



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

CRUISE RESULTS

Cruise 2004-01 *F/V Arcturus*
Cruise 2004-01 *F/V Aldebaran*

2004 Eastern Bering Sea Crab and Groundfish Survey

June-August 2004

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 May to August 2004. 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 the following:

1. Data on the distribution, abundance, and biological condition of important groundfish and crab species for the North Pacific Fishery Management Council.
2. Catch per unit effort (CPUE) and size composition data for the commercial fisheries of the U.S.
3. Support for ongoing studies on the biology, behavior, and dynamics of key ecosystem components.

Secondary objectives comprised:

1. To conduct additional sampling in areas of high king crab and Tanner crab abundance to reduce variability in population estimates.
2. To evaluate the calibration of the trawl warps and the performance and geometry of the bottom trawl using net mensuration sensors.

3. To collect and preserve specimens of fish and invertebrates to enhance the voucher database.
4. To collect stomach samples for trophic interaction research.
5. To collect and preserve various specimens from both fish and invertebrates for special study requests.
6. To collect data on the distribution and biology of the butterfly sculpin and marbled eelpout.

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 dandyline. Each lower dandyline had a 0.61 m chain extension connected to the lower wing edge to improve bottom tending characteristics.

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 bottom trawl survey began in Dutch Harbor, Alaska on June 1. The *Aldebaran* and *Arcturus* completed the charter on August 4 in Dutch Harbor. Intervening port calls were made to Dutch Harbor on June 22 and July 13 to exchange scientific personnel. Additional port calls were made to St. Paul Island on June 30 and July 26 to exchange scientific and vessel personnel.

Prior to the beginning of the survey, both vessels marked the trawl warp using trawl wire meters. The vessel geometric counter read-outs were checked and calibrated to the mechanical meters to ensure that appropriate and consistent amounts of wire were

used at all sampling sites.

Upon completion of the scheduled standard survey stations, the *Aldebaran* conducted some exploratory work near the Pribilof Islands to determine whether measurable avoidance behaviors exist for walleye pollock in response to the vessel and/or bottom trawl.

Upon completion of its portion of the survey, the *Arcturus* proceeded to the area north of St. Matthew Island to collect biological information on butterfly sculpin and marbled eelpout as well as *opilio* Tanner crab. Once this study was completed the *Arcturus* proceeded to Pavlov Bay to conduct the shrimp survey.

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. The *Arcturus* and *Aldebaran* 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 CD's 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.

RESULTS

The *Arcturus* and *Aldebaran* conducted 413 bottom trawls during the standard survey including 403 successfully completed trawls at scheduled sampling sites and 10 unsuccessful hauls. An additional 8 successful tows were made around two crab "hot spot" locations where more than 100 legal red king crab were encountered at one standard sampling site. These additional tows were conducted to reduce variability in the crab estimates. Upon completion of the standard survey *Arcturus* conducted 10 trawls north of St. Matthew Island to collect additional biological data on species of interest.

Biological data collected from fish species are summarized in Table 1. The two vessels recorded 185,353 length measurements

from the major fish species and 8,597 age structures were collected and preserved. Individual length-weight data were also recorded during the otolith collection process. A total of 2,045 stomachs were preserved from walleye pollock 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 km². Catch rates of important fish and crab species, by depth zone, are shown in Table 2.

Walleye pollock (*Theragra chalcogramma*) was the most abundant round-fish species and had an overall CPUE of 89.0 kg/ha trawled. They were encountered at nearly all sampling sites, with largest mean catches (134.2 kg/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 (13.0 kg/ha).

Northern rock sole (*Lepidopsetta polyxystra*) and yellowfin sole (*Limanda aspera*) were the most abundant flatfish species, with overall CPUE values of 50.0 kg/ha and 54.3 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 and around the Pribilof Islands (Figs. 4 and 5). Yellowfin sole catches decreased sharply with increased depth, from 126.6 kg/ha in waters less than 50 m to less than 0.1 kg/ha in waters greater than 100 m (Table 2). A similar depth-related decrease trend in rock sole abundance was also observed.

Pacific cod (*Gadus macrocephalus*) were encountered at most of the sites sampled (Fig. 6). Mean catch rates were smallest at inner shelf stations less than 50 m (7.1 kg/ha) and greatest in the central shelf region (18.1kg/ha).

Alaska plaice (*Pleuronectes 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 37.8 kg/ha. Alaska plaice and arrowtooth flounder/Kamchatka flounder were the most abundant species of this group, with an overall catch rate of 10.2 kg/ha and 11.5 kg/ha respectively.

Snow crab (*Chionocetes opilio*) was the most abundant commercially important crab species encountered, with a total average catch rate of 4.0 kg/ha. Red king crab (*Paralithodes camtschatica*) had an overall mean CPUE of 2.7 kg/ha while blue king crab (*P. platypus*) and Bairdi Tanner crab had overall catch rates of less than 0.1 kg/ha and 1.2 kg/ha trawled respectively.

SCIENTIFIC PERSONNEL^a**Arcturus****Leg 1** 6/1-6/22

E. Acuna^b
 G. Mundell
 F. Morado
 J. Kuras
 C. Armistead^d
 R. Tobin^c

Leg 2 6/22-7/13

S. Kotwicki^b
 D. Benjamin
 M. Yang
 V. Lowe
 C. Armistead^d
 E. Munk^d

Leg 3 7/13-8/4

D. Benjamin^b
 C. Johnston
 R. Erickson
 J. Kuras
 J. Berger
 B. O'Gorman^d

Aldebaran**Leg 1** 6/1-6/22

D. Nichol^b
 S. Kotwicki
 J. Brogan
 T. Buckley
 G. Cronin
 P. Anderson^d

Leg 2 6/22-7/13

P. Cumiskey^{bd}
 D. Nichol
 M. Nelson
 B. Matta
 S. VanSant^d
 R. Rensmeyer^c

Leg 3 7/13-8/4

E. Acuna^b
 K. Rand
 T. Jewell
 C. Yeung
 S. Persselin^d 7/13-7/26
 R. Rensmeyer^c 7/13-7/26
 C. Wilson^{7/26-8/4}
 A. DeRobertis^{7/26-8/4}

^a Personnel from the AFSC, Seattle, unless otherwise noted

^b Field Party Chief

^c Personnel from the International Pacific Halibut Commission

^d Personnel from the AFSC, Kodiak Laboratory

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Table 1.--Biological data collected during the 2004 eastern Bering Sea crab-groundfish survey.

Species	Length measurements	Age structures ^{1/}	Stomach samples
Walleye pollock	44,102	1,660	2,045
Pacific cod	10,802	1,063	--
Yellowfin sole	29,047	782	--
Northern rock sole	34,930	449	--
Flathead sole/ Bering flounder ^{2/}	21,158	477	--
Pacific halibut	2,810	1,526	--
Alaska plaice	9,182	394	--
Arrowtooth flounder/ Kamchatka flounder ^{3/}	16,681	596	--
Greenland turbot	606	290	--
Rex sole	1,396	--	--
Longhead dab	2,338	--	--
Plain sculpin	3,137	520	--
Great sculpin	719	264	--
Warty sculpin	326	130	--
Yellow Irish lord	898	241	--
Starry flounder	1,193	--	--
Alaska skate	4,210	--	--
Bering skate	198	--	--
Pacific Ocean perch	162	--	--
Misc. skates	4	--	--
Misc. species	1,453	205	--
Total	185,353	8,597	2,045

^{1/} Individual length-weight data were also collected.

^{2/} Age structures were collected from flathead sole only.

^{3/} Age structures were collected from arrowtooth flounder only.

Table 2.--Catch rates (kg/ha) by depth zone of commercially important fish and crab species taken aboard the *Arcturus* and *Aldebaran* during the 2004 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	13.0	134.2	78.4	89.0
Yellowfin sole	126.6	45.9	<0.1	54.3
Rock sole	110.0	44.5	2.1	50.0
Pacific cod	7.1	18.1	11.5	13.6
Alaska plaice	10.0	15.6	0.4	10.2
Flathead sole/ Bering flounder	2.3	16.3	18.3	13.2
Arrowtooth flounder/ Kamchatka flounder	0.5	10.1	24.7	11.5
Pacific halibut	4.4	2.0	2.9	2.9
Opilio Tanner crab	<0.1	6.5	3.1	4.0
Red king crab	4.5	3.3	0.0	2.7
Bairdi Tanner crab	0.1	1.5	1.6	1.2
Blue king crab	<0.1	0.1	<0.1	<0.1

83/112 EASTERN

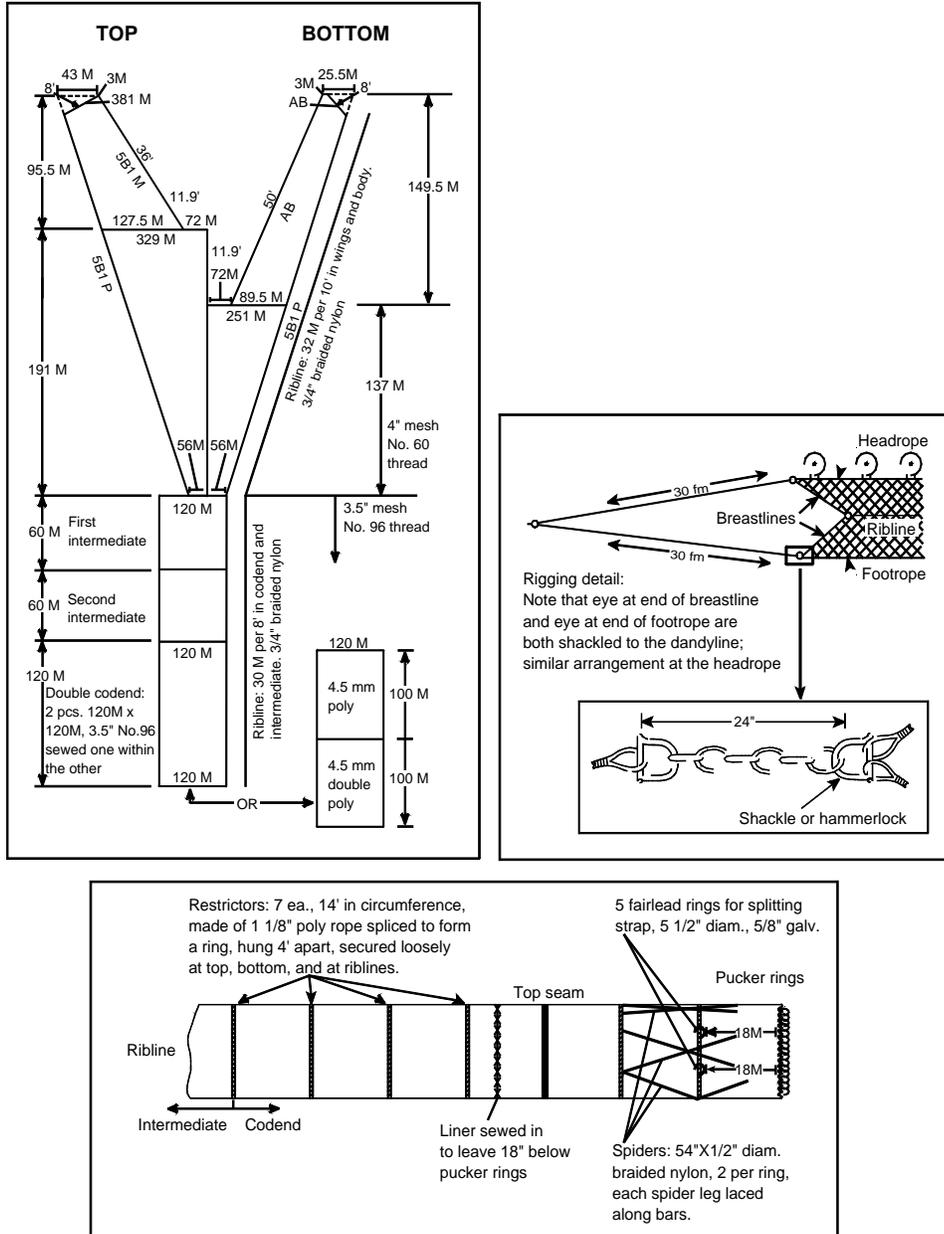


Figure 1.--Diagram of the 83-112 eastern bottom trawl used in the 2004 eastern Bering Sea groundfish survey.

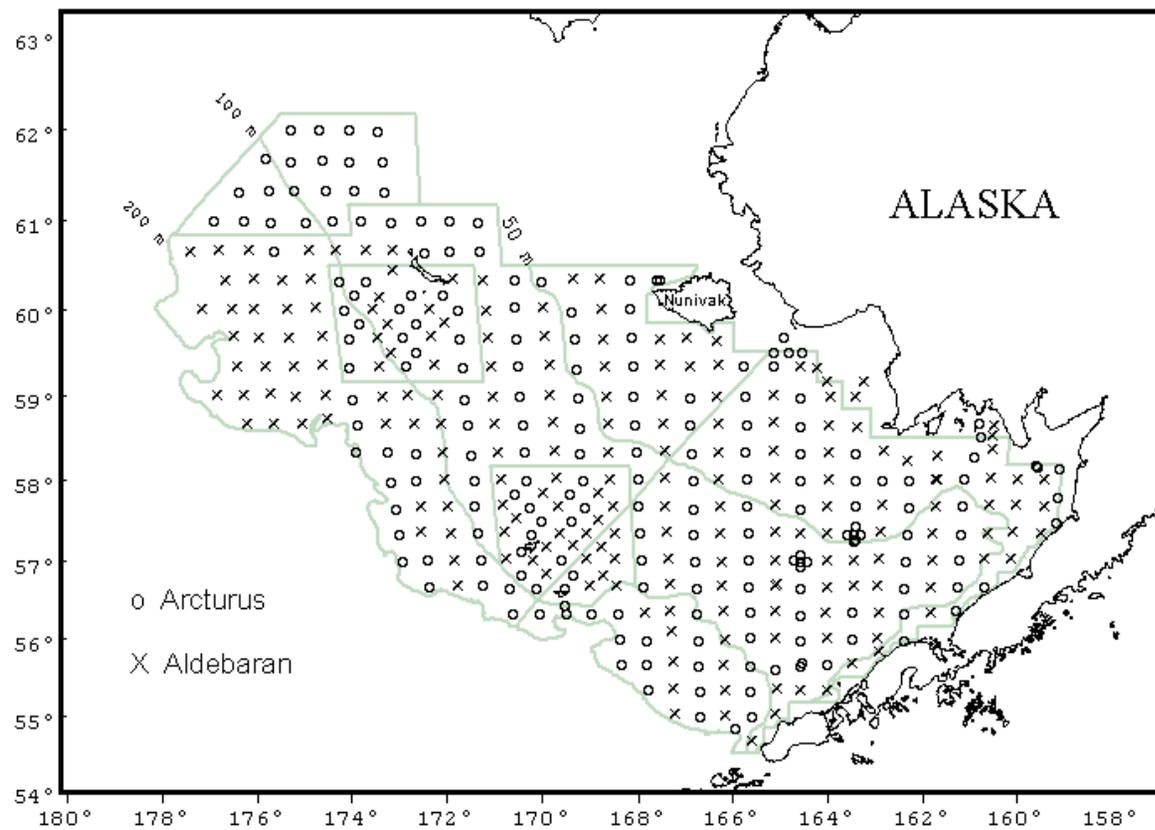


Figure 2--Distribution of total sampling effort by the Aldebaran and Arcturus during the 2004 eastern Bering Sea bottom trawl survey.

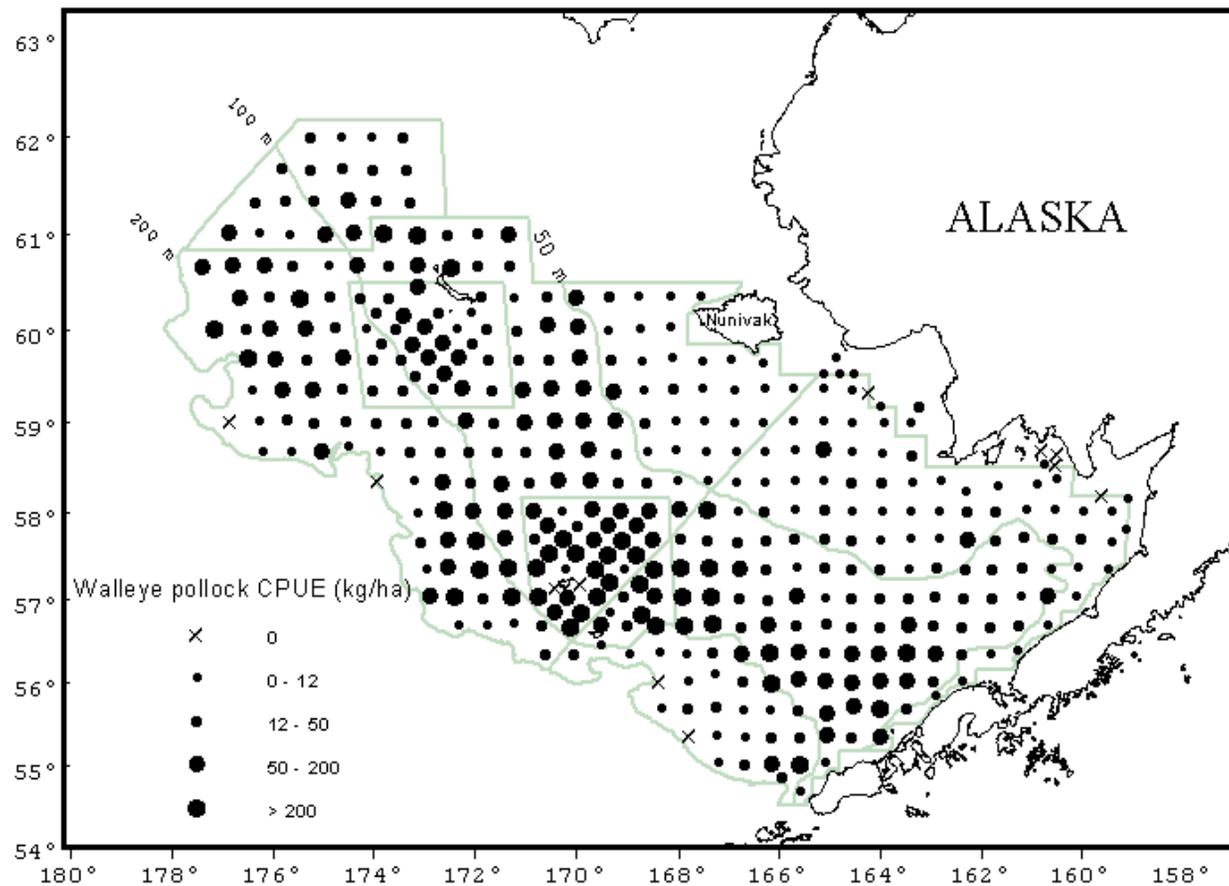


Figure 3--Distribution of and relative abundance of walleye pollock during the 2004 eastern Bering Sea bottom trawl survey.

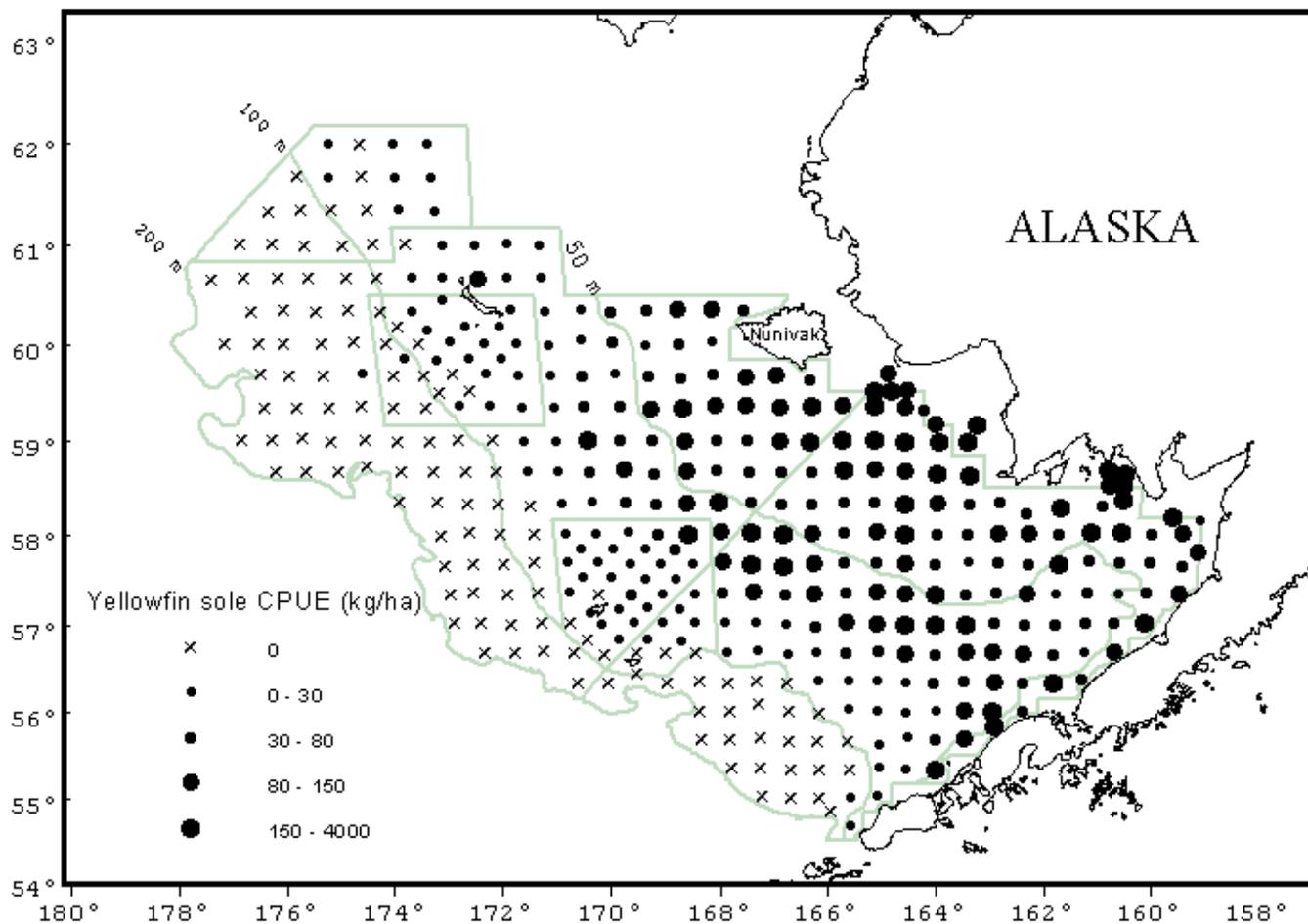


Figure 4--Distribution and relative abundance of yellowfin sole during the 2004 eastern Bering Sea bottom trawl survey.

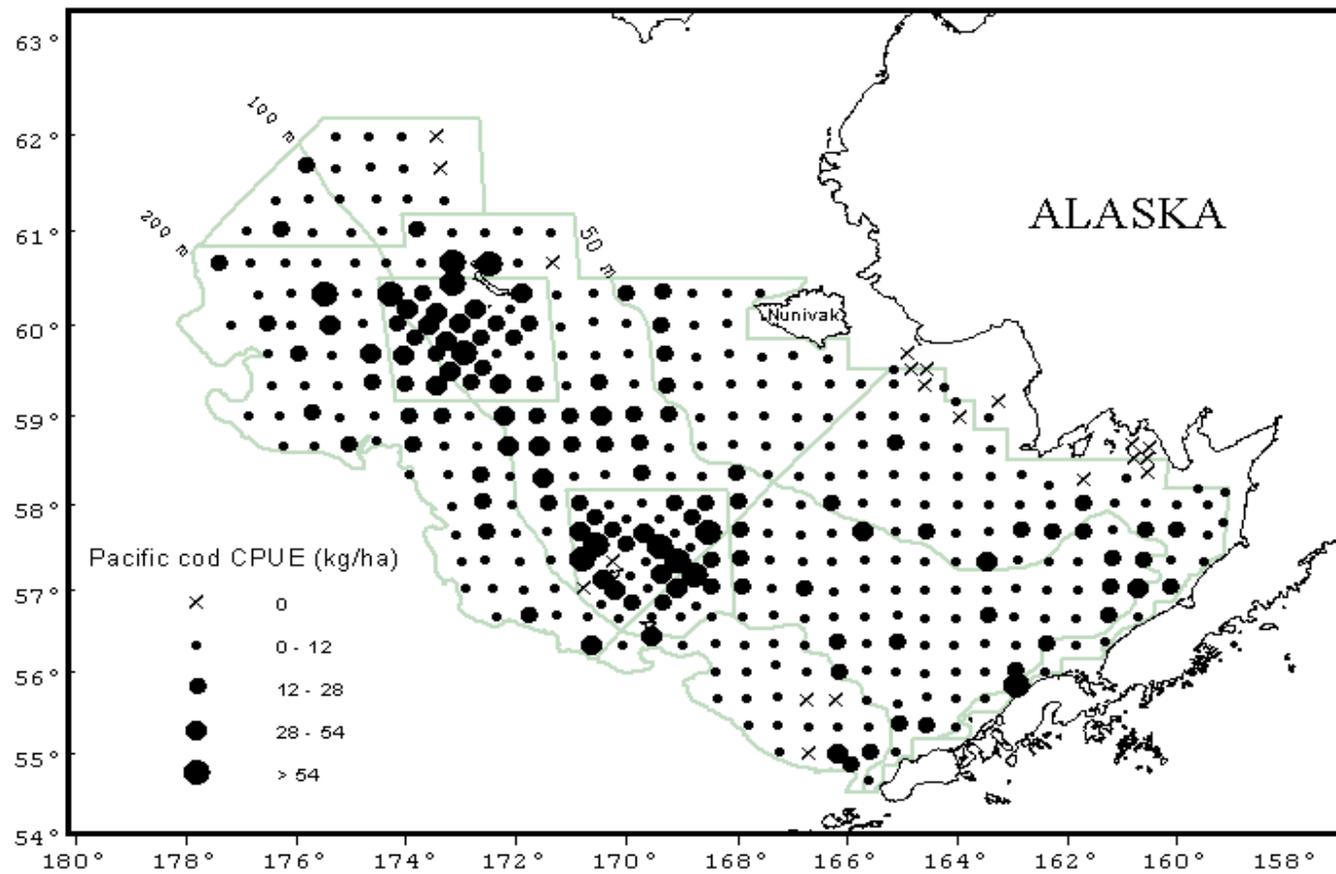


Figure 6--Distribution of and relative abundance of Pacific cod during the 2004 eastern Bering Sea bottom trawl survey.