The Status of Steller Sea Lion Populations and the Development of Fisheries in the Gulf of Alaska and Aleutian Islands

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ABSTRACT

The goal of our study was to assess the status of Steller sea lions in Alaska, review their population biology, and develop a simulation model to explore the role that harvesting and incidental kills by fisheries may have played in the sea lion decline. We also attempted to relate the population declines to the amount of fish caught in the Gulf of Alaska and Aleutian Islands, and to the number of vessels fishing from 1950 to 1990.

Using life tables to estimate population size, the numbers of Steller sea lions were estimated for all rookeries for which information was available in each of six areas in the Gulf of Alaska and Aleutian Islands. The total population appears to have risen from 150,000 to 210,000 from the mid 1950s to 1967. The population was then stable for roughly ten years, then increased to 225,000 by 1979. Since then it has decreased to about 85,000. Most of the decline took place in Area 3 (Kodiak region) but there were also significant declines in Areas 4 to 6 (westward of Kodiak). Increases have occurred in the smaller populations of Areas 1 and 2 (southeast Alaska and Prince William Sound).

A major growth in domestic fisheries occurred after the declaration of 200 mile zones. The traditional fisheries for salmon, herring and halibut were augmented by major groundfish fisheries. The decline in the numbers of Steller sea lions has been coincidental with the growth in the numbers and size of vessels and the increase in catch.

The stabilization in the numbers of Steller sea lions in the Gulf of Alaska from 1956 to 1980 can be attributed to the direct effect of incidental capture in fishing gear, the shooting of sea lions and the harvesting of adults and pups. However, these factors explain but a small portion of the recent population decline, from 1980 to the present. Some sea lions are missing in the arithmetic of population dynamics which cannot be accounted for by movements of animals from one area to another. Whether these losses are caused by the removal of food resources is a circumstantial possibility, but evidence of local abundance of food resources at particular times of the year for particular segments of the population is needed to build a convincing case. Other causes, such as diseases and parasites must also be kept in mind as possible contributing factors.

Research on Steller sea lions should focus on the decline in abundance since 1980, changes in body size, the diet at various seasons of the year, bioenergetics and nutritional requirements, and assessment of local abundance of various food items. Long term research on the ecosystem dynamics of the region will be necessary for long term management of all living resources but how best to focus that research is a matter of current scientific debate that will not be resolved quickly.

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FOREWORD

This study was undertaken at the request of the Pacific States Marine Fisheries Commission. Concern for the status of Steller sea lions in Alaska has raised questions about the possible causes for the recent population decline and in particular the extent to which fisheries removals and fisheries related activities may be contributing factors.

We embarked on this study with some diffidence. Many who are more familiar with the raw data and who have spent more time in its interpretation have already said much that we might say. We have not attempted to recapitulate all that has been reviewed by others or deal with any particular topic in detail. Rather we have tried to write what amounts to a brief analysis and commentary on the central issues. In doing so, our advantage, if we have any, is detachment from management responsibility or advocacy. To that extent we hope that what follows will be a useful addition to the rapidly growing literature on the Steller sea lions of the North Pacific.

l. INTRODUCTION

Historically, Steller sea lions *(Eumetopias jubatus)* like all pinnipeds, were seen as nuisances to the fishing industry and to government agencies that managed commercial fisheries because they damaged catch and fishing gear and apparently competed with fishermen for fish (Mathisen 1959). Attempts to control harbour seals in Alaska began with a bounty program in 1927. The practice of paying fishermen and hunters for jaw bones did not stop until the 1960s when it became apparent that the bounty system was ineffective and expensive (Andersen 1951, Matkin and Fay 1980). In place of the bounty, controlled hunts were conducted in areas where seals caused heavy damage to commercial fisheries. Bounties were only paid for dead harbour seals, not for Steller sea lions. Sea lions were nevertheless shot by fishermen who felt they were doing their industry a service. An experimental commercial harvest of 630 sea lion bulls was attempted in 1959 but proved uneconomical (Thorsteinson and Lensink 1962). There was also a sea lion pup harvest from 1963 to 1972 during which 45,000 animals were taken for their pelts (ITG 1978). Government sanctioned control measures and harvests stopped in 1972 with the introduction of the Marine Mammal Protection Act.

The first sea lion survey was flown in 1956 by Mathisen and Lopp (1963). Data from this and subsequent flights suggest that the total population size in the Gulf of Alaska and Aleutian Islands was about 176,000 animals (Kenyon and Rice 1961). This was considerably higher than the number believed to have been present during the early part of the century (ITG 1978). Surveys of different Alaskan rookeries and haulouts made sporadically through the 1960s and 1970s suggest the population in Alaska exceeded 200,000 animals in the early 1970s and was near the maximum level attainable within the ecological limits of the sea lion's habitat (TTG 1978). From 1974 to 1980 the size of the Alaskan population was estimated at over 196,000 (Loughlin *et al.* 1984). In 1989, the estimate was 81,000 (Loughlin *et al.* 1992).

The first sign that something was amiss among Alaskan sea lions appeared in the mid 1970s in the eastern Aleutians. Surveys between 1975 and 1977 counted 50% fewer animals in the eastern Aleutians than surveys conducted between 1956 and 1968 (Braham et al. 1980). Elsewhere in the Aleutians, sea lion numbers were stable (Fiscus et *al*. 1981) and did not appear to decline until the early 1980s (Merrick et *al*. 1987). Similarly, declines in the central and western Gulf of Alaska were noted in the early 1980s (Merrick *et al*. 1987). Linear regressions suggest an overall population decline of 52% between 1956-60 and 1985 (Merrick et al. 1987). More recent surveys in 1989 indicate the declines have continued unabated (Loughlin et al. 1992). Declines have also occurred in the Soviet Union (Perlov 1991), but not in southeastern Alaska (Alaska Department of Fish and Game, unpublished data) or Canada (Bigg 1985).

In 1990, the Steller sea lion was listed as a threatened species under the U.S. Endangered Species Act. Since that time a Recovery Plan has be-en developed by a Recovery Team appointed by the National Marine Fisheries Service. The Recover Plan reviews factors that may have affected the sea lion population and identifies actions needed to stop the decline and encourage population growth (Recovery Plan 1992).

Why Steller sea lions have declined in Alaska remains unresolved. Factors suggested as possible causes include: nutritional stress caused by commercial fishery removals of sea lion prey; direct kills of sea lions by commercial and subsistence harvesting, and intentional and incidental kills by fisheries; entanglement in marine debris; disease; and disturbance (Braham et al. 1980, Merrick et *al*. 1987, Hoover 1988, Lowry and Loughlin 1990, Recovery Plan 1992). Data to assess each of these possibilities is limited.

The goal of our study was to assess the status of Steller sea lions in Alaska, review their population biology, and develop a simulation model to explore the role that harvesting and incidental kills by fisheries may have played in the decline of Steller sea lions. We also attempted to relate the population declines to the amount of fish caught in the Gulf of Alaska and Aleutian Islands, and to the number of vessels fishing from 1950 to 1990.

We begin by outlining the biology of Steller sea lions and by describing a procedure to estimate total population size from counts of adults and pups. After discussing population trends, we present an overview of the development of commercial fisheries in Alaska. Data were compiled for six areas comprising the Gulf of Alaska and waters surrounding the Aleutian Islands (Fig. 1.1). Study areas were chosen by the proximity of rookeries to one another and by the similarity of population trends at individual sites (Merrick et al. 1987). Numbers of sea lions killed by harvesting and commercial fisheries are assessed and a simulation model is proposed to reconstruct the estimated number of sea lions alive from 1956 to 1990. The results are shown to provide a better understanding of that part of the decline that can be explained by direct killings. We comment on the Steller Sea Lion Recovery Plan and conclude by outlining some directions for future research that may offer further insight into the decline of Steller sea lions.

2. SEA LION BIOLOGY

Steller sea lions range from the Channel Islands off southern California around the Pacific Rim to northern Japan, but most of the world population breeds between the central Gulf of Alaska and the western Aleutians (Scheffer 1958, Schusterman 1981, King 1983, Loughlin *et al.* 1984). Sea lions mate, give birth and care for their pups at rookery sites, and rest and moult at haulout sites. Most are used for hauling out during the non-breeding season. Sometimes both breeding and resting animals congregate together, making a site difficult to classify. There are about 38 major rookeries (Fig. 1.1) and over 250 haulout sites in Alaska (Loughlin *et al.* 1992). Most of the haulout and rookery sites are on remote and exposed rocks and islands, and are generally believed to be in close proximity to food resources.

Maximum life expectancy of males and females is about 18 and 30 years, respectively (Calkins and Pitcher 1982, Table 2.1, Fig. 2.1). Females produce their first pup between the ages of 3 and 9 years (Fig. 2.2, Calkins and Pitcher 1982). Mature males begin to breed between the ages of 8 and 10 years (Thorsteinson and Lensink 1962, Calkins and Pitcher 1982).

Weighing as much as 2,400 pounds (800 kgs), males begin to come ashore at rookeries in mid May, and will remain on land until mid July without eating or drinking. Males hold territories an average of two years (range l-7 years). The smaller females (700-800 pounds: 260 kgs) arrive shortly after the males and give birth to a single pup within three days of being on land. The females usually mate about two weeks after pupping. Adults and dependent young tend to concentrate on rookery sites until October, dispersing to haulouts for the remainder of the year.

Pups weigh about 23 kg at birth (Calkins and Pitcher 1982) and are born from late May to early July, with the peak of pupping occurring in June (Scheffer 1945, Pike and Maxwell 1958, Mathisen et *al*. 1962, Gentry 1970, Pitcher and Calkins 1981, Bigg 1985). Females tend to stay with their pups for the first 5 - 13 days after birth then go to sea to feed (Sandegren 1970). Feeding trips generally last for less than 24 hours and occur every 1 to 3 days (Sandegren 1970). Pups generally nurse for a year and are weaned before the next breeding season, although some pups may maintain a bond with their mother for up to 3 years. Young sea lions (l-3 years old) are often seen suckling adult females at rookery and haulout sites (Gentry 1970, Sandegren 1970, Calkins and Pitcher 1982).

Sea lions often feed in groups and tend to feed at night between 9 pm and 6 am (Spalding 1964, Fiscus and Bains 1966, Gentry 1970, Merrick et *al*. 1988). Feeding in groups may help to control the movement of large schools of fish and make them easier to exploit (Schusterman 1981). Sea lions may feed close to shore or may travel 100 or more miles (>150 km) out to sea. Stomach samples indicate sea lions prey upon a wide selection of fishes, including capelin, sand lance, pollock, herring, cod, salmon, flatfishes, sculpins, squid, octopus and occasionally seal pups (Fiscus and Baines 1966, Pitcher 1981, Calkins and Pitcher 1982, Lowry *et al. 1982).* Most fish, including fish up to 2 kg, are swallowed whole (Mathisen et *al. 1962,* Jameson and Kenyon 1977). Large prey are torn apart and consumed at the surface (Spalding 1964). Food requirements of sea lions are believed to be between 2 and 6% of their body weight per day (Mate and Gentry 1979).

Sea lions appear to prefer the coastal shelf region within 45 km of shore, although they can be found over 100 km from shore in waters over 2,000 m deep (Kenyon and Rice 1961, Fiscus and Baines 1966, Fiscus et *al.* 1976). Few sea lions are sighted at sea during June and July, the breeding season (Fiscus et al. 1976).

Seasonal variation in numbers of sea lions at rookeries appears to be similar wherever sea lions breed (Bigg 1985). Typically, the number present at rookeries is lowest in December and highest after pupping in July before the adults disperse (Aumiller and Orth 1980, Smith 1988). Sea lions continue to use haulout sites during the winter months and do not undertake extensive migrations like some other pinnipeds. However, males may disperse further north than females (D. Calkins, pers. comm.), and tagged subadults have been sighted up to 1,500 km from where they were marked (Calkins and Pitcher 1982).

Tagging and branding studies suggest that most sea lions return to their birth sites as they become sexually mature (Calkins and Pitcher 1982). Such a phenomenon, which is well documented in northern fur seals (Kenyon and Wilke 1953), suggests the possibility that each sea lion rookery may be a somewhat distinct breeding stock.

3. EVALUATION 0F SEA LION NUMBERS AND TRENDS

Extensive surveys of sea lions have been conducted from air, sea and land over many years since the mid 1950s. Early counts in the 1950s and 1960s were made visually on site and from scrutinizing photographs taken in conjunction with sea otter surveys done over many months (Kenyon and Rice 1961, Mathisen and Lopp 1963). Sea lion surveys through the 1970s and 1980s tried to optimize the number of animals observed ashore by counting during midday at the peak of the breeding *season* in June and July (Braham *et al.* 1980, Fiscus *et al.* 1981, Calkins and Pitcher 1982, Withrow 1982, Bigg 1985, Merrick et al. 1987, 1988, 1990, 1991; Loughlin et *al.* 1984, 1986, 1992).

Although sea lions haul out at predictable places and are relatively easy to count, there is always some uncertainty about the number of animals that were at sea and not counted. The numbers of animals counted on land can be affected by tides, weather, visibility, time of day and time of month, among other factors (Withrow 1982). Thus sea lion counts are not estimates of total population size but are considered to be minimum estimates of the number of animals using a particular site. At face value they serve as relative indices of population size and trends in abundance.

Pup counts provide an independent measure of productivity. It is generally accepted that pups, which do not leave the rookery during their first two months of life, provide a better index of population size and trend than do counts of adults. The best estimates of pup production are usually made by people walking through the rookery (this causes adults to move towards the water SO that the remaining pups can be counted). However logistics for such counts is costly and they may disrupt the rookery. Pups can also be counted visually from shore or from photographs, but pups can be missed if hidden behind rocks and other animals. In general, counting pups on land provides a more reliable index of population trends than aerial surveys (Berkson and DeMaster 1985).

The following section examines trends in the numbers of animals counted on 38 rookeries from southeast Alaska to the Aleutian Islands (Fig. 1.1) and attempts to estimate the total population size from pup and adult counts by area in the Gulf of Alaska and Aleutian Islands. The numbers of pups and adults' counted at rookeries between 1956 and 1991 (Appendix 1) were obtained from both published and unpublished sources (Kenyon and Rice 1961, Mathisen and Lopp 1963, Braham *et* al. 1980, Fiscus *et al.* 1981, Calkins and Pitcher 1982, Withrow 1982, Bigg 1985, Byrd 1989, Merrick *et al.* 1987, 1988, 1990, 1991; Loughlin et al. 1984, 1986, 1992). Original data sources were used whenever possible, because errors were noted in a few published data summaries. In general the data are considered sparse (Appendix 1).

3.1 Life Table Estimation of Population Size

The total sea lion population (pups + adults') was estimated for each of the six areas (Fig. 1.1) using rookery counts made during the months of June and July (Appendix 1). We explored two approaches based on applying life table statistics to the numbers of pups and adults counted at rookery sites (Bigg 1985, Loughlin *et al. 1992).*

A mathematical model (see Section 5) with survival and reproductive rates (Figs. 2.1 - 2.2, Table 2.1) taken from York (1990a) and Calkins and Pitcher (1982), produced a simulated population consisting of 21.54% pups, 25.04% adult males' and 53.42% adult females'. The total size of the simulated population was 4.64 (= 0.2154^{-1}) times the number of pups born. Similarly, the number of pups born was 0.27 (= $21.54 \times [25.04+53.42]^{-1}$) times the number of adults alive. Thus we extrapolated the size of the Gulf of Alaska sea lion population from the numbers of pups and adults' counted at rookeries during aerial and shore surveys.

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[1]Adults include both immature (juvenile) and mature animals.

The number of pups actually observed in the wild is a minimum estimate of the actual number born in a given year. For example, a census conducted in June will fail to account for pups born in July. Similarly, a July *or* August census will miss pups that died and are no longer on the rookery. Pups hidden behind rocks or other sea lions are another complication. We therefore applied a 10% correction factor to all recorded pup counts to account for dead pups or those nor yet born. Thus, in years, when pups were counted at all rookeries of a given area,

$$\begin{aligned} \textit{Total Population} &= 1.10 \times 4.64 \times \textit{pups counted} \\ &= 5.10 \times \textit{pups counted}. \end{aligned} \tag{3.1}$$

As with pups, the number of adults counted at a rookery is a minimum estimate of the total number present (unless the site is also being used as a haulout). For example, some lactating females are at sea during censuses, while other sea lions may not use rookeries at all during the breeding season. Loughlin et al. (1992) estimate that populations consist of 33% more adults than the number counted at rookeries based on life table analysis and adult counts made by Merrick *et al.* (1991) between the islands of Chirikof and Kiska in 1990. Thus, we estimated

$$\begin{aligned} \textit{Total Population} &= (1.33 + 1.33 \times 0.27) \times \text{adults } \textit{counted} \\ &= 1.69 \times \textit{adults counted}, \end{aligned} \tag{3.2}$$

which accounts for the number of adults alive plus the estimated numbers of pups born.

If pups or adults were counted on all rookeries of a given area, the total population size was estimated by applying Eqs. 3.1 and 3.2. In some years, pup or adult counts were available for ail rookeries, except a few. Under these circumstances, we interpolated the number present on missed rookeries from counts made in adjoining years. In other years, no estimates were made if too few rookeries were surveyed.

3.2 Estimates of Population Size by Area

The number of pups and adults counted by rookery, year and area are contained in Appendix 1 and Figs. 3.1- 3.10. Estimates of the number of sea lions missed at unsurveyed rookeries, and the results of applying Eqs. 3.l and 3.2 to the total counts, are contained in Appendix 2. Total population size and estimates of population trends are shown in Figs. 3.11 -3.17.

The following summarizes changes in sea lion numbers by rookery and area, and discusses the estimates of total population size in Areas 1 to 6 from 1956 to 1990. We treated sea Zion aggregations in each area as distinct populations, although they may in fact be best thought of as sub-populations because the actual degree of mixing is not known. Population estimates were based upon the combined trends of pup and adult counts from individual rookeries. In general greater confidence was placed upon population estimates derived from pup counts because pups do not leave the rookery during the fast few months after birth, and adult numbers can vary considerably if mature animals are away from the rookery or immature animals are using the rookery as a haulout.

Area 1. There are currently 3 major rookeries and 5 major haulout sites in southeastern Alaska (Fig 1.1). The largest rookery in Alaska is currently For-rester Island. The two other rookeries, White Sisters and Hazy Island, used to be classified as haulouts until the late 1970s when *some* of the females using these sites began giving birth. Since then, there has been a steady increase in pup production on these former haulouts (Fig. 3.1, Appendix 1).

The total number of sea lions (pups and adults) in Area 1 was estimated to be 5.1 times the number of pups born (Eq. 3.1). From 1980 to 1991 we assumed the annual increase in pup production at Hazy Island and White Sisters was approximately linear when field estimates were unavailable (Fig. 3.1). Prior to this time, we assumed that pups were born only on For-rester Island.

The estimated number of sea Lions in southeast Alaska (assuming that Forrester Island has always been the major rookery) increased from under a hundred in the 1920s (Rowley 1929) to 350 in 1945 (Imler and Sarber 1947), 2,500 in 1957 (Mathisen and Lopp 1963) and levelled off at about 9,000 in the early 1970s (Fig. 3.11). The population appeared to remain relatively stable through the 1970s and early 1980s, but has been increasing since about 1986 (Fig. 3.11).

Area 2. The Prince William Sound sea lion population is the smallest of all 6 Areas in the Gulf of Alaska. The region contains 2 rookeries and 5 major haulouts (Loughlin et *al*. 1992). In July of 1956, most of the 234 pups counted by Mathisen and Lopp (1963) were born on Wooded Island (Fig. 3.2, Appendix 1). Twenty years later, the bulk of the breeding population was on Seal Rocks Fig. 3.2, Appendix l), possibly because the 1964 earthquake changed the topographies of the two islands (Sandegren 1970, Calkins and Pitcher 1982).

On Seal Rocks, the numbers of pups increased from 21 in 1956 to almost 800 in 1984 (Fig. 3.2, Appendix 1). Since the mid 1980s the total number counted (adults and pups) has been declining. At Wooded Island, over 200 pups were born in 1956, but less than 50 were counted in subsequent survey years (1968, 1973 and 1976).

A best guess of the total number of sea lions present in Area 2 during the 1950s and 1960s is 1,000 animals (based on total pup counts). Numbers increased from the early 1970s to the mid 1980s, peaking at about 3,500 animals (Fig. 3.12). The most recent surveys suggest the current Prince William Sound population is roughly 3,000 (Appendix 2) and shows signs of a small increase in size from 1989 to 1991.

Estimates of sea lion numbers in Area 2 were based on pup counts and are considerably lower than estimates derived from adult counts (Fig. 3.12). For example, the adult based estimates during the 1950s through 1970s suggest there were about 4,500 sea lions present, in contrast to the 1,000 we estimate were actually there (Appendix 2). Although the adult based estimates always exceed the pup based estimates, the difference appears to have diminished through the 1980s. This suggests that many of the adults counted in Area 2 are not part of this breeding population and were not born in this area. Perhaps many of the young males and females hauled out and counted in Area 2 originated from larger populations to the west (i.e. Area 3).

Area 3. More sea lions breed among the 5 rookeries and 13 major haulouts in the Kodiak Island region than anywhere else in Alaska. A sixth location, Chiswell, appears to be no longer used as a breeding site. Pup production on Marmot and Sugarloaf Islands (formerly the two largest rookeries in Alaska) suggest the population increased over two periods of time: 1956-67 and 1975-80 (Figs. 3.3,3.4 and 3.13). Overall, the total number of sea lions in Area 3 apparently increased from 55,000 to 75,000 during the first period, and from 70,000 to 90,000 during the second (Appendix 2). However, after 1980, the population declined precipitously and is currently estimated at approximately 30,000 animals (1990 level).

Area 4. There are 5 rookeries and 7 major haulouts in Area 4. Pup and adult counts suggest there were about 20,000 sea lions in Area 4 during the late 1950s. By the late 1970s the population had doubled to between 35- and 45-thousand. We assumed the increase over this 20-year period was linear, although it could be well argued that the population did not begin to increase until the early 1970s. There are no data for this time period. However, pup counts over the past decade indicate the total population declined from 45,000 in 1979, to 8,000 in 1990 (Figs. 3.5, 3.6 and 3.14).

Area 5. There are 7 rookeries and 5 major haulouts in Area 5. Adult and pup counts were regularly made between 1957 and 1990 (Figs. 3.7 and 3.8, Appendix I). They suggest a relatively stable population through the 1960s of about 45,000 sea lions. The decline did not begin until the early 1970s and appears to have been continuous. In 1990 approximately 10,000 animals remained (Fig. 3.15, Appendix 2).

Area 6. The western Aleutians contain 12 rookeries and 7 major haulouts. Pup counts, made sporadically at only 5 sites since 1977, indicate a declining population (Fig. 3.10). Adults, also sporadically counted at as many as 14 sites since 1959, indicate the western Aleutian population has been declining since at least 1977, if not earlier (Fig. 3.9). However, between 1959 and the early 1970s the data suggest the adult population increased.

Because there are so many rookery sites in Area 6, and because different sites were counted in different years, it is difficult to reconstruct the total number of sea lions present with any accuracy. Based on the adult counts, the population apparently consisted of approximately 35,000 sea lions during the early 1960s and 50,000 animals in 1979 (Fig. 3.16). Pup counts in 1989 and 1990 suggest there are currently about 25,000 animals in the population.

3.3 Changes in Sea Lion Numbers in the Gulf of Alaska and Aleutians

Considered as a whole, the number of sea lions in the Gulf of Alaska and Aleutian Islands appears to have risen from 150,000 animals in the mid 1950s to 210,000 in 1967 (Fig. 3.17a). The population remained relatively stable for the next 10 years, then increased and peaked at 225,000 in 1979. However, since 1979, the population has declined by over 60% (roughly 5% per year) and currently consists of about 85,000 animals (1991 level).

A slightly different picture emerges when changes in population size are considered on a region by region basis (Fig. 3.17b). For example, more than 63% of the decline in the Gulf population since 1979 can be attributed to the decline in Area 3, the largest breeding population in Alaska. While the 4 largest populations (Areas 3 - 6) have declined, increases have been recorded in abundance in Area 1 since the mid 1950s. In Area 2, the smallest of the Gulf populations, increases have been recorded in pup production for the past 3 years. Of the 4 regions where sea lions declined the declines began at different times. For example, Area 5 was the first to decline, beginning in the mid 1960s. Declines in the other 3 areas appear to have begun around 1978 (Area 6), 1980 (Area 4) and 1981 (Area 3), and have continued to present.

4. COMMERCIAL FISHERIES OF THE GULF OF ALASKA

The decline in the numbers of sea lions in Alaskan and Aleutian waters could have come about for a variety of reasons, but the coincidental developments in the commercial fisheries of the region are an obvious possible contributing factor. Aside from the possible effects of direct removals of food for sea lions, there are the indirect effects on food sources arising from restructuring of the complex interrelationships among species in an ecosystem when some species are removed. There are also the direct effects of fisheries and fishermen on sea lions, for example, shootings and incidental capture by gear. For these several reasons, we attempted to summarize the commercial fisheries developments of the region over the past forty years.

The traditional and *early* commercial fisheries of Alaska were mostly near shore and concentrated on species most readily captured on small scale gear. Salmon, herring and halibut dominated the catch. But early in the 1950s a new era began to unfold. A major Japanese driftnet fishery for salmon spread across most of the North Pacific. At the same time Japanese and Soviet crab fleets began to set tangle net fisheries for king crabs in the Eastern Bering Sea, Japanese drift netted for herring, and high seas trawling expanded into the Bering Sea, the Gulf of Alaska and the Pacific coast of Canada. These developments commanded the attention of the International North Pacific Fisheries Commission until the declaration of 200 mile exclusive zones, after which many of the issues became more domestic than international.

The vigorous growth of Alaska-based fisheries was under way before the declaration of 200 mile zones, and from those roots rapidly replaced unlimited foreign catches with licensed catches by foreign vessels, joint venture operations and expanded shore based domestic operations-Throughout this transition total catches remained high. By the late 1980s the erstwhile Alaskan fisheries for salmon, herring and halibut had been almost overshadowed by a groundfish production well in excess of a million metric tons per year.

The Alaska Peninsula and the Aleutian Islands provide a natural boundary between the ecosystems of the Bering Sea and the Gulf of Alaska. In general, stocks of many species of fish and invertebrates are separate in the two areas, but there are many overlappings. For example, juvenile salmon from Bristol Bay stocks in the Eastern Bering Sea venture south of the Aleutians and in their homeward migration pass northward through the islands. Sea lions, which are the focus of interest for this study, appear much more closely associated wish Gulf of Alaska and Aleutian resources than with those of the Bering Sea. During the summer season, male sea lions may venture far to the north into the Bering Sea, but females and pups are more or less confined to the immediate vicinity of the islands of the Aleutian chain.

For the purposes of this study we have chosen to exclude the fisheries of the Bering Sea except for the areas surrounding the Aleutians. Including all of the eastern Bering Sea fisheries would introduce a great deal of information which we felt was extraneous to the issue at hand. Excluding most of the Bering Sea fisheries data seemed the better alternative, especially because the fisheries of the past two decades in the Gulf of Alaska have been the most significant for female and juvenile sea lions of the Gulf area.

The fisheries data which follow were grouped to coincide with the six areas we used to compile the seat lion data (Fig. 1.1). For each of six groups of species, shrimps, crabs, halibut, groundfish, herring and salmon, Figures 4.1 to 4.30 and Appendix 3 and 4 give catches and numbers of vessels for each area as well as the total catch and total number of vessels participating in the catch.

The data have been assembled from the records of a number of different management agencies that define different geographical regions for their statistical purposes. The catch data are based on reported catches and do not include bycatches. They are thus minimal estimates of actual catch. (Details of the sources and the methodology of assembling the statistics are given in Appendix 5.)

4.1 Catch by Major Groups of Species

Salmon. In recent years, sockeye and pink salmon, the most abundant species on the North American coast have reached record levels of abundance and have been caught in record numbers (Figs. 4.1 and 4.2). Major fisheries are located in Prince William Sound and off Kodiak, Cook Inlet, the Alaska Peninsula and the Copper River.

The annual numbers of vessels fishing salmon in Areas 1 to 6 were not available for this period and were assumed to be equal to the average number for the period 1969-73 for Area 1, 1969-75 for Areas 3 and 5, and 1969-78 for Areas 2 and 4, in each case, years in which the catch was relatively stable. It was assumed that ten vessels fished Area 6 between 1951-1967 (Fig. *4.3).*

Herring. The United States has conducted a herring fishery in the Gulf of Alaska since the early 1880s. Annual catches of approximately 100,000 metric tons were reported between 1925 and 1940, but dropped in the early 1960s to under 10,000 metric tons (Lyles 1965). The annual amount of herring landed has since risen to about 30,000 metric tons (Fig. 4.4). Major fishing areas are southeastern Alaska (Area I), Prince William Sound (Area 2) and around Kodiak Island (Area 3). In recent years the fishery has been aimed at the market for roe and is closely timed accordingly. The number of vessels involved has increased in recent years (Fig. 4.5).

Halibut. Commercial fishing for Pacific halibut began in southeastern Alaska in 1895. Since 1910 halibut have been caught both inshore and offshore by American and Canadian vessels using set lines.

An average of 45 million pounds of halibut was caught each year in the Gulf of Alaska between 1950 and 1970 (Fig. 4.6). Catches dropped and remained low through the 1970s and did not return to earlier levels until the early 1980s when large numbers of halibut were caught in Area 3 (Fig. 4.6). A dramatic rise occurred in the numbers of small vessels fishing halibut through the late 1970s and 1980s (Fig. 4.7).

Groundfish (excluding *halibut).* Until the late 1970s most groundfish exploitation in the Gulf of Alaska was conducted by large vessels from Japan and the Soviet Union (Fig. 4.8a). Pacific ocean perch was the first species targeted by the Soviet Union in 1962, but catches were not officially reported by area until 3966 when a total of 83,000 metric tons was caught (Fig. 4.8a). Annual catches of Pacific ocean perch before 1966 may have been between 100,000 and 350,000 metric tons, but no records are available to confirm this. Japan began fishing flatfish, blackcod, pacific cod, pollock and Ocean perch in 1963. As with the Soviet fleet, the principal fishing areas were the Aleutians (Area 6) and Kodiak/Chirikof region (Area 3). Both Soviet and Japanese catches declined during the late 1970s and 1980s as the U.S. assumed greater control over fishing in its 200 mile zone (Fig. 4.8a).

Small quantities of Pacific cod were caught and reported by the domestic U.S. fleet in the southeastern Gulf (Area 1) beginning in the mid 1950s. It was not until 1973 that the U.S. fishery moved westward to other regions of the Gulf of Alaska. Since then the total groundfish catch of the U.S. has risen considerably, reaching 155,000 metric tons in 1988 (Fig. 4.8a).

Joint-venture fisheries, in which domestic vessels may deliver catches to foreign vessels (primarily Soviet, Korean, Japanese and Polish), began in 1978 and expanded annually. In 1985, the total groundfish catch in the Gulf of Alaska peaked at just under 550,000 metric tons of which pollock accounted for over 95% (Figs. 4.8b and 4.9). Joint venture groundfish catches have been under 150,000 metric tons since 1986 and falling. Except in the Aleutians (Area 6), joint venture fisheries were not conducted in 1989 and 1990.

The total catch and numbers of vessels catching groundfish in the Gulf of Alaska since 1962 are given in Appendix 3 and 4 and Figs. 4.9 to 4.11. Our counts of foreign vessels should be considered reasonable guesses, not firm estimates. Comparing numbers of boats operating in each of the groundfish fisheries can be misleading because of the great difference in vessel size. In particular it should be noted that the largest U.S. vessels were smaller than the smallest Soviet and Japanese vessels.

Shellfish. Commercial fisheries for shrimp, king crab, Tanner crab, Dungeness crab and other miscellaneous species are described by Larson (1990), Donaldson (1991), Kimker (1991), Koeneman et *al*. (1991), and Nippes (1991).

Commercial harvesting of shrimp began in 1915 in southeast Alaska. However, since 1959 the principal Alaskan shrimp fishery has been located around Kodiak Island in Area 3. Shrimp are caught in beam trawls, otter trawls and pot traps. Total landings in the Gulf of Alaska rose rapidly from 1964 to 1973 and then fell (Fig. 4.12).

The U.S. king crab fishery (Fig. 4.13) was centred in the central Gulf (Area 3: Kodiak Island, South Peninsula and Cook Inlet). It began as a trawl fishery in the 1940s and was replaced by a pot fishery beginning in 1959. The central Gulf has supported more king crab boats than all the other Gulf regions combined. The number of king crabs caught declined from 1965 to 1983 after which the fishery was closed (Fig. 4.13). The Tanner crab fishery (Fig. 4.14) began in the late 1960s and grew rapidly as the king crab fishery declined. As with king crabs, the fishery has been concentrated in the central Gulf (Area 3) and has declined considerably over the past decade. Dungeness crabs (Fig. 4.15) have been fished commercially since the turn of the century with the largest fisheries centred in southeast Alaska (Area 1) and Kodiak Island (Area 3).

Overall, there has been a steady increase in the number of vessels catching crabs (Fig. 4.16). Total catches of crabs were higher between the early 1960s and late 1970s, but have dropped off considerably since 1980 (Fig. 4.16). The largest catch of crabs and shrimp and the greatest number of vessels participating in this fishing occur in Area 3 (Fig. 4.17) although the importance of Area 1 has increased dramatically since 1980 (Fig. 4.17)

4.2 Summary of Catch by Area.

As is indicated in the foregoing, the various fisheries are unequally distributed across the six sea lion areas. In terms of quantities of fish landed, Gulf of Alaska and Aleutian fisheries are dominated by catches of groundfish and salmon (Fig. 4.18). Areas 1 and 2 have been heavily fished for salmon, halibut and herring (Fig. 4.19 and 4.20). Area 3 has had a major groundfish fishery in recent years (Fig.4.21). Areas 4 and 5 have supported mixed fisheries with greatest catches of salmon and groundfish (Figs. 4.22 and 4.23). Area 6 was dominated by groundfish fisheries in recent years (Fig. 4.24).

Combining catches for each area for the years from 1950 to 1990 indicates the historical dominance of Area 1 that was replaced by the growth in catches in Area 3 (Fig. 4.25). The numbers of vessels was highest in Area 1 throughout the whole period with Area 3 a consistent second In the past decade the numbers of vessels in Areas 2 and 5 have increased substantially.

From the 1950s to the late 1960s the sum of the numbers of vessels participating in the various fisheries was in the order of 6,000 to 7,000, increasing to between 12,000 and 14,000 in the early 1980s and thereafter returning to slightly more than 12,000 (Fig. 4.26). How many vessels were participating in several fisheries is not known, but the total fleet involved is considerably less than these sums would indicate.

Averaging over the whole period Areas 1 and 3 have been fished by 76% of the vessels which have taken 58% of the catch, Areas 4, 5, and 6 by 8% of the vessels for 29% of the catch, and Area 2 by 16% of the vessels for 13% of the catch (Figs. 4.27 to 4.30). It is important to keep in mind that over the whole period the fishing capabilities of much of the fleet were greatly increased. Larger vessels with better gear and improved finding and navigation devices have meant that though the present fleet may be not much larger than that of 20 years ago its capacities for catching fish are much greater.

Precise data on the numbers of vessels are in general difficult to obtain. In some cases, the numbers of vessels may be inferred from the numbers of licences or permits for a fishery or from the landings records. Many vessels fish in more than one area and fish seasonally for different species and therefore are counted more than once. For example, tanner crab vessels may also fish salmon, herring, halibut, groundfish and shellfish. For most vessels, there is no record of where and when they fished so that it is not possible to specify how many vessels fished in a particular area at a particular time. There are also substantial differences in vessel size both within and between the various fisheries, the largest vessels being those associated with the groundfish trawl fishery.

For these reasons, the catch and number of vessels participating in a fishery, taken together, are useful as broad indicators of human activity that might have possible impact on sea lions, but their limitations as more precise indicators must be kept in mind.

5. SEA LION SIMULATION STUDY

5.1 Model Description

A simple age-class model was used to explore the effect of pup harvests and incidental kills on sea lion populations breeding from 1956 to 1990. The simulation reconstructed the estimated number of pups and adults alive in the Gulf of Alaska and Aleutian Islands. It considered the sea lion population to be spatially homogeneous within each of the 6 broad geographic regions of the North Pacific (Fig. 1.1) but stratified the population by sex and 30 age-classes (x), with pups being the 0 age class Two sets of population data were retained, one for the number of males ($N_{x,m}$) and one for the females ($N_{x,f}$).

No density dependent regulatory mechanisms were assumed to be operational. Density dependent changes have never been convincingly demonstrated in any pinniped population (Trites 1990). This is not to say that they do not exist; rather it reflects an incomplete understanding of the changes that occur in pinniped populations as densities rise and fall, and carrying capacities shift. Hence the model did not include explicit mechanisms of density dependence, except as they may be reflected in survival rates.

Age specific survival rates, $s_{x,m}$ and $s_{x,f}$, were taken from York (1990a,b) for females and from Calkins and Pitcher (1982) for males, modified slightly (Table 2.1 and Fig. 2.1) so that population growth rate could be set by multiplying them by a constant, *r*. For example, there was zero population growth when r = 1.00, and 4% growth per year when survival rates were multiplied by r = 1.04. Extraneous mortality rates (deaths due to causes other than those described by the survival rates) were allowed to vary annually, and were fixed by comparing the field estimates to the simulated numbers of pups born and adults counted. The best estimates of extraneous mortality rates (d) produced the best fit of model output to population data.

The numbers of males and females dying by extraneous factors ($D_{x,m}$ and $D_{x,f}$) were expressed in terms of the total number that died times the proportion ($p_{x,m}$ and $p_{x,f}$) of animals that were vulnerable to being caught and killed at age x, i.e.

$$D_{x,m} = p_{x,m} d \sum_{x=0}^{30} N_{x,m}$$

and

$$D_{x,f} = p_{x,f} d \sum_{x=0}^{30} N_{x,f} \quad .$$

Vulnerabilities to all extraneous factors other than pup kills, were estimated from the number (by age and sex) of incidentally taken sea lions which died during trawl fishing operations of foreign and joint venture vessels in Alaska during 1978-87 (Fig. 5.1). Neither sex appears to be taken selectively. The proportion of males to females in the trawl samples (39.7%:60.3%) was not significantly different from the proportion of males to females in the simulated population (35.8%:64.2%, Yates corrected $\chi^2_1 = 0.879$, $p = 0.349$).

The annual cycle of the model began in January of each year and followed the history of the population, including the harvesting of pups and incidental kills of adults. The simulation determined the numbers that survived from one year to the next as

$$N_{x+1,m} = s_{x,m}(N_{x,m} - 0.5D_{x,m})$$

and

$$N_{x+1,f} = s_{x,f}(N_{x,f} - 0.5D_{x,f}) \quad .$$

Extraneous deaths were assumed to occur in both the spring and the fall, and were split equally among the two seasons (i.e. 0.5 $D_{x,m}$). All births were assumed to occur on July 1, at the end of the first 6 month period. Pups born to females killed between July and December were assumed to perish because they would nor have been weaned and able to survive on their own. Hence, for the last 6 months of the year

$$N_{x,m} = N_{x,m} - 0.5 D_{x,m}$$

and

$$N_{x,f} = N_{x,f} - 0.5 D_{x,f} \ .$$

The number of pups produced by mothers that survived this second stage of extraneous mortality was determined from

$$N_{0,m} = 0.5 \left(\sum_{x=1}^{30} b_x N_{x,f} \right) - P_m$$

and

$$N_{0,f} = 0.5 \left(\sum_{x=1}^{30} b_x N_{x,f} \right) - P_f \ .$$

where b_x are age specific natality rates (Table 2.1) from Calkins and Pitcher (1982) and P_m and P_f are the numbers of male and female pups harvested (Table 5.1). The ratio at birth of male to female pups was assumed equal.

The model simulated the Gulf of Alaska and Aleutian Islands population from 1956 with an initial herd having a stable age distribution and a size equal to the estimated number of animals alive in 1956. We also explored the dynamics of sub-populations breeding in Areas 1, 3 and 5. The last year of simulation was 1991.

5.2 Simulation Results and Model Discussion

Estimates of sea lion abundance in the Gulf of Alaska and Aleutian Islands suggest the population increased approximately 4% per year from 1956 to 1967 (Fig. 5.2a). Holding the intrinsic growth rate constant at r = 1.04 suggests the rate of disappearance[2] before 1968 was less than 1% or, equivalently, 1,200 animals per year, rising to 5% or 4,000 adults between 1968 and 1972 (Fig. 5.2b). The model attributes the rapid decline of sea lions between 1980 and 1990 to a rapid increase in the proportion of animals annually disappearing from the Gulf and Aleutians (from 4% of the population in 1978 to 14% in 1990). The numbers of sea lions dying each year from various sources of extraneous mortality would have increased from 4,000 per year in 1978 to 16,000 in 1985, to be consistent with the estimated population decline shown in Fig. 52a. The model suggests the number of animals disappearing per year from the population has since dropped to about 12,000 in 1990.

The dynamics of the simulated population are consistent with changes in population size that occurred from 1956 to 1991. The intrinsic growth rate of 4% per year was consistent with population growth during the late 1950s when new commercial fisheries in the area were only beginning. With chosen growth rates of 5 or 6%, annual disappearance rates would have to be increased by 0.075 and 0.150 respectively to produce the same fit of simulation output to field data. Similarly, disappearance rates would be lowered if intrinsic growth rates were also

[2] Disappearances attributed to emigration or shooting, entanglement, entrapment, starvation and other sources of extraneous mortality.

lowered. Thus the dynamics of our simulated population were essentially a tradeoff between intrinsic growth capabilities and rate of disappearance.

The apparent stability in the size of the population (at around 200,000 animals) between 1964 and 1977 was likely a consequence of harvesting 45,000 pups (Table 5.1, Fig. 5.2a). Had pups not been harvested the population might have been at least 5% larger than the 1980 estimate. Since 1979 the population has declined rapidly. In the span of 12 years, the population has dropped from 225,000 to 81,000 sea lions. It would take about 25 years to return from the present level to 225,000 sea lions if the population were to maintain a 4% intrinsic growth rate and no sea lions were to die from extraneous factors.

The decline of sea lions in the North Pacific began first in Area 5. Simulation results (based on r = 1.04) suggest that extraneous mortality was insignificant in Area 5 until the early 1960s (Fig. 5.3b). From 1960 to 1975 the rate of disappearance rose from 0 to 10% of the population (about 3,000 seals in 1975). Since 1976, 10 -12% of the population has disappeared each year. Pup harvests (1963-72) were particularly significant in reducing the large Cape Morgan and Ugamak breeding populations and likely contributed to the overall population decline in Area 5 (Fig. 5.3a). Removing the pups undoubtedly magnified the population decline in Area 5 and made the downward trend more conspicuous and easier to detect than if the pups had not been harvested. However, something more than pup harvests had to occur to bring the population down to its present level.

In Area 3, which contains the largest breeding population in Alaska, sea lions increased over two periods of time: 1950-67 and 1974-80 (Fig. 5.4a). The period of relative constancy in population size through the late 1960s and early 1970s could be related to the large pup harvests of Area 3 (Table 2, Fig. 5.4a). Assuming an intrinsic growth rate of 4%, the model points to two periods of extraneous mortality: 1968-75 and 1981 to present (Fig. 5.4b). At other times (1956-

67 and 1976-80) the population could not have sustained extraneous mortality and still maintained a 4% growth rate.

The possibility that extraneous mortality was absent in Area 3 between 1976 and 1980 and did not exist prior to 1968 is unlikely given that aboriginals traditionally hunted sea lions here and commercial fisheries interacted with sea lions throughout the 1970s. Thus, either the intrinsic growth rate in Area 3 was higher than 4%, or seals emigrated to Area 3 from other regions of Alaska. A growth rate of 4.5% would have been sufficient to sustain an annual aboriginal harvest of 500 adults during the early 1960s, but during the late 1970s the rapid rise in population size was more likely due to the arrival of sea lions from adjoining areas, such as from the declining population in Area 5. However there are no data to verify such speculations.

In Area I, unlike other areas of Alaska, sea lions have been increasing since early this century. Population density increased from 4,500 animals in 1956 to 17,500 in 1991 at an average rate of about 4% per year (Fig. 5.5). Assuming that sea lions in Area 1 form a closed population, the model suggests the intrinsic growth rate must be higher than 4% if extraneous mortality occurred. However, since 1985 the population appears to be growing faster than can be accounted for by intrinsic growth alone (roughly 8% per year), suggesting the possibility that a substantial emigration of sea lions has occurred from either British Columbia or from other regions of Alaska. It is difficult to reconcile the recent rate of population buildup with survival rates if animals are not coming from elsewhere. It is possible that increased pup survival rates coupled with immigration could provide the observed rate of increase. In any case it is important to note that immigration into Area 1 can account for only a small fraction of the unaccounted losses from other areas. Again there are no data to verify such speculation.

In summary, the model suggests the harvesting of 45,000 sea lion pups between 1963 and 1972 reduced some local populations. Overall, the harvesting of pups may even have held constant the total number of sea lions breeding in the Gulf of Alaska and Aleutian Islands through the 1960s and 70s. But pup harvests cannot account for population declines observed through the 1980s. Nor can the overall population decline be explained by animals leaving the Gulf although the model does suggest that some local changes in abundance could be attributed to animals moving from one area to another within the Gulf and Aleutians. The model further suggests that the low rate at which sea lions disappeared from the region gradually increased through the 1960s and 1970s. Since 1979 the numbers of sea lions unaccounted for rose dramatically from 3% to 14% of the population each year.

6. SHOOTING DEATHS AND INCIDENTAL CATCHES

The disappearance of sea lions depicted by the simulation model might be explained by shooting and catching sea lions during commercial fishing. Many have suggested this source of mortality contributed to the overall decline of Steller sea lions in Alaska (Braham et *al.* 1980, Loughlin *et al.* 1984, Merrick et al. 1987, Calkins 1989, Perez and Loughlin 1991).

Sea lions are sometimes incidentally caught in net fisheries and in hook and line fisheries. They may also be shot by fishermen when near fishing gear or while hauled out on land. Unfortunately the numbers of sea lion deaths that might be attributable to commercial fishing can only be loosely approximated because the extent of incidental mortalities has never been well documented.

Calkins (1989) developed a risk factor analysis to assess which of the commercial domestic fisheries might cause the highest mortality of sea lions. He considered the type of fishery, the temporal proximity of the fishery to sea lions, and the amount of fishing effort (number of fishing permits issued). He concluded, for finfisheries (herring, salmon and groundfish) managed by the state of Alaska, that sea lions were more likely to be entangled or shot in the Prince William Sound drift gillnet fishery than in any other fishery. The next highest risk fisheries were the groundfish and set net fisheries around Kodiak Island followed by the troll fishery in southeast Alaska. Calkins (1989) felt that beach and purse seine fishing caused little mortality, largely because the gear tended to be set and retrieved in a short time. Interactions with longline and jig fisheries appears also to be low, although there are occasional reports of sea lions taking fish from longlines.

Drift gillnets and set gillnets tend to target fish with high economic value. Gillnetters set long stretches of nets for extended periods, during which time they may watch their net and protect their catch from harbour seal and sea lion predation. In 1978, Matkins and Fay (1980) estimated that 450 gillnetters fishing the Copper River delta (south east of Prince William Sound) shot or caught about 300 sea lions. Conflicts with sea lions occurred primarily in May and early June. Ten years later, Wynne (1990) reported that sea lion conflicts continued to occur predominately in the spring, but that the numbers dying had dropped significantly. Unfortunately the data were insufficient to estimate the actual number of sea lions killed in 1988, either intentionally or incidentally. It appears though that the average rate of kill could have been as high as 1 sea lion per gillnetter in the 1970s and may have dropped to under 1 sea lion per 4 vessels in the late 1980s.

In the foreign and joint venture trawl fisheries that targeted groundfish, sea lions accounted for about 90% of the marine mammals incidentally caught in the Gulf of Alaska and Bering Sea between 1973 and 1988 (Loughlin *et al*. 1983, Loughlin and Nelson 1986, Perez and Loughlin 1991). Most sea lion mortalities were recorded around Kodiak Island and the Aleutian Islands at a rate of over 25 sea lions per 10,000 mt of groundfish landed (Perez and Loughlin 1991). In the 1970s and early 1980s, this amounted to between 500 and 2,000 sea lions per year (Table 6.1); but after 1986, the numbers caught dropped to under 100 per year (Perez and Loughlin 1991). Joint venture trawlers caught more sea lions (66% of the total) than did the foreign trawlers; yet the joint venture boats only caught 24% of the total amount of groundfish landed between 1973 and 1988 (Perez and Loughlin 1991).

The estimated numbers of sea lions caught by foreign trawlers prior to 1978 (Table 6.1) may be low. For example, Perez and Loughlin (1991) cite NMFS correspondence suggesting that as many as 4,400 northern sea lions may have died in the Japanese trawl fishery in 1971. Similarly, the mortality estimates fail to account for the large numbers of sea lions that were intentionally shot. For example, joint-venture trawlers often towed their catch alongside their boats until it could be delivered to a processor ship. Sea lions climbing onto the full nets to grab at the fish were easy targets. Anecdotal accounts suggest some boats were able to shoot as many as 200 sea lions in a single morning. Most of these shootings probably occurred aboard joint-venture boats between 1981 and 1986. Foreign boats tended not to carry guns or else enforced strict gun control. Thus the numbers of sea lions killed in the trawl fishery (Table 6.1) should be considered minimum estimates.

Information about incidental catches in the domestic groundfish fishery is scant because only a small proportion of the trawl fleet (3%) was observed through voluntary participation. The results, while limited, suggest that very few sea lions were caught by domestic trawlers (Craig and Owen 1988). In fact only 3 sea lions were reported caught between 1978 and 1989, all of which were caught in a single set in 1980 (Craig and Owen 1988, Owen 1990). The low catch rates of the domestic fleet are surprising given that most of the domestic vessels participated in the joint venture fishery, or else employed the same gear in the same areas as the joint venture boats. Owen (1990) suggests few sea lions were caught in the early 1980s, because the domestic fleet largely targeted Pacific cod during daylight hours when fewer sea lions were feeding. The apparent lack of kills through the late 1980s, when the domestic fishery grew rapidly, may also reflect a change in attitude towards the killing of sea lions, or a change in fishing methods and locations, or both.

Interactions between troll fishermen and sea lions have not been documented, although anecdotal information *from* discussions with fishermen suggest moderate to high interactions (Calkins 1989). This is further supported by observations of sea lions on rookeries and haulouts entangled in troll gear (Calkins 1989). Given the high value of troll caught fish, it is conceivable that trollers shoot at sea lions near their gear. However data is not available to estimate the extent of such mortality.

Shellfish fisheries also had an impact on sea lions. During the 1960s, some hunters shot and butchered sea lions to sell the meat as bait to shrimp trap and crab pot fishermen. Some crab fishermen also shot sea lions because they chewed and sank the buoys that marked their pots. Today however, buoy designs have changed and the meat, while never a major source of bait, is no longer used.

Sea lions have been harvested for centuries by natives in many Alaskan communities for their meat, hide and other body parts (Haynes and Mishler 1991), but there are few records of the numbers of sea lions killed. Subsistence harvests during the 1980s probably took between 200 and 400) sea lions among 25 communities in which kills were documented; but there are between 25 and 30 additional communities where at least some harvest likely occurred (Haynes and Mishler 1991). Considering a substantial number of animals probably sank after dying, the total number of sea lions shot by natives in the Aleutians and Gulf of Alaska before 1980 may have exceeded 500 animals. However data from villages in the Kodiak area suggest the subsistence harvest declined substantially through the 1980s (Haynes and Mishler 1991). This drop in numbers harvested might reflect the decline in relative abundance of the sea lions in Alaska, or perhaps a dietary shift away from sea mammals, or both (Haynes and Mishler 1991).

Another type of killing is “drive-by” shootings, that is shooting from boats as they passed close to sea lion haulouts and rookeries. While it is common knowledge that these events occurred, there is no information on how many or how few people took part, nor how much damage they inflicted. Some fishermen felt they were doing a service by killing sea lions. For others it was simply a sport. In all likelihood shooting sea lions on land disrupted the rookery and may have caused pups to be trampled as startled sea lions rushed to the sea. However it is unlikely that large numbers of adults were killed because of the difficulty of shooting accurately from small boats.

Amendments to the Marine Mammal Protection Act in 1988 made it illegal for fishermen to shoot at or near any Steller sea lion for any reason in U.S. waters (Lowry and Loughlin 1990). Vessels were prohibited from coming within 3 miles of Steller sea lion rookeries west of 150°, and the Secretary of Commerce was empowered to place observers on any fishing vessel to monitor accidental capture of sea lions in fishing gear. Violations of laws protecting sea lions are subject to severe penalties including boat seizure, fines up to $25,000, and imprisonment.

Numbers of sea lions killed by various fishery and subsistence activities are estimated in Table 6.2. For the most part the estimates are little better than best guesses. Nevertheless they do give some sense of the magnitude of killings that might have occurred over the past three decades. The numbers killed probably rose from a level of 1,500 animals per year in the late 1950s to a peak of around 4,000 animals in the early 1980s (Fig. 6.1). Mortality likely decreased through the late 1980s as the sea lion population declined and public attitudes towards sea lions changed. Discussions with fishermen suggest that many of them became aware of the seriousness of the sea lion population decline in the late 1980s, and modified their behaviour because of the political and economic ramifications of shooting sea lions. The current number of sea lions taken by fisheries and subsistence harvests is probably less than 500 animals per year.

7. DISCUSSION

7.1 Effects of the Fisheries on Sea Lions

Some people have inferred from counts of sea lions made in the 1950s and 1980s that sea lion numbers have been declining since 1956. In actual fact the counts only reflect how much smaller the current population is compared to previous levels, and do not by themselves show when the declines began. Our assessment of rookery trends and attempt to estimate total population sizes confirm the findings of Braham et *al.* (1980) that sea lions first began declining in the eastern Aleutians (Area 5). Declines in Areas 3, 4 and 6 did not being until 1979-81. Overall the total sea lion population in the Gulf of Alaska and Aleutian Islands appears to have been large and relatively stable throughout the 1950s, 60s and 70s. Since 1980, sea lions have rapidly declined except in southeastern Alaska.

Simulation modelling is a useful tool for understanding the kinds of processes that might have occurred in the sea lion population over the past 30 years. In our case it helps to understand the consequences of harvesting pups and the level of kills the commercial fishing industry would have had to inflict upon sea lions to explain the population decline. It should be kept in mind, however, that different models, incorporating many different assumptions than the ones we explored, could effectively replicate the observed population decline. Our model is by no means unique. Nevertheless, the essence of any model that might be put forward to explain the decline of Steller sea lions must involve a tradeoff between birth and immigration, and mortality and emigration- As such, our simple model, while unable ‘to reveal the exact mechanisms of population change, gives useful insight into the sorts of processes and the range of changes that would have had to occur between 1956 and 1991 to produce the changes observed in population size.

Our model indicates the harvesting of 45,000 sea lion pups between 1963 and 1972 was substantial and contributed to stabilizing the numbers of sea lions breeding in the Gulf of Alaska and Aleutian islands through the 1960s and 70s. Incidental and intentional kills also appear to be a significant part of the story. Estimated levels of fishery kills (Fig. 6.1) are consistent with the numbers of sea lions unaccounted for through the 1960s and 1970s (Fig. 5.2b). Thus the data suggest that population growth of sea lions in the Gulf of Alaska and Aleutians was increasingly impeded from 1956 to 1980 by direct kills of sea lions by commercial and subsistence harvesting, and by intentional and incidental kills by fisheries. But fishery kills at the level we have considered can only explain a small part of the sea lion decline since 1980. Should incidental and intentional kills have been higher, there would be less unexplained mortality to account for.

Since 1980, the model suggests over 10,000 sea lions have disappeared from the population each year. Such a level is far higher than even the most exaggerated estimates of fishery kills might account for. In our opinion, something other than fishery kills occurred through the 1980s.

York (1990b) used a mathematical model to gain insight into changes that occurred on Marmot Island (Area 3) from 1975 to 1986. Her goal was to alter model input parameters (juvenile survival, adult survival, and fecundity) by fixed amounts to see what changes would be consistent with observed decreases in population abundance and changes in age structure at Marmot Island. Samples of sea lions collected during 1975-78 (Calkins and Pitcher 1982) and during 1985-86 (Calkins and Goodwin 1988) suggest that pregnancy rates among mature females did not change over time (Calkins and Goodwin 1988), but that the average age of females older than 3 years increased by 1.55 years (York 1990b). During this same period, the population declined 5% per year (Merrick et *al.* 1987). York (1990b) found the simplest explanation that accounted for the observed changes was a 20% decrease in juvenile survival (ages 0-3 years) between 1975 and 1985, with no change in adult survival or fecundity.

There is a good deal of evidence that juvenile survival may be the critical factor that affects the overall growth and decrease of pinniped and other large mammal populations (Caughley 1970; Hanks and McIntosh 1973; Richens 1967; Eberhardt 1977, 1981; Eberhardt and Siniff 1977; Trites and Larkin 1989; Trites 1990). Unfortunately there are no data to calculate the survival rate of juvenile sea lions. But theory and modelling (York 1990b) tend to implicate poor survival of young in the post 1980 decline.

Stability of sex ratios on rookeries and haulouts since 1976 suggest both sexes are equally affected by the decline (Merrick *et al.* 1988). The most likely sources of mortality in the 1980s could be disease or shortages of prey. Sea lions are known to carry certain diseases that might influence mortality, but pathological conditions have not been well documented (Hoover 1988). Information about diet and the availability of prey is also incomplete. However, measurements taken in 1985-86 suggest sea lions were smaller and had lower blood haemoglobin values than seals measured in 1975-78 (Calkins and Goodwin 1988) implying that sea lions may have been nutritionally stressed.

The gross statistics of catch in the Gulf of Alaska (Fig. 4.18) would seem to present a circumstantial case for effects on food resources for sea lions: increases in the total catch have coincided with a decline in sea lion abundance. But as several authors have pointed out, life is never so simple. Over the same period of time there is evidence for major changes in the relative and total abundance of some species of fish in the Gulf of Alaska and the Bering *Sea* (Alverson 1991). For example, biomass of salmon and pollock increased significantly in the Gulf of Alaska during the 1970s and early 1980s (Low 1991). Such prey species appear to have been more abundant in the early 1980s than they were during the 1960s when Steller sea lions were more numerous (Alverson 1991). Pollock biomass has since decreased in the Gulf of Alaska (Low 1991) and appears to be approaching the low 1960s levels. However, without knowing the abundance of Steller sea lion prey in areas where the sea lions forage, it is difficult to know what kind of significance to attach to the reported changes in biomass.

Some of the changes in prey abundance may reflect long term periodic oceanographic changes and perhaps long term climatic change. For example, Brodeur and Ware (1992) report that zooplankton biomass in the Gulf of Alaska increased by a factor of l.7 during the period 1957 to 1980. With the possible exception of salmon, stock and recruitment relationships are weak, non-existent or unknown for most species. Interactions among species are complex and the ecosystem dynamics are fast paced (Springer 1992).

This present lack of understanding has not come about from lack of effort The long term studies of the National Marine Fisheries Service Laboratory in Seattle have abundantly demonstrated the very large amount of knowledge that is necessary to build a descriptive model of the Bering Sea ecosystem. A predictive model requires even greater understanding. Similar enterprises related to European and North Atlantic waters have explored a variety of approaches, none of which has proven particularly relevant to management needs. Current proposals to explore the meaning of the catch phrase "ecosystem management" are indicative of the state of the art. With these sorts of considerations it is not yet profitable to speculate with a multispecies, multiple gear simulation of the region by time and by subregion, or with a multispecies model incorporating ecosystem dynamics.

Some modelling exercises might be appropriate given certain kinds of data that are currently available. For example, sea lion numbers are more likely to be related to seasonal patterns of abundance of fish that arise from migratory movements and the seasonal pattern of fishing activities than to the gross statistics of catch. If the actual numbers of vessels in each area at each season is not known, some guesses might be made about which fisheries on which species in which areas would be most or least likely to have an impact on sea lion food resources. Fisheries on pollock in Area 3 would seem a likely place to suspect resource depletion. Fisheries on salmon seem unlikely to have had an impact on availability of salmon as food: total salmon production has been at record high levels. Herring stocks are at relatively low levels although it is doubtful whether the fishery is responsible for current stock sizes.

To gain substantive appreciation of the impact of fishing on food resources for sea lions it will be necessary to obtain information at a much more local level on much shorter time scales than is currently available. The sort of information needed includes, for particular rookeries, seasonal patterns in diet and foraging behaviour of sea lions, seasonal depletion of food resources of various types within the foraging range of male, female and juvenile sea lions, and implications of depletions for meeting energetic requirements for maintenance and growth. The lack of information of this kind, which is required to build other than a broad circumstantial case, has been recognized in the Steller Sea Lion Recovery Plan and the studies recommended should be given high priority.

All of the foregoing having been said, it seems likely that the removals of large quantities of groundfish, particularly pollock, have had some impact on local availability of food for sea lions, especially in winter months. The effect of these removals would presumably be more *severe* on juveniles than adults and on females rather than males. Whether effects of this kind are significant factors in sea lion abundance has yet to be demonstrated but is well worth further investigation.

The decline in sea lion numbers is not an isolated case. Declines have also been noted in Alaskan populations of harbour seals and northern fur seals. On Tugidak Island (near Kodiak Island) harbour seals declined by 85% between 1976 and 1988 (Pitcher 1990). Limited data from other regions of Alaska also indicate population declines have occurred since the mid 1970s in the southeastern Bering Sea and Prince William Sound (Pitcher 1990). Northern fur seals, numbering over 1 million in the early 1950s, have declined over two periods of time since the mid 1950s and are currently less than 50% of their former abundance (Lander and Kajimura 1982). The first decline, 1955-70 can be explained by the commercial harvesting of females and a series of years of poor juvenile survival rates (Eberhardt 1981, York and -Hartley 1981, Trites and Larkin 1989). The most recent decline from 1975 to 1984 appears to be due to a high mortality of juveniles and adult females (Trites and Larkin 1989). Failure of the Pribilof population to recover may be related to shortages of prey for juveniles as they migrate south in the fall and winter (Trites 1992). The extent to which the declines of Alaskan sea lions, fur seals and harbour seals are coincidental or related to a common factor is certainly worth further consideration.

To summarize, the stabilization in the numbers of sea lions in the Gulf of Alaska from 1956 to 1980 can be attributed to the direct effect of incidental capture in fishing gear, the shooting of sea lions and the harvesting of adults and pups. However, these factors explain but a small portion of the recent population decline, from 1980 to the present, Some sea Lions are missing in the arithmetic of population dynamics. Whether these losses are caused by the removal of food resources is a circumstantial possibility, but evidence of local abundance of food resources at particular times of the year for particular segments of the population is needed to build a convincing case. Other causes, such as diseases and parasites must also be kept in mind as possible contributing factors.

7.2 Research Needs

In further research, emphasis should be placed on the changes that have occurred since the early 1980s when the major decline in abundance occurred. Changes in body size should be confirmed: detailed body measurements of animals caught in trawls are a potential source of data. Information on the diet of sea lions should be given high priority. The collection of scats from rookery and haulout sites should be undertaken at all seasons of the year. Studies of the bioenergetics of sea lions and their nutritional requirements are also necessary as a basis for interpreting data on changes in body measurements and data on diets.

Research on the fisheries impacts should centre on assessment of local abundance of various food items for sea lions at various times of the year. Data on the population dynamics of pollock in the Gulf of Alaska or the Eastern Bering Sea are probably only broadly correlated with the local availability to sea lions of pollock of a particular size at a particular time of year. The same might be said of other species on which sea lions prey.

Long term research on the ecosystem dynamics of the region will be necessary for proper management of all of the living marine resources, including those that are harvested and those that are not. How best to focus that research is a current topic of debate in many fisheries management circles and will not be resolved quickly.

Meanwhile, it is prudent to maintain the fisheries but to constrain them so as to minimize their possible impact on sea lions. This is the essential thrust of the Steller Sea Lion Recovery Plan and management actions being taken by the National Marine Fisheries Service. Whether the protection measures are appropriate is not easy to judge at this time. They should certainly be subject to research. While it is improbable that the protection measures will be the eventual solution to the issues concerned with the interactions of fisheries and sea lions, there can be little argument with the research agenda of the recovery plan. The important thing is to get on with the research, revising the agenda as the findings unfold.

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Table 2.1. Steller sea lion Life table. Male and female survival rates from York (1990a,b) and Calkins and Pitcher (1982) were modified to ensure zero population growth. Pregnancy rates were taken from Calkins and Pitcher (1982).

Age	Age Specific Survival		Birth	Cumulative Survival	
	Female	Male	Rate	Female	Male
0	0.660	0520	0.000	0.660	0.520
1	0.810	0.650	0.000	0.535	0.338
2	0.900	0.780	0.000	0.481	0.264
3	0.930	0.860	0.202	0.447	0.227
4	0.909	0.870	0.359	0.407	0.197
5	0.895	0.850	0.523	0.364	0.168
6	0.884	0.831	0.630	0.322	0.139
7	0.875	0.814	0.630	0.282	0.113
8	0.867	0.798	0.630	0.244	0.090
9	0.859	0.782	0.630	0.210	0.071
10	0.853	0.768	0.630	0.179	0.054
11	0.847	0.754	0.630	0.152	0.041
12	0.841	0.740	0.630	0.127	0.030
13	0.836	0.727	0.630	0.107	0.022
14	0.831	0.715	0.630	0.089	0.016
15	0.827	0.703	0.630	0.073	0.011
16	0.822	0.690	0.630	0.060	0.008
17	0.818	0.679	0.630	0.049	0.005
18	0.814	0.667	0.630	0.010	0.003
19	0.810	0.656	0.630	0.032	0.002
20	0.807	0.646	0.630	0.026	0.001
21	0.803	0.634	0.630	0.021	0.001
22	0.800	0.624	0.630	0.017	0.001
23	0.797	0.614	0.630	0.013	0.000
24	0.794	0.603	0.630	0.011	0.000
25	0.791	0.593	0.630	0.008	0.000
26	0.788	0.583	0.630	0.007	0.000
27	0.785	0.573	0.630	0.005	0.000
28	0.782	0.563	0.630	0.004	0.000
29	0.780	0.554	0.630	0.003	0.000
30	0.777	0.544	0.630	0.002	0.000

Table 5.1. Steller sea lion pup harvests by area, 1963-72. Note that Round Island is next to Ugamak in Area 5. (source: ITG 1978).

Year	Area 3		Area 4		Area 5			Area Totals		
	Marmot	Sugarloaf	Atkins	Jude	Round	Ugamak	Akutan	3	4	5
1963		4,000						4,000	0	0
1964		1,500						1,500	0	0
1965	1,024	2,005	259	72	574		1,659	3,029	331	2,233
1966	1,650	1,400					857	3,050	0	857
1967	2,657	2,180						4,855	0	0
1968	2,150	1,968					80	4,118	0	80
1969	2,516	2,692						5,208	0	0
1970	2,365	1,008				525	2,159	3,373	0	2,684
1971						1,064	2,250	0	0	3,314
1972	1,800		379	556		2,184	1,627	1,800	935	3,811
Total	14,180	16,753	638	628	574	3,773	8,632	30,933	1,266	12,979

Table 6.1. Estimated number of Steller sea lions killed incidentally in the foreign and joint-venture groundfish trawl fisheries in Alaska during 1966-88 (from Perez and Loughlin 1991).

Year	Aleutians		Gulf of Alaska		Total
	Foreign	J-V	Foreign	J-V	
1966	260	0	320	0	580
1967	470	0	290	0	760
1968	540	0	240	0	780
1969	670	0	140	0	810
1970	990	0	90	0	1,080
1971	1,450	0	150	0	1,600
1972	560	0	290	0	850
1973	1,470	0	270	0	1,740
1974	1,410	0	330	0	1,740
1975	1,190	0	390	0	1,580
1976	1,150	0	410	0	1,560
1977	490	0	260	0	750
1978	335	0	247	0	582
1979	465	0	197	2	664
1980	472	4	240	3	719
1981	422	9	159	50	640
1982	210	16	68	1,462	1,756
1983	198	118	69	306	691
1984	147	157	115	304	723
1985	112	187	8	102	409
1986	31	154	0	80	265
1987	0	46	0	4	50
1988	0	43	0	1	44
TOTAL	13,042	734	4,283	2,314	20,373

Table 6.2. Estimated number of sea lions killed by various fishery and subsistence activities. Subsistence harvests were based on a report by Haynes and Mishler (1989). Incidental catches in trawl fisheries are from Perez and Loughlin (1991) for 1966-88. For years prior to 1966, the sea lion take was estimated from the total amount of groundfish landed (200 mt per sea lion caught the average rate of kill between 1966 and 1980). Intentional shootings of sea lions from trawl vessels were attributed only to the joint venture fishery at a rate of 20 sea lions per boat per year. The number of sea lions killed in salmon fisheries and other fisheries (shrimp, crabs, herring, & halibut) include both incidental and intentional kills, and were based on vessels counts. Salmon vessels were assumed to kill an average of one sea lion every 5 years from 1956 to 1985, while vessels participating in the other fisheries were assumed to kill an average of one sea lion every 10 years. The rate of kill was presumed to drop exponentially after 1985. Kill rates are hypothetical and were based on personal interviews and studies by Matkins and Fay (1980). Calkins (1981), and Wynne (1990). Incidence of sea lion entanglement in fishing debris are believed to be low (Loughlin et al. 1986, Merrick et *al.* 1988) and were assumed to increase from 30 animals to 100 through the 1960s.

Year	Subsistence Harvest	Trawl Fisheries Incidental	Trawl Fisheries Intentional	Salmon Fisheries	Other Fisheries	Marine Debris	Total
1956	500	1	0	1,025	64	30	1,620
1957	500	0	0	1,025	74	35	1,634
1958	500	0	0	1,025	77	40	1,642
1959	500	0	0	1,025	86	45	1,657
1960	500	0	0	1,025	89	50	1,664
1961	500	1	0	1,025	93	55	1,673
1962	500	2	0	1,025	114	60	1,701
1963	500	111	0	1,025	126	65	1,827
1964	500	644	0	1,025	108	70	2,347
1965	500	887	0	1,025	112	75	2,599
1966	500	580	0	1,025	130	80	2,315
1967	500	760	0	1,025	132	85	2,502
1968	500	780	0	1,031	134	90	2,535
1969	500	810	0	1,007	137	95	2,549
1970	500	1,080	0	1,309	144	100	3,134
1971	500	1,600	0	959	167	100	3,326
1972	500	850	0	1,047	210	100	2,707
1973	500	1,740	0	922	217	100	3,479
1974	500	1,740	0	1,382	200	100	3,922
1975	500	1,580	0	1,234	289	100	3,704
1976	500	1,560	0	1,334	338	100	3,833
1977	475	750	0	1,584	332	100	3,241
1978	450	582	20	1,819	436	100	3,407
1979	425	664	80	1,653	450	100	3,373
1980	400	719	130	1,698	441	100	3,488
1981	375	640	160	1,480	553	100	3,308
1982	350	1,756	345	1,321	561	100	4,433
1983	325	691	370	1,440	637	100	3,563
1984	300	723	1120	1,524	586	100	4,353
1985	275	409	1180	1,458	497	100	3,918
1986	250	265	378	868	824	100	2,685
1987	225	50	190	581	493	100	1,639
1988	200	44	51	353	323	100	1,071
1989	175	25	18	145	154	100	617
1990	150	25	0	111	103	100	489
Total	14,875	22,069	4,041	38,560	9,432	2,975	91,953

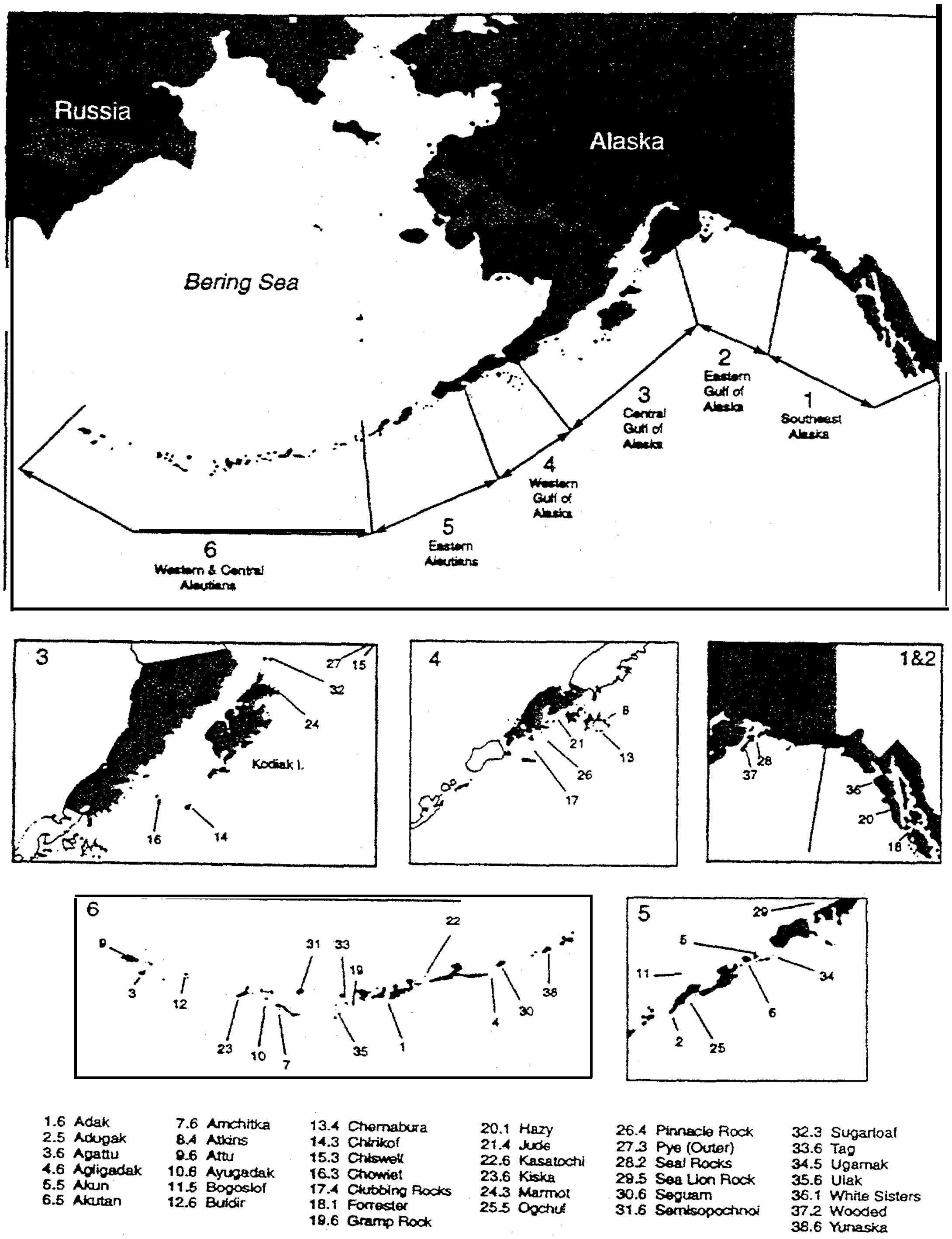


Fig. 1.1. Map of the Gulf of Alaska and Aleutians showing Steller sea lion rookeries in the six study areas. Rookery sites are numbered and designated on the basis of assigments given by Merrick et al. (1988) and Loughlin *et al.* (1992). Number. suffixes identify the areas in which the rookeries are found.

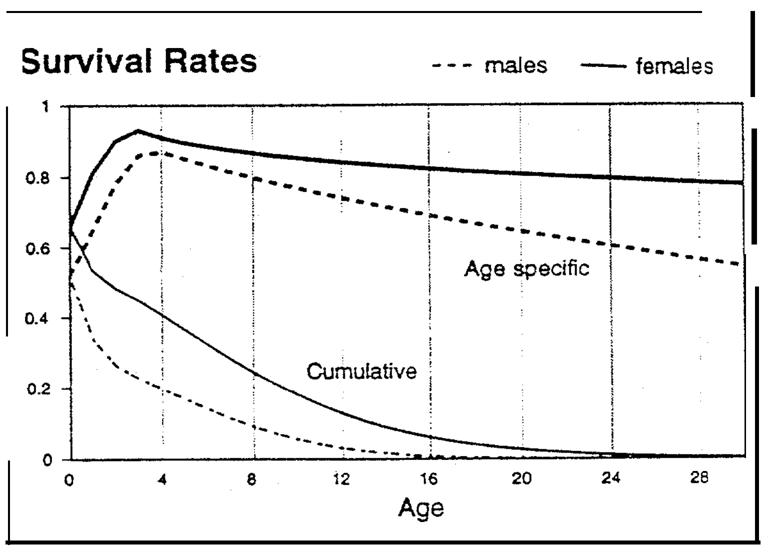


Fig. 2.1. Age specific and cumulative survival rates of male and female Steller sea lions (from Table 2.1).

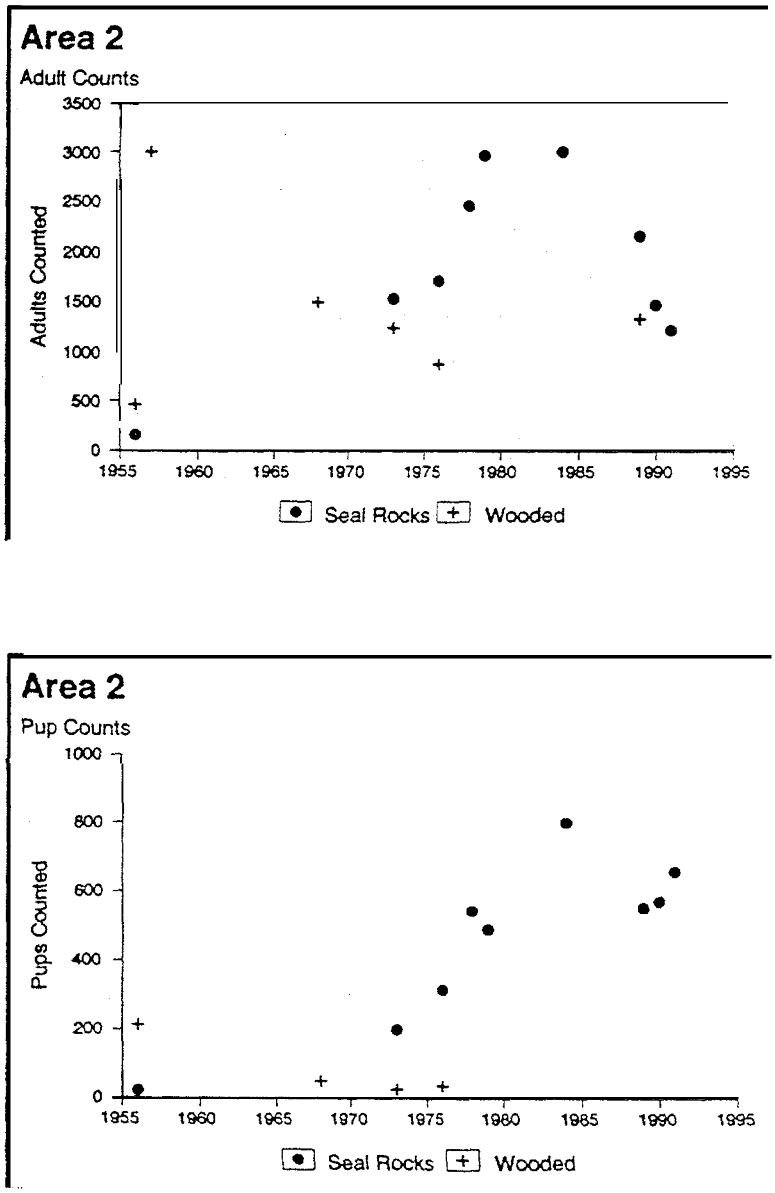
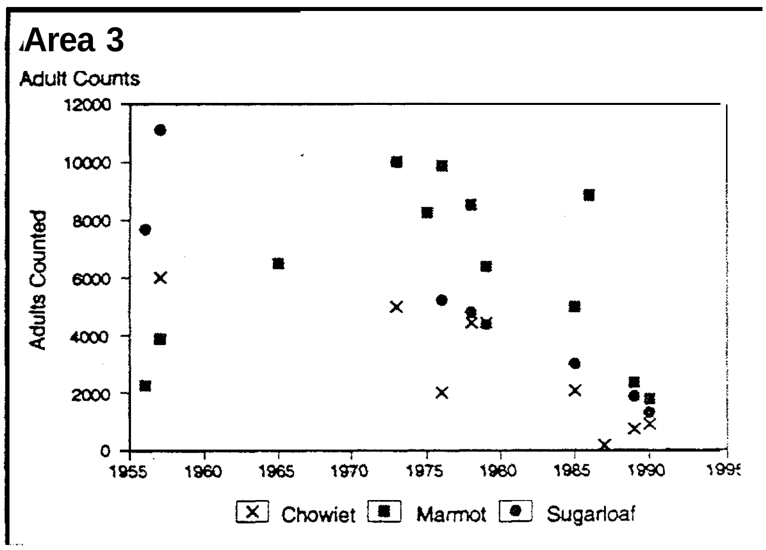


Fig. 3.2, Numbers of Steller sea lion adults and pups counted in Area 2 on two rookeries: Seal Rocks and Wooded Island.



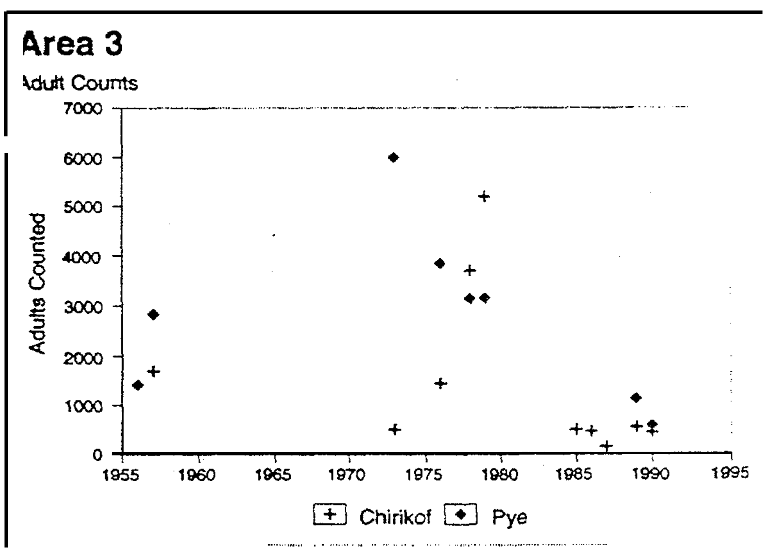


Fig. 3.3. Numbers of Steller sea lions counted in Area 3 on five rookeries: Chowiet, Marmot, Sugarloaf, Chirikof, and Pye.

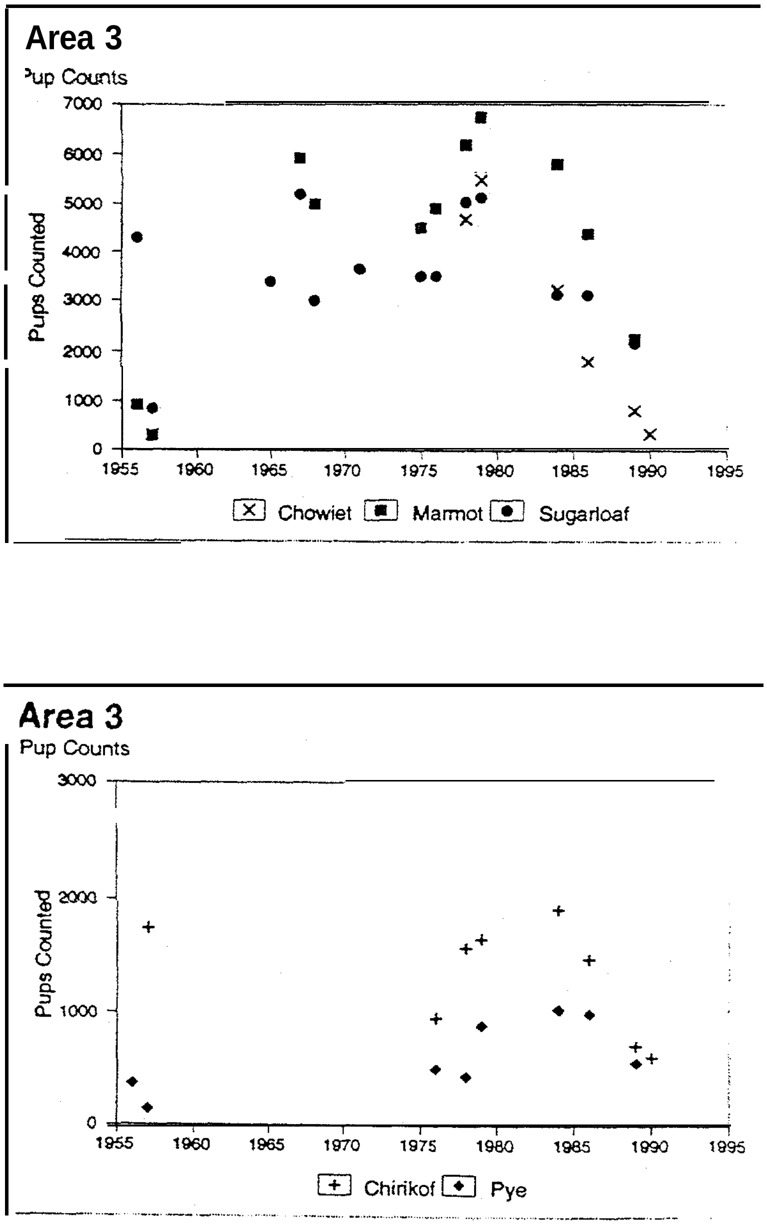
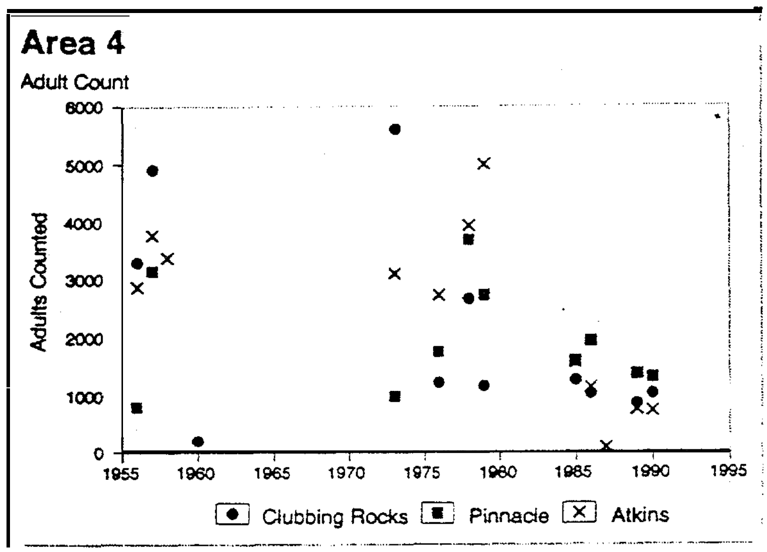


Fig. 3.4. Numbers of Steller sea lion pups counted in Area 3 on five rookeries: Chowiet, Marmot, Sugarloaf, Chirikof, and Pye.



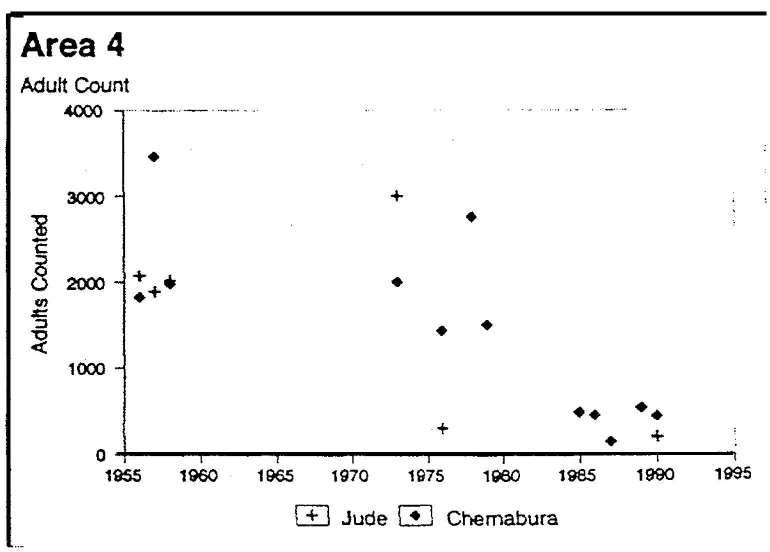


Fig. 3.5. Numbers of Steller sea lions counted in Area 4 on five rookeries: Clubbing Rocks, Pinnacle, Atkins, Jude, and Chemabura.

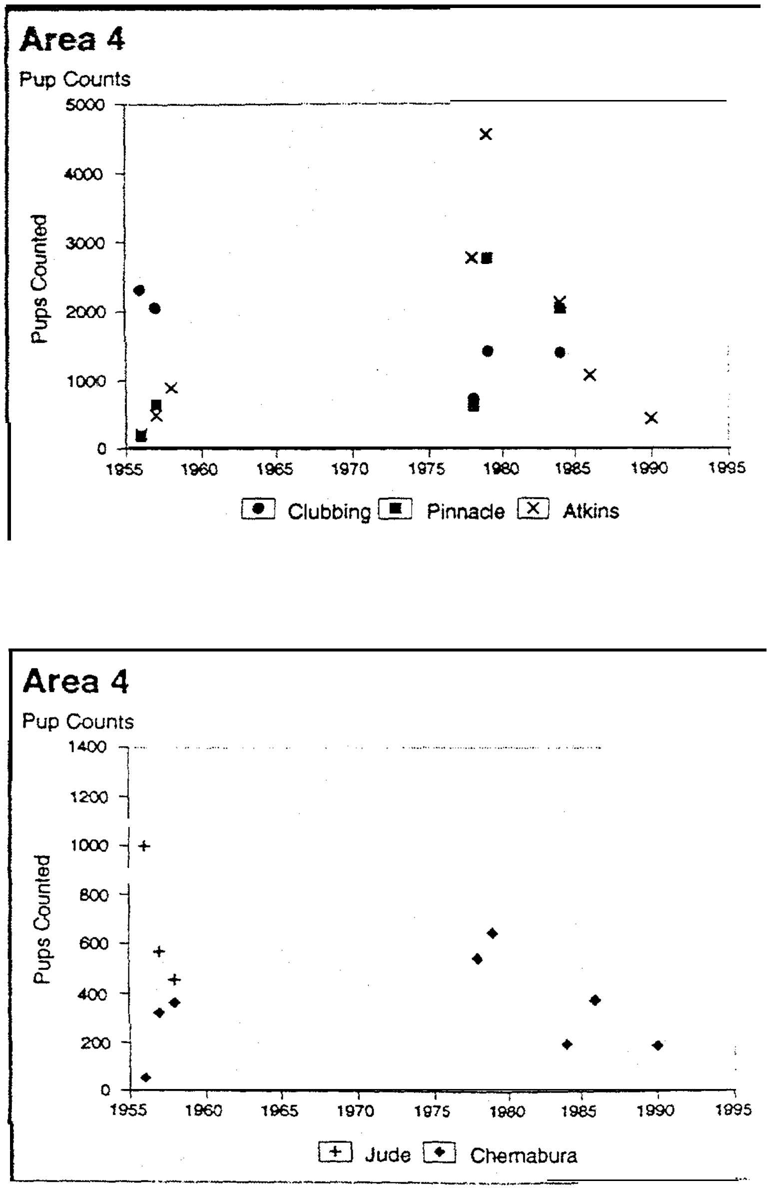
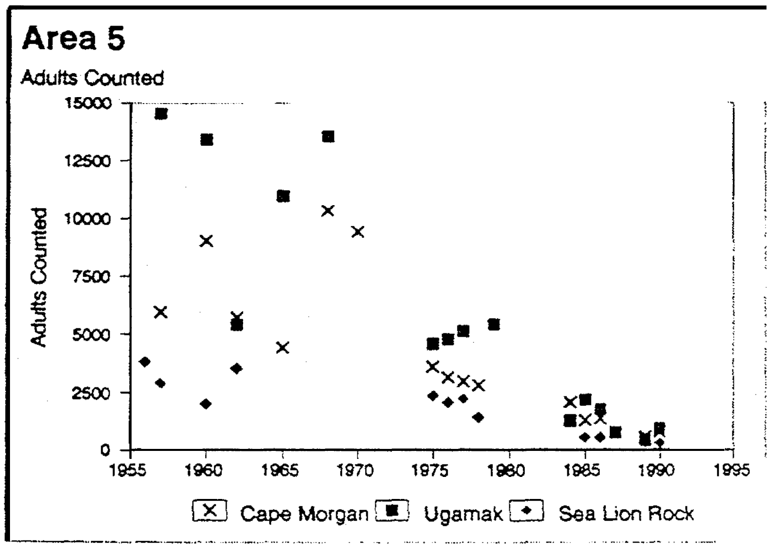


Fig. 3.6. Numbers of Steller sea lion pups counted in Area 4 on five rookeries: Clubbing Rocks, Pinnacle, Atkins, Jude, and Chemabura.



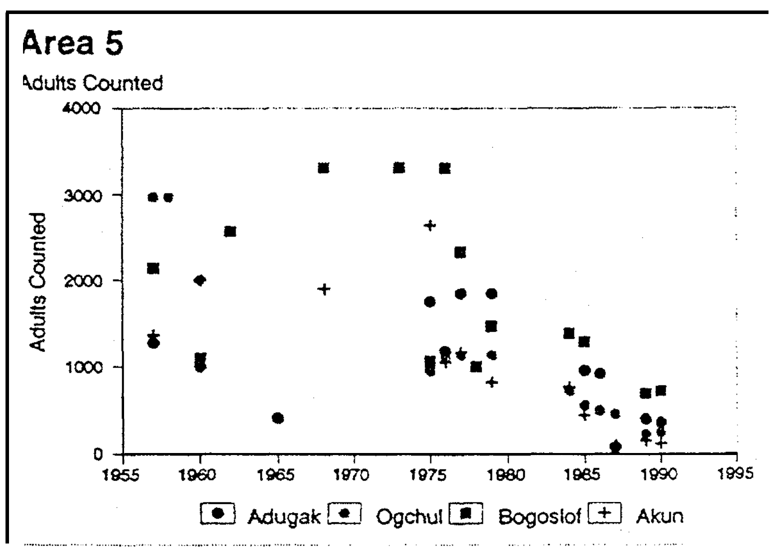


Fig. 3.7. Numbers of Steller sea lions counted in Area 5 on seven rookeries: Cape Morgan, Ugamak, Sea Lion Rock, Adugak, Ogchul, Bogoslof, and Akuh.

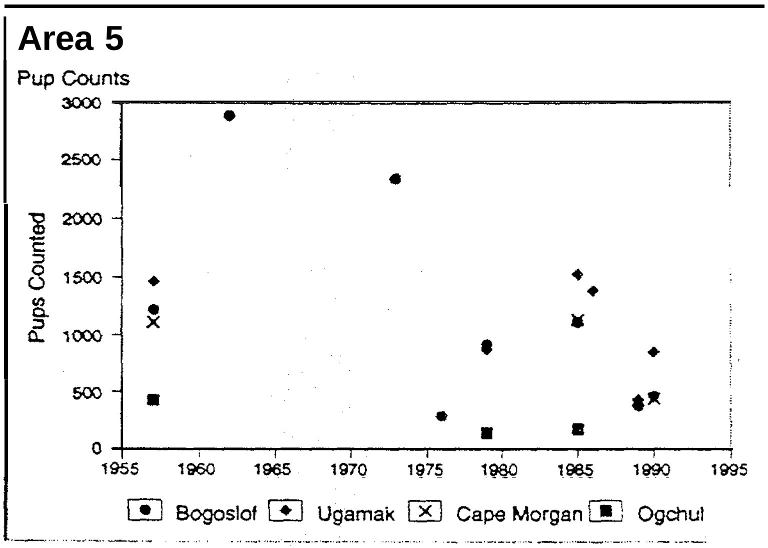


Fig. 3.8. Numbers of Steller sea lion pups counted in Area 5 on four rookeries: Cape Morgan, Ugamak, Ogchul, and Bogoslof.

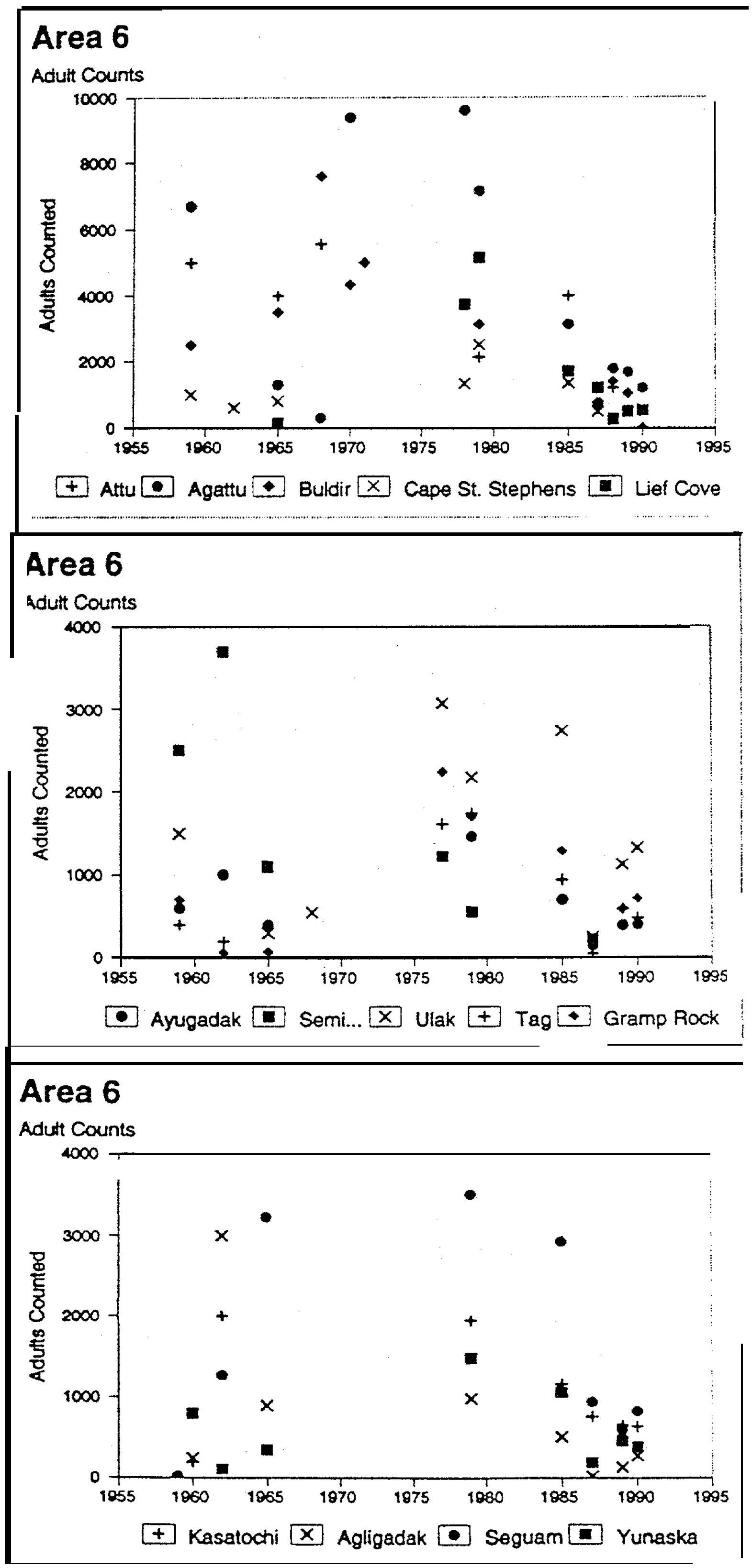


Fig. 3.9. Numbers of Steller sea lions counted in Area 6 on fourteen rookeries: Attu, Agattu, Buldir, Cape St. Stephens, Lief Cove, Ayugadak, Semisopochnoi, Ulak, Tag, Gramp

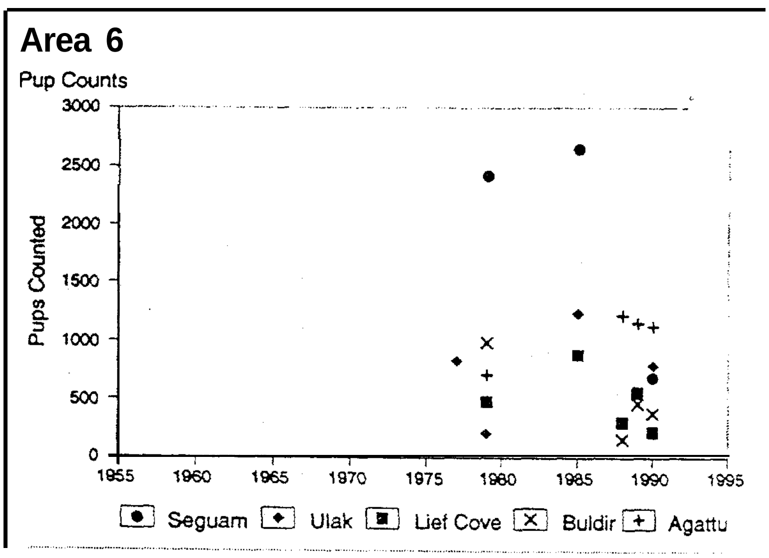


Fig. 3.10. Numbers of Steller sea lion pups counted in Area 6 on five rookeries: Seguam, Ulak, Lief Cove, Buldir, and Agattu.

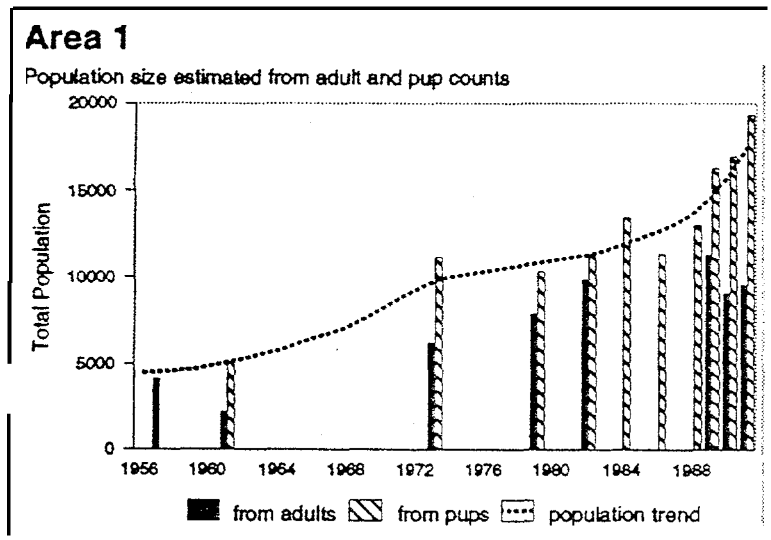


Fig. 3.11. Total number of Steller sea lions in Area 1 estimated from pup counts and adult counts. The population trend is indicated by the dashed line.

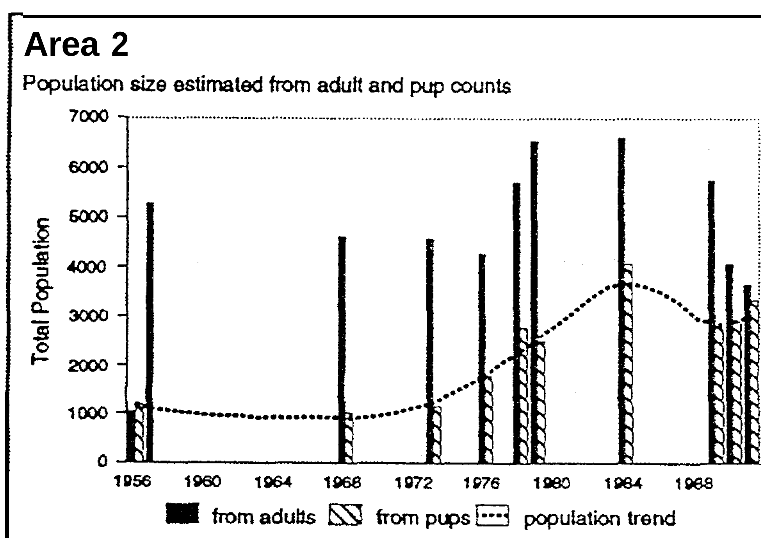


Fig. 3.12. Total number of Steller sea lions in Area 2 estimated from pup counts and adult counts. The population trend is indicated by the dashed line.

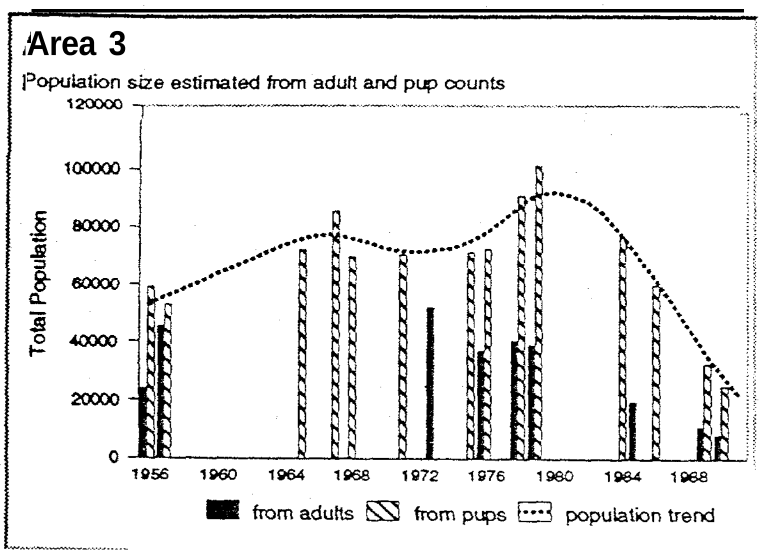


Fig. 3.13. Total number of Steller sea lions in Area 3 estimated from pup counts and adult counts. The population trend is indicated by the dashed line.

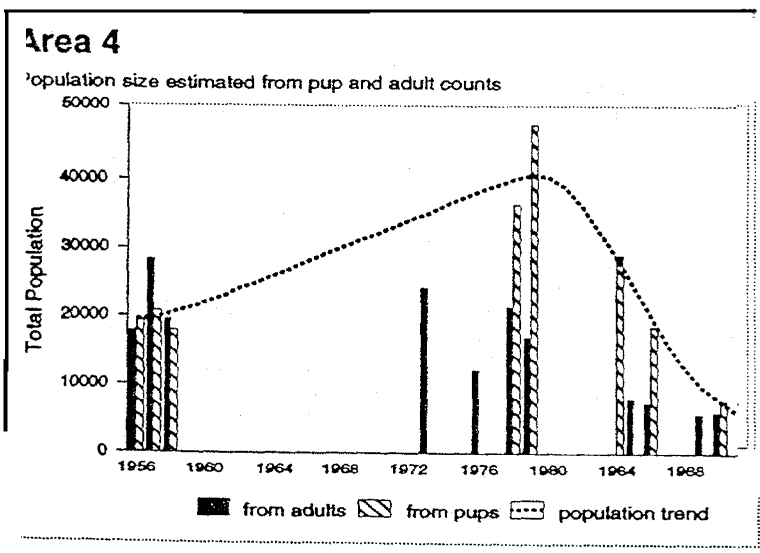


Fig. 3.14. Total number of Steller sea lions in Area 4 estimated from pup counts and adult counts. The population trend is indicated by the dashed line.

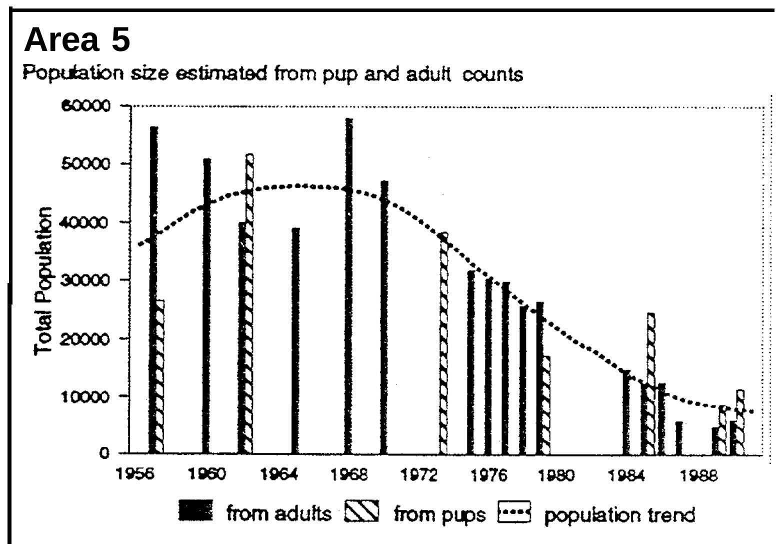


Fig. 3.15. Total number of Steller sea lions in Area 5 estimated from pup counts and adult counts. The population trend is indicated by the dashed line.

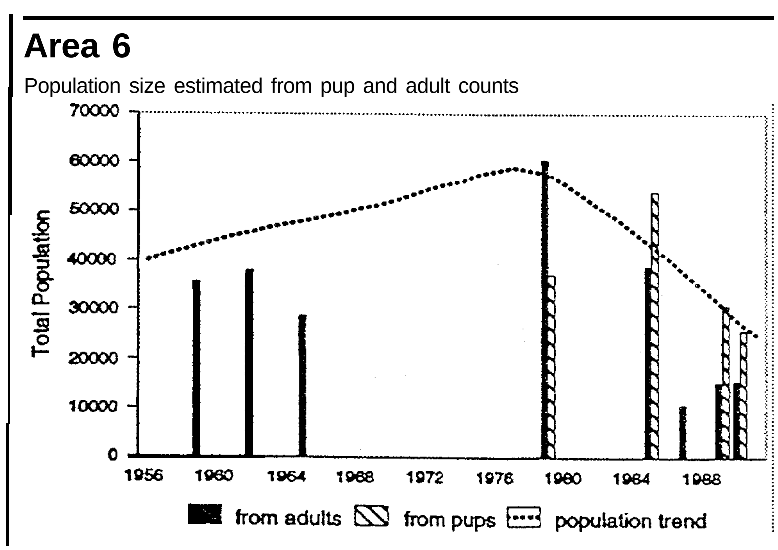


Fig. 3.16. Total number of Steller sea lions in Area 6 estimated from pup counts and adult counts, The population trend is indicated by the dashed line.

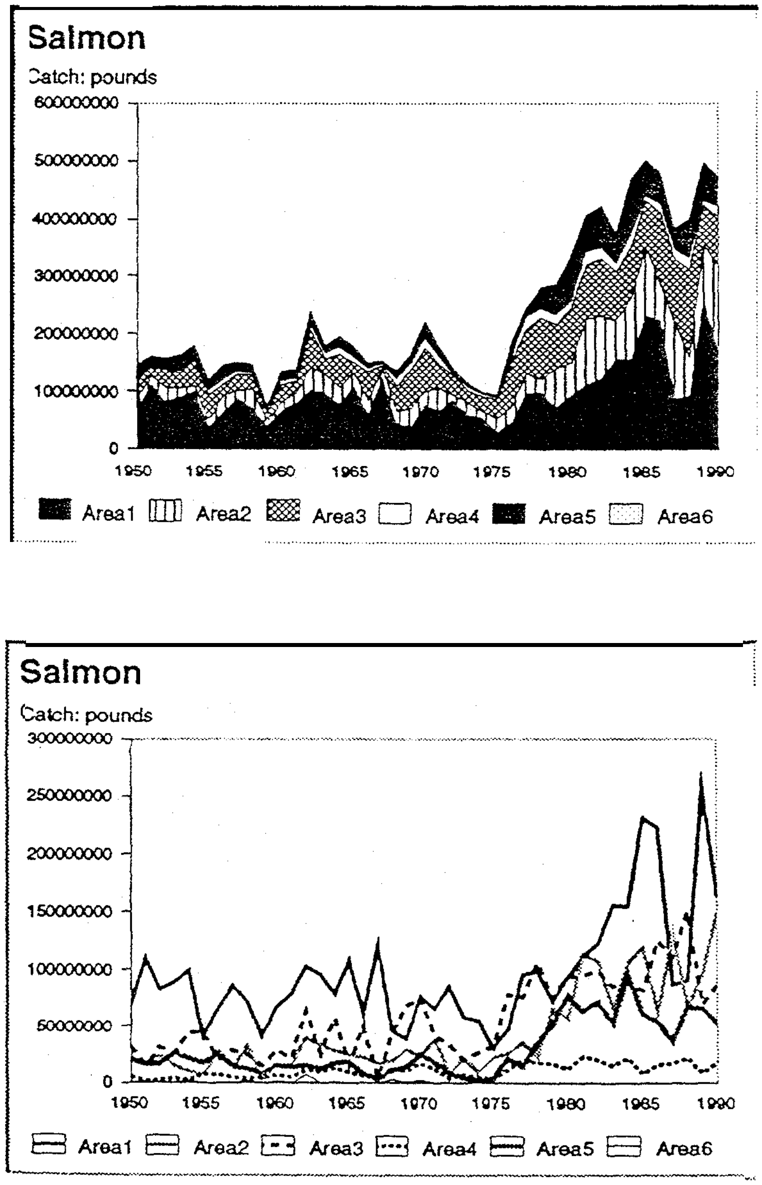


Fig. 4.2. Annual commercial catch of salmon in pounds by area in Alaska from 1950 to 1990.

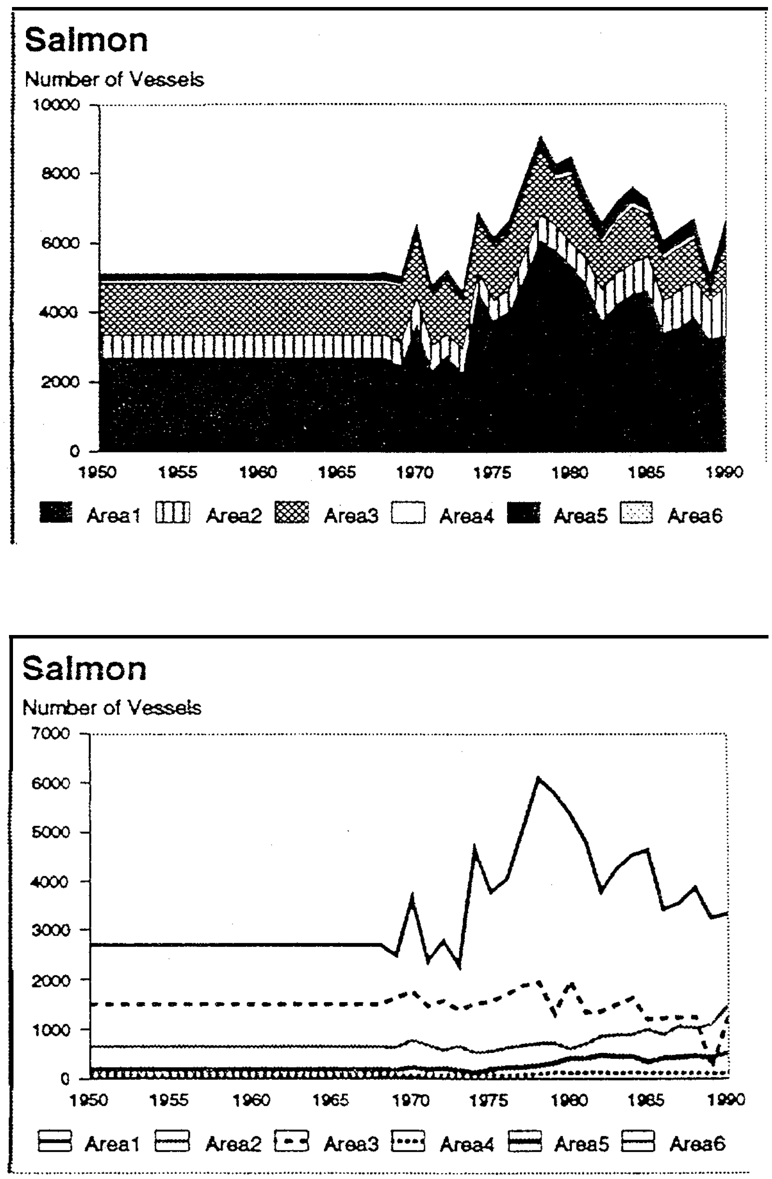
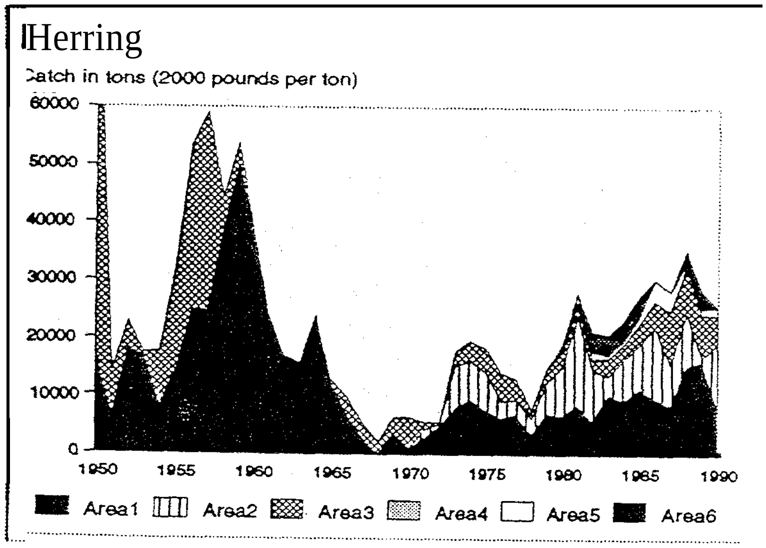


Fig. 4.3. Annual number of vessels engaged in commercial salmon fisheries in Alaska by area from 1969 to 1990.



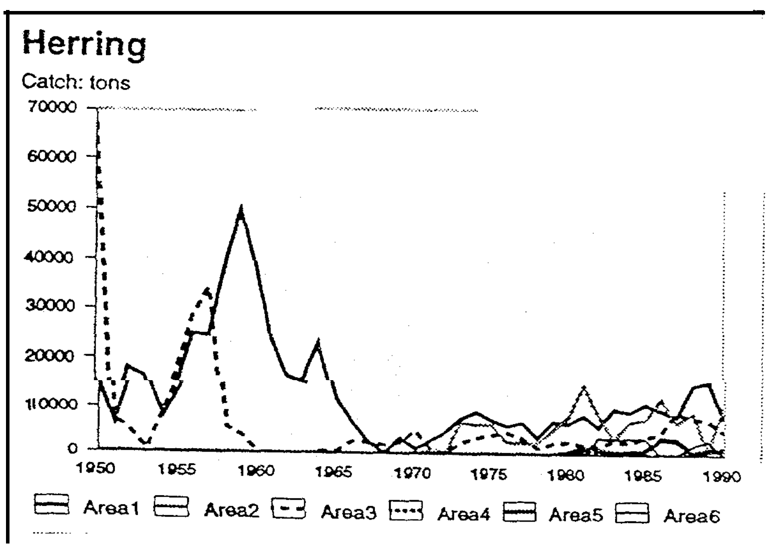


Fig. 4.4. Annual commercial catch of herring in tons by area in Alaska from 1950 to 1990.

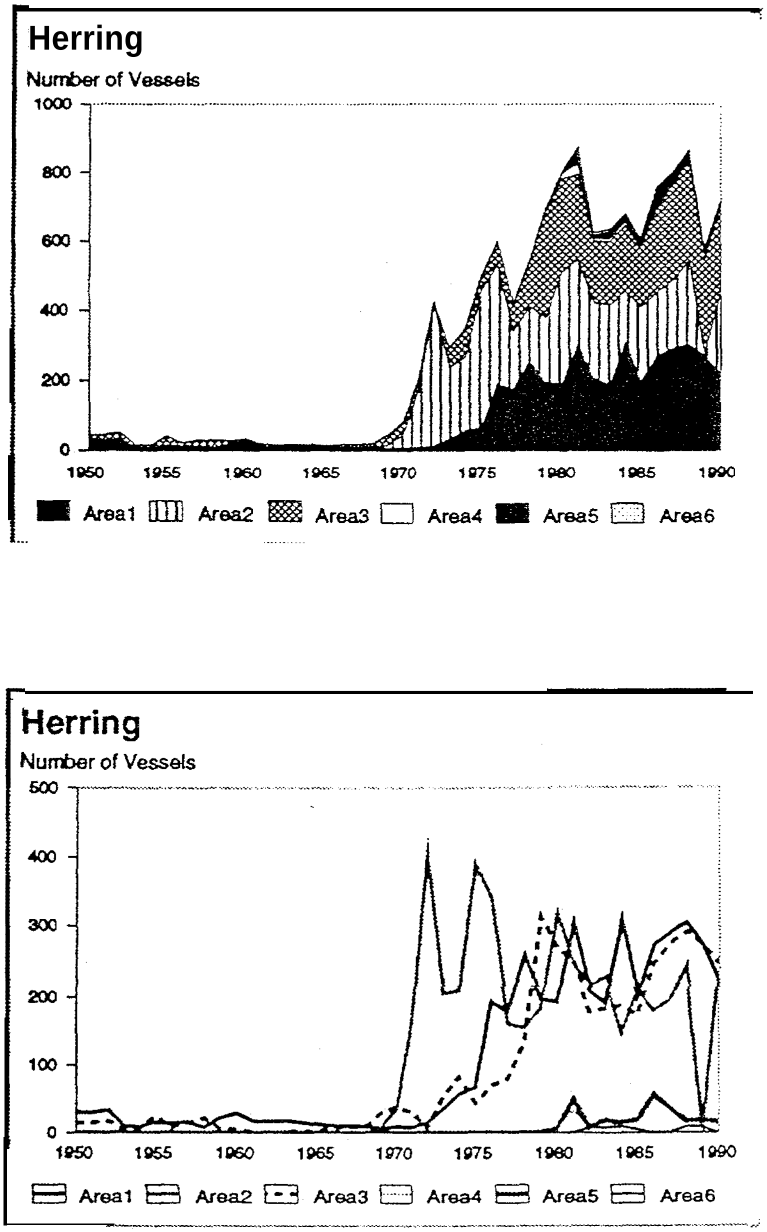
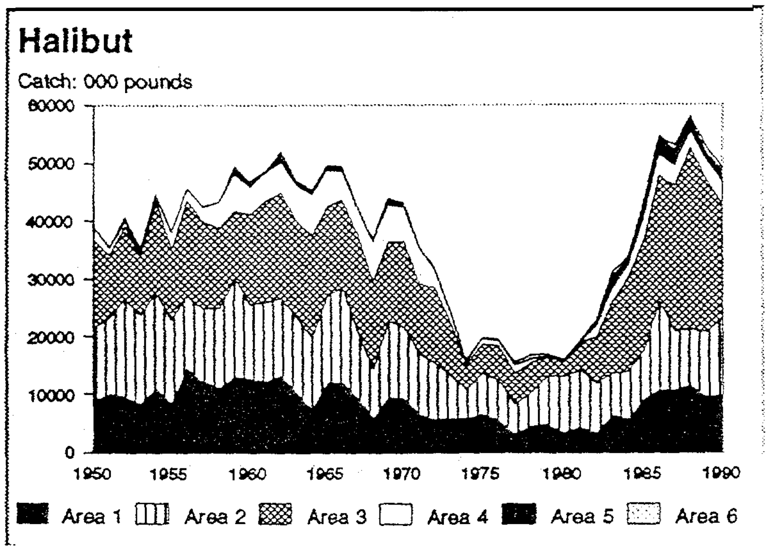


Fig. 4.5. Annual number of vessels engaged in the commercial herring fishery in Alaska by area from 1950 to 1990.



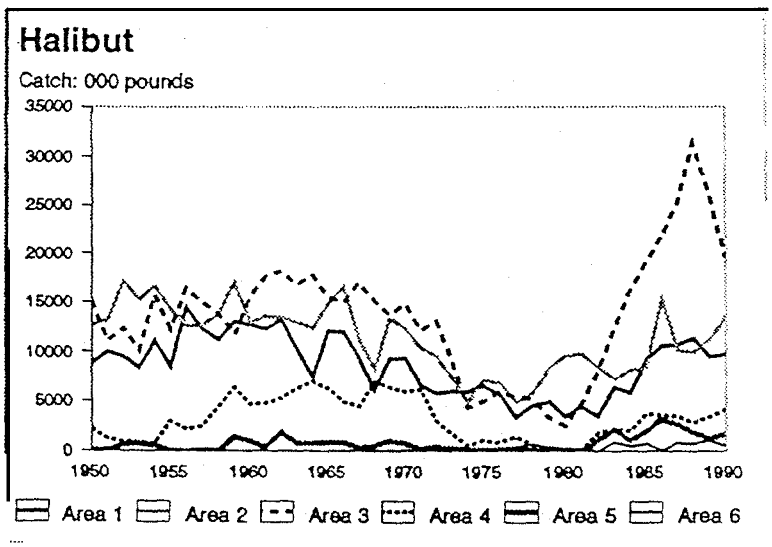
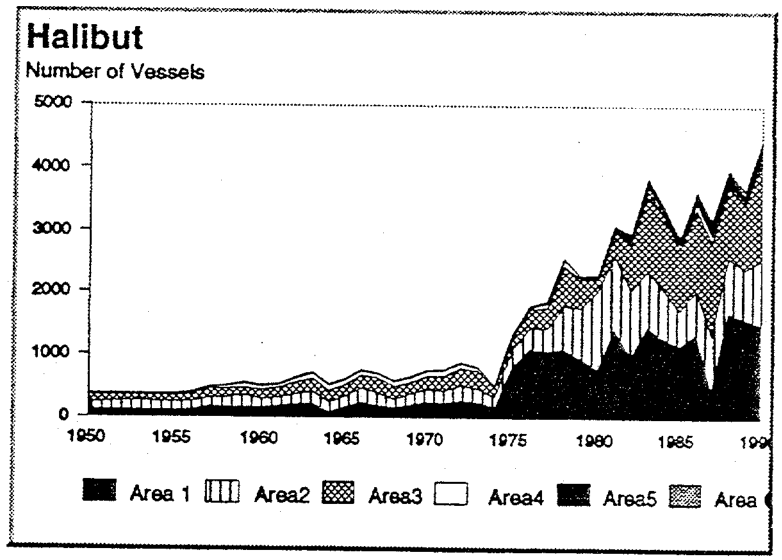


Fig. 4.6. Annual commercial catch of halibut in Alaska in thousands of pounds by area from 1950 to 1990.



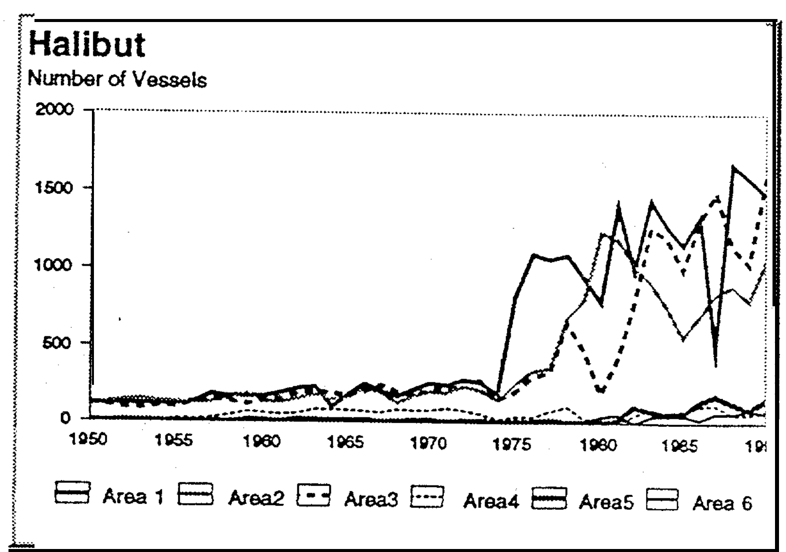
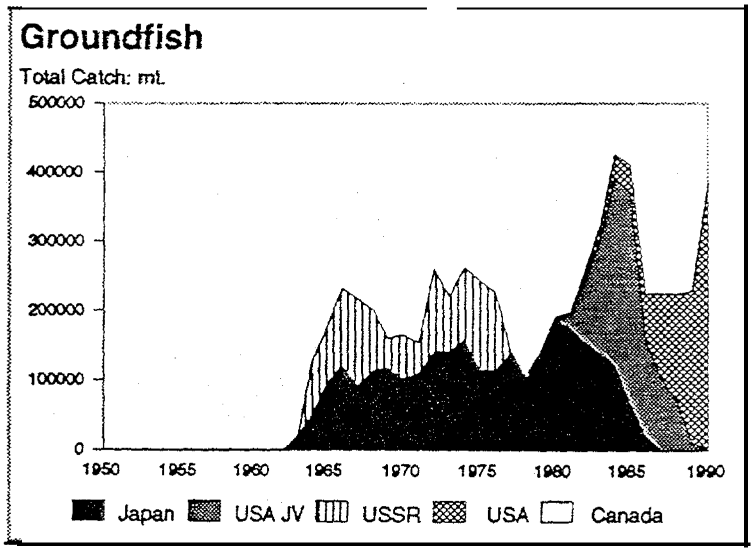
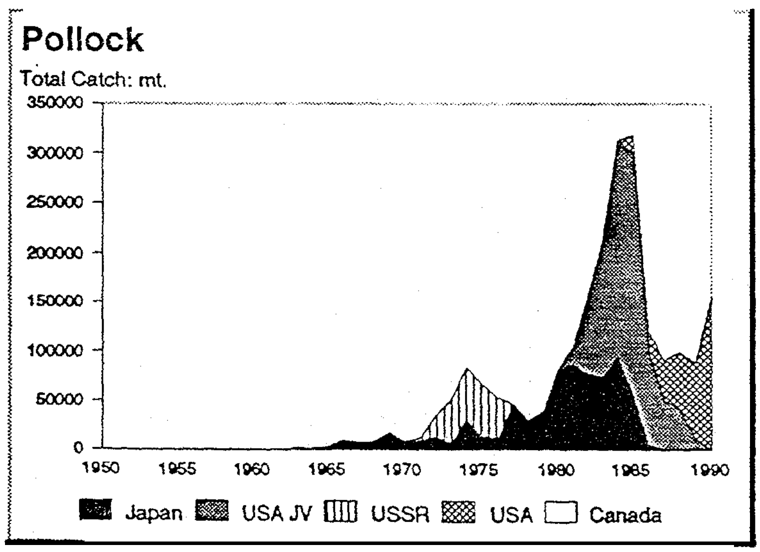


Fig. 4.7. Annual number of vessels engaged in the commercial halibut fishery in Alaska by area from 1950 to 1990.

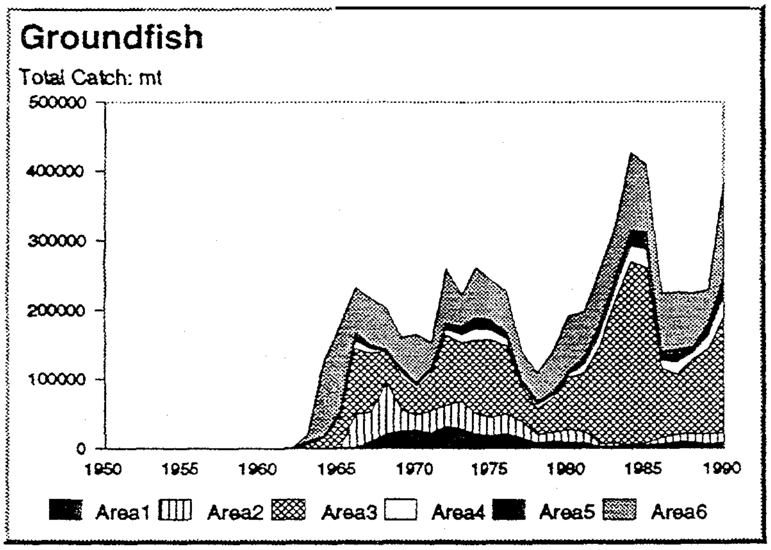


A.



B.

Fig. 4.8. Annual recorded catch of A. pollock and B. groundfish (including pollock) in metric tons by domestic, joint venture and foreign vessels in the Gulf of Alaska from 1962 to 1990.



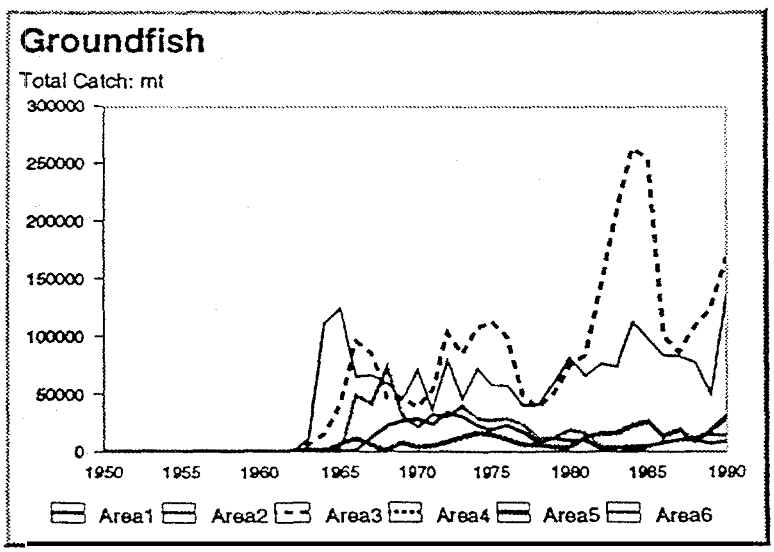
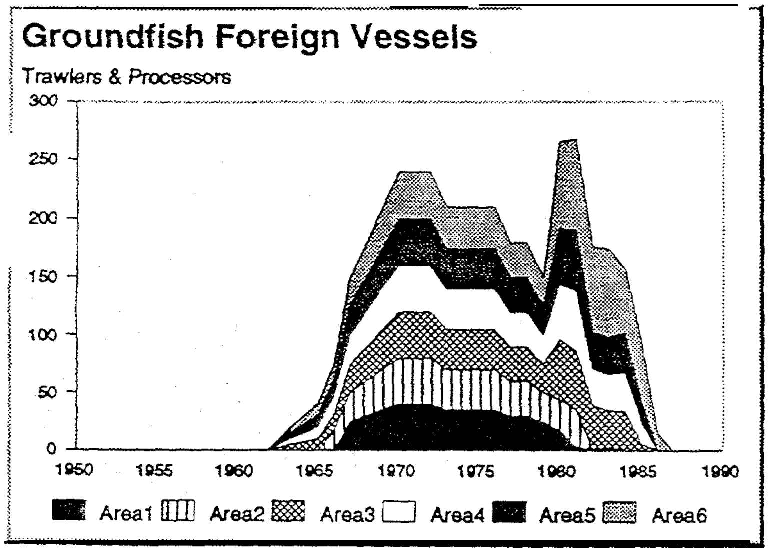


Fig. 4.9. Annual commercial catch of groundfish in metric tons in Alaska by area from 1962 to 1990.

A.



B.

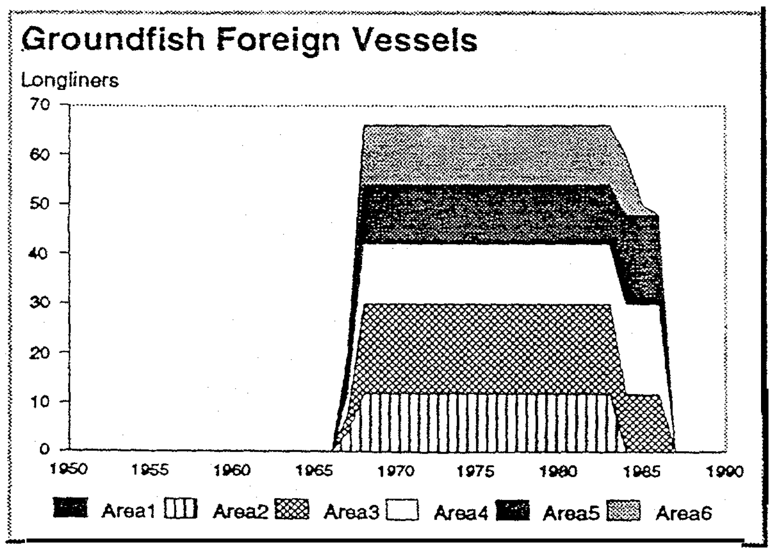
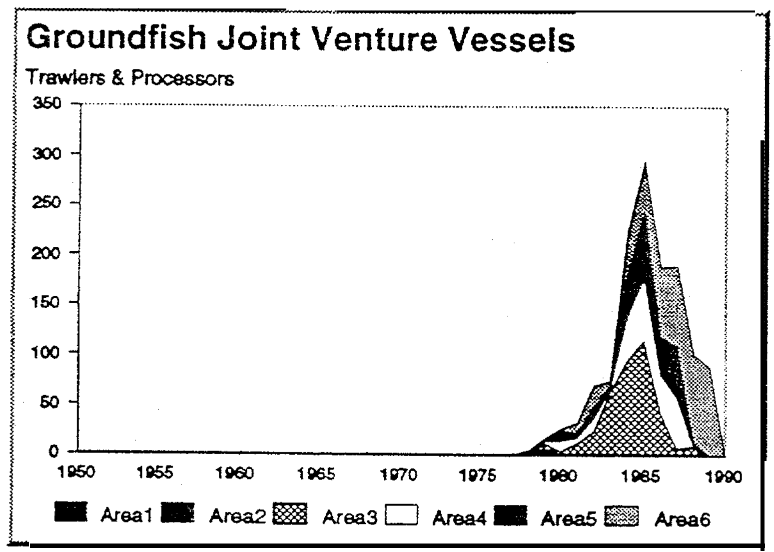
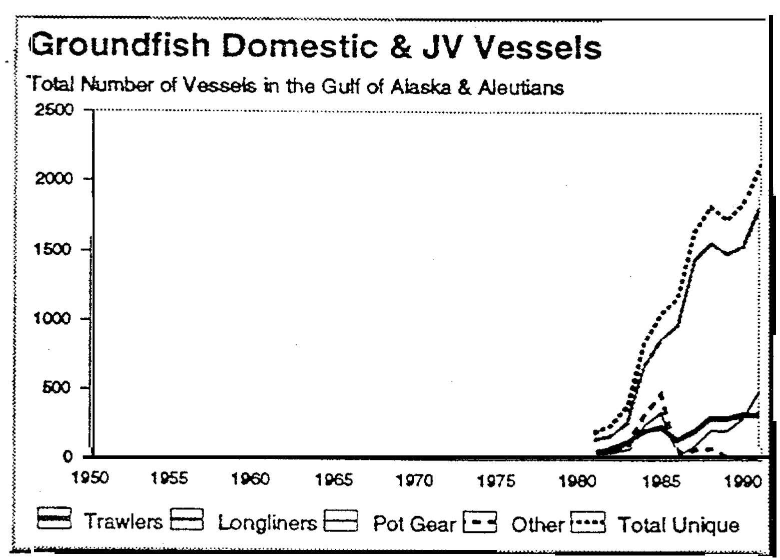


Fig. 4.10. Annual number of foreign vessels engaged in commercial groundfish fisheries in Alaska by area from 1962 to 1986. A. Trawlers and processors. B. Longliners.

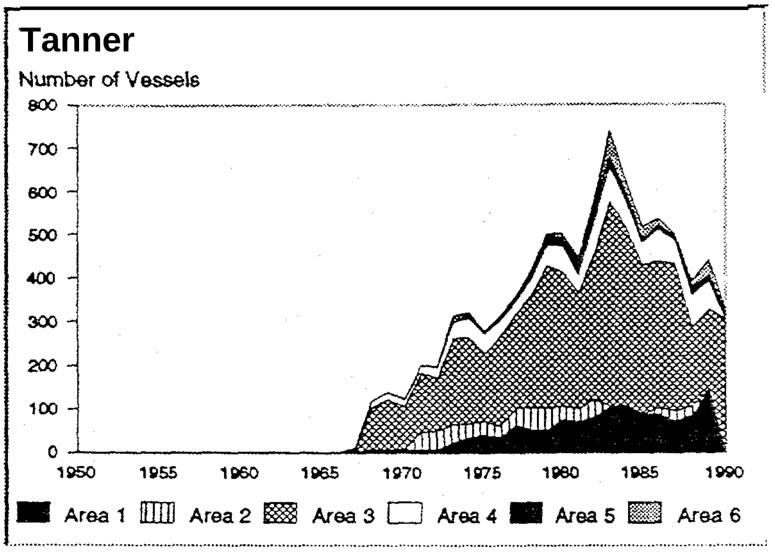


A.

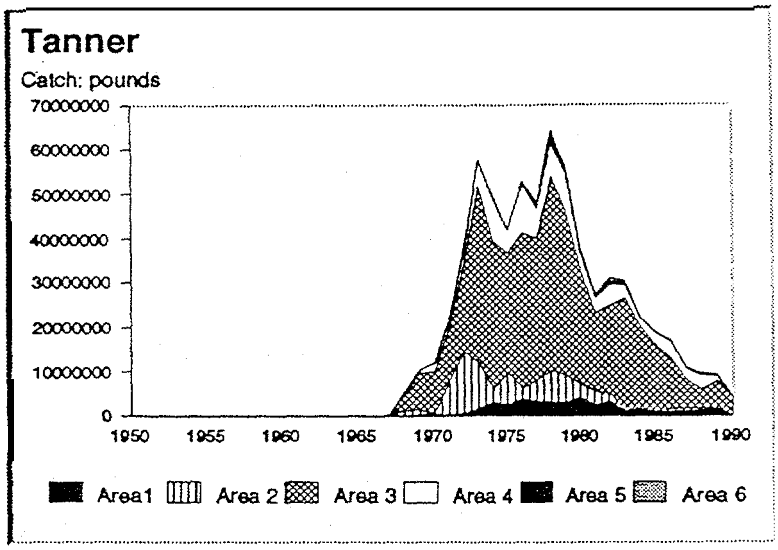


B.

Fig. 4.11. Annual number of domestic and joint venture vessels engaged in commercial groundfish fisheries in Alaska. A. Trawlers and processors by area from 1978 to 1990. B. Other gear types from 1981 to 1990.

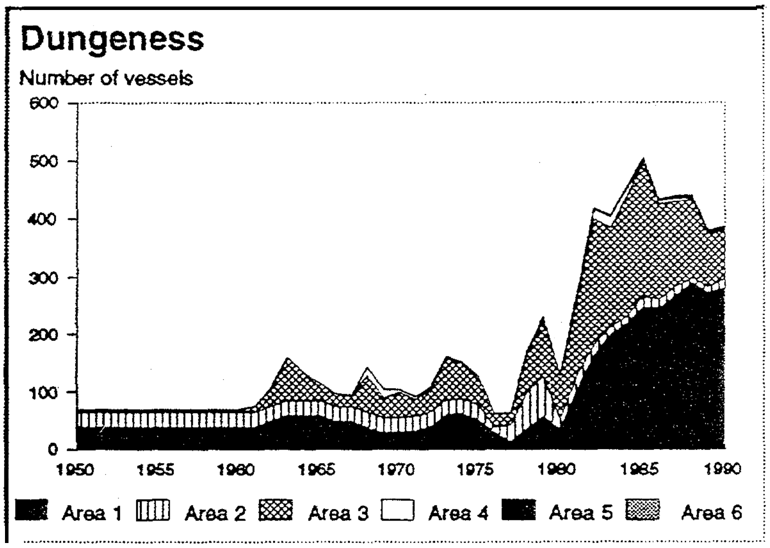


A.

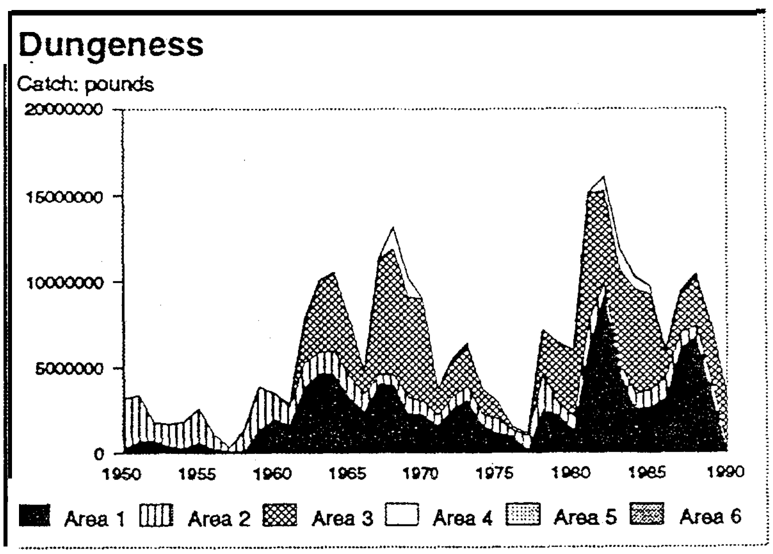


B.

Fig. 4.14. Annual effort by area in the commercial Tanner crab fishery in Alaska from 1950 to 1990. A. Number of vessels. B. Catch in pounds.

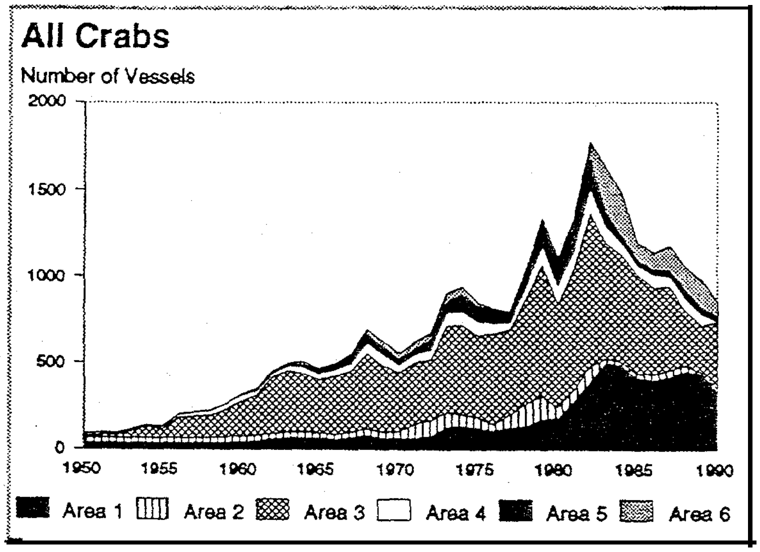


A.



B.

Fig. 4.15. Annual effort by area in the commercial Dungeness crab fishery in Alaska from 1950 to 1990. A. Number of vessels. B. Catch in pounds.



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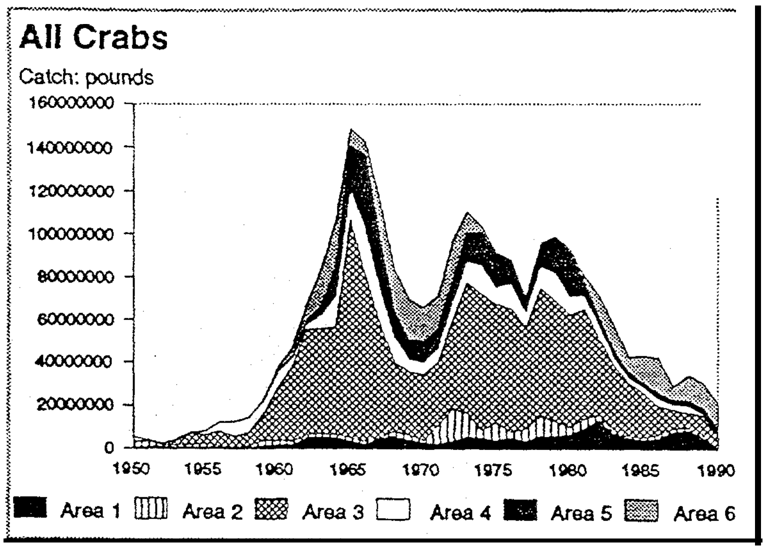
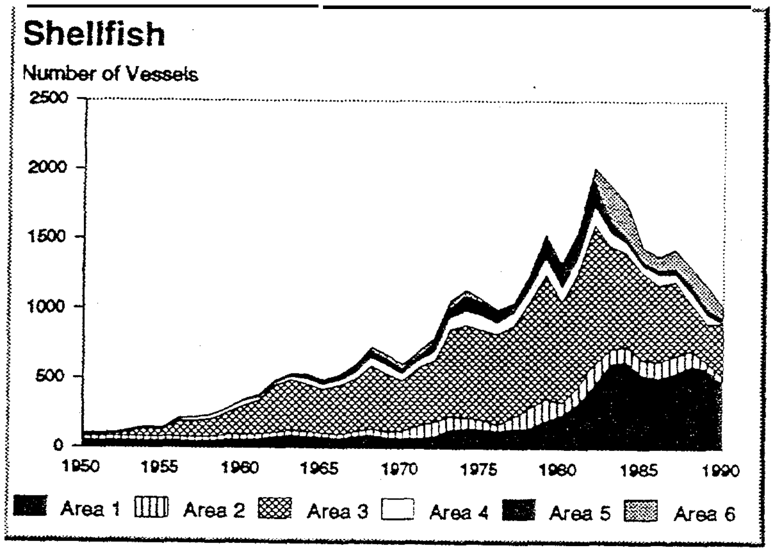


B.

Fig. 4.16. Annual effort by area in the commercial crab fishery (all species) in Alaska from 1950 to 1990. **A.** Number of Vessels. B. Catch in pounds.



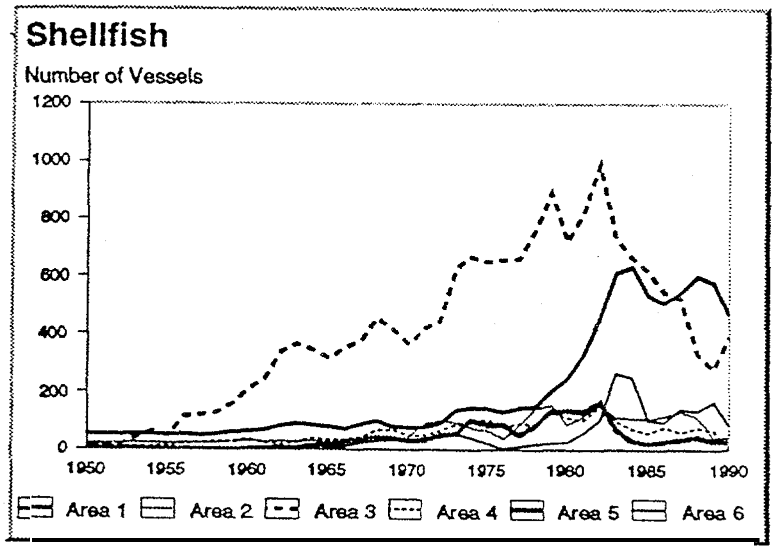
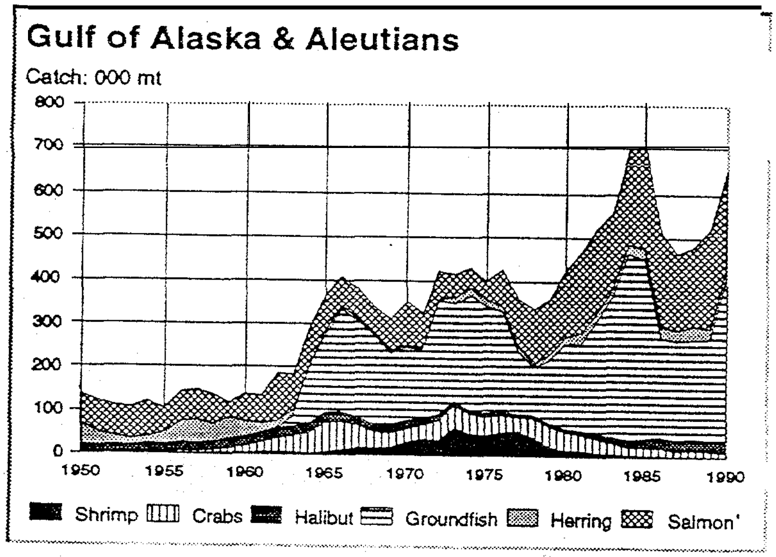


Fig. 4.17. Annual number of vessels engaged in the commercial shellfish fishery (crabs and shrimp) in Alaska by area from 1950 to 1990.



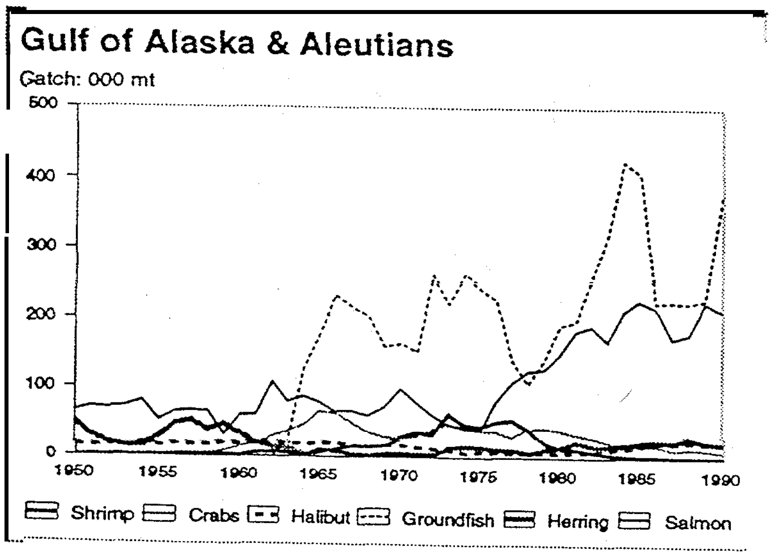
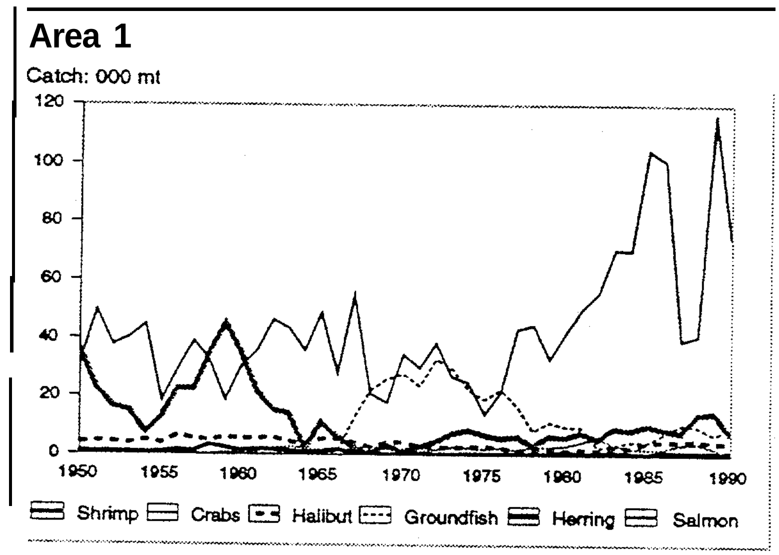
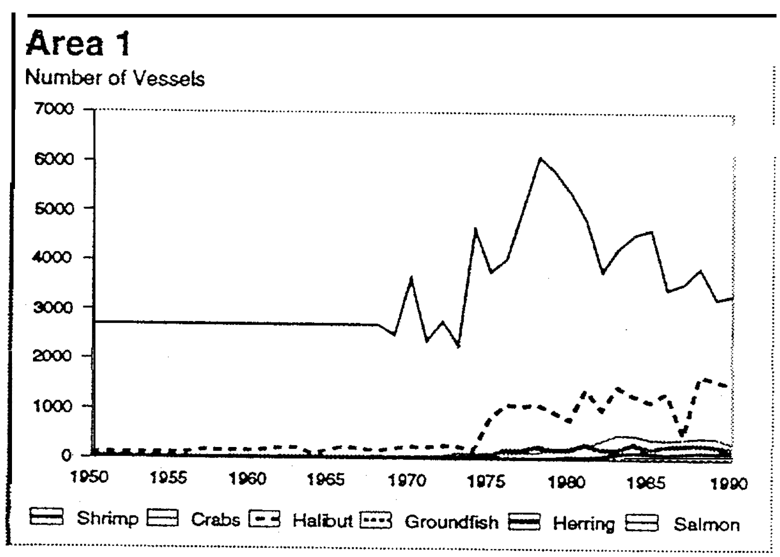


Fig. 4.18. Annual catch in metric tons by species in the Gulf and Alaska and Aleutians from 1950 to 1990.

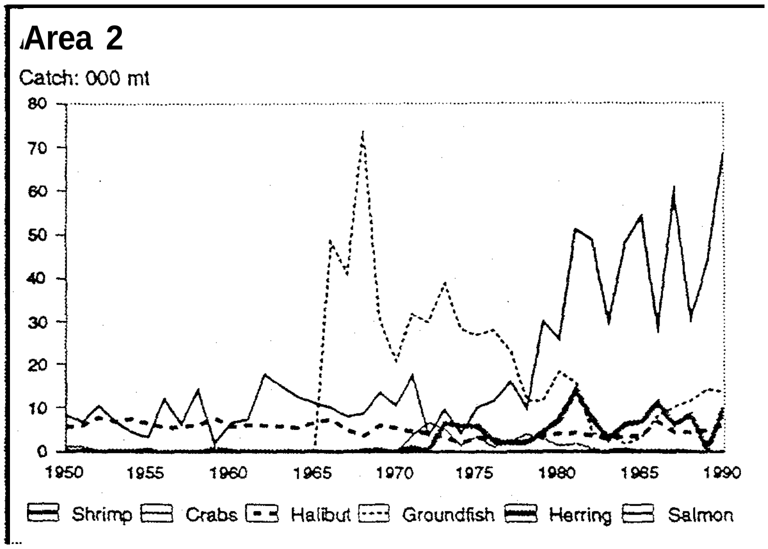


A.

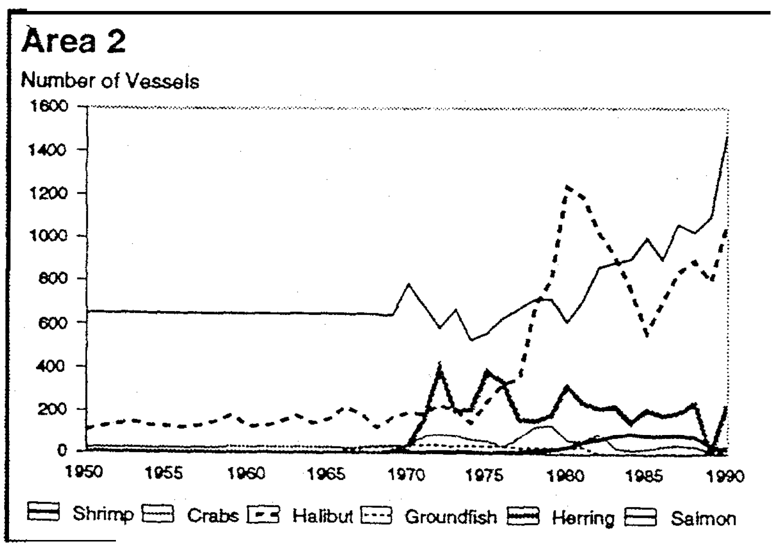


B.

Fig 4.19. Annual commercial fishing effort in Area. 1 for all species from 1950 to 1990. A. Catch in thousands of metric tons. B. Number of vessels.

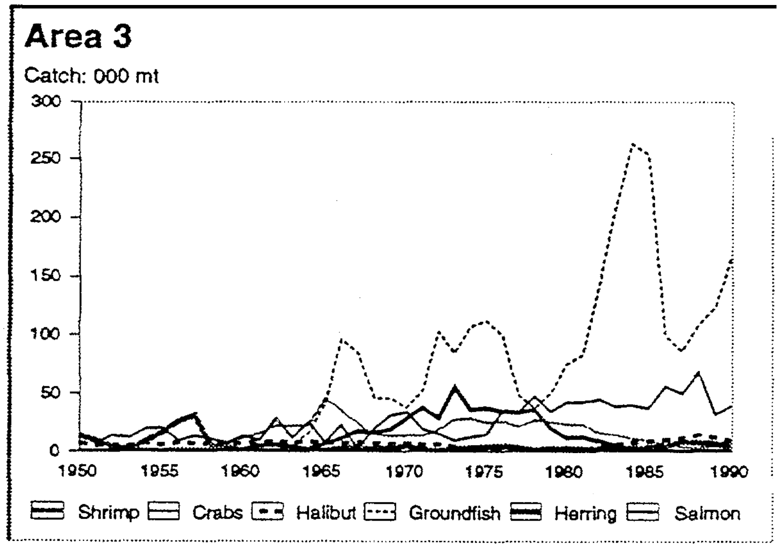


A.

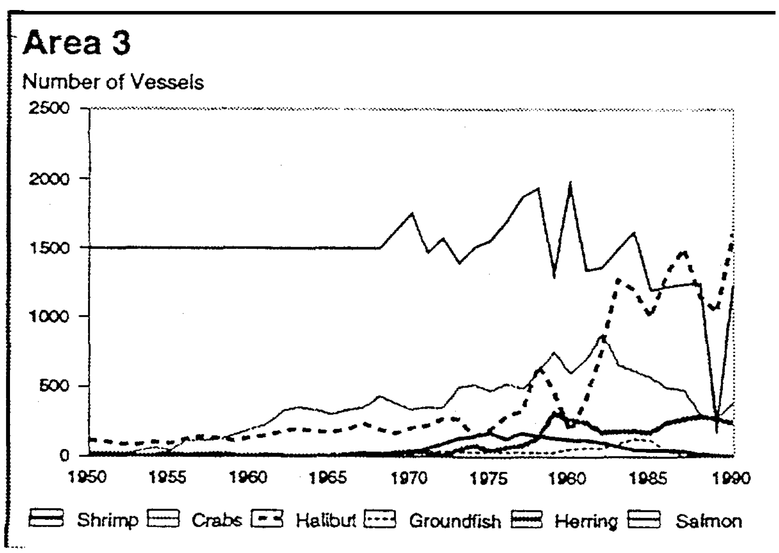


B.

Fig. 4.20. Annual commercial fishing effort in Area 2 for all species from 1950 to 1990. A. Catch in thousands of metric tons. B. Number of vessels.

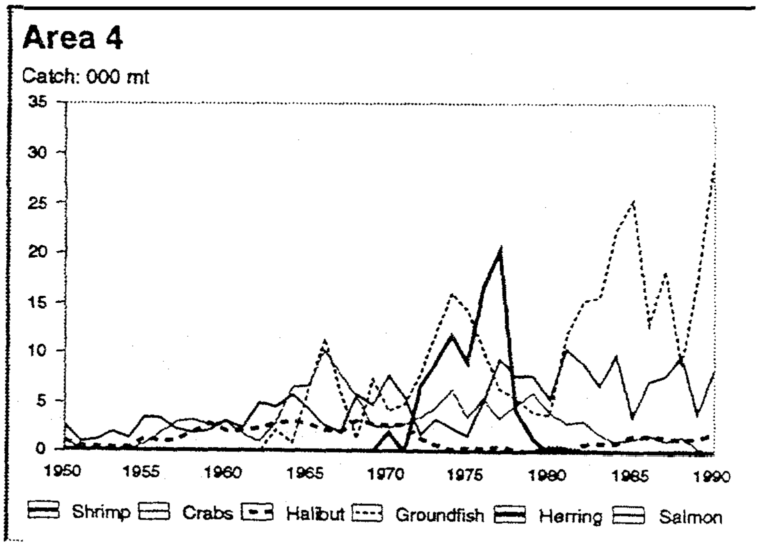


A.

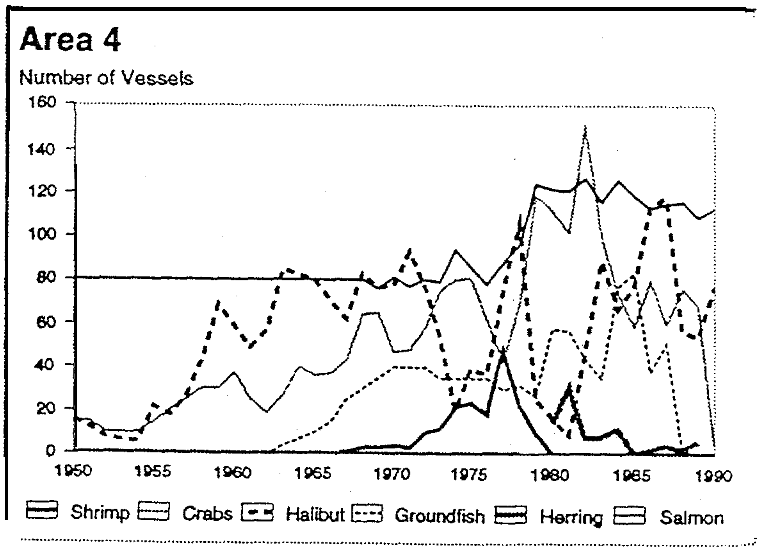


B.

Fig. 4.21. Annual commercial fishing effort in Area 3 for all species from 1950 to 1990. A. Catch in thousands of metric tons. **B.** Number of vessels.

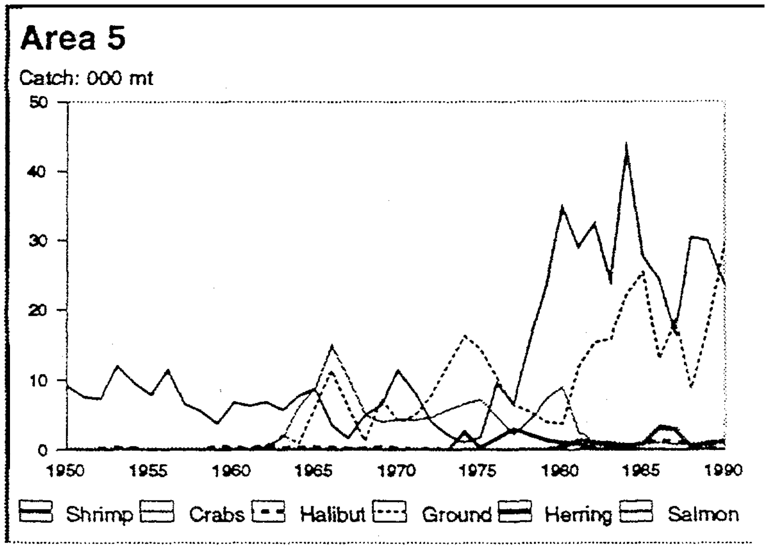


A.

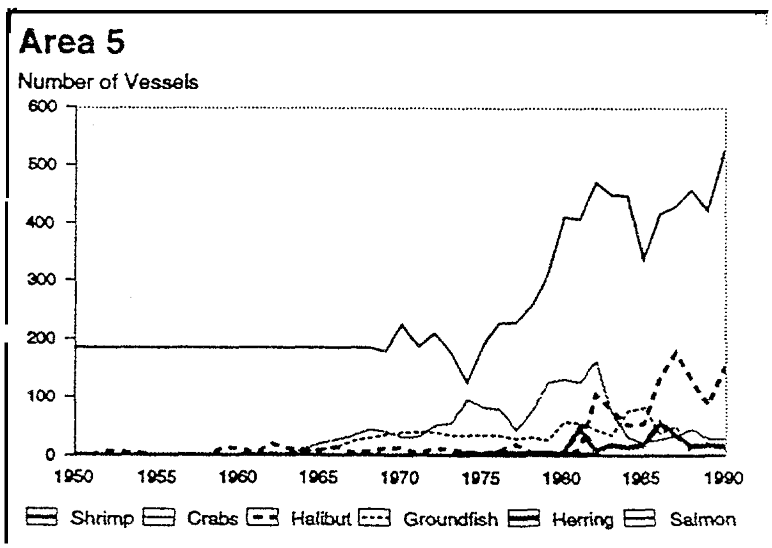


B.

Fig. 4.22. Annual commercial fishing effort in Area 4 for all species from 1950 to 1990. A. Catch in thousands of metric tons. B. Number of vessels.

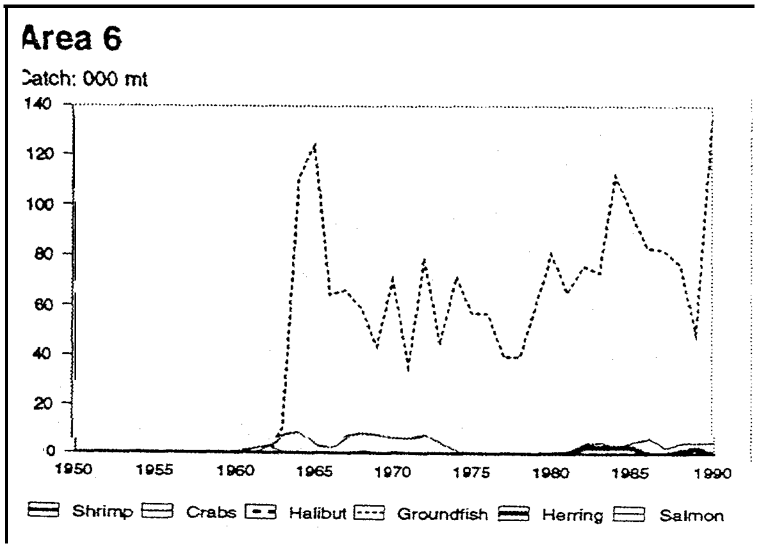


A.

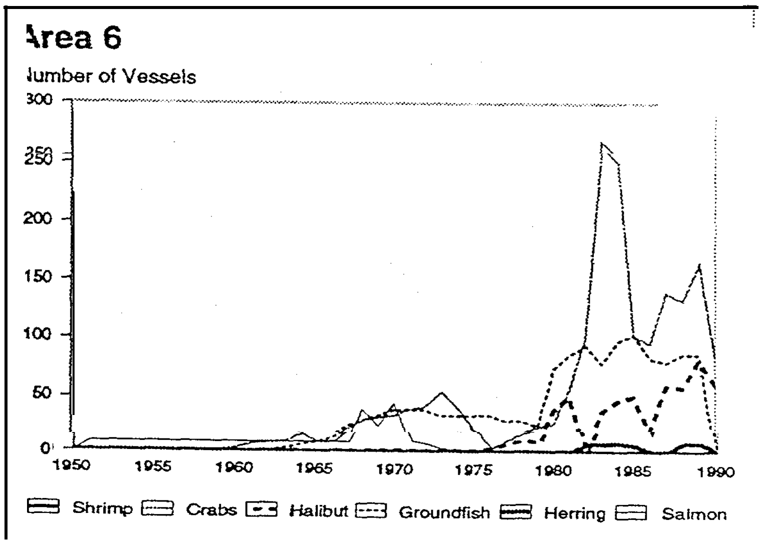


B.

Fig. 4.23. Annual commercial fishing effort in Area 5 for all species from 1950 to 1990. A. Catch in thousands of metric tons. B. Number of vessels.

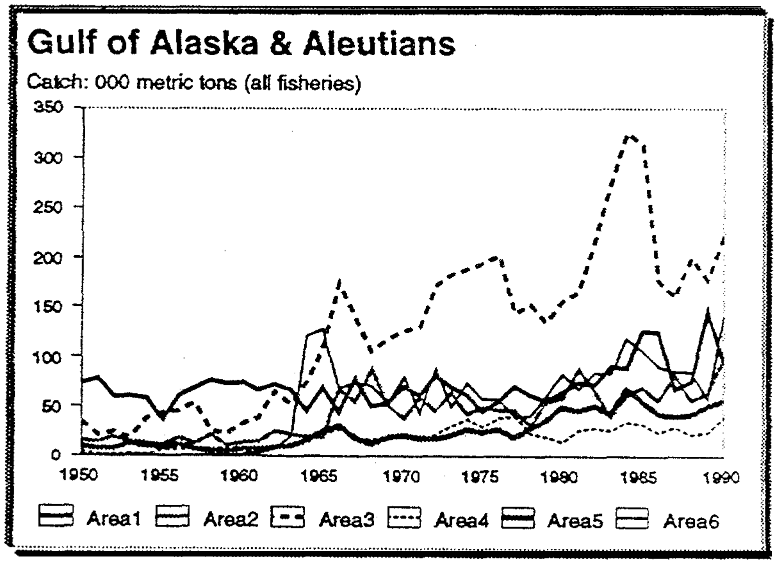


A.

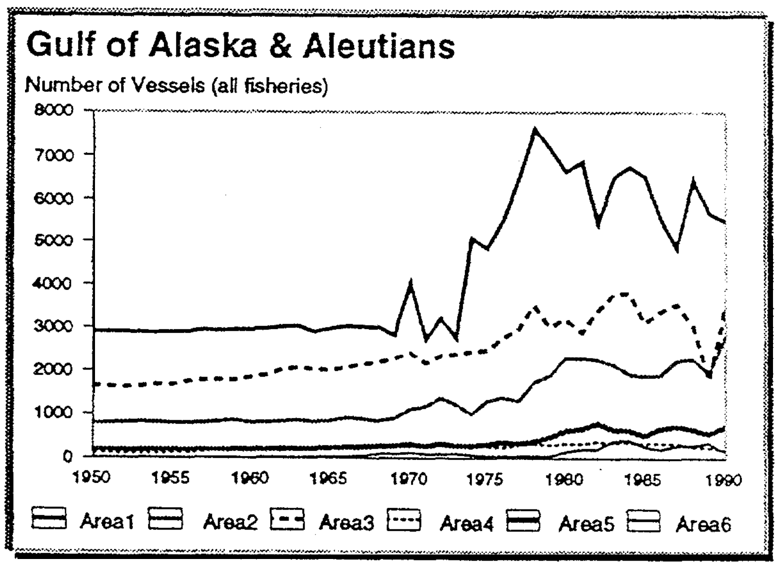


B.

Fig. 4.24. Annual commercial fishing effort in Area 6 for all species from 1950 to 1990. A- Catch in thousands of metric tons. B. Number of *vessels*.

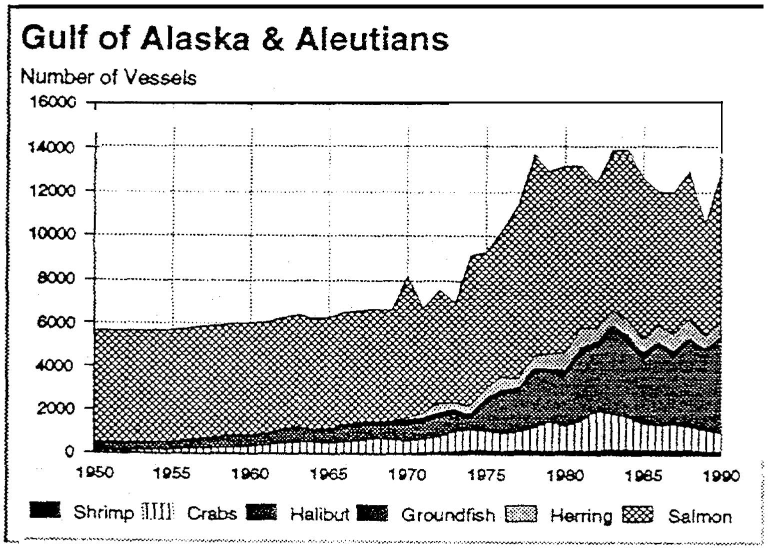


A.



B.

Fig. 4.25. Annual commercial fishing effort in the Gulf of Alaska and Aleutians by area for all species from 1950 to 1990. A. Catch in metric tons. B. Numbers of vessels.



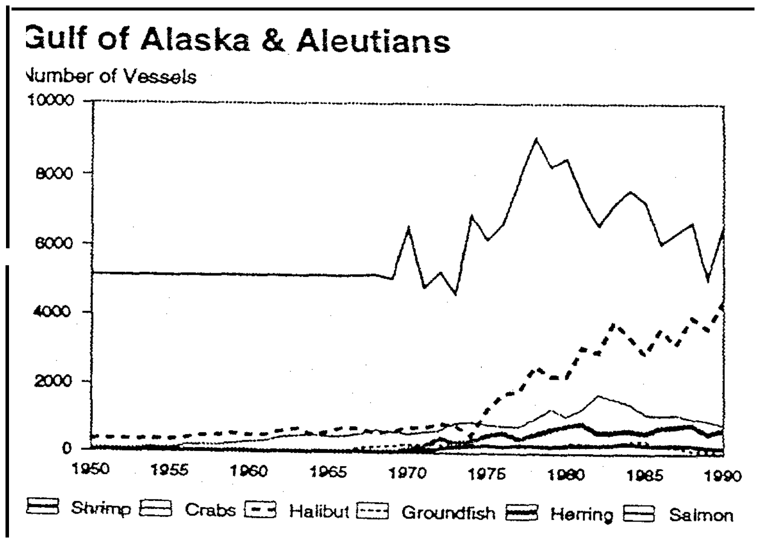


Fig. 4.26. Annual number of vessels engaged by species in the commercial fishing in the Gulf of Alaska and Aleutians from 1950 to 1990.

A.

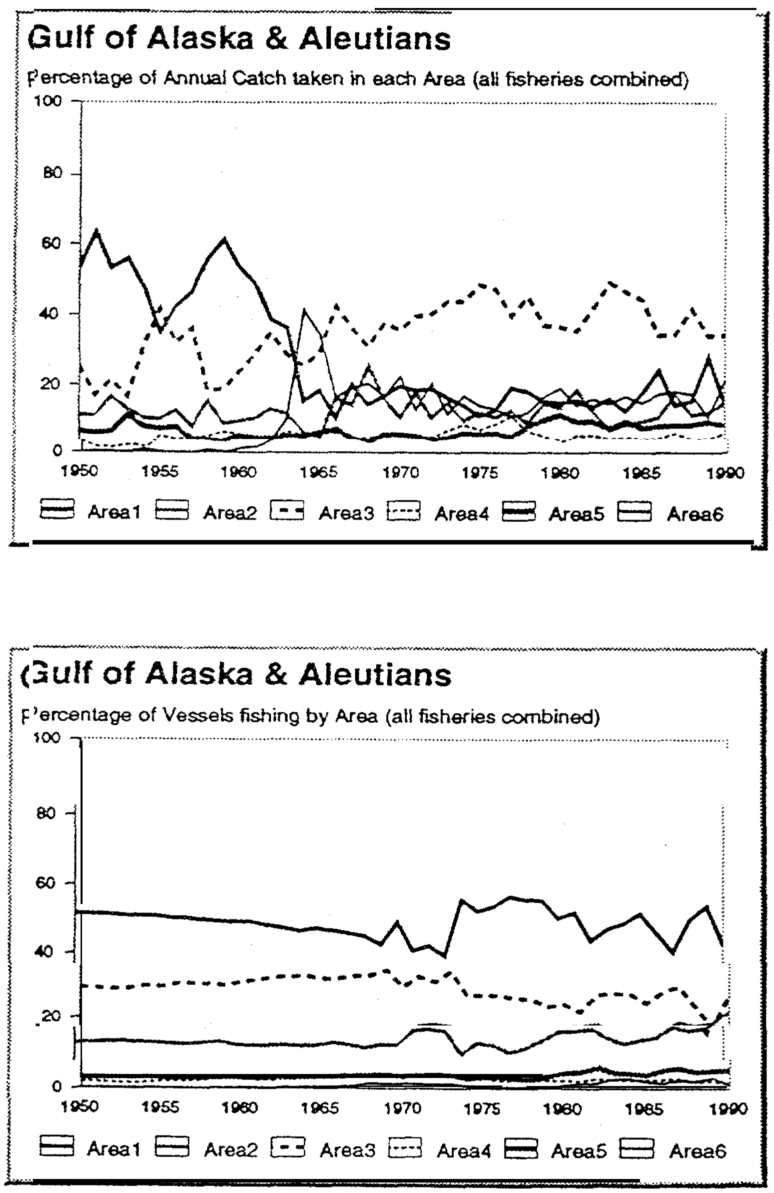


Fig. 4.27. Percentage of annual commercial fishing effort by area for all species in the Gulf of Alaska and Aleutians from 1950 to 1990. A. Annual catch. B. Number of vessels.

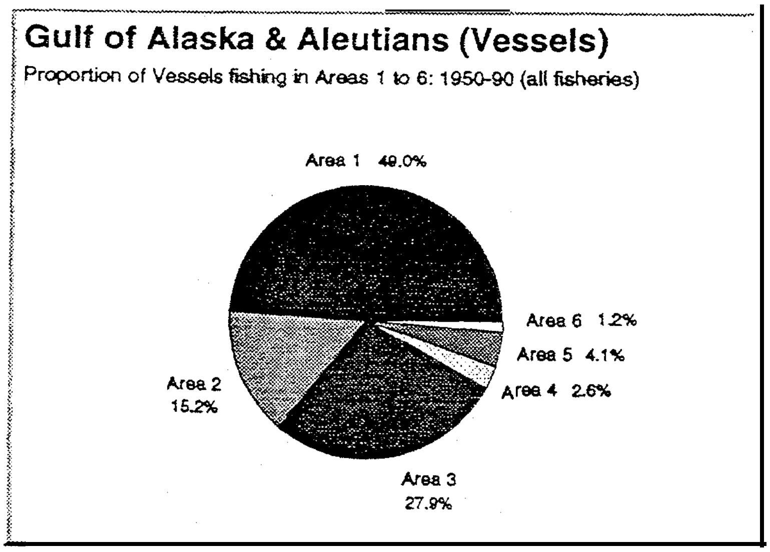


Fig. 4.28. Proportion of vessels operating in each area of the Gulf of Alaska and Aleutians from 1950 to 1990.

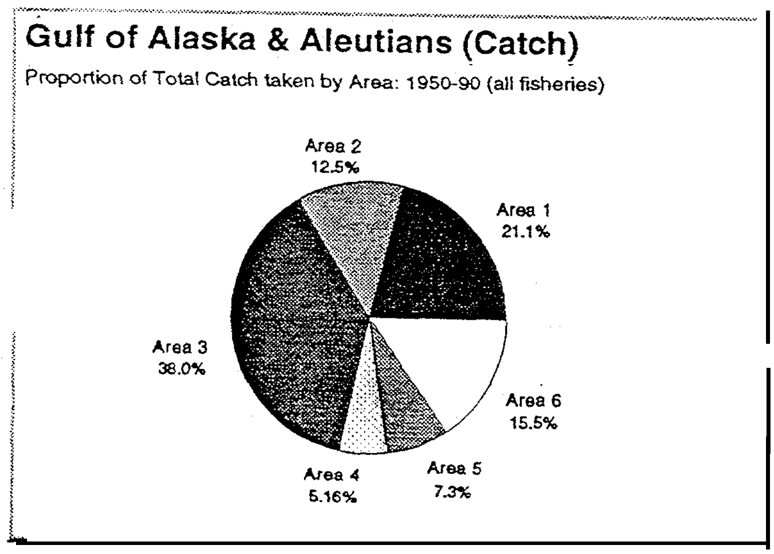


Fig. 4.29. Proportion of total catch from each area of the Gulf of Alaska and Aleutians from 1950 to 1990.

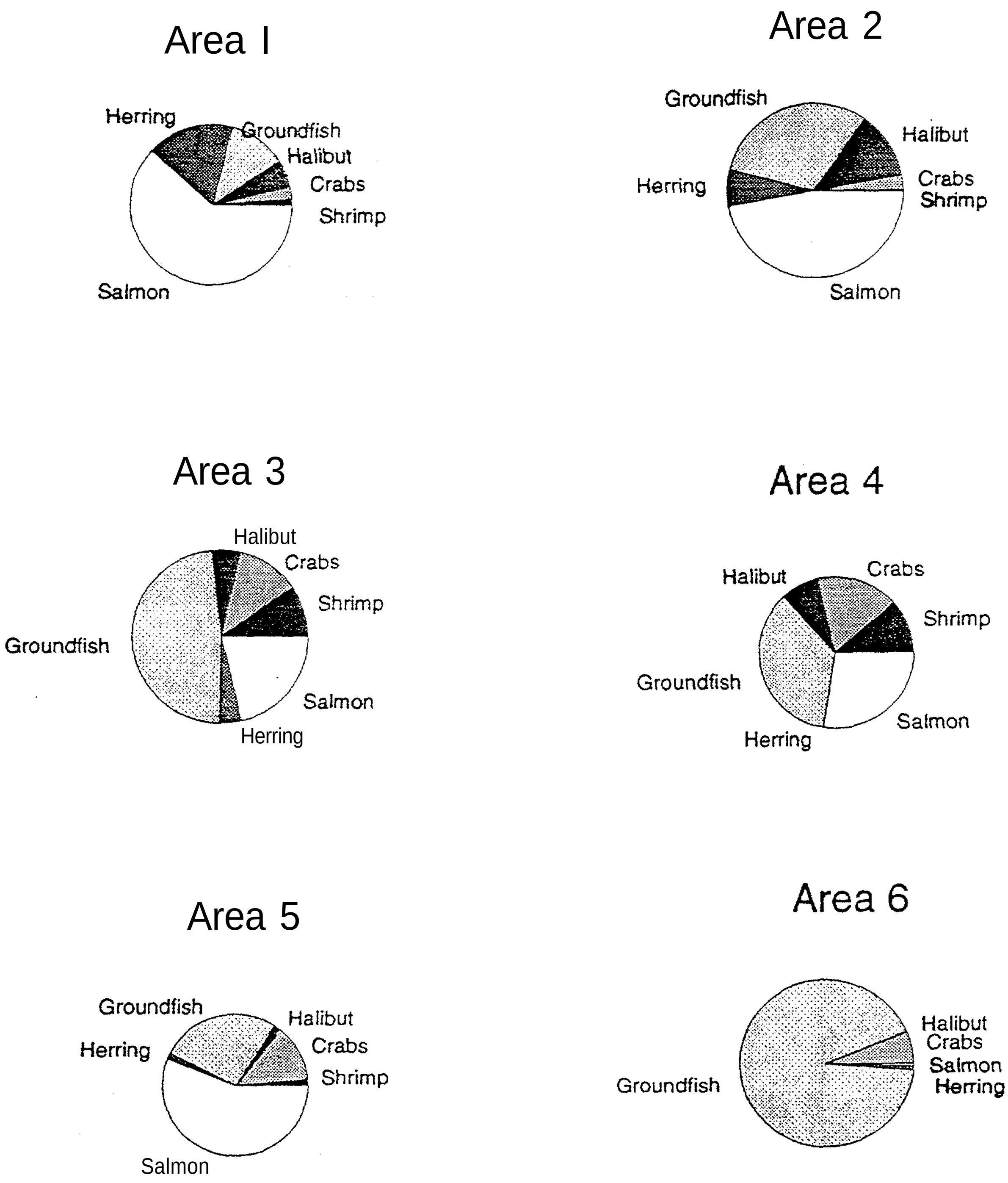


Fig. 4.30. Catch composition by area of commercial fisheries in the Gulf of Alaska and Aleutians.

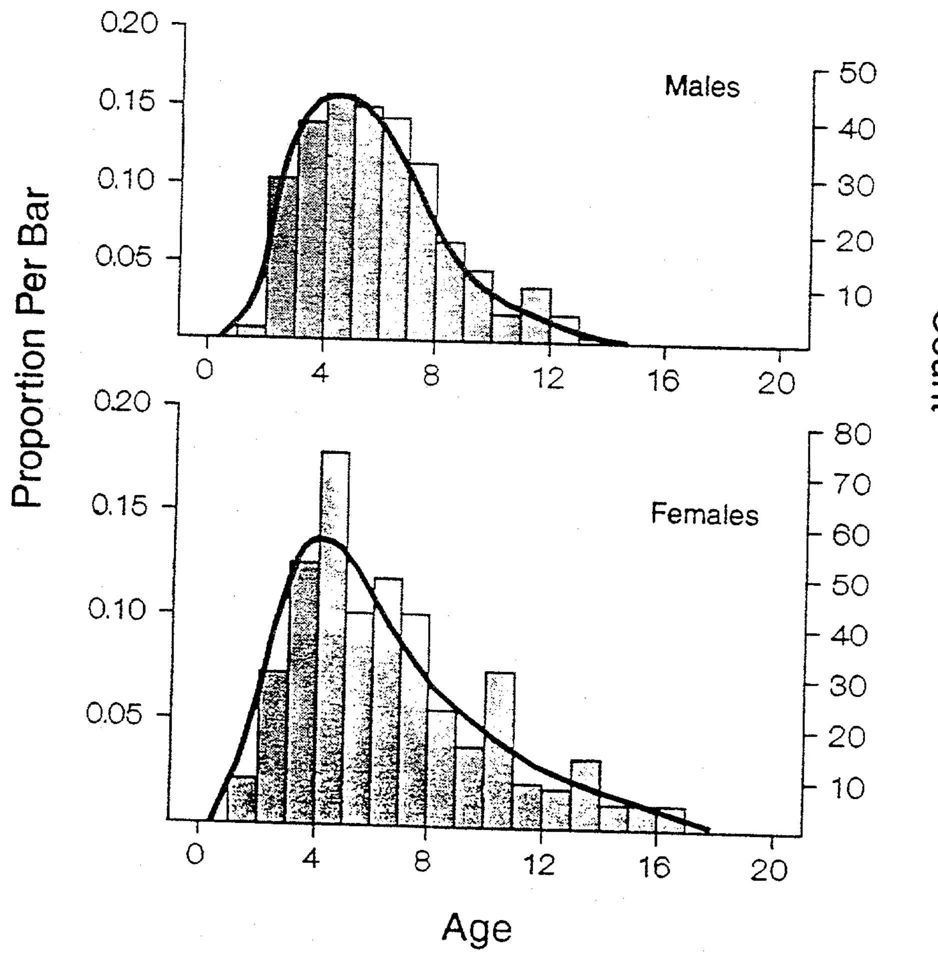
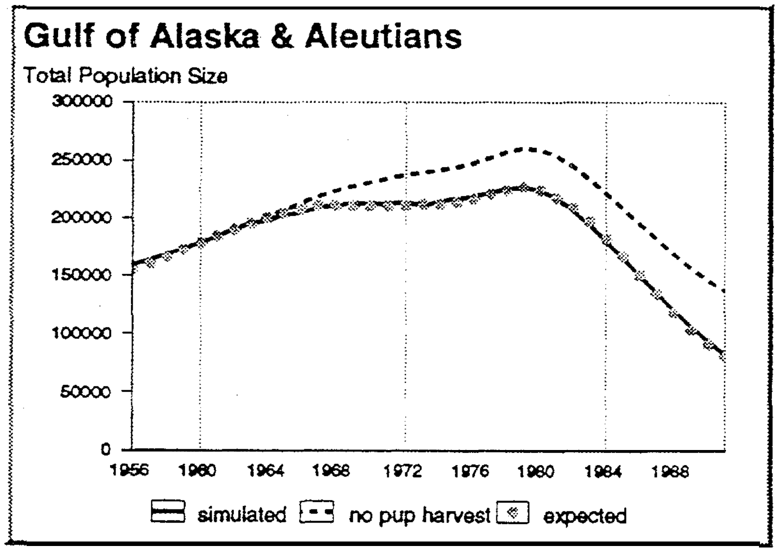
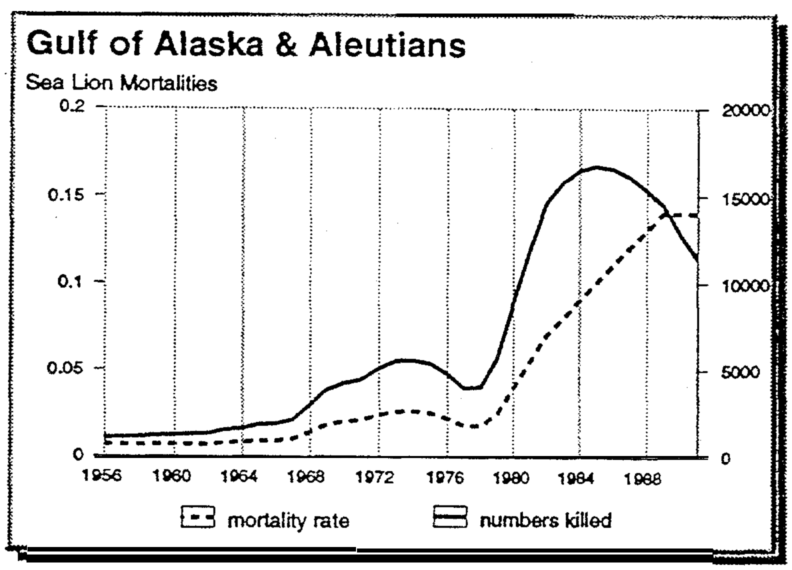


Fig. 5.1. Number by age and sex of incidentally caught Steller sea lions that died during trawl fishing by foreign and joint venture vessels from 1978-87 (data from Perez and Loughlin 199 1). The smoothed curve (a univariate non-parametric kernel density estimator) shows the probability of being caught.

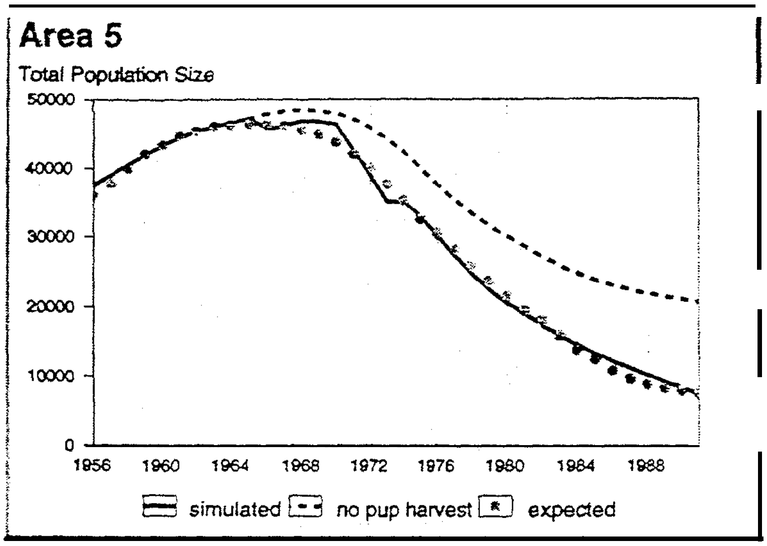


A.

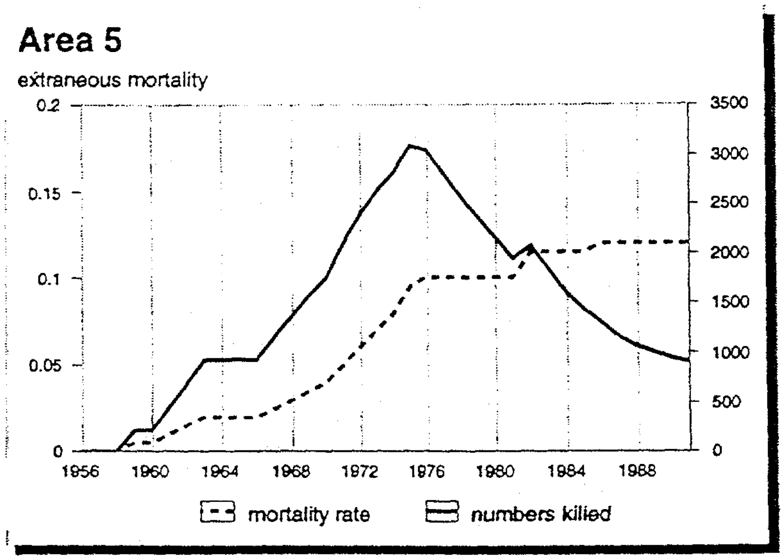


B.

Fig.5.2. Simulated numbers of Steller sea lions in the Gulf of Alaska and Aleutian Islands from 1956 to 1991. A, Population trend in the presence or absence of a pup harvest. B. Annual rate of disappearance and numbers of sea lions missing from the population.

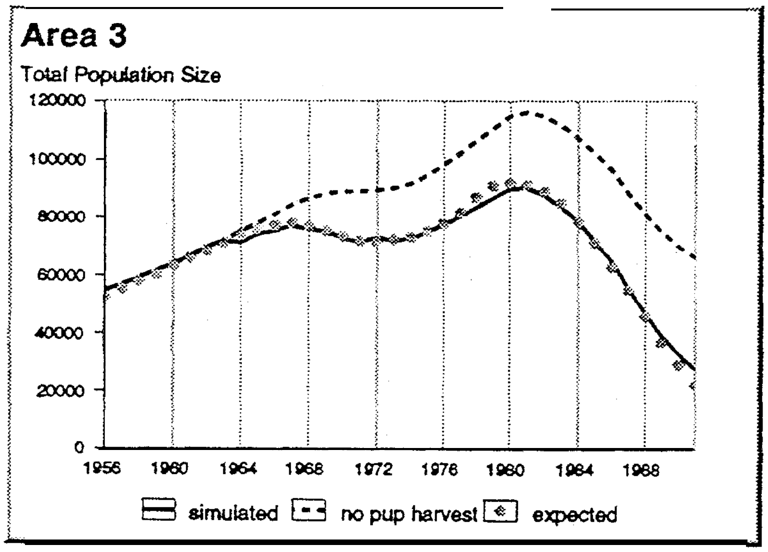


A.

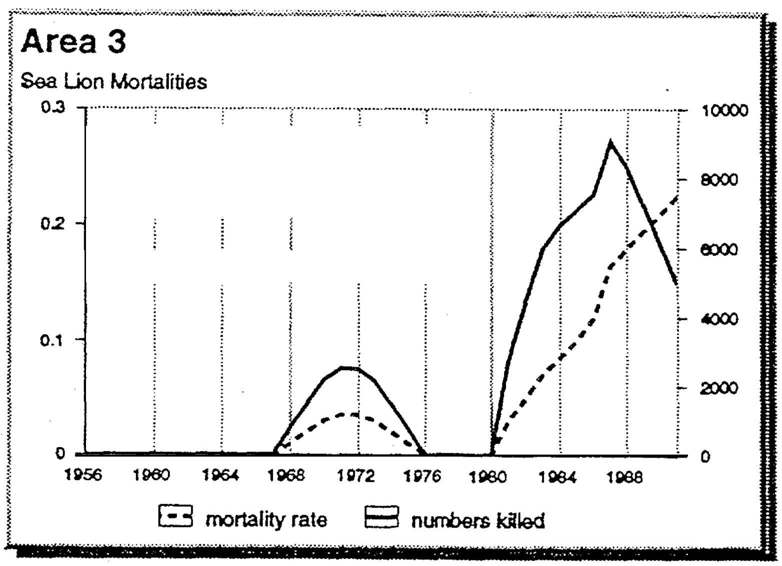


B.

Fig. 5.3. Simulated numbers of Steller sea lions in Area 5 from 1956 to 191. A. Population trend in the presence or absence of a pup harvest. B. Annual rate of disappearance and numbers of sea lions missing from the population.



A.



B.

Fig. 5.4. Simulated numbers of Steller sea lions in Area 3 from 1956 to 1991. A. Population trend in the presence or absence of a pup harvest. B. Annual rate of disappearance and numbers of sea lions missing from the population.

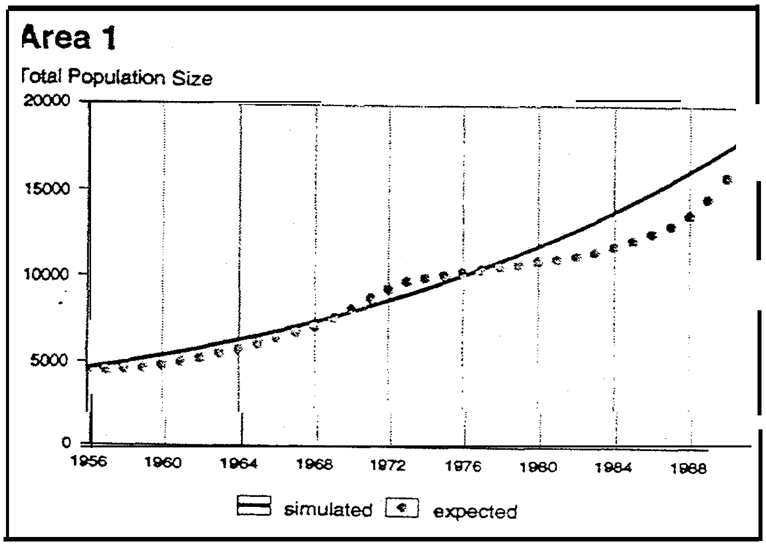


Fig. 5.5. Simulated numbers of Steller sea lions in Area 1 from 1956 to 991.

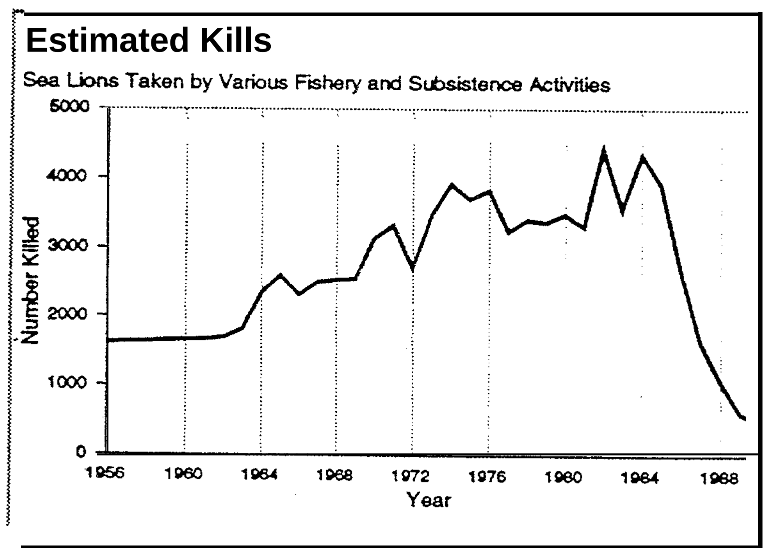


Fig. 6.1. Estimated kill of Steller sea lions taken by various fishery and subsistence activities from 1950 to 1990. (from Table 6.2)

APPENDIX 1. Counts by area of Steller sea lion adults and pups at rookeries in the Gulf of Alaska and Aleutians.

Area 1

		day	month	adults	pups	Total
1956	White Sisters					NA
	Hazy					NA
	Forrester					NA
1957	White Sisters					NA
	Hazy	0	4			NA
	Forrester	0	4	2500		NA
1958	White Sisters					NA
	Hazy					NA
	Forrester					NA
1959	White Sisters					NA
	Hazy					NA
	Forrester					NA
1960	White Sisters					NA
	Hazy					NA
	Forrester					NA
1961	White Sisters					NA
	Hazy					NA
	Forrester	20	6	1300	1096	2396
1962	White Sisters					NA
	Hazy					NA
	Forrester					NA
1963	White Sisters					NA
	Hazy					NA
	Forrester					NA
1964	White Sisters					NA
	Hazy					NA
	Forrester					NA
1965	White Sisters					NA
	Hazy					NA
	Forrester					NA
1966	White Sisters					NA
	Hazy					NA
	Forrester					NA
1967	White Sisters					NA
	Hazy					NA
	Forrester					NA
1968	White Sisters					NA
	Hazy					NA
	Forrester					NA
1969	White Sisters					NA
	Hazy					NA
	Forrester					NA
1970	White Sisters					NA
	Hazy					NA
	Forrester					NA
1971	White Sisters					NA
	Hazy					NA
	Forrester					NA
1972	White Sisters					NA
	Hazy					NA
	Forrester					NA
1973	White Sisters					NA
	Hazy					NA
	Forrester	29	6	3787	2400	6187
1974	White Sisters					NA
	Hazy					NA
	Forrester					NA
1975	White Sisters	0	5	700		NA
	Hazy					NA
	Forrester					NA
1976	White Sisters					NA
	Hazy					NA
	Forrester					NA
1977	White Sisters					NA
	Hazy					NA
	Forrester					NA
1978	White Sisters					NA
	Hazy					NA
	Forrester					NA
1979	White Sisters	0	7	761	3	764
	Hazy	0	7	893	30	923
1979	Forrester	0	7	3121	2187	5308
1980	White Sisters					NA
	Hazy					NA
	Forrester					NA
1981	White Sisters					NA
	Hazy					NA
	Forrester					NA
1982	White Sisters	0	7	934		NA
	Hazy	0	7	1268		NA
	Forrester	0	7	3777	2227	6004
1983	White Sisters					NA
	Hazy					NA
	Forrester					NA
1984	White Sisters					NA
	Hazy					NA
	Forrester				2568	NA
1985	White Sisters					NA
	Hazy					NA
	Forrester					NA
1986	White Sisters					NA
	Hazy					NA
	Forrester				1954	NA
1987	White Sisters					NA
	Hazy					NA
	Forrester					NA
1988	White Sisters					NA
	Hazy					NA
	Forrester				2202	NA
1989	White Sisters	20	6	734		NA
	Hazy	22	6	1462		NA
	Forrester	22	6	4648	2844	7492
1990	White Sisters	8	7	980		NA
	Hazy	4	7	1187	638	1825
	Forrester	4	7	3324	2932	6256
1991	White Sisters			860	95	955
	Hazy			1278	808	2086
	Forrester			3648	3261	6909

Area 2

		day	month	adults	pups	Total
1956	Seal Rocks	21	7	162	21	183
	Wooded	21	7	466	213	679
1957	Seal Rocks					NA
	Wooded	27	6	3000		NA
1958	Seal Rocks					NA
	Wooded					NA
1959	Seal Rocks					NA
	Wooded					NA
1960	Seal Rocks					NA
	Wooded					NA
1961	Seal Rocks					NA
	Wooded					NA
1962	Seal Rocks					NA
	Wooded					NA
1963	Seal Rocks					NA
	Wooded					NA
1964	Seal Rocks					NA
	Wooded					NA
1965	Seal Rocks					NA
	Wooded					NA
1966	Seal Rocks	4	9			846
	Wooded					NA
1967	Seal Rocks					NA
	Wooded					NA
1968	Seal Rocks					NA
	Wooded	27	5	1500	49	1549
1969	Seal Rocks					NA
	Wooded					NA
1970	Seal Rocks					NA
	Wooded					NA
1971	Seal Rocks					NA
	Wooded					NA
1972	Seal Rocks					NA
	Wooded					NA
1973	Seal Rocks	26	6	1533	200	1733
	Wooded	26	6	1243	26	1269
1974	Seal Rocks	5	9			1750
	Wooded	6	9			1114
1975	Seal Rocks					NA
	Wooded					NA
1976	Seal Rocks	0	6	1709	316	2025
	Wooded	0	6	878	35	913
1977	Seal Rocks					NA
	Wooded					NA
1978	Seal Rocks	0	6	2463	544	3007
	Wooded					NA
1979	Seal Rocks	0	6	2961	491	3452
	Wooded					NA
1980	Seal Rocks					NA
	Wooded					NA
1981	Seal Rocks					NA
	Wooded					NA
1982	Seal Rocks					NA
	Wooded					NA
1983	Seal Rocks					NA
	Wooded					NA
1984	Seal Rocks			3000	799	3799
	Wooded					NA
1985	Seal Rocks					NA
	Wooded					NA
1986	Seal Rocks					NA
	Wooded					NA
1987	Seal Rocks					NA
	Wooded					NA
1988	Seal Rocks					NA
	Wooded					NA
1989	Seal Rocks	18	6	2159	553	2712
	Wooded	18	6	1533		NA
1990	Seal Rocks	12	7	1471	571	2042
	Wooded					NA
1991	Seal Rocks			1220	657	1877
	Wooded					NA

Area 3

			day	month	adults	pups	Total
1956	Chowiet		22	7	0	0	NA
	Chirikof						NA
	Marmot		22	7	2262	926	3188
	Sugarloaf		22	7	7698	4300	11998
	Outer	Pye	22	7	1415	368	1783
		Signal					NA
	Chiswell		21	7	1459	564	2023
1957	Chowiet		27	6	6014	309	6323
	Chirikof		27	6	1695	1742	3437
	Marmot		27	6	3866	291	4157
	Sugarloaf		27	6	11113	850	11963
	Outer	Pye	27	6	2848	141	2989
		Signal					NA
	Chiswell		27	6	1930	82	2012
1958	Chowiet						NA
	Chirikof						NA
	Marmot						NA
	Sugarloaf						NA
	Outer	Pye					NA
		Signal					NA
	Chiswell						NA
1959	Chowiet						NA
	Chirikof						NA
	Marmot						NA
	Sugarloaf						NA
	Outer	Pye					NA
		Signal					NA
	Chiswell						NA
1960	Chowiet						NA
	Chirikof						NA
	Marmot						NA
	Sugarloaf						NA
	Outer	Pye					NA
		Signal					NA
	Chiswell						NA
1961	Chowiet						NA
	Chirikof						NA
	Marmot						NA
	Sugarloaf						NA
	Outer	Pye					NA
		Signal					NA
	Chiswell						NA
1962	Chowiet						NA
	Chirikof						NA
	Marmot						NA
	Sugarloaf						NA
	Outer	Pye					NA
		Signal					NA
	Chiswell						NA
1963	Chowiet						NA
	Chirikof						NA
	Marmot						NA
	Sugarloaf						NA
	Outer	Pye					NA
		Signal					NA
	Chiswell						NA
1964	Chowiet						NA
	Chirikof						NA
	Marmot						NA
	Sugarloaf						NA
	Outer	Pye					NA
		Signal					NA
	Chiswell						NA
1965	Chowiet						NA
	Chirikof						NA
	Marmot		0	6	6500		NA
	Sugarloaf		0	7		3391	NA
	Outer	Pye					NA
		Signal					NA
	Chiswell						NA
1966	Chowiet						NA
	Chirikof						NA
	Marmot						NA
	Sugarloaf						NA
	Outer	Pye					NA
		Signal					NA
	Chiswell						NA
1967	Chowiet						NA
	Chirikof						NA
	Marmot					5900	NA
	Sugarloaf					5200	NA
	Outer	Pye					NA
		Signal					NA
	Chiswell						NA
1968	Chowiet						NA
	Chirikof						NA
	Marmot					5000	NA
	Sugarloaf					3000	NA
	Outer	Pye					NA
		Signal					NA
	Chiswell						NA
1969	Chowiet						NA
	Chirikof						NA
	Marmot						NA
	Sugarloaf						NA
	Outer	Pye					NA
		Signal					NA
	Chiswell						NA
1970	Chowiet						NA
	Chirikof						NA
	Marmot						NA
	Sugarloaf						NA
	Outer	Pye					NA
		Signal					NA
	Chiswell						NA
1971	Chowiet						NA
	Chirikof						NA
	Marmot						NA
	Sugarloaf					3650	NA
	Outer	Pye					NA
		Signal					NA
	Chiswell						NA
1972	Chowiet						NA
	Chirikof						NA
	Marmot						NA
	Sugarloaf						NA
	Outer	Pye					NA
		Signal					NA
	Chiswell						NA
1973	Chowiet				5000		NA
	Chirikof				500		NA
	Marmot				10000		NA
	Sugarloaf				10000		NA
	Outer	Pye			6000		NA
		Signal					NA
	Chiswell						NA
1974	Chowiet						NA
	Chirikof						NA
	Marmot						NA
	Sugarloaf						NA
	Outer	Pye					NA
		Signal					NA
	Chiswell						NA
1975	Chowiet						NA
	Chirikof						NA
	Marmot		0	10	8256	4500	12756
	Sugarloaf					3500	NA
	Outer	Pye					NA
		Signal					NA
	Chiswell						NA
1976	Chowiet		0	3	2000		NA
	Chirikof		0	6	1437	954	2391

Area 3

Year	Site		day	month	adults	pups	Total
1976	Marmot		0	6	9862	4900	14762
	Sugarloaf		0	6	5226	3500	8726
	Outer	Pye	0	6	3847	500	4347
		Signal	0	6	69		NA
	Chiswell		0	6	1106		NA
1977	Chowiet						NA
	Chirikof						NA
	Marmot						NA
	Sugarloaf						NA
	Outer	Pye					NA
		Signal	28	6	2		NA
	Chiswell						NA
1978	Chowiet		0	6	4419	4670	9089
	Chirikof		0	6	3699	1573	5272
	Marmot		0	6	8506	6140	14646
	Sugarloaf		0	6	4810	5021	9831
	Outer	Pye	0	6	3142	431	3573
		Signal					NA
	Chiswell						NA
1979	Chowiet		0	6	4441	5485	9926
	Chirikof		0	6	5199	1649	6848
	Marmot		29	6	6381	6741	13122
	Sugarloaf		0	6	4374	5123	9497
	Outer	Pye	0	6	3155	888	4043
		Signal					NA
	Chiswell						NA
1980	Chowiet						NA
	Chirikof						NA
	Marmot						NA
	Sugarloaf						NA
	Outer	Pye					NA
		Signal					NA
	Chiswell						NA
1981	Chowiet						NA
	Chirikof						NA
	Marmot						NA
	Sugarloaf						NA
	Outer	Pye					NA
		Signal					NA
	Chiswell						NA
1982	Chowiet						NA
	Chirikof						NA
	Marmot						NA
	Sugarloaf						NA
	Outer	Pye					NA
		Signal					NA
	Chiswell						NA
1983	Chowiet						NA
	Chirikof						NA
	Marmot						NA
	Sugarloaf						NA
	Outer	Pye					NA
		Signal					NA
	Chiswell						NA
1984	Chowiet					3207	NA
	Chirikof					1913	NA
	Marmot					5751	NA
	Sugarloaf					3114	NA
	Outer	Pye				1034	NA
		Signal	10	7	146		NA
	Chiswell						NA
1985	Chowiet		9	6	2059		NA
	Chirikof		10	6	487		NA
	Marmot		9	6	4963		NA
	Sugarloaf		9	6	2901		NA
	Outer	Pye					NA
		Signal	10	6	0		NA
	Chiswell						NA
1986	Chowiet					1731	NA
	Chirikof		9	7	456	1476	1932
	Marmot		21	7	8619	4381	13200
	Sugarloaf					3107	NA
	Outer	Pye				993	NA
		Signal					NA
	Chiswell						NA
1987	Chowiet		1	5	186		NA
	Chirikof		1	5	150		NA
	Marmot						NA
	Sugarloaf						NA
	Outer	Pye					NA
		Signal	2	5	136		NA
	Chiswell						NA
1988	Chowiet						NA
	Chirikof						NA
	Marmot						NA
	Sugarloaf						NA
	Outer	Pye					NA
		Signal					NA
	Chiswell						NA
1989	Chowiet		14	6	737	820	1557
	Chirikof		15	6	544	709	1253
	Marmot		14	6	2331	2199	4530
	Sugarloaf		13	6	1861	2109	3970
	Outer	Pye	13	6	1127	557	1684
		Signal	16	6	0		NA
	Chiswell		17	6	456		NA
1990	Chowiet		14	6	897	344	1241
	Chirikof		23	6	442	607	1049
	Marmot		13	6	1766		NA
	Sugarloaf		12	6	1319		NA
	Outer	Pye	12	6	589		NA
		Signal	16	6	35		NA
	Chiswell						NA

Area 4

		day	month	adults	pups	Total
1956	Clubbing Rocks	28	7	3292	2321	5613
	Pinnacle Rock	28	7	798	185	983
	Jude	28	7	2070	999	3069
	Chernabura	28	7	1825	53	1878
	Atkins	28	7	2861	215	3076
1957	Clubbing Rocks	6	8	4919	2054	6973
	Pinnacle Rock	28	8	3142	641	3783
	Jude	6	8	1892	570	2462
	Chernabura	6	8	3457	323	3780
	Atkins	6	6	3769	482	4251
1958	Clubbing Rocks					NA
	Pinnacle Rock					NA
	Jude	3	7	2019	455	2474
	Chernabura	3	7	1980	364	2344
	Atkins	3	7	3377	895	4272
1959	Clubbing Rocks					NA
	Pinnacle Rock					NA
	Jude					NA
	Chernabura					NA
	Atkins					NA
1960	Clubbing Rocks	0	3	200		NA
	Pinnacle Rock					NA
	Jude					NA
	Chernabura					NA
	Atkins					NA
1961	Clubbing Rocks					NA
	Pinnacle Rock					NA
	Jude					NA
	Chernabura					NA
	Atkins					NA
1962	Clubbing Rocks					NA
	Pinnacle Rock					NA
	Jude					NA
	Chernabura					NA
	Atkins					NA
1963	Clubbing Rocks					NA
	Pinnacle Rock					NA
	Jude					NA
	Chernabura					NA
	Atkins					NA
1964	Clubbing Rocks					NA
	Pinnacle Rock					NA
	Jude					NA
	Chernabura					NA
	Atkins					NA
1965	Clubbing Rocks					NA
	Pinnacle Rock					NA
	Jude					NA
	Chernabura					NA
	Atkins					NA
1966	Clubbing Rocks					NA
	Pinnacle Rock					NA
	Jude					NA
	Chernabura					NA
	Atkins					NA
1967	Clubbing Rocks					NA
	Pinnacle Rock					NA
	Jude					NA
	Chernabura					NA
	Atkins					NA
1968	Clubbing Rocks					NA
	Pinnacle Rock					NA
	Jude					NA
	Chernabura					NA
	Atkins					NA
1969	Clubbing Rocks					NA
	Pinnacle Rock					NA
	Jude					NA
	Chernabura					NA
	Atkins					NA
1970	Clubbing Rocks					NA
	Pinnacle Rock					NA
	Jude					NA
	Chernabura					NA
1970	Atkins					NA
1971	Clubbing Rocks					NA
	Pinnacle Rock					NA
	Jude					NA
	Chernabura					NA
	Atkins					NA
1972	Clubbing Rocks					NA
	Pinnacle Rock					NA
	Jude					NA
	Chernabura					NA
	Atkins					NA
1973	Clubbing Rocks			5600		NA
	Pinnacle Rock			960		NA
	Jude			3000		NA
	Chernabura			2000		NA
	Atkins			3100		NA
1974	Clubbing Rocks					NA
	Pinnacle Rock					NA
	Jude					NA
	Chernabura					NA
	Atkins					NA
1975	Clubbing Rocks					NA
	Pinnacle Rock					NA
	Jude					NA
	Chernabura					NA
	Atkins					NA
1976	Clubbing Rocks	0	6	1217		NA
	Pinnacle Rock	0	6	1745		NA
	Jude	0	6	302		NA
	Chernabura	0	6	1437		NA
	Atkins	0	6	2726		NA
1977	Clubbing Rocks					NA
	Pinnacle Rock					NA
	Jude					NA
	Chernabura					NA
	Atkins					NA
1978	Clubbing Rocks	0	7	2663	725	3388
	Pinnacle Rock	0	7	3692	615	4307
	Jude					NA
	Chernabura	0	6	2758	545	3303
	Atkins	0	6	3943	2750	6693
1979	Clubbing Rocks	0	6	1162	1419	2581
	Pinnacle Rock	0	6	2731	2748	5479
	Jude					NA
	Chernabura	0	6	1504	646	2150
	Atkins	0	6	5000	4538	9538
1980	Clubbing Rocks					NA
	Pinnacle Rock					NA
	Jude					NA
	Chernabura					NA
	Atkins					NA
1981	Clubbing Rocks					NA
	Pinnacle Rock					NA
	Jude					NA
	Chernabura					NA
	Atkins					NA
1982	Clubbing Rocks					NA
	Pinnacle Rock					NA
	Jude					NA
	Chernabura					NA
	Atkins					NA
1983	Clubbing Rocks					NA
	Pinnacle Rock					NA
	Jude					NA
	Chernabura					NA
	Atkins					NA
1984	Clubbing Rocks				1394	NA
	Pinnacle Rock				2013	NA
	Jude					NA
	Chernabura				200	NA
	Atkins				2093	NA
1985	Clubbing Rocks	10	6	1251		NA
	Pinnacle Rock	10	6	1588		NA
	Jude					NA

Area 4

		day	month	adults	pups	Total
1985	Chernabura	10	6	487		NA
	Atkins	10	6	1562		NA
1986	Clubbing Rocks	6	7	1023		NA
	Pinnacle Rock	9	7	1932		NA
	Jude					NA
	Chernabura	9	7	456	379	835
	Atkins	9	7	1129	1072	2201
1987	Clubbing Rocks					NA
	Pinnacle Rock					NA
	Jude					NA
	Chernabura	1	5	150		NA
	Atkins	1	5	84		NA
1988	Clubbing Rocks					NA
	Pinnacle Rock					NA
	Jude					NA
	Chernabura					NA
	Atkins					NA
1989	Clubbing Rocks	15	6	856		NA
	Pinnacle Rock	15	6	1366		NA
	Jude					NA
	Chernabura	15	6	644		NA
	Atkins	15	6	755		NA
1990	Clubbing Rocks	22	6	1021		NA
	Pinnacle Rock	22	6	1305		NA
	Jude	16	6	200		NA
	Chernabura	23	6	442	193	635
	Atkins	23	6	728	435	1163

Area 5

Year	Site	Subsite	day	month	adults	pups	Total
1956	Adugak						NA
	Ogchul						NA
	Bogoslof						NA
	Akutan	Cape Morgan					NA
		North End					NA
		Reef - Lava					NA
		S. Shore					NA
	Akun	Akun Head					NA
		Billingshead					NA
	Ugamak						NA
	Sea Lion Rock	Amak	28	7	252	1	NA
		Amak/Sea lion rock	28	7	3780	1035	4815
1957	Adugak		30	9	1275	96	1371
	Ogchul		30	9	2966	425	3391
	Bogoslof		30	9	2136	1217	3353
	Akutan	Cape Morgan	30	9	5940	1111	7051
		North End	30	6	719		NA
		Reef - Lava	30	9	3335	624	3959
		S. Shore					NA
	Akun	Akun Head					NA
		Billingshead	13	8	1361	0	NA
	Ugamak		30	9	14536	1466	16002
	Sea Lion Rock	Amak	28	6	3016	0	NA
		Amak/Sea lion rock	28	6	2871	229	3100
1958	Adugak						NA
	Ogchul		30	9	2966		NA
	Bogoslof						NA
	Akutan	Cape Morgan					NA
		North End					NA
		Reef - Lava					NA
		S. Shore					NA
	Akun	Akun Head					NA
		Billingshead					NA
	Ugamak						NA
	Sea Lion Rock	Amak					NA
		Amak/Sea lion rock					NA
1959	Adugak						NA
	Ogchul						NA
	Bogoslof						NA
	Akutan	Cape Morgan					NA
		North End					NA
		Reef - Lava					NA
		S. Shore					NA
	Akun	Akun Head					NA
		Billingshead					NA
	Ugamak						NA
	Sea Lion Rock	Amak					NA
		Amak/Sea lion rock					NA
1960	Adugak		3	3	1000		NA
	Ogchul		3	3	2000		NA
	Bogoslof		3	3	1100		NA
	Akutan	Cape Morgan	3	3	9000		NA
		North End					NA
		Reef - Lava	3	3	6720		NA
		S. Shore					NA
	Akun	Akun Head	3	3	100		NA
		Billingshead	3	3	2000		NA
	Ugamak		3	3	13400		NA
	Sea Lion Rock	Amak	0	0	350		NA
		Amak/Sea lion rock	0	0	2000		NA
1961	Adugak						NA
	Ogchul						NA
	Bogoslof						NA
	Akutan	Cape Morgan					NA
		North End					NA
		Reef - Lava					NA
		S. Shore					NA
	Akun	Akun Head					NA
		Billingshead					NA
	Ugamak						NA
	Sea Lion Rock	Amak					NA
		Amak/Sea lion rock					NA
1962	Adugak						NA
	Ogchul						NA
	Bogoslof		26	8	2566	2885	5451
	Akutan	Cape Morgan	0	0	5700		NA
		North End					NA
		Reef - Lava					NA
		S. Shore					NA
	Akun	Akun Head					NA
		Billingshead					NA
	Ugamak		0	0	5400		NA
	Sea Lion Rock	Amak	0	0	2000		NA
		Amak/Sea lion rock	0	0	3500		NA
1963	Adugak						NA
	Ogchul						NA
	Bogoslof						NA
	Akutan	Cape Morgan					NA
		North End					NA
		Reef - Lava					NA
		S. Shore					NA
	Akun	Akun Head					NA
		Billingshead					NA
	Ugamak						NA
	Sea Lion Rock	Amak					NA
		Amak/Sea lion rock					NA
1964	Adugak						NA
	Ogchul						NA
	Bogoslof						NA
	Akutan	Cape Morgan					NA
		North End					NA
		Reef - Lava					NA
		S. Shore					NA
	Akun	Akun Head					NA
		Billingshead					NA
	Ugamak						NA
	Sea Lion Rock	Amak					NA
		Amak/Sea lion rock					NA
1965	Adugak		6	5	400		NA
	Ogchul						NA
	Bogoslof						NA
	Akutan	Cape Morgan	0	6	4400		NA
		North End					NA
		Reef - Lava					NA
		S. Shore					NA
	Akun	Akun Head					NA
		Billingshead					NA
	Ugamak		8	6	10975		NA
	Sea Lion Rock	Amak	8	6	4100		NA
		Amak/Sea lion rock					NA
1966	Adugak						NA
	Ogchul						NA
	Bogoslof						NA
	Akutan	Cape Morgan					NA
		North End					NA
		Reef - Lava					NA
		S. Shore					NA
	Akun	Akun Head					NA
		Billingshead					NA
	Ugamak						NA
	Sea Lion Rock	Amak					NA
		Amak/Sea lion rock					NA
1967	Adugak						NA
	Ogchul						NA
	Bogoslof						NA
	Akutan	Cape Morgan					NA
		North End					NA
		Reef - Lava					NA
		S. Shore					NA
	Akun	Akun Head					NA
		Billingshead					NA
	Ugamak						NA
	Sea Lion Rock	Amak					NA
		Amak/Sea lion rock					NA
1968	Adugak						NA
	Ogchul						NA
	Bogoslof				3310		NA
	Akutan	Cape Morgan	0	0	10316		NA

Area 5

			day	month	adults	pups	Total
1968	Akutan	North End	11	6	0		NA
		Reef - Lava	0	0	0		NA
		S. Shore	9	6	0		NA
	Akun	Akun Head	11	6	0		NA
		Billingshead	11	6	1900		NA
	Ugamak		18	6	13553		NA
	Sea Lion Rock	Amak					NA
		Amak/Sea lion rock					NA
1969	Adugak						NA
	Ogchul						NA
	Bogoslof						NA
	Akutan	Cape Morgan					NA
		North End					NA
		Reef - Lava					NA
		S. Shore					NA
	Akun	Akun Head					NA
		Billingshead					NA
	Ugamak						NA
	Sea Lion Rock	Amak					NA
		Amak/Sea lion rock					NA
1970	Adugak						NA
	Ogchul						NA
	Bogoslof						NA
	Akutan	Cape Morgan	13	6	9416		NA
		North End					NA
		Reef - Lava	13	6	910		NA
		S. Shore					NA
	Akun	Akun Head					NA
		Billingshead					NA
	Ugamak						NA
	Sea Lion Rock	Amak					NA
		Amak/Sea lion rock					NA
1971	Adugak						NA
	Ogchul						NA
	Bogoslof						NA
	Akutan	Cape Morgan					NA
		North End					NA
		Reef - Lava					NA
		S. Shore					NA
	Akun	Akun Head					NA
		Billingshead					NA
	Ugamak						NA
	Sea Lion Rock	Amak					NA
		Amak/Sea lion rock					NA
1972	Adugak						NA
	Ogchul						NA
	Bogoslof						NA
	Akutan	Cape Morgan					NA
		North End					NA
		Reef - Lava					NA
		S. Shore					NA
	Akun	Akun Head					NA
		Billingshead					NA
	Ugamak						NA
	Sea Lion Rock	Amak					NA
		Amak/Sea lion rock					NA
1973	Adugak						NA
	Ogchul						NA
	Bogoslof		29	6	3310	2328	5638
	Akutan	Cape Morgan					NA
		North End					NA
		Reef - Lava					NA
		S. Shore					NA
	Akun	Akun Head					NA
		Billingshead					NA
	Ugamak						NA
	Sea Lion Rock	Amak					NA
		Amak/Sea lion rock					NA
1974	Adugak						NA
	Ogchul						NA
	Bogoslof						NA
	Akutan	Cape Morgan					NA
		North End					NA
		Reef - Lava					NA
	Akutan	S. Shore					NA
	Akun	Akun Head	0	6	3		NA
		Billingshead					NA
	Ugamak						NA
	Sea Lion Rock	Amak					NA
		Amak/Sea lion rock					NA
1975	Adugak		0	6	1750		NA
	Ogchul		9	6	947		NA
	Bogoslof		0	6	1059		NA
	Akutan	Cape Morgan	0	6	3585		NA
		North End	17	6	0		NA
		Reef - Lava	0	6	364		NA
		S. Shore	0	6	7		NA
	Akun	Akun Head	18	6	0		NA
		Billingshead	0	6	2641		NA
	Ugamak		0	4	4569		NA
	Sea Lion Rock	Amak	0	6	2316		NA
		Amak/Sea lion rock	0	6	2360		NA
1976	Adugak		0	6	1177		NA
	Ogchul		19	6	1109		NA
	Bogoslof		0	6	3308	291	3599
	Akutan	Cape Morgan	0	6	3145		NA
		North End	18	6	0		NA
		Reef - Lava	0	6	674		NA
		S. Shore	0	6	0		NA
	Akun	Akun Head					NA
		Billingshead	0	6	1050		NA
	Ugamak		0	6	4760		NA
	Sea Lion Rock	Amak	0	6	1777		NA
		Amak/Sea lion rock	0	6	2076		NA
1977	Adugak		29	6	1842		NA
	Ogchul		28	6	1130		NA
	Bogoslof		29	6	2328		NA
	Akutan	Cape Morgan	28	6	2967		NA
		North End	28	6	3		NA
		Reef - Lava	28	6	302		NA
		S. Shore	28	6	0		NA
	Akun	Akun Head	28	6	0		NA
		Billingshead	28	6	1166		NA
	Ugamak		28	6	5106		NA
	Sea Lion Rock	Amak	28	6	1315		NA
		Amak/Sea lion rock	28	6	2227		NA
1978	Adugak						NA
	Ogchul						NA
	Bogoslof		31	5	1000		NA
	Akutan	Cape Morgan	0	0	2796		NA
		North End					NA
		Reef - Lava					NA
		S. Shore					NA
	Akun	Akun Head					NA
		Billingshead					NA
	Ugamak						NA
	Sea Lion Rock	Amak	19	6	688		NA
		Amak/Sea lion rock	19	6	1386		NA
1979	Adugak				1842	98	1940
	Ogchul				1130	140	1270
	Bogoslof		15	7	1463	914	2377
	Akutan	Cape Morgan					NA
		North End					NA
		Reef - Lava			2967		NA
		S. Shore					NA
	Akun	Akun Head	12	4	10		NA
		Billingshead	12	4	820		NA
	Ugamak				5408	871	6279
	Sea Lion Rock	Amak					NA
		Amak/Sea lion rock					NA
1980	Adugak						NA
	Ogchul						NA
	Bogoslof						NA
	Akutan	Cape Morgan					NA
		North End					NA
		Reef - Lava					NA
		S. Shore					NA
	Akun	Akun Head					NA

Area 5

			day	month	adults	pups	Total
1980	Akun	Billingshead					NA
	Ugamak						NA
	Sea Lion Rock	Amak					NA
		Amak/Sea lion rock					NA
1981	Adugak						NA
	Ogchul						NA
	Bogoslof						NA
	Akutan	Cape Morgan					NA
		North End					NA
		Reef - Lava					NA
		S. Shore					NA
	Akun	Akun Head					NA
		Billingshead					NA
	Ugamak						NA
	Sea Lion Rock	Amak					NA
		Amak/Sea lion rock					NA
1982	Adugak						NA
	Ogchul						NA
	Bogoslof						NA
	Akutan	Cape Morgan					NA
		North End					NA
		Reef - Lava					NA
		S. Shore					NA
	Akun	Akun Head					NA
		Billingshead					NA
	Ugamak						NA
	Sea Lion Rock	Amak					NA
		Amak/Sea lion rock					NA
1983	Adugak						NA
	Ogchul						NA
	Bogoslof						NA
	Akutan	Cape Morgan					NA
		North End					NA
		Reef - Lava					NA
		S. Shore					NA
	Akun	Akun Head					NA
		Billingshead					NA
	Ugamak						NA
	Sea Lion Rock	Amak					NA
		Amak/Sea lion rock					NA
1984	Adugak						NA
	Ogchul		11	7	712		NA
	Bogoslof				1379		NA
	Akutan	Cape Morgan	10	7	2064		NA
		North End					NA
		Reef - Lava	10	7	449		NA
		S. Shore					NA
	Akun	Akun Head					NA
		Billingshead	10	7	760		NA
	Ugamak		10	7	1252		NA
	Sea Lion Rock	Amak	8	7	353		NA
		Amak/Sea lion rock	8	7	1298		NA
1985	Adugak		11	6	955	844	1799
	Ogchul		11	6	547	172	719
	Bogoslof		11	6	1287	1109	2396
	Akutan	Cape Morgan	10	6	1269	1130	2399
		North End					NA
		Reef - Lava	10	6	441		NA
		S. Shore					NA
	Akun	Akun Head					NA
		Billingshead	10	6	435	60	495
	Ugamak		27	6	2185	1526	3711
	Sea Lion Rock	Amak	10	6	302		NA
		Amak/Sea lion rock	10	6	538		NA
1986	Adugak		10	7	915		NA
	Ogchul		10	7	486		NA
	Bogoslof						NA
	Akutan	Cape Morgan	10	7	1338		NA
		North End					NA
		Reef - Lava					NA
		S. Shore					NA
	Akun	Akun Head					NA
		Billingshead					NA
	Ugamak		1	7	1751	1386	3137
1986	Sea Lion Rock	Amak	29	6	599		NA
		Amak/Sea lion rock	29	6	527		NA
1987	Adugak		3	5	78		NA
	Ogchul		3	5	447		NA
	Bogoslof						NA
	Akutan	Cape Morgan	2	5	0		NA
		North End	2	5	0		NA
		Reef - Lava	2	5	564		NA
		S. Shore	2	5	0		NA
	Akun	Akun Head	2	5	0		NA
		Billingshead	2	5	100		NA
	Ugamak		2	5	748		NA
	Sea Lion Rock	Amak	2	5	399		NA
		Amak/Sea lion rock	2	5	733		NA
1988	Adugak						NA
	Ogchul						NA
	Bogoslof						NA
	Akutan	Cape Morgan					NA
		North End					NA
		Reef - Lava					NA
		S. Shore					NA
	Akun	Akun Head					NA
		Billingshead					NA
	Ugamak						NA
	Sea Lion Rock	Amak					NA
		Amak/Sea lion rock					NA
1989	Adugak		16	6	392		NA
	Ogchul		16	6	217		NA
	Bogoslof		16	6	682	381	1063
	Akutan	Cape Morgan	15	6	578		NA
		North End	15	6	0		NA
		Reef - Lava	15	6	0		NA
		S. Shore	15	6	0		NA
	Akun	Akun Head	15	6	0		NA
		Billingshead	15	6	150		NA
	Ugamak		15	6	450	434	884
	Sea Lion Rock	Amak	15	6	98		NA
		Amak/Sea lion rock	15	6	344		NA
1990	Adugak		17	6	350	262	612
	Ogchul		17	6	240		NA
	Bogoslof		17	6	713	461	1174
	Akutan	Cape Morgan	16	6	765	442	1207
		North End	16	6	0		NA
		Reef - Lava	16	6	40		NA
		S. Shore	16	6	0		NA
	Akun	Akun Head	16	6	0		NA
		Billingshead	16	6	118	63	181
	Ugamak		16	6	915	851	1766
	Sea Lion Rock	Amak	16	6	226		NA
		Amak/Sea lion rock	16	6	286		NA

Area 6

			day	month	adults	pups	Total
	Attu						NA
	Agattu						NA
	Buldir						NA
	Kiska	Cape ST Stec					NA
		Lief Cove					NA
		Other Sites					NA
		Sirius Point					NA
		Sobaka & Ve					NA
	Ayugadak						NA
	Amchitka	Column Rock					NA
		East Cape					NA
		Other					NA
1956	Semisopochnoi						NA
	Ulak						NA
	Tag						NA
	Gramp Rock						NA
	Adak	Cape Yatak					NA
		Lake Point					NA
		Other Site					NA
	Kasatochi						NA
	Agligadak						NA
	Seguam	Finch Point					NA
		Saddleridge					NA
		South					NA
	Yunaska						NA
	Attu						NA
	Agattu						NA
	Buldir						NA
	Kiska	Cape ST Stec					NA
		Lief Cove					NA
		Other Sites					NA
		Sirius Point					NA
		Sobaka & Ve					NA
	Ayugadak						NA
	Amchitka	Column Rock					NA
		East Cape					NA
		Other					NA
1957	Semisopochnoi						NA
	Ulak						NA
	Tag						NA
	Gramp Rock						NA
	Adak	Cape Yatak					NA
		Lake Point					NA
		Other Site					NA
	Kasatochi						NA
	Agligadak						NA
	Seguam	Finch Point					NA
		Saddleridge					NA
		South					NA
	Yunaska						NA
	Attu						NA
	Agattu						NA
	Buldir						NA
	Kiska	Cape ST Stec					NA
		Lief Cove					NA
		Other Sites					NA
		Sirius Point					NA
		Sobaka & Ve					NA
	Ayugadak						NA
	Amchitka	Column Rock					NA
		East Cape					NA
		Other					NA
1958	Semisopochnoi						NA
	Ulak						NA
	Tag						NA
	Gramp Rock						NA
	Adak	Cape Yatak					NA
		Lake Point					NA
		Other Site					NA
	Kasatochi						NA
	Agligadak						NA
	Seguam	Finch Point					NA
		Saddleridge					NA
		South					NA

			day	month	adults	pups	Total
1958	Yunaska						NA
	Attu		0	5	5010		NA
	Agattu		0	5	6700		NA
	Buldir		0	5	2500		NA
	Kiska	Cape ST Stec	19	5	1000		NA
		Lief Cove	19	5	0		NA
		Other Sites					NA
		Sirius Point					NA
		Sobaka & Ve	19	5	400		NA
	Ayugadak		19	5	600		NA
	Amchitka	Column Rock	19	5	600		NA
		East Cape	19	5	200		NA
		Other	19	5	450		NA
1959	Semisopochnoi		26	5	2500		NA
	Ulak		26	5	1500		NA
	Tag		26	5	400		NA
	Gramp Rock		26	5	700		NA
	Adak	Cape Yatak	24	5	800		NA
		Lake Point	24	5	2550		NA
		Other Site					NA
	Kasatochi						NA
	Agligadak						NA
	Seguam	Finch Point	27	5	100		NA
		Saddleridge	27	5	25		NA
		South	27	5	300		NA
	Yunaska						NA
	Attu						NA
	Agattu						NA
	Buldir						NA
	Kiska	Cape ST Stec					NA
		Lief Cove					NA
		Other Sites					NA
		Sirius Point					NA
		Sobaka & Ve					NA
	Ayugadak						NA
	Amchitka	Column Rock					NA
		East Cape					NA
		Other					NA
1960	Semisopochnoi						NA
	Ulak						NA
	Tag						NA
	Gramp Rock						NA
	Adak	Cape Yatak					NA
		Lake Point					NA
		Other Site					NA
	Kasatochi		27	5	200		NA
	Agligadak		26	5	250		NA
	Seguam	Finch Point					NA
		Saddleridge					NA
		South					NA
	Yunaska		27	5	800		NA
	Attu						NA
	Agattu						NA
	Buldir						NA
	Kiska	Cape ST Stec					NA
		Lief Cove					NA
		Other Sites					NA
		Sirius Point					NA
		Sobaka & Ve					NA
	Ayugadak						NA
	Amchitka	Column Rock					NA
		East Cape					NA
		Other					NA
1961	Semisopochnoi						NA
	Ulak						NA
	Tag						NA
	Gramp Rock						NA
	Adak	Cape Yatak					NA
		Lake Point					NA
		Other Site					NA
	Kasatochi						NA
	Agligadak						NA
	Seguam	Finch Point					NA
		Saddleridge					NA

Area 6

Year	Site		day	month	adults	pups	Total
1961	Seguam	South					NA
	Yunaska						NA
1962	Attu						NA
	Agattu						NA
	Buldir						NA
	Kiska	Cape ST Stec	29	3	800		NA
		Lief Cove	29	3	0		NA
		Other Sites	29	3	0		NA
		Sirius Point	29	3	0		NA
		Sobaka & Ve	29	3	200		NA
	Ayugadak		29	3	1005		NA
	Amchitka	Column Rock	29	3	1515		NA
		East Cape	29	3	25		NA
		Other	29	3	2560		NA
	Semisopochnoi		0	0	3700		NA
	Ulak						NA
	Tag		5	4	200		NA
	Gramp Rock		0	0	62		NA
	Adak	Cape Yatak	6	4	100		NA
		Lake Point					NA
		Other Site	6	4	200		NA
	Kasatochi		7	4	2000		NA
	Agligadak		7	4	3000		NA
	Seguam	Finch Point	7	4	200		NA
		Saddleridge	7	4	1275		NA
		South	7	4	700		NA
	Yunaska		7	4	110		NA
1963	Attu						NA
	Agattu						NA
	Buldir						NA
	Kiska	Cape ST Stec					NA
		Lief Cove					NA
		Other Sites					NA
		Sirius Point					NA
		Sobaka & Ve					NA
	Ayugadak						NA
	Amchitka	Column Rock					NA
		East Cape					NA
		Other					NA
	Semisopochnoi						NA
	Ulak						NA
	Tag						NA
	Gramp Rock						NA
	Adak	Cape Yatak					NA
		Lake Point					NA
		Other Site					NA
	Kasatochi						NA
	Agligadak						NA
	Seguam	Finch Point					NA
		Saddleridge					NA
		South					NA
	Yunaska						NA
1964	Attu						NA
	Agattu						NA
	Buldir						NA
	Kiska	Cape ST Stec					NA
		Lief Cove					NA
		Other Sites					NA
		Sirius Point					NA
		Sobaka & Ve					NA
	Ayugadak						NA
	Amchitka	Column Rock					NA
		East Cape					NA
		Other					NA
	Semisopochnoi						NA
	Ulak						NA
	Tag						NA
	Gramp Rock						NA
	Adak	Cape Yatak					NA
		Lake Point					NA
		Other Site					NA
	Kasatochi						NA
	Agligadak						NA
	Seguam	Finch Point					NA

Year	Site		day	month	adults	pups	Total
1964	Seguam	Saddleridge					NA
		South					NA
	Yunaska						NA
1965	Attu		2	5	4000		NA
	Agattu		2	5	1300		NA
	Buldir		2	5	3500		NA
	Kiska	Cape ST Stec	2	5	800		NA
		Lief Cove	2	5	150		NA
		Other Sites	2	5	250		NA
		Sirius Point	2	5	250		NA
		Sobaka & Ve	2	5	235		NA
	Ayugadak		2	5	400		NA
	Amchitka	Column Rock	2	5	200		NA
		East Cape	2	5	200		NA
		Other	2	5	310		NA
	Semisopochnoi		3	5	1100		NA
	Ulak		2	5	300		NA
	Tag		2	5	0		NA
	Gramp Rock		2	5	75		NA
	Adak	Cape Yatak	26	4	100		NA
		Lake Point					NA
		Other Site	26	4	510		NA
	Kasatochi						NA
	Agligadak		21	4	900		NA
	Seguam	Finch Point	6	5	500		NA
		Saddleridge	6	5	3230		NA
		South	6	5	670		NA
	Yunaska		21	4	350		NA
1966	Attu						NA
	Agattu						NA
	Buldir						NA
	Kiska	Cape ST Stec					NA
		Lief Cove					NA
		Other Sites					NA
		Sirius Point					NA
		Sobaka & Ve					NA
	Ayugadak						NA
	Amchitka	Column Rock					NA
		East Cape					NA
		Other					NA
	Semisopochnoi						NA
	Ulak						NA
	Tag						NA
	Gramp Rock						NA
	Adak	Cape Yatak					NA
		Lake Point					NA
		Other Site					NA
	Kasatochi						NA
	Agligadak						NA
	Seguam	Finch Point					NA
		Saddleridge					NA
		South					NA
	Yunaska						NA
1967	Attu						NA
	Agattu						NA
	Buldir						NA
	Kiska	Cape ST Stec					NA
		Lief Cove					NA
		Other Sites					NA
		Sirius Point					NA
		Sobaka & Ve					NA
	Ayugadak						NA
	Amchitka	Column Rock					NA
		East Cape					NA
		Other					NA
	Semisopochnoi						NA
	Ulak						NA
	Tag						NA
	Gramp Rock						NA
	Adak	Cape Yatak					NA
		Lake Point					NA
		Other Site					NA
	Kasatochi						NA
	Agligadak						NA

Area 6

Year	Site	Subsite	day	month	adults	pups	Total
1967	Seguam	Finch Point					NA
		Saddleridge					NA
		South					NA
	Yunaska						NA
1968	Attu		0	7	6575		NA
	Agattu		0	7	300		NA
	Buldir		0	7	7600		NA
	Kiska	Cape ST Ste					NA
		Lief Cove					NA
		Other Sites					NA
		Sirius Point					NA
		Sobaka & Ve					NA
	Ayugadak						NA
	Amchitka	Column Rock					NA
		East Cape					NA
		Other					NA
	Semisopochnoi						NA
	Ulak		5	4	550		NA
	Tag						NA
	Gramp Rock						NA
	Adak	Cape Yakak					NA
		Lake Point					NA
		Other Site					NA
	Kasatochi						NA
	Agligadak						NA
	Seguam	Finch Point					NA
		Saddleridge					NA
		South					NA
	Yunaska						NA
1969	Attu						NA
	Agattu						NA
	Buldir						NA
	Kiska	Cape ST Ste					NA
		Lief Cove					NA
		Other Sites					NA
		Sirius Point					NA
		Sobaka & Ve					NA
	Ayugadak						NA
	Amchitka	Column Rock					NA
		East Cape					NA
		Other					NA
	Semisopochnoi						NA
	Ulak						NA
	Tag						NA
	Gramp Rock						NA
	Adak	Cape Yakak					NA
		Lake Point					NA
		Other Site					NA
	Kasatochi						NA
	Agligadak						NA
	Seguam	Finch Point					NA
		Saddleridge					NA
		South					NA
	Yunaska						NA
1970	Attu		0	0			NA
	Agattu		0	0	9385		NA
	Buldir		0	0	4350		NA
	Kiska	Cape ST Ste					NA
		Lief Cove					NA
		Other Sites					NA
		Sirius Point					NA
		Sobaka & Ve					NA
	Ayugadak						NA
	Amchitka	Column Rock					NA
		East Cape					NA
		Other					NA
	Semisopochnoi						NA
	Ulak						NA
	Tag						NA
	Gramp Rock						NA
	Adak	Cape Yakak					NA
		Lake Point					NA
		Other Site					NA
	Kasatochi						NA
	Agligadak						NA
	Seguam	Finch Point					NA
		Saddleridge					NA
		South					NA
	Yunaska						NA
1971	Attu						NA
	Agattu						NA
	Buldir		23	6	5024		NA
	Kiska	Cape ST Ste					NA
		Lief Cove					NA
		Other Sites					NA
		Sirius Point					NA
		Sobaka & Ve					NA
	Ayugadak						NA
	Amchitka	Column Rock					NA
		East Cape					NA
		Other					NA
	Semisopochnoi						NA
	Ulak						NA
	Tag						NA
	Gramp Rock						NA
	Adak	Cape Yakak					NA
		Lake Point					NA
		Other Site					NA
	Kasatochi						NA
	Agligadak						NA
	Seguam	Finch Point					NA
		Saddleridge					NA
		South					NA
	Yunaska						NA
1972	Attu						NA
	Agattu						NA
	Buldir						NA
	Kiska	Cape ST Ste					NA
		Lief Cove					NA
		Other Sites					NA
		Sirius Point					NA
		Sobaka & Ve					NA
	Ayugadak						NA
	Amchitka	Column Rock					NA
		East Cape					NA
		Other					NA
	Semisopochnoi						NA
	Ulak						NA
	Tag						NA
	Gramp Rock						NA
	Adak	Cape Yakak					NA
		Lake Point					NA
		Other Site					NA
	Kasatochi						NA
	Agligadak						NA
	Seguam	Finch Point					NA
		Saddleridge					NA
		South					NA
	Yunaska						NA
1973	Attu						NA
	Agattu						NA
	Buldir						NA
	Kiska	Cape ST Ste					NA
		Lief Cove					NA
		Other Sites					NA
		Sirius Point					NA
		Sobaka & Ve					NA
	Ayugadak						NA
	Amchitka	Column Rock					NA
		East Cape					NA
		Other					NA
	Semisopochnoi						NA
	Ulak						NA
	Tag						NA
	Gramp Rock						NA
	Adak	Cape Yakak					NA
		Lake Point					NA
		Other Site					NA

			day	month	adults	pups	Total
1973	Kasatochi						NA
	Agligadak						NA
	Seguam	Finch Point					NA
		Saddleridge					NA
		South					NA
	Yunaska						NA
1974	Attu						NA
	Agattu						NA
	Buldir						NA
	Kiska	Cape ST Stec					NA
		Lief Cove					NA
		Other Sites					NA
		Sirius Point					NA
		Sobeka & Ve					NA
	Ayugadak						NA
	Amchitka	Column Rock					NA
		East Cape					NA
		Other					NA
	Semisopochnoi						NA
	Ulak						NA
	Tag						NA
	Gramp Rock						NA
	Adak	Cape Yatak					NA
		Lake Point					NA
		Other Site					NA
	Kasatochi						NA
	Agligadak						NA
	Seguam	Finch Point					NA
		Saddleridge					NA
		South					NA
	Yunaska						NA
1975	Attu						NA
	Agattu						NA
	Buldir						NA
	Kiska	Cape ST Stec					NA
		Lief Cove					NA
		Other Sites					NA
		Sirius Point					NA
		Sobeka & Ve					NA
	Ayugadak						NA
	Amchitka	Column Rock					NA
		East Cape					NA
		Other					NA
	Semisopochnoi						NA
	Ulak						NA
	Tag						NA
	Gramp Rock						NA
	Adak	Cape Yatak					NA
		Lake Point					NA
		Other Site					NA
	Kasatochi						NA
	Agligadak						NA
	Seguam	Finch Point					NA
		Saddleridge					NA
		South					NA
	Yunaska						NA
1976	Attu						NA
	Agattu						NA
	Buldir						NA
	Kiska	Cape ST Stec					NA
		Lief Cove					NA
		Other Sites					NA
		Sirius Point					NA
		Sobeka & Ve					NA
	Ayugadak						NA
	Amchitka	Column Rock					NA
		East Cape					NA
		Other					NA
	Semisopochnoi						NA
	Ulak						NA
	Tag						NA
	Gramp Rock						NA
	Adak	Cape Yatak					NA
		Lake Point					NA
	Adak	Other Site					NA
	Kasatochi						NA
	Agligadak						NA
	Seguam	Finch Point					NA
		Saddleridge					NA
		South					NA
	Yunaska						NA
1977	Attu						NA
	Agattu						NA
	Buldir						NA
	Kiska	Cape ST Stec					NA
		Lief Cove					NA
		Other Sites					NA
		Sirius Point					NA
		Sobeka & Ve					NA
	Ayugadak						NA
	Amchitka	Column Rock					NA
		East Cape					NA
		Other					NA
	Semisopochnoi		0	7	1223		NA
	Ulak		0	7	3068	827	3895
	Tag		31	7	1613		NA
	Gramp Rock		31	7	2235		NA
	Adak	Cape Yatak					NA
		Lake Point					NA
		Other Site					NA
	Kasatochi						NA
	Agligadak						NA
	Seguam	Finch Point					NA
		Saddleridge					NA
		South					NA
	Yunaska						NA
1978	Attu						NA
	Agattu		0	7	9600		NA
	Buldir						NA
	Kiska	Cape ST Stec	9	8	1350		NA
		Lief Cove	9	8	3750		NA
		Other Sites	9	8	22		NA
		Sirius Point	9	8	22		NA
		Sobeka & Ve	9	8	930		NA
	Ayugadak						NA
	Amchitka	Column Rock					NA
		East Cape					NA
		Other					NA
	Semisopochnoi						NA
	Ulak						NA
	Tag						NA
	Gramp Rock						NA
	Adak	Cape Yatak					NA
		Lake Point					NA
		Other Site					NA
	Kasatochi						NA
	Agligadak						NA
	Seguam	Finch Point					NA
		Saddleridge					NA
		South					NA
	Yunaska						NA
1979	Attu		8	7	2141	642	2783
	Agattu		6	7	7150	707	7857
	Buldir				3137	985	4122
	Kiska	Cape ST Stec	8	7	2511	137	2648
		Lief Cove	8	7	5166	476	5642
		Other Sites	8	7	2	0	NA
		Sirius Point	8	7	2	0	NA
		Sobeka & Ve	8	7	50	0	NA
	Ayugadak		7	7	1463	22	1485
	Amchitka	Column Rock	3	7	1943	135	2078
		East Cape	3	7	639	0	NA
		Other	3	7	440	0	NA
	Semisopochnoi		3	7	556	25	581
	Ulak		0	7	2170	204	2374
	Tag		1	7	1740		NA
	Gramp Rock		2	7	1705		NA
	Adak	Cape Yatak	28	6	270		NA

Area 6

			day	month	adults	pups	Total
1979	Adak	Lake Point	28	6	1075	20	1095
		Other Site	28	6	2		NA
	Kasatochi		25	6	1963	213	2166
	Agligadak		22	6	993		NA
	Seguam	Finch Point	21	6	42	0	NA
		Saddleridge	21	6	3514	2407	5921
		South	21	6	1197	87	1284
	Yunaska		19	6	1497	752	2249
1980	Attu						NA
	Agattu						NA
	Buldir						NA
	Kiska	Cape ST Stec					NA
		Lief Cove					NA
		Other Sites					NA
		Sirius Point					NA
		Sobaka & Ve					NA
	Ayugadak						NA
	Amchitka	Column Rock					NA
		East Cape					NA
		Other					NA
	Semisopochnoi						NA
	Ulak						NA
	Tag						NA
	Gramp Rock						NA
	Adak	Cape Yatak					NA
		Lake Point					NA
		Other Site					NA
	Kasatochi						NA
	Agligadak						NA
	Seguam	Finch Point					NA
		Saddleridge					NA
		South					NA
	Yunaska						NA
1981	Attu						NA
	Agattu						NA
	Buldir						NA
	Kiska	Cape ST Stec					NA
		Lief Cove					NA
		Other Sites					NA
		Sirius Point					NA
		Sobaka & Ve					NA
	Ayugadak						NA
	Amchitka	Column Rock					NA
		East Cape					NA
		Other					NA
	Semisopochnoi						NA
	Ulak						NA
	Tag						NA
	Gramp Rock						NA
	Adak	Cape Yatak					NA
		Lake Point					NA
		Other Site					NA
	Kasatochi						NA
	Agligadak						NA
	Seguam	Finch Point					NA
		Saddleridge					NA
		South					NA
	Yunaska						NA
1982	Attu						NA
	Agattu						NA
	Buldir						NA
	Kiska	Cape ST Stec					NA
		Lief Cove					NA
		Other Sites					NA
		Sirius Point					NA
		Sobaka & Ve					NA
	Ayugadak						NA
	Amchitka	Column Rock					NA
		East Cape					NA
		Other					NA
	Semisopochnoi						NA
	Ulak						NA
	Tag						NA
	Gramp Rock						NA

			day	month	adults	pups	Total
1982	Adak	Cape Yatak					NA
		Lake Point					NA
		Other Site					NA
	Kasatochi						NA
	Agligadak						NA
	Seguam	Finch Point					NA
		Saddleridge					NA
		South					NA
	Yunaska						NA
1983	Attu						NA
	Agattu						NA
	Buldir						NA
	Kiska	Cape ST Stec					NA
		Lief Cove					NA
		Other Sites					NA
		Sirius Point					NA
		Sobaka & Ve					NA
	Ayugadak						NA
	Amchitka	Column Rock					NA
		East Cape					NA
		Other					NA
	Semisopochnoi						NA
	Ulak						NA
	Tag						NA
	Gramp Rock						NA
	Adak	Cape Yatak					NA
		Lake Point					NA
		Other Site					NA
	Kasatochi						NA
	Agligadak						NA
	Seguam	Finch Point					NA
		Saddleridge					NA
		South					NA
	Yunaska						NA
984	Attu						NA
	Agattu						NA
	Buldir						NA
	Kiska	Cape ST Stec					NA
		Lief Cove					NA
		Other Sites					NA
		Sirius Point					NA
		Sobaka & Ve					NA
	Ayugadak						NA
	Amchitka	Column Rock					NA
		East Cape					NA
		Other					NA
	Semisopochnoi						NA
	Ulak						NA
	Tag						NA
	Gramp Rock						NA
	Adak	Cape Yatak					NA
		Lake Point					NA
		Other Site					NA
	Kasatochi						NA
	Agligadak						NA
	Seguam	Finch Point					NA
		Saddleridge					NA
		South					NA
	Yunaska						NA
85	Attu		0	0	4000		NA
	Agattu		23	6	3130		NA
	Buldir						NA
	Kiska	Cape ST Stec	13	6	1351		NA
		Lief Cove	13	6	1715	882	2597
		Other Sites	13	6	0		NA
		Sirius Point	13	6	0		NA
		Sobaka & Ve	13	6	297		NA
	Ayugadak		13	6	702	329	1031
	Amchitka	Column Rock	13	6	728		NA
		East Cape	13	6	1005		NA
		Other	13	6	0		NA
	Semisopochnoi						NA
	Ulak		13	6	2729	1236	3965
	Tag		13	6	944	703	1647

Area 6

			day	month	adults	pups	Total
	Gramp Rock		13	6	1290	909	2199
	Adak	Cape Yatak	13	6	325		NA
		Lake Point	13	6	964	558	1522
		Other Site	13	6	0		NA
1985	Kasatochi		12	6	1170	892	2062
	Agligadak		12	6	514	30	544
	Seguam	Finch Point	12	6	57		NA
		Saddleridge	12	6	2942	2635	5577
		South	12	6	607		NA
	Yunaska		11	6	1071	1026	2097
	Attu						NA
	Agattu						NA
	Buldir						NA
	Kiska	Cape ST Stec					NA
		Lief Cove					NA
		Other Sites					NA
		Sirius Point					NA
		Sobaka & Ve					NA
	Ayugadak						NA
	Amchitka	Column Rock					NA
		East Cape					NA
		Other					NA
1986	Semisopochnoi						NA
	Ulak						NA
	Tag						NA
	Gramp Rock						NA
	Adak	Cape Yatak					NA
		Lake Point					NA
		Other Site					NA
	Kasatochi						NA
	Agligadak						NA
	Seguam	Finch Point					NA
		Saddleridge					NA
		South					NA
	Yunaska						NA
	Attu		8	5	662		NA
	Agattu		8	5	749		NA
	Buldir		8	5	625		NA
	Kiska	Cape ST Stec	8	5	502		NA
		Lief Cove	8	5	1210		NA
		Other Sites	8	5	109		NA
		Sirius Point	8	5	109		NA
		Sobaka & Ve	8	5	113		NA
	Ayugadak		6	5	149		NA
	Amchitka	Column Rock					NA
		East Cape	6	5	495		NA
		Other	6	7	299		NA
987	Semisopochnoi		6	5	222		NA
	Ulak		6	5	251		NA
	Tag		6	5	47		NA
	Gramp Rock		6	5	178		NA
	Adak	Cape Yatak	4	6	37		NA
		Lake Point	4	5	224		NA
		Other Site	4	5	2		NA
	Kasatochi		3	5	769		NA
	Agligadak		3	5	25		NA
	Seguam	Finch Point	3	5	347		NA
		Saddleridge	3	5	951		NA
		South	3	5	298		NA
	Yunaska		3	5	193		NA
	Attu		0	6	1203	110	1313
	Agattu		0	6	1783	1218	3001
	Buldir		0	6	1396	160	1556
	Kiska	Cape ST Stec					NA
		Lief Cove			270	305	575
		Other Sites					NA
88		Sirius Point					NA
		Sobaka & Ve					NA
	Ayugadak						NA
	Amchitka	Column Rock					NA
		East Cape					NA
		Other					NA
	Semisopochnoi						NA
	Ulak						NA

			day	month	adults	pups	Total
	Tag						NA
	Gramp Rock						NA
	Adak	Cape Yatak					NA
		Lake Point					NA
		Other Site					NA
1988	Kasatochi						NA
	Agligadak						NA
	Seguam	Finch Point					NA
		Saddleridge					NA
		South					NA
	Yunaska						NA
	Attu						NA
	Agattu		29	6	1680	1153	2833
	Buldir		29	6	1039	463	1502
	Kiska	Cape ST Stec	20	6	464		NA
		Lief Cove	20	6	510	559	1069
		Other Sites	20	6	0		NA
		Sirius Point	20	6	0		NA
		Sobaka & Ve	20	6	52		NA
	Ayugadak		20	6	389		NA
	Amchitka	Column Rock					NA
		East Cape	20	6	20		NA
		Other	20	6	0		NA
1989	Semisopochnoi						NA
	Ulak		20	6	1123		NA
	Tag		20	6	590		NA
	Gramp Rock		20	6	590	747	1337
	Adak	Cape Yatak	20	6	424		NA
		Lake Point	20	6	0		NA
		Other Site	20	6	0		NA
	Kasatochi		17	6	659		NA
	Agligadak		17	6	132		NA
	Seguam	Finch Point	17	6	0		NA
		Saddleridge	17	6	602	556	1158
		South	17	6	107		NA
	Yunaska		17	6	466		NA
	Attu						NA
	Agattu		0	7	1199	1127	2326
	Buldir		0	7	0.666	381	NA
	Kiska	Cape ST Stec	15	7	564	212	776
		Lief Cove	15	7	528	221	749
		Other Sites	15	7			NA
		Sirius Point					NA
		Sobaka & Ve					NA
	Ayugadak		14	7	401	163	564
	Amchitka	Column Rock	13	7	197	148	345
		East Cape	20	6	106		NA
		Other	20	6	0		NA
1990	Semisopochnoi						NA
	Ulak		20	6	1324	790	2114
	Tag		20	6	478	357	835
	Gramp Rock		20	6	712	448	1160
	Adak	Cape Yatak					NA
		Lake Point	20	6	592	137	729
		Other Site	20	6	0		NA
	Kasatochi		20	6	641	178	819
	Agligadak		20	6	274	0	NA
	Seguam	Finch Point					NA
		Saddleridge	20	6	833	684	1517
		South	20	6	181		NA
	Yunaska		17	6	391	230	621

APPENDIX 2. Total Steller sea lion population size estimated from pup and adult counts, The number counted is the sum of counts from Appendix 1. The numbers of pups and adults were estimated for rookeries not censused. Total count is the sum of counts and estimates. The total estimated population size is derived from equations 3.1 and 3.2.

Total Area 1

		adults	pups	Total
1956	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1957	Number Counted	2500	0	NA
	Number Estimated			NA
	Total Count	2500	0	NA
	Estimated Population	4125	0	4125
1958	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1959	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1960	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1961	Number Counted	1300	1096	2396
	Number Estimated		0	NA
	Total Count	1300	1096	2396
	Estimated Population	2145	5594	5594
1962	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1963	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1964	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1965	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1966	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1967	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1968	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1969	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1970	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1971	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1972	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1973	Number Counted	3767	2400	6167
	Number Estimated		0	NA
	Total Count	3767	2400	6167
	Estimated Population	6249	12250	12250

		adults	pups	Total
1974	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1975	Number Counted		0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1976	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1977	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1978	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1979	Number Counted	4775	2220	6995
	Number Estimated		0	NA
	Total Count	4775	2220	6995
	Estimated Population	7879	11331	11331
1980	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1981	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1982	Number Counted	5979	2227	8206
	Number Estimated		210	NA
	Total Count	5979	2437	8416
	Estimated Population	9865	12438	12438
1983	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1984	Number Counted	0	2568	NA
	Number Estimated		320	NA
	Total Count	0	2888	NA
	Estimated Population	0	14740	14740
1985	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1986	Number Counted	0	1954	NA
	Number Estimated		485	NA
	Total Count	0	2439	NA
	Estimated Population	0	12449	12449
1987	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1988	Number Counted	0	2202	NA
	Number Estimated		600	NA
	Total Count	0	2802	NA
	Estimated Population	0	14301	14301
1989	Number Counted	6844	2844	9688
	Number Estimated		665	NA
	Total Count	6844	3509	10353
	Estimated Population	11293	17910	17910
1990	Number Counted	5491	3570	9061
	Number Estimated		80	NA
	Total Count	5491	3650	9141
	Estimated Population	9060	18630	18630
1991	Number Counted	5786	4164	9950
	Number Estimated			NA
	Total Count	5786	4164	9950
	Estimated Population	9547	21253	21253

Total Area 2

		adults	pups	Total
1956	Number Counted	628	234	862
	Number Estimated			0
	Total Count	628	234	862
	Estimated Population	1036	1194	1194
1957	Number Counted	3000	0	3000
	Number Estimated	200		200
	Total Count	3200	0	3200
	Estimated Population	5280	0	5280
1958	Number Counted	0	0	0
	Number Estimated			0
	Total Count	0	0	0
	Estimated Population	0	0	0
1959	Number Counted	0	0	0
	Number Estimated			0
	Total Count	0	0	0
	Estimated Population	0	0	0
1960	Number Counted	0	0	0
	Number Estimated			0
	Total Count	0	0	0
	Estimated Population	0	0	0
1961	Number Counted	0	0	0
	Number Estimated			0
	Total Count	0	0	0
	Estimated Population	0	0	0
1962	Number Counted	0	0	0
	Number Estimated			0
	Total Count	0	0	0
	Estimated Population	0	0	0
1963	Number Counted	0	0	0
	Number Estimated			0
	Total Count	0	0	0
	Estimated Population	0	0	0
1964	Number Counted	0	0	0
	Number Estimated			0
	Total Count	0	0	0
	Estimated Population	0	0	0
1965	Number Counted	0	0	0
	Number Estimated			0
	Total Count	0	0	0
	Estimated Population	0	0	0
1966	Number Counted	0	0	646
	Number Estimated			0
	Total Count	0	0	0
	Estimated Population	0	0	0
1967	Number Counted	0	0	0
	Number Estimated			0
	Total Count	0	0	0
	Estimated Population	0	0	0
1968	Number Counted	1500	49	1549
	Number Estimated	1300	150	1450
	Total Count	2800	199	2999
	Estimated Population	4620	1016	4620
1969	Number Counted	0	0	0
	Number Estimated			0
	Total Count	0	0	0
	Estimated Population	0	0	0
1970	Number Counted	0	0	0
	Number Estimated			0
	Total Count	0	0	0
	Estimated Population	0	0	0
1971	Number Counted	0	0	0
	Number Estimated			0
	Total Count	0	0	0
	Estimated Population	0	0	0
1972	Number Counted	0	0	0
	Number Estimated			0
	Total Count	0	0	0
	Estimated Population	0	0	0
1973	Number Counted	2776	226	3002
	Number Estimated	0		0
	Total Count	2776	226	3002
	Estimated Population	4580	1154	4580
1974	Number Counted	0	0	0
1974	Number Estimated			0
	Total Count	0	0	0
	Estimated Population	0	0	0
1975	Number Counted	0	0	0
	Number Estimated			0
	Total Count	0	0	0
	Estimated Population	0	0	0
1976	Number Counted	2587	351	2938
	Number Estimated			0
	Total Count	2587	351	2938
	Estimated Population	4269	1792	4269
1977	Number Counted	0	0	0
	Number Estimated			0
	Total Count	0	0	0
	Estimated Population	0	0	0
1978	Number Counted	2463	544	3007
	Number Estimated	1000		1000
	Total Count	3463	544	4007
	Estimated Population	5714	2777	5714
1979	Number Counted	2961	491	3452
	Number Estimated	1000		1000
	Total Count	3961	491	4452
	Estimated Population	6536	2506	6536
1980	Number Counted	0	0	0
	Number Estimated			0
	Total Count	0	0	0
	Estimated Population	0	0	0
1981	Number Counted	0	0	0
	Number Estimated			0
	Total Count	0	0	0
	Estimated Population	0	0	0
1982	Number Counted	0	0	0
	Number Estimated			0
	Total Count	0	0	0
	Estimated Population	0	0	0
1983	Number Counted	0	0	0
	Number Estimated			0
	Total Count	0	0	0
	Estimated Population	0	0	0
1984	Number Counted	3000	799	3799
	Number Estimated	1000		1000
	Total Count	4000	799	4799
	Estimated Population	6600	4078	6600
1985	Number Counted	0	0	0
	Number Estimated			0
	Total Count	0	0	0
	Estimated Population	0	0	0
1986	Number Counted	0	0	0
	Number Estimated			0
	Total Count	0	0	0
	Estimated Population	0	0	0
1987	Number Counted	0	0	0
	Number Estimated			0
	Total Count	0	0	0
	Estimated Population	0	0	0
1988	Number Counted	0	0	0
	Number Estimated			0
	Total Count	0	0	0
	Estimated Population	0	0	0
1989	Number Counted	3492	553	4045
	Number Estimated			0
	Total Count	3492	553	4045
	Estimated Population	5762	2823	5762
1990	Number Counted	1471	571	2042
	Number Estimated	1000		1000
	Total Count	2471	571	3042
	Estimated Population	4077	2914	4077
1991	Number Counted	1220	657	1877
	Number Estimated	1000		1000
	Total Count	2220	657	2877
	Estimated Population	3663	3353	3663

Total Area 3

		adults	pups	Total
1956	Number Counted	11375	5594	16969
	Number Estimated	3159	6000	9159
	Total Count	14534	11594	26128
	Estimated Population	23981	59176	59176
1957	Number Counted	25536	3333	28869
	Number Estimated	1930	7000	8930
	Total Count	27466	10333	37799
	Estimated Population	45319	52740	52740
1958	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1959	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1960	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1961	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1962	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1963	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1964	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1965	Number Counted		3391	NA
	Number Estimated		10800	NA
	Total Count	0	14191	NA
	Estimated Population	0	72431	72431
1966	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1967	Number Counted	0	11100	NA
	Number Estimated		5650	NA
	Total Count	0	16750	NA
	Estimated Population	0	85492	85492
1968	Number Counted	0	8000	NA
	Number Estimated		5700	NA
	Total Count	0	13700	NA
	Estimated Population	0	69925	69925
1969	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1970	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1971	Number Counted	0	3650	NA
	Number Estimated		10150	NA
	Total Count	0	13800	NA
	Estimated Population	0	70435	70435
1972	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1973	Number Counted	31500	0	NA
	Number Estimated			NA
	Total Count	31500	0	NA
	Estimated Population	51975	0	51975
1974	Number Counted	0	0	NA

		adults	pups	Total
1974	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1975	Number Counted		8000	NA
	Number Estimated		6000	NA
	Total Count	0	14000	NA
	Estimated Population	0	71456	71456
1976	Number Counted	22372	9854	32226
	Number Estimated		4400	NA
	Total Count	22372	14254	36626
	Estimated Population	36914	72752	72752
1977	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1978	Number Counted	24576	17835	42411
	Number Estimated			NA
	Total Count	24576	17835	42411
	Estimated Population	40550	91030	91030
1979	Number Counted	23650	19686	43436
	Number Estimated			NA
	Total Count	23650	19686	43436
	Estimated Population	36658	101498	101498
1980	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1981	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1982	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1983	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1984	Number Counted	0	15019	NA
	Number Estimated			NA
	Total Count	0	15019	NA
	Estimated Population	0	76657	76657
1985	Number Counted	10520	0	NA
	Number Estimated	1400		NA
	Total Count	11920	0	NA
	Estimated Population	19668	0	19668
1986	Number Counted		11688	NA
	Number Estimated			NA
	Total Count	0	11688	NA
	Estimated Population	0	59656	59656
1987	Number Counted		0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1988	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1989	Number Counted	6600	6394	12994
	Number Estimated			NA
	Total Count	6600	6394	12994
	Estimated Population	10890	32635	32635
1990	Number Counted	5013	951	5964
	Number Estimated		3900	NA
	Total Count	5013	4851	9864
	Estimated Population	8271	24760	24760

Total Area 4

Year		adults	pups	Total
1956	Number Counted	10846	3773	14619
	Number Estimated			NA
	Total Count	10846	3773	14619
	Estimated Population	17896	19257	19257
1957	Number Counted	17179	4070	21249
	Number Estimated			NA
	Total Count	17179	4070	21249
	Estimated Population	28345	20773	28345
1958	Number Counted	7376	1714	9090
	Number Estimated	4500	1800	6300
	Total Count	11876	3514	15390
	Estimated Population	19595	17935	19595
1959	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1960	Number Counted		0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1961	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1962	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1963	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1964	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1965	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1966	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1967	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1968	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1969	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1970	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1971	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1972	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1973	Number Counted	14680	0	NA
	Number Estimated			NA
	Total Count	14680	0	NA
	Estimated Population	24222	0	24222
1974	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1975	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1976	Number Counted	7427	0	NA
	Number Estimated			NA
	Total Count	7427	0	NA
	Estimated Population	12255	0	12255
1977	Number Counted		0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1978	Number Counted	13056	4635	17691
	Number Estimated		2500	NA
	Total Count	13056	7135	20191
	Estimated Population	21542	36417	36417
1979	Number Counted	10397	9351	19748
	Number Estimated		50	NA
	Total Count	10397	9401	19798
	Estimated Population	17155	47963	47963
1980	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1981	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1982	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1983	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1984	Number Counted	0	5700	NA
	Number Estimated			NA
	Total Count	0	5700	NA
	Estimated Population	0	29093	29093
1985	Number Counted	4888	0	NA
	Number Estimated			NA
	Total Count	4888	0	NA
	Estimated Population	8065	0	8065
1986	Number Counted	4540	1451	5991
	Number Estimated		2200	NA
	Total Count	4540	3651	8191
	Estimated Population	7491	18635	18635
1987	Number Counted		0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1988	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1989	Number Counted	3521	0	NA
	Number Estimated			NA
	Total Count	3521	0	NA
	Estimated Population	5810	0	5810
1990	Number Counted	3696	628	4324
	Number Estimated		900	NA
	Total Count	3696	1528	5224
	Estimated Population	6098	7799	7799

Total Area 5

Year		adults	pups	Total
1956	Number Counted			NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1957	Number Counted	34101	4544	38645
	Number Estimated	0	650	NA
	Total Count	34101	5194	39295
	Estimated Population	56267	26510	56267
1958	Number Counted		0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1959	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1960	Number Counted	30850	0	NA
	Number Estimated	0		NA
	Total Count	30850	0	NA
	Estimated Population	50903	0	50903
1961	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1962	Number Counted	19166	2885	22051
	Number Estimated	5100	7250	12350
	Total Count	24266	10135	34401
	Estimated Population	40039	51729	51729
1963	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1964	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1965	Number Counted	19875	0	NA
	Number Estimated	3800		NA
	Total Count	23675	0	NA
	Estimated Population	39064	0	39064
1966	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1967	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1968	Number Counted	29079	0	NA
	Number Estimated	6000		NA
	Total Count	35079	0	NA
	Estimated Population	57880	0	57880
1969	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1970	Number Counted	9416	0	NA
	Number Estimated	19200		NA
	Total Count	28616	0	NA
	Estimated Population	47216	0	47216
1971	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1972	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1973	Number Counted		2328	NA
	Number Estimated		5200	NA
	Total Count	0	7528	NA
	Estimated Population	0	36423	36423
1974	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1975	Number Counted	19227	0	NA
	Number Estimated	0		NA
	Total Count	19227	0	NA
	Estimated Population	31725	0	31725
1976	Number Counted	18402		NA
	Number Estimated	0		NA
	Total Count	18402	0	NA
	Estimated Population	30363	0	30363
1977	Number Counted	18081	0	NA
	Number Estimated	0		NA
	Total Count	18081	0	NA
	Estimated Population	29834	0	29834
1978	Number Counted	5870	0	NA
	Number Estimated	9700		NA
	Total Count	15570	0	NA
	Estimated Population	25691	0	25691
1979	Number Counted	10663	2023	12686
	Number Estimated	5350	1350	6700
	Total Count	16013	3373	19386
	Estimated Population	26421	17216	26421
1980	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1981	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1982	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1983	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1984	Number Counted	7838	0	NA
	Number Estimated	1200		NA
	Total Count	9038	0	NA
	Estimated Population	14913	0	14913
1985	Number Counted	7518	4841	12359
	Number Estimated	0	0	NA
	Total Count	7518	4841	12359
	Estimated Population	12405	24708	24708
1986	Number Counted	5616		NA
	Number Estimated	2000		NA
	Total Count	7616	0	NA
	Estimated Population	12566	0	12566
1987	Number Counted	2505	0	NA
	Number Estimated	1000		NA
	Total Count	3505	0	NA
	Estimated Population	5783	0	5783
1988	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1989	Number Counted	2911	815	3726
	Number Estimated		900	NA
	Total Count	2911	1715	4626
	Estimated Population	4803	6753	6753
1990	Number Counted	3615	2079	5694
	Number Estimated		150	NA
	Total Count	3615	2229	5844
	Estimated Population	5965	11377	11377

Total Area 6

		adults	pups	Total
1956	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1957	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1958	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1959	Number Counted	21535	0	NA
	Number Estimated			NA
	Total Count	21535	0	NA
	Estimated Population	35533	0	35533
1960	Number Counted		0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1961	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1962	Number Counted	10467	0	NA
	Number Estimated	12500		NA
	Total Count	22967	0	NA
	Estimated Population	37896	0	37896
1963	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1964	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1965	Number Counted	15405	0	NA
	Number Estimated	2000		NA
	Total Count	17405	0	NA
	Estimated Population	28718	0	28718
1966	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1967	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1968	Number Counted		0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1969	Number Counted		0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1970	Number Counted		0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1971	Number Counted		0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1972	Number Counted		0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1973	Number Counted		0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1974	Number Counted		0	NA

		adults	pups	Total
1974	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1975	Number Counted		0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1976	Number Counted		0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1977	Number Counted			NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1978	Number Counted		0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1979	Number Counted	36646	6705	43351
	Number Estimated		550	NA
	Total Count	36646	7255	43901
	Estimated Population	60466	37030	60466
1980	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1981	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1982	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1983	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1984	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1985	Number Counted	21772	8612	30384
	Number Estimated	1800	1975	3775
	Total Count	23572	10587	34159
	Estimated Population	38894	54036	54036
1986	Number Counted	0	0	NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1987	Number Counted	6506	0	NA
	Number Estimated			NA
	Total Count	6506	0	NA
	Estimated Population	10738	0	10738
1988	Number Counted			NA
	Number Estimated			NA
	Total Count	0	0	NA
	Estimated Population	0	0	0
1989	Number Counted	8112	3478	11590
	Number Estimated	1200	2575	3775
	Total Count	9312	6053	15365
	Estimated Population	15365	30895	30895
1990	Number Counted	7268.666	4939	12208
	Number Estimated	2200	125	2325
	Total Count	9468.666	5064	14533
	Estimated Population	15623	25847	25847

APPENDIX 3 Number of vessels operating by Area in the six principal commercial fisheries in the Gulf of Alaska and Aleutians.

Vessels

	Area1							Area2						
	Shrimp	Crabs	Halibut	Groundfish	Herring	Salmon	Total	Shrimp	Crabs	Halibut	Groundfish	Herring	Salmon	Total
1950	15	40	120	0	30	2700	2905	0	25	112	0	0	650	787
1951	15	40	120	0	30	2700	2905	0	25	126	0	0	650	801
1952	15	40	120	0	34	2700	2909	0	25	141	0	0	650	816
1953	15	40	120	0	11	2700	2886	0	25	149	0	0	650	824
1954	15	40	120	0	9	2700	2884	0	25	134	0	0	650	809
1955	15	40	120	0	16	2700	2891	0	25	130	0	0	650	805
1956	15	40	132	0	14	2700	2901	0	25	123	0	0	650	798
1957	10	40	183	0	16	2700	2949	0	25	131	0	0	650	806
1958	14	40	167	0	9	2700	2930	0	25	153	0	0	650	828
1959	22	41	170	0	22	2700	2955	0	30	184	0	0	650	864
1960	21	43	168	0	29	2700	2961	1	30	132	0	0	650	813
1961	20	49	190	0	18	2700	2977	0	30	129	0	0	650	809
1962	25	59	219	0	17	2700	3020	1	30	154	0	0	650	835
1963	23	69	229	0	18	2700	3039	1	30	182	0	0	650	863
1964	18	68	99	0	16	2700	2901	1	30	145	0	0	650	826
1965	13	68	179	0	13	2700	2973	1	27	164	0	0	650	842
1966	16	57	249	1	11	2700	3034	0	27	224	15	0	650	916
1967	18	70	201	25	11	2700	3025	1	30	191	25	0	650	897
1968	17	82	169	30	11	2700	3009	5	35	125	30	0	650	845
1969	15	66	212	35	7	2487	2822	5	35	171	35	9	644	899
1970	13	65	254	40	10	3649	4031	10	36	196	40	35	788	1105
1971	12	66	242	40	9	2367	2736	10	80	192	40	163	688	1173
1972	16	75	278	40	15	2778	3202	11	90	235	40	405	586	1367
1973	10	127	262	35	35	2287	2756	11	85	210	35	206	672	1219
1974	14	133	188	35	58	4650	5078	11	65	147	35	210	531	999
1975	19	125	826	35	67	3776	4848	7	60	249	35	390	563	1304
1976	22	110	1099	35	194	4039	5499	9	32	334	35	340	630	1380
1977	17	128	1066	30	179	5054	6474	9	75	357	30	162	675	1308
1978	18	134	1093	30	258	6089	7622	17	126	690	30	155	716	1734
1979	29	174	950	27	198	5798	7176	21	134	809	29	183	720	1896
1980	66	181	792	18	194	5381	6632	29	59	1239	26	319	612	2284
1981	51	278	1408	4	304	4821	6866	55	63	1195	31	243	709	2296
1982	69	385	999	0	210	3783	5446	66	89	1027	1	213	864	2260
1983	111	500	1448	0	192	4250	6501	84	29	918	2	226	888	2147
1984	145	488	1277	0	310	4526	6746	93	16	764	0	147	901	1921
1985	124	414	1158	0	201	4632	6529	84	23	567	0	210	1002	1886
1986	113	397	1341	0	273	3424	5548	83	34	704	0	181	900	1902
1987	127	417	481	0	291	3543	4859	88	42	844	0	196	1068	2238
1988	151	449	1680	0	305	3866	6451	80	34	896	0	242	1026	2278
1989	143	436	1589	0	273	3238	5679	35	9	803	0	3	1099	1949
1990	139	330	1488	0	221	3313	5491	27	17	1059	0	233	1471	2807
Average	43	157	566	11	101	3391	4269	21	43	401	13	109	734	1320

Vessels

	Area3							Area4						
	Shrimp	Crabs	Halibut	Groundfish	Herring	Salmon	Total	Shrimp	Crabs	Halibut	Groundfish	Herring	Salmon	Total
1950	0	8	121	0	15	1500	1644	0	15	16	0	0	80	111
1951	0	15	110	0	15	1500	1640	0	15	12	0	0	80	107
1952	0	17	93	0	18	1500	1628	0	10	8	0	0	80	98
1953	0	40	90	0	6	1500	1636	0	10	7	0	0	80	97
1954	0	65	106	0	7	1500	1678	0	10	6	0	0	80	96
1955	0	50	98	0	25	1500	1673	0	15	22	0	0	80	117
1956	0	115	129	0	8	1500	1752	0	20	18	0	0	80	118
1957	0	120	148	0	15	1500	1783	0	25	26	0	0	80	131
1958	3	125	138	0	22	1500	1788	0	30	43	0	0	80	153
1959	5	155	117	0	7	1500	1784	0	30	69	0	0	80	179
1960	11	198	139	0	6	1500	1854	0	37	59	0	0	80	176
1961	12	233	154	0	2	1500	1901	0	25	49	0	0	80	154
1962	11	327	185	0	1	1500	2024	0	19	57	0	0	80	156
1963	10	356	204	4	2	1500	2076	0	27	85	4	0	80	196
1964	6	338	186	7	4	1500	2041	0	40	83	7	0	80	210
1965	11	305	176	10	3	1500	2005	0	36	80	10	0	80	206
1966	17	335	198	15	8	1500	2073	0	37	70	15	0	80	202
1967	25	353	240	25	9	1500	2152	1	43	62	25	0	80	211
1968	20	435	199	30	9	1500	2193	3	64	83	30	0	80	260
1969	31	384	174	35	29	1626	2279	3	65	78	35	0	76	255
1970	26	339	210	40	38	1758	2411	4	47	77	40	0	81	249
1971	63	355	225	40	31	1466	2180	3	48	93	40	0	77	261
1972	94	351	274	40	7	1573	2339	10	58	77	40	0	80	265
1973	133	496	273	35	54	1391	2382	12	75	54	35	0	79	255
1974	150	517	150	35	83	1508	2443	22	80	20	35	0	94	251
1975	175	474	199	35	44	1556	2483	24	81	40	35	0	86	266
1976	132	524	296	35	70	1697	2754	19	62	37	35	0	78	231
1977	171	489	329	30	80	1872	2971	48	43	75	30	0	88	284
1978	151	609	657	30	134	1936	3517	23	69	106	32	0	96	326
1979	139	754	474	31	314	1312	3024	10	119	26	27		124	306
1980	125	594	188	56	268	1963	3194	0	112	17	58	15	122	324
1981	122	700	414	64	248	1339	2887	0	102	9	57	31	121	320
1982	106	886	783	62	179	1362	3378	0	151	47	44	8	127	377
1983	75	658	1272	96	183	1495	3779	0	100	89	35	8	116	348
1984	52	614	1200	129	188	1618	3801	0	74	67	77	12	126	356
1985	48	569	1000	121	174	1198	3110	0	59	77	83	0	119	338
1986	48	498	1317	43	246	1221	3373	0	80	114	38	2	113	347
1987	43	481	1503	7	275	1239	3548	0	60	118	51	4	115	348
1988	20	313	1152	9	292	1247	3033	0	76	57	2	2	116	253
1989	8	271	1035	0	273	211	1798	0	68	54	0	6	109	237
1990	5	387	1601	0	246	1232	3471	0	4	77	0		113	194
Average	50	362	428	26	89	1471	2426	4	52	55	22	2	92	228

Vessels

	Area5							Area6						
	Shrimp	Crabs	Halibut	Groundfish	Herring	Salmon	Total	Shrimp	Crabs	Halibut	Groundfish	Herring	Salmon	Total
1950	0	0	2	0	0	185	187	0	0	0	0	0	0	0
1951	0	0	1	0	0	185	186	0	0	1	0	0	10	11
1952	0	0	8	0	0	185	193	0	0	0	0	0	10	10
1953	0	0	5	0	0	185	190	0	0	0	0	0	10	10
1954	0	0	4	0	0	185	189	0	0	0	0	0	10	10
1955	0	0	1	0	0	185	186	0	0	0	0	0	10	10
1956	0	0	0	0	0	185	185	0	0	0	0	0	10	10
1957	0	0	1	0	0	185	186	0	0	0	0	0	10	10
1958	0	0	0	0	0	185	185	0	0	0	0	0	10	10
1959	0	0	14	0	0	185	199	0	0	0	0	0	10	10
1960	0	0	12	0	0	185	197	0	4	1	0	0	10	15
1961	0	4	4	0	0	185	193	0	8	0	0	0	10	18
1962	0	6	20	0	0	185	211	0	9	1	1	0	10	21
1963	0	4	13	4	0	185	206	0	11	1	4	0	10	26
1964	0	12	10	7	0	185	214	0	18	1	7	0	10	36
1965	0	21	10	10	0	185	226	0	10	0	10	0	10	30
1966	0	27	14	15	0	185	241	0	10	1	15	0	10	36
1967	0	34	6	25	0	185	250	0	22	1	25	0	10	58
1968	0	44	7	30	0	185	266	0	30	1	30	0	40	101
1969	0	41	12	35	0	179	267	0	33	1	35	0	25	94
1970	0	32	13	40	0	225	310	0	35	2	40	0	46	123
1971	0	32	5	40	0	187	264	0	40	1	40	0	11	92
1972	2	51	12	40	0	210	315	0	43	1	40	0	8	92
1973	2	56	11	35	0	176	280	0	56	2	35	0	3	96
1974	7	96	7	35	0	126	271	0	43	1	35	0	0	79
1975	3	83	4	35	0	190	315	0	23	1	35	0	0	59
1976	8	80	10	35	0	228	361	0	3	3	35	0	0	41
1977	7	45	20	30	0	229	331	0	12	8	30	0	0	50
1978	7	77	6	32	0	259	381	0	19	12	30	0	0	61
1979	7	126	2	27	1	312	475	0	24	10	25	0	0	59
1980	4	132	4	58	6	411	615	0	27	39	75	0	0	141
1981	6	127	13	57	49	408	660	0	59	52	87	0	0	198
1982	2	163	105	44	8	470	792	0	103	0	95	8	0	206
1983	0	72	78	35	19	449	653	0	266	38	80	8	0	392
1984	0	33	53	77	15	448	626	0	252	48	99	9	0	408
1985	0	22	55	83	19	337	516	0	104	52	104	6	0	266
1986	0	28	134	38	56	416	672	0	97	21	85	0	0	203
1987	0	34	178	51	36	429	728	0	141	61	81	0	0	283
1988	0	46	131	2	17	458	654	0	134	60	88	9	0	291
1989	0	29	87	0	19	422	557	0	166	84	88	9	0	347
1990	0	29	153	0	16	525	723	0	83	62	0	0	0	145
Average	1	39	30	22	6	259	357	0	46	14	33	1	7	101

Vessels

	All Areas						
	Shrimp	Crabs	Halibut	Groundfish	Herring	Salmon	Total
1950	15	88	370	0	45	5115	5633
1951	15	95	371	0	45	5125	5651
1952	15	92	370	0	52	5125	5654
1953	15	115	370	0	17	5125	5642
1954	15	140	370	0	16	5125	5666
1955	15	130	370	0	41	5125	5681
1956	15	200	402	0	22	5125	5764
1957	10	210	488	0	31	5125	5864
1958	17	220	501	0	31	5125	5894
1959	27	256	553	0	29	5125	5990
1960	33	312	510	0	35	5125	6015
1961	32	349	525	0	20	5125	6051
1962	37	450	636	1	18	5125	6267
1963	34	497	714	16	20	5125	6406
1964	25	506	524	28	20	5125	6228
1965	25	467	609	40	16	5125	6282
1966	33	493	756	76	19	5125	6502
1967	45	552	701	150	20	5125	6593
1968	45	690	584	180	20	5155	6674
1969	54	624	647	210	45	5037	6617
1970	53	554	753	240	83	6547	8230
1971	88	621	757	240	203	4796	6705
1972	133	668	877	240	427	5235	7580
1973	168	895	812	210	295	4608	6988
1974	204	934	513	210	351	6909	9121
1975	228	846	1319	210	501	6171	9275
1976	190	811	1779	210	604	6672	10266
1977	252	792	1856	180	421	7918	11419
1978	216	1034	2564	184	547	9096	13641
1979	206	1331	2271	166	696	8266	12936
1980	224	1105	2279	291	802	8489	13190
1981	234	1329	3091	300	875	7398	13227
1982	243	1777	2961	246	626	6606	12459
1983	270	1625	3843	248	636	7198	13820
1984	290	1477	3409	382	681	7619	13858
1985	256	1191	2909	391	610	7288	12645
1986	244	1134	3631	204	758	6074	12045
1987	258	1175	3185	190	802	6394	12004
1988	251	1052	3976	101	867	6713	12960
1989	186	979	3652	88	583	5079	10567
1990	171	850	4440	0	716	6654	12831
Average	119	699	1494	128	308	5955	8703

APPENDIX 4. Catch in metric tons of the six principal commercial fisheries in the Gulf of Alaska and Aleutians.

Catch

	Area1							Area2						
	Shrimp	Crabs	Halibut	Groundfish	Herring	Salmon	Total	Shrimp	Crabs	Halibut	Groundfish	Herring	Salmon	Total
1950	0.96	0.14	4.01	0.00	36.29	31.46	72.88	0.00	1.31	5.77	0.00	0.00	8.49	15.57
1951	0.77	0.34	4.52	0.00	22.68	49.74	78.06	0.00	1.21	5.95	0.00	0.00	6.72	13.88
1952	0.88	0.37	4.34	0.00	16.46	37.73	59.77	0.00	0.46	7.81	0.00	0.00	10.55	18.82
1953	0.78	0.20	3.81	0.00	15.07	40.42	60.28	0.00	0.57	6.92	0.00	0.00	6.83	14.33
1954	0.65	0.15	5.01	0.00	7.43	44.96	58.20	0.00	0.68	7.56	0.00	0.00	4.61	12.85
1955	0.81	0.30	3.88	0.00	13.16	18.42	36.56	0.00	0.89	6.51	0.00	0.00	3.34	10.74
1956	1.50	0.14	6.58	0.14	22.69	29.85	60.71	0.00	0.37	5.71	0.00	0.00	12.36	18.44
1957	1.07	0.06	5.56	0.08	22.45	39.26	68.47	0.00	0.10	5.74	0.00	0.00	6.25	12.08
1958	3.45	0.07	5.06	0.02	35.20	32.58	76.40	0.00	0.54	6.26	0.00	0.00	14.47	21.27
1959	2.50	0.65	5.91	0.04	45.33	18.71	73.15	0.00	1.15	7.75	0.00	0.00	1.93	10.82
1960	1.52	0.91	5.77	0.08	35.30	30.57	74.13	0.00	0.80	5.84	0.00	0.00	6.83	13.47
1961	1.91	0.97	5.57	0.16	21.88	35.89	66.37	0.00	0.56	6.17	0.00	0.00	7.41	14.14
1962	1.76	2.37	6.01	0.09	15.37	46.50	72.09	0.00	0.63	6.13	0.00	0.00	17.90	24.66
1963	1.41	2.63	4.64	0.15	14.16	43.68	66.67	0.00	0.57	5.89	0.24	0.00	15.07	21.77
1964	0.82	2.48	3.37	0.41	2.13	35.89	45.09	0.00	0.59	5.61	0.02	0.00	12.78	19.00
1965	1.33	1.76	5.47	0.21	11.03	48.92	68.74	0.00	0.57	6.73	0.06	0.00	11.29	18.65
1966	1.72	1.18	5.46	1.11	6.21	28.07	43.74	0.00	0.46	7.55	48.59	0.00	10.27	66.87
1967	1.02	2.12	4.27	12.49	2.54	55.17	77.60	0.00	0.25	5.11	41.18	0.00	8.14	54.68
1968	0.93	2.86	2.77	21.97	0.18	21.06	49.77	0.00	0.91	3.77	73.60	0.00	8.85	87.13
1969	0.10	1.96	4.23	25.97	3.18	17.83	53.27	0.00	1.00	6.06	30.34	0.33	13.58	51.33
1970	0.35	1.52	4.25	27.83	1.10	34.66	69.80	0.01	0.38	5.58	20.80	0.10	10.69	37.56
1971	0.48	1.18	3.00	23.63	2.71	30.01	61.02	0.00	3.83	4.73	31.73	1.20	17.58	59.06
1972	0.37	1.81	2.62	33.03	4.51	38.54	80.90	0.00	6.78	4.34	29.81	0.27	3.91	45.11
1973	0.31	2.60	2.71	29.93	7.21	26.79	69.56	0.00	5.07	3.35	38.96	6.48	9.68	63.56
1974	0.55	2.49	2.69	22.53	8.57	24.99	61.84	0.01	1.59	2.21	28.28	6.04	4.31	42.44
1975	0.47	2.01	2.97	19.05	6.91	13.86	45.28	0.01	3.63	3.22	26.71	5.93	10.06	49.56
1976	0.42	2.43	2.58	22.47	5.70	21.65	55.26	0.06	1.19	3.11	27.96	2.56	11.66	46.54
1977	0.44	1.85	1.53	16.86	6.29	43.28	70.24	0.06	2.55	2.22	23.18	2.28	16.07	46.38
1978	0.48	2.81	2.05	8.21	3.33	44.78	61.65	0.21	4.18	2.61	11.67	2.27	9.99	30.92
1979	0.47	2.87	2.24	11.25	6.43	33.07	56.33	0.31	3.04	3.76	11.86	4.73	30.07	53.77
1980	1.31	3.15	1.58	9.76	8.07	42.20	64.06	0.29	1.59	4.35	18.36	7.45	25.78	57.82
1981	0.47	4.54	2.01	9.40	7.79	50.24	74.45	0.10	2.00	4.43	15.90	13.91	51.19	87.53
1982	0.78	6.23	1.59	2.52	5.44	55.63	72.18	0.24	1.10	3.81	4.35	7.72	48.95	66.17
1983	1.12	3.39	2.90	3.53	9.23	70.58	90.75	0.27	0.21	3.29	4.08	2.97	29.66	40.48
1984	0.79	2.44	2.65	4.66	8.49	70.21	89.24	0.67	0.39	3.67	1.94	6.43	48.13	61.24
1985	0.36	2.05	4.18	4.52	10.18	104.79	126.06	0.31	0.48	3.85	3.38	7.02	54.19	69.23
1986	1.34	2.37	4.81	7.38	8.88	101.07	125.85	0.22	0.77	6.99	8.45	11.31	28.26	56.00
1987	0.95	3.72	4.85	10.49	7.73	39.53	67.26	0.15	0.70	4.63	10.23	6.26	59.75	81.72
1988	0.93	4.13	5.16	9.78	13.85	41.06	74.92	0.12	0.51	4.51	11.80	8.51	30.51	55.98
1989	0.99	2.50	4.32	7.09	14.60	116.86	146.35	0.03	0.29	5.09	14.30	0.59	43.55	63.85
1990	1.09	0.00	4.42	9.05	7.32	74.37	96.25	0.07	0.18	6.11	13.59	10.07	68.64	98.66
Average	0.99	1.90	3.94	8.68	12.22	43.53	71.25	0.08	1.32	5.14	13.45	2.79	19.52	42.29

Catch

	Area3							Area4						
	Shrimp	Crabs	Halibut	Groundfish	Herring	Salmon	Total	Shrimp	Crabs	Halibut	Groundfish	Herring	Salmon	Total
1950	0.00	0.03	6.85	0.00	13.61	14.09	34.58	0.00	0.96	1.03	0.00	0.00	2.56	4.55
1951	0.00	0.09	5.00	0.00	9.07	6.75	20.92	0.00	0.27	0.56	0.00	0.00	1.00	1.83
1952	0.00	0.18	5.62	0.00	4.31	14.01	24.12	0.00	0.11	0.43	0.00	0.00	1.10	1.65
1953	0.00	1.03	4.57	0.00	0.73	11.68	18.00	0.00	0.17	0.37	0.00	0.00	1.98	2.52
1954	0.00	2.39	7.14	0.00	8.59	19.76	37.88	0.00	0.14	0.35	0.00	0.00	1.31	1.80
1955	0.00	1.78	5.55	0.00	15.97	20.40	43.69	0.00	0.74	1.35	0.00	0.00	3.53	5.63
1956	0.00	3.14	7.48	0.00	26.05	9.03	45.70	0.00	1.91	0.98	0.00	0.00	3.41	6.30
1957	0.00	2.55	6.81	0.00	31.21	13.02	53.59	0.00	3.03	1.14	0.00	0.00	2.26	6.43
1958	0.01	2.70	6.27	0.00	5.06	10.99	25.07	0.00	3.29	2.03	0.00	0.00	1.91	7.23
1959	1.30	5.62	5.29	0.00	3.49	6.92	22.62	0.00	2.80	2.90	0.00	0.00	2.17	7.87
1960	1.45	11.28	7.07	0.00	0.05	12.95	32.80	0.00	3.04	2.15	0.00	0.00	3.20	8.39
1961	5.03	15.78	8.01	0.00	0.02	9.68	38.51	0.00	1.77	2.18	0.00	0.00	2.44	6.40
1962	5.74	22.08	8.24	0.00	0.00	28.88	64.94	0.00	1.03	2.40	0.00	0.00	4.99	8.43
1963	4.59	22.14	7.62	6.10	0.00	11.61	52.05	0.00	2.97	2.86	2.20	0.00	4.56	12.58
1964	1.97	22.65	8.06	15.52	0.55	25.77	74.51	0.00	6.51	3.16	0.94	0.00	5.81	16.42
1965	6.27	46.02	7.06	40.67	0.60	7.45	108.08	0.00	6.67	2.85	6.26	0.00	4.40	20.18
1966	10.93	35.34	6.82	95.70	2.52	22.75	174.05	0.00	10.24	2.24	11.42	0.00	2.74	26.64
1967	17.36	24.25	7.71	85.44	2.35	2.04	139.15	0.00	7.83	2.02	6.03	0.00	2.00	17.88
1968	16.16	14.54	6.86	46.18	1.82	19.71	105.28	0.00	5.60	3.14	1.30	0.00	5.82	15.86
1969	18.95	13.37	6.22	46.20	2.24	31.11	118.10	0.00	2.65	2.90	7.37	0.00	4.79	17.71
1970	28.61	13.92	6.72	38.01	4.67	34.16	126.10	2.00	2.48	2.69	4.18	0.00	7.75	19.09
1971	37.80	13.21	5.52	53.07	1.02	19.18	129.80	0.00	2.85	2.80	4.93	0.00	5.61	16.19
1972	26.78	18.69	5.93	102.56	0.24	15.35	171.55	6.69	3.52	1.37	7.89	0.00	1.77	21.23
1973	55.79	27.56	4.12	84.42	2.23	9.22	183.33	9.07	4.57	0.79	12.09	0.00	3.35	29.86
1974	36.18	28.69	1.96	107.16	3.24	12.00	189.25	11.86	6.38	0.26	16.21	0.00	2.45	37.17
1975	37.67	25.07	2.26	111.88	3.77	14.60	195.25	9.09	3.54	0.48	14.40	0.00	1.67	29.18
1976	35.02	25.99	2.72	99.25	4.40	35.63	203.01	16.85	5.52	0.37	10.40	0.00	5.13	38.27
1977	33.50	21.39	2.44	48.64	3.23	34.54	143.73	20.41	3.40	0.65	6.46	0.00	9.43	40.37
1978	36.37	26.96	2.37	37.56	1.30	48.16	152.71	4.27	4.78	0.28	5.48	0.00	7.75	22.56
1979	20.17	25.48	1.52	50.64	2.18	34.41	134.41	1.42	6.01	0.04	4.06	0.00	7.77	19.31
1980	11.82	23.54	1.14	75.04	2.44	42.67	156.64	0.00	4.10	0.06	3.79	0.53	5.44	13.93
1981	12.40	23.12	2.17	83.25	1.97	43.00	165.92	0.00	2.94	0.05	11.86	0.40	10.49	25.74
1982	8.85	15.82	3.65	143.86	1.68	44.96	218.83	0.00	3.17	0.84	15.30	0.17	9.05	28.54
1983	6.08	14.08	5.64	208.97	2.76	38.76	275.30	0.00	1.84	0.95	15.77	0.08	6.77	25.41
1984	2.19	11.16	7.37	262.91	2.33	40.24	326.20	0.00	1.11	0.92	22.41	0.06	9.85	34.35
1985	1.56	9.37	8.66	253.94	3.53	37.18	314.24	0.00	1.37	1.69	25.40	0.00	3.63	32.09
1986	0.69	6.02	9.89	99.87	4.11	56.82	177.40	0.00	1.79	1.63	12.97	0.01	7.20	23.59
1987	0.03	4.02	11.38	86.18	8.59	50.20	160.41	0.00	1.17	1.58	18.51	0.07	7.76	29.09
1988	0.01	3.14	14.20	108.39	7.29	68.45	201.49	0.00	1.59	1.29	8.80	0.05	9.82	21.55
1989	0.01	4.23	11.94	123.81	6.84	31.67	178.49	0.00	0.52	1.54	17.70	0.06	3.95	23.77
1990	0.00	3.13	8.87	167.69	4.63	39.36	223.68	0.00	0.03	1.89	29.45	0.00	8.31	39.67
Average	11.76	14.43	6.21	65.44	4.90	25.59	128.33	1.99	3.03	1.44	7.40	0.04	4.80	18.71

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	Area5							Area6						
	Shrimp	Crabs	Halibut	Groundfish	Herring	Salmon	Total	Shrimp	Crabs	Halibut	Groundfish	Herring	Salmon	Total
1950	0.00	0.00	0.07	0.00	0.00	9.23	9.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1951	0.00	0.00	0.03	0.00	0.00	7.61	7.64	0.00	0.00	0.01	0.00	0.00	0.38	0.39
1952	0.00	0.00	0.30	0.00	0.00	7.31	7.61	0.00	0.00	0.00	0.00	0.00	0.26	0.26
1953	0.00	0.00	0.34	0.00	0.00	11.99	12.33	0.00	0.00	0.00	0.00	0.00	0.12	0.12
1954	0.00	0.00	0.26	0.00	0.00	9.61	9.88	0.00	0.00	0.00	0.00	0.00	0.93	0.93
1955	0.00	0.00	0.04	0.00	0.00	7.87	7.91	0.00	0.00	0.00	0.00	0.00	0.09	0.09
1956	0.00	0.00	0.00	0.00	0.00	11.45	11.45	0.00	0.00	0.00	0.00	0.00	0.01	0.01
1957	0.00	0.00	0.05	0.00	0.00	6.63	6.68	0.00	0.00	0.00	0.00	0.00	0.13	0.13
1958	0.00	0.00	0.01	0.00	0.00	5.62	5.62	0.00	0.00	0.00	0.00	0.00	0.99	0.99
1959	0.00	0.00	0.62	0.00	0.00	3.85	4.47	0.00	0.00	0.00	0.00	0.00	0.04	0.04
1960	0.00	0.00	0.45	0.00	0.00	6.84	7.29	0.00	0.95	0.01	0.00	0.00	0.73	1.69
1961	0.00	0.02	0.17	0.00	0.00	6.38	6.57	0.00	2.17	0.00	0.00	0.00	0.16	2.32
1962	0.00	0.70	0.83	0.00	0.00	6.90	8.43	0.00	3.63	0.01	0.25	0.00	3.23	7.12
1963	0.00	1.77	0.36	2.20	0.00	5.76	10.09	0.00	8.12	0.03	11.23	0.00	0.16	19.54
1964	0.00	6.24	0.36	0.94	0.00	7.77	15.32	0.00	9.61	0.00	111.00	0.00	0.32	120.93
1965	0.00	8.71	0.41	6.26	0.00	8.73	24.10	0.00	3.65	0.00	123.95	0.00	0.00	127.61
1966	0.00	14.90	0.40	11.42	0.00	3.65	30.36	0.00	2.67	0.03	64.82	0.00	0.10	67.62
1967	0.00	10.30	0.16	6.03	0.00	1.68	18.17	0.00	7.69	0.00	66.49	0.00	0.01	74.20
1968	0.00	5.13	0.23	1.30	0.00	5.04	11.70	0.00	9.02	0.00	59.48	0.00	1.45	69.94
1969	0.00	4.06	0.48	7.37	0.00	6.45	18.36	0.00	8.64	0.04	43.98	0.00	0.45	53.12
1970	0.00	4.38	0.34	4.18	0.00	11.45	20.35	0.00	7.28	0.05	71.02	0.00	1.18	79.53
1971	0.00	4.26	0.11	4.93	0.00	8.27	17.57	0.00	7.02	0.00	35.75	0.00	0.06	42.83
1972	0.00	4.74	0.22	7.89	0.00	4.01	16.86	0.00	8.49	0.01	79.39	0.00	0.00	87.90
1973	0.00	5.80	0.13	12.09	0.00	2.24	20.25	0.00	4.50	0.02	44.77	0.00	0.00	49.29
1974	2.61	6.60	0.10	16.21	0.00	1.13	26.64	0.00	1.29	0.05	72.30	0.00	0.00	73.64
1975	0.41	7.25	0.06	14.40	0.00	1.84	23.95	0.00	0.20	0.00	57.14	0.00	0.00	57.34
1976	1.66	4.87	0.09	10.40	0.00	9.62	26.64	0.00	0.03	0.05	57.27	0.00	0.00	57.35
1977	3.06	2.26	0.12	6.46	0.00	6.49	18.42	0.00	0.43	0.18	40.05	0.00	0.00	40.67
1978	2.24	4.29	0.01	5.48	0.00	15.67	27.69	0.00	0.47	0.31	39.90	0.00	0.00	40.69
1979	1.49	7.30	0.00	4.06	0.01	23.50	36.37	0.00	0.31	0.19	60.06	0.00	0.00	60.56
1980	1.11	9.04	0.01	3.79	0.41	34.98	49.35	0.00	0.82	0.13	81.41	0.00	0.00	82.36
1981	0.99	2.64	0.00	11.86	1.36	28.97	45.82	0.00	1.39	0.11	65.56	0.00	0.00	67.07
1982	0.00	1.19	0.47	15.30	1.10	32.58	50.63	0.00	4.88	0.00	76.30	3.28	0.00	84.46
1983	0.00	1.22	0.97	15.77	0.57	24.14	42.67	0.00	5.47	0.41	73.74	3.22	0.00	82.84
1984	0.00	0.99	0.49	22.41	0.58	43.46	67.92	0.00	3.28	0.23	112.26	3.25	0.00	119.02
1985	0.00	0.71	0.91	25.40	0.91	27.80	55.72	0.00	5.73	0.35	97.53	3.22	0.00	106.84
1986	0.00	1.11	1.45	12.97	3.24	24.40	43.16	0.00	7.27	0.05	83.34	0.00	0.00	90.66
1987	0.00	0.85	1.21	18.51	3.01	16.66	40.24	0.00	2.79	0.37	82.59	0.00	0.00	85.75
1988	0.00	1.00	0.86	8.80	0.61	30.54	41.80	0.00	5.28	0.34	77.29	1.82	0.00	84.73
1989	0.00	1.19	0.56	17.70	0.94	29.94	50.32	0.00	5.20	0.48	49.27	2.79	0.00	57.74
1990	0.00	1.04	0.78	29.45	1.27	23.60	56.14	0.00	5.52	0.27	134.50	0.00	0.00	140.30
Average	0.33	3.04	0.35	7.40	0.34	13.21	24.68	0.00	3.26	0.09	48.11	0.43	0.26	52.16

Catch

	All Areas						
	Shrimp	Crabs	Halibut	Groundfish	Herring	Salmon	Total
1950	0.96	2.43	17.72	0.00	49.90	65.84	136.87
1951	0.77	1.91	16.07	0.00	31.75	72.20	122.72
1952	0.88	1.13	18.49	0.00	20.78	70.96	112.23
1953	0.78	1.97	16.02	0.00	15.80	73.02	107.59
1954	0.65	3.37	20.32	0.00	16.02	81.17	121.54
1955	0.81	3.72	17.33	0.00	29.13	53.65	104.63
1956	1.50	5.56	20.75	0.14	48.74	65.92	142.62
1957	1.07	5.74	19.29	0.08	53.66	67.55	147.39
1958	3.46	6.60	19.65	0.02	40.28	66.56	136.57
1959	3.80	10.21	22.47	0.04	48.82	33.60	118.95
1960	2.97	16.98	21.28	0.08	35.34	61.13	137.78
1961	6.94	21.26	22.10	0.16	21.90	61.95	134.32
1962	7.50	30.44	23.61	0.34	15.37	108.41	185.67
1963	6.00	38.19	21.40	22.11	14.16	80.84	182.70
1964	2.78	48.06	20.56	128.83	2.67	88.33	291.27
1965	7.61	67.38	22.52	177.41	11.63	80.79	367.35
1966	12.65	64.79	22.50	233.04	8.72	67.59	409.29
1967	18.38	52.43	19.28	217.67	4.89	69.04	381.68
1968	17.09	38.05	16.78	203.83	2.00	61.93	339.68
1969	19.05	31.69	19.95	161.23	5.75	74.22	311.88
1970	30.97	29.95	19.63	166.12	5.86	99.89	352.43
1971	38.28	32.35	16.16	154.04	4.94	80.71	326.47
1972	35.84	44.03	14.49	260.57	5.03	63.58	423.54
1973	65.17	50.09	11.11	222.27	15.93	51.28	415.85
1974	51.21	47.05	7.29	262.69	17.85	44.87	430.97
1975	47.65	41.70	8.96	243.57	16.62	42.04	400.57
1976	54.02	40.03	8.91	227.75	12.67	83.70	427.07
1977	57.52	31.89	7.14	141.66	11.80	109.82	359.81
1978	43.57	43.49	7.63	108.29	6.90	126.35	336.23
1979	23.87	45.02	7.74	141.94	13.35	128.82	360.74
1980	14.52	42.25	7.26	192.15	16.90	151.08	424.16
1981	13.97	36.63	8.78	197.82	25.44	183.89	466.52
1982	9.86	32.39	10.36	257.63	19.38	191.18	520.81
1983	6.47	26.21	14.16	321.85	18.82	169.93	557.45
1984	3.65	19.37	15.33	426.59	21.15	211.89	697.97
1985	2.22	19.71	19.64	410.17	24.86	227.58	704.19
1986	2.25	19.34	24.81	224.97	27.55	217.75	516.67
1987	1.13	13.25	24.03	226.51	25.67	173.89	464.47
1988	1.07	15.66	26.36	224.85	32.14	180.30	480.46
1989	1.03	13.93	23.93	229.86	25.82	225.96	520.53
1990	1.17	9.91	22.33	383.72	23.29	214.27	654.70
Average	15.15	26.98	17.18	150.49	20.71	106.92	337.42

APPENDIX 5. Sources And Methodology of Assembling the Gulf of Alaska and Aleutian Fishing Statistics

Data for shellfish, halibut, groundfish, herring and salmon fisheries were grouped to coincide with the six sea lion areas of our study. Total catches and numbers of vessels fishing in each of the six areas were assembled from the records of a number of different management agencies that define different geographical regions for their statistical purposes. The following details the sources and methodology of assembling the fishery statistics.

Salmon. The amount of salmon caught and the number of vessels (including set nets) engaged in the U.S. salmon fishery was determined from catch statistics kept by the Alaska Department of Fish and Game for the years 1969 to 1990 (Carol Smith, pers. comm., Commercial Fish Division, ADFG, Juneau) and from Eggers' (1989) summary of commercial salmon catches for the years 1950 to 1968.

Since 1969, the total catch and number of commercial vessels landing salmon have been recorded in 21 management areas in the Gulf of Alaska and Bering Sea. We pooled the data to reflect the six sea lion areas of our study as follows: Area 1 (Statistical Regions A, B, C and D), Area 2 (E), Area 3 (H and K), Area 4 (L), Area 5 (M) and Area 6 (O and R).

The numbers of salmon caught between 1950 and 1968 are summarized by Management Regions contained in Eggers (1989) and were assumed to correspond to the following sea lion areas: Area 1 (Southeastern Alaska), Area 2 (Cordova Area), Area 3 (Kodiak), Area 4 (Chignik), Area 5 (South Peninsula) and Area 6 (Aleutian Islands). The mass of salmon caught in each area from 1950 to 1968 equalled the numbers of each species landed multiplied by their respective average weights. Average weights were calculated by species and area from catches landed between 1969 and 1990.

Between 1950 and 1968, the amount of salmon caught from one year to the next was relatively constant (Figs. 4.1 and 4.2). However the annual number of vessels fishing for salmon in Areas 1 to 6 during this time was not available and was assumed to equal the average number of vessels fishing between 1969-73 (for Area l), 1969-75 (Areas 3,5) and 1969-78 (Areas 2,4). These years reflect periods of time when catch was relatively stable. Ten salmon vessels were assumed to be in Area 6 between 1951 and 1967.

Herring. The amount of herring caught and the number of vessels engaged in the U.S. herring fishery (Figs. 4.4 and 4.5) were determined from catch statistics recorded by the Alaska Department of Fish and Game (1969 to 1990) and from annual reports published by the International North Pacific Fisheries Commission (1952 to 1968) (e.g. INPFC 1960). Since 1969, the total catch and number of vessels landing herring have been recorded in 21 management areas in the Gulf of Alaska and Bering Sea. The data, obtained from the Commercial Fish Division (ADFG, Juneau), were pooled to reflect the six sea lion areas of our study: Area 1 (Herring Statistical Regions A, B, C and D), Area 2 (E), Area 3 (H and K) Area 4 (L), Area 5 (M) and Area 6 (0 and R). From 1952 to 1968 herring catches detailed in the INPFC reports are grouped by region, either southeast Alaska or central Alaska, and were assumed to correspond to sea lion Areas 1 and 3 respectively. Note however that central Alaska data also includes Prince William Sound (Area 2), but a breakdown of herring catches between Kodiak and Prince William Sound could not be obtained.

Halibut. The International Pacific Halibut Commission maintains fishing records (catch and effort) from 30 regulatory areas in the Gulf of Alaska (see Myhre et *al.* 1977, and annual reports e.g. IPHC 1989). Catch and effort data from the regulatory regions were pooled for the six sea lion areas as follows: Area 1 (14-18s), Area 2 (18n-25), Area 3 (26-30), Area 4 (31-33), Area 5 (34-38), Area 6 (39-43).

G.J. Peltonen (pers. comm., International Pacific Halibut Commission, University of Washington, Seattle, WA) estimated the annual number of vessels fishing for halibut in the Gulf of Alaska between 1956 and 1990. Unfortunately the vessel data were compiled for broad statistical regions and can only be apportioned to the 6 sea lion areas by making simplifying assumptions. Vessel counts between 1956 and 1974 did not include boats that landed less than 10,000 pounds per year. We therefore assumed that the number of small vessels fishing halibut increased linearly by multiplying the 1956 large vessel count by 1.0 and increasing the correction factor for subsequent years in a stepwise fashion such that by 1974 the total number of vessels equalled the number of large vessels times 4.0. From 1950 to 1955, we assumed there were 120 vessels in southeast Alaska (Area 1) and a total of 250 in the other 5 areas, based on the average numbers of large vessels fishing between 1956 and 1960.

From 1950 to 1980, we apportioned the total vessel count among Areas 2 - 6 according to the amount of fishing effort expended in each of the areas. CPUE was consistent between areas from 1950 to 1980, but varied greatly from 1981 to 1990. We therefore allotted vessel counts from 7 halibut management regions (1981 to 1990) according to region and/or fishing effort, weighted by catch. Prior to 1981, vessels fishing in southeastern Alaska (Area 1) were grouped in a statistical area that extended as far south as Oregon. We therefore assumed that 1) 30% of the southern fleet was in southeastern Alaska from 1950 to 1974, and 2) this proportion increased from 30 to 50% between 1975 and 1980.

Groundfish ***(excluding halibut).*** The amount of pollock and groundfish (including pollock) landed in the Gulf of Alaska by the foreign fleet (Japan and Russia), the U.S. Domestic Fleet, and the Joint Venture Fisheries were obtained from Forrester et ***al.*** (1978, 1983) as well as from the annual statistical yearbook publications (1977-88) of the International North Pacific Fisheries Commission (INPFC). Total catches in 1989 and 1990 were obtained from Galen Tromble (pers. comm. NMFS, Juneau Alaska) and Heather Weikart (pers. comm. NMFS, Seattle WA).

No information could be obtained on the amount of groundfish caught by foreign fleets registered in Korea, Poland, China, Taiwan and West Germany.

The INPFC groundfish statistical regions corresponding to the sea lion areas were: Southeastern (Area 1). Yakutat (Area 2), Kodiak and Chirikof (Area 3), Shumagin (Areas 4 and 5) and Aleutian (Area 6). Groundfish catches are detailed in Appendix 3 and 4 and Figures 4.8 to 4.11.

Records detailing the number of vessels (longliners, processors and catcher boats) landing groundfish by region and year are incomplete. INPFC annual reports contain the number of Japanese and American vessels by type that fished for groundfish in the Northeast Pacific Region from 1963 to 1979 (an area extending from California to the Gulf of Alaska). These reports do not detail the number of vessels by groundfish statistical region, nor the number of vessels operated by other nations. Since 1980, the number of vessels and days spent fishing by foreign and joint venture fisheries have been tabulated for the Gulf of Alaska and Bering Sea. Records have also been maintained since 1980 on observer effort in each of the INPFC statistical regions (Ren Narita, pers. comm., NMFS, Seattle, WA).

Our counts of foreign vessels should be considered reasonable guesses, not firm estimates. We apportioned the numbers of foreign vessels participating in the fishery (1980-90) by the number of observer days in each INPFC region, and assumed vessels fished more than one region in any given year. For years prior to 1980, we assumed that foreign vessels in the Gulf of Alaska were distributed equally among the INPFC regions and crudely indexed the total vessel count in each year to the known number of Japanese vessels. Vessel counts. for the joint venture fisheries (1980-90) were made by Heather Weikart (pers. comm.), while numbers of domestic US boats were determined from the numbers of licences issued (G. Tromble, pers. comm.).

Shellfish. Commercial fisheries for shrimp, king crab, Tanner crab, Dungeness crab and other miscellaneous species are described by Larson (1990), Donaldson (1991), Kimker (1991), Koeneman et *al*. (1991), and Nippes (1991). Their reports contain catch statistics for eight shellfish management regions corresponding to our six sea lion areas as follows: Area 1 (southeast Alaska), Area 2 (Prince William Sound), Area 3 (Cook Inlet, Kodiak, and Chignik), Area 4 (South Peninsula), Area 5 (Eastern Aleutians: Dutch Harbour / Adak) and Area 6 (Western Aleutians). In general the number of vessels fishing shellfish was recorded throughout the 1970s and 1980s (Fig. 4.12). In earlier years (notably the 1960s), only the weight or numbers caught were noted, while little or no information could be obtained for the 1950s fisheries. In such cases we estimated the numbers of vessels based on the amount of shellfish landed, and made conservative guesses when all that was obtainable was an historical confirmation that a fishery took place.