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NOAA Technical Memorandum NMFS-AFSC-88

Catch-per-unit-effort, Length, and Depth Distributions of Major Groundfish and Bycatch Species in the Bering Sea, Aleutian Islands, and Gulf of Alaska Regions Based on Groundfish Fishery Observer Data

by
L. W. Fritz, A. Greig, and R. F. Reuter

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
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Abstract

The identification and description of essential fish habitat (EFH) for fish species managed under fishery management plans (FMPs) is a requirement of the Magnuson-Stevens Fishery Conservation and Management Act of 1996. Groundfish species off Alaska are managed under two FMPs, one covering the Bering Sea-Aleutian Islands (BSAI) region and another the Gulf of Alaska (GOA). This report summarizes data collected by groundfish fishery observers from 1973-96 that may be useful in the identification and description of EFH for adult and juvenile life stages of groundfish and various species caught as bycatch. Length-frequency and depth distributions of groundfish species in commercial catches are provided in graphical form. As an index of relative spatial distribution, groundfish catch-per-unit-effort (CPUE) is displayed on a series of charts covering the BSAI and GOA regions.

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Introduction

The Magnuson-Stevens Fishery Conservation and Management Act (Act) of 1996 required the National Marine Fisheries Service (NMFS) and regional fishery management councils to describe and identify essential fish habitat (EFH) for species managed by fishery management plans (FMPs). Essential fish habitat is defined in the Act as "those waters and substrate necessary for spawning, breeding, feeding, and growth to maturity" of *fish*, which is also defined in the Act as "finfish, mollusks, crustaceans and all other forms of marine animal and plant life other than marine mammals and birds". The North Pacific Fishery Management Council (NPFMC) must identify EFH off Alaska for each life stage (egg, larva, juvenile, and adult) of each species managed under FMPs. The NPFMC administers five FMPs, two of which are for groundfish in the Bering Sea and Aleutian Islands (BSAI) region and the Gulf of Alaska (GOA). The other three FMPs are for BSAI king and Tanner crab (*Paralithodes* spp., *Lithodes* spp., and *Chionoecetes* spp.) and Pacific salmon (*Oncorhynchus* spp.) fisheries in the U.S. Exclusive Economic Zone (EEZ) off Alaska, and scallop *(Patinopectin caurinus, Chlamys* spp., and *Crassodoma gigantea)* fisheries off the coast of Alaska.

This report summarizes groundfish fishery observer data to aid in the geographical description and identification of EFH for species managed under the BSAI and GOA groundfish FMPs. Scientific observers have been placed aboard commercial groundfish vessels fishing in the BSAI and GOA regions since passage of the original Magnuson Fishery Conservation and Management Act in 1976. Observers have collected large amounts of a wide variety of data on fishery catches that are useful in the EFH identification process for those species and life stages targeted by fisheries or caught as bycatch.

This report displays in a series of graphs and charts the length-frequencies, depth distributions, and relative catches-per-unit-effort (CPUE) of groundfish species (Table 1) caught by commercial fisheries from 1973 to 1996. The length-frequency data summarizations show what life stages are caught by groundfish fisheries off Alaska (principally adults with some juveniles), while the depth and CPUE data reveal their relative spatial distributions.

Methods

Groundfish fishery observer data are stored in two main databases: foreign and domestic. The foreign fishery data, which also includes those data collected aboard joint-venture vessels, were collected prior to 1991 when foreign nations were permitted to fish for groundfish off Alaska. While the earliest data in the database were collected in 1973, most of the data were

collected between 1980 and 1987. Methods used by observers aboard foreign and joint-venture vessels to collect catch data are described by Nelson et al. (1981). The domestic groundfish fishery observer data were collected aboard U.S.-flagged vessels according to the methods described by the NMFS (NMFS 1996). The domestic data range in collection date from 1986 to the present. For this analysis, data collected through 1996 are summarized.

Fishery observers collect many types of data on commercial groundfish catches, including (but not limited to):

- Gear type used;
- Duration of haul, number of hooks or pots deployed;
- Retrieval location of catch: latitude and longitude to the nearest minute;
- Fishing depth of gear and bottom depth at the location fished;
- Weights of individual species in samples of the catch (extrapolated to the whole haul or gear set once data are verified upon the observer's return); and
- Length-frequency of the target species.

Data summarized in this report consist of three types: 1) fish length by species and gear type; 2) percent occurrence of each species in catch composition samples taken at various depths by each gear type; and 3) catch-per-unit-effort of each species by location and gear type. Gear types used were trawls (which includes all types of trawls, such as bottom, midwater (or pelagic), and pair trawls), longlines (hook and line), and pots. From a random distribution of hauls, observers obtain a random sample of the catch. Hauls for which species composition has been estimated are termed "sampled hauls". The methods used to summarize each data type are described below.

Length-frequency distributions were compiled by species and dominant gear type for the combined BSAI-GOA regions and foreign-domestic databases. Data are presented as both percent frequency and cumulative percent frequency distributions by length.

The distribution of each species by depth was analyzed by calculating the percent of sampled hauls within a certain depth range that contained the species. The depth ranges used were in 50 m intervals to 500 m, and in 100 m intervals to 1000 m. For some species, data in several of the deepest ranges were accumulated in a single "plus" group. Fishing depth was used to summarize depth distributions of species caught by trawls, while bottom depth was used for longlines and pots. For walleye pollock, which is caught principally by midwater/pelagic trawls, there is a difference between fishing depth and bottom depth. For all other species, which are caught primarily by bottom trawls, longlines, or pots, fishing depth and bottom depth are identical.

$$(1)\quad CPUE_{x,p,g} = \frac{\sum_{i=1}^{n} W_{x,p,g,i}}{\sum_{i=1}^{n} E_{p,g,i}}$$

Catch-per-unit-effort (CPUE) was summarized by location and gear type to reveal patterns of relative density of each species across all areas and times fished. The retrieval location of sampled hauls is recorded in the observer database to the nearest minute of latitude and longitude. Consequently, if the location of all sampled hauls is plotted, a grid is formed with points spaced 1 nautical mile (nmi) apart vertically (by latitude) and approximately 0.5 nmi apart horizontally (by longitude). The average CPUE was calculated using Equation (1), where W is the weight (in kg) of species or species group x in sampled haul I taken at point p by gear type g, E is the measure of effort (for trawl gear = hours trawled during sampled haul I; longlines = number of hooks deployed divided by 100 in sampled haul I; pots = number of pots deployed in sampled haul I) at point p for gear type g, and n is the number of hauls of gear type g sampled at point p. Species or species groups for which average CPUE at each sampled location was calculated are listed in Table 1. For spatial analysis and display, 1 was added to the calculated average CPUE, and it was then rounded to the nearest integer.

Some rudimentary spatial analysis of the CPUE data was performed using ARC and ARCVIEW software from ESRI, Inc. First, the data were gridded; a 1 km (on a side) square grid was placed over the data and their attributes (e.g., CPUE, number of sampled hauls) were assigned to individual grid cells. A grid size of 1 km^2 was chosen to ensure that no more than one sampled location fell within a single grid cell. However, this also created many grid cells which had no sampled locations within them.

Second, a neighborhood function was then applied to the grid. For each 1 km^2 grid cell, the maximum CPUE in the 5 cell by 5 cell (= 5 km X 5 km) neighborhood centered at the processing cell was found and assigned to the new 25 km^2 cell. This process eliminated many of the empty cells (artificially created by the 1 km^2 grid) and better represented the area over which the sample(s) were taken than if the data were plotted as a single point at the haul position; for these analyses, only haul retrieval position was available and the actual area fished surrounded this point. For display, each new 25 km^2 cell was placed into one of four bins depending on the CPUE value: 1) maximum average CPUE=0: no individuals of the species had been found in sampled hauls taken in this cell; and 2) the lower, middle, and upper thirds of the remaining non-zero CPUE values.

The 5 km X 5 km neighborhood function was inappropriate to use to display the distribution of effort because the neighborhood assessed moves one grid cell (in this case 1 km^2)

at a time. If the sum of sampled hauls were computed in this manner, individual locations would be included as many as 9 times. Consequently, a different method was used to display the spatial distribution of sampled hauls. First, a 5 km X 5 km grid was constructed and a number was assigned to each cell. Second, minute-by-minute effort data were assigned to each grid cell based on their location, and the number of sampled hauls and units of effort (hours, hooks, and pots) were summed within each cell. The 5 km X 5 km grid cells created for display of effort distribution do not match those created to display each species' CPUE distribution (each of which are different and reflect the relative distribution of each species).

All maps of CPUE and effort distribution were prepared using the Albers equal area conic projection with a reference longitude of 154°W. The BSAI and GOA regions were each divided into two sections for display on facing pages with only minimal overlap. The western boundary of the GOA management region is actually at 170°W, but the GOA region maps only extend to approximately 165°W. The area south of the Aleutian Island archipelago from 165°W to 170°W which is in the GOA management region is displayed on the BSAI charts.

Results and Discussion

Length-frequency distributions from the fishery reveal that groundfish fisheries catch predominately adults and late juveniles of targeted species, and that different gear types can have different selectivities (Fig. 1). Most of the distributions are unimodal and generally bell-shaped, including those for walleye pollock, yellowfin sole, Pacific cod (all gear types), arrowtooth flounder, rock sole, flathead sole, Dover sole, sablefish (longline), rex sole, Pacific ocean perch, shortraker rockfish (longline) yelloweye rockfish (both gear types), and Atka mackerel. Bimodal distributions were observed for Greenland turbot (both trawls and longlines, but trawls caught smaller fish), Alaska plaice, sablefish (trawl) and thornyhead rockfish. Some of the rockfish length-frequency distributions were skewed, with the tails of the distribution at either large (shortraker (trawl) and rougheye) or small sizes (northern and dusky).

Percent frequency of occurrence of groundfish species in sampled hauls taken within various depth ranges are shown in Figure 2. Using these data, species can be grouped together (see below) based on their frequency of occurrence in samples taken on the inner-middle shelf (to depths of 100 m), outer shelf (100-200 m), upper slope (200-500 m), and lower slope (500-1000 m). Many species are assigned to more than one group if they were found in a broad range of depths in commercial samples. These depth-range groups are based solely on commercial sampling and represent only where the species have been predominately caught by fisheries. As

such, they may not represent the actual distribution of most of the individuals of each species because of the inability of the gear to be worked in some areas (due to untrawlable rocky conditions), differences in the timing of fishing in an area and the distribution of the fish, and various fishery management regulations. Examples of these discontinuities appear in the depth distributions for arrowtooth flounder, which appears to be most prevalent on the inner shelf but is actually more broadly distributed, and for Atka mackerel, which is caught by the fishery primarily at depths between 100 and 200 m, but are known to migrate to shallower waters to spawn in summer (Wolotira et al. 1993; Zolotov 1993).

Inner-Middle Shelf	Outer Shelf	Upper Slope	Lower Slope
Walleye pollock	Walleye pollock	Walleye pollock	Walleye pollock
Pacific cod	Pacific cod	Dover sole	Greenland turbot
Yellowfin sole	Rock sole	Rex sole	Dover sole
Rock sole	Rex sole	Flathead sole	Sablefish
Alaska plaice	Flathead sole	Pacific ocean perch	Yelloweye rockfish
Flathead sole	Pacific ocean perch	Shortaker rockfish	Thornyheads
	Northern rockfish	Rougheye rockfish	
	Dusky rockfish	Northern rockfish	
	Atka mackerel	Dusky rockfish	

Spatial fishery CPUE distributions for each species and gear type listed in Table 1 are shown in Figures 3-38. These reveal not only the depth distributions shown in Figure 2, but also where within the BSAI and GOA regions each species has appeared in fishery samples, and the relative degree to which they have appeared. The size of the fishery database summarized is detailed in Table 2 and the spatial distribution of sampling effort is shown in Figures 39-41.

Several factors contribute to the results being more heavily influenced by samples taken in the BSAI relative to the GOA. First, there have been more hauls sampled within the BSAI than the GOA region (Figs. 39-41), which reflects the relative sizes of the groundfish catches within the two areas. Second, larger vessels, such as catcher-processors capable of pulling large nets, have worked more extensively in the BSAI region than in the GOA. Therefore, CPUEs in the BSAI would likely be larger than in the GOA for the same species because of the greater number of sampled hauls taken aboard large vessels. There was no attempt to standardize CPUEs in this analysis to account for differences in fishing power related to the size or power of each vessel or the size and type of gear (e.g., type and mesh size of trawl); this may be a valid

criticism of the methods used in data summarization. Despite these possible shortcomings, the distributions of species CPUE by groundfish fisheries shown in Figures 3-38 are very similar to those for adult and late juvenile fish appearing in charts prepared by Allen and Smith (1988), NOAA's National Ocean Service (NOS 1988; 1990), and Wolotira et al. (1993).

Fishery management regulations, particularly those controlling when, where, and how much fish can be caught have certainly affected the distribution of fisheries and as such, the distributions of species' CPUE shown in Figures 3-38. One of these restrictions, taken in 1987, was the permanent closure of North Pacific Fishery Management Council Area 512 in the southeastern Bering Sea to trawling to protect spawning aggregations of red king crab (Witherell and Pautzke 1997). Area 512 is located south of 58°N between 160°W and 162°W. The result of this closure is a lack of sampled fishery haul locations in this area, resulting in straight line edges in the distribution of sampled hauls. Similarly, Area 518 was closed to directed walleye pollock fishing beginning in 1992 to protect spawning aggregations of the Aleutian Basin walleye pollock stock (Fritz et al. 1995). Area 518 is located between 167°W and 170°W north of the Aleutian Islands and south of the 200 m isobath. Total allowable catch quotas for walleye pollock, among other groundfish, are allocated separately to the Aleutian Islands district (located west of 170°W and south of 55°N to the edge of the Exclusize Economic Zone, 200 miles south of the Aleutian Island archipelago) and eastern Bering sea districts. As a result of separate spatial walleye pollock quotas and the closure of Area 518, pelagic trawl effort in deep Aleutian Basin waters north of the archipelago stops abruptly at 170°W. These two area closures are only two examples of how regulations affect both the distributions of fisheries and their CPUEs as shown in Figures 3-38. More detailed summaries of the regulatory history of North Pacific groundfish fishery management are available in Fredin (1987), Witherell and Roberts (1996), Witherell and Pautzke (1997), and Witherell (1997).

The maps of fishery CPUE distribution by species presented in this report are useful in describing where the fishery has been successful in catching adult groundfish. However, as discussed above, there are many factors that influence the distribution of fisheries that may be independent of the distribution of adults of the target species. Therefore, the maps in this report should be used in conjunction with other reference materials and data to determine the areal extent of EFH for adult groundfish as required under the Act.

Acknowledgments

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Table 1.--List of species and gear types for which groundfish fishery observer data were summarized.

		Gear Type		
Species or Group	**Scientific Name**	**Trawl**	**Longline**	**Pot**
Walleye pollock	*Theragra chalcogramma*	X		
Pacific cod	*Gadus macrocephalus*	X	X	X
Yellowfin sole	*Pleuronectes (=Limanda) asper*	X		
Greenland turbot	*Reinhardtius hippoglossoides*	X	X	
Arrowtooth flounder	*Atheresthes stomias*, *A. evermanni*	X		
Rock sole	*Pleuronectes bilineatus*	X		
Alaska plaice	*Pleuronectes quadrituberculatus*	X		
Dover sole	*Microstomus pacificus*	X		
Rex sole	*Errex zachirus*	X		
Flathead sole	*Hippoglossoides elassodon*	X		
Sablefish	*Anoplopoma fimbria*	X	X	
Pacific ocean perch	*Sebastes alutus*	X		
Shortraker rockfish	*Sebastes borealis*	X	X	
Rougheye rockfish	*Sebastes aleutianus*	X	X	
Northern rockfish	*Sebastes polyspinus*	X		
Dusky rockfish	*Sebastes ciliatus*	X		
Yelloweye rockfish	*Sebastes ruberrimus*	X	X	
Thornyhead rockfish	*Sebastolobus alascanus, S. macrochir, S. altivelis*	X		
Atka mackerel	*Pleurogrammus monopterygius*	X		
Squid spp.	Decapoda, *Moroteuthis robusta*	X		
Octopus spp.	Octopoda, Vampyromorpha	X		X
Sculpin spp.	Cottidae	X	X	
Smelt spp.	Osmeridae	X		
Skate spp.	Rajidae	X	X	
Shark spp.	Squaliformes	X	X	

Table 2.--Statistical summary of groundfish fishery observer data collected from 1973 to 1996 and summarized in this report.

A. Locations (minute latitude by minute longitude) Sampled by Observers

Gear Type	Number of Locations Sampled	Number of Hauls Sampled		Number (and %) of Locations with:			Sampled Effort	
		All Locations	Range at Each Location	1 Sampled Haul	2 Sampled Hauls	3+ Sampled Hauls	All Locations	Range at Each Location
Trawl	154,485	428,893	1 - 130	75,605 (50%)	31,842 (20%)	47,038 (30%)	1,614,570 hours	0.02 - 568 hours
Longline	47,332	81,178	1 - 38	29,968 (63%)	9,601 (21%)	7,763 (16%)	880,279,900 hooks	1 - 255,700 hooks
Pot	8,959	21,038	1 - 79	5,383 (60%)	1,606 (18%)	1,970 (22%)	1,458,705 pots	1 - 3,138 pots

B. Within 5 km X 5 km Grid Cells

Gear Type	Number of Grid Cells Sampled	Number of Hauls Sampled		Number (and %) of Cells with:			Sampled Effort	
		All Cells	Range Within Each Cell	1 Sampled Haul	2 Sampled Hauls	3+ Sampled Hauls	All Cells	Range Within Each Cell
Trawl	28,752	428,893	1 - 1,022	6,623 (23%)	3,180 (11%)	18,949 (66%)	1,614,570 hours	0.05 - 5,607 hours
Longline	12,240	81,178	1 - 132	4,059 (33%)	1,942 (16%)	6,239 (51%)	880,279,900 hooks	1 - 1,222,600 hooks
Pot	3,405	21,038	1 - 496	1,311 (38%)	511 (15%)	1,583 (47%)	1,458,705 pots	1 - 14,314 pots

Figures

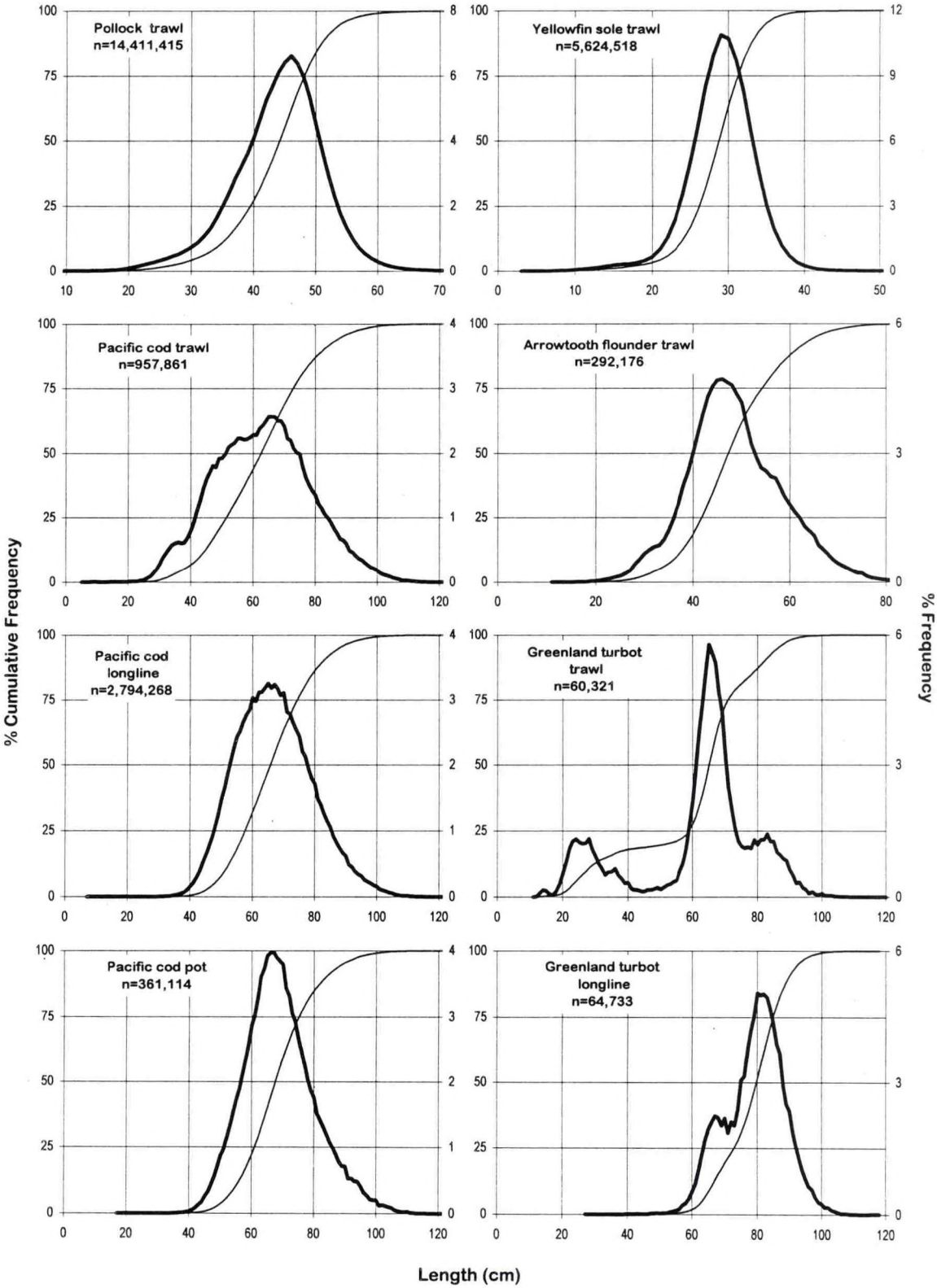


Figure 1a. Percent length-frequency distributions from fishery, by species and gear. Thick line is percent frequency at length; thin line is cumulative percent frequency. (n= number of fish measured)

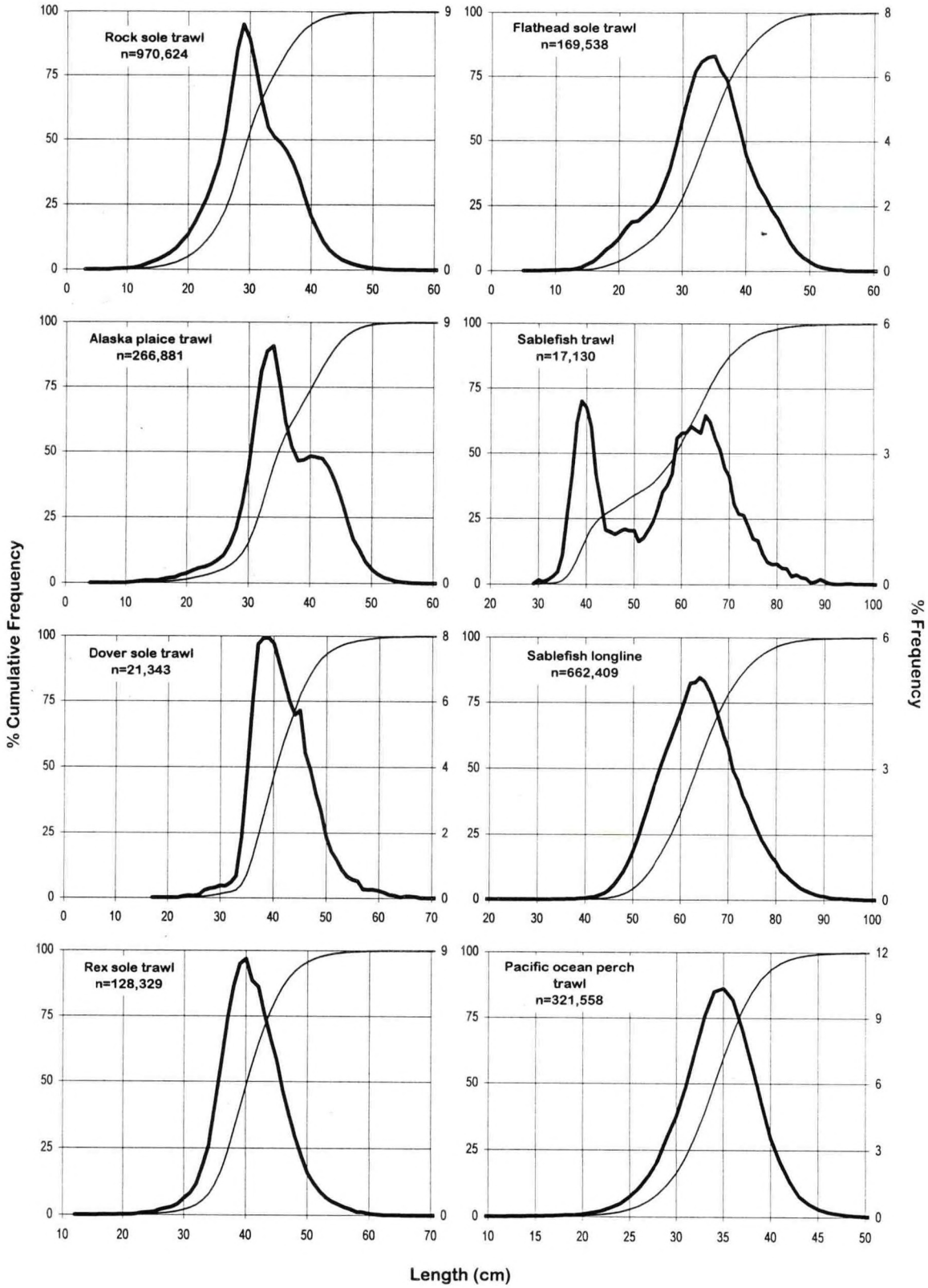


Figure 1b. Percent length-frequency distributions from fishery, by species and gear. Thick line is percent frequency at length; thin line is cumulative percent frequency. (n=number of fish measured)

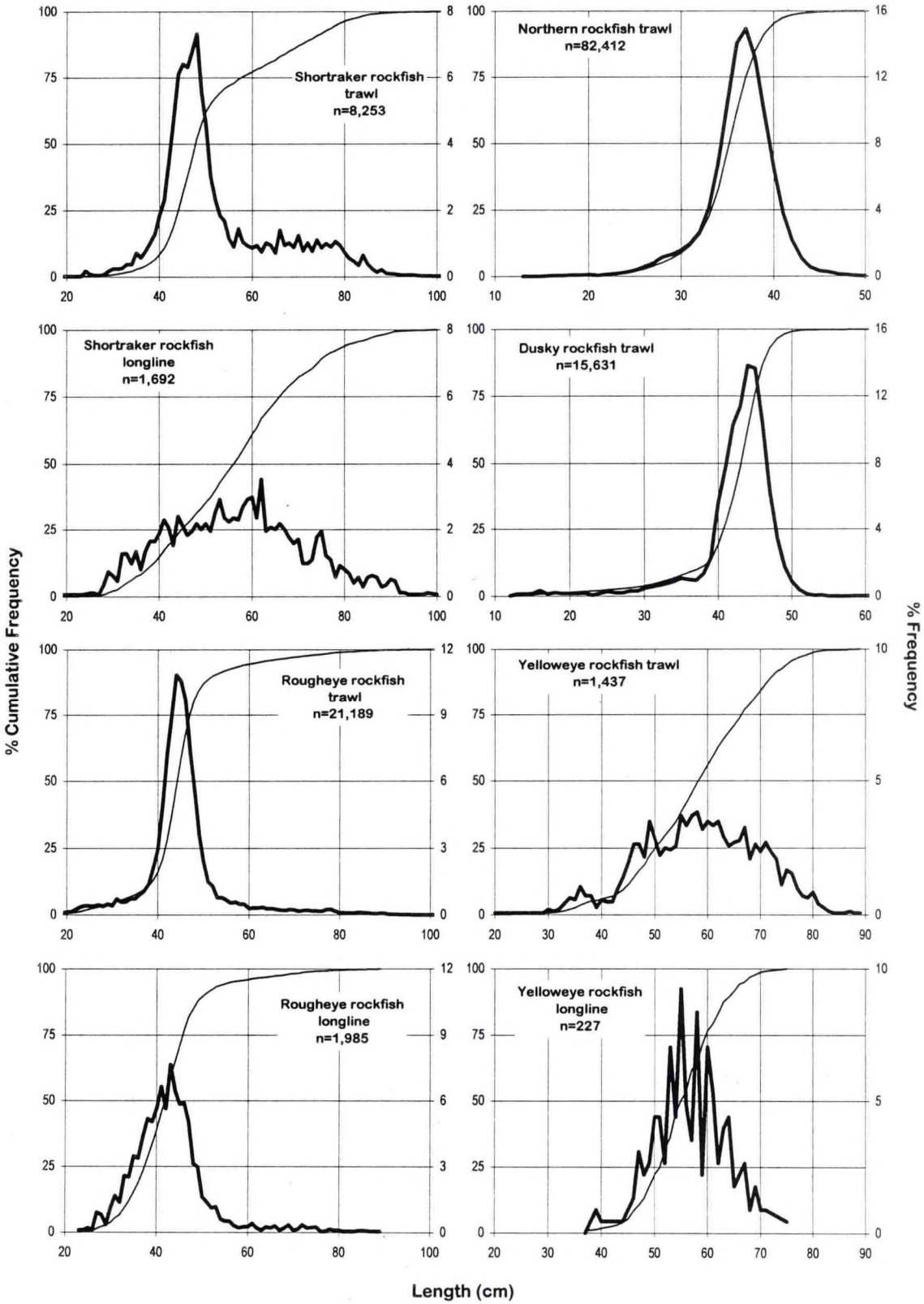


Figure 1c. Percent length-frequency distributions from fishery, by species and gear. Thick line is percent frequency at length; thin line is cumulative percent frequency. (n=number of fish measured)

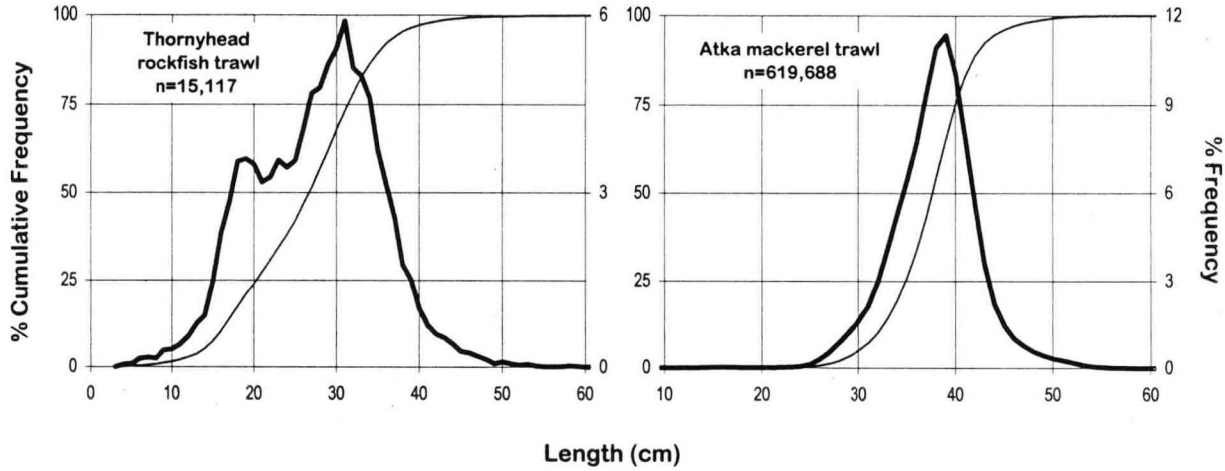


Figure 1d. Percent length-frequency distributions from fishery, by species and gear. Thick line is percent frequency at length; thin line is cumulative percent frequency. (n=number of fish measured)

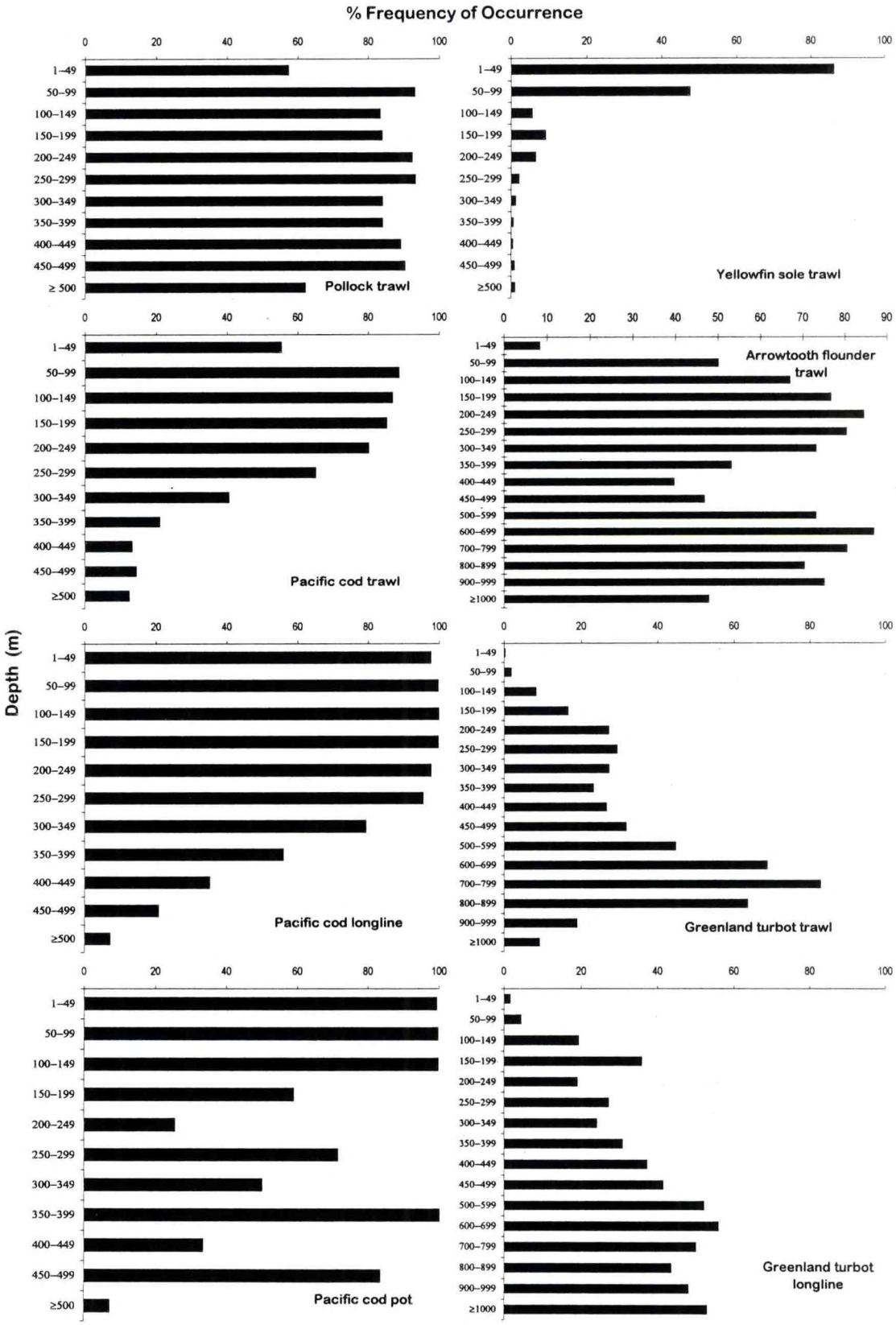


Figure 2a. Percent frequency of occurrence of groundfish species in sampled commercial hauls taken within each depth range by trawl (fishing depth), longline and pot gear (both bottom depth) .

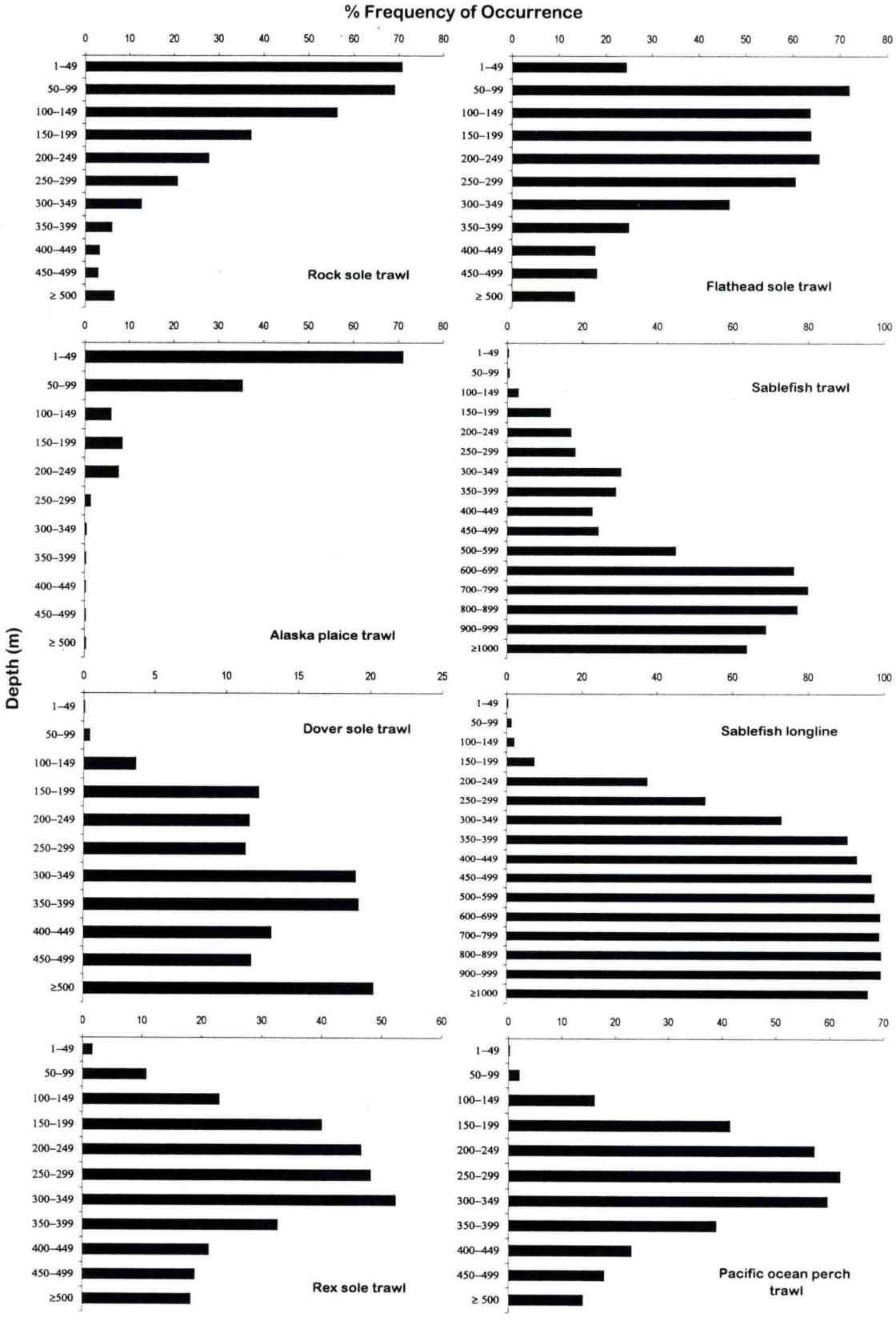


Figure 2b. Percent frequency of occurrence of groundfish species in sampled commercial hauls taken within each depth range by trawl (fishing depth), longline and pot gear (both bottom depth) .

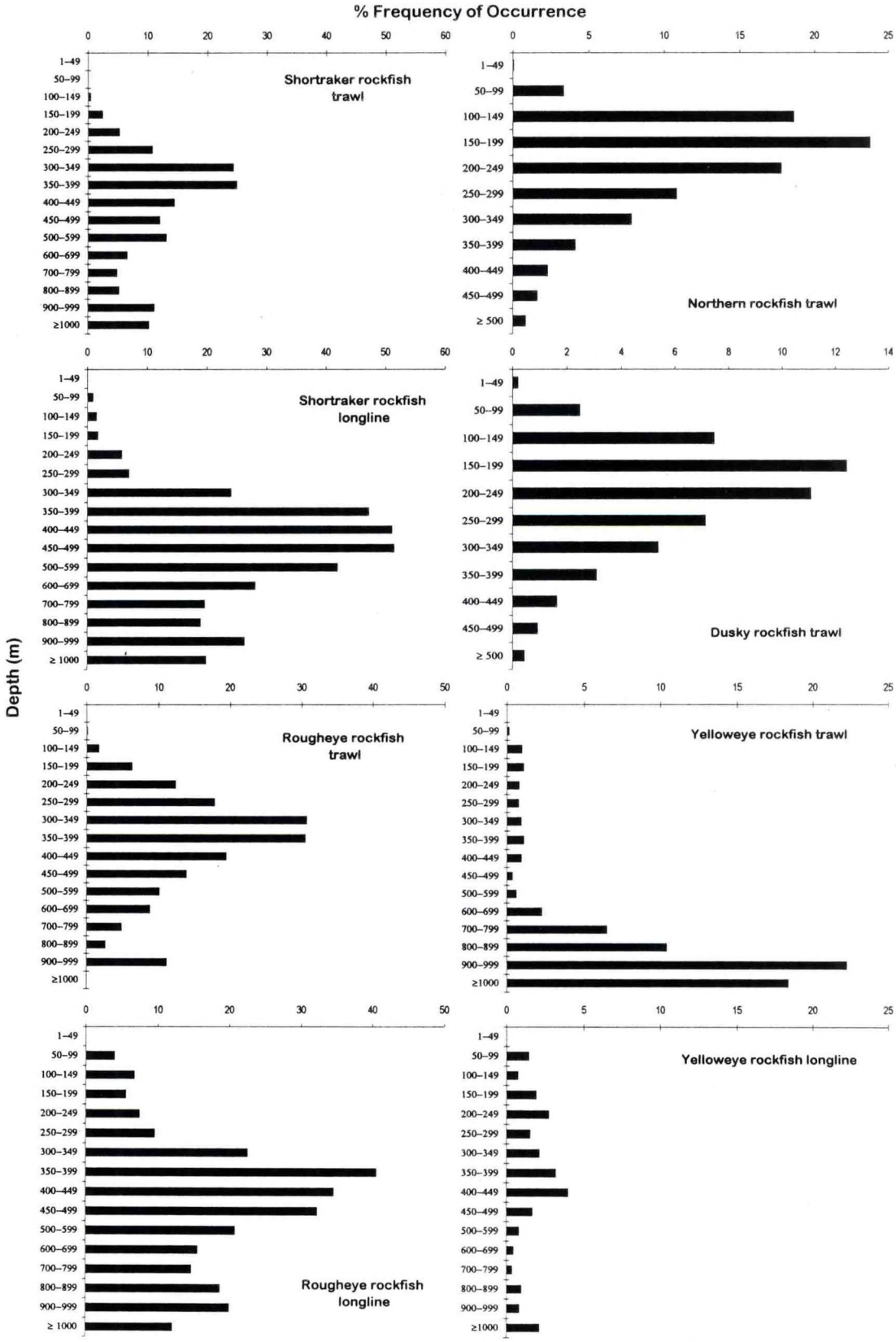


Figure 2c. Percent frequency of occurrence of groundfish species in sampled commercial hauls taken within each depth range by trawl (fishing depth), longline and pot gear (both bottom depth) .

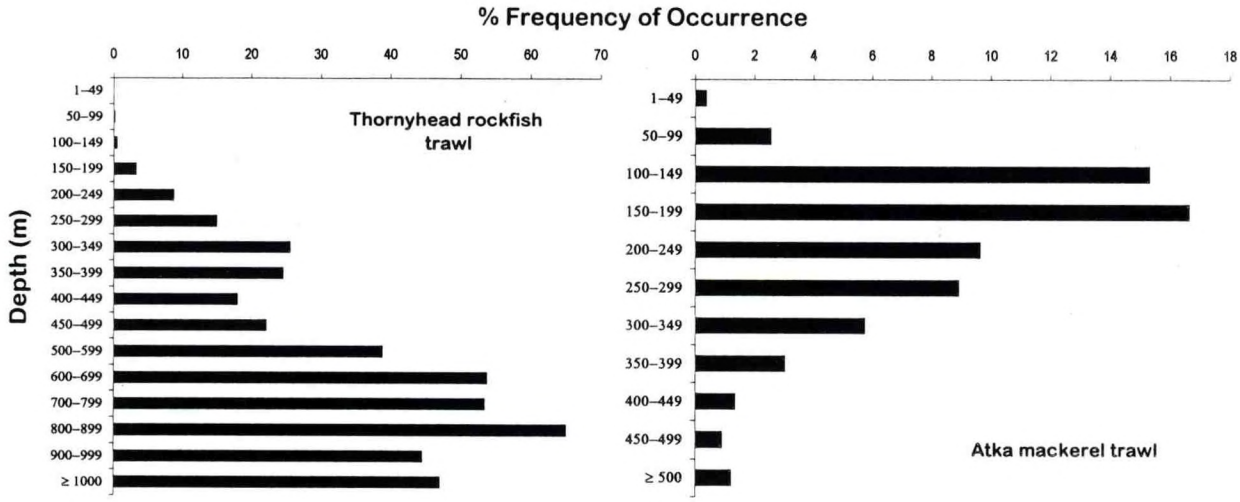


Figure 2d. Percent frequency of occurrence of groundfish species in sampled commercial hauls taken within each depth range by trawl (fishing depth), longline and pot gear (both bottom depth) .

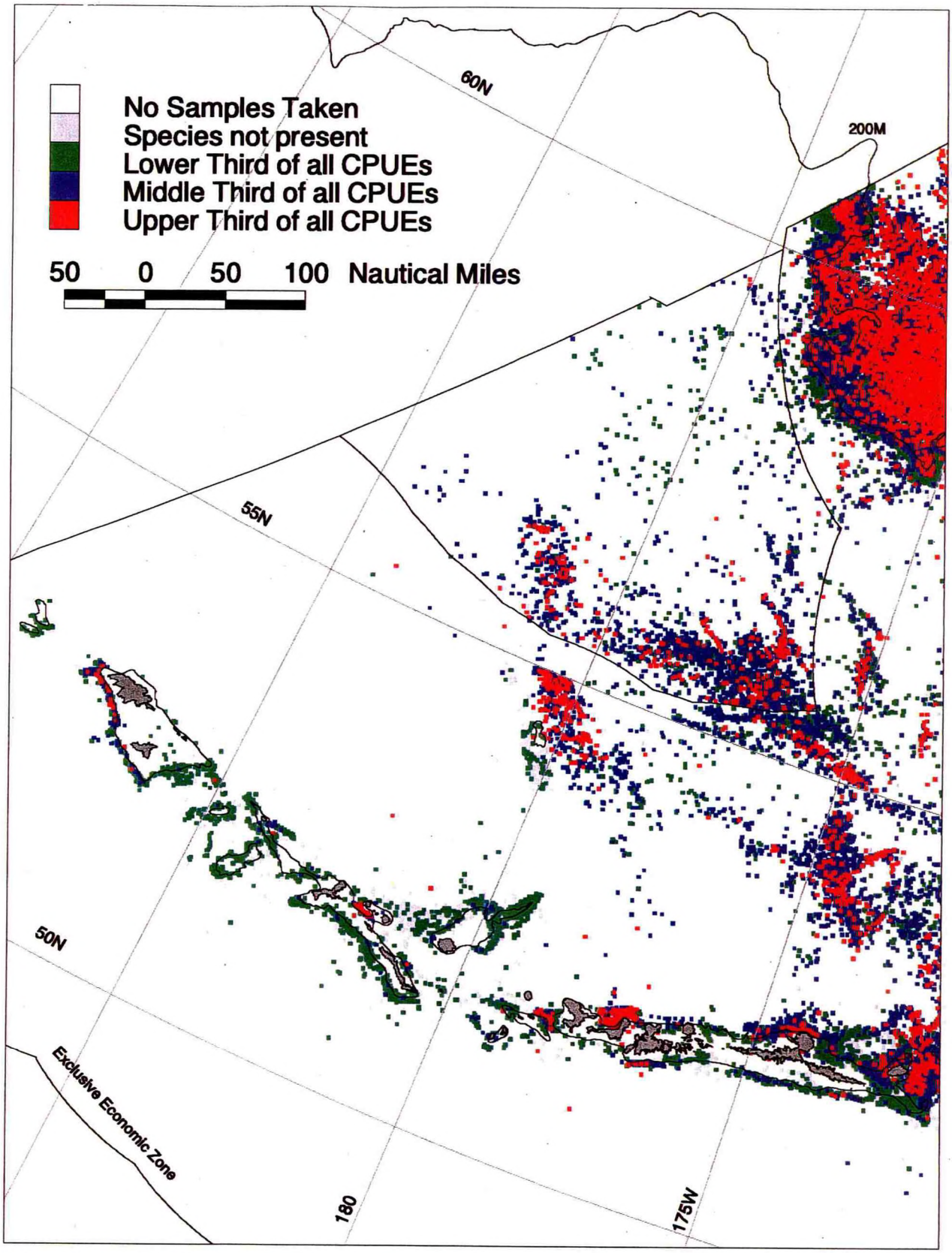
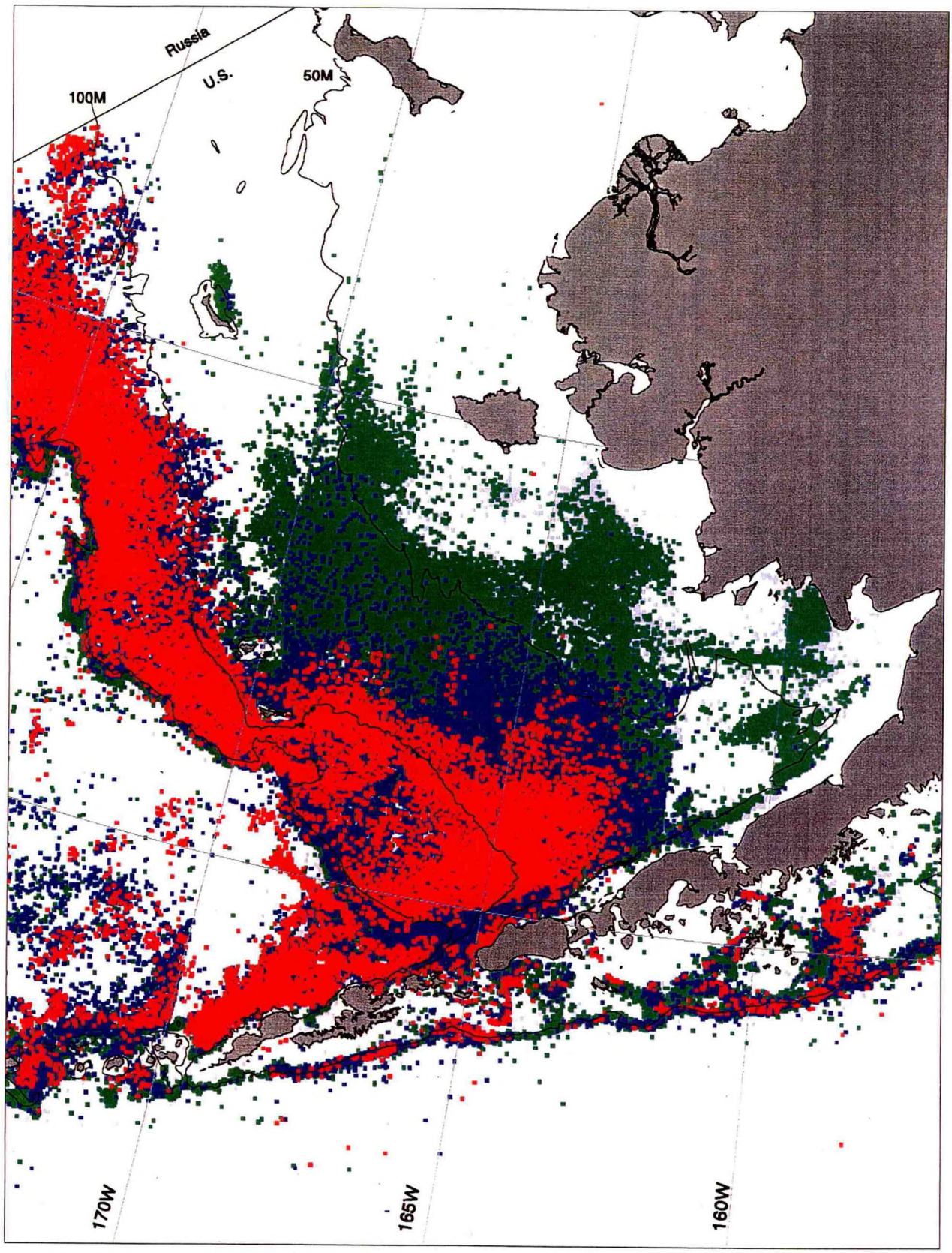


Figure 3.a Pollock catch per unit effort (CPUE) summary for



BSAI region, based on Alaskan trawl groundfish observer data.

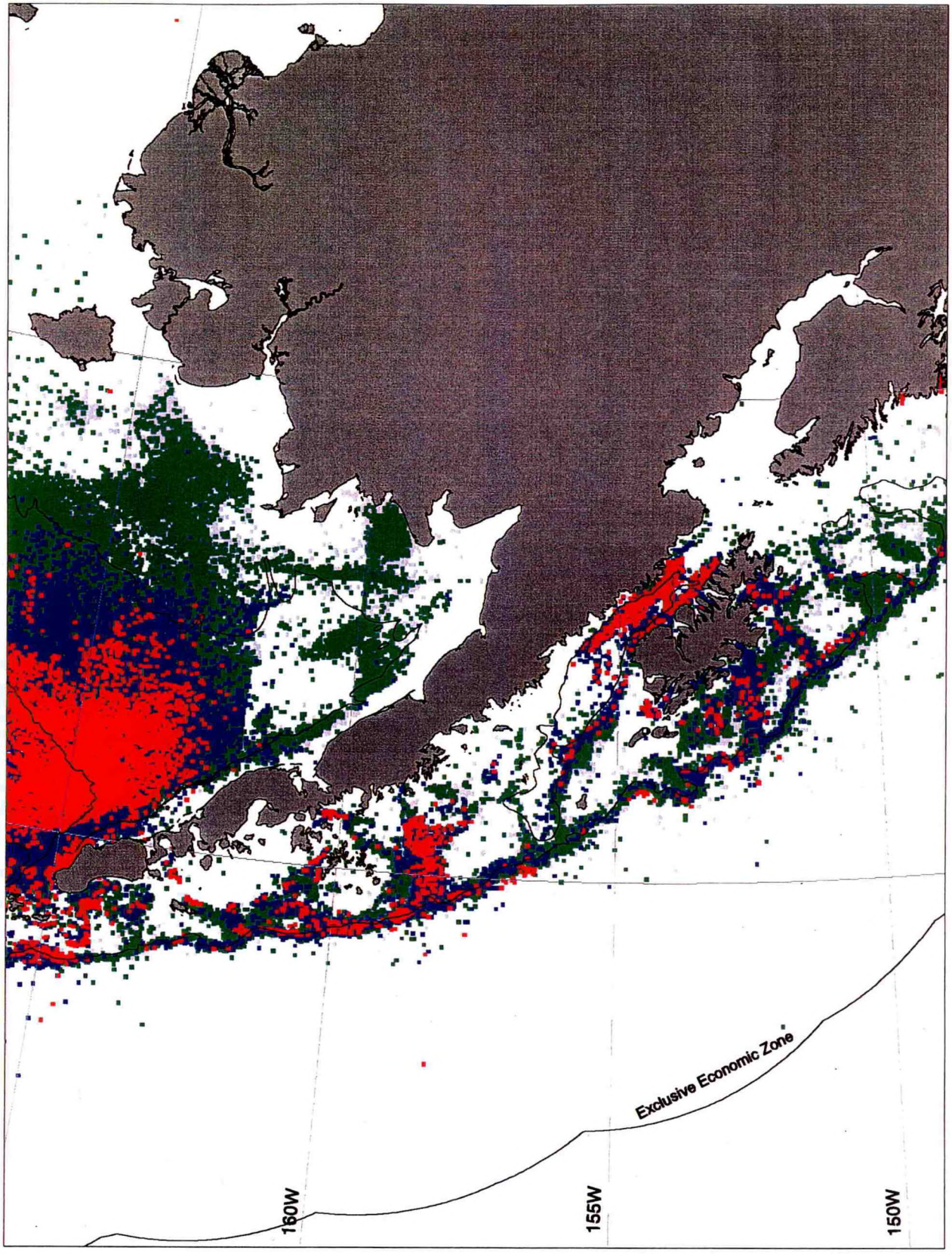
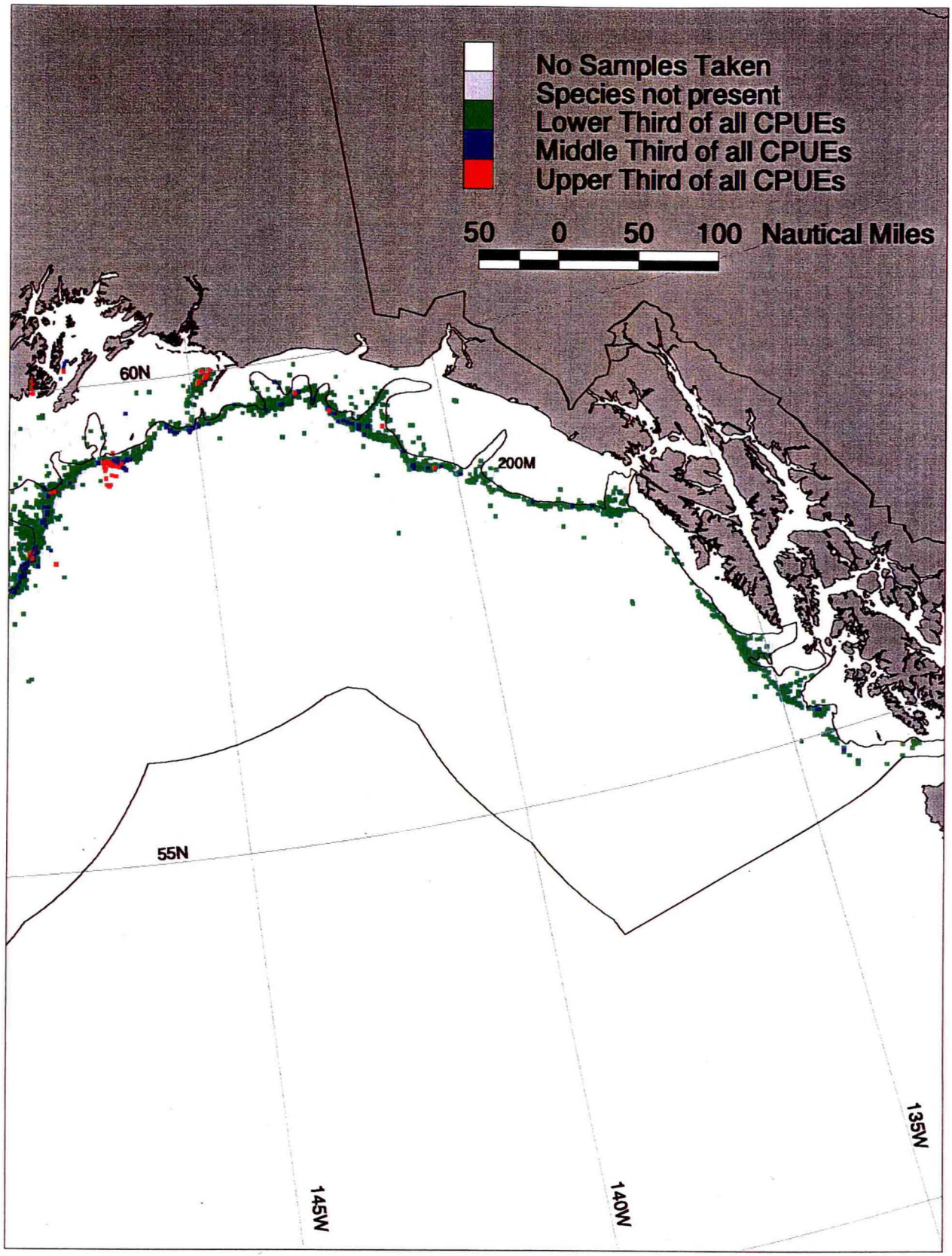


Figure 3.b Pollock catch per unit effort (CPUE) summary for



GOA region, based on Alaskan trawl groundfish observer data.

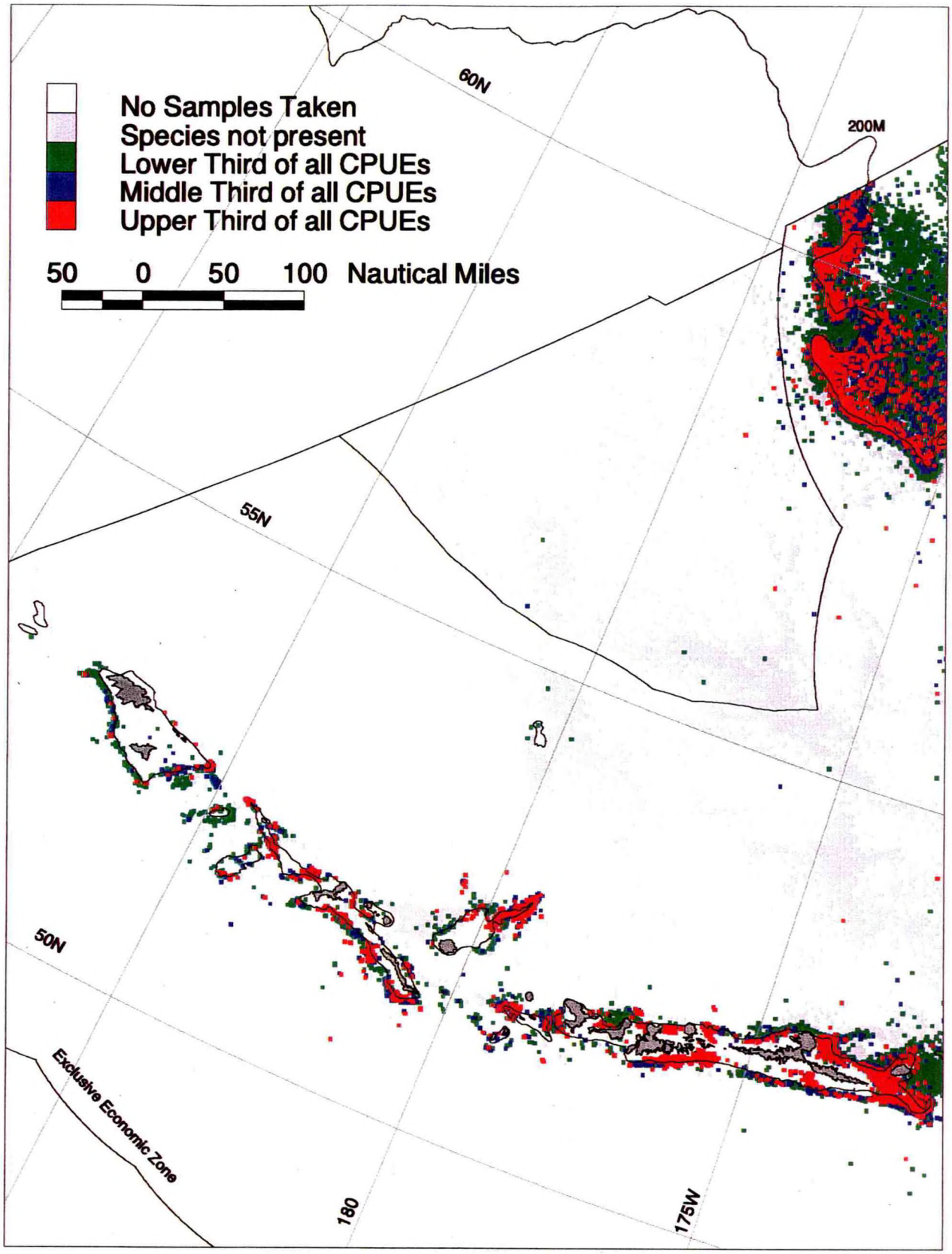
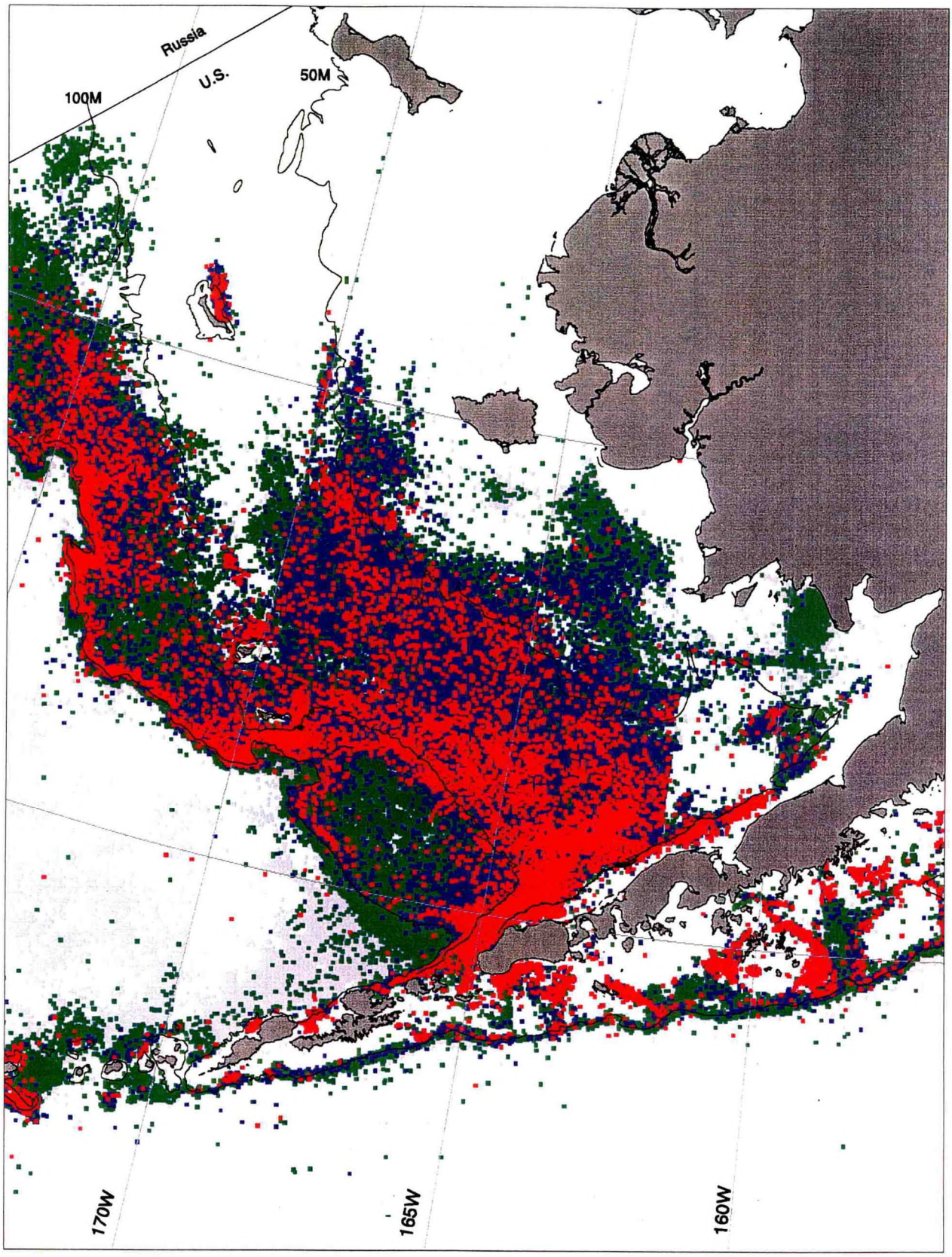


Figure 4.a Pacific cod catch per unit effort (CPUE) summary for



BSAI region, based on Alaskan trawl groundfish observer data.

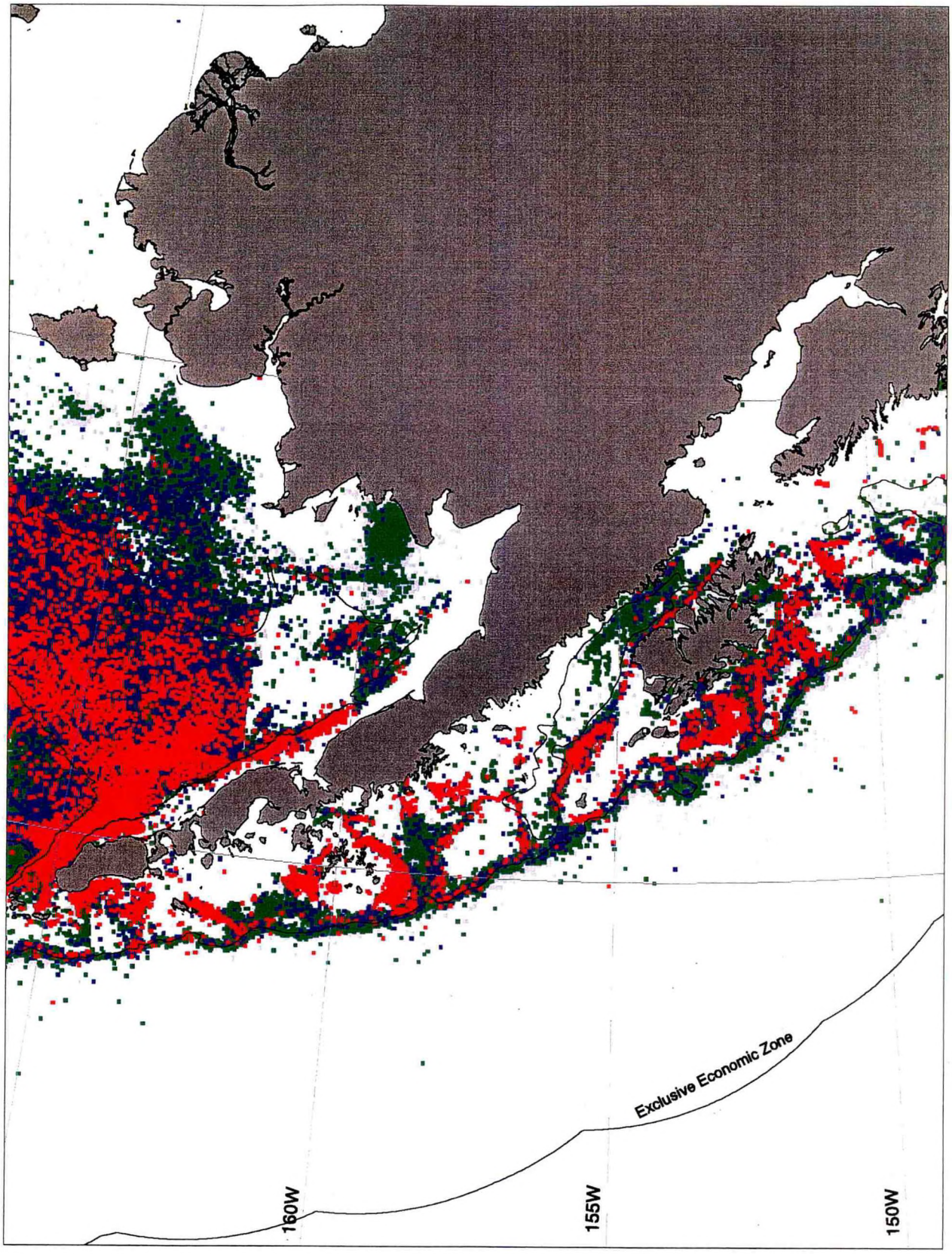
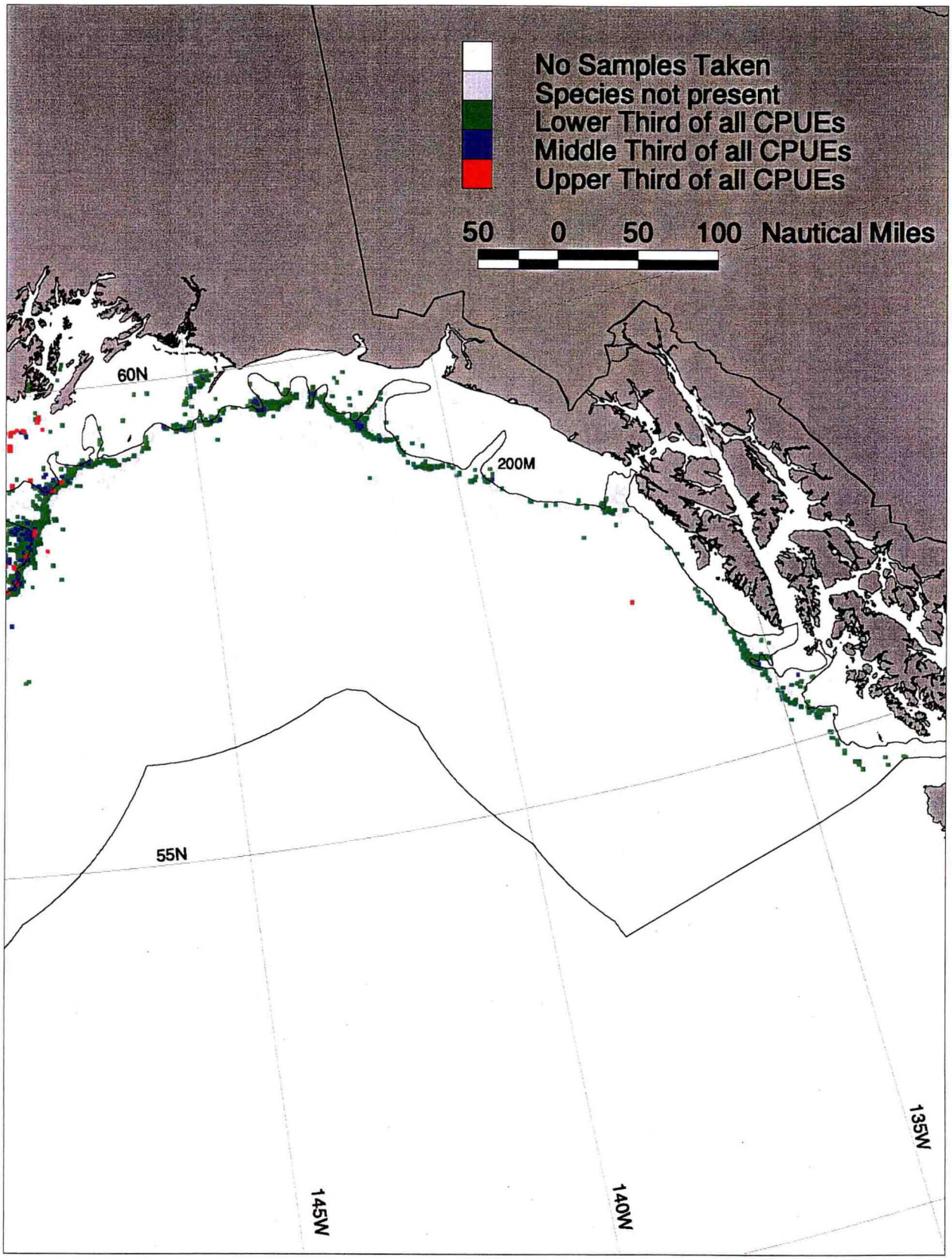


Figure 4.b Pacific cod catch per unit effort (CPUE) summary for



GOA region, based on Alaskan trawl groundfish observer data.

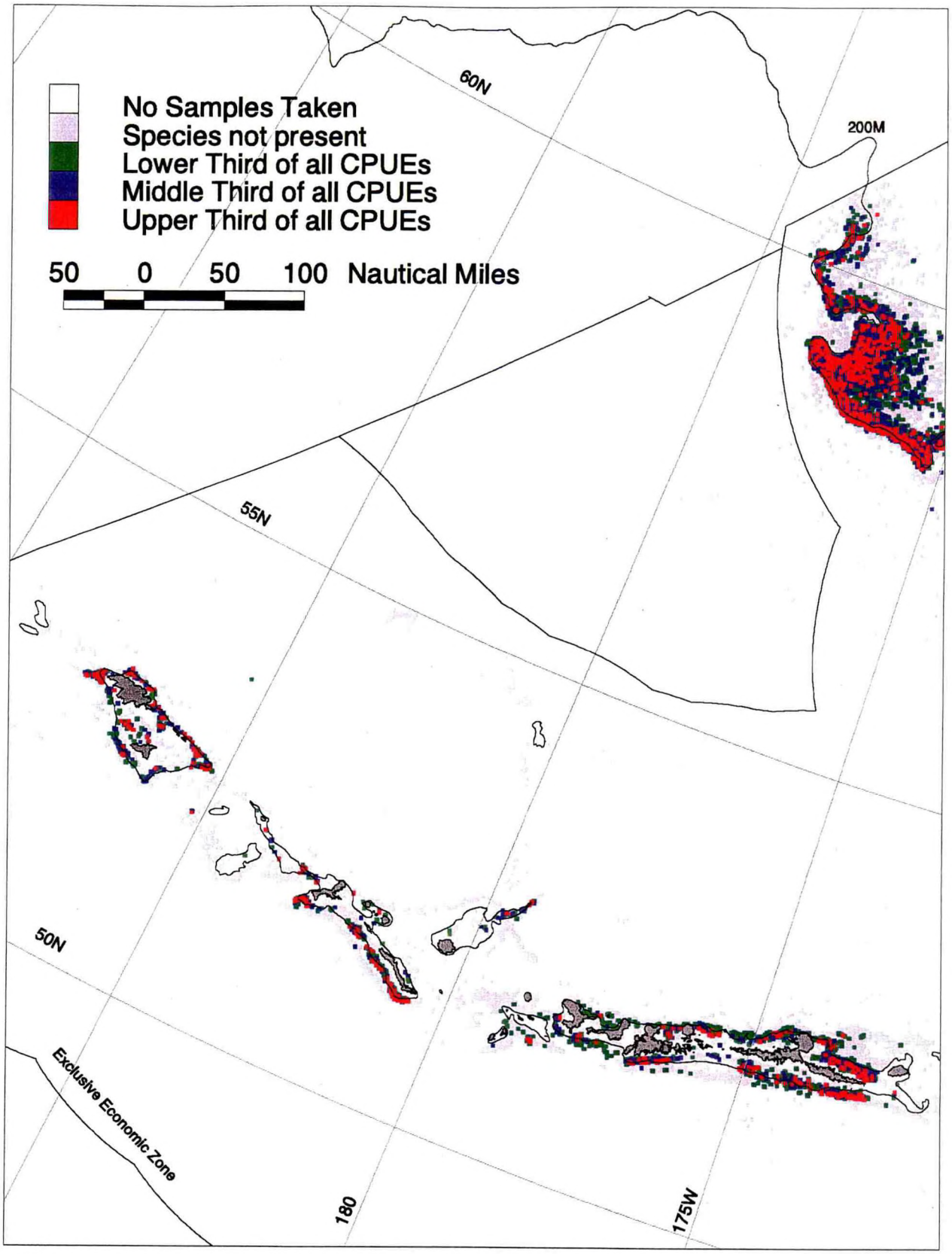
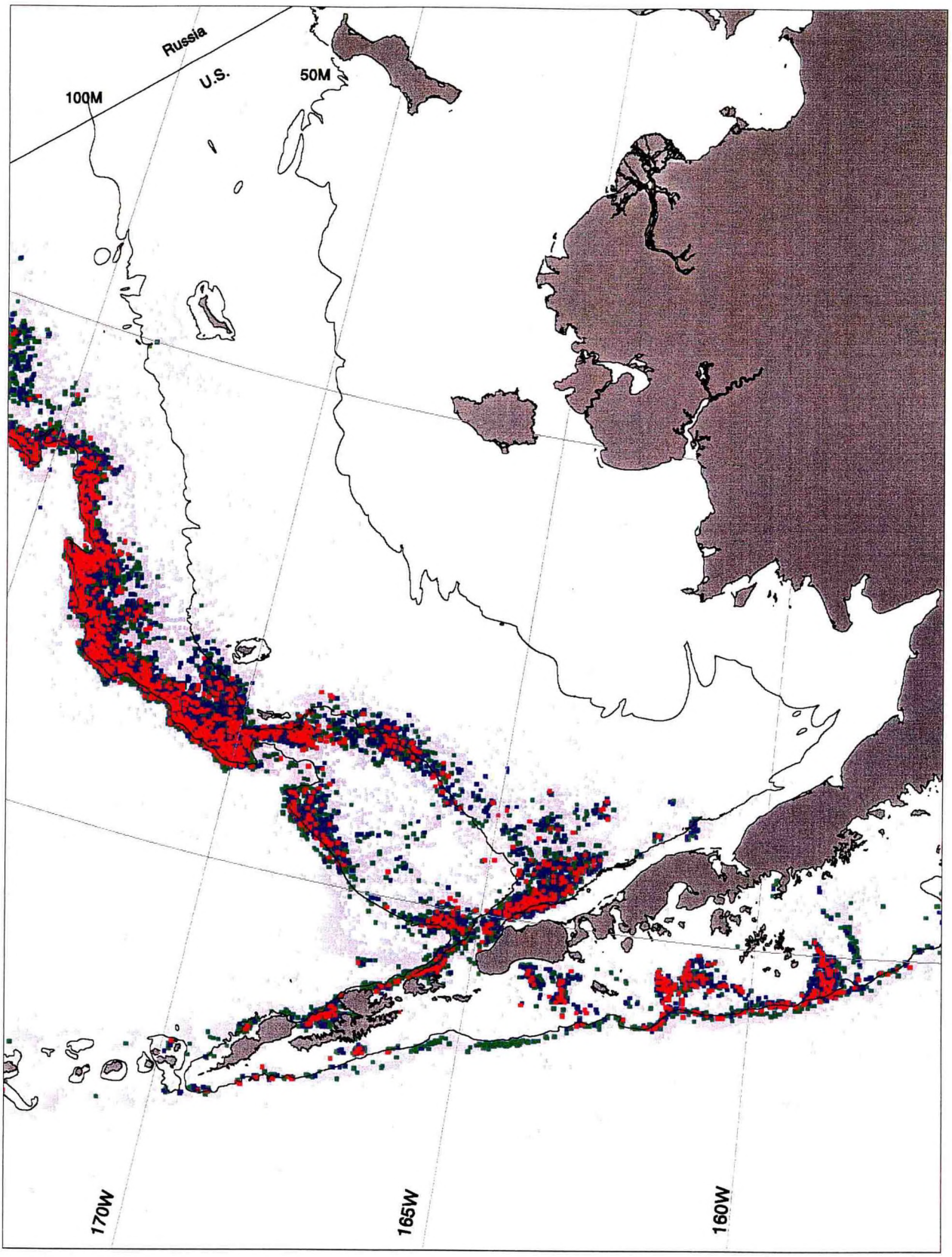


Figure 5.a Pacific cod catch per unit effort (CPUE) summary for



BSAI region, based on Alaskan longline groundfish observer data.

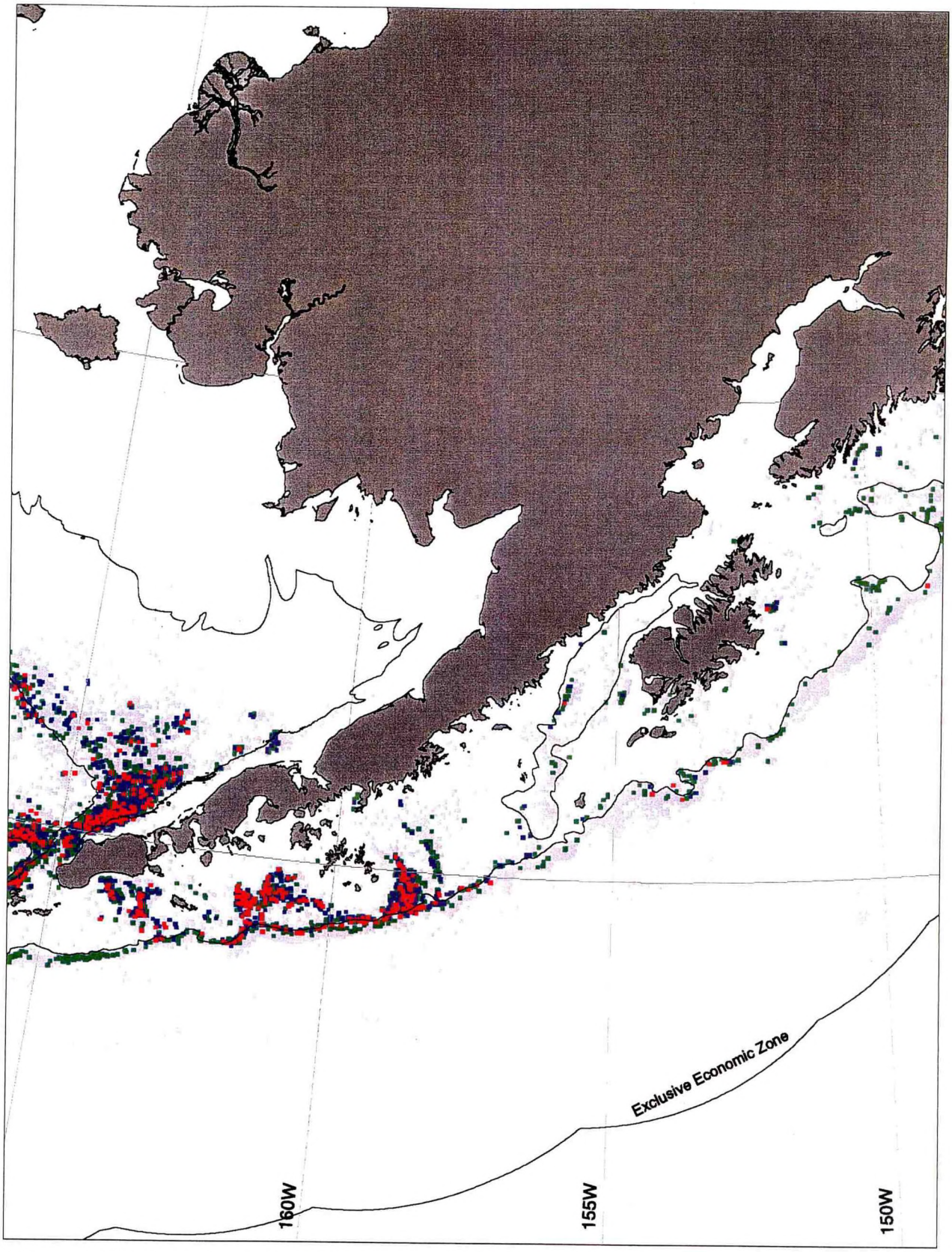
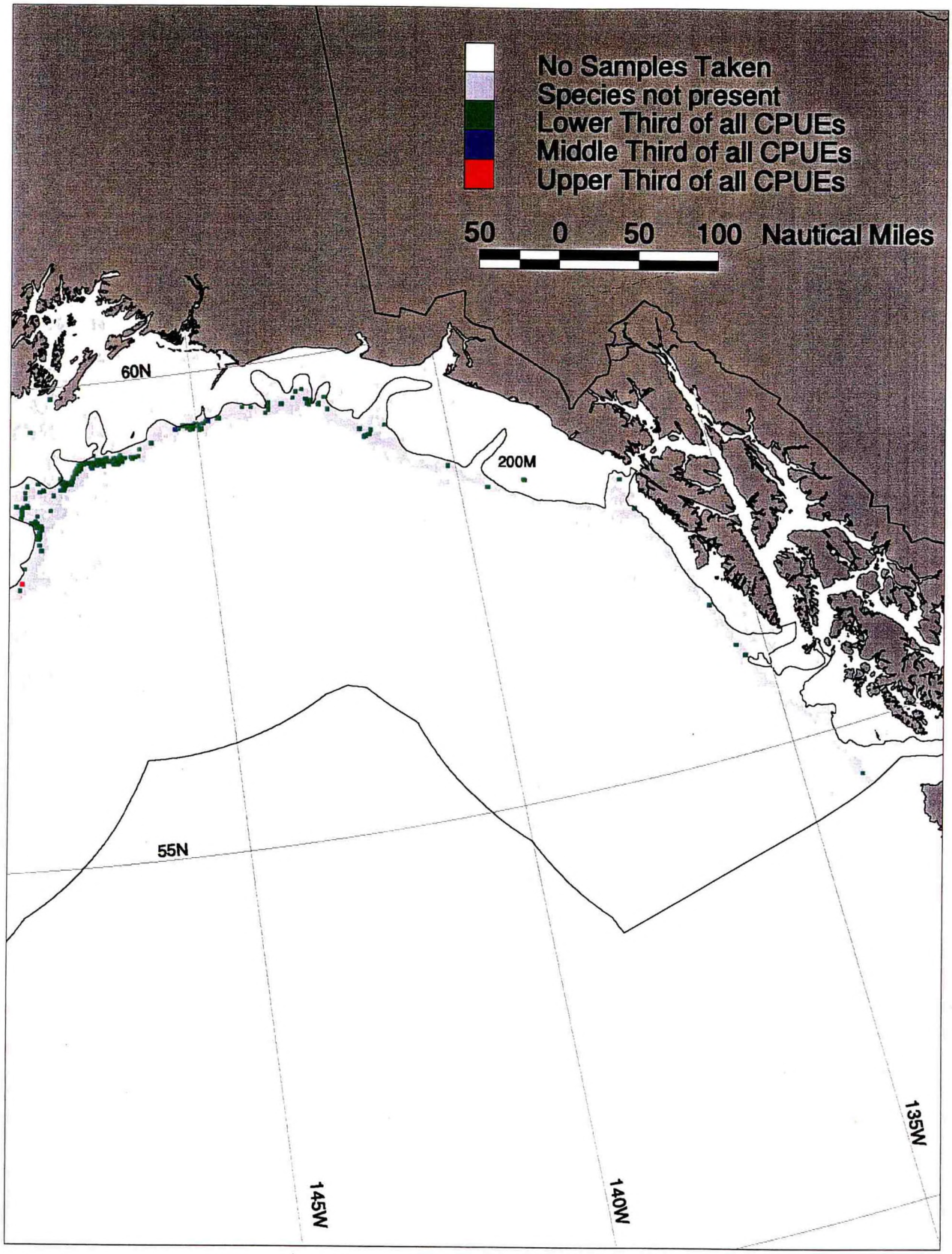


Figure 5.b Pacific cod catch per unit effort (CPUE) summary for



GOA region, based on Alaskan longline groundfish observer data.

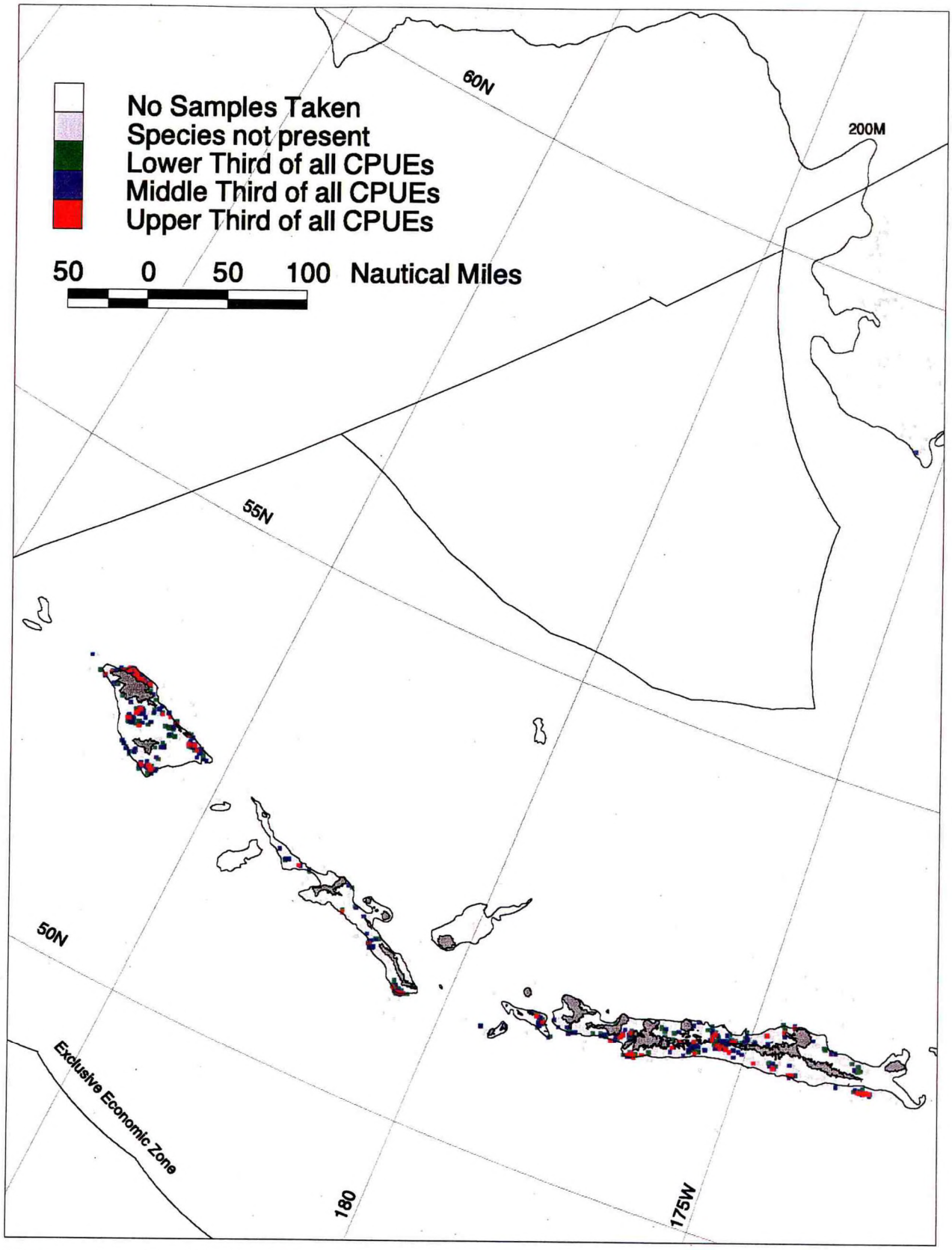
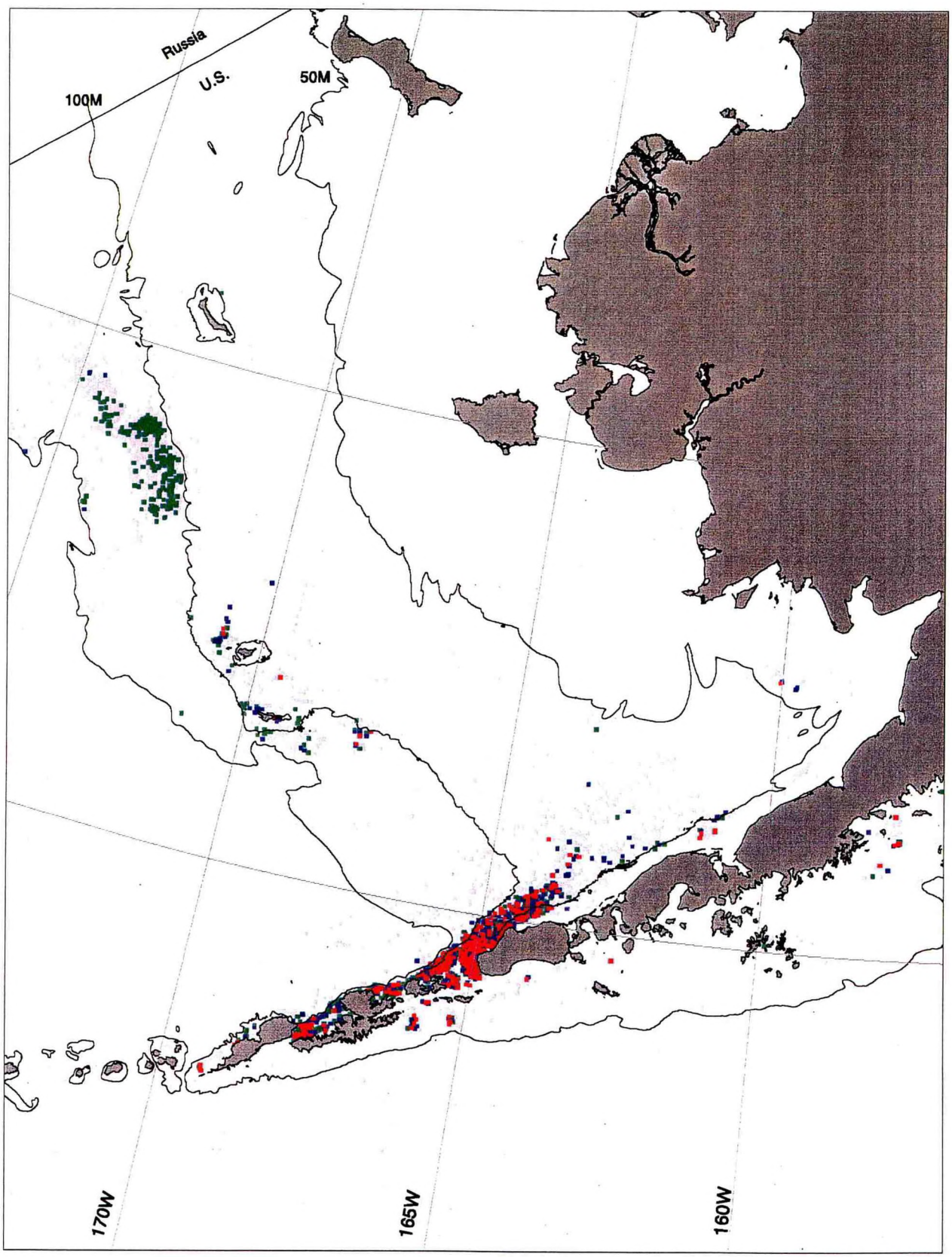


Figure 6.a Pacific cod catch per unit effort (CPUE) summary for



BSAI region, based on Alaskan pot groundfish observer data.

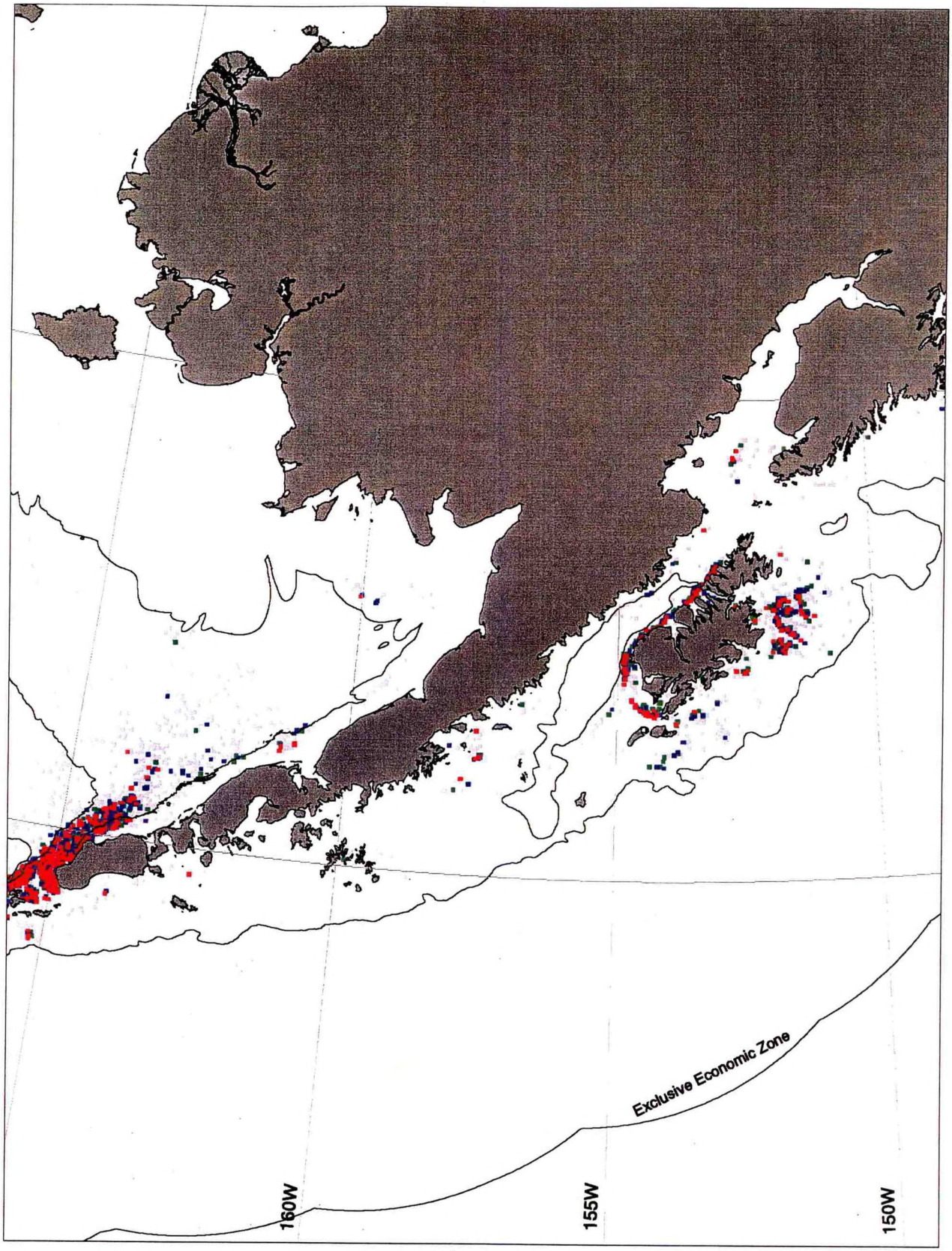
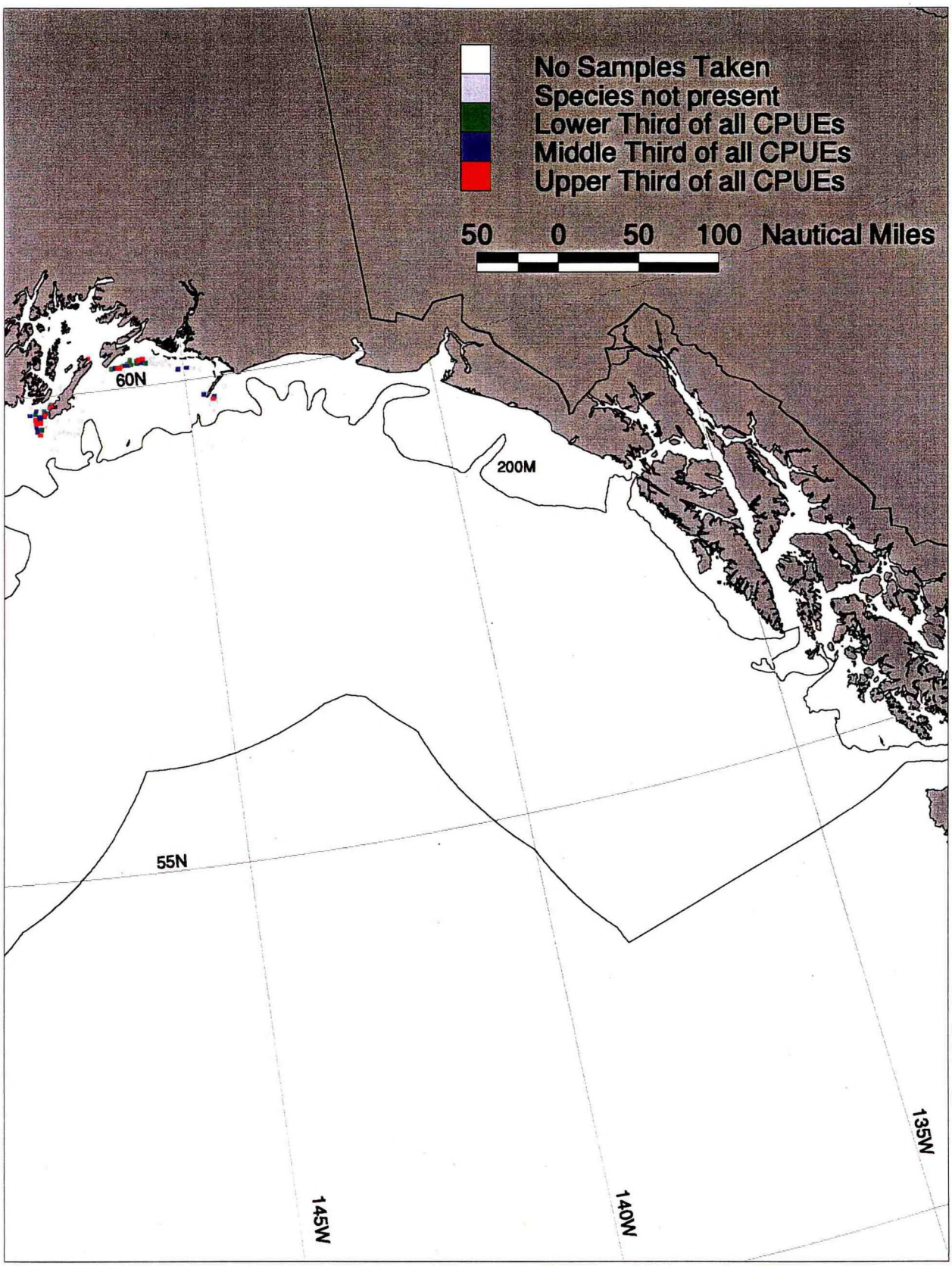


Figure 6.b Pacific cod catch per unit effort (CPUE) summary for



GOA region, based on Alaskan pot groundfish observer data.

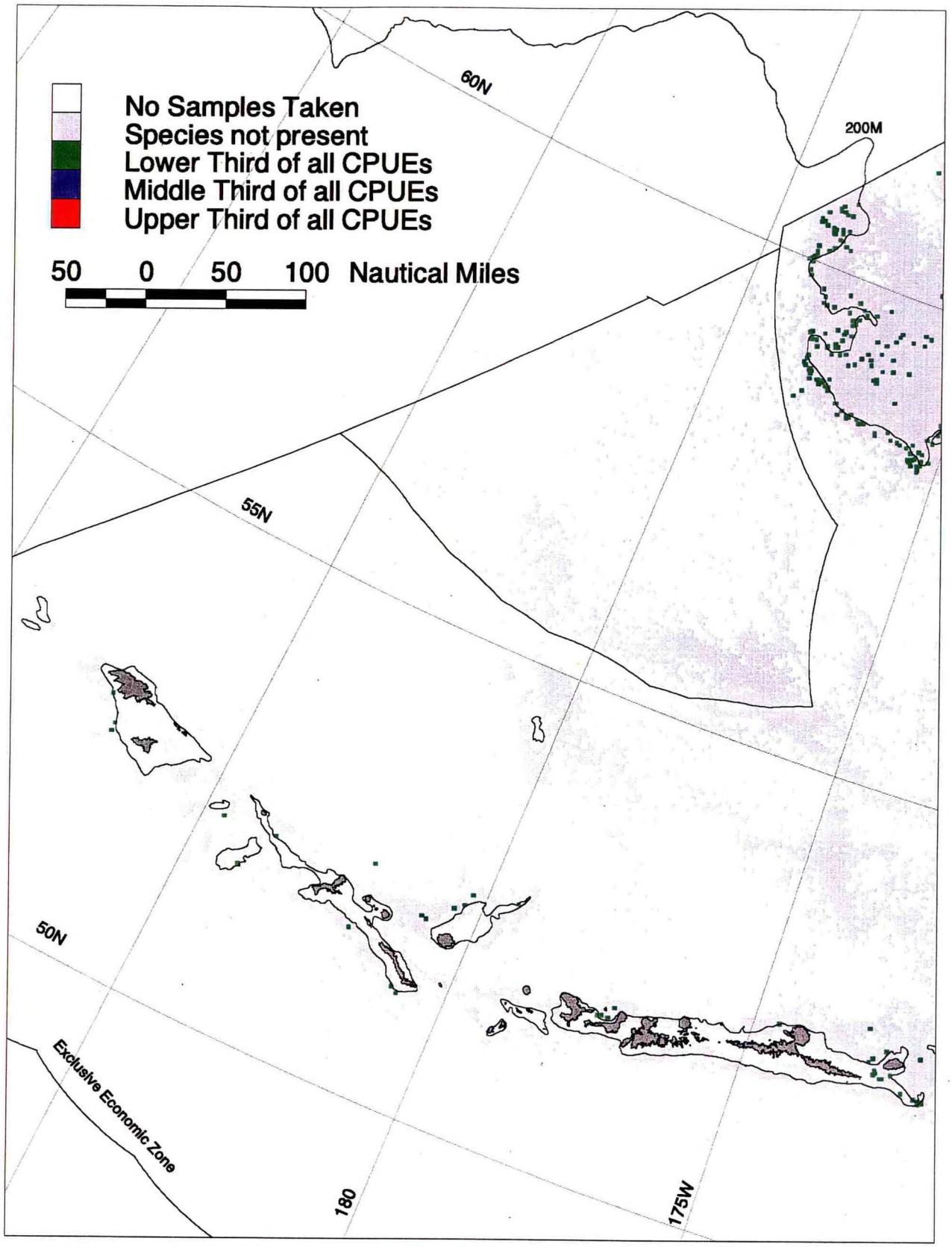
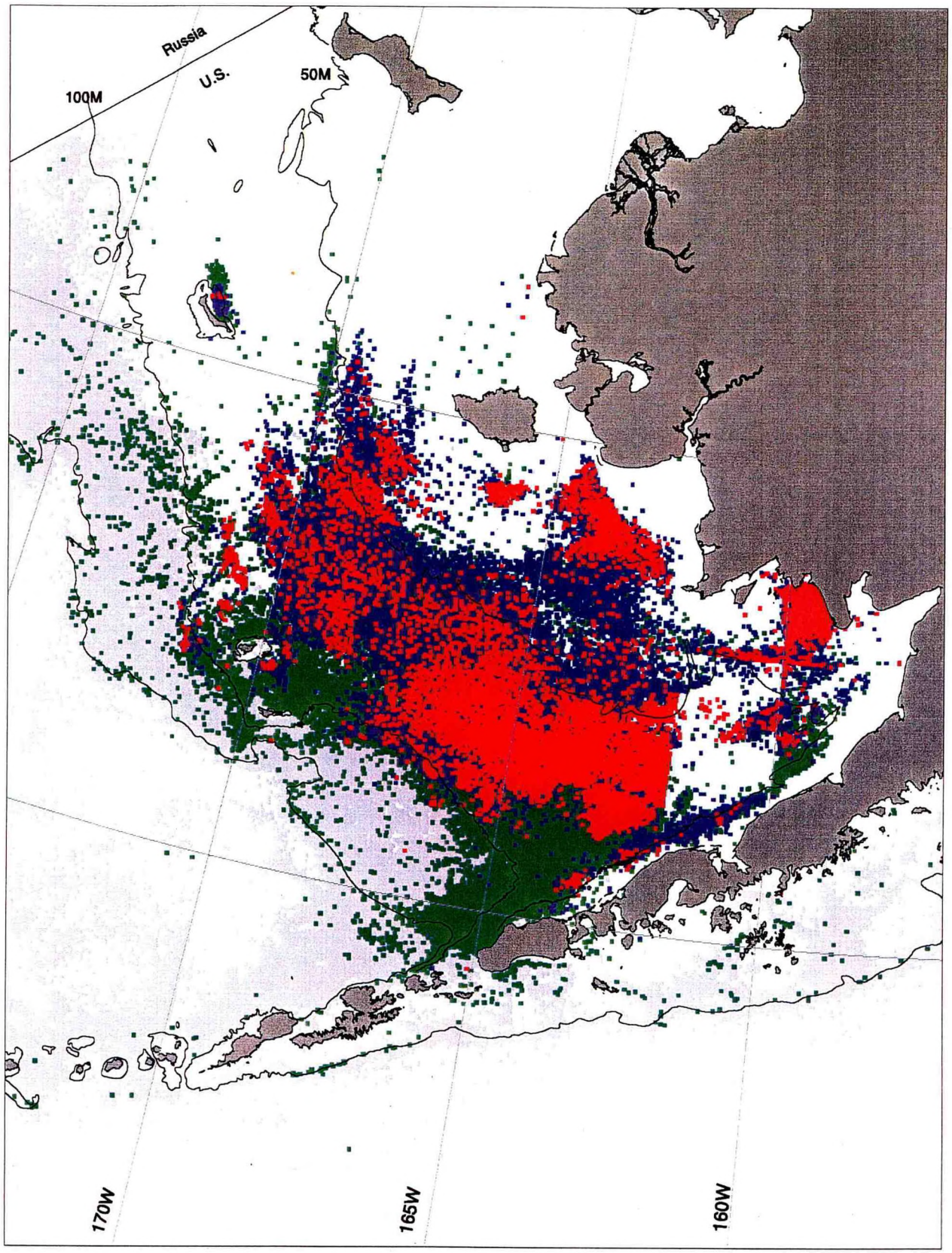


Figure 7.a Yellowfin sole catch per unit effort (CPUE) summary for



BSAI region, based on Alaskan trawl groundfish observer data.

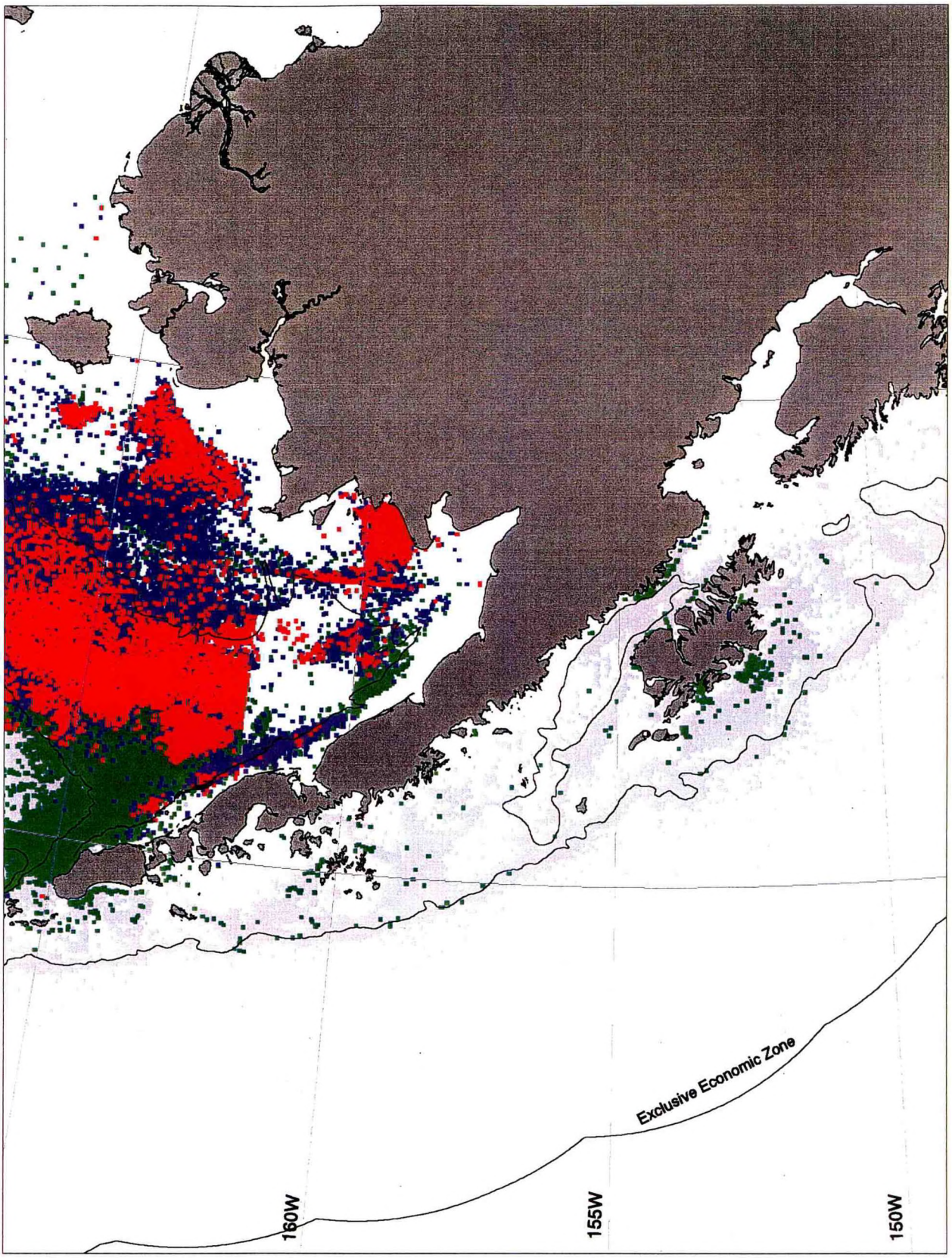
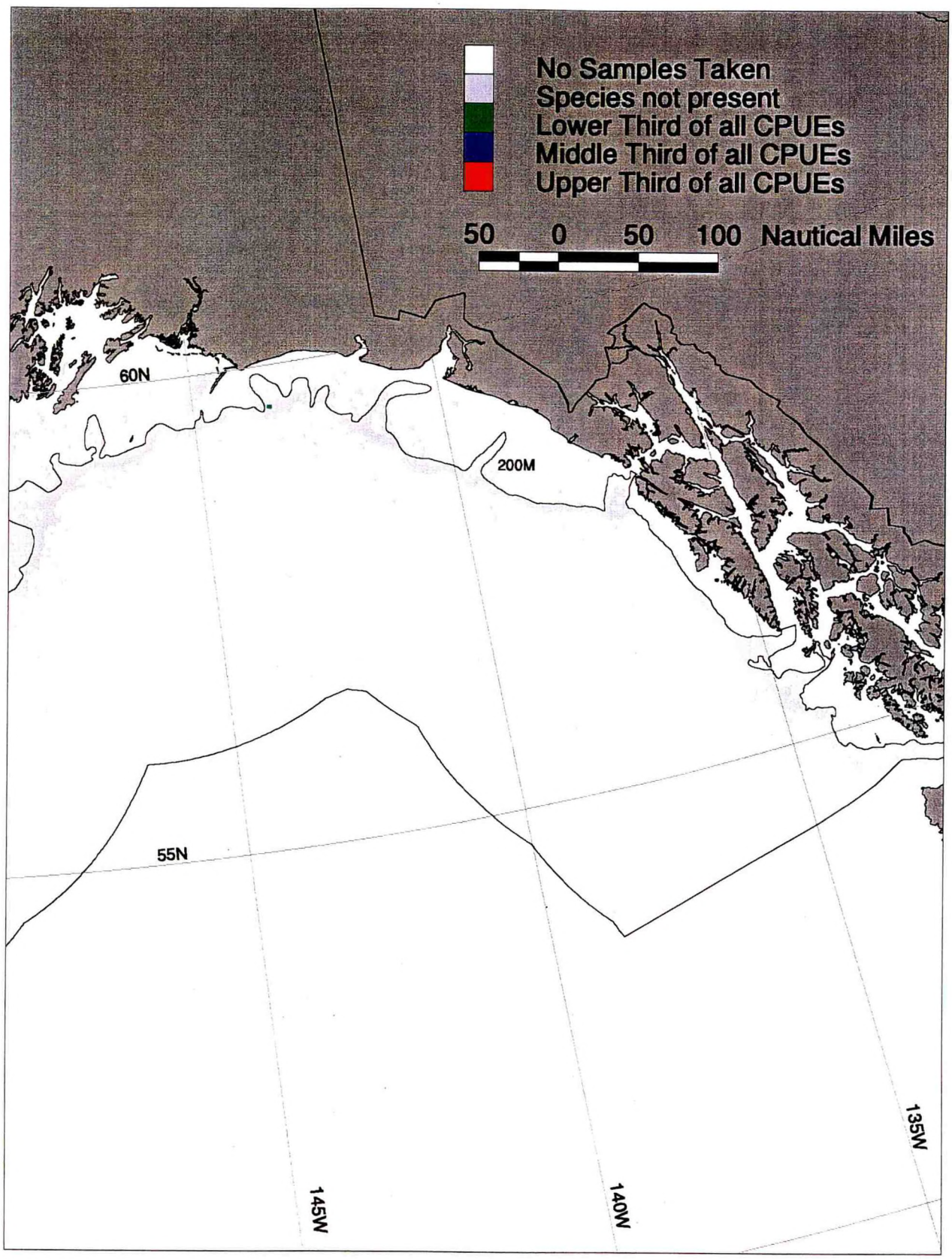


Figure 7.b Yellowfin sole catch per unit effort (CPUE) summary for



GOA region, based on Alaskan trawl groundfish observer data.

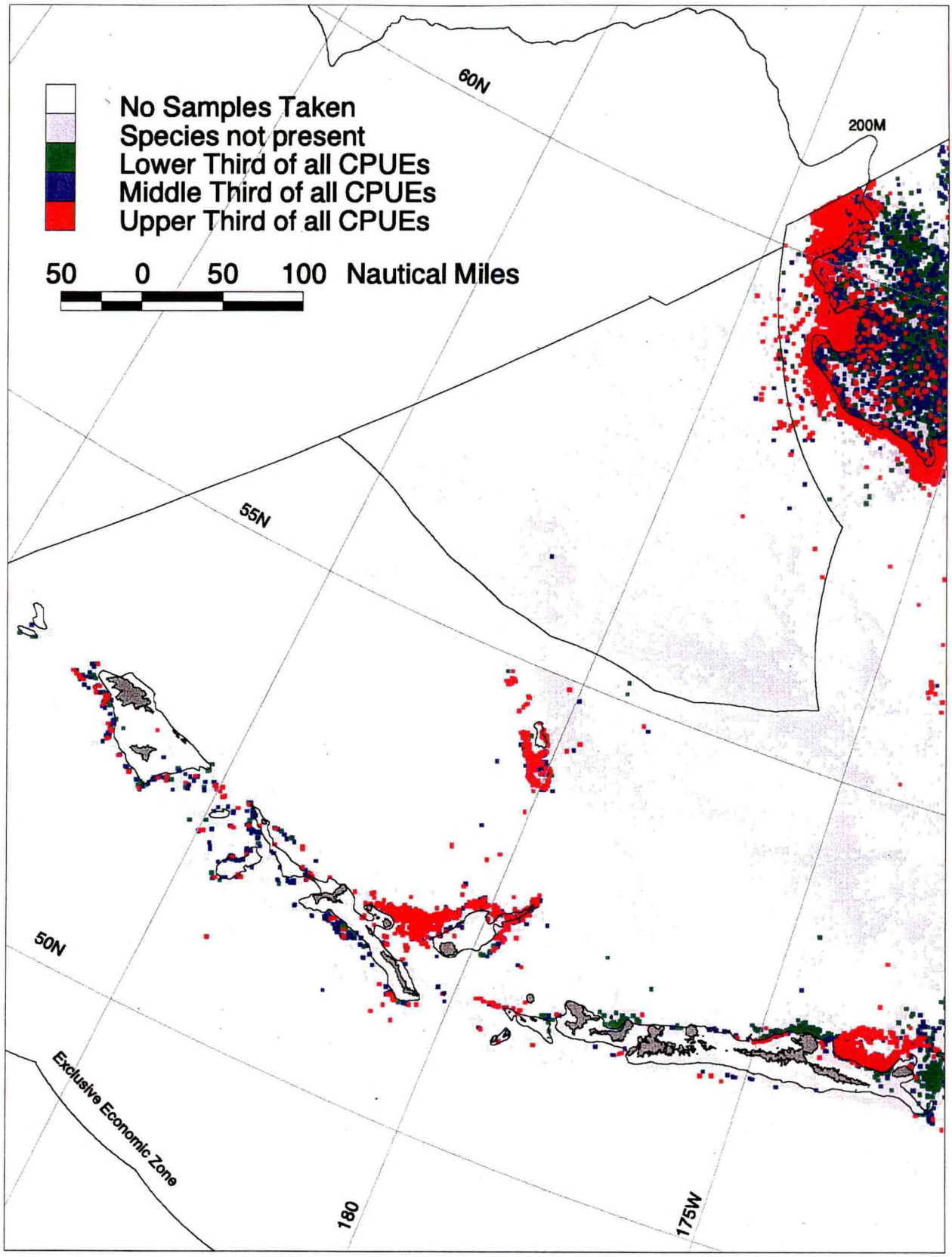
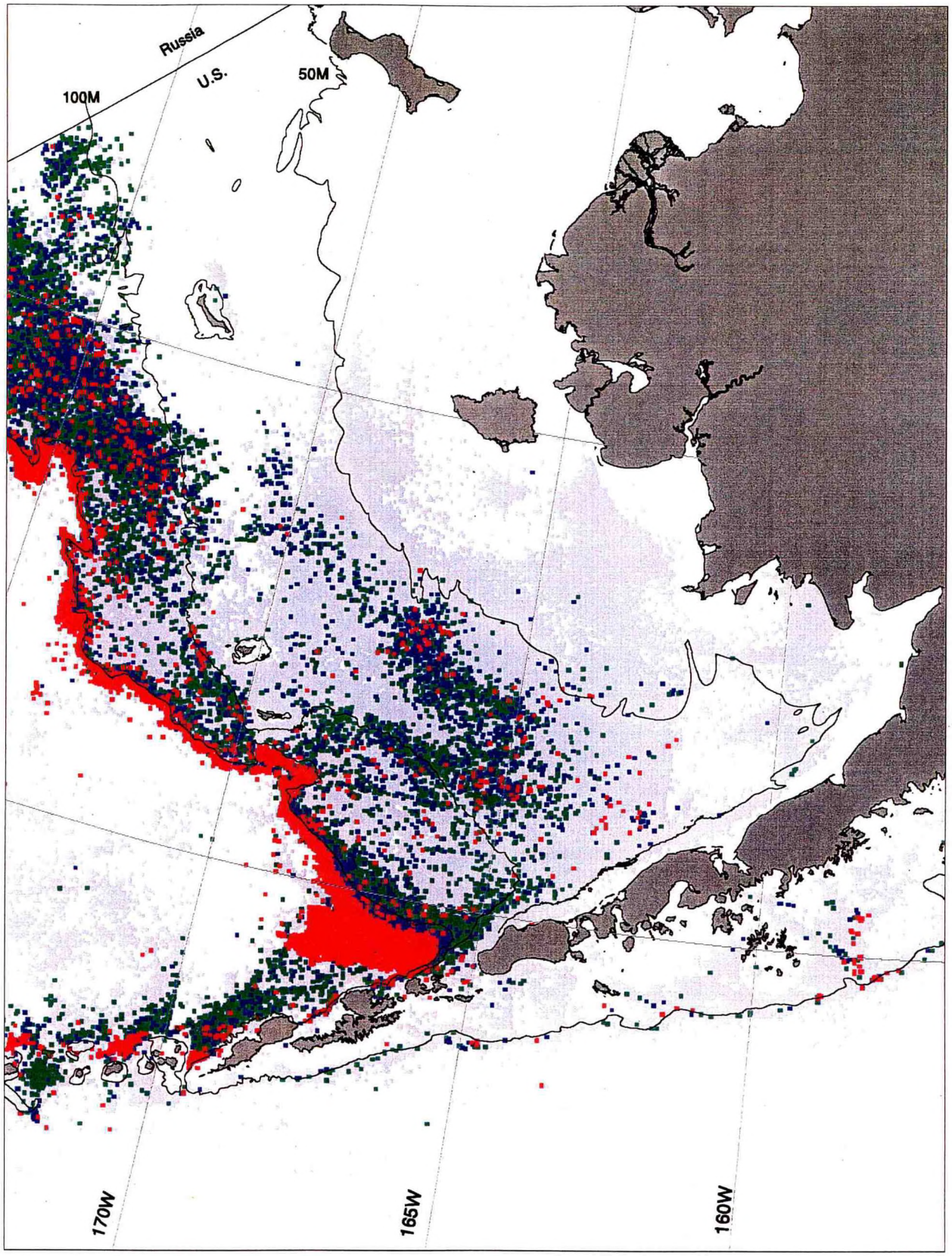


Figure 8.a Greenland turbot catch per unit effort (CPUE) summary for



BSAI region, based on Alaskan trawl groundfish observer data.

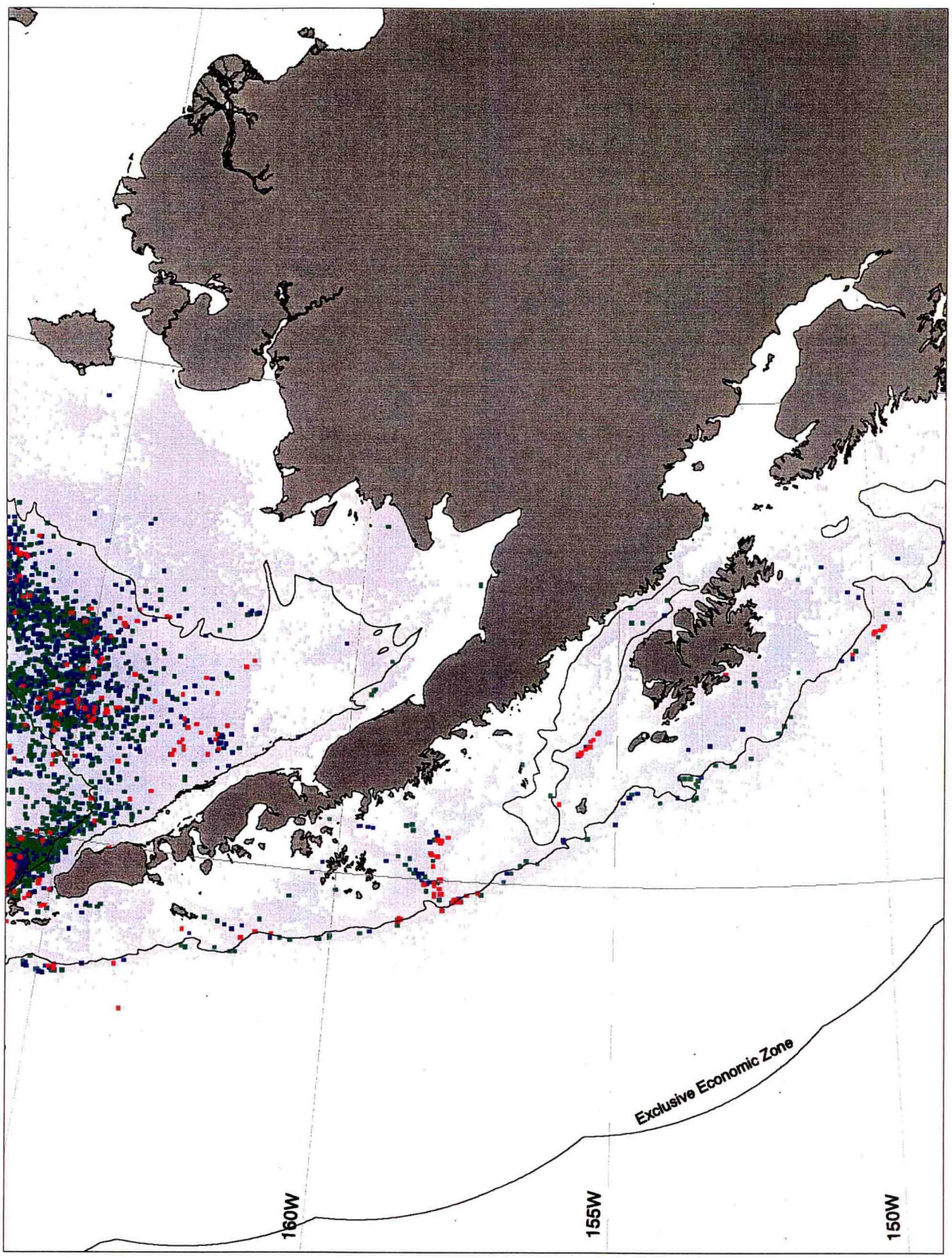
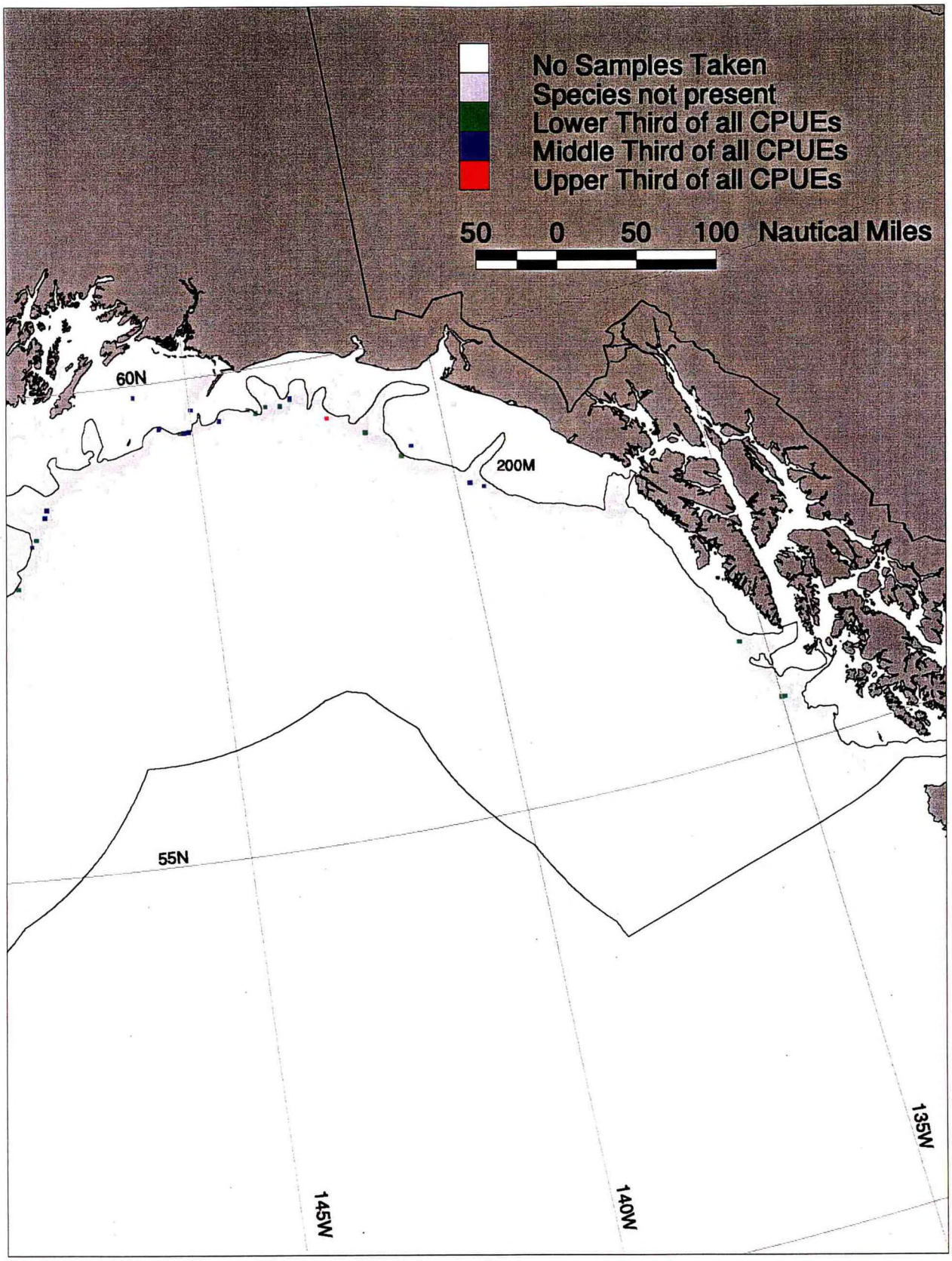


Figure 8.b Greenland turbot catch per unit effort (CPUE) summary for



GOA region, based on Alaskan trawl groundfish observer data.

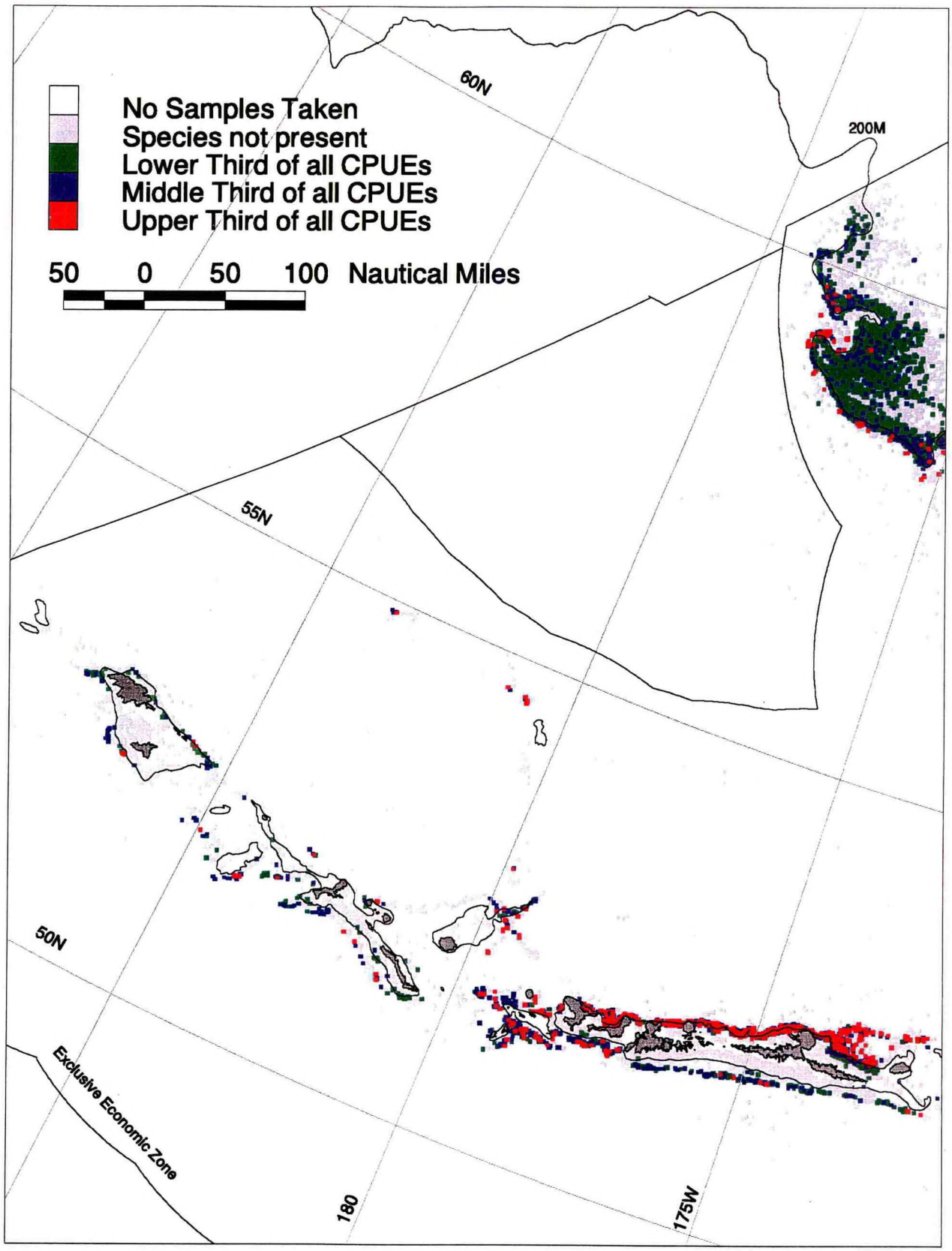
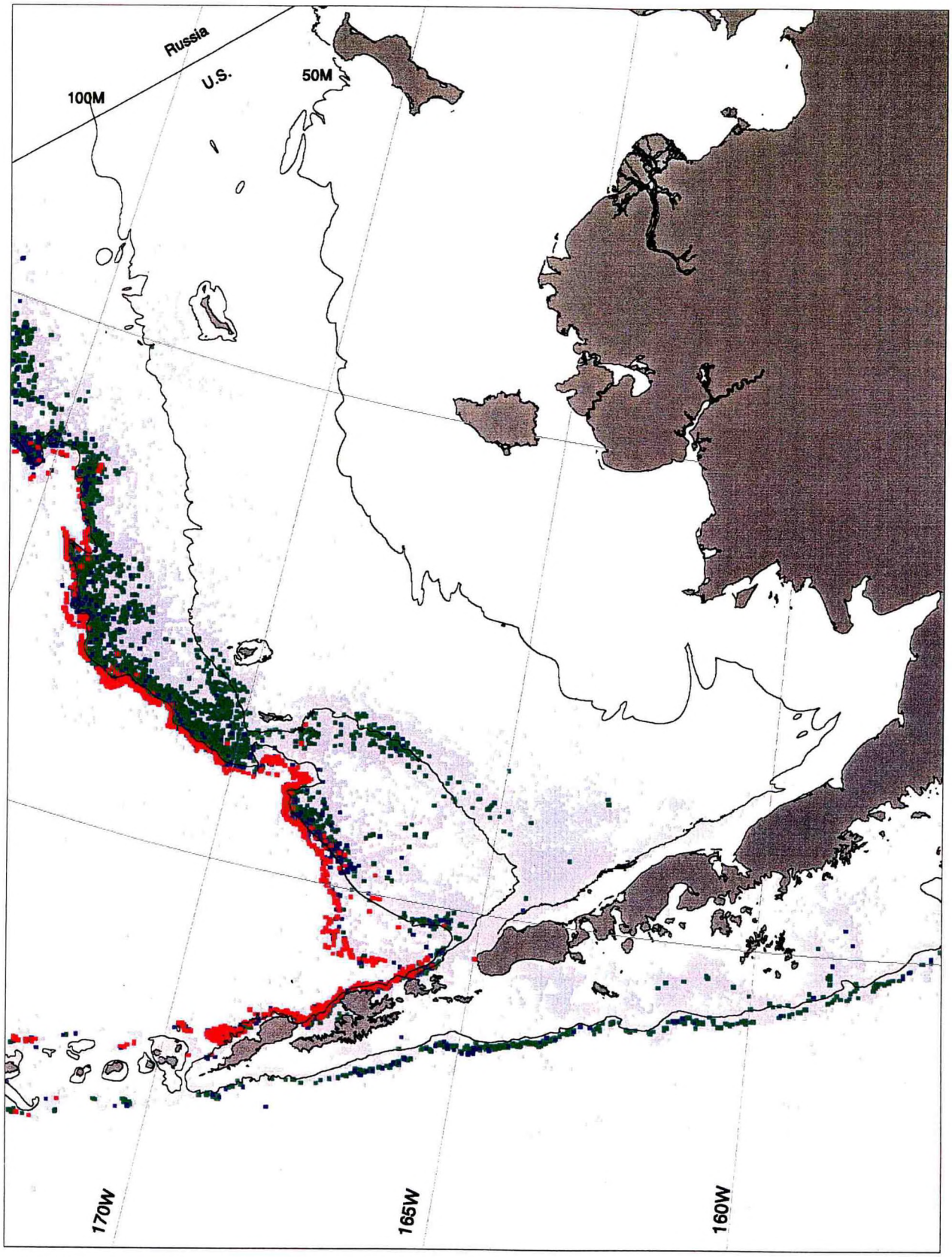


Figure 9.a Greenland turbot catch per unit effort (CPUE) summary for



BSAI region, based on Alaskan longline groundfish observer data.

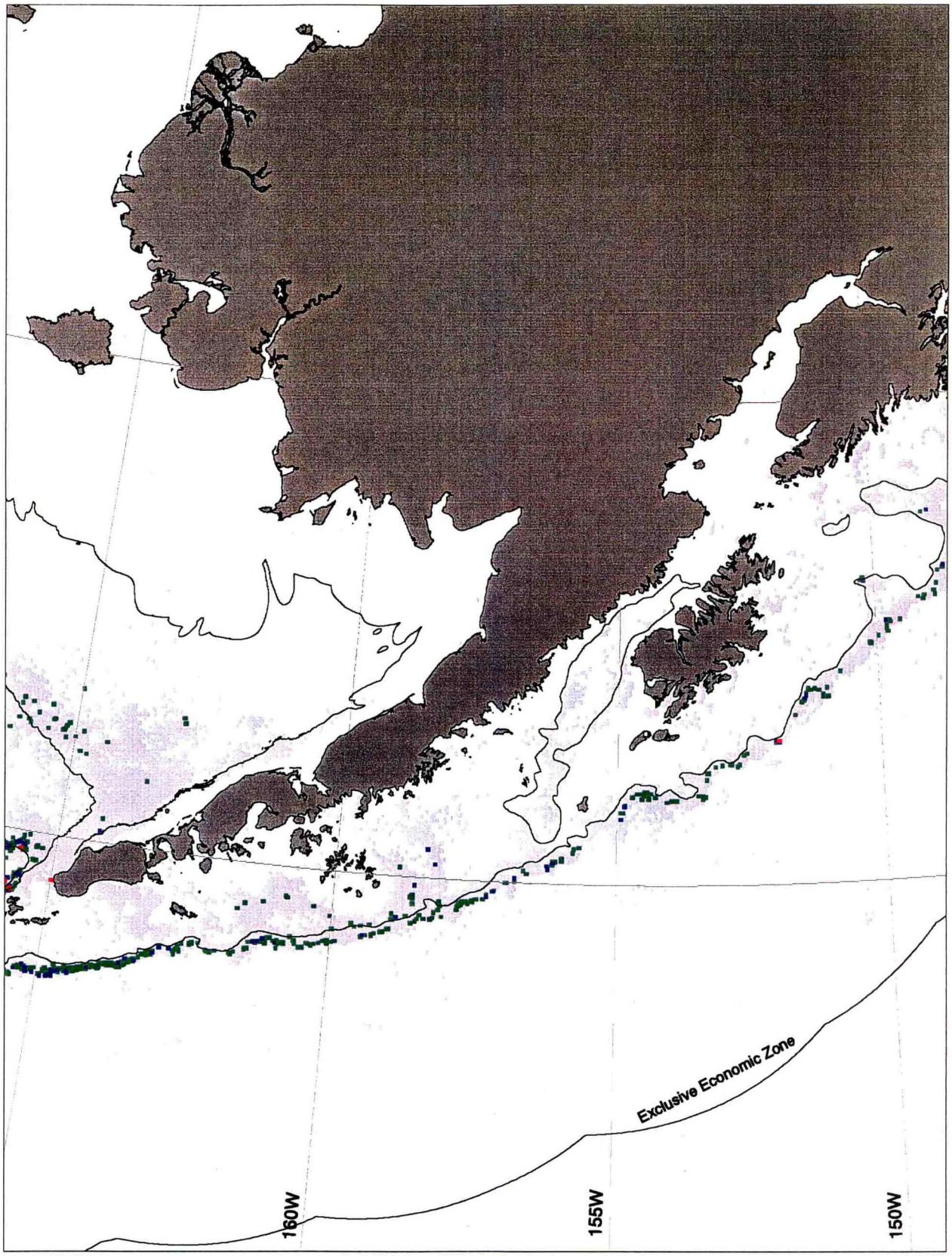
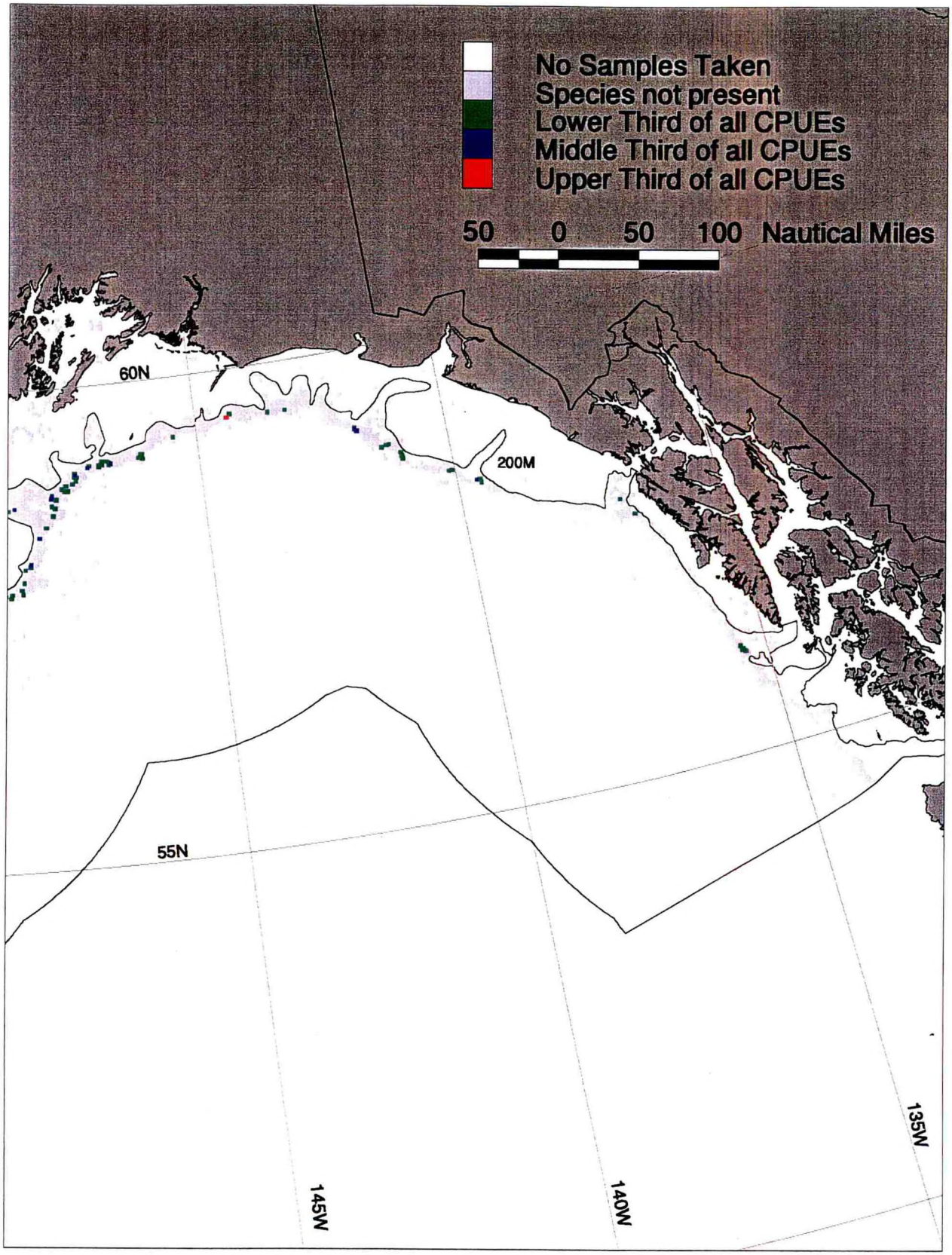


Figure 9.b Greenland turbot catch per unit effort (CPUE) summary for



GOA region, based on Alaskan longline groundfish observer data.

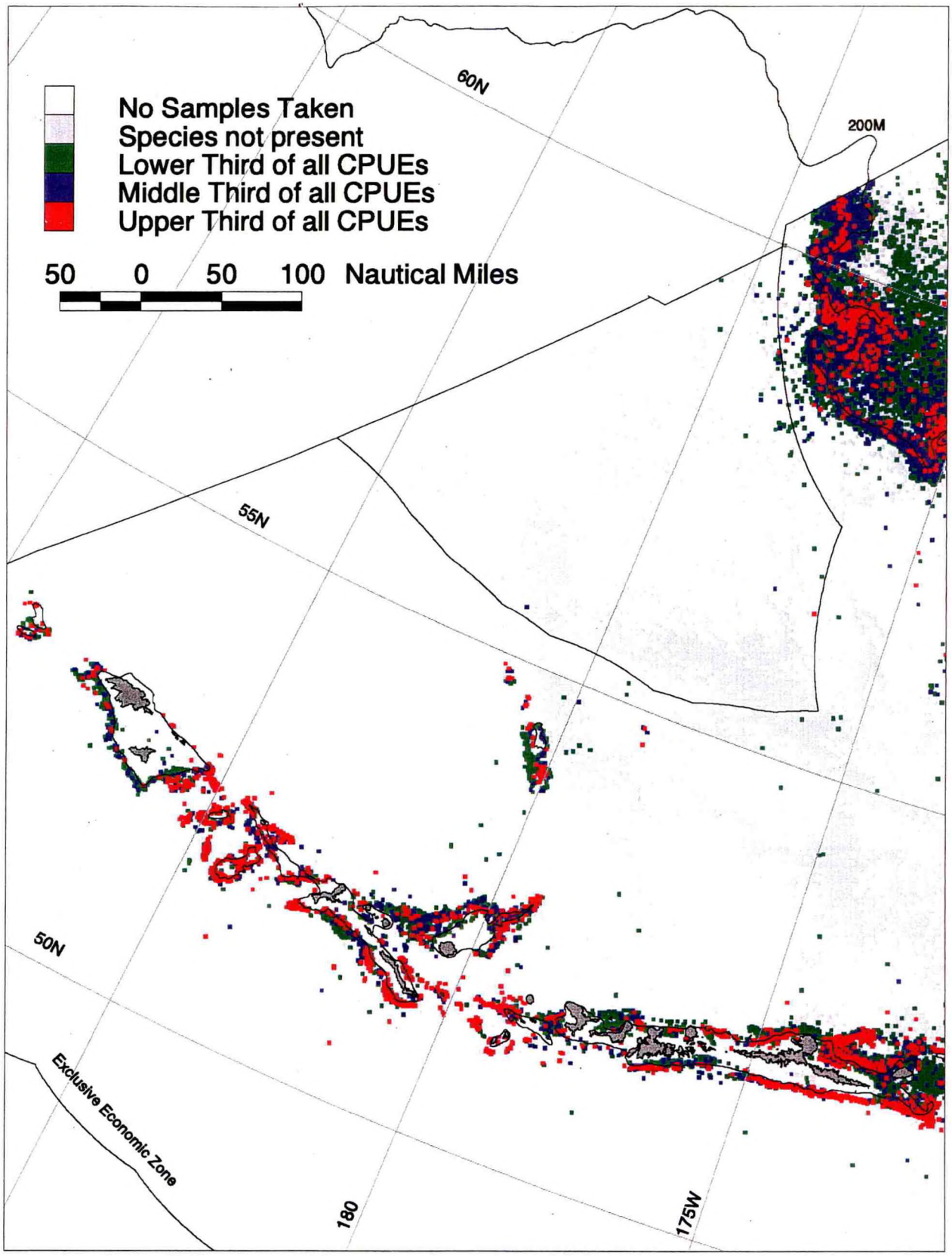
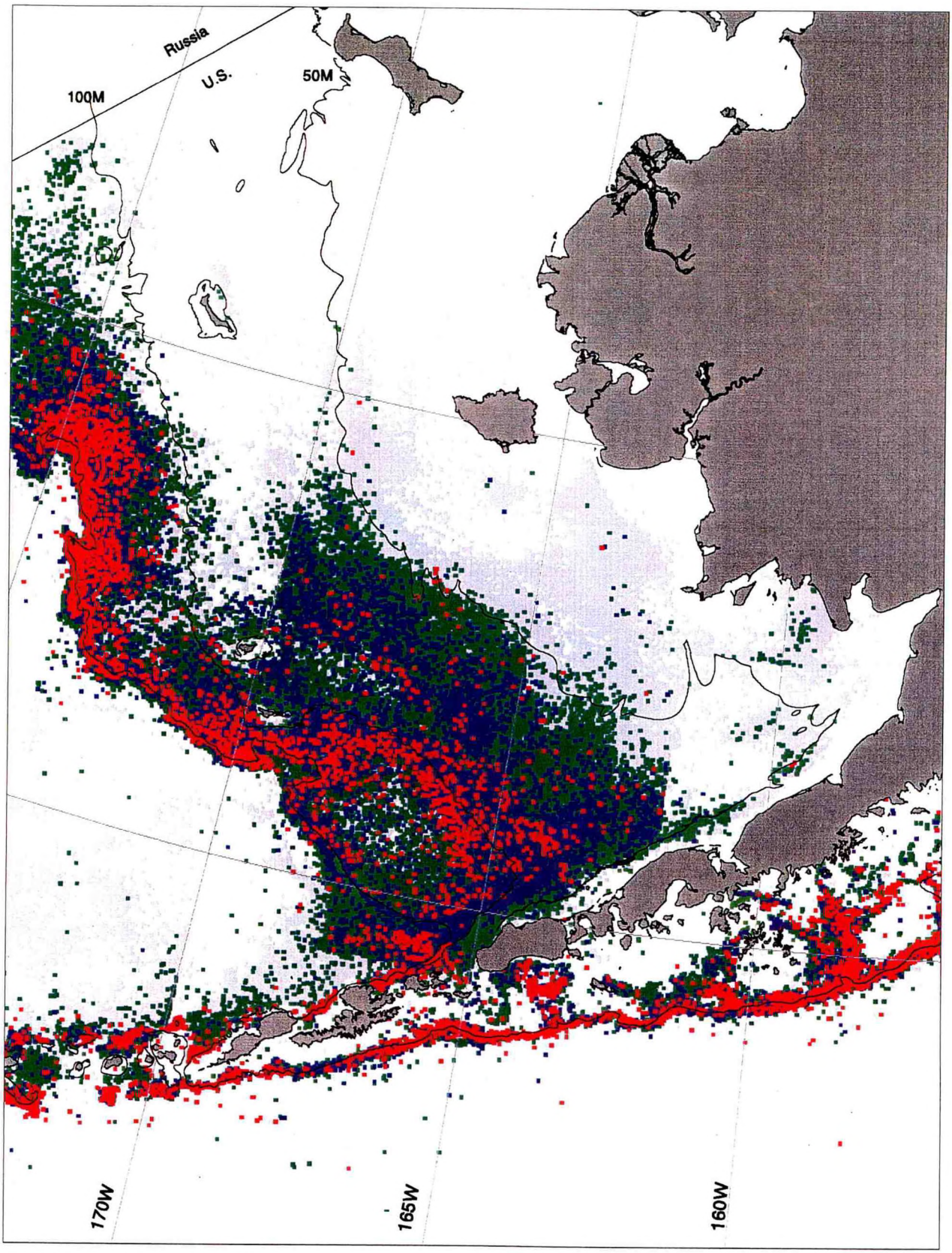


Figure 10.a Arrowtooth flounder catch per unit effort (CPUE) summary for



BSAI region, based on Alaskan trawl groundfish observer data.

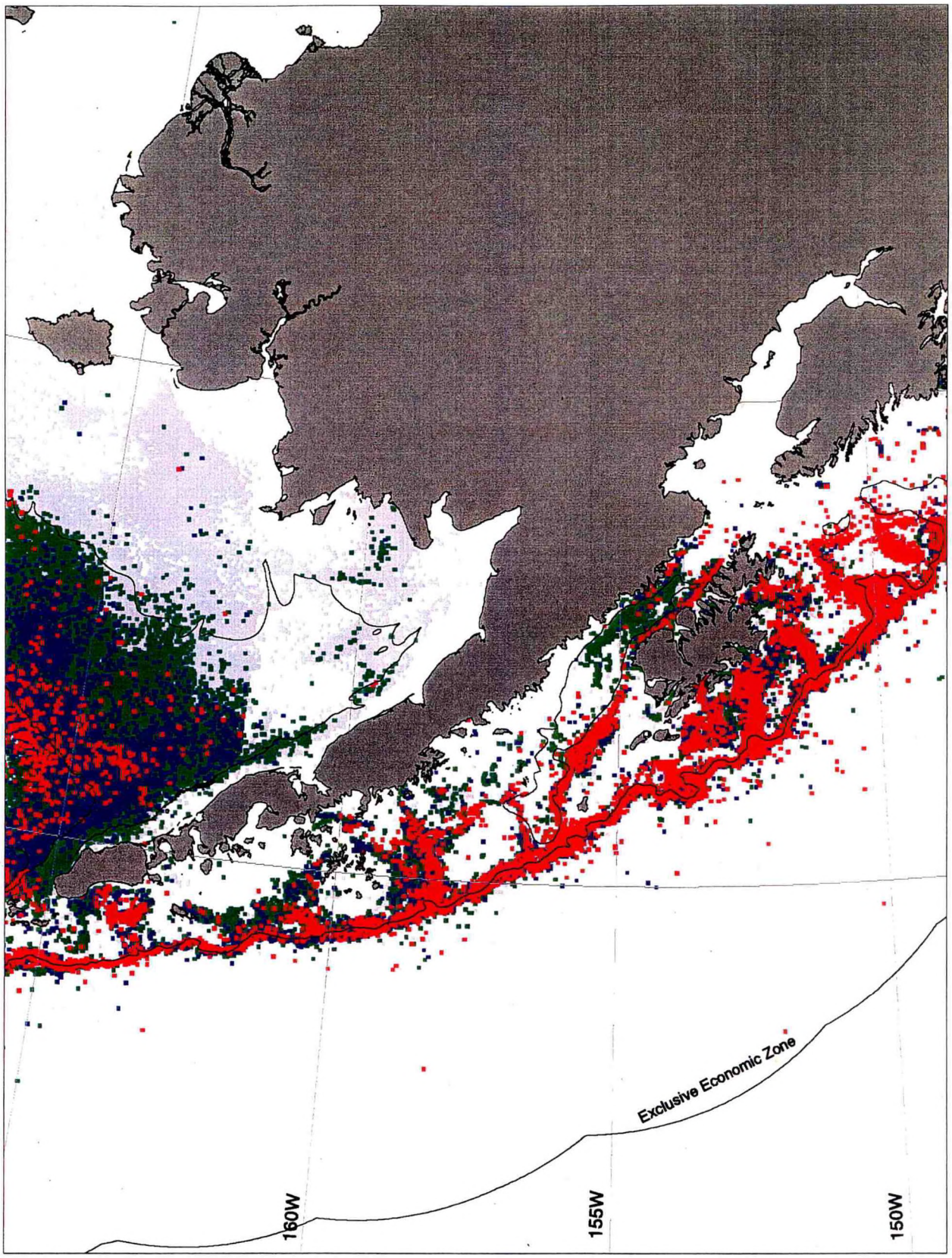
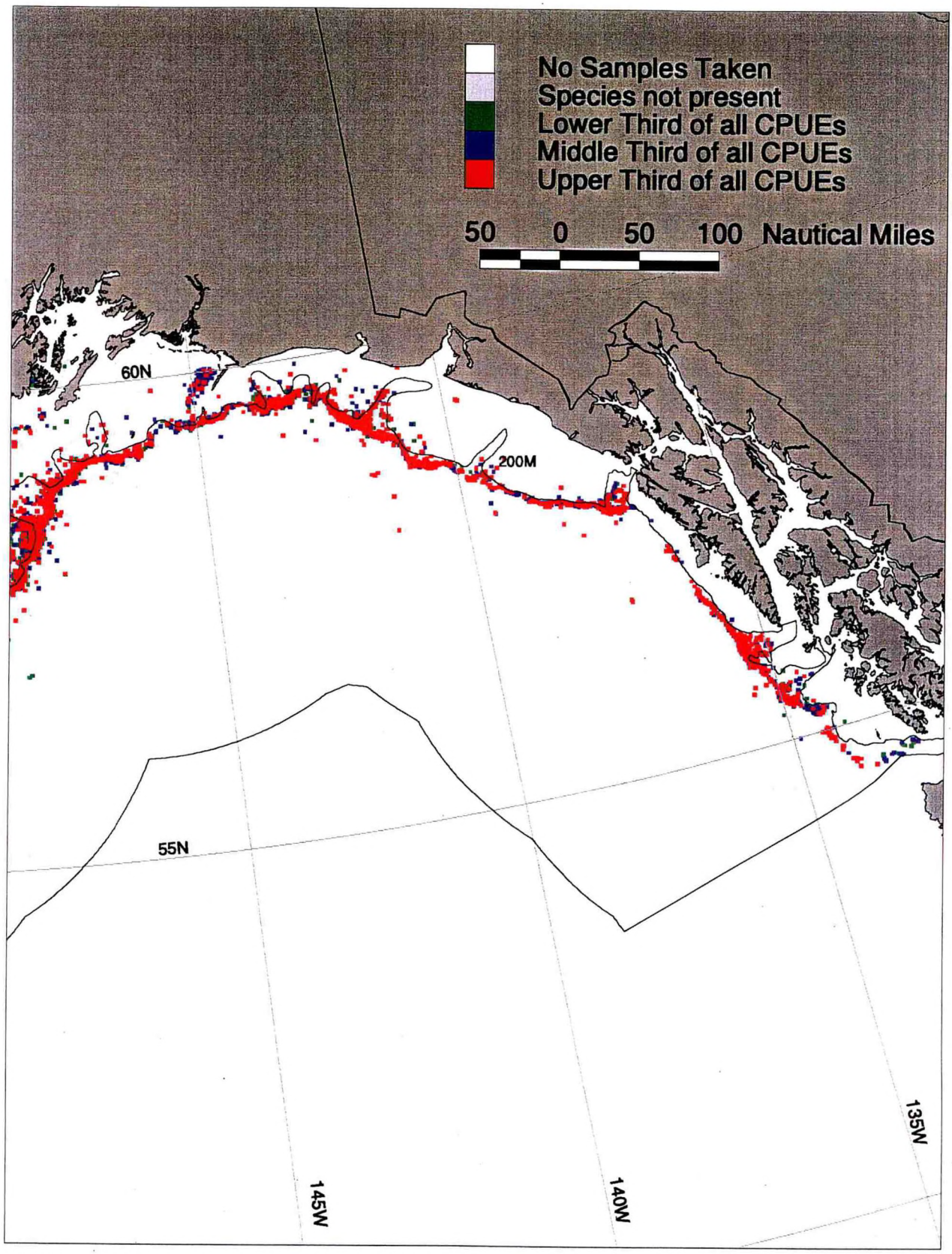


Figure 10.b Arrowtooth flounder catch per unit effort (CPUE) summary for



GOA region, based on Alaskan trawl groundfish observer data.

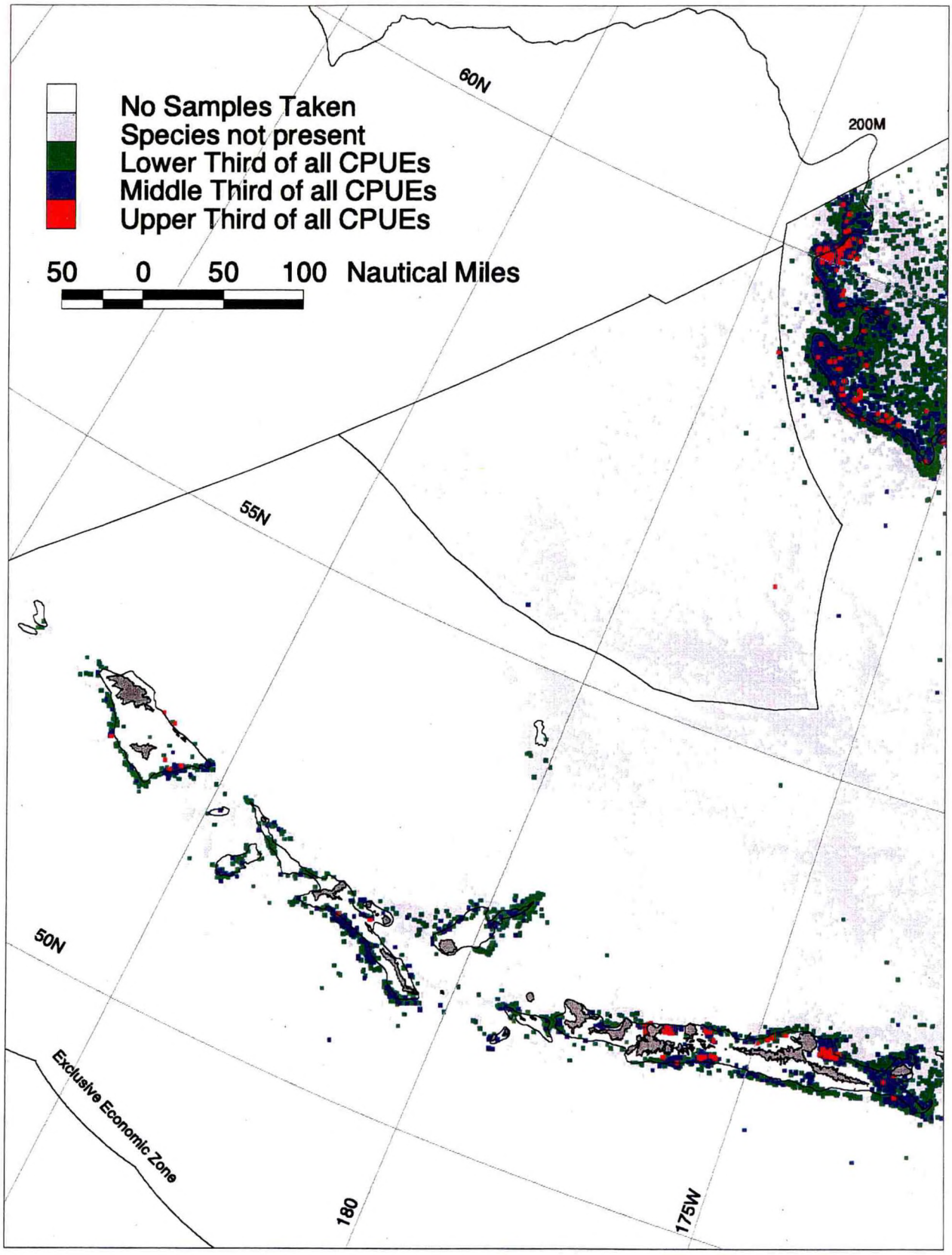
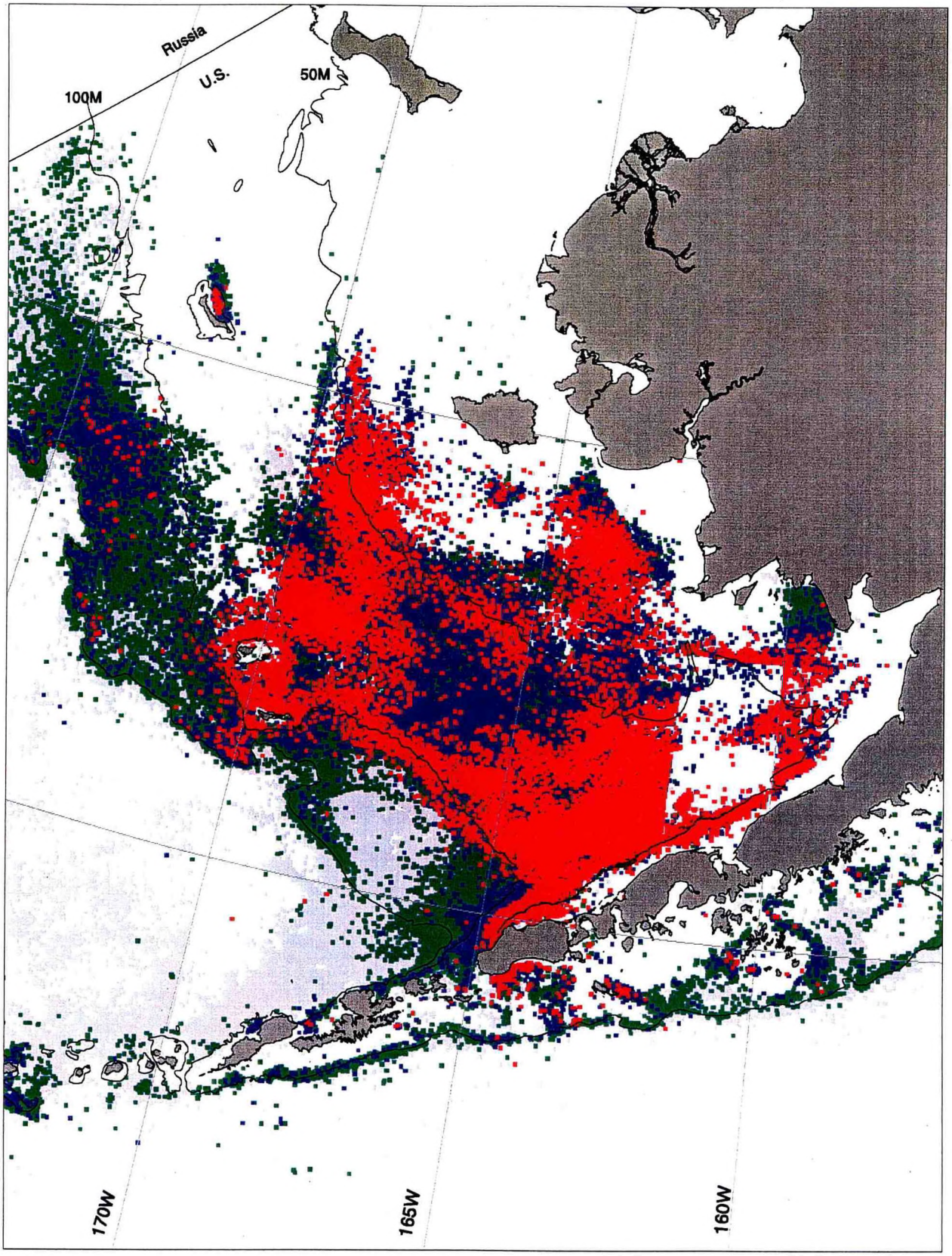


Figure 11.a Rock sole catch per unit effort (CPUE) summary for



BSAI region, based on Alaskan trawl groundfish observer data.

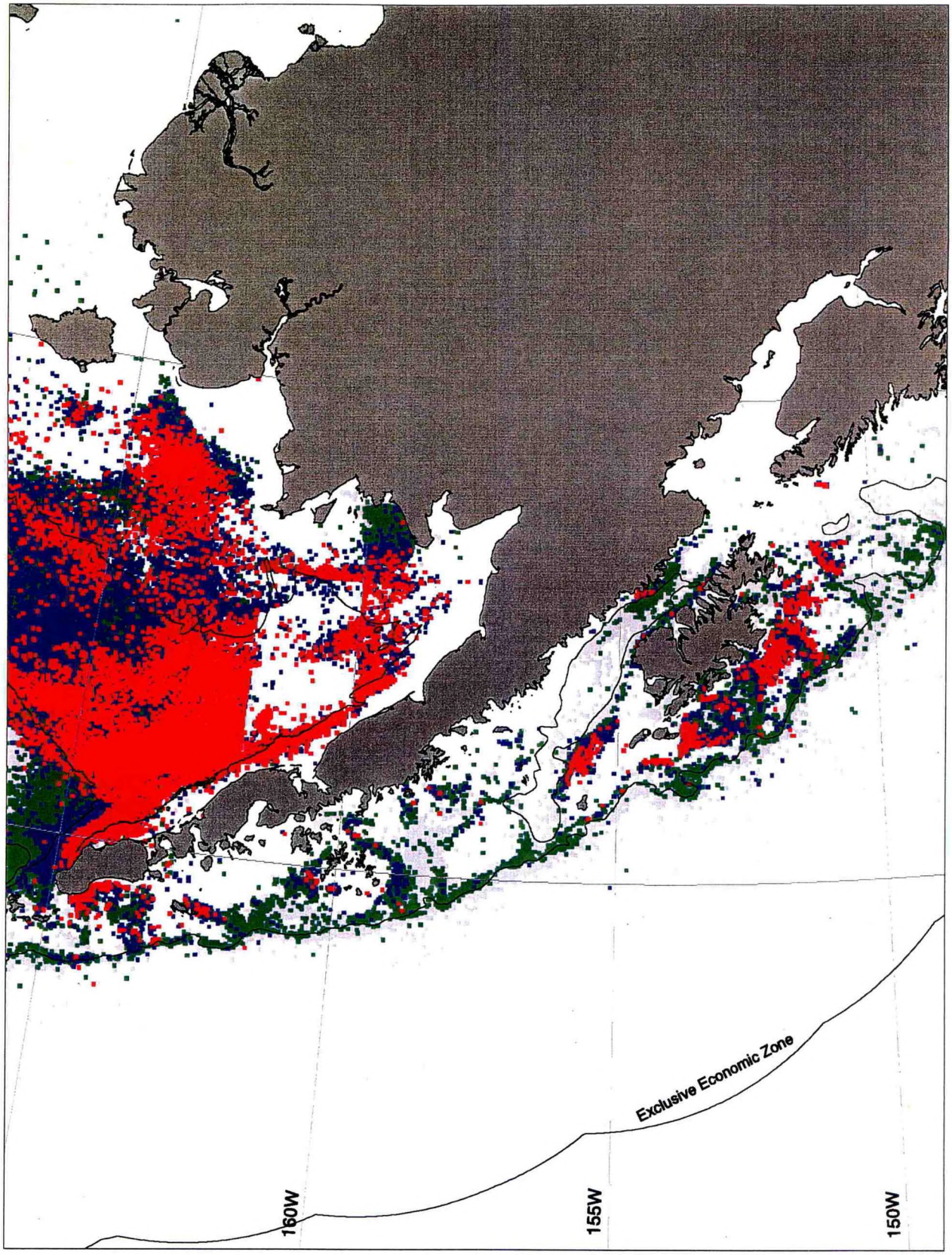
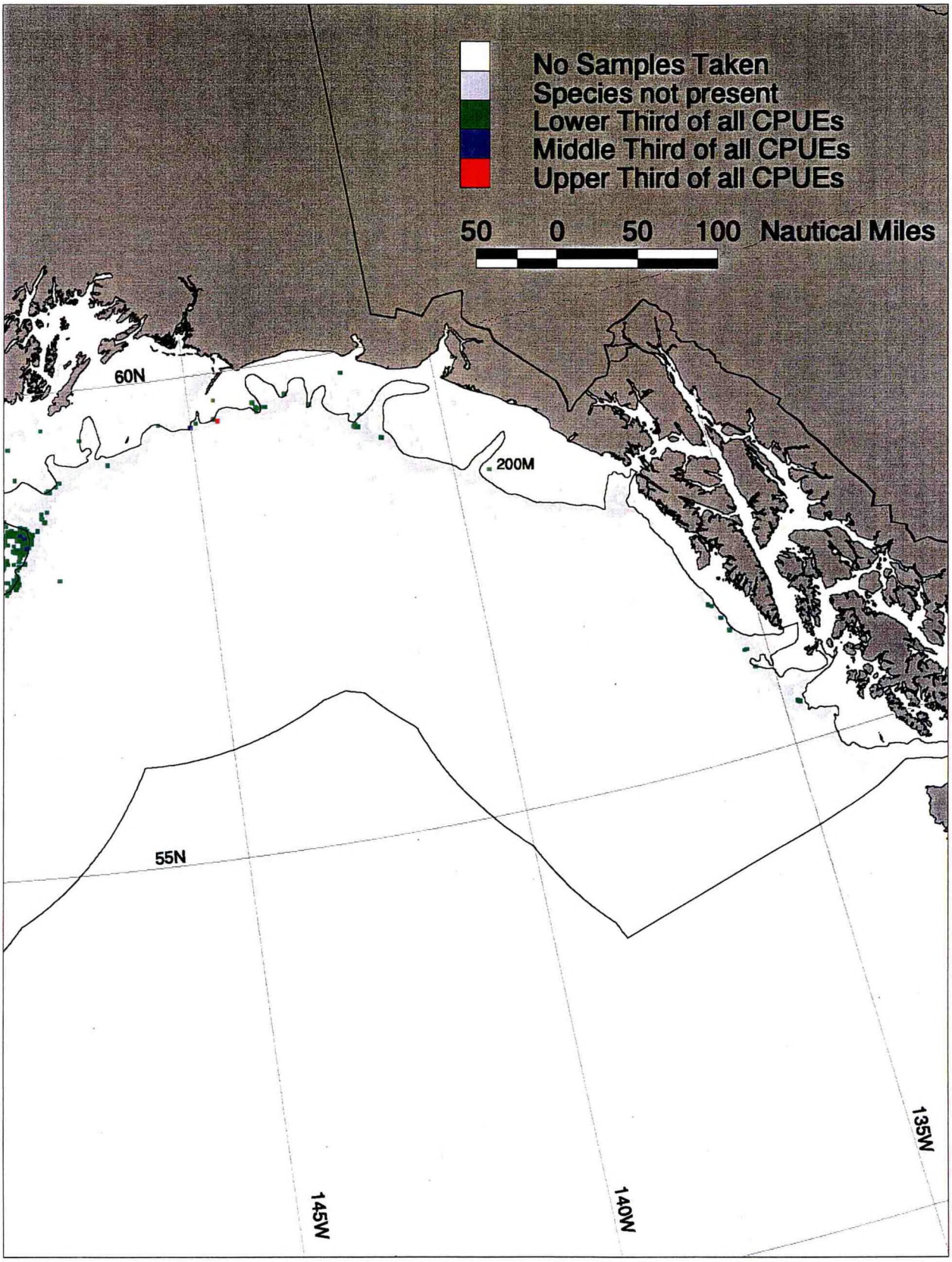


Figure 11.b Rock sole catch per unit effort (CPUE) summary for



GOA region, based on Alaskan trawl groundfish observer data.

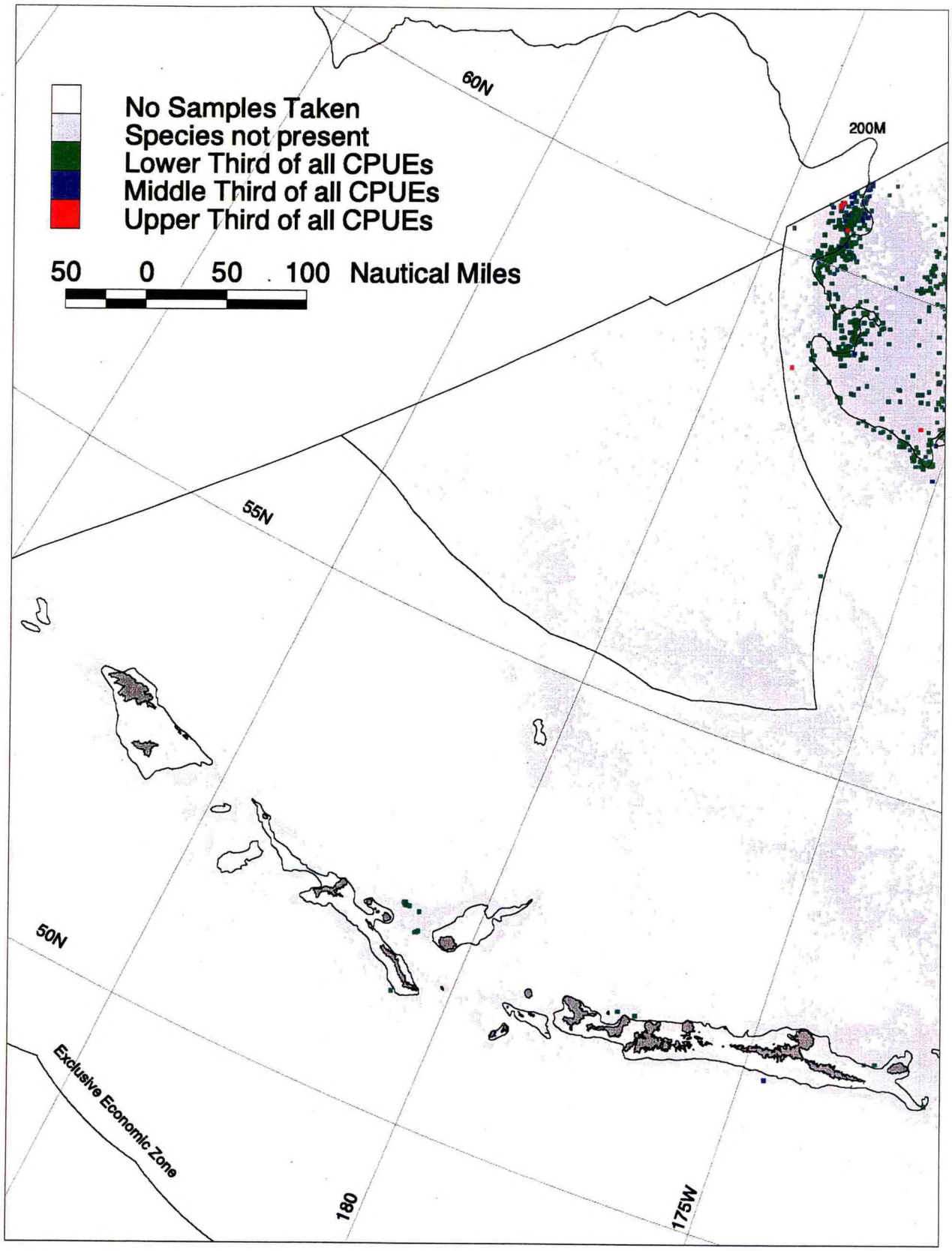
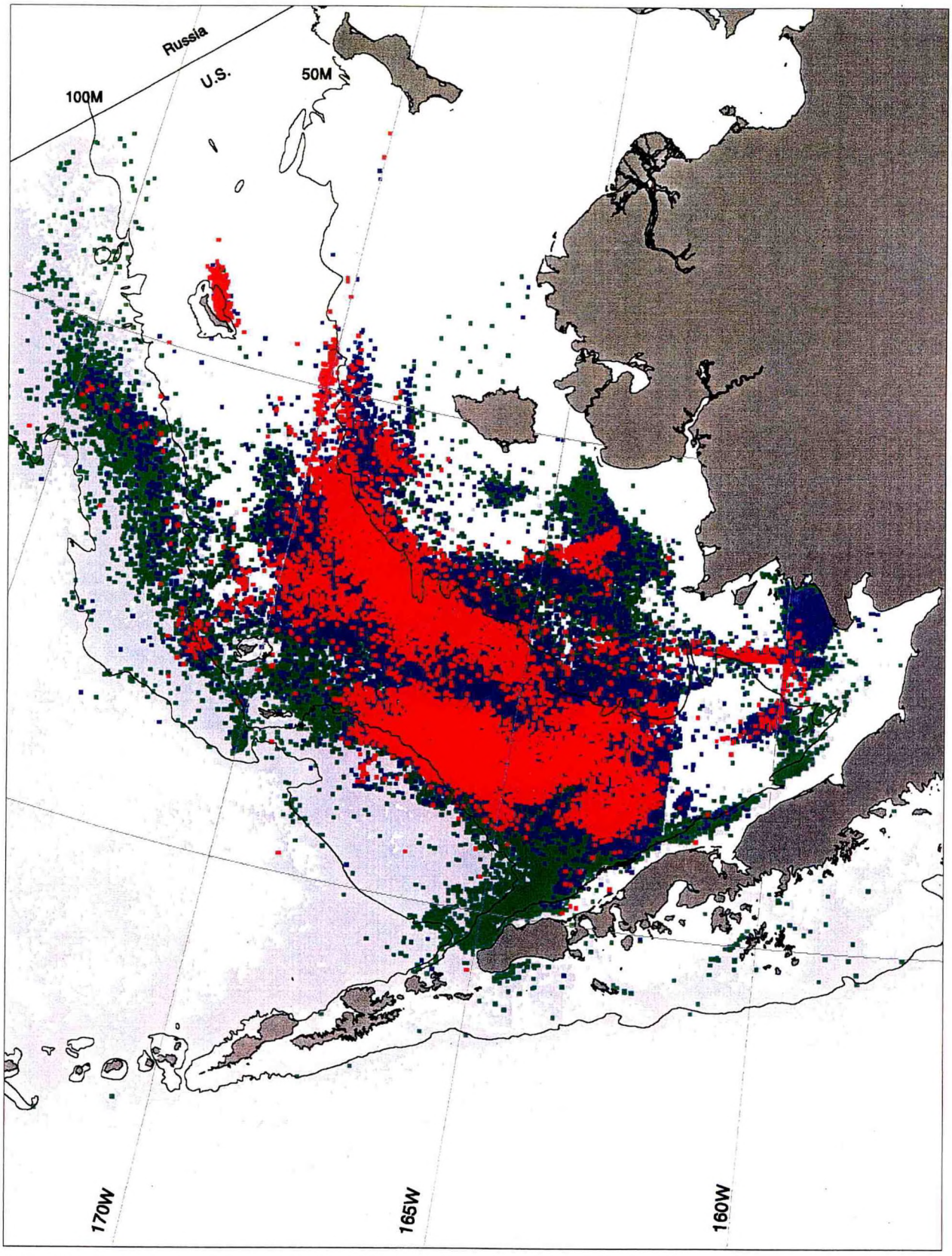


Figure 12.a Alaska plaice catch per unit effort (CPUE) summary for



BSAI region, based on Alaskan trawl groundfish observer data.

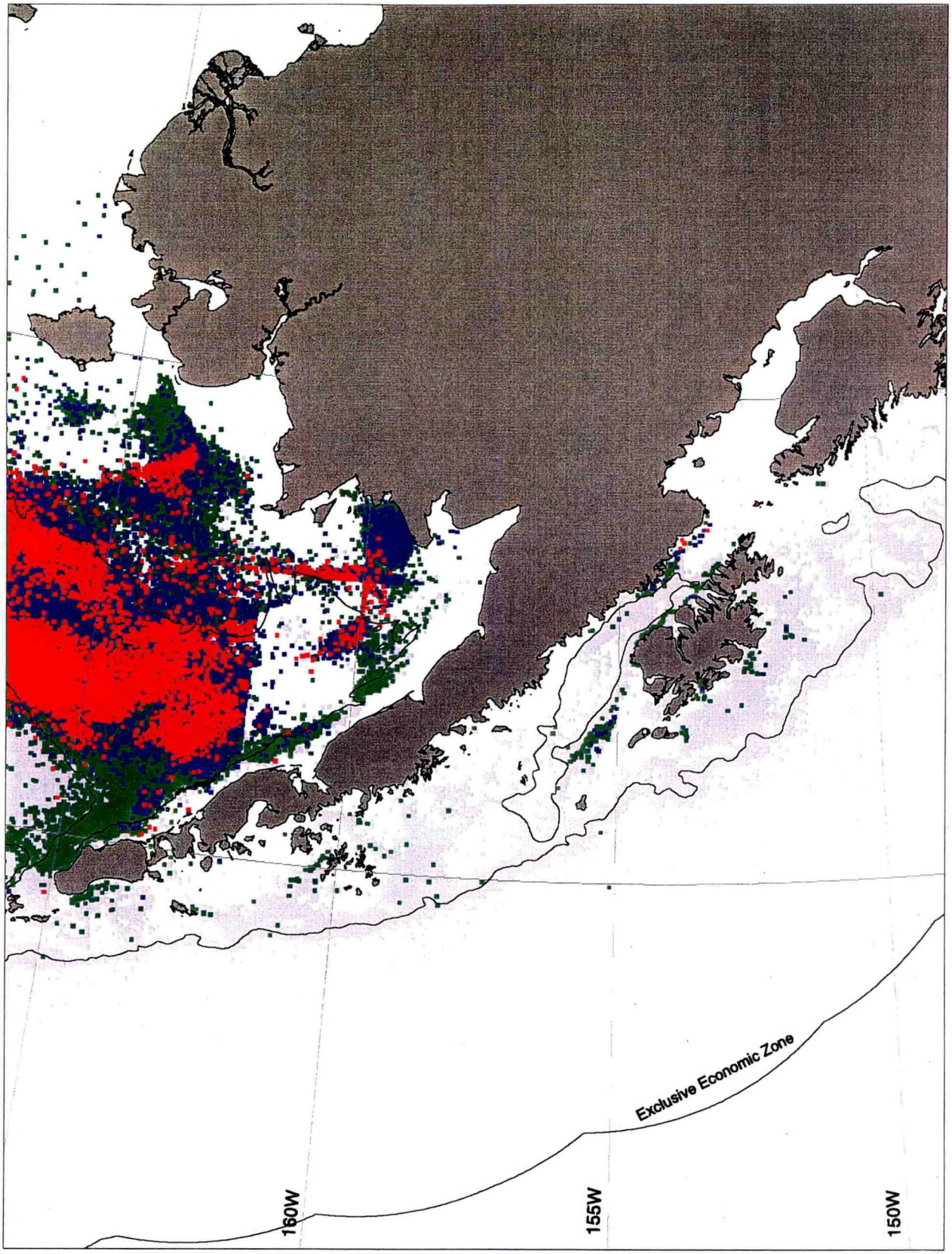
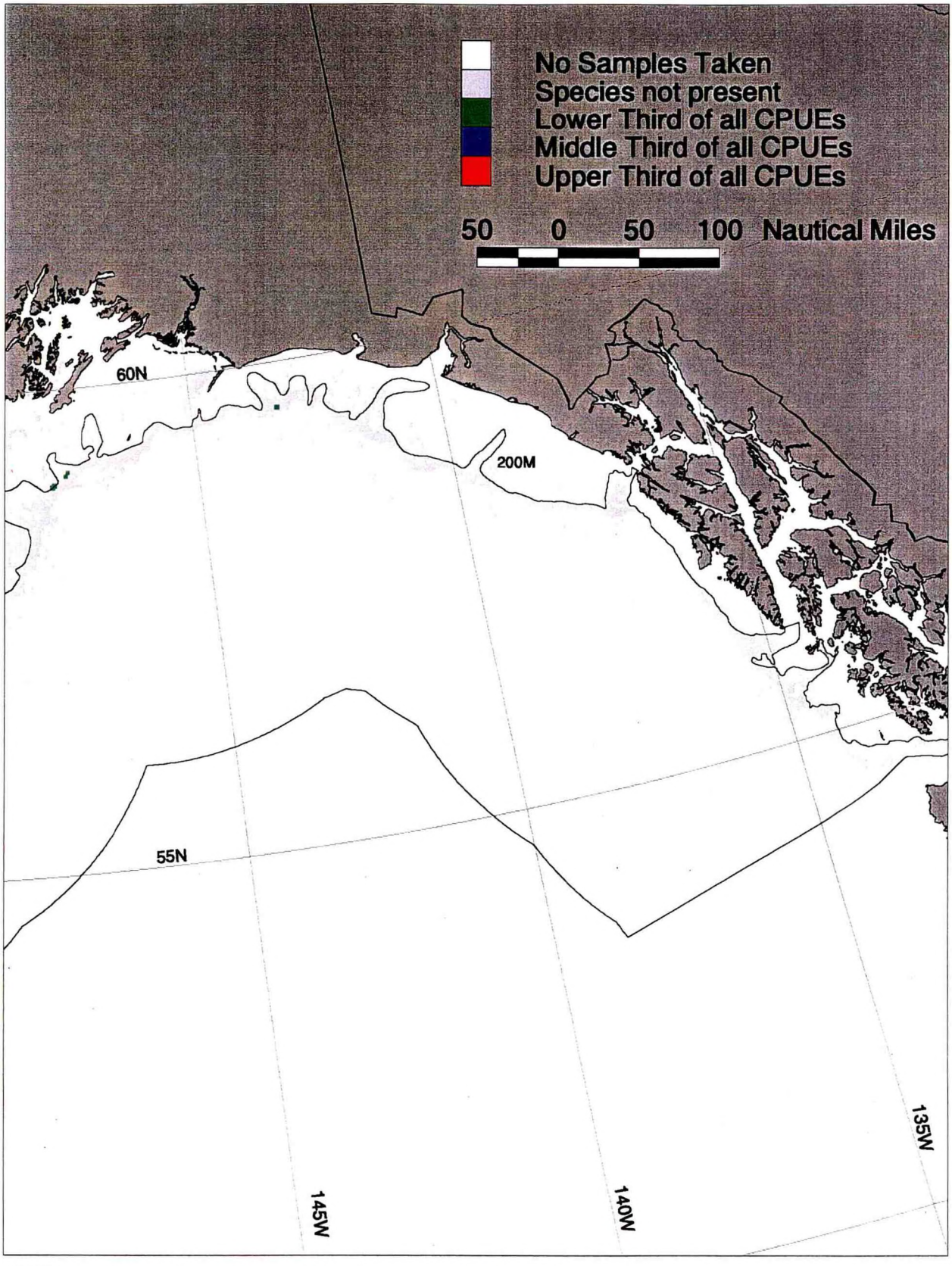


Figure 12.b Alaska plaice catch per unit effort (CPUE) summary for



GOA region, based on Alaskan trawl groundfish observer data.

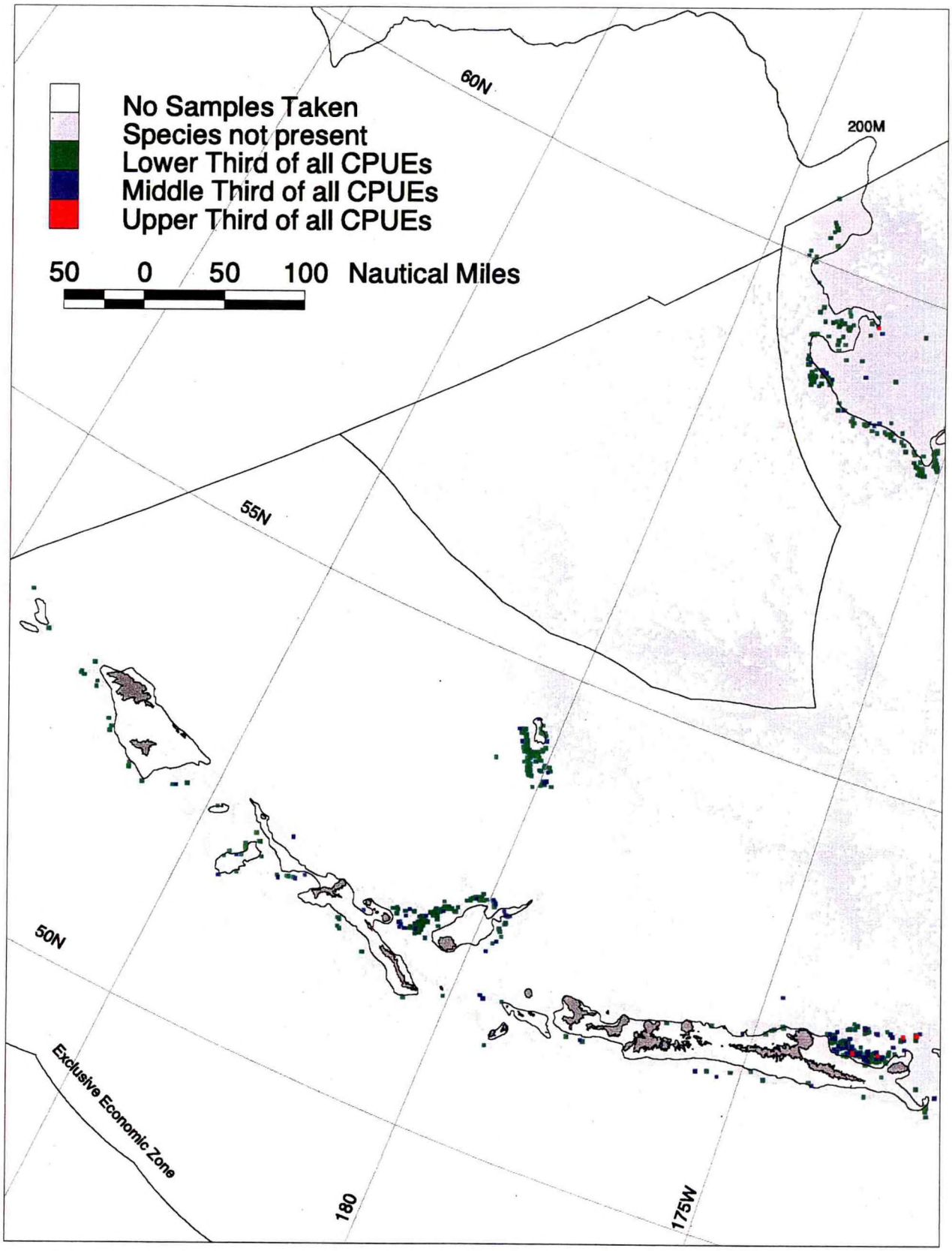
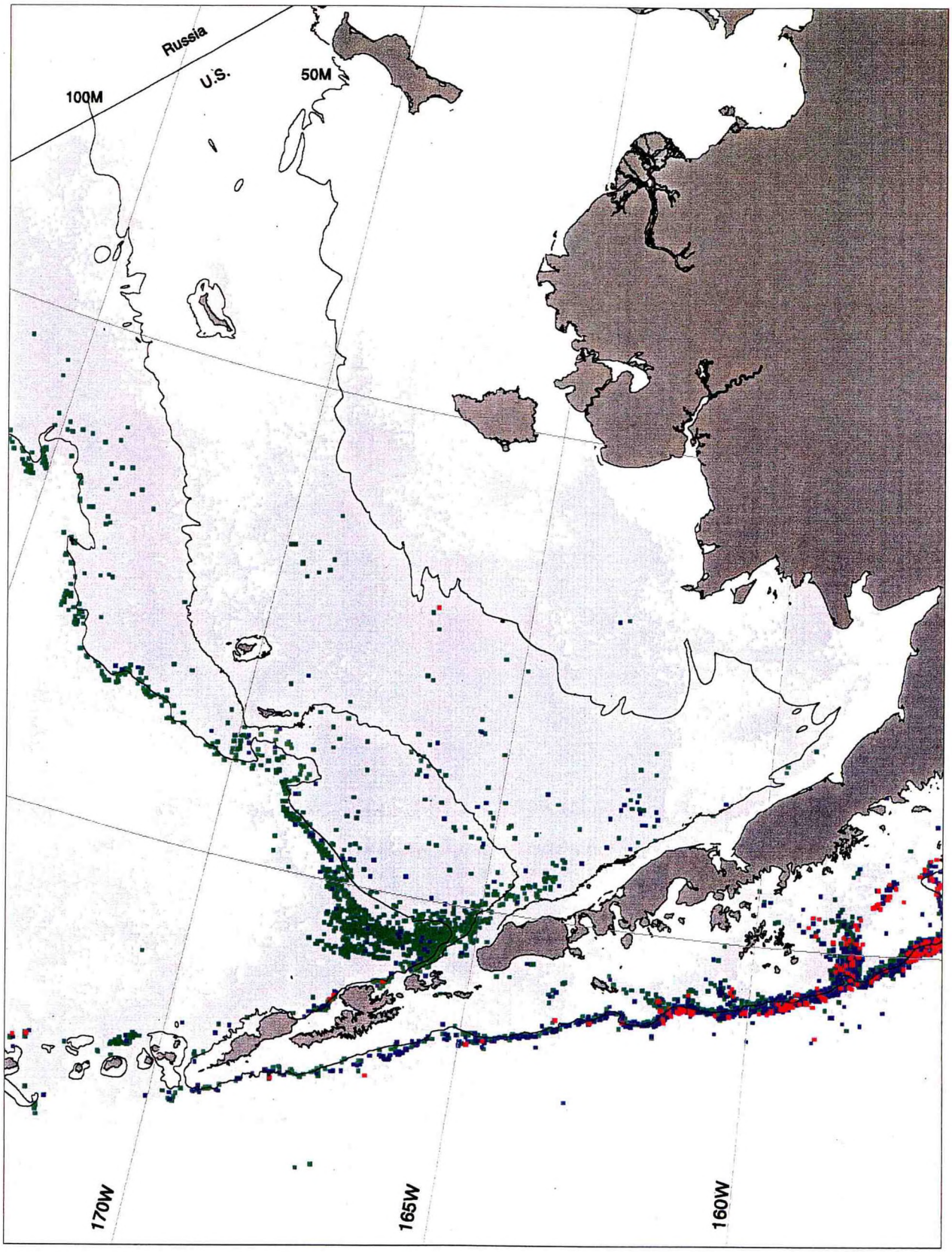


Figure 13.a Dover sole catch per unit effort (CPUE) summary for



BSAI region, based on Alaskan trawl groundfish observer data.

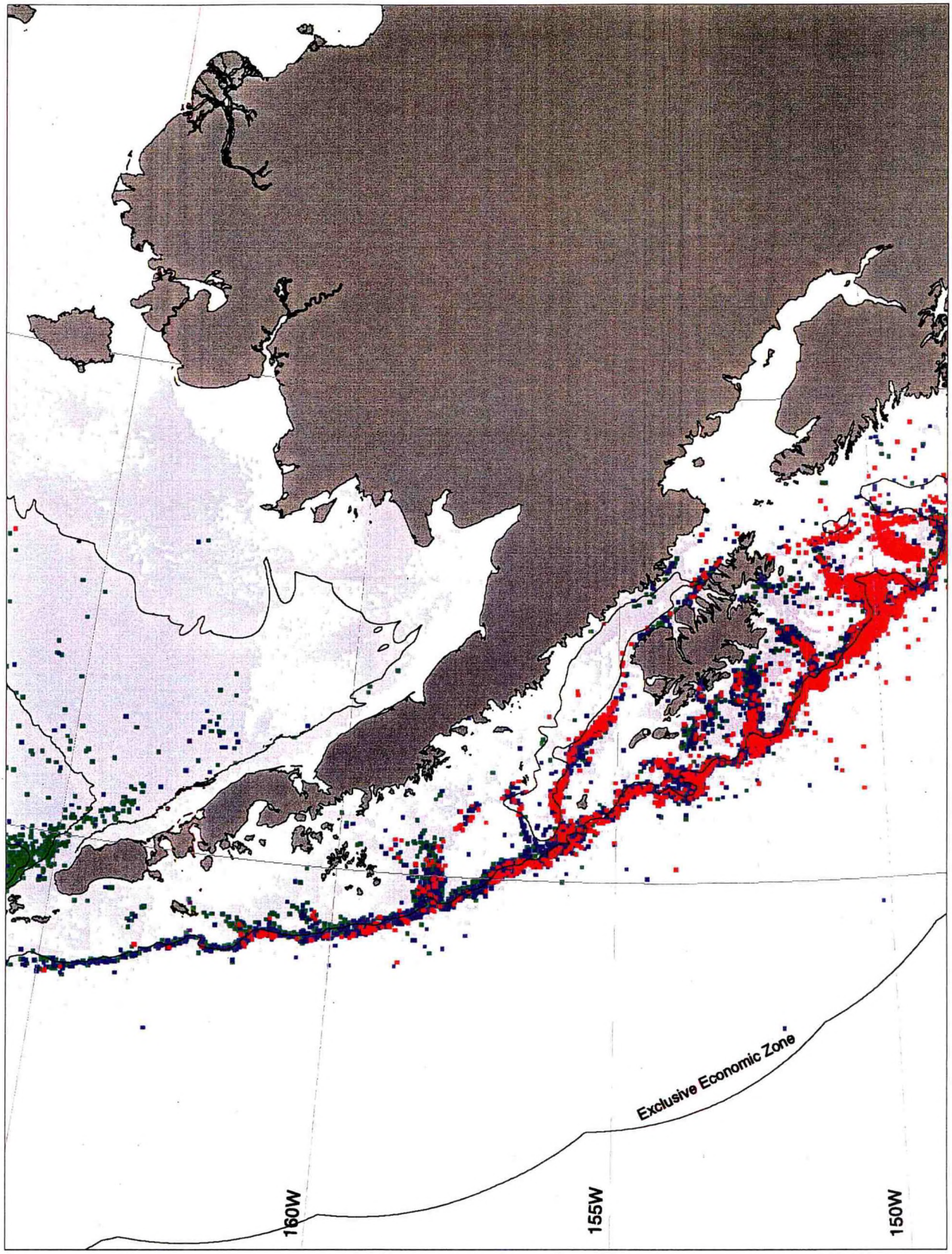
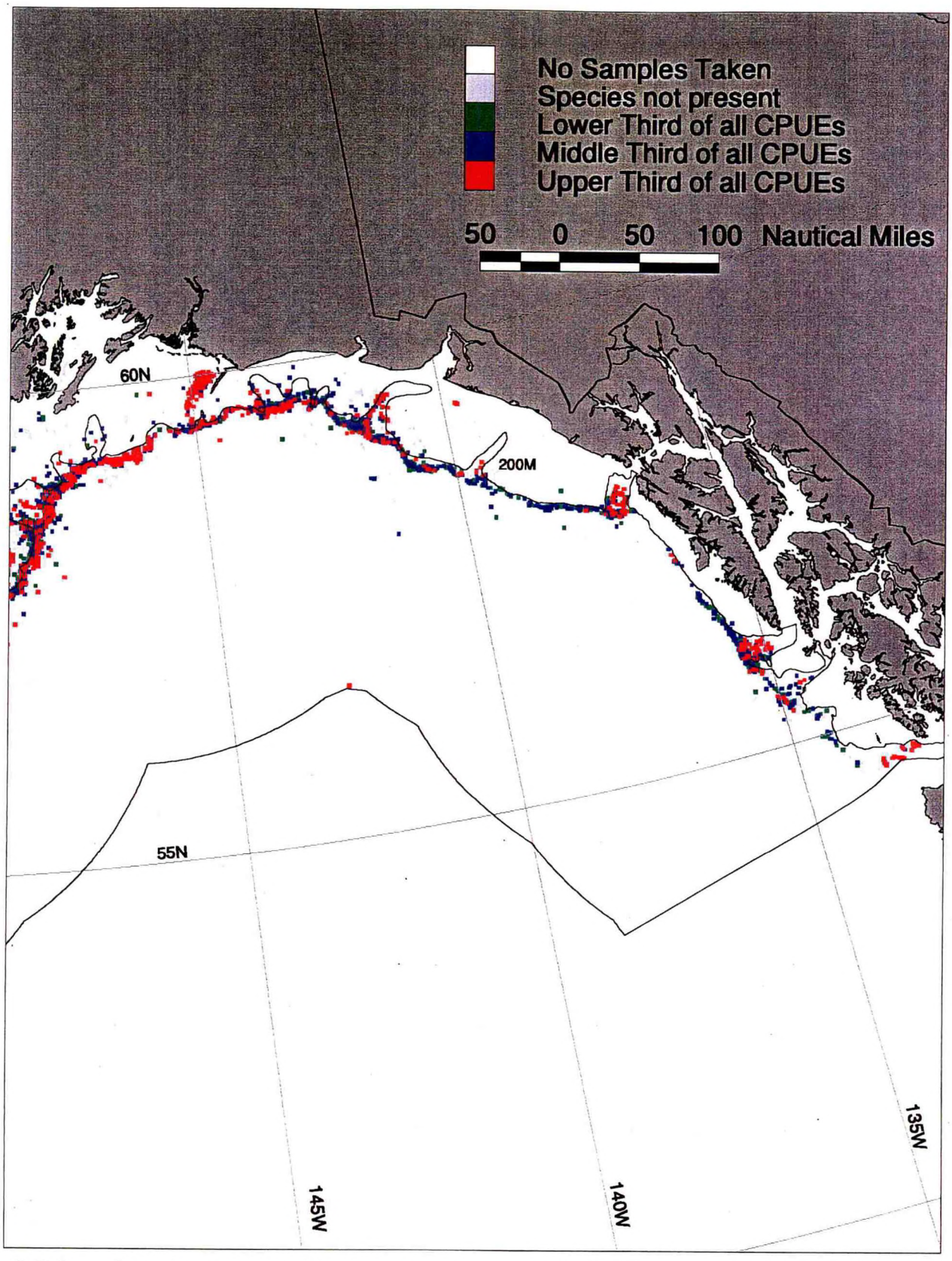


Figure 13.b Dover sole catch per unit effort (CPUE) summary for



GOA region, based on Alaskan trawl groundfish observer data.

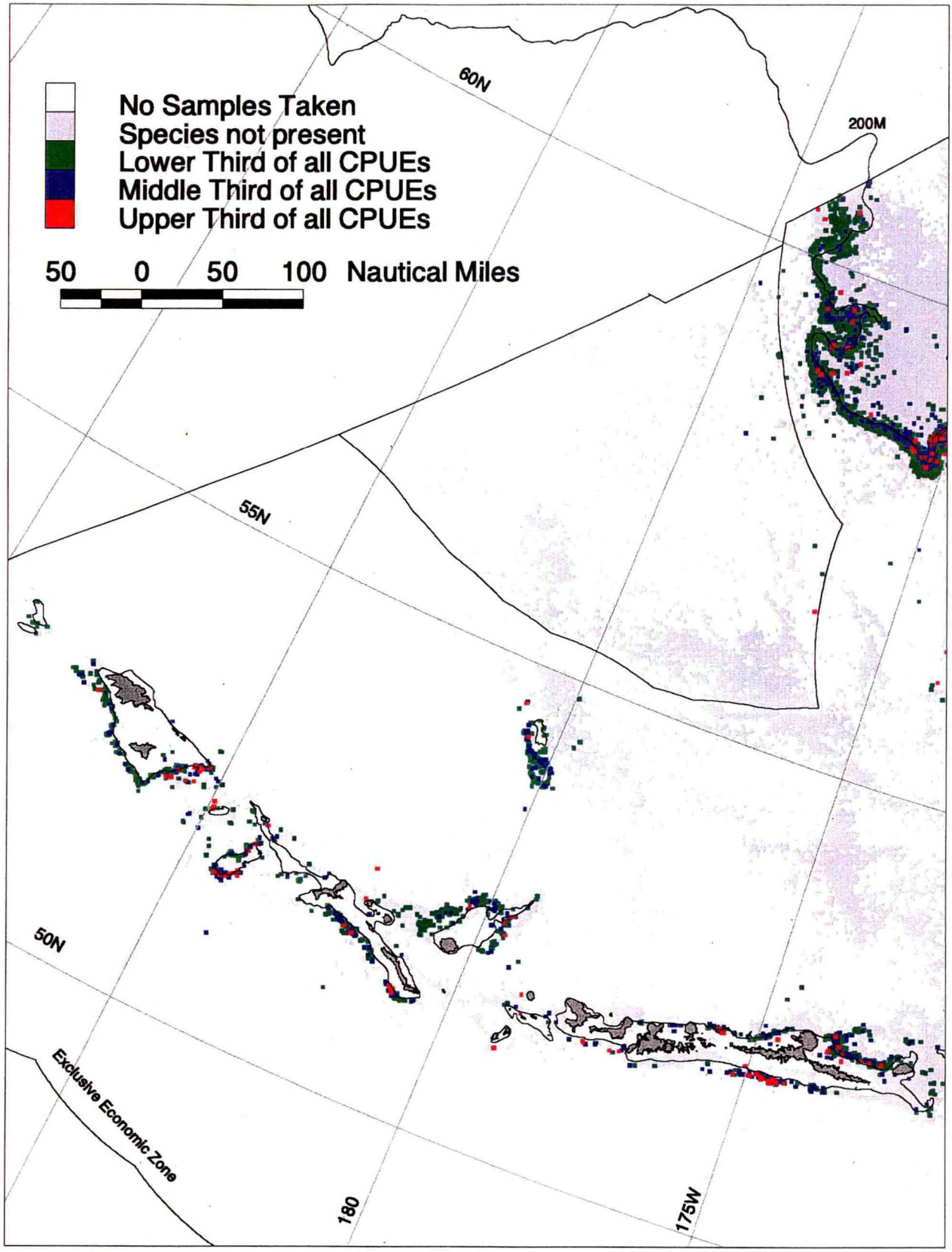
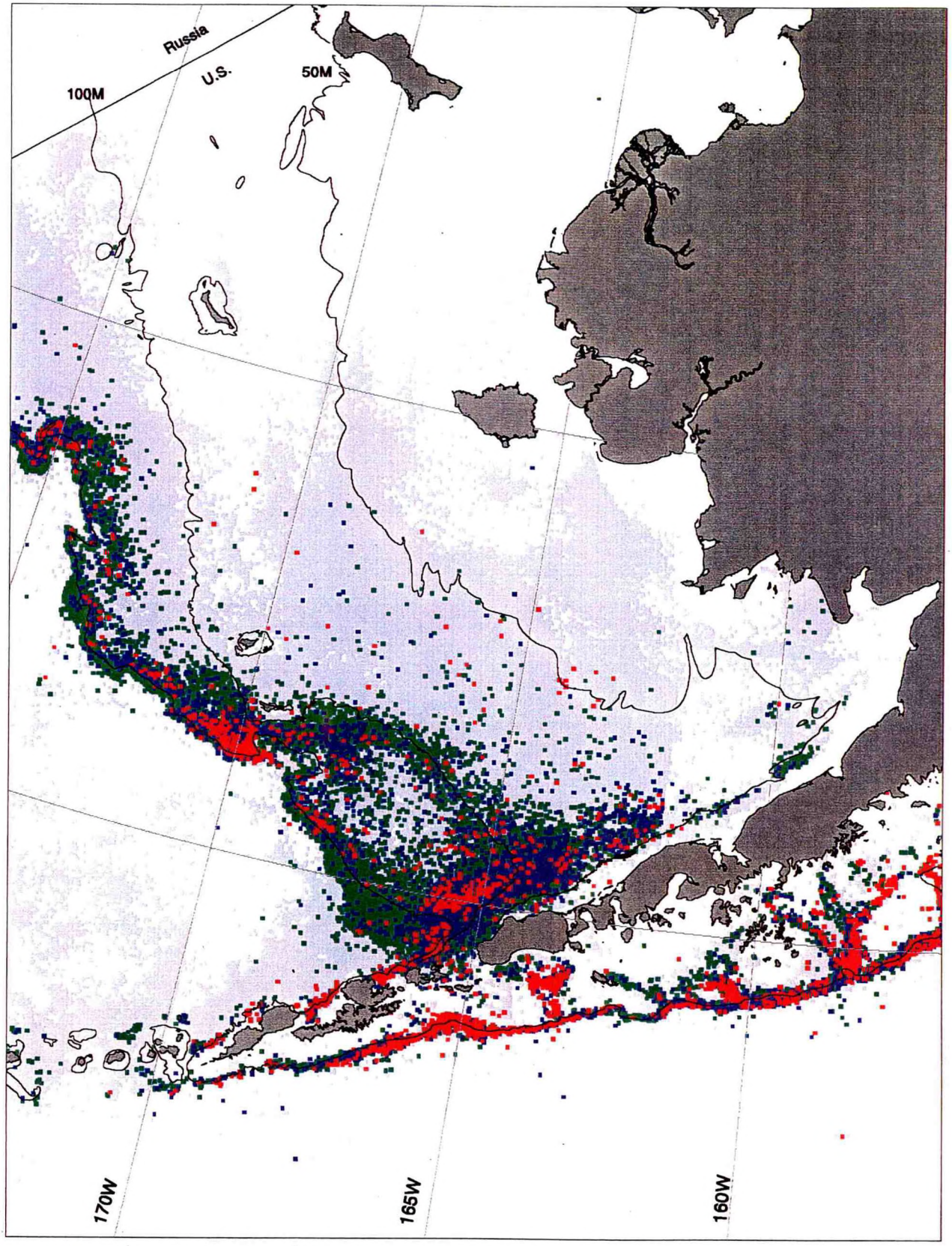


Figure 14.a Rex sole catch per unit effort (CPUE) summary for



BSAI region, based on Alaskan trawl groundfish observer data.

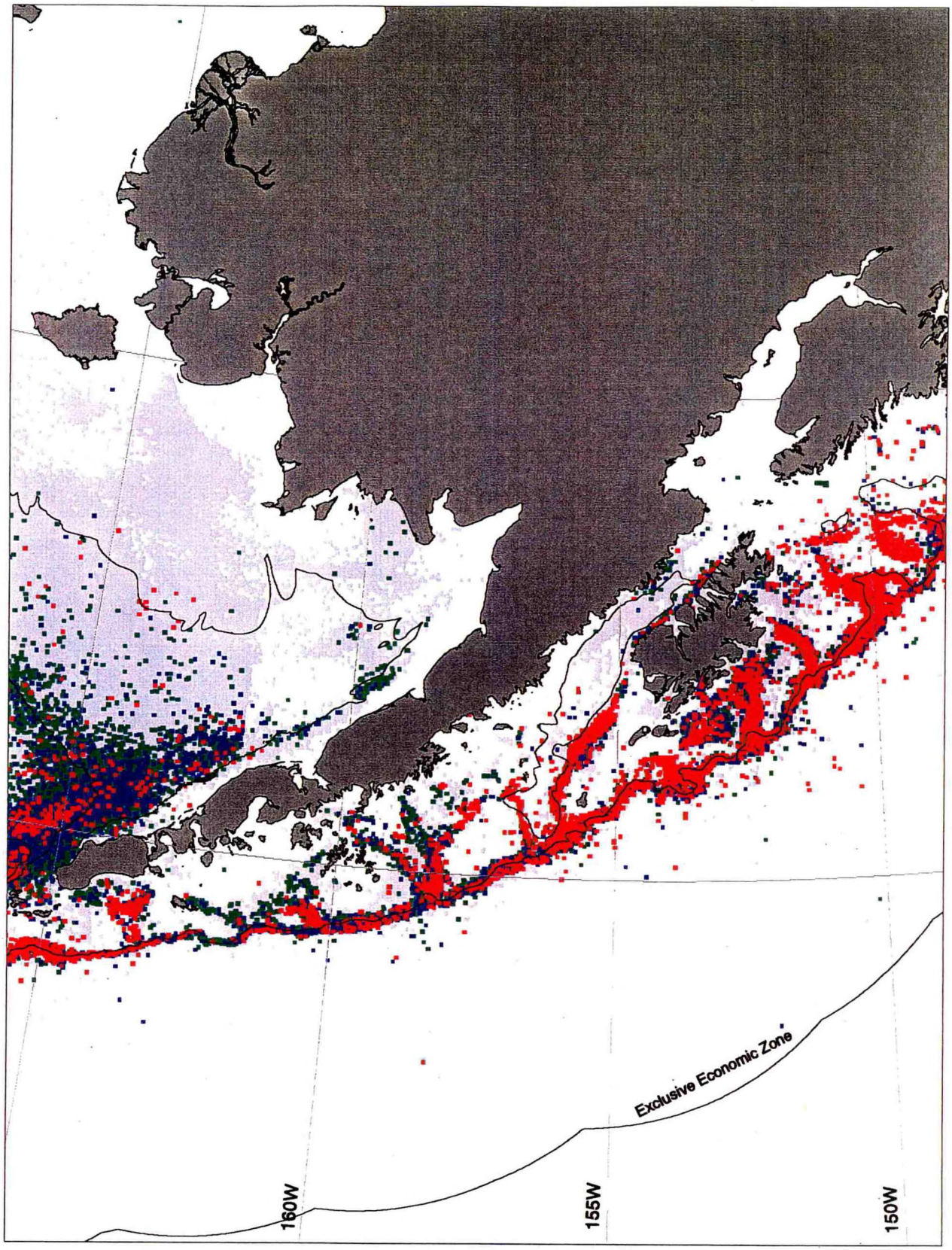
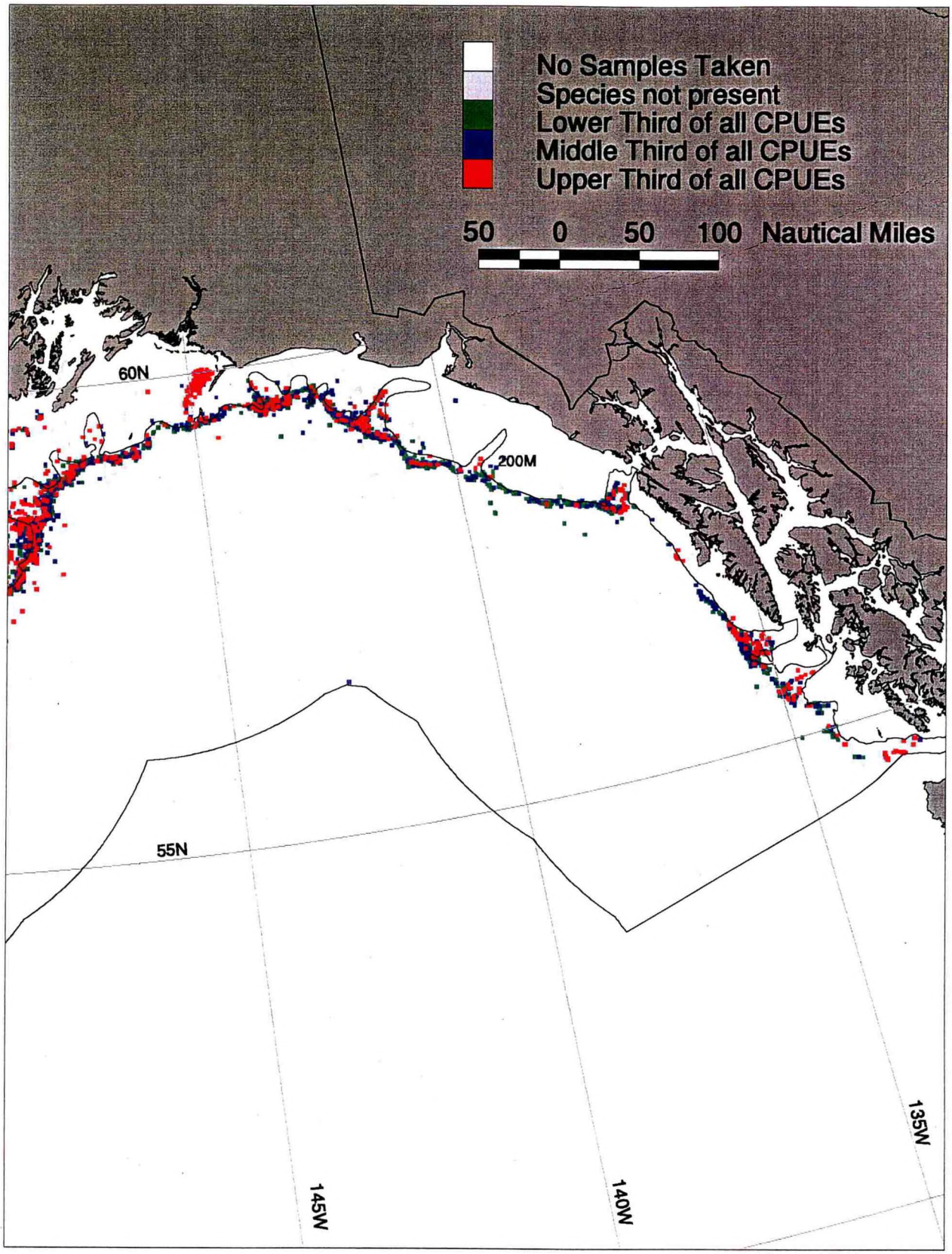


Figure 14.b Rex sole catch per unit effort (CPUE) summary for



GOA region, based on Alaskan trawl groundfish observer data.

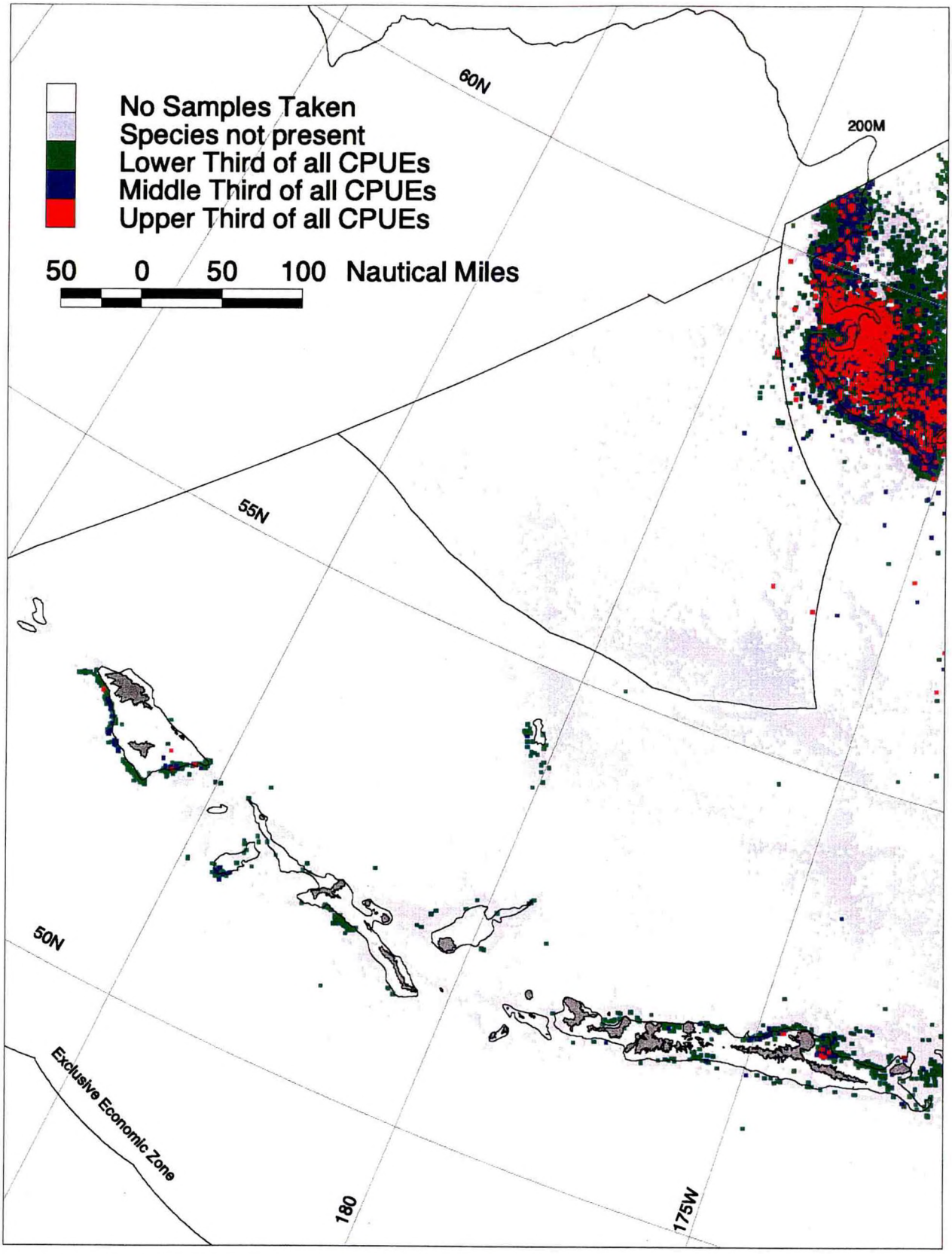
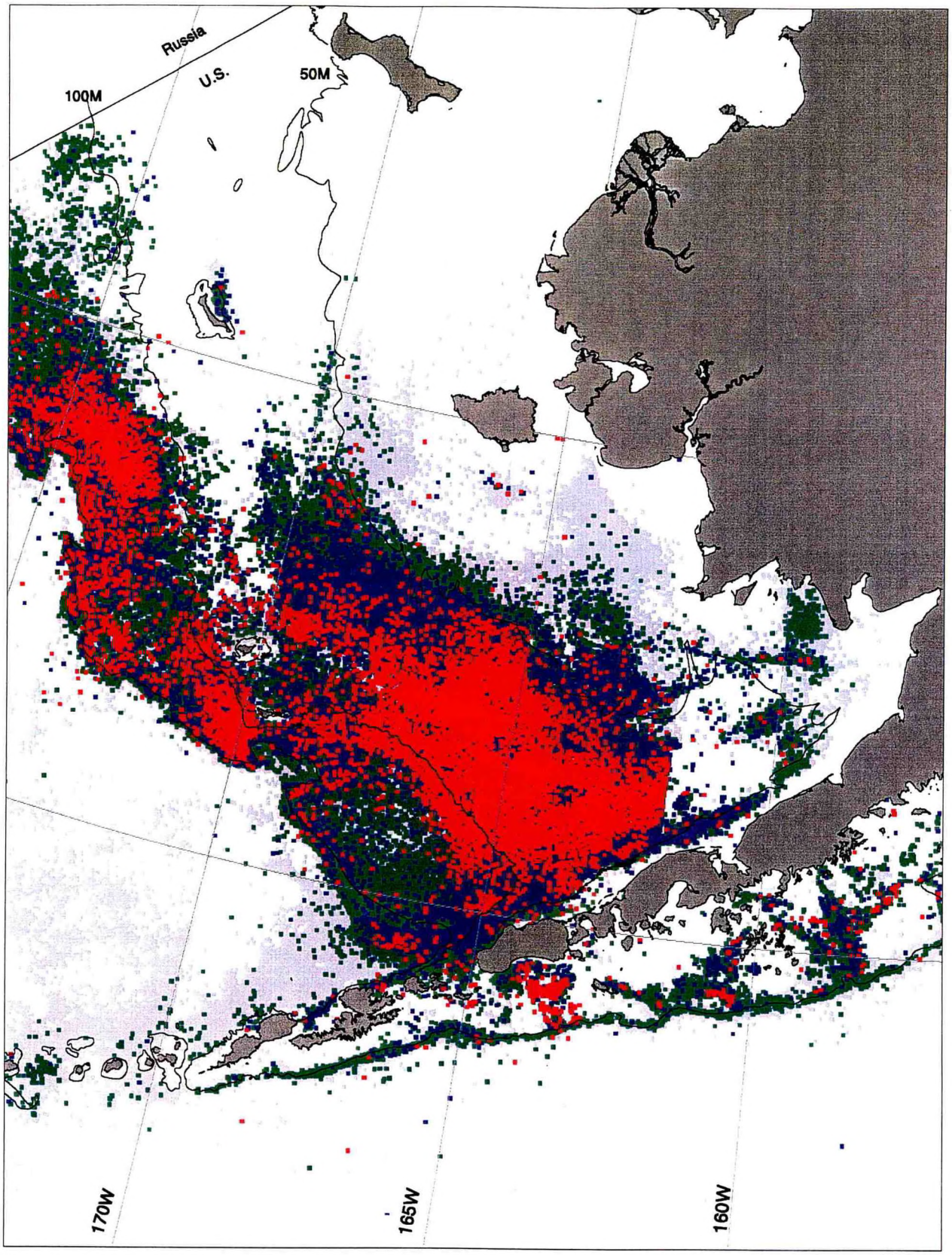


Figure 15.a Flathead sole catch per unit effort (CPUE) summary for



BSAI region, based on Alaskan trawl groundfish observer data.

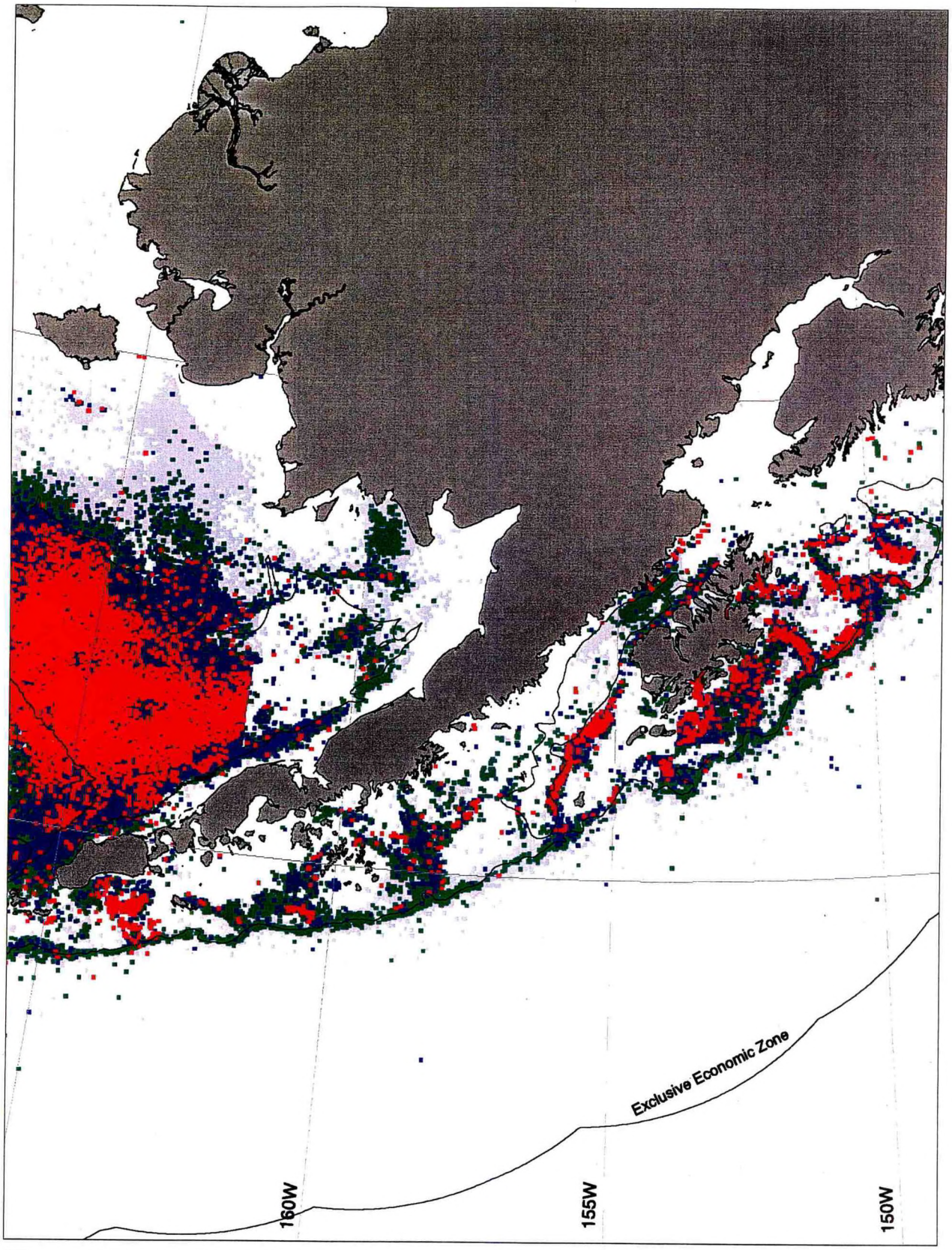
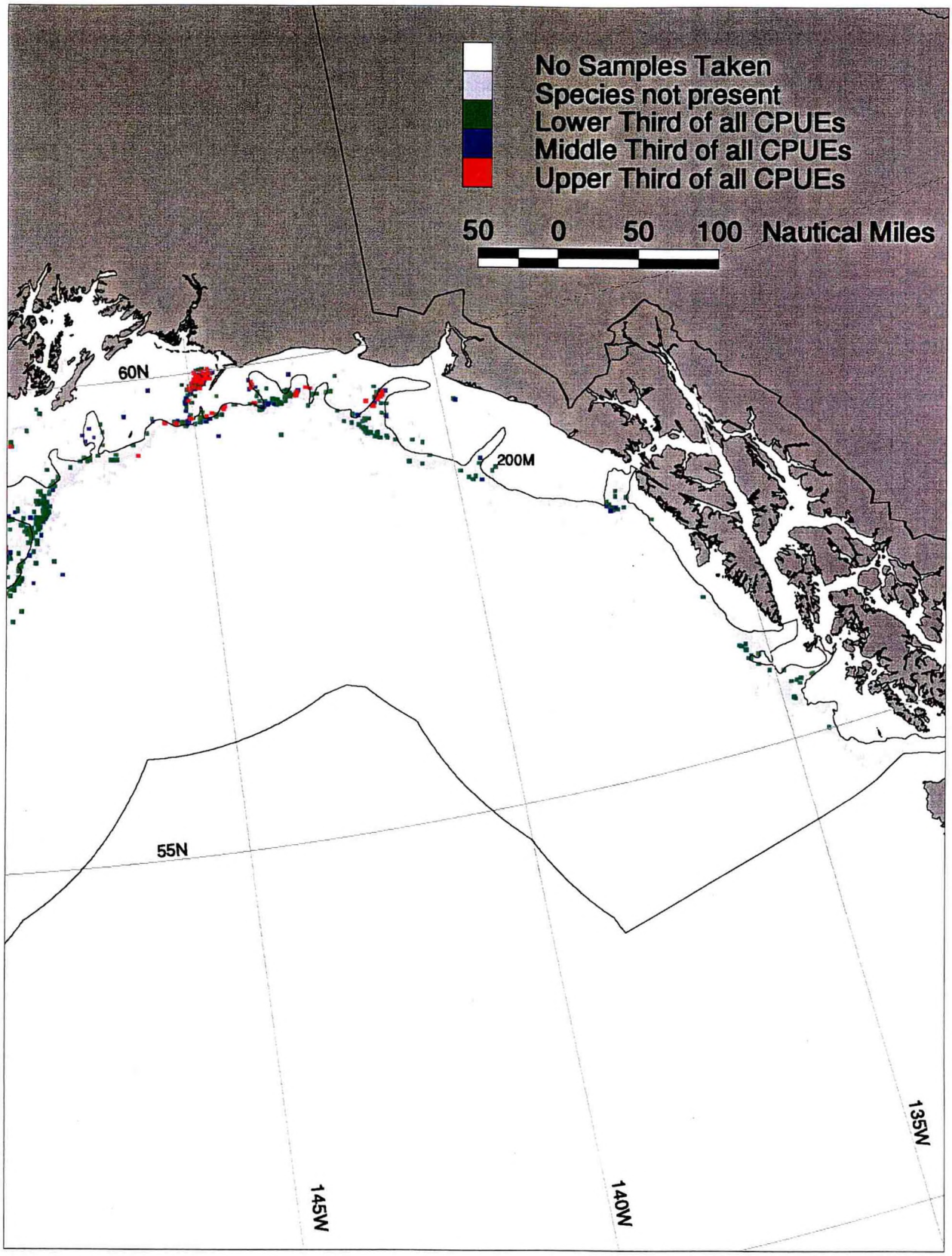


Figure 15.b Flathead sole catch per unit effort (CPUE) summary for



GOA region, based on Alaskan trawl groundfish observer data.

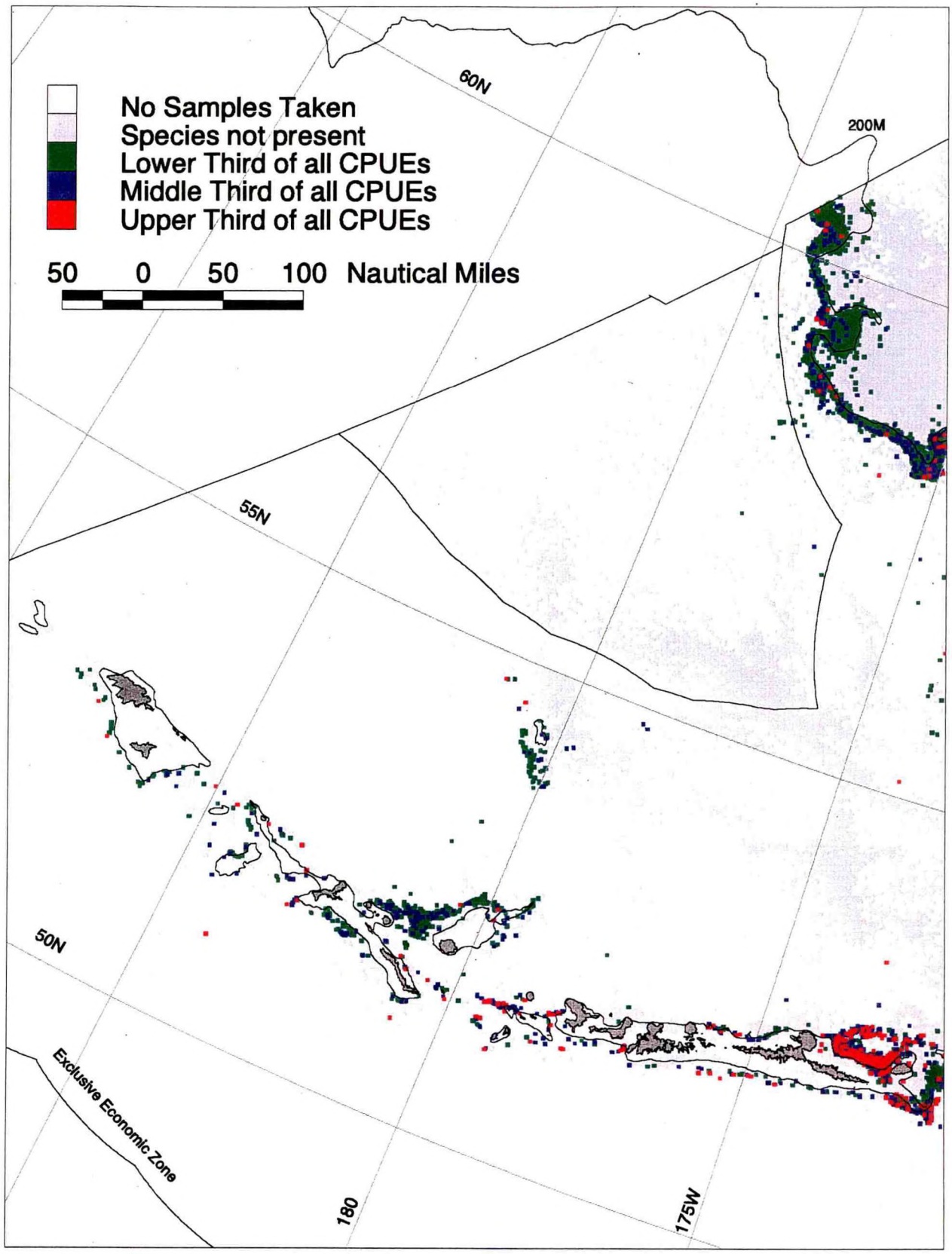
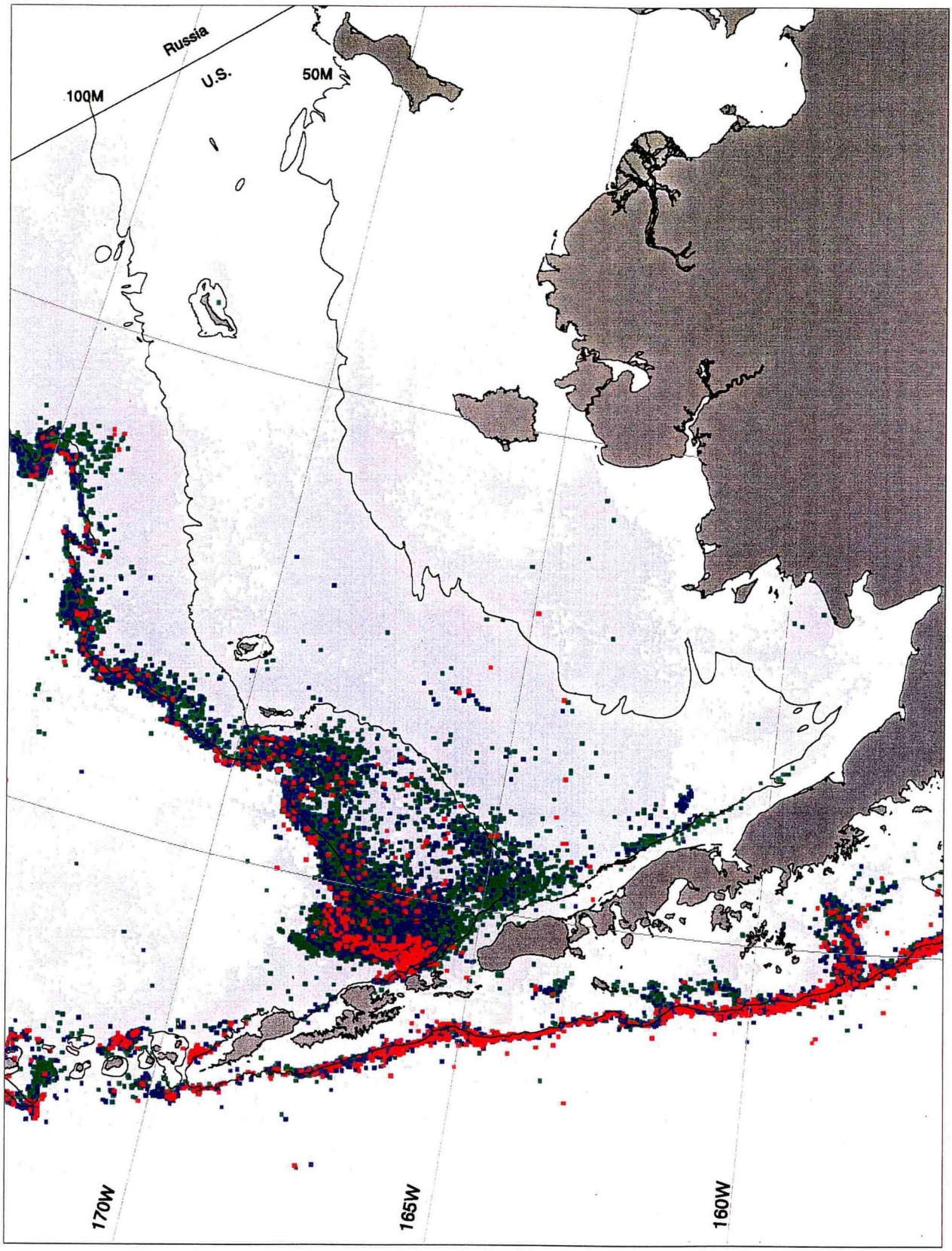


Figure 16.a Sablefish catch per unit effort (CPUE) summary for



BSAI region, based on Alaskan trawl groundfish observer data.

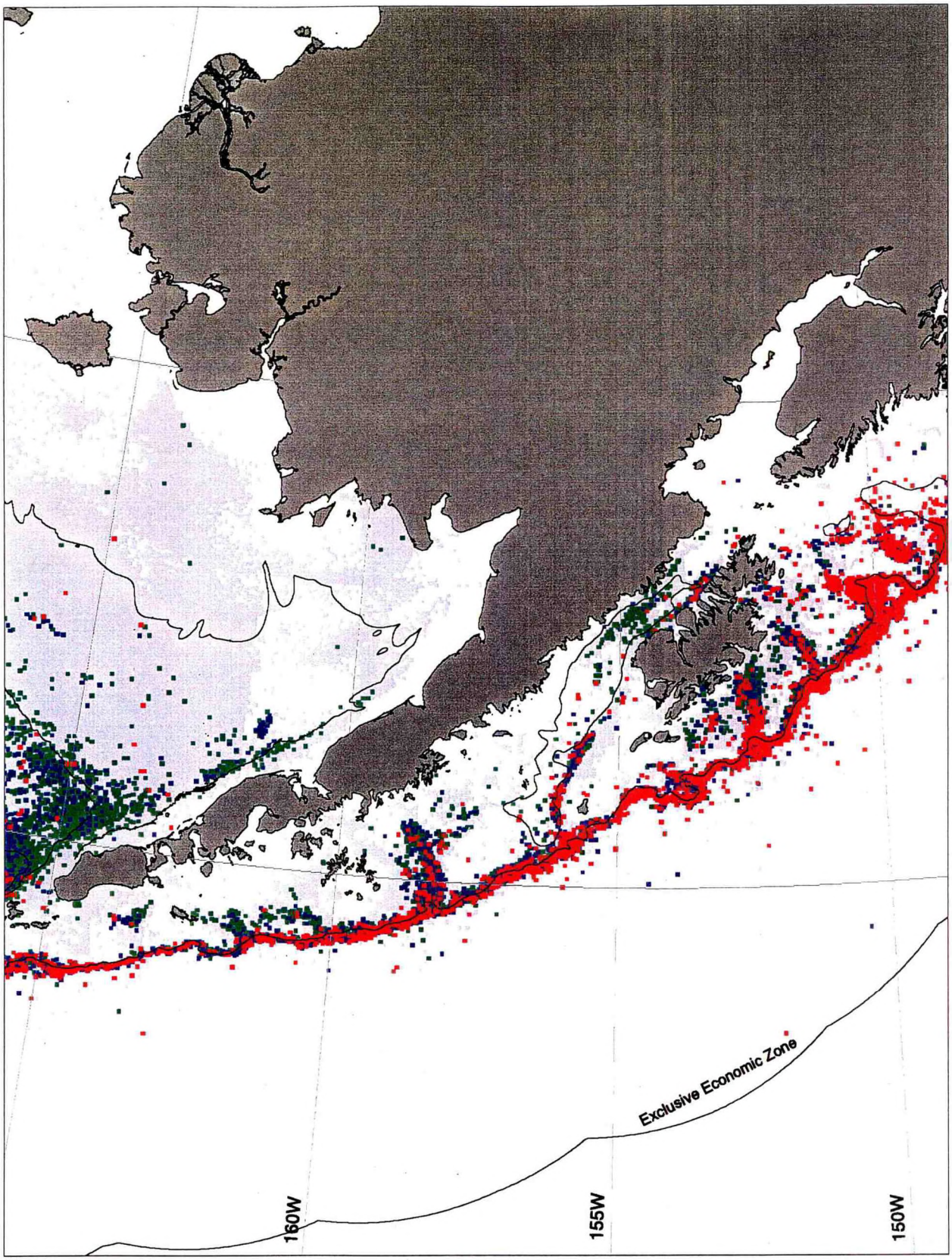
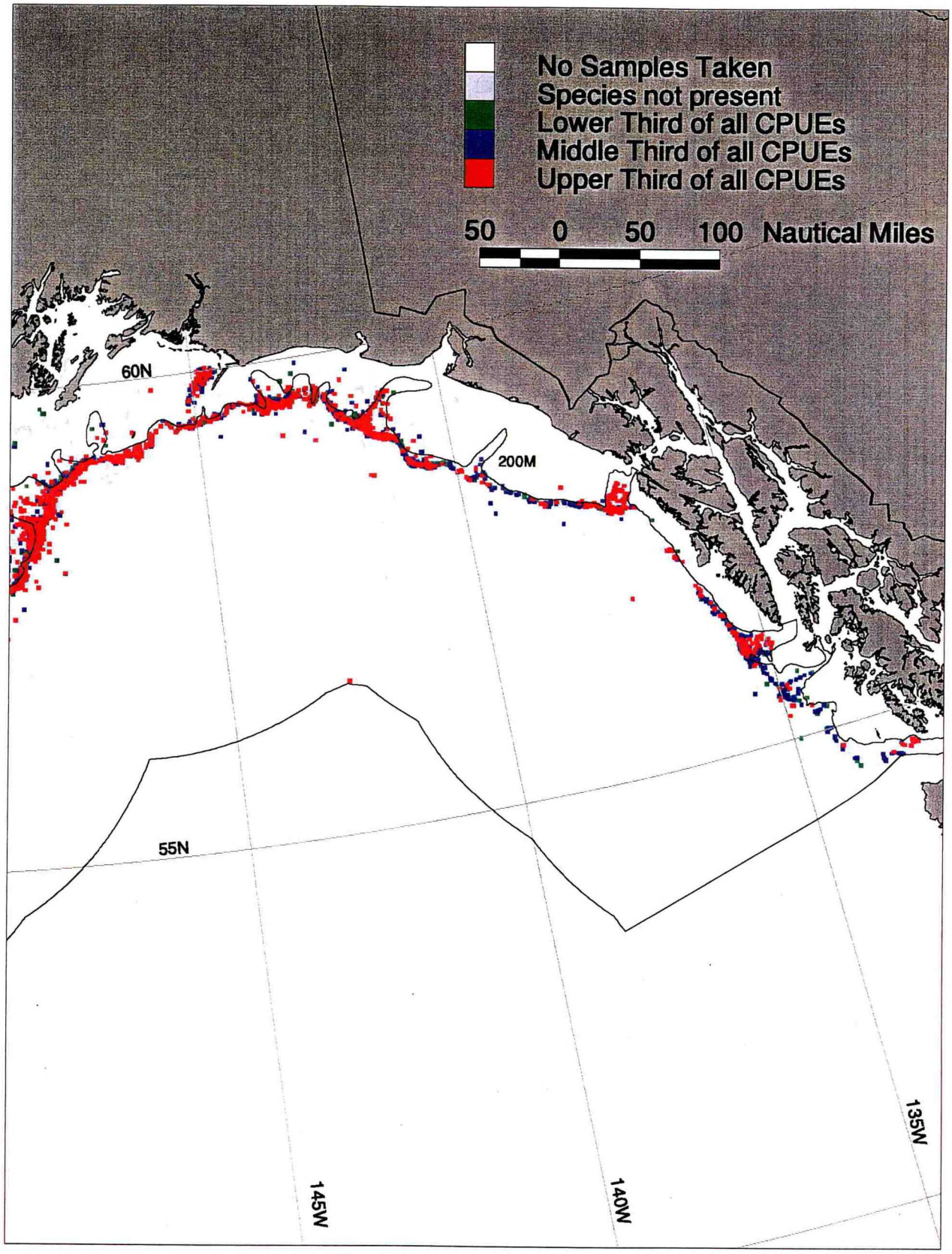


Figure 16.b Sablefish catch per unit effort (CPUE) summary for



GOA region, based on Alaskan trawl groundfish observer data.

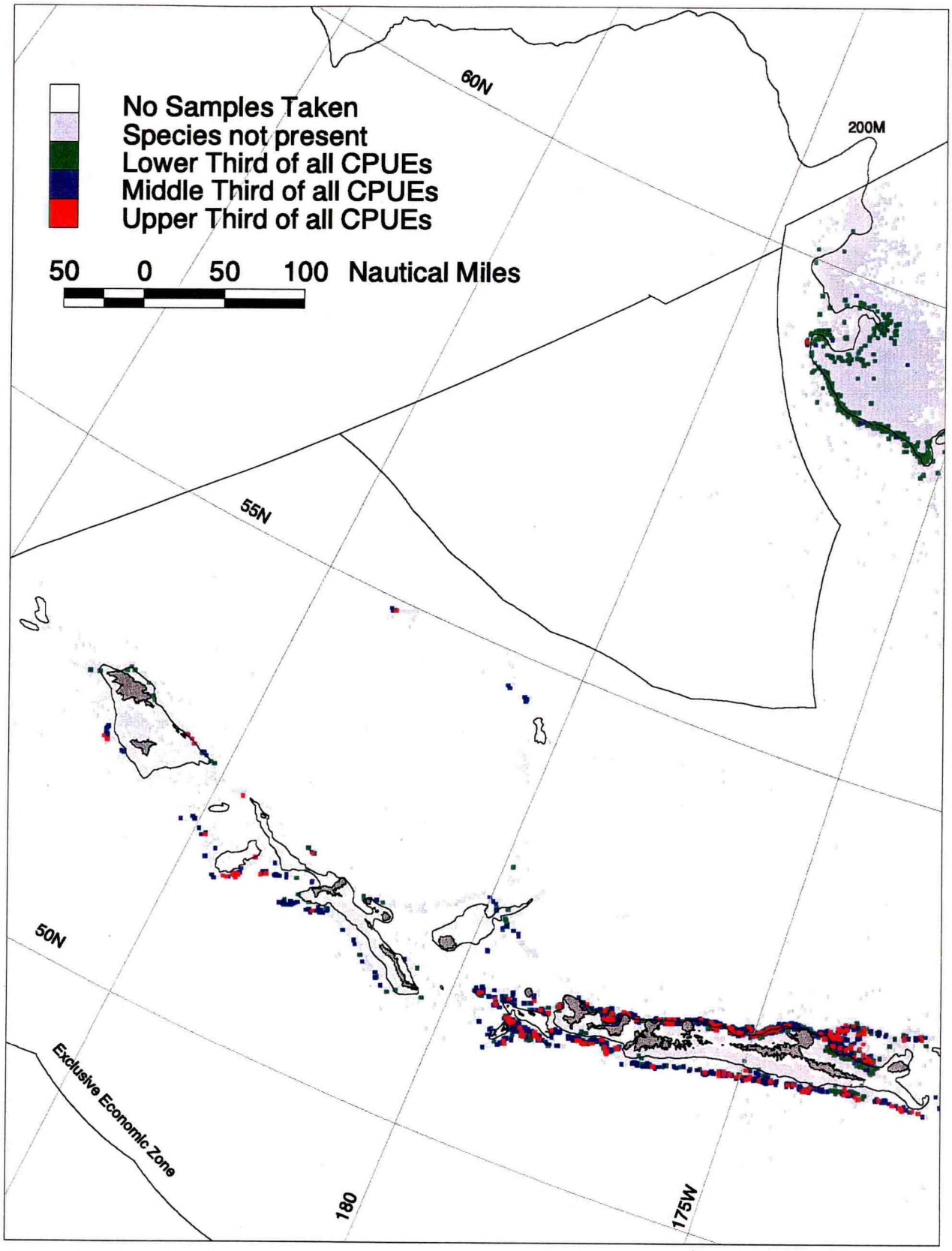
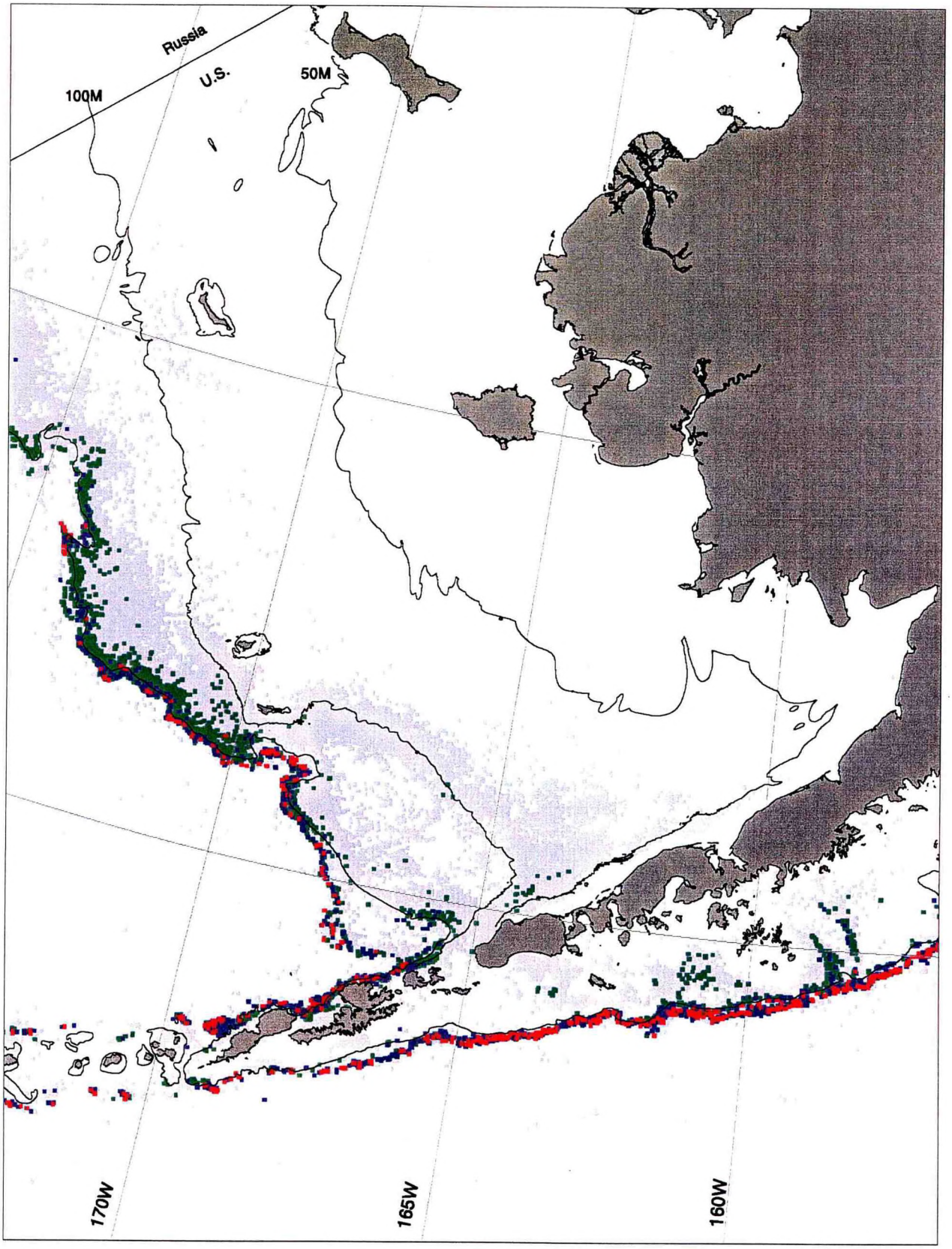


Figure 17.a Sablefish catch per unit effort (CPUE) summary for



BSAI region, based on Alaskan longline groundfish observer data.

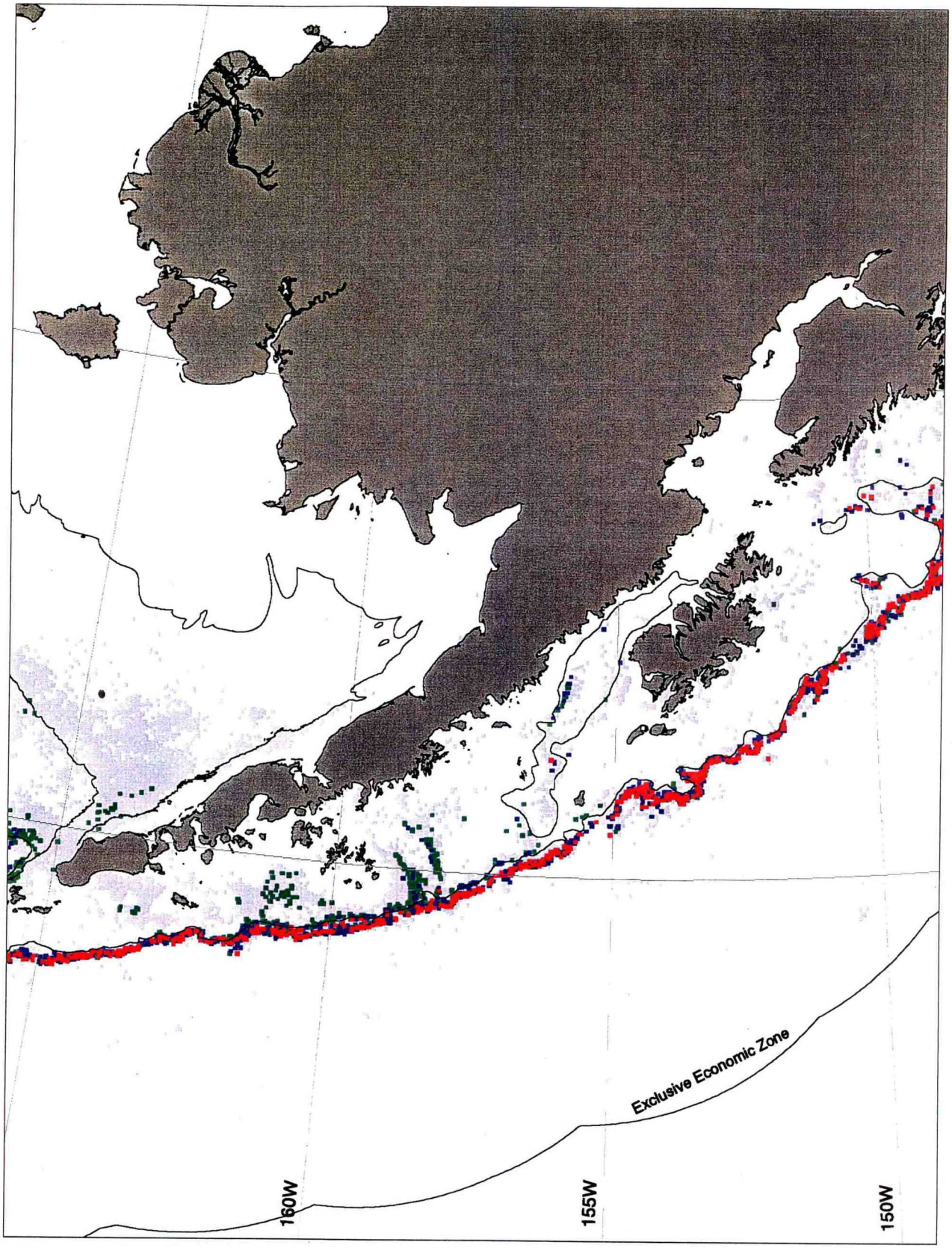
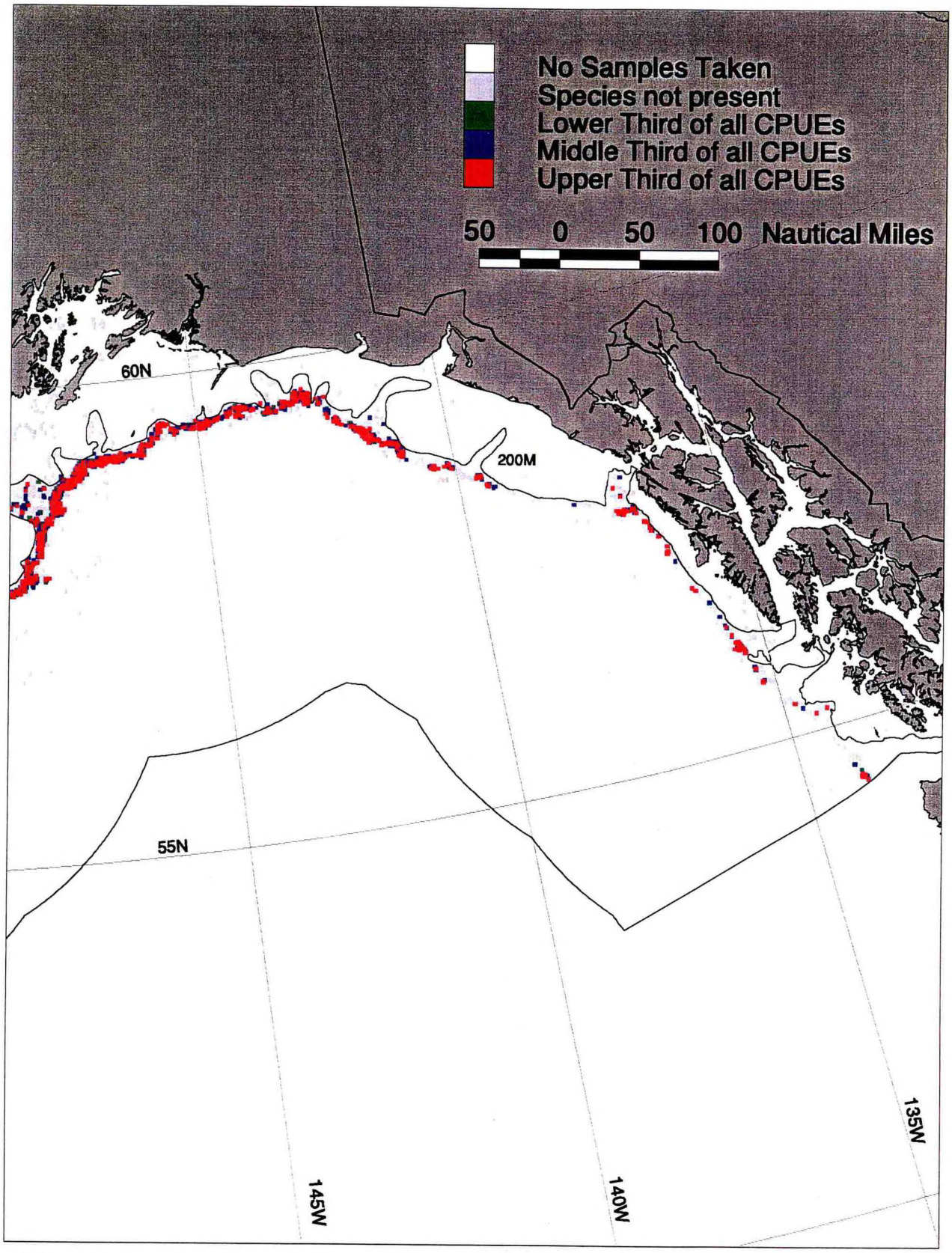


Figure 17.b Sablefish catch per unit effort (CPUE) summary for



GOA region, based on Alaskan longline groundfish observer data.

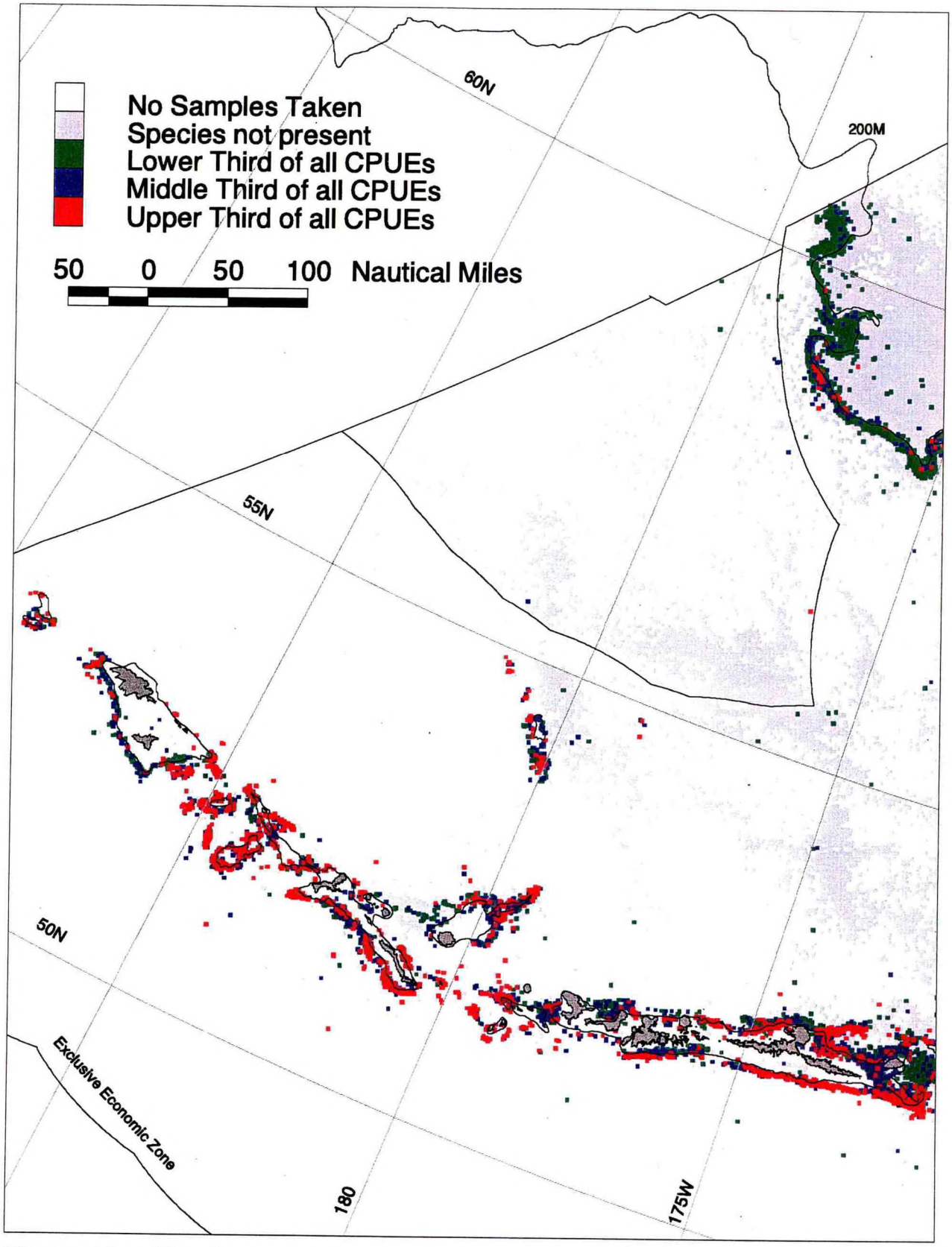
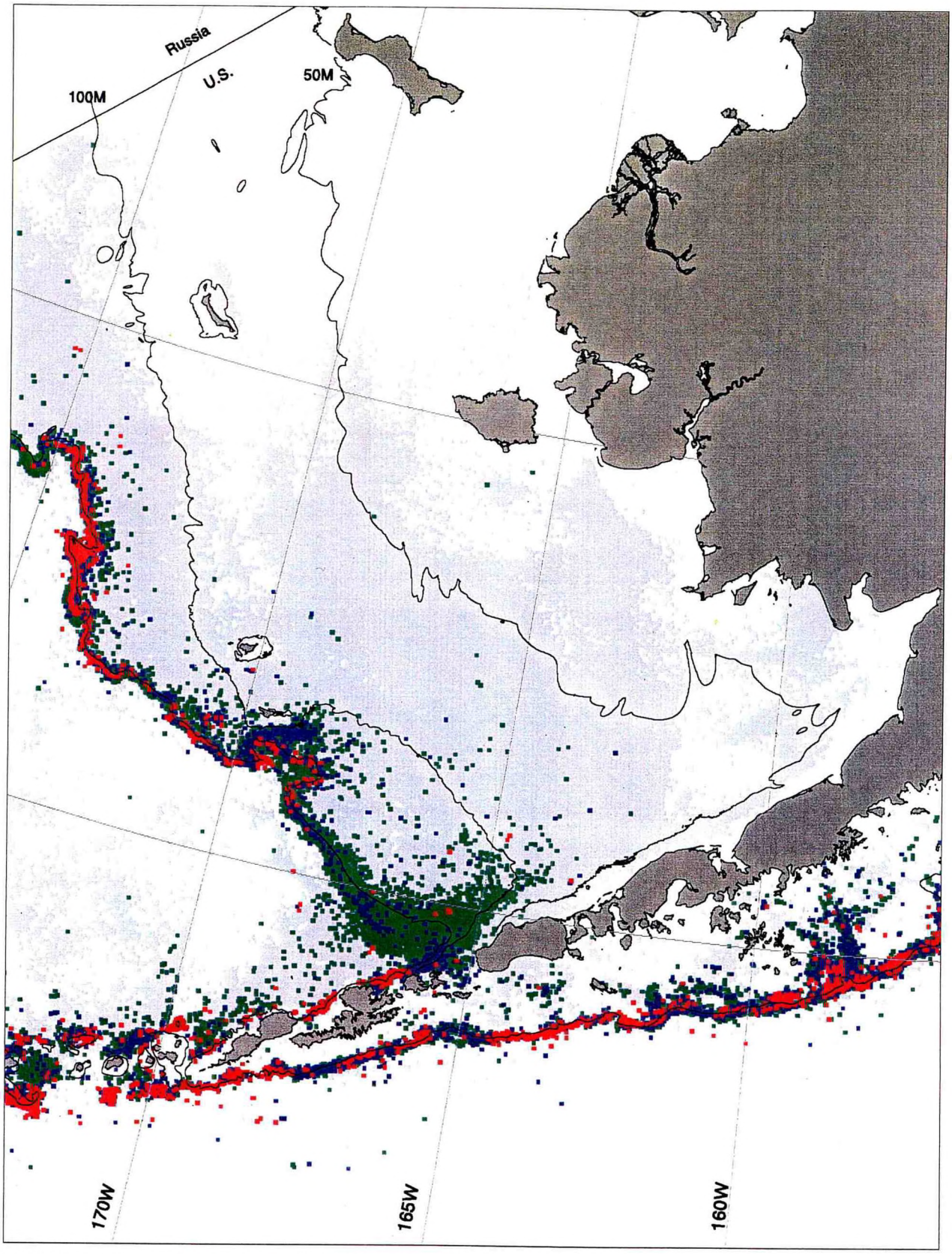


Figure 18.a Pacific ocean perch catch per unit effort (CPUE) summary for



BSAI region, based on Alaskan trawl groundfish observer data.

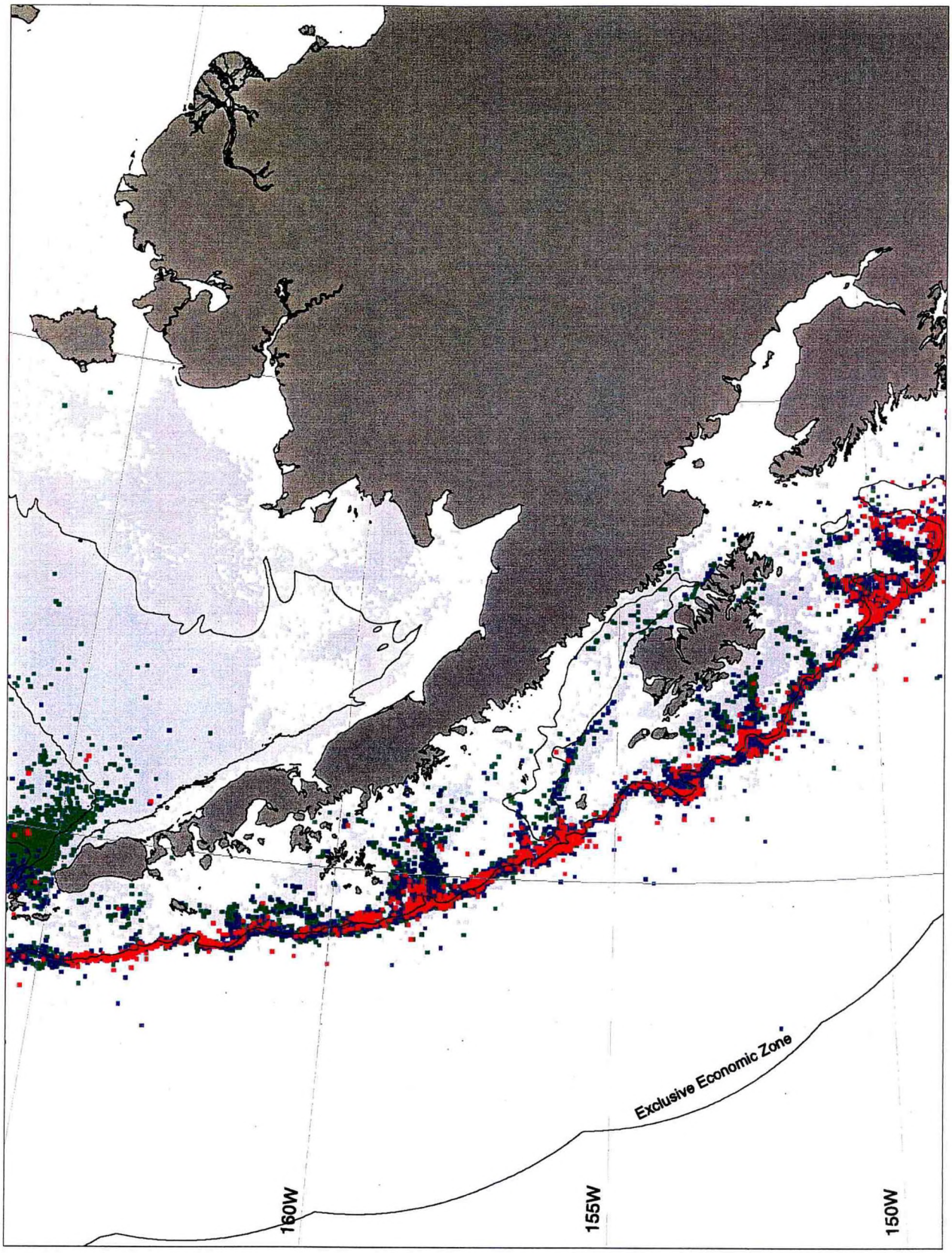
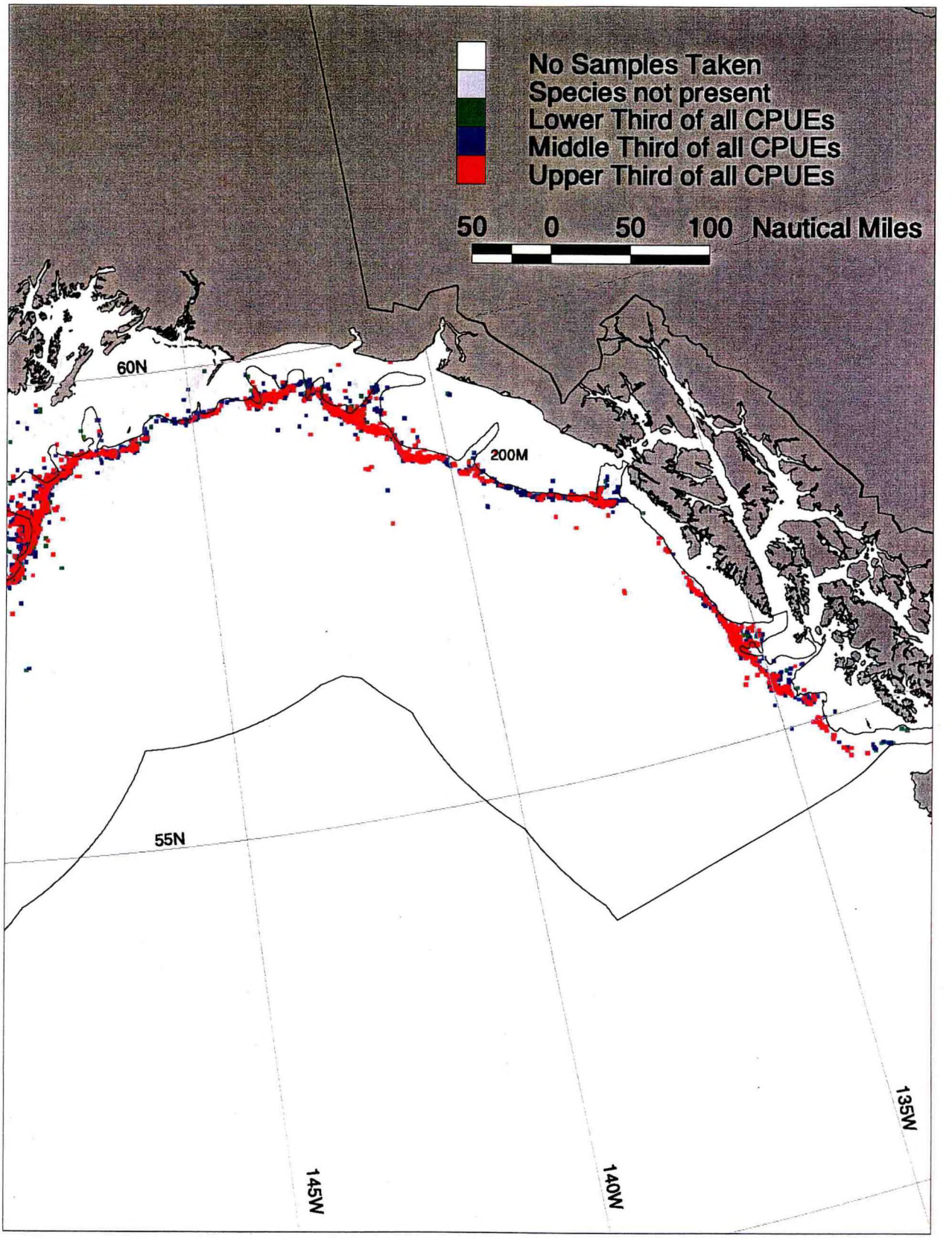


Figure 18.b Pacific ocean perch catch per unit effort (CPUE) summary for



GOA region, based on Alaskan trawl groundfish observer data.

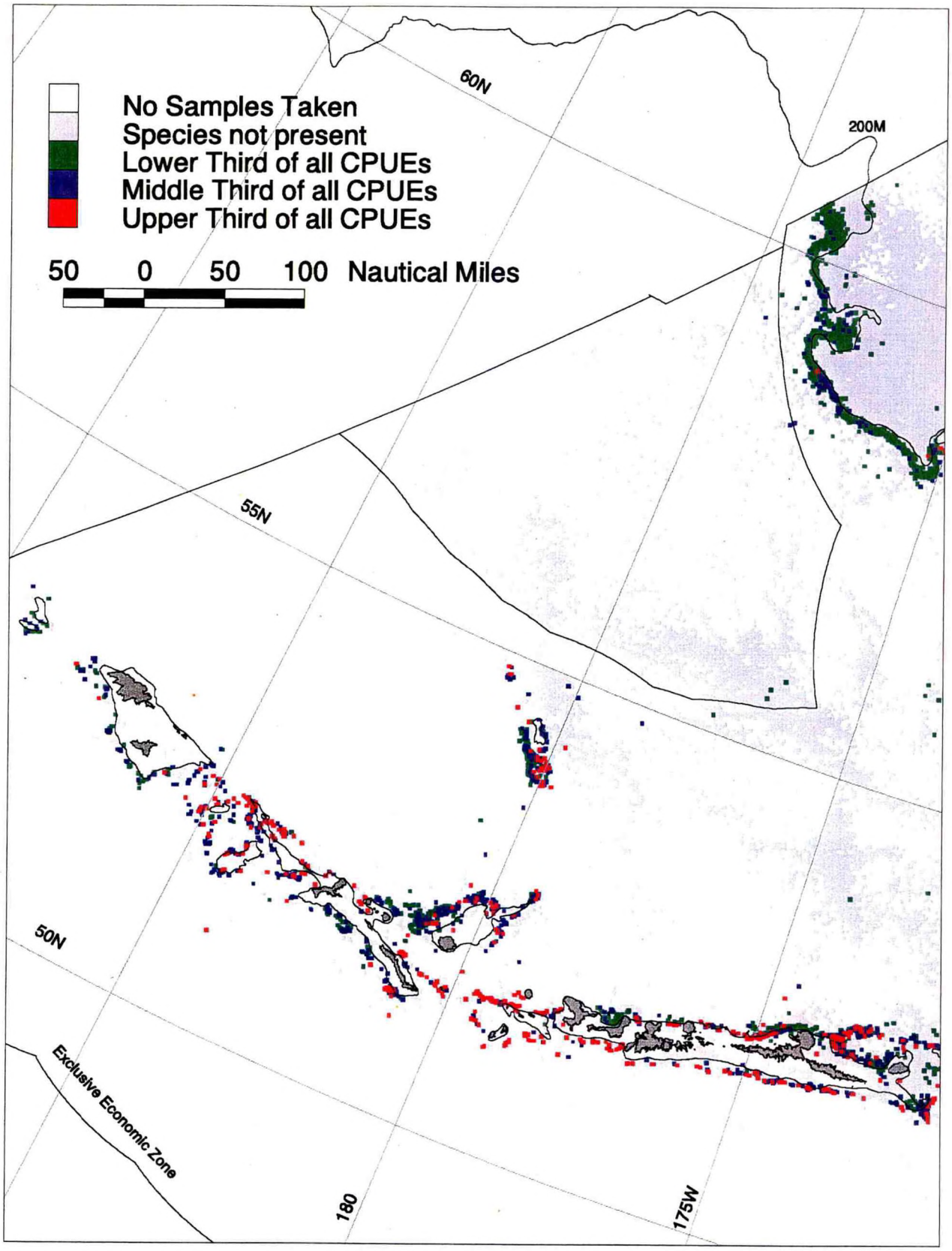
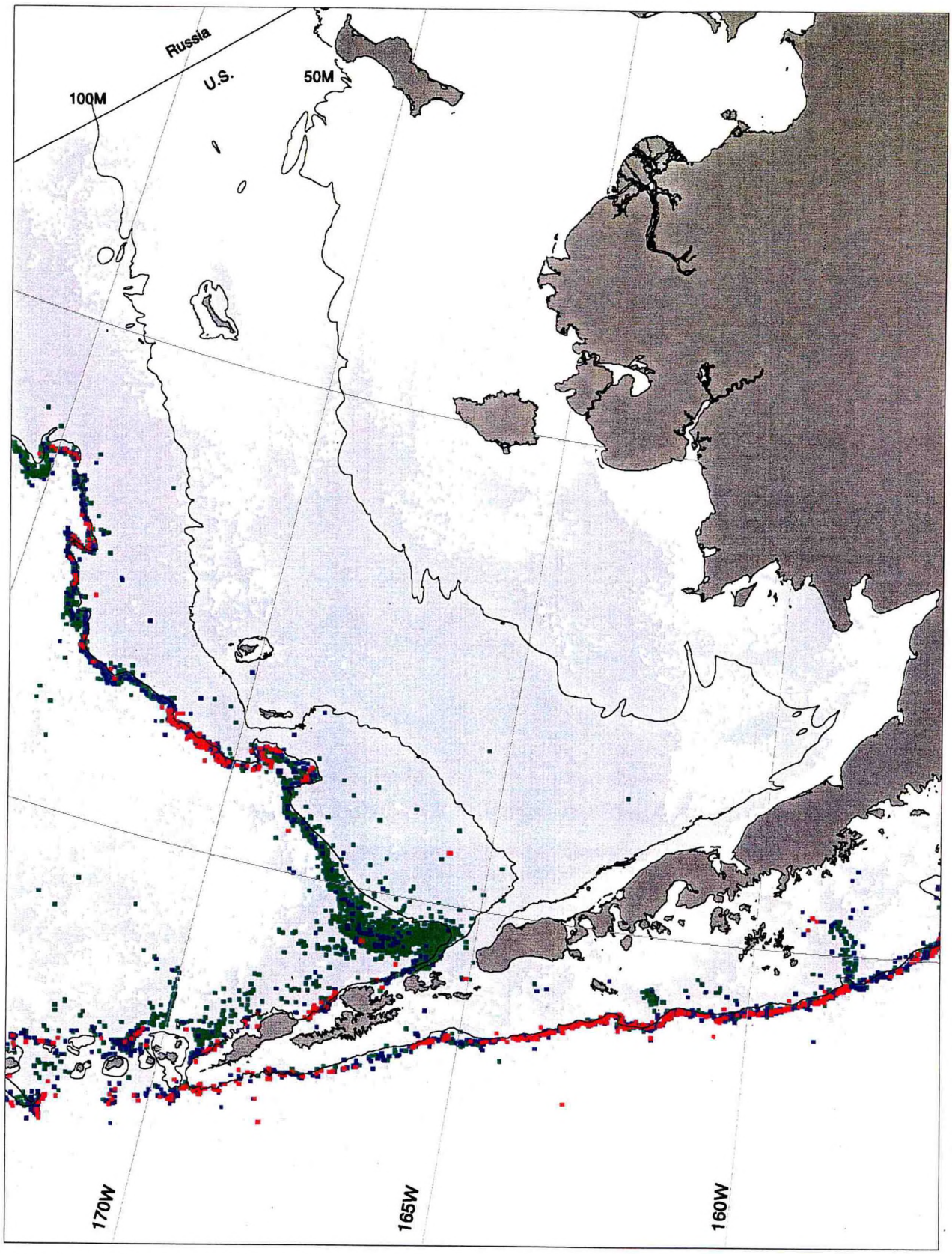


Figure 19.a Shortraker rockfish catch per unit effort (CPUE) summary for



BSAI region, based on Alaskan trawl groundfish observer data.

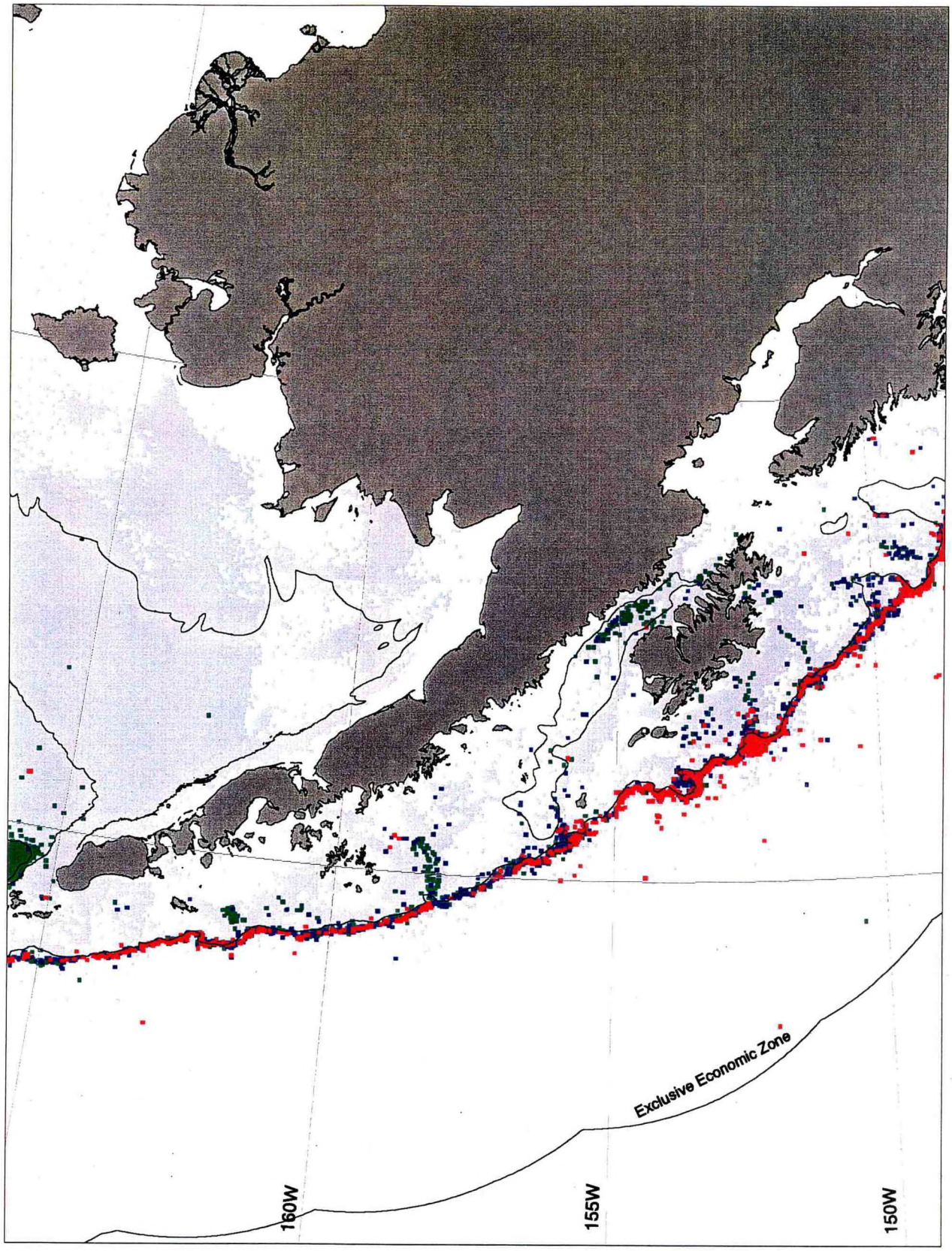
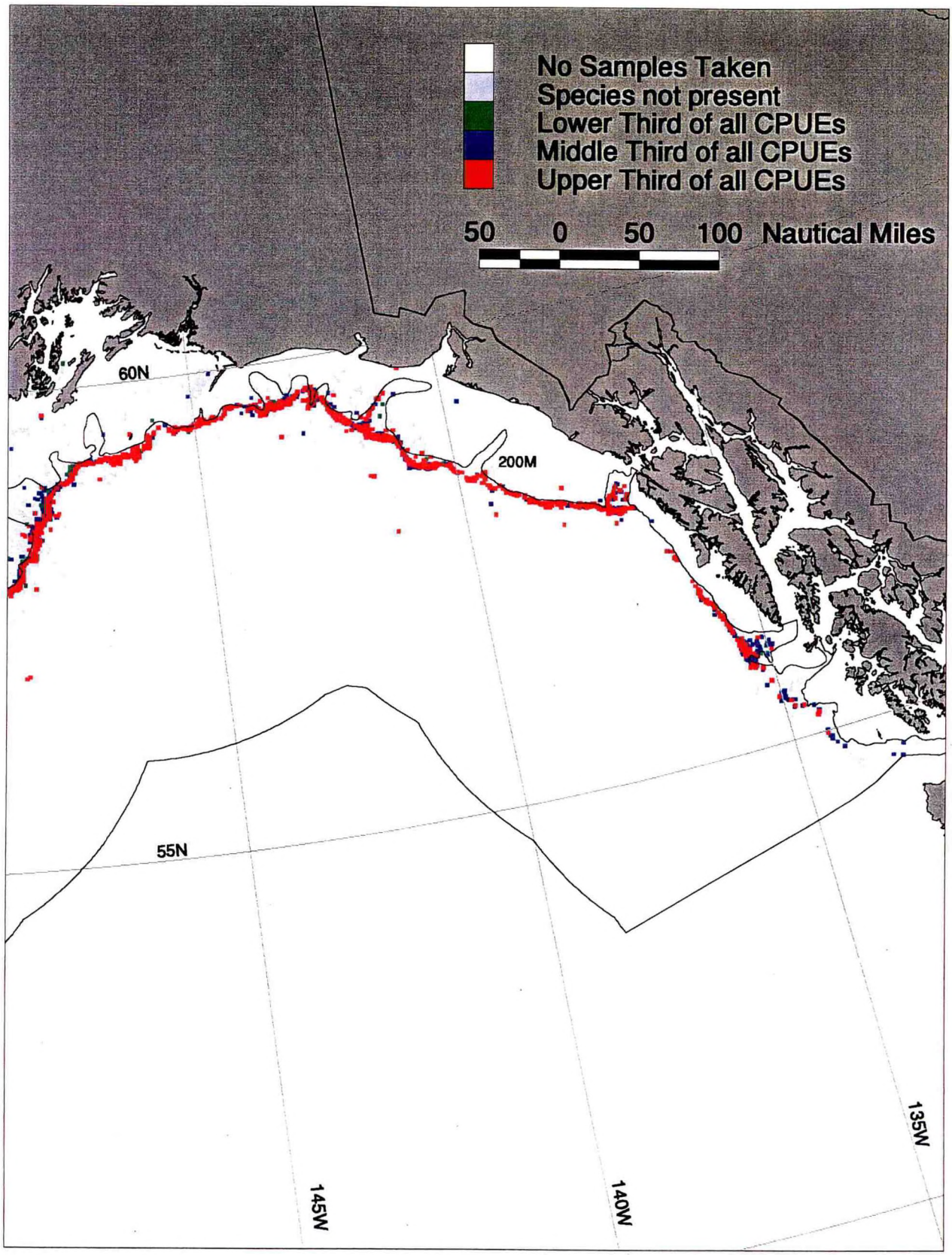


Figure 19.b Shortraker rockfish catch per unit effort (CPUE) summary for



GOA region, based on Alaskan trawl groundfish observer data.

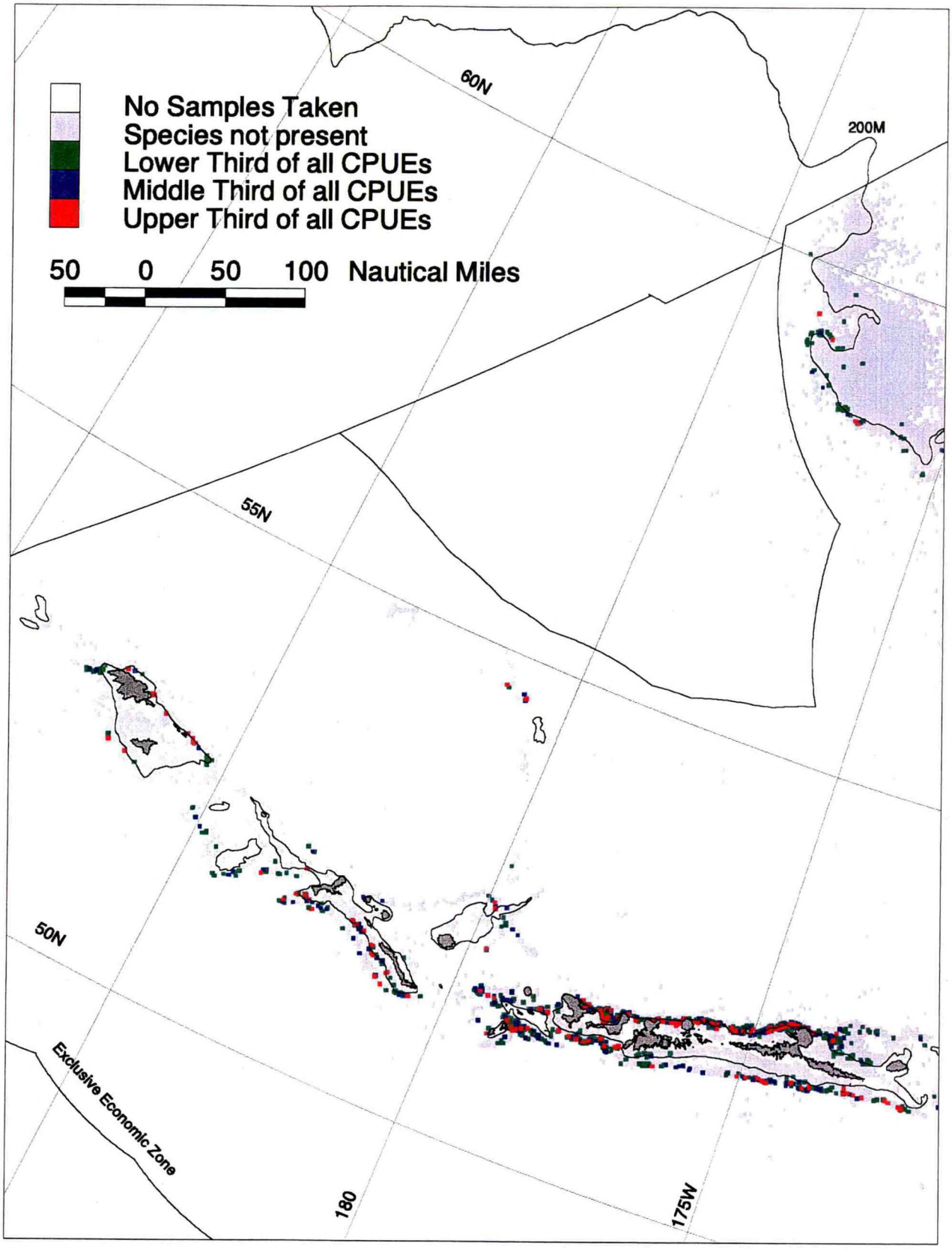
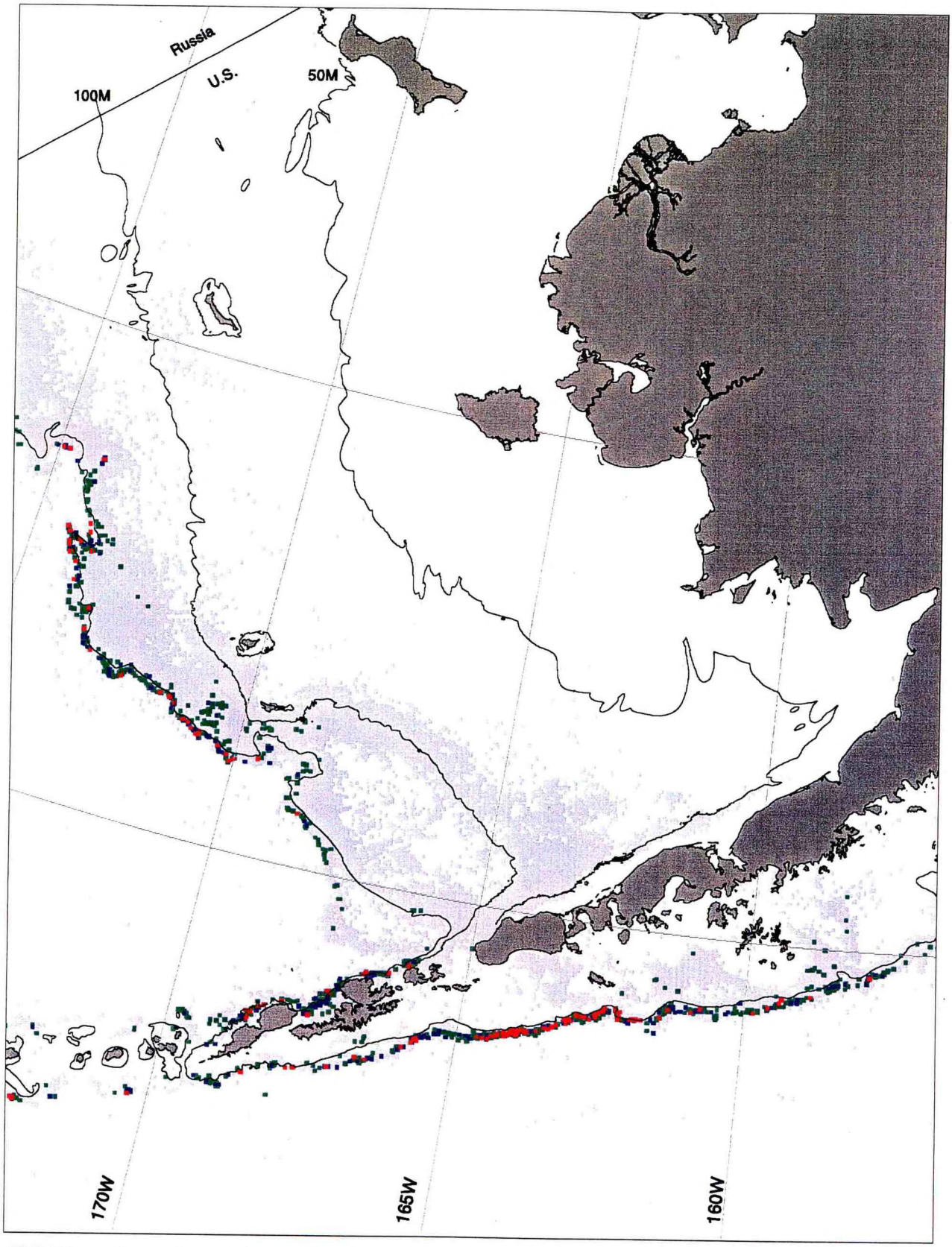


Figure 20.a Shortraker rockfish catch per unit effort (CPUE) summary for



BSAI region, based on Alaskan longline groundfish observer data.

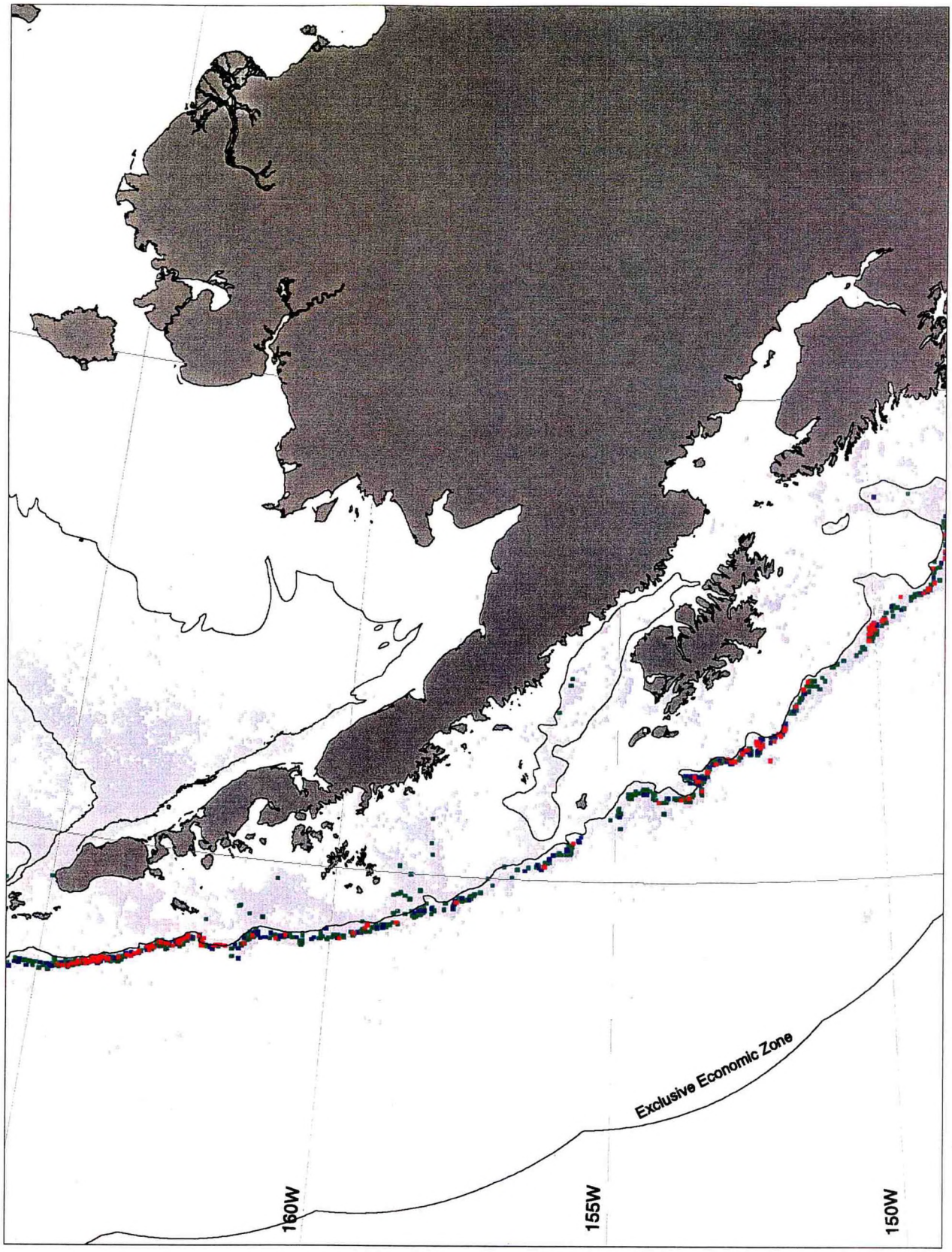
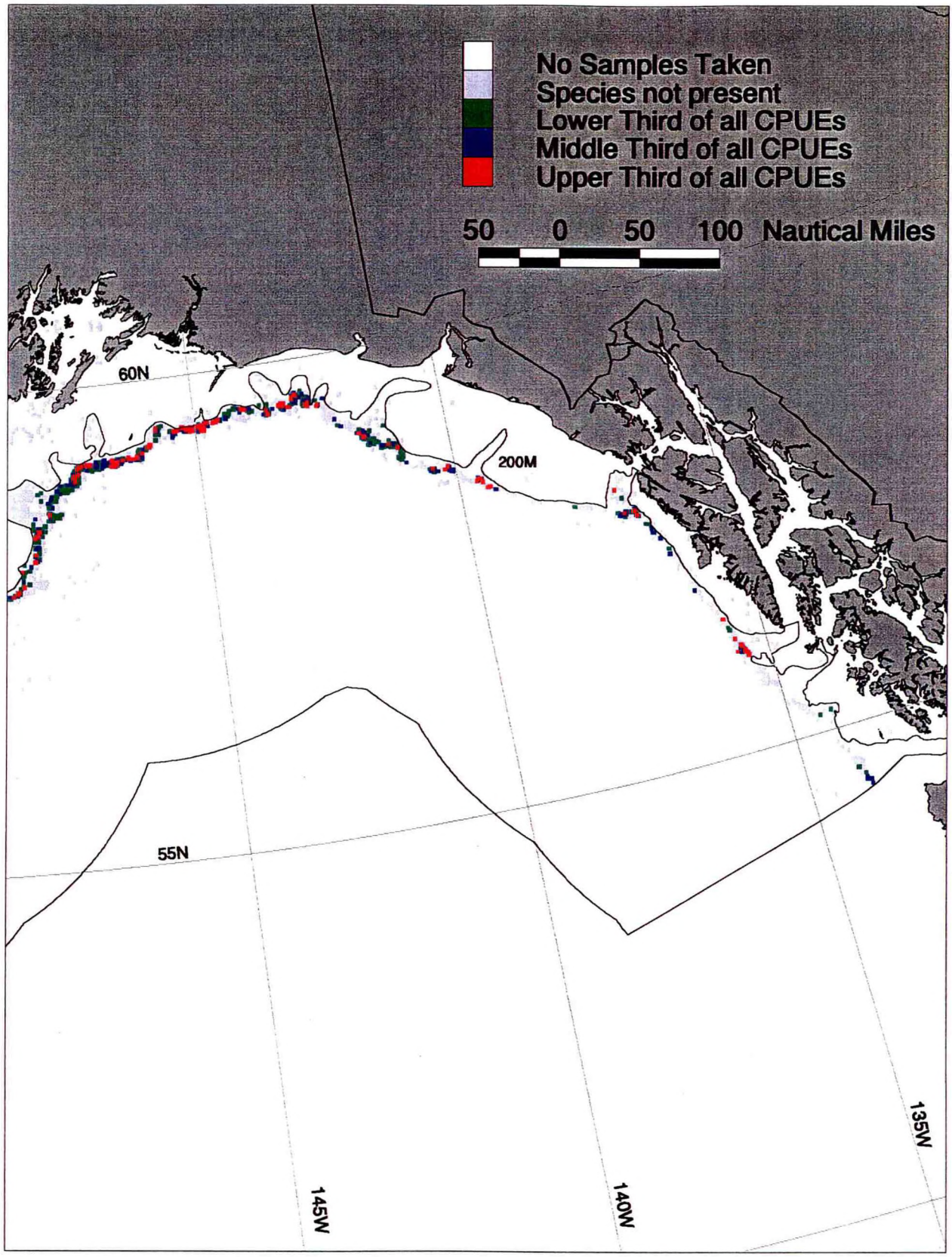


Figure 20.b Shortraker rockfish catch per unit effort (CPUE) summary for



GOA region, based on Alaskan longline groundfish observer data.

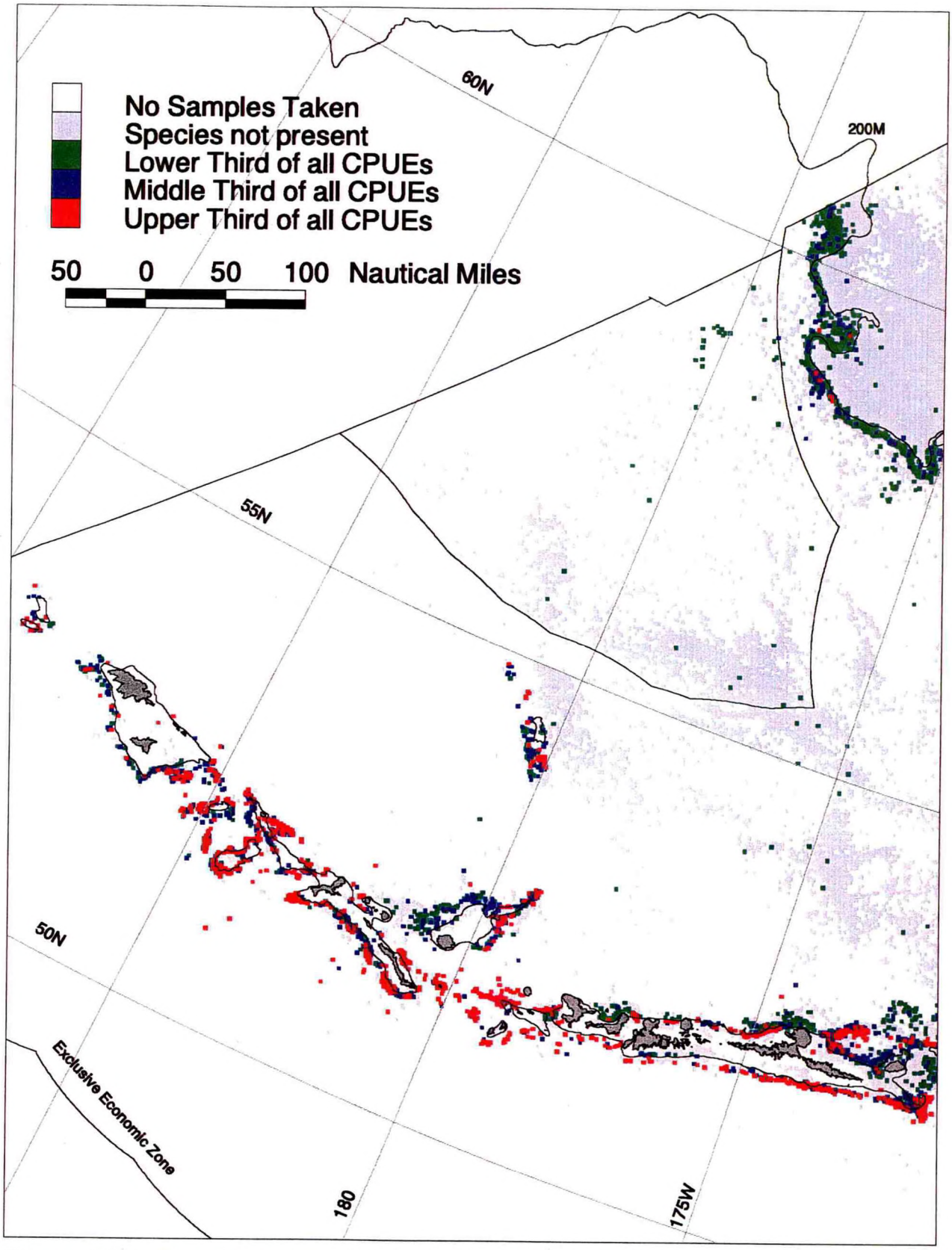
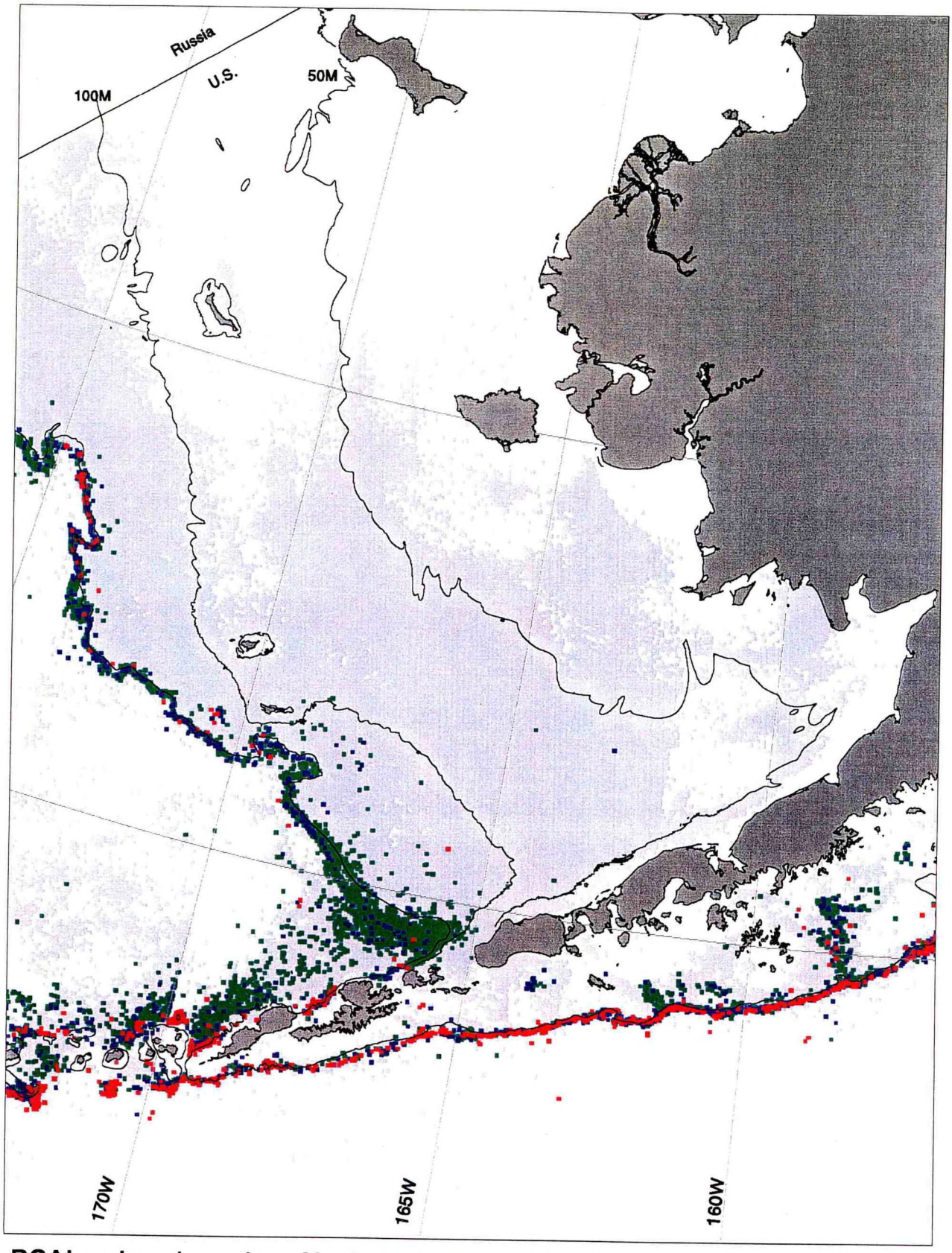


Figure 21.a Rougheye rockfish catch per unit effort (CPUE) summary for



BSAI region, based on Alaskan trawl groundfish observer data.

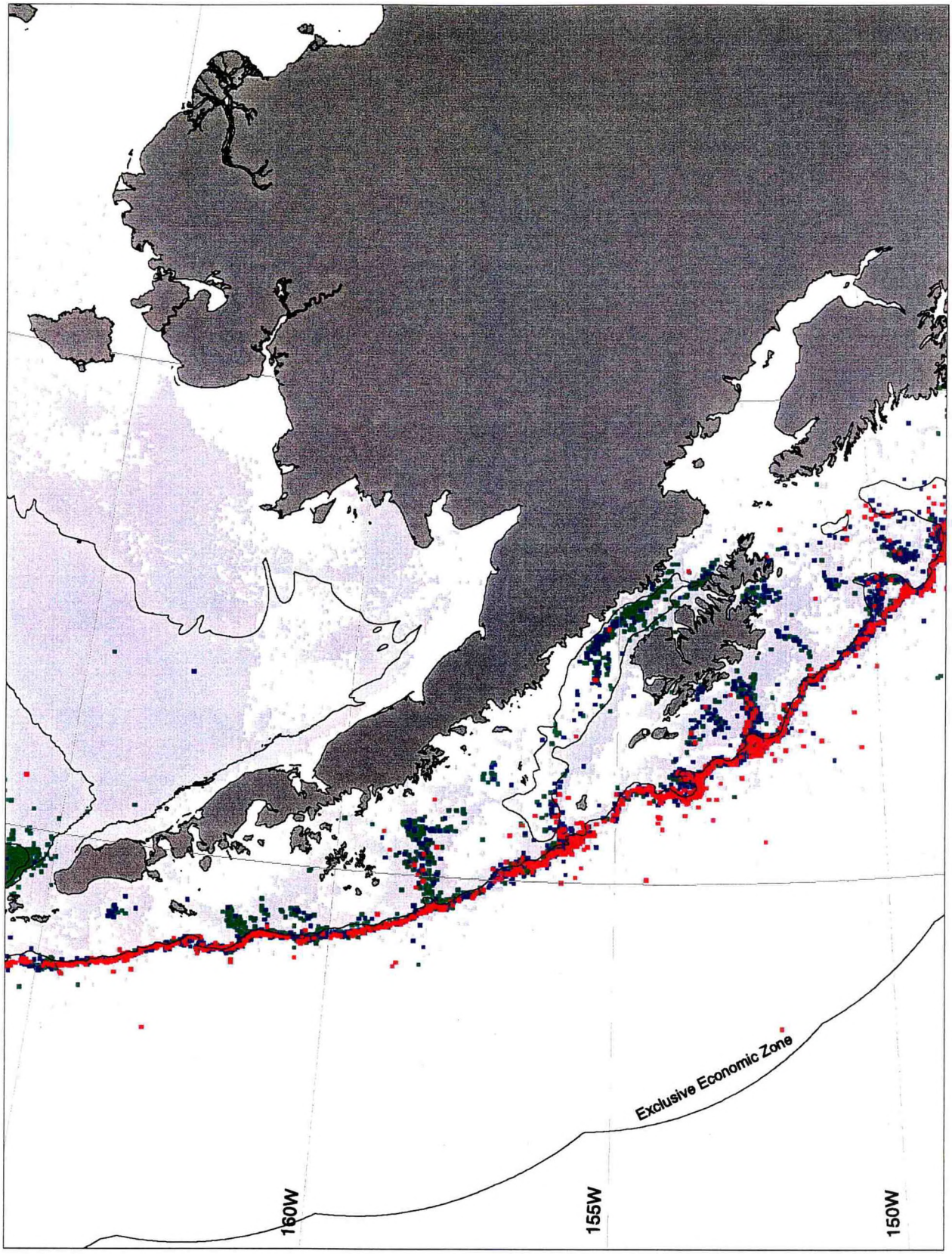
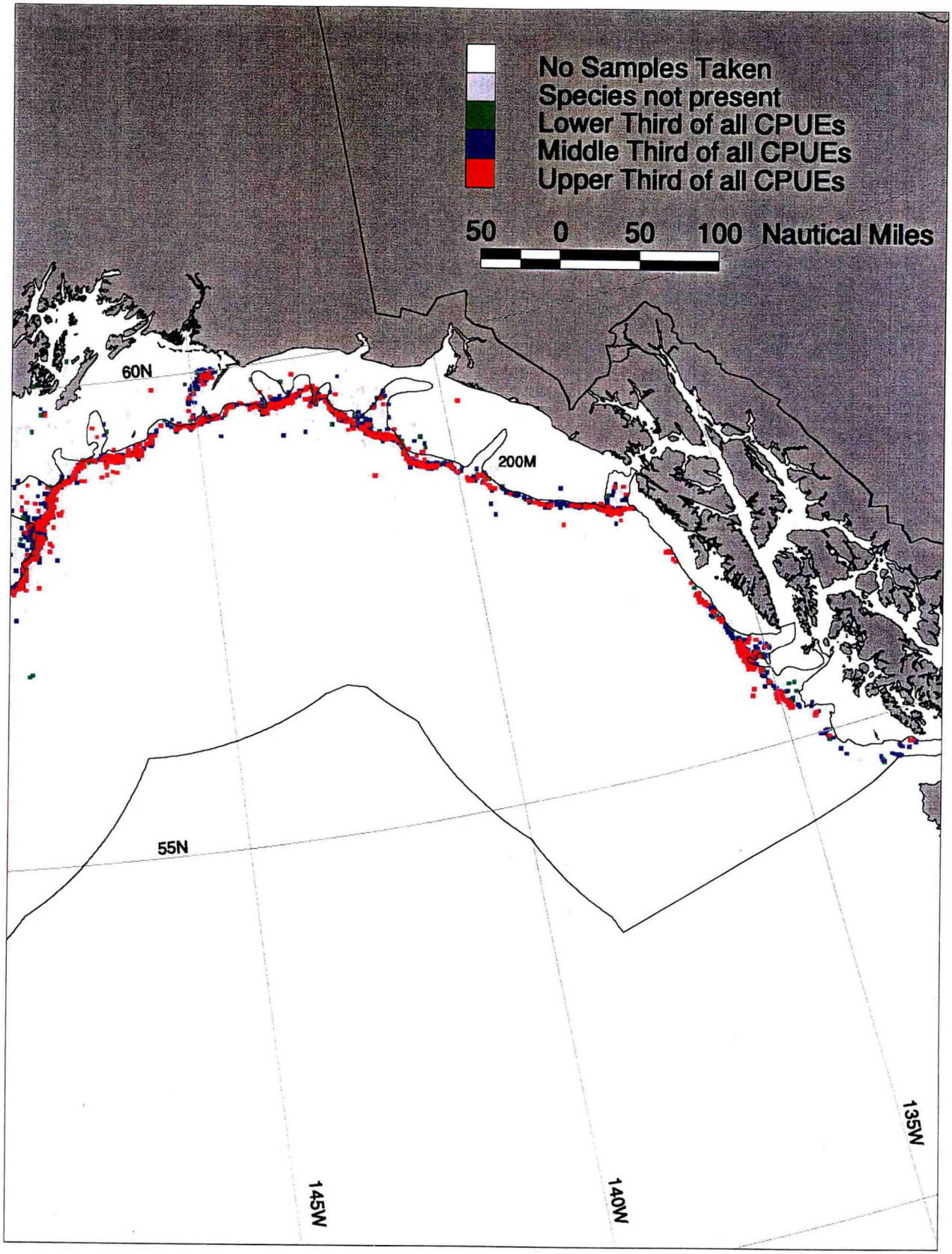


Figure 21.b Rougheye rockfish catch per unit effort (CPUE) summary for



GOA region, based on Alaskan trawl groundfish observer data.

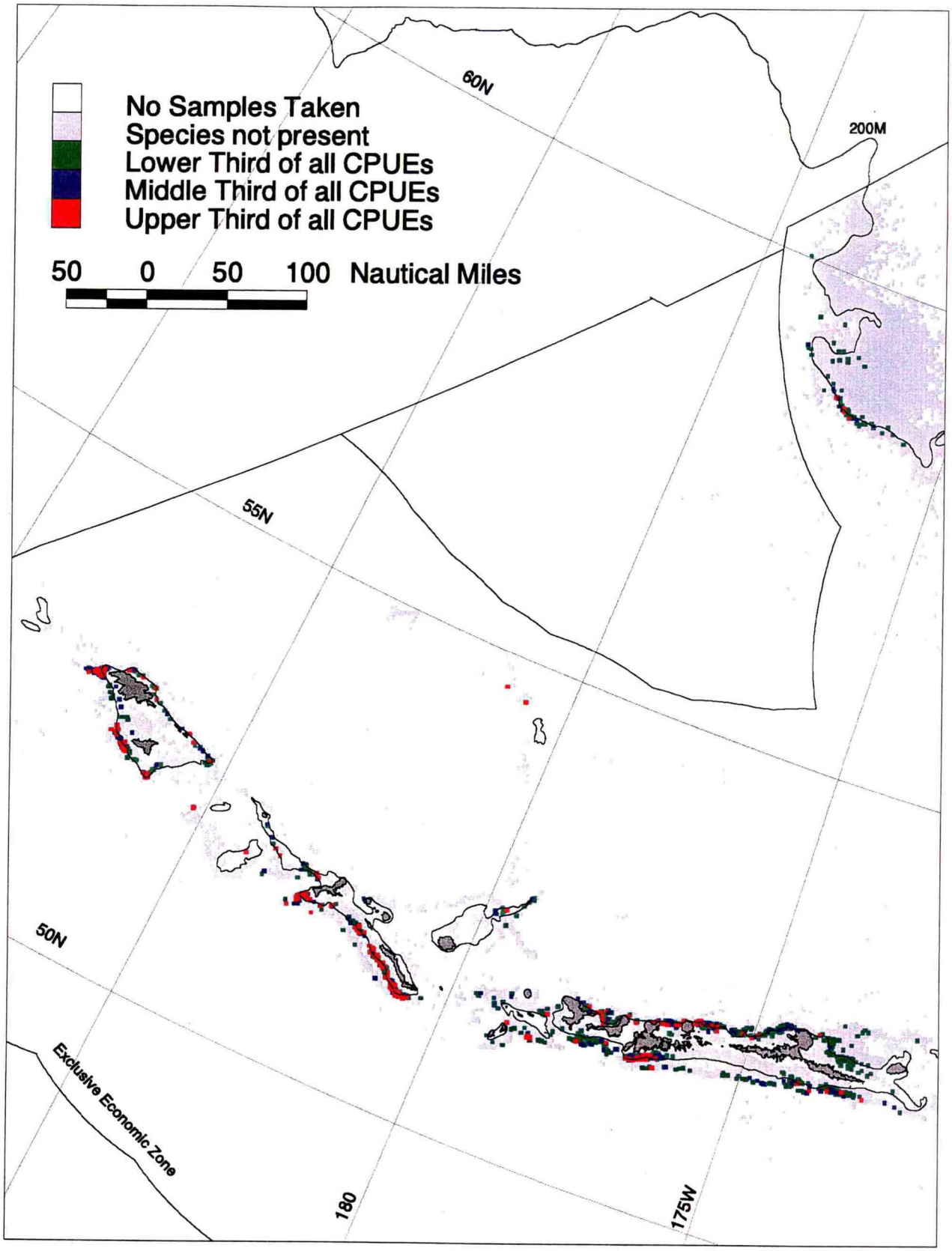
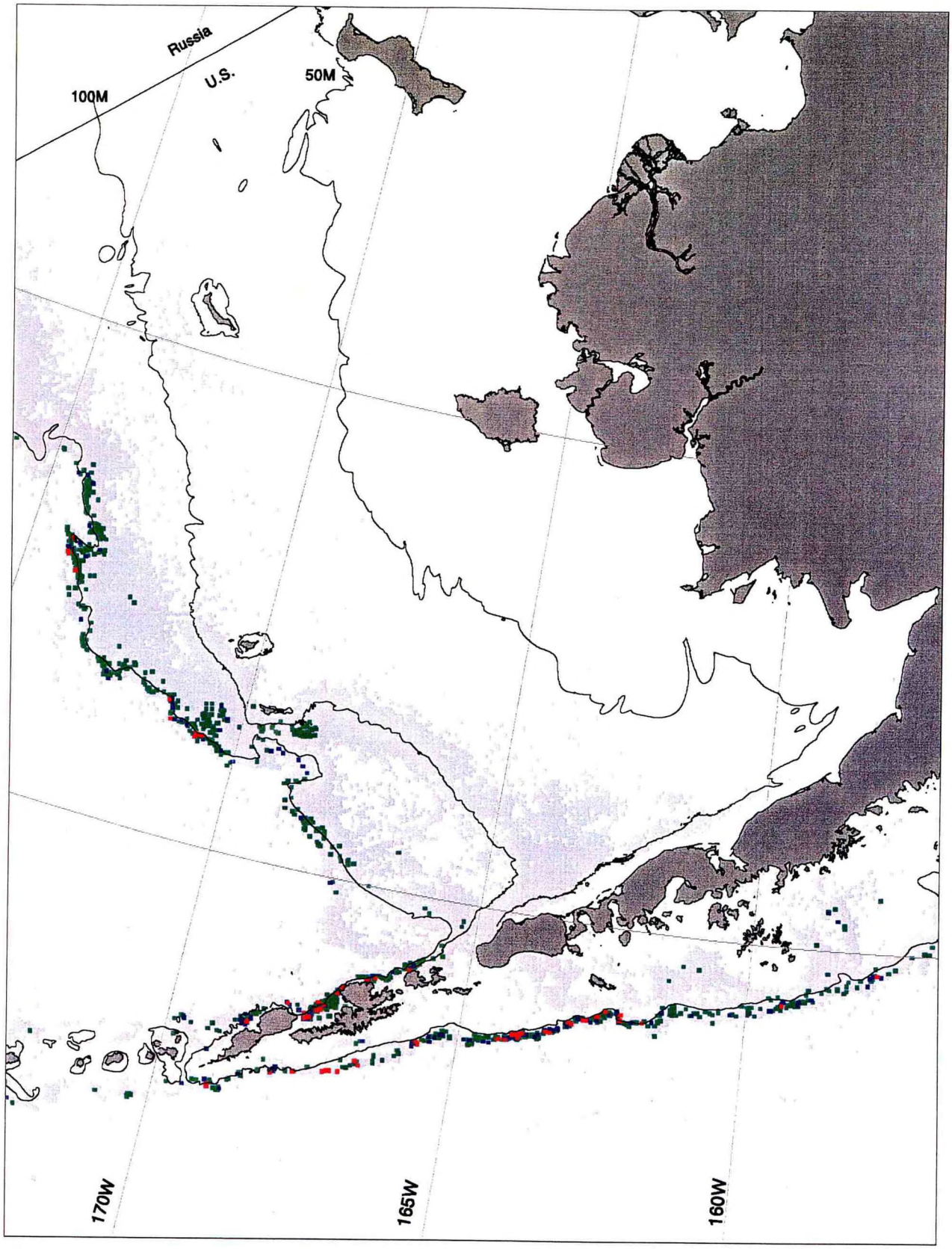


Figure 22.a Rougheye rockfish catch per unit effort (CPUE) summary for



BSAI region, based on Alaskan longline groundfish observer data.

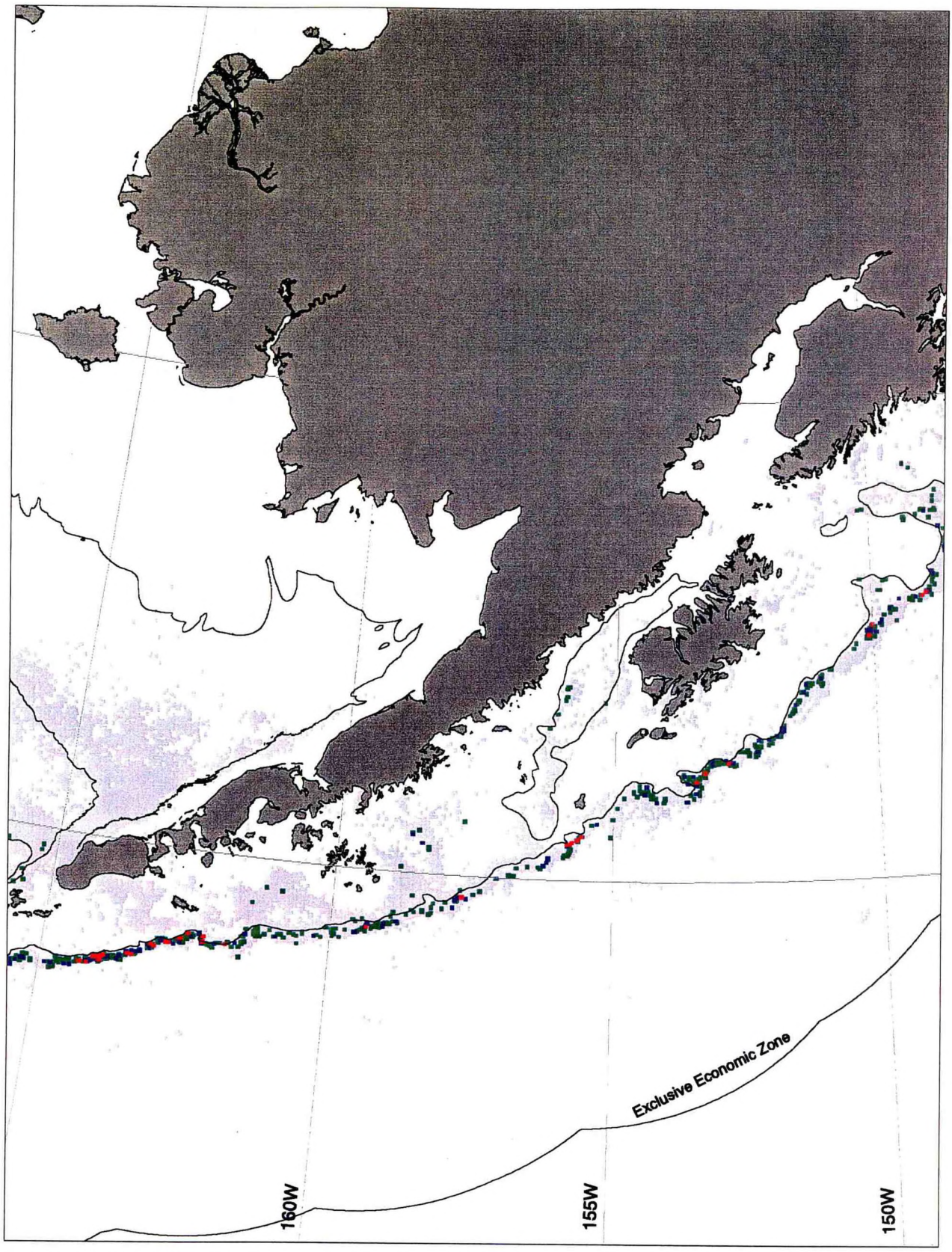
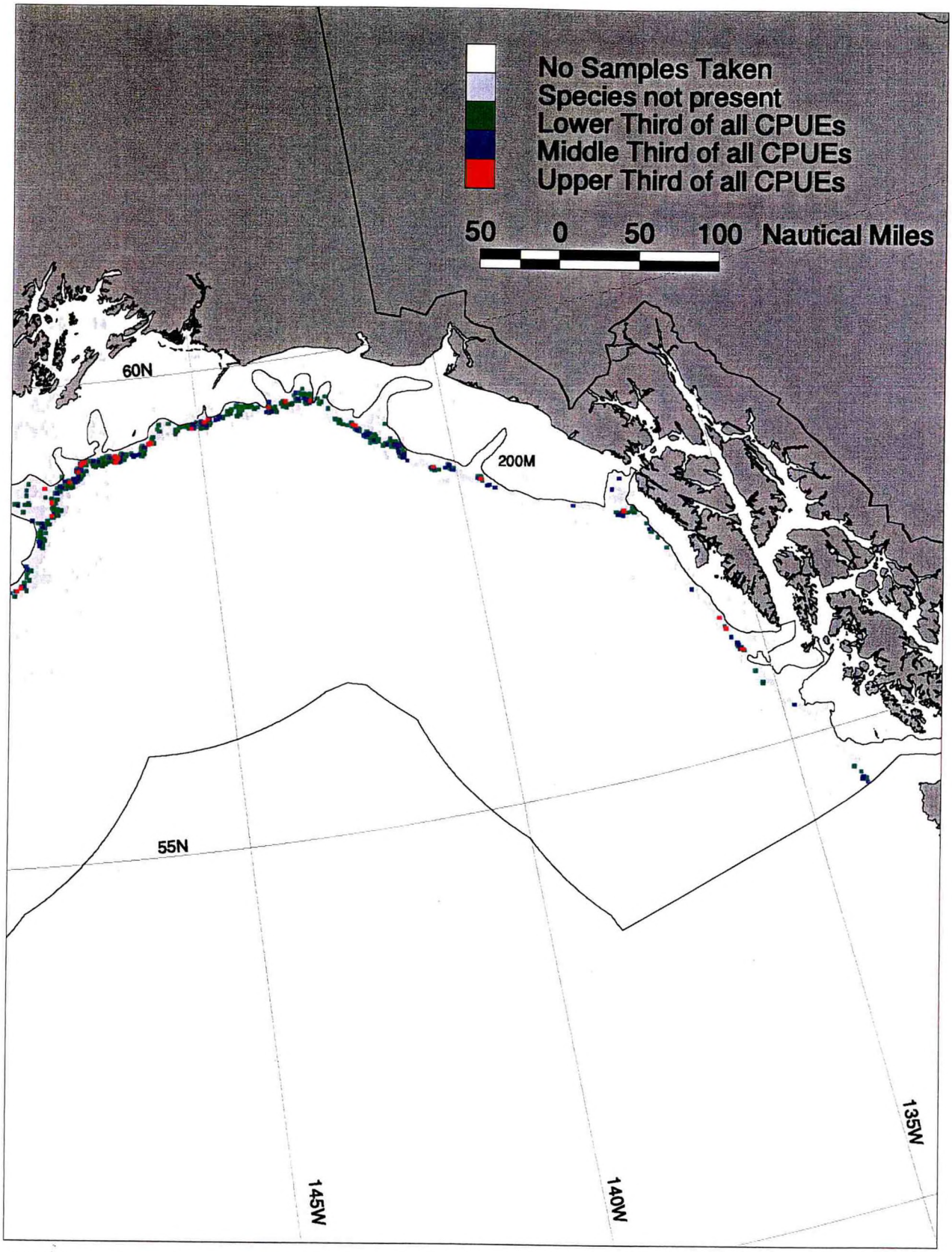


Figure 22.b Rougheye rockfish catch per unit effort (CPUE) summary for



GOA region, based on Alaskan longline groundfish observer data.

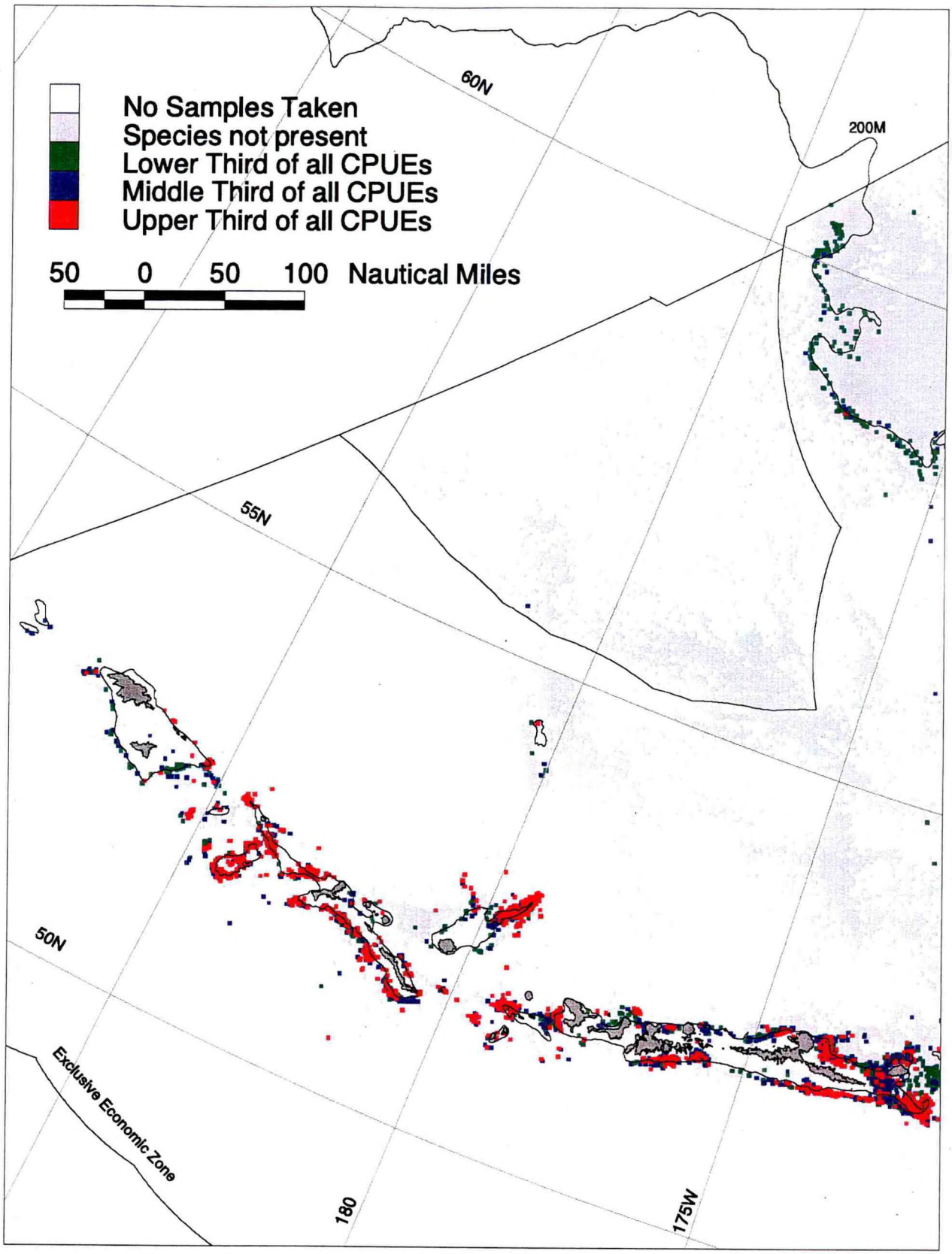
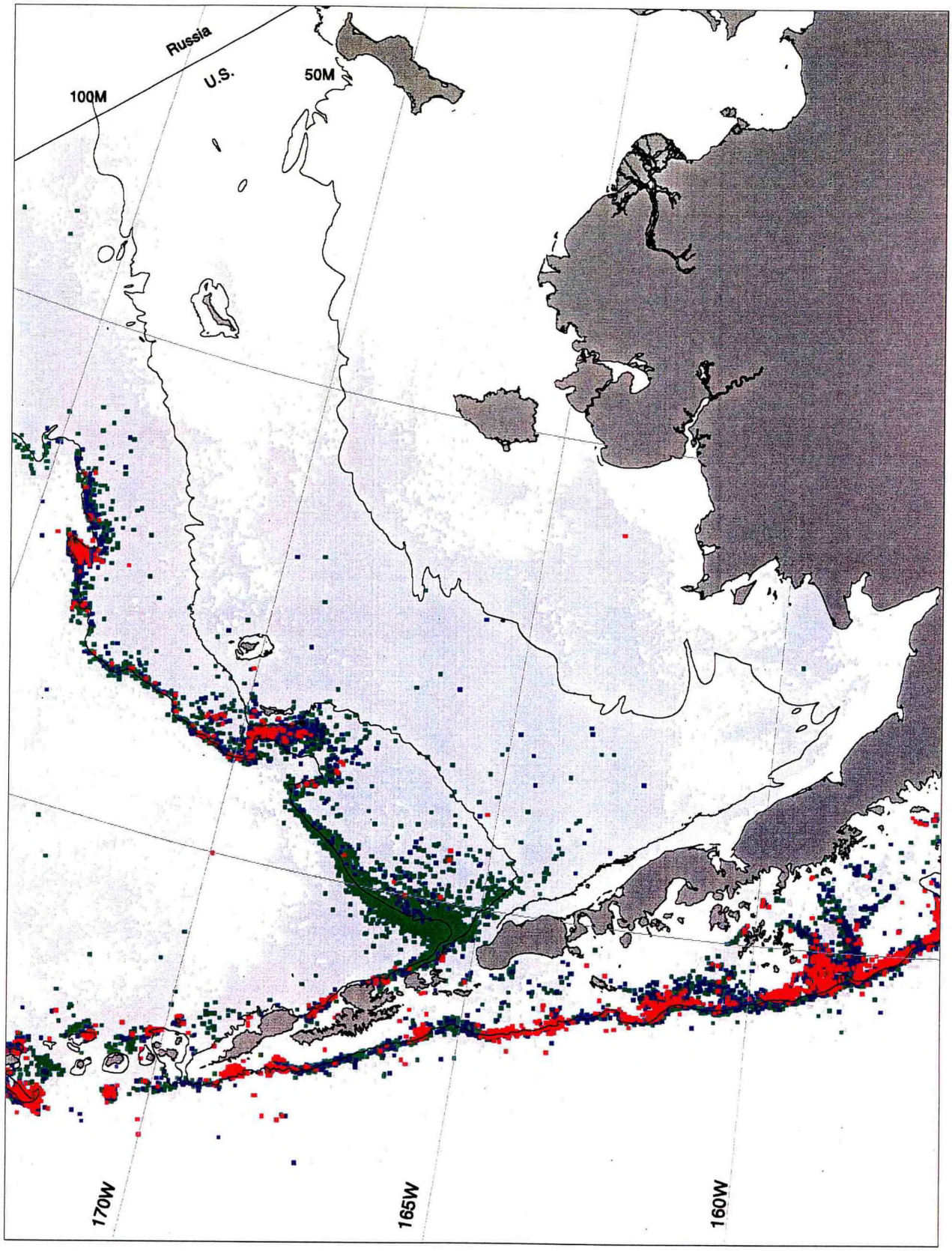


Figure 23.a Northern rockfish catch per unit effort (CPUE) summary for



BSAI region, based on Alaskan trawl groundfish observer data.

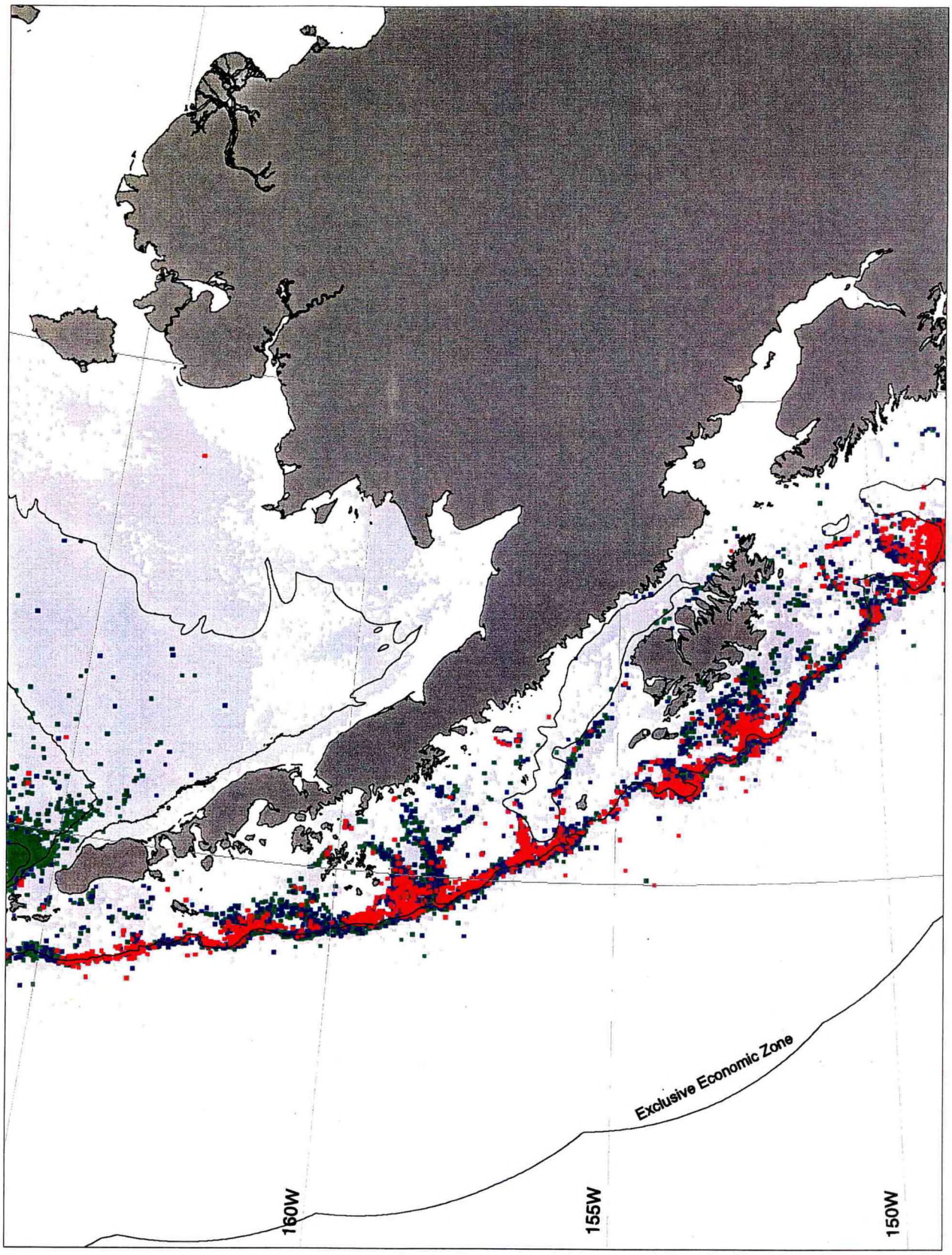
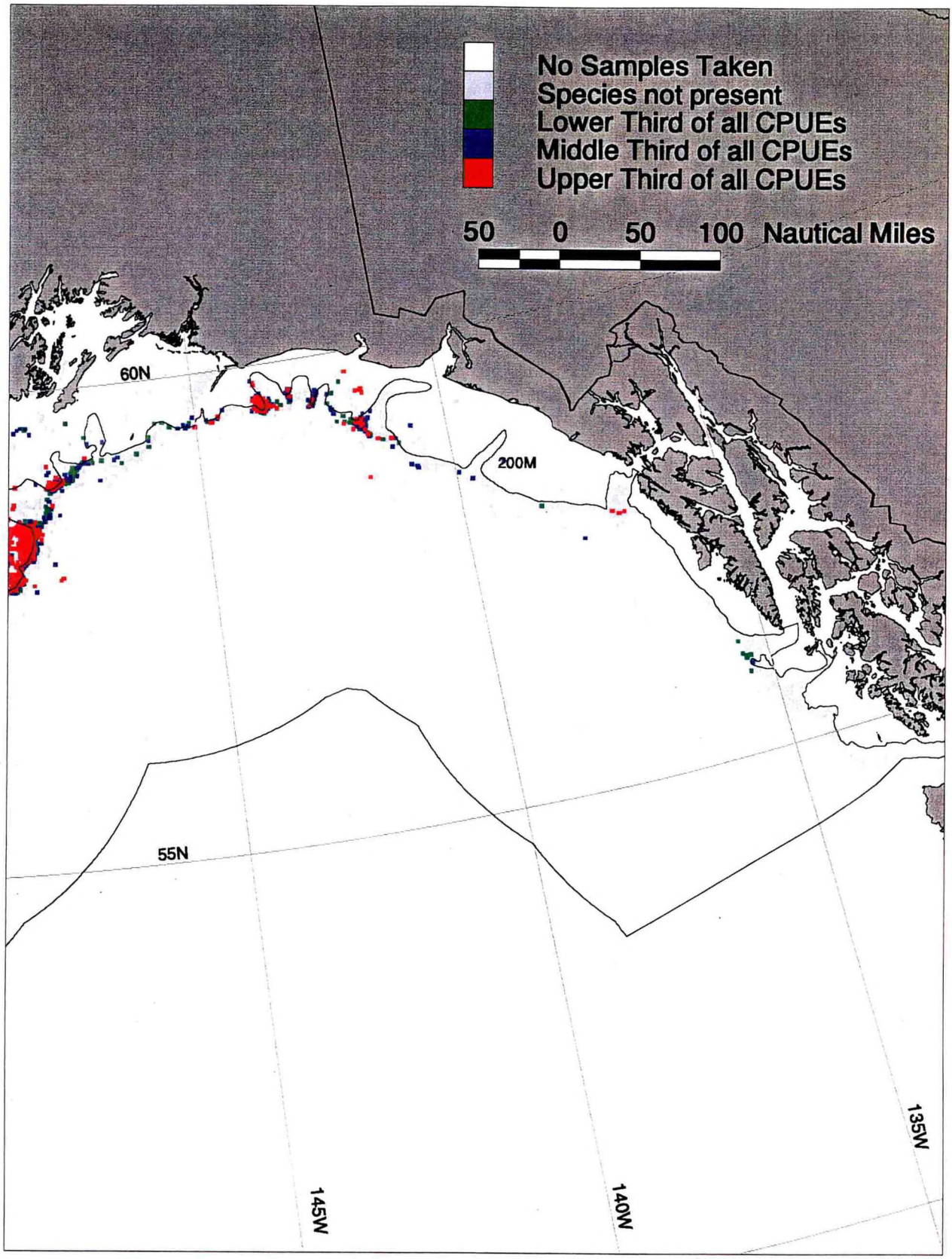


Figure 23.b Northern rockfish catch per unit effort (CPUE) summary for



GOA region, based on Alaskan trawl groundfish observer data.

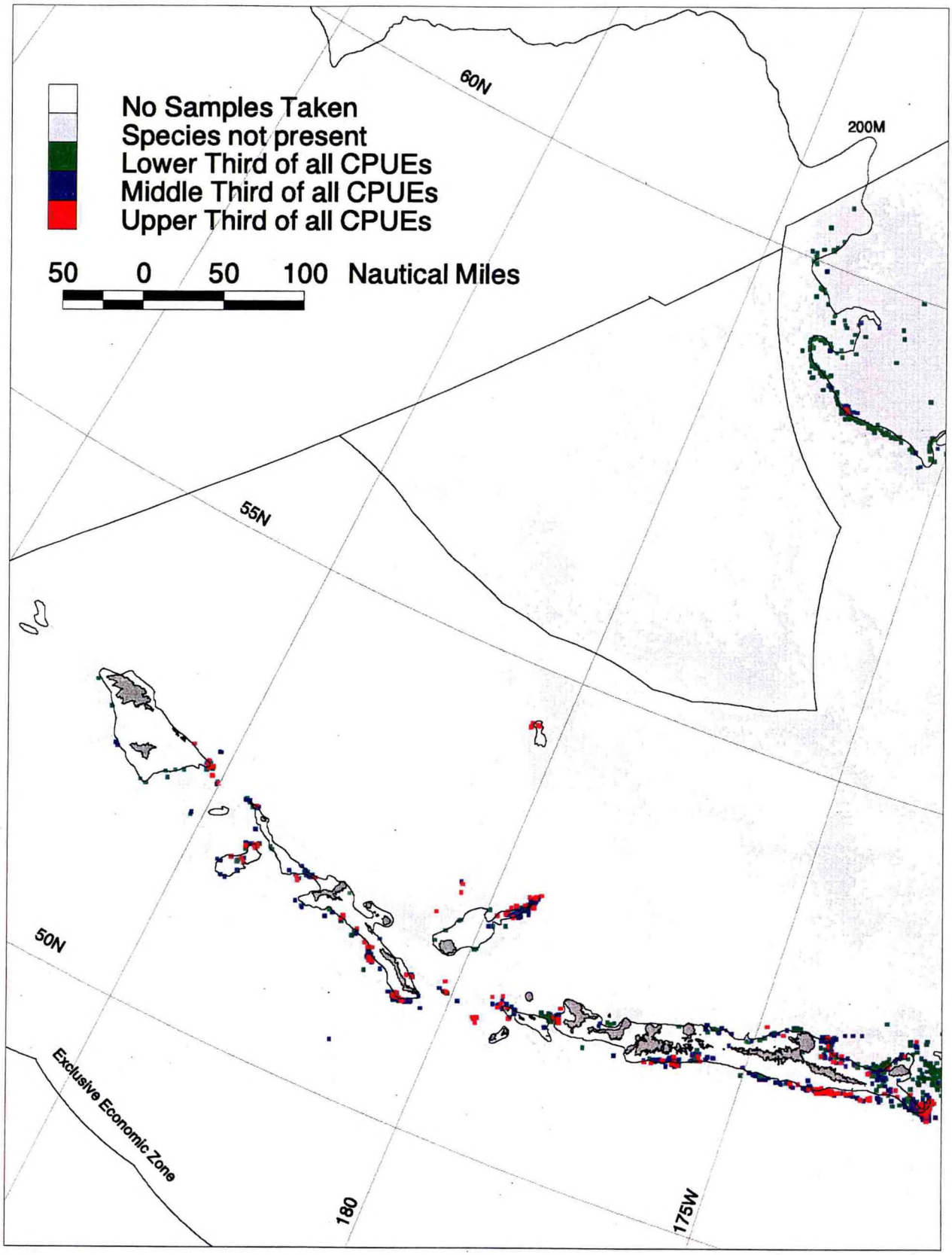
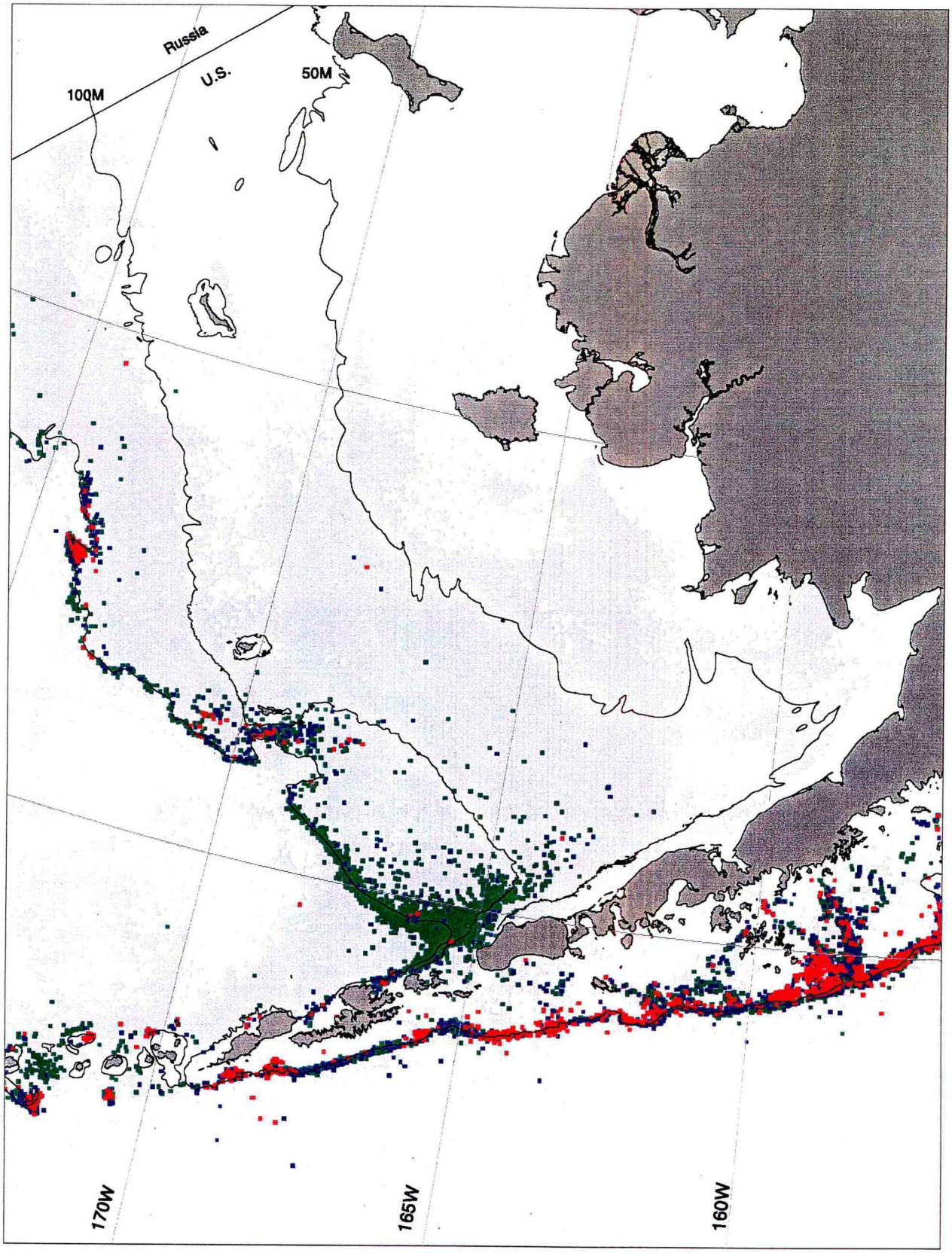


Figure 24.a Dusky rockfish catch per unit effort (CPUE) summary for



BSAI region, based on Alaskan trawl groundfish observer data.

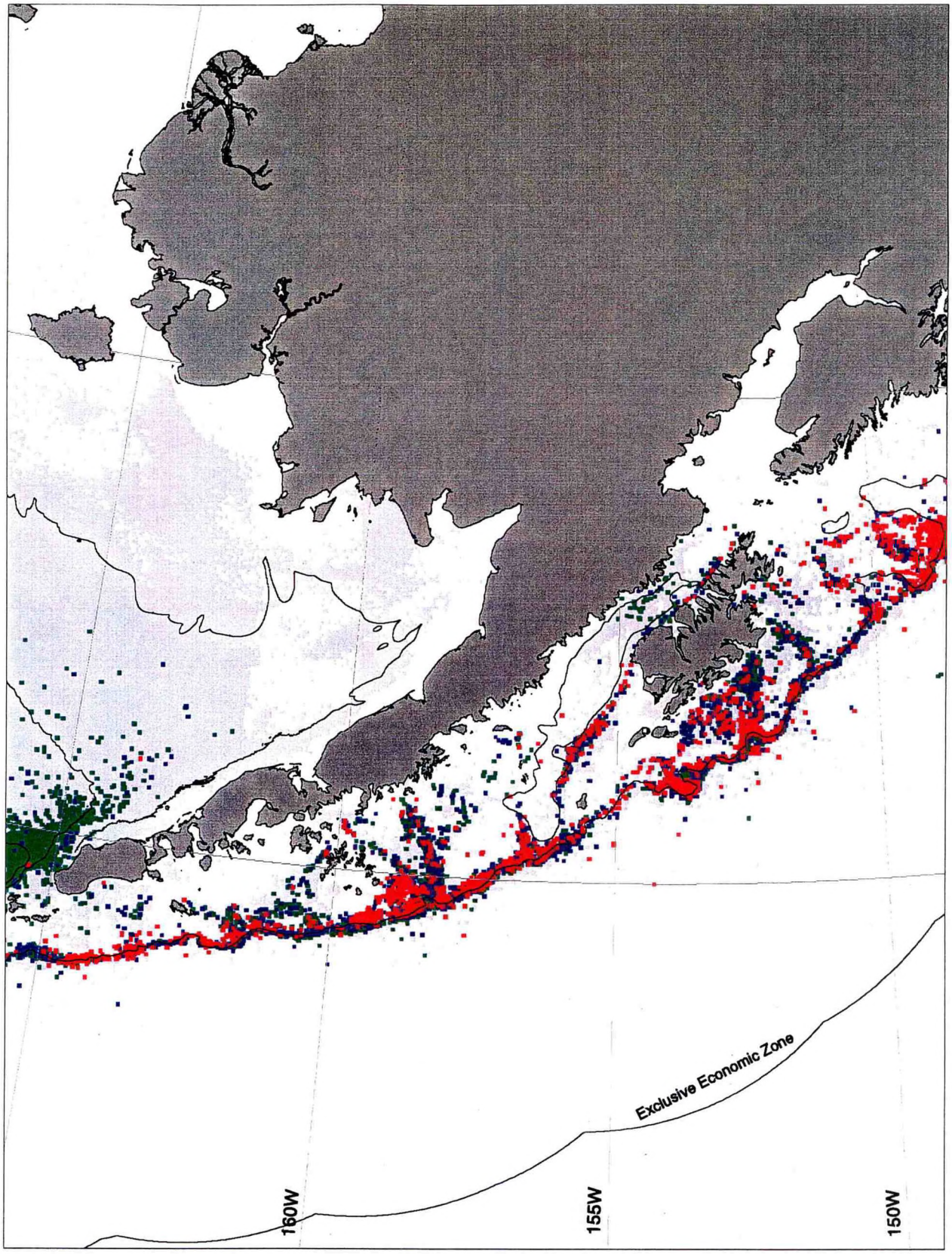
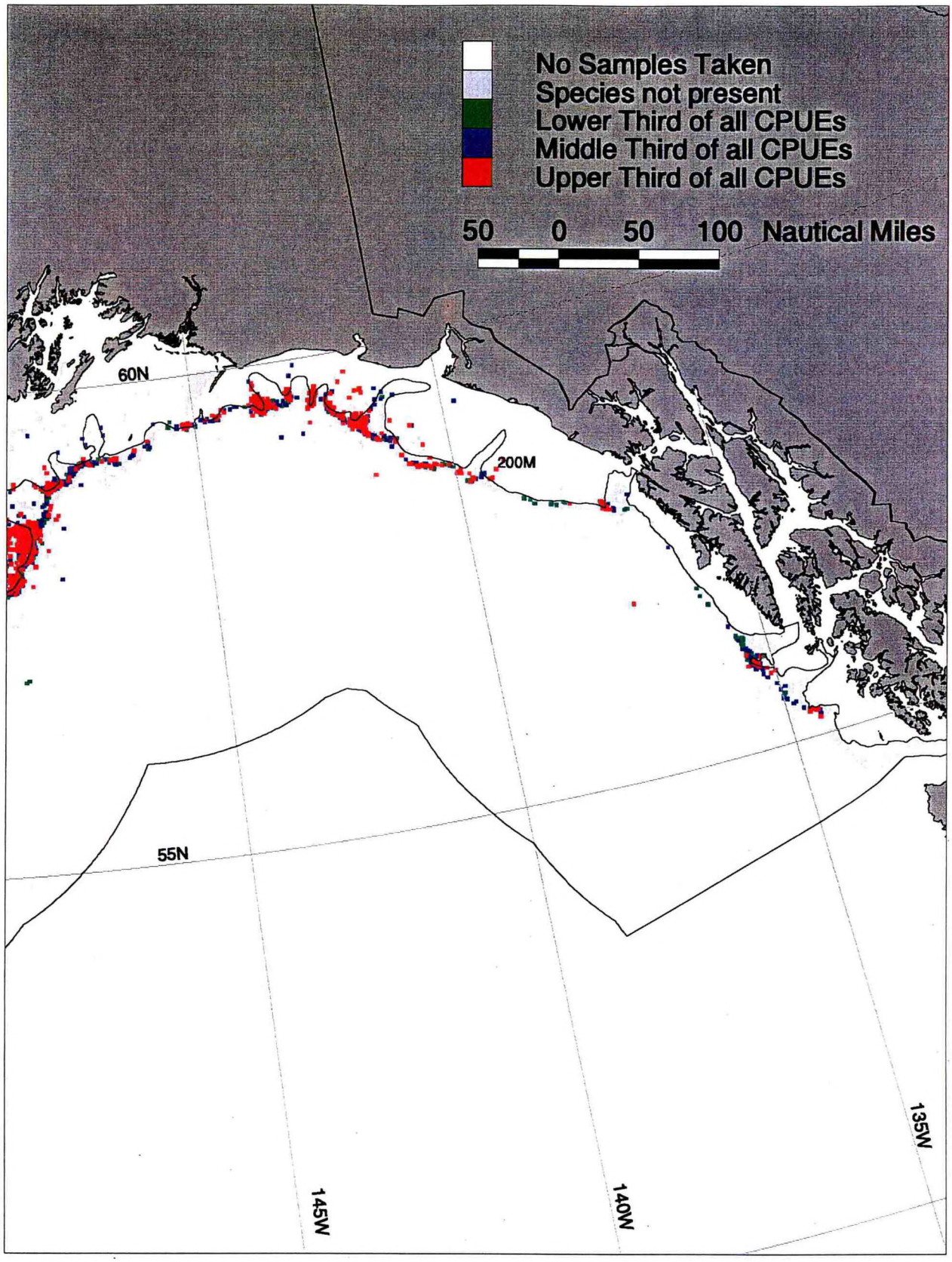


Figure 24.b Dusky rockfish catch per unit effort (CPUE) summary for



GOA region, based on Alaskan trawl groundfish observer data.

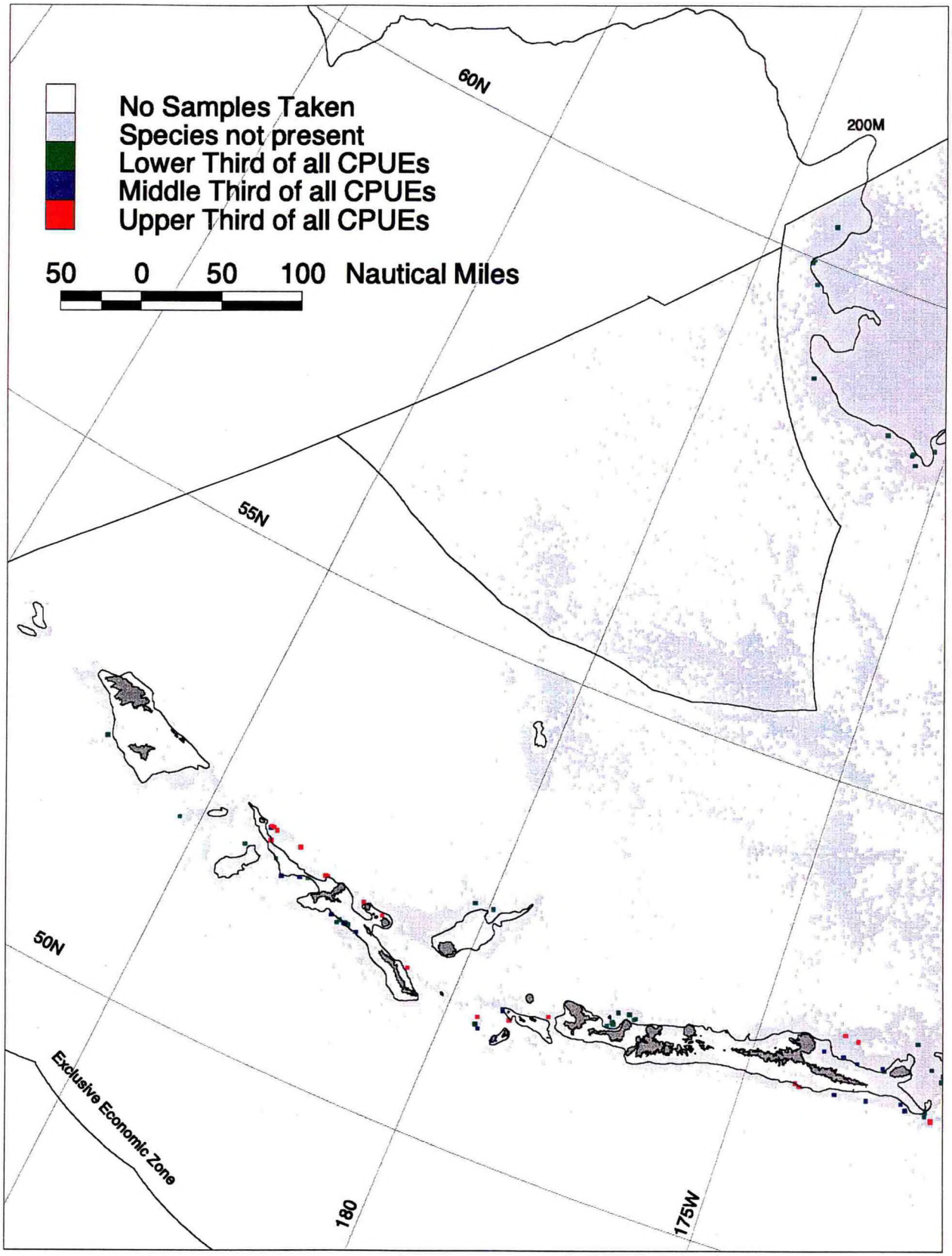
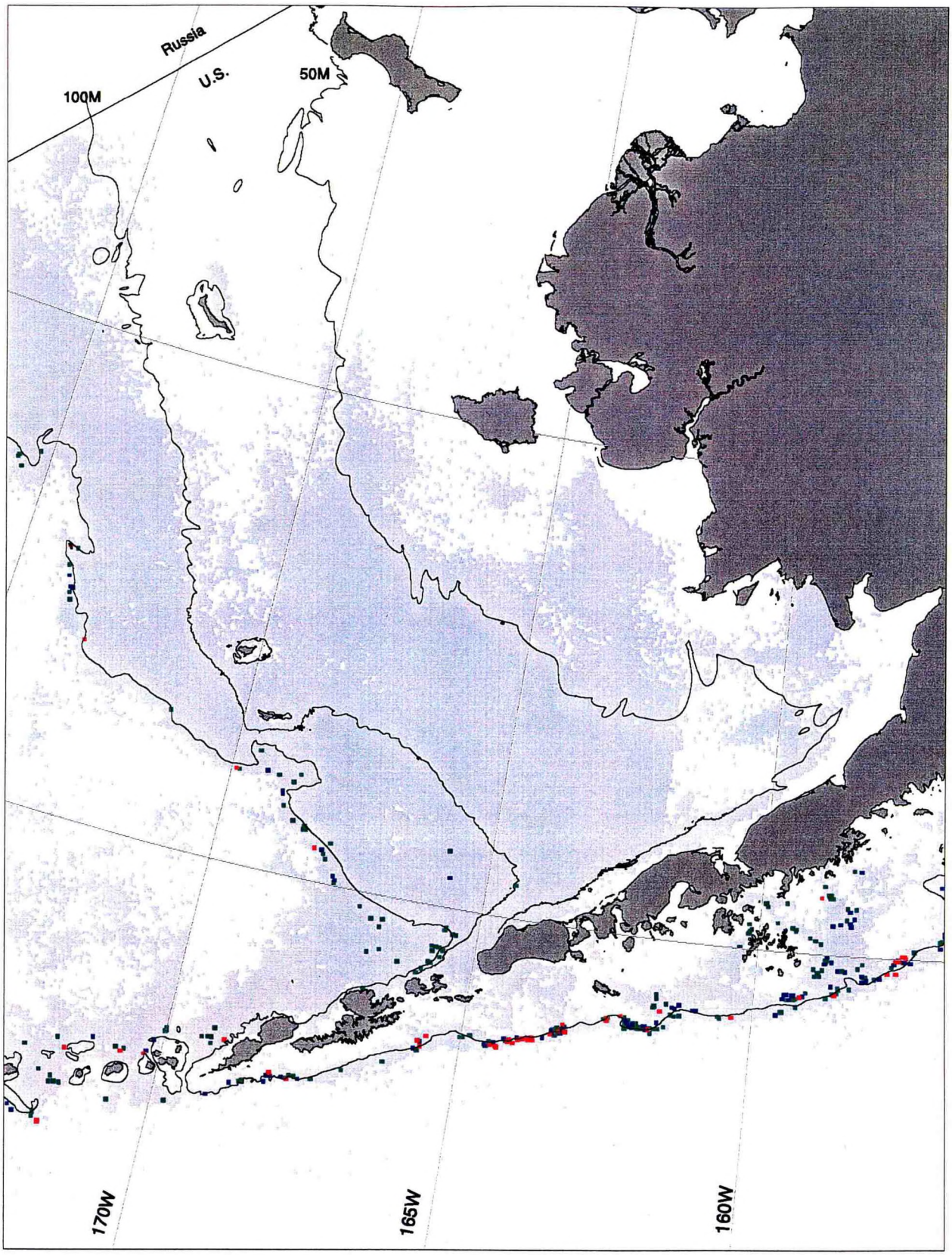


Figure 25.a Yelloweye rockfish catch per unit effort (CPUE) summary for



BSAI region, based on Alaskan trawl groundfish observer data.

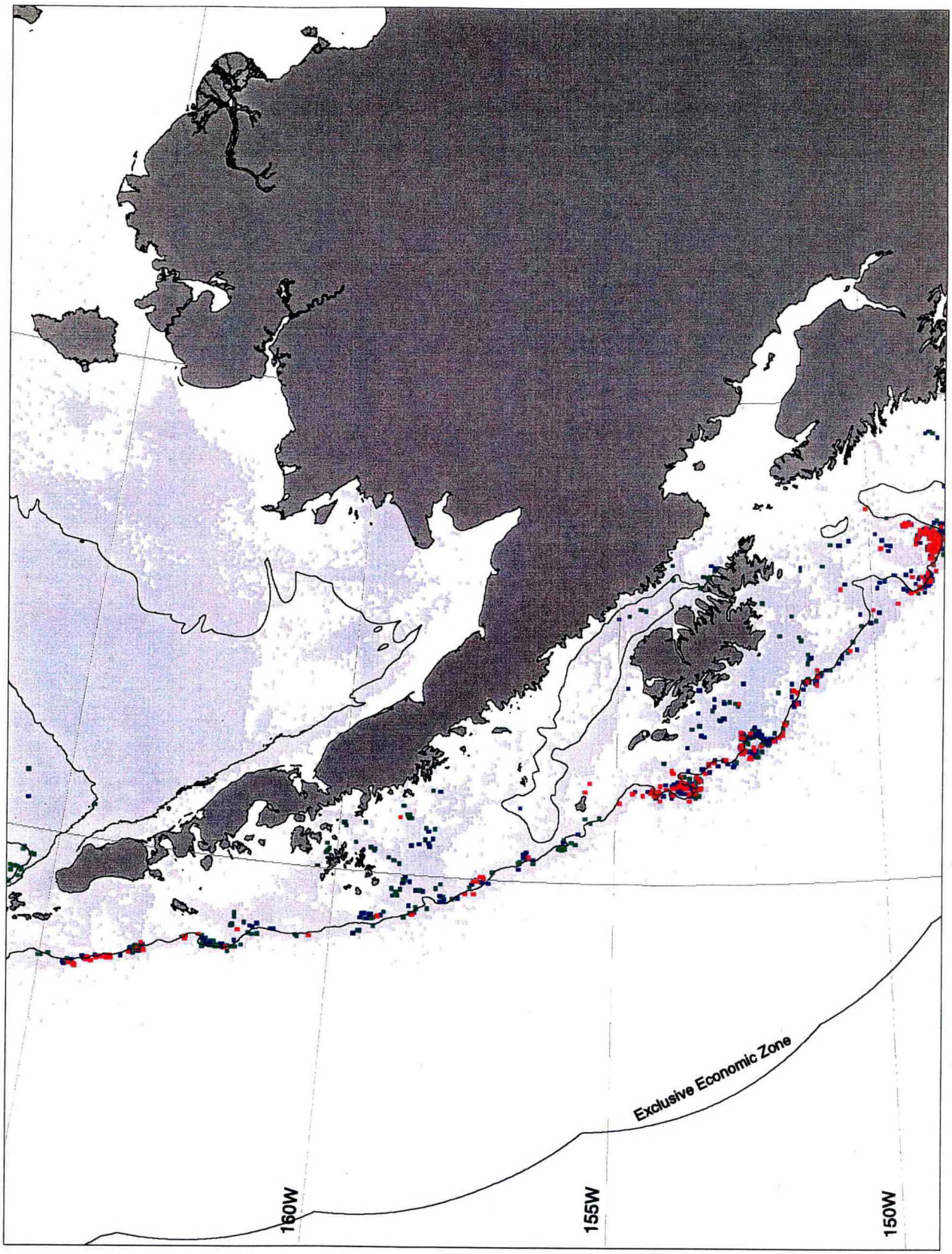
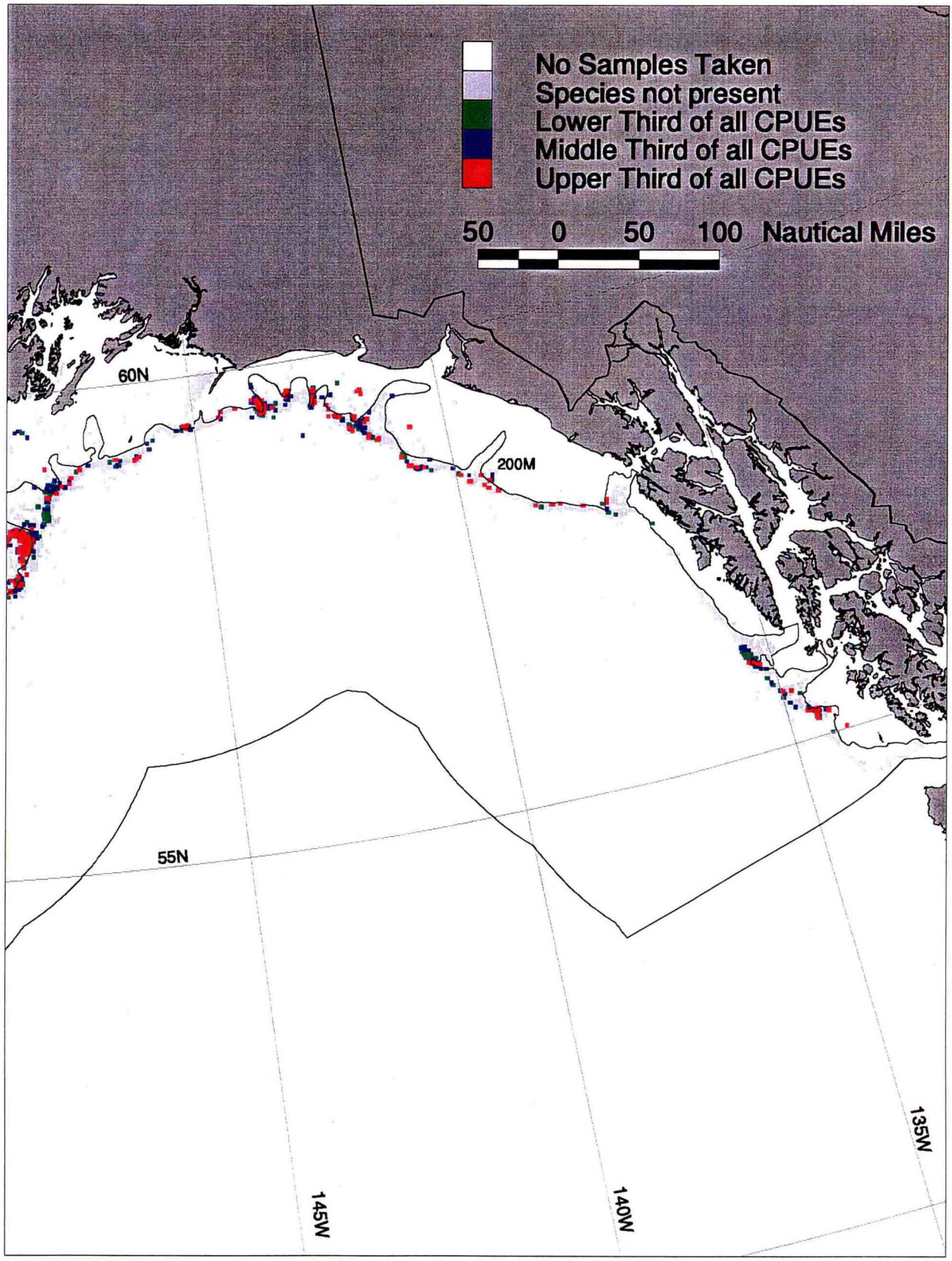


Figure 25.b Yelloweye rockfish catch per unit effort (CPUE) summary for



GOA region, based on Alaskan trawl groundfish observer data.

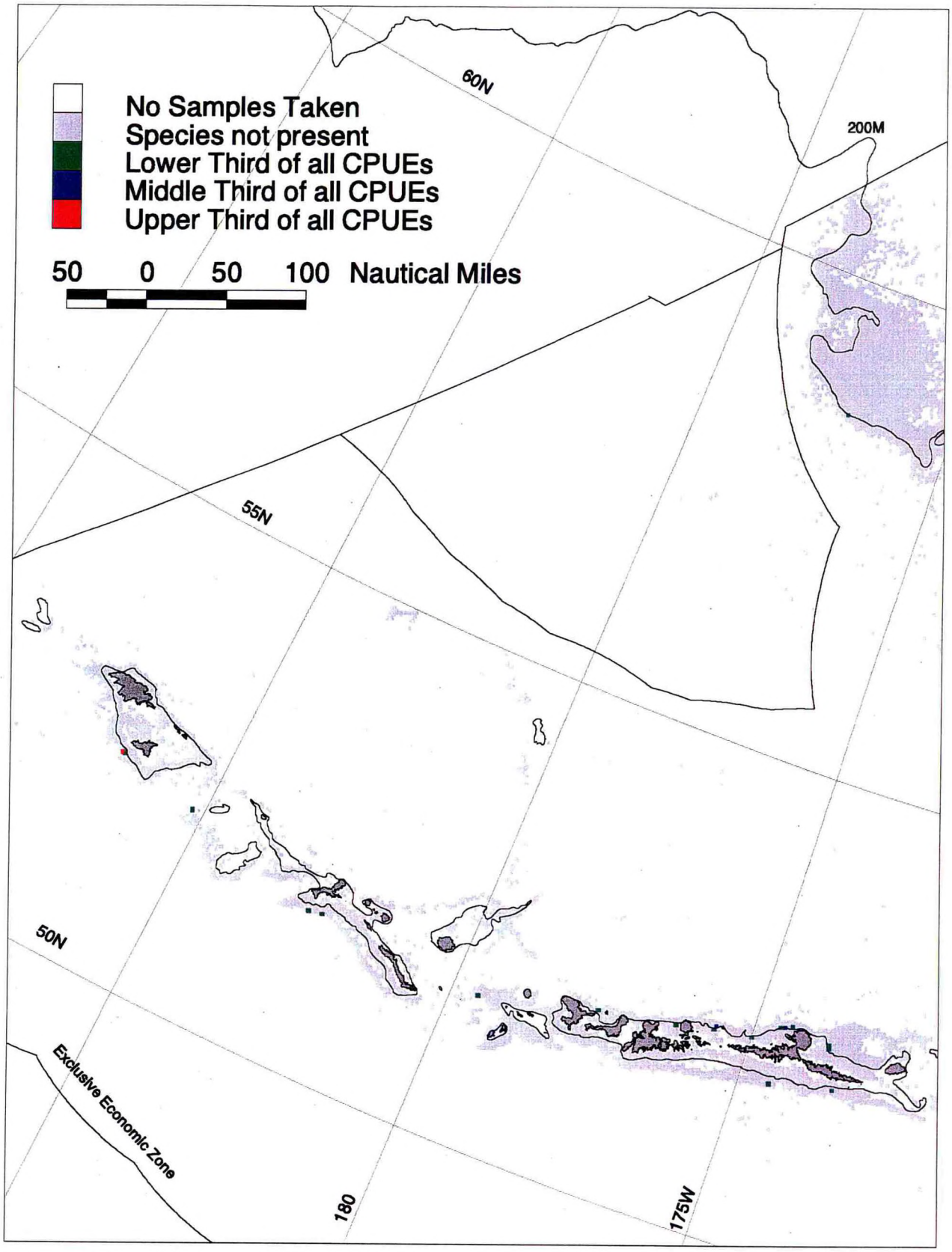
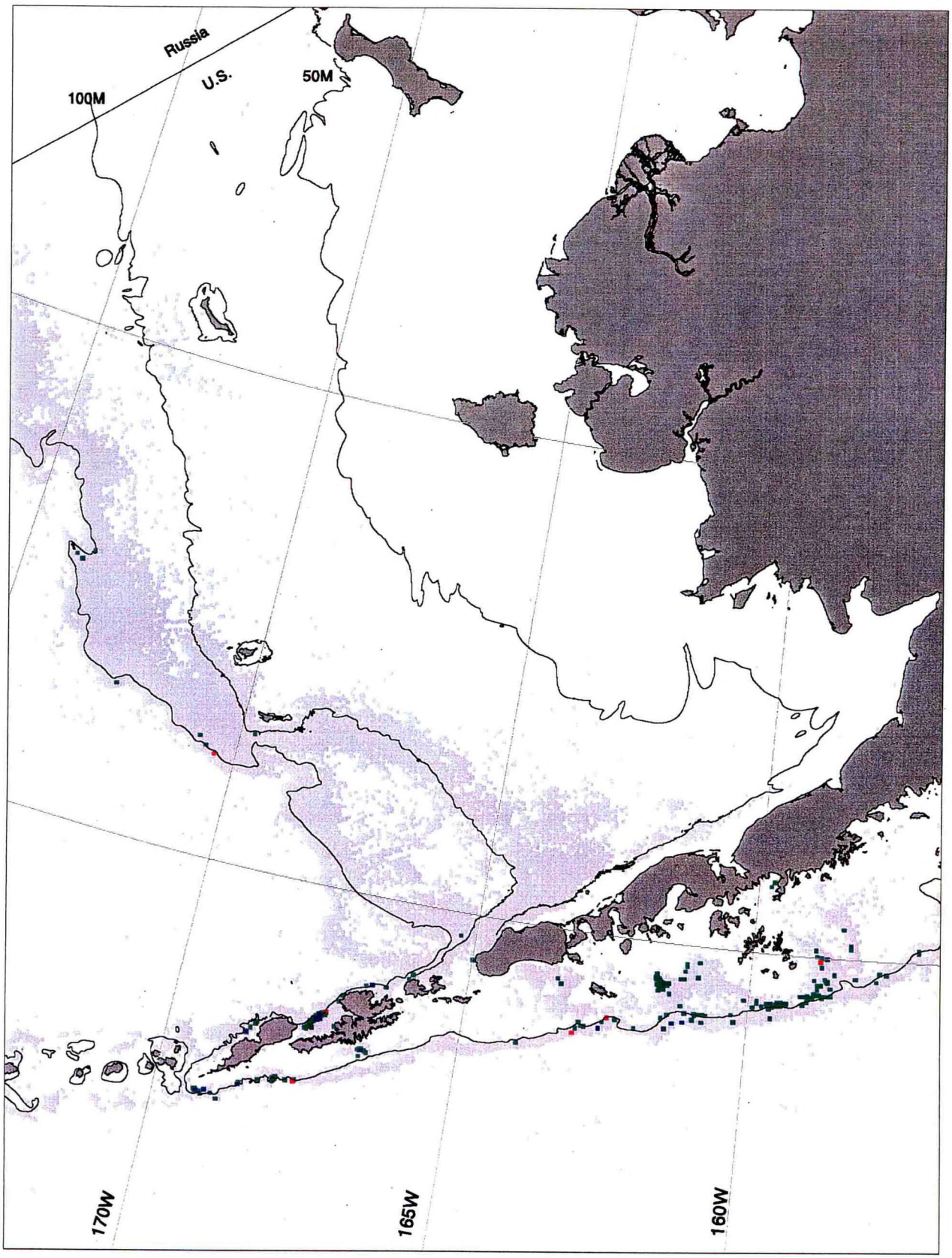


Figure 26.a Yelloweye rockfish catch per unit effort (CPUE) summary for



BSAI region, based on Alaskan longline groundfish observer data.

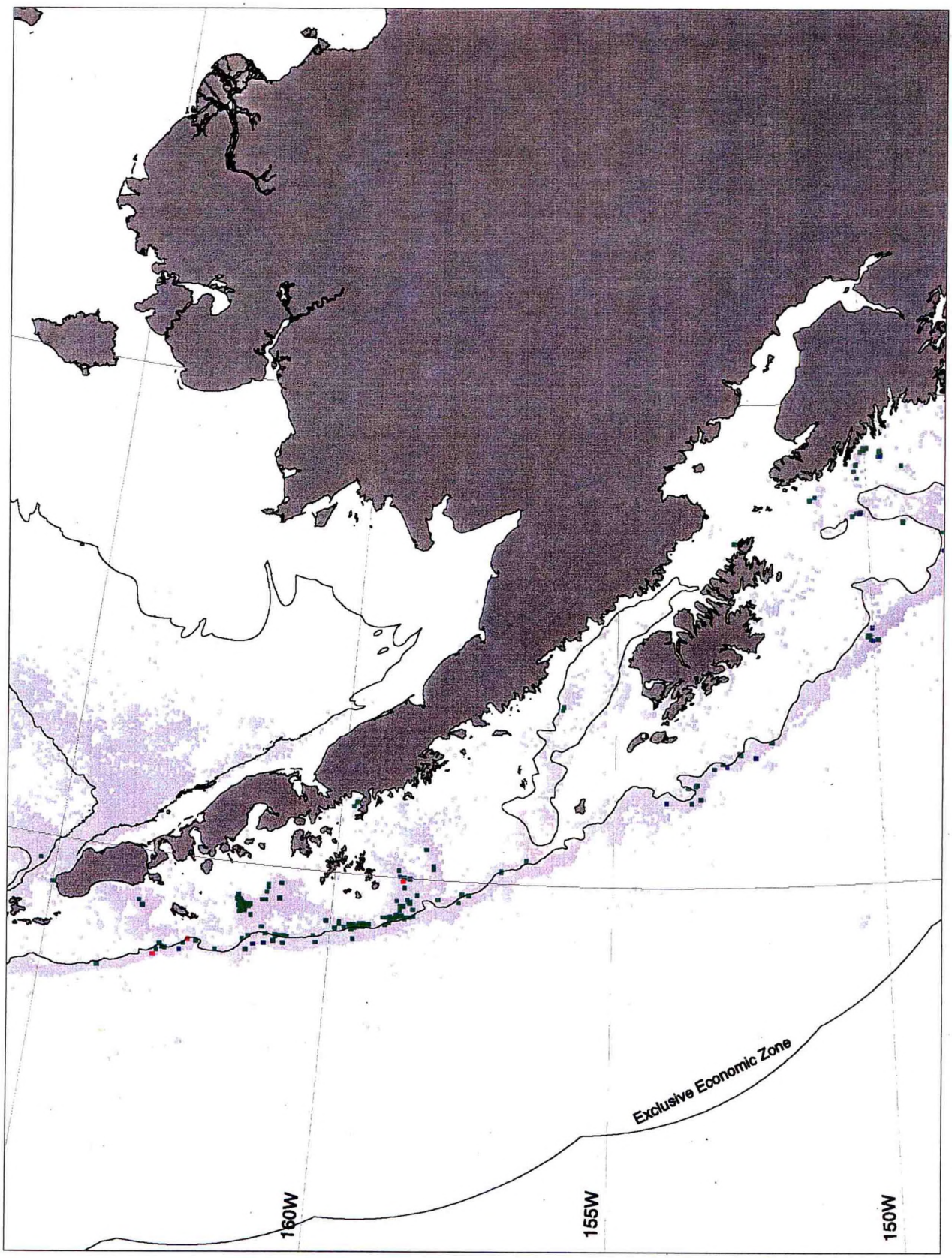
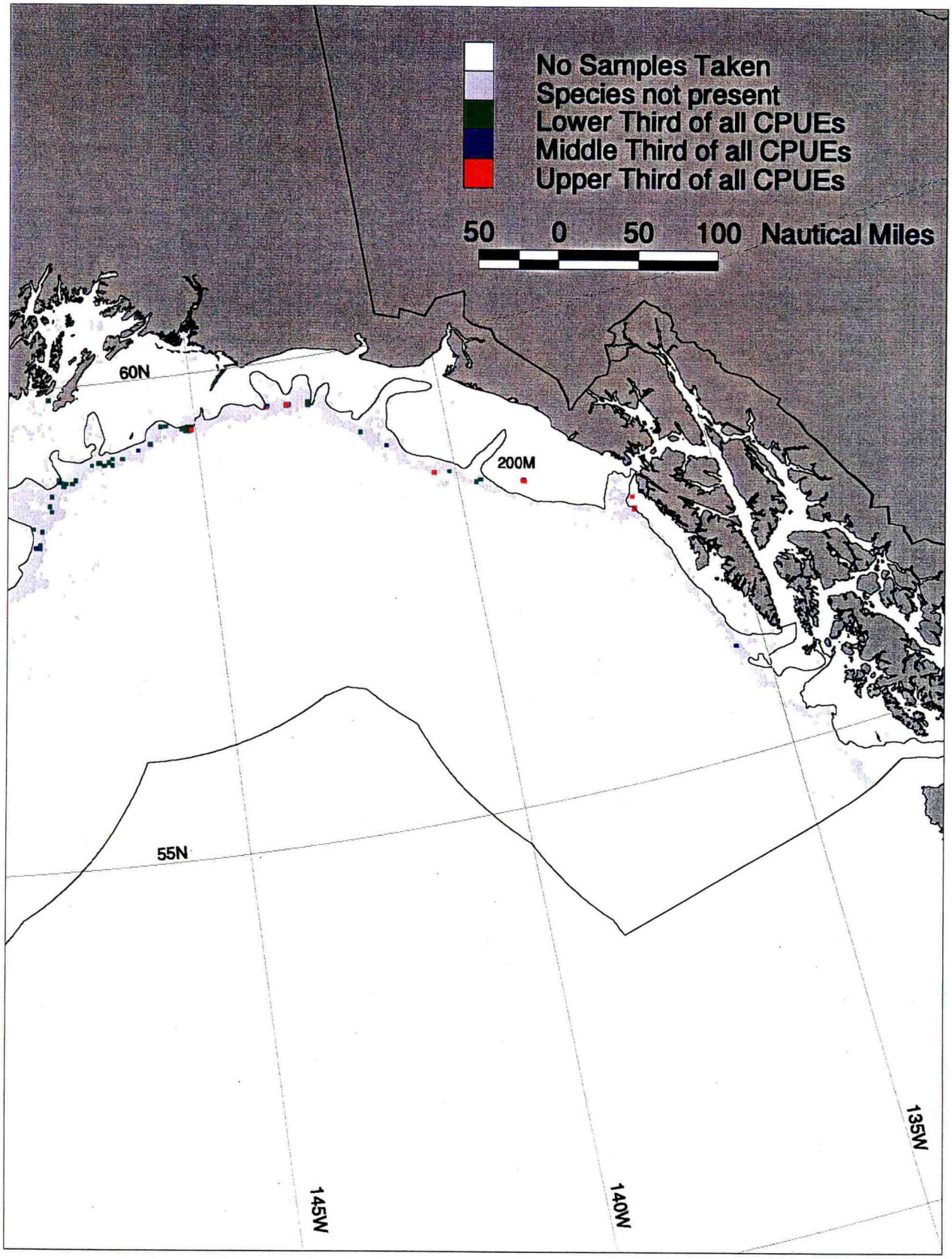


Figure 26.b Yelloweye rockfish catch per unit effort (CPUE) summary for



GOA region, based on Alaskan longline groundfish observer data.

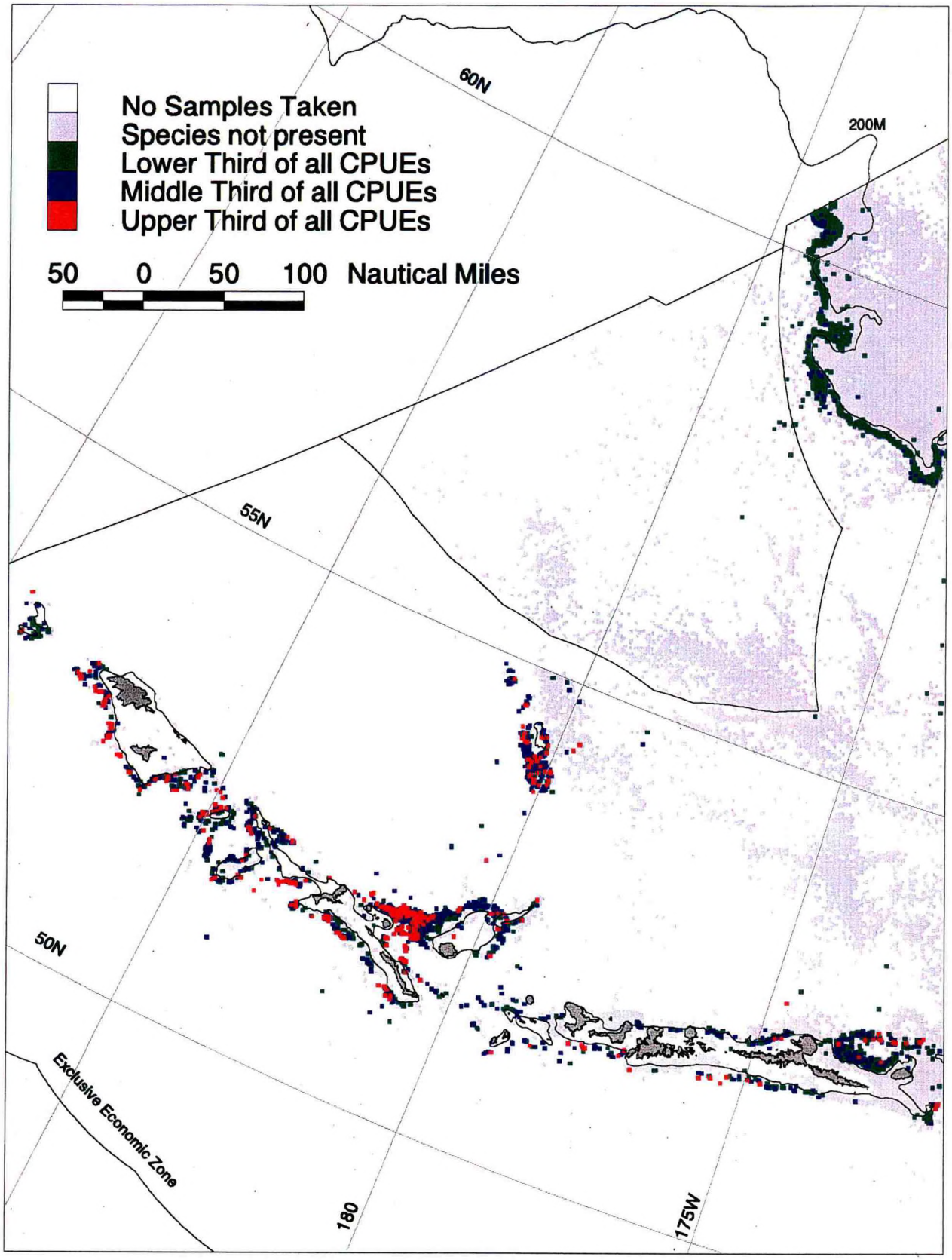
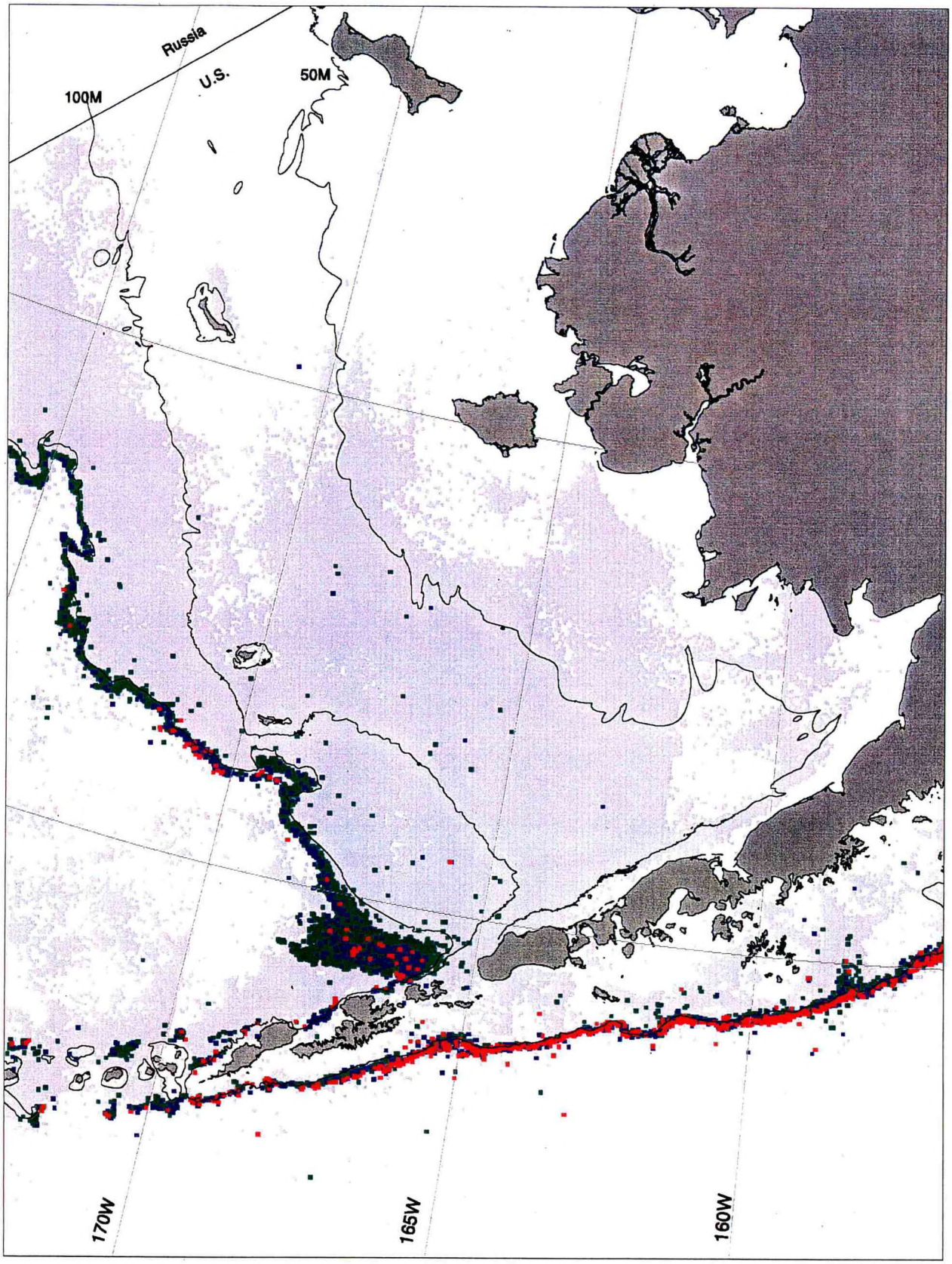


Figure 27.a Thornyhead rockfish catch per unit effort (CPUE) summary for



BSAI region, based on Alaskan trawl groundfish observer data.

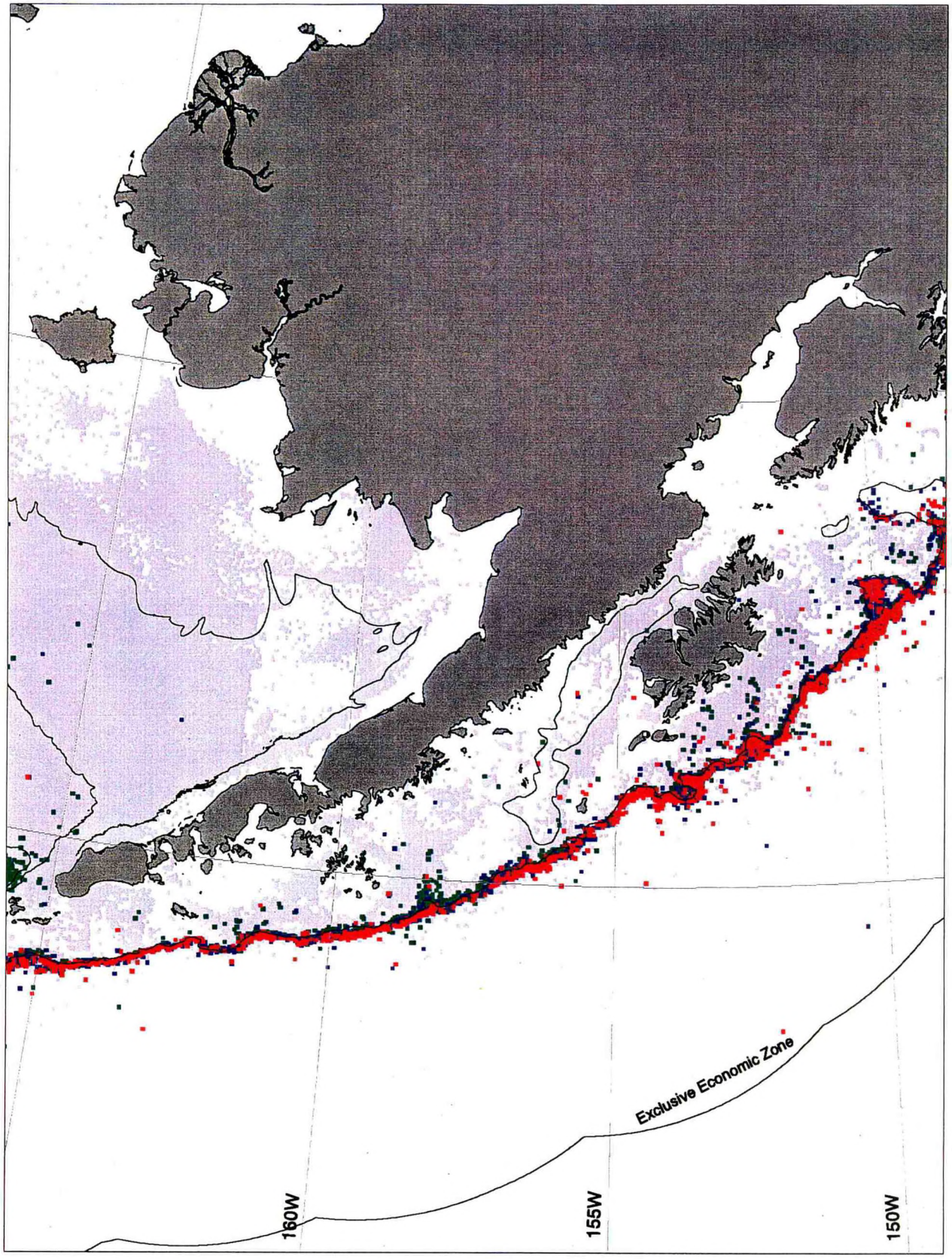
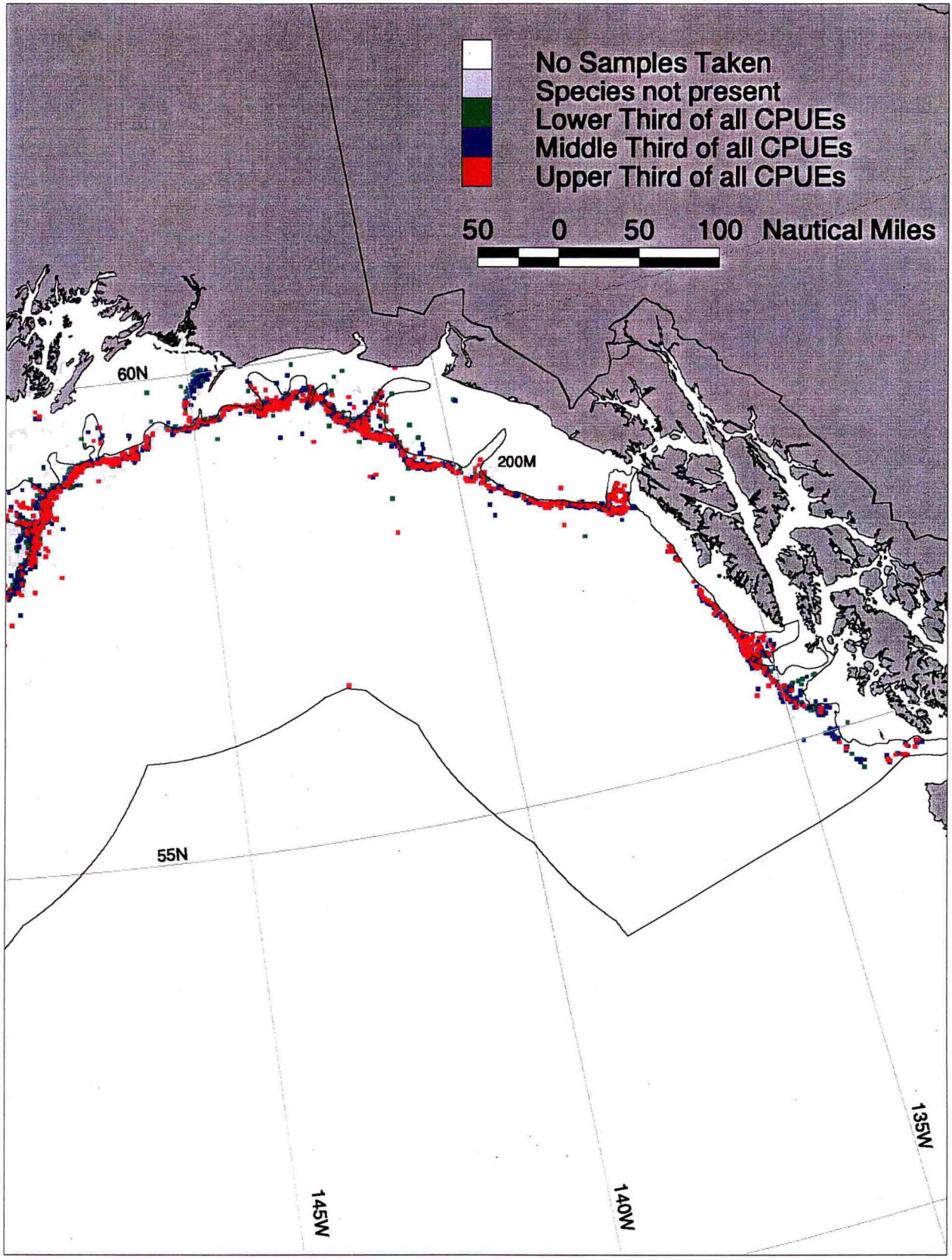


Figure 27.b Thornyhead rockfish catch per unit effort (CPUE) summary for



GOA region, based on Alaskan trawl groundfish observer data.

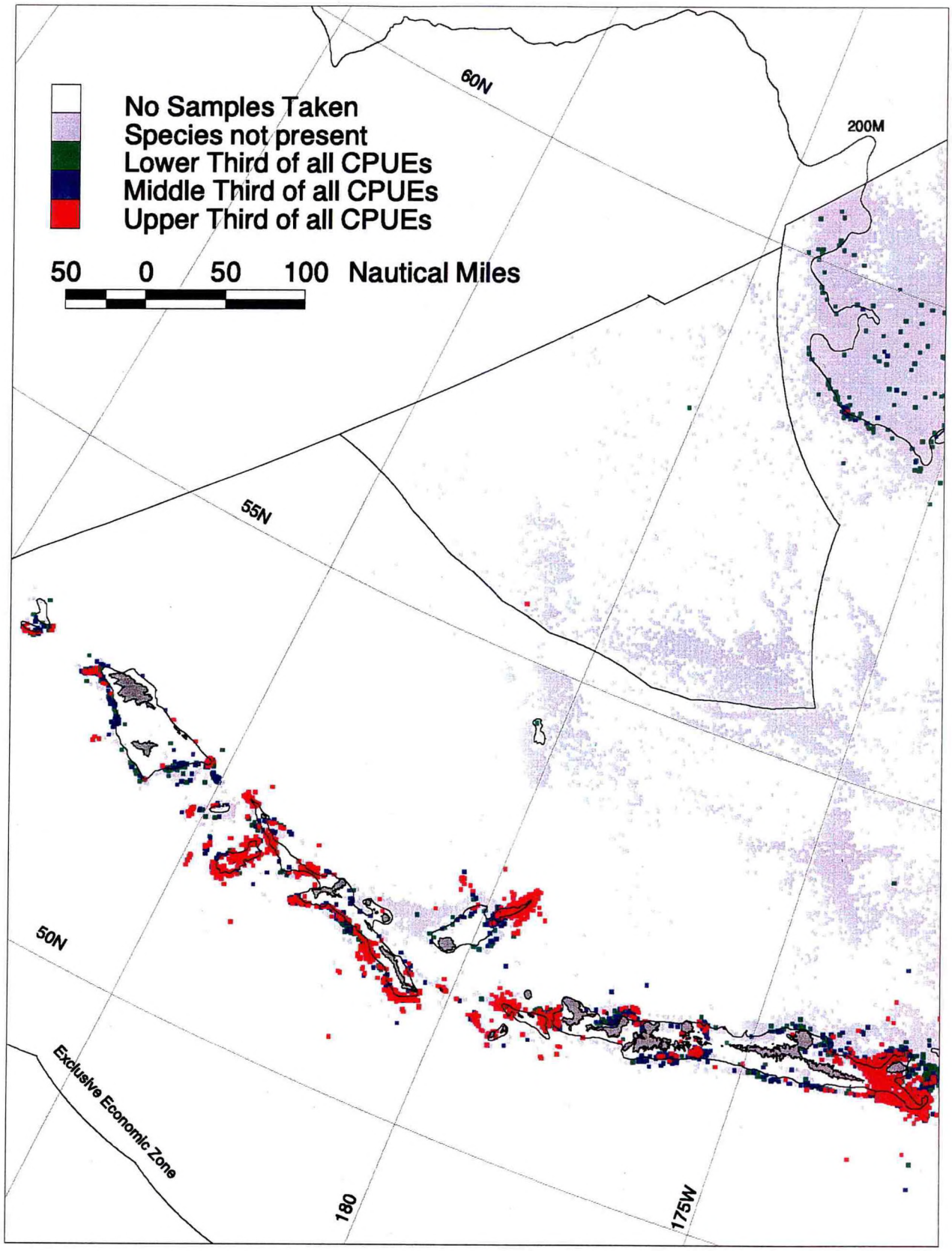
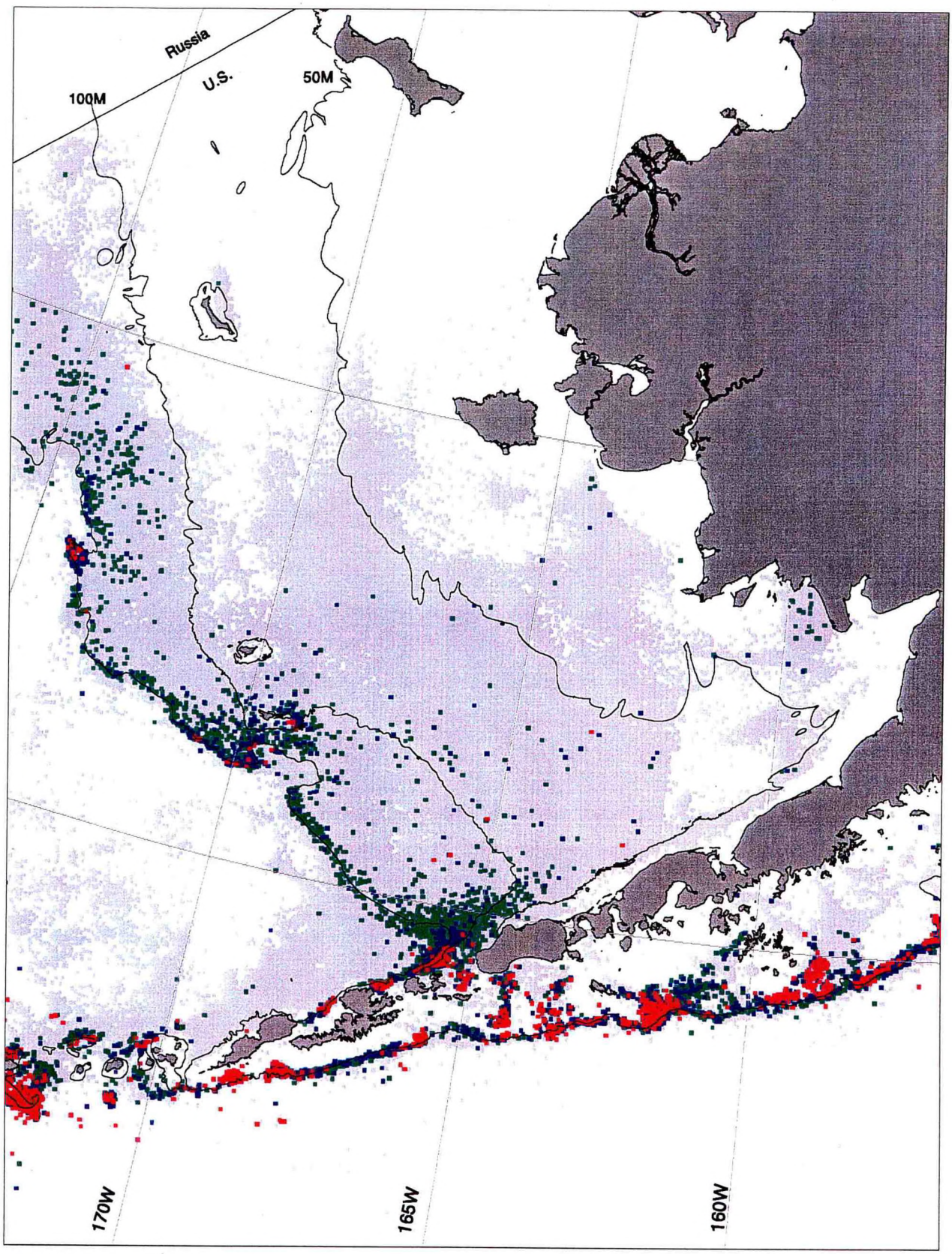


Figure 28.a Atka mackerel catch per unit effort (CPUE) summary for



BSAI region, based on Alaskan trawl groundfish observer data.

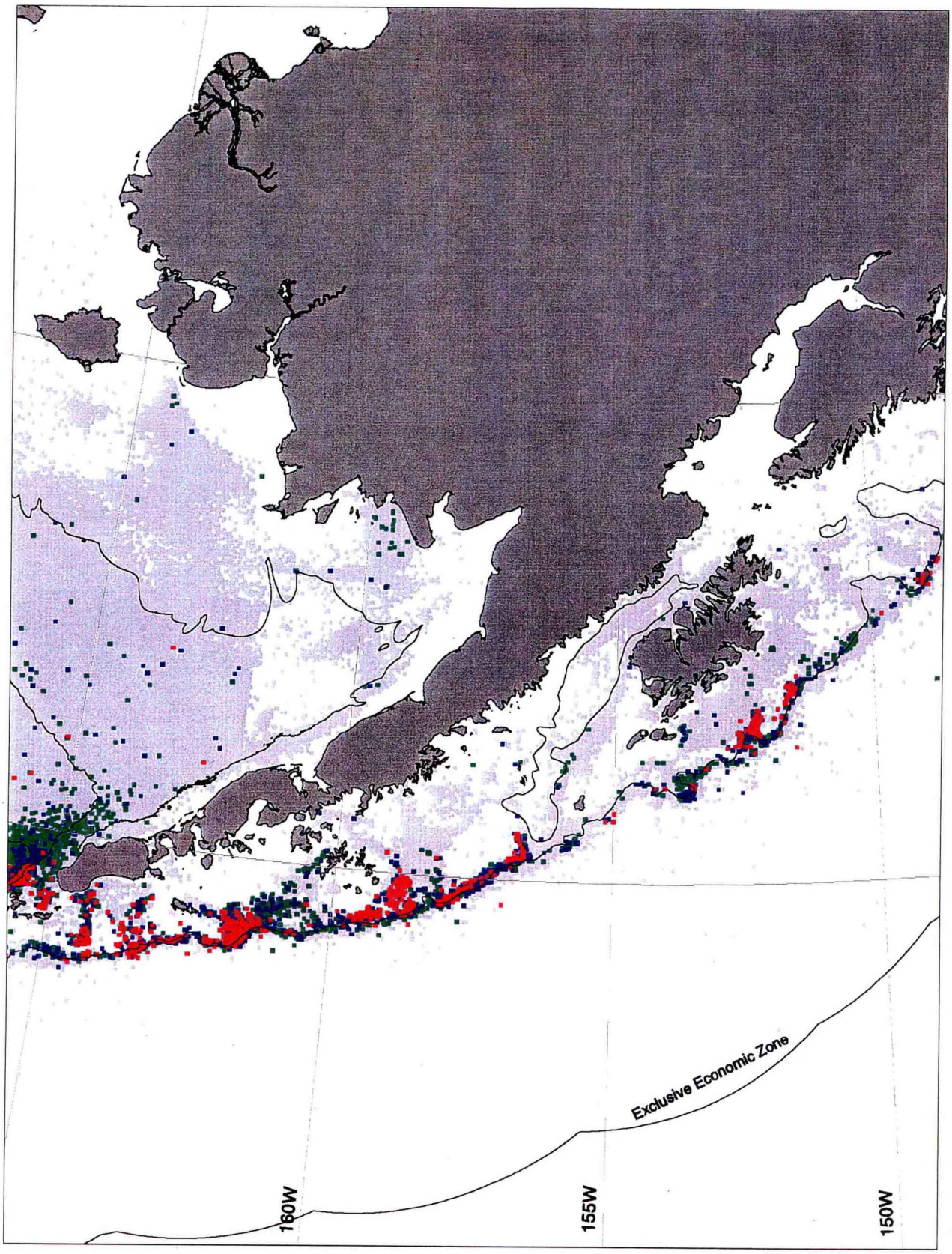
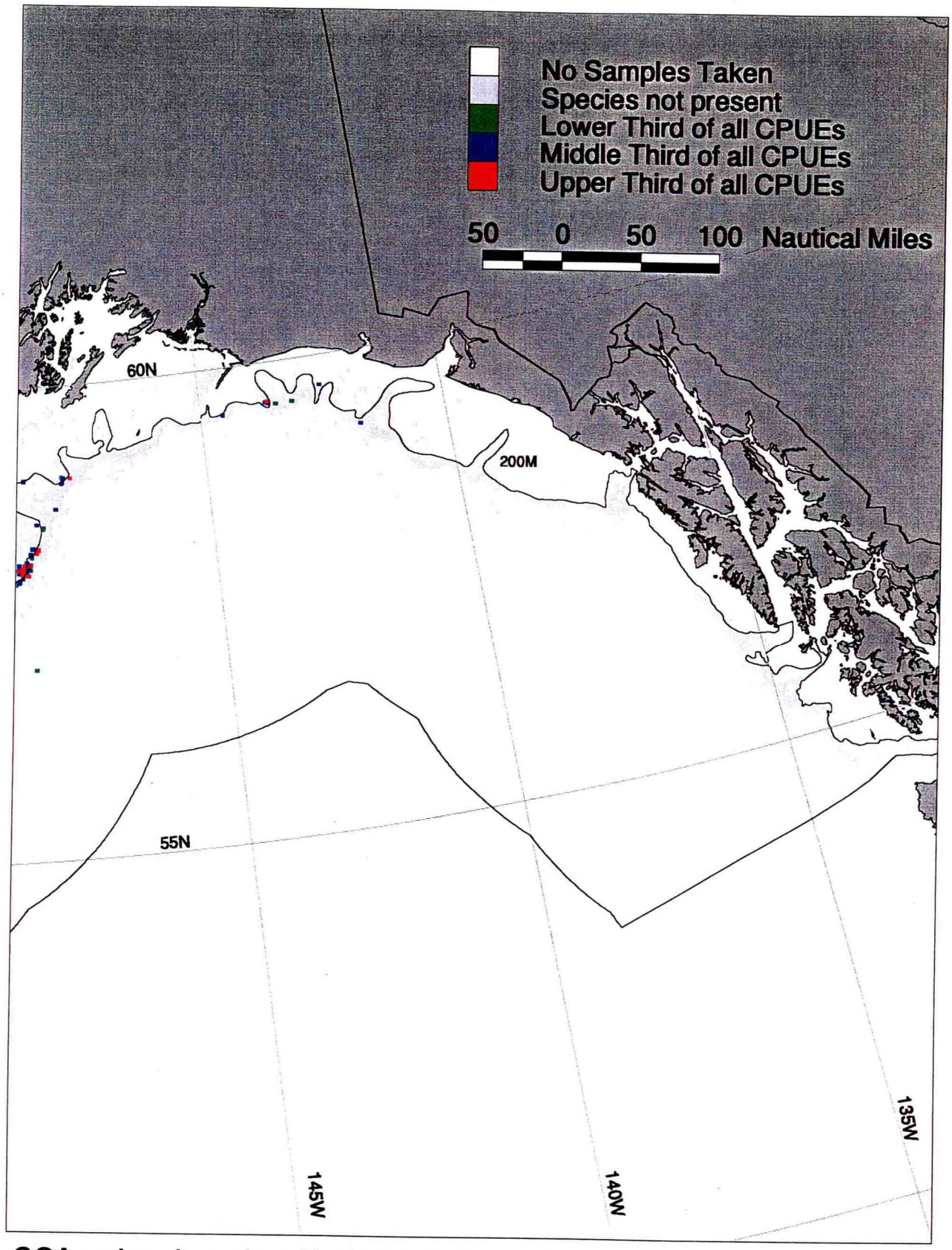


Figure 28.b Atka mackerel catch per unit effort (CPUE) summary for



GOA region, based on Alaskan trawl groundfish observer data.

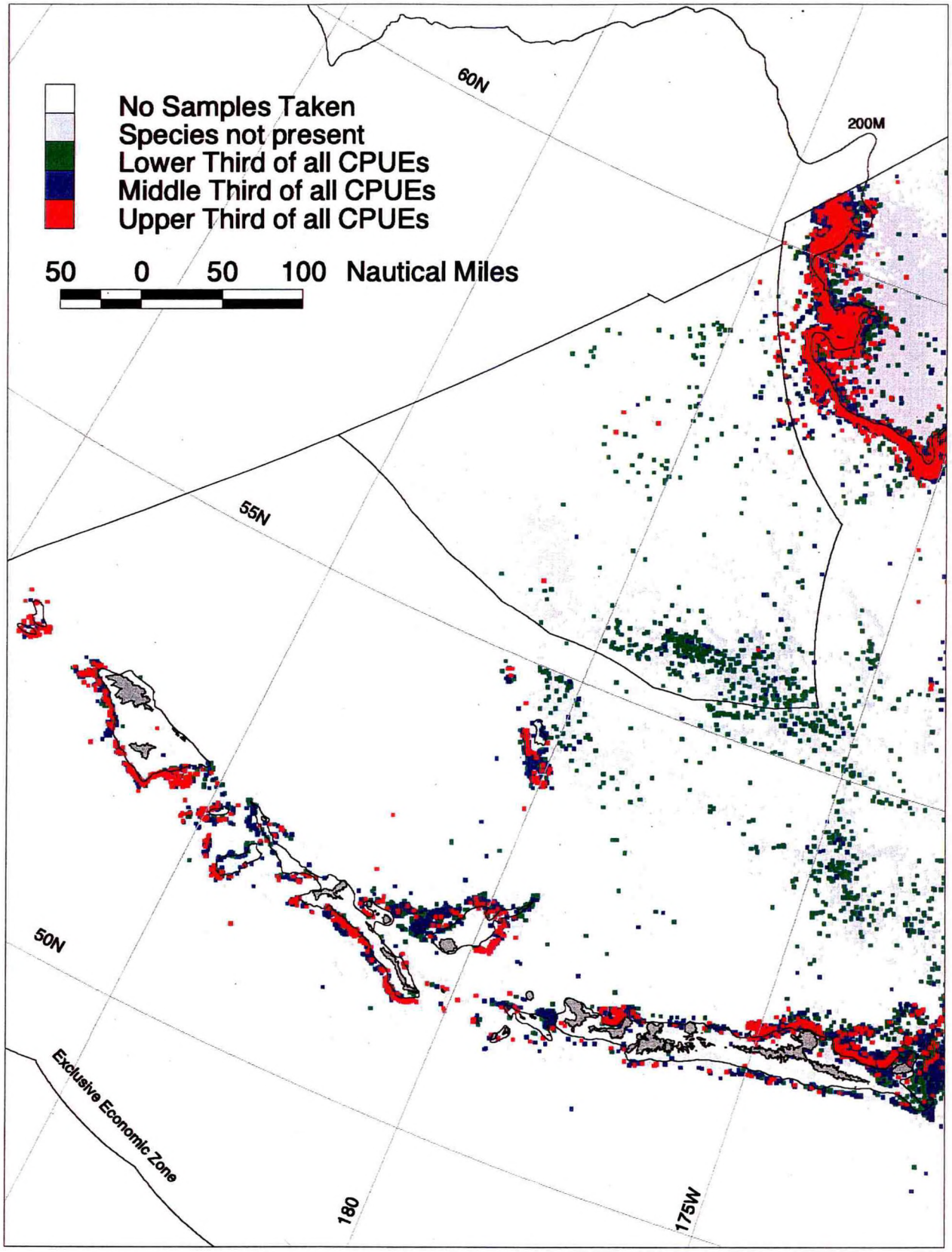
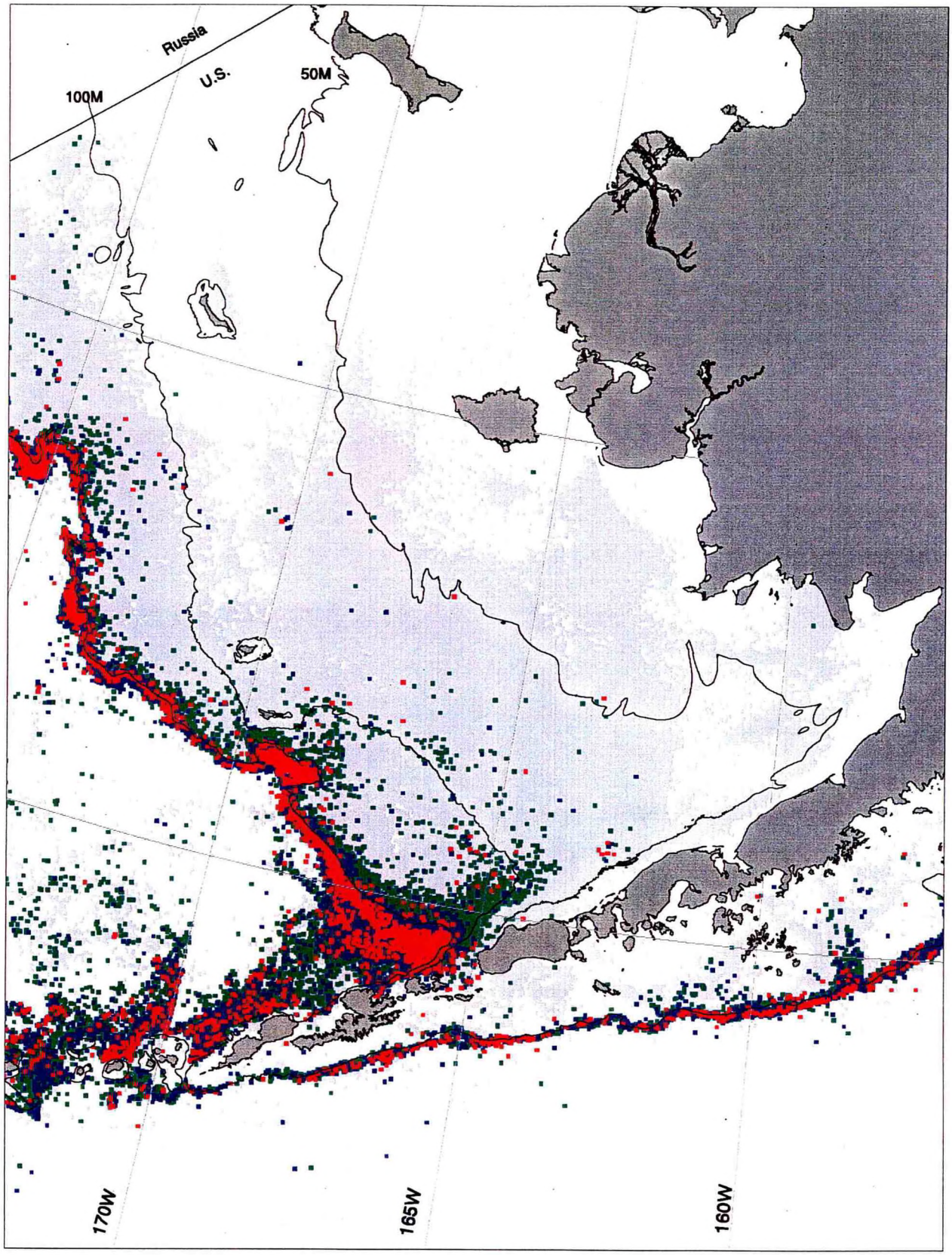


Figure 29.a Squid catch per unit effort (CPUE) summary for



BSAI region, based on Alaskan trawl groundfish observer data.

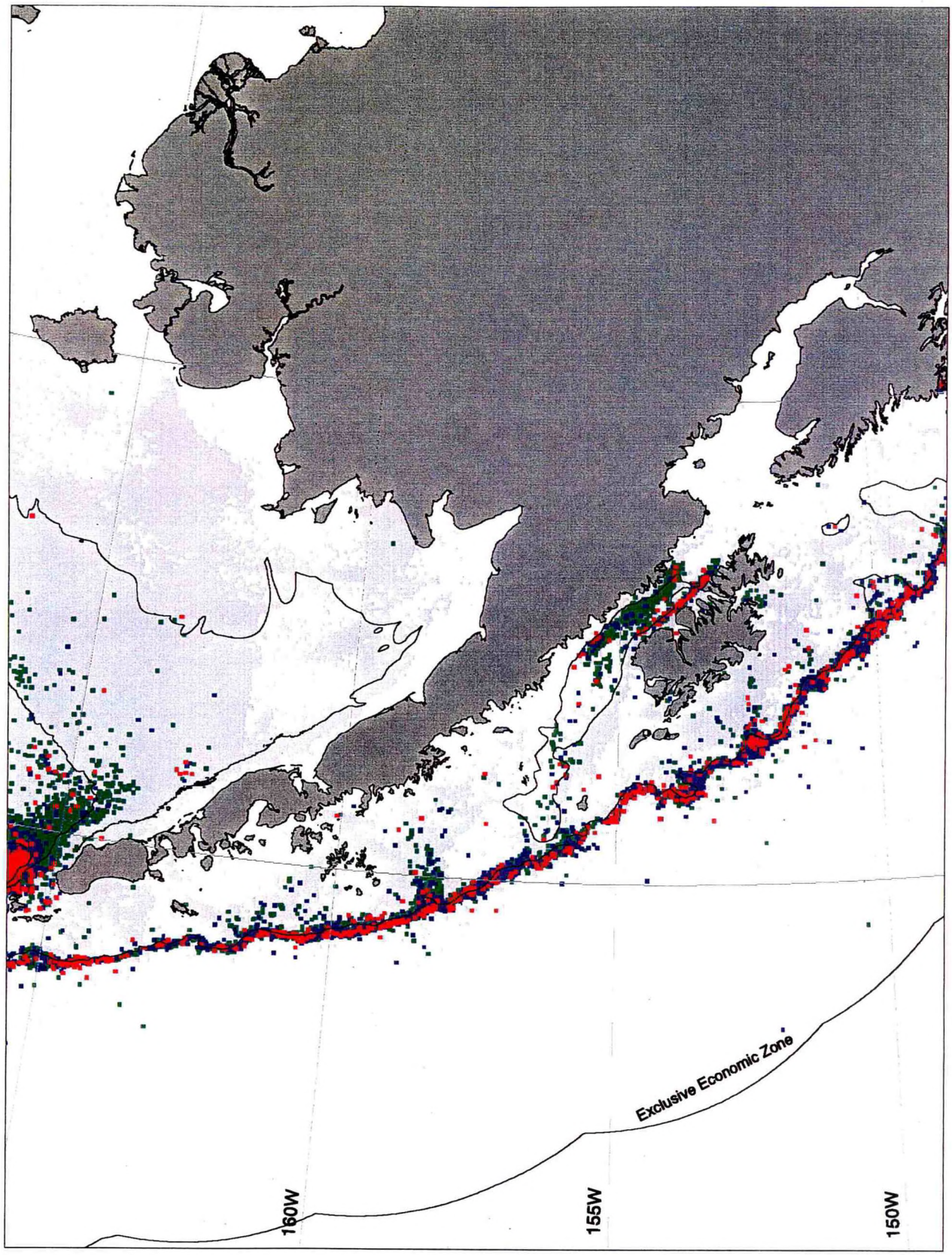
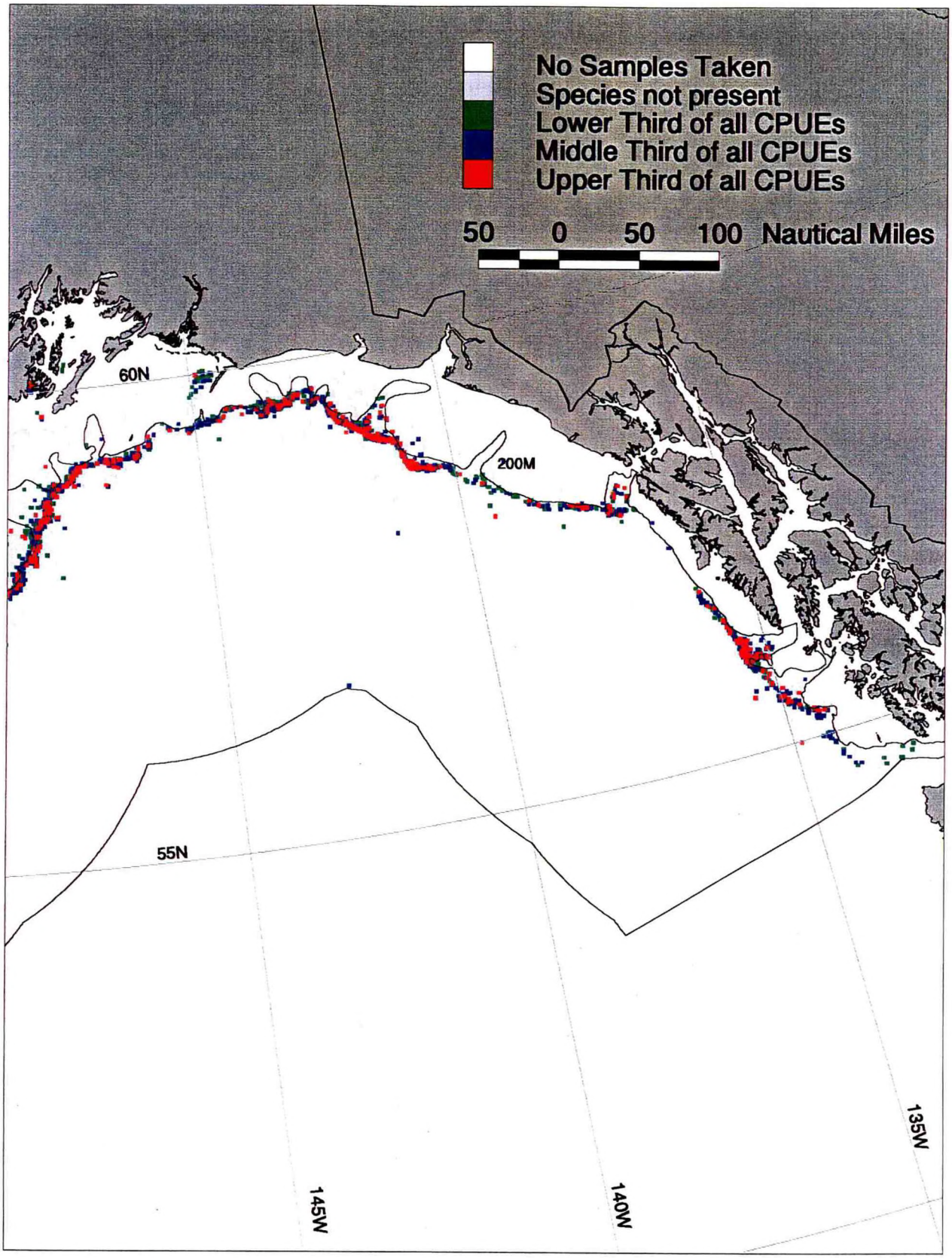


Figure 29.b Squid catch per unit effort (CPUE) summary for



GOA region, based on Alaskan trawl groundfish observer data.

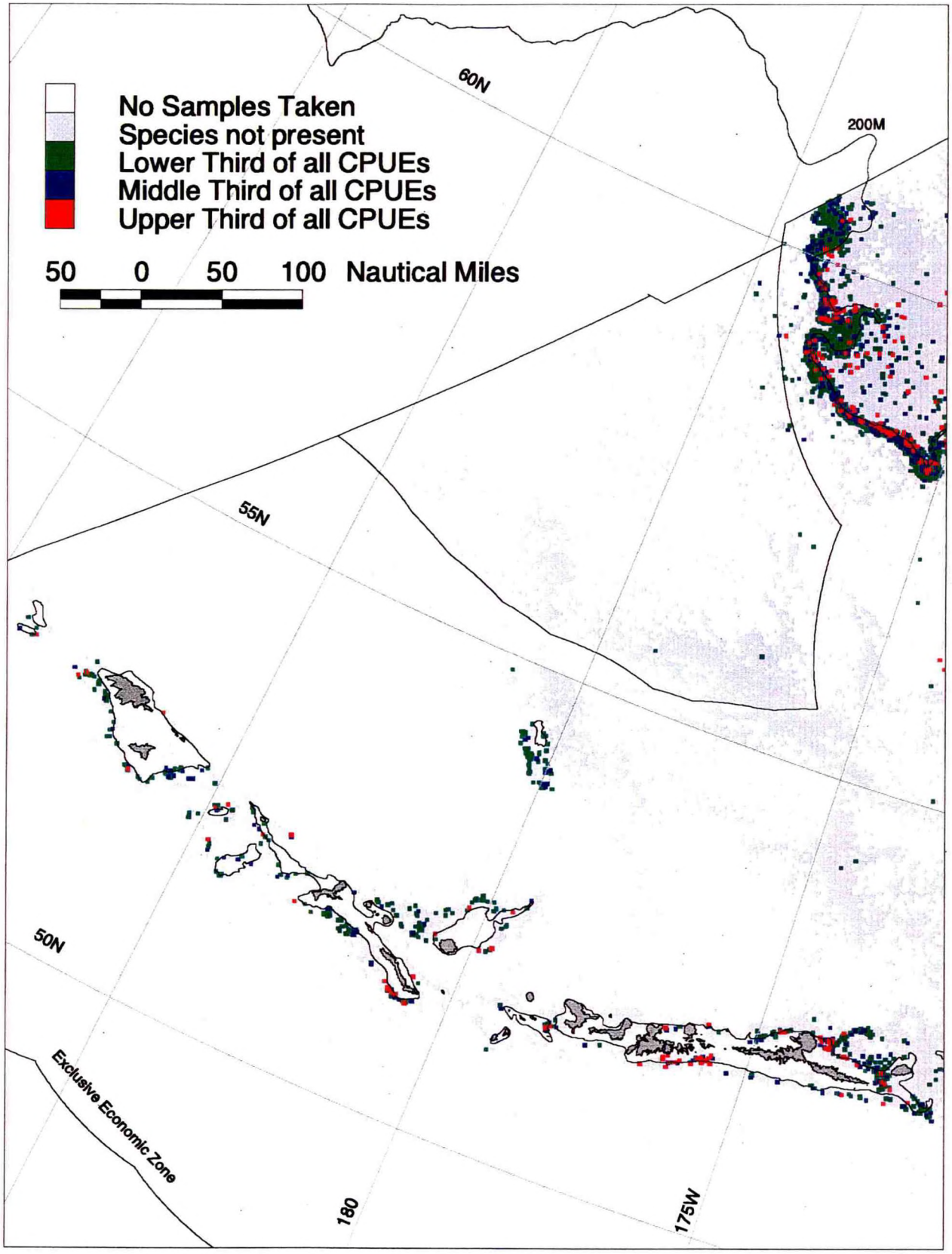
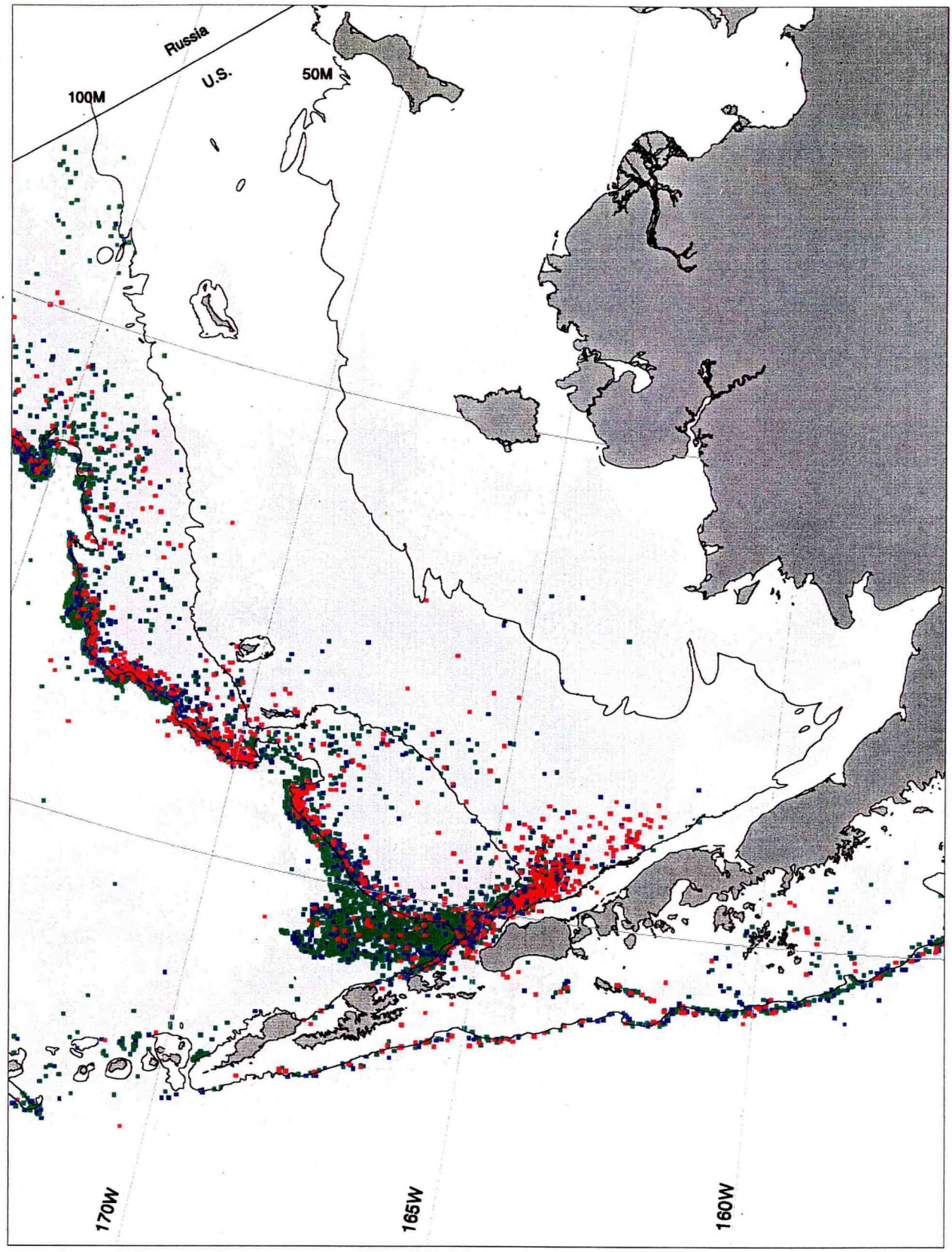


Figure 30.a Octopus catch per unit effort (CPUE) summary for



BSAI region, based on Alaskan trawl groundfish observer data.

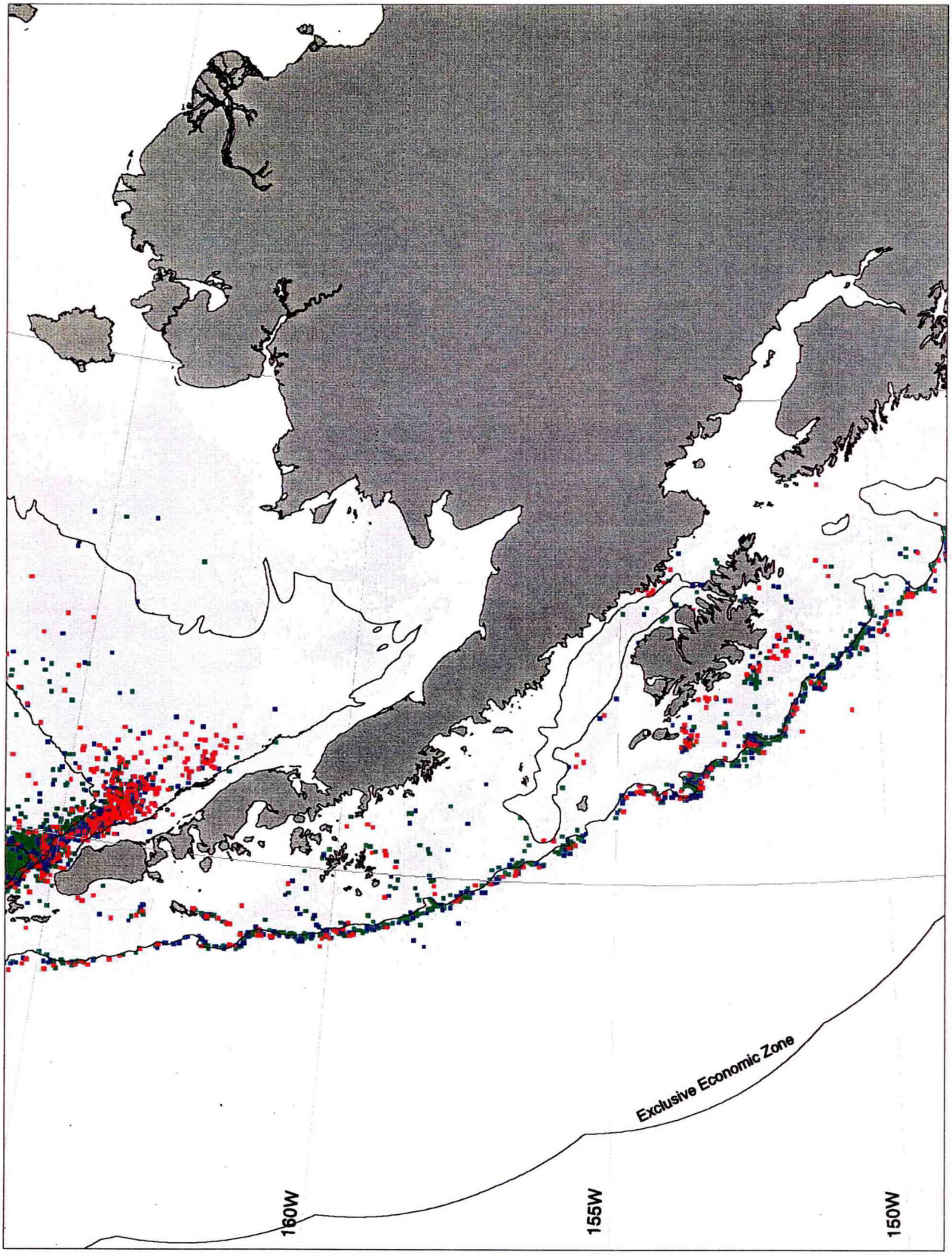
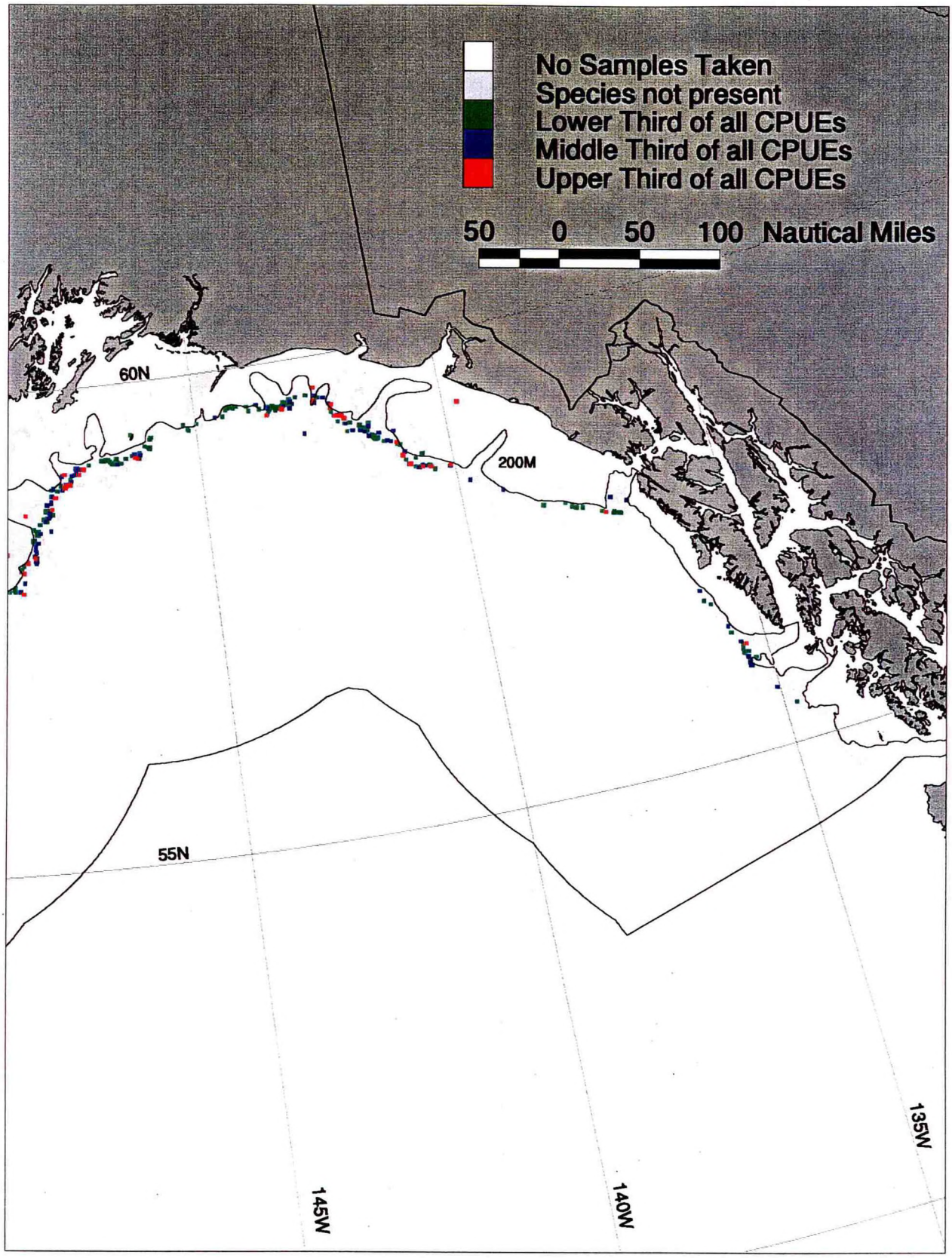


Figure 30.b Octopus catch per unit effort (CPUE) summary for



GOA region, based on Alaskan trawl groundfish observer data.

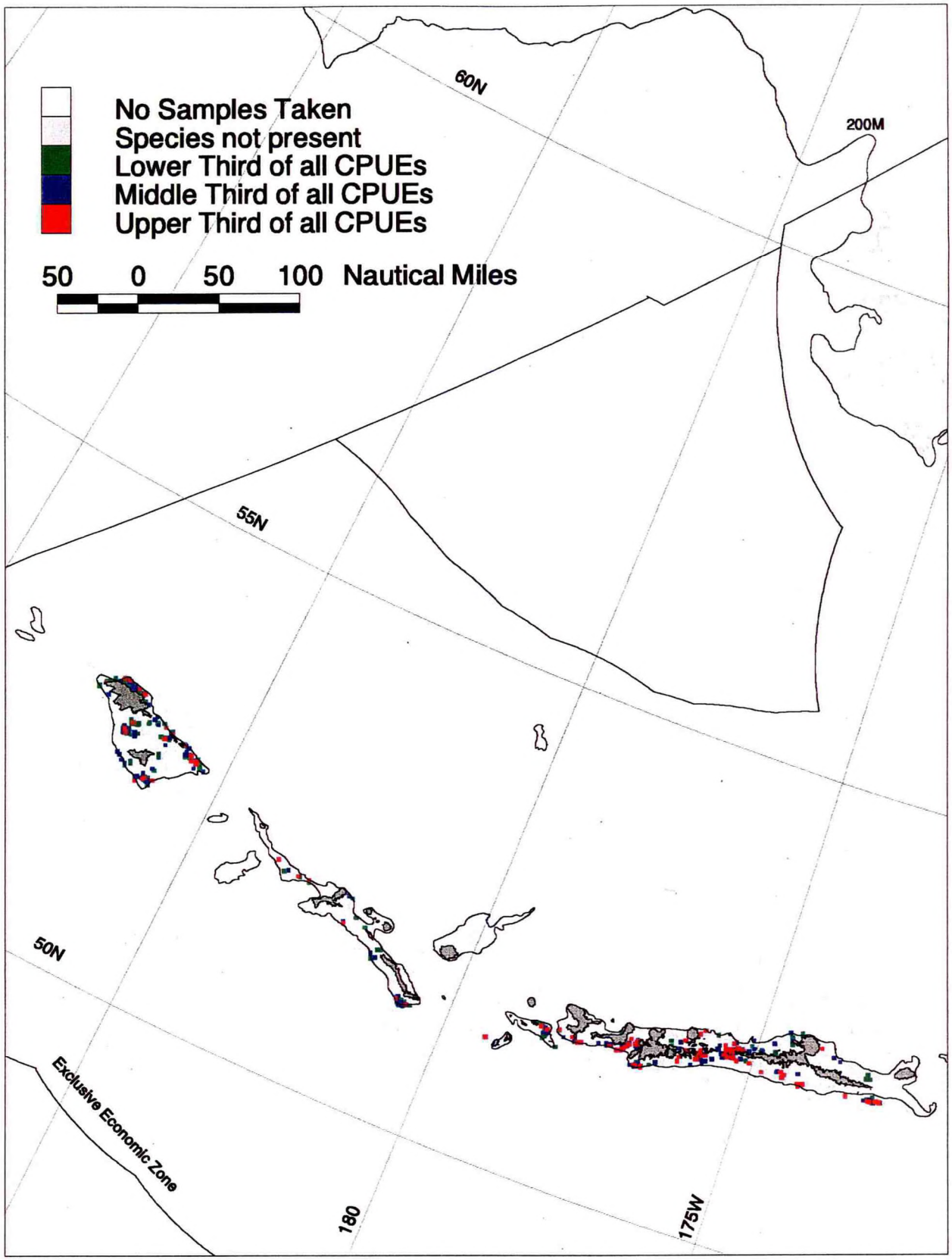
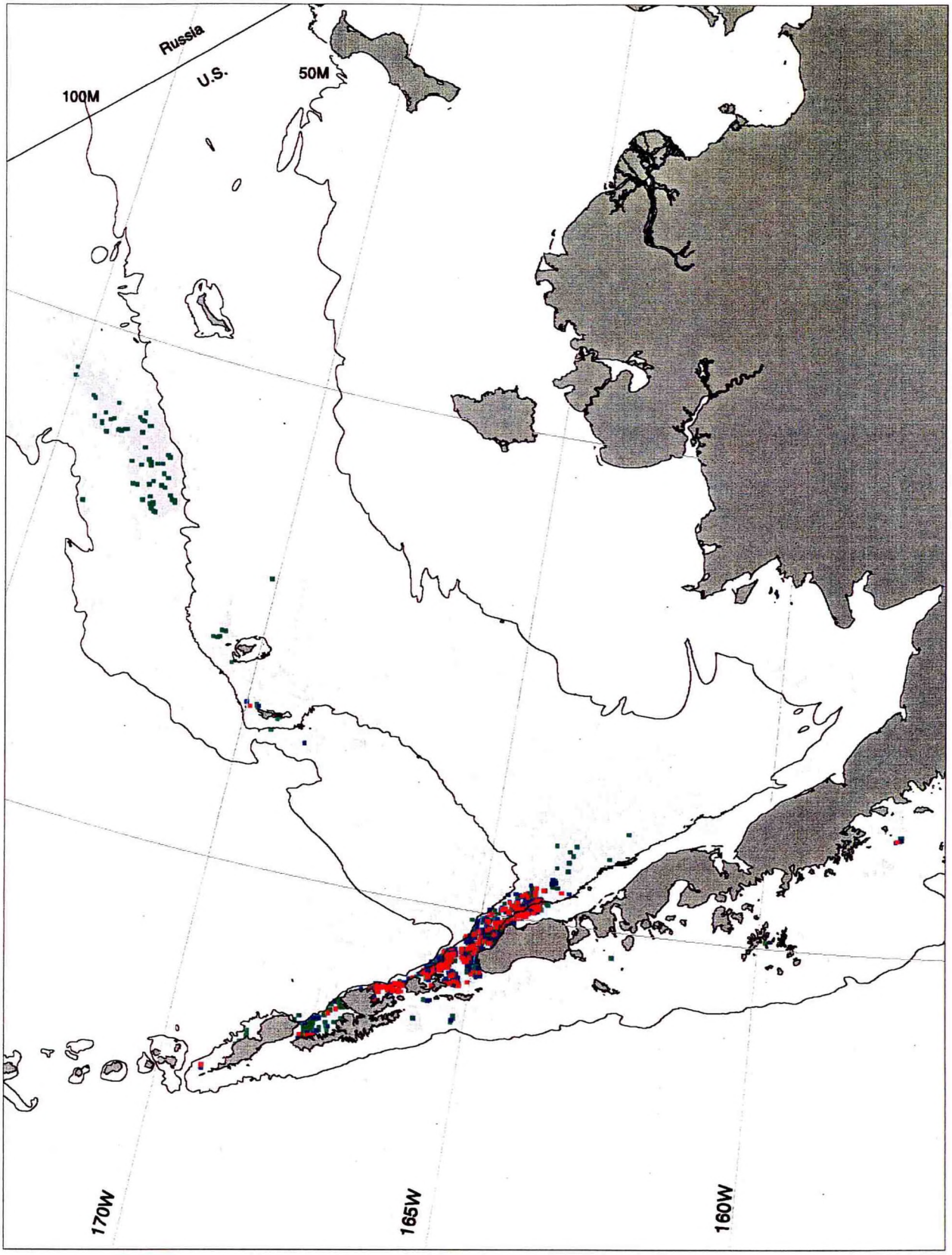


Figure 31.a Octopus catch per unit effort (CPUE) summary for



BSAI region, based on Alaskan pot groundfish observer data.

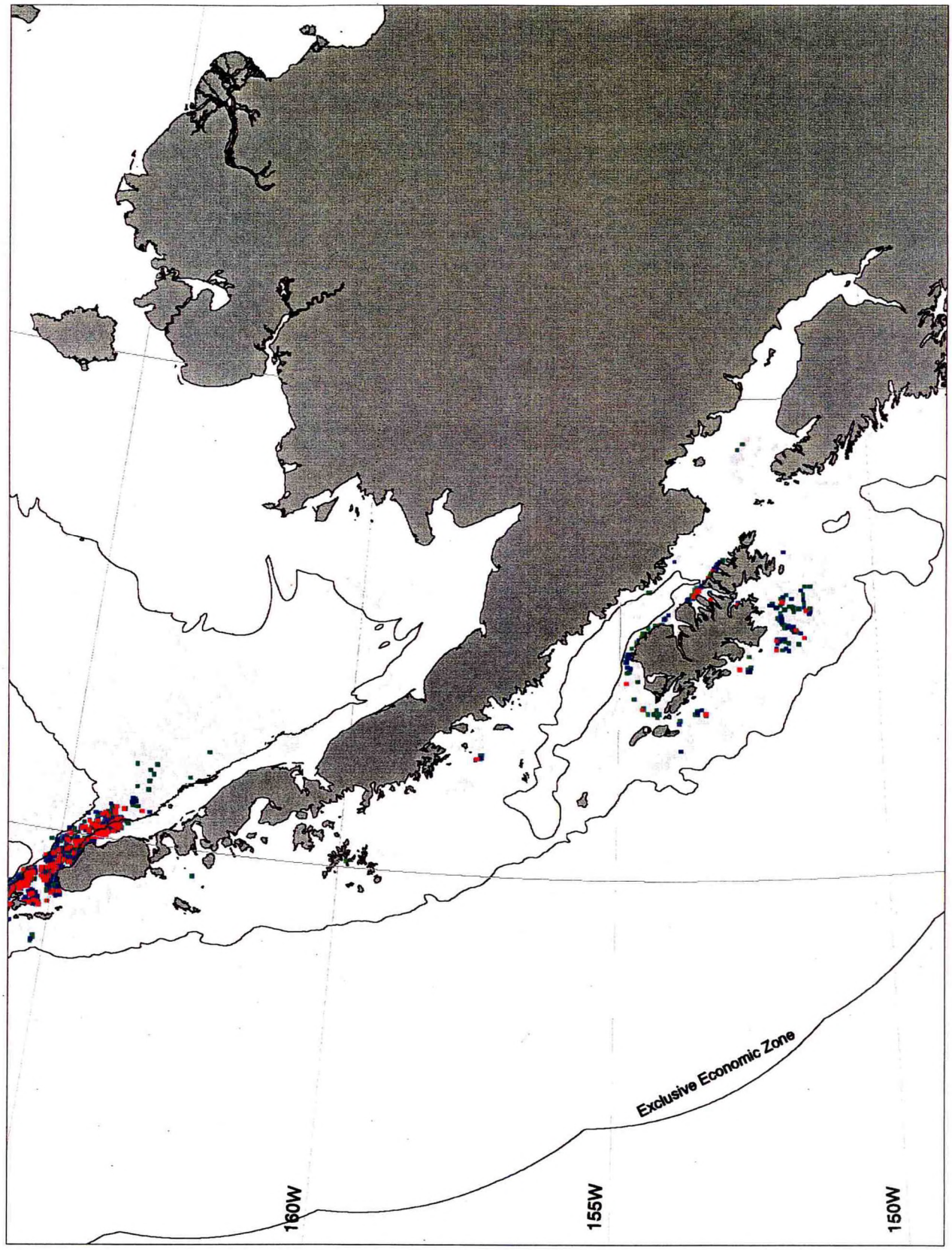
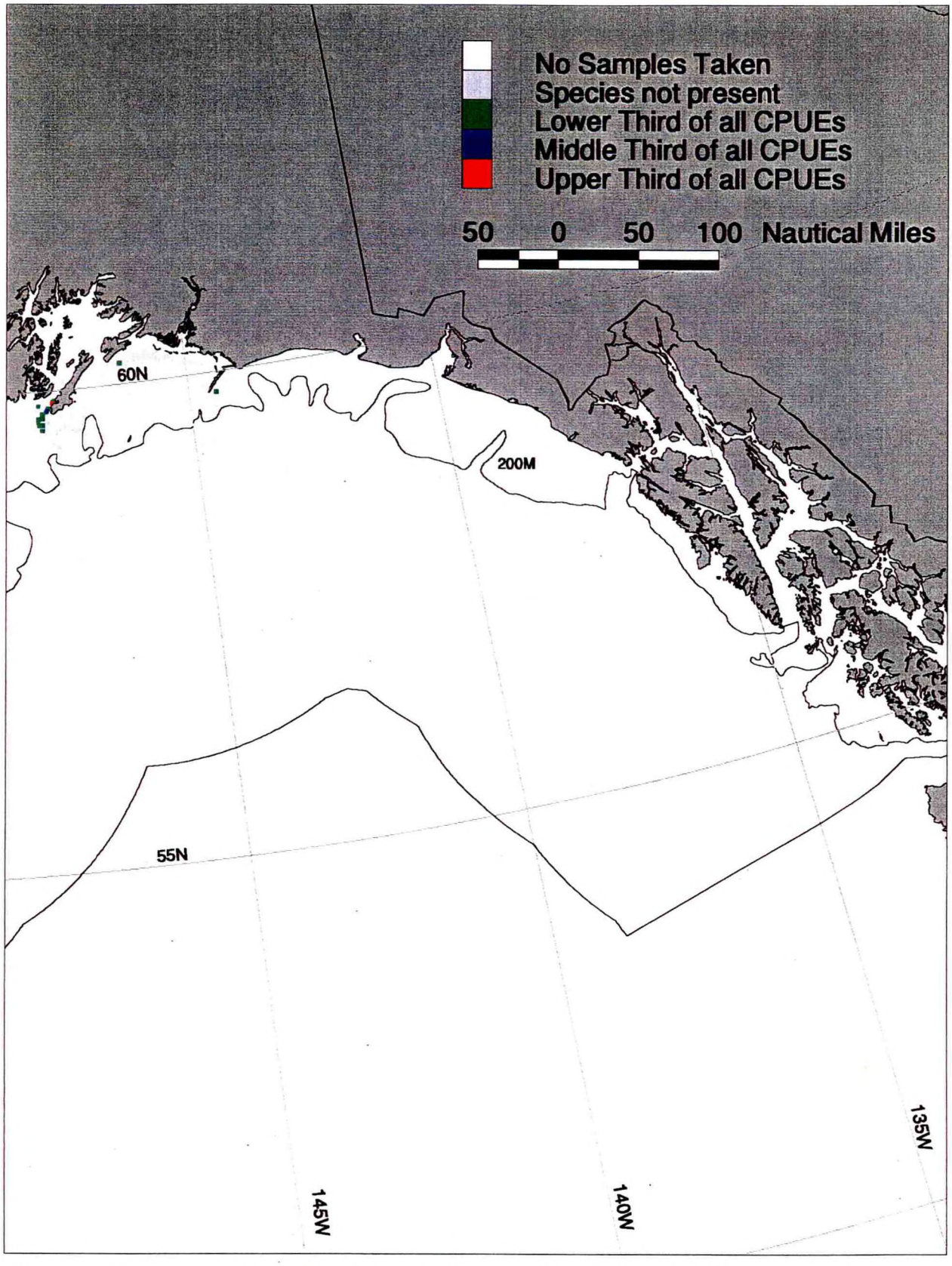


Figure 31.b Octopus catch per unit effort (CPUE) summary for



GOA region, based on Alaskan pot groundfish observer data.

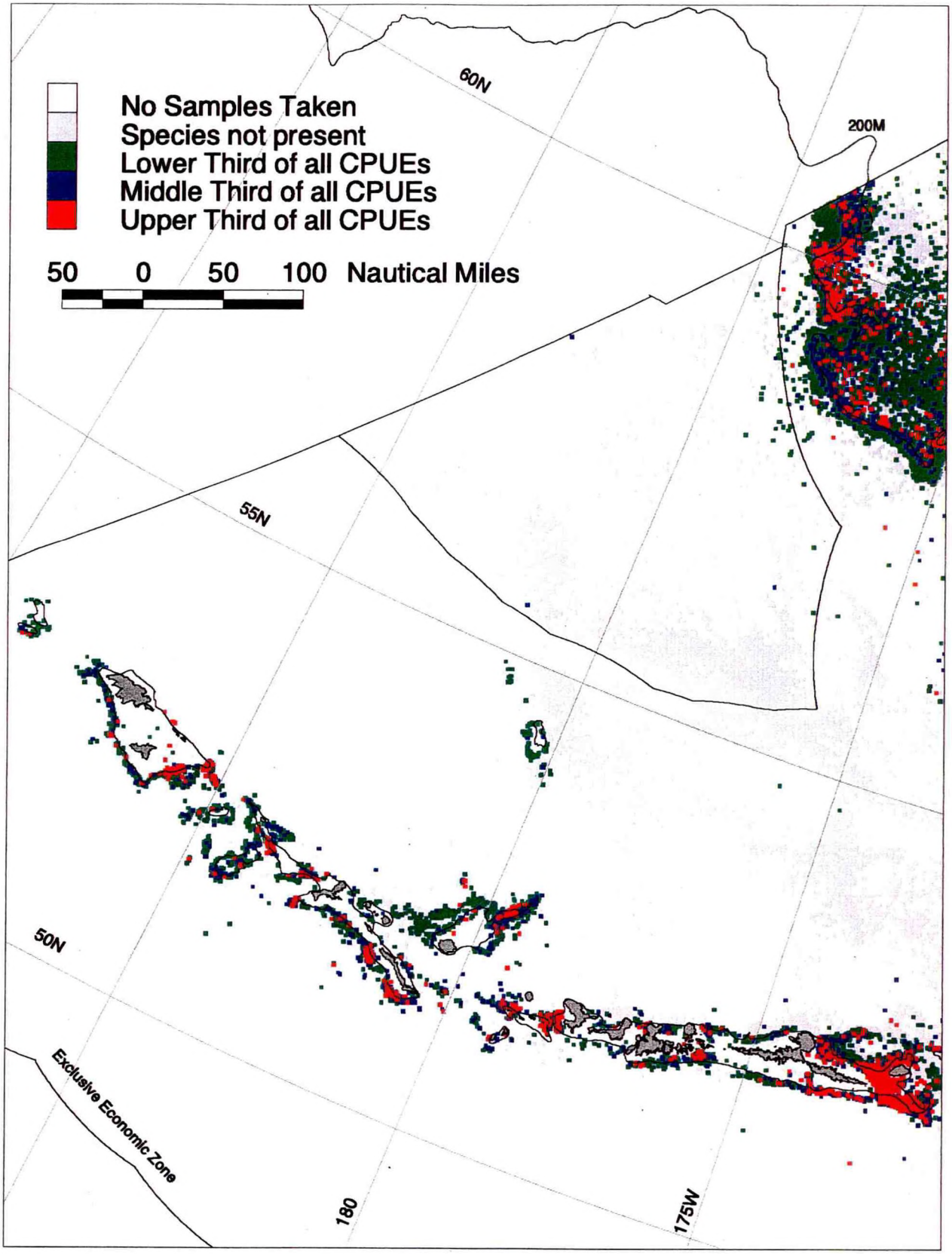
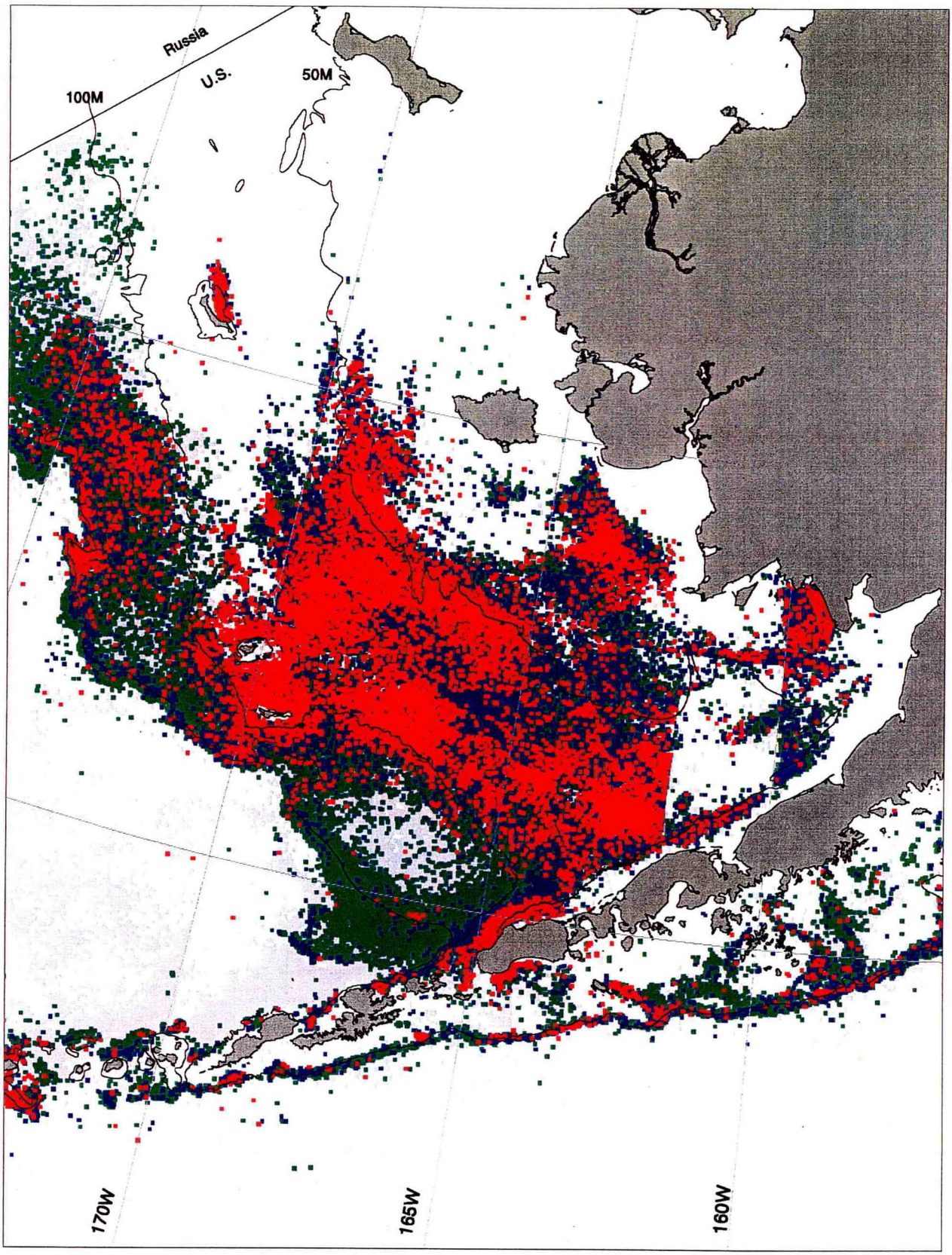


Figure 32.a Sculpins catch per unit effort (CPUE) summary for



BSAI region, based on Alaskan trawl groundfish observer data.

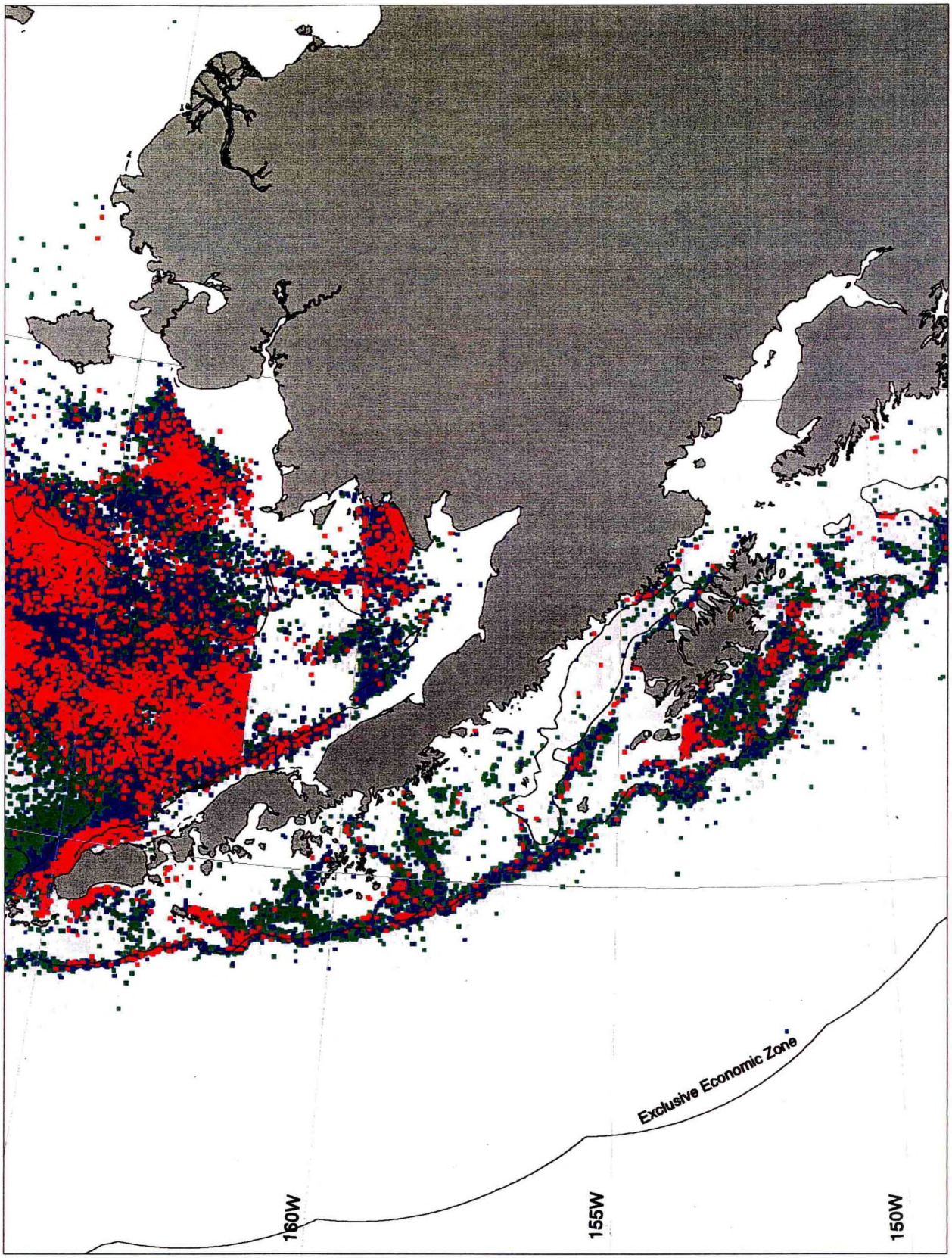
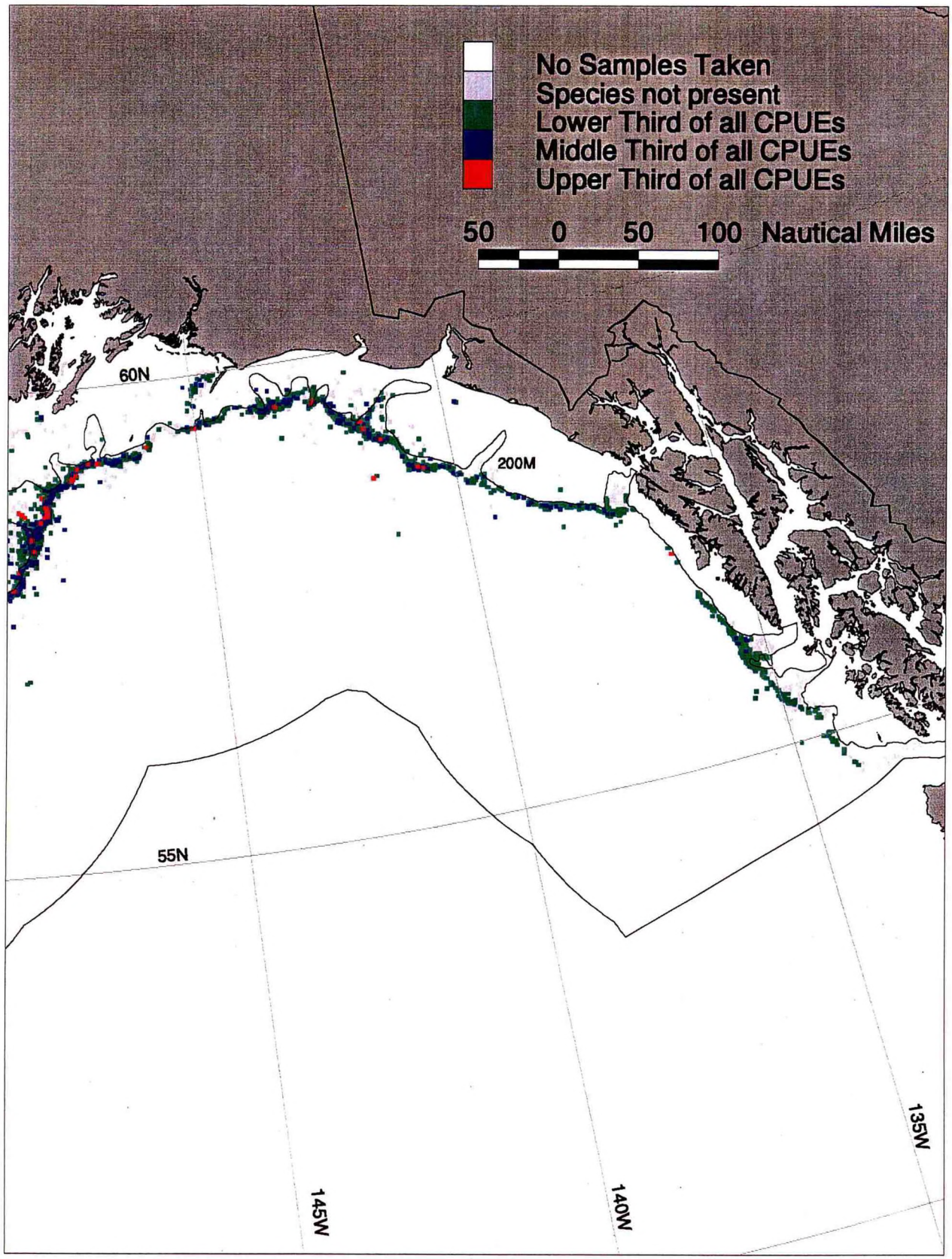


Figure 32.b Sculpins catch per unit effort (CPUE) summary for



GOA region, based on Alaskan trawl groundfish observer data.

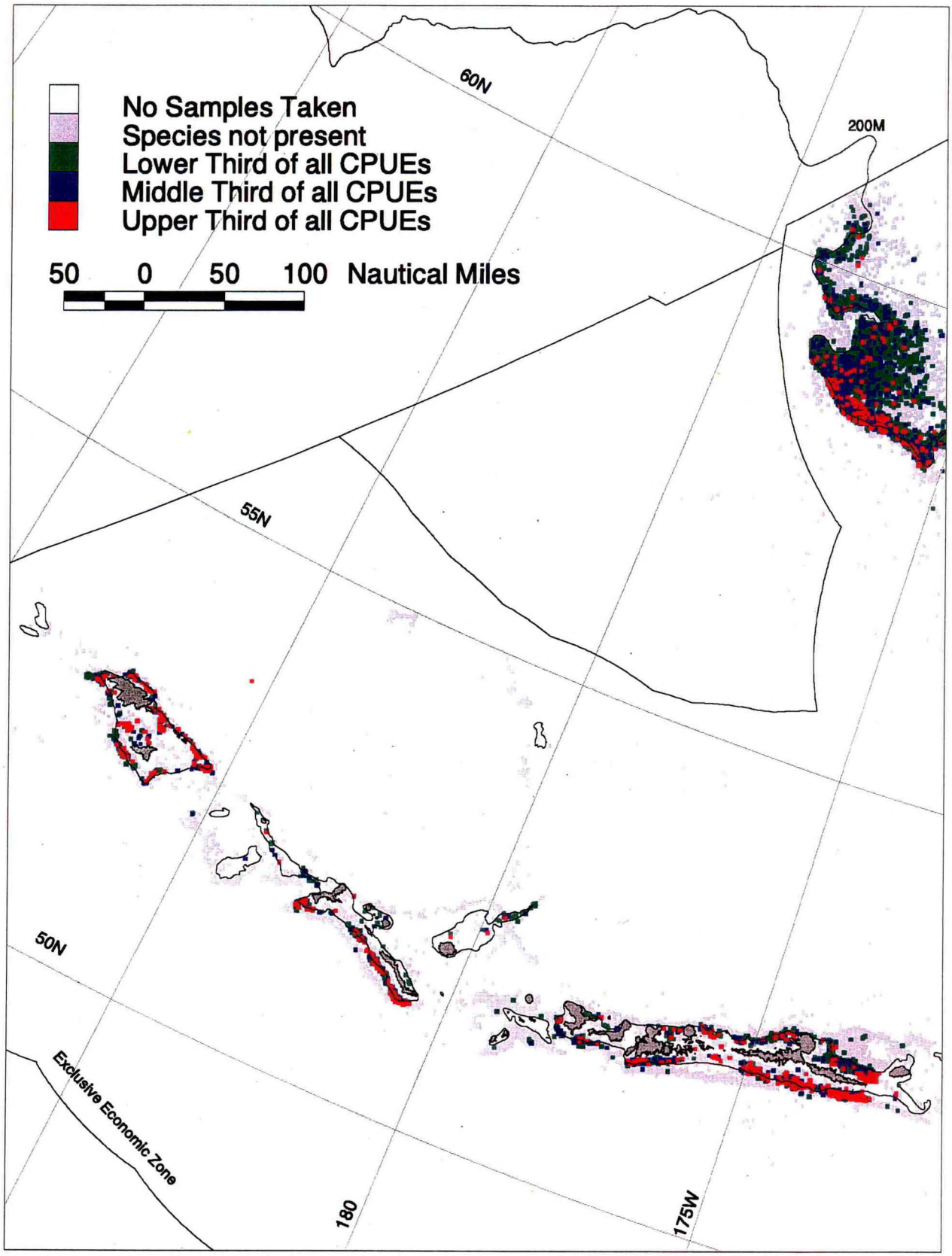
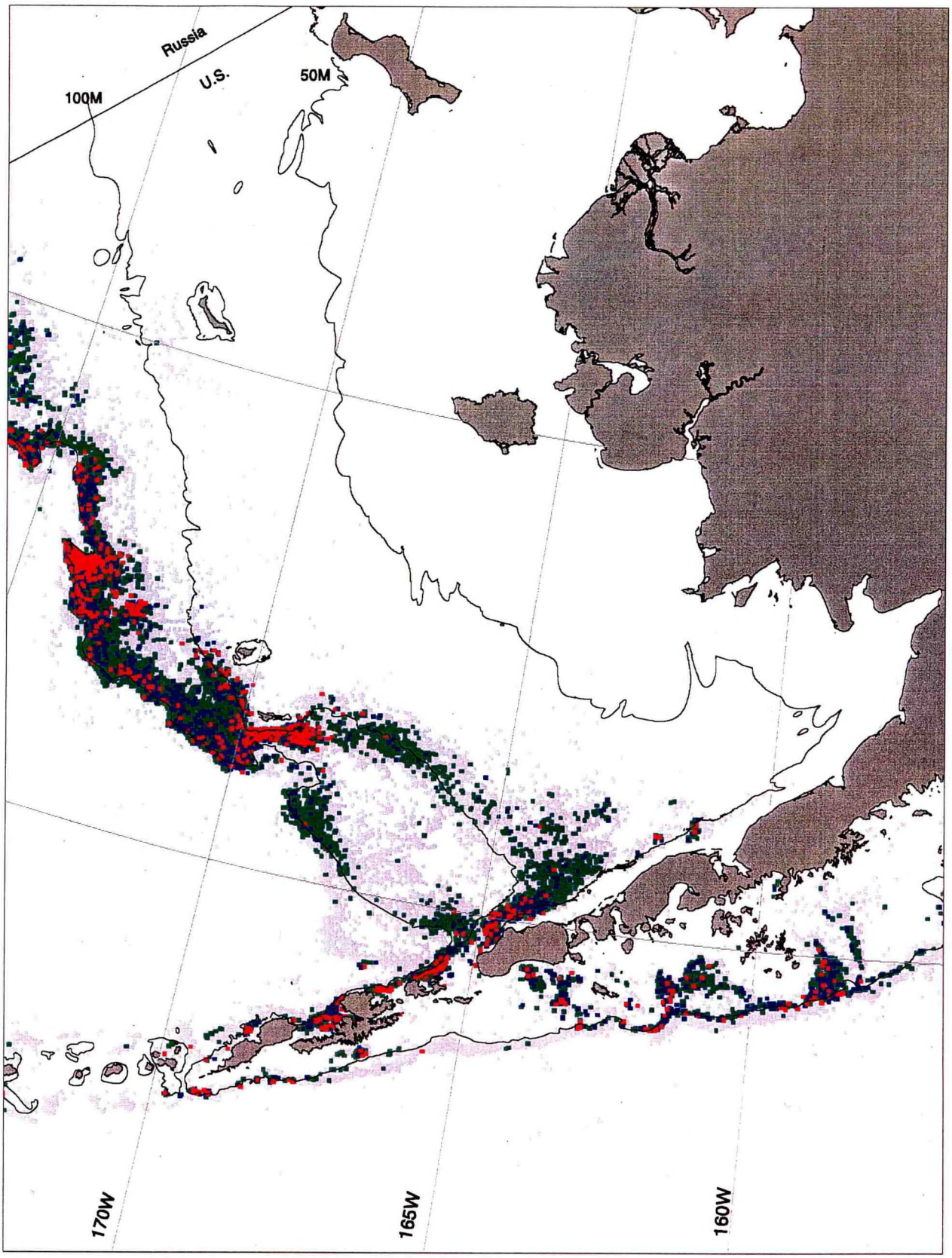


Figure 33.a Sculpin catch per unit effort (CPUE) summary for



BSAI region, based on Alaskan longline groundfish observer data.

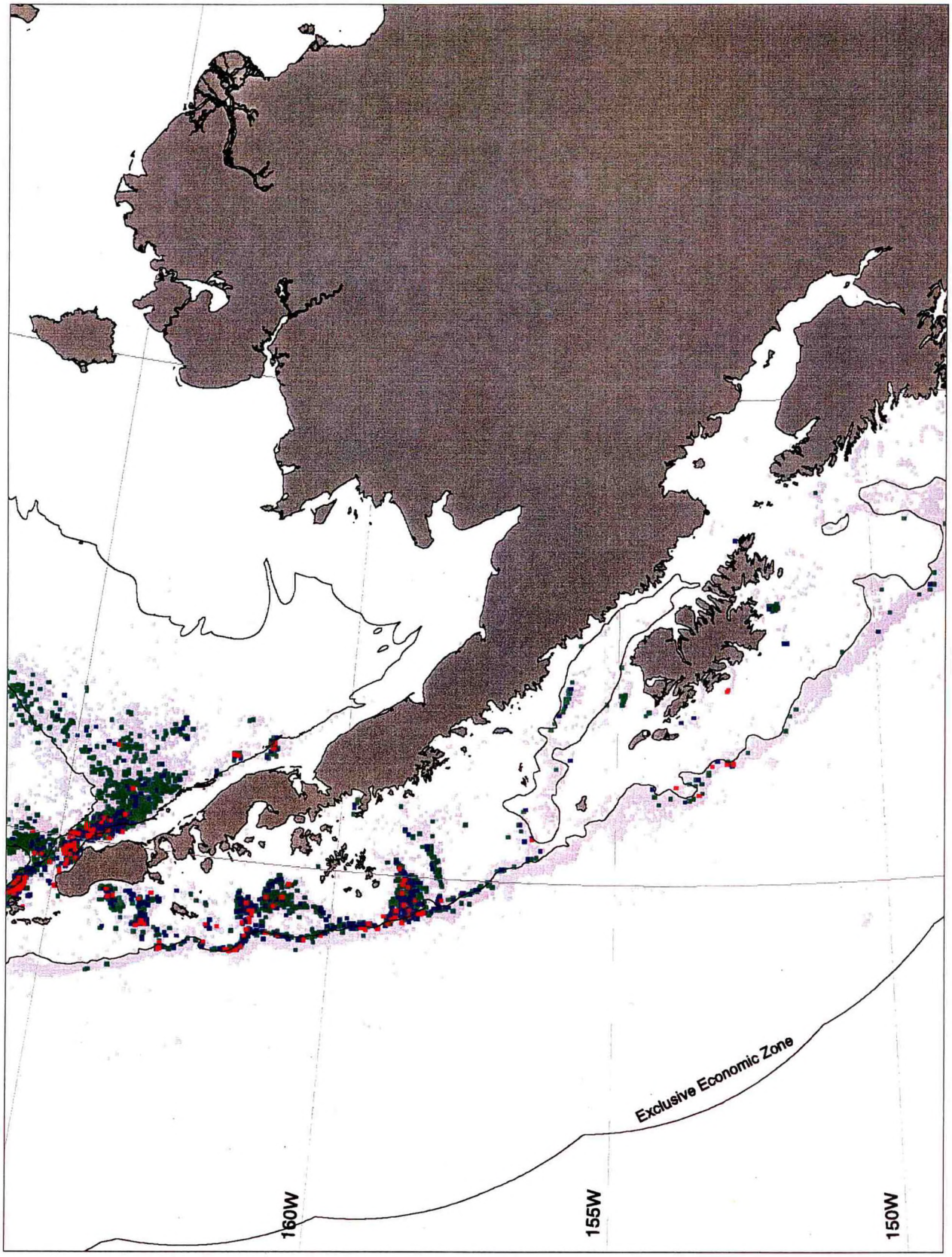
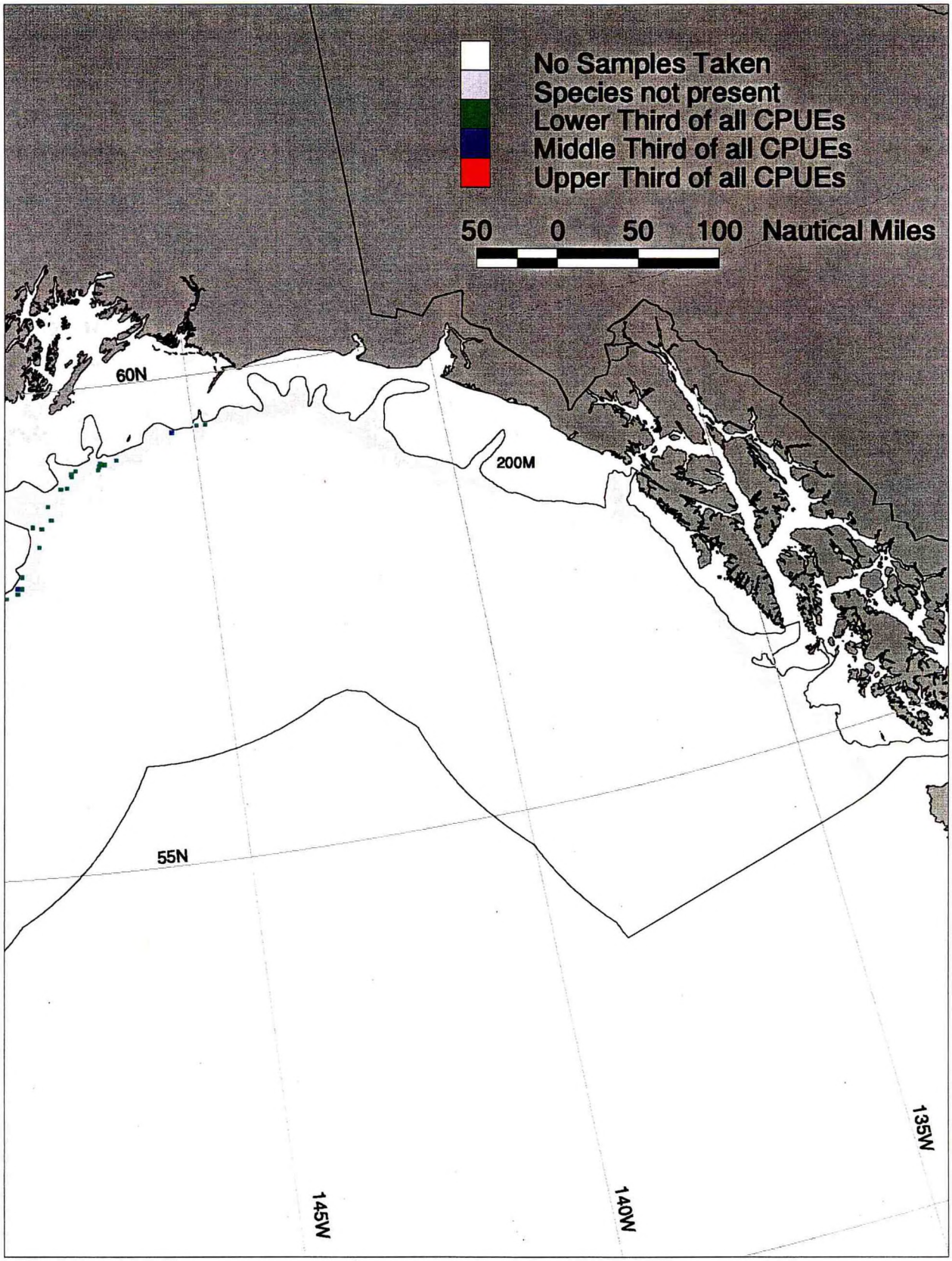


Figure 33.b Sculpin catch per unit effort (CPUE) summary for



GOA region, based on Alaskan longline groundfish observer data.

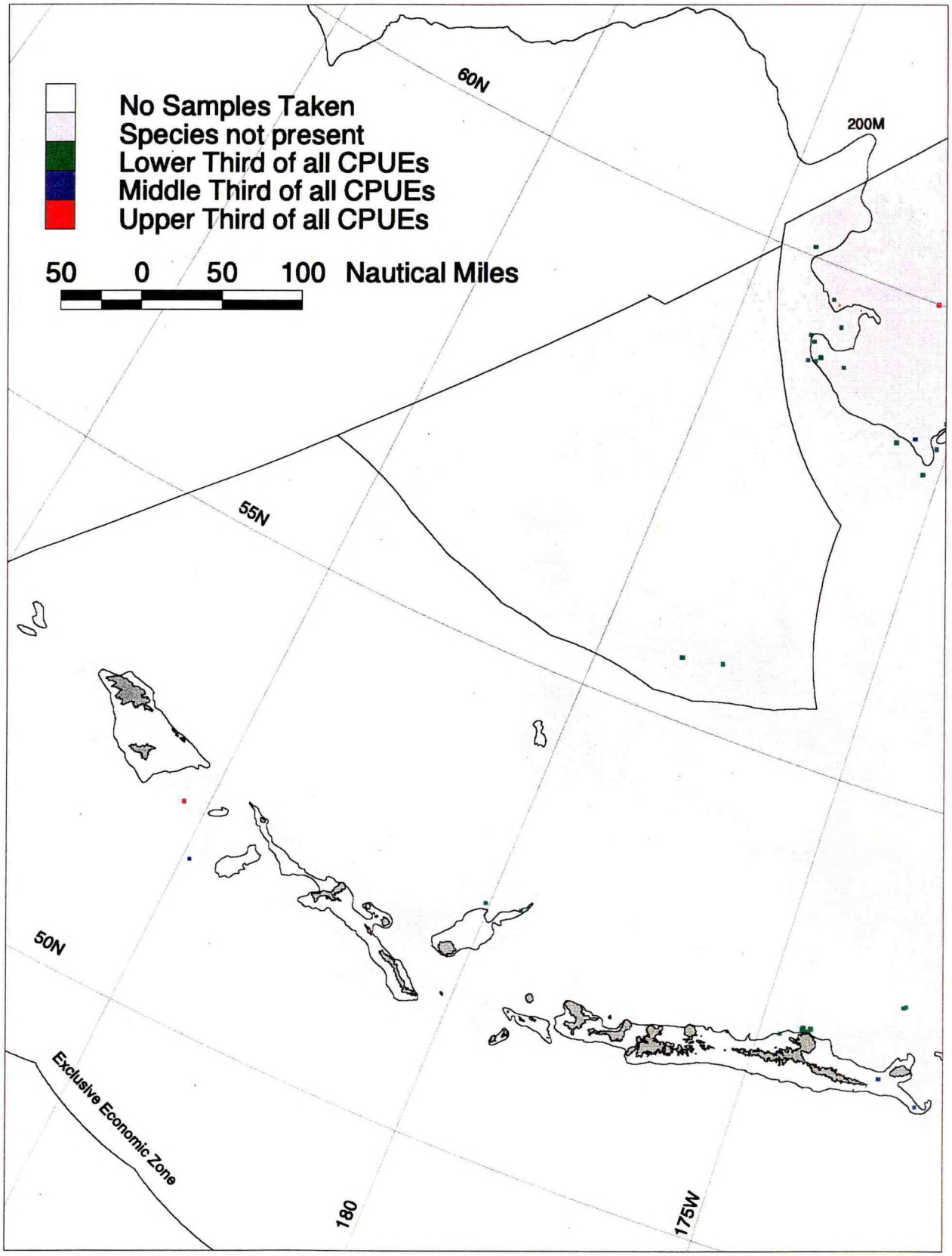
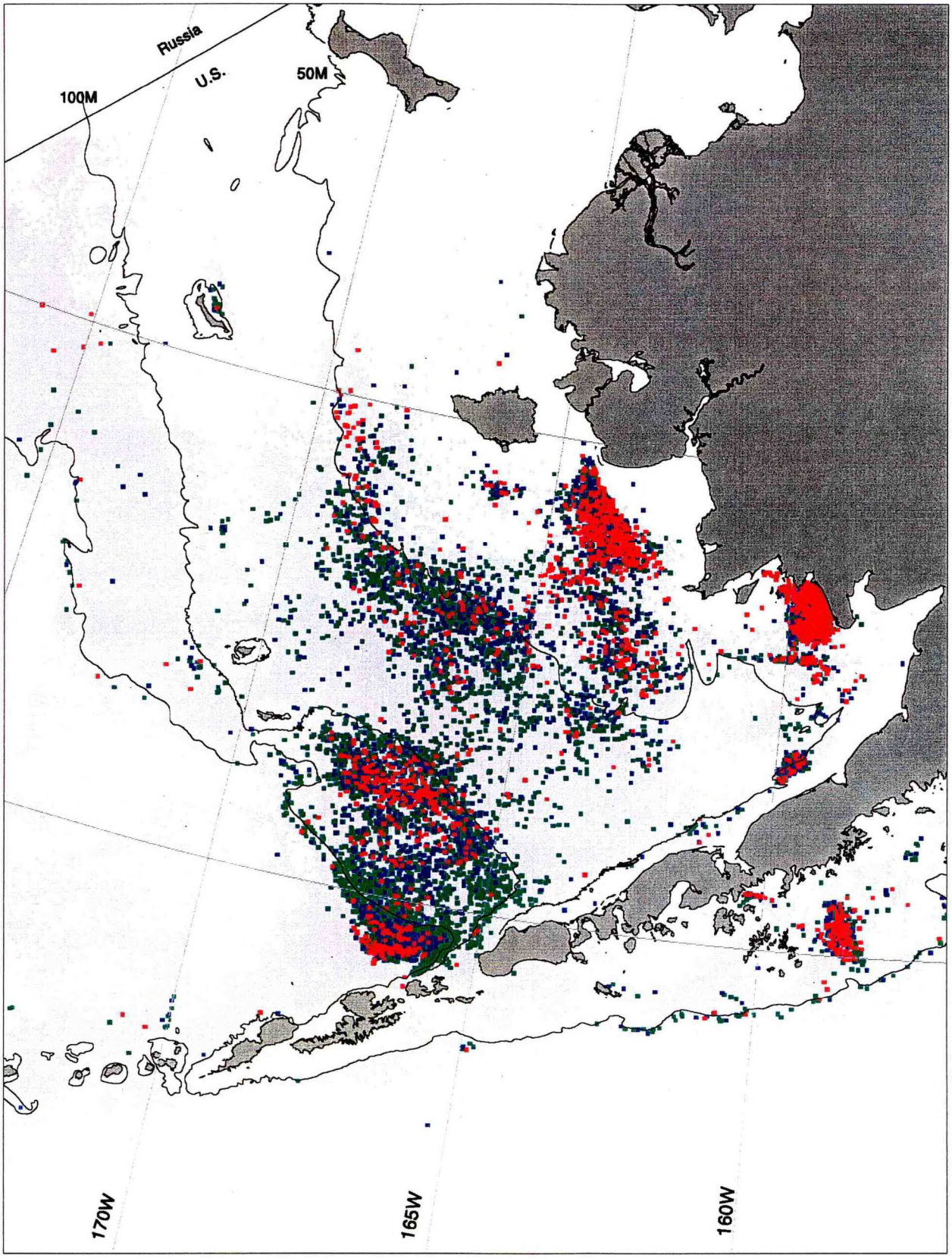


Figure 34.a Smelt catch per unit effort (CPUE) summary for



BSAI region, based on Alaskan trawl groundfish observer data.

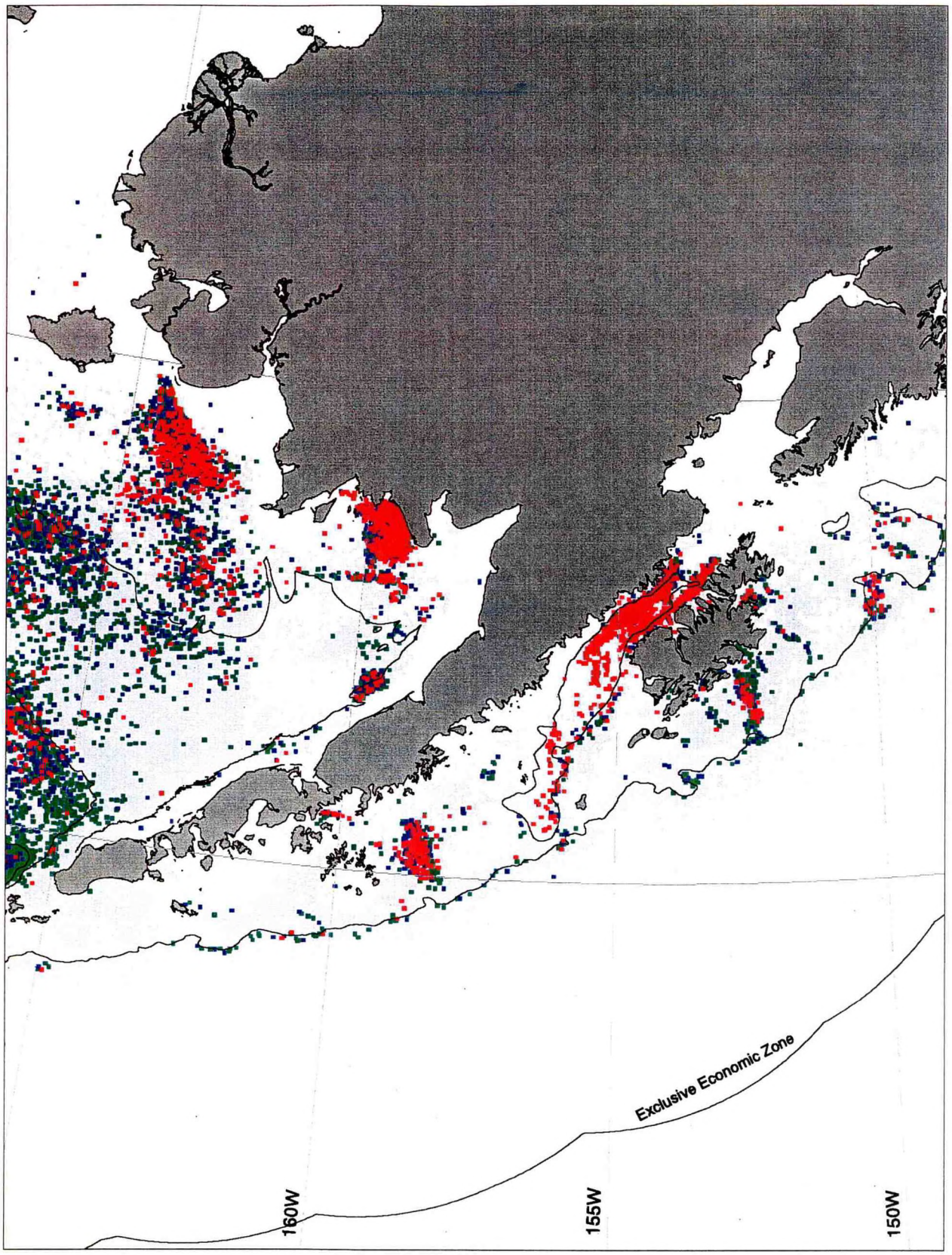
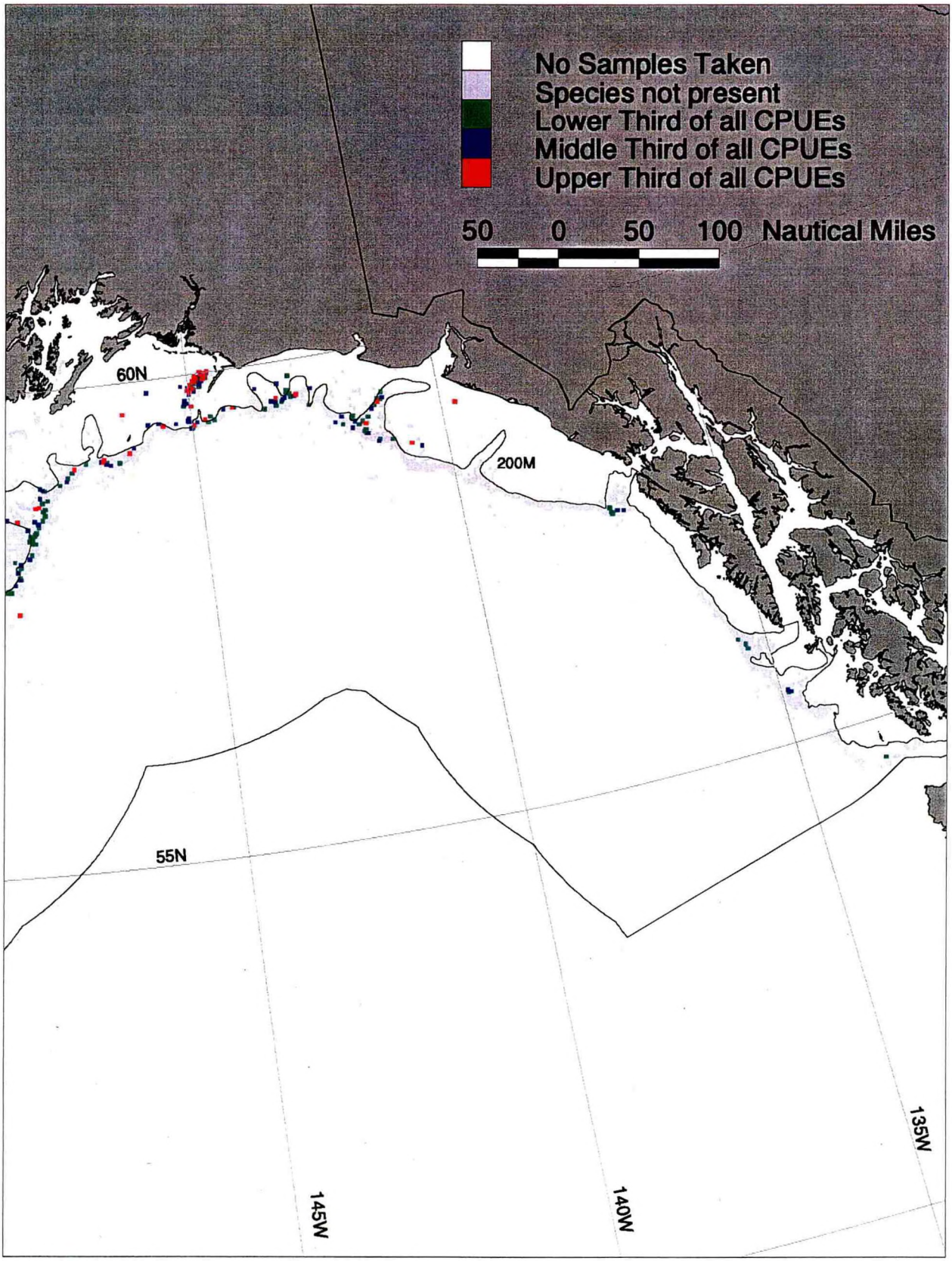


Figure 34.b Smelt catch per unit effort (CPUE) summary for



GOA region, based on Alaskan trawl groundfish observer data.

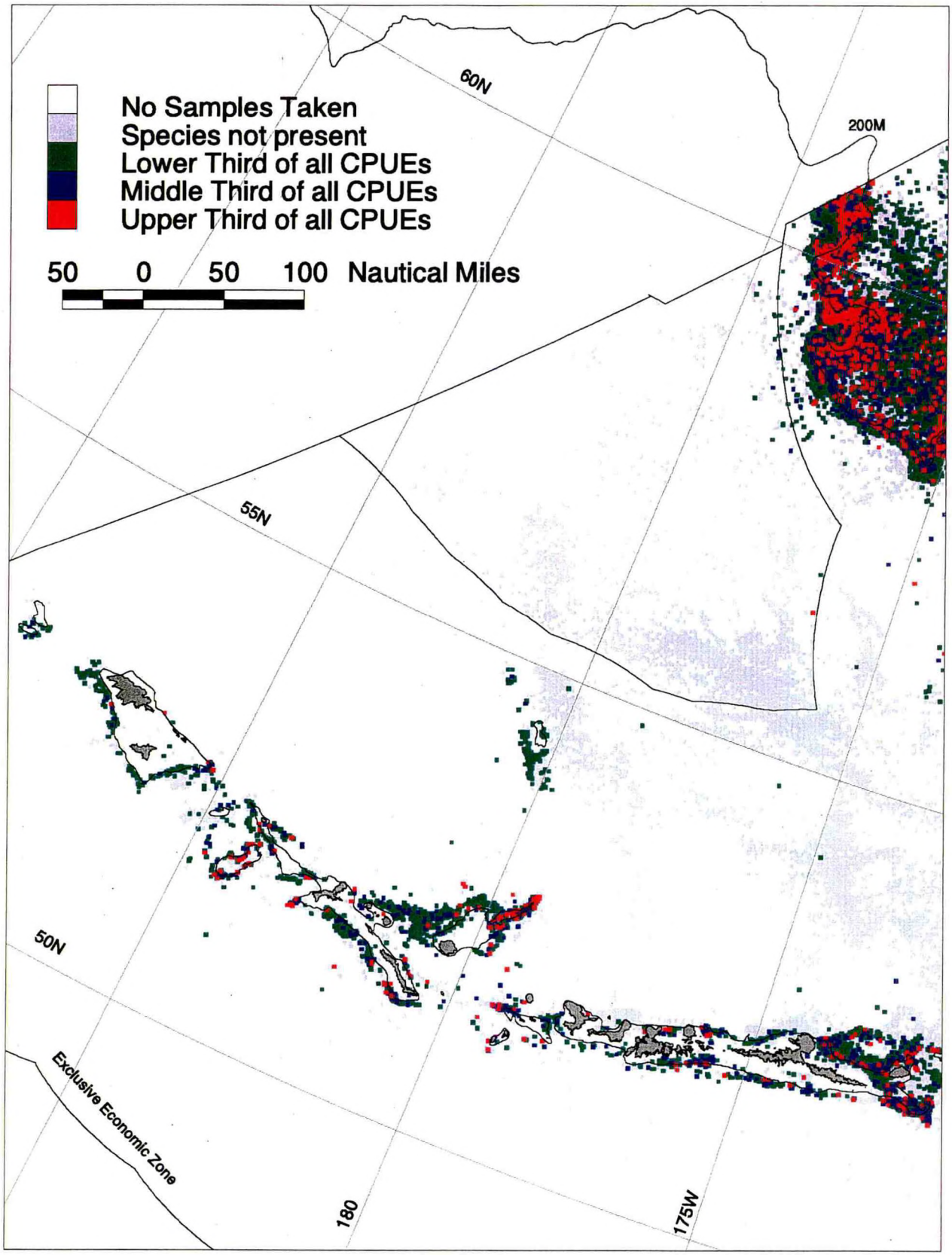
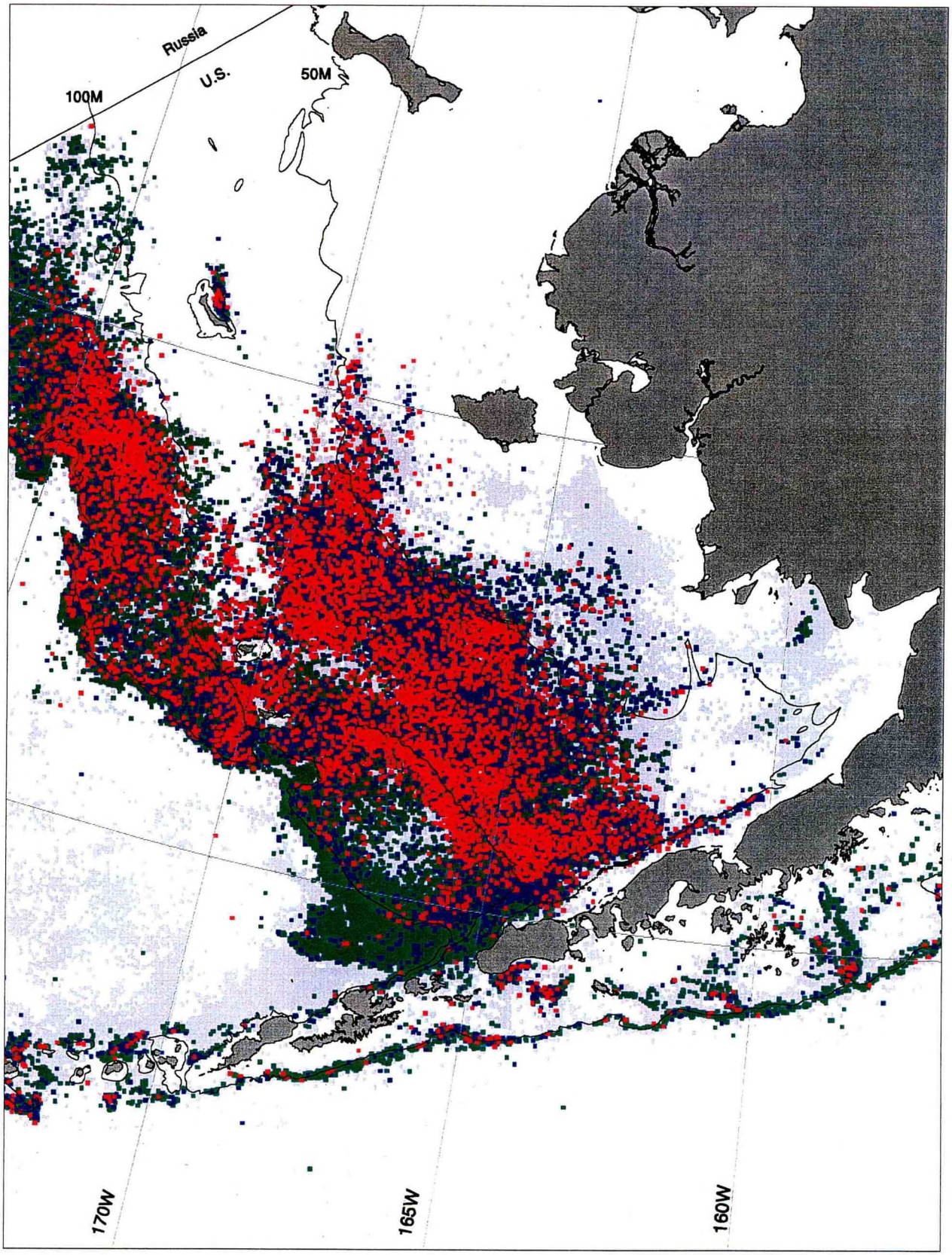


Figure 35.a Skates catch per unit effort (CPUE) summary for



BSAI region, based on Alaskan trawl groundfish observer data.

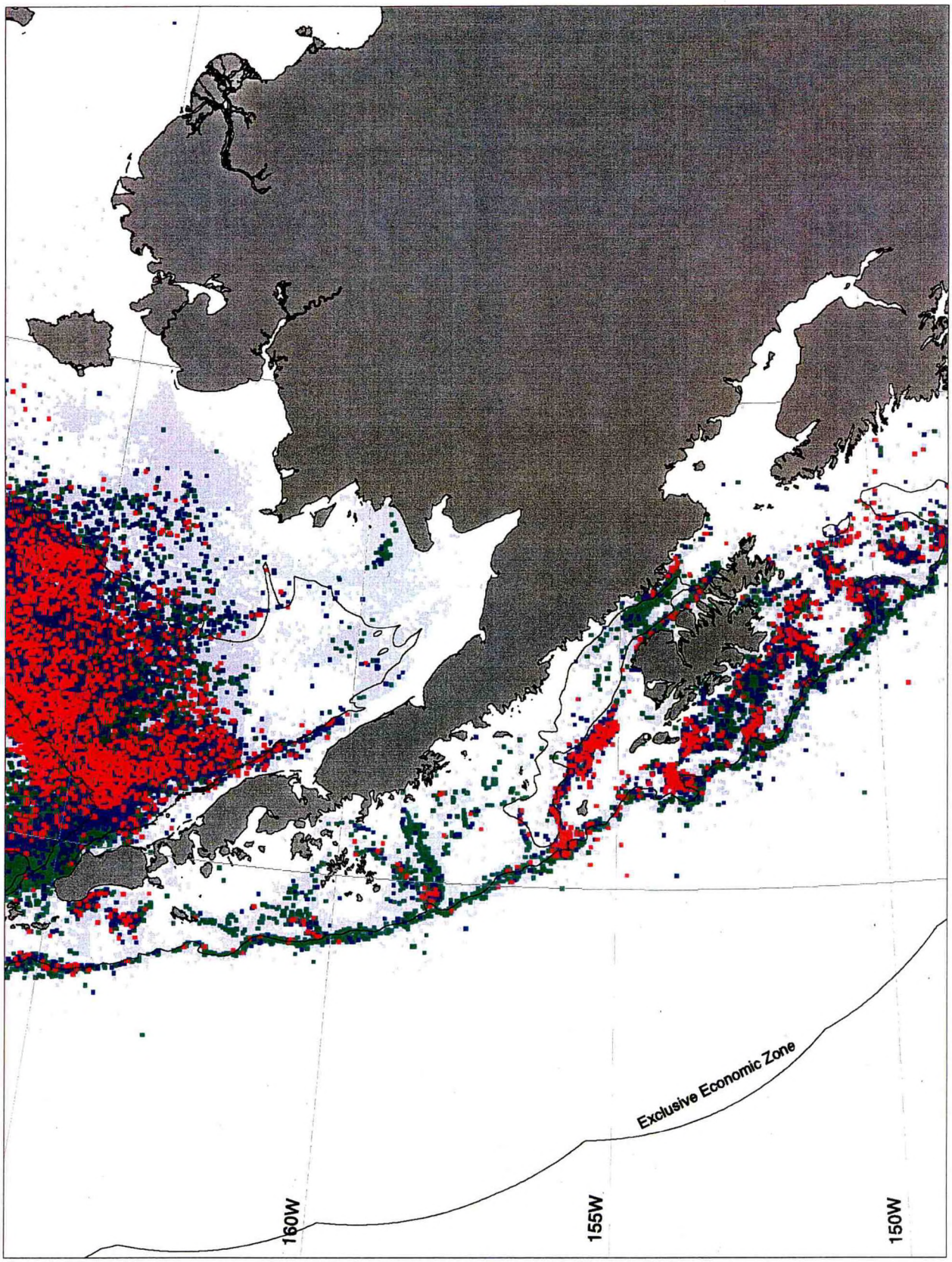
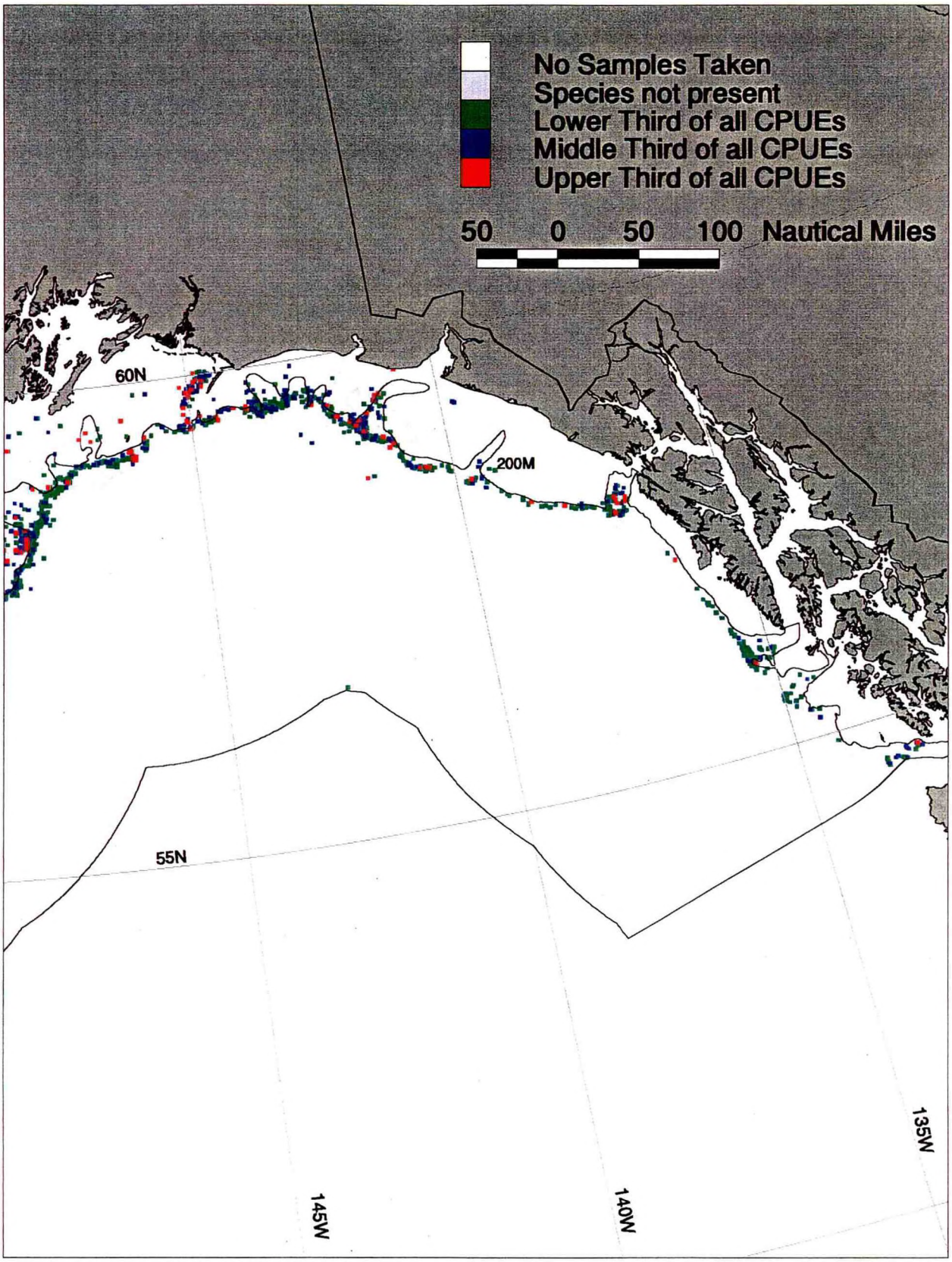


Figure 35.b Skates catch per unit effort (CPUE) summary for



GOA region, based on Alaskan trawl groundfish observer data.

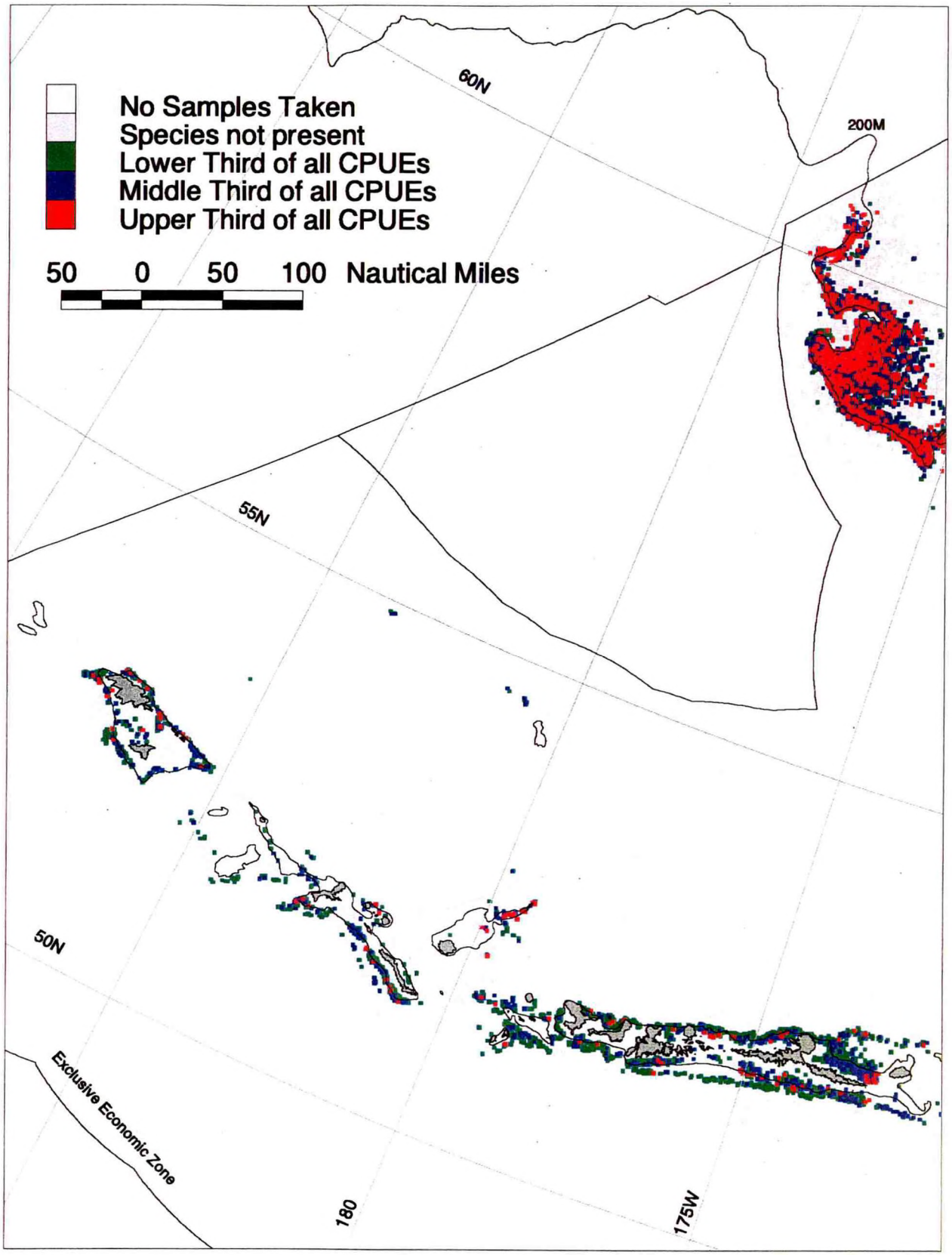
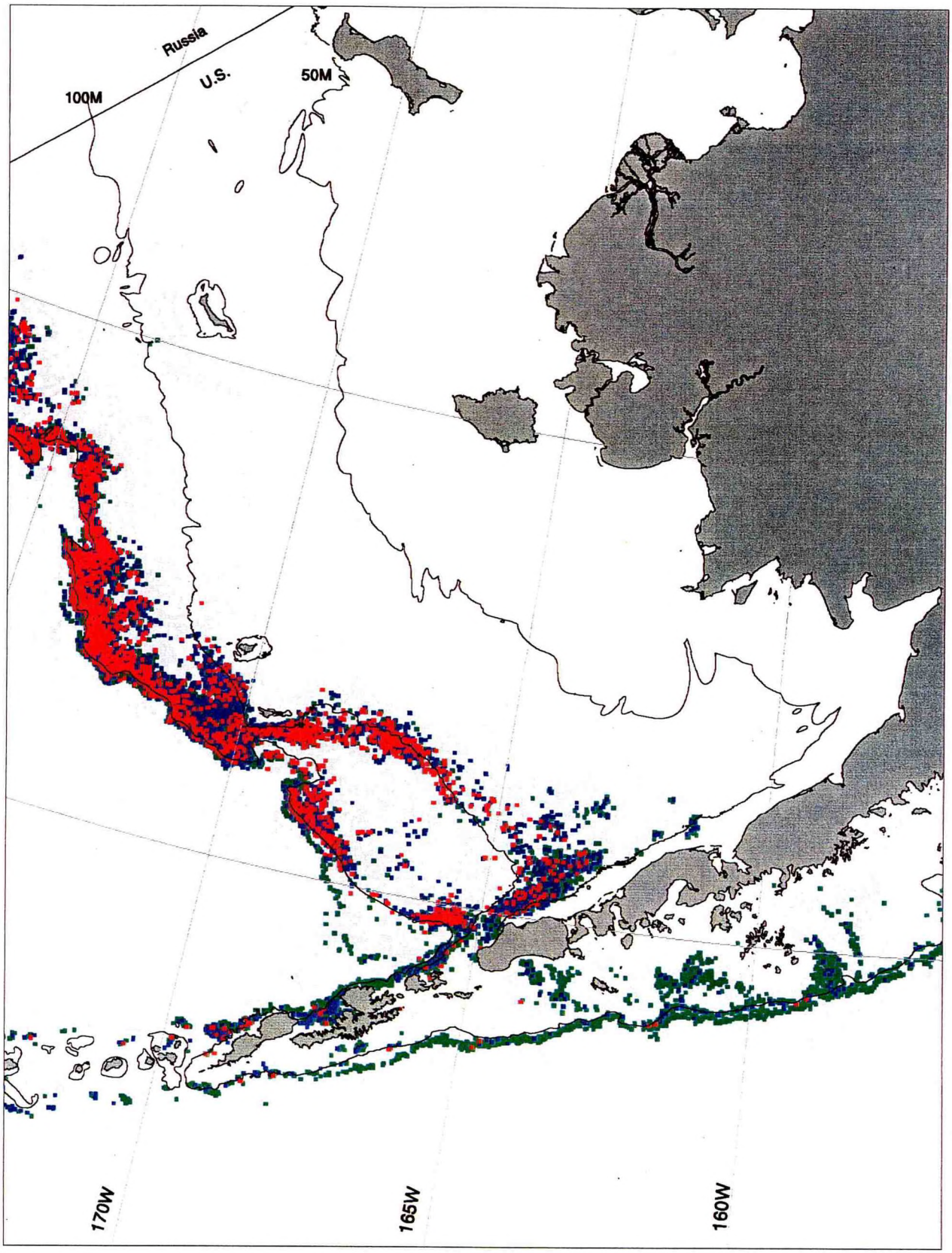


Figure 36.a Skates catch per unit effort (CPUE) summary for



BSAI region, based on Alaskan longline groundfish observer data.

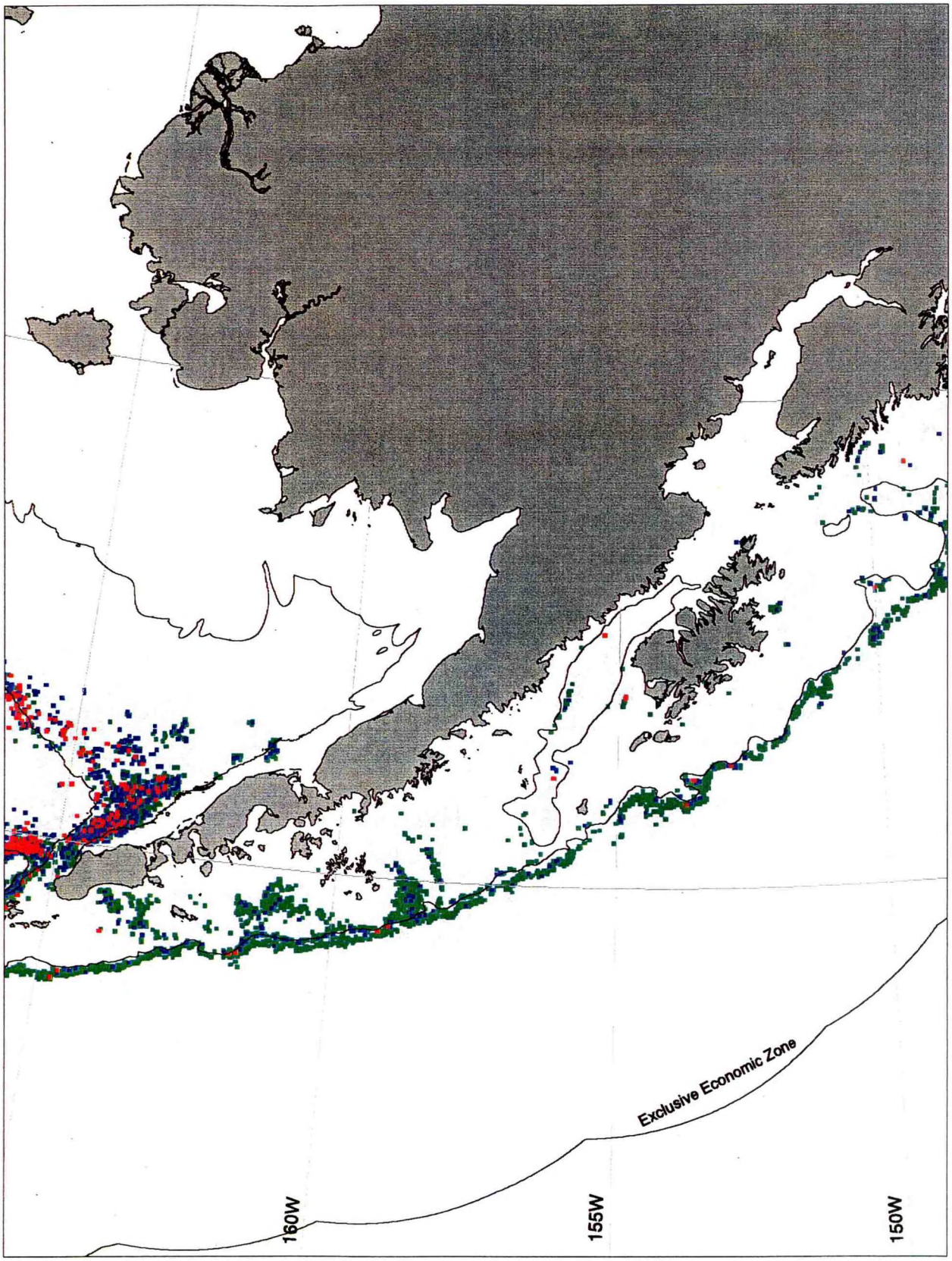
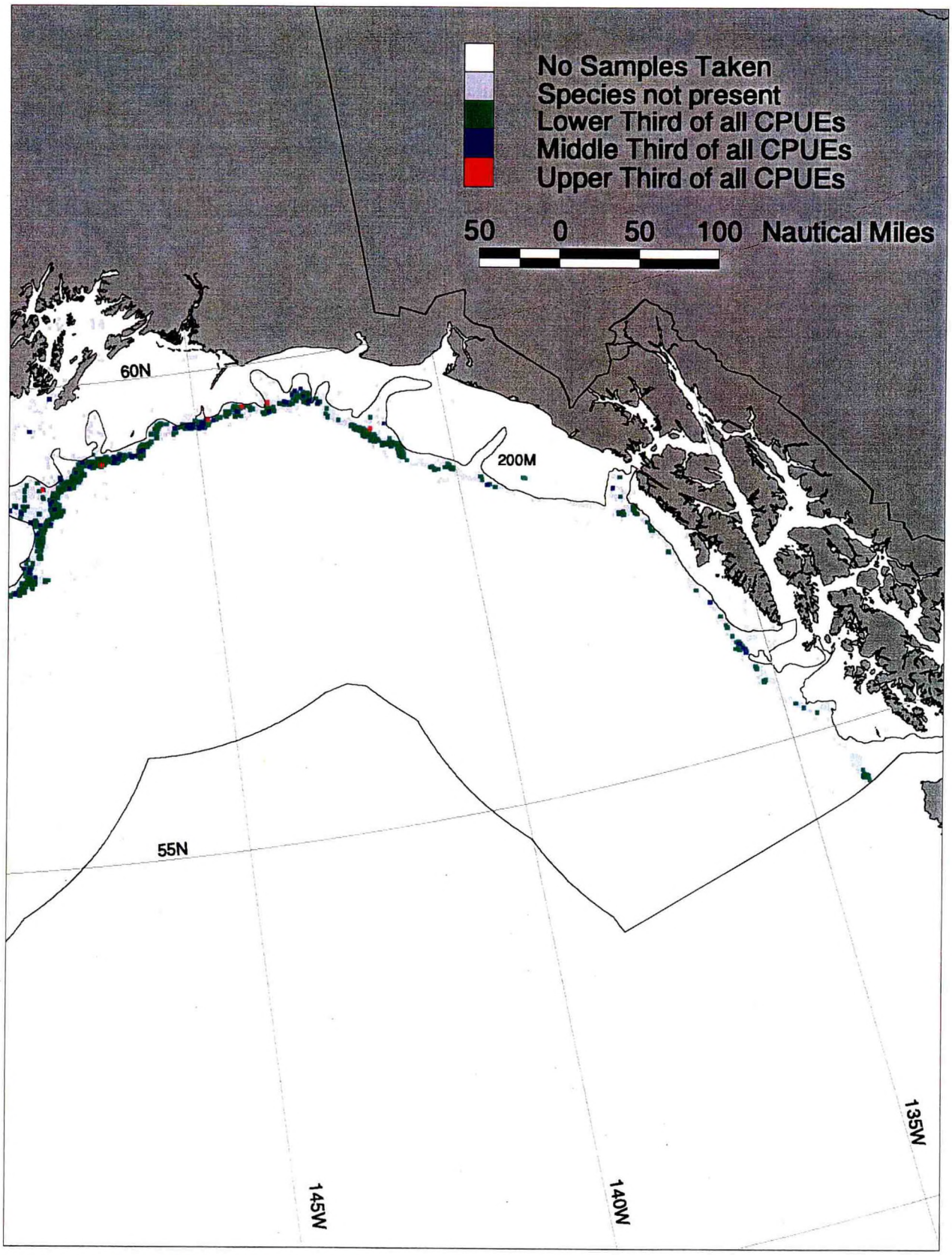


Figure 36.b Skates catch per unit effort (CPUE) summary for



GOA region, based on Alaskan longline groundfish observer data.

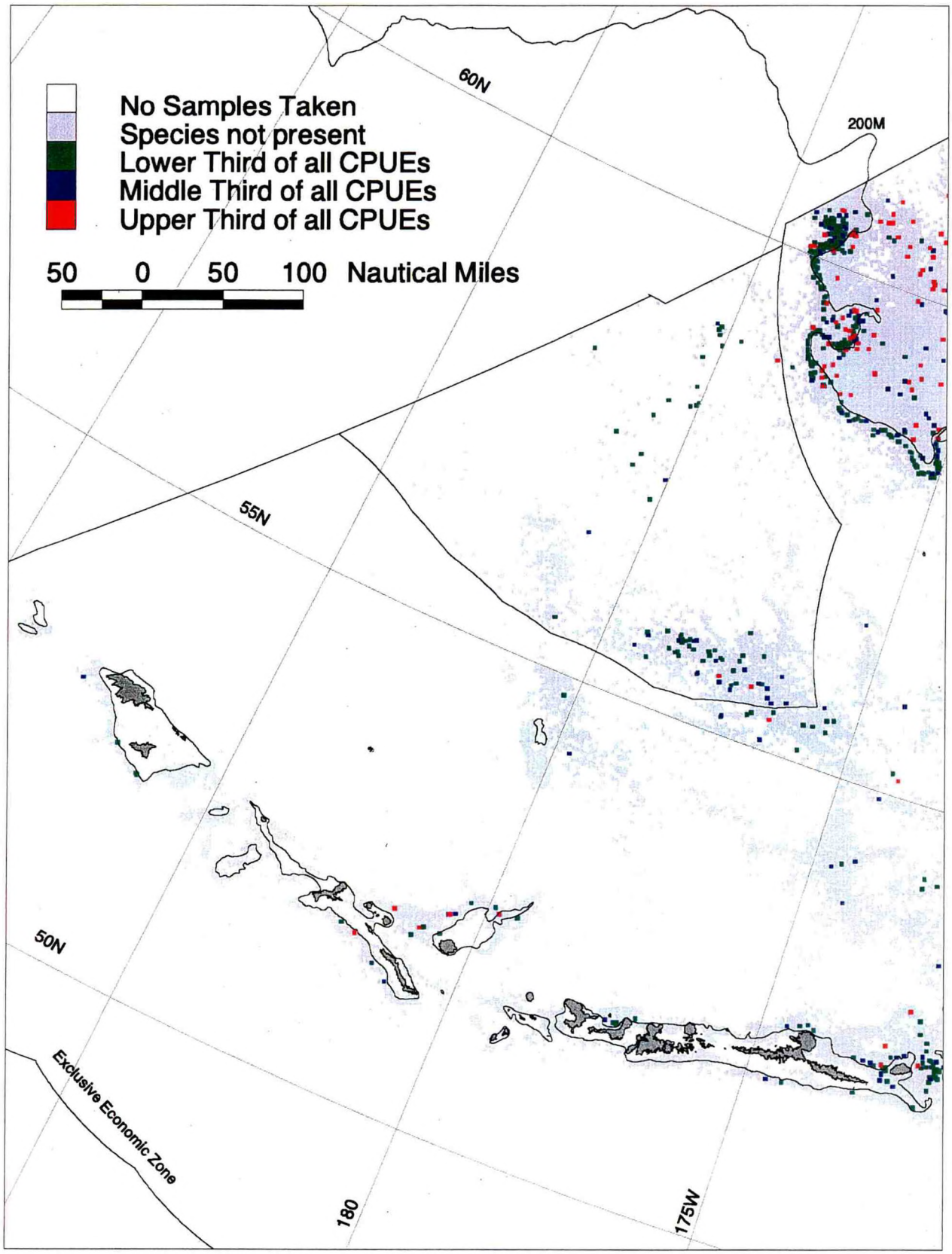
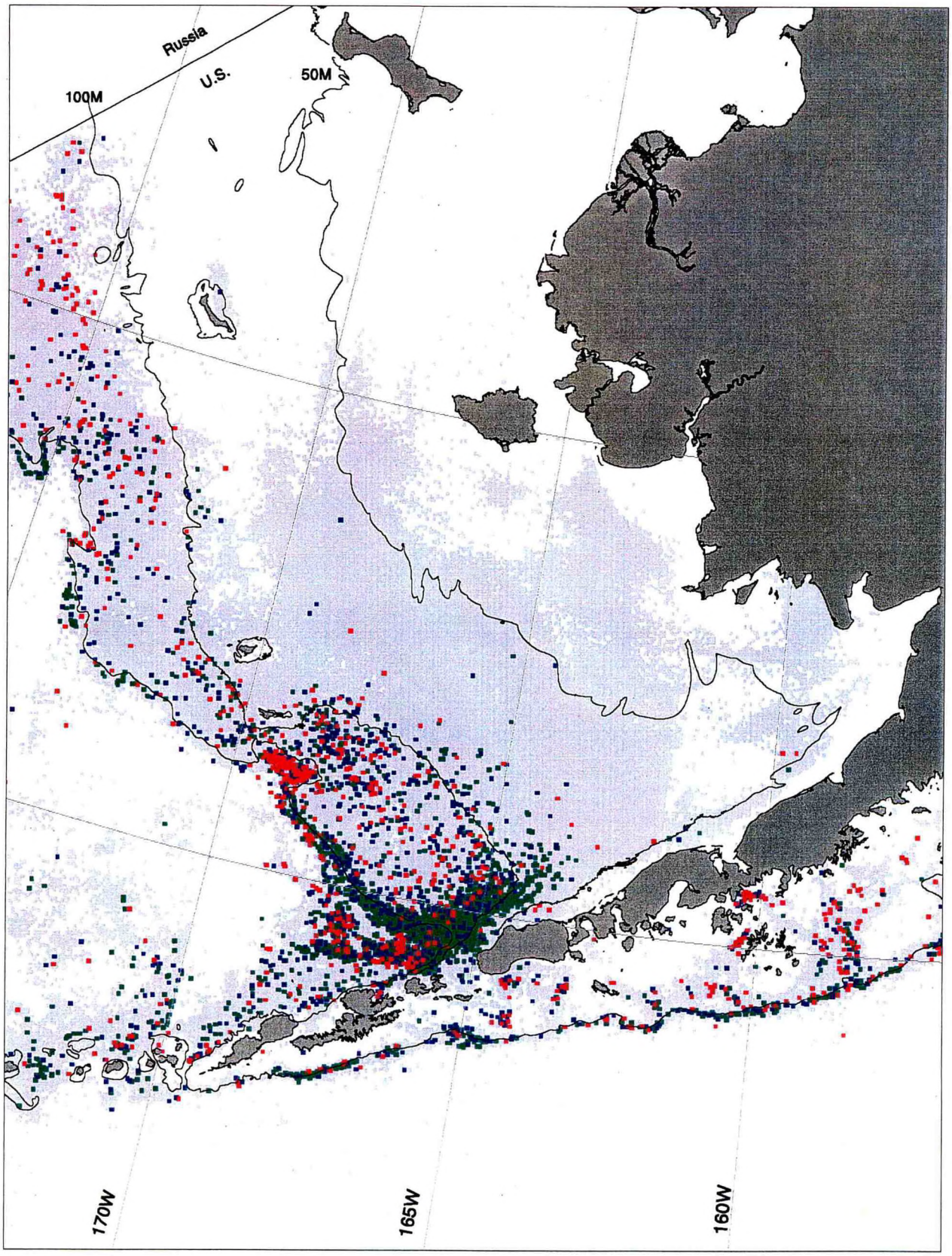


Figure 37.a Sharks catch per unit effort (CPUE) summary for



BSAI region, based on Alaskan trawl groundfish observer data.

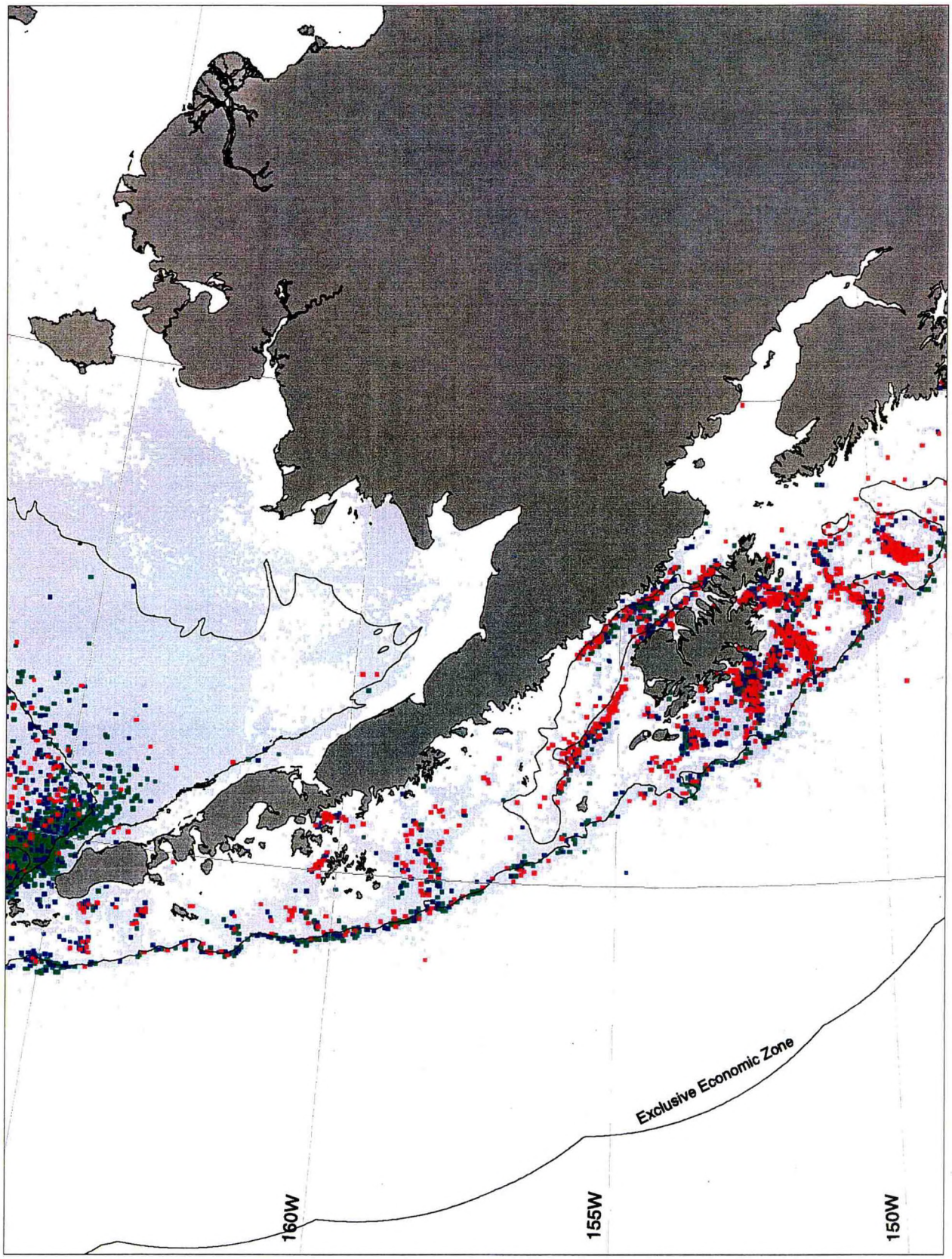
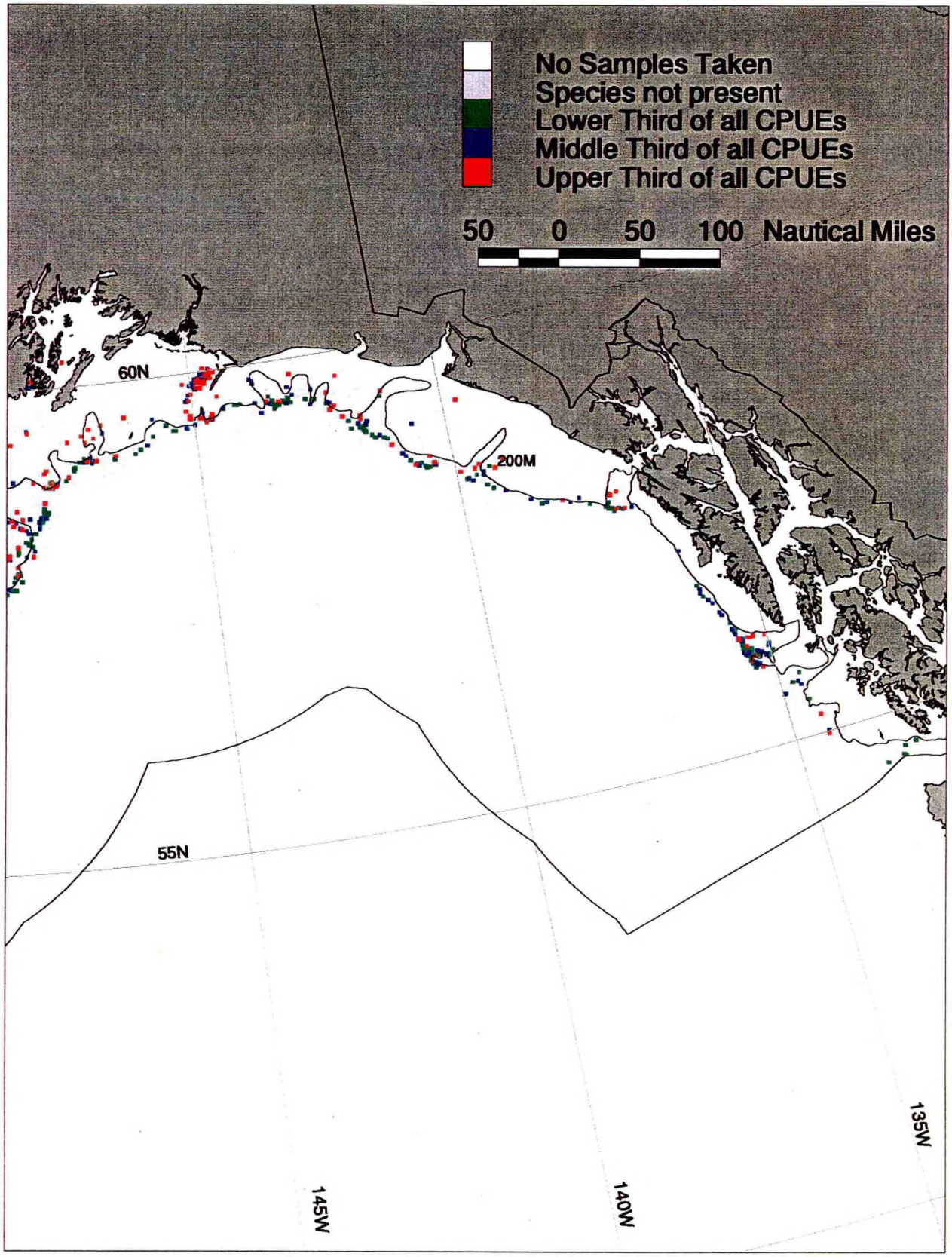


Figure 37.b Sharks catch per unit effort (CPUE) summary for



GOA region, based on Alaskan trawl groundfish observer data.

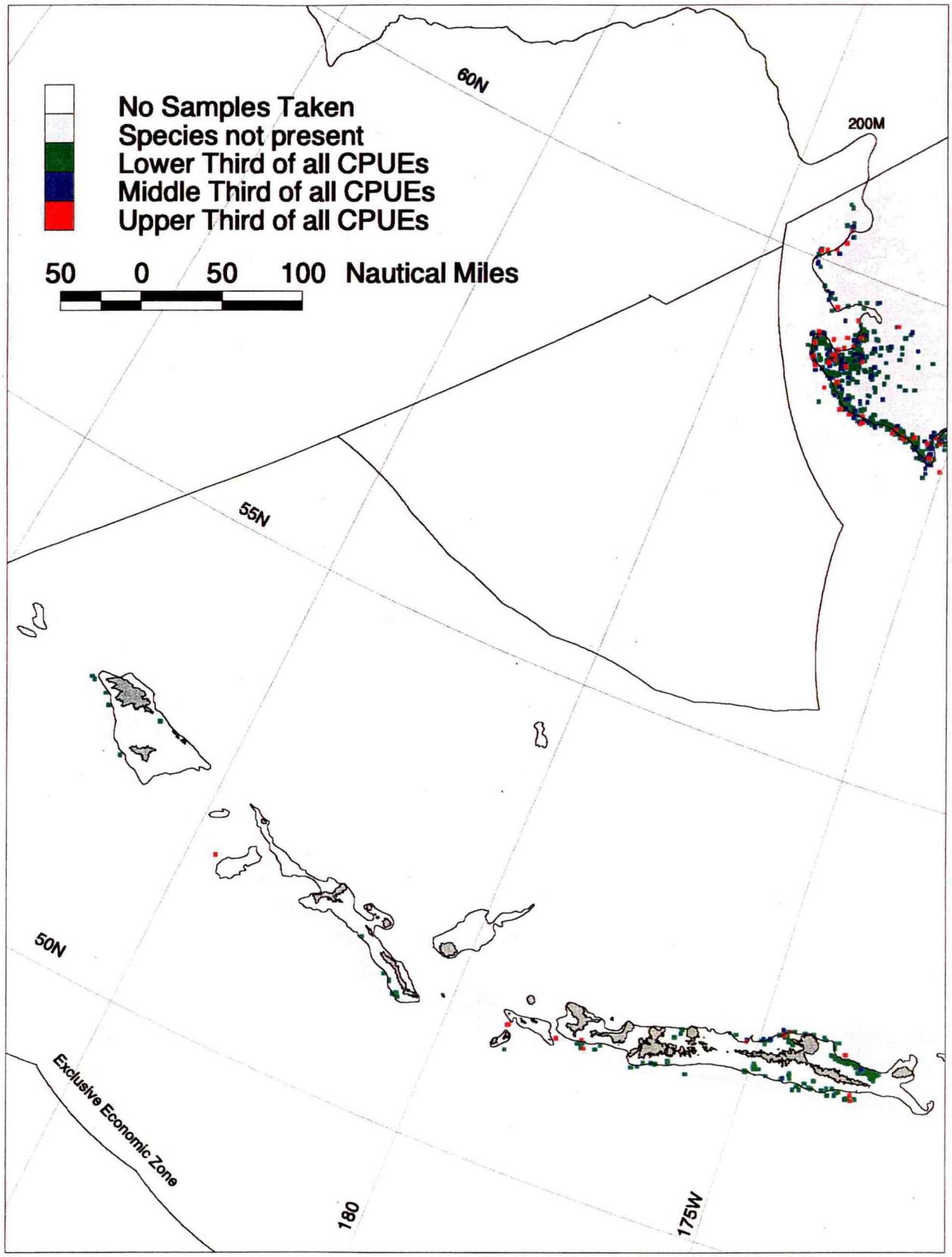
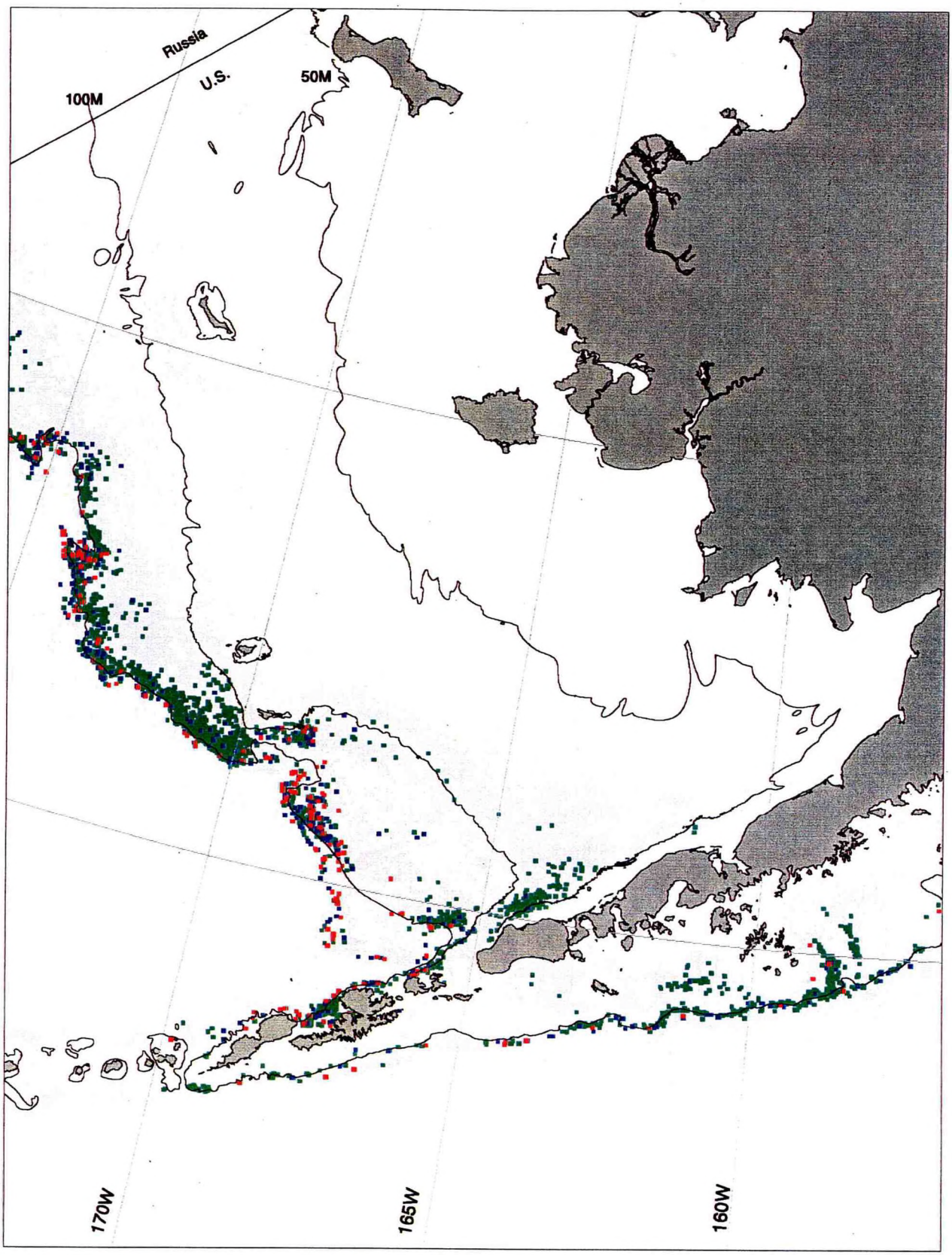


Figure 38.a Sharks catch per unit effort (CPUE) summary for



BSAI region, based on Alaskan longline groundfish observer data.

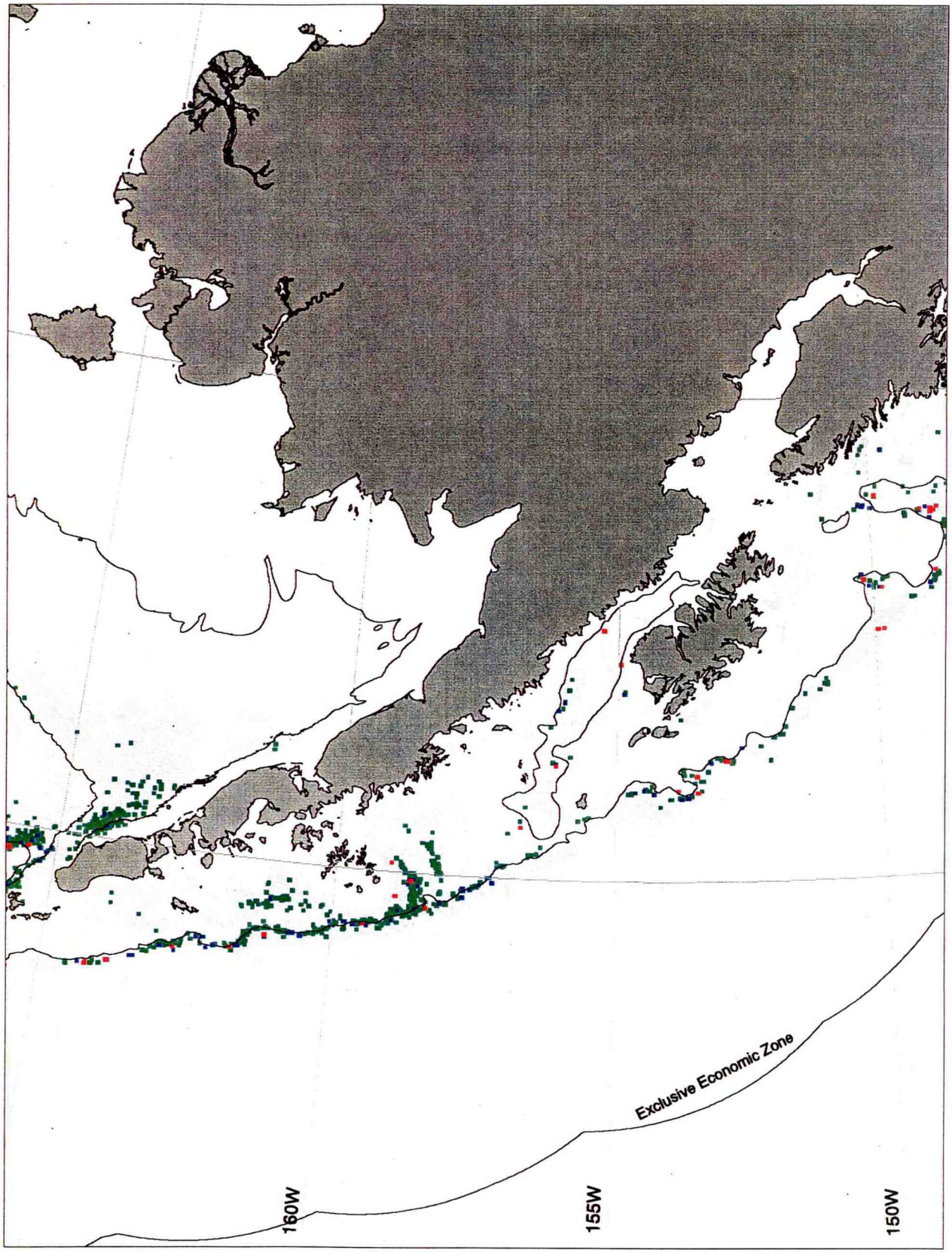
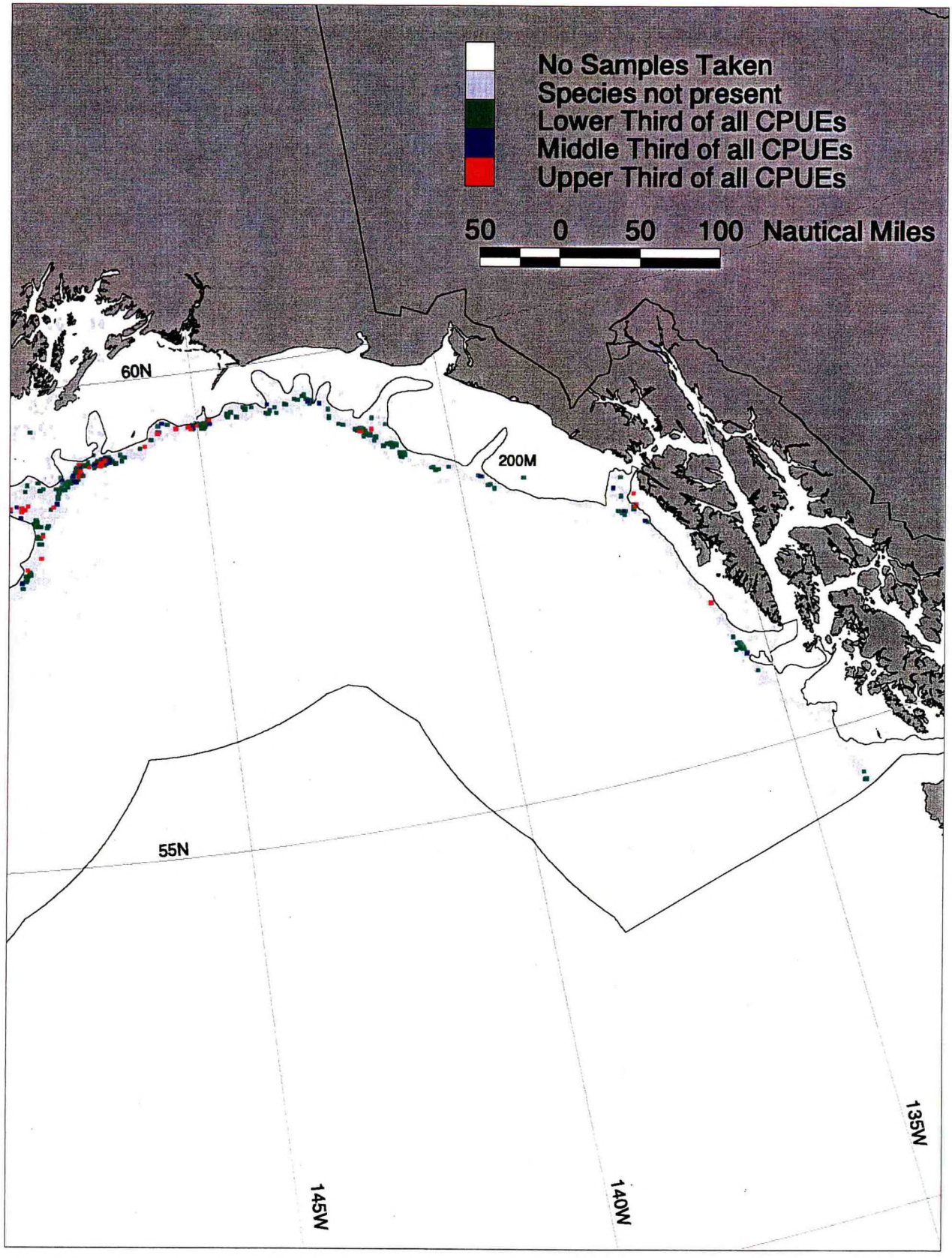


Figure 38.b Sharks catch per unit effort (CPUE) summary for



GOA region, based on Alaskan longline groundfish observer data.

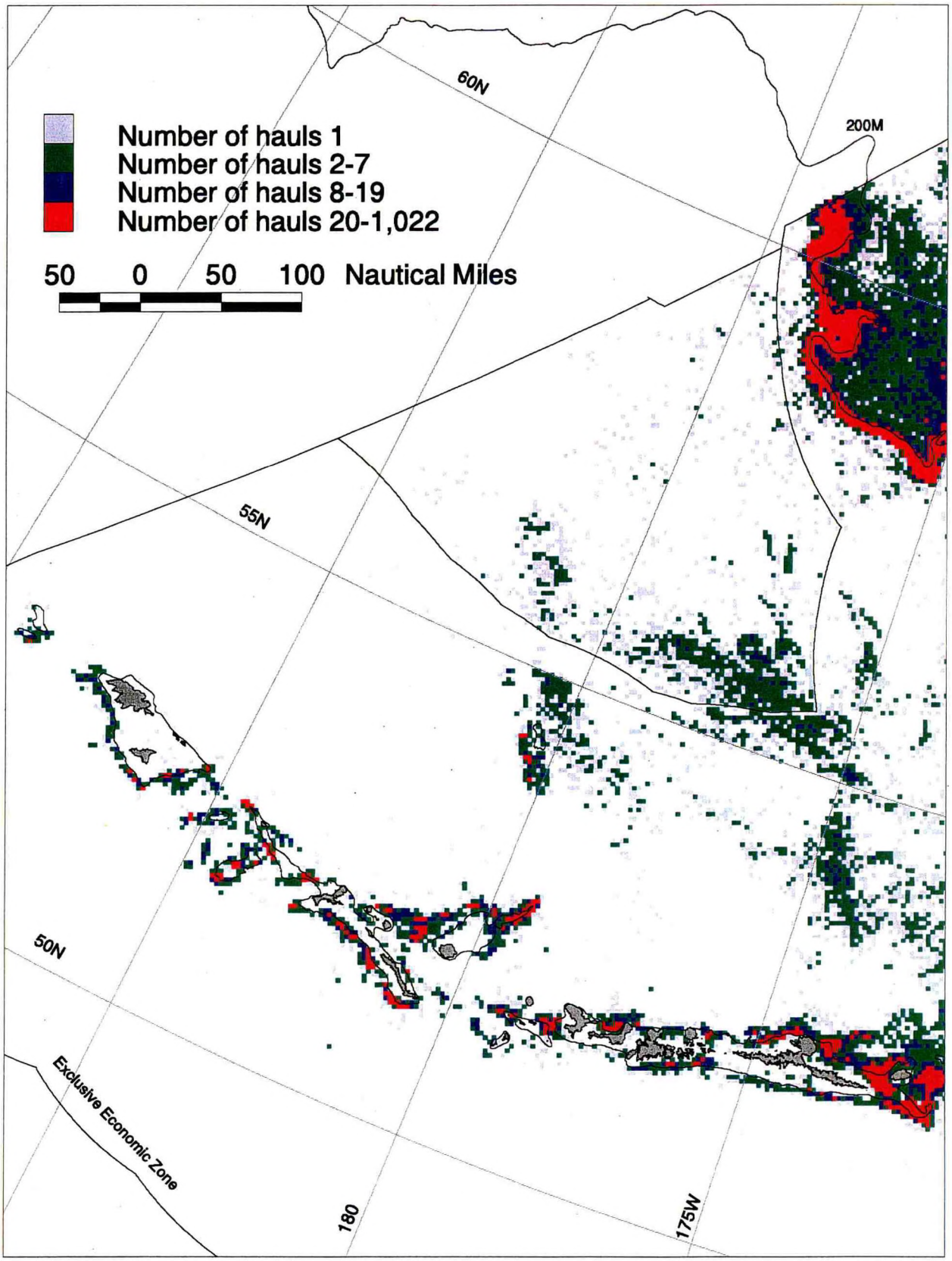
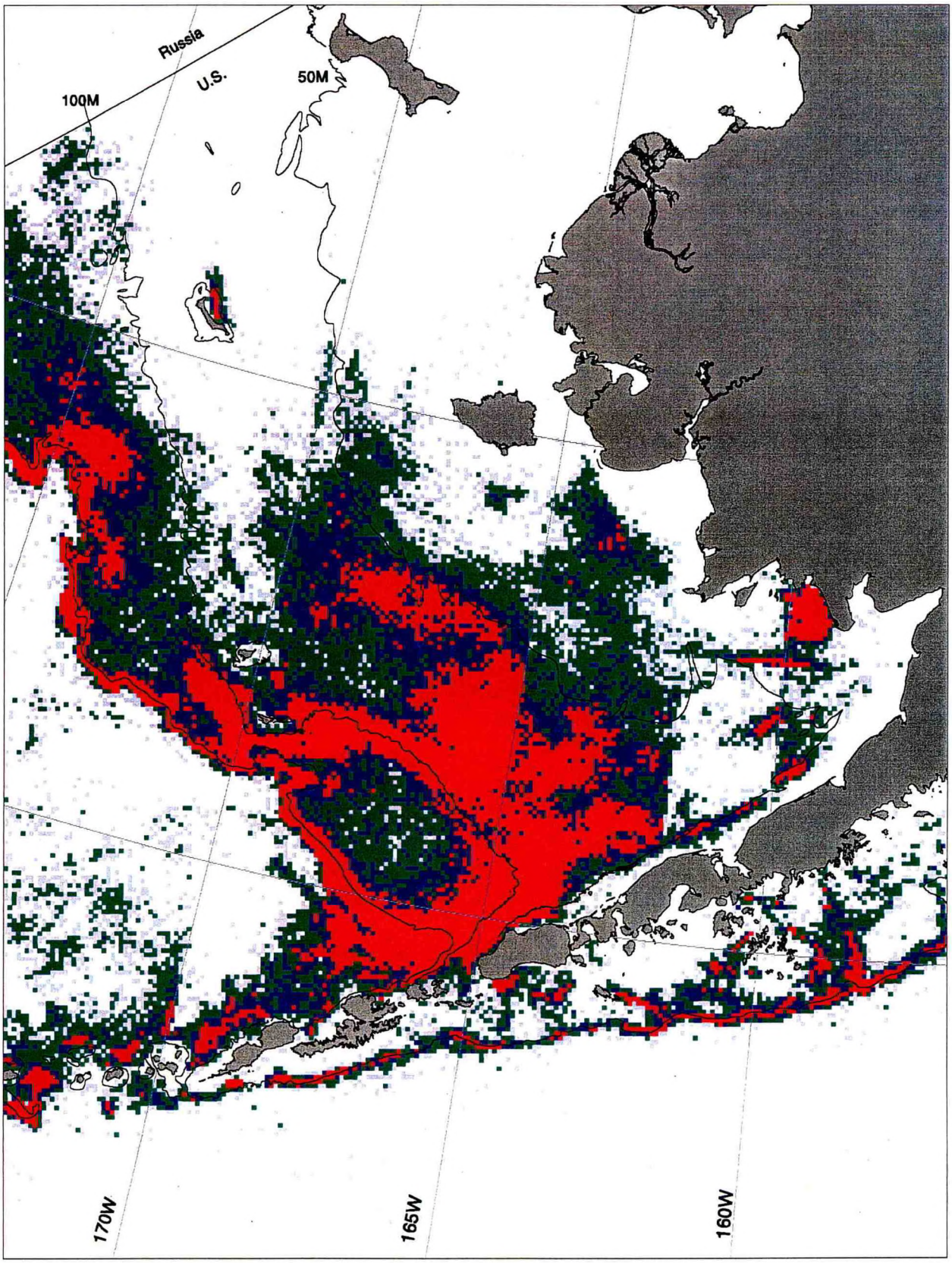


Figure 39.a Total hauls per grid cell summary for



BSAI region, based on Alaskan trawl groundfish observer data.

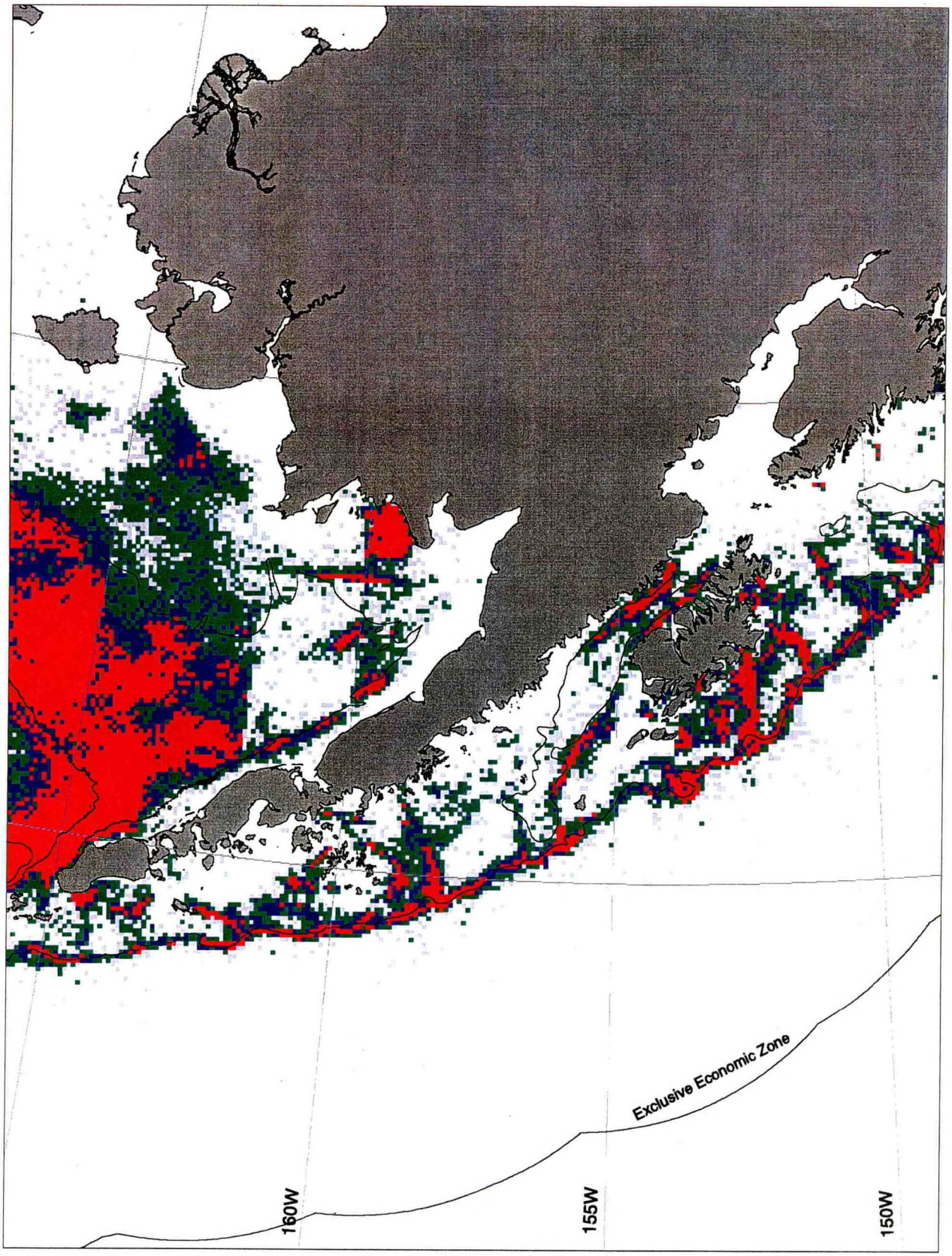
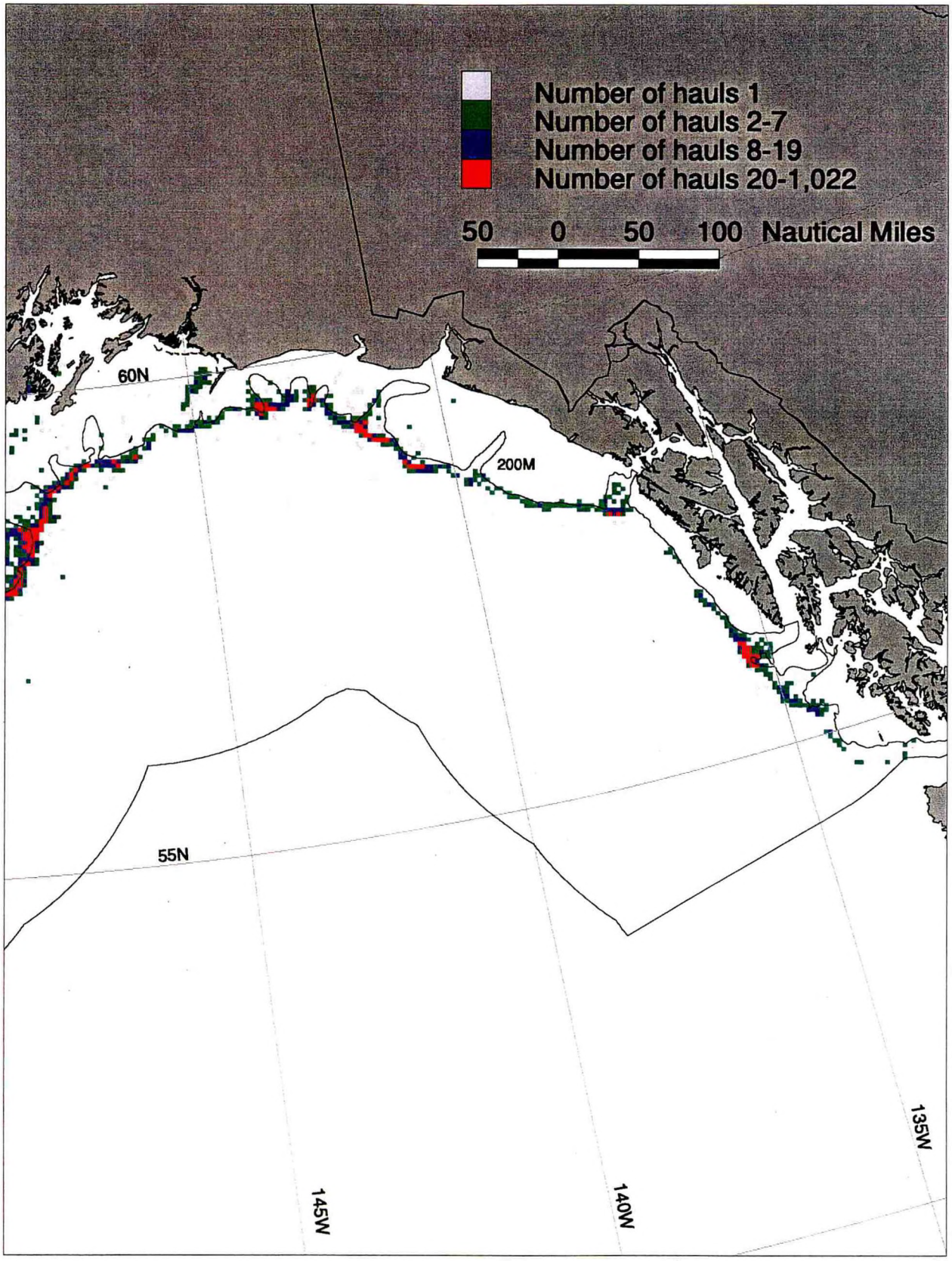


Figure 39.b Total hauls per grid cell summary for



GOA region, based on Alaskan trawl groundfish observer data.

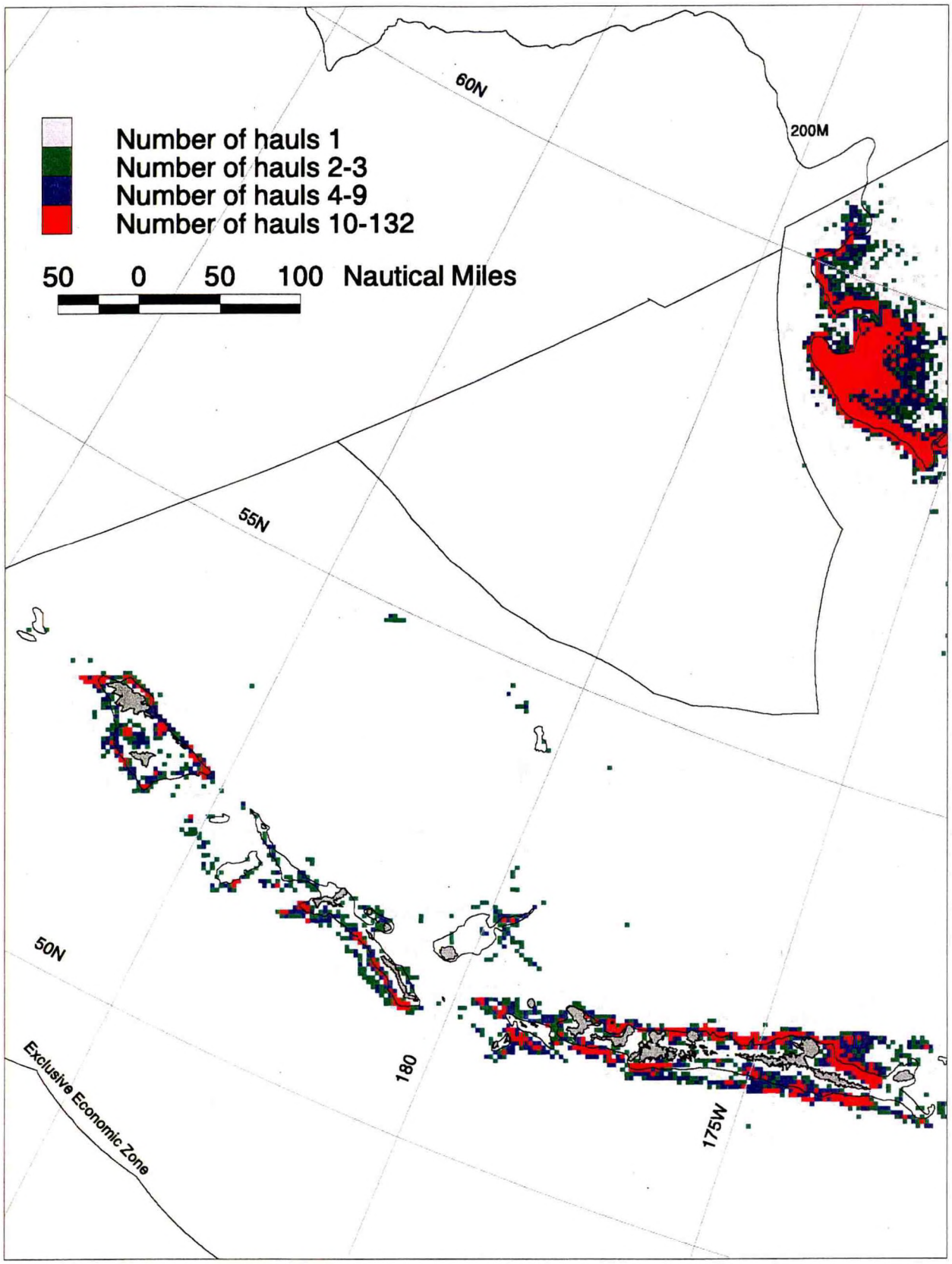
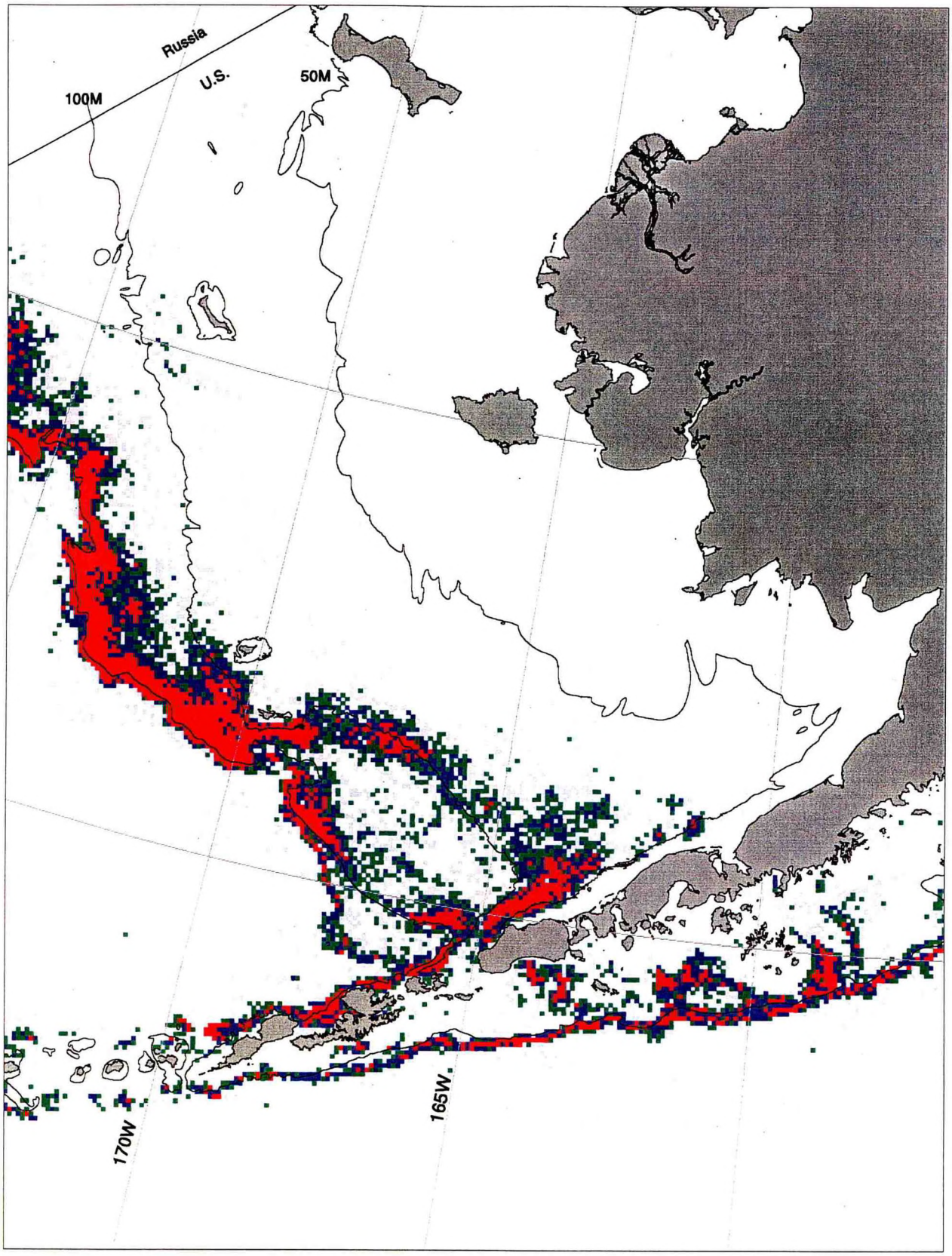


Figure 40.a Total hauls per grid cell summary for



BSAI region, based on Alaskan longline groundfish observer data.

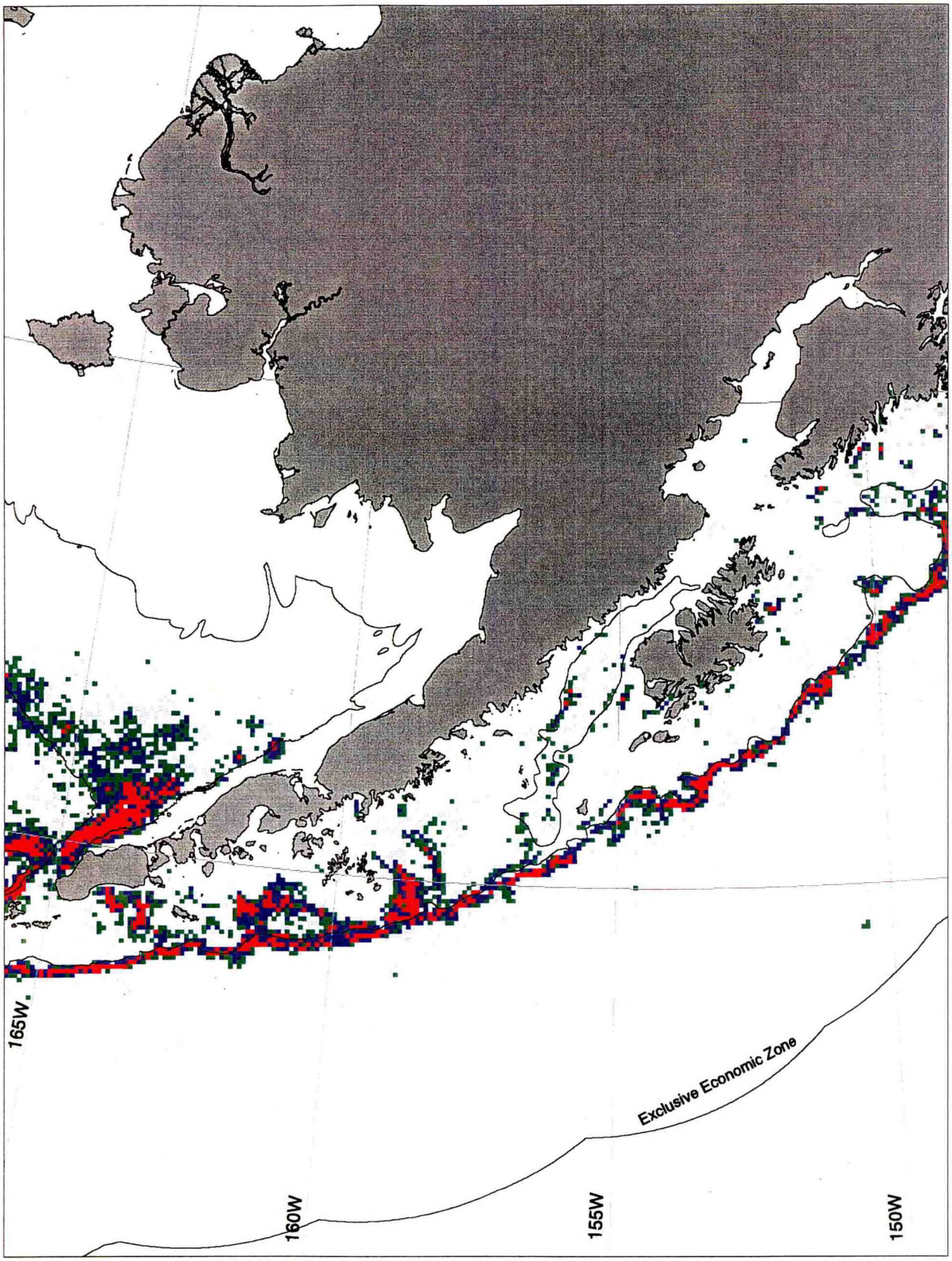
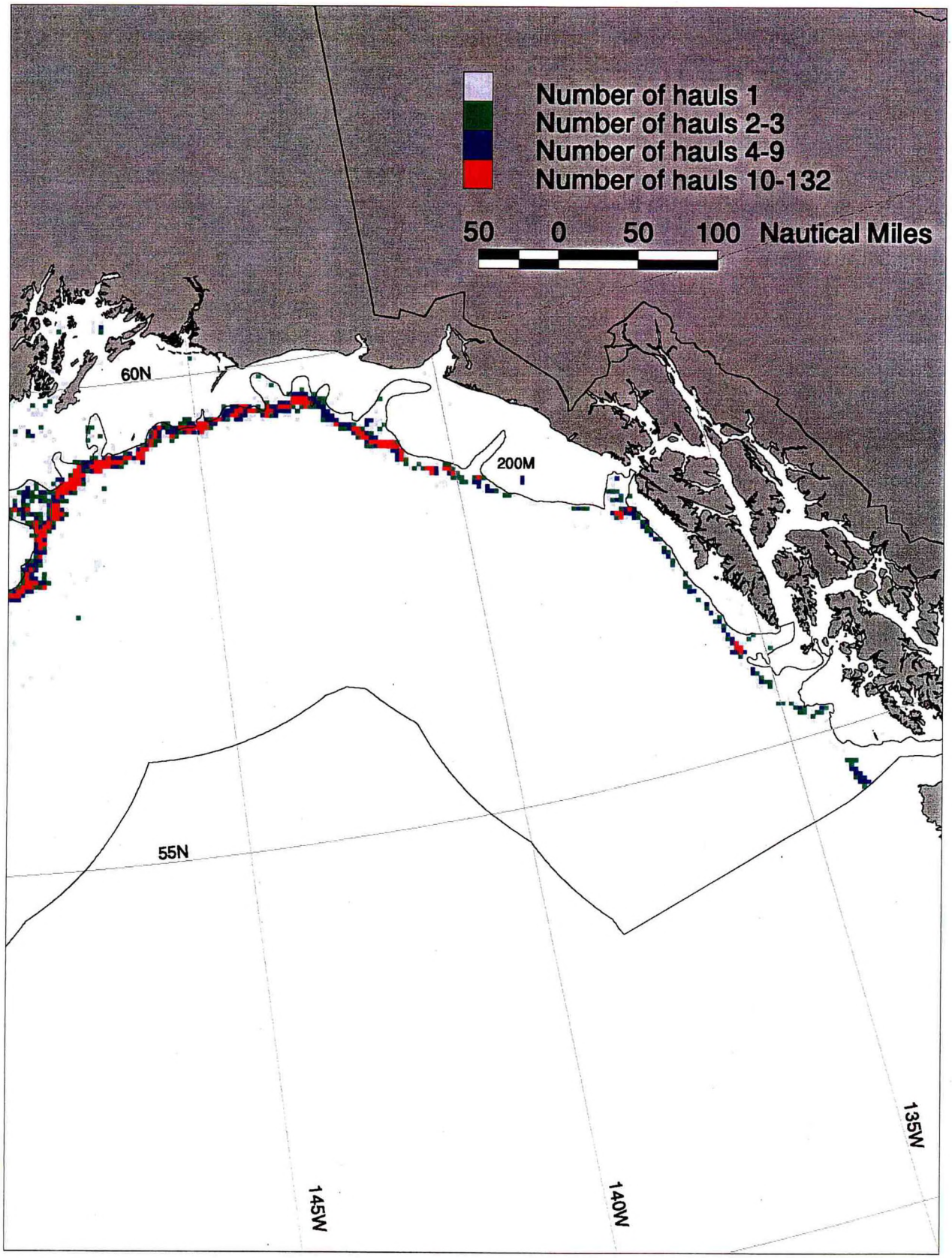


Figure 40.b Total hauls per grid cell summary for



GOA region, based on Alaskan longline groundfish observer data.

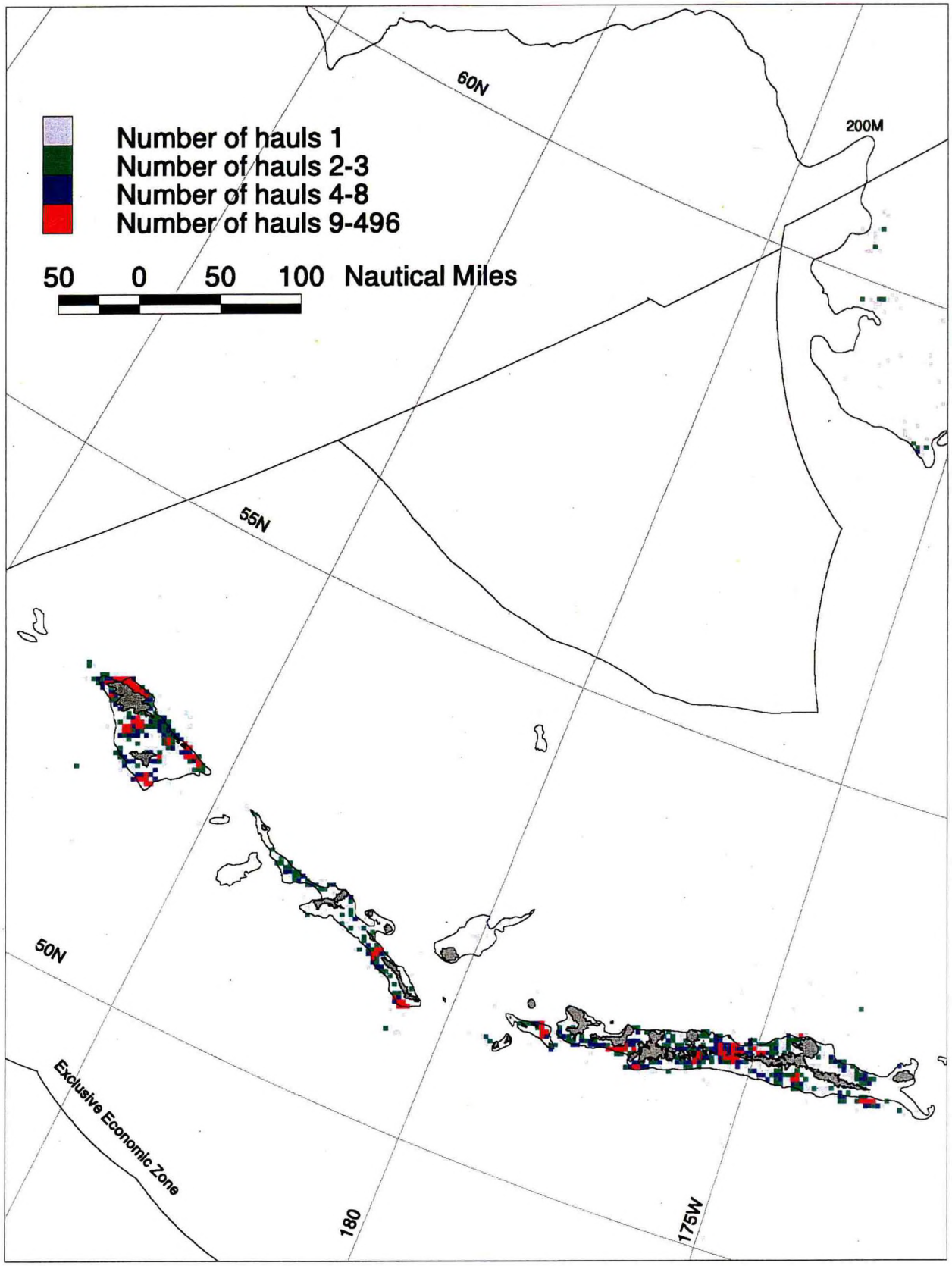
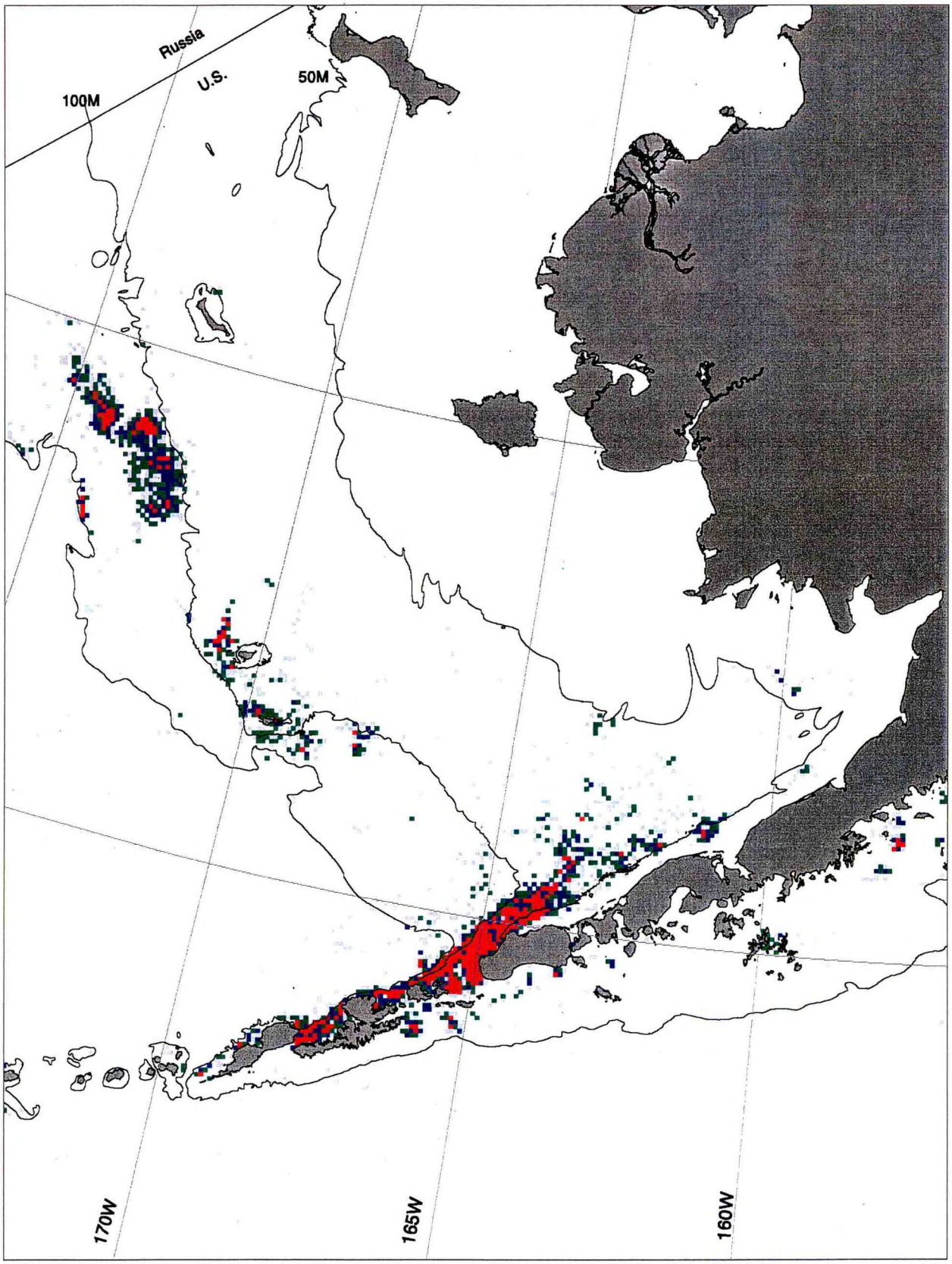


Figure 41.a Total hauls per grid cell summary for



BSAI region, based on Alaskan pot groundfish observer data.

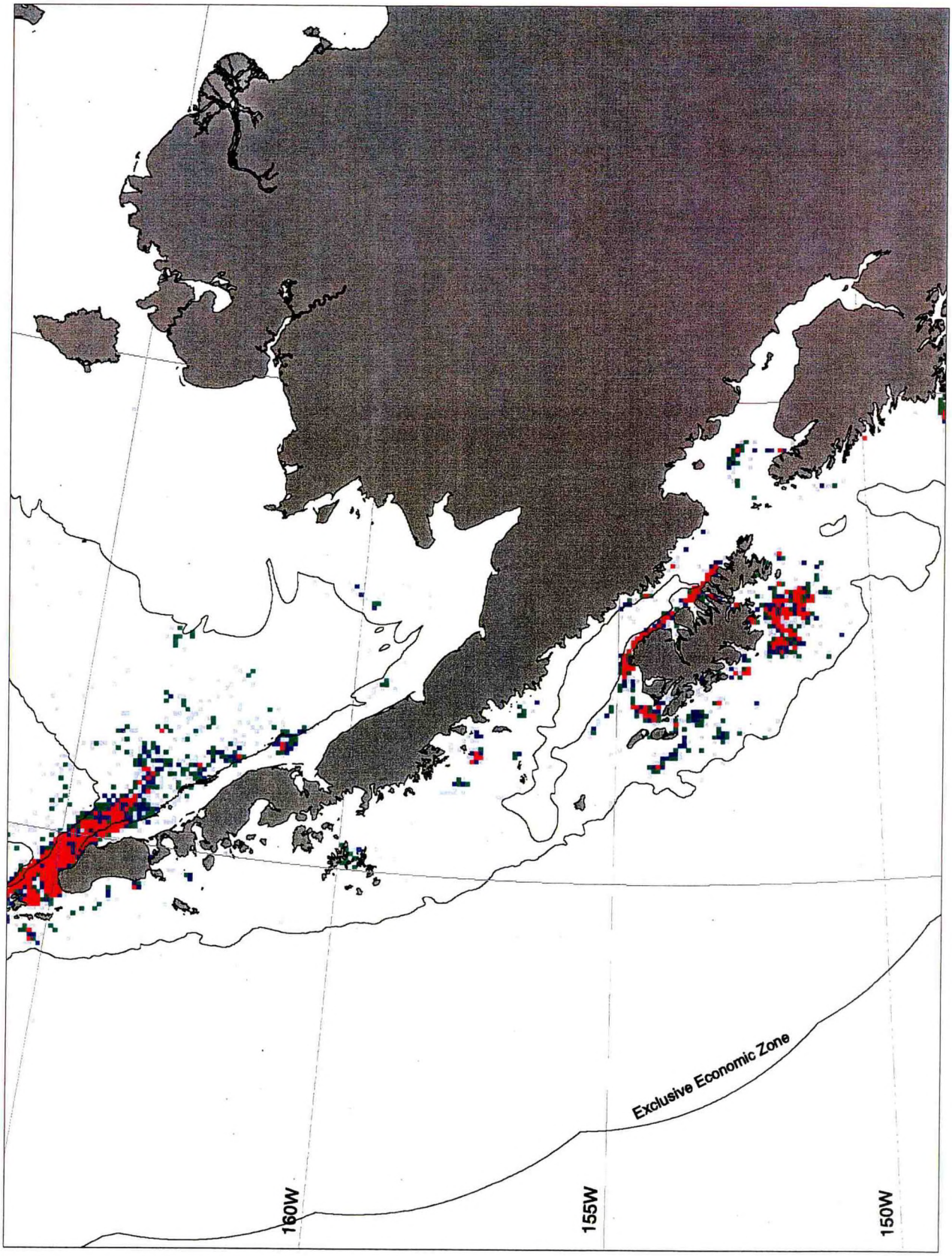
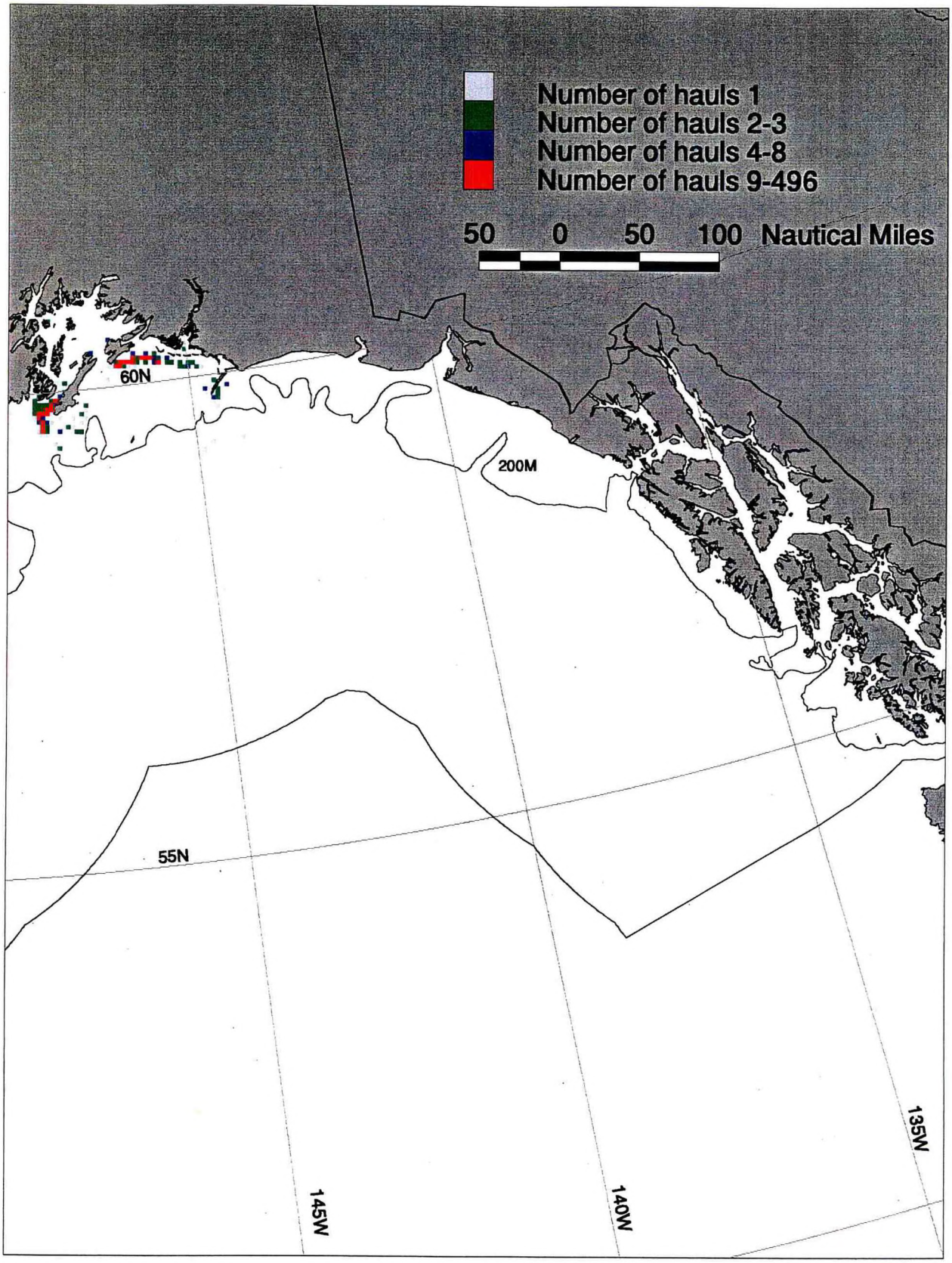


Figure 41.b Total hauls per grid cell summary for



GOA region, based on Alaskan pot groundfish observer data.

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