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UPDATE OF THE 2010 SUMMER SCOTIAN SHELF AND BAY OF FUNDY RESEARCH VESSEL SURVEY

by

D. S. Clark and J. Emberley

Fisheries and Oceans Canada
Science Branch, Maritimes Region
St. Andrews Biological Station
St. Andrews, NB E5B 2L9

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ABSTRACT

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DFO has conducted summer research vessel surveys in the Maritimes Region, Northwest Atlantic Fisheries Organization Divisions 4VWX and a small portion of 5Y, using a standardized protocol since 1970. Results of these surveys provide information on trends in abundance for most groundfish and other fish and invertebrate species on the Scotian Shelf and in the Bay of Fundy. While these data reflect trends in biomass and abundance and are a critical part of science-based stock assessments, a full assessment, including other sources of data, would be required to evaluate the impacts of management measures on population status.

Data are presented for the major commercial species, for species that comprise a large part of the survey catch, and for species where the 2010 catch was either unusually high or low. In 2010, additional survey tows were completed in deeper water off the shelf edge (750 – 1,800 m) to investigate species composition and biomass in deeper waters.

Minimum objectives were completed for all survey strata. High catches were noted for several species, including halibut, silver hake and winter flounder. Exploratory sets conducted in deep water had catches similar in size to sets on the shelf; however, the species composition was quite distinct.

INTRODUCTION

The DFO summer Scotian Shelf and Bay of Fundy research vessel (RV) survey, hereafter referred to as the summer RV survey, has been conducted annually in Northwest Atlantic Fisheries Organization (NAFO) Divisions 4VWX5Y since 1970. The summer RV survey follows a stratified random sampling design (Halliday and Kohler 1971), and includes both hydrographic sampling and sampling of fish and invertebrates using a bottom otter trawl. These survey data are the primary data source for monitoring trends in species distribution, abundance, and biological condition within the region, and also provide data to the Atlantic Zonal Monitoring Program (AZMP) for monitoring hydrographic variability. This document is intended to provide a synopsis of the findings of the 2010 survey and to examine these data in the context of long term survey results (see also DFO 2011a). The results from 2009 can be found in Clark *et al.* 2010 and DFO 2010a.

The bottom trawl survey was originally planned to provide biomass and abundance trends for groundfish residing at depths from about 50 m to 400 m, and was extended to cover depths down to 750 m in 1999. Survey indices are expected to be proportional to biomass and abundance for most species. The distribution of some species, however, such as cusk and turbot, may not be fully covered by the survey. Biomass and abundance trends for theses species may only provide indication of direction of change over time. Catches of pelagic species, such as herring, may also not reflect abundance trends. For all these species, other biological information, such as length and weight are still relevant and are available on the Maritimes Regional Ecosystem Survey database.

There were changes to the net used and the vessel conducting the survey in 1982 and 1983. From 1970 – 1981 the RV A.T. Cameron, a side-trawler using the Yankee 36 trawl, was used for the survey. In 1982, the RV Lady Hammond was used, towing a Western IIA trawl. Since 1983, the Alfred Needler has been the primary survey vessel, and the Western IIA trawl has been used in all years. Conversion factors were calculated for net and vessel changes (Fanning 1985). There were, however, some difficulties in conducting the conversion studies, due to equipment problems (Koeller and Smith 1983) and the conversion factor is no longer used for cod (Clark *et al.* 1994; Mohn *et al*. 1998). A conversion of 1.2 is used for cod. This is equivalent to the change in wingspread for the two nets, and is roughly equivalent to the difference in catchability coefficients for cod from the two nets calculated through population modelling (Clark 1997). Conversion factors were generally small for most species; for silver hake, however, a large conversion factor (>2) was calculated, but was not considered reliable (Fanning 1985). Given the magnitude of the calculated conversion factor, its poor precision, and the problems experienced during the conversion study, biomass data for silver hake are only used from 1983 to the present.

There have also been some changes in data collection protocols. Invertebrate species other than lobster and short-fin squid were not recorded consistently before 1999. Individual fish weights were collected for very few species in the 1980s, so there is a gap in time series for condition factors for most fish species.

There are some species which are similar in appearance which have not been consistently distinguished throughout the time series. This is generally only a concern for uncommon species; it is, however, an issue for interpreting data for white hake. The common identification guide which was originally used at-sea (Leim and Scott 1966) synonymized red hake and white hake, and these were not consistently distinguished at-sea until about 1982. Bundy and Simon (2005) reviewed these data and concluded that because red hake comprise such a small part of the combined biomass for the two species, biomass trends were still useful for white hake for the entire survey series. While red hake are a small part of the biomass index, they are a large part of the combined catch for hake <35cm; including length frequency data from before 1982 would misrepresent the average catch at-length for white hake. In recognition of this, the long-term average catch-at-length for white hake only uses data from 1982 to the present.

For long-term averages, the most appropriate starting point has been selected for each species. In the case of white hake, biomass plots start in 1970 but the abundance index data only go back to 1982. For silver hake, biomass plots and abundance index data are used starting in 1982. This is in conjunction with the change in the type of trawl, from a Yankee 36 to a Western IIA, as well as more consistent identification of white hake and red hake.

In 2010, additional survey tows were completed in deeper water off the shelf edge (750 – 1,800 m) to investigate species composition and biomass in deeper waters. Catches from these stations are not included in the biomass index estimates, to ensure that comparability with other years is maintained. Distribution plots are included here only for the most abundant species noted at these depths. Tables of the entire catches at these depths are also presented.

The survey area has been divided into three zones, based on oceanography and biogeography. Trends are shown for the entire shelf survey area, and also for three separate regions: eastern Scotian Shelf (4VW; strata 440 - 466), western Scotian Shelf (4X East; strata 470 - 481), and Gulf of Maine/Bay of Fundy (4X West; strata 482 - 495). Differences in patterns of fish abundance and species composition are apparent for these regions during the survey. Strata 496 - 498 (the shelf edge; 350 m – 750 m) have been sampled in most years since 1996, while strata 501 - 505 (750 m – 1,800 m) have not previously been sampled as part of the stratified random survey series. These depths are considered separate biogeographic zones and since they have not been sampled in all years, are not included in the long-term biomass index estimates.

Plots of the size and distribution of catches are provided for selected species and stratified average catches are compared with past results to provide a general overview of trends in abundance and biomass. For select commercial species where individual fish weights have been collected throughout most of the time series, trends in condition (Fulton's K: weight/length^3) are also included (Ricker 1975).

Data are presented for the major commercial species, for species that comprise a large part of the survey catch, and for species where the 2010 catch was either unusually high or low (see also DFO 2011a). The set of species examined to determine if catches in 2010 were unusual was restricted to those where the area occupied exceeded 7,000 square nautical miles (approximately 1/7th of the surveyed area) in 2010, or averaged greater than this in the 1970s, the 1980s or the 1990s. The species examined were restricted in this manner to avoid rare species for which catches display high inter-annual variability.

Comparisons of stratified length frequencies for 2009 and 2010 to the long-term mean are also included for major commercial fish species. These data were summarized to assist in reviewing trends in abundance that are directly relevant to fisheries management when they are developing advice on allowable catch; hence, these data are grouped by the applicable stock management areas for each species.

SAMPLING OF TRAWL CATCH

Basic data, total numbers and weight caught, and length frequencies (LF) were collected from all successful sets according to protocols documented by Koeller (1981). This was updated in 1995 and again in 2007 to record increased sampling details (M. Strong and S. Gavaris, DFO Maritimes Region, Manual bottom trawl surveys Marine Fish Scotia-Fundy Region, unpublished; B. Hatt and D. Clark, DFO Maritimes Region, Manual bottom trawl surveys Maritimes Region, unpublished).

Length stratified samples for individual fish weight, one per centimeter (by sex if required), were taken from each set for all fish species. In addition, otoliths were taken from cod, haddock, pollock, white hake, silver hake, cusk, halibut, roundnose grenadier and blue hake. Maturity stages were assigned for silver hake. All sampling and set information were entered directly in a database with online data editing using an Oracle-based data entry system called the Groundfish Surveys at sea Entry system (GSE).

Stomachs were collected from selected species according to length stratified requirements. Identification of stomach contents was conducted at sea when possible while some stomachs were frozen for later analysis.

HYDROGRAPHIC OBSERVATIONS

At all successfully fished stations and one unfished station, profiles of temperature, conductivity (salinity), oxygen concentration, fluorescence, and irradiance (PAR extinction) were obtained with a SBE-25 Conductivity, Temperature and Depth (CTD) meter fitted on a Carousel Rosette deployed by the CCGS Alfred Needler. Niskin bottles attached to the Rosette collected water from the bottom, 25m and 50m (intermediate depths) when possible, and from 5m (near surface) for the following sampling:

- 5m: salinity (x1), nutrients (x2), chlorophyll-a (x2) and oxygen determination (x2);
- 25m: nutrients (x2), chlorophyll-a (x2);
- 50m: nutrients (x2), chlorophyll-a (x2); and
- bottom: salinity (x1), nutrients (x2), chlorophyll-a (x2) and oxygen determination (x2).

Oxygen measurements were performed after the CTD cast using an ORION 842 bench meter. Salinity determinations were made using a Guildline 'Portasal' salinometer.

Chlorophyll-a samples were processed onboard with a Turner-Designs fluorometer. Surface temperatures were measured using a VEMCO SEATEMP temperature probe. VEMCO depth/temperature miniloggers were attached to the trawl to monitor bottom water/fishing depth temperature.

Additional sampling was undertaken for the AZMP. At 28 selected stations, vertical zooplankton tows (202 micron mesh ring-net) were made from bottom to surface.
The Halifax hydro station was occupied three times during the course of the 2010 mission. On each occasion the following sampling was conducted:

- vertical CTD profile of the entire water column (including a fluorometer sensor and dissolved oxygen probe),
- two vertical zooplankton net tows from bottom to surface; one with each of the 76 and 202 micron ring-nets,
- Secchi depth measurement, and
- Niskin bottles on CTD rosette sampled at 10 depths through the water column – samples analyzed for oxygen, nutrients, salinity, chlorophyll-a, and phytoplankton enumeration.

TRAWL MENSURATION

Scanmar sensors were used to document the trawl characteristics. Wing spread, door spread, headline height and clearance were all recorded for sets, when possible. A Marport system was also used on a trial basis to record trawl characteristics during the 2010 summer RV survey.

RESULTS

The annual summer RV survey was conducted on the CCGS Alfred Needler between July 6 and August 9, 2010. A total of 203 fishing stations were completed during the survey. In NAFO Divisions 4X5Y (strata 470 - 495), 75 valid tows were completed, while 121 valid tows were completed in NAFO Divisions 4VW (strata 440 - 466) and 7 valid tows were completed in strata 496 - 498 (Scotian shelf edge; depth <750 m), (Figure 1). Seven tows were designated as unrepresentative either due to net damage or because tow duration was less than 20 minutes.

The 2010 survey started one day late due to time required to replace a sick member of the ship's personnel. Two more days were lost on separate occasions due to mechanical problems. Select stations were dropped from the survey due to these delays; however, minimum sampling requirements were met for all strata.

There were 104 species of fish recorded during the survey (Table 1). The most frequently captured fish were Atlantic herring, silver hake, haddock and American plaice while those contributing most to the weight caught were redfish, haddock, silver hake, Atlantic herring and cod.

There were 116 separate invertebrate codes used during the survey (Table 2). This is near the 2009 number and considerably greater than in 2006 when 63 invertebrate species were recorded. This was a result of a broader sampling strategy, and was accomplished through increasing experience of survey personnel in identification of invertebrates. The most frequently captured invertebrates were short-fin squid, pink shrimp, sponges, and sea anemone while orange footed sea cucumber, northern shrimp, American lobster and short-fin squid contributed most to the weight of the invertebrate catch.

An additional 19 valid tows and two unrepresentative tows were completed in the deep water (750-1,800 m), beginning off the edge of the Scotian shelf near Western Bank and moving west into 4X. There were 126 vertebrate species recorded from the deep catches (Table 3). The most frequently captured species were stout sawpalate, Gray's cutthroat eel, *Lampanyctus macdonaldi* and blue hake while those contributing most to weight caught were roundnose grenadier, black dogfish, Agassiz's smoothhead and Portuguese shark.

There were a total of 64 invertebrate species caught during the deep portion of the survey (Table 4). The most frequently captured species were *Acanthephyra pelagica*, *Sabinea* spp, jellyfishes and Gnathophausia while sand dollars, red deepsea crab, *Acanthephyra pelagica* and sea urchins contributed most to the invertebrate catch weight.

A variety of special samples were collected in addition to those required as part of the standard sampling protocol (Table 5). Any species recorded at sea as unidentified were retained for later identification. Some unidentified vertebrates were delivered to the Bedford Institute of Oceanography (BIO) for identification by Daphne Themalis while others were sent to the Atlantic Reference Center (ARC). Unidentified cephalopods were retained and shipped to Elizabeth Shea at the Delaware Museum of Natural History (DMNH) for further identification. Echinoderms retained, mainly sea urchins and sea stars, were sent to Jason Addison at the University of New Brunswick (UNB). Other unidentified invertebrates such as shrimp were retained and delivered to the ARC for further identification.

DISTRIBUTION, ABUNDANCE AND CONDITION OF SAMPLED SPECIES

The total biomass estimate for the survey at depths less than 365 m (strata 440 – 495; hereafter referred to as the Shelf strata) is displayed in Figure 2. Prior to 1999, data were not collected on most invertebrate species; therefore, this estimate is restricted to all vertebrate species plus lobster and squid and does not include catches from the deep tows. The total biomass index for 4VW was at the second highest level since 1991. In both 4X East and 4X West total biomass indices are variable throughout the time series. This estimate can be heavily influenced by a small number of species. For example, a large catch of dogfish from 4X East in 2007 resulted in the highest biomass estimate for this area in the time series. In 2010, this was not the case.

Catches in the deep water strata (501 – 504) seemed similar in size to those from the Shelf strata, but with higher species diversity. The average catch weights per tow in the deep strata were below the median for Shelf strata, but were still larger than the average for many individual shelf strata (Figure 3). Stratum 502 (1000 m – 1200 m) had the highest average catch of the deep strata. The shelf edge strata (496 - 498) had high average catch per tow. These catches were dominated by redfish.

The average numbers of species caught per tow were higher in the deep strata than in the Shelf strata (Figure 4). Catches on the shelf edge were similar in diversity to those from Shelf strata. For all the Shelf strata, catches in strata 490 – 495 (the Bay of Fundy) were noticeably more speciose than other regions.

Species composition appears quite distinct in the different depth zones. The shelf edge (350 m - 750 m) has limited overlap in species composition with the shelf strata, and also limited overlap with deeper water. Several skates (barndoor skate, thorny skate and smooth skate) along with cusk, wolffish and monkfish are known to inhabit deeper water; however none were caught in deepwater sets in this survey. Greenland halibut was the only species which was widely observed in both shelf and deepwater sets. While none of the standard commercial species were observed in deep water, the biomass was similar to the shelf, and many of the species observed were large-bodied fish.

Distribution, biomass, length frequency, and condition trend plots are included for some of the more abundant fish and invertebrates species in the survey catch (Figures 5 to 87) and for other species of commercial importance. Catch weight data for each species are adjusted to the survey area and used to produce a biomass index (Halliday and Koeller 1981). Length frequency plots for each species are derived from the number caught at length. The total number at length is calculated for the survey area and is used as an abundance index (Halliday and Koeller 1981). The length frequency plots for cod (DFO 2011b), silver hake (Showell *et al.* 2005), pollock (Stone *et al.* 2009), redfish (Branton 1999; Power 2000) and Atlantic halibut (DFO 2010b) are produced for the particular area used in the assessments for these species.
A distribution plot is also included for roundnose grenadier, which was the most abundant species from the deep tows. Tables 3 and 4 show the total catches by species from the deep tows.

INDIVIDUAL SPECIES TRENDS

An index of individual species summaries and associated figures is located in Table 6 of this document. Biomass comparisons are made for some species using current year estimate (2010), last year estimate (2009), short term (2005-2009) average, medium term (1995-2009) average, and long term (1970-2009) average and are shown in Table 7. Maps of NAFO Divisions, Strata boundaries, and common fishing grounds on the Scotian Shelf are provided in Appendix A and Appendix B to accompany text on distribution and trend for each species.

Atlantic cod catches were widespread throughout the survey area, although most catches were small. Only 3 sets caught greater than 50 kg, all occurring in 4V (Figure 5). Biomass indices in 4VW declined in 2010 but remains above short and medium term averages. The biomass index in 4X East was above both the short and medium term averages in 2009, and near the long term average. The biomass index declined in 2010 and was the fourth lowest in the time-series. In 4X West, the cod biomass index for 2010 was the lowest in the series (Figure 6, Table 7). Abundance indices for 4Vn were well below average for all lengths above 45 cm`, but they were at or above average for smaller cod (Figure 7). In 4VsW, abundance in 2010 was above average for lengths 3 - 14 cm and 63 - 71 cm, but below average for all other lengths (Figure 8). Cod abundance in 4X East in 2010 was below average for all lengths except the 6 - 8 cm and 15 - 17 cm groupings (Figure 9). Similarly, in 4X West abundance was well below average for all lengths except for 3 - 8 cm lengths (Figure 10). Cod condition in 4VW showed no clear trend, and remained lower than in the 1970s. Condition in 4X East and West has also been variable and in 2010 it was below average (Figure 11).

Haddock catches were widespread in 2010 (Figure 12). The biomass indices were lower in both 4X East and 4VW, with the latter declining from the highest point in the series in 2009. Biomass for all areas in 2010 was below the long term and medium term averages. 4X West was the only area where biomass was above the short term average (Figure 13, Table 7). The 4VW abundance indices were below average for most lengths, unlike in 2009. Catches at lengths <28 cm (consistent with length at age 0 and 1) were about average in 4VW (Figure 14). In 4X East (Figure 15) and 4X West (Figure 16), abundance was well above average for lengths up to 10.5 cm (age 0) but was below average for most other lengths <40 cm in 2010. Haddock condition declined in all areas in 2010, and remained below average (Figure 17).

White hake remain distributed throughout the survey area, with the largest catches in the Gulf of Maine (4Xpq) and in 4Vn (Figure 18). Biomass indices in 4VW, 4X East and 4X West were near the short and medium term averages, but all remained well below the long term average (Figure 19, Table 7). Abundance indices in 2010 continued to be below average for most lengths in 4VW (Figure 20). In 4X East, abundance was above average for most lengths less than 37 cm but well below average for most other lengths (Figure 21). Abundance in 4X West was high for lengths below 25 cm and near average for many other lengths (Figure 22). Condition of white hake declined in 2010 and was at the lowest for the time series in all areas (Figure 23).

Catches of **silver hake** in the 2010 survey were widespread, but with the bulk of the catches occurring in areas west of Sable Island (4WX5Y; Figure 24). The biomass index in 4VW increased slightly in 2010 and remained well above short, medium and long term averages. In 4X East, biomass remained close to the 2009 estimate and was above short and medium term averages, but below long term average. In 4X West, biomass increased in 2010 to the highest in the survey series; however, this was largely the result of one large catch at the mouth of the Bay of Fundy. The 2009 estimate was near the short term average and just below the medium and long term averages (Figure 25, Table 7). The 2010 abundance indices (strata 440-483) were well above average for lengths below 20 cm, and were at or above average for most other lengths (Figure 26). Condition has increased since 2000 but declined in 2010 to just below average (Figure 27).

Pollock catches were mainly located near the 4W/4X line and in the Gulf of Maine (Figure 28). Biomass in 4VW has declined annually since a peak in 2007 and in 2010 is below the short, medium and long term averages. In 4X East the 2009 estimate was high and although there was a decline in 2010, the estimate remained higher than the short and medium term averages. The biomass estimate in 4X West was near the short term average in 2009 but declined in 2010 to the lowest level observed since 1983; well below short, medium and long term averages (Figure 29, Table 7). Abundance indices in the eastern component (4VWXmn) were near or above average for lengths between 33 and 59 cm but there were very few large or small fish (Figure 30). In the western component (4Xopqrs5Y), the abundance indices were well below average in 2010 for all lengths (Figure 31). Pollock condition shows a general decline since the beginning of the surveys and in 2010 was below average in all areas (Figure 32).

Redfish catches were widespread throughout the survey area (Figure 33). The biomass index in 4VW has increased annually since 2007 and in 2010 was at its highest level in 20 years; higher than short, medium and long term averages. In 4X East the biomass index was the highest for the series in 2009 and although biomass declined in 2010, it was near the long term average. Redfish biomass in 4X West also declined in 2010 and was below short and medium term averages but near the long term average (Figure 34, Table 7). In Unit II (strata 440-456, 464), redfish abundance was above average and above 2009 values for most lengths below 23 cm (Figure 35). Abundance indices for Unit III (strata 457-463, 465-485) redfish in 2010 were below 2009 levels at most lengths, but values were still above average for lengths 4 - 10 cm and also for lengths 20 - 25 cm. All other lengths were below average (Figure 36). In 2010, condition was below average for all areas and was the lowest in the series for 4X east (Figure 37).

Atlantic Halibut were caught throughout the survey area (Figure 38). Biomass increased in 2010 for all areas and overall, has reached the highest in the series (Figure 39). Halibut abundance (4VWX5Y) was also above 2009 levels and well above average for most lengths (Figure 40).

Winter flounder were caught mainly in the Bay of Fundy with smaller catches also occurring on Browns Bank and Western Bank (Figure 41). In 4VW, biomass increased and was at its highest level since 2001. Biomass indices in 4X East has shown decline since 2001 and was below short, medium, and long term averages. In 4X West, biomass continued to increase in 2010 to the highest in the series, with the 2009 value being the second highest, and the short term and medium term averages higher than the long term average (Figure 42, Table 7). Abundance of winter flounder in 4X East was above average for some scattered lengths but at or below average for most lengths, especially larger fish (Figure 43). In 4X West, abundance was well above average for all lengths, with the exception of a few lengths above 38 cm (Figure 44).

Witch flounder were caught throughout the survey area (Figure 45). The biomass index for 4VW has shown a general increase since the early 1990's. In 2010, the biomass index was below the short term average but remained near the medium and long term averages. In 4X East, the biomass index remained below short, medium and long term averages, while biomass in 4X West has been increasing since 2007 and in 2010 was above short, medium and long term averages (Figure 46, Table 7). Abundance indices for 4VW fell from 2009 levels but remained above average for most lengths below 40 cm (Figure 47). In 4X East, abundance was above average for some scattered lengths but very low for lengths >42 cm (Figure 48). Abundance in 4X West was higher than 2009 and above average at most smaller sizes (Figure 49). Lengths greater than 49 cm continued to be absent from the survey catches.

American plaice were widespread throughout the survey area in 2010, with the largest catches primarily in 4V (Figure 50). Biomass indices for 4VW reached a recent peak in 2006 but have declined annually since then. The 2010 biomass estimate was below all averages and was the third lowest in the series (Figure 51, Table 7). Abundance indices in 2010 were similar to those for 2009. Abundance indices at all lengths were below average, with the exception of some of the lengths less than 18 cm (Figure 52).

Most **yellowtail flounder** catches in 2010 were caught in 4VW, with a small percentage caught in 4X (Figure 53). The biomass index for 4VW reached a low in 2003 but has since shown a general increase. In 2010, the biomass index declined and was below the short and long term average but near the medium term average (Figure 54, Table 7). Abundance of yellowtail flounder was above average for lengths less than 27 cm, but was less than average for all lengths greater than 27 cm (Figure 55).

Spiny dogfish were caught almost exclusively in 4X, with most catches coming from the Bay of Fundy and Gulf of Maine (Figure 56). Biomass has been variable from year to year with no clear trend (Figure 57).

The largest catches of **winter skate** in 2010 came from Browns Bank and the Bay of Fundy (Figure 58). Despite an increase in 4X West, overall biomass remained at a low level (Figure 59).

Thorny skate were caught primarily in 4V during the 2010 survey (Figure 60). Biomass was at or near the lowest level on record for all areas (Figure 61).

Catches of **Greenland halibut** were mainly in 4V, with the exception of catches made in the deep sets off the edge in 4WX (Figure 62). Biomass indices have been variable but remained at a high level compared to the period prior to the 1990s (Figure 63).

Roundnose grenadier were caught in 17 of the 21 tows completed in the deep water (750-1800 m; Figure 64). It was the most abundant and had the highest biomass caught among all species from the deep tows.

Atlantic herring catches were widely distributed throughout the survey area (Figure 65). Biomass indices for 4VW and 4X East increased in 2010 after recent declines (Figure 66). There remains no clear trend with herring biomass and it is not clear that survey catches reflect population biomass for herring, due to their primarily pelagic distribution.

Argentine catches were few but widely distributed along the shelf edge and in the Gulf of Maine (Figure 67). Biomass indices overall increased in 2010 to the highest in the series, but this was due to one set in 4X West catching over 500 kg (Figure 68). As with herring, it is not clear if survey catches are reflecting population biomass trends for argentine. These species are primarily pelagic, and small changes in vertical distribution may strongly influence bottom trawl catches.

Biomass of **northern sandlance** showed increase in 4VW for 2010. Sandlance have not traditionally shown up in catches within 4X but have been increasing since 2008 in 4X East (Figure 69)

Catches of **cusk** have declined throughout the series in all areas. In 4VW and 4X East, biomass remained low for 2010 but in 4X West biomass increased to its highest level since 2001 (Figure 70).

Atlantic Wolffish biomass has followed a declining trend since the 1980s and reached a low in 2009. In 2010, biomass increased in 4VW and 4X East but remained at a low level (Figure 71).

Monkfish have also shown decline and in 2010 were near the lowest level for all areas (Figure 72).

Biomass indices for **red hake** show no recent trend and were below average in all areas (Figure 73).

Biomass of **blackbelly rosefish** remained at a low level in 4VW and 4X East, but increased in 4X West to the second highest level in the series (Figure 74).

Ocean pout biomass declined in the 1990s and has remained at a low level in all areas since 2000 (Figure 75).

Biomass of **northern hagfish** has been variable without trend throughout the series (Figure 76).

American lobster catches came mainly from 4X, although the second highest catches on record were found in 4W (Figure 77). Biomass has increased since the 1990s and has remained variable at a high level in all areas (Figure 78).

Short-fin squid were caught throughout the survey area (Figure 79). Survey catches for short-fin squid show high inter-annual variability. In 2010, biomass was below average in 4VW and 4X East but above average in 4X West (Figure 80).

Sea scallop catches in 2010 came mainly from Browns Bank and Western Bank (Figure 81). Biomass showed a slight increase in 4X East while declining in both 4VW and 4X West (Figure 82).

Catches of **snow crab** occurred primarily in the eastern portion of 4VW and were rarely encountered in 4X (Figure 83). Biomass in 4VW declined in 2010 but remained above average (Figure 84).

Pink shrimp were distributed widely throughout the survey area (Figure 85).

Northern shrimp were primarily found in 4VW (Figure 86).

Catches of **orange footed sea cucumber** were mainly in 4VW with the largest catches coming from Banquereau (Figure 87).

BOTTOM TEMPERATURE AND SALINITY

Temperature and salinity data were collected at each standard station from the 2010 survey. Contour plots of these data show general patterns of water masses in the region (Figures 88 and 89). The general patterns are consistent with past years with the coldest water on the Eastern Scotian Shelf, warm saline water in the Central Scotain Shelf and Georges Basin, and warm water of low salinity in the Bay of Fundy. The differences between average by stratum in 2010 and the long term average from 1970-2009 for both temperature and salinity are shown in Figures 90 and 91. Although there were no striking deviations from the longterm averages, temperature and salinity appear to be slightly higher, in 4X in particular.

CONCLUSIONS

While time did not permit the completion of all planned sets, the minimum objectives were completed for all survey strata. High catches were noted for several species, including halibut, silver hake and winter flounder. Exploratory sets conducted in deep water (750 m – 1,800 m) had catches similar in size to sets on the shelf; however, the species composition was quite distinct. Other than Greenland Halibut, there were no species which were widespread both in deep water and on the shelf.

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Table 1. Summary of vertebrate catch from the 2010 summer RV survey.

Species Code	Common Name	Scientific Name	Sets Occupied	Total Weight (Kg)	Total Number	Age Samples	Stomach Samples
60	Herring(Atlantic)	*Clupea harengus*	130	3590	25280		
14	Silver Hake	*Merluccius bilinearis*	128	4450	60773	1673	365
11	Haddock	*Melanogrammus aeglefinus*	125	4454	9740	1586	501
40	American Plaice	*Hippoglossoides platessoides*	125	506	3210		332
10	Cod(Atlantic)	*Gadus morhua*	116	2043	2258	613	277
23	Redfish Unseparated	*Sebastes*	110	12683	92303		407
41	Witch Flounder	*Glyptocephalus cynoglossus*	108	309	1629		206
300	Longhorn Sculpin	*Myoxocephalus octodecemspinosus*	80	338	2312		185
42	Yellowtail Flounder	*Limanda ferruginea*	77	590	4600		186
12	White Hake	*Urophycis tenuis*	75	757	1077	682	233
320	Sea Raven	*Hemitripterus americanus*	66	253	414		245
30	Halibut(Atlantic)	*Hippoglossus hippoglossus*	65	490	190	173	118
610	Northern Sand Lance	*Ammodytes dubius*	59	279	15784		
201	Thorny Skate	*Amblyraja radiata*	57	126	437		107
16	Pollock	*Pollachius virens*	56	1219	876	284	135
13	Squirrel or Red Hake	*Urophycis chuss*	53	36	330		94
340	Alligatorfish	*Aspidophoroides monopterygius*	52	1	378		
43	Winter Flounder	*Pseudopleuronectes americanus*	48	1212	4878		132
202	Smooth Skate	*Malacoraja senta*	34	37	129		55
304	Mailed Sculpin	*Triglops murrayi*	33	2	190		2
400	Monkfish,Goosefish.Angler	*Lophius americanus*	33	44	41		28
640	Ocean Pout(Common)	*Macrozoarces americanus*	31	13	54		
50	Striped Atlantic Wolffish	*Anarhichas lupus*	26	38	79		3
31	Turbot,Greenland Halibut	*Reinhardtius hippoglossoides*	25	305	391		94
64	Capelin	*Mallotus villosus*	25	5	648		35
880	Hookear Sculpin Atl.	*Artediellus atlanticus*	25	<1	47		
62	Alewife	*Alosa pseudoharengus*	22	36	318		
203	Little Skate	*Leucoraja erinacea*	20	73	159		17
220	Spiny Dogfish	*Squalus acanthias*	20	782	483		61

Species Code	Common Name	Scientific Name	Sets Occupied	Total Weight (Kg)	Total Number	Age Samples	Stomach Samples
112	Longfin Hake	*Urophycis chesteri*	19	20	184		49
123	Rosefish(Black Belly)	*Helicolenus dactylopterus*	18	49	308		10
204	Winter Skate	*Leucoraja ocellata*	18	147	191		55
241	Northern Hagfish	*Myxine glutinosa*	18	2	34		
114	Fourbeard Rockling	*Enchelyopus cimbrius*	15	2	45		
410	Marlin-Spike Grenadier	*Nezumia bairdii*	15	3	89		15
623	Daubed Shanny	*Lumpenus maculatus*	15	2	301		
701	Butterfish	*Peprilus triacanthus*	15	3	51		
620	Laval's Eelpout	*Lycodes lavalaei*	14	13	241		
70	Mackerel(Atlantic)	*Scomber scombrus*	13	13	57		1
622	Snake Blenny	*Lumpenus lumpretaeformis*	13	2	86		
200	Barndoor Skate	*Dipturus laevis*	12	111	19		4
61	Shad American	*Alosa sapidissima*	10	129	138		
314	Spatulate Sculpin	*Icelus spatula*	10	<1	26		
160	Argentine(Atlantic)	*Argentina silus*	9	564	1094		13
502	Atlantic Spiny Lumpsucker	*Eumicrotremus spinosus*	9	1	32		
712	White Barracudina	*Notolepis rissoi*	9	<1	22		
150	Lanternfish	*Myctophidae*	8	<1	87		
15	Cusk	*Brosme brosme*	7	21	12	12	12
604	Snipe Eel	*Nemichthys scolopaceus*	6	<1	31		
646	Atlantic Soft Pout	*Melanostigma atlanticum*	6	<1	115		
149	Longnose Greeneye	*Parasudis truculenta*	5	<1	14		
350	Atlantic Sea Poacher	*Leptagonus decagonus*	5	<1	11		
19	Off-Shore Hake	*Merluccius albidus*	4	12	13		
221	Black Dogfish	*Centroscyllium fabricii*	4	20	70		
301	Shorthorn Sculpin	*Myoxocephalus scorpius*	4	1	7		
501	Lumpfish	*Cyclopterus lumpus*	4	7	4		
619	Eelpout Newfoundland	*Lycodes terraenova*	4	1	5		
122	Cunner	*Tautogolabrus adspersus*	3	2	5		
159	Boa Dragonfish	*Stomias boa*	3	6	317		
182	Lanternfish Kroyer's	*Notoscopelus elongatus Kroyeri*	3	<1	15		
303	Grubby or Little Sculpin	*Myoxocephalus aenaeus*	3	<1	17		

Species Code	Common Name	Scientific Name	Sets Occupied	Total Weight (Kg)	Total Number	Age Samples	Stomach Samples
625	Radiated Shanny	*Ulvaria subbifurcata*	3	<1	4		
626	4-Line Snake Blenny	*Eumesogrammus praecisus*	3	<1	8		
720	Atlantic Saury,Needlefish	*Scomberesox saurus*	3	<1	2		
17	Tomcod(Atlantic)	*Microgadus tomcod*	2	<1	6		
113	Blue Antimora/Hake	*Antimora rostrata*	2	<1	2		
142	Fourspot Flounder	*Hippoglossina oblonga*	2	<1	2		
143	Brill/Windowpane	*Scophthalmus aquosus*	2	1	3		
169	Viperfish	*Chauliodus sloani*	2	<1	7		
411	Roughhead Grenadier	*Macrourus berglax*	2	2	3		
505	Seasnail,Gelatinous	*Liparis fabricii*	2	<1	2		
520	Sea Tadpole	*Careproctus reinhardti*	2	<1	3		
602	Gray's Cutthroat Eel	*Synaphobranchus kaupi*	2	1	31		
630	Wrymouth	*Cryptacanthodes maculatus*	2	3	2		
743	American Barrelfish	*Hyperoglyphe perciformis*	2	<1	3		
39	Black Swallower	*Chiasmodon niger*	1	<1	1		
44	Gulf Stream Flounder	*Citharichthys arctifrons*	1	<1	3		
94	Atlantic Moonfish	*Vomer setapinnis*	1	<1	1		
155	Longtooth Anglemouth	*Gonostoma elongatum*	1	<1	7		
156	Short-nose Greeneye	*Chlorophthalmus agassizi*	1	<1	2		
216	Atlantic Torpedo	*Torpedo nobiliana*	1	19	1		
302	Arctic Staghorn Sculpin	*Gymnocanthus tricuspis*	1	1	1		
307	Polar Sculpin	*Cottunculus microps*	1	<1	1		
414	Rock Grenadier(Roundnose)	*Coryphaenoides rupestris*	1	<1	1		
455	Eels, Cutthroat	*Synaphobranchidae*	1	<1	1		
500	Seasnail Unidentified	*Liparis*	1	<1	2		
511	Blacksnout Seasnail	*Paraliparis copei*	1	<1	3		
512	Seasnail,Dusky	*Liparis gibbus*	1	<1	1		
515	Sea Tadpole	*Careproctus*	1	<1	3		
595	Red Dory	*Cyttopsis rosea*	1	<1	1		
601	Snubnose Eel, Slime Eel	*Simenchelys parasitica*	1	<1	1		
603	Wolf Eelpout	*Lycenchelys verrilli*	1	<1	3		
607	Duckbill Oceanic Eel	*Nessorhamphus ingolfianus*	1	<1	2		

Species Code	Common Name	Scientific Name	Sets Occupied	Total Weight (Kg)	Total Number	Age Samples	Stomach Samples
616	Fish Doctor	*Gymnelis viridis*	1	<1	1		
637	Spotfin Dragonet	*Foetorepus agassizi*	1	<1	2		
647	Shorttailed Eelpout(Vahl)	*Lycodes vahlii*	1	1	6		
704	American John Dory	*Zenopsis ocellata*	1	1	1		
711	Short Barracudina	*Paralepis atlantica*	1	<1	7		
725	Atlantic Gymnast	*Xenodermichthys copei*	1	<1	4		
777	Thorny Tinselfish	*Grammicolepis brachiusculus*	1	<1	1		
805	Tonguefish	*Symphurus*	1	<1	2		
819	Loose Jaws	*Malacosteidae*	1	<1	1		
844	Batfish,Spiny	*Halieutichthys aculeatus*	1	<1	1		
1054	Duckbill Barracudina	*Paralepis atlantica Kroyer*	1	<1	2		

Table 2. Summary of invertebrate catch from the 2010 summer RV survey (Note: some invertebrates were not counted and show total number as -)

Species Code	Common Name	Scientific Name	Sets Occupied	Total Weight (Kg)	Total Number
4511	Short-fin Squid	*Illex illecebrosus*	131	319	3605
2212	Pink Shrimp	*Pandalus montagui*	102	152	45054
8600	Sponges	*Porifera*	90	117	1615
8300	Sea Anemone	*Anthozoa*	86	31	371
2526	Snow Crab (Queen)	*Chionoecetes opilio*	83	307	2162
6117	*Hippasteria phrygiana*	*Hippasteria phrygiana*	78	22	230
6123	Spiny sunstar	*Crossaster papposus*	59	20	374
6411	Green Sea Urchin	*Strongylocentrotus droebachiensis*	56	129	724
2550	American Lobster	*Homarus americanus*	54	428	355
4521	Octopus	*Octopoda*	54	2	144
6611	Orange Footed Sea Cucumber	*Cucumaria frondosa*	52	1871	690
6110	Asterias	*Asterias*	51	95	391
6500	Sand Dollars	*Clypeasteroida*	50	43	1034
2511	Jonah Crabs	*Cancer borealis*	49	51	409
6121	Purple Sunstar	*Solaster endeca*	49	15	124
2559	Hermit Crabs	*Paguridae*	46	5	106
8500	Jellyfishes	*Scyphozoa*	46	38	90
4210	Whelks	*Buccinum*	45	15	136
6113	*Leptasterias polaris*	*Leptasterias polaris*	43	176	1009
6119	Blood Star	*Henricia sanguinolenta*	43	1	292
4321	Sea Scallop	*Placopecten magellanicus*	42	43	595
1823	Sea Potato	*Boltenia*	40	12	156
2211	Northern Shrimp	*Pandalus borealis*	38	738	112396
2521	*Hyas Coarctatus*	*Hyas coarctatus*	37	4	134
2523	Northern Stone Crab	*Lithodes maja*	34	15	51
6101	*Ceremaster granularis*	*Ceremaster granularis*	33	3	113
6200	Brittle Star	*Ophiuroidea*	33	3	1748
2513	Atlantic Rock Crab	*Cancer irroratus*	32	46	471
6111	*Asterias rubens*	*Asterias rubens*	30	3	532
6115	Mud Star	*Ctenodiscus crispatus*	30	3	598

Species Code	Common Name	Scientific Name	Sets Occupied	Total Weight (Kg)	Total Number
2527	Toad Crab	*Hyas araneus*	28	12	200
6125	*Pteraster militaris*	*Pteraster militaris*	27	1	172
6300	Basket Stars	*Gorgonocephalidae,Asteronychidae*	27	93	138
8318	Sea Pen	*Pennatulacea*	24	1	152
4322	Iceland Scallop	*Chlamys islandica*	22	20	199
6131	*Diplopteraster multipes*	*Diplopteraster multipes*	22	3	60
2312	*Lebbeus polaris*	*Lebbeus polaris*	21	<1	251
2416	Crangon	*Crangon*	21	2	625
8346	*Pseudarchaster parelii*	*Pseudarchaster parelii*	21	1	51
2600	Krill Shrimp	*Euphausiacea*	19	2	5655
2221	*Pasiphaea multidentata*	*Pasiphaea multidentata*	18	4	1429
2990	Barnacles	*Cirripedia*	18	22	334
6211	Daisy	*Ophiopholis aculeata*	18	<1	70
4536	Bobtail Squid	*Sepiolodae*	15	<1	17
5100	Sea Spider	*Pycnogonida*	15	<1	55
3200	Sea Mouse	*Aphrodita hastata*	14	1	489
2411	*Argis dentata*	*Argis dentata*	13	12	2945
3212	Aphrodita	*Aphrodita*	13	5	32
6100	Asteroidea	*Asteroidea*	13	2	108
6129	*Poraniomorpha hispida*	*Poraniomorpha hispida*	13	1	28
3501	*Lepidonotus squamatus*	*Lepidonotus squamatus*	11	<1	238
8347	*Psilaster andromeda*	*Psilaster andromeda*	11	1	110
2316	*Spirontocaris spinus*	*Spirontocaris spinus*	10	<1	556
4317	Bar,Surf Clam	*Spisula solidissima*	9	3	39
2415	*Pontophilys norvegicus*	*Pontophilus norvegicus*	7	<1	21
4330	Mussels	*Mytilidae*	7	5	8
2313	*Spirontocaris liljeborgii*	*Spirontocaris liljeborgii*	6	<1	109
4300	Bivalvia	*Bivalvia*	6	<1	70
2319	*Lebbeus groenlandicus*	*Lebbeus groenlandicus*	5	<1	81
2414	*Sclerocrangon boreas*	*Sclerocrangon boreas*	5	<1	21
2419	*Sabinea sarsi*	*Sabinea sarsi*	5	<1	37
2532	Red Deepsea Crab	*Chaceon quinquedens*	5	10	53

Species Code	Common Name	Scientific Name	Sets Occupied	Total Weight (Kg)	Total Number
4221	Northern Moonsnail	*Euspira heros*	5	2	9
4381	Anomia	*Anomia*	5	<1	31
6213	*Ophiura sarsi*	*Ophiura sarsi*	5	<1	5
8324	Sea Cauliflower, Strawberries	*Eunephthya rubiformis*	5	<1	25
9300	Seaweed,(Algae),Kelp	*Thallophyta*	5	16	-
2213	*Atlantopandalus propinqvus*	*Atlantopandalus propinqvus*	4	<1	27
2417	*Crangon septemspinosa*	*Crangon septemspinosa*	4	<1	150
4514	Squid	*Loliginidae,Ommastrephidae*	4	<1	14
6600	Sea Cucumbers	*Holothuroidea*	4	2	10
8100	Comb Jellies	*Ctenophora*	4	<1	12
8327	Soft Coral Unidentified	*Soft Coral Unidentified*	4	<1	4
2100	Shrimps	*Decapoda*	3	<1	12
2223	*Sergestes arcticus*	*Sergestes arcticus*	3	1	854
2541	*Axius serratus*	*Axius serratus*	3	<1	4
3100	Bristle Worms	*Polychaeta*	3	<1	6
3101	Large Polychaete, 3mm Dia	*Polychaeta,Large*	3	<1	9
4332	Horse Mussels	*Modiolus modiolus*	3	7	83
8000	Ctenophores,Coelenterates,Porifera	*Ctenophores,Coelenterates,Porifera*	3	<1	40
8335	Cup Coral	*Flabellum*	3	1	2
8601	Russian Hats	*Vazella pourtalesi*	3	58	84
1826	Sea Grapes	*Molgula manhattensis*	2	<1	10
2200	Pandalidae	*Pandalidae*	2	3	2247
2421	*Sabinea septemcarinata*	*Sabinea septemcarinata*	2	<1	11
2556	*Munida valida*	*Munida valida*	2	<1	3
2611	*Meganyctiphanes norvegica*	*Meganyctiphanes norvegica*	2	1	2
2800	Amphipoda	*Amphipoda*	2	<1	2
2811	Gammaridae	*Gammaridae*	2	<1	2
4304	Ocean Quahaug	*Arctica islandica*	2	<1	4
4310	Clams	*Protobranchia, Heterodonta*	2	1	11
4328	Anomoidae	*Anomoidae*	2	<1	103
6413	Heart Urchin	*Brisaster fragilis*	2	<1	1
7100	Nematoda	*Nematoda*	2	<1	6

Species Code	Common Name	Scientific Name	Sets Occupied	Total Weight (Kg)	Total Number
8400	Hydrozoa	*Hydrozoa*	2	<1	-
1821	Sea Squirts	*Ascidia*	1	<1	1
2220	Shrimp	*Pasiphaea tarda*	1	<1	23
2320	Lebbeus	*Lebbeus*	1	<1	2
2331	*Eualus macilentus*	*Eualus macilentus*	1	<1	49
2332	*Eualus fabricii*	*Eualus fabricii*	1	<1	30
2400	Crangonidae	*Crangonidae*	1	<1	1
2980	Red Isopod	*Isopoda*	1	<1	1
3221	Chone	*Chone*	1	<1	1
3551	Blood Worm	*Glycera capitata*	1	<1	-
4307	*Astarte undata*	*Astarte undata*	1	<1	-
4316	Astarte	*Astarte*	1	<1	60
4400	Sea Slugs	*Nudibranchia*	1	<1	1
6120	Henrica	*Henrica*	1	<1	5
6130	*Poraniomorpha borealis*	*Poraniomorpha borealis*	1	<1	1
6201	*Ophiacantha abyssicola*	*Ophiacantha abyssicola*	1	<1	2
6511	*Echinarachnius parma*	*Echinarachinus parma*	1	<1	16
6718	Molpadia	*Molpadia*	1	<1	1
8323	Bubble Gum Coral	*Paragorgia arborea*	1	11	-
8326	*Acanthogorgia armata*	*Acanthogorgia armata*	1	<1	-
8353	*Acanthephyra pelagica*	*Acanthephyra pelagica*	1	<1	1
8354	Sergia	*Sergia*	1	<1	2

Table 3. Summary of vertebrate catch from the deep sets during the 2010 summer RV survey.

Species Code	Common Name	Scientific Name	Sets Occupied	Total Weight (Kg)	Total Number	Age Samples
613	Stout Sawpalate	*Serrivomer beani*	21	4	128	
602	Gray's Cutthroat Eel	*Synaphobranchus kaupi*	20	126	1079	
146	*Lampanyctus macdonaldi*	*Lampanyctus macdonaldi*	20	3	226	
113	Blue Antimora/Hake	*Antimora rostrata*	19	63	187	33
795	Beans Blueback	*Scopelogadus beanii*	19	4	161	
157	Glacier Lanternfish	*Benthosema glaciale*	19	1	283	
176	Goitre Blacksmelt	*Bathylagus euryops*	18	4	113	
414	Rock Grenadier(Roundnose)	*Coryphaenoides rupestris*	17	640	1151	82
594	Smoothhead,Agassiz's	*Alepocephalus agassizii*	17	267	736	
247	Longnose Chimaera	*Harriotta raleighana*	17	106	91	
221	Black Dogfish	*Centroscyllium fabricii*	16	308	441	
169	Viperfish	*Chauliodus sloani*	16	6	202	
31	Turbot,Greenland Halibut	*Reinhardtius hippoglossoides*	15	181	110	
223	Portuguese Shark	*Centroscymnus coelolepis*	14	210	68	
865	*Aldrovandia phalacra*	*Aldrovandia phalacra*	14	2	63	
601	Snubnose Eel, Slime Eel	*Simenchelys parasitica*	13	9	84	
248	Knifenose Chimaera	*Rhinochimaera atlantica*	12	115	36	
159	Boa Dragonfish	*Stomias boa*	12	3	94	
410	Marlin-Spike Grenadier	*Nezumia bairdii*	11	34	360	
604	Snipe Eel	*Nemichthys scolopaceus*	11	0	30	
862	*Dicrolene Introniger*	*Dicrolene introniger*	10	2	25	
614	Pelican Gulper	*Eurypharynx pelecanoides*	10	1	17	
712	White Barracudina	*Notolepis rissoi*	10	0	18	
983	Apristurus	*Apristurus*	9	80	60	
39	Black Swallower	*Chiasmodon niger*	8	1	11	
138	Mirror Lanternfish	*Lampadena speculigera*	8	0	14	
883	*Gonostoma bathyphilum*	*Gonostoma bathyphilum*	8	0	11	
224	Rough Sagre	*Etmopterus princeps*	7	55	50	
1028	*Halosauropsis macrochir*	*Halosauropsis macrochir*	7	41	137	
814	*Bathysaurus ferox*	*Bathysaurus ferox*	7	10	23	

Species Code	Common Name	Scientific Name	Sets Occupied	Total Weight (Kg)	Total Number	Age Samples
308	Pallid Sculpin	*Cottunculus thompsoni*	7	9	13	
588	*Scopelosaurus lepidus*	*Scopelosaurus lepidus*	7	1	12	
711	Short Barracudina	*Paralepis atlantica*	7	1	15	
716	Straightline Dragonfish	*Borostomias antarcticus*	7	1	13	
155	Longtooth Anglemouth	*Gonostoma elongatum*	7	0	9	
182	Lanternfish Kroyer's	*Notoscopelus elongatus Kroyeri*	7	0	8	
774	Ogrefish	*Anoplogaster cornuta*	6	0	6	
700	Atlantic Silver Hatchfish	*Argyropelecus aculeatus*	6	0	8	
411	Roughhead Grenadier	*Macrourus berglax*	5	13	6	
242	Deepwater Chimaera	*Hydrolagus affinis*	5	11	9	
947	*Apristurus laurussoni*	*Apristurus laurussoni*	5	7	11	
112	Longfin Hake	*Urophycis chesteri*	5	7	26	
914	*Holtbyrnia anomala*	*Holtbyrnia anomla*	5	0	10	
724	Bairds Smoothead	*Alepocephalus bairdii*	4	90	34	
749	Slickhead	*Conocara salmonea*	4	16	57	
740	Spiny Eel	*Notacanthus chemnitzii*	4	3	5	
1017	*Rouleina attrita*	*Rouleina attrita*	4	2	13	
1030	*Aldrovandia affinis*	*Aldrovandia affinis*	4	0	7	
863	*Bathypterois quadrifilis*	*Bathypterois quadrifilis*	4	0	3	
180	Spotted Lanternfish	*Myctophum punctatum*	4	0	5	
109	Dainty Mora	*Halargyreus johnsonii*	3	14	28	
115	Threebeard Rockling	*Gaidropsarus ensis*	3	6	10	
649	Cusk-Eels Includes Brotulidae	*Ophidiidae*	3	2	15	
596	Bigeye Smooth-Head	*Bajacalifornia megalops*	3	1	3	
598	Eelpouts	*Zoarcidae*	3	0	8	
1019	*Ilyophis brunneus*	*Ilyophis brunneus*	3	0	6	
612	*Derichthys serpentinus*	*Derichthys serpentinus*	3	0	3	
646	Atlantic Soft Pout	*Melanostigma atlanticum*	3	0	9	
833	Lizardfish,Largescale	*Saurida brasiliensis*	2	7	12	
116	Silver Rockling	*Gaidropsarus argentatus*	2	2	5	
1013	Nezumia	*Nezumia*	2	2	14	
209	Shorttail Skate	*Amblyraja jenseni*	2	1	3	
416	Grenadiers	*Macrouridae*	2	1	5	

Species Code	Common Name	Scientific Name	Sets Occupied	Total Weight (Kg)	Total Number	Age Samples
739	Shortspine Tapirfish	*Polyacanthonotus rissoanus*	2	0	2	
484	*Paralepis elongata*	*Paralepis elongata*	2	0	3	
949	Dragonfish,Bighead	*Borostomias*	2	0	3	
1012	*Bassogigas gilli*	*Bassogigas gilli*	2	0	4	
177	Loosejaw	*Malacosteus niger*	2	0	2	
1054	Duckbill Barracudina	*Paralepis atlantica Kroyer*	2	0	4	
909	Chiasmodon	*Chiasmodon*	2	0	3	
1045	*Bathypterois phenax*	*Bathypterois phenax*	2	0	2	
607	Duckbill Oceanic Eel	*Nessorhamphus ingolfianus*	2	0	2	
709	Transparent Hatchetfish	*Sternoptyx diaphana*	2	0	3	
135	*Hygophum hygomi*	*Hygophum hygomi*	2	0	6	
729	*Omosudis lowei*	*Omosudis lowei*	2	0	2	
819	Loose Jaws	*Malacosteidae*	2	0	2	
184	Largescale Lanternfish	*Symbolophorus veranyi*	2	0	2	
183	Lanternfish Patchwork	*Notoscopelus resplendens*	2	0	2	
758	Dofleins Lanternfish	*Lobianchia dofleini*	2	0	3	
30	Halibut(Atlantic)	*Hippoglossus hippoglossus*	1	9	1	1
239	Deepsea Cat Shark	*Apristurus profundorum*	1	5	3	
1072	*Cataetyx laticeps*	*Cataetyx laticeps*	1	3	1	
963	Smoothhead	*Rouleina maderensis*	1	1	3	
1060	*Coryphaenoides carapinus*	*Coryphaenoides carapinus*	1	1	90	
211	Skates	*Rajidae*	1	1	1	
194	Moras	*Moridae*	1	1	1	
1052	Rouleina	*Rouleina*	1	0	2	
1050	Black Oreo	*Neocyttus helgae*	1	0	1	
240	Sea Lamprey	*Petronyzon marinus*	1	0	1	
768	Oneirodes	*Oneirodes*	1	0	1	
1032	*Bathytroctes microlepis*	*Bathytroctes microlepis*	1	0	1	
565	Barracudina	*Paralepis*	1	0	3	
532	*Cubiceps gracilis*	*Cubiceps gracilis*	1	0	6	
41	Witch Flounder	*Glyptocephalus cynoglossus*	1	0	1	
784	Black Scabbardfish	*Aphanopus carbo*	1	0	1	
1064	Coryphaenoides	*Coryphaenoides*	1	0	4	

Species Code	Common Name	Scientific Name	Sets Occupied	Total Weight (Kg)	Total Number	Age Samples
800	*Poromitra crassiceps*	*Poromitra crassiceps*	1	0	1	
1041	Laemonema	*Laemonema*	1	0	13	
343	Lampadena	*Lampadena*	1	0	1	
745	Anglemouth	*Gonostomatidae (NS)*	1	0	2	
979	Alepocephalus	*Alepocephalus*	1	0	1	
557	*Melamphaes suborbitalis*	*Melamphaes suborbitalis*	1	0	1	
617	Common Wolf Eel	*Lycenchelus paxillus*	1	0	1	
1039	*Bathypterois longipes*	*Bathypterois longipes*	1	0	1	
615	Backfin Tapirfish	*Lipogenys gillii*	1	0	1	
38	Swallowers	*Pseudoscopelus*	1	0	1	
705	*Argyropelecus gigas*	*Argyropelecus gigas*	1	0	1	
287	*Notoscopelus bolini*	*Notoscopelus bolini*	1	0	1	
488	*Evermanella indica*	*Evermanella indica*	1	0	1	
356	*Rondeletia Loricata*	*Rondeletia loricata*	1	0	1	
526	*Bathylagus bericoides*	*Bathylagus bericoides*	1	0	1	
755	Anglemouth(NS)	*Cyclothone*	1	0	5	
869	Seasnail	*Paraliparis garmani*	1	0	3	
1037	Bathypterois	*Bathypterois*	1	0	1	
494	*Scopeloberyx robustus*	*Scopeloberyx robustus*	1	0	2	
750	Cardinalfish	*Howella brodiei*	1	0	1	
396	*Photostomias guernei*	*Photostomias guernei*	1	0	1	
731	Shortnose lancetfish	*Alepisaurus brevirostris*	1	0	1	
186	*Taaningichthys minimus*	*Taaningichthys minimus*	1	0	1	
307	Polar Sculpin	*Cottunculus microps*	1	0	1	
338	Aristostomias	*Aristostomias*	1	0	1	
465	*Lampanyctus photonotus*	*Lampanyctus photonotus*	1	0	1	
511	Blacksnout Seasnail	*Paraliparis copei*	1	0	1	
1038	*Bathypterois grallator*	*Bathypterois grallator*	1	0	1	
158	Muller's Pearlsides	*Maurolicus muelleri*	1	0	1	
684	*Vinciguerria nimbaria*	*Vinciguerria nimbaria*	1	0	1	

Table 4. Summary of invertebrate catch from the deep sets during the 2010 summer RV survey (Note: some invertebrates were not counted and show total number as -).

Species Code	Common Name	Scientific Name	Sets Occupied	Total Weight (Kg)	Total Number
8353	*Acanthephyra pelagica*	*Acanthephyra pelagica*	17	7	971
2420	Sabinea	*Sabinea*	15	1	156
8500	Jellyfishes	*Scyphozoa*	14	5	103
2771	Gnathophausia	*Gnathophausia*	12	<1	34
2220	Shrimp	*Pasiphaea tarda*	11	2	79
8335	Cup Coral	*Flabellum*	11	2	211
6400	Sea Urchins	*Strongylocentrotus*	9	6	41
2532	Red Deepsea Crab	*Chaceon quinquedens*	8	9	47
5101	Pycnogonidae	*Pycnogonidae*	8	<1	63
6500	Sand Dollars	*Clypeasteroida*	8	10	69
8346	*Pseudarchaster parelii*	*Pseudarchaster parelii*	8	<1	14
5100	Sea Spider	*Pycnogonida*	7	<1	77
6200	Brittle Star	*Ophiuroidea*	7	6	61
2222	*Parapasiphaea sulcatifrons*	*Parapasiphaea sulcatifrons*	6	<1	11
4500	Cephalopoda	*Cephalopoda*	6	3	25
4584	Mastigoteuthis	*Mastigoteuthis*	5	<1	11
8354	Sergia	*Sergia*	5	1	43
2559	Hermit Crabs	*Paguridae*	4	<1	20
2566	*Munidopsis curvirostra*	*Munidopsis curvirostra*	4	<1	6
2611	*Meganyctiphanes norvegica*	*Meganyctiphanes norvegica*	4	<1	144
4511	Short-fin Squid	*Illex illecebrosus*	4	3	11
6300	Basket Stars	*Gorgonocephalidae,Asteronychidae*	4	<1	7
8300	Sea Anemone	*Anthozoa*	4	1	9
8347	*Psilaster Andromeda*	*Psilaster andromeda*	4	<1	11
2219	Pasiphaeidae	*Pasiphaeidae*	3	<1	14
2361	Acanthephyra	*Acanthephyra*	3	1	106
4514	Squid (NS)	*Loliginidae,Ommastrephidae*	3	<1	3
4521	Octopus	*Octopoda*	3	5	4
6123	Spiny sunstar	*Crossaster papposus*	3	1	7

Species Code	Common Name	Scientific Name	Sets Occupied	Total Weight (Kg)	Total Number
8318	Sea Pen	*Pennatulacea*	3	1	6
2100	Shrimps	*Decapoda*	2	<1	13
2800	Amphipoda	*Amphipoda*	2	<1	3
2980	Red Isopod	*Isopoda*	2	<1	1
2990	Barnacles	*Cirripedia*	2	<1	7
4555	Histioteuthis	*Histioteuthis*	2	<1	2
4569	Gonatus	*Gonatus*	2	<1	3
6100	Asteroidea	*Asteroidea*	2	<1	2
6129	*Poraniomorpha hispida*	*Poraniomorpha hispida*	2	<1	3
8332	Coral (NS)	*Anthozoa*	2	<1	1
2213	*Atlantopandalus propinqvus*	*Atlantopandalus propinqvus*	1	<1	1
2223	*Sergestes arcticus*	*Sergestes arcticus*	1	<1	1
2400	Crangonidae	*Crangonidae*	1	<1	4
2415	*Pontophilys norvegicus*	*Pontophilus norvegicus*	1	<1	1
2525	Spiny Crab	*Lithodes/Neolithodes*	1	<1	-
2528	Porcupine Crab	*Neolithodes grimaldii*	1	<1	1
2554	Galatheidae	*Galatheidae*	1	<1	2
3212	Aphrodita	*Aphrodita*	1	<1	2
4400	Sea Slugs	*Nudibranchia*	1	<1	-
4515	Illex	*Illex*	1	1	3
4529	Octopodidae	*Octopodidae*	1	<1	-
4599	*Gonatus fabricii*	*Gonatus fabricii*	1	<1	1
4660	*Gonatus steenstrupii*	*Gonatus steenstrupii*	1	<1	1
6212	Ophiura	*Ophiura*	1	<1	2
6397	Sand Dollars,Urchins (NS)	*Echinoidea*	1	1	27
6511	*Echinarachnius parma*	*Echinarachinus parma*	1	<1	1
6600	Sea Cucumbers (NS)	*Holothuroidea*	1	<1	-
8322	Sea Corn	*Primnoa resedaeformis*	1	<1	-
8323	Bubble Gum Coral	*Paragorgia arborea*	1	1	-
8326	*Acanthogorgia armata*	*Acanthogorgia armata*	1	<1	-
8328	*Anthomastus grandiflorus*	*Anthomastus grandiflorus*	1	1	-
8361	*Anthoptilum grandiflorum*	*Anthoptilum grandiflorum*	1	<1	-

Species Code	Common Name	Scientific Name	Sets Occupied	Total Weight (Kg)	Total Number
8363	Halipterus (Balticina)	*Halipterus (Balticina)*	1	<1	-
8520	Jellyfish	*Pelagia noctiluca*	1	<1	4
8600	Sponges	*Porifera*	1	<1	-

Table 5. Special samples collected during the 2010 summer RV survey.

Organism Requested	Details of Request
Skate Purses	All
Striped Wolffish	All Whole
Barndoor Skate	All Whole
Winter Skate	Tissue Sample
Sea Urchins	Strongylocentrotus droebachensis and S. pallidus – Up to 20 per set
Sea Stars	Asterias forbesi and A. rubens – Up to 20 per set
Ocean Pout	Tissue Sample Collection
Winter Flounder	Tissue Sample Collection
Phytoplankton/Water samples	20 1-liter samples
Haddock	30 Whole
American Plaice or Witch Flounder	30 Whole
Mussels	30 Whole
Atlantic Herring	30 Whole
American Plaice (4VsW)	500 – otoliths and maturity
Cephalopods (*Grimpoteuthis*)	At least 1 per set per species

Table 6. Index of individual species summaries and associated figures.

Species	**Summary Page**	**Figure Page**
Atlantic Cod (*Gadus morhua*)	6	34
Haddock (*Melanogrammus aeglefinus*)	7	38
White Hake (*Urophycis tenuis*)	7	42
Silver Hake (*Merluccius bilinearis*)	7	46
Pollock (*Pollachius virens*)	7	49
Redfish (*Sebastes*)	8	52
Atlantic Halibut (*Hippoglossus hippoglossus*)	8	55
Winter Flounder (*Pseudopleuronectes americanus*)	8	57
Witch Flounder (*Glyptocephalus cynoglossus*)	8	60
American Plaice (*Hippoglossoides platessoides*)	9	63
Yellowtail Flounder (*Limanda ferruginea*)	9	65
Spiny Dogfish (*Squalus acanthias*)	9	67
Winter Skate (*Leucoraja ocellata*)	9	69
Thorny Skate (*Amblyraja radiata*)	9	71
Greenland Halibut (*Reinhardtius hippoglossoides*)	9	73
Roundnose Grenadier (*Coryphaenoides rupestris*)	9	75
Atlantic Herring (*Clupea harengus*)	9	76
Argentine (*Argentina silus*)	9	78
Northern Sandlance (*Ammodytes dubius*)	10	79
Cusk (*Brosme brosme*)	10	80
Atlantic Wolffish (*Anarhichas lupus*)	10	80
Monkfish (*Lophius americanus*)	10	81
Red Hake (*Urophycis chuss*)	10	81
Blackbelly Rosefish (*Helicolenus dactylopterus*)	10	82
Ocean Pout (*Macrozoarces americanus*)	10	82
Northern Hagfish (*Myxine glutinosa*)	10	83
American Lobster (*Homarus americanus*)	10	84
Short-fin Squid (*Illex illecebrosus*)	10	86
Sea Scallop (*Placopecten magellanicus*)	10	88
Snow Crab (*Chionoecetes opilio*)	10	90
Pink Shrimp (*Pandalus montagui*)	10	92
Northern Shrimp (*Pandalus borealis*)	10	93
Orange Footed Sea Cucumber (*Cucumaria frondosa*)	11	94

Table 7. Comparison of 2010 summer RV survey biomass estimate with 2009 estimate, short term average (2005-2009), medium term average (1995-2009), and the long term average (1970-2009).

Stock/Region	2010	2009	2005-2009 Avg	1995-2009 Avg	*1970-2009 Avg
4VW Cod	41491	71027	31000	19785	70149
4X5Y Cod (4X east)	1835	8042	3213	4663	8428
4X5Y Cod (4X west)	1203	6930	4974	10809	13412
4VW Haddock	48339	158331	79637	63521	61228
4X5Y Haddock (4X east)	26834	49564	39011	34753	34813
4X5Y Haddock (4X west)	18702	17089	15375	23188	22501
4VW White Hake	5507	6160	5719	6047	10414
4X5Y White Hake (4X east)	1748	2736	1555	1602	2759
4X5Y White Hake (4X west)	12587	17089	11304	11865	16435
4VW Silver Hake	29024	28782	15570	18783	23885
4X5Y Silver Hake (4X east)	8764	8988	4976	5887	10077
4X5Y Silver Hake (4X west)	61940	2247	2281	4229	4122
4VW Pollock	4429	6426	13840	8918	16528
4X5Y Pollock (4X east)	13378	24145	10927	8945	17596
4X5Y Pollock (4X west)	5826	50278	54781	29496	25924
4VW Redfish	117253	97627	55029	42594	65009
4X5Y Redfish (4X east)	43251	274230	118934	67731	44801
4X5Y Redfish (4X west)	28642	43451	62765	31960	22555
4VW American Plaice	12038	12829	18754	17125	24912
4VW Witch Flounder	3955	11029	5843	3833	3938
4X5Y Witch Flounder (4X east)	241	368	452	659	674
4X5Y Witch Flounder (4X west)	2084	1664	867	892	1210
4VW Yellowtail Flounder	10197	16733	11814	10074	13782
4X5Y Winter Flounder (4X east)	404	576	598	1058	560
4X5Y Winter Flounder (4X west)	12580	6590	4422	3403	2669

*Silver hake long term average is for 1982-2009.

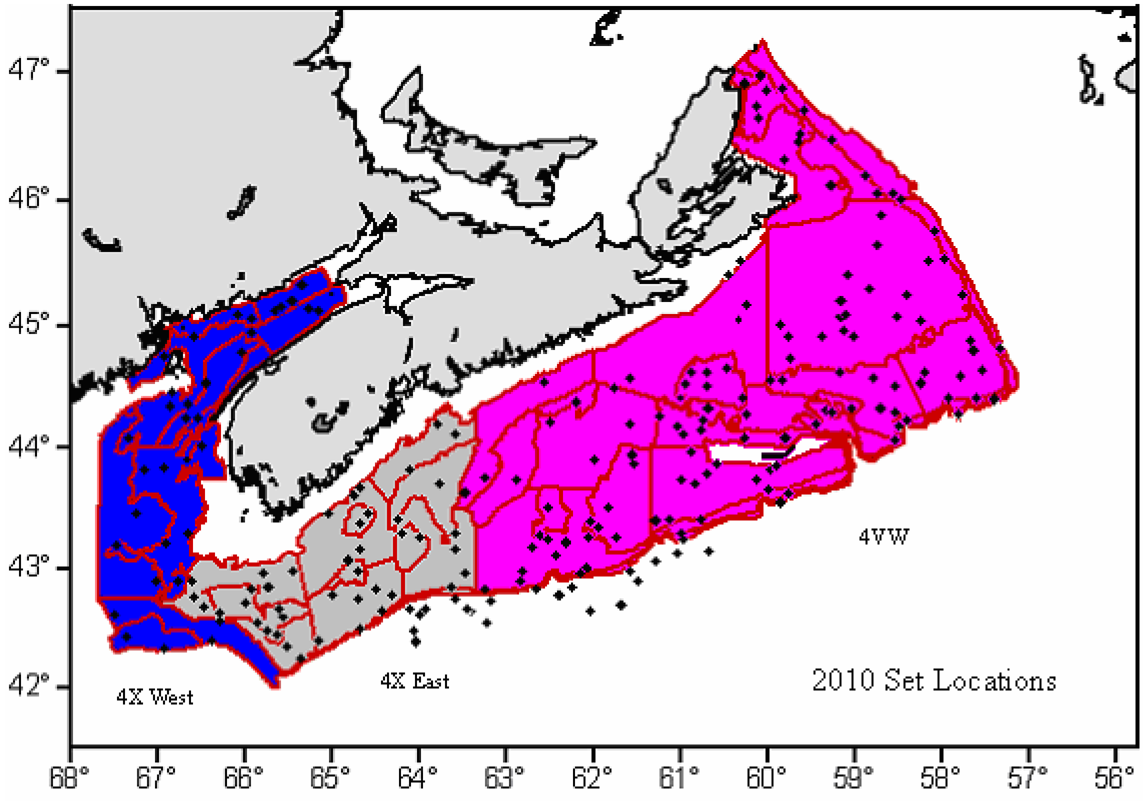


Figure 1. Station locations and geographical zones from the 2010 summer RV survey (Blue=4X West, Grey=4X East, Pink=4VW).

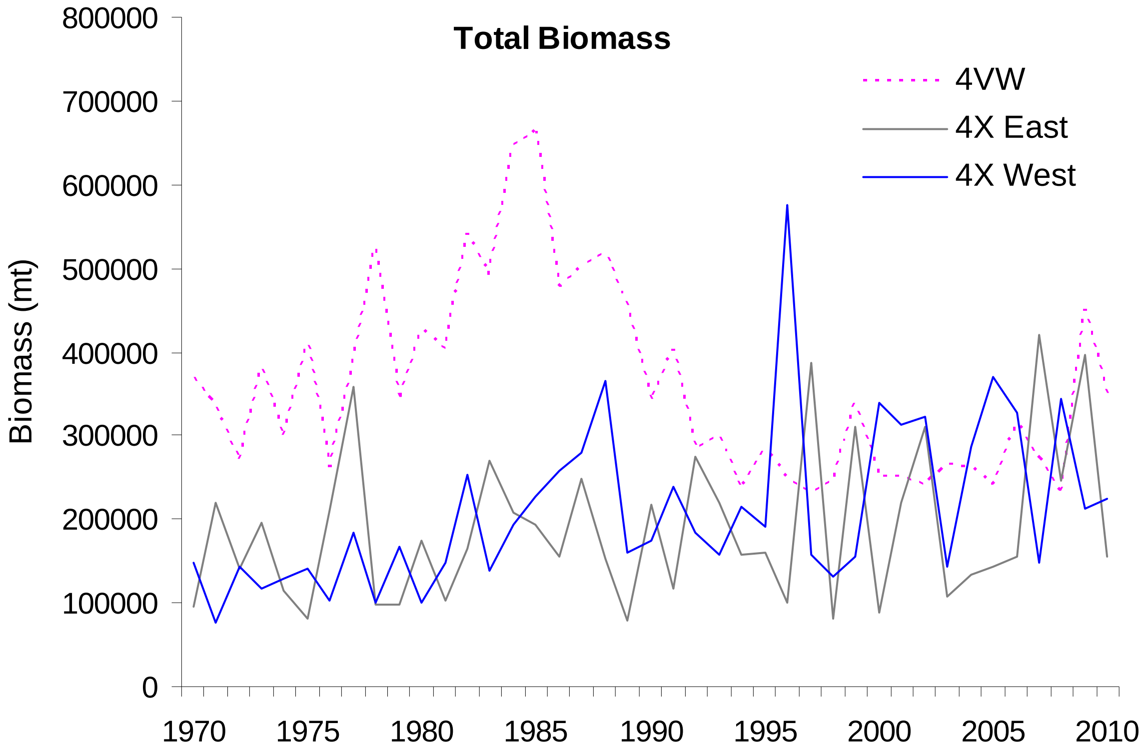


Figure 2. Total biomass estimate from the 2010 summer RV survey.

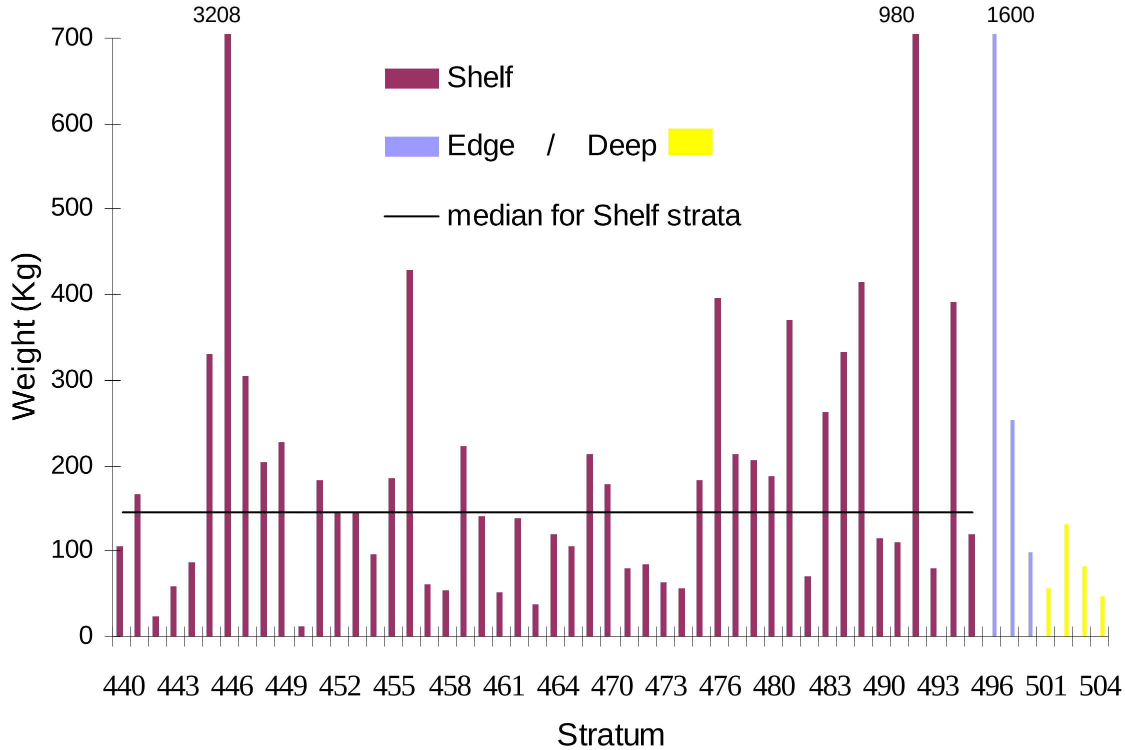


Figure 3. Comparison of average catch weight per tow by strata for the shelf strata (440-495), edge strata (496-498) and deep strata (501-504).

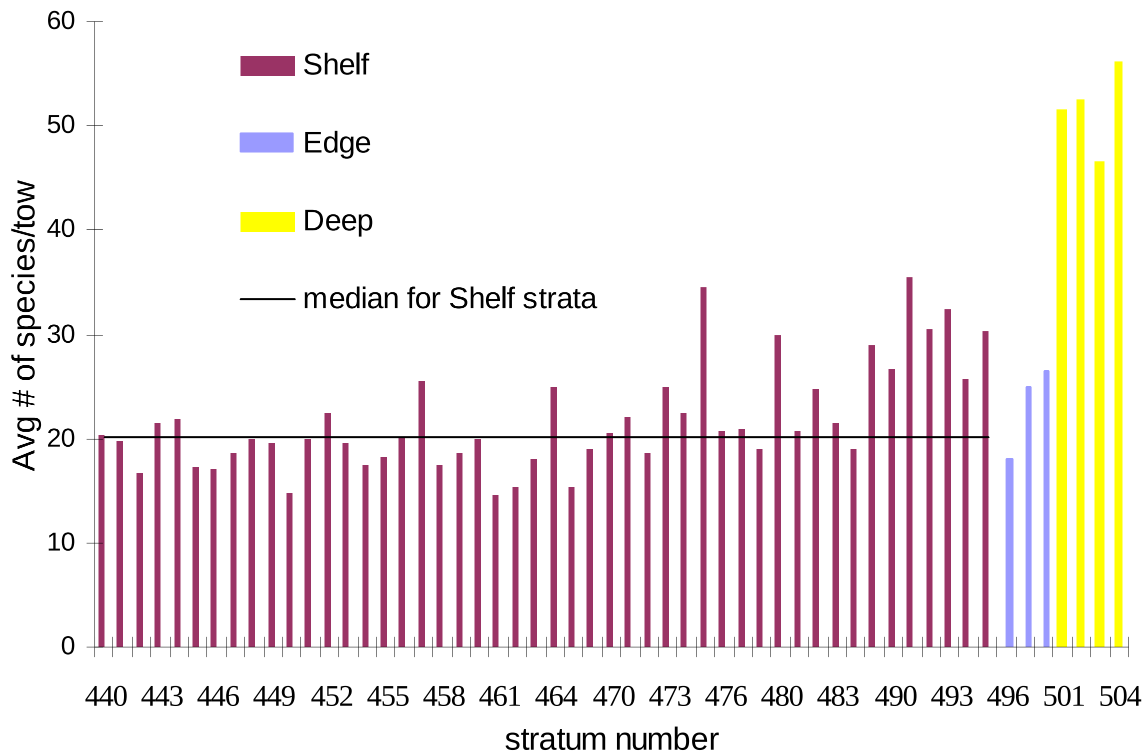


Figure 4. Average number per tow of species caught by strata for the shelf strata (440-495), edge strata (496-498) and deep strata (501-504).

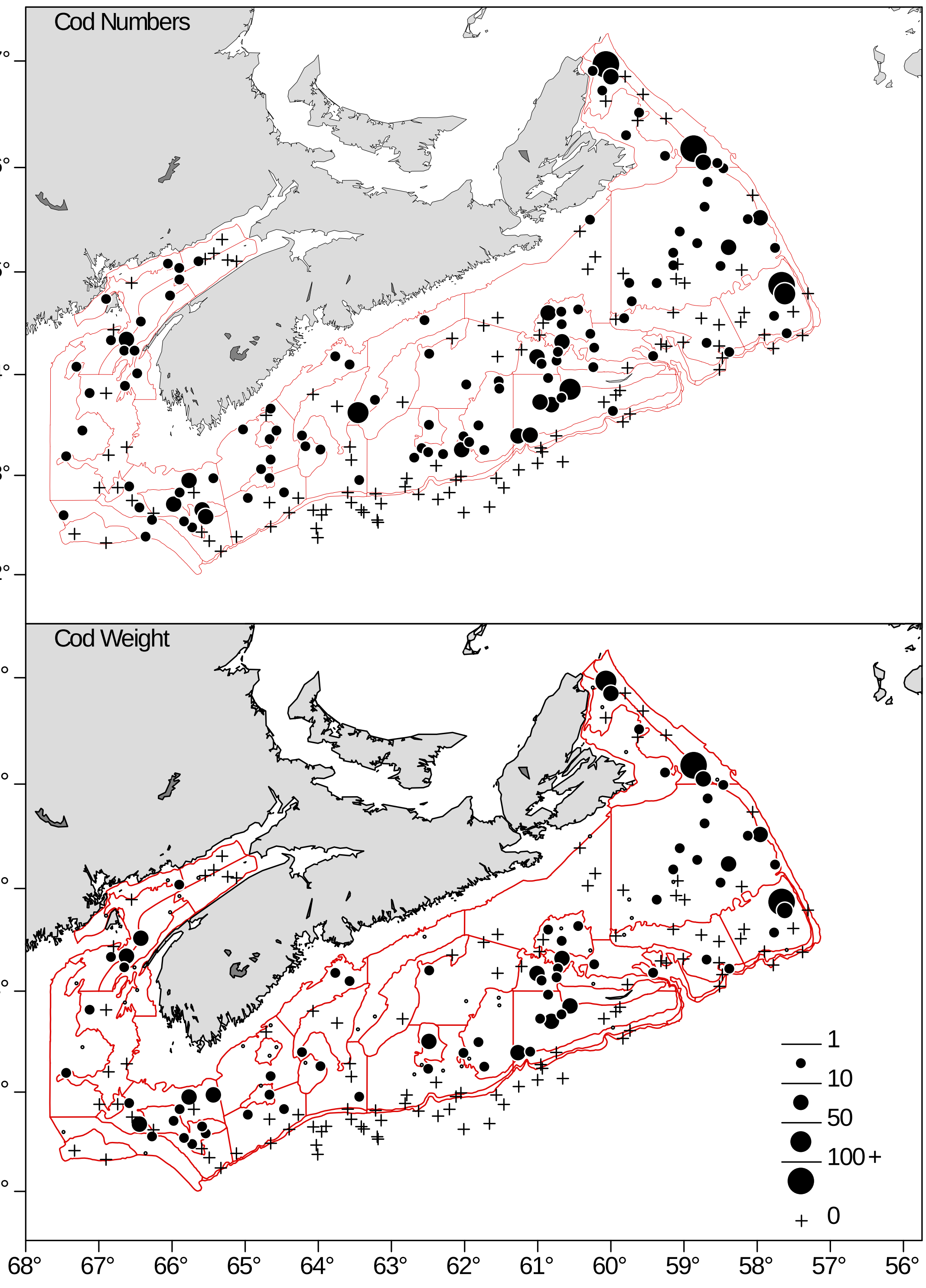


Figure 5. Distribution of cod catches during the 2010 summer RV survey (scale represents both weight (kg) and numbers).

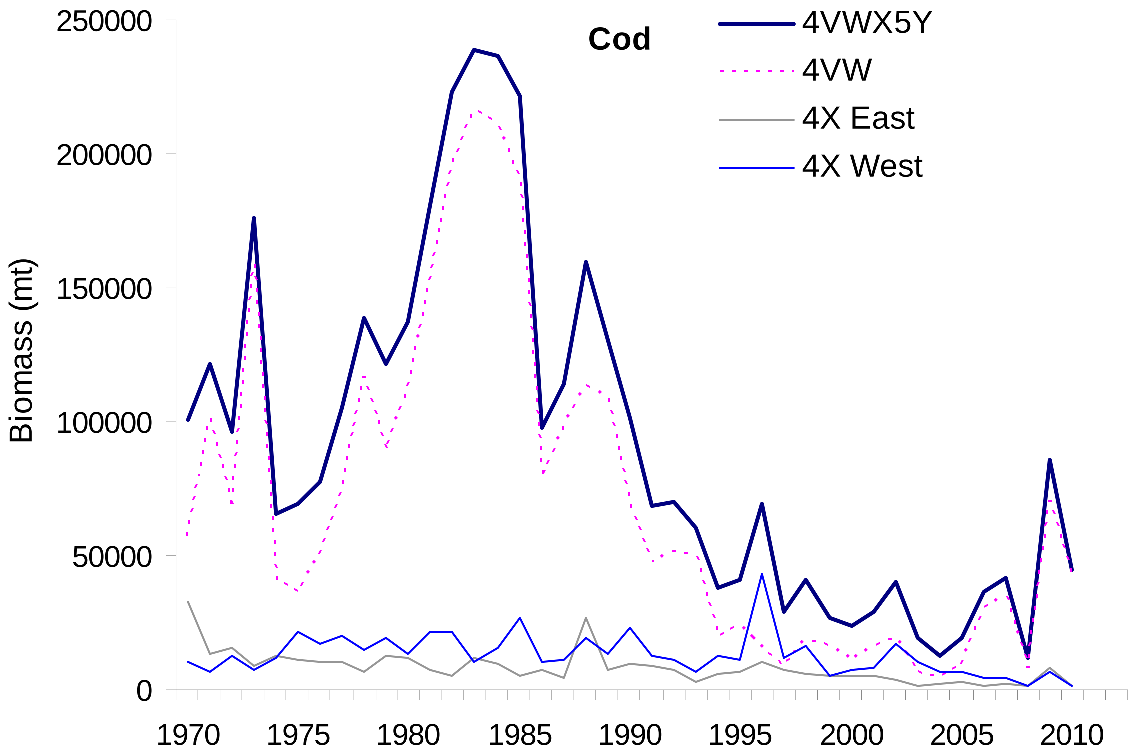


Figure 6. Biomass estimate for cod in 4VWX5Y from the summer RV survey.

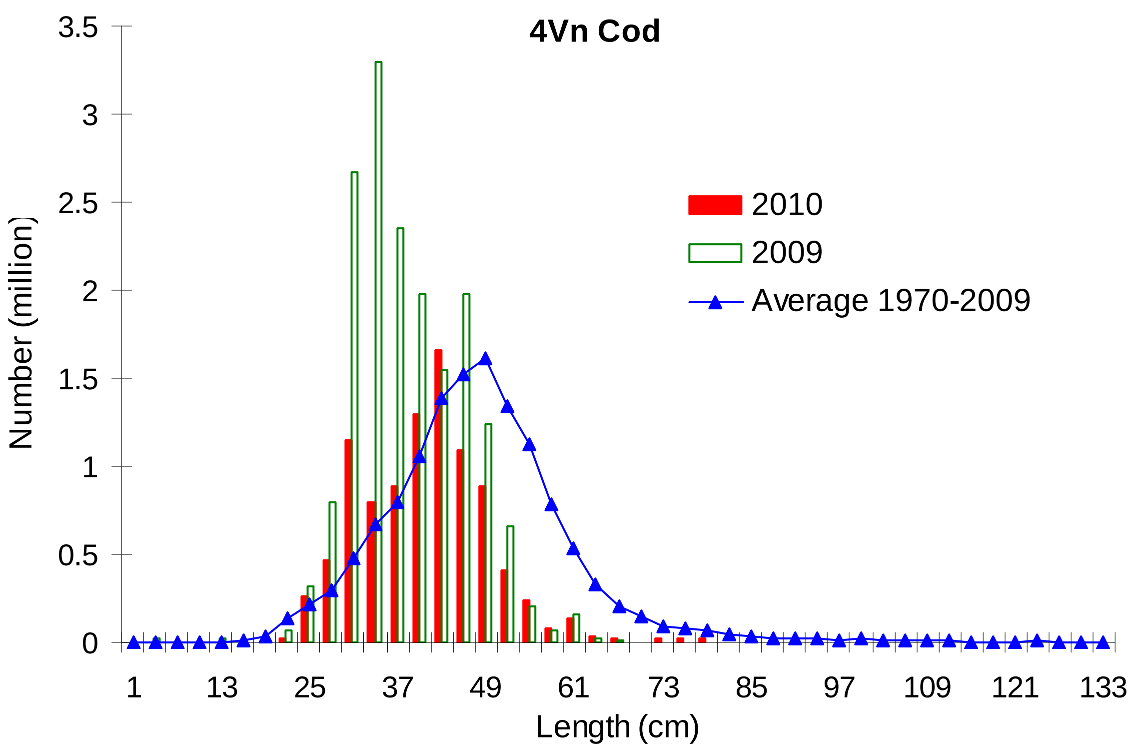


Figure 7. Length composition for cod in 4Vn from the summer RV survey.

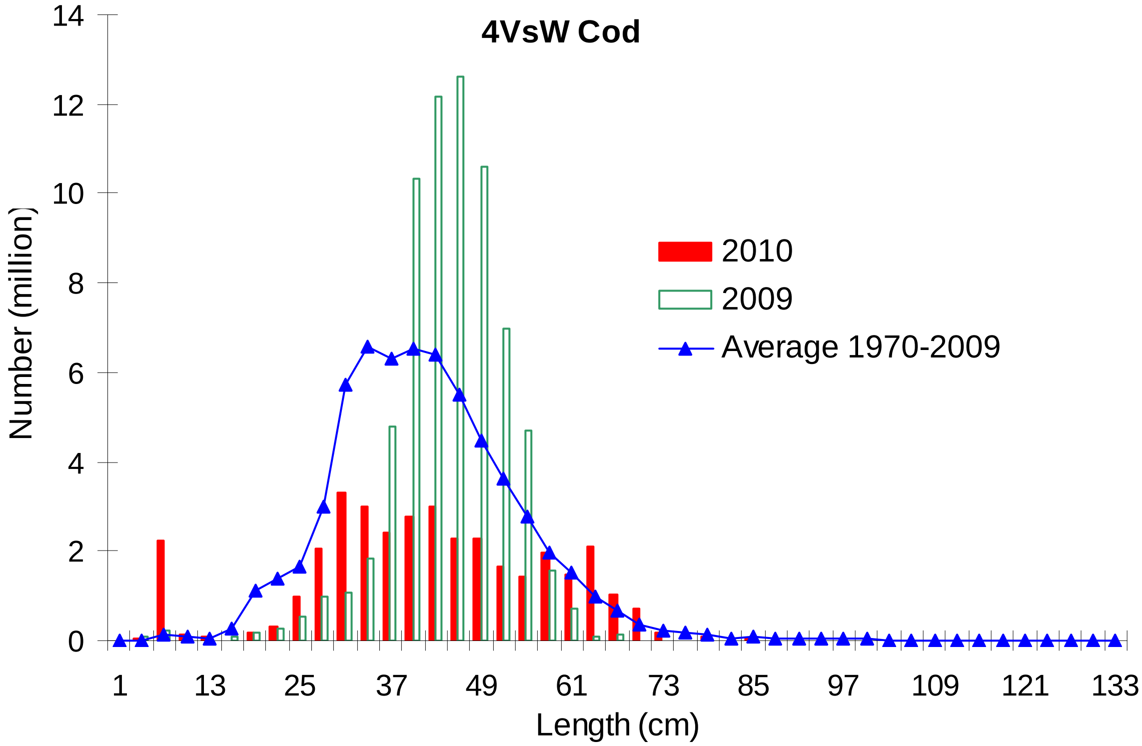


Figure 8. Length composition for cod in 4VsW from the summer RV survey.

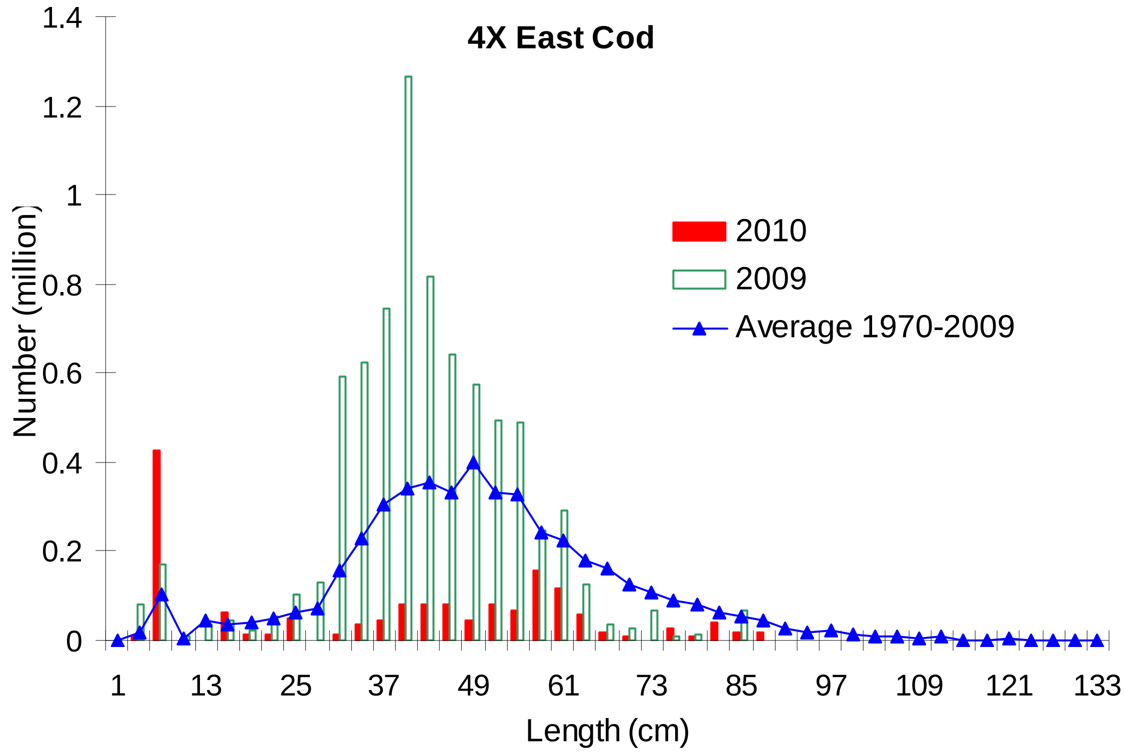


Figure 9. Length composition for cod in 4X East from the summer RV survey.

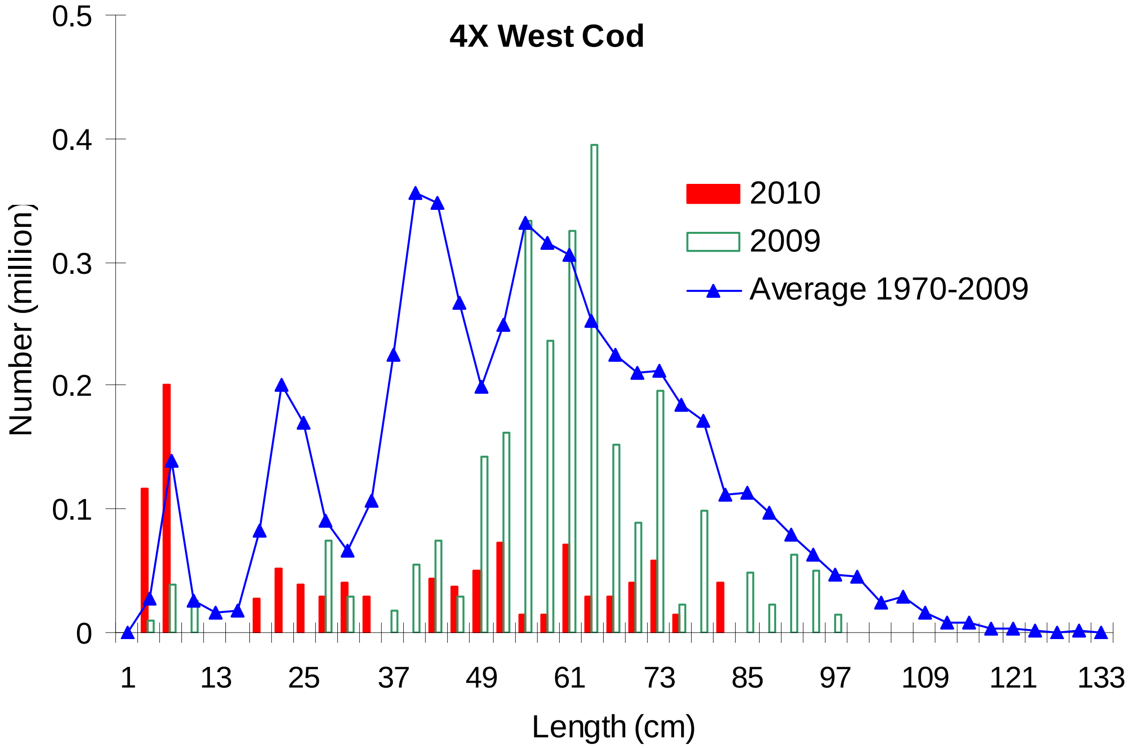


Figure 10. Length composition for cod in 4X West from the summer RV survey.

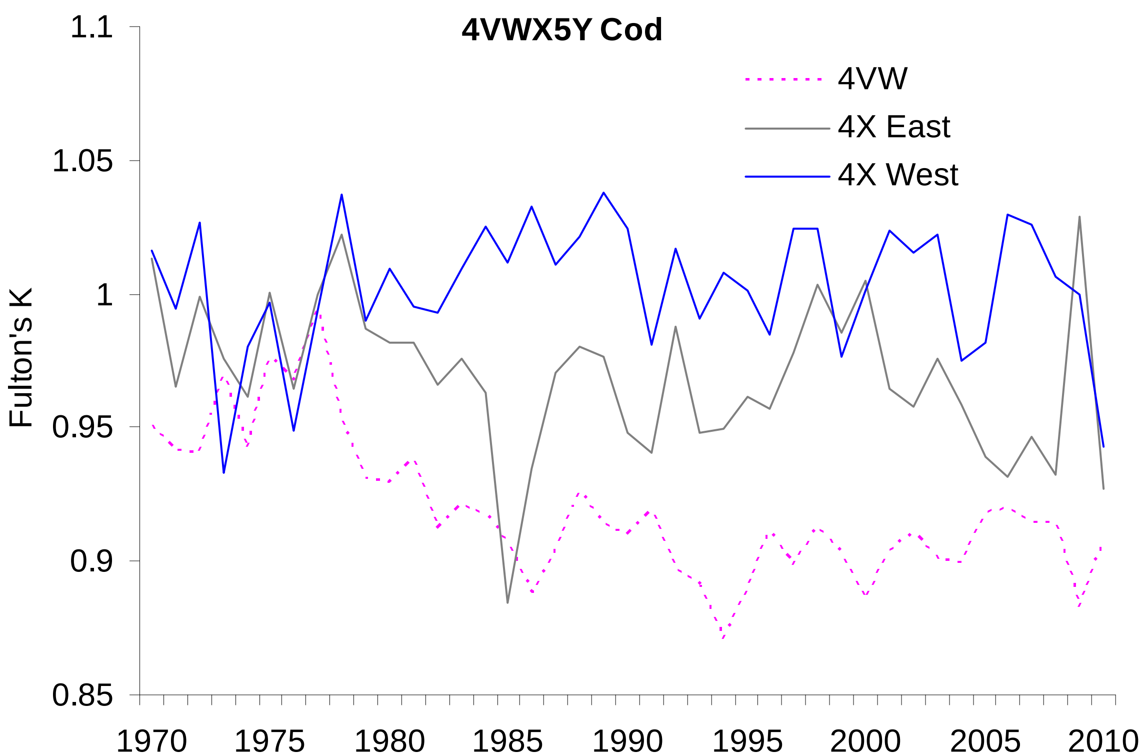


Figure 11. Condition factor (Fulton's K) for cod in 4VWX5Y from the summer RV survey.

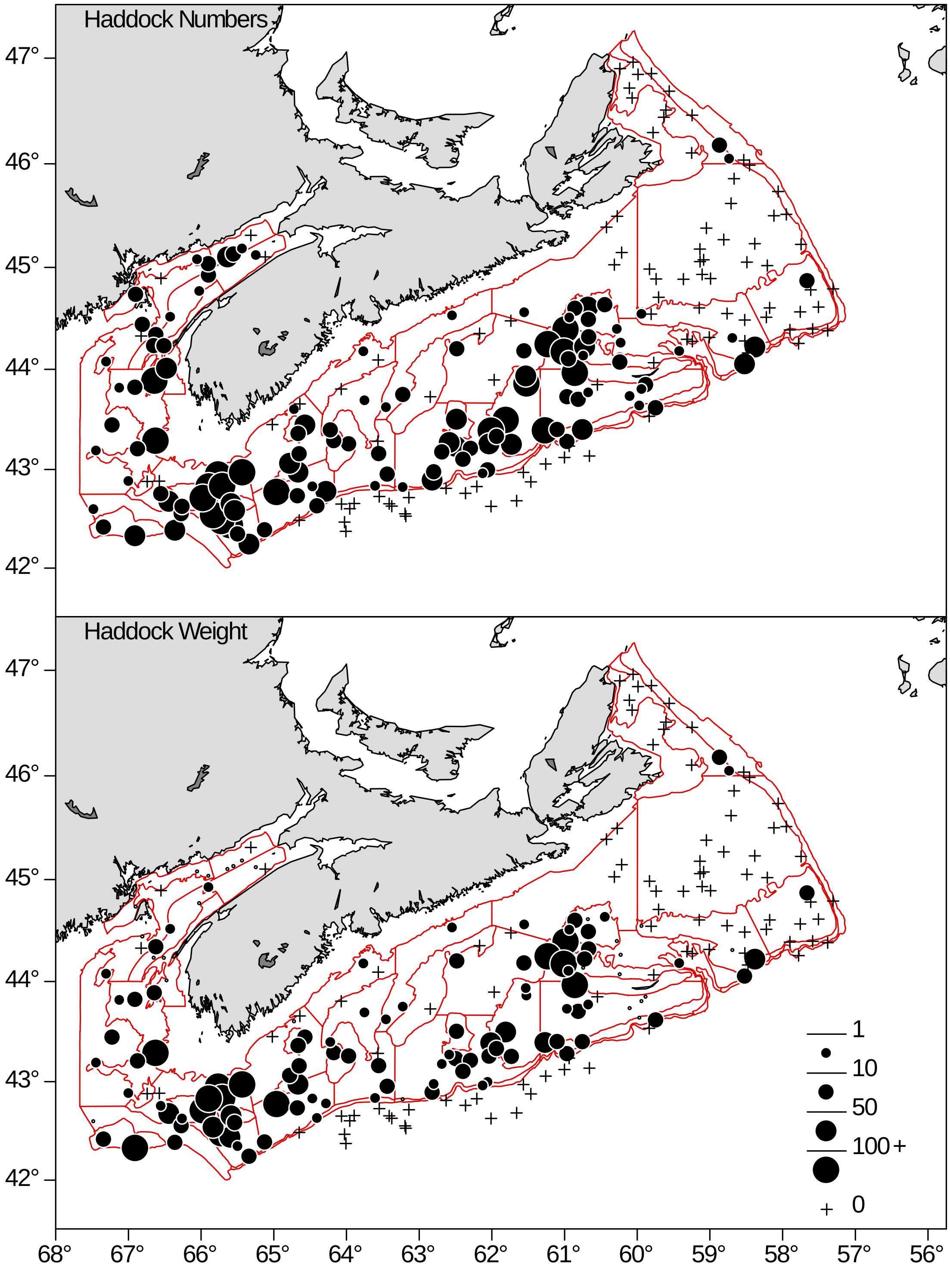


Figure 12. Distribution of haddock catches during the 2010 summer RV survey (scale represents both weight (kg) and numbers).

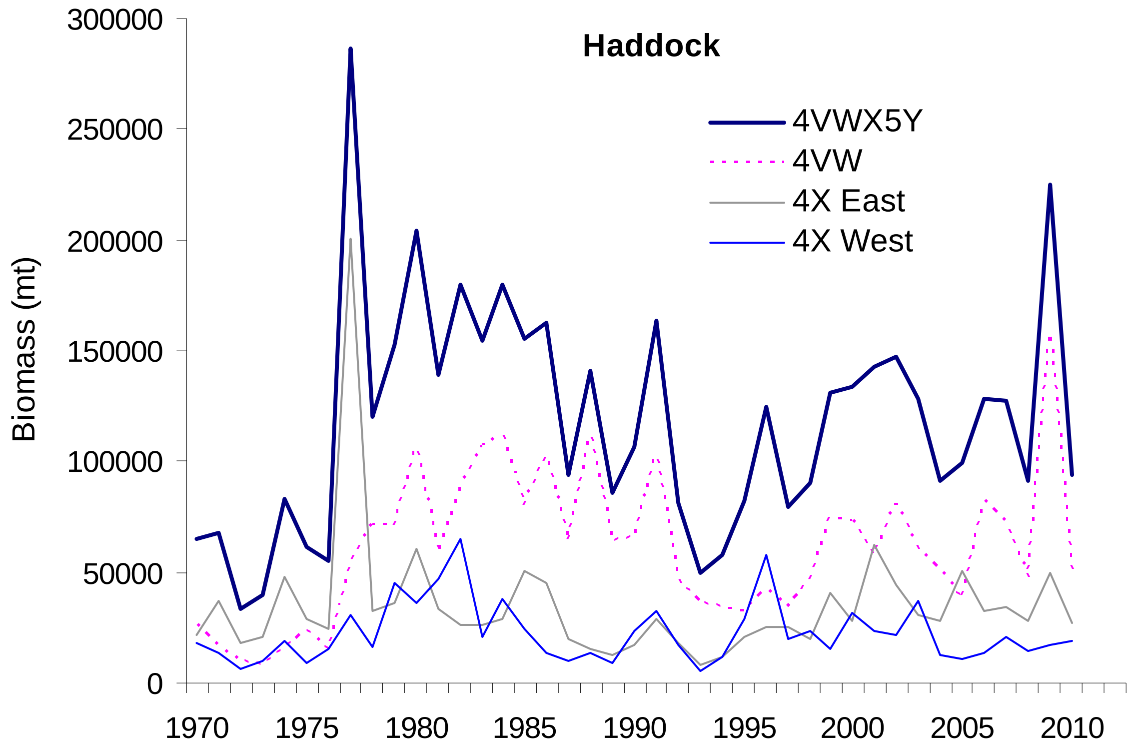


Figure 13. Biomass estimate for haddock in 4VWX5Y from the summer RV survey.

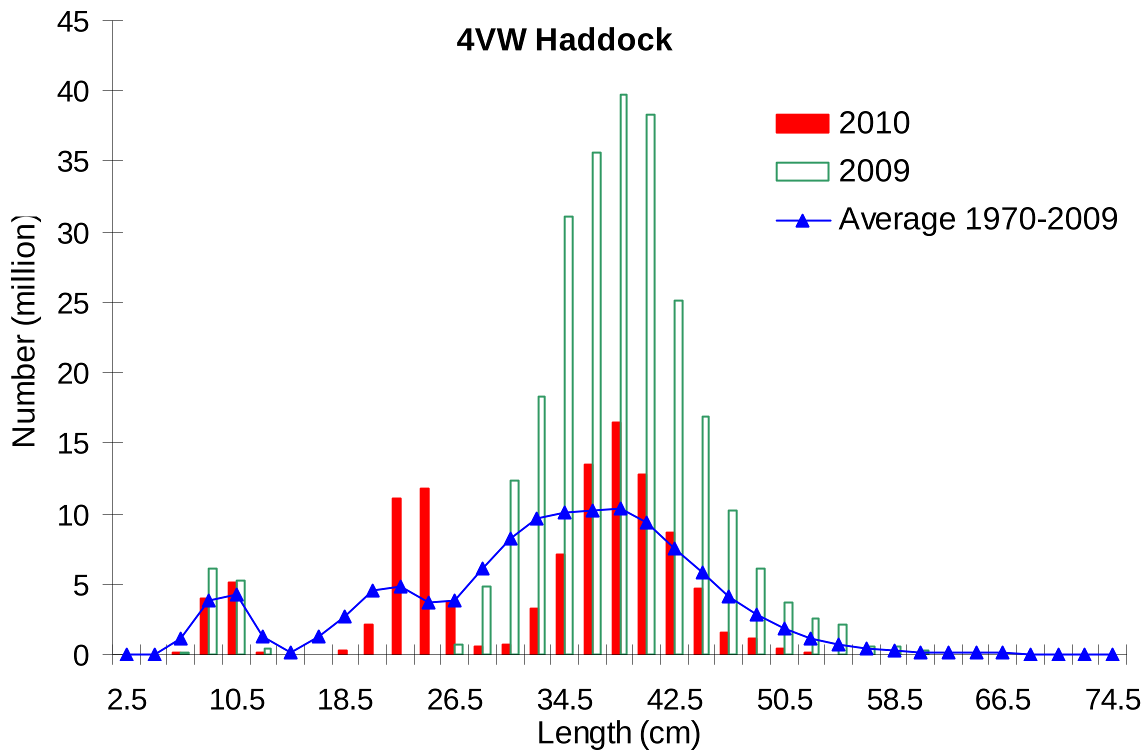


Figure 14. Length composition for haddock in 4VW from the summer RV survey.

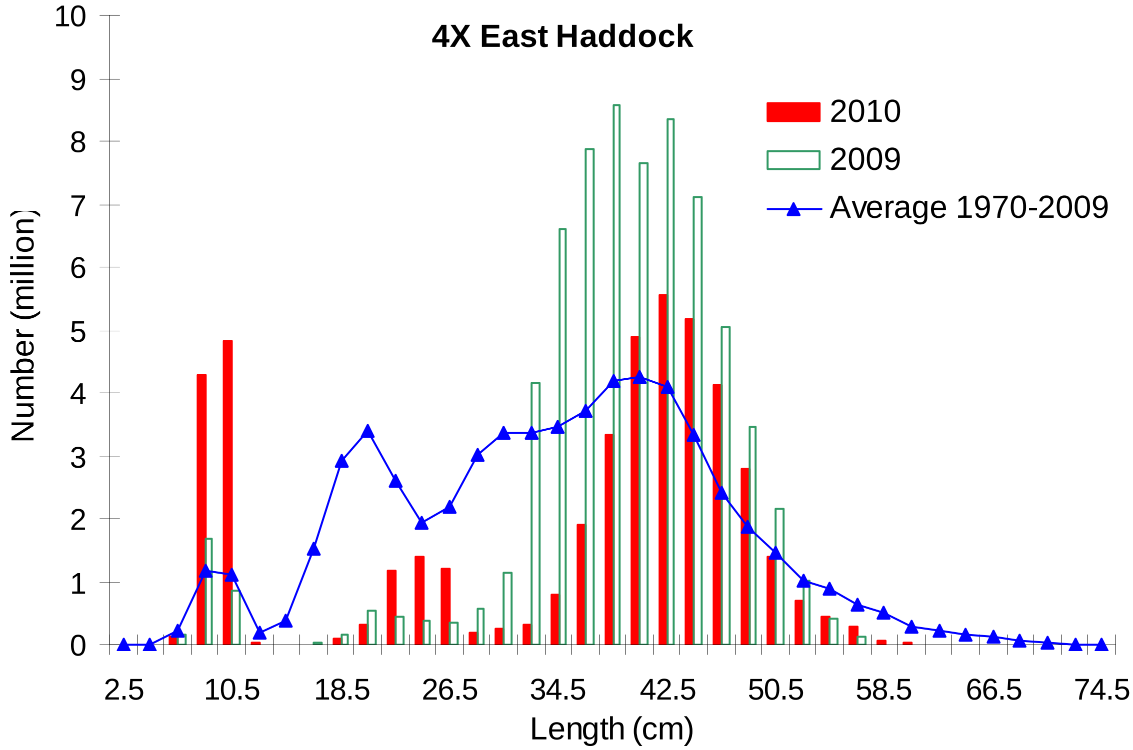


Figure 15. Length composition for haddock in 4X East from the summer RV survey.

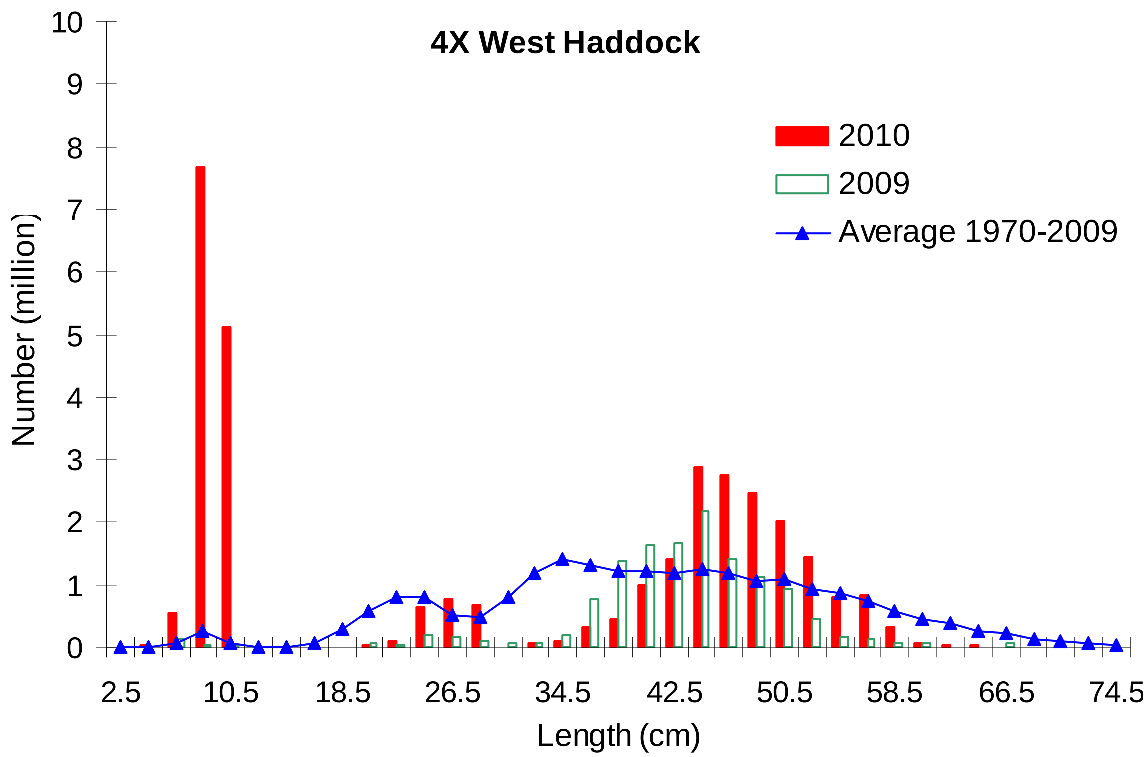


Figure 16. Length composition for haddock in 4X West from the summer RV survey.

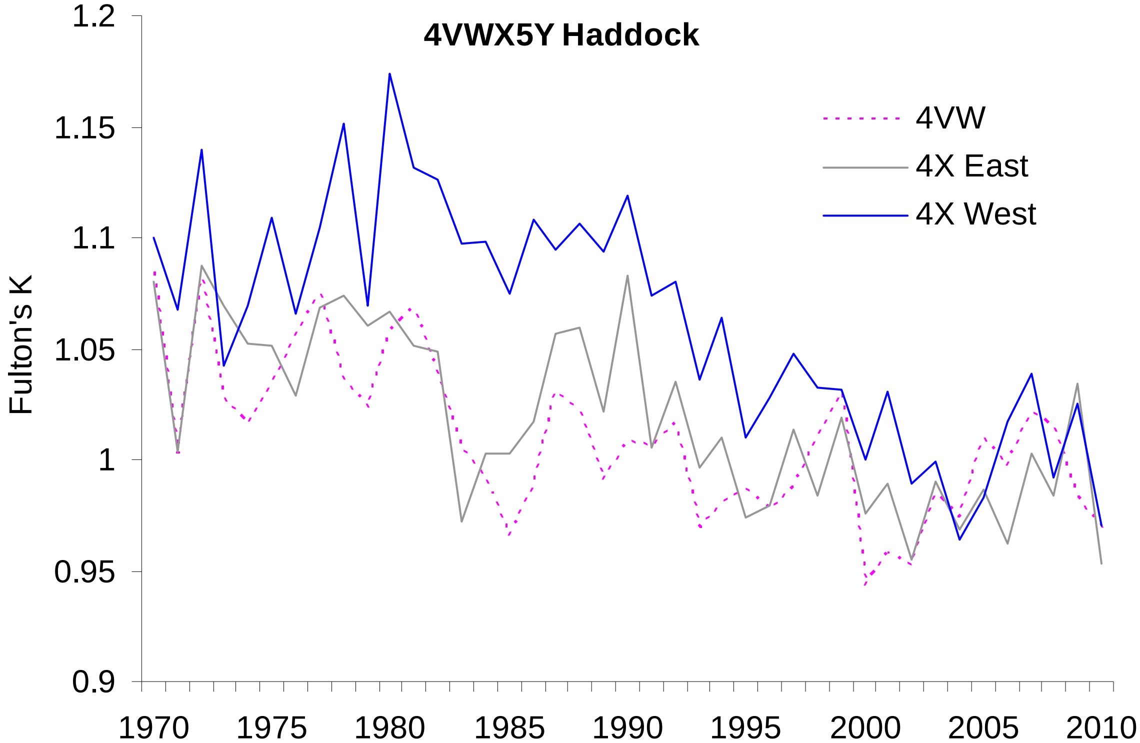


Figure 17. Condition factor (Fulton's K) for haddock in 4VWX5Y from the summer RV survey.

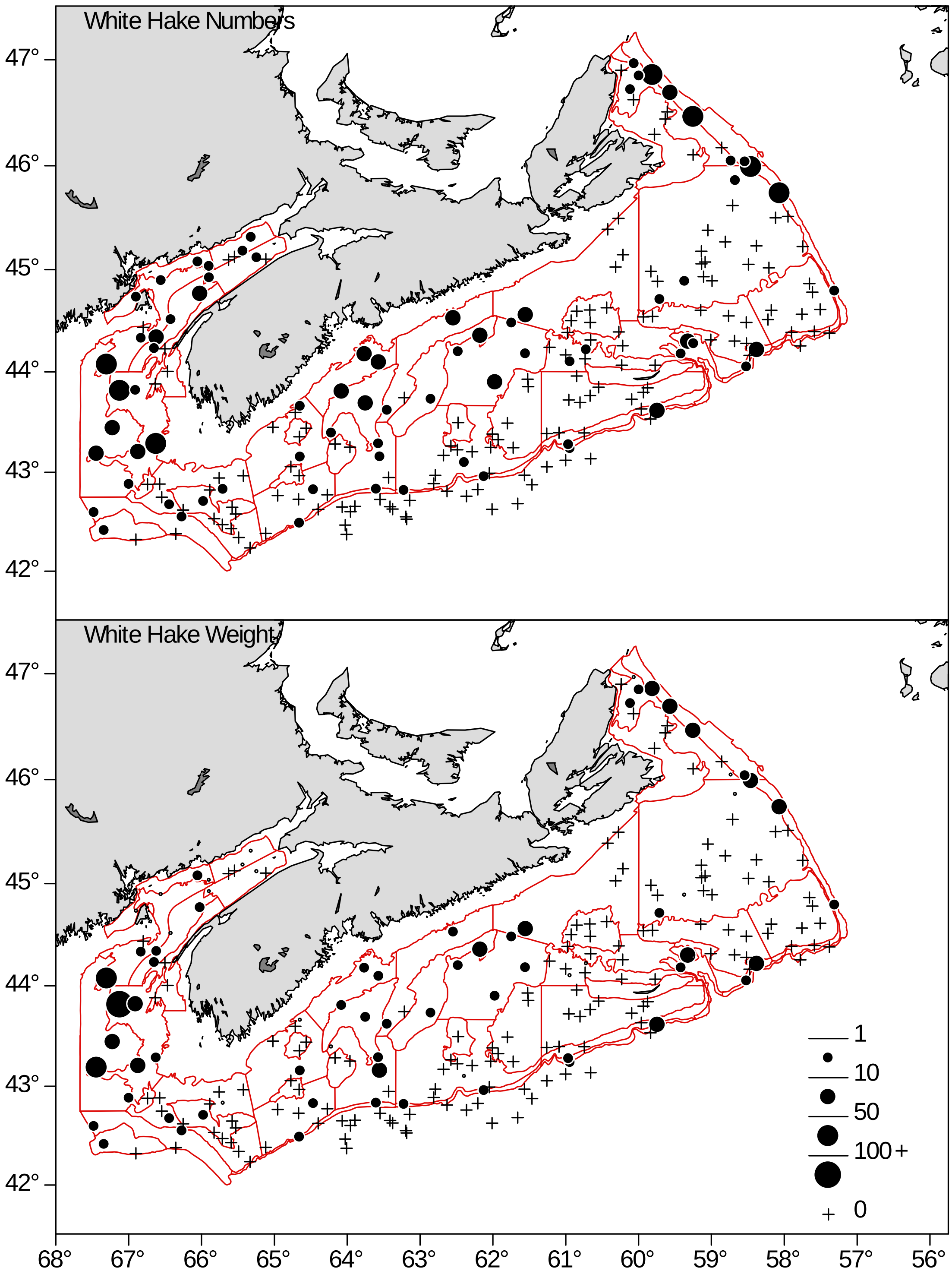


Figure 18. Distribution of white hake catches during the 2010 summer RV survey (scale represents both weight (kg) and numbers).

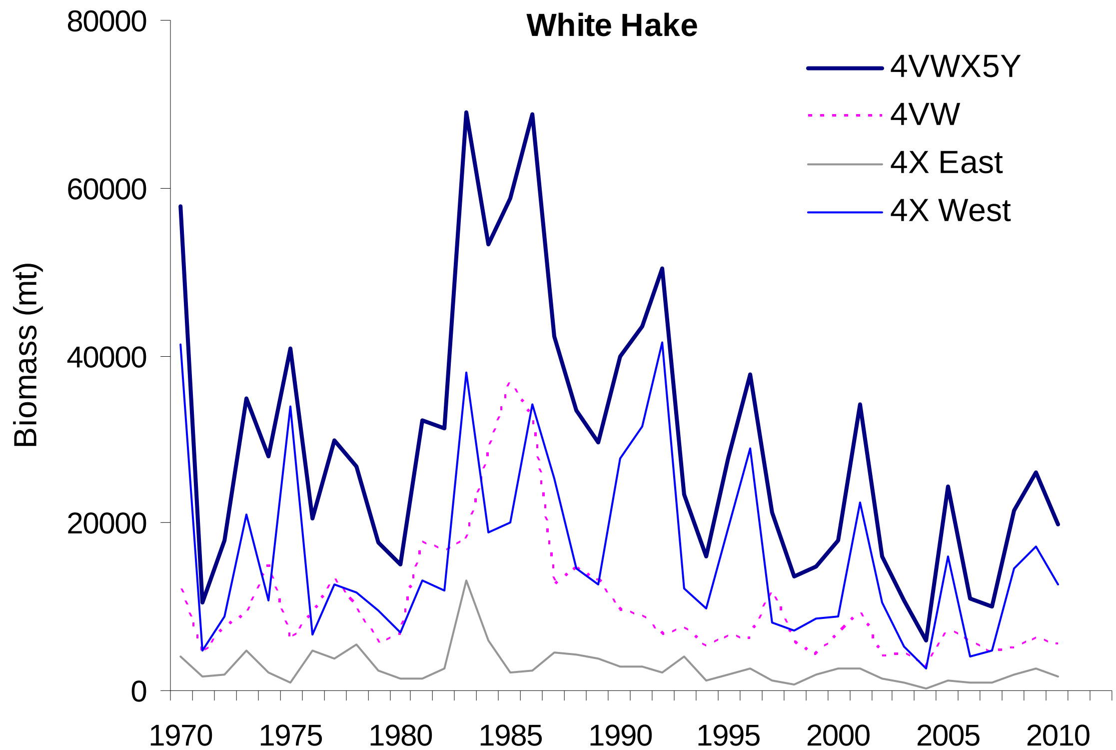


Figure 19. Biomass estimate for white hake in 4VWX5Y from the summer RV survey.

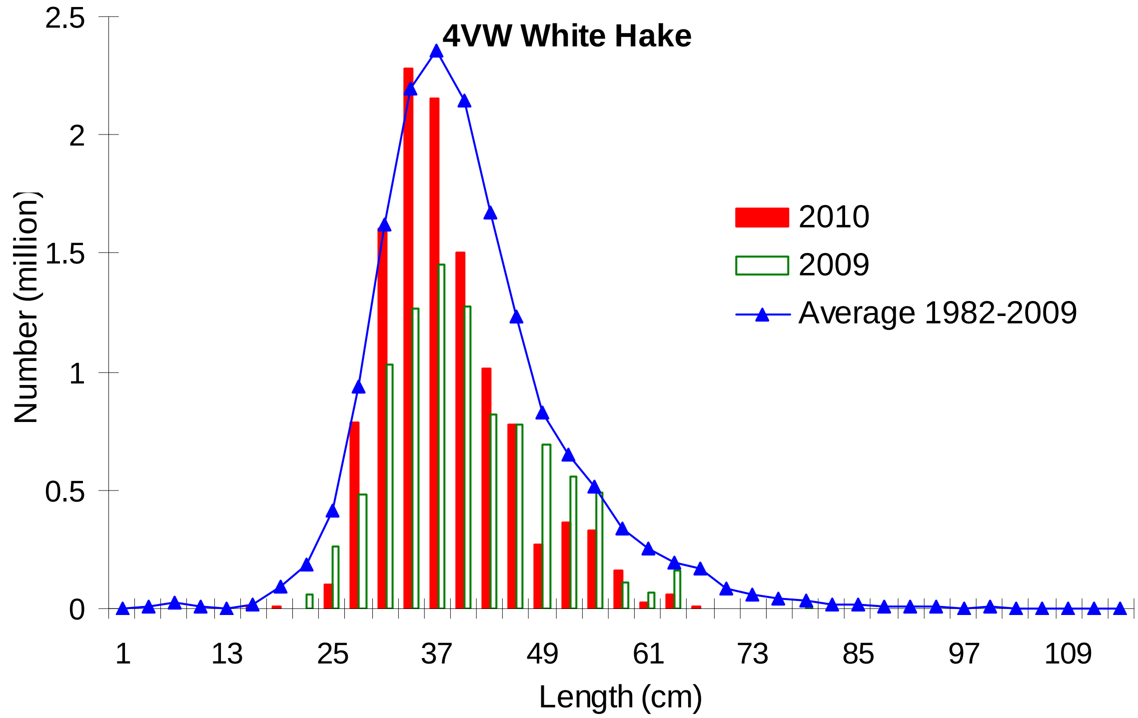


Figure 20. Length composition for white hake in 4VW from the summer RV survey.

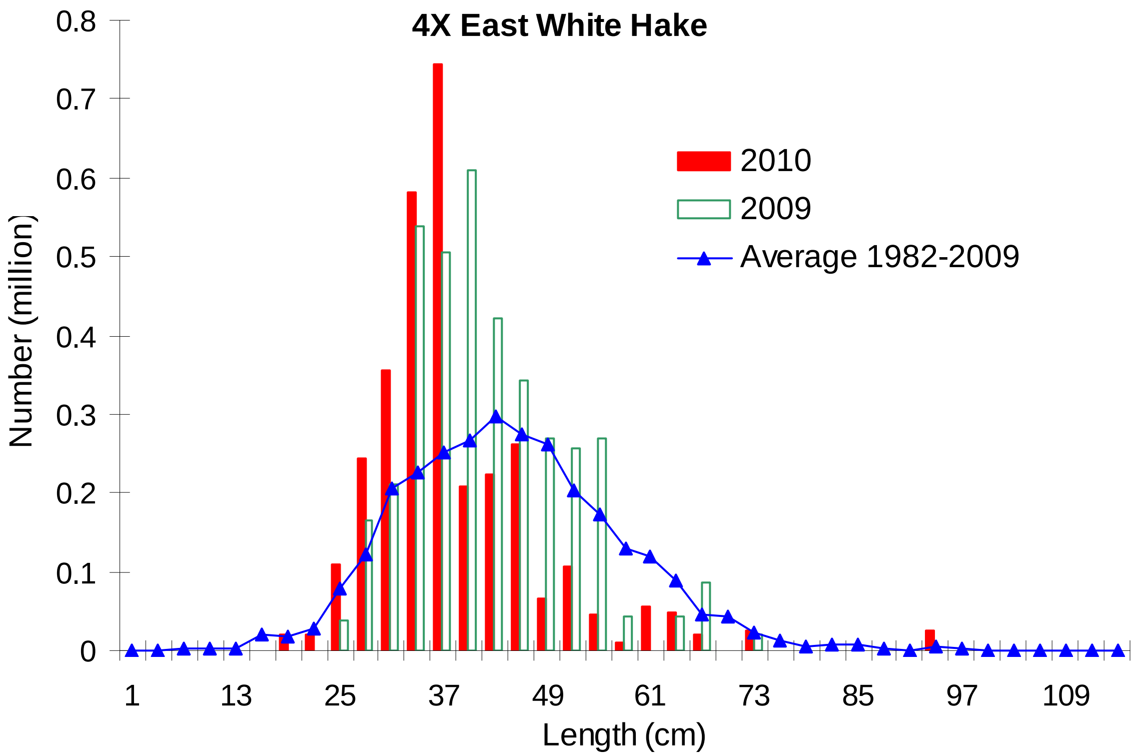


Figure 21. Length composition for white hake in 4X East from the summer RV survey.

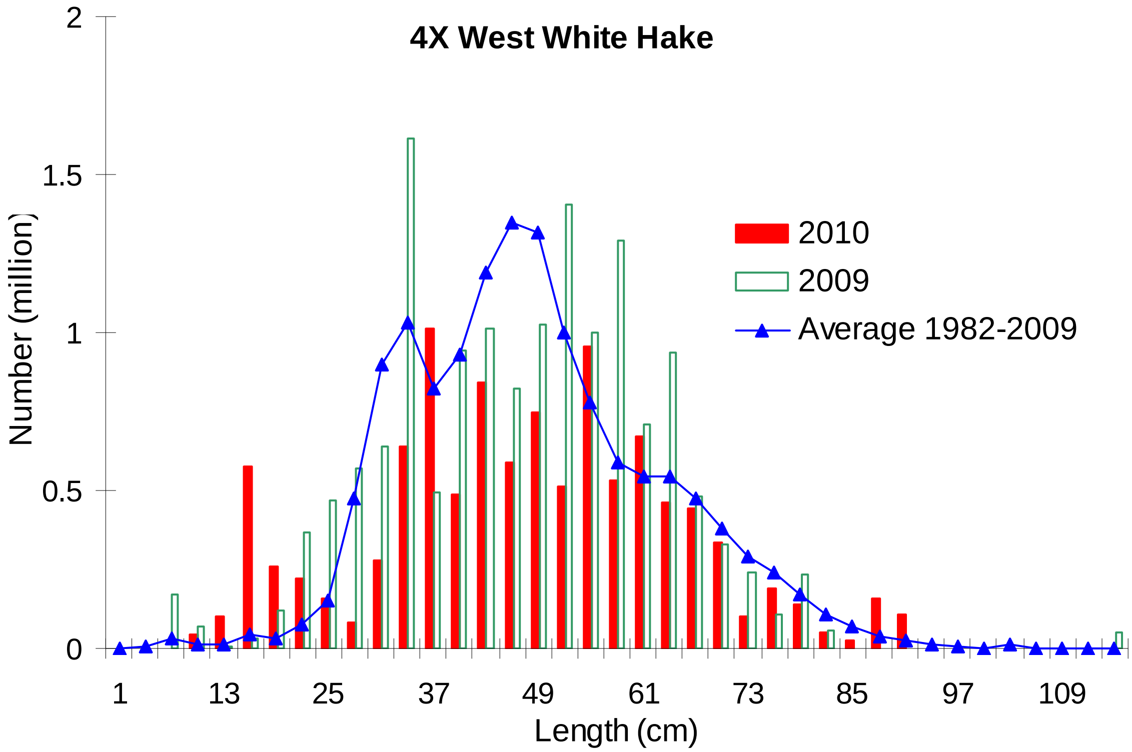


Figure 22. Length composition for white hake in 4X West from the summer RV survey.

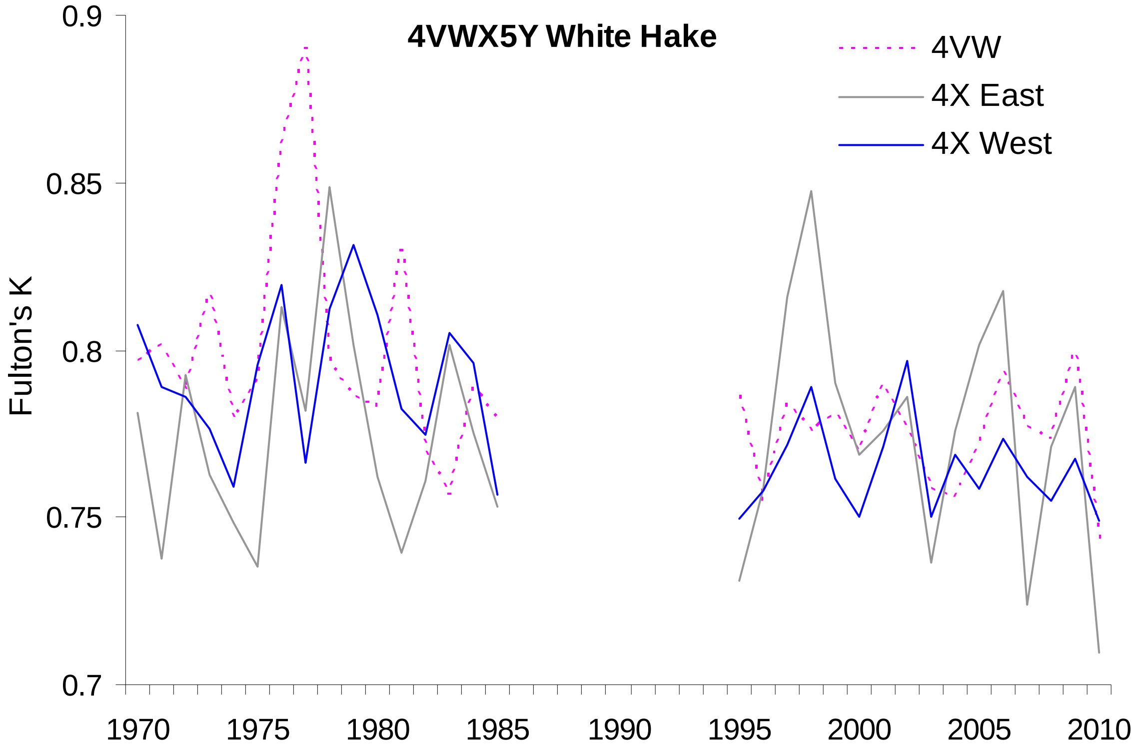


Figure 23. Condition factor (Fulton's K) for white hake in 4VWX5Y from the summer RV survey.

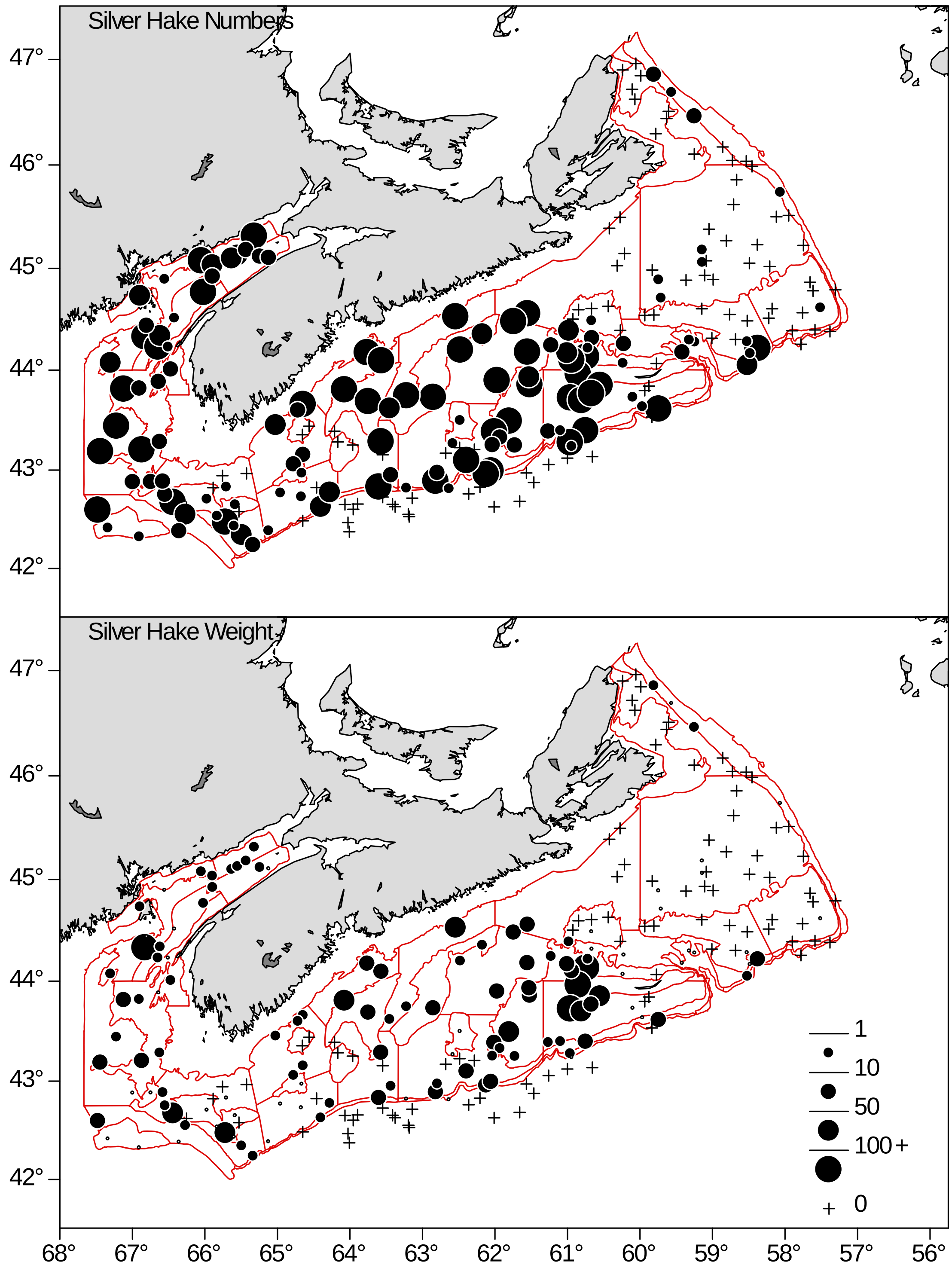


Figure 24. Distribution of silver hake catches during the 2010 summer RV survey (scale represents both weight (kg) and numbers).

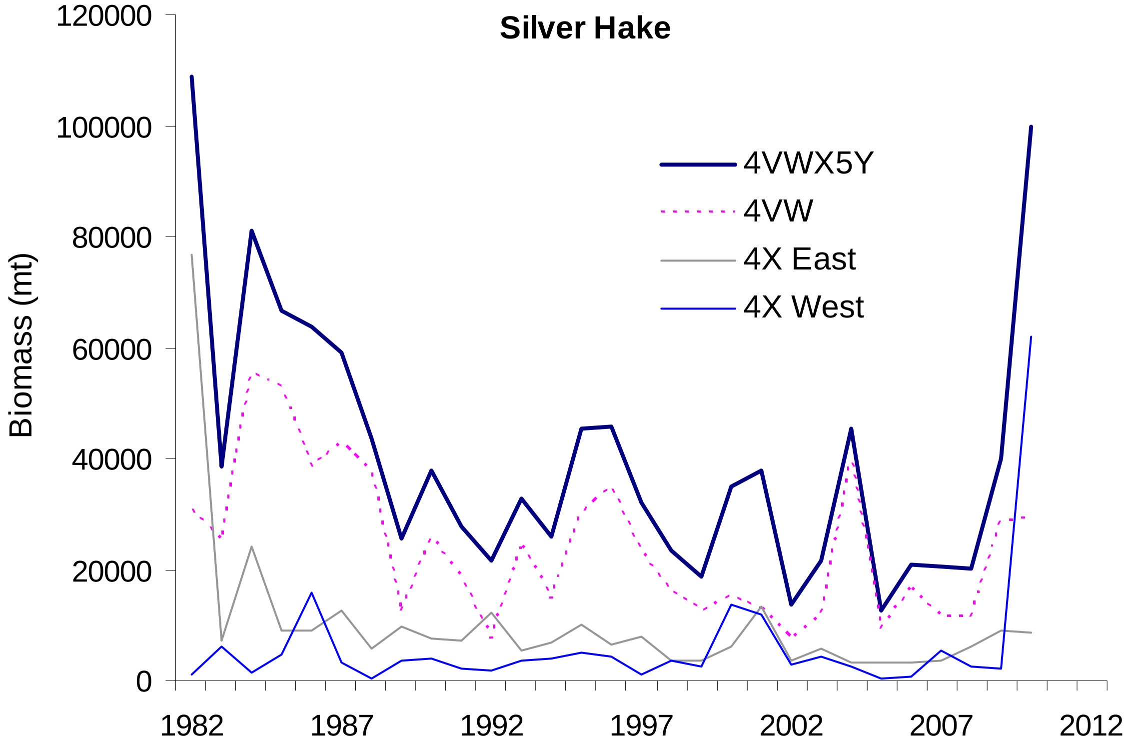


Figure 25. Biomass estimate for silver hake in 4VWX5Y from the summer RV survey.

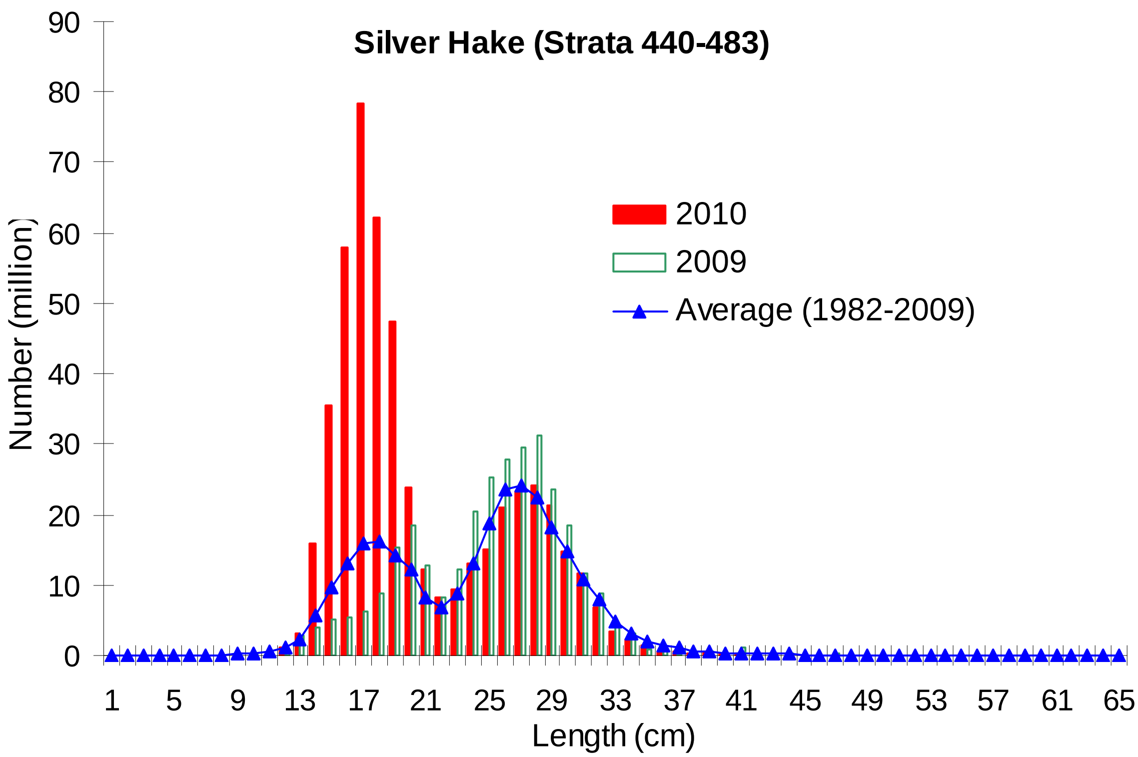


Figure 26. Length composition for silver hake in strata 440-483 from the summer RV survey.

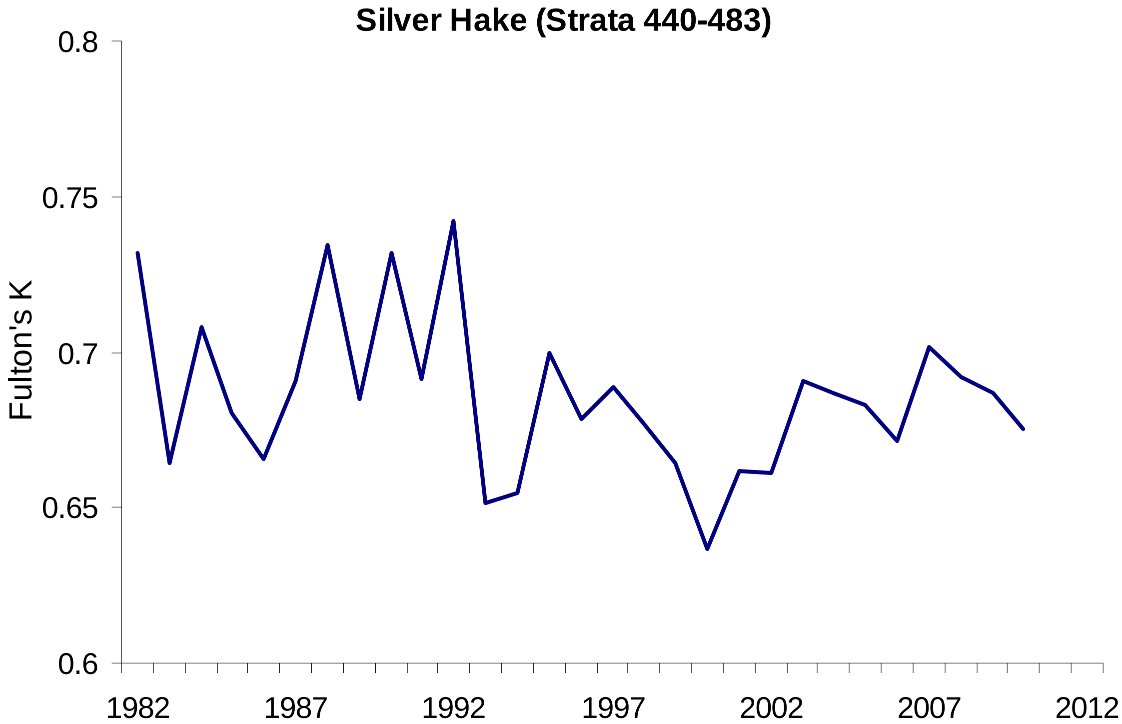


Figure 27. Condition factor (Fulton's K) for silver hake in strata 440-483 from the summer RV survey.

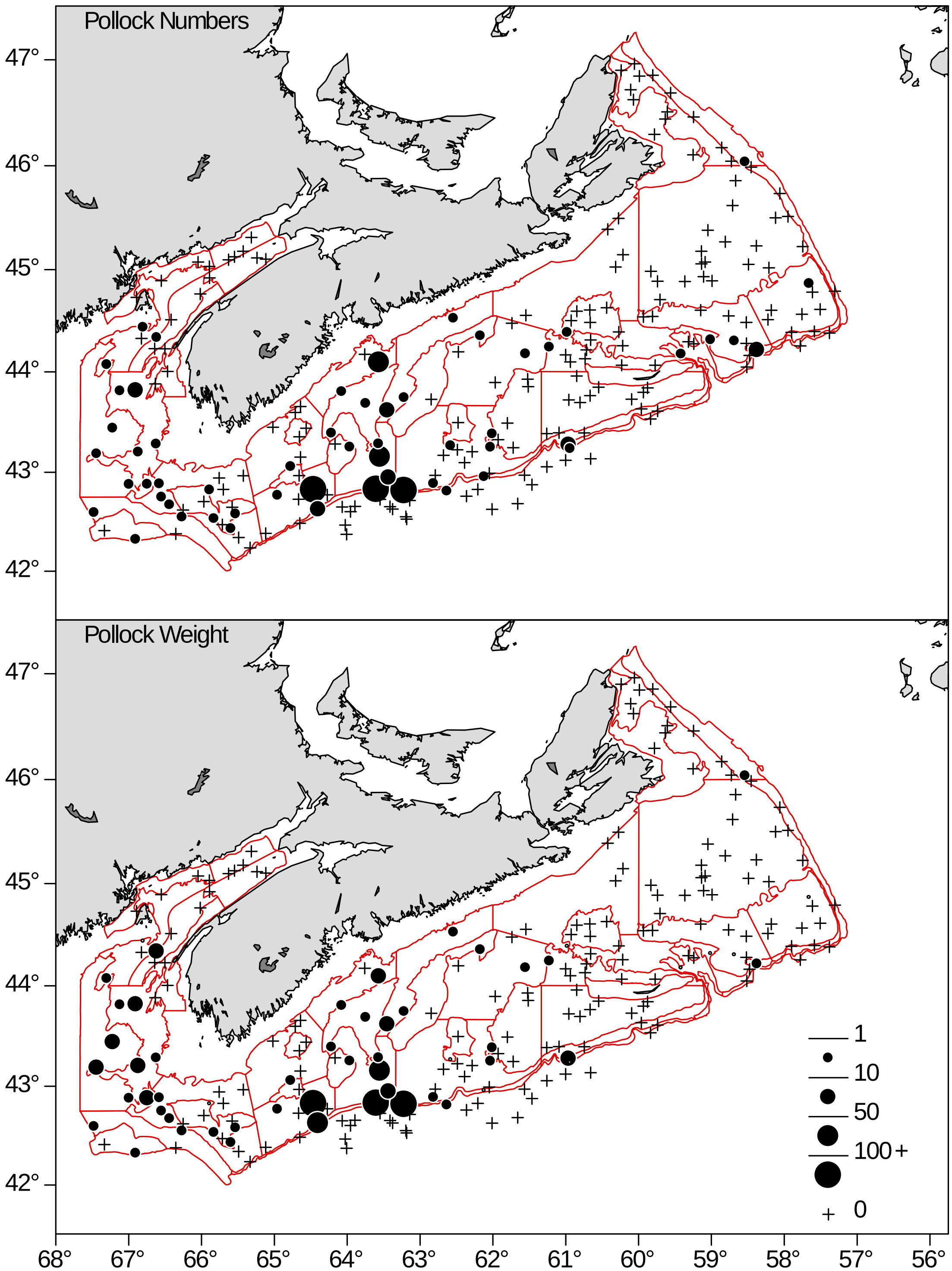


Figure 28. Distribution of pollock catches during the 2010 summer RV survey (scale represents both weight (kg) and numbers).

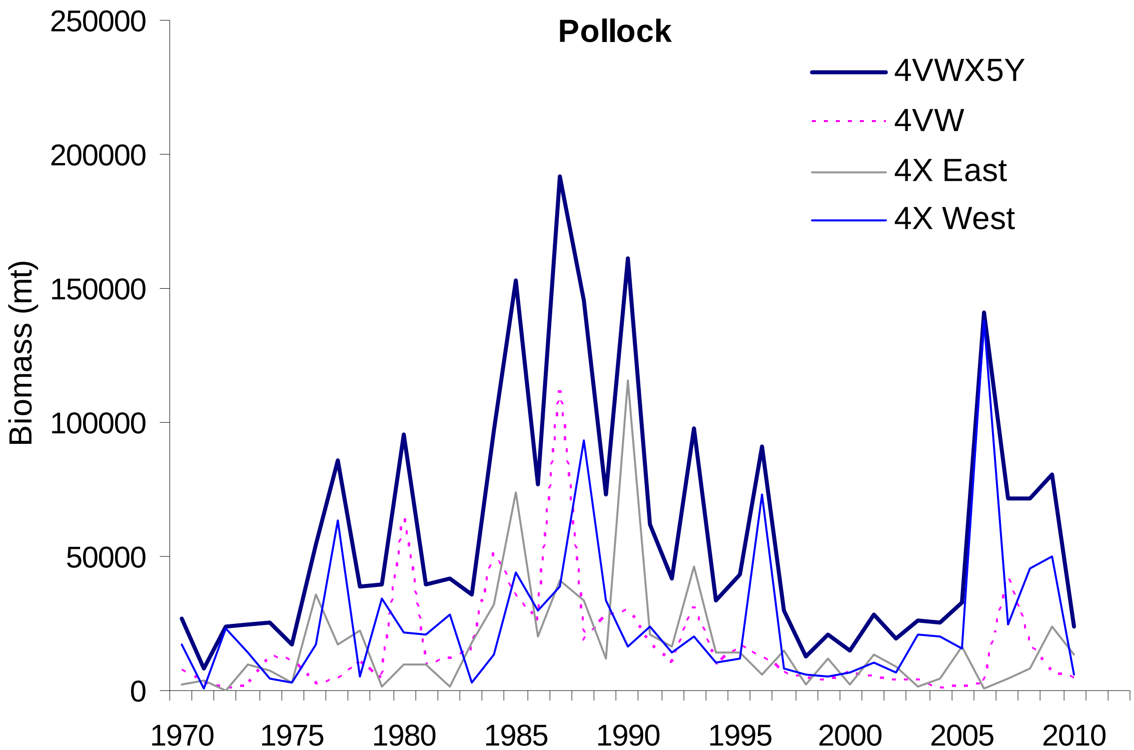


Figure 29. Biomass estimate for pollock in 4VWX5Y from the summer RV survey.

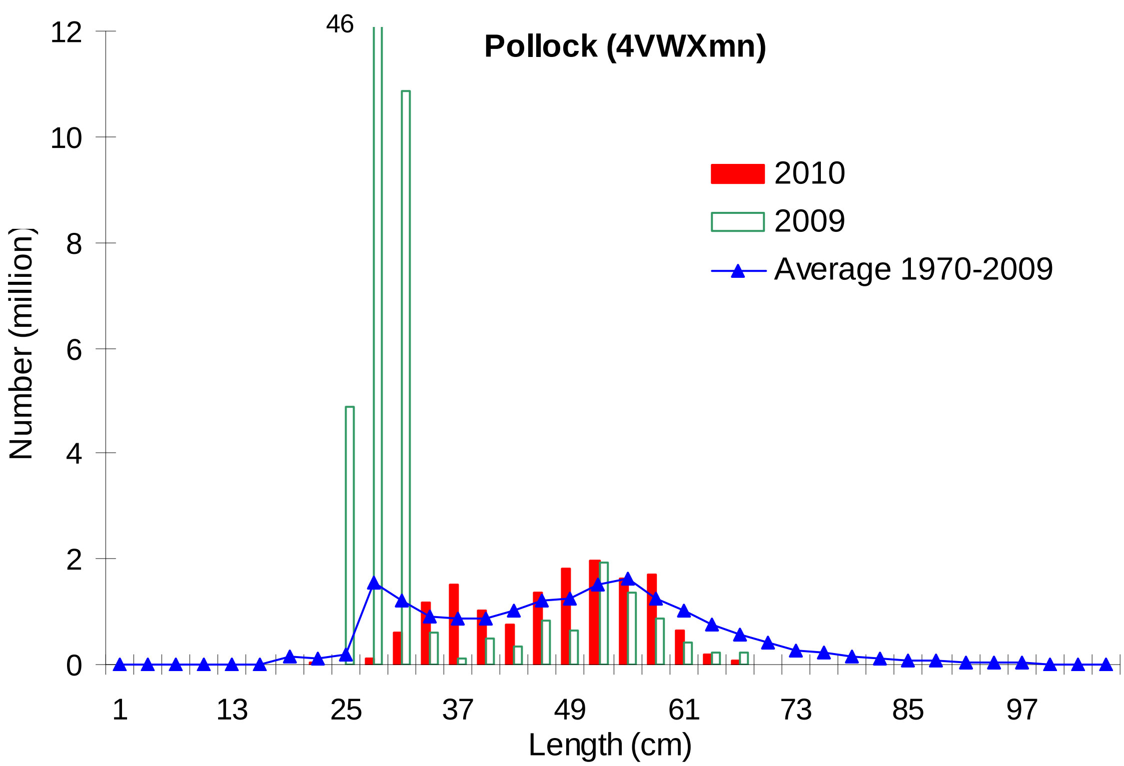


Figure 30. Length composition for pollock in the Eastern component from the summer RV survey.

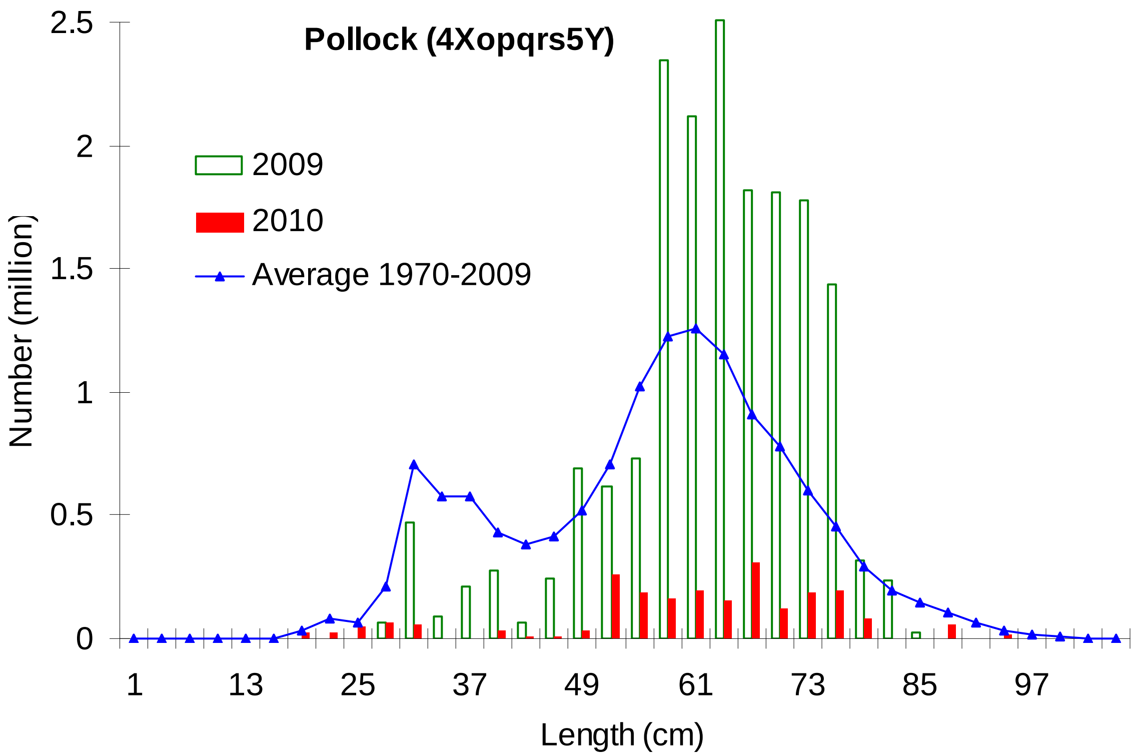


Figure 31. Length composition for pollock in the Western component from the summer RV survey.

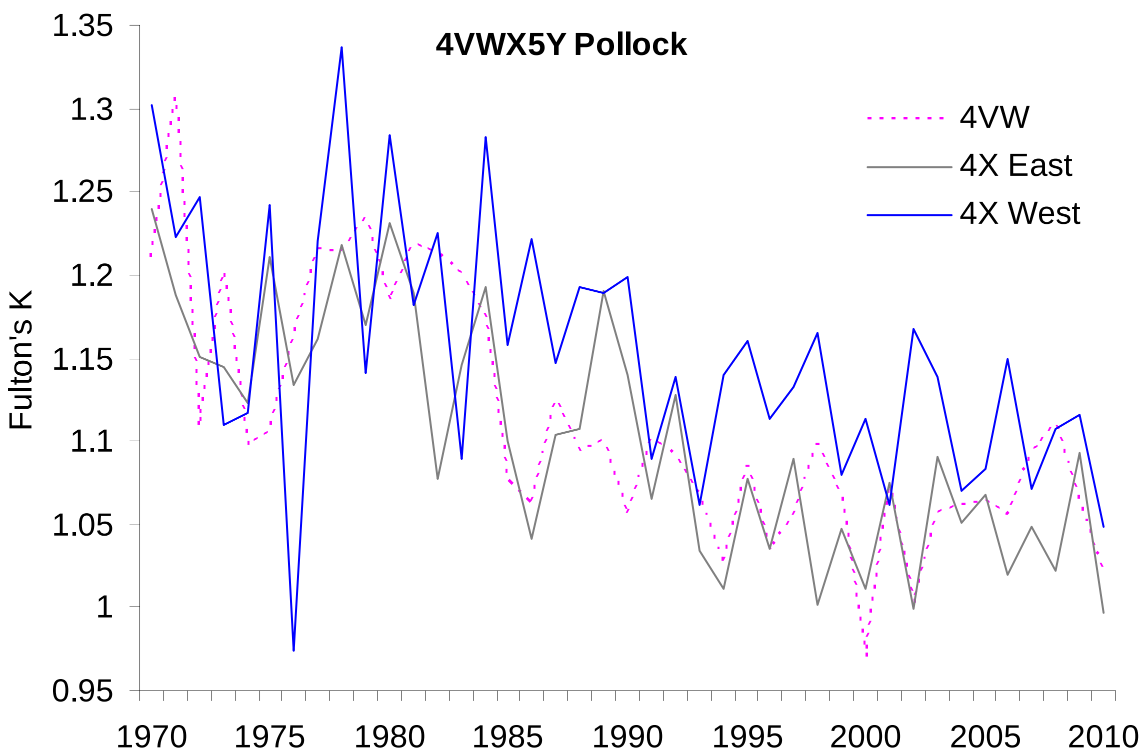


Figure 32. Condition factor (Fulton's K) for pollock in 4VWX5Y from the summer RV survey.

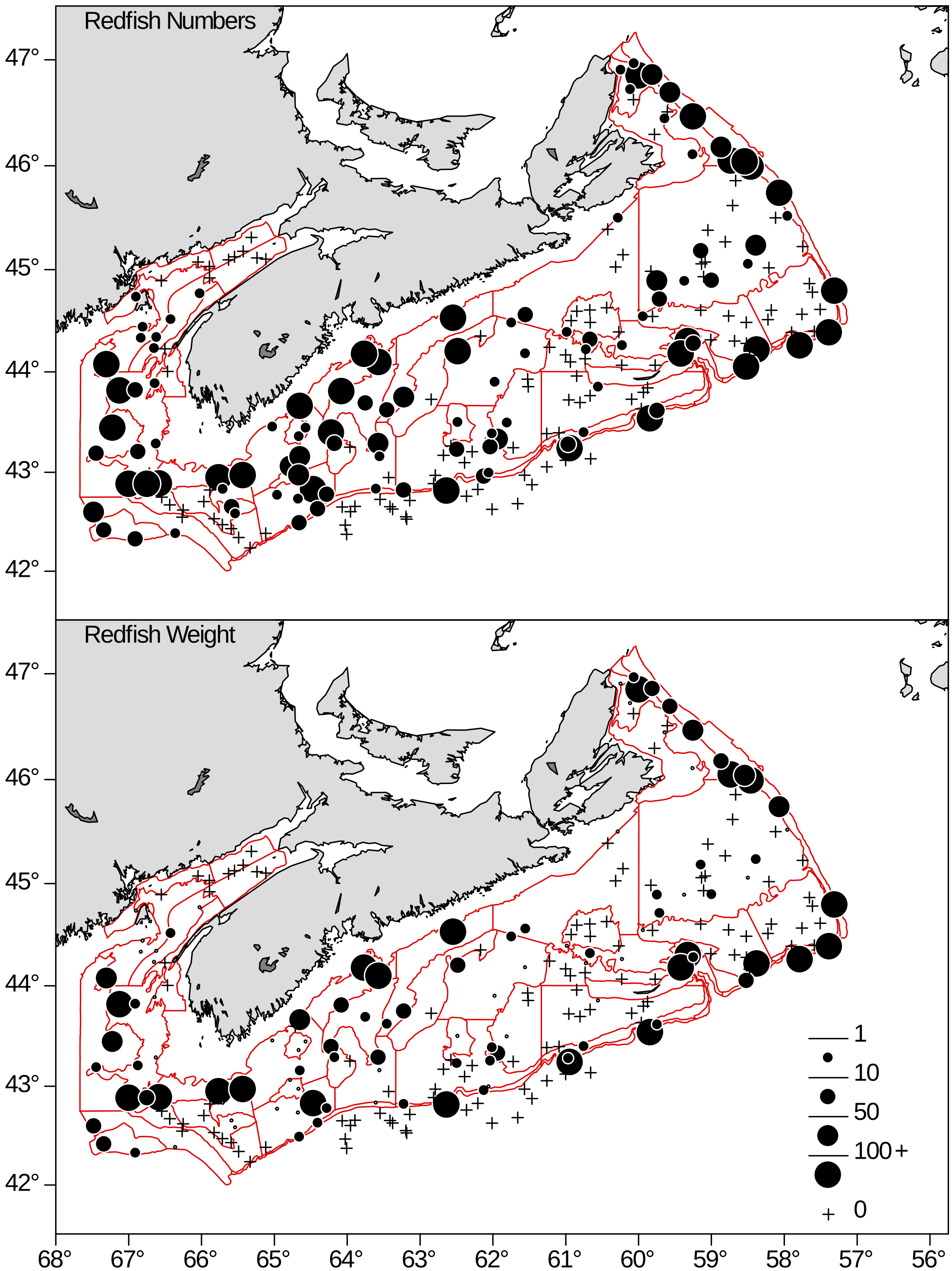


Figure 33. Distribution of redfish catches during the 2010 summer RV survey (scale represents both weight (kg) and numbers).

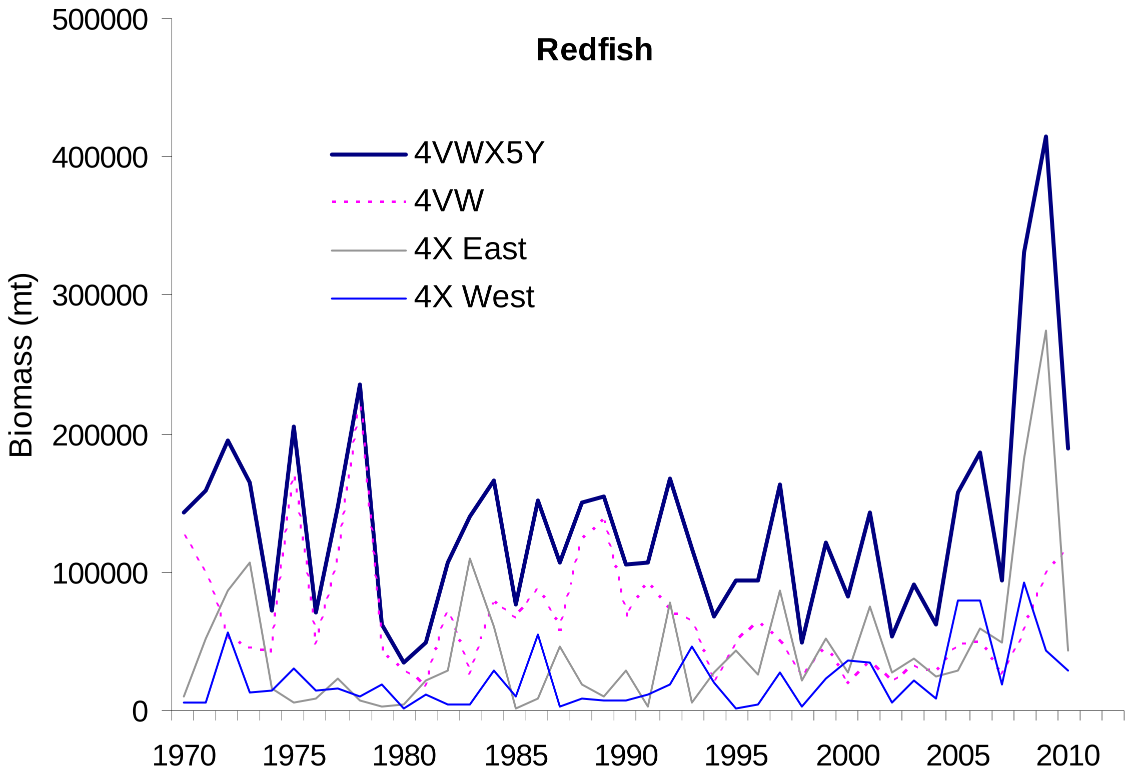


Figure 34. Biomass estimate for redfish in 4VWX5Y from the summer RV survey.

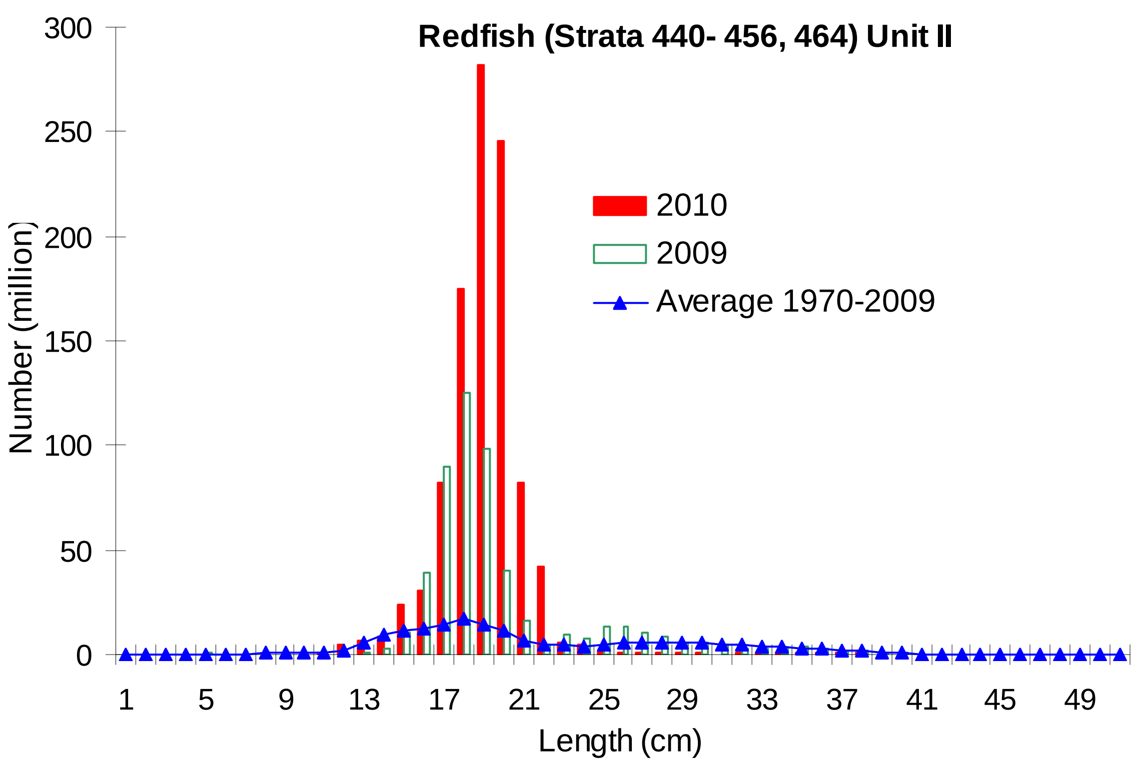


Figure 35. Length composition for redfish in Unit II from the summer RV survey.

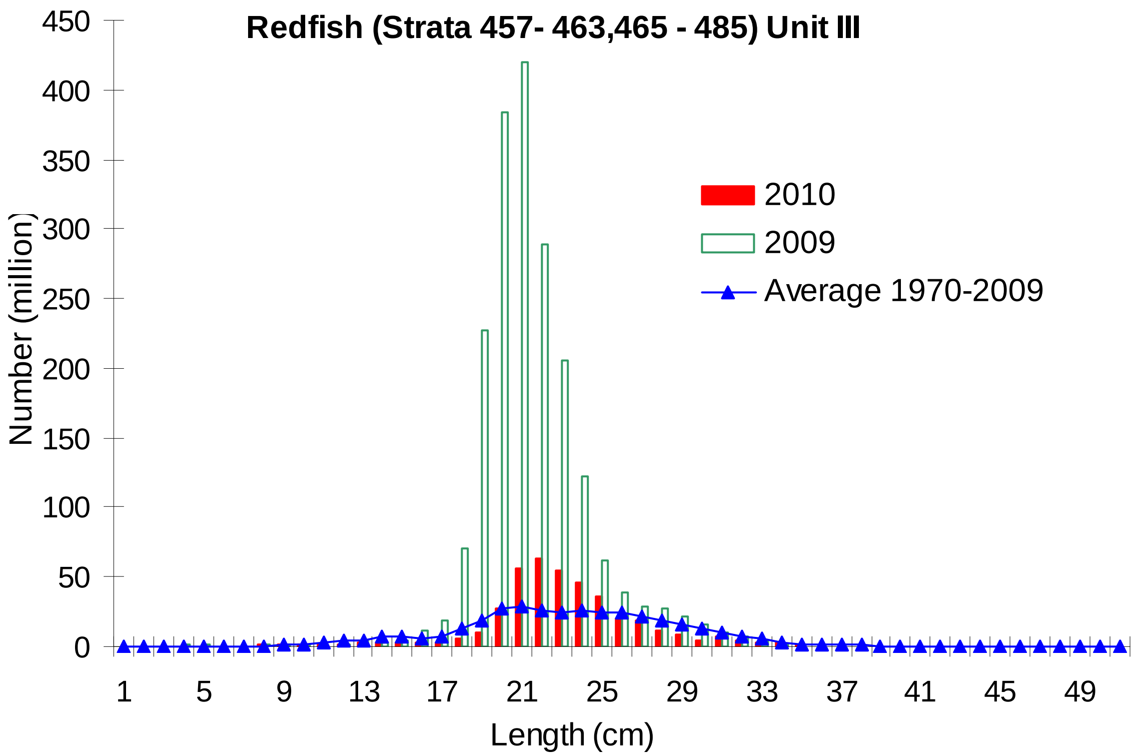


Figure 36. Length composition for redfish in Unit III from the summer RV survey.

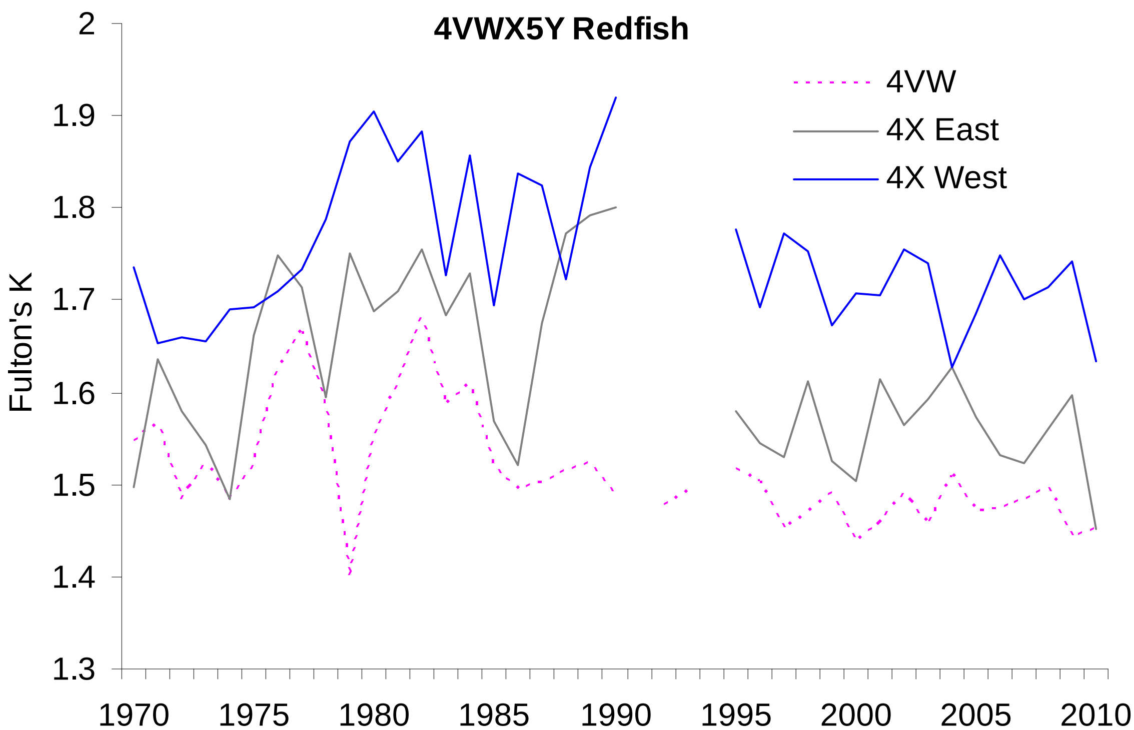


Figure 37. Condition factor (Fulton's K) for redfish in 4VWX5Y from the summer RV survey.

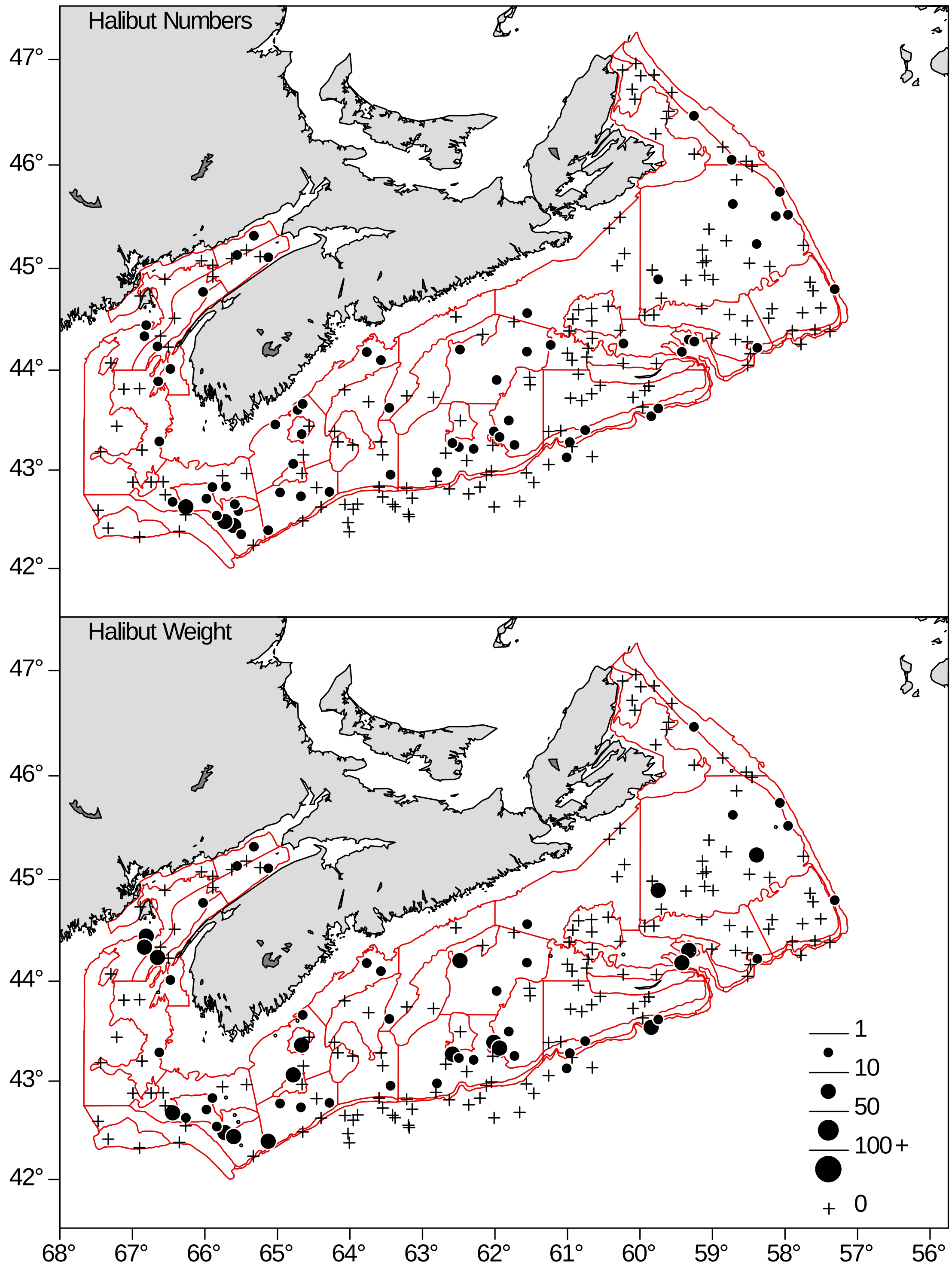


Figure 38. Distribution of Atlantic halibut catches during the 2010 summer RV survey (scale represents both weight (kg) and numbers).

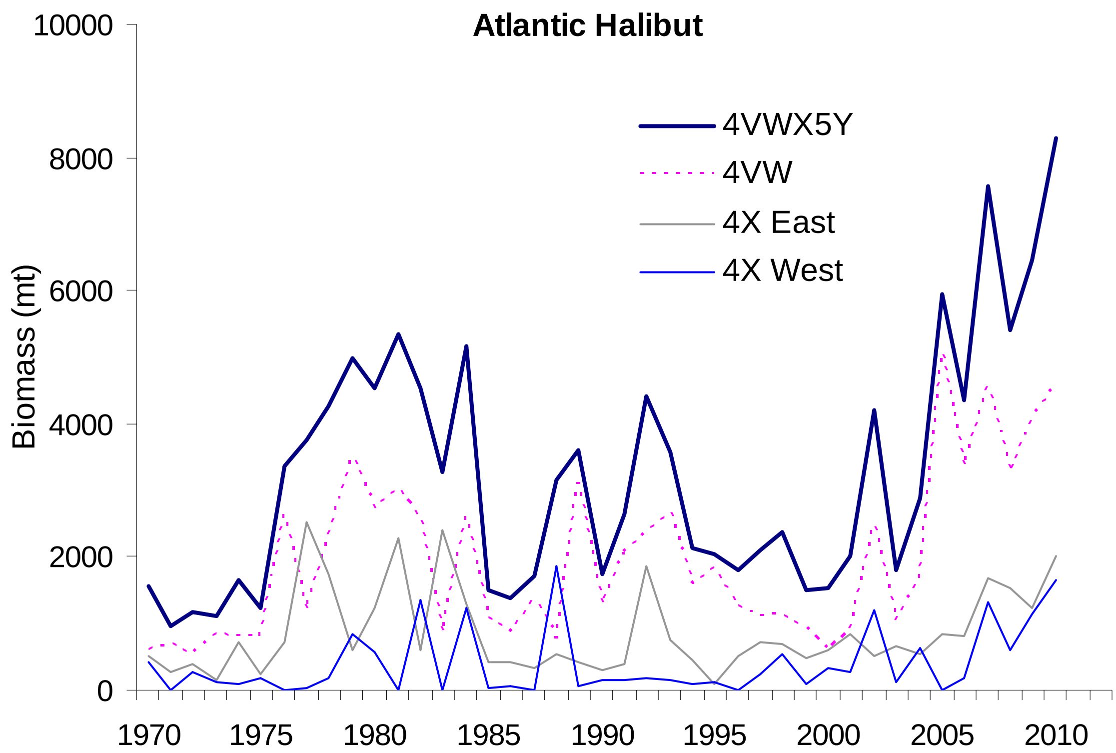


Figure 39. Biomass estimate for Atlantic halibut in 4VWX5Y from the summer RV survey.

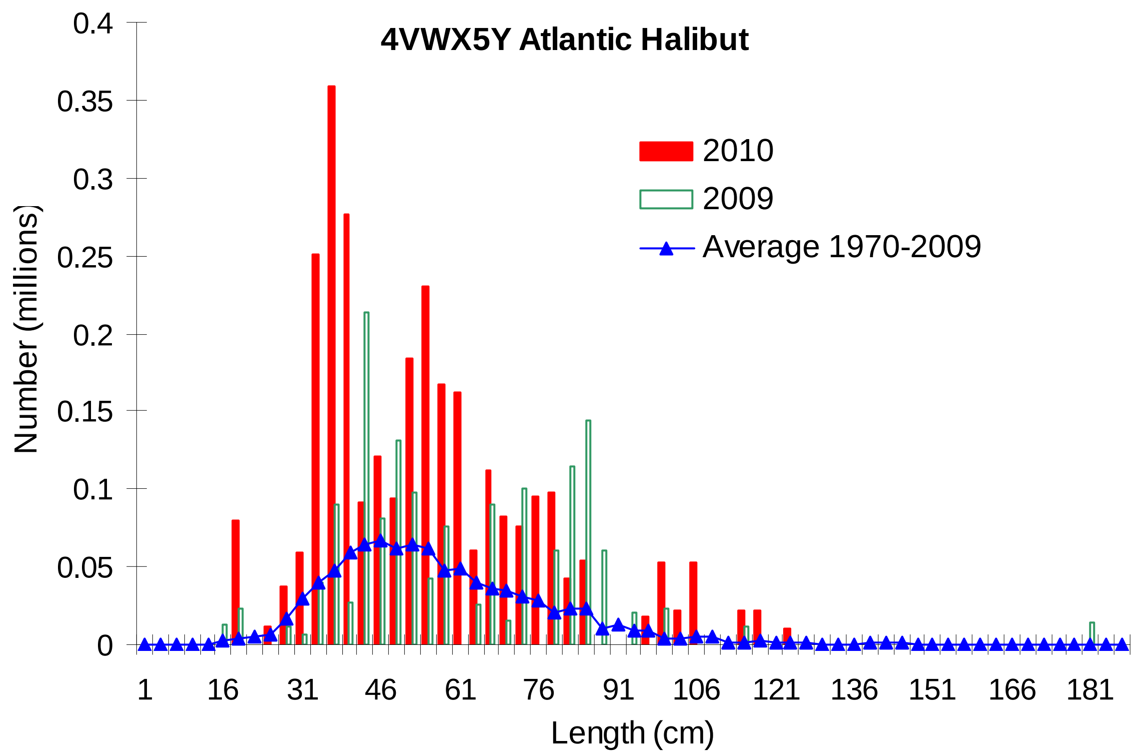


Figure 40. Length composition for Atlantic halibut in 4VWX5Y from the summer RV survey.

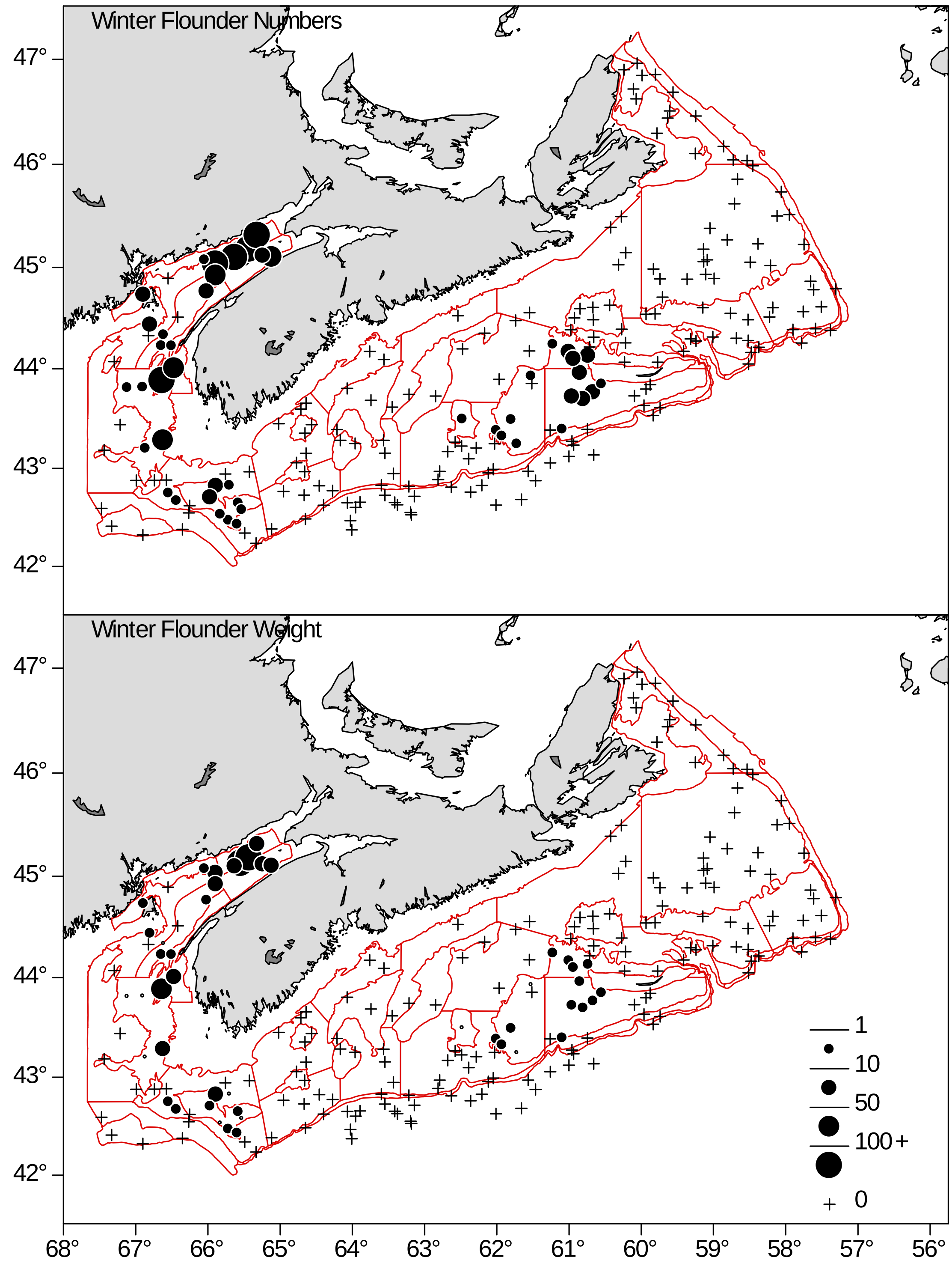


Figure 41. Distribution of winter flounder catches during the 2010 summer RV survey (scale represents both weight (kg) and numbers).

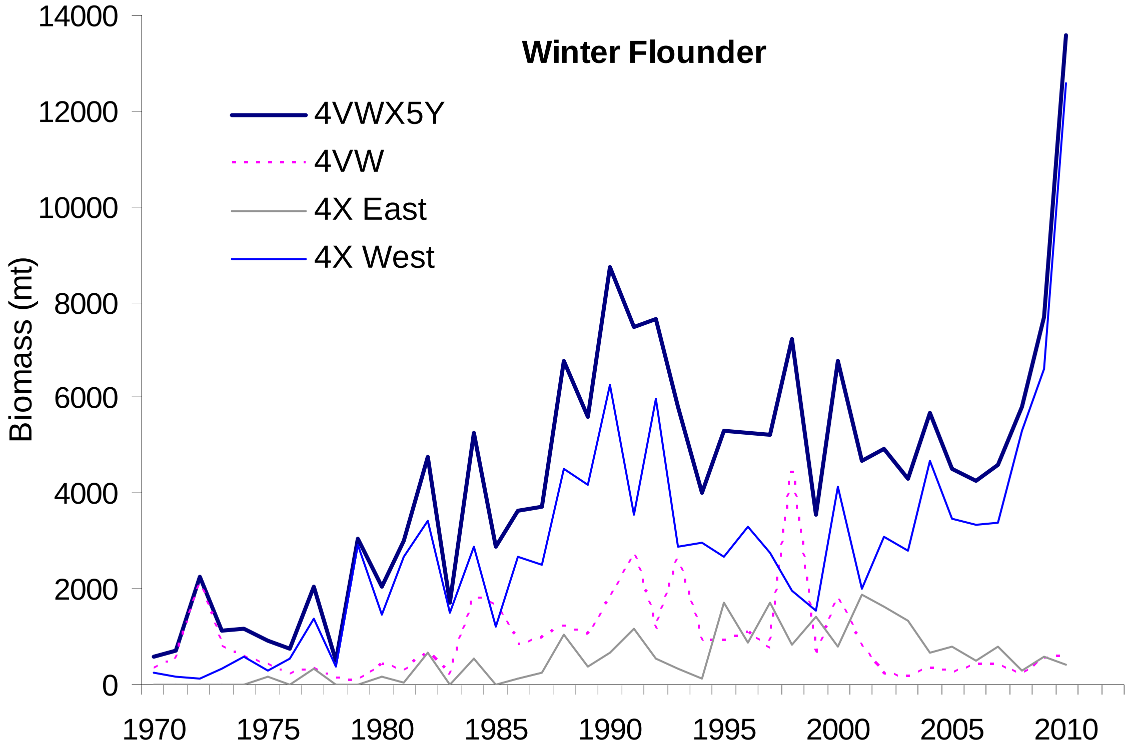


Figure 42. Biomass estimate for winter flounder in 4VWX5Y from the summer RV survey.

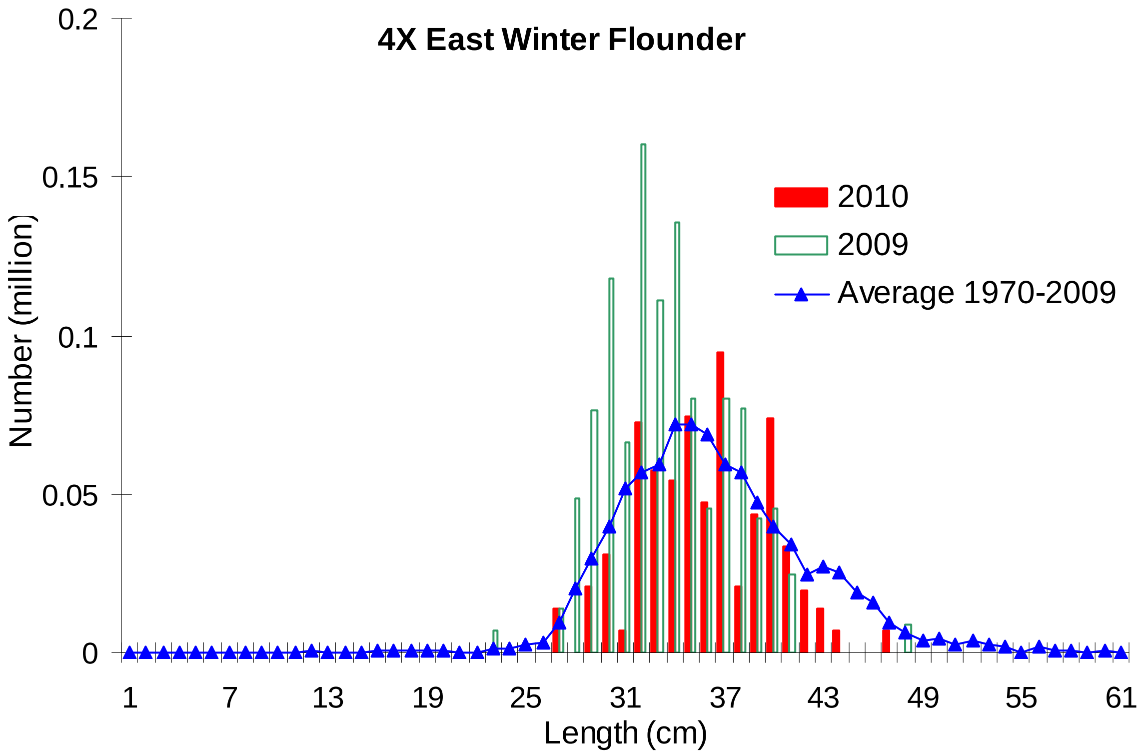


Figure 43. Length composition for winter flounder in 4X East from the summer RV survey.

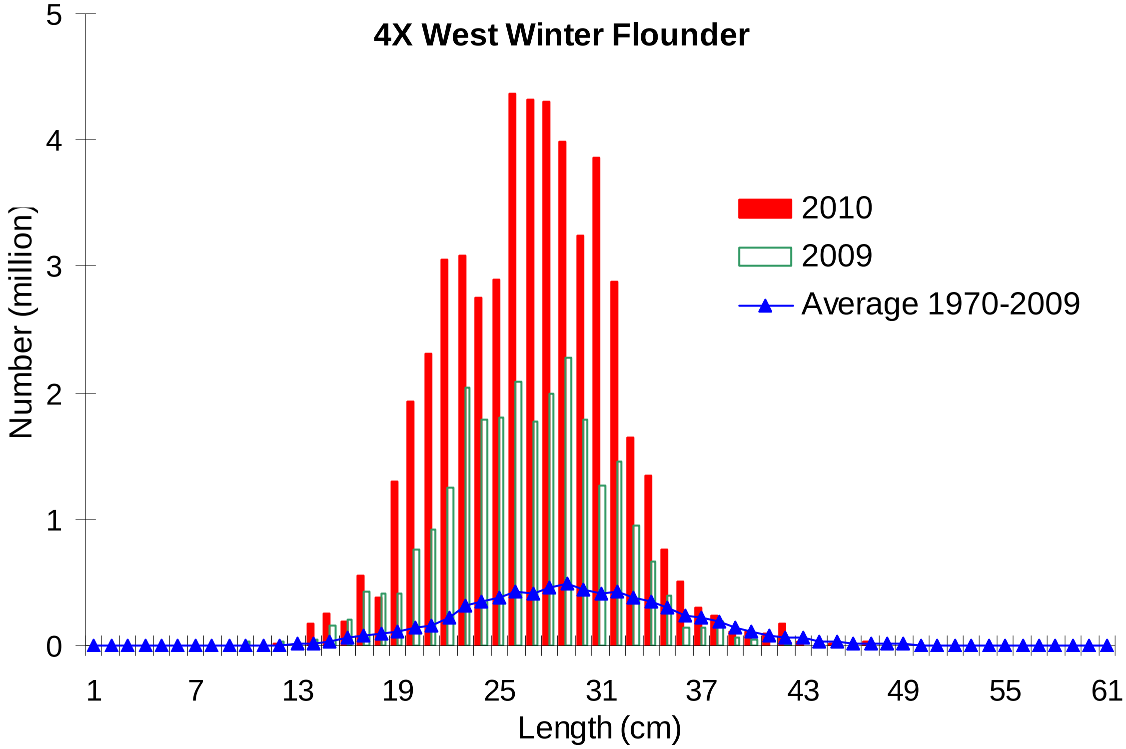


Figure 44. Length composition for winter flounder in 4X West from the summer RV survey.

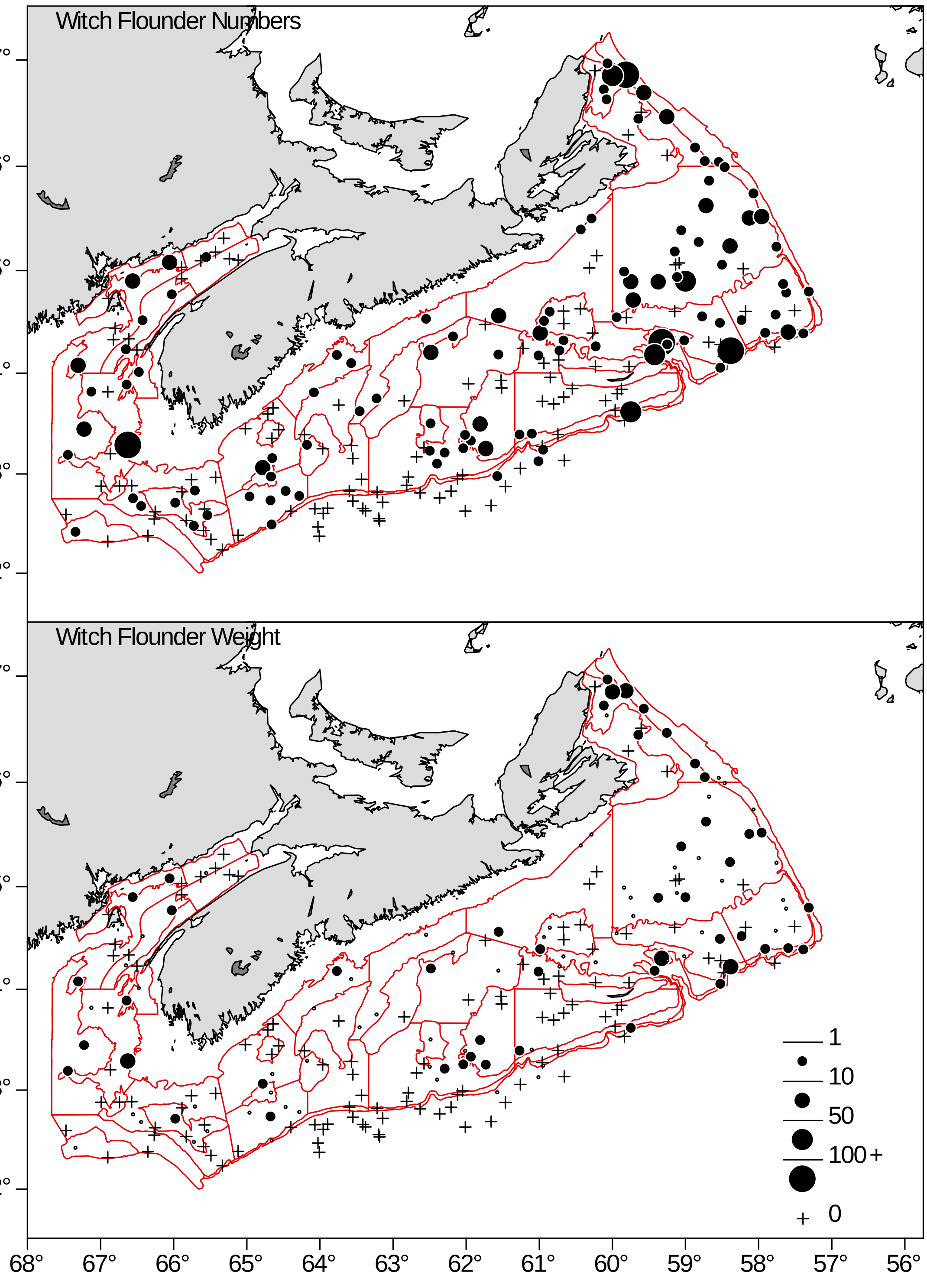


Figure 45. Distribution of witch flounder catches during the 2010 summer RV survey (scale represents both weight (kg) and numbers).

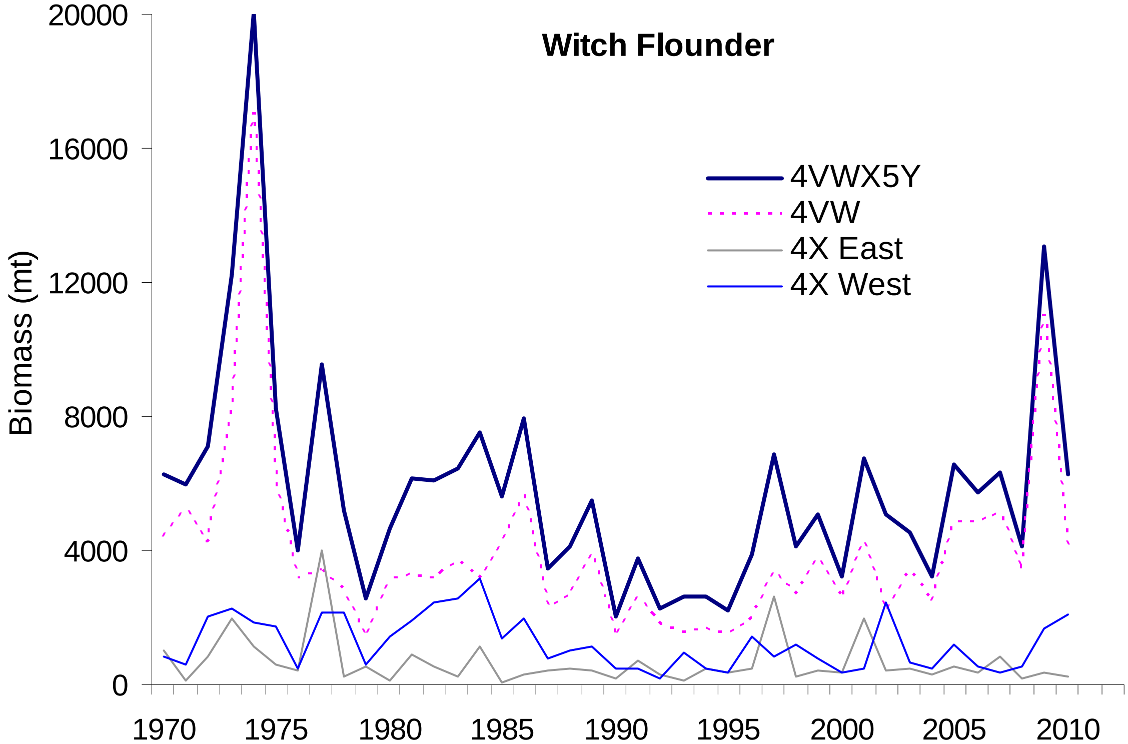


Figure 46. Biomass estimate for witch flounder in 4VWX5Y from the summer RV survey.

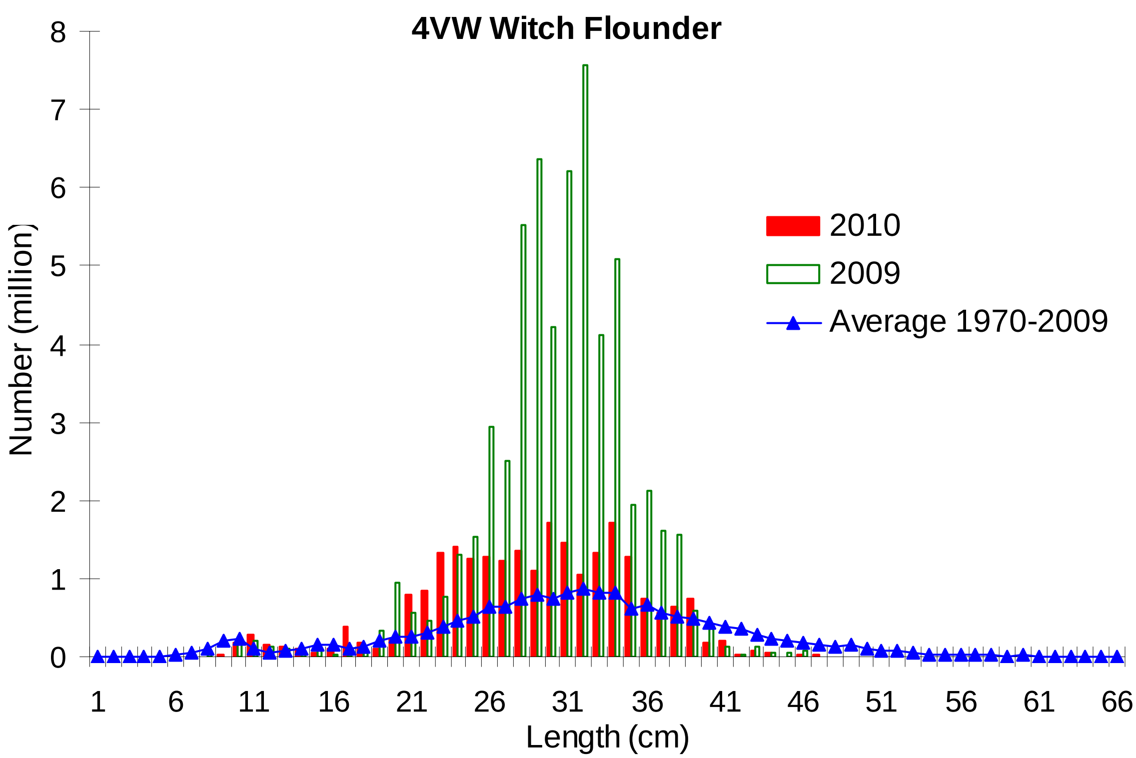


Figure 47. Length composition for witch flounder in 4VW from the summer RV survey.

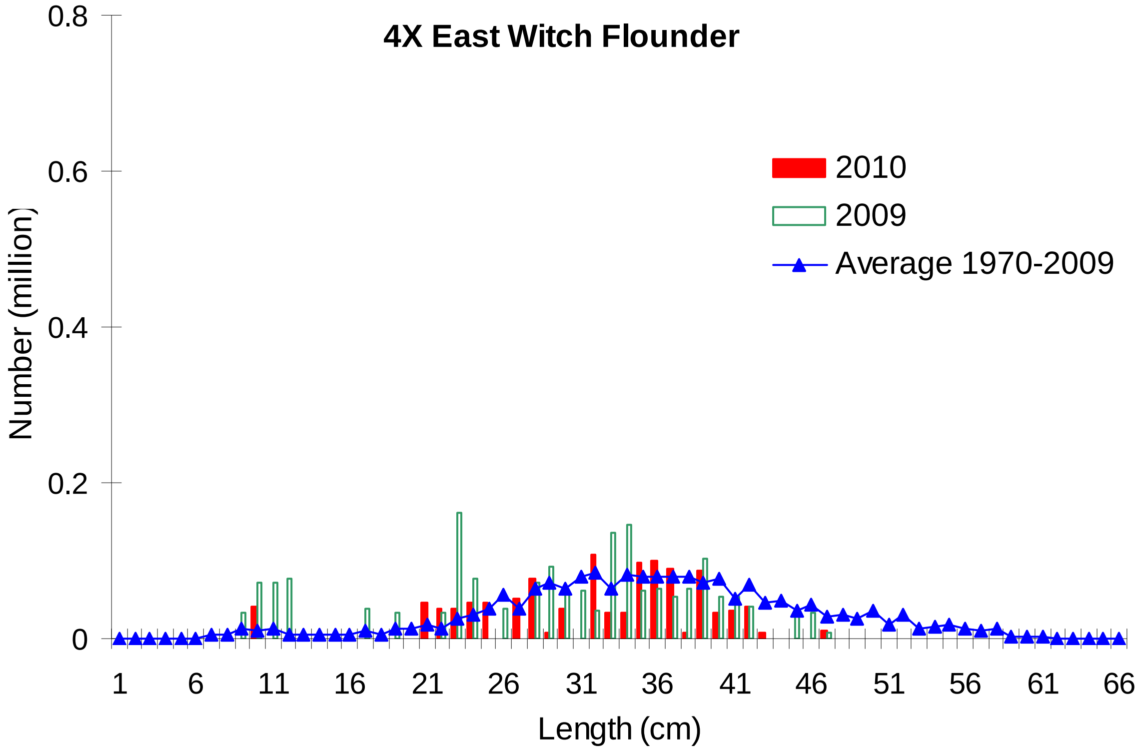


Figure 48. Length composition for witch flounder in 4X East from the summer RV survey.

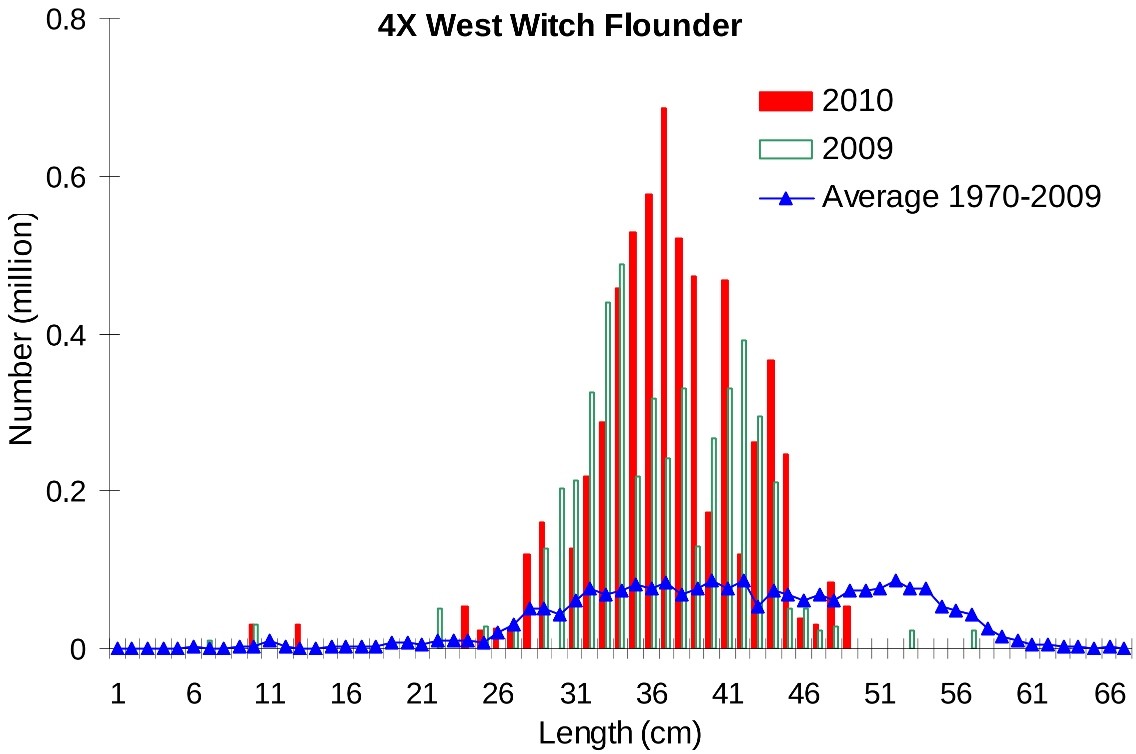


Figure 49. Length composition for witch flounder in 4X West from the summer RV survey.

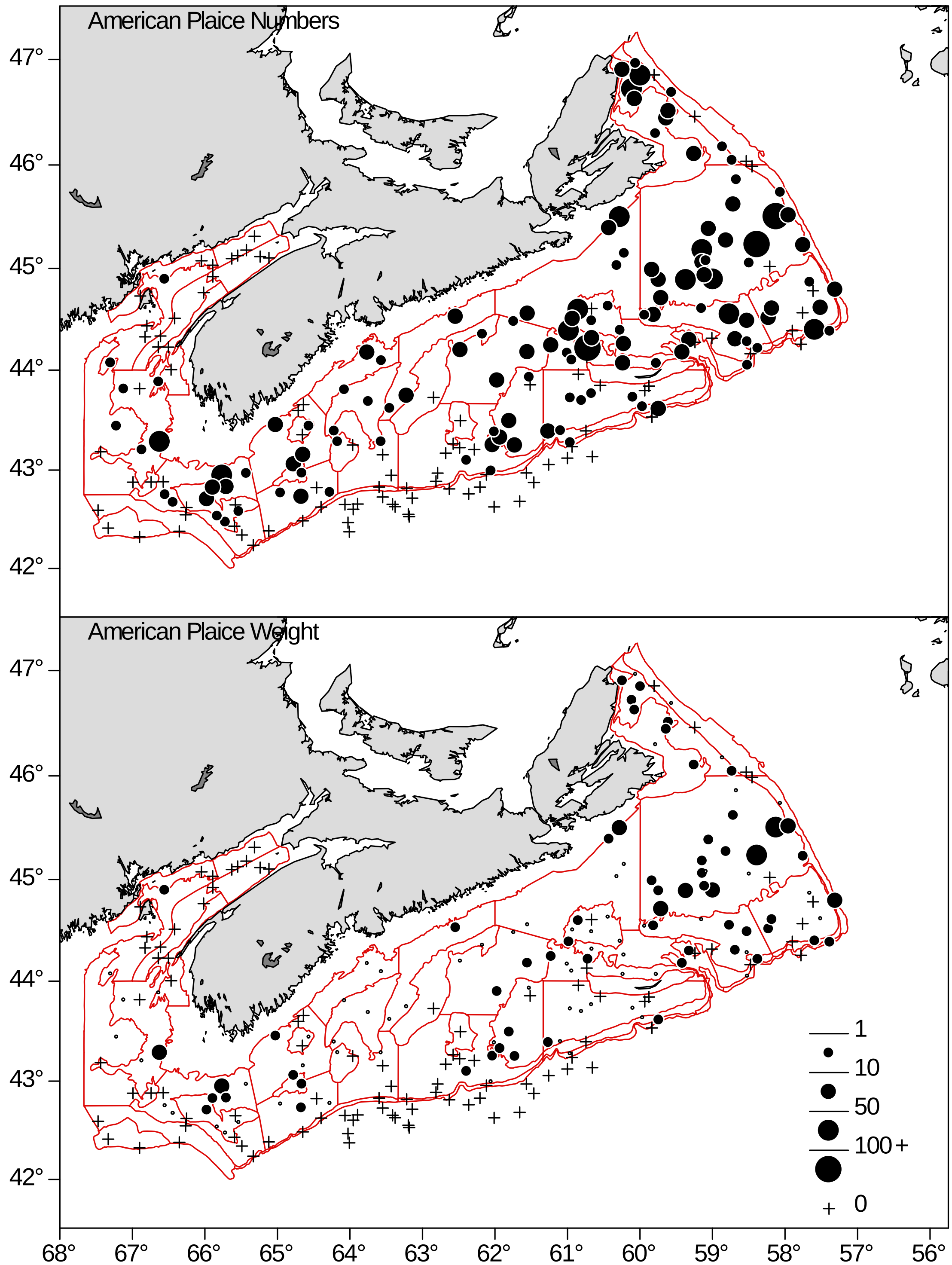


Figure 50. Distribution of American plaice catches during the 2010 summer RV survey (scale represents both weight (kg) and numbers).

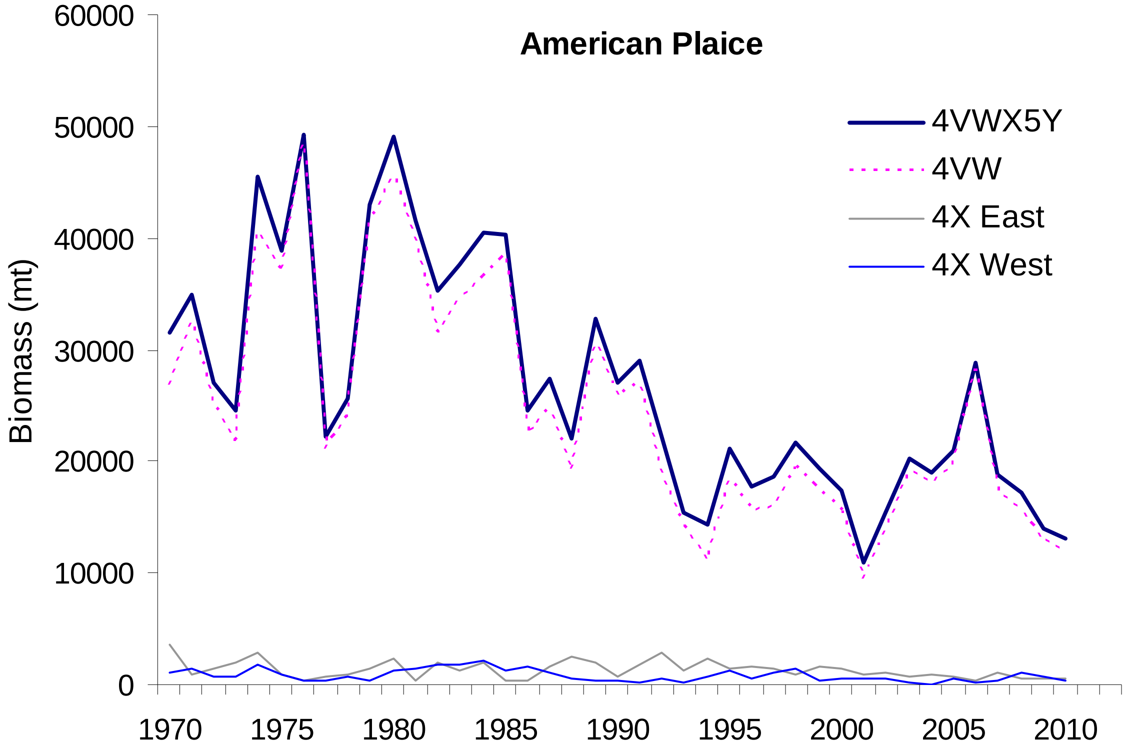


Figure 51. Biomass estimate for American plaice in 4VWX5Y from the summer RV survey.

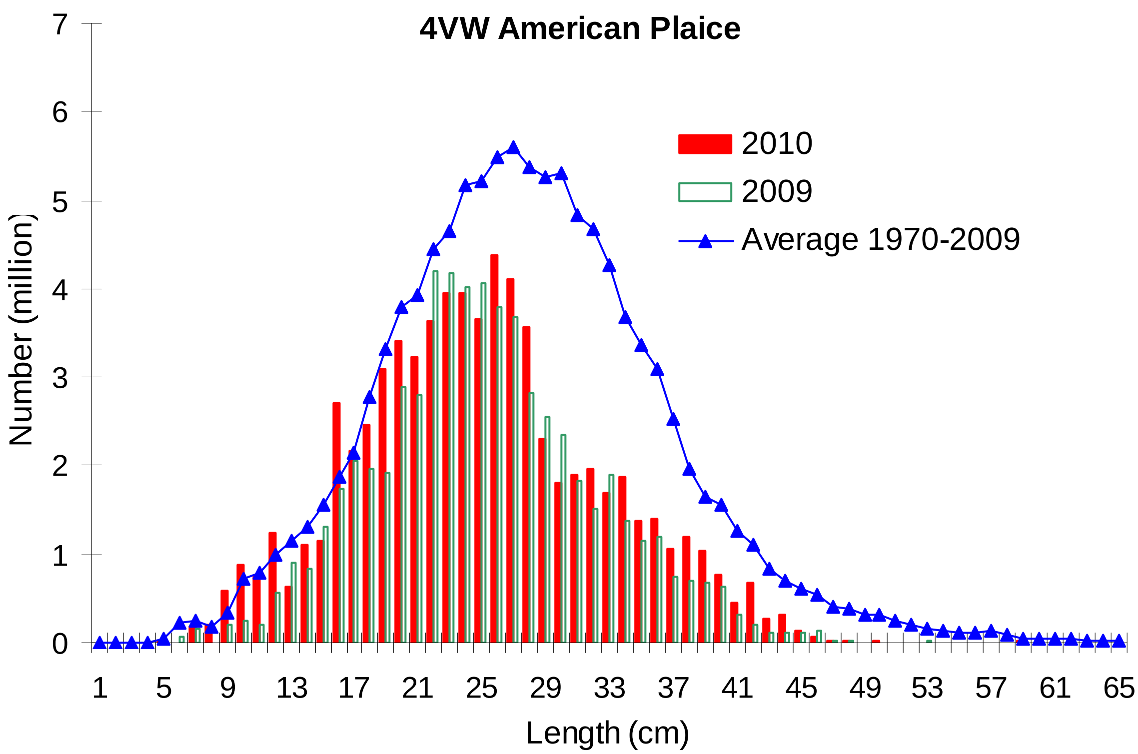


Figure 52. Length composition for American plaice in 4VW from the summer RV survey.

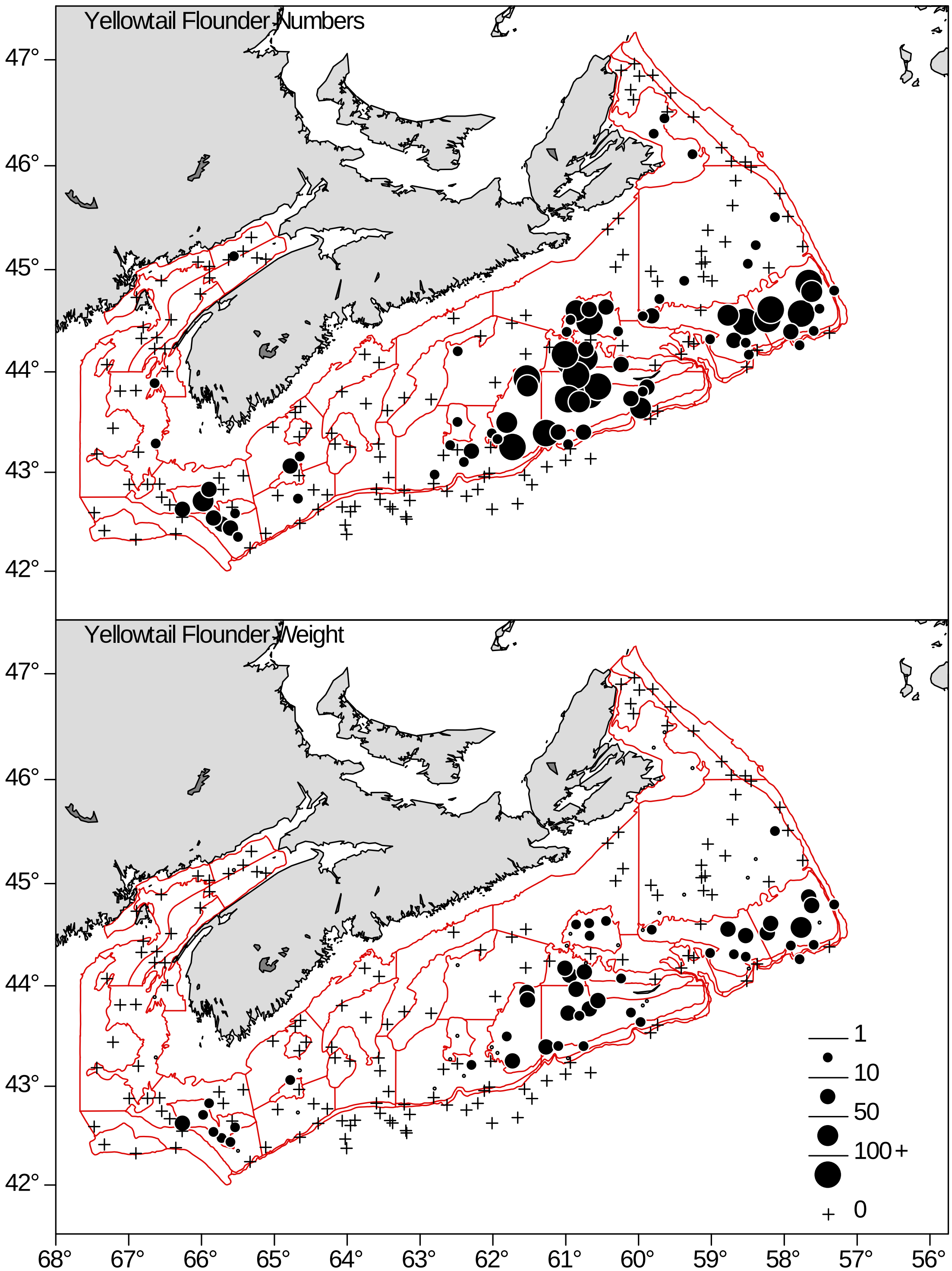


Figure 53. Distribution of yellowtail flounder catches during the 2010 summer RV survey (scale represents both weight (kg) and numbers).

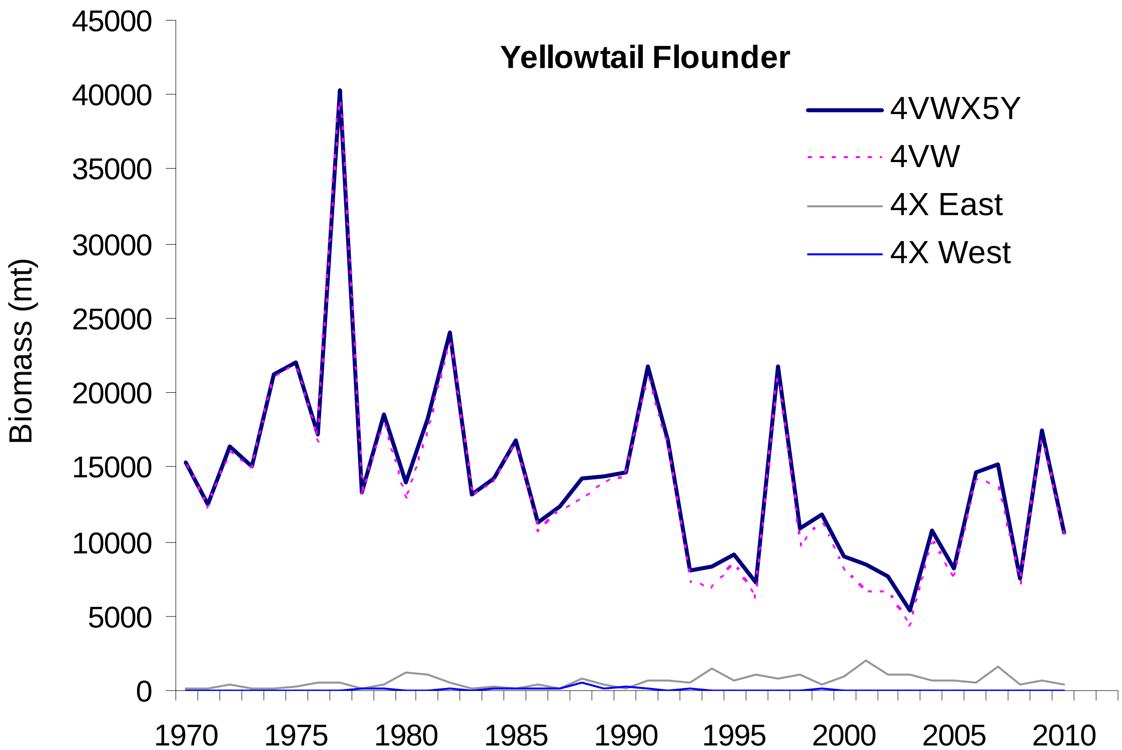


Figure 54. Biomass estimate for yellowtail flounder in 4VWX5Y from the summer RV survey.

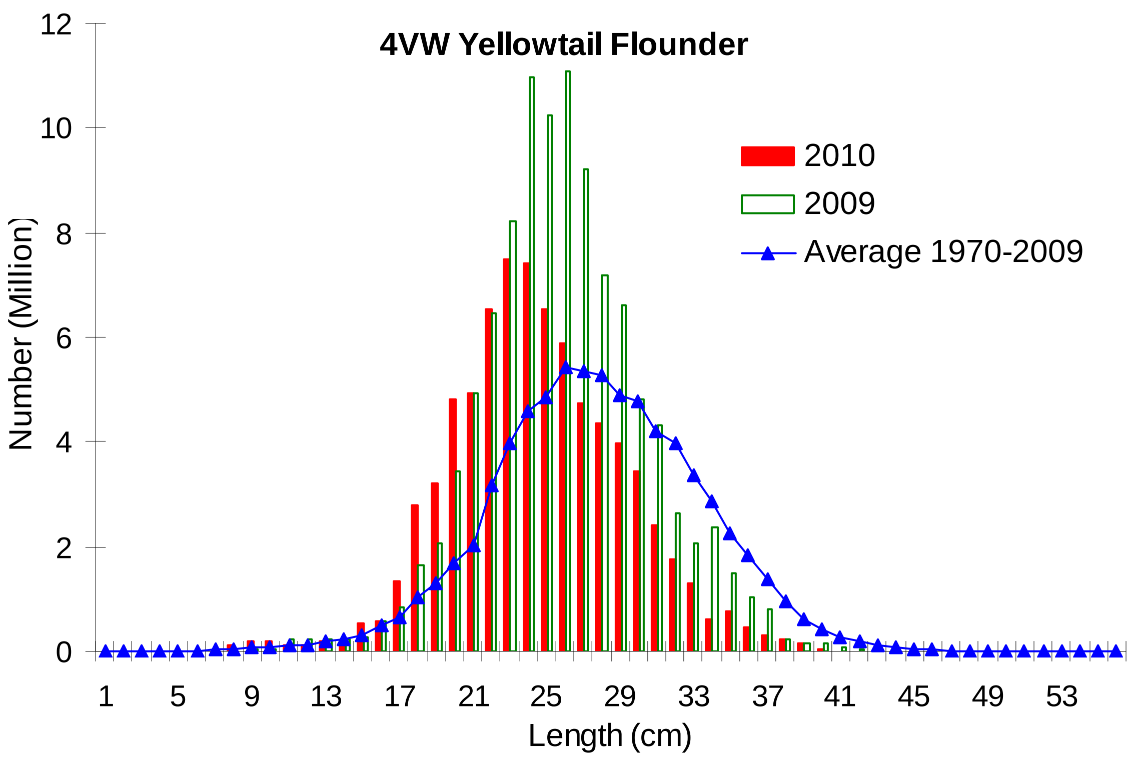


Figure 55. Length composition for yellowtail flounder in 4VW from the summer RV survey.

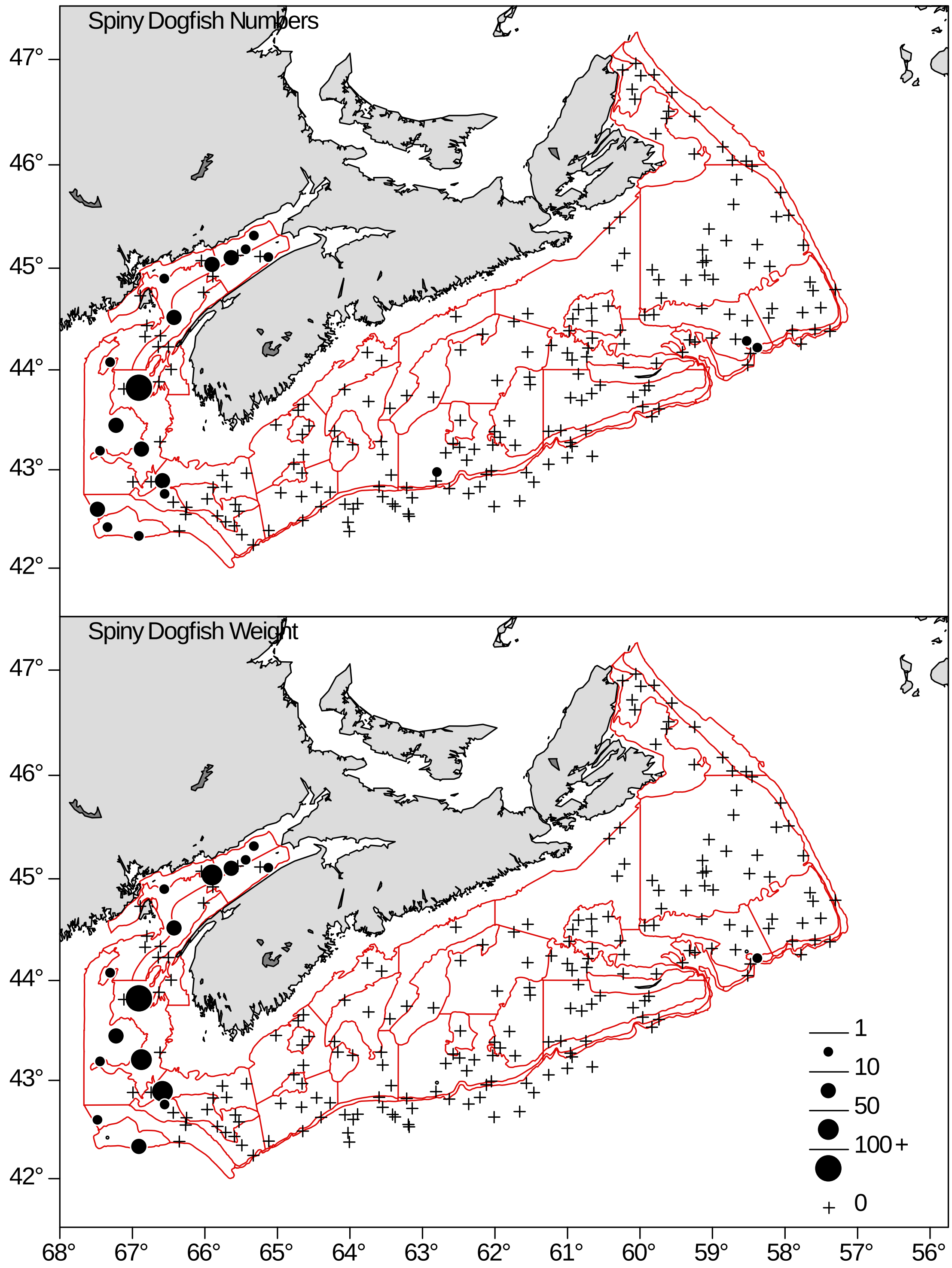


Figure 56. Distribution of spiny dogfish catches during the 2010 summer RV survey (scale represents both weight (kg) and numbers).

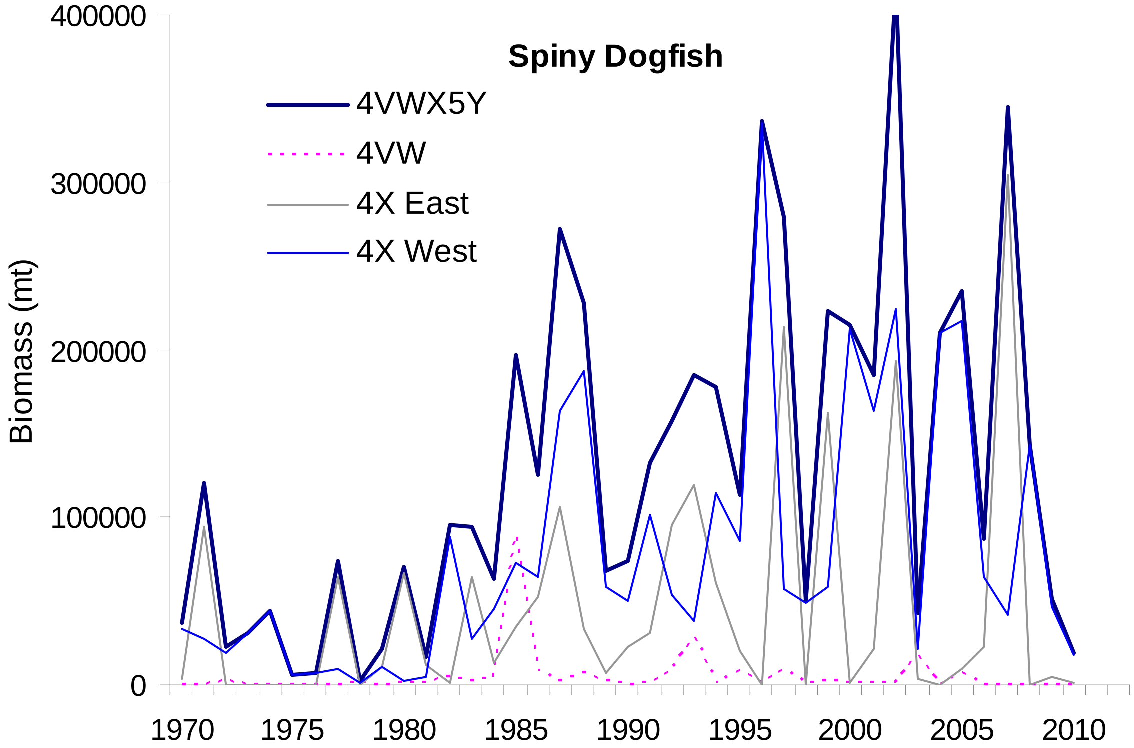


Figure 57. Biomass estimate for spiny dogfish in 4VWX5Y from the summer RV survey.

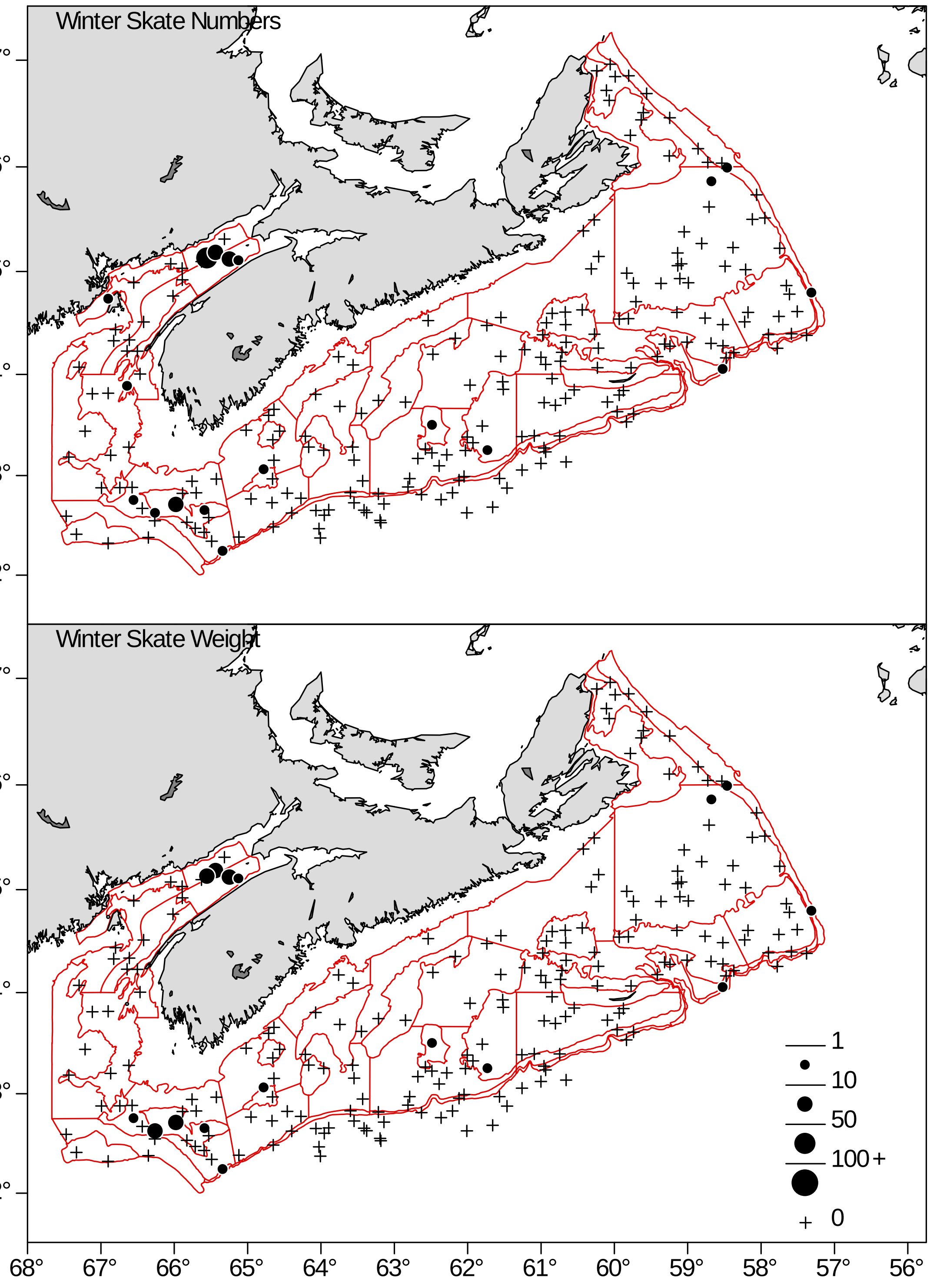


Figure 58. Distribution of winter skate catches during the 2010 summer RV survey (scale represents both weight (kg) and numbers).

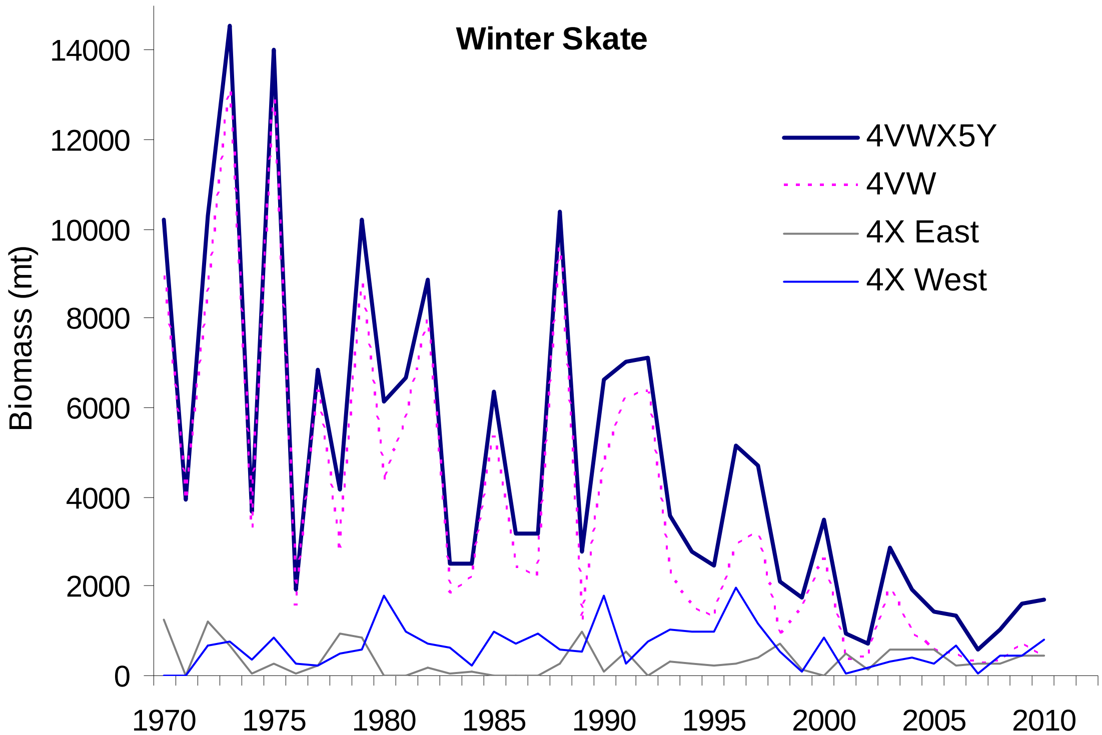


Figure 59. Biomass estimate for winter skate in 4VWX5Y from the summer RV survey.

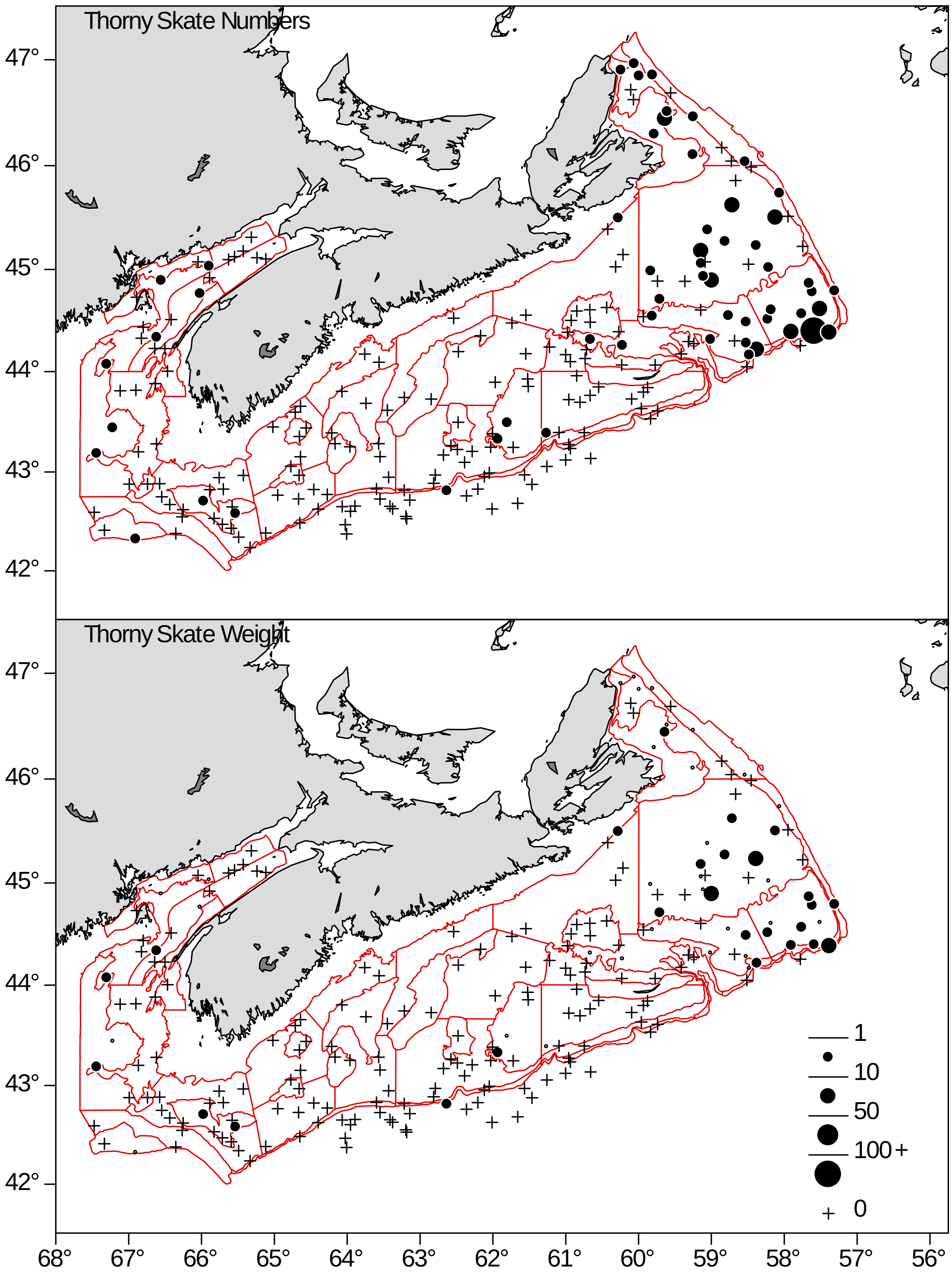


Figure 60. Distribution of thorny skate catches during the 2010 summer RV survey (scale represents both weight (kg) and numbers).

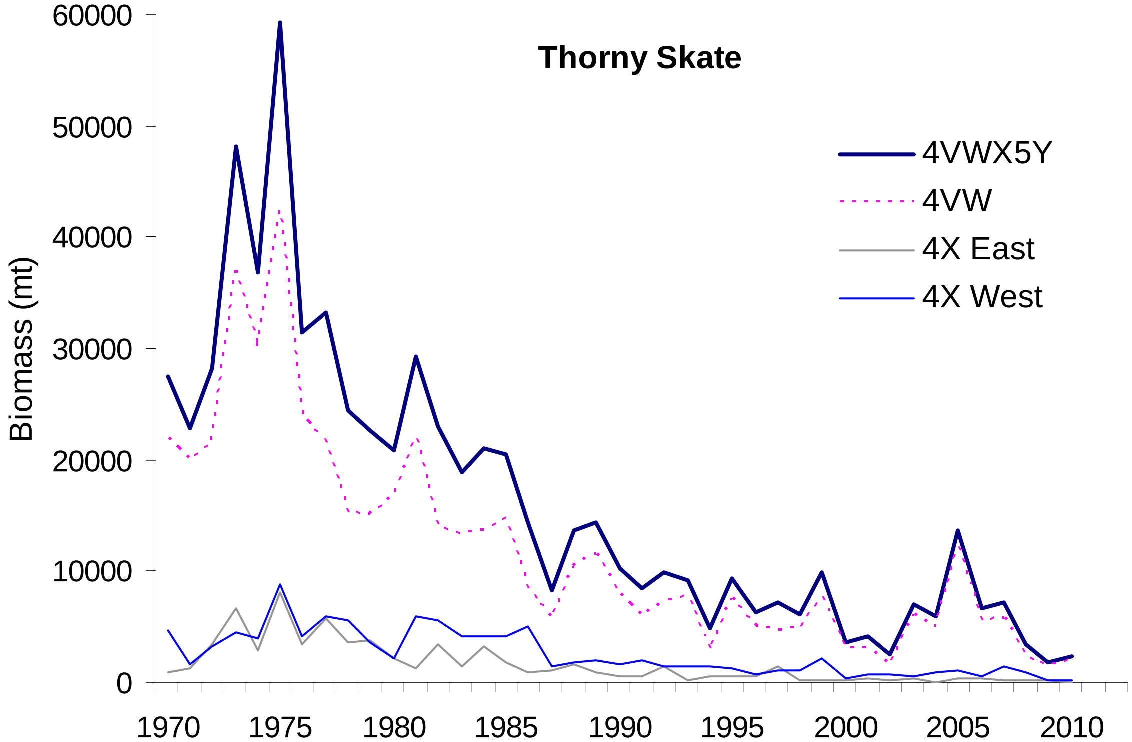


Figure 61. Biomass estimate for thorny skate in 4VWX5Y from the summer RV survey.

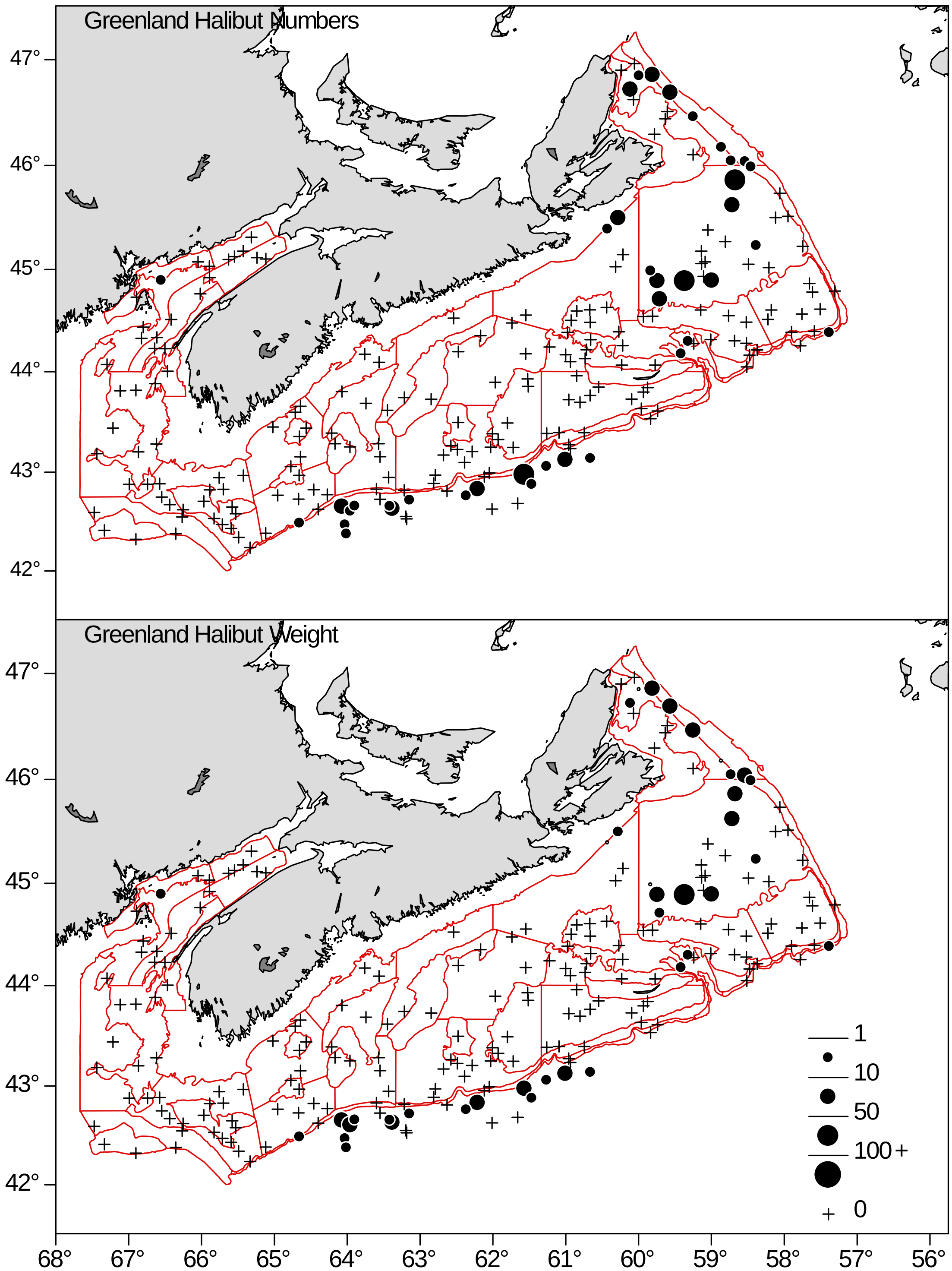


Figure 62. Distribution of Greenland halibut catches during the 2010 summer RV survey (scale represents both weight (kg) and numbers).

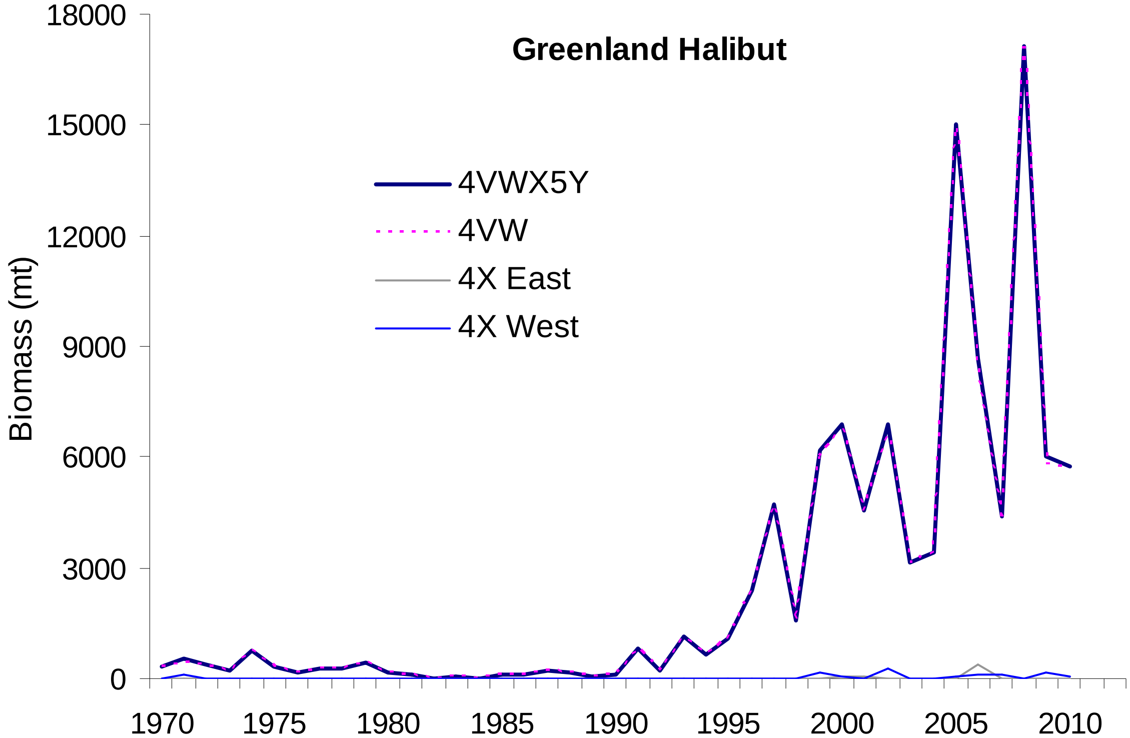


Figure 63. Biomass estimate for Greenland halibut in 4VWX5Y from the summer RV survey.

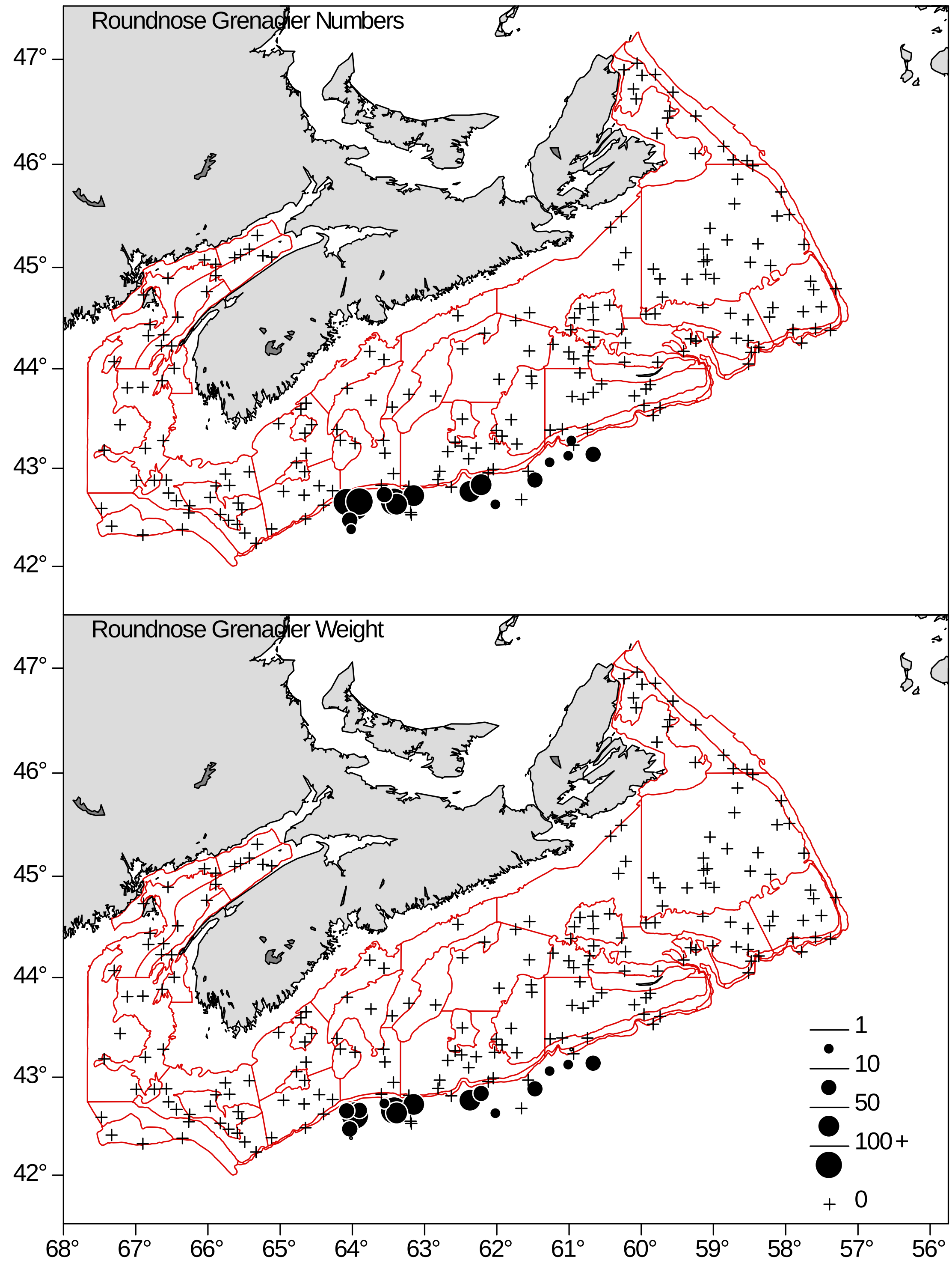


Figure 64. Distribution of roundnose grenadier catches during the 2010 summer RV survey (scale represents both weight (kg) and numbers).

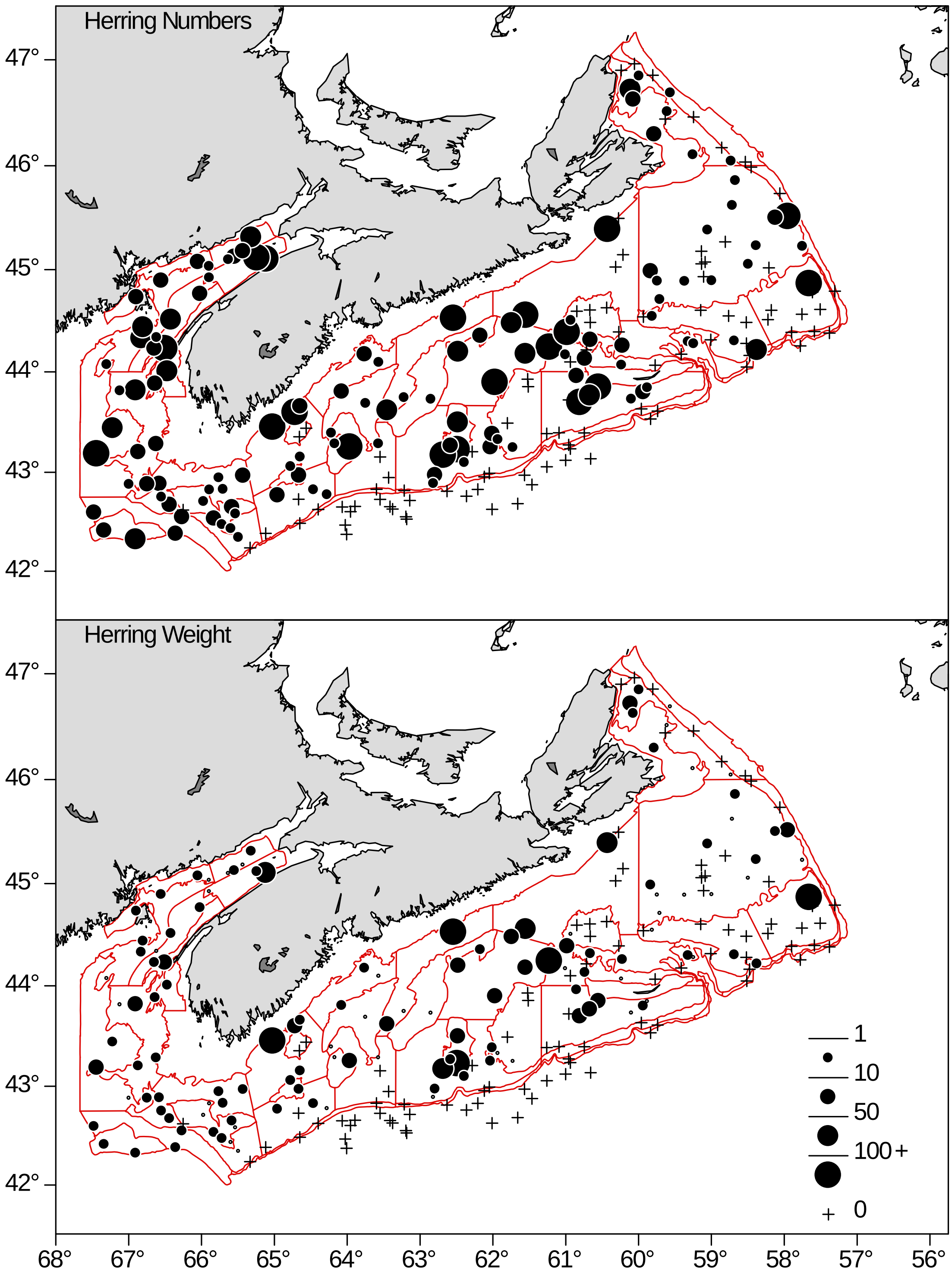


Figure 65. Distribution of Atlantic herring catches during the 2010 summer RV survey (scale represents both weight (kg) and numbers).

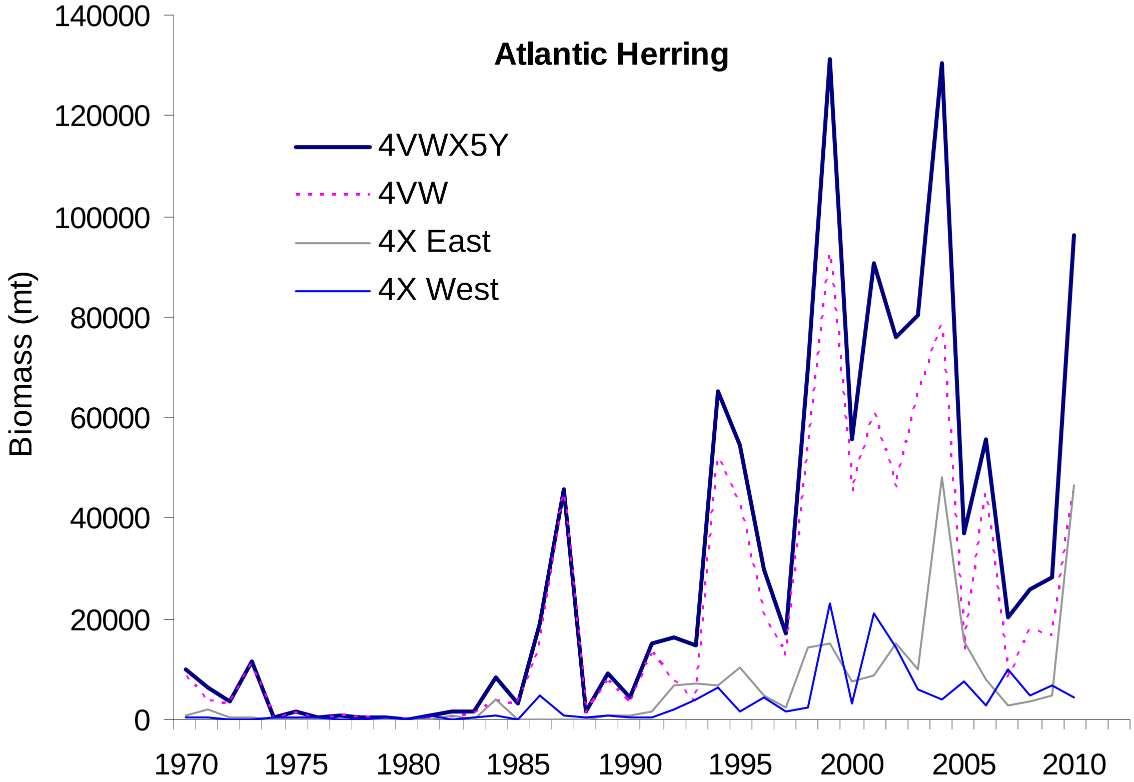


Figure 66. Biomass estimate for Atlantic herring in 4VWX5Y from the summer RV survey.

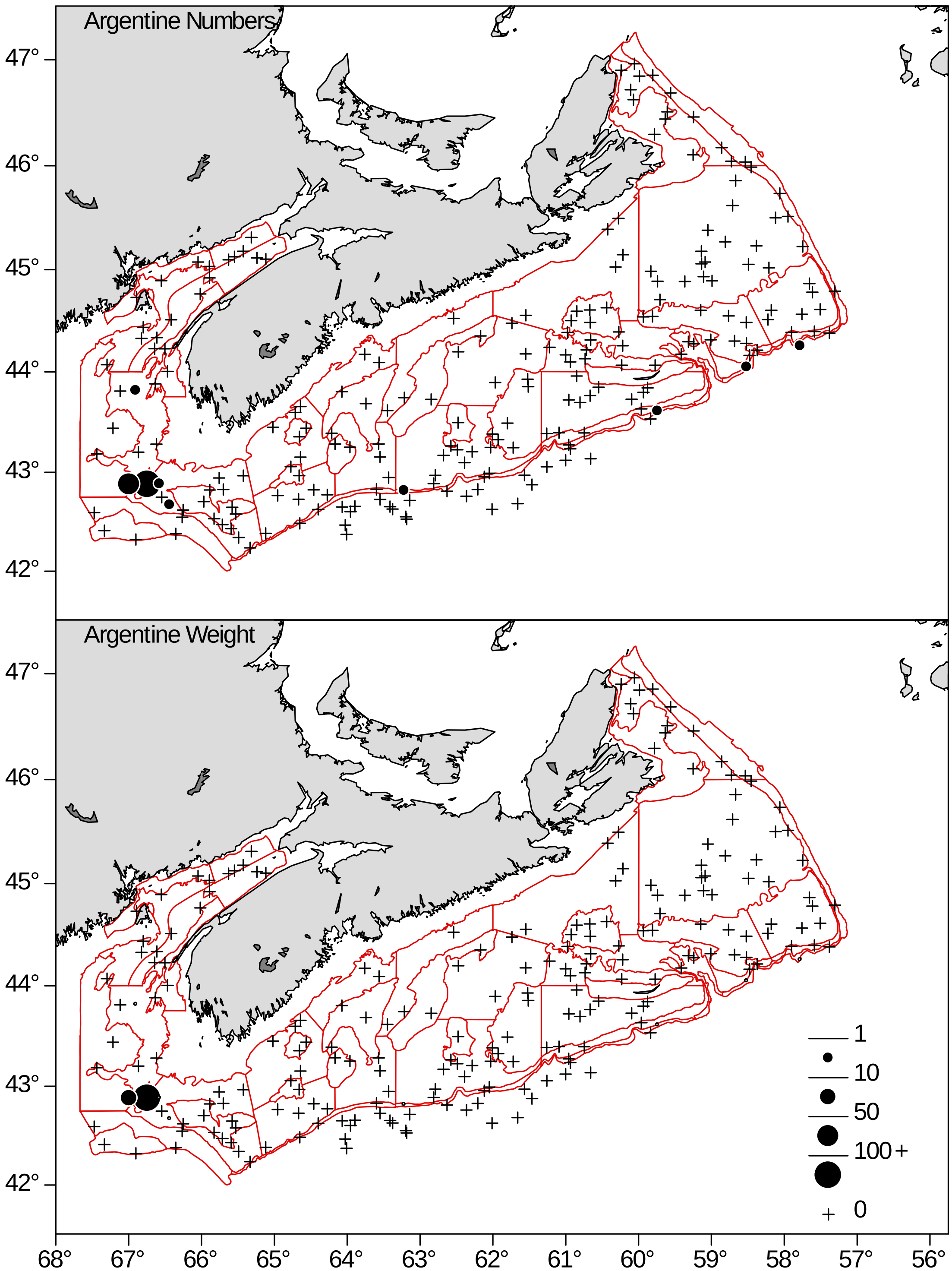


Figure 67. Distribution of argentine catches during the 2010 summer RV survey (scale represents both weight (kg) and numbers).

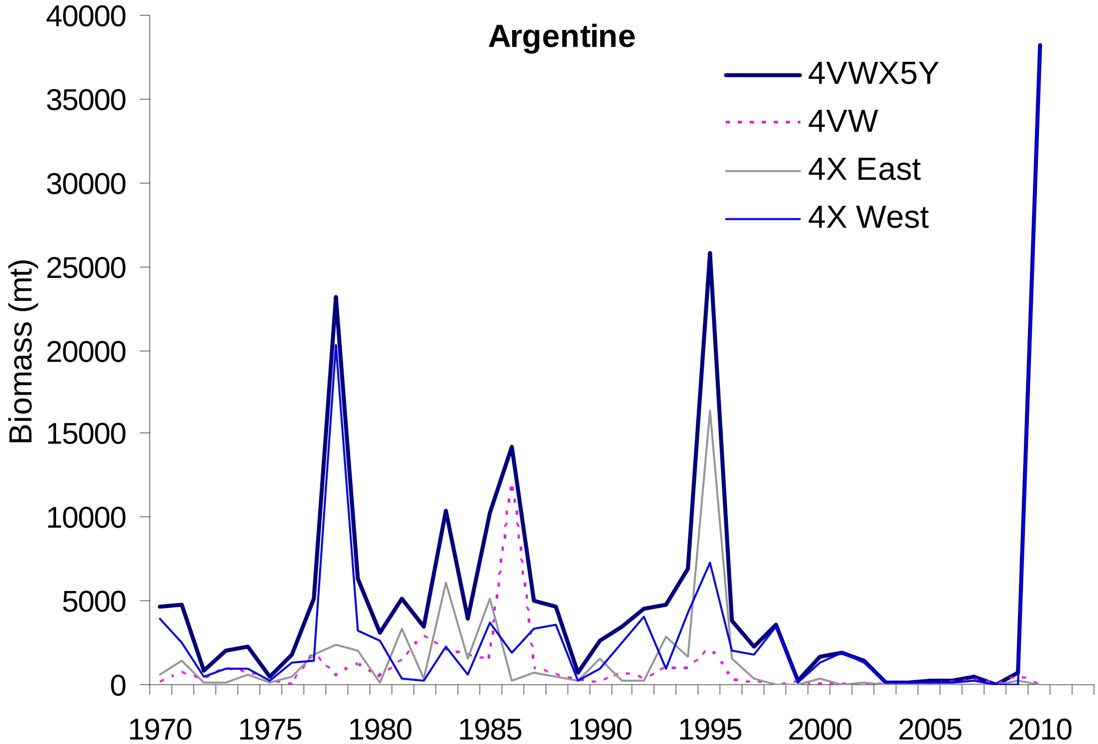


Figure 68. Biomass estimate for argentine in 4VWX5Y from the summer RV survey.

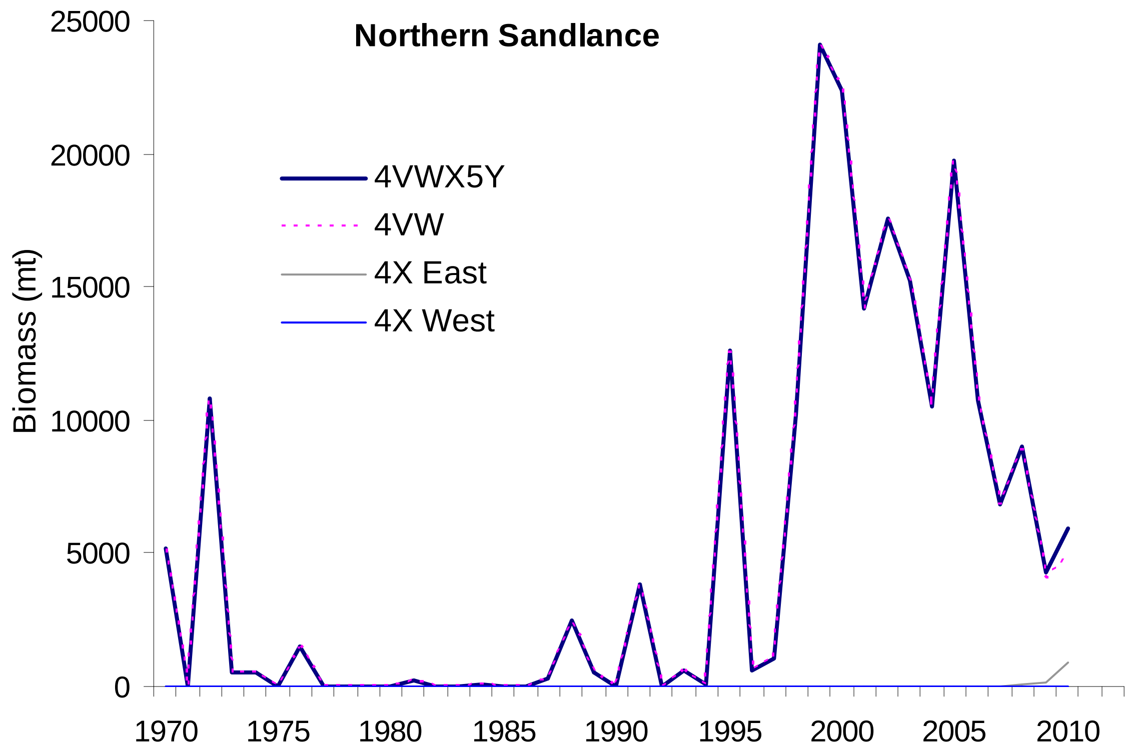


Figure 69. Biomass estimate for northern sandlance in 4VWX5Y from the summer RV survey.

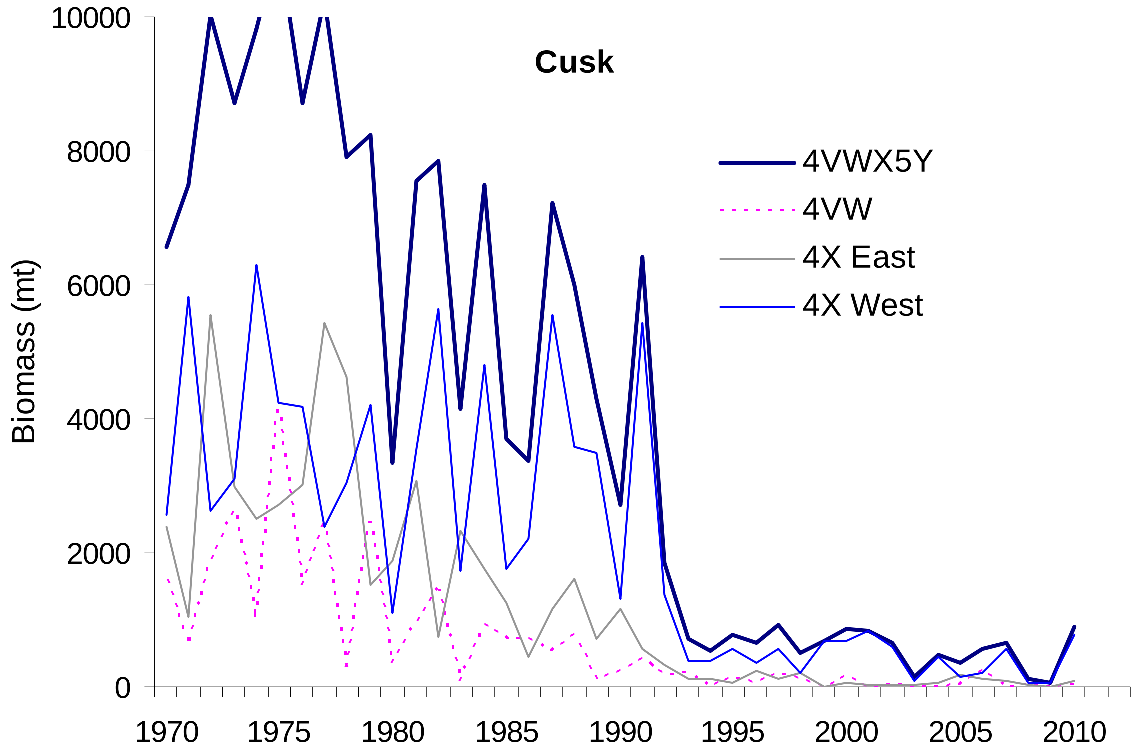


Figure 70. Biomass estimate for cusk in 4VWX5Y from the summer RV survey.

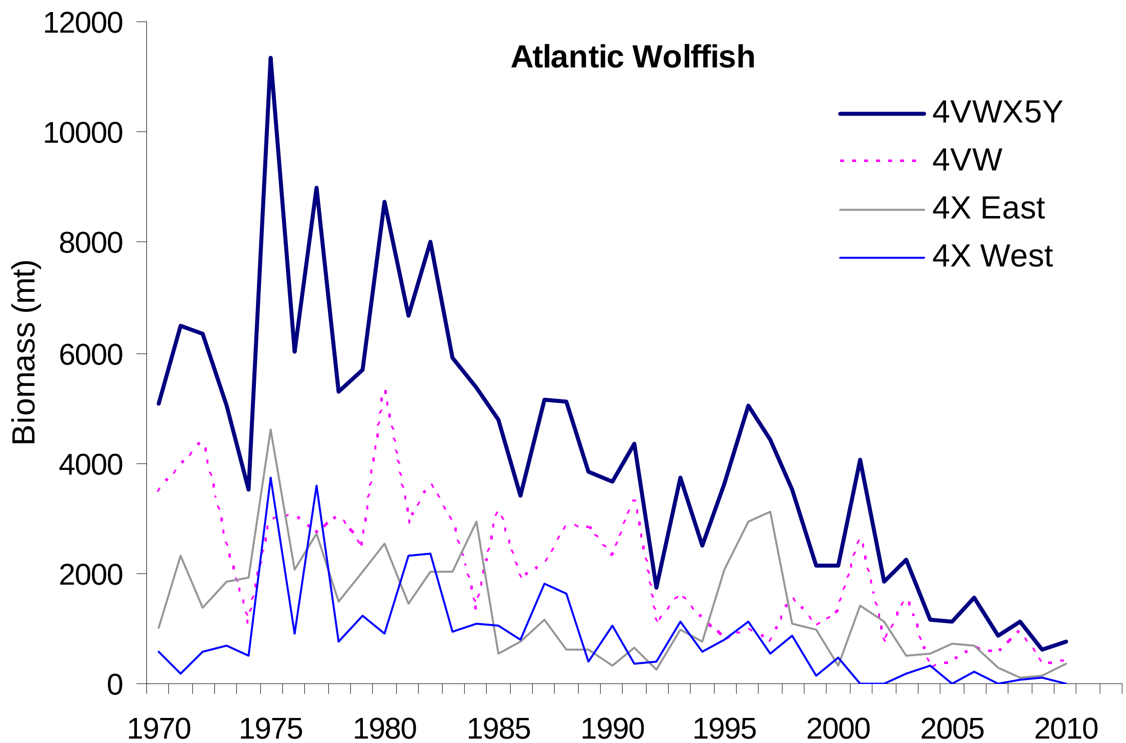


Figure 71. Biomass estimate for Atlantic wolffish in 4VWX5Y from the summer RV survey.

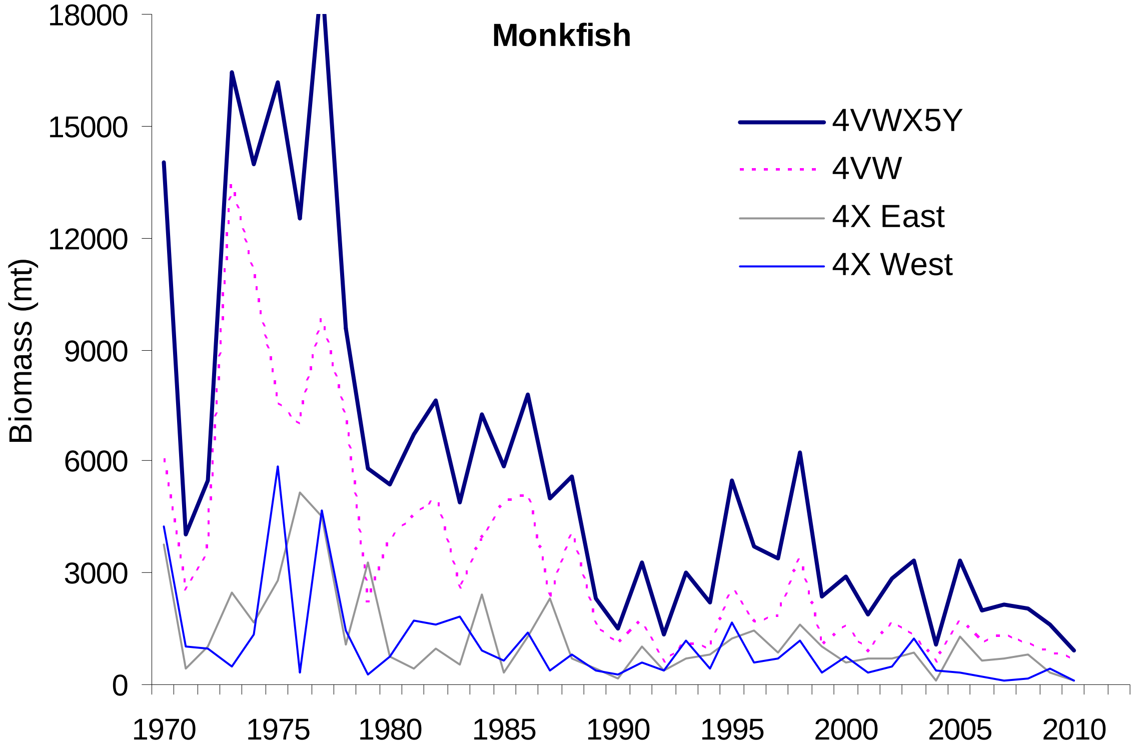


Figure 72. Biomass estimate for monkfish in 4VWX5Y from the summer RV survey.

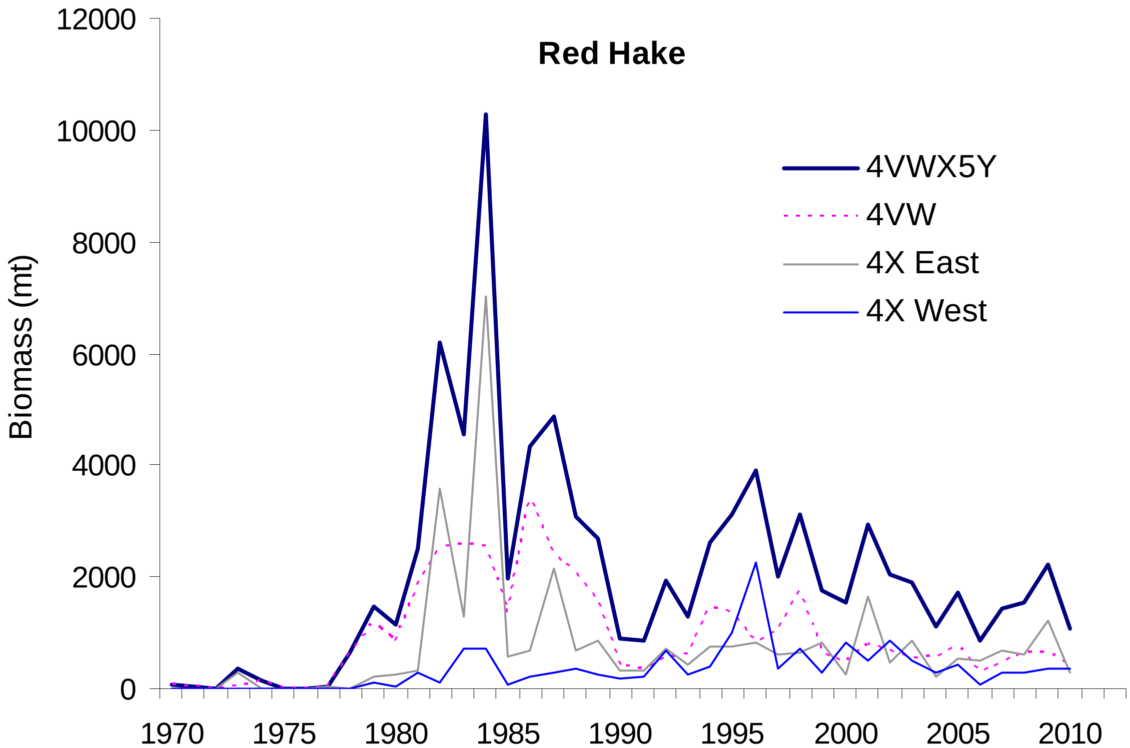


Figure 73. Biomass estimate for red hake in 4VWX5Y from the summer RV survey.

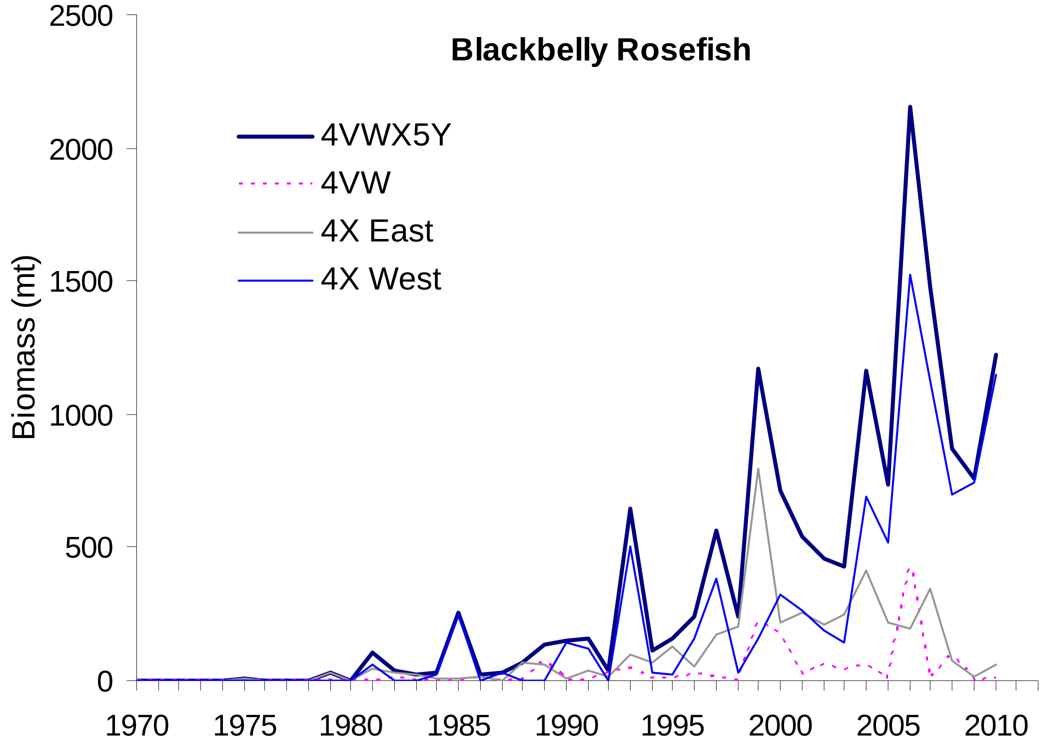


Figure 74. Biomass estimate for blackbelly rosefish in 4VWX5Y from the summer RV survey.

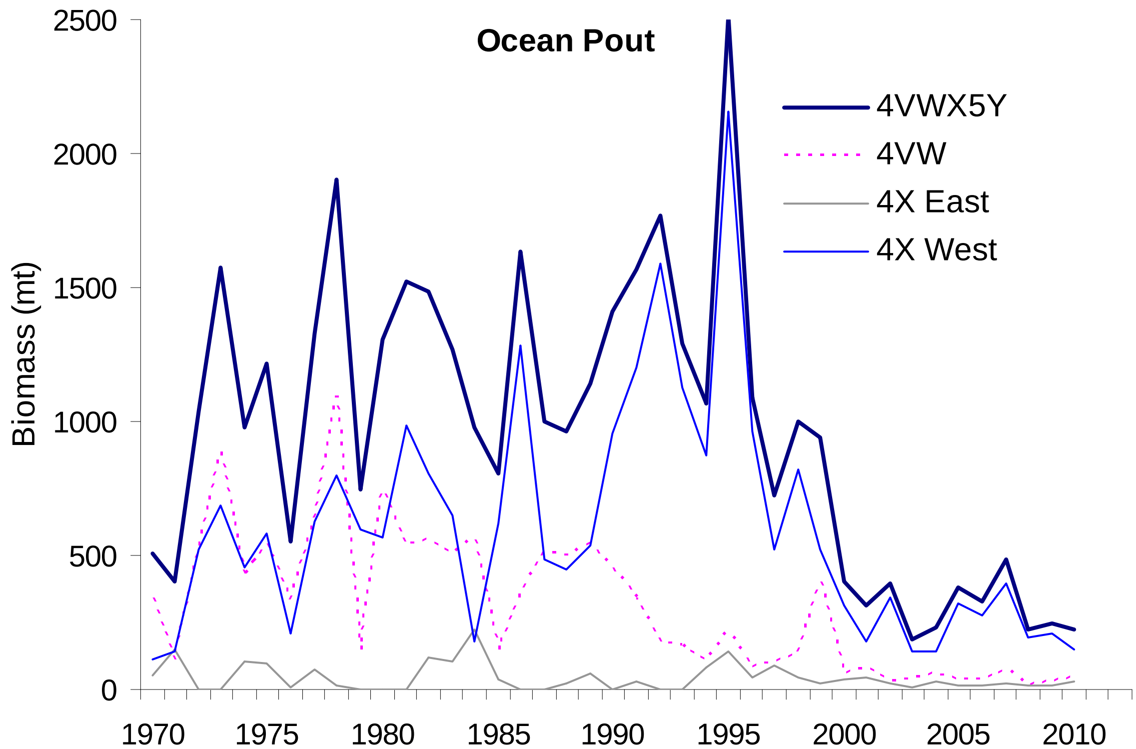


Figure 75. Biomass estimate for ocean pout in 4VWX5Y from the summer RV survey.

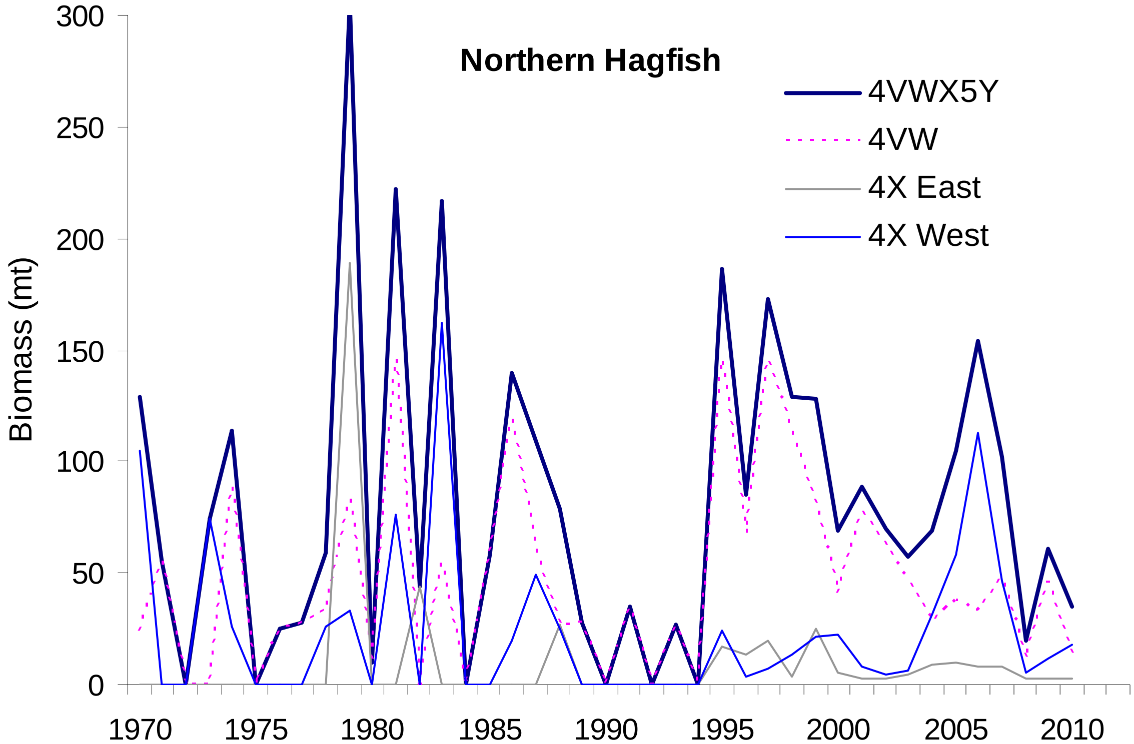


Figure 76. Biomass estimate for northern hagfish in 4VWX5Y from the summer RV survey.

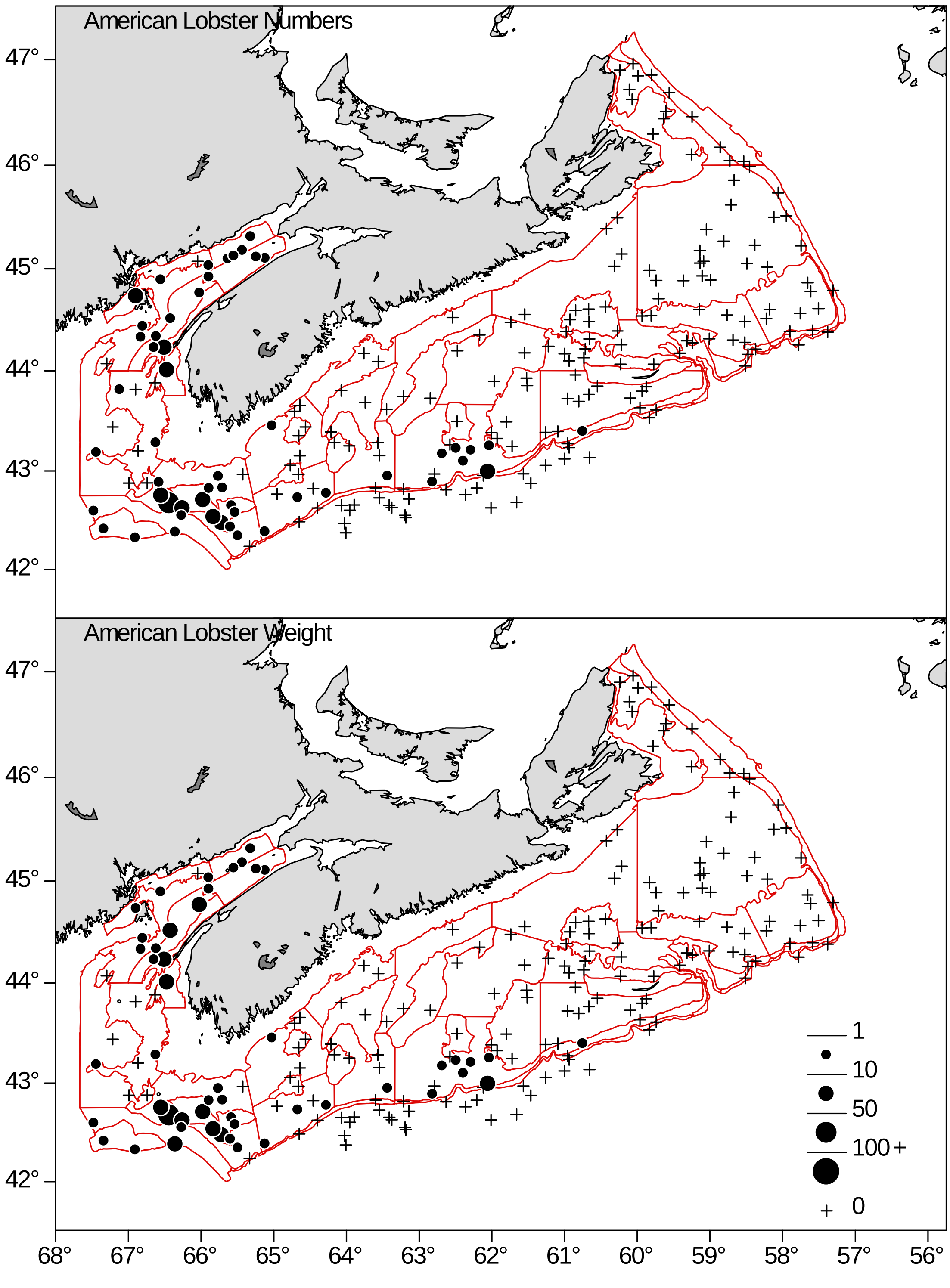


Figure 77. Distribution of American lobster catches during the 2010 summer RV survey (scale represents both weight (kg) and numbers).

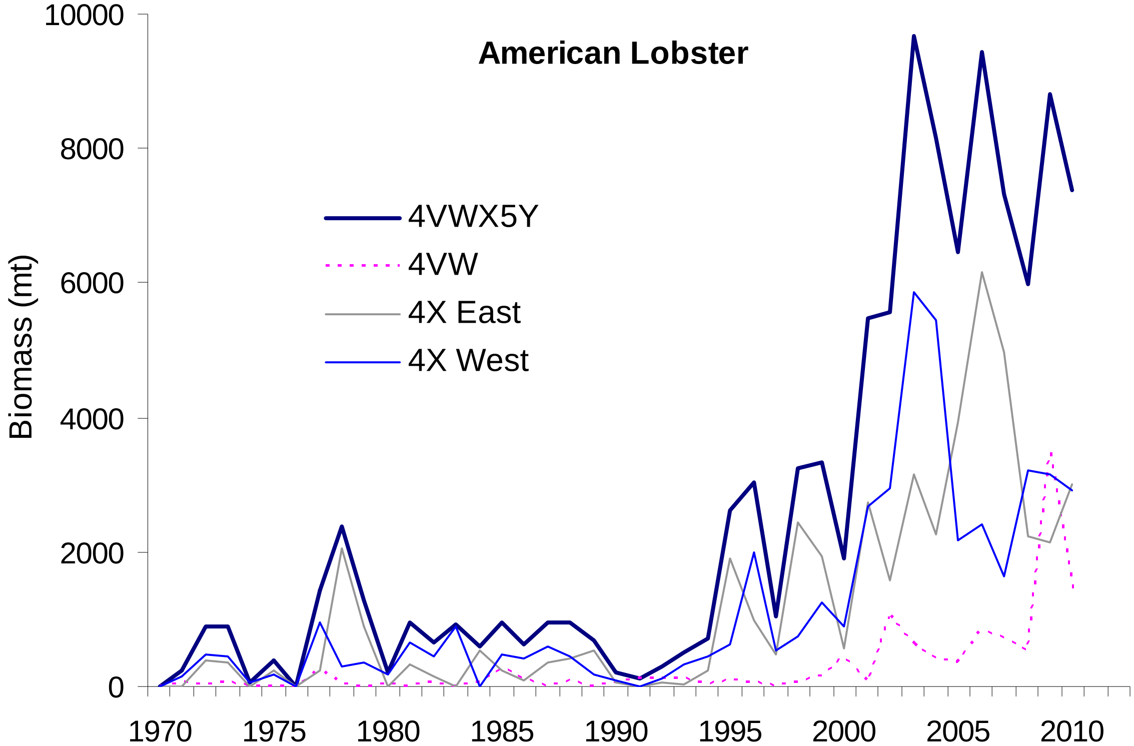


Figure 78. Biomass estimate for American lobster in 4VWX5Y from the summer RV survey.

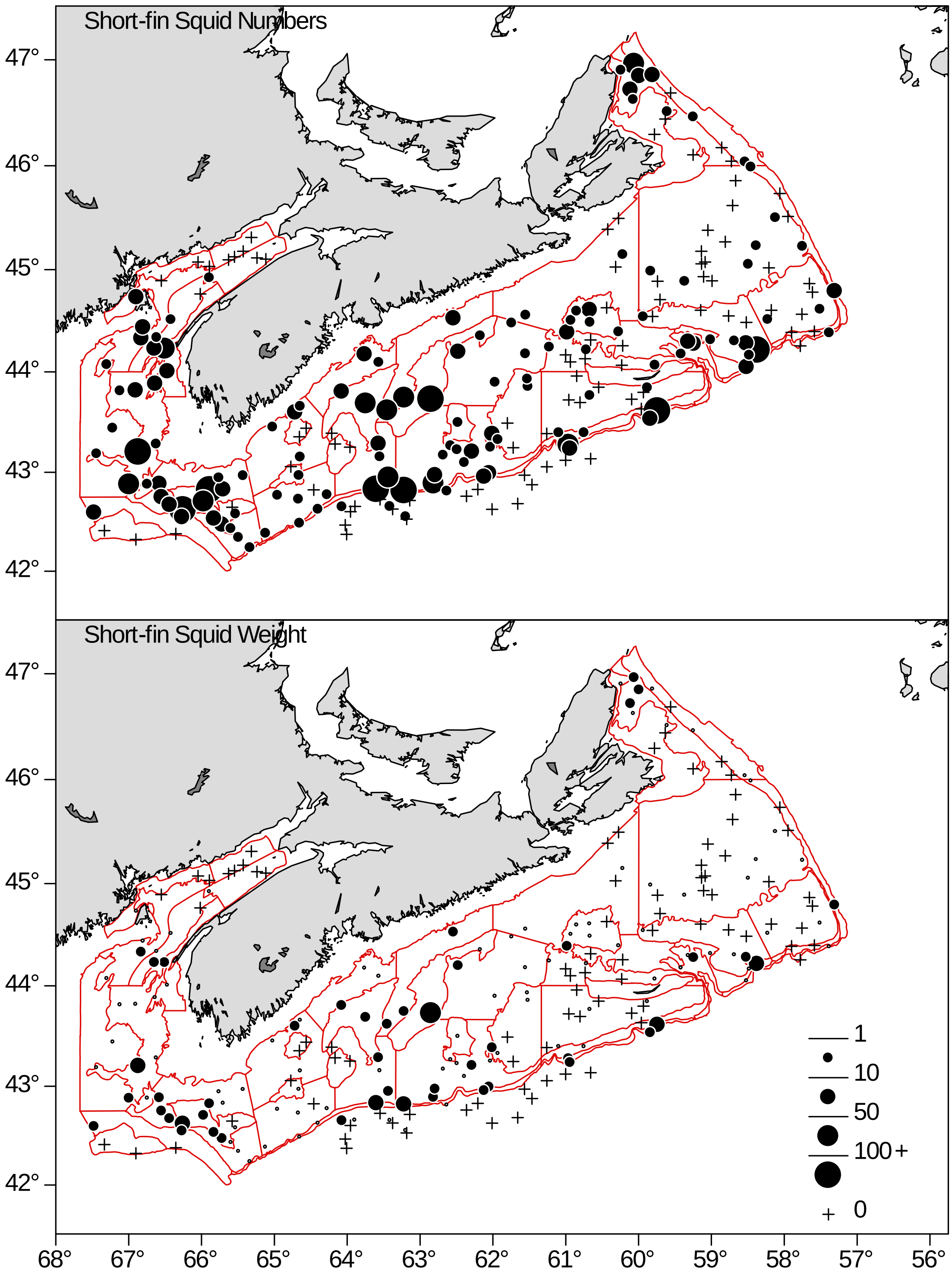


Figure 79. Distribution of short-fin squid catches during the 2010 summer RV survey (scale represents both weight (kg) and numbers).

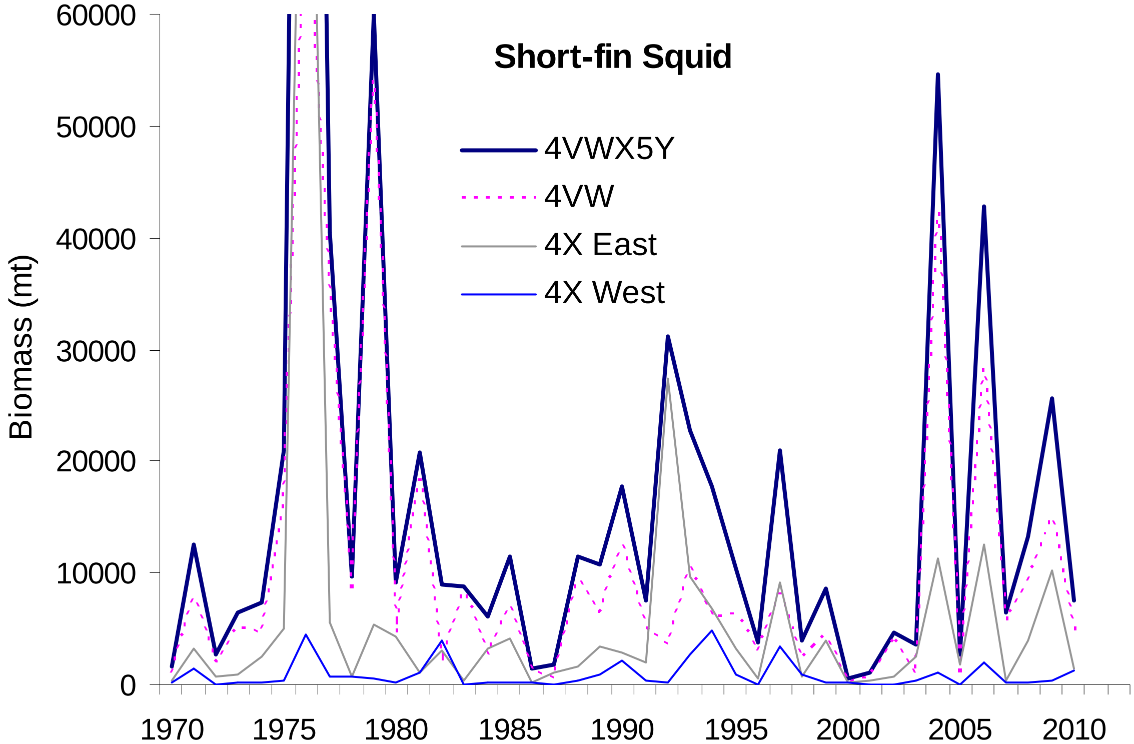


Figure 80. Biomass estimate for short-fin squid in 4VWX5Y from the summer RV survey.

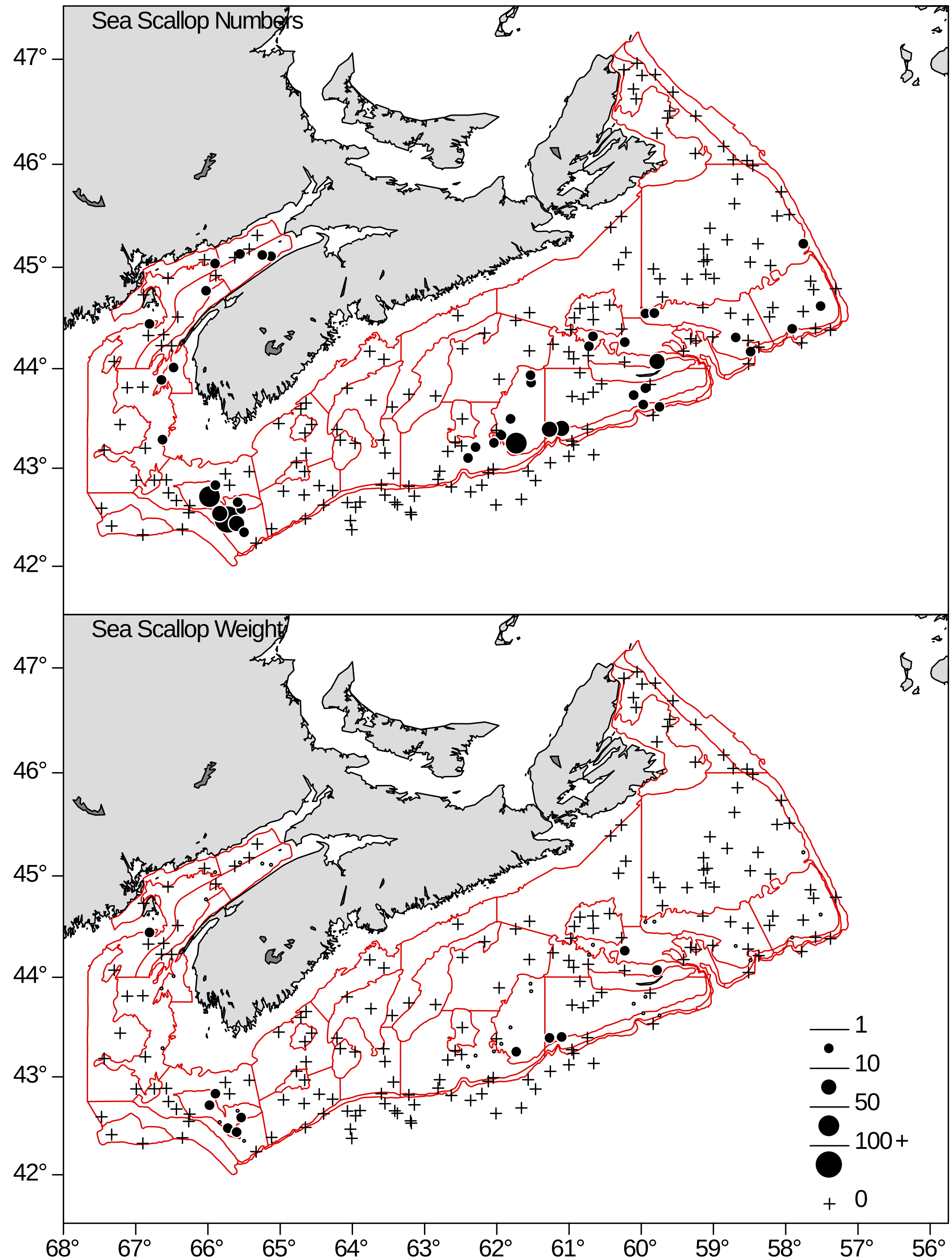


Figure 81. Distribution of sea scallop catches during the 2010 summer RV survey (scale represents both weight (kg) and numbers).

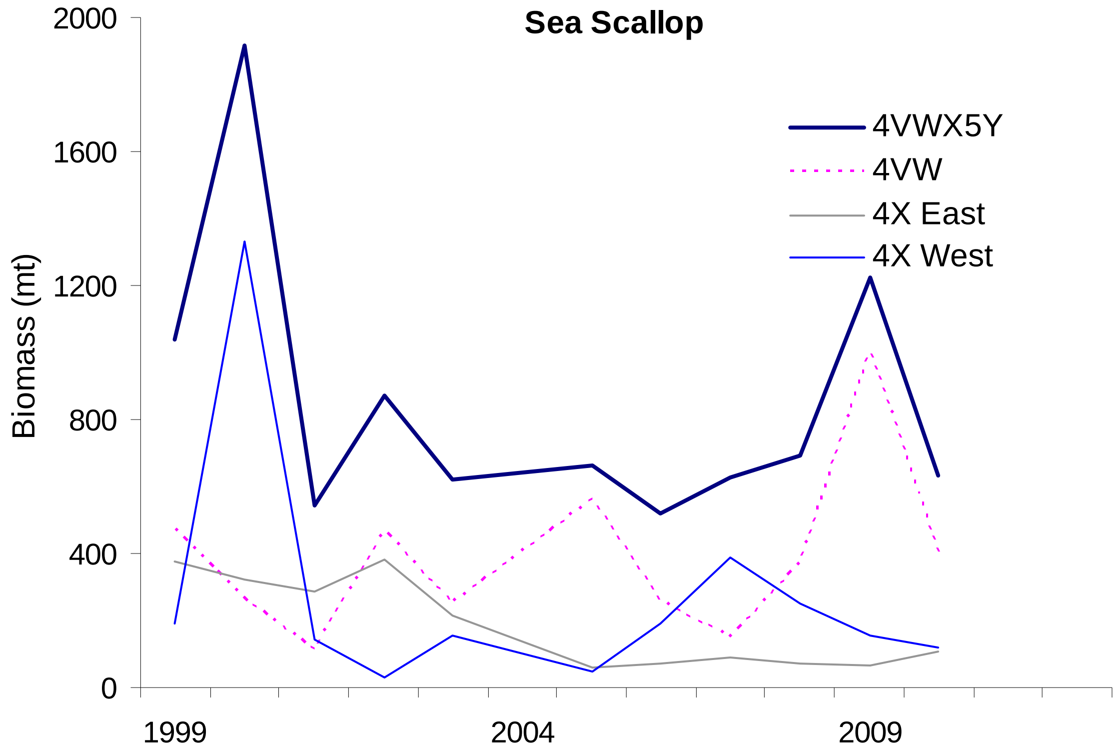


Figure 82. Biomass estimate for sea scallop in 4VWX5Y from the summer RV survey.

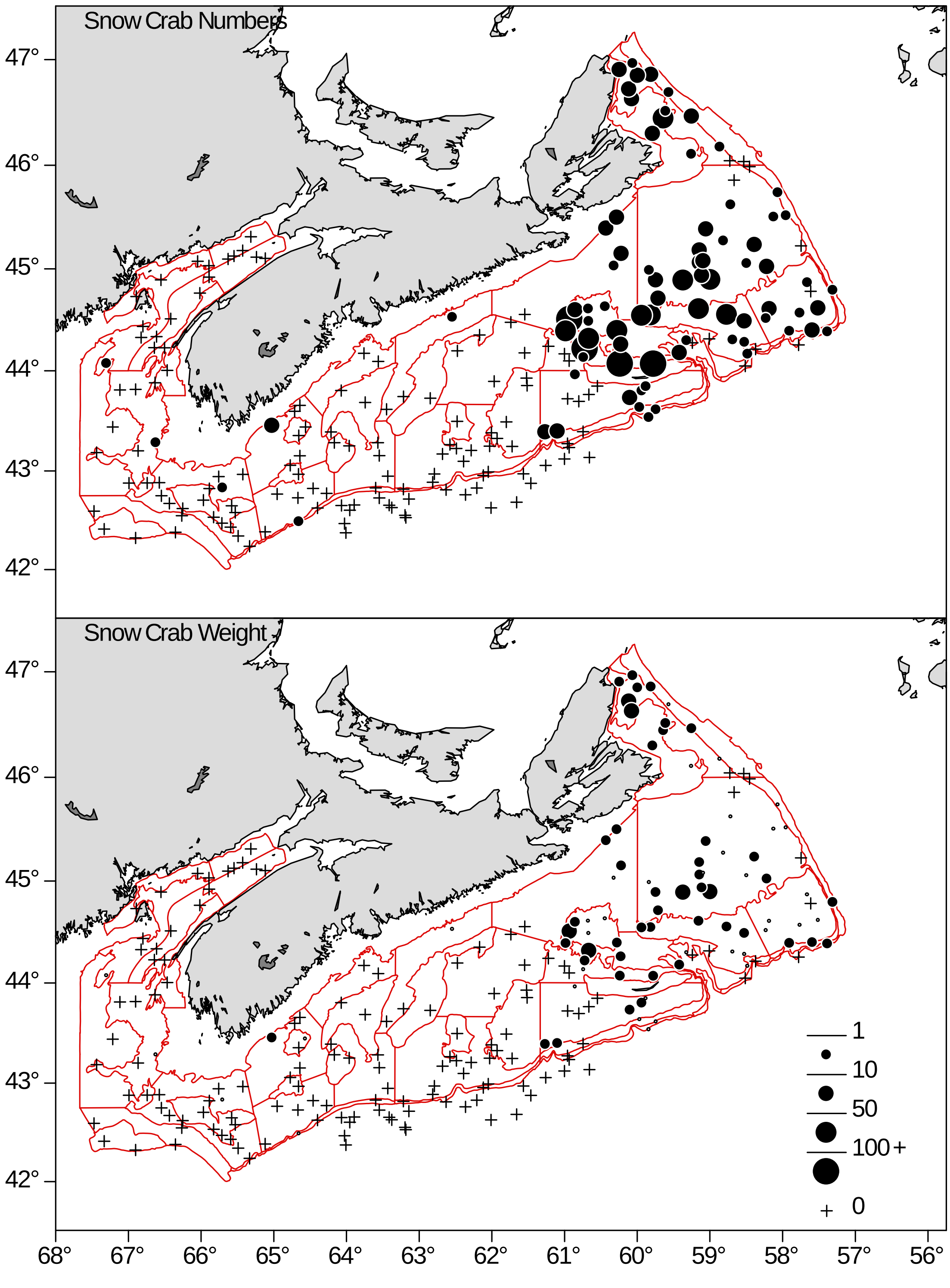


Figure 83. Distribution of snow crab catches during the 2010 summer RV survey (scale represents both weight (kg) and numbers).

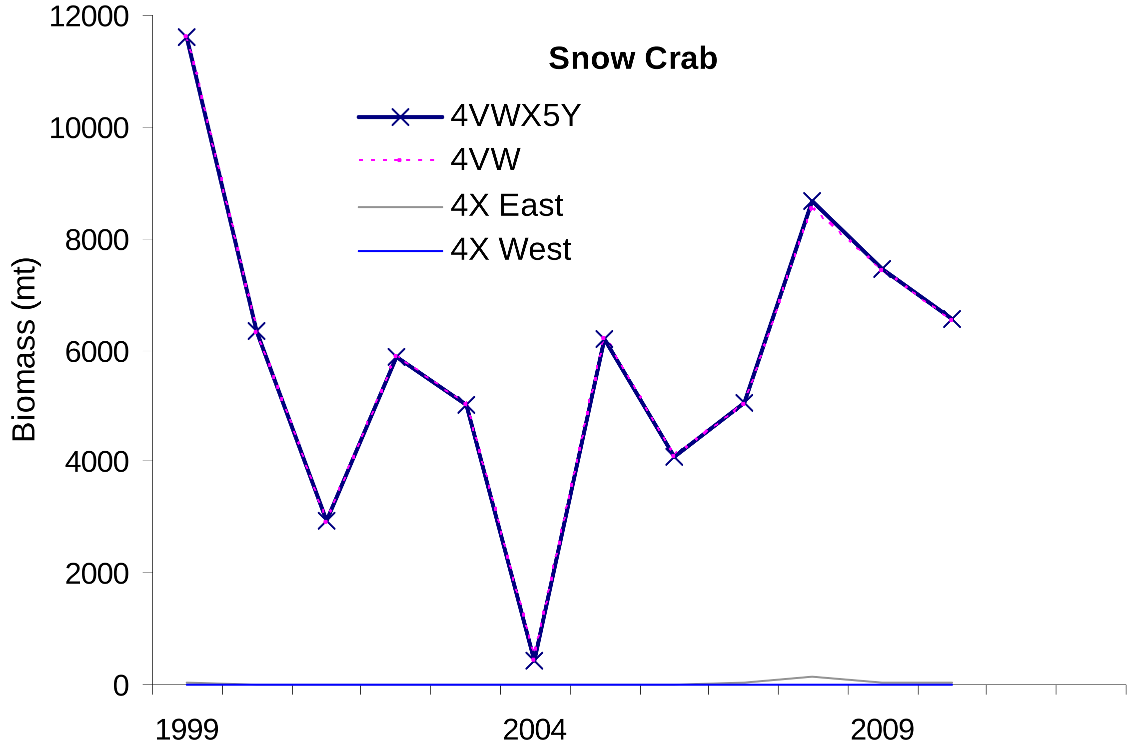


Figure 84. Biomass estimate for snow crab in 4VWX5Y from the summer RV survey.

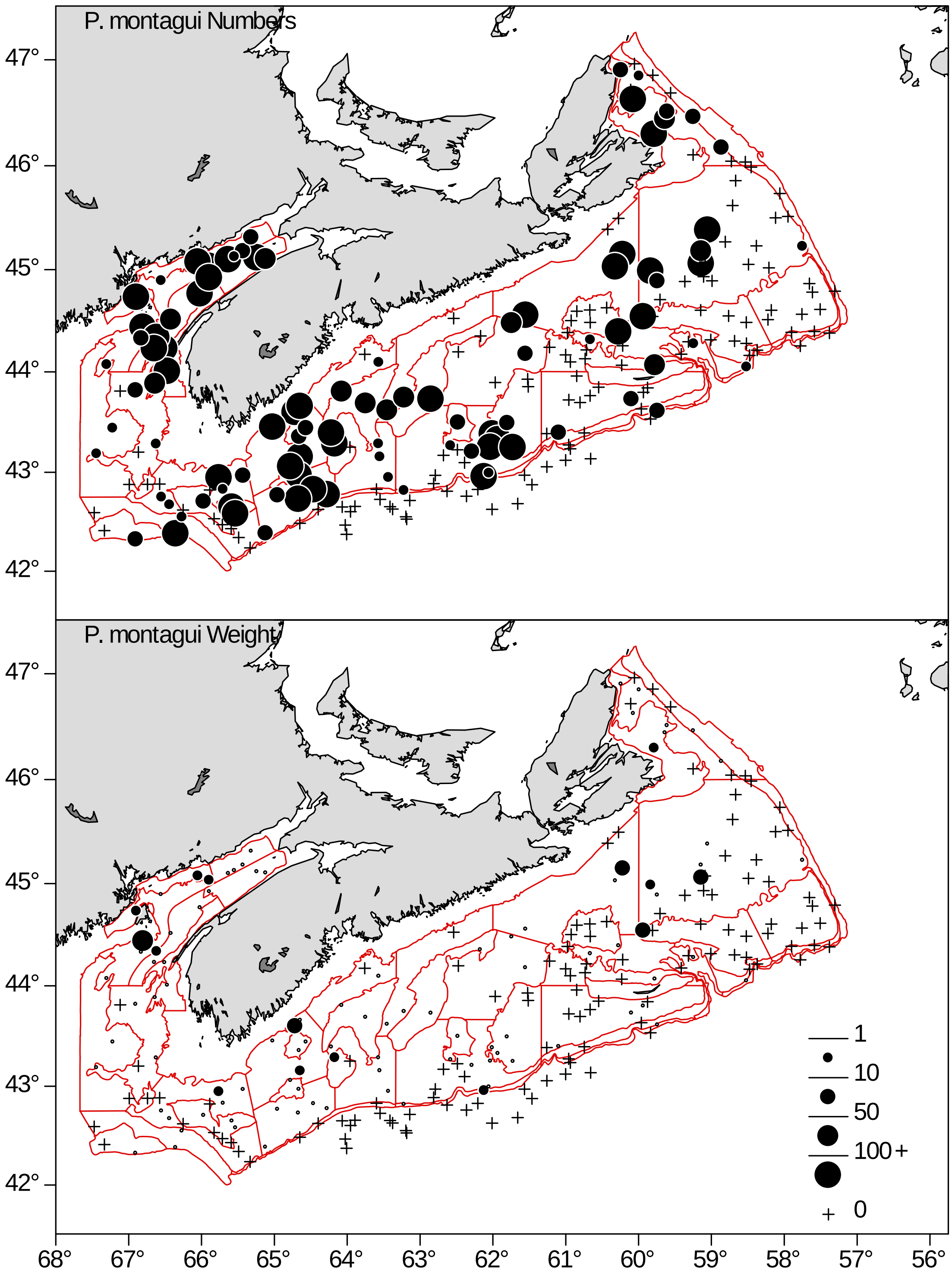


Figure 85. Distribution of pink shrimp catches during the 2010 summer RV survey (scale represents both weight (kg) and numbers).

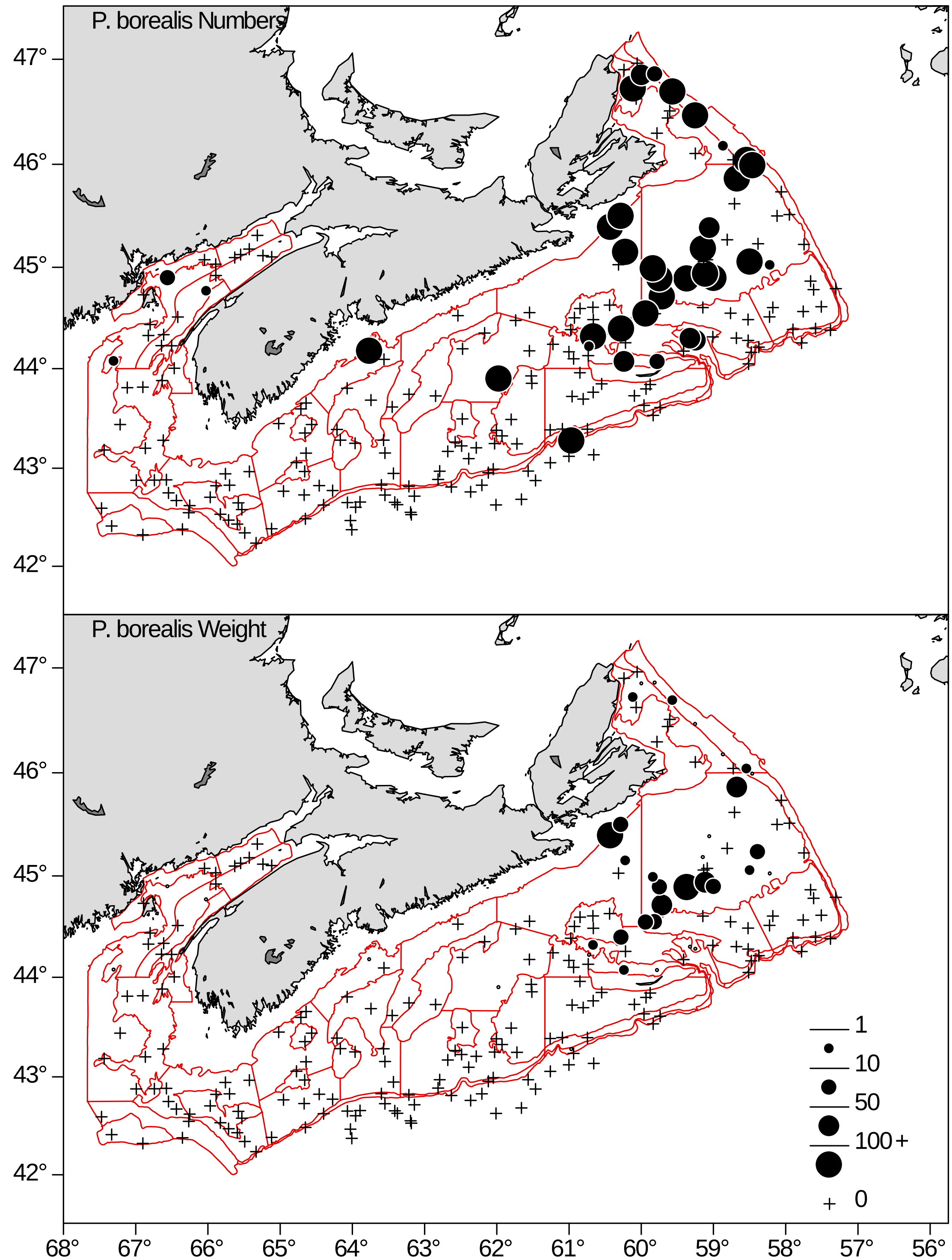


Figure 86. Distribution of northern shrimp catches during the 2010 summer RV survey (scale represents both weight (kg) and numbers).

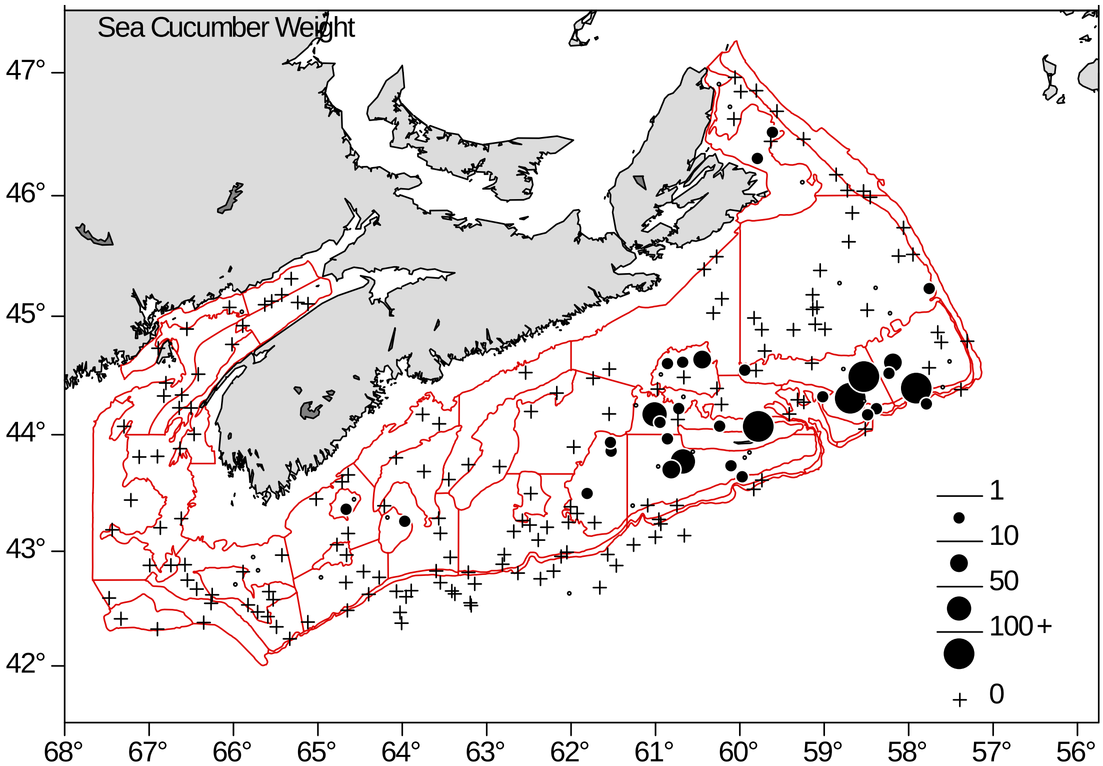


Figure 87. Distribution of sea cucumber (*Cucumaria frondosa*) catches during the 2010 summer RV survey (scale represents weight in kg).

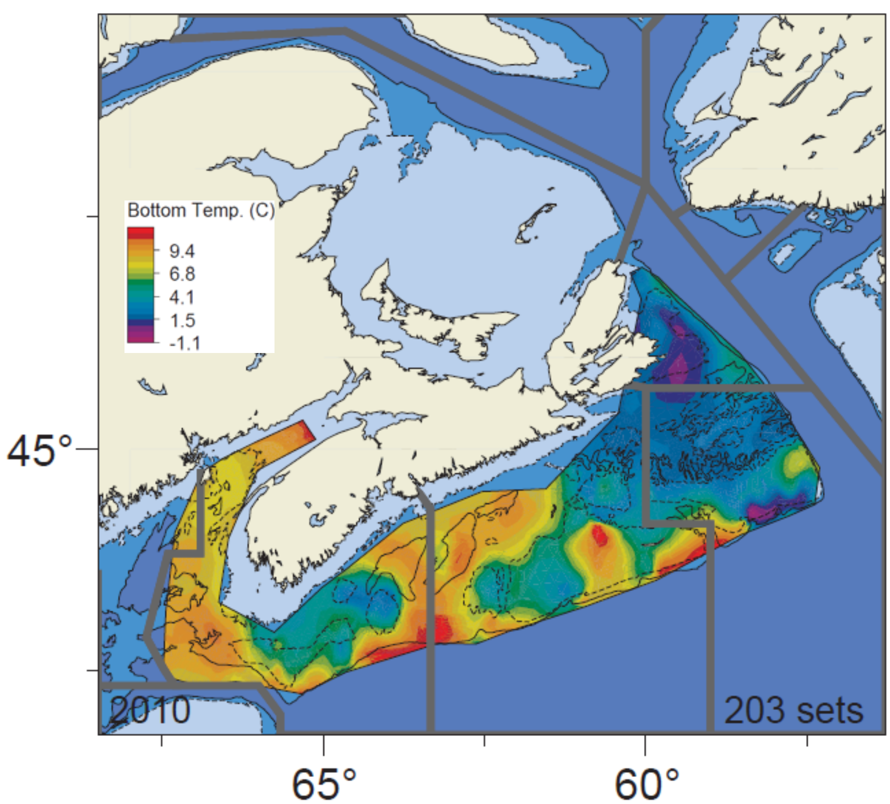


Figure 88. Bottom temperature distribution from the 2010 summer RV survey.

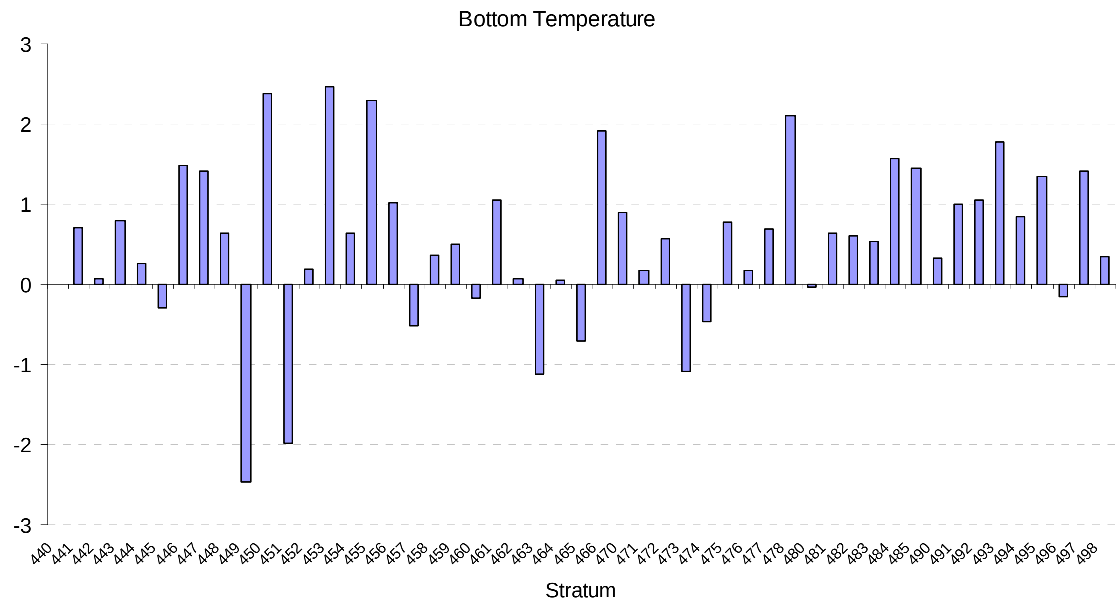


Figure 89. Bottom temperature anomaly plot from the 2010 summer RV survey.

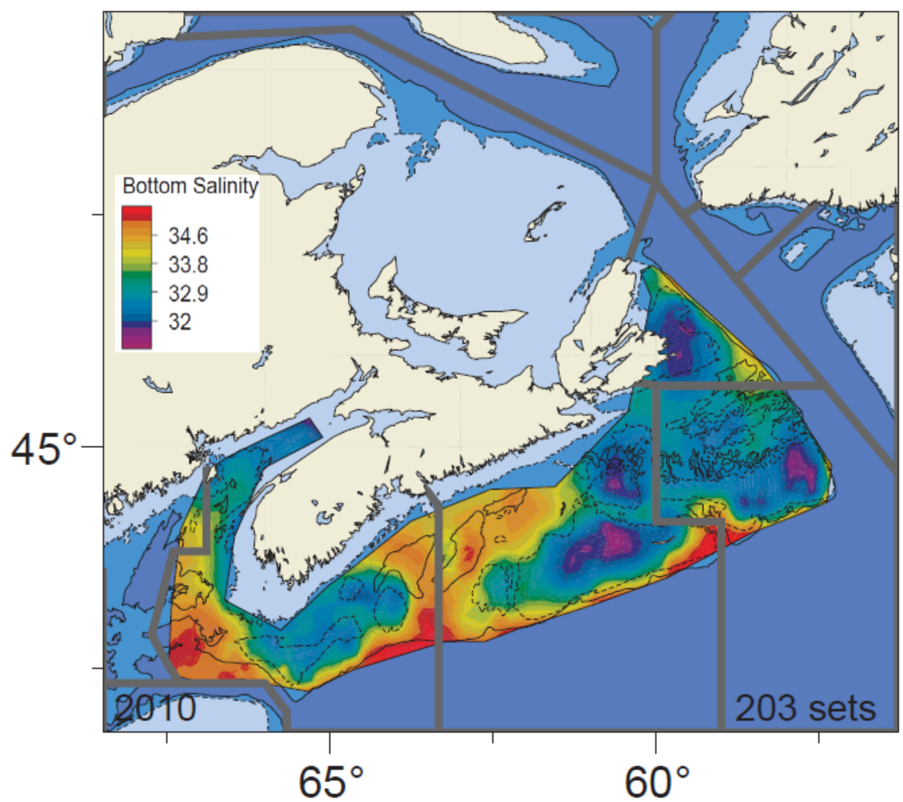


Figure 90. Bottom salinity distribution from the 2010 summer RV survey.

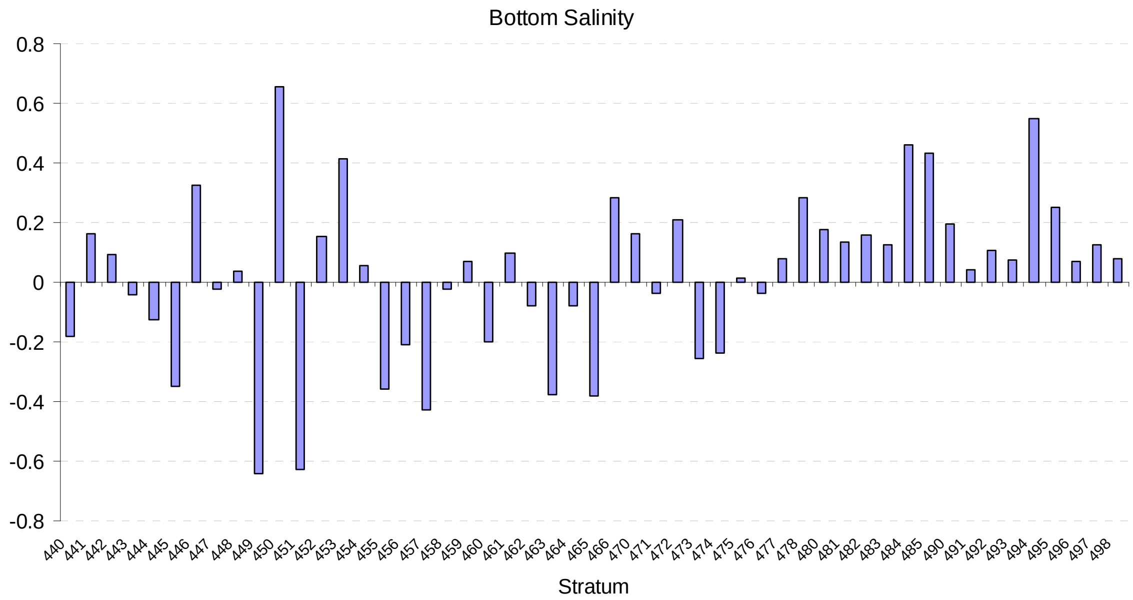
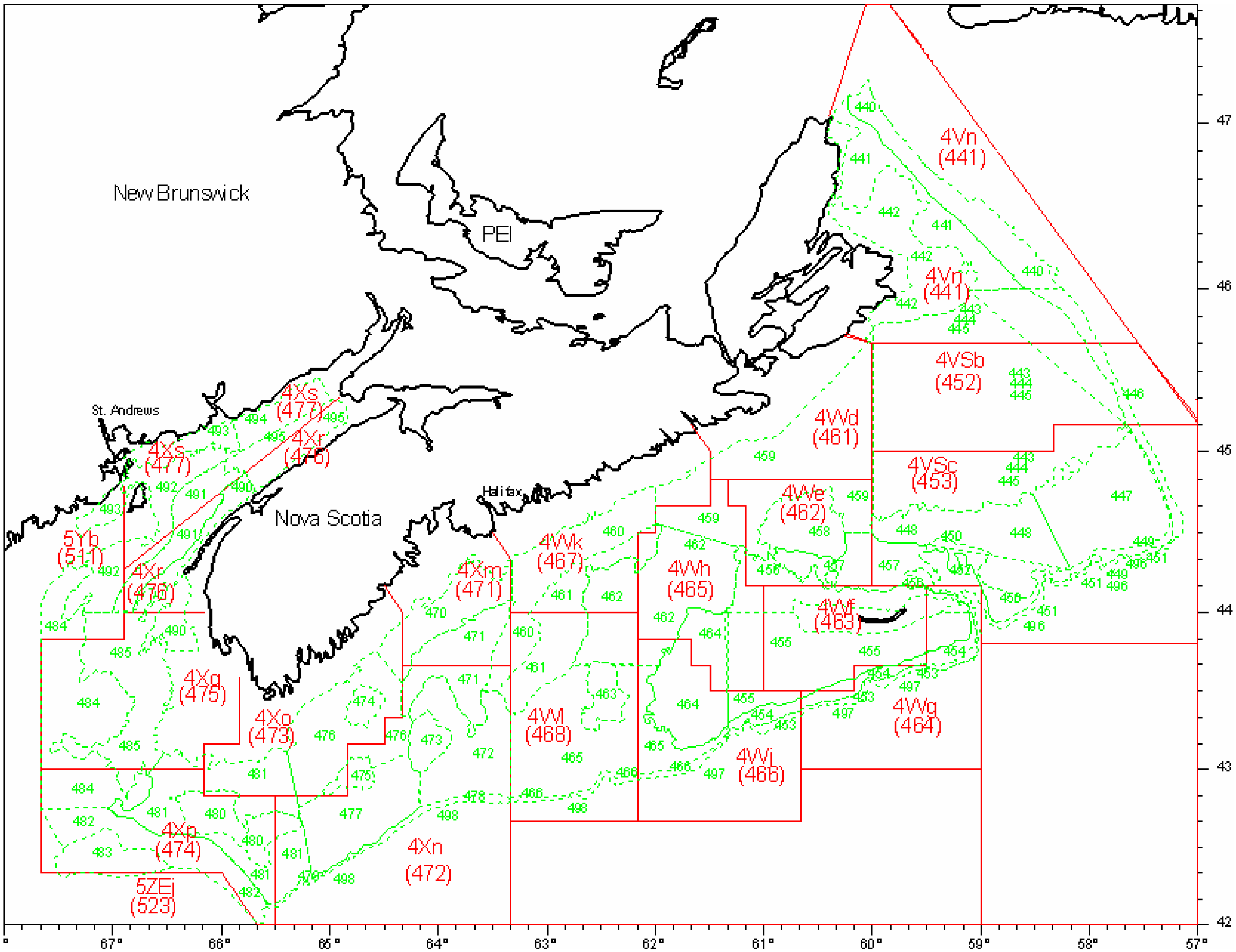


Figure 91. Bottom salinity anomaly plot from the 2010 summer RV survey.

Appendix A. NAFO divisions 4VWX5Y and subunits (red) and DFO summer Scotian Shelf and Bay of Fundy Research Vessel Survey Strata (green).



Appendix B. Some common fishing areas on the Scotian Shelf and Bay of Fundy.