



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

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CRUISE RESULTS

Cruise 85-1 ALASKA  
Cruise 85-1 ARGOSY  
1985 Bering Sea Triennial Groundfish Survey  
June-October 1985

The 1985 Bering Sea triennial groundfish survey was completed by Northwest and Alaska Fisheries Center (NAFAC) personnel in cooperation with scientists of the Far Seas Fisheries Research Laboratory, Shimizu, Japan during the period June-October 1985. This comprehensive survey consisted of several elements. The standard Bering Sea groundfish bottom trawl survey, completed annually, was performed by the U.S. stern trawler Argosy and the research vessel Alaska. This survey consisted of 353 stations on the continental shelf (depths less than 180 m) between Unimak Pass and St. Matthew Island during the period June-August (Fig. 1). During the same time period, the Japanese stern trawler Daikichi Maru No. 32 completed a survey of 312 stations along the continental slope at depths generally greater than 182 m (100 fms). The results of this last work will be reported later in a joint U.S.-Japan data report. The third major element of the survey was a hydroacoustic assessment of midwater pollock (see cruise results of Morning Star cruise 85-1).

After the completion of the standard bottom trawl survey, the vessel Argosy completed a 16 station survey of the northern shelf between St. Matthew Island and St. Lawrence Island and then surveyed 78 stations within Norton Sound (Fig. 2). These latter areas are only surveyed during triennial years (1979, 1982, 1985, etc.).

In addition to this major survey work, several other experiments were conducted. These included work to determine relative fishing powers between U.S. and Japanese fishing gears (Fig. 3), an examination of juvenile king crab distributions near the Pribilof Islands, and a joint experiment with the Japanese vessel Daikichi Maru No. 32, the Argosy, and the U.S. trawler Morning Star engaged in the hydroacoustic survey to study the vertical distribution of walleye pollock and diurnal changes in this distribution (Fig. 3). The results of these experiments will be summarized in separate reports.



## OBJECTIVES

The objectives of the 1985 NWAFC bottom trawl survey were to:

1. Continue the annual series of bottom trawl surveys to assess crab and groundfish resources on the eastern Bering Sea continental shelf from Unimak Pass to St. Matthew Island.
2. Complete additional surveys on the continental shelf north of St. Matthew Island and within Norton Sound to continue triennial assessments of resources in those regions.
3. Participate in a joint experiment with the Pelagic Resource Assessment Group of the NWAFC and the Far Seas Fisheries Research Laboratory to investigate variation in the off-bottom versus on-bottom distributions of walleye pollock.
4. Compare the fishing efficiency between standard U.S. sampling nets as used by the vessel Argosy and Japanese nets as used by the vessel Daikichi Maru No. 32.
5. Complete additional experiments as time permitted, including the tagging of Pacific cod, collection of fish stomachs for feeding studies, collection of tissue samples for DNA studies, and investigate the distribution of juvenile king crab near the Pribilof Islands.

## VESSELS AND GEAR

The 30.5 m research vessel Alaska is a house-forward stern trawler and the 38 m Argosy is a house-forward crabber/trawler. The vessels were equipped with modern trawling systems and adequate fishing electronics.

Both vessels were equipped with 83-112 eastern trawls as modified in 1982. These nets have a 25.3 m (83 ft.) headrope and a 34.1 m (112 ft.) footrope. They were towed behind 1000 kg, 1.8 X 2.7 m steel V-doors and 54.9 m paired dandyines. Each lower dandyline had a 0.18 m chain extension connected to the lower wing edge to improve bottom tending characteristics. The trawl towed by the Argosy was found to have a mean towing width of 18.0 m as determined by gear mensuration tests during the cruise. The trawl towed by the Alaska was assumed to have a mean towing width of 16.4 m as measured in 1983.

## SURVEY DESIGN AND METHODS

### STANDARD SURVEY

The eastern Bering Sea shelf is surveyed annually based on a 20 x 10 nm grid. The standard survey has 329 stations (131,600 nm<sup>2</sup>) located in the center of these grid squares (Fig. 1). Higher density sampling is performed around the Pribilof Islands and St. Matthew Island by sampling the corner of the grids to more adequately sample crab stocks. These additional 26 stations bring the total to 355 stations. During 1985, 353 of these stations were

successfully sampled. The survey is designed for two vessels to begin the survey on adjoining columns of stations at the eastern end of Bristol Bay. The vessels then sample alternate columns moving westerly across the shelf. This alternate column design allows the use of statistical techniques to determine differences in relative fishing power between the two vessel/gear combinations.

In 1985, the vessel Alaska began the survey on 1 June, but the vessel Argosy was not available until 1 July. As a result, the standard sampling plan was not used. The vessel Alaska sampled all stations from inner Bristol Bay to approximately 166°W. Due to the pressing need for data on blue king crab stocks around St. Matthew Island, on 1 July both vessels commenced work near Nunivak Island and sampled all westerly stations to the north of latitude 58° N. The two vessels then returned to approximate longitude 166° W. and commenced sampling alternate columns westerly and south of 58° N.

#### EXTENDED TRIENNIAL SURVEY

During 1985, the survey was extended to include portions of the shelf north of St. Matthew Island and also within Norton Sound. On the north shelf, sixteen stations were sampled based on every other row and column of the grid; in effect, a 40 X 40 nm grid (Fig. 2). Within Norton Sound, a 10 X 10 nm grid was established comprising 78 stations.

The survey schedule for each vessel was as follows:

#### Alaska

June 1- August 11                      Survey the continental shelf from inner Bristol Bay, westward to the shelf edge.

#### Argosy

July 1- August 13                      Survey the continental shelf from longitude 166° W. to the shelf edge.

August 21- August 23                      Participate in a joint study of walleye pollock distribution with Daikichi Maru No. 32 and Morning Star

August 25- August 30                      Complete gear comparison experiments with Daikichi Maru No. 32.

September 1- September 3                      Complete survey of standard eastern Bering Sea areas.

September 4- September 7                      Complete survey of juvenile king crab near the Pribilof Islands.

September 8- October 10                      Complete survey of Norton Sound and north shelf areas.

## RESULTS

The following assumptions and limitations concerning the survey should be noted:

- 1) It is assumed that all fish in the path of the trawl are retained while in fact some fish escape the trawl. Others are herded into the trawl by the action of the doors and dandy lines. In addition, some species, such as walleye pollock, have vertical distributions such that a significant portion of the stocks are above the net mouth. Adjustments are not made to the data to compensate for these biases.
- 2) For purposes of biomass estimations, each station is taken to be representative of the grid block and estimates are extrapolated to include the entire area.

### Standard area

Walleye pollock was the most abundant species in the standard survey area with a mean catch rate of 97 kg/hectare trawled (Table 1). That catch rate was double the rate for the second ranked species, yellowfin sole (49 kg/ha). Pacific cod (21 kg/ha), rock sole (14 kg/ha), and Alaska plaice (12 kg/ha) were ranked 3rd through 5th respectively. Pacific cod, walleye pollock, rock sole, flathead sole, and yellowfin sole were each found at over 75% of the stations in the standard area.

#### Inner shelf (less than 50m depth)

The nearshore waters cover about 25% of the standard survey area. The catches within these waters were dominated by yellowfin sole (Table 2). The catch rate of 105 kg/ha was nearly four times the value for the second ranked species, rock sole (27 kg/ha). Walleye pollock, Pacific cod, and Alaska plaice were also abundant.

#### Central shelf (50-100m depth)

The large central shelf area covers about 45% of the standard survey area. Walleye pollock (72 kg/ha) and yellowfin sole (49 kg/ha) were abundant in these areas as well as the inner shelf (Table 2). Although the relative ranking and catch rates were different than on the inner shelf, those two species, combined with Alaska plaice, Pacific cod, and rock sole comprised the major portion of the catches.

#### Outer shelf (100-200m depth)

The waters at depths between 100 m and the shelf edge (about 200 m) cover approximately 30% of the standard survey area. Walleye pollock catch rates of 200 kg/ha were nearly 8 times larger than Pacific cod, the second most abundant species at 27 kg/ha (Table 2). Arrowtooth flounder and flathead sole, traditional deeper water species, had mean catch rates of 8 kg/ha.

### North shelf area

The northern shelf area is primarily an extension of the central shelf and extends from St. Matthew Island to St. Lawrence Island. Like the central shelf, the catches in this area were dominated by walleye pollock (137 kg/ha) (Table 3). Invertebrates form a greater proportion of the overall weight of catches in this more northern region and *Opilio tanner* crab ranked second in the catches (18 kg/ha) after walleye pollock, followed by Pacific cod at 13.5 kg/ha.

### Norton Sound

Invertebrates make up the major portion of the catches within Norton Sound. The purple-orange seastar (*Asterias amurensis*) was the dominant species with a catch rate of 26 kg/ha. Saffron cod was the leading fish species with a mean catch rate of 7.9 kg/ha (Table 4).

### Distribution and Length Composition

The standard survey area of the eastern Bering Sea shelf supports a diverse fauna as indicated by the 300 taxonomic entities identified in the catches. However, seven fish species and the purple-orange seastar made up nearly 90% of the cumulative catch.

### Walleye pollock

Walleye pollock made up over 40% of the total catch rate in the standard survey. Although they were distributed across almost the entire shelf, catch rates increased as depth increased. Rates were highest in the southern areas of each depth zone. The catch rates were also high in the northern shelf region, but the station density was relatively low. Walleye pollock catches on the shelf consisted of a wide range of size and age groups (Fig. 4) dominated by relatively large fish (35-60cm) with a strong secondary mode of age 1 fish (mean length approximately 12 cm.).

### Yellowfin sole

Yellowfin sole was the second most abundant fish species caught in the standard survey and made up approximately 20% of the total catch rate. Abundances were highest on the inner shelf, particularly to the south in Bristol Bay. Catch rates along the central shelf were moderately high but decreased to less than 1 kg/ha on the outer shelf. The length distribution shows a wide range of sizes from juveniles to large fish with a mean length of 27.6 cm (Fig. 4).

### Pacific cod

Pacific cod were rather evenly distributed across the shelf with slightly higher catches along the outer shelf. They made up almost 9% of the total catch rate. Large numbers of juveniles, estimated to be from the 1982 and 1984 year classes, were present in the length distribution (Fig. 4).

Rock sole

Rock sole were found primarily in the southern portions of the inner and central shelf regions. Catches along the outer shelf were relatively small. The catch rate for rock sole represented about 6% of the total. The length distribution reflects an apparent good recruitment of younger fish based on the mode centered at about 20 cm (Fig. 4).

Alaska plaice

Alaska plaice were distributed largely in the northern portions of the inner shelf and throughout the central shelf. Plaice made up about 5% of the total and survey catches were almost exclusively adult fish (Fig. 4). The mean length of Alaska plaice was 35.0 cm.

Flathead sole

Flathead sole were most abundant in the deeper waters of the central and outer shelf. The mean catch rate represented about 2% of the total. The length distribution ranged from 7-48 cm with a mean value of 25.7 cm (Fig. 4).

Arrowtooth flounder

Arrowtooth flounder were found across the shelf except in the northern areas of the inner shelf. Catch rates increased to the south and as depth increased. The mean catch rate accounted for about 1.5% of the total. Several distinct modes could be seen in the length distribution, reflecting the high growth rate of this species (Fig. 4). The mean length of arrowtooth flounder was 33.6 cm.

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Alaska

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Table 1.--Catch rates (kg/ha) of commercially important species taken during the 1985 standard eastern Bering Sea survey.

<u>Species</u>	<u>kg/ha</u>
Walleye pollock	97.3
Yellowfin sole	49.0
Pacific cod	20.6
Rock sole	14.3
Alaska plaice	11.9
Flathead sole	5.4
Arrowtooth flounder	3.5
Pacific halibut	1.5
Sablefish	0.4
Greenland turbot	0.2

Table 2.--Catch rates (kg/ha) of commercially important species by depth interval.

<u>Inner shelf</u> <u>&lt; 50 m</u>		<u>Central shelf</u> <u>50-100 m</u>		<u>Outer shelf</u> <u>100-200 m</u>	
<u>Species</u>	<u>kg/ha</u>	<u>Species</u>	<u>kg/ha</u>	<u>Species</u>	<u>kg/ha</u>
Yellowfin sole	104.5	Walleye pollock	72.4	Walleye pollock	199.9
Rock sole	27.1	Yellowfin sole	48.9	Pacific cod	27.1
Walleye pollock	24.8	Alaska plaice	19.9	Arrowtooth fl.	8.4
Pacific cod	19.8	Pacific cod	17.0	Flathead sole	8.4
Alaska plaice	10.2	Rock sole	15.2	Rock sole	1.7
Pacific halibut	2.2	Flathead sole	6.0	Pacific halibut	1.6
Flathead sole	1.0	Arrowtooth fl.	2.3	Sablefish	1.3
Arrowtooth fl.	0.1	Pacific halibut	1.0	Alaska plaice	0.9
Sablefish	< 0.1	Greenland turbot	< 0.1	Greenland turbot	0.5
Greenland turbot	< 0.1	Sablefish	< 0.1	Yellowfin sole	0.3

Table 3.--Catch rates (kg/ha) for the most abundant fish species taken during the 1985 survey of the northern Bering Sea shelf.

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<u>Species</u>	<u>kg/ha</u>
Walleye pollock	136.7
Pacific cod	20.6
Yellowfin sole	9.3
Butterfly sculpin	6.9
Alaska plaice	4.5
Shorthorn sculpin	4.0
Flathead sole	2.2
Pacific herring	1.9

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Table 4.--Catch rates (kg/ha) for the most abundant fish species taken during the 1985 Norton Sound survey.

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<u>Species</u>	<u>kg/ha</u>
Saffron cod	7.9
Yellowfin sole	3.0
Plain sculpin	2.8
Starry flounder	2.4
Alaska plaice	0.9
Pacific cod	0.9
Walleye pollock	0.6
Pacific herring	0.4
Antlered sculpin	0.3
Rainbow smelt	0.3

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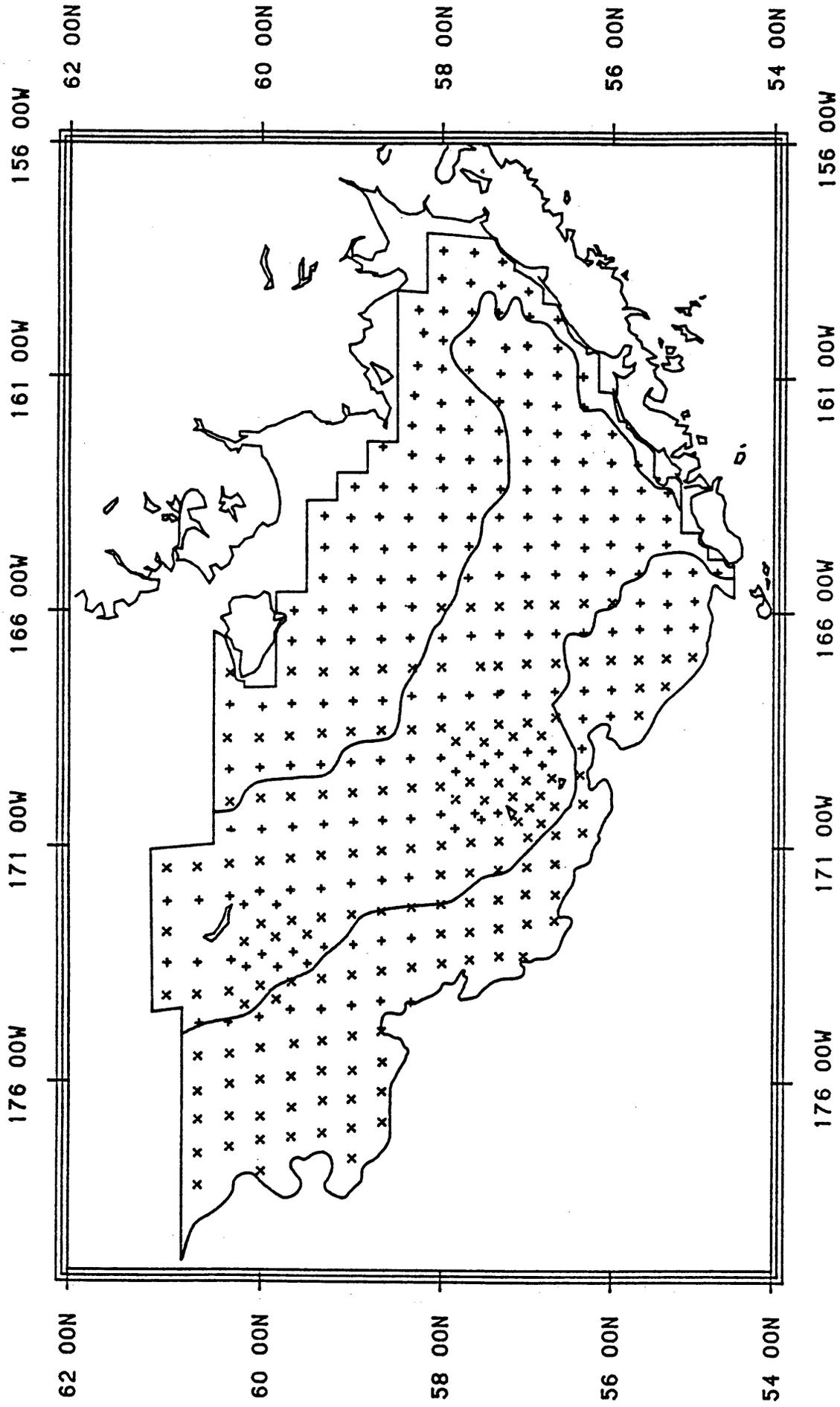


Figure 1.-- Stations completed in the standard eastern Bering Sea survey in 1985 by the Alaska (+) and Argosy (X).

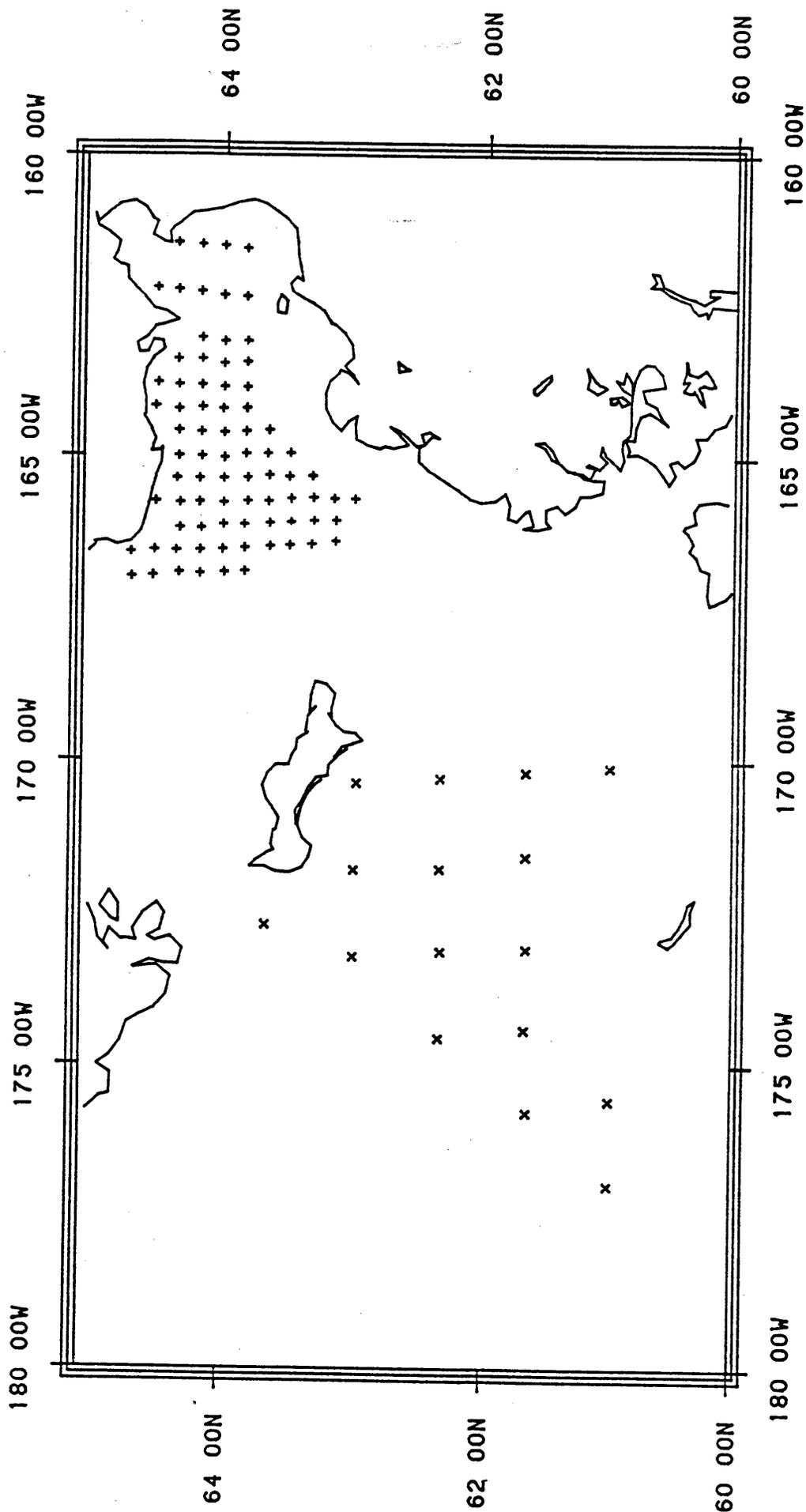


Figure 2.-- Stations completed on the northern Bering Sea shelf (X) and within Norton Sound (+) during the 1985 triennial survey.

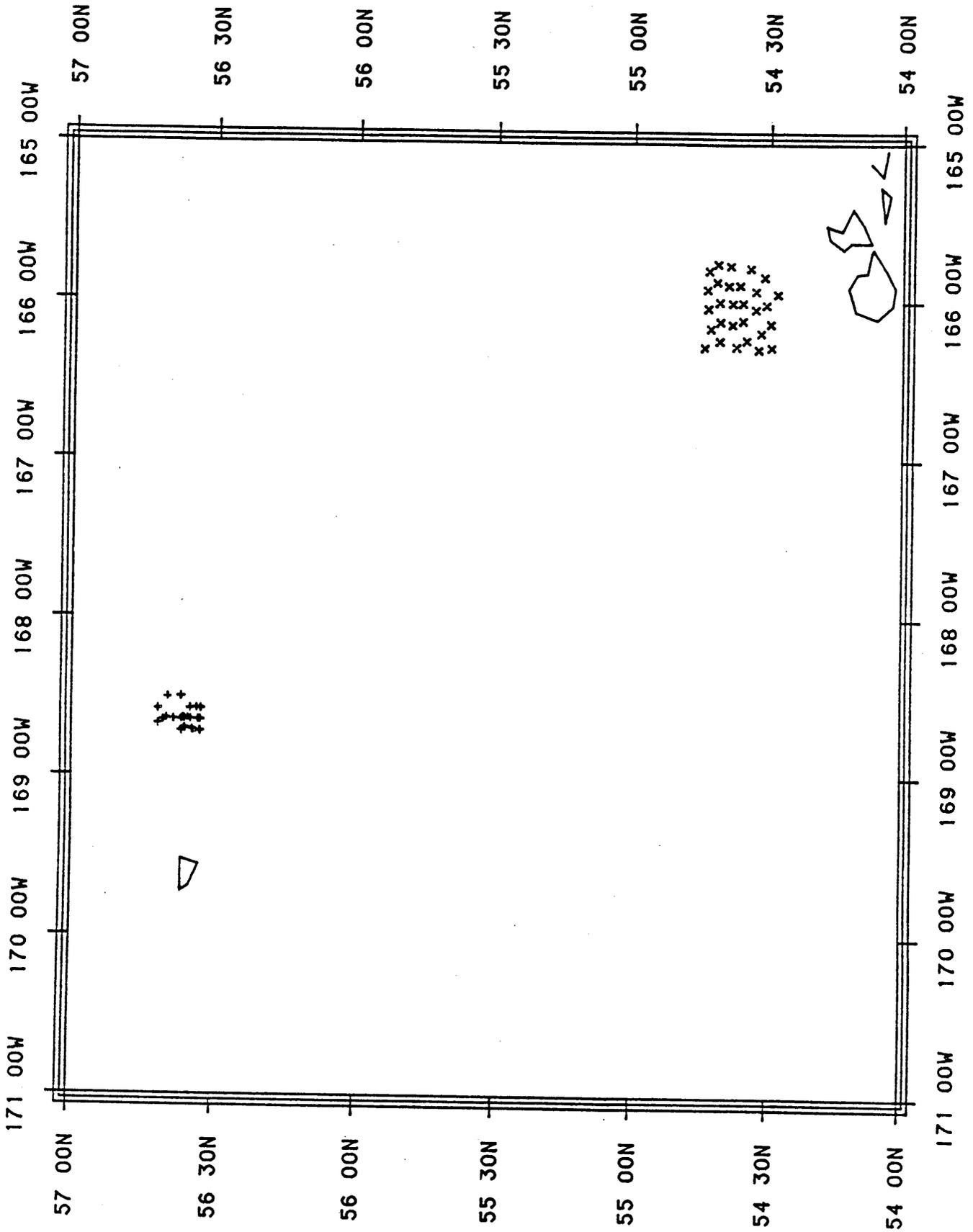


Figure 3.-- Stations completed in the joint pollock distribution experiment (+) and gear comparison experiments (X) during 1985.

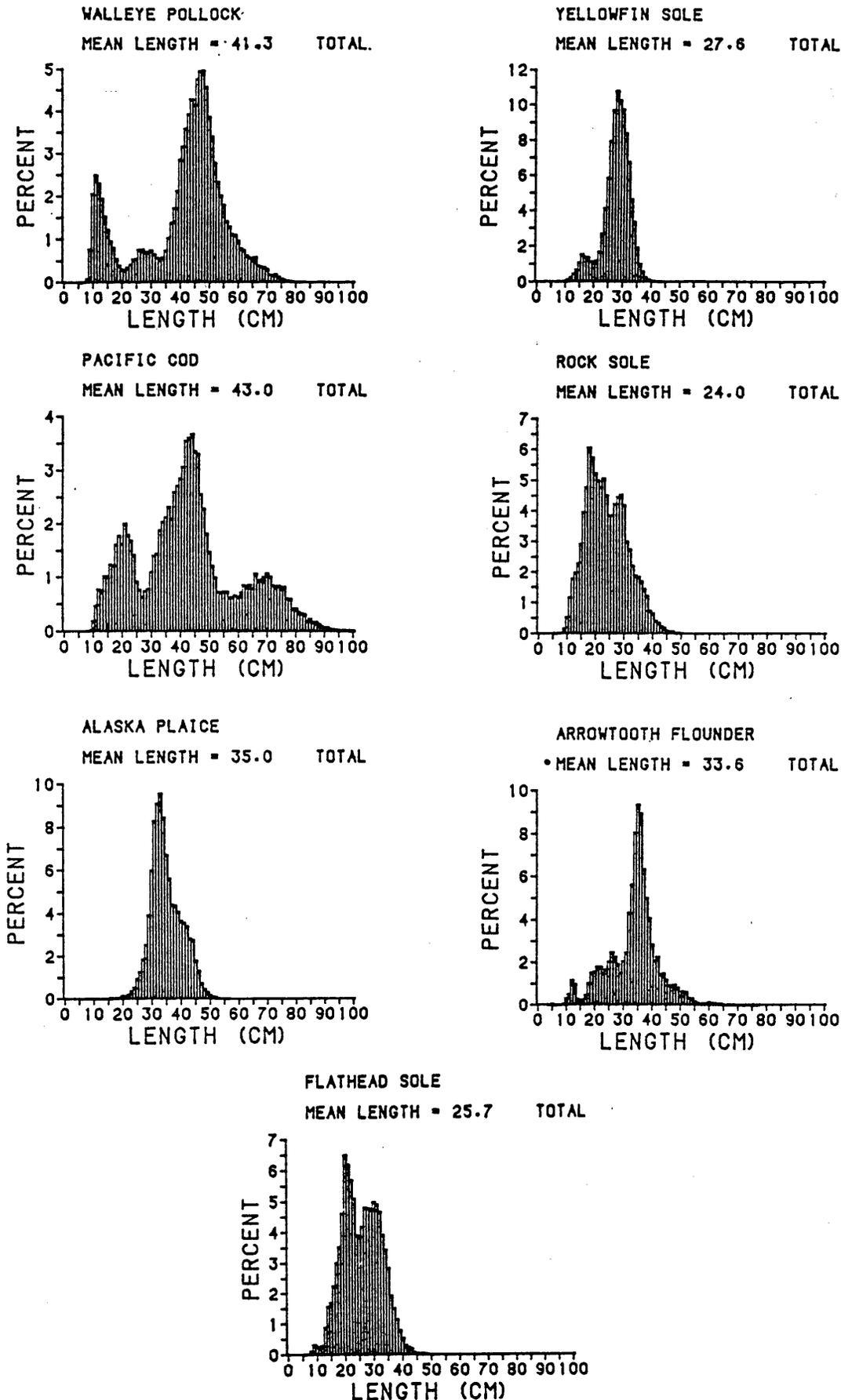


Figure 4.-- Length composition of major species in the 1985 Bering Sea survey.