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Data Report: 1991 Bottom Trawl Survey of the Aleutian Islands Area

by
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U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
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ABSTRACT

The Resource Assessment and Conservation Engineering (RACE) Division of the Alaska Fisheries Science Center, Seattle, Washington, conducted a groundfish resources survey of the Aleutian Islands region from July to September 1991. Previous surveys in this region occurred in 1980, 1983, and 1986. The survey area covered the southern Bering Sea, from long. 165 ^{o} W to 170° W and the Aleutian Islands waters, from long. 170° W to 170^{o}30' E. Two chartered vessels, the Green Hope and Ocean Hope 1, completed 377 preselected stations covering the continental shelf and slope from 16 m to 521 m in depth. Both vessels were equipped with standard RACE Division Noreastem high- opening bottom trawls rigged with rubber bobbin roller gear.

The primary survey objectives were to define the distribution and relative abundance of the principal groundfish and commercially important invertebrate species inhabiting the Aleutian Islands region from near shore to approximately 500 m in depth and to collect data to define selected biological parameters for age, growth, length-weight relationships, feeding habits, and size, sex, and age composition. The survey also collected ancillary data and specimens requested by other research groups.

Survey results are presented, including estimates of biomass and catch per unit of effort, species distribution, length frequency distributions, and length-weight relationships for important commercial species.

A total of 111 fish species were identified from the survey catches."Walleye pollock, Pacific cod, Atka mackerel, Pacific ocean perch, and northern rockfish were the dominant species within the survey region. Sablefish, Pacific halibut, arrowtooth flounder, and giant grenadier were locally abundant in some areas. The only abundant

invertebrate in the survey region was red (magistrate armhook) squid, which was the sixth most abundant species in the Southwest Aleutian Islands area.

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PREFACE

This document is the third of three standard reports[1] presenting data from the 1991 Aleutian Islands groundfish survey conducted by the National Marine Fisheries Service (NMFS). These reports are:

1) A Cruise Report, outlining the survey objectives, documenting itinerary, and personnel, and summarizing the major accomplishments:

2) A Report to the Industry, containing a fishing log consisting of raw haul and catch data for each haul made during the survey as well as species-based summaries of catch per unit effort by haul; and

3) This document, a Data Report, containing a detailed description of the planning and implementation of the survey, distribution and abundance charts, length frequency plots, tables of estimated biomass, catch per unit effort, average weight and length estimates, and length versus weight regression parameters.

[1]Available from Director, Resource Assessment and Conservation Engineering Division, Alaska Fisheries Science Center, National Marine Fisheries Service, 7600 Sand Point Way N.E., Building 4, BIN C15700, Seattle, WA 98115-0070.

INTRODUCTION

The Resource Assessment and Conservation Engineering (RACE) Division of the Alaska Fisheries Science Center (AFSC) conducted a groundfish resources trawl survey of the Aleutian Islands region from July to September, 1991.

The survey objectives were to

1) Define the distribution of the principal groundfish and commercially important invertebrate species inhabiting the Aleutian Islands region from near shore to approximately 500 m in depth:

2) Obtain data from which to estimate the abundance of the principal groundfish species:

3) Collect data to define selected biological parameters for age, growth, length-weight relationships, feeding habits and size, sex, and age composition;

4) Collect accurate net mensuration data on trawls used by the vessels involved in the survey; and

5) Obtain ancillary data and collect specimens requested by other research groups, including incidence of Pacific lamprey (Lampetra tridentata) predation on walleye pollock (Theragra chalcogramma), pollock blood samples for DNA stock identification studies, whole fish specimens for the University of Washingtons fish collection, whole specimens of skates for Bucknell University, and specimens of snails for the NMFS Observer Program of the AFSCs Resource Ecology and Fisheries Management (REFM) Division.

Previous major surveys in this region, made in cooperation with the National Research Institute for Far Sea Fisheries, Fisheries Agency of Japan, occurred in 1980, 1983, and 1986 (Ronholt et al. In prep.). In 1991, two chartered vessels, the Green Hope and Ocean Hope 1, sampled preselected stations covering the continental shelf and slope

from 16 m to 521 m in depth (Fig. l), and two additional stations at 697 m and 711 m to collect specimens. The survey area covered a portion of the southern Bering Sea, from long. 165°W to 170°W and the Aleutian Islands, from long. 170°W to 170°30E (Fig. 2).

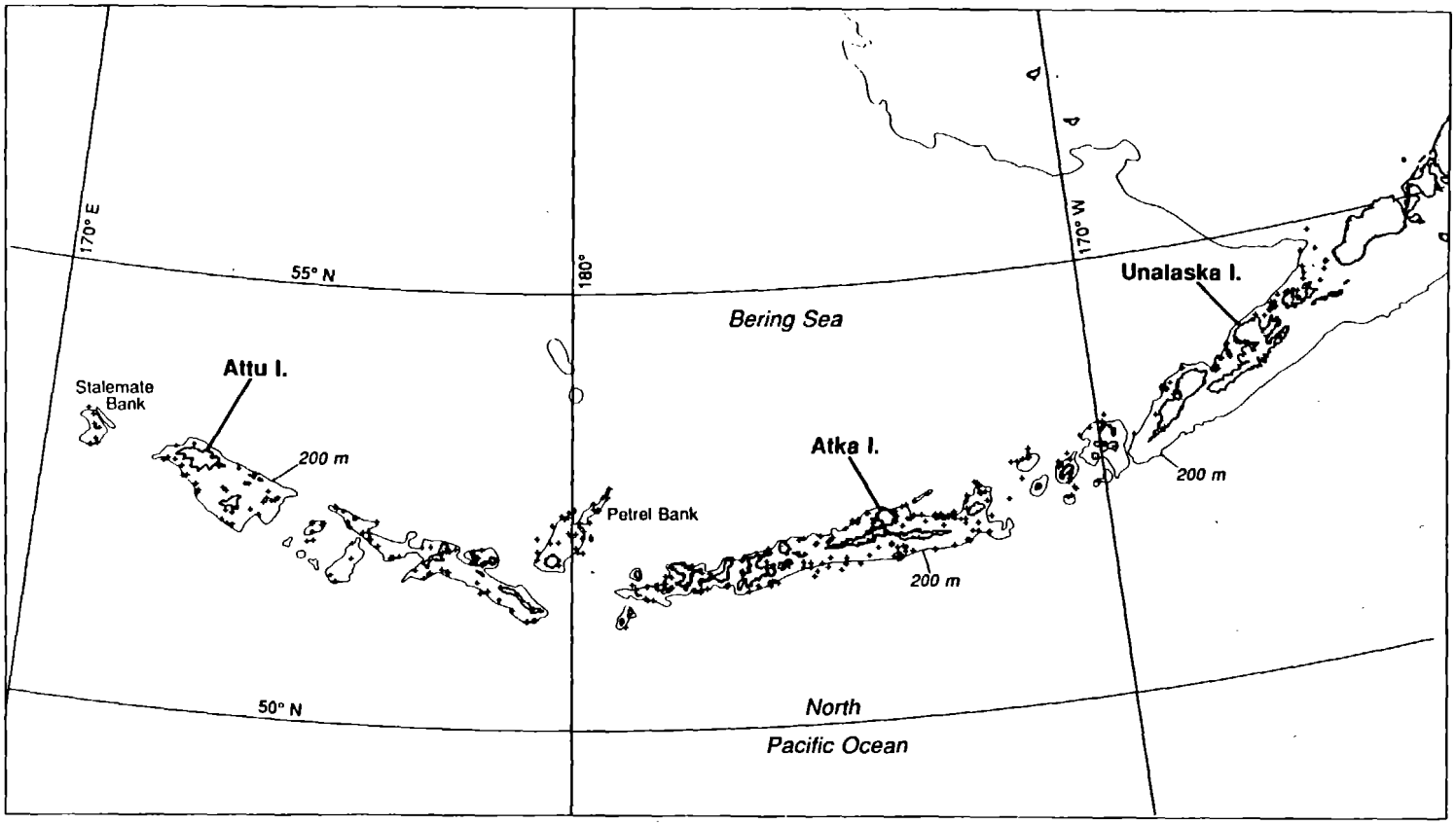

Figure l.--Stations sampled during the 1991 Aleutian Islands bottom trawl survey.

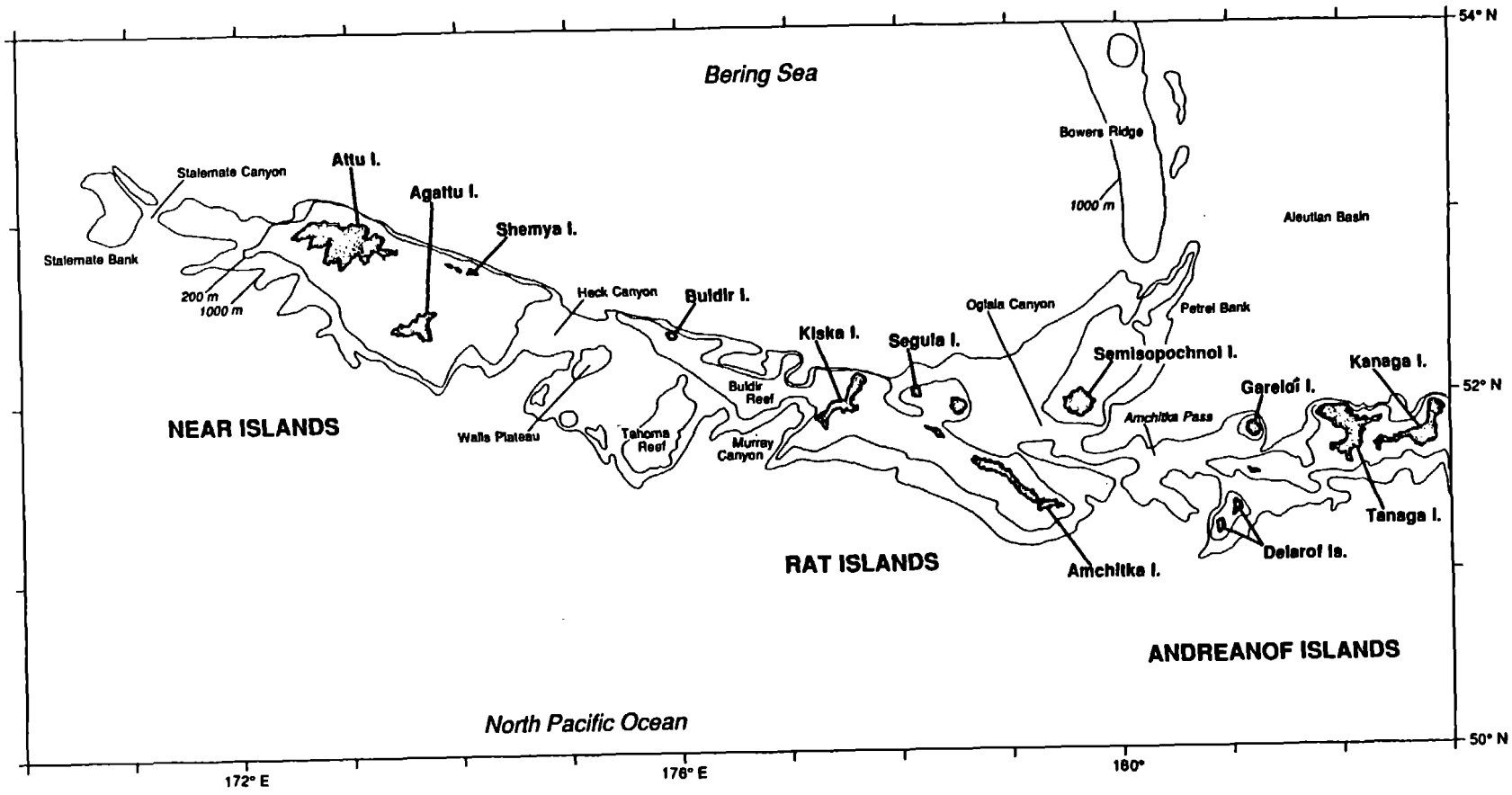

Figure 2.--Area surveyed during the 1991 Aleutian Islands bottom trawl survey.

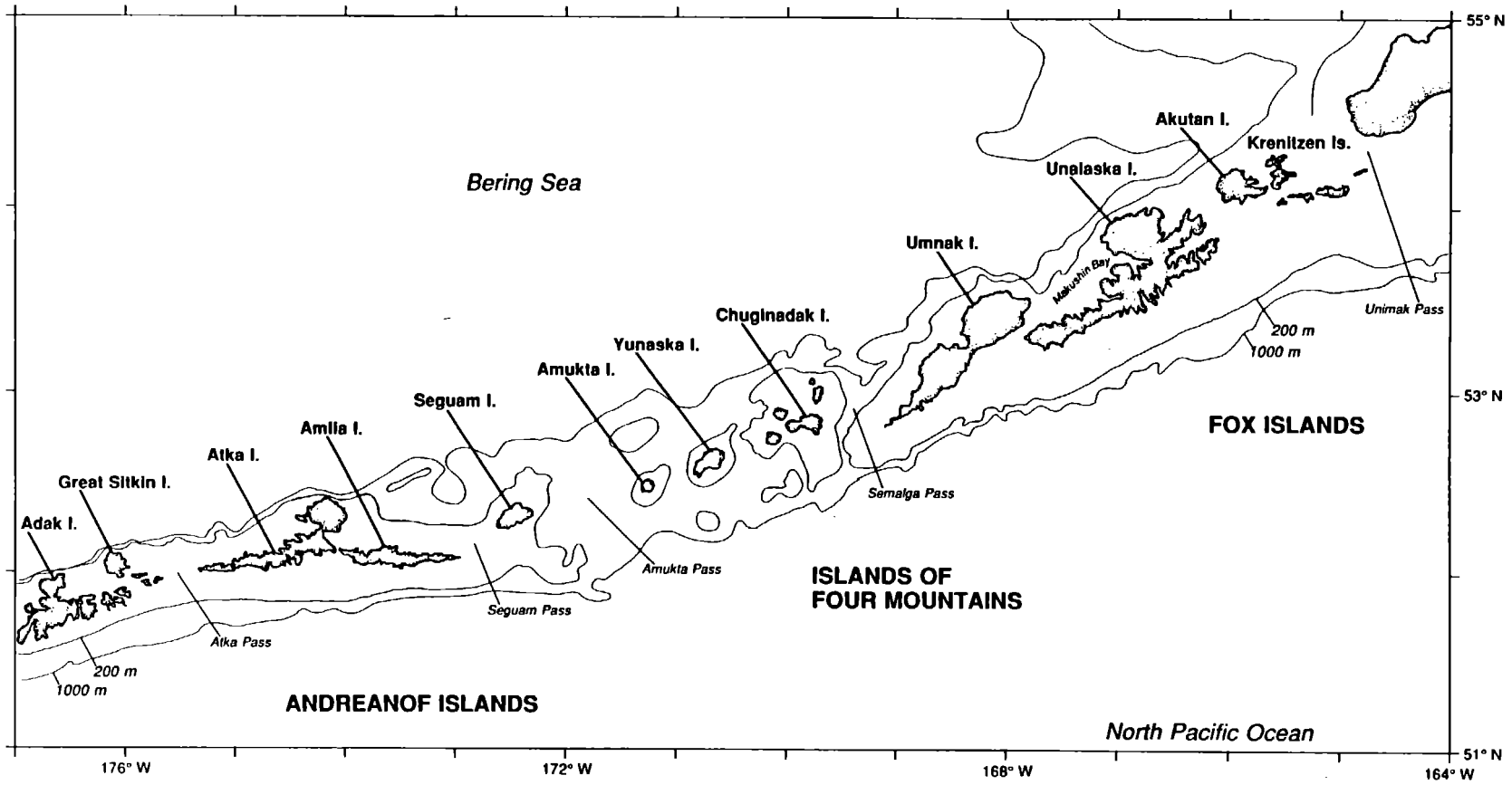

Figure 2.--Continued.

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METHODS

Vessels and Gear

Two chartered commercial stem trawlers were used throughout the survey. The Ocean Hope 1 is 32.9 m (108 feet) in length and powered by a single main engine with 850 continuous horsepower. Deck equipment included paired hydraulic winches with 1,100 m (600 fathom) of 2.2 cm (7/8 inch) cable per drum, two hydraulic net reels (one mounted over the stem ramp and the other mounted forward on the working deck), and two winches (one moveable) mounted on the main boom for lifting. The Green Hope is 30.7 m (100 feet) in length and powered by a single main engine with 565 continuous horsepower. Deck equipment included paired hydraulic trawl winches with 1,463 m (800 fathoms) of 1.91 cm (3/4 inch) cable per drum, two hydraulic net reels (one mounted over the stem ramp and the other mounted forward on the working deck), and two stationary winches mounted on the main boom for lifting. Electronic equipment on both vessels consisted of Global Positioning System (GPS) and Loran C receivers with converters for geodetic positions, Loran C video plotters, two radars, single band and VHF radios, color video fish finders, and auto-pilots.

Both vessels used standard RACE Division Poly-Nor'eastem, hard bottom, high-opening bottom trawls constructed of 12.7 cm (5 inch) stretched mesh polyethylene web with a 3.2 cm (l-1/4 inch) stretched mesh nylon liner in the codend to retain smaller specimens. Each trawl was rigged with rubber bobbin roller gear and towed with 54.9 m [30 fathom) triple dandylines and 1.83 m x 2.74 m (6 feet x 9 feet), 800 kg (1,800 lbs) steel V-doors. An acoustic net mensuration system, consisting of headrope and wing units transmitting to a towed hydrophone, was used to measure the horizontal

and vertical dimensions of the survey trawls used by each vessel. Complete gear specifications and diagrams are presented in Appendix A.

Survey Area and Sampling Design

The geography of the Aleutian Islands presented several problems in survey station selection. Unlike the Bering Sea and Gulf of Alaska, where the continental shelf is wide enough to allow selection of stations on a grid, the shelf in the Aleutian Islands is narrow to nonexistent. Where the shelf does exist, areas rich in coral and sponge which are associated with a rocky irregular substrate present difficulty in sampling with standard survey trawls. These considerations, along with a reduction of available vessel tune compared to previous surveys, influenced the decision to not select station locations in a completely random manner since a majority of stations would likely occur on untrawlable ground.

Limited vessel time and the need to achieve a reasonable level of sampling intensity weighed heavily on the decision to use successfully trawled stations from previous surveys as a pool from which 1991 survey stations would be selected.

The Aleutian Islands survey region was divided into five major geographical units: the Southern Bering Sea Area and the Northeast, Northwest, Southeast, and Southwest Aleutian Islands Areas. Each of these areas was divided longitudinally into two to three subareas (Fig. 3). A depth zone (l-100 m, 101-200 m, 201-300 m, and 30l-500 m) within a subarea defines a stratum for planning and analysis purposes. This sampling design was used in 1991 to provide consistency with previous surveys. Data from triennial surveys conducted in 1980 and 1983 were analyzed to determine the number of stations required in each strata to provide the lowest variance for abundance

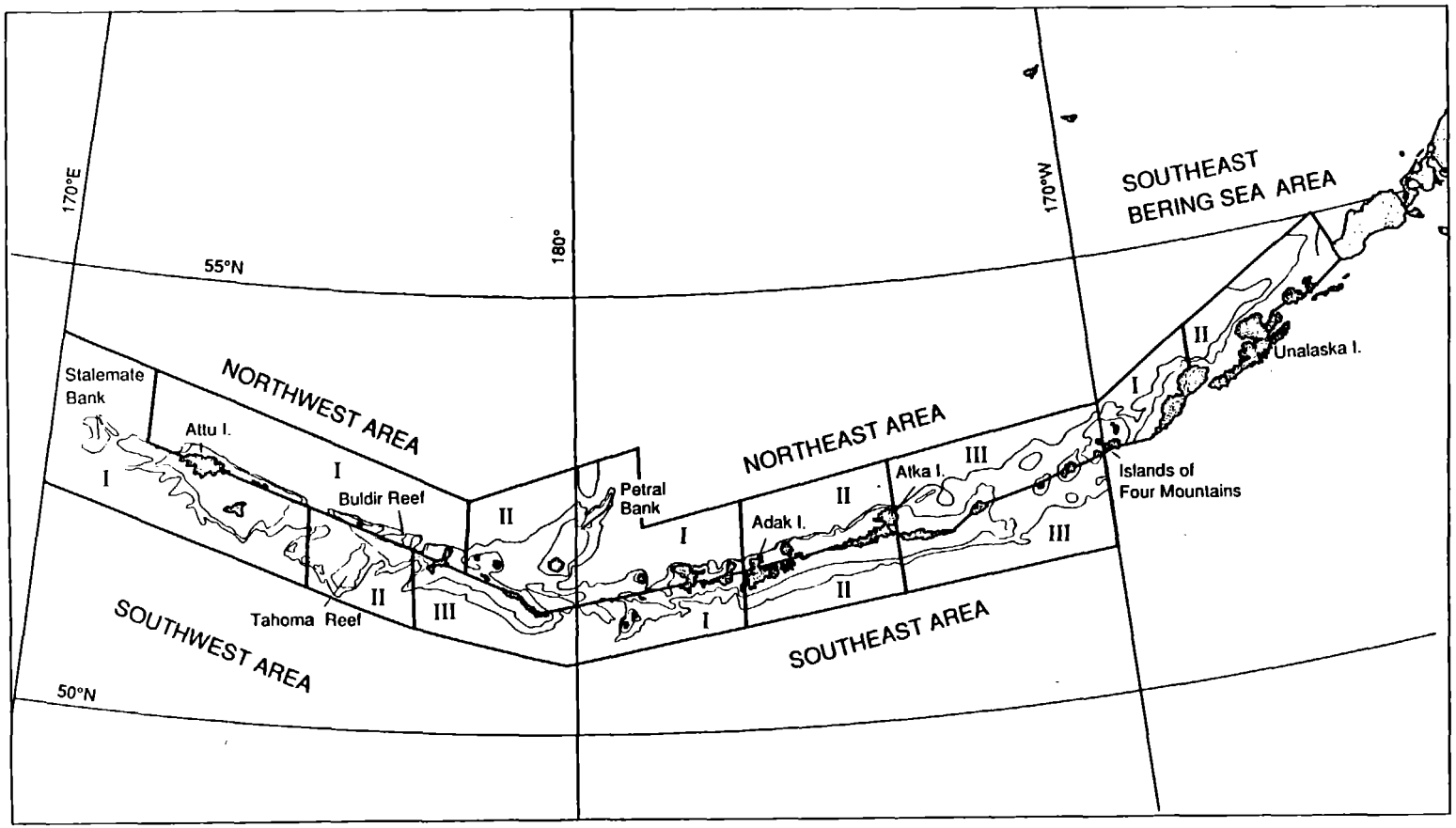

Figure 3. --Areas and subareas used for the 1991 Aleutian Islands bottom trawl survey. A stratum is defined as a depth zone within a subarea.

estimates of major species throughout the survey area (Ronholt et al. In prep.). This sample allocation scheme was used in 1986, and again for the 1991 survey.

Successfully sampled stations from all previous years were pooled and distributed among subareas by geographic location based on sample allocation units. The allocation units were essentially longitudinal subdivisions of each stratum (depth zone in a subarea) resulting in regions of approximately equal area. This ensured that selected stations were well distributed throughout each subarea. Within each sample allocation unit, the allocated number of stations were selected at random from the unit's pool of previously sampled stations. These selected stations were then randomly prioritized to three levels of importance, which allowed rapid selection of stations by Chief Scientists as survey progress was monitored and remaining stations needed to be selected on a priority basis. Half of the stations were assigned top priority and the remaining stations were evenly split between medium and low priority. If an odd number of stations were split, the leftover station was assigned medium priority. If a sample allocation unit contained only two stations, they were both assigned top priority. A total of 452 stations were selected, which resulted in 372 possible stations if all high and medium priority stations were sampled. Completion of the high priority stations would represent the minimum number of observations necessary to meet the survey objectives. After selection, stations were then divided between the two participating vessels.

Assignment of stations to each vessel was evenly distributed to allow the vessels to operate together throughout much of the survey area. During the course of the survey, some stations were reallocated between vessels by the Chief Scientists to minimize running time between stations.

Collection and Processing of Samples

Catches weighing less than 1.1 metric tons (t) were completely sorted and weighed by species. Larger catches were subsampled after obtaining total weight with a load cell or estimating it volumetrically. The dominant species were subsampled prior to sorting. Whenever possible, all non-dominant fish and large invertebrate species in the catch were completely sorted, counted, and weighed. All fish and commercial crabs were identified to species whenever possible. Some fish, such as certain skates (Rajidae), for which taxonomic information was scarce or under revision, were identified to family or genus if positive species identification was impossible.

Data collection effort was concentrated on 13 species selected based on their commercial value or high abundance in the sampling area. The priority species were

walleye pollock	*Theragra chalcogramma*
Pacific cod	*Gadus macroce*
Atka mackerel	*Pleurogrammus monopterygius*
sablefish	*Anoplopoma fimbria*
Pacific ocean perch	*Sebastes alutus*
northern rockfish	*Sebastes polvspinis*
rougheye rockfish	*Sebastes aleutianus.*
shortraker rockfish	*Sebastes borealis*
shortspine thornyhead	*Sebastolobus alascanus*
rock sole	*Pleuronectes bilineatus*
arrowtooth flounder	*Atheresthes evermanni*
Pacific halibut	*Hippoglossus stenolepis*
Greenland turbot	*Reinhardtius hippoglossoides*

Less sampling effort was applied to other commercial species with patchy or limited distributions, such as

rex sole	*Errex zachiru*
Dover sole	*Microstomus pacificus*
flathead sole	*Hippoglossoides elassodon*
Kamchatka flounder	*Atheresthes stomias*
yellowfin sole	*Pleuronectes asper*
Pacific herring	*Clupea pallasi*
other rockfish species	*Sebastes spp.*

A random sample of each commercial species was sorted by sex and individual fork lengths (FL) were measured. Age structures (otoliths, scales, or both) and individual weight and length (FL) data were randomly collected for the priority species. International Pacific Halibut Commission biologists participating in the survey collected age structures and other biological data for Pacific halibut throughout the cruise. Biologists from the AFSC's Trophic Interactions Program collected stomach samples from the priority species throughout the survey.

Data Analysis

Biomass estimates were calculated using the area-swept method (Alverson and Pereyra 1969). Each catch was standardized by dividing catch weight by the area swept by the trawl during each tow. This method produces catch per unit of effort (CPUE), with units of kilograms per square kilometer trawled.. Mean CPUE was estimated for each species as the arithmetic mean of observed CPUE values from all successfully trawled stations within each stratum. Mean CPUE for the entire survey region was estimated as an area weighted mean of the stratum estimates. Mean CPUE values for areas within the survey region were also calculated in this way.

Biomass estimates were calculated for each stratum by multiplying the mean CPUE by the stratum area. Population numbers for each stratum were calculated by dividing the station CPUE by the mean weight of individuals at each station and then multiplying the arithmetic mean of population numbers from all stations in a stratum by the stratum area. Estimates of biomass and population numbers by area and region were calculated by summing strata estimates.

Size composition for each stratum was estimated by first expanding the length frequency sample for each station to the total catch (in numbers) per square kilometer

for that station. The stratum population within a sex-length category was calculated by multiplying the stratum population by the proportion of fish in that category from the summed station data. Population size composition estimates were summed over strata to create estimates by area. A detailed description of the analytical procedures is presented in Wakabayashi et al. (1985).

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RESULTS

Survey Results

Of the 452 stations allocated for the 1991 groundfish survey, 377 stations were attempted and 340 of these were considered successful and were included in biomass and size composition analysis (Table 1). Successful tows fell into two categories. The first category included tows in which there were no noticeable problems such as net damage or abnormal behavior of the net or vessel during the tow: 80% of the successful tows fell into this category. The second category included tows where the net briefly hung up on the bottom or was found to be tom, but the problems were not substantial enough to affect the catch. This category contributed 10% of the successful tows. The remaining 37 tows were considered unsuccessful due to either severe hang up, significant trawl damage or other abnormality in the tow procedure which could affect the quality of the tow.

Because of good weather and generally trouble-free vessel operations, most selected stations in the Southern Bering Sea and Northeast and Southeast Aleutian areas were attempted during the first two-thirds of the survey period. In the Southern Bering Sea Area, only one station was bypassed (98% attempted), while in the Northeast and Southeast Areas over 84% of the stations were attempted. In the western Aleutian Island areas, the last one-third of the survey period was marked by deteriorating weather conditions, the expenditure of additional running time to procure fuel, and generally poor bottom conditions, which combined to reduce the sampling density. In the Northwest and Southwest Areas, 58% and 70% of the allocated stations were attempted, respectively. In both western areas, less than 44% of the l-100 m stations were attempted.

Table 1. -Number of allocated, attempted, and successfully completed stations and sampling density during the 1991 Aleutian Islands groundfish survey.

Area	Depth (m)	Number of stations			Area (km^2)	Stations per 1000 km^2
		Allocated	Attempted	Successful		
Northeast	1-100	24	16	16	3,759	4.3
	101-200	60	57	49	5,066	9.7
	201-300	32	23	22	2,665	8.3
	301-500	26	24	21	3,776	5.6
	All depths	142	120	108	15,266	7.1
Northwest	1-100	24	8	7	2,360	3.0
	101-200	20	14	13	2,627	4.9
	201-300	16	13	12	1,070	11.2
	301-500	6	3	3	1,742	1.7
	All depths	66	38	35	7,800	4.5
Southeast	1-100	10	7	6	4,174	1.4
	101-200	40	41	40	4,754	8.4
	201-300	22	21	19	4,082	4.7
	301-500	10	10	8	3,817	2.1
	All depths	82	79	73	16,827	4.3
Southwest	1-100	18	8	6	4,411	1.4
	101-200	58	44	38	6,531	5.8
	201-300	14	10	9	2,295	3.9
	301-500	14	11	10	3,409	2.9
	All depths	104	73	63	16,645	3.8
Total Aleutian Islands	1-100	76	39	35	14,704	2.4
	101-200	178	156	140	18,978	7.4
	201-300	84	67	62	10,111	6.1
	301-500	56	48	42	12,746	3.3
	All depths	394	310	279	56,538	4.9
Southern Bering Sea	1-100	36	35	32	4,819	6.6
	101-200	24	23	22	3,272	6.7
	201-300	4	3	3	1,002	3.0
	301-500	4	6	4	1,272	3.1
	All depths	68	67	61	10,365	5.9

Overall, 90% of the tows were successful, ranging by area from 86% to 92% successful. Many of the successfully towed stations from previous surveys had been sampled by larger Japanese vessels using trawls equipped with automobile tire roller gear more suitable for the rough bottom conditions encountered. In 1991, the U.S. trawls equipped with smaller roller gear were not as successful at some of those stations. Unsuccessful tows were most prevalent in the 101-200 m strata in the Northeast Area (14%), the combined l-100 m and 101-200 m strata in the Southeast Area (15%), 301-500 m strata in the Southeast Area (20%), and the 301-500 m strata in the Southern Bering Sea (34%). More than 75% of the hauls attempted in the l-100 m strata in the Northwest and Southwest Areas were successful, even though bottom conditions in those areas contributed to a low percentage (less than 33%) of attempted hauls.

The low number of attempted stations and relatively low success rate for stations in the shallow strata, particularly in the western Aleutian Islands, suggests the need to evaluate the merits of expending additional effort to locate trawlable locations.

Distribution, Abundance, and Biological Data

Catch Results by Area

A total of 111 fish species representing 28 families were identified during the 1991 Aleutian Islands groundfish survey. Appendix B presents lists of fish and invertebrate species encountered.

Relative abundance estimates, reported as CPUE; are presented in Table 2 for the 20 most abundant groundfish species in each of the five reporting areas. The four areas comprising the Aleutian Islands region were generally dominated by 5 species: Atka mackerel, Pacific ocean perch, waIleye pollock, northern rockfish, and Pacific cod, which as group accounted for 86% of the 20 most abundant species. These five species were also the most dominant species in the Northeast and Southwest Areas. In the Northwest Area, giant grenadiers were the fifth most abundant species, followed by northern rockfish. Northern rockfish were relatively uncommon in the Southeast Area, where sablefish were fifth in relative abundance. Atka mackerel was the most abundant species in all but the Northeast Area, contributing over 39% of the CPUE of the 20 most common groundfish in each of the other Aleutian Islands Areas.

The Southern Bering Sea region had a noticeably different species composition, dominated by walleye pollock, which contributed almost 50% of the total CPUE in this area. The 5 dominant species in this area were walleye pollock, arrowtooth flounder, Pacific cod, rock sole, and Pacific halibut, which together accounted for 82% of the total CPUE of the 20 most dominant species. Northern rockfish and Pacific ocean perch were both present in low densities, while Atka mackerel were encountered in only trace amounts.

Table 2. -Mean CPUE (kg/km) by area for the 20 most abundant groundfish encountered during the 1991 Aleutian Islands groundfish survey.

Northeast Area		Northwest Area		Southeast Area	
Species	CPUE	Species	CPUE	Species	CPUE
Pacific ocean perch	6,640	Atka mackerel	11,240	Atka mackerel	8,448
Walleye pollock	5,828	Pacific ocean perch	4,149	Walleye pollock	2,362
Pacific cod	3,561	Pacific cod	2,972	Pacific cod	1,986
Atka mackerel	3,023	Walleye pollock	2,691	Pacific ocean perch	1,601
Northern rockfish	915	Giant grenadier	1,427	Sablefish	1,205
Giant grenadier	809	Northern rockfish	1,304	Pacific halibut	1,012
Rock sole	631	Rock sole	1,037	Rougheye rockfish	407
Pacific halibut	523	Kamchatka flounder	867	Rock sole	326
Greenland turbot	428	Pacific halibut	573	Northern rockfish	265
Arrowtooth flounder	343	Skates	514	Arrowtooth flounder	219
Kamchatka flounder	278	Greenland turbot	439	Skates	188
Skates	234	Shortraker rockfish	315	Pacific sleeper shark	79
Shortraker rockfish	113	Arrowtooth flounder	302	Shortraker rockfish	75
Prowfish	105	Myoxocephalus spp.	172	Giant grenadier	73
Rougheye rockfish	103	Rougheye rockfish	93	Myoxocephalus spp.	69
Flathead sole	93	Ebony eelpout	80	Kamchatka flounder	69
Darkfin sculpin	71	Yellow Irish lord	63	Darkfin sculpin	64
Myoxocephalus spp.	52	Shortspine thornyhead	56	Yellow Irish lord	60
Yellow Irish lord	51	Prowfish	55	Kelp greenling	33
Bigmouth sculpin	51	Spectacled sculpin	43	Rex sole	16
Number of hauls	108	Number of hauls	35	Number of hauls	73

Southwest Area		All Aleutian Areas		Southern Bering Sea	
Species	CPUE	Species	CPUE	Species	CPUE
Atka mackerel	24,763	Atka mackerel	12,171	Walleye pollock	7,866
Pacific ocean perch	14,701	Pacific ocean perch	7,170	Arrowtooth flounder	1,637
Northern rockfish	9,193	Walleye pollock	3,242	Pacific cod	1,362
Pacific cod	3,525	Northern rockfish	3,212	Rock sole	1,120
Walleye pollock	2,017	Pacific cod	3,000	Pacific halibut	986
Red squid	1,887	Pacific halibut	599	Shortraker rockfish	638
Shortraker rockfish	887	Red squid	560	Flathead sole	623
Rock sole	481	Rock sole	552	Pacific ocean perch	219
Kamchatka flounder	314	Giant grenadier	493	Yellow Irish lord	216
Skates	313	Sablefish	369	Myoxocephalus spp.	196
Arrowtooth flounder	294	Shortraker rockfish	357	Greenland turbot	186
Shortspine thornyhead	272	Kamchatka flounder	308	Pacific sleeper shark	160
Pacific halibut	265	Arrowtooth flounder	286	Rex sole	132
Rougheye rockfish	193	Skates	277	Rougheye rockfish	123
Giant grenadier	192	Rougheye rockfish	218	Northern rockfish	74
Prowfish	168	Greenland turbot	214	Kamchatka flounder	72
Flathead sole	152	Shortspine thornyhead	104	Pacific herring	61
Greenland turbot	118	Prowfish	88	Darkfin sculpin	53
Myoxocephalus spp.	61	Myoxocephalus spp.	76	Bigmouth sculpin	49
Rex sole	45	Flathead sole	76	Shortspine thornyhead	45
Number of hauls	63	Number of hauls	279	Number of hauls	61

Individual weight and length measurements were collected for most of the dominant fish species present in the survey area. These data were used to estimate the relationship between weight and length using a non-linear regression of weight on length for each species. The equation used for the regression was

$$Weight_{(grams)} = a \cdot Length_{(mm)}^{b}.$$

Plots and parameters from this regression analysis are presented in Appendix C.

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Catch Results by Species

Walleye pollock--Walleye pollock were distributed throughout the survey area, occurring at 70% of the Aleutian Islands stations, but at only 48% of the Southern Bering Sea stations (Fig. 4 and Table 3). Approximately 64% of the total survey area biomass of 264,830 t was distributed in the Northeast Aleutian Islands and Southern Bering Sea Areas. Over 80% of the estimated biomass in the Aleutian Islands region was found between 101 and 300 m, while over 90% of the Southern Bering Sea biomass occurred in depths shallower than 200 m.

Several length modes were noted for fish from both the Aleutian Islands and Southern Bering Sea areas. The most distinctive were a juvenile mode of 15-25 cm (FL), an intermediate mode of 25-40 cm (FL) fish and the largest mode composed of fish greater than 40 cm (FL) (Fig. 5). Clear separable modes were not evident for larger fish. In the Southern Bering Sea and Northeast Aleutian Islands Area, most fish smaller than 40 cm (FL) were found in the l-100 m depth interval. Only trace amounts of pollock were found in this depth interval in the remaining Aleutian Islands region.

Table 3. -Total number of survey hauls, hauls containing walleye pollock, estimated biomass, CPUE, mean weight, and mean length based on the 1991 Aleutian Islands groundfish survey, by geographical areas and depth intervals.

Area	Depth (m)	Number of trawl hauls	Hauls with catch	CPUE (kg/km^2)	Biomass (t)	Mean weight (kg)	Mean length (cm)
Northeast	1 - 100	16	10	817	3,072	0.4	27.5
	101 - 200	49	39	12,392	62,777	0.8	46.7
	201 - 300	22	17	5,629	15,003	1.0	49.4
	301 - 500	21	14	2,153	8,129	1.2	53.3
	All depths	108	80	5,828	88,981	0.9	46.2
Northwest	1 - 100	7	2	1	3	---	---
	101 - 200	13	8	2,113	5,552	0.5	38.5
	201 - 300	12	12	14,383	15,391	1.0	50.6
	301 - 500	3	1	24	42	1.1	---
	All depths	35	23	2,691	20,988	0.8	45.6
Southeast	1 - 100	6	0	0	0	---	---
	101 - 200	40	26	2,943	13,989	0.8	44.1
	201 - 300	19	17	3,855	15,733	0.9	48.1
	301 - 500	8	5	2,628	10,032	1.1	53.4
	All depths	73	48	2,362	39,754	0.9	47.5
Southwest	1 - 100	6	2	6	29	0.1	---
	101 - 200	38	29	2,637	17,223	0.9	45.8
	201 - 300	9	8	7,018	16,103	1.0	48.8
	301 - 500	10	6	66	225	1.1	---
	All depths	63	45	2,017	33,580	0.9	47.1
Total Aleutian Islands	1 - 100	35	14	211	3,104	0.4	27.5
	101 - 200	140	102	5,245	99,541	0.8	45.5
	201 - 300	62	54	6,154	62,230	1.0	49.2
	301 - 500	42	26	1,446	18,428	1.2	53.3
	All depths	279	196	3,242	183,303	0.9	46.5
Aleutian Islands biomass, 95% confidence interval: 100,415 - 266,191 metric tons							
Southern Bering Sea	1 - 100	32	11	8,612	41,501	1.0	46.9
	101 - 200	22	14	11,852	38,782	1.1	51.1
	201 - 300	3	2	1,094	1,095	1.0	50.6
	301 - 500	4	2	117	149	0.9	---
	All depths	61	29	7,866	81,527	1.0	48.8
Southern Bering Sea biomass, 95% confidence interval: 2,890 - 160,165 metric tons							

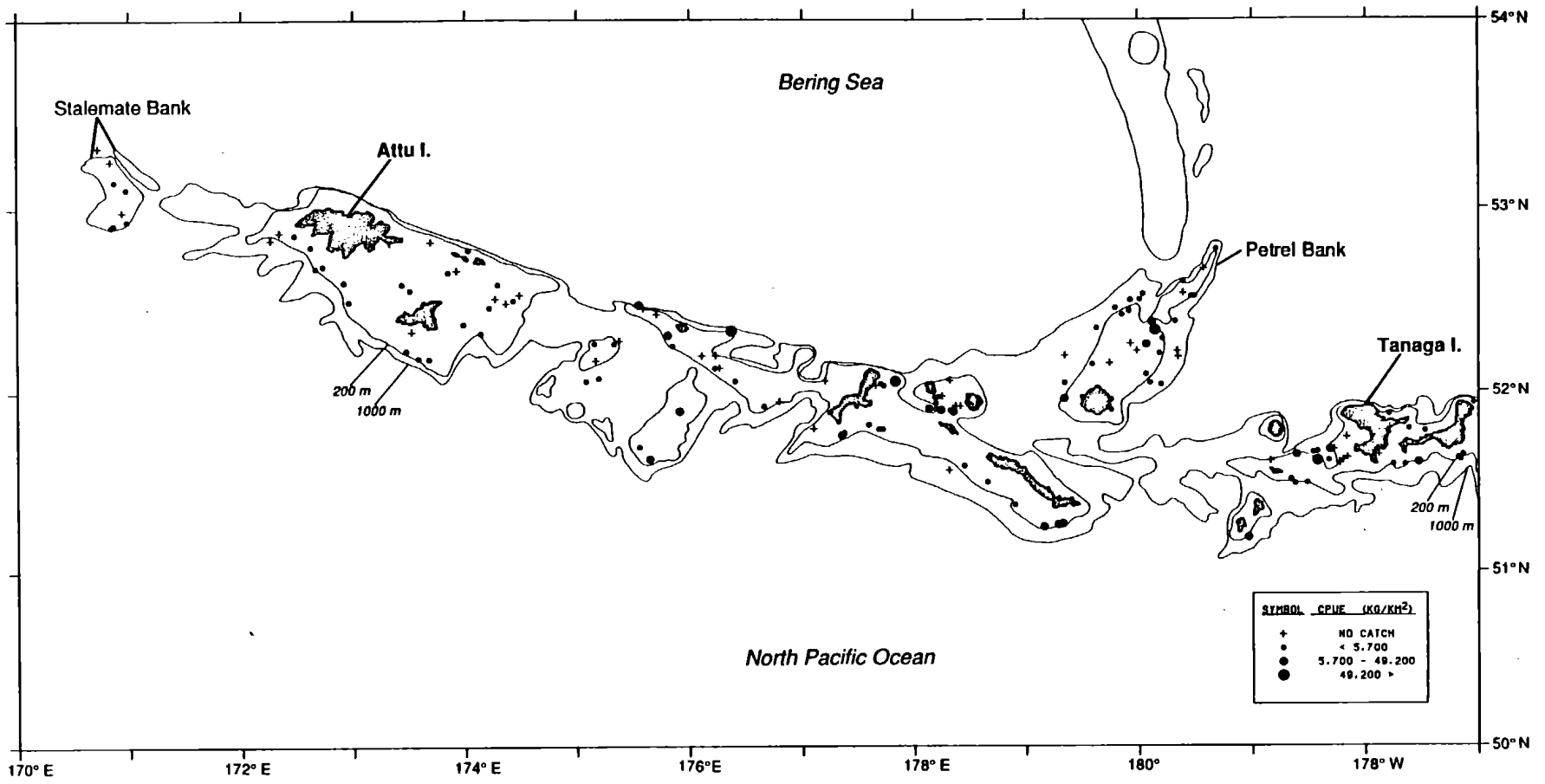
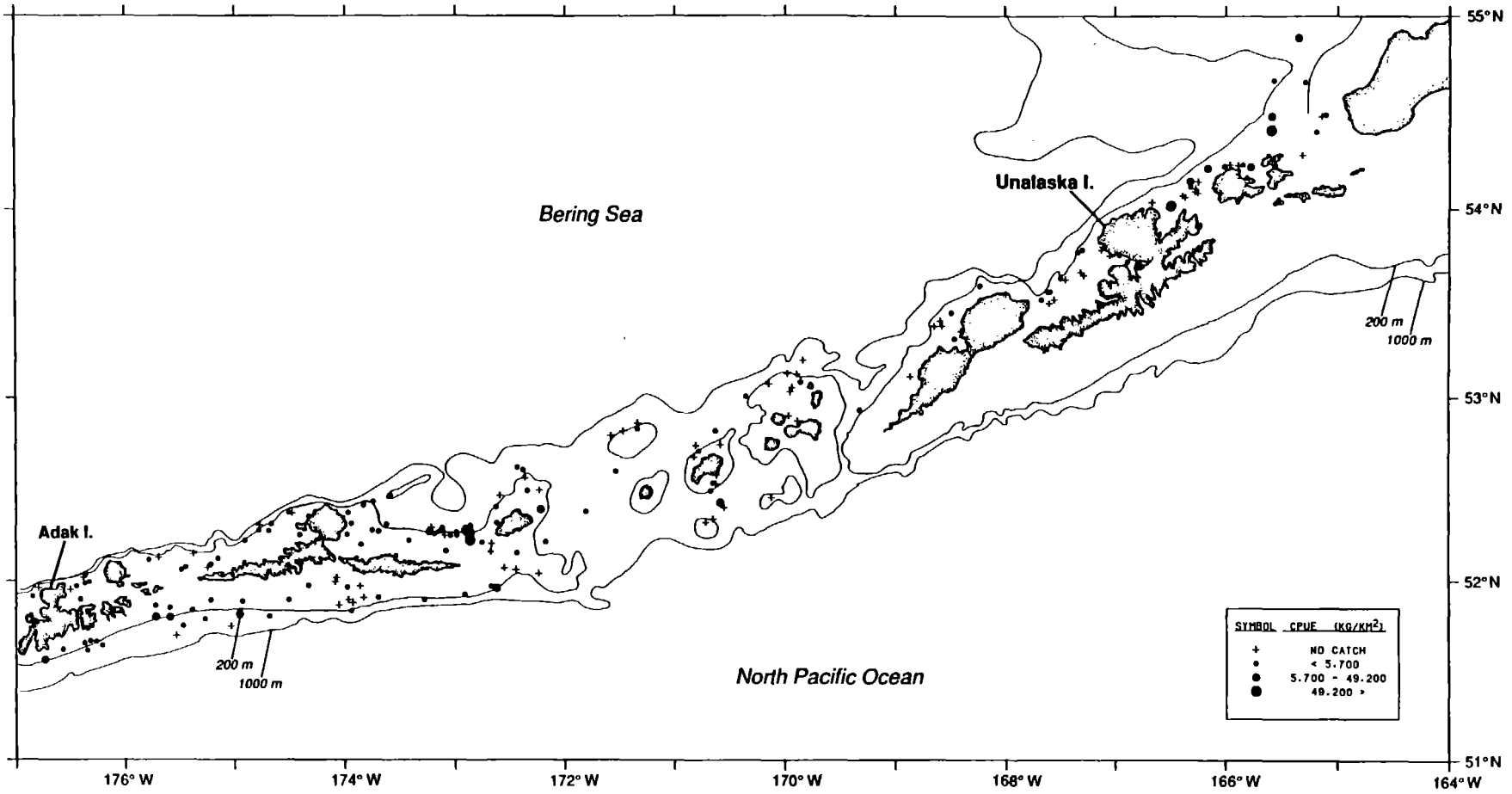


Figure 4.--Distribution and relative abundance of walleye pollock, 1991 Aleutian Islands bottom trawl survey. Abundance is categorized by catches below the mean (5,700 kg/km^2), between the mean and two standard deviations above the mean, and greater than two standard deviations above the mean.



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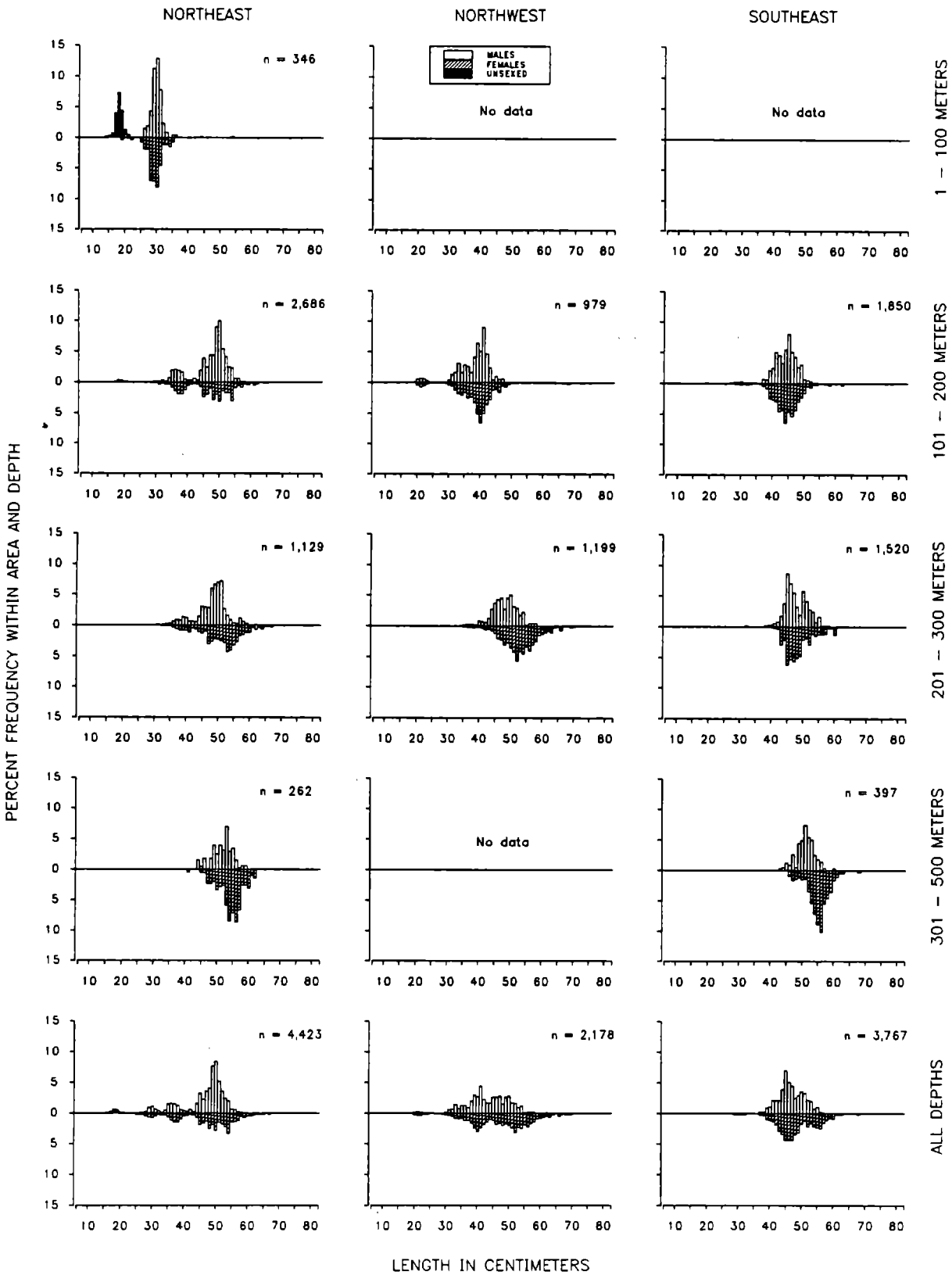

Figure 5. --Size composition of wolleve pollock from the 1991 Aleutian Islands survey

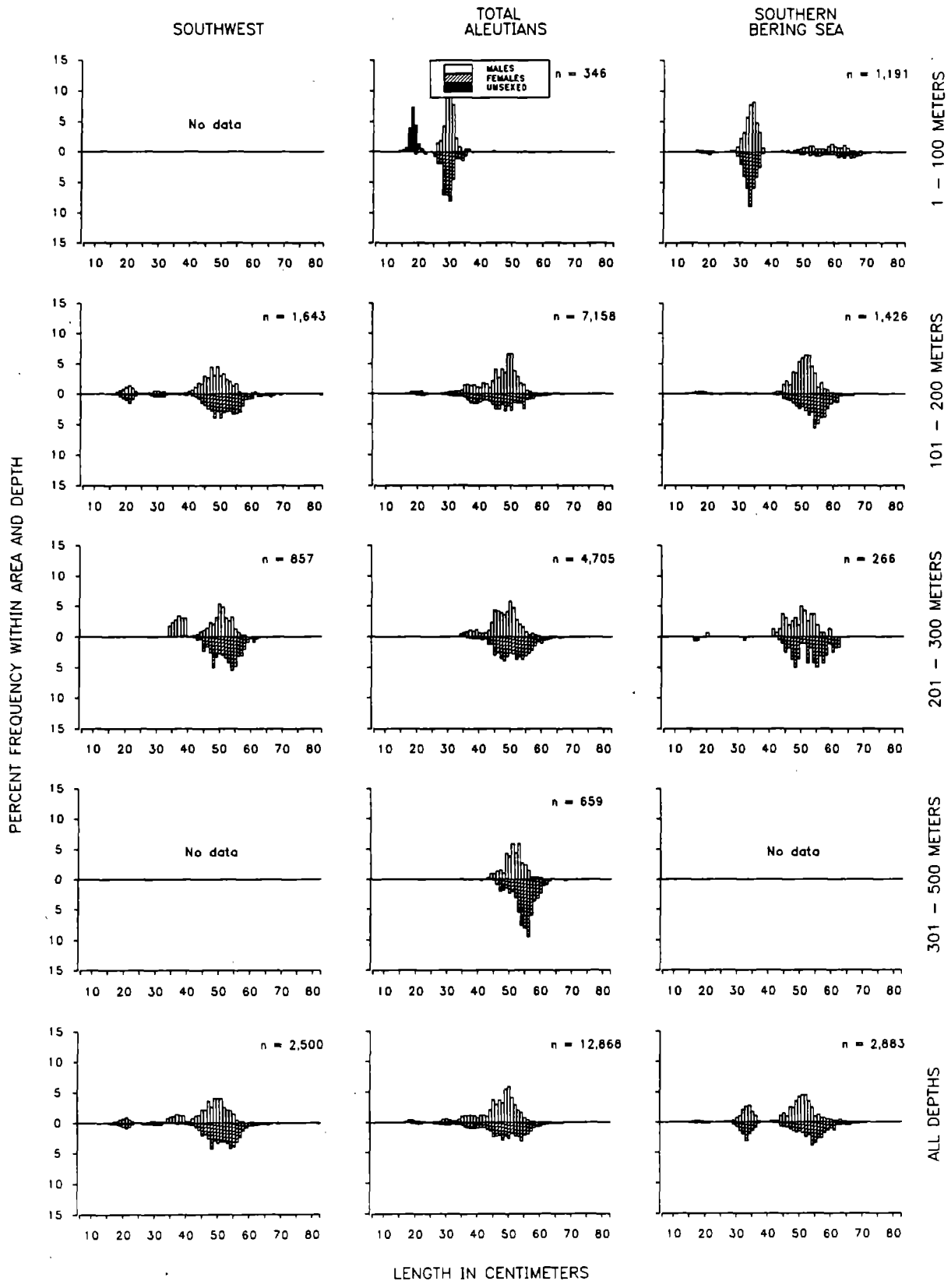

Figure 5. --Continued.

Pacific cod--Pacific cod were distributed relatively evenly throughout the survey area, occurring at over 70% of the stations in the Aleutian Islands region and 67% of stations in the Southern Bering Sea (Fig. 6 and Table 4). Over 80% of the total estimated biomass of 183,756 t was distributed in depths shallower than 200 m with the remainder occurring in the 200-300 m depth interval. High concentrations of cod (greater than 21,500 kg/km^2) occurred at several stations in the Northeast area.

The length distribution of Pacific cod ranged from 15 to 115 cm (FL). A strong length mode of 25-45 cm (FL) fish occurred in the two shallowest strata throughout the survey area (Fig. 7). An additional mode of smaller. 15-30 cm (FL) fish was also evident in the l-100 m depth interval of the Southern Bering Sea. In general, Pacific cod average length and weight increased with depth.

Table 4. --Total number of survey hauls, hauls containing Pacific cod, estimated biomass, CPUE, mean weight, and mean length based on the 1991 Aleutian Islands groundfish survey, by geographical areas and depth intervals.

Area	Depth (m)	Number of trawl hauls	Hauls with catch	CPUE (kg/km^2)	Biomass (t)	Mean weight (kg)	Mean length (cm)
Northeast	1 - 100	16	13	1,604	6,030	1.5	44.4
	101 - 200	49	44	5,018	25,421	3.4	59.6
	201 - 300	22	17	8,583	22,874	4.4	70.3
	301 - 500	21	2	8	32	2.1	---
	All depths	108	76	3,561	54,357	3.3	59.2
Northwest	1 - 100	7	7	4,316	10,184	2.5	50.6
	101 - 200	13	10	4,626	12,155	3.1	56.1
	201 - 300	12	6	784	839	4.6	66.7
	301 - 500	3	0	0	0	---	---
	All depths	35	23	2,972	23,178	2.9	53.6
Southeast	1 - 100	6	6	2,478	10,344	0.6	36.6
	101 - 200	40	36	3,323	15,799	3.0	60.0
	201 - 300	19	17	1,613	6,582	2.9	62.4
	301 - 500	8	1	182	694	2.5	61.4
	All depths	73	60	1,986	33,419	1.3	43.8
Southwest	1 - 100	6	5	8,739	38,546	4.3	66.5
	101 - 200	38	30	2,765	18,060	3.2	61.3
	201 - 300	9	7	886	2,033	4.3	66.4
	301 - 500	10	2	13	43	3.3	---
	All depths	63	44	3,525	58,682	3.9	64.4
Total Aleutian Islands	1 - 100	35	31	4,428	65,104	1.9	45.9
	101 - 200	140	120	3,764	71,435	3.2	59.5
	201 - 300	62	47	3,197	32,327	4.0	67.8
	301 - 500	42	5	60	769	2.5	61.4
	All depths	279	203	3,000	169,635	2.6	53.4
Aleutian Islands biomass, 95% confidence interval: 123,623 - 215,648 metric tons							
Southern Bering Sea	1 - 100	32	24	1,386	6,679	1.4	41.7
	101 - 200	22	14	1,785	5,841	2.2	54.9
	201 - 300	3	2	1,582	1,584	3.3	---
	301 - 500	4	1	13	17	3.2	---
	All depths	61	41	1,362	14,121	1.8	46.4
Southern Bering Sea biomass, 95% confidence interval: 6,812 - 21,429 metric tons							

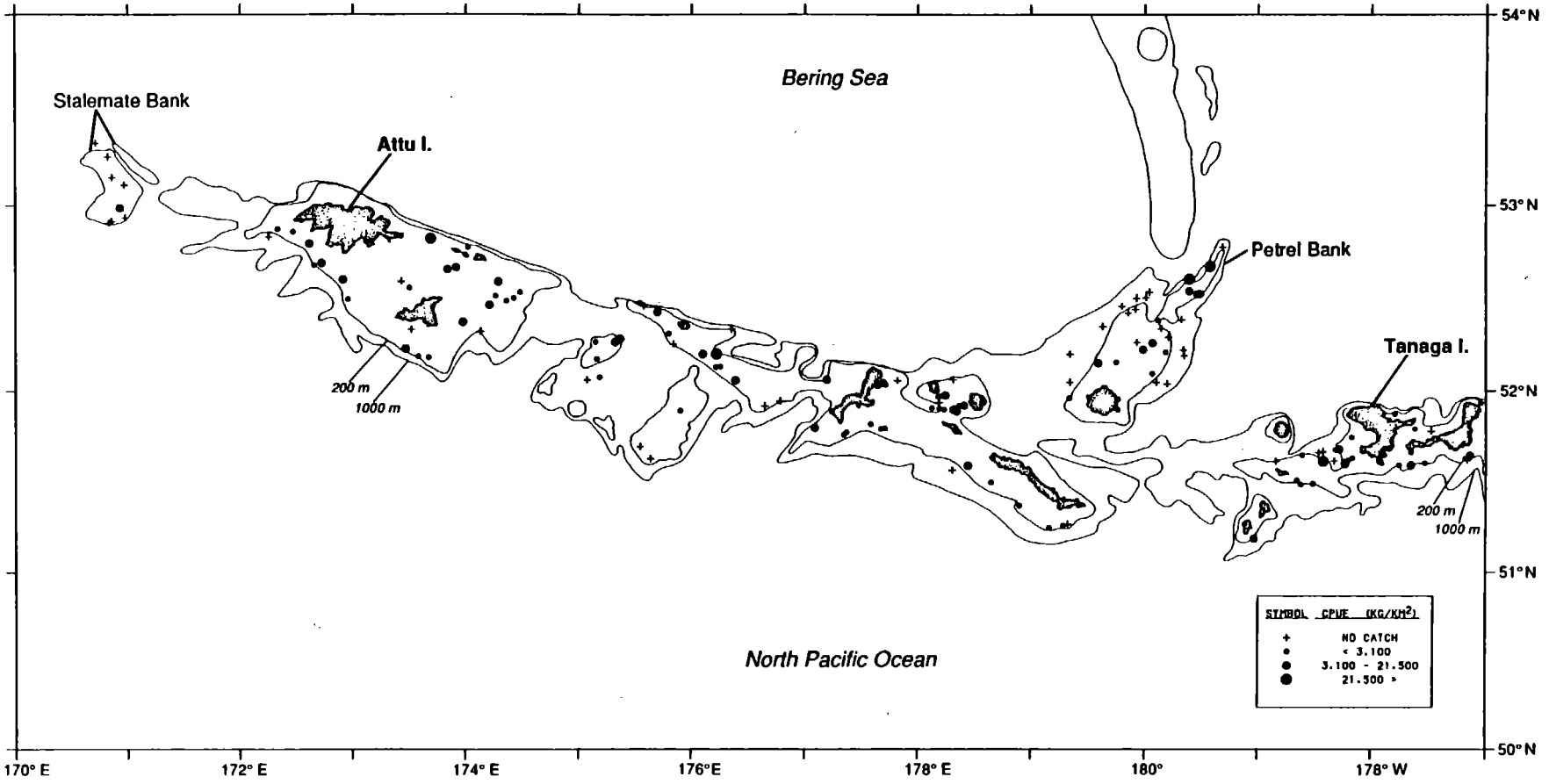

Figure 6. --Distribution and relative abundance of Pacific cod, 1991 Aleutian Islands bottom trawl survey. Abundance is categorized by catches below the mean (3,100 kg/km^2), between the mean and two standard deviations above the mean, and greater than two standard deviations above the mean.

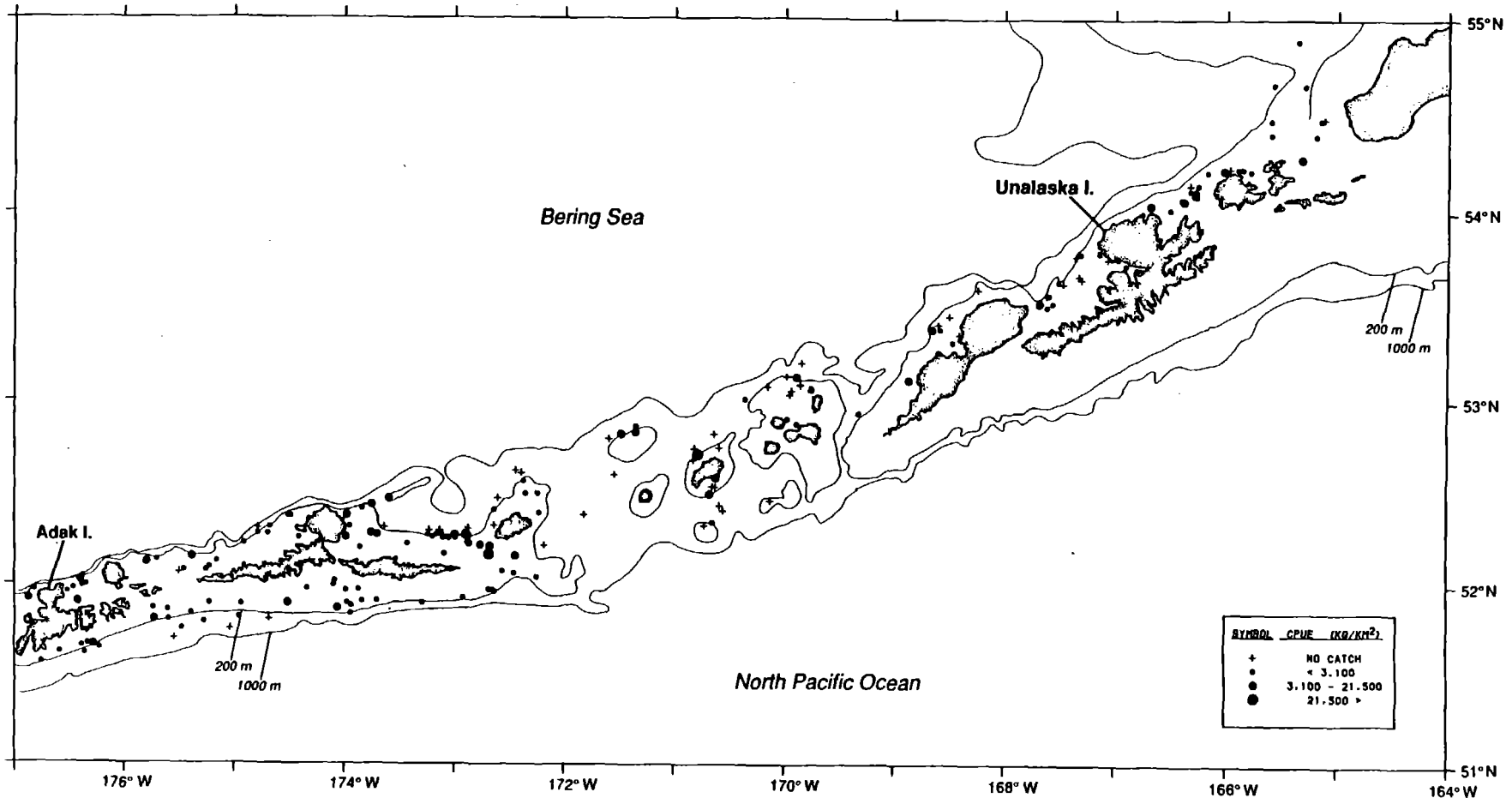

Figure 6. --Continued.

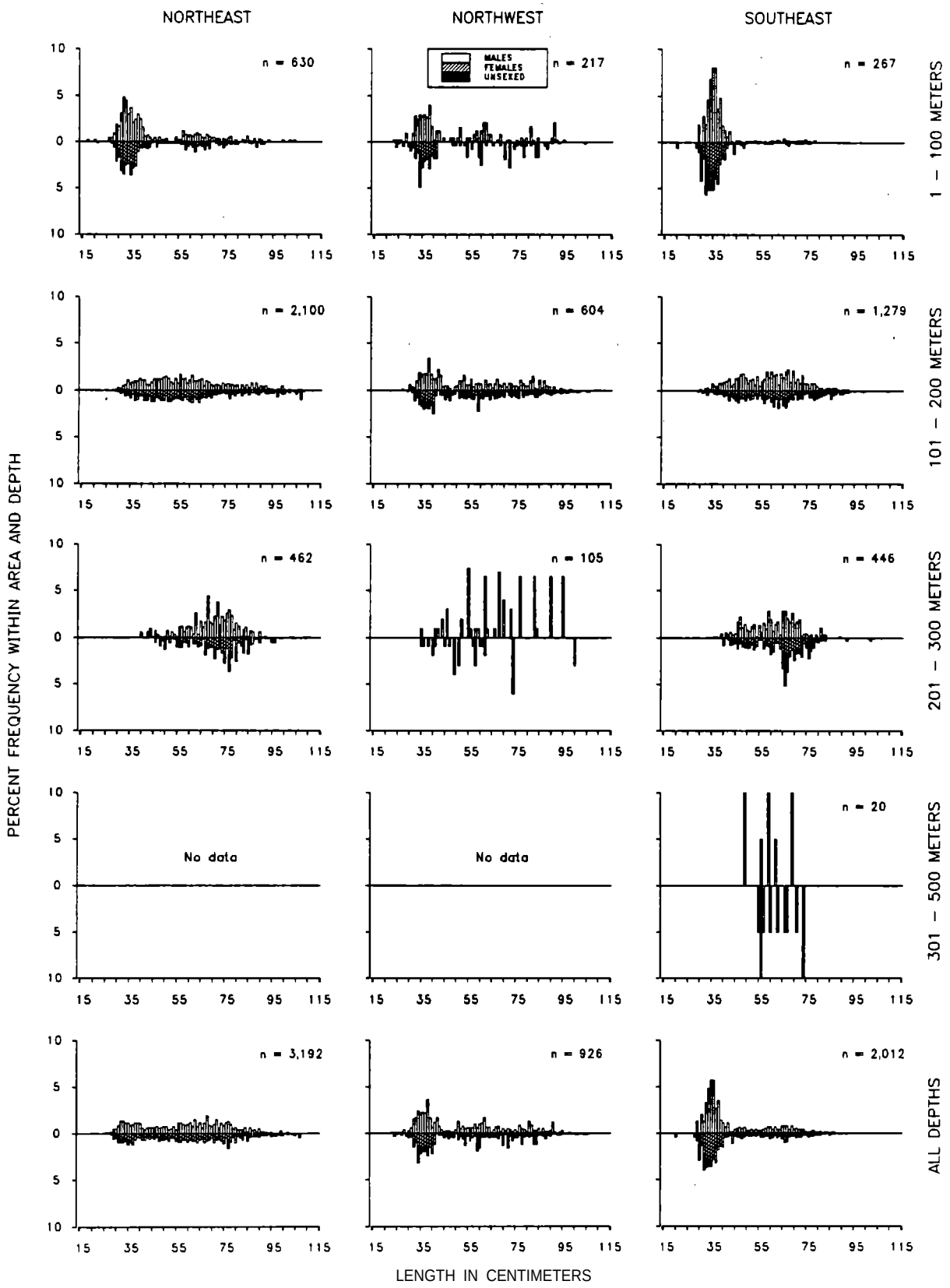

Figure 7.--Size composition of Pacific cod from the 1991 Aleutian Islands survey.

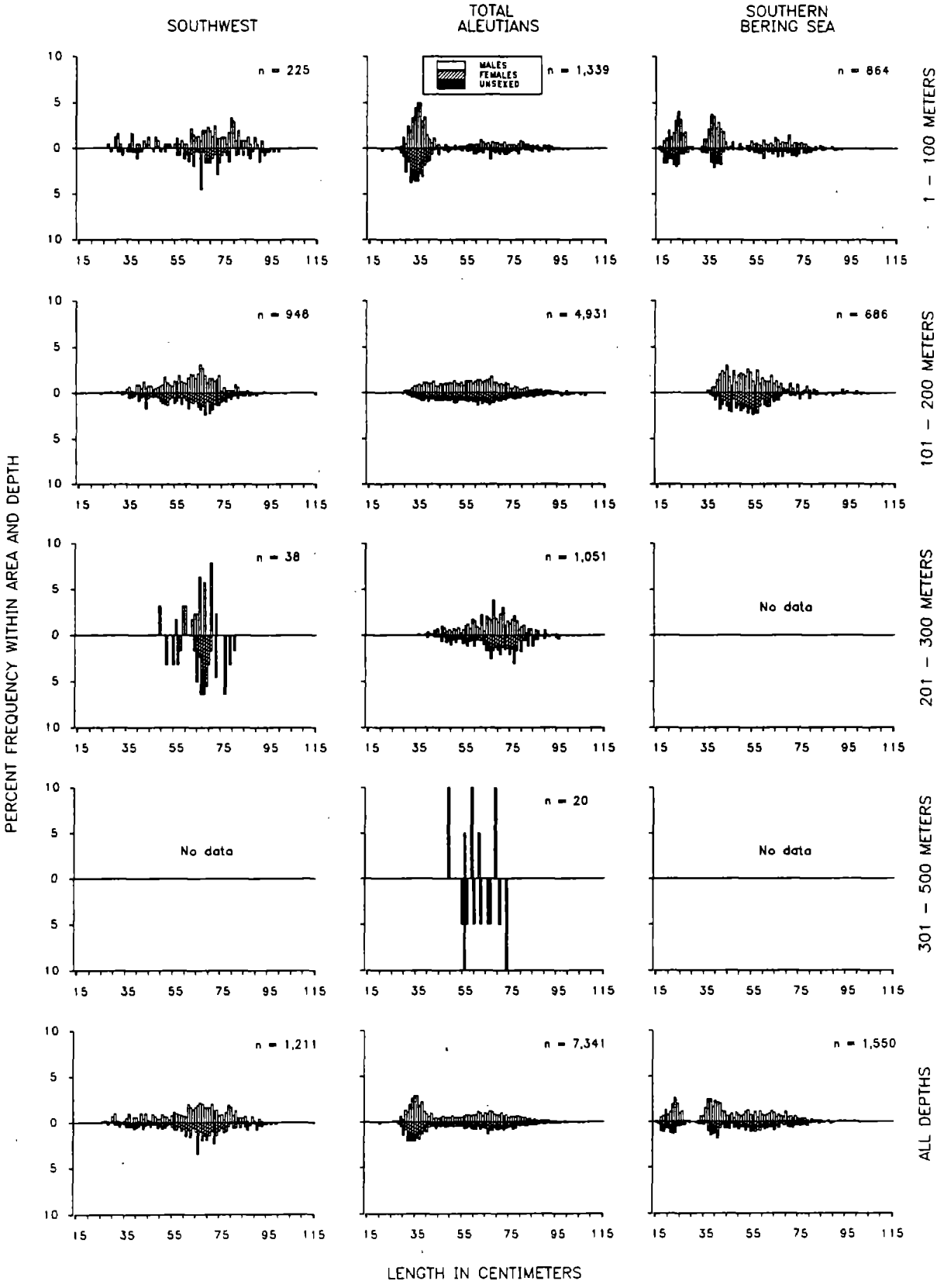

Figure 7. --Continued

Sablefish-Sablefish were sparse in the survey area, with significant catches occurring only in the Southeast Area (Fig. 8). Sablefish occurred at less than 6% of all stations, although they were found in 33% of the stations in the 301-500 m strata (Table 5). Biomass was estimated to be 20,846 t in the Aleutian Islands region and only 228 t in the Southern Bering Sea. Most of the estimated biomass of sablefish in the survey area was a result of relatively high abundance in a limited area south of Atka Island. All sablefish were found at depths greater than 200 m, except in the Southern Bering Sea, where two stations contained sablefish in the 101-200 m depth interval. In all areas, sablefish were most abundant in the 301-500 m depth interval. Because the survey was limited to depths of less than 500 m, an important portion of sablefish habitat was not surveyed, and estimates of CPUE and biomass are not representative of the entire Aleutian Islands region population.

The only length observations were from the Southeast Area 301-500 m depth interval where sablefish ranged in length from approximately 45 to 85 cm (FL) (Fig. 9).

Table 5. --Total number of survey hauls, hauls containing sablefish, estimated biomass, CPUE, mean weight, and mean length based on the 1991 Aleutian Islands groundfish survey, by geographical areas and depth intervals.

Area	Depth (m)	Number of trawl hauls	Hauls with catch	CPUE (kg/km^2)	Biomass (t)	Mean weight (kg)	Mean length (cm)
Northeast	1 - 100	16	0	0	0	---	---
	101 - 200	49	0	0	0	---	---
	201 - 300	22	1	31	83	6.1	---
	301 - 500	21	6	63	238	3.0	---
	All depths	108	7	21	321	3.5	---
Northwest	1 - 100	7	0	0	0	---	---
	101 - 200	13	0	0	0	---	---
	201 - 300	12	0	0	0	---	---
	301 - 500	3	1	76	132	3.2	---
	All depths	35	1	17	132	3.2	---
Southeast	1 - 100	6	0	0	0	---	---
	101 - 200	40	0	0	0	---	---
	201 - 300	19	2	37	152	4.2	---
	301 - 500	8	5	5,271	20,122	3.5	68.3
	All depths	73	7	1,205	20,274	3.5	68.3
Southwest	1 - 100	6	0	0	0	---	---
	101 - 200	38	0	0	0	---	---
	201 - 300	9	0	0	0	---	---
	301 - 500	10	2	35	120	4.3	---
	All depths	63	2	7	120	4.3	---
Total Aleutian Islands	1 - 100	35	0	0	0	---	---
	101 - 200	140	0	0	0	---	---
	201 - 300	62	3	23	235	4.7	---
	301 - 500	42	14	1,617	20,611	3.5	68.3
	All depths	279	17	369	20,846	3.5	68.3
Aleutian Islands biomass, 95% confidence interval: 0 - 105,588 metric tons							
Southern Bering Sea	1 - 100	32	0	0	0	---	---
	101 - 200	22	2	21	68	1.7	---
	201 - 300	3	0	0	0	---	---
	301 - 500	4	1	125	160	4.5	---
	All depths	61	3	22	228	3.0	---
Southern Bering Sea biomass, 95% confidence interval: 114 - 341 metric tons							

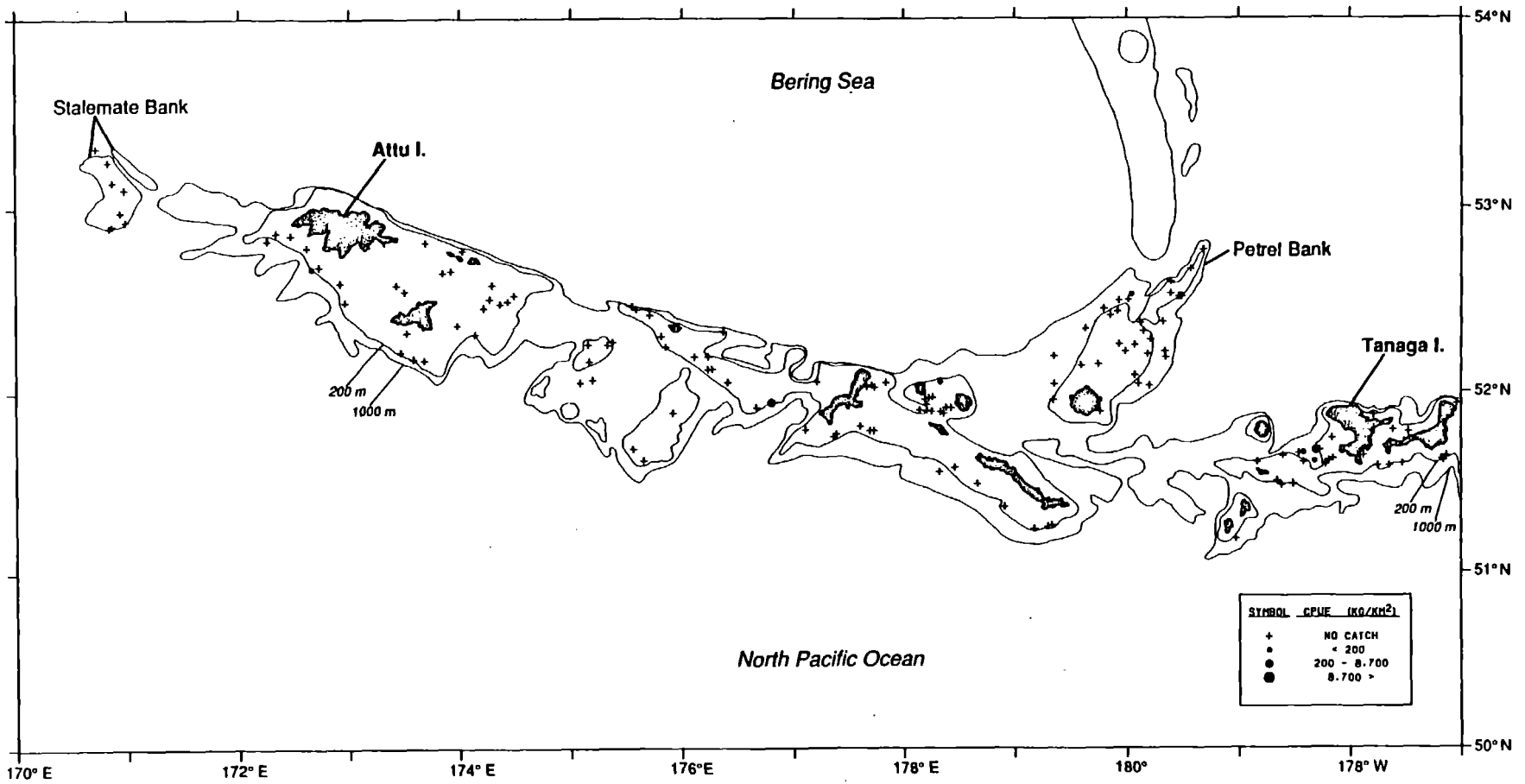

Figure 8.--Distribution and relative abundance of sablefish, 1991 Aleutian Islands bottom trawl survey. Abundance is categorized by catches below the mean (200 kg/km^2), between the mean and two standard deviations above the mean, and greater than two standard deviations above the mean.

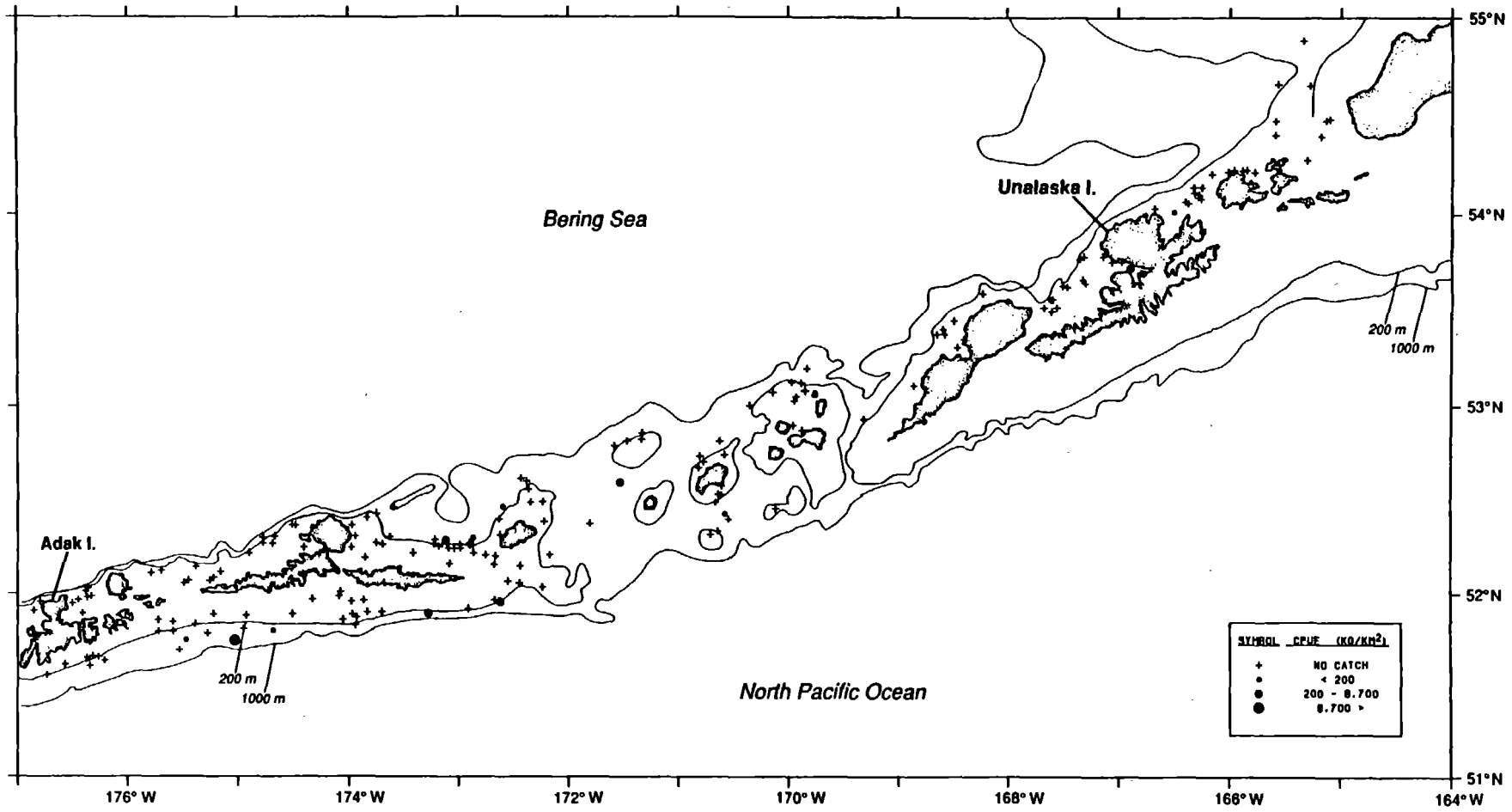

Figure 8.--Continued

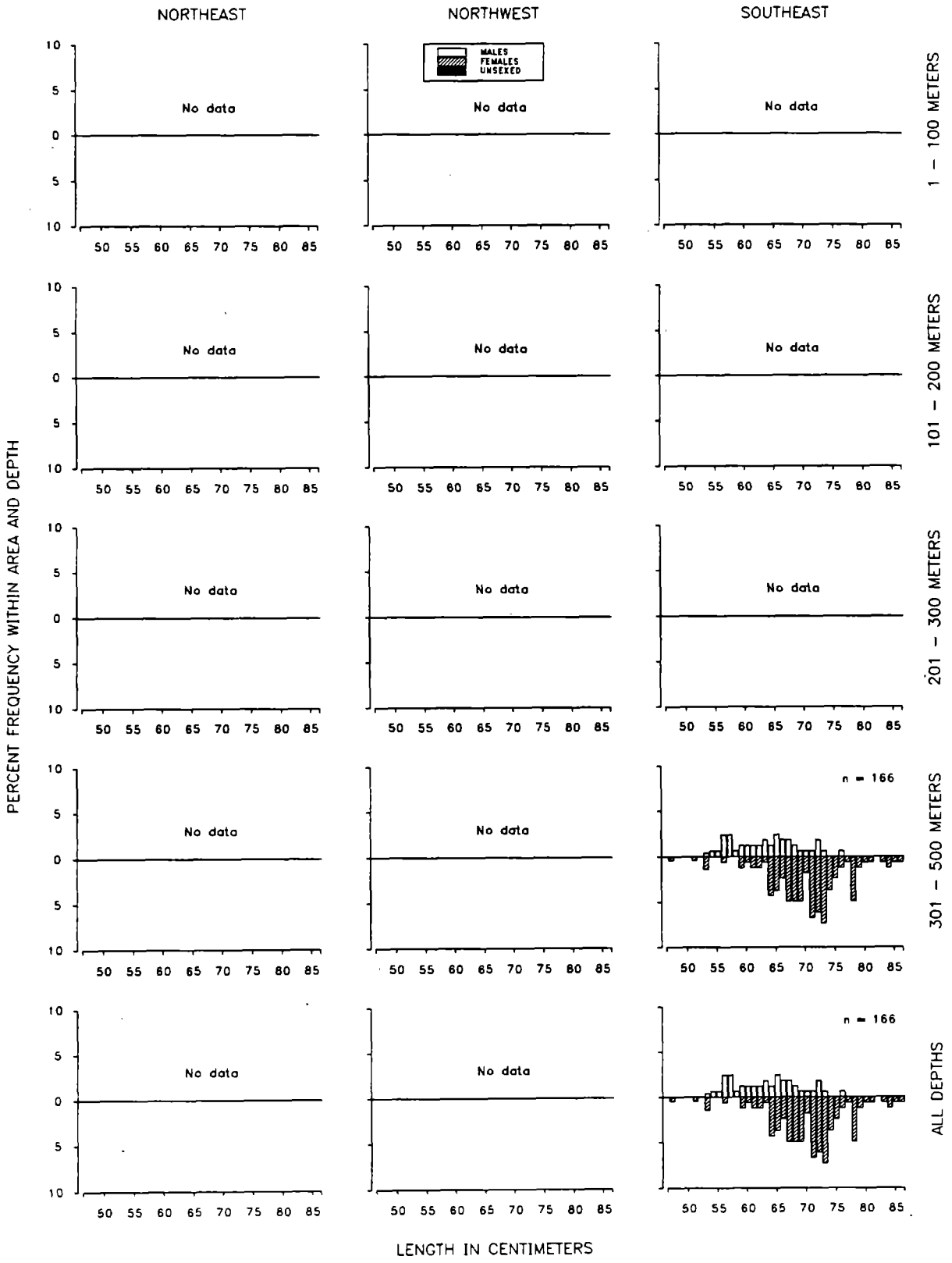

Figure 9.--Size composition of sablefish from the 1991 Aleutian Islands survey

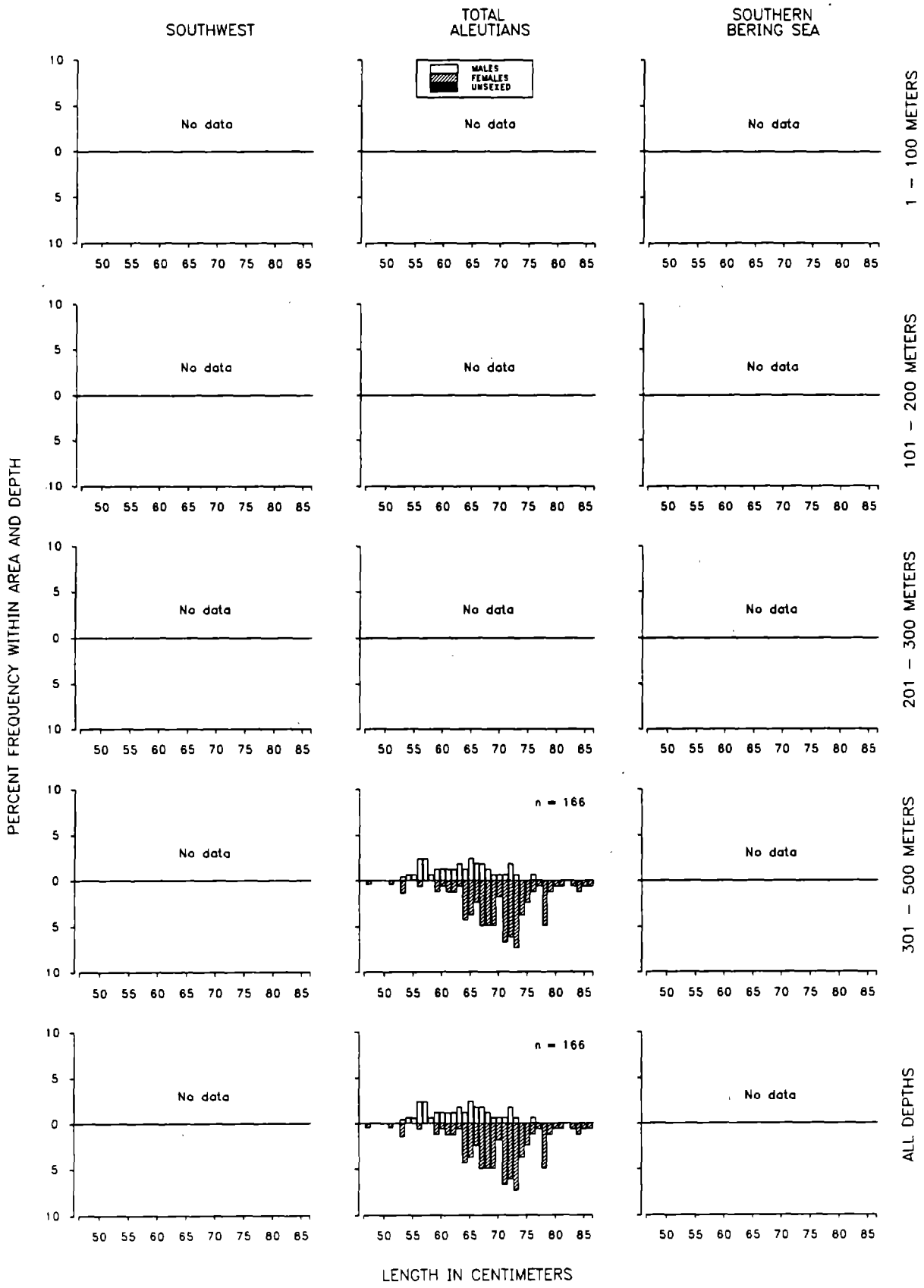

Figure 9.--Continued.

Atka mackerel--The distribution of Atka mackerel was extremely patchy throughout the survey area (Fig. 10). This species occurred at 42% of the stations in the Aleutian Islands region, and at 65% of the stations in the Northwest and Southwest Areas combined (Table 6). Concentrations were extremely high at some stations, with the largest catch of 10,262 kg occurring during- a 23-minute tow in Tanaga Pass. Atka mackerel occurred at only 18% of the stations in the Southern Bering Sea where catch rates were very low. Nearly 60% of the estimated biomass of 688,239 t was found in the Southwest Aleutian Islands Area. Atka mackerel was concentrated in the l-200 m depth intervals, with only trace amounts occurring between 201 and 300 m.

Data from the l-100 m depth strata indicated two length modes of 25-35 cm (FL) and 35-45 cm (FL), but the separation of these modes was not clear in the 101-200 m depth intervals where a similar size range was evident (Fig. 11). Due to the small number of fish caught in the Southern Bering Sea, no length frequency data were available for that area.

Table 6.-Total number of survey hauls, hauls containing Atka mackerel, estimated biomass. CPUE, mean weight, and mean length based on the 1991 Aleutian Islands groundfish survey. by geographical areas and depth intervals.

Area	Depth (m)	Number of trawl hauls	Hauls with catch	CPUE (kg/km²)	Biomass (t)	Mean weight (kg)	Mean length (cm)
Northeast	1 - 100	16	6	3,935	14,792	0.3	27.8
	101 - 200	49	19	6,155	31,181	0.6	34.7
	201 - 300	22	4	66	177	0.4	30.9
	301 - 500	21	0	0	0	---	---
	All depths	108	29	3,023	46,151	0.4	31.4
Northwest	1 - 100	7	6	15,697	37,042	0.4	31.9
	101 - 200	13	12	19,212	50,476	0.6	36.6
	201 - 300	12	6	139	149	0.7	---
	301 - 500	3	0	0	0	---	---
	All depths	35	24	11,240	87,666	0.5	34.2
Southeast	1 - 100	6	5	20,862	87,081	0.4	29.5
	101 - 200	40	15	11,566	54,985	0.6	36.8
	201 - 300	19	3	20	83	0.4	30.8
	301 - 500	8	0	0	0	---	---
	All depths	73	23	8,448	142,149	0.4	31.4
Southwest	1 - 100	6	6	47,662	210,230	0.5	34.8
	101 - 200	38	31	30,920	201,922	0.5	34.0
	201 - 300	9	3	14	33	0.4	---
	301 - 500	10	0	0	0	---	---
	All depths	63	40	24,763	412,185	0.5	34.4
Total Aleutian Islands	1 - 100	35	23	23,745	349,146	0.4	32.4
	101 - 200	140	77	17,840	338,564	0.5	34.8
	201 - 300	62	16	44	441	0.5	30.8
	301 - 500	42	0	0	0	---	---
	All depths	279	116	12,171	688,151	0.5	33.5
Aleutian Islands biomass, 95% confidence interval: 447,163 - 929,140 metric tons							
Southern Bering Sea	1 - 100	32	9	12	59	0.6	---
	101 - 200	22	1	1	4	0.9	---
	201 - 300	3	1	25	25	1.8	---
	301 - 500	4	0	0	0	---	---
	All depths	61	11	8	88	0.7	---
Southern Bering Sea biomass, 95% confidence interval: 40 - 135 metric tons							

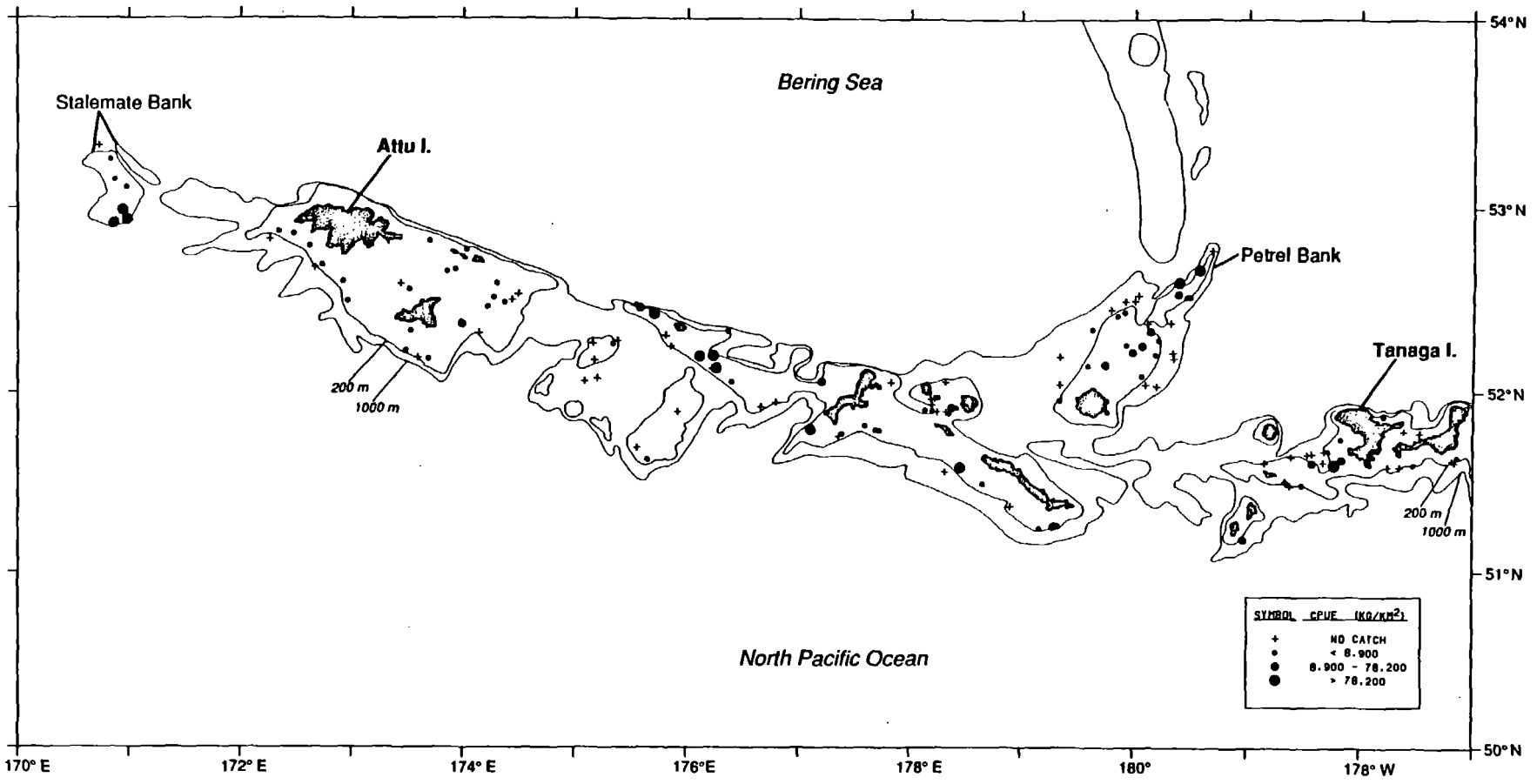

Figure l0.--Distribution and relative abundance of Atka mackerel, 1991 Aleutian Islands bottom trawl survey. Abundance is categorized by catches below the mean (8,900 kg/km^2), between the mean and two standard deviations above the mean, and greater than two standard deviations above the mean.

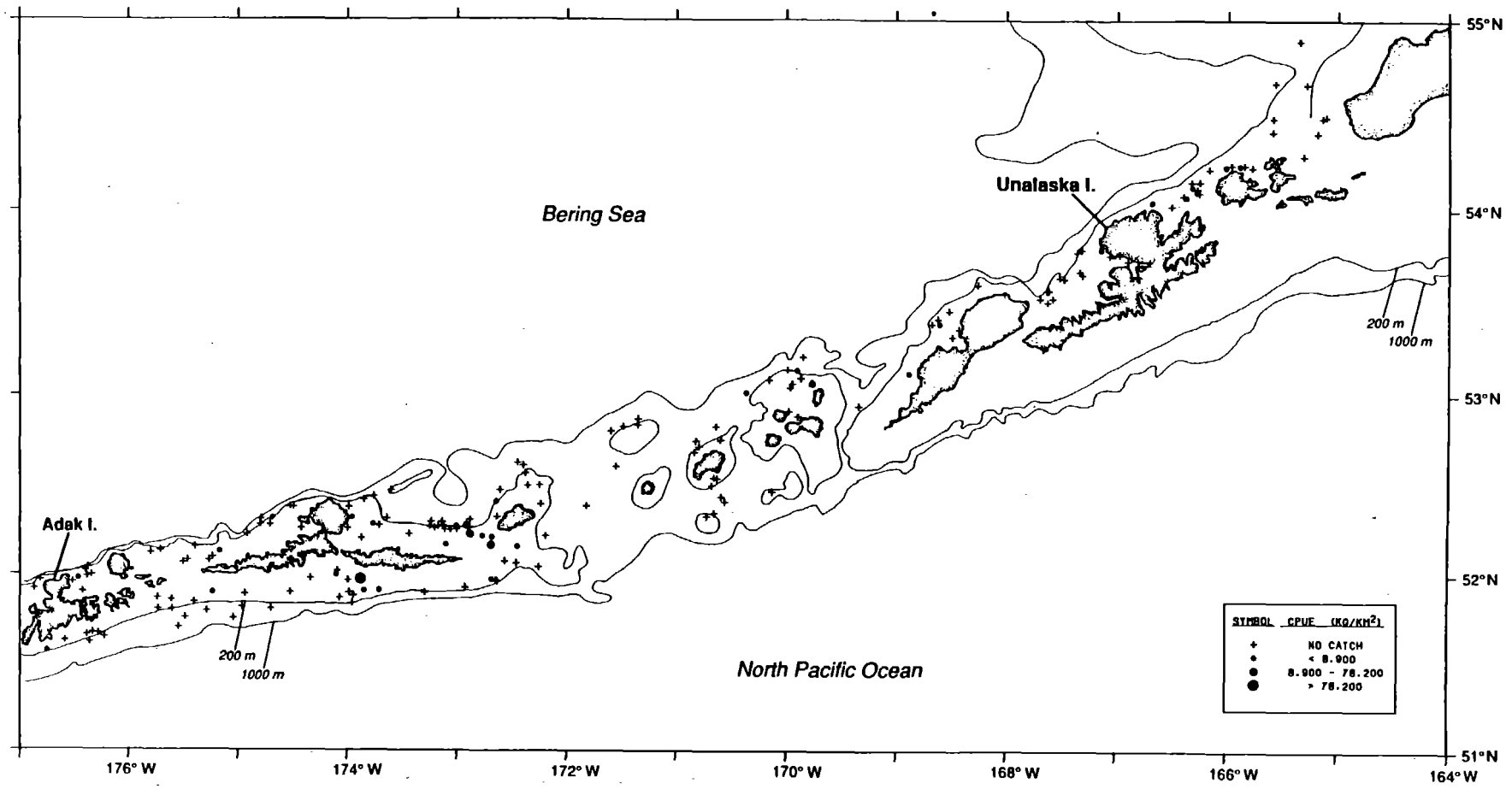

Figure 10.--Continued.

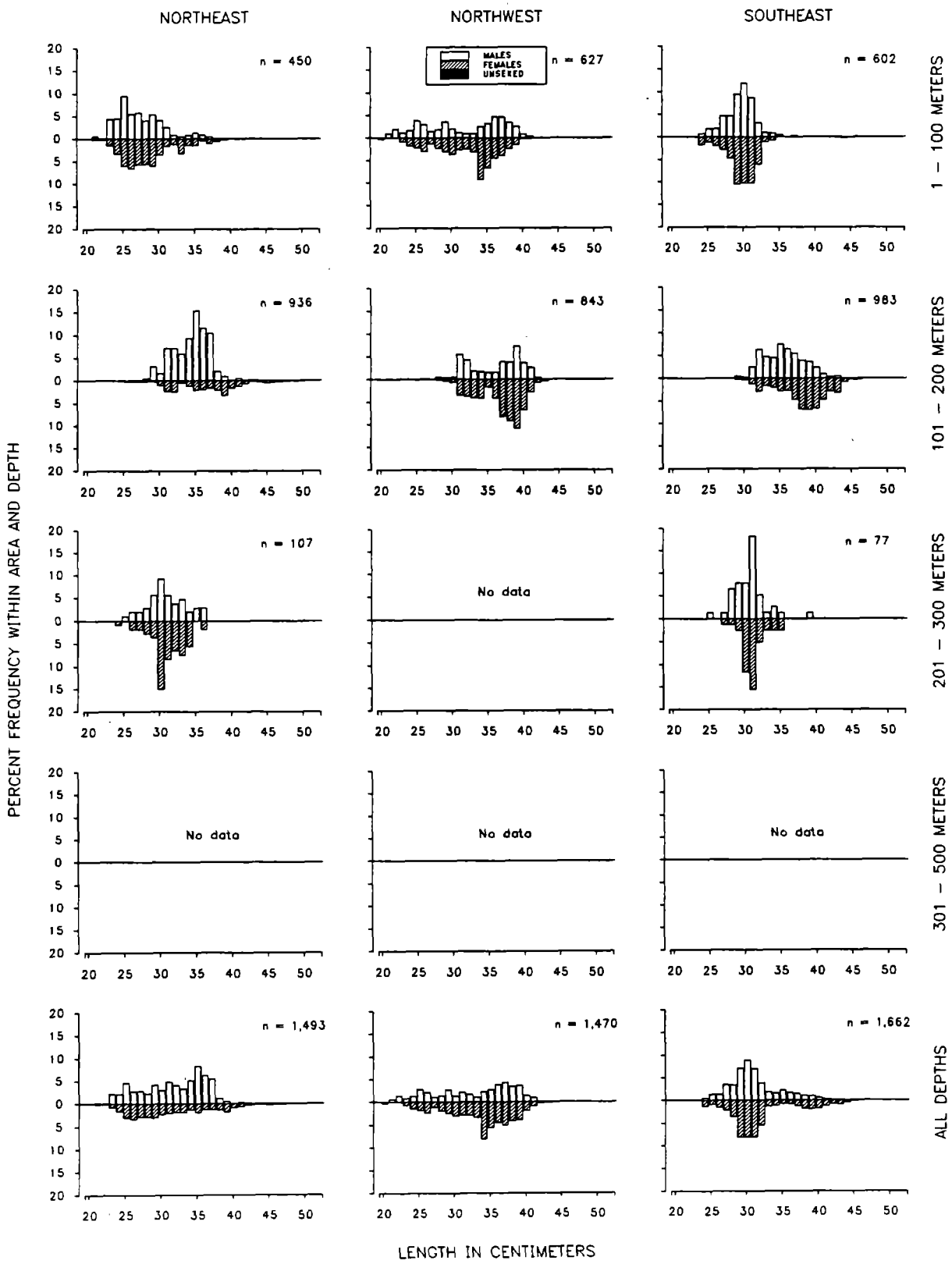

Figure 11.--Size composition of Atka mackerel from the 1991 Aleutian Islands survey.

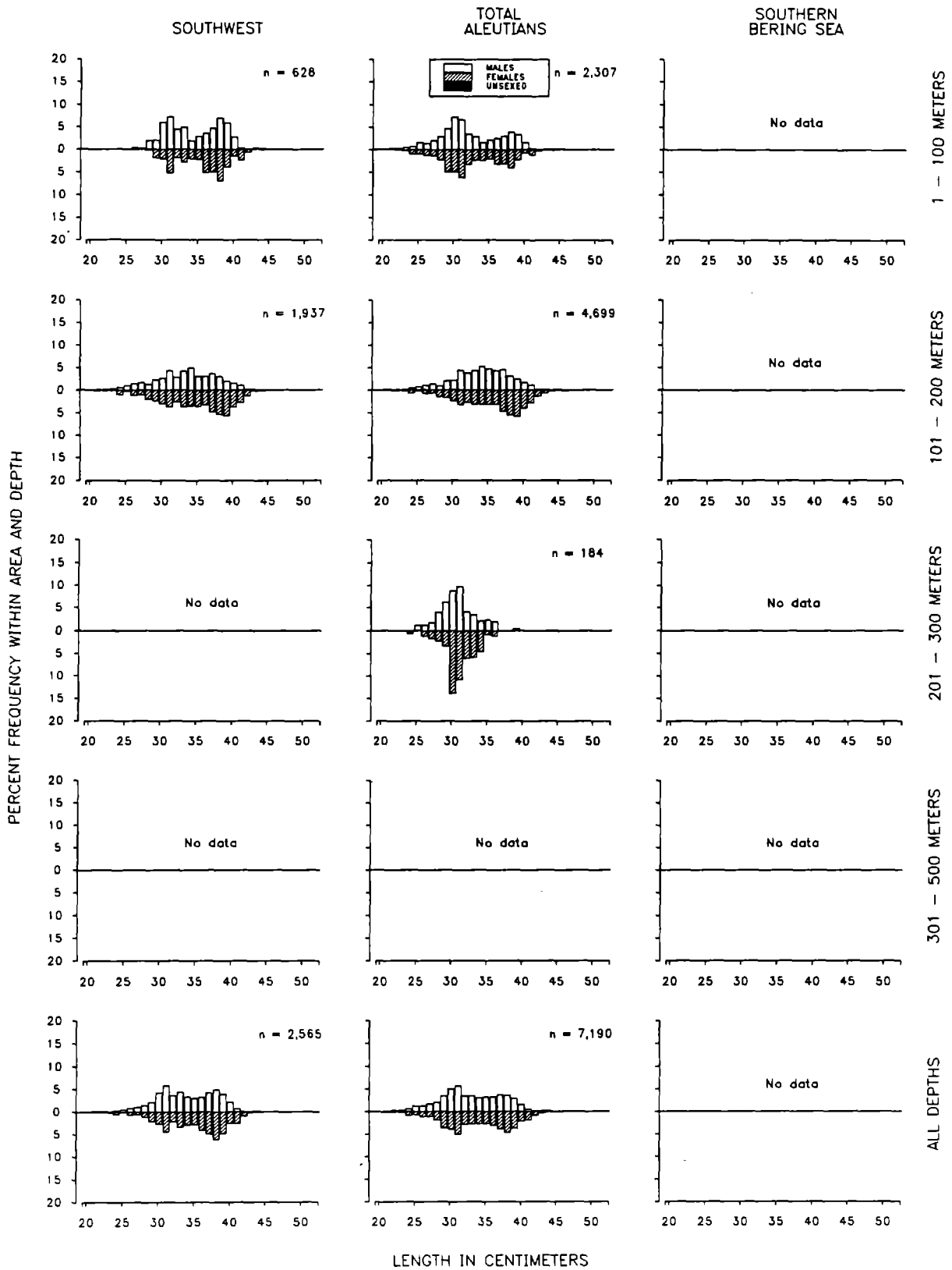

Figure 11 --Continued

Arrowtooth flounder--Arrowtooth flounder were evenly distributed throughout the survey area (Fig. 12), occurring at 64% of the stations in the Aleutian Islands region and 74% of the stations in the Southern Bering Sea (Table 7). The estimated biomass of 16,971 t in the Southern Bering Sea was similar to the estimate of 16,159 t for the entire Aleutian Islands region.

Length frequency data for arrowtooth flounder show a wide size range of 11-82 cm (FL) with no easily separable modes (Fig. 13). There was a general trend toward larger fish at deeper depths.

Table 7.--Total number of survey hauls, hauls containing arrowtooth flounder, estimated biomass, CPUE, mean weight, and mean length based on the 1991 Aleutian Islands groundfish survey,, by geographical areas and depth intervals.

Area	Depth (m)	Number of trawl hauls	Hauls with catch	CPUE (kg/km²)	Biomass (t)	Mean weight (kg)	Mean length (cm)
Northeast	1 - 100	16	9	459	1,726	0.3	29.4
	101 - 200	49	38	483	2,447	0.6	38.0
	201 - 300	22	12	243	647	1.2	49.5
	301 - 500	21	13	110	416	1.3	49.1
	All depths	108	72	343	5,236	0.5	33.8
Northwest	1 - 100	7	1	50	119	0.3	30.1
	101 - 200	13	7	128	337	0.8	44.0
	201 - 300	12	9	376	402	1.2	37.6
	301 - 500	3	3	860	1,499	3.4	---
	All depths	35	20	302	2,356	1.4	37.2
Southeast	1 - 100	6	2	3	14	0.2	---
	101 - 200	40	25	270	1,283	0.6	36.7
	201 - 300	19	16	482	1,966	1.3	47.2
	301 - 500	8	3	109	416	1.4	49.1
	All depths	73	46	219	3,680	0.9	41.4
Southwest	1 - 100	6	2	62	275	0.4	33.3
	101 - 200	38	28	372	2,429	0.7	40.2
	201 - 300	9	6	850	1,950	2.5	51.5
	301 - 500	10	5	68	232	2.4	---
	All depths	63	41	294	4,887	1.0	40.9
Total Aleutian Islands	1 - 100	35	14	145	2,135	0.3	29.8
	101 - 200	140	98	342	6,495	0.6	38.7
	201 - 300	62	43	491	4,966	1.5	47.9
	301 - 500	42	24	201	2,563	2.2	49.1
	All depths	279	179	286	16,159	0.7	37.0
Aleutian Islands biomass, 95% confidence interval: 11,570 - 20,748 metric tons							
Southern Bering Sea	1 - 100	32	21	277	1,333	0.2	26.8
	101 - 200	22	17	3,125	10,225	0.6	38.4
	201 - 300	3	3	1,644	1,646	1.0	47.2
	301 - 500	4	4	2,960	3,767	1.5	52.4
	All depths	61	45	1,637	16,971	0.6	37.3
Southern Bering Sea biomass, 95% confidence interval: 9,693 - 24,249 metric tons							

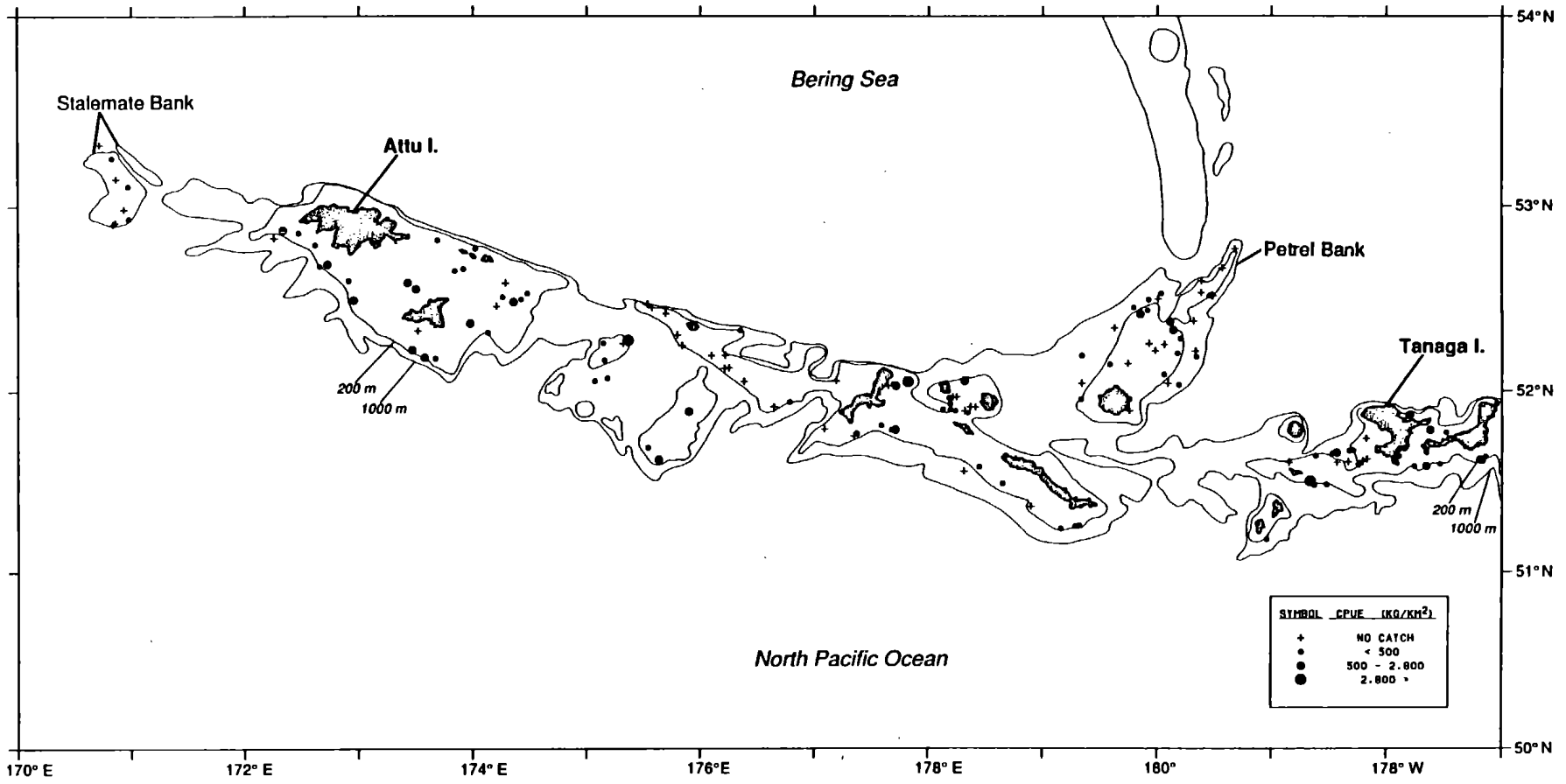

Figure 12.--Distribution and relative abundance of arrowtooth flounder, 1991 Aleutian Islands bottom trawl survey. Abundance is categorized by catches below the mean (500 kg/km²), between the mean and two standard deviations above the mean, and greater than two standard deviations above the mean.

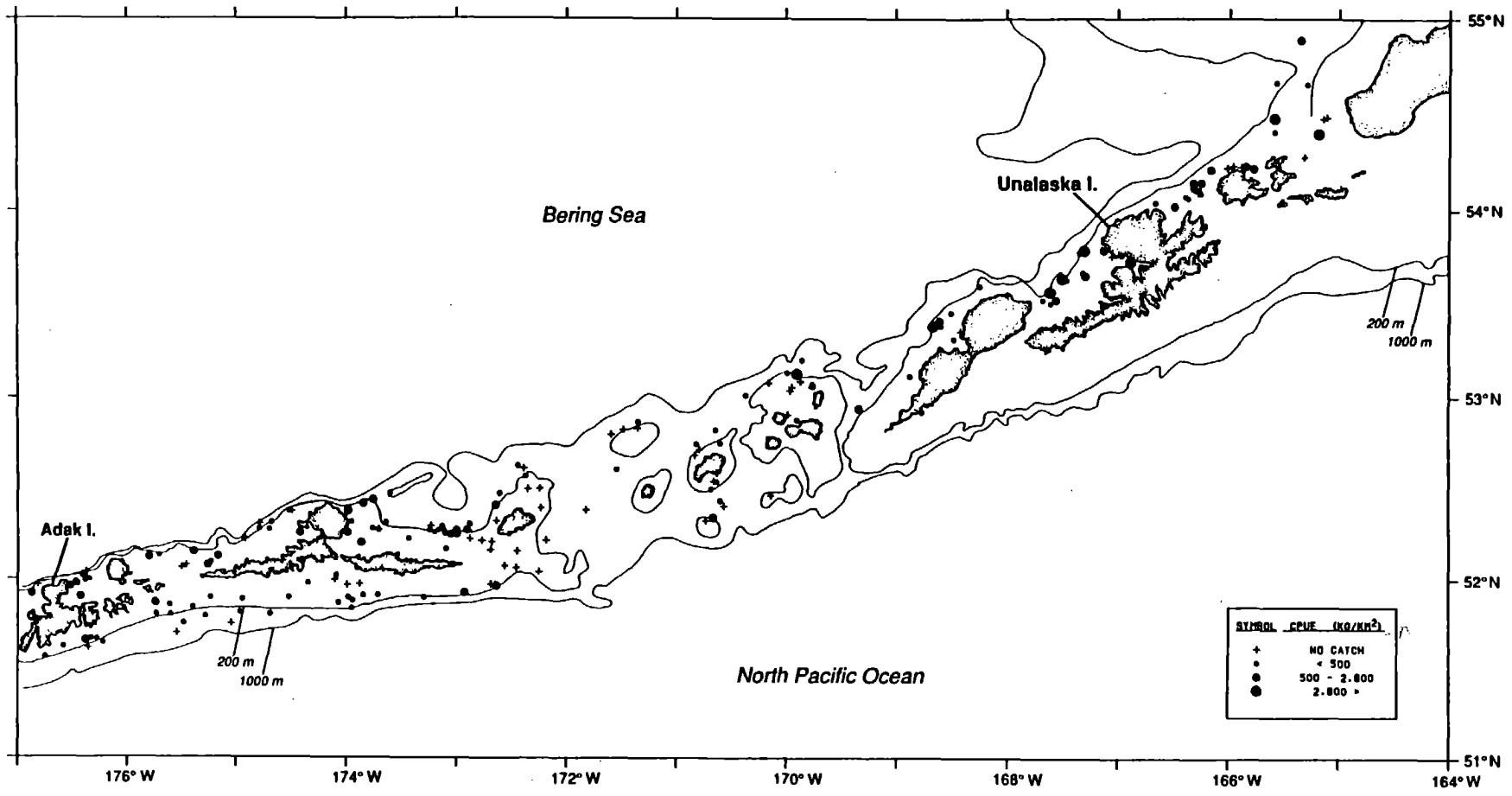

Figure 12.--Continued.

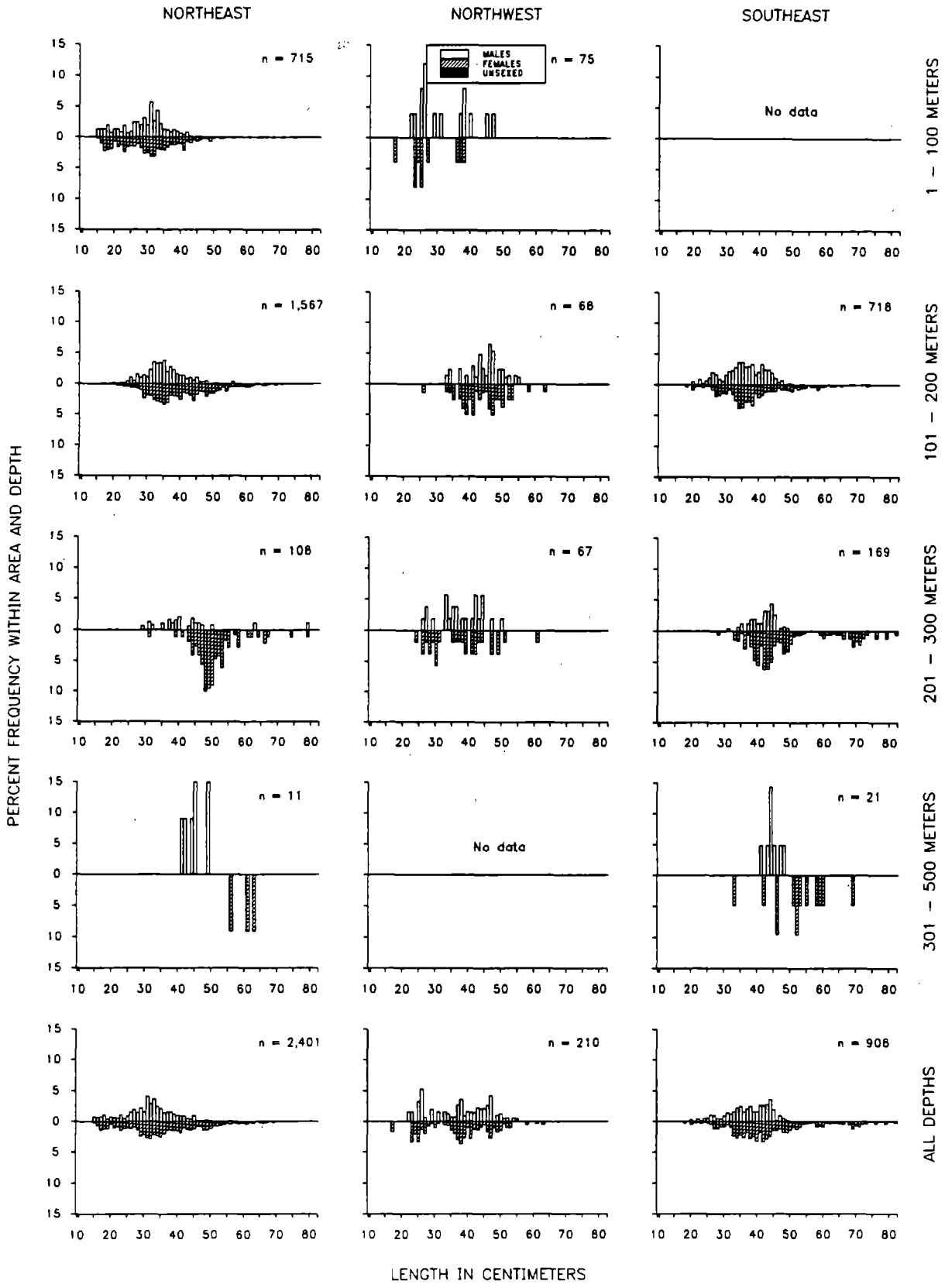

Figure 13.--Size composition of arrowtooth flounder from the 1991 Aleutian Islands survey.

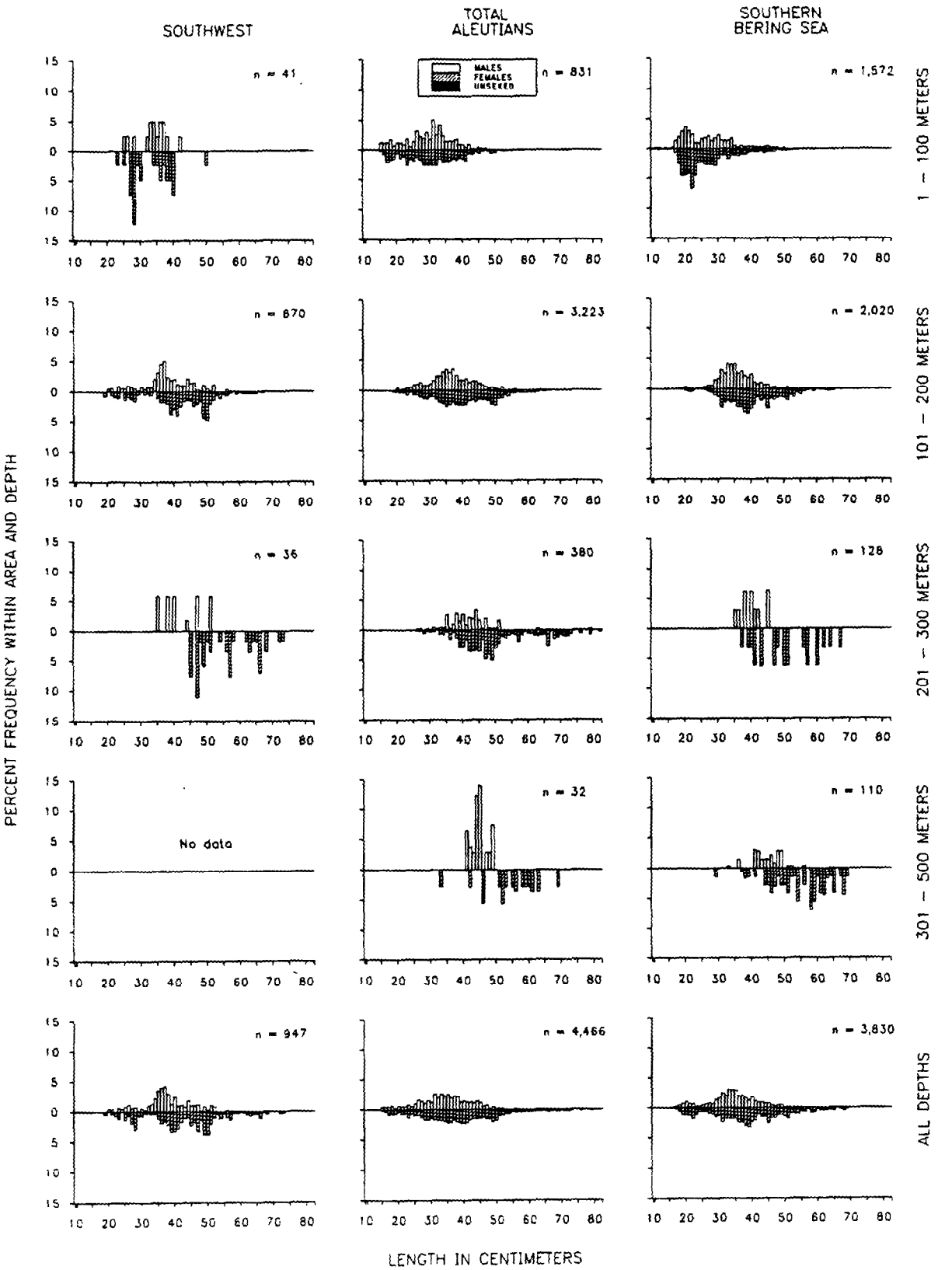

Figure 3.--Continued

Kamchatka flounder--During the 1991 survey, Kamchatka flounder was consistently identified and separated from arrow-tooth flounder. Previous surveys generally grouped these two species together as arrowtooth flounder.

The Kamchatka flounder was distributed throughout the Aleutian Islands, but was found only in trace amounts at the extreme western boundary of the Southern Bering Sea (Fig. 14), where the estimated biomass was only 742 t (Table 8). The estimated biomass for Kamchatka flounder in the Aleutian Islands region was 17,395 t. The biomass of Kamchatka flounder (6,764 t) was significantly higher than for arrowtooth flounder (2,356 t) in the Northwest Area, although overall biomass in the Aleutian Islands region was similar (16,159 t for arrow-tooth flounder and 17,395 t for Kamchatka flounder).

The length range for Kamchatka flounder was even greater than for arrowtooth flounder, ranging from 15 to 93 cm (FL) (Fig. 15). There was a very distinct trend in size at depth, with fish larger than 45 cm (FL) absent from the shallowest strata, and fish smaller than 35 cm (FL) scarce at greater depths.

Table 8.--Total number of survey hauls, hauls containing Kamchatka flounder, estimated biomass. CPUE, mean weight, and mean length based on the 1991 Aleutian Islands groundfish survey, by geographical areas and depth intervals.

Area	Depth (m)	Number of trawl hauls	Hauls with catch	CPUE (kg/km^2)	Biomass (t)	Mean weight (kg)	Mean length (cm)
Northeast	1 - 100	16	6	74	280	0.3	26.8
	101 - 200	49	29	92	467	0.4	33.8
	201 - 300	22	10	294	784	1.7	60.6
	301 - 500	21	14	721	2,721	2.6	57.8
	All depths	108	59	278	4,252	1.2	43.0
Northwest	1 - 100	7	1	5	13	0.1	---
	101 - 200	13	4	20	52	0.7	---
	201 - 300	12	9	785	840	2.3	63.7
	301 - 500	3	3	3,363	5,859	2.2	57.6
	All depths	35	17	867	6,764	2.1	58.3
Southeast	1 - 100	6	0	0	0	---	---
	101 - 200	40	13	13	62	0.4	35.4
	201 - 300	19	9	40	164	1.8	---
	301 - 500	8	5	243	928	2.0	---
	All depths	73	27	69	1,154	1.6	35.4
Southwest	1 - 100	6	1	1	4	0.1	---
	101 - 200	38	20	92	602	0.7	39.3
	201 - 300	9	6	166	380	2.0	63.0
	301 - 500	10	8	1,244	4,240	4.4	66.0
	All depths	63	35	314	5,225	2.5	54.8
Total Aleutian Islands	1 - 100	35	8	20	296	0.3	26.8
	101 - 200	140	66	62	1,183	0.5	36.0
	201 - 300	62	34	214	2,169	2.0	62.2
	301 - 500	42	30	1,079	13,747	2.7	59.3
	All depths	279	138	308	17,395	1.8	51.1
Aleutian Islands biomass, 95% confidence interval: 8,154 - 26,636 metric tons							
Southern Bering Sea	1 - 100	32	0	0	0	---	---
	101 - 200	22	0	0	0	---	---
	201 - 300	3	1	25	25	0.9	---
	301 - 500	4	2	564	717	3.6	65.0
	All depths	61	3	72	742	3.3	65.0
Southern Bering Sea biomass, 95% confidence interval: 0 - 2,994 metric tons							

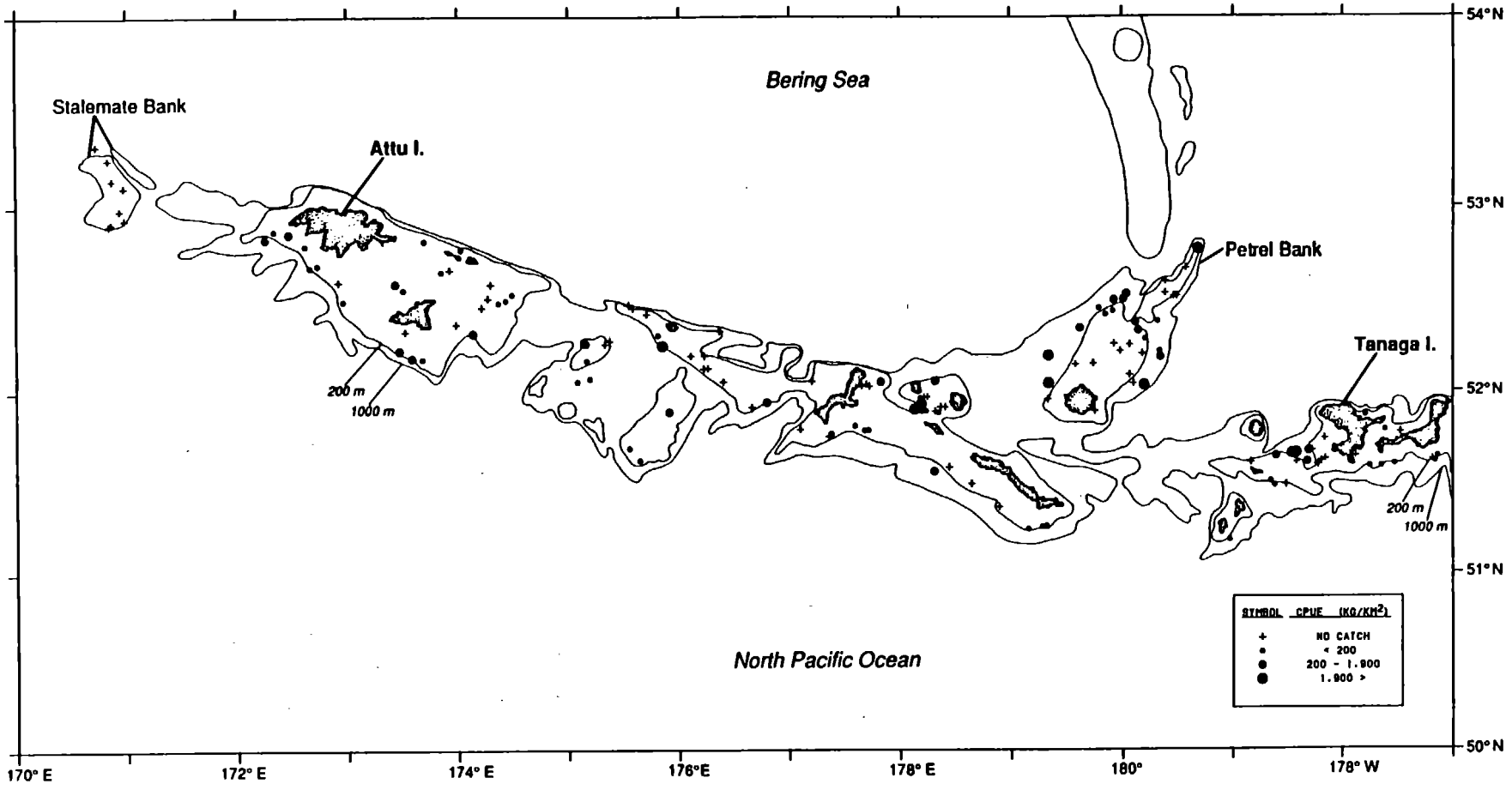

Figure 14.--Distribution and relative abundance of Kamchatka flounder, 1991 Aleutian Islands bottom trawl survey. Abundance is categorized by catches below the mean (200 kg/km^2), between the mean and two standard deviations above the mean, and greater than two standard deviations above the mean.

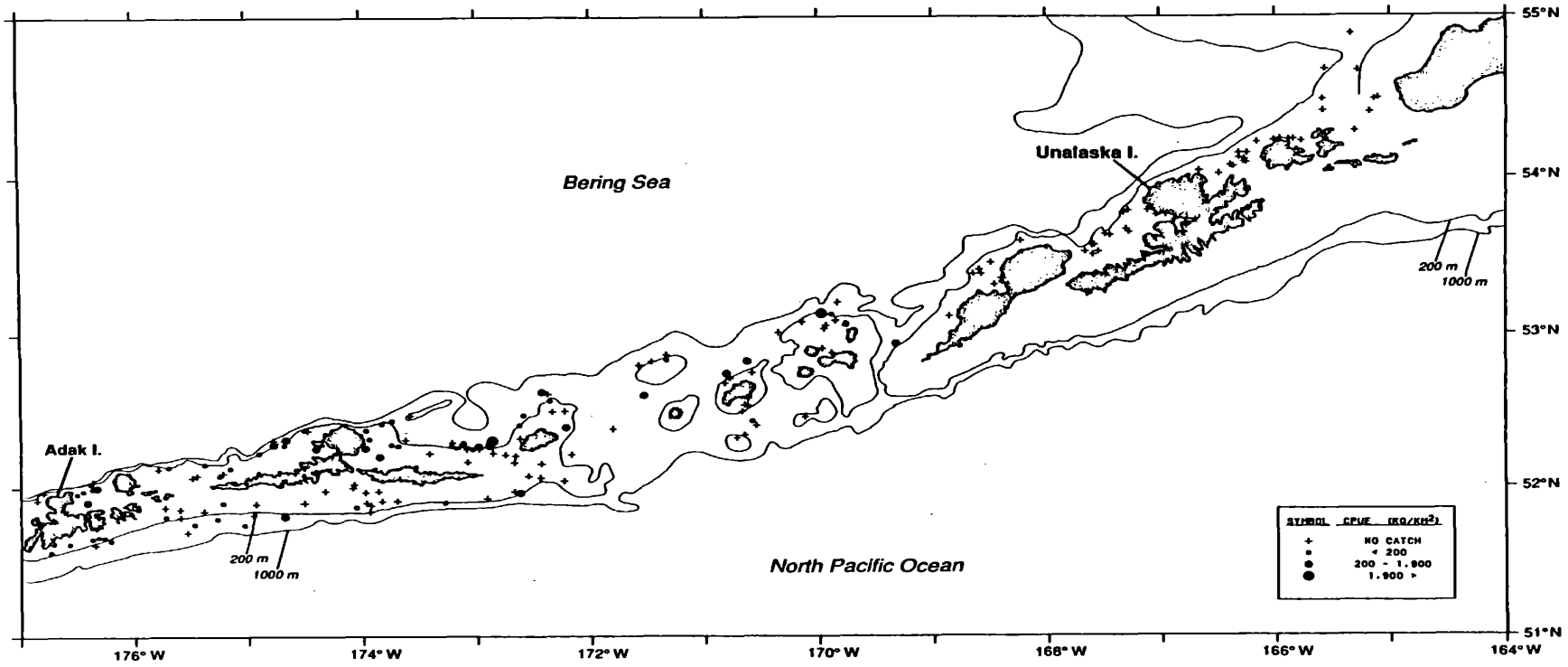

Figure l4.--Continued.

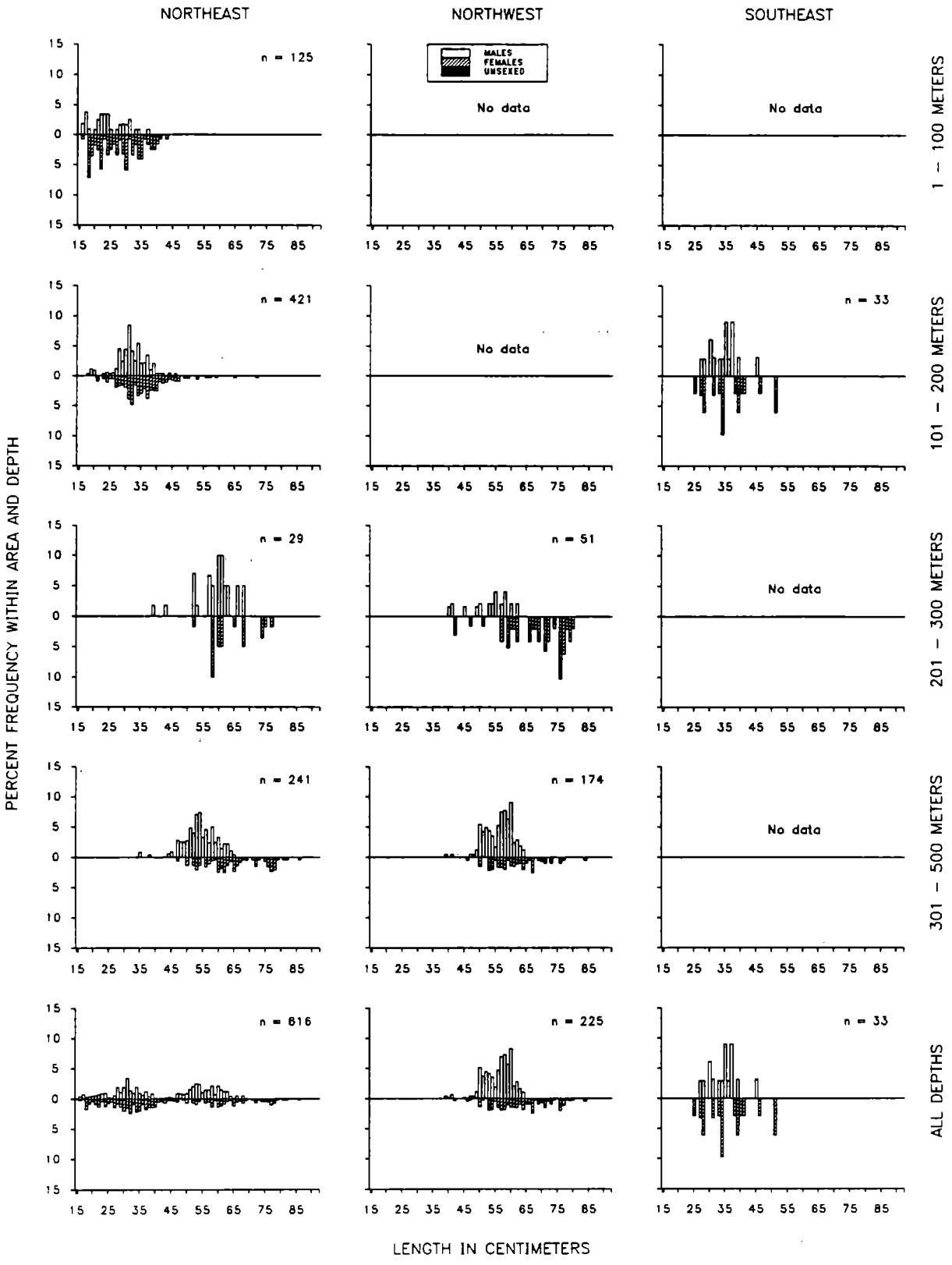

Figure 15.--Size composition of Kamchatka flounder from the 1991 Aleutian Islands survey.

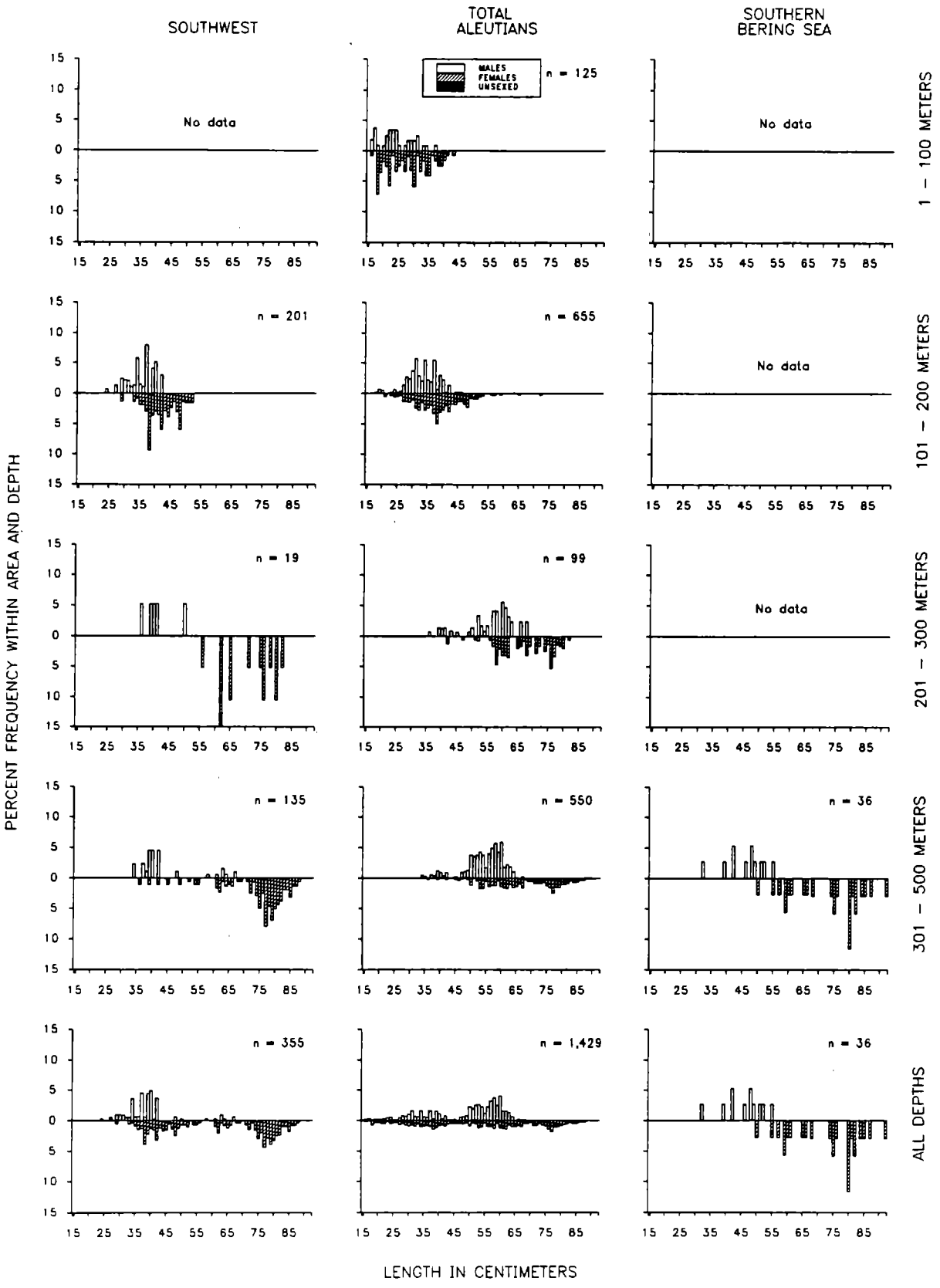

Figure 15.--Continued

Pacific halibut--Pacific halibut were frequently encountered in the Southern Bering Sea, occurring at 77% of the stations, but were less common in the Aleutian Islands region, occurring in only 46% of these stations (Fig. 16 and Table 9). The estimated biomass of Pacific halibut was 33,892 t in the Aleutian Islands region and 10,219 t in the Southern Bering Sea. In the Aleutian Islands region, halibut were least common in the Southwest Area, where they occurred at only 25% of the stations but occurred relatively frequently in the Southeast Area (63%), where over 50% of the total estimated biomass in the Aleutian Islands region were found. Most halibut were found in depths less than 200 m, but this species occurred at all depths in the survey.

Pacific halibut had the widest length range of all species encountered in the survey, ranging from 15 to 180 cm (FL) (Fig. 17). Because they were generally returned to the sea alive, Pacific halibut were usually not sexed during the survey, so length data are presented for both sexes grouped. A strong mode in the 30-40 cm (FL) range was evident in the Southern Bering Sea Area, but there were no clear modes in data from the Aleutian Islands region. There was a strong trend toward larger fish at deeper depths.

Table 9.--Total number of survey hauls, hauls containing Pacific halibut, estimated biomass, CPUE, mean weight, and mean length based on the 1991 Aleutian Islands groundfish survey, by geographical areas and depth Intervals.

Area	Depth (m)	Number of trawl hauls	Hauls with catch	CPUE (kg/km^2)	Biomass (t)	Mean weight (kg)	Mean length (cm)
Northeast	1 - 100	16	15	876	3,293	3.5	62.6
	101 - 200	49	27	627	3,178	7.0	76.2
	201 - 300	22	7	414	1,103	12.1	95.6
	301 - 500	21	2	110	414	39.8	142.4
	All depths	108	51	523	7,989	5.3	69.3
Northwest	1 - 100	7	4	462	1,091	3.3	61.1
	101 - 200	13	7	1,144	3,006	12.6	94.8
	201 - 300	12	4	345	370	9.9	91.2
	301 - 500	3	0	0	0	---	---
	All depths	35	15	573	4,466	7.3	76.1
Southeast	1 - 100	6	4	1,424	5,944	4.2	67.4
	101 - 200	40	30	1,434	6,817	7.2	78.7
	201 - 300	19	11	607	2,479	10.8	92.4
	301 - 500	8	1	469	1,791	26.0	120.6
	All depths	73	46	1,012	17,030	6.4	75.0
Southwest	1 - 100	6	2	606	2,672	19.3	94.8
	101 - 200	38	13	256	1,670	8.8	87.3
	201 - 300	9	0	0	0	---	---
	301 - 500	10	1	19	65	8.3	88.0
	All depths	63	16	265	4,407	13.1	90.4
Total Aleutian Islands	1 - 100	35	25	884	13,000	4.6	66.4
	101 - 200	140	77	773	14,671	8.0	81.1
	201 - 300	62	22	391	3,952	11.1	93.1
	301 - 500	42	4	178	2,270	26.1	120.3
	All depths	279	128	599	33,892	6.6	74.5
Aleutian Islands biomass, 95% confidence interval: 22,889 - 44,896 metric tons							
Southern Bering Sea	1 - 100	32	31	1,423	6,858	1.8	46.9
	101 - 200	22	16	591	1,934	3.7	61.5
	201 - 300	3	1	1,424	1,426	34.9	136.0
	301 - 500	4	0	0	0	---	---
	All depths	61	48	986	10,219	2.3	49.4
Southern Bering Sea biomass, 95% confidence interval: 7,786 - 12,651 metric tons							

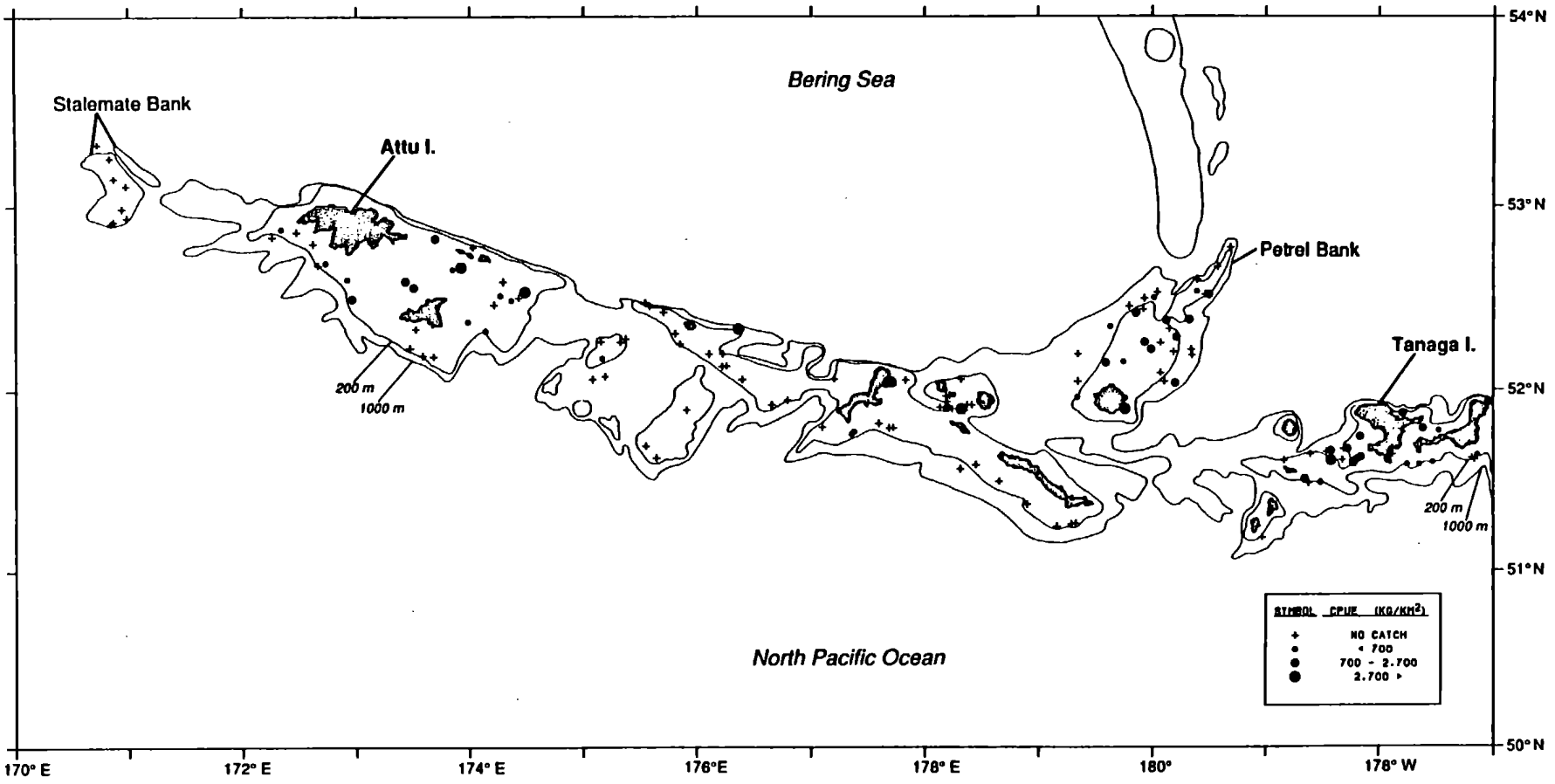

Figure 16.--Distribution and relative abundance of Pacific halibut, 1991 Aleutian Islands bottom trawl survey. Abundance is categorized by catches below the mean (700 kg/km²), between the mean and two standard deviations above the mean, and greater than two standard deviations above the mean.

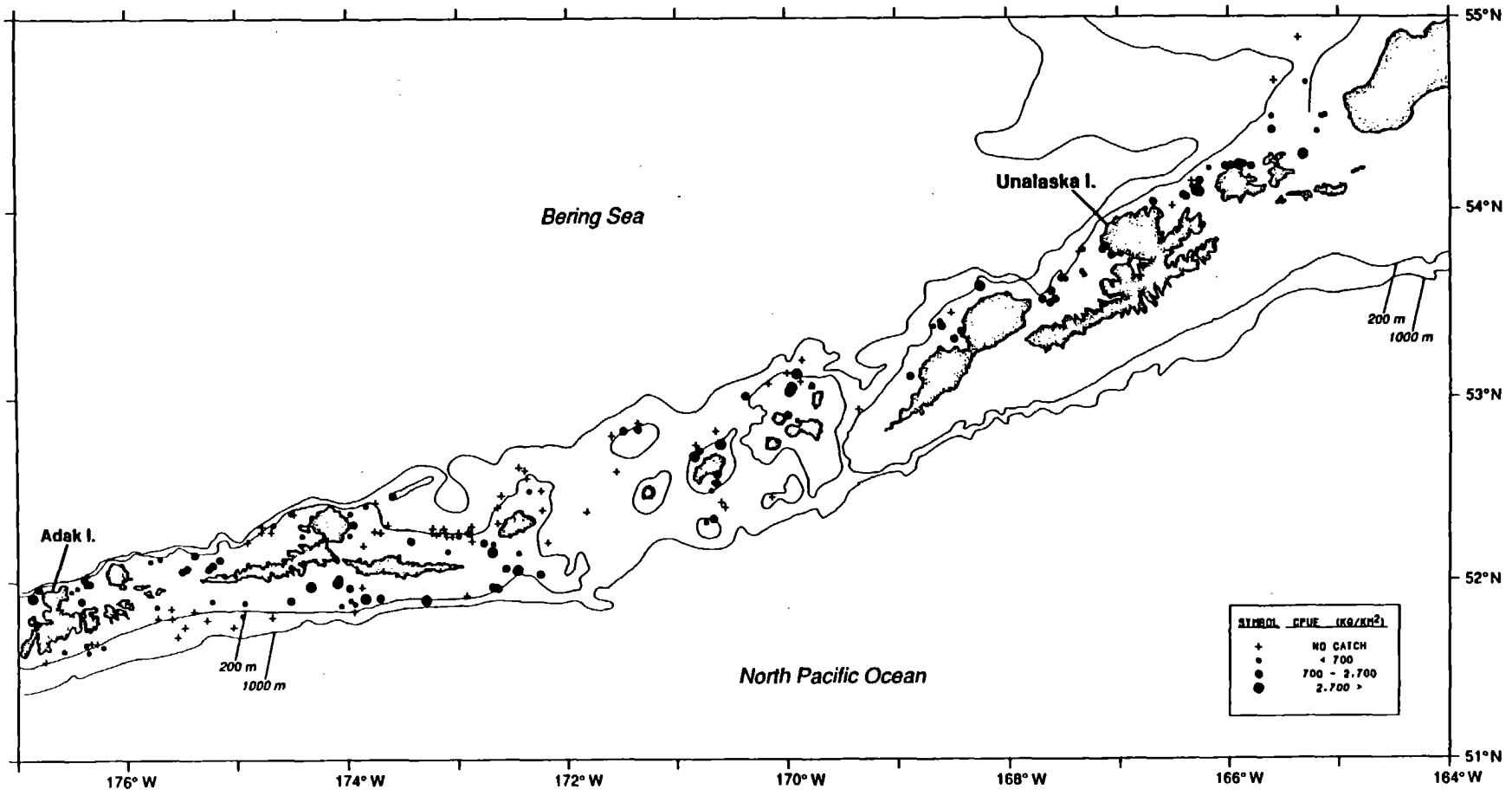

Figure 16.--Continued.

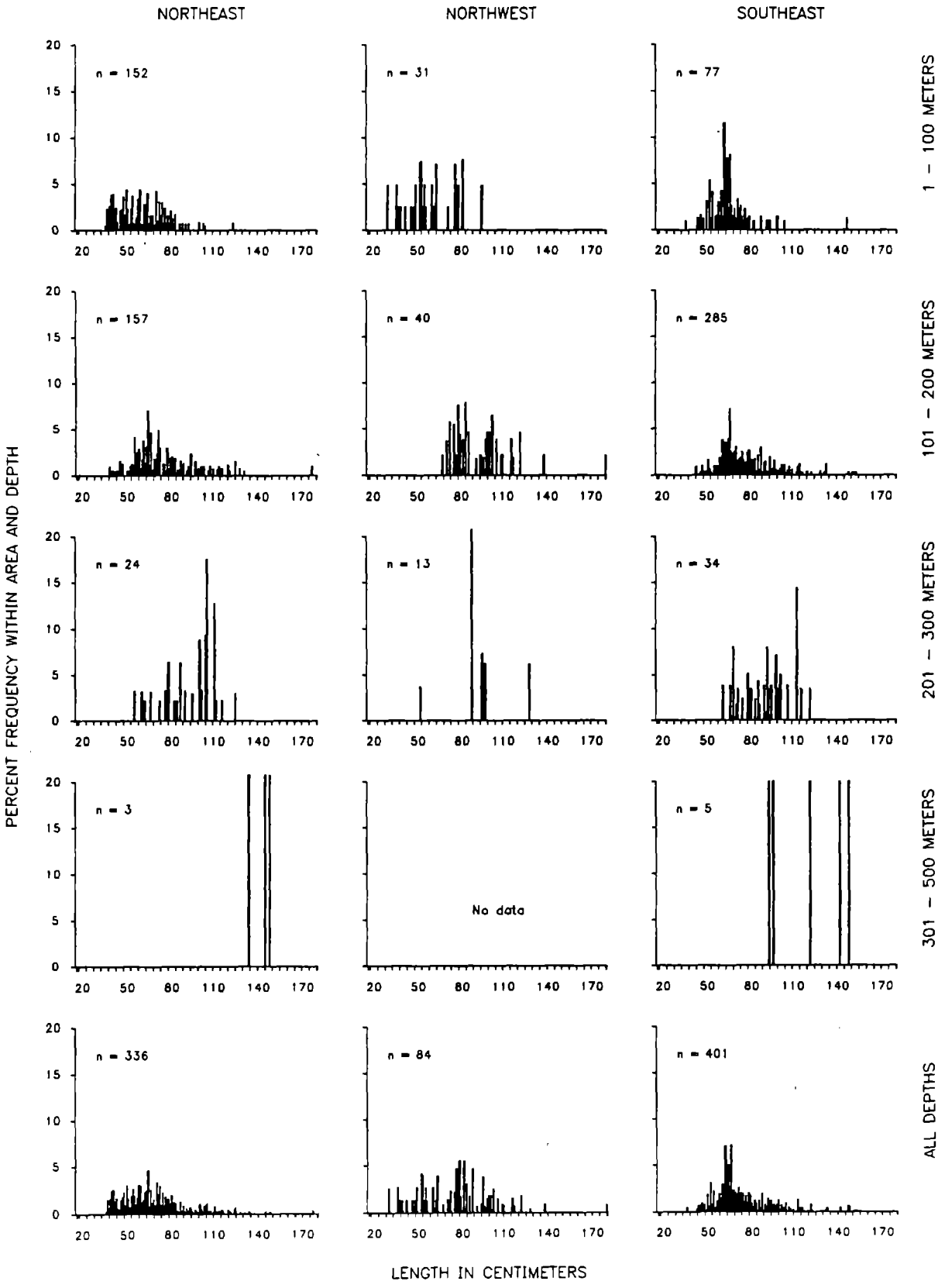

Figure 17.--Size composition of Pacific halibut from the 1991 Aleutian Islands survey

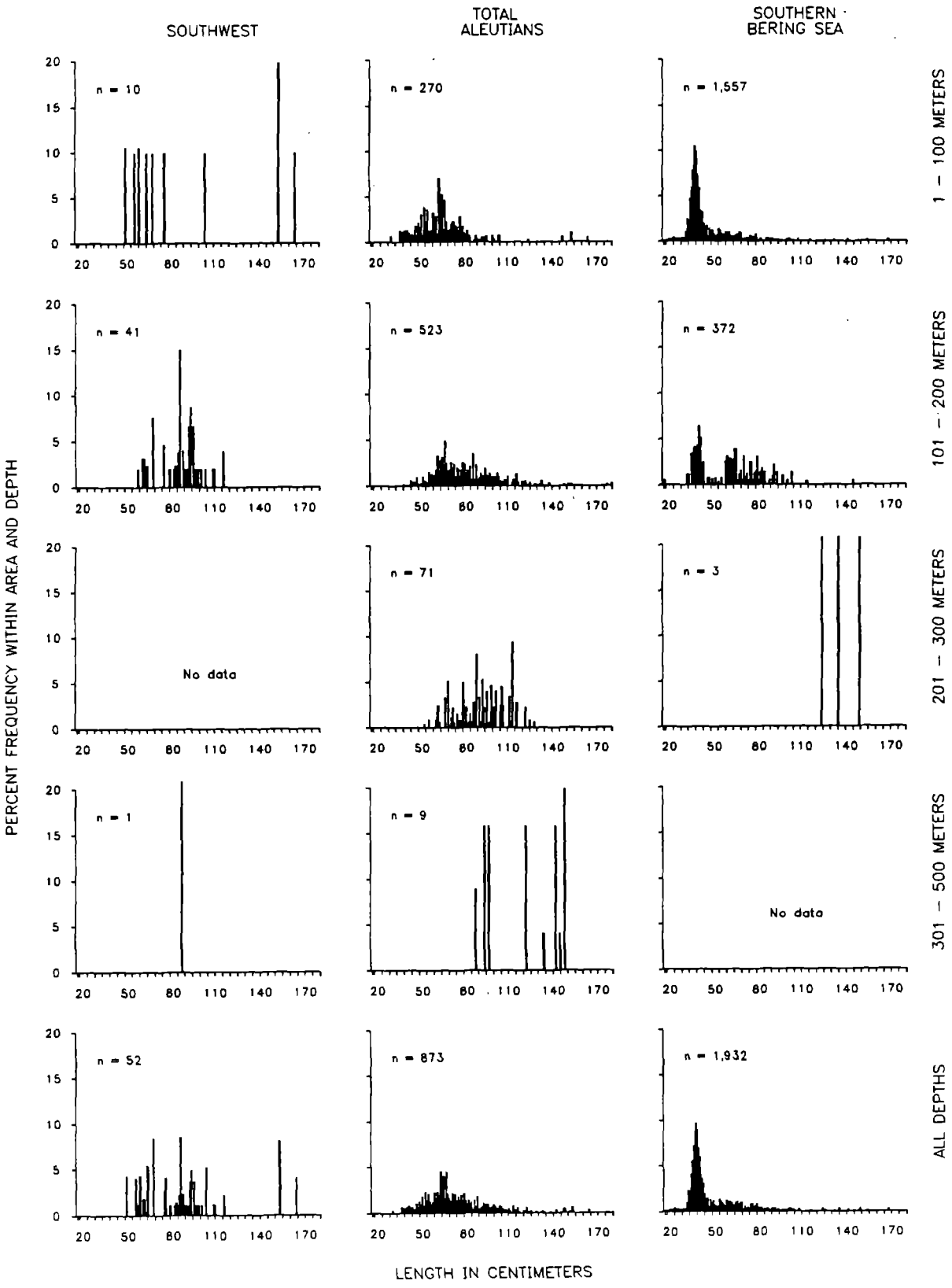

Figure 17.--Continued.

Rock sole--Rock sole were common throughout the survey area (Fig. 18), occurring at 72% of the stations in the Aleutian Islands region and 80% of the stations in the Southern Bering Sea (Table 10). Nearly 90% of the total estimated rock sole biomass of 42,832 t occurred in depths less than 200 m.

The length distribution of rock sole increased with depth (Fig. 19). Males were numerically dominant in the shallow strata, while catches of rock sole observed deeper than 200 m were composed primarily of larger females.

Table 10.--Total number of survey hauls, hauls containing rock sole, estimated biomass, CPUE, mean weight. and mean length based on the 1991 Aleutian Islands groundfish survey, by geographical areas and depth intervals.

Area	Depth (m)	Number of trawl hauls	Hauls with catch	CPUE (kg/km²)	Biomass (t)	Mean weight (kg)	Mean length (cm)
Northeast	1 - 100	16	16	1,607	6,040	0.2	26.2
	101 - 200	49	44	604	3,058	0.4	30.9
	201 - 300	22	15	194	517	0.6	36.3
	301 - 500	21	3	7	25	0.7	---
	All depths	108	78	631	9,640	0.3	27.5
Northwest	1 - 100	7	6	1,574	3,715	0.2	26.4
	101 - 200	13	12	541	1,420	0.3	30.1
	201 - 300	12	9	2,666	2,853	0.5	34.6
	301 - 500	3	3	55	96	0.3	---
	All depths	35	30	1,037	8,085	0.3	28.6
Southeast	1 - 100	6	6	467	1,949	0.3	27.9
	101 - 200	40	34	582	2,765	0.4	32.3
	201 - 300	19	14	180	734	0.5	34.6
	301 - 500	8	3	11	44	0.5	---
	All depths	73	57	326	5,491	0.4	30.4
Southwest	1 - 100	6	4	497	2,193	0.5	33.3
	101 - 200	38	30	870	5,679	0.3	30.2
	201 - 300	9	3	60	137	0.5	---
	301 - 500	10	0	0	0	---	---
	All depths	63	37	481	8,008	0.4	30.9
Total Aleutian Islands	1 - 100	35	32	945	13,897	0.2	27.0
	101 - 200	140	120	681	12,921	0.4	30.7
	201 - 300	62	41	419	4,240	0.5	34.8
	301 - 500	42	9	13	165	0.3	---
	All depths	279	202	552	31,224	0.3	28.9
Aleutian Islands biomass, 95% confidence interval: 24,032 - 38,416 metric tons							
Southern Bering Sea	1 - 100	32	31	1,954	9,416	0.4	31.1
	101 - 200	22	17	666	2,180	0.5	32.5
	201 - 300	3	1	12	12	0.5	---
	301 - 500	4	0	0	0	---	---
	All depths	61	49	1,120	11,608	0.4	31.3
Southern Bering Sea biomass, 95% confidence interval: 7,563 - 15,653 metric tons							

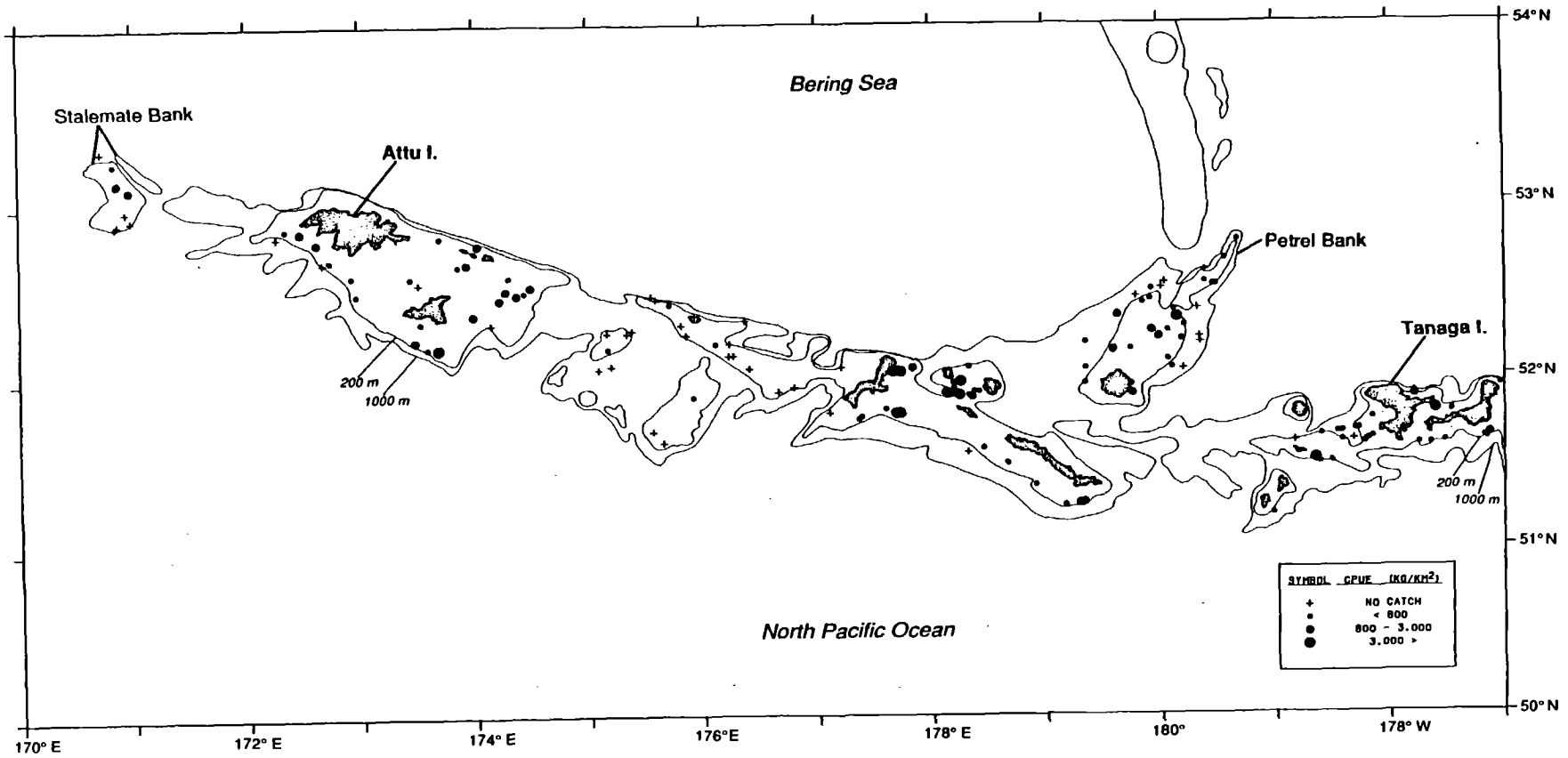

Figure 18.--Distribution and relative abundance of rock sole, 1991 Aleutian Islands bottom trawl survey. Abundance is categorized by catches below the mean (800 kg/km^2), between the mean and two standard deviations above the mean, and greater than two standard deviations above the mean.

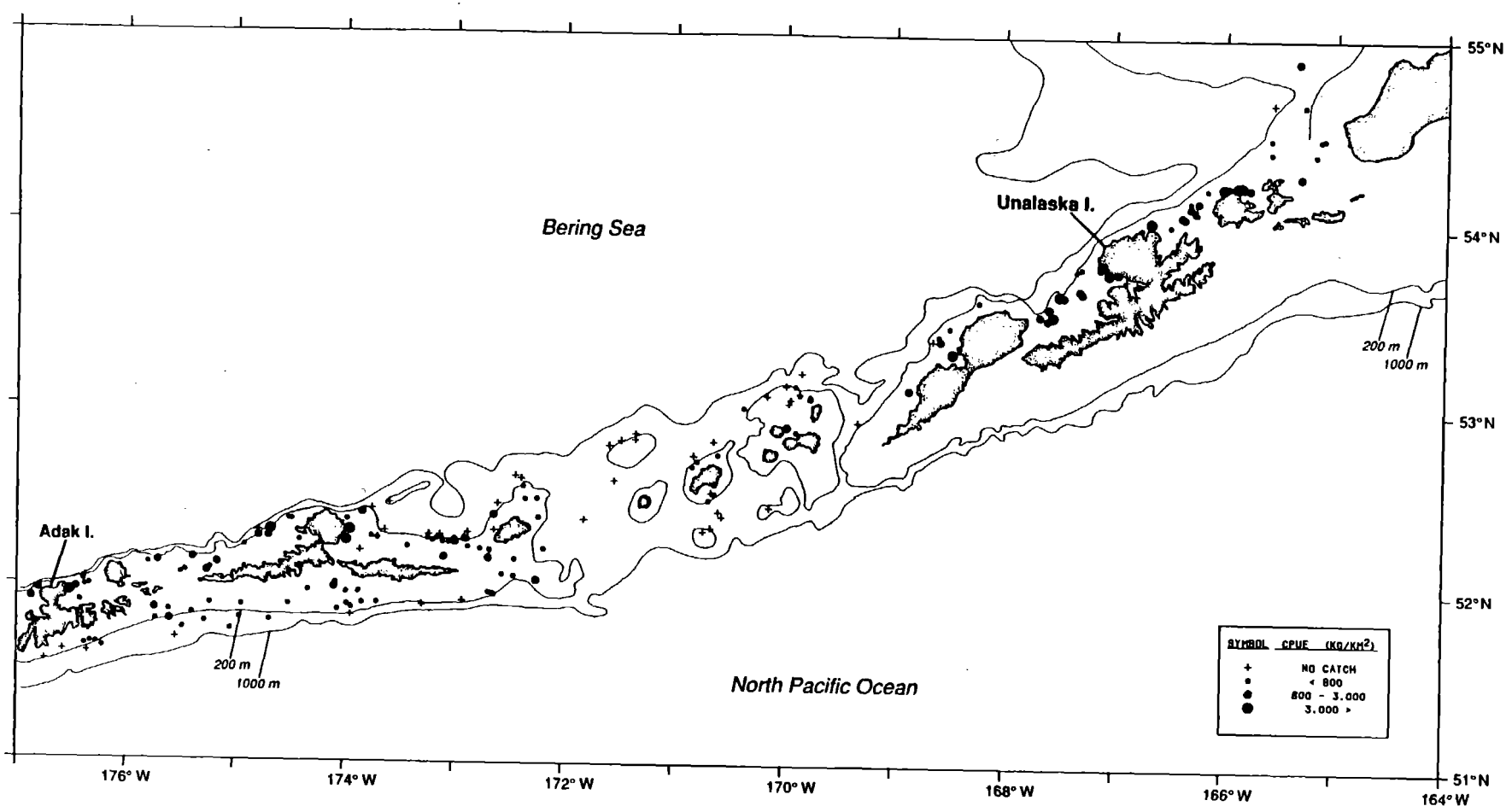

Figure 18.--Continued.

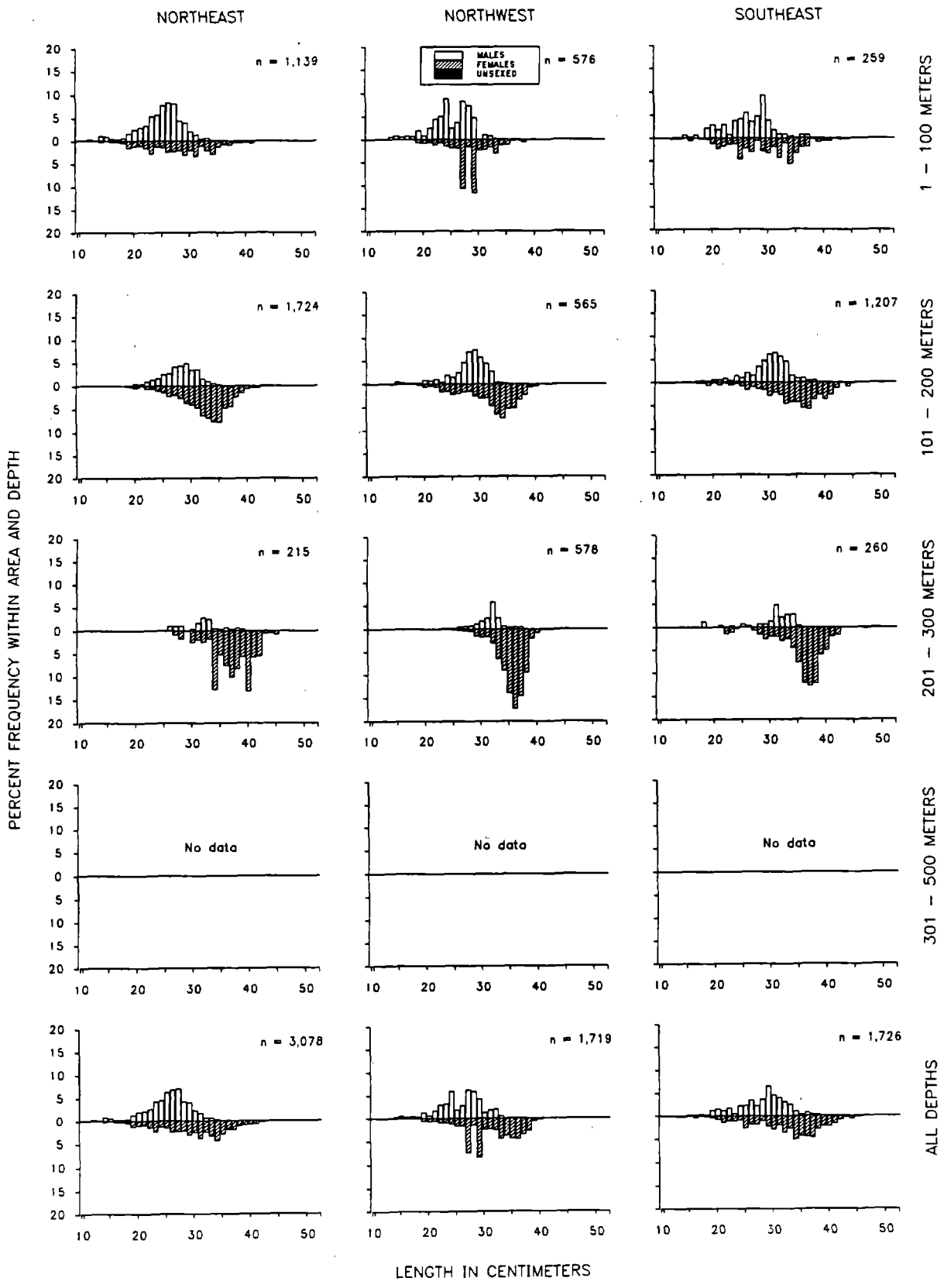

Figure I9.--Size composition of rock sole from the 1991 Aleutian Islands survey

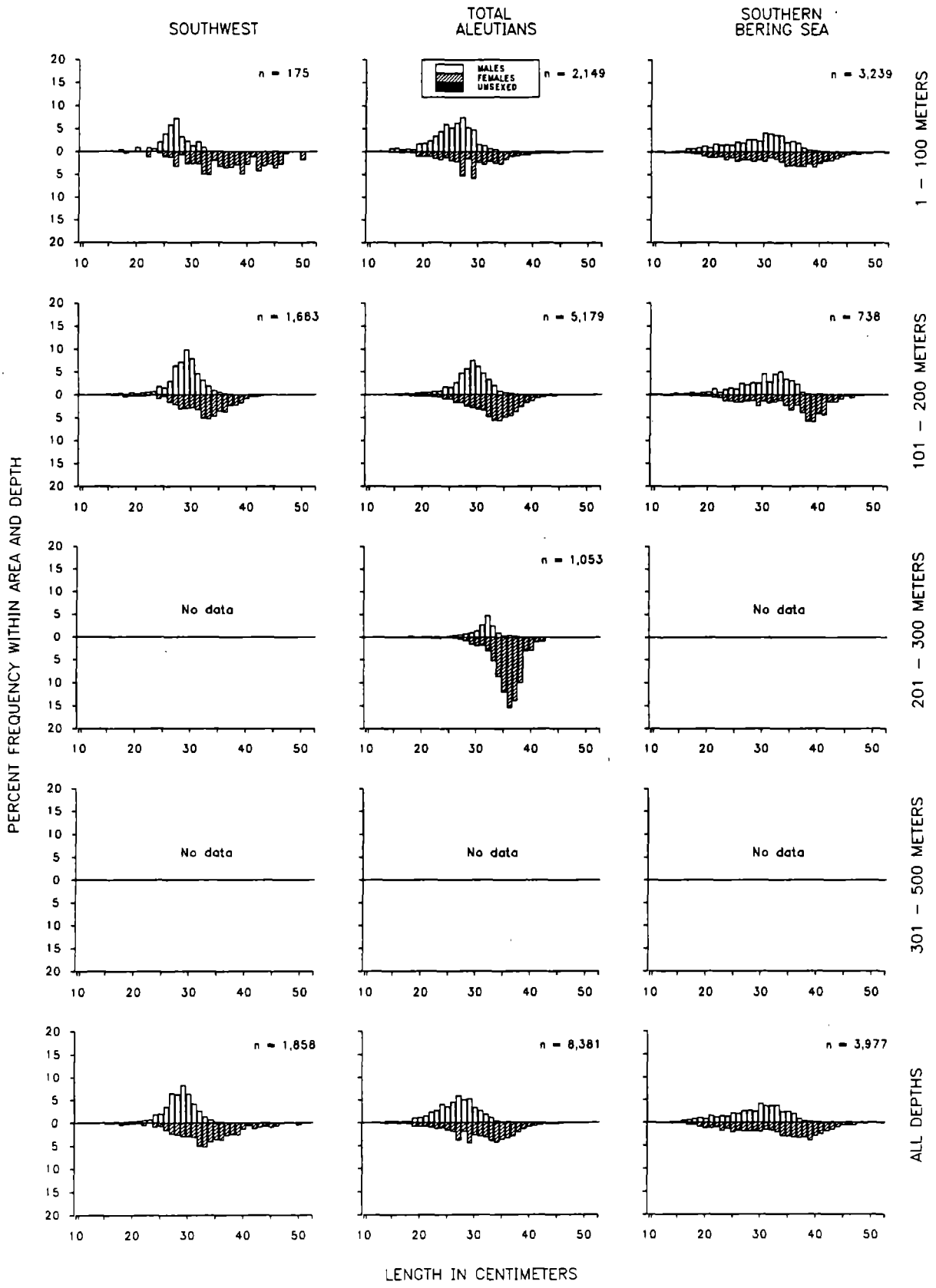

Figure 19.--Continued.

Greenland turbot--With a total estimated biomass of only 14,000 t (Table 11), Greenland turbot was sparsely and unevenly distributed throughout the survey area (Fig. 20). Over 50% of the total estimated biomass (6,541 t) in the Aleutian Islands occurred in the Northeast Area, followed by the Northwest Area with 28% of the biomass. Only trace amounts were found in the Southeast Area. The greatest biomass of Greenland turbot occurred at depths greater than 300 m. Since the survey covers only part of the depth range of this species, the biomass estimate is useful only for those depths surveyed, and will not adequately reflect total abundance.

All Greenland turbot caught during the survey were large fish, with no individuals less than 55 cm (FL) (Fig. 21). The average length for females was consistently greater than for males. In two area-depth intervals (Northeast Area 101-200 m and Southern Bering Sea Area 301-500 m) only female turbot were captured, while in all other areas with data, males dominated the numbers caught.

Table 11.--Total number of survey hauls, hauls containing Greenland turbot, estimated biomass, CPUE, mean weight, and mean length based on the 1991 Aleutian Islands groundfish survey, by geographical areas and depth Intervals.

Area	Depth (m)	Number of trawl hauls	Hauls with catch	CPUE (kg/km^2)	Biomass (t)	Mean weight (kg)	Mean length (cm)
Northeast	1 - 100	16	0	0	0	---	---
	101 - 200	49	3	100	507	7.9	87.4
	201 - 300	22	1	12	33	5.8	---
	301 - 500	21	14	1,589	6,001	2.7	66.6
	All depths	108	18	428	6,541	2.8	67.1
Northwest	1 - 100	7	0	0	0	---	---
	101 - 200	13	0	0	0	---	---
	201 - 300	12	1	5	6	1.8	---
	301 - 500	3	3	1,962	3,419	4.4	73.0
	All depths	35	4	439	3,424	4.3	73.0
Southeast	1 - 100	6	0	0	0	---	---
	101 - 200	40	0	0	0	---	---
	201 - 300	19	0	0	0	---	---
	301 - 500	8	2	38	146	5.8	---
	All depths	73	2	9	146	5.8	---
Southwest	1 - 100	6	0	0	0	---	---
	101 - 200	38	1	6	41	5.9	---
	201 - 300	9	1	97	223	7.0	---
	301 - 500	10	7	498	1,696	4.1	71.9
	All depths	63	9	118	1,961	4.3	71.9
Total Aleutian Islands	1 - 100	35	0	0	0	---	---
	101 - 200	140	4	29	548	7.7	87.4
	201 - 300	62	3	26	262	6.5	---
	301 - 500	42	26	884	11,262	3.2	68.7
	All depths	279	33	214	12,072	3.4	69.0
Aleutian Islands biomass, 95% confidence interval: 3,814 - 20,330 metric tons							
Southern Bering Sea	1 - 100	32	0	0	0	---	---
	101 - 200	22	0	0	0	---	---
	201 - 300	3	0	0	0	---	---
	301 - 500	4	3	1,515	1,928	5.8	78.9
	All depths	61	3	186	1,928	5.8	78.9
Southern Bering Sea biomass, 95% confidence interval: 0 - 5,635 metric tons							

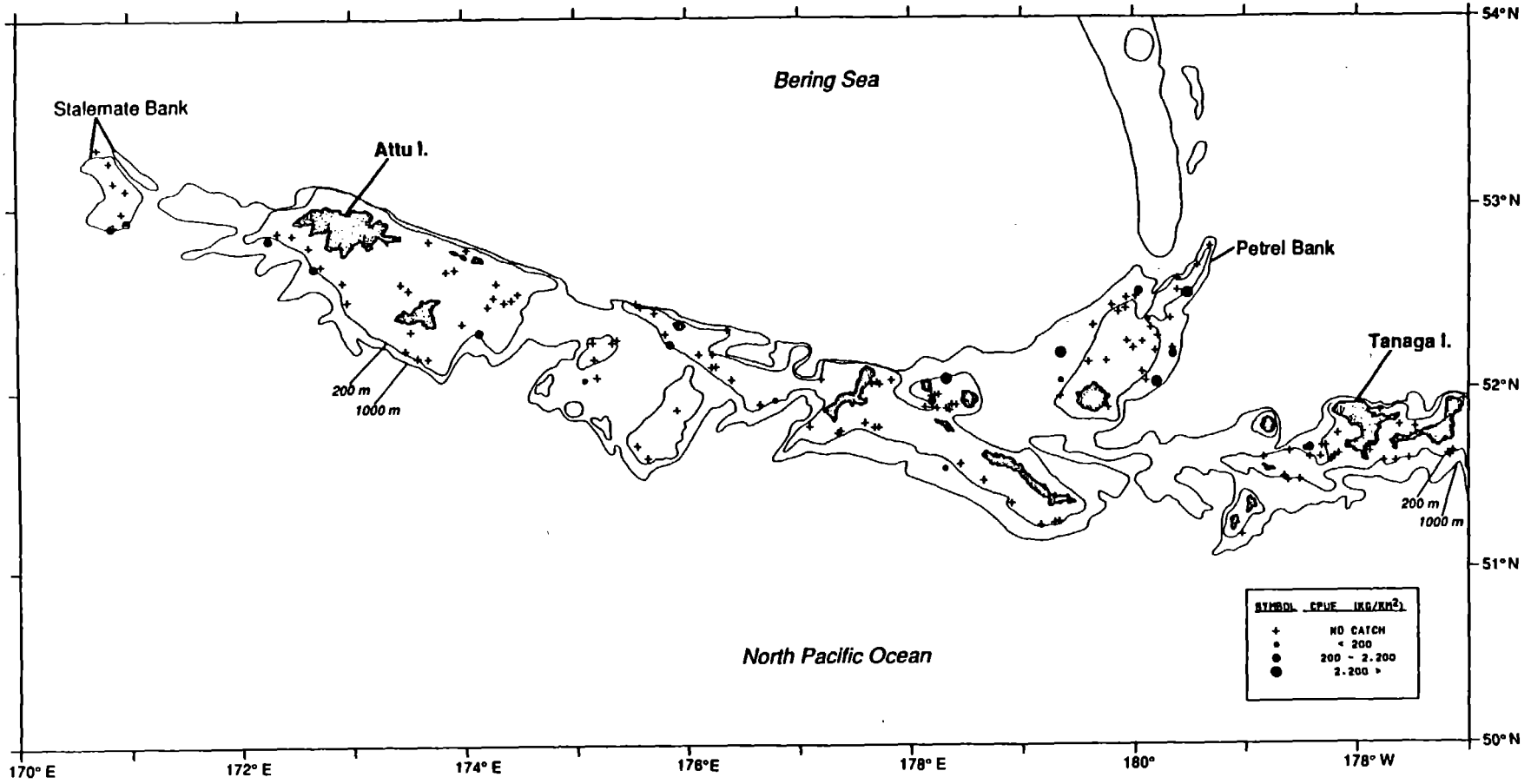

Figure 20.--Distribution and relative abundance of Greenland turbot, 1991 Aleutian Islands bottom trawl survey. Abundance is categorized by catches below the mean (200 kg/km^2), between the mean and two standard deviations above the mean, and greater than two standard deviations above the mean.

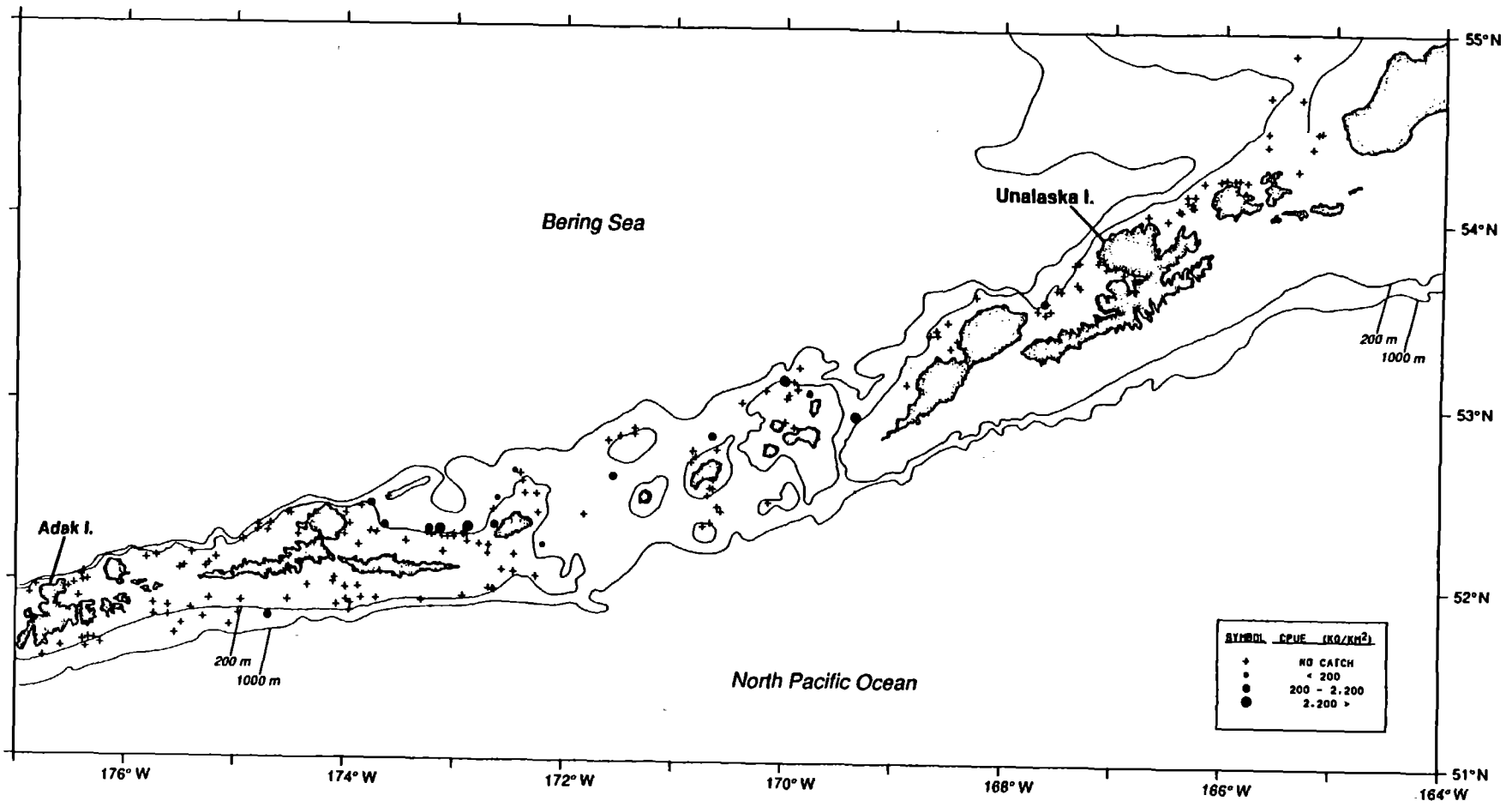

Figure 20.--Continued.

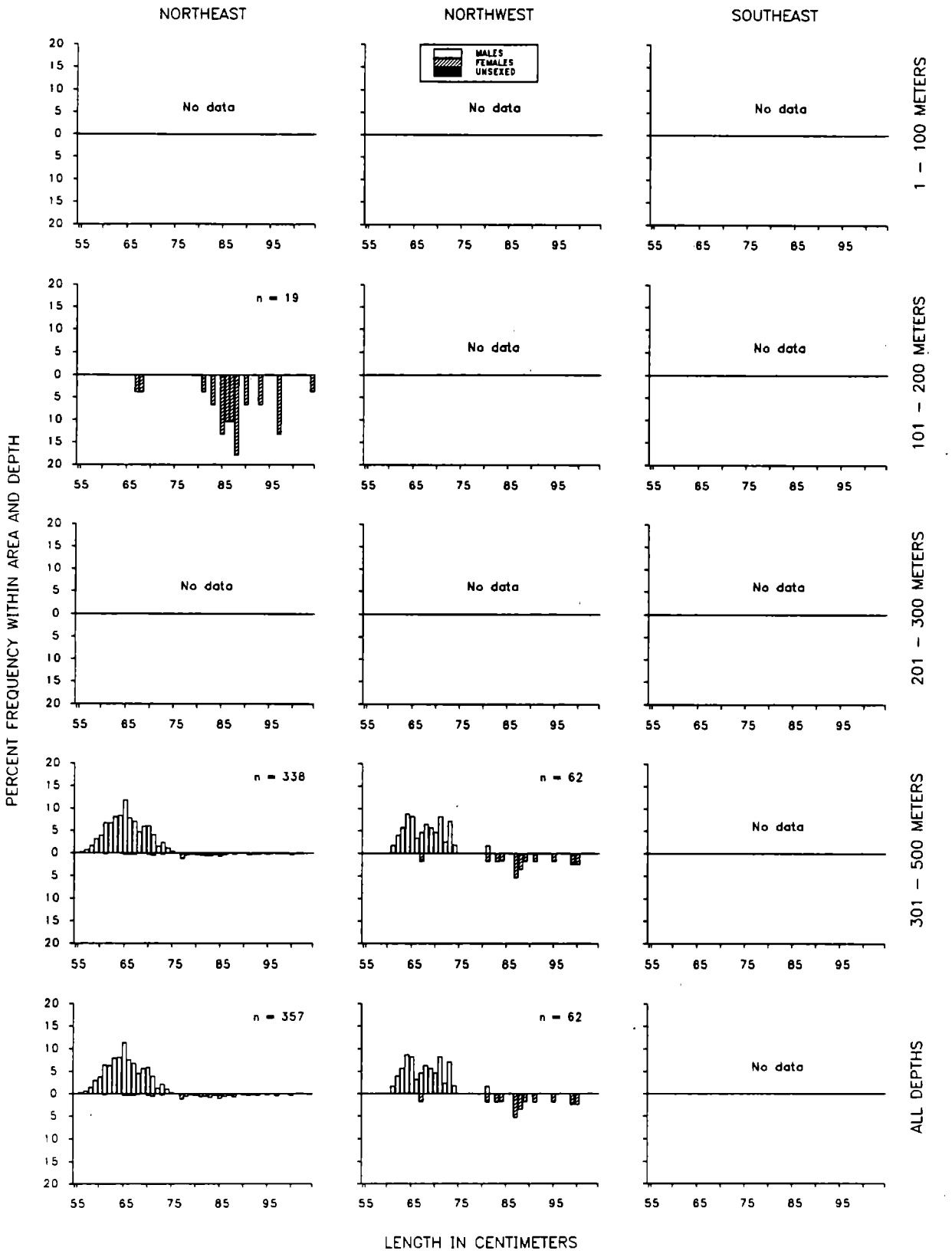

Figure 21.--Size composition of Greenland turbot from the 1991 Aleutian Islands survey.

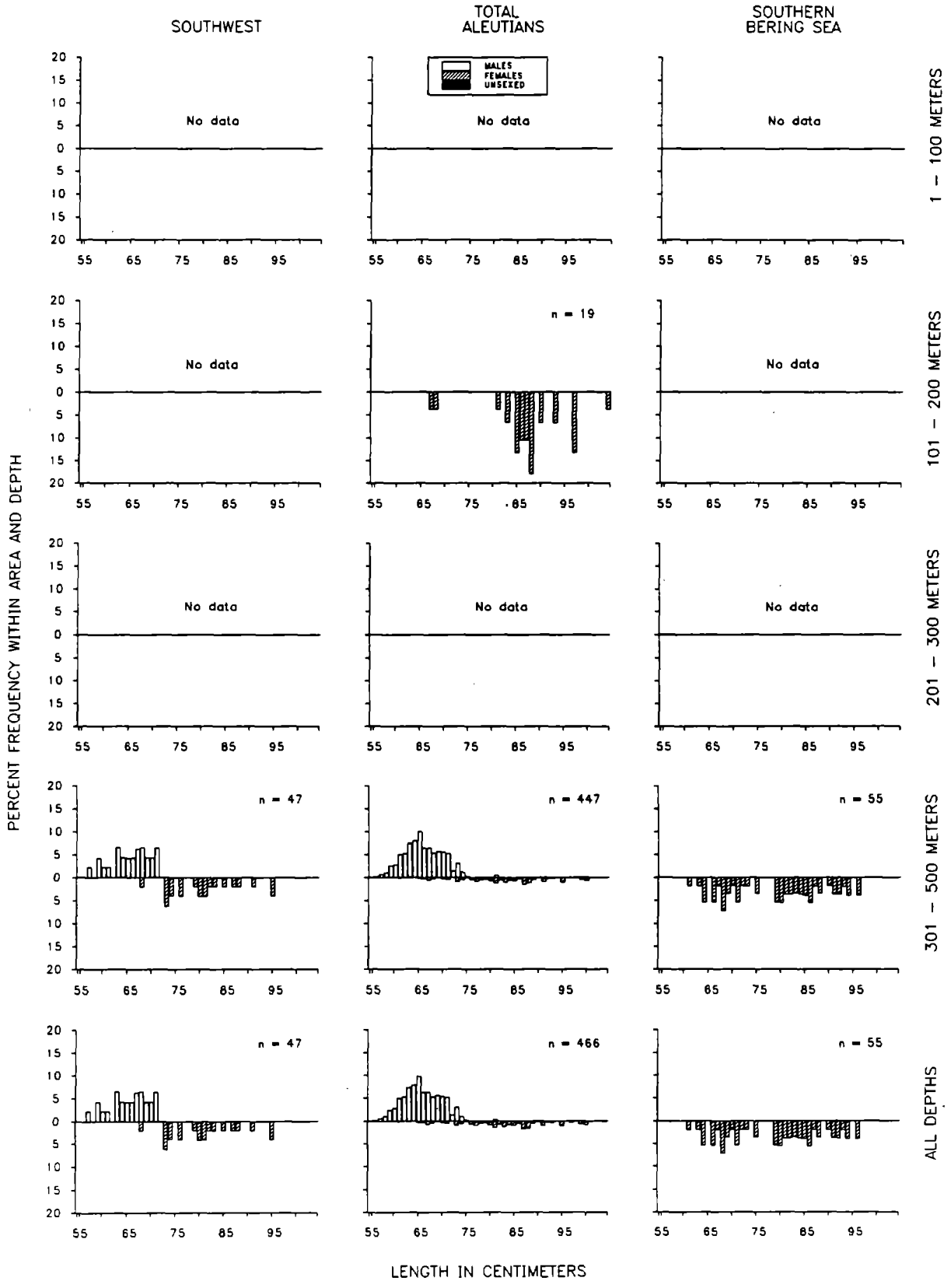

Figure 21.--Continued.

Other Flatfish- Eight other flatfish species were encountered during the survey. Flathead sole, rex sole, and Dover sole were encountered in moderate numbers in various locations. Flathead sole was the seventh most abundant groundfish species in the Southern Bering Sea with an estimated biomass of 6,461 t (Table 12), and was the twentieth most abundant species in the Aleutian Islands region, with an estimated biomass of 4,273 t. Rex sole was the thirteenth most abundant species in the Southern Bering Sea, with an estimated biomass of 1,367 t (Table 13). In the Aleutian Islands region rex sole had an estimated biomass of 1,552 t, but it was not among the 20 dominant species. Dover sole was found at several deepwater stations, but at low abundance, with an estimated biomass of less than 450 t throughout the survey region (Table 14). In previous surveys, this deepwater species was encountered most frequently below the 500 m maximum depth sampled during 1991.

Several shallow-water species, English sole (Pleuronectes vetulus), butter sole (Pleuronectes isolepis), yellowfin sole (Pleuronectes asper), and starry flounder (Platichthys stellatus) were encountered only in the Southern Bering Sea Area (Tables 15-18 respectively). Biomass estimates were very low (less than 400 t) for each of these species. Pacific sanddab (Citharichthys sordidus) was also encountered in trace amounts during the survey (less than 1 t).

Table 12.--Total number of survey hauls, hauls containing flathead sole, estimated biomass, CPUE, mean weight, and mean length based on the 1991 Aleutian islands groundfish survey, by geographical areas and depth intervals.

Area	Depth (m)	Number of trawl hauls	Hauls with catch	CPUE (kg/km^2)	Biomass (t)	Mean weight (kg)	Mean length (cm)
Northeast	1 - 100	16	1	80	301	0.2	27.8
	101 - 200	49	14	214	1,082	0.1	23.6
	201 - 300	22	5	12	33	0.5	---
	301 - 500	21	0	0	0	---	---
	All depths	108	20	93	1,416	0.1	24.2
Northwest	1 - 100	7	1	101	238	0.3	29.2
	101 - 200	13	2	4	11	0.2	34.1
	201 - 300	12	1	29	31	0.3	30.4
	301 - 500	3	0	0	0	---	---
	All depths	35	4	36	279	0.3	29.6
Southeast	1 - 100	6	0	0	0	---	---
	101 - 200	40	2	6	30	0.5	38.4
	201 - 300	19	5	3	12	0.3	---
	301 - 500	8	0	0	0	---	---
	All depths	73	7	3	43	0.4	38.4
Southwest	1 - 100	6	2	10	42	0.4	---
	101 - 200	38	21	350	2,288	0.3	27.8
	201 - 300	9	3	90	206	0.5	34.9
	301 - 500	10	0	0	0	---	---
	All depths	63	26	152	2,536	0.3	28.2
Total Aleutian Islands	1 - 100	35	4	39	580	0.2	28.4
	101 - 200	140	39	180	3,410	0.2	25.9
	201 - 300	62	14	28	283	0.4	34.0
	301 - 500	42	0	0	0	---	---
	All depths	279	57	76	4,273	0.2	26.4
Aleutian Islands biomass, 95% confidence interval: 2,383 - 6,163 metric tons							
Southern Bering Sea	1 - 100	32	18	267	1,289	0.2	25.6
	101 - 200	22	14	1,169	3,827	0.3	31.2
	201 - 300	3	2	1,073	1,074	0.5	36.5
	301 - 500	4	1	213	271	0.5	37.0
	All depths	61	35	623	6,461	0.3	30.4
Southern Bering Sea biomass, 95% confidence interval: 1,832 - 11,090 metric tons							

Table 13.--Total number of survey hauls, hauls containing rex sole, estimated biomass, CPUE, mean weight. and mean length based on the 1991 Aleutian Islands groundfish survey, by geographical areas and depth intervals.

Area	Depth (m)	Number of trawl hauls	Hauls with catch	CPUE (kg/km^2)	Biomass (t)	Mean weight (kg)	Mean length (cm)
Northeast	1 - 100	16	0	0	0	---	---
	101 - 200	49	8	19	97	0.5	41.6
	201 - 300	22	5	9	25	0.5	---
	301 - 500	21	7	28	104	0.5	42.2
	All depths	108	20	15	225	0.5	41.8
Northwest	1 - 100	7	0	0	0	---	---
	101 - 200	13	0	0	0	---	---
	201 - 300	12	5	50	53	0.5	---
	301 - 500	3	3	145	253	0.6	45.9
	All depths	35	8	39	306	0.6	45.9
Southeast	1 - 100	6	0	0	0	---	---
	101 - 200	40	3	4	20	0.5	42.9
	201 - 300	19	4	28	114	0.5	42.9
	301 - 500	8	2	35	134	0.5	40.2
	All depths	73	9	16	269	0.5	41.4
Southwest	1 - 100	6	0	0	0	---	---
	101 - 200	38	15	68	445	0.5	44.0
	201 - 300	9	4	60	137	0.5	---
	301 - 500	10	4	50	169	0.5	42.3
	All depths	63	23	45	752	0.5	43.5
Total	1 - 100	35	0	0	0	---	---
Aleutian	101 - 200	140	26	30	562	0.5	43.5
Islands	201 - 300	62	18	33	329	0.5	42.9
	301 - 500	42	16	52	661	0.5	42.9
	All depths	279	60	27	1,552	0.5	43.2
Aleutian Islands biomass, 95% confidence interval: 1,023 - 2,081 metric tons							
Southern	1 - 100	32	6	38	184	0.5	40.0
Bering Sea	101 - 200	22	9	108	352	0.4	37.3
	201 - 300	3	2	81	81	0.7	43.6
	301 - 500	4	1	589	750	0.3	42.8
	All depths	61	18	132	1,367	0.3	41.4
Southern Bering Sea biomass, 95% confidence interval: 937 - 1,798 metric tons							

Table 14.--Total number of survey hauls, hauls containing Dover sole, estimated biomass, CPUE, mean weight, and mean length based on the 1991 Aleutian Islands groundfish survey, by geographical areas and depth intervals.

Area	Depth (m)	Number of trawl hauls	Hauls with catch	CPUE (kg/km^2)	Biomass (t)	Mean weight (kg)	Mean length (cm)
Northeast	1 - 100	16	0	0	0	---	---
	101 - 200	49	2	1	3	0.5	---
	201 - 300	22	0	0	0	---	---
	301 - 500	21	4	10	38	2.5	---
	All depths	108	6	3	40	2.0	---
Northwest	1 - 100	7	0	0	0	---	---
	101 - 200	13	0	0	0	---	---
	201 - 300	12	0	0	0	---	---
	301 - 500	3	0	0	0	---	---
	All depths	35	0	0	0	---	---
Southeast	1 - 100	6	0	0	0	---	---
	101 - 200	40	0	0	0	---	---
	201 - 300	19	0	0	0	---	---
	301 - 500	8	0	0	0	---	---
	All depths	73	0	0	0	---	---
Southwest	1 - 100	6	0	0	0	---	---
	101 - 200	38	2	7	45	1.2	---
	201 - 300	9	2	30	69	1.1	---
	301 - 500	10	1	5	16	3.2	---
	All depths	63	5	8	129	1.2	---
Total Aleutian Islands	1 - 100	35	0	0	0	---	---
	101 - 200	140	4	2	47	1.1	---
	201 - 300	62	2	7	69	1.1	---
	301 - 500	42	5	4	54	2.7	---
	All depths	279	11	3	170	1.4	---
Aleutian Islands biomass, 95% confidence interval: 7 - 332 metric tons							
Southern Bering Sea	1 - 100	32	1	0	1	0.3	---
	101 - 200	22	1	1	2	0.4	---
	201 - 300	3	0	0	0	---	---
	301 - 500	4	1	188	239	0.9	41.3
	All depths	61	3	23	242	0.8	41.3
Southern Bering Sea biomass, 95% confidence interval: 238 - 246 metric tons							

Table 15.--Total number of survey hauls, hauls containing English sole, estimated biomass, CPUE, mean weight, and mean length based on the 1991 Aleutian Islands groundfish survey, by geographical areas and depth intervals.

Area	Depth (m)	Number of trawl hauls	Hauls with catch	CPUE (kg/km^2)	Biomass (t)	Mean weight (kg)	Mean length (cm)
Northeast	1 - 100	16	0	0	0	---	---
	101 - 200	49	0	0	0	---	---
	201 - 300	22	0	0	0	---	---
	301 - 500	21	0	0	0	---	---
	All depths	108	0	0	0	---	---
Northwest	1 - 100	7	0	0	0	---	---
	101 - 200	13	0	0	0	---	---
	201 - 300	12	0	0	0	---	---
	301 - 500	3	0	0	0	---	---
	All depths	35	0	0	0	---	---
Southeast	1 - 100	6	0	0	0	---	---
	101 - 200	40	0	0	0	---	---
	201 - 300	19	0	0	0	---	---
	301 - 500	8	0	0	0	---	---
	All depths	73	0	0	0	---	---
Southwest	1 - 100	6	0	0	0	---	---
	101 - 200	38	0	0	0	---	---
	201 - 300	9	0	0	0	---	---
	301 - 500	10	0	0	0	---	---
	All depths	63	0	0	0	---	---
Total Aleutian Islands	1 - 100	35	0	0	0	---	---
	101 - 200	140	0	0	0	---	---
	201 - 300	62	0	0	0	---	---
	301 - 500	42	0	0	0	---	---
	All depths	279	0	0	0	---	---
Aleutian Islands biomass, 95% confidence interval: 0 - 0 metric tons							
Southern Bering Sea	1 - 100	32	3	10	48	0.3	28.5
	101 - 200	22	0	0	0	---	---
	201 - 300	3	0	0	0	---	---
	301 - 500	4	0	0	0	---	---
	All depths	61	3	5	48	0.3	28.5
Southern Bering Sea biomass, 95% confidence interval: 0 - 139 metric tons							

Table 16.--Total number of survey hauls, hauls containing butter sole, estimated biomass, CPUE, mean weight, and mean length based on the 1991 Aleutian Islands groundfish survey, by geographical areas and depth intervals.

Area	Depth (m)	Number of trawl hauls	Hauls with catch	CPUE (kg/km^2)	Biomass (t)	Mean weight (kg)	Mean length (cm)
Northeast	1 - 100	16	0	0	0	---	---
	101 - 200	49	0	0	0	---	---
	201 - 300	22	0	0	0	---	---
	301 - 500	21	0	0	0	---	---
	All depths	108	0	0	0	---	---
Northwest	1 - 100	7	0	0	0	---	---
	101 - 200	13	0	0	0	---	---
	201 - 300	12	0	0	0	---	---
	301 - 500	3	0	0	0	---	---
	All depths	35	0	0	0	---	---
Southeast	1 - 100	6	0	0	0	---	---
	101 - 200	40	0	0	0	---	---
	201 - 300	19	0	0	0	---	---
	301 - 500	8	0	0	0	---	---
	All depths	73	0	0	0	---	---
Southwest	1 - 100	6	0	0	0	---	---
	101 - 200	38	0	0	0	---	---
	201 - 300	9	0	0	0	---	---
	301 - 500	10	0	0	0	---	---
	All depths	63	0	0	0	---	---
Total Aleutian Islands	1 - 100	35	0	0	0	---	---
	101 - 200	140	0	0	0	---	---
	201 - 300	62	0	0	0	---	---
	301 - 500	42	0	0	0	---	---
	All depths	279	0	0	0	---	---
Aleutian Islands biomass, 95% confidence interval: 0 - 0 metric tons							
Southern Bering Sea	1 - 100	32	6	25	120	0.3	32.2
	101 - 200	22	1	1	3	---	---
	201 - 300	3	0	0	0	---	---
	301 - 500	4	0	0	0	---	---
	All depths	61	7	12	123	0.4	32.2
Southern Bering Sea biomass, 95% confidence interval: 0 - 303 metric tons							

Table 17.--Total number of survey hauls, hauls containing yellowfin sole, estimated biomass, CPUE, mean weight. and mean length based on the 1991 Aleutian Islands groundfish survey, by geographical areas and depth Intervals.

Area	Depth (m)	Number of trawl hauls	Hauls with catch	CPUE (kg/km^2)	Biomass (t)	Mean weight (kg)	Mean length (cm)
Northeast	1 - 100	16	0	0	0	---	---
	101 - 200	49	0	0	0	---	---
	201 - 300	22	0	0	0	---	---
	301 - 500	21	0	0	0	---	---
	All depths	108	0	0	0	---	---
Northwest	1 - 100	7	0	0	0	---	---
	101 - 200	13	0	0	0	---	---
	201 - 300	12	0	0	0	---	---
	301 - 500	3	0	0	0	---	---
	All depths	35	0	0	0	---	---
Southeast	1 - 100	6	0	0	0	---	---
	101 - 200	40	0	0	0	---	---
	201 - 300	19	0	0	0	---	---
	301 - 500	8	0	0	0	---	---
	All depths	73	0	0	0	---	---
Southwest	1 - 100	6	0	0	0	---	---
	101 - 200	38	0	0	0	---	---
	201 - 300	9	0	0	0	---	---
	301 - 500	10	0	0	0	---	---
	All depths	63	0	0	0	---	---
Total Aleutian Islands	1 - 100	35	0	0	0	---	---
	101 - 200	140	0	0	0	---	---
	201 - 300	62	0	0	0	---	---
	301 - 500	42	0	0	0	---	---
	All depths	279	0	0	0	---	---
Aleutian Islands biomass, 95% confidence interval: 0 - 0 metric tons							
Southern Bering Sea	1 - 100	32	7	77	373	0.7	36.6
	101 - 200	22	1	1	5	0.5	---
	201 - 300	3	0	0	0	---	---
	301 - 500	4	0	0	0	---	---
	All depths	61	8	36	378	0.7	36.6
Southern Bering Sea biomass, 95% confidence interval: 0 - 946 metric tons							

Table 18.--Total number of survey hauls, hauls containing starry flounder, estimated biomass, CPUE, mean weight, and mean length based on the 1991 Aleutian Islands groundfish survey, by geographical areas and depth intervals.

Area	Depth (m)	Number of trawl hauls	Hauls with catch	CPUE (kg/km^2)	Biomass (t)	Mean weight (kg)	Mean length (cm)
Northeast	1 - 100	16	0	0	0	---	---
	101 - 200	49	0	0	0	---	---
	201 - 300	22	0	0	0	---	---
	301 - 500	21	0	0	0	---	---
	All depths	108	0	0	0	---	---
Northwest	1 - 100	7	0	0	0	---	---
	101 - 200	13	0	0	0	---	---
	201 - 300	12	0	0	0	---	---
	301 - 500	3	0	0	0	---	---
	All depths	35	0	0	0	---	---
Southeast	1 - 100	6	0	0	0	---	---
	101 - 200	40	0	0	0	---	---
	201 - 300	19	0	0	0	---	---
	301 - 500	8	0	0	0	---	---
	All depths	73	0	0	0	---	---
Southwest	1 - 100	6	0	0	0	---	---
	101 - 200	38	0	0	0	---	---
	201 - 300	9	0	0	0	---	---
	301 - 500	10	0	0	0	---	---
	All depths	63	0	0	0	---	---
Total Aleutian Islands	1 - 100	35	0	0	0	---	---
	101 - 200	140	0	0	0	---	---
	201 - 300	62	0	0	0	---	---
	301 - 500	42	0	0	0	---	---
	All depths	279	0	0	0	---	---
Aleutian Islands biomass, 95% confidence interval: 0 - 0 metric tons							
Southern Bering Sea	1 - 100	32	3	43	207	2.0	48.9
	101 - 200	22	0	0	0	---	---
	201 - 300	3	0	0	0	---	---
	301 - 500	4	0	0	0	---	---
	All depths	61	3	20	207	2.0	48.9
Southern Bering Sea biomass, 95% confidence interval: 0 - 569 metric tons							

Pacific ocean perch-- With an estimated biomass of 405,366 t, Pacific ocean perch were common throughout the Aleutian Islands region, occurring at 60% of all stations, but they were rare in the Southern Bering Sea, occurring at 28% of the stations and in relatively low abundance (2,274 t) (Fig. 22 and Table 19). Over 99% of all Pacific ocean perch occurred in the 101-300 m depth range. Very high CPUE values were found at stations located throughout both western areas, on Petrel Bank and in both eastern areas immediately east of Atka Island. Over 69% of the estimated biomass in the Aleutian Islands region occurred in the Southwest Area, followed by the Northeast Area with 25%.

Most Pacific ocean perch observed in the l-100 m strata in both the Aleutian islands and Southern Bering Sea areas were juveniles of 10 to 25 cm (FL) (Fig. 23). This size group was rare at deeper depths (101-200 m) and absent below 200 m. The mean lengths of Pacific ocean perch were generally highest in the western Aleutian Islands region and exhibited a distinct increasing size trend with increasing depth in all areas. In most areas the average size of females was slightly larger than males.

Table 19.--Total number of survey hauls, hauls containing Pacific ocean perch, estimated biomass, CPUE, mean weight, and mean length based on the 1991 Aleutian Islands groundfish survey, by geographical areas and depth intervals.

Area	Depth (m)	Number of trawl hauls	Hauls with catch	CPUE (kg/km^2)	Biomass (t)	Mean weight (kg)	Mean length (cm)
Northeast	1 - 100	16	8	15	55	0.1	15.6
	101 - 200	49	30	8,536	43,244	0.4	31.4
	201 - 300	22	18	21,740	57,939	0.6	34.4
	301 - 500	21	9	34	127	0.7	36.0
	All depths	108	65	6,640	101,366	0.5	32.8
Northwest	1 - 100	7	1	13	30	0.6	---
	101 - 200	13	6	1,050	2,758	0.5	32.0
	201 - 300	12	12	27,624	29,562	0.9	38.2
	301 - 500	3	1	5	9	0.7	---
	All depths	35	20	4,149	32,359	0.8	37.3
Southeast	1 - 100	6	2	1	6	0.1	---
	101 - 200	40	23	2,673	12,709	0.2	22.9
	201 - 300	19	16	3,151	12,861	0.4	29.3
	301 - 500	8	5	358	1,367	0.5	33.9
	All depths	73	46	1,601	26,944	0.2	25.0
Southwest	1 - 100	6	2	59	262	---	14.8
	101 - 200	38	23	16,589	108,335	0.4	30.3
	201 - 300	9	9	59,308	136,089	0.7	36.3
	301 - 500	10	2	3	11	0.6	---
	All depths	63	36	14,701	244,698	0.5	32.6
Total Aleutian Islands	1 - 100	35	13	24	354	0.1	14.9
	101 - 200	140	82	8,802	167,046	0.4	29.2
	201 - 300	62	55	23,385	236,451	0.7	35.3
	301 - 500	42	17	119	1,515	0.5	34.1
	All depths	279	167	7,170	405,366	0.5	31.8
Aleutian Islands biomass, 95% confidence interval: 212,989 - 597,744 metric tons							
Southern Bering Sea	1 - 100	32	5	5	24	0.1	19.5
	101 - 200	22	7	309	1,010	0.2	25.1
	201 - 300	3	3	944	945	0.6	35.7
	301 - 500	4	2	232	295	1.0	---
	All depths	61	17	219	2,274	0.3	26.6
Southern Bering Sea biomass, 95% confidence interval: 0 - 4,957 metric tons							

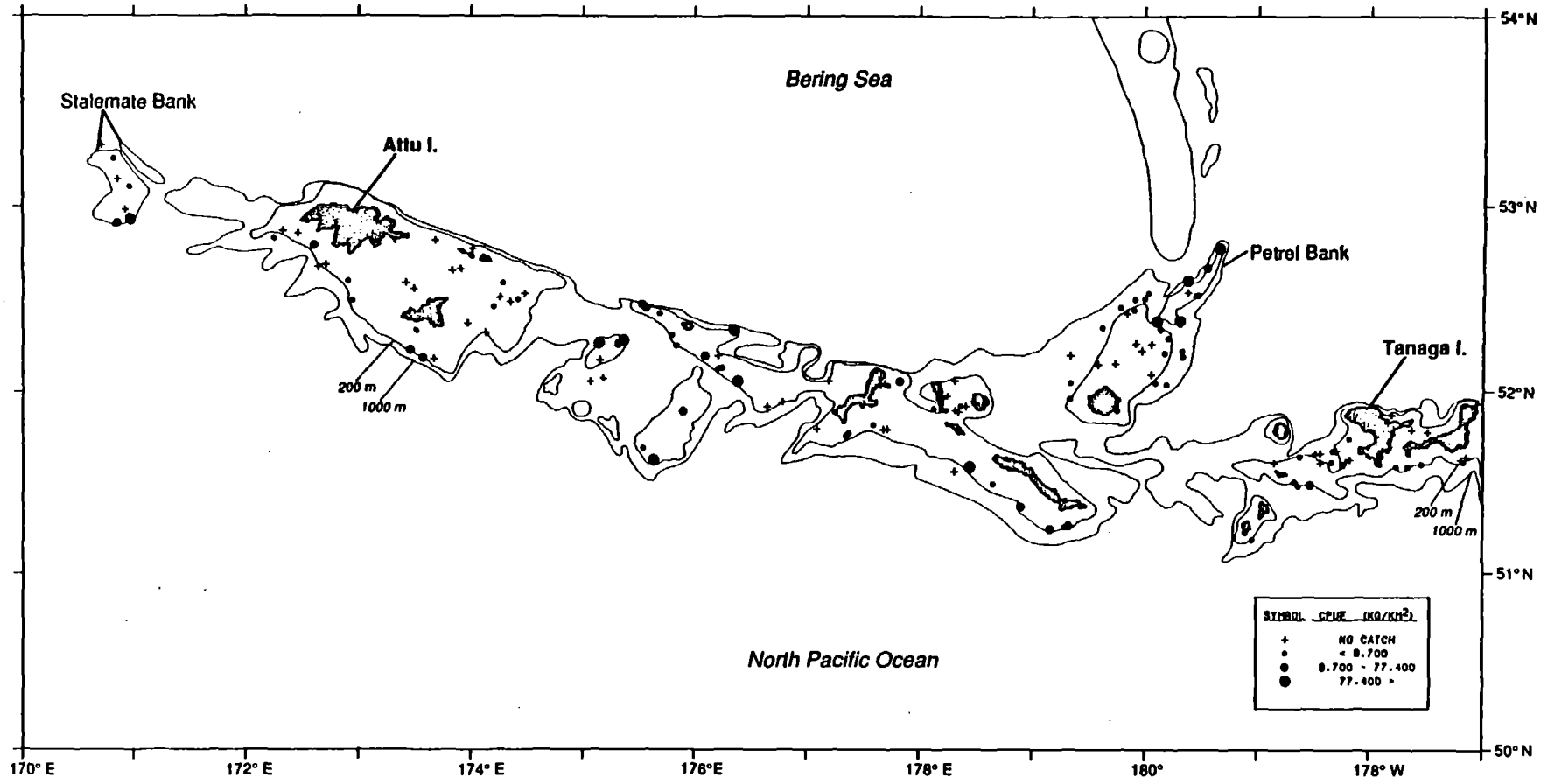

Figure 22.--Distribution and relative abundance of Pacific ocean perch, 1991 Aleutian Islands bottom trawl survey. Abundance is categorized by catches below the mean (8,700 kg/km^2), between the mean and two standard deviations above the mean, and greater than two standard deviations above the mean.

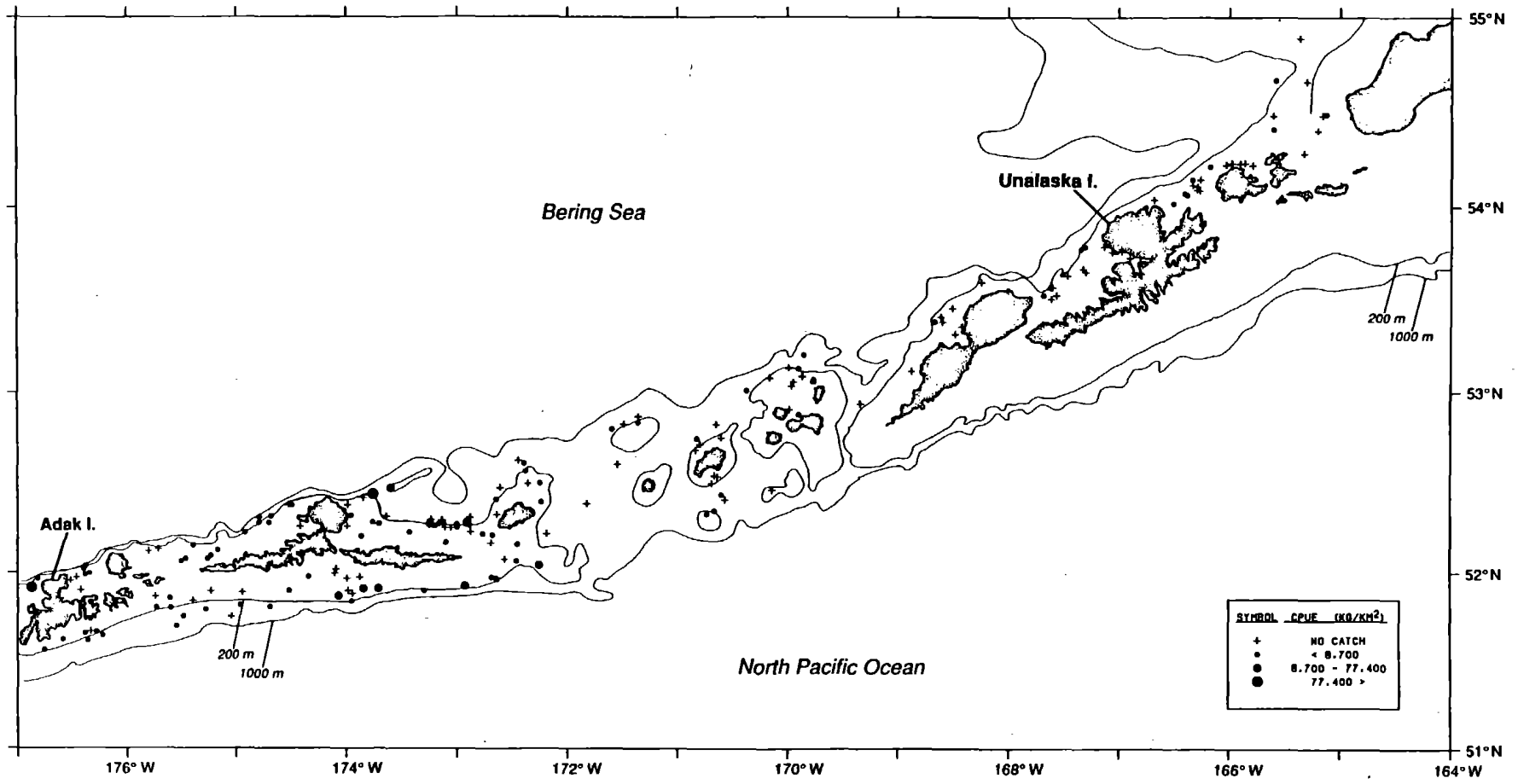

Figure 22.--Continued.

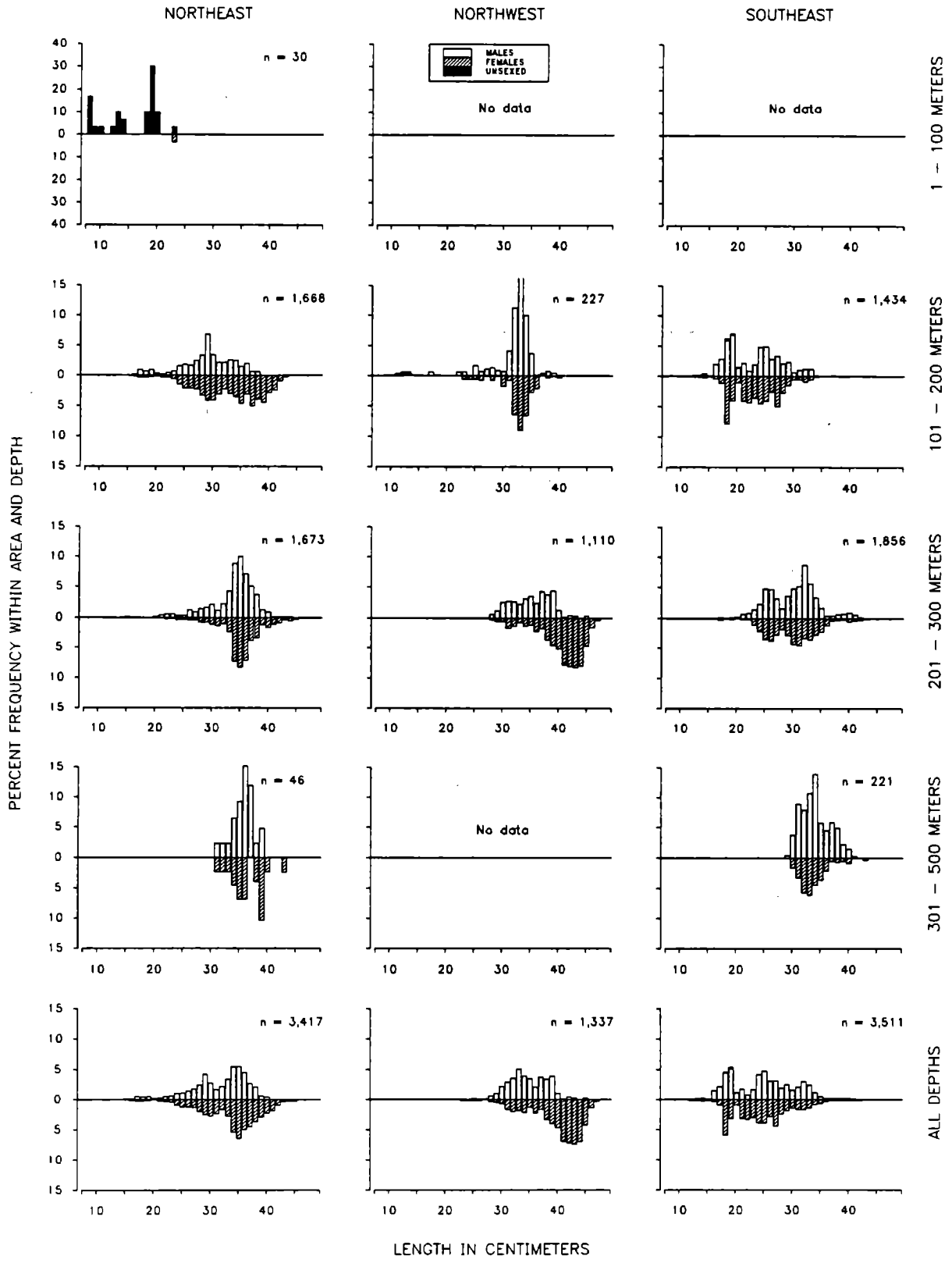

Figure 23.--Size composition of Pacific ocean perch from the 1991 Aleutian Islands survey.

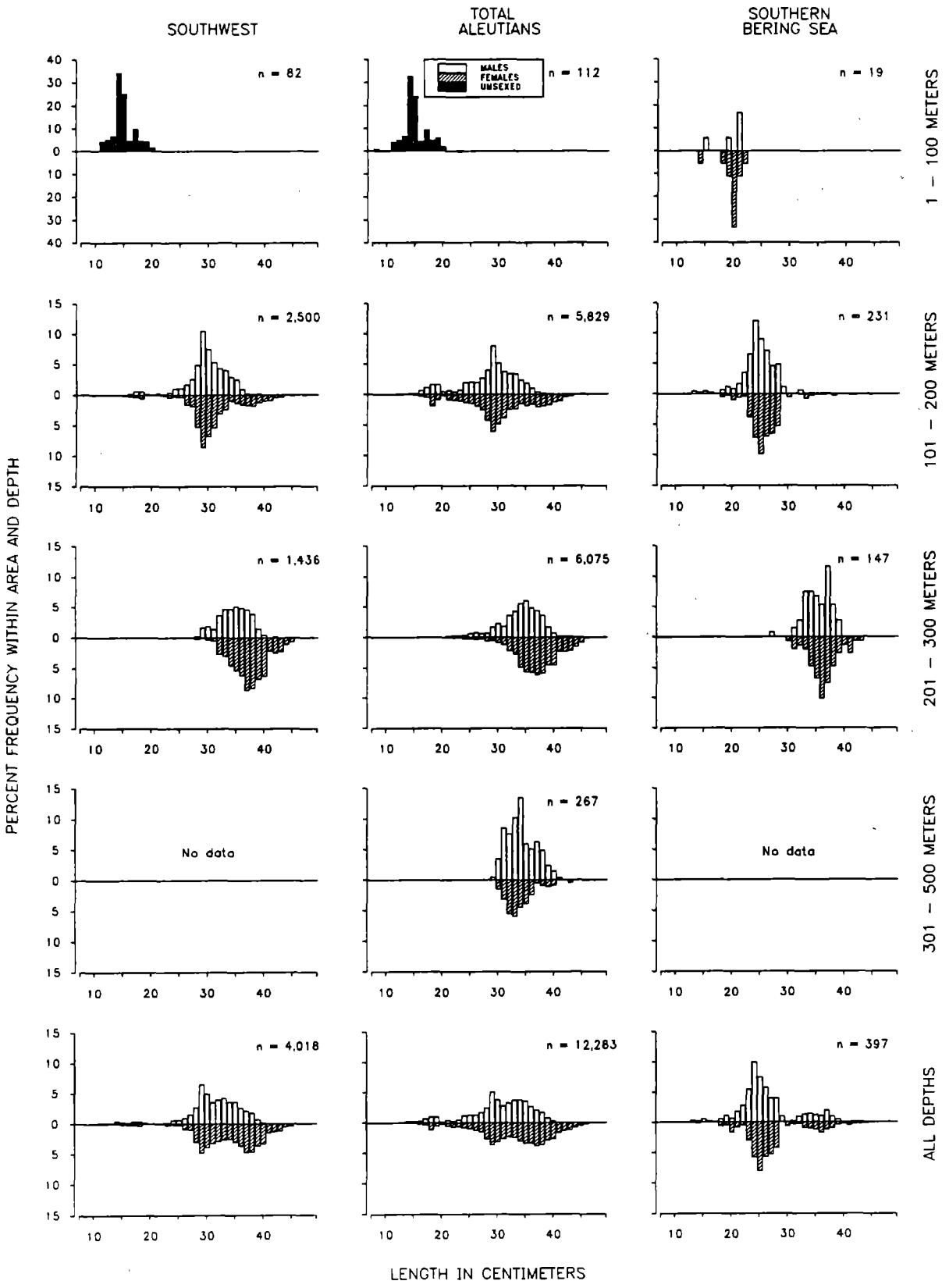

Figure 23.--Continued.

Northern rockfish-- Northern rockfish were scattered in pockets of high concentration, mainly in the western Aleutian Islands and on Petrel Bank (Fig. 24). This species occurred at only 38% of all Aleutian Islands stations, but CPUE at some of these stations was high (Table 20). Over 84% of the total estimated biomass of 182,494 t was found in the Southwest Aleutian Islands Area. Northern rockfish were uncommon in the Southern Bering Sea, occurring at 21% of these stations, and in low abundance, with an estimated biomass of under 800 t. Over 99% of northern rockfish sampled occurred in depths of l-200 m.

Northern rockfish varied from less than 20 cm to 40 cm (FL) in length. Individuals of less than 20 cm were restricted to l-100 m in depth (Fig. 25). The average length of females was slightly greater than males in each area-depth interval.

Table 20.--Total number of survey hauls, hauls containing northern rockfish, estimated biomass, CPUE, mean weight, and mean length based on the 1991 Aleutian Islands groundfish survey, by geographical areas and depth Intervals.

Area	Depth (m)	Number of trawl hauls	Hauls with catch	CPUE (kg/km^2)	Biomass (t)	Mean weight (kg)	Mean length (cm)
Northeast	1 - 100	16	4	524	1,969	0.4	27.7
	101 - 200	49	21	2,240	11,348	0.4	29.8
	201 - 300	22	8	241	641	0.7	36.2
	301 - 500	21	2	1	5	0.5	---
	All depths	108	35	915	13,963	0.4	29.7
Northwest	1 - 100	7	1	4,166	9,831	0.3	26.0
	101 - 200	13	5	77	202	0.6	---
	201 - 300	12	6	130	139	0.5	31.1
	301 - 500	3	0	0	0	---	---
	All depths	35	12	1,304	10,173	0.3	26.0
Southeast	1 - 100	6	2	3	11	0.3	---
	101 - 200	40	13	925	4,397	0.4	29.6
	201 - 300	19	10	13	54	0.4	30.9
	301 - 500	8	1	1	3	0.4	---
	All depths	73	26	265	4,464	0.4	29.6
Southwest	1 - 100	6	4	19,016	83,878	0.5	30.4
	101 - 200	38	24	10,579	69,086	0.4	31.1
	201 - 300	9	3	16	38	0.6	---
	301 - 500	10	1	4	12	0.9	---
	All depths	63	32	9,193	153,014	0.5	30.7
Total Aleutian Islands	1 - 100	35	11	6,508	95,689	0.4	29.6
	101 - 200	140	63	4,481	85,033	0.4	30.8
	201 - 300	62	27	86	872	0.6	34.9
	301 - 500	42	4	2	20	0.7	---
	All depths	279	105	3,212	181,613	0.4	30.2
Aleutian Islands biomass, 95% confidence interval: 111,722 - 251,504 metric tons							
Southern Bering Sea	1 - 100	32	6	61	292	0.2	21.0
	101 - 200	22	7	144	471	0.4	29.8
	201 - 300	3	0	0	0	---	---
	301 - 500	4	0	0	0	---	---
	All depths	61	13	74	763	0.3	24.4
Southern Bering Sea biomass, 95% confidence interval: 0 - 1,727 metric tons							

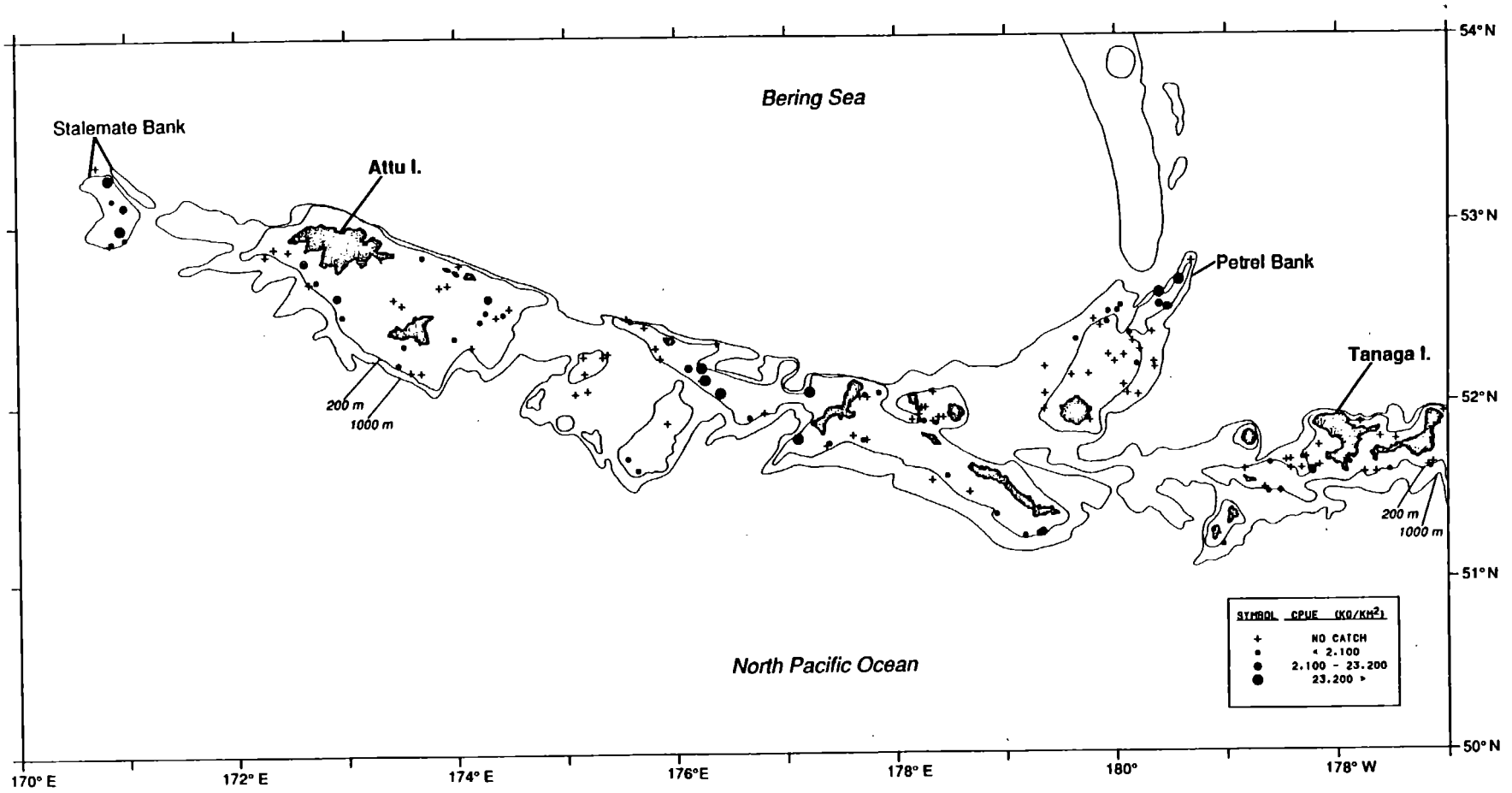

Figure 24.--Distribution and relative abundance of northern rockfish, 1991 Aleutian Islands bottom trawl survey. Abundance is categorized by catches below the mean (2,100 kg/km²), between the mean and two standard deviations above the mean, and greater than two standard deviations above the mean.

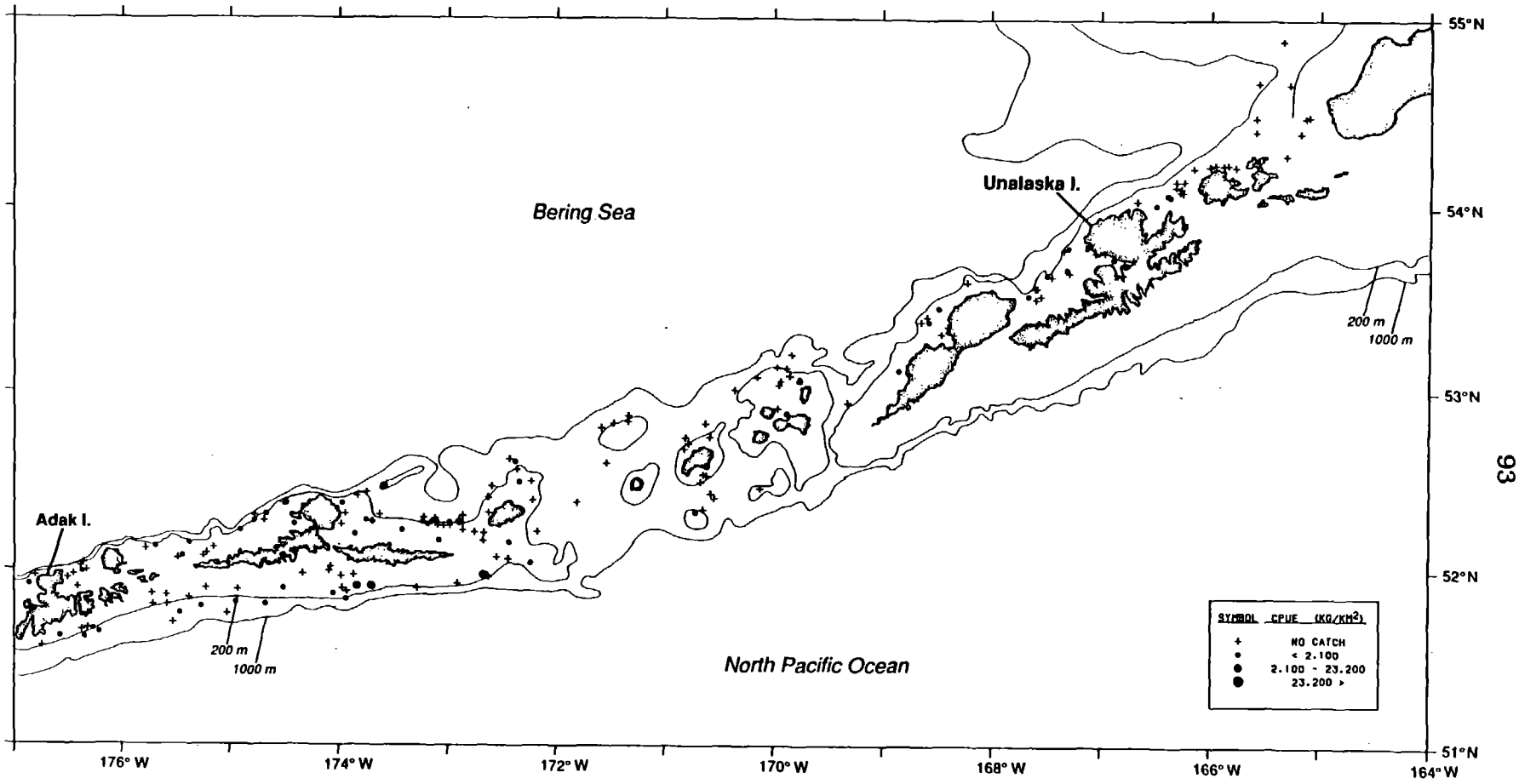

Figure 24.--Continued.

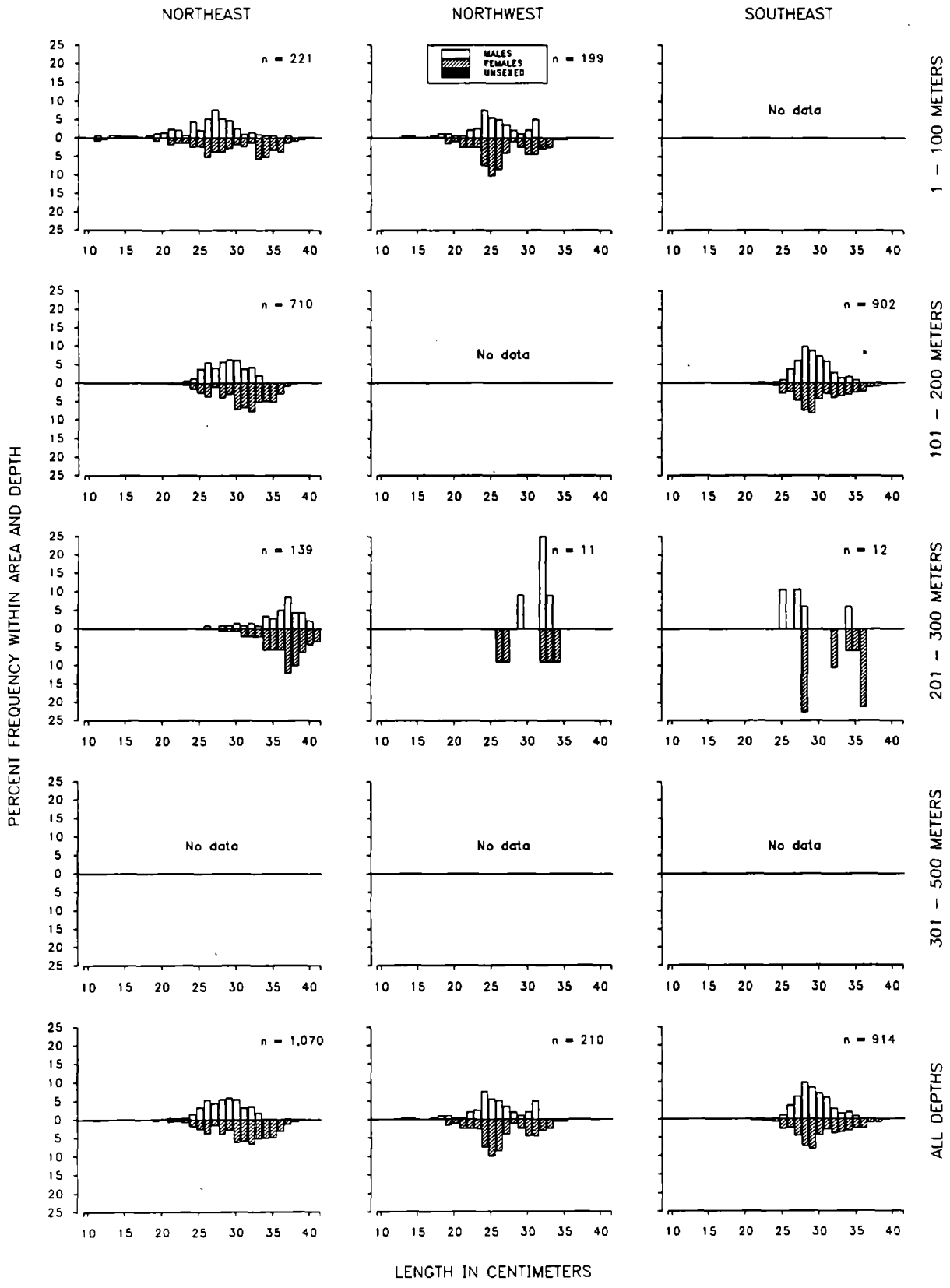

Figure 25.--Size composition of northern rockfish from the 1991 Aleutian Islands survey

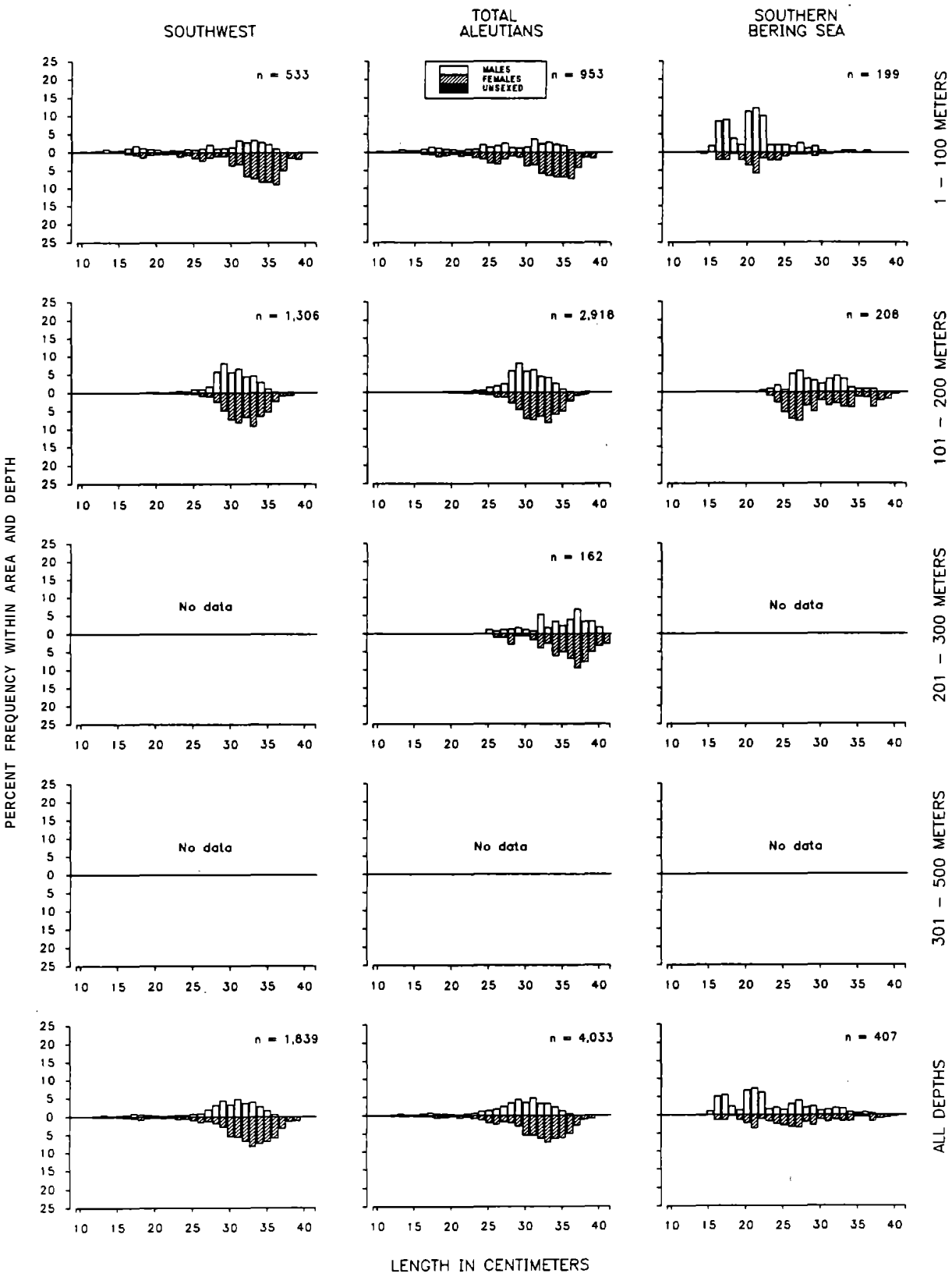

Figure 25.--Continued.

Rougheye rockfish--Rougheye rockfish is a deepwater species sporadically distributed throughout the survey area (Fig. 26). They occurred in 57% of the Aleutian Islands stations deeper than 200 m; and in 85% of the Southern Bering Sea stations at the same depths (Table 21). Most of the 13,625 t biomass of this species was found below 300 m. Large CPUE values were found from stations in the Southern Bering Sea., Southwest and Southeast Areas, and on Petrel Bank

Although smaller fish tend to be associated with shallower depths, size segregation with depth does not appear to be strong (Fig. 27). Most of the sampled rougheye rockfish were in the 30-50 cm (FL) range

Table 21.--Total number of survey hauls, hauls containing rougheye rockfish, estimated biomass, CPUE, mean weight, and mean length based on the 1991 Aleutian Islands groundfish survey, by geographical areas and depth intervals.

Area	Depth (m)	Number of trawl hauls	Hauls with catch	CPUE (kg/km^2)	Biomass (t)	Mean weight (kg)	Mean length (cm)
Northeast	1 - 100	16	1	3	13	1.1	---
	101 - 200	49	3	5	25	1.2	41.3
	201 - 300	22	7	152	406	1.3	41.6
	301 - 500	21	14	298	1,127	1.3	42.7
	All depths	108	25	103	1,572	1.3	42.4
Northwest	1 - 100	7	0	0	0	---	---
	101 - 200	13	0	0	0	---	---
	201 - 300	12	8	144	154	0.7	33.9
	301 - 500	3	3	329	572	1.5	44.2
	All depths	35	11	93	727	1.2	41.5
Southeast	1 - 100	6	0	0	0	---	---
	101 - 200	40	3	22	107	0.5	32.3
	201 - 300	19	9	46	189	0.6	30.0
	301 - 500	8	5	1,716	6,551	1.0	38.8
	All depths	73	17	407	6,847	1.0	38.2
Southwest	1 - 100	6	0	0	0	---	---
	101 - 200	38	6	71	461	0.7	32.7
	201 - 300	9	5	732	1,680	1.2	---
	301 - 500	10	8	313	1,066	1.6	42.8
	All depths	63	19	193	3,206	1.1	37.7
Total Aleutian Islands	1 - 100	35	1	1	13	1.1	---
	101 - 200	140	12	31	592	0.6	32.8
	201 - 300	62	29	240	2,429	1.1	35.4
	301 - 500	42	30	731	9,316	1.1	39.8
	All depths	279	72	218	12,351	1.0	38.8
Aleutian Islands biomass, 95% confidence interval: 0 - 29,539 metric tons							
Southern Bering Sea	1 - 100	32	0	0	0	---	---
	101 - 200	22	3	15	48	3.0	---
	201 - 300	3	2	108	108	0.9	---
	301 - 500	4	4	878	1,118	1.5	45.9
	All depths	61	9	123	1,274	1.4	45.9
Southern Bering Sea biomass, 95% confidence interval: 1,033 - 1,514 metric tons							

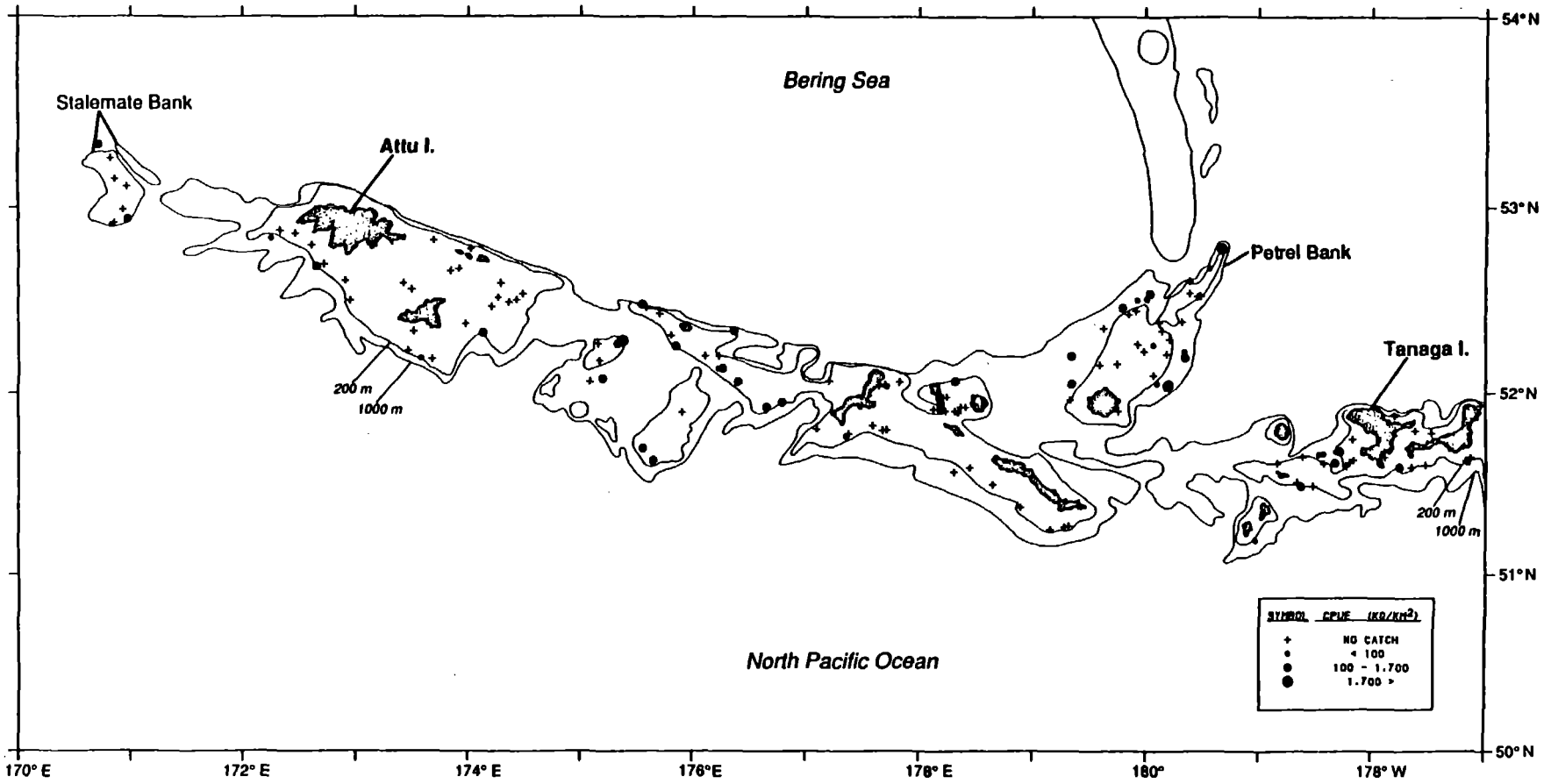

Figure 26.--Distribution and relative abundance of rougheye rockfish, 1991 Aleutian Islands bottom trawl survey. Abundance is categorized by catches below the mean (100 kg/km^2), between the mean and two standard deviations above the mean. and greater than two standard deviations above the mean.

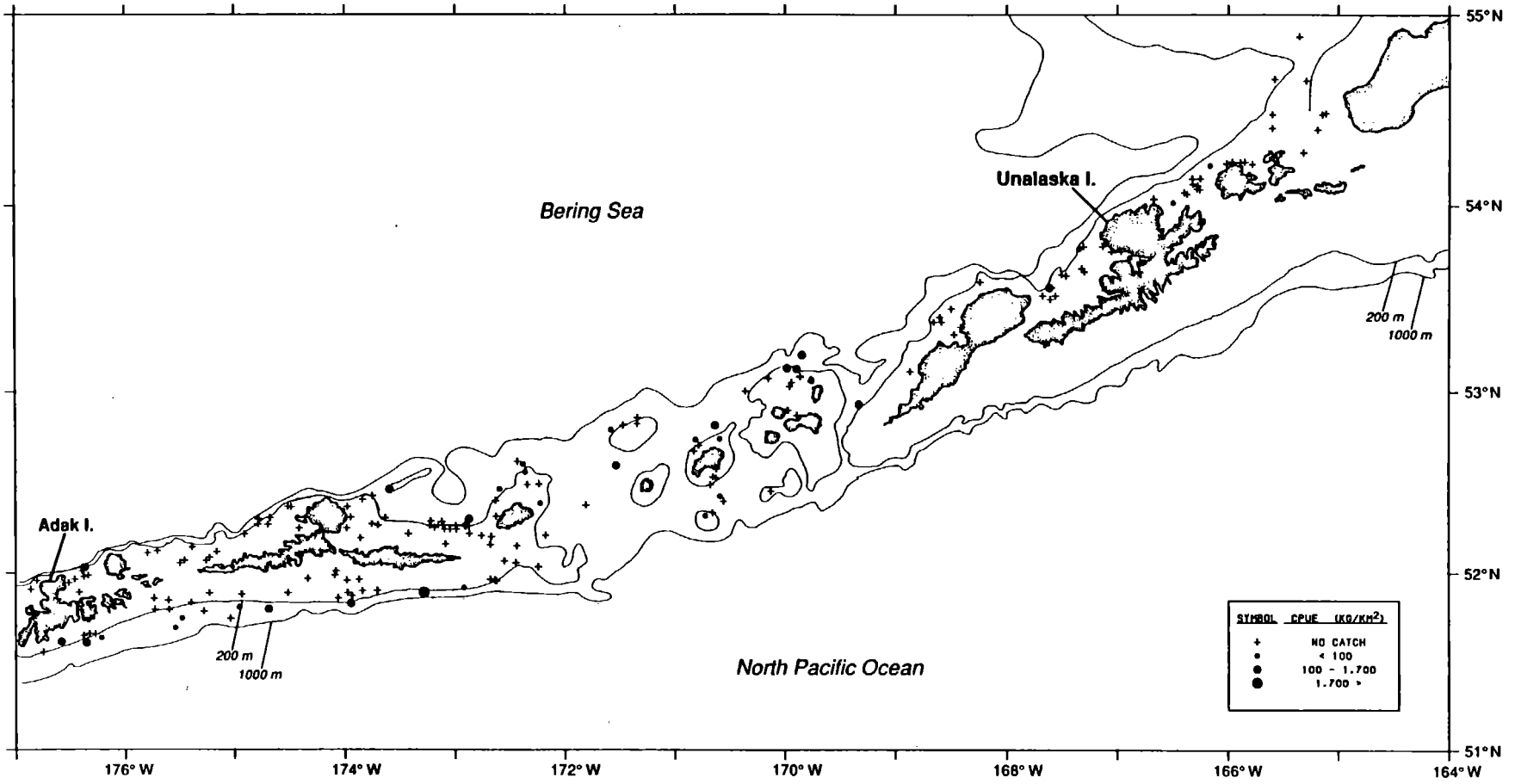

Figure 26.--Continued.

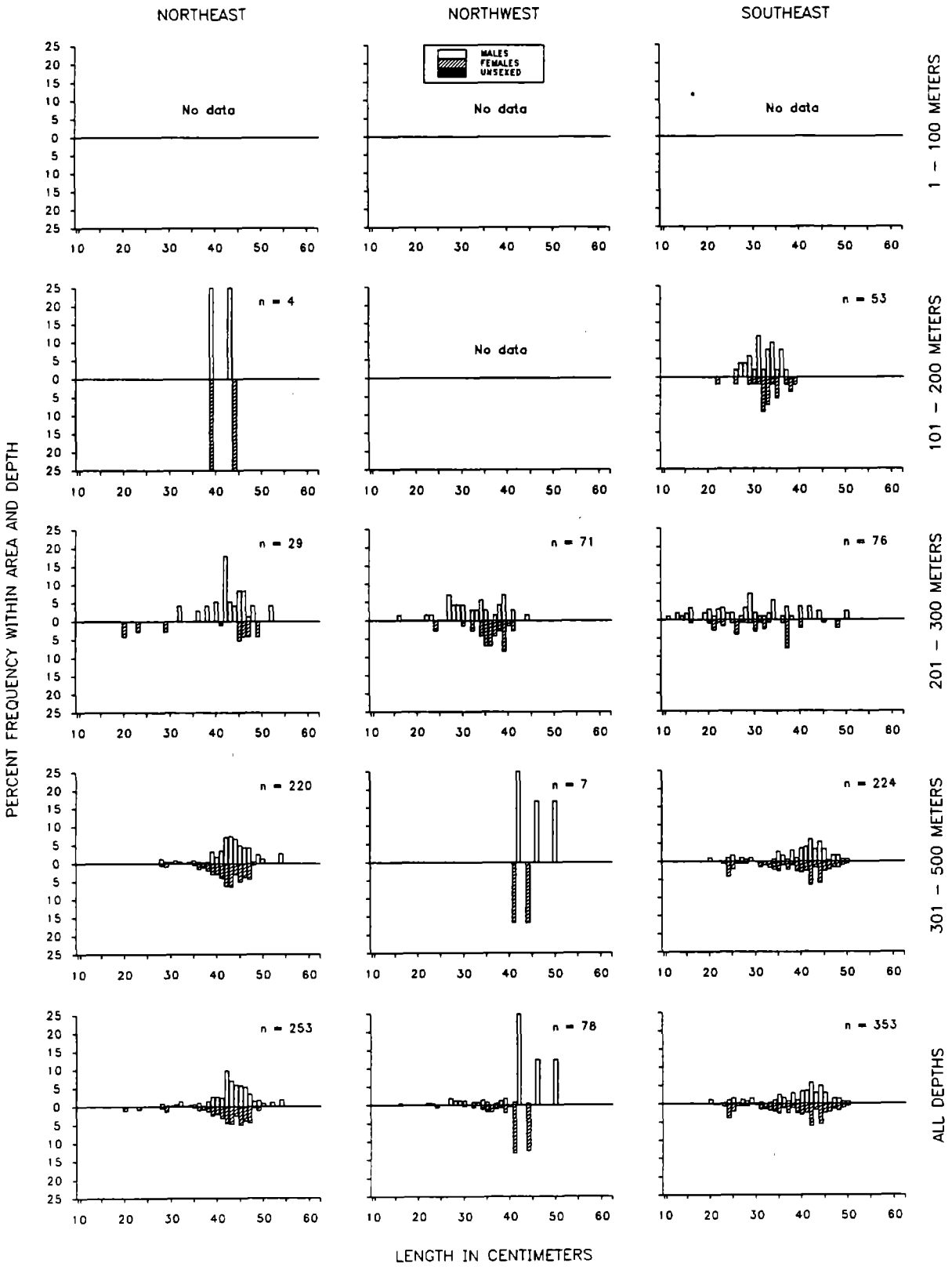

Figure 27.--Size composition of rougheye rockfish from the 1991 Aleutian Islands survey

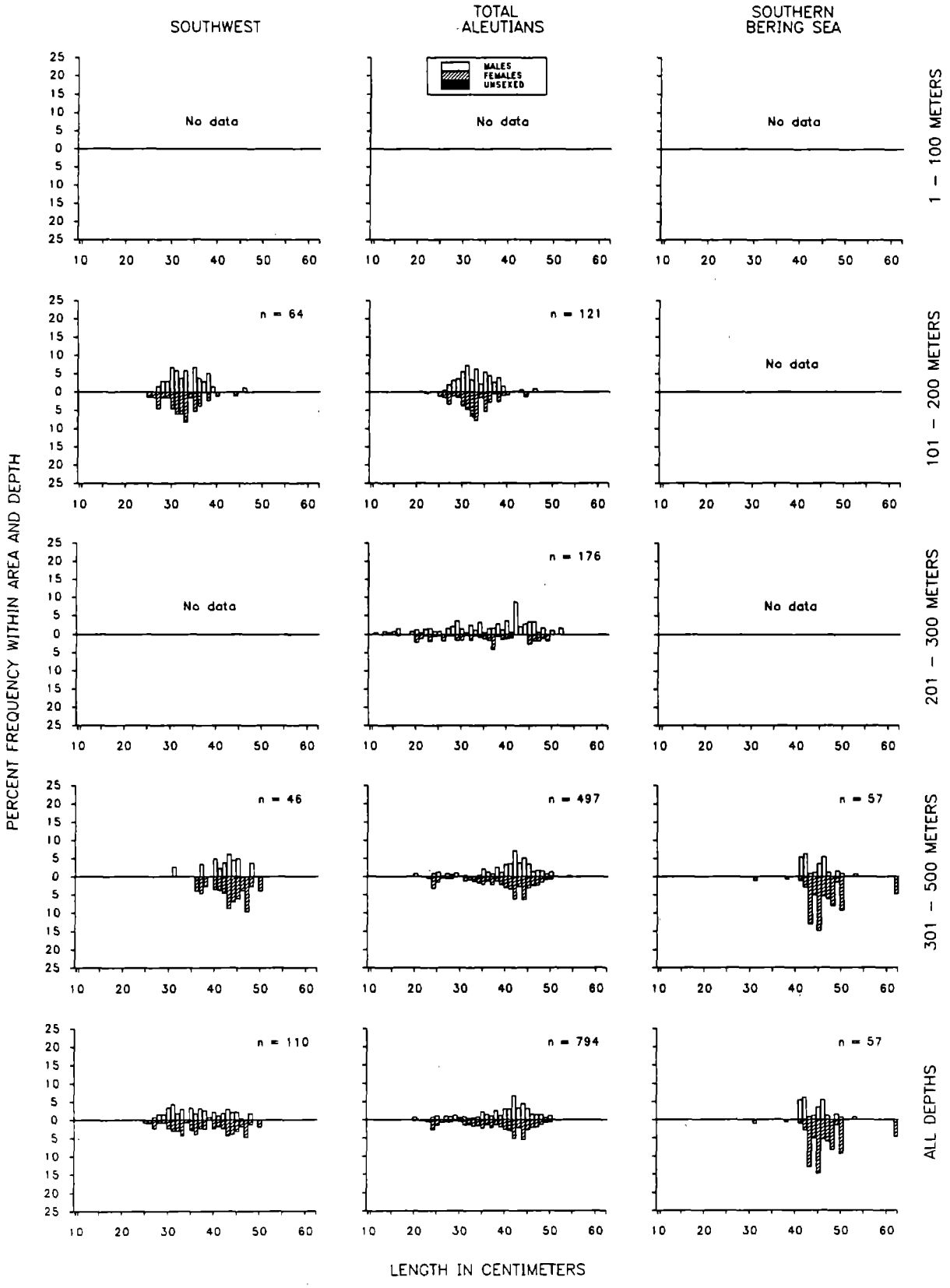

Figure 27.--Continued

Shortraker rockfish- Shortraker rockfish were sparsely scattered throughout the survey area in deeper water (Fig. 28). They were found at over 70% of all stations in the 301-500 m depth range, which contained 93% of the total shortraker rockfish biomass in the Aleutian Islands region and 100% of the biomass in the Southern Bering Sea (Table 22). Only trace amounts of shortraker rockfish were found in depths less than 200 m. The total estimated biomass of shortraker rockfish was 26,808 t. Over 73% of the estimated biomass occurred in the Southwest Area,- but relatively high CPUE values were found at stations on Petrel Bank, west of Tanaga Island, south of Atka and Amlia Islands, north of the Islands of Four Mountains, and east of Umnak Island.

A wide length distribution (ranging from 18 to 88 cm (FL)) of shortraker rockfish were observed in most areas (Fig. 29). A higher proportion of larger fish were found in the 201-300 m strata than in the 301-500 m strata, but this could be an artifact of small sample size in the shallower strata.

Table 22.--Total number of survey hauls, hauls containing shortraker rockfish, estimated biomass, CPUE, mean weight, and mean length based on the 1991 Aleutian Islands groundfish survey, by geographical areas and depth intervals.

Area	Depth (m)	Number of trawl hauls	Hauls with catch	CPUE (kg/km^2)	Biomass (t)	Mean weight (kg)	Mean length (cm)
Northeast	1 - 100	16	0	0	0	---	---
	101 - 200	49	1	0	2	0.6	---
	201 - 300	22	1	154	411	3.7	56.0
	301 - 500	21	11	347	1,309	2.3	48.2
	All depths	108	13	113	1,722	2.5	49.5
Northwest	1 - 100	7	0	0	0	---	---
	101 - 200	13	0	0	0	---	---
	201 - 300	12	4	439	470	4.2	60.6
	301 - 500	3	3	1,139	1,985	3.0	53.8
	All depths	35	7	315	2,455	3.2	54.8
Southeast	1 - 100	6	0	0	0	---	---
	101 - 200	40	0	0	0	---	---
	201 - 300	19	8	76	312	2.3	43.3
	301 - 500	8	5	248	947	1.5	38.7
	All depths	73	13	75	1,259	1.6	39.1
Southwest	1 - 100	6	0	0	0	---	---
	101 - 200	38	1	2	14	1.6	---
	201 - 300	9	1	25	57	5.9	---
	301 - 500	10	10	4,308	14,687	2.1	41.2
	All depths	63	12	887	14,757	2.1	41.2
Total Aleutian Islands	1 - 100	35	0	0	0	---	---
	101 - 200	140	2	1	16	1.3	---
	201 - 300	62	14	124	1,249	3.4	54.9
	301 - 500	42	29	1,485	18,928	2.2	42.4
	All depths	279	45	357	20,193	2.2	42.8
Aleutian Islands biomass, 95% confidence interval: 0 - 60,518 metric tons							
Southern Bering Sea	1 - 100	32	0	0	0	---	---
	101 - 200	22	0	0	0	---	---
	201 - 300	3	0	0	0	---	---
	301 - 500	4	3	5,199	6,615	1.9	47.9
	All depths	61	3	638	6,615	1.9	47.9
Southern Bering Sea biomass, 95% confidence interval: 5,074 - 8,156 metric tons							

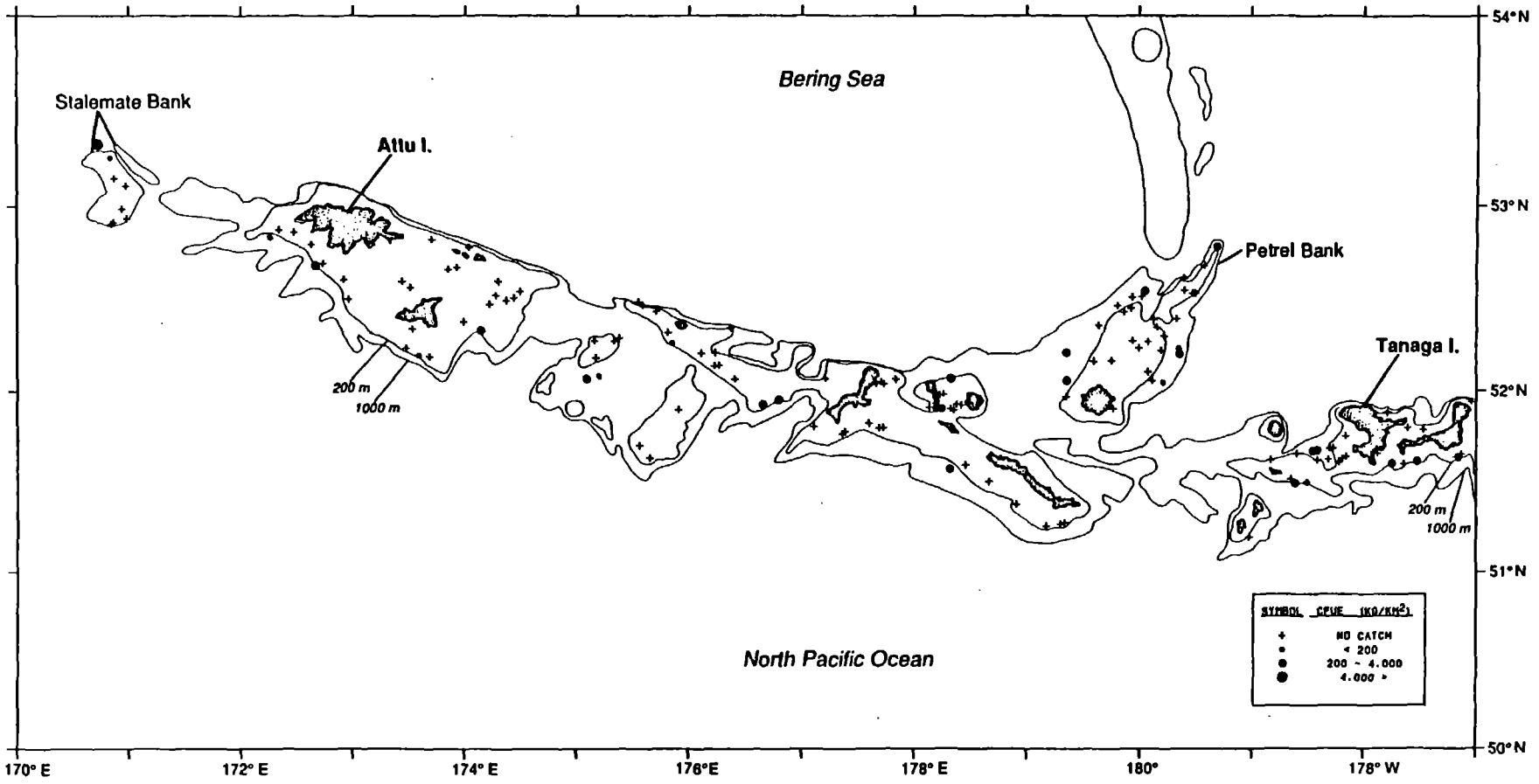

Figure 28.--Distribution and relative abundance of short-raker rockfish, 1991 Aleutian Islands bottom trawl survey. Abundance is categorized by catches below the mean (200 kg/km^2), between the mean and two standard deviations above the mean, and greater than two standard deviations above the mean.

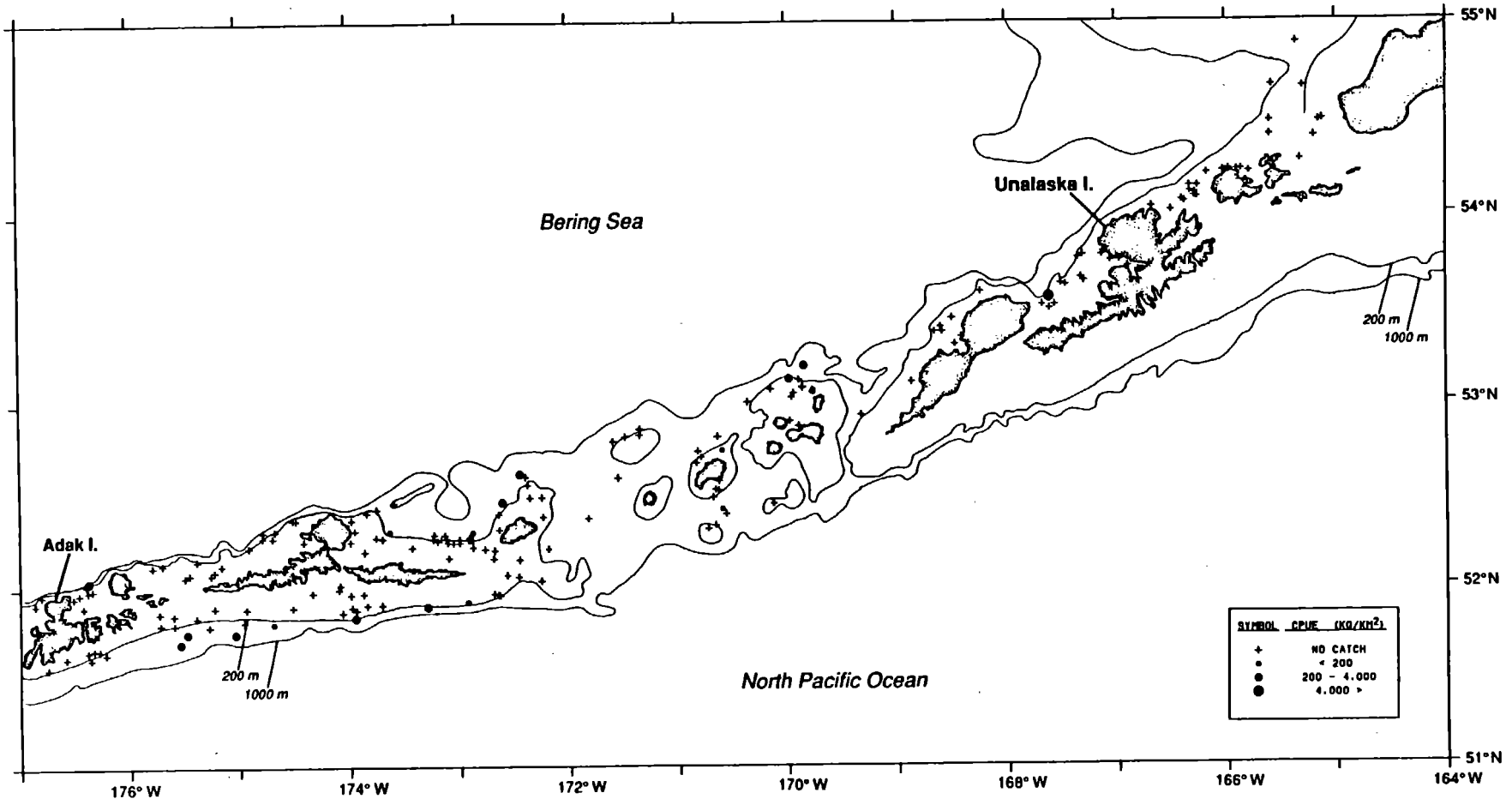

Figure 28.--Continued.

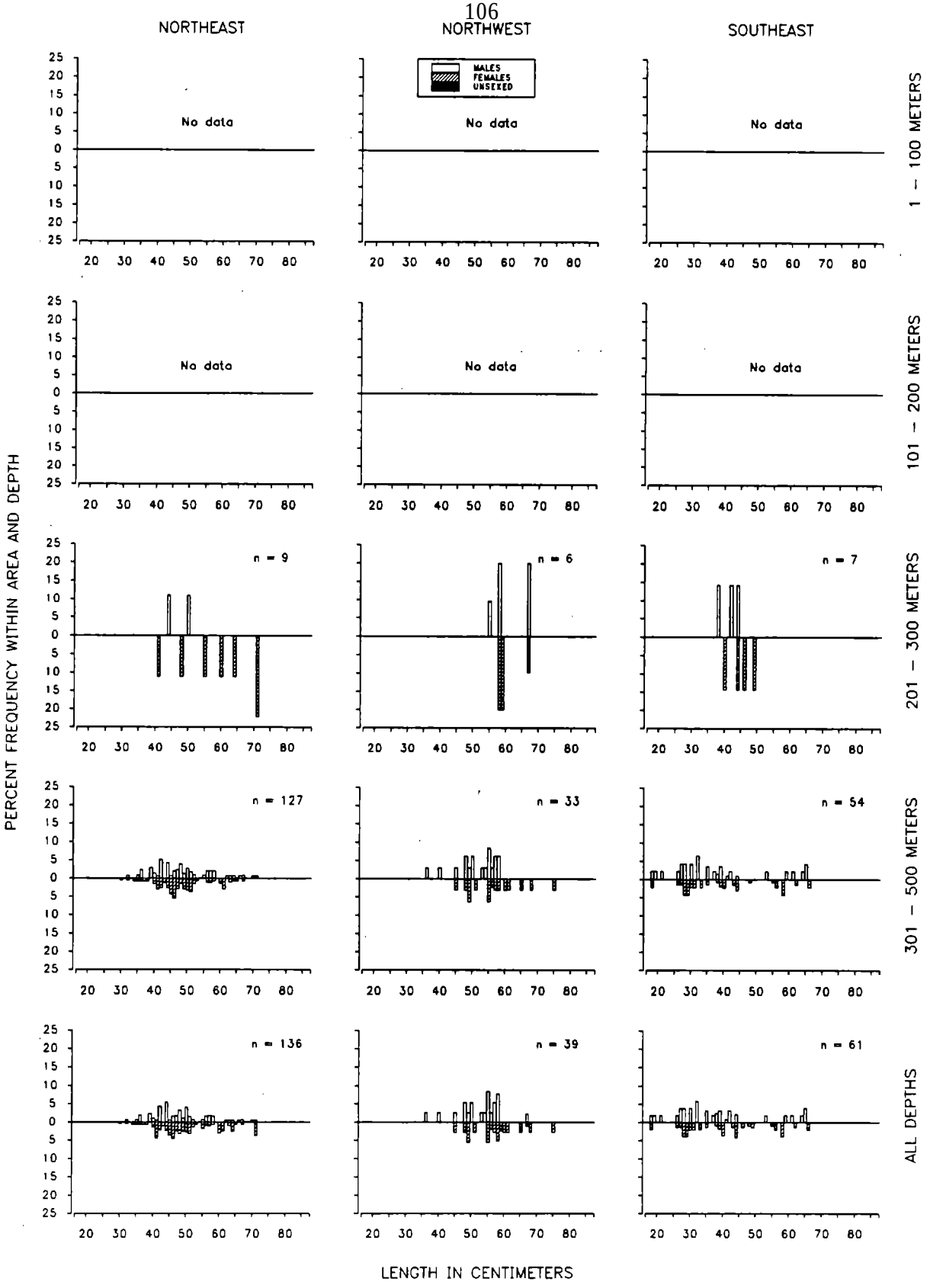

Figure 29.--Size composition of shortraker rockfish from the 1991 Aleutian Islands survey.

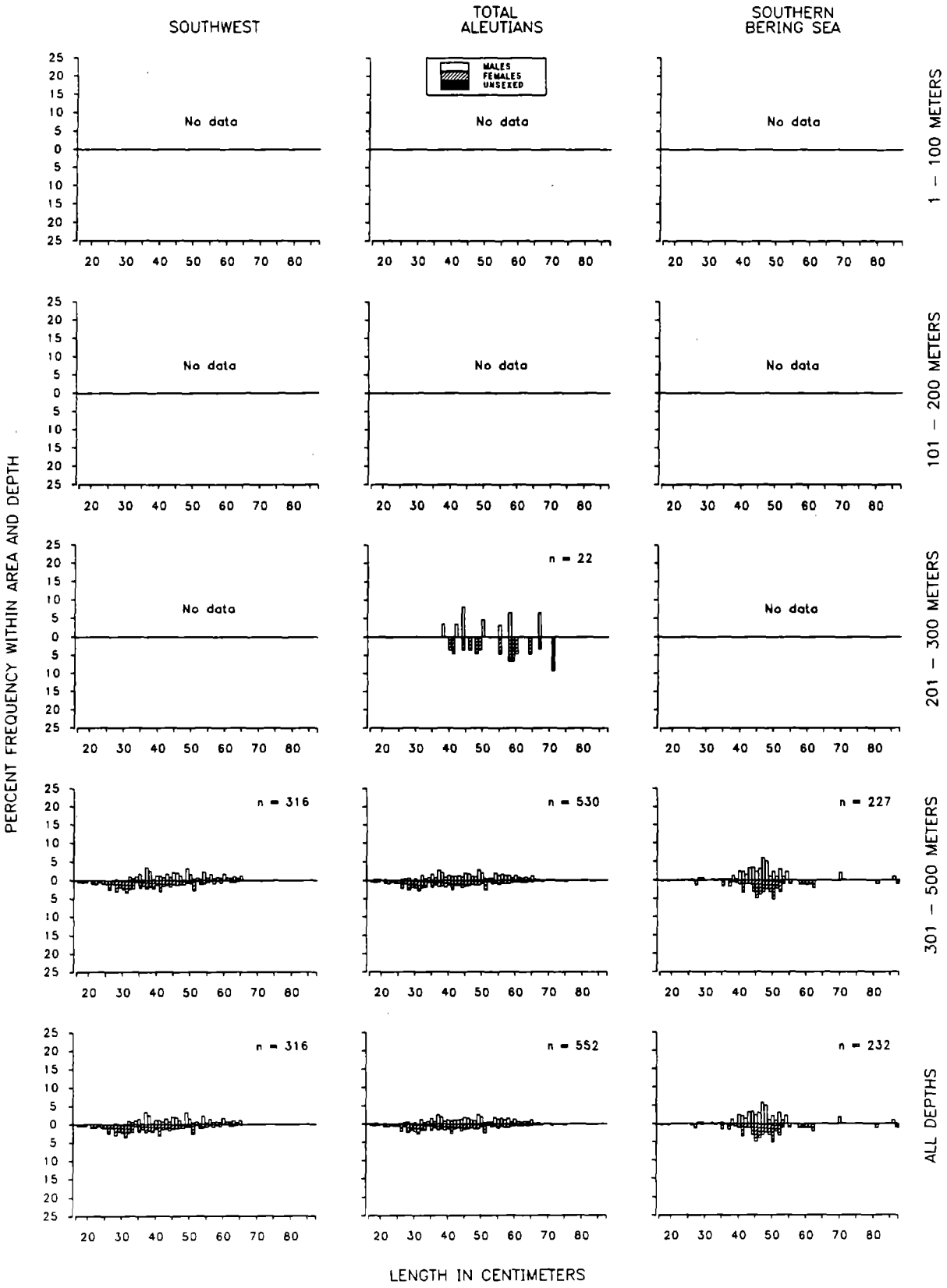

Figure 29.--Continued

Shortspine thornyhead-- Shortspine thornyhead were patchily distributed with low abundance over most of the areas and depths sampled (Fig. 30). Estimated biomass was 5,853 t in the Aleutian Islands region, but only 469 t in the Southern Bering Sea. Thornyheads occurred at 50% of all stations in the 301-500 m strata, and were increasingly rare at shallower depths (Table 23). The highest observed abundance was found in the Southwest Area, with 72% of the estimated survey biomass, and on Petrel Bank, which spans the boundary between the Northwest and Northeast Areas. Over 75% of the estimated biomass of this species was found in depths greater than 300 m. Because this survey did not cover the entire depth range of thornyheads, estimates can only be considered to reflect abundance in the depths sampled.

In most area-depth intervals, length frequencies were fairly evenly distributed over a wide 15-50 cm (FL) range (Fig. 31). There was no clear relationship between depth and size, except that the few fish found in the 101-200 m depth range were generally smaller fish.

Table 23.--Total number of survey hauls, hauls containing shortspine thornyhead, estimated biomass, CPUE, mean weight, and mean length based on the 1991 Aleutian Islands groundfish survey, by geographical areas and depth intervals.

Area	Depth (m)	Number of trawl hauls	Hauls with catch	CPUE (kg/km^2)	Biomass (t)	Mean weight (kg)	Mean length (cm)
Northeast	1 - 100	16	0	0	0	---	---
	101 - 200	49	1	0	2	0.3	32.5
	201 - 300	22	2	106	282	0.7	37.0
	301 - 500	21	6	107	404	0.5	30.4
	All depths	108	9	45	687	0.5	32.6
Northwest	1 - 100	7	0	0	0	---	---
	101 - 200	13	0	0	0	---	---
	201 - 300	12	2	120	129	0.7	36.1
	301 - 500	3	2	177	309	1.1	43.9
	All depths	35	4	56	438	1.0	41.0
Southeast	1 - 100	6	0	0	0	---	---
	101 - 200	40	0	0	0	---	---
	201 - 300	19	2	3	13	0.8	37.5
	301 - 500	8	3	50	190	0.6	34.5
	All depths	73	5	12	203	0.6	34.6
Southwest	1 - 100	6	0	0	0	---	---
	101 - 200	38	0	0	0	---	---
	201 - 300	9	3	473	1,086	0.6	35.2
	301 - 500	10	10	1,009	3,440	0.4	31.2
	All depths	63	13	272	4,526	0.5	32.0
Total	1 - 100	35	0	0	0	---	---
Aleutian	101 - 200	140	1	0	2	0.3	32.5
Islands	201 - 300	62	9	149	1,510	0.6	35.6
	301 - 500	42	21	341	4,342	0.5	31.7
	All depths	279	31	104	5,853	0.5	32.5
Aleutian Islands biomass, 95% confidence interval: 2,598 - 9,109 metric tons							
Southern	1 - 100	32	0	0	0	---	---
Bering Sea	101 - 200	22	0	0	0	---	---
	201 - 300	3	0	0	0	---	---
	301 - 500	4	2	369	469	0.7	34.5
	All depths	61	2	45	469	0.7	34.5
Southern Bering Sea biomass, 95% confidence interval: 166 - 773 metric tons							

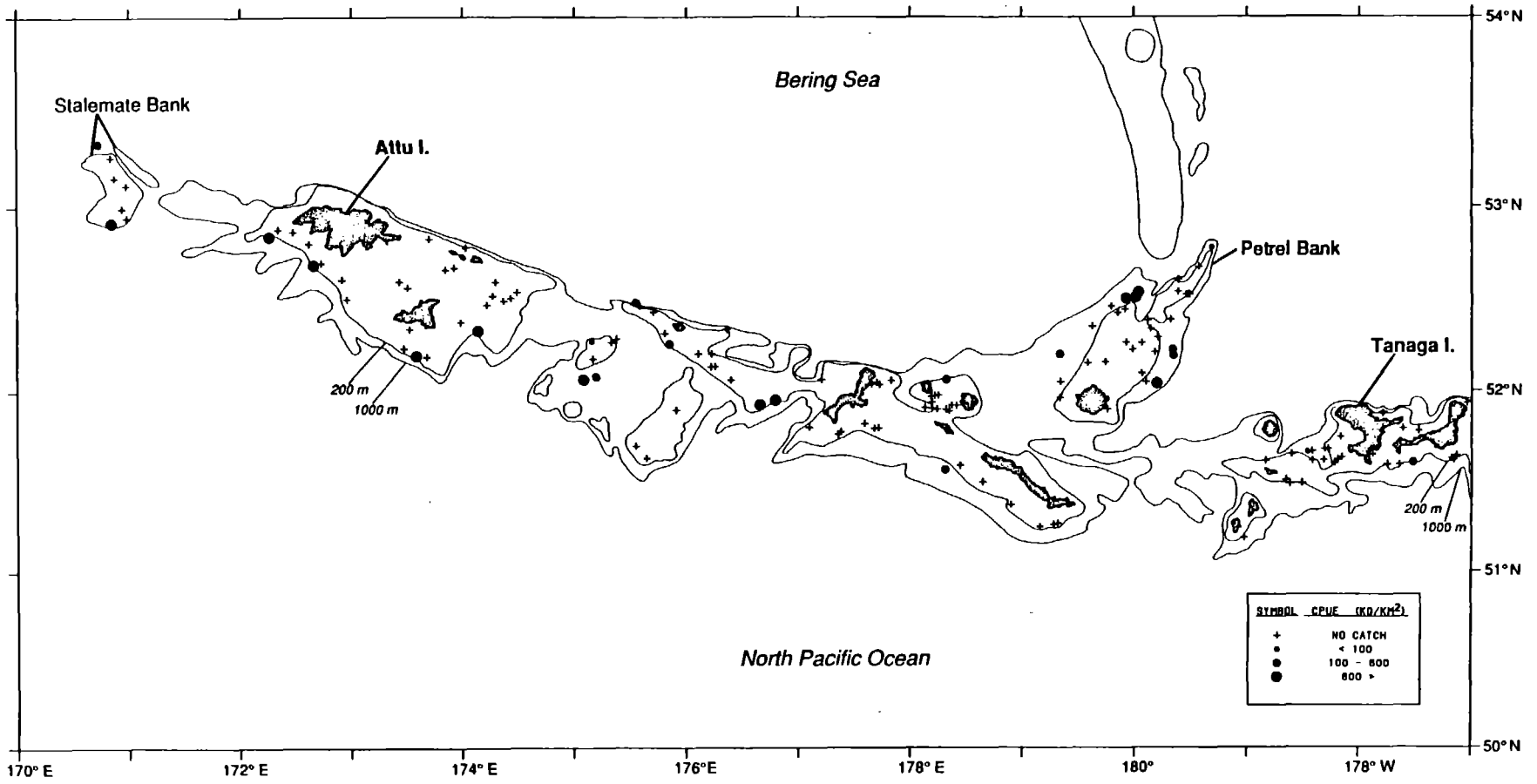

Figure 30.--Distribution and relative abundance of shortspine thornyhead, 1991 Aleutian Islands bottom trawl survey. Abundance is categorized by catches below the mean (100 kg/km²), between the mean and two standard deviations above the mean, and greater than two standard deviations above the mean.

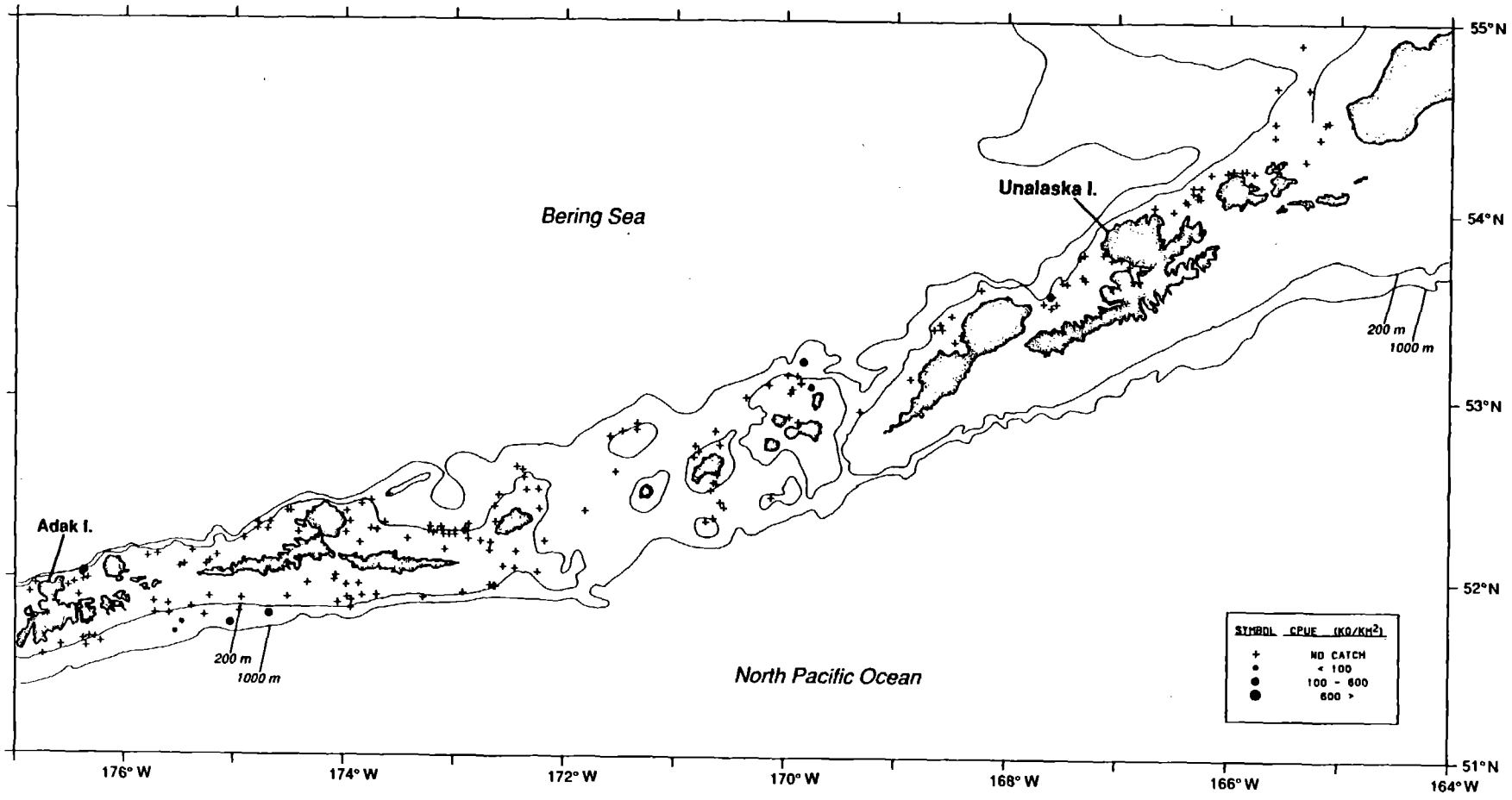

Figure 30.--Continued.

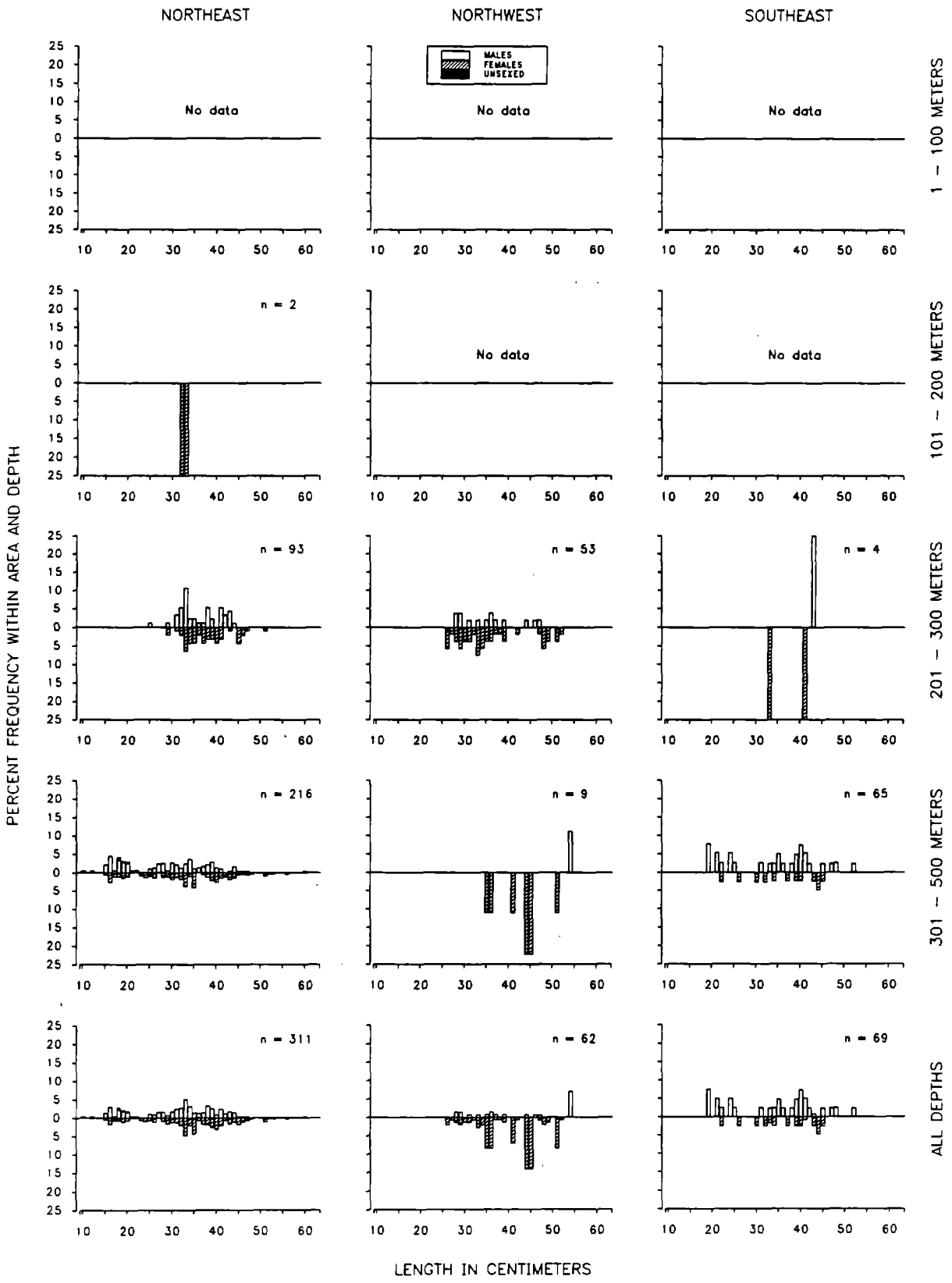

Figure 31.--Size composition of shortspine thornyhead from the 1991 Aleutian Islands survey

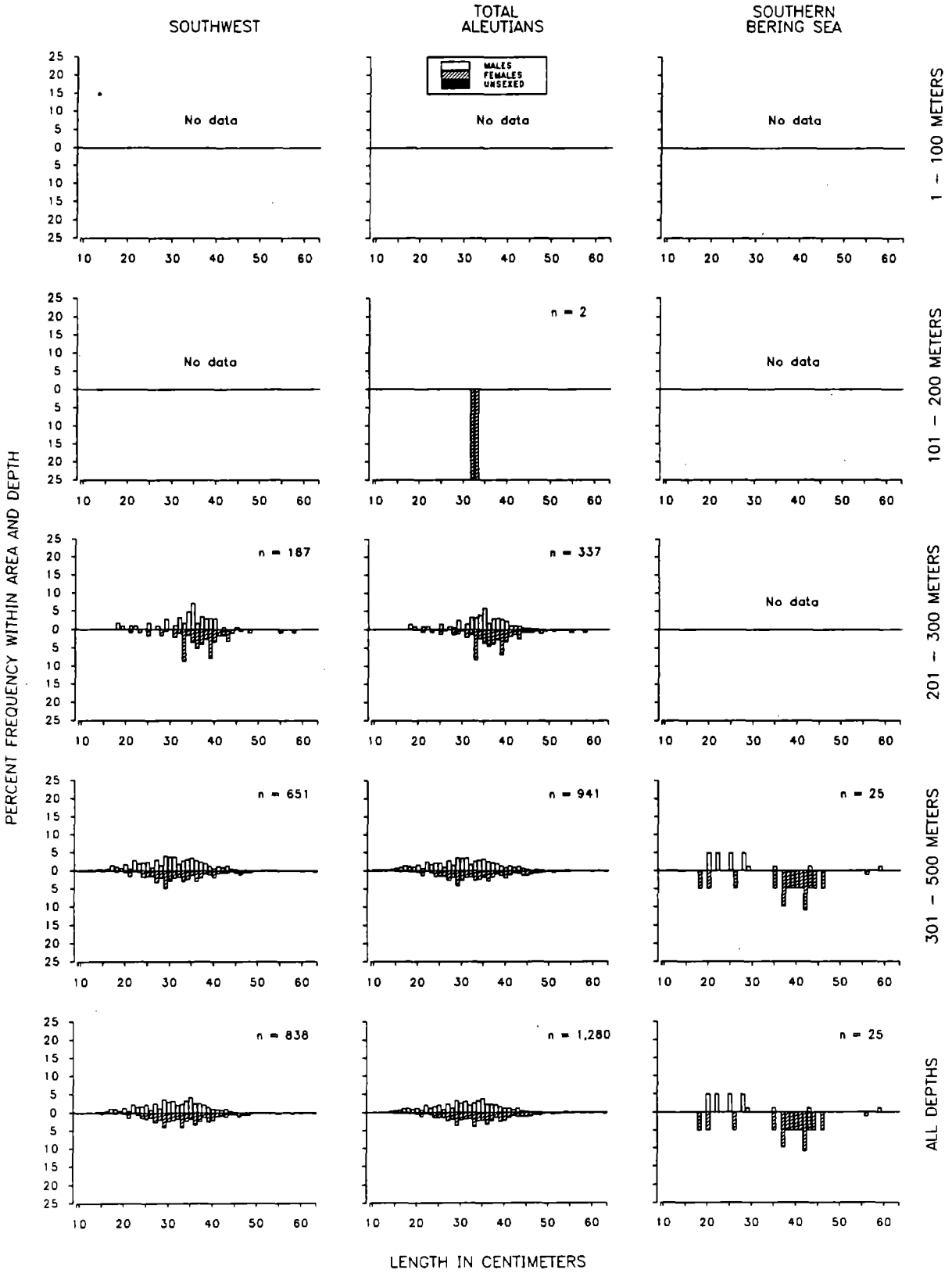

Figure 31.--Continued

Other rockfish--Four other rockfish species occurred in the survey region. Dusky rockfish (Sebastes ciliatus), harlequin rockfish (Sebastes variegatus), redbanded rockfish (Sebastes babcocki), and sharpchin rockfish (Sebastes zacentrus) were encountered at least once during the survey. Dusky rockfish were distributed throughout the entire survey area (Table 24). Total estimated biomass was 564 t. Abundance was low in the southern Aleutian Islands region and extremely low in the Southern Bering Sea Area and northern Aleutian areas. Harlequin rockfish occurred in all areas of the Aleutian Islands, but were low in abundance throughout this region, with a total estimated biomass of only 29 t (Table 25). Redbanded rockfish were found at one station in the Southern Bering Sea Area, but with an estimated biomass of approximately 1 t (Table 26). Sharpchin rockfish were found at two shallow stations in the Southern Bering Sea Area in low abundance with an estimated biomass of 3 t (Table 27).

Table 24.--Total number of survey hauls, hauls containing dusky rockfish, estimated biomass, CPUE, mean weight, and mean length based on the 1991 Aleutian Islands groundfish survey, by geographical areas and depth intervals.

Area	Depth (m)	Number of trawl hauls	Hauls with catch	CPUE (kg/km^2)	Biomass (t)	Mean weight (kg)	Mean length (cm)
Northeast	1 - 100	16	0	0	0	---	---
	101 - 200	49	5	12	61	1.6	43.1
	201 - 300	22	0	0	0	---	---
	301 - 500	21	0	0	0	---	---
	All depths	108	5	4	61	1.6	43.1
Northwest	1 - 100	7	0	0	0	---	---
	101 - 200	13	0	0	0	---	---
	201 - 300	12	2	26	28	1.1	---
	301 - 500	3	0	0	0	---	---
	All depths	35	2	4	28	1.1	---
Southeast	1 - 100	6	1	1	5	0.2	---
	101 - 200	40	5	29	137	1.4	---
	201 - 300	19	0	0	0	---	---
	301 - 500	8	0	0	0	---	---
	All depths	73	6	8	141	1.2	---
Southwest	1 - 100	6	0	0	0	---	---
	101 - 200	38	3	33	219	1.2	41.1
	201 - 300	9	1	21	48	1.3	---
	301 - 500	10	1	3	11	1.3	---
	All depths	63	5	17	277	1.3	41.1
Total	1 - 100	35	1	0	5	0.2	---
Aleutian	101 - 200	140	13	22	416	1.3	41.4
Islands	201 - 300	62	3	7	75	1.2	---
	301 - 500	42	1	1	11	1.3	---
	All depths	279	18	9	507	1.3	41.4
Aleutian Islands biomass, 95% confidence interval: 36 - 979 metric tons							
Southern	1 - 100	32	2	9	46	0.2	23.3
Bering Sea	101 - 200	22	2	4	12	0.8	---
	201 - 300	3	0	0	0	---	---
	301 - 500	4	0	0	0	---	---
	All depths	61	4	6	57	0.3	23.3
Southern Bering Sea biomass, 95% confidence interval: 0 - 185 metric tons							

Table 25.--Total number of survey hauls, hauls containing harlequin rockfish, estimated biomass, CPUE, mean weight, and mean length based on the 1991 Aleutian Islands groundfish survey, by geographical areas and depth intervals.

Area	Depth (m)	Number of trawl hauls	Hauls with catch	CPUE (kg/km^2)	Biomass (t)	Mean weight (kg)	Mean length (cm)
Northeast	1 - 100	16	0	0	0	---	---
	101 - 200	49	1	0	0	0.1	---
	201 - 300	22	0	0	0	---	---
	301 - 500	21	0	0	0	---	---
	All depths	108	1	0	0	0.1	---
Northwest	1 - 100	7	0	0	0	---	---
	101 - 200	13	0	0	0	---	---
	201 - 300	12	1	2	2	0.5	---
	301 - 500	3	0	0	0	---	---
	All depths	35	1	0	2	0.5	---
Southeast	1 - 100	6	0	0	0	---	---
	101 - 200	40	1	0	2	0.2	---
	201 - 300	19	0	0	0	---	---
	301 - 500	8	1	0	2	0.2	---
	All depths	73	2	0	3	0.2	---
Southwest	1 - 100	6	0	0	0	---	---
	101 - 200	38	2	2	15	0.3	---
	201 - 300	9	2	3	8	0.4	---
	301 - 500	10	0	0	0	---	---
	All depths	63	4	1	23	0.3	---
Total Aleutian Islands	1 - 100	35	0	0	0	---	---
	101 - 200	140	4	1	17	0.3	---
	201 - 300	62	3	1	10	0.4	---
	301 - 500	42	1	0	2	0.2	---
	All depths	279	8	1	29	0.3	---
Aleutian Islands biomass, 95% confidence interval: 0 - 63 metric tons							
Southern Bering Sea	1 - 100	32	0	0	0	---	---
	101 - 200	22	0	0	0	---	---
	201 - 300	3	0	0	0	---	---
	301 - 500	4	0	0	0	---	---
	All depths	61	0	0	0	---	---
Southern Bering Sea biomass, 95% confidence interval: 0 - 0 metric tons							

Table 26.--Total number of survey hauls, hauls containing redbanded rockfish, estimated biomass, CPUE, mean weight, and mean length based on the 1991 Aleutian Islands groundfish survey, by geographical areas and depth Intervals.

Area	Depth (m)	Number of trawl hauls	Hauls with catch	CPUE (kg/km^2)	Biomass (t)	Mean weight (kg)	Mean length (cm)
Northeast	1 - 100	16	0	0	0	---	---
	101 - 200	49	0	0	0	---	---
	201 - 300	22	0	0	0	---	---
	301 - 500	21	0	0	0	---	---
	All depths	108	0	0	0	---	---
Northwest	1 - 100	7	0	0	0	---	---
	101 - 200	13	0	0	0	---	---
	201 - 300	12	0	0	0	---	---
	301 - 500	3	0	0	0	---	---
	All depths	35	0	0	0	---	---
Southeast	1 - 100	6	0	0	0	---	---
	101 - 200	40	0	0	0	---	---
	201 - 300	19	0	0	0	---	---
	301 - 500	8	0	0	0	---	---
	All depths	73	0	0	0	---	---
Southwest	1 - 100	6	0	0	0	---	---
	101 - 200	38	0	0	0	---	---
	201 - 300	9	0	0	0	---	---
	301 - 500	10	0	0	0	---	---
	All depths	63	0	0	0	---	---
Total Aleutian Islands	1 - 100	35	0	0	0	---	---
	101 - 200	140	0	0	0	---	---
	201 - 300	62	0	0	0	---	---
	301 - 500	42	0	0	0	---	---
	All depths	279	0	0	0	---	---
Aleutian Islands biomass, 95% confidence interval: 0 - 0 metric tons							
Southern Bering Sea	1 - 100	32	0	0	0	---	---
	101 - 200	22	1	0	1	0.1	---
	201 - 300	3	0	0	0	---	---
	301 - 500	4	0	0	0	---	---
	All depths	61	1	0	1	0.1	---
Southern Bering Sea biomass, 95% confidence interval: 0 - 3 metric tons							

Table 27.--Total number of survey hauls, hauls containing sharpchin rockfish, estimated biomass, CPUE, mean weight, and mean length based on the 1991 Aleutian Islands groundfish survey, by geographical areas and depth intervals.

Area	Depth (m)	Number of trawl hauls	Hauls with catch	CPUE (kg/km^2)	Biomass (t)	Mean weight (kg)	Mean length (cm)
Northeast	1 - 100	16	0	0	0	---	---
	101 - 200	49	0	0	0	---	---
	201 - 300	22	0	0	0	---	---
	301 - 500	21	0	0	0	---	---
	All depths	108	0	0	0	---	---
Northwest	1 - 100	7	0	0	0	---	---
	101 - 200	13	0	0	0	---	---
	201 - 300	12	0	0	0	---	---
	301 - 500	3	0	0	0	---	---
	All depths	35	0	0	0	---	---
Southeast	1 - 100	6	0	0	0	---	---
	101 - 200	40	0	0	0	---	---
	201 - 300	19	0	0	0	---	---
	301 - 500	8	0	0	0	---	---
	All depths	73	0	0	0	---	---
Southwest	1 - 100	6	0	0	0	---	---
	101 - 200	38	0	0	0	---	---
	201 - 300	9	0	0	0	---	---
	301 - 500	10	0	0	0	---	---
	All depths	63	0	0	0	---	---
Total Aleutian Islands	1 - 100	35	0	0	0	---	---
	101 - 200	140	0	0	0	---	---
	201 - 300	62	0	0	0	---	---
	301 - 500	42	0	0	0	---	---
	All depths	279	0	0	0	---	---
Aleutian Islands biomass, 95% confidence interval: 0 - 0 metric tons							
Southern Bering Sea	1 - 100	32	2	1	3	0.1	---
	101 - 200	22	0	0	0	---	---
	201 - 300	3	0	0	0	---	---
	301 - 500	4	0	0	0	---	---
	All depths	61	2	0	3	0.1	---
Southern Bering Sea biomass, 95% confidence interval: 0 - 9 metric tons							

Sculpins-- Several species of sculpins were encountered frequently during the 1991 survey. The genus Myoxocephalus was among the 20 dominant taxa in all of the areas sampled (Table 2). It is unlikely that any given species from this group would have been among the dominant groundfish groups in the Aleutian Islands region, but the great sculpin (Myoxocephalus polyacanthocephalus) was the dominant representative of the genus in the Southern Bering Sea Area, where the genus Myoxocephalus was the tenth most abundant taxa. Darkfin sculpins (m zonurus) and blackfin sculpins (Malacocottus kincaidi) also appeared frequently among the 20 dominant taxa in the Aleutian Islands and Southern Bering Sea regions. These small fish were numerically significant at many stations, and occurred in moderate numbers at all depths sampled during the survey. The genus Hemilepidotus was also widely distributed throughout the survey region. The yellow Irish lord (Hemilepidotus jordani) was frequently encountered in the Aleutian Islands region, although its biomass was relatively low. They were more common in the Southern Bering Sea, where they were the ninth most abundant groundfish species. Most other Cottidae found during the survey (Table B-l) were sparsely distributed and encountered only occasionally in small numbers.

Skates--Skates of the genera Bathyraja, Raja, and Rhinoraja were encountered throughout the survey. As a group, skates were important in the Aleutian Islands region, ranking fourteenth in overall abundance (Table 2). This taxa has commercial potential, but further research is needed to adequately describe each species.

Cephalopods-Red (magistrate armhook) squid (Berryteuthis magister) was encountered throughout the survey (Table 28). Red squid was the sixth most abundant species in the Southwest Aleutian Islands Area, however only trace amounts were found in the other Aleutian Islands areas and in the Southern Bering Sea. Two other squid species (Rossia pacifica and Moroteuthis robusta and two species of octopus [Octopus dofleini and Octopus leioderma) were caught in the survey, but in trace amounts (Table B-2).

Crabs--Six species of commercially important crabs were caught during the 1991 survey: golden king crab (Lithodes aequispina), scarlet king crab [Lithodes couesi), red king crab (Paralithodes camtschatica), Tanner crab [Chionoecetes bairdi), snow crab (Chionoecetes opilio), and hair crab (Erimacrus isenbeckii). None of these species were estimated to be in high abundance in any area, nor were these species found at any station in significant quantities. The sampling gear used for the survey was not designed to efficiently capture crab, so this survey will not provide representative results.

Table 28.--Total number of survey hauls, hauls containing red squid, estimated biomass, CPUE, mean weight. and mean length based on the 1991 Aleutian Islands groundfish survey, by geographical areas and depth intervals.

Area	Depth (m)	Number of trawl hauls	Hauls with catch	CPUE (kg/km^2)	Biomass (t)	Mean weight (kg)	Mean length (cm)
Northeast	1 - 100	16	0	0	0	---	---
	101 - 200	49	7	3	18	0.4	---
	201 - 300	22	5	20	53	0.5	---
	301 - 500	21	8	20	75	0.4	---
	All depths	108	20	10	146	0.4	---
Northwest	1 - 100	7	1	3	7	0.5	---
	101 - 200	13	2	2	4	0.2	---
	201 - 300	12	2	9	9	0.3	---
	301 - 500	3	1	14	25	0.5	---
	All depths	35	6	6	46	0.4	---
Southeast	1 - 100	6	0	0	0	---	---
	101 - 200	40	0	0	0	---	---
	201 - 300	19	5	15	60	0.4	---
	301 - 500	8	2	5	18	0.3	---
	All depths	73	7	5	78	0.4	---
Southwest	1 - 100	6	0	0	0	---	---
	101 - 200	38	4	352	2,302	0.4	---
	201 - 300	9	4	12,617	28,950	0.6	---
	301 - 500	10	6	45	153	0.4	---
	All depths	63	14	1,887	31,404	0.5	---
Total Aleutian Islands	1 - 100	35	1	0	7	0.5	---
	101 - 200	140	13	122	2,323	0.4	---
	201 - 300	62	16	2,875	29,072	0.6	---
	301 - 500	42	17	21	271	0.4	---
	All depths	279	47	560	31,673	0.5	---
Aleutian Islands biomass, 95% confidence interval: 0 - 154,864 metric tons							
Southern Bering Sea	1 - 100	32	0	0	0	---	---
	101 - 200	22	1	7	24	0.5	---
	201 - 300	3	1	19	19	0.5	---
	301 - 500	4	3	85	108	0.5	---
	All depths	61	5	15	151	0.5	---
Southern Bering Sea biomass, 95% confidence interval: 75 - 226 metric tons							

CITATIONS

Alverson, D. L., and W. T. Pereyra. 1969. Demersal fish explorations in the northeastern Pacific Ocean - An evaluation of exploratory fishing methods and analytical approaches to stock size and yield forecasts. J. Fish. Res. Board Can. 26: 1985-200 1.

Ronholt, L., K. Teshima, and D. Kessler. In preparation. The groundfish resources of the Aleutian Islands, 1980- 1986. Alaska Fisheries Science Center, 7600 Sand Point Way NE, Seattle, WA 98115.

Wakabayashi, K., R. G. Bakkala, and M. S. Alton. 1985. Methods of the U.S.-Japan demersal trawl surveys. p. 7-29. In R. G. Bakkala and K. Wakabayashi (editors), Results of cooperative U.S.-Japan groundfish investigations in the Bering Sea during May-August 1979. Int. North Pac. Fish. Comm., Bull. 44.

APPENDIX A

Gear Specifications and Diagrams

Figure A- 1 illustrates the Poly-Nor'eastem high-opening bottom trawl used in the 1991 Aleutian Island groundfish survey.

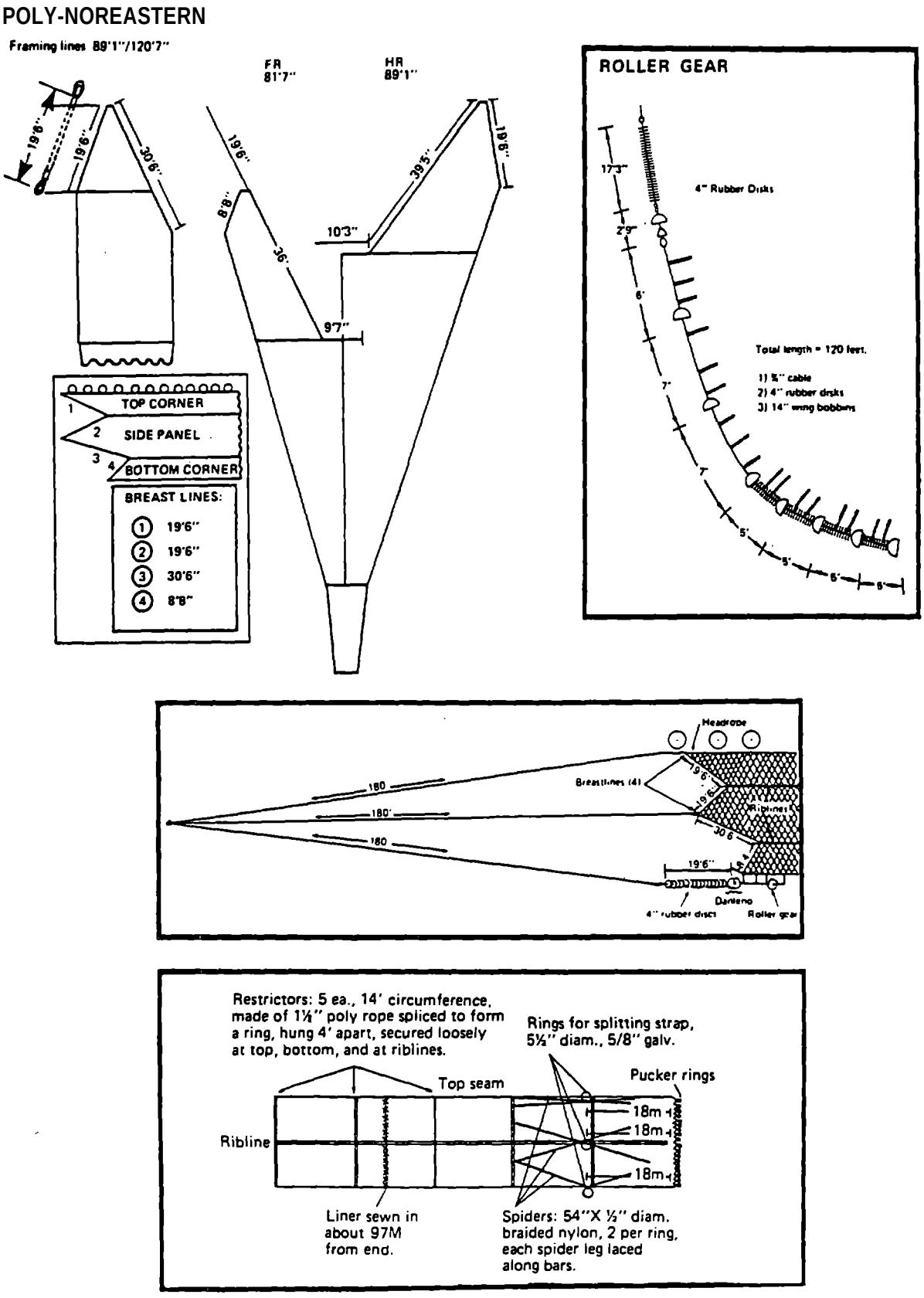

Figure A- 1 .--Schematic diagram of the bottom trawl, roller gear and accessory gear used by the chartered trawlers Ocean Hope 1 and Green Hope during the 1991 Aleutian Islands bottom trawl survey.

APPENDIX B

Lists of Species Encountered

Tables B-l and B-2 list fish and invertebrate species encountered and identified during the 1991 Aleutian Island groundfish survey. Fish are listed in phylogenetic order. Most common and scientific names are from Robins et al. (1991), except as noted by superscripts Invertebrates are listed in phylogenetic order by phylum. Order of listings and common names are provided for convenience, and do not imply adherence to a particular phylogenetic system.

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Table B- 1 .--List of fish identified 126

Table B-2.--List of invertebrates identified 130

Table B-1.--List of fish identified during the 1991 Aleutian Island groundfish survey.

Family	Scientific name	Common name
Petromyzontidae		lampreys
	Lampetra tridentata	Pacific lamprey
Squalidae		dogfish sharks
	Somniosus pacificus	Pacific sleeper shark
Rajidae		skates
	Bathyraja abyssicola[1]	deepsea skate
	Bathyraja aleutica	Aleutian skate
	Bathyraja interrupta	sandpaper (Bering) skate
	Bathyraja lindbergi[1]	Commander skate
	Bathyraja maculata[1]	whiteblotched skate
	Bathyraja parmifera	Alaska skate
	Bathyraja trachura	roughtail skate
	Raja binoculata	big skate
	Raja rhina	longnose skate
	Rhinoraja longi[4]	
Clupeidae		herrings
	Clupea pallasi	Pacific herring
Bathylagidae		deepsea smelts
	Bathylagus milleri[3]	robust blacksmelt
	Leuroglossus schmidti	northern smoothtongue
Osmeridae		smelts
	Thaleichthys pacificus	eulachon
Salmonidae		trouts
	Oncorhynchus keta	chum salmon
Stomiidae		dragonfishes
	Chauliodus macouni	Pacific viperfish
Myctophidae		lanternfishes
	Lampanyctus jordani[2]	brokenline lampfish
	Hygophum reinhardti[2]	slender lanternfish
	Protomyctophum thompsoni[3]	northern flashlightfish
	Stenobrachius leucopsarus	northern lampfish
	Symbolophorus californiense[3]	California lanternfish
Gadidae		cods
	Gadus macrocephalus	Pacific cod
	Theragra chalcogramma	walleye pollock
Macrouridae		grenadiers
	Albatrossia pectoralis	giant grenadier
	Coryphaenoides spp.	
Melamphaeidae		bigscales
	Melamphaes lugubris[3]	highsnout bigscale
	Poromitra crassiceps[3]	crested bigscale

Table B-1.--Continued.

Family	Scientific name	Common name
Oneirodidae		dreamers
	Oneirodes acanthias[3]	spiny dreamer
Scorpaenidae		rockfishes
	Sebastes aleutianus	rougheye rockfish
	Sebastes alutus	Pacific ocean perch
	Sebastes babcocki	redbanded rockfish
	Sebastes borealis	shortraker rockfish
	Sebastes ciliatus	dusky rockfish
	Sebastes polyspinis	northern rockfish
	Sebastes variegatus	harlequin rockfish
	Sebastes zacentrus	sharpchin rockfish
	Sebastolobus alascanus	shortspine thornyhead
	Sebastolobus macrochir	broadbanded thornyhead
Anoplopomatidae		sablefishes
	Anoplopoma fimbria	sablefish
Hexagrammidae		greenlings
	Hexagrammos decagrammus	kelp greenling
	Pleurogrammus monopterygius	Atka mackerel
Cottidae		sculpins
	Archistes plumarius[2]	
	Artediellus pacificus	hookhorn sculpin
	Bolinia euryptera[6]	
	Dasycottus setiger	spinyhead sculpin
	Enophrys diceraus	antlered sculpin
	Enophrys lucasi	leister sculpin
	Gymnocanthus galeatus	armorhead sculpin
	Hemilepidotus	red Irish lord
	Hemilepidotus jordani	yellow Irish lord
	Hemilepidotus papilio	butterfly sculpin
	Hemilepidotus zapus	longfin Irish lord
	Hemitripterus bolini	bigmouth sculpin
	Icelus spatula	spatulate sculpin
	Icelus spiniger	thorny sculpin
	Leptocottus armatus	Pacific staghorn sculpin
	Malacocottus kincaidi	blackfin sculpin
	Malacocottus zonurus	darkfin sculpin
	Microcottus sellaris	brightbelly sculpin
	Myoxocephalus polyacanthocephalus	great sculpin
	Myoxocephalus verrucosus	warty sculpin
	Nautichthys oculofasciatus	sailfin sculpin
	Paricelinus hopliticus	thornback sculpin
	Psychrolutes spp.	
	Thyriscus anoplus	sponge sculpin
	Triglops forficatus	scissortail sculpin
	Triglops macellus	roughspine sculpin
	Triglops pingeli	ribbed sculpin
	Triglops scepticus	spectacled sculpin

Table B-1.--Continued.

Family	Scientific name	Common name
Agonidae		poachers
	Agonopsis vulsa	northern spearnose poacher
	Aspidophoroides bartoni	Aleutian alligatorfish
	Bathyagonus nigripinnis	blackfin poacher
	Hypsagonus quadricornis	fourhorn poacher
	Podothecus acipenserinus	sturgeon poacher
	Sarritor frenatus	sawback poacher
Cyclopteridae		lumpsuckers
	Acantholiparis opercularis	spiny snailfish
	Aptocyclus ventricosus	smooth lumpsucker
	Careproctus cypselurus[2]	blackfinned snailfish
	Careproctus melanurus	blacktail snailfish
	Careproctus phasma	spectral snailfish
	Eumicrotremus orbis	Pacific spiny lumpsucker
	Liparis callyodon	spotted snailfish
	Liparis gibbus	variegated snailfish
Bathymasteridae		ronquils
	Bathymaster caeruleofasciatus	Alaskan ronquil
	Bathymaster signatus	searcher
Zoarcidae		eelpouts
	Bothrocara brunneum	twoline eelpout
	Lycodes brevipes	shortfin eelpout
	Lycodes concolor	ebony eelpout
	Lycodes cortezianus	bigfin eelpout
	Lycodes diapterus	black eelpout
	Lycodes palearis	wattled eelpout
Stichaeidae		pricklebacks
	Chirolophis decoratus	decorated warbonnet
Cryptacanthodidae		wrymouths
	Cryptacanthodes aleutensis	dwarf wrymouth
Zaproridae		prowfishes
	Zaprora silenus	prowfish
Trichodontidae		sandfishes
	Trichodon trichodon	Pacific sandfish
Ammodytidae		sand lances
	Ammodytes hexapterus	Pacific sand lance
Bothidae		lefteye flounders
	Citharichthys sordidus	Pacific sanddab

Table B-l .-Continued.

Family	Scientific name	Common name
Pleuronectidae		righteye flounders
	Atheresthes evermanni	Kamchatka flounder
	Atheresthes stomias	arrowtooth flounder
	Errex zachirus	rex sole
	Hippoglossoides elassodon	flathead sole
	Hippoglossus stenolepis	Pacific halibut
	Microstomus pacificus	Dover sole
	Platichthys stellatus	starry flounder
	Pleuronectes asper	yellowfin sole
	Pleuronectes bilineatus	rock sole
	Pleuronectes isolepis	butter sole
	Pleuronectes vetulus	English sole
	Reinhardtius hippoglossoides	Greenland turbot

[1]Allen, M. J. 1983. Provisional key to the skates (Rajidae) of the Bering Sea. Unpublished manuscript. Northwest and Alaska Fisheries Center, RACE, 7600 Sand Point Way NE, Seattle, WA 98115, 9 P.

[2]Baxter, R. 1989. Annotated key to the fishes of Alaska. Unpublished manuscript. Center for Alaskan Coastal Studies, P.O. Box 2225, Homer, Alaska 99669,716 p.

[3]Hart. J. L. 1973. Pacific Fishes of Canada, Fish. Res. Board Can., No. 180. Ottawa 740 p.

[4]Raschi, W.. and J. D. McEachran. 1991. Rhinoraja longi, a new species of skate from the outer Aleutian Islands. with comments on the status of Rhinoraja (Chondrichthyes, Rajoidei). Can. J. Zool. 69: 1889-1903.

[5]Robins, C. R., R. M. Bailey, C. E. Bond, J. R. Brooker, E. A. Lachner, R. N. Lea, and W. B. Scott. 1991. Common and scientific names of fishes from the United States and Canada. Fifth edition. Am. Fish. Soc. Spec. Publ. No. 20. 183 p.

[6]Yabe, M. 1991. Bolinia euryptera, a new genus and species of sculpin (Scorpaeniformes: Cottidae) from the Bering Sea. Copeia 1991(2):329-339.

Table B-2.--List of invertebrates idenified during the 1991 Aleutian Island groundfish survey.

Phylum	Scientific name	Common name
Phylum Porifera		sponges
	Suberites ficus	hermit sponge
	Mycale loveni	tree sponge
	Myxilla incrustans	scallop sponge
	Class Hexactinellida	glass sponge
Phylum Coelenterata		corals
	Primnoa willeyi	Alaska coral
	Primnoa spp.	Primnoa corals
	Paragorgia arborea	Kamchatka coral
	Callogorgia spp.	golden corals
	Virgularia spp.	smoothstem seawhips
	Stylatula spp.	slender seawhips
	Ptilosarcus gurneyi	Gurney's sea pen
	Metridium senile	frilled anenome
	Metridium spp.	Metridium anenomes
Phylum Ctenophora		comb jellies
Phylum Annelida		annelid worms
	Class Polychaeta	polychaete worms
	Carcinobdella cyclostomum	striped sea leech
Phylum Arthropoda		arthropods
barnacles	Balanus spp.	unidentified barnacles
	Balanus evermanni	giant barnacle
shrimp	Eualus barbata	beaked eualid
	Lebbeus groenlandicus	spiny lebbeid
	Pandalus jordani	ocean shrimps
	Pandalus borealis	northern shrimps
	Pandalus tridens	yellowleg pandalid
	Pandalus goniurus	humpy shrimp
	Pandalus hypsinotus	coonstripe shrimp
	Pandalus spp.	unidentified pandalid
	Pandalopsis dispar	sidestripe shrimp
	Crangon spp.	unidentified crangonid
	Argis spp.	unidentified argid
	Sclerocrangon boreas	sculptured shrimp
crabs	Pagurus aleuticus	Aleutian hermit
	Pagurus brandti	sponge hermit
	Pagurus capillatus	hairy hermit
	Pagurus dalli	whiteknee hermit
	Pagurus spp.	hermit crabs
	Acantholithodes hispidus	fuzzy crab
	Lithodes aequispina	golden king crab
	Lithodes couesi	scarlet king
	Paralithodes camtschatica	red king crab
	Placetron wosnessenskii	scaled crab
	Rhinolithodes wosnessenskii	rhinoceros crab

Table B-2.--Continued.

Phylum	Scientific name	Common name
Phylum Decopoda (cont.)		decapod crabs
crabs (cont.)	Chionoecetes bairdi	Tanner crab
	Chionoecetes opilio	snow crab '
	Hyas lyratus	Arctic lyre crab
	Hyas spp.	lyre crabs
	Oregonia gracilis	graceful decorator crab
	Cancer oregonensis	pygmy rock crab
	Erimacrus isenbeckii	hair crab
	Telmessus cheiragonus	helmet crab
	Class Pycnogonida	sea spiders
Phylum Mollusca		mollusks
chitons	unidentified chitons	unidentified chitons
gastropods	unidentified limpets	unidentified limpets
	Natica spp.	moon snails
	Fusitriton oregonensis	Oregon triton
	Boreotrophon spp.	boreotrophon snails
	Buccinum sigmatopleura	
	Buccinum spp.	buccinum snails
	Beringius kennicotti	Kennicott's beringius
	Beringius beringii	northern beringius
	Beringius stimpsoni	Stimpson's beringius
	Colus spp.	colus snails
	Neptunea pribiloffensis	Pribilof whelk
	Neptunea spp.	neptune snails
	Volutopsius spp.	volutopsius snails
	Arctomelon stearnsii	Alaska volute
	Tochuina tetraquetra	giant orange tochui
bivalves	Yoldia thraciaeformis	broad yoldia
	Modiolus modiolus	northern horsemussel
	Chlamys islandica	Iceland scallop
	Chlamys rubida	Hind's scallop
	Chlamys spp.	chlamys scallops
	Pododesmus macroschisma	Alaska falsejingle
	Hiatella arctica	arctic hiatella
	Clinocardium spp.	cockles
	Dentalium spp.	
cephalopods	Rossia pacifica	Pacific bobtailed squid
	Berryteuthis magister	red squid
	Moroteuthis robusta	robust clubhook squid
	Octopus dofleini	giant octopus
	Octopus leioderma	smoothskin octopus

Table B-2.--Continued.

Phylum	Scientific name	Common name
Phylum Echinodermata		echinoderms
Echinoidea	Strongylocentrotus droebachiensis	green sea urchin
Asteroid starfish	Luidiaster dawsoni	
	Ceramaster japonicus	red bat star
	Ceramaster patagonicus	orange bat star
	Ceramaster spp.	Ceramaster sea stars
	Hippasteria spinosa	spiny red sea star
	Mediaster aequalis	vermillion sea star
	Pseudarchaster spp.	scarlet sea star
	Crossaster borealis	grooved sea star
	Crossaster papposus	rose sea star
	Crossaster spp.	Crossaster sea stars
	Solaster endeca	northern sun sea star
	Solaster stimpsoni	sun sea star
	Solaster spp.	Solaster sea stars
	Diplopteraster multipes	pincushion sea star
	Pteraster obscurus	obscure sea star
	Pteraster tesselatus	cushion sea star
	Pteraster spp.	Pteraster sea stars
	Henricia leviuscula	blood sea star
	Henricia tumida	tumid sea star
	Henricia spp.	Henricia sea stars
	Lethasterias nanimensis	blackspined sea star
	Pycnopodia helianthoides	twentyarm sea star
Ophiuroid starfish	unidentified brittlestarfish	brittlestarfish
	Gorgonocephalus caryi	basketstarfish
Holothuroidea	Bathyplotes spp.	slender sea cucumbers
	Cucumaria fallax	sea football
	Cucumaria spp.	Cucumaria sea cucumbers
	Psolus fabricii	brownscaled sea cucumber
	Psolus spp.	Psolus sea cucumbers
Phylum Sipuncula		sipunculid worms
Phylum Ectoprocta		bryozoans
Phylum Chordata		chordates
Ascidiacea		tunicates
	Halocynthia aurantium	sea peach
	Halocynthia spp.	Halocynthia tunicates
	unidentified species	compound ascidians
Thaliacea		salps

APPENDIX C

Length-Weight Regressions for Major Species

Length-weight relationships for major species were calculated using a non-linear least-squares regression algorithm. The equation used for the regression was

$$Weigh_{(grams)} = a \cdot Length_{(mm)}^{b}.$$

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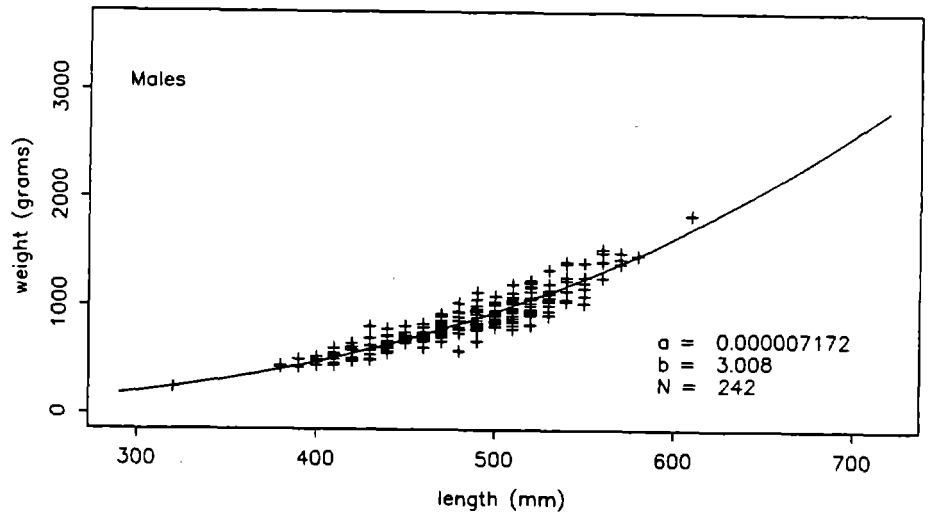
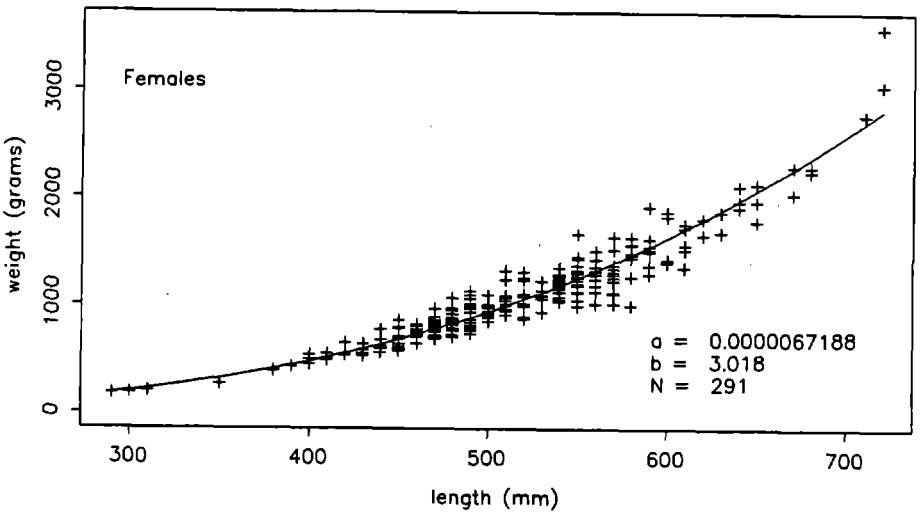
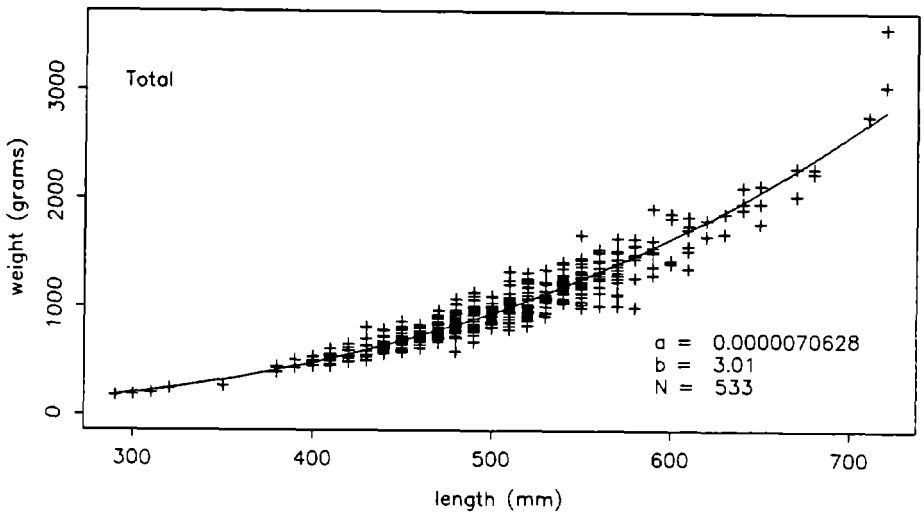
WALLEYE POLLOCK

length vs. weight regression ($weight_{(grams)} = a \cdot length^{b}_{(mm)}$)

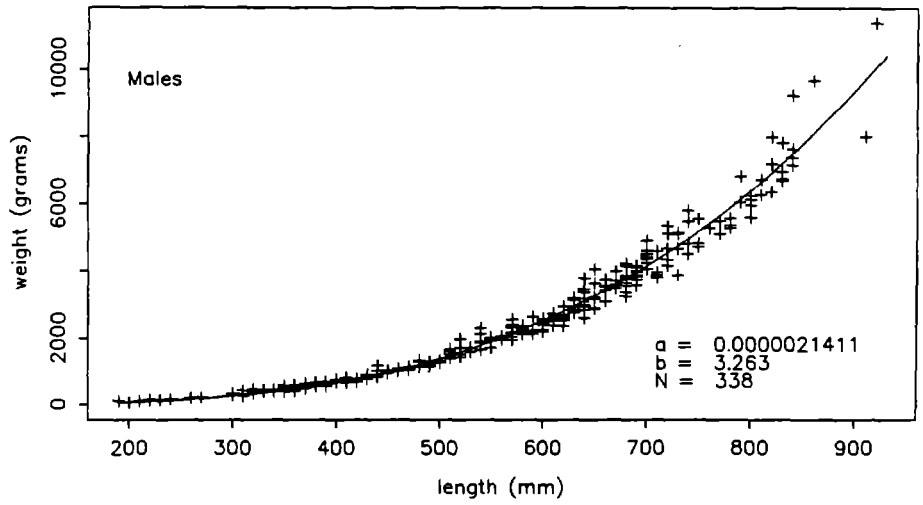


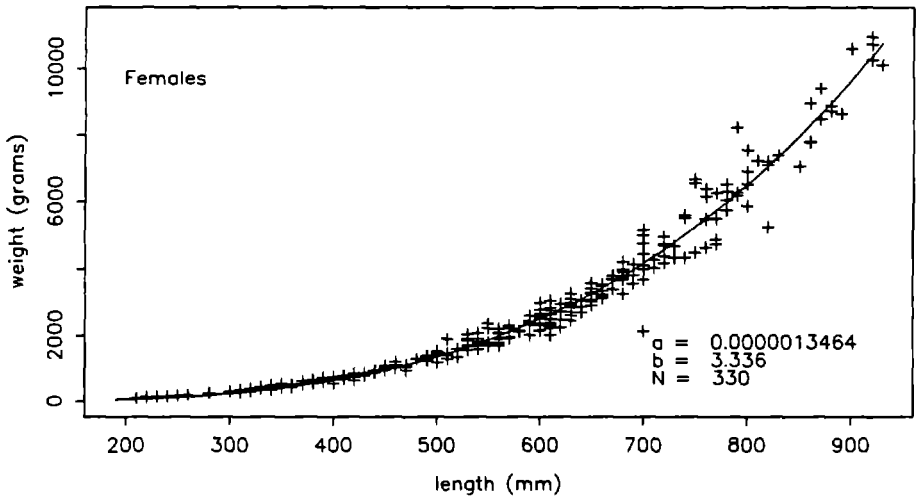


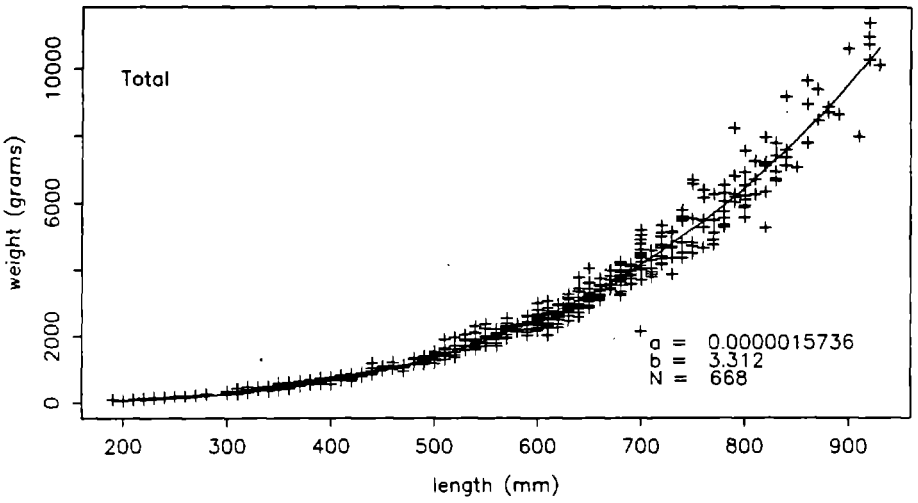


PACIFIC COD

length vs. weight regression ($weight_{(grams)} = a \cdot length^{b}_{(mm)}$)

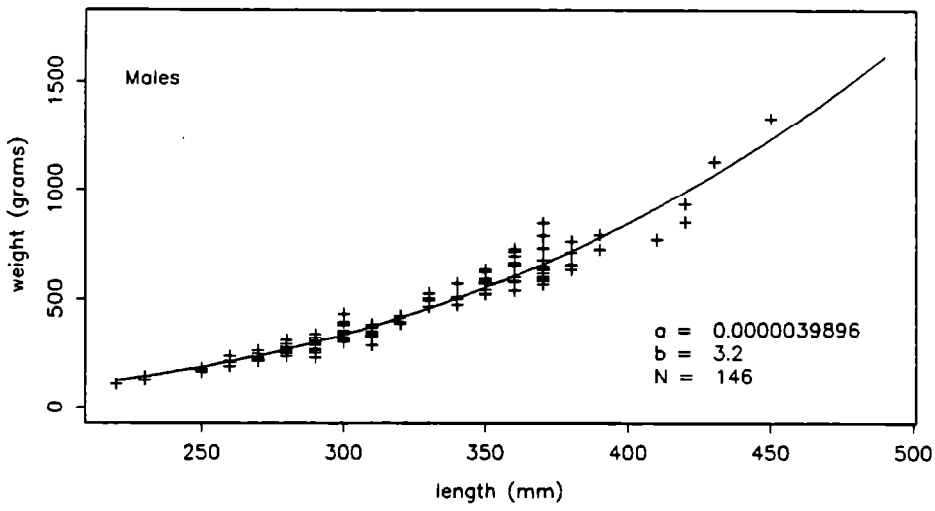


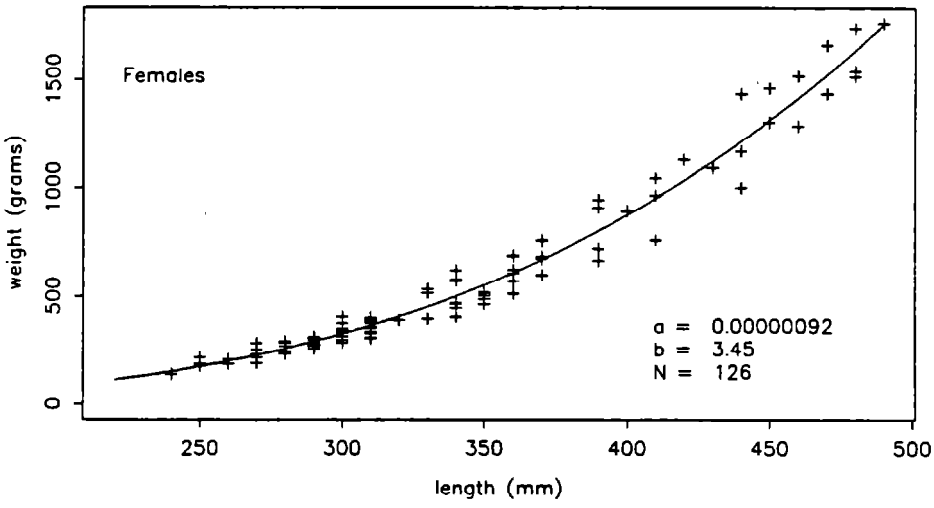


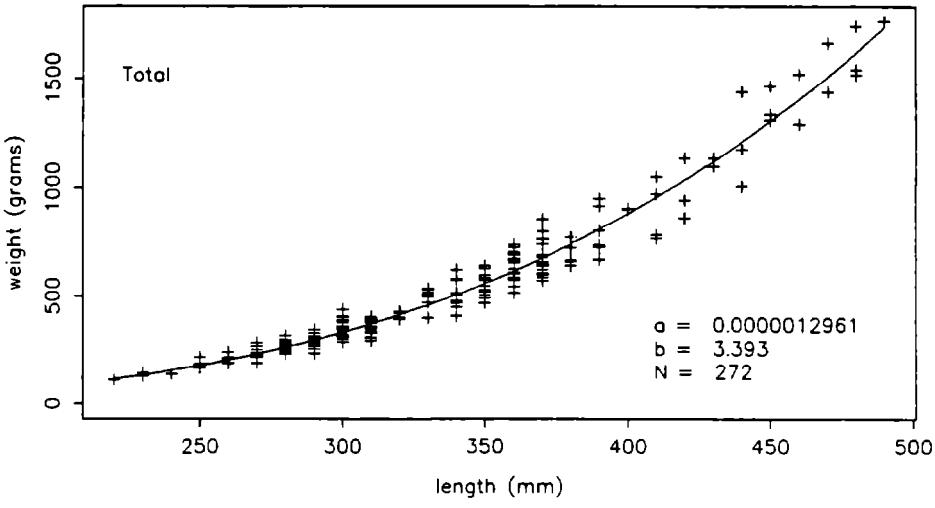


ATKA MACKEREL

length vs. weight regression ($weight_{(grams)} = a \cdot length^{b}_{(mm)}$)







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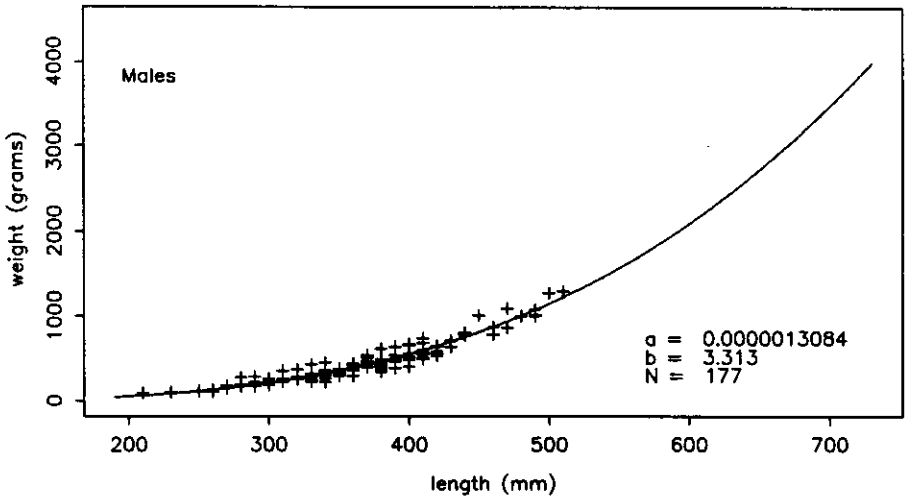
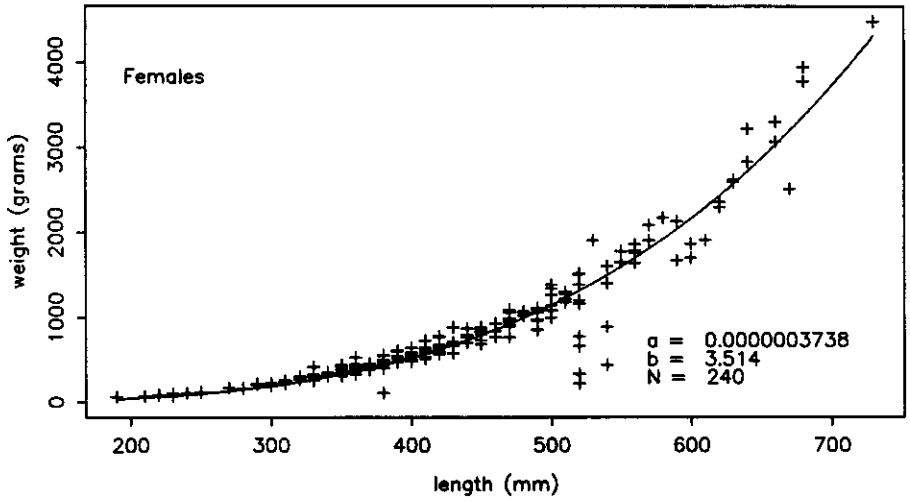
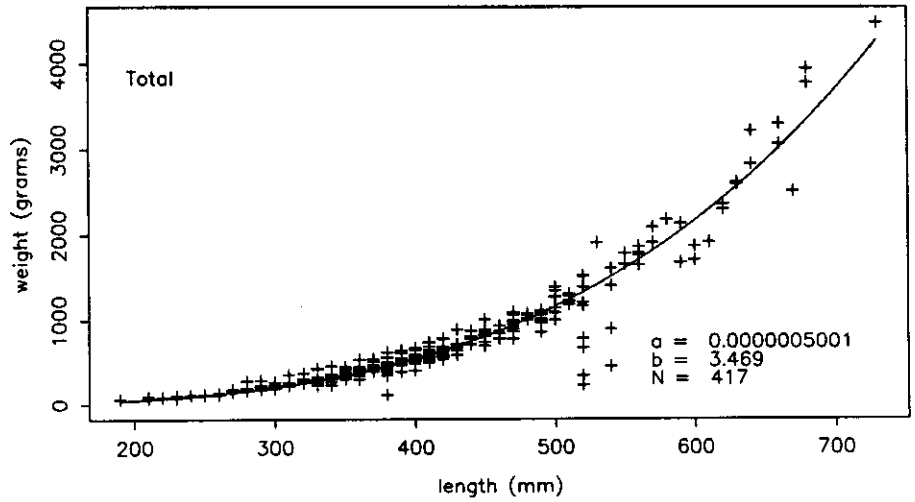
ARROWTOOTH FLOUNDER

length vs. weight regression ($weight_{(grams)} = a * length^{b}_{(mm)}$)

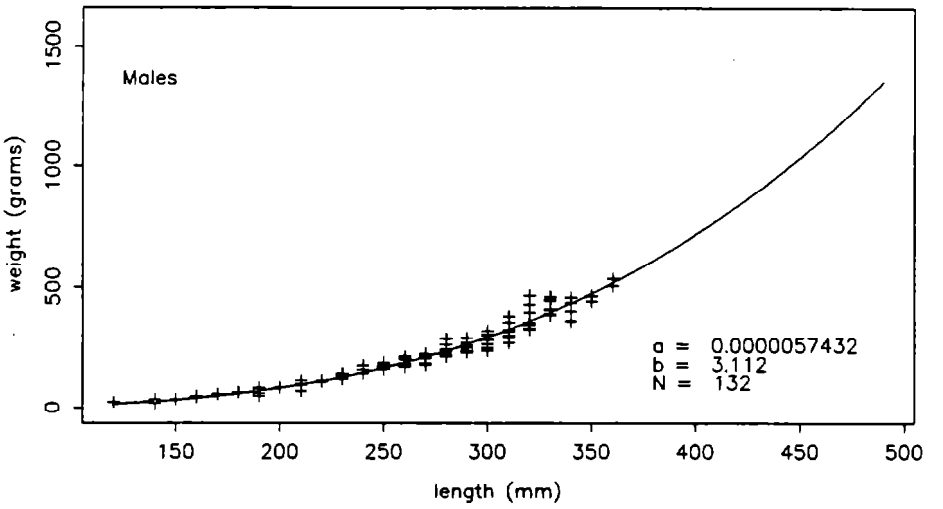


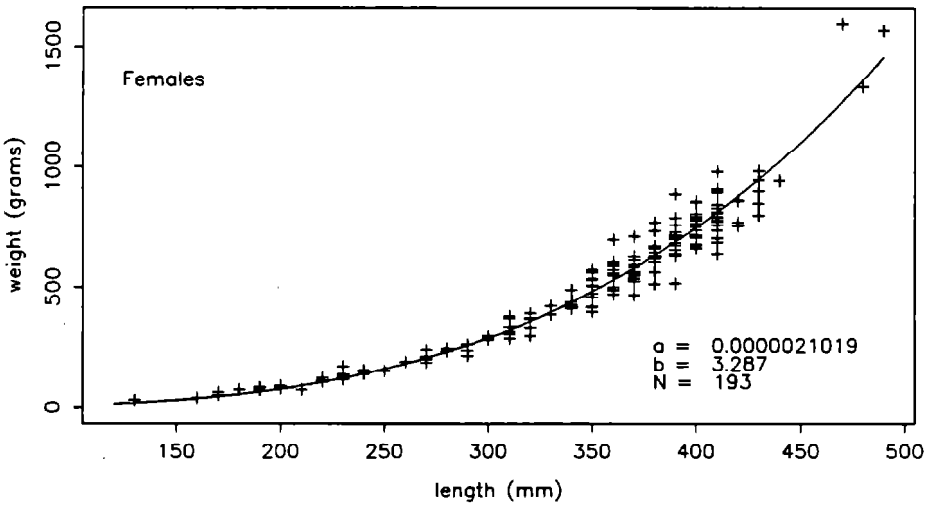


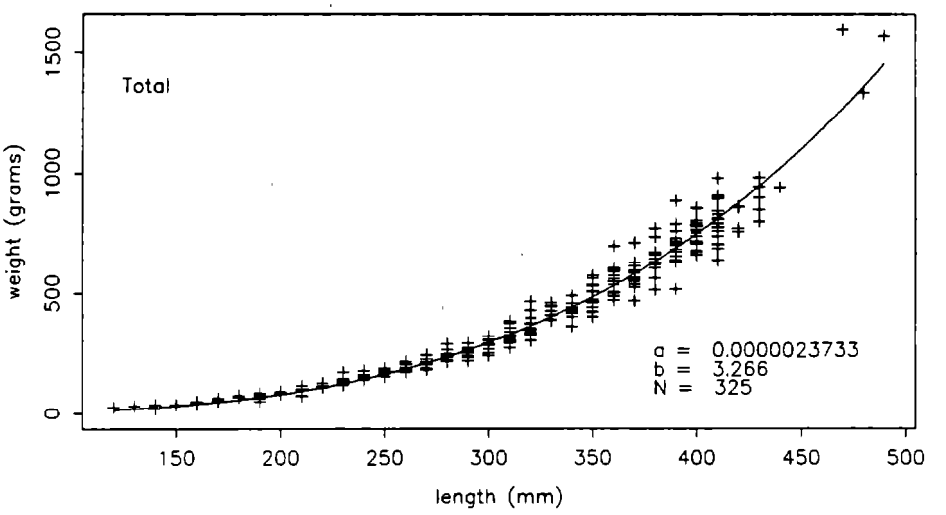


ROCK SOLE

length vs. weight regression ($weight_{(grams)} = a \cdot length^{b}_{(mm)}$)

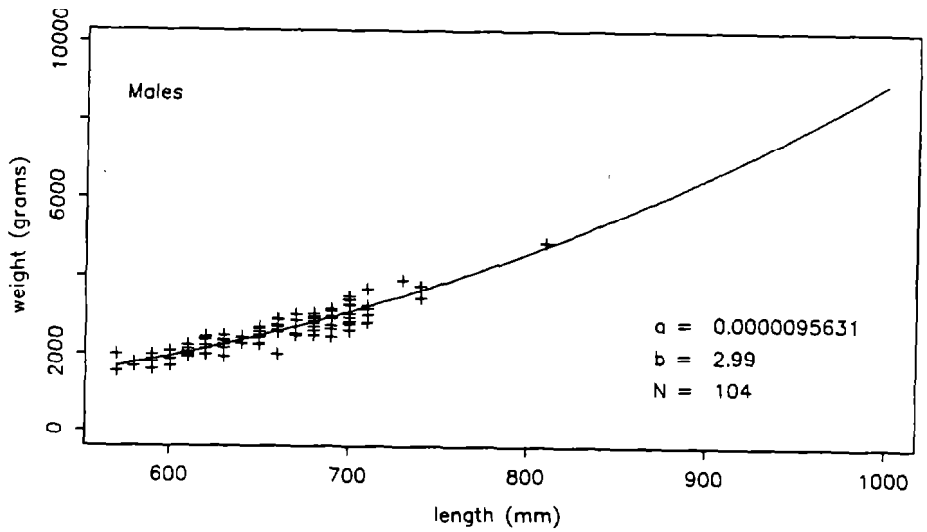


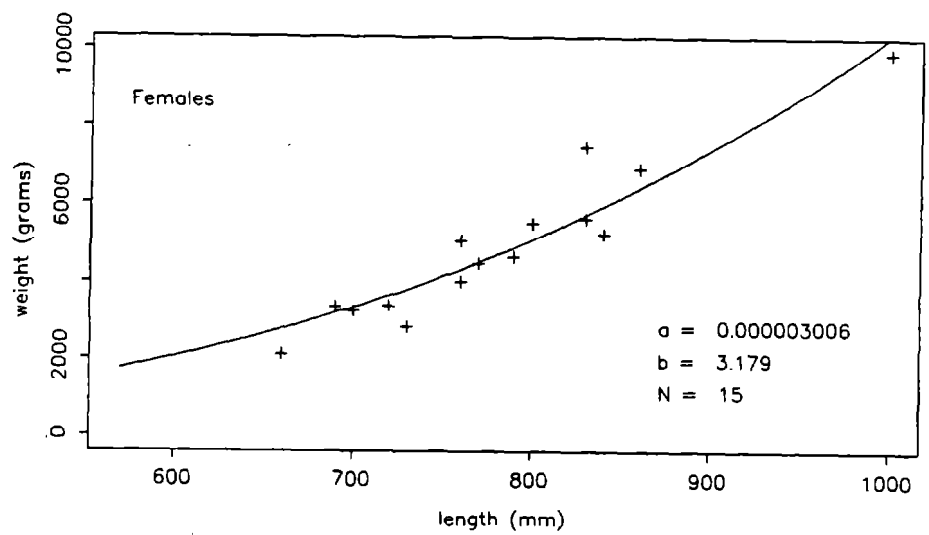


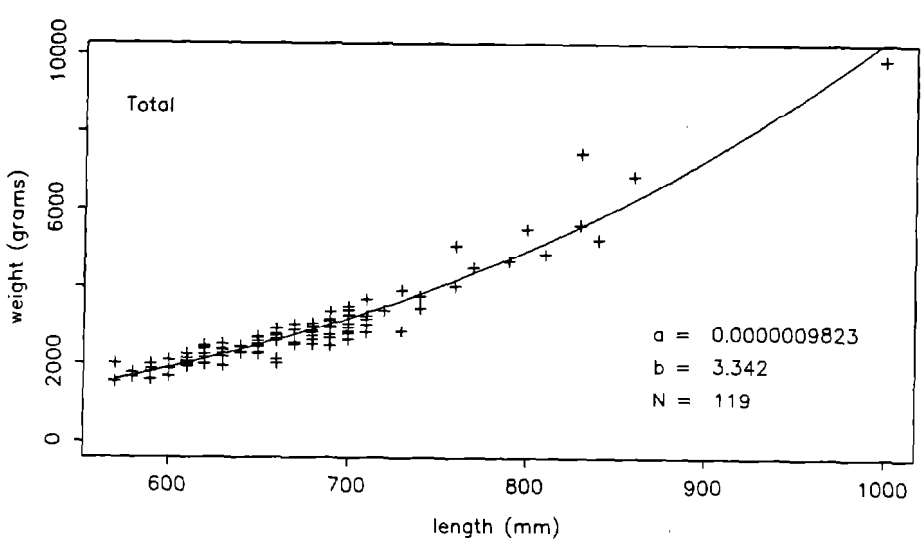


GREENLAND TURBOT

length vs. weight regression ($weight_{(grams)} = a \cdot length^{b}_{(mm)}$)

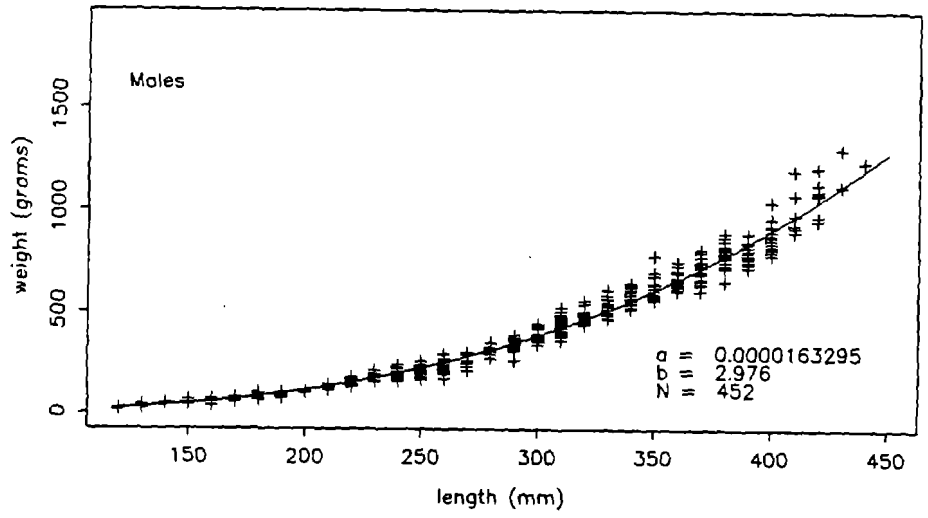


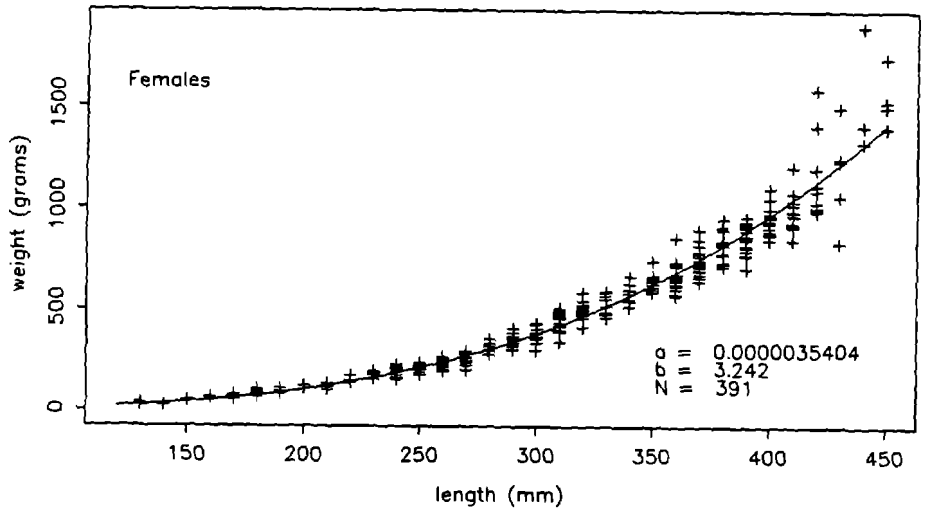


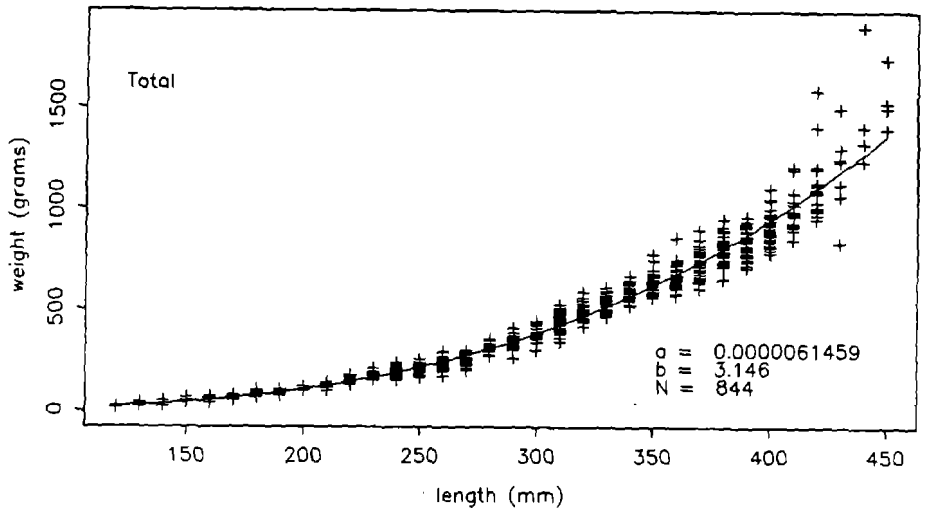


PACIFIC OCEAN PERCH

length vs. weight regression ($weight_{(grams)} = a \cdot length^{b}_{(mm)}$)

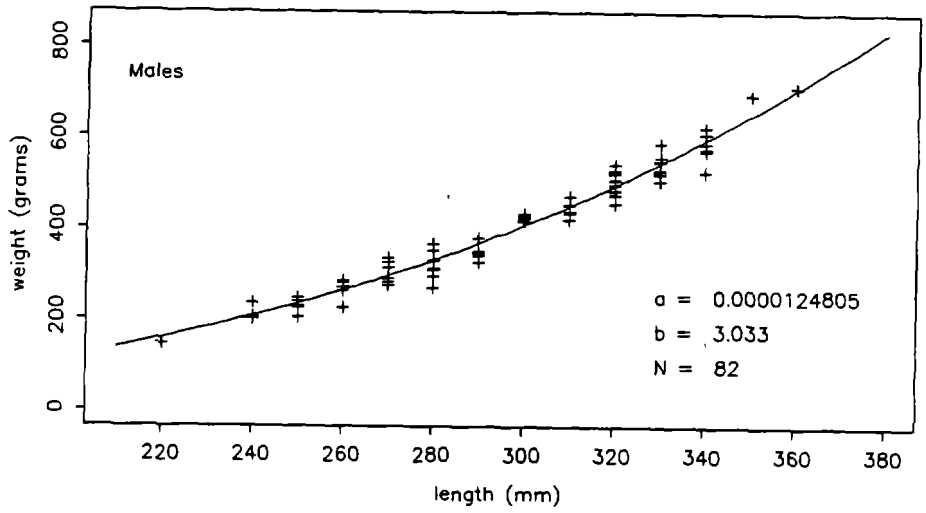


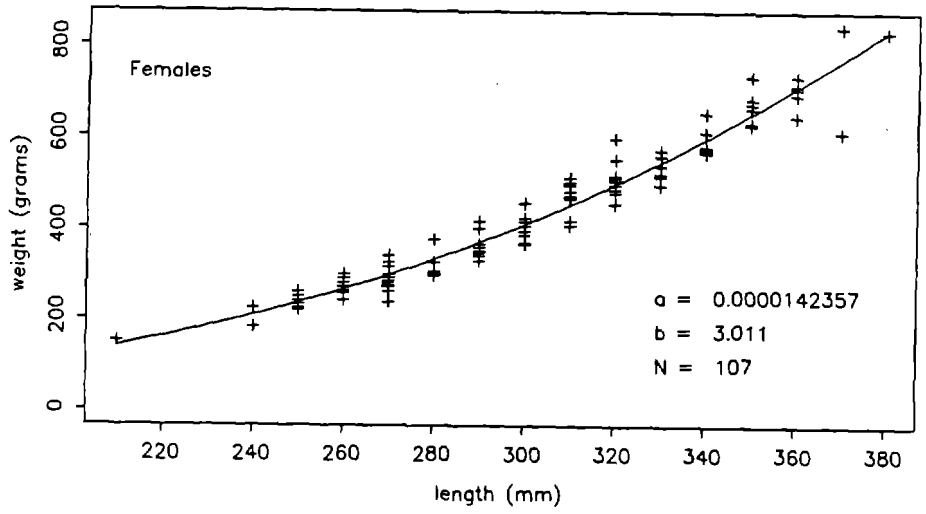


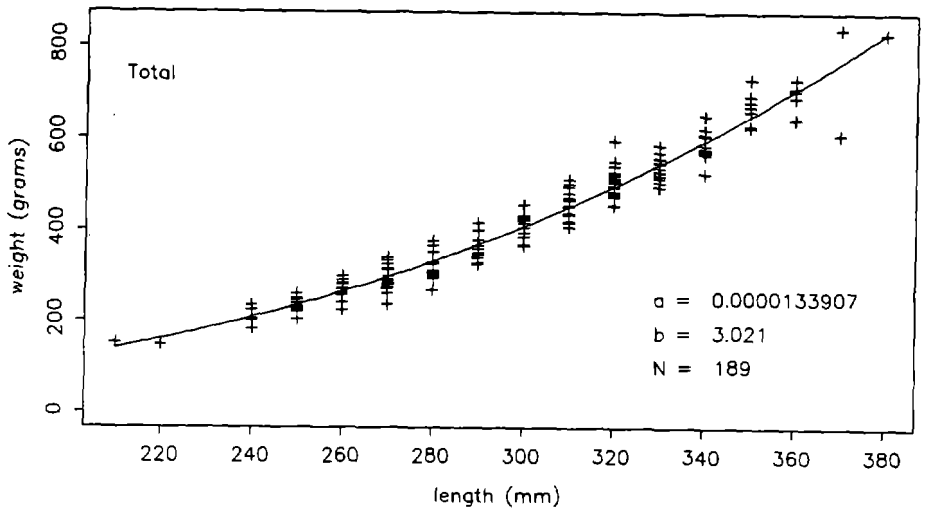


NORTHERN ROCKFISH

length vs. weight regression ($weight_{(grams)} = a \cdot length^{b}_{(mm)}$)

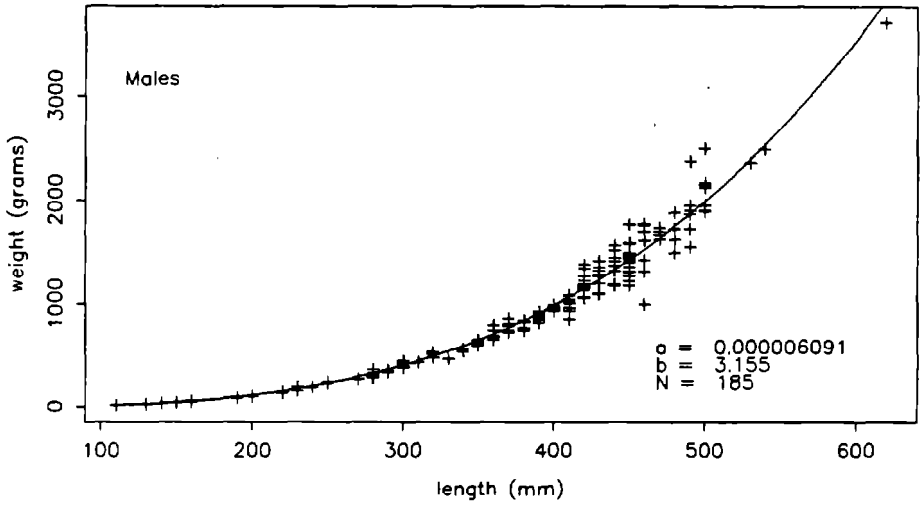


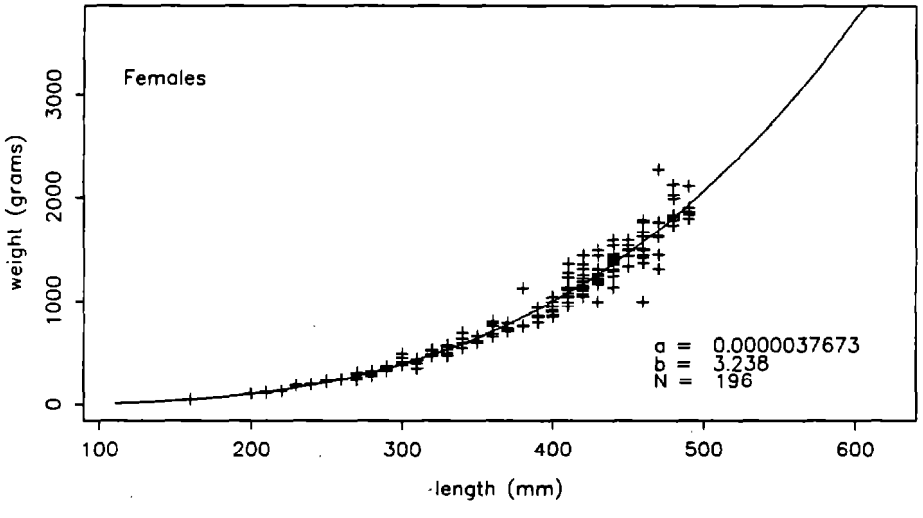


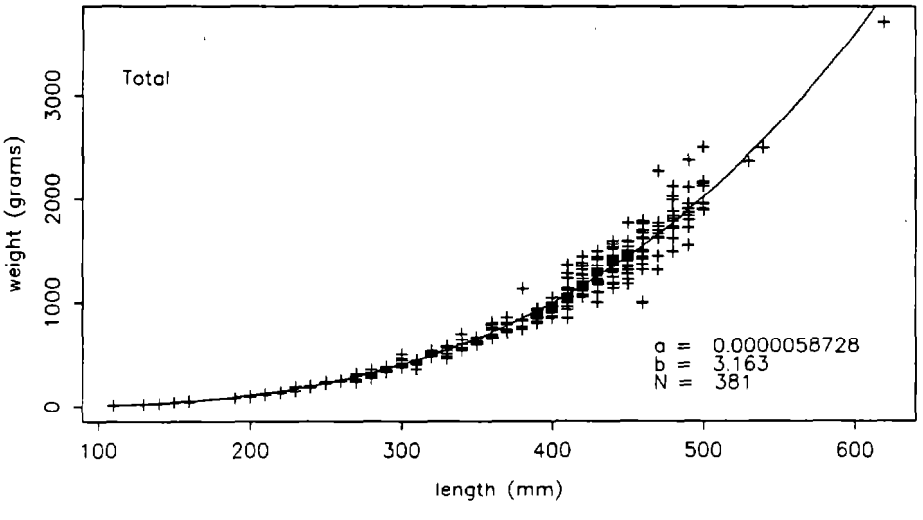


ROUGHEYE ROCKFISH

length vs. weight regression ($weight_{(grams)} = a \cdot length^{b}_{(mm)}$)

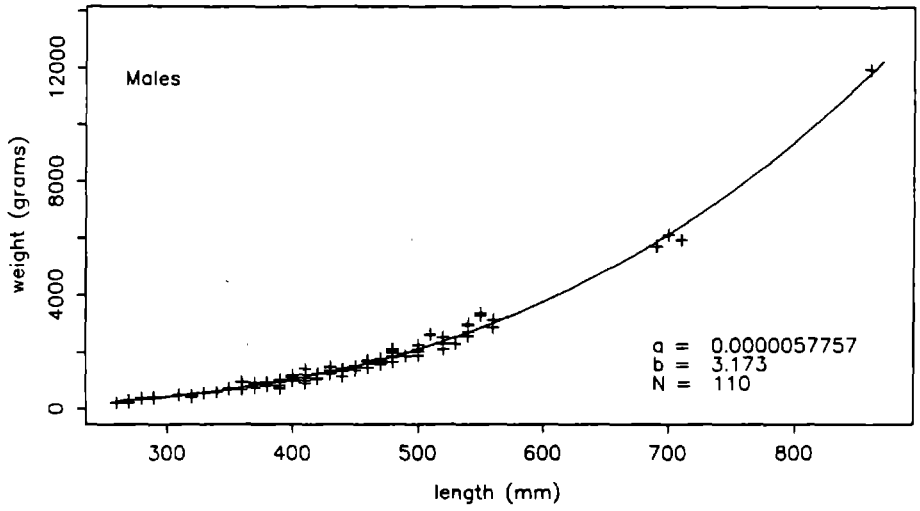


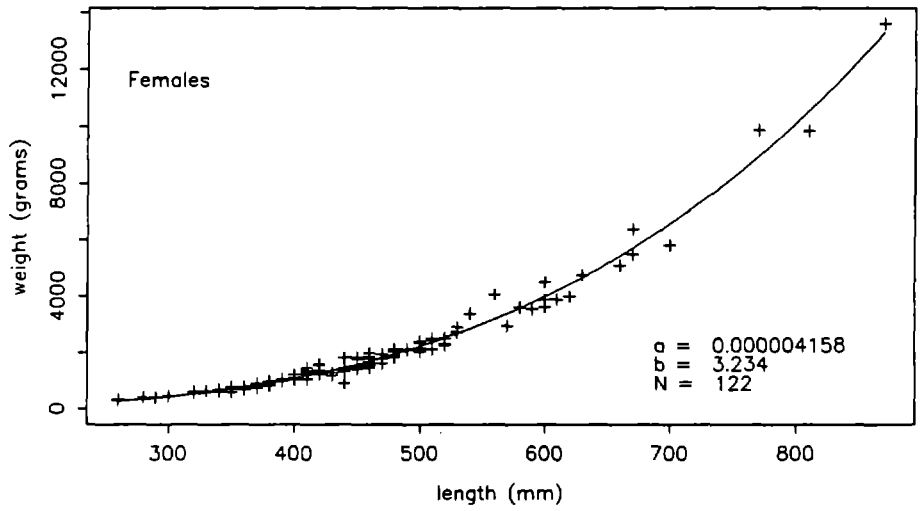


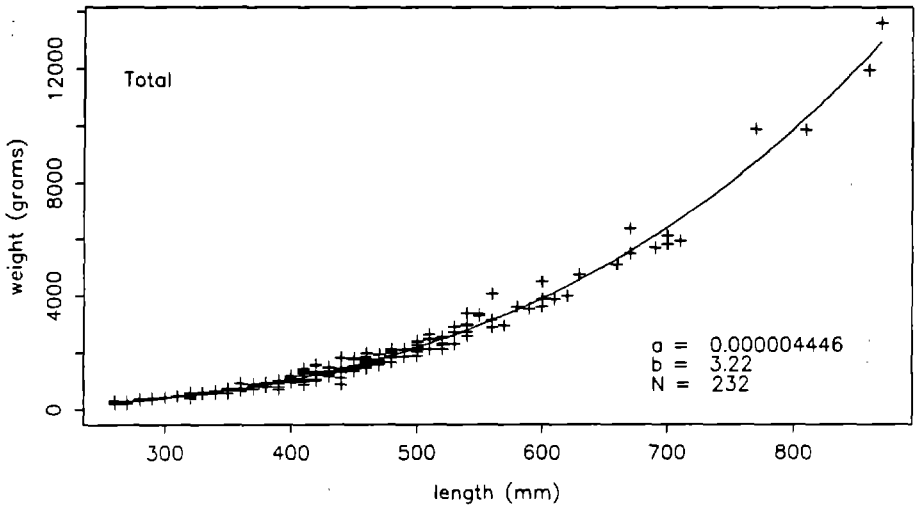


SHORTRAKER ROCKFISH

length vs. weight regression ($weight_{(grams)} = a \cdot length^{b}_{(mm)}$)

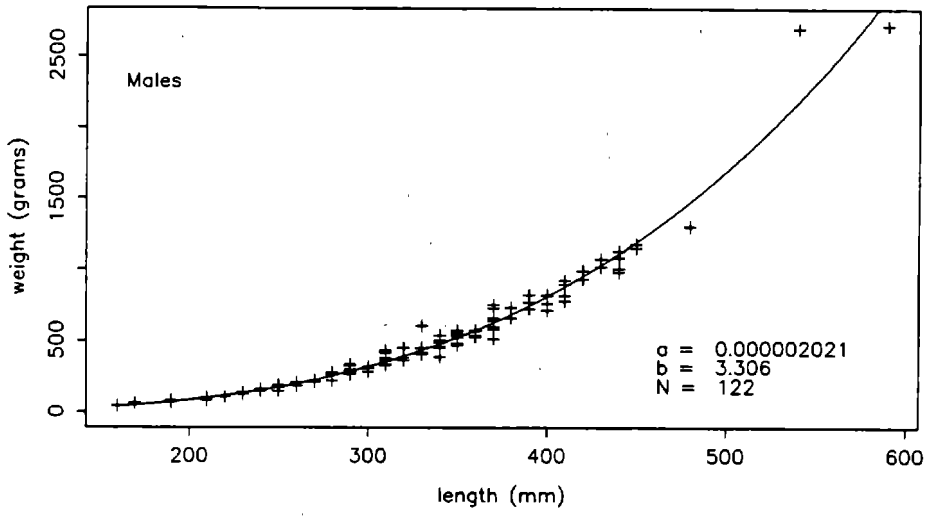


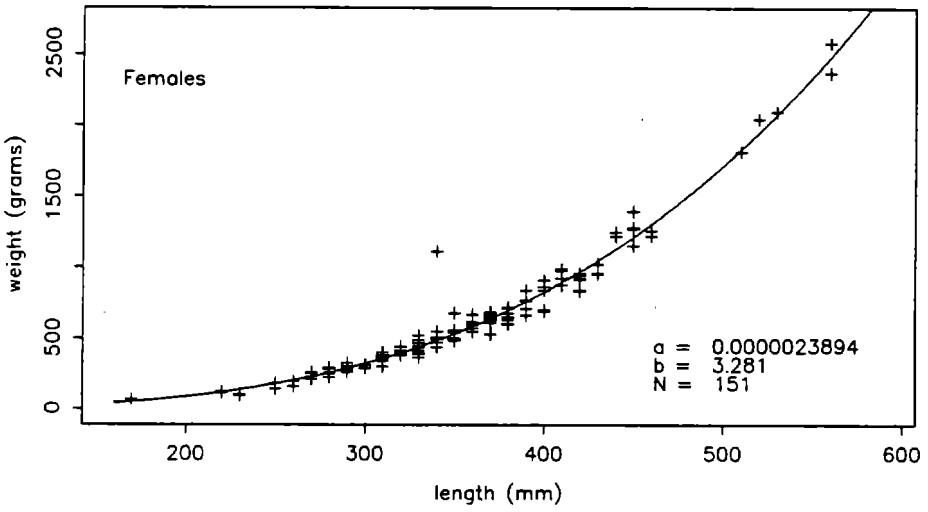


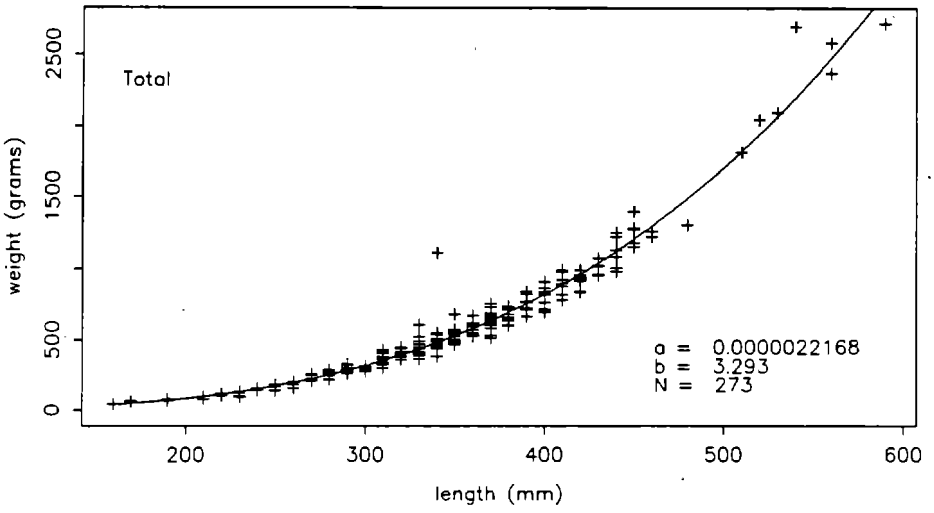


SHORTSPINE THORNYHEAD

length vs. weight regression ($weight_{(grams)} = a \cdot length^{b}_{(mm)}$)







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