NOAA Technical Memorandum NMFS

JULY 1990

TRENDS IN LANDINGS, SPECIES COMPOSITION, LENGTH-FREQUENCY DISTRIBUTIONS, AND SEX RATIOS OF 11 ROCKFISH SPECIES (Genus *Sebastes*) FROM CENTRAL AND NORTHERN CALIFORNIA PORTS (1978-88)

Donald E. Pearson
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NOAA-TM-NMFS-SWFC-145

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

Errata List

Due to a data entry error on the landing weight of one port sample, the estimated landings for 1981 Eureka are incorrect. The corrected values are shown below. These changes do not affect the conclusions, and only slightly alter the results of this study.

The updated landings (in standard tons) for Eureka in 1981 (Appendix B) are:

Species	Previous Value	Updated Value
S. chlorostictus	120.0	146.0
S. crameri	120.0	129.9
S. diploproa	4.8	5.7
S. goodei	224.6	261.6
S. paucispinus	2033.8	1827.5
S. pinniger	975.8	1004.1
Total Landings	8225.7	8256.3

Figures 4, 5, and 7, and Table 2 are slightly affected by these changes, while the effect on the remaining figures would be negligible.

This study is based on the best available data. As with any working database, the data are subject to updating. The authors suggest that potential users of these data should contact the Tiburon Laboratory of the National Marine Fisheries Service for the most current version available.

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This TM series is used for documentation and timely communication of preliminary results, interim reports, or special purpose information; and have not received complete formal review, editorial control, or detailed editing.

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U.S. DEPARTMENT OF COMMERCE
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ABSTRACT

This study was undertaken to examine changes in the landings, species composition, length-frequency distributions, and sex ratios of 11 species of rockfish (genus Sebastes) caught by the California trawl fishery from 1978 to 1988. Data used in the study were obtained from a port sampling program operating throughout the state of California. The 11 species examined in this study represent the most important rockfish species (by weight) in the landings during the study period.

Total landings of the 11 species of rockfish have declined since the peak years of 1980-82 at all ports. Generally Eureka had the highest total landings and Morro Bay had the lowest. Species composition varied substantially between years. Both S. entomelas and S. paucispinis declined in importance after 1982, while S. goodei and S. crameri have increased in relative importance. Species composition is quite different among ports; however, S. entomelas and S. paucispinis were important at all six ports. Most species showed a reduction in mean length during the 11 year study period with S. flavidus, S. pinniger, and female S. goodei showing the sharpest declines. Examination of sex ratio changes was inconclusive but suggested an increase in the percentage of male S. goodei coastwide since 1984.

CONTENTS

INTRODUCTION

This study was initiated to evaluate changes in length frequency distributions for rockfish (genus Sebastes) in the California trawl fishery during the period 1978-88. Although many species are taken in the fishery, 11 species (Table 1) dominate the catch and comprise approximately 80% of the total landings. With the exception of widow rockfish (S. entomelas), little is known about the status of these stocks (Pacific Fishery Management Council [PFMC] 1989). With the data that were available from the California commercial port sampling program, and landing receipt data, we examined the species composition, landed weights, length-frequency distributions, and sex ratios of the Sebastes spp. catch at six port complexes in central and northern California. We were particularly interested in studying species which had never been assessed (e.g., S. aurora, S. chlorostictus, S. crameri, S. diploproa, S. melanostomus, and S. rufus). Information of this kind has the potential to reveal trends in the population and/or the fishery, and can also help direct future research efforts.

Table 1. List of species and common names of the 11 species of Sebastes studied with information on their known geographic ranges and possible depth distributions (Source Miller and Lea 1972).

SPECIES	COMMON NAME	RANGE	DEPTH (m)
Sebastes aurora	Aurora rockfish	S. California--Canada	200--600
Sebastes chlorostictus	Greenspotted rockfish	Baja California--Washington	50--220
Sebastes crameri	Darkblotched rockfish	S. California--Bering Sea	80--400
Sebastes diploproa	Splitnose rockfish	Baja California--Alaska	230--500
Sebastes entomelas	Widow rockfish	Baja California--Alaska	0--300
Sebastes flavidus	Yellowtail rockfish	S. California--Alaska	0--260
Sebastes goodei	Chilipepper	Baja California--Canada	0--600
Sebastes melanostomus	Blackgill rockfish	Baja California--Washington	240--600
Sebastes paucispinis	Bocaccio	Baja California--Alaska	0--350
Sebastes pinniger	Canary rockfish	Baja California--Alaska	0--260
Sebastes rufus	Bank (Red Widow) rockfish	Baja California--Oregon	30--280

Information concerning the species composition of the catch can be useful when evaluating appropriate levels of exploitation. If a species is heavily impacted by fishing, its proportion in the total catch may decline. Since species usually have different natality and natural mortality (M) schedules, uniform fishing pressure on an assemblage of co-occurring species often alters the species composition of the landings until a new equilibrium point is reached. In the process, low productivity species may become overexploited. This is particularly likely when fishing mortality rates (F) are high. A practical difficulty with this approach is that landings of many species

are strongly influenced by market conditions; it is quite possible to target effort in such a way so as to significantly alter the species composition of the landings. An example of this is the widow rockfish fishery. Market conditions allowed development of a new fishery on this species from 1980-82, in addition, improved methods (targeted midwater trawling) caused S. entomelas to become the single most important rockfish species in the west coast groundfish landings (Gunderson 1984).

Examining the distribution of lengths over time can show whether a population is in equilibrium with fishing effort (Ricker 1975). Several factors influence the length structure of landings, including: spatial heterogeneity in the distribution of length classes and the consequent targeting that can occur, changes in either the rate of growth or the rate of fishing (Beverton and Holt 1957), differential emigration and immigration of size classes (i.e., fluctuating availability), and intrinsic length-specific selection by fishing gears. Although this study makes no attempt to establish causal mechanisms for observed changes in length distributions, some possible hypotheses are discussed.

Changes in sex ratio can reveal whether a fishery differentially harvests a specific sex and, ultimately, whether one sex is harvested at a rate that the stock cannot sustain. This is particularly important for species where the fishery tends to catch a high proportion of females, as might be expected with sexually dimorphic species like rockfish. Female rockfish tend to be larger and faster growing than males (Westrheim and Harling 1975; Archibald et al 1981; Wilson 1984; Wyllie Echeverria 1986; Lenarz and Wyllie Echeverria 1991).

In this study we used data collected by the California cooperative groundfish survey and commercial landing data obtained from wholesaler receipt data which were compiled by the California Department of Fish and Game (CDF&G). The cooperative survey is conducted jointly by the National Marine Fisheries Service (NMFS), and CDF&G. The purpose of the survey is to provide biological and catch data to assist in the management of the California commercial rockfish fishery. Sample data are collected at ports throughout California and are expanded to the entire landings using the procedure developed by Sen (1984). The result is an estimate of the landings and catch characteristics of commercial rockfish stocks in California.

The expanded sample data were plotted and examined for trends; no attempt was made to apply rigorous statistical analysis to the data. Consequently, given the large volume of data included in this study, we are likely to have overlooked certain patterns. We also believe that some of the specific trends we have identified may be spurious. This paper is, therefore, primarily a summary of statistical indices concerning

the catch of northern and central California rockfishes, and should be considered a starting point for further in-depth analysis of patterns in the port sampling and landings data.

METHODS

California cooperative rockfish survey methods

Port sampling is done at six port complexes in central and northern California (hereafter referred to as ports; Fig. 1). Sampling at Bodega Bay began in 1981. In recent years sampling at San Francisco has been intermittent due to a reduction in landings and logistical difficulties in sampling this port complex. Sampling at Morro Bay began in 1980. Although other ports in southern California are sampled as part of the survey, due to the sparse amount of data collected, and the late start of sampling operations there (1983), we excluded those ports from consideration in this study.

Sampling procedures call for two 50 lb (± 1 lb) clusters of fish to be randomly selected from bins at the commercial dealer's place of business. Each cluster is sorted separately by species and the total weight of each species is obtained. The total length and sex of each fish is recorded. If sex cannot be determined then an unknown sex is reported. The otoliths of selected species are removed, cleaned, and stored dry for age determination at a later time. Vessel ID, gear type, market category, and landing weight for the sample are also recorded.

Each sampler enters the measurement and landing data into a data file and sends it and the otoliths to the CDF&G office in Menlo Park each month. Copies of the data and otoliths for certain species are forwarded to the Tiburon Laboratory of NMFS for further analysis.

At the end of each year, the sample data are expanded to estimate all commercial landings using dealer receipts. This is done to estimate the total weight, number, length and age distributions of each species landed for each port and quarter of the year. The expansion of the data is accomplished in a multi-step calculation set forth in Sen (1984).

Methods used in this study

Based on the numbers of fish measured in the six ports from 1978-88 (Appendix A), we selected 11 species of rockfish to examine. Although we had sufficient data to examine both longspine thorneyhead (*Sebastolobus altivelis*) and shortspine thorneyhead (*S. alascanus*), which are important species in the landings, we dropped them from consideration because a full assessment was being undertaken by another researcher with the National Marine Fisheries Service in La Jolla, California (Larry

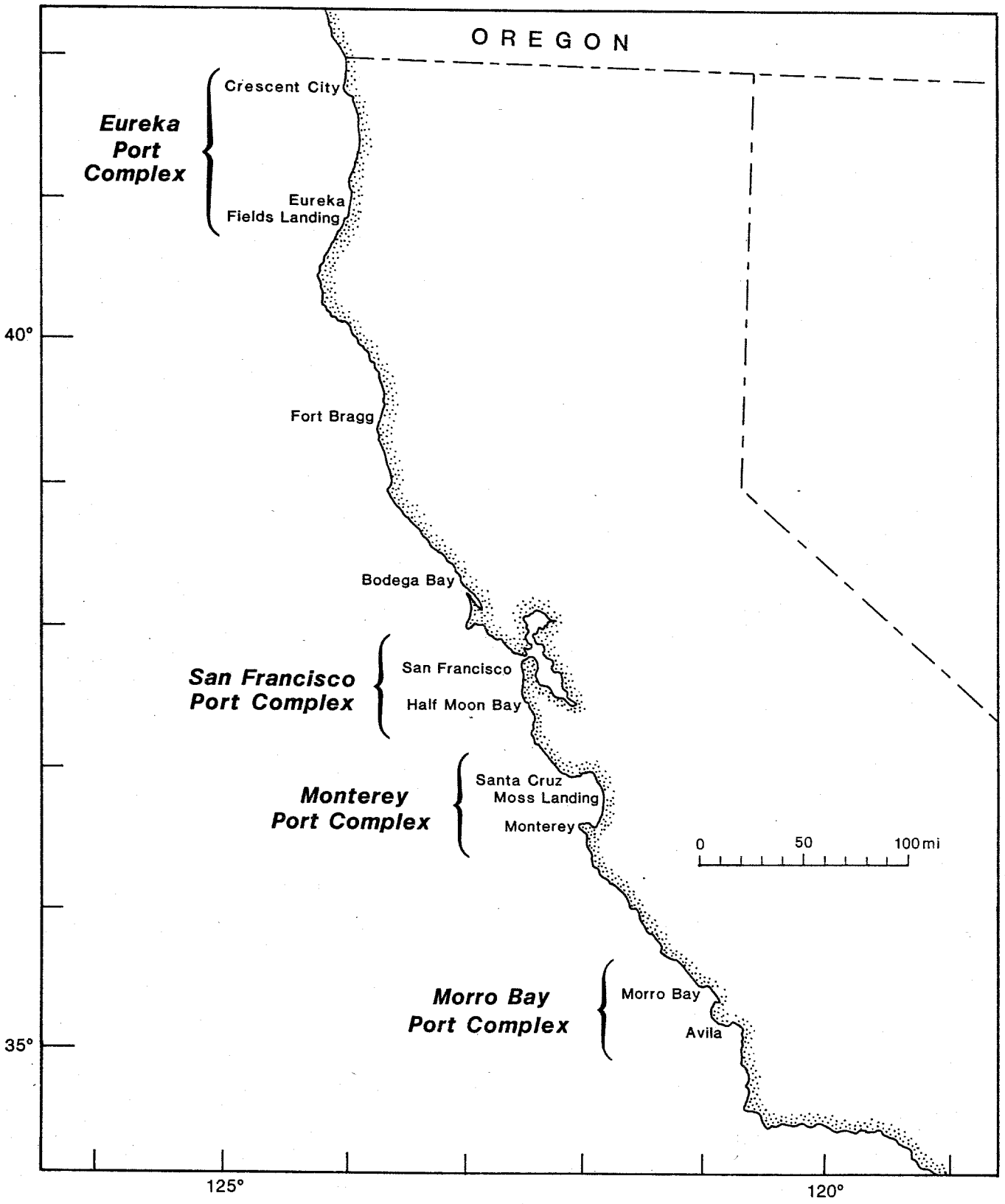


Figure 1. Map of the California coast showing the location of the ports and port complexes sampled by the California Cooperative Groundfish survey.

Jacobson, Nat. Mar. Fish. Serv., La Jolla, CA 92038).

We used only trawl caught fish (midwater trawl, roller gear, and bottom trawl) in order to eliminate differences in size structure arising from different fishing gears. We used the expanded sample data in this analysis because they more accurately reflect the true catch (William Lenarz, Nat. Mar. Fish. Serv., Tiburon, CA 94920, pers. commun., Dec. 1989). If the data included fish of unknown sex, we apportioned these into male and female categories based on the length-specific sex ratios for that species-year-port-quarter combination. To judge the importance of stratifying the analysis by sex, we generated length-frequency plots for each sex using data from all years and ports combined; these were then examined visually for obvious differences. The sexes were analyzed separately for those species showing differences in size structure. To deal with problems associated with small sample size, we dropped from consideration any estimates based upon expansions of 20 or fewer measured fish.

To examine trends in species composition we calculated the total landed weight, pooled over the 11-yr study period, of each of the 11 species at each port (Appendix B). The total landed weight of all 11 species was also determined (Appendix C). The five most important species (hereafter called primary species) at each port were then identified based on total landed weight over the 11 year study period. Then we plotted the percent each of the five primary species contributed to the total landed weight of all 11 species at each port in each year. Each of these plots was inspected for obvious trends.

Trends in landings were studied by plotting total catches of each of the 11 species by year and port. To clarify latitudinal relationships in landings, we also examined catch trends for each species normalized to the long term (1978-88) mean and variance at each port. These data also assisted in establishing interspecific dependencies in the pattern of catches; plots were examined for obvious trends.

To determine changes in length composition over time and among ports we plotted means, tenth percentiles, and ninetieth percentiles of length for each species (and sex if required) by year and port. We then inspected the graphs for trends, concentrating on species that were most abundant; however, we also noted strong trends for species of lesser importance. We also examined standard deviations and medians (Appendices D and E). If many gaps were present in the data, we typically ignored that port and species unless the trend was unusually strong.

Trends in sex ratio were evaluated by plotting the percentage males (from Appendix F) from the expanded landings of each species-port-year combination. This analysis was performed

for all species, including those showing no obvious alterations in length structure.

RESULTS

Examination of length-frequency data by sex for each species led us to conclude that the two sexes of S. aurora and S. chlorostictus had similar size distributions (Fig. 2). The remaining nine species, however, seemed to show that females either tended to reach a larger size than males or they were substantially more abundant in the largest size categories. Consequently, for all species except S. aurora and S. chlorostictus, analyses of length data were performed separately by sex.

Landings

Of the six ports, Eureka generally had the highest combined landings of Sebastes spp. each year (Fig. 3). Morro Bay typically had the lowest landings. The period from 1980-82 produced the highest landings for most ports; catches have declined since that time due at least in part to changes in regulations.

Coastwide, S. entomelas, S. paucispinis, and S. goodei have decreased in total landed weight in recent years, while S. rufus and S. crameri have increased (Fig. 4) (Appendix B). Examination of normalized landings by port shows that some species are similar in the time course of landings, including: S. diploproa, S. entomelas, and S. pinniger (Fig. 5). Sebastes rufus has been characterized by sporadic landings at different ports; commercial fishermen in Monterey call this species the "lucky fish" (i.e., it is caught only when you are lucky, and not necessarily when you are looking for it) (Frank Henry, Calif. Dept. Fish and Game, Menlo Park, CA 94025, pers. commun., Dec. 1989). Catches of S. entomelas showed a rapid increase in landings early in the time series, followed by a fairly steady decline. For this species in particular, normalized landings since 1978 have followed a similar pattern among ports (Fig. 5). Fort Bragg is an exception to this trend, having high normalized landings in 1986 and 1987 and somewhat lower landings in 1982.

Species Composition

Overall, species composition in the coastwide landings varied substantially among years (Fig. 6). There has been a tendency for species composition to become more heterogenous over time. Much of this variation was due to large changes in landings of S. entomelas. Other factors responsible for variation in species composition include: recent increases in landings of S. crameri at Eureka, a general decline in the relative importance of S. paucispinis at all ports, abrupt and

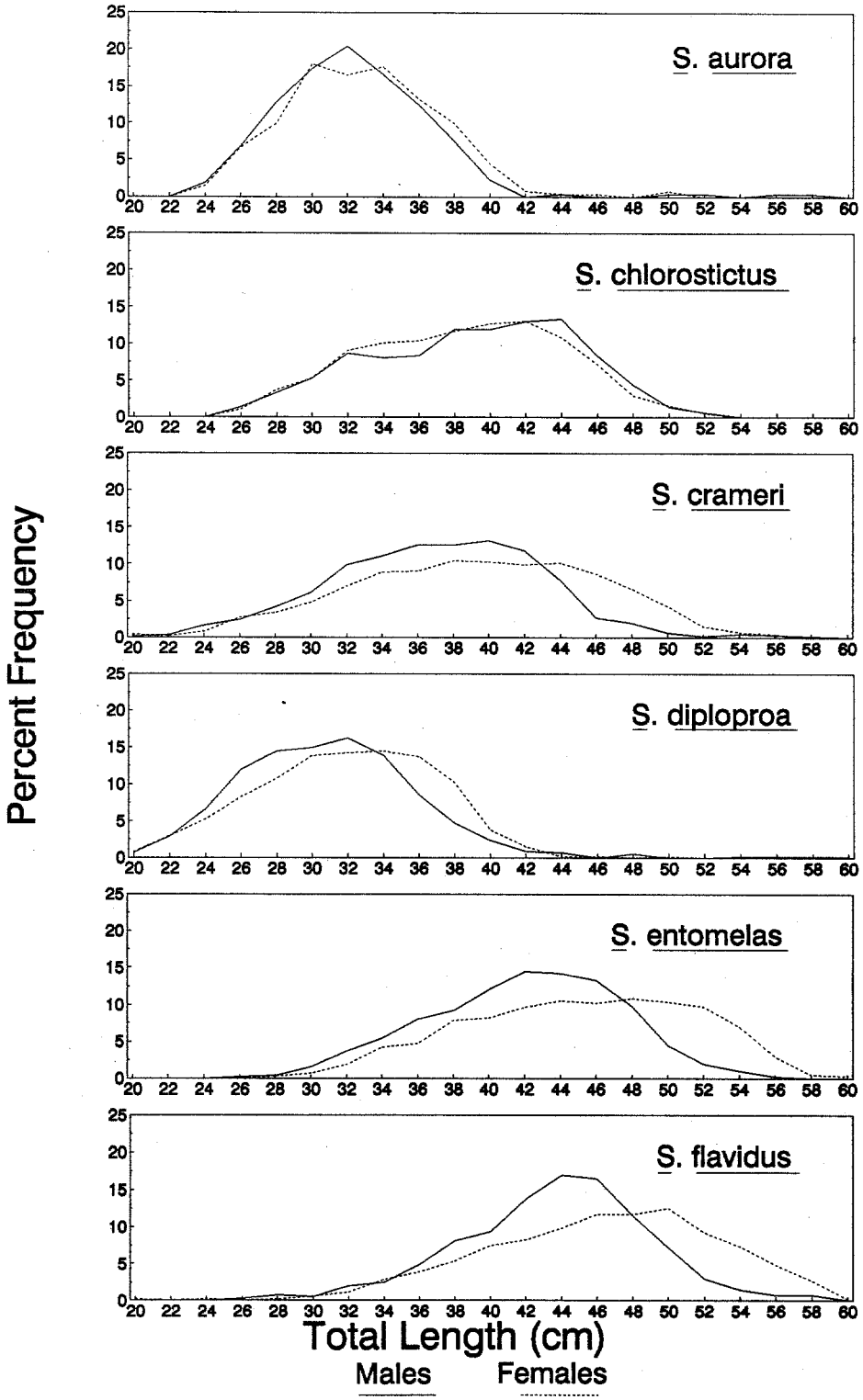
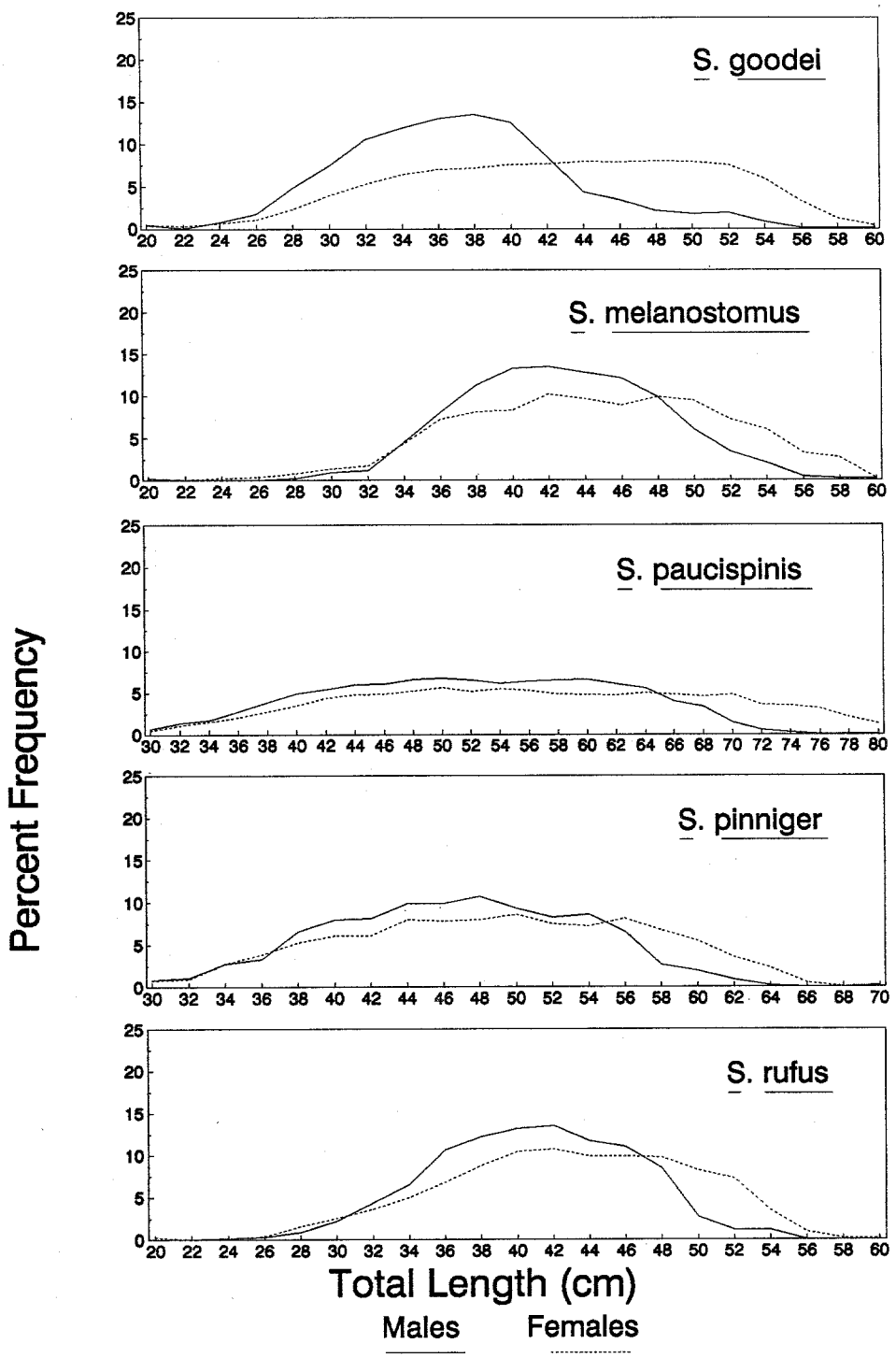


Figure 2. Length distributions by sex of the eleven species of rockfish (genus Sebastes) used in this study. Sample data from all ports and years were combined.



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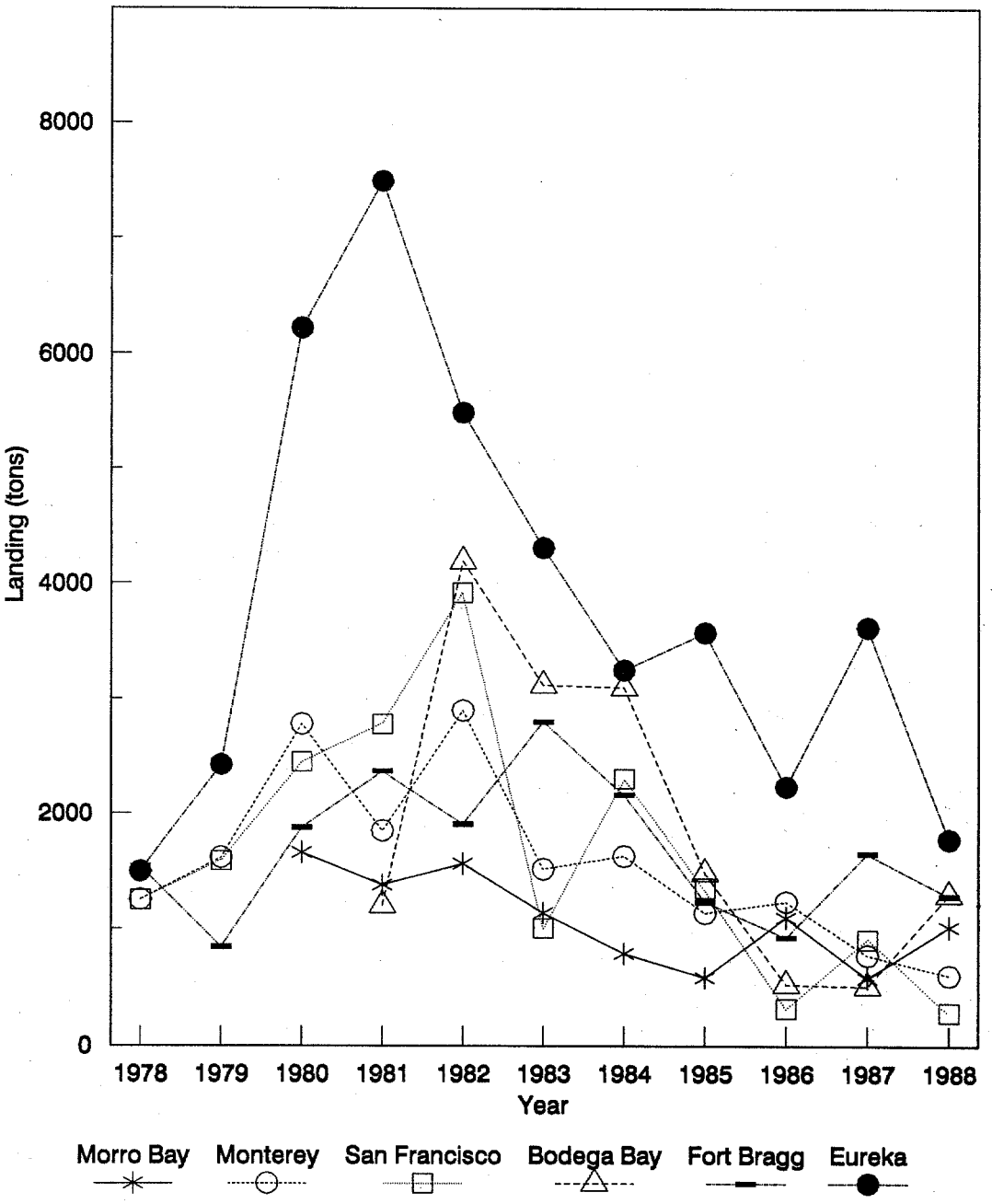

Figure 3. Total landing weight in standard tons of eleven species of rockfish (genus Sebastes) at six ports during an eleven year port sampling program (1978-1988).

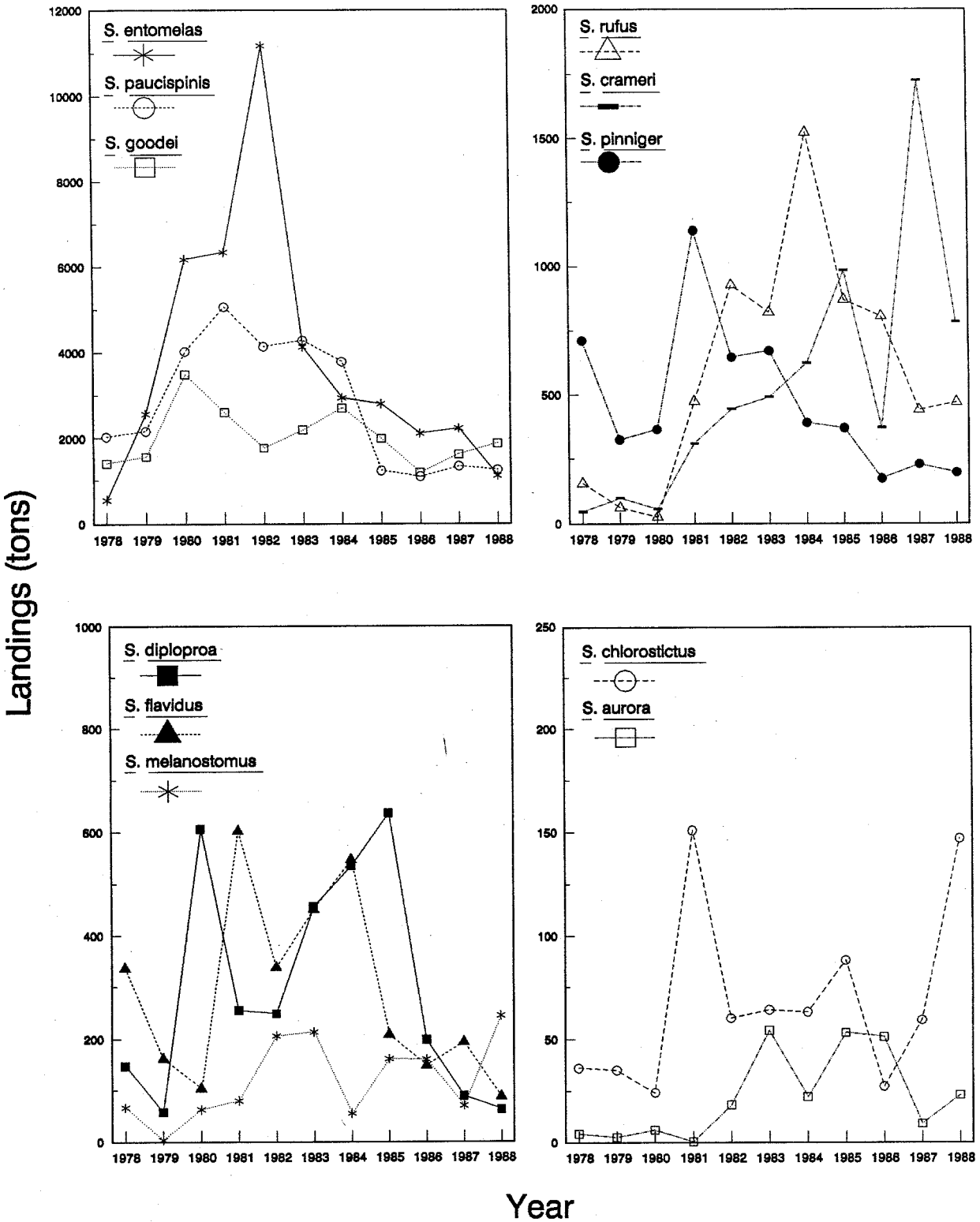

Figure 4. Combined landing weights of 11 species of rockfish (genus Sebastes) during an 11 year port sampling program with all ports combined.

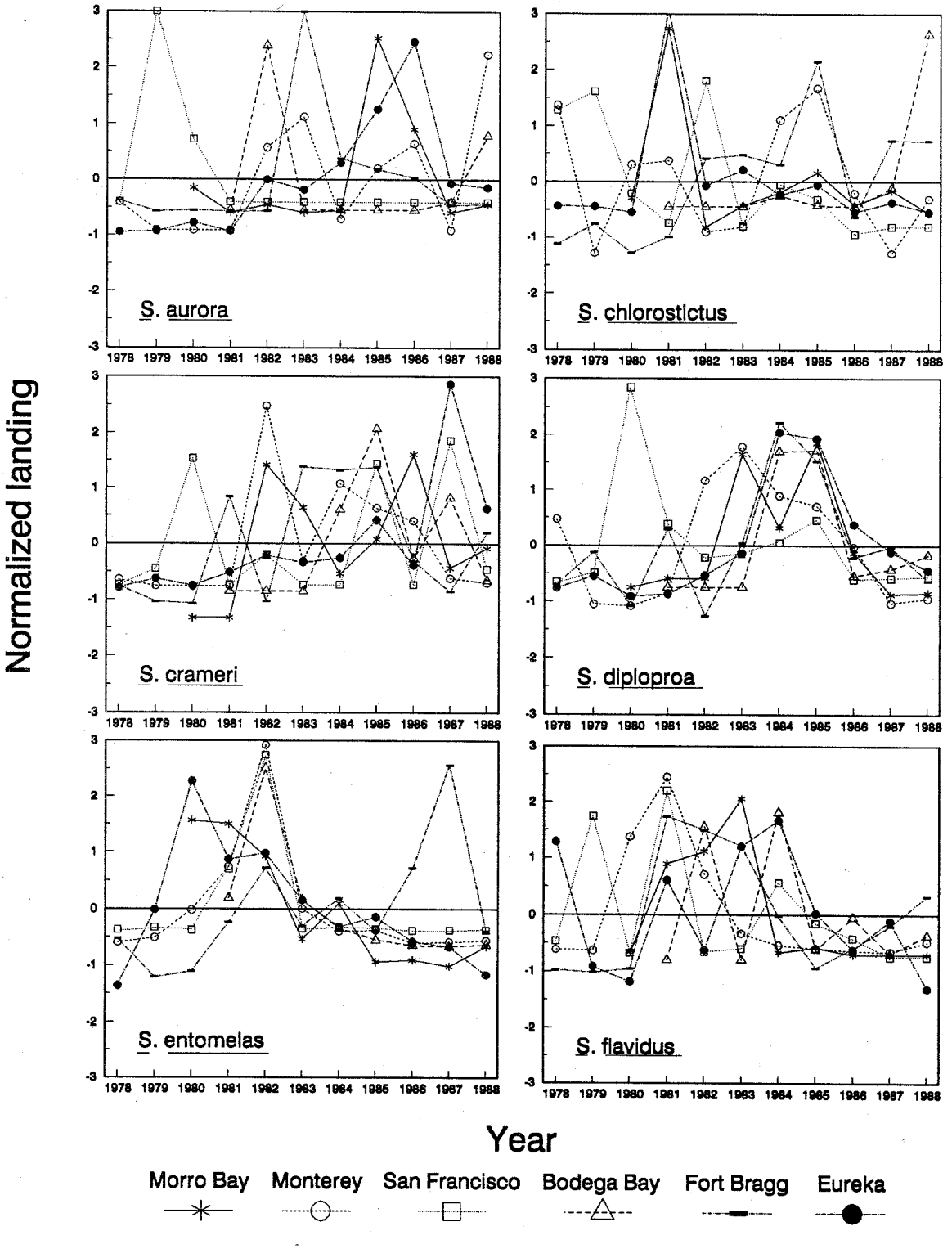

Figure 5. Normalized landings (X-mean/standard deviation) for each of the 11 species of rockfish (genus Sebastes) for six ports during an 11 year port sampling program.

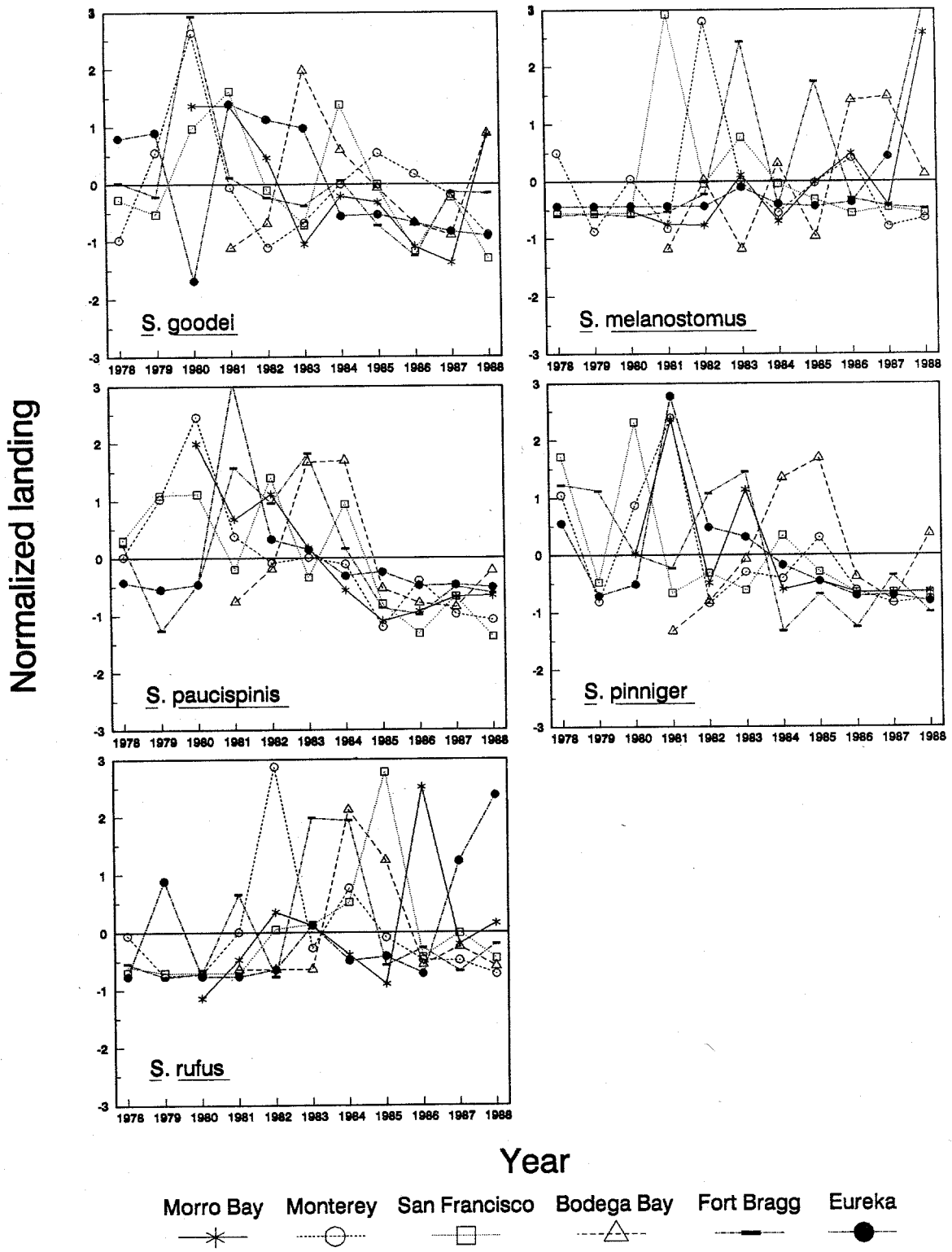

Figure 5 cont.

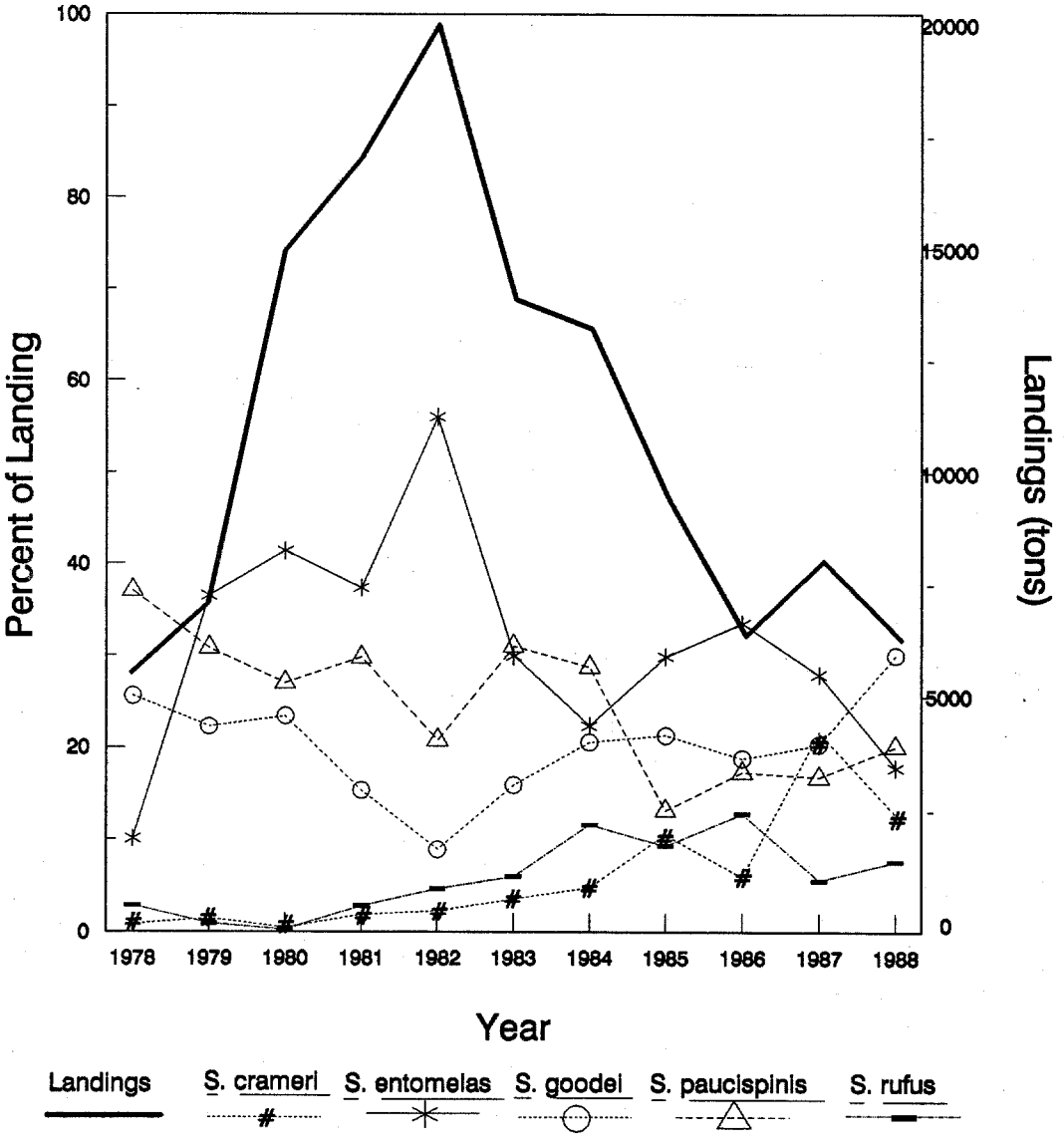

Figure 6. Species composition by percent of total landing weight from the California trawl fishery. Top five species by weight are shown. Total yearly landings (right scale, heavy solid line) are included for reference.

sporadic alterations in the landings of S. rufus, and a switching in relative abundance of S. goodei and S. paucispinis at all ports, with landings of S. goodei outranking S. paucispinis in most recent years.

Nine of the 11 species were determined to be primary in at least one port (Table 2). Sebastes paucispinis and S. entomelas were primary at all ports, while S. crameri and S. melanostomus were primary species at only one port. All ports have shown substantial changes in species composition (Fig. 7).

Table 2. Total landings (tons) of the eleven species of rockfish at the six ports included in this study. Data are for the period 1978-88. Values which are underlined indicate one of the five most abundant species at that port complex.

SPECIES	PORT						
	MORRO BAY	MONTEREY	SAN FRANCISCO	BODEGA BAY	FORT BRAGG	EUREKA	TOTAL
Sebastes aurora	39	40	3	5	70	84	241
Sebastes chlorostictus	28	39	41	122	267	258	756
Sebastes crameri	139	346	52	279	1241	3878	5938
Sebastes diploproa	323	921	1173	95	446	336	3303
Sebastes entomelas	456	1774	3524	7234	2204	26923	46001
Sebastes flavidus	67	252	332	192	471	1859	3177
Sebastes goodei	2900	5136	5417	2357	5478	1499	22512
Sebastes melanostomus	391	445	115	78	230	64	1326
Sebastes paucispinis	3783	6917	6889	3474	5280	4047	30720
Sebastes pinniger	55	37	161	385	1513	3063	5219
Sebastes rufus	1873	1398	503	1162	1329	307	6582
Total	9654	17306	18212	15382	18527	42318	121400

As landings of rockfish at Morro Bay have declined, S. paucispinis has declined in importance, becoming less abundant than S. goodei (Fig. 7). The species which showed the greatest increase in percent composition was S. rufus, which went from nearly zero percent in 1980, to a level equal with the previous two species by 1988.

Like Morro Bay, catches of rockfish from Monterey have generally declined since the peak years of 1980-82 (Fig. 7). Throughout this time S. paucispinis and S. goodei have maintained a dominant position in the landings. During 1981-83, S. entomelas comprised a substantial share of the market, but since that time this species has not appeared in great quantities. In recent years, S. rufus and S. diploproa have made minor but relatively consistent contributions, especially through 1986. Since then S. goodei and S. paucispinis have accounted for virtually all rockfish landings.

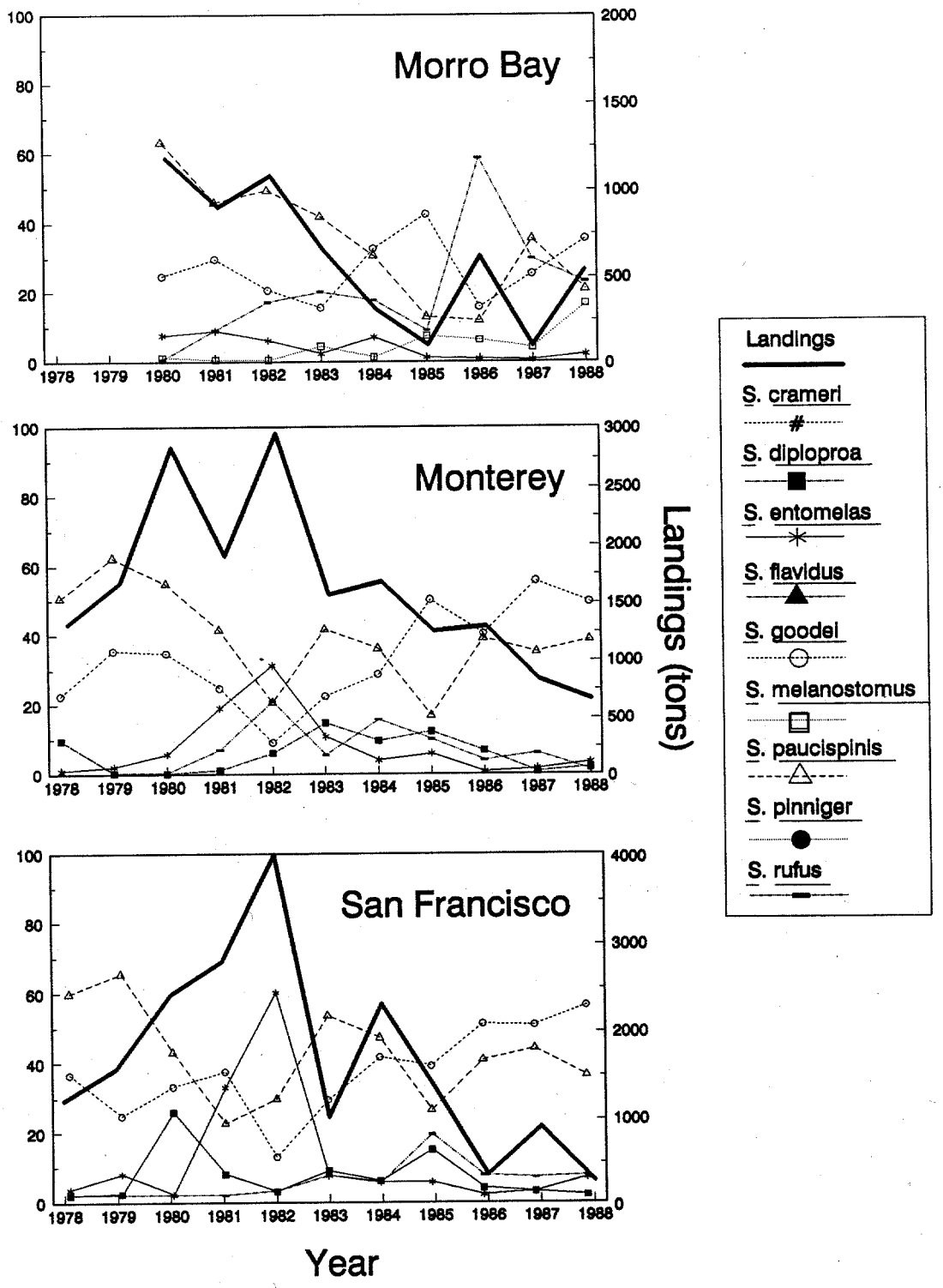

Figure 7. Species composition by percent of total landing weight for the six ports included in this study over an 11 year period. Top five species (by total weight for the 11 year study period) were used for each port. Total landings (right scale, heavy solid line) are presented for comparison.

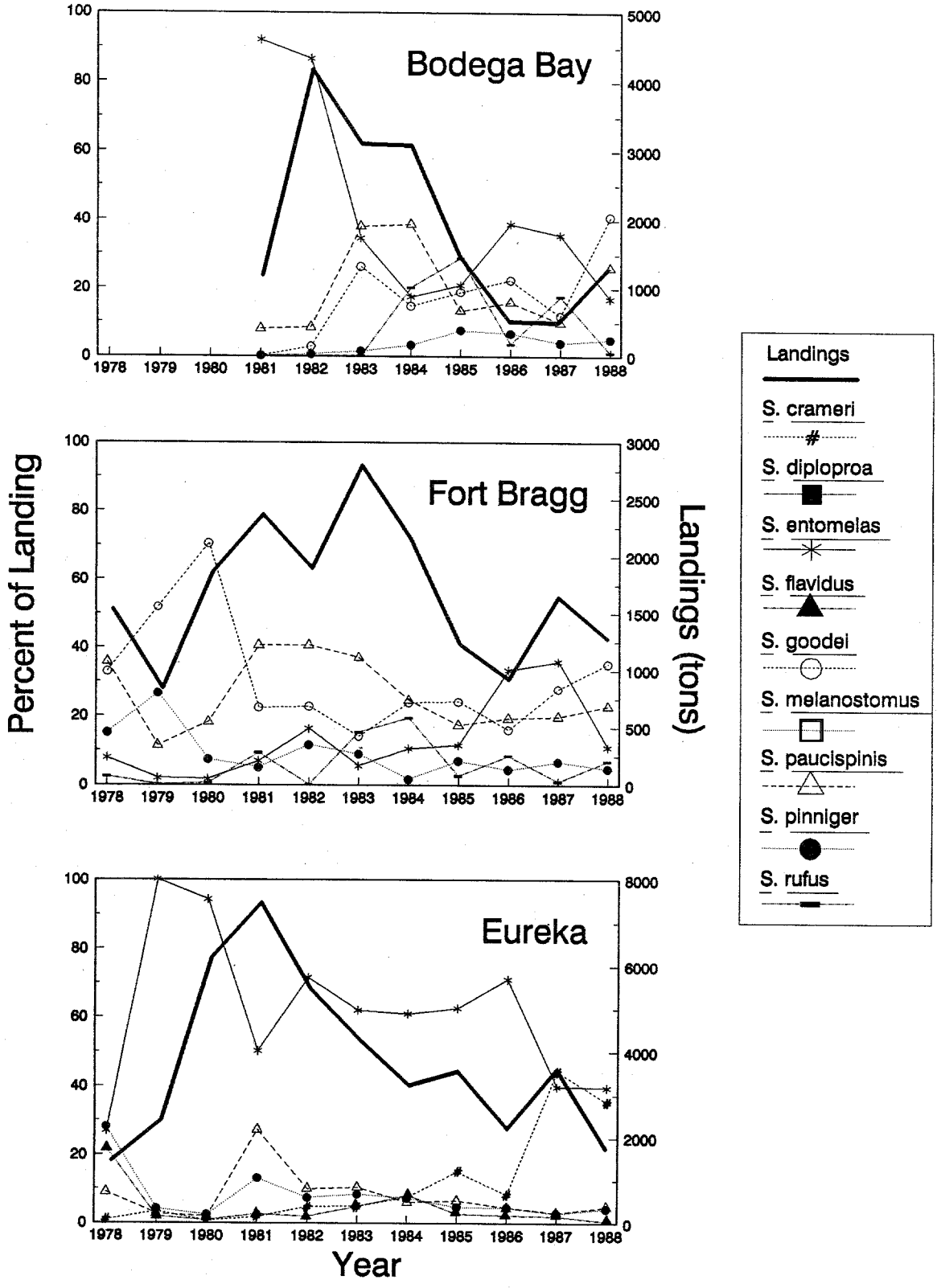

Figure 7 cont.

Rockfish landings at San Francisco showed a strong increase from 1978 through 1982, followed by a period of declining catches (Fig. 7). Throughout the study period, S. goodei and S. paucispinis have dominated the landings, with the exception of 1981-82 when S. entomelas catches were very large. Other species caught, but in consistently low percentages, were S. diploproa and S. rufus.

Bodega Bay also shows a declining trend in overall landings of Sebastes spp. from 1982-88 (Fig. 7). At this port S. entomelas has been the dominant species landed throughout the time series. Nonetheless, this species has declined from in excess of 80% of the landings early in the decade, to roughly 30% in recent years. The remainder of the catch has been comprised principally of S. paucispinis and S. goodei, although S. rufus and S. pinniger are common.

Landings from Fort Bragg did not show the general pattern of decline since 1978 that characterized other ports (Fig. 7). Throughout the study period, S. paucispinis and S. goodei played a dominant role at this port. Note also that early in the time series S. pinniger was fairly important (approximately 20% of landings), but the relative importance of this species slowly declined over the years. In contrast, the proportion of the catch comprised by S. entomelas tended to increase; in 1986 and 1987 it was the most important species landed.

The catch of Sebastes spp. from Eureka rose abruptly from 1978 through 1981 and has steadily declined since then (Fig. 7). Sebastes entomelas has dominated the catch of rockfish at this port, comprising well over 50% of all landings from 1979-86. More recently (1987-88) S. crameri has increased in importance to capture 40% of the rockfish market.

Note from these comparisons that S. entomelas and S. paucispinis were among the top five species at all ports considered (Table 2); these species are very important components of the California commercial rockfish catch. The primary species at Fort Bragg and Bodega Bay were the same, however their relative importance was somewhat different. In Bodega Bay, S. entomelas dominated the landings from 1981-1983 while it was ranked between third and fifth in importance at the same time in Fort Bragg.

Length Composition

In each of the following species accounts, summary statistics depicting long term (1978-88) trends in length composition are presented graphically. Specifically, trends in the mean, 10th percentile, and 90th percentile of the length-frequency distributions from the landings can reveal the effects of exploitation. For example, a declining trend in mean size is

expected during the non-equilibrium phase that immediately follows an increase in fishing mortality. Similarly, a declining trend in the 10th length percentile (a measure of the size at entry to the fishery) might indicate progressive targeting on small fish, whether by altering mesh size or by selecting different locations for trawling.

Sebastes aurora (Fig. 8): Little or no change in length structure during the study period; not a primary species at any of the six ports; not sexually dimorphic in length.

Sebastes chlorostictus (Fig. 9): Little or no change in length structure, although some evidence of increased harvest of small fish at Monterey (1984-86); not a primary species at any of the six ports; not sexually dimorphic in length.

Sebastes crameri (Fig. 10): A primary species at Eureka; mean lengths of males and females declining somewhat at Eureka, Fort Bragg, and possibly Monterey; little pattern evident in 10th and 90th percentile statistics, although some evidence of decline in 10th percentile at Fort Bragg and Monterey, especially for females.

Sebastes diploproa (Fig. 11): A primary species at Monterey and San Francisco; suggestion of decline in mean size, especially for males at Morro Bay and females at Monterey and Bodega Bay; possible increased harvest of small males at Morro Bay and Eureka and small females at Monterey; potentially reduced catch of large males at Morro Bay and perhaps Fort Bragg and large females at Bodega Bay; the possible increase in mean size of females at San Francisco seems due to reduced harvest of small fish; apparent increase in the mean size of females at Morro Bay could be a result of the small sample size in recent years (Appendix A).

Sebastes entomelas (Fig. 12): A primary species at all ports; clear declines in the mean size of males everywhere except at San Francisco and Bodega Bay; females seem to have declined in mean size particularly at the more southerly ports (Morro Bay, Monterey, and San Francisco); reduction in mean size of males has been due to increased harvest of small fish (Fort Bragg), decreased harvest of large fish (Morro Bay), or both (Monterey and Eureka); mean size of females has declined largely due to an increased harvest of small fish (all ports except Bodega Bay), coupled with declines in the catch of large fish (southern ports of Morro Bay, Monterey, and San Francisco).

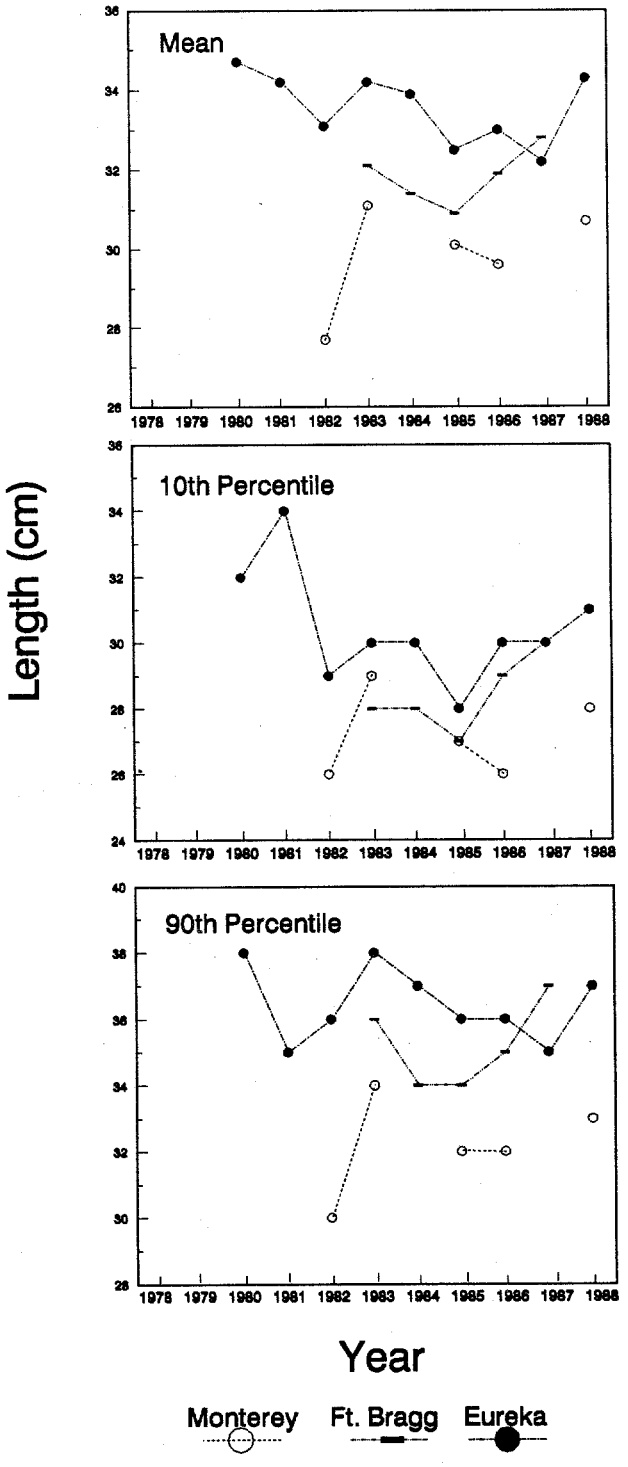

Figure 8. Mean, 10th percentile, and 90th percentiles for the length distributions of S. aurora (sexes combined). Only ports and years for which at least 20 fish were measured were included.

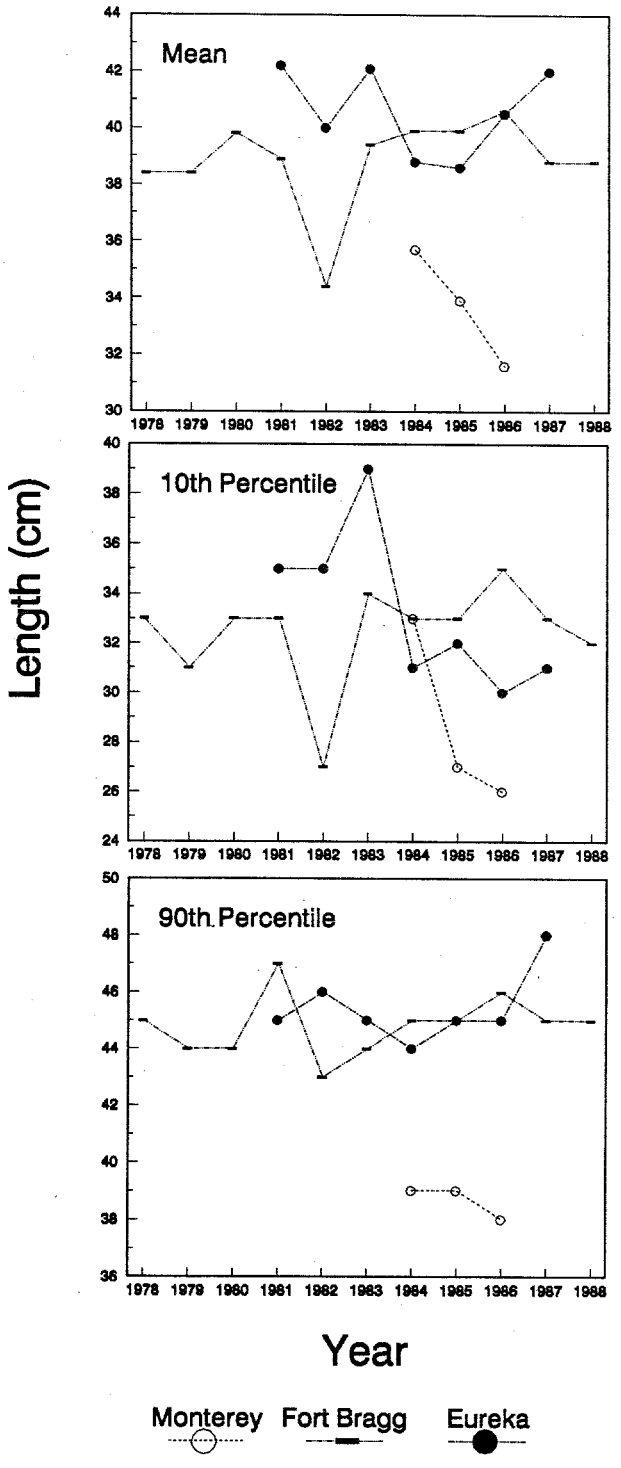

Figure 9. Mean, 10th percentile, and 90th percentiles for the length distributions of S. chlorostictus (sexes combined). Only years and ports for which at least 20 fish were measured are included.

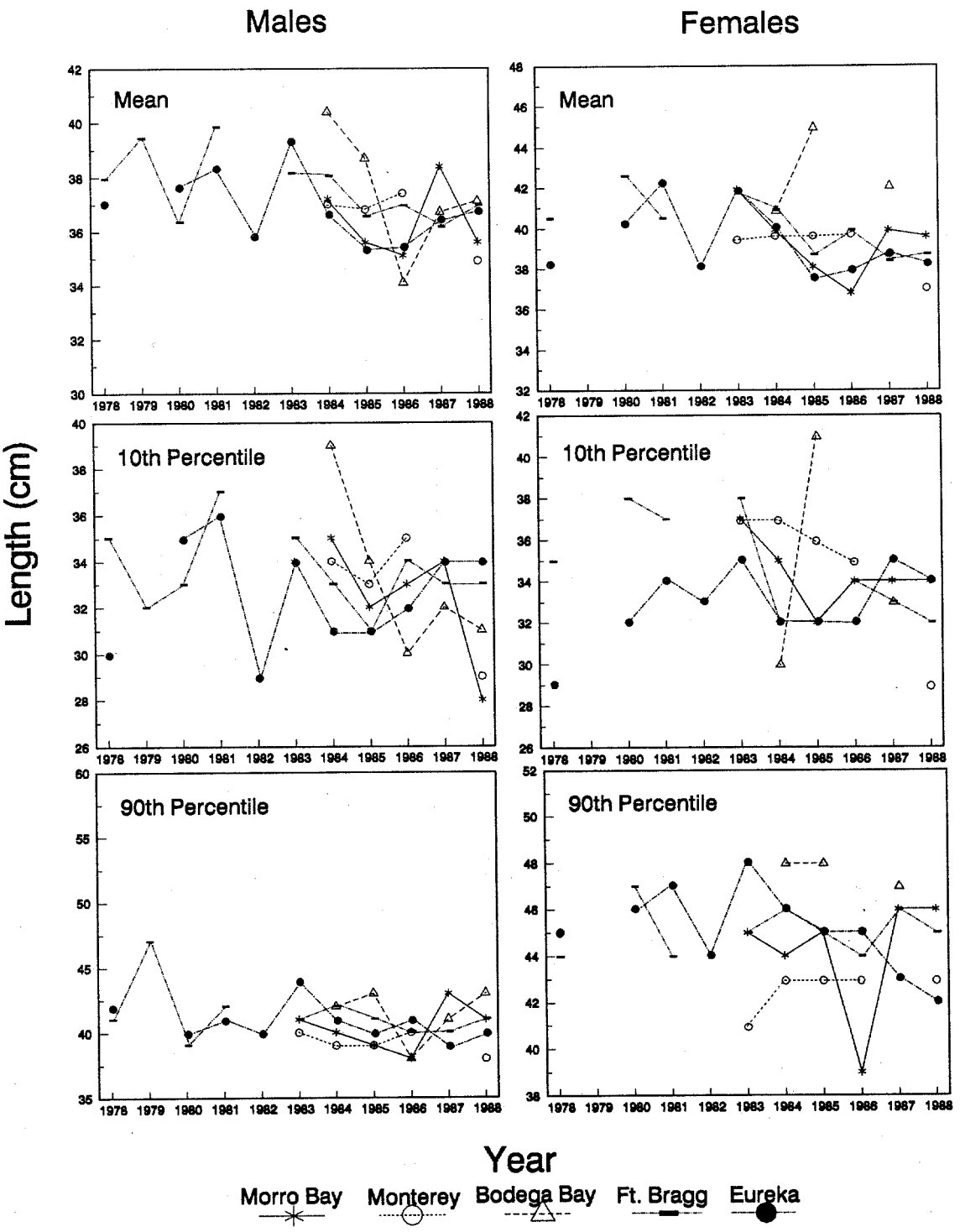

Figure 10. Mean, 10th percentile, and 90th percentiles for the length distributions of male an female S. crameri. Only ports and years for which at least 20 fish were measured are included.

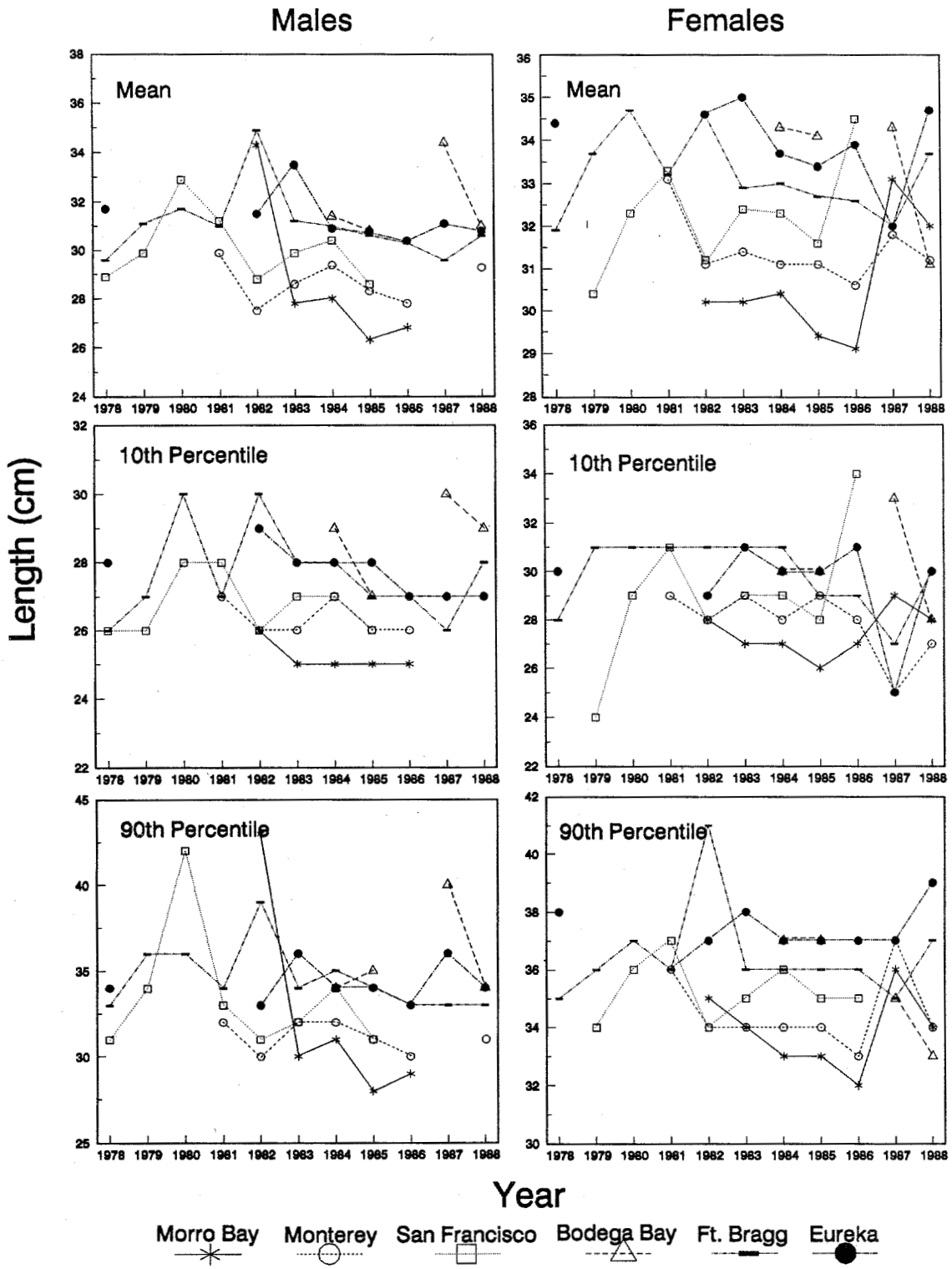

Figure 11. Mean, 10 percentile, and 90th percentiles for the length distributions of male and female S. diploproa. Only ports and years for which at least 20 fish were measured are included.

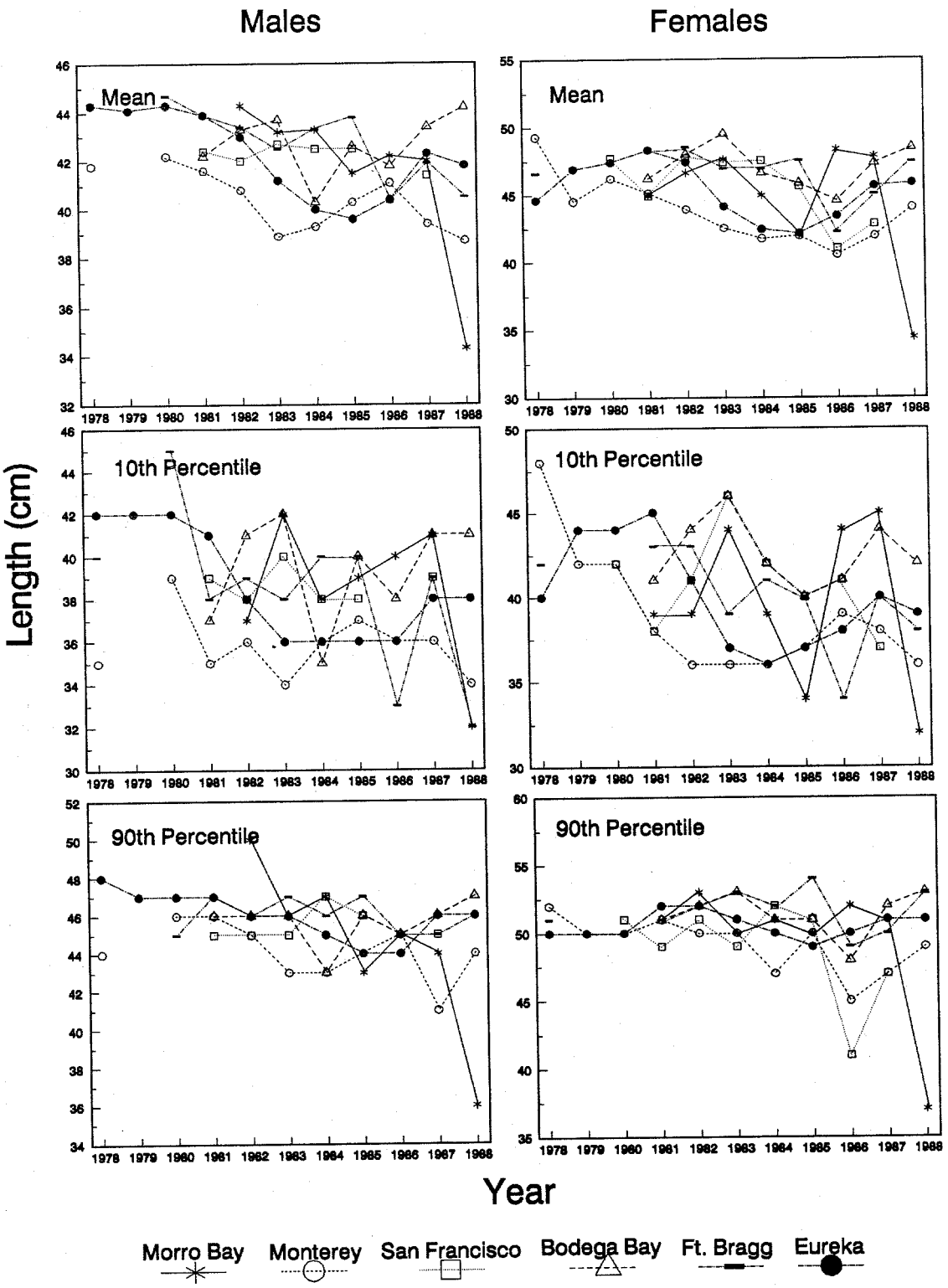

Figure 12. Mean, 10th percentile, and 90th percentiles for the length distributions of male and female S. entomelas. Only ports and years for which at least 20 fish were measured are included.

Sebastes flavidus (Fig. 13): A primary species at Eureka; definite overall decline in the mean size of males, particularly at Fort Bragg and Eureka; declining mean size of males due both to an increased harvest of small fish and a decreased catch of large fish (Monterey, Fort Bragg, and Eureka); similar declines in the mean size of females, especially to the north (Fort Bragg and Eureka); like males, reduction in mean size of females due to increased harvest of small fish in conjunction with declining catches of large fish.

Sebastes goodei (Fig. 14): A primary species at all ports except Eureka (where it still contributes substantially to total landings)(Appendix B); clear evidence of declining mean size of male fish at northern ports (Fort Bragg and Eureka) and a similar trend is suggested at the four remaining ports; declining size of males mainly due to a reduction in the 10th length percentile (increased catch of small fish) at Morro Bay and Bodega Bay, a reduction in the 90th length percentile (decreased catch of large fish) at Monterey and San Francisco, and a reduction in both these statistics at the two most northerly ports; patterns for female fish more strongly evident than for males; declines have occurred in the mean size of females at all ports except perhaps Monterey; clear increases in the catch of small fish at Morro Bay, Fort Bragg, and Eureka; steady declines in the harvest of large females at all ports except possibly Monterey; Monterey is unusual in that the catch of small females (25-30 cm TL) was particularly high early in the time series (1978-79).

Sebastes melanostomus (Fig. 15): A primary species only at Morro Bay; indications of a decline in the mean size of male fish at Morro Bay and, possibly, at Fort Bragg; these declines due to reductions in both the 10th and 90th percentile statistics; a similar pattern is evident for female fish landed at Morro Bay; catch of large females (90th percentile) at Fort Bragg have actually tended to increase over time.

Sebastes paucispinis (Fig. 16): A primary species at all ports; a coherent pattern in the length structure of both males and females landed at all ports is clearly evident; this pattern is probably due to the influx of very strong year classes (PFMC 1984), making firm conclusions regarding the effects of fishing on length composition difficult to establish; some suggestion of declining numbers of large fish caught, especially males at Monterey, San Francisco, and Eureka.

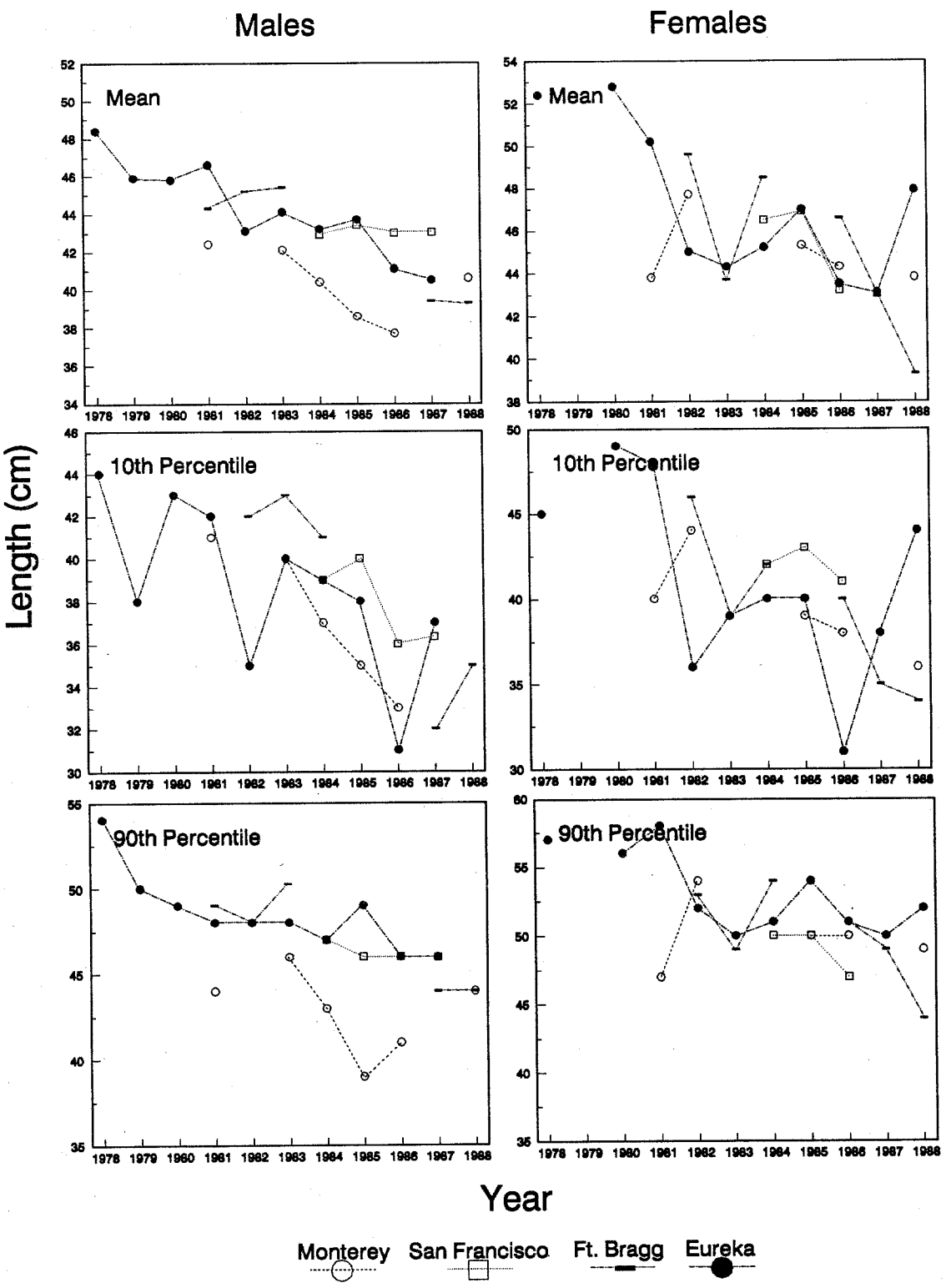

Figure 13. Mean, 10th percentile, and 90th percentiles for the length distributions of male and female S. flavidus. Only ports and years for which at least 20 fish were measured are included.

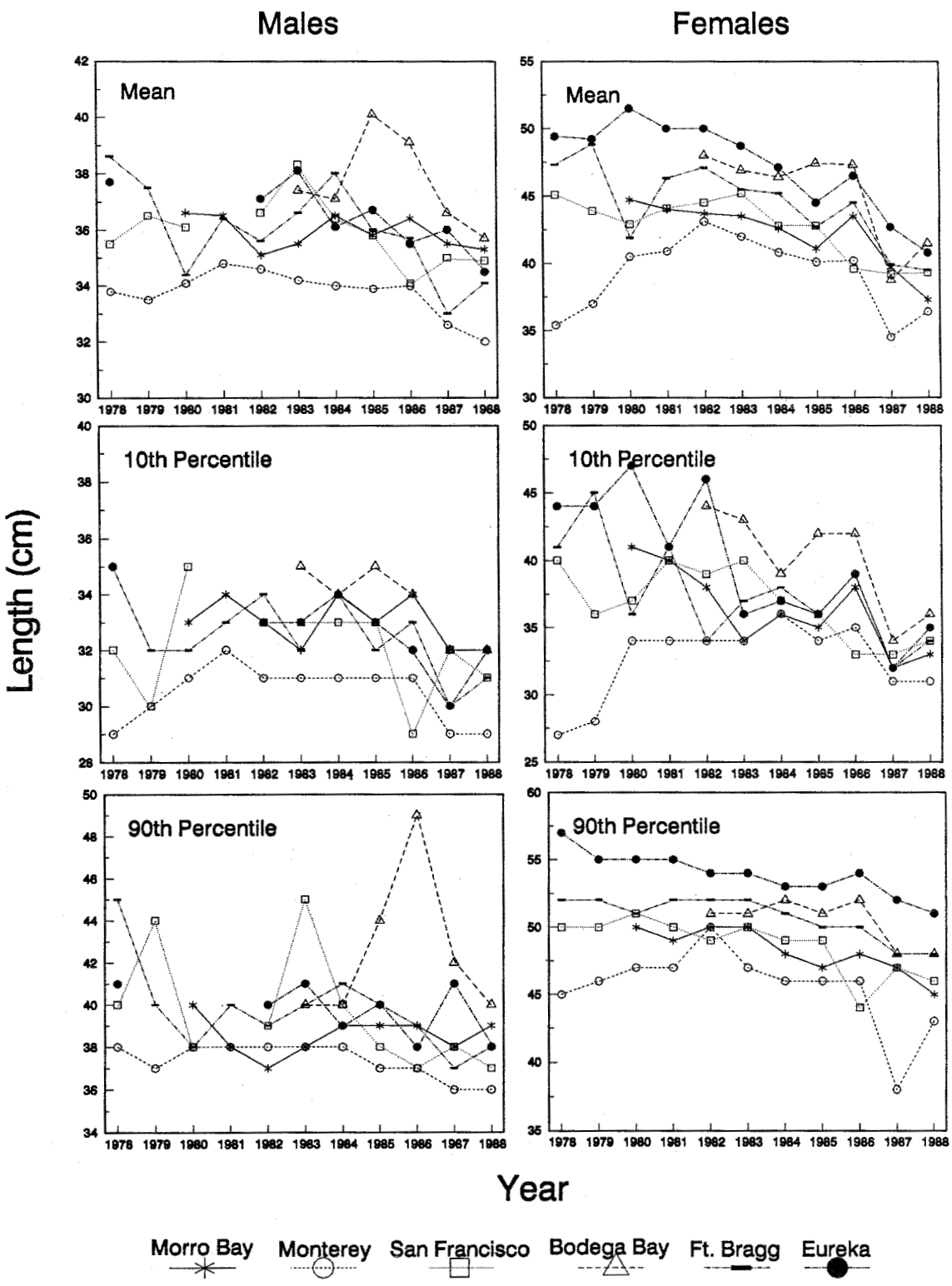

Figure 14. Mean, 10th percentile, and 90th percentiles for the length distributions of male and female S. goodei. Only ports and years for which at least 20 fish were measured are included.

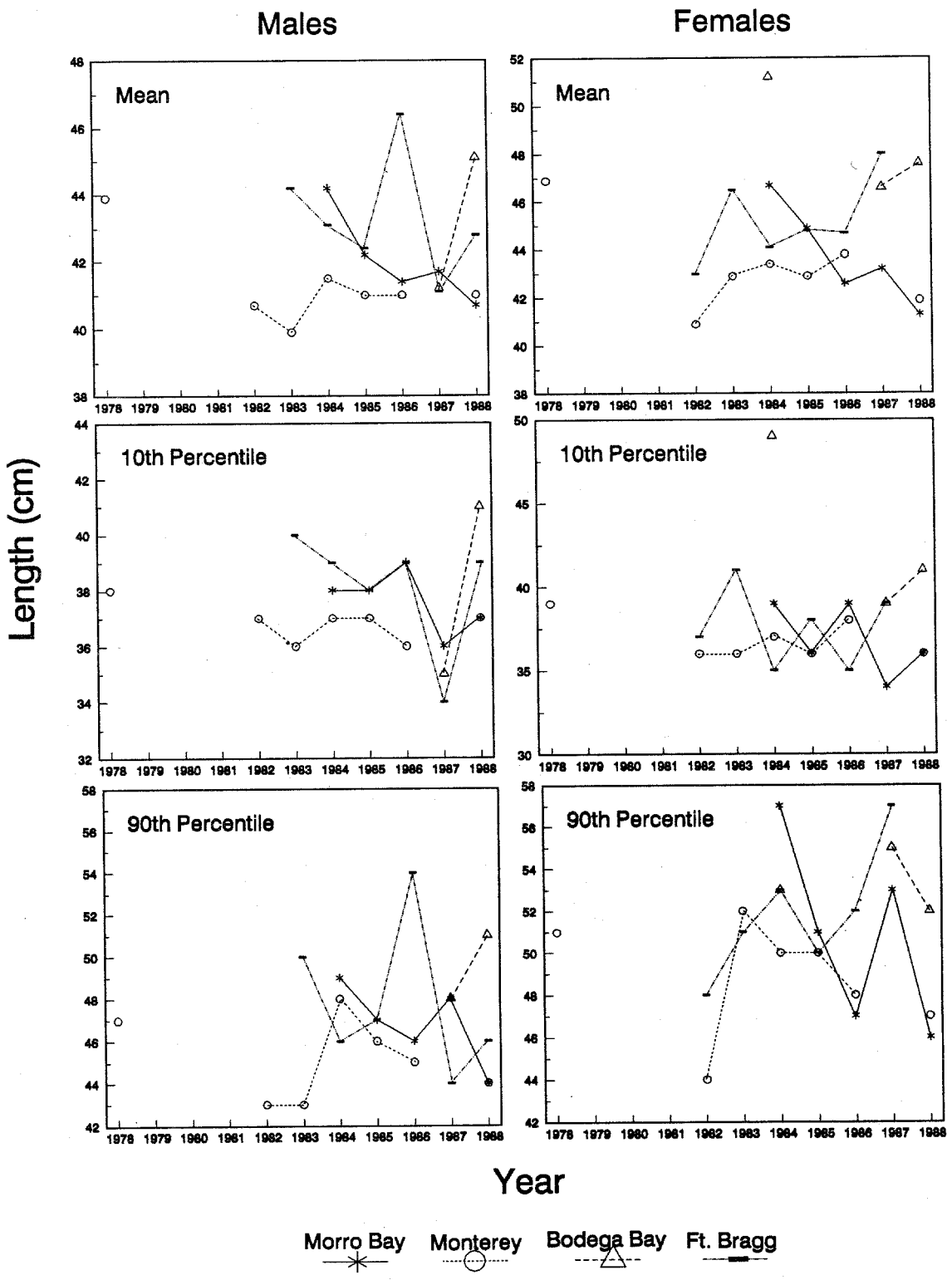

Figure 15. Mean, 10th percentile, and 90th percentiles for the length distributions of male and female S. melanostomus. Only ports and years for which at least 20 fish were measured are included.

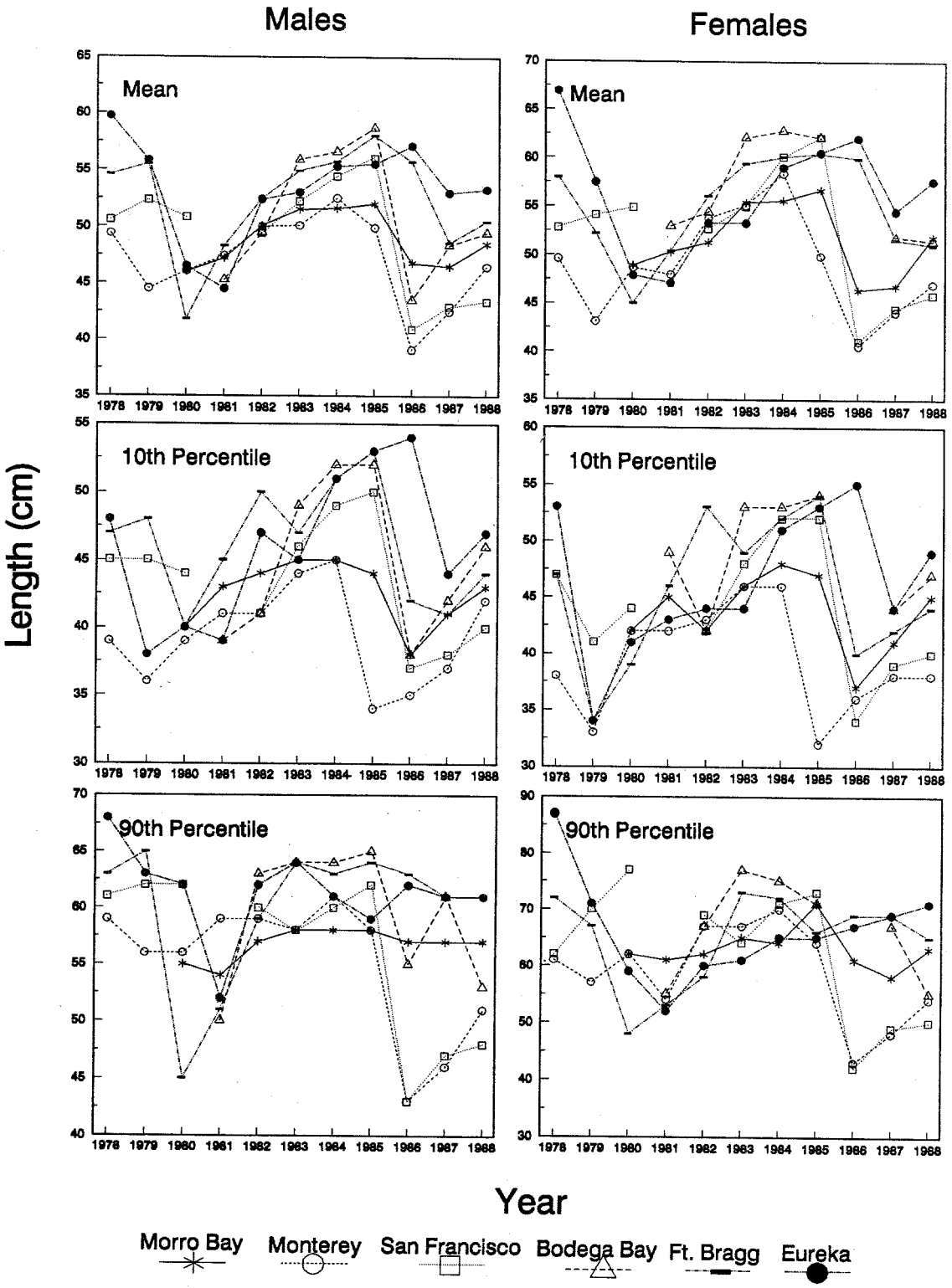

Figure 16. Mean, 10th percentile, and 90th percentiles for the length distributions of male and female S. paucispinus. Only ports and years for which at least 20 fish were measured are included.

Sebastes pinniger (Fig. 17): A primary species at the three northern ports (Bodega Bay, Fort Bragg, and Eureka); landings of both sexes at Eureka and Fort Bragg exhibited a definite decrease in mean length, due primarily to a reduction in the relative frequency of large fish caught in association with an increase in the proportion of small fish caught.

Sebastes rufus (Fig. 18): A primary species at four ports (Morro Bay, Monterey, Bodega Bay, and Fort Bragg); clear decreasing trends are evident in the mean size of males landed at Monterey, San Francisco, Bodega Bay, and possibly Morro Bay; in all cases this has been due primarily to increased harvesting of small fish (i.e., declining 10th percentile); female fish from San Francisco have apparently increased in mean length due to a rise in the number of large fish caught.

When length data for all ports were combined (weighted to actual landings in the ports), S. flavidus and S. pinniger showed a strong tendency for a decrease in mean length (Fig. 19). Sebastes crameri, S. goodei, S. melanostomus, and S. paucispinis appear to decrease in length during the time series, while Sebastes diploproa may have increased in mean length. The trends for the remaining species are less clear.

Among these rockfishes there is an additional superimposed tendency for size (mean TL cm) to increase with latitude (Fig. 20). Many species, (e.g., S. chlorostictus, S. diploproa, S. goode, S. pinniger, and S. rufus), are found to be larger the farther north they are caught. This trend, however, does not relate to overall abundance in the landings since both S. goodei and S. diploproa are important in southern ports, while S. pinniger is clearly a more northerly distributed species. Data for Monterey shows a smaller mean size for S. chlorostictus, S. crameri, S. diploproa, S. entomelas, S. flavidus, and particularly S. goodei and S. paucispinis than at the other ports. Therefore, four of the five primary species for this port are smaller than they are at ports to either the north or the south.

Sex Ratio

There were no clear trends for sex ratio for most species (Fig. 21). One exception was S. goodei, for which the percentage of males was generally less than 40% through 1981 but gradually increased since that time. This may be due to the strong sexual size dimorphism demonstrated by this species (Fig. 2), in association with size selective fishing mortality. Likewise, the percentages of male S. paucispinis, S. crameri, and S. aurora show some indications of having increased at Eureka. Coastwide, the percentage of male S. entomelas may have gone up since 1979.

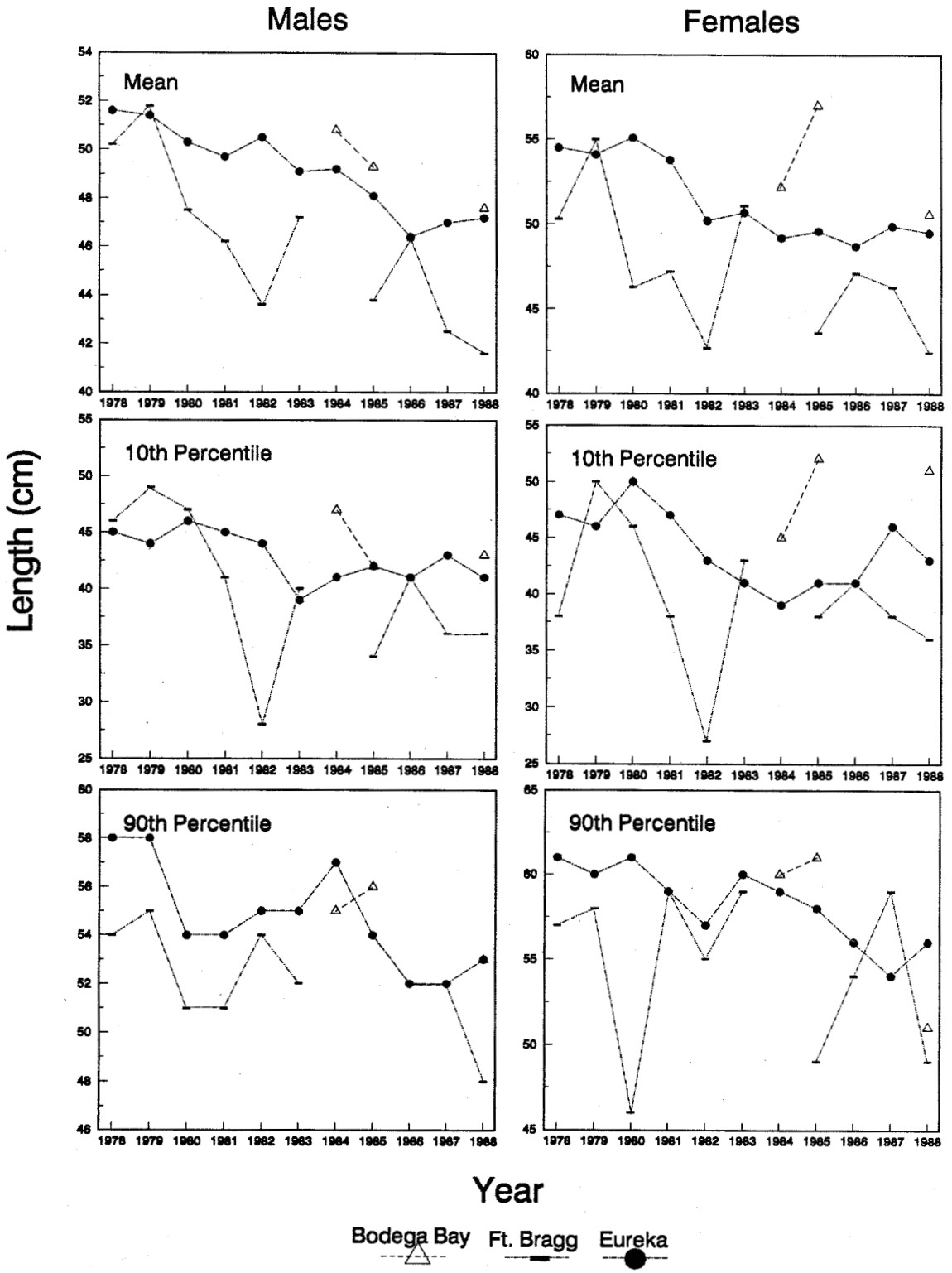

Figure 17. Mean, 10th percentile, and 90th percentiles for the length distributions of male and female S. pinniger. Only ports and years for which at least 20 fish were measured are included.

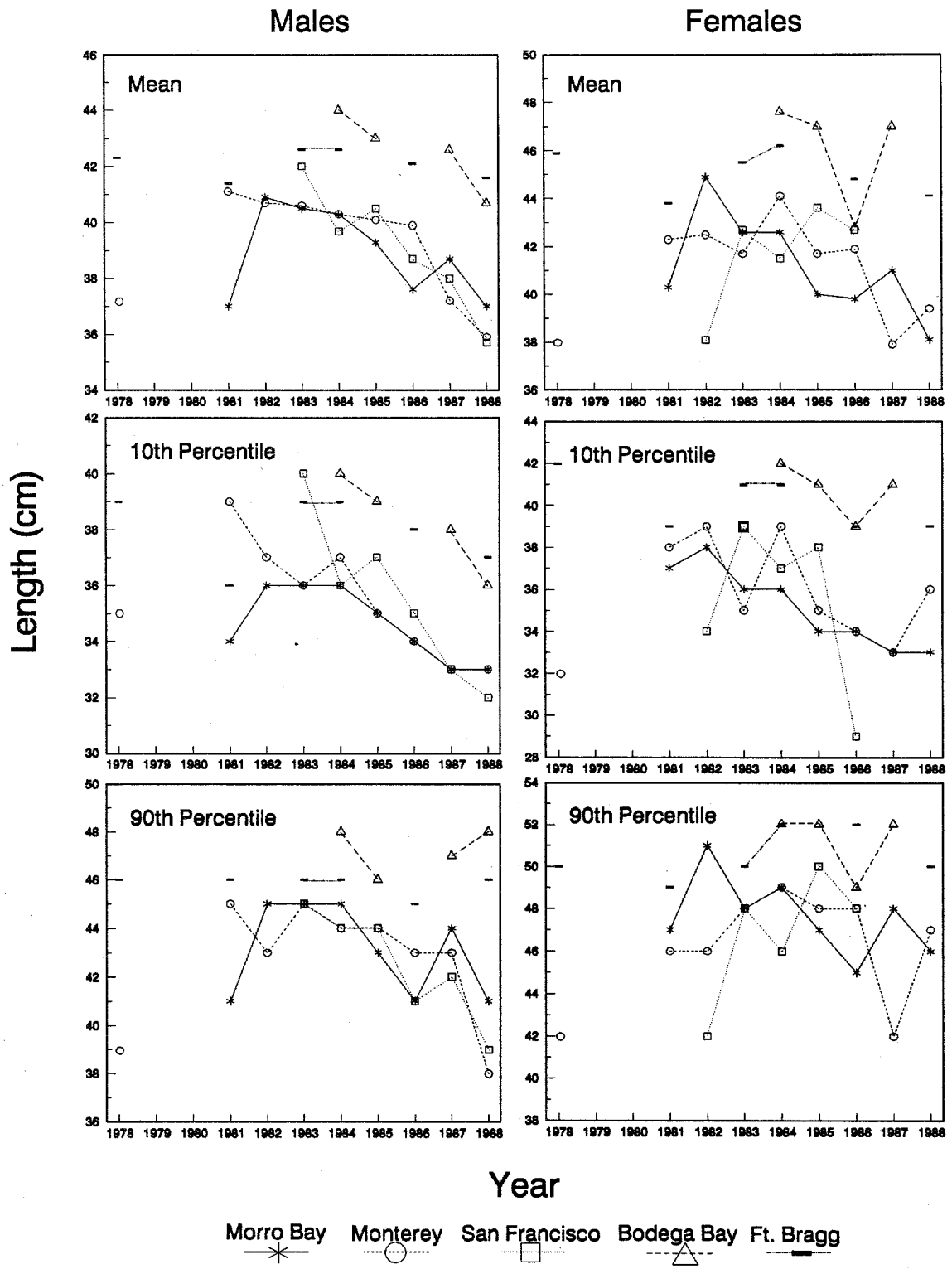

Figure 18. Mean, 10th percentile, and 90th percentiles for the length distributions of male and female S. rufus. Only ports and years for which at least 20 fish were measured are included.

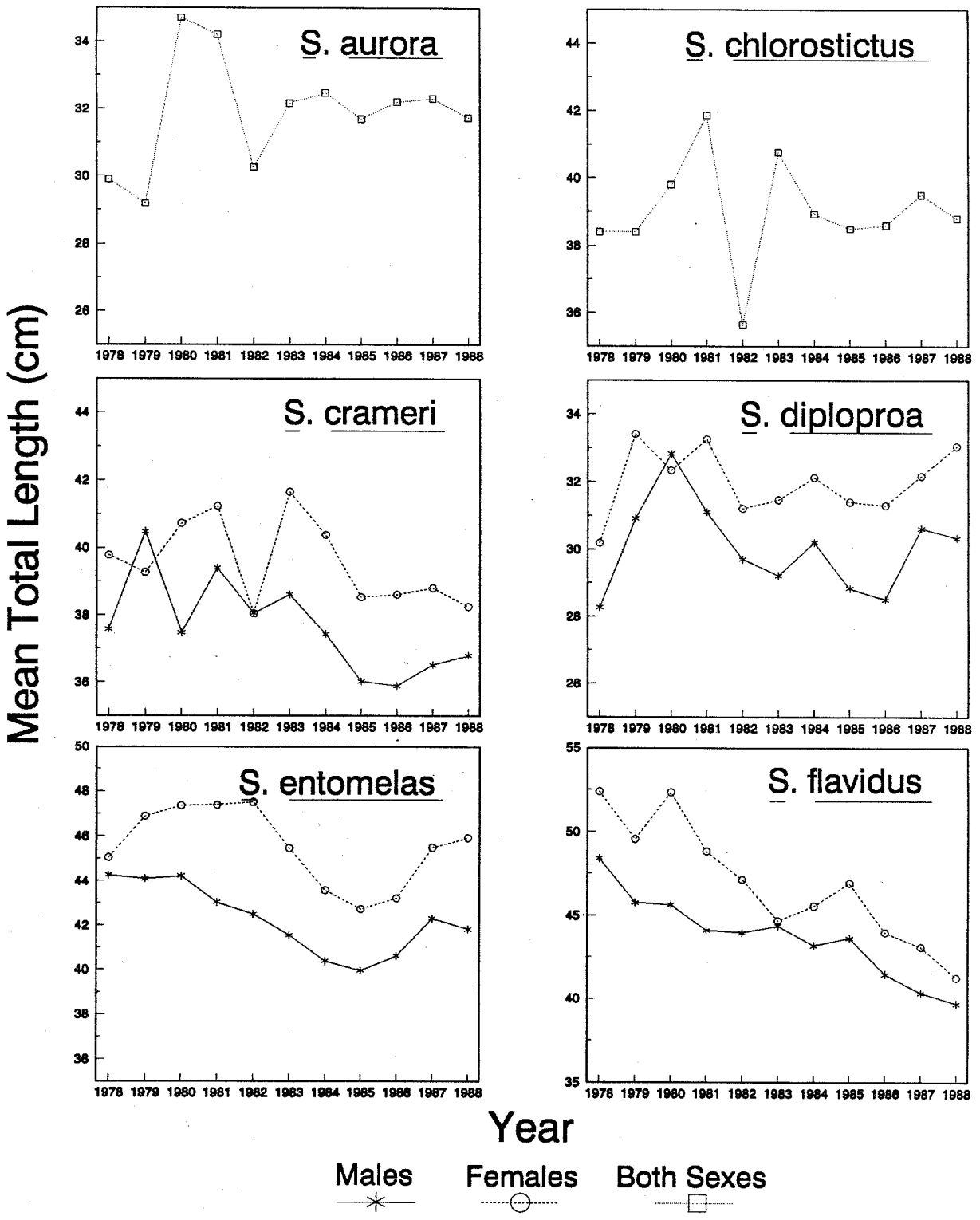

Figure 19. Mean length of 11 species of rockfish (genus Sebastes) from an 11 year port sampling program. Data from all ports was combined.

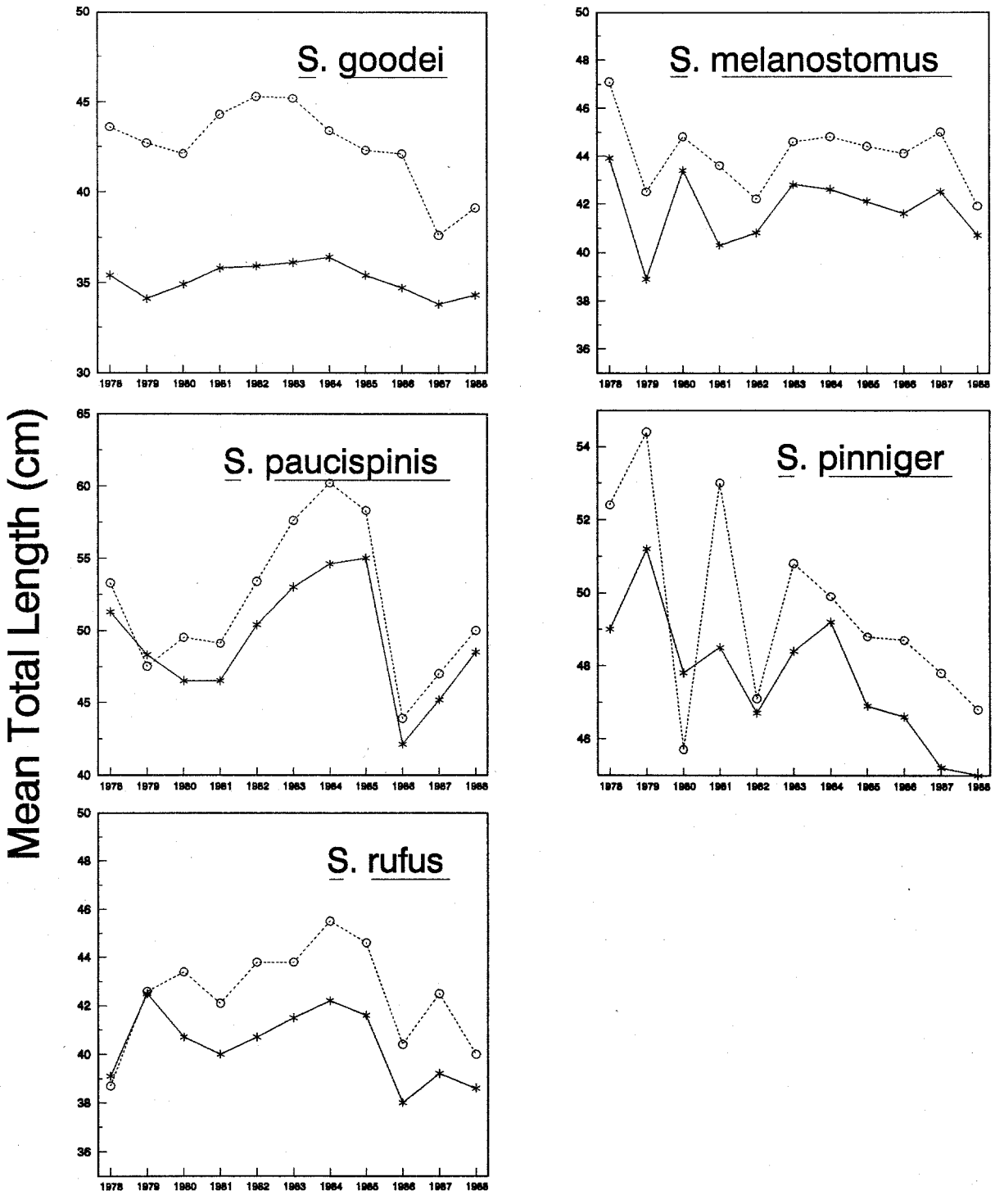

Figure 19 cont.

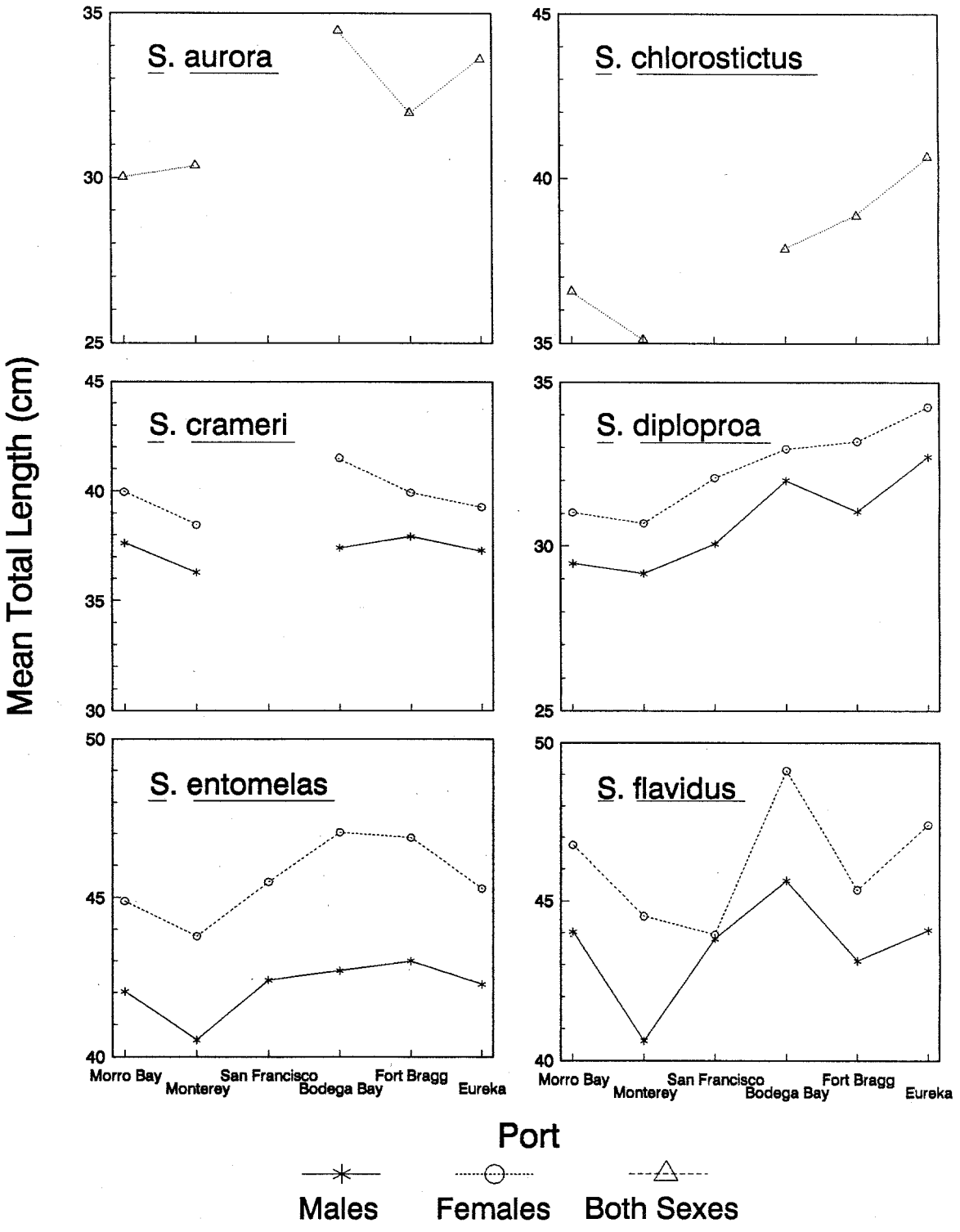

Figure 20. Mean total length of 11 species of rockfish (genus Sebastes) at six ports. Data is from all years combined. Sexes were combined for S. aurora and S. chlorostictus. When fewer than 20 fish were measured, the value was omitted.

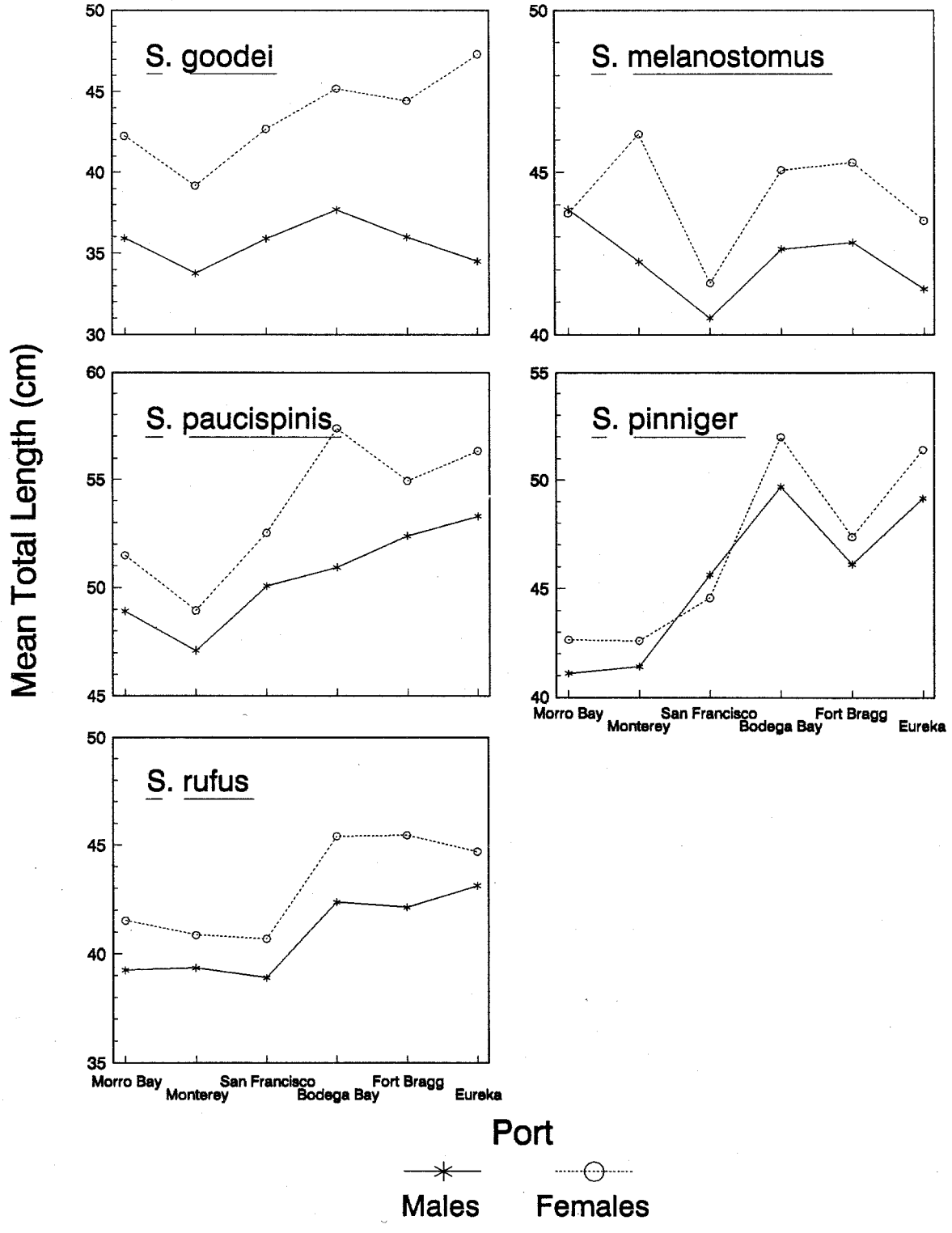

Figure 20 cont.

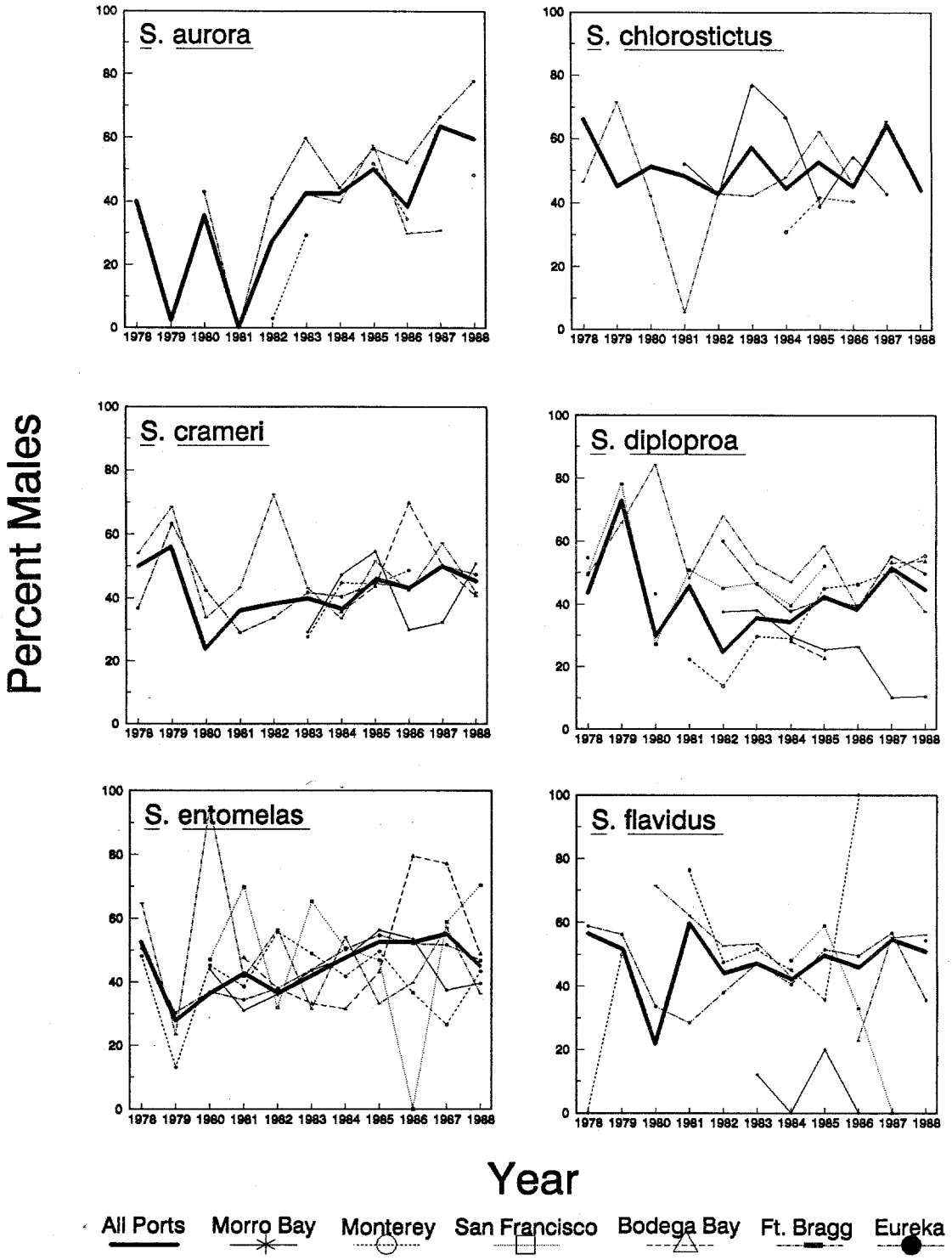

Figure 21. Percent of male rockfish in the commercial landings at six ports during an 11 year study period. Only year-port groups in which at least 20 fish were measured and sexed are included.

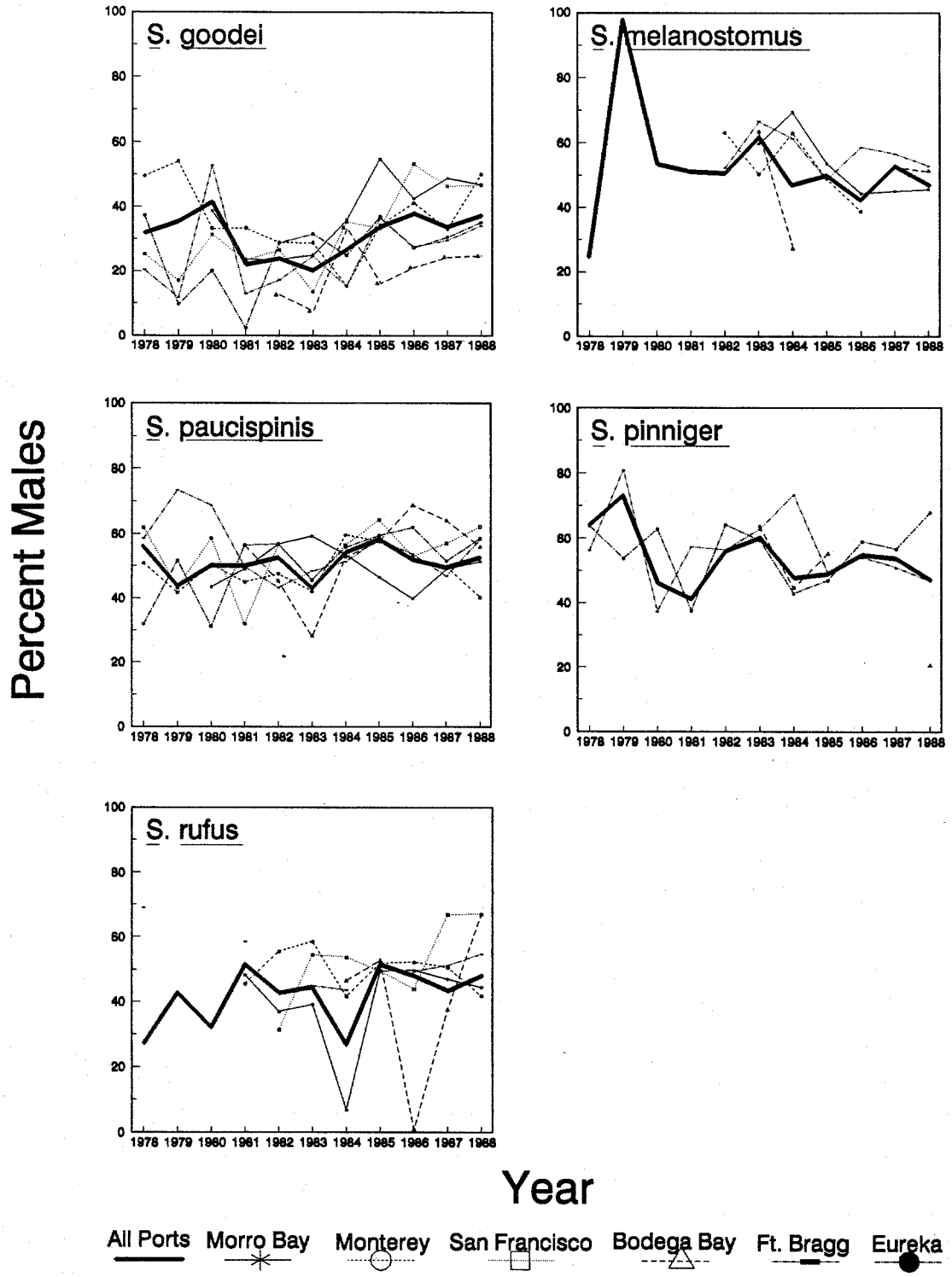

Figure 21 cont.

Conversely, while the percentage of male S. diploproa has been increasing at Monterey, it apparently has decreased at Morro Bay. It should be emphasized that all these are highly tentative conclusions requiring further study and statistical analysis to confirm.

DISCUSSION

Sex Length Differences

Sexual size dimorphism occurs commonly among the rockfish (Westrheim and Harling 1975; Archibald et al 1981; Wilson 1984; Wyllie Echeverria 1986; Lenarz and Wyllie Echeverria In press). Our data from the California trawl fishery support that conclusion, with females being more abundant than males in the large size classes in nine of 11 cases. It is noteworthy that the two species which failed to show such differences (S. aurora and S. chlorostictus), were the only rockfish that were not primary species at any port. Moreover, using the ecological classification advanced by Lenarz and Wyllie Echeverria (Lenarz and Wyllie Echeverria 1991), these two rockfishes are demersal in habit, whereas all the others are characteristically found up in the water column. They proposed that similarity in size of males and females among demersal species is related to territorial defense by males. Our study seems to support their findings. It has also been suggested that sexual size dimorphism confers a selective advantage to an organism if fecundity is related to size of females but not males for the species (Wyllie Echeverria 1986). Maximization of reproduction for females is best accomplished by increased size, while for males it is maximized by early onset of sexual maturity, thereby expending energy on reproduction rather than growth. Since all of the primary species showed sexual dimorphism, and the definition of a primary species was related to abundance in the fishery, the hypothesis that sexual dimorphism is favored through natural selection seems to be supported by our data.

Landings and Species Composition

Since 1982 there has been a steady decline in the California commercial rockfish fishery (Fig. 3). Strong regulations have been applied to the widow rockfish fishery in recent years to protect the stock. Much of this decline can be attributed to the "fishing-up" (Ricker 1975) of a large widow rockfish resource (Gunderson 1984). Additionally, catches of rockfish are sometimes strongly affected by market conditions, which can lead commercial fishermen to switch to other groundfish species, including Dover sole (Microstomus pacificus), and sablefish (Anoplopoma fimbria). These factors have served to reduce landings and thereby redirect fishing effort to alternate species (PFMC 1987). Consequently, it is impossible to adequately monitor the status of any given stock using total landings data

alone.

Age based approaches provide a powerful array of stock-assessment methods. However, they are labor intensive and in certain instances unreliable. Some species have proven difficult to age and age techniques must be validated before these methods can be routinely applied with confidence. Unfortunately, validation studies are expensive, time consuming, and have not been completed for most commercial species of rockfish.

The use of fishing effort to examine the status of the stocks is also problematic. Ordinarily some form of logbook data are required. Analyzing this information however, can be a difficult task; interpretation of effort data requires great care particularly for rockfish where mixed catches are common and determination of the target species is hard to accomplish.

Examination of species composition data can provide clues into the status of a fishery by showing how abundant certain species are in relation to others. In this study we observed that landings of S. paucispinis have declined in relation to S. goodei. These two species are frequently caught together and thus experience a high degree of "technological interaction" (Pope 1979). This supports the idea of an overall decline in the abundance of S. paucispinis. It could also mean that S. goodei has increased in abundance, or that greater targeting on S. goodei has occurred (Frank Henry, Calif. Dept. Fish and Game, Menlo Park, CA 94025, Pers. commun., Dec. 1989). Certainly some alterations in species composition have been due to switching behavior (i.e., targeting) on the part of the fleet. This is particularly true with regard to S. entomelas, which developed into a major and distinct midwater fishery between 1980 and 1982 (Gunderson 1984). Identification of changes in directed fishing effort is a major obstacle to the interpretation of the species composition data presented in this study.

Changes in Length

A change in the average size of fish in the landings can be brought about by many factors, biological and otherwise. Biological factors include, but are not limited to: alterations in mortality and growth rates, fluctuations in rates of recruitment, and changes in length-specific rates of immigration or emigration to the available stock. Non-biological factors can include instability in the spatial pattern of fishing activity, variation in targeting different species, and alterations in the intrinsic selective properties of the fishing gear.

When the average length declines, due either to a decrease in growth or to increases in natality or mortality, it signifies that the length structure of the stock is in disequilibrium. This need not, however, imply that the exploitation rate is

excessive. Unfished stocks of long-lived species, like members of the genus Sebastes, typically display somewhat stable length-frequency distributions when viewed over an extended period of time. During the very earliest stages of harvesting, the average size of fish that are vulnerable to the fishing gear remains relatively unchanged, regardless of the amount of fishing that occurs. However, the increase in mortality rate that arises due to fishing ultimately reduces the number of fish that survive to reach the largest size categories. This affect, over time, leads to a reduction in average length. A new equilibrium point will not be reached until vital rates remain unchanged for a period of time equal to the fishable lifespan (ignoring random fluctuations in recruitment and growth) (Beverton and Holt 1957). Then, if fishing pressure is not too great, the stock will reach a new equilibrium point and a new, stable length distribution will be reached. Many species are known to increase their rate of growth as population density goes down, a compensatory population response (Beverton and Holt 1957).

In this study we frequently observed declining trends in the average size of fish (Figs. 8-18). Some species showed a marked reduction in mean TL at virtually all ports examined (e.g., S. flavidus), whereas others appeared to be more stable (e.g., S. diploproa). One means of quantifying the extent to which length composition has changed is to calculate the percentage reduction in mean size that occurred during the 1978-88 time period. To accomplish this, the data were combined among all ports (Fig. 19) and, for each species-sex combination, a simple linear regression of mean annual total length on year was calculated. Percentage reduction was then estimated as $100(\hat{L}_{88} - \hat{L}_{78})/\hat{L}_{78}$, where $\hat{L}_{88}$ and $\hat{L}_{78}$ were predictions from the regression for 1988 and 1978, respectively. Using this approach we found that some species showed a substantial reduction in mean size (Fig. 22). The average size of S. flavidus and S. pinniger showed the largest declines. Species like S. crameri, S. entomelas, and S. paucispinis were intermediate in their response to exploitation. It should be noted that in the case of S. paucispinis, the strong overlying pattern of recruitment to the fishery of strong yearclasses makes it difficult to attribute changes in length distribution to exploitation. In the case of S. goodei, females showed a much sharper reduction in mean length than males. It is worth noting that sexual size dimorphism in this species is particularly strong (Fig. 2), and the percent of males in the landings appears to be increasing. This may indicate that the stock is experiencing a strong impact from fishing down of the females or possibly to increased targeting on males.

Further studies are underway at the Tiburon Laboratory to examine possible natural mortality rates and determine whether the observed changes may be due to excessive fishing preasure. The results presented in this paper are tentative but indicate the need for more research.

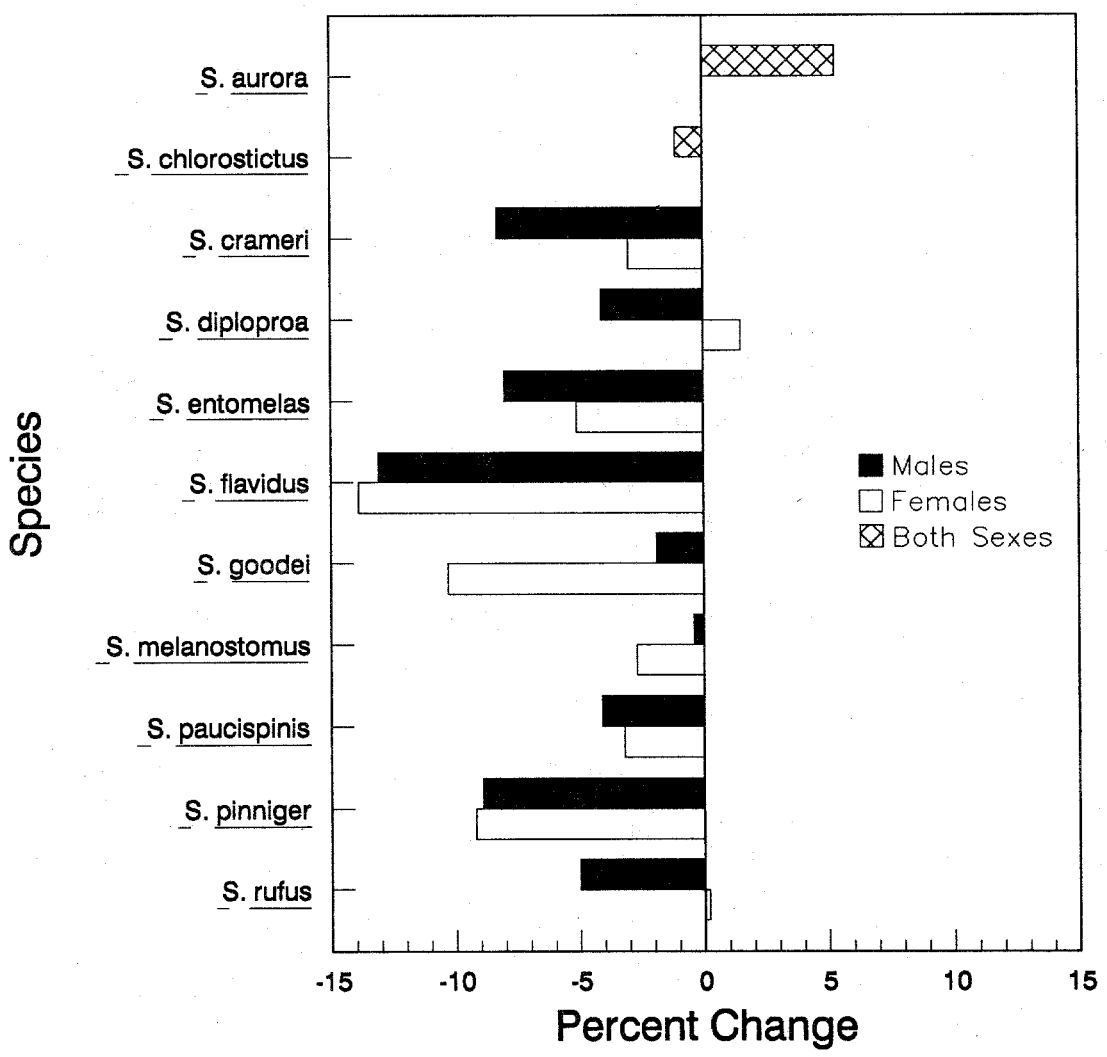

Figure 22. Percent reduction in mean total length from 1978 to 1988 for 11 species of rockfish. Data for all ports combined. Male and female lengths were combined for S. aurora and S. chlorostictus since lengths were found to be similar (Fig. 2).

SUMMARY

Total landings of 11 species of rockfish have declined since the peak years of 1980-82. The decline is strongest at Eureka and least at Fort Bragg. Eureka typically had the highest total landings and Morro Bay generally had the lowest.

Peak landing years for S. entomelas were quite similar among ports. Other species, particularly S. rufus and S. melanostomus show no similarity in peak landing years among ports.

Species composition has varied substantially among years. Sebastes entomelas and S. paucispinis constitute a smaller fraction of the total landings in recent years than during 1978-82. Sebastes goodei and S. crameri have increased in relative importance in recent years. Species composition is quite different among ports; however, S. entomelas and S. paucispinis are important at all six ports.

Most species showed a reduction in mean length during the 11 year study period with female S. flavidus, S. pinniger, and female S. goodei showing the sharpest declines. Strong declines in mean length were also observed for S. crameri, S. entomelas, and S. goodei. Changes in mean length were not uniform at all ports or between sexes. The reductions in mean length suggest that many of the stocks are not in equilibrium with fishing effort.

Most species tended to have a greater mean length the farther north they were caught. Monterey, although not the most southern port in the study, had the smallest mean length for seven of the 11 species included in the study.

ACKNOWLEDGEMENTS

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Appendix A. Actual number of male and female rockfish (Sebastes spp) measured at six ports during an 11 year commercial port sampling program in California. - indicates not sampled

S. aurora

	Morro Bay		Monterey		San Francisco		Bodega Bay		Fort Bragg		Eureka	
Year	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1978	-	-	1	1	0	0	-	-	5	12	1	0
1979	-	-	0	0	0	8	-	-	0	0	0	2
1980	2	3	0	0	0	1	-	-	2	2	7	18
1981	0	0	0	0	0	0	0	0	0	0	14	7
1982	0	2	13	17	0	0	4	4	2	2	22	30
1983	0	0	14	24	0	0	0	0	190	236	38	47
1984	2	11	4	2	0	0	0	0	137	143	62	68
1985	159	222	30	29	0	0	0	0	62	43	128	91
1986	22	22	22	17	0	0	0	0	40	71	213	191
1987	0	0	0	0	0	0	28	8	15	20	64	55
1988	4	4	76	65	0	0	19	0	10	6	32	12

S. chlorostictus

	Morro Bay		Monterey		San Francisco		Bodega Bay		Fort Bragg		Eureka	
Year	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1978	-	-	10	3	5	4	-	-	11	16	9	6
1979	-	-	2	0	1	2	-	-	13	8	10	4
1980	3	3	3	2	5	4	-	-	30	25	8	11
1981	1	1	0	0	0	1	0	0	14	26	16	17
1982	1	3	4	5	2	1	0	0	10	16	18	16
1983	7	12	0	3	1	0	0	0	25	26	30	12
1984	12	4	12	15	2	4	7	12	24	20	24	11
1985	38	49	21	23	6	7	4	6	38	29	33	36
1986	4	5	8	12	0	0	0	0	22	34	10	25
1987	7	9	0	0	0	0	23	6	43	25	13	11
1988	1	5	3	8	1	0	9	9	42	48	9	7

S. crameri

	Morro Bay		Monterey		San Francisco		Bodega Bay		Fort Bragg		Eureka	
Year	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1978	-	-	4	0	0	0	-	-	49	36	72	160
1979	-	-	0	4	0	1	-	-	36	18	15	17
1980	0	0	0	0	0	1	-	-	24	37	63	87
1981	0	0	0	1	0	0	0	0	12	28	52	114
1982	2	16	5	11	0	0	0	0	18	11	184	241
1983	18	41	14	30	0	0	0	0	105	115	205	271
1984	33	34	200	220	0	0	24	44	94	143	510	656
1985	134	123	177	241	14	11	57	55	182	214	807	962
1986	46	69	128	148	0	0	23	9	140	182	801	909
1987	24	33	4	9	9	2	50	41	88	64	1,225	1,096
1988	24	20	52	39	1	2	24	10	93	118	471	483

S. diploproa

	Morro Bay		Monterey		San Francisco		Bodega Bay		Fort Bragg		Eureka	
Year	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1978	-	-	79	105	22	16	-	-	130	116	59	41
1979	-	-	6	12	79	21	-	-	113	99	2	0
1980	6	5	0	0	30	49	-	-	59	39	11	15
1981	3	16	18	44	21	19	0	0	22	21	5	4
1982	34	47	41	139	58	72	0	0	31	40	35	50
1983	161	437	281	518	100	110	0	0	168	160	126	96
1984	237	601	238	497	150	196	41	80	493	483	309	385
1985	210	707	452	523	194	193	63	130	255	192	256	279
1986	32	83	219	216	8	22	8	3	178	276	218	282
1987	5	35	9	31	5	0	56	61	147	160	144	133
1988	11	31	86	110	0	0	31	22	23	36	27	27

S. entomelas

	Morro Bay		Monterey		San Francisco		Bodega Bay		Fort Bragg		Eureka	
Year	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1978	-	-	24	76	7	16	-	-	79	50	62	77
1979	-	-	6	33	2	12	-	-	9	14	124	236
1980	11	16	25	30	9	33	-	-	29	10	196	350
1981	17	30	36	57	69	26	327	382	26	29	277	470
1982	22	57	379	443	350	378	234	361	100	105	831	1,242
1983	54	31	257	303	42	39	121	169	130	230	600	877
1984	103	151	85	123	26	29	75	117	212	195	1,040	1,020
1985	55	55	246	273	94	143	133	170	73	167	926	903
1986	25	31	81	93	17	28	120	35	308	382	950	969
1987	62	33	50	67	55	25	128	62	527	464	804	789
1988	46	76	165	143	18	7	166	133	130	163	589	729

S. flavidus

	Morro Bay		Monterey		San Francisco		Bodega Bay		Fort Bragg		Eureka	
Year	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1978	-	-	3	2	6	3	-	-	3	1	92	71
1979	-	-	2	2	8	9	-	-	1	0	28	15
1980	0	16	5	11	5	8	-	-	15	7	34	33
1981	2	2	31	18	6	2	0	0	37	17	28	37
1982	7	1	4	43	2	1	3	2	27	30	78	110
1983	12	18	69	85	3	0	0	0	35	39	134	157
1984	10	14	18	17	23	26	22	31	14	20	358	356
1985	3	22	23	17	125	148	3	6	1	7	133	134
1986	14	11	48	46	31	65	6	3	17	27	84	103
1987	5	2	3	6	34	6	2	2	23	24	69	78
1988	6	7	84	78	0	0	6	8	46	47	17	21

S. goodei

	Morro Bay		Monterey		San Francisco		Bodega Bay		Fort Bragg		Eureka	
Year	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1978	-	-	316	361	68	167	-	-	123	493	23	97
1979	-	-	480	535	78	174	-	-	131	461	11	103
1980	71	136	120	206	117	258	-	-	169	483	15	45
1981	96	187	100	173	16	57	1	0	68	255	3	34
1982	80	214	389	719	44	130	6	33	97	290	58	204
1983	133	388	209	563	52	239	21	235	136	419	114	212
1984	673	936	268	1,297	283	514	139	199	144	549	57	214
1985	1,215	1,372	839	1,986	303	695	72	252	253	424	87	238
1986	294	592	696	1,532	94	295	48	90	221	534	140	277
1987	499	628	387	727	236	265	44	197	409	990	112	206
1988	693	841	665	1,092	104	122	104	246	304	624	98	155

S. melanostomus

	Morro Bay		Monterey		San Francisco		Bodega Bay		Fort Bragg		Eureka	
Year	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1978	-	-	28	42	0	0	-	-	1	2	0	0
1979	-	-	0	0	0	0	-	-	11	2	0	0
1980	2	6	6	1	0	0	-	-	13	9	0	0
1981	3	1	5	1	12	10	0	0	2	1	0	0
1982	10	6	27	61	10	3	9	6	11	22	0	0
1983	8	15	60	47	5	7	14	8	71	39	0	2
1984	39	41	113	48	4	6	9	23	30	36	0	2
1985	230	232	190	193	5	2	5	5	75	74	0	0
1986	116	131	177	240	0	0	7	6	44	42	5	5
1987	70	90	6	1	2	1	71	80	51	41	8	4
1988	238	250	74	64	0	0	56	51	21	17	26	39

S. paucispinis

	Morro Bay		Monterey		San Francisco		Bodega Bay		Fort Bragg		Eureka	
Year	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1978	-	-	317	421	234	214	-	-	290	268	34	50
1979	-	-	342	603	134	144	-	-	77	41	32	38
1980	211	291	124	143	164	167	-	-	211	242	106	127
1981	176	181	129	152	13	16	27	24	195	185	169	158
1982	216	148	418	489	182	171	44	43	146	163	370	434
1983	338	268	381	471	165	141	61	120	267	214	281	296
1984	456	405	315	248	298	220	146	132	131	107	218	180
1985	243	252	373	310	218	135	84	64	79	67	159	99
1986	249	389	656	756	88	65	37	7	170	133	123	86
1987	523	521	332	342	207	130	74	63	294	294	173	165
1988	296	311	531	671	53	27	98	84	235	159	59	48

S. pinniger

	Morro Bay		Monterey		San Francisco		Bodega Bay		Fort Bragg		Eureka	
Year	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1978	-	-	4	2	19	9	-	-	125	81	156	115
1979	-	-	9	1	1	1	-	-	76	24	48	32
1980	3	1	6	8	17	26	-	-	65	37	108	65
1981	3	7	3	0	0	0	0	0	28	27	70	71
1982	1	0	0	0	2	3	6	4	80	80	192	176
1983	2	6	1	4	2	1	10	11	84	57	163	154
1984	24	23	1	4	10	2	35	32	18	15	112	119
1985	11	13	7	11	21	20	50	37	63	53	116	76
1986	1	0	0	4	0	0	8	9	58	51	171	109
1987	1	4	0	0	1	0	13	6	72	81	84	67
1988	0	2	2	1	0	0	20	10	74	92	64	35

S. rufus

	Morro Bay		Monterey		San Francisco		Bodega Bay		Fort Bragg		Eureka	
Year	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1978	-	-	53	58	7	18	-	-	35	22	0	0
1979	-	-	1	0	0	0	-	-	2	0	3	4
1980	1	7	1	1	0	0	-	-	4	8	0	0
1981	43	51	45	62	0	0	0	0	40	24	1	2
1982	71	87	180	199	12	27	0	0	8	6	7	4
1983	184	272	121	101	34	28	2	1	86	113	20	21
1984	246	288	377	459	74	67	151	179	70	97	12	5
1985	336	389	269	308	162	157	226	143	7	9	10	7
1986	874	923	127	138	36	61	9	23	48	60	2	5
1987	443	478	198	213	22	14	28	44	13	13	16	29
1988	418	569	200	185	29	15	42	16	67	54	38	35

Appendix B. Estimated landing weight (standard tons) of rockfish (Sebastes spp.) at six ports as estimated by the California cooperative groundfish survey. - indicates not sampled

S. aurora

Year	Morro Bay	Monterey	San Francisco	Bodega Bay	Fort Bragg	Eureka
1978	-	2.0	0	-	2	0
1979	-	0	2.1	-	0	0.2
1980	3.2	0	0.7	-	0.2	1.4
1981	0	0	0	0	0	0.2
1982	1.0	5.9	0	3.4	0.1	7.6
1983	0	8.0	0	0	39.7	6.1
1984	0.3	0.8	0	0	10.6	10.0
1985	22.6	4.4	0	0	8.3	17.8
1986	10.9	6.1	0	0	6.8	27.5
1987	0	0	0	0.2	1.3	7.1
1988	1.0	12.4	0	1.5	1.4	6.5

S. chlorostictus

Year	Morro Bay	Monterey	San Francisco	Bodega Bay	Fort Bragg	Eureka
1978	-	7.3	9.2	-	10.3	9.6
1979	-	0	10.5	-	14.8	9.3
1980	2.0	4.3	3.0	-	8.4	6.1
1981	13.4	4.5	0.8	0	12.0	120.3
1982	0	1.1	8.9	0	29.3	21.0
1983	1.5	1.3	0.6	0	30.1	30.0
1984	2.3	6.6	3.7	6.5	27.9	16.0
1985	3.7	8.1	2.6	1.0	50.8	21.5
1986	1.5	2.9	0	0	16.4	6.4
1987	2.5	0	0.6	11.1	33.3	11.7
1988	1.0	2.7	0.6	102.9	33.2	6.3

S. crameri

Year	Morro Bay	Monterey	San Francisco	Bodega Bay	Fort Bragg	Eureka
1978	-	4.8	0	-	41.6	0
1979	-	0.2	1.9	-	14.6	82.2
1980	0	0	15.2	-	11.2	29.6
1981	0	0.4	0	0	191.5	120.3
1982	32.0	133.4	3.3	0	14.9	261.1
1983	23.0	18.1	0	0	242.8	206.7
1984	9.1	75.7	0	59.6	237.3	242.2
1985	16.3	57.5	14.6	119.5	242.2	533.8
1986	34.2	47.9	0	23.7	82.3	185.0
1987	10.4	5.9	17.3	68.2	31.5	1591.9
1988	14.4	2.4	1.8	7.9	130.8	625.6

S. diploproa

Year	Morro Bay	Monterey	San Francisco	Bodega Bay	Fort Bragg	Eureka
1978	-	119.7	0.1	-	20.5	8.1
1979	-	2.9	5.2	-	36.9	14.3
1980	7.1	0.9	585.6	-	9.4	3.7
1981	13.1	18.1	170.4	0	48.4	4.8
1982	13.2	173.2	44.0	0	4.2	14.7
1983	98.9	220.5	68.7	0	41.7	26.4
1984	47.9	152.3	99.6	38.7	104.3	90.9
1985	106.7	137.6	181.2	39.1	84.3	87.4
1986	30.6	80.8	7.2	3.2	34.2	41.6
1987	2.4	4.5	10.3	5.0	39.5	27.1
1988	3.3	10.9	0	9.1	22.2	17.4

S. entomelas

Year	Morro Bay	Monterey	San Francisco	Bodega Bay	Fort Bragg	Eureka
1978	-	10.2	20.2	-	120.4	402.4
1979	-	31.4	95.1	-	16.6	2419.6
1980	124.4	154.4	5.4	-	31.6	5858.0
1981	121.4	348.8	857.1	1103.9	164.2	3750.1
1982	93.9	905.5	2335.2	3622.4	308.7	3910.5
1983	25.3	160.4	55.6	1071.8	154.8	2666.0
1984	55.0	60.8	83.4	532.7	227.6	1973.1
1985	6.3	65.4	49.2	306.4	141.3	2228.0
1986	7.8	7.4	0.2	201.4	308.7	1582.5
1987	2.6	11.1	8.9	179.2	590.8	1434.0
1988	19.3	18.9	13.3	215.9	139.7	698.5

S. flavidus

Year	Morro Bay	Monterey	San Francisco	Bodega Bay	Fort Bragg	Eureka
1978	-	1.3	11.4	-	1.8	322.4
1979	-	0.8	101.6	-	0.1	59.4
1980	0.4	70.9	2.7	-	2.8	27.4
1981	16.7	108.4	120.2	0	115.2	241.3
1982	19.0	47.5	2.2	70.4	104.8	94.3
1983	28.9	11.2	6.0	0	92.9	311.8
1984	0.4	3.9	53.3	78.1	41.8	368.1
1985	1.3	2.0	24.2	5.4	3.5	171.7
1986	0	0.1	13.3	22.2	17.6	94.7
1987	0	0	0	3.1	34.4	155.5
1988	0	5.9	0	13.0	56.0	12.4

S. goodei

Year	Morro Bay	Monterey	San Francisco	Bodega Bay	Fort Bragg	Eureka
1978	-	282.1	431.4	-	505.3	186.8
1979	-	571.2	361.1	-	436.8	193.2
1980	408.6	965.0	763.9	-	1318.3	29.1
1981	408.9	455.2	985.6	0.5	528.5	225.1
1982	322.4	257.3	440.8	113.5	430.5	207.6
1983	177.1	338.6	274.8	816.0	392.4	198.4
1984	257.5	466.7	909.5	450.3	514.5	100.5
1985	246.9	569.8	501.0	276.4	296.4	102.3
1986	172.9	499.5	154.0	115.7	147.6	93.7
1987	146.2	431.6	441.2	58.8	457.1	83.4
1988	359.9	299.1	153.6	525.4	450.9	78.4

S. melanostomus

Year	Morro Bay	Monterey	San Francisco	Bodega Bay	Fort Bragg	Eureka
1978	-	63.6	0	-	2.9	0
1979	-	0	0	-	3.7	0
1980	18.1	42.3	0	-	2.4	0
1981	6.7	2.3	66.7	0	4.7	0
1982	6.0	169.5	6.3	9.9	14.0	0
1983	48.7	39.6	25.5	0	94.4	4.4
1984	9.2	15.1	9.9	12.3	8.2	0.5
1985	42.6	39.1	4.6	1.8	73.3	0
1986	67.0	59.2	0	21.4	11.9	0.9
1987	22.9	3.9	1.9	22.0	7.8	11.6
1988	169.5	10.6	0	10.7	6.4	46.5

S. paucispinis

Year	Morro Bay	Monterey	San Francisco	Bodega Bay	Fort Bragg	Eureka
1978	-	635.0	719.0	-	547.8	133.2
1979	-	1002.3	1001.7	-	95.5	63.1
1980	1044.9	1524.8	1002.5	-	338.9	113.5
1981	632.2	765.1	573.9	94.9	959.4	2038.0
1982	769.3	595.9	1108.9	348.4	771.8	545.4
1983	474.6	630.3	516.0	1181.0	1033.1	446.0
1984	241.5	587.1	1037.1	1192.5	528.3	193.8
1985	74.9	189.6	329.2	194.1	212.6	228.9
1986	129.0	481.6	122.0	81.8	178.2	97.6
1987	204.5	272.0	381.1	49.1	323.0	105.8
1988	211.6	233.1	97.2	332.5	291.1	81.5

S. pinniger

Year	Morro Bay	Monterey	San Francisco	Bodega Bay	Fort Bragg	Eureka
1978	-	7.6	53.9	-	231.3	418.6
1979	-	0.1	4.1	-	223.3	98.3
1980	6.3	6.9	67.5	-	137.8	147.1
1981	27.9	13.0	0	0	119.4	977.8
1982	1.5	0	6.1	18.9	219.8	400.0
1983	16.6	2.2	1.1	45.5	248.3	357.6
1984	0.5	1.7	22.8	97.1	36.1	232.5
1985	1.8	4.6	8.3	109.5	85.2	161.3
1986	0	0.9	0	34.0	41.1	97.3
1987	0	0	0	19.1	109.4	99.8
1988	0.1	0.3	0	61.3	60.9	73.0

S. rufus

Year	Morro Bay	Monterey	San Francisco	Bodega Bay	Fort Bragg	Eureka
1978	-	117.5	0.5	-	36.8	0
1979	-	0	0	-	0.5	60.0
1980	9.5	5.8	0	-	9.3	0
1981	125.7	127.4	0	0	220.6	0
1982	268.5	604.8	47.1	0	2.0	4.3
1983	228.6	80.8	55.3	0.3	424.1	32.2
1984	140.0	253.0	80.9	620.4	417.5	10.0
1985	52.3	111.9	236.6	423.3	32.8	12.7
1986	642.3	46.7	17.8	18.1	78.3	1.7
1987	171.8	45.0	45.4	87.8	17.8	72.2
1988	234.5	5.6	16.4	11.3	88.9	113.6

Appendix C. Estimated combined landing weight (standard tons) of 11 species of rockfish (genus Sebastes) landed at six ports during an 11 year port sampling program. - indicates not sampled

Year	Morro Bay	Monterey	San Francisco	Bodega Bay	Fort Bragg	Eureka
1978	-	1251.0	1245.6	-	1520.7	1481.1
1979	-	1608.9	1583.4	-	843.0	2999.6
1980	1624.5	2775.3	2447.0	-	1870.3	6215.9
1981	1366.0	1843.1	2774.6	1199.3	2365.3	7477.9
1982	1526.8	2894.1	4002.8	4187.0	1900.2	5466.5
1983	1123.2	1511.0	1003.5	3114.5	2795.9	4285.9
1984	763.7	1624.0	2300.1	3088.2	2154.4	3237.5
1985	575.4	1190.0	1351.5	1476.1	1230.9	3565.1
1986	1096.2	1233.2	314.5	521.5	925.5	2228.9
1987	563.3	774.0	906.8	503.6	1645.3	3600.1
1988	1014.7	601.9	282.9	1281.5	1281.7	1759.7

Appendix D. Sample standard deviations of mean length in 11 species of rockfish (Sebastes spp) measured at six ports during an 11 year commercial port sampling program in California. When fewer than 20 fish were measured the values were not computed. - indicates not sampled

S. aurora (sexes combined)

Year	Morro Bay	Monterey	San Francisco	Bodega Bay	Fort Bragg	Eureka
1978	-			-		
1979	-			-		
1980				-		2.37
1981						0.78
1982		3.03				3.36
1983		2.16			3.27	3.07
1984					2.47	3.00
1985		2.24			3.95	3.21
1986		2.38			2.38	2.43
1987					2.75	2.19
1988		2.26				2.23

S. chlorostictus (sexes combined)

Year	Morro Bay	Monterey	San Francisco	Bodega Bay	Fort Bragg	Eureka
1978	-			-	3.92	
1979	-			-	5.48	
1980				-	4.45	
1981					4.72	3.39
1982					6.10	5.14
1983					3.65	3.78
1984		2.85			4.54	5.36
1985		4.45			4.26	5.17
1986		4.57			4.49	5.68
1987					4.72	5.11
1988					4.71	

S. crameri

	Morro Bay		Monterey		San Francisco		Bodega Bay		Fort Bragg		Eureka	
Year	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1978	-	-	0.90				-	-	2.40	3.80	4.43	6.06
1979	-	-					-	-	5.14			
1980							-	-	3.61	3.78	2.35	5.75
1981									1.56	3.17	2.35	4.40
1982											4.36	5.17
1983		3.06		1.77					2.61	3.97	4.31	4.88
1984	2.14	3.27	2.50	2.54			1.58	6.74	3.32	3.15	3.93	5.41
1985	3.47	5.51	2.46	5.03			5.09	3.06	3.54	5.27	3.63	4.86
1986	2.30	2.55	2.24	2.99			3.82		2.65	3.99	3.56	5.04
1987	3.44	5.03					4.83	4.94	3.42	4.74	2.38	3.07
1988	4.19	4.77	3.03	5.10			4.28		3.02	4.63	2.54	3.21

S. diploproa

	Morro Bay		Monterey		San Francisco		Bodega Bay		Fort Bragg		Eureka	
Year	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1978	-	-			1.84		-	-	2.53	2.50	2.23	3.01
1979	-	-			3.29	4.12	-	-	3.32	2.26		
1980					6.53	2.84	-	-	2.76	2.60		
1981			1.45	2.51	2.15	1.90			2.94	1.96		
1982	8.54	2.60	1.90	2.46	1.87	2.40			4.08	3.44	3.96	2.71
1983	2.19	2.82	2.15	2.16	2.41	2.67			2.22	2.15	7.05	3.81
1984	2.70	2.53	2.19	2.62	2.76	2.87	2.07	2.75	2.64	2.57	2.41	2.94
1985	1.46	2.56	2.19	2.37	2.03	2.49	3.18	3.24	2.76	2.60	2.29	2.78
1986	2.08	2.02	2.22	2.58		0.50			2.27	2.74	2.34	2.89
1987		3.74		4.43			3.07	1.25	2.71	3.25	3.44	4.25
1988		2.88	2.11	2.68			2.18	2.25	1.72	2.97	2.40	3.37

S. entomelas

	Morro Bay		Monterey		San Francisco		Bodega Bay		Fort Bragg		Eureka	
Year	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1978	-	-	2.87	2.06			-	-	3.42	3.52	2.59	4.14
1979	-	-		2.98			-	-			2.19	2.86
1980			2.18	2.72		3.44	-	-	1.01		2.49	2.55
1981		4.41	3.58	4.39	2.32	4.13	3.33	4.25	2.99	3.45	2.41	3.08
1982	4.60	5.64	3.42	5.55	2.67	3.82	2.34	3.33	2.58	3.73	3.15	4.40
1983	1.37	2.97	3.51	5.06	1.88	1.96	1.84	2.78	3.31	5.26	3.78	5.40
1984	3.09	4.80	2.95	4.27	3.55	3.49	3.45	4.41	2.63	4.13	3.48	5.22
1985	1.78	5.69	3.07	4.80	3.70	4.34	2.61	4.20	3.11	5.37	2.79	4.28
1986	1.84	3.27	3.01	3.07		2.02	2.55	2.82	4.23	5.64	3.12	4.43
1987	1.43	2.50	2.34	4.13	2.16	3.46	2.08	3.04	2.63	3.95	3.12	4.30
1988	2.13	3.42	4.52	4.62			2.81	3.94	4.74	5.47	3.42	4.70

S. flavidus

	Morro Bay		Monterey		San Francisco		Bodega Bay		Fort Bragg		Eureka	
Year	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1978	-	-					-	-			3.88	4.64
1979	-	-					-	-			3.36	
1980							-	-			2.82	3.79
1981			1.36	2.65					2.60		2.23	4.43
1982				3.85					2.14	2.70	5.67	6.21
1983			2.78						3.10	4.10	3.23	4.73
1984			2.28		2.46	2.70				4.19	3.22	4.28
1985			1.24	5.69	2.24	2.41					3.91	4.96
1986			3.36	4.99	3.37	2.39				3.91	4.98	7.34
1987					3.51				4.52	5.55	3.44	4.18
1988			2.11	5.01					4.36	4.35		5.33

S. goodei

	Morro Bay		Monterey		San Francisco		Bodega Bay		Fort Bragg		Eureka	
Year	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1978	-	-	3.85	6.38	3.76	4.35	-	-	4.49	4.36	1.95	5.22
1979	-	-	2.94	6.91	5.21	5.15	-	-	4.28	3.57		4.22
1980	3.76	4.05	2.64	5.28	1.81	5.39	-	-	2.58	5.52		3.04
1981	2.20	3.67	2.58	4.91		3.50			2.72	4.34		5.21
1982	1.88	4.23	3.13	5.51	2.33	3.90		3.25	2.42	5.75	2.42	4.45
1983	2.41	5.23	2.78	4.67	7.55	4.18	1.99	3.62	3.39	5.45	4.08	6.47
1984	2.24	4.63	2.87	4.17	3.19	4.88	2.47	5.04	4.13	4.92	2.31	6.15
1985	2.20	4.49	2.66	4.57	1.95	5.00	3.57	3.67	3.21	5.31	2.85	5.98
1986	2.45	4.44	2.63	4.45	3.23	4.22	4.30	4.39	2.74	4.50	2.74	5.53
1987	2.65	6.50	2.79	3.39	2.59	5.52	4.22	5.46	2.95	6.29	2.95	6.74
1988	2.56	4.64	2.82	4.34	2.07	4.99	3.25	5.54	3.20	5.10	3.20	6.36

S. melanostomus

	Morro Bay		Monterey		San Francisco		Bodega Bay		Fort Bragg		Eureka	
Year	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1978	-	-	3.35	3.54			-	-				
1979	-	-					-	-				
1980							-	-				
1981												
1982			2.09	3.46						4.00		
1983			3.27	5.06					3.43	3.65		
1984	4.37	5.26	4.03	5.51				3.15	2.60	6.10		
1985	3.52	5.92	4.46	6.21					3.24	4.51		
1986	3.21	4.52	3.41	4.80					6.04	7.22		
1987	4.46	6.63					4.36	6.04	3.43	5.15		
1988	2.96	4.23	2.95	4.67			4.02	4.19	3.17			

S. paucispinis

	Morro Bay		Monterey		San Francisco		Bodega Bay		Fort Bragg		Eureka	
Year	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1978	-	-	8.19	8.62	6.13	6.41	-	-	6.52	9.75	6.65	11.64
1979	-	-	8.93	10.05	6.71	10.44	-	-	7.86	10.35	8.94	14.54
1980	5.86	8.22	6.31	8.53	7.41	13.24	-	-	3.21	5.62	7.25	8.42
1981	4.45	6.92	6.19	6.05			4.61	5.77	4.32	6.05	7.16	4.43
1982	4.95	6.82	6.51	8.75	6.26	9.70	7.25	8.99	4.21	5.46	6.13	6.72
1983	5.42	7.85	5.45	7.80	4.75	7.55	5.36	8.67	5.62	8.81	6.06	7.57
1984	4.89	6.42	5.74	8.81	4.81	7.40	4.81	8.13	4.57	6.88	4.09	6.02
1985	6.19	9.22	8.13	12.43	5.30	8.13	5.57	6.98	4.20	5.60	2.68	5.52
1986	8.00	9.45	4.57	5.80	5.65	8.01	7.64		7.74	10.62	5.82	6.06
1987	5.65	6.27	4.13	4.71	4.12	4.86	6.70	8.47	7.99	10.11	7.20	11.25
1988	5.19	7.42	4.39	6.66	3.13	5.21	4.49	4.40	6.51	7.56	6.12	10.26

S. pinniger

	Morro Bay		Monterey		San Francisco		Bodega Bay		Fort Bragg		Eureka	
Year	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1978	-	-					-	-	3.73	5.87	4.58	5.12
1979	-	-					-	-	2.55	2.79	6.31	4.56
1980							-	-	3.01	2.44	3.36	4.49
1981									3.93	7.36	3.26	4.93
1982									9.40	11.02	4.61	5.37
1983									4.73	6.92	5.59	6.38
1984							3.07	6.13			5.64	7.00
1985							7.51	4.35	6.77	5.28	4.54	6.15
1986									4.35	5.45	3.82	5.47
1987									5.55	7.58	3.59	3.79
1988							4.51	2.39	4.36	5.45	4.19	5.90

S. rufus

	Morro Bay		Monterey		San Francisco		Bodega Bay		Fort Bragg		Eureka	
Year	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1978	-	-	1.92	5.07			-	-	2.88	3.00		
1979	-	-					-	-				
1980							-	-				
1981	3.32	3.78	1.99	3.24					3.50	3.12		
1982	3.76	4.99	2.34	3.22		3.40						
1983	3.58	4.45	3.38	5.21	2.47	3.68			2.69	3.61		
1984	3.51	4.91	2.72	3.77	3.03	3.45	3.31	4.17	2.52	3.80		
1985	3.42	4.84	3.25	5.11	3.63	4.81	2.84	4.36				
1986	2.80	3.99	3.45	5.72	2.92	6.69		5.03	2.76	4.31		
1987	4.07	5.58	3.32	3.27	3.40		3.34	4.15				
1988	3.41	4.72	2.53	4.25	2.70		3.74		3.31	4.12		

Appendix E. Median length of 11 species of rockfish (Sebastes spp) measured at six ports during an 11 year commercial port sampling program in California. Medians are shown only when 20 or more fish were measured. - indicates not sampled

S. aurora (sexes combined)

Year	Morro Bay	Monterey	San Francisco	Bodega Bay	Fort Bragg	Eureka
1978	-			-		
1979	-			-		
1980				-		34
1981						34
1982		28				34
1983		31			32	34
1984					32	34
1985		30			31	33
1986		30			32	33
1987					32	32
1988		31				35

S. chlorostictus (sexes combined)

Year	Morro Bay	Monterey	San Francisco	Bodega Bay	Fort Bragg	Eureka
1978	-			-	39	
1979	-			-	41	
1980				-	40	
1981					39	43
1982					32	41
1983					39	42
1984		35			41	42
1985		34			41	40
1986		31			42	43
1987					39	44
1988					40	

S. crameri

	Morro Bay		Monterey		San Francisco		Bodega Bay		Fort Bragg		Eureka	
Year	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1978	-	-	31				-	-	38	41	38	40
1979	-	-					-	-	41			
1980							-	-	38	43	38	40
1981									40	42	38	43
1982											37	37
1983		43		40					38	42	39	42
1984	38	39	37	40			40	43	38	43	37	41
1985	36	38	37	40			40	45	37	40	35	37
1986	35	36	38	40			33		37	40	35	37
1987	38	40					36	42	35	38	37	39
1988	35	39	35	39			38		37	38	37	38

S. diploproa

	Morro Bay		Monterey		San Francisco		Bodega Bay		Fort Bragg		Eureka	
Year	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1978	-	-			29		-	-	29	32	32	35
1979	-	-			30	32	-	-	31	34		
1980					30	32	-	-	31	35		
1981			30	33	32	34			32	34		
1982	32	29	27	31	28	32			37	33	31	35
1983	28	30	28	31	30	33			31	33	32	34
1984	28	30	29	31	30	33	31	35	31	33	31	34
1985	26	29	28	31	28	32	30	35	30	33	31	33
1986	27	29	28	31		35			30	33	31	34
1987		33		33			34	35	30	32	31	32
1988		33	30	31			31	32	31	34	31	35

S. entomelas

	Morro Bay		Monterey		San Francisco		Bodega Bay		Fort Bragg		Eureka	
Year	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1978	-	-	43	49			-	-	44	46	44	44
1979	-	-		44			-	-			44	47
1980			42	46		49	-	-	45		44	47
1981		45	43	46	43	47	43	47	45	49	44	49
1982	44	48	42	45	42	48	44	48	44	49	44	48
1983	43	50	38	42	43	47	44	50	42	49	42	45
1984	44	45	39	41	42	49	41	47	44	48	40	41
1985	42	42	40	41	43	45	43	46	44	48	39	41
1986	42	48	42	39		41	42	44	41	42	41	43
1987	41	48	41	39	41	42	43	47	42	45	42	45
1988	34	34	40	46			45	49	42	48	42	47

S. flavidus

	Morro Bay		Monterey		San Francisco		Bodega Bay		Fort Bragg		Eureka	
Year	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1978	-	-					-	-			47	55
1979	-	-					-	-			47	
1980							-	-			45	54
1981			43	44					45		47	50
1982				47					46	50	44	46
1983			41						45	43	44	45
1984			41		43	46				49	43	45
1985			39	48	43	47					43	46
1986			40	45	45	43				47	42	46
1987					44				40	43	40	42
1988			41	44					39	38		49

S. goodei

	Morro Bay		Monterey		San Francisco		Bodega Bay		Fort Bragg		Eureka	
Year	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1978	-	-	34	35	36	46	-	-	38	48	37	48
1979	-	-	34	36	37	45	-	-	38	50		49
1980	36	44	34	40	36	41	-	-	34	40		52
1981	36	44	35	41		44			37	47		52
1982	35	44	35	44	37	44		49	35	48	37	51
1983	36	45	34	43	37	45	37	47	37	46	38	51
1984	37	44	34	41	36	43	37	47	38	46	37	49
1985	36	41	34	40	36	42	40	48	36	42	37	45
1986	36	44	34	40	34	39	39	48	36	44	35	47
1987	36	41	32	34	35	39	36	36	32	41	38	43
1988	35	36	32	36	35	37	35	39	33	38	33	38

S. melanostomus

	Morro Bay		Monterey		San Francisco		Bodega Bay		Fort Bragg		Eureka	
Year	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1978	-	-	45	47			-	-				
1979	-	-					-	-				
1980							-	-				
1981												
1982			41	41						44		
1983			41	43					43	47		
1984	45	46	41	42				53	44	43		
1985	42	46	41	43					42	45		
1986	41	43	41	44					47	47		
1987	41	44					41	48	42	48		
1988	41	42	41	43			43	49	43			

S. paucispinis

	Morro Bay		Monterey		San Francisco		Bodega Bay		Fort Bragg		Eureka	
Year	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1978	-	-	50	50	49	51	-	-	55	58	62	67
1979	-	-	42	39	51	54	-	-	57	52	60	62
1980	44	45	44	45	47	46	-	-	41	45	45	48
1981	46	48	46	48			46	52	48	49	42	47
1982	50	51	50	53	49	52	49	55	51	56	51	54
1983	51	55	50	54	51	54	55	59	54	58	52	54
1984	51	55	52	59	54	60	55	61	55	59	55	59
1985	53	56	52	53	56	62	58	63	57	61	55	61
1986	44	42	38	40	40	40	41		58	63	58	64
1987	45	45	42	44	43	45	46	49	45	47	56	49
1988	48	50	46	47	43	46	49	51	48	50	51	52

S. pinniger

	Morro Bay		Monterey		San Francisco		Bodega Bay		Fort Bragg		Eureka	
Year	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1978	-	-					-	-	50	51	51	57
1979	-	-					-	-	52	56	51	55
1980							-	-	47	46	51	56
1981									47	45	50	54
1982									46	46	51	51
1983									47	52	51	51
1984							51	53			50	50
1985							51	59	43	43	49	50
1986									46	47	46	49
1987									41	45	47	50
1988							48	51	41	42	48	50

S. rufus

	Morro Bay		Monterey		San Francisco		Bodega Bay		Fort Bragg		Eureka	
Year	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1978	-	-	37	39			-	-	42	46		
1979	-	-					-	-				
1980							-	-				
1981	37	39	40	42					41	44		
1982	41	46	41	42		38						
1983	41	43	41	42	41	42			43	46		
1984	40	42	41	45	40	42	44	48	43	46		
1985	40	40	41	42	40	44	43	48				
1986	38	40	41	43	39	45		46	42	44		
1987	39	41	37	38	39		43	47				
1988	37	37	36	38	36		40		41	43		

Appendix F. Estimated number (thousands) of 11 species of rockfish (genus Sebastes) by sex (unknown sex are shown in parentheses) at six ports during an 11 year port sampling program. 0 indicates less than 50 estimated, - indicates not sampled

S. aurora

	Morro Bay		Monterey		San Francisco		Bodega Bay		Fort Bragg		Eureka	
Year	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1978	-	-	2.0	2.0	0	0	-	-	1.6	3.4	0	0
1979	-	-	0	0	0	4.3	-	-	0	0	0.1	0.1
1980	3.2	4.7	0	0	0	1.4	-	-	0.2	0.2 (0.1)	0.6	0.8
1981	0	0	0	0	0	0	0	0	0	0	0	0.3
1982	0	2.0	0.6	20.5	0	0	5.4	2.3	0.2	0	7.8	11.3
1983	0	0	4.8	11.6	0	0	0	0	23.8	32.7	5.9	4.0
1984	0.2	0.4	0.8	0.6	0	0	0	0	8.2	12.5	6.8	8.6
1985	22.6	28.3	4.7	4.4	0	0	0	0	6.6	4.9	16.4	12.7
1986	5.8	18.3	4.2	8.0	0	0	0	0	3.6	8.5	22.8	21.0
1987	0	0	0	0	0	0	0.2	0	0.8	1.8	8.9	4.5
1988	1.7	0.9	11.8	12.7	0	0	2.3	0	1.1	0.8	7.7	2.2

S. chlorostictus

	Morro Bay		Monterey		San Francisco		Bodega Bay		Fort Bragg		Eureka	
Year	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1978	-	-	5.9	1.4	5.3	1.8	-	-	3.9	4.5	4.8	2.3
1979	0	-	0	0	0.8	9.0	-	-	10.0	4.0	3.1	3.3
1980	1.5 (0.5)	0.6	4.7 (1.2)	2.0	0	3.0	-	-	2.7	3.7 (0.4)	2.9	1.3 (0.4)
1981	4.6	2.0	0 (9.1)	0	0	0.6	0	0	0.5	8.7	40.0	36.9
1982	0	-	0.6	1.1	6.2	1.6	0	0	26.0	34.8	7.3	9.8
1983	0.3	1.0	0	1.2	0.4	0	0	0	10.2	14.0	18.7	5.7
1984	1.2	0.1	2.1	4.7	3.1	1.5	1.5	7.8	11.7	12.7	9.0	4.5
1985	1.5	2.1	4.2	5.9	1.9	0.5	0.3	0.5	19.8	12.0	6.8	10.7
1986	0.5	0.9	1.9	2.8	0	0	0	0	5.4	6.4	2.6	2.2
1987	1.6	1.7	0	0	0	0 (0.4)	10.1	2.5	19.1	10.0	3.5	4.7
1988	0	1.6	0 (0.3)	1.9	1.1	0	64.9	74.5	11.6	14.4	3.9	3.6

S. crameri

Year	Morro Bay Male	Morro Bay Female	Monterey Male	Monterey Female	San Francisco Male	San Francisco Female	Bodega Bay Male	Bodega Bay Female	Fort Bragg Male	Fort Bragg Female	Eureka Male	Eureka Female
1978	-	-	0.7	0 (4.6)	0	0	-	-	20.8	17.8	4.7	8.1
1979	-	-	0	0 (0.1)	0	9.0	-	-	8.5	3.9	42.5	24.7
1980	0	0	0	0	0	30.1 (0.3)	-	-	3.0	5.9 (0.1)	15.4	21.0 (1.2)
1981	0	0	0	0.2	0	0	0	0	68.9	90.3	27.9	68.5 (2.7)
1982	8.1	30.1	45.3	97.1	0	0 (3.5)	0	0	64.1	24.5	93.7	184.3
1983	8.3	20.2	4.8	12.6	0	0	0	0	91.0	120.3	73.5	102.8
1984	4.2	4.7	31.0	38.3	0	0	14.3	25.9	67.2	134.1	91.2	134.6
1985	8.4	7.0	23.6	29.5	6.2	6.2	33.6	43.4 (2.9)	98.1	92.3	252.9	315.9
1986	13.0	30.6	22.6	23.9	0	0	14.5	6.3	32.1	44.0	84.4	111.0
1987	2.9	6.1	3.0	2.6	5.8	1.7 (8.0)	25.8	25.7 (3.0)	18.1	13.6	861.3	856.5
1988	7.2	7.0	1.5	1.2 (0.2)	0.7	0.7	3.5	5.1	49.2	68.6	327.1	363.4

S. diploproa

Year	Morro Bay Male	Morro Bay Female	Monterey Male	Monterey Female	San Francisco Male	San Francisco Female	Bodega Bay Male	Bodega Bay Female	Fort Bragg Male	Fort Bragg Female	Eureka Male	Eureka Female
1978	-	-	113.4	157.0 (8.9)	0.1	0.1	-	-	19.8	20.4	7.4	6.1
1979	-	-	1.1	3.0 (3.7)	8.0	2.2	-	-	42.2	22.0	19.0	0
1980	7.9	7.9	0	0 (1.9)	230.1	608.3	-	-	18.2	3.4 (0.9)	3.0	3.9
1981	6.9	34.1 (1.1)	6.8	23.6	154.7	147.7	0	0	70.6	75.5 (0.1)	5.0	2.0
1982	12.2	20.2 (0.1)	46.6	289.9 (4.6)	41.9	50.3	0	0	11.5	5.4	13.4	8.9
1983	76.3	123.8	134.8	317.7 (0.1)	53.1	59.9	0	0	40.3	36.1	16.8	19.3
1984	32.2	76.4	90.5	222.0	73.5	110.2 (1.9)	17.2	43.9	86.8	97.3	58.4	95.5
1985	65.0	190.1	129.0	157.1 (0.3)	193.6	175.9	16.8	56.9	67.9	48.0	63.1	87.2
1986	18.3	51.0	90.5	104.3 (1.1)	0	9.6	2.1	0.9	24.0	37.7	26.7	40.5
1987	0.5	4.4	4.3	4.2	1.9 (18.2)	0	4.0	3.5	39.6	37.8	29.0	23.5
1988	0.7	5.9	12.7	10.2	0	0	7.2	6.2	13.5	22.2	13.6	13.7

S. entomelas

Year	Morro Bay Male	Morro Bay Female	Monterey Male	Monterey Female	San Francisco Male	San Francisco Female	Bodega Bay Male	Bodega Bay Female	Fort Bragg Male	Fort Bragg Female	Eureka Male	Eureka Female
1978	-	-	2.7	2.9 (1.3)	3.7	11.2	-	-	53.9	29.4	151.3	148.3
1979	-	-	2.9	19.2	9.0	48.3	-	-	2.1	6.8	491.4	1131.4
1980	35.0 (0.3)	44.4	78.3	94.8 (8.2)	1.6	1.8	-	-	20.4	1.1 (0.2)	1296.2	2208.6 (563.3)
1981	29.3	65.1	102.5	163.3	491.5	214.1	393.2	430.6 (1.5)	47.7	67.1	864.3	1643.8
1982	37.6	66.7	430.5	341.2 (1.4)	1441.4	3056.0	918.3	1502.7 (1.2)	120.2	92.5	1024.8	1670.8
1983	7.3	9.4	78.6	81.8 (0.4)	25.9	13.8	220.1	443.9	32.1	70.0 (0.6)	981.7	1260.7 (32.1)
1984	18.7	20.6	23.1	32.1	29.1	28.4	112.7	245.7 (4.4)	92.1	78.1	939.6	931.2
1985	2.7	2.1	30.3	30.7 (0.2)	18.6	21.0	96.3	126.4	20.2	40.7	1167.3	968.3
1986	3.0	2.6	3.3	5.7 (0.1)	0	0.4	149.4	38.8	116.2	176.2	733.9	676.5
1987	0.6	1.0	2.5	6.9	3.0	2.1 (0.7)	103.3	30.8 (2.5)	267.5	201.8	562.5	525.6
1988	12.0	18.3	6.9	9.0	6.4	2.7	67.1	70.2	34.9	60.9	264.9	300.4

S. flavidus

Year	Morro Bay Male	Morro Bay Female	Monterey Male	Monterey Female	San Francisco Male	San Francisco Female	Bodega Bay Male	Bodega Bay Female	Fort Bragg Male	Fort Bragg Female	Eureka Male	Eureka Female
1978	-	-	0	0.6	4.7	2.4	-	-	0.7	0.6	108.4	76.0
1979	-	-	0.4	0.4	33.2	33.2	-	-	0.1	0	20.9	16.3
1980	0	0.3	8.7	38.7 (9.1)	0.4	3.4	-	-	1.5	0.6	4.4	8.7 (1.1)
1981	2.7	5.9	61.9	19.2	103.4	17.1	0	0	47.8	29.1	37.3	93.5
1982	8.9	13.4	15.4	17.0	1.4	1.2	1.5	3.3	36.9	33.2	26.9	44.0
1983	1.9	13.9	4.8	4.5	2.6	0	0	0	30.2	26.4	125.2	140.4
1984	0	0.2	1.9	2.3	17.9	19.3	21.1	25.5	10.8	14.4	111.0	162.7
1985	0.2	0.8	0.5	0.9	9.9	6.9	0.6	2.9	0.4	1.2	57.4	54.1
1986	0	0	0.1	0	3.2	6.5	6.2	4.1	2.4	8.1	38.0	38.6
1987	0	0	0	0	0	0	1.0	1.0	15.7	12.7	75.6	57.7
1988	0	0	2.5	2.1	0	0	3.1	4.7	27.6	21.6	3.0	5.0

S. goodei

Year	Morro Bay Male	Morro Bay Female	Monterey Male	Monterey Female	San Francisco Male	San Francisco Female	Bodega Bay Male	Bodega Bay Female	Fort Bragg Male	Fort Bragg Female	Eureka Male	Eureka Female
1978	-	-	217.5	221.4 (55.4)	89.0	263.4	-	-	77.3	304.3	55.7	93.4
1979	-	-	566.6	481.2 (38.9)	64.3	314.8	-	-	34.5	261.6	14.5	137.6
1980	209.6	331.9 (3.5)	357.7	716.5 (13.8)	292.3	638.7	-	-	864.9	775.1 (7.4)	2.5	10.0 (6.2)
1981	110.7	358.8	167.8	333.9 (1.1)	227.6	749.8 (1.7)	1.0	0	54.4	369.3	2.6	111.7 (30.9)
1982	78.0	253.1	80.7	198.3	145.0	401.9	11.4	81.5	56.8	274.6	43.3	107.3
1983	50.7	152.4 (2.8)	126.1	311.9	30.2	194.4	37.3	477.3 (4.5)	89.5	274.7	52.0	112.7
1984	106.5	189.8	81.3	453.1	356.1	651.1 (1.3)	132.3	265.3 (4.2)	66.1	371.5	20.6	62.3
1985	176.3	145.4	256.1	491.1 (1.4)	180.5	361.0	31.4	166.3	96.5	167.1	35.1	59.8
1986	79.3	107.2	292.9	419.2 (3.7)	101.7	89.3 (0.6)	18.0	68.1	40.0	105.1	20.8	55.5
1987	93.0	97.4	287.9	580.8 (18.7)	86.2	99.7	17.1	53.9	174.9	415.1	26.3	59.5
1988	260.2	294.6	180.4	179.9 (49.0)	97.6	111.7	145.9	449.5	198.9	383.6	33.1	60.9

S. melanostomus

Year	Morro Bay Male	Morro Bay Female	Monterey Male	Monterey Female	San Francisco Male	San Francisco Female	Bodega Bay Male	Bodega Bay Female	Fort Bragg Male	Fort Bragg Female	Eureka Male	Eureka Female
1978	-	-	9.3	27.3	0	0	-	-	0.4	0.8	0	0
1979	-	-	0	0	0	0	-	-	5.5	0.1	0	0
1980	3.2	9.5	11.8	2.0 (2.0)	0	0	-	-	0.8	0.6 (0.2)	0	0
1981	3.3	1.1	1.8	0.5	26.0	25.7	0	0	0.2	0.1	0	0
1982	3.0	0	93.3	54.5	6.6	1.8	25.3	49.2	361.3	330.2	0	0
1983	11.7	7.9	16.7	16.5	11.2	5.8	9.2	5.3	42.5	21.3	0	0
1984	4.3	1.9	8.0	4.7	1.6	7.4	1.6	4.3	3.8	2.4	0	0.3
1985	16.5	14.3	15.0	15.7	2.0	0.8	0.7	0.4	23.6	24.9	0	0
1986	24.5	30.8	17.9	28.2	0	0	6.0	10.3	4.1	2.9	0.4	0.4
1987	7.7	9.4	1.7	0.4 (1.4)	1.0	0.4	8.0	7.2	3.0	2.3	4.1	2.1
1988	69.9	83.3	5.8	3.3	0	0	4.1	3.9	1.9	1.7	19.4	18.9

S. paucispinis

	Morro Bay		Monterey		San Francisco		Bodega Bay		Fort Bragg		Eureka	
Year	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1978	-	-	193.7 (40.3)	187.9	274.5	169.3	-	-	150.4	106.8	12.4	26.5
1979	-	-	336.6 (154.7)	471.5	265.8	349.0	-	-	34.7	12.6	18.0	16.9
1980	455.3 (6.3)	592.8	469.3 (28.9)	463.5	325.5	229.2	-	-	204.4 (2.6)	93.0	23.5 (6.0)	52.0
1981	226.6	236.9	273.5 (15.0)	334.7	84.9	180.2	40.4 (2.8)	31.3	328.1	332.6	904.2	697.1
1982	311.3	236.9	169.0	186.5	522.0 (4.5)	400.2	85.6	103.4	173.0	226.8	170.0	129.0
1983	138.2	95.1	145.6	200.5	101.0	120.7	104.9	268.4	201.1	214.6	107.1	127.5
1984	72.2	62.6	170.1	115.2	259.1	200.0	233.9	209.9	114.4	108.9	49.4	39.1
1985	17.2	19.8	66.8 (0.2)	48.7	86.5	48.0	39.5	29.0	35.0	25.1	57.8	39.3
1986	40.0	60.3	330.9 (8.2)	303.6	71.4 (0.8)	63.6	26.0	11.8	37.3	32.2	24.1	14.8
1987	78.0	81.2	144.6 (1.2)	146.9	73.4	55.2	19.4	10.9	90.9	103.2	27.9	26.3
1988	71.5	67.8	76.0 (0.8)	112.8	46.1	28.0	116.8	92.2	100.1	71.7	22.2	15.7

S. pinniger

	Morro Bay		Monterey		San Francisco		Bodega Bay		Fort Bragg		Eureka	
Year	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1978	-	-	2.7	0.7	45.8	4.0	-	-	62.5	48.6	117.1	65.9
1979	-	-	0	0.2	4.1	0	-	-	75.8	17.8	22.6	19.4
1980	1.5	4.1	5.9	6.9	29.9	37.8	-	-	25.4	42.5 (1.1)	34.8 (8.8)	20.5
1981	6.8	10.7	10.9	0	0	0	0	0	42.1	31.2	161.1	266.6
1982	19.6	43.5	0	0	3.0	2.1	5.7	3.4	96.3	74.4	121.8	67.8
1983	1.6	2.1	0.6	1.2	0.8	0.5	13.6	7.7	81.2	48.0	107.1	73.0
1984	0.3	0.3	0.4	0.8	9.4	1.9	19.6	24.3	16.3	5.9	52.2	69.4
1985	0.5	0.8	0.7 (0.3)	2.8	3.5	3.2	25.8	20.9	24.8	25.6	37.7	42.7
1986	0	0	0	0.6	0	0	8.3	8.3	13.4	11.4 (0.2)	32.5	22.5
1987	0	0	0	0	0	0	6.6	2.8	35.0	33.8	30.8	23.5
1988	0	0.3	0.1	0.1	0	0	6.0	23.1	22.6	25.7	26.6	12.5

S. rufus

Year	Morro Bay Male	Morro Bay Female	Monterey Male	Monterey Female	San Francisco Male	San Francisco Female	Bodega Bay Male	Bodega Bay Female	Fort Bragg Male	Fort Bragg Female	Eureka Male	Eureka Female
1978	-	-	24.3	98.5	0.1	0.3	-	-	20.6	9.2	0	0
			(19.3)									
1979	-	-	0.8	0	0	0	-	-	0.7	0	20.5	30.0
1980	3.0	7.0	2.3	3.5	0	0	-	-	1.2	2.5	0	0
									(1.6)			
1981	66.8	71.7	47.2	56.5	0	0	0	0	97.4	69.0	0	0
			(5.9)									
1982	284.9	487.5	272.9	218.6	21.6	47.3	0	0	0.9	0.5	3.2	0.5
			(7.2)									(0.1)
1983	106.6	165.7	43.3	30.7	23.7	19.8	0.7	0	119.8	146.6	8.0	11.4
	(1.1)											
1984	49.6	676.7	87.4	122.6	40.1	34.7	173.5	200.1	123.2	159.8	3.2	3.4
			(0.8)									
1985	25.8	26.5	51.6	47.8	92.5	94.7	138.7	124.5	5.1	4.6	4.0	2.8
	(0.6)							(0.5)				
1986	359.7	364.5	21.3	19.5	5.8	7.4	0.1	11.8	27.7	28.4	0.1	0.8
	(0.3)		(0.6)		(0.6)							
1987	78.1	88.1	27.5	27.0	9.3	4.6	19.6	32.8	6.4	6.1	12.7	38.0
1988	123.3	153.8	2.8	3.9	15.2	7.5	7.3	3.6	36.8	30.4	45.1	45.2
			(0.3)		(12.0)							

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