



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
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CRUISE RESULTS

NOAA VESSEL MILLER FREEMAN
CRUISE NO. 92-10
1992 ALASKA FISHERIES SCIENCE CENTER
WEST COAST UPPER CONTINENTAL SLOPE
GROUND FISH TRAWL SURVEY
OCTOBER 16-NOVEMBER 13, 1992

A bottom trawl survey of the groundfish resources of the upper continental slope was recently completed by the Resource Assessment and Conservation Engineering Division of the Alaska Fisheries Science Center (AFSC). This report summarizes the preliminary results of the survey.

ITINERARY

The survey was conducted aboard the NOAA research vessel Miller Freeman between October 16 and November 13, 1992. Substitutions of scientific personnel were made in Astoria, Oregon, during a mid-cruise break October 29-31. The survey area covered the upper continental slope waters 183-1,280 m (100-699 fm) deep in the U.S. portion of the International North Pacific Fisheries Commission (INPFC) Vancouver area (lat 48°05'N-47°30'N) and the northern portion of the INPFC Columbia area (47°30'N-45°23'N) off the Washington and northern Oregon coast. In addition to the scientific objectives stated below, the vessel maintained extensive environmental and operational data for forwarding to National Resource Consultants in support of a space-based monitoring program designed to monitor illegal foreign fishing from satellites. The Miller Freeman also participated in a joint National Marine Fisheries Service/U.S. Navy exercise to gather acoustical profiles of the ship's noise characteristics under various operating conditions throughout the cruise.

OBJECTIVES

The annual groundfish slope surveys are designed to describe and monitor the abundance, geographic, bathymetric distribution, and biological characteristics of major groundfish resources inhabiting the upper continental slope of the U.S. Pacific coast. Previous surveys in this series were conducted in 1984, 1988,



1989, 1990, and 1991, each covering a different portion of the U.S. Pacific coast. The 1992 slope survey covered the U.S. portion of the INPFC Vancouver area and the northern portion of the INPFC Columbia area. The specific objectives for this cruise were to:

1. obtain biological data including sex, length, and length-weight for sablefish (Anoplopoma fimbria), Dover sole (Microstomus pacificus), shortspine thornyhead (Sebastolobus alascanus), longspine thornyhead (Sebastolobus altivelis), arrowtooth flounder (Atheresthes stomias), Pacific grenadier (Coryphaenoides acrolepis), and giant grenadier (Albatrossia pectoralis);
2. obtain age samples and maturity data from shortspine and longspine thornyhead, sablefish, Dover sole, and arrowtooth flounder for stock assessment purposes;
3. obtain stomach samples from nine species of bathypelagic fish that inhabit the slope to determine trophic relationships of the fish community [arrowtooth flounder, Dover sole, sablefish, shortspine and longspine thornyhead, Pacific hake (Merluccius productus), Pacific grenadier, giant grenadier, and deepsea sole (Embassichthys bathybius)];
4. obtain sablefish flesh firmness and color characteristic data from fish sacrificed for aging;
5. describe the fish community of the slope and how it varies with bathymetry;
6. describe the physical characteristics (temperature and salinity profiles of the water column) of the slope habitat; and
7. collect samples requested for special studies conducted by scientists at various fishery agencies and academic institutions.

VESSEL AND GEAR

The research vessel Miller Freeman is a 65.5-m (215-ft) stern trawler equipped with modern trawling, oceanographic, and hydrographic sampling systems and navigation and fishing electronics. The standard survey trawl used was the polyethylene high-opening Northeastern bottom trawl equipped with mud-sweep roller gear constructed of 203-mm (8-in) solid rubber disks strung on 16-mm high tensile chain. Dimensions of this net are: 27.2-m (89-ft) headrope, 37.4-m (123-ft) footrope including the "flying wings". The body is constructed of 127-mm stretched mesh polyethylene netting, an 89-mm stretched mesh codend, and a 32-mm

stretched mesh codend liner. Each wing was attached to a 907-kg (2,000-lb), 1.8-m x 2.7-m (6-ft x 9-ft) steel V-door by three 55-m (180-ft) dandyines made of 16-mm galvanized steel cable. A SCANMAR¹ acoustic trawl mensuration system was used to obtain mean fishing dimensions of the Noreastern trawl and a Furuno wireless netsonde system was used to monitor bottom contact throughout each trawl haul. A Richard Brancker XL-200 submersible data logger was attached to the trawl and used in conjunction with a Trimble Global Positioning System (GPS) unit for gathering data on the time, depth, water temperature, and geodetic position for each trawl. Expendable bathythermograph (XBT) probes were used to obtain temperature profiles at sites too deep for the XL-200 (max depth = 1,000 m). These data were integrated with fishing dimensions of the net, producing a comprehensive set of data describing gear performance in space and time.

Water column temperature and salinity profiles were obtained using a Seabird Seacat SBE19 conductivity/temperature/depth (CTD) probe. Plankton samples for a domoic acid study were obtained by doing a hand-cast with a 20- μ m, 0.25-m plankton net and the samples were preserved in 1% formalin.

SURVEY DESIGN AND METHODS

The survey area was stratified into six depth strata as follows: 183-366 m (100-199 fm), 367-549 m (200-299 fm), 550-732 m (300-399 fm), 733-914 m (400-499 fm), 915-1,097 m (500-599 fm), and 1,098-1,280 m (600-699 fm). Trawl station sites were placed randomly along 19 east-west tracklines situated 16.7 km (9 nm) apart in each of the six depth strata. The number of stations per depth stratum were allotted proportionally to the trackline length across each stratum by assigning one station for every 13.0 km of linear trackline length (e.g., there would be three stations allocated to a stratum with a trackline length of 30 km).

Stations were surveyed with the ship's fathometer and GPS plotter before and during net deployment. Sampling at each station consisted of a controlled bottom trawl haul with a netsonde attached to the headrope to monitor bottom contact. A CTD cast was made at shallow, intermediate, and deep stations on each trackline to obtain temperature and salinity profiles of the slope water column. After the trawl settled to the bottom, it was towed for 30 minutes at strata 1, 2, and 3 using a scope ratio of approximately 2.5:1. Sixty-minute hauls were made at strata 4, 5, and 6 using scope ratios of approximately 2:1.

¹ Reference to trade names or commercial firms does not constitute endorsement by the National Marine Fisheries Service, NOAA.

Towing speed was approximately 2 knots at all stations and trawling operations occurred 24 hours per day. Trawl fishing dimensions were monitored at all stations in strata 1, 2, 3, and 4. Station data, including time, geodetic position, trawl dimensions, distance fished, salinity and temperature profiles, and catch and length information were stored for later analysis using shipboard computer systems.

All catches were sorted to the lowest possible taxon, weighed, counted, and processed according to standard AFSC protocols. Samples of each fish species caught in every haul were measured for length composition. Otolith (age) samples were collected from the primary target groundfish species by sex-centimeter intervals in three depth strata (183-549 m, 550-914 m, and 915-1,280 m). Other biological data were collected from the major fish species encountered. Special study collections were stored in appropriate fixatives or frozen.

RESULTS

A total of 122 preselected potential trawl stations were established along 19 tracklines. There was time during the cruise to survey 112 stations along the first 18 tracklines and 34 stations had to be abandoned because the ground was unfavorable for trawling. Major canyons with steep grades predominated in most of the survey area and the hydrographic charts were not sufficiently detailed or accurate, making the task of surveying difficult and time consuming. Successful tows were made at the remaining 78 stations (Fig. 1). Another three tows were unsuccessful because of net damage, bad weather, or failure of the trawl to reach bottom. Temperature-salinity profiles were obtained at 42 trawl sites using the CTD, and the XBT was used to obtain another 10 trawl site temperature profiles. The XL-200 data logger was also used to obtain temperature-depth profiles of the trawl for 56 tows.

A total of 95 fish species belonging to 42 families were identified in catches throughout the survey. In addition to the fish species, samples contained representatives from numerous orders of invertebrates. The types and numbers of biological data collected from fish are summarized in Table 1. Table 2 summarizes the length-frequency data collected from non-target species. Age structures collected from fish species will be read by the age determination unit of the AFSC.

Tables 3 and 4 show the dominant groundfish species and grooved Tanner crab caught by INPFC area and depth stratum, ranked in order of catch per unit effort (CPUE) expressed in kg/km trawled. The dominant groundfish species caught in each stratum were similar for the U.S. Vancouver and the Columbia INPFC areas. Spiny dogfish (Squalus acanthias), Pacific hake, and Dover sole

were the three most abundant groundfish species in stratum 1 (183-366 m). Pacific hake, Dover sole, sablefish, and shortspine thornyhead were the four most abundant groundfish species in stratum 2 (367-549 m). Sablefish, Dover sole, and longspine and shortspine thornyheads were the top four groundfish species in stratum 3 (550-732 m). Longspine and shortspine thornyheads, sablefish, grooved Tanner crab, and Dover sole were the five most abundant species in stratum 4 (733-914 m). A group consisting of six species--shortspine and longspine thornyheads, Pacific and giant grenadiers, sablefish, and grooved Tanner crab--dominated catches in strata 5 and 6 (915-1,280 m).

The mean CPUE distributions for grooved Tanner crab and for the four primary-target groundfish species are shown in Fig. 2 by depth stratum and INPFC area. Longspine thornyheads and grooved Tanner crab had higher mean CPUE in the three deepest strata compared to the three shallow strata. The converse was true for Dover sole and sablefish. Mean CPUE for shortspine thornyhead ranged from 3.8-14.2 kg/km and there was no apparent trend with depth.

Plots of unweighted size composition of several commercially-important groundfish species are provided in Figs. 3-6, showing their size composition by depth stratum and by sex for the U.S. Vancouver and Columbia INPFC areas pooled.

Samples for additional projects were also collected. Maturity and gonadal-somatic index (GSI) data were collected for arrowtooth flounder for the Washington Department of Fisheries. Maturity and GSI data, as well as ovaries for fecundity analysis, were collected from rougheye rockfish (Sebastes aleutianus) for an AFSC study of the reproductive biology of rougheye rockfish. Twoline eelpouts (Bothrocara pusillum) and Pacific grenadier were collected for the Moss Landing Laboratory to do research on resource partitioning between the two species. Pacific grenadiers and giant grenadiers were measured snout-to-vent plus total length and weight to obtain data for deriving a conversion factor between the two measurements. The AFSC pathology laboratory collected pathology samples from five different slope groundfish species (arrowtooth flounder, Dover sole, Pacific hake, longspine thornyhead, and shortspine thornyhead) as part of an ongoing study to monitor fish health. White muscle tissue samples from four commercial slope species (shortspine and longspine thornyhead, Dover sole, and sablefish) were obtained for the Southwest Fisheries Science Center to do stock identification research. Forty-seven domoic acid plankton samples were obtained in conjunction with CTD casts for the University of Washington School of Oceanography for investigations concerning the occurrence of domoic acid toxin in west coast shellfish populations.

SCIENTIFIC PERSONNEL

<u>Name</u>	<u>Position</u>	<u>Organization</u>
<u>Leg I (October 16-29)</u>		
Mark Wilkins	Chief Scientist	AFSC
Bill Flerx	Fishery Biologist	AFSC
Robert Lauth	Fishery Biologist	AFSC
Steve Syrjala	Statistician Biologist	AFSC
Dave Somerton	Fishery Biologist	AFSC
Mike MacEwan	Net Mender	AFSC
Robin Harrison	Fishery Biologist	AFSC
Julie Pearce	Fishery Biologist	AFSC
Dave King	Fishing Gear Maint.	AFSC
Melissa Grader	Biological Technician	AFSC
Debra McFee	Biological Technician	AFSC

Leg II (October 31-November 13)

Robert Lauth	Chief Scientist	AFSC
Bill Flerx	Fishery Biologist	AFSC
Mike MacEwan	Net Mender	AFSC
Bob Mikus	Fishery Biologist	ODFW
Jim McClelland	Biological Technician	AFSC
Allen Shimada	Fishery Biologist	AFSC
James Smart	Net Mender	AFSC
Ron Payne	Biological Technician	AFSC
Frank Shaw	Fishery Biologist	AFSC
Eric Brown	Fishery Biologist	AFSC
Michael Martin	Fishery Biologist	AFSC

AFSC - Alaska Fisheries Science Center, Seattle, Washington
 ODFW - Oregon Department of Fish and Wildlife, Newport, Oregon

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Table 1.--Biological data collected during the 1992 west coast upper continental slope groundfish trawl survey of the U.S. portion of the INPFC Vancouver and the northern portion of the INPFC Columbia statistical areas.

Fish species sampled	Otoliths, maturity, and weight data	Length-frequency data	AFSC stomach samples	AFSC pathology samples	AFSC fecundity samples	WDF maturity samples	SWFSC tissue samples	Total/vent length & weight data
Arrowtooth flounder	220	785	39	11		98	-----	-----
Deepsea sole	-----	739	111	-----	-----	-----	-----	-----
Dover sole	542	5,028	166	42	-----	-----	15	-----
Giant grenadier	-----	1,295	94	-----	-----	-----	-----	213
Pacific grenadier	-----	2,817	40	-----	-----	-----	-----	398
Pacific hake	-----	2,806	98	36	-----	-----	-----	-----
Longspine thornyhead	549	10,032	141	13	-----	-----	30	-----
Rougheye rockfish	-----	122	-----	-----	43	-----	-----	-----
Sablefish	500	2,388	113	-----	-----	-----	15	-----
Shortspine thornyhead	712	5,117	179	12	-----	-----	15	-----
Total	2,523	31,129	981	114	43	98	75	611

Table 2.--Number of non-target fish measured during the 1992 west coast upper continental slope groundfish trawl survey of the U.S. portion of the INPFC Vancouver and the northern portion of Columbia statistical areas.

Fish taxon	Length-frequencies
Black hagfish	314
Skates	447
Sharks	1,289
Other flatfish	4,207
Other rockfish	3,773
Other grenadiers	104
Other roundfish	4,412
Total	14,546

Table 3.--Mean CPUE (kg/km trawled) of the 20 most abundant groundfish and selected crab species caught during the 1992 west coast upper continental slope groundfish survey of the U.S. portion of the INPFC Vancouver area.

Species name	Stratum 1 183-366m	Species name	Stratum 2 367-549m	Species name	Stratum 3 550-732m	Species name	Stratum 4 733-914m
Spiny dogfish	100.8	Dover sole	58.0	Sablefish	21.9	Longpine thornyhead	70.3
Pacific hake	76.1	Pacific hake	26.6	Longpine thornyhead	16.5	Shortspine thornyhead	9.0
Dover sole	43.5	Sablefish	16.2	Dover sole	15.6	Sablefish	8.9
Sharpchin rockfish	41.8	Shortspine thornyhead	11.7	Shortspine thornyhead	7.5	Grooved Tanner crab	7.1
Pacific ocean perch	41.6	Longpine thornyhead	6.1	Pacific grenadier	5.2	Dover sole	3.8
Rex sole	26.4	Rex sole	3.2	Twoline eelpout	4.9	Giant grenadier	3.6
Longnose skate	23.7	Longnose skate	2.5	Pacific hake	2.2	Deepsea sole	3.0
Arrowtooth flounder	23.1	Arrowtooth flounder	2.1	Black eelpout	2.2	Black hagfish	0.9
Sablefish	20.9	Bering skate	1.8	Deepsea sole	1.9	Pacific grenadier	0.8
Slender sole	17.4	Spiny dogfish	1.4	Black skate	1.4	Black skate	0.8
Widow rockfish	16.0	Black eelpout	1.3	Grooved Tanner crab	0.9	Twoline eelpout	0.6
Spotted ratfish	10.9	Bigfin eelpout	1.2	Brown cat shark	0.8	Kamchatka eelpout	0.5
Shortspine thornyhead	8.5	Brown cat shark	0.8	Giant grenadier	0.6	Popeye grenadier	0.4
Rougheye rockfish	7.0	Pacific ocean perch	0.8	Spotted ratfish	0.5	California slickhead	0.3
English sole	6.0	Deepsea sole	0.7	Black hagfish	0.5	Snailfish unidentified	0.2
Greenstriped rockfish	5.8	Twoline eelpout	0.6	Snailfish unidentified	0.3	Robust blacksmelt	0.1
Bering skate	3.5	Petrale sole	0.5	Pacific flatnose	0.3	Spotted ratfish	<0.1
Yellowmouth rockfish	3.5	Snailfish unidentified	0.3	Longfin dragonfish	<0.1	Brown cat shark	<0.1
Rosethorn rockfish	2.6	Black skate	0.3	Lanternfish unidentified	<0.1	Lanternfish unidentified	<0.1
Bigfin eelpout	1.6	Slender sole	0.3	Blackfin poacher	<0.1	Threadfin slickhead	<0.1
Number of hauls	6	Number of hauls	4	Number of hauls	3	Number of hauls	4
Species name	Stratum 5 915-1,097m	Species name	Stratum 6 1,098-1,280m	Species name	All Strata 183-1,280m		
Longpine thornyhead	58.6	Longpine thornyhead	24.1	Longpine thornyhead	29.3		
Pacific grenadier	33.4	Giant grenadier	15.6	Dover sole	20.2		
Sablefish	12.0	Pacific grenadier	9.4	Pacific hake	17.5		
Shortspine thornyhead	8.3	Shortspine thornyhead	4.0	Spiny dogfish	17.0		
Giant grenadier	6.2	Sablefish	2.9	Sablefish	13.8		
Grooved Tanner crab	3.9	Grooved Tanner crab	2.1	Shortspine thornyhead	8.2		
Deepsea sole	1.9	Twoline eelpout	1.6	Pacific grenadier	8.1		
Black skate	1.2	Black skate	1.6	Pacific ocean perch	7.1		
Twoline eelpout	1.1	Deepsea sole	1.6	Sharpchin rockfish	7.0		
California slickhead	0.6	Pacific flatnose	1.3	Rex sole	4.9		
Kamchatka eelpout	0.5	Robust blacksmelt	0.1	Longnose skate	4.4		
Dover sole	0.4	California slickhead	0.1	Giant grenadier	4.3		
Black hagfish	0.2	Pacific hake	0.1	Arrowtooth flounder	4.2		
Pacific hake	0.2	Kamchatka eelpout	0.1	Slender sole	3.0		
Pacific flatnose	0.1	Black hagfish	<0.1	Widow rockfish	2.7		
Popeye grenadier	0.1	Lanternfish unidentified	<0.1	Grooved Tanner crab	2.4		
Threadfin slickhead	<0.1	Blackchin	<0.1	Spotted ratfish	1.9		
Snailfish unidentified	<0.1	Pacific viperfish	<0.1	Deepsea sole	1.5		
Pacific viperfish	<0.1	Blackmouth eelpout	<0.1	Twoline eelpout	1.5		
Blacksmelt unidentified	<0.1	Crested bigscale	<0.1	Rougheye rockfish	1.2		
Number of hauls	5	Number of hauls	2	Number of hauls	24		

Table 4.--Mean CPUE (kg/km trawled) of the 20 most abundant groundfish and selected crab species caught during the 1992 west coast upper continental slope groundfish survey of the northern portion of the INPFC Columbia area.

Species name	Stratum 1 183-366m	Species name	Stratum 2 367-549m	Species name	Stratum 3 550-732m	Species name	Stratum 4 733-914m
Spiny dogfish	169.6	Pacific hake	79.5	Dover sole	29.2	Longspine thornyhead	51.6
Pacific hake	108.8	Dover sole	66.4	Longspine thornyhead	26.2	Sablefish	17.9
Dover sole	48.5	Sablefish	19.3	Sablefish	22.3	Grooved Tanner crab	10.3
Sablefish	46.9	Shortspine thornyhead	14.2	Shortspine thornyhead	9.6	Dover sole	4.6
Pacific ocean perch	36.9	Rex sole	9.6	Pacific hake	9.0	Shortspine thornyhead	3.8
Darkblotched rockfish	36.5	Arrowtooth flounder	6.1	Grooved Tanner crab	5.3	Deepsea sole	2.1
Longnose skate	15.3	Shortraker rockfish	4.1	Deepsea sole	2.7	California slickhead	1.7
Rex sole	12.7	Pacific ocean perch	3.9	Twoline eelpout	1.5	Kamchatka eelpout	0.8
Slender sole	10.6	Longspine thornyhead	3.8	Pacific sleeper shark	1.3	Giant grenadier	0.7
Spotted ratfish	10.1	Longnose skate	3.6	Arrowtooth flounder	1.3	Pacific grenadier	0.7
Sharpchin rockfish	9.7	Rougheye rockfish	3.1	Brown cat shark	1.0	Black hagfish	0.5
Shortspine thornyhead	8.2	Bering skate	3.1	Black skate	0.9	Threadfin slickhead	0.4
Jack mackerel	7.7	Bigfin eelpout	2.0	Black eelpout	0.8	Twoline eelpout	0.3
Splitnose rockfish	4.6	Spiny dogfish	1.9	Giant grenadier	0.7	Brown cat shark	0.3
Bering skate	4.3	Brown cat shark	1.6	Bigfin eelpout	0.7	Pacific hake	0.2
Greenstriped rockfish	3.9	Slender sole	1.5	Threadfin slickhead	0.6	Blacksmelt unidentified	0.2
Rougheye rockfish	3.2	Splitnose rockfish	1.5	Pacific flatnose	0.5	Black skate	0.1
Yellowtail rockfish	2.9	Darkblotched rockfish	0.7	Pacific grenadier	0.4	Careproctus sp.	<0.1
Redbanded rockfish	2.4	Black eelpout	0.6	Pacific ocean perch	0.4	Broadfin lanternfish	<0.1
Pacific cod	2.2	Black skate	0.4	Bering skate	0.3	Snailfish unidentified	<0.1
Number of hauls	10	Number of hauls	11	Number of hauls	12	Number of hauls	9
Species name	Stratum 5 915-1,097m	Species name	Stratum 6 1,098-1,280m	Species name	All Strata 183-1,280m		
Longspine thornyhead	67.0	Longspine thornyhead	45.2	Pacific hake	33.0		
Giant grenadier	10.4	Giant grenadier	30.8	Longspine thornyhead	32.3		
Sablefish	9.4	Grooved Tanner crab	13.1	Spiny dogfish	28.6		
Grooved Tanner crab	7.6	Sablefish	12.1	Dover sole	26.5		
Pacific grenadier	6.6	Pacific grenadier	11.7	Sablefish	21.3		
Shortspine thornyhead	5.3	Shortspine thornyhead	11.4	Shortspine thornyhead	8.7		
California slickhead	2.7	Dover sole	8.4	Giant grenadier	7.1		
Deepsea sole	1.8	Pacific flatnose	1.8	Pacific ocean perch	6.9		
Dover sole	1.7	Black skate	1.7	Darkblotched rockfish	6.2		
Twoline eelpout	0.6	Twoline eelpout	1.6	Grooved Tanner crab	6.1		
Black skate	0.6	Deepsea sole	1.5	Rex sole	3.7		
Kamchatka eelpout	0.2	California slickhead	1.1	Pacific grenadier	3.2		
Black hagfish	0.2	Popeye grenadier	0.3	Longnose skate	3.2		
Blacksmelt unidentified	0.2	Kamchatka eelpout	0.3	Slender sole	2.0		
Brown cat shark	0.1	Blacksmelt unidentified	0.2	Spotted ratfish	1.8		
Threadfin slickhead	0.1	Pacific hake	0.2	Sharpchin rockfish	1.6		
Pacific flatnose	0.1	Brown cat shark	0.1	Arrowtooth flounder	1.5		
Pacific hake	<0.1	Black hagfish	<0.1	Deepsea sole	1.4		
Brownnout spookfish	<0.1	Careproctus sp.	<0.1	Bering skate	1.3		
Popeye grenadier	<0.1	Broadfin lanternfish	<0.1	Jack mackerel	1.3		
Number of hauls	8	Number of hauls	7	Number of hauls	57		

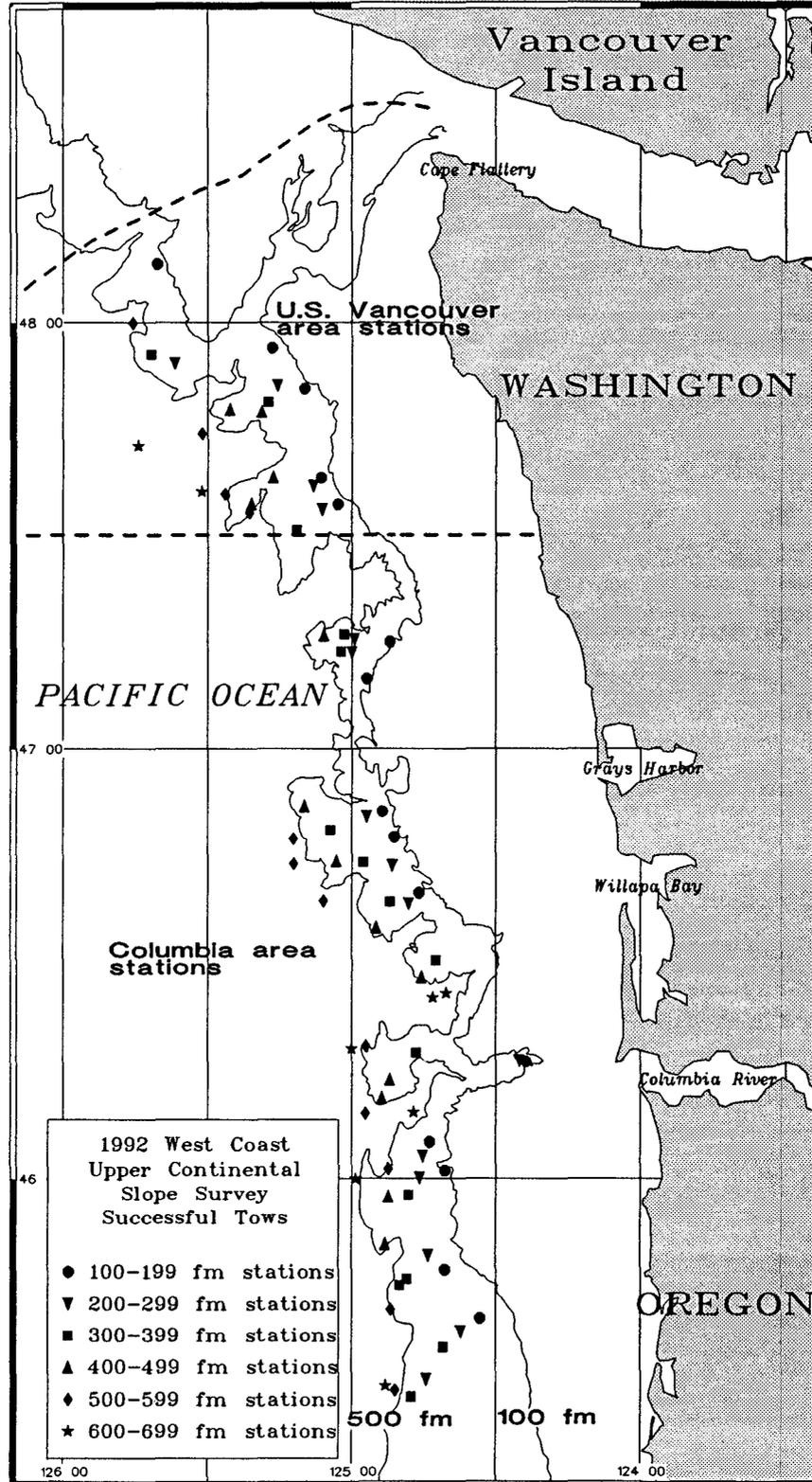
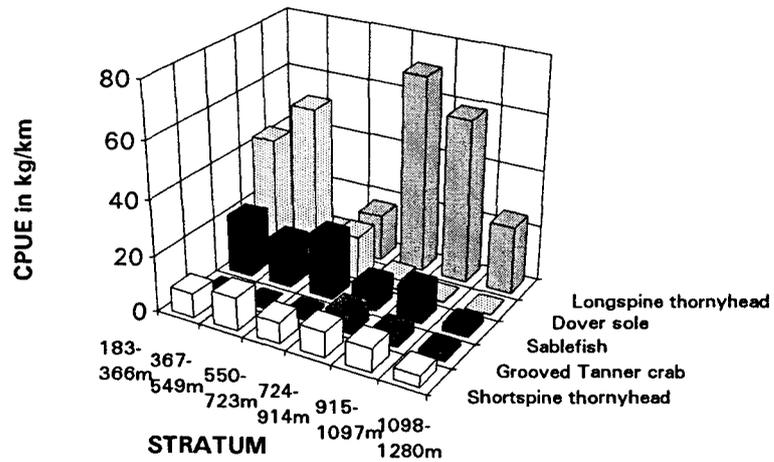


Figure 1.--Stations sampled successfully with bottom trawl hauls during the 1992 west coast upper continental slope survey.

U.S. Vancouver area



Columbia area

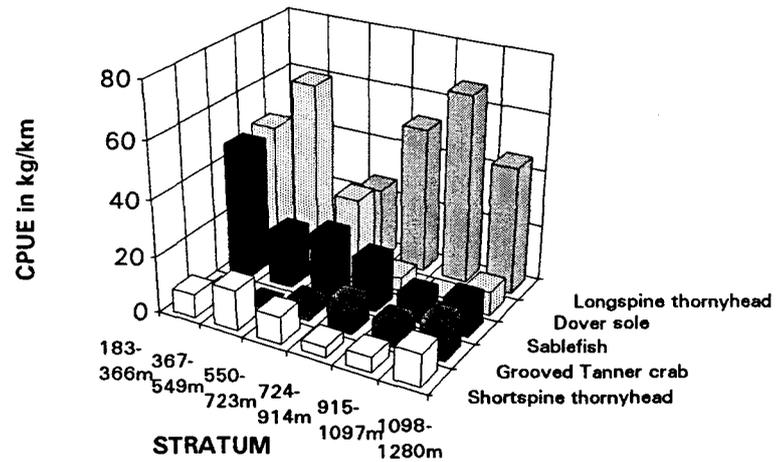


Figure 2.--Summary of the CPUE distributions for four fish species and grooved Tanner crab for the U.S Vancouver and Columbia INPFC areas by depth stratum during the 1992 west coast slope survey.

DOVER SOLE

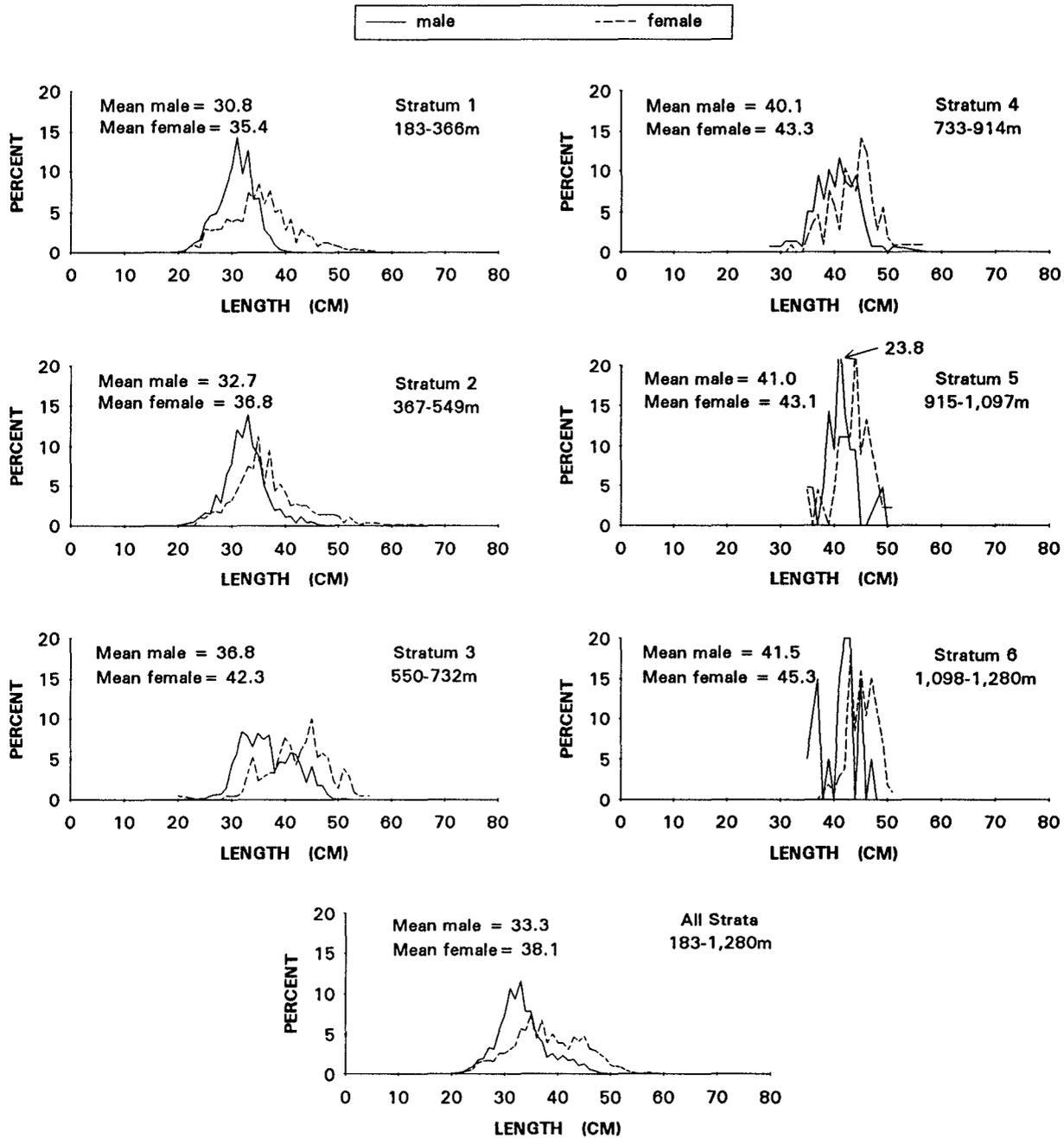


Figure 3.--Unweighted size composition (fork length) of Dover sole by sex and by stratum for the U.S Vancouver and Columbia INPFC areas pooled.

SABLEFISH

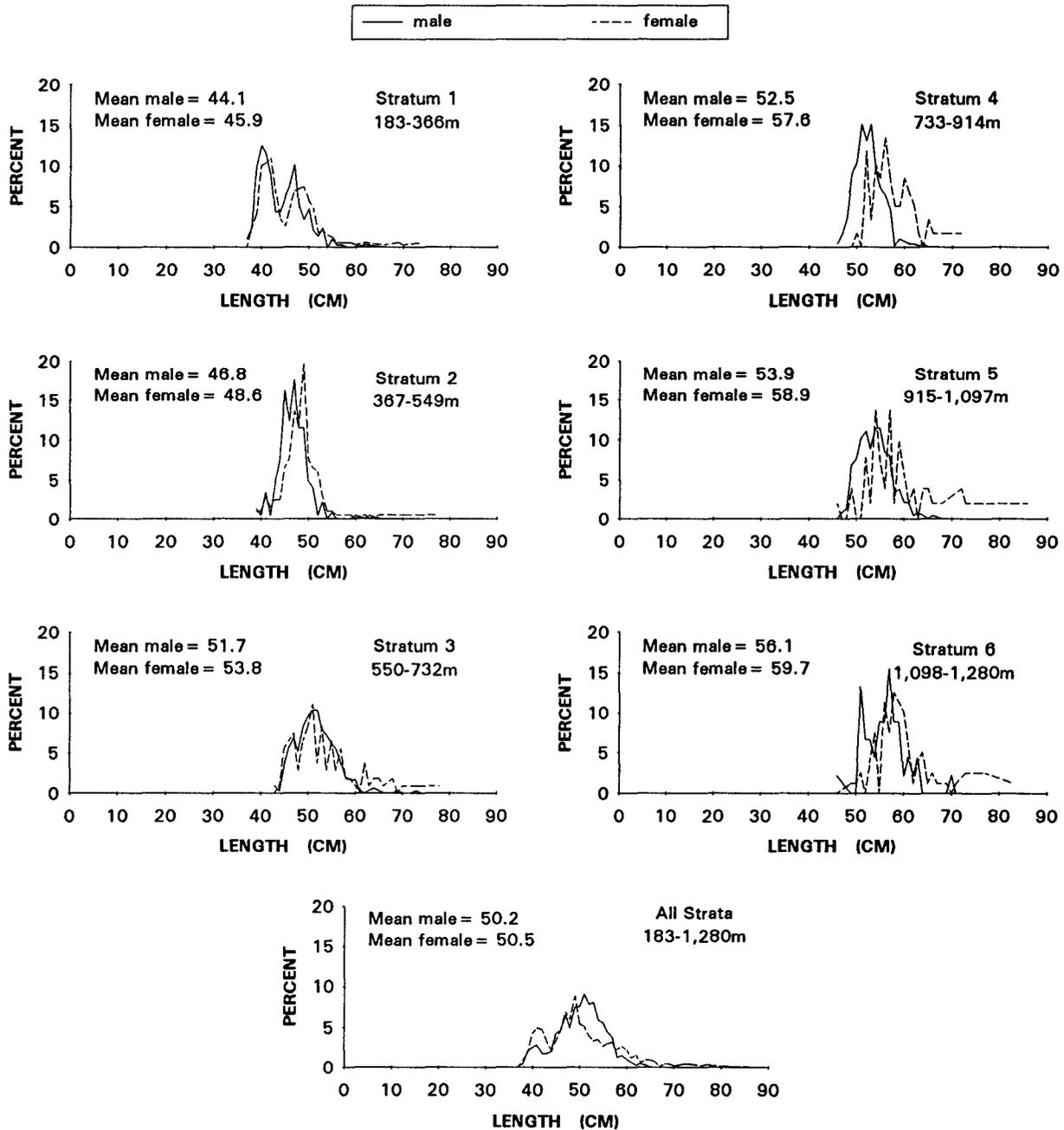


Figure 4.--Unweighted size composition (fork length) of sablefish by sex and by stratum for the U.S Vancouver and Columbia INPFC areas pooled.

SHORTSPINE THORNYHEAD

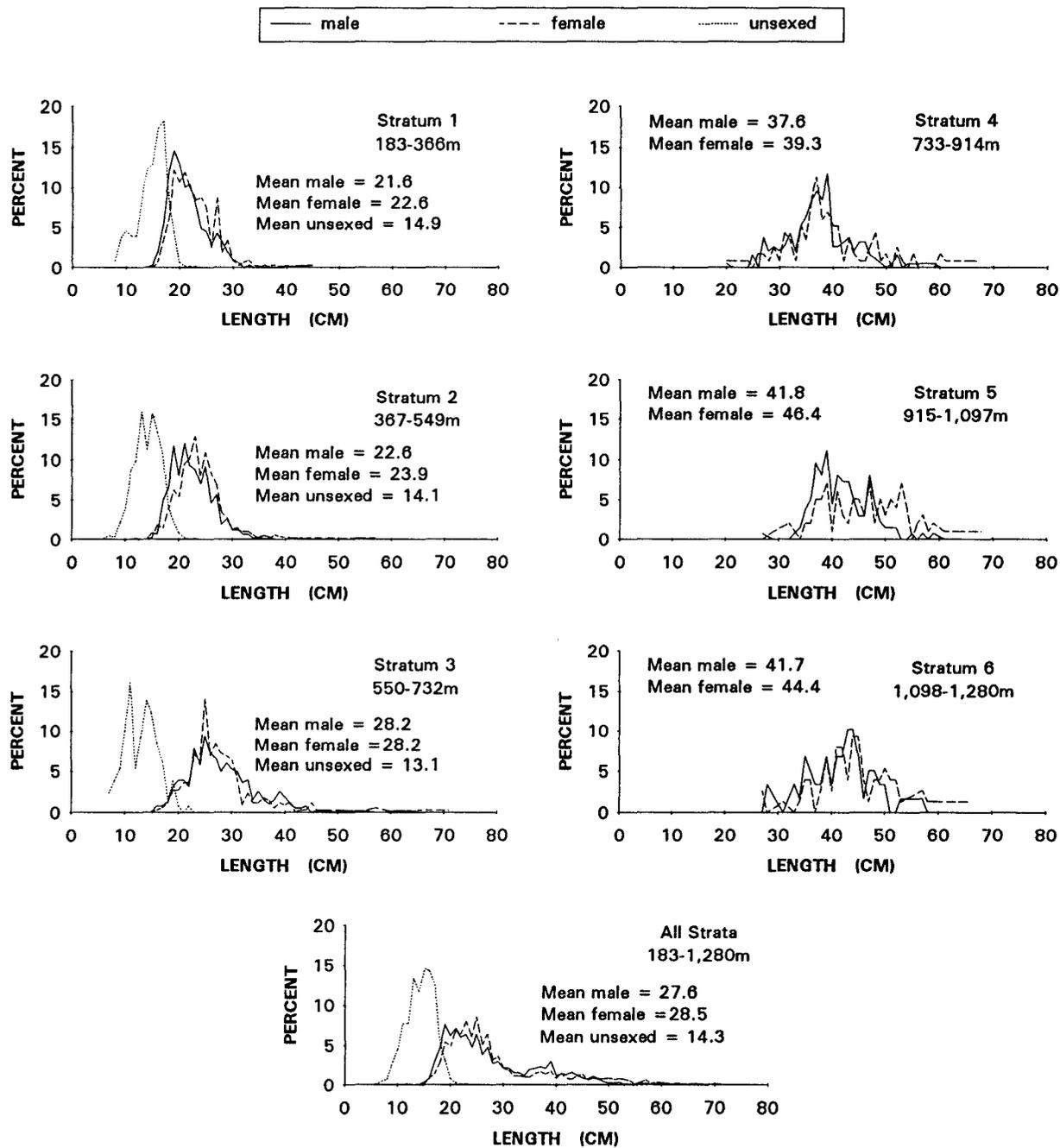


Figure 5.--Unweighted size composition (fork length) of shortspine thornyhead by sex and by stratum for the U.S Vancouver and Columbia INPFC areas pooled

LONGSPINE THORNYHEAD

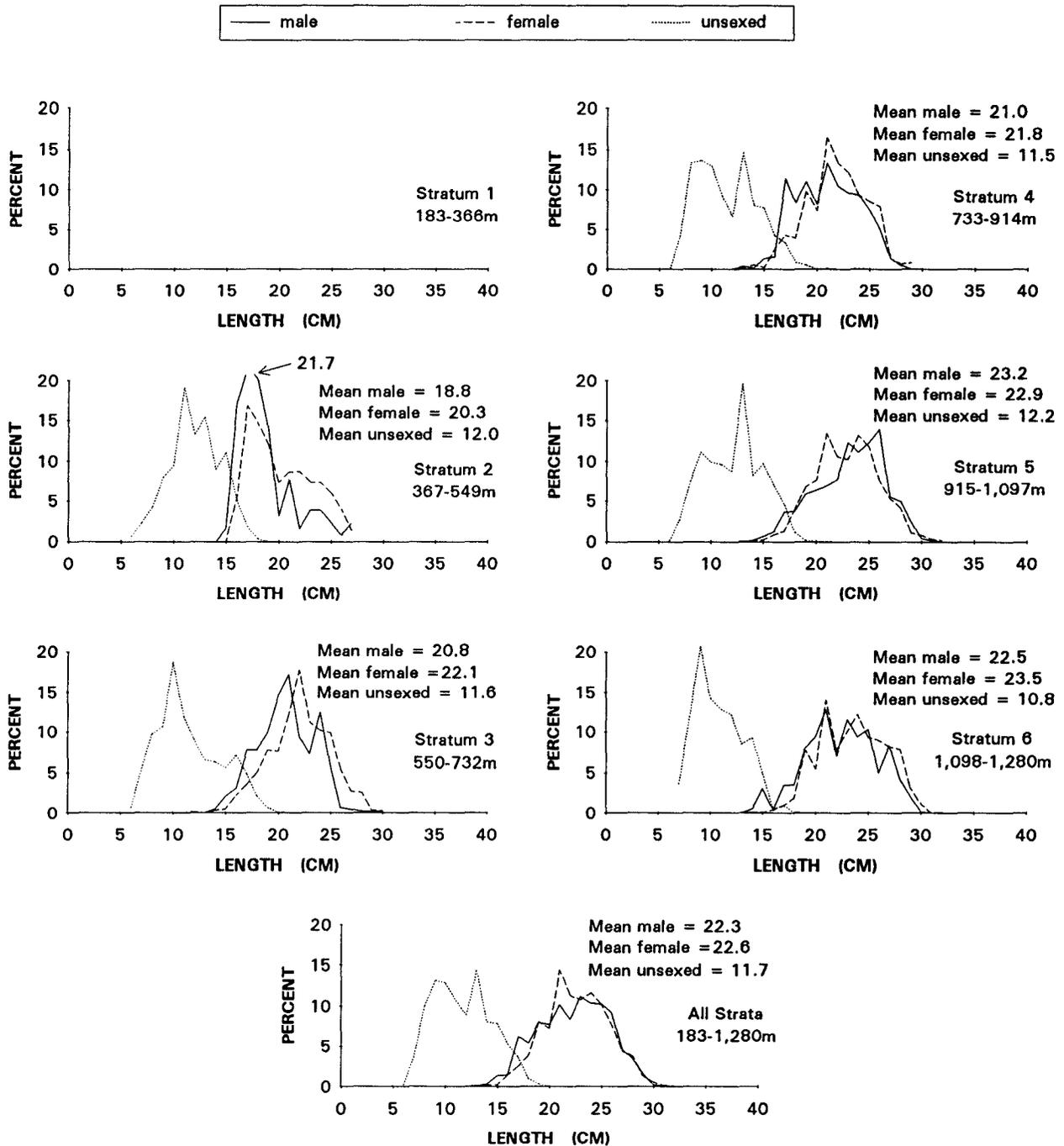


Figure 6.--Unweighted size composition (fork length) of longspine thornyhead by sex and by stratum for the U.S Vancouver and Columbia INPFC areas pooled.