



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
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Resource Assessment and Conservation Engineering Division
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November 30, 1993

CRUISE RESULTS

Cruise 93-1 Arcturus
Cruise 93-1 Aldebaran
1993 Eastern Bering Sea Crab and Groundfish Survey
June-August 1993

The Resource Assessment and Conservation Engineering Division of the Alaska Fisheries Science Center (AFSC) conducted the annual crab and groundfish survey of the eastern Bering Sea from June to August 1993. This was a continuation of the annual series of eastern Bering Sea crab-groundfish assessment surveys which began in 1971.

OBJECTIVES

The primary objective of this survey was to continue the annual series of assessment surveys of crab and groundfish of the eastern Bering sea to provide information for:

1. the North Pacific Fishery Management Council on the distribution, abundance, and biological condition of important groundfish and crab species;
2. the U.S. fishing industry on catch per unit effort (CPUE) and size composition; and
3. the support of ongoing studies on the biology, behavior, and dynamics of key ecosystem components.

Secondary objectives were to:

1. conduct additional sampling in areas of high king crab and Tanner crab abundance to reduce variability in population estimates;
2. collect ovaries from yellowfin sole for batch fecundity and mature ovarian cycling studies;
3. retrieve and redeploy long-term bottom temperature sensors which record year-around seawater temperatures;



4. evaluate trawl performance and configuration with net mensuration equipment;
5. collect stomach samples for food habit studies;
6. collect and preserve various whole specimens and tissue samples from both fish and invertebrates for special study requests; and
7. conduct a localized depletion experiment to evaluate the capture probability of animals in the path of the standard bottom trawl.

VESSELS AND GEAR

Sampling at the standard sites was coordinated between two chartered commercial vessels, the F/V Arcturus and the F/V Aldebaran. Both vessels were 39.6 m (130 ft) in length.

The standard bottom trawl used at all sampling stations was an 83-112 eastern trawl. These nets have a 25.3-m (83-ft) headrope and a 34.1-m (112-ft) footrope (Figure 1). They were towed behind 1,000-kg, 1.8-m X 2.7-m, steel V-doors and 54.9-m (180.1-ft) paired dandyline. Each lower dandyline had a 0.61-m chain extension connected to the lower wing edge to improve bottom tending characteristics. The 83-112 eastern trawl has been the standard sampling net used during annual eastern Bering Sea surveys since 1982 when it replaced the 400-mesh eastern trawl, previously used since the 1970s.

Seawater temperature profiles were collected at most sampling sites using a micro-bathythermograph attached to the headrope of the net. Surface seawater temperatures were also collected with a thermometer lowered over the side of the ships.

Net mensuration systems aboard both vessels were used to provide sampling net configuration and performance data to be used in area-swept and CPUE calculations.

ITINERARY

The Arcturus and Aldebaran departed Dutch Harbor, Alaska, on June 2 and returned to Dutch Harbor on August 1 upon the completion of the 1993 eastern Bering Sea crab-groundfish survey. Intervening port calls were made by both vessels in Dutch Harbor on June 20 and July 13 to obtain supplies and exchange scientific personnel.

SURVEY DESIGN AND METHODS

The standard survey area is shown in Figure 2. Sampling sites were established on the basis of a 20-nm x 20-nm grid pattern used during previous surveys, although more intensive sampling was carried out in the Pribilof Islands and St. Matthew Island regions to collect additional data on crab populations. Additional stations northwest of the standard survey area were established to estimate the abundance of Tanner crab (Chionoecetes opilio) in an area that has produced high commercial landings in recent years. Several days were allocated to intensify sampling efforts near standard station locations where large concentrations of king or Tanner crab were encountered.

At the beginning of the survey, the Aldebaran retrieved temperature array devices from Port Moller, Port Heiden, and Kvichak Bay which had been deployed during the 1992 eastern Bering Sea crab and groundfish survey. The temperature data were recorded and these devices were reset at three sites off Port Moller. Information obtained from these units provides a year-around record of seawater temperature fluctuations in Bristol Bay. The Arcturus and Aldebaran then sampled alternate north/south rows of stations proceeding from Bristol Bay westward to the shelf edge. A tow 30 minutes in duration was made at most sampling sites. All catches were sorted to the lowest possible taxon, weighed, and enumerated. Station data--including time, position, trawl performance, and distance fished, as well as catch information--were entered onto diskettes with shipboard computer systems. Collections of age samples (by sex-centimeter category), size composition, and other biological data were collected from the major fish species encountered. Length-width measurements, shell condition, clutch size, and tissues and organs for various studies were collected from the major crab species. Special study collections were stored in appropriate fixatives or were frozen.

Upon the completion of the standard survey, a site near St. Paul Island was selected to conduct a localized depletion experiment. This experiment was designed to compare estimates of population size computed from area-swept statistics with those derived from Leslie-Delury analysis to compute the catchability of selected species. Both vessels sampled randomly chosen transects in a single 0.5-nm x 0.5-nm area. Each tow was fixed at 0.5 nm in distance. Tanner crab (C. opilio) and the snail Neptunea pribiloffensis were retained from each tow, counted, and processed for size composition. All other species were discarded.

RESULTS

The Arcturus and Aldebaran conducted a total of 396 bottom trawls during the survey--including 376 successfully completed trawls at scheduled sampling sites, 14 opportunistic hauls to collect additional information on crab, and 6 unsuccessful hauls. An additional 80 bottom trawls were completed during the localized depletion study.

Biological data collected from fish species are summarized in Table 1. The two vessels recorded approximately 150,700 length measurements from the major fish species and about 3,900 age structures were collected and preserved. Individual length-weight data were also recorded for Pacific cod. Over 9,000 stomachs were preserved from various fish taxa for feeding habit analysis. Over 600 ovary pairs were collected from yellowfin sole for batch fecundity estimation and examination of mature ovarian cycling. Whole specimens and tissue samples of various fish and invertebrate species were preserved for identification, training, and other purposes.

The total standard survey area encompassed approximately 463,400 km² and overall catches averaged 325.2 kg/ha trawled. Catch rates of commercially-important fish and crab species, by depth zone, are shown in Table 2.

Walleye pollock was the most abundant fish species and had an overall CPUE of 115.3 kg/ha trawled. They were encountered at nearly all sampling sites, with largest mean catches (136.3 kg/ha) observed in central shelf waters at depths of 50-100 m (Figure 3). Mean catches were much lower at depths less than 50 m (33.9 kg/ha).

Yellowfin sole and rock sole were the most abundant flatfish species, with overall CPUE values of 41.0 kg/ha and 36.1 kg/ha, respectively. Yellowfin sole were primarily restricted to central and inner shelf waters, while rock sole were more broadly distributed with concentrations in Bristol Bay, around the Pribilof Islands, and the outer shelf (Figures 4 and 5). Yellowfin sole catches decreased sharply with increased depth, from 107.6 kg/ha in waters less than 50 m to 0.1 kg/ha in waters greater than 100 m. A similar depth-related decrease in rock sole abundance was also observed.

Pacific cod were encountered at nearly all sites sampled (Figure 6). Catch rates varied only slightly by depth zone with mean catches ranging from 13.8 kg/ha to 15.5 kg/ha.

Alaska plaice, flathead sole/Bering flounder, arrowtooth/Kamchatka flounder, and Pacific halibut had a combined catch rate of 32.2 kg/ha. Alaska plaice and flathead sole/Bering flounder were the most abundant species of this group, with an overall catch rate of 9.0 kg/ha and 9.9 kg/ha, respectively.

Tanner crab (*C. opilio*) was the most abundant commercially-important crab species encountered, with a total average catch rate of 8.9 kg/ha. Red king crab, blue king crab, and Tanner crab (*C. bairdi*) each had overall catch rates of less than 1.5 kg/ha trawled.

SCIENTIFIC PERSONNEL^a

Arcturus

<u>Leg 1</u>	<u>Leg 2</u>	<u>Leg 3</u>
D. Nichol ^b	G. Walters ^b	P. Anderson ^{bc}
D. Roetcisoender	P. Goddard	P. Goddard
R. Wiggins	D. McFee	D. McFee
M. Conrad	D. Holtz	C. Derrah
B. Dew ^c	S. Payne ^c	B. Wood
F. Hartsock ^c	J. Orensanz ^d	K. Smith ^c

Aldebaran

<u>Leg 1</u>	<u>Leg 2</u>	<u>Leg 3</u>
C. Armistead ^b	C. Armistead ^b	R. MacIntosh ^{bc}
D. Fisk	D. Benjamin	D. Nichol
D. Smith	K. Rohrbach	B. McConnaughey
J. Haaga ^c	P. Cummiskey ^c	B. Page
K. Smith ^c	R. Clark ^c	E. Munk ^c

^a Personnel from AFSC, Seattle, unless otherwise noted

^b Field Party Chief

^c Personnel from AFSC, Kodiak Laboratory

^d Personnel from University of Washington

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Table 1.--Biological data collected by the Arcturus and Aldebaran during the 1993 eastern Bering Sea crab-groundfish survey.

Species	Length measurements	Age structures ^{1/}	Stomach samples
Walleye pollock	43,278	1,399	3,363
Pacific cod ^{2/}	10,500	653	2,499
Yellowfin sole	26,651	552	792
Rock sole	27,624	448	445
Flathead sole/ Bering flounder	20,968	140 ^{3/}	491
Pacific halibut	1,799	--	388
Alaska plaice	8,365	186	300
Arrowtooth flounder/ Kamchatka flounder	8,484	361 ^{4/}	585
Greenland turbot	632	181	100
Rex sole	467	--	--
Sakhalin sole	55	--	--
Starry flounder	103	--	--
Saffron cod	74	--	--
Longhead dab	22	--	--
Pacific herring	1,215	--	--
Skate species	424	--	424
Misc. species	10	--	--
Total	<u>150,671</u>	<u>3,920</u>	<u>9,387</u>

^{1/} Scale scrape samples, in addition to otoliths, were collected from Pacific cod. Only otoliths were taken from all other species.

^{2/} Individual length-weight data were also collected from Pacific cod.

^{3/} Age structures were collected from flathead sole only.

^{4/} Age structures were collected from each species separately.

Table 2.--Catch rates (kg/ha) by depth zone of commercially important fish and crab species taken aboard the Arcturus and Aldebaran during the 1993 eastern Bering Sea crab-groundfish survey.

Species	Inner shelf < 50 m	Central shelf 50-100 m	Outer shelf 100-200 m	Total area
Walleye pollock	33.9	136.3	133.8	115.3
Yellowfin sole	107.6	39.0	0.1	41.0
Rock sole	93.8	33.3	2.2	36.1
Pacific cod	13.8	15.5	14.3	14.8
Alaska plaice	12.4	12.4	1.1	9.0
Flathead sole/ Bering flounder	2.4	10.5	13.8	9.9
Arrowtooth flounder/ Kamchatka flounder	0.0	6.2	24.0	10.3
Pacific halibut	4.9	1.2	3.2	3.0
Opilio Tanner crab	4.2	11.1	8.3	8.9
Red king crab	0.8	2.1	0.0	1.2
Bairdi Tanner crab	1.0	1.7	1.3	1.4
Blue king crab	<0.1	1.6	1.1	1.1
Total effort (hectares)	421.9	856.5	490.9	1,769.3

83/112 EASTERN

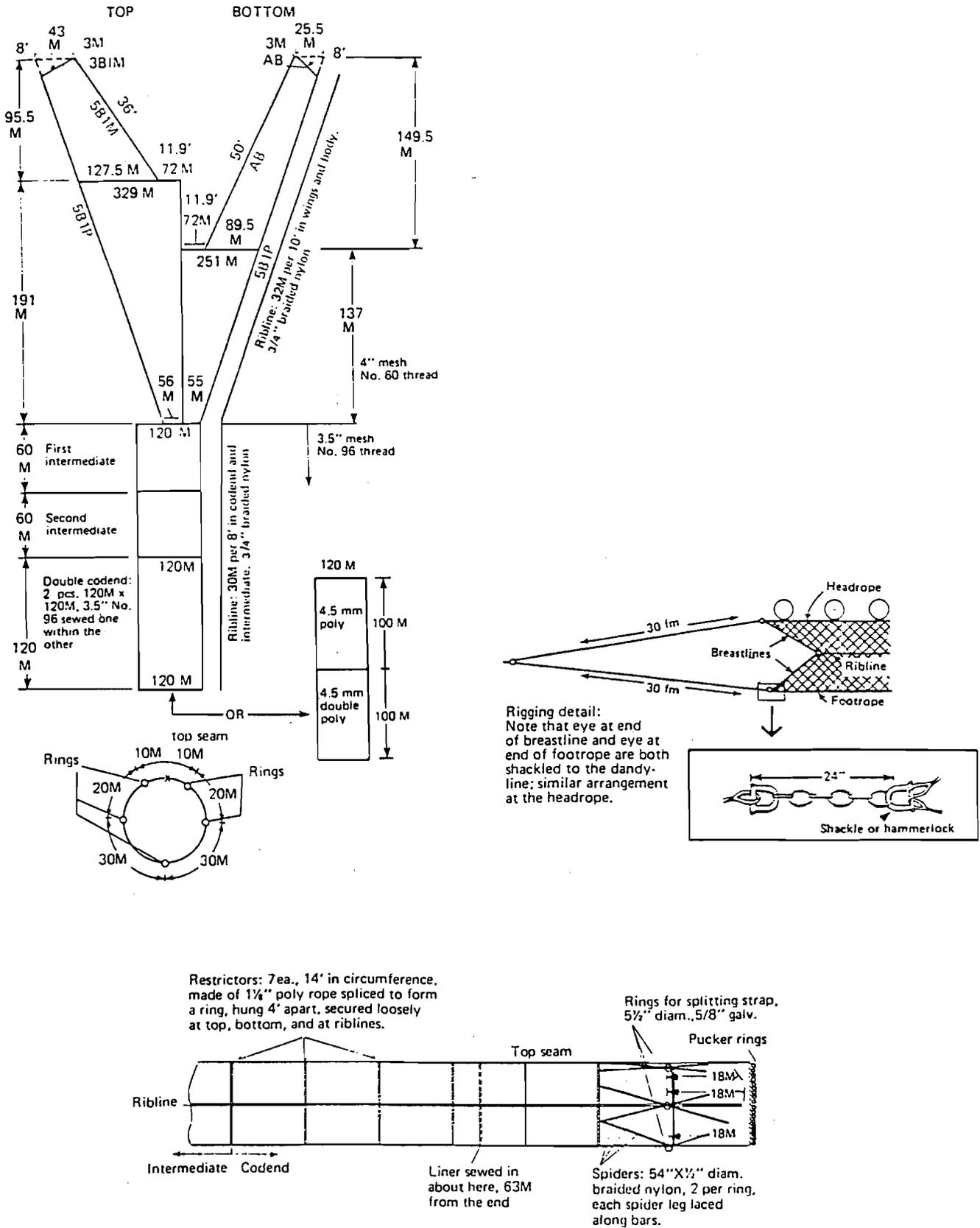


Figure 1.--Schematic diagram of sampling trawl used during the 1993 eastern Bering Sea crab and groundfish survey.

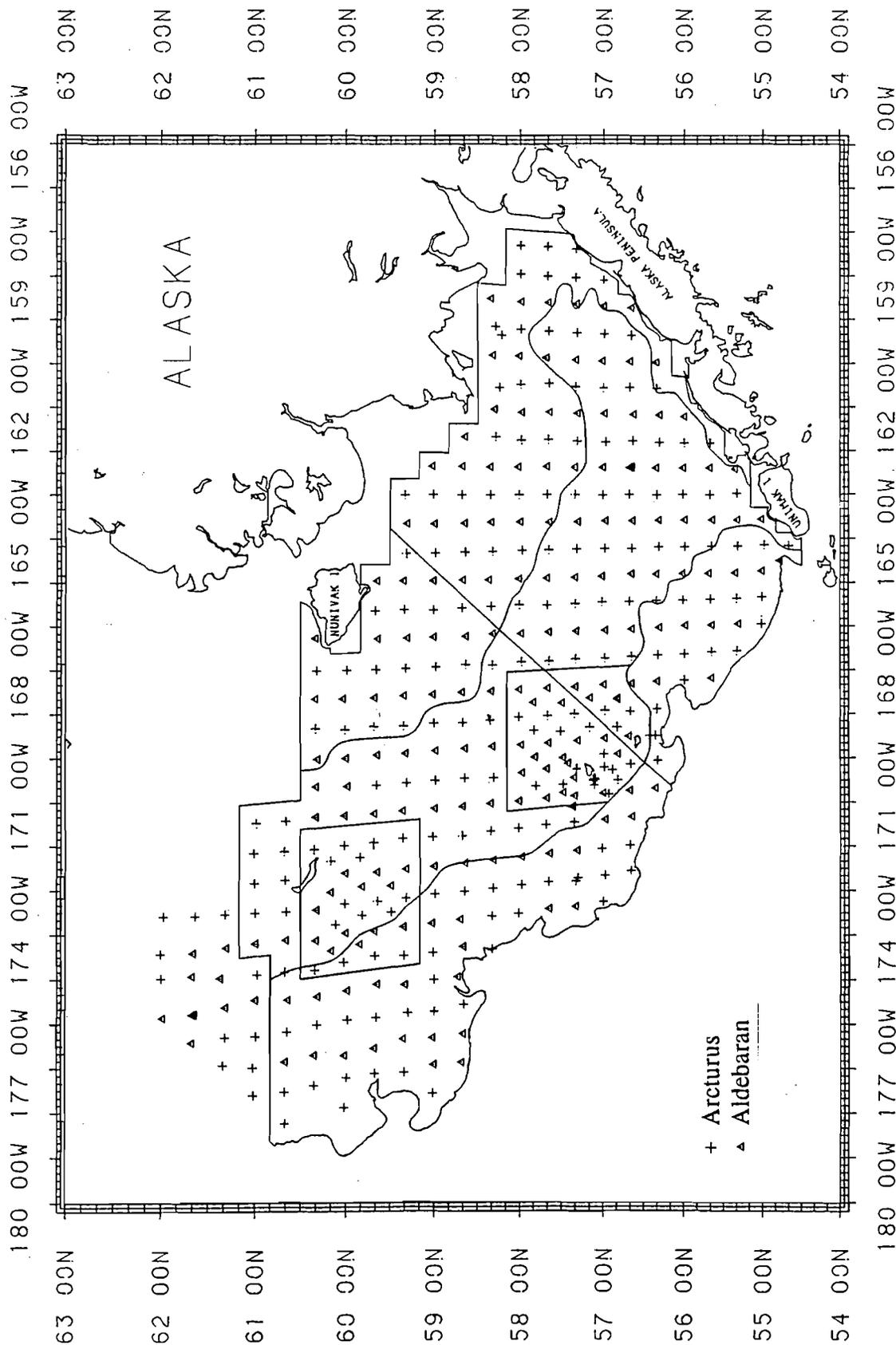


Figure 2.--Distribution of total sampling effort by the Arcturus and Aldebaran during the 1993 eastern Bering Sea crab and groundfish survey.

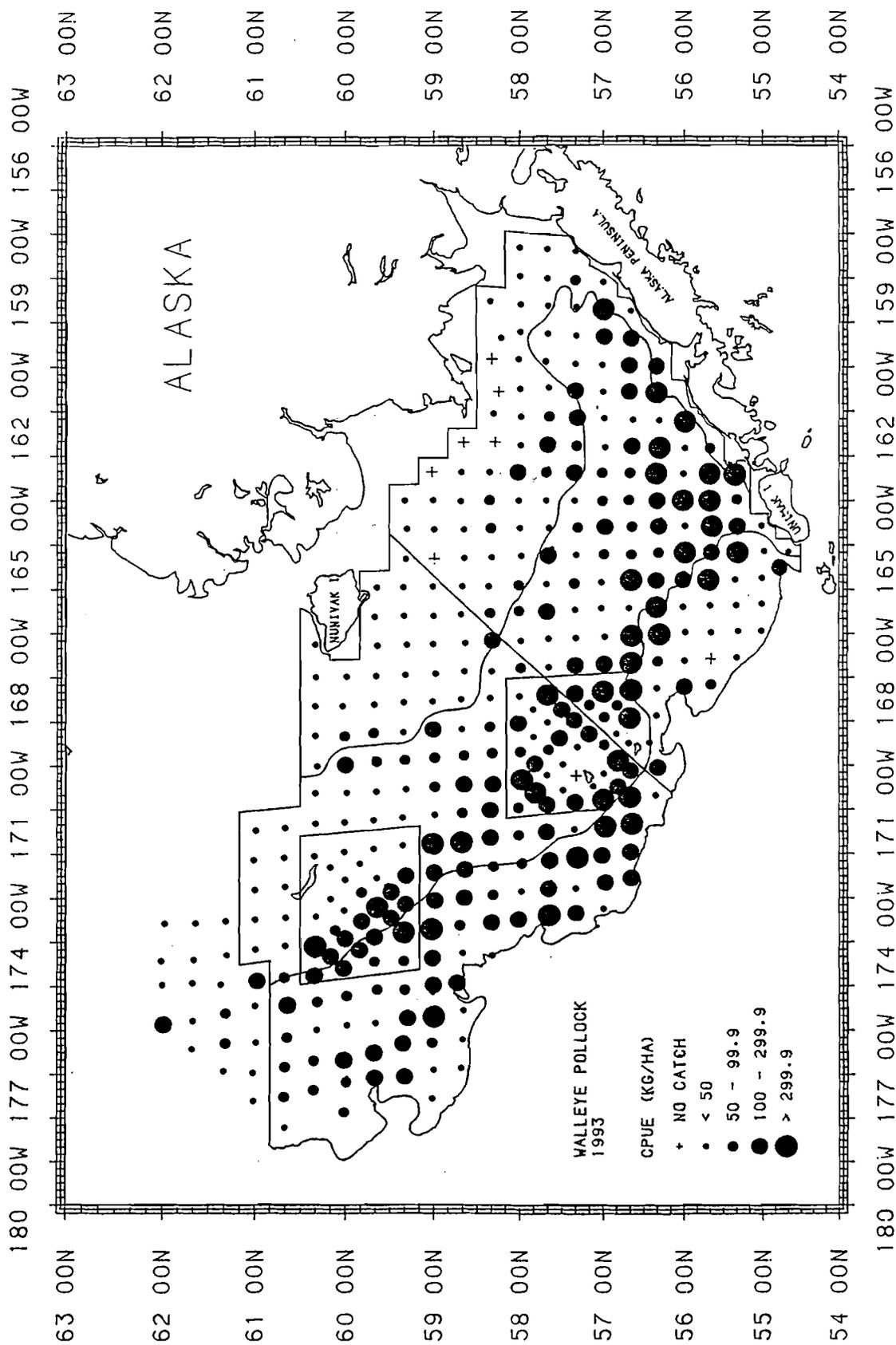


Figure 3.--Distribution of catch rates of walleye pollock from the overall area surveyed during the 1993 eastern Bering Sea crab and groundfish survey.

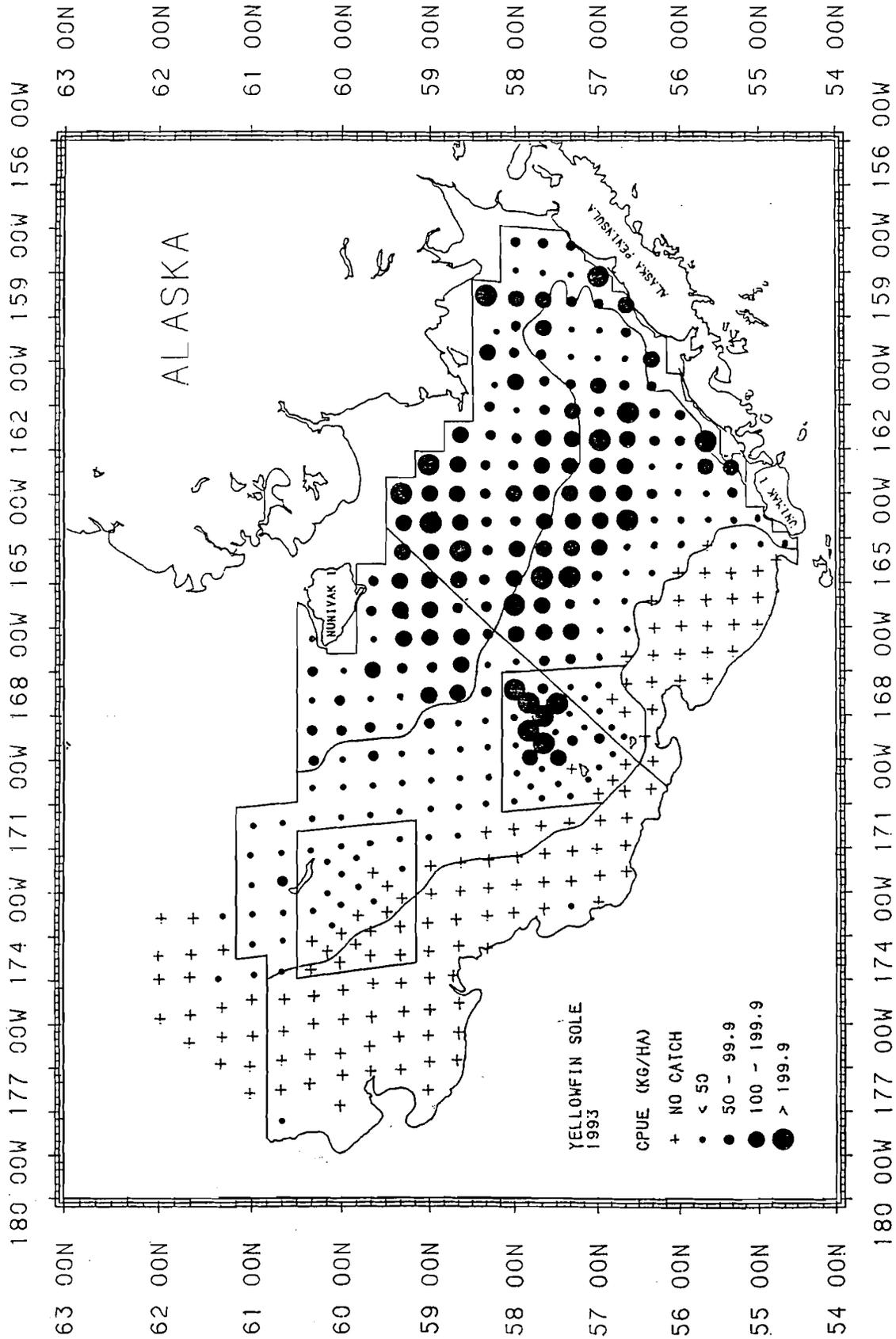


Figure 4.--Distribution of catch rates of yellowfin sole from the overall area surveyed during the 1993 eastern Bering Sea crab and groundfish survey.

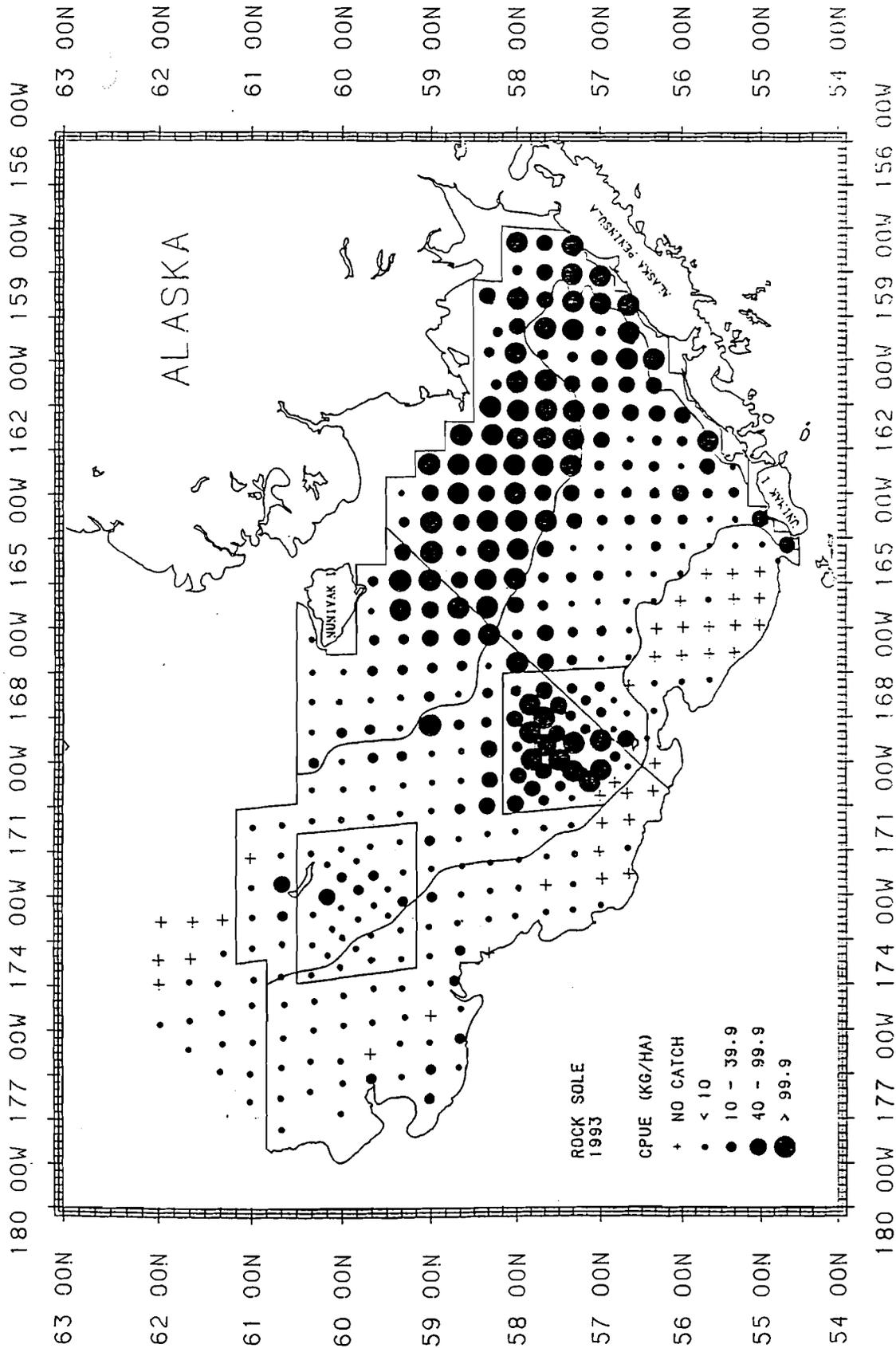


Figure 5.--Distribution of catch rates of rock sole from the overall area surveyed during the 1993 eastern Bering Sea crab and groundfish survey.

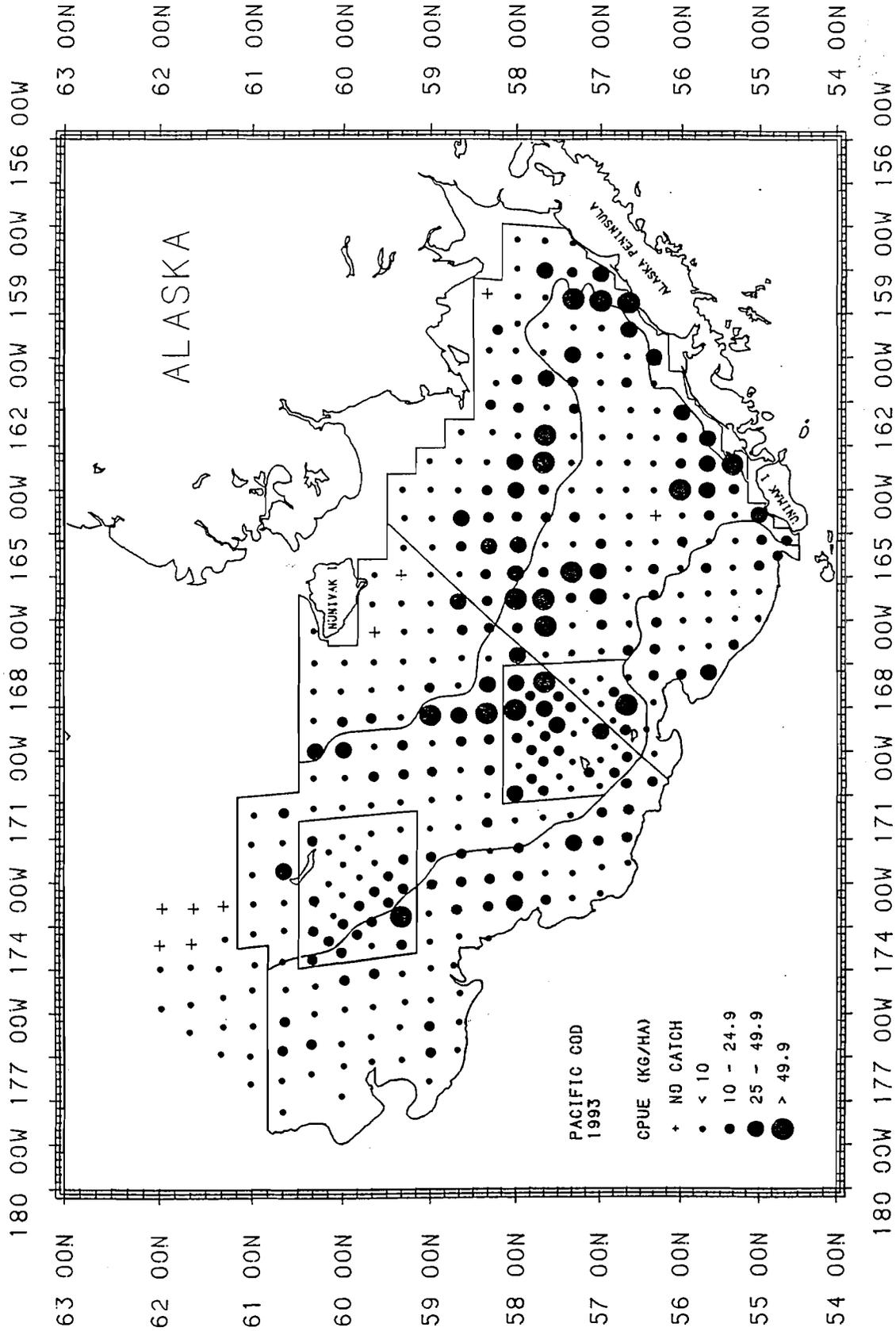


Figure 6.--Distribution of catch rates of Pacific cod from the overall area surveyed during the 1993 eastern Bering Sea crab and groundfish survey.