AN EVALUATION OF PINNIPED-FISHERY INTERACTIONS IN CALIFORNIA

A Report to the Pacific States Marine Fisheries Commission (PSMFC)
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INTRODUCTION

OTHER ECOSYSTEM LEVEL IMPACTS

1995 PACIFIC HARBOR SEAL AND CALIFORNIA SEA LION AERIAL SURVEYS
- Introduction and Methods
- Results
  - Pacific Harbor Seals
  - California Sea Lions

PINNIPED-SALMONID INTERACTIONS
- Introduction
- Salmonid-Pinniped Interactions and Depredations in Rivers and Estuaries
- Salmonid-Pinniped Interactions and Depredations in Open Ocean
  - Commercial Ocean Salmon Operations
  - Recreational Ocean Salmon Fisheries
- Economic Impacts to California
- Conclusions

INTERACTIONS WITH NON-SALMONID FISHERIES

COMMERCIAL FISHERIES
- Gill net Fisheries
- Pacific Herring Fishery
- Round-Haul Fisheries
- Trap Fisheries
- Live Bait Operations
- Other Commercial Fisheries
- Summary

RECREATIONAL FISHERIES
- Introduction
- California sea lion Interaction and Depredation with CPFV's
- Impacts to the Southern California CPFV Fishery
- Summary and Conclusions

CONCLUSION

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INTRODUCTION

The following report is a summary of information compiled to help evaluate and describe the interactions and depredations by California sea lions and Pacific harbor seals in California's fisheries and coastal ecosystems. Data from this study are intended to facilitate negotiations between the Pacific States Marine Fisheries Commission (PSMFC), on behalf of the State, and the National Marine Fisheries Service (NMFS), as directed by the 1994 re-authorization of the Marine Mammal Protection Act (MMPA), in hopes that they will develop recommendations and solutions to alleviate the problems caused by pinnipeds.

California sea lion (*Zalophus californianus californianus*) and Pacific harbor seal (*Phoca vitulina richardsii*) populations are increasing rapidly (doubling approximately every 10-15 years). Prior to this report, the distribution of California sea lions and Pacific harbor seals along the California coast during periods other than peak abundance was unknown. Few data exist to describe seasonal distribution for any of the pinniped populations, and existing data tends to be localized, unavailable, or dated. The last seasonal coast-wide survey for all pinniped species was completed in 1982 by Bonnell *et al.* (1983). Bonnell's study incorporated birds and all marine mammal species in nearshore waters, thus it did not conclusively enumerate pinniped haul-out sites (areas where pinnipeds come ashore to rest) on shore. Up-to-date seasonal distribution information for California sea lions and Pacific harbor seals is essential to assess and evaluate the potential impacts of the populations on specific fisheries, fishing areas (*e.g.* identification and numbers of animals at haul-out sites close to salmon runs, or areas with heavy fishing pressure) and the marine ecosystem in general.

In California, the last comprehensive study of pinniped-fishery interactions was completed in 1979-1981 by Miller *et al.* (1983). Miller found that pinnipeds adversely affected (fish depredation and gear damage) the salmon troll, halibut gill net, and commercial passenger fishing vessel (CPFV) fisheries. Pinnipeds also interacted with other fisheries (hook and line, round haul, trap, and trawl fisheries) but to a lesser degree. At that time, the California sea lion was the major species involved in fish and gear loss. Counts of California sea lions and Pacific harbor seals have doubled in the past ten years (Barlow *et al.* 1995) and the rate of pinniped-fishery interactions has also increased.

The first objective of this study was to obtain current information on the haul-out sites utilized by California sea lions and Pacific harbor seals. Since the study was initiated in September 1995, and results were due by December 1995, we conducted one aerial survey during September. However, we had previously surveyed the coastline in July and results from that survey were incorporated into this report. We identified current haul-out sites and the number of California sea lions and Pacific harbor seals utilizing each site. Sites were grouped

by area and the data compared with two seasons of Bonnell's 1983 study.

Our second objective was to identify, substantiate, and determine the coast-wide degree of direct and indirect interaction between pinnipeds and California's fisheries (as much as could be accomplished in a four-month period). We utilized information from the Department's Ocean Salmon Project (OSP) to define the degree of interaction with pinnipeds in the commercial (troll), and recreational (CPFV and private skiff) ocean salmon fisheries. We used reports of pinniped depredation from CPFV logs to determine the rates and degree of impact in the non-salmonid recreational fishery. Finally, we utilized additional sources of data; commercial fishing logs of gill net fishers, NMFS observer data, and interviews with fishermen to produce the following comprehensive report.

OTHER ECOSYSTEM LEVEL IMPACTS

Herein, we describe problems and impacts of California sea lions and Pacific harbor seals pertinent to California's salmonid and non-salmonid fisheries. There are additional ecosystem level impacts, such as competition for space and resources that this report does not address in detail. We have also provided additional information further detailed in NMFS' scientific and investigative report to Congress.

For the past five years California sea lions have hauled out on Pier 39 in San Francisco. The numbers have ranged from six animals in 1990, to 486 in 1994, and as many as 627 in 1991. These sea lions foul the pier and nearby water and act aggressively towards humans who attempt to chase them off. The same scenario happened in Monterey Bay, where numerous California sea lions took over the docks and prevented boat owners from accessing their vessels. They also fouled the area and damaged the docks and boats with their weight.

Recently, there have been reports of California sea lions negatively interacting with humans. One woman jogger was bit by a 200 pound female sea lion as she approached the animal who was lying on a Santa Barbara beach (Santa Barbara News Press, June 19, 1993). Residents of Crescent City have written to CDFG and reported California sea lions climbing into boats and stealing fish laid out on docks. In addition, they report sea lion assaults on people who carry fish. One man reports a sea lion grabbing him by the leg while he was on the dock (Letters to NMFS & CDFG, 1994). Other reports are anecdotal and cannot be documented. For example; during April 1995, the following accounts were reported to OSP samplers. In the Fort Bragg area, a fisherman was cleaning his salmon in the ocean when a California sea lion took the fish from his hands, scratching him in the process. Another report involved a California sea lion biting through the landing net of a recreational fisherman in the act of landing a salmon. California sea lions have also been reported climbing into fishing boats in search of food, the crew unable to dislodge the animal.

When pinnipeds haul out on public beaches and piers, the public is restricted from using the area so as not to harass the animals. In San Diego, the city designated a portion of La Jolla shoreline as a harbor seal refuge. Now the seals have begun to haul out on the sandy beach adjacent to the designated haul-out, a site popular with tourists. To disturb the seals, even in the course of diving in the area, or trifling on the adjacent beach, would be marine mammal harassment, a federal offense.

There is suspicion that aquaculture facilities, such as oyster beds, are being contaminated

with bacteria from pinniped waste in areas where pinnipeds are numerous.

Virtually the entire population of California sea lions are in southern California waters during the breeding season. It is logical to assume that an increasing population of top predators is consuming a vast amount of biomass. To what degree this consumption effects the food chain, and the ecosystem as a whole, is unknown. Increasing populations of pinnipeds may change quotas in various fisheries where pinnipeds are known consume the same species, such as Pacific sardine, northern anchovy, and Pacific herring.

1995 PACIFIC HARBOR SEAL AND CALIFORNIA SEA LION AERIAL SURVEYS

Introduction and Methods

Up-to-date seasonal distribution information for California sea lions and harbor seals is essential to assess and evaluate the potential impacts of the populations on specific fisheries, fishing areas, and the marine ecosystem in general. The last seasonal coast-wide survey that detailed distribution and abundance of California sea lions was completed in 1982 (Bonnell *et al.* 1983) and was not specifically directed at sea lions, (it incorporated all marine mammal species and birds, on-shore and off-shore). CDFG has conducted surveys of harbor seals along the California coast since 1982. These surveys have been conducted specifically to count all harbor seals in the state of California during their early summer molting period.

To address this lack of information in seasonal abundance and distribution of pinnipeds, PSMFC contracted with CDFG to obtain additional data. For this report, we surveyed the California coast for Pacific harbor seals and California sea lions in July and September, 1995. We surveyed the coastline at an altitude of approximately 183 meters (600 feet) in CDFG's Partenavia P68 Observer airplane, which was fitted with a large photographic port (approximately 70 cm X 70 cm) located in the floor behind the copilot seat. This port enabled the photographer to recognize pinnipeds well before passing over them and to take nearly vertical pictures, which contributes less counting bias to the survey than oblique pictures (Miller et al. 1983). The survey team consisted of a pilot, data recorder, and photographer. We photographed pinnipeds with a motor-driven Hasselblad camera and large capacity (70 frames) film magazines. The data recorder kept track of position, time, frames exposed, estimated number of animals with a lap-top computer and a flight book of coastal charts. The exposed film from the aerial photographs was compared previous photographs (from 1981-1994) for site identification. After identifying the sites we used dissecting microscopes to count the pinnipeds.

Results

We surveyed the California mainland coastline[1] on July 10th-13th (summer survey) and September 25th-29th (fall survey). For the summer survey we counted; 20,323 Pacific harbor seals at 375 mainland haul-out sites, 3,012 harbor seals at 106 Channel Island (CI) haul-out sites, and 11,259 California sea lions at 34 mainland haul-out sites. For the fall survey we counted; 4,972 Pacific harbor seals at 133 mainland haul-out sites, 748 harbor seals at 53 CI haul-out sites, and 15,898 California sea lions at 56 mainland haul-out sites. We were unable to survey the Farallon Islands but have included 1995 estimates in the discussion.

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[1] *We surveyed the Channel Islands in both surveys, but due to time constraints, sea lion counts were not available for this report. NMFS maintains data on California sea lion abundance in the Channel Islands.*

Pacific Harbor Seals

In California, harbor seals are one of the more commonly observed pinnipeds along the coast. They are widely distributed on the mainland and offshore islands where they haul-out and breed on intertidal sandbars, rocky shores and beaches. Unlike California sea lions, Pacific harbor seals do not make extensive pelagic migrations. They do however, make local movements associated with food or breeding and on occasion have been observed to move 300-500 km (Herder 1986; D. Hanan, unpublished data). Since at least the 1960's, the abundance of harbor seals in California has been increasing and they have continued to occupy new haul-out sites.

During aerial surveys for harbor seals only a proportion of the total population of seals is hauled out. To account for the proportion of seals off-shore during the survey, a correction factor is applied to the count. Boveng (1988) reviewed radio tagging studies and estimated that the proportion of seals hauled out and counted during a census represents 50% to 70% of the total population. To estimate the best total population, Boveng suggested 1.4 as the best correction factor.

The 1.4 correction factor applied to summer counts yields a population estimate of 28,452 harbor seals on the mainland and 4,217 in the Channel Islands (32,669 total). The correction factor applied to fall counts yields a population estimate of 6,961 harbor seals on the mainland and 1,047 in the Channel Islands (8,008 total). We counted 75% fewer seals in the fall (both mainland and island) than in the summer, illustrating the seasonal variation in abundance and distribution. To conform with NMFS's scientific investigative report to Congress, 1995 distribution and abundance of harbor seals in California are summarized by "Area" in Table A. Each value in the table has been increased with the 1.4 correction factor.

California Sea Lions

California sea lions are the most abundant pinniped in California. California sea lions are a migratory species with maximum abundance on-shore occurring during the summer breeding season. They breed during July primarily at the Channel Islands in southern California, although some breeding occurs at Año Nuevo Island in central California, and the Farallon Islands off San Francisco. After the breeding season, adult and sub-adult males migrate north, although some remain at haul-out sites in central and northern California. Males may migrate as far north as British Columbia, Canada, then return south in March to May. Movements of females are unknown; it is thought that they remain in the areas of the rookeries or make short trips either northward or southward along the coast.

California sea lions are surveyed annually during the breeding season at the Channel Islands by NMFS (Barlow *et al.* 1995). There are also recent counts of California sea lions at Año Nuevo Island (NMFS), and the Farallons (Pt. Reyes Bird Observatory). Bonnell *et al.* (1983) conducted seasonal surveys (spring, summer, fall and winter) of birds and marine mammals, including sea lions, from 1980 to 1982. He reported a total of 139 different haul out sites in central and northern California.

We compared our findings for the 1995 July and September surveys to Bonnell's summer (June-July) and fall (September-October) surveys of 1980-1982. We matched our sites as close as possible to those listed by Bonnell, based on latitude and common site name. In Bonnell's

study, the number of occupied mainland haul-out sites ranged from 16 (1981) to 22 (1980, 1982) in the summer and 34 (1982) to 38 (1981) in the fall. We found 24 occupied mainland sites in the summer and 32 in the fall. Bonnell's counts of sea lions ranged from 4,378 (1980) to 11,209 (1982) in the summer, and from 10,334 (1980) to 24,348 (1982) in the fall. If we assume that there were a minimum of 3,000 sea lions at the Farallons[2] in the summer (which we were unable to survey) and 1,000 in the fall, then total counts for 1995 would be approximately 14,300 sea lions ashore during the summer survey, and 16,900 sea lions ashore at the time of the fall survey. Año Nuevo Island (summer) had the highest concentrations of sea lions. We counted 6,745 California sea lions, 60% of the total we counted or 47% of the estimated (including Farallons) population ashore on the mainland during the summer. Other site comparisons can be found in Tables B and C. To conform with NMFS's scientific investigative report to Congress, 1995 distribution and abundance of California sea lions in California are summarized by "Area" in Table D.

[2] *From 1994 estimates by W. Sydeman personal communication to M. Lowry NMFS, July 1995.*

PINNIPED - SALMONID INTERACTIONS

Introduction

For this report, evidence of pinniped depredation on salmonids has come from observations, interviews, and analyses of pinniped scats. Along the California coast, pinnipeds prey on adult salmon and smolts at river mouths, estuaries and in the open ocean (Jones 1981, Herder 1983, Miller *et al.* 1983, Hart 1987, Hanson 1993, Stanley and Scheffer 1995, CDFG unpublished data 1995).

Salmonid-Pinniped Interactions and Depredations in Rivers and Estuaries

At the Klamath River, Pacific harbor seal feeding rates on salmonids were found to be less than 1% in the 1960's and 1970's (Herder 1983). In the early 1980's, Hart (1987) investigated the impact of harbor seals on migrating salmon and steelhead and showed that harbor seals consumed 3.6% (1981) and 7.9% (1982) of the chinook salmon, coho salmon and steelhead trout, released from a seining-tagging operation. A majority of the fish were consumed by as few as 12 individual seals. In addition, harbor seals were exclusively responsible for depredation of salmon in the Native American subsistence gill net fishery at the Klamath River, Area 2 (Herder 1983). Salmon had a depredation rate of 13.2%; of 447 fish caught in nets, 59 showed signs of harbor seal depredation. At that time the harbor seal population in the area was estimated at 150-200 animals. Further analysis revealed that as few as seven harbor seals per day were responsible for all the observed depredations. Stanley and Shaffer (1995) studied harbor seal depredation from CDFG caught and tagged salmonids at the Lower Klamath River from 1984 to 1988. They found that harbor seals took 3.1% to 5.5% of fish that were seined, tagged, and released. The majority of depredations occurred on days when seining operations took place. It was assumed that tagged fish were fatigued and less capable of avoiding seals. There were few observed depredations on days without seining operations.

At the Russian River, Hanson (1993) found that California sea lions were more successful at capturing free swimming salmonids than harbor seals. Hanson observed California sea lions to have a catch rate of 0.52 fish/hour, (74% of all pursuits resulting in captures) whereas Pacific harbor seals had a catch rate of 0.27 fish/hour (19% of all pursuits resulting in captures).

Stanley and Shaffer's 1984-1988 was the last documented study to report direct interactions and depredations between harbor seals and salmonids in a river system. No current data are available for comparison although there are recent reports from sport and commercial fishermen describing large groups of sea lions and harbor seals at coastal river mouths. One observation from a commercial fisherman with 25 years of fishing experience[3], describes sea lions barricading the Russian river mouth during runs of salmon and steelhead. Another fisherman depicts a large group of male sea lions at Noyo Harbor awaiting the return of coho salmon. An avid sport fisherman portrays harbor seals preying on salmon at river mouths when ocean access is blocked by sand bars created by storm activity. In September 1995, during the

[3] *Personal communication, Ms. Diane Schoditsch, November 1995, Ventura, Ventura County, California.*

harbor seal and sea lion aerial survey previously described in this report, we observed a minimum of 50 harbor seals foraging on what we assumed to be salmonids, at the mouth of the Klamath River. Harbor seals were lined up side by side, from bank to bank, in rows of four to five, feeding in the shallow waters where the river flowed into the ocean.

There is documented evidence of pinniped depredation on coho salmon and steelhead returning up river to spawn. At Scotts Creek, in the Monterey area of California (Area 6), tooth and claw marks were found on 36% of sampled coho salmon and 46% of sampled steelhead (Monterey Bay Salmon and Trout Project 1994-95, unpublished data). At the Davenport ocean farming operation (Santa Cruz County) Miller *et al.* (1983) reported that 15% of returning adult salmon were bitten by harbor seals. At a collection facility on the Snake River (Washington), Harmon *et al.* (1994) concluded that tooth and claw marks on adult salmon were probably caused by harbor seals (based on the size), and that sea lions may be more efficient predators and therefore leave fewer survivors. It is hypothesized that considerable fish mortalities (direct and indirect) may result from confrontations with pinnipeds (Harmon *et al.*) and that pinniped induced stress from scarring, injuries and infections may also result in lowered spawning success (Monterey Bay Salmon and Trout Project).

Salmonid-Pinniped Interactions and Depredations in the Open Ocean

California sea lions are the primary species involved in the ocean depredations (Miller *et al.* 1983, Hanan *et al.* 1989, CDFG-OSP-unpublished data). In the open ocean pinnipeds prey upon salmon by removing and/or damaging fish hooked by commercial troll, CPFV, or recreational fisheries. To document the degree and extent of sea lion depredation in ocean salmon fisheries, we used 1995 data collected by the Department's Ocean Salmon Project (OSP).

CDFG's OSP estimates annual landings, fishing effort, and marine mammal interactions in California's ocean salmon fisheries. The project also determines the contribution of hatchery reared salmon to commercial and recreational fisheries. To estimate ocean landings, fishing effort, and interactions, OSP uses stratified random sampling for at least 20% of the salmon landed by commercial (troll) and recreational (CPFV and skiff) fisheries in California. Five major port areas were sampled between the Oregon border and Pt. Conception: Crescent City, Eureka, Fort Bragg, San Francisco, and Monterey (Figure 1). All of these port areas consist of several minor-ports (Table 1) with salmon landings. Minor-ports for the recreational skiff fishery are generally launch ramps or boat hoists within the port area where samplers can interview all sport anglers that land at the site during a sample day. Minor-ports for the CPFV fishery are docks within a port area where CPFV's return to unload anglers after fishing for salmon. Since commercial fishing for ocean salmon was prohibited between the Oregon border and Horse Mountain, California during 1995 (Figure 1, Table 2), commercial landings were sampled only at major dealers in Fort Bragg, San Francisco, and Monterey port areas. Recreational fishing was allowed along the entire California coast during 1995; however, fishing north of Horse Mountain was more restrictive and included the use of quotas (Table 2). Due to an unusual southern distribution of salmon, sampling was expanded to include Santa Barbara, Ventura, Oxnard and Port Hueneme.

For 1995, California ocean salmon harvest statistics were extrapolated from data collected by the project's sampling program, combined with information obtained from commercial dealer

landing receipts and CPFV logbooks.

Commercial Ocean Salmon Operations

In 1979 and 1980, Miller *et al.* (1983) found that the commercial salmon troll fishery had the highest rate of salmon depredation by pinnipeds of all fisheries surveyed. Miller reported that the commercial salmon troll fishery lost 12,459 legal sized salmon to sea lion depredation in 1980. The numbers of depredated salmon for 1995 were much (seven times) greater. For the 1995 commercial salmon troll season, sea lions were estimated to have taken a total of 86,700 salmon (legals and sub-legals) while commercial trollers landed 734,800 salmon. Sea lions depredated almost 12% of what was commercially landed. Estimated sea lion take and estimated landings are summarized by area and month in Table 3 (commercial fishing was prohibited between the Oregon border and Horse Mountain, California, accordingly there are no data for Crescent City and Eureka).

For 1995, sea lion depredation rates were greatest in the Monterey area (Pigeon Point south to the Mexican border). Sea lions took more salmon in this area although commercial landings were greater in the San Francisco area (Point Arena south to Pigeon Point). The depredation rate in Monterey, percentage of sea lion takes relative to the number of salmon landed by the commercial trollers, was 15% (all months summed) compared to 9% for the San Francisco area. More fish were taken during the month of May in both San Francisco and Monterey corresponding with the southward migration of sea lions to their breeding rookeries. Miller *et al.* (1983) found similar results in 1980, the San Francisco and Monterey areas experienced the greatest losses of salmon in May. August and September had the highest depredation rates in both areas (Figure 2) corresponding to the post-breeding northward migration of male sub-adult and adult California sea lions.

Recreational Ocean Salmon Fisheries

In California, salmon are fished by recreational anglers along the entire coast, however, in recent years most fishing effort has taken place in the San Francisco and Monterey Bay areas. In 1995, the recreational salmon fishery extended well into southern California.

In 1995, Monterey and San Francisco dominated the recreational ocean salmon landings (Table 4) and experienced the greatest degree of sea lion depredation (Figure 3). The highest depredation rates (number of sea lion takes relative to total angler landings) occurred in the Monterey area during March (21%), April (27%), and September (19%), coinciding with the male sea lion spring southward and fall northward migrations. The 1995 commercial troll fishery demonstrated similar findings with increased depredation rates in May, August and September (there was no commercial fishing effort prior to May).

An estimated total of 27,900 salmon were lost to sea lions in 1995. In the Monterey area during April, sea lions took an estimated 11,900 salmon from anglers' lines, 43% of the total number of salmon taken in the recreational fishery for the 1995 season (CPFV and private skiff combined).

Economic Impacts to California

Changing salmon management concerns have resulted in continual adjustments in salmon fishing regulations such as allocations between ocean and inland user groups, harvest quotas, and time and area closures. Ocean fishing regulations have become more restrictive. The Pacific Fisheries Management Council (PFMC) recently restricted commercial and recreational salmon regulations off California to protect endangered chinook and depressed coho stocks, resulting in various northern California area closures and a statewide ban on coho landings (Table 2). Increased sea lion depredations may result in further restrictions for commercial and recreational fishers.

Commercial and recreational fishing is an important social and economic asset in California. Salmon fishing represented over $28,856,000 million in California[4] (PFMC 1995). Increased pinniped populations and increased interactions resulting in salmon losses, will certainly have a negative economic impact in California. Commercial troll fishermen lose approximately $20 for every legal sized salmon depredated by sea lions as well as the cost for gear (spoons, leaders, hooks, lures) lost or damaged. Depending on the success of the fishermen, annual losses can range from $2000 to $10,000 or more per year. In 1980, Miller *et al.* (1983) determined that the value of salmon taken by sea lions in 1980 was $274,000, based on a value of $22 per fish. In 1995, an estimated total of 86,700 salmon were lost to sea lions in the commercial troll fishery. Assuming that the sub-legals depredated by sea lions would of been taken in the fishery at a later date, the ex-vessel price of salmon lost to sea lions in 1995 totaled $1,734,000 (based on a value of $20 per fish, excluding gear). If the 1995 recreational take by sea lions is included, the salmon value rises to $2,920,000.

Conclusions

California sea lions and Pacific harbor seals depredate salmonids in the open ocean and river systems. In the case of endangered or depleted salmon stocks, it is critical to determine the degree of salmon mortality attributable to sea lions and harbor seals, and alleviate the situation before depressed salmon populations are further decimated or possibly lost forever.

Coast-wide surveys are necessary to determine the duration, location and number of harbor seals and sea lions in areas close to salmon and steelhead runs, particularly those of special interest. Seasonal food habit studies of both harbor seals and sea lions would help assess the degree of depredation of adult salmon returning to rivers, and the take of juveniles entering the ocean. These studies should include scat analyses as well as direct observations. Scientific studies are needed to investigate the degree of direct and indirect salmon mortality to salmonids caused from encounters with pinnipeds. Data are required to address the extent of depredation by sea lions and seals on free swimming salmonids as well as the degree of indirect mortality associated with pinniped scarring, injury, infection, and lowered spawning success.

California sea lions depredate ocean salmon fisheries. Fishermen have reported that sometimes the sea lion predation was so severe they were forced to suspend fishing operations.

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[2] *Total personal incomes associated with activities in the salmon fisheries.*

Miller *et al.*(1983) and recent 1995 data illustrate that depredation rates coincide with the spring and fall sea lion migration patterns. In 1980, Miller *et al.*(1983) estimated that commercial troll fishermen lost 1% of the catch to sea lions. In 1995, commercial troll fishermen reportedly lost 12% of the catch to sea lions. The increased depredation rate for 1995, corresponds to increased sea lion populations (Barlow *et al.* 1995). CDFG's OSP provides initial data that illustrate a degree of depredation, but additional, more in-depth studies are required.

Sea lion depredations in commercial and recreational ocean fisheries may influence salmon populations. When sea lions remove a hooked salmon, commercial fishermen and anglers continue fishing to replace the depredated fish. Hooked fish lost to sea lions are losses to the population that need to be taken into consideration when determining allotments and quotas. Thus, sampling programs need to be expanded to better assess the take of legal and sub-legal salmon by commercial fishermen, anglers, and sea lions. In addition, on-board observations are needed to provide a more extensive report of sea lion interactions and depredations, and to validate reported losses by both commercial and recreational fishermen.

Finally, there is a need for innovative and effective deterrent devices and methodologies to eliminate, discourage and reduce sea lion and harbor seal depredation on adult and juvenile salmon both in the open ocean and inland rivers.

INTERACTIONS WITH NON-SALMONID FISHERIES

From 1979-1981, Miller *et al.* (1983) investigated the relationships between marine mammals and California's commercial and recreational fisheries. He found that California sea lions and Pacific harbor seals interacted and depredated catch in the commercial; salmon troll, gill net, round-haul, trap, hook and line, and trawl fisheries, and recreational CPFV, pier and private boat fisheries. Since Miller's study, populations of California sea lions and Pacific harbor seals have at least doubled (Barlow *et al.* 1995). We analyzed available data sources from non-salmonid commercial fisheries as well as the non-salmonid CPFV fishery. Results and findings are summarized in the next two sections of this report.

COMMERCIAL FISHERIES

Gill Net Fisheries

In California's gill net fisheries, both California sea lion and Pacific harbor seal depredate fish and damage gear. Miller *et al.* (1983) reported the highest pinniped depredation rate in the gill net fisheries to occur in the halibut and white seabass set gill net fisheries off southern California (in 1980) where pinnipeds depredated 10% of the catch. In contrast, the white croaker, Pacific bonito, and flying fish, gill net fisheries experienced a depredation rate of less than 2%. We have documented nearly the same situation at the present time. Currently, sea lions and harbor seals primarily depredate catch in the halibut, white seabass, and barracuda, gill net fisheries, and there are some reports of pinniped depredation in gill net fisheries that target mackerel, Pacific bonito, rockfish, and shark and swordfish for their catch but these accounts are minimal.

From July 1990 to July 1994, NMFS's Federal Observer Program placed observers aboard set gill net boats to monitor marine mammal mortality (the majority of these boats targeted halibut for catch). Observers also collected information on marine mammal depredations as well as fish data. Over the four-year time-period, observers monitored 996 set gill net trips; a total of 60,967 sets. Pinniped depredation was reported in 11,547 or 19% of the observed sets.

California halibut are fished with gill nets, primarily in southern California, throughout the year. White seabass and barracuda are seasonally fished in April through July for two to three months, with small mesh drift gill nets (usually 6.5" mesh for white seabass and 3.5" mesh for barracuda). We reviewed gill net logs from fishermen targeting white seabass (CDFG gill net fishing logs; unpublished data) and found that in the 1993-94[5] white seabass season, 20% of the reported fishing days had accounts of "fish lost to pinnipeds." In the 1994-95 season there was a reported loss in 12% of the reported fishing days. Commercial fishermen[6] report that pinnipeds can damage 10% to 30% of the catch daily; a monetary loss of approximately $50 to $75 per day, or $3,000 to $4,000 for a season.

In 1981, Miller *et al.* (1983) found that sea lions depredated 1.2% of the swordfish catch

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[5] *Commercial fishing seasons extend from April 1st, to March 31st of the following year.*

[6] *Personal communication, Mr. Tony West, November 1995, San Pedro, Los Angeles County, California.*

in the shark-swordfish drift gill net fishery. Data from NMFS federal observer program for July 1990 to July 1994, revealed 250 or 2.5% of the total observed drift gill net sets (9,892 total) sustained pinniped depredation.

In addition to depredation of catch, sea lions and harbor seals damage gill net gear; pinnipeds tear the net, and leave holes and/or knots. For 1980, the total estimated value of fish removed by pinnipeds and gear loss in California gill net fisheries was $121,000 (Miller *et al.* 1983). Today, individual fishermen claim that gear damage and catch loss in gill net fisheries ranges from $1,000 to $20,000 annually.

Fishing effort in the halibut set gill net fishery declined substantially over the past five years, from over 7,000 days of effort and over 200 boats in 1990, to less than 2,000 days of effort and less than 40 boats in 1994 (Beeson 1995). Much of the effort declined to due to the implementation of California state Proposition 132[7]. According to commercial gill net fishermen, depredation rates have increased over the past five years and depredation of catch and damage to gear is greater than ever. With fewer boats setting nets, depredations become more frequent for boats that remain in the fishery. A typical scenario is described by a veteran commercial gill net fisherman[8]; "A fisherman rises well before dawn to reach his boat and depart out to sea to pull his nets. Up come the nets; (wind blowing at 20-25 knots) first catch, 2 skates, next catch, 2 halibut heads, next catch, 1 halibut tail with two vertebrae. As the sky gets lighter, ocean condition become more unstable. Further down the net, a huge head appears over the edge, a 200 pound sea lion with a 15 pound halibut firmly clenched in its' jaws. With painful frustration, the fisherman heads back to the harbor". This description depicts the frustration of our local gill net fishermen. Many fishermen are being "put out of business" by continual pinniped depredations and related loss of income. Finally, commercial fishermen have reported that during El Niño periods, pinniped depredation is more intense. A major El Niño is predicted in the next 12 to 18 months. When this occurs we can expect pinniped depredation to significantly increase and further impact our commercial fisheries. Examples of the degree of damage to gill net catch caused by sea lions and harbor seals are included at the end of this report (contributed by Mr.E. Ben Henke).

Pacific Herring Fishery

In California, Pacific herring are fished during the winter spawning season from (November to March), in San Francisco Bay, Tomales Bay, Humboldt Bay and Crescent City. In the 93-94 season (November-March) there were 352 gill net permittees and 32 round-haul permittees (discussed below in round-haul section) (CDFG, 1995). Both California sea lions and Pacific harbor seals interact and depredate this fishery. Miller *et al.* (1983) reported that foraging activities by sea lions and harbor seals in San Francisco Bay "was slow and deliberate," and usually involved only one to four animals per net. When fishing was heavy and many gill nets were catching fish, foraging frequencies were less as there were fewer pinnipeds at any one net. When fishing was light there was an increased foraging frequency per net. Total depredation

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[7] *Proposition 132, enacted in January 1994, prohibits gill net fishing within three miles of shore.*

[8] *Personal communication, Mr. Eugene Ben Henke, November 1995, Ojai, Ventura County, California.*

of catch was less than 1% for both the 1979-80 and 1980-81 seasons. According to one Humboldt Bay herring fisherman[9], in 1972 (when there were just a few harbor seals in the area), one could set a herring gill net in Humboldt Bay and leave it for three hours. Now due to the increase in harbor seals as well as a resident population of male sea lions in the area (ten years ago to see one or two sea lions in the area was unusual), the net cannot be left to soak for more than 30 minutes, otherwise only fish gill plates or fish heads will remain. Fishermen claim that sea lions follow their boats. The amount of interaction is dependent on the number of boats fishing in the area. In Eureka, there were four boats permitted for herring, in Crescent City there were three. Thus, gill net herring fishermen experienced more interaction in Eureka and Crescent City, than the majority of those in San Francisco Bay. Damage to herring gill net gear is done primarily by sea lions. Herring gill nets are made of fine monofilament web. Sea lions tear the gear by jumping on and over the corkline which rips the net.

Round-Haul Fisheries

California sea lions and harbor seals interact with the round-haul herring fishery, and purse seine fisheries for squid, sardine, and mackerel by foraging in the nets and frightening fish out of the net (Miller *et al.* 1983). Damage to the round-haul nets is attributable to pinniped depredation. Round-haul nets cost around $30,000 each, and sea lions have been observed "chewing" portions of the net and are responsible for small and large tears in the net. In the round-haul herring fishery, Miller found that only sea lions were involved in depredations. He surmised that the activity of the round-haul vessels attracted the sea lions.

The population of sea lions during Miller's survey was at least half of what it is today. One commercial round-haul fishermen commented that today it is not uncommon to find 40 to 50 animals in a round-haul net in San Francisco Bay. Commercial fishermen fear that in the future it will be impossible to fish herring in San Francisco Bay or squid in Monterey Bay due to the degree of pinniped interactions.

Trap Fisheries

Lobster, crab, and live-fish trap fishermen, report that California sea lions frequently destroy their traps. Miller's 1983 study did not report any pinniped interaction or depredation in the trap fisheries. However, now that has changed and sea lions have learned how to open traps and take bait (sea lions do not prey on the trapped lobsters or crab, but attempt to remove the bait). If the bait cannot be reached, the traps are frequently broken (doors ripped off) or destroyed during the sea lion's attempt to break in. Traps are also smashed when sea lions retrieve bait through the mesh. These interactions are most prominent in the San Diego area, although reports have come from Ventura and Santa Barbara.

Trap fishermen in San Diego have stated that sea lions have destroyed half their traps each year (Munroe 95). One fisherman reported losing 50 traps. At $20 each (excluding labor), plus $8,000 in lost catch (1 lost lobster/trap/per day, at 150 days per season, or 1,000 pounds)

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[9] *Personal communication, Mr. Ken Bates, Cloudburst Fishing Company, November 1995, Eureka, Humboldt County, California.*

the loss becomes substantial. Removal of bait and/or broken traps along with loss of gear and loss of catch, results reduced income for trap fishermen. Several trap fishermen reported increased depredations since the implementation of Proposition 132.

Live Bait Operations

Pinnipeds also interfere with bait fish operations. California sea lions have been known to haul out on bait barges and block the operator's access. They have also been known to blow air from the sides and bottoms of receivers, startling the fish and causing them to jump out of the containment. One such account was described by a bait barge operator[10] in Eureka, California who runs a live bait operation with anchovies and sardines. In the spring, 200 scoops of anchovies would be loaded into the barge, 50% would be lost overnight to sea lions (his re-modeled bait barge now rests on the bottom of the bay to prevent sea lion tampering). These types of interactions result in additional expenses to the operators.

Other Commercial Fisheries

Other commercial fisheries with pinniped interactions and depredations include the hook and line, and trawl fisheries. In the commercial hook and line fishery Miller *et al.* (1983) reported that 1,141 pounds of rockfish, less than 1% of the total catch, were depredated by sea lions in southern California. We had two reports of sea lions depredating hook and line fisheries. One described sea lions depredating mackerel used to bait a shark set line[11], while the second mentioned sea lions depredating mackerel caught for the fresh fish market. Miller *et al.* (1983) reported sea lions removing fish in the cod end of trawl nets. There were no current data regarding the trawl fishery.

Summary

At the present time, there are no current comprehensible data sets to assess the degree of interaction and depredation (loss of catch and damage to gear) and the economic loss in commercial fisheries. Studies need to be completed for all commercial fisheries. It is obvious that effective deterrents and other techniques need to be fully investigated to alleviate the negative interactions and depredations of pinnipeds. Commercial fishermen are frustrated[12] with MMPA's 1994 "no touch" policy[13], which prohibits them from protecting their gear and catch at a time when pinniped populations and depredations are escalating.

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[10] *Personal communication, Mr. Ken Bates, November 1995, Eureka, Humboldt County, California.*

[11] *Personal communication, Mr. Eugene Ben Henke, November 1995, Ojai, Ventura County, California.*

[12] *Comments from commercial fishermen are included in Appendix I.*

[13] *Additional comments by commercial fishermen and their opinions to remedy the pinniped problem are included as an appendix to this report.*

INTERACTIONS WITH NON-SALMONID FISHERIES

RECREATIONAL FISHERIES

Introduction to Non-Salmonid Recreational Fisheries

In California, recreational marine fishing is an important economic asset to the state economy. In 1989, NMFS's Marine Recreational Fishery Statistics Survey (MRFSS) estimated that anglers spent $796 million in California (Golden 1992); of this amount, $536 million was spent in southern California (Thompson and Crooke, 1991). Anglers fish year-round from piers, jetties, beaches, shores, private boats, and CPFV's. Sport anglers pay a fee to ride and fish from CPFV's (historically called partyboats), as these boats provide the best opportunity for the average angler to catch a variety of species.

There is a distinction in the CPFV catch between central/northern California and southern California (Table 5). Species composition, fishing methods, and fishing effort vary between the different areas due to a natural delineation at Point Conception (Santa Barbara County) separating colder, rougher seas of central and northern California from warmer, calmer waters of southern California. In central and northern California, rockfish and salmon are the most popular species and both dominate the CPFV catch. Rockfish are typically targeted for catch during the fall and winter while salmon are targeted in the spring and summer. Other favored species include lingcod, striped bass, sturgeon, and sharks.

In southern California, species composition and fishing methods are more diverse. The CPFV fleet targets Pacific mackerel, kelp bass, barred sand bass, California halibut, Pacific bonito, California barracuda, white seabass, yellowtail, tunas, sharks, rockfish, ocean whitefish, and California sheephead. Species caught in the nearshore shallow waters include kelp bass, barred sand bass, halibut, California barracuda, yellowtail and white seabass. Species caught in offshore surface waters include tunas (albacore, yellowfin, bigeye, skipjack and bluefin) while rockfish are caught on offshore deep reefs. In general, southern California CPFV's are larger, carry more passengers, and frequently can fish multi-day trips.

California Sea Lion Interaction and Depredation with CPFV's

Interactions between salmonid recreational fisheries (CPFV or private boat), and pinnipeds are discussed separately in the salmonid section of this report. The majority of salmon fishing effort occurs in central and northern California, although there is some salmonid effort and pinniped interaction in southern California waters. However, the majority of total CPFV effort occurs in southern California (CPFV 1994 log data). In 1994, there was a total of 26,987 CPFV trips; 61% of these trips fished in southern California waters, while 39% of the trips fished in central and northern California waters (Figure 5). Of the total trips, more than 80% targeted non-salmonid species. Of the total fish caught, salmonids accounted for 9%. There are numerous interactions and depredations between sea lions and non-salmonid fish caught by anglers aboard CPFV's. Miller *et al.* (1983), first documented these interactions and depredations in 1979 and 1980, while Hanan *et al.* (1989) investigated them from 1984 to 1988. Current depredations are reported in CPFV log records. Therefore, the remainder of this section

will discuss the interactions between CPFV's and sea lions involving non-salmonid fish.

California state law (Fish and Game Code of California, §7923, and California Code of Regulations, Title 14, §225.7) requires that all CPFV's keep and submit logs detailing fishing activities (date, area fished, number of anglers, time fished) and catch for each fishing trip. In 1994, the logbook format was changed and a "lost to seals[14]" field was added. Unfortunately, due to a misinterpretation of another field, the entire 1994 CPFV log database had not been finalized at the time of this report. However, we were able to edit and analyze the logs from boats operating in the San Diego area for 1994 data. In addition, we utilized the 1995 CPFV log database (preliminary) which contained statewide records from January through July for a comparison of pinniped interaction. Fishing logs may not provide an exact account of fishing activity because some skippers over or under report fish landings and seal interactions. They may also submit delinquent records, but generally the logs provide a relative index of fishing activity and interactions.

California sea lions are the primary pinniped species involved in CPFV depredation of catch and interactions with fisheries, whereas Pacific harbor seals are rarely involved (Miller *et al.* 1983, Hanan *et al.* 1989). Sea lions directly affect CPFV fishing by consuming bait and chum and depredating fish that have been caught and are being reeled in. The presence of sea lions in the vicinity of a CPFV stops fish from feeding and often scares them away. Miller *et al.* (1983) found that fewer fish were caught by CPFV's when a sea lion was merely present the fishing area. Consequently, when sea lions are present, skippers frequently move the boats to other fishing areas resulting in additional fuel costs and loss of fishing time. Skippers also try to rid their boats of the animals by passing close to other fishing vessels in hopes of shifting the sea lions's attention towards fishing activity on the other vessel (Miller *et al.* 1983). Typically, during sea lion depredation, the angler rarely sees the sea lion take the fish. Instead, sea lions maintain a safe distance from the boat and swim under it to take a fish, or a portion of a fish, when the angler has a hook-up. The sea lions resurfaces some safe distance from the boat to consume their catch (Hanan *et al.* 1989). Many times with soft bodied fish species like California barracuda, the sea lions simply eat the belly meat and discard the remainder of the fish. Anglers also lose gear if the line is broken by the sea lion. Various methods, such as "seal bombs" and acoustic deterrents have been used to discourage or prevent the sea lions from taking fish, but without lasting success as sea lions tend to habituate or learn to avoid the devices.

Impacts to the Southern California CPFV Fishery

Southern California experiences CPFV/sea lion interactions and depredations (involving non-salmonid species) throughout the year. For the first seven months of 1995, 14% of all non-salmonid trips were depredated by sea lions (1,414 depredated trips out of 10,042 total trips) by sea lions). A depredated trip was defined as a CPFV trip with at least one fish reported taken by sea lions. In comparison, in central/northern California less than 2% of the non-salmonid trips were depredated by sea lions (55 depredated trips out of 2,939 total trips). The majority

[14] *"Seals" is a universal term; it is not intended to differentiate between sea lions or harbor seals.*

of these depredations involved California barracuda, and most depredations occurred in nearshore coastal waters in the Los Angeles and San Diego areas.

In 1979 and 1980 Miller *et al.* (1983) sampled "at sea" CPFV trips and interviewed boats in central, northern and southern California. Results from the samples and interviews revealed that no interaction occurred north of Avila (San Luis Obispo County) and depredation was rare except in the San Diego area. At that time the total loss from depredation by California sea lions in southern California was 15,141 non-salmonid fish (for twelve months of 1980) with a market value[15] of $28,100 (Pacific bonito comprised 78% of the loss). We analyzed the CPFV fishing logs, statewide, for the first seven months of 1995, January through July, and found that 26,138 non-salmonid fish were taken by pinnipeds (Table 6); of this total, 97% (or 25,451 fish) were taken in southern California with a market value exceeding $145,200 (California barracuda comprised 59% of the loss).

The San Diego area CPFV fleet fishes rockfish in the fall and winter along with ocean whitefish and sheephead, whereas California barracuda and white seabass are targeted in the spring and summer, and basses (kelp and sand) are targeted during the summer months and into the fall. Sea lion depredations occur during all months. We analyzed the 1994 data, and found the percentage of depredated CPFV trips to range from 7% in February to a high of 38% in April (number of depredated trips relative to the total number of trips). The highest percentage of depredated trips occurred during March through May (Figure 6). California barracuda was the species taken most often (Figure 7) by sea lions although anglers in the San Diego area landed more rockfish, mackerel, kelp and barred sand bass than barracuda.

Hanan *et al.* (1989), studied the interaction and depredation rates of sea lions and CPFV's in the San Diego area from 1984 to 1988 found interaction and depredation rates to decrease in the spring and early summer, and increase during mid-summer. Hanan attributed this seasonal trend to sea lions congregating in the Channel Islands for the breeding season. Hanan also found that the interaction and depredation rates declined during the study period which followed an El Niño, and was possibly due to reduced fish availability or desirability. Recreational landings of Pacific bonito by CPFV's have declined over the past ten years whereas CPFV landings of California barracuda have increased dramatically[16] (CDFG CPFV data). California barracuda accounted for 83% (for the first seven months of 1995) and 41% (for all 12 months of 1994) of all fish species taken by sea lions in the San Diego area (excluding trips in Mexican waters). California barracuda are undoubtedly an available and desirable fish for sea lions at the present time.

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[15] *Market value is calculated as the price that one would have to pay for the fish at a fresh fish market.*

[16] *Comparison of 1984 and 1994 recreational landings of California bonito and California barracuda*

	1984	*1994*
Bonito	*377,678*	*105,580*
Barracuda	*79,706*	*261,600*

Summary and Conclusions

Sea lions have been a significant problem in the non-salmonid CPFV fishery in southern California, primarily in the San Diego region, since at least the early 1980's and they continue to be a significant problem today. Sea lions are negatively impacting the livelihood of the CPFV industry. Based on interviews conducted with CPFV skippers by Munroe (1995) the number of fish and patrons have declined over the past 20 years. CPFV skippers claim that they are losing their customers because they get frustrated by the sea lions continually taking their catch.

Sea lion modified behavior may be responsible for some sea lion interactions and depredations. The "rogue animal" concept discussed in Hanan *et al.* (1989), suggests that a majority of the CPFV/sea lion interactions and depredations are caused by a small population of sea lions that have learned to follow boats and depredate hooked fish. Certain sea lions may be attracted to the sound of particular boat which they perceive as a "dinner bell".

CPFV's tend to fish in the same fishing spots and sea lions may have learned to find the boats. In 1994, and the first part of 1995, more than half of the total trips in the San Diego area fished in three blocks, 860, 861, and 878 (Figure 8) and accordingly, there were more losses of fish to sea lions in these blocks than in other areas. Miller *et al.* (1983) found the same condition in 1980, the most consistent losses to pinnipeds occurred in block 860 and areas immediately to the north. Hanan concluded that a select group of sea lions learned it was easier to follow fishing boats and take a few big sportfish, that they would normally be unable to catch, than to catch a larger number of smaller fish such as sardines and anchovies.

We have described and substantiated the degree of pinniped interaction and depredation in the non-salmonid CPFV fishery. At the present time, there is no available data to assess the degree of interaction and depredation in the other modes (pier, jetty, beach, shore, and private boat) of recreational fishing. Since sea lions interact and depredate CPFV's it seems probable that they would also interact and depredate private boats. In either case, sea lion depredation is having a negative impact on southern California sport fishing, an economically and socially important fishery that makes a significant contribution to local economies.

The sea lion-CPFV interaction and depredation problem needs to be remedied. Additional and more complete information are required to assess the economic and social impacts of sea lions on fisheries. Data are needed on age, sex, daily habits, and local haul out sites so that depredations by one or more of these strata can be mitigated. It is imperative that new technologies and techniques, such as mechanical deterrents and taste aversion methods, be instigated. Limiting access to local haul-out sites utilized by sea lions depredating CPFV's must be considered. If other methods fail, lethal removal of problem sea lions must be realized.

CONCLUSION

We have attempted to provide as much information as available in this short time period. It is evident that coastal pinnipeds are negatively affecting California's commercial and recreational ocean salmon fisheries, commercial gill net, trap, and round haul fisheries as well as the non-salmonid CPFV fishery. Currently, it is incomprehensible to predict the effects of increasing pinniped populations when we are unaware of the full extent of their impacts on fisheries and the ecosystem in general. For each section described in this report, we have recommended areas for further research and investigation and potential solutions to alleviate specific pinniped impacts.

It is crucial to determine the degree of salmon mortality attributable to sea lions and harbor seals and alleviate the situation, particularly in the case of threatened and endangered salmonid stocks. It is necessary to determine the season, distribution, and abundance of pinnipeds as well as seasonal food habit studies (scat analyses and observations) to assess the degree of depredation on adult and juvenile salmon. It is essential that we investigate the degree of direct and indirect salmon mortality attributable from encounters with pinnipeds. Sampling programs should be expanded and utilize on-board observers to provide more extensive reports of sea lion interactions and depredations, and to validate reported losses by fishermen. Finally, there is a need to develop innovative and effective deterrent devices and methodologies to eliminate, discourage and reduce sea lion and harbor seal impacts on society.

However, if we cannot develop effective methods and devices to successfully deter pinnipeds and prevent negative impacts; long range mitigative measures, such as population management by birth control and/or lethal removals of problem animals must be considered.

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Table A. Abundance of Pacific Harbor Seals in California 1995

AREA	Summer 1995		Fall 1995	
	Harbor seals	# Haul-outs	Harbor seals	# Haul-outs
AREA 1	1,077	10	216	4
AREA 2	613	119	91	6
AREA 3	3,132	50	1,624	28
AREA 4	7,361	37	2,366	12
AREA 5	6,870	118	458	65
AREA 6	3,983	26	1,348	13
AREA 7	4,285	9	144	1
AREA 8 Main	1,131	6	714	4
AREA 8 CI	4,217	106	1,047	53
Total	32,669	481	8,008	186

Pacific harbor seal counts have been increased with a 1.4 correction factor.

Area Descriptions

AREA 1: Crescent City - Smith River; Crescent City to the Oregon border.
AREA 2: Klamath River Area; Rocky Point to Crescent City.
AREA 3: Point Mendocino Area; Cape Mendocino to Rocky Point (No. of Trinidad).
AREA 4: North Coast; Bodega Head to Cape Mendocino.
AREA 5: San Francisco Bay; Montara to Bodega Head includes areas within San Francisco Bay and the Farallon Islands.
AREA 6: Monterey Bay Area; Point Sur to Montara, includes Año Nuevo.
AREA 7: Central Coast; Pt. Arguello to Point Sur.
AREA 8:Southern California Bight; United States/Mexico border to Pt. Arguello; including all eight Channel Islands. Area 8 has the largest population of harbor seals in California as it is the largest geographical area in terms of available coastline. Area 8 includes more than 340 miles of mainland shoreline, representing one-third of the entire coast of California. In addition, there are 279 miles of shoreline provided by the eight off-shore Southern California Bight (SCB) Channel Islands.

Table B. Summer Haul-out Sites of California Sea Lions in 1980, 1981, 1982, and 1995

BONNELL_S	LATITUDE	SUM80	SUM81	SUM82	SUM95
PT. ARGUELLO ROCK	3434.00	0	0	32	
PT. ARGUELLO	3434.00	0	16		
PT. SAL	3453.00	253	1055	755	
SANTA MARIA RIVER	3458.00		1		
PECHO ROCK	3510.00	585	1568	581	
NUK ROCK	3512.00			2	
LION ROCK, MAINLAND	3513.00	22	13	84	
LION ROCK, OFFSHORE	3513.00	621	830	1259	
PT. ESTERO	3527.00	1			
WHITE ROCK	3532.00	50	75	128	
PIEDRAS BLANCAS ROCK	3539.00	159	721	460	650
PIEDRAS BLANC OUTER	3539.00	288	38	605	
	3539.00		6		
WHALEBOAT ROCK	3552.00	4		75	
SAN MARTIN ROCKS	3553.00		80	188	
CAPE SAN MARTIN	3553.00			15	56
VICENTE CREEK	3602.00			212	
	3612.00				154
	3612.00				24
	3612.00			2	
SEA LION ROCKS	3621.00	388	6	383	
LOBOS ROCKS	3627.00	57	130	0	
	3629.00				387
BIRD ROCK	3635.00			388	369
MONTEREY HARBOR	3636.00	29		2	490
STEAMER (SEAL ROCKS)	3657.00	118		270	
	3657.00				129
ANO NUEVO ISLAND	3706.00	1317	2871	3169	6745
MIRAMAR	3729.00	1			
S.E. FARALLON ISLAND	3741.00	207	523	2543	
N. FARALLON	3746.00	1	2		
SEAL ROCKS	3746.00	2			
PT. REYES	3759.00	61		55	8
BODEGA ROCK	3817.00				799
FORT ROSS REEF	3830.00	1			
	3830.00				14
FISH ROCKS	3848.00			1	
SOLDIER FRANK PT.	3945.00	1			
	3953.00				12
PUNTA GORDA GENERAL	4015.00				26
SEA LION ROCK	4018.00				30
CAPE MENDOCINO	4026.00				471
SUGAR LOAF ISLAND	4026.00				2
FLAT IRON ROCK	4103.00				1
	4107.00				2
PATRICKS PT.	4107.00				22
KLAMATH RIVER	4132.00				4
CASTLE ROCK	4145.00				17
INNER CASTLE REEF	4145.00	212			
SW SEAL ROCK	4148.00				571
NW SEAL ROCK	4150.00				276

Table C. Fall Haul-out Sites of California Sea Lions in 1980, 1981, 1982, and 1995

SITE_NAME	LATITUDE	FALL_1980	FALL_1981	FALL_1982	FALL_1995
SAN CLEMENTE	3325.00				6
POINT DUME	3345.00				1
PT. SAL	3453.00	89	513	305	1
PECHO ROCK	3510.00	41	374	708	
NUK ROCK	3512.00	4	2		
LION ROCK, MAINLAND	3513.00	7	11		
LION ROCK, OFFSHORE	3513.00	707	2800	1553	1119
	3531.80				42
WHITE ROCK	3532.00	40	0	26	
PIEDRAS BLANCAS ROCK	3539.00	66	375	338	270
PIEDRAS BLANC OUTER	3539.00	585	1136	242	344
WHALEBOAT ROCK	3552.00	1			
SAN MARTIN ROCKS	3553.00	161	251	269	
CAPE SAN MARTIN	3553.00		132	233	
VICENTE CREEK	3602.00		18		
	3612.00				541
	3612.00	81	48	150	
VENTURA ROCKS	3620.00				16
LOBOS ROCKS	3627.00	178	361	243	376
SEA LION ROCKS	3631.00	341	166	397	
BIRD ROCK	3635.00	117	145	704	1161
MONTEREY HARBOR	3636.00	510	384	989	155
PT. PINOS	3638.00				5
STEAMER (SEAL ROCKS)	3657.00	145	182	190	
	3657.00				33
ANO NUEVO ISLAND	3706.00	2834	4960	7319	5825
S.E. FARALLON ISLAND	3741.00	1058	1988	5063	
	3749.00				118
N. FARALLON	3746.00		29	46	
SEAL ROCKS	3746.00	50	9	38	
PT. REYES	3759.00	167	40	62	154
BODEGA ROCK	3817.00	150	356	1077	1729
TIMBER COVE, GENERAL	3831.00		6		
FISH ROCKS	3848.00	235	205	383	34
COVE ROCK	3908.00	14			
CUFFY PT.	3908.00		9		
PT. CABRILLO	3921.00	2			
SOLDIER FRANK PT.	3945.00				236
MISTAKE PT.	3951.00	345	318	390	
	3957.00		1		
PT. NO PASS, GENERAL	3958.00	3			
COOSKIE CREEK	4013.00	16			
SEA LION GULCH	4014.00	36	78	41	
PUNTA GORDA GENERAL	4015.00				73
SEA LION ROCK	4018.00	12	38	20	
CAPE MENDOCINO	4026.00	35			5
SUGAR LOAF ISLAND	4026.00		6	41	
FALSE CAPE PK	4030.00			2	
BLANK ROCK	4103.00	85	125	87	
LITTLE FLAT IRON RK	4103.00	3	20	4	
FLAT IRON ROCK	4103.00	701	454	786	1100
	4104.00				95
WHITE ROCK MAINLAND	4105.00	8			
CONE ROCK MAINLAND	4106.00		110	88	64
	4107.00				43
	4107.00		50	103	
KLAMATH RIVER	4132.00				90
CRESCENT CITY HARBOR	4144.00				18

Table C Continued. Fall Haul-out Sites of California Sea Lions

SITE_NAME	LATITUDE	FALL_1980	FALL_1981	FALL_1982	FALL_1995
CASTLE ROCK	4145.00	904	589	1446	2046
INNER CASTLE REEF	4145.00	517	579	838	
	4148.00				2
NW SEAL ROCK	4150.00	86	52	167	192
	4150.00				4

Table D. Mainland Abundance of California Sea Lions in California 1995

AREA	Summer 1995	Fall 1995
AREA 1	864	2,262
AREA 2	4	90
AREA 3	25	1,302
AREA 4	1,354	2,077
AREA 5	3,008*	1,272*
AREA 6	8,120	7,555
AREA 7	884	2,334
AREA 8	0	6
Total	14,259	16,898

*Includes an estimate of 3,000 sea lions at the Farallons in the summer and 1,000 sea lions in the fall.

Area Descriptions

AREA 1: Crescent City - Smith River; Crescent City to the Oregon border.
AREA 2: Klamath River Area; Rocky Point to Crescent City.
AREA 3: Point Mendocino Area; Cape Mendocino to Rocky Point (No. of Trinidad).
AREA 4: North Coast; Bodega Head to Cape Mendocino.
AREA 5: San Francisco Bay; Montara to Bodega Head includes areas within San Francisco Bay and the Farallon Islands.
AREA 6: Monterey Bay Area; Point Sur to Montara, includes Año Nuevo.
AREA 7: Central Coast; Pt. Arguello to Point Sur.
AREA 8:Southern California Bight; United States/Mexico border to Pt. Arguello; including all eight Channel Islands. Area 8 has the largest population of harbor seals in California as it is the largest geographical area in terms of available coastline. Area 8 includes more than 340 miles of mainland shoreline, representing one-third of the entire coast of California. In addition, there are 279 miles of shoreline provided by the eight off-shore Southern California Bight (SCB) Channel Islands.

Table 1. Major port areas in California and their associated minor-ports by fishery, 1995.

Major Port	Minor port	Commercial Troll	Recreational Skiff	Recreational Charterboat
Crescent City				
	Crescent City (launch ramp)	*	Y	N
	Crescent City (docks)	*	Y	Y
	Crescent City comm'l docks	*	Y	N
Eureka				
	Field's Landing	*	Y	N
	King Salmon	*	Y	Y
	Trinidad (launch hoist)	*	Y	N
	Trinidad (floating docks)	*	Y	Y
Fort Bragg				
	Fort Bragg/Noyo	Y	Y	Y
	Shelter Cove	Y	Y	Y
	Albion	N	Y	N
	Pt. Arena	N	Y	N
San Francisco				
	Princeton	Y	Y	Y
	San Francisco	Y	N	Y
	Berkeley/Emeryville	N	Y	Y
	Sausalito	Y	Y	Y
	Bodega Bay	Y	Y	Y
Monterey				
	Santa Cruz	Y	Y	Y
	Moss Landing	Y	Y	N
	Monterey (Harbormaster)	Y	Y	Y
	Monterey (Coast Guard Station)	N	Y	N
	Morro Bay	Y	Y	Y
	Avila/Port San Luis	Y	Y	Y
	Santa Barbara	Y	Y	Y
	Ventura	Y	Y	Y
	Oxnard/Port Hueneme	N	Y	Y

* Commercial fishing for ocean salmon is prohibited between Horse Mountain and Oregon border in 1995.

Table 2. Commercial and recreational regulations for California ocean salmon fishing in 1995.

Fishery	Area	Season	Salmon Species	Quota	Special Restrictions
Commercial (Min. size limit: 26" total length)					
	Oregon border to Horse Mt.	None	--	--	--
	Horse Mt. to Pt. Arena	Sept 1–30	All except Coho	None	Max. 6 lines/boat; barbless hooks
	Pt. Arena to Pt. Reyes	July 5–Sept 30	All except Coho	None	Max. 6 lines/boat; barbless hooks
	Pt. Reyes to Pt. San Pedro	May 24–July 4 July 19–Sept 30	All except Coho " " "	None "	Max. 6 lines/boat; barbless hooks " " " " "
	Pt. San Pedro to Mexico Border	May 1–June15 July 19–Sept 30	All except Coho " " "	None "	Max. 6 lines/boat; barbless hooks " " " " "
Recreational (Min. size limit: 20" total length)					
	Oregon border to Horse Mt. (Klamath Management Zone)	May 17–July 8 Aug 16–31	All except Coho " " "	10,600 chinook 900 chinook	Barbless hooks required; 1 salmon/day; Fishing allowed Wed. to Sun. only
		Sept 1–9	" " "	no quota	Barbless hooks required; 1 salmon/day; Fishing allowed everyday; 6 salmon/7 days
	Horse Mt. to Pt. Arena	Feb 18–June 30 Aug 1–Nov 12	All except Coho* " " "	None	Barbless hooks required; 2 salmon/day " " " " " "
	Pt. Arena to Mexico Border	Mar 4–Oct 29	All except Coho*	None	Barbless hooks required**; 2 salmon/day; San Francisco Bay mouth area closed in March.

* – No retention of coho salmon in recreational fishery after April 30, 1995.

** – north of Pt Conception only.

Table 3. 1995 Estimated Commercial Salmon Troll Landings and Loss to California Sea Lions

Month	Major Port	Sea lion Take	Estimated Landings Legal + Sub-legal
May - September	Fort Bragg Area	**200**	**3,800**
May	San Francisco Area	23,200	175,400
June	San Francisco Area	10,700	100,700
July	San Francisco Area	2,100	131,900
August	San Francisco Area	1,100	5,900
September	San Francisco Area	1,600	5,700
Total	San Francisco Area	**38,700**	**419,600**
May	Monterey Area	21,600	121,700
June	Monterey Area	12,500	60,000
July	Monterey Area	7,700	120,800
August	Monterey Area	6,000	12,300
September	Monterey Area	200	400
Total	Monterey Area	**48,000**	**315,200**
Total	**All Areas**	**86,900**	**738,600**

Values are rounded to the nearest 100.
Refer to Table 1. for Area Descriptions

Table 4. Estimated 1995 Recreational (CPFV and Private Skiff) Salmon Landings and Loss to California Sea Lions in California

Month	Major Port	Sea lion Take	Estimated Angler Landings
May-September	Crescent City Area	**100**	**11,000**
May-September	Eureka Area	**100**	**16,500**
May-September	Fort Bragg Area	**600**	**42,900**
March	San Francisco Area	400	14,400
April	San Francisco Area	1,300	19,200
May	San Francisco Area	900	18,800
June	San Francisco Area	400	32,600
July	San Francisco Area	1,200	86,500
August	San Francisco Area	300	25,200
September	San Francisco Area	300	16,400
Total	San Francisco Area	**4,800**	**213,100**
March	Monterey Area	2,700	14,600
April	Monterey Area	11,900	45,000
May	Monterey Area	3,300	32,100
June	Monterey Area	1,900	29,600
July	Monterey Area	1,400	82,800
August	Monterey Area	1,200	10,800
September	Monterey Area	100	200
Total	Monterey Area	**22,500**	**215,100**
Total	**All Areas**	**27,900**	**498,600**

Values are rounded to the nearest 100.
Refer to Table 1. for Area Descriptions

Table 5. Popular Non-Salmonid Species Landed in 1994 by CPFV's in California

Central and Northern California

Species	# Landed
Mackerel, Pacific and jack	4,998
Sharks	1,242
Lingcod	27,476
Halibut, California	5,120
Flounder, unspecified	3,639
Rockfish spp.	913,994
Cabezon	1,233
Salmon, Chinook	97,623
Bass, striped	2,412
Sturgeon	171
Others	15,679
Total	1,073,587

Southern California

Species	# Landed
Rockfish spp.	428,725
Mackerel, Pacific	351,772
Bass, barred sand	271,104
Bass, kelp	265,219
Barracuda, California	261,600
Whitefish, ocean	95,548
Bonito, Pacific	92,600
Scorpionfish, spotted	78,338
Halfmoon	48,673
Sheephead, California	18,585
Others	243,051
Total	2,155,215

Table 6. Non-Salmonid Species Taken by Pinnipeds from CPFV's, January - July 1995

Central and Northern California

Species	# Taken by Pinnipeds
Rockfish spp	409
Flounder, unspecified	147
Lingcod	64
Cabezon	24
Bass, striped	15
Mackerel, jack	14
Halibut, California	11
Sturgeon	2
Sole, sand	1
Total	687

Southern California

Species	# Taken by Pinnipeds
Barracuda, California	14,998
Mackerel, Pacific	7,531
Bass, barred sand	927
Bass, kelp	692
Bonito, Pacific	255
Rockfish spp.	196
Whitefish, ocean	189
Seabass, white	182
Halibut, California	114
Yellowtail	105
Croaker, white	97
Scorpionfish, California spotted	42
Sheephead, California	34
Halfmoon	28
Lingcod	26
Tuna, bluefin and albacore	13
Tuna, yellowfin and skipjack	9
Wahoo	4
Sharks, miscellaneous	4
Cabezon	2
Dolphinfish	2
Flounder, unspecified	1
Total	25,451

Figure 1.

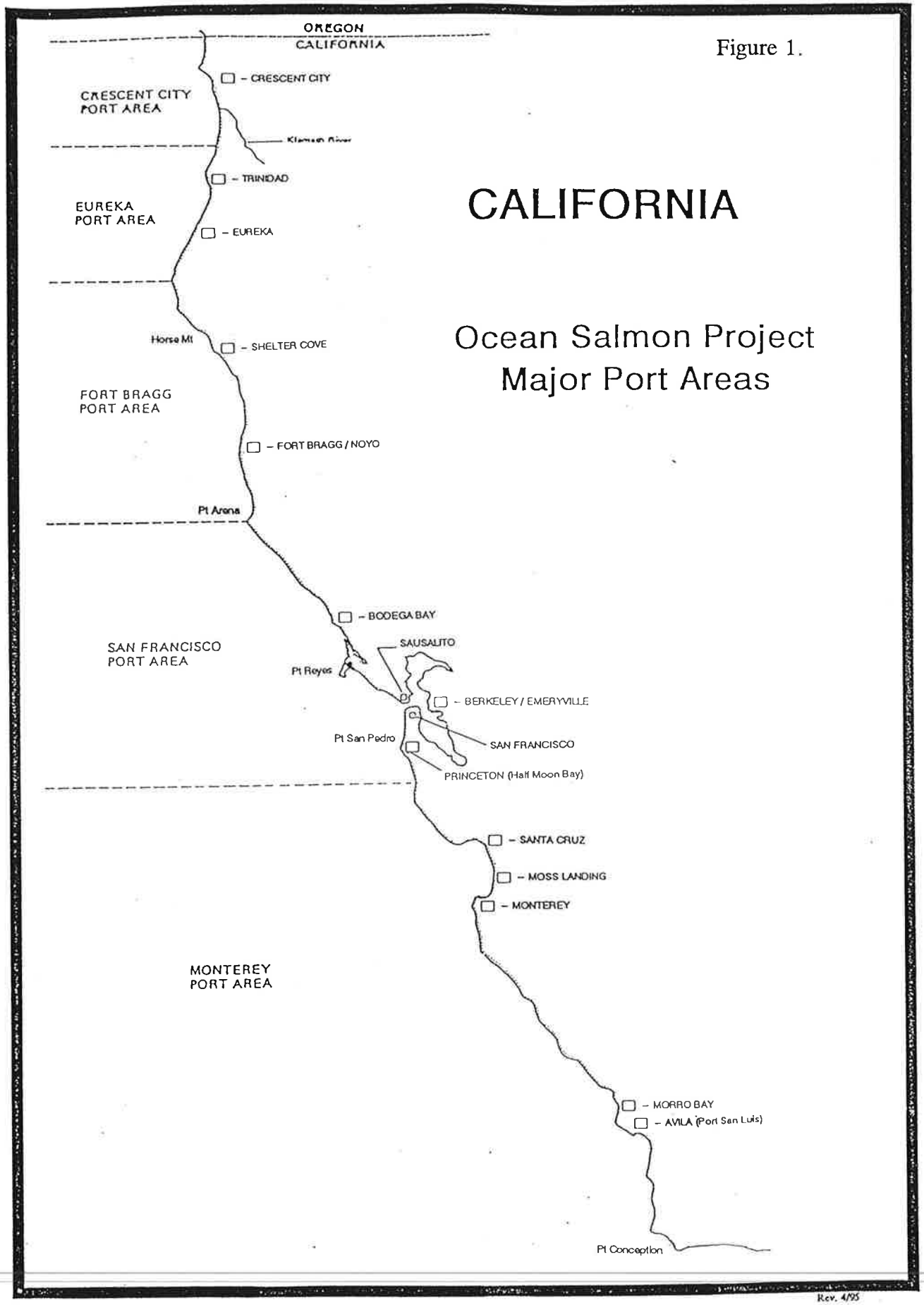

OREGON
CALIFORNIA
– CRESCENT CITY
CRESCENT CITY PORT AREA
Klamath River
– TRINIDAD
EUREKA PORT AREA
– EUREKA
Horse Mt
– SHELTER COVE
FORT BRAGG PORT AREA
– FORT BRAGG / NOYO
Pt Arena
– BODEGA BAY
SAUSALITO
SAN FRANCISCO PORT AREA
Pt Reyes
– BERKELEY / EMERYVILLE
Pt San Pedro
SAN FRANCISCO
PRINCETON (Half Moon Bay)
– SANTA CRUZ
– MOSS LANDING
– MONTEREY
MONTEREY PORT AREA
– MORRO BAY
– AVILA (Port San Luis)
Pt Conception
CALIFORNIA
Ocean Salmon Project
Major Port Areas
Rev. 4/95

Figure 2. 1995 Commercial Ocean Salmon Troll Depredation Rates

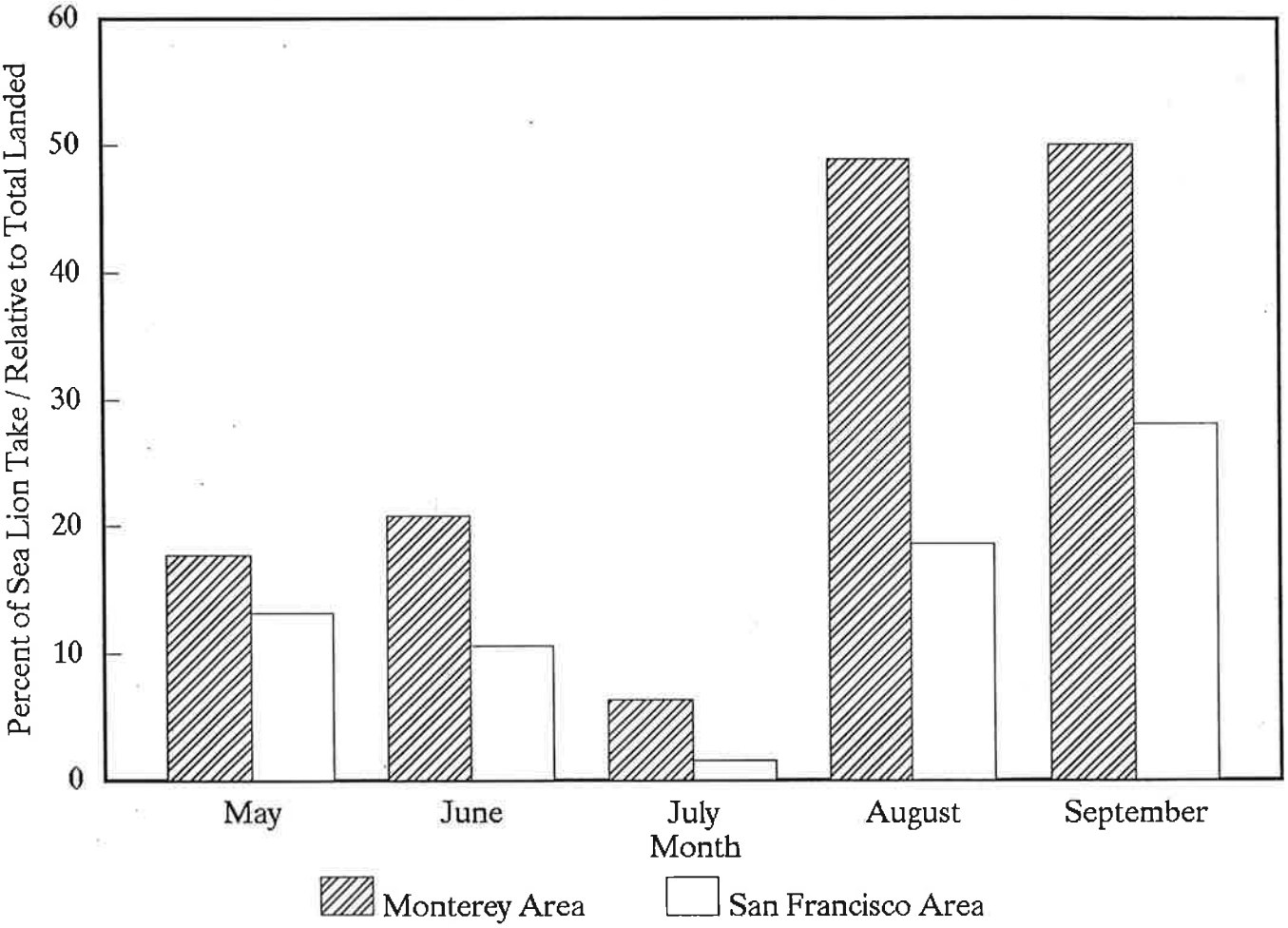


Figure 3. 1995 Recreational Salmon Interaction/Depredation Rates

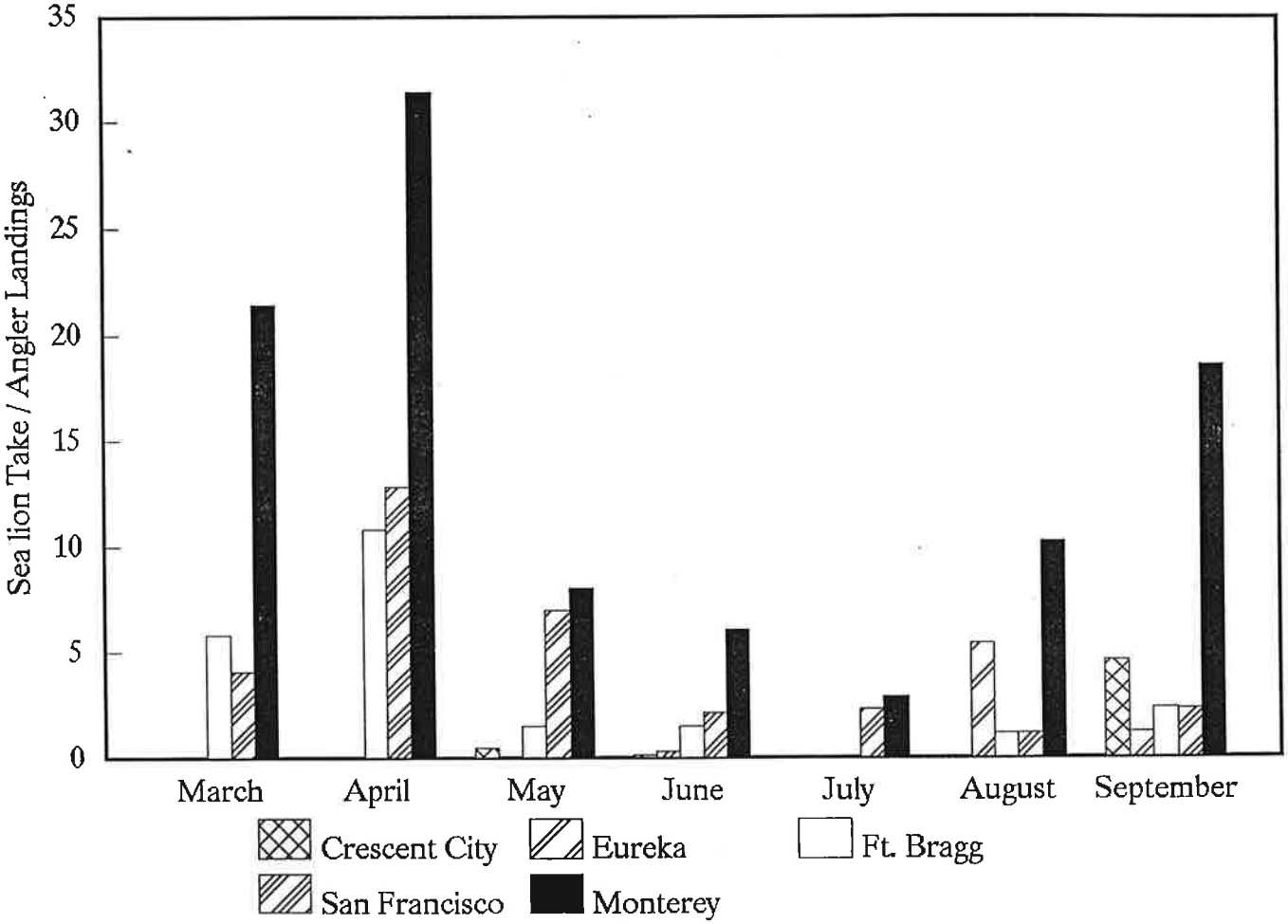


Figure 4. 1995 Estimated Ocean Salmon Taken by Sea Lions

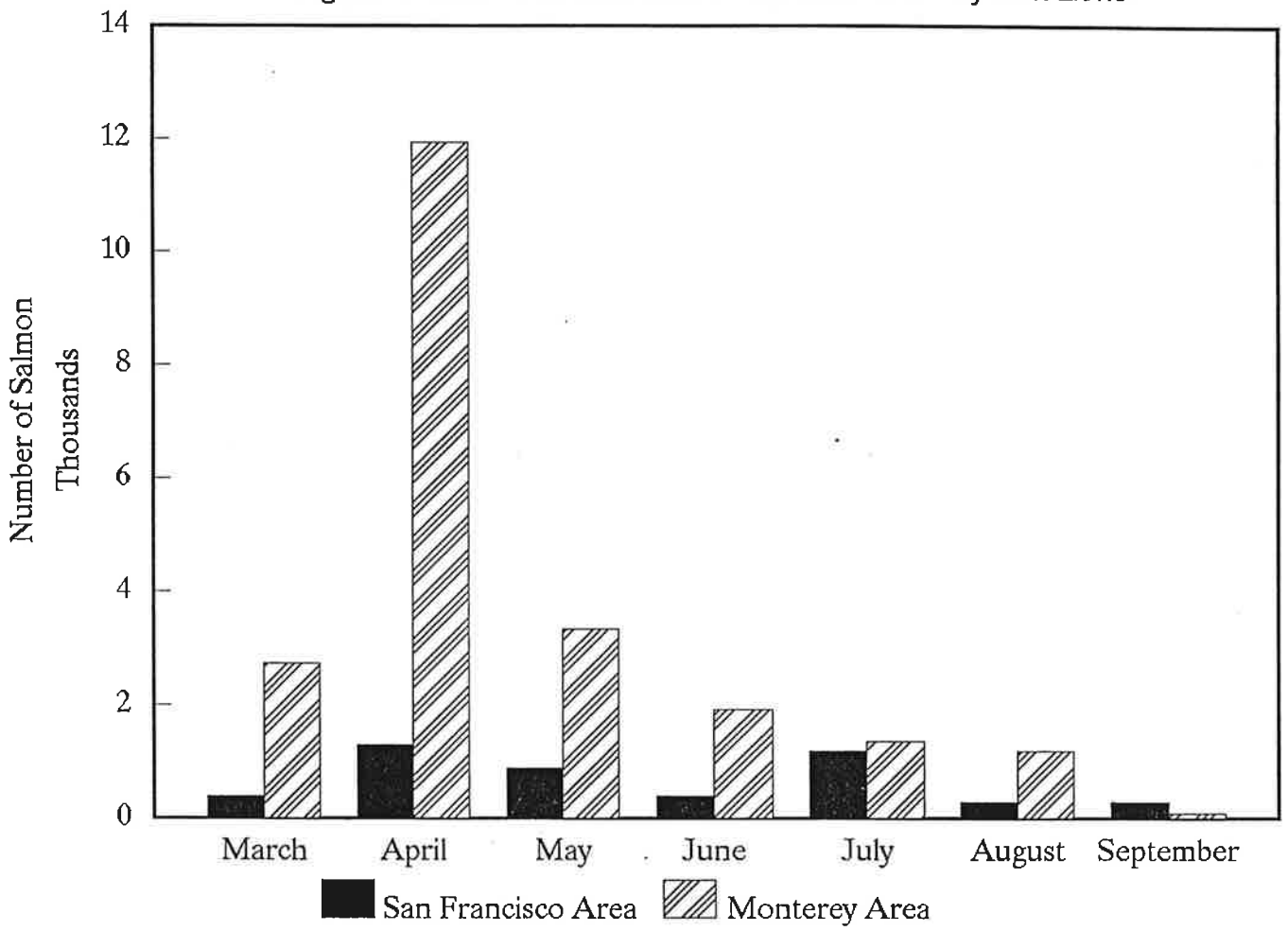


Figure 5. 1994 Commercial Passenger Fishing Vessel Effort in California

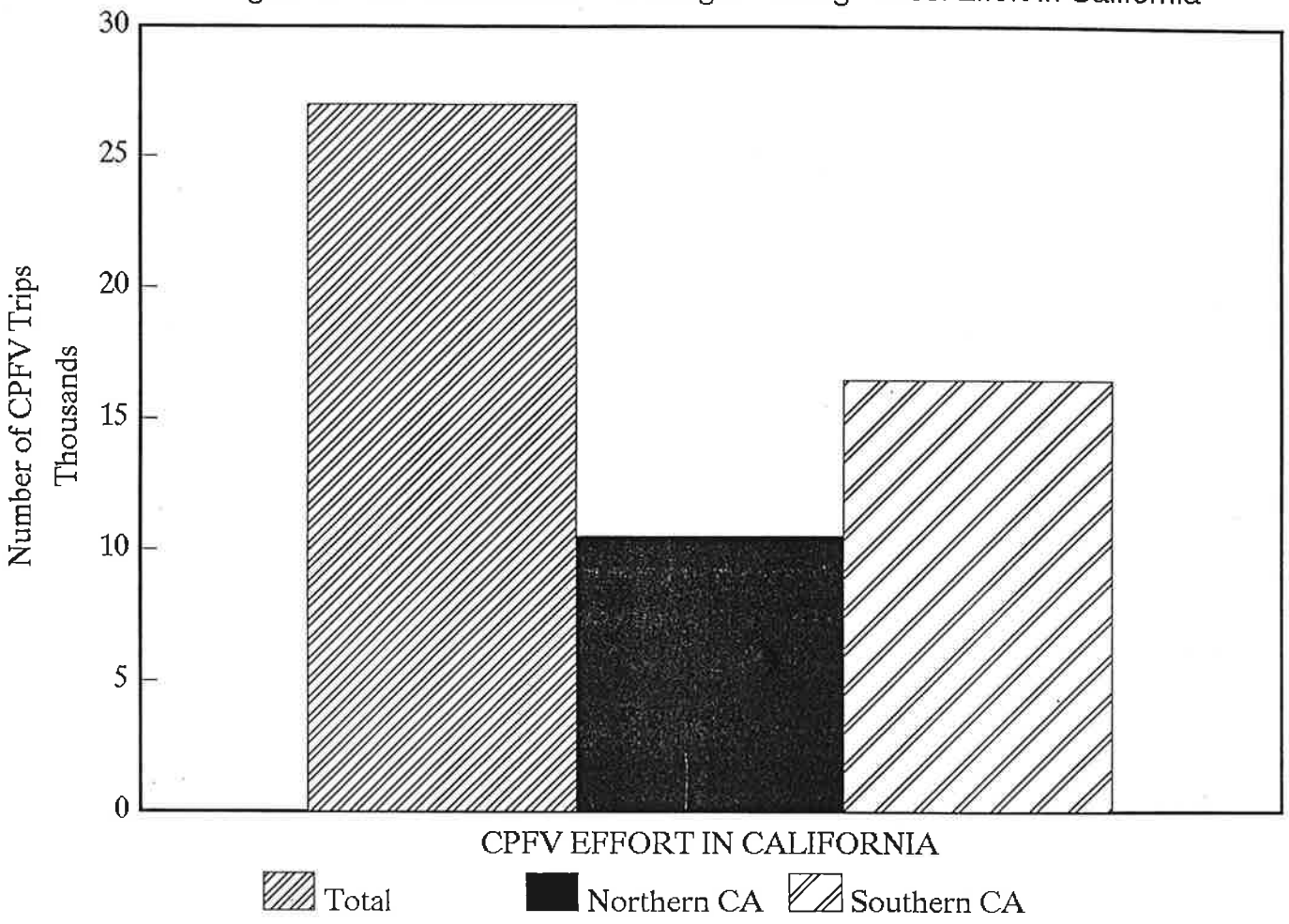


Figure 6. 1994 Rates of Depredation in San Diego CPFV's

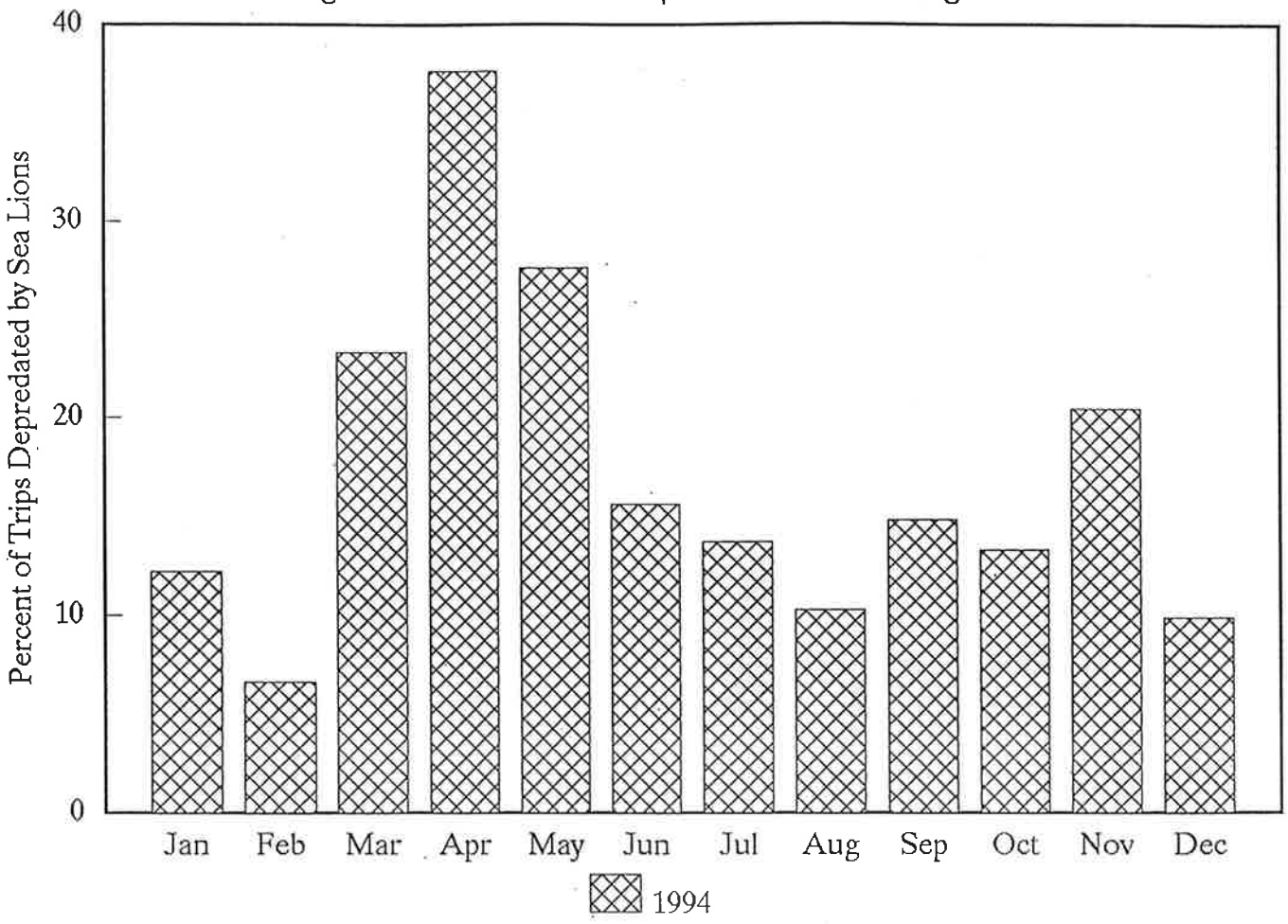
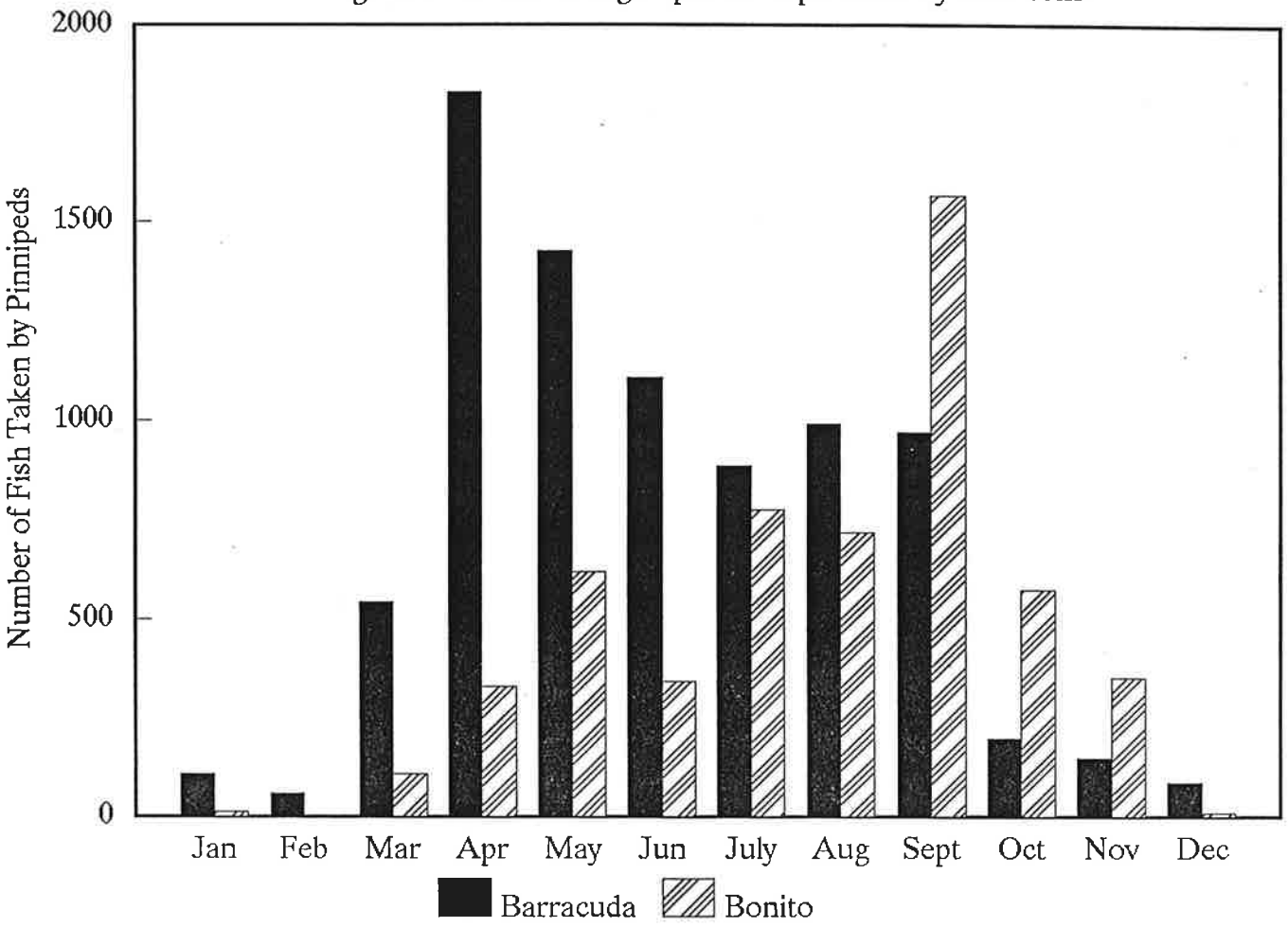


Figure 7. 1994 San Diego Species Depredated by Sea Lions



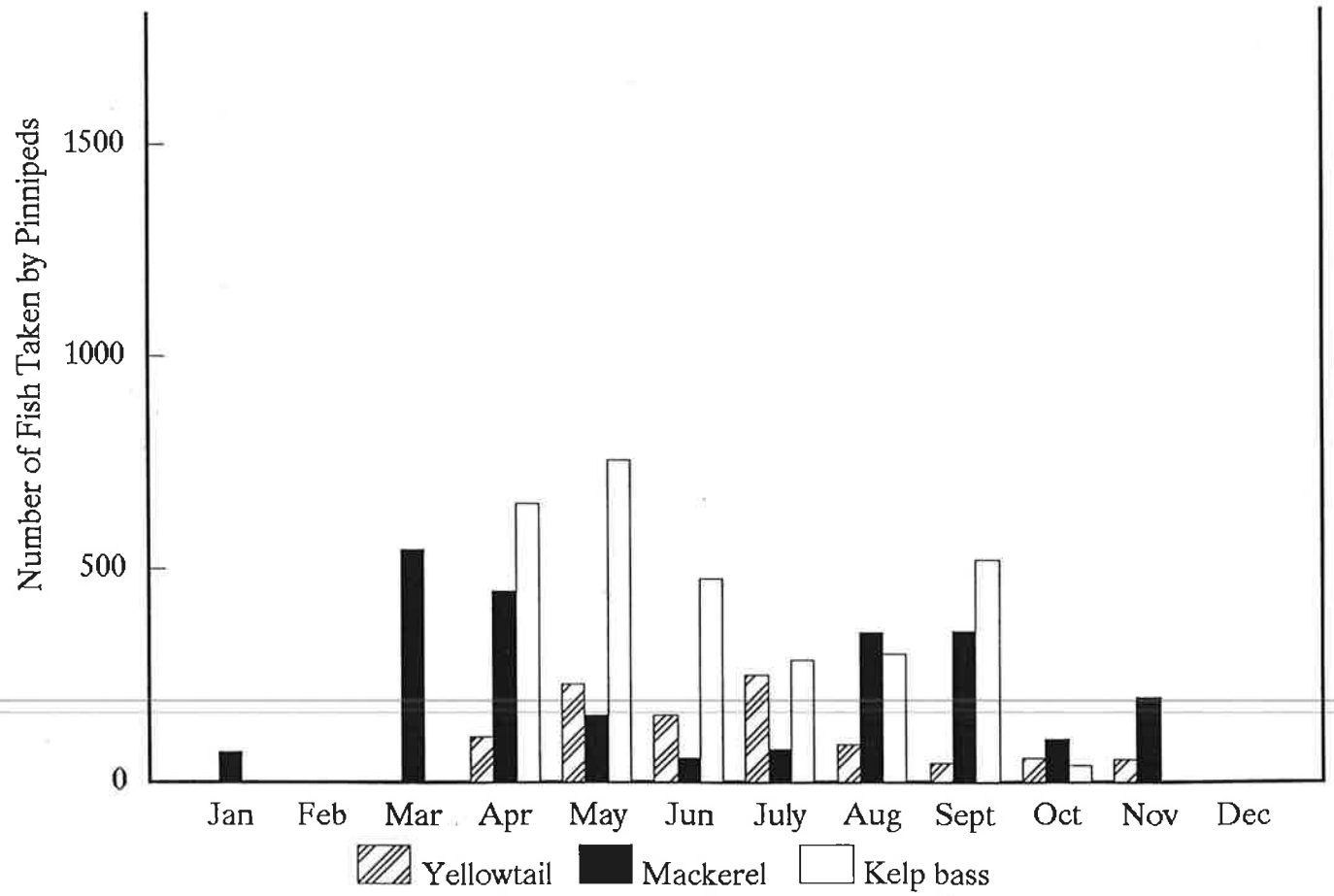
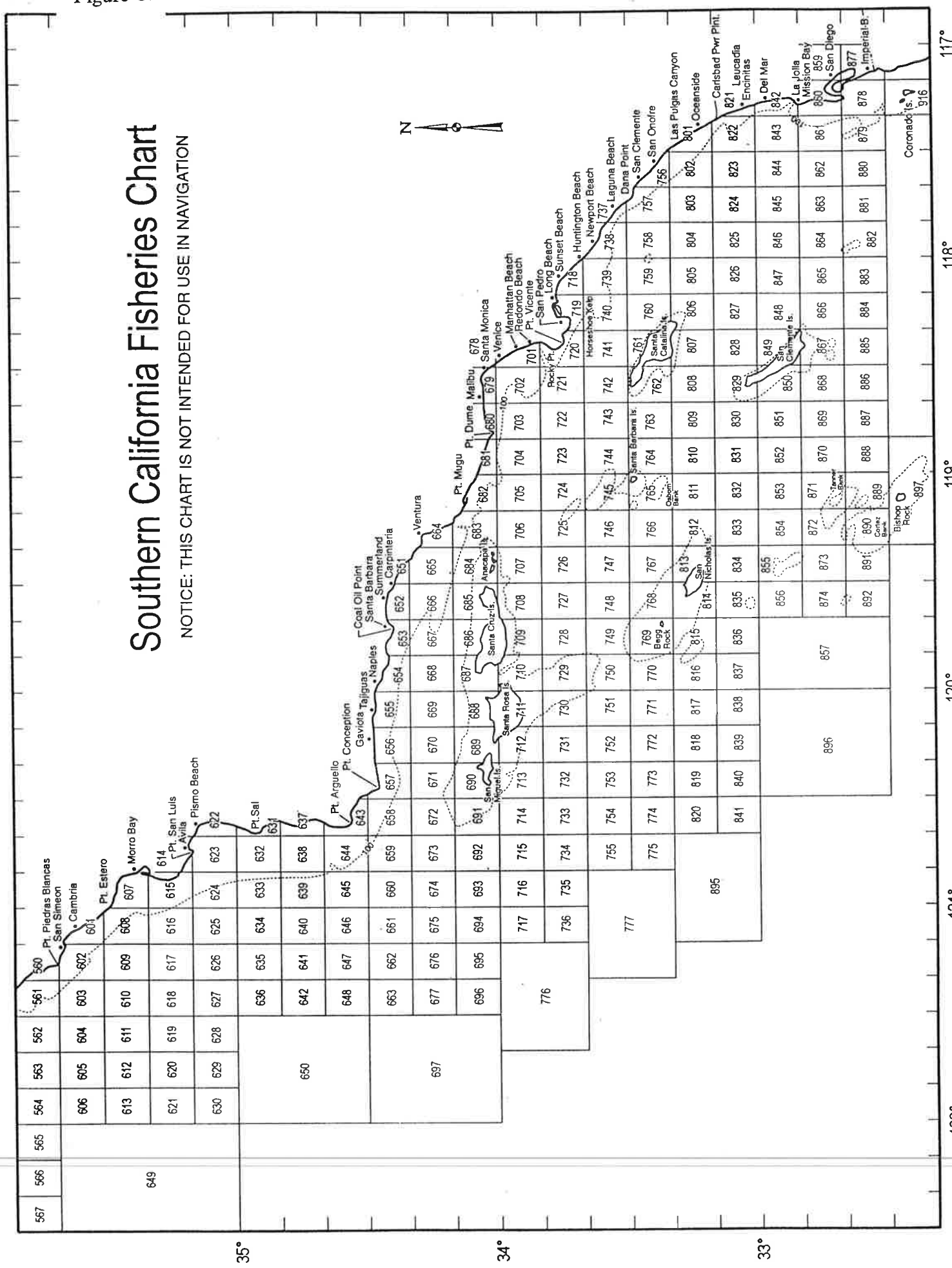


Figure 8.


Southern California Fisheries Chart
NOTICE: THIS CHART IS NOT INTENDED FOR USE IN NAVIGATION
N
Pt. Piedras Blancas
San Simeon
Cambria
Pt. Estero
Morro Bay
Pt. San Luis
Avila
Pismo Beach
Pt. Sal
Pt. Arguello
Pt. Conception
Gaviota
Tajiguas
Naples
Coal Oil Point
Santa Barbara
Summerland
Carpinteria
Ventura
Pt. Mugu
Pt. Dume
Malibu
Santa Monica
Venice
Manhattan Beach
Redondo Beach
Pt. Vicente
San Pedro
Long Beach
Sunset Beach
Huntington Beach
Newport Beach
Laguna Beach
Dana Point
San Clemente
San Onofre
Las Pulgas Canyon
Oceanside
Carlsbad Pwr Plnt.
Leucadia
Encinitas
Del Mar
La Jolla
Mission Bay
San Diego
Imperial B.
Coronado Is.
Rocky Pt.
Horseshoe Kelp
Santa Barbara Is.
Santa Catalina Is.
San Clemente Is.
Anacapa Is.
Santa Cruz Is.
Santa Rosa Is.
San Miguel Is.
San Nicholas Is.
Osborn Bank
Begg Rock
Cortez Bank
Tanner Bank
Bishop Rock
35°
34°
33°
122°
121°
120°
119°
118°
117°

Appendix I. Comments from Commercial Fishermen.

We asked commercial fishermen; "What do you think could be done to remedy the sea lion-harbor seal problem?" and received the following comments:

-Do away with the MMPA.

-Thin out the herds, fishermen have been in balance with nature for over 200 years, they need to be able to protect their livelihood, sea lions don't have enough natural predators anymore.
-Re-educate environmentalists, thin herds, identify animals that are a constant problem and eliminate them, treat pinnipeds as a resource, perhaps utilize them as pet food.
-Re-locate problems animals, don't regulate fishermen if they are damaging their livelihood.
-Advocate birth control.
-Stop reducing their (pinnipeds) natural food supply caused by over-harvesting the oceans.
-Population control; allow fishermen to kill them when interfering with fishing operations, or initiate a limited, controlled sea lion harvest.
-Let native Americans traditionally harvest them (pinnipeds).
-Lethally remove problem animals.
-Utilize effective deterrents.
-Control the population by culling.
-Thin out the population.
-Reduce the population.
-Cull enough sea lions to offset increasing depredation of catch.
-Let fishermen use force to protect their livelihood.
-Decrease the population.
-Allow intentional take of sea lions in salmon troll fishery.
-Let fishermen shoot them when their catch is being destroyed.
-One month open season.
-Let fishermen have depredation permits similar to what farmer's have.
-Cull the herds.
-Let fishers be able to shoot problem animals, not all of them rob gear and fish.
-Remove problem animals, a small minority is responsible for trap catch and damage.
-Do not medically treat sick animals,
-Allow fishers to shoot problem animals that interfere with fishing operations.
-Population control, thin out the herds
-Control the population, if these animals were rodents at a harbor, their numbers would be immediately reduced.
-Reduce the populations; Don't let public sentiment dictate policy. Hunting for deer and elk poses no lasting threat to the population. Let naturally diseased animals die in the wild, where they will be consumed by other animals. People are interfering with nature.
-I hope the fishermen and the State can work together to solve the problem, The State has no idea how out of control the problems are.
-Develop a fur fishery, and harvest the meat.
-Animal control, regardless of species, is a must for proper management.
-Sea lions are not stupid, shoot a few and they will soon learn that boats are not an easy meal. If nothing is done they soon learn that it is an easy way to obtain food. Harbor seals do not ever seem to scare fish, they pose no problem

Additional Comments

-There are too many sea lions, trained to destruct.
-Some days my crew and I fish 12-15 hours a day and because of sea lions we barely make $125 per day and pay for fuel. I am a third generation fishermen and if sea lions are not controlled I will be the last. (submitted by a salmon troll, round-haul and gill netter)

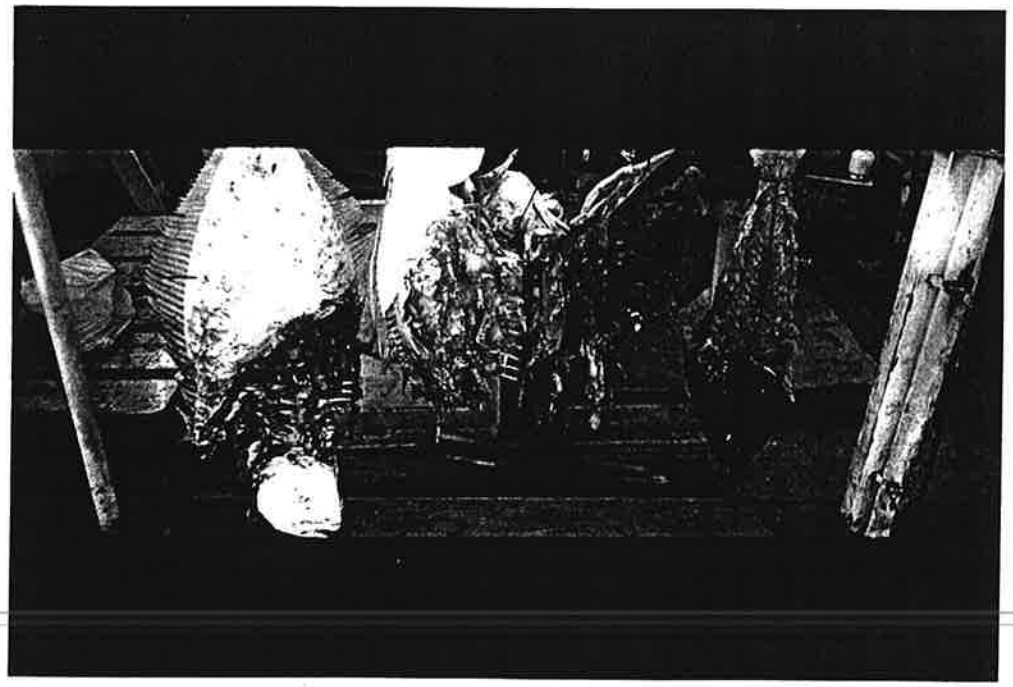
Appendix I. Continued Comments from Commercial Fishermen.

-I have been fishing for 25 years and am a lover of all animals, even sea lions. It is obvious that the sea lion population has increased. Problem animals like Hershel should be humanely destroyed. Advocate birth control if possible. Salmon and steelhead populations need help, not sea lions.
-NMFS should stop spending so much money on counting the numbers of animals; my gill net buy out didn't even come close to being realistic, look at the money spent on pinnipeds! The future should put things into proper perspective. Don't let the sad looking eyes of the seals influence policy!
-Sea lions are the main problem. Harbor seals are less aggressive and can be scared off when feeding on gill nets where sea lions cannot. Sea lions open lobster and crab traps.
-Commercial fishermen are so used to the sea lion problem that we expect it, leave the seals alone, take our losses and go on without fishing activities each day.
-This is a huge problem that won't go away on its own.
-In the past 2 years I have had to stop fishing because of aggressive sea lions, they seriously affect my ability to fish as I have done in the past 30 years. The no touch policy is a joke. The people making decisions don't know....

EXAMPLES OF GILL NET CATCH DESTROYED BY PACIFIC HARBOR SEALS AND CALIFORNIA SEA LIONS IN SOUTHERN CALIFORNIA

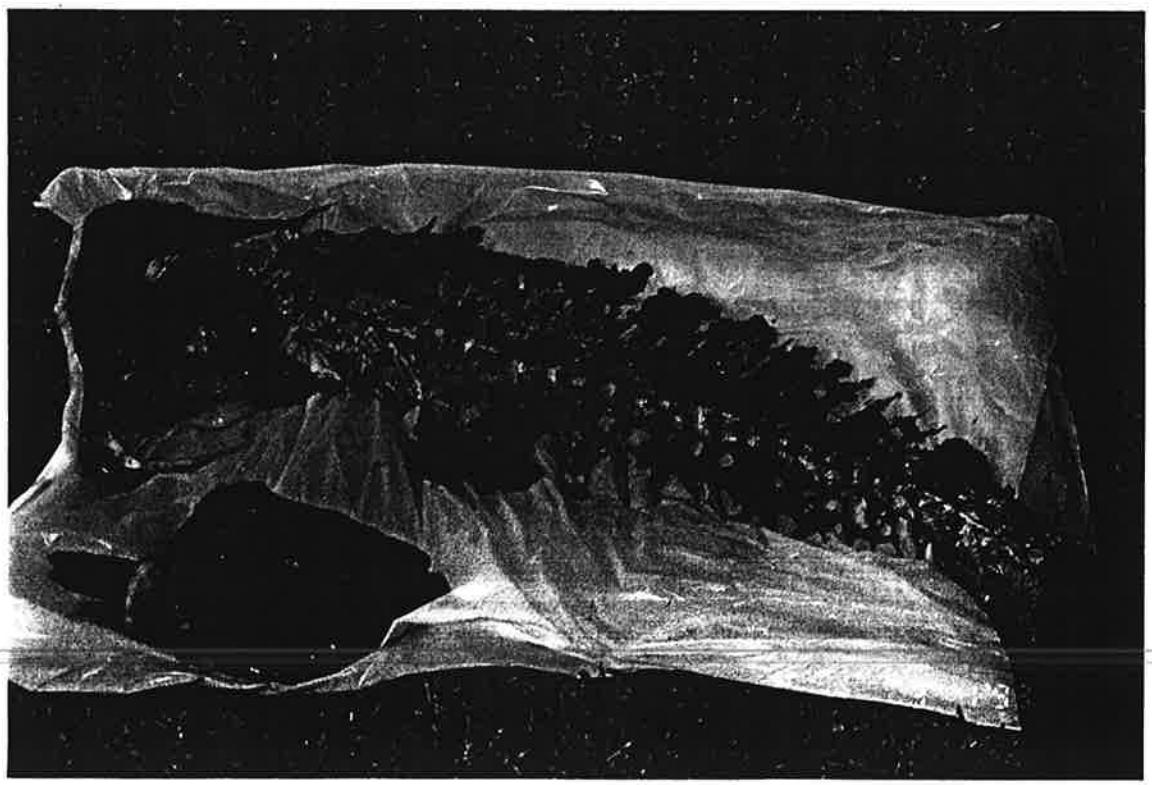
CALIFORNIA HALIBUT

Dent Marina Fuel Dock
3-16-94
35 lb. Halibut



EXAMPLES OF GILL NET CATCH DESTROYED BY PACIFIC HARBOR SEALS AND CALIFORNIA SEA LIONS IN SOUTHERN CALIFORNIA

CALIFORNIA HALIBUT



EXAMPLES OF GILL NET CATCH DESTROYED BY PACIFIC HARBOR SEALS AND CALIFORNIA SEA LIONS IN SOUTHERN CALIFORNIA

CALIFORNIA HALIBUT AND WHITE SEABASS