conducted systematic surveys of Barn Owl roosts and documented from 16 to 130 murrelet adults killed annually by Barn Owls. The numbers of murrelets depredated varied considerably from year to year. Highest numbers were taken in years of low deer mouse populations, the owl's preferred prey. Drost also reported a significant inverse relationship between owl predation and murrelet breeding success; breeding success was reduced in years of high owl predation. This reduction in breeding success was assumed to stem from the loss of at least one member of a breeding pair, since two birds are required to successfully hatch eggs (Murray et al. 1983). Both owl and mouse numbers varied considerably from year to year, with changes in owl numbers lagging slightly behind changes in mouse numbers. Numbers of owls counted on the island between 1982-1987 ranged from lows of 4-7 to as high as 25-30 birds.

From Drost's data, Sydeman et al. (1998) estimated an annual mean of 57.2 murrelets killed by Barn Owls on Santa Barbara Island, representing 1.84-3.43% of the Santa Barbara Island population (including adults and subadults). Using Population Viability Analyses and estimates of adult survivorship, Sydeman et al. (1998) determined that the effects of observed levels of owl predation on adult survivorship may be sufficient to cause a decline in the Santa Barbara Island population. These authors believed that elimination of such owl predation may result in a stable murrelet population.

Non-systematic surveys at Santa Barbara Island in 1996-1999 documented that from eight (1996) to 165 (1999; mean = 56.0) murrelets were killed by avian predators (mostly Barn

Owls) per year (Wolf et al. 2000). Systematic Barn Owl surveys (following the methods of Drost 1989) during the 1999 murrelet breeding season resulted in counts of 21-33 owls on the island (Wolf et al. 2000). High predation in 1999 almost certainly resulted, in part, from high light levels caused by squid fishing boats (see below).

It is not clear if recent levels of Barn Owl predation at Santa Barbara Island are similar to historic levels or is a result of other changes in the island's ecosystem (e.g., increased owl population). Although Barn Owls are known to occur at several murrelet breeding islands, almost no information is available on owl predation at other colonies. However, given the declining murrelet population at Santa Barbara Island, any substantial level of predation will exacerbate this decline and impede recovery.

Deer mice. At Santa Barbara Island, deer mice can prey extensively on Xantus's Murrelet eggs. Deer mice prey primarily on the first egg of a clutch while it is left unattended during the eight-day period between laying of the first and second eggs (Murray et al. 1983). Murrelets rarely lay replacement clutches if the first clutch fails. Egg predation by deer mice is primarily responsible for variations in murrelet breeding success at Santa Barbara Island. This is caused by the cyclic nature of the deer mouse population, which results in annual variation in egg predation (Drost and Fellers 1991, Drost and Lewis 1995). In 1975-1978, Murray et al. (1983) reported that at least 36% of murrelet eggs were depredated by mice. Between 1983-1995, egg predation averaged 46.5% (range = 22.9-73.7%; summarized in Sydeman et al. 1998). Assuming annual rates of population decline between 2.5-5.3% per year between 1977 and 1991, Sydeman et al. (1998) estimated that a reduction of 26-61% in mouse predation could result in a near-stable murrelet population. It is suspected that current predation levels may be higher than historic levels due to changes in island vegetation from past ranching activities, causing changes in mouse diet or populations.

Peregrine Falcon. Peregrines have long been known to be significant predators of adult Xantus's Murrelets (Drost and Lewis 1995). In the California Channel Islands, Peregrines currently breed on San Miguel, Santa Rosa, Santa Cruz, Anacapa, and Santa Barbara islands, and murrelet remains have been found at Peregrine eyeties at all of these islands (B. J. Walton, pers. comm.). Peregrines have also increased dramatically along the Baja California coast in recent years, and likely prey on murrelets at these locations as well. However, Peregrine predation on murrelets has been little studied, and impacts to murrelet populations are unknown. The recent reappearance of breeding Peregrines on Santa Barbara Island, where a pair has been present since at least 1996 (Wolf et al. 2000; B. J. Walton, pers. comm.), may increase predation pressure at this largest U.S. murrelet colony.

Artificial Light Pollution

Murrelets, like many other nocturnal seabirds, are attracted to lights at night (Carter et al. 2000). Murrelets have been recorded to land on lighted boats anchored off colonies, sometimes by the dozens, where they become disoriented and can be injured or killed. These occurrences have been documented mostly by researchers using their bright deck lights to attract murrelets for capture (DeLong 1967, 1968a, 1968b; DeLong and Brownell 1968; Whitworth et al. 1997; Carter et al. 2000; R. L. DeLong, pers. comm.), but suggests it occurs frequently. Murrelets also may be attracted to bright lights on shore and on offshore oil platforms in the Southern California Bight (Carter et al. 2000). Large numbers of fishing, diving and pleasure boats, often using bright deck lights, spend many nights per year anchored or fishing beside murrelet breeding islands. Thus, the impacts of light attraction may be of a chronic and serious nature.

The potential impacts of bright lights from commercial market squid (*Loligo opalescens*) fishing vessels on Xantus's Murrelets has recently raised much concern to research, state and federal agency personnel (Nur et al. 1999, Carter et al. 2000, Roth and Sydeman 2000). This

fishing industry uses high wattage lights (about 30,000 watts per boat) to attract squid to the surface, where they are captured in purse seine nets (Vojkovich 1998). Squid boats operate in shallow waters just offshore of murrelet breeding colonies in the California Channel Islands, with several vessels often fishing simultaneously within the same area. The boat lights brightly illuminate the surrounding waters and island shorelines (Roth and Sydeman 2000; G. J. McChesney, pers. obs.). Since the late 1980s, the California squid fishery has increased remarkably, with nearly all of this increase occurring in southern California. Squid landings in southern California increased from an average of 9,000 tons during the 1970s and early 1980s to over 41,000 tons during the 1990s (Vojkovich 1998). The number of vessels participating in this fishery has also increased, from about 85 vessels in the 1970s and 1980s to over 200 in the late 1990s (including 170 in southern California in 1999; Vojkovich 1998, CDFG 2000a). In the past, the southern California fishery operated mostly in the fall and winter. However, extensive fishing has occurred recently (1999) in the spring during the murrelet breeding season (CDFG 2000a, unpubl. data). As a representation of fishing effort, Figures 5 and 6, respectively, show total monthly squid landings for southern California in 1989-1999, and landings at important murrelet breeding islands in 1995-1999 (i.e., when fishing increased dramatically).

Observations from the Channel Islands National Park seabird monitoring program indicate bright lights from squid boats contribute to increased murrelet predation from nocturnal predators and may disrupt murrelet courtship and breeding activities (Nur et al. 1999, Carter et al. 2000, Roth and Sydeman 2000). For example, squid fishing occurred off Santa Barbara Island during much of the murrelet breeding season in 1999 (Figure 6) and researchers documented an unusually high 165 murrelet carcasses on Santa Barbara Island. Much of this mortality was attributed to Barn Owl predation. In addition, five murrelets were observed that were killed by Western Gulls (Wolf et al. 2000), a mostly diurnal species that rarely takes adult murrelets. High levels of predation almost certainly were due, in part, to bright squid boat lights illuminating the area and aiding nocturnal predators (i.e., owls and sometimes gulls) in locating

and capturing murrelets. The bright lights also may disorient and disrupt birds congregating just offshore of colonies, birds coming and going from nest sites, and chicks departing the island (possibly causing permanent separation from parents). In 1999, high nest abandonment in the study plot closest to the most intensive fishing at Santa Barbara Island may have been related to bright lights (Wolf et al. 2000).

Unfortunately, little other information is available on the impacts of bright lights on murrelets. Many nocturnal seabird species display highly reduced activity levels on moonlit nights, when they are more susceptible to predation (e.g., Manuwal 1974, Storey and Grimmer 1986, Ainley et al. 1990, Watanuki 1986, Keitt 1998). For birds that are active, predation levels tend to be higher in bright moonlit conditions (Nelson 1989, Keitt 1998). Thus, it is expected that murrelet activity at colonies would decrease and predation levels would increase in the conditions created by bright lights. Murrelets also may land upon these and other vessels frequently, possibly resulting in substantial mortality. However, no observer program has been implemented to document these occurrences. Other studies have documented bright lights on vessels and along coastlines to be a chronic problem, with hundreds and even thousands of seabirds sometimes involved (e.g., Dick and Donaldson 1978, Telfer 1987, Weimerskirch et al. 2000). Given the recent broad-scale and frequent squid fishing activity among the California Channel Islands, their impacts could be severe to the small murrelet population, even if fishing is conducted only during certain breeding seasons.

In February 2000, the California Fish and Game Commission (Commission) considered closing squid fishing off Anacapa, Santa Barbara, and San Miguel islands to eliminate potential impacts at these major seabird nesting islands. These closures would have helped protect murrelets at their largest colony in the U.S. at Santa Barbara Island and smaller colonies at Anacapa and San Miguel islands. However, the Commission failed to adopt this measure and instead required light shields and a limit of 30,000 watts per boat, effective 31 May 2000 (CDFG

Regulations, Section 149, Title 14, CCR, subsections (c) and (d)). The benefits of these measures to murrelets, if any, remain uncertain.

Minor Threats

Human disturbance at colonies

Murrelets may be affected by other types of human disturbance at nesting colonies. Murrelets often abandon nests when handled (Murray 1983) and may be sensitive to other forms of disturbance as well (e.g., noise; Roth and Sydeman 2000). Excessive disturbance, including habitat degradation, could result from high levels of human visitation to nesting areas, causing nest or even colony abandonment. To date, the Channel Islands National Park has not prevented park visitors from accessing murrelet nesting areas, such as sea caves and offshore rocks. Sea cave visitation is of particular concern at Anacapa and Santa Cruz islands. Fishing villages on Mexican nesting islands and increased recreation among the California Channel and Baja California islands pose potentially major threats to murrelets from disturbance to birds and nesting habitat.

Oceanographic and prey changes

Little is known of Xantus's Murrelet diet. A sample of 22 collected birds in the mid-1970s indicated that Santa Barbara Island murrelets fed on larval fish, especially northern anchovies (*Engraulis mordax*; Hunt and Butler 1980, Hunt et al. 1981). Recent oceanographic changes in the California Current System may have affected murrelet diets through warmer ocean temperatures, declines in zooplankton, and changes in fish populations, including a large decline in the southern California anchovy stock (Roth and Sydeman 2000, Whitworth et al. 2000). These changes likely have influenced murrelet foraging areas, as birds from Santa

Barbara Island foraged much farther from the island in the mid-1990s than in the mid-1970s (Whitworth et al. 2000). Possible reduced adult, subadult, and juvenile survival, or reduced breeding success may be a result of prey shortages (Sydeman et al. 1998, 2001). Effects of oceanographic and prey changes may be more serious than is currently recognized. For example, several species of seabirds in California have experienced declines in reproductive success during the warm ocean period of the 1980s and 1990s (Sydeman et al. 2001). While murrelets may adapt to these natural changes, the impacts are exacerbated by the many other factors affecting the species. More data on foraging ecology are needed to determine these effects.

Military Operations

Extensive military activities (i.e., weapons testing and various training exercises) occur in the large naval Sea Test Range off southern California. Military activities in the Sea Test Range have increased over the last two decades. Studies of Xantus's Murrelets radio-marked at Santa Barbara Island showed high overlap between murrelet foraging distribution and areas of extensive Sea Test Range use (Carter et al. 2000). Military operations may result in disturbance or death of murrelets. However, the extent of such impacts to murrelets is unknown.

Bycatch in fisheries

Alcids are commonly reported as bycatch in commercial fisheries, especially gillnets (e.g., Nettleship et al. 1984, DeGange et al. 1993, Julian and Beeson 1998). The only documented occurrences of Xantus's Murrelets killed as fisheries bycatch were ten birds killed between 5 July and 20 August 1987 in drift gillnets off the coast of British Columbia (Carter et al. 2000). However, some of these birds were also oiled making the exact cause of mortality difficult to determine. Observer programs off California did not record any murrelets captured in

a near shore California halibut (*Paralichthys californicus*) set gillnet fishery known for high seabird bycatch, and a pelagic drift gillnet fishery for broadbill swordfish (*Xiphias gladius*), thresher shark (*Alopias vulpinus*), and shortfin mako shark (*Isurus oxyrinchus*; Julian and Beeson 1998). However, other gillnet fisheries in California (including near breeding colonies in the Southern California Bight) have had little or no observer coverage. For example, a reasonably large set and drift gill net fishery exists for the white seabass (*Atractoscion nobilis*) off southern California (CDFG 2000b). White seabass gill nets are made with 6- to 7-inch (152-178 mm) mesh, which is small enough to capture seabirds. An observer program for bycatch conducted by CDFG in 1983-1989 documented no murrelets but did record ten cormorants (*Phalacrocorax* spp.) killed in gill nets set for white seabass. However, observers covered only 3% of logged fishing days (CDFG 2000b), which may have underrepresented seabird bycatch.

In 1994, gill net fishing was banned within three nautical miles of shore in California waters from Point Conception to the Mexican border. Since then, the mostly near shore white seabass fishery has shifted offshore and now focuses more heavily around the northern Channel Islands (CDFG 2000b). Thus, this fishery, and perhaps others, has moved into habitats utilized more heavily by Xantus's Murrelets and may in fact capture and kill murrelets. If so, such bycatch would lead to further population decline. Updated observer information, from a more intensive program than in 1983-1988, is needed to determine if murrelets are occurring as fisheries bycatch.

SUMMARY

In this petition, we have provided the best available information on population size, trends, threats, and other appropriate biological information, of the Xantus's Murrelet. Much of this information, such as on population status and threats, is based on relatively small bits of data that had to be put together to formulate an assessment of the true situation. These limited data

are due to the murrelet's secretive nature on land and pelagic lifestyle at sea, which make the species a poor study subject. An assessment of the true impacts of the many threats described here is further exacerbated by the lack of data collected by state and federal government agencies responsible for resource protection. For example, data are lacking on seabird mortality in most of California's gill net fisheries, and no attempt has been made to quantify the numbers and disposition of birds landing aboard brightly lit vessels and oil platforms near murrelet colonies. No detailed studies have been conducted on the impacts of non-native mammals to murrelet populations, despite the large numbers of cats, rats and other mammals introduced to many islands, particularly in Baja California. Given these limitations, we also relied on studies of other species and similar situations, and formulated assumptions on how this information applies to the Xantus's Murrelet.

Despite the limited data on Xantus's Murrelets, certain information about these birds, and the possible fate of the species, cannot be ignored. It is clear this is a rare species with a limited breeding range. In fact, it is one of the rarest seabirds in the North Pacific. The available data also indicate large declines throughout the breeding range over the last century, mainly due to high levels of predation by non-native mammals and possibly other factors not well understood. Furthermore, data indicate that between 1977 and 1991, the largest murrelet colony in the U.S. (Santa Barbara Island) declined between 23 and 61%. Nest monitoring data from the Channel Islands National Park seabird monitoring program strongly suggest this decline has continued since 1991. The decline at Santa Barbara Island is associated with low and declining reproductive success caused largely by high egg predation by deer mice, high predation levels on adults by Barn Owls, and possibly other factors such as declining prey populations and collisions with brightly-lit boats. The loss of this colony, should it occur, could be detrimental to the U.S. murrelet population.

In addition to the better understood threats, any or all of the various other threats summarized above also could be assisting murrelet declines. Given the species low population level and low breeding success, additional mortality of even tens or hundreds of birds will be extremely difficult, if not impossible, to replace under current conditions. Such mortality is not hard to imagine given an event such as a large oil spill off the southern California coast, continued use of high wattage boat lights off murrelet colonies, or high levels of gill net fishing in murrelet foraging areas. Although data on these threats are few, to ignore them would be an oversight of potentially devastating proportions.

Based on our assessment, we believe the Xantus's Murrelet is in danger of extinction and should be listed as threatened under the California Fish and Game Code. This listing is necessary to provide much needed protection to the species, and to better assure appropriate mitigation for past, present, and future impacts. Although some measures are now being taken that will benefit the species, such as proposed removal of rats from Anacapa Island and recent removal of non-native mammals from several of the Baja California islands, these measures are not guaranteed to assure the species recovery on these islands or at other important murrelet colonies (e.g., Santa Barbara Island). However, if successful and without the influence of other impacts, recovery may take decades or longer. In addition, little has been done to address various threats under the control of federal and state agencies, such as the impacts of bright boat lights and protection of nesting areas. It has become clear that without Endangered status, little can be done to assure the long-term survival and recovery of the Xantus's Murrelet population. It is only with such status that agencies will gather the necessary information and take appropriate conservation measures for the species.

We also feel the entire species, including U.S. and Mexican breeding populations as well as both subspecies, should be listed. Similar and serious declines have occurred in both the U.S. and Mexican breeding populations. It is highly likely that some interchange of individual birds

occurs between colonies in the U.S. and Mexico, particularly between U.S. colonies and the relatively large Los Coronados Islands colony located just across the U.S.-Mexican border. Also, given the murrelets tendency to disperse northward following breeding (Briggs et al. 1987, Whitworth et al. 2000), birds from Mexican colonies almost certainly spend a considerable portion of their lives in U.S. waters. Furthermore, the more rare southern subspecies, *S. h. hypoleucus*, is almost entirely confined to breeding at two Mexican island groups (Guadalupe Island and San Benito Islands). Populations of this subspecies appear to be well below historical levels due to predation and habitat destruction by introduced mammals (Jehl and Everett 1985, Everett and Anderson 1991, McChesney and Tershy 1998). Birds of *S. h. hypoleucus* occur in U.S. waters in the fall, at least in some years (Briggs et al. 1981, 1987; Unitt 1984). Breeding also has occurred in the U.S. (Winnett et al. 1979), and other data (H. R. Carter, unpubl. data) indicate that breeding in the U.S. may occur regularly. Thus, full protection of the southern subspecies, as well as the more numerous U.S. breeder *S. h. scrippsi*, is necessary.

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Table 1. Estimated breeding population sizes (numbers of breeding birds) of Xantus's Murrelets by island or island group with documented nesting. For the larger islands and island groups, see references for more detailed estimates by colony or island.[1]

Island	Population	Methods[2]	Source
California Channel Islands, U.S.A.			
San Miguel Island	200[3]	1,2	Carter et al. (1992), H. R. Carter (unpubl. data)
Santa Cruz Island	400[4]	1,2	Carter et al. (1992), H. R. Carter (unpubl. data)
Anacapa Island	100-400	1,2	McChesney et al. (2000)
Santa Barbara Island	1,544[5,6]	1	Carter et al. (1992)
*Santa Catalina Island	125	2	Carter et al. (1992), H. R. Carter (unpubl. data)
San Clemente Island	125	1,2	Carter et al. (1992), H. R. Carter (unpubl. data)
(U.S.A. subtotal)	2,494-2,794		
Baja California, Mexico			
Los Coronados Islands (1)[7]	750	1	R. L. Pitman (in Drost and Lewis 1995)
Los Coronados Islands (2)[7]	1,500-3,500	1,2[8]	Keitt (2000)
*Todos Santos Islands	50-250	1,2	Keitt (2000)
*San Martin Island	50-250	1,2	Keitt (2000)
San Geronimo Island	100-500	1,2	Keitt (2000)
San Benito Islands	525-2,200	1,2	Keitt (2000)
Guadalupe Island	1,000-2,000	1	R. L. Pitman and W. T. Everett (pers. comm.)
(Mexico subtotal)	2,475-8,700		
Total	4,969-11,494		

[1] Islands with suspected breeding only are indicated with an asterisk (*). Breeding at these locations suggested by presence of suitable nesting habitat, past nest records, and recent detection of vocalizing birds just offshore.
[2] 1 = Nest and/or habitat survey; 2 = vocal detection survey.
[3] Carter et al. (1992) estimated 150 breeding birds. Revised estimate is based on additional surveys conducted in 1994-1996.
[4] Carter et al. (1992) estimated 26 breeding birds. Revised estimate is based on additional surveys conducted in 1994-1996.
[5] Using Carter et al.'s (1992) data, Sydeman et al. (1998) estimated 847 breeding birds on Santa Barbara Island proper (compared to 1,402 breeding birds in Carter et al. 1992) based on a recalculation of the "L" correction factor for crevice occupancy rates.
[6] Carter et al. (2000) reported a range of 1,500-3,000 breeding birds.
[7] These are separate, independent estimates. For the Mexican subtotal and overall total, the Pitman (in Drost and Lewis 1995) estimate was used toward the lower ends of the ranges, and the Keitt (2000) estimate was used toward the upper ends of the ranges.
[8] Carter et al. (1996) also conducted vocal detection surveys at Los Coronados Islands but did not estimate population size. However, based on vocal detection levels, they felt Pitman's estimate for Los Coronados Islands was too low.

Table 2. Current and extirpated introduced mammals and human occupation of the California Channel and Northwestern Baja California islands (modified after McChesney and Tershy 1998).

Island name	Current	Extirpated	Human occupation
CALIFORNIA CHANNEL ISLANDS[1]			
San Miguel Island	Black Rats	Cats (domestic), sheep, pigs, horses	CINP[2]
Santa Cruz Island	Sheep, pigs	Cats (domestic), horses	The Nature Conservancy, CINP
Santa Rosa Island	Deer, elk	Sheep, cattle, pigs	CINP, Ranching
Anacapa Island			
East Anacapa I.	Black Rats	Rabbits, sheep	CINP
Middle Anacapa I.	Black Rats	Sheep	CINP
West Anacapa I.	Black Rats	Cats, sheep	CINP
Santa Barbara Island	None	Cats, rabbits, sheep, goats, pigs	CINP
San Nicolas Island	Cats	Sheep, horses	U.S. Navy
Santa Catalina Island	Cats, Black and Brown rats, goats, cattle, bison, horses	Sheep	Residential, Santa Catalina Island Conservancy
San Clemente Island	Cats, Black Rats	Goats, sheep	U.S. Navy
NORTHWESTERN BAJA CALIFORNIA ISLANDS			
Los Coronados Islands			
North Coronado I.	None	Cats (1995-96)[3]	None (formerly, temporary fishing camp)
Middle Coronado I.	None		None
South Coronado I.	Cats, goats, burros	Rabbits	Mexican Navy, Lighthouse
Todos Santos Islands			
North Todos Santos I.	Cats, dogs, burros	Goats	Mexican Navy, Lighthouse
South Todos Santos I.	None	Cats (1998)[3], Rabbits (1998)[3]	Abalone farm
San Gerónimo Island	Cats, dogs, burros		Permanent fishing camp
San Martín Island	Cats, dogs	Rabbits	Permanent fishing camp
San Benito Islands			
East Benito I.	Rabbits	Cats	None
Middle Benito I.	Rabbits[3, 4]	Cats	None
West Benito I.	Burros	Cats, rabbits (1998)[3], goats (1998)[3]	Permanent fishing camp
Natividad Island	Cats[4, 5], dogs	goats (1998)[5], sheep (1998)[5]	Town, fish cannery
Cedros Island	Cats, dogs, rats, goats, burros		Large town, factories, Mexican Navy
San Roque Island	None	Cats (1994)[5], rats (1994)[5]	None
Asunción Island	None	Cats (1994)[5]	None
Guadalupe Island	Cats, dogs, rats, House Mice, goats		Mexican Navy, town

Table 2 (con't).

[1] All California Channel Islands formerly were ranched extensively.
[2] CINP, Channel Islands National Park. Includes personnel housing, maintenance, camping and other recreation.
[3] Removal by Mexican Instituto Nacional de Ecología and the Island Conservation and Ecology Group (http://www.islandconservation.org).
[4] Removal in progress.
[6] Removal by Vizcaino Biosphere Reserve, Island Conservation and Ecology Group (http://www.islandconservation.org), and the local fishing cooperative.

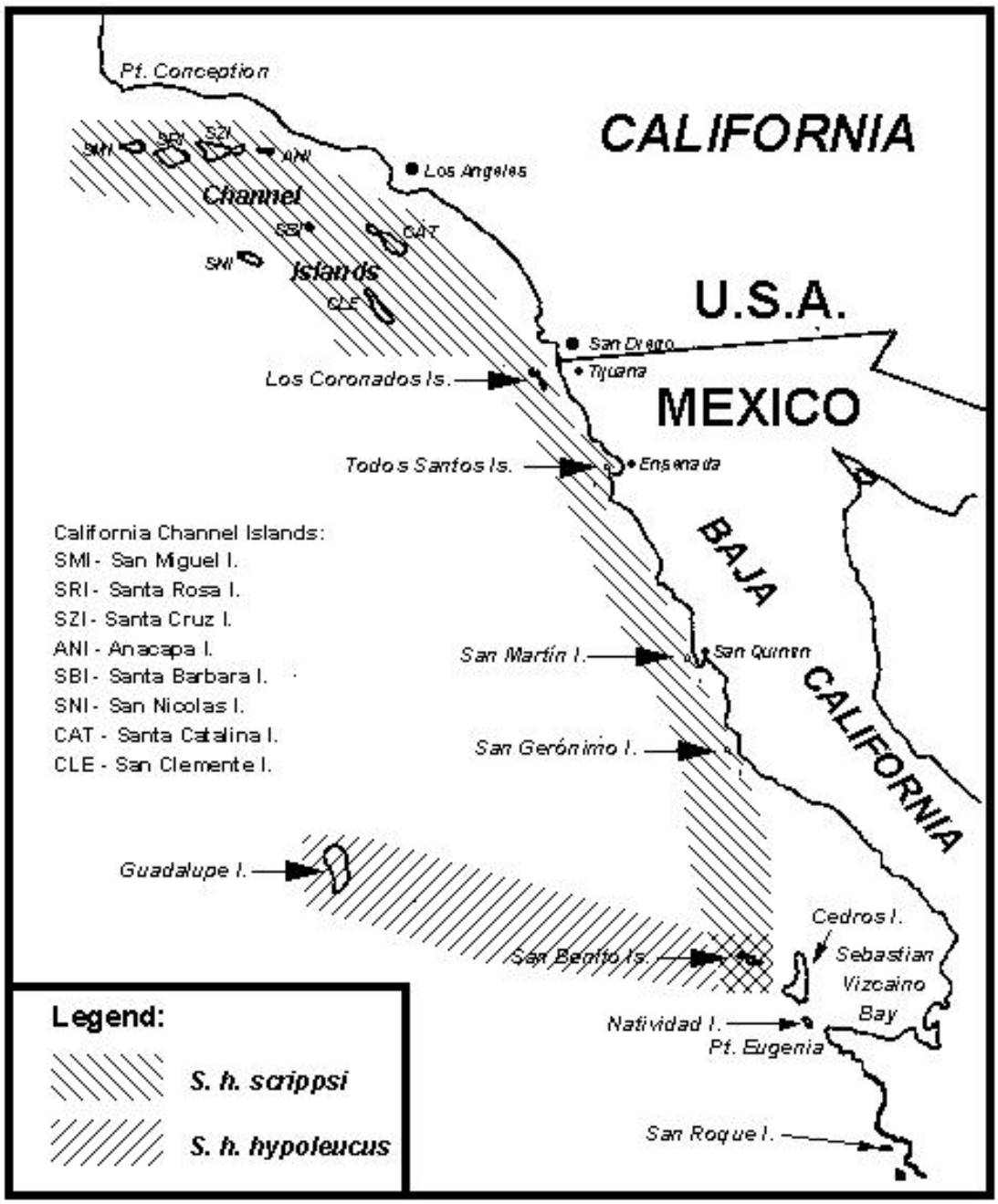

Figure 1. Map of the Xantus' Murrelet breeding range, including the two subspecies.

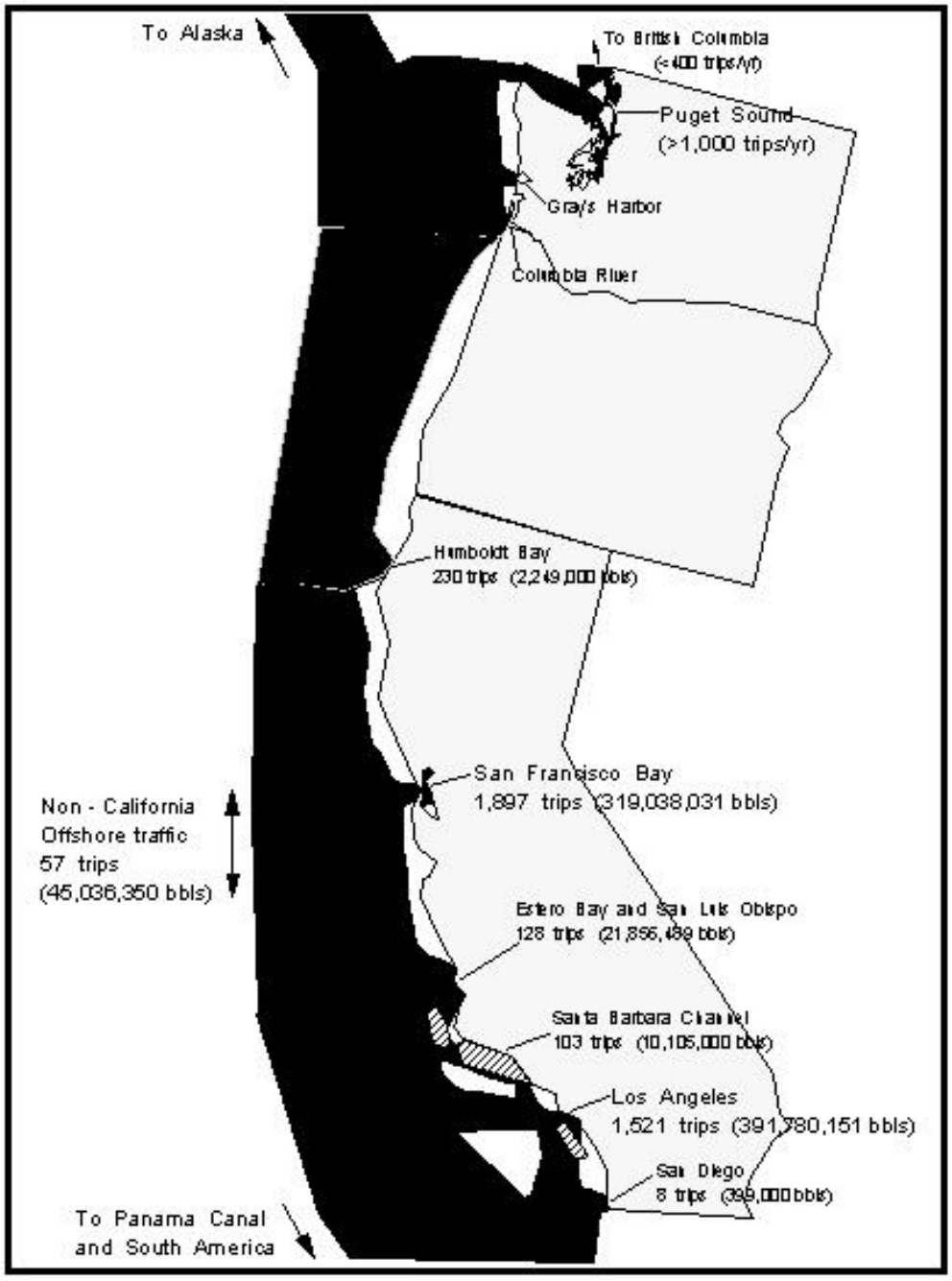

Figure 2. Tanker and barge movements along the west coast of the United States for crude oil and petroleum.

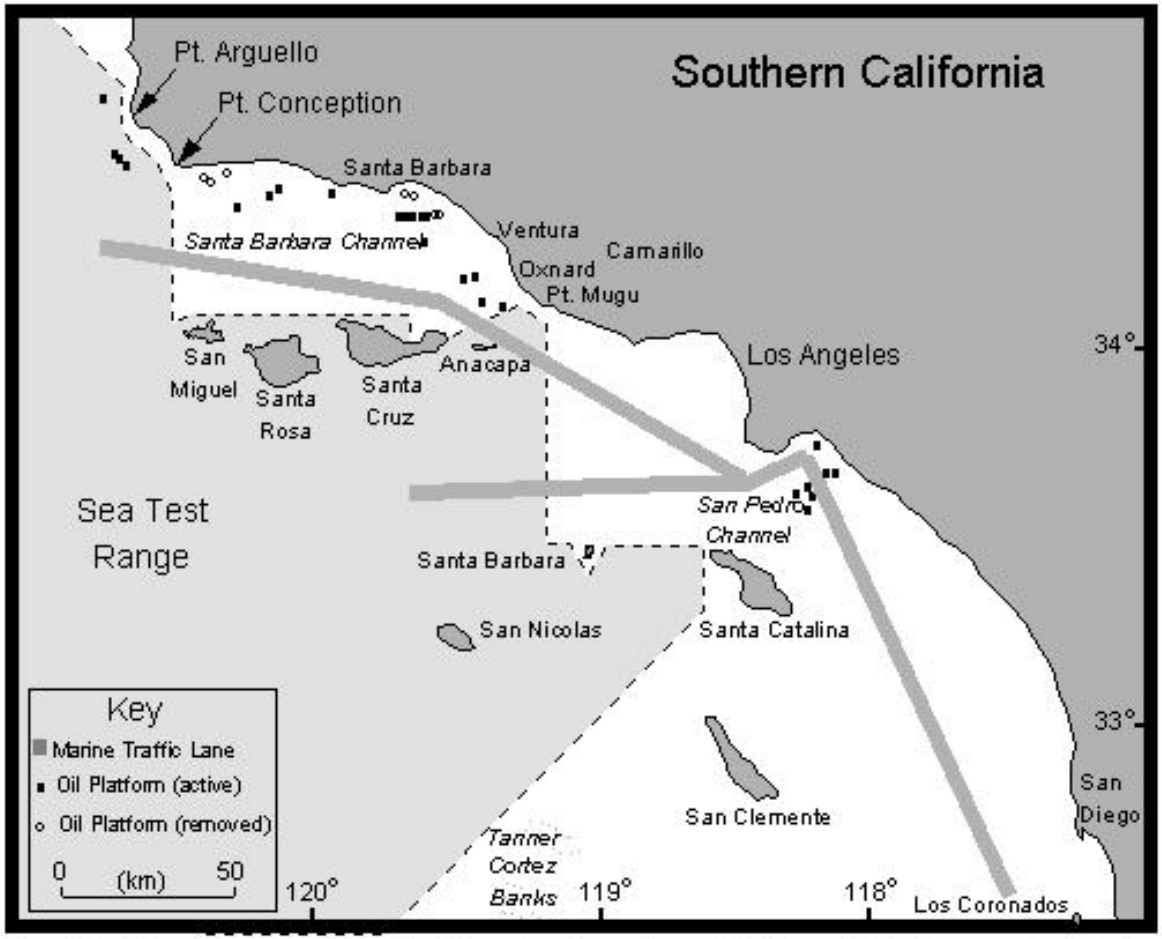

Figure 3. Map of Southern California Bight showing marine traffic lanes, oil platforms, and part of the U.S. military Sea Test Range (from Carter et al. 2000).

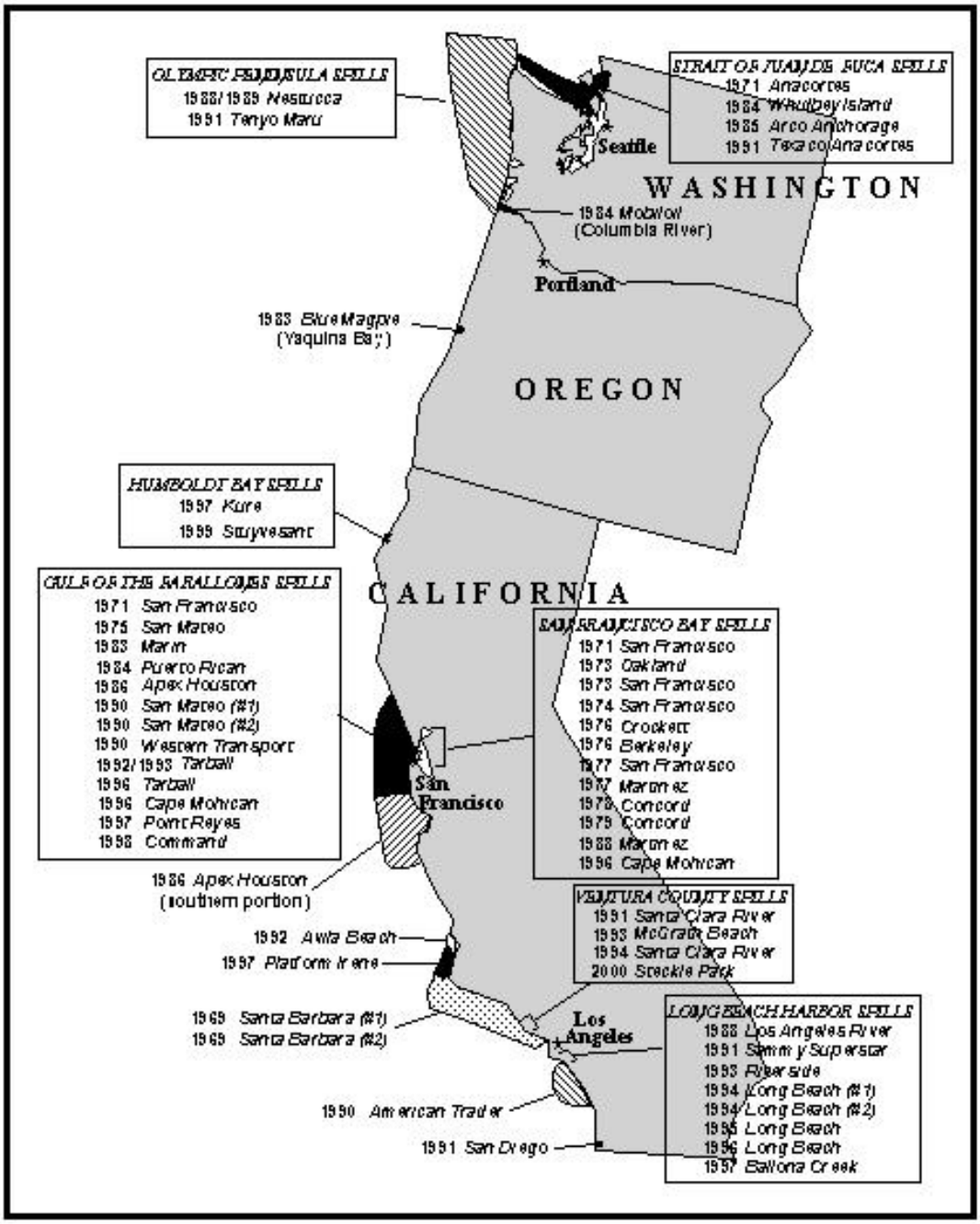

Figure 4. Known major oil spills off California, Oregon, and Washington, 1971-2000 (updated from Carter et al. 1998).

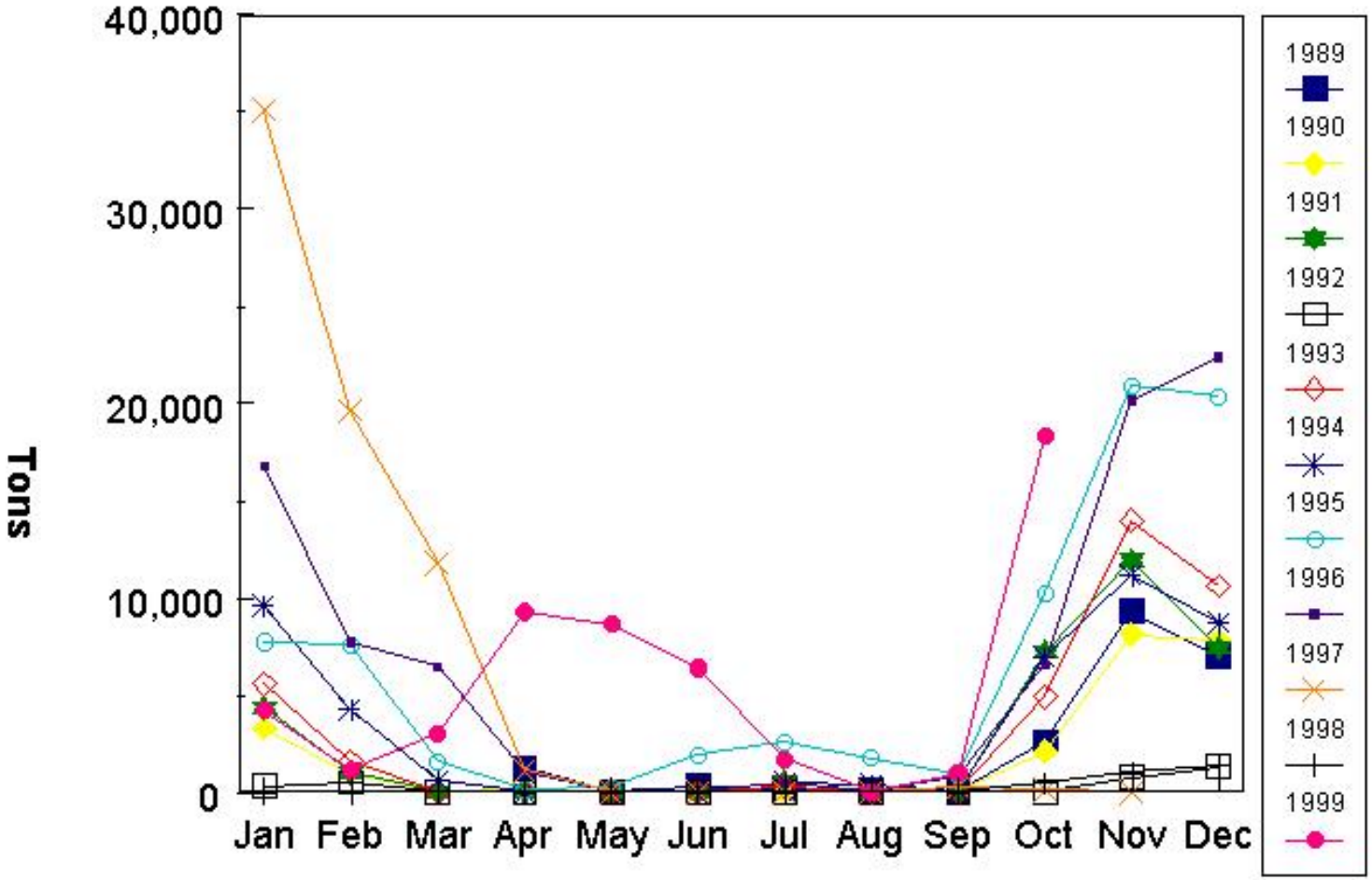

Figure 5. Monthly squid landings in southern California, 1989-1999 (from California Department of Fish and Game landings receipt database). Data for 1999 are preliminary and available only through July.

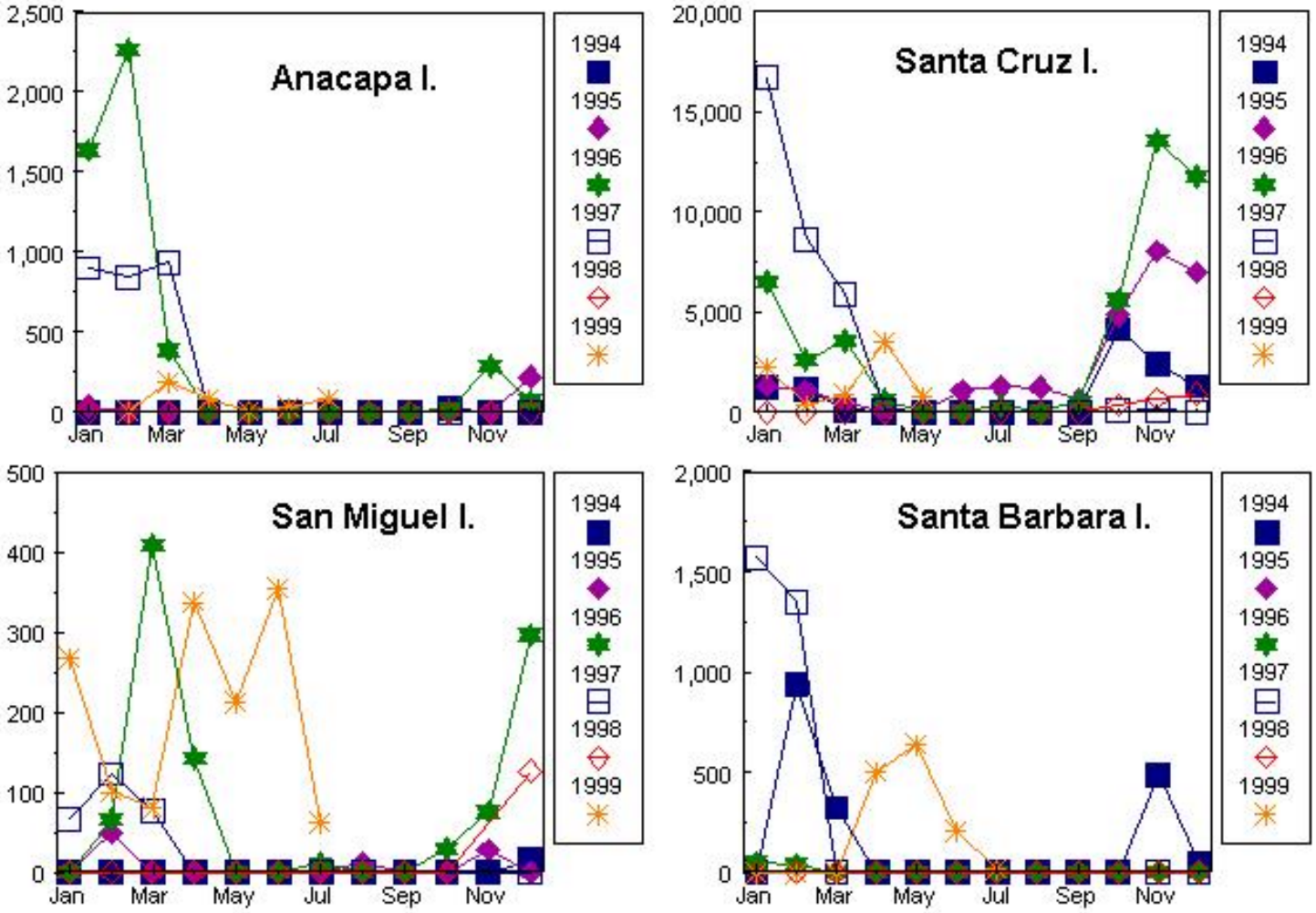

Figure 6. Monthly squid landings (tons) by year at Anacapa, Santa Cruz, San Miguel, and Santa Barbara islands. Santa Cruz Island includes Santa Cruz Passage (between Santa Cruz and Santa Rosa islands). Data from California Department of Fish and Game landings receipt database. Data from 1999 are preliminary and are available only through July.