



MARITIMES RESEARCH VESSEL SURVEY TRENDS ON THE SCOTIAN SHELF AND BAY OF FUNDY FOR 2022

Context

Fisheries and Oceans Canada (DFO) has conducted Summer Research Vessel (RV) surveys in the Maritimes Region, Northwest Atlantic Fisheries Organization (NAFO) Divisions 4VWX5Yb, using a standardized protocol since 1970 (Figure 1). Results of these surveys provide information on trends in abundance for most groundfish species in the Maritimes Region. 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. DFO Resource Management requested a review of the DFO Summer RV Survey information on the following list of fish stocks: 4Vn, 4VsW, and 4X5Y Atlantic Cod; 4VW and 4X5Y Haddock; 4X and 4VW White Hake; 4VWX Silver Hake; 4VWX+5 Pollock; Unit II and Unit III Redfish; 3NOPs4VWX5Zc Atlantic Halibut; 4VW and 4X American Plaice; 4VW and 4X Witch Flounder; 4VW and 4X Winter Flounder; 4VW and 4X Yellowtail Founder; 4VW and 4X Smooth Skate; 4VW and 4X Thorny Skate; 4VW and 4X Barndoor Skate; 4VW and 4X Winter Skate; 4VW and 4X Little Skate; 4VW and 4X Atlantic Wolffish; 4VW and 4X Monkfish; 4VW and 4X Longhorn Sculpin; 4VWX Spiny Dogfish; 4X and 4VW Red Hake; 4X and 4VW Sea Raven; 4X and 4VW Ocean Pout; and 4VWX Blackbelly Rosefish. In addition, biomass trends relative to the Scotia Fundy Groundfish Advisory Committee (SFGAC) accepted biomass reference points were requested for White Hake (biomass for lengths > 41 cm in 4X). The survey information will be used by DFO Resource Management as background for discussions with various stakeholders on recommendations for management measures and to determine which stocks should be reviewed in more detail in 2023.

In addition, a review of available survey information was undertaken for a suite of species, including Black Sea Bass, Dusky Shark, Triggerfish, John Dory, and Tilefish. These species are being captured as bycatch in commercial fishing operations but are not covered under any license conditions and cannot be landed.

This Science Response Report results from the regional peer review of December 6–7, 2022, on the Update of Maritimes Research Vessel Survey Trends on the Scotian Shelf and Bay of Fundy.

Background

The DFO Summer RV Survey of the Scotian Shelf and Bay of Fundy has been conducted annually since 1970. The survey follows a stratified random sampling design and includes sampling of fish and invertebrates using a bottom otter trawl, along with physical oceanographic and plankton sampling. These surveys are the primary data source for monitoring trends in species distribution, abundance, and biological condition within the region.

There were changes to the net used and the vessel conducting the survey in 1982 and 1983, along with some changes in data collection protocols. While the vessel change in 1983 would

not be expected to strongly influence catches, the change in trawl in 1982 should impact catch. The Yankee 36 trawl used from 1970–1982 had a slightly narrower wingspread and a lower headline and smaller footgear than the Western Ila (W Ila). These differences in trawl configuration would be expected to lead to higher catches of fish that disperse up into the water column with the W Ila, but also lower catches for the W Ila of fish that are strongly associated with the substrate or whose escape response when frightened is to hide on the sea floor. Conversion factors were calculated for only a limited number of commercial species. Conversion factors calculated by Fanning (1985) range from about 0.8 for American Plaice, Yellowtail Flounder, Witch Flounder, and Winter Flounder, to 1.2 for Haddock, and over 2 for Silver Hake. For most other species, no conversion factor has been calculated for the change in trawl. For species that have no conversion factor, abundance indices for the period 1970–1981 may not be directly comparable to those from subsequent years. For long-term averages, the most appropriate starting point has been selected for each species (for details see Clark and Emberley 2011).

The bottom trawl surveys were designed to provide abundance trends for fish and invertebrates between depths of about 30 m to 400 m. Survey indices are expected to be proportional to abundance for most species.

Strata boundaries are shown in Figure 2 for the NAFO Area 4VWX5. From 1970–1995, sampling was generally restricted to strata 440–495. Spatial coverage was extended to the Scotian Shelf slope (strata 496–498) in 1996 and the Fundian Channel (5Z9) in 2011. The sampled area expanded to include strata 558 and 559 in 2015 and 5Z2 in 2016 and now regularly includes all offshore waters of the Maritimes Region down to a depth of 750 m.

Catch distribution plots for the entire DFO Summer RV Survey area are provided for a suite of species that are commonly caught in the 4VWX groundfish fishery. Biomass index trends are shown for the area appropriate for each stock. Comparisons of 2020 and 2022 length frequencies from the survey catch to the long-term mean (from beginning of survey series, or the period deemed appropriate for that particular species, to 2019) are also included, using data from the geographic areas that are used in assessments for those stocks.

All strata from 440–495 have had some sampling annually since 1970 with the exception of 2018, 2021 and 2022. In all three years, sampling was conducted in all standard strata in 4X5Yb, as well as 5Zc in 2021 and 2022, but the majority of the survey area, including all of 4V and most of 4W were not sampled due mostly to mechanical problems with vessels. Of the 280 stations selected for sampling in 2018, 2021 and 2022, only 85, 107 and 153 successful tows were completed, respectively.

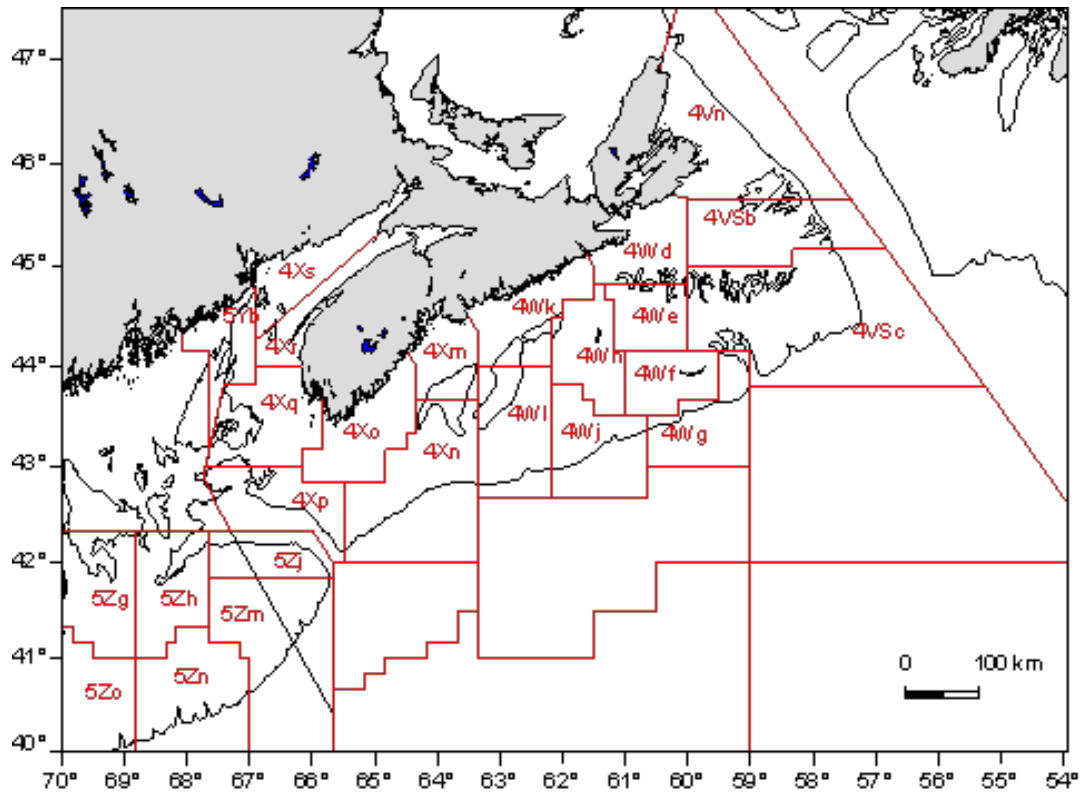


Figure 1. Northwest Atlantic Fisheries Organization (NAFO) Divisions and subareas.

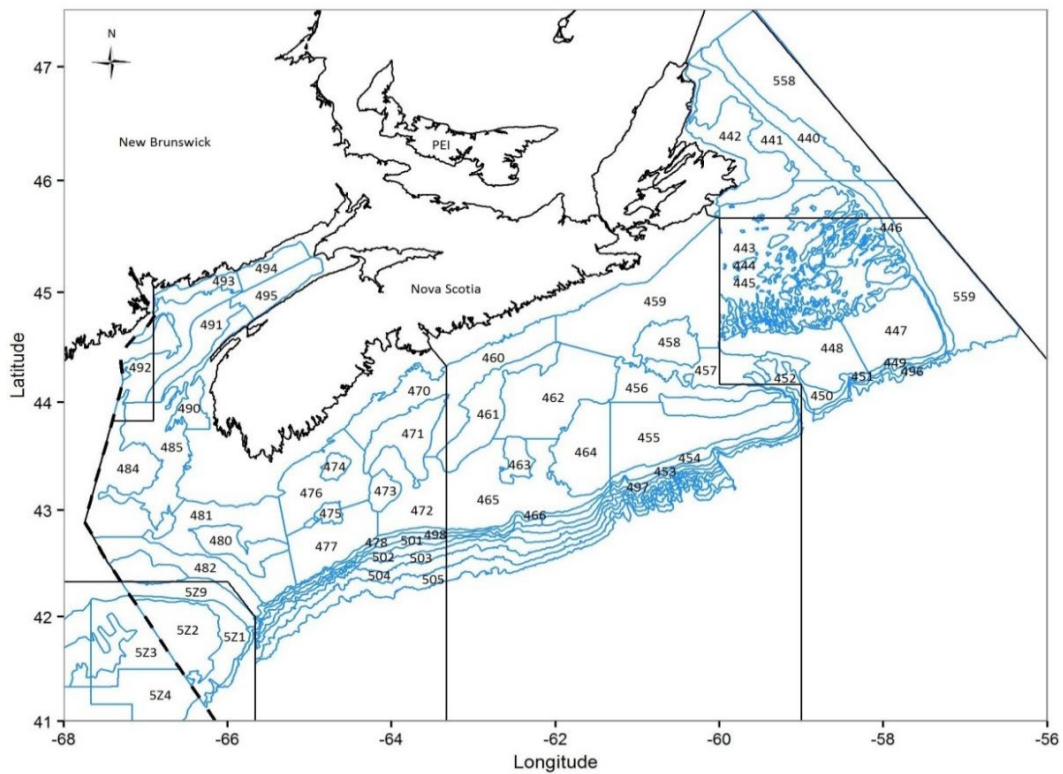


Figure 2. Fisheries and Oceans Canada DFO Summer Research Vessel Survey strata.

Analysis

The stratified random survey design ensures that sampling takes place throughout the range covered by the survey. The strata were originally selected to represent different depths and habitats. Sampling occurs at randomly selected stations within all strata. The data are averaged within each stratum, weighted by stratum area, and then summed over all appropriate strata for each stock. While this ensures that sampling is representative of the entire area, low sampling intensity means that there is high variability, particularly for stocks that are highly aggregated or that inhabit only a small part of the entire survey area; single data points in the biomass series should be interpreted with caution as large inter-annual changes could simply reflect variability in the data rather than changes in population abundance. Comparisons between the long-term and short-term averages may be more useful for representing the relative status of the population. Large inter-annual changes could also reflect the appearance of a strong year-class or, conversely, the impact of a single large tow; thus, biomass indices should be interpreted with reference to the length-frequency data and the distribution of catches to see if these data aid interpretation.

In 2022, 153 successful fishing tows were completed by the CCGS *Te/eost* out of 280 planned between July 7 and August 6. This is the third lowest number of valid tows in the last decade, better only than 2018 and 2021, when lost vessel time meant that less than half the area was covered, as was the case in 2022. All of 4V and most of 4W received no survey coverage in 2022 as these were the last areas planned to be covered during the survey. At least two sets were completed in each stratum from 460–495 and in 5Z1, 5Z2, 5Z9. No sets were completed in strata 440–459, 496–498, 558–559. Low sampling intensity will increase variability in the indices and also reduce the chances that rare species will be encountered.

Biomass indices for each stock are calculated using the set of strata which are included in calculating indices for the stock assessment. As no assessments have integrated data from strata added since 1996, these data are not included in time series trends. For some stocks, where these deeper water strata, or strata from Georges Bank, appear to be important parts of the stock distribution, the potential contribution to biomass indices of these strata has been discussed.

The time series of survey biomass indices and the three-year (3-yr) running geometric mean (GM) are compared to 40% and 80% of the long-term geometric mean to provide context for biomass levels. The geometric mean was selected for these comparisons to reduce the impact of very high values observed in some years. The values are presented in Table 1.

Maritimes Region

**Science Response: Maritimes Region RV
Scotian Shelf and Bay of Fundy Survey Trends**

Table 1. DFO Summer Research Vessel Survey biomass indices (tonnes) for species by stock/region for 2019, 2020, 2022, current 3-yr geometric mean (GM) biomass index (2019, 2020, 2022), and 40% and 80% of the long-term GM biomass index (1970–2020). 2021 biomass indices are not included as conversion factors were not yet available

Stock/Region	2019	2020	2022	Current 3-yr GM	40% Long-term GM	80% Long-term GM
4X Atlantic Cod	1,443	1,669	1,335	1,476	5,070	10,140
4X Haddock	28,081	32,942	35,906	32,145	19,436	38,873
4X White Hake	7,811	6,771	6,348	6,950	5,482	10,964
4X West Silver Hake *	4,138	14,379	39,406	13,285	1,396	2,791
Western Component Pollock	8,990	9,311	5,034	7,497	7,655	15,310
4X American Plaice	217	341	294	279	555	1,111
4X Witch Flounder	1,797	1,270	525	1,062	593	1,187
4X Yellowtail Flounder	78	155	63	92	170	340
4X Winter Flounder	3,983	4,608	3,499	4,005	1,056	2,113
4X Atlantic Wolffish	335	320	226	289	400	800
4X Monkfish	1,110	1,495	1,033	1,197	618	1,236
4X Smooth Skate	273	326	292	296	143	286
4X Thorny Skate	287	162	69	147	657	1,314
4X Barndoor Skate	1,651	1,515	3,536	2,068	32	63
4X Winter Skate	401	1,456	699	742	302	605
4X Little Skate	1,362	1,455	2,009	1,585	196	392
4X Longhorn Sculpin	1,023	1,012	1,035	1,023	501	1,002
4X Red Hake *	2,046	1,784	7,333	2,991	508	1,016
4X Ocean Pout	89	21	49	45	158	316
4X Sea Raven	673	1,471	1,364	1,105	659	1,318

*For Silver Hake and Red Hake, the long-term average is 1982–2020

The time series of abundance-at-length indices are compared with long-term (full time series) and short-term (ten years) median values to provide context on population length composition for each stock.

For some species, including Silver Hake and Haddock, modes are apparent in the length-frequency data at smaller sizes that are comprised primarily of individual year-classes, providing information on relative abundance of pre-recruit ages.

For all stocks in 4X5Yb, short and long-term GM values include data up to 2020 and 3-yr GM values are calculated using data from 2019, 2020 and 2022. Data for 2021 were collected on the new Offshore Fishing Science Vessel, CCGS *Capt. Jacques Cartier*, and using new trawl gear termed the Northwest Atlantic Ecosystem Survey Trawl (NEST). Conversion factors for this change in vessel and gear are not yet available, thus, data cannot be compared to the historical time series. Length-based conversion factors for many fish and invertebrate species will be calculated upon completion of comparative fishing in the summer of 2023.

Biomass and abundance indices could not be updated for stocks that extend into 4VW given the lack of survey coverage in this area since 2020.

Of note in the data, particularly for Cod and Haddock, is the increased abundance of young-of-the-year fish (Age 0) in recent years. The short-term median length frequency shows a strong mode at < 10 cm for both Cod and Haddock. This likely reflects earlier spawning and, thus, these fish, that in the past would have still been in the pelagic phase in July, are available to the July survey in recent years.

Maritimes Region

The total biomass index for 4X shows high inter-annual variability but no clear trend over time (Figure 3a). The large drop in biomass from 2018–2019 reflects lower catches for most demersal species. The increase in biomass for 2022 is largely reflective of higher than average catches of Silver Hake, representing 49% of the total demersal biomass.

In 4W, demersal fish biomass increased in the 1980s, but, in the early 1990s, dropped back to the level seen in the 1970s (Figure 3b). The biomass for 2020 is lower than in 2019, largely due to lower Haddock and Spiny Dogfish catches in the area.

In 4V, the demersal fish biomass dropped in the 1990s and has remained low since then (Figure 3c). Although the area has seen larger catches of Cod this year, the biomass for 4V is lower than in 2019, largely due to lower catches of Haddock, Silver Hake, and redfish.

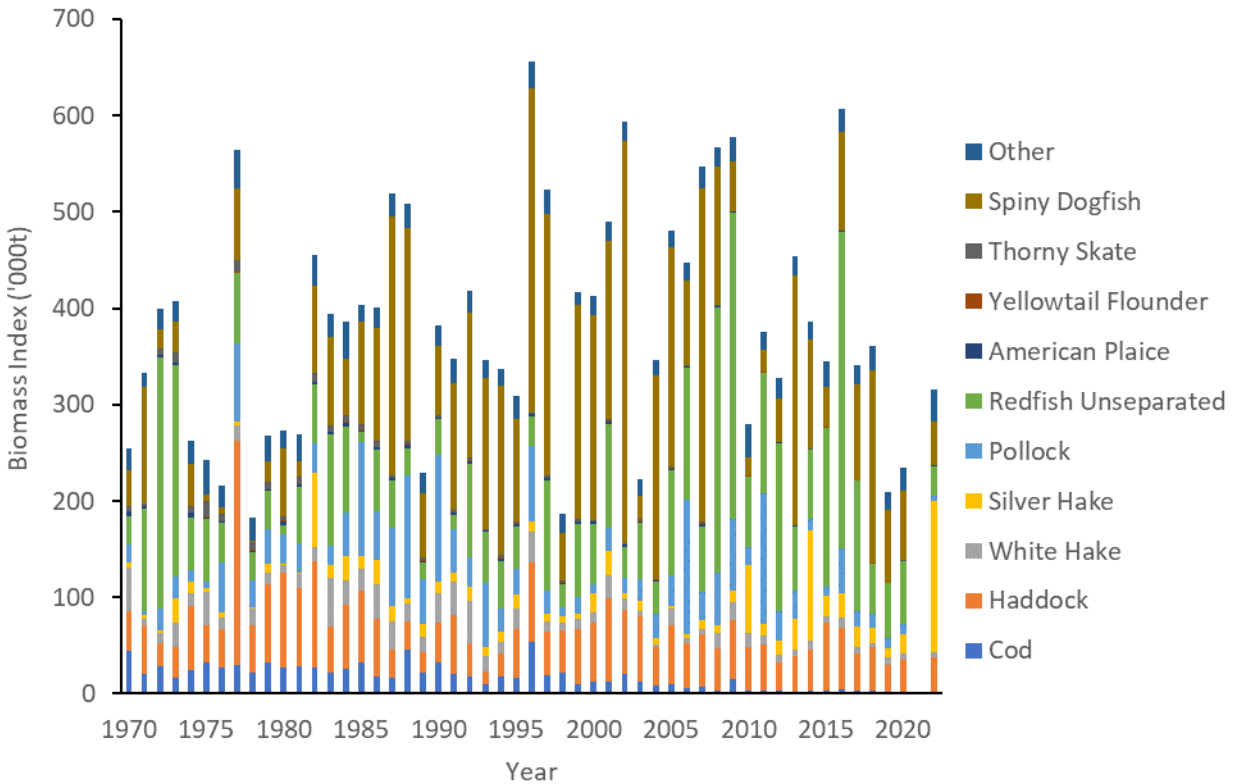


Figure 3a. Biomass indices for the top ten demersal fish species (bars) in 4X and for all other demersal fish species combined. Refer to Figure 1 for NAFO Divisions within the Maritimes Region.

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Maritimes Region

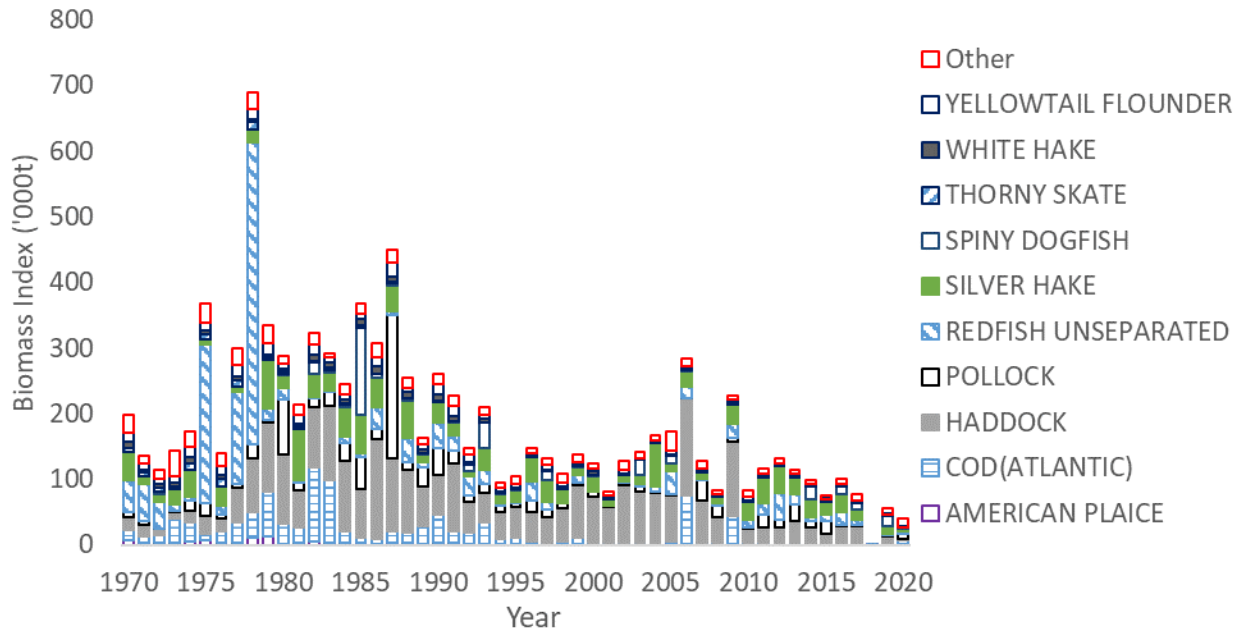


Figure 3b. Biomass indices for the top ten demersal fish species (bars) in 4W and for all other demersal fish species combined. Refer to Figure 1 for NAFO Divisions within the Maritimes Region.

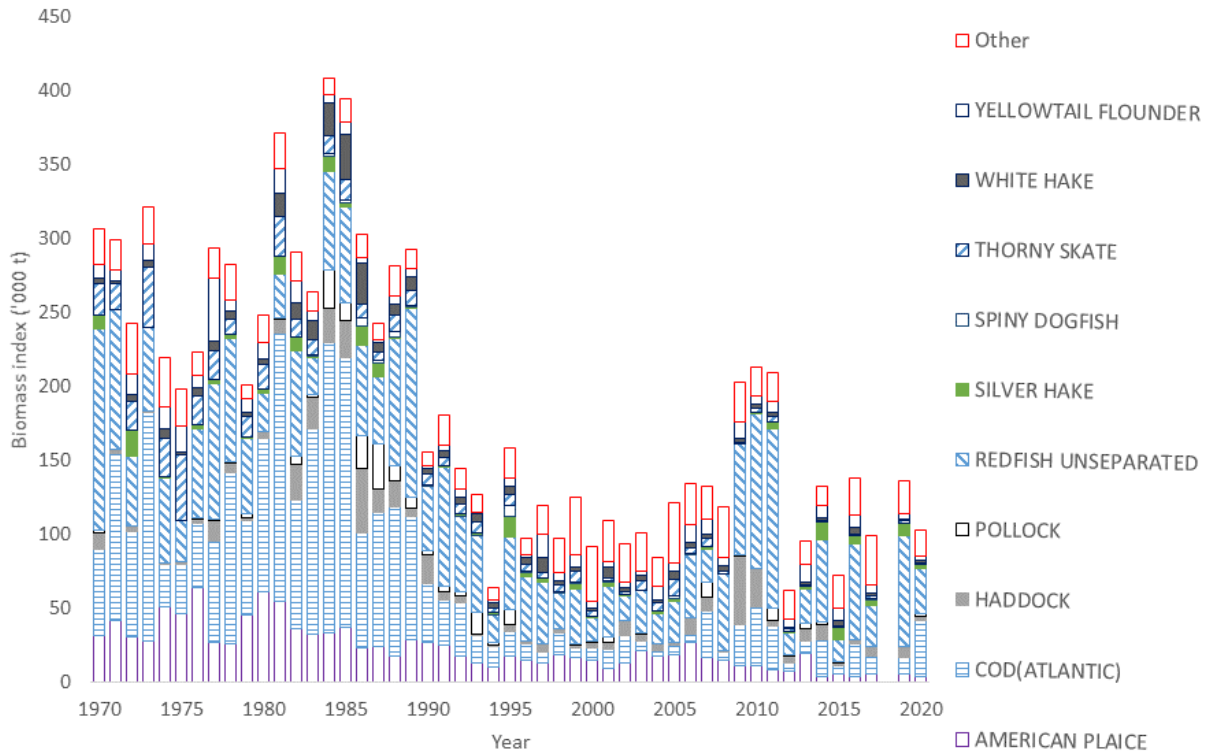


Figure 3c. Biomass indices for the top ten demersal fish species (bars) in 4V and for all other demersal fish species combined. Refer to Figure 1 for NAFO divisions within the Maritimes Region.

In 4X, Spiny Dogfish, Redfish, and Haddock have made up the bulk of the demersal fish biomass index throughout the time series (Figure 3a). While Cod and Thorny Skate have clearly declined over time, their combined biomass did not represent a large part of the total (12% in the 1970s). These declines are balanced by increases for other species, so, there has been no general decline in demersal fish biomass over time.

In 4W, increases in Atlantic Cod, Haddock, and Redfish led to the increase in biomass in the 1980s (Figure 3b). Biomass indices for Atlantic Cod and Redfish dropped to very low levels in 4W by the 1990s and were responsible for most of the overall decline in biomass. Haddock biomass has declined in 4W since about 2010, and total demersal fish biomass in recent years has been the lowest in the time series.

In 4V, Atlantic Cod and American Plaice comprised a large part of the biomass index in the 1970s and 1980s; both have experienced large declines (Figure 3c). Redfish did not experience the same drop in biomass and are the largest contributors to the 4V biomass indices in the last decade. While additional species, including Thorny Skate, White Hake, and Yellowtail Flounder, have also declined since the 1980s in 4V, there are no demersal fish species that have experienced a large increase in biomass over time, so the overall index has remained low since the early 1990s.

Atlantic Cod

The largest Atlantic Cod (*Gadus morhua*) catches came from Georges Bank in 2022, although no catches exceeded > 25 kg (Figure 4a). The 3-yr GM in 4X remains under 40% of the long-term GM for the 12th year in a row and is the lowest in the entire time series (Figure 4b). Abundance indices are generally below the short-term median for most lengths (Figure 4c).

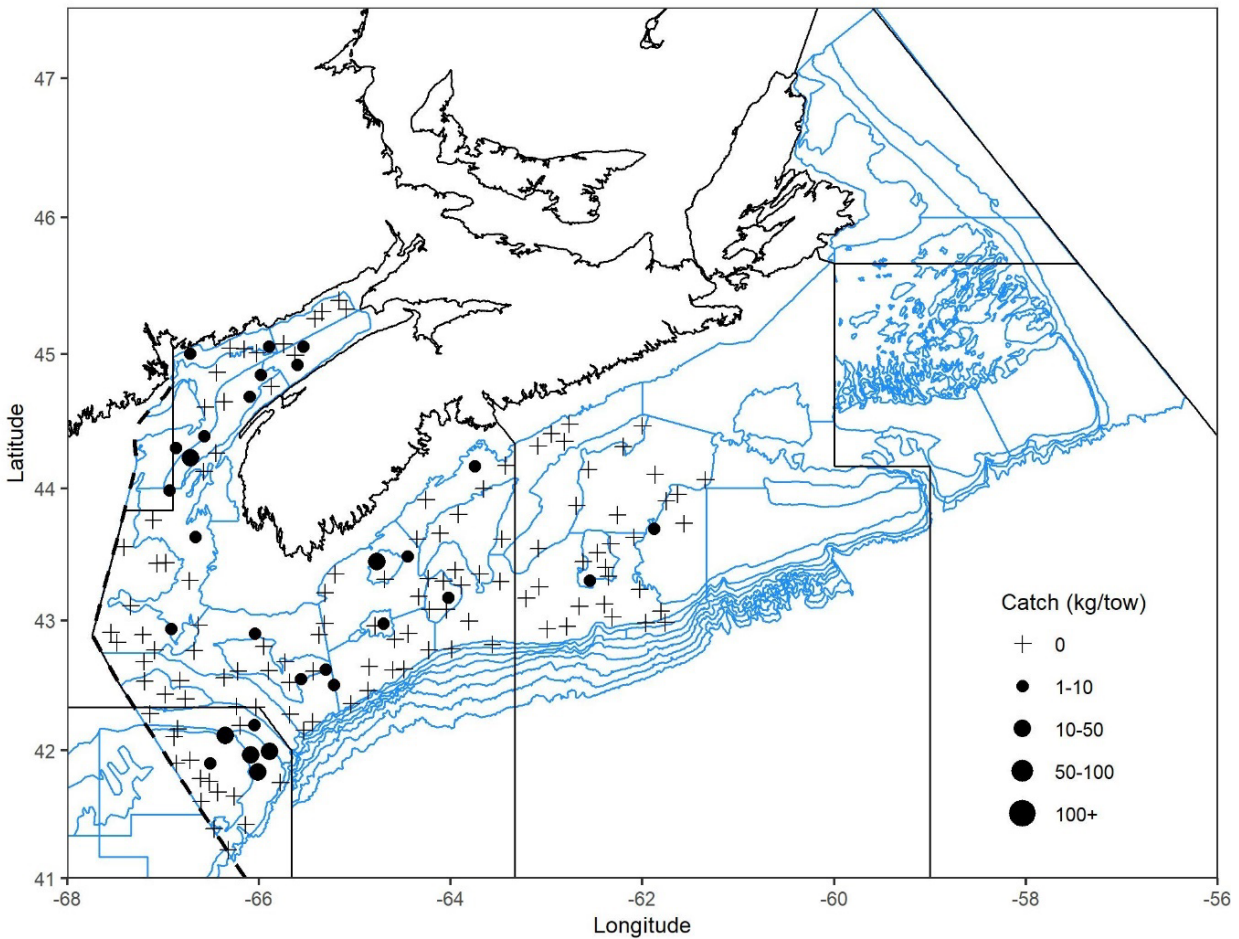


Figure 4a. Distribution of Atlantic Cod catches during the 2022 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

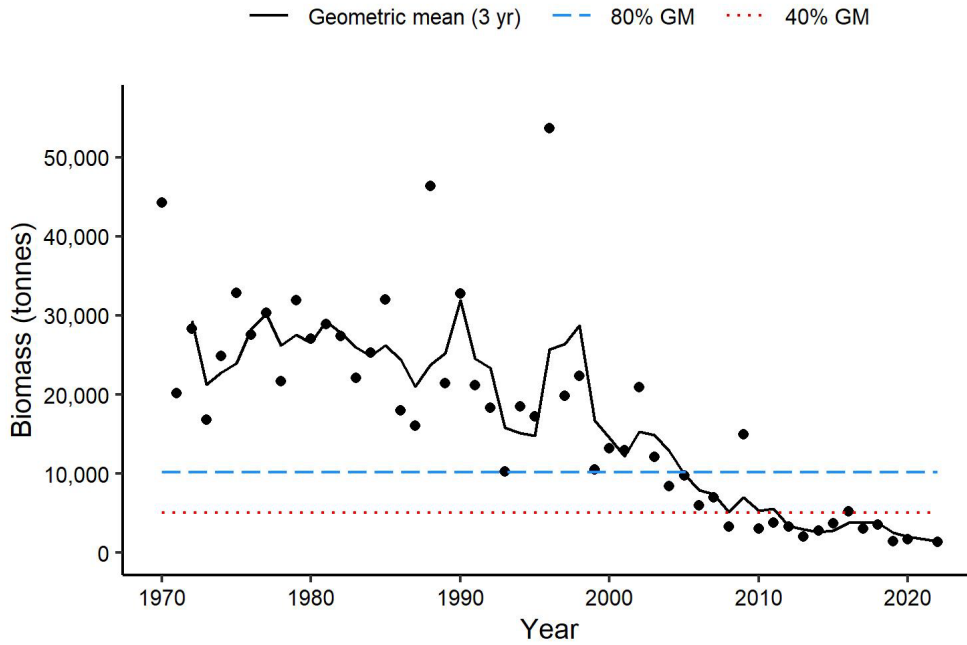


Figure 4b. Biomass index for Atlantic Cod in 4X from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2020), respectively. The black dots represent the biomass index for that year.

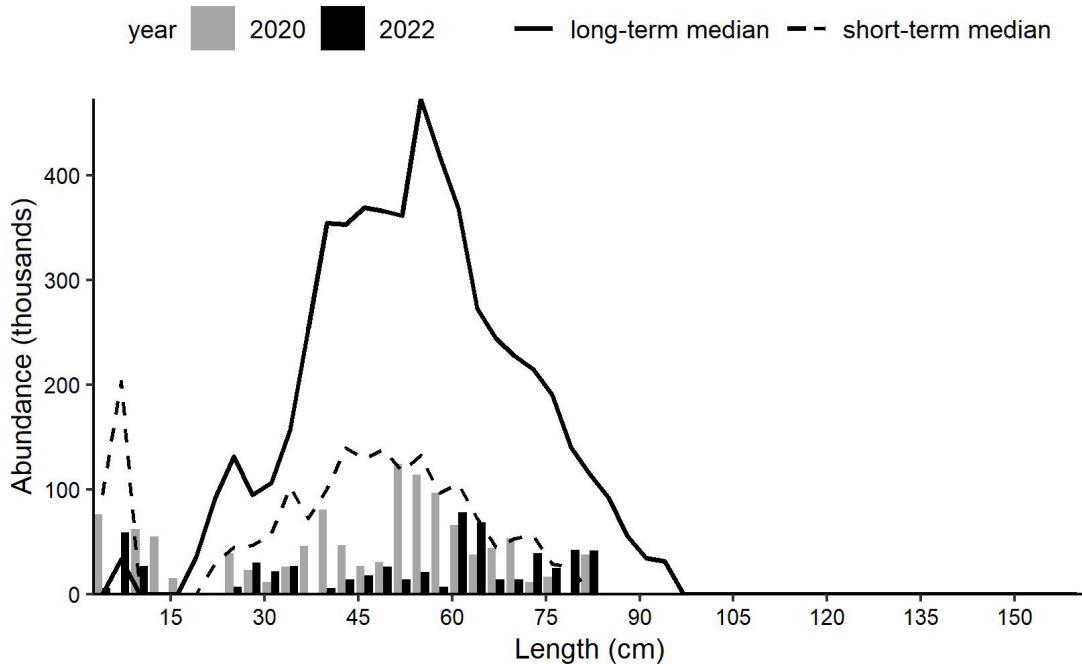


Figure 4c. Length frequency indices for Atlantic Cod in 4X from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2022 survey. Grey bars represent the number in thousands at length from the 2020 survey. The solid black line represents the median in thousands at length for the time period 1970–2019. The dashed black line represents the median in thousands at length for the time period 2010–2019.

Haddock

Haddock (*Melanogrammus aeglefinus*) were caught in most sets in 4X in 2022, with larger tows (> 100 kg) coming from Browns Bank and Georges Bank. The 3-yr GM remains between 40–80% of the long-term GM (Figure 5b). The numbers-at-length were generally at or below the short-term median with the exception of lengths 22–27 cm (Figure 5c). Abundance indices for fish < 15 cm are generally similar to the short-term median indicating an average recruitment of Age 0 and Age 1 Haddock.

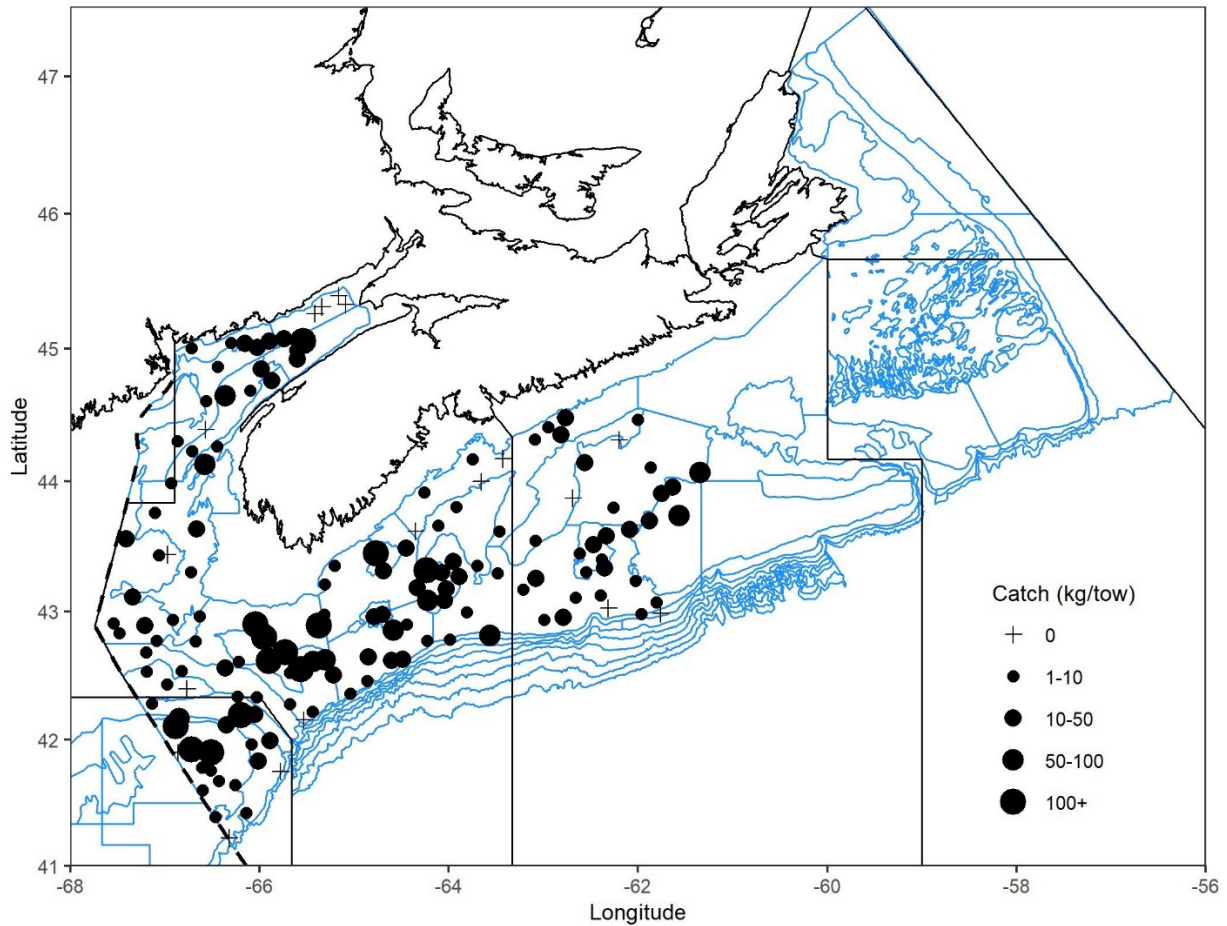


Figure 5a. Distribution of Haddock catches during the 2022 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

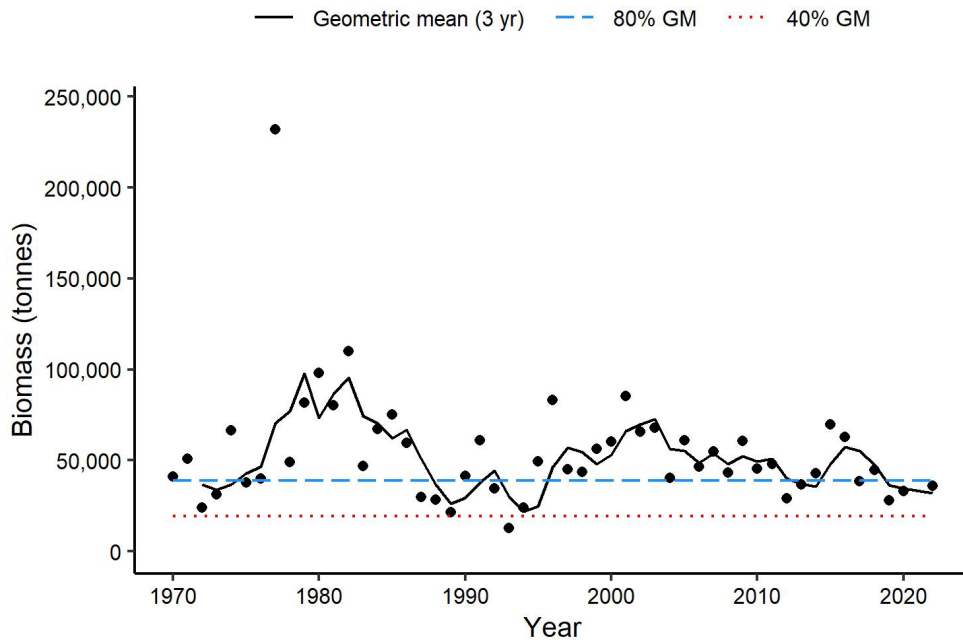


Figure 5b. Biomass index for Haddock in 4X from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2020), respectively. The black dots represent the biomass index for that year.

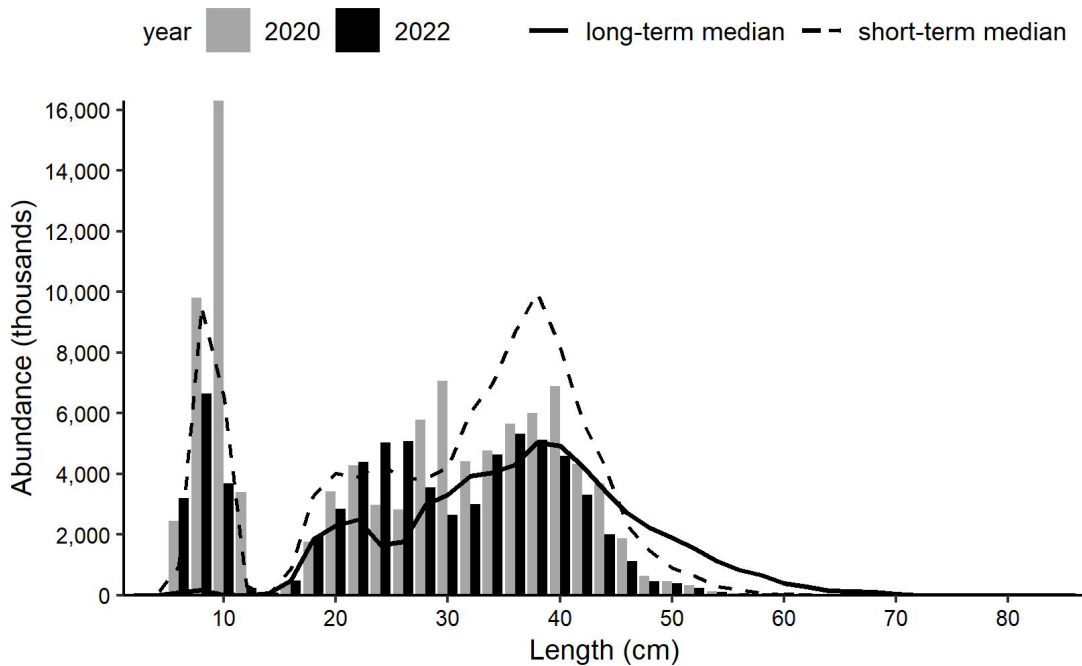


Figure 5c. Length frequency indices for Haddock in 4X from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2022 survey. Grey bars represent the number in thousands at length from the 2020 survey. The solid black line represents the median in thousands at length for the time period 1970–2019. The dashed black line represents the median in thousands at length for the time period 2010–2019.

White Hake

White Hake (*Urophycis tenuis*) were caught primarily in the deeper waters of the Fundian Channel and Gulf of Maine (Figure 6a). No sets with a catch of over 50 kg were recorded in 2022. In 4X, the 3-yr GM remained between 40–80% of the long-term GM (Figure 6b). Abundance indices were generally below the short- and long-term medians but above for several lengths > 69 cm, indicating that although the biomass indices remained low, the population includes some large, older fish (Figure 6c).

The 2015 Recovery Potential Assessment (RPA) (Guenette and Clark 2016) proposed a biomass recovery target of 6,867 t mature biomass (> 41 cm) in 4X5Z. The 3-yr GM biomass index for 4X White Hake > 41 cm remained below the biomass recovery target that was proposed in the RPA for the 7th year in a row (Figure 6d).

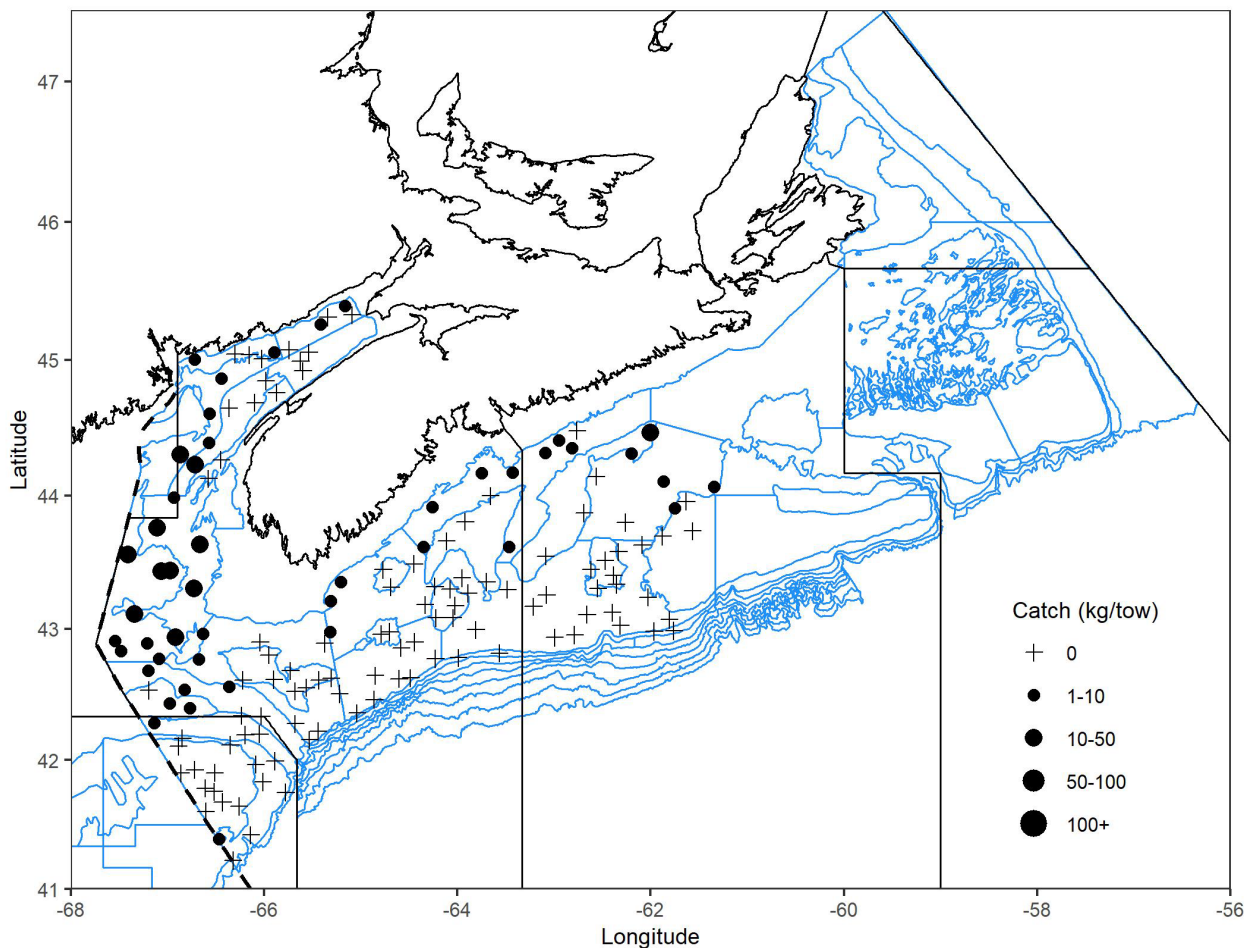


Figure 6a. Distribution of White Hake catches during the 2022 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

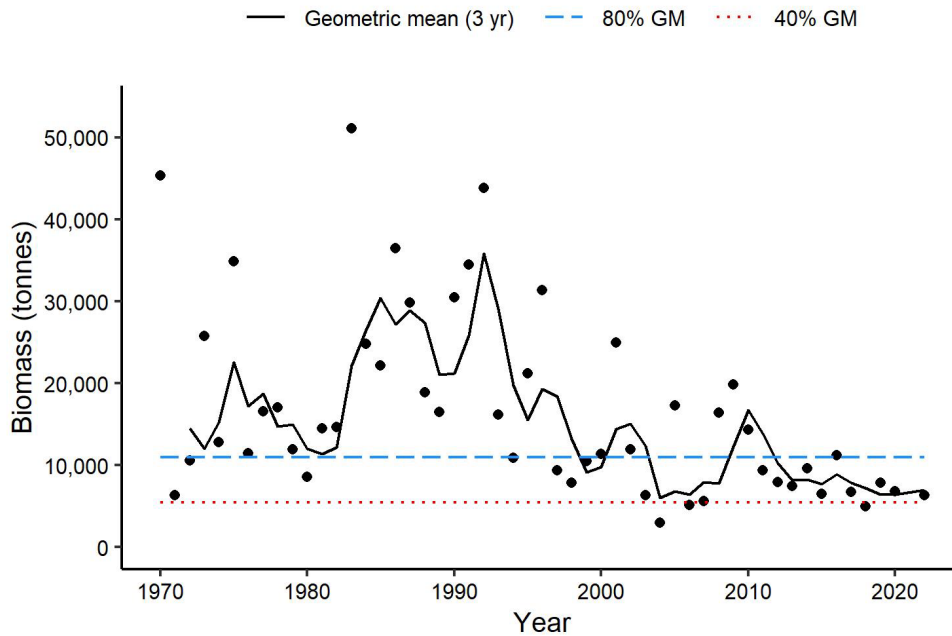


Figure 6b. Biomass index for White Hake in 4X from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2020), respectively. The black dots represent the biomass index for that year.

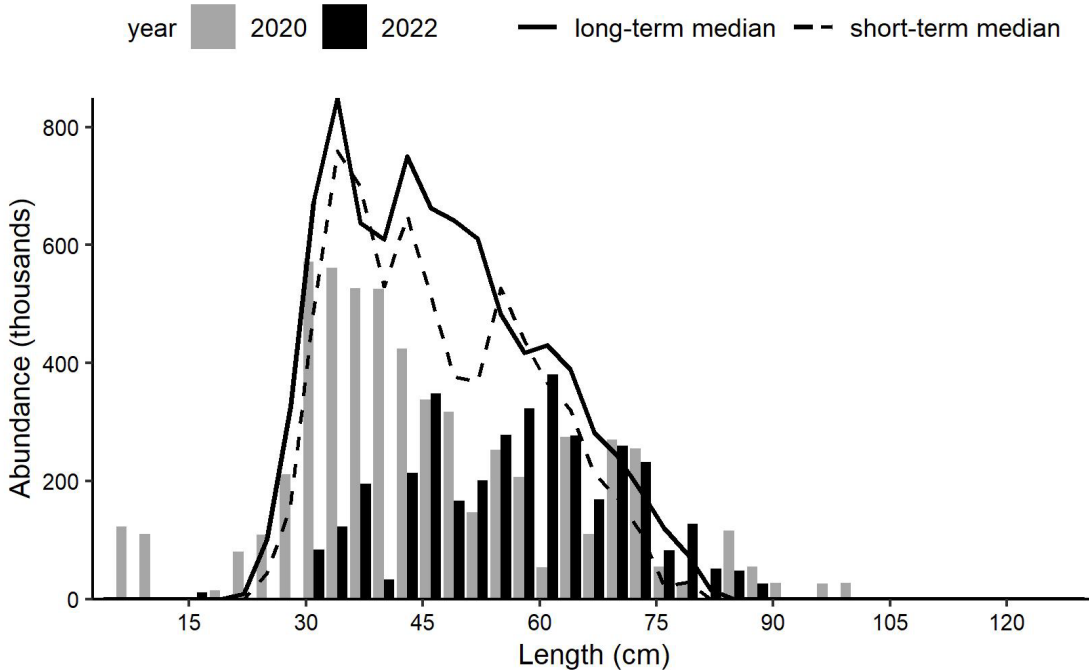


Figure 6c. Length frequency indices for White Hake in 4X from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2022 survey. Grey bars represent the number in thousands at length from the 2020 survey. The solid black line represents the median in thousands at length for the time period 1970–2019. The dashed black line represents the median in thousands at length for the time period 2010–2019.

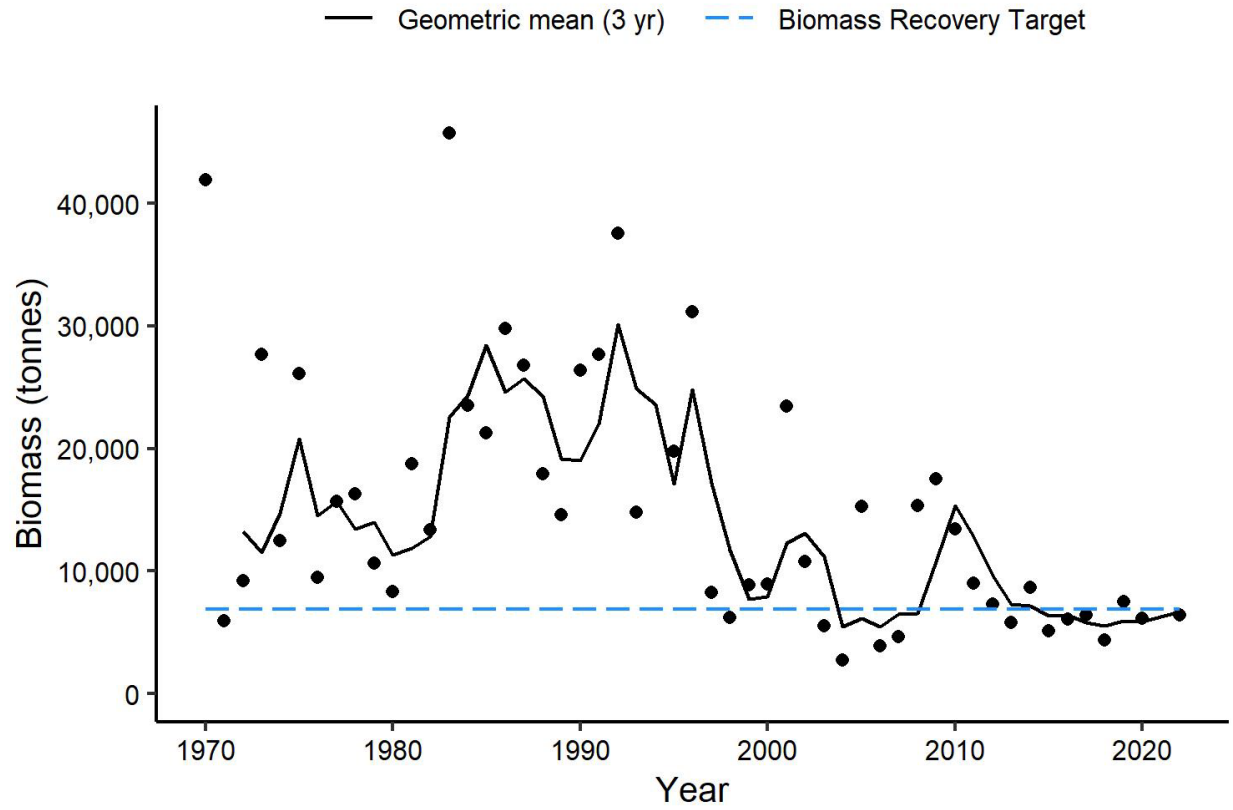


Figure 6d. Biomass index for 4X White Hake > 41 cm from the DFO Summer RV Survey represented by the black circles. The solid black line represents the three-year geometric mean. The dashed blue line represents the biomass recovery target (6,867 t).

Silver Hake

Silver Hake (*Merluccius bilinearis*) were caught throughout most of the survey area covered in 2022, with the largest catches in the Bay of Fundy (Figure 7a). The 3-yr GM in the Bay of Fundy (4X west) was well above 80% of the long-term GM in 2022 and the biomass index was the third highest in the time series (Figure 7b). Indices at lengths > 17 cm were above the short- and long-term medians (Figure 7c).

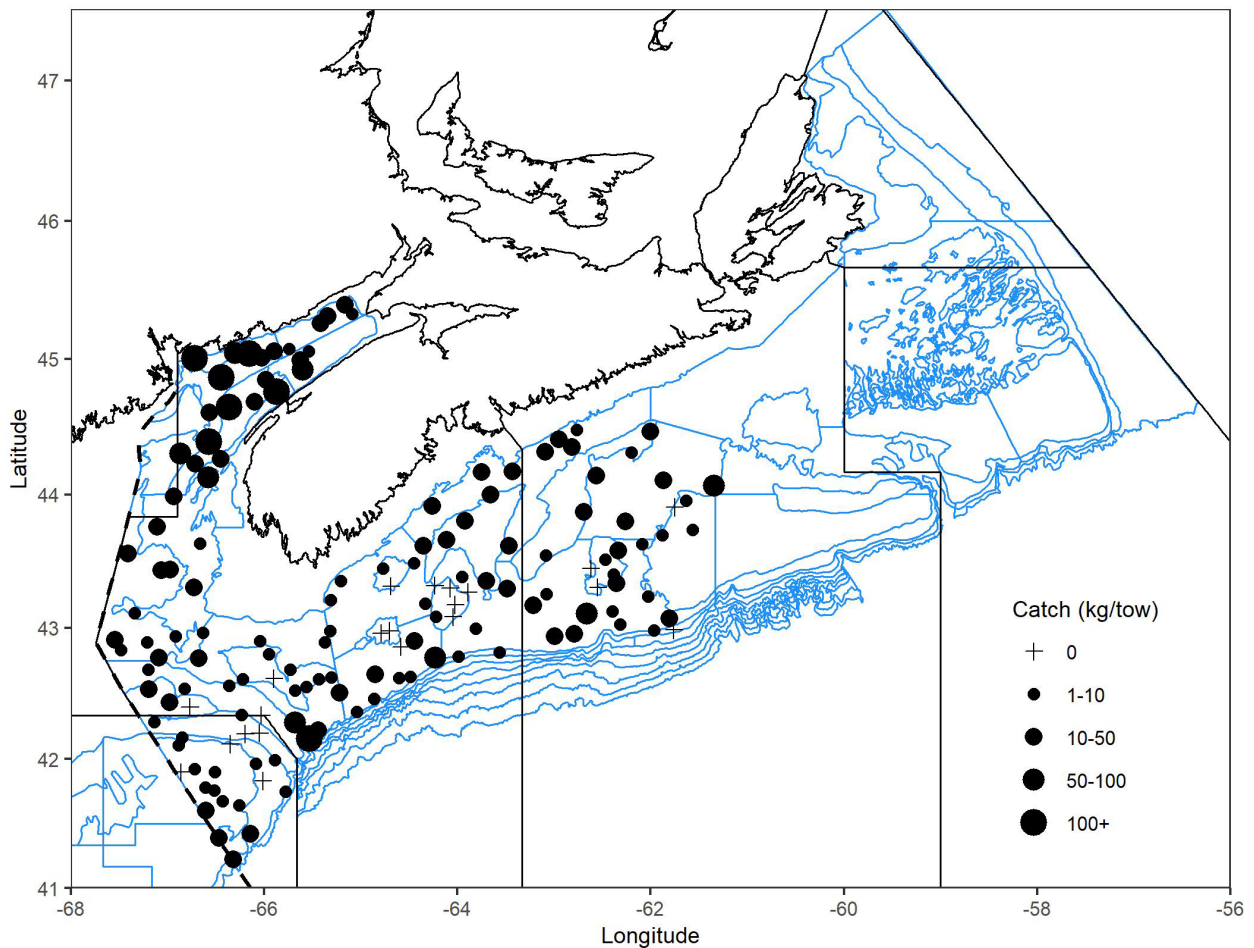


Figure 7a. Distribution of Silver Hake catches during the 2022 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

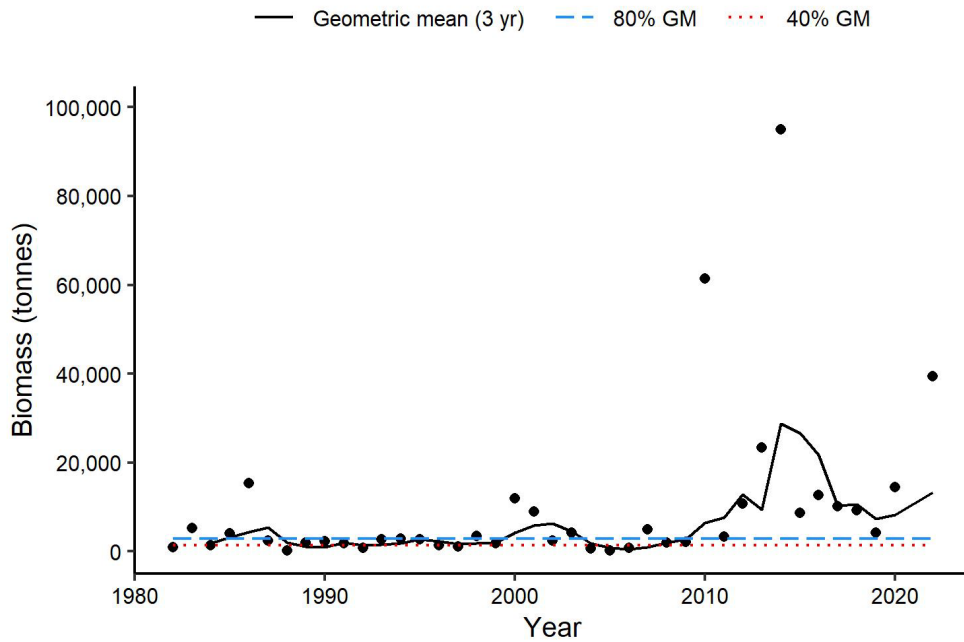


Figure 7b. Biomass index for Silver Hake in 4X west (strata 484–495) from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1982–2020), respectively. The black dots represent the biomass index for that year.

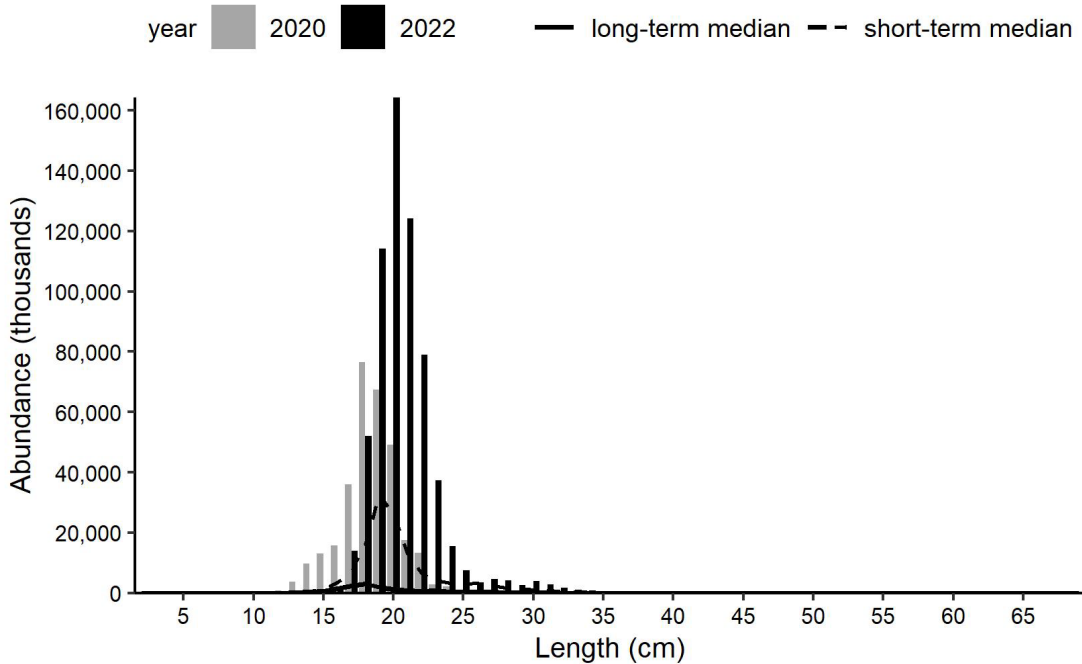


Figure 7c. Length frequency indices for Silver Hake in 4X west (strata 484–495) from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2022 survey. Grey bars represent the number in thousands at length from the 2020 survey. The solid black line represents the median in thousands at length for the time period 1982–2019. The dashed black line represents the median in thousands at length for the time period 2010–2019.

Pollock

Pollock (*Pollachius virens*) were caught primarily in deeper water in the Fundian Channel, the Gulf of Maine and on the Northeast peak of Georges Bank (Figure 8a). The 3-yr GM biomass index for Western Component Pollock is below 40% of the long-term GM for the first time since 2000 (Figure 8b). Indices-at-length were at or below the short-term median for most lengths with the exception of lengths > 75 cm (Figure 8c).

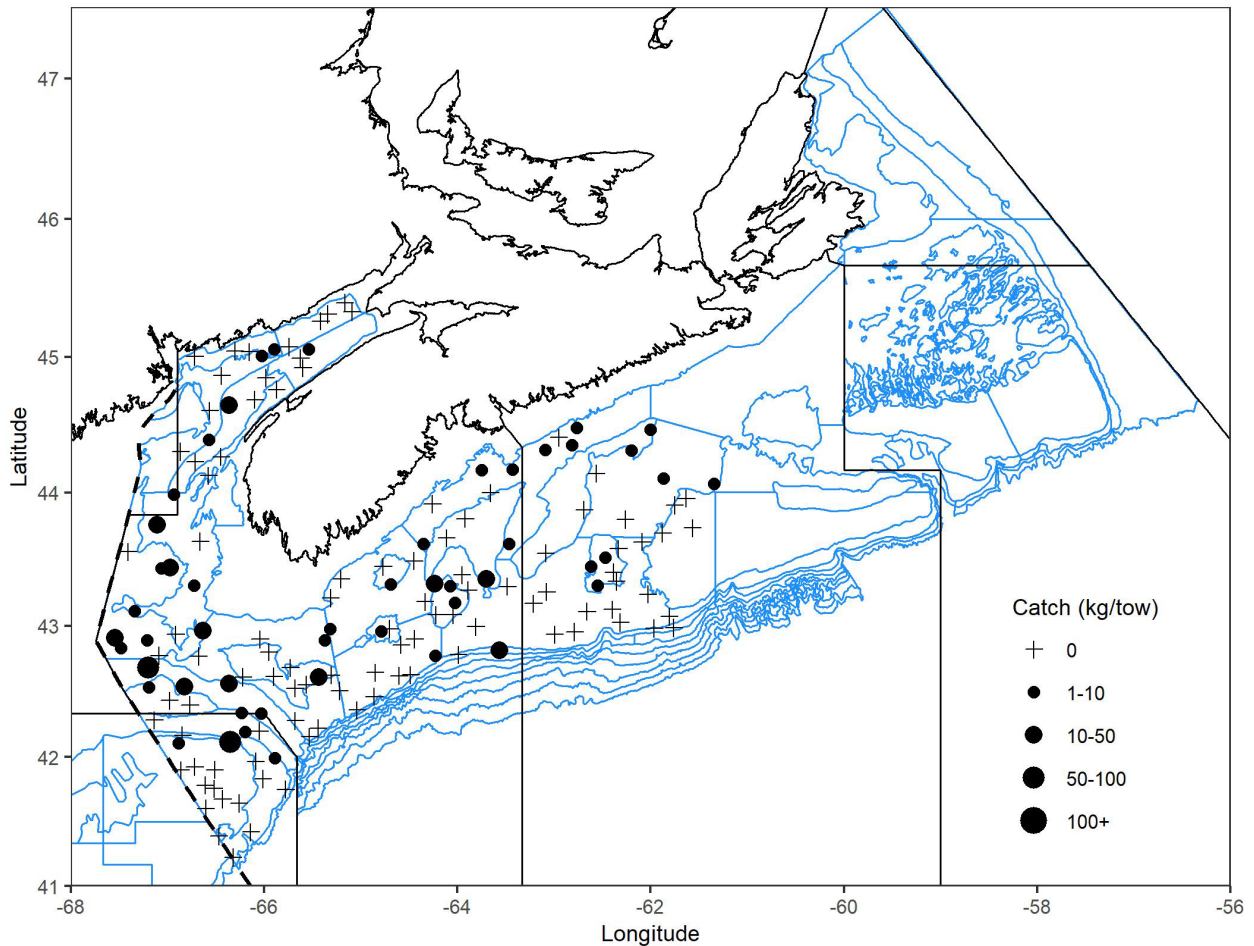


Figure 8a. Distribution of Pollock catches during the 2020 DFO Summer RV Survey including the Laurentian channel and Georges Bank. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

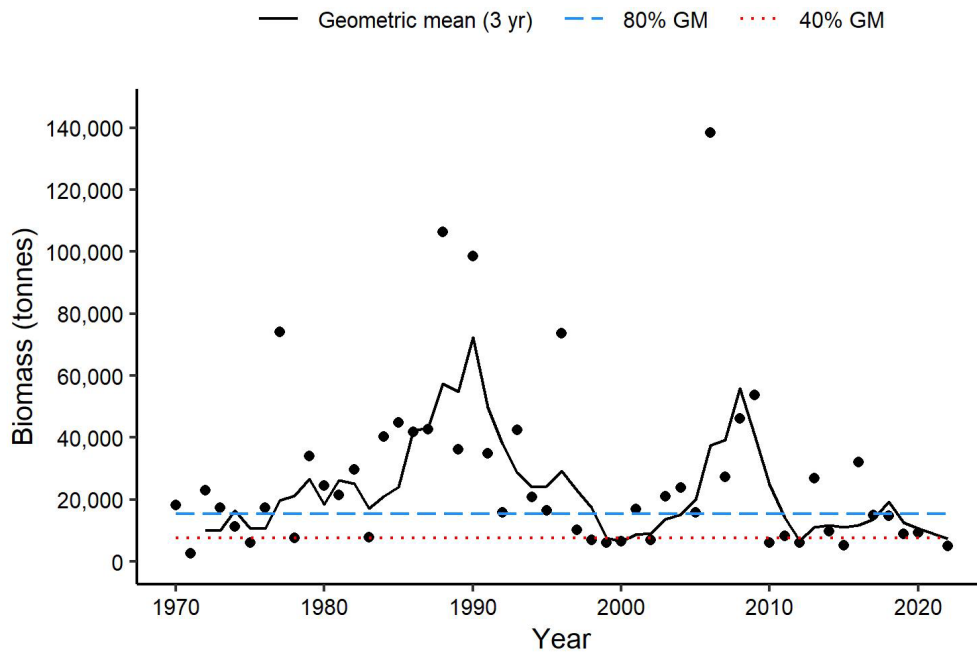


Figure 8b. Biomass index for Western Component Pollock (strata 474, 476, 480–495) from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2020), respectively. The black dots represent the biomass index for that year.

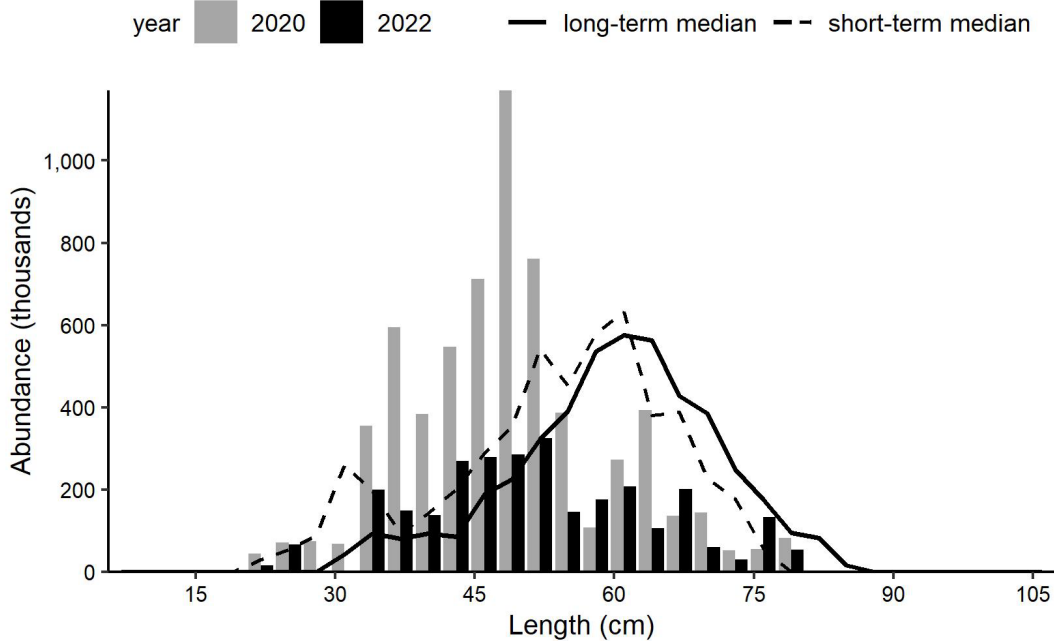


Figure 8c. Length frequency indices for Western Component Pollock (strata 474, 476, 480–495) from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2022 survey. Grey bars represent the number in thousands at length from the 2020 survey. The solid black line represents the median in thousands at length for the time period 1970–2019. The dashed black line represents the median in thousands at length for the time period 2010–2019.

Redfish

Redfish (*Sebastes fasciatus* and *Sebastes mentella*) catches were largest in the deeper waters of the inshore Scotian Shelf in 4X (Figure 9a). Sampling by the DFO Summer RV Survey within the index area for Unit II Redfish was incomplete in 2022; thus, biomass and length indices cannot be shown. In Unit III, three strata (456, 458, 459) within the index area were not covered by the survey in 2022; however, a sufficient portion of the Unit III area was covered and can provide some useful information.

The 2022 biomass index for Unit III Redfish decreased from 2020 to below 40% of the long-term GM for the first time since 2002 (Figure 9b) and the 3-yr GM is between 40–80% of the long-term GM. The short-term median abundance indices are generally higher than the long-term, reflecting the recent high abundance. The abundance indices were below the short-term medians for all lengths except for lengths < 16 cm, which may be indicative of an above average recruitment (Figure 9c).

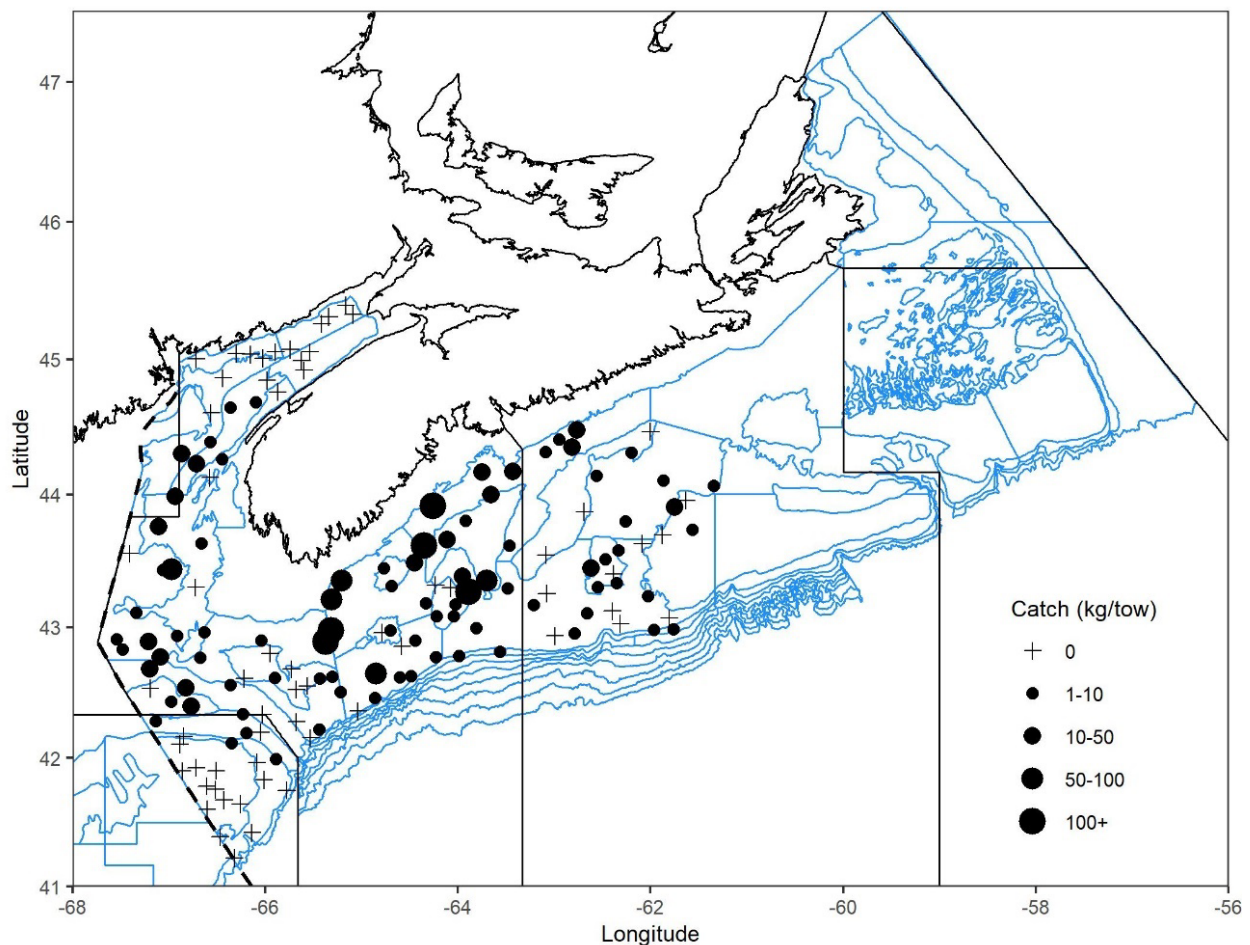


Figure 9a. Distribution of redfish catches during the 2020 DFO Summer RV Survey including the Laurentian channel and Georges Bank. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

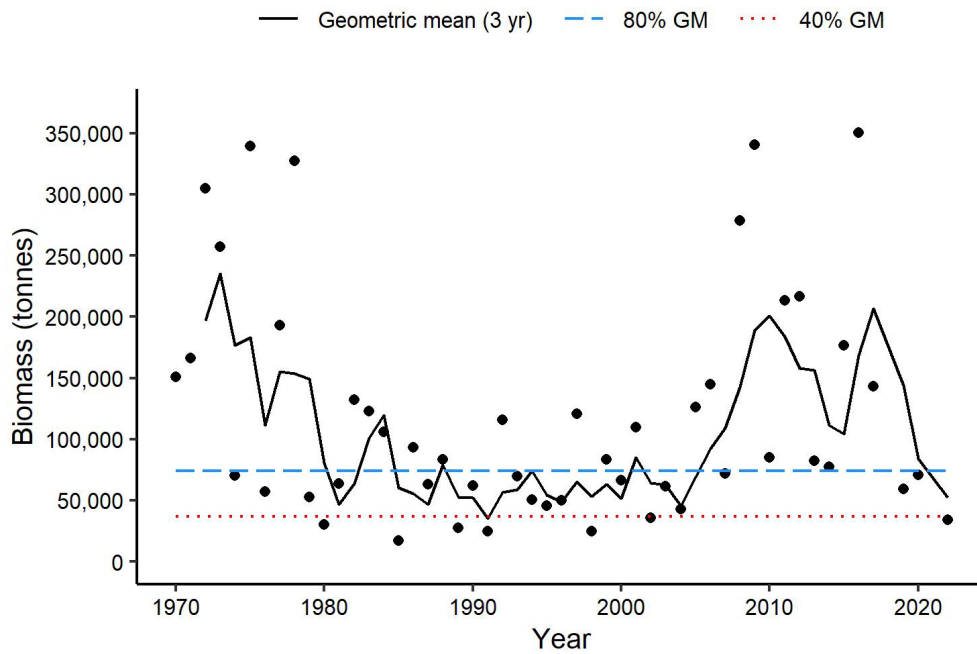


Figure 9b. Biomass index for Unit III Redfish (strata 456, 458–495) from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2020), respectively. The black dots represent the biomass index for that year.

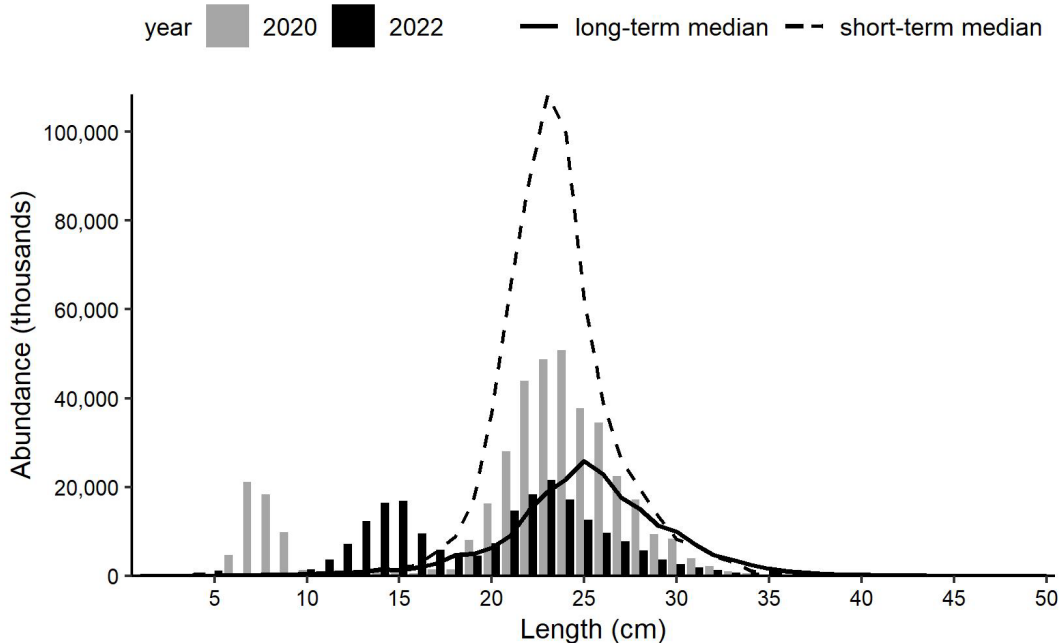


Figure 9c. Length frequency indices for Unit III Redfish (strata 456, 458–495) from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2022 survey. Grey bars represent the number in thousands at length from the 2020 survey. The solid black line represents the median in thousands at length for the time period 1970–2019. The dashed black line represents the median in thousands at length for the time period 2010–2019.

Atlantic Halibut

Sampling by the DFO Summer Survey was spatially incomplete in 2022; however, a sufficient portion of the survey area was covered to provide some useful information for Atlantic Halibut (*Hippoglossus hippoglossus*) (Figure 10a). The 2022 biomass index in 4X is the third highest observed in the time series and the 3-yr GM remains well above 80% of the long-term GM (Figure 10b). Indices of abundance for fish > 50 cm were generally above the short-term median for 4X in 2022 with more larger fish than observed in 2020 (Figure 10c).

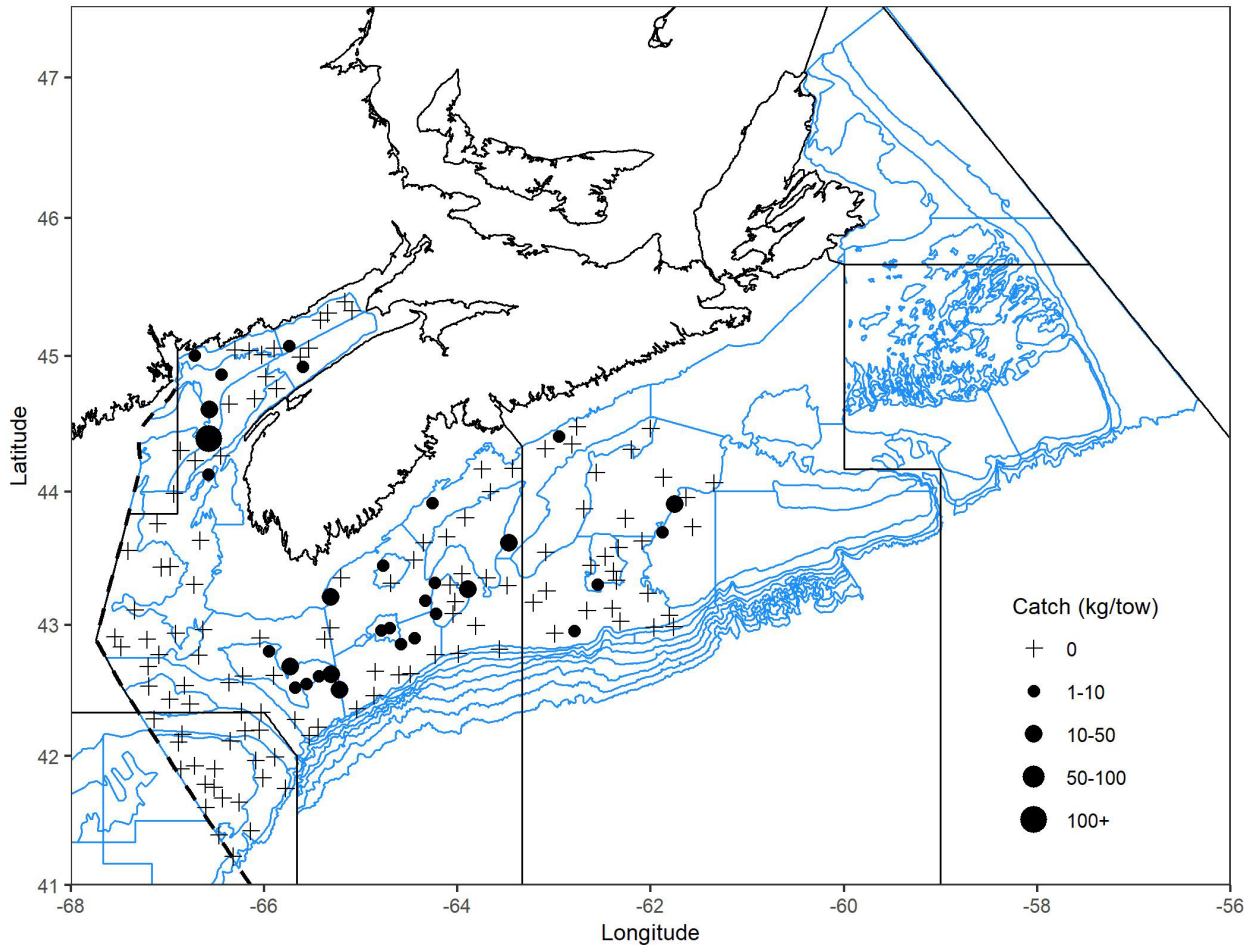


Figure 10a. Distribution of Atlantic Halibut catches during the 2022 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

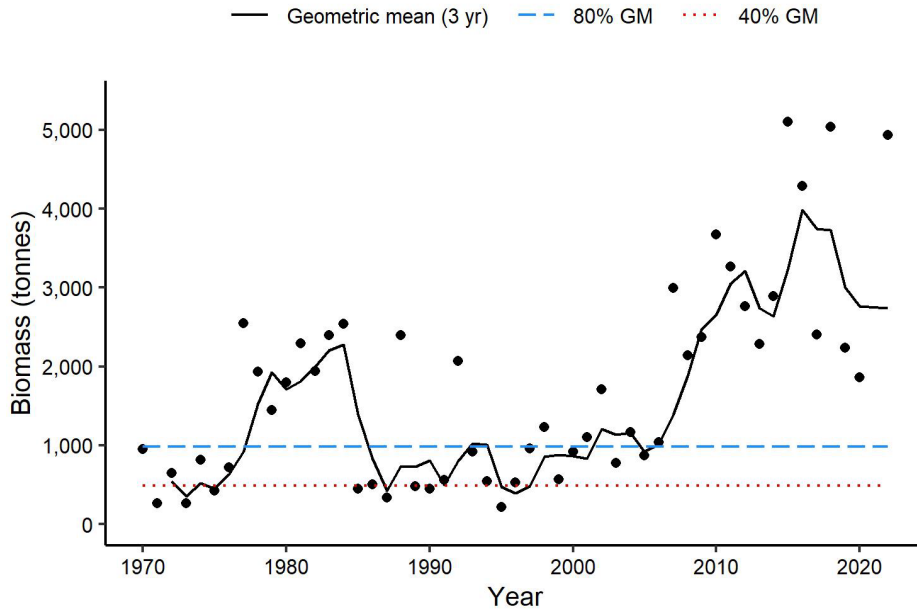


Figure 10b. Biomass index for Halibut in 4X from the DFO Summer RV Survey. The 3-year geometric mean biomass is represented by the solid black line. The dashed blue and dotted red lines represent 80% and 40% of the long-term GM (1970-2020), respectively. The black dots represent the biomass estimate for that year.

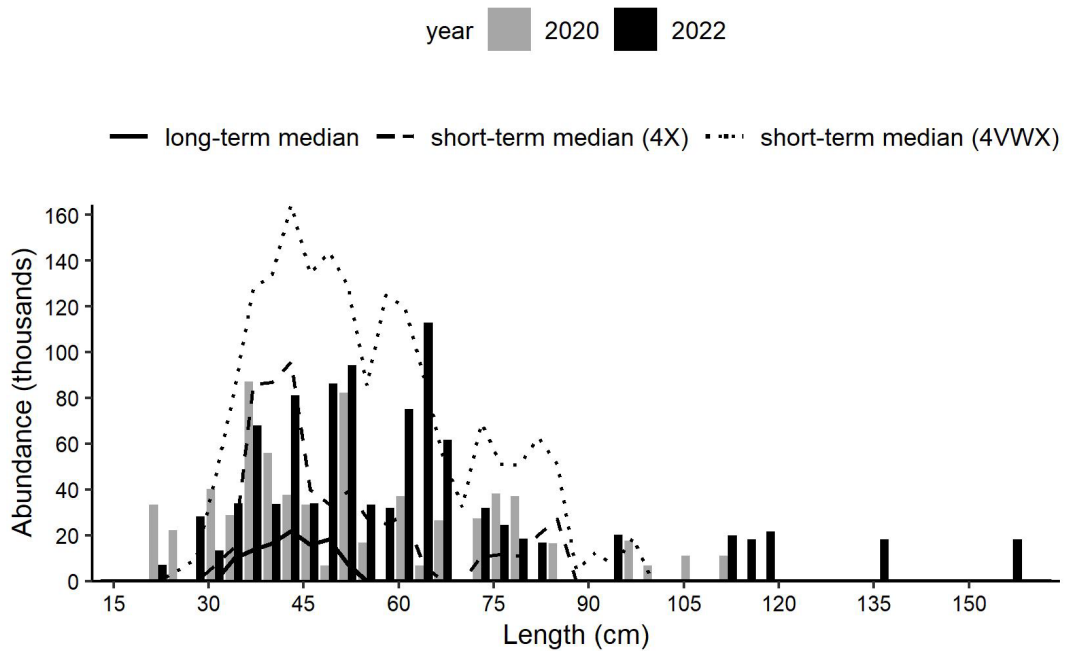


Figure 10c. Length frequency indices for Halibut in 4X from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2022 survey. Grey bars represent the number in thousands at length from the 2020 survey. The solid black line represents the median in thousands at length for the time period 1970-2019 in 4X. The dashed black line represents the median in thousands at length for the time period 2010-2019 in 4X. The dotted black line represents the median in thousands at length for the time period 2009-2017, 2019 in 4VWX.

Yellowtail Flounder

Yellowtail Flounder (*Limanda ferruginea*) were caught primarily on Browns and Georges Banks in 2022 (Figure 11a). The 3-yr GM for 4X is under 40% of the long-term GM for the eighth year in a row (Figure 11b). The abundance indices were generally at or below the short-term median for all lengths < 39 cm and there were no fish < 27 cm captured in 2022 indicative of potentially poor recruitment in 4X (Figure 11c).

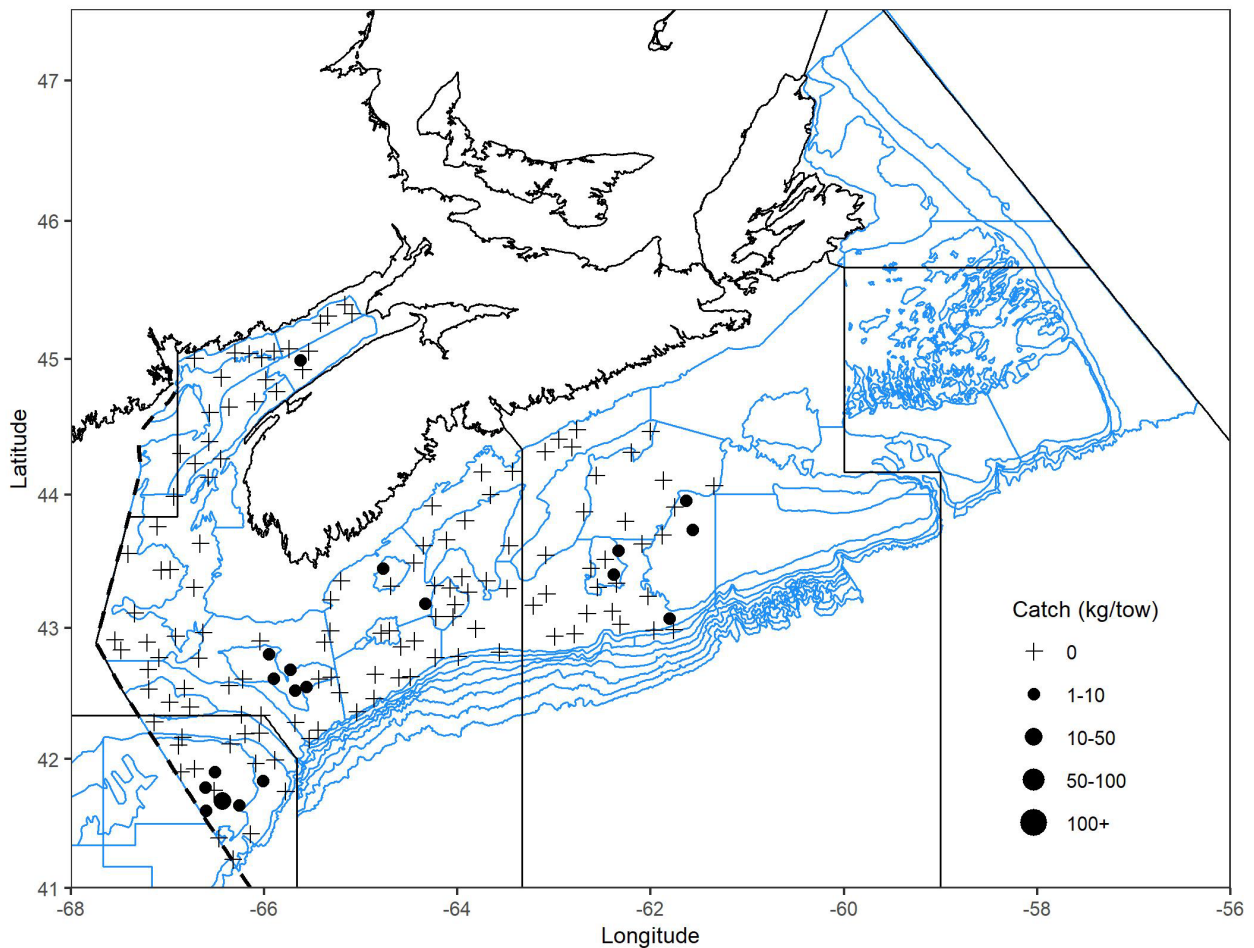


Figure 11a. Distribution of Yellowtail Flounder catches during the 2022 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

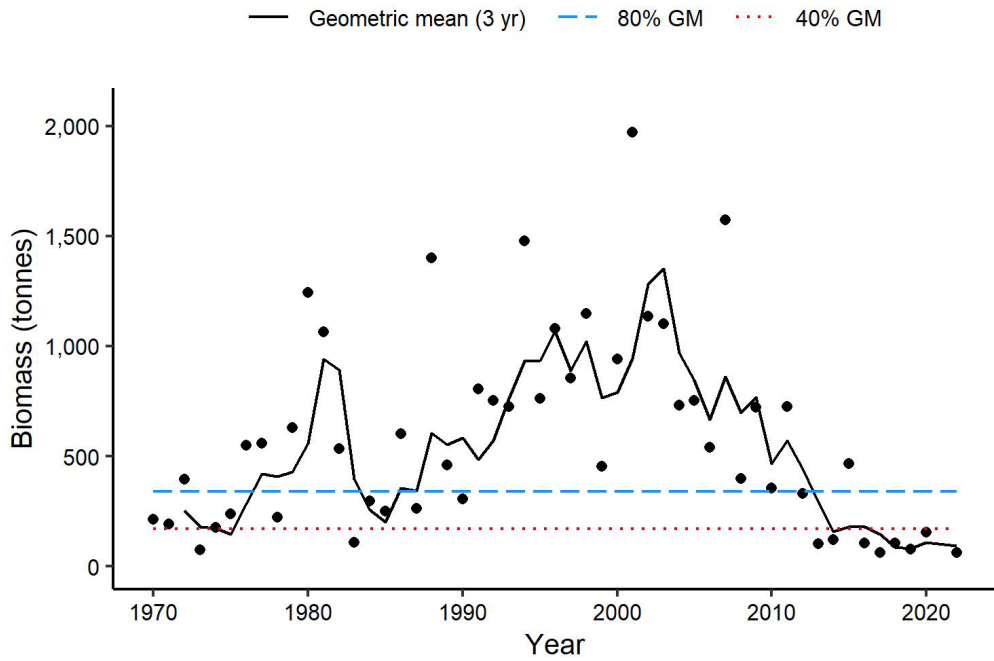


Figure 11b. Biomass index for Yellowtail Flounder in 4X from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2020), respectively. The black dots represent the biomass index for that year.

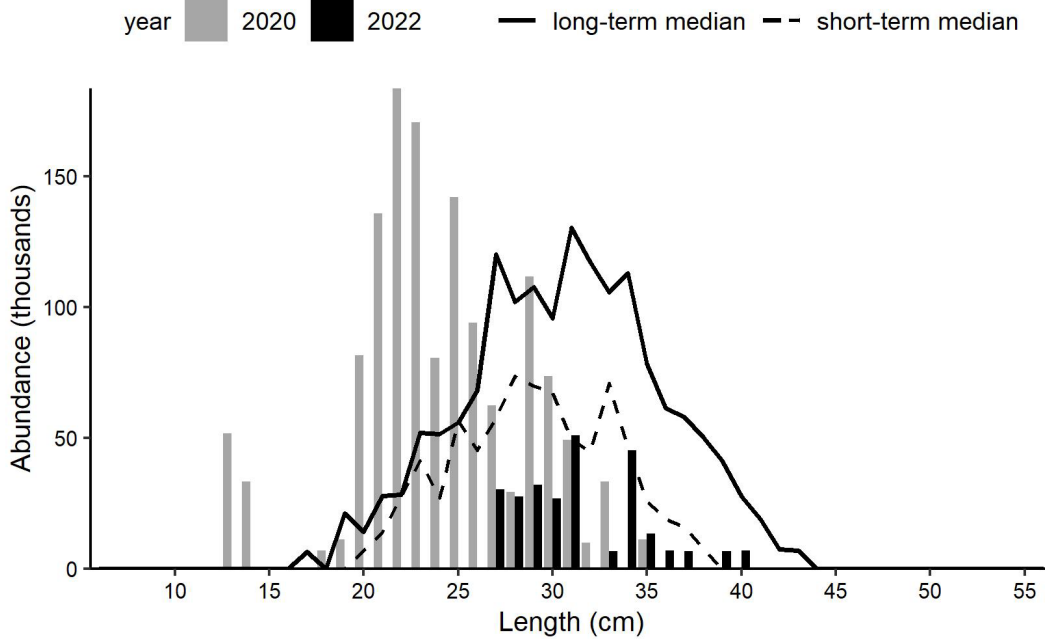


Figure 11c. Length frequency indices for Yellowtail Flounder in 4X from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2022 survey. Grey bars represent the number in thousands at length from the 2020 survey. The solid black line represents the median in thousands at length for the time period 1970–2019. The dashed black line represents the median in thousands at length for the time period 2010–2019.

American Plaice

American Plaice (*Hippoglossoides platessoides*) catches were generally small in the 2022 Summer RV Survey (Figure 12a). In 4X, the 3-yr GM remains below 40% of the long-term GM for the 8th year in a row (Figure 12b). Abundance indices in 2022 are below both the short- and long-term medians for most lengths in 4X (Figure 12c). American Plaice < 17 cm, which are often observed and apparent in the short- and long-term medians, were largely absent from the catch in 2022.

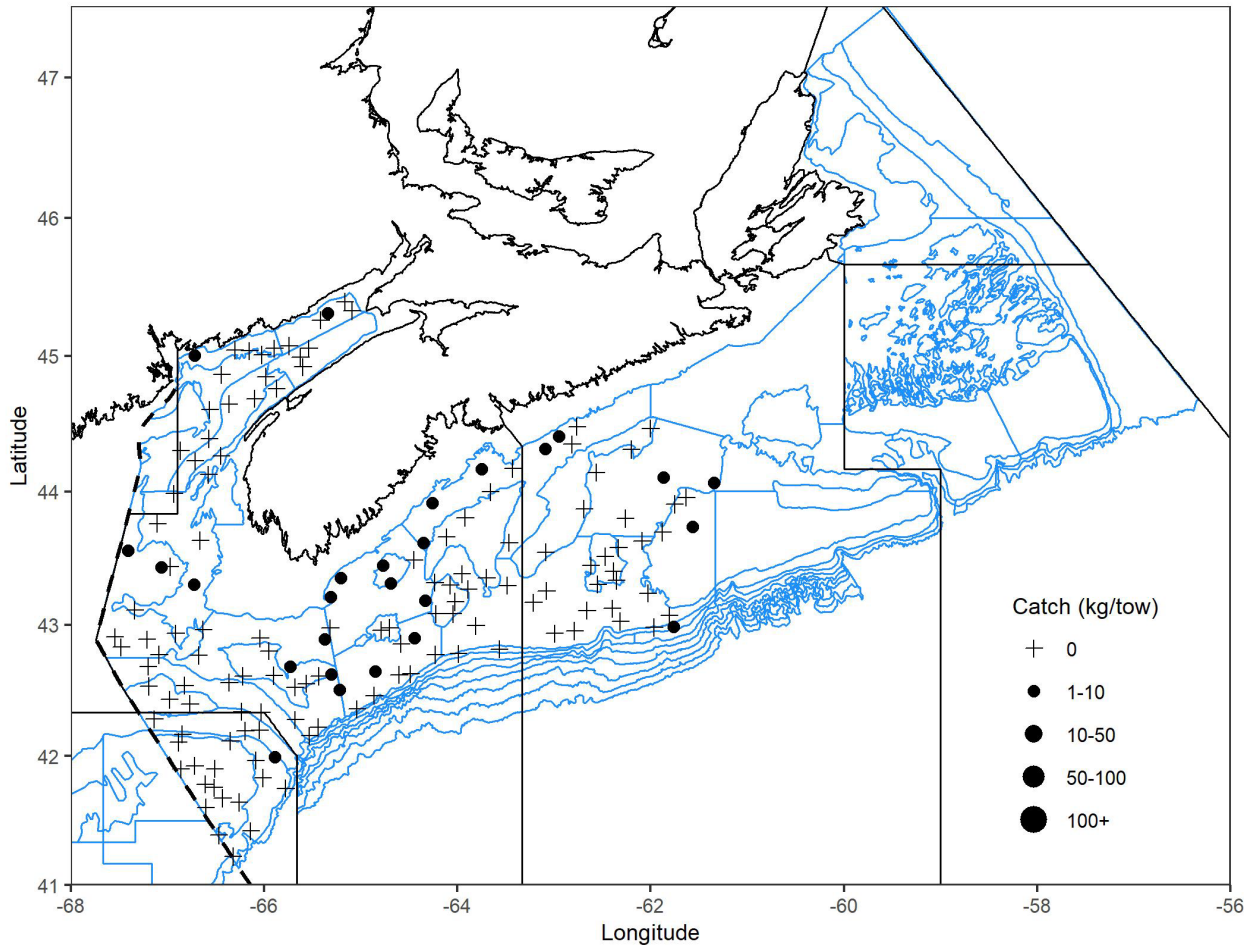


Figure 12a. Distribution of American Plaice catches during the 2022 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

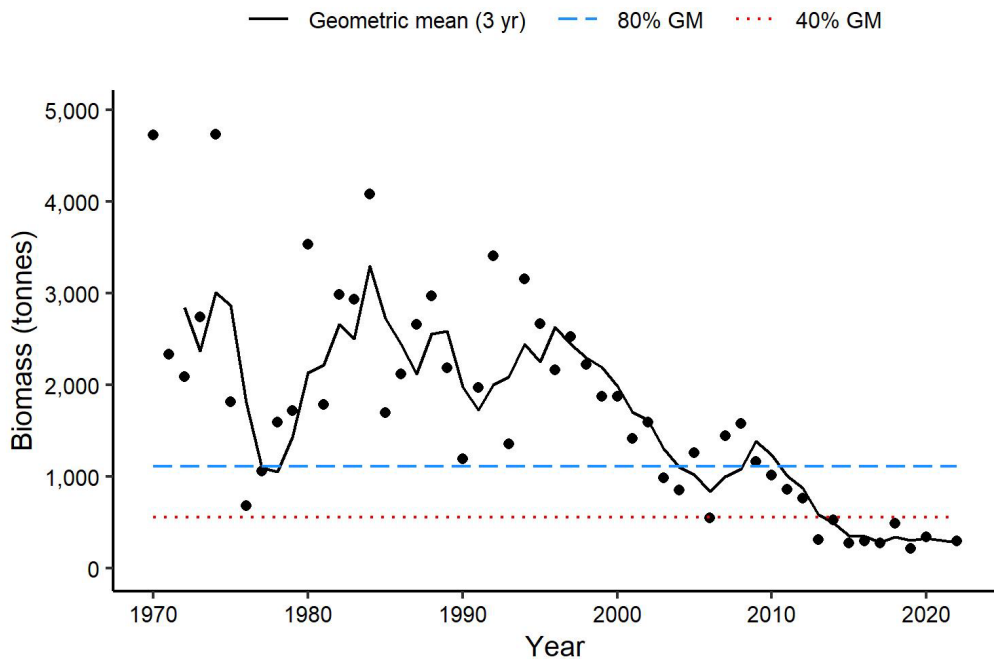


Figure 12b. Biomass index for American Plaice in 4X from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2020), respectively. The black dots represent the biomass index for that year.

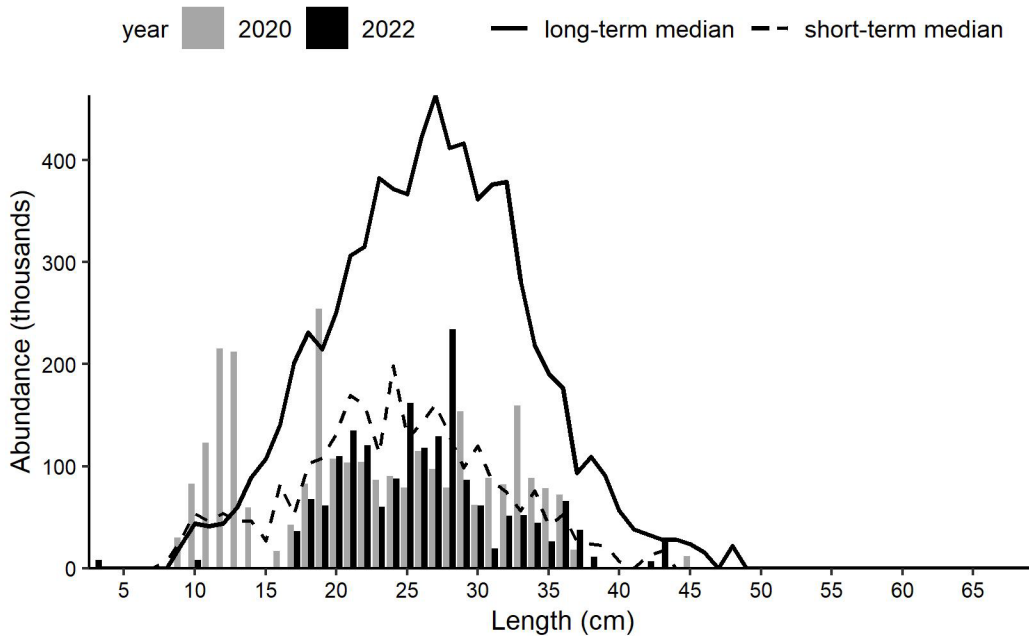


Figure 12c. Length frequency indices for American Plaice in 4X from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2022 survey. Grey bars represent the number in thousands at length from the 2020 survey. The solid black line represents the median in thousands at length for the time period 1970–2019. The dashed black line represents the median in thousands at length for the time period 2010–2019.

Witch Flounder

Witch Flounder (*Glyptocephalus cynoglossus*) were widespread in the survey area in 2022 (Figure 13a); however, catches were generally small. The 2022 biomass index for 4X is the third lowest in the time series and the 3-yr GM fell below 80% of the long-term GM for the first time in 6 years (Figure 13b). The length-frequency indices in 2022 were similar to the long-term medians, but well below the short-term medians for most lengths (Figure 13c). Witch Flounder above 45 cm have been largely absent from catches in the last 20 years.

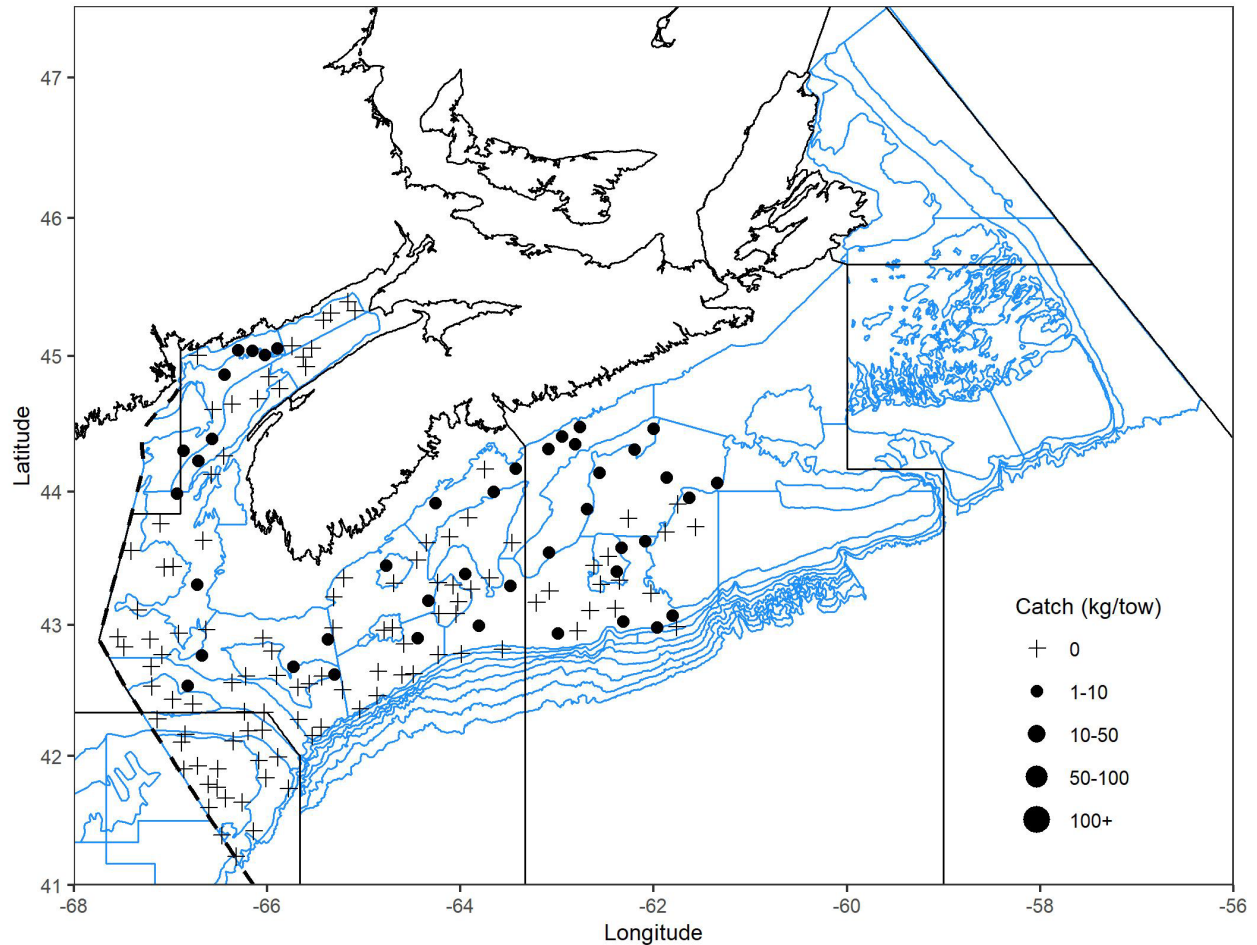


Figure 13a. Distribution of Witch Flounder catches during the 2022 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

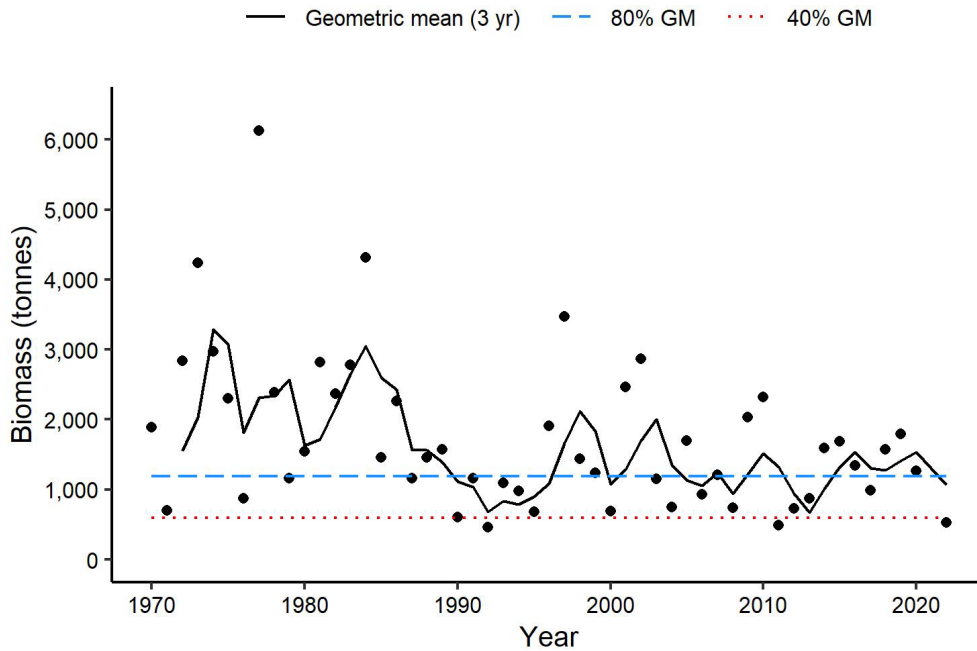


Figure 13b. Biomass index for Witch Flounder in 4X from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2020), respectively. The black dots represent the biomass index for that year.

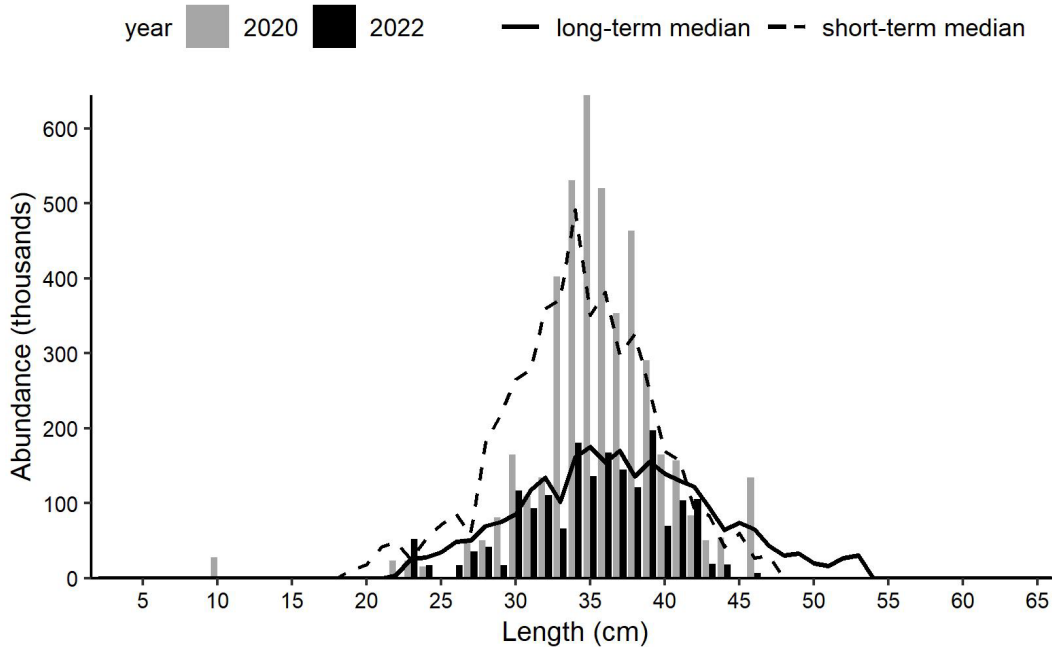


Figure 13c. Length frequency indices for Witch Flounder in 4X from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2022 survey. Grey bars represent the number in thousands at length from the 2020 survey. The solid black line represents the median in thousands at length for the time period 1970–2019. The dashed black line represents the median in thousands at length for the time period 2010–2019.

Winter Flounder

Winter Flounder (*Pseudopleuronectes americanus*) were caught primarily on shallow banks and in the Bay of Fundy (Figure 14a). In 4X, the 3-yr GM has remained above 80% of the long-term GM since 1988 (Figure 14b). The short-term median abundance indices-at-length are higher than the long-term medians at length under 36 cm (Figure 14c). In 2022, the indices-at-length are below short-term medians under 29 cm.

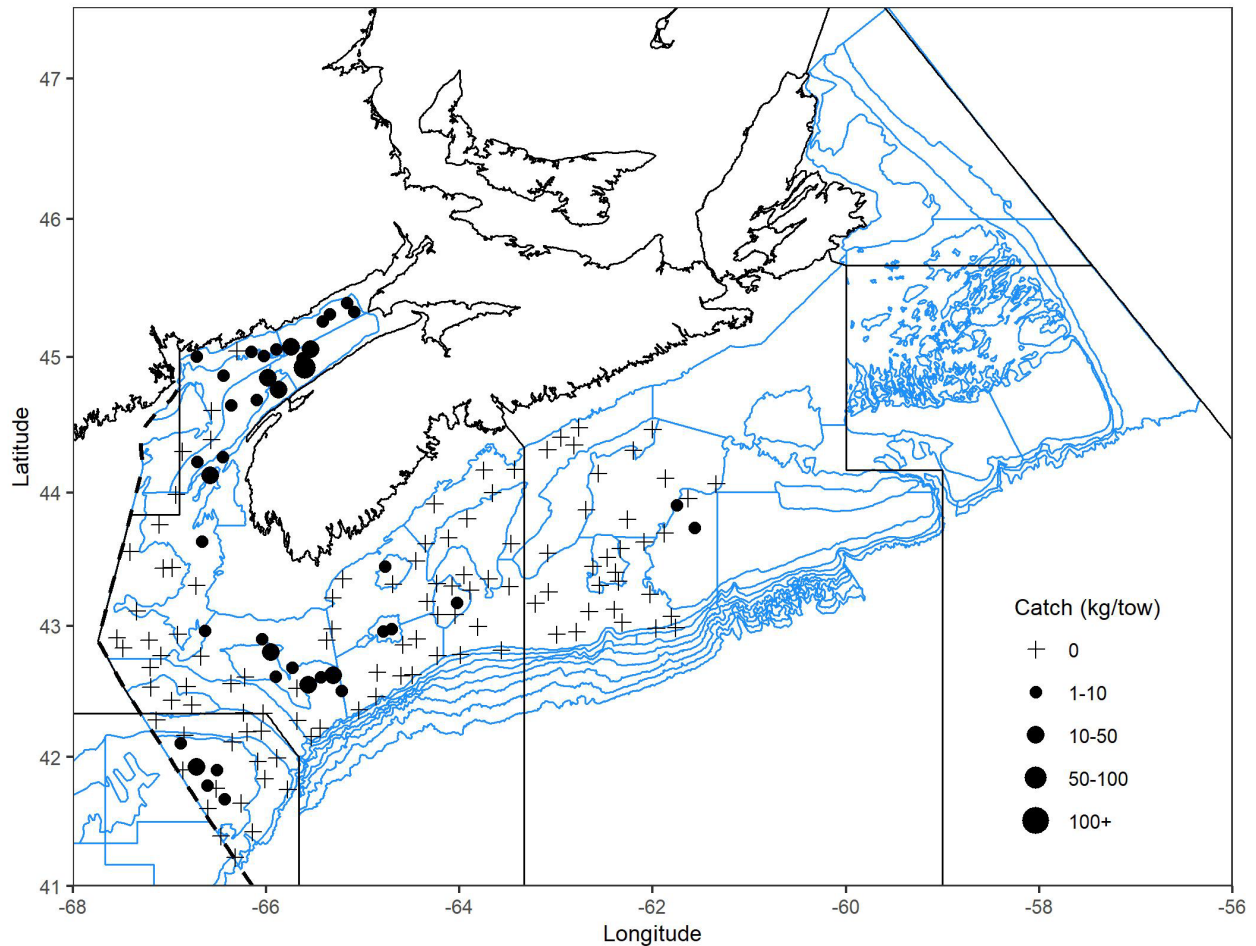


Figure 14a. Distribution of Winter Flounder catches during the 2022 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

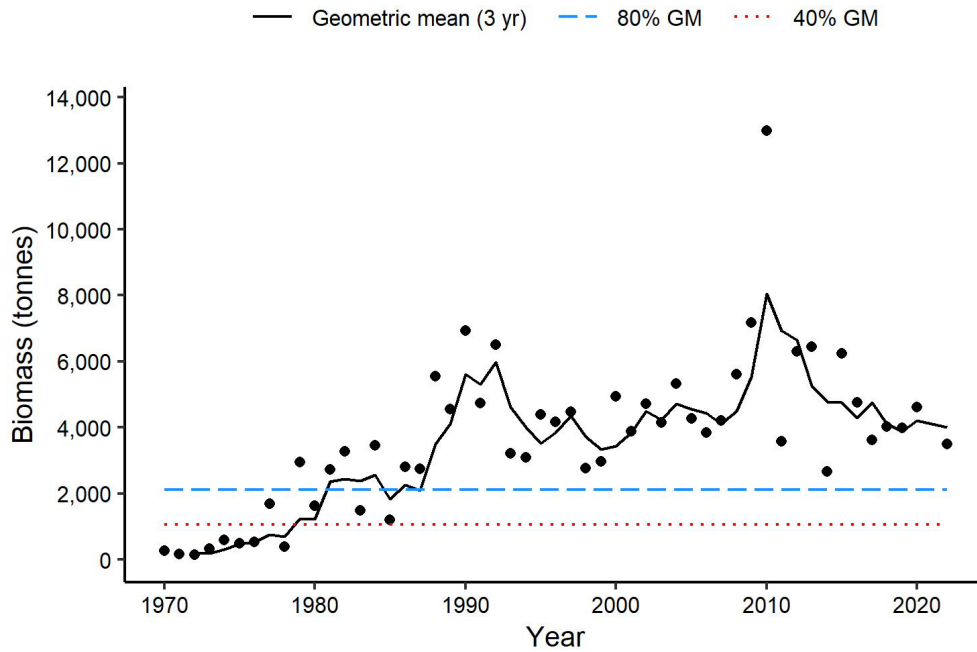


Figure 14b. Biomass index for Winter Flounder in 4X from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2020), respectively. The black dots represent the biomass index for that year.

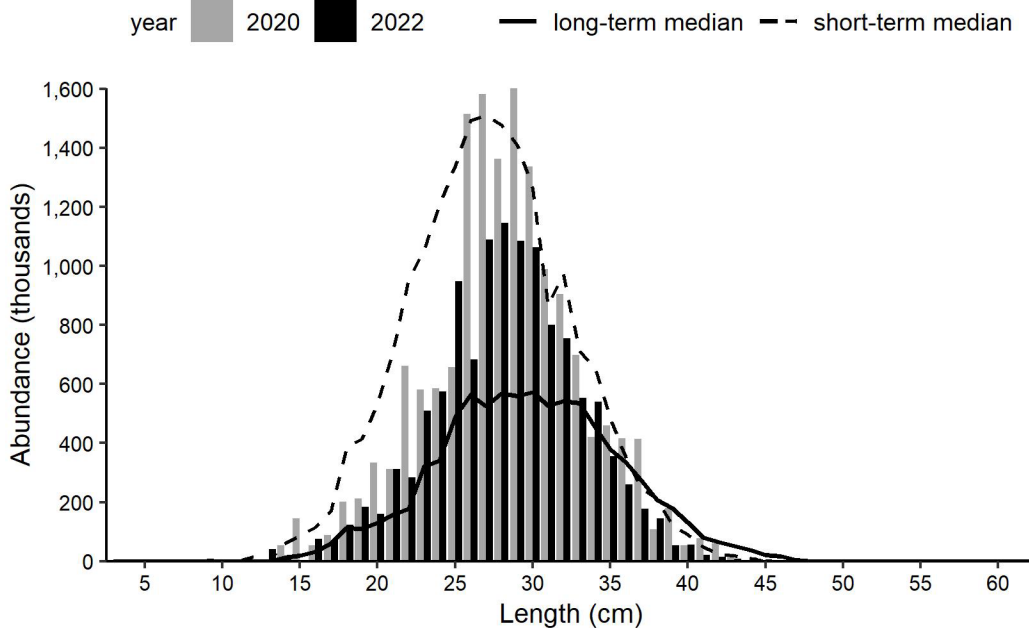


Figure 14c. Length frequency indices for Winter Flounder in 4X from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2022 survey. Grey bars represent the number in thousands at length from the 2020 survey. The solid black line represents the median in thousands at length for the time period 1970–2019. The dashed black line represents the median in thousands at length for the time period 2010–2019.

Atlantic Wolffish

Atlantic Wolffish (*Anarhichas lupus*) catches in 2022 came primarily from shallow banks or depths < 100 m (Figure 15a). The 3-yr GM biomass index for 2022 remains below 40% of the long-term GM in 4X (Figure 15b). It has been stable at a low level since about 2012. Only 12 individuals were caught (Figure 15c).

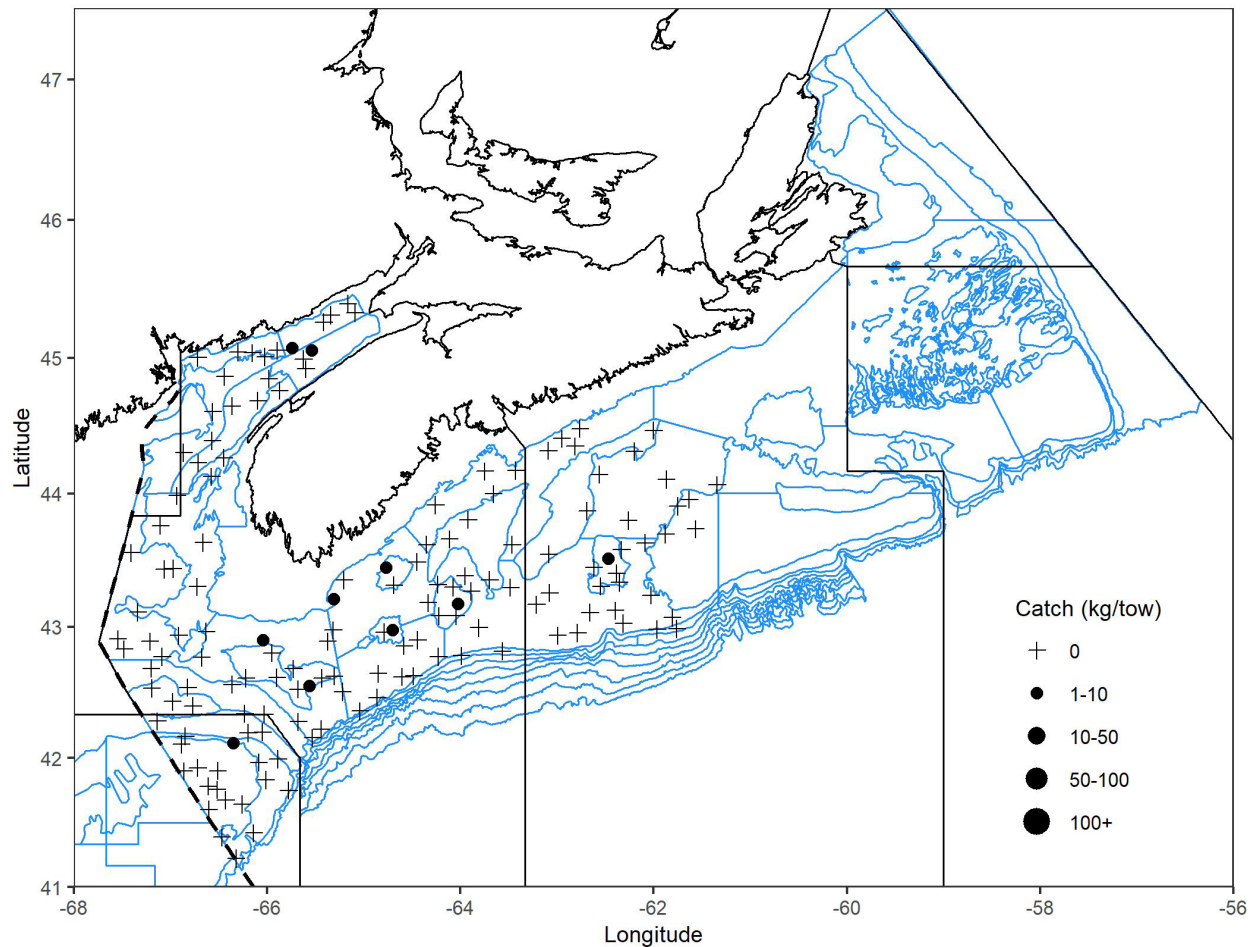


Figure 15a. Distribution of Atlantic Wolffish catches during the 2022 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

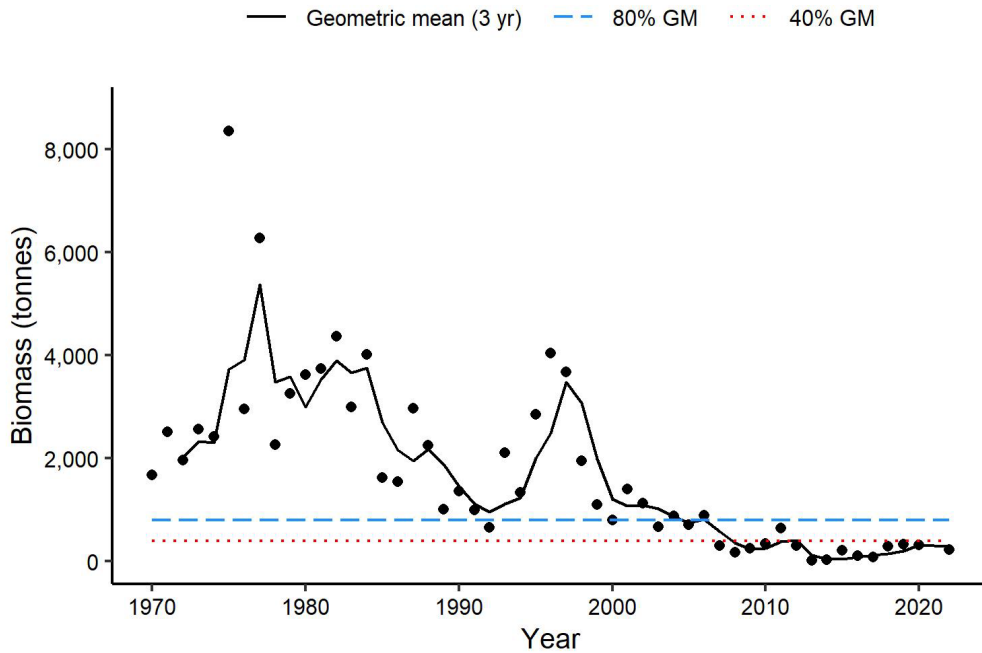


Figure 15b. Biomass index for Atlantic Wolffish in 4X from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2020), respectively. The black dots represent the biomass index for that year.

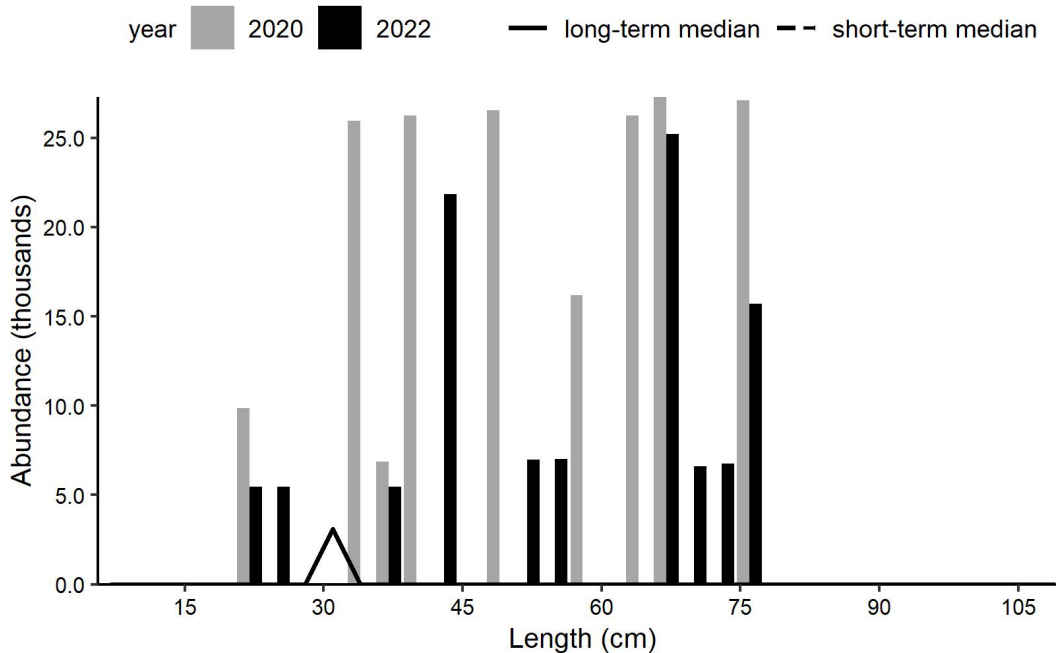


Figure 15c. Length frequency indices for Atlantic Wolffish in 4X from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2022 survey. Grey bars represent the number in thousands at length from the 2020 survey. The solid black line represents the median in thousands at length for the time period 1970–2019.

Monkfish

Monkfish (*Lophius americanus*) catches were scattered through much of 4X and Georges Bank in 2022 (Figure 16a). In 4X, the 3-yr GM in 2022 fell below 80% of the long-term GM (Figure 16b). The indices-at-length are above both the long-term and short-term medians for most lengths (Figure 16c).

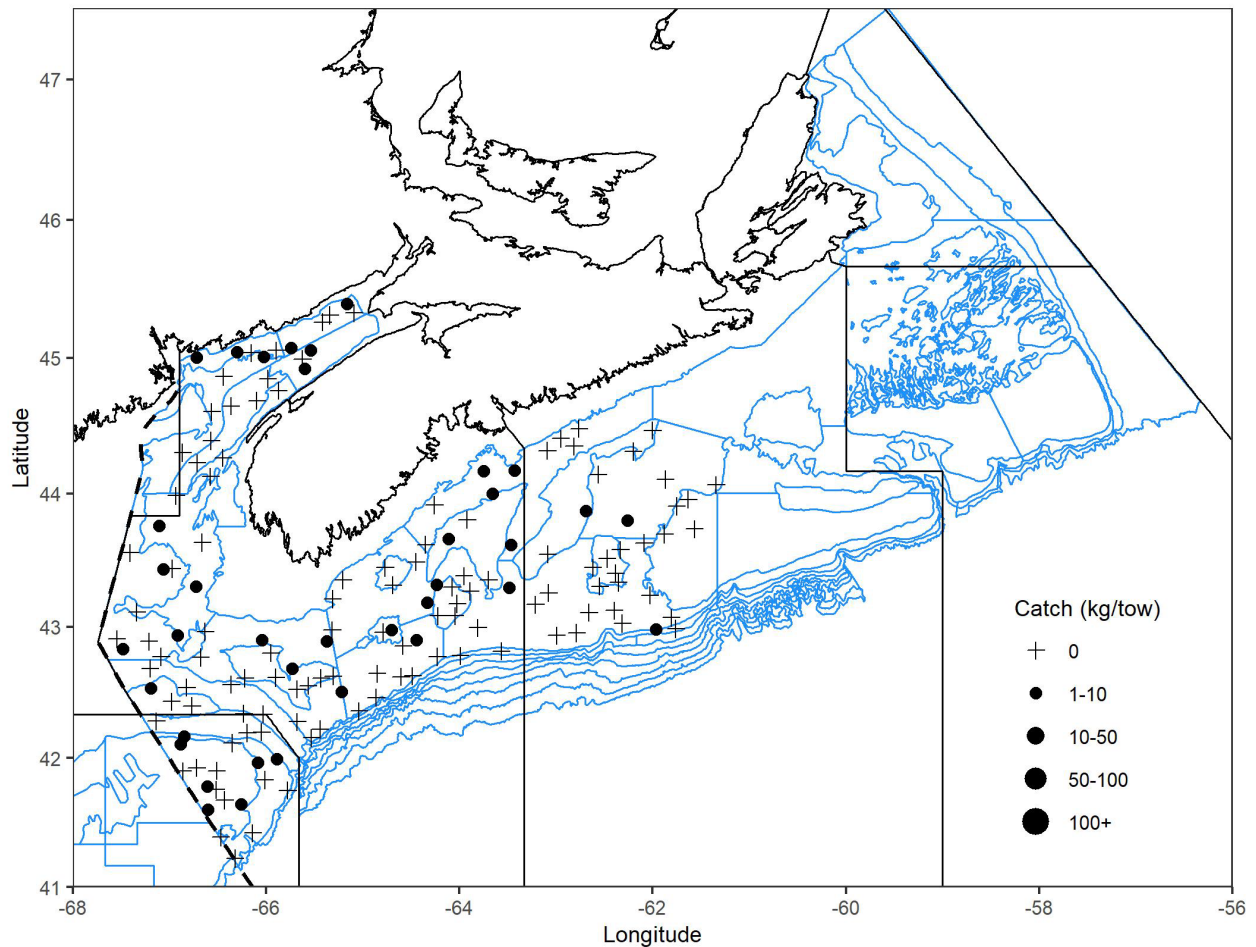


Figure 16a. Distribution of Monkfish catches during the 2022 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

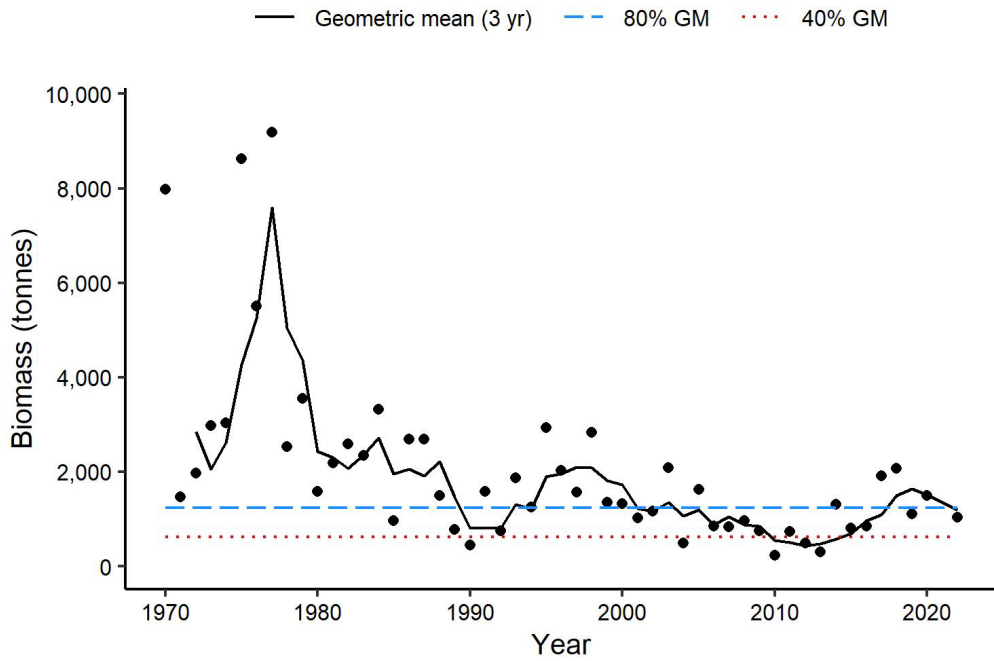


Figure 16b. Biomass index for Monkfish in 4X from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2020), respectively. The black dots represent the biomass index for that year.

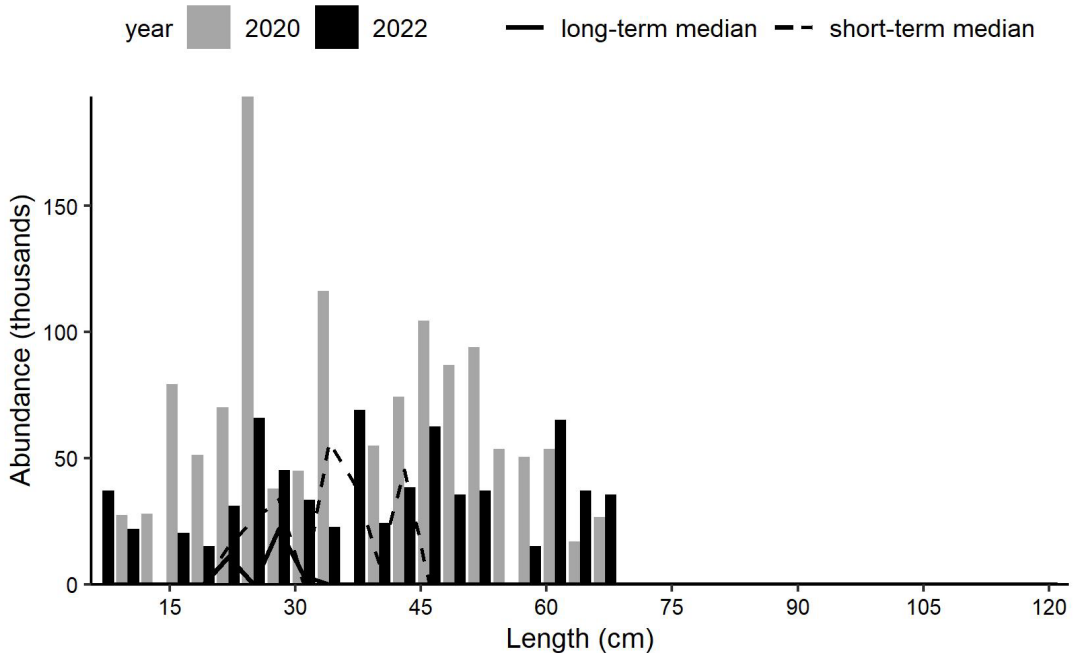


Figure 16c. Length frequency indices for Monkfish in 4X from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2022 survey. Grey bars represent the number in thousands at length from the 2020 survey. The solid black line represents the median in thousands at length for the time period 1970–2019. The dashed black line represents the median in thousands at length for the time period 2010–2019.

Longhorn Sculpin

Longhorn Sculpin (*Myoxocephalus octodecemspinosus*) are caught primarily on the Scotian Shelf banks and in the Bay of Fundy (Figure 17a). In 4X, the 3-yr GM increased from 2020 and is now at 80% of the long-term mean (Figure 17b). Abundance indices-at-length are near or above the short-term median for most lengths with the exception of lengths between 15–19 cm (Figure 17c).

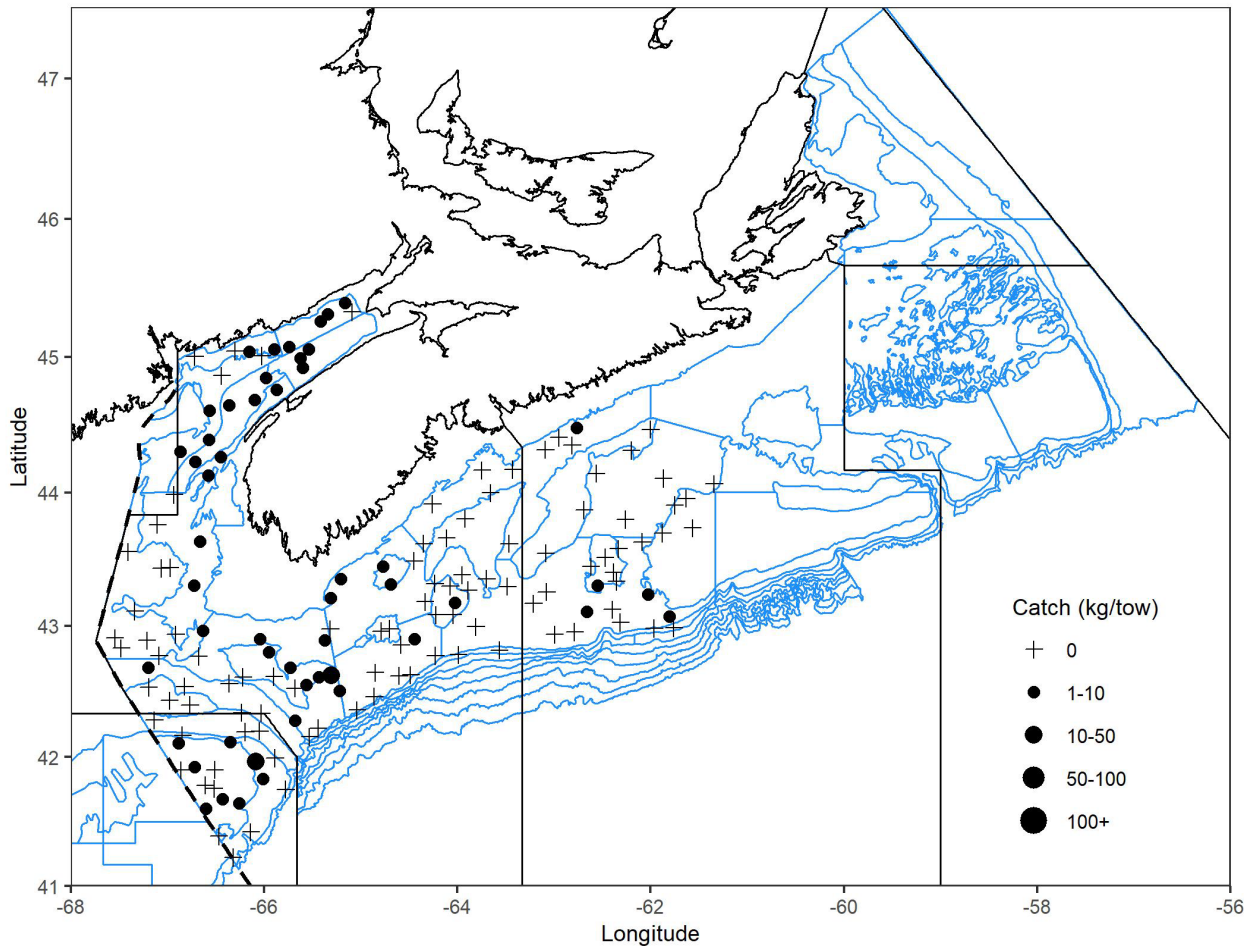


Figure 17a. Distribution of Longhorn Sculpin catches during the 2022 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

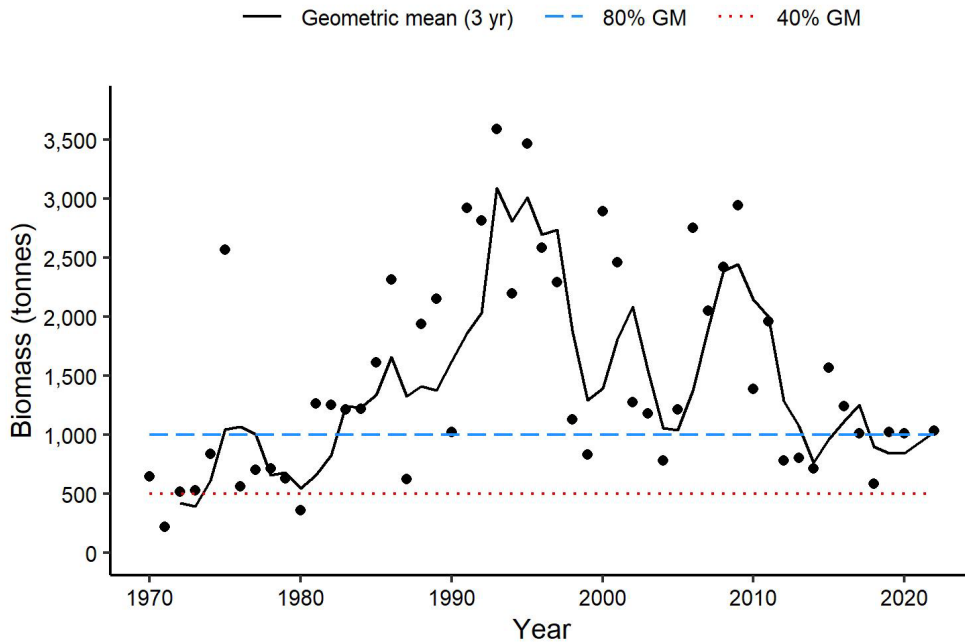


Figure 17b. Biomass index for Longhorn Sculpin in 4X from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2020), respectively. The black dots represent the biomass index for that year.

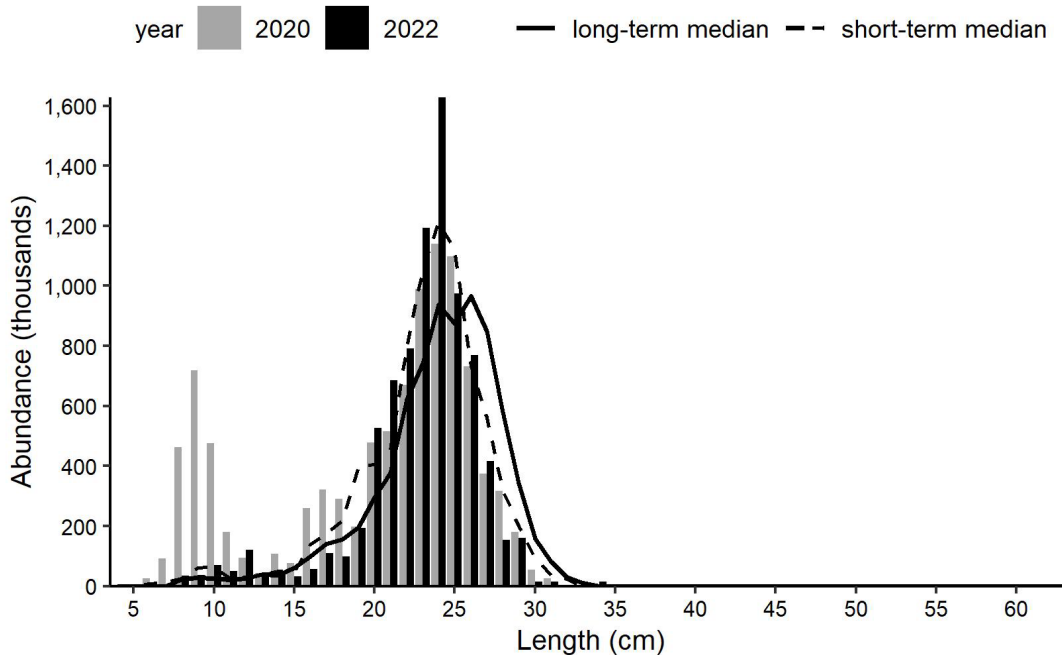


Figure 17c. Length frequency indices for Longhorn Sculpin in 4X from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2022 survey. Grey bars represent the number in thousands at length from the 2020 survey. The solid black line represents the median in thousands at length for the time period 1970–2019. The dashed black line represents the median in thousands at length for the time period 2010–2019.

Barndoor Skate

Barndoor Skate (*Dipturus laevis*) were caught primarily on Georges Bank and on the Scotian Shelf in 2022 (Figure 18a). The 2022 biomass index for Barndoor Skate in 4X is the highest in the time series and the 3-yr GM remains high (Figure 18b). Prior to 1998, catches were close to zero for all sizes of Barndoor Skates, so the median indices are zero for all lengths. In 2022, Barndoor Skates were caught at lengths ranging from 48 to 128 cm in 4X (Figure 18c).

Barndoor Skate are a large wide ranging fish which prefer the warmer waters in the Maritimes Region. When reviewed by the Committee on the Status of Endangered Wildlife in Canada, the Designatable Unit (DU) included 4VWX5Zc; all of the area typically covered by the summer survey since 2011. On Georges Bank (5Zc) the biomass index in 2022 was 3,458 t, roughly equivalent to the index for 4X alone (3,536 t) and included two of the largest tows ever recorded for Barndoor Skate. In the winter, few Barndoor Skate are caught on top of Georges Bank (5Z1+2), as they move off the bank into deeper waters of the Fundian Channel and Gulf of Maine. Given their seasonal movements and preference for warmer water, it may be more informative to look at biomass trends for Barndoor Skates for the survey area as a whole rather than separately for NAFO Unit Areas.

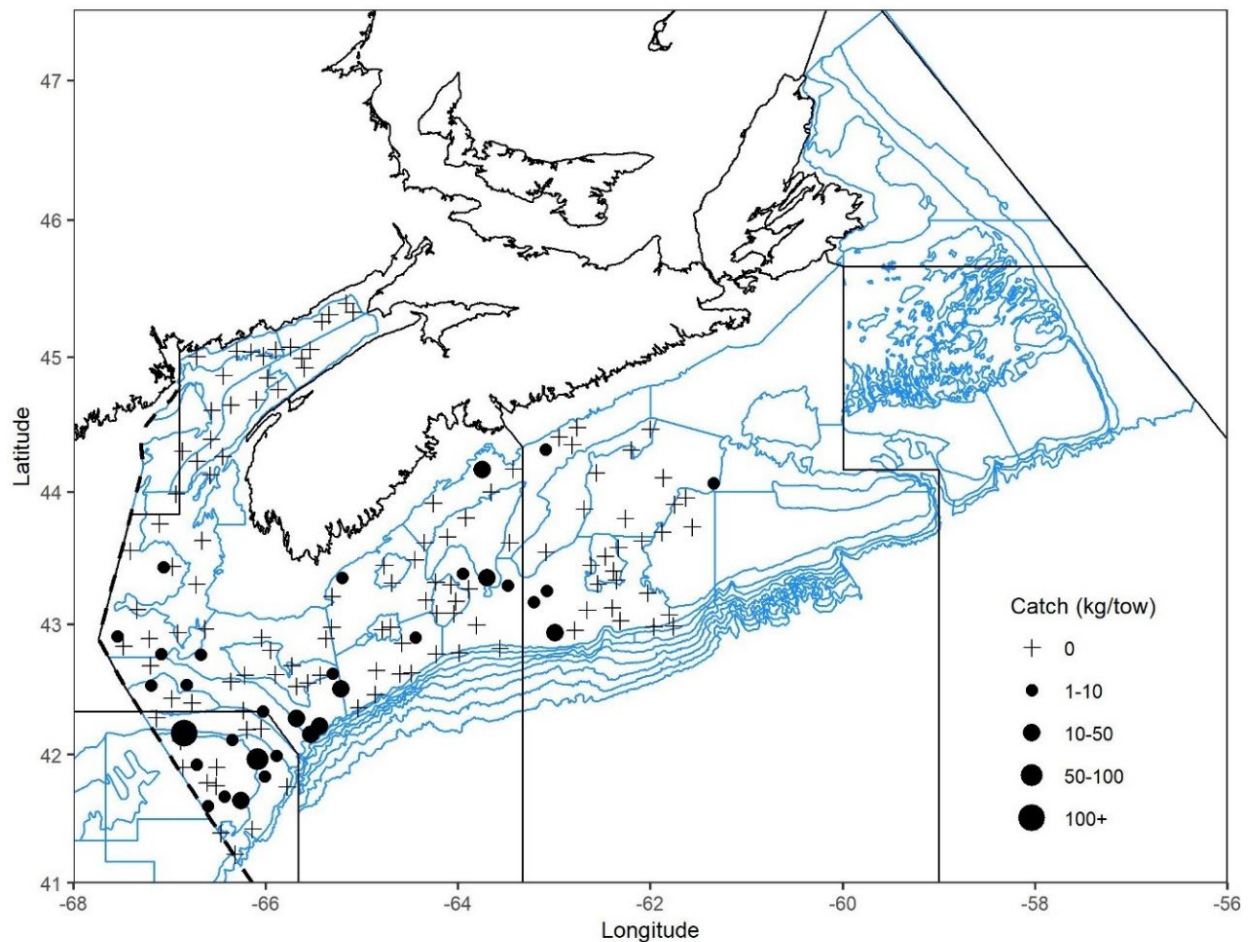


Figure 18a. Distribution of Barndoor Skate catches during the 2022 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

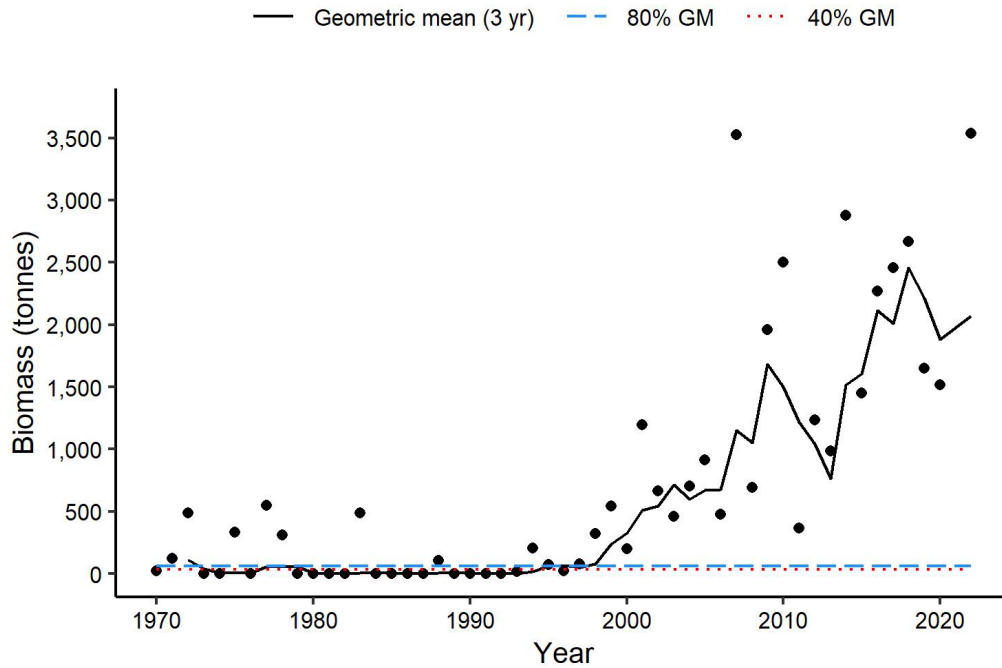


Figure 18b. Biomass index for Barndoor Skate in 4X from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2020), respectively. The black dots represent the biomass index for that year.

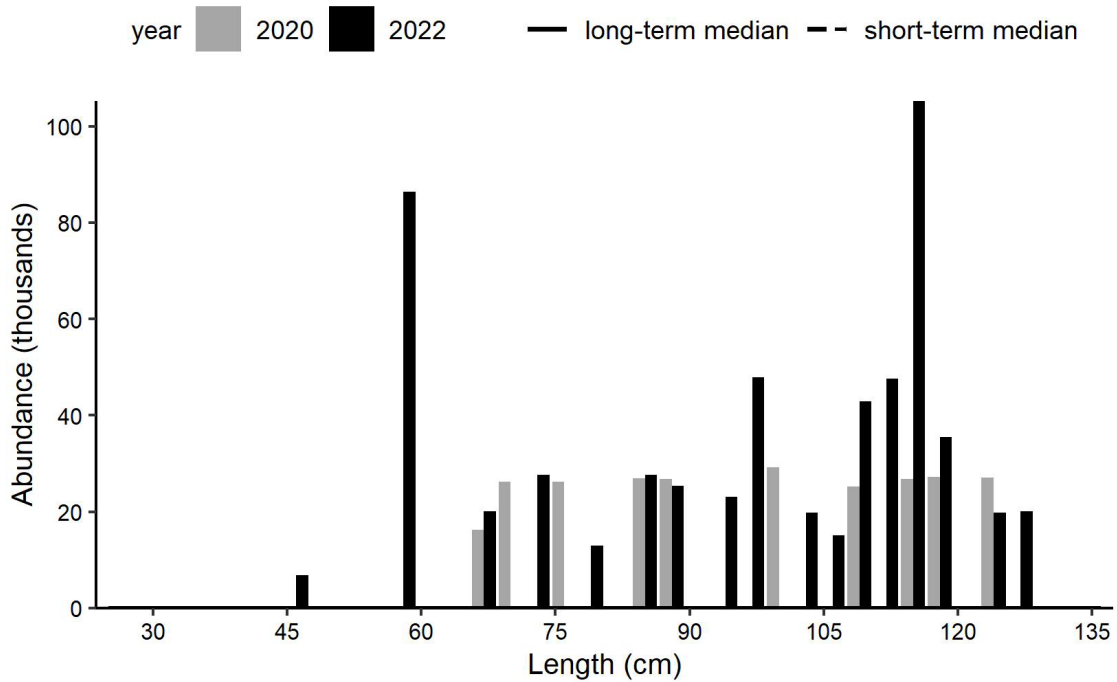


Figure 18c. Length frequency indices for Barndoor Skate in 4X from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2022 survey. Grey bars represent the number in thousands at length from the 2020 survey.

Thorny Skate

Thorny Skate (*Amblyraja radiata*) were caught at only six stations in 2022 (Figure 19a). In 4X, the biomass index in 2022 is the lowest in the series and the 3-yr GM has been below 40% of the long-term GM since 2009 (Figure 19b). Only six individuals were caught in 2022, four of which were in 4X (Figure 19c).

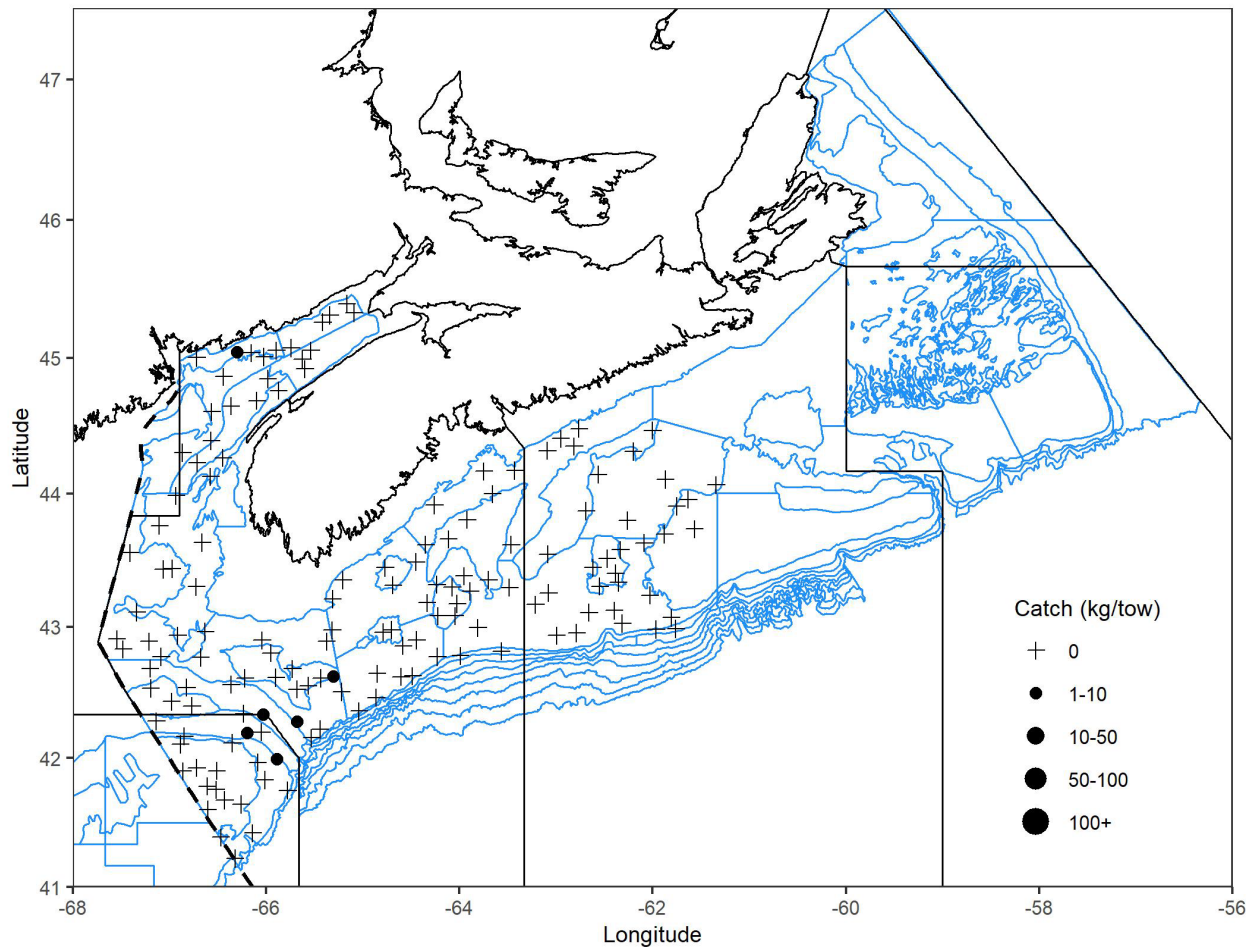


Figure 19a. Distribution of Thorny Skate catches during the 2022 DFO Summer RV Survey including the Laurentian channel and Georges Bank. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

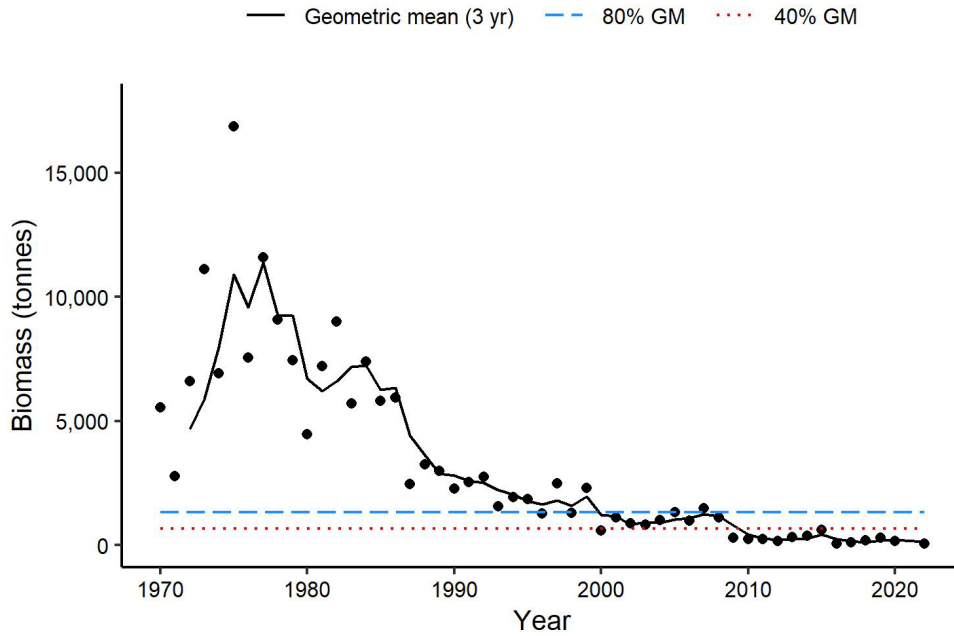


Figure 19b. Biomass index for Thorny Skate in 4X from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2020), respectively. The black dots represent the biomass index for that year.

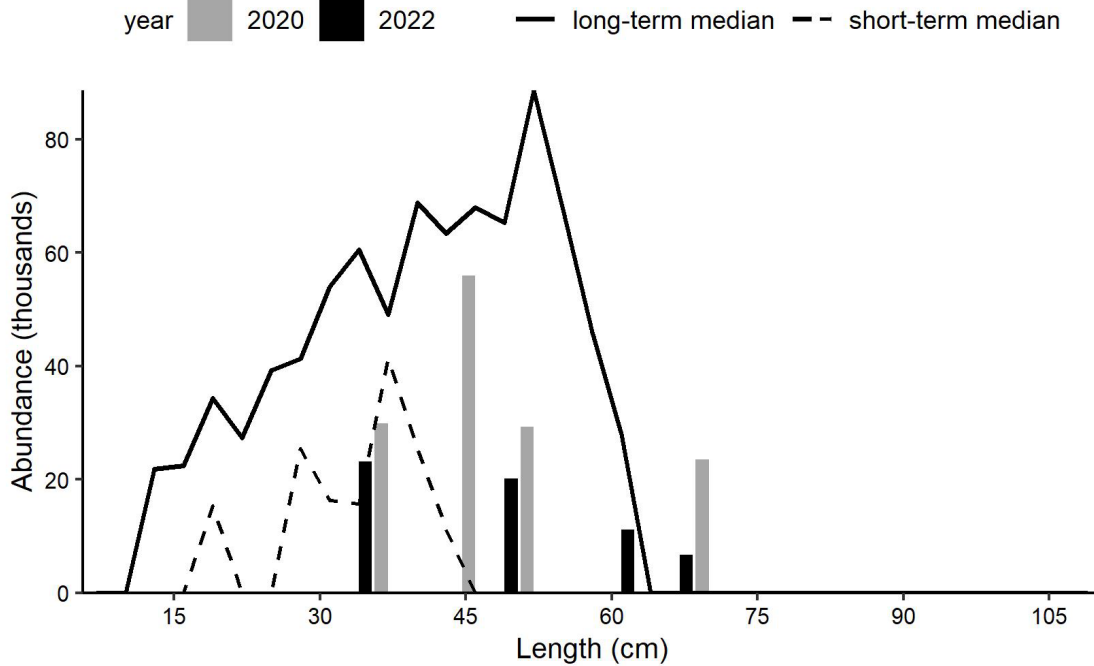


Figure 19c. Length frequency indices for Thorny Skate in 4X from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2022 survey. Grey bars represent the number in thousands at length from the 2020 survey. The solid black line represents the median in thousands at length for the time period 1970–2019. The dashed black line represents the median in thousands at length for the time period 2010–2019.

Winter Skate

Winter Skate (*Leucoraja ocellata*) and Little Skate (*Leucoraja erinacea*) cannot be reliably distinguished at lengths less than about 40 cm (for more information, see McEachran and Musick 1973). The practice at sea in most years was to record immature Winter and Little skates for which the identification was uncertain as Winter Skates. Given that the majority of the skates recorded as Winter Skates in the surveys are in this length range, the biomass trends were influenced by the contribution of fish for which identification was uncertain. For this document, only Winter Skates > 40 cm are included in calculating the biomass indices.

Winter Skate were caught primarily on Georges Bank, with some catches in the Bay of Fundy (Figure 20a). In 4X, the 3-yr GM remains above 80% of the long-term GM (Figure 20b). Abundance indices are above both the short- and long-term medians for most lengths (Figure 20c).

The biomass index for Georges Bank from the 2022 Summer RV Survey was 30,132 t; this is 43 times the index for 4X and 30 times the index for Georges Bank in the winter survey. The Designatable Unit (DU) for Winter Skate includes both 4X and 5Z; however, they are seldom caught in the deeper water of the Fundian Channel between Browns Bank and Georges Bank. While it may be appropriate to review the biomass trends for 4X and 5Zc separately, summer survey data may be useful in reviewing the status of Winter Skate on Georges Bank.

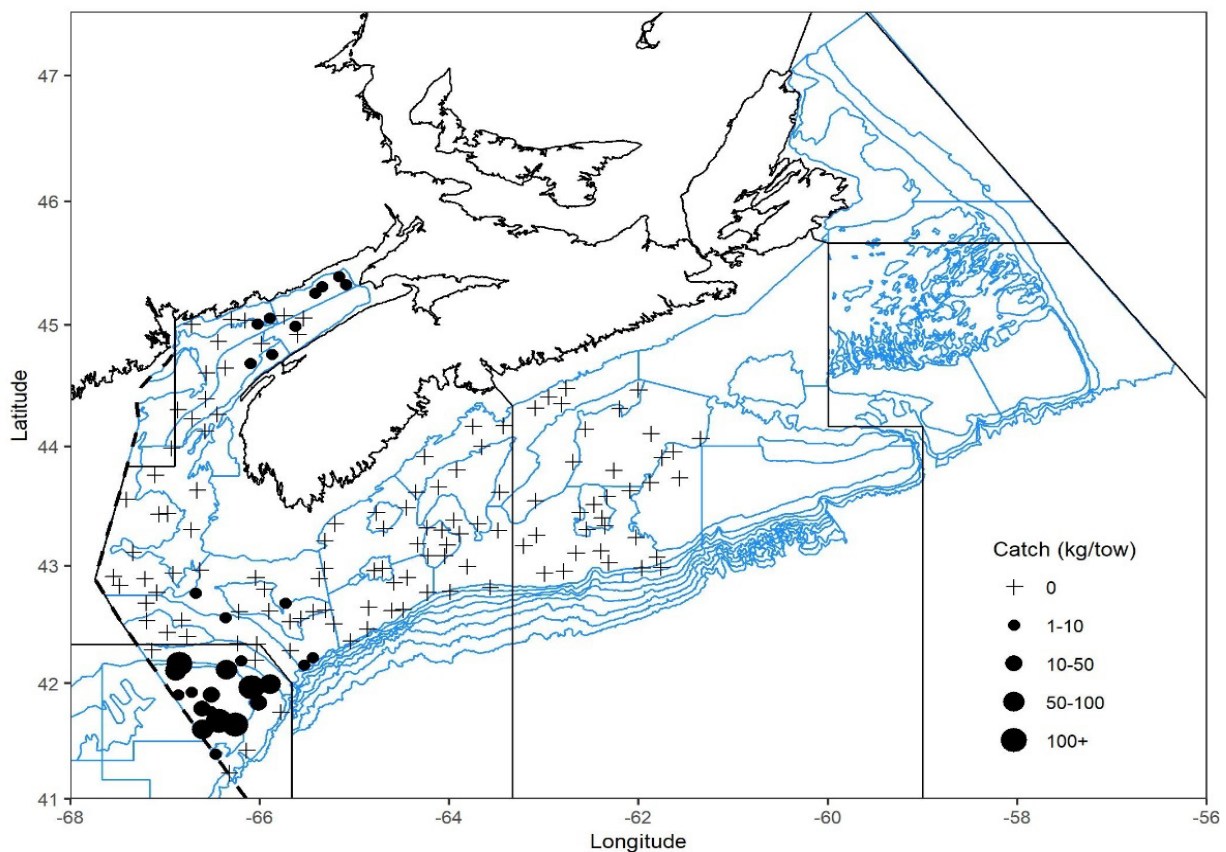


Figure 20a. Distribution of Winter Skate catches during the 2022 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

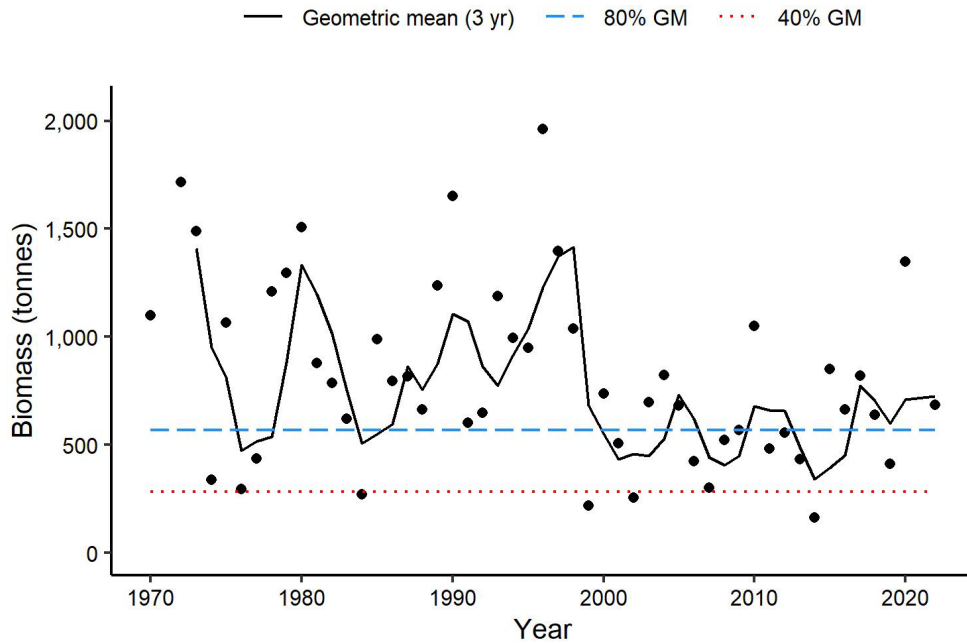


Figure 20b. Biomass index for Winter Skate > 40 cm in 4X from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2020), respectively. The black dots represent the biomass index for that year.

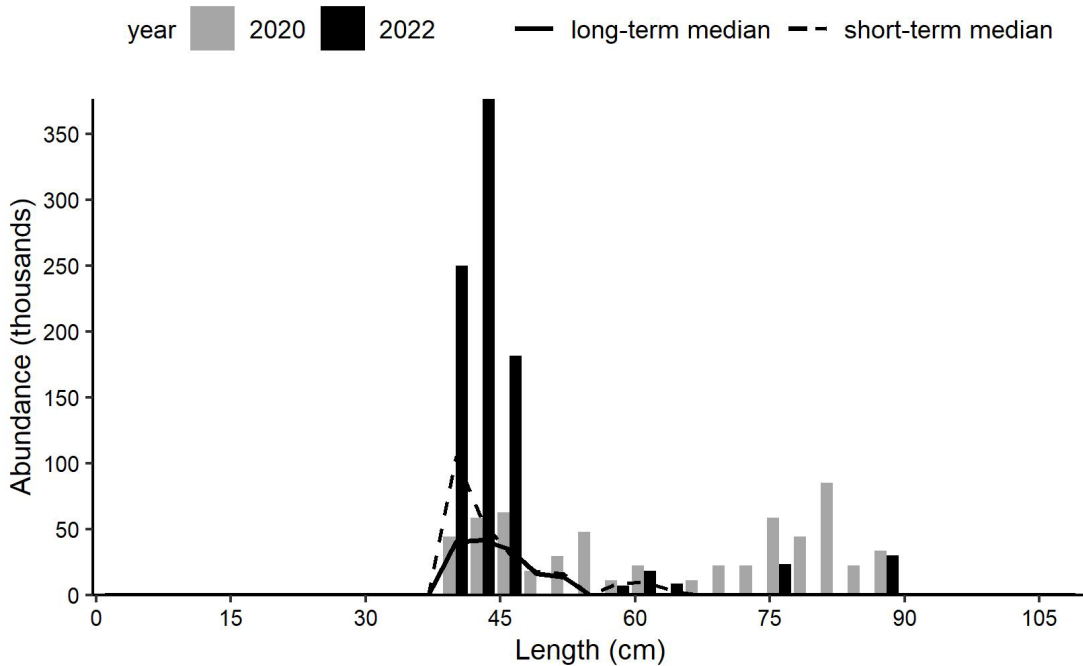


Figure 20c. Length frequency indices for Winter Skate > 40 cm in 4X from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2022 survey. Grey bars represent the number in thousands at length from the 2020 survey. The solid black line represents the median in thousands at length for the time period 1970–2019. The dashed black line represents the median in thousands at length for the time period 2010–2019.

Little Skate

Winter Skate (*Leucoraja ocellata*) and Little Skate (*Leucoraja erinacea*) cannot be reliably distinguished when immature (for more information, see McEachran and Musick 1973). The practice at sea in most years was to record these immature skates as Winter Skates. Little Skate begin to mature at about 32 cm and can then be easily distinguished from Winter Skate. For this document, only Little Skates > 32 cm are included in the long-term average length frequency.

Little Skate were caught primarily on Browns Bank, Georges Bank, in the Bay of Fundy and along the western Scotian Shelf edge (Figure 21a). The 3-yr GM for 4X is the highest in the series and remains well above 80% of the long-term GM (Figure 20b). Abundance indices remain above both the long- and short-term medians for most lengths (Figure 21c).

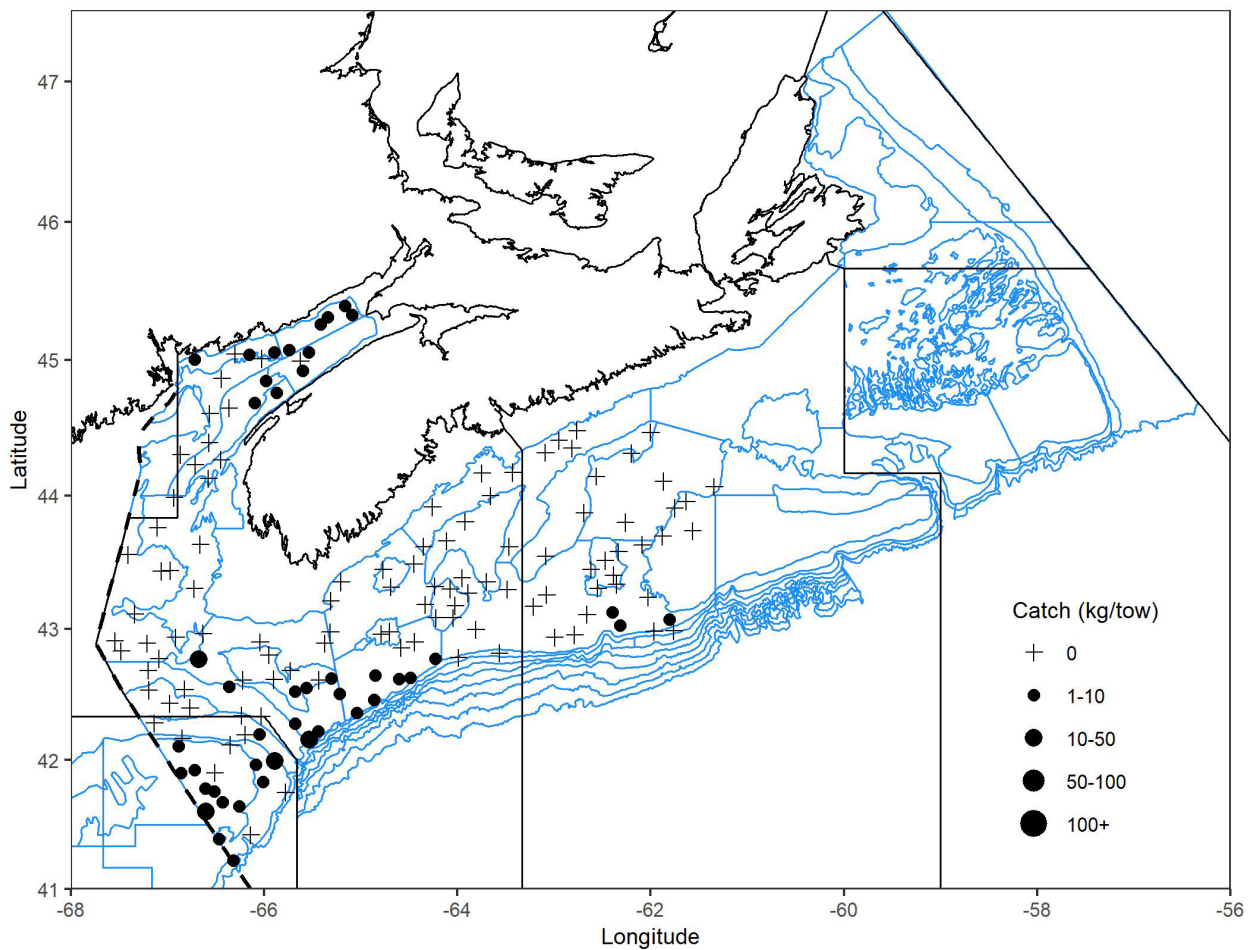


Figure 21a. Distribution of Little Skate catches during the 2022 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

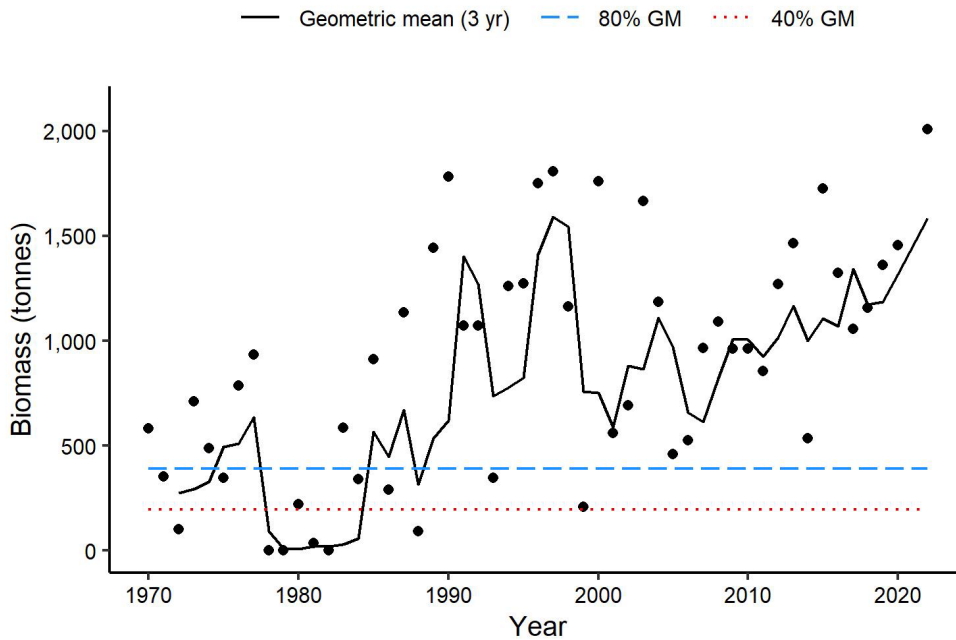


Figure 21b. Biomass index for Little Skate in 4X from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2020), respectively. The black dots represent the biomass index for that year.

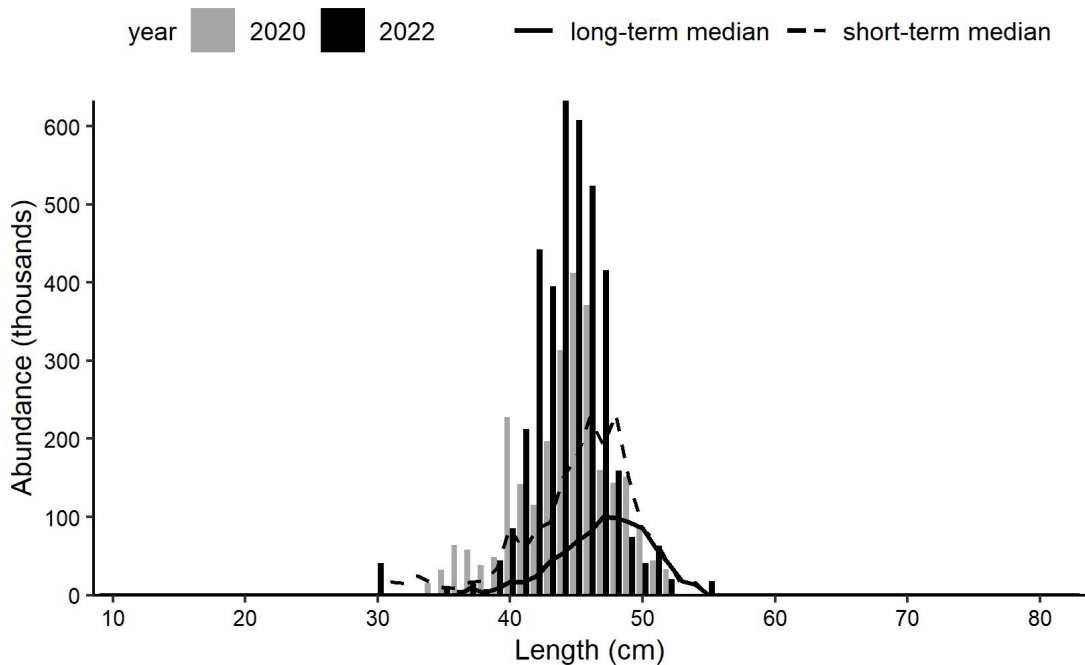


Figure 21c. Length frequency indices for Little Skate in 4X from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2022 survey. Grey bars represent the number in thousands at length from the 2020 survey. The solid black line represents the median in thousands at length for the time period 1970–2019. The dashed black line represents the median in thousands at length for the time period 2010–2019.

Smooth Skate

Smooth Skate (*Malacoraja senta*) were caught primarily in western 4X in the Gulf of Maine and Bay of Fundy (Figure 22a). In 4X, the 3-yr GM has increased from its lowest point in the early 1990s and fluctuated around 80% of the long-term GM in recent years (Figure 22b). In 2022, it remains above 80% of the long-term GM. Abundance indices were above the long-term median for most lengths in 2022 (Figure 22c).

Biomass indices for Smooth Skate in the Winter RV Survey are higher than those from the Summer RV Survey and, in recent years, winter survey biomass indices have been higher in 4X than in the late 1970s and early 1980s. Winter RV Surveys have used the Western Ila trawl in all years, whereas the trawl used for the Summer RV Survey changed in 1982 from a Yankee 36 to the Western Ila. No conversion factor has been calculated for Smooth Skate in relation to this change in net.

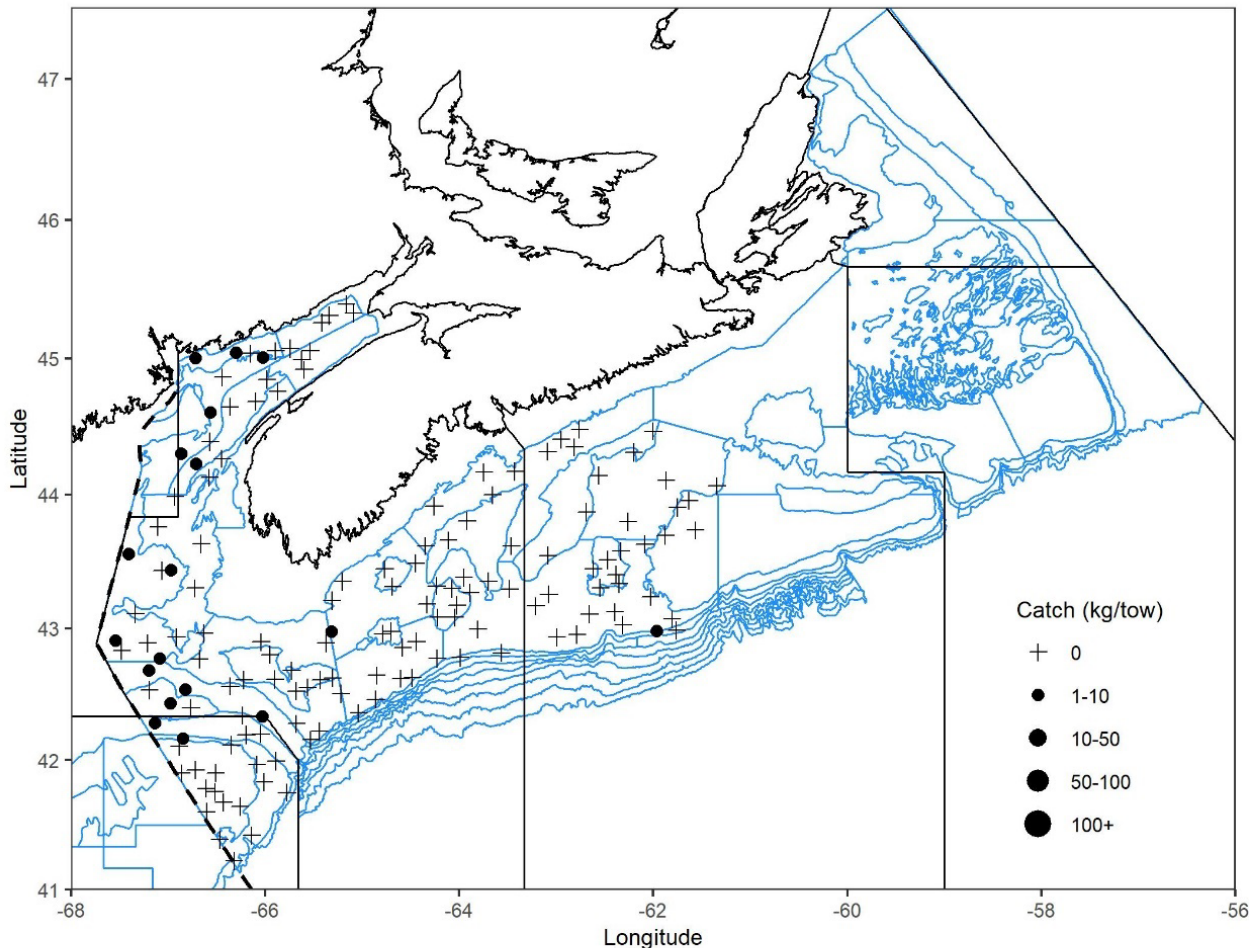


Figure 22a. Distribution of Smooth Skate catches during the 2022 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

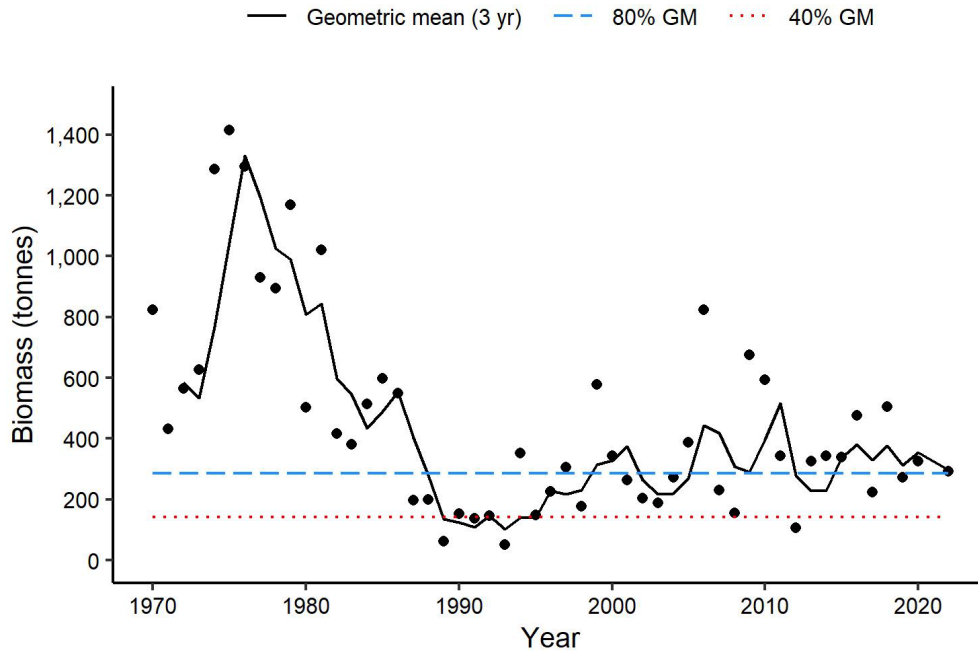


Figure 22b. Biomass index for Smooth Skate in 4X from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2020), respectively. The black dots represent the biomass index for that year.

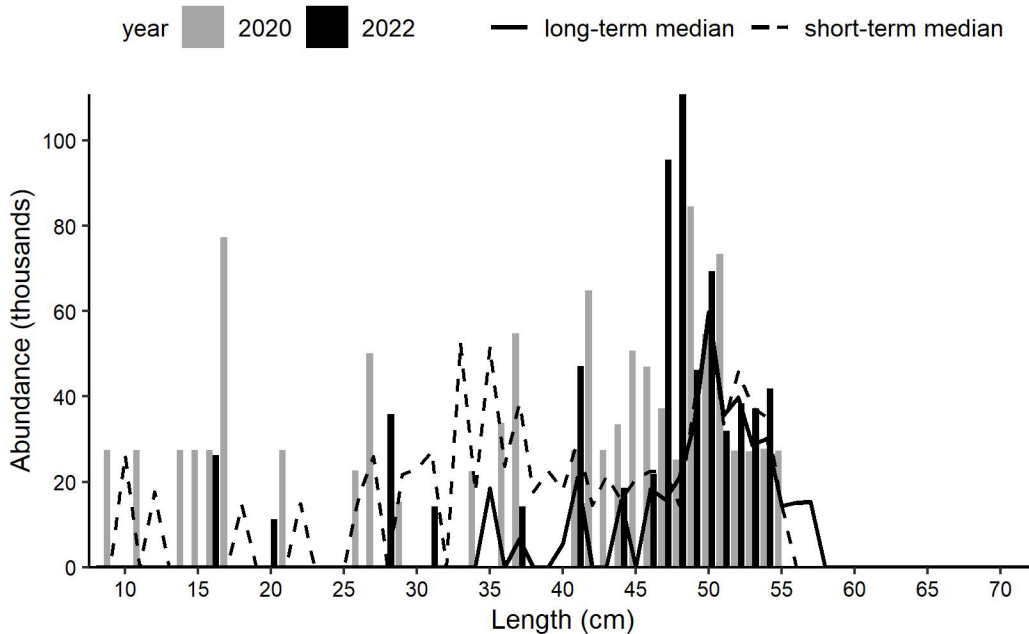


Figure 22c. Length frequency indices for Smooth Skate in 4X from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2022 survey. Grey bars represent the number in thousands at length from the 2020 survey. The solid black line represents the median in thousands at length for the time period 1970–2019. The dashed black line represents the median in thousands at length for the time period 2010–2019.

Spiny Dogfish

Spiny Dogfish (*Squalus acanthias*) are well distributed in 4X and on Georges Bank (Figure 23a). The Summer RV Survey did not cover the entire index area for Spiny Dogfish (4VWX) in 2022; however, catches in 4X contribute on average approximately 95% of the total biomass for the index area.

Inter-annual variability in survey catch is high for Spiny Dogfish. In 4X, the 3-yr GM biomass index is above 80% of the long-term GM in 2022 (Figure 23b). The indices-at-length are generally at or below the median values for most lengths in 2022 (Figure 23c). The Spiny Dogfish population extends across the Canada-United States (US) boundary, with the majority of the population in US waters in most years. The biomass index for 5Zc was 33,605 t compared to 44,495 t for 4X. Dogfish caught on Georges Bank were smaller than in 4X, with the indices-at-length peaking at 55–58 cm.

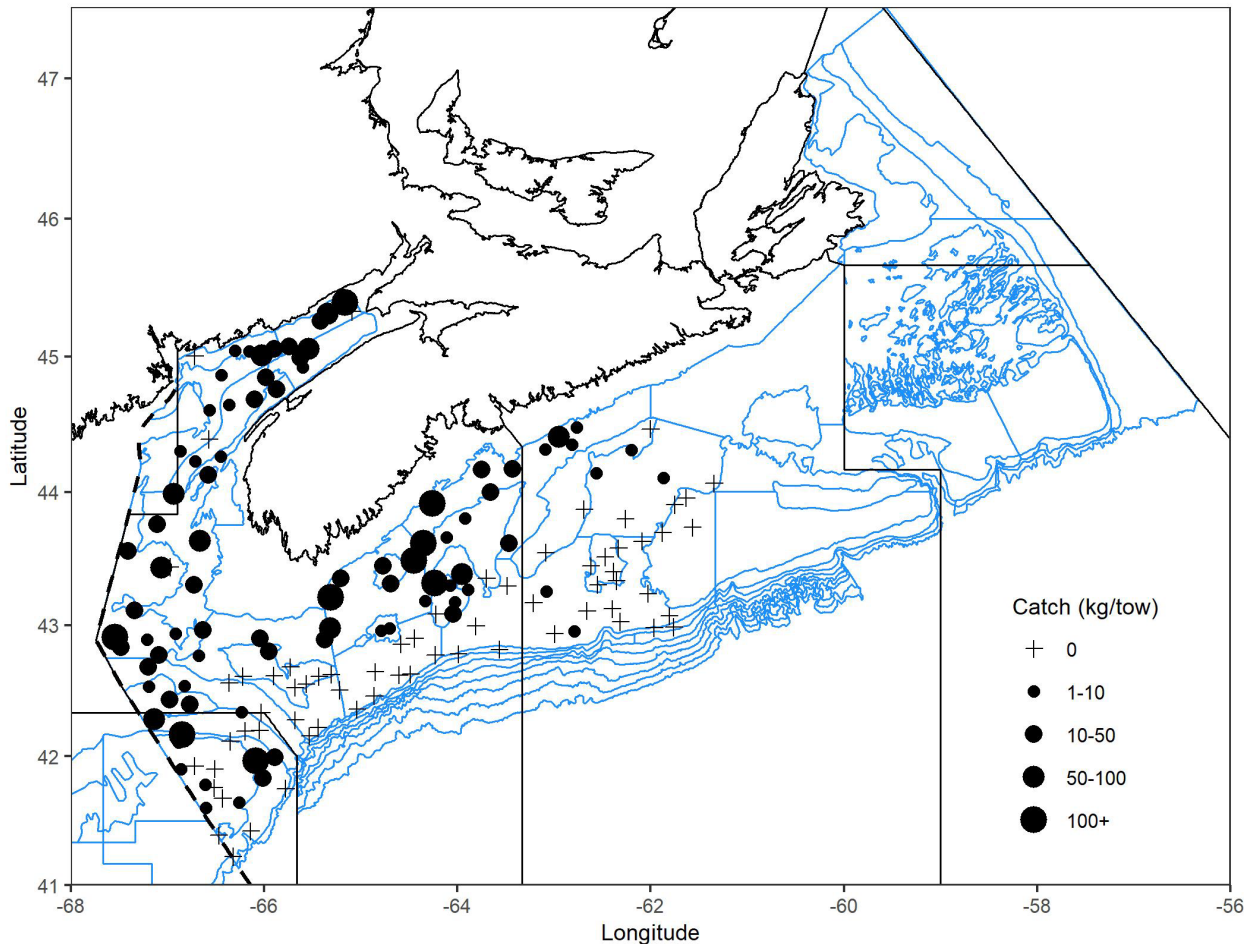


Figure 23a. Distribution of Spiny Dogfish catches during the 2022 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

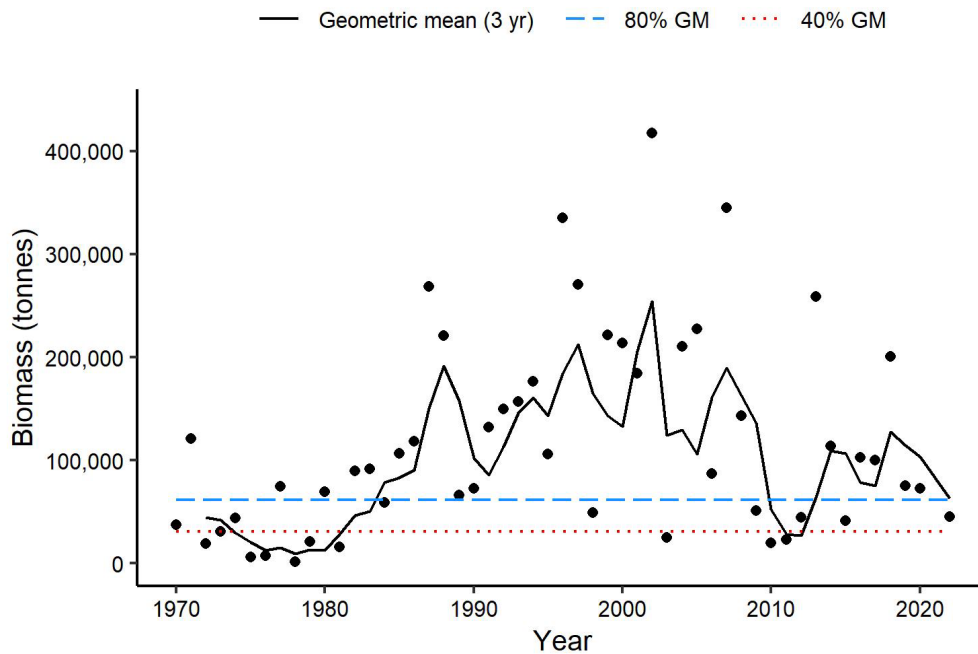


Figure 23b. Biomass index for Spiny Dogfish in 4X from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2020), respectively. The black dots represent the biomass index for that year.

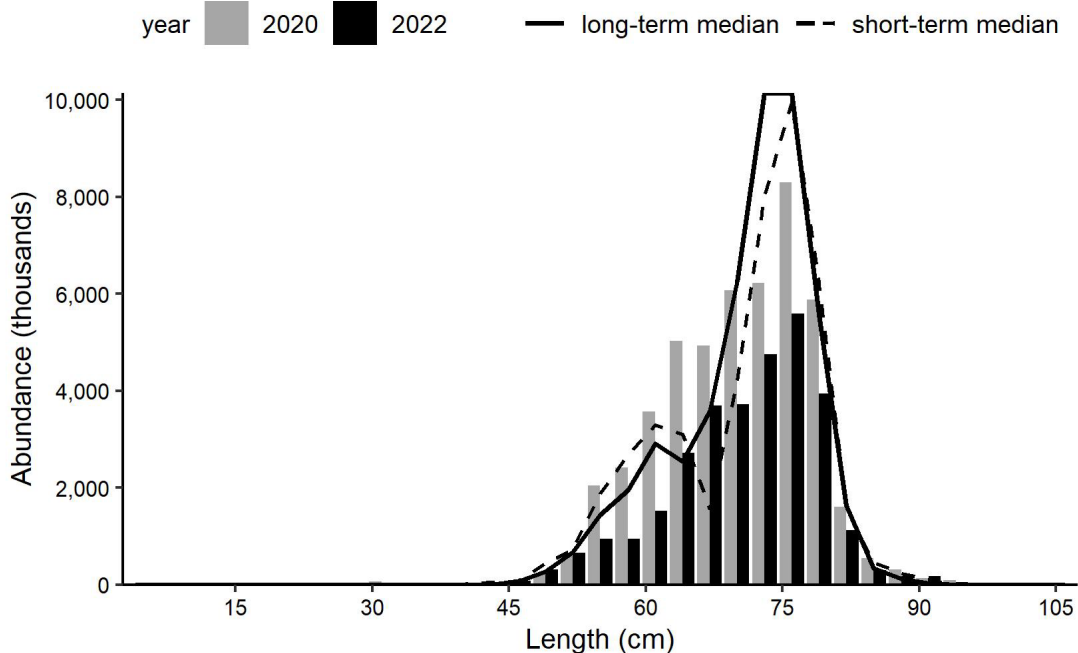


Figure 23c. Length-frequency indices for Spiny Dogfish in 4X from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2022 survey. Grey bars represent the number in thousands at length from the 2020 survey. The solid black line represents the median in thousands at length for the time period 1970–2019. The dashed black line represents the median in thousands at length for the time period 2010–2019.

Red Hake

Red Hake (*Urophycis chuss*) can be difficult to distinguish from White Hake. Prior to about 1985, these two species were not consistently separated. The standard guide to Canadian Atlantic Fishes (Leim and Scott 1966) did not differentiate them.

Red Hake were caught throughout the area covered in 2022 (Figure 24a). In 4X, the 2022 biomass index and 3-yr GM are the second highest in the time series (Figure 24b) but are largely influenced by one big tow (182 kg) near the edge of the Fundian Channel (Figure 24a). The short-term median numbers-at-length are generally higher than the long-term median in 4X, indicating a general increase in abundance. The indices-at-length in 2022 are above the short-term and long-term median values for all lengths > 20 cm (Figure 24c).

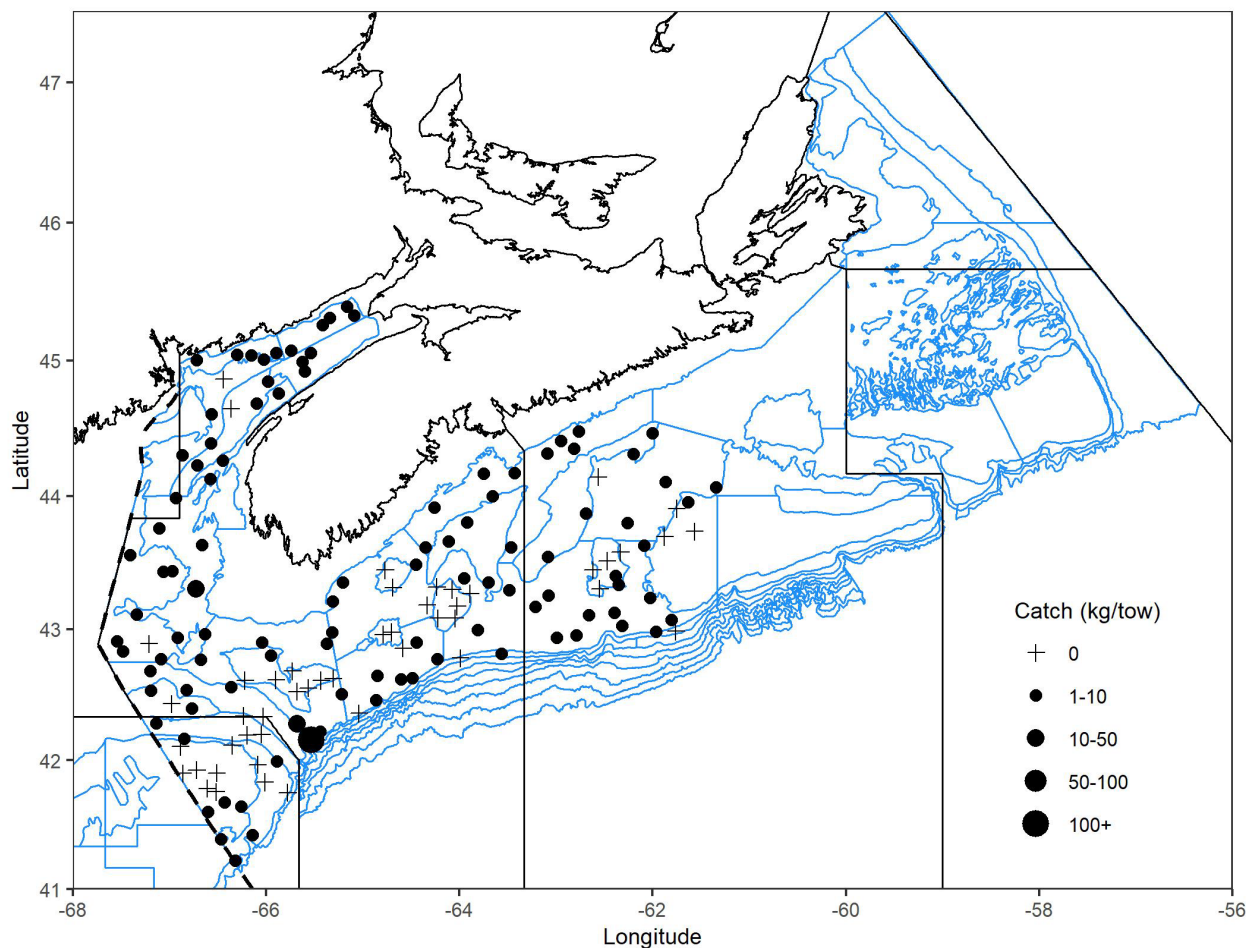


Figure 24a. Distribution of Red Hake catches during the 2022 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

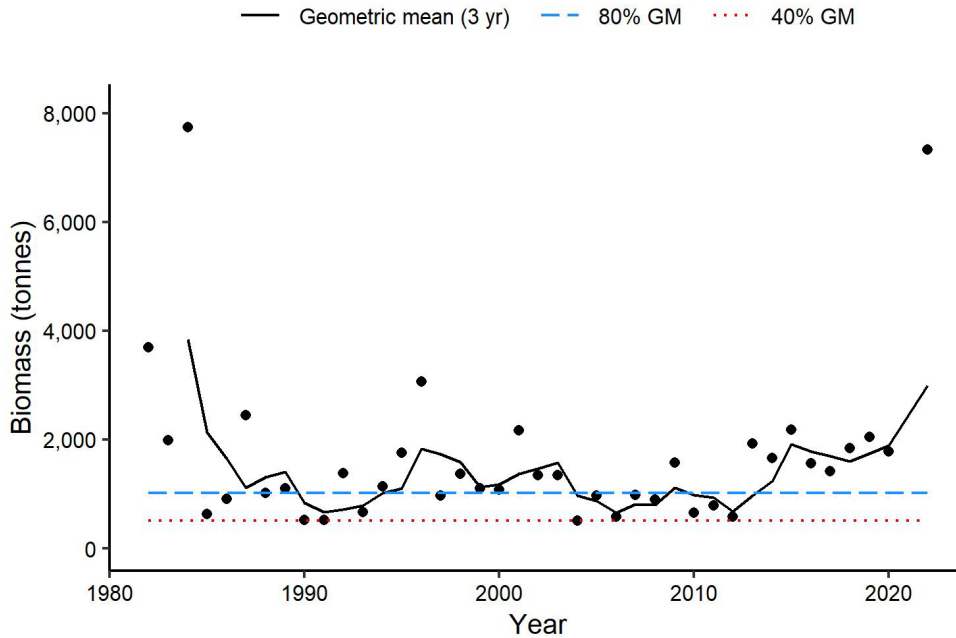


Figure 24b. Biomass index for Red Hake in 4X from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1982–2020), respectively. The black dots represent the biomass index for that year.

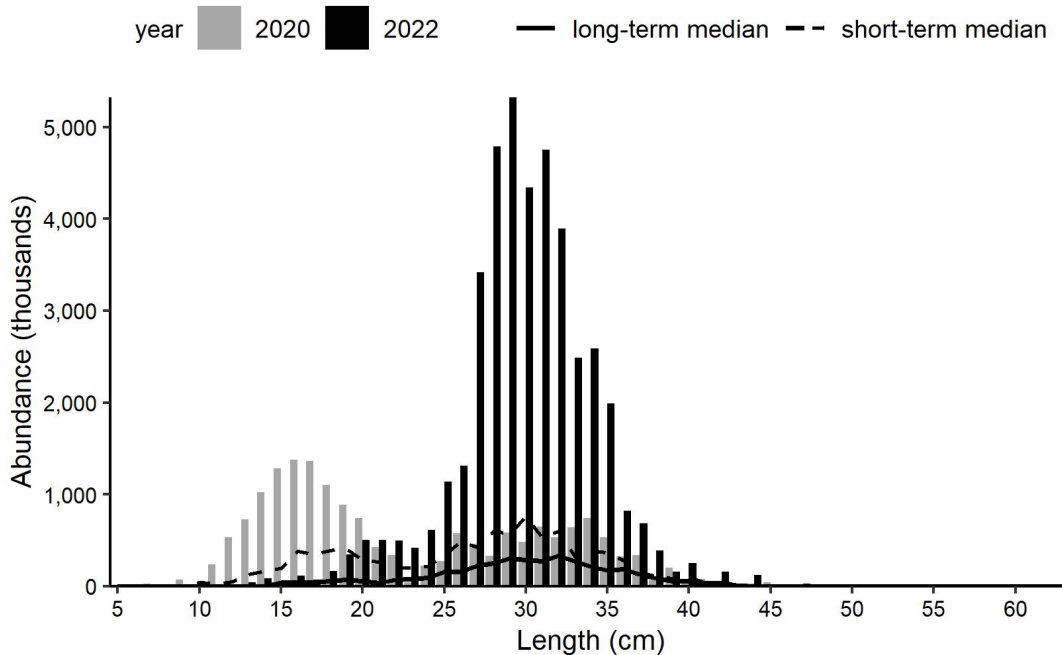


Figure 24c. Length frequency indices for Red Hake in 4X from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2022 survey. Grey bars represent the number in thousands at length from the 2020 survey. The solid black line represents the median in thousands at length for the time period 1982–2019. The dashed black line represents the median in thousands at length for the time period 2010–2019.

Sea Raven

Sea Raven (*Hemitripteris americanus*) are caught primarily on the banks and in the Bay of Fundy (Figure 25a). In 4X, the 2022 biomass index remained above 80% of the long-term GM after increasing from the lowest in the time series in 2019, while the 3-yr GM remained among the lowest in the series (Figure 25b). The indices-at-length in 2022 are generally above the long-term median for most lengths (Figure 25c).

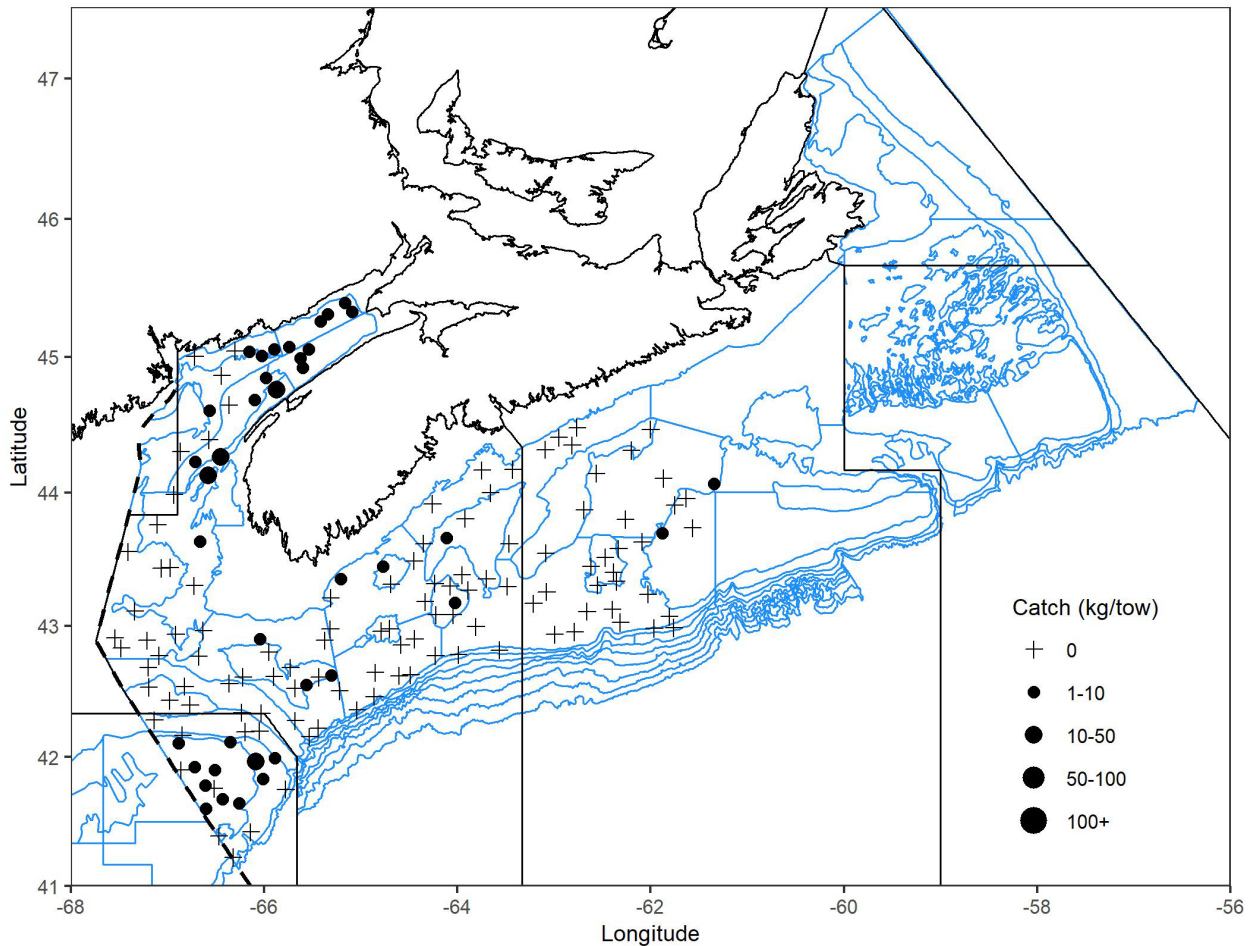


Figure 25a. Distribution of Sea Raven catches during the 2022 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

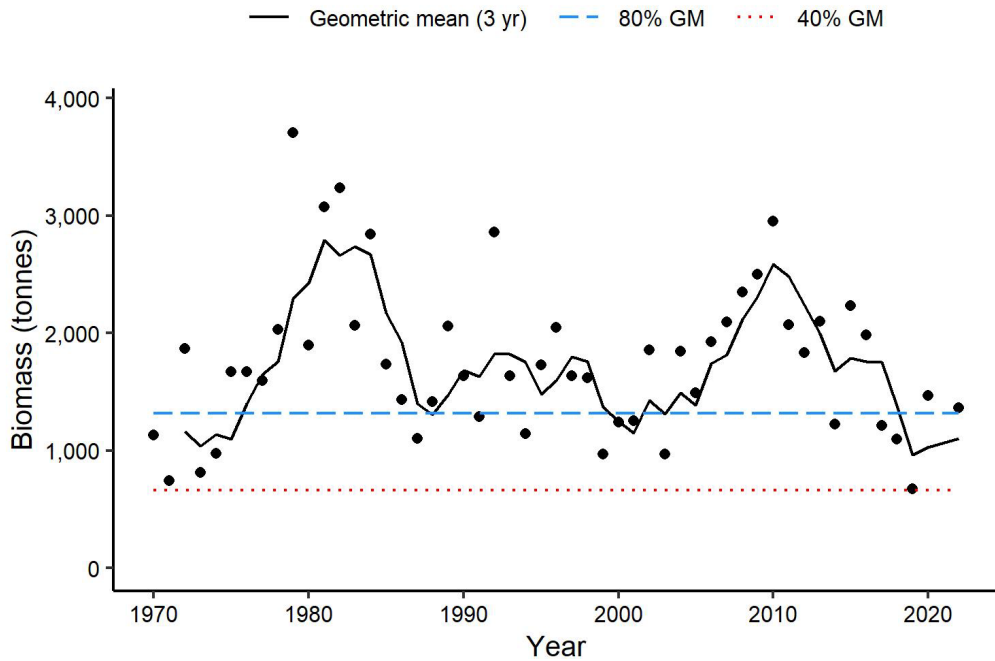


Figure 25b. Biomass index for Sea Raven in 4X from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2020), respectively. The black dots represent the biomass index for that year.

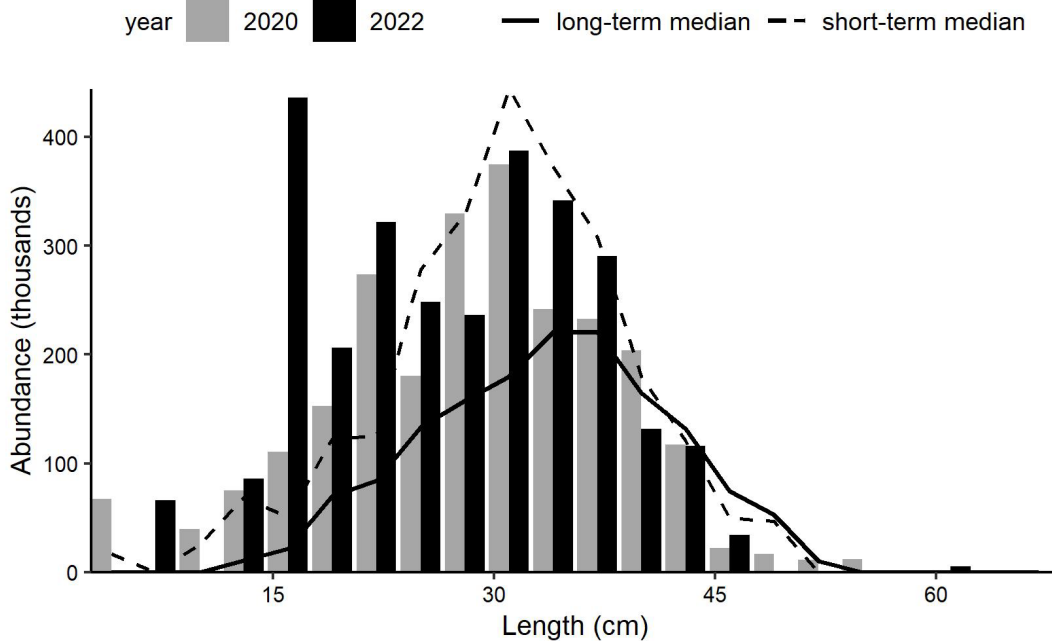


Figure 25c. Length frequency indices for Sea Raven in 4X from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2022 survey. Grey bars represent the number in thousands at length from the 2020 survey. The solid black line represents the median in thousands at length for the time period 1970–2019. The dashed black line represents the median in thousands at length for the time period 2010–2019.

Ocean Pout

Ocean Pout (*Zoarces americanus*) were caught primarily on Georges Bank in 2022 (Figure 26a). In 4X, the 3-yr GM is the lowest in the time series and has been below 40% of the long-term GM for the last 8 years (Figure 26b). Catches of larger Ocean Pout are very low relative to the median values in 4X (Figure 26c).

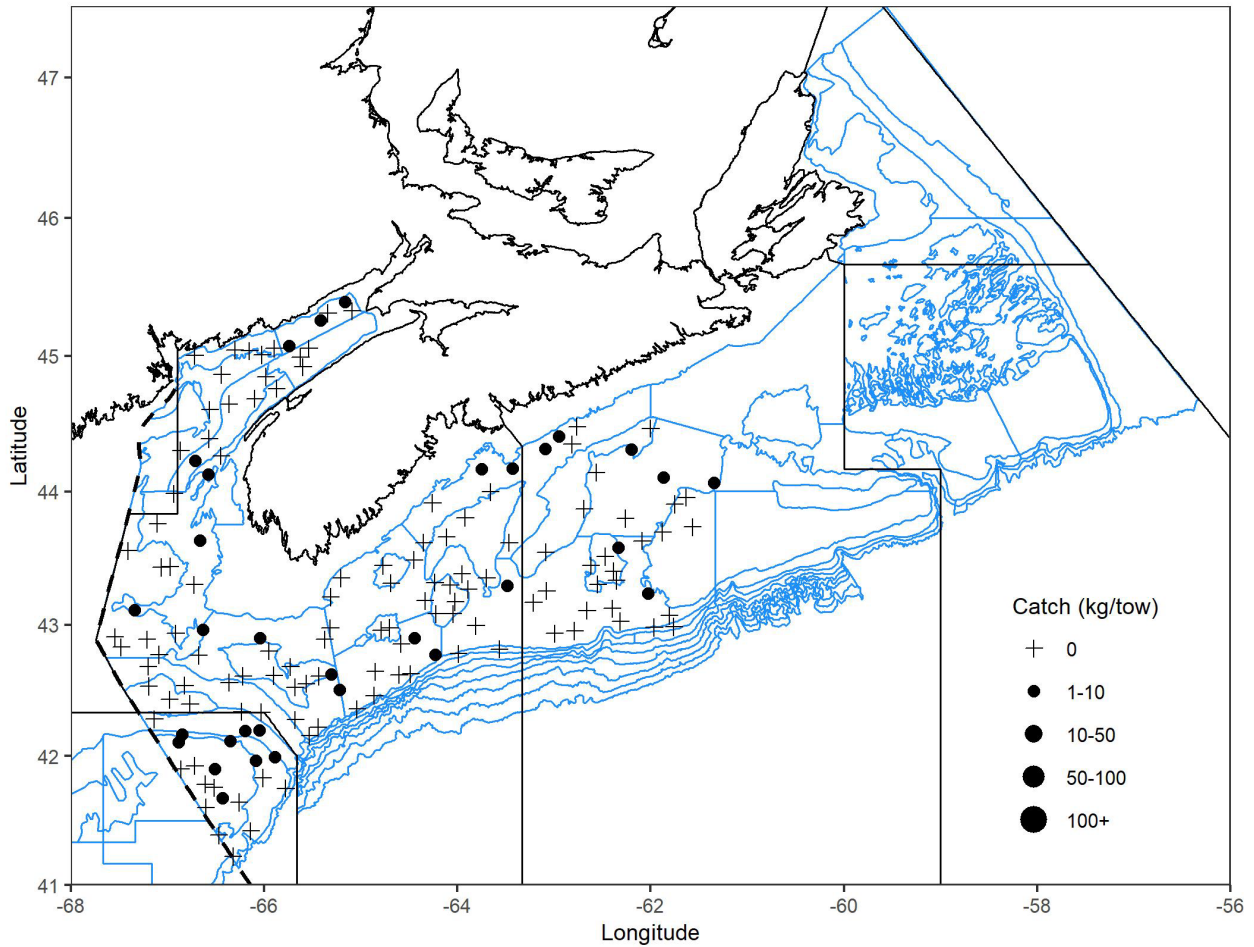


Figure 26a. Distribution of Ocean Pout catches during the 2022 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

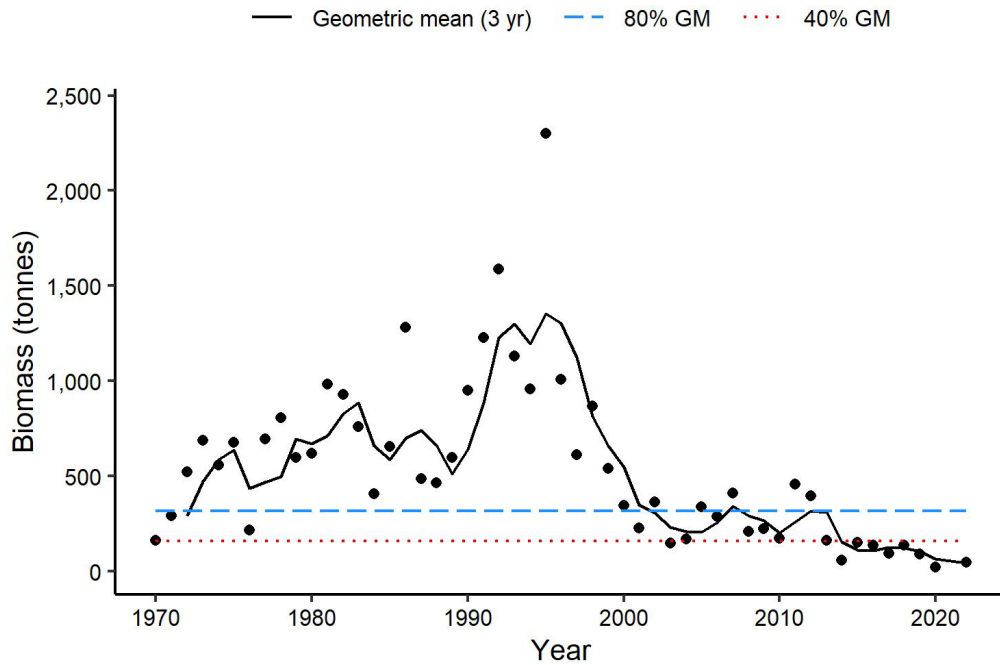


Figure 26b. Biomass index for Ocean Pout in 4X from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2020), respectively. The black dots represent the biomass index for that year.

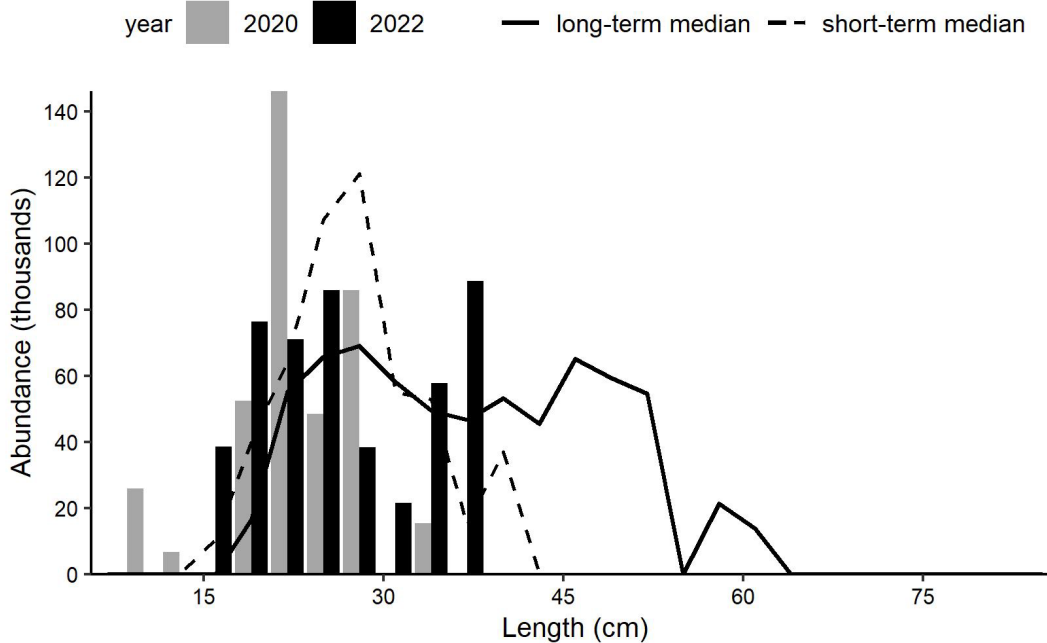


Figure 26c. Length frequency indices for Ocean Pout in 4X from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2022 survey. Grey bars represent the number in thousands at length from the 2020 survey. The solid black line represents the median in thousands at length for the time period 1970–2019. The dashed black line represents the median in thousands at length for the time period 2010–2019.

Blackbelly Rosefish

Blackbelly Rosefish (*Helicolenus dactylopterus*) are caught primarily in the deeper warmer waters of the Fundian Channel and along the edge of the Scotian Shelf during the Summer RV Survey (Figure 27a). They would also generally be found in the deeper strata along the shelf edge (370 m–750 m); however, these strata were not sampled in 2022 due to lost vessel time. Blackbelly Rosefish have been caught in the survey in all years since 1980, but their biomass index has increased since 1990 and has varied at a higher level since about 2004 (Figure 27b). Due to incomplete survey coverage in 2022, a biomass index is not available for the 4VWX index area; however, in 4X, the 3-yr GM and biomass index in 2022 are the highest in the series.

The short-term median indices-at-length are generally higher than the long-term indices-at-length, particularly above 25 cm; this reflects the overall increase in abundance, particularly for larger fish, which were rarely caught earlier in the series (Figure 27c). In 2022, indices-at-length in 4X were above the short-term median values for all lengths except fish between 9–15 cm (Figure 27c).

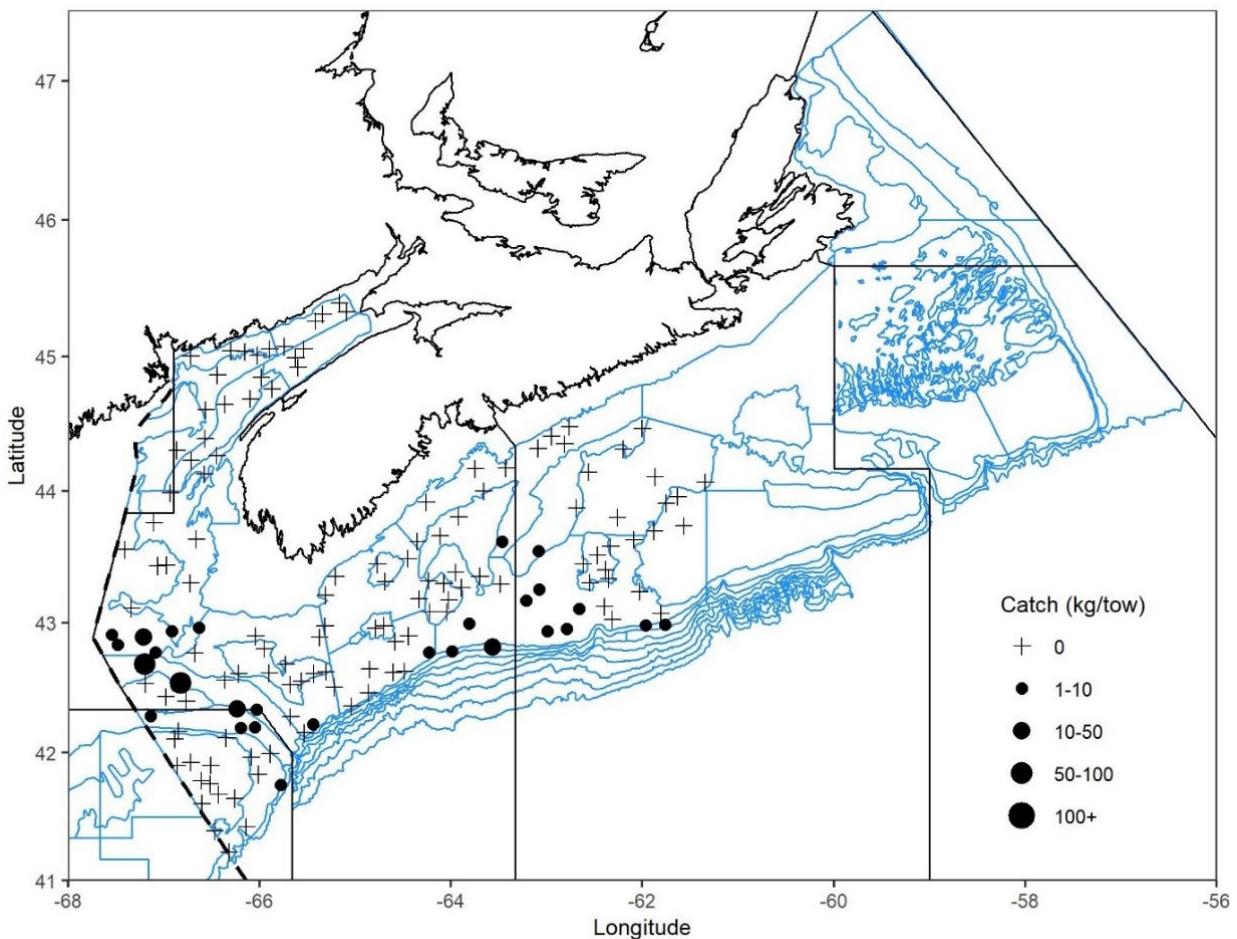


Figure 27a. Distribution of Blackbelly Rosefish catches during the 2022 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

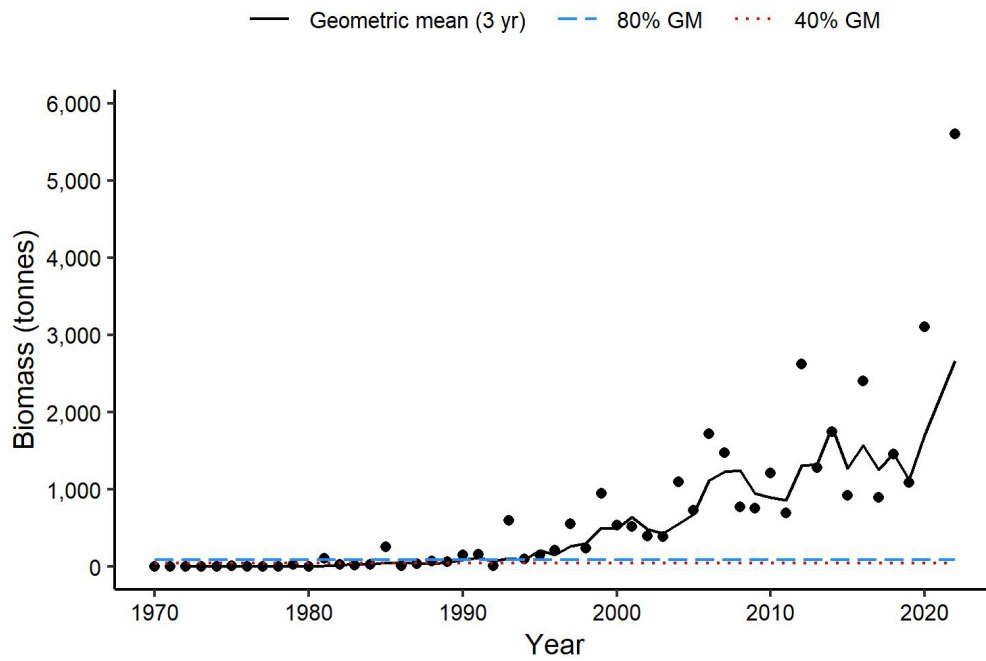


Figure 27b. Biomass index for Blackbelly Rosefish in 4X from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2020), respectively. The black dots represent the biomass index for that year.

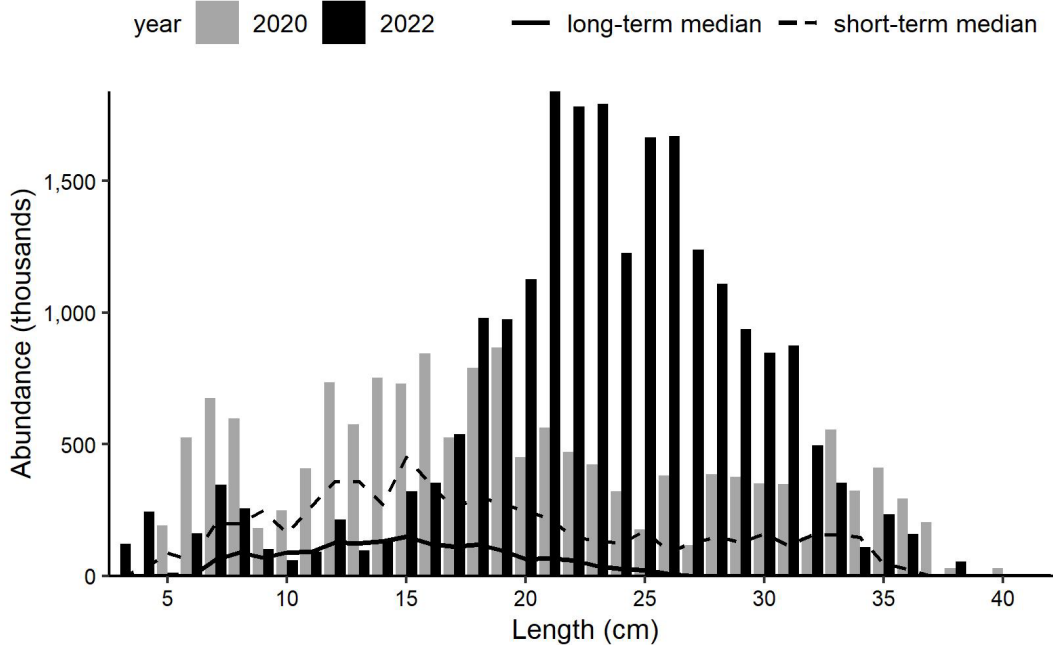


Figure 27c. Length frequency indices for Blackbelly Rosefish in 4X from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2022 survey. Grey bars represent the number in thousands at length from the 2020 survey. The solid black line represents the median in thousands at length for the time period 1970–2019. The dashed black line represents the median in thousands at length for the time period 2010–2019.

John Dory

John Dory (*Zenopsis conchifer*) are caught during the Summer RV Survey primarily in the deeper warmer waters along the edge of the Scotian Shelf and in the Scotian Gulf (South of Halifax), as well as in the Fundian Channel (Figure 28). John Dory catches were rare for most of the time series, but since 2014, they have been caught every year, with the largest catch exceeding 150 kg in 2018. While their distribution remains restricted within the survey area, they can be locally abundant. John Dory caught in the survey have included adults in spawning condition and juveniles as small as 5 cm. In 2022, John Dory were caught in four sets in 4WX and 5Z including the second largest catch in the time series (24 kg). Biomass indices for John Dory are not available for 2022 due to incomplete survey coverage, and indices for 4X are not representative given the majority of catches come from 4W.

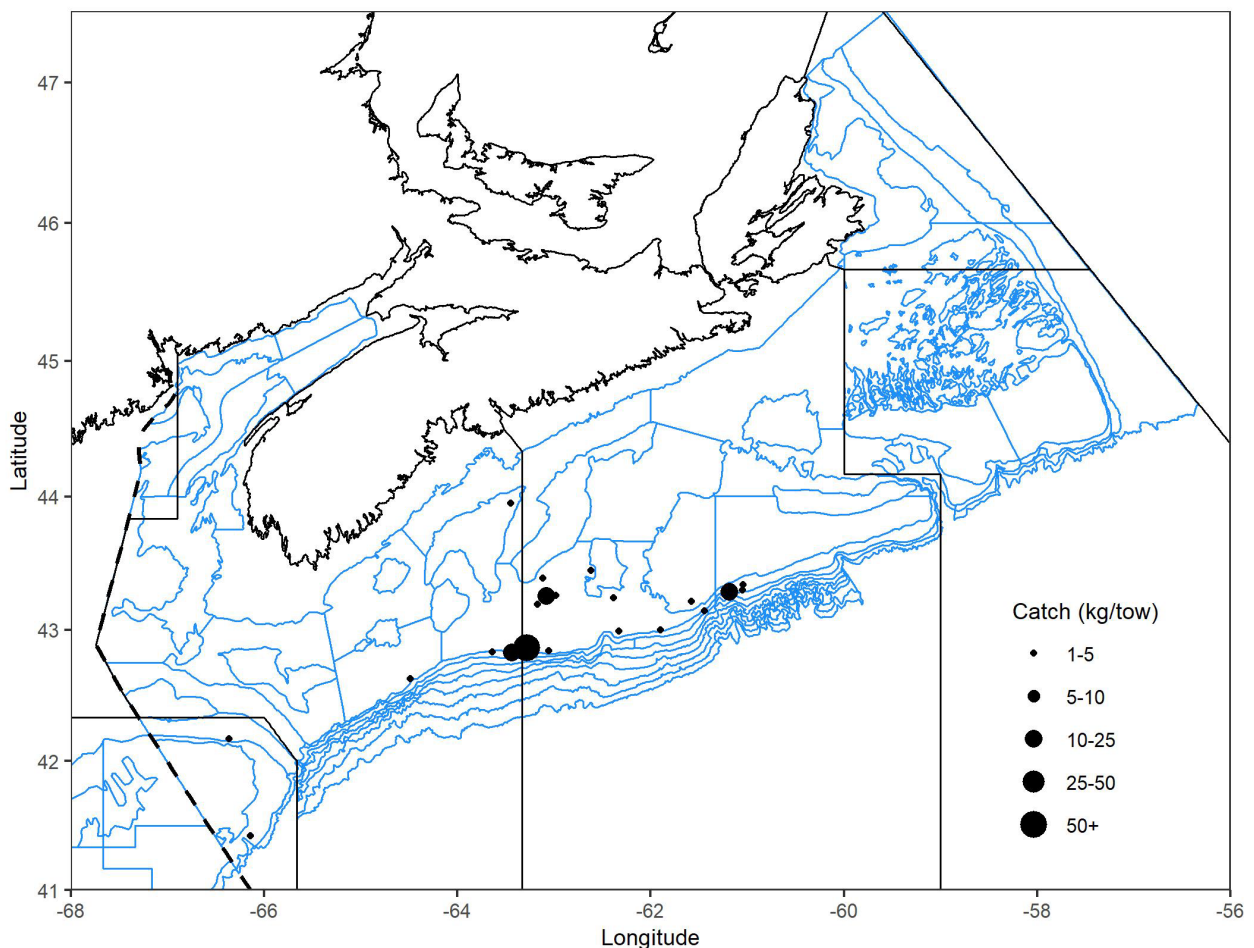


Figure 28. Distribution of John Dory catches during the DFO Summer RV Surveys from 2014–2022. Black circles represent catches. The circle area is proportional to the catch size.

Shortfin Squid

Shortfin Squid (*Illex illecebrosus*) are a short-lived, highly migratory species, with a broad distribution in the North Atlantic. They are caught throughout the survey area (Figure 29a). The 2022 Summer RV Survey did not cover the entire index area (4VWX) for Shortfin Squid; however, biomass indices for 4X are provided (Figure 29b).

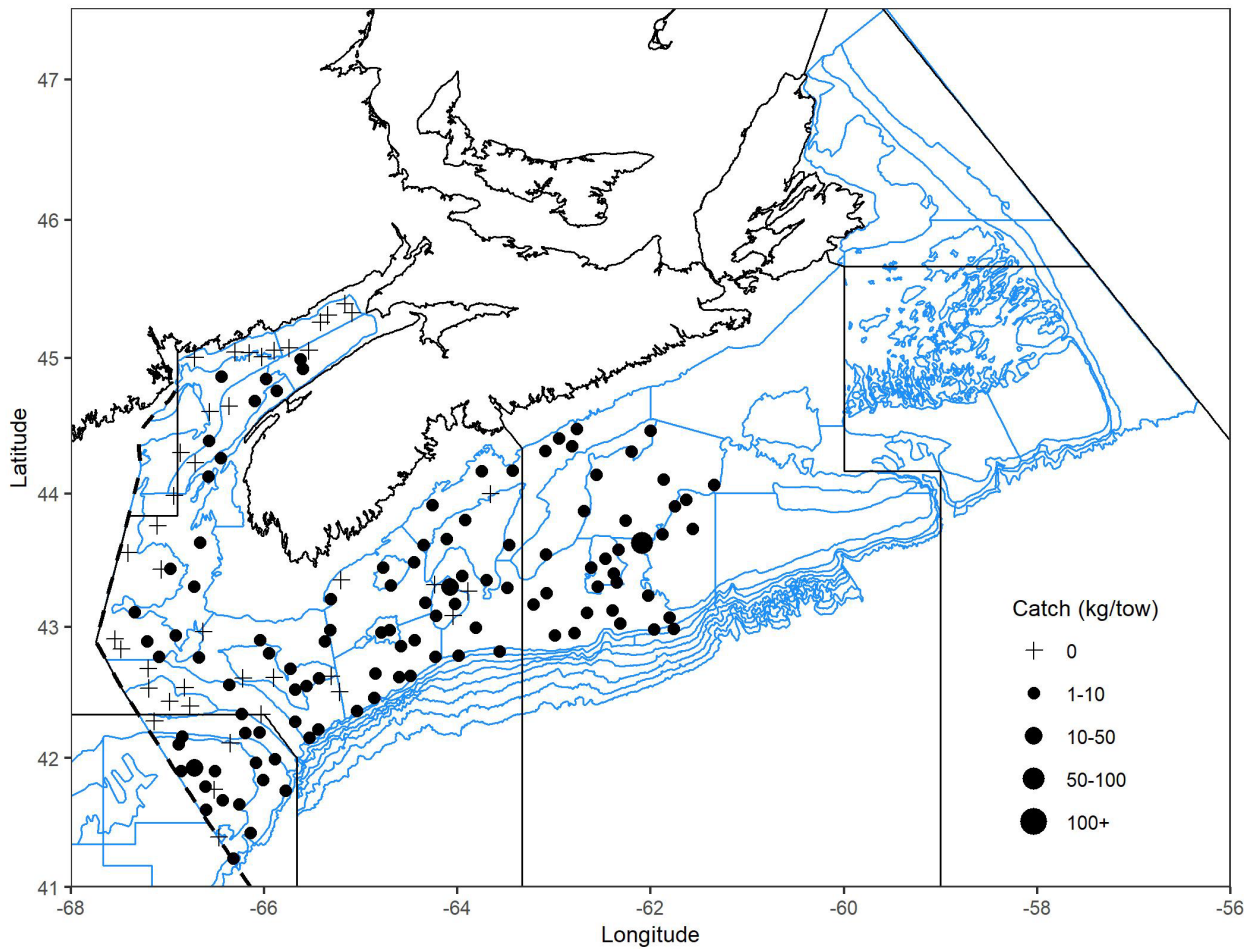


Figure 29a. Distribution of Shortfin Squid catches during the 2022 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

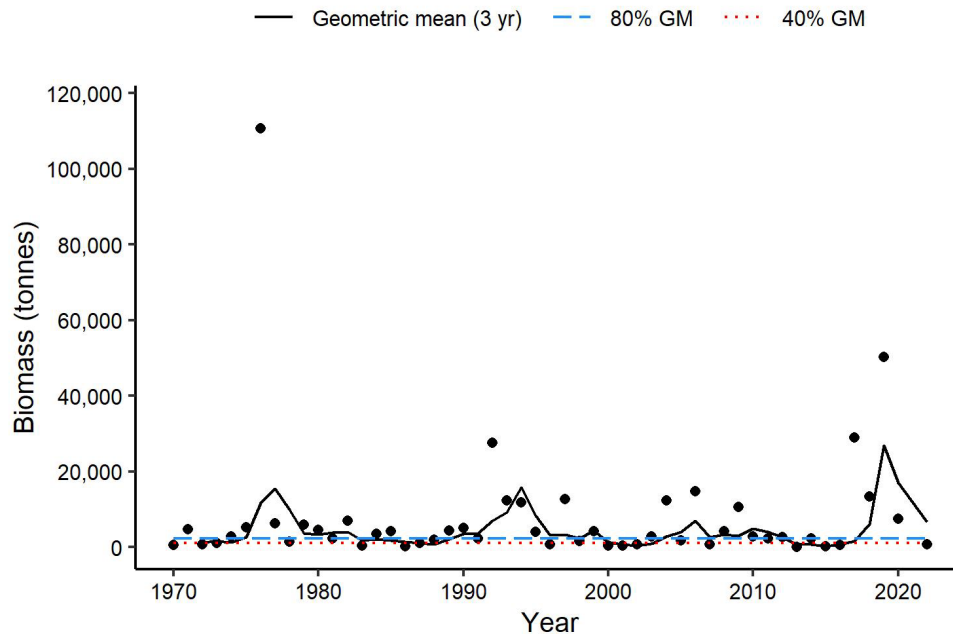


Figure 29b. Biomass index for Shortfin Squid in 4X from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2020), respectively. The black dots represent the biomass index for that year.

Other Species

Dusky Shark (*Carcharhinus obscurus*) is a large pelagic shark. None have been captured in any Maritimes Region survey, and these surveys are unlikely to provide useful information on distribution or abundance for this species.

Triggerfish (*Balistes capriscus*) are a demersal fish common off Florida and in other sub-tropical waters on both sides of the Atlantic. They are a demersal fish, which should be susceptible to capture by a bottom trawl; however, only one specimen has ever been caught in the Summer RV Survey time series. If these are being captured in commercial fisheries, it may be a seasonal migrant or may be found in depths not regularly sampled by the survey.

Tilefish (*Lopholatilus chamaeleonticeps*) are large, slow-growing fish found in deep, warm waters off the US coast from the Gulf of Mexico to Georges Bank. Four specimens have been caught during the time series, ranging in size from 1.0 to 10.3 kg. All four specimens were captured in locations where the bottom temperature exceeded 10°C. This species is caught in both recreational and commercial fisheries off the US coast, generally with hook and line. The Summer RV Surveys may not be suitable for providing useful information on distribution or abundance for this species.

Black Sea Bass (*Centropristis striata*) are a demersal species found from the Gulf of Mexico to Maine. This species has been caught during Winter RV Surveys on Georges Bank but has not been recorded during the Summer RV Survey.

Conclusions

In 2022, sampling was conducted in all standard strata in 4X5Yb and 5Zc, but the majority of the survey area, including all of 4V and most of 4W were not sampled due to mechanical problems with vessels. Of the 280 stations selected for sampling in 2022, 153 successful tows were completed in 24 fishing days. This marks the third time since the survey began in 1970 that there has not been some sampling in all strata from 440–495, all of which were in the last 5 years (2018, 2021, 2022). In addition, a total of 153 CTD casts and 25 vertical zooplankton tows were completed. A variety of special sampling was also completed including the collection of tissue samples from a various species for genetic and stable isotope analyses, multi-species stomach collections for predator/prey and diet analyses, and monkfish tail weights for commercial landings conversion factors.

Several species more commonly associated with warmer waters south of the Scotian Shelf have been caught in the Summer RV survey in recent years. Some, like Blackbelly Rosefish, are now well established on the Scotian Shelf. As water temperatures warm on the Scotian Shelf, it is expected that more southern species will appear in the survey and will become established in the region.

The total biomass index for demersal fish from the survey has been low in 4V since the 1990s. In 4W, total demersal fish biomass increased in the 1980s, then declined in the 1990s. Recently in 4W, biomass has declined to the lowest levels in the time series as Haddock biomass has declined.

The total biomass index for 4X shows high inter-annual variability but no clear trend over time. The large drop in biomass index in 2019 and 2020 reflects lower catches for most demersal species. The biomass index in 2022 increased from 2020, largely due to higher than average catches of Silver Hake which represented 49% of the total demersal biomass in 4X.

The numbers of large fish have been low for several species in recent years, and, for some species, the length range has been constricted. This constriction is apparent in the length frequency figures, with the long-term median length frequency extending to larger sizes or with much lower numbers at larger sizes in the most recent 10 years for species including Cod, Haddock, Witch Flounder, American Plaice, Thorny Skate, and Ocean Pout.

The abundance index for Age 0 4X Haddock was the highest in the time series in 2018, but this was not carried through to 2019, where there was no indication of strong year-classes for either Age 0 or 1. In 2020 and 2022, there has been a rebound, and abundance indices are generally similar to the short-term median for lengths below 15 cm.

The 3-yr GM for 4X Cod, 4X American Plaice, and 4X Ocean Pout are the lowest in the time series. The 2022 biomass indices for 4X Cod, 4X American Plaice, 4X Thorny Skate and 4X Ocean Pout are also the lowest in the time series.

The 3-yr GM for 4X Cod, 4X Yellowtail Flounder, 4X American Plaice, 4X Thorny Skate, 4X Wolffish, and 4X Ocean Pout have been consistently below 40% of the long-term GM for several years.

The 3-yr GM for 4X West (Bay of Fundy) Silver Hake, 4X Winter Flounder, 4X Red Hake, 4X Little Skate, 4X Barndoor Skate, and 4X Smooth Skate have been consistently above 80% of the long-term GM for several years.

Biomass indices for White Hake in 4X remain in the Critical Zone in 2022, relative to the biomass recovery targets.

Changes in biomass indices from one year to the next for individual species should be interpreted cautiously. A 3-yr GM of the survey biomass indices reduces the apparent variability in biomass estimates and may better reflect actual biomass trends. For those species where a population model is used, the inter-annual variability in population biomass estimates is lower than the variability in survey estimates. Additional information from commercial landings and age composition, where available, can help in interpreting survey data.

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