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

February 7, 2006 F/AKC1:JC

# CRUISE RESULTS

## Cruise 2005-01 FV *Arcturus*
## Cruise 2005-01 FV *Aldebaran*
## 2005 Eastern Bering Sea Crab and Groundfish Survey
## May-July 2005

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 July 2005. This was a continuation of the annual series of eastern Bering Sea crab and 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 standard stations was coordinated between two chartered commercial fishing vessels, the F/V *Arcturus* and F/V *Aldebaran*. Both vessels were 39.6 m (130 ft) in length.

The bottom trawl used for sampling 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 816 kg, 1.8 X 2.7 m, steel V-doors and paired 54.9 m (180.1 ft) dandylines. Each lower dandyline had a 61 cm chain extension connected to the lower wing edge to improve bottom tending characteristics.

A bathythermograph was attached to the headrope and deployed with each trawl, resulting in oblique depth/temperature profiles of the water column. Surface seawater temperatures were also collected with a bucket thermometer.

Bottom contact sensors (inclinometers) provided data to assess bottom tending performance. Net mensuration sensors were also used to assess trawl performance and to provide net geometry data to calculate the area swept by the bottom trawl.

## ITINERARY

The charter of the F/V *Arcturus* and F/V *Aldebaran* began in Dutch Harbor, Alaska on May 30, 2005. The survey was completed on July 25, 2005 and both vessels offloaded in Dutch Harbor. Intermediate port calls were made to Dutch Harbor on June 17 and July 6 to exchange scientific personnel. An additional port call was made to St. Paul Island on June 28 to exchange both scientific and vessel personnel.

Prior to the beginning of the survey, both vessels marked the trawl warps with paint at 45.73 m (25 fm) intervals. The vessels' geometric counter readouts were verified and calibrated to the marks on the trawl warps to ensure that consistent amounts of wire were deployed at all sampling stations.

## SURVEY DESIGN AND METHODS

The total standard survey area encompassed approximately 46,340,000 ha. Sampling stations were based on a 37.04 km (20 nm) square grid pattern established during previous surveys. However, more intensive sampling was conducted in the Pribilof Islands and St. Matthew Island regions to collect supplemental data on crab populations. When possible, the F/V *Arcturus* and F/V *Aldebaran* sampled alternate, longitudinal columns of stations proceeding from Bristol Bay westward to the shelf edge. Figure 2 details the distribution of sampling by vessel as well as the strata used for the standard survey design. Tows of 30 minutes in duration were made at most sampling stations. At each station, observations of time, position, trawl performance and distance fished were recorded. All catches were sorted to the lowest possible taxon, weighed, and enumerated. Age, size composition, and other biological data were collected for the major fish species encountered. Catch and station data were entered into shipboard computer systems. Carapace length and width, shell condition and clutch size were observed and recorded from the major crab species, and various tissues and organs were collected for further analysis. Collections for approved research projects were stored in appropriate fixatives or were frozen.

## RESULTS

The F/V *Arcturus* and F/V *Aldebaran* conducted 417 bottom trawls during the survey, including 402 successfully completed trawls and 15 unsuccessful trawls.

Biological data collected from fish species are summarized in Table 1. The two vessels recorded 183,540 randomly selected length measurements by sex from the major fish species. Sagittal otoliths were extracted from 8,065 fish, stratified by size and sex, and preserved for age analysis. Correlated length/weight measurements were also recorded during the otolith collection process. A total of 1,709 stomachs were either scanned and recorded or preserved for feeding habit analysis.

Whole specimens of selected fish and invertebrate species were preserved for use in identification training programs and other research. Various tissue samples were removed and preserved for approved research projects.

Table 2 contains the percentage of all stations sampled where fish or commercial crab species, excluding non-commercial invertebrates, accounted for the majority of the catch by weight. Catch rates of commercial fish and crab species are listed by Stratum and total survey area in Table 3.

Walleye pollock (*Theragra chalcogramma*) were the most abundant roundfish species and had an overall catch per unit effort (CPUE) of 110.79 kg/ha. Pollock were encountered at almost all sampling stations (Figure 3), with the largest mean catches (231.84 kg/ha) observed in Stratum 6 at depths of 81-171 m. The catch rate was much lower at relatively shallower Stratum 1 (10.65 kg/ha).

Yellowfin sole (*Limanda aspera*) and northern rock sole (*Lepidopsetta polyxystra)* were the most abundant flatfish species with overall CPUE values of 60.93 and 45.74 kg/ha, respectively. The catch rates for yellowfin sole and northern rock sole were highest in Stratum 1, with respective CPUE values of 185.81 and 115.73 kg/ha. At relatively deeper Strata 5 and 6, the catch rates for both flatfish species exhibited a marked decrease. Specifically, yellowfin sole were encountered at only two stations in Strata 5 and 6 combined (Figure 4).

Pacific cod (*Gadus macrocephalus*) were encountered at most of the sites sampled (Figure 6). Mean catch rates were smallest in Stratum 5 (4.98 kg/ha) and greatest in Stratum 4 (21.64 kg/ha) with a total CPUE of 13.03 kg/ha.

Other commercially important flatfish species yielded their highest catch rates in distinct strata. The highest catch rates for Alaska plaice (*Pleuronectes quadrituberculatus*) occurred in Stratum 4 (21.17 kg/ha). The highest combined catch rates for flathead sole (*Hippoglossoides elassodon*) and Bering flounder (*H. robustus*) occurred in Stratum 3 (23.04 kg/ha). Combined catch rates for arrowtooth flounder (*Atherestes stomias*) and Kamchatka flounder (*A. evermanni*) peaked in Stratum 5 (42.26 kg/ha). Catch rates for Pacific halibut (*Hippoglossus stenolepis*) were highest in Stratum 1 (4.85 kg/ha), but were reasonably consistent between all strata with a total CPUE of 3.02 kg/ha.

Tanner crab (*Chionocetes opilio*) was the most abundant commercial crab species encountered, with a total CPUE of 5.70 kg/ha. The catch rates for bairdi Tanner crab (*C. bairdi*) were less overall (2.15 kg/ha), but considerably higher in Stratum 5 (6.92 kg/ha) than opilio Tanner crab (0.37 kg/ha). Red king crab (*Paralithodes camtschatica*) had a total CPUE of 2.32 kg/ha and was most abundant in Stratum 3 (6.22 kg/ha), while blue king crab (*P. platypus*) had overall catch rates of less than 0.1 kg/ha. Both king crab species were absent from Strata 5 and 6, and blue king crab was also not caught within Stratum 1.

**SCIENTIFIC PERSONNEL**[a]

**F/V Arcturus**

| Leg 1[b] | Leg 2 | Leg 3 |
|---|---|---|
| D. Nichol[c] | D. Nichol[c] 6/17-7/6 | J. Hoff[c] |
| C. Armistead[e] | J. Hoff[c] 6/17-7/6 | J. Kuras |
| G. Mundell | J. Kuras | E. Munk[e] |
| G. Lang | J. Murphy | S. VillageCenter |
| M. Litzow | S. Persselin[e] | R. Hibpshman |
| K. Calif | A. Whitehouse | S. Neidetcher |
| | C. Shavey | |

**F/V Aldebaran**

| Leg 1[b] | Leg 2 | Leg 3 |
|---|---|---|
| S. Kotwicki[c] | L. Britt[c] | E. Acuna[c] |
| S. VanSant[e] | P. Cummiskey[e] | J. Haaga[e] |
| J. Brogan | K. Gravel | R. Barr |
| D. Stevenson | J. Berger | P. Jensen |
| C. Blood | M. Nelson | J. Conner |
| K. Smith | B. Gauthier[d] | B. Gauthier[d] |

[a] Personnel from the AFSC, Seattle, unless otherwise noted
[b] Leg dates: Leg 1 (5/30 - 6/17); Leg 2 (6/17 – 7/6); Leg 3 (7/6 –7/25)
[c] Field Party Chief
[d] Personnel from the International Pacific Halibut Commission
[e] Personnel from the AFSC, Kodiak Laboratory

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Table 1 - Biological data collected during the 2005 Eastern Bering Sea Crab and Groundfish Survey.

| Species | Length Measurements | Age Structures[1] | Stomach Samples |
|---|---|---|---|
| Walleye pollock | 37,028 | 1,676 | 707 |
| Pacific cod | 12,118 | 1,315 | 494 |
| Yellowfin sole | 26,792 | 680 | -- |
| Northern rock sole | 32,122 | 426 | 37 |
| Flathead sole/ Bering flounder[2] | 21,590 | 549 | -- |
| Pacific halibut | 2,181 | 883 | 41 |
| Alaska plaice | 11,454 | 341 | -- |
| Arrowtooth flounder/ Kamchatka flounder[3] | 18,488 | 555 | 20 |
| Greenland turbot | 442 | 294 | 29 |
| Rex sole | 1,095 | -- | -- |
| Longhead dab | 2,145 | -- | -- |
| Plain sculpin | 3,344 | 343 | -- |
| Great sculpin | 870 | 403 | -- |
| Warty sculpin | 466 | 176 | -- |
| Yellow Irish lord | 1,078 | 222 | -- |
| Starry flounder | 677 | -- | -- |
| Alaska skate | 4,589 | -- | 35 |
| Bering skate | 123 | -- | 2 |
| Pacific Ocean perch | 192 | -- | -- |
| Misc. skates | 20 | -- | -- |
| Misc. species | 6,726 | 202 | 344 |
| Total | 183,540 | 8,065 | 1,709 |

[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 – Percentage of all stations sampled where fish or commercial crab species accounted for the majority of the catch by weight during the 2005 Eastern Bering Sea Crab and Groundfish Survey.

| Species | Percent of Stations Sampled |
|---|---|
| Walleye pollock | |
| Northern rock sole | 20 |
| Yellowfin sole | 18 |
| Snow crab | 9 |
| Arrowtooth flounder | 7 |
| Alaska plaice | 6 |
| Flathead sole | 3 |
| Pacific cod | 1 |
| Pacific herring | < 1 |
| Alaska skate | < 1 |
| Bering flounder | < 1 |
| Marbled eelpout | < 1 |
| Pacific ocean perch | < 1 |

Table 3 – CPUE (kg/ha) of commercially important species by Stratum during the 2005 Eastern Bering Sea Crab and Groundfish Survey.

| Species | Stratum | | | | | | Total |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | |
| Walleye pollock | 10.65 | 12.24 | 128.23 | 107.66 | 83.21 | 231.84 | 110.79 |
| Yellowfin sole | 185.81 | 72.18 | 75.97 | 27.25 | 0.22 | 0.11 | 60.93 |
| Northern rock sole | 115.73 | 72.57 | 46.33 | 38.38 | 1.02 | 2.55 | 45.74 |
| Pacific cod | 5.83 | 6.87 | 10.20 | 21.64 | 4.98 | 18.20 | 13.03 |
| Alaska plaice | 8.89 | 10.82 | 14.85 | 21.17 | NC* | 0.90 | 10.87 |
| Flathead sole/ Bering flounder | 4.22 | 0.12 | 23.04 | 9.19 | 17.63 | 18.16 | 13.18 |
| Arrowtooth flounder/ Kamchatka flounder | 1.55 | 0.12 | 23.61 | 5.82 | 42.26 | 29.03 | 16.35 |
| Pacific halibut | 4.85 | 3.92 | 2.45 | 2.75 | 2.28 | 2.35 | 3.02 |
| Opilio Tanner crab | < 0.01 | 0.31 | 1.54 | 18.50 | 0.37 | 4.88 | 5.70 |
| Bairdi Tanner crab | 0.29 | 0.03 | 2.51 | 3.06 | 6.92 | 1.20 | 2.15 |
| Blue king crab | NC | 0.03 | < 0.01 | 0.31 | NC | NC | 0.08 |
| Red king crab | 4.95 | 0.23 | 6.22 | 0.36 | NC | NC | 2.32 |

* NC = None Caught within the Stratum.

## 83/112 EASTERN

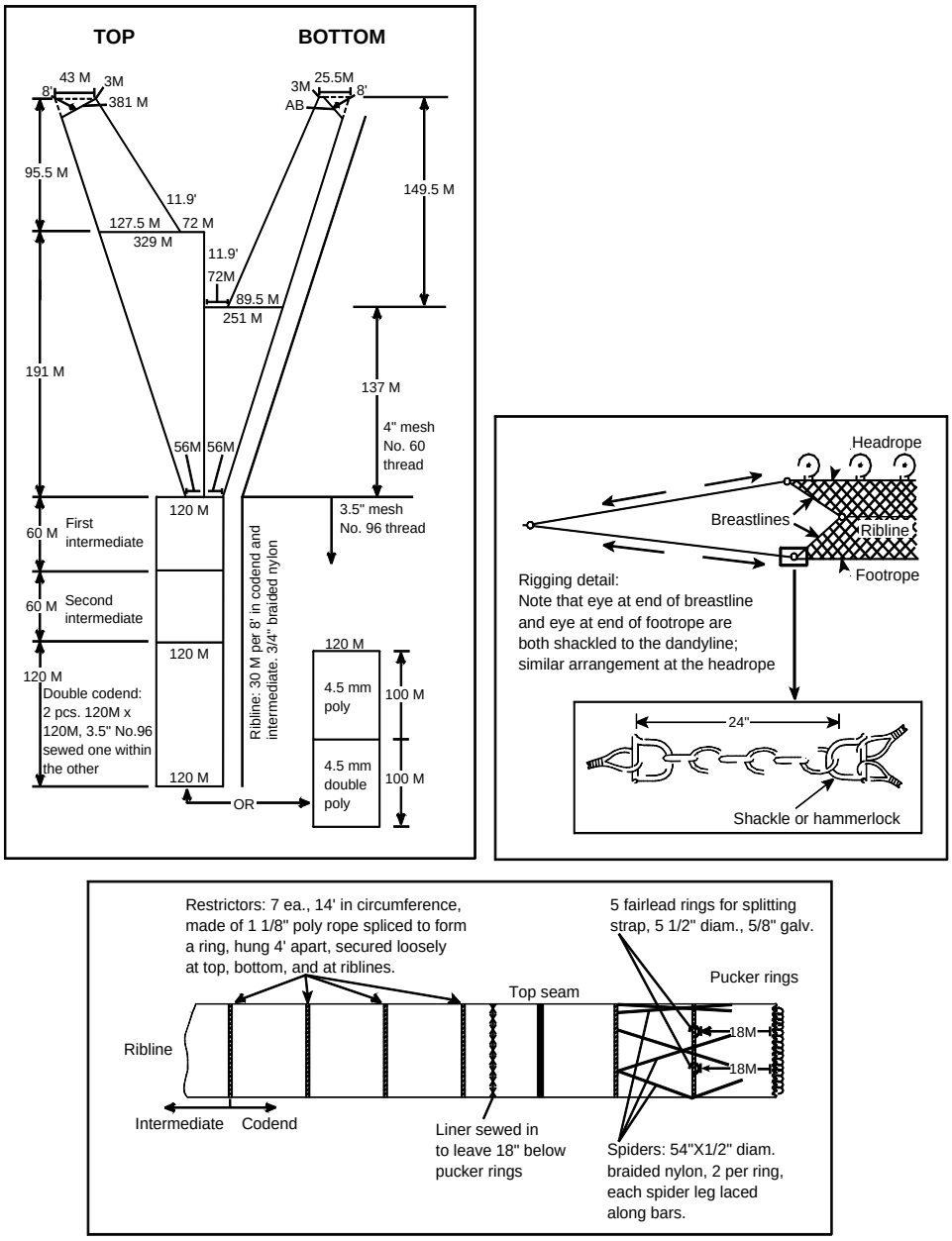


Figure 1 - Diagram of the 83-112 eastern bottom trawl used in the 2005 Eastern Bering Sea Crab and Groundfish Survey.

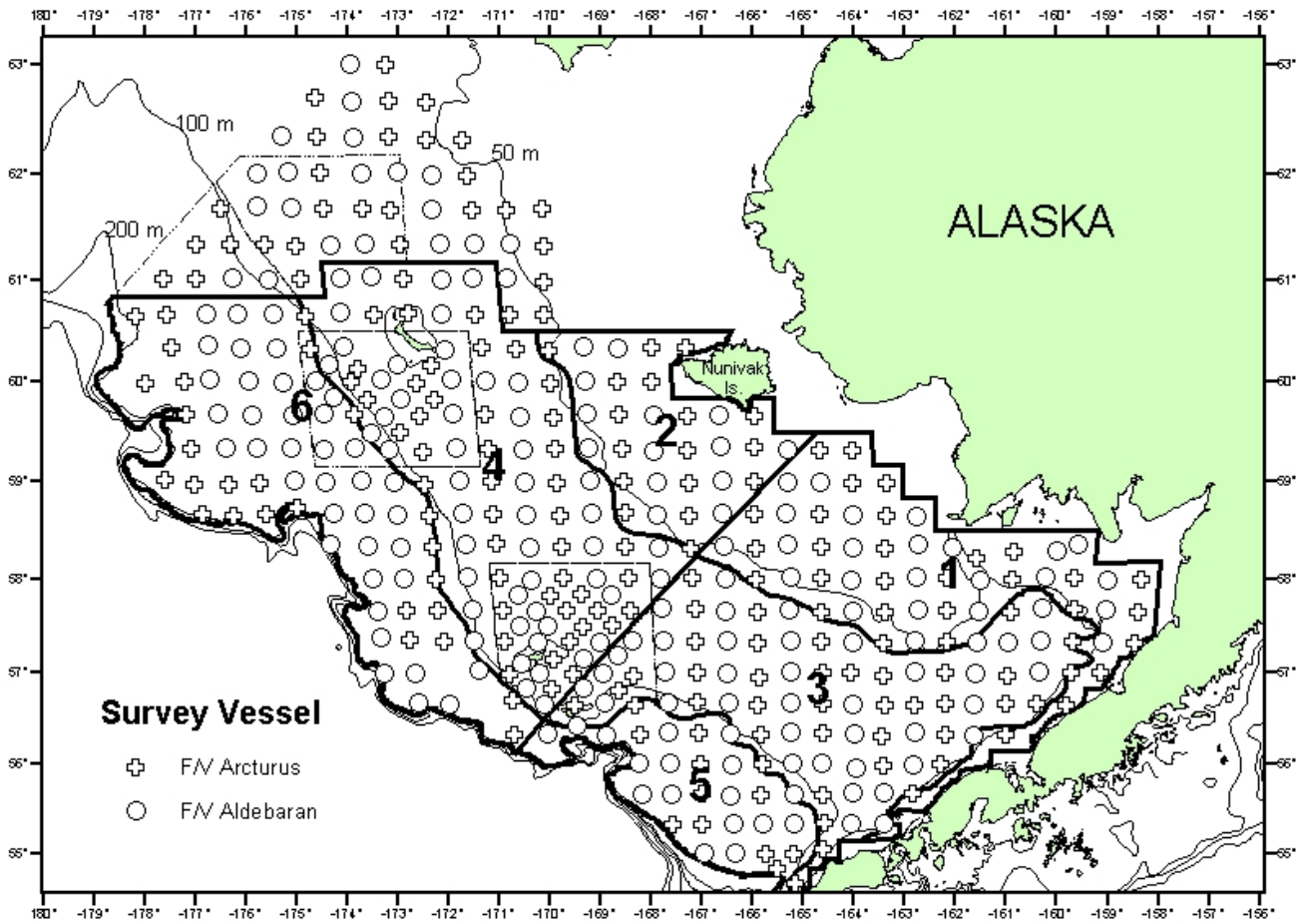


Figure 2 - Distribution of total sampling effort by the F/V *Arcturus* and F/V *Aldebaran* during the 2005 Eastern Bering Sea Crab and Groundfish Survey.

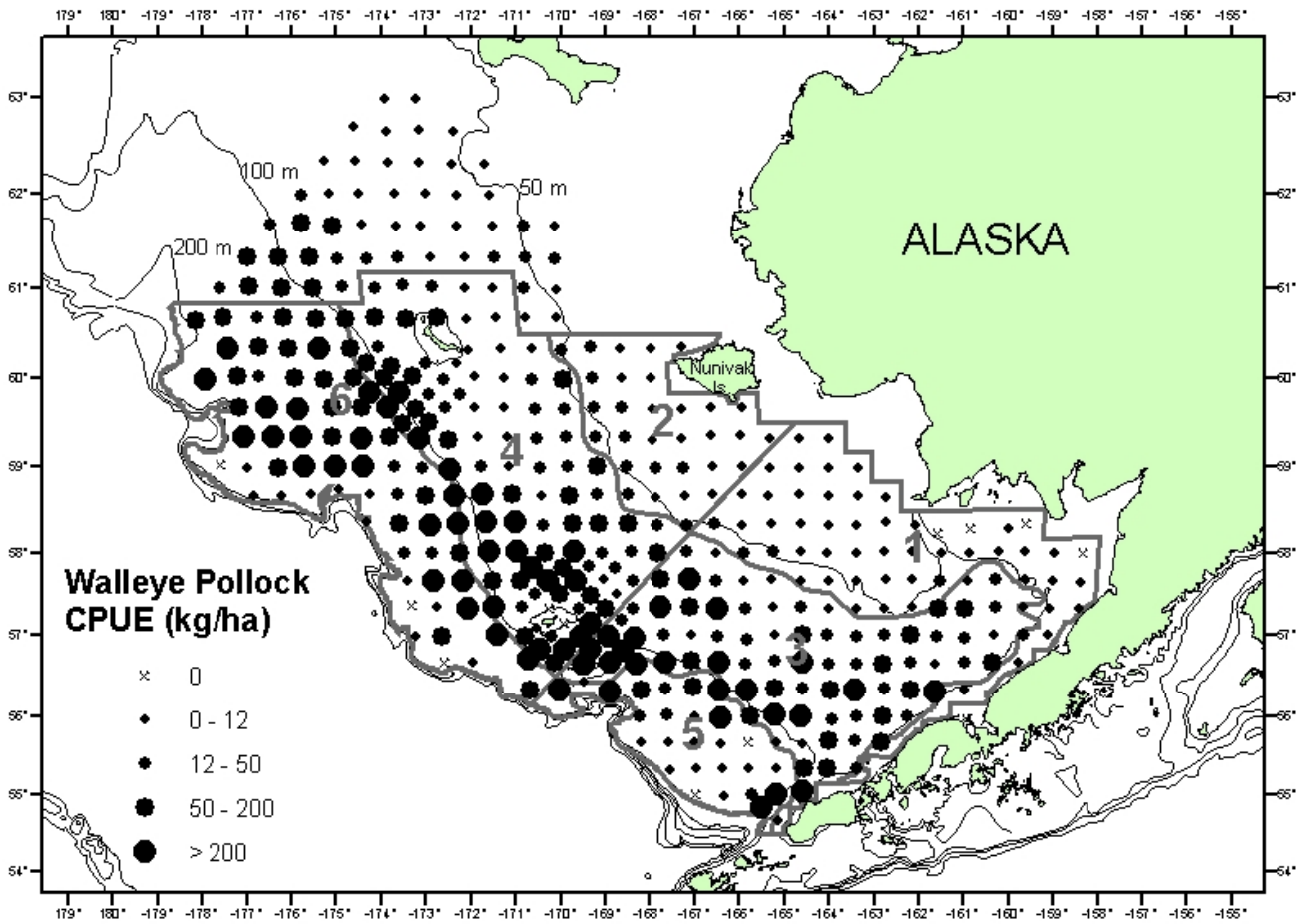


Figure 3 - Catch rates (kg/ha) of walleye pollock during the 2005 Eastern Bering Sea Crab and Groundfish Survey.

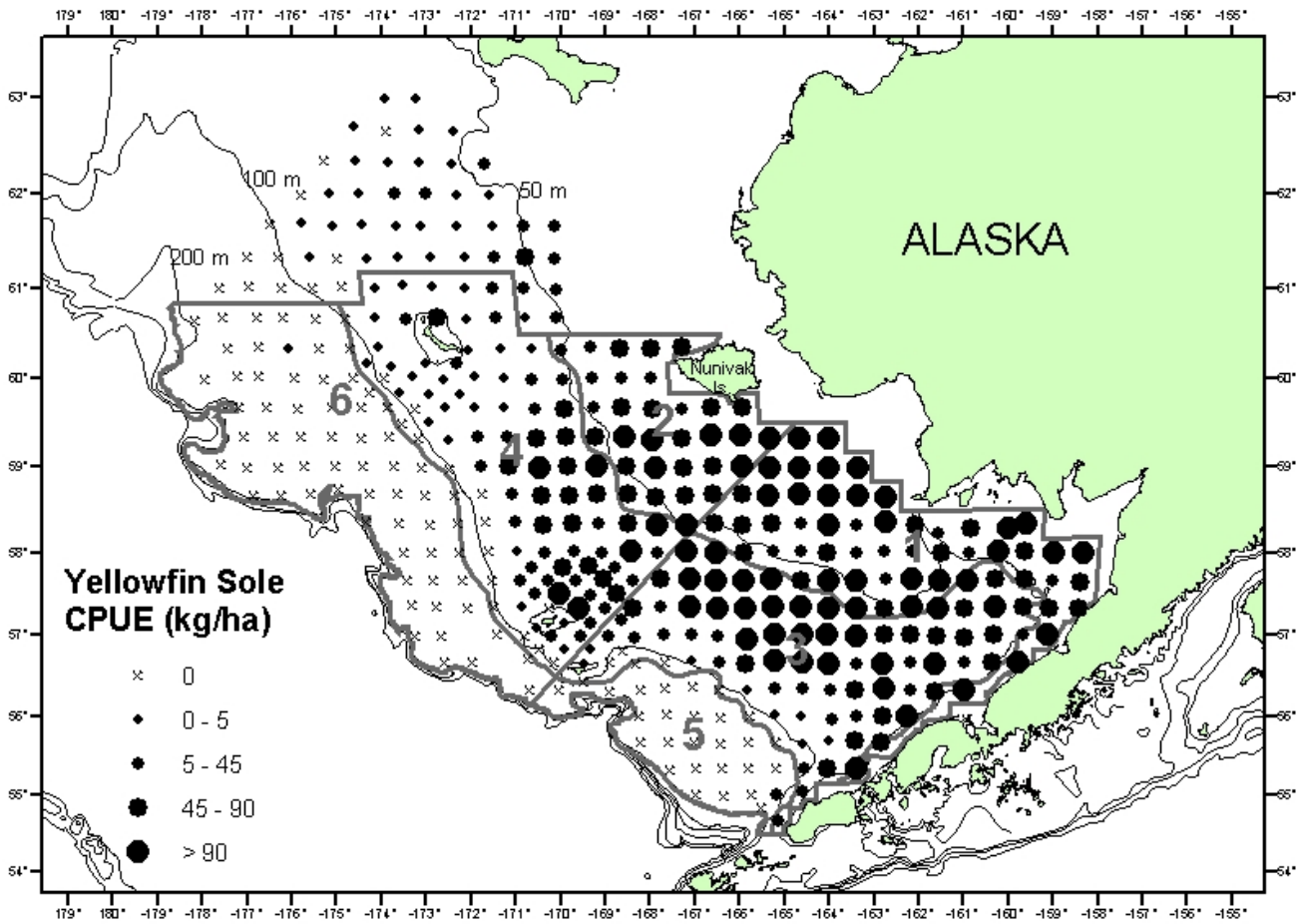


Figure 4 - Catch rates (kg/ha) of yellowfin sole during the 2005 Eastern Bering Sea Crab and Groundfish Survey.

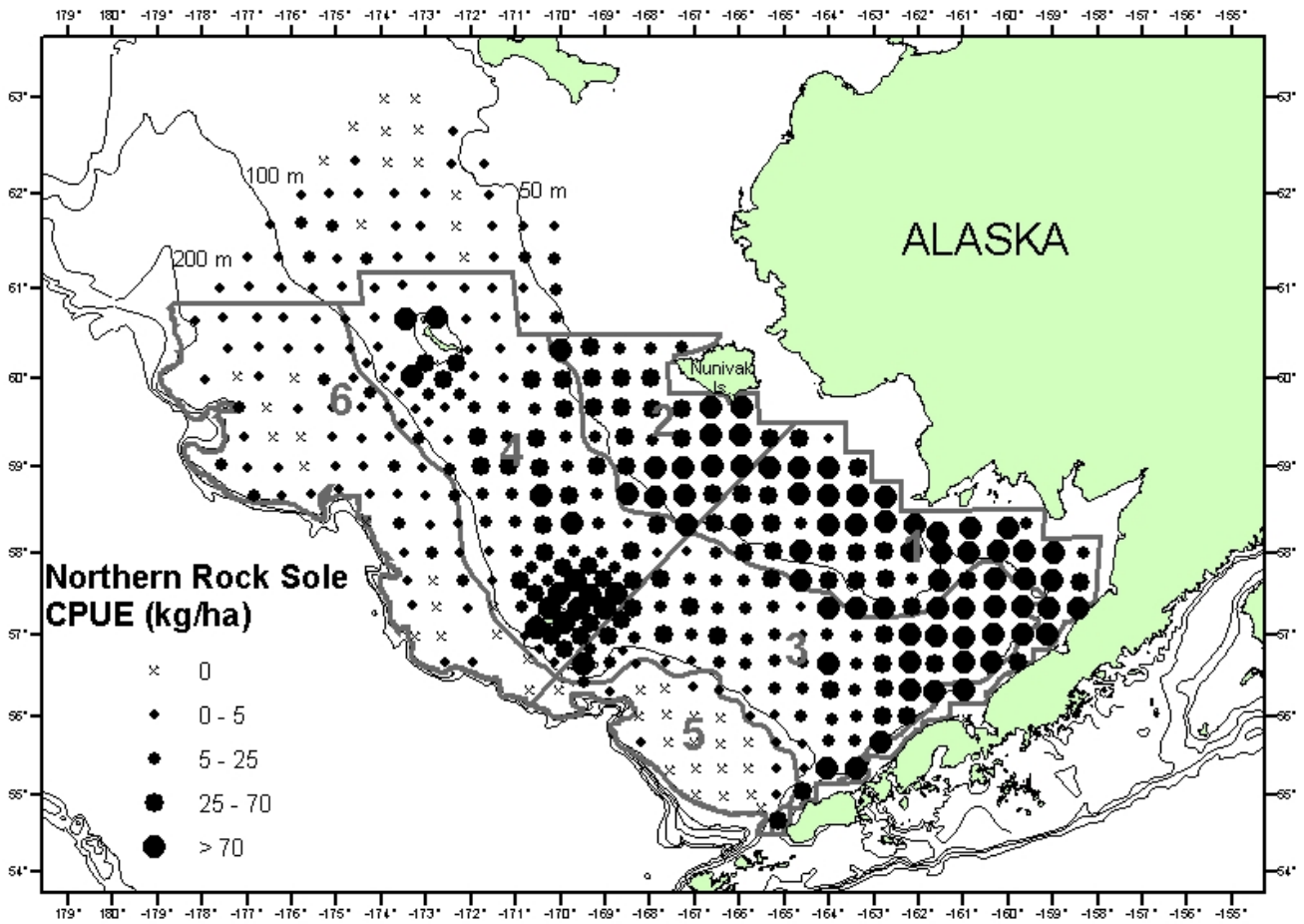


Figure 5 - Catch rates (kg/ha) of northern rock sole during the 2005 Eastern Bering Sea Crab and Groundfish Survey.

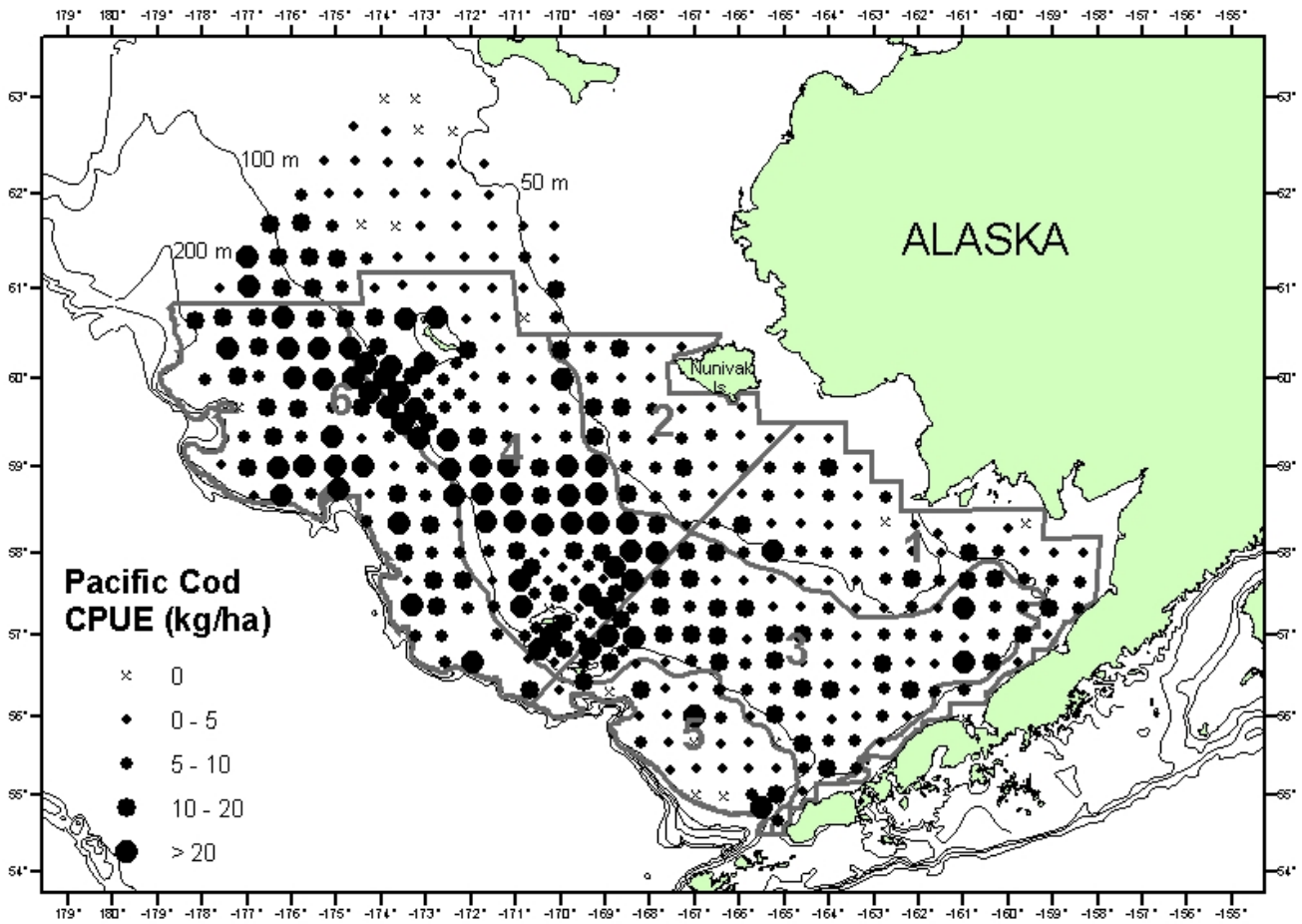


Figure 6 - Catch rates (kg/ha) of Pacific cod during the 2005 Eastern Bering Sea Crab and Groundfish Survey.