



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

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Resource Assessment and Conservation  
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**CRUISE RESULTS**  
**CHARTERED VESSEL GOLDEN FLEECE**  
**CRUISE NO. 89-2**  
**ALASKA FISHERIES SCIENCE CENTER (AFSC) AND**  
**SOUTHWEST FISHERIES SCIENCE CENTER (SWFSC)**  
**COOPERATIVE SABLEFISH SURVEY**  
**SEPTEMBER 13-OCTOBER 5, 1989**

A commercial bottom trawl vessel was chartered for the period September 13-October 5, 1989, to survey sablefish and other groundfish resources on the upper continental slope from 44°09'N to 45°21'N latitude off Newport, Oregon, between the depths of 183 and 1,280 m (100-700 fm). This report summarizes the results of that survey.

**OBJECTIVES**

This cruise was designed to replicate two previous cooperative surveys completed during the winter by the NOAA ships Miller Freeman (November 25-December 18, 1988) and David Starr Jordan (February 21-April 7, 1989) in a study area off Oregon to provide an assessment of sablefish and associated groundfish resources and interseasonal variability. The specific objectives of the cruise were:

1. to examine sablefish size, age, sex ratio, and reproductive condition as a function of bathymetric distribution in late summer and early fall;
2. to continue studies of juvenile sablefish movements through tagging;
3. to determine size and age at first maturity, fecundity, food habits, and habitat characteristics of key shelf species including sablefish, Dover sole, shortspine thornyhead, and arrowtooth flounder;
4. to describe the fish community of the slope and how it varies with bathymetry and season;



5. to collect samples to investigate water content of Dover sole flesh and how it varies with depth and age; and
6. to collect stomach samples for studies of predator-prey relationships of selected species in the community.

## VESSEL AND GEAR

The Golden Fleece is a 31.7 m (104 ft) long, steel hulled trawler powered by twin 624 hp diesel engines. Deck equipment includes two hydraulic trawl winches with an automatic warp tensioning system, 1,829 m of 25.4 mm trawl cable per winch drum, two net reels (one mounted over the stern ramp and the other forward on the work deck), and two winches mounted on fore and aft gantries for lifting trawl catches. Electronic equipment includes two loran-C receivers, a loran-C video plotter, depth sounders, scanning sonar, VHF and single-sideband transceivers, an auto-pilot, and dual radars.

The standard survey trawl used was the polyethylene high-opening Nor'eastern bottom trawl equipped with mud-sweep roller gear constructed of 203 mm (8 in) solid rubber disks strung on 12.7 mm high tensile chain. Dimensions of this net are: 27.2 m headrope; 37.4 m footrope, including "flying wings"; body constructed of polyethylene mesh; 89 mm stretched mesh codend; and a 32 mm stretched mesh codend liner. The net was spread with 1.8 x 2.7 m steel "V" doors weighing approximately 680 kg each.

Water column temperature profiles were obtained with expendable bathythermograph (XBT) probes.

## SURVEY DESIGN AND METHODS

The area surveyed included a portion of the International North Pacific Fisheries Commission (INPFC) Columbia statistical area from Heceta Head, Oregon (44°09'N), to near Cape Lookout, Oregon (45°21'N), between the depths of 183 and 1,280 m (Figure 1). This study area was selected because: it was surveyed to 915 m (500 fm) in 1984 and to 1,280 m (700 fm) in late 1988 and early 1989; it is a productive habitat for sablefish; it offers a variety of bottom topography; and it is located near the deepwater port of Newport, Oregon. The survey area was stratified into six depth strata: 183-366, 367-549, 550-732, 733-914, 915-1,097, and 1,098-1,280 m (100-199, 200-299, 300-399, 400-499, 500-599, and 600-700 fm). Trawl station sites were situated randomly along nine tracklines 16.7 km apart in each of the six depth strata. The number of stations per depth stratum were allocated proportionally to the trackline length across each stratum as follows:

<u>Linear distance along trackline within depth stratum</u>	<u>Number of stations allocated to trackline section</u>
<13.0 km	1
13.1-25.9 km	2
>26.0 km	3

Station sampling consisted of a controlled bottom trawl and an XBT cast. At depths shallower than 732 m the trawl was towed for 30 minutes after allowing sufficient time for the net to settle to the bottom and a scope ratio of approximately 2.5:1 was used. At deeper stations 60-minute hauls were made using scope ratios of 1.2-2.0:1. Towing speed was approximately 2 knots at all stations and all trawl samples were obtained during daylight hours (approximately 0700-1900 h). All catches were sorted to the lowest possible taxon, weighed, counted, and processed according to standard AFSC and SWFSC protocol. Station data, including time, position, depth, trawl specifications, distance fished, and catch and length information, were stored for later analysis using shipboard computer systems. Age samples by sex-centimeter category, maturity, individual weight, stomach content, and other biological data were collected from target groundfish species.

## RESULTS

Trawling operations were successful at 46 of the 52 sampling stations (88%). Some stations were moved from pre-selected sites to find terrain suitable for trawling. Three of the six unsuccessful tows resulted in extensive damage to the net and the other three tows were unsuccessful because there was insufficient trawl warp available to allow enough scope for the net to maintain proper bottom contact in the deepest sections of the survey area.

The 20 most abundant species taken in each depth stratum were ranked in order of catch per unit effort (CPUE) expressed in kg/km trawled (Table 1). The mean CPUE distributions by depth stratum for grooved Tanner crab and five groundfish species are shown in Figure 2. Relative abundance over all depth strata and presence or absence of each species in a stratum are also shown in Figure 2.

Sablefish was taken in each depth stratum and was the most abundant species (91.5 and 104.2 kg/km) in the 367-549 m and 550-732 m strata. It was the fourth most abundant species in the shallow stratum and was second or third most abundant in the strata deeper than 732 m. Dover sole was also taken in all

Table 1.--Mean CPUE (kg/km) of the 20 most abundant groundfish and selected crab species caught during the 1989 West Coast upper continental slope groundfish survey.

Stratum 1		Stratum 2		Stratum 3		Stratum 4	
Species name	183-366 m	Species name	367-549 m	Species name	550-732 m	Species name	733-914 m
Pacific hake	81.7	Sablefish	91.5	Sablefish	104.2	Longspine thornyhead	132.2
Longnose skate	57.5	Dover sole	90.6	Longspine thornyhead	51.3	Sablefish	45.7
Dover sole	51.8	Shortspine thornyhead	31.9	Dover sole	46.1	Dover sole	28.5
Sablefish	39.5	Pacific hake	20.1	Shortspine thornyhead	25.3	Shortspine thornyhead	13.7
Arrowtooth flounder	25.3	Arrowtooth flounder	11.6	Grooved Tanner crab	19.9	Grooved Tanner crab	6.5
Shortspine thornyhead	23.9	Pacific halibut	11.2	Giant grenadier	9.3	Giant grenadier	4.9
Pacific halibut	17.6	Darkblotched rockfish	8.0	Longnose skate	5.5	Pacific grenadier	3.3
Darkblotched rockfish	17.5	Pacific ocean perch	7.6	Black skate	5.3	California slickhead	2.5
Rex sole	17.4	Longnose skate	7.5	Brown cat shark	3.7	Deepsea sole	2.1
Spiny dogfish	16.1	Shortraker rockfish	6.8	Pacific hake	3.0	Black hagfish	1.7
Pacific ocean perch	16.0	Bering skate	5.4	Twoline eelpout	2.9	Threadfin slickhead	1.3
Sharpchin rockfish	11.1	Rex sole	4.0	Blacktail snailfish	2.5	Twoline eelpout	0.7
Spotted ratfish	11.0	Bigfin eelpout	3.3	Pacific grenadier	2.3	Brown cat shark	0.6
Splitnose rockfish	10.1	Aurora rockfish	2.4	Deepsea sole	1.4	Snakehead eelpout	0.4
Bering skate	7.6	Brown cat shark	1.9	Black hagfish	1.3	Pacific hake	0.4
Lingcod	6.8	Black eelpout	1.0	Bering skate	0.8	Black skate	0.3
English sole	5.5	Blacktail snailfish	0.9	Black eelpout	0.8	King-of-the-salmon	0.2
Slender sole	5.0	Black hagfish	0.8	Pacific flatnose	0.6	Blacktail snailfish	0.2
Bigfin eelpout	4.0	Splitnose rockfish	0.7	Rex sole	0.4	Pacific lamprey	<0.1
Eulachon	3.4	Slender sole	0.6	Bigfin eelpout	0.3	Robust Blacksmelt	<0.1
Number of hauls	14	Number of hauls	6	Number of hauls	6	Number of hauls	8

Stratum 5		Stratum 6		All Strata	
Species name	915-1,097 m	Species name	1,098-1,280 m	Species name	183-1,280 m
Pacific grenadier	74.6	Pacific grenadier	55.8	Sablefish	54.4
Longspine thornyhead	60.8	Longspine thornyhead	33.4	Longspine thornyhead	46.3
Sablefish	30.9	Sablefish	14.8	Dover sole	37.4
Shortspine thornyhead	11.3	Shortspine thornyhead	8.9	Pacific grenadier	22.7
California slickhead	7.2	Giant grenadier	5.9	Shortspine thornyhead	19.2
Dover sole	7.2	Black skate	3.3	Pacific hake	17.6
Giant grenadier	6.5	California slickhead	3.2	Longnose skate	11.8
Grooved Tanner crab	3.8	Pacific flatnose	2.9	Arrowtooth flounder	6.1
Black skate	2.2	Grooved Tanner crab	2.7	Grooved Tanner crab	5.5
Twoline eelpout	1.9	Twoline eelpout	1.4	Pacific halibut	4.8
Deepsea sole	1.6	Deepsea sole	1.2	Giant grenadier	4.4
Pacific flatnose	0.7	Deepsea skate	0.8	Darkblotched rockfish	4.2
Black hagfish	0.7	Robust blacksmelt	0.5	Pacific ocean perch	3.9
Snakehead eelpout	0.3	Threadfin slickhead	0.4	Rex sole	3.6
Threadfin slickhead	0.3	Black hagfish	0.4	Spiny dogfish	2.7
Pacific hake	0.3	Dover sole	0.3	Bering skate	2.3
Brown cat shark	0.2	Pacific hake	0.2	California slickhead	2.2
Blacktail snailfish	0.1	Snakehead eelpout	0.1	Spotted ratfish	1.9
Robust blacksmelt	0.1	Blacktail snailfish	<0.1	Sharpchin rockfish	1.8
Broadfin lanternfish	<0.1	Snailfish sp.	<0.1	Black skate	1.8
Number of hauls	8	Number of hauls	4	Number of hauls	46

strata and was the second or third most abundant species in all strata between 183 and 914 m. Dover sole abundance decreased in deeper waters. Longspine thornyhead was taken in all strata except the 183-366 m stratum and was the most abundant species (132.2 kg/km) in the 733-914 m stratum. Longspine thornyhead was the second most abundant species in the 550-732, 915-1,097 and 1,098-1,280 m strata (51.3, 60.8, and 33.4 kg/km, respectively). Shortspine thornyhead was taken in all strata and was most abundant (31.9 kg/km) in the 367-549 m stratum. In the shallowest stratum, shortspine thornyhead was the sixth most abundant species, and in waters deeper than 549 m, it was the fourth most abundant species. Arrowtooth flounder was taken in waters 183-547 m deep and was most abundant (25.3 kg/km) in the 183-366 m stratum. Grooved Tanner crab was taken only in the four deepest strata and was most abundant (19.9 kg/km) in the 550-732 m stratum.

Biological information collected from target species (sablefish, Dover sole, shortspine thornyhead, arrowtooth flounder, and any Sebastes sp. which were major catch components) included: individual length and weight, maturity stage, otoliths, and tissue samples (Dover sole only). Sablefish, Dover sole, longspine and shortspine thornyhead, and deepsea sole were sampled for stomach contents to establish feeding habits. Length measurements were taken from subsamples of all fish species in each catch. Length frequency distributions for sablefish, Dover sole, shortspine thornyhead, and arrowtooth flounder over all depth strata are shown in Figure 3. Table 2 summarizes the biological data collected during the survey.

Table 2.--Summary of biological data collected during the 1989 West Coast slope groundfish survey. Data collected and abbreviations used include: length frequencies (LF), otoliths for age determination (Otolith), stomach and contents, maturity observations, individual fish weights, and muscle tissue samples for water content determinations.

<u>Species</u>	<u>LF</u>	<u>Otolith</u>	<u>Stomach</u>	<u>Maturity</u>	<u>Weight</u>	<u>Tissue</u>
Sablefish	3,029	454	306	454	387	---
Dover sole	3,034	506	521	2,009	499	500
Shortspine thornyhead	3,952	608	501	476	322	---
Arrowtooth flounder	427	197	---	185	76	---
Longspine thornyhead	4,190	---	236	---	---	---
Deepsea sole	330	---	45	---	---	---
Other flatfish	2,736	---	---	---	---	---
Other roundfish	11,810	---	---	---	---	---
All species combined	29,508	---	---	---	---	---

Sea surface temperature (SST) was obtained with bucket thermometers at most trawl stations and bottom water temperature (BWT) was obtained using XBT probes at one or a few trawl sites within each depth stratum. SSTs were between 12.0 and 15.2°C and averaged 13.5°C (Figure 4). BWTs were between 3.5 and 6.8°C and averaged 4.8°C.

### SCIENTIFIC PERSONNEL

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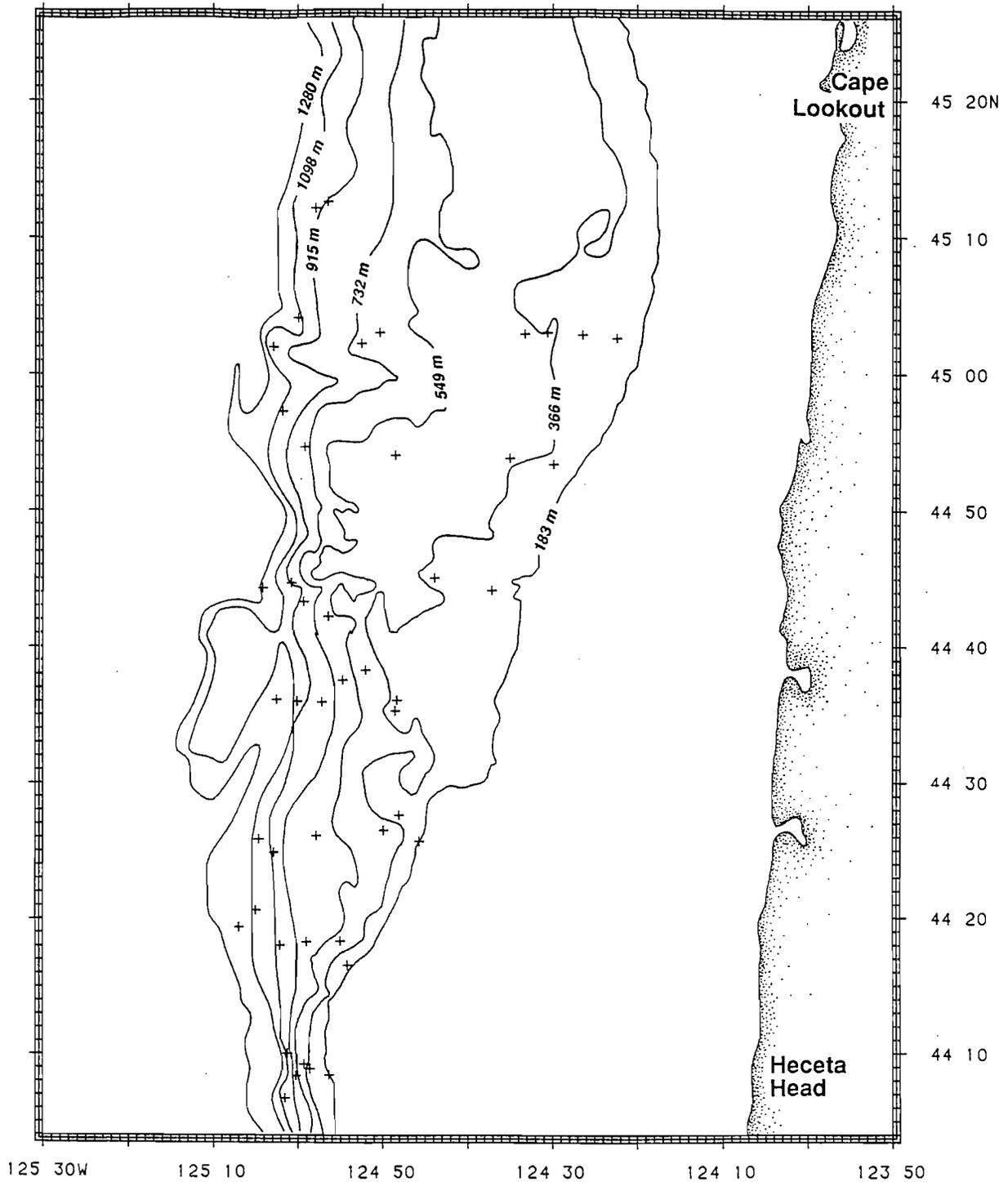


Figure 1.--Survey area showing the 46 successful tows of the 1989 Alaska Fisheries Science Center and Southwest Fisheries Science Center Cooperative Sablefish Survey, 13 September - 5 October. Equivalent depth intervals are 183 m = 100 fm, 366 m = 200 fm, 549 m = 300 fm, 732 m = 400 fm, 915 m = 500 fm, 1,098 = 600 fm, 1,280 m = 700 fm.

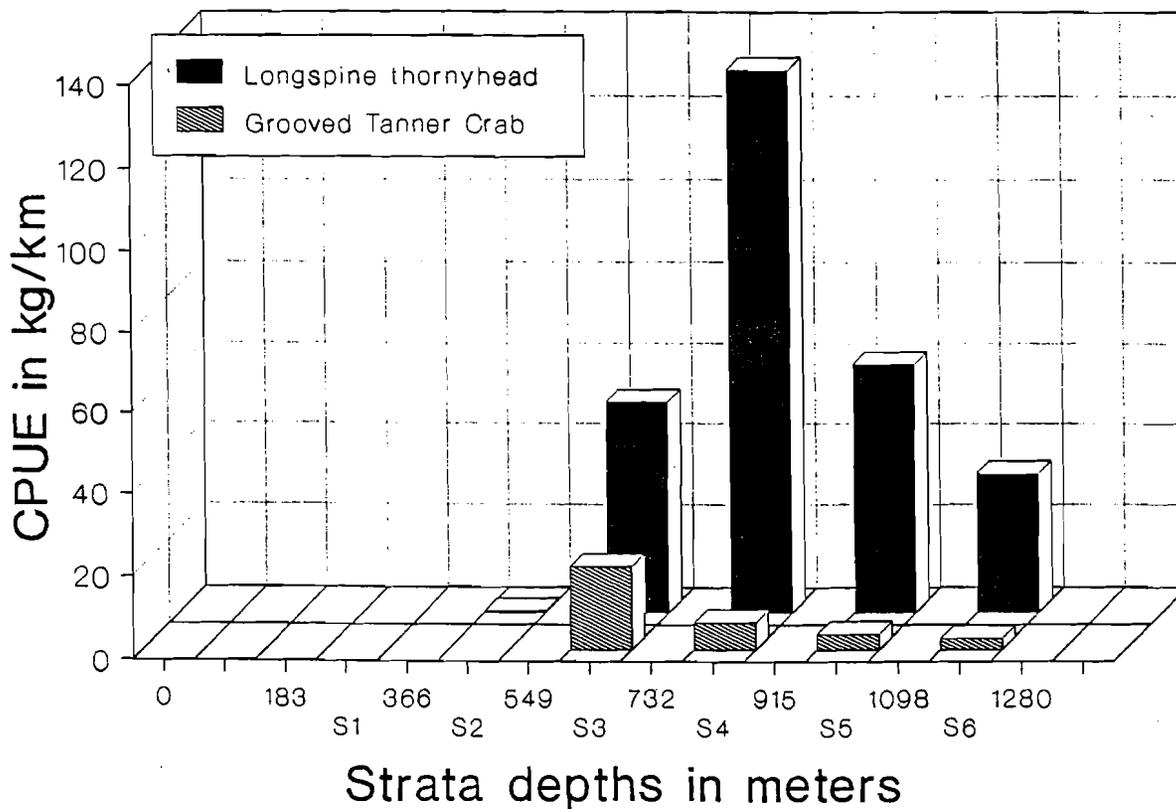
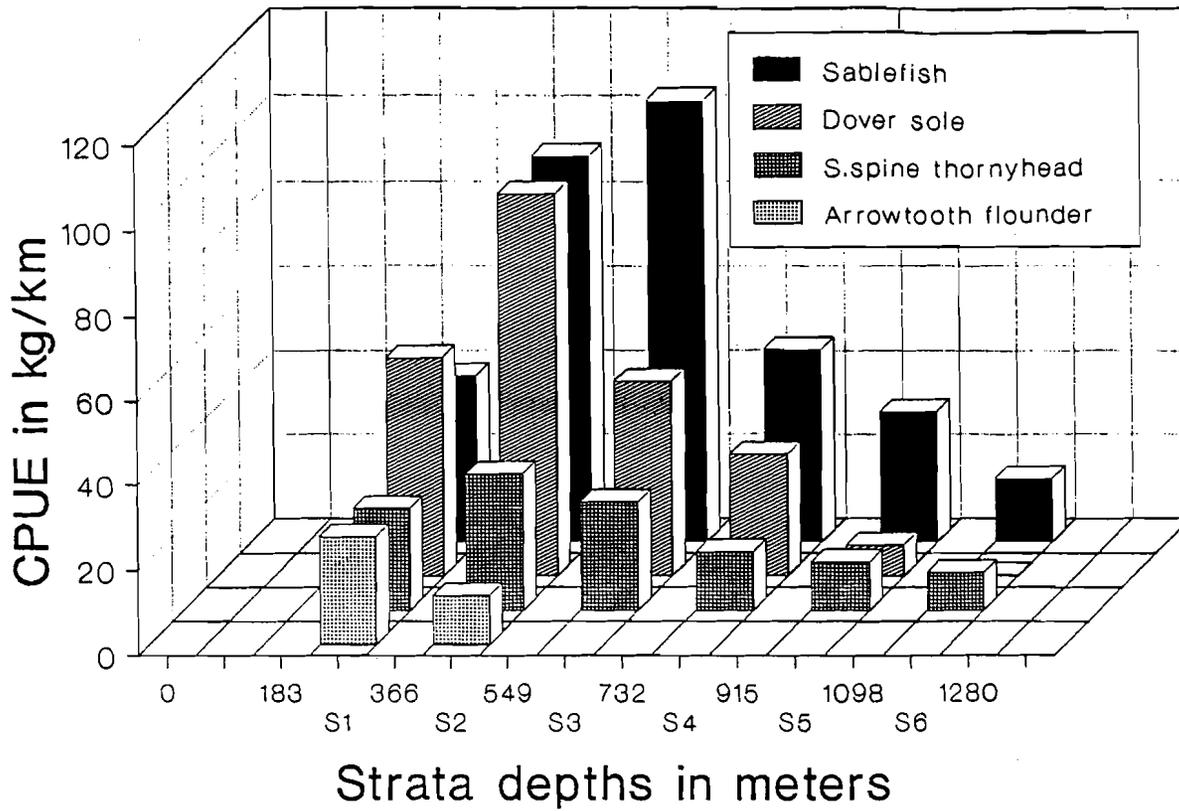


Figure 2.--Summary of the CPUE distributions by depth stratum for five fish species and grooved Tanner crab during the 1989 Cooperative sablefish survey.

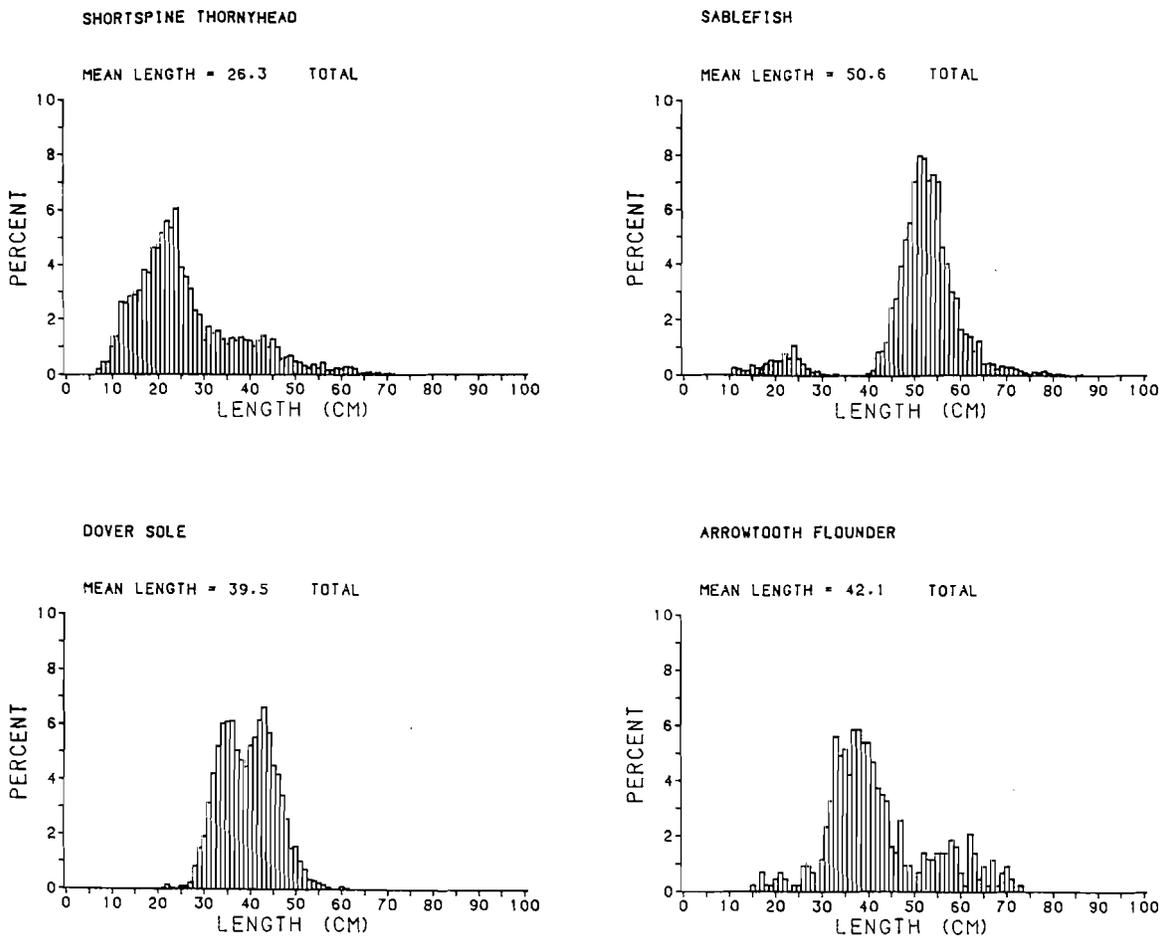


Figure 3.--Unweighted size composition (fork length) of primary target species pooled over all depth strata between 183 and 1,280 m.

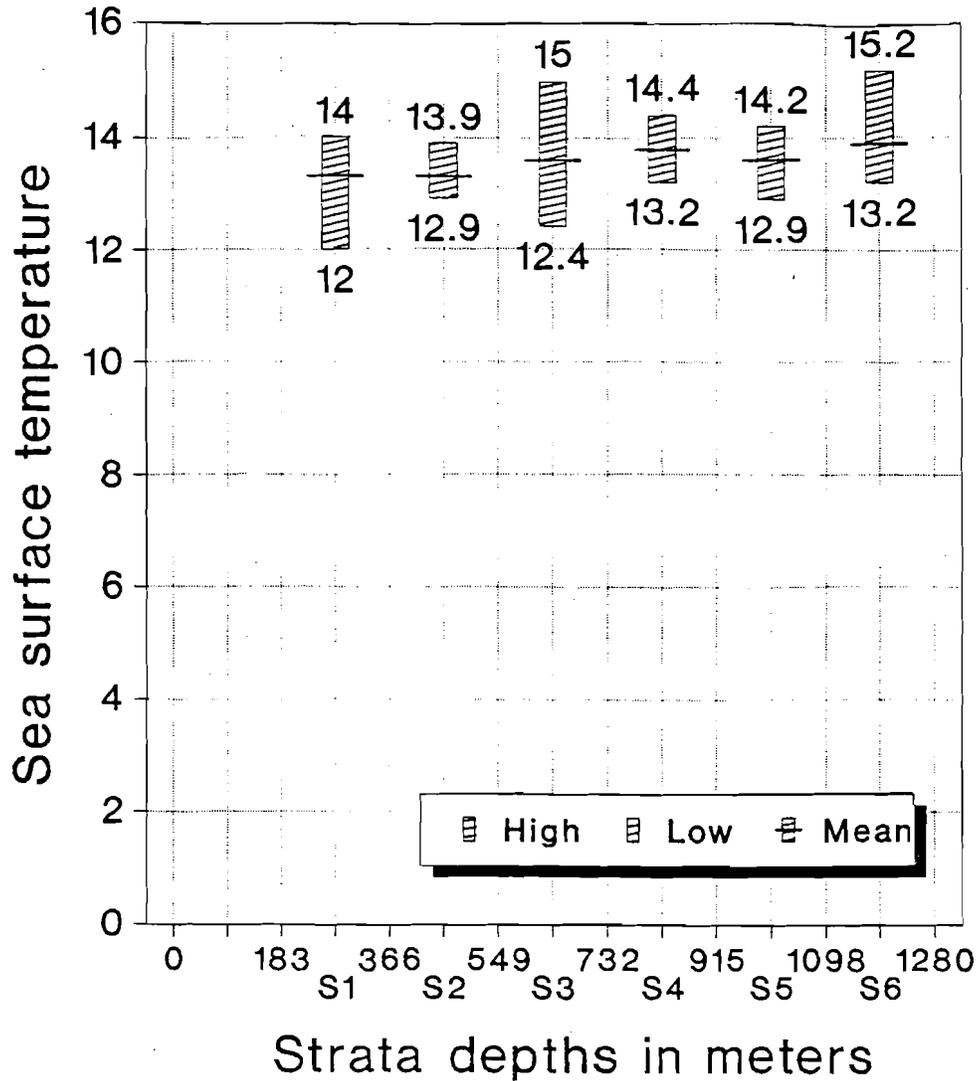


Figure 4.--Temperature ranges and mean sea surface temperatures by depth stratum (183-366, 367-549, 550-732, 733-914, 915-1,097, 1,098-1,280 m) observed during the 1989 Cooperative sablefish survey.