



NOAA Technical Memorandum NMFS-AFSC-100

Aerial and Land-Based Surveys of Steller Sea Lions (*Eumetopias jubatus*) in Alaska, June and July 1997 and 1998

by
J. L. Sease and T. R. Loughlin

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Alaska Fisheries Science Center

April 1999

NOAA Technical Memorandum NMFS

The National Marine Fisheries Service's Alaska Fisheries Science Center uses the NOAA Technical Memorandum series to issue informal scientific and technical publications when complete formal review and editorial processing are not appropriate or feasible. Documents within this series reflect sound professional work and may be referenced in the formal scientific and technical literature.

The NMFS-AFSC Technical Memorandum series of the Alaska Fisheries Science Center continues the NMFS-F/NWC series established in 1970 by the Northwest Fisheries Center. The new NMFS-NWFSC series will be used by the Northwest Fisheries Science Center.

This document should be cited as follows:

Sease, J. L., and T. R. Loughlin. 1999. Aerial and land-based surveys of Steller sea lions (Eumetopias jubatus) in Alaska, June and July 1997 and 1998. U. S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-100, 61 p.

Reference in this document to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.



NOAA Technical Memorandum NMFS-AFSC-100

Aerial and Land-Based Surveys of Steller Sea Lions (*Eumetopias jubatus*) in Alaska, June and July 1997 and 1998

by
J. L. Sease and T. R. Loughlin

Alaska Fisheries Science Center
7600 Sand Point Way N.E., BIN C-15700
Seattle, WA 98115-0070

U.S. DEPARTMENT OF COMMERCE

William M. Daley, Secretary

National Oceanic and Atmospheric Administration

D. James Baker, Under Secretary and Administrator

National Marine Fisheries Service

Penelope D. Dalton, Assistant Administrator for Fisheries

April 1999

Notice to Users of this Document

In the process of converting the original printed document into an Adobe .PDF format, slight differences in formatting occur. The material presented in the original printed document and this .PDF, however, is the same.

ABSTRACT

The National Marine Fisheries Service (NMFS) and the Alaska Department of Fish and Game (ADF&G) conducted aerial and land-based surveys of Steller sea lions (*Eumetopias jubatus*) in Alaska during June and July 1997 and 1998. During a limited-range survey in 1997, we counted a total of 16,249 non-pup Steller sea lions on 127 rookery and haul-out sites in the central and western Gulf of Alaska and eastern Aleutian Islands. In 1998, we counted a total of 39,597 non-pups on 236 rookery and haul-out sites Alaska-wide. Of these sea lions, 20,976 were on 33 trend rookeries, indicating declines of 7.0% from 1996 and 24.0% from 1990. The estimated average annual decline for the trend rookeries was 3.5% from 1990 to 1998.

The western stock of Steller sea lions in Alaska includes animals from the eastern Gulf of Alaska through the western Aleutian Islands. At 30 western-stock trend rookeries, we counted 14,368 non-pups in 1998, which indicated declines of 12.2% from 1996 and 35.0% from 1990. The estimated average annual rate of decline from 1990 to 1998 was 5.4%. Complete western-stock counts were not available for all rookery and haul-out trend sites because a number of sites were not surveyed in the eastern Gulf of Alaska in 1998. Counts for rookery and haul-out trend sites in the central Gulf of Alaska through the western Aleutian Islands suggested western-stock declines of 9.3% from 1996 and 26.6% from 1991, or an estimated average annual decline of 4.3% over the 7-year period.

In the Kenai Peninsula to Kiska Island index area, a sub-area within the Alaska portion of the western stock, we counted 24,318 non-pup sea lions at 203 surveyed sites. Of these, 16,315 were at 69 trend sites (26 rookeries and 43 haulouts), and 11,994 were at 26 trend rookeries.

The 1998 count for the 69 trend sites was a decline of 8.9% from 1996 and 28.3% from 1990. The estimated annual rates of decline were 4-5% for trend sites and trend rookeries (1990 to 1996) and 2% for all surveyed sites (1991 to 1996).

The eastern stock is represented in Alaska only by Southeast Alaska, where we counted 8,693 non-pups at 11 trend sites (rookeries and haulouts). This indicated an increase of 5.6% from 1996, a *decline* of 1.5% from 1994, and an increase of 14.0% from 1990. The estimated average annual rate of increase from 1990 to 1998 for trend sites in Southeast Alaska was 1.8%. Overall changes were similar for the three trend rookeries in Southeast Alaska, as was the estimated annual increase of 2.0% from 1990 to 1998.

The ADF&G and NMFS counted 6,932 live pups at 12 rookeries in Alaska in 1997 and 13,607 pups at 40 rookeries Alaska-wide in 1998. The 1998 count included all rookeries in Alaska except Walrus Island in the Pribilof Islands. Pup numbers in the eastern stock (Southeast Alaska) increased by 12.3% from 1994 to 1998, and generally increased by about 2% per year since 1990. The western stock in Alaska (excluding the western Aleutian Islands) declined by 19.0% from 1994 to 1998. In the western Aleutian Islands, pup numbers declined 18% from 1997 to 1998, the only years for which comprehensive comparison is possible.

Considering non-pup and pup counts together, the western-stock region showing the most positive trend during recent years was the central Aleutian Islands. The worst observed declines were in the western Aleutian Islands: 13-16% overall for non-pups from 1996 to 1998 and 18% for pups from 1997 to 1998.

CONTENTS

	<u>Page</u>
Abstract	iii
Introduction	1
Methods	3
Aerial Surveys of Non-Pups	4
Land-Based Pup Surveys	5
Data Analysis	7
Results	9
Aerial Surveys of Non-Pups	9
Comparison of Western and Eastern Stocks	10
Kenai to Kiska Index Area	11
Subareas Outside of the Kenai to Kiska Index Area	13
Proportion of Non-pups on Rookeries	13
Land-Based Pup Surveys	14
Discussion	15
Western Stock.	15
Eastern Stock	16
Distribution at Rookery and Haul-out Sites	16
Acknowledgments	18
Citations	19

INTRODUCTION

In November 1990, the National Marine Fisheries Service (NMFS) listed Steller sea lions (*Eumetopias jubatus*) as “threatened” range-wide under the U.S. Endangered Species Act (ESA)(55 Federal Register 49204). The Final Recovery Plan for Steller sea lions (NMFS 1992) included a recommendation for annual Alaska-wide surveys of Steller sea lions and a range-wide survey every 5 years. At the same time, the aerial survey protocol underwent two peer reviews. One of the conclusions of these reviews was that switching from an annual to a biennial schedule would result in reduced risk for survey personnel and considerable monetary savings with minimal loss of statistical power for trend analysis (Sease et al. 1993). The biennial schedule for the Alaska-wide survey went into effect in 1992, which effectively changed the range-wide schedule to every 4 years.

Bickham et al. (1996) detected genetic differences within the Steller sea lion population, which led to the identification of two stocks, separated approximately at 144° W long. (Loughlin 1997). This two-stock model was incorporated into management actions in June 1997 with the listing of the western stock, which occurs from Prince William Sound, Alaska, westward to Russia and Japan, as “endangered” under the ESA (62 Federal Register 24345). The eastern stock, which occurs from Southeast Alaska to California, remains classified as threatened.

The NMFS and the Alaska Department of Fish and Game (ADF&G) conducted aerial and land-based surveys of non-pup (adult and juvenile) and pup Steller sea lions from Southeast Alaska through the western Aleutian Islands during June and July 1997 and during June and July 1998. These efforts continued a series of surveys conducted in Alaska since the mid-1970s

(Braham et al. 1980, Calkins and Pitcher 1982, Loughlin et al. 1984, Merrick et al. 1987, Loughlin et al. 1990, Merrick et al. 1991, Merrick et al. 1992, Sease et al. 1993, Strick et al. 1997, Sease et al. 1999). This report, like others in recent years, focuses primarily on counts of non-pup Steller sea lions at trend rookery and haul-out sites. Analyses in this report concentrate on counts from 1990 to 1998 or 1991 to 1998. Longer historical perspectives are included in Merrick et al. (1991: for 1956-90) and Sease et al. (1993: for 1976-92).

The 1998 aerial survey served both as the biennial Alaska-wide survey and the quadrennial range-wide survey. Although 1997 was not a scheduled survey year, the NMFS conducted a limited aerial survey of non-pup sea lions in the central and western Gulf of Alaska and the eastern Aleutian Islands. The primary objective of the 1997 effort was to provide greater detail about sea lion population trends in regions that experienced stronger-than-average year classes of walleye pollock (*Theragra chalcogramma*). These strong year classes of pollock could provide a natural experiment for investigating links between availability of prey (e.g., juvenile pollock) for juvenile sea lions and the overall status of sea lions. Of particular interest were the 1989 year class for pollock in the eastern Bering Sea and the 1994 year class in the western Gulf of Alaska (Ianneli et al. 1998, Hollowed et al. 1998).

The 1998 survey effort also included pup counts at virtually all rookeries in Alaska. The last state-wide pup count in Alaska, which was in 1994, included most rookeries except those in the western Aleutian Islands (Strick et al. 1997). During the intervening surveys, the NMFS and the ADF&G counted pups at several selected rookeries each year.

METHODS

The 1997 surveys adhered to protocols of earlier aerial and land-based surveys (Braham et al. 1980, Calkins and Pitcher 1982, Merrick et al. 1991, Merrick et al. 1992, Loughlin et al. 1992, Sease et al. 1993, Strick et al. 1997, Sease et al. 1999). The 1998 surveys included minor modifications, as described below. Most of the analyses in this report focus on “trend sites.” Trend sites are those rookeries and haul-out sites surveyed consistently from the 1970s to the present, thus allowing analysis of population trends on a decadal scale. Trend sites include the majority of animals observed in each survey (64.7% in 1997, 71.7% in 1998). Most non-trend sites are haulouts with few animals. The only major rookeries that are not trend sites are located on Outer and Attu Islands. Rookeries are those sites where adult males actively defend territories, pups are born, and mating takes place. Haul-out sites are those where sea lions predictably rest on land (haul out), but where few or no pups are born (Calkins and Pitcher 1982, Loughlin et al. 1984).

The list of trend sites was reduced from 103 to 95 in 1992 by combining some adjacent sites (e.g., Ugamak and Round Islands in the eastern Aleutian Islands) into single new trend sites (Sease et al. 1993). The number of trend sites increased to 96, and the number of trend rookeries increased to 33 beginning with the 1996 survey report (Sease et al. 1999) to accommodate the separate listing for the rookeries at Cape Sabak and Gillon Point, Agattu Island, in the western Aleutian Islands. These are merely “book-keeping” changes that do not affect the total counts of sea lions on trend sites and trend rookeries.

As noted above, the 1997 aerial survey was limited to the central and western Gulf of Alaska and the eastern Aleutian Islands. In addition, dense fog prevented surveying the two trend

rookeries at Adugak and Ogchul Islands in the eastern Aleutian Islands in 1997. The 1998 aerial survey included all trend rookeries in Alaska; however, we did not survey seven trend haul-out sites in the eastern Gulf of Alaska, two trend sites in Southeast Alaska, and numerous non-trend sites in both regions.

Aerial Surveys of Non-Pups

In 1997, the NMFS counted and photographed non-pup Steller sea lions from an aircraft flying over rookery and haul-out sites from Steep Cape, off the Kenai Peninsula in southcentral Alaska, to Umnak Island in the eastern Aleutian Islands from 10 June to 15 June (Table 1a). In 1998, the NMFS and ADF&G surveyed rookery and haul-out sites from Forrester Island in Southeast Alaska to Attu Island in the western Aleutian Islands from 10 June to 24 June (Table 1b). Flight tracks in each year included traditional sea lion rookeries and haul-out sites, but potential haul-out sites along the flight path also were examined en route. Under ideal conditions, we surveyed each site at 100-150 knots air speed, 150-200 m (500-650 ft) altitude, and 500 m ($\frac{1}{4}$ nautical mile) offshore, depending on the topography of the site. Strong winds occasionally required flying at higher altitudes or farther offshore, whereas fog or low clouds sometimes required flying at a lower altitude or closer inshore. The 1997 survey employed a single aircraft and survey team. The 1998 survey was divided into two regions, each with separate aircraft and personnel; ADF&G surveyed Southeast Alaska and the eastern Gulf of Alaska; NMFS surveyed the Gulf of Alaska and Aleutian Islands, from the Kenai Peninsula westward to Attu Island.

We photographed sea lions at most sites using 35-mm, manual-focus cameras with motor drives and zoom lenses (70-210 mm or equivalent) and moderately fast (e.g., ISO 200) color

transparency (slide) film. Where appropriate, sequential photographs overlapped slightly to guarantee complete coverage of a site. NMFS survey personnel also photographed each site using a high-resolution 8-mm (HI-8) video camera. Video recordings provided an overview of each site and served as a backup in case the slides were unusable. In the laboratory, we counted sea lions from projected images. For the NMFS portion of the survey, the final count of non-pup sea lions for each rookery or haulout was the mean for two independent counters. If the individual results for a particular site differed by 10% or more, each person re-counted the sea lion images for that site. For their portion of the survey, ADF&G had a second, independent counter to verify or detect errors in results from the original counter. Both survey teams used direct visual counts instead of photographs for sites with few animals (e.g., 10 or fewer sea lions).

The ADF&G used medium-format (126-mm, 5-in.) vertical photography to count non-pups at 10 sites in Southeast Alaska. This technique has proven effective for counting Steller sea lions at Año Nuevo Island, California (Westlake et al. 1997), and in Southeast Alaska (ADF&G, Wildlife Conservation Division, 333 Raspberry Road, Anchorage, AK 99518, unpubl. data). Counts of non-pups were made directly from the medium-format color transparencies.

Land-Based Pup Surveys

In 1997, the ADF&G and NMFS counted sea lion pups at 12 rookeries from Southeast Alaska to the western Aleutian Islands between 24 June and 7 July. ADF&G personnel counted pups at Forrester Island, Hazy Island, and White Sisters rookeries in Southeast Alaska. NMFS personnel counted pups at eight rookeries in the Aleutian Islands. In 1998, we conducted almost all pup counts between 24 June to 5 July. At Semisopchnoi Island (central Aleutian Islands), we

counted pups on 19 June, which was several days earlier than is optimal for pup counts (i.e., prior to the peak of pupping, and thus potentially undercounting because of pups not yet born) (Chumbley et al. 1997). We counted only nine pups on the island at that time (Table 1 b), and as it was unlikely that many more pups would be born there, expending 2 days of ship time for a return visit on a more optimal date was not warranted.

In 1998, ADF&G personnel counted pups at the Forrester Island, Hazy Island, and White Sisters rookeries in Southeast Alaska, at Seal Rocks and Fish (Wooded) Islands in the eastern Gulf of Alaska, and at Outer, Sugarloaf, and Marmot Islands in the central Gulf of Alaska. NMFS personnel counted pups at 32 rookeries from Chirikof Island in the central Gulf of Alaska to Attu Island in the western Aleutian Islands. Vessels delivered survey teams to within 2-4 km of a site; the survey team then went ashore in small boats. At several sites in Southeast Alaska and the Gulf of Alaska the survey team traveled to the rookery by helicopter. After all sea lions other than pups were cleared from the beach, two or three biologists each counted all live pups on the beach and in the water. The final pup count for each rookery was the mean of the two or three independent counts.

We employed alternative counting methods at several small rookeries in 1998 to avoid the disturbance associated with a standard beach count. We counted pups from overlooks at three sites: Fish Island in the eastern Gulf of Alaska, and Ayugadak Island and Cape St. Stephen (Kiska Island) in the central Aleutian Islands. We counted pups from a boat immediately offshore at five rookeries: Ogchul Island in the eastern Aleutian Islands; Agligadak Island, Sviechnikof Harbor (Amlia Island), Semisopchnoi Island, and East Cape (Amchitka Island) in the central Aleutian Islands. Each of these rookeries contained very few pups and, presumably, counting errors due to

unobserved pups were negligible. As with the standard beach counts, three or four biologists each counted all pups.

Data Analysis

Geographical regions used for analyzing survey results were the same as those used in previous survey reports (Merrick et al. 1987, Loughlin et al. 1990, Merrick et al. 1991, Merrick et al. 1992, Sease et al. 1993, Strick et al. 1997, Sease et al. 1999) and those adopted in the Final Recovery Plan for Steller sea lions (NMFS 1992): Southeast Alaska; eastern, central, and western Gulf of Alaska; eastern, central, and western Aleutian Islands; and the Bering Sea (Fig. 1). The Bering Sea region contains few haul-out sites and only one rookery (Walrus Island in the Pribilof Islands). We did not survey the Bering Sea region because of logistical limitations.

Another geographical region used during the analyses of survey data is the Kenai Peninsula (Outer Island) to Kiska Island index area, which includes four of the smaller regions listed above: the central and western Gulf of Alaska, and the eastern and central Aleutian Islands. This index area was selected initially because it encompassed what historically was the center of the Steller sea lions' range and it typically included about 60% of the Alaska sea lion population (Merrick et al. 1987, NMFS 1992).

Analyses for population trends included subtotals of non-pups 1) at rookery trend sites, 2) at all trend sites (rookeries and haul-out sites), and 3) at all surveyed sites for a) the entire range of the 1998 survey, b) for the eastern and western stocks, c) for the Kenai to Kiska index area, and d) for smaller geographical regions. The 1997 counts are presented and discussed on a regional basis but generally not included in analyses due to the limited nature of that survey.

Overall changes in numbers of non-pups and pups, either regionally or for individual rookeries, were expressed as a percentage of the earlier count. We estimated annual rate of change for 1990 to 1998 or 1991 to 1998 from the slope of a simple linear regression of the natural log of counts on survey year, testing the null hypothesis of no trend using the significance of the slope for the natural-log regression.

For most regions, the number of sites included in the “all surveyed sites” sub-totals varied slightly between surveys. Virtually all sites that account for these differences included very few (< 10) animals and many were unoccupied during recent surveys (1991 and later), thus the impact of these differences was negligible. Numerous sites in Southeast Alaska and the eastern Gulf of Alaska were not surveyed in 1998, preventing calculation of subtotals for all surveyed sites (both regions) and for trend sites (eastern Gulf of Alaska). This report does include a subtotal for trend sites in Southeast Alaska, even though two sites were not surveyed in 1998. The haul-out sites in question (Turnabout Island and Cape Fairweather) accounted for only one non-pup in 1992, none in 1994, and one in 1996 (Sease et al. 1993, Strick et al. 1997, Sease et al. 1999), and the likely effect of these missing counts in 1998 was inconsequential.

It should be noted that, with the exception of the distinction between the eastern and western stocks, the geographical divisions between regions are somewhat arbitrary and may not accurately reflect the underlying structure of stocks or other subunits of the population, if they exist. We present results for each region to identify and highlight varying population trends in the different regions. However, readers should not think that sea lion populations in one region are separate and independent of those in other regions.

RESULTS

Aerial Surveys of Non-pups

During the limited-range survey in 1997, we counted a total of 16,249 non-pup Steller sea lions on 127 rookery and haul-out sites in the central and western Gulf of Alaska and eastern Aleutian Islands. This included subtotals of 10,505 non-pups at 33 trend sites and 7,919 at 13 trend rookeries (Table 1a). Additional results from the 1997 survey are presented in conjunction with regional trends.

In 1998, we counted a total of 39,597 non-pup Steller sea lions on 236 rookery and haul-out sites from Southeast Alaska through the western Aleutian Islands (Table 1b). Of these sites, 142 (60%) were occupied by 20 or more sea lions, 20 sites (8%) were occupied by fewer than 20 sea lions, and 74 sites (31%) were unoccupied. At the 33 trend rookeries Alaska-wide, we counted 20,976 non-pups in 1998, indicating declines of 7.0% from the 1996 count (22,562) and 24.0% from 1990 (27,604)(Tables 1b, 2; Fig. 2). The estimated average annual rate of decline for the 33 trend rookeries from 1990 to 1998, based on natural log regression, was 3.5% ($P < 0.001$; 95% C.I. 2.9% to 4.0%)(Table 2).

Many haul-out sites in the eastern Gulf of Alaska and Southeast Alaska, including some trend sites, were not surveyed in 1998, precluding Alaska-wide comparisons for all trend sites (rookeries and haulouts) and for all surveyed sites. The broadest geographical area over which these subtotals could be calculated was from the Kenai Peninsula to the western Aleutian Islands, a major portion of the western stock in Alaska.

Comparison of Western and Eastern Stocks

Most of the sites surveyed in 1998 (215: 91%) are part of the western stock. Of these sites, 126 (58%) included more than 20 sea lions, 19 sites (9%) included 1 to 19 animals, and 70 (33%) were unoccupied. Of the western-stock sites occupied by more than 20 sea lions, 124 were surveyed in both 1996 and 1998; 51 (41%) declined by more than 5% during the 2-year interval, 65 (52%) increased by more than 5%, and 8 (6%) changed less than 5%. Of the 16 eastern-stock sites occupied by 20 or more sea lions in 1998, nine (56.2%) declined by more than 5% from 1996, six (37.5%) increased by more than 5%, and one (6.3%) changed by less than 5%.

The 1998 count of non-pups at western-stock trend rookeries (14,368) indicated declines of 12.2% from 1996 (16,358) and 35.0% from 1990 (22,113)(Table 3). The estimated average annual rate of decline from 1990 to 1998 was 5.4% (95% C.I.: 4.3% to 6.5%; $P < 0.001$). Counts for all trend sites and for all surveyed sites in the western stock can be approximated using subtotals for the central Gulf of Alaska through the western Aleutian Islands. For all 212 sites surveyed in this region, the 1998 count of 27,185 non-pups indicated declines from each survey since 1991 and an estimated average annual decline from 1991 to 1998 of 2.5% ($P = 0.001$; 95% C.I. 1.9% to 3.1%)(Table 2). Declines at 73 rookery and haul-out trend sites were greater, with an average annual decline of 4.3% ($P = 0.002$; 95% C.I. 2.9% to 5.7%) since 1991 (Table 2).

Alternatively, western-stock subtotals for all trend sites or for all surveyed sites can be approximated by including estimates for the un-surveyed sites in the eastern Gulf of Alaska, based on the 1996 survey (Sease et al. 1999): 1,000 non-pups for 22 un-surveyed trend and non-trend site counts or 500 non-pups for six un-surveyed trend site counts. These estimates were about 2.5% and 3.5% of the western-stock sub-totals for those site categories, respectively. Using

these estimates for missing counts in the eastern Gulf of Alaska, overall declines were slightly greater than for the Kenai to Attu region, above. Average annual declines were 5.3% for trend sites from 1990 to 1998 and 3.3% for all surveyed sites from 1991 to 1998 (Table 3).

The eastern stock is represented in Alaska only by Southeast Alaska, where we counted 8,693 non-pups at 11 trend sites (rookeries and haulouts) in 1998. This indicated increases of 12.7% to 15.0% from survey counts in 1990, 1991, and 1992, a decline of 1.5% from 1994 (8,826), and an increase of 5.6% from 1996 (8,231)(Table 3). The estimated average annual rate of increase from 1990 to 1998 for trend sites in Southeast Alaska was 1.8% (95% C.I.: 3.6% to 0.1%; $P = 0.059$). Two trend sites (Turnabout Island and Cape Fairweather) were not surveyed in 1998, but combined they accounted for only one non-pup in 1992, none in 1994, and one in 1996 (Sease et al. 1993, Strick et al. 1997, Sease et al. 1999). It is unlikely, therefore, that these missing counts affected the trend site sub-total. Overall changes were similar for the three trend rookeries in Southeast Alaska, with an estimated annual increase of 2.0% from 1990 to 1998 (Table 3). The number of missing counts for non-trend sites in Southeast Alaska precluded examining trends for all surveyed sites.

Kenai to Kiska Index Area

We counted 24,318 non-pup sea lions at 203 surveyed sites in the Kenai to Kiska index area in 1998, indicating declines of 1.2% from 1996 (24,625) and 11.0% since 1991 (27,313) (Table 2, Fig. 2). The index area includes 69 trend sites (26 rookeries and 43 haulouts) where we counted 16,315 non-pup sea lions in 1998. This indicated declines of 8.9% from 1996 (17,900) and 28.3% from the 1990 count (22,754)(Table 2, Fig. 2). There were 11,994 non-pup sea lions

on the 26 trend rookeries in the Kenai to Kiska area; overall declines were slightly greater than for the trend rookeries and haulouts (Table 2, Fig. 2). Estimated annual rates of decline in the Kenai to Kiska index area were 1.8% ($P = 0.002$; 95% C.I. 1.2% to 2.3%) for all 203 surveyed sites from 1991 to 1998, 4.1% ($P < 0.001$; 95% C.I. 3.5% to 4.7%) for the 69 trend sites and 5.2% ($P < 0.001$; 95% C.I. 4.2% to 6.3%) for the 26 trend rookeries from 1990 to 1998.

The central Aleutian Islands, one of the four regions making up the Kenai to Kiska index area, is the only one in which numbers of non-pups increased (4%) from 1996 to 1998 at trend rookery and haul-out sites (Table 4, Fig. 3a). Although the actual change was small (< 250 animals), this represented a shift from decline during every other survey interval since 1990. Non-pup counts at trend sites in all other regions declined by 10% to 18%. For trend rookeries only (Table 5, Fig. 3b), numbers of non-pups increased only in the eastern Gulf of Alaska (34%: 544 to 730), a region represented by only one trend rookery. However, the two rookeries in the eastern Gulf of Alaska taken together, remained essentially unchanged from 1996 to 1998 (1,046 to 1,060; Table 8). Declines at trend rookeries in the other regions from 1996 to 1998 ranged from 3% in the western Gulf of Alaska to 24% in the central Gulf of Alaska. Non-pup counts declined (18% for all trend sites, 23% for trend rookeries) from 1996 to 1998 in the eastern Aleutian Islands, a region where numbers had increased slightly since 1990. For all surveyed sites, numbers of non-pups increased from 1996 to 1998 in the central Aleutian Islands (7%: 7,181 to 7,689) and the western Gulf of Alaska (2%: 5,724 to 5,855) while declining in three other regions surveyed (Table 6, Fig. 4).

The 1996 counts for the central and western Gulf of Alaska and the eastern Aleutian Islands fit the overall trend of the past several years, but with relatively greater decline (12% to

20%) from 1996 to 1997 and a lesser decline (1% to 10%) from 1997 to 1998 (Tables 4, 5, and 6; Figs. 3a, 3b, and 4a). Inclusion of the 1997 subtotals for the eastern Aleutian Islands in Figures 3a, 3b, and 4a required adjustment of the counts from other surveys to correct for missing counts from trend rookeries at Bogoslof and Adugak Islands in 1997.

Subareas Outside of the Kenai to Kiska Index Area

The western Aleutian Islands was the only region outside of the Kenai to Kiska index area surveyed completely in 1998. Numbers of non-pups at all surveyed sites, all trend sites, or trend rookeries in the western Aleutian Islands declined by 13% to 16% from 1996 to 1998 (Tables 4, 5, 6; Figs. 4b, 5a, 5b). This followed marginal increases from 1994 to 1996. The overall trend since 1990, however, has been a decline of about 4% to 7% per year. Non-pup numbers in the eastern Gulf of Alaska declined continuously since at least 1989 (Tables 4, 5, 6; Figs. 4b, 5a, 5b). For the three sites surveyed there in 1998, the decline continued, although at a lesser rate (4.7%: 1,546 to 1,473). Numbers of non-pups at trend sites and trend rookeries in Southeast Alaska generally increased by about 2% per year from 1990 to 1998 (Tables 4, 5; Figs. 4b, 5).

Proportion of Non-pups on Rookeries

The overall proportion of non-pups from all surveyed sites that were present on rookeries declined by about 10% from 1996 to 1998 (0.609 to 0.554) for the region from the central Gulf of Alaska through the western Aleutian Islands, the largest area over which this could be calculated. This follows similar declines for each survey since 1991, when the proportion of non-pups on rookeries was 0.663. For individual regions from 1991 through 1998, the proportion of non-pups

on rookeries generally increased in the western Aleutian Islands, but declined in each of the other regions (Table 7, Fig. 6). In the eastern Gulf of Alaska, the proportion on rookeries increased dramatically from 1994 to 1996, but data were not available to examine the trend for 1996 to 1998.

Land-Based Pup Surveys

ADF&G and NMFS counted 6,932 live pups at 12 rookeries from Southeast Alaska through the western Aleutian Islands in 1997 using the standard beach-count method (Tables 1a, 9). Using medium-format aerial photographs (Westlake et al. 1997; ADF&G, Wildlife Conservation Division, unpubl. data), ADF&G counted an additional 716 pups at three other rookeries: Seal Rocks and Fish (Wooded) Island in the eastern Gulf of Alaska, and Outer Island in the central Gulf of Alaska (Table 9). These counts were combined with beach counts (Tables 9 and 10) to provide a more complete time series of pup counts for these rookeries. Although analyses are not complete, these two techniques produce comparable results for these rookeries (ADF&G, Wildlife Conservation Division, unpubl. data). In 1998, the ADF&G and NMFS counted a total of 13,607 pups at 40 rookeries. This included all rookeries in Alaska except Walrus Island in the Pribilof Islands. Of these pups, we counted a total of 290 (2.1%) from overlooks and 70 (0.5%) from boats offshore.

The total number of pups from Southeast Alaska through the central Aleutian Islands declined by 10.6% from 1994 to 1998 (Table 10). Pups at western-stock sites declined by 19.0% whereas those from the eastern stock *increased* by 12.3%. Pups from the eastern stock in Alaska generally increased by about 2% per year since 1990 (Table 10, Fig. 7). In the eastern Gulf of

Alaska, pup numbers increased by 13% from 1997 and 18% from 1996, although they are still 24% below the 1994 count. Pup counts from the central Gulf of Alaska through the central Aleutian Islands declined by 9% to 34% between 1994 and 1998. In the western Aleutian Islands, pup numbers declined 18% from 1997 to 1998.

DISCUSSION

Western Stock

Results of these most recent surveys indicate that the western stock of Steller sea lions in Alaska continued to decline during 1997 and 1998. The rate of decline for non-pups increased from 1996 to 1998 at all trend sites (rookeries and haulouts) and at trend rookeries over wide geographical areas (e.g., Kenai to Kiska or the eastern Gulf of Alaska to Attu) after having abated slightly during the previous 2 years (Fig. 2). This general decline also was apparent in pup production, as the total pup count for the western stock in Alaska declined by 19% from 1994 to 1998. Pup numbers have been in decline at least since 1990 (Tables 9, 10; Fig. 7) for most of the western-stock regions.

In contrast to other western-stock regions, the central Aleutian Islands showed signs that long-term negative trends may be abating. From 1996 to 1998, non-pup numbers decreased by 8% at trend rookeries, but *increased* by 4% and 7% at all trend sites and all surveyed sites, respectively. Pup numbers in the central Aleutian Islands declined by 8.8% from 1994 to 1998, but they remained stable across the central half to two-thirds of the region—from Seguam Island (172° 30' W long.) westward through the Delarof Islands (179° W long.). In the eastern Gulf of Alaska, pup numbers increased from 1996 to 1998 despite a steep decline in non-pup numbers

since about 1989. There are only two rookeries in the eastern Gulf, however, and non-pup counts were incomplete for 1998. Thus, caution is warranted in drawing conclusions about trends in this region. The largest observed declines were in the western Aleutian Islands, where non-pup numbers declined by at least 13% from 1996 to 1998 and pup numbers declined by 18% from 1997 to 1998. It bears repeating that, with the exception of the differentiation between the eastern and western stocks, these regional boundaries are not based on ecological or other biological parameters, and differences in regional trends should be interpreted with caution.

Eastern Stock

Numbers of non-pups in Southeast Alaska declined slightly from 1989 to 1990 and again from 1994 to 1996, but the overall trend from 1990 to 1998 has been about a 2% per year increase. Pup numbers in Southeast Alaska also increased by about 2% per year since 1990. The Steller sea lions in Southeast Alaska represent approximately one-half of the eastern stock; any analysis of population trends for this stock must include animals in British Columbia and the western United States. Trends in British Columbia and Oregon, at least for non-pup counts, are approximately parallel to those of Southeast Alaska (P. Olesiuk, Canada Department of Fisheries and Oceans, unpubl. data; R. Brown, Oregon Department of Fish and Wildlife, unpubl. data), indicating continued growth of the eastern stock.

Distribution at Rookery and Haul-out Sites

Over most geographical regions, the magnitudes and rates of change in non-pup counts generally were greatest for trend rookeries, intermediate for trend rookery and haul-out sites, and

lowest for all surveyed sites. The differences between these various subtotals is the inclusion of increasing numbers of sea lions from haul-out sites. The greater declines at rookeries implies a relative shift of the population away from rookeries and towards haulouts. In fact, the proportion of non-pups on rookeries has been declining in most regions since 1991 (Table 7, Fig. 6). Despite the general population declines in western-stock regions, the absolute numbers of non-pups on haul-out sites in the western Gulf of Alaska and the eastern and central Aleutian Islands increased from 1991 through 1998 (Fig. 8). Merrick et al. (1992) speculated that a shift of non-pups from rookeries to haul-out sites could reflect a relative increase in numbers of juvenile sea lions, which tend to congregate more on haulouts than on rookeries. This could signify a positive trend for the population, as poor juvenile survival has been suggested as a major contributing factor in the population declines (NMFS 1992, York 1994, NMFS 1995).

An alternative interpretation to the observed decline in the proportion of non-pup sea lions on rookeries is that an increasing proportion of adult females have been forgoing breeding, therefore spending more time at haul-out sites than at rookeries. Delayed onset of reproduction, increased interval between pupping, reduced success in carrying pregnancies to term, and reduced survival of adult females are examples of changes in vital parameters that could cause a general decline in reproduction and a decrease in the proportion of adults on rookeries. Testing the likelihood of these hypotheses requires determining if the population of sea lions on haul-out sites is being skewed to include more juveniles or more adult females. At present we do not have the appropriate data.

ACKNOWLEDGMENTS

NMFS and ADF&G thank Aero Commander NW, Wenatchee, Washington (1997, 1998) and Aero Air, Hillsboro, Oregon (1998) for aircraft transportation during aerial surveys. For vessel support during pup counts we thank the masters and crews of the R/V *Medeia* (1997) and the R/V *Curllew* (1998) in Southeast Alaska, the F/V *Big Valley* in the Aleutian Islands (1997) and Gulf of Alaska and Unimak Pass region (1998), and the M/V *Tiglax* in the Aleutian Islands (1997 and 1998). The U.S. Coast Guard, Sitka Air Station (1997, 1998), and Maritime Helicopters, Kodiak, Alaska (1998), provided helicopter transportation to several rookeries in Southeast Alaska and the Gulf of Alaska. We greatly appreciate the wide-ranging assistance from personnel of the Alaska Maritime National Wildlife Refuge (AMNWR) in Homer, Alaska, and especially J. Williams and the staff at the Refuge's Aleutian Islands Unit on Adak Island.

P. Olesiuk (Canada Department of Fisheries and Oceans) and M. Strick and M. Horning (NMFS) participated in the NMFS aerial surveys; M. Strick and J. Thomason (NMFS) counted sea lions from slides. B. Porter and B. Taylor (ADF&G) and Morgan Lynn (NMFS) participated in flights and counting for the ADF&G aerial survey in 1998. M. Bohan, P. Browne, K. Chumbley, C. Gburski, M. Horning, T. Loughlin, T. Ragen, L. Rea, M. Strick, J. Thomason, and R. Towell (NMFS), and W. Cunningham, D. McAllister, K. Pitcher, B. Porter, and U. Swain (ADF&G) participated in pup counts. C. Gburski, L. LaFrance, and A. Tiplady helped proofread tables. Comments from D. Rugh, J. Jansen, T. Loughlin, A. Tiplady, and A. York improved the manuscript. G. Duker and J. Lee provided editorial support. We conducted these surveys under the authority of NMFS Marine Mammal Protection Act Permits Nos. 809 (1997) and 782-1447 (1998) and Special Use Permit No. 51576 from the Alaska Maritime National Wildlife Refuge.

CITATIONS

- Bickham, J.W., J.C. Patton, and T.R. Loughlin. 1996. High variability for control-region sequences in a marine mammal--implications for conservation and biogeography of Steller sea lion (*Eumetopias jubatus*). *J. Mammal.* 77:95-108.
- Braham, H.W., R.D. Everitt, and D.J. Rugh. 1980. Northern sea lion population decline in the eastern Aleutian Islands. *J. Wildl. Manage.* 44:25-33.
- Calkins, D.G., and K.W. Pitcher. 1982. Population assessment, ecology and trophic relationships of Steller sea lions in the Gulf of Alaska. Alaska Department of Fish and Game, Final Report RU243. Alaska Department of Fish and Game, 333 Raspberry Road, Anchorage, AK 99502, 76 p.
- Chumbley, K., J. Sease, M. Strick, and R. Towell. 1997. Field studies of Steller sea lions (*Eumetopias jubatus*) at Marmot Island, Alaska, 1979 through 1994. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-77, 99 p.
- Hollowed, A.B., E. Brown, J. Ianelli, B. Megrey, and C. Wilson. 1998. Walleye pollock. Pages 29-90 in Stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska as projected for 1999. Gulf of Alaska Groundfish Plan Team, North Pacific Fisheries Management Council, P.O. Box 103136, Anchorage, AK 99510.
- Ianelli, J.N., L. Fritz, T. Honkalehto, N. Williamson, and G. Walters. 1998. Eastern Bering Sea walleye pollock stock assessment with yield considerations for 1999. Pages 31-112 in Stock assessment and fishery evaluation report for the groundfish resources of the Bering Sea/Aleutian Islands regions. Bering Sea and Aleutian Islands Groundfish Plan Team, North Pacific Fisheries Management Council, P.O. Box 103136, Anchorage, AK 99510.
- Loughlin, T.R. 1997. Using the phylogeographic method to identify Steller sea lion stocks, p. 159-171. In A.E. Dizon, S.J. Chivers, and W.F. Perrin (editors), *Molecular genetics of marine mammals*. Soc. Mar. Mammal., Spec. Publ. No. 3.
- Loughlin, T.R., A.S. Perlov, and V.A. Vladimirov. 1990. Survey of northern sea lions (*Eumetopias jubatus*) in the Gulf of Alaska and Aleutian Islands during June 1989. U.S. Dep. Commer., NOAA Tech. Memo. NMFS F/NWC-176, 26 p.
- Loughlin, T.R., A.S. Perlov, and V.A. Vladimirov. 1992. Range-wide survey and estimation of total number of Steller sea lions in 1989. *Mar. Mammal Sci.* 8:220-239.
- Loughlin, T.R., D.J. Rugh, and C.H. Fiscus. 1984. Northern sea lion distribution and abundance: 1956-80. *J. Wildl. Manage.* 48:729-740.

- Merrick, R.L., D.G. Calkins, and D.C. McAllister. 1992. Aerial and ship-based surveys of Steller sea lions in Southeast, Alaska, the Gulf of Alaska, and Aleutian Islands during June and July 1991. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-1, 37 p.
- Merrick, R.L., L.M. Ferm, R.D. Everitt, R.R. Ream, and L.A. Lessard. 1991. Aerial and ship-based surveys of northern sea lions, (*Eumetopias jubatus*) in the Gulf of Alaska and Aleutian Islands during June and July 1990. U.S. Dep. Commer., NOAA Tech. Memo. NMFS F/NWC-196, 34 p.
- Merrick, R.L., T.R. Loughlin, and D.G. Calkins. 1987. Decline in abundance of the northern sea lion, *Eumetopias jubatus*, in Alaska, 1956-86. Fish. Bull., U.S. 85:351-365.
- NMFS (National Marine Fisheries Service). 1992. Recovery plan for the Steller sea lion (*Eumetopias jubatus*). Prepared by the Steller Sea Lion Recovery Team for the National Marine Fisheries Service, Silver Spring, Maryland, 92 p.
- NMFS (National Marine Fisheries Service). 1995. Status review of the United States Steller sea lion (*Eumetopias jubatus*) population. Prepared by the National Marine Mammal Laboratory, Alaska Fisheries Science Center, Seattle, Washington, 45 p.
- Sease, J.L., J.P. Lewis, D.C. McAllister, R.L. Merrick, and S.M. Mello. 1993. Aerial and ship-based surveys of Steller sea lions (*Eumetopias jubatus*) in Southeast Alaska, the Gulf of Alaska, and Aleutian Islands during June and July 1992. U.S. Dep. Commer., NOAA Tech. Memo. NMFS F/NWC-17, 57 p.
- Sease, J.L., J.M. Strick, R.L. Merrick, and J.P. Lewis. 1999. Aerial and land-based surveys of Steller sea lions (*Eumetopias jubatus*) in Alaska, June and July 1996. U.S. Dep. Commer., NOAA Tech. Memo. NMFS F/NWC-99, 43 p.
- Strick, J.M., L.W. Fritz, and J.P. Lewis. 1997. Aerial and ship-based surveys of Steller sea lions (*Eumetopias jubatus*) in Southeast Alaska, the Gulf of Alaska, and Aleutian Islands during June and July 1994. U.S. Dep. Commer., NOAA Tech. Memo. NMFS F/NWC-71, 55 p.
- Westlake, R.L., W.L. Perryman, and K.A. Ono. 1997. Comparison of vertical aerial photographic and ground censuses of Steller sea lions at Año Nuevo Island, July 1990-1993. Mar. Mammal Sci. 13:207-218.
- York, A.E. 1994. The population dynamics of northern sea lions, 1975-1985. Mar. Mammal Sci. 10:38-51.

Table 1a.--Counts of adult and juvenile (non-pup) Steller sea lions at rookery (*) and haul-out sites in Alaska during June and July 1997. Trend sites () are those sites used for analyses of trends in survey counts. Count types are photographic (P) or visual (V). Sites are arranged approximately in geographical order from Dixon Entrance in Southeast Alaska to Attu Island in the western Aleutian Islands.

Location	Non-pup count			Pup count	
	Date	Type	Count	Date	Count
Southeast Alaska					
Forrester *			n.s. ¹	29 June	2,798
Hazy Islands *			n.s.	7 July	1,157
White Sisters *			n.s.	5 July	205
Subtotals for Southeast Alaska					
Pups at 3 rookeries					4,160
Eastern Gulf of Alaska					
Steep Point	10 June	P	110		
Rabbit	10 June	V	0		
Central Gulf of Alaska					
Outer*	10 June	P	225		
Nuka Point	10 June	V	0		
Gore Point	10 June	V	0		
East Chugach	10 June	V	3		
Perl	10 June	P	136		
Nagahut Rocks	10 June	V	0		
Cape Elizabeth	10 June	P	35		
Flat	10 June	V	0		
West Amatuli	10 June	V	0		
Sugarloaf *	10 June	P	625		
Ushagat	10 June	P	96		
Rocks south of Ushagat	10 June	P	21		
Sud	10 June	V	0		
Latax Rocks	10 June	P	170		
Sea Otter	10 June	P	101		
Afognak/Tonki Cape	10 June	V	0		
Sea Lion Rocks (Marmot)	10 June	P	37		

Table 1a.--Non-pup and pup counts - 1997, continued.

Location	Non-pup count			Pup count	
	Date	Type	Count	Date	Count
Marmot *	10 June	P	781		
Long	10 June	P	77		
Kodiak/Cape Chiniak	11 June	P	113		
Ugak	11 June	V	0		
Kodiak/Gull Point	11 June	P	87		
Kodiak/Cape Barnabas	11 June	V	0		
Twoheaded	11 June	P	308		
Cape Sitkinak	11 June	P	138		
Sundstrom	11 June	V	0		
Kodiak/Cape Hepburn	11 June	V	0		
Kodiak/Cape Alitak	11 June	V	0		
Cape Ikolik	11 June	P	56		
Kodiak/Sturgeon Head	10 June	V	0		
Kodiak/Cape Uyak	10 June	V	0		
Kodiak/Cape Kuliuk	10 June	V	0		
Kodiak/Cape Ugat	10 June	P	99		
Noisy	10 June	V	0		
Kodiak/Malina Point	10 June	V	0		
Kodiak/Steep Cape	10 June	P	42		
Kodiak/Cape Paramanof	10 June	V	0		
Shaw	10 June	P	248		
Cape Douglas	10 June	V	0		
Shakun Rocks	10 June	P	109		
Cape Nukshak	10 June	V	0		
Cape Ugyak	10 June	V	0		
Cape Gull	10 June	V	0		
Cape Kuliak	10 June	V	0		
Takli	10 June	P	34		
Puale Bay	10 June	P	143		
Kilokak Rocks	11 June	P	90		
Aiugnak Columns	11 June	P	95		
Ugaiushak	11 June	P	10		

Table 1a.--Non-pup and pup counts - 1997, continued.

Location	Non-pup count			Pup count	
	Date	Type	Count	Date	Count
Sutwik	11 June	P	143		
Chowiet *	11 June	P	538		
Chirikof *	11 June	P	295		
Nagai Rocks	11 June	P	204		
Subtotals for the Central Gulf of Alaska					
All 53 sites			5,059		
15 trend rookery and haul-out sites			3,352		
4 trend rookery sites			2,239		
Western Gulf of Alaska					
Lighthouse Rocks	12 June	P	92		
Atkulik	11 June	V	0		
Kak	11 June	P	235		
Chankliut	12 June	V	0		
Seal Cape	12 June	V	0		
Mitrofanía	13 June	P	266		
Spitz	13 June	P	21		
Kupreanof Point	13 June	P	34		
Castle Rock	13 June	P	77		
Atkins *	13 June	P	544		
Chernabura *	13 June	P	729		
Twins	13 June	V	0		
The Haystacks	13 June	P	30		
The Whaleback	13 June	P	343		
Nagai Island					
Mountain Point	13 June	V	0		
Rocks west of Cape Wedge	13 June	V	0		
Sea Lion Rocks (Shumagins)	13 June	P	174		
Unga					
Cape Unga	13 June	V	0		
Acheredin Pt.	13 June	P	63		
Jude	13 June	P	435		

Table 1a.--Non-pup and pup counts - 1997, continued.

Location	Non-pup count			Pup count	
	Date	Type	Count	Date	Count
Omega	13		n.s.		
Wosnesenski	13 June	V	1		
Olga Rocks	13 June	P	266		
Sushilnoi Rocks	13 June	P	154		
Pinnacle Rock *	13 June	P	1,007		
Hunt	13 June	V	0		
Clubbing Rocks *	13 June	P	934		
Cherni	13 June	V	0		
Hague	13 June	P	77		
Caton	13 June	V	0		
South Rock	13 June	P	402		
Bird	13 June	P	147		
Rock	13 June	V	0		
Subtotals for the Western Gulf of Alaska					
All 32 sites			6,031		
9 trend rookery and haul-out sites			3,633		
4 trend rookery sites			3,214		
Eastern Aleutian Islands					
Unimak					
Cape Lasaref	13 June	V	0		
Cape Lutke	13 June	V	0		
Scotch Cap	13 June	V	0		
Sennett Point	13 June	V	0		
Cape Sarichef	13 June	P	221		
Cave Point	13 June	V	0		
Okseno f Point	13 June	V	0		
Amak	13 June	P	919		
Sea Lion Rocks (Amak) *	13 June	P	452		
Ugamak and Round *	13 June	P	840	7 July	589
Aiktak	13 June	P	53		
Kaligigan	13 June	V	1		
Tigalda/NE Rocks	13 June	P	170		

Table 1a.--Non-pup and pup counts - 1997, continued.

Location	Non-pup count			Pup count	
	Date	Type	Count	Date	Count
Tigalda South side	13 June	P	49		
Basalt Rock	13 June	V	0		
Tanginak	14 June	P	29		
Rootok	13 June	P	146		
Akun					
Jackass Point	14 June	V	2		
Billings Head *	14 June	P	247		
Akun Head	14 June	V	0		
Akutan					
North Head	14 June	V	0		
Reef Point/Lava Bight	14 June	P	43		
Cape Morgan *	14 June	P	760		
Battery Point	14 June	V	2		
Baby Islands			n.s.		
Old Man Rocks	14 June	P	138		
Egg	14 June	V	1		
Outer Signal	14 June	P	15		
Inner Signal	14 June	V	0		
Unalaska					
Cape Sedanka	14 June	V	0		
Cape Wislow	14 June	V	0		
Bishop Point	14 June	P	205		
Makushin Bay	14 June	P	38		
Cape Starichkof	14 June	V	0		
Spray Cape	14 June	V	0		
Whalebone Cape	14 June	V	0		
Cape Izigan	14 June	P	342		
Bogoslof *			n.s.	5 July	281
Umnak					
Cape Idak			n.s.		
Reindeer Point			n.s.		
Cape Chagak			n.s.		
Aguliuk Point			n.s.		

Table 1a.--Non-pup and pup counts - 1997, continued.

Location	Non-pup count			Pup count	
	Date	Type	Count	Date	Count
Umnak (continued)					
Cape Aslik	14 June	P	67		
Emerald	14 June	V	0		
Polivnoi Rock	14 June	P	117		
Pillars	14 June	V	0		
Ogchul *	14 June	P	167		
Vsevidof	14 June	P	25		
Samalga			n.s.		
Adugak *			n.s.		
Subtotals for the Eastern Aleutian Islands					
All 42 sites (pups at 2 rookeries)			5,049²		870
9 trend rookery and haul-out sites²			3,520²		
5 trend rookery sites²			2,466²		
Central Aleutian Islands					
Yunaska			n.s.	24 June	192
Seguam/Saddleridge *			n.s.	4 July	463
Kasatochi *			n.s.	1 July	268
Subtotals for the Central Aleutian Islands					
3 rookeries					923
Western Aleutian Islands					
Buldir *			n.s.	26 June	120
Agattu ³					
Cape Sabak *			n.s.	25 June	379
Gillon Point *			n.s.	25 June	258
Attu/Cape Wrangell*			n.s.	24 June	222
Subtotals for the Western Aleutian Islands					
all 4 rookeries					979
3 trend rookery sites³					757

Table 1a.--Non-pup and pup counts - 1997, continued.

Location	Non-pup count			Pup count	
	Date	Type	Count	Date	Count
Subtotals for central and western Gulf of Alaska and eastern Aleutian Islands					
All 127 sites (pups at 12 rookeries)			16,249	6,932	
33 trend rookery and haul-out sites^{2,3}			10,505²		
13 trend rookery sites^{2,3}			7,919²		

¹ "n.s." indicates sites not surveyed in 1997.

² Trend rookeries at Bogoslof and Adugak islands not surveyed because of fog.

³ Two Trend Rookeries on Agattu Island previously reported as one Trend Rookery site

Table 1b.--Counts of adult and juvenile (non-pup) Steller sea lions at rookery (*) and haul-out sites in Alaska during June and July 1998. Trend sites () are those sites used for analyses of trends in survey counts. Count types are photographic (P = 35-mm, MF = medium-format) or visual (V). Sites are arranged approximately in geographical order from Dixon Entrance in Southeast Alaska to Attu Island in the western Aleutian Islands.

Location	Non-pup count			Pup count	
	Date	Type	Count	Date	Count
Southeast Alaska					
West Rock	22 June	MF	427		
Forrester *	22 June	MF	3,788	5 July	2,753
Wolf Rock	22 June	V	0		
Cape Bartolome	21 June	V	0		
Cape Addington	21 June	MF	686		
Timbered	21 June	MF	221		
Coronation	21 June	MF	89		
Hazy Islands *	21 June	MF	1,962	4 July	1,199
Cape Ommaney	20 June	MF	382		
Sea Lion Rock (Puffin Bay)	21 June	MF	422		
Biali Rock	20 June	MF	432		
Jacob Rock	20 June	P	209		
Kaiuchali (Biorka)	20 June	P	30		
Turnabout			n.s. ¹		
The Brothers	21 June	MF	713		
Sea Lion Island	20 June	V	0		
White Sisters *	20 June	P	858	4 July	282
Cape Cross	20 June	V	0		
Cape Bingham	21 June	V	1		
Graves Rock	20 June	P	445		
Inian	20 June	P	77		
Harbor Point	20 June	P	197		
Cape Fairweather			n.s.		
Subtotals for Southeast Alaska					
At 21 sites (pups at 3 rookeries)			10,939		4,234
At 11 trend sites			8,693		
3 trend rookery sites			6,608		4,234

Table 1b.--Non-pup and pup counts - 1998, continued.

Location	Non-pup count			Pup count	
	Date	Type	Count	Date	Count
Eastern Gulf of Alaska					
Sitkagi Bluffs			n.s.		
Cape St. Elias	21 June	MF	413		
Seal Rocks *	27 June	P	730	29 June	542
Fish (Wooded)	27 June	P	330	27 June	147 ²
Glacier			n.s.		
The Needle			n.s.		
Point Elrington			n.s.		
Rugged			n.s.		
Chiswell			n.s.		
Seal Rock (Kenai)			n.s.		
Subtotals for the Eastern Gulf of Alaska					
At 3 sites (pups at 2 rookeries)			1,473		689
1 trend rookery site			730		542
Central Gulf of Alaska					
Outer*	10 June	P	344	5 July	113
Nuka Point	10 June	V	0		
Gore Point	10 June	V	0		
East Chugach	10 June	V	0		
Perl	10 June	P	127		
Nagahut Rocks	10 June	V	0		
Cape Elizabeth	10 June	P	42		
Flat	10 June	V	0		
West Amatuli	10 June	V	0		
Sugarloaf *	10 June	P	646	4 July	703
Ushagat	10 June	P	95		
Rocks south of Ushagat	10 June	P	3		
Sud	10 June	V	0		
Latax Rocks	10 June	P	109		
Sea Otter	10 June	P	123		
Afognak/Tonki Cape	10 June	V	0		

Table 1b.--Non-pup and pup counts - 1998, continued.

Location	Non-pup count			Pup count	
	Date	Type	Count	Date	Count
Sea Lion Rocks (Marmot)	10 June	P	61		
Marmot *	10 June	P	694	1 July	642
Long	10 June	P	70		
Kodiak/Cape Chiniak	10 June	P	212		
Ugak	10 June	V	0		
Kodiak/Gull Point	10 June	P	70		
Kodiak/Cape Barnabas	10 June	V	0		
Twoheaded	10 June	P	378		
Cape Sitkinak	10 June	P	100		
Sundstrom	10 June	V	0		
Kodiak/Cape Alitak	10 June	V	0		
Cape Ikolik	10 June	P	47		
Tombstone Rock	10 June	V	3		
Kodiak/Sturgeon Head	10 June	V	0		
Kodiak/Cape Uyak	10 June	V	0		
Kodiak/Cape Kuliuk	10 June	V	0		
Kodiak/Cape Ugat	10 June	P	128		
Noisy	10 June	V	0		
Kodiak/Malina Point	10 June	V	0		
Kodiak/Steep Cape	11 June	P	34		
Kodiak/Cape Paramanof	11 June	V	0		
Shaw	11 June	V	0		
Cape Douglas	11 June		n.s.		
Shakun Rocks	11 June	P	56		
Cape Nukshak	11 June	V	0		
Cape Ugyak	11 June	V	0		
Cape Gull	11 June	V	0		
Cape Kuliak	11 June	V	0		
Takli	11 June	P	35		
Puale Bay	11 June	P	136		
Kilokak Rocks	11 June	P	77		
Aiugnak Columns	11 June	P	81		

Table 1b.--Non-pup and pup counts - 1998, continued.

Location	Non-pup count			Pup count	
	Date	Type	Count	Date	Count
Ugaiushak	11 June	P	19		
Sutwik	11 June	P	178		
Aghiyuk	11 June	P	9		
Chowiet *	11 June	P	515	28 June	234
Chirikof *	11 June	P	266	27 June	184
Nagai Rocks	11 June	P	313		
Subtotals for the Central Gulf of Alaska					
All 53 sites (pups at all 5 rookeries)			4,971		1,876
15 trend rookery and haul-out sites			3,346		
4 trend rookery sites			2,121		1,763
Western Gulf of Alaska					
Lighthouse Rocks	11 June	P	131		
Atkulik	11 June	V	0		
Kak	11 June	P	236		
Chankliut	11 June		n.s.		
Seal Cape	11 June	V	0		
Mitrofanina	11 June	P	247		
Spitz	11 June	P	27		
Kupreanof Point	11 June	P	11		
Castle Rock	12 June	P	155		
Atkins *	12 June	P	602	29 June	352
Chernabura *	12 June	P	624	29 June	54
Twins	12 June	V	0		
The Haystacks	12 June	P	61		
The Whaleback	12 June	P	317		
Nagai Island					
Mountain Point	12 June	P	24		
Rocks west of Cape Wedge	12 June	V	0		
Sea Lion Rocks (Shumagins)	12 June	P	152		
Unga					
Cape Unga	12 June	V	0		

Table 1b.--Non-pup and pup counts - 1998, continued.

Location	Non-pup count			Pup count	
	Date	Type	Count	Date	Count
Unga (continued)					
Acheredin Pt.	12 June	P	147		
Jude	12 June	P	450		
Omega	12 June	V	0		
Wosnesenski	12 June	V	0		
Olga Rocks	12 June	P	375		
Sushilnoi Rocks	12 June	P	109		
Pinnacle Rock *	12 June	P	865	30 June	639
Umga	12 June	V	0		
Clubbing Rocks *	12 June	P	858	30 June	448
Cherni	12 June	V	2		
Hague	12 June	V	0		
South Rock	12 June	P	408		
Bird	12 June	P	54		
Rock	12 June	V	0		
Subtotals for the Western Gulf of Alaska					
All 31 sites (pups at 4 rookeries)			5,855		1,493
9 trend rookery and haul-out sites			3,361		
4 trend rookery sites			2,949		1,493
Eastern Aleutian Islands					
Unimak					
Cape Lasaref	12 June	V	0		
Cape Lutke	12 June	V	0		
Scotch Cap	12 June	V	0		
Sennett Point	12 June	V	0		
Cape Sarichef	12 June	P	367		
Cave Point	12 June	V	0		
Oksenof Point	12 June	V	0		
Amak	12 June	P	946		
Sea Lion Rocks (Amak) *	12 June	P	445	1 July	134
Ugamak and Round *	12 June	P	744	2 July	558

Table 1b.--Non-pup and pup counts - 1998, continued.

Location	Non-pup count			Pup count	
	Date	Type	Count	Date	Count
Aiktak	12 June	P	103		
Kaligigan	12 June	V	0		
Tigalda/NE Rocks	12 June	P	133		
Tigalda South side	12 June	P	47		
Basalt Rock	12 June	V	0		
Tanginak	12 June	P	69		
Rootok	13 June	P	210		
Akun					
Jackas Point	13 June	V	0		
Billings Head *	13 June	P	213	3 July	56
Akun Head	13 June	V	0		
Akutan					
North Head	13 June	V	0		
Reef Point/Lava Bight	13 June	P	54		
Cape Morgan *	13 June	P	681	3 July	505
Battery Point	13 June	V	2		
Baby Islands	12 June	V	0		
Old Man Rocks	13 June	P	149		
Egg	13 June	V	0		
Outer Signal	13 June	P	46		
Inner Signal	13 June	P	16		
Unalaska					
Cape Sedanka	13 June	P	18		
Cape Wislow	13 June	V	0		
Bishop Point	13 June	P	204		
Makushin Bay	13 June	P	66		
Cape Starichikof	13 June	V	0		
Spray Cape	13 June	V	0		
Whalebone Cape	13 June	V	0		
Cape Izigan	13 June	P	264		
Bogoslof *	13 June	P	274	5 July	220
Umnak					
Cape Idak	13 June	V	0		

Table 1b.--Non-pup and pup counts - 1998, continued.

Location	Non-pup count			Pup count	
	Date	Type	Count	Date	Count
Umnak (continued)					
Reindeer Point	13 June	V	0		
Cape Chagak	13 June	V	0		
Aguliuk Point	13 June	V	0		
Cape Aslik	13 June	P	74		
Emerald	13 June	V	0		
Polivnoi Rock	13 June	P	163		
Pillars	13 June	P	33		
Rocks 3.3nmi north of Ogchul	13 June	P	66		
Ogchul *	13 June	P	137	5 July	42 ³
Vsevidof	13 June	P	48		
Samalga	13 June	V	n.s.		
Adugak *	13 June	P	231	4 July	135
Subtotals for the Eastern Aleutian Islands					
All 50 sites (pups at 7 rookeries)			5,803		1,650
11 trend rookery and haul-out sites			3,847		
7 trend rookery sites			2,725		1,650
Central Aleutian Islands					
Uliaga	13 June	P	93		
Kagamil	13 June	V	0		
Chuginadak	13 June	P	36		
Carlisle	13 June	V	0		
Herbert	13 June	V	5		
Yunaska *	13 June	P	210	3 July	161
Chagulak	13 June	P	40		
Amukta	14 June	P	10		
Seguam					
Saddleridge *	14 June	P	586	2 July	479
Other	14 June	P/V	289		
Agligadak *	14 June	P	40	2 July	0 ³

Table 1b.--Non-pup and pup counts - 1998, continued.

Location	Non-pup count			Pup count	
	Date	Type	Count	Date	Count
Amlia					
Sviechnikof*	14 June	P	117	2 July	13 ³
East Cape	14 June	P	221		
Tanadak (Amlia)	14 June	P	11		
Sagigik	14 June	P	5		
Amatagis	14 June	V	0		
Sagchudak	14 June	V	0		
Atka					
North Cape	14 June	P	156		
Cape Korovin	14 June	V	0		
Salt	14 June	V	0		
Koniuji	14 June	V	0		
Kasatochi *	14 June	P	351	1 July	247
Oglodak	14 June	P	71		
Ikiginak	14 June	V	1		
Fenimore	14 June	P	23		
Tagalak	14 June	P	134		
Chagul	14 June	P	82		
Anagaksik	14 June	P	34		
Igitkin	14 June	V	0		
Great Sitkin	14 June	P	57		
Little Tanaga	14 June	P	235		
Kagalaska	14 June	P	43		
Adak					
Argonne Point/Cape Moffet	15 June	P/V	43		
Cape Yakak/Lake Point *	15 June	P	684	30 June	340
Crone	15 June	V	0		
Kanaga					
North Cape/Cape Miga	15 June	P	104		
Ship Rock	15 June	P	164		
Bobrof	15 June	P	13		

Table 1b.--Non-pup and pup counts - 1998, continued.

Location	Non-pup count			Pup count	
	Date	Type	Count	Date	Count
Tanaga					
Bumpy Point	15 June	P	17		
Cape Sasmik	15 June	P	183		
Ilak	16 June	P	67		
Gramp Rock *	16 June	P	571	29 June	456
Ugidak	16 June	P	42		
Tag *	16 June	P	371	29 June	238
Skagul	16 June	V	0		
Gareloi	16 June	V	0		
Kavalga	16 June	P	53		
Unalga and Dinkum Rocks	16 June	P	121		
Tanadak (Ulak)	16 June	P	7		
Ulak/Hasgox Point *	16 June	P	698	29 June	521
Amatignak	16 June	P	112		
Semisopchnoi*	16 June	P	143	19 June	6 ³
Amchitka					
Ivakin Point	16 June	V	0		
East Cape	16 June	P	148	28 June	9 ³
Cape St. Makarias	16 June	V	0		
Column Rocks*	16 June	P	113	28 June	70
Bird	16 June	P	26		
Ayugadak *	16 June	P	179	28 June	89 ²
Rat	16 June	P	85		
Little Sitkin	16 June	P	80		
Segula	16 June	V	4		
Sea Lion Rocks (Kiska)	16 June	V	1		
Tanadak (Kiska)	16 June	P	96		
Kiska					
Sobaka-Vega Pt.	16 June	P	109		
Cape St. Stephen *	16 June	P	224	27 June	54 ²
Lief Cove *	16 June	P	285	27 June	179
Witchcraft Point	16 June	P	30		

Table 1b.--Non-pup and pup counts - 1998, continued.

Location	Non-pup count			Pup count	
	Date	Type	Count	Date	Count
Kiska (continued)					
Sirius Point	16 June	P	61		
Pillar Rock	16 June	P	5		
Subtotals for the Central Aleutian Islands					
All 69 sites (pups at all 15 rookeries)			7,689		2,862
34 trend rookery and haul-out sites			5,761		
11 trend rookery sites			4,199		2,764
Western Aleutian Islands					
Buldir *	16 June	P	336	26 June	122
Ingenstrem Rocks	16 June	V	0		
Shemya	16 June	P	160		
Nizki	16 June	V	0		
Alaid	16 June	P	269		
Agattu ⁴					
Cape Sabak *	16 June	P	827	24 June	314
Gillon Point *	16 June	P	481	24 June	213
Attu					
Cape Wrangell*	16 June	P	584	25 June	154
Other	16 June	P	210		
Subtotals for the Western Aleutian Islands					
All 9 sites (pups at all 4 rookeries)			2,867		803
4 trend rookery and haul-out sites⁴			1,913		
3 trend rookery sites⁴			1,644		649
Totals for Kenai to Kiska					
All 203 sites (pups at 31 rookeries)			24,318		7,881
69 trend rookery and haul-out sites			16,315		
26 trend rookery sites			11,994		7,670

Table 1b.--Non-pup and pup counts - 1998, continued.

Location	Non-pup count			Pup count	
	Date	Type	Count	Date	Count
Subtotals for all surveyed sites					
			39,597		13,607
			28,394		
			20,976		13,095

¹ "n.s." indicates sites not surveyed in 1998.

² Pup counts by observation at overlook, not beach count.

³ Pup counts by observation from boat immediately offshore, not beach count.

⁴ Two Trend Rookeries on Agattu Island previously reported as one Trend Rookery site

⁵ Not comparable to all sites and all trend site counts from previous years because of incomplete coverage of sites in Southeast Alaska and the eastern Gulf of Alaska in 1998

Table 2.--Counts of adult and juvenile (non-pup) Steller sea lions observed at trend rookeries, at all trend sites (rookeries and haulouts), and at all surveyed sites in the Kenai to Kiska index area and Alaska state-wide for June and July aerial surveys from 1990 to 1998, including estimated annual rates of change with upper and lower 95% confidence interval and significance (P) from linear regression (see text).

Year	Kenai to Kiska index area			All of Alaska	All of Alaska (Kenai to Attu) ¹		
	Trend rookeries (n = 26)	All trend sites (n = 69)	All surv. sites (n = 203)	Trend rookeries (n = 33)	All trend sites (n = 73)	All surv. sites (n = 212)	
1990	18,694	22,754	inc. ²	27,604	inc.	inc.	
1991	17,186	21,737	27,313	26,879	24,822	32,236	
1992	16,589	20,679	26,854	25,849	23,548	31,387	
1994	14,505	18,713	25,995	23,452	20,750	29,364	
1996	13,905	17,900	24,625	22,562	20,090	28,036	
1998	11,994	16,315	24,318	20,976	18,228	27,185	
Overall change							
1990 1998	35.8%	28.3%	--	24.0%	--	--	
1991 1998	30.2%	24.9%	11.0%	22.0%	26.6%	15.7%	
1992 1998	27.7%	21.1%	9.4%	18.9%	22.6%	13.4%	
1994 1998	17.3%	12.8%	6.5%	10.6%	12.2%	7.4%	
1996 1998	13.7%	8.9%	1.2%	7.0%	9.3%	3.0%	
Estimated annual rate of change							
1990 1998	5.2%	4.1%	--	3.5%	--	--	
1991-1998	--	--	1.8%	--	4.3%	2.5%	
Upper 95%	4.2%	3.5%	1.2%	2.9%	2.9%	1.9%	
Lower 95%	6.3%	4.7%	2.3%	4.0%	5.7%	3.1%	
P	< 0.001	< 0.001	0.002	< 0.001	0.002	0.001	

¹ Alaska-wide totals not available because of incomplete counts at trend sites in Southeast Alaska and the eastern Gulf of Alaska.

² "inc." indicates incomplete survey data.

Table 3.--Counts of adult and juvenile (non-pup) Steller sea lions from the eastern and western stocks in Alaska at trend rookeries, at all trend sites (rookeries and haul-outs), and at all surveyed sites during June and July aerial surveys from 1990 to 1998, including number of sites in each region (n) and estimated annual rate of change with upper and lower limits for the 95% confidence interval and significance (P) from linear regression (see text).

Year	Eastern Stock (Southeast Alaska)			Western Stock in Alaska		
	Trend rookeries (n = 3)	All trend sites (n = 13)	All surv. sites (n = 58)	Trend rookeries (n = 30)	All trend sites (n = 82)	All surv. sites (n = 222)
1990	5,491	7,629	inc. ¹	22,113	30,525	inc.
1991	5,786	7,715	9,449	21,093	29,418	37,048
1992	5,945	7,558	10,003	19,904	27,286	35,747
1994	6,496	8,826	11,787	16,956	24,119	33,361
1996	6,204	8,231	10,907	16,358	22,223	30,622
1998	6,608	8,693 ²	inc.	14,368	20,201 ³	29,658 ⁴
Overall change						
1990-1998	20.3%	14.0%		35.0%	33.8%	--
1991-1998	14.2%	12.7%		31.9%	31.3%	20.0%
1992-1998	11.2%	15.0%		27.8%	26.0%	17.0%
1994-1998	1.7%	1.5%		15.3%	16.2%	11.1%
1996-1998	6.5%	5.6%		12.2%	9.1%	3.2%
Estimated annual rate of change						
1990-1998	2.0%	1.8%		5.4%	(5.3%) ³	--
1991-1998	--	--	(3.3%)	--	--	(3.3%) ⁴
Lower 95%	3.5%	3.6%	(12.0%)	4.3%	4.7%	2.5%
Upper 95%	0.6%	0.1%	(5.4%)	6.5%	5.9%	4.1%
P	0.017	0.059	(0.243)	<0.001	<0.001	0.001

¹ "inc." indicates incomplete survey data.

² Only 11 of 13 trend sites surveyed in 1998 (see text).

³ Includes estimate of 500 non-pups for 6 un-surveyed trend sites in the eastern Gulf of Alaska in 1998.

⁴ Includes estimate of 1,000 non-pups for 22 un-surveyed trend and non-trend sites in the eastern Gulf of Alaska.

⁵ Regression calculated for 1991-1996 only.

Table 4.--Counts of adult and juvenile (non-pup) Steller sea lions observed at **ROOKERY AND HAUL-OUT TREND SITES** in seven subareas of Alaska during June and July aerial surveys from 1990 to 1998.

Year	Southeast Alaska (n=13)	Gulf of Alaska			Aleutian Islands		
		Eastern (n=9)	Central (n=15)	Western (n=9)	Eastern (n=11)	Central (n=34)	Western (n=4)
1990	7,629	5,444	7,050	3,915	3,801	7,988	2,327
1991	7,715	4,596	6,273	3,734	4,231	7,499	3,085
1992	7,558	3,738	5,721	3,720	4,839	6,399	2,869
1994	8,826	3,369	4,520	3,982	4,421	5,790	2,037
1996	8,231	2,133	3,915	3,741	4,716	5,528	2,190
1997	inc. ¹	inc.	3,352	3,633	inc.	inc.	inc.
1998	8,693	inc.	3,346	3,361	3,847	5,761	1,913
Overall change							
1990 1998	14%		53%	14%	1%	28%	18%
1991 1998	13%		47%	10%	9%	23%	38%
1992 1998	15%		42%	10%	21%	10%	33%
1994 1998	2%		26%	16%	13%	1%	6%
1996 1998	6%		15%	10%	18%	4%	13%
1997 1998			< 1%	7%			

¹ “inc.” indicates incomplete or no survey data.

Table 5.--Counts of adult and juvenile (non-pup) Steller sea lions observed at **ROOKERY TREND SITES** in seven subareas of Alaska during June and July aerial surveys from 1990 to 1998.

Year	Southeast Alaska (n=3)	Gulf of Alaska			Aleutian Islands		
		Eastern (n=1)	Central (n=4)	Western (n=4)	Eastern (n=7)	Central (n=11)	Western (n=3)
1990	5,491	1,491	5,043	3,496	3,417	6,738	1,928
1991	5,786	1,220	4,337	3,235	3,519	6,095	2,687
1992	5,945	784	4,306	3,313	3,712	5,258	2,531
1994	6,496	636	3,099	3,155	3,515	4,736	1,815
1996	6,204	544	2,795	3,030	3,538	4,542	1,909
1997	inc. ¹	inc.	2,239	3,214	inc.	inc.	inc.
1998	6,608	730	2,121	2,949	2,725	4,199	1,644
Overall change							
1990-1998	20%	51%	58%	16%	20%	38%	15%
1991-1998	14%	40%	51%	9%	23%	31%	39%
1992-1998	11%	7%	51%	11%	27%	20%	35%
1994-1998	2%	15%	32%	7%	22%	11%	9%
1996-1998	7%	34%	24%	3%	23%	8%	14%
1997-1998			5%	8%			

¹ “inc.” indicates incomplete or no survey data.

Table 6.--Counts of adult and juvenile (non-pup) Steller sea lions observed at **ALL SURVEYED ROOKERY AND HAUL-OUT SITES** in seven subareas of Alaska during June and July aerial surveys from 1991 to 1998. Except where noted, the number of sites for each region is for the 1998 survey (see text).

Year	Southeast	Gulf of Alaska			Aleutian Islands		
	Alaska (n=58) ¹	Eastern (n=25) ¹	Central (n=53)	Western (n=31)	Eastern (n=50)	Central (n=69)	Western (n=9)
1991	9,449	4,812	7,715	5,341	5,291	8,966	4,923
1992	10,003	4,360	7,330	5,502	5,715	8,307	4,533
1994	11,787	3,997	6,795	5,719	6,055	7,426	3,369
1996	10,907	2,586	5,751	5,724	5,969	7,181	3,411
1997	inc. ²	inc.	5,059	6,031	inc.	inc.	inc.
1998	inc.	inc.	4,971	5,855	5,803	7,689	2,867
Overall change							
1991	1998		36%	10%	10%	14%	42%
1992	1998		32%	6%	2%	7%	37%
1994	1998		27%	2%	4%	4%	15%
1996	1998		14%	2%	3%	7%	16%
1997	1998		2%	3%			

¹ Number of sites surveyed in 1996 (Strick et al. 1999).

² "inc." indicates incomplete or no survey data.

Table. 7--Proportion of adult and juvenile (non-pup) Steller sea lions on rookeries, compared to numbers of non-pups on all surveyed sites, in seven subareas of Alaska during June and July aerial surveys from 1991 to 1998. Subtotals include counts for five non-trend rookeries, as indicated in the footnotes, as well as all non-trend haul-out sites listed in Table 2 and in Merrick et al. (1992), Sease et al. (1993), and Strick et al. (1997), and Strick et al. (1999). [Note: the equivalent versions of this table for survey reports from 1994 and earlier included only trend rookeries and haul-out sites.]

Year	Southeast	Gulf of Alaska			Aleutian Islands			Alaska-wide
	Alaska	Eastern ¹	Central ²	Western	Eastern	Central ³	Western ⁴	
1991	0.6123	0.5341	0.6054	0.6057	0.6651	0.7282	0.6953	0.6395
1992	0.5943	0.4103	0.6206	0.6021	0.6495	0.6687	0.7249	0.6153
1994	0.5511	0.3215	0.5158	0.5517	0.5805	0.6823	0.7878	0.5687
1996	0.5688	0.4045	0.5415	0.5294	0.5927	0.6635	0.7710	0.5858
1997	inc. ⁵	inc.	0.4871	0.5329	inc.	inc.	inc.	inc.
1998	inc.	inc.	0.4959	0.5037	0.4696	0.5760	0.7771	inc.

¹ Includes non-trend rookery at Wooded (Fish) Island.

² Includes non-trend rookery at Outer (Pye) Island.

³ Includes non-trend rookeries at Amlia Island (Sviechnikof Harbor) and Amchitka Island (Column Rocks).

⁴ Includes rookery at Cape Wrangell, Attu Island.

⁵ "inc." indicates incomplete or no survey data.

Table 8.--Counts of adult and juvenile (non-pup) Steller sea lions at principal rookeries in Alaska during June and July surveys from 1991 through 1998, including overall percent change (1998) between the count for each year and the count for 1998.

Rookery	1991 (1998)	1992 (1998)	1994 (1998)	1996 (1998)	1997 (1998)	1998
Southeast Alaska						
Forrester	3,648 (4%)	3,508 (8%)	4,013 (6%)	3,551 (7%)		3,788
Hazy	1,278 (54%)	1,576 (24%)	1,615 (21%)	1,759 (12%)		1,962
White Sisters	860 (<1%)	861 (<1%)	868 (1%)	894 (4%)		858
Eastern Gulf of Alaska						
Seal Rocks	1,220 (40%)	784 (7%)	636 (15%)	544 (34%)		730
Wooded (Fish)	1,350 (76%)	1,005 (67%)	649 (49%)	502 (34%)		330
Central Gulf of Alaska						
Outer	334 (3%)	243 (42%)	406 (15%)	319 (8%)	225 (53%)	344
Sugarloaf	1,216 (47%)	1,184 (45%)	976 (34%)	741 (13%)	625 (3%)	646
Marmot	1,459 (52%)	1,581 (56%)	1,091 (36%)	1,102 (37%)	781 (11%)	694
Chowiet	716 (28%)	771 (33%)	599 (14%)	592 (13%)	538 (4%)	515
Chirikof	946 (72%)	770 (65%)	433 (39%)	360 (26%)	295 (10%)	266

Table 8.--**Non-pup** counts at selected rookeries, 1991-1998, continued.

Rookery	1991 (1998)	1992 (1998)	1994 (1998)	1996 (1998)	1997 (1998)	1998
Western Gulf of Alaska						
Atkins	616 (2%)	792 (24%)	571 (5%)	624 (4%)	544 (11%)	602
Chernabura	650 (4%)	459 (36%)	676 (8%)	422 (48%)	729 (14%)	624
Pinnacle Rock	1,049 (18%)	1,092 (21%)	977 (11%)	1,027 (16%)	1007 (14%)	865
Clubbing Rocks	920 (7%)	970 (12%)	931 (8%)	957 (10%)	934 (8%)	858
Eastern Aleutian Islands						
Sea Lion Rock	300 (48%)	329 (35%)	480 (7%)	590 (25%)	452 (2%)	445
Ugamak (and Round)	1,063 (30%)	954 (22%)	971 (23%)	854 (13%)	840 (11%)	744
Akun (Billings Head)	156 (37%)	271 (21%)	220 (3%)	346 (38%)	247 (14%)	213
Akutan (Cape Morgan)	818 (17%)	1,061 (36%)	908 (25%)	934 (27%)	760 (10%)	681
Bogoslof	558 (51%)	540 (49%)	413 (34%)	382 (28%)		274
Ogchul	229 (11%)	235 (14%)	209 (3%)	155 (31%)	167 (22%)	203
Adugak	395 (42%)	322 (28%)	314 (26%)	277 (17%)		231

Table 8.--**Non-pup** counts at selected rookeries, 1991-1998, continued.

Rookery	1991 (1998)	1992 (1998)	1994 (1998)	1996 (1998)	1997 (1998)	1998
Central Aleutian Islands						
Yunaska	398 (47%)	393 (47%)	426 (51%)	340 (38%)		210
Seguam (Saddleridge)	684 (14%)	696 (16%)	658 (11%)	553 (6%)		586
Kasatochi	466 (25%)	376 (7%)	288 (22%)	331 (6%)		351
Adak (Lake Point- and Cape Yakak)	847 (19%)	614 (11%)	766 (11%)	618 (11%)		684
Gramp Rock	773 (26%)	691 (17%)	537 (6%)	582 (2%)		571
Tag	440 (16%)	370 (<1%)	310 (20%)	321 (16%)		371
Ulak (Hasgox Point)	1,046 (33%)	1,059 (34%)	866 (19%)	844 (17%)		698
Amchitka (Column Rocks)	233 (52%)	194 (42%)	188 (40%)	137 (18%)		113
Ayugadak	324 (45%)	313 (43%)	285 (37%)	281 (36%)		179
Kiska (Lief Cove)	506 (44%)	357 (20%)	359 (21%)	341 (16%)		285
Kiska (Cape St. Stephen)	380 (41%)	248 (10%)	233 (4%)	258 (13%)		224

Table 8.--**Non-pup** counts at selected rookeries, 1991-1998, continued.

Rookery	1991 (1998)	1992 (1998)	1994 (1998)	1996 (1998)	1997 (1998)	1998
Western Aleutian Islands						
Buldir	589 (43%)	454 (26%)	345 (3%)	313 (7%)		336
Agattu (Cape Sabak)	1,429 (42%)	1,304 (37%)	961 (14%)	1,001 (17%)		827
Agattu (Gillon Point)	670 (28%)	773 (38%)	509 (6%)	595 (19%)		481
Attu (Cape Wrangell)	736 (21%)	755 (23%)	839 (30%)	721 (19%)		584
Eastern Stock (Southeast Alaska 3 rookeries)	5,786 (4.8%)	5,945 (7.3%)	6,496 (15.2%))	6,204 (11.2%))		5,510
Western Stock (33 rookeries)	23,516 (33.0%))	21,960 (28.2%))	19,030 (17.2%))	17,964 (12.2%))		15,765
Kenai to Kiska (27 rookeries)	17,522 (28.8%))	16,885 (26.1%))	15,091 (17.3%))	14,288 (12.7%))		12,477
All 36 Rookeries	29,302 (27.4%))	27,905 (23.8%))	25,526 (16.7%))	24,168 (12.0%))		21,275

Table 9.--Counts of Steller sea lion **pups** at rookeries in Alaska during June and July surveys from 1990, 1994, 1996, 1997, and 1998 including the percent change (1998) from the earlier counts to the 1998 counts.

Rookery	1990 (1998)	1994 (1998)	1996 (1998)	1997 (1998)	1998
Southeast Alaska					
Forrester	2,932 (6%)	2,757 (<1%)	2,764 (<1%)	2,798 (2%)	2,753
Hazy	638 (88%)	862 (39%)	768 (56%)	1,157 (4%)	1,199
White Sisters	30 (840%)	151 (87%)	182 (55%)	205 (38%)	282
Eastern Gulf of Alaska					
Seal Rocks	571 (5%)	598 (9%)	352 (54)	487 ¹ (11)	542
Fish (Wooded)		305 (52%)	232 (37%)	123 ¹ (20)	147 ²
Central Gulf of Alaska					
Outer	363 (69%)	119 (5)	114 (1)	106 ¹ (7)	113
Sugarloaf	1,638 (57%)	958 (27)			703
Marmot	1,611 ³ (60%)	804 (20%)	632 (2)		642
Chowiet	582 ⁴ (60%)	625 (63)			234
Chirikof	607 (70%)	325 (43)			184

Table 9.--Pup counts at selected rookeries, 1990-1998, continued

Rookery	1990 (1998)	1994 (1998)	1996 (1998)	1997 (1998)	1998
Western Gulf of Alaska					
Atkins	433 (19%)	324 (9%)	366 (4)		352
Chernabura	197 (73%)	139 (61)			54
Pinnacle Rock	794 ³ (20%)	652 (2)			639
Clubbing Rocks		547 (18)			448
Eastern Aleutian Islands					
Ugamak	847 (34%)	574 (3%)	706 (21)	589 (5)	558
Akun (Billingshead)	63 (11%)	69 (19%)			56
Akutan (Cape Morgan)	442 (14%)	631 (20%)			505
Bogoslof	461 (52%)	322 ⁵ (32%)	282 ⁶ (22%)	281 (22%)	220
Ogchul		94 (55%)			42
Adugak	262 (48%)	180 (25%)			135

Table 9.--Pup counts at selected rookeries, 1990-1998, continued

Rookery	1990 (1998)	1994 (1998)	1996 (1998)	1997 (1998)	1998
Central Aleutian Islands					
Yunaska	230 (30%)	217 (26%)		192 (16%)	161
Seguam	684 (30%)	444 (8%)		463 (3%)	479
Kasatochi	178 (39%)	215 (15%)		268 (8%)	247
Adak (Lake Point/ Cape Yakak)	137 (148%)	327 (4%)			340
Gramp	448 (2%)	425 (7%)			456
Tag	357 (33%)	234 (2%)			238
Ulak (Hasgox Point)	790 (34%)	638 (18%)			521
Amchitka (Column Rocks)	148 (53%)	114 (39%)			70
Ayugadak	163 (45%)	142 (37%)			89
Kiska (Cape St. Stephen)	212 (75%)	120 (55%)			54
Kiska (Lief Cove)	221 (19%)	233 (23%)			179

Table 9.--Pup counts at selected rookeries, 1990-1998, continued

Rookery	1990 (1998)	1994 (1998)	1996 (1998)	1997 (1998)	1998
Western Aleutian Islands					
Buldir				120 (2%)	122
Agattu (Cape Sabak)				379 (17%)	314
Agattu (Gillon Point)				258 (17%)	213
Attu (Cape Wrangell)				222 (31%)	154
Subtotals for 28 rookeries counted in 1990, 1994, and 1998					
Eastern Stock (3 rookeries)	3,600 (17.6%)	3,770 (12.3%)	3,714 (14.0%)	4,160 (1.8%)	4,234
Western Stock (25 rookeries)	12,439 (37.5%)	9,429 (17.6%)			7,771
All 28 rookeries	16,039 (25.2%)	13,199 (9.0%)			12,005
Subtotals for 31 rookeries counted in 1994, and 1998					
Eastern Stock (3 rookeries)	3,600 (17.6%)	3,770 (12.3%)	3,714 (14.0%)	4,160 (1.8%)	4,234
Western Stock (28 rookeries)		10,375 (19.0%)			8,408
All 31 rookeries		14,145 (10.6%)			12,642

¹ Count from medium-format photographs (Westlake et al. 1997, ADF&G, unpublished data).² Count from observation point at periphery of rookery.³ 1991 count.⁴ Mean of 1989 and 1990 counts.⁵ 1993 count.⁶ 1995 count.

Table 10. --Regional summaries for counts of Steller sea lion **pups** at rookeries in Southeast Alaska, the Gulf of Alaska, and Aleutian Islands during June and July surveys from 1990, 1994, 1996, 1997, and 1998 including the percent change (1998) from the earlier counts to the 1998 counts. Except as noted, rookeries are as listed in Table 8.

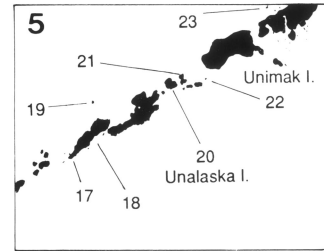
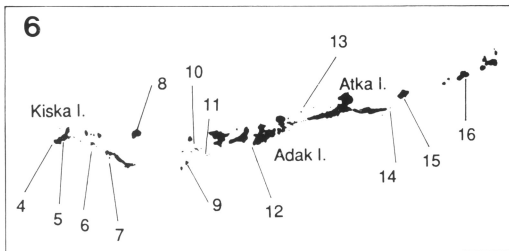
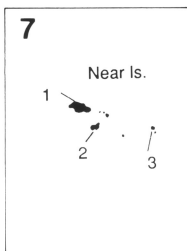
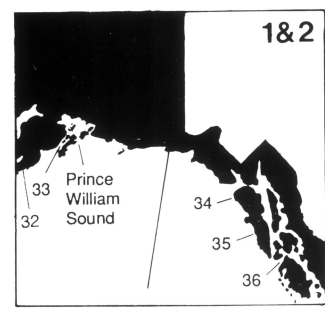
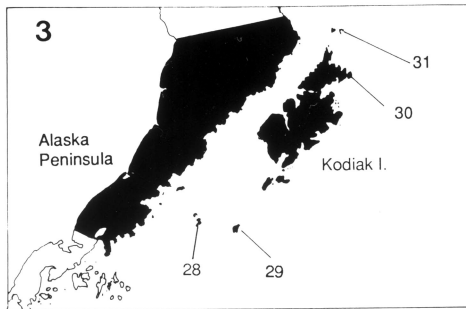
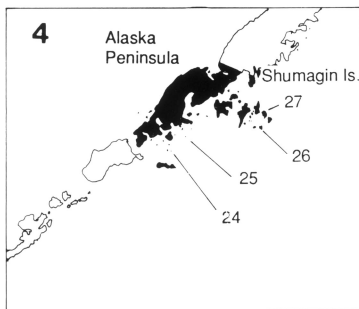
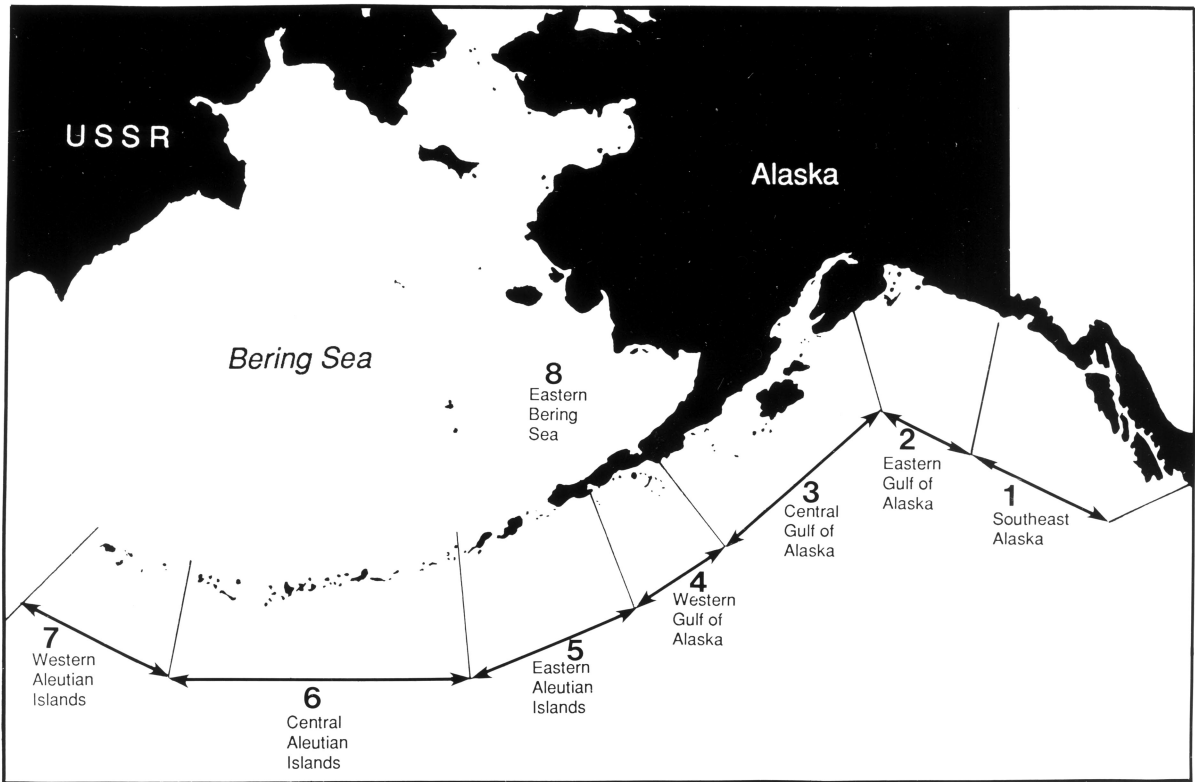
Region	1990 (1998)	1994 (1998)	1996 (1998)	1997 (1998)	1998
Southeast Alaska (n = 3)	3,600 (17.6%)	3,770 (12.3%)	3,714 (14.0%)	4,160 (1.8%)	4,234
Eastern Gulf of Alaska (n = 2)		903 (23.7%)	584 (18.0%)	610 ¹ (13.0%)	689
Central Gulf of Alaska (n = 5)	4,801 ² (60.9)	2,831 (33.7%)			1,876
Western Gulf of Alaska (n = 4)		1,662 (10.2%)			1,493
Eastern Aleutian Islands (n = 6)		1,870 (18.9%)			1,516 ³
Central Aleutian Islands (n = 11)	3,568 ⁴ (20.6)	3,109 ⁴ (8.8)			2,834 ⁴
Western Aleutian Islands (n = 4)				979 (18.0)	803
Western Stock (eastern Gulf of Alaska to central Aleutian Islands)(n = 28)		10,375 (19.0)			8,408
Alaska-wide (Southeast Alaska to central Aleutian Islands)(n = 31)		14,145 (10.6)			12,642

¹ Counts from medium-format photographs in 1997 (Westlake et al. 1997, ADF&G, unpublished data).

² Includes 1991 pup count for Marmot I. and mean of 1989 and 1990 counts for Chowiet I.

³ Does not include 134 pups at Sea Lion Rock (Amak) in 1998 (not counted in 1994).

⁴ Does not include Agligadak (0 pups in 1990 and 1998), Sviechnikof Harbor (Amlia I.: 13 pups in 1998), Semisopochnoi I. (21 pups in 1994, 6 in 1998), or East Cape (Amchitka I.: 6 pups in 1994, 9 in 1998).



- | | | | | | | |
|----------|----------------|---------------|-------------|-------------------|--------------|------------------|
| 1 Attu | 4,5 Kiska | 11 Gramp Rock | 17 Adugak | 22 Ugamak | 27 Atkins | 33 Seal Rocks |
| 2 Agattu | 6 Ayugadak | 12 Adak | 18 Ogchul | 23 Sea Lion Rock | 28 Chowiet | 34 White Sisters |
| 3 Buldir | 7 Amchitka | 13 Kasatochi | 19 Bogoslof | 24 Clubbing Rocks | 29 Chirikof | 35 Hazy |
| | 8 Semisopchnoi | 14 Agligadak | 20 Akutan | 25 Pinnacle Rock | 30 Marmot | 36 Forrester |
| | 9 Ulak | 15 Seguam | 21 Akun | 26 Chernabura | 31 Sugarloaf | |
| | 10 Tag | 16 Yunaska | | | 32 Outer | |

Figure 1. – Map of Alaska, showing seven geographical regions used for analyses of aerial survey results and major rookeries, as modified from Merrick et al. (1987).

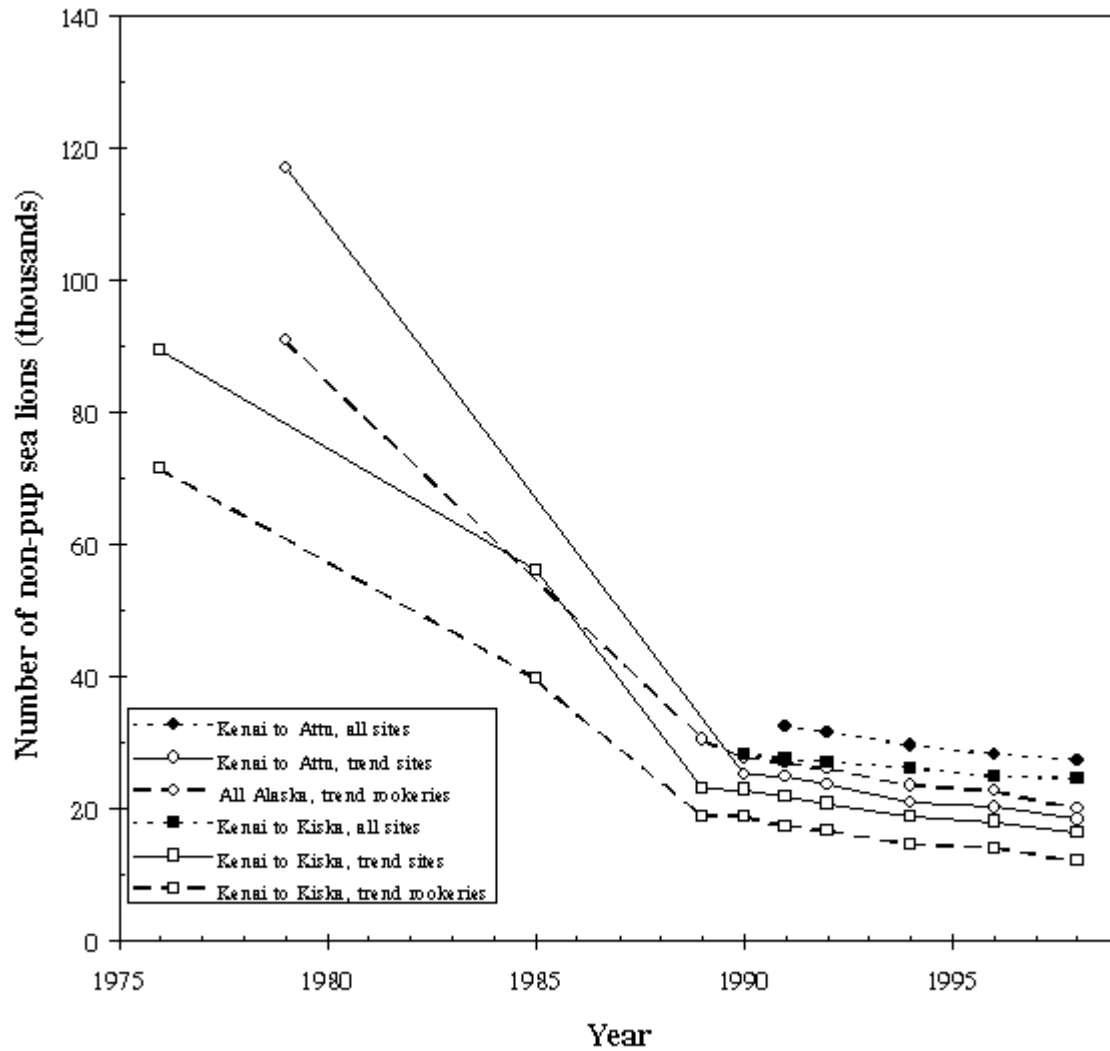


Figure 2.--Counts of non-pup (adult and juvenile) Steller sea lions at all surveyed sites, all trend sites (rookeries and major haulouts), and trend rookeries for Alaska state-wide and for the Kenai Peninsula to Kiska Island index area, 1970s to 1998. All counts are from aerial surveys.

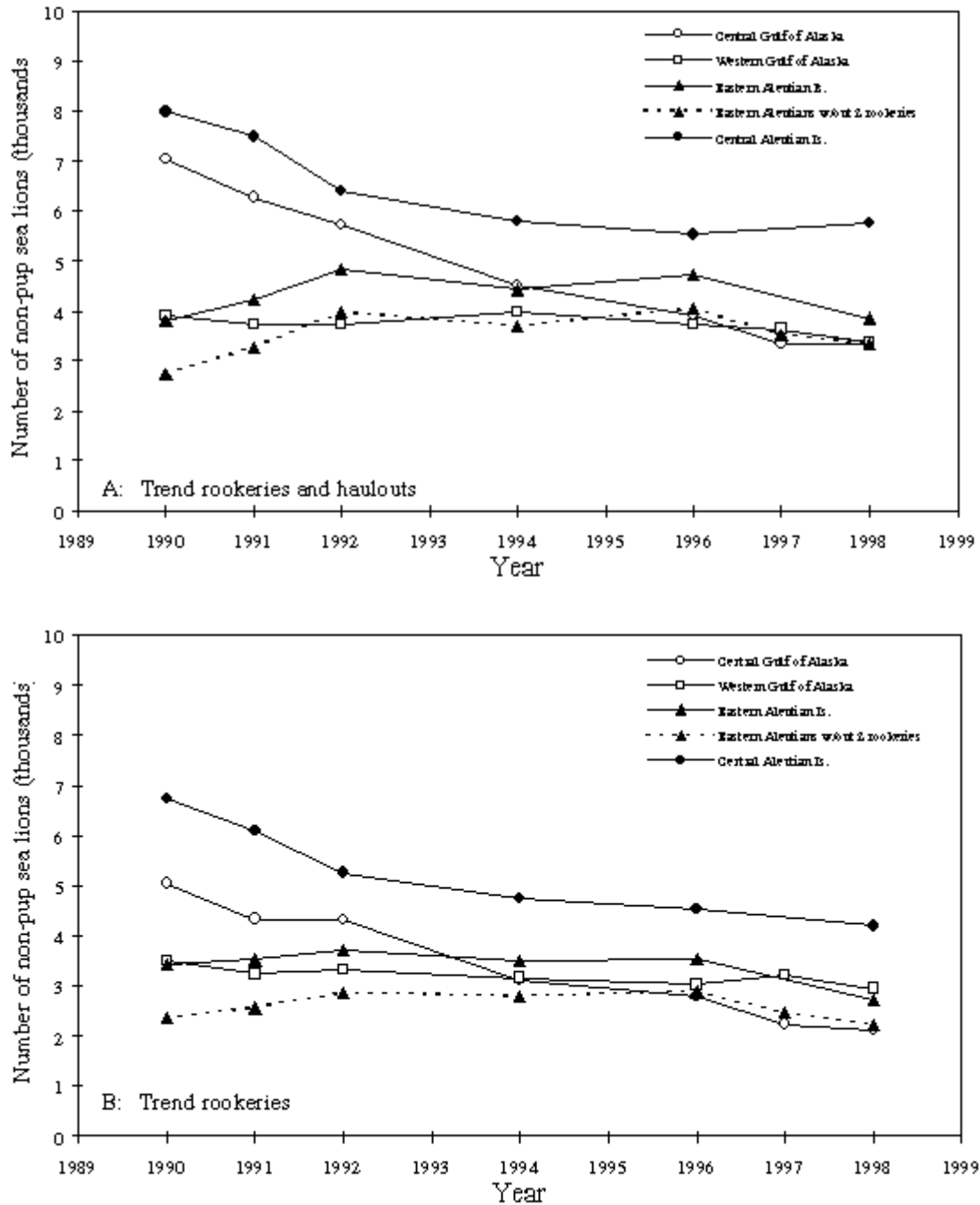


Figure 3.--Numbers of non-pup (adult and juvenile) Steller sea lions counted on trend rookery and haulout sites (A) and on trend rookery sites (B) in the Kenai to Kiska index area, by region, 1990 to 1998. The trend for the eastern Aleutian Islands also is shown without Bogoslof and Adugak Islands, which were not surveyed in 1997 because of dense fog.

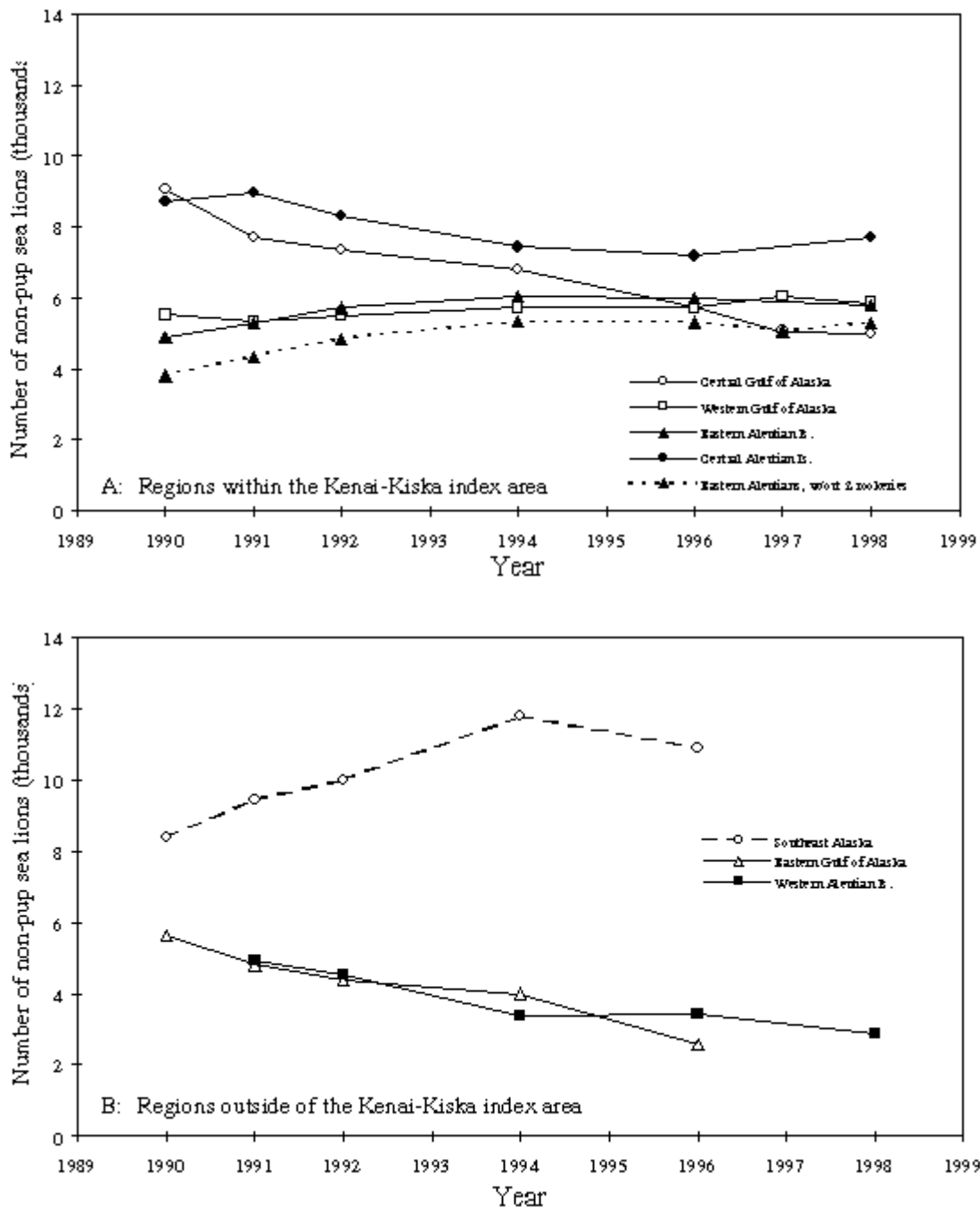


Figure 4.--Numbers of non-pup (adult and juvenile) Steller sea lions counted on all surveyed sites in the regions within (A) and outside of (B) the Kenai to Kiska index area, 1990 to 1998. The trend for the eastern Aleutian Islands also is shown without Bogoslof and Adugak Islands, which were not surveyed in 1997 because of dense fog.

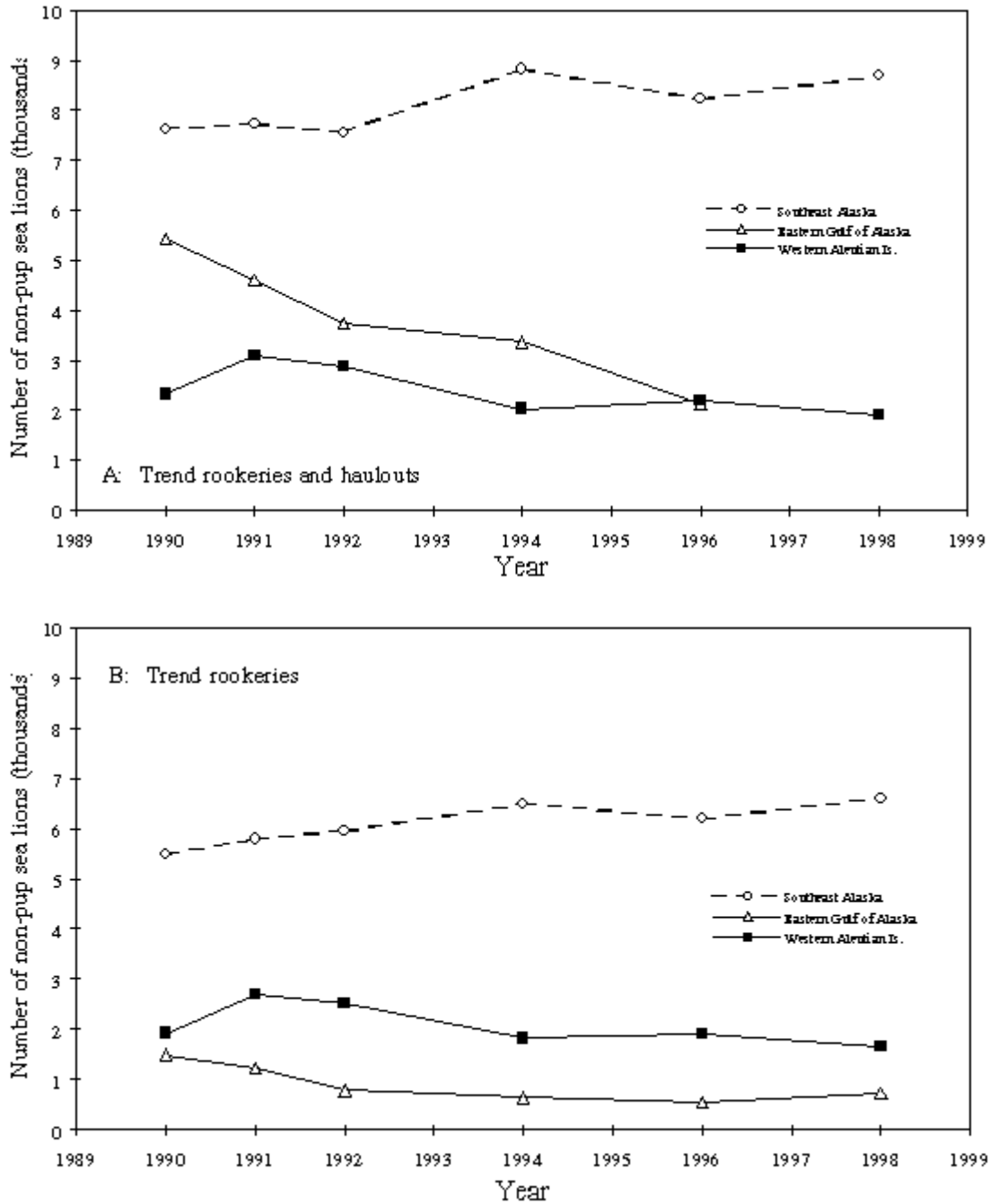


Figure 5.---Numbers of non-pup (adult and juvenile) Steller sea lions counted on trend rookery and haulout sites (A) and on trend rookery sites (B) in regions outside of the Kenai to Kiska index area, 1990 to 1998.

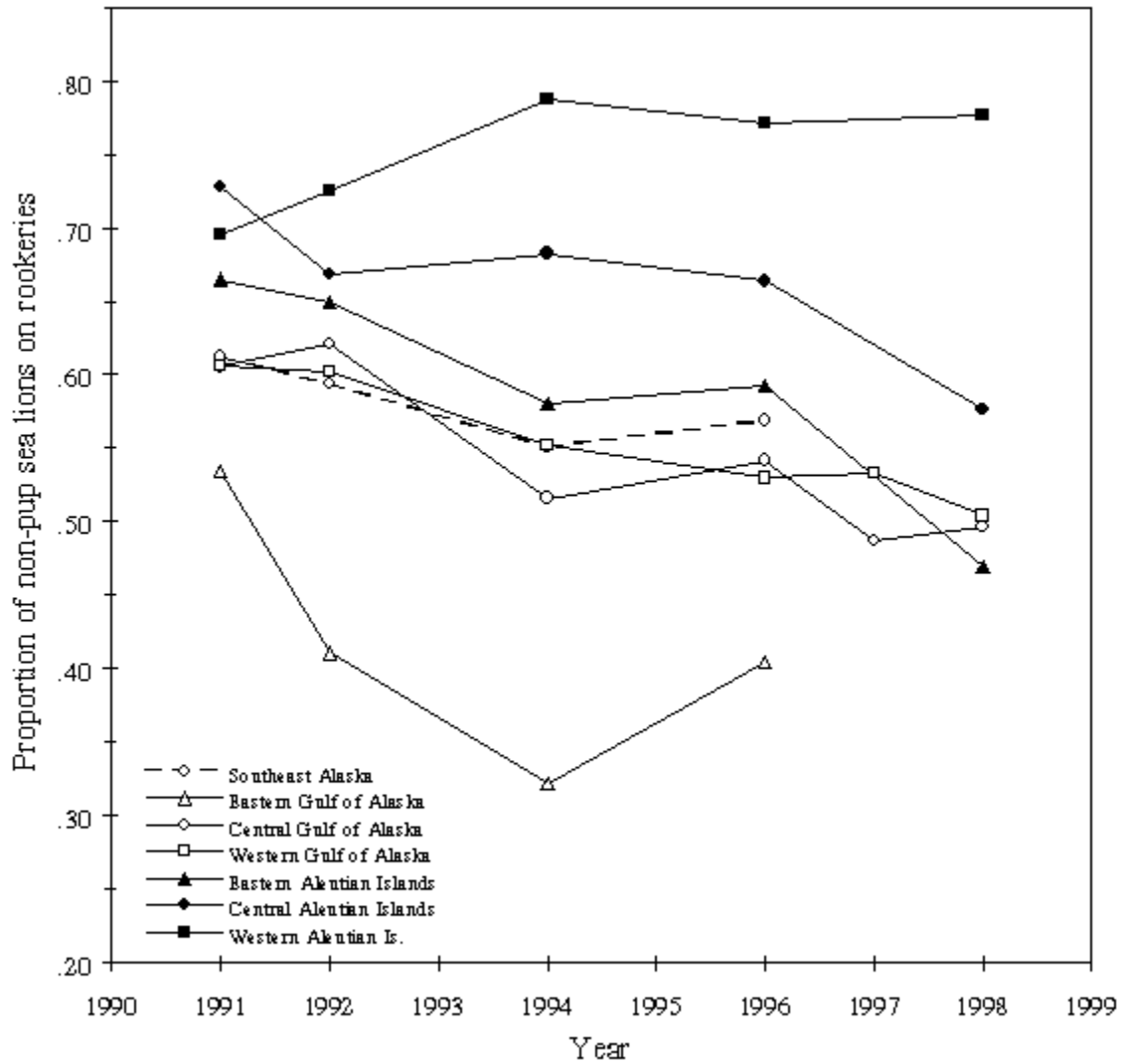


Figure 6.--Proportions of non-pup (adult and juvenile) Steller sea lions located on rookeries, compared to numbers of non-pups on all surveyed sites, by region, 1991 to 1998. Counts include five rookeries and about 180 haulouts that are not trend sites, as listed in Tables 1, 2, and 7.

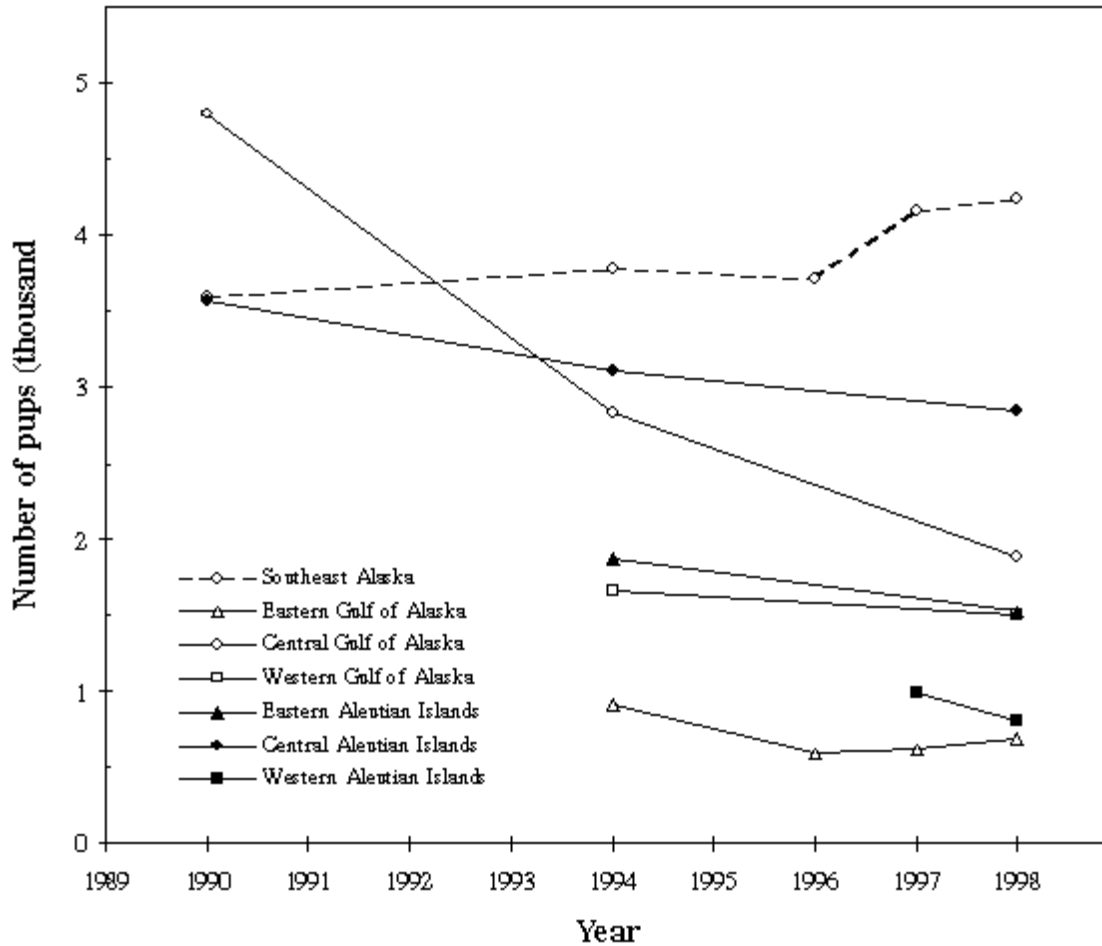


Figure 7.--Counts of Steller sea lion pups at rookeries in Alaska, by region, 1990 to 1998. Counts for individual rookeries and for regional subtotals are provided in Tables 8 and 9, respectively.

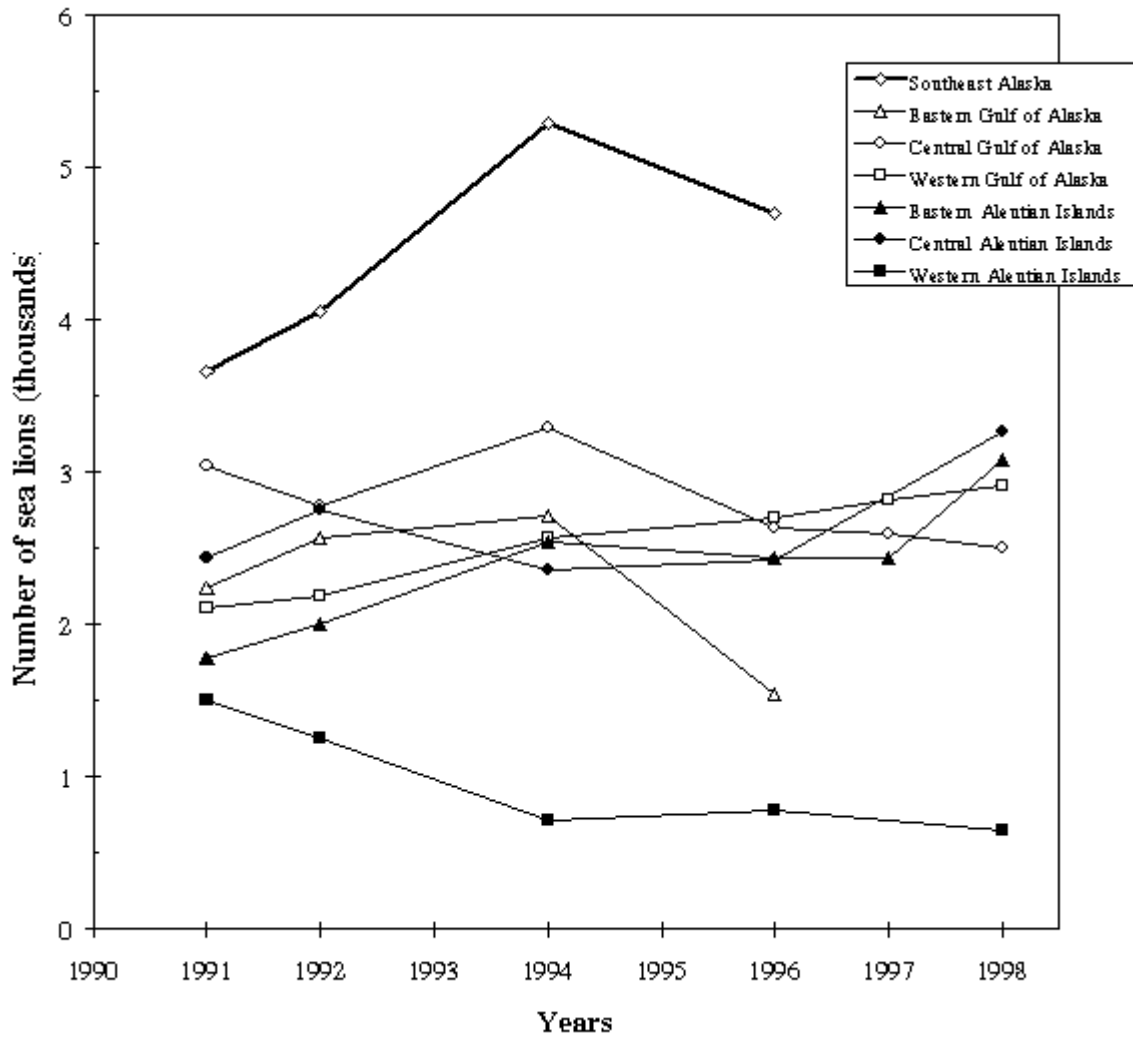


Figure 8.--Counts of non-pup (adult and juvenile) Steller sea lions on all haul-out sites (counts at all surveyed sites minus counts at rookeries) in Alaska, by region, 1991 to 1998.

RECENT TECHNICAL MEMORANDUMS

Copies of this and other NOAA Technical Memorandums are available from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22167 (web site: www.ntis.gov). Paper and microfiche copies vary in price.

AFSC-

- 99 SEASE, J. L., J. M. STRICK, R. L. MERRICK, and J. P. LEWIS. 1999. Aerial and land-based surveys of Steller sea lions (Eumetopias jubatus) in Alaska, June and July 1996, 43 p. NTIS number pending
- 98 LAUTH, R. R. 1999. The 1997 Pacific West Coast upper continental slope trawl survey of groundfish resources off Washington, Oregon, and California: Estimates of distribution, abundance, and length composition, 284 p. NTIS No. PB99-133043.
- 97 HILL, P. S., and D. P. DEMASTER. 1998. Alaska marine mammal stock assessments, 1998, 166 p. NTIS No. PB99-130791.
- 96 WING, B. L., M. M. MASUDA, C. M. GUTHRIE III, and J. H. HELLE. 1998. Some size relationships and genetic variability of Atlantic salmon (Salmo salar) escapees captured in Alaska fisheries, 1990-95, 32 p. NTIS No. PB99-118697.
- 95 ORR, J. W., M. A. BROWN, and D. C. BAKER. 1998. Guide to rockfishes (Scorpaenidae) of the genera Sebastes, Sebastolobus, and Adelosebastes of the northeast Pacific Ocean, 46 p. NTIS No. PB99-114217.
- 94 THROWER, F., R. MARTIN, and R. HEINTZ. 1998. Effect of seawater entry date on 24-hour plasma sodium concentration and survival of juvenile spring chinook salmon (Oncorhynchus tshawytscha) reared in marine net-pens, 18 p. NTIS No. PB98-173545.
- 93 MURPHY, J. M., N. E. MALONEY, and B. L. WING. 1998. Distribution and abundance of zooplankton in the north Pacific Subarctic Frontal Zone and adjacent water masses, 31 p. NTIS No. PB98-159163.
- 92 FRITZ, L. W., and S. A. LOWE. 1998. Seasonal distributions of Atka mackerel (Pleurogrammus monopterygius) in commercially-fished areas of the Aleutian Islands and Gulf of Alaska, 29 p. NTIS No. PB98-153703.
- 91 WING, B. L., and J. J. PELLA. 1998. Time series analyses of climatological records from Auke Bay, Alaska, 90 p. NTIS No. PB98-149206.
- 90 PACUNSKI, R. E., P. A. LIVINGSTON, and B. S. MILLER. 1998. Food of flathead sole Hippoglossoides elassodon in the eastern Bering Sea, 27 p. NTIS No. PB98-148679.
- 89 WILKINS, M. E., M. ZIMMERMANN, and K. L. WEINBERG. 1998. The 1995 Pacific west coast bottom trawl survey of groundfish resources: Estimates of distribution, abundance, and length and age composition, 138 p. plus Appendices. NTIS No. PB98-136252.
- 88 FRITZ, L. W., A. GREIG, and R. F. REUTER. 1998. Catch-per-unit-effort, length, and depth distributions of major groundfish and bycatch species in the Bering Sea, Aleutian Islands, and Gulf of Alaska regions based on groundfish fishery observer data, 179 p. NTIS No. PB98-139298.
- 87 SINCLAIR, E. H. (editor) 1997. Fur seal investigations, 1996, 115 p. NTIS No. PB98-131790.
- 86 SINCLAIR, E.H. (editor). 1997. Fur seal investigations, 1995, 188 p. NTIS No. PB98-131808.
- 85 KINOSHITA, R. K., A. GREIG, and J. M. TERRY. 1998. Economic status of the groundfish fisheries off Alaska, 1996, 91 p. NTIS No. PB98-126170.