NOAA Technical Memorandum NMFS-AFSC-42

# The 1992 Pacific West Coast Bottom Trawl Survey of Groundfish Resources: Estimates of Distribution, Abundance, and Length Composition

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

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September 1994

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## ABSTRACT

The 1992 Alaska Fisheries Science Center West Coast triennial bottom trawl survey was conducted to assess stocks of groundfish inhabiting the continental shelf waters off the coasts of California, Oregon, Washington, and British Columbia. This was the sixth survey in an ongoing series to monitor long-term trends in the distribution and abundance of these groundfish populations.

The objectives of the 1992 survey were similar to those of the 1989 survey; however, the survey design shifted emphasis away from estimating rockfish abundance, as had been the case in the early surveys (1977, 1980, 1983, and 1986), and instead emphasized assessing a broader range of groundfish species. The design also focused upon precisely estimating the near-bottom component of the Pacific hake (Merluccius productus) and juvenile (age 1+) sablefish (Anoplopoma fimbria) resource. The survey encompassed the coastal waters from Pt. Conception, California, to central Vancouver Island, British Columbia (34°30′-49°40′N lat.), between the depths of 55 and 366 m. A total of 569 stations were occupied, of which 501 were successfully sampled. Catches included 135 different species.

Survey design and the methods used are described, the data collected are summarized, and the results of analyses of distribution, abundance, and biological parameters are presented. Data on water temperature, catch composition, relative abundance, and geographic distribution are reported. Estimates of biomass,

population abundance, and length composition are also presented. Data appendices are located in a separate companion volume.

CONTENTS

Introduction . . . . . 1
Survey Methods . . . . . 4
Survey Period and Sampling Area . . . . . 4
Vessels and Sampling Gear . . . . . 5
Trawl Station Allocation . . . . . 8
Trawling Procedures . . . . . 10
Catch Sampling and Oceanographic Data Collection . . . 10
Data Analyses . . . . . 12
Results . . . . . 13
Haul, Catch, and Biological Data . . . . . 13
Temperature Data . . . . . 20
Relative Abundance . . . . . 26
Biomass and Population Estimates . . . . . 59
Length Composition . . . . . 73
Length-Weight Relationships . . . . . 105
Additional Data and Studies . . . . . 108
Acknowledgments . . . . . 109
Citations . . . . . 110

# INTRODUCTION

In 1992, the sixth in an ongoing series of groundfish assessment surveys of the continental shelf resources off the coasts of California, Oregon, Washington, and British Columbia was carried out by the Resource Assessment and Conservation Engineering (RACE) Division of the Alaska Fisheries Science Center (AFSC). These bottom trawl surveys, initiated in 1977 and repeated triennially, were designed to provide resource managers with fishery-independent data about the distribution, abundance, and biological characteristics of several commercially important species, particularly Pacific hake (Merluccius productus, also known as Pacific whiting), sablefish (Anoplopoma fimbria), and many of the shelf rockfish species. Hydroacoustic surveys of the off-bottom component of the Pacific hake population were performed in conjunction with these bottom trawl surveys by the hydroacoustic task group of the RACE Division.

The first of these bottom trawl surveys, conducted in 1977 (Gunderson and Sample 1980), sampled between Pt. Hueneme, California, (34°00'N lat.) and the U.S.-Canada border in depths ranging from 91 to 457 m (50-250 fm). The sampling effort was stratified by depth and latitude according to fishery catch information. The following two surveys, conducted in 1980 (Coleman 1986) and 1983 (Weinberg et al. 1984), emphasized obtaining better biomass estimates of canary (Sebastes pinniger) and yellowtail rockfish (S. flavidus), while maintaining the goals of a multi-species monitoring program. In 1980, strata

were adjusted and sampling depths shifted to cover the 55-366 m depth interval (30-200 fm), while the latitudinal boundaries extended from Monterey Bay, California (36°48′N lat.) to northern Vancouver Island, British Columbia (50°00′N lat.). This survey design and survey area was repeated in 1983 but only extended as far north as Vancouver Island's Estevan Point (49°15′N lat.). The results of the 1980 and 1983 surveys indicated the need for further work to improve the precision of canary and yellowtail rockfish abundance estimates. Consequently, in 1986 the sampling effort was reallocated to concentrate on the 92-219 m depth interval north of 42°35′N lat., where canary and yellowtail rockfish were thought to be most abundant (Coleman 1988). Results of these first four surveys were also used to examine trends in the distribution and abundance of 14 of the more commercially important groundfish species (Dark and Wilkins 1994) and rockfish community structure and species assemblages (Weinberg 1994).

Despite efforts to improve the precision of rockfish abundance estimates over the first four iterations of the triennial survey, the large variances of the estimates remained a problem. We concluded that precise estimates of rockfish abundance were not possible using current trawl survey methods and that higher priority should be given to obtaining the information that the survey methods can provide well. Consequently, beginning in 1989 the triennial bottom trawl survey was designed to monitor a broad range of demersal species and

also focus on providing precise estimates of Pacific hake and pre-recruit sablefish abundance. The specific objectives of the 1992 survey were

1) to describe and assess the demersal component of the Pacific hake resource;
2) to describe and assess the abundance of the pre-recruit component of sablefish, specifically those 1.5 years old because the abundance of these pre-recruits estimated from trawl survey data has been shown to be consistent with that inferred from commercial catch levels;
3) to monitor the status of other important groundfish stocks;
4) to determine the biological characteristics (e.g., size and age compositions, size at maturity, length/weight relationships and feeding habits) of key groundfish species;
5) to continue studies on the movement of juvenile sablefish through tagging;
6) to collect oceanographic data describing habitat, including sea temperature and salinity profiles; and
7) to collect samples requested for special studies conducted by scientists at various fishery agencies and academic institutions.

This report documents the survey design and field procedures used, summarizes the data collected, and presents the results of the standard RACE analyses. Included are summaries of catches, relative densities, distributions, and estimates of biomass, population abundance, and size compositions for selected species. Age compositions are not reported here because analyses of the age structures were not complete at the time of publication. For the sake of brevity, our discussion concentrates on the primary target species of this survey, Pacific hake and sablefish, in the areas of most concern to management. Unabridged printouts of the results of analyses, which include numerous species, are available upon request as appendices bound in a separate volume. Selected data files and files containing results of analyses (e.g., size composition and age composition when complete) can also be obtained upon request.

## SURVEY METHODS

### Survey Period and Sampling Area

The 1992 survey was conducted from 12 July to 7 October, matching the time period of previous triennial surveys. Operations began off Pt. Conception, California, and proceeded northward to central Vancouver Island off Clayoquot Sound (34°30′-49°40′ N lat.). We sampled stations between the depths of 55 and 366 m (30-200 fm). As during the 1989 survey, the survey area was extended farther south than most of the previous triennial surveys to facilitate detection of concentrations of

juvenile Pacific hake and sablefish. Stations in Canada were sampled to help estimate density at the northern limit of the Pacific hake distribution and to collect more complete data sets on transboundary stocks such as yellowtail rockfish, Pacific ocean perch (Sebastes alutus), and lingcod (Ophiodon elongatus).

## Vessels and Sampling Gear

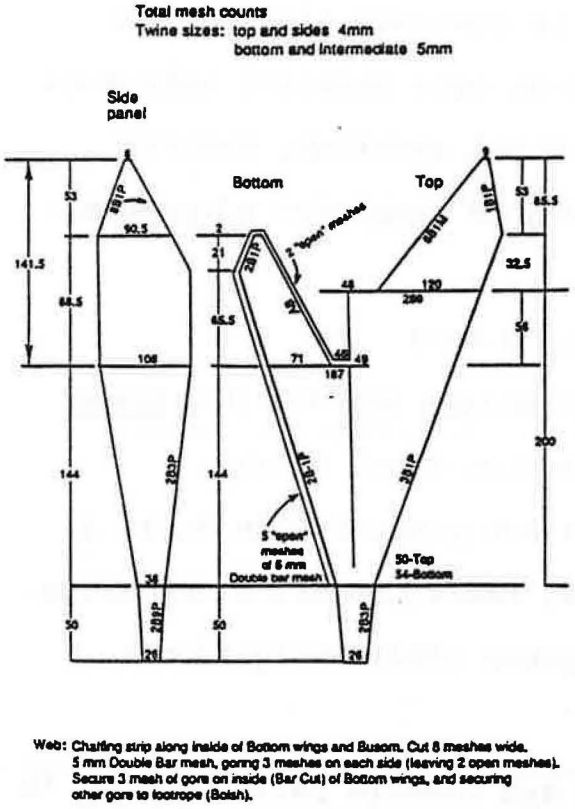
Two commercial trawlers, the R/V Alaska and the F/V Green Hope, were chartered to conduct the bottom trawl survey. Pertinent details about these vessels are presented in Table 1. Each vessel was equipped with dual net reels, modern electronics, and Loran C and Global Positioning System (GPS) navigational aids.

Table 1.--Attributes of the net used and vessels participating in the 1992 triennial West Coast groundfish survey.

| Vessel | Vessel length | Horse-power | Mean net width | Survey period Start | Finish |
|---|---|---|---|---|---|
| Alaska | 30.5 m | 855 | 12.75 m | 20 Aug. | 13 Oct. |
| Green Hope | 30.7 m | 565 | 12.51 m | 12 July | 5 Oct. |

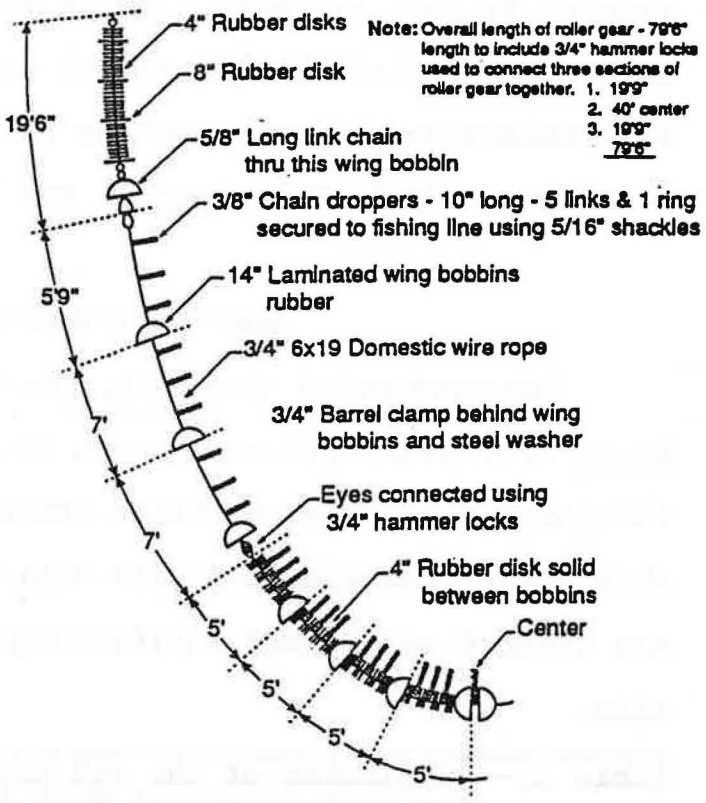
The standard RACE high-opening Nor'eastern trawl, constructed of polyethylene mesh and equipped with bobbin roller gear, was used aboard both vessels throughout the 1992 survey (Fig. 1). This trawl has a 27.2 m headrope and a 37.4 m footrope. All trawls were rigged consistently with RACE survey gear standards employing three 55 m dandylines (1.59 cm steel

## Poly Nor'Eastern trawl




Web: Chafing strip along inside of Bottom wings and Busom. Cut 8 meshes wide. 5 mm Double Bar mesh, gaining 3 meshes on each side (leaving 2 open meshes). Secure 3 mesh of gore on inside (Bar Cut) of Bottom wings, and securing other gore to footrope (Bolsh).

## Roller gear




Note: Overall length of roller gear - 79'6" length to include 3/4" hammer locks used to connect three sections of roller gear together. 1. 19'9" 2. 40' center 3. 19'9" 79'6"

| | | |
|---|---|---|
| Netting | - | Polyethylene, 5 inch, 4 mm and 5 mm twine. 4 mm top and sides. 5 mm bottom and intermediate. |
| Headrope | - | 88' 1" plus thimbled eyes of 1/2" 6 x 19 galvanized wire rope wrapped with 3/8" 3-strand polypropylene rope. |
| Footrope (Bolsh Line) | - | 81' 7" plus thimbled eyes of 3/8" 6 x 19 galvanized wire rope wrapped with polypropylene rope. |
| Fishing Line | - | 79' 7 1/2" shot pressed long link chain. Safe working load 11,300 lbs. |
| Roller gear | - | 79' 6" eye to eye of 3/4" diameter, 6 x 19 galvanized wire rope with 14" bobbins. |
| Breastlines | - | 3/8" 6 x 19 galvanized wire rope wrapped with 3/8" polypropylene. Top corner 19' 6"; bottom corner 8' 8"; top side panel 19' 6"; bottom side panel 30' 6". Over all lengths are "plus" thimbled eye at wing tips. |
| Riblines | - | 3/4" Sampson Z and 1 Duraline. Top two 114.17' and bottom two 104.45' (hang 98% of stretched seam length). Web secured to riblines using Beasels every 16". |
| Flotation | - | 90 pieces, 8" aluminum XX Deep Sea water floats. |
| Restrictors | - | Polypropylene rope, 1" diameter, 14 ft circumference and secured loosely to codend at each ribline, 4 ft apart, 5 pieces. |
| Splitting gear | - | 1/2" diameter galvanized wire rope, 21 ft long. The wire is passed through 4 galvanized steel rings which are secured to each ribline. |
| Side seams | - | Panels are joined to each other gathering 3 meshes (4 knots) from each panel. Panels which are secured to framing lines have a selvaged edge created by gathering 3 meshes. |
| Codend | - | 110 meshes long x 100 meshes deep. 3 1/2" stretched (including 1 knot) 4 mm Double Bar mesh. |
| | | A) Chafing gear - 5 1/2" 6 mm Double Bar mesh with hula skirt secured to Chaffer. Full coverage of codend. |
| Codend liner | - | Nylon, no. 18, 1 1/4" stretched mesh, 313 meshes circumference and 300 meshes deep, laced to the inside of codend. When stretched the liner protrudes 2 to 3 ft beyond codend. |

*Note: Chafing strip along inside of Bottom wings and Busom.

Figure 1.--The sampling trawl and accessories used during the 1992 West Coast triennial bottom trawl survey.

cable) connected to each wing and fished with 2.1 x 1.5 m steel V-doors weighing approximately 567 kg each.

Measurements of the trawl's horizontal opening (wingtip to wingtip) were collected during most tows using a SCANMAR net mensuration system. Mean net widths were calculated for each trawl haul. The overall mean path width of trawl hauls by the Alaska was 12.75 m (range 10.9-14.9 m). The overall mean path width of trawl hauls by the Green Hope was 12.51 m (range 9.5-16.1 m). In those instances when horizontal measurements were unavailable, the average net width (m) was estimated using the following relationships (C. Rose, Alaska Fish. Sci. Cent., pers. commun., Oct., 1993):

Alaska

$$\text{Net width} = 14.56 + S_x - 258.034/S - 1.294\ V$$

Green Hope

$$\text{Net width} = 12.344 + 0.007\ S_x - 77.444/D$$

where: $S_x$ = excess scope (m) = S - 16.516 + 1.966 D

S = scope = wire out (m)

V = speed (m/s)

D = depth (m).

The above equations were derived by multiple regression analysis of a set of variables known to be important in determining the horizontal opening of the net (Rose 1993).

## Trawl Station Allocation

A systematic-random design was used to allocate sampling effort in accordance with the primary survey objectives: to estimate the abundance of Pacific hake and juvenile sablefish while maintaining the broader multi-species assessment goal. The entire survey area was fitted with a sampling framework similar to the low-density levels used in prior surveys. Four bands of latitude were identified from recent fishery statistics and survey results as having higher than average densities of age 1+ sablefish. These areas were designated "high-density" strata and were sampled at a higher rate. The boundaries of these high-density strata were 34°30′-35°40′, 36°50′-38°00′, 44°40′-46°30′, and 47°50′-48°20′ N lat. (Fig. 2).

The survey area was further divided into two depth strata separated by the 183 m contour (100 fm); Pacific hake and juvenile sablefish catch rates decline significantly outside this contour. Tracklines were then laid across the shallow (55-183 m) and deep (184-366 m) depth strata at intervals of 18.5 km. In the four high-density strata, additional tracklines were placed halfway between the 18.5 km tracklines across the shallow depth stratum only. Stations were randomly located along tracklines at the rate of one station per 7.4 km in the shallow stratum and one station per 9.3 km in the deep stratum. At least one station was assigned to each depth stratum along each trackline segment. A total of 601 stations were established. The two vessels fished alternate tracklines (alternate pairs in the high-density areas)

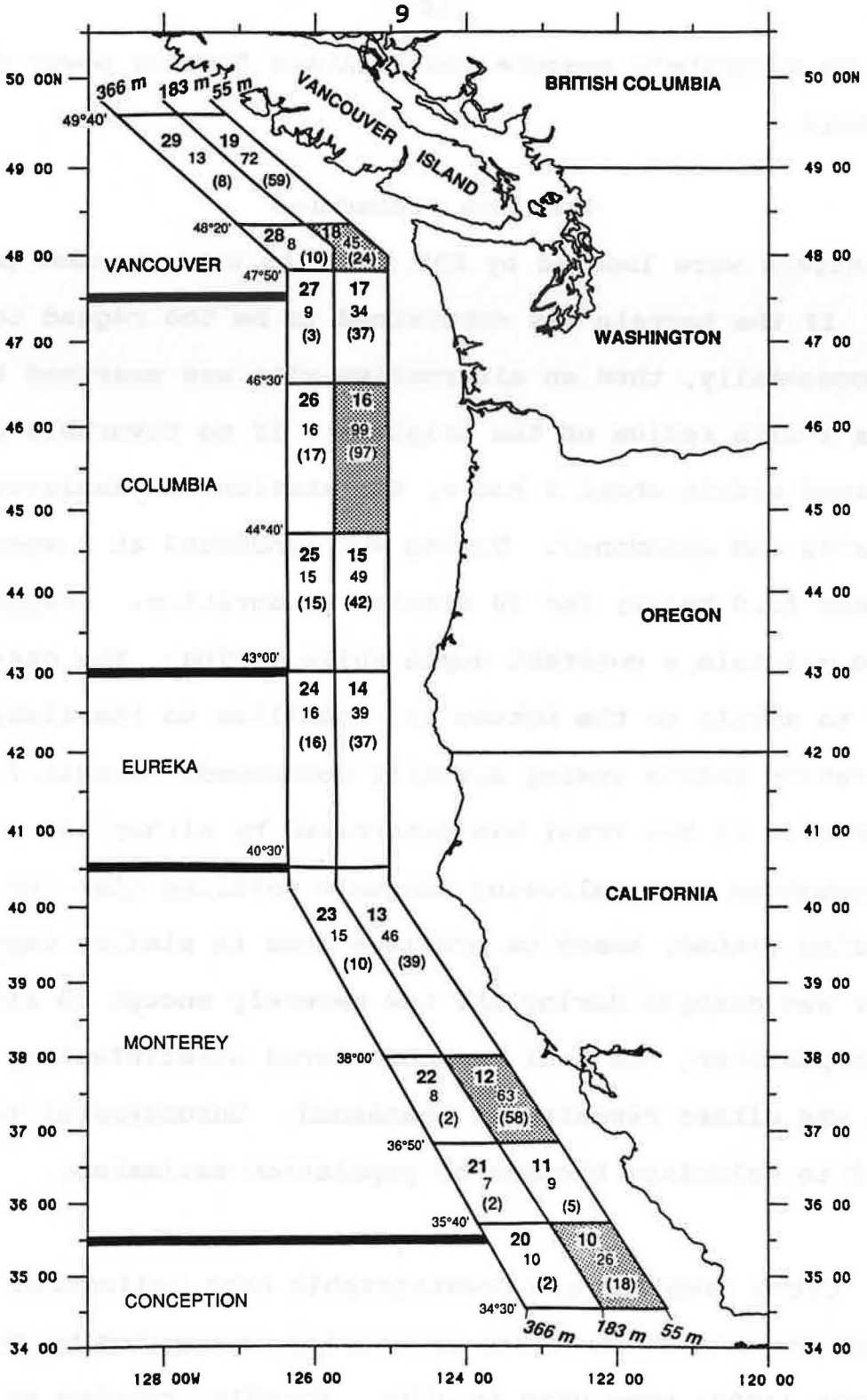



Figure 2.--The 1992 West Coast triennial bottom trawl survey area and station allocation. The number of successfully completed stations are shown in parentheses. International North Pacific Fisheries Commission statistical areas are also shown.

to help us accurately measure the relative fishing power of the two vessels.

## Trawling Procedures

Stations were located by GPS and then echo sounded prior to towing. If the terrain was determined to be too rugged to tow upon successfully, then an alternative site was searched for within a 1-mile radius of the original. If no favorable ground was located within about 2 hours, the station was declared untrawlable and abandoned. Towing was conducted at a speed of 1.54 m/sec (3.0 knots) for 30 minutes in duration. Skippers tried to maintain a constant depth while towing. The gear was allowed to settle to the bottom and stabilize to its fishing configuration before towing actually commenced. Stable fishing configuration of the trawl was determined by either the SCANMAR instrumentation or by allowing adequate settling time for the depth being fished, based on previous tows in similar depths. If the gear was damaged during the tow severely enough to affect catch composition, the haul was considered unsatisfactory and the station was either repeated or abandoned. Unsuccessful tows were not used to calculate biomass or population estimates.

## Catch Sampling and Oceanographic Data Collection

The procedures for catch processing documented by Gunderson and Sample (1980) were used in 1992. Briefly, catches which fit on the sampling table (about 1 metric ton (t)) were processed entirely, while larger catches were either weighed by an

electronic load cell (up to 4.5 t), or measured volumetrically. In all cases, catches greater than 1 t were subsampled using the method described by Hughes (1976). Catches were then sorted by species, weighed, and enumerated. Fork length measurements (cm) were obtained by sex for primary and secondary target species[1] whenever they were caught. Lengths were also taken for other major components of the catch when time allowed.

Otoliths used for age determination, along with individual specimen weight and maturity data, were collected from a variety of species. Collections for Pacific hake and sablefish were stratified by length interval (5 otoliths/sex/cm) for biological subareas. Collections for canary and splitnose rockfish (S. diploproa) were stratified by larger size intervals for the entire survey area. Random collections were made for yellowtail, canary, and shortbelly (S. jordani) rockfish, and Pacific ocean perch. We collected stratified samples of individual fish weights (5 observations/sex/cm from each state and from Canada) for several commercially important species. Outside requests for meristic data, and for samples of stomach contents, fin rays, tissues, and whole fish were also fulfilled.

In 1992, more comprehensive collection of oceanographic data was undertaken. Surface temperatures were taken by bucket thermometer and bottom temperatures were measured with net-

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[1]Primary target species are Pacific hake and sablefish. Secondary target species are Dover sole, rex sole, English sole, arrowtooth flounder, Pacific ocean perch, yellowtail rockfish, canary rockfish, bocaccio, chilipepper, and lingcod.

mounted data loggers at virtually every station. Temperature and salinity profiles of the water column were collected at selected stations along each trackline sampled by the Green Hope with a Seabird CTD (conductivity, temperature, and depth) probe. CTD casts were made at the deepest station in the deep stratum and alternately at the shallowest and deepest station in the shallow stratum.

## Data Analyses

Several analyses are performed routinely on RACE survey data. These include:

1) estimation of relative abundance,
2) estimation of population biomass,
3) estimation of population numbers, and
4) estimation of the population's size composition.

We used the area-swept method as described by Gunderson and Sample (1980) to estimate population biomass and numbers. Briefly, this method entails standardizing samples from each station into catch per unit effort (CPUE) in terms of either kilograms or numbers per hectare trawled (kg/ha, no./ha) and calculating the arithmetic mean for each sampling stratum. Relative abundance (mean CPUE) computed for International North Pacific Fisheries Commission (INPFC) areas and for the total survey is the sum of sampling stratum mean CPUEs weighted by their respective areas. Population biomass and numbers are defined as the sum of the stratum mean CPUEs multiplied by the

stratum areas. In cases where our sampling stratum boundaries overlap more than one INPFC area, we expand the overall sampling stratum mean CPUE to the area of that portion of the sampling stratum within the INPFC area.

Length-frequency data were weighted by CPUE (nos./ha) and expanded to the total estimated population abundance to estimate the population size composition for each species. As with abundance estimates, stratum estimates were summed to derive the estimated size compositions for individual INPFC areas and for the total survey. Selected size composition estimates will be applied to age-length keys to obtain estimated age compositions, when the age data is available.

## RESULTS

### Haul, Catch, and Biological Data

During 1992, 501 of the 601 stations were successfully sampled within the 55-366 m depth bounds. Forty-four tows were unsuccessful due to damaged trawls, 34 stations were abandoned due to untrawlable bottom, and 7 stations were not attempted due to time constraints. In a detailed analysis of trawl performance following the survey, 24 hauls that had previously been considered successful were found to have not stayed in contact with the bottom for most or all of the duration of the haul. These hauls were pronounced unsuccessful. Sampling density

ranged from 5.8 to 13.3 hauls per 1,000 $km^2$ in the shallow strata and from 0 to 14.9 hauls per 1,000 $km^2$ in the deep strata (Table 2). Overall, the average sampling density was slightly higher in the shallow strata (9.9 hauls per 1,000 $km^2$) than in the deep (8.3 hauls per 1,000 $km^2$) strata. Figure 3 shows the location of successful tows by depth stratum.

A total of 135 fish species representing 45 fish families were identified over the course of the survey (Table 3). Members from several additional families were taken but identified only to genus. Table 3 also lists the frequencies of occurrence, depth ranges and the range of distribution by latitude for all fish species identified in trawl samples. The greatest number of species taken (n=41) belonged to the rockfish (Scorpaenidae) family, followed by the flatfishes (Pleuronectidae) with 14, and the sculpins (Cottidae) with 10 species. The number of length measurements of individual fish are reported by INPFC area and depth stratum in Table 4, and the number of specimens collected for other samples are reported in Table 5. A total of 1,666 juvenile sablefish were tagged and released during the survey. Appendix A, located in the separate, but companion Data Appendices volume to this Technical Memorandum, summarizes the catch data by haul for each vessel.

Table 2.--The sampling strata boundaries used for analyses, stratum areas ($km^2$), and sampling density (hauls/1,000 $km^2$) based on successful tows during the 1992 triennial west coast groundfish survey. Strata have been grouped according to International North Pacific Fisheries Commission (INPFC) management areas. Differences in totals are due to rounding.

| | Shallow stratum (55-183 m) | | | | Deep stratum (184-366 m) | | | |
|---|---|---|---|---|---|---|---|---|
| Latitude bounds | Code | Area | No. hauls | Hauls/ 1,000 $km^2$ | Code | Area | No. hauls | Hauls/ 1,000 $km^2$ |
| **Vancouver** | | | | | | | | |
| 48°20′-49°40′ | 19 | 8,338.8 | 59 | 7.1 | 29 | 1,141.8 | 8 | 7.0 |
| 47°50′-48°20′ | 18 | 2,294.3 | 24 | 10.5 | 28 | 864.7 | 10 | 11.6 |
| 47°30′-47°50′ | 17 | 1,032.7 | 9 | 8.7 | 27 | 124.8 | 1 | 8.0 |
| 47°30′-49°40′ | -- | 11,665.4 | 92 | 7.9 | -- | 2,131.0 | 19 | 8.9 |
| **Vancouver (Canada only)** | | | | | | | | |
| 48°20′-49°40′ | 19 | 7,976.2 | 53 | 6.6 | 29 | 872.2 | 6 | 6.9 |
| Border-48°20′ | 18 | 171.5 | 1 | 5.8 | 28 | 77.5 | 1 | 12.9 |
| Border-49°40′ | -- | 8,147.4 | 54 | 6.6 | -- | 949.7 | 7 | 7.4 |
| **Vancouver (U.S. only)** | | | | | | | | |
| 48°20′-Border | 19 | 362.5 | 6 | 16.6 | 29 | 269.6 | 2 | 7.4 |
| 47°50′-48°20′ | 18 | 2,122.8 | 23 | 10.8 | 28 | 786.8 | 9 | 11.4 |
| 47°30′-47°50′ | 17 | 1,032.7 | 9 | 8.7 | 27 | 124.8 | 1 | 8.0 |
| 47°30′-Border | -- | 3,518.1 | 38 | 10.8 | -- | 1,181.3 | 12 | 9.8 |
| **Columbia** | | | | | | | | |
| 46°30′-47°30′ | 17 | 3,378.1 | 28 | 8.3 | 27 | 411.9 | 2 | 4.9 |
| 44°40′-46°30′ | 16 | 6,014.3 | 97 | 16.1 | 26 | 2,118.7 | 17 | 8.0 |
| 43°00′-44°40′ | 15 | 6,250.3 | 42 | 6.7 | 25 | 1,508.1 | 15 | 9.9 |
| 43°00′-47°30′ | -- | 15,642.8 | 167 | 10.7 | -- | 4,038.7 | 34 | 8.4 |
| **Eureka** | | | | | | | | |
| 40°30′-43°00′ | 14 | 4,090.8 | 37 | 9.0 | 24 | 1,076.3 | 16 | 14.9 |
| 40°30′-43°00′ | -- | 4,090.8 | 37 | 9.0 | -- | 1,076.3 | 16 | 14.9 |
| **Monterey** | | | | | | | | |
| 38°00′-40°30′ | 13 | 4,724.3 | 39 | 8.3 | 23 | 1,112.3 | 10 | 9.0 |
| 36°50′-38°00′ | 12 | 3,735.2 | 58 | 15.5 | 22 | 493.9 | 2 | 4.0 |
| 35°40′-36°50′ | 11 | 712.4 | 5 | 7.0 | 21 | 293.9 | 2 | 6.8 |
| 35°30′-35°40′ | 10 | 142.0 | 2 | 14.1 | 20 | 108.4 | 0 | 0 |
| 35°30′-40°30′ | -- | 9,313.9 | 104 | 11.2 | -- | 2,008.6 | 14 | 7.0 |
| **Conception** | | | | | | | | |
| 34°30′-35°30′ | 10 | 1,200.1 | 16 | 13.3 | 20 | 983.7 | 2 | 2.0 |
| 34°30′-35°30′ | -- | 1,200.1 | 16 | 13.3 | -- | 983.7 | 2 | 2.0 |
| **1992 Totals** | | | | | | | | |
| Canada total | -- | 8,147.4 | 54 | 6.6 | -- | 949.7 | 7 | 7.4 |
| U.S. total | -- | 33,765.3 | 362 | 10.7 | -- | 9,288.2 | 78 | 8.4 |
| Total area | -- | 41,913.1 | 416 | 9.9 | -- | 10,237.9 | 85 | 8.3 |

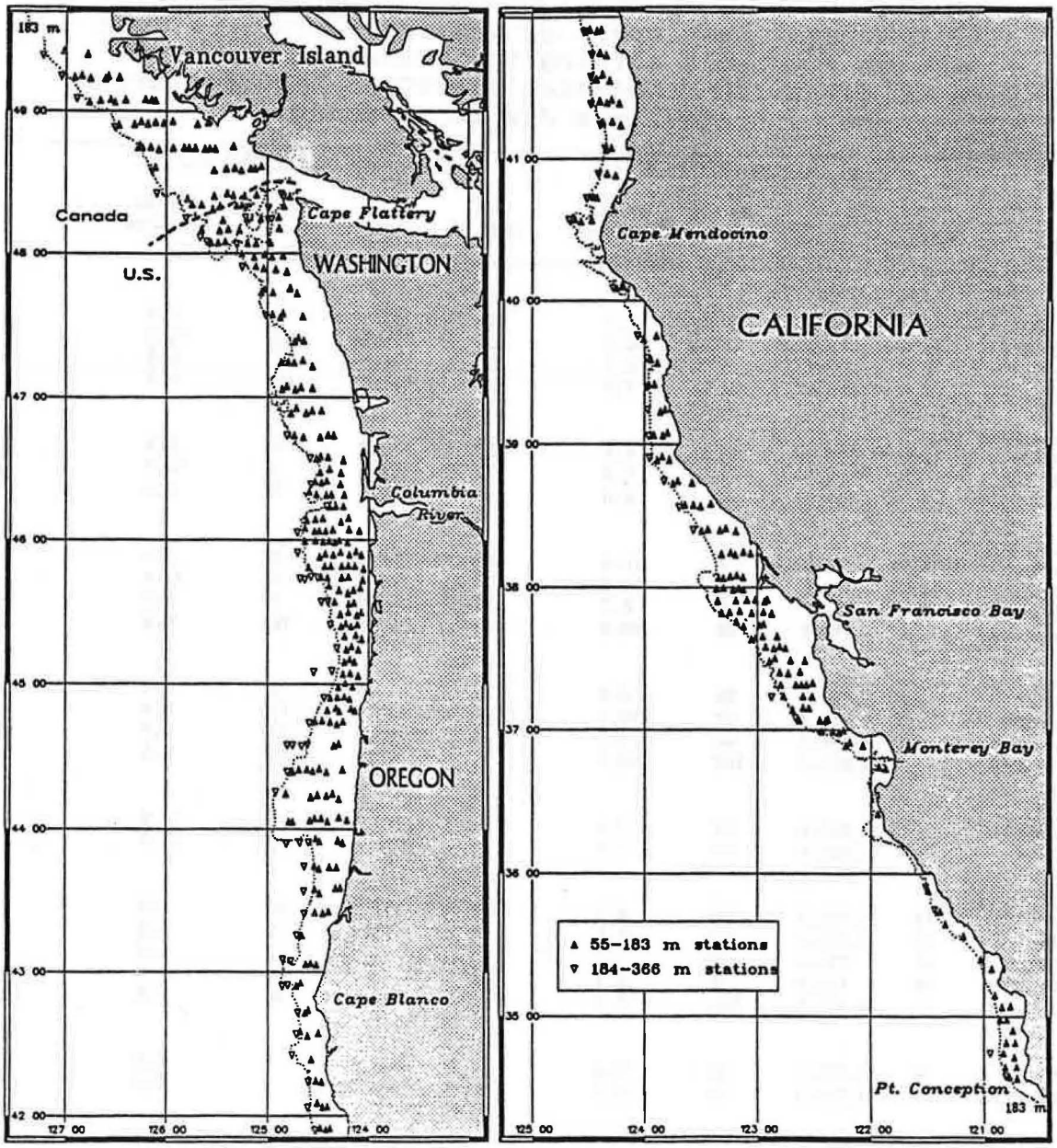


Figure 3.--Stations sampled successfully with bottom trawl hauls during the 1992 West Coast triennial bottom trawl survey.

Table 3.--Frequency of occurrence, depth and latitude ranges for fish species caught during the 1992 triennial West Coast groundfish survey.

| Family and species | Common name | Frequency of occurrence | Min. depth (m) | Max. depth (m) | Mean depth (m) | Latitude range S/N (ddmm)° |
|---|---|---|---|---|---|---|
| Myxinidae | | | | | | |
| *Eptatretus stouti* | Pacific hagfish | 2 | 121 | 165 | 143 | 4436/4445 |
| Petromyzontidae | | | | | | |
| *Petromyzontidae unident.* | Lamprey unident. | 1 | 335 | 335 | 335 | 4435/4435 |
| *Lampreta tridentata* | Pacific lamprey | 3 | 77 | 324 | 202 | 3714/4424 |
| Chimaeridae | | | | | | |
| *Hydrolagus colliei* | Spotted ratfish | 234 | 51 | 360 | 149 | 3439/4925 |
| Hexanchidae | | | | | | |
| *Hexanchus griseus* | Sixgill shark | 4 | 95 | 302 | 156 | 3525/3815 |
| Alopiidae | | | | | | |
| *Alopias vulpinus* | Thresher shark | 1 | 68 | 68 | 68 | 3443/3443 |
| Scyliorhinidae | | | | | | |
| *Scyliorhinidae unident.* | Cat shark unident. | 1 | 360 | 360 | 360 | 3524/3524 |
| *Apristurus brunneus* | Brown cat shark | 6 | 201 | 362 | 284 | 3435/4435 |
| Carcharhinidae | | | | | | |
| *Galeorhinus zyopterus* | Soupfin shark | 1 | 70 | 70 | 70 | 3729/3729 |
| *Mustelus henlei* | Brown smoothhound | 4 | 62 | 104 | 79 | 3445/3824 |
| Squalidae | | | | | | |
| *Squalus acanthias* | Spiny dogfish | 381 | 51 | 360 | 140 | 3439/4925 |
| Squatinidae | | | | | | |
| *Squatina californica* | Pacific angel shark | 1 | 73 | 73 | 73 | 3444/3444 |
| Torpedinidae | | | | | | |
| *Torpedo californica* | Pacific electric ray | 53 | 55 | 327 | 124 | 3439/4820 |
| Rajidae | | | | | | |
| *Rajidae unident.* | Skate unident. | 2 | 82 | 159 | 121 | 4315/4405 |
| *Bathyraja interrupta* | Sandpaper skate | 49 | 64 | 348 | 213 | 3714/4846 |
| *Raja binoculata* | Big skate | 70 | 55 | 305 | 117 | 3760/4925 |
| *Raja inornata* | California skate | 1 | 60 | 60 | 60 | 3720/3720 |
| *Raja rhina* | Longnose skate | 113 | 60 | 360 | 160 | 3435/4925 |
| *Raja stellulata* | Starry skate | 2 | 84 | 128 | 106 | 4425/4425 |
| Acipenseridae | | | | | | |
| *Acipenser medirostris* | Green sturgeon | 1 | 57 | 57 | 57 | 4404/4404 |
| Clupeidae | | | | | | |
| *Alosa sapidissima* | American shad | 191 | 51 | 240 | 118 | 3443/4925 |
| *Clupea pallasi* | Pacific herring | 314 | 55 | 322 | 110 | 3435/4925 |
| *Sardinops sagax* | Pacific sardine | 53 | 51 | 234 | 115 | 3725/4915 |
| Engraulidae | | | | | | |
| *Engraulis mordax* | Northern anchovy | 27 | 55 | 154 | 85 | 3435/4304 |
| Argentinidae | | | | | | |
| *Argentinidae unident.* | Argentine unident. | 1 | 97 | 97 | 97 | 3714/3714 |
| *Argentina sialis* | Pacific argentine | 38 | 75 | 172 | 117 | 3439/3905 |
| Osmeridae | | | | | | |
| *Allosmerus elongatus* | Whitebait smelt | 49 | 55 | 154 | 82 | 3754/4856 |
| *Thaleichthys pacificus* | Eulachon | 196 | 59 | 348 | 139 | 4044/4925 |
| Salmonidae | | | | | | |
| *Oncorhynchus kisutch* | Coho salmon | 4 | 70 | 101 | 84 | 3645/3725 |
| *Oncorhynchus tshawytscha* | Chinook salmon | 99 | 55 | 265 | 97 | 3645/4924 |
| Sternoptychidae | | | | | | |
| *Sternoptychidae unident.* | Hatchetfish unident. | 2 | 249 | 360 | 305 | 3524/3534 |
| Synodontidae | | | | | | |
| *Synodus lucioceps* | California lizardfish | 3 | 59 | 73 | 64 | 3444/3654 |
| Myctophidae | | | | | | |
| *Diaphus theta* | California headlightfish | 2 | 289 | 316 | 303 | 3444/3504 |
| *Myctophidae unident.* | Lanternfish unident. | 14 | 185 | 360 | 262 | 3524/4819 |
| *Stenobrachius leucopsarus* | Northern lampfish | 2 | 265 | 316 | 291 | 3454/3545 |
| Gadidae | | | | | | |
| *Gadus macrocephalus* | Pacific cod | 96 | 57 | 326 | 145 | 4315/4924 |

Table 3.--Continued.

| Family and species | Common name | Frequency of occurrence | Min. depth (m) | Max. depth (m) | Mean depth (m) | Latitude range S/N (ddmm) |
|---|---|---|---|---|---|---|
| **Gadidae (continued)** | | | | | | |
| *Microgadus proximus* | Pacific tomcod | 100 | 51 | 139 | 81 | 3729/4925 |
| *Theragra chalcogramma* | Walleye pollock | 48 | 51 | 326 | 147 | 4354/4924 |
| *Merluccius productus* | Pacific hake | 445 | 55 | 362 | 149 | 3435/4925 |
| **Macrouridae** | | | | | | |
| *Macrouridae unident.* | Grenadier unident. | 1 | 201 | 201 | 201 | 4243/4243 |
| **Ophidiidae** | | | | | | |
| *Ophidiidae unident.* | Cusk-eel unident. | 2 | 119 | 324 | 221 | 4206/4225 |
| *Chilara taylori* | Spotted cusk-eel | 17 | 57 | 249 | 128 | 3435/4624 |
| **Batrachoididae** | | | | | | |
| *Porichthys unident.* | Toadfish unident. | 1 | 110 | 110 | 110 | 4845/4845 |
| *Porichthys notatus* | Plainfin midshipman | 116 | 55 | 247 | 102 | 3434/4855 |
| **Ceratiidae** | | | | | | |
| *Ceratiidae unident.* | Seadevil unident. | 1 | 311 | 311 | 311 | 3435/3435 |
| **Scomberesocidae** | | | | | | |
| *Cololabi saira* | Pacific saury | 4 | 66 | 139 | 95 | 4335/4925 |
| **Scorpaenidae** | | | | | | |
| *Sebastes unident.* | Rockfish unident. | 6 | 60 | 338 | 171 | 3720/4644 |
| *Sebastes aleutianus* | Rougheye rockfish | 60 | 108 | 337 | 165 | 4034/4856 |
| *Sebastes alutus* | Pacific ocean perch | 100 | 108 | 362 | 202 | 3855/4923 |
| *Sebastes auriculatus* | Brown rockfish | 3 | 68 | 82 | 74 | 3739/3844 |
| *Sebastes aurora* | Aurora rockfish | 1 | 219 | 219 | 219 | 4623/4623 |
| *Sebastes babcocki* | Redbanded rockfish | 67 | 108 | 362 | 228 | 3435/4923 |
| *Sebastes borealis* | Shortraker rockfish | 1 | 326 | 326 | 326 | 3834/3834 |
| *Sebastes brevispinis* | Silvergray rockfish | 21 | 71 | 219 | 160 | 4545/4923 |
| *Sebastes caurinus* | Copper rockfish | 5 | 59 | 121 | 87 | 3439/3750 |
| *Sebastes chlorostictus* | Greenspotted rockfish | 14 | 57 | 278 | 129 | 3445/4820 |
| *Sebastes crameri* | Darkblotched rockfish | 168 | 77 | 362 | 183 | 3435/4925 |
| *Sebastes diploproa* | Splitnose rockfish | 90 | 71 | 362 | 251 | 3435/4923 |
| *Sebastes elongatus* | Greenstriped rockfish | 221 | 84 | 283 | 155 | 3445/4925 |
| *Sebastes entomelas* | Widow rockfish | 66 | 60 | 326 | 175 | 3445/4905 |
| *Sebastes eos* | Pink rockfish | 1 | 247 | 247 | 247 | 3435/3435 |
| *Sebastes flavidus* | Yellowtail rockfish | 106 | 60 | 223 | 139 | 3445/4925 |
| *Sebastes goodei* | Chilipepper | 95 | 66 | 338 | 167 | 3434/4406 |
| *Sebastes helvomaculatus* | Rosethorn rockfish | 83 | 84 | 348 | 180 | 3654/4923 |
| *Sebastes hopkinsi* | Squarespot rockfish | 6 | 73 | 159 | 114 | 3439/3524 |
| *Sebastes jordani* | Shortbelly rockfish | 86 | 70 | 327 | 166 | 3435/4904 |
| *Sebastes levis* | Cowcod | 3 | 126 | 247 | 173 | 3655/4005 |
| *Sebastes maliger* | Quillback rockfish | 9 | 51 | 115 | 77 | 4425/4905 |
| *Sebastes melanops* | Black rockfish | 2 | 62 | 68 | 65 | 3509/4053 |
| *Sebastes melanostomus* | Blackgill rockfish | 1 | 326 | 326 | 326 | 3834/3834 |
| *Sebastes miniatus* | Vermilion rockfish | 9 | 59 | 247 | 106 | 3439/3844 |
| *Sebastes mystinus* | Blue rockfish | 2 | 60 | 80 | 70 | 3720/3724 |
| *Sebastes ovalis* | Speckled rockfish | 1 | 104 | 104 | 104 | 3445/3445 |
| *Sebastes paucispinis* | Bocaccio | 52 | 60 | 311 | 156 | 3435/4923 |
| *Sebastes pinniger* | Canary rockfish | 98 | 51 | 221 | 136 | 3509/4925 |
| *Sebastes proriger* | Redstripe rockfish | 61 | 68 | 232 | 155 | 3944/4925 |
| *Sebastes reedi* | Yellowmouth rockfish | 13 | 139 | 362 | 227 | 4415/4925 |
| *Sebastes rosaceus* | Rosy rockfish | 1 | 73 | 73 | 73 | 3520/3520 |
| *Sebastes rosenblatti* | Greenblotched rockfish | 7 | 102 | 252 | 160 | 3459/3845 |
| *Sebastes ruberrimus* | Yelloweye rockfish | 38 | 75 | 188 | 138 | 3738/4914 |
| *Sebastes rubrivinctus* | Flag rockfish | 1 | 360 | 360 | 360 | 3524/3524 |
| *Sebastes rufus* | Bank rockfish | 11 | 104 | 327 | 246 | 3435/4305 |
| *Sebastes saxicola* | Stripetail rockfish | 120 | 66 | 360 | 183 | 3435/4923 |
| *Sebastes semicinctus* | Halfbanded rockfish | 44 | 59 | 163 | 105 | 3435/4006 |
| *Sebastes serranoides* | Olive rockfish | 2 | 110 | 115 | 112 | 3524/3539 |
| *Sebastes wilsoni* | Pygmy rockfish | 31 | 68 | 256 | 144 | 3445/4925 |
| *Sebastes zacentrus* | Sharpchin rockfish | 111 | 68 | 338 | 187 | 3738/4925 |
| *Sebastolobus alascanus* | Shortspine thornyhead | 109 | 108 | 362 | 236 | 3435/4923 |

Table 3.--Continued.

| Family and species | Common name | Frequency of occurrence | Min. depth (m) | Max. depth (m) | Mean depth (m) | Latitude range S/N (ddmm) |
|---|---|---|---|---|---|---|
| Anoplopomatidae | | | | | | |
| Anoplopoma fimbria | Sablefish | 366 | 51 | 362 | 159 | 3435/4925 |
| Hexagrammidae | | | | | | |
| Hexagrammus decagrammus | Kelp greenling | 15 | 51 | 154 | 91 | 3724/4905 |
| Ophiodon elongatus | Lingcod | 230 | 51 | 344 | 122 | 3439/4925 |
| Oxylebius pictus | Painted greenling | 1 | 68 | 68 | 68 | 3739/3739 |
| Zaniolepis frenata | Shortspine combfish | 2 | 123 | 247 | 185 | 3435/3654 |
| Zaniolepis latipinnis | Longspine combfish | 19 | 57 | 166 | 92 | 3443/4759 |
| Cottidae | | | | | | |
| Cottidae unident. | Sculpin unident. | 3 | 82 | 159 | 120 | 4315/4415 |
| Hemilepidotus jordani | Red Irish lord | 1 | 112 | 112 | 112 | 4825/4825 |
| Hemilepidotus spinosus | Brown Irish lord | 2 | 57 | 82 | 70 | 4325/4856 |
| Icelinus filamentosus | Threadfin sculpin | 66 | 57 | 348 | 164 | 3655/4914 |
| Icelinus occulatus | Frogmouth sculpin | 3 | 159 | 241 | 208 | 4305/4534 |
| Icelinus tenuis | Spotfin sculpin | 1 | 113 | 113 | 113 | 4820/4820 |
| Leptocottus armatus | Pacific staghorn sculpin | 13 | 57 | 132 | 87 | 4404/4624 |
| Malacocottus kincaidi | Blackfin sculpin | 3 | 219 | 240 | 232 | 4543/4804 |
| Paricelinus hopliticus | Thornback sculpin | 3 | 165 | 238 | 207 | 4445/4544 |
| Radulinus asprellus | Slim sculpin | 1 | 79 | 79 | 79 | 4244/4244 |
| Scorpaenichthys marmoratus | Cabezon | 1 | 104 | 104 | 104 | 4304/4304 |
| Agonidae | | | | | | |
| Agonidae unident. | Poacher unident. | 3 | 84 | 238 | 179 | 4503/4914 |
| Agonopsis vulsa | Northern spearnose poacher | 3 | 71 | 159 | 121 | 4534/4820 |
| Bathyagonous pentacanthus | Bigeye poacher | 4 | 188 | 230 | 208 | 4635/4835 |
| Occella verrucosa | Warty poacher | 2 | 82 | 337 | 209 | 4325/4344 |
| Podothecus acipenserinus | Sturgeon poacher | 12 | 60 | 223 | 110 | 4405/4923 |
| Xeneretmus latifrons | Blacktip poacher | 5 | 139 | 247 | 188 | 3655/4621 |
| Xeneretmus leiops | Smootheye poacher | 4 | 165 | 344 | 235 | 4505/4807 |
| Cyclopteridae | | | | | | |
| Liparis unident. | Snailfish unident. | 1 | 311 | 311 | 311 | 4754/4754 |
| Cyclopteridae unident. | Snailfish unident. | 7 | 201 | 304 | 253 | 3435/4905 |
| Careproctus melanurus | Blacktail snailfish | 2 | 324 | 360 | 342 | 3524/4225 |
| Carangidae | | | | | | |
| Trachurus symmetricus | Jack mackerel | 128 | 51 | 241 | 121 | 3625/4856 |
| Bramidae | | | | | | |
| Brama japonica | Pacific pomfret | 1 | 66 | 66 | 66 | 4624/4624 |
| Sciaenidae | | | | | | |
| Genyonemus lineatus | White croaker | 69 | 55 | 172 | 86 | 3434/3844 |
| Embiotocidae | | | | | | |
| Cymatogaster aggregata | Shiner perch | 48 | 51 | 113 | 77 | 3434/4924 |
| Hyperprosopon anale | Spotfin surfperch | 3 | 55 | 62 | 58 | 3729/3815 |
| Zalembius rosaceus | Pink seaperch | 96 | 55 | 172 | 95 | 3434/3953 |
| Bathymasteridae | | | | | | |
| Ronquilus jordani | Northern ronquil | 4 | 121 | 188 | 161 | 4759/4853 |
| Zoarcidae | | | | | | |
| Zoarcidae unident. | Eelpout unident. | 1 | 82 | 82 | 82 | 4336/4336 |
| Lycodes cortezianus | Bigfin eelpout | 102 | 71 | 360 | 204 | 3435/4923 |
| Lycodes diapterus | Black eelpout | 10 | 119 | 362 | 294 | 3439/4614 |
| Lycodopsis pacifica | Blackbelly eelpout | 50 | 60 | 289 | 136 | 3453/4856 |
| Stichaeidae | | | | | | |
| Poroclinus rothrocki | Whitebarred prickleback | 2 | 148 | 205 | 176 | 4654/4815 |
| Cryptacanthodidae | | | | | | |
| Cryptacanthodes giganteus | Giant wrymouth | 1 | 219 | 219 | 219 | 4315/4315 |
| Anarhichadidae | | | | | | |
| Anarrhichthys ocellatus | Wolf-eel | 3 | 51 | 101 | 80 | 4845/4853 |
| Zaproridae | | | | | | |
| Zaprora silenus | Prowfish | 3 | 77 | 198 | 132 | 4424/4815 |
| Icosteidae | | | | | | |
| Icosteus aenigmaticus | Ragfish | 2 | 77 | 101 | 89 | 4414/4435 |

Table 3.--Continued.

| Family and species | Common name | Frequency of occurrence | Min. depth (m) | Max. depth (m) | Mean depth (m) | Latitude range S/N (ddmm) |
|---|---|---|---|---|---|---|
| Scombridae | | | | | | |
| *Scomber japonicus* | Chub mackerel | 146 | 55 | 241 | 127 | 3444/4856 |
| Stromateidae | | | | | | |
| *Icichthys lockingtoni* | Medusafish | 6 | 55 | 128 | 77 | 3439/4713 |
| *Peprilus simillimus* | Pacific pompano | 81 | 55 | 172 | 86 | 3434/4634 |
| Bothidae | | | | | | |
| *Citharichthys sordidus* | Pacific sanddab | 326 | 51 | 278 | 101 | 3434/4924 |
| *Citharichthys xanthostigma* | Longfin sanddab | 1 | 66 | 66 | 66 | 3455/3455 |
| *Paralichthys californicus* | California halibut | 3 | 59 | 73 | 63 | 3439/3449 |
| Pleuronectidae | | | | | | |
| *Pleuronectes unident.* | Flatfish unident. | 1 | 97 | 97 | 97 | 4006/4006 |
| *Atheresthes stomias* | Arrowtooth flounder | 313 | 55 | 362 | 145 | 4005/4925 |
| *Eopsetta exilis* | Slender sole | 357 | 55 | 362 | 147 | 3435/4925 |
| *Eopsetta jordani* | Petrale sole | 297 | 55 | 338 | 122 | 3439/4925 |
| *Errex zachirus* | Rex sole | 504 | 51 | 362 | 140 | 3434/4925 |
| *Hippoglossoides elassodon* | Flathead sole | 79 | 66 | 326 | 143 | 4501/4925 |
| *Hippoglossus stenolepis* | Pacific halibut | 102 | 57 | 362 | 163 | 3854/4923 |
| *Microstomus pacificus* | Dover sole | 436 | 55 | 362 | 150 | 3435/4925 |
| *Platichthys stellatus* | Starry flounder | 4 | 62 | 71 | 65 | 3754/4425 |
| *Pleuronectes bilineata* | Rock sole | 51 | 51 | 139 | 85 | 3739/4905 |
| *Pleuronectes isolepis* | Butter sole | 7 | 57 | 79 | 68 | 3824/4905 |
| *Pleuronectes vetulus* | English sole | 380 | 51 | 338 | 121 | 3434/4924 |
| *Pleuronectes decurrens* | Curlfin sole | 54 | 55 | 188 | 80 | 3434/4905 |
| *Psettichthys melanostictus* | Sand sole | 22 | 55 | 90 | 70 | 3729/4820 |
| Molidae | | | | | | |
| *Mola mola* | Ocean sunfish | 1 | 146 | 146 | 146 | 4559/4559 |

*ddmm=degrees and minutes of latitude

## Temperature Data

Sea surface temperatures measured at 536 stations using a bucket thermometer ranged from 9.6° to 17.9°C. The overall mean surface temperature was 13.4°C. Temperature and salinity profiles were taken from 89 selected stations assigned to the *Green Hope*. Bottom temperatures from 502 stations were extracted from either the data logger or the CTD temperature-depth profiles (range 6.2° to 11.8°C, mean = 8.3°C). Figures 4 and 5 illustrate the observed surface and bottom temperatures, respectively, by latitude from the 1992 survey and compare these data with temperature data collected in previous triennial surveys.

Table 4.--Number of length frequency measurements collected by International North Pacific Fisheries Commission area during the 1992 triennial West Coast groundfish bottom trawl survey.

| Species | Conception area | | Monterey area | | Eureka area | | Columbia area | | Vancouver area | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 55-183m | 184-366m | 55-183m | 184-366m | 55-183m | 184-366m | 55-183m | 184-366m | 55-183m | 184-366m |
| Arrowtooth flounder | -- | -- | -- | -- | 298 | 303 | 1,113 | 335 | 2,594 | 533 |
| Butter sole | -- | -- | -- | -- | -- | -- | -- | -- | 34 | -- |
| Curlfin sole | -- | -- | -- | -- | -- | -- | 12 | -- | -- | -- |
| Dover sole | 5 | 265 | 363 | 1,220 | 385 | 1,092 | 3,098 | 1,407 | 2,523 | 1,254 |
| English sole | 42 | -- | 2,768 | 243 | 531 | 75 | 4,627 | 58 | 2,074 | 61 |
| Flathead sole | -- | -- | -- | -- | -- | -- | 219 | -- | 710 | 126 |
| Pacific halibut | -- | -- | 3 | 1 | 5 | 5 | 55 | 33 | 70 | 48 |
| Pacific sanddab | 1,227 | -- | 6,185 | 5 | 2,001 | -- | 2,593 | -- | 2,243 | -- |
| Petrale sole | 6 | -- | 110 | 7 | 217 | 43 | 534 | 13 | 163 | 12 |
| Rex sole | 33 | 170 | 2,487 | 438 | 1,675 | 808 | 7,153 | 1,371 | 3,220 | 938 |
| Rock sole | -- | -- | 36 | -- | -- | -- | 143 | -- | 386 | -- |
| Sand sole | -- | -- | 13 | -- | -- | -- | 40 | -- | 53 | -- |
| Slender sole | -- | 42 | 1 | -- | 1 | -- | 172 | -- | 512 | 148 |
| Pacific hake | 611 | 1,379 | 4,208 | 2,872 | 1,260 | 1,972 | 23,651 | 5,731 | 5,913 | 1,235 |
| Sablefish | 10 | 34 | 485 | 176 | 13 | 562 | 2,997 | 1,927 | 1,079 | 338 |
| American shad | -- | -- | -- | -- | -- | -- | 19 | -- | -- | -- |
| Chinook salmon | -- | -- | -- | -- | 27 | -- | 2 | -- | -- | -- |
| Chub mackerel | -- | -- | -- | -- | -- | -- | 563 | 12 | -- | -- |
| Jack mackerel | -- | -- | -- | -- | -- | -- | 371 | -- | -- | -- |
| Lingcod | 16 | -- | 159 | -- | 16 | 10 | 361 | 6 | 307 | 17 |
| Pacific cod | -- | -- | -- | -- | -- | -- | 4 | -- | 156 | 39 |
| Pacific herring | -- | -- | -- | -- | 216 | -- | -- | -- | -- | -- |
| Pacific sardine | -- | -- | -- | -- | -- | -- | 91 | -- | -- | -- |
| Pacific tomcod | -- | -- | -- | -- | 109 | -- | -- | -- | -- | -- |
| Walleye pollock | -- | -- | -- | -- | -- | -- | 1 | -- | 605 | -- |
| Shortspine thornyhead | -- | 14 | -- | 360 | -- | 117 | 8 | 50 | 130 | 735 |
| Bank rockfish | -- | -- | -- | 56 | -- | -- | -- | 70 | -- | -- |
| Blue rockfish | -- | -- | 273 | -- | -- | -- | -- | -- | -- | -- |
| Bocaccio | 259 | 14 | 188 | 23 | -- | 4 | -- | 1 | 19 | 30 |

Table 4.--Continued.

| Species | Conception area 55-183m | Conception area 184-366m | Monterey area 55-183m | Monterey area 184-366m | Eureka area 55-183m | Eureka area 184-366m | Columbia area 55-183m | Columbia area 184-366m | Vancouver area 55-183m | Vancouver area 184-366m |
|---|---|---|---|---|---|---|---|---|---|---|
| Brown rockfish | -- | -- | 5 | -- | -- | -- | -- | -- | -- | -- |
| Canary rockfish | -- | -- | 94 | -- | 1 | 2 | 251 | 12 | 290 | 30 |
| Chilipepper | 829 | 69 | 2,943 | 337 | 1 | 16 | -- | -- | -- | -- |
| Darkblotched rockfish | -- | 1 | 4 | 181 | 98 | 354 | 210 | 311 | 476 | 26 |
| Flag rockfish | -- | 1 | -- | -- | -- | -- | -- | -- | -- | -- |
| Greenspotted rockfish | 7 | -- | 4 | -- | -- | -- | 4 | -- | 1 | -- |
| Greenstriped rockfish | 7 | -- | 465 | -- | 70 | 41 | 995 | 167 | 788 | 384 |
| Halfbanded rockfish | 493 | -- | 269 | -- | -- | -- | -- | -- | -- | -- |
| Olive rockfish | 121 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Pacific ocean perch | -- | -- | -- | 7 | 14 | 108 | 8 | 604 | 585 | 1,021 |
| Pygmy rockfish | 49 | -- | -- | -- | -- | -- | 540 | -- | 726 | 8 |
| Quillback rockfish | -- | -- | -- | -- | -- | -- | 1 | -- | 16 | -- |
| Redbanded rockfish | -- | -- | -- | 7 | -- | 7 | -- | -- | 6 | 73 |
| Redstripe rockfish | -- | -- | 34 | -- | -- | -- | 513 | 160 | 2,493 | 448 |
| Rosethorn rockfish | -- | -- | -- | -- | -- | -- | 67 | -- | 388 | 199 |
| Rougheye rockfish | -- | -- | -- | -- | -- | -- | 102 | -- | 222 | 27 |
| Sharpchin rockfish | -- | -- | 312 | 128 | -- | 104 | 19 | 411 | 1,191 | 511 |
| Shortbelly rockfish | 693 | 780 | 2,642 | 1,133 | -- | 59 | 3 | -- | -- | -- |
| Silvergray rockfish | -- | -- | -- | -- | -- | -- | 3 | 2 | 19 | 197 |
| Speckled rockfish | 78 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Splitnose rockfish | -- | 903 | -- | 1,879 | -- | 459 | 6 | 411 | 19 | 200 |
| Squarespot rockfish | 12 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Stripetail rockfish | 272 | 920 | 2,716 | 1,099 | 46 | 619 | -- | 98 | -- | -- |
| Vermilion rockfish | 142 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Widow rockfish | 157 | -- | 420 | -- | -- | 6 | 76 | 17 | 47 | 1 |
| Yelloweye rockfish | -- | -- | -- | -- | -- | -- | 10 | -- | 13 | 1 |
| Yellowmouth rockfish | -- | -- | -- | -- | -- | -- | -- | 33 | -- | 1 |
| Yellowtail rockfish | 140 | -- | 349 | -- | 15 | 1 | 434 | 91 | 1,465 | 38 |

Table 5.--Number of biological data samples collected during the 1992 triennial West Coast bottom trawl groundfish survey.

| Species | Age structure* | Specimen weight | Maturity sample | Pathobiology sample |
|---|---|---|---|---|
| Pacific lamprey | -- | -- | -- | 1 |
| Arrowtooth flounder | -- | 256 | 197 | 53 |
| Dover sole | -- | 367 | 321 | 116 |
| English sole | -- | -- | -- | 2 |
| Pacific halibut | 177 | -- | -- | 43 |
| Petrale sole | -- | 159 | -- | -- |
| Rex sole | -- | -- | -- | 1 |
| Pacific hake | 1,088 | 958 | 790 | 154 |
| Sablefish | 730 | 588 | 313 | 101 |
| Lingcod | 343 | 268 | 105 | -- |
| Shortspine thornyhead | -- | -- | -- | 61 |
| Bocaccio | 125 | 101 | 46 | -- |
| Canary rockfish | 280 | 214 | 106 | -- |
| Chilipepper | 246 | 187 | 141 | 1 |
| Pacific ocean perch | 702 | 617 | 160 | 1 |
| Silvergray rockfish | 52 | 52 | 52 | -- |
| Widow rockfish | 34 | 55 | 40 | -- |
| Yelloweye rockfish | -- | -- | -- | 2 |
| Yellowtail rockfish | 933 | 882 | 380 | -- |

*Finrays were collected from lingcod. Otoliths were collected from all other species.

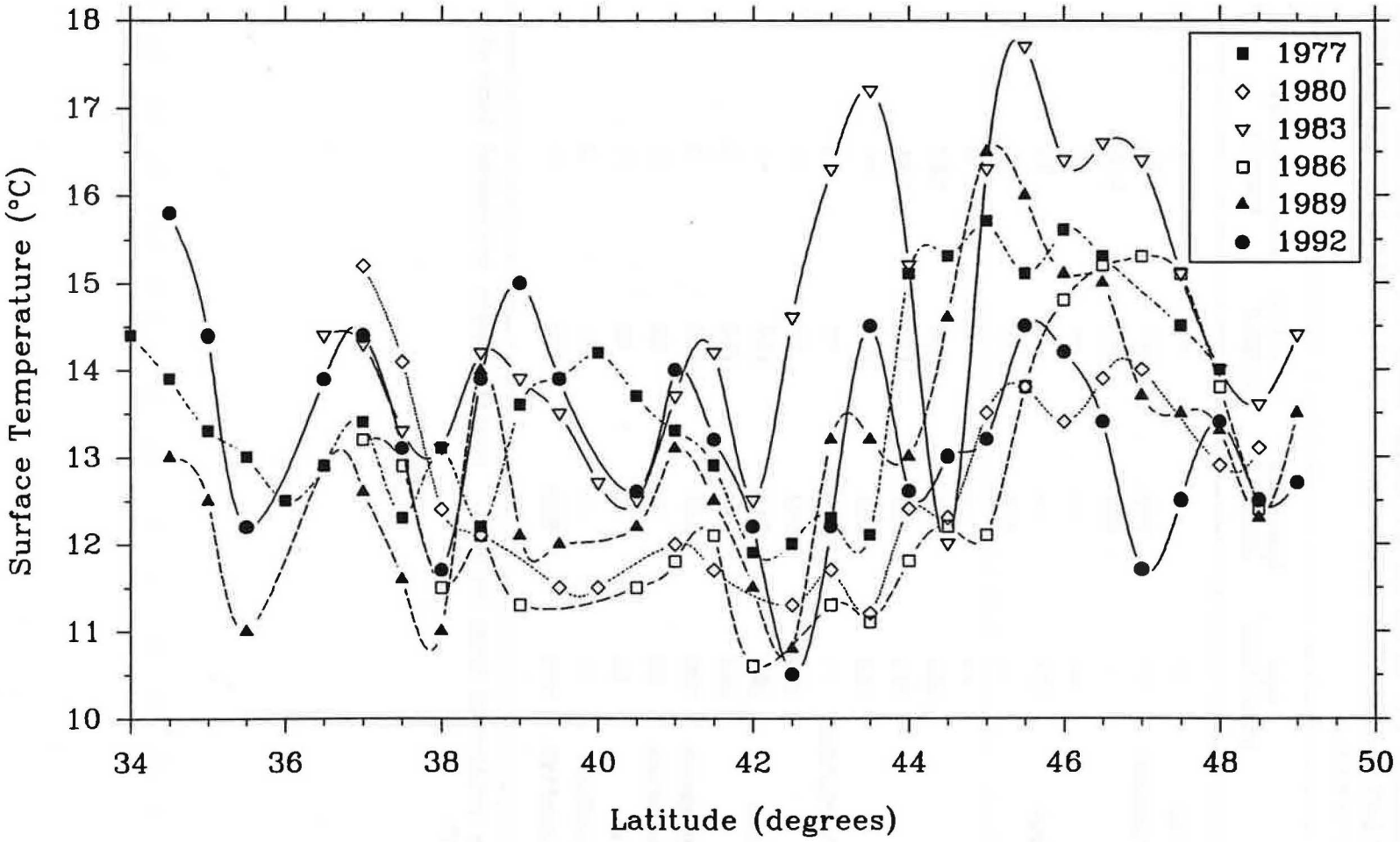




**Figure 4.--Observed sea surface temperatures, averaged by one-half degree latitude, during the 1977-1992 West Coast triennial bottom trawl surveys.**

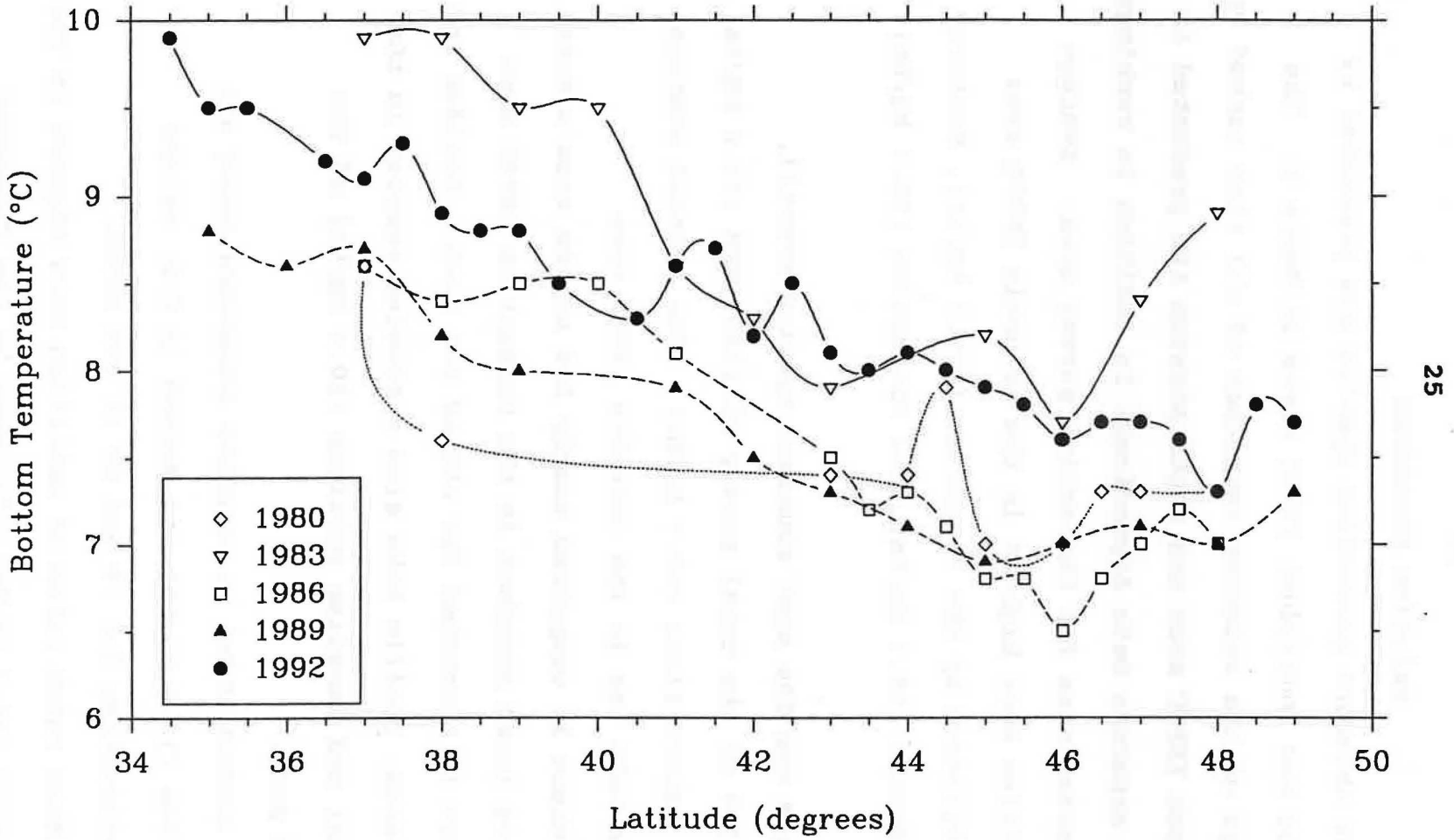


**Figure 5.--Observed bottom temperatures, averaged by one-half degree latitude, during the 1980-1992 West Coast triennial bottom trawl surveys.**

## Relative Abundance

The 20 most abundant groundfish species are presented by depth stratum for the individual INPFC areas in Table 6. The complete listings of the relative abundance of all fish ranked by mean CPUE for each INPFC area and depth stratum are presented in Appendix B (see separate Data Appendices) in addition to rankings of fish and invertebrates for the entire survey area. Average total fish densities were highest in the Columbia INPFC area (244.4 kg/ha), followed by the Vancouver (203.3 kg/ha), Monterey (106.3 kg/ha), Eureka (65.7 kg/ha), and Conception (35.6 kg/ha) INPFC areas.

Pacific hake was the most abundant species overall, accounting for 38% of the total survey finfish CPUE (67.6 kg/ha) and 41% in U.S. waters alone (69.7 kg/ha). The highest average CPUE for Pacific hake was in the Columbia INPFC area (127.6 kg/ha), where it comprised nearly 52% of the area's total. Pacific hake were least abundant in the Conception INPFC area (8.8 kg/ha) where it accounted for 25% of all fish. Besides the Columbia INPFC area, Pacific hake also dominated samples in the U.S. (65.8 kg/ha) and Canadian portions (50.0 kg/ha) of the Vancouver INPFC area.

Sablefish ranked third in relative abundance among all species surveywide (11.7 kg/ha) and second in U.S. waters (13.3 kg/ha), accounting for 7% and 8% of the catch, respectively. Mean catch rates of sablefish were highest in the Columbia INPFC area (24.1 kg/ha), followed by the Vancouver

Table 6.--Mean CPUE (kg/ha) for the 20 most abundant groundfish species by International North Pacific Fisheries Commission area and depth stratum during the 1992 West Coast triennial groundfish survey.

| CONCEPTION AREA 55-183 m | | CONCEPTION AREA 184-366 m | | CONCEPTION AREA 55-366 m | |
|---|---|---|---|---|---|
| Species | CPUE | Species | CPUE | Species | CPUE |
| Bocaccio | 6.1 | Pacific hake | 16.6 | Pacific hake | 8.8 |
| Chilipepper | 4.5 | Stripetail rockfish | 7.6 | Bocaccio | 3.6 |
| Widow rockfish | 4.3 | Splitnose rockfish | 7.3 | Chilipepper | 3.6 |
| Pacific hake | 2.4 | Chilipepper | 2.4 | Stripetail rockfish | 3.5 |
| Northern anchovy | 2.2 | Shortbelly rockfish | 1.2 | Splitnose rockfish | 3.3 |
| Pacific sanddab | 2.0 | Dover sole | 0.8 | Widow rockfish | 2.4 |
| Halfbanded rockfish | 1.8 | Bocaccio | 0.5 | Northern anchovy | 1.2 |
| Vermilion rockfish | 1.7 | Sablefish | 0.5 | Pacific sanddab | 1.1 |
| Pacific pompano | 1.6 | Rex sole | 0.5 | Halfbanded rockfish | 1.0 |
| White croaker | 1.5 | Bigfin eelpout | 0.1 | Vermilion rockfish | 0.9 |
| Yellowtail rockfish | 1.2 | Shortspine thornyhead | 0.1 | Pacific pompano | 0.9 |
| Speckled rockfish | 0.8 | Plainfin midshipman | <0.1 | Shortbelly rockfish | 0.9 |
| Shortbelly rockfish | 0.6 | Pink rockfish | <0.1 | White croaker | 0.8 |
| Spiny dogfish | 0.6 | Redbanded rockfish | <0.1 | Yellowtail rockfish | 0.7 |
| Pacific electric ray | 0.4 | Snailfish unidentified | <0.1 | Speckled rockfish | 0.4 |
| Plainfin midshipman | 0.3 | Spotted cusk-eel | <0.1 | Dover sole | 0.4 |
| Pink seaperch | 0.3 | Shortspine combfish | <0.1 | Spiny dogfish | 0.3 |
| Lingcod | 0.2 | Bank rockfish | <0.1 | Sablefish | 0.3 |
| Thresher shark | 0.2 | California headlightfish | <0.1 | Rex sole | 0.3 |
| English sole | 0.2 | | | Pacific electric ray | 0.2 |
| Number of hauls | 16 | Number of hauls | 2 | Number of hauls | 18 |

| MONTEREY AREA 55-183 m | | MONTEREY AREA 184-366 m | | MONTEREY AREA 55-366 m | |
|---|---|---|---|---|---|
| Species | CPUE | Species | CPUE | Species | CPUE |
| Chilipepper | 24.1 | Shortbelly rockfish | 54.7 | Shortbelly rockfish | 21.3 |
| Shortbelly rockfish | 14.5 | Pacific hake | 29.6 | Chilipepper | 20.9 |
| White croaker | 13.4 | Splitnose rockfish | 13.9 | White croaker | 11.1 |
| Widow rockfish | 11.9 | Stripetail rockfish | 10.3 | Pacific hake | 10.4 |
| Pacific herring | 8.0 | Dover sole | 8.4 | Widow rockfish | 10.0 |
| Pacific hake | 6.5 | Spiny dogfish | 8.3 | Pacific herring | 6.6 |
| Stripetail rockfish | 4.0 | Chilipepper | 4.7 | Stripetail rockfish | 5.0 |
| Pacific sanddab | 3.6 | Sablefish | 2.3 | Pacific sanddab | 3.0 |
| Spiny dogfish | 1.8 | Rex sole | 1.6 | Spiny dogfish | 2.9 |
| English sole | 1.5 | English sole | 1.6 | Splitnose rockfish | 2.3 |
| Sharpchin rockfish | 1.1 | Darkblotched rockfish | 1.6 | English sole | 1.6 |
| Rex sole | 0.9 | Shortspine thornyhead | 0.8 | Dover sole | 1.6 |
| Sablefish | 0.8 | Bank rockfish | 0.6 | Rex sole | 1.1 |
| Yellowtail rockfish | 0.7 | Sharpchin rockfish | 0.6 | Sablefish | 1.0 |
| Big skate | 0.6 | Bocaccio | 0.3 | Sharpchin rockfish | 1.0 |
| Plainfin midshipman | 0.5 | Shortraker rockfish | 0.3 | Yellowtail rockfish | 0.6 |
| Lingcod | 0.5 | Widow rockfish | 0.3 | Big skate | 0.5 |
| Pacific pompano | 0.5 | Bigfin eelpout | 0.1 | Plainfin midshipman | 0.5 |
| Bocaccio | 0.5 | Petrale sole | 0.1 | Bocaccio | 0.4 |
| Greenstriped rockfish | 0.3 | Greenstriped rockfish | 0.1 | Lingcod | 0.4 |
| Number of hauls | 104 | Number of hauls | 14 | Number of hauls | 118 |

Table 6.--Continued.

| EUREKA AREA 55-183 m | | EUREKA AREA 184-366 m | | EUREKA AREA 55-366 m | |
|---|---|---|---|---|---|
| Species | CPUE | Species | CPUE | Species | CPUE |
| Jack mackerel | 23.5 | Pacific hake | 28.1 | Jack mackerel | 18.7 |
| Pacific herring | 16.5 | Dover sole | 12.7 | Pacific herring | 13.4 |
| Pacific sanddab | 5.8 | Sablefish | 10.5 | Pacific hake | 9.6 |
| Pacific hake | 4.8 | Stripetail rockfish | 9.3 | Pacific sanddab | 4.6 |
| Rex sole | 1.8 | Splitnose rockfish | 5.2 | Dover sole | 3.4 |
| Chinook salmon | 1.4 | Darkblotched rockfish | 3.0 | Sablefish | 2.3 |
| Whitebait smelt | 1.0 | Rex sole | 2.0 | Stripetail rockfish | 2.2 |
| Dover sole | 1.0 | Arrowtooth flounder | 1.7 | Rex sole | 1.8 |
| English sole | 0.7 | Pacific herring | 1.5 | Chinook salmon | 1.2 |
| Arrowtooth flounder | 0.5 | Shortspine thornyhead | 1.3 | Splitnose rockfish | 1.1 |
| Big skate | 0.4 | Spiny dogfish | 1.2 | Darkblotched rockfish | 0.9 |
| Petrale sole | 0.4 | Shortbelly rockfish | 1.0 | Whitebait smelt | 0.8 |
| Pacific halibut | 0.3 | Sharpchin rockfish | 1.0 | Arrowtooth flounder | 0.8 |
| Spotted ratfish | 0.3 | Lingcod | 0.8 | English sole | 0.7 |
| Darkblotched rockfish | 0.3 | Pacific halibut | 0.6 | Petrale sole | 0.4 |
| Stripetail rockfish | 0.3 | Pacific ocean perch | 0.6 | Pacific halibut | 0.4 |
| Eulachon | 0.3 | English sole | 0.5 | Spiny dogfish | 0.4 |
| Pacific tomcod | 0.2 | Longnose skate | 0.4 | Big skate | 0.3 |
| Yellowtail rockfish | 0.2 | Chinook salmon | 0.4 | Spotted ratfish | 0.3 |
| Spiny dogfish | 0.2 | Greenstriped rockfish | 0.4 | Lingcod | 0.3 |
| Number of hauls | 37 | Number of hauls | 16 | Number of hauls | 53 |

| COLUMBIA AREA 55-183 m | | COLUMBIA AREA 184-366 m | | COLUMBIA AREA 55-366 m | |
|---|---|---|---|---|---|
| Species | CPUE | Species | CPUE | Species | CPUE |
| Pacific hake | 143.9 | Sablefish | 90.1 | Pacific hake | 127.6 |
| Jack mackerel | 22.3 | Pacific hake | 64.7 | Sablefish | 24.1 |
| Chub mackerel | 13.0 | Sharpchin rockfish | 36.8 | Jack mackerel | 17.8 |
| Pacific sanddab | 7.5 | Darkblotched rockfish | 12.4 | Chub mackerel | 10.9 |
| Sablefish | 7.0 | Dover sole | 10.0 | Sharpchin rockfish | 8.1 |
| Spiny dogfish | 6.1 | Spiny dogfish | 9.9 | Spiny dogfish | 6.8 |
| Rex sole | 5.0 | Redstripe rockfish | 9.0 | Pacific sanddab | 6.0 |
| English sole | 4.4 | Splitnose rockfish | 7.3 | Rex sole | 4.9 |
| Dover sole | 2.8 | Pacific ocean perch | 6.2 | Dover sole | 4.3 |
| Lingcod | 2.3 | Yellowtail rockfish | 4.5 | English sole | 3.7 |
| Redstripe rockfish | 2.2 | Rex sole | 4.3 | Redstripe rockfish | 3.6 |
| Pygmy rockfish | 1.9 | Shortspine thornyhead | 3.3 | Darkblotched rockfish | 2.9 |
| Yellowtail rockfish | 1.9 | Arrowtooth flounder | 3.1 | Yellowtail rockfish | 2.4 |
| Greenstriped rockfish | 1.6 | Pacific halibut | 3.0 | Lingcod | 1.9 |
| Pacific halibut | 1.4 | Chub mackerel | 2.6 | Greenstriped rockfish | 1.7 |
| American shad | 1.2 | Greenstriped rockfish | 2.4 | Pacific halibut | 1.7 |
| Pacific herring | 1.1 | Spotted ratfish | 1.6 | Pygmy rockfish | 1.5 |
| Arrowtooth flounder | 1.0 | Longnose skate | 1.4 | Splitnose rockfish | 1.5 |
| Big skate | 0.8 | Rosethorn rockfish | 1.0 | Arrowtooth flounder | 1.4 |
| Canary rockfish | 0.8 | Stripetail rockfish | 0.9 | Pacific ocean perch | 1.3 |
| Number of hauls | 167 | Number of hauls | 34 | Number of hauls | 201 |

Table 6.--Continued.

| US VANCOUVER AREA 55-183 m | | US VANCOUVER AREA 184-366 m | | US VANCOUVER AREA 55-366 m | |
|---|---|---|---|---|---|
| Species | CPUE | Species | CPUE | Species | CPUE |
| Pacific hake | 81.8 | Pacific hake | 18.0 | Pacific hake | 65.8 |
| Spiny dogfish | 56.4 | Dover sole | 15.1 | Spiny dogfish | 44.8 |
| Sablefish | 18.7 | Spiny dogfish | 10.3 | Sablefish | 15.6 |
| Yellowtail rockfish | 15.9 | Pacific halibut | 9.0 | Redstripe rockfish | 12.6 |
| Redstripe rockfish | 15.4 | Arrowtooth flounder | 7.8 | Yellowtail rockfish | 12.2 |
| Pacific herring | 12.9 | Sablefish | 6.6 | Pacific herring | 9.7 |
| Pygmy rockfish | 8.4 | Pacific ocean perch | 5.2 | Pygmy rockfish | 6.3 |
| Pacific sanddab | 3.5 | Redstripe rockfish | 4.2 | Dover sole | 5.3 |
| Sharpchin rockfish | 3.0 | Spotted ratfish | 3.4 | Arrowtooth flounder | 3.9 |
| Arrowtooth flounder | 2.6 | Rex sole | 3.3 | Pacific halibut | 3.6 |
| English sole | 2.3 | Shortspine thornyhead | 2.9 | Sharpchin rockfish | 3.0 |
| Dover sole | 2.0 | Sharpchin rockfish | 2.8 | Pacific sanddab | 2.6 |
| Pacific halibut | 1.8 | Longnose skate | 2.4 | Rex sole | 2.1 |
| Rex sole | 1.7 | Walleye pollock | 1.9 | English sole | 2.0 |
| Pacific cod | 1.6 | Pacific cod | 1.9 | Pacific cod | 1.6 |
| Greenstriped rockfish | 1.5 | Greenstriped rockfish | 1.8 | Greenstriped rockfish | 1.6 |
| Big skate | 1.3 | Rougheye rockfish | 1.2 | Pacific ocean perch | 1.4 |
| American shad | 1.3 | Yellowtail rockfish | 1.1 | Big skate | 1.1 |
| Darkblotched rockfish | 0.9 | English sole | 0.9 | American shad | 1.1 |
| Widow rockfish | 0.7 | Flathead sole | 0.8 | Spotted ratfish | 1.0 |
| Number of hauls | 38 | Number of hauls | 12 | Number of hauls | 50 |

| CANADIAN VANCOUVER AREA 55-183 m | | CANADIAN VANCOUVER AREA 184-366 m | | CANADIAN VANCOUVER AREA 55-366 m | |
|---|---|---|---|---|---|
| Species | CPUE | Species | CPUE | Species | CPUE |
| Pacific hake | 54.1 | Pacific ocean perch | 88.6 | Pacific hake | 50.0 |
| Spiny dogfish | 48.0 | Redstripe rockfish | 33.3 | Spiny dogfish | 45.4 |
| Yellowtail rockfish | 10.0 | Spiny dogfish | 22.8 | Redstripe rockfish | 11.2 |
| Arrowtooth flounder | 8.8 | Silvergray rockfish | 19.2 | Pacific ocean perch | 10.1 |
| Pacific herring | 8.6 | Arrowtooth flounder | 15.0 | Arrowtooth flounder | 9.5 |
| Redstripe rockfish | 8.6 | Pacific hake | 14.9 | Yellowtail rockfish | 9.0 |
| Dover sole | 6.7 | Dover sole | 14.1 | Pacific herring | 7.7 |
| Walleye pollock | 4.1 | Sharpchin rockfish | 13.6 | Dover sole | 7.4 |
| Rex sole | 3.7 | Sablefish | 9.1 | Sablefish | 3.9 |
| Lingcod | 3.6 | Bocaccio | 7.0 | Rex sole | 3.8 |
| Eulachon | 3.5 | Pacific cod | 5.2 | Walleye pollock | 3.7 |
| Sablefish | 3.3 | Splitnose rockfish | 5.0 | Sharpchin rockfish | 3.4 |
| English sole | 2.2 | Rex sole | 4.2 | Lingcod | 3.4 |
| Sharpchin rockfish | 2.2 | Greenstriped rockfish | 3.9 | Eulachon | 3.1 |
| Pacific cod | 2.0 | Canary rockfish | 3.1 | Pacific cod | 2.3 |
| Flathead sole | 1.8 | Rosethorn rockfish | 2.7 | Silvergray rockfish | 2.3 |
| Longnose skate | 1.6 | Redbanded rockfish | 2.5 | English sole | 2.0 |
| Canary rockfish | 1.4 | Spotted ratfish | 2.4 | Flathead sole | 1.6 |
| Pacific halibut | 1.3 | Pacific halibut | 2.0 | Canary rockfish | 1.6 |
| Greenstriped rockfish | 1.2 | Lingcod | 1.6 | Longnose skate | 1.5 |
| Number of hauls | 54 | Number of hauls | 7 | Number of hauls | 61 |

Table 6.--Continued.

| ENTIRE AREA 55-183 m | | ENTIRE AREA 184-366 m | | ENTIRE AREA 55-366 m | |
|---|---|---|---|---|---|
| Species | CPUE | Species | CPUE | Species | CPUE |
| Pacific hake | 74.5 | Pacific hake | 39.2 | Pacific hake | 67.6 |
| Spiny dogfish | 16.6 | Sablefish | 38.8 | Spiny dogfish | 15.1 |
| Jack mackerel | 10.7 | Sharpchin rockfish | 16.3 | Sablefish | 11.7 |
| Pacific herring | 6.8 | Pacific ocean perch | 11.5 | Jack mackerel | 8.6 |
| Chilipepper | 5.5 | Shortbelly rockfish | 10.4 | Pacific herring | 5.5 |
| Sablefish | 5.0 | Dover sole | 10.0 | Shortbelly rockfish | 4.7 |
| Chub mackerel | 4.9 | Spiny dogfish | 8.8 | Chilipepper | 4.6 |
| Pacific sanddab | 4.7 | Splitnose rockfish | 7.3 | Redstripe rockfish | 4.3 |
| Yellowtail rockfish | 4.1 | Redstripe rockfish | 6.6 | Chub mackerel | 4.2 |
| Redstripe rockfish | 3.8 | Darkblotched rockfish | 5.5 | Sharpchin rockfish | 4.1 |
| Shortbelly rockfish | 3.2 | Stripetail rockfish | 4.1 | Dover sole | 4.0 |
| Rex sole | 3.1 | Arrowtooth flounder | 3.7 | Pacific sanddab | 3.8 |
| White croaker | 3.0 | Rex sole | 3.0 | Yellowtail rockfish | 3.6 |
| Widow rockfish | 3.0 | Pacific halibut | 2.5 | Rex sole | 3.1 |
| English sole | 2.7 | Shortspine thornyhead | 2.0 | Arrowtooth flounder | 2.5 |
| Dover sole | 2.6 | Silvergray rockfish | 1.8 | Widow rockfish | 2.4 |
| Arrowtooth flounder | 2.3 | Yellowtail rockfish | 1.8 | White croaker | 2.4 |
| Lingcod | 1.7 | Greenstriped rockfish | 1.6 | Pacific ocean perch | 2.4 |
| Pygmy rockfish | 1.4 | Spotted ratfish | 1.2 | English sole | 2.3 |
| Sharpchin rockfish | 1.2 | Chilipepper | 1.1 | Stripetail rockfish | 1.5 |
| Number of hauls | 416 | Number of hauls | 85 | Number of hauls | 501 |

(8.0 kg/ha), Eureka (2.3 kg/ha), Monterey (1.0 kg/ha), and Conception (0.3 kg/ha) INPFC areas. Sablefish accounted for between 0.8% and 9.9% of INPFC area fish catches.

Catch composition and relative densities varied widely among geographic areas. In the total survey area, the four most abundant species, after Pacific hake (67.6 kg/ha), were spiny dogfish (Squalus acanthias) (15.1 kg/ha), sablefish (11.7 kg/ha), jack mackerel (Trachurus symmetricus) (8.6 kg/ha), and Pacific herring (Clupea pallasi) (5.5 kg/ha). These five species as a group accounted for 61% of finfish CPUE. In U.S. waters only, four of the same species were among the five most abundant. Pacific hake (69.7 kg/ha) was most abundant, followed by

sablefish (13.3 kg/ha), jack mackerel (10.4 kg/ha), spiny dogfish (8.9 kg/ha), and chilipepper (S. goodei) (5.6 kg/ha). Moving from south to north and listed in order of abundance, the five most prominent species in the Conception INPFC area were Pacific hake (8.8 kg/ha), bocaccio (S. paucispinis), chilipepper, stripetail rockfish (S. saxicola), and splitnose rockfish; in the Monterey INPFC area: shortbelly rockfish (21.3 kg/ha), chilipepper, white croaker (Genyonemus lineatus), Pacific hake, and widow rockfish (S. entomelas); in the Eureka INPFC area: jack mackerel (18.7 kg/ha), Pacific herring, Pacific hake, Pacific sanddab (Citharichthys sordidus), and Dover sole (Microstomus pacificus); in the Columbia INPFC area: Pacific hake (127.6 kg/ha), sablefish, jack mackerel, chub mackerel (Scomber japonicus), and sharpchin rockfish (S. zacentrus); in the U.S. Vancouver INPFC area: Pacific hake (65.8 kg/ha), spiny dogfish, sablefish, redstripe rockfish (S. proriger) and yellowtail rockfish; and in the Canadian Vancouver INPFC area: Pacific hake (50.0 kg/ha), spiny dogfish, redstripe rockfish, Pacific ocean perch, and arrowtooth flounder (Atheresthes stomias).

The catch composition also varied between depth strata. In the shallow stratum (55-183 m) for the entire survey area, Pacific hake (74.5 kg/ha) dominated catches, followed by spiny dogfish, jack mackerel, Pacific herring, and chilipepper. The five most abundant species in the deep stratum (184-366 m) were

Pacific hake (39.2 kg/ha), sablefish, sharpchin rockfish, Pacific ocean perch, and shortbelly rockfish.

Maps of the geographical distribution of the primary and secondary target species, based on station catch rates, are presented by species in Figures 6-31 in alphabetical order. Distribution maps of the following selected additional groundfish species also appear:

| | | |
|---|---|---|
| Darkblotched rockfish | Redstripe rockfish | Spiny dogfish |
| Greenstriped rockfish | Sharpchin rockfish | Splitnose rockfish |
| Pacific halibut | Shortbelly rockfish | Stripetail rockfish |
| Pacific sanddab | Shortspine thornyhead | Widow rockfish |
| Petrale sole | Silvergray rockfish | |

For each species, all non-zero station catch rates were sorted in decreasing order and categorized as the top 10%, middle 30%, and lowest 60% of the values. The distribution of sampling effort should be considered when viewing these charts since increased sampling in an area may give the impression of high densities when, in fact, CPUE was only moderate or low.

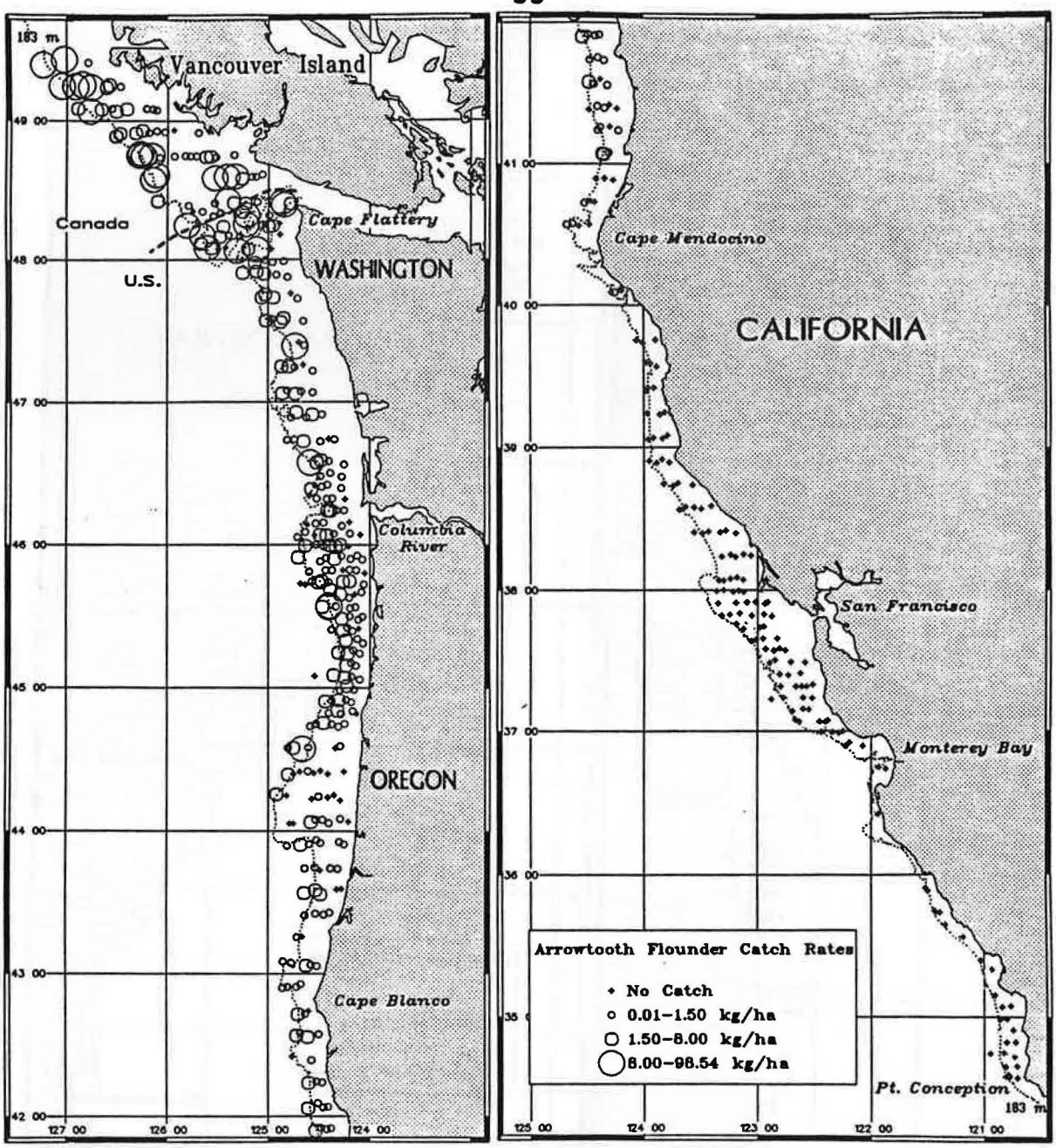


Figure 6.--Arrowtooth flounder distribution and relative abundance measured in catch rates (kg/ha) from the 1992 West Coast triennial bottom trawl survey.

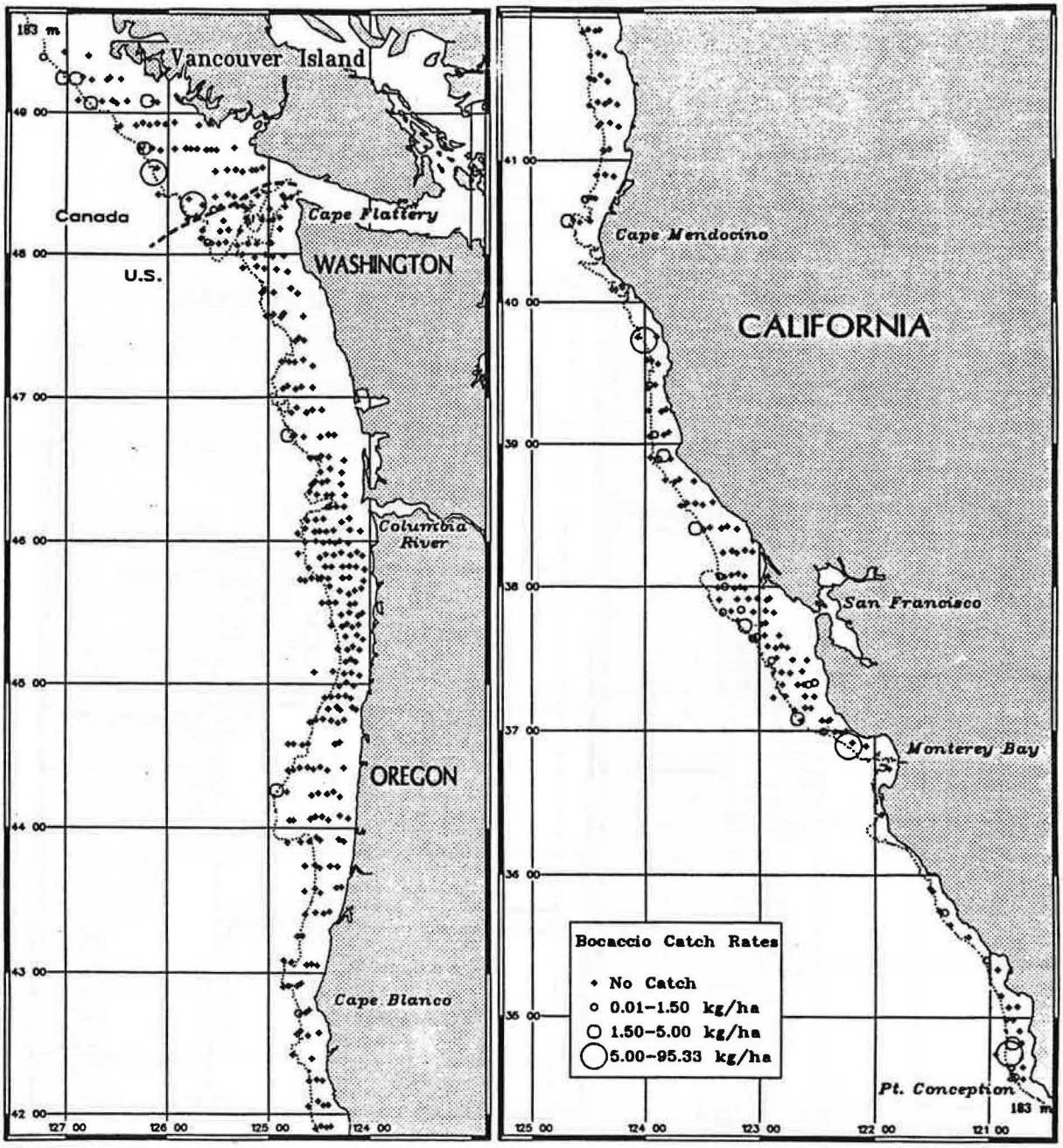


Figure 7.--Bocaccio distribution and relative abundance measured in catch rates (kg/ha) from the 1992 West Coast triennial bottom trawl survey.

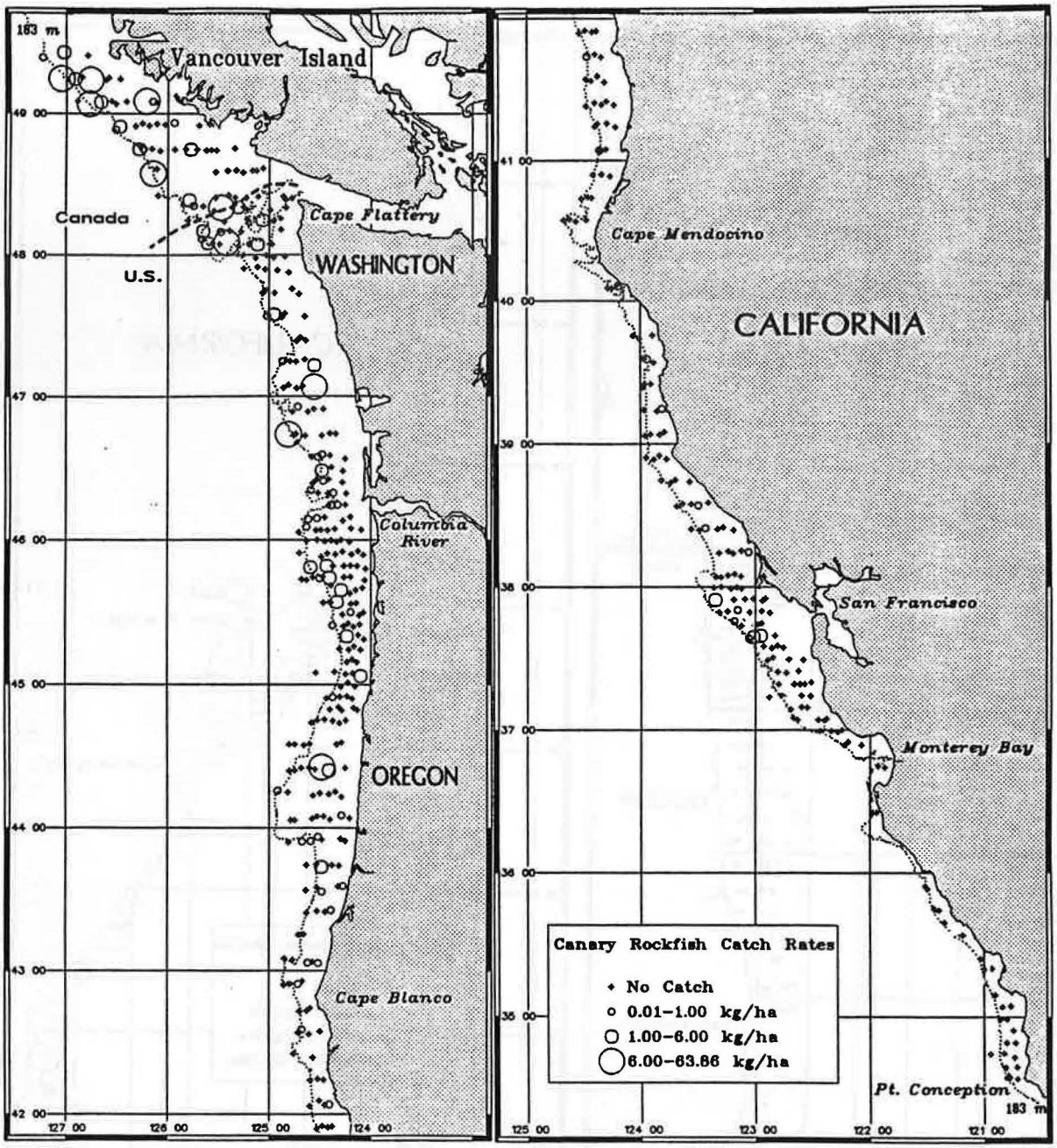


Figure 8.--Canary rockfish distribution and relative abundance measured in catch rates (kg/ha) from the 1992 West Coast triennial bottom trawl survey.

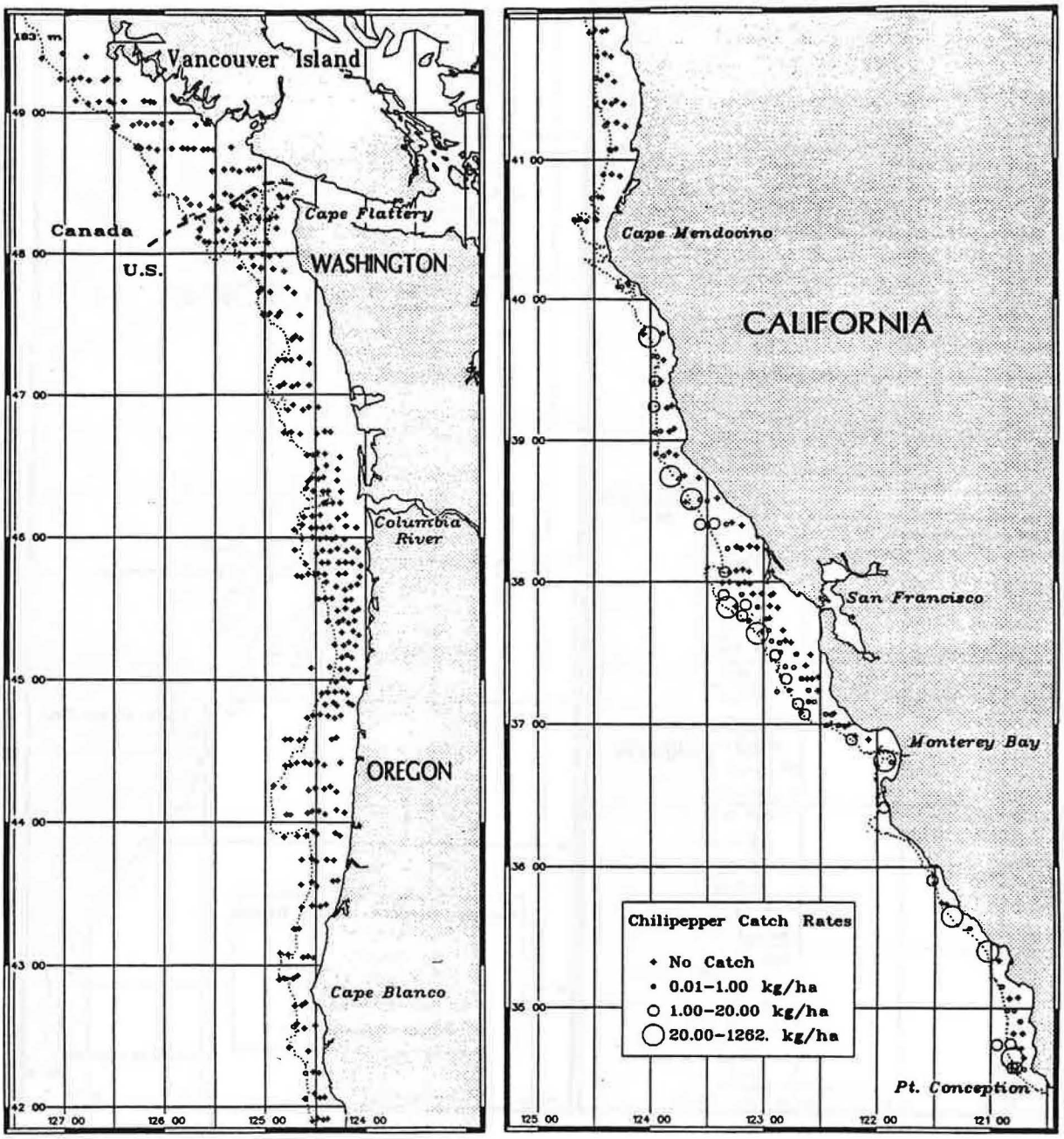


Figure 9.--Chilipepper distribution and relative abundance measured in catch rates (kg/ha) from the 1992 West Coast triennial bottom trawl survey.

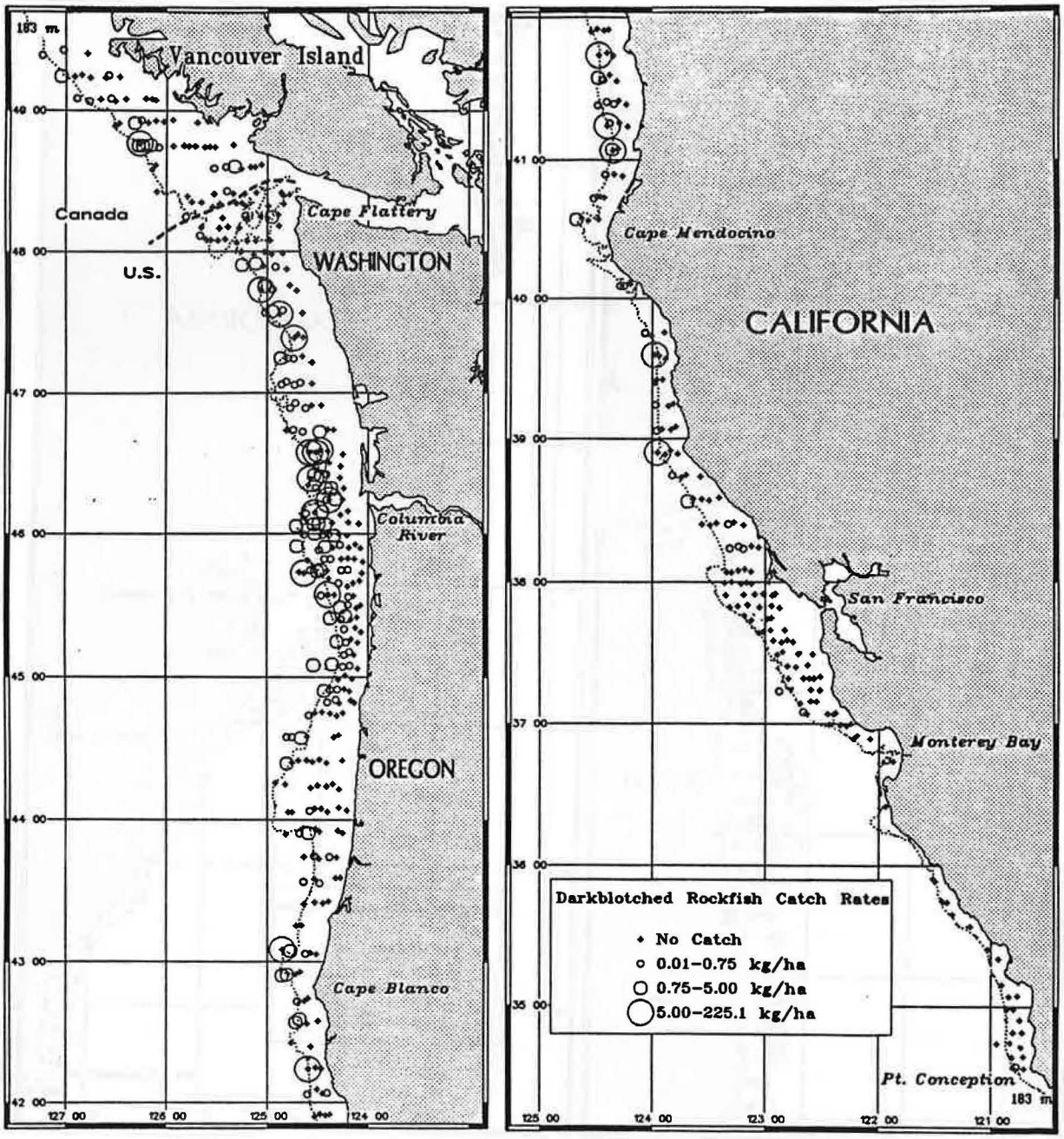


Figure 10.--Darkblotched rockfish distribution and relative abundance measured in catch rates (kg/ha) from the 1992 West Coast triennial bottom trawl survey.

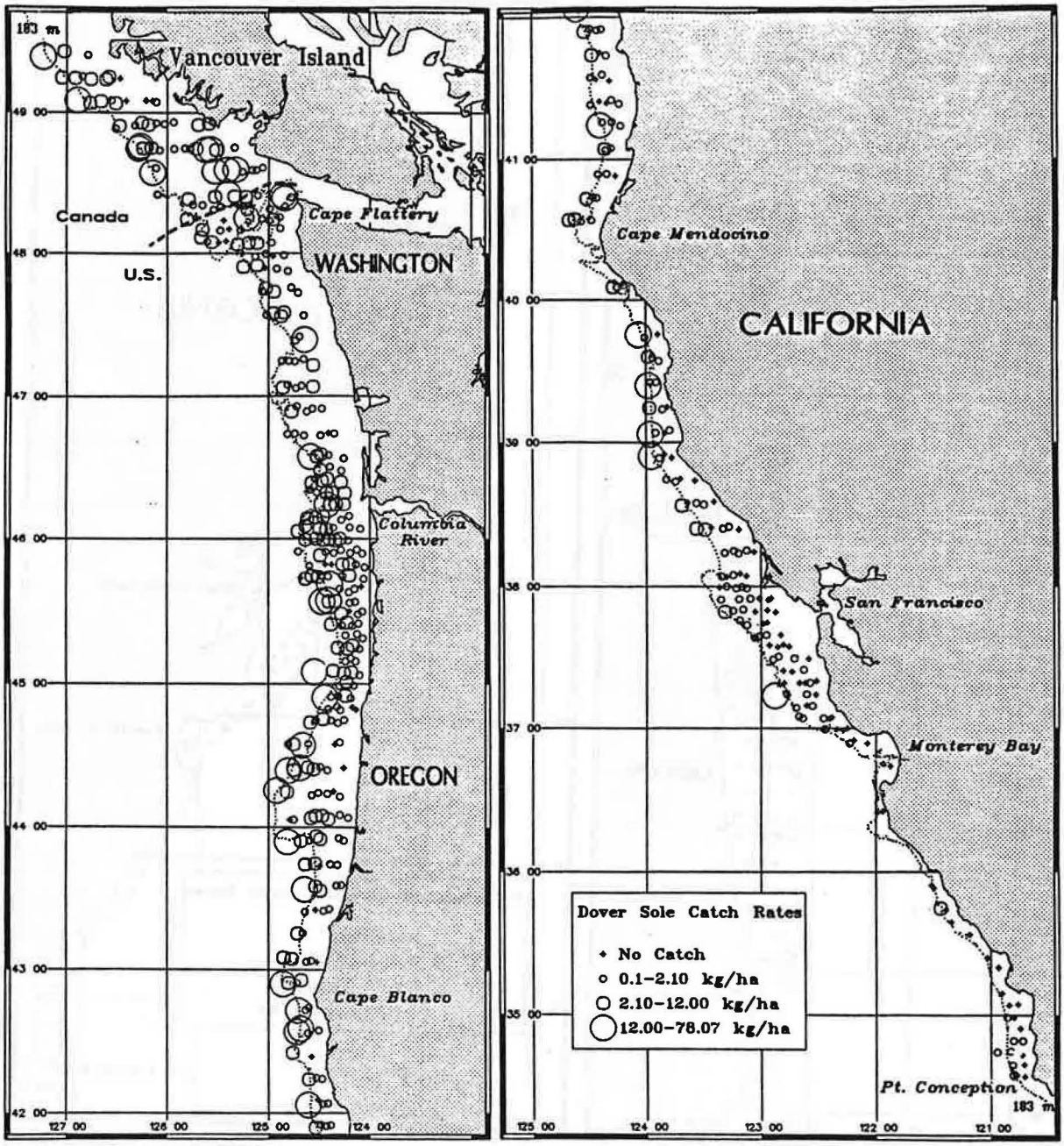


Figure 11.--Dover sole distribution and relative abundance measured in catch rates (kg/ha) from the 1992 West Coast triennial bottom trawl survey.

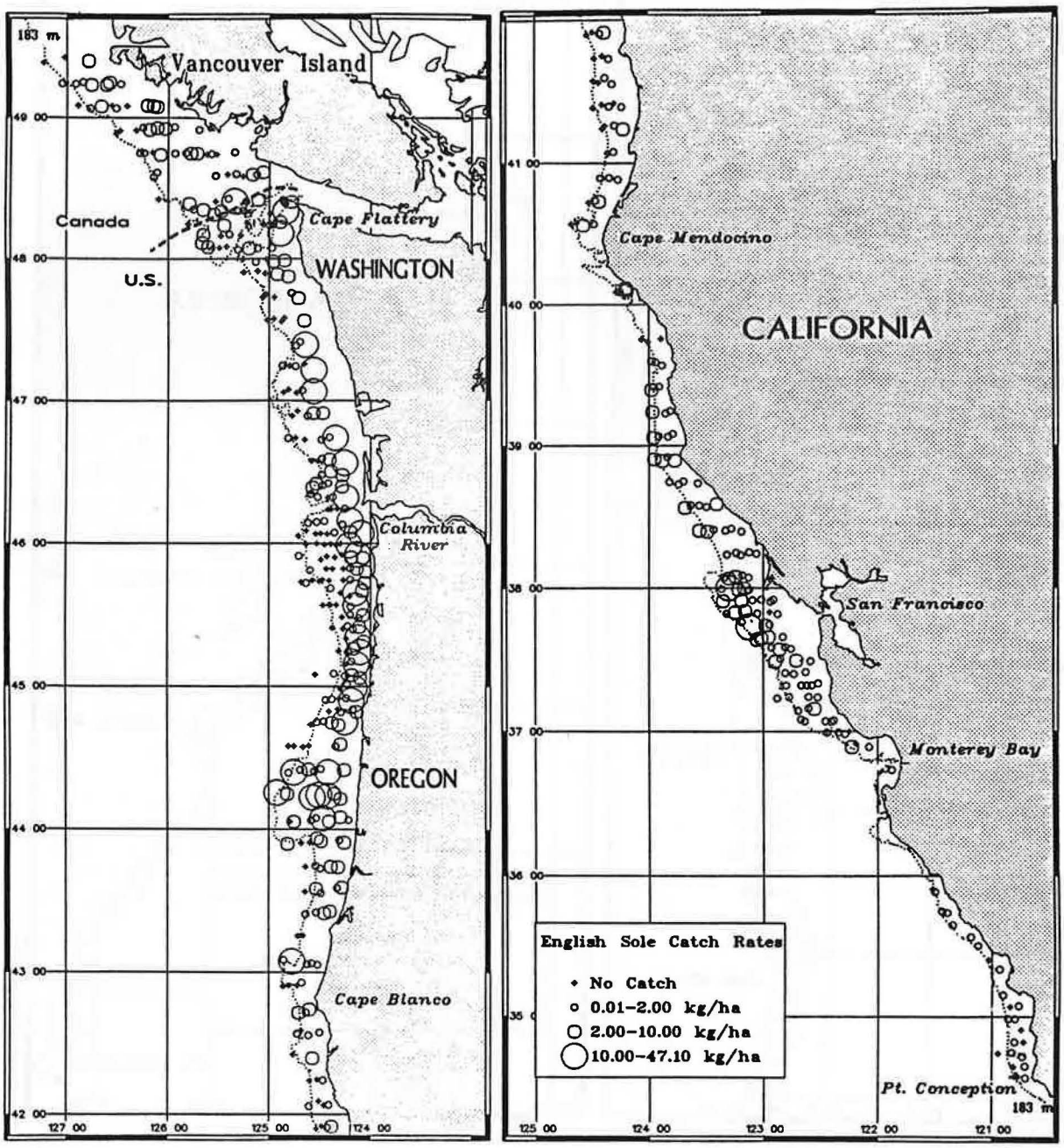


Figure 12.--English sole distribution and relative abundance measured in catch rates (kg/ha) from the 1992 West Coast triennial bottom trawl survey.

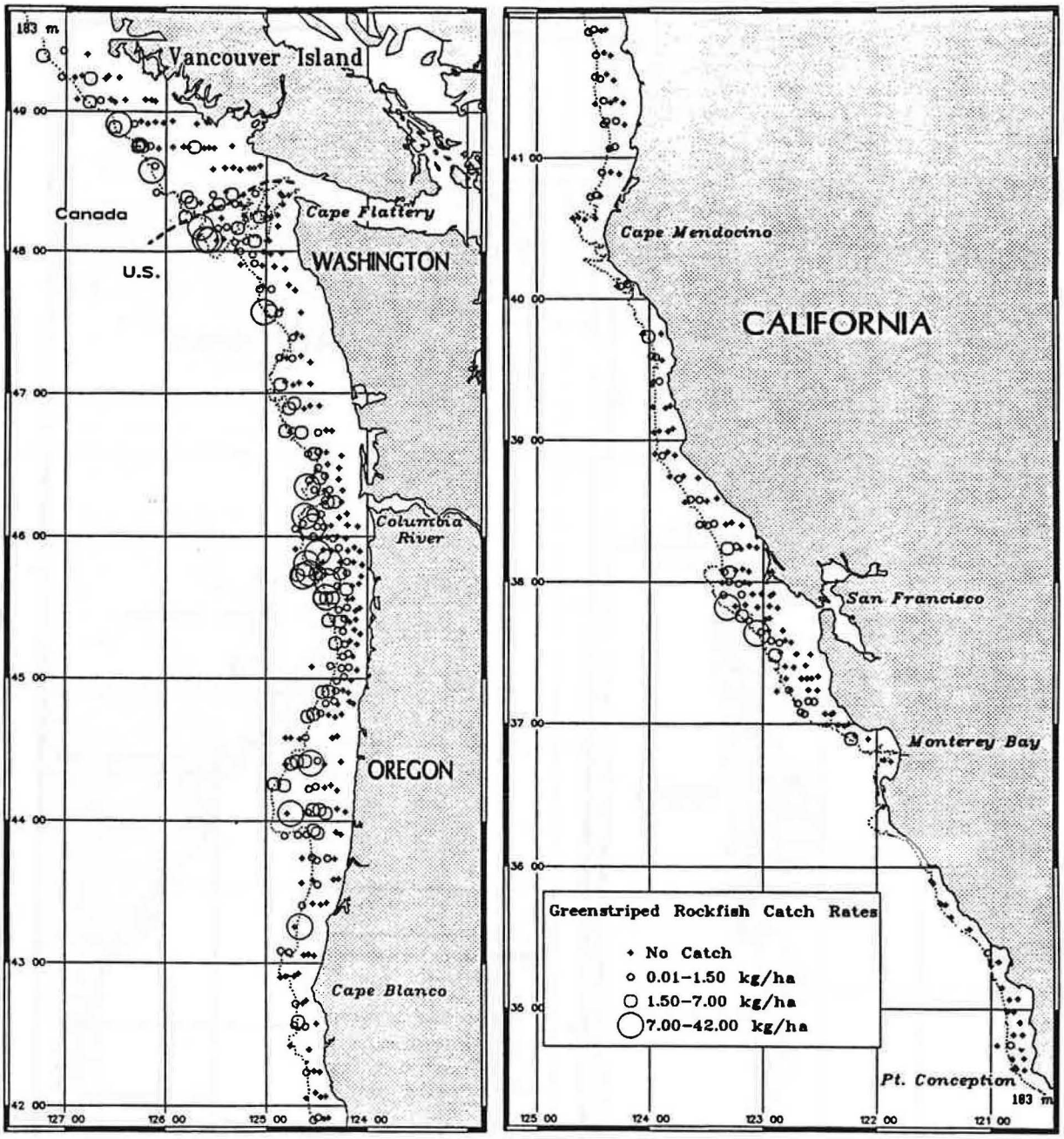


Figure 13.--Greenstriped rockfish distribution and relative abundance measured in catch rates (kg/ha) from the 1992 West Coast triennial bottom trawl survey.

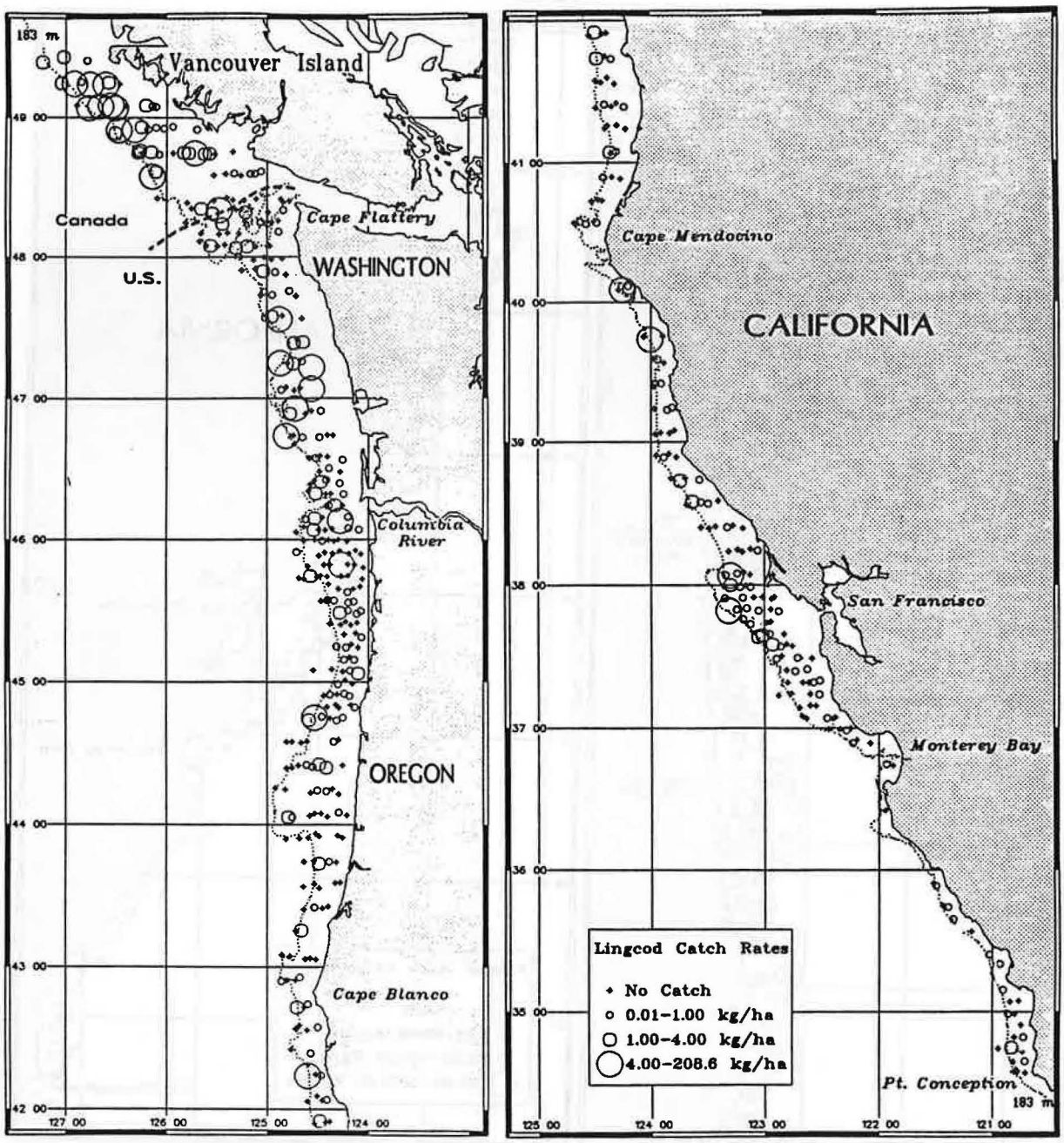


Figure 14.--Lingcod distribution and relative abundance measured in catch rates (kg/ha) from the 1992 West Coast triennial bottom trawl survey.

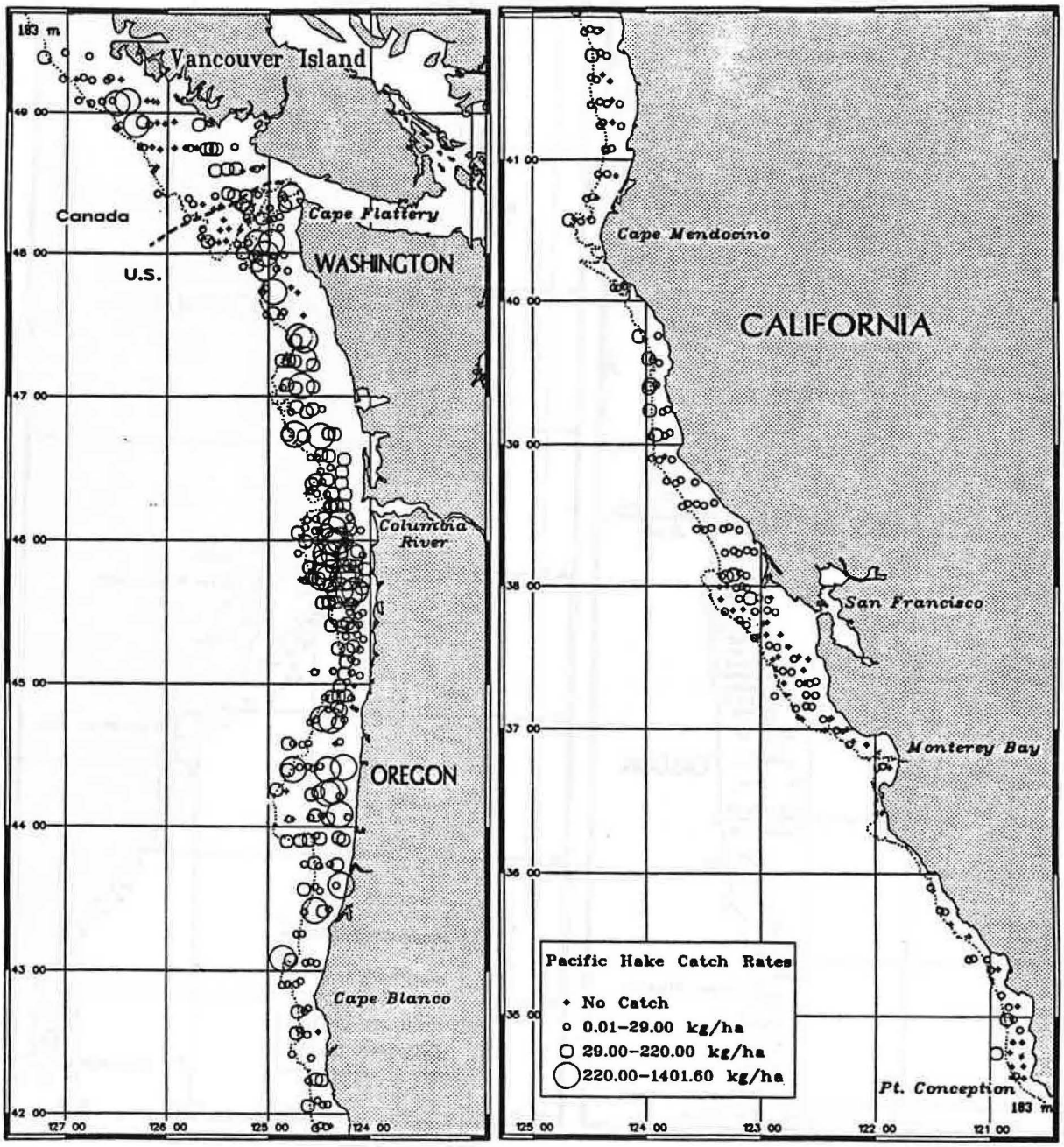


Figure 15.--Pacific hake distribution and relative abundance measured in catch rates (kg/ha) from the 1992 West Coast triennial bottom trawl survey.

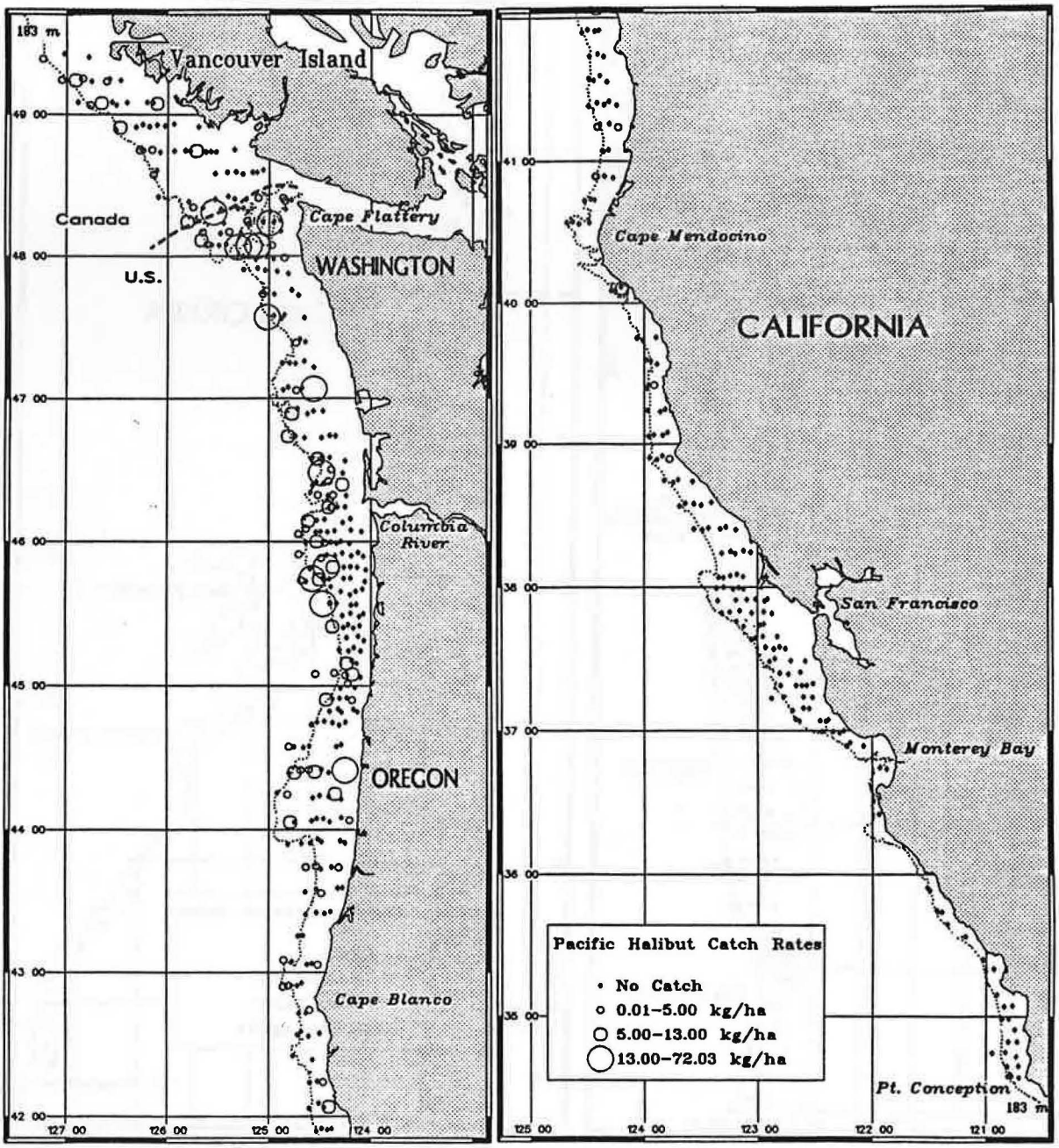


**Figure 16.--Pacific halibut distribution and relative abundance measured in catch rates (kg/ha) from the 1992 West Coast triennial bottom trawl survey.**

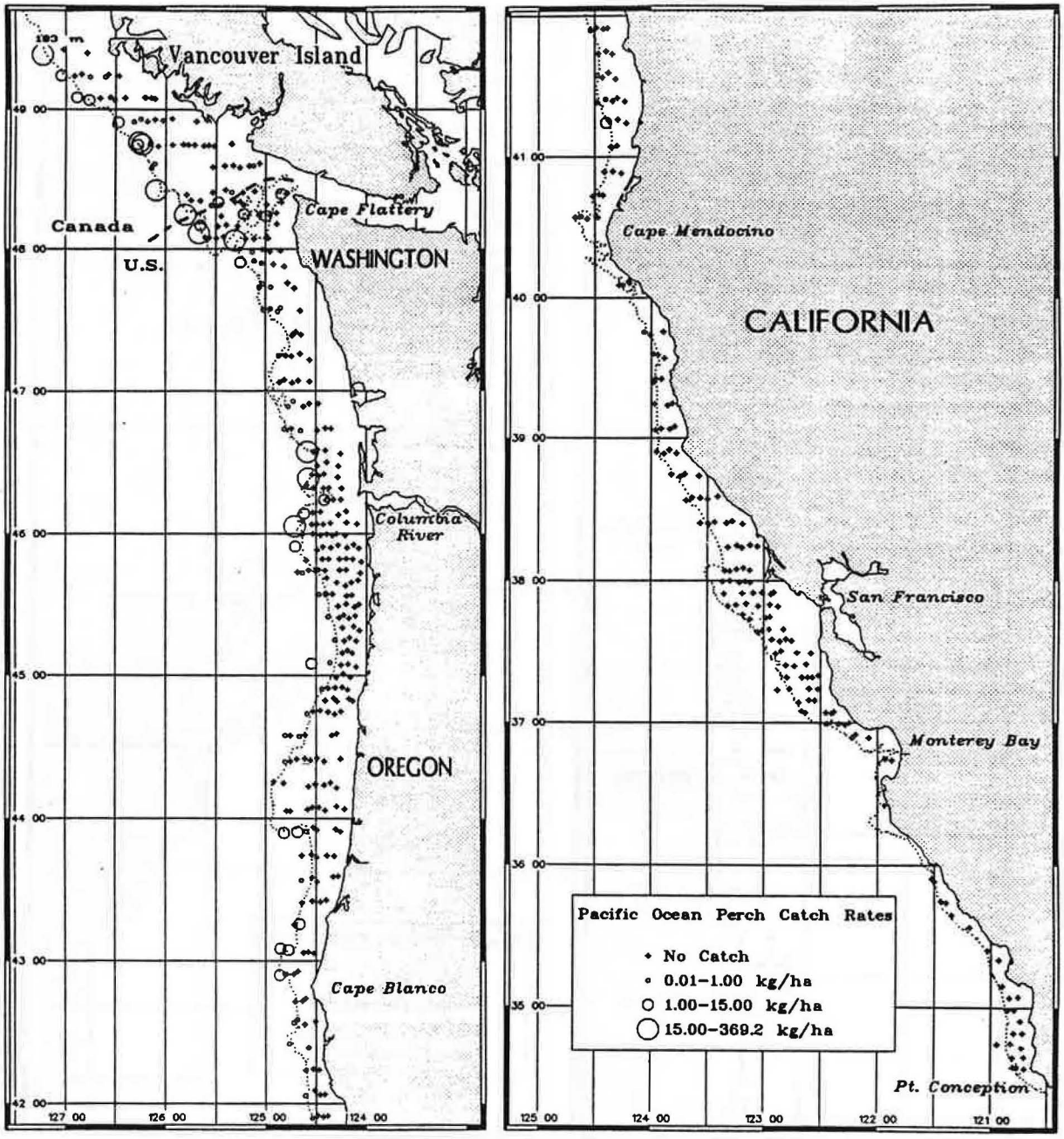


Figure 17.--Pacific ocean perch distribution and relative abundance measured in catch rates (kg/ha) from the 1992 West Coast triennial bottom trawl survey.

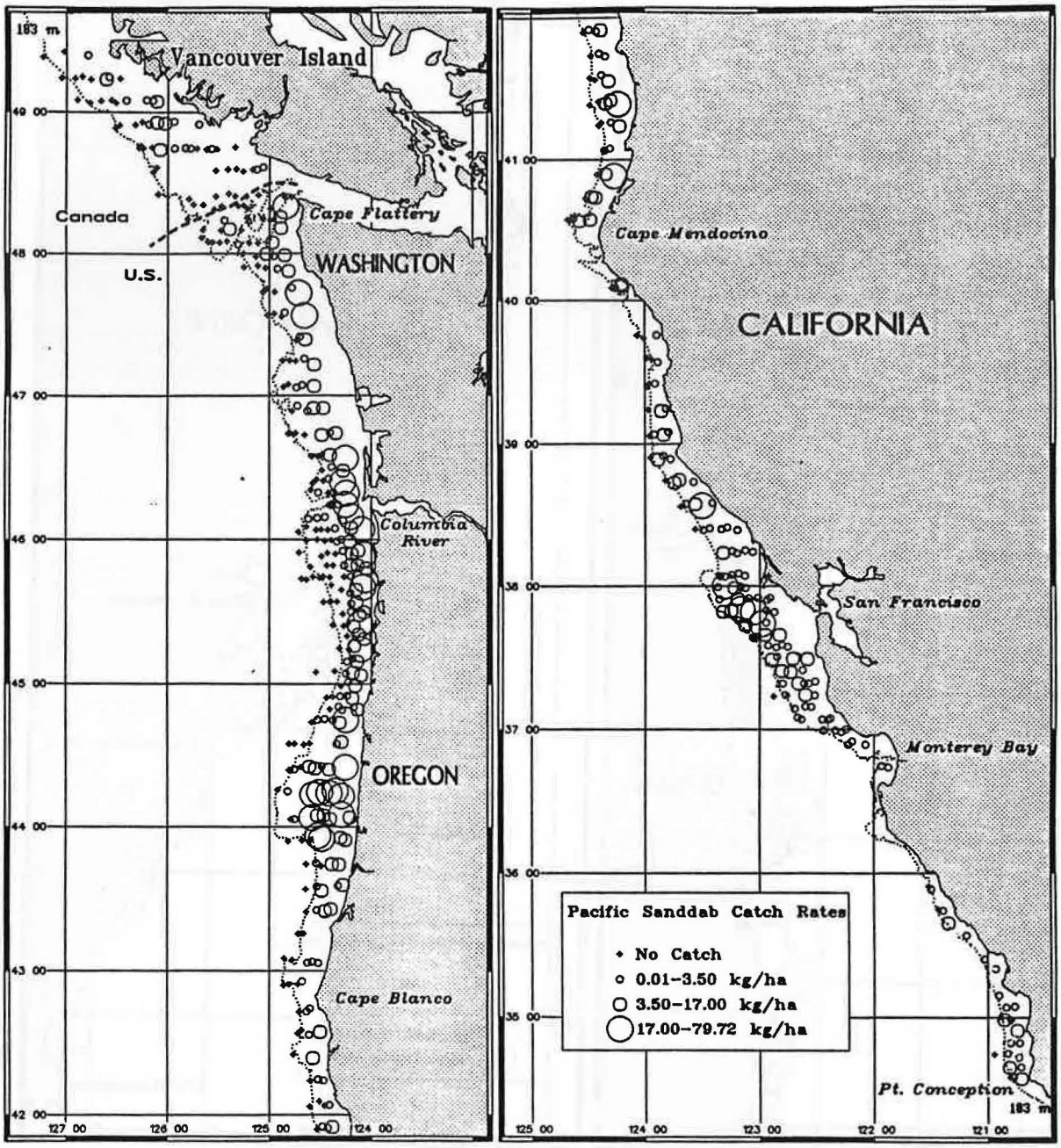


Figure 18.--Pacific sanddab distribution and relative abundance measured in catch rates (kg/ha) from the 1992 West Coast triennial bottom trawl survey.

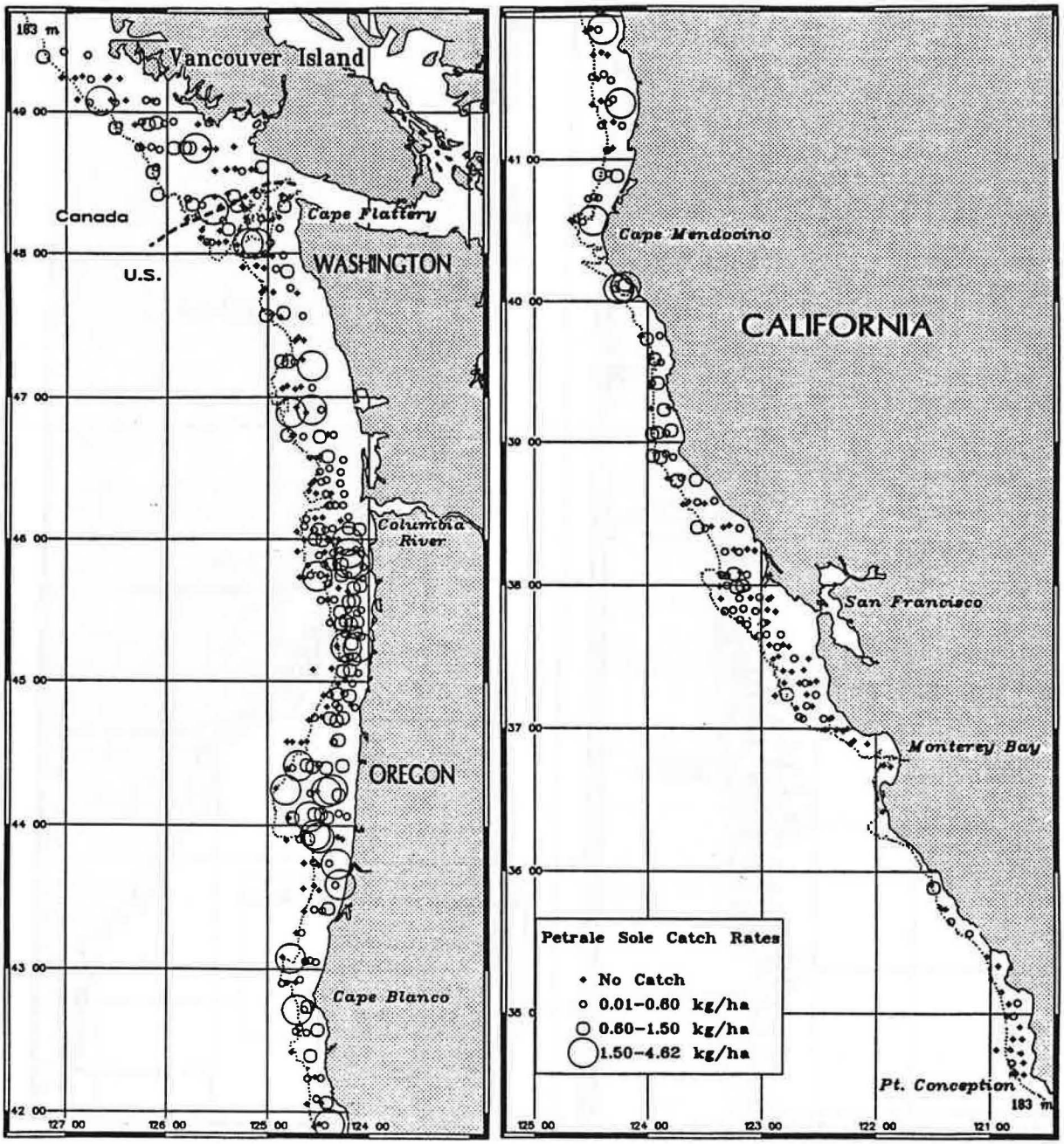


Figure 19.--Petrale sole distribution and relative abundance measured in catch rates (kg/ha) from the 1992 West Coast triennial bottom trawl survey.

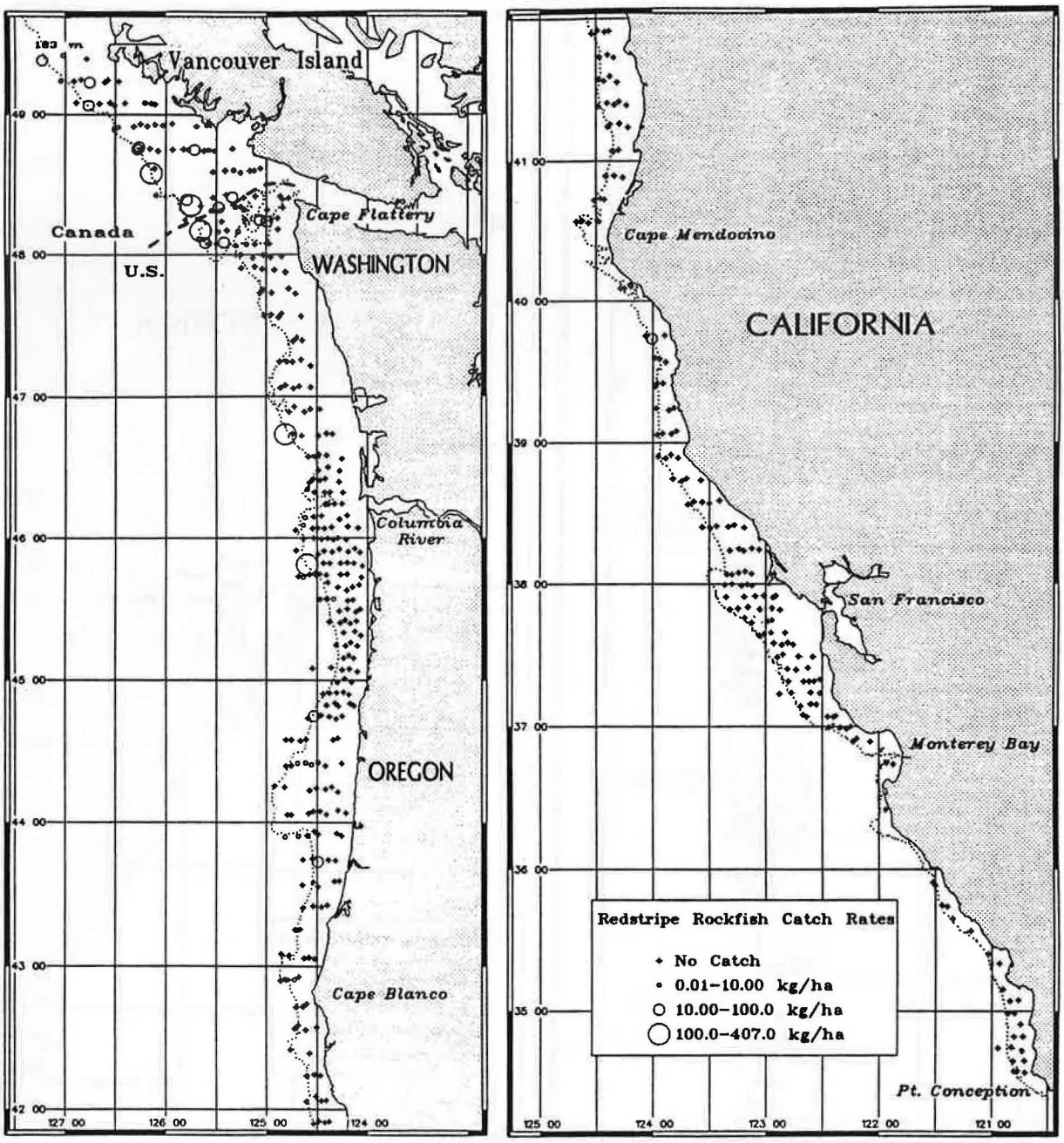


Figure 20.--Redstripe rockfish distribution and relative abundance measured in catch rates (kg/ha) from the 1992 West Coast triennial bottom trawl survey.

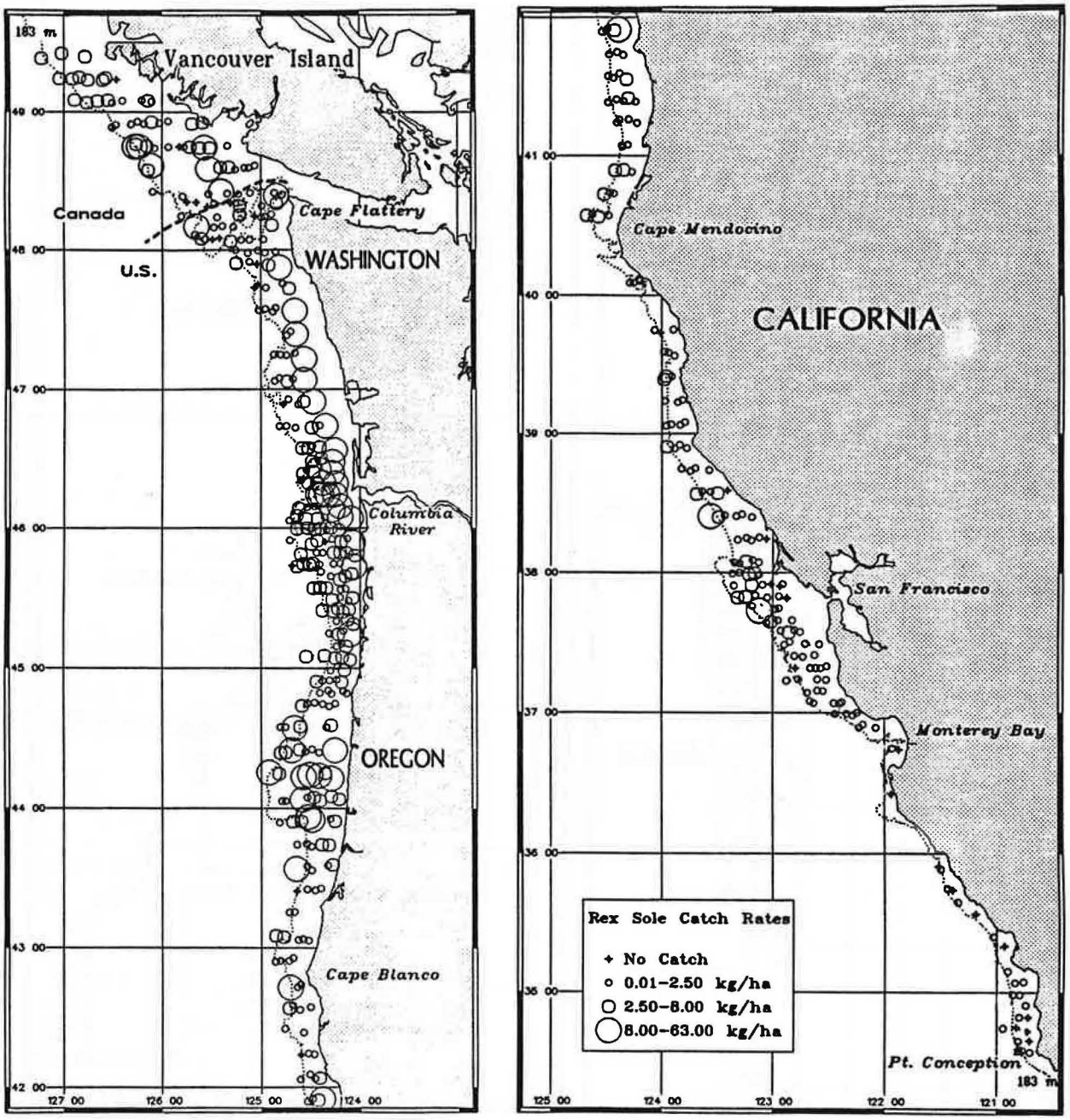


Figure 21.--Rex sole distribution and relative abundance measured in catch rates (kg/ha) from the 1992 West Coast triennial bottom trawl survey.

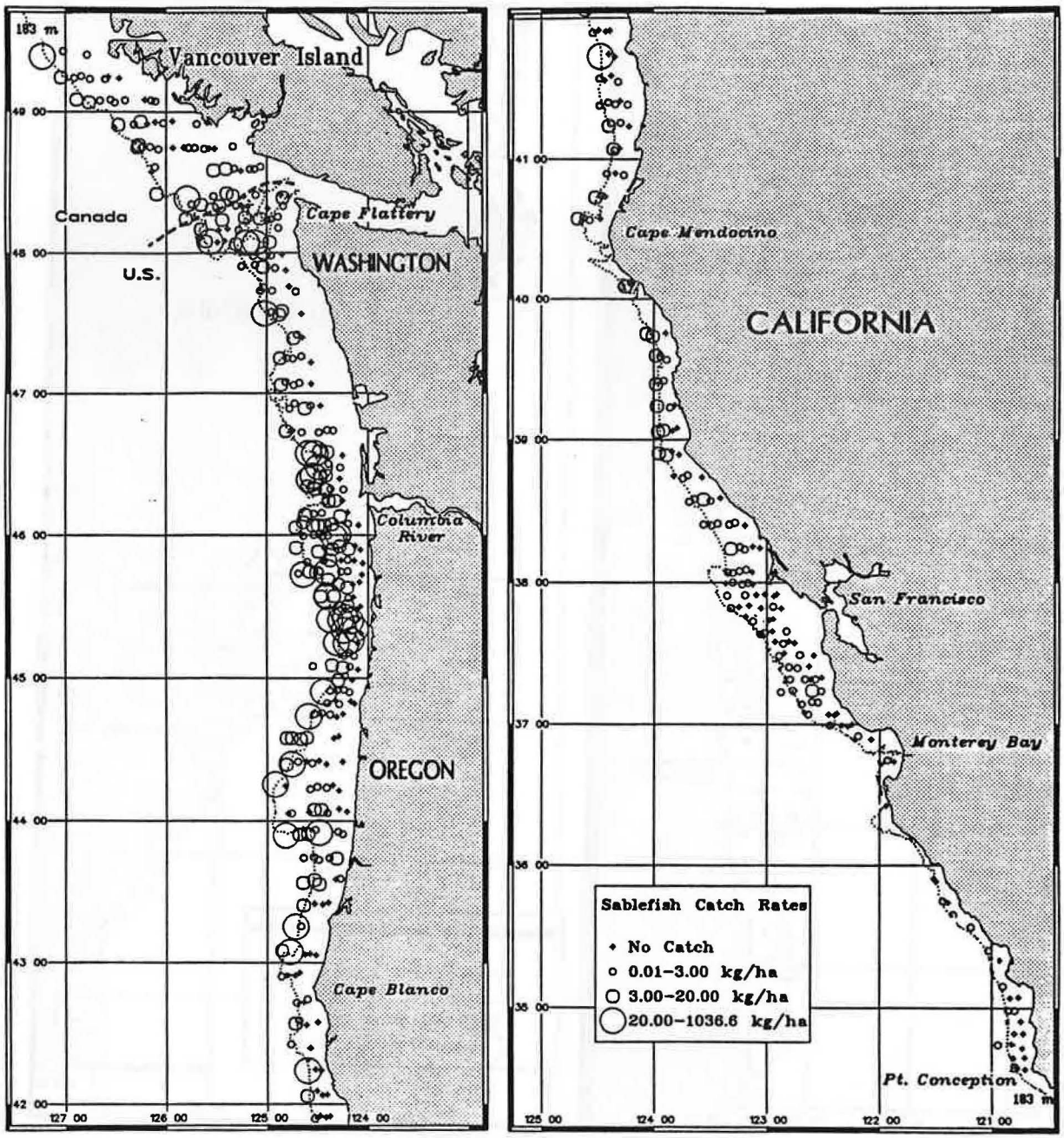


Figure 22.--Sablefish distribution and relative abundance measured in catch rates (kg/ha) from the 1992 West Coast triennial bottom trawl survey.

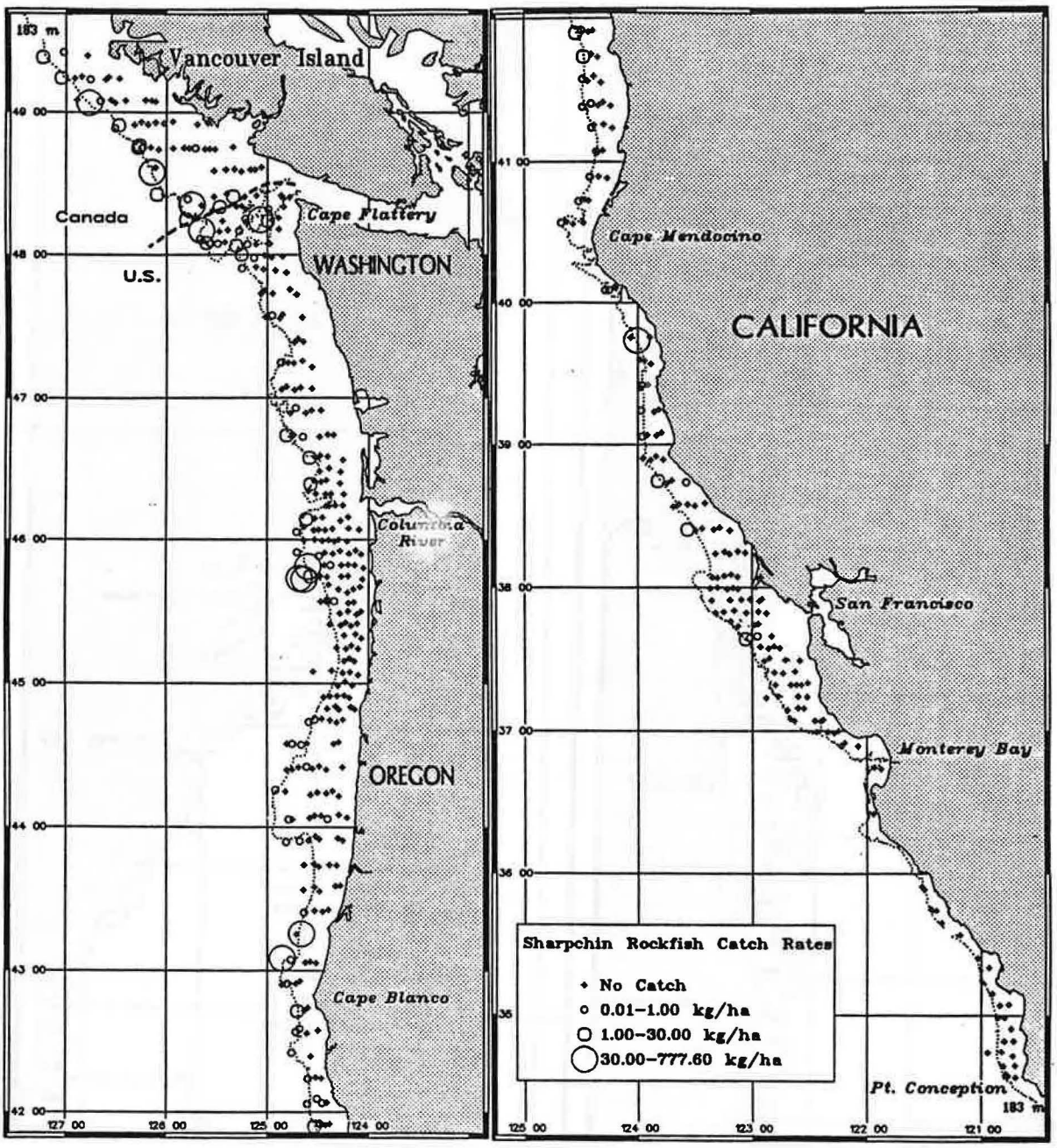


Figure 23.--Sharpchin rockfish distribution and relative abundance measured in catch rates (kg/ha) from the 1992 West Coast triennial bottom trawl survey.

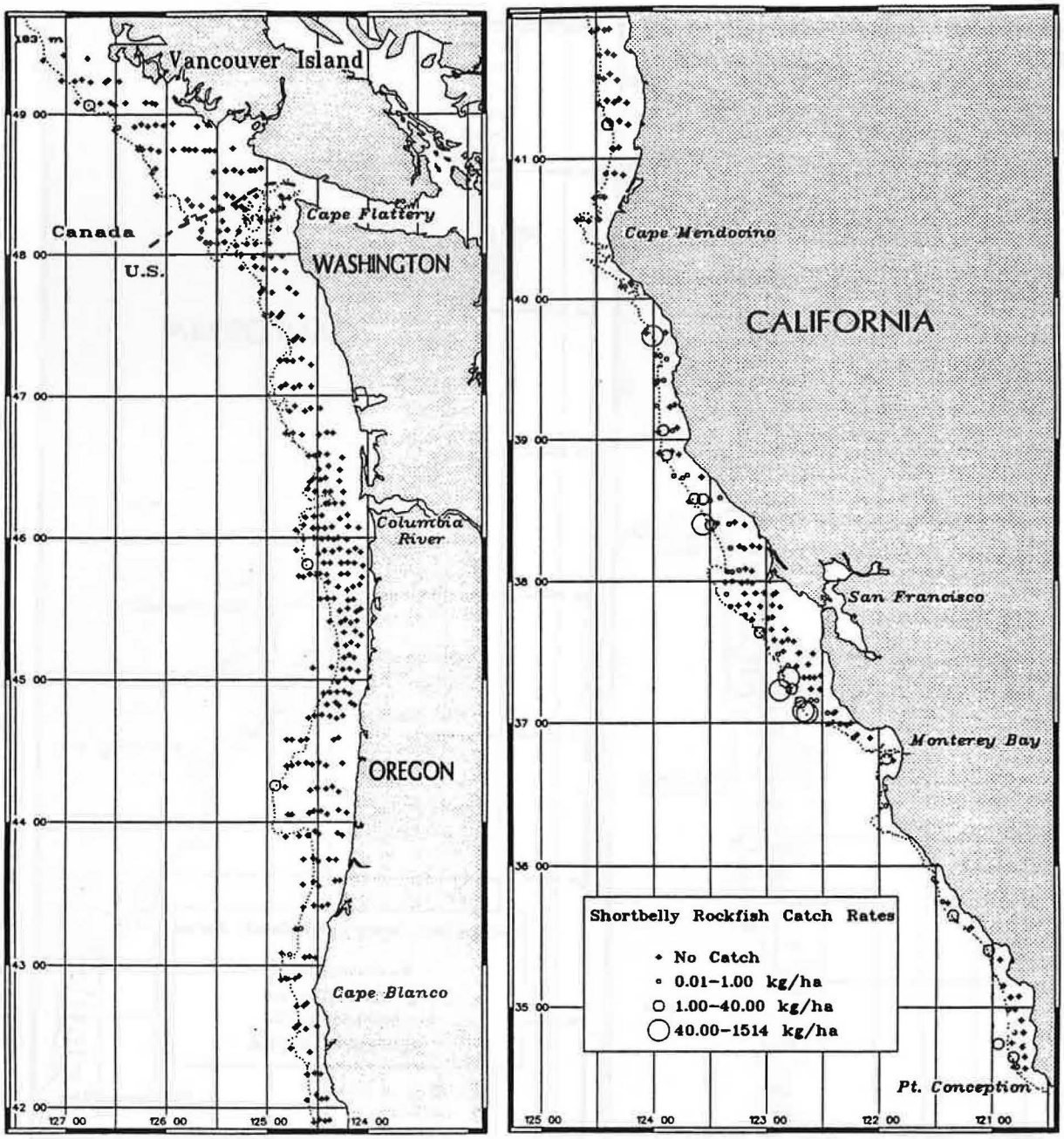


Figure 24.--Shortbelly rockfish distribution and relative abundance measured in catch rates (kg/ha) from the 1992 West Coast triennial bottom trawl survey.

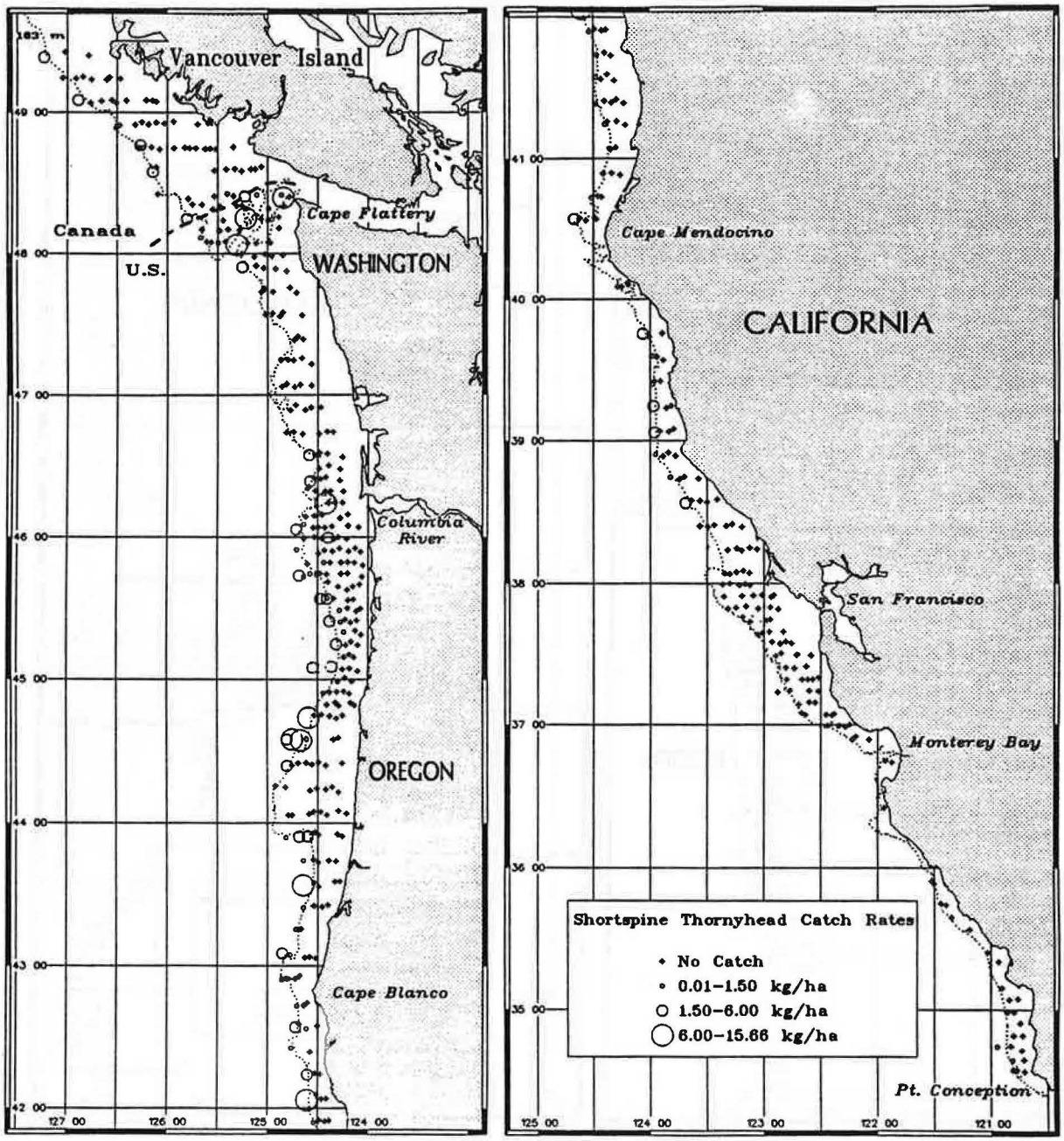


Figure 25.--Shortspine thornyhead distribution and relative abundance measured in catch rates (kg/ha) from the 1992 West Coast triennial bottom trawl survey.

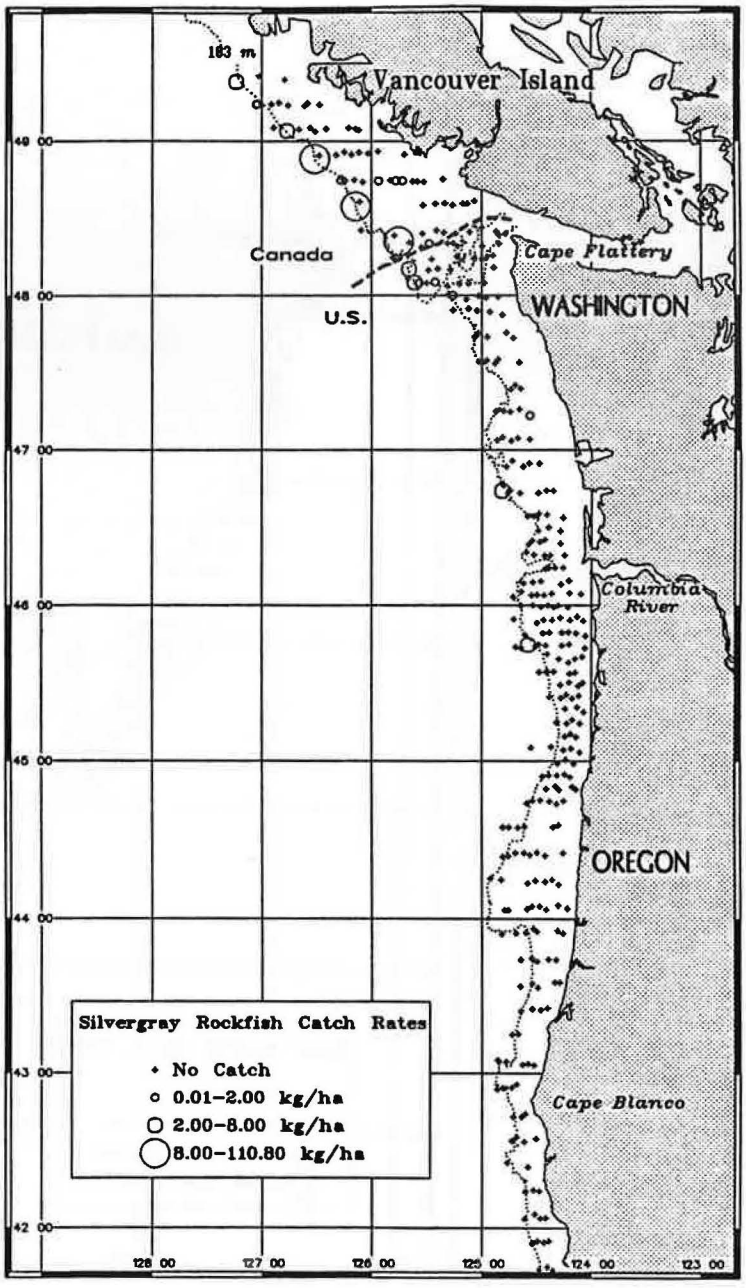


Figure 26.--Silvergray rockfish distribution and relative abundance measured in catch rates (kg/ha) from the 1992 West Coast triennial bottom trawl survey.

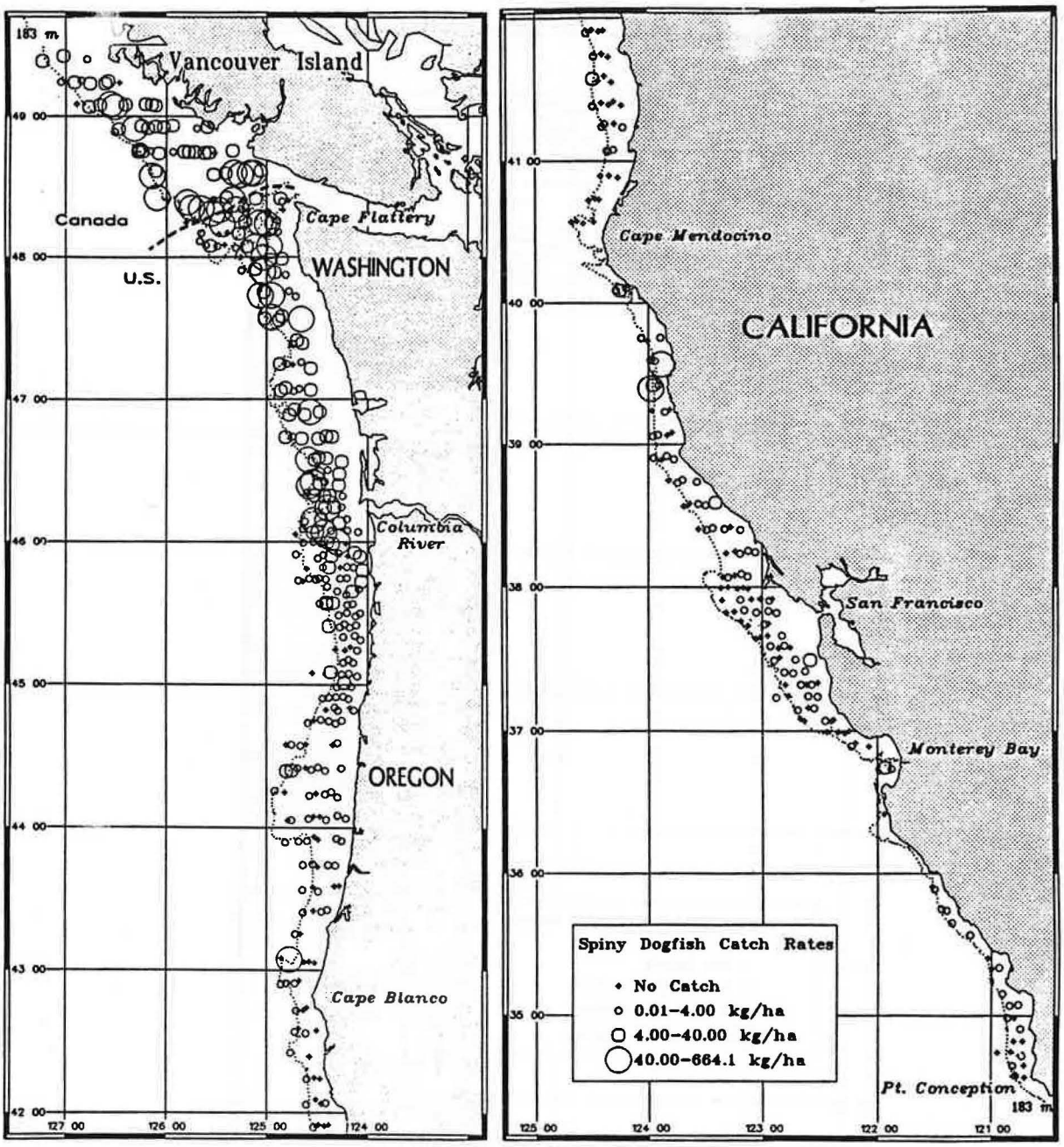


Figure 27.--Spiny dogfish distribution and relative abundance measured in catch rates (kg/ha) from the 1992 West Coast triennial bottom trawl survey.

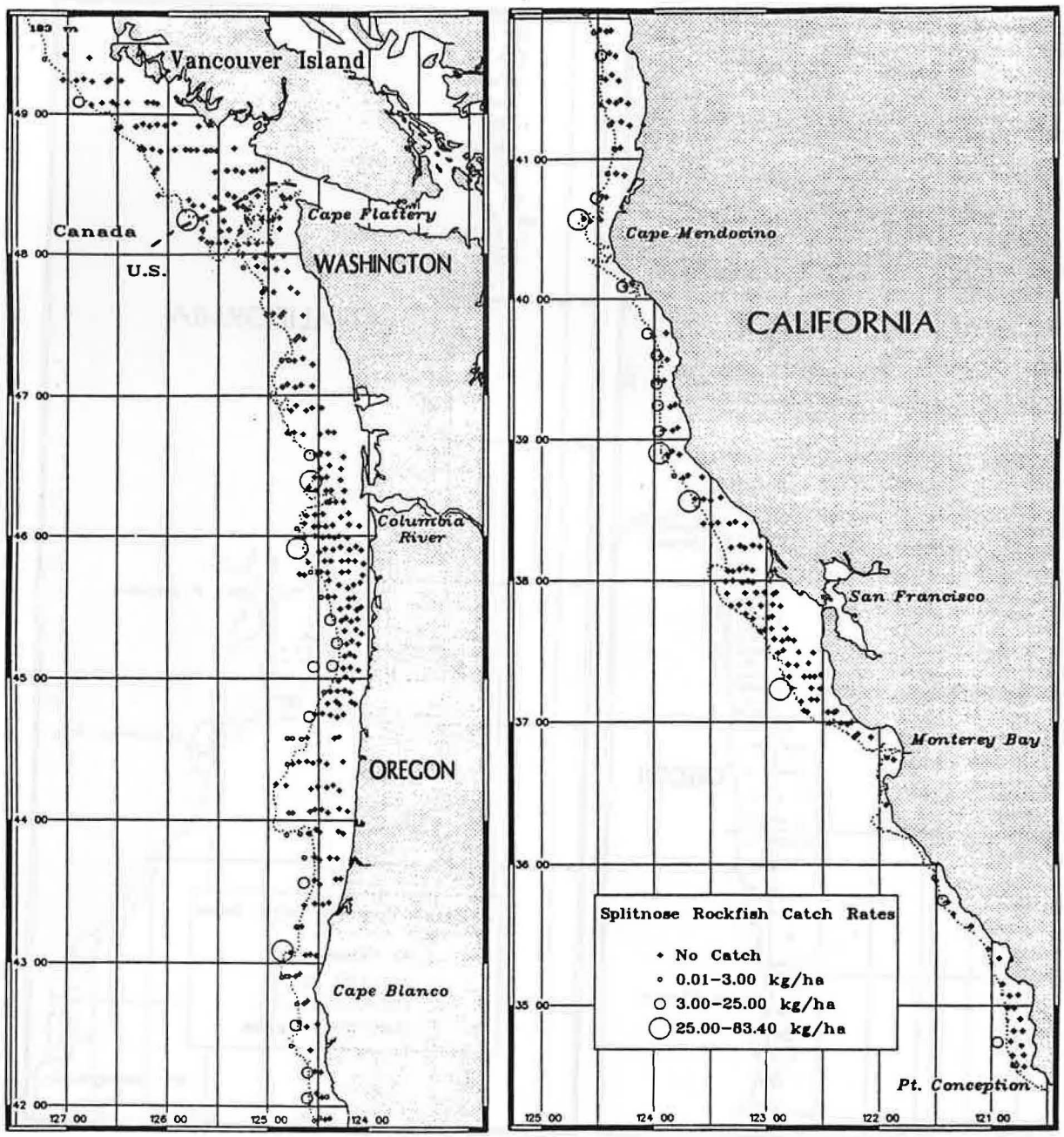


Figure 28.--Splitnose rockfish distribution and relative abundance measured in catch rates (kg/ha) from the 1992 West Coast triennial bottom trawl survey.

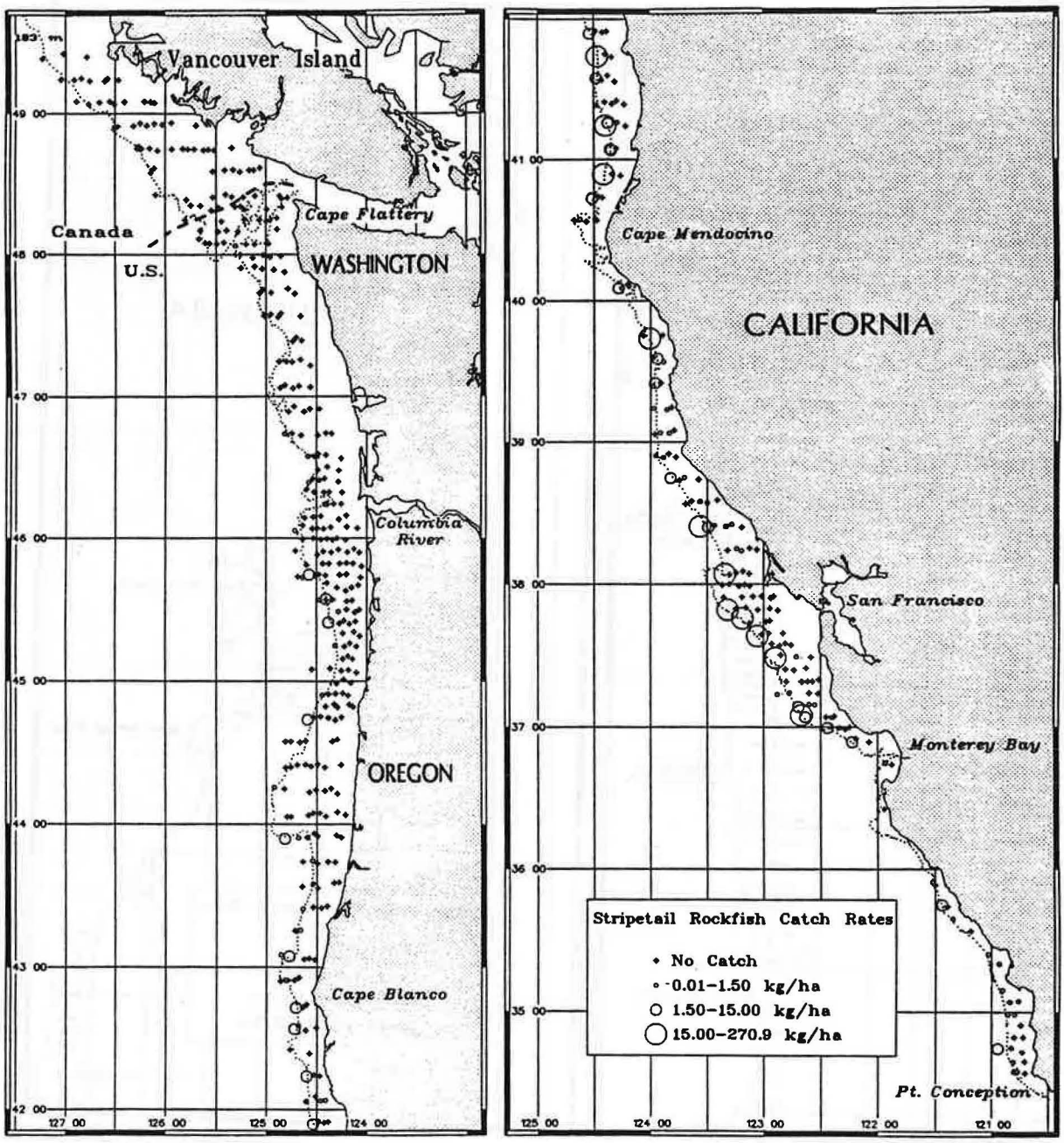


Figure 29.--Stripetail rockfish distribution and relative abundance measured in catch rates (kg/ha) from the 1992 West Coast triennial bottom trawl survey.

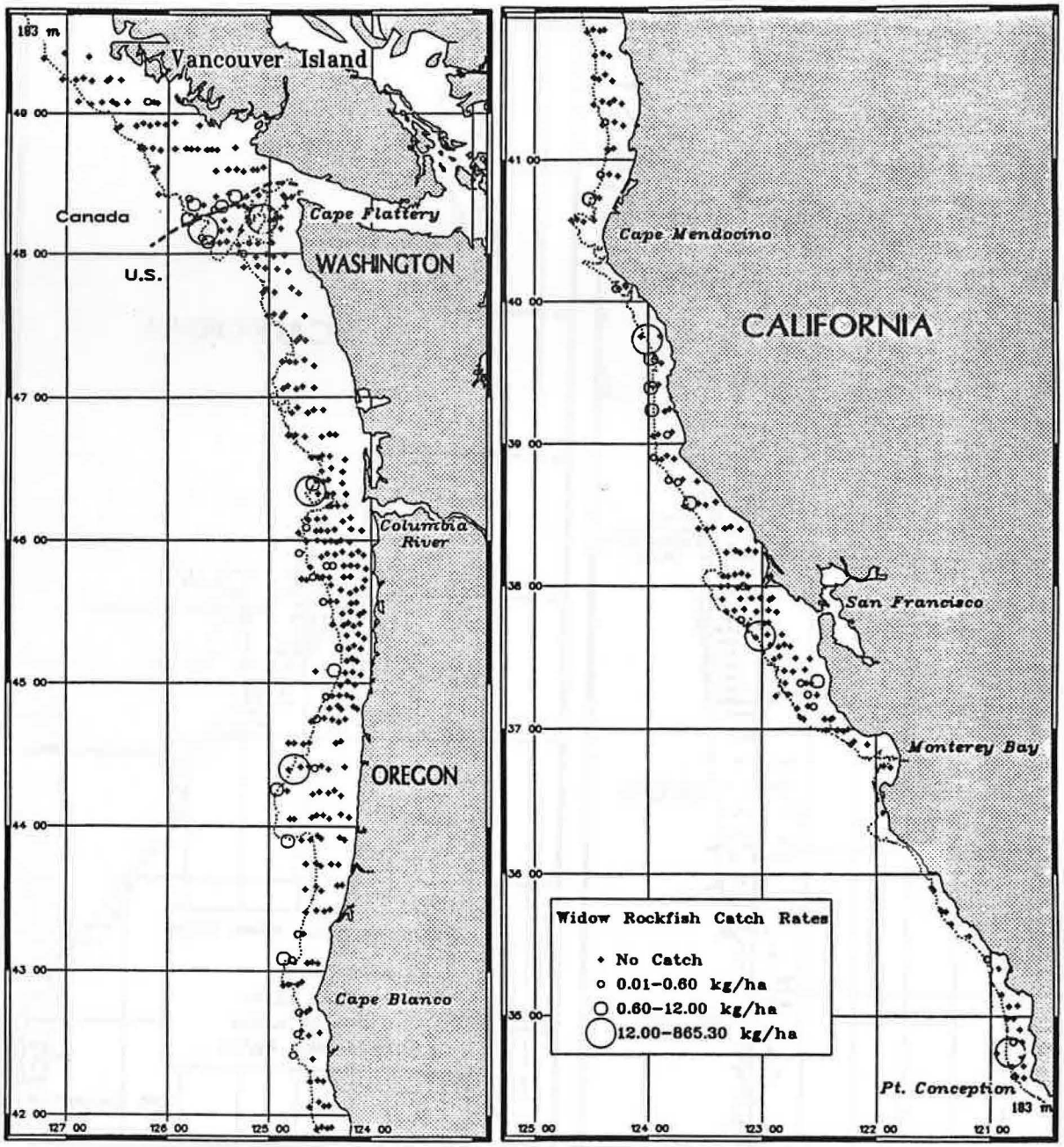


Figure 30.--Widow rockfish distribution and relative abundance measured in catch rates (kg/ha) from the 1992 West Coast triennial bottom trawl survey.

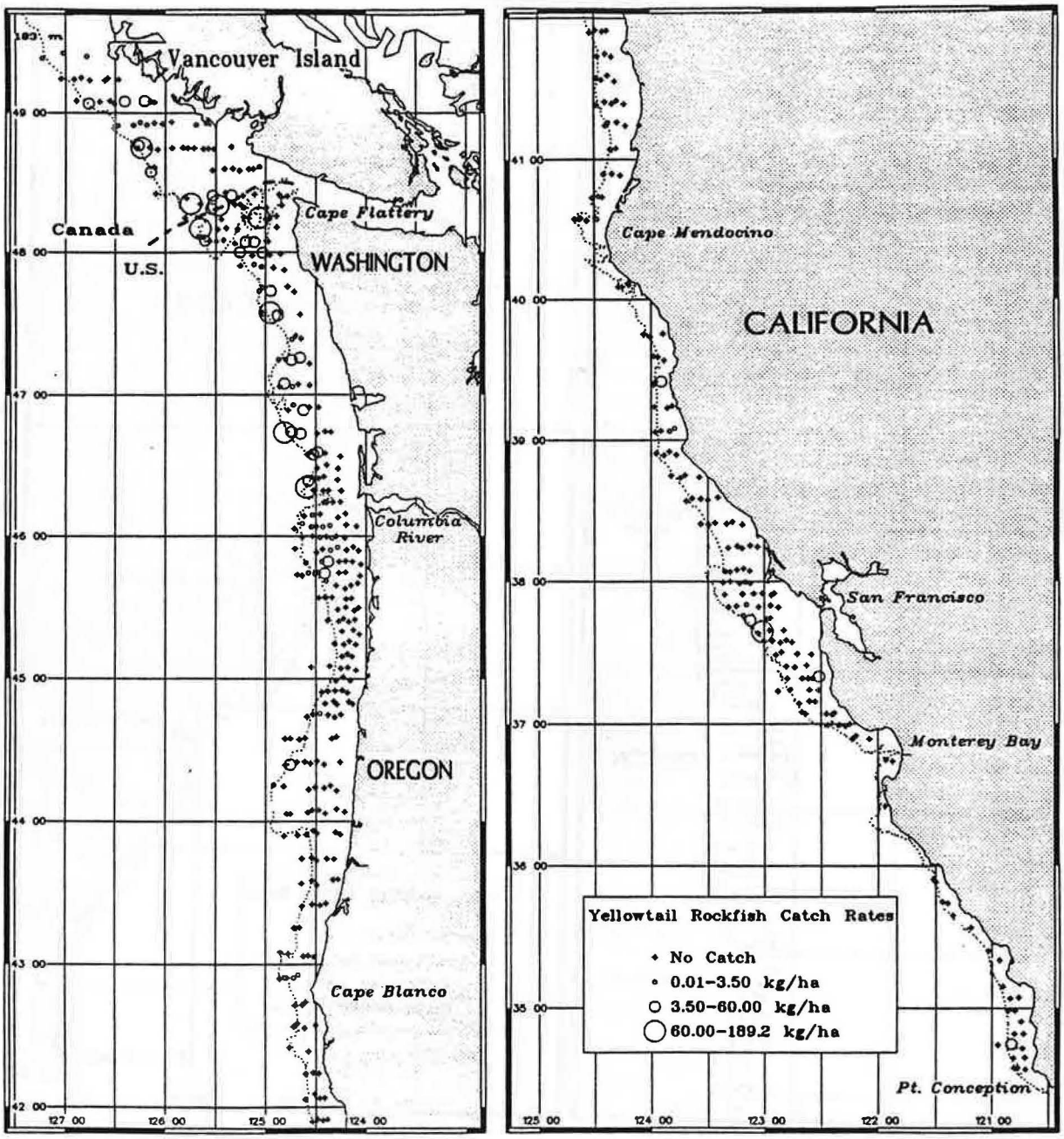


Figure 31.--Yellowtail rockfish distribution and relative abundance measured in catch rates (kg/ha) from the 1992 West Coast triennial bottom trawl survey.

## Biomass and Population Estimates

Abundance estimates in tons (t) of biomass and associated 90% confidence intervals are presented for various taxa in the total survey and by INPFC area and depth stratum in Tables 7-9. Similarly, estimates of population numbers are presented for important species groups in Tables 10-12. Detailed listings of biomass and population estimates are presented for the major species in Appendix C, located in the Data Appendices volume.

The on-bottom component of the Pacific hake population was estimated to be 352,538 t for the entire area (Table 7). Two of the five INPFC areas accounted for 95% of the total estimated Pacific hake biomass: 67% in the Columbia INPFC area and 27% in the Vancouver INPFC area. Sixteen percent was in Canadian waters (57,342 t). Pacific hake biomass in the shallow stratum was estimated to be 312,403 t (Table 8), or 89% of the total, while 40,136 t was in the deep stratum (Table 9).

The total sablefish biomass estimate was 60,812 t (Table 7). The Columbia and Vancouver INPFC areas contributed 78% and 18%, respectively, of the total sablefish biomass between the depths of 55 and 366 m. Sablefish in Canadian waters (3,654 t) amounted to 6% of the total. The sablefish biomass estimate in the shallow stratum was 21,088 t (Table 8) or 35% of the total and 39,724 t in the deep stratum (Table 9) or 65% of the total.

We should warn readers that the biomass and population estimates presented are likely to be conservative since only a

portion of the stock may be available to the bottom trawl and some escapement may occur. For lack of data on species-by-species catchability, abundance calculations are based on the assumption that all fish in front of the trawl and between the wingtips are captured. The degree of conservative bias will vary among species. For instance, a large portion of the total Pacific hake stock is pelagic and would be missed by a bottom trawl. Also, because roller gear is used, escapement underneath the trawl is likely to occur, particularly for the flatfish species. Furthermore, the survey covers limited portions of the depth and geographic range of many of these species.

As mentioned previously, this survey targets many species and provides general information where it lacks in specific information. This survey is the only fishery-independent source of information on the abundance, distribution, and length and age-composition for many of these species. Stock assessment scientists utilize our survey results, along with commercial catch data, in order to set the most appropriate catch levels.

Table 7.--Estimates of fish biomass from the 1992 West Coast groundfish survey by International North Pacific Fisheries Commission (INPFC) area for the combined depth strata (55-366 m). Confidence intervals are expressed as a percentage of the point estimate. "T" denotes trace value. Differences in totals result from rounding.

| Taxon | Estimated biomass (t) and 90% confidence interval | % of total fish biomass | Estimated biomass (t) by INPFC subarea and 90% confidence interval | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Conception | Monterey | Eureka | Columbia | US-Vancouver | Can-Vancouver | Vancouver |
| **Cartilaginous** | | | | | | | | | |
| Spiny dogfish | 78,499 ± 25 | 8.52 | 81 ± 60 | 3,271 ± 91 | 199 ± 72 | 15,427 ± 24 | 20,118 ± 60 | 39,405 ± 35 | 59,523 ± 32 |
| Skates and rays | 6,983 ± 20 | 0.76 | 52 ± 108 | 777 ± 54 | 280 ± 61 | 2,953 ± 29 | 1,038 ± 34 | 1,883 ± 45 | 2,922 ± 33 |
| Sharks | 78,774 ± 25 | 8.55 | 100 ± 59 | 3,488 ± 86 | 222 ± 66 | 15,441 ± 24 | 20,118 ± 60 | 39,405 ± 35 | 59,523 ± 32 |
| Total cartilaginous | 88,452 ± 22 | 9.60 | 161 ± 62 | 4,491 ± 67 | 650 ± 43 | 19,259 ± 19 | 21,545 ± 56 | 42,345 ± 32 | 63,891 ± 30 |
| **Flatfish** | | | | | | | | | |
| Arrowtooth flounder | 13,283 ± 25 | 1.44 | - | 1 ± 300 | 390 ± 31 | 2,786 ± 19 | 2,202 ± 26 | 7,903 ± 39 | 10,105 ± 33 |
| Dover sole | 21,024 ± 16 | 2.28 | 77 ± 436 | 1,750 ± 68 | 1,767 ± 47 | 8,373 ± 17 | 1,906 ± 29 | 7,152 ± 34 | 9,057 ± 31 |
| English sole | 12,151 ± 15 | 1.32 | 19 ± 74 | 1,746 ± 23 | 358 ± 40 | 6,858 ± 21 | 1,247 ± 39 | 1,923 ± 28 | 3,170 ± 24 |
| Pacific halibut | 6,575 ± 26 | 0.71 | - | 132 ± 106 | 200 ± 67 | 3,476 ± 30 | 1,748 ± 65 | 1,020 ± 46 | 2,767 ± 48 |
| Pacific sanddab | 19,821 ± 18 | 2.15 | 245 ± 47 | 3,339 ± 32 | 2,356 ± 60 | 11,869 ± 25 | 982 ± 39 | 1,029 ± 61 | 2,011 ± 38 |
| Petrale sole | 2,108 ± 13 | 0.23 | 5 ± 100 | 271 ± 27 | 200 ± 40 | 1,068 ± 18 | 205 ± 42 | 360 ± 34 | 564 ± 28 |
| Rex sole | 16,027 ± 12 | 1.74 | 57 ± 372 | 1,197 ± 22 | 948 ± 31 | 9,108 ± 15 | 1,443 ± 29 | 3,275 ± 26 | 4,718 ± 21 |
| Total flatfish | 95,628 ± 9 | 10.38 | 417 ± 62 | 8,669 ± 19 | 6,280 ± 28 | 45,009 ± 12 | 10,263 ± 17 | 24,991 ± 21 | 35,254 ± 17 |
| **Rockfish** | | | | | | | | | |
| Shortspine thornyhead | 2,207 ± 24 | 0.24 | 6 ± 50 | 146 ± 43 | 140 ± 74 | 1,335 ± 33 | 306 ± 65 | 275 ± 56 | 581 ± 48 |
| Bocaccio | 2,330 ± 71 | 0.25 | 525 ± 149 | 586 ± 71 | 21 ± 119 | 74 ± 234 | 197 ± 140 | 746 ± 120 | 944 ± 123 |
| Canary | 3,228 ± 50 | 0.35 | - | 88 ± 70 | 17 ± 88 | 1,262 ± 85 | 584 ± 70 | 1,277 ± 60 | 1,861 ± 49 |

Table 7.--Continued.

| Taxon | Estimated biomass (t) and 90% confidence interval | % of total fish biomass | Estimated biomass (t) by INPFC subarea and 90% confidence interval | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Conception | Monterey | Eureka | Columbia | US-Vancouver | Can-Vancouver | Vancouver |
| Rockfish (cont.) | | | | | | | | | |
| Chilipepper | 24,231 ± 112 | 2.63 | 1,044 ± 65 | 23,165 ± 117 | 22 ± 59 | - | - | - | - |
| Darkblotched | 7,177 ± 72 | 0.78 | - | 301 ± 96 | 440 ± 56 | 5,757 ± 89 | 330 ± 75 | 350 ± 100 | 680 ± 62 |
| Greenstriped | 5,999 ± 24 | 0.65 | 2 ± 150 | 328 ± 55 | 111 ± 73 | 3,552 ± 27 | 793 ± 67 | 1,213 ± 66 | 2,006 ± 51 |
| Pacific ocean perch | 12,568 ± 81 | 1.36 | - | 3 ± 167 | 65 ± 103 | 2,243 ± 84 | 5,358 ± 117 | 4,899 ± 130 | 10,257 ± 98 |
| Redstripe | 22,573 ± 52 | 2.45 | - | 163 ± 169 | 1 | 5,856 ± 109 | 7,392 ± 90 | 9,161 ± 61 | 16,554 ± 57 |
| Sharpchin | 21,592 ± 84 | 2.34 | - | 1,136 ± 150 | 115 ± 79 | 15,858 ± 113 | 1,922 ± 58 | 2,561 ± 61 | 4,483 ± 47 |
| Shortbelly | 24,254 ± 90 | 2.63 | 207 ± 97 | 23,855 ± 91 | 111 ± 174 | 50 ± 106 | 1 ± 300 | 29 ± 169 | 31 ± 165 |
| Silvergray | 2,179 ± 136 | 0.24 | - | - | - | 70 ± 134 | 524 ± 134 | 1,584 ± 143 | 2,109 ± 141 |
| Splitnose | 7,464 ± 43 | 0.81 | 721 ± 512 | 2,714 ± 91 | 573 ± 88 | 2,906 ± 71 | 411 ± 160 | 139 ± 130 | 550 ± 134 |
| Stripetail | 8,004 ± 52 | 0.87 | 757 ± 517 | 5,745 ± 68 | 1,119 ± 57 | 380 ± 72 | 3 ± 167 | - | 3 ± 167 |
| Widow | 12,765 ± 139 | 1.39 | 457 ± 173 | 11,226 ± 158 | 21 ± 95 | 627 ± 79 | 266 ± 103 | 168 ± 96 | 434 ± 78 |
| Yellowtail | 19,034 ± 44 | 2.07 | 95 ± 169 | 668 ± 114 | 74 ± 96 | 5,365 ± 67 | 5,169 ± 80 | 7,627 ± 75 | 12,795 ± 58 |
| Total rockfish | 186,389 ± 29 | 20.24 | 4,544 ± 81 | 70,671 ± 62 | 2,858 ± 34 | 50,100 ± 44 | 26,695 ± 54 | 31,522 ± 47 | 58,216 ± 39 |
| Other fish | | | | | | | | | |
| Lingcod | 7,461 ± 61 | 0.81 | 21 ± 81 | 489 ± 50 | 148 ± 57 | 3,009 ± 107 | 1,051 ± 94 | 2,743 ± 62 | 3,793 ± 53 |
| Pacific hake | 352,538 ± 20 | 38.27 | 1,893 ± 549 | 11,856 ± 37 | 4,971 ± 42 | 237,913 ± 21 | 38,564 ± 40 | 57,342 ± 65 | 95,905 ± 44 |
| Sablefish | 60,812 ± 42 | 6.60 | 59 ± 422 | 1,144 ± 29 | 1,174 ± 69 | 47,322 ± 50 | 7,459 ± 117 | 3,654 ± 58 | 11,113 ± 87 |
| Total fish | 921,117 ± 11 | 100.00 | 7,797 ± 263 | 119,613 ± 37 | 33,929 ± 49 | 464,883 ± 14 | 113,393 ± 27 | 181,502 ± 24 | 294,895 ± 19 |

Table 8.--Estimates of fish biomass from the 1992 West Coast groundfish survey by International North Pacific Fisheries Commission (INPFC) area for the shallow depth stratum (55-183 m). Confidence intervals are expressed as a percentage of the point estimate. "T" denotes trace value. Differences in totals result from rounding.

| Taxon | Estimated biomass (t) and 90% confidence interval | % of shallow fish biomass | Estimated biomass (t) by INPFC subareas and 90% confidence interval | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Conception | Monterey | Eureka | Columbia | US-Vancouver | Can-Vancouver | Vancouver |
| **Cartilaginous** | | | | | | | | | |
| Spiny dogfish | 69,505 ± 28 | 9.53 | 81 ± 60 | 1,688 ± 74 | 70 ± 107 | 11,582 ± 27 | 18,479 ± 65 | 37,605 ± 36 | 56,084 ± 34 |
| Skates and rays | 5,576 ± 20 | 0.76 | 52 ± 108 | 765 ± 54 | 222 ± 75 | 2,161 ± 36 | 704 ± 41 | 1,673 ± 50 | 2,377 ± 39 |
| Sharks | 69,742 ± 28 | 9.57 | 100 ± 59 | 1,905 ± 66 | 70 ± 107 | 11,582 ± 27 | 18,479 ± 65 | 37,605 ± 36 | 56,084 ± 34 |
| Total cartilaginous | 76,781 ± 25 | 10.53 | 161 ± 62 | 2,888 ± 46 | 421 ± 58 | 14,137 ± 22 | 19,262 ± 62 | 39,911 ± 34 | 59,173 ± 32 |
| **Flatfish** | | | | | | | | | |
| Arrowtooth flounder | 9,502 ± 33 | 1.30 | - | 1 ± 300 | 203 ± 38 | 1,565 ± 19 | 1,093 ± 39 | 6,640 ± 45 | 7,733 ± 41 |
| Dover sole | 10,777 ± 22 | 1.48 | 1 ± 200 | 144 ± 45 | 397 ± 83 | 4,413 ± 21 | 837 ± 26 | 4,985 ± 40 | 5,822 ± 36 |
| English sole | 11,285 ± 16 | 1.55 | 19 ± 74 | 1,438 ± 26 | 301 ± 42 | 6,493 ± 21 | 1,152 ± 41 | 1,881 ± 29 | 3,034 ± 25 |
| Pacific halibut | 4,019 ± 29 | 0.55 | - | 132 ± 106 | 137 ± 91 | 2,136 ± 40 | 815 ± 73 | 799 ± 56 | 1,614 ± 48 |
| Pacific sanddab | 19,819 ± 18 | 2.72 | 245 ± 47 | 3,337 ± 32 | 2,356 ± 60 | 11,869 ± 25 | 982 ± 39 | 1,029 ± 61 | 2,011 ± 38 |
| Petrale sole | 1,890 ± 14 | 0.26 | 5 ± 100 | 247 ± 29 | 168 ± 44 | 972 ± 18 | 179 ± 48 | 318 ± 37 | 497 ± 31 |
| Rex sole | 12,908 ± 14 | 1.77 | 4 ± 75 | 879 ± 22 | 729 ± 37 | 7,386 ± 18 | 1,086 ± 38 | 2,823 ± 30 | 3,909 ± 25 |
| Total flatfish | 74,445 ± 11 | 10.21 | 289 ± 41 | 6,400 ± 22 | 4,336 ± 35 | 36,114 ± 14 | 6,537 ± 22 | 20,768 ± 24 | 27,305 ± 20 |
| **Rockfish** | | | | | | | | | |
| Shortspine thornyhead | 115 ± 62 | 0.02 | - | - | T | 36 ± 69 | 6 ± 67 | 73 ± 85 | 79 ± 82 |
| Bocaccio | 1,434 ± 91 | 0.20 | 485 ± 161 | 516 ± 79 | - | - | 16 ± 75 | 249 ± 85 | 265 ± 84 |
| Canary | 2,591 ± 59 | 0.36 | - | 88 ± 70 | 11 ± 109 | 1,007 ± 100 | 429 ± 90 | 1,056 ± 69 | 1,485 ± 58 |

Table 8.--Continued.

| Taxon | Estimated biomass (t) and 90% confidence interval | % of shallow fish biomass | Estimated biomass (t) by INPFC subarea and 90% confidence interval | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Conception | Monterey | Eureka | Columbia | US-Vancouver | Can-Vancouver | Vancouver |
| Rockfish (cont.) | | | | | | | | | |
| Chilipepper | 23,056 ± 118 | 3.16 | 811 ± 84 | 22,241 ± 122 | 5 ± 140 | - | - | - | - |
| Darkblotched | 1,580 ± 42 | 0.22 | - | 6 ± 100 | 122 ± 140 | 912 ± 46 | 206 ± 61 | 335 ± 104 | 541 ± 71 |
| Greenstriped | 4,362 ± 30 | 0.60 | 2 ± 150 | 314 ± 57 | 68 ± 115 | 2,480 ± 35 | 555 ± 93 | 943 ± 80 | 1,498 ± 64 |
| Pacific ocean perch | 820 ± 73 | 0.11 | - | 1 | 6 ± 83 | 65 ± 102 | 54 ± 69 | 695 ± 81 | 749 ± 79 |
| Redstripe | 15,801 ± 57 | 2.17 | - | 163 ± 169 | 1 | 3,412 ± 118 | 5,479 ± 118 | 6,746 ± 61 | 12,225 ± 66 |
| Sharpchin | 4,891 ± 54 | 0.67 | - | 1,024 ± 166 | 5 ± 100 | 1,066 ± 109 | 1,088 ± 88 | 1,708 ± 75 | 2,796 ± 60 |
| Shortbelly | 13,611 ± 123 | 1.87 | 94 ± 102 | 13,453 ± 124 | T | 33 ± 142 | 1 ± 300 | 29 ± 169 | 31 ± 165 |
| Silvergray | 289 ± 85 | 0.04 | - | - | - | 5 ± 180 | 71 ± 94 | 213 ± 106 | 284 ± 86 |
| Splitnose | 23 ± 91 | T | - | - | 9 ± 156 | 3 ± 133 | 1 ± 200 | 9 ± 156 | 11 ± 127 |
| Stripetail | 3,849 ± 81 | 0.53 | 10 ± 110 | 3,715 ± 84 | 120 ± 98 | 4 ± 125 | - | - | - |
| Widow | 12,393 ± 143 | 1.70 | 457 ± 173 | 11,176 ± 158 | 5 ± 160 | 344 ± 124 | 246 ± 111 | 166 ± 98 | 412 ± 82 |
| Yellowtail | 17,216 ± 47 | 2.36 | 95 ± 169 | 668 ± 114 | 71 ± 100 | 4,081 ± 71 | 4,704 ± 88 | 7,560 ± 76 | 12,264 ± 60 |
| Total rockfish | 110,679 ± 41 | 15.18 | 2,663 ± 92 | 53,718 ± 76 | 435 ± 74 | 17,097 ± 48 | 15,967 ± 78 | 20,799 ± 56 | 36,766 ± 49 |
| Other fish | | | | | | | | | |
| Lingcod | 7,021 ± 65 | 0.96 | 21 ± 81 | 489 ± 50 | 60 ± 67 | 2,872 ± 112 | 955 ± 103 | 2,624 ± 65 | 3,579 ± 56 |
| Pacific hake | 312,403 ± 22 | 42.85 | 259 ± 139 | 6,054 ± 50 | 1,950 ± 65 | 211,760 ± 23 | 36,507 ± 42 | 55,873 ± 67 | 92,380 ± 46 |
| Sablefish | 21,088 ± 49 | 2.89 | 6 ± 83 | 699 ± 43 | 44 ± 59 | 10,783 ± 36 | 6,646 ± 132 | 2,910 ± 71 | 9,555 ± 101 |
| Total fish | 729,000 ± 13 | 100.00 | 4,084 ± 59 | 92,507 ± 45 | 24,802 ± 66 | 353,237 ± 16 | 93,061 ± 32 | 161,309 ± 27 | 254,370 ± 22 |

Table 9.--Estimates of fish biomass from the 1992 West Coast groundfish survey by International North Pacific Fisheries Commission (INPFC) area for the deep depth stratum (184-366 m). Confidence intervals are expressed as a percentage of the point estimate. "T" denotes trace value. Differences in totals result from rounding.

| Taxon | Estimated biomass (t) and 90% confidence interval | % of deep fish biomass | Estimated biomass (t) by INPFC subarea and 90% confidence interval | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Conception | Monterey | Eureka | Columbia | US-Vancouver | Can-Vancouver | Vancouver |
| **Cartilaginous** | | | | | | | | | |
| Spiny dogfish | 8,994 ± 48 | 4.68 | - | 1,583 ± 177 | 129 ± 97 | 3,845 ± 59 | 1,638 ± 58 | 1,800 ± 110 | 3,438 ± 77 |
| Skates and rays | 1,407 ± 38 | 0.73 | - | 12 ± 158 | 58 ± 71 | 792 ± 48 | 334 ± 63 | 210 ± 109 | 544 ± 65 |
| Sharks | 9,032 ± 48 | 4.70 | - | 1,583 ± 177 | 152 ± 85 | 3,721 ± 65 | 1,638 ± 58 | 1,800 ± 110 | 3,438 ± 77 |
| Total cartilaginous | 11,670 ± 36 | 6.07 | - | 1,602 ± 175 | 229 ± 65 | 5,122 ± 41 | 2,283 ± 40 | 2,434 ± 81 | 4,717 ± 55 |
| **Flatfish** | | | | | | | | | |
| Arrowtooth flounder | 3,781 ± 32 | 1.97 | - | - | 188 ± 51 | 1,221 ± 35 | 1,110 ± 35 | 1,262 ± 67 | 2,372 ± 47 |
| Dover sole | 10,247 ± 24 | 5.33 | 76 ± 441 | 1,606 ± 74 | 1,370 ± 57 | 3,959 ± 29 | 1,069 ± 48 | 2,167 ± 72 | 3,235 ± 64 |
| English sole | 866 ± 41 | 0.45 | - | 307 ± 56 | 56 ± 130 | 366 ± 81 | 95 ± 100 | 42 ± 81 | 137 ± 80 |
| Pacific halibut | 2,555 ± 49 | 1.33 | - | - | 63 ± 79 | 1,339 ± 47 | 933 ± 109 | 220 ± 59 | 1,153 ± 97 |
| Pacific sanddab | 2 ± 650 | T | - | 2 ± 600 | - | - | T | - | T |
| Petrale sole | 218 ± 37 | 0.11 | - | 25 ± 84 | 31 ± 106 | 95 ± 65 | 26 ± 50 | 42 ± 57 | 67 ± 49 |
| Rex sole | 3,119 ± 19 | 1.62 | 52 ± 410 | 317 ± 62 | 218 ± 51 | 1,721 ± 27 | 357 ± 29 | 452 ± 56 | 810 ± 41 |
| Total flatfish | 21,183 ± 18 | 11.03 | 128 ± 428 | 2,269 ± 53 | 1,944 ± 49 | 8,895 ± 20 | 3,725 ± 30 | 4,223 ± 56 | 7,949 ± 40 |
| **Rockfish** | | | | | | | | | |
| Shortspine thornyhead | 2,092 ± 25 | 1.09 | 6 ± 33 | 146 ± 43 | 140 ± 73 | 1,299 ± 34 | 300 ± 67 | 201 ± 74 | 502 ± 54 |
| Bocaccio | 896 ± 131 | 0.47 | 40 ± 83 | 70 ± 443 | 21 ± 119 | 74 ± 234 | 181 ± 152 | 497 ± 177 | 678 ± 170 |
| Canary | 637 ± 113 | 0.33 | - | - | 7 ± 114 | 255 ± 252 | 155 ± 110 | 221 ± 116 | 376 ± 93 |

Table 9.--Continued.

| Taxon | Estimated biomass (t) and 90% confidence interval | % of deep fish biomass | Estimated biomass (t) by INPFC subarea and 90% confidence interval | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Conception | Monterey | Eureka | Columbia | US-Vancouver | Can-Vancouver | Vancouver |
| Rockfish (cont.) | | | | | | | | | |
| Chilipepper | 1,174 ± 90 | 0.61 | 233 ± 83 | 924 ± 115 | 17 ± 65 | - | - | - | - |
| Darkblotched | 5,597 ± 92 | 2.91 | - | 295 ± 98 | 318 ± 58 | 4,846 ± 106 | 124 ± 227 | 15 ± 100 | 139 ± 204 |
| Greenstriped | 1,637 ± 37 | 0.85 | - | 14 ± 121 | 43 ± 53 | 1,072 ± 43 | 238 ± 61 | 271 ± 111 | 508 ± 80 |
| Pacific ocean perch | 11,748 ± 86 | 6.12 | - | 2 ± 250 | 59 ± 112 | 2,178 ± 86 | 5,304 ± 119 | 4,204 ± 151 | 9,508 ± 105 |
| Redstripe | 6,772 ± 122 | 3.52 | - | - | - | 2,443 ± 289 | 1,914 ± 104 | 2,415 ± 170 | 4,329 ± 127 |
| Sharpchin | 16,701 ± 108 | 8.69 | - | 112 ± 124 | 110 ± 83 | 14,793 ± 121 | 834 ± 72 | 852 ± 118 | 1,686 ± 83 |
| Shortbelly | 10,644 ± 142 | 5.54 | 113 ± 361 | 10,403 ± 145 | 111 ± 173 | 17 ± 147 | - | - | - |
| Silvergray | 1,890 ± 156 | 0.98 | - | - | - | 65 ± 152 | 454 ± 154 | 1,371 ± 164 | 1,825 ± 162 |
| Splitnose | 7,441 ± 43 | 3.87 | 721 ± 512 | 2,714 ± 91 | 564 ± 90 | 2,903 ± 71 | 410 ± 161 | 130 ± 138 | 540 ± 137 |
| Stripetail | 4,155 ± 69 | 2.16 | 747 ± 524 | 2,030 ± 124 | 999 ± 63 | 376 ± 72 | 3 ± 167 | - | 3 ± 167 |
| Widow | 372 ± 71 | 0.19 | - | 50 ± 66 | 16 ± 119 | 283 ± 93 | 20 ± 105 | 2 ± 100 | 22 ± 105 |
| Yellowtail | 1,819 ± 235 | 0.95 | - | - | 3 ± 133 | 1,285 ± 255 | 464 ± 221 | 67 ± 149 | 531 ± 160 |
| Total rockfish | 75,710 ± 39 | 39.41 | 1,880 ± 397 | 16,953 ± 101 | 2,422 ± 38 | 33,003 ± 63 | 10,728 ± 72 | 10,722 ± 92 | 21,450 ± 67 |
| Other fish | | | | | | | | | |
| Lingcod | 440 ± 56 | 0.23 | - | - | 88 ± 85 | 138 ± 129 | 96 ± 64 | 119 ± 88 | 215 ± 67 |
| Pacific hake | 40,136 ± 24 | 20.89 | 1,834 ± 631 | 5,802 ± 59 | 3,022 ± 56 | 26,152 ± 32 | 2,057 ± 59 | 1,469 ± 44 | 3,526 ± 43 |
| Sablefish | 39,724 ± 59 | 20.68 | 53 ± 468 | 445 ± 35 | 1,130 ± 72 | 36,539 ± 64 | 814 ± 25 | 744 ± 65 | 1,558 ± 41 |
| Total fish | 192,116 ± 22 | 100.00 | 3,713 ± 500 | 27,106 ± 64 | 9,127 ± 31 | 111,646 ± 32 | 20,332 ± 39 | 20,193 ± 57 | 40,525 ± 41 |

Table 10.--Estimates of fish population numbers (x 1,000) from the 1992 West Coast groundfish survey by International North Pacific Fisheries Commission (INPFC) area for the combined depth strata (55-366 m). Confidence intervals are expressed as a percentage of the point estimate. "T" denotes trace value. Differences in totals result from rounding.

| Taxon | Estimated total population and 90% confidence interval | Estimated population numbers (x 1,000) by INPFC subarea and 90% confidence interval | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Conception | Monterey | Eureka | Columbia | US-Vancouver | Can-Vancouver | Vancouver |
| **Cartilaginous** | | | | | | | | |
| Spiny dogfish | 69,544 ± 32 | 60 ± 72 | 5,708 ± 92 | 424 ± 72 | 18,135 ± 25 | 23,277 ± 80 | 21,940 ± 33 | 45,217 ± 47 |
| **Flatfish** | | | | | | | | |
| Arrowtooth flounder | 22,150 ± 15 | - | 8 ± 169 | 1,597 ± 27 | 6,373 ± 16 | 3,764 ± 24 | 10,407 ± 28 | 14,172 ± 23 |
| Dover sole | 62,120 ± 13 | 383 ± 417 | 8,259 ± 66 | 5,500 ± 40 | 28,057 ± 17 | 5,290 ± 27 | 14,631 ± 28 | 19,921 ± 26 |
| English sole | 61,711 ± 17 | 94 ± 61 | 10,431 ± 27 | 2,049 ± 40 | 36,404 ± 22 | 5,928 ± 48 | 6,806 ± 36 | 12,734 ± 31 |
| Pacific halibut | 711 ± 26 | - | 11 ± 95 | 26 ± 61 | 337 ± 27 | 214 ± 64 | 122 ± 44 | 336 ± 47 |
| Pacific sanddab | 178,938 ± 17 | 3,121 ± 43 | 36,143 ± 33 | 26,921 ± 58 | 97,198 ± 23 | 7,808 ± 37 | 7,747 ± 58 | 15,555 ± 36 |
| Petrale sole | 5,133 ± 13 | 16 ± 83 | 637 ± 29 | 908 ± 46 | 2,652 ± 16 | 413 ± 46 | 508 ± 32 | 920 ± 29 |
| Rex sole | 133,444 ± 11 | 424 ± 419 | 9,666 ± 19 | 12,620 ± 35 | 84,281 ± 14 | 9,783 ± 29 | 16,670 ± 23 | 26,452 ± 19 |
| **Rockfish** | | | | | | | | |
| Shortspine thornyhead | 15,611 ± 27 | 58 ± 11 | 927 ± 43 | 959 ± 62 | 10,237 ± 37 | 1,988 ± 61 | 1,443 ± 58 | 3,431 ± 47 |
| Bocaccio | 1,773 ± 78 | 641 ± 122 | 782 ± 84 | 11 ± 119 | 20 ± 138 | 45 ± 125 | 168 ± 110 | 213 ± 113 |
| Canary | 3,401 ± 65 | - | 236 ± 71 | 15 ± 74 | 1,179 ± 90 | 427 ± 82 | 1,541 ± 109 | 1,971 ± 91 |
| Chilipepper | 93,976 ± 89 | 10,866 ± 87 | 83,044 ± 100 | 65 ± 71 | - | - | - | - |
| Darkblotched | 21,456 ± 60 | 5 ± 174 | 688 ± 78 | 1,273 ± 54 | 17,034 ± 75 | 1,355 ± 56 | 1,101 ± 77 | 2,456 ± 47 |
| Greenstriped | 23,234 ± 23 | 18 ± 139 | 1,604 ± 55 | 425 ± 66 | 14,388 ± 28 | 2,863 ± 64 | 3,937 ± 69 | 6,800 ± 51 |

Table 10.--Continued.

| Taxon | Estimated total population and 90% confidence interval | Estimated population numbers (x 1,000) by INPFC subareas and 90% confidence interval | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Conception | Monterey | Eureka | Columbia | US-Vancouver | Can-Vancouver | Vancouver |
| Rockfish (cont.) | | | | | | | | |
| Pacific ocean perch | 21,616 ± 65 | - | 11 ± 129 | 307 ± 88 | 4,334 ± 74 | 7,027 ± 91 | 9,937 ± 98 | 16,964 ± 80 |
| Redstripe | 62,316 ± 48 | - | 470 ± 169 | 6 ± 169 | 17,239 ± 100 | 20,137 ± 81 | 24,464 ± 58 | 44,601 ± 53 |
| Sharpchin | 106,381 ± 85 | - | 5,695 ± 143 | 575 ± 73 | 81,657 ± 110 | 8,193 ± 67 | 10,260 ± 67 | 18,453 ± 52 |
| Shortbelly | 290,887 ± 101 | 3,735 ± 73 | 285,740 ± 101 | 782 ± 173 | 379 ± 122 | 11 ± 164 | 240 ± 164 | 251 ± 164 |
| Silvergray | 1,133 ± 134 | - | - | - | 36 ± 122 | 267 ± 135 | 831 ± 140 | 1,097 ± 138 |
| Splitnose | 46,238 ± 47 | 6,337 ± 602 | 13,194 ± 107 | 5,418 ± 67 | 19,643 ± 68 | 1,260 ± 136 | 386 ± 104 | 1,647 ± 116 |
| Stripetail | 80,514 ± 51 | 7,790 ± 446 | 62,270 ± 64 | 7,923 ± 57 | 2,506 ± 67 | 24 ± 225 | T ± 184 | 24 ± 223 |
| Widow | 24,620 ± 149 | 556 ± 172 | 23,150 ± 158 | 25 ± 84 | 514 ± 75 | 226 ± 104 | 150 ± 78 | 367 ± 78 |
| Yellowtail | 15,394 ± 43 | 101 ± 171 | 996 ± 105 | 57 ± 79 | 3,894 ± 69 | 4,393 ± 88 | 5,912 ± 67 | 10,305 ± 56 |
| Other fish | | | | | | | | |
| Lingcod | 3,460 ± 24 | 55 ± 72 | 664 ± 37 | 103 ± 37 | 1,337 ± 38 | 401 ± 47 | 899 ± 44 | 1,300 ± 35 |
| Pacific hake | 674,981 ± 18 | 25,830 ± 535 | 63,256 ± 40 | 17,975 ± 39 | 428,893 ± 20 | 59,908 ± 41 | 79,120 ± 69 | 139,027 ± 45 |
| Sablefish | 63,912 ± 42 | 131 ± 388 | 2,098 ± 32 | 1,164 ± 59 | 50,076 ± 51 | 7,649 ± 117 | 2,793 ± 49 | 10,443 ± 93 |

Table 11.--Estimates of fish population numbers (x 1,000) from the 1992 West Coast groundfish survey by International North Pacific Fisheries Commission (INPFC) area for the shallow depth strata (55-183 m). Confidence intervals are expressed as a percentage of the point estimate. "T" denotes trace value. Differences in totals result from rounding.

| Taxon | Estimated shallow population and 90% confidence interval | Estimated population numbers (x 1,000) by INPFC subares and 90% confidence interval | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Conception | Monterey | Eureka | Columbia | US-Vancouver | Can-Vancouver | Vancouver |
| Cartilaginous | | | | | | | | |
| Spiny dogfish | 58,194 ± 37 | 60 ± 72 | 2,985 ± 78 | 230 ± 124 | 12,902 ± 28 | 21,659 ± 86 | 20,359 ± 35 | 42,017 ± 50 |
| Flatfish | | | | | | | | |
| Arrowtooth flounder | 18,143 ± 18 | - | 8 ± 169 | 1,018 ± 34 | 4,714 ± 19 | 2,720 ± 32 | 9,683 ± 30 | 12,404 ± 26 |
| Dover sole | 32,409 ± 17 | 14 ± 75 | 1,071 ± 43 | 1,748 ± 66 | 17,027 ± 22 | 2,761 ± 33 | 9,789 ± 27 | 12,550 ± 24 |
| English sole | 59,097 ± 17 | 94 ± 61 | 9,308 ± 30 | 1,886 ± 42 | 35,336 ± 23 | 5,755 ± 49 | 6,718 ± 36 | 12,473 ± 31 |
| Pacific halibut | 445 ± 30 | - | 11 ± 95 | 16 ± 85 | 206 ± 32 | 118 ± 79 | 93 ± 55 | 212 ± 54 |
| Pacific sanddab | 178,900 ± 17 | 3,121 ± 43 | 36,107 ± 33 | 26,921 ± 58 | 97,198 ± 23 | 7,806 ± 37 | 7,747 ± 58 | 15,553 ± 36 |
| Petrale sole | 4,800 ± 14 | 16 ± 83 | 592 ± 30 | 813 ± 50 | 2,504 ± 16 | 387 ± 48 | 488 ± 34 | 875 ± 30 |
| Rex sole | 108,903 ± 13 | 56 ± 45 | 7,714 ± 21 | 10,268 ± 42 | 68,495 ± 16 | 7,718 ± 36 | 14,652 ± 25 | 22,370 ± 21 |
| Rockfish | | | | | | | | |
| Shortspine thornyhead | 484 ± 54 | 2 ± 174 | T ± 174 | 3 ± 169 | 182 ± 63 | 34 ± 73 | 273 ± 82 | 307 ± 76 |
| Bocaccio | 1,406 ± 96 | 591 ± 132 | 645 ± 97 | - | - | 5 ± 90 | 66 ± 84 | 71 ± 82 |
| Canary | 3,126 ± 71 | - | 236 ± 71 | 9 ± 95 | 1,062 ± 99 | 365 ± 94 | 1,453 ± 115 | 1,819 ± 98 |
| Chilipepper | 91,567 ± 92 | 10,359 ± 92 | 81,182 ± 103 | 25 ± 149 | - | - | - | - |
| Darkblotched | 7,578 ± 35 | 5 ± 174 | 95 ± 94 | 395 ± 126 | 4,996 ± 38 | 1,016 ± 55 | 1,072 ± 79 | 2,088 ± 50 |
| Greenstriped | 16,893 ± 29 | 18 ± 139 | 1,524 ± 57 | 305 ± 91 | 10,036 ± 36 | 2,011 ± 89 | 3,001 ± 87 | 5,011 ± 66 |

Table 11.--Continued.

| Taxon | Estimated shallow population and 90% confidence interval | Estimated population numbers (x 1,000) by INPFC subarea and 90% confidence interval | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Conception | Monterey | Eureka | Columbia | US-Vancouver | Can-Vancouver | Vancouver |
| Rockfish (cont.) | | | | | | | | |
| Pacific ocean perch | 4,173 ± 56 | - | 8 ± 169 | 94 ± 93 | 409 ± 81 | 414 ± 73 | 3,249 ± 67 | 3,663 ± 63 |
| Redstripe | 46,553 ± 53 | - | 470 ± 169 | 6 ± 169 | 11,749 ± 119 | 15,700 ± 101 | 18,627 ± 58 | 34,328 ± 59 |
| Sharpchin | 24,528 ± 56 | - | 4,969 ± 164 | 32 ± 83 | 7,124 ± 108 | 5,470 ± 96 | 6,932 ± 83 | 12,402 ± 66 |
| Shortbelly | 234,840 ± 122 | 2,415 ± 99 | 231,863 ± 124 | 6 ± 118 | 305 ± 148 | 11 ± 164 | 240 ± 164 | 251 ± 164 |
| Silvergray | 168 ± 66 | - | - | - | 9 ± 169 | 36 ± 88 | 123 ± 82 | 159 ± 69 |
| Splitnose | 245 ± 70 | 2 ± 174 | T ± 174 | 79 ± 155 | 77 ± 100 | 26 ± 90 | 61 ± 117 | 87 ± 89 |
| Stripetail | 42,777 ± 75 | 428 ± 87 | 41,549 ± 77 | 771 ± 85 | 29 ± 109 | - | - | - |
| Widow | 24,301 ± 151 | 556 ± 172 | 23,093 ± 159 | 6 ± 169 | 287 ± 115 | 287 ± 115 | 148 ± 79 | 359 ± 77 |
| Yellowtail | 14,140 ± 45 | 101 ± 171 | 996 ± 105 | 56 ± 82 | 3,004 ± 75 | 4,074 ± 94 | 5,871 ± 67 | 9,944 ± 58 |
| Other fish | | | | | | | | |
| Lingcod | 3,268 ± 25 | 55 ± 72 | 664 ± 37 | 76 ± 44 | 1,252 ± 41 | 360 ± 51 | 861 ± 45 | 1,221 ± 37 |
| Pacific hake | 556,402 ± 20 | 4,220 ± 139 | 42,921 ± 54 | 5,381 ± 57 | 369,620 ± 23 | 57,133 ± 43 | 77,127 ± 70 | 134,259 ± 46 |
| Sablefish | 24,435 ± 44 | 22 ± 82 | 1,572 ± 41 | 90 ± 50 | 13,397 ± 35 | 6,995 ± 128 | 2,358 ± 57 | 9,353 ± 104 |

Table 12.--Estimates of fish population numbers (x 1,000) from the 1992 West Coast groundfish survey by International North Pacific Fisheries Commission (INPFC) area for the deep depth stratum (184-366 m). Confidence intervals are expressed as a percentage of the point estimate. "T" denotes trace value. Differences in totals result from rounding.

| Taxon | Estimated deep population and 90% confidence interval | Estimated population numbers (x 1,000) by INPFC subarea and 90% confidence interval | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Conception | Monterey | Eureka | Columbia | US-Vancouver | Can-Vancouver | Vancouver |
| **Cartilaginous** | | | | | | | | |
| Spiny dogfish | 11,351 ± 54 | - | 2,723 ± 179 | 195 ± 63 | 5,233 ± 60 | 1,618 ± 62 | 1,581 ± 116 | 3,200 ± 78 |
| **Flatfish** | | | | | | | | |
| Arrowtooth | 4,007 ± 21 | - | - | 579 ± 48 | 1,659 ± 35 | 1,044 ± 29 | 724 ± 54 | 1,768 ± 32 |
| Dover sole | 29,711 ± 21 | 369 ± 433 | 7,188 ± 75 | 3,754 ± 51 | 11,030 ± 25 | 2,529 ± 46 | 4,842 ± 70 | 7,371 ± 61 |
| English sole | 2,615 ± 42 | - | 1,123 ± 59 | 163 ± 138 | 1,068 ± 83 | 173 ± 91 | 87 ± 94 | 261 ± 74 |
| Pacific halibut | 266 ± 51 | - | - | 10 ± 86 | 131 ± 50 | 96 ± 113 | 29 ± 63 | 125 ± 96 |
| Pacific sanddab | 38 ± 588 | - | 35 ± 631 | - | - | 2 ± 183 | T ± 184 | 3 ± 183 |
| Petrale sole | 333 ± 45 | - | 45 ± 101 | 95 ± 98 | 148 ± 71 | 26 ± 89 | 20 ± 67 | 45 ± 58 |
| Rex sole | 24,541 ± 19 | 368 ± 482 | 1,952 ± 53 | 2,352 ± 51 | 15,786 ± 27 | 2,065 ± 26 | 2,018 ± 47 | 4,083 ± 32 |
| **Rockfish** | | | | | | | | |
| Shortspine thornyhead | 15,117 ± 28 | 56 ± 23 | 927 ± 43 | 956 ± 62 | 10,055 ± 38 | 1,954 ± 62 | 1,170 ± 70 | 3,124 ± 51 |
| Bocaccio | 367 ± 100 | 49 ± 75 | 137 ± 528 | 11 ± 119 | 20 ± 138 | 39 ± 145 | 103 ± 176 | 142 ± 167 |
| Canary | 274 ± 105 | - | - | 5 ± 127 | 117 ± 226 | 64 ± 107 | 88 ± 112 | 152 ± 89 |
| Chilipepper | 2,409 ± 89 | 507 ± 92 | 1,862 ± 115 | 40 ± 71 | - | - | - | - |
| Darkblotched | 13,877 ± 91 | - | 593 ± 89 | 878 ± 57 | 12,038 ± 105 | 339 ± 233 | 29 ± 107 | 368 ± 216 |
| Greenstriped | 6,341 ± 35 | - | 80 ± 130 | 120 ± 51 | 4,352 ± 40 | 852 ± 54 | 937 ± 103 | 1,789 ± 72 |

Table 12.--Continued.

| Taxon | Estimated deep population and 90% confidence interval | Estimated population numbers (x 1,000) by INPFC subarea and 90% confidence interval | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Conception | Monterey | Eureka | Columbia | US-Vancouver | Can-Vancouver | Vancouver |
| Rockfish (cont.) | | | | | | | | |
| Pacific ocean perch | 17,443 ± 80 | - | 3 ± 183 | 213 ± 121 | 3,925 ± 82 | 6,613 ± 97 | 6,688 ± 144 | 13,302 ± 102 |
| Redstripe | 15,763 ± 122 | - | - | - | 5,489 ± 287 | 4,437 ± 102 | 5,837 ± 172 | 10,273 ± 130 |
| Sharpchin | 81,853 ± 109 | - | 726 ± 120 | 544 ± 77 | 74,533 ± 120 | 2,723 ± 67 | 3,328 ± 126 | 6,051 ± 93 |
| Shortbelly | 56,046 ± 109 | 1,319 ± 326 | 53,877 ± 113 | 775 ± 175 | 74 ± 146 | - | - | - |
| Silvergray | 965 ± 157 | - | - | - | 27 ± 173 | 230 ± 155 | 707 ± 163 | 937 ± 161 |
| Splitnose | 45,993 ± 47 | 6,665 ± 602 | 13,194 ± 107 | 5,339 ± 68 | 19,566 ± 69 | 1,234 ± 139 | 325 ± 122 | 1,559 ± 123 |
| Stripetail | 37,737 ± 74 | 7,362 ± 472 | 20,720 ± 122 | 7,153 ± 63 | 2,478 ± 68 | 24 ± 225 | T ± 184 | 24 ± 223 |
| Widow | 319 ± 66 | - | 56 ± 64 | 19 ± 100 | 227 ± 91 | 15 ± 103 | 2 ± 103 | 17 ± 103 |
| Yellowtail | 1,254 ± 244 | - | - | 2 ± 175 | 891 ± 263 | 320 ± 228 | 41 ± 148 | 361 ± 205 |
| Other fish | | | | | | | | |
| Lingcod | 192 ± 62 | - | - | 27 ± 73 | 85 ± 105 | 41 ± 70 | 38 ± 96 | 79 ± 66 |
| Pacific hake | 118,579 ± 67 | 21,610 ± 631 | 20,335 ± 54 | 12,594 ± 52 | 59,272 ± 33 | 2,775 ± 60 | 1,993 ± 49 | 4,768 ± 44 |
| Sablefish | 39,478 ± 63 | 109 ± 463 | 525 ± 43 | 1,074 ± 64 | 36,679 ± 68 | 654 ± 19 | 435 ± 66 | 1,090 ± 35 |

## Length Composition

Estimated population length compositions for several groundfish species are presented in alphabetical order by sex and INPFC area (Figs. 32-60). Pacific hake and sablefish include length compositions by depth stratum; all depths combined, shallow and deep. The length compositions of the remaining species are presented for the combined depths only. For more detail, Appendix D located in the Data Appendices volume contains listings of estimated length compositions for major species by sex for each INPFC area. These estimates are also available in computer-readable format upon request for any species from which length data were collected.

The Pacific hake length distribution had three modes. For the total survey area, there were small peaks at 23 cm and 35 cm, but the majority of the population was centered at 46 cm (Fig. 41). The overall population mean length was 42.4 cm. Specimens ranged in length from 9 to 90 cm, surveywide. The male and female components of the population were very similar with the average size of females (42.9 cm) being only slightly larger than that of the males (42.2 cm). Generally, only smaller Pacific hake were found in the southern portion of the survey region. The majority of juvenile hake (under 30 cm) were encountered in the Monterey and Conception INPFC areas, where they accounted for 59% and 30% of the total estimated juvenile population, respectively. The majority of hake larger than 40 cm were encountered in the Columbia (71%) and Vancouver (26%) INPFC

areas. Pacific hake lengths averaged 22.9, 28.8, 31.8, 44.4, 46.9 and 48.1 cm for the Conception, Monterey, Eureka, Columbia, U.S. Vancouver and Canadian Vancouver INPFC areas, respectively. Mean lengths of Pacific hake in the shallow stratum of the Columbia area were slightly longer than in the deep stratum due to the presence of a large group of 33-37 cm fish (Figs. 42-43). In other U.S. waters, the mean lengths of hake in shallow strata were shorter than in deep strata, which is the more typical trend (Weinberg et al. 1994). Mean lengths in the shallow and deep strata were about equal in Canada.

Only the shallow end of the sablefish distribution was sampled by the 55-366 m depth bounds of the survey. At these depths, the estimated length distribution for sablefish was generally unimodal with a peak at 46 cm (Fig. 50). Larger fish were present in low numbers; less than 2% of the entire population was longer than 55 cm. Sablefish samples from throughout the survey area ranged from 19 to 93 cm in length, but the overall average length of the population was 45.3 cm. The majority of the population (73%) ranged from 42 to 49 cm in length. The average length of males was 44.9 cm and the average length of females was 46.3 cm. Juveniles (under 42 cm) accounted for the majority of the populations in the Conception (69%) and Monterey (79%) INPFC areas, but they accounted for 25% or less of the populations in all the other INPFC areas. Mean sablefish lengths were lower in the Conception (39.1 cm) and Monterey (39.0 cm) INPFC areas than in the northern areas, where mean

length ranged from 45.3 to 48.7 cm. Mean sablefish lengths in deep strata were greater than in the shallow strata in all INPFC areas (Figs. 51-52).

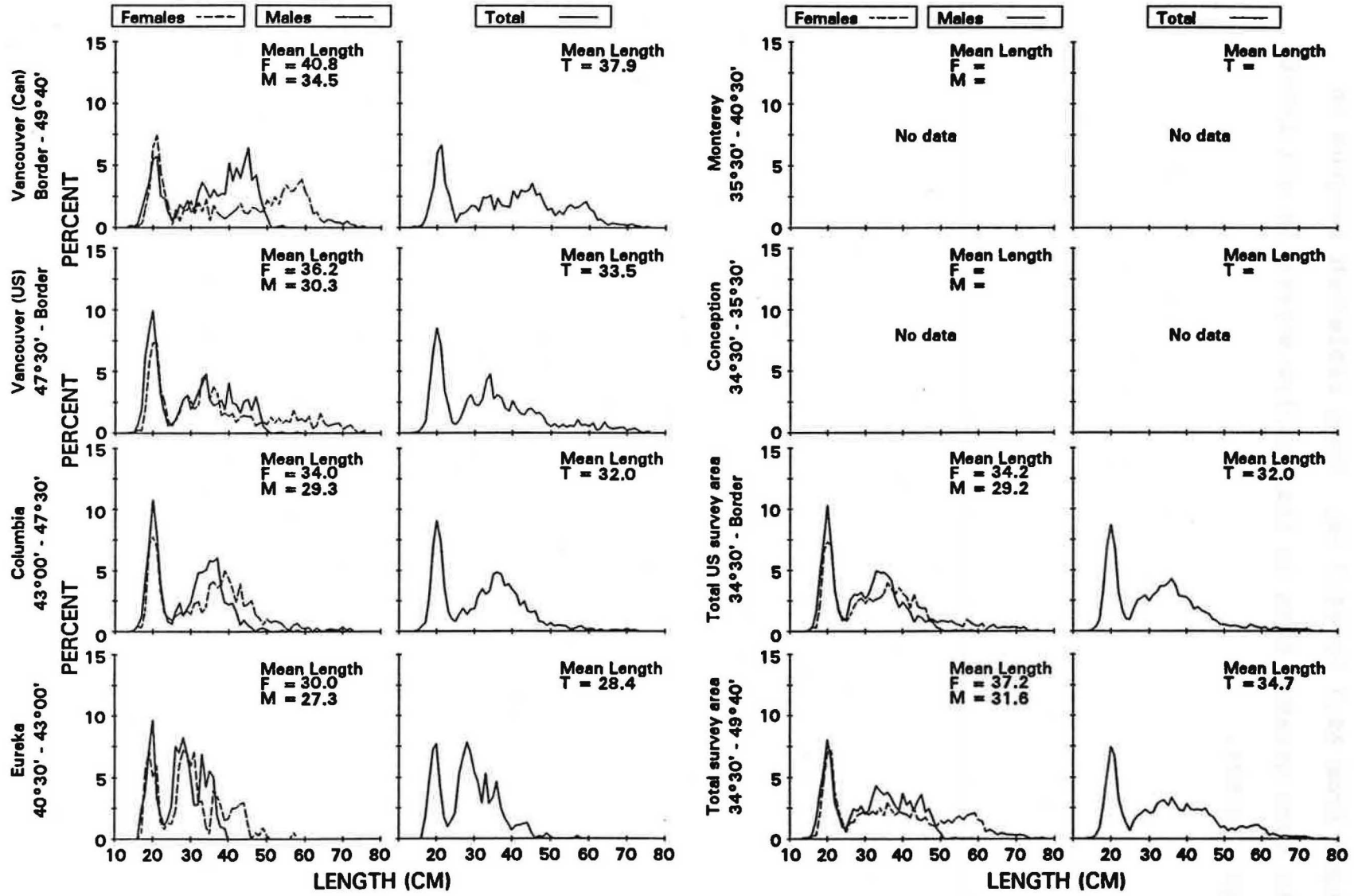


Figure 32.-- Arrowtooth flounder estimated population size composition (weighted by area) by sex and International North Pacific Fisheries Commission area for all depths sampled (55-366 m) from the 1992 bottom trawl survey. Specimens ranged in length from 14 to 77 cm.

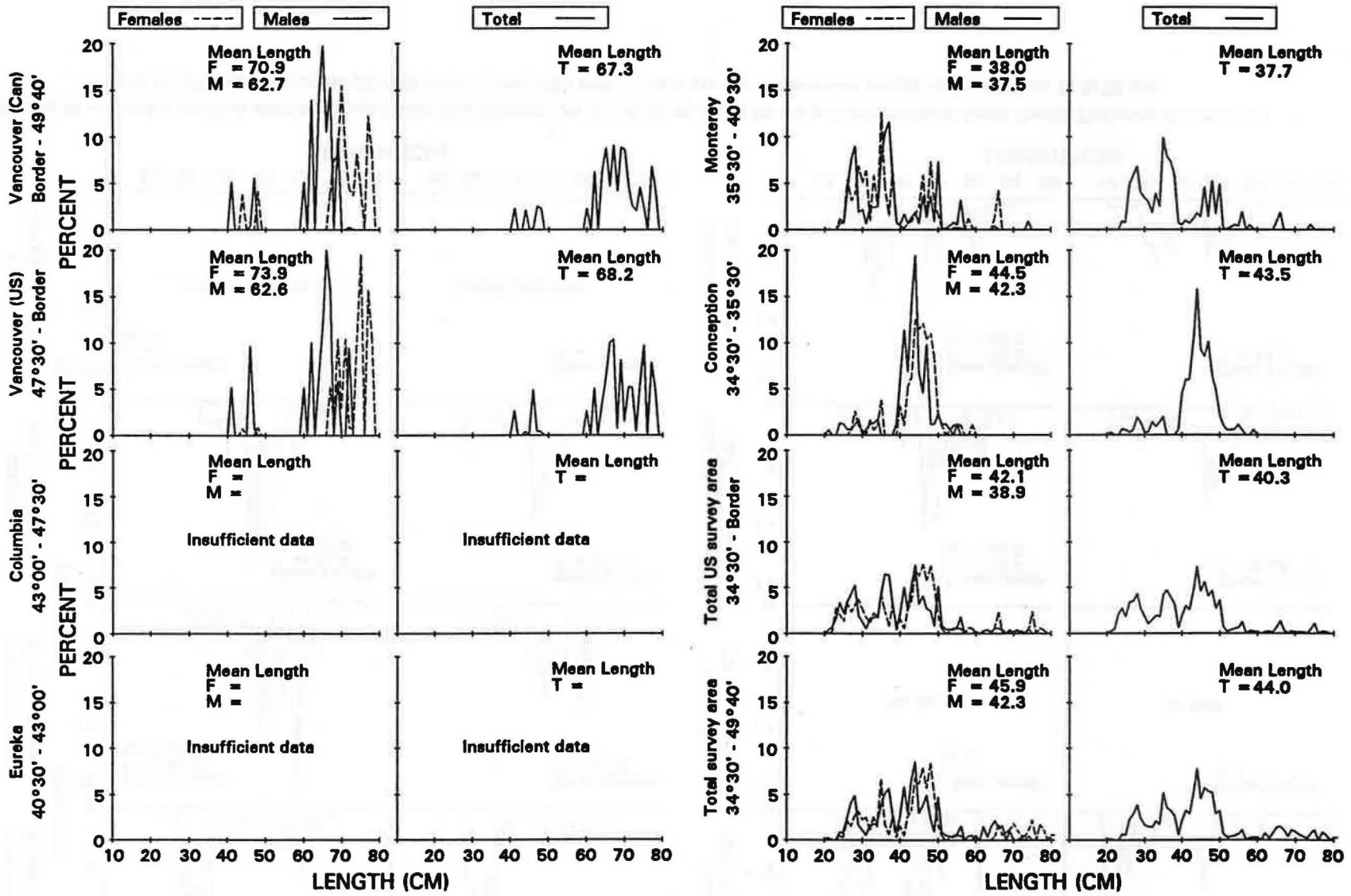


Figure 33.-- Bocaccio estimated population size composition (weighted by area) by sex and International North Pacific Fisheries Commission area for all depths sampled (55-366 m) from the 1992 bottom trawl survey. Specimens ranged in length from 21 to 81 cm. Measured fish falling outside the x-axis scale account for less than 0.1 percent of the total estimated population

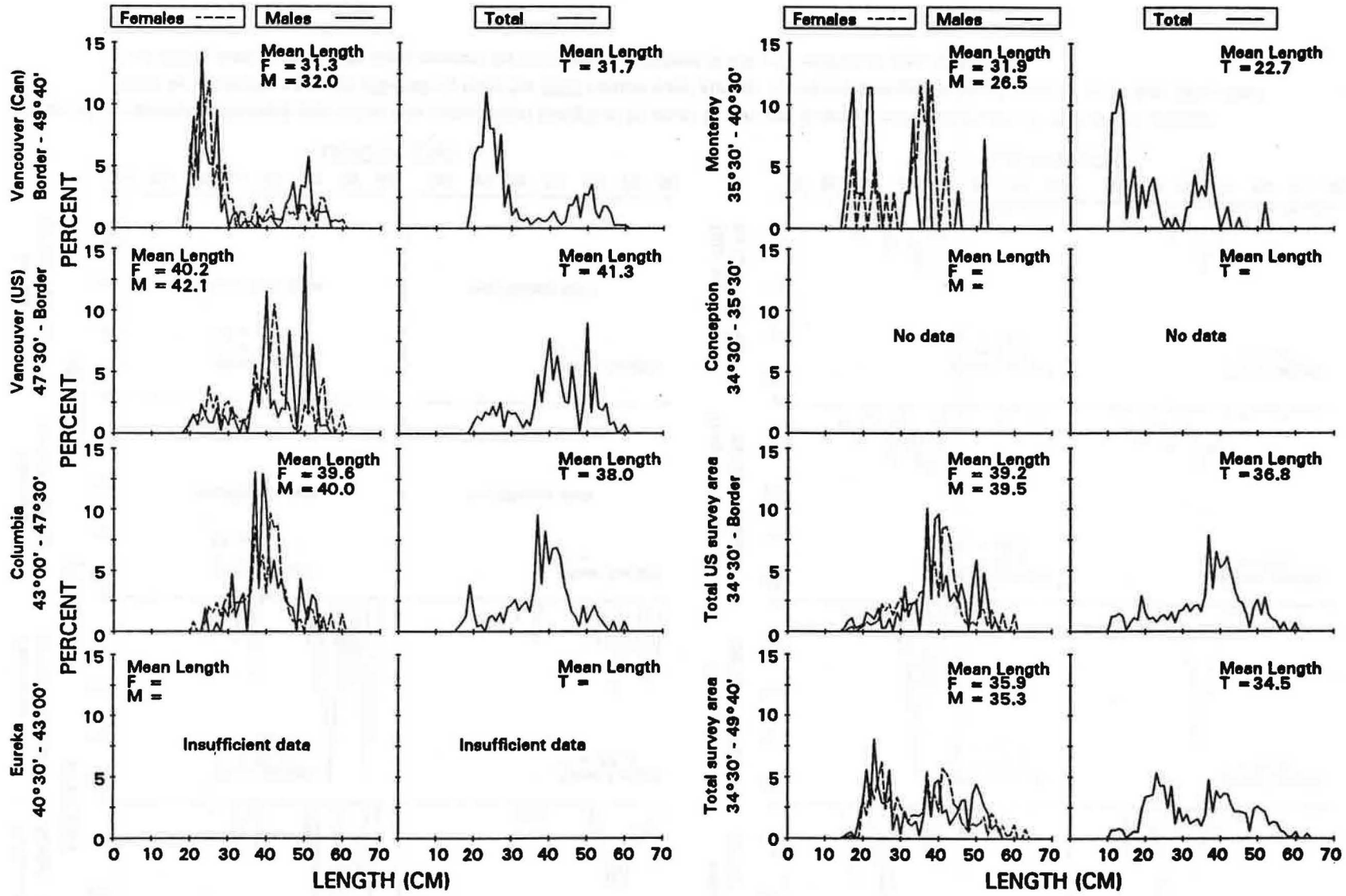


Figure 34.– Canary rockfish estimated population size composition (weighted by area) by sex and International North Pacific Fisheries Commission area for all depths sampled (55-366 m) from the 1992 bottom trawl survey. Specimens ranged in length from 11 to 63 cm.

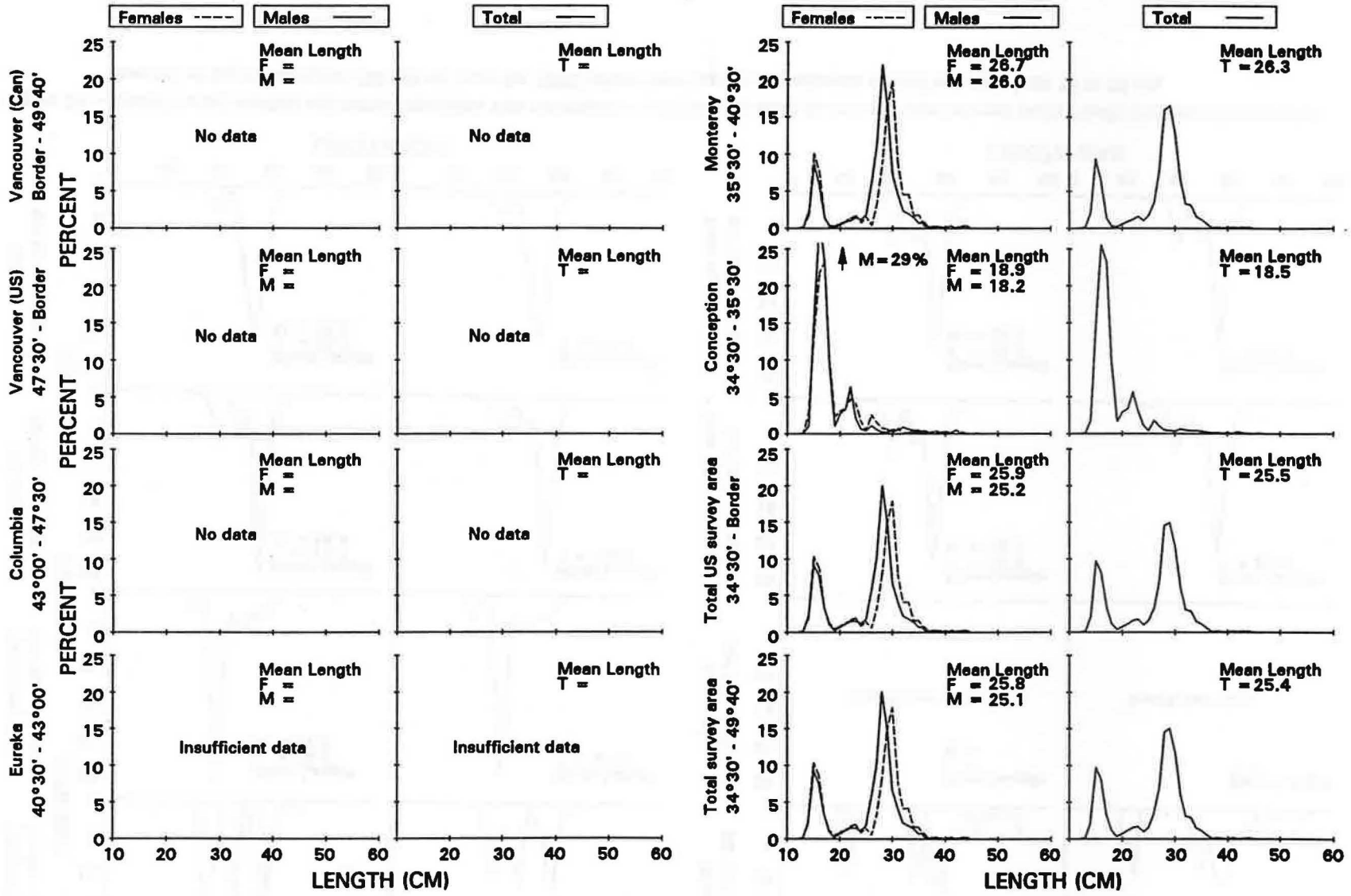


Figure 35.— Chilipepper rockfish estimated population size composition (weighted by area) by sex and International North Pacific Fisheries Commission area for all depths sampled (55-366 m) from the 1992 bottom trawl survey. Specimens ranged in length from 11 to 50 cm.

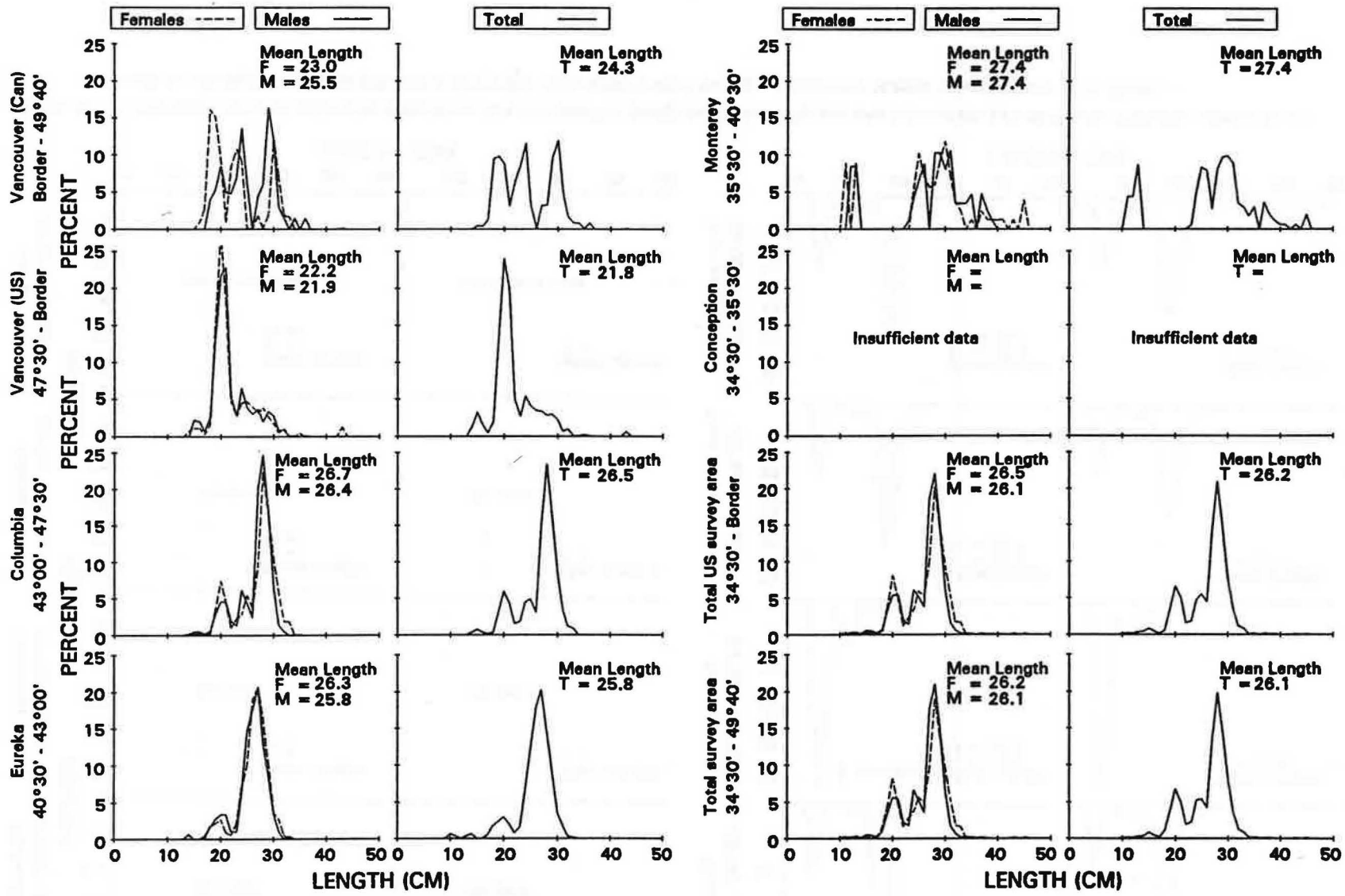


Figure 36.– Darkblotched rockfish estimated population size composition (weighted by area) by sex and International North Pacific Fisheries Commission area for all depths sampled (55-366 m) from the 1992 bottom trawl survey. Specimens ranged in length from 10 to 50 cm.

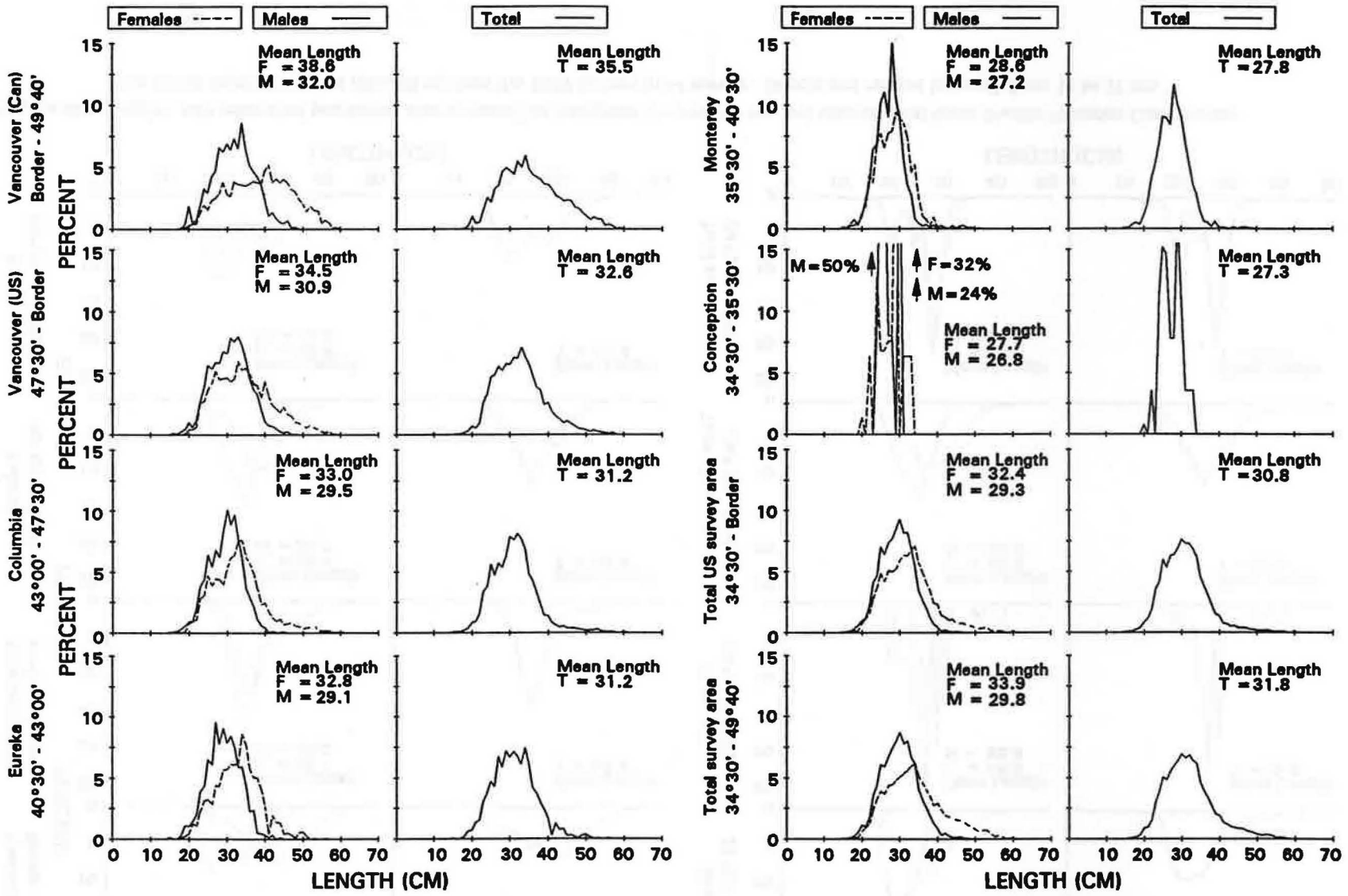


Figure 37.— Dover sole estimated population size composition (weighted by area) by sex and International North Pacific Fisheries Commission area for all depths sampled (55-366 m) from the 1992 bottom trawl survey. Specimens ranged in length from 15 to 62 cm.

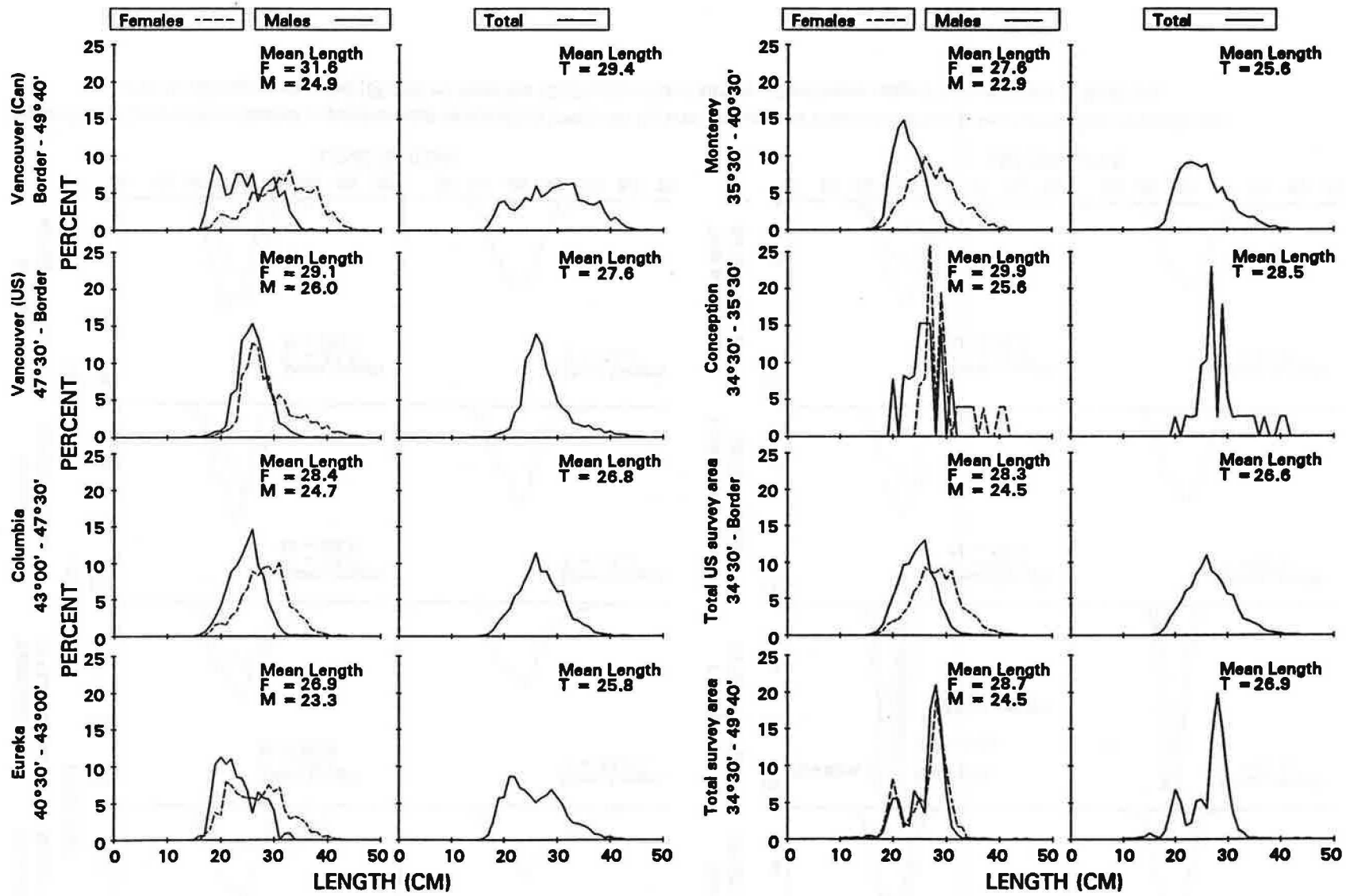


Figure 38.— English sole estimated population size composition (weighted by area) by sex and International North Pacific Fisheries Commission area for all depths sampled (55-366 m) from the 1992 bottom trawl survey. Specimens ranged in length from 14 to 47 cm.

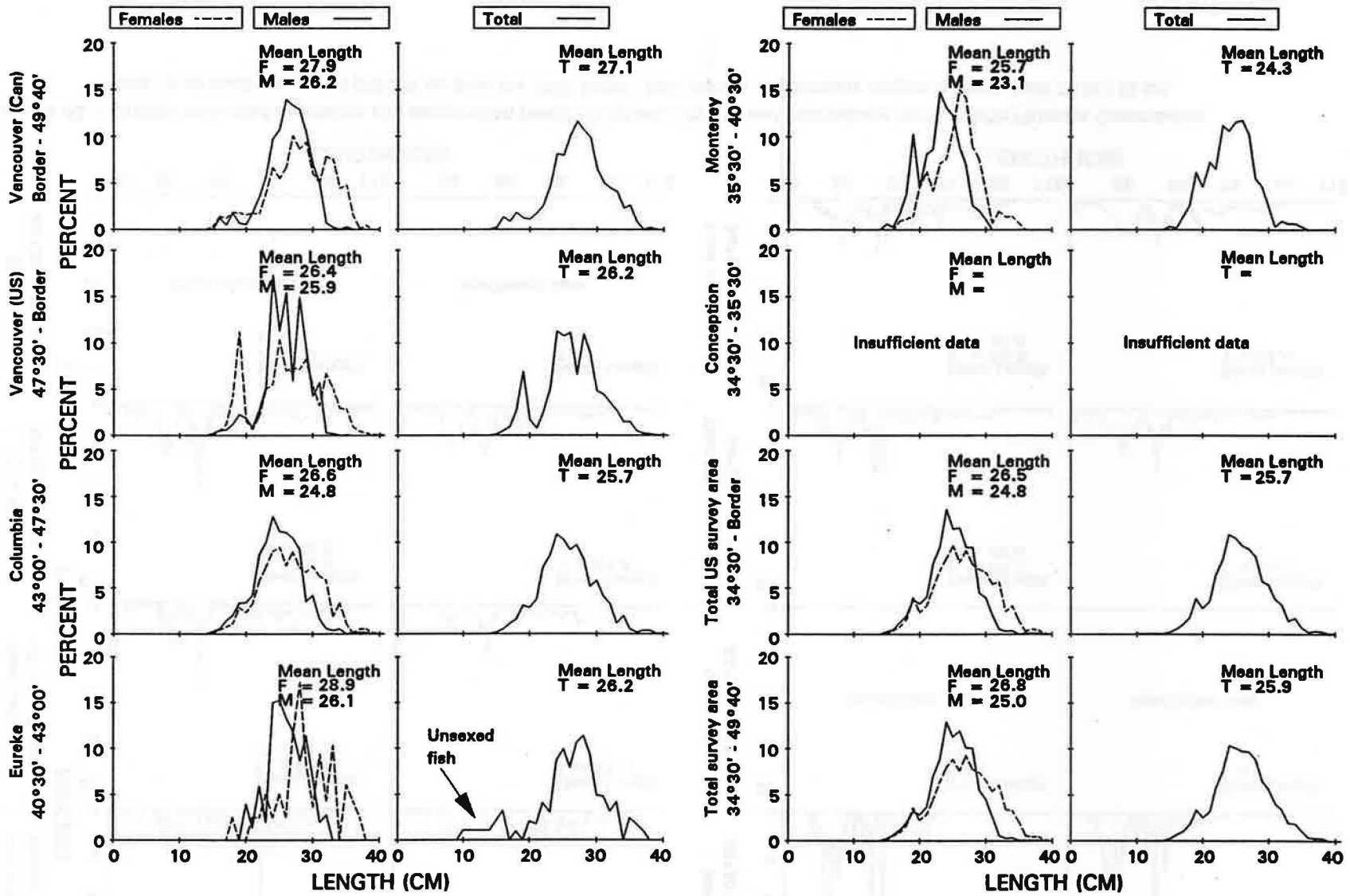


Figure 39.— Greenstriped rockfish estimated population size composition (weighted by area) by sex and International North Pacific Fisheries Commission area for all depths sampled (55-366 m) from the 1992 bottom trawl survey. Specimens ranged in length from 10 to 40 cm.

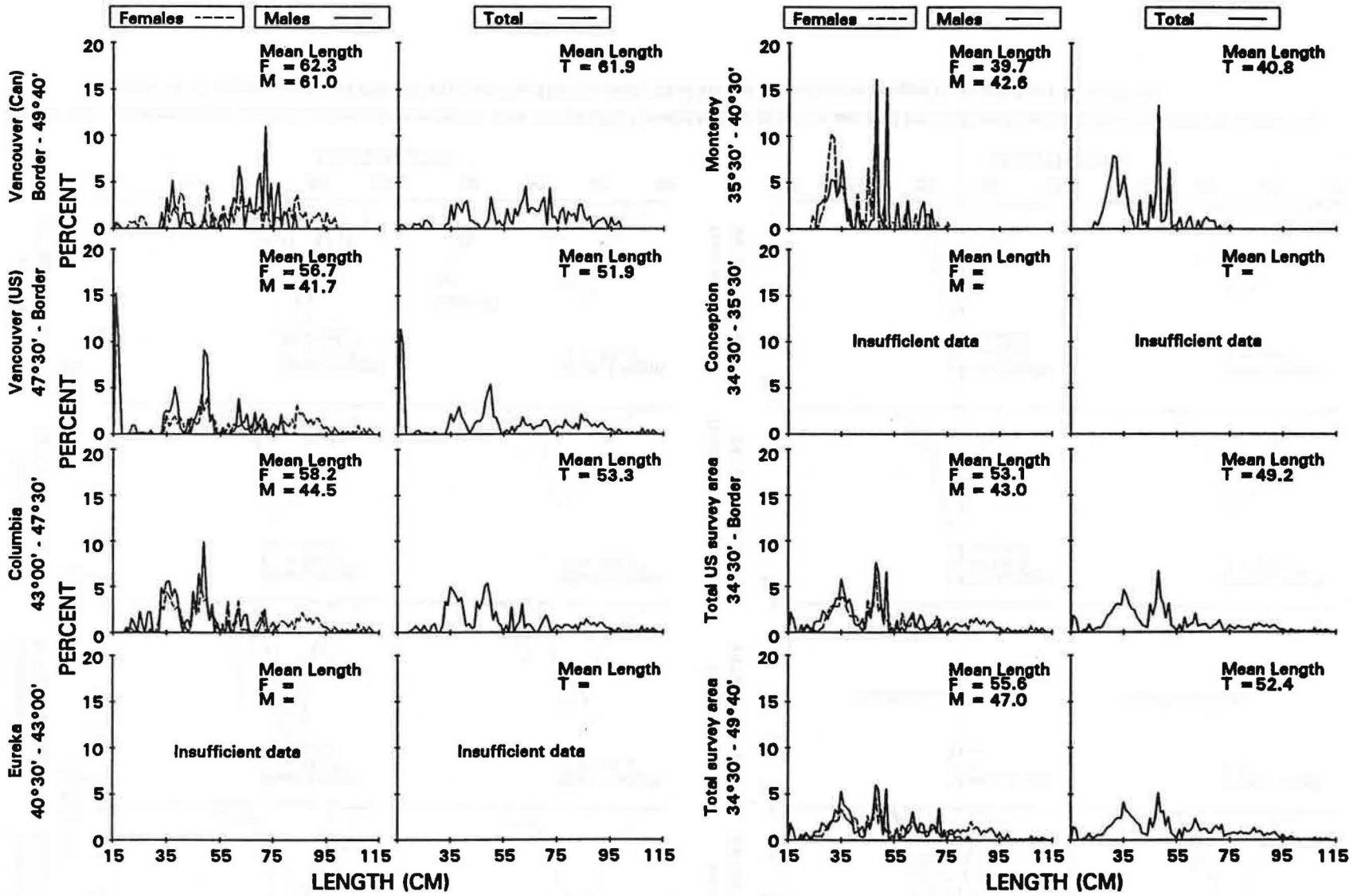


Figure 40.-- Lingcod estimated population size composition (weighted by area) by sex and International North Pacific Fisheries Commission area for all depths sampled (55-366 m) from the 1992 bottom trawl survey. Specimens ranged in length from 16 to 112 cm.

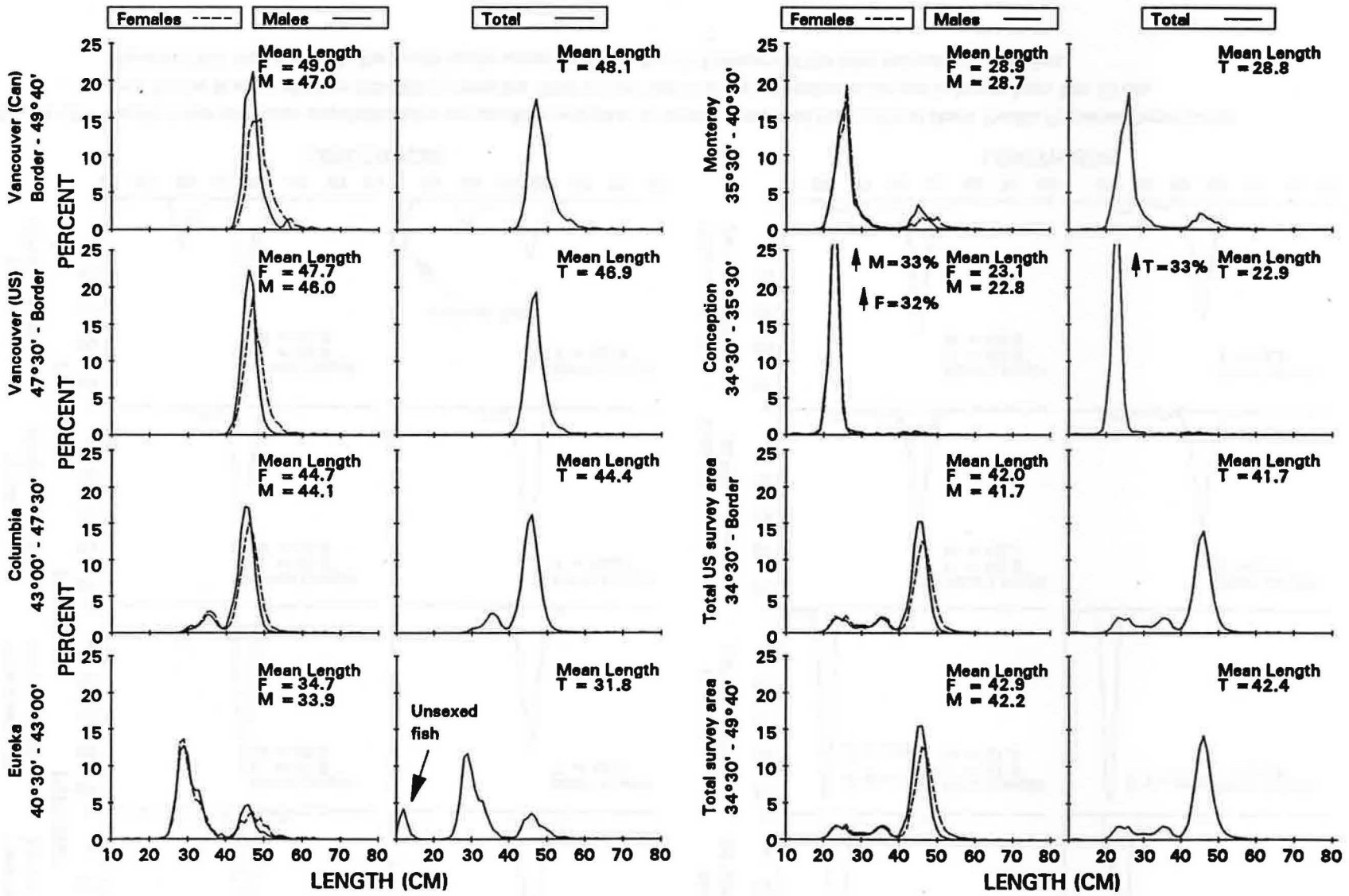


Figure 41.— Pacific hake estimated population size composition (weighted by area) by sex and International North Pacific Fisheries Commission area for all depths sampled (55-366 m) from the 1992 bottom trawl survey. Specimens ranged in length from 9 to 90 cm. Measured fish falling outside the x-axis scale account for less than 0.1 percent of the total estimated population.

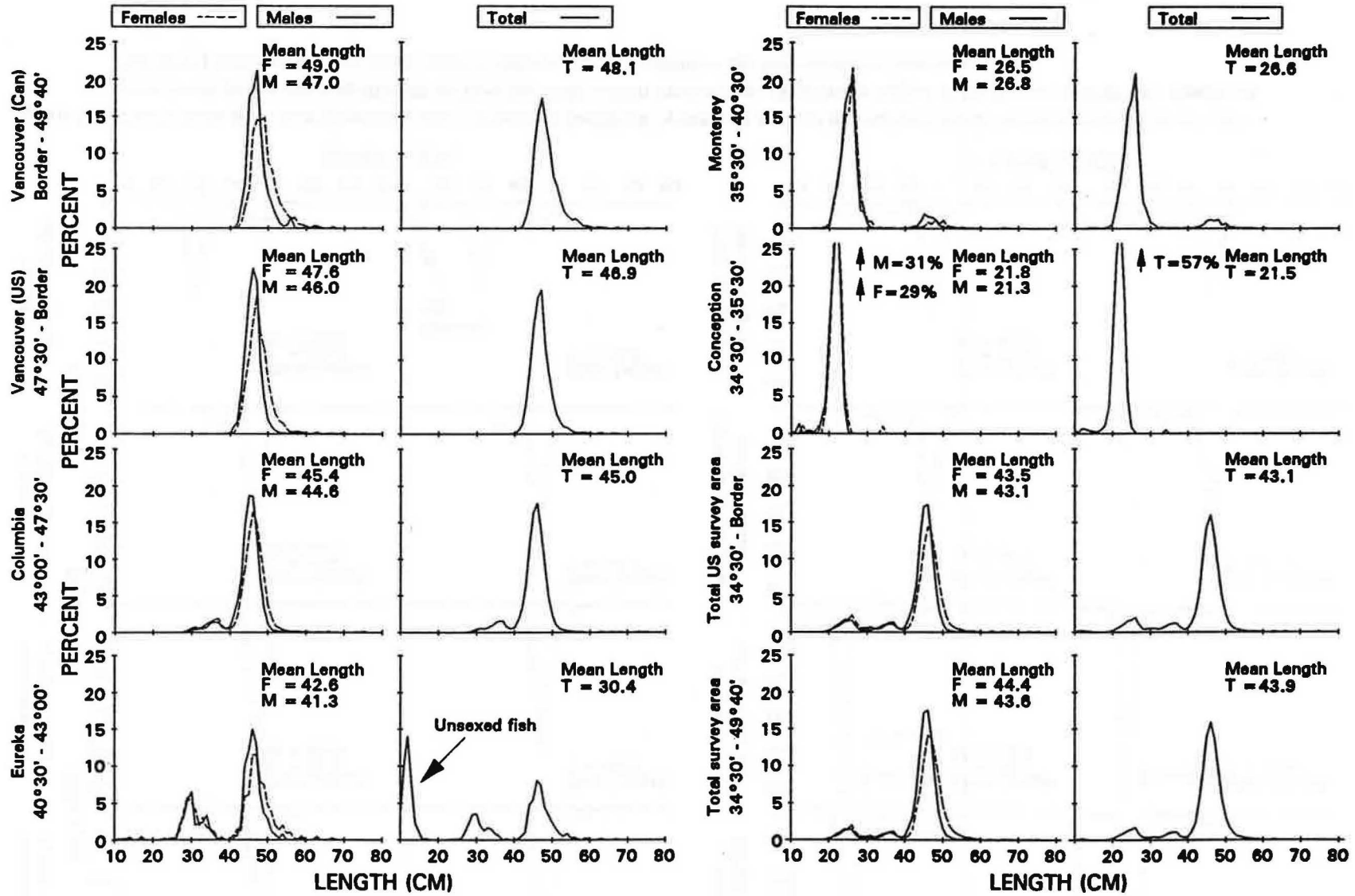


Figure 42.— Pacific hake estimated population size composition (weighted by area) by sex and International North Pacific Fisheries Commission area for the shallow stratum (55-183 m) from the 1992 bottom trawl survey. Specimens ranged in length from 9 to 90 cm. Measured fish falling outside the x-axis scale account for less than 0.1 percent of the total estimated population.

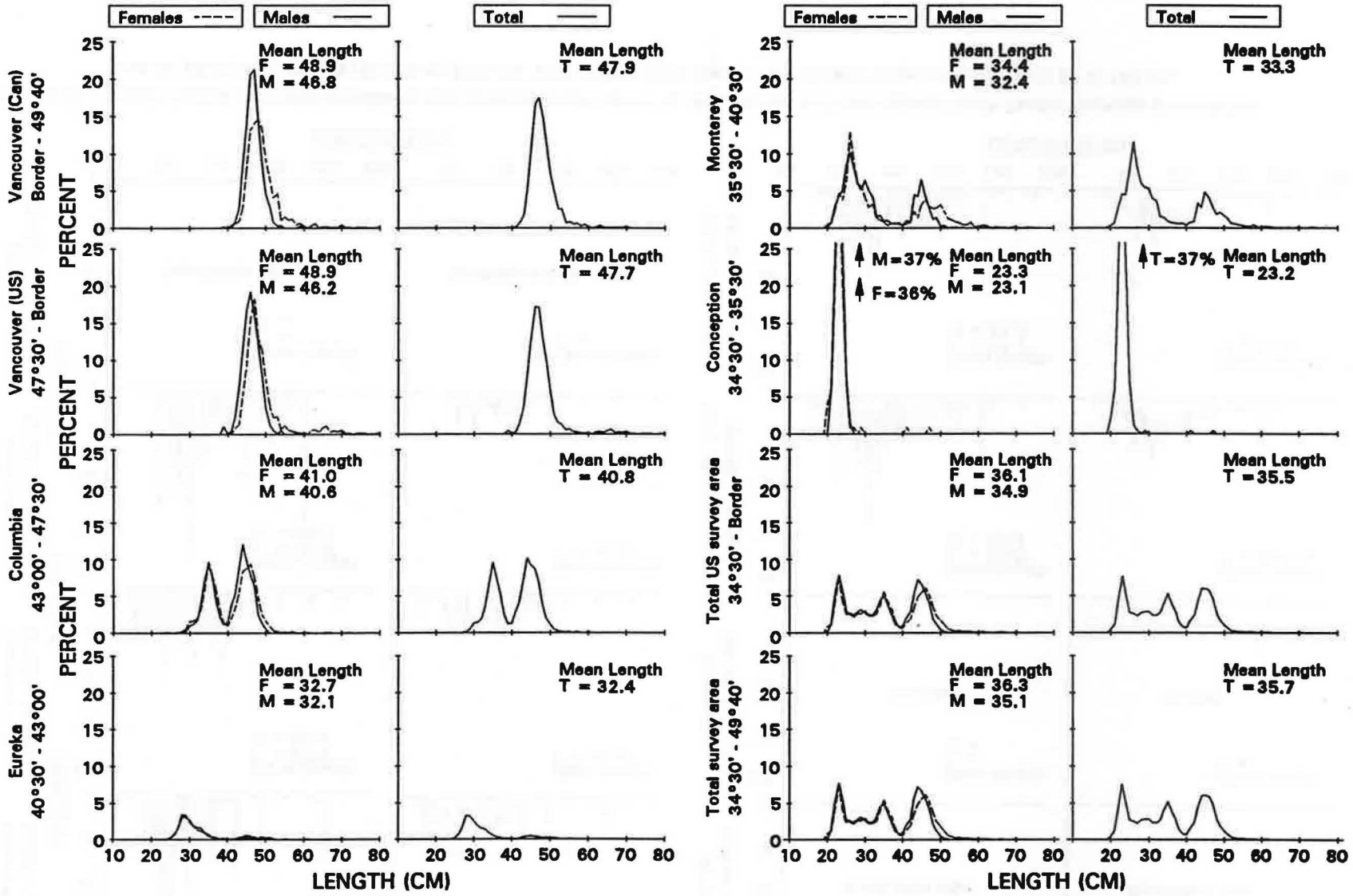


Figure 43.-- Pacific hake estimated population size composition (weighted by area) by sex and International North Pacific Fisheries Commission area for the deep stratum (184-366 m) from the 1992 bottom trawl survey. Specimens ranged in length from 9 to 90 cm. Measured fish falling outside the x-axis scale account for less than 0.1 percent of the total estimated population.

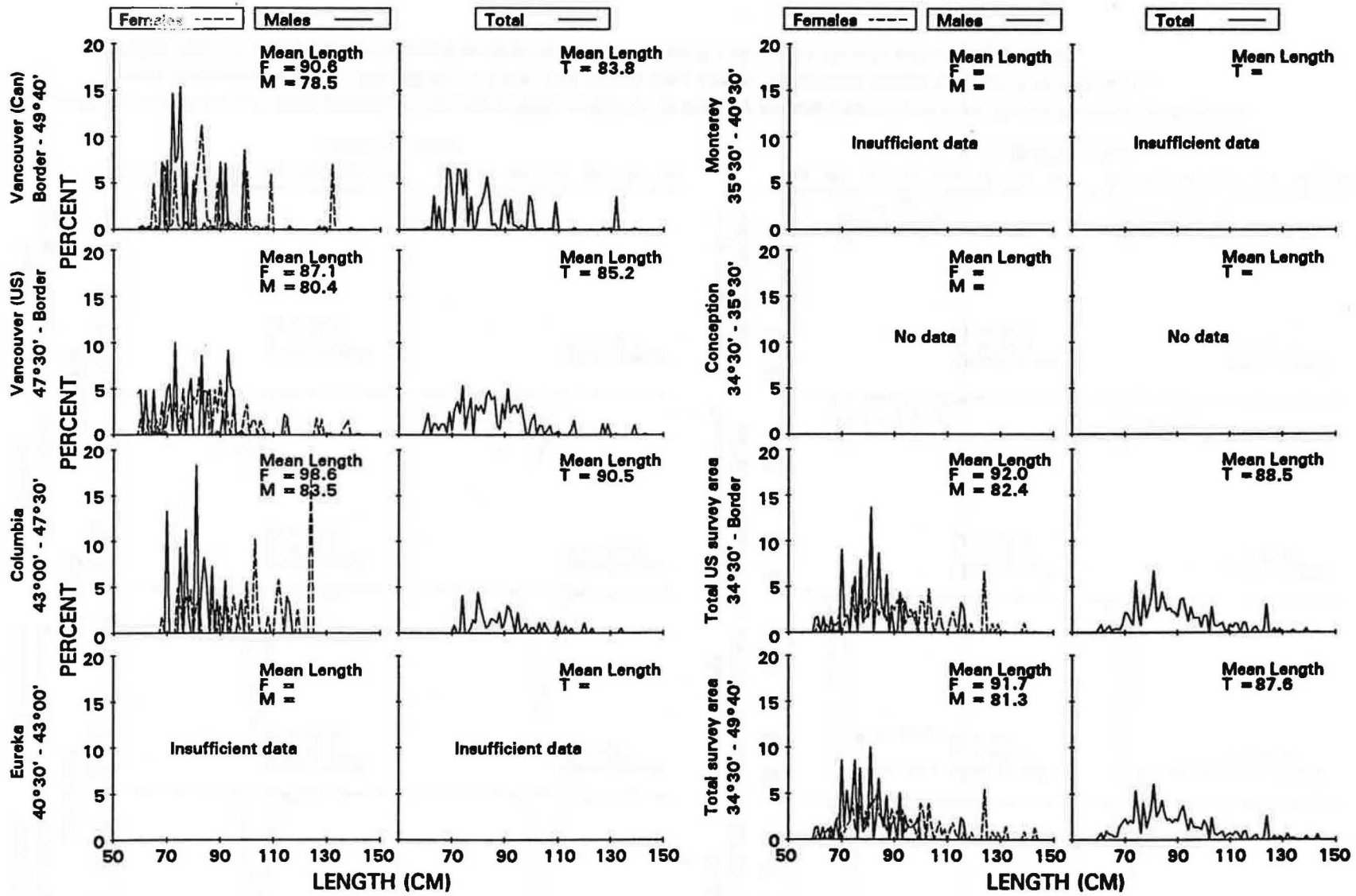


Figure 44.-- Pacific halibut estimated population size composition (weighted by area) by sex and International North Pacific Fisheries Commission area for all depths sampled (55-366 m) from the 1992 bottom trawl survey. Specimens ranged in length from 60 to 143 cm.

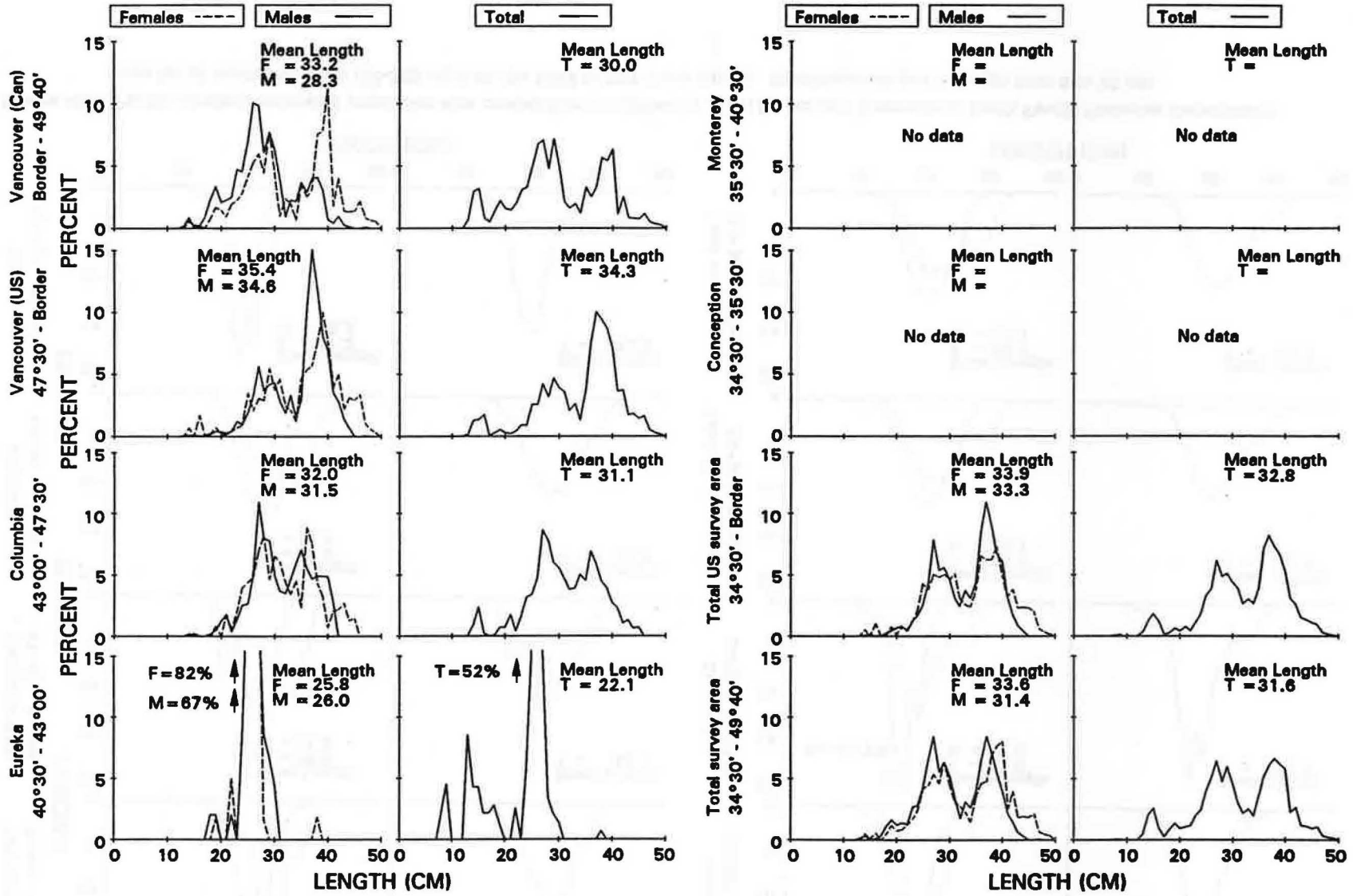


Figure 45.– Pacific ocean perch estimated population size composition (weighted by area) by sex and International North Pacific Fisheries Commission area for all depths sampled (55-366 m) from the 1992 bottom trawl survey. Specimens ranged in length from 8 to 49 cm.

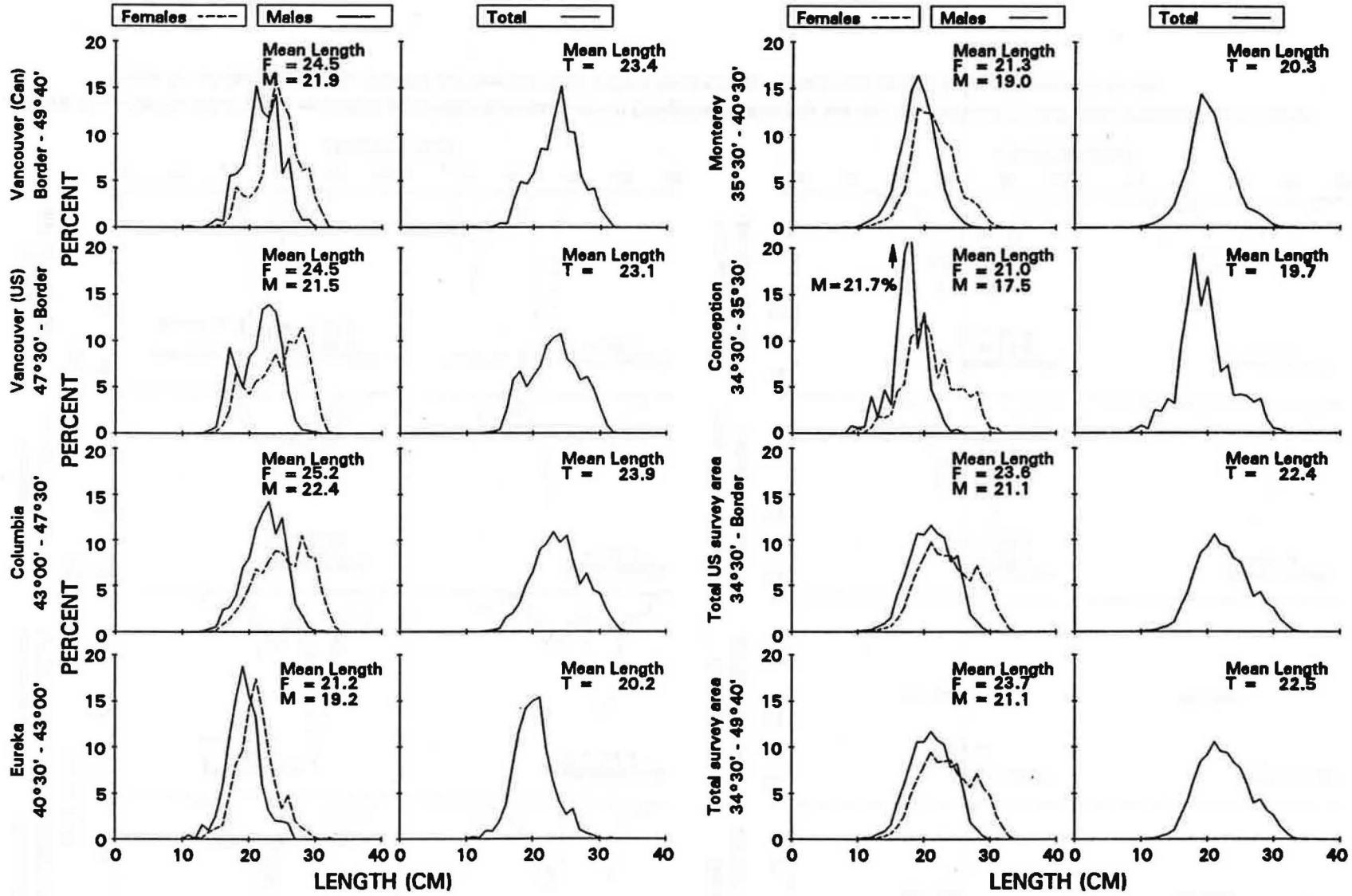


Figure 46.-- Pacific sanddab estimated population size composition (weighted by area) by sex and International North Pacific Fisheries Commission area for all depths sampled (55-366 m) from the 1992 bottom trawl survey. Specimens ranged in length from 8 to 33 cm.

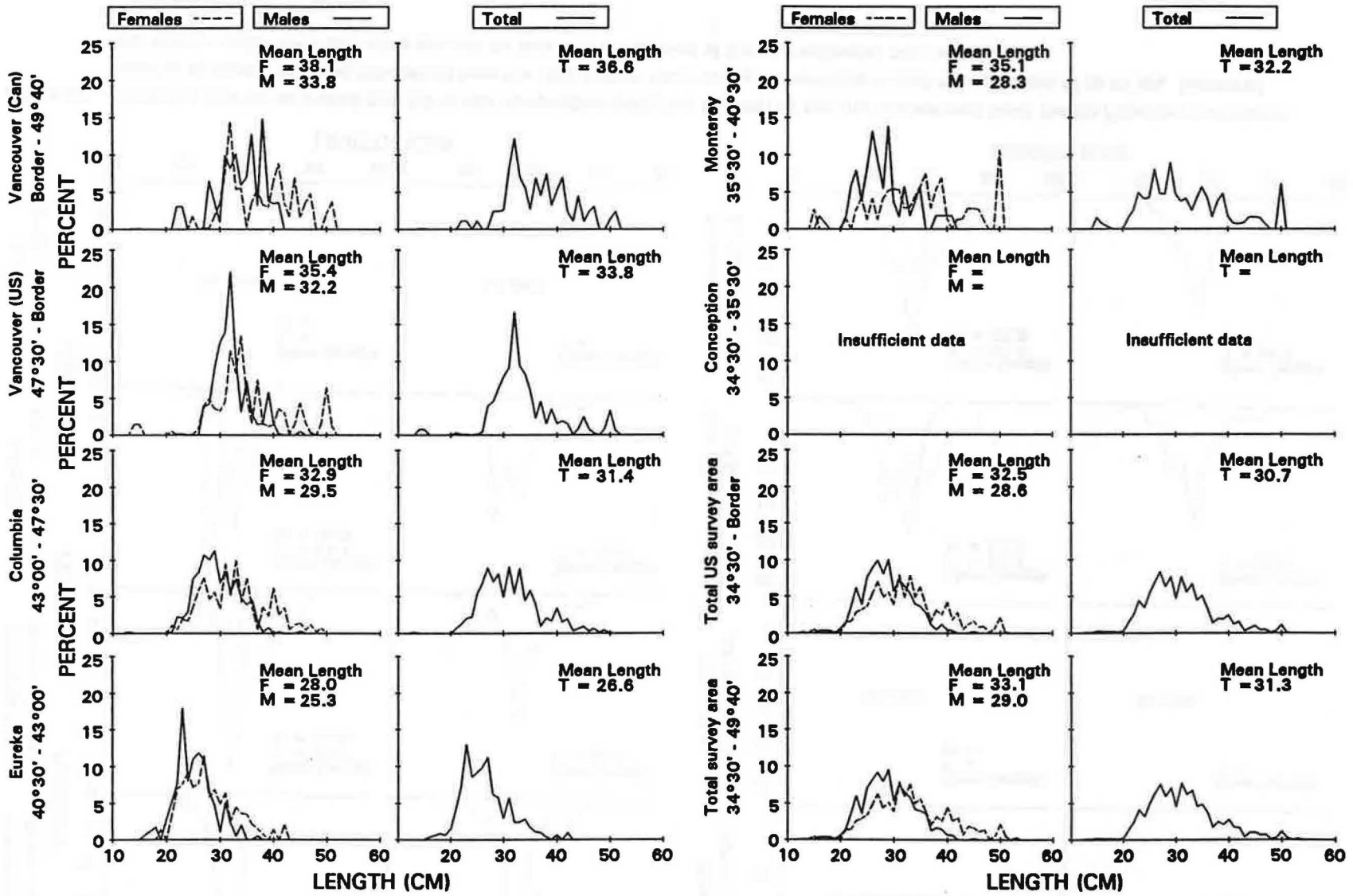


Figure 47.— Petrale sole estimated population size composition (weighted by area) by sex and International North Pacific Fisheries Commission area for all depths sampled (55-366 m) from the 1992 bottom trawl survey. Specimens ranged in length from 13 to 53 cm.

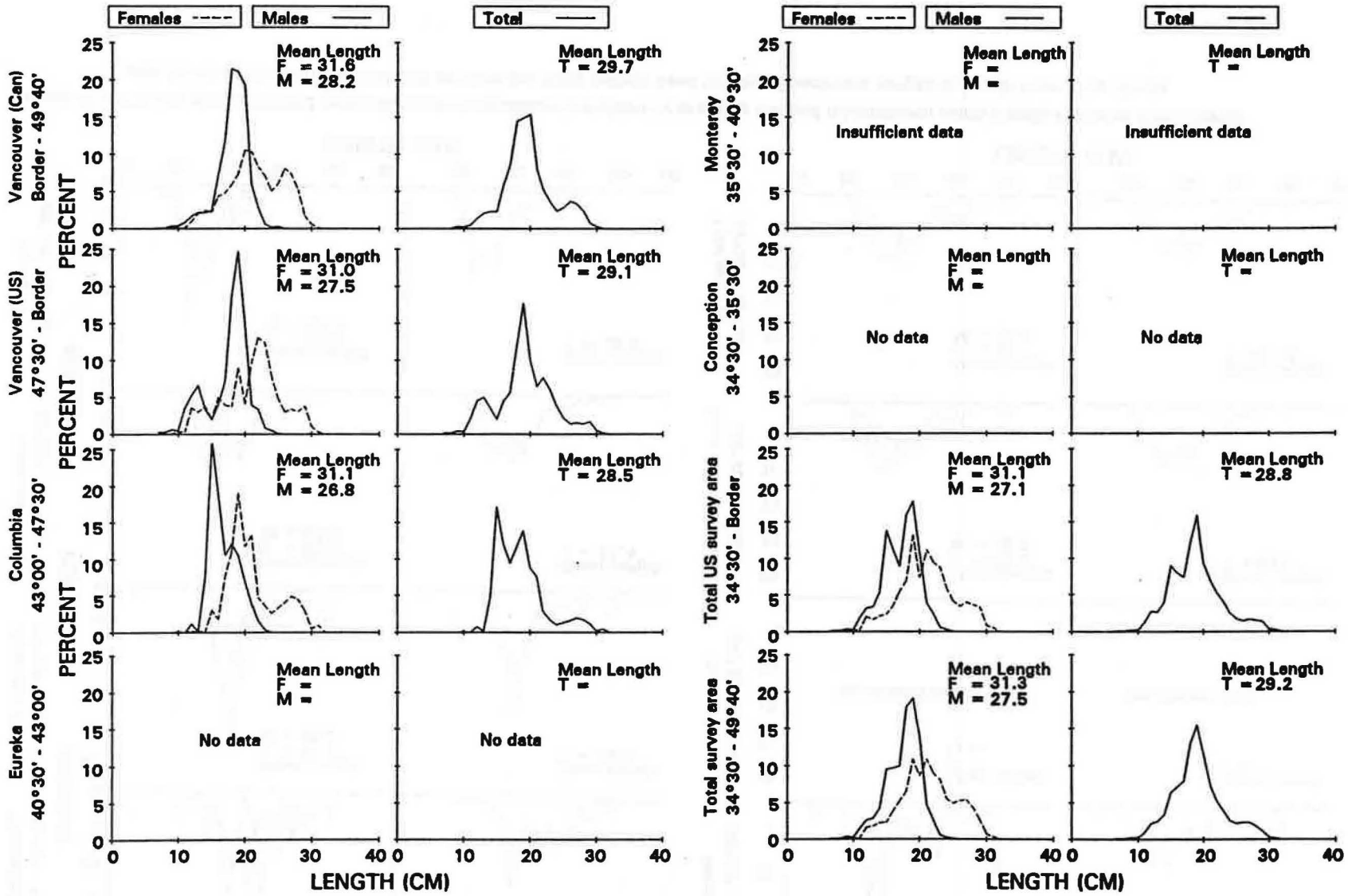


Figure 48.– Redstripe rockfish estimated population size composition (weighted by area) by sex and International North Pacific Fisheries Commission area for all depths sampled (55-366 m) from the 1992 bottom trawl survey. Specimens ranged in length from 17 to 41 cm. Measured fish falling outside the x-axis scale account for less than 0.1 percent of the total estimated population.

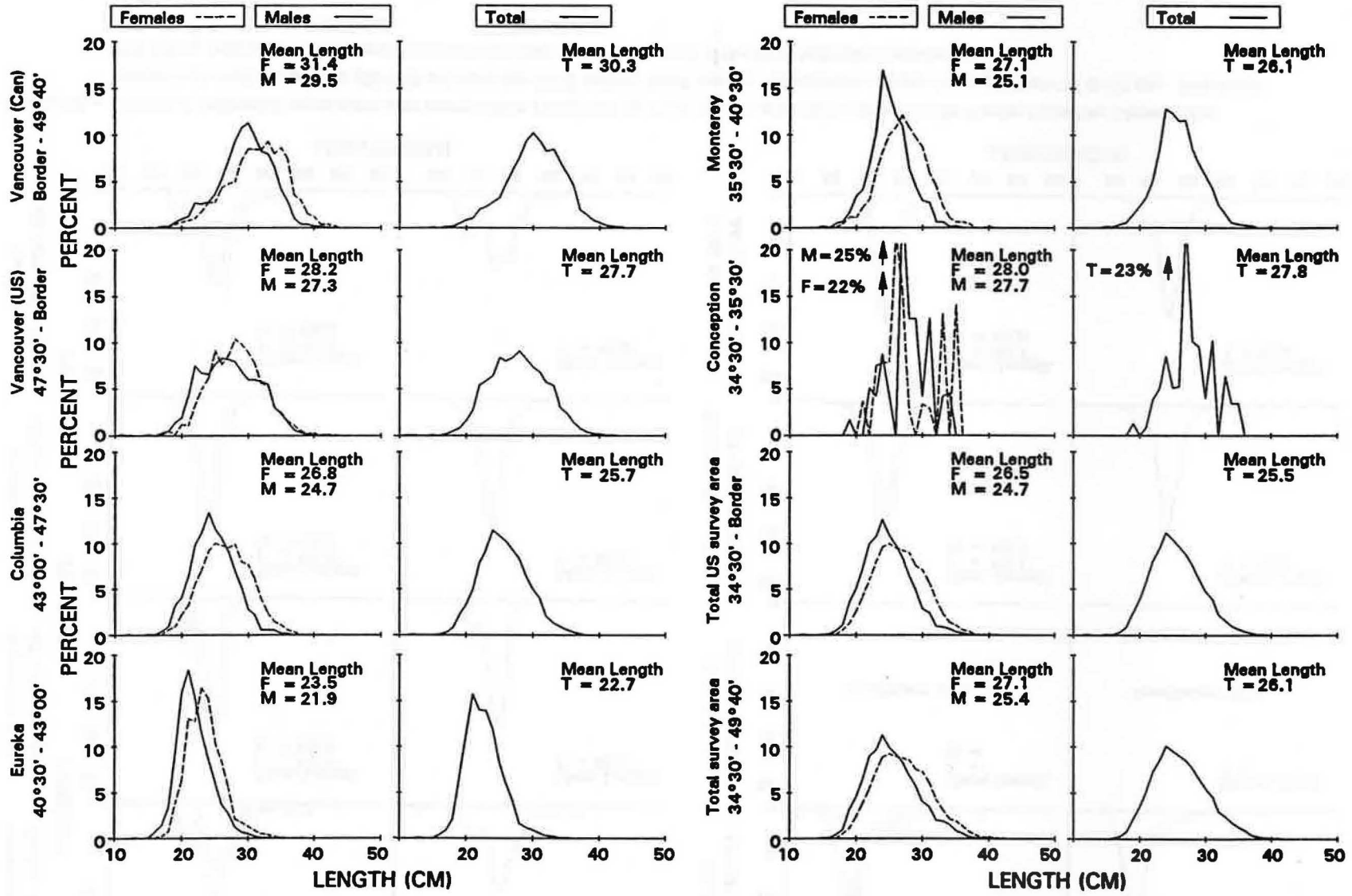


Figure 49.— Rex sole estimated population size composition (weighted by area) by sex and International North Pacific Fisheries Commission area for all depths sampled (55-366 m) from the 1992 bottom trawl survey. Specimens ranged in length from 9 to 54 cm. Measured fish falling outside the x-axis scale account for less than 0.1 percent of the total estimated population.

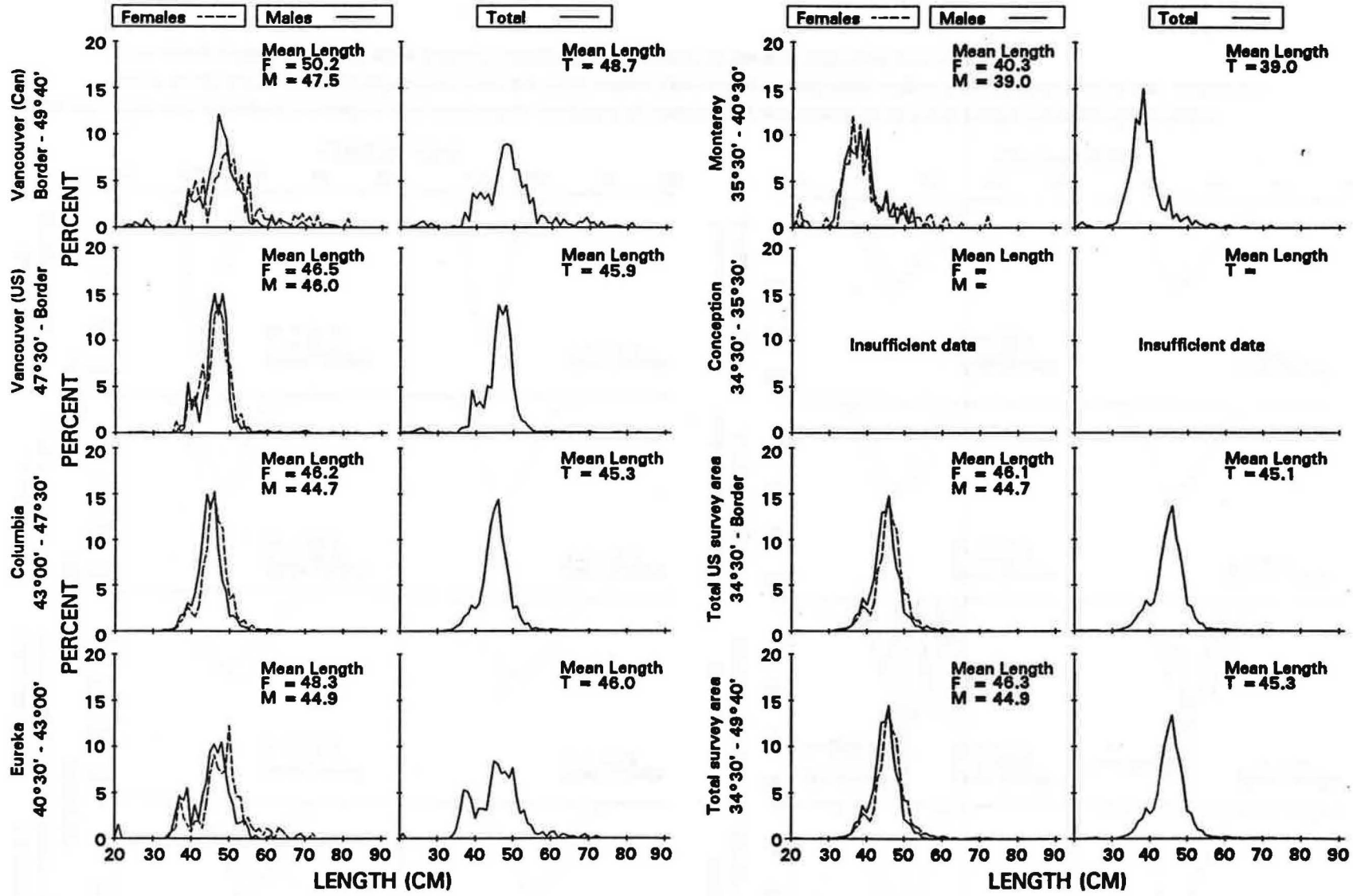


Figure 50.– Sablefish estimated population size composition (weighted by area) by sex and International North Pacific Fisheries Commission area for all depths sampled (55-366 m) from the 1992 bottom trawl survey. Specimens ranged in length from 19 to 93 cm. Measured fish falling outside the x-axis scale account for less than 0.1 percent of the total estimated population.

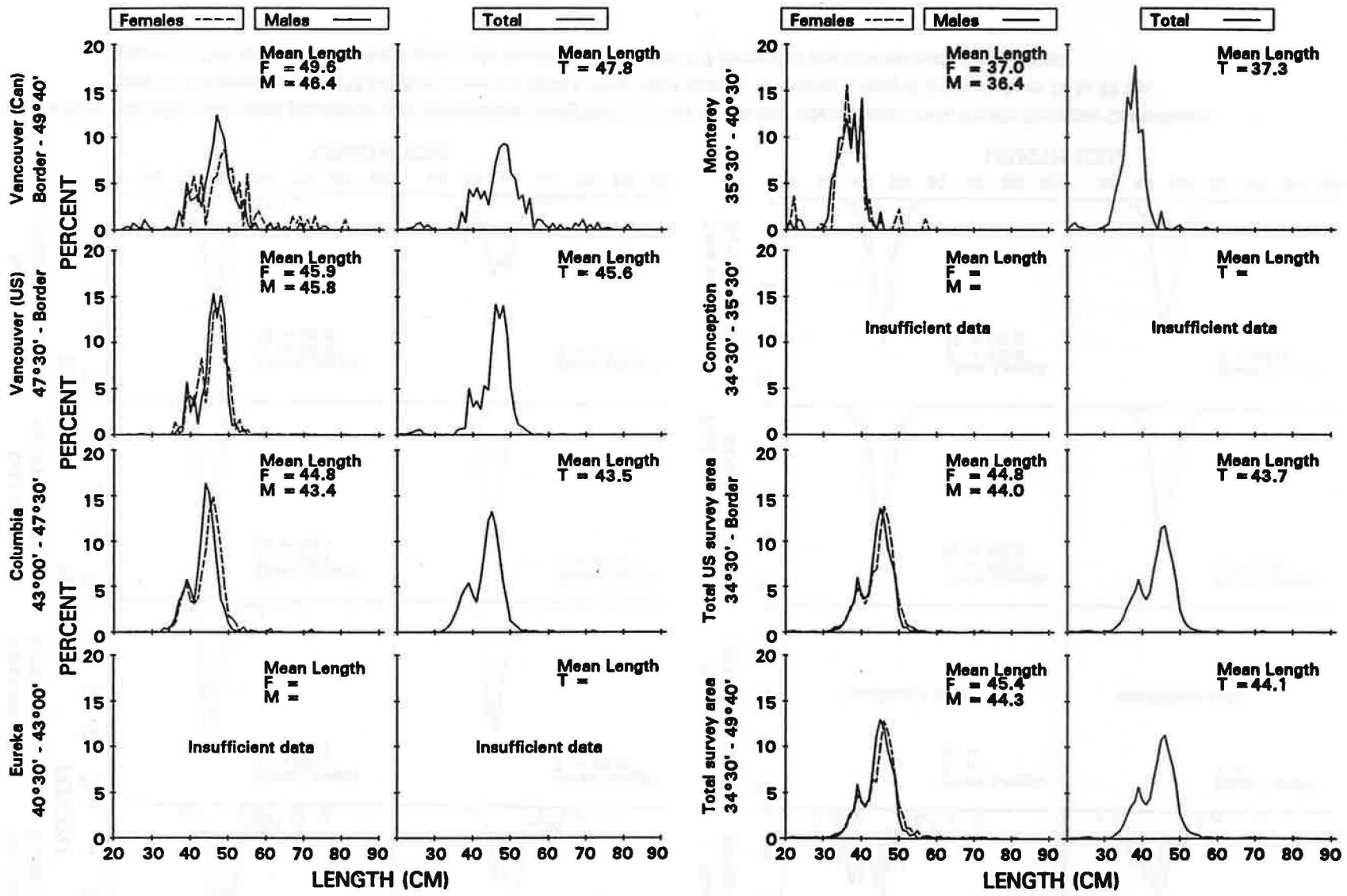


Figure 51.— Sablefish estimated population size composition (weighted by area) by sex and International North Pacific Fisheries Commission area for the shallow stratum (55-183 m) from the 1992 bottom trawl survey. Specimens ranged in length from 19 to 93 cm. Measured fish falling outside the x-axis scale account for less than 0.1 percent of the total estimated population.

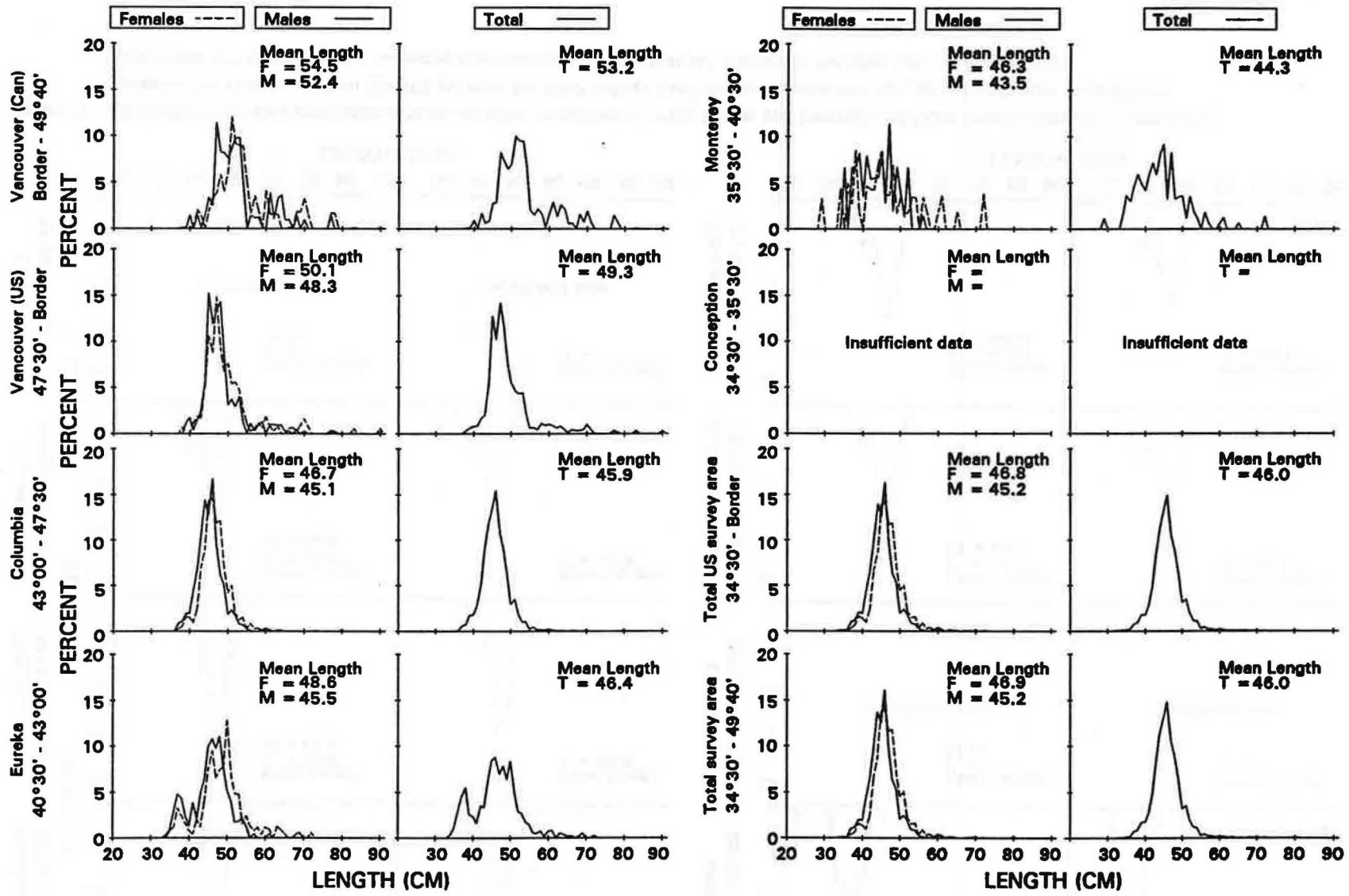


Figure 52.— Sablefish estimated population size composition (weighted by area) by sex and International North Pacific Fisheries Commission area for the deep stratum (183-366 m) from the 1992 bottom trawl survey. Specimens ranged in length from 19 to 93 cm. Measured fish falling outside the x-axis scale account for less than 0.1 percent of the total estimated population.

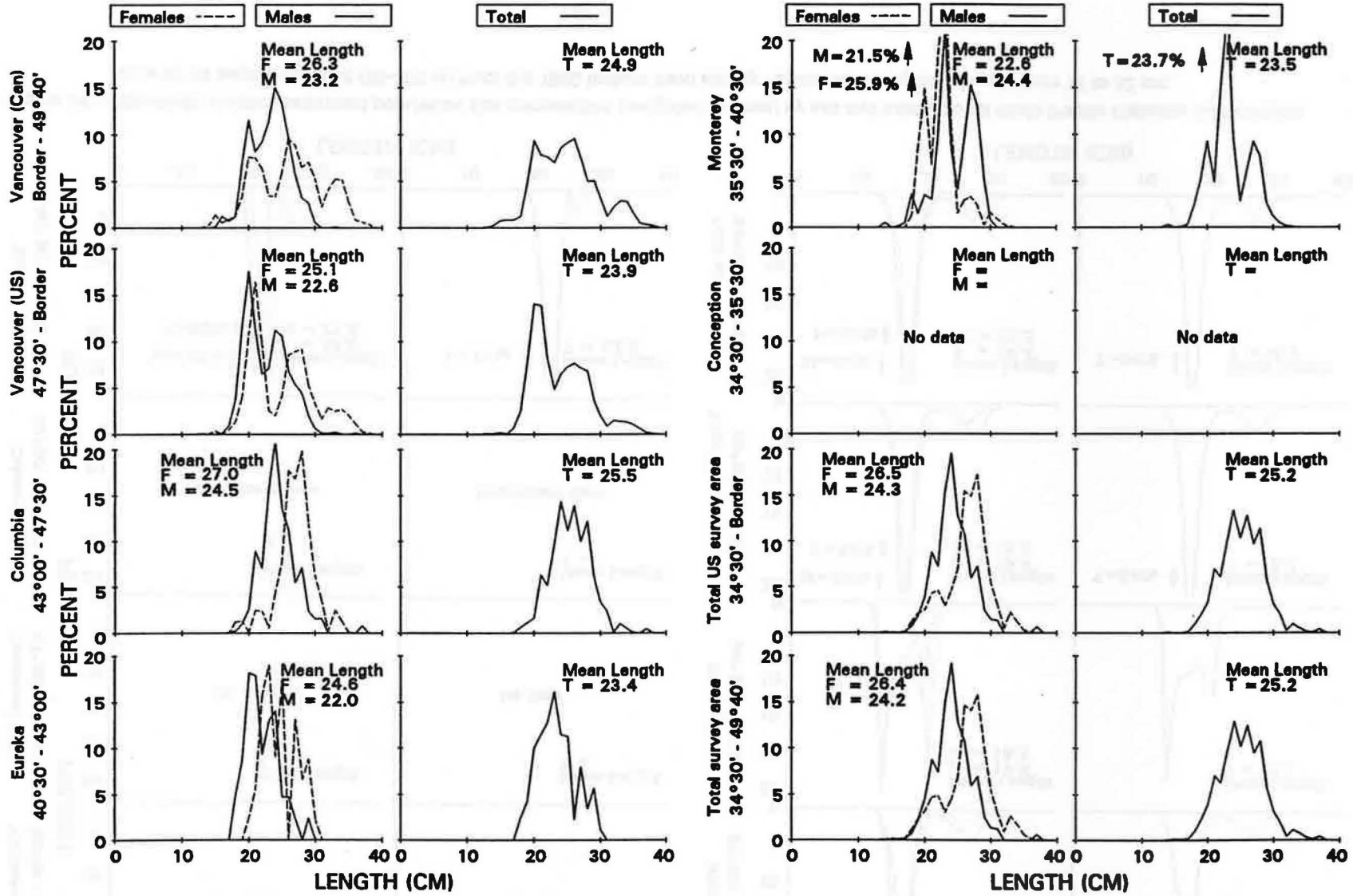


Figure 53.-- Sharpchin rockfish estimated population size composition (weighted by area) by sex and international North Pacific Fisheries Commission area for all depths sampled (55-366 m) from the 1992 bottom trawl survey. Specimens ranged in length from 13 to 38 cm.

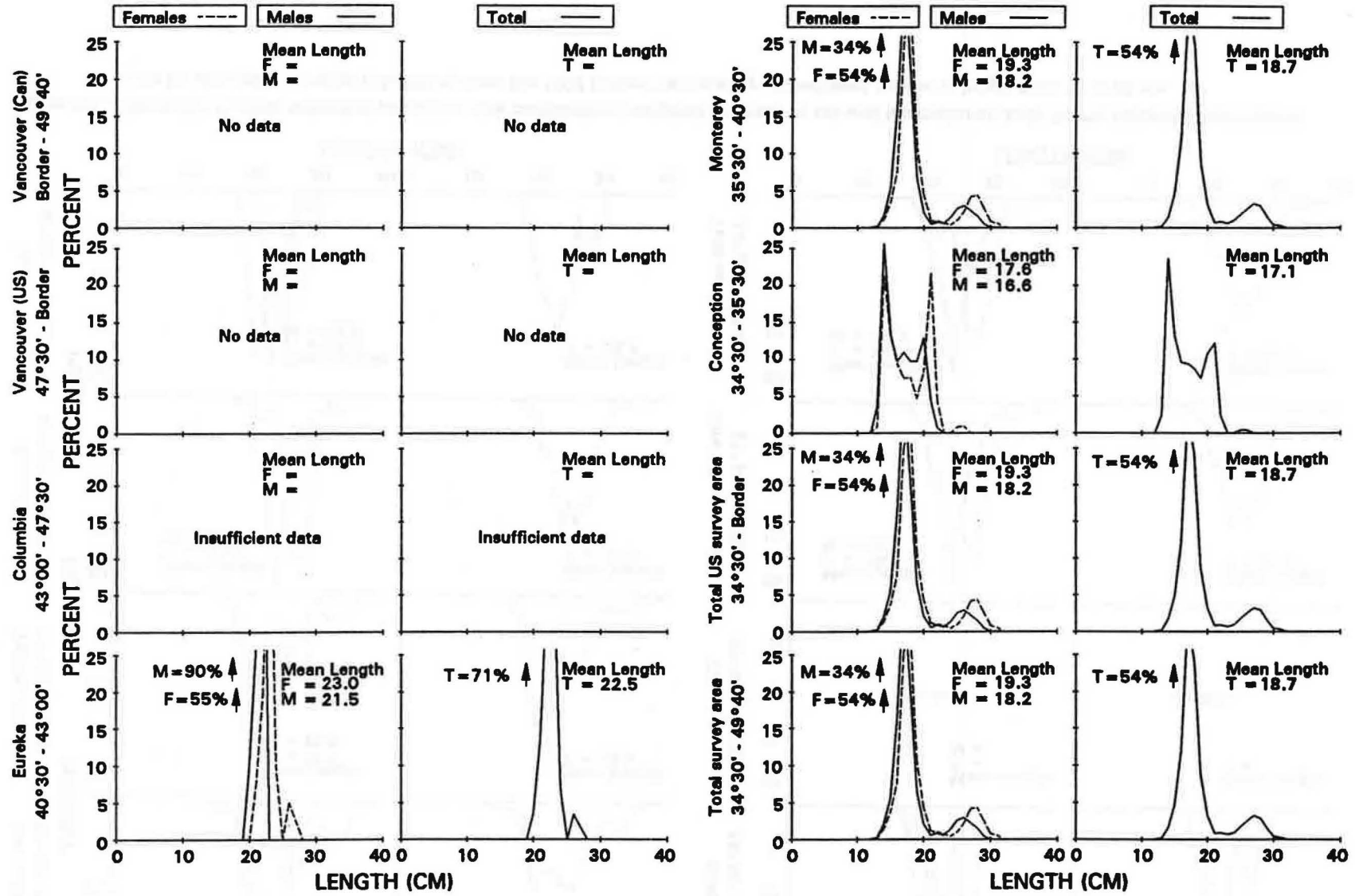


Figure 54.– Shortbelly rockfish estimated population size composition (weighted by area) by sex and International North Pacific Fisheries Commission area for all depths sampled (55-366 m) from the 1992 bottom trawl survey. Specimens ranged in length from 12 to 32 cm.

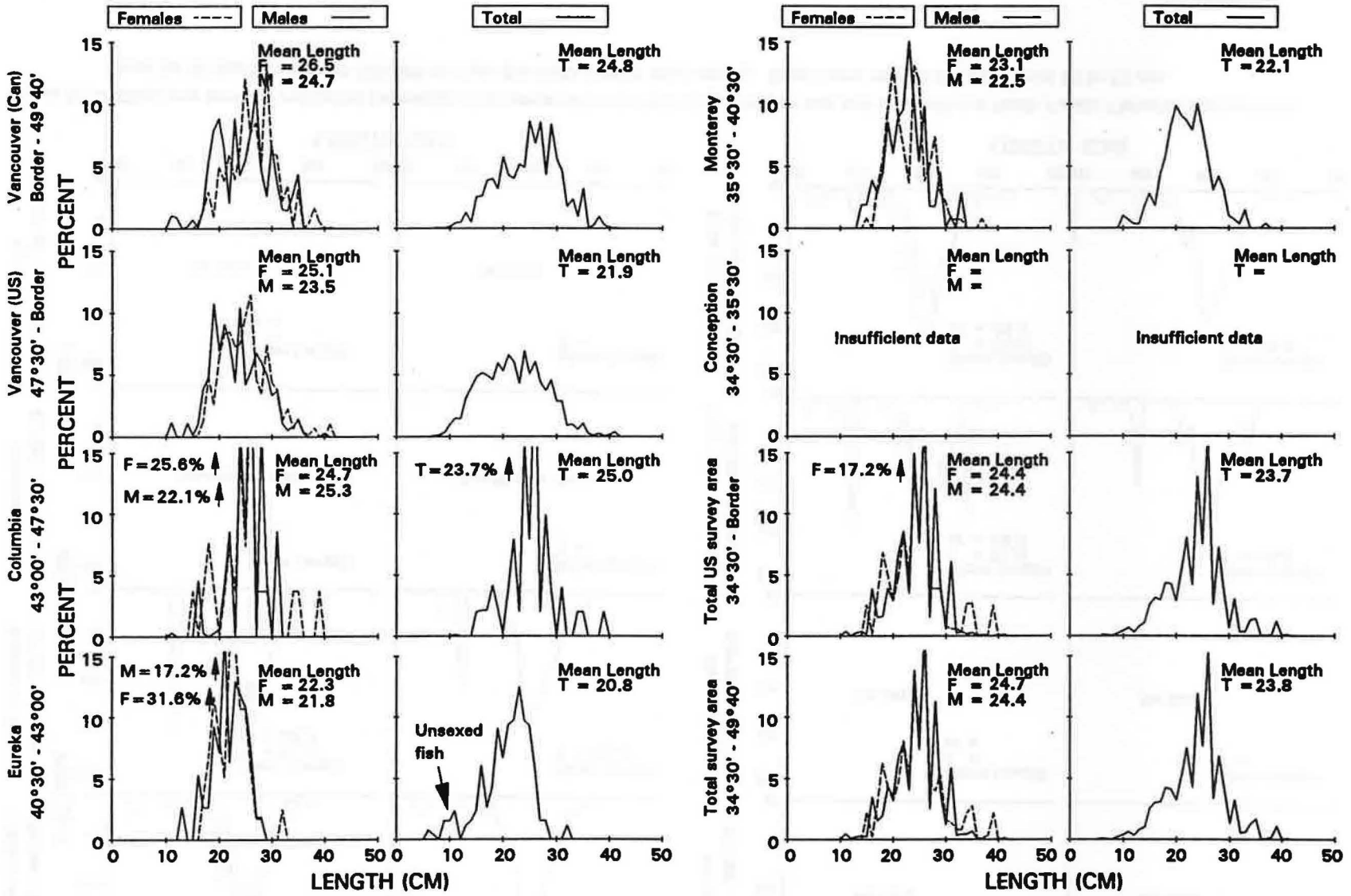


Figure 55.— Shortspine thornyhead estimated population size composition (weighted by area) by sex and International North Pacific Fisheries Commission area for all depths sampled (55-366 m) from the 1992 bottom trawl survey. Specimens ranged in length from 6 to 41 cm.

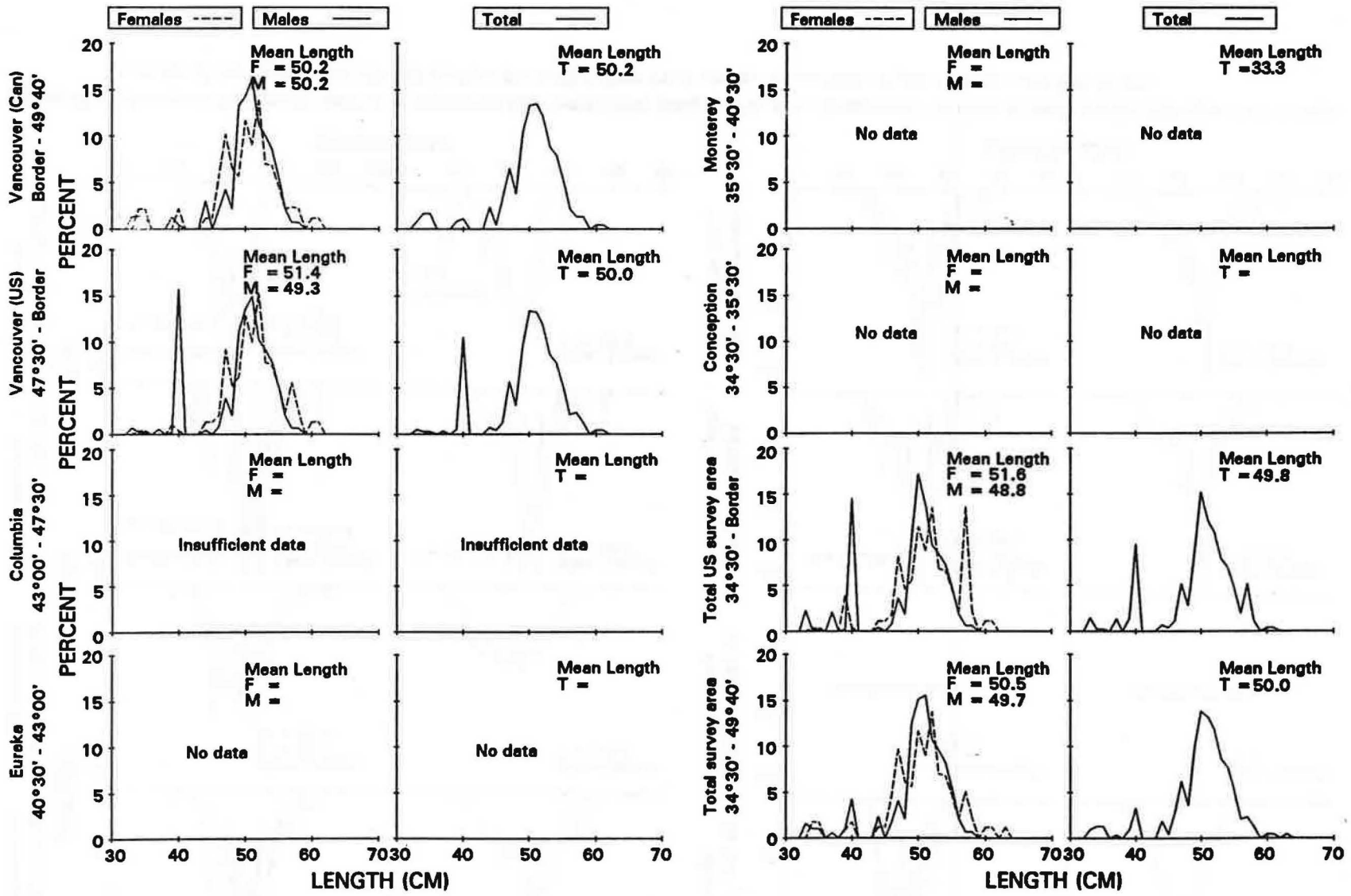


Figure 56.– Silvergray rockfish estimated population size composition (weighted by area) by sex and International North Pacific Fisheries Commission area for all depths sampled (55-366 m) from the 1992 bottom trawl survey. Specimens ranged in length from 33 to 63 cm.

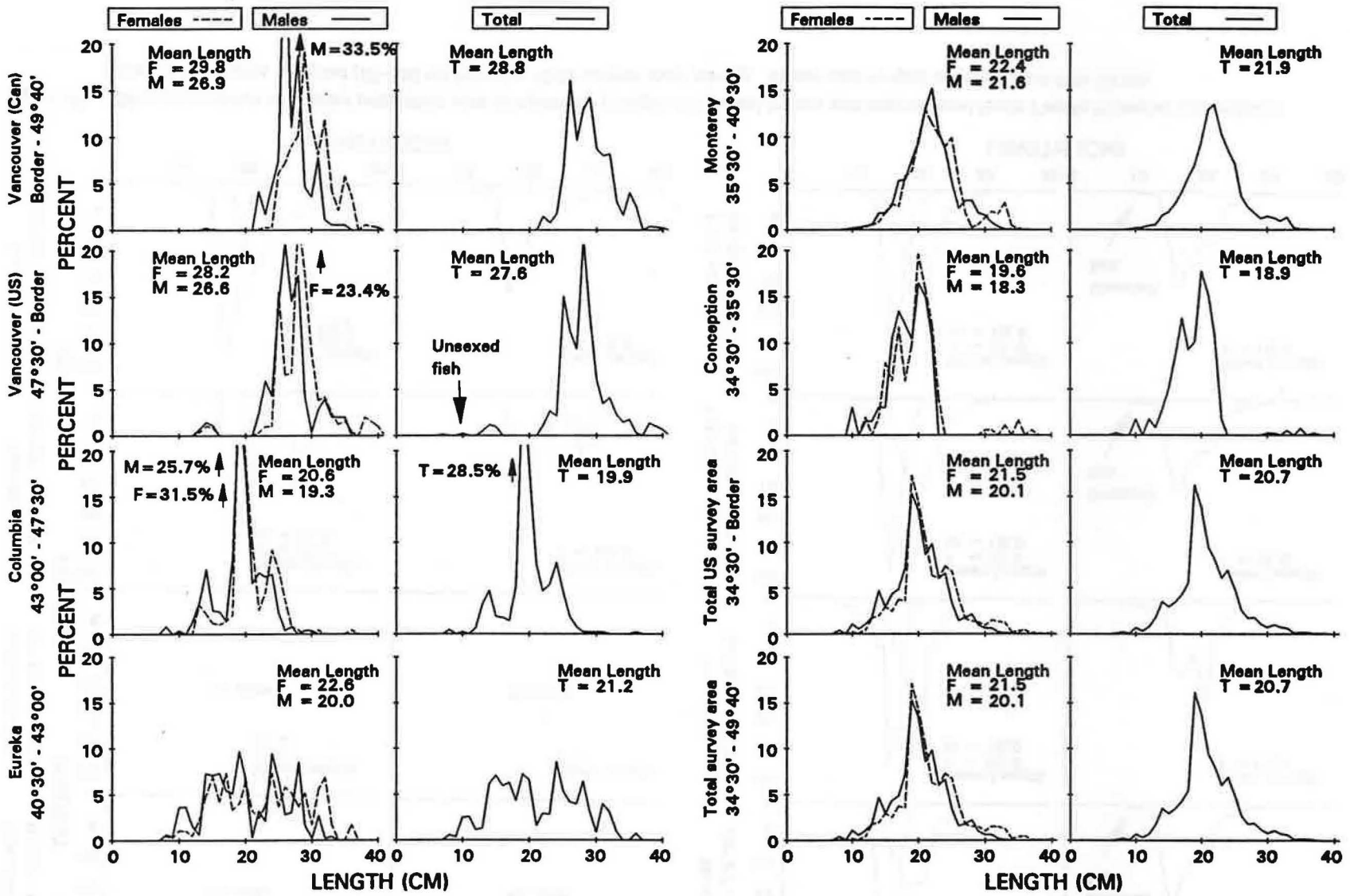


Figure 57.— Splitnose rockfish estimated population size composition (weighted by area) by sex and International North Pacific Fisheries Commission area for all depths sampled (55-366 m) from the 1992 bottom trawl survey. Specimens ranged in length from 7 to 40 cm.

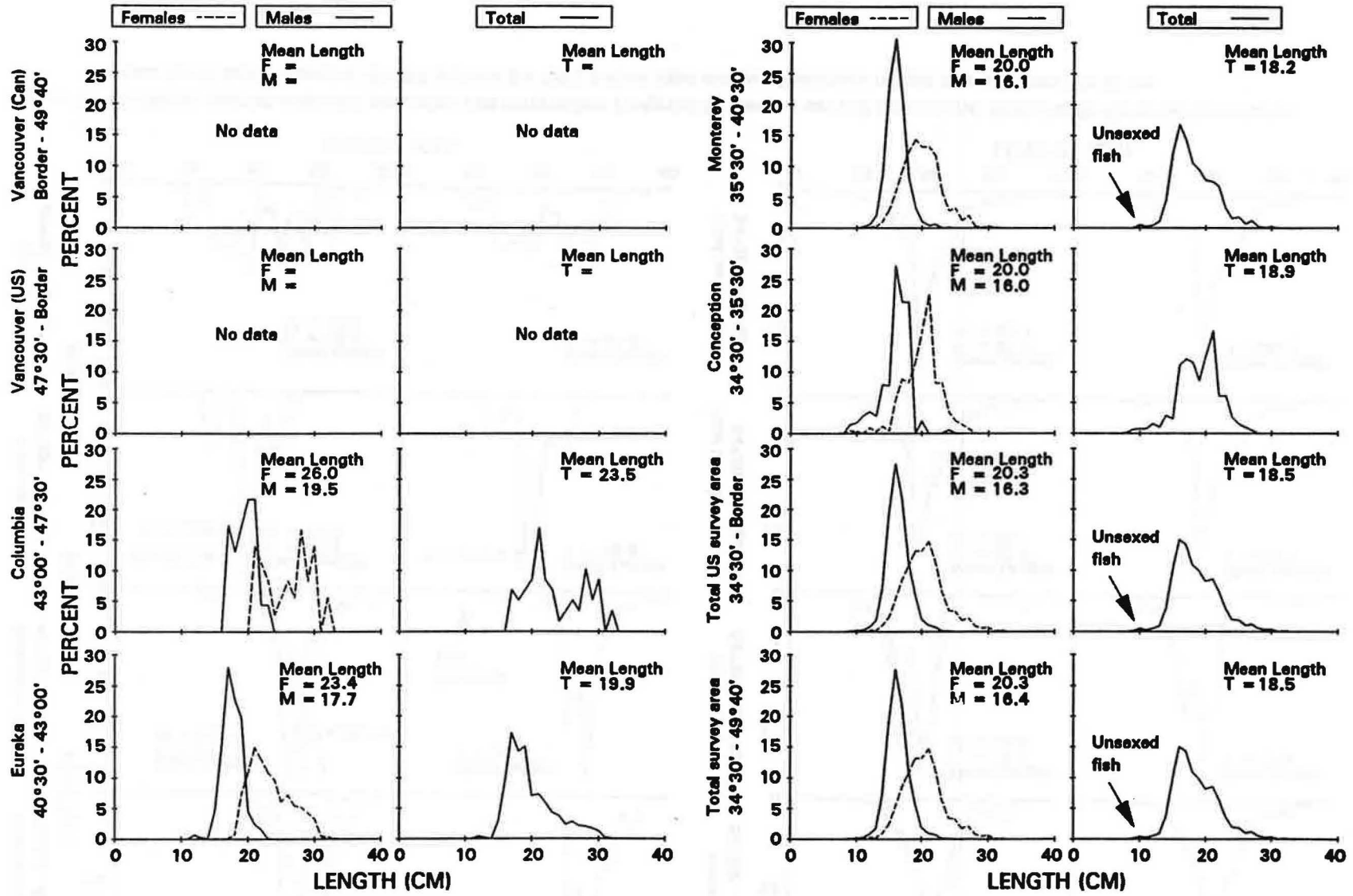


Figure 58.— Stripetail rockfish estimated population size composition (weighted by area) by sex and International North Pacific Fisheries Commission area for all depths sampled (55-366 m) from the 1992 bottom trawl survey. Specimens ranged in length from 8 to 33 cm.

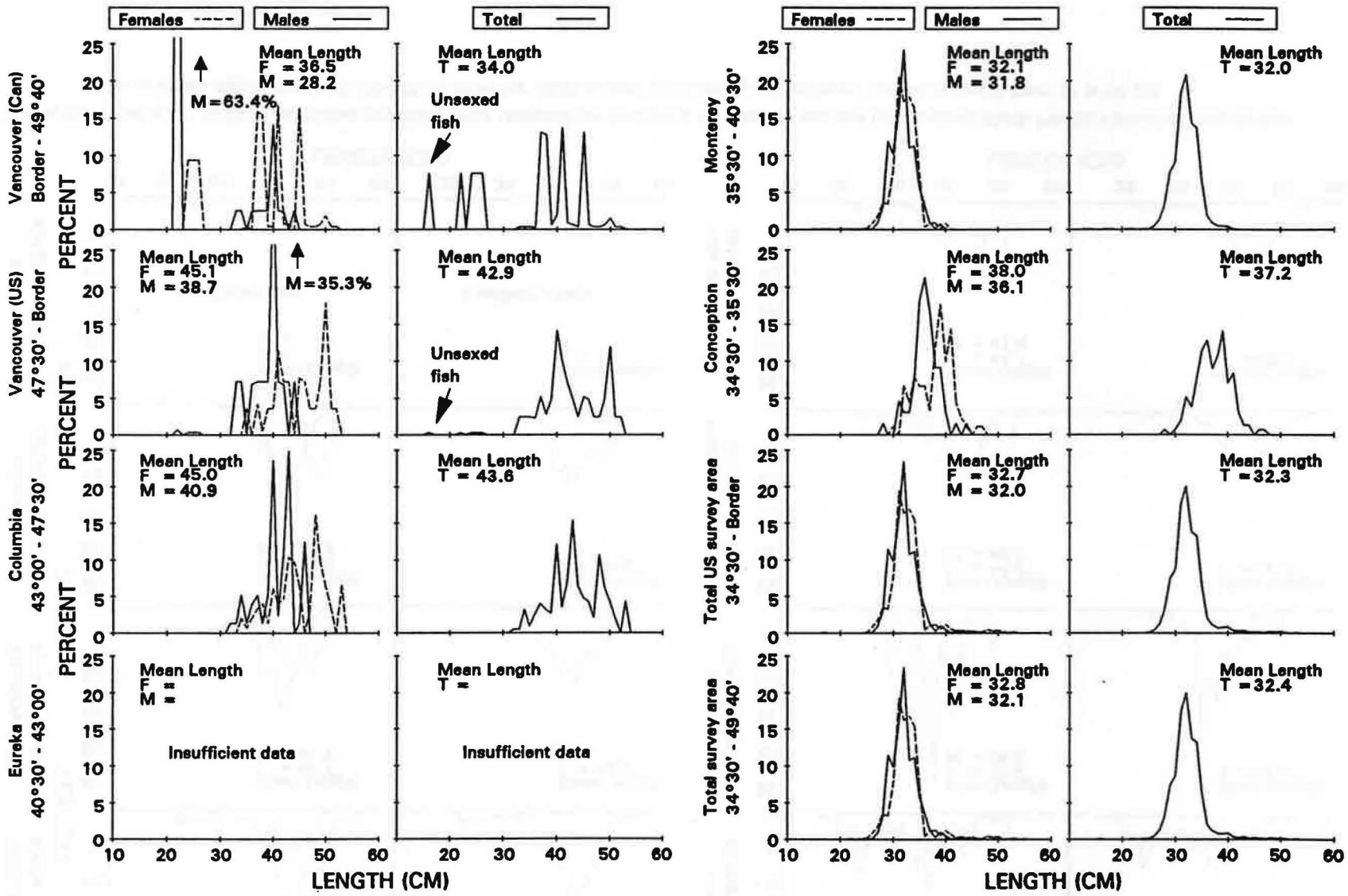


Figure 59.-- Widow rockfish estimated population size composition (weighted by area) by sex and International North Pacific Fisheries Commission area for all depths sampled (55-366 m) from the 1992 bottom trawl survey. Specimens ranged in length from 11 to 55 cm.

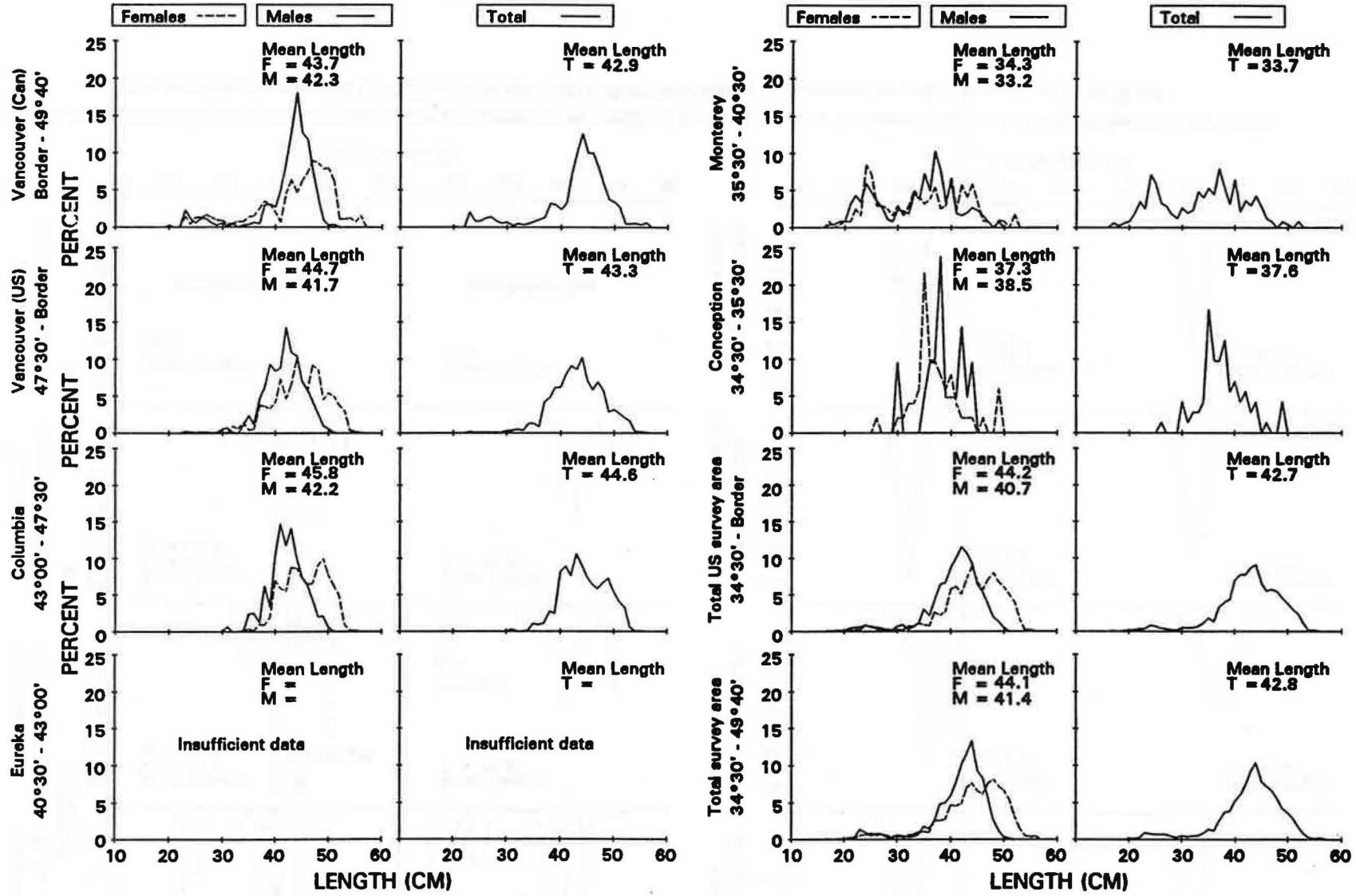


Figure 60.– Yellowtail rockfish estimated population size composition (weighted by area) by sex and International North Pacific Fisheries Commission area for all depths sampled (55-366 m) from the 1992 bottom trawl survey. Specimens ranged in length from 17 to 58 cm.

## Length-Weight Relationships

From the individual fish weight samples, we determined length-weight relationships using a linear least-squares regression model on log-transformed data. Results of these analyses are summarized in Table 13 for males, females, and for all fish combined (including unsexed fish). The following equations describe the relationships for Pacific hake and sablefish (sexes combined):

Pacific hake:

$$\text{estimated weight (g)} = 0.0037825 * (L)^{3.132733}$$

Sablefish:

$$\text{estimated weight (g)} = 0.0041043 * (L)^{3.218131}$$

where L = fork length (cm).

Table 13.--The length-weight relationships from the 1992 triennial West Coast survey using a linear least-squares fit for the equation:

$$\text{Fish weight (g)} = a * \text{fork length (cm)}^{b}$$

| Species | Sex | Number sampled | Length-weight coefficients a | b | Predicted weight at length (g) | | |
|---|---|---|---|---|---|---|---|
| | | | | | 30 cm | 50 cm | 65 cm |
| Pacific | M | 403 | 0.0050879 | 3.045724 | 160.5 | 760.6 | 1691.1 |
| hake | F | 550 | 0.0035126 | 3.156379 | 161.4 | 809.5 | 1853.0 |
| | T | 956 | 0.0037825 | 3.132733 | 160.4 | 794.7 | 1807.8 |
| | | | | | 40 cm | 50 cm | 65 cm |
| Sablefish | M | 265 | 0.0032556 | 3.278913 | 583.0 | 1211.7 | 2864.3 |
| | F | 309 | 0.0034825 | 3.260086 | 581.8 | 1204.2 | 2832.4 |
| | T | 587 | 0.0041043 | 3.218131 | 587.3 | 1204.3 | 2801.8 |
| | | | | | 30 cm | 40 cm | 50 cm |
| Arrowtooth | M | 98 | 0.0050871 | 3.154700 | 232.5 | 576.1 | 1164.7 |
| flounder | F | 157 | 0.0041949 | 3.237759 | 254.3 | 645.4 | 1329.2 |
| | T | 255 | 0.0034294 | 3.280571 | 240.4 | 617.8 | 1284.7 |
| | | | | | 40 cm | 50 cm | 60 cm |
| Bocaccio | M | 46 | 0.0038128 | 3.292447 | 717.7 | 1496.3 | 2727.2 |
| | F | 44 | 0.0023494 | 3.417033 | 700.2 | 1501.0 | 2798.7 |
| | T | 90 | 0.0027588 | 3.376060 | 706.9 | 1501.6 | 2778.8 |
| | | | | | 20 cm | 40 cm | 55 cm |
| Canary | M | 111 | 0.0104680 | 3.133124 | 124.8 | 1094.7 | 2969.0 |
| rockfish | F | 101 | 0.0090889 | 3.172685 | 122.0 | 1099.9 | 3020.9 |
| | T | 212 | 0.0097914 | 3.151773 | 123.4 | 1096.9 | 2992.8 |
| | | | | | 20 cm | 30 cm | 35 cm |
| Chilipepper | M | 71 | 0.0045690 | 3.315379 | 94.0 | 360.6 | 601.2 |
| | F | 80 | 0.0096280 | 3.078217 | 97.4 | 339.2 | 545.1 |
| | T | 151 | 0.0071271 | 3.173042 | 95.7 | 346.6 | 565.3 |
| | | | | | 25 cm | 35 cm | 45 cm |
| Dover sole | M | 120 | 0.0062187 | 3.121513 | 143.7 | 410.7 | 900.0 |
| | F | 228 | 0.0035684 | 3.275378 | 135.3 | 407.3 | 927.6 |
| | T | 348 | 0.0043044 | 3.224541 | 138.6 | 410.0 | 922.1 |
| | | | | | 30 cm | 60 cm | 85 cm |
| Lingcod | M | 90 | 0.0016011 | 3.447811 | 198.3 | 2163.5 | 7189.5 |
| | F | 177 | 0.0017460 | 3.411412 | 191.0 | 2032.6 | 6669.5 |
| | T | 267 | 0.0018144 | 3.406298 | 195.1 | 2068.4 | 6774.8 |
| | | | | | 20 cm | 30 cm | 40 cm |
| Pacific | M | 308 | 0.0109020 | 3.089707 | 114.1 | 399.4 | 971.4 |
| ocean | F | 282 | 0.0094513 | 3.137396 | 114.1 | 407.2 | 1004.1 |
| perch | T | 621 | 0.0079124 | 3.186097 | 110.5 | 402.3 | 1006.1 |
| | | | | | 20 cm | 30 cm | 40 cm |
| Petrale sole | M | 76 | 0.0025055 | 3.431999 | 73.1 | 294.0 | 789.1 |
| | F | 90 | 0.0023194 | 3.453135 | 72.1 | 292.5 | 789.8 |
| | T | 166 | 0.0023985 | 3.444131 | 72.6 | 293.3 | 790.0 |
| | | | | | 46 cm | 50 cm | 58 cm |
| Silvergray | M | 32 | 0.0057855 | 3.226579 | 1340.8 | 1754.7 | 2832.6 |
| rockfish | F | 20 | 0.0066036 | 3.185154 | 1305.9 | 1703.2 | 2732.5 |
| | T | 52 | 0.0066831 | 3.186980 | 1330.9 | 1736.1 | 2786.1 |

Table 13.--Continued.

| Species | Sex | Number sampled | Length-weight coefficients a | b | Predicted weight at length (g) | | |
|---|---|---|---|---|---|---|---|
| | | | | | 35 cm | 40 cm | 44 cm |
| Widow rockfish | M | 17 | 0.0111780 | 3.095326 | 560.6 | 1016.8 | 1365.8 |
| | F | 38 | 0.0142520 | 3.016179 | 647.2 | 968.2 | 1290.7 |
| | T | 55 | 0.0205130 | 2.923433 | 669.9 | 989.8 | 1307.9 |
| | | | | | 20 cm | 35 cm | 50 cm |
| Yellowtail rockfish | M | 411 | 0.0091988 | 3.134157 | 110.0 | 635.5 | 1943.4 |
| | F | 434 | 0.0097627 | 3.120440 | 112.0 | 642.3 | 1954.8 |
| | T | 845 | 0.0094126 | 3.129153 | 110.9 | 638.8 | 1950.1 |

## Additional Data and Studies

Data from age structures were not available at the time this report was written. These age results, including population at age and biomass at age, will be available upon request from the authors when the analyses are completed. A state-by-state analysis of length-weight relationships is also available.

We carried out several special studies requested by colleagues in other agencies or institutions during this AFSC survey. Samples and data collected for these studies were processed and analyzed by those requesting them. A collection of individual lingcod lengths and age structures (dorsal spines) were collected for Washington Department of Fisheries and Wildlife (WDFW). Arrowtooth flounder maturity data were also recorded for WDFW during otolith sampling. Personnel from the AFSC Trophic Interactions Group collected stomachs from a variety of species and also recorded information on the relationship between gall bladder size, bile color, and feeding condition of selected species. Individual fish (<20 cm) samples were also collected for the Trophic Interactions Group. Individual fish from different size groups and areas were also collected and frozen for the National Marine Mammal Laboratory (NMML) at the AFSC to provide them with a reference library of potential prey items. Tissue samples of shortspine and longspine thornyhead, Dover sole, and sablefish were collected for the Southwest Fisheries Science Center from sites off Washington, Oregon, and Canada. Pacific halibut otoliths were collected by International

Pacific Halibut Commission (IPHC) staff to provide them with information on size and age by sex from trawl samples for comparison with data obtained from longline collections. IPHC staff also collected and froze whole halibut specimens for a parasite study. Whole fish were collected and frozen for use in the AFSC Observer training program. We collected yellowtail, canary, widow, and silvergray rockfish otoliths for the Canadian Department of Fisheries and Oceans off southwest Vancouver Island.

## ACKNOWLEDGMENTS

Many individuals were involved in the 1992 West Coast triennial bottom trawl survey, both in collecting the data at sea and in manuscript preparation at the AFSC. We would like to express our thanks to the captains and crew aboard the Alaska and the Green Hope for providing safe and efficient platforms from which to conduct our operations. We are also appreciative to the biologists from the AFSC and those cooperating from the Southwest Fisheries Science Center, International Pacific Halibut Commission, Oregon State University, and the Makah Tribal Council who participated in this survey. Finally, thanks go to Franklin R. Shaw and Norman B. Parks for their roles in data editing and Katherine Zecca and Wendy Carlson for graphics support.

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