UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest and Alaska Fisheries Center
Resource Assessment and Conservation
Engineering Division
7600 Sand Point Way Northeast
BIN C15700, Building 4
Seattle, Washington 98115-0070

January 28, 1988

CRUISE RESULTS

Cruise 87-1 Alaska
Cruise 87-1 Pat San Marie
1987 Eastern Bering Sea Crab and Groundfish Survey
May-August 1987

The Resource Assessment and Conservation Engineering (RACE) Division of the Northwest and Alaska Fisheries Center (NWAFC) completed the annual crab and groundfish survey of the eastern Bering Sea during May-August 1987. This was a continuation of the annual series of eastern Bering Sea crab-groundfish assessment surveys.

OBJECTIVES

The primary objectives of this survey were to:

1. collect catch and biological data on principal species of crab and groundfish to provide information for management purposes, the fishing industry, and for scientific studies; and

2. collect hydrographic and environmental data in the study area.

Secondary objectives were to:

1. sample station transects on the continental slope to evaluate slope index sites;

2. examine crab by-catch in inshore trawling areas;

3. investigate reported scallop mortality near Unimak Island;

4. establish juvenile crab monitor sites;

5. tag Pacific cod, Pacific halibut, and Greenland turbot; and

6. collect stomach samples for fish feeding studies.

VESSELS AND GEAR

Survey activities were conducted aboard two chartered vessels, the 30.5 m University of Washington research vessel Alaska and the 30.8 m commercial fishing vessel Pat San Marie. The standard bottom trawl used by both vessels at continental shelf stations was an 83-112 Eastern trawl, as modified in 1982. These nets have a 25.3 m (83 ft.) headrope and a 34.1 m (112 ft.) footrope. They were towed behind 1,000 kg, 1.8 X 2.7 m steel V-doors and 54.9 m paired dandylines. Each lower dandyline had a 0.18 m chain extension connected to the lower wing edge to improve bottom tending characteristics. A Noreastern trawl with a 27.4 m (90 ft.) headrope and 39.0 m (128 ft.) footrope was used to sample transect stations on the continental slope. The Noreastern trawl had three 54.9 m bridles from each wing and was also equipped with roller gear. Descriptions of the sampling gear used during the survey are given in Figures 1 and 2.

The Alaska participated in the survey from May 23 to August 2. The Pat San Marie began its portion of the survey on May 30 and finished on August 8 upon completion of the survey.

SURVEY DESIGN AND METHODS

The primary study region included continental shelf waters north from Unimak Pass along the 200 meter depth contour to approximately 62° N and east to the Alaska mainland (Fig. 3). Standard sampling sites were established on the basis of a 20 x 20 nmi grid system, although more intensive sampling was conducted in the Pribilof Islands and St. Matthew Island regions to collect additional information on crab populations.

Additional non-standard sampling sites were identified to collect data for special study requests:

1. Twelve stations were established in an area near Port Moller to examine crab by-catch at inshore trawling areas. This region, located in a trawl closure area, was investigated to determine the potential extent of incidental crab catch by bottomfish trawlers.

2. Shelf sampling sites were also established, in response to an industry request, to investigate whether fish carcasses dumped by processing vessels were causing scallop mortality in an area near Unimak Pass.

3. Several monitor sites along the Alaska Peninsula were identified for assessment of juvenile crab too small to be adequately sampled with survey trawls. Standard crab pots filled with trawl webbing served as artificial habitats to attract small crab. The pots will be retrieved around May or June during the 1988 annual survey and biological information will be collected on the juvenile crab. A long-term digital recording thermograph was included at each site and, when recovered, may provide the first continuous year-round record of bottom water temperatures from the eastern Bering Sea.

4. A series of station transects were also scheduled to be sampled along the continental slope to evaluate potential slope index sites.

5. Additional stations northwest of the standard survey area (Fig. 3) were established in order to estimate the abundance of Tanner crabs (Chionoecetes opilio) in an area that produced high commercial landings during 1986.

The two vessels were assigned alternate north-south columns of stations throughout most of the survey area to determine between-vessel relative fishing powers through comparisons of catch rates (Fig. 3). Sampling started in Bristol Bay and progressed westerly to the shelf edge. All tows were 30 minutes in duration.

Net mensuration systems were installed aboard both vessels to provide gear configuration and performance data to be used in area swept calculations. Sea water temperature profiles were collected at each station using expendable bathythermograph (XBT) probes. Additional meteorological data were collected aboard the Alaska and transmitted to shore-based users via the Geostationary Operational Environmental Satellite (GOES) network.

The catch at each sampling site was sorted, weighed, and enumerated by species. Size composition and age samples by sex-centimeter category, as well as other biological data, were collected from the major fish species encountered. Length-width measurements, shell condition, clutch size, and various tissues and organs for pathological and parasite studies were collected from major crab species.

RESULTS

A total of 375 trawl hauls were successfully completed from the 386 sampling sites originally scheduled on the continental shelf (Fig. 3). An additional three tows were conducted to examine reported scallop mortality near Unimak Pass. Although 72 sampling locations were identified on the continental slope, only 7 trawls were completed. Equipment malfunctions and poor

weather conditions prevented any meaningful sampling of the continental slope portion of the survey. Of 145 vessel days assigned to the survey, a total of 94 days were spent fishing, 12.5 days in transit to and from the survey area, 18.5 days in port to exchange scientific personnel or facilitate repairs, and 20 days were lost to unfishable weather conditions.

Data collected from the net mensuration equipment aboard the Pat San Marie indicated that net configuration varied by depth. At fishing depths less than 100 m the 83-112 eastern trawl had a mean path width of 16.67 m with a vertical opening of 2.24 m. However, at depths more than 100 m the mean path width increased to 17.80 m and the vertical opening decreased slightly to 2.17 m. Due to equipment malfunction, no configuration data was collected for the Alaska trawl.

Approximately 144,000 length measurements were recorded by sex-centimeter category from the major fish species and nearly 5,200 age structures were collected. Biological data collected from fish species are summarized in Table 1. About 4,400 stomachs were preserved from various taxa for feeding habit analysis. About 260 Pacific halibut and 700 Pacific cod were tagged and released to provide information on stock movements. Very few viable Greenland turbot were encountered during the survey and, consequently, only five were tagged. Organ and tissue samples were collected from both crab and fish species for laboratory examinations. Scallop tissue samples were also preserved to assess reported scallop mortality.

The total survey area encompassed approximately 136,000 nmi^2 and overall catches averaged 330 kg/ha trawled. Fish comprised about 79% (260 kg/ha) of the total catch, while invertebrates accounted for the remaining 21% or 70 kg/ha. Walleye pollock and yellowfin sole combined comprised nearly 51% of the total catch.

Walleye pollock was the most abundant species encountered, with an overall CPUE value of 112.4 kg/ha trawled (Table 2). They were taken at nearly all sampling sites occupied, with largest mean catches (227.8 kg) observed in outer shelf waters (100-200 m, Fig. 4). Mean catches were greatly reduced at depths less than 50 m (23.7 kg/ha).

Yellowfin sole and rock sole were the most abundant flatfish species, with overall CPUE values of 53.0 kg/ha and 26.9 kg/ha, respectively. Yellowfin sole were primarily restricted to central and inner shelf waters while rock sole were found throughout the area but with major concentrations in Bristol Bay and near the Pribilof Islands (Figs. 5 and 6). Yellowfin sole catches decreased sharply with increased depth, from 123.9 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, as shown in Figure 7. Catch rates varied by depth zone from 21.4 kg/ha at depths less than 50 m to 31.9 kg/ha at depths of 100-200 m, with an overall average of 24.6 kg/ha trawled.

Alaska plaice, flathead sole, arrowtooth flounder, and Pacific halibut had a combined catch rate of 28.9 kg/ha. Alaska plaice was the most abundant species of this group, with highest catch rates (11.6-17.9 kg/ha) in waters less than 100 m. Highest catch rates of arrowtooth flounder (15.1 kg/ha) and flathead sole (14.8 kg/ha) were located in waters 100-200 m.

The Tanner crab C. opilio was the most abundant commercially important crab species encountered, with a total average catch rate of 15.2 kg/ha (Table 2). Catch rates for red king crab, blue king crab, and the Tanner crab C. bairdi had relatively low overall catch rates of 2.5 kg/ha or less.

SCIENTIFIC PERSONNEL[a]

Alaska

Leg 1	Leg 2	Leg 3
T. Sample[b]	P. Raymore[b]	P. Raymore[b]
D. Fisk	C. Armistead	D. Fisk
D. Rothous	R. Hoff	R. Brodeur
R. MacIntosh[c]	E. Munk[c]	P. Anderson[c]
F. Hartsock[c]	P. Cummiskey[c]	M. Dick[c]

Pat San Marie

Leg 1	Leg 2	Leg 3
K. Halliday[b]	B. Otto[bc]	A. Shimada[b]
M. Bailey	J. Sassano	M. Bohle
V. Bryant	V. Bryant	D. Molenaar
P. Wyman	P. Wyman	F. Hartsock[c]
B. Stevens[c]	J. Parkhurst	B. Dew[c]

a Personnel from NWAFC, Seattle, unless otherwise noted
b Chief Scientist
c Personnel from NWAFC, Kodiak Laboratory

For further information contact Dr. Gary Stauffer, Director, Resource Assessment and Conservation Engineering Division, Northwest and Alaska Fisheries Center, National Marine Fisheries Service, 7600 Sand Point Way NE., Building 4, BIN C15700, Seattle, WA 98115-0070 -- Telephone (206) 526-4170.

Table 1.--Collections of biological data and samples during the summer 1987 eastern Bering Sea crab-groundfish survey.

Species	Length measurements	Stomach scans	Age structures[1/]	Stomach samples	Number tagged
Walleye pollock	40,144	30	1,356	1,323	--
Pacific cod	10,497	--	1,005	820	700
Sablefish	83	--	--	--	--
Yellowfin sole	31,249	--	859[2/]	918	--
Rock sole	26,202	--	429	227	--
Flathead sole/ Bering Flounder	16,599	13	520	540	--
Pacific halibut	988	--	--	--	258
Alaska plaice	8,542	--	287	168	--
Arrowtooth flounder/ Kamchatka flounder	8,119	--	616	332	--
Greenland turbot	377	--	164	77	5
Rex sole	525	2	--	--	--
Pacific herring	210	--	--	--	--
Pacific ocean perch	15	--	--	--	--
Butter sole	97	--	--	--	--
Longhead dab	501	--	--	--	--
Misc. species	179	71	--	--	--
Total	144,327	116	5,236	4,405	963

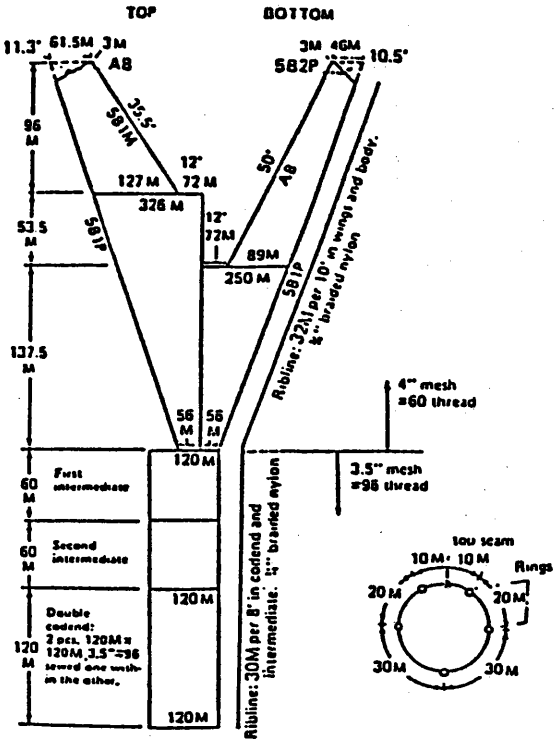
1/ Dorsal spines and scale samples were collected from Pacific cod. Otoliths were collected from all other species.

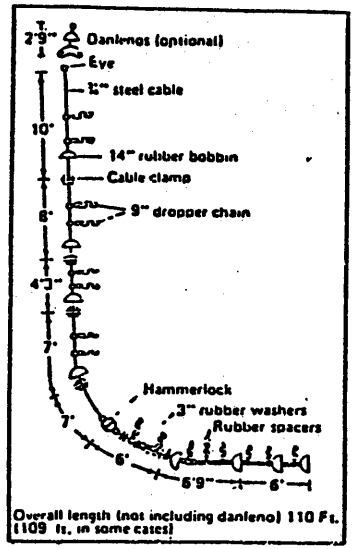
2/ Individual length-weight data were also recorded for yellowfin sole.

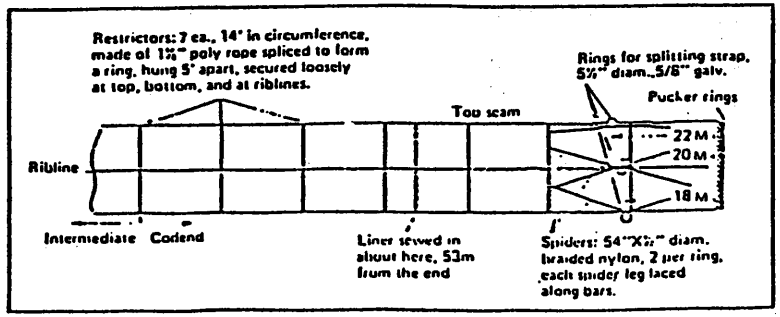
Table 2.--Catch rates (kg/ha) by depth zone of commercially important fish and crab species taken during the 1987 eastern Bering Sea crab and groundfish survey.

Species	Inner Shelf <50 m	Central Shelf 50 - 100 m	Outer Shelf 100 - 200 m	Total Area
Walleye pollock	23.7	88.3	227.8	112.4
Yellowfin sole	123.9	47.1	<0.1	53.0
Rock sole	54.4	26.3	3.6	26.9
Pacific cod	21.4	21.6	31.9	24.6
Alaska plaice	11.6	17.9	2.7	11.9
Flathead sole	1.6	8.9	14.8	8.7
Arrowtooth flounder	0.1	4.0	15.1	6.2
Pacific halibut	1.8	1.7	3.1	2.1
Opilio Tanner crab	0.8	26.4	10.3	15.2
Red king crab	1.3	2.5	<0.1	1.5
Bairdi Tanner crab	1.1	2.1	0.6	1.4
Blue king crab	0.0	0.3	<0.1	0.1

83/112 EASTERN







Netting - nylon, preshrunk and dyed green.

Headrope - 83.9 ft., 1/2" diam. 6 x 19 galv. wire rope, wrapped with 5/16 inch polypropylene rope.

Footrope - 111.9 ft., 5/8" diam. 6 x 19 galv. wire rope wrapped with 5/16 inch polypropylene rope, the whole wrapped with split pieces of heavy rubber hose; 172 ft. of 5/16" galv. chain hung to footrope, every tenth link seized to the footrope at eight-inch intervals, the lower edges of the wings and throat hung to the loops of chain thus formed.

Roller gear - optional.

Breastlines - 11.3 ft. upper, and 10.5 ft. lower sections, joined with a "hammer-lock," made of 1/2" diam. galv. wire rope, wrapped with 1/4" poly rope. Breastline lengths may vary slightly.

Riblines - 3/4" diam. braided nylon or equivalent extending the length of the first intermediate or beyond on some trawls.

Flotation - 17 8" aluminum floats along each wing. In the bosom, 3 16" alum. floats, one in each corner and one in the middle, plus 4 8" alum. floats, all 7 floats spaced equally. Total = 41 floats.

Codend liner - 1 1/4" mesh, No. 18 nylon, 360 meshes around, 200 meshes deep, laced to inner bag 63 meshes from the end, three liner meshes to each bag mesh. Actual mesh counts of liners encountered in the field may vary, but when the bag is empty and the codend untied and the bag and liner are stretched out, the liner should protrude some 2-3 feet beyond the end of the codend.

Chafing gear - varies, may be 3/8" diam. poly rope, hog-ringed to form 9 1/2" meshes, each piece 46 meshes deep x 55 meshes around. Alternatively may be 1/2" diam. poly rope, interwoven into 9" meshes, 18 meshes deep x 36 meshes around. In either case, chafing gear should be laced to the bag with 2 ft. of bag protruding.

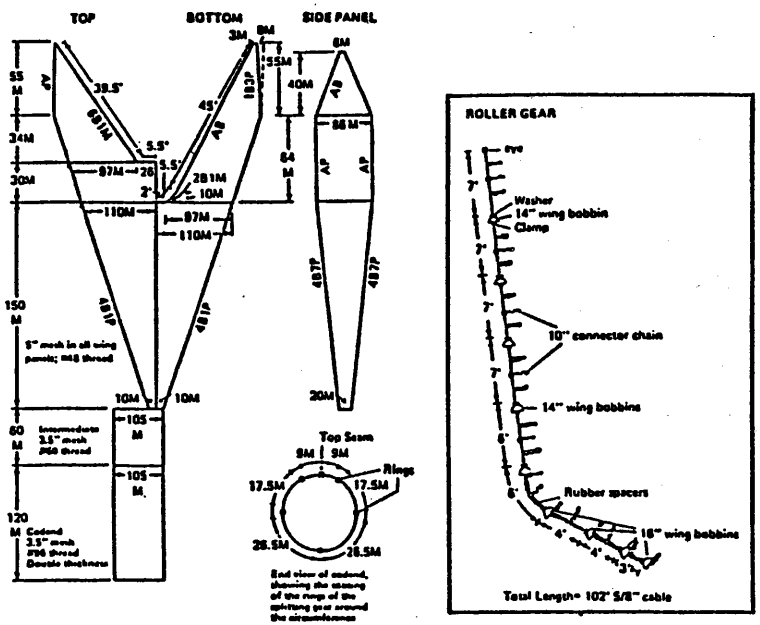
Sideseams - upper and lower wing panels and body panels laced together gathering 2 meshes (3 knots) from each panel. These plans allow for this, giving mesh counts for each panel as it should be cut out, mesh counts on panels in finished trawls will be reduced accordingly.

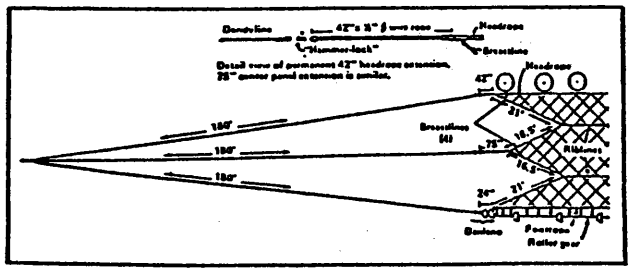
Rigging - Dandylines: 25 fathoms single, 15 fathoms double, all wires 5/8" galv.

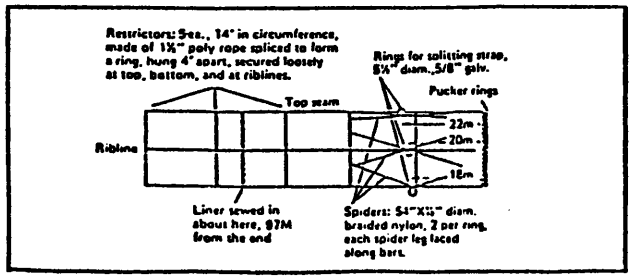
Doors - 6 ft. x 9 ft. V-doors, 2,000 pounds.

Figure 1.--Description of the 83-112 Eastern bottom trawl used during the 1987 eastern Bering Sea crab-groundfish survey.

NOREASTERN







NOREASTERN

Netting-Nylon, preshrunk and dyed green

Headrope-90 ft. 1/2" galv. wire rope, wrapped with 1/4" polpropylene rope

Footrope-105 ft. 3/8" galv. wire rope, wrapped with 3/8"poly rope

Roller Gear-102 ft. 5/8" galv. wire rope, with rollers (see separate plan of roller gear for details).

Breastlines-4 each 21 ft. 3/8" galv. wire rope wraped with 1/4" poly rope, for upper and lower wings. 4 each 16.5 ft., 3/8" galv. wire rope wrapped with 1/4" poly rope, for center panels.

Riblines-4 each, 142 ft. 1" poly rope laced to the side seams where upper and lower panels are sewed to the side panels, then following the same mesh on back to the codend. The riblines are hung to the stretched mesh web 1:1 throughout the body, hung in 10% in intermediate and codend.

Flotation-21 12" diam. plastic floats tied every 4.5 ft.

Codend liner-1 1/4" mesh, No. 18 nylon, 300 meshes around and 300 meshes deep, laced to the inner bag 97 meshes up from the rings. Actual mesh counts of liners encountered in the field may vary, but when the bag is empty and the codend untied, and the codend and liner are stretched out, the liner should protrude some 2-3 ft. beyond the pucker rings.

Chafing gear-10" meshes, 3/8" poly rope hog-ringed (or interwoves) together, 46 meshes around and 21 1/2 meshes deep, laced to outer bag 68.5 meshes up from the pucher rings.

Restrictors-5 each, 1" poly rope spliced into rings 14 ft. in circumference, secured loosely to the codend at each ribline, 4 ft. apart.

Splitting gear- one splitting strap (construction varies, but often a 21 ft. piece of 1/2" wire rope with an eye at each end, secured with a shackle) passed through 5 galv. steel rings sewed to the codend (see diagram for placement). Each ring attachment point is reinforced with a "spider". Each spider consists of two 54" pieces of 1/2" braided nylon rope, each piece tied to the ring with a clove hitch such that there are four spider legs of equal length trailing from the ring. The ring is then positioned and the 4 legs spread out opposite each other and laced along the bars.

Side seams-uper and lower wing and body and side panels are all laced together gathering two meshes (three knots) from each side of the seam. This plan shows "finished" mesh counts, so add 2 meshes per seam when cutting out panels.

Rigging-Dandylines: 3 pcs. for each side, 5/8" galv. wire rope 30fm long.

Doors-6' x 9' steel v-doors, 2000 lbs for all vessels, except 5' x 7' steel v-doors, 1200 lbs. minimum for West Coast Grounfish Survey

NOTE-Some older trawls may be encountered with wing and body panels of #30 or #42 tread, but these are being replaced with #48 thread when they need repair.

Figure 2.--Description of the Noreastern bottom trawl used during the 1987 eastern Bering Sea crab-groundfish survey.

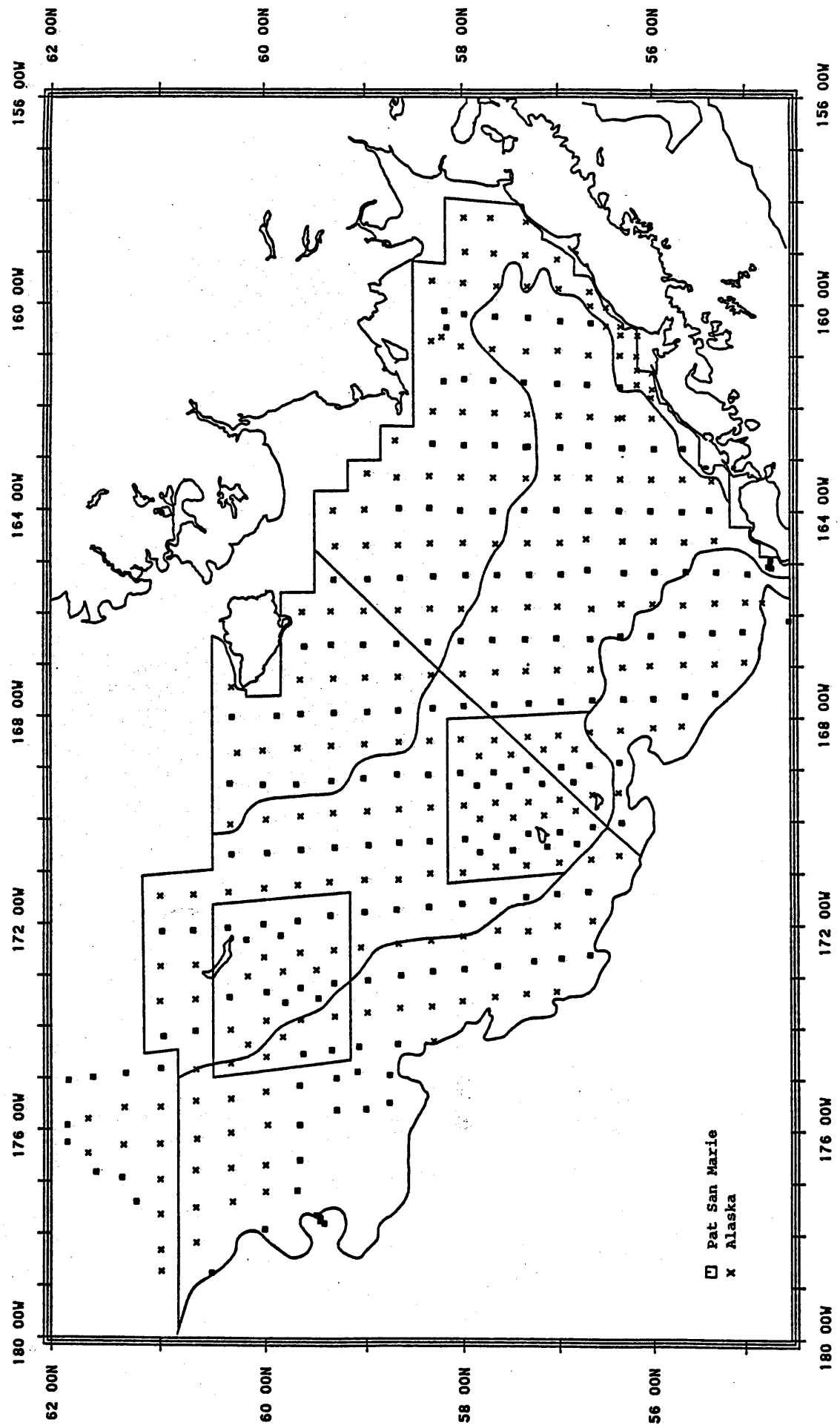


Figure 3.--Sampling sites and survey subareas used during the 1987 eastern Bering crab-groundfish survey.

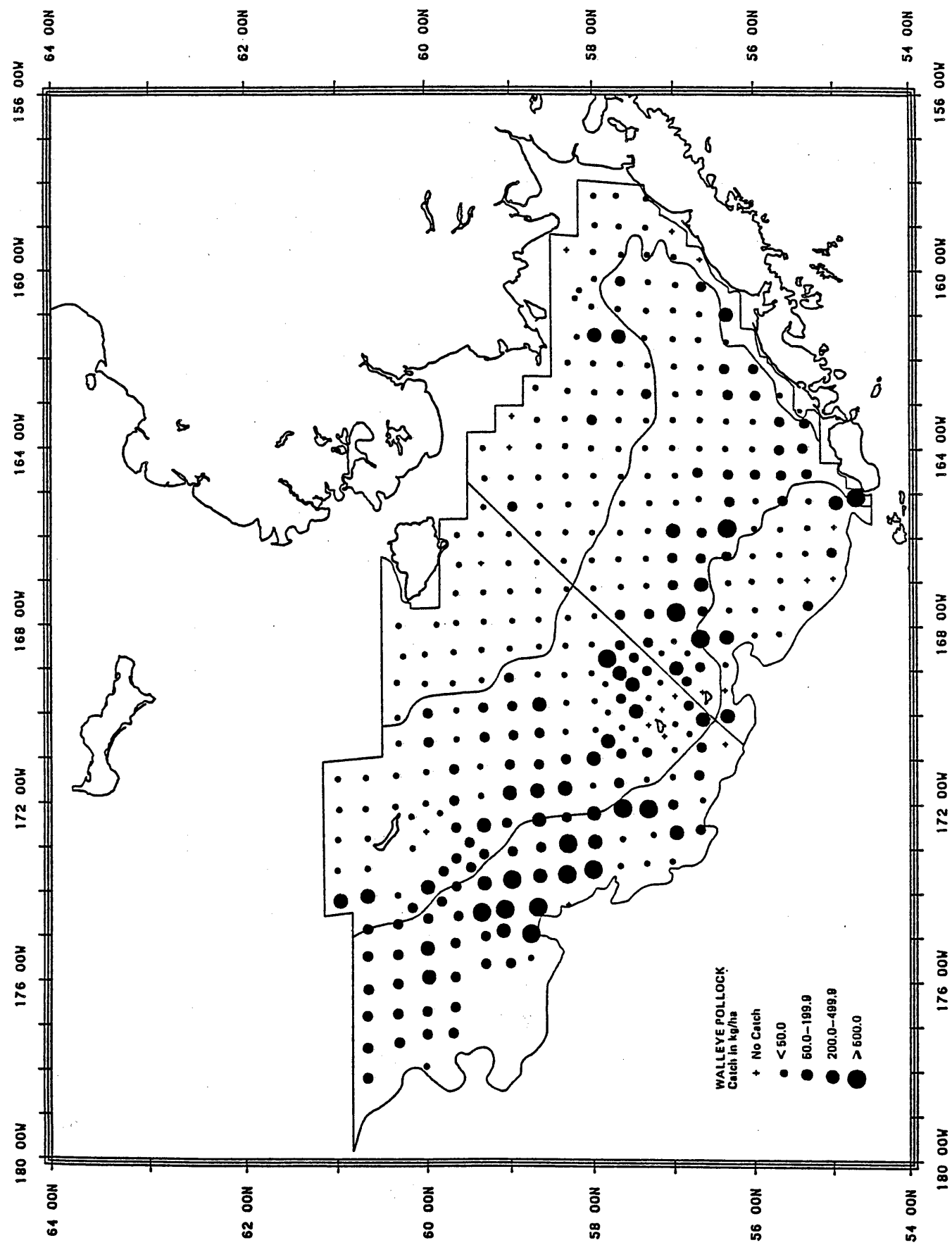


Figure 4.--Distribution of catch rates (kg/ha) of walleye pollock during the 1987 eastern Bering Sea crab-groundfish survey.

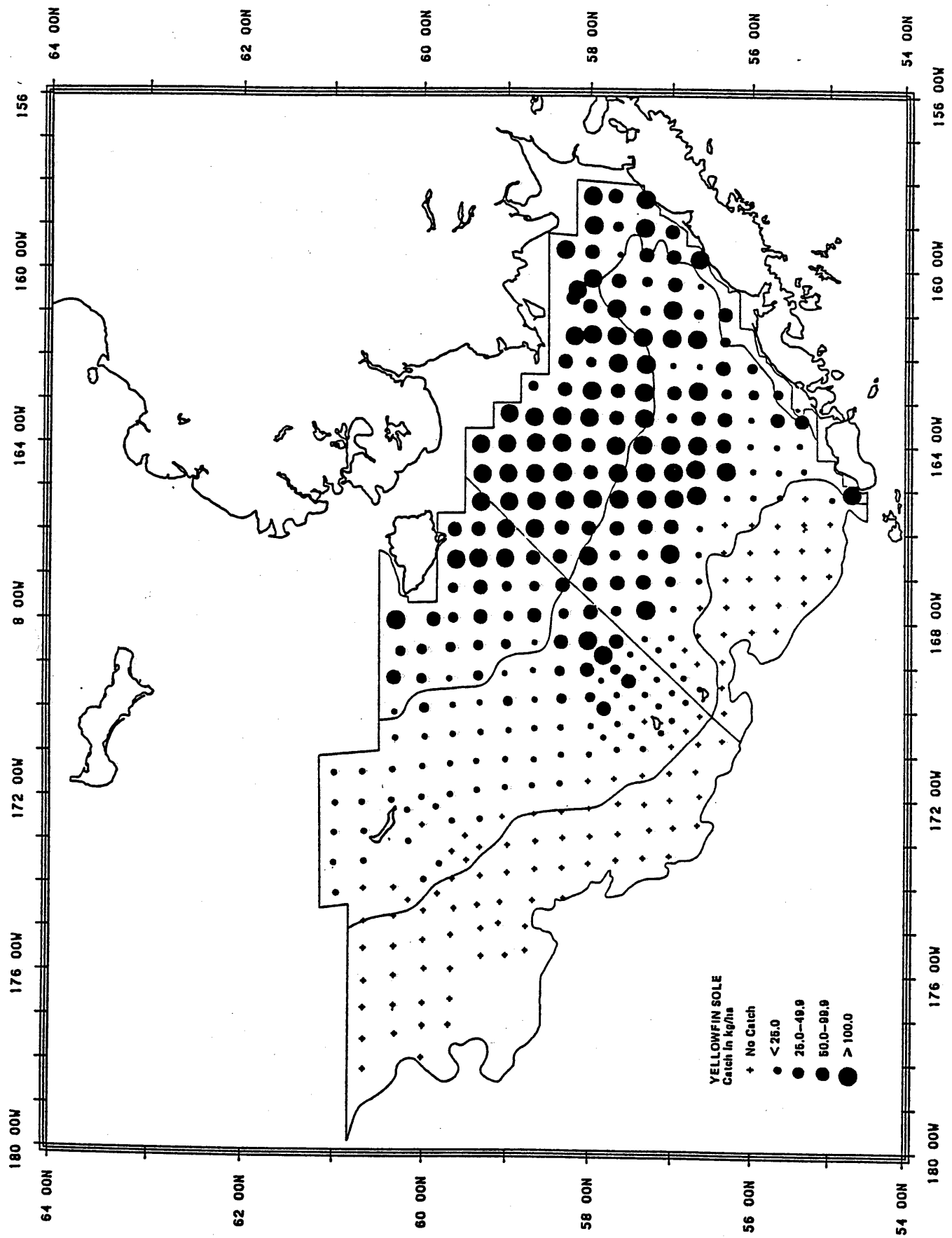


Figure 5.--Distribution of catch rates (kg/ha) of yellowfin sole during the 1987 eastern Bering Sea crab-groundfish survey.

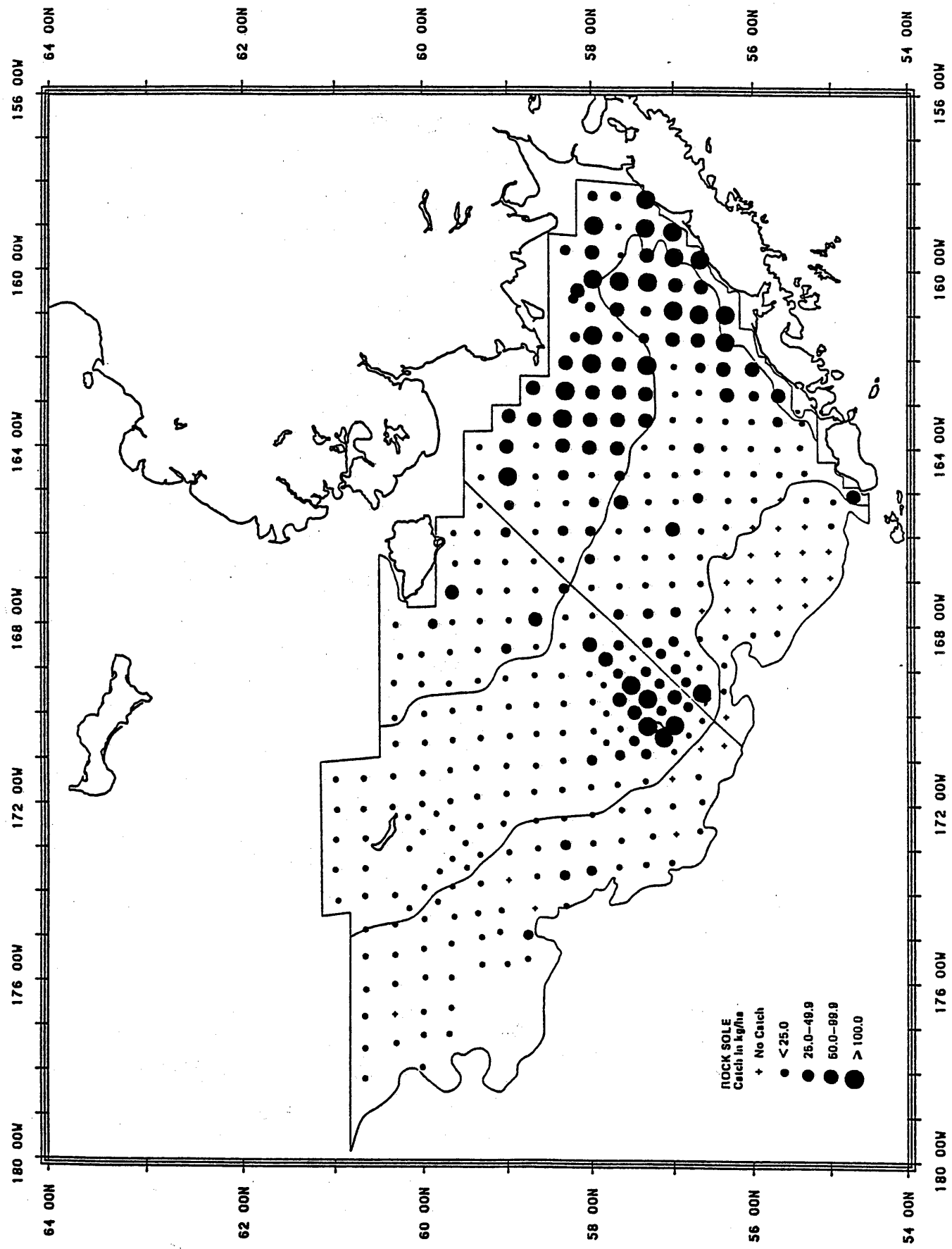


Figure 6.--Distribution of catch rates (kg/ha) of rock sole during the 1987 eastern Bering Sea crab-groundfish survey.

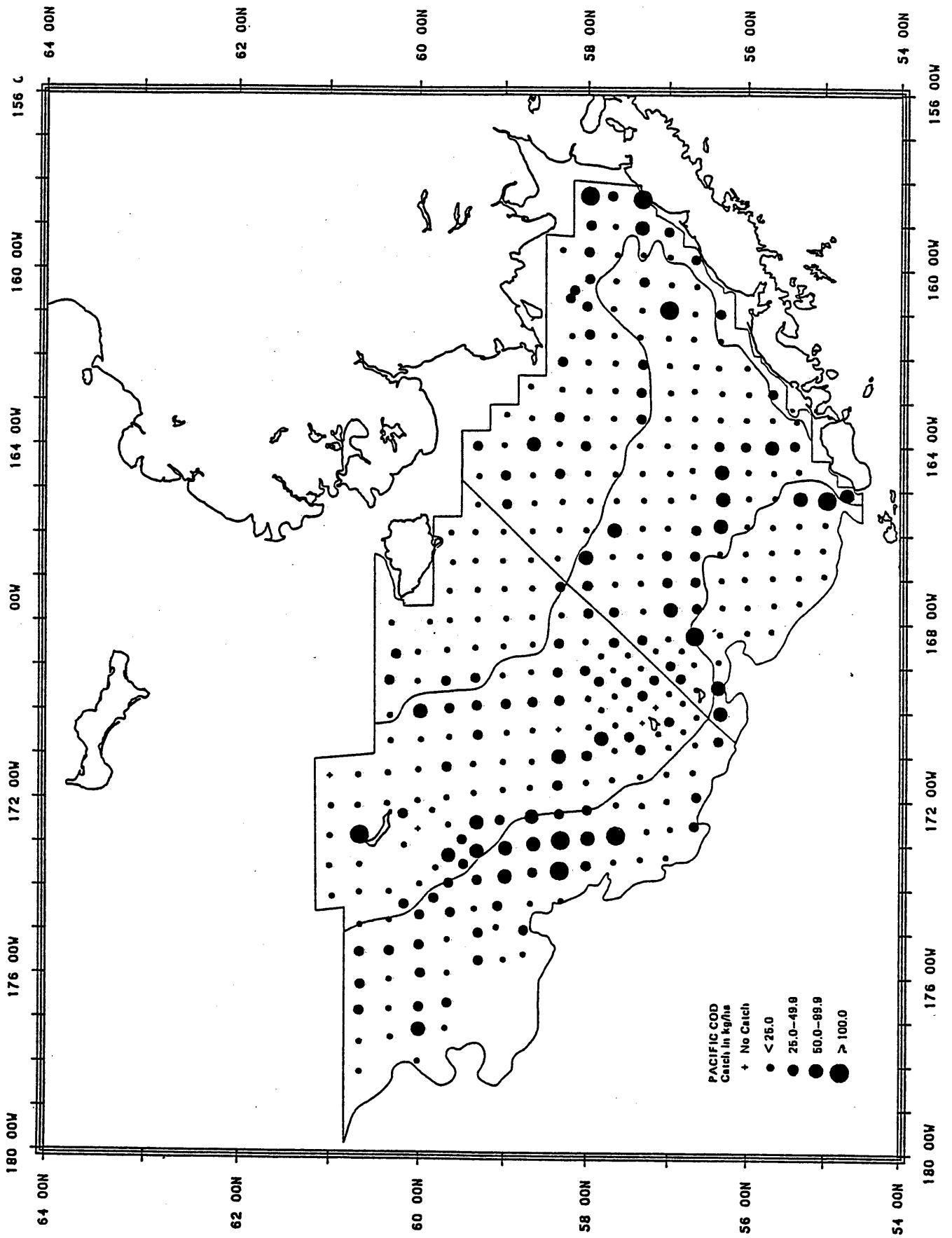


Figure 7.--Distribution of catch rates (kg/ha) of Pacific cod during the 1987 eastern Bering Sea crab-groundfish survey.