November 23, 1998 F/AKC2:TS

CRUISE RESULTS

Cruise 98-1 F/V *Arcturus*
Cruise 98-1 F/V *Aldebaran*

1998 Eastern Bering Sea Crab and Groundfish Survey

June-August 1998

The Resource Assessment and Conservation Engineering (RACE) Division of the Alaska Fisheries Science Center (AFSC) conducted the annual crab and groundfish bottom trawl survey of the eastern Bering Sea shelf from June to August 1998. 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. evaluate bottom trawl performance and configuration with net mensuration equipment;

3. evaluate the effect of reducing trawl duration from 30 minutes to 15 minutes on catches of red king crab and snow crab;

4. collect data on capture and escapement rates of crabs at the footrope of the standard sampling net;

5. collect stomach samples for trophic interaction studies;

6. collect specimens of bigmouth sculpin (*Hemitripterus bolini*), egg masses, ovaries, and sponge to describe bigmouth sculpin development and life history;

7. collect and preserve various whole specimens and tissue samples from both fish and invertebrates for special study requests;

8. collect sea whips for ageing and growth studies;

9. collect saffron cod and arctic cod for ageing studies;

10. document whale observations made during the survey;

11. collect prey samples for food habit studies of the northern fur seal; and

12. collect data for determining density factors for converting catch volume to catch weight.

VESSELS AND GEAR

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

The bottom trawl used at all standard 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 (Fig. 1). They were towed behind 1,000 kg, 1.8 X 2.7 m, steel V-doors and 54.9 m (180.1 ft) paired dandylines. 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 bucket thermometer.

Net mensuration systems and bottom contact sensors aboard both vessels were used to provide sampling net configuration and performance data to be used in area-swept and catch-per-unit-effort (CPUE) calculations.

ITINERARY

The *Arcturus* and *Aldebaran* began the survey in Dutch Harbor, Alaska on June 5. Both vessels returned to Dutch Harbor on August 6 upon the completion of the 1998 eastern Bering Sea crab-groundfish survey. Intervening port calls were made by both vessels in Dutch Harbor on June 26, and July 17 to obtain supplies and/or 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 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 that area.

The *Arcturus* and *Aldebaran* then sampled alternate north/south columns of stations proceeding from Bristol Bay westward to the shelf edge. Tows of 30 minutes in duration were made at most sampling sites. All catches were sorted to the lowest possible taxon, weighed, and enumerated. Station data including time, position, trawl performance, distance fished as well as catch information were entered onto diskettes with shipboard computer systems. 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.

A comparative study to evaluate the effect on crab catches by reducing sampling duration from 30 minutes to 15 minutes was conducted during the standard survey. A total of 60 sampling sites were identified in Bristol Bay to assess the effect on red king crab catches. An additional 20 sites were scheduled in the northern portion of the study area to obtain data on snow crab catch rates.

Upon completion of the standard survey, the *Arcturus* conducted the footrope capture rate study with the 83-112 eastern trawl. A secondary underbag net was attached to the wingtips and along the riblines as far back as the intermediate of the primary net. At the intermediate, the underbag split away from the primary and a complete secondary codend formed below the primary. The underbag had an independent footrope which attached to the lower bridles. This underbag was designed to capture fish and crabs that may escape under the footrope of the primary net. A beam trawl was also attached to the net to obtain additional information on escapement.

RESULTS

The *Arcturus* and *Aldebaran* conducted 380 standard bottom trawls during the survey including 375 successfully completed trawls at scheduled sampling sites and 5 unsuccessful hauls. In addition, a total of 141 trawl hauls were conducted to evaluate catch variability in tow duration during the course of the standard survey.

Upon completion of the standard survey, the *Arcturus* conducted an additional 34 hauls to evaluate the capture and escapement of fish and crabs at the footrope of the 83-112 bottom trawl. While the *Arcturus* conducted this study, the *Aldebaran* completed an additional 31 comparative 15/30 minute trawls.

Biological data collected from fish species are summarized in Table 1. The two vessels recorded 175,809 length measurements from the major fish species and nearly 3,933 age structures were collected and preserved. Individual length-weight data were also recorded for Pacific cod. A total of 6,830 stomachs were preserved from various fish taxa for feeding habit analysis.

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 km^2. Catch rates of important fish and crab species, by depth zone, are shown in Table 2.

Walleye pollock (*Theragra chalcogramma*) was the most abundant roundfish species and had an overall CPUE of 50.0 kg/ha trawled. They were encountered at nearly all sampling sites, with largest mean catches (66.5kg/ha) observed in central shelf waters at depths of 50-100 m (Fig. 3). Mean catches were much lower at depths less than 50 m (33.8 kg/ha).

Yellowfin sole (*Limanda aspera*)and rock sole (*Pleuronectes bilineata*) were the most abundant flatfish species, with overall CPUE values of 50.8 kg/ha and 47.3 kg/ha, respectively. Yellowfin sole were primarily restricted to the 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 (Figs. 4 and 5). Yellowfin sole catches decreased sharply with increased depth, from 92.1 kg/ha in waters less than 50 m to less than 1.0 kg/ha in waters greater than 100 m (Table 2). A similar depth-related decrease in rock sole abundance was also observed.

Pacific cod (*Gadus macrocephalus*) were encountered at nearly all sites sampled (Fig. 6). Catch rates were smallest at inner shelf stations less than 50 m.

Alaska plaice (*P. quadrituberculatus*), flathead sole/Bering flounder (*Hippoglossoides elassodon* and *H. robustus*), arrowtooth/Kamchatka flounder (*Atherestes stomias* and *A. evermanni*), and Pacific halibut (*Hippoglossus stenolepis*) had a combined catch rate of 34.9 kg/ha. Alaska plaice and flathead sole/Bering flounder were the most abundant species of this group, with an overall catch rate of 9.8 kg/ha and 14.2 kg/ha respectively.

Opilio Tanner crab (*Chionocetes opilio*) was the most abundant commercially important crab species encountered, with a total average catch rate of 7.3 kg/ha. Red king crab (*Paralithoides camtschatica*)had an overall mean CPUE of 1.8 kg/ha while blue king crab (*P. platypus*) and Bairdi Tanner crab (*C. bairdi*) each had overall catch rates of 0.5 kg/ha trawled.

SCIENTIFIC PERSONNEL[a]

F/V *Arcturus*

Leg 1	Leg 2	Leg 3
D. Nichol[b]	G. Walters[b]	B. Otto[bd]
J. Hoff	D. Benjamin	D. Benjamin
T. Buckley	S. Kotwicki[c]	G. Mundell
S. Kotwicki[c]	M. Nelson	J. Heeren
R. MacIntosh[d]	E. Munk[d]	M. Chandler[e]
K. Smith	F. Stewart[d]	J. Reisenweber[e]

F/V *Aldebaran*

Leg 1	Leg 2	Leg 3
C. Armistead[bd]	J. Haaga[bd]	P. Cummiskey[bd]
G. Mundell	D. Nichol	G. Hoff
D. Benjamin	R. McConnaughey	R. Harrison
D. Smith	F. Morado	M. Yang
L. Curtis	I. Dorang	T. Wilson[c]
J. Hagga[d]	K. Smith	L. Roberson[d]

[a] Personnel from the Alaska Fisheries Science Center (AFSC), Seattle, unless otherwise noted
[b] Field Party Chief
[c] Personnel from the International Pacific Halibut Commission
[d] Personnel from the Alaska Fisheries Science Center, Kodiak Laboratory, Kodiak, AK
[e] Personnel from National Marine Fisheries Service, Office of Science and Technology, Silver Spring, MD

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

Table 1.--Biological data collected during the during the 1998 eastern Bering Sea crab-groundfish survey.

Species	Length measurements	Age structures[1/2/]	Stomach samples
Walleye pollock	37,673	1,261	2,271
Pacific cod	9,582	694	1,645
Yellowfin sole	34,589	575	812
Rock sole	44,256	409	253
Flathead sole/ Bering flounder[3/]	24,930	87	470
Pacific halibut	1,504		388
Alaska plaice	10,104	420	197
Arrowtooth flounder/ Kamchatka flounder[4/]	10,020	280	326
Greenland turbot	435	207	94
Rex sole	609	--	--
Longhead dab	495	--	--
Sculpins	624	--	58
Starry flounder	420	--	--
Misc. skates	316	--	316
Pacific herring	45	--	--
Pacific Ocean perch	13	--	--
Misc. species	194	--	--
Total	175,809	3,933	6,830

[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 1998 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	36.7	66.5	33.8	50.5
Yellowfin sole	92.1	56.5	0.9	50.8
Rock sole	109.0	35.7	9.7	47.3
Pacific cod	13.5	13.3	9.0	12.2
Alaska plaice	8.8	14.0	3.0	9.8
Flathead sole/ Bering flounder	3.1	12.3	28.3	14.2
Arrowtooth flounder/ Kamchatka flounder	0.1	5.3	18.3	7.4
Pacific halibut	3.6	2.7	5.1	3.5
Opilio Tanner crab	0.3	9.8	9.5	7.3
Red king crab	1.8	2.8	0.1	1.8
Bairdi Tanner crab	0.1	0.6	0.6	0.5
Blue king crab	0.0	0.9	0.1	0.5

83/112 EASTERN

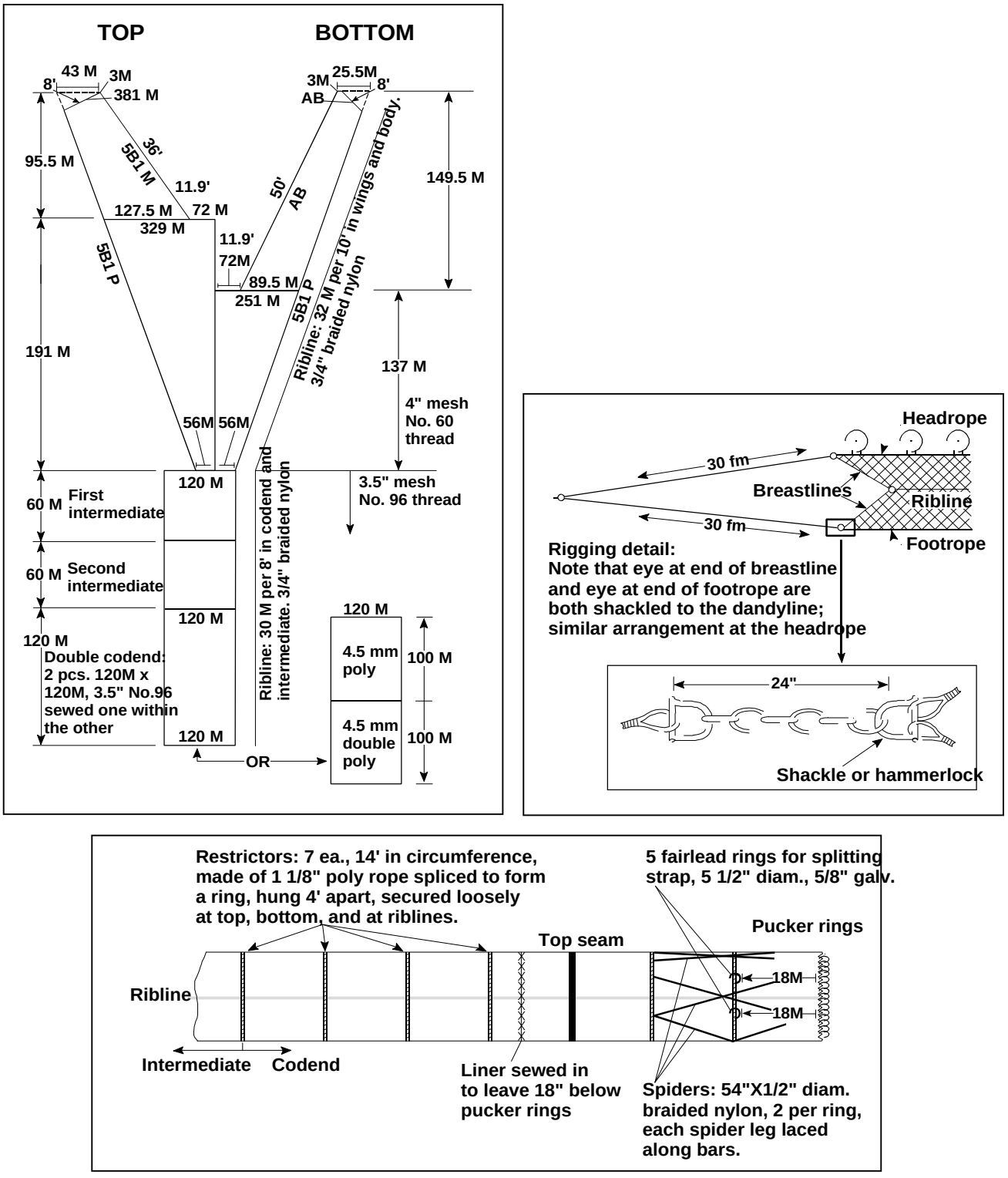

Figure 1. Diagram of the 83-112 Eastern bottom trawl used in the 1998 eastern Bering Sea groundfish survey.

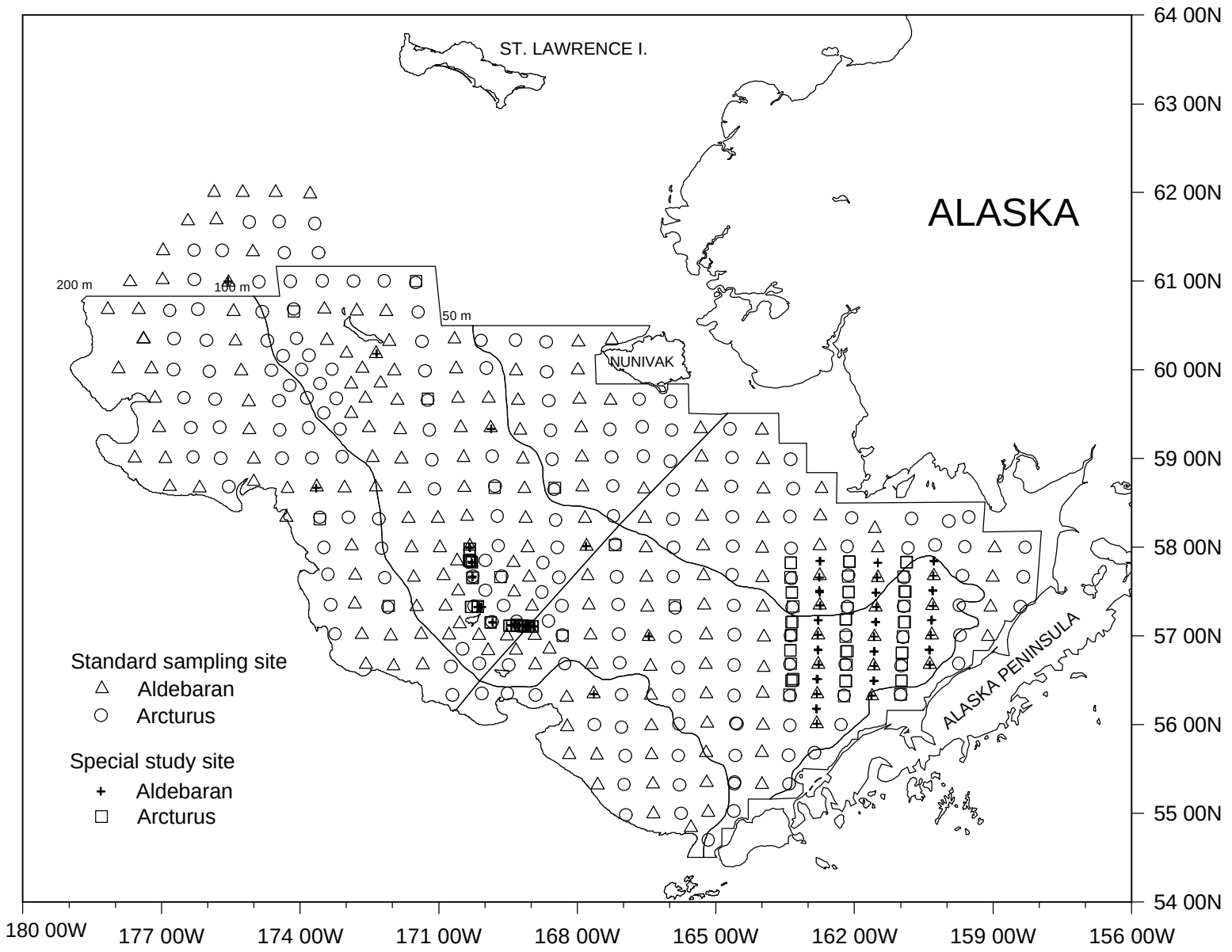

Figure 2.--Distribution of total sampling effort by the Aldebaran and Arcturus during the 1998 eastern Bering Sea bottom trawl survey.

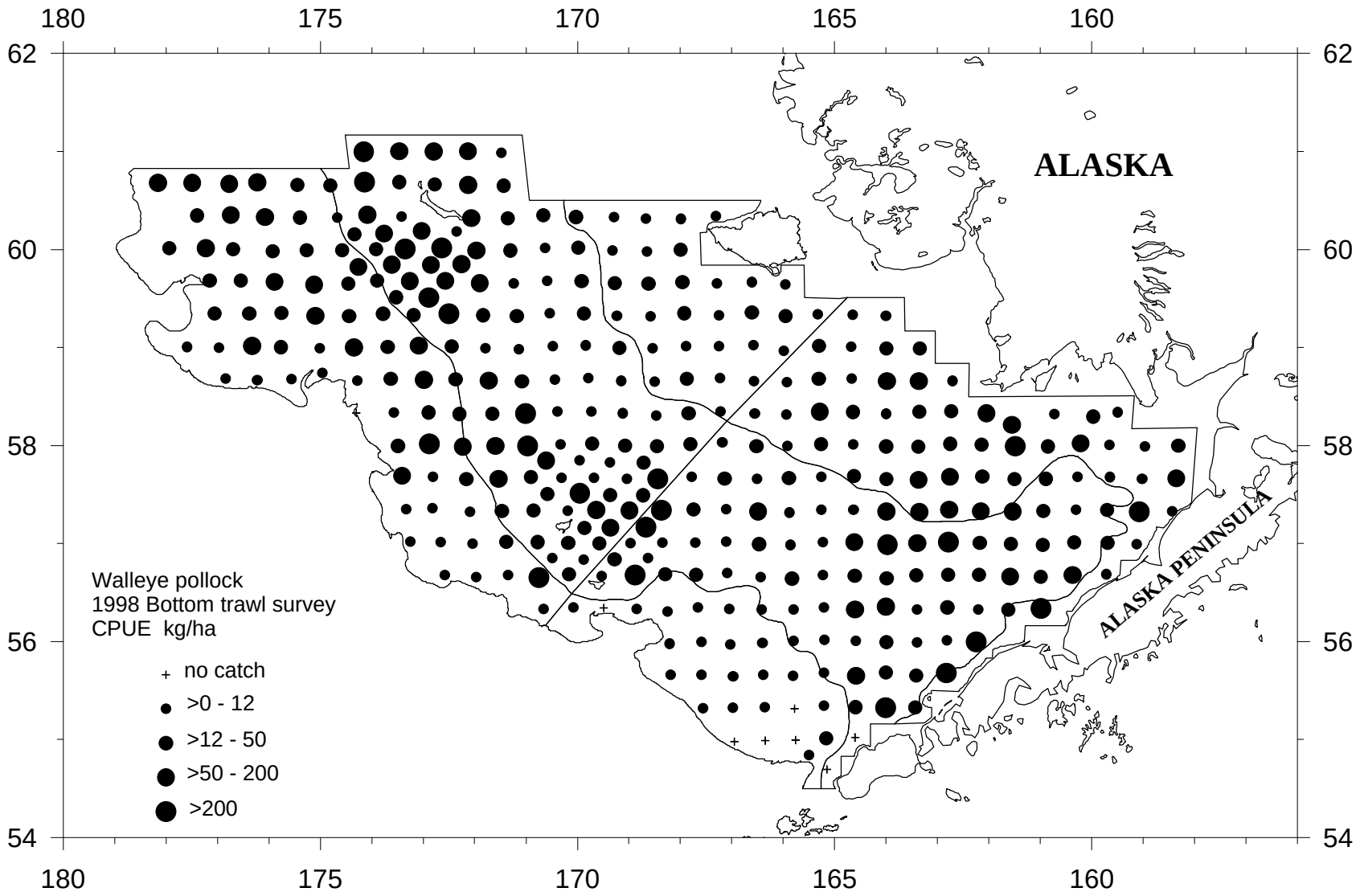

Figure 3.--Distribution and relative abundance of walleye pollock during the 1998 eastern Bering Sea bottom trawl survey.

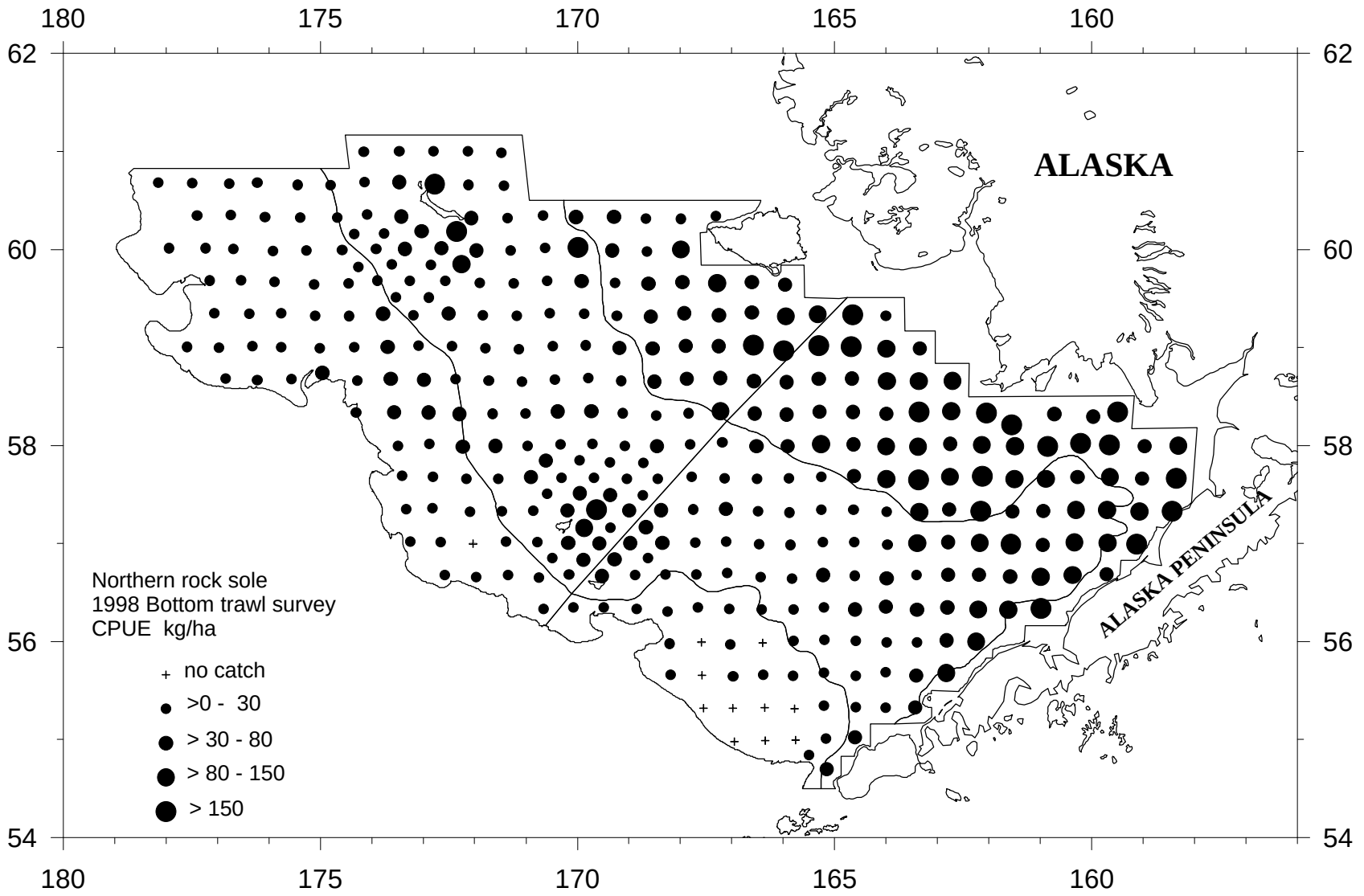

Figure 4.--Distribution and relative abundance of northern rock sole during the 1998 eastern Bering Sea bottom trawl survey.

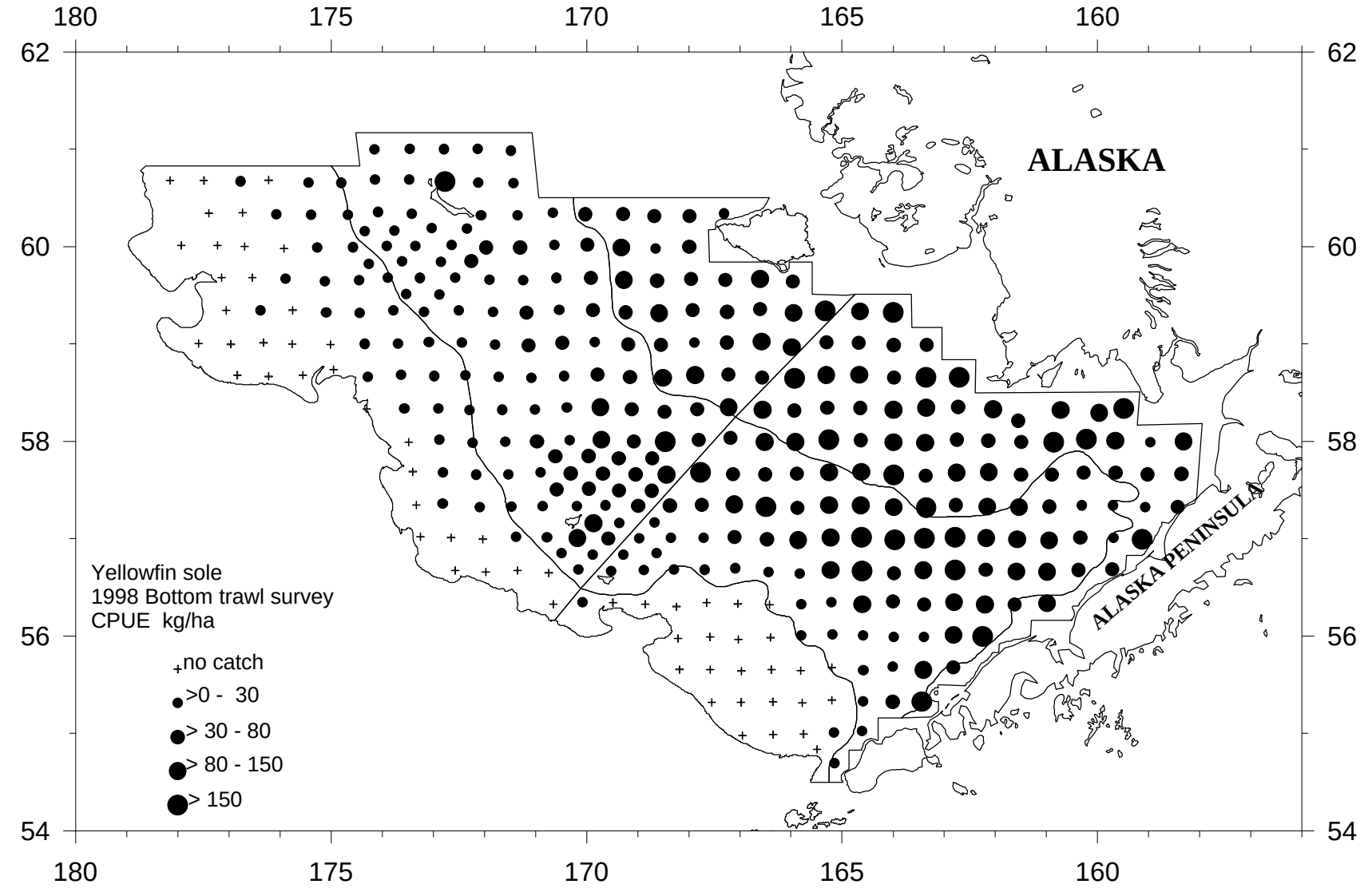

Figure 5.--Distribution and relative abundance of yellowfin sole during the 1998 eastern Bering Sea bottom trawl survey.

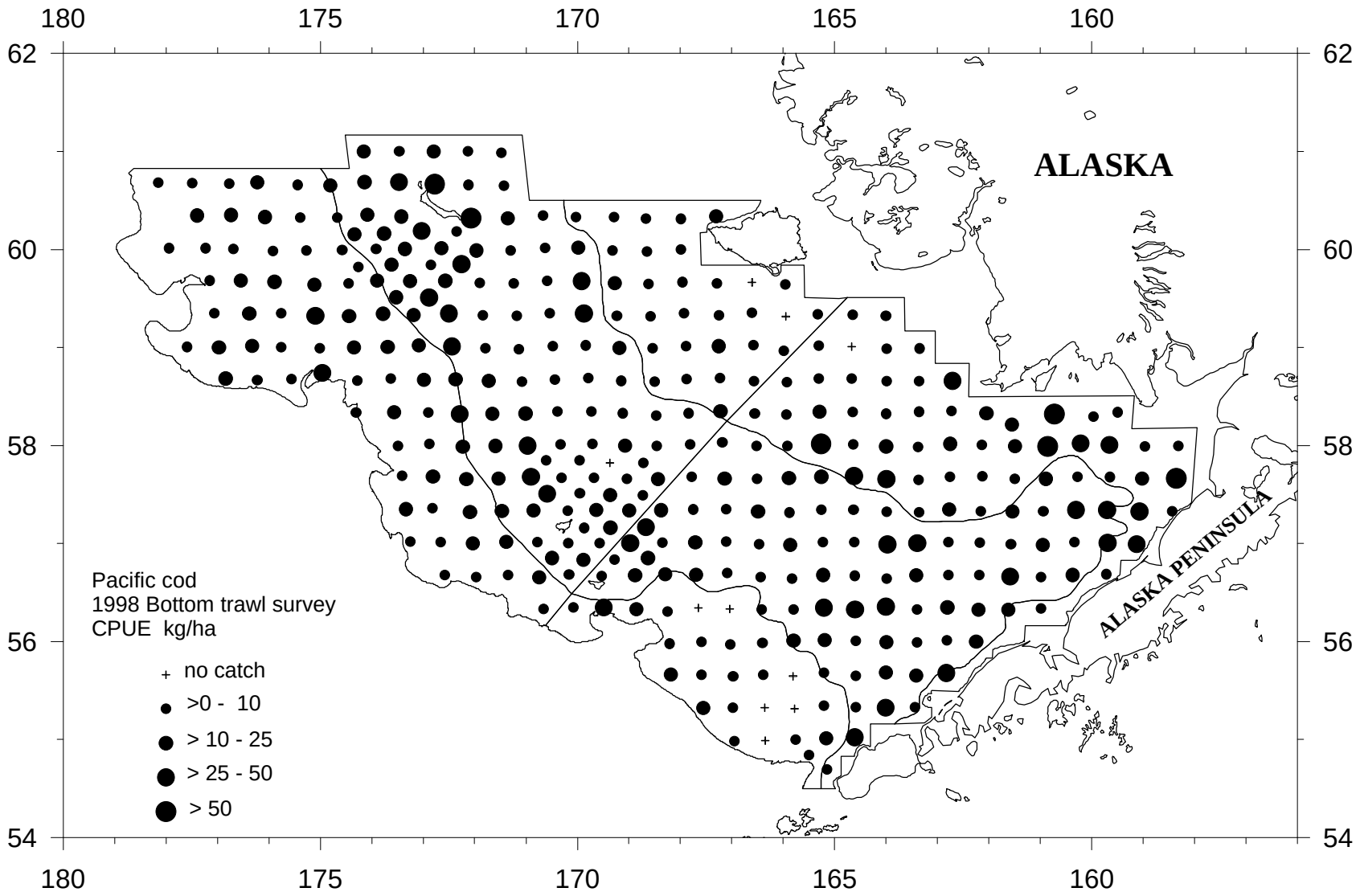

Figure 6.--Distribution and relative abundance of Pacific cod during the 1998 eastern Bering Sea bottom trawl survey.