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Ecosystems and
Oceans Science

Sciences des écosystèmes
et des océans

Maritimes Region

**Canadian Science Advisory Secretariat
Science Response 2020/0019**

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

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. Resource Management requested a review of the DFO 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. 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) and Unit III redfish (biomass for lengths >22 cm). 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 2020.

In addition, a review of available survey information was undertaken for a suite of species, including Blackbelly Rosefish, 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 Science Response Process of December 4–5, 2019, on the Maritimes Research Vessel Survey Trends on the Scotian Shelf and Bay of Fundy.

Additional publications from this meeting will be posted on the [DFO Science Advisory Schedule](#) as they become available.

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. 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. These changes may affect the biomass

trends for some species. 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 4VWX5 area. Sampling was conducted in all 4VWX5Yb strata and in the deeper strata of area 5Zc (Canadian portion of 5Z). The sampled area expanded to include strata 558 and 559 in 2015 and 5Z2 in 2016. 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 2018 and 2019 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 2017) are also included, using data from the geographic areas that are used in assessments for those stocks. For stocks where the index area was not covered in 2018, the indices for 2017 and 2019 are shown.

The expanded survey strata are not used in biomass or length frequency calculations because they have only been sampled for a short time frame. With additional years of data, a methodology will be developed to interpret indices including these data relative to earlier period, and then these strata will be included in calculations.

All strata from 440–495 have had some sampling annually since 1970 with the exception of 2018. In 2018, sampling was conducted in all standard strata in 4X5Yb, but the majority of the survey area, including all of 4V, most of 4W and depths <183 m in 5Zj, were not sampled in 2018 due to mechanical problems with the vessel. Of the 270 stations selected for sampling in 2018, only 85 successful tows were completed.

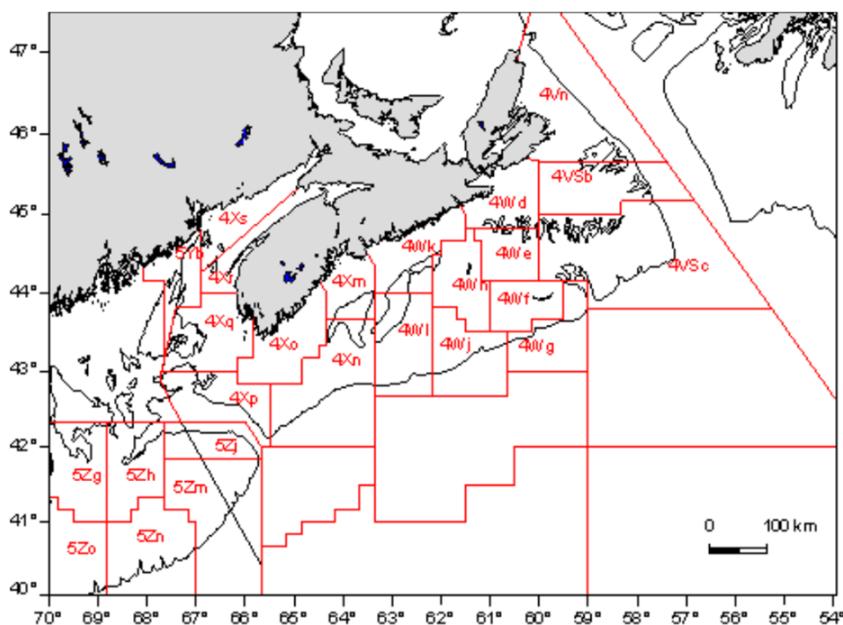


Figure 1. Northwest Atlantic Fisheries Organization (NAFO) Divisions.

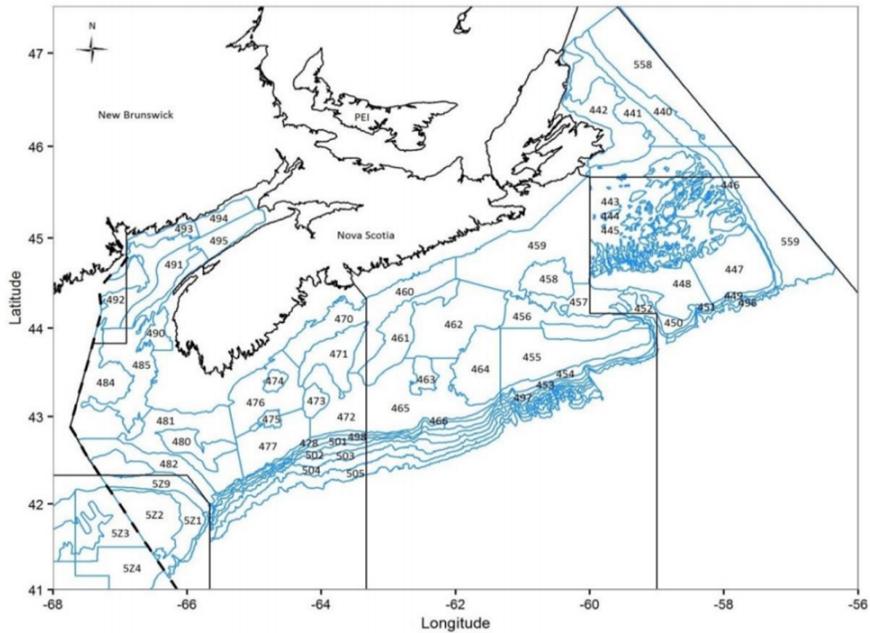


Figure 2. Fisheries and Oceans Canada DFO Summer Research Vessel Survey strata.

Analysis

The stratified random survey design ensures that sampling takes places 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 there are other data to aid interpretation.

The time series of survey biomass indices and the three-year (3-yr) running geometric mean are compared to 40% and 80% of the long-term geometric mean (GM) 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. Information on the calculation of these indices is contained in Stone and Gross (2012). This can also be used as an indication of recruitment strength for species such as Haddock where recruitment pulses are apparent in the length frequency.

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 is not thought to be indicative of stronger recent recruitment. Rather, this likely reflects earlier spawning and, thus, these fish are available to the July survey in recent years, when in the past they would have still been in the pelagic phase in July.

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. 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).

In 4V, the demersal fish biomass dropped in the 1990s and has remained low since then (Figure 3c).

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.

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 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, unlike 4V or 4W, there has been no general decline in demersal fish biomass over time.

Changes in biomass indices from one year to the next for individual species should be interpreted cautiously. 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 can help in interpreting survey data. The running 3-yr geometric mean may be a better indicator of biomass trends.

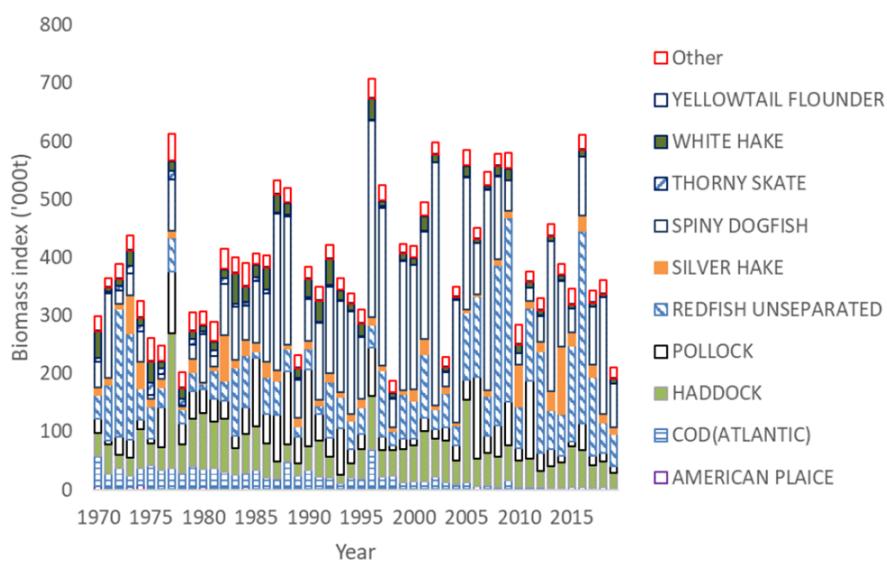


Figure 3a. Biomass indices for the top ten demersal fish species (bars) in 4X and for all other demersal fish species combined. Refer to Figure 1 for NAFO Divisions within the Maritimes Region.

Figure 3. 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.

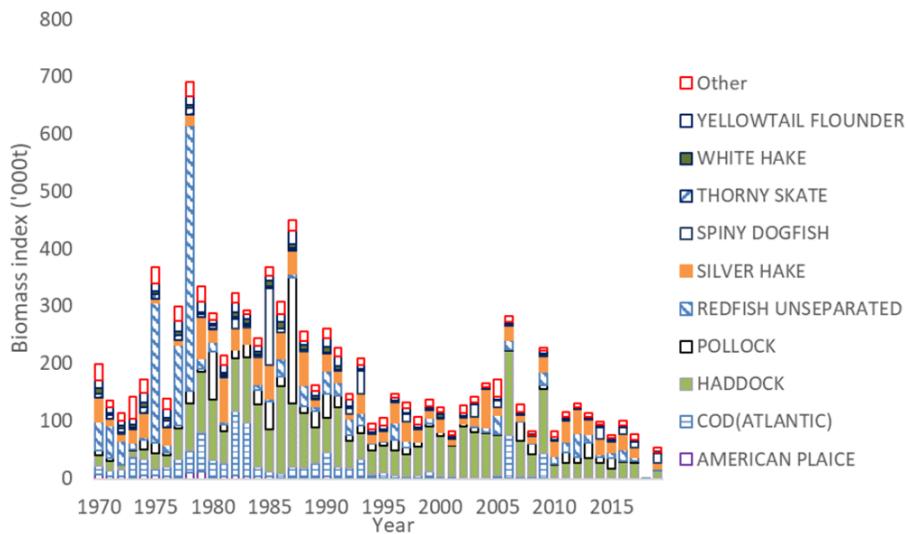


Figure 3b. Biomass indices for the top ten demersal fish species (bars) in 4W and for all other demersal fish species combined. Refer to Figure 1 for NAFO Divisions within the Maritimes Region.

Figure 4. 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.

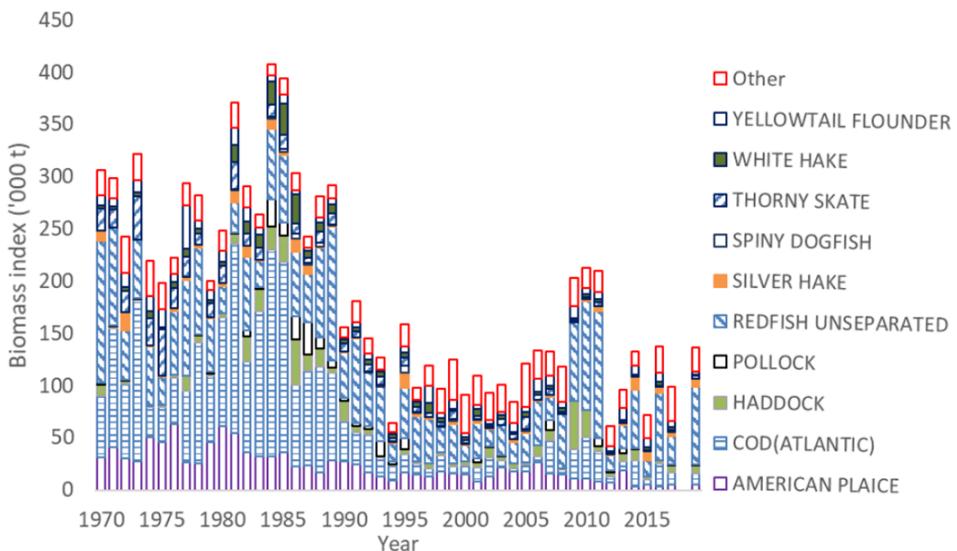


Figure 3c. Biomass indices for the top ten demersal fish species (bars) in 4V and for all other demersal fish species combined. Refer to Figure 1 for NAFO divisions within the Maritimes Region.

Figure 5. 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.

Table 1. DFO Summer Research Vessel Survey biomass indices (tonnes) for species by stock/region for 2017, 2018, 2019, current 3-yr Geometric Mean (GM) biomass index, and 40% and 80% of the long-term GM biomass index (1970–2018). NA: Indices not available due to reduced spatial coverage of the 2018 survey. For Silver Hake and Red Hake, the long-term average is 1982–2016.

Stock/Region	2017	2018	2019	Current 3-yr GM	40% Long-term GM	80% Long-term GM
4X Atlantic Cod	3,068	3,500	1,443	2,493	5,524	11,048
4VsW Atlantic Cod	10,217	NA'	10,877	5,729	10,313	20,627
4Vn Atlantic Cod	1,296	NA	331	2,070	6,528	3,264
4VW Haddock	35,796	NA	21,485	29,151	19,031	38,062
4X Haddock	38,456	44,628	28,081	36,391	19,812	39,623
4VW White Hake	4,150	NA	1,306	3,047	3,029	6,059
4X VW White Hake	6,735	4,988	7,811	6,402	5,626	11,251
4VWX Silver Hake	31,321	NA	25,068	33,077	12,980	28,959
4XWest Silver Hake	10,112	9,301	4,138	7,301	1,337	2674
WesternComoonentPollock	15,052	14,836	8,990	12,615	7,889	15,778
EasternComoonent Pollock	3,222	NA	2,541	5,053	7,152	14,304
Unit II redfish	28,808	NA	75,080	51,918	16,804	33,607
Unit III redfish	141,450	NA	57,589	141,224	36,939	73,877
4X American Plaice	276	487	217	308	594	1,187
4VW American Plaice	5,763	NA	5,182	4,717	7,537	15,074
4XWitch Flounder	984	1,577	1,797	1,408	593	1,186
4VW Wrtch Flounder	4,803	NA	5,542	5,560	1,386	2,772
4X Yellowtail Flounder	61	105	78	80	180	359
4VW Yellowtail Flounder	7,984	NA	4,675	7,194	4,863	9,726
4XWinter Flounder	3,626	4,035	3,983	3,877	1036	2,071
4VWWinter Flounder	577	NA	310	377	245	490
3N0Ps4VWX5Zc Atlantic Halibut	15,437	NA	12,183	12,933	1,318	2,636
4X Atlantic Wolffish	82	295	335	201	419	838
4VW Atlantic Wolffish	354	NA	447	293	492	985
4X Monkfish	1,906	2,075	1,110	1,638	623	1,246
4VW Monkfish	863	NA	1,109	961	800	1,599
4X Smooth Skate	224	504	273	313	144	288
4VW Smooth Skate	140	NA	149	150	116	232
4X Thomv Skate	113	193	287	184	714	1,428

Stock/Region	2017	2018	2019	Current 3-yr GM	40% Long-term GM	80% Long-term GM
4VW Thorny Skate	1 858	NA	2 485	1 762	2 633	5265
4XBarndoor Skate	2,457	2,668	1,651	2,212	28	56
4VW Bamdoor Skate	1,340	NA	0	116	5	11
4XWinter Skate	840	571	401	577	302	604
4VW Winter Skate	562	NA	22	83	644	1,288
4X Little Skate	1,013	1, 156	1,362	1,185	188	375
4VW Little Skate	136	NA	35	59	13	25
4X L Sculoin	1 013	584	1 024	902	505	1 011
4VW L Sculoin	1 043	NA	1 234	1 118	858	1 717
4X Red Hake	1,419	1,848	2,046	1,751	497	994
4VW Red Hake	1, 149	NA	1,395	1,626	381	761
4X Ocean Pout	95	137	89	105	173	346
4VW Ocean Pout	12	NA	52	5	50	100
4X Sea Raven	1,213	1,097	673	964	673	1,346
4VW Sea Raven	1,475	NA	959	1,001	335	671

Atlantic Cod

The largest Atlantic Cod (*Gadus morhua*) catches came from Georges Bank and Banquereau. There were no catches >50 kg in 4X or 4Vn in 2019; the biomass indices are the lowest in the time series in both areas and indices at length are below both long- and short-term medians for most lengths. The biomass index in 4VsW for 2019 is similar to 2017; in both years, abundance indices for larger cod are above the short-term medians.

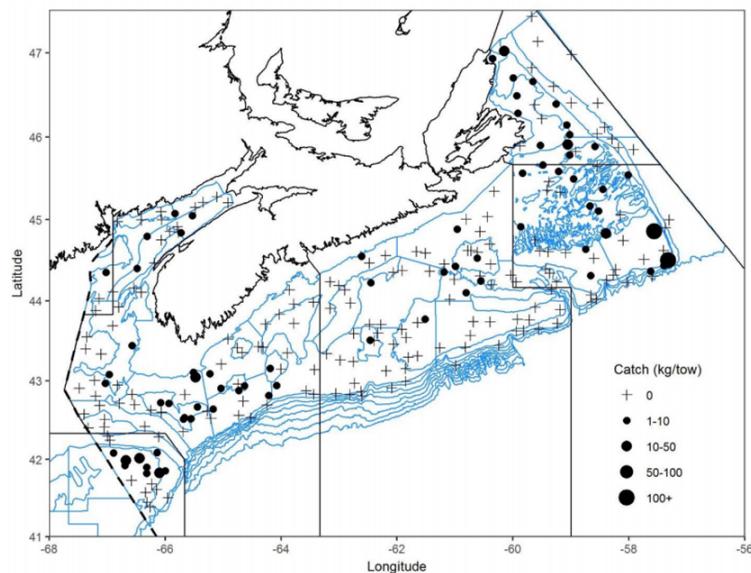


Figure 4a. Distribution of Atlantic Cod catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

Figure 6. 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.

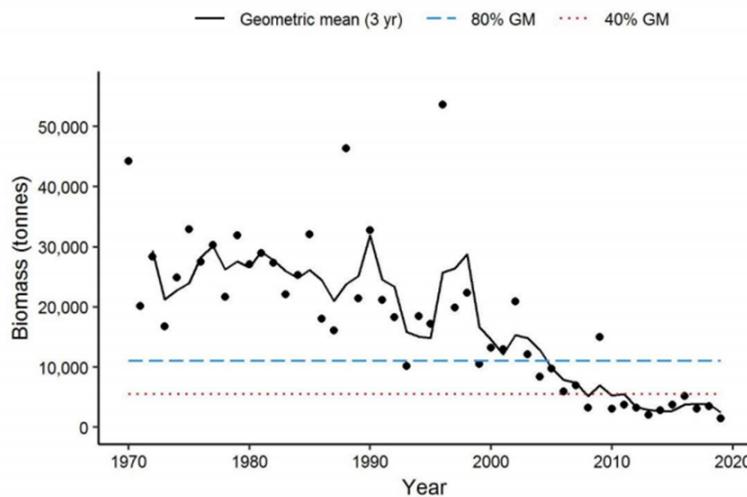


Figure 4b. Biomass index for Atlantic Cod in 4X from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2018), respectively. The black dots represent the biomass index for that year.

Figure 7. 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 (1970–2018), respectively. The black dots represent the biomass index for that year.

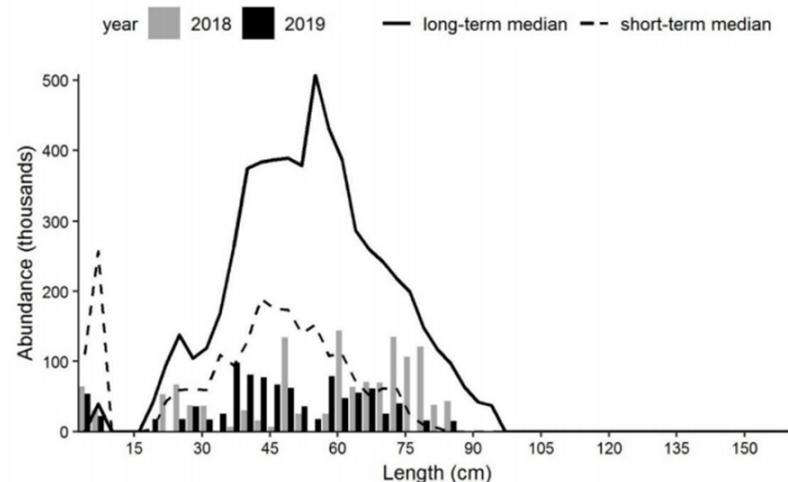


Figure 4c. Length frequency indices for Atlantic Cod in 4X from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 8. (ref:caption9-fig-cod-lengthfreq4X)

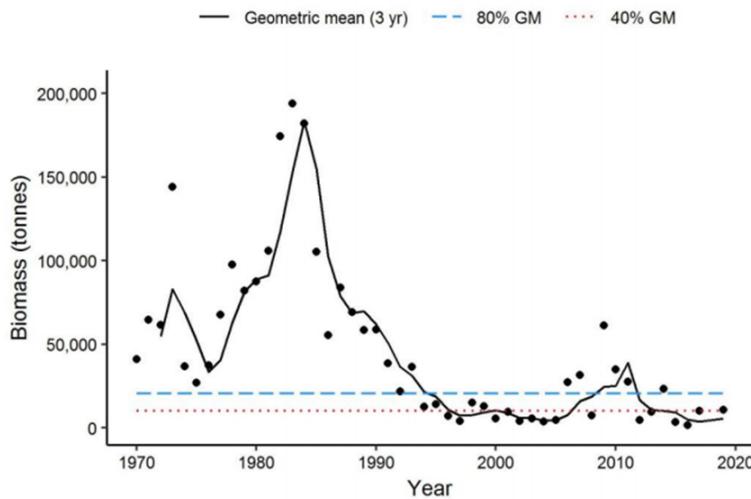


Figure 4d. Biomass index for Atlantic Cod in 4VsW from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2017), respectively. The black dots represent the biomass index for that year.

Figure 9. Biomass index for Atlantic Cod in 4VsW 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 (1970–2017), respectively. The black dots represent the biomass index for that year.

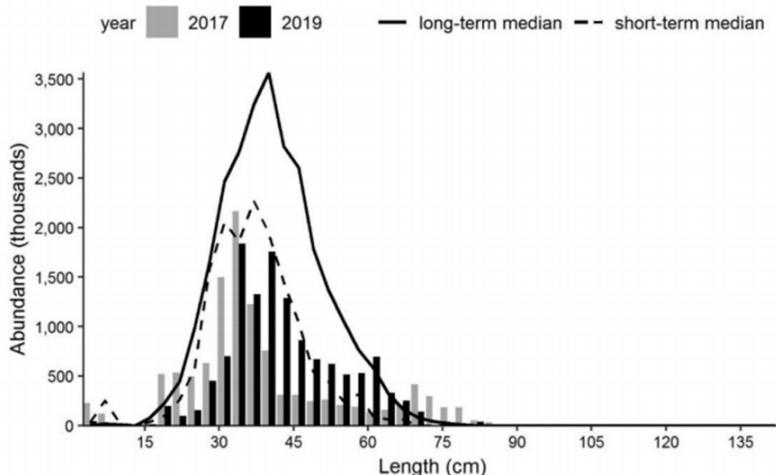


Figure 4e. Length frequency indices for Atlantic Cod in 4VsW from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 10. Length frequency indices for Atlantic Cod in 4VsW from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

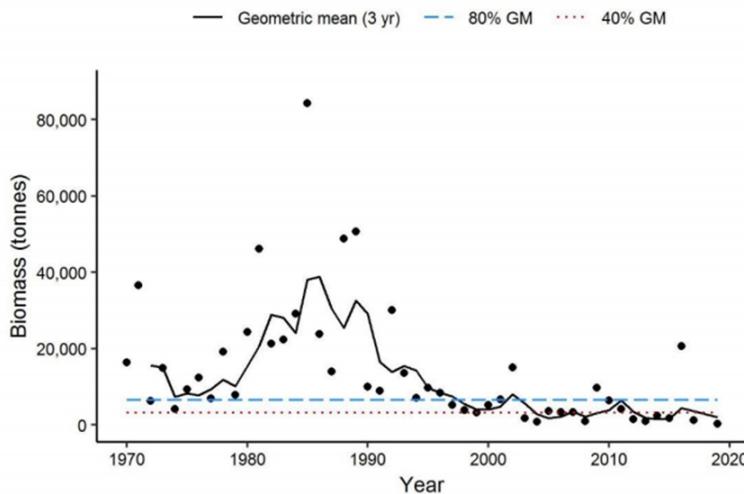


Figure 4f. Biomass index for Atlantic Cod in 4Vn from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2017), respectively. The black dots represent the biomass index for that year.

Figure 11. Biomass index for Atlantic Cod in 4Vn 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 (1970–2017), respectively. The black dots represent the biomass index for that year.

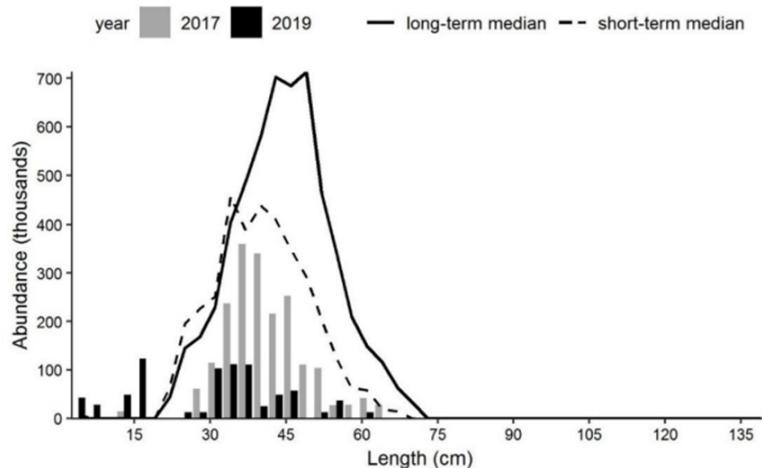


Figure 4g. Length frequency indices for Atlantic Cod in 4Vn from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 12. Length frequency indices for Atlantic Cod in 4Vn from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Haddock

There were very few sets where the catch of Haddock (*Melanogrammus aeglefinus*) exceeded 100 kg in 4X in 2019. While Haddock were caught in almost every set in 4X, the biomass index was the lowest since 1994. In 2019, there was no indication of strong recruitment and the numbers at length were generally below the short-term median at all lengths.

In 4VW, the biomass index was among the lowest in the time series. As in 4X, the numbers at length were generally below the short-term median at all lengths.

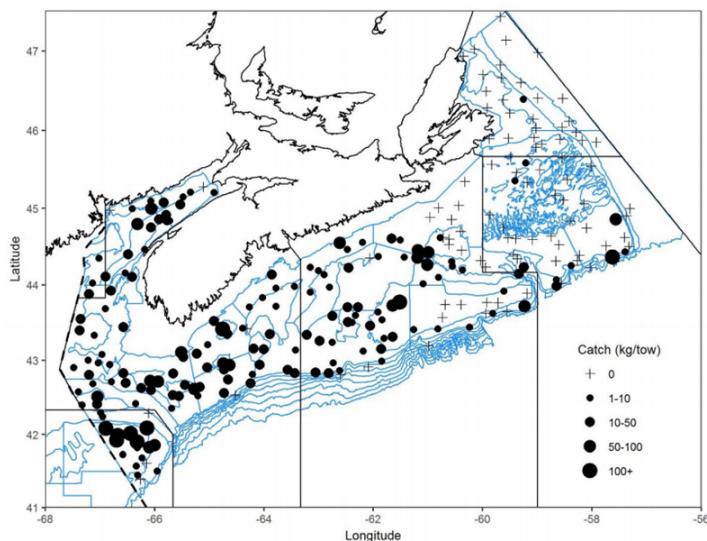


Figure 5a. Distribution of Haddock catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

Figure 13. Distribution of Haddock catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

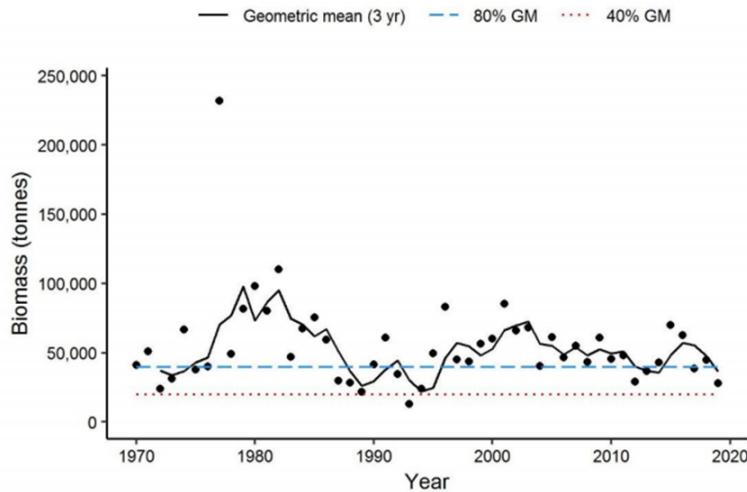


Figure 5b. Biomass index for Haddock in 4X from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2018), respectively. The black dots represent the biomass index for that year.

Figure 14. 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 (1970–2018), respectively. The black dots represent the biomass index for that year.

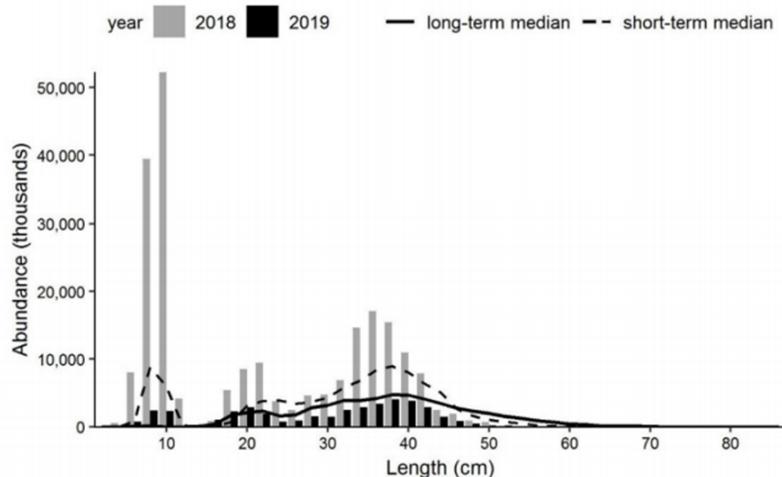


Figure 5c. Length frequency indices for Haddock in 4X from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 15. Length frequency indices for Haddock in 4X from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

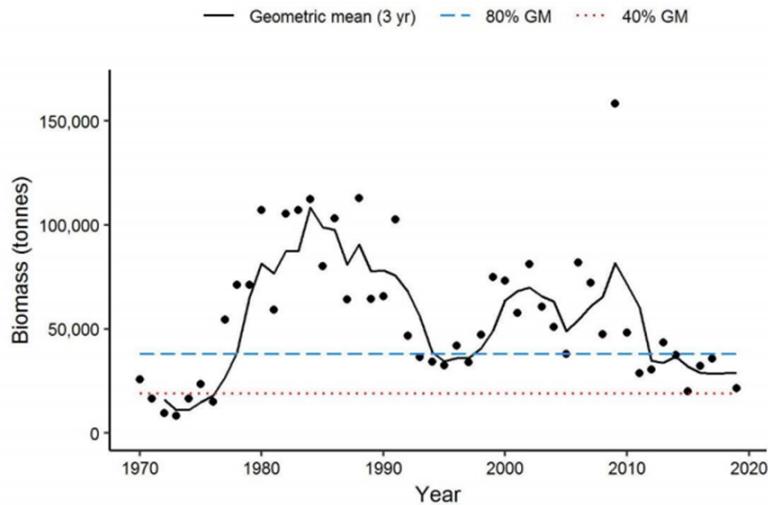


Figure 5d. Biomass index for Haddock in 4VW from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2017), respectively. The black dots represent the biomass index for that year.

Figure 16. Biomass index for Haddock in 4VW 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 (1970–2017), respectively. The black dots represent the biomass index for that year.

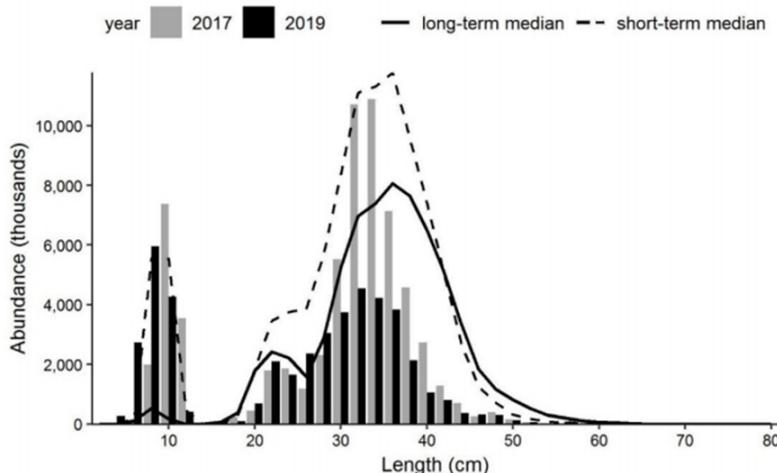


Figure 5e. Length frequency indices for Haddock in 4VW from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 17. Length frequency indices for Haddock in 4VW from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

White Hake

White Hake (*Urophycis tenuis*) are broadly distributed in deeper waters along the shelf edge and in basins of the Scotian Shelf and Gulf of Maine. There were two sets in 2019, in Jordan Basin, where a catch of over 50 kg was recorded. White Hake biomass indices have been low relative to the long term. In 2018, catches in 4X included large numbers of juveniles, peaking at 33 cm. In 2019, the mode is at 45 cm and likely tracks growth for a year class. Indices at lengths >90 cm were above the median in 2019. The biomass index for 4X White Hake >41 cm remained below the Recovery Potential Assessment defined critical biomass reference point (3-yr geometric mean; Guenette and Clark 2016) in 2019. The biomass index for 4VW White Hake >41 cm has been below the RPA defined biomass recovery target since 2003. The biomass index in 2019 is the lowest in the time series, primarily due to low catches in 4Vn.

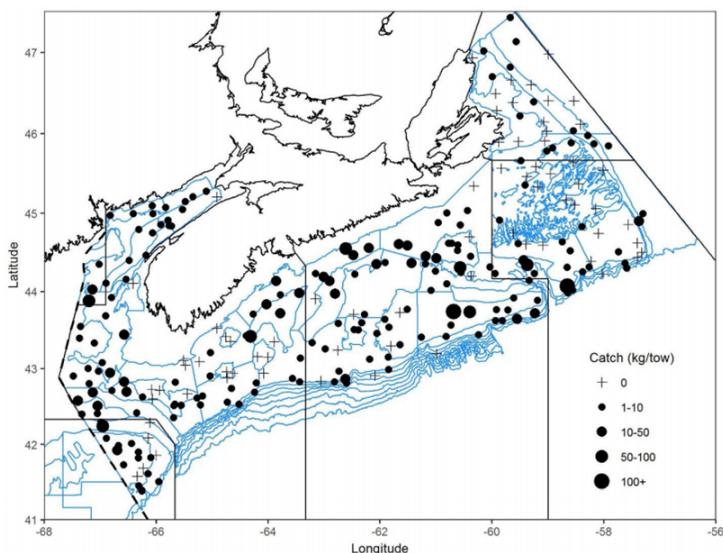


Figure 7a. Distribution of Silver Hake catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

Figure 18. Distribution of White Hake catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

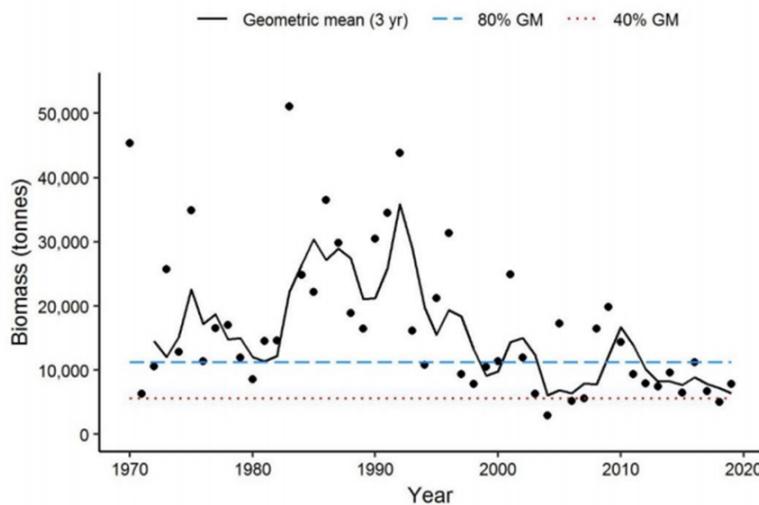


Figure 6b. Biomass index for White Hake in 4X from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2018), respectively. The black dots represent the biomass index for that year.

Figure 19. 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 (1970–2018), respectively. The black dots represent the biomass index for that year.

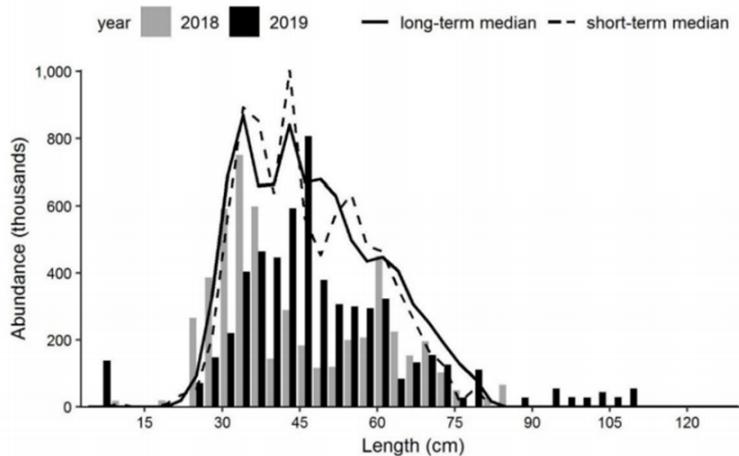


Figure 6c. Length frequency indices for White Hake in 4X from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 20. 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 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017

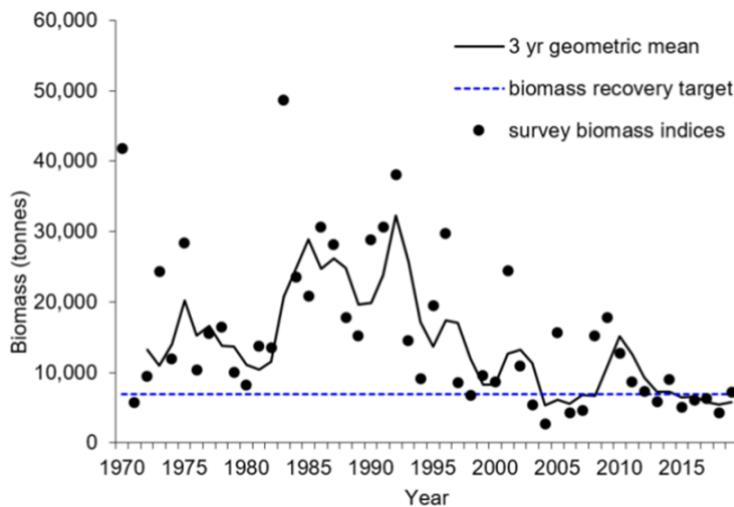


Figure 6d. Biomass index for 4X White Hake >41 cm from the DFO Summer RV Survey represented by the black circles. The solid black line represents the three-year geometric mean. The dashed blue line represents the biomass recovery target.

Figure 21. 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.

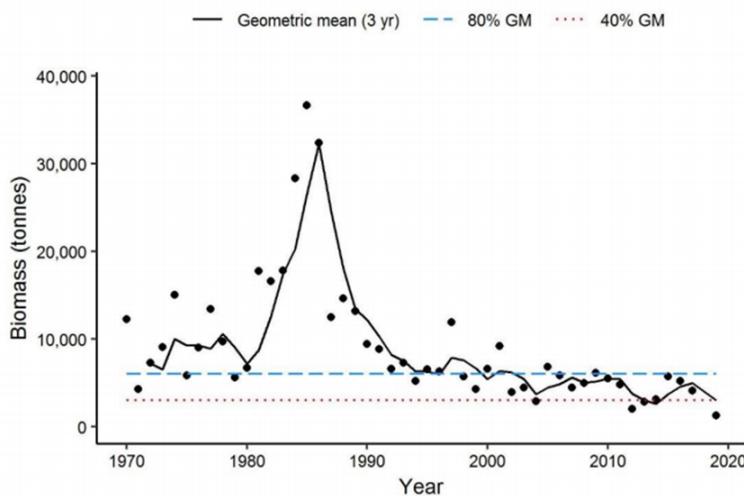


Figure 6e. Biomass index for White Hake in 4VW from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2017), respectively. The black dots represent the biomass index for that year.

Figure 22. Biomass index for White Hake in 4VW 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 (1970–2017), respectively. The black dots represent the biomass index for that year.

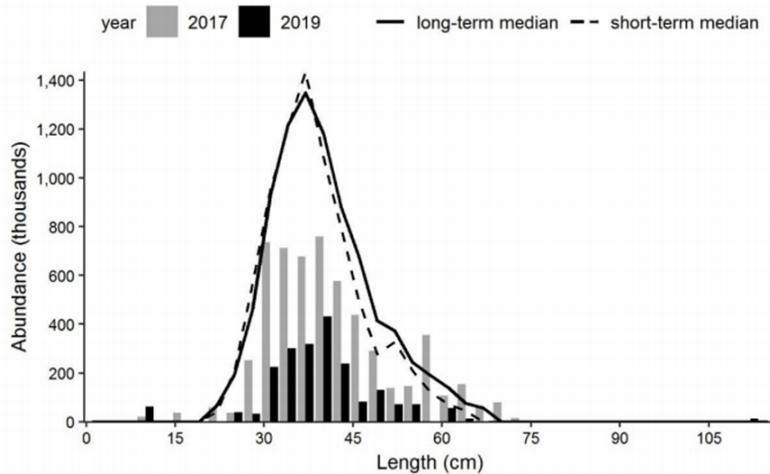


Figure 6f. Length frequency indices for White Hake in 4VW from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 23. Length frequency indices for White Hake in 4VW from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

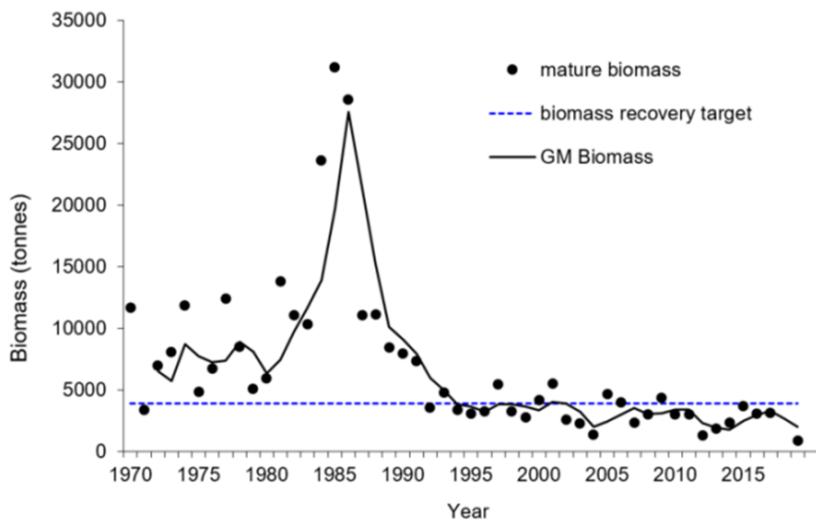


Figure 6g. Biomass index for 4VW White Hake >41 cm from the DFO Summer RV Survey represented by the black circles. The solid black line represents the three-year geometric mean. The dashed blue line represents the biomass recovery target.

Figure 24. Biomass index for 4VW 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.

Silver Hake

Silver Hake (*Merluccius bilinearis*) were caught throughout most of the survey area, with the largest catches on Sable Island Bank and Banquereau. The 3-yr GM biomass index for the Scotian Shelf stock area (4VWX east) remains above 80% of the long-term mean. Abundance indices are above the short-term GM for all lengths below 24 cm, indicative of above average recruitment. The biomass index and abundance in the Bay of Fundy (4X west) was near average in 2019, with indices at lengths <25 cm generally below the short-term median.

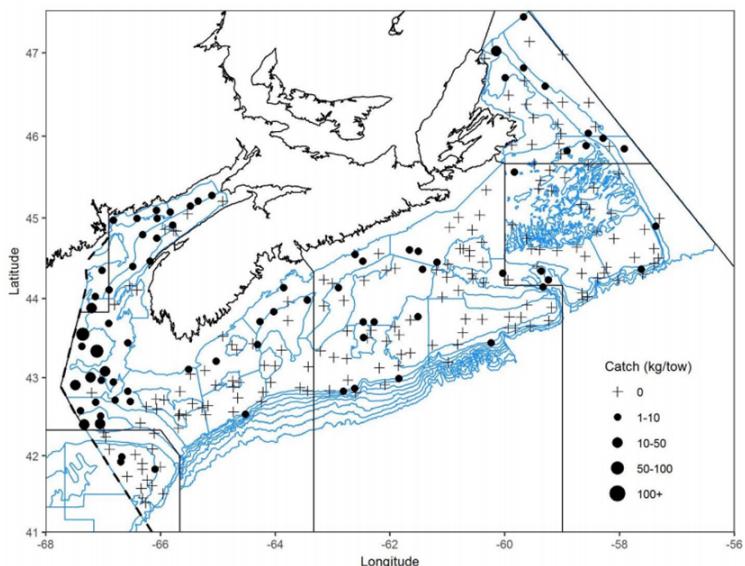


Figure 6a. Distribution of White Hake catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

Figure 25. Distribution of Silver Hake catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

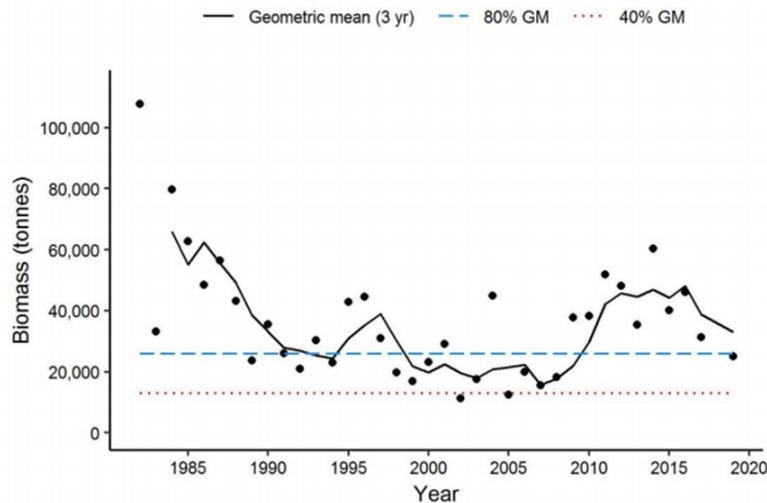


Figure 7b. Biomass index for Silver Hake in 4VWX east (strata 440–483) from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1982–2017), respectively. The black dots represent the biomass index for that year.

Figure 26. Biomass index for Silver Hake in 4VWX east (strata 440–483) 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 (1982–2017), respectively. The black dots represent the biomass index for that year.

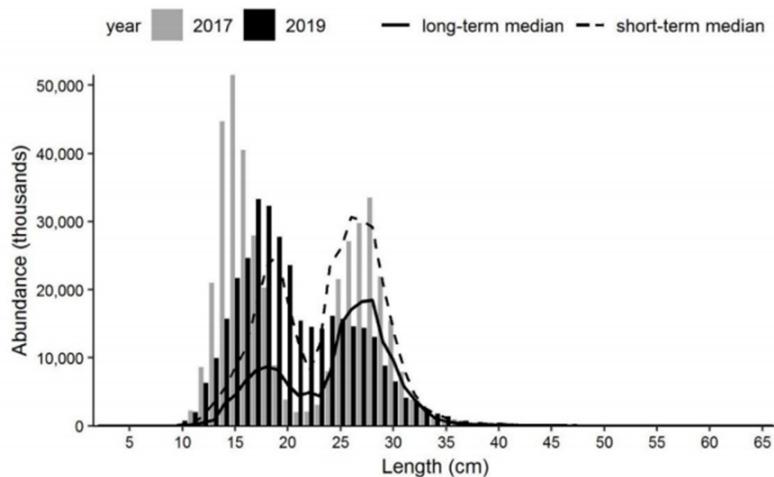


Figure 7c. Length frequency indices for Silver Hake in 4VWX east (strata 440–483) from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 27. Length frequency indices for Silver Hake in 4VWX east (strata 440–483) from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

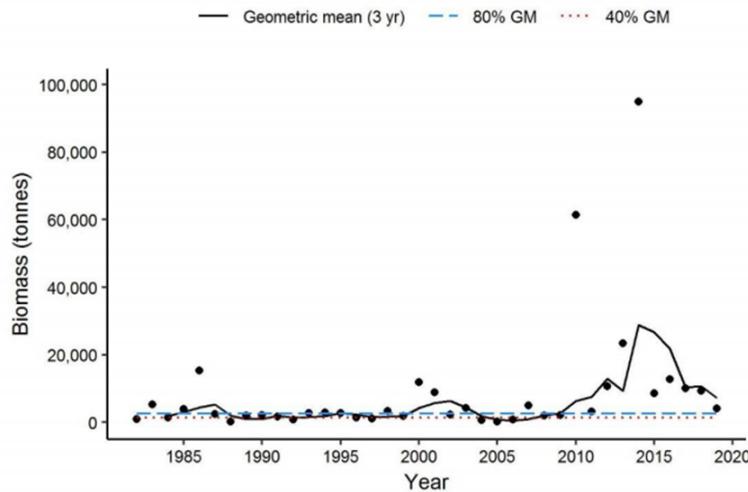


Figure 28. Biomass index for Silver Hake in 4X west (strata 484–495) from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1982–2017), respectively. The black dots represent the biomass index for that year.

Figure 28. 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 (1982–2017), respectively. The black dots represent the biomass index for that year.

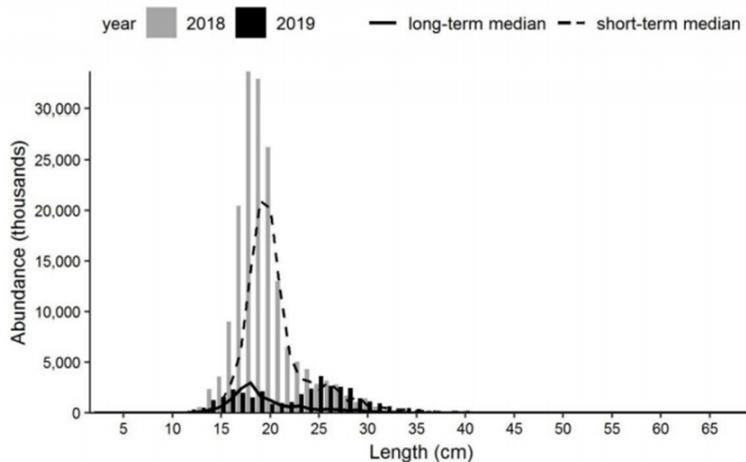


Figure 29. Length frequency indices for Silver Hake in 4X west (strata 484–495) from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 29. 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 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Pollock

Pollock (*Pollachius virens*) were caught primarily in deeper water adjacent to Georges Bank and in the Gulf of Maine. The 3-yr GM Western Component biomass index is between 40% and 80% of the long-term mean. Indices at length of Western Component Pollock were below both the long-term and short-term median for lengths greater than 51 cm. Very few Pollock were caught in the east, and indices at length were below the short-term and long-term median for Eastern Pollock at most lengths in both 2017 and 2019.

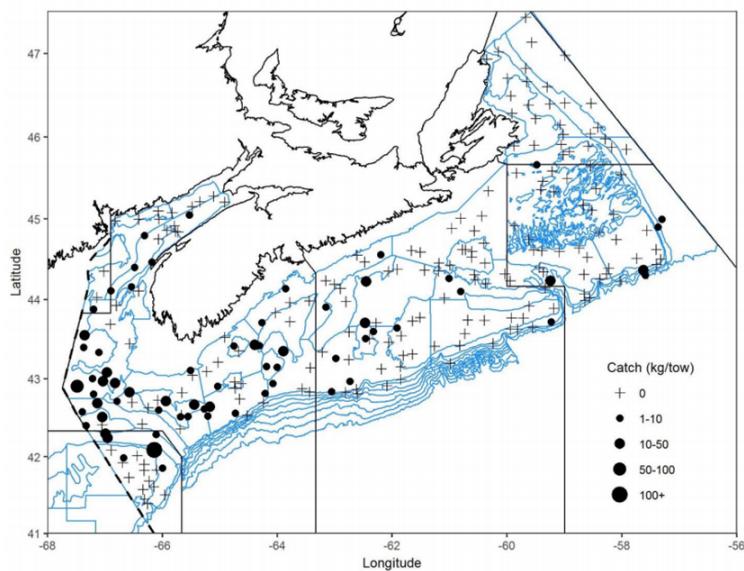


Figure 8a. Distribution of Pollock catches during the 2019 DFO Summer RV Survey including the Laurentian channel and Georges Bank. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

Figure 30. Distribution of Pollock catches during the 2019 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.

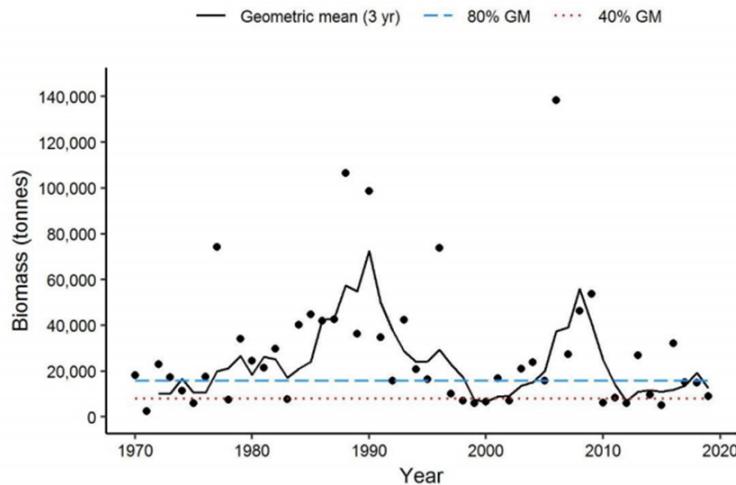


Figure 8b. Biomass index for Western Component Pollock (strata 474, 476, 480–495) from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2018), respectively. The black dots represent the biomass index for that year.

Figure 31. 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 (1970–2018), respectively. The black dots represent the biomass index for that year.

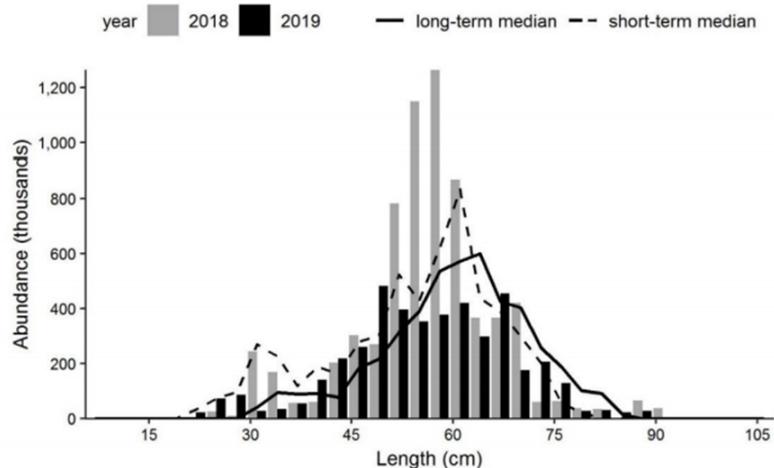


Figure 8c. Length frequency indices for Western Component Pollock (strata 474, 476, 480–495) from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 32. 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 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

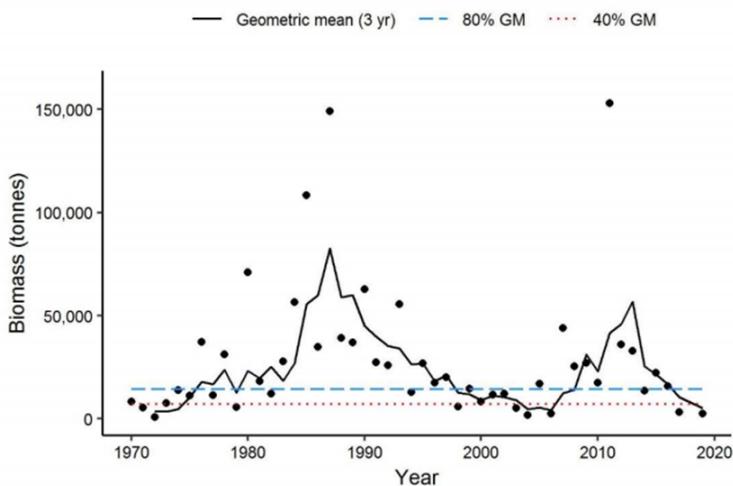


Figure 8d. Biomass index for Eastern Component Pollock (strata 440–473, 475, 477, 478) from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2017), respectively. The black dots represent the biomass index for that year.

Figure 33. Biomass index for Eastern Component Pollock (strata 440–473, 475, 477, 478) 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 (1970–2017), respectively. The black dots represent the biomass index for that year.

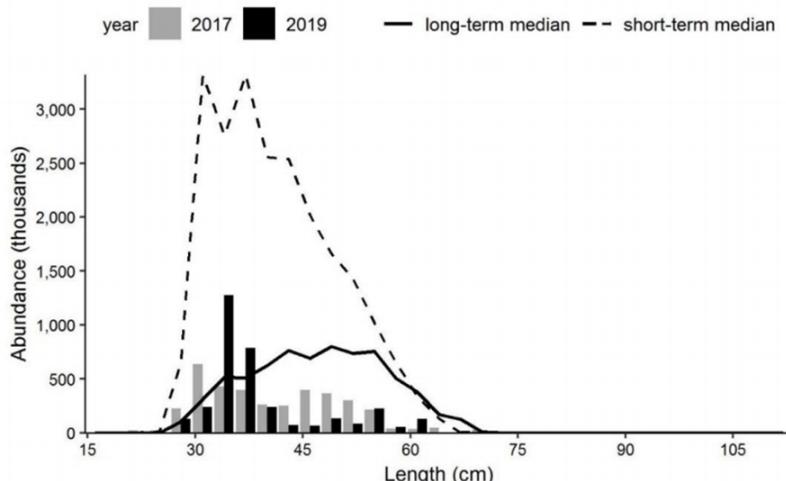


Figure 8e. Length frequency indices for Eastern Component Pollock (strata 440–473, 475, 477, 478) from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 34. Length frequency indices for Eastern Component Pollock (strata 440–473, 475, 477, 478) from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Redfish

Catches of redfish were largest along the Laurentian Channel and in deeper strata in 4X. The deep water of the Laurentian Channel has only been included in the summer survey coverage for 4 years and, thus, it is not used in the abundance index. The data are available for use in redfish assessments and should be included in indices once detailed analyses have been undertaken.

Biomass indices for Unit II redfish have high inter-annual variability. In 2019, the survey indices were well above averages between 20 and 26 cm. The 3-yr average biomass index is well above 80% of the long-term mean.

In Unit III, the 2019 biomass index is the lowest since 2004 but the 3-yr GM biomass index remains above 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 are below averages for lengths >23 cm. The mature biomass index (five-year average biomass for fish >22 cm) in 2019 is among the highest in the series and remains in the healthy zone.

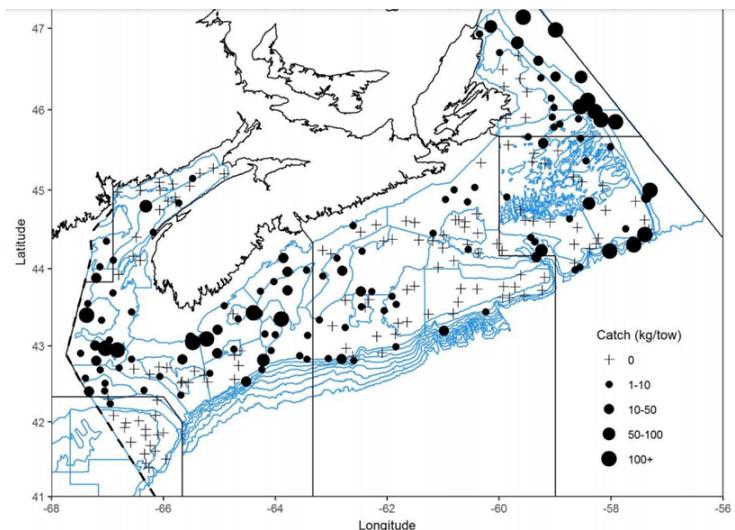


Figure 9a. Distribution of Redfish catches during the 2019 DFO Summer RV Survey including the Laurentian channel and Georges Bank. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

Figure 35. Distribution of Redfish catches during the 2019 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.

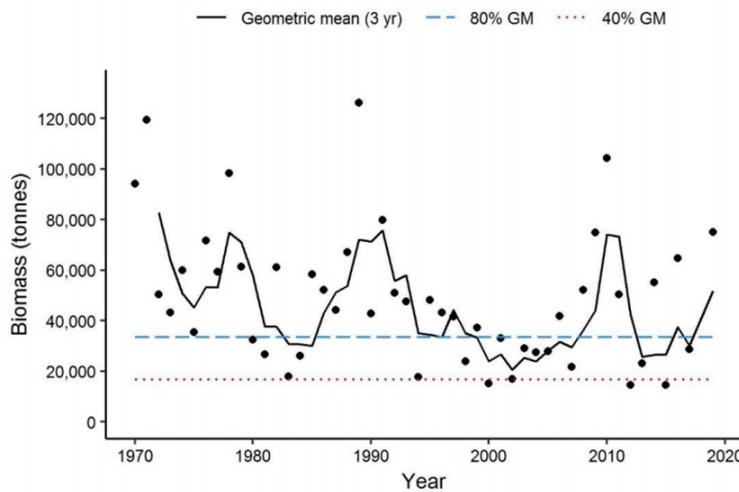


Figure 9b. Biomass index for Unit II redfish (strata 440–456, 464) from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2018), respectively. The black dots represent the biomass index for that year.

Figure 36. Biomass index for Unit II redfish (strata 440–456, 464) 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 (1970–2018), respectively. The black dots represent the biomass index for that year.

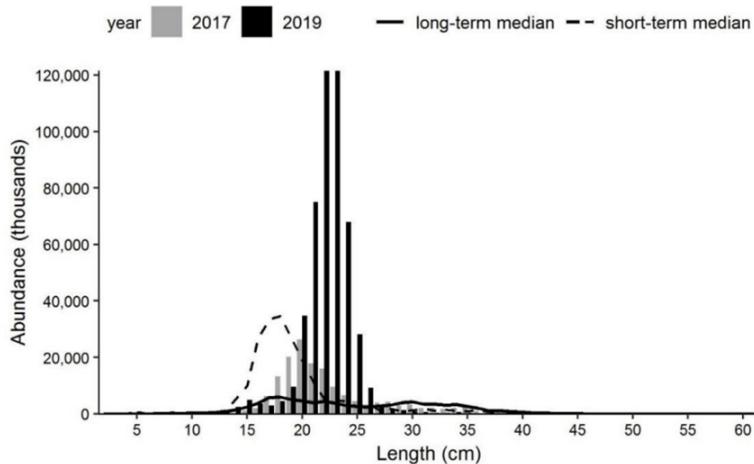


Figure 9c. Length frequency indices for Unit II redfish (strata 440–456, 464) from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 37. Length frequency indices for Unit II redfish (strata 440–456, 464) from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

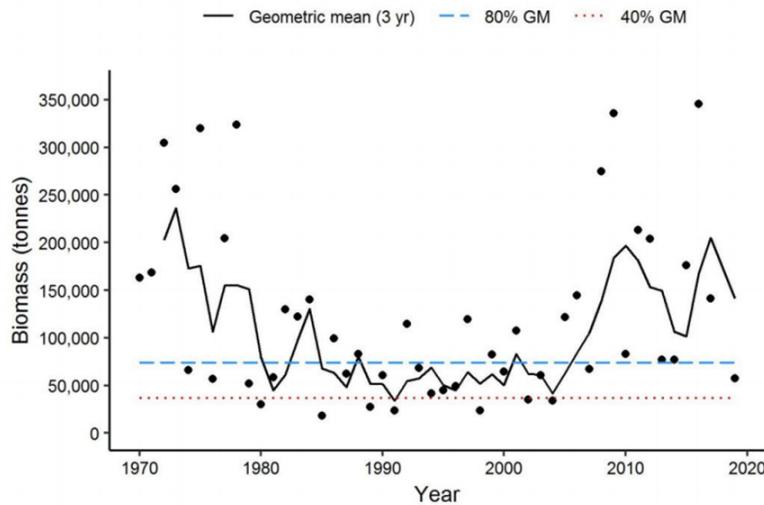


Figure 9d. Biomass index for Unit III redfish (strata 457–463, 465–485) from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2017), respectively. The black dots represent the biomass index for that year.

Figure 38. Biomass index for Unit III redfish (strata 457–463, 465–485) 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 (1970–2017), respectively. The black dots represent the biomass index for that year.

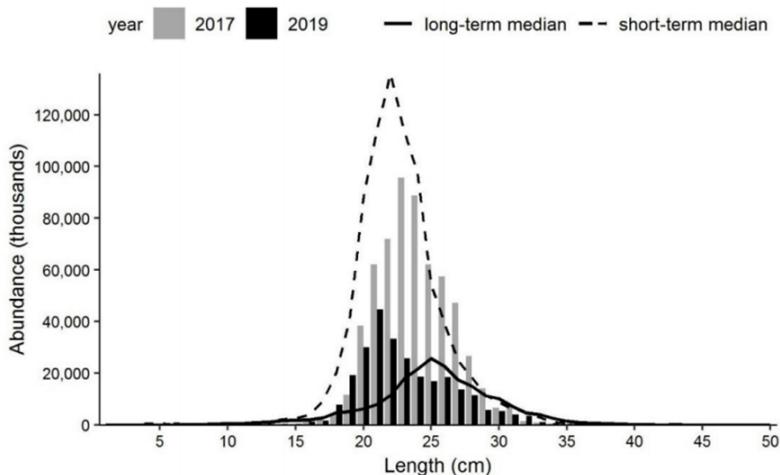


Figure 9e. Length frequency indices for Unit III redfish (strata 457–463, 465–485) from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 39. Length frequency indices for Unit III redfish (strata 457–463, 465–485) from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

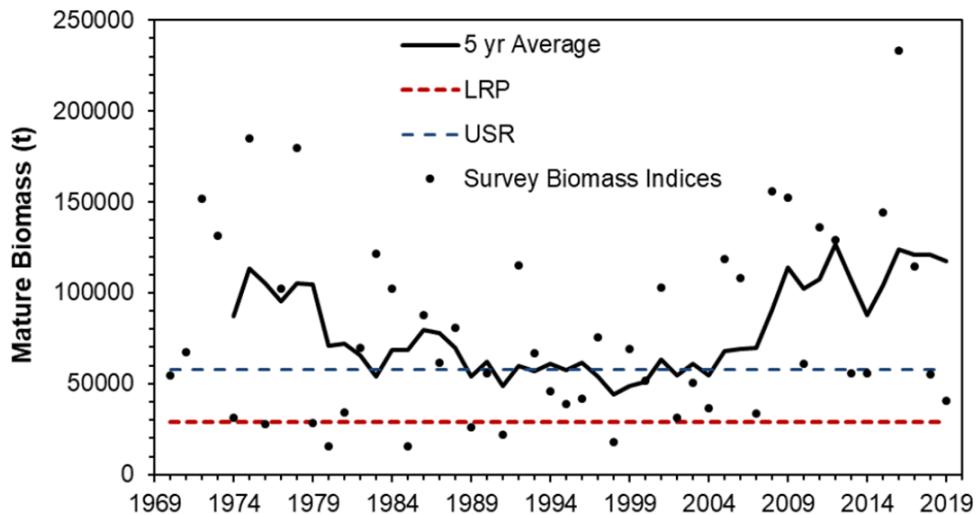


Figure 9f. Biomass index for Unit III redfish >22 cm from the DFO Summer RV Survey represented by the black circles. The solid black line represents the 5-year arithmetic mean. The dashed red line represents the limit reference point and the dashed blue line represents the upper stock reference point.

Figure 40. Biomass index for Unit III redfish >22 cm from the DFO Summer RV Survey represented by the black circles. The solid black line represents the 5-year arithmetic mean. The dashed red line represents the limit reference point and the dashed blue line represents the upper stock reference point.

Atlantic Halibut

Atlantic Halibut (*Hippoglossus hippoglossus*) catches were wide-spread in the survey area. The biomass index was the highest in the series in 2017 at about 15,000 t and the second highest in the series in 2019. Indices of abundance for fish <48 cm were well below the short-term median in 2019, suggesting recruitment may be lower than in most recent years for these year classes.

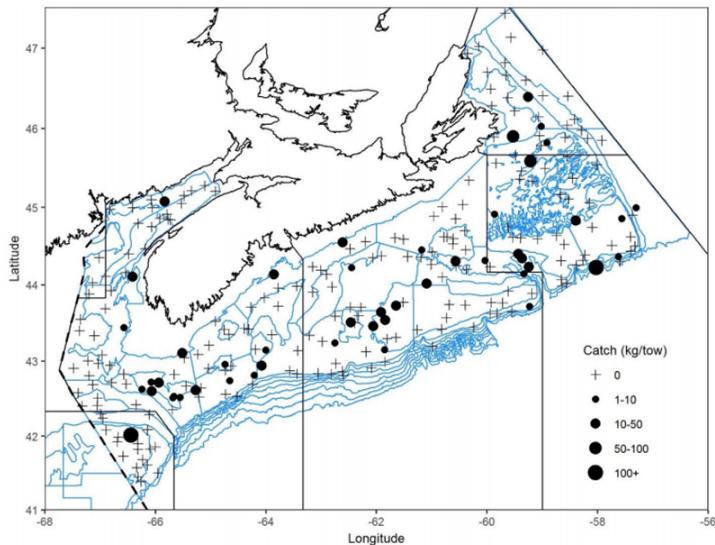


Figure 10a. Distribution of Atlantic Halibut catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

Figure 41. Distribution of Atlantic Halibut catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

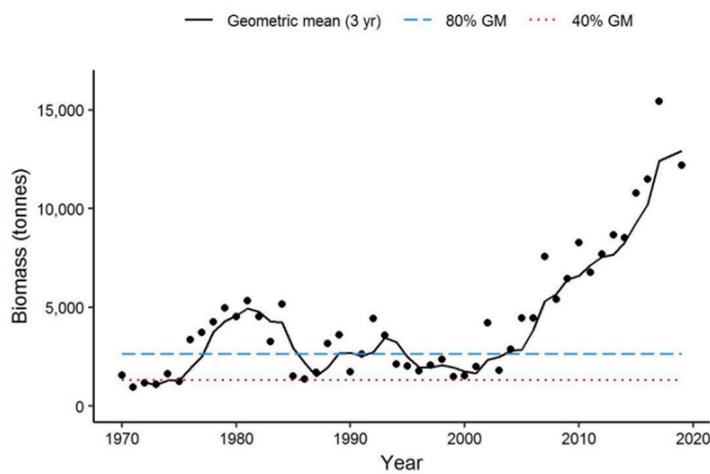


Figure 10b. Biomass index for 3NOPs4VWX5Zc Atlantic Halibut in 4VWX from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2017), respectively. The black dots represent the biomass index for that year

Figure 42. Biomass index for 3NOPs4VWX5Zc Atlantic Halibut in 4VWX 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 (1970–2017), respectively. The black dots represent the biomass index for that year.

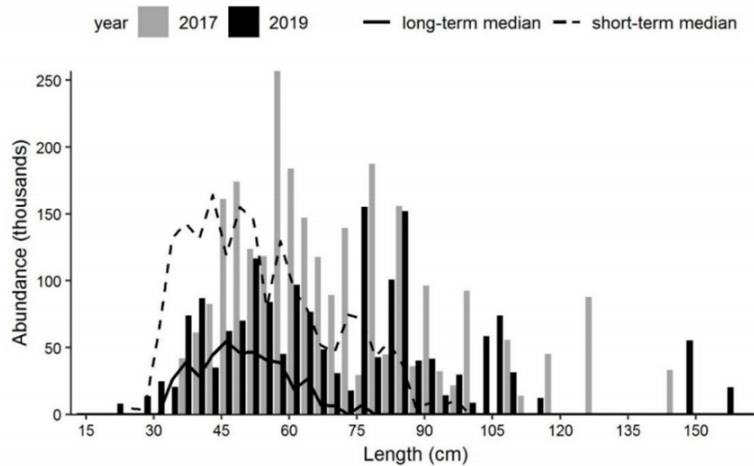


Figure 10c. Length frequency indices for 3NOPs4VWX5Zc Atlantic Halibut in 4VWX from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 43. Length frequency indices for 3NOPs4VWX5Zc Atlantic Halibut in 4VWX from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Yellowtail Flounder

Yellowtail Flounder (*Limanda ferruginea*) were caught primarily in 4Vs and south-eastern 4W. Catches in 4X were primarily from Browns Bank. The biomass indices for 4X in 2018 and 2019 were among the lowest in the series. In 2019, the length-frequency indices were below long-term and short-term medians at all lengths, with no fish above 36 cm. In 4VW, the biomass index in 2019 was the second lowest in the time series and the 3-yr GM was the lowest since 2004. The indices at length in 4VW are below the long-term and short-term median for lengths over 22 cm.

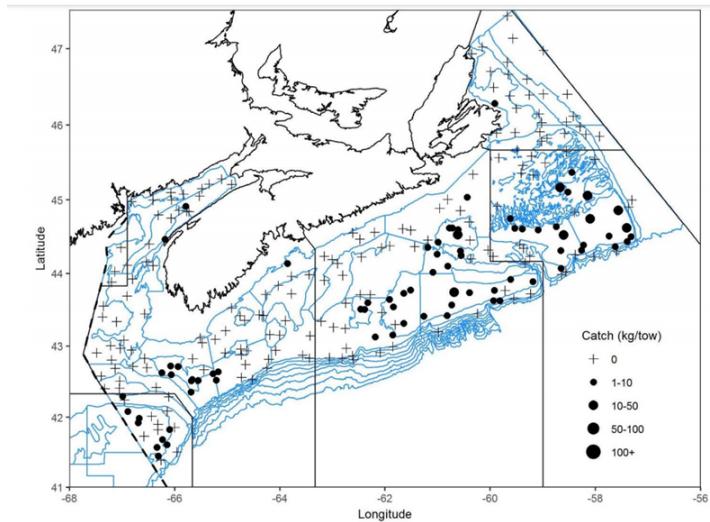


Figure 11a. Distribution of Yellowtail Flounder catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

Figure 44. Distribution of Yellowtail Flounder catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

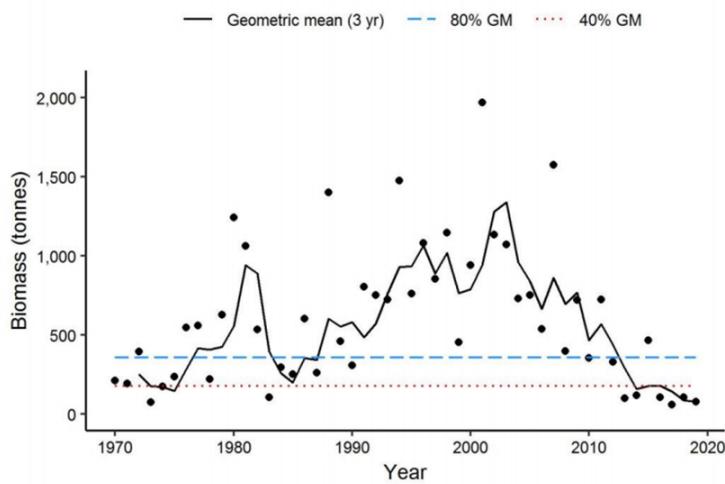


Figure 11b. Biomass index for Yellowtail Flounder in 4X from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2018), respectively. The black dots represent the biomass index for that year.

Figure 45. 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 (1970–2018), respectively. The black dots represent the biomass index for that year.

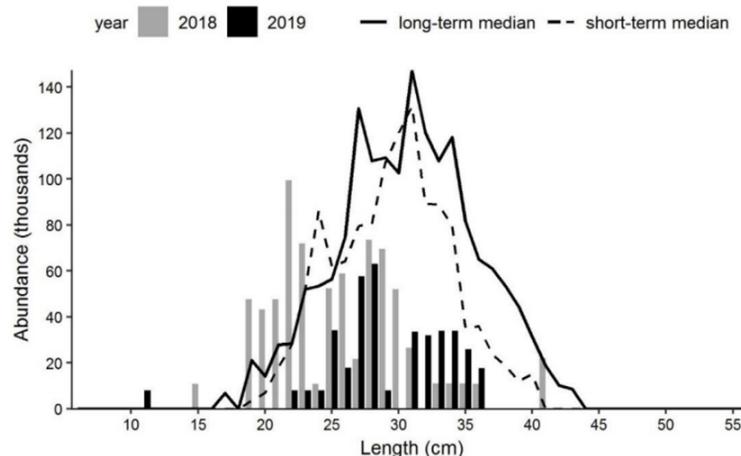


Figure 11c. Length frequency indices for Yellowtail Flounder in 4X from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 46. 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 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

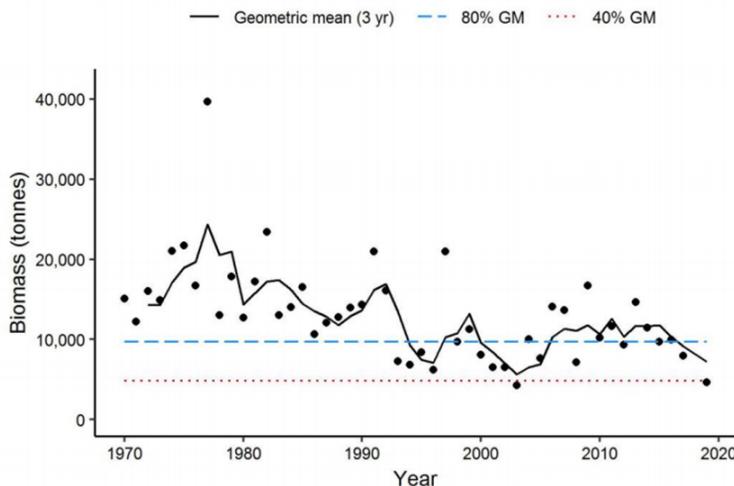


Figure 11d. Biomass index for Yellowtail Flounder in 4VW from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2017), respectively. The black dots represent the biomass index for that year.

Figure 47. Biomass index for Yellowtail Flounder in 4VW 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 (1970–2017), respectively. The black dots represent the biomass index for that year.

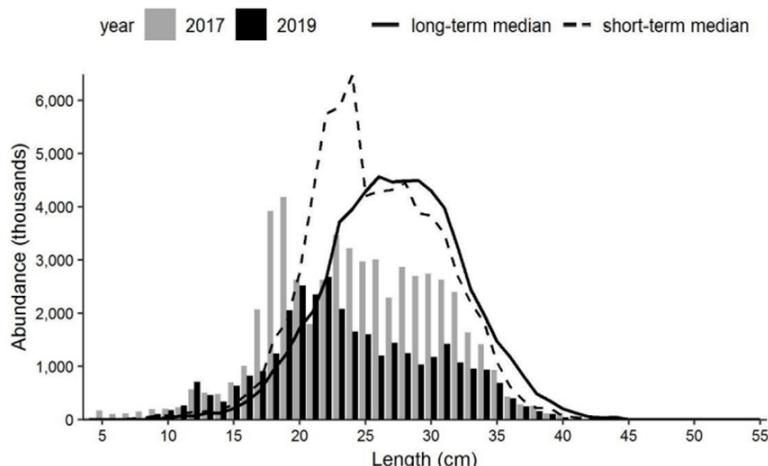


Figure 11e. Length frequency indices for Yellowtail Flounder in 4VW from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 48. Length frequency indices for Yellowtail Flounder in 4VW from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

American Plaice

American Plaice (*Hippoglossoides platessoides*) catches were generally small in the 2019 survey. The biomass index in 2019 is the lowest in the time series for 4X and the third lowest in 4VW. Abundance is low at all lengths above 15 cm in both 4X and 4VW.

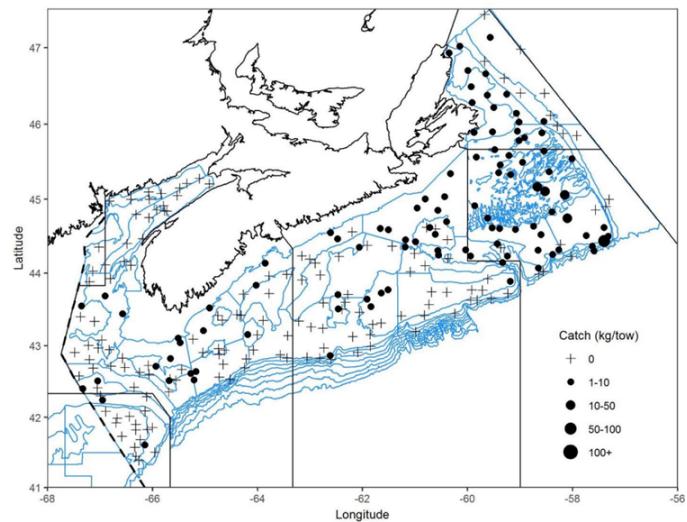


Figure 12a. Distribution of American Plaice catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

Figure 49. Distribution of American Plaice catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

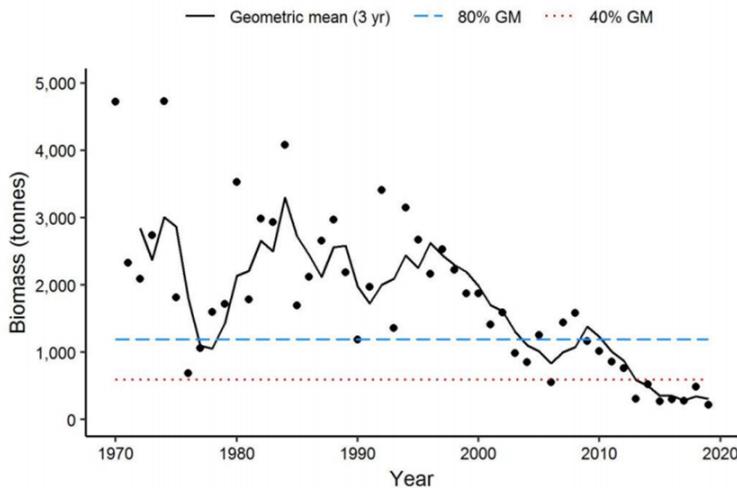


Figure 12b. Biomass index for American Plaice in 4X from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2018), respectively. The black dots represent the biomass index for that year.

Figure 50. 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 (1970–2018), respectively. The black dots represent the biomass index for that year.

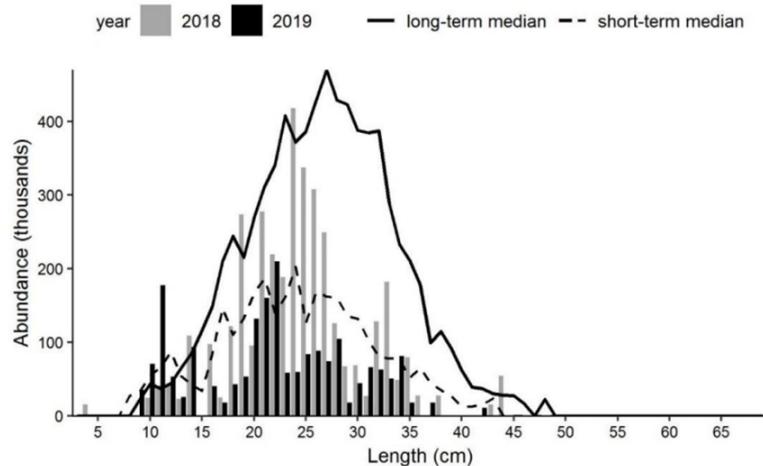


Figure 12c. Length frequency indices for American Plaice in 4X from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 51. 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 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

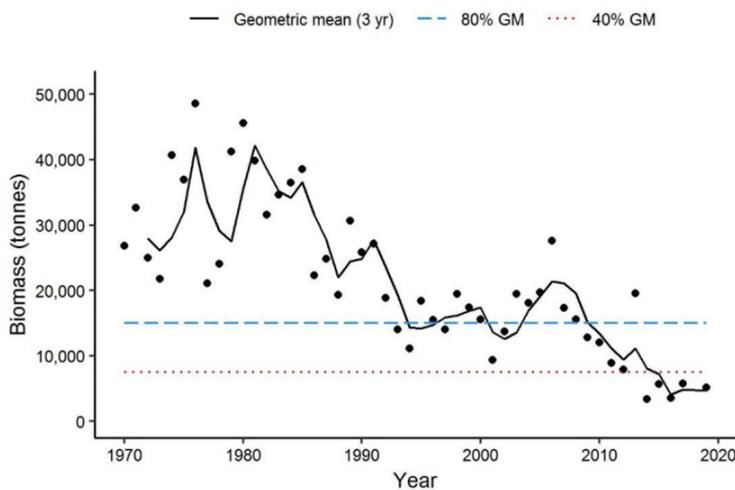


Figure 12d. Biomass index for American Plaice in 4VW from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2017), respectively. The black dots represent the biomass index for that year.

Figure 52. Biomass index for American Plaice in 4VW 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 (1970–2017), respectively. The black dots represent the biomass index for that year.

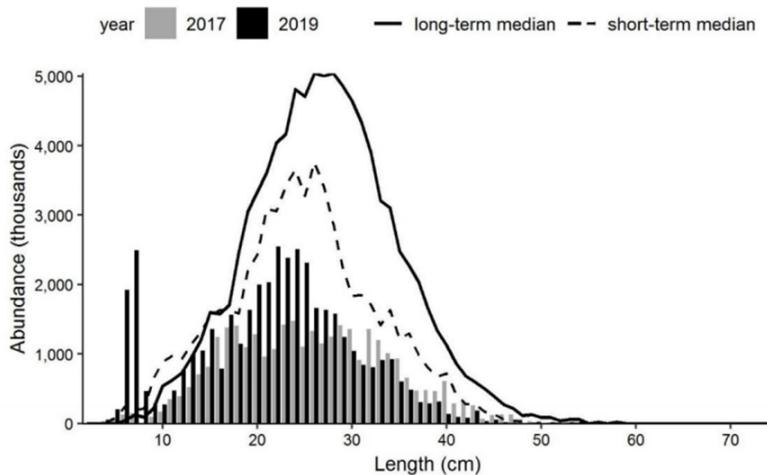


Figure 12e. Length frequency indices for American Plaice in 4VW from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 53. Length frequency indices for American Plaice in 4VW from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Witch Flounder

Witch Flounder (*Glyptocephalus cynoglossus*) were widespread in the survey area in 2019. The 3-yr mean biomass index has fluctuated around 80% of the long-term mean in 4X for the last 20 years. The length-frequency indices in both 2018 and 2019 are above the short-term median for most lengths between 30 and 40 cm and in 2019 are high for lengths <22 cm. Witch Flounder above 45 cm have been largely absent from catches in the last 20 years.

In 4VW, the biomass indices for both 2018 and 2019 are well above 80% of the long-term mean and the 3-yr GM was among the highest since the 1970s. The abundance indices are also high for most lengths relative to both the long-term and short-term averages.

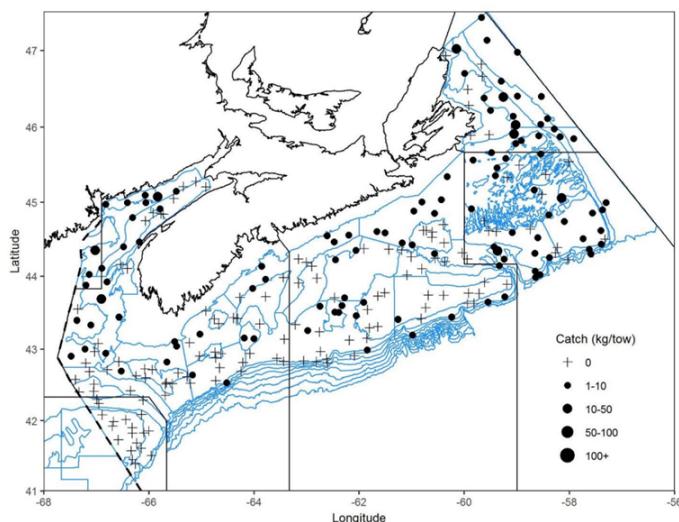


Figure 13a. Distribution of Witch Flounder catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

Figure 54. Distribution of Witch Flounder catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

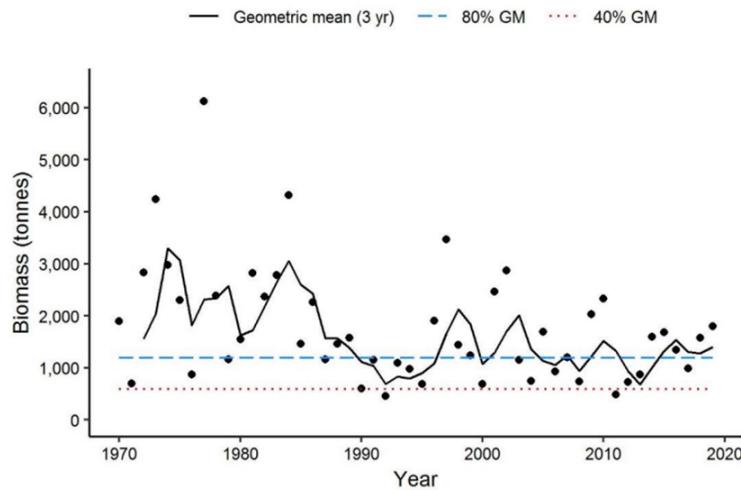


Figure 13b. Biomass index for Witch Flounder in 4X from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2018), respectively. The black dots represent the biomass index for that year.

Figure 55. 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 (1970–2018), respectively. The black dots represent the biomass index for that year.

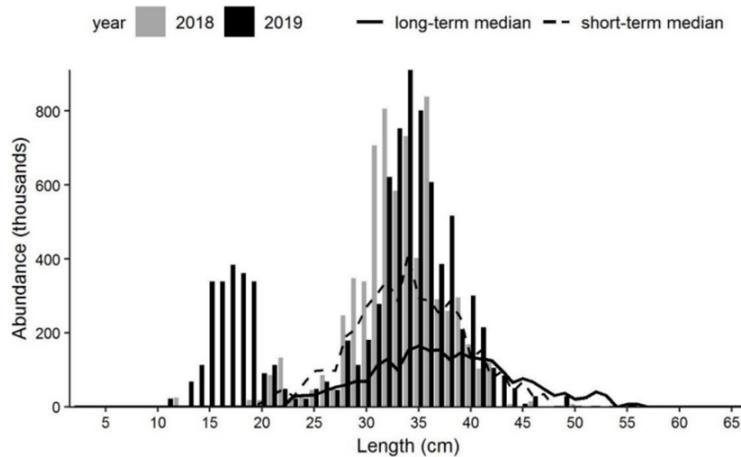


Figure 13c. Length frequency indices for Witch Flounder in 4X from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 56. 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 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

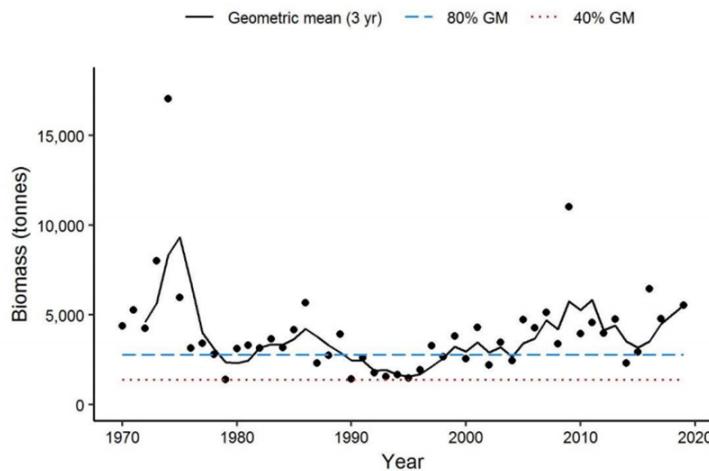


Figure 13d. Biomass index for Witch Flounder in 4VW from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2017), respectively. The black dots represent the biomass index for that year.

Figure 57. Biomass index for Witch Flounder in 4VW 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 (1970–2017), respectively. The black dots represent the biomass index for that year.

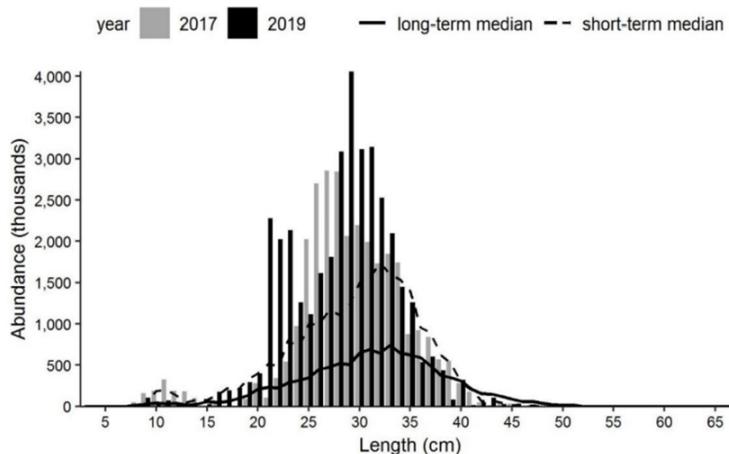


Figure 13e. Length frequency indices for Witch Flounder in 4VW from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 58. Length frequency indices for Witch Flounder in 4VW from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Winter Flounder

Winter Flounder (*Pseudopleuronectes americanus*) were caught primarily at the western end of the survey area in 2019. Biomass indices in 4X have generally been higher since 1990. The short-term median indices at length are generally higher than the long-term medians. In 2019, the indices at length are below short-term medians for most lengths. In 4VW, the biomass index in 2019 is close to 40% of the long-term GM. Indices at length are above the short-term median for small fish but at or below both short- and long-term GM above 21 cm.

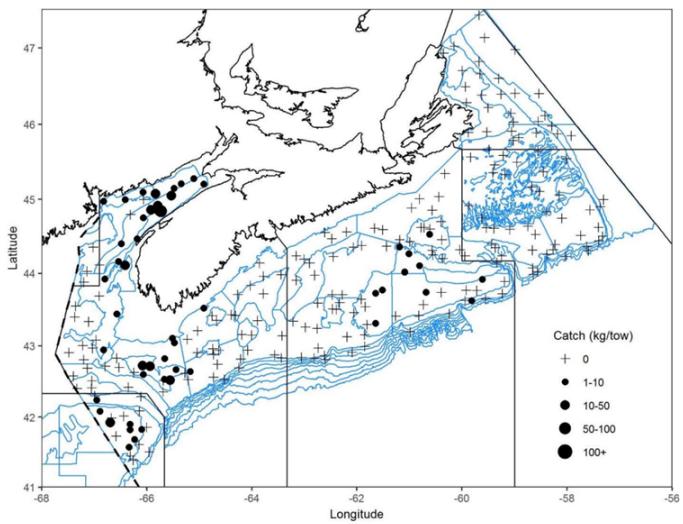


Figure 14a. Distribution of Winter Flounder catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

Figure 59. Distribution of Winter Flounder catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

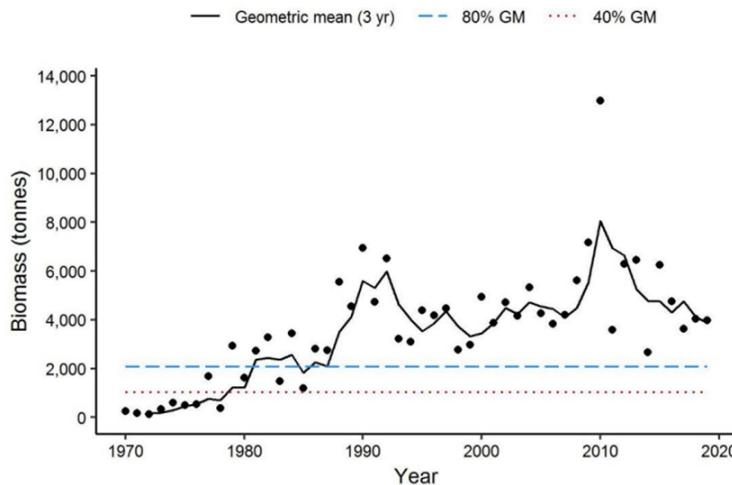


Figure 14b. Biomass index for Winter Flounder in 4X from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2018), respectively. The black dots represent the biomass index for that year.

Figure 60. 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 (1970–2018), respectively. The black dots represent the biomass index for that year.

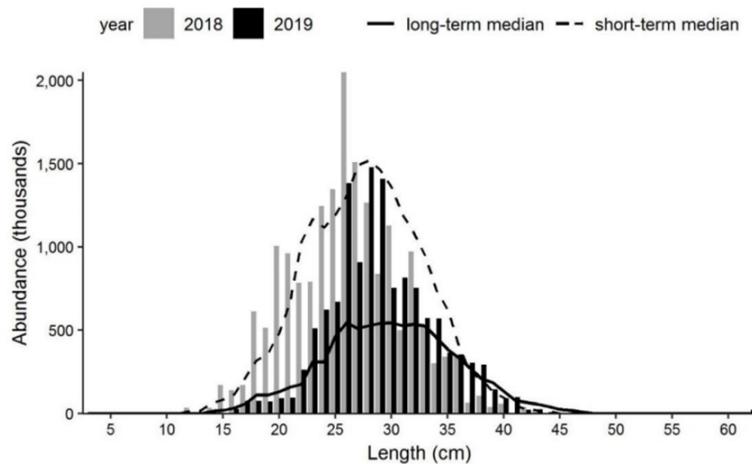


Figure 14c. Length frequency indices for Winter Flounder in 4X from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 61. 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 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

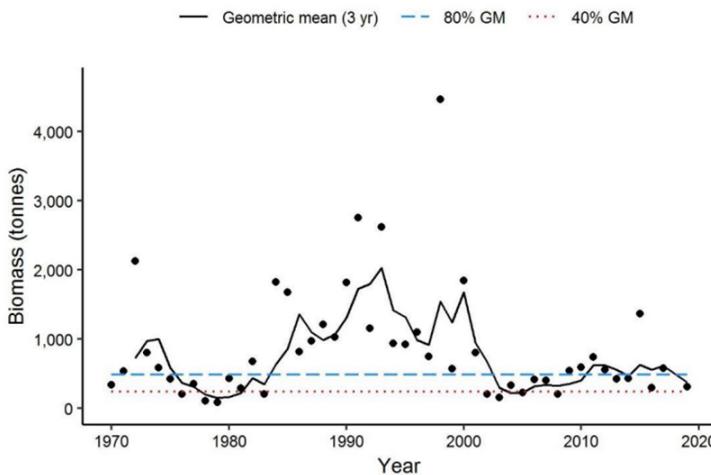


Figure 14d. Biomass index for Winter Flounder in 4VW from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2017), respectively. The black dots represent the biomass index for that year.

Figure 62. Biomass index for Winter Flounder in 4VW 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 (1970–2017), respectively. The black dots represent the biomass index for that year.

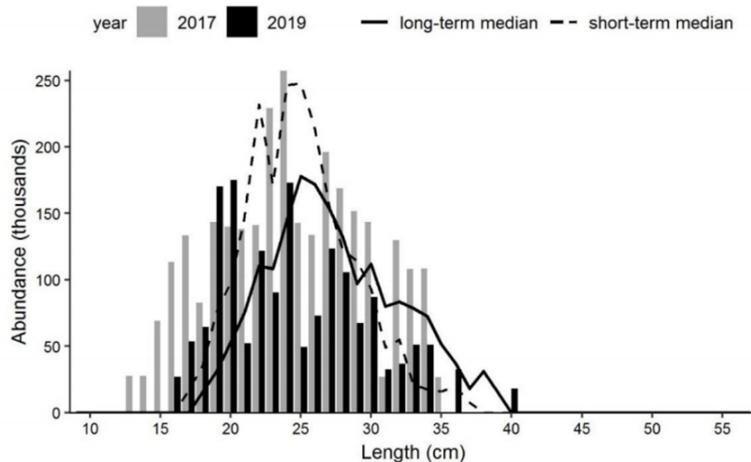


Figure 14e. Length frequency indices for Winter Flounder in 4VW from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 63. Length frequency indices for Winter Flounder in 4VW from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Atlantic Wolffish

Atlantic Wolffish (*Anarhichas lupus*) catches in 2019 came primarily from 4V, with sporadic catches elsewhere. The 3-yr GM biomass index for 2019 remains below 40% of the long-term GM in 4X but appears stable. In 4VW, the indices at length were close to the long-term and short-term medians in 2017 and 2019. The biomass index in 4VW in 2019 was the highest since 2011 but remains below 40% of the long-term GM.

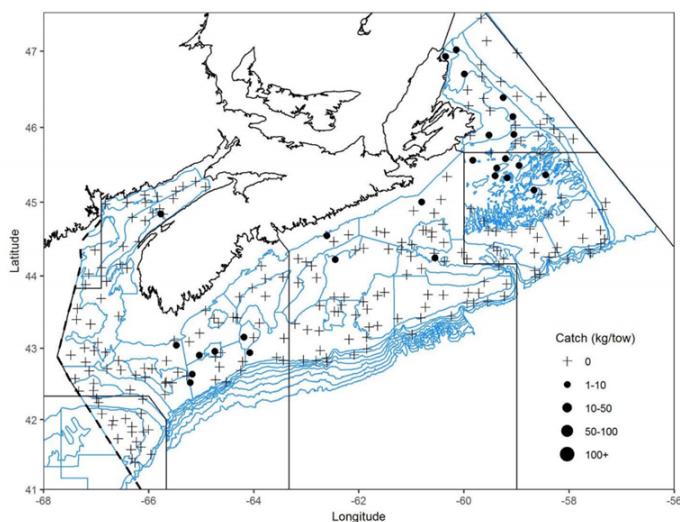


Figure 15a. Distribution of Atlantic Wolffish catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

Figure 64. Distribution of Atlantic Wolffish catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

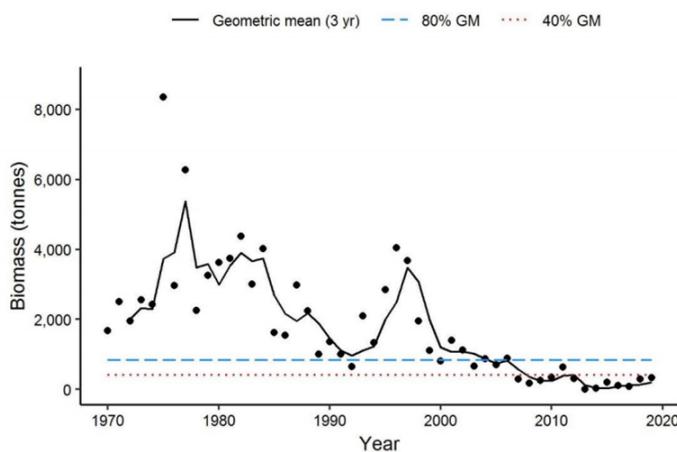


Figure 15b. Biomass index for Atlantic Wolffish in 4X from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2018), respectively. The black dots represent the biomass index for that year.

Figure 65. 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 (1970–2018), respectively. The black dots represent the biomass index for that year.

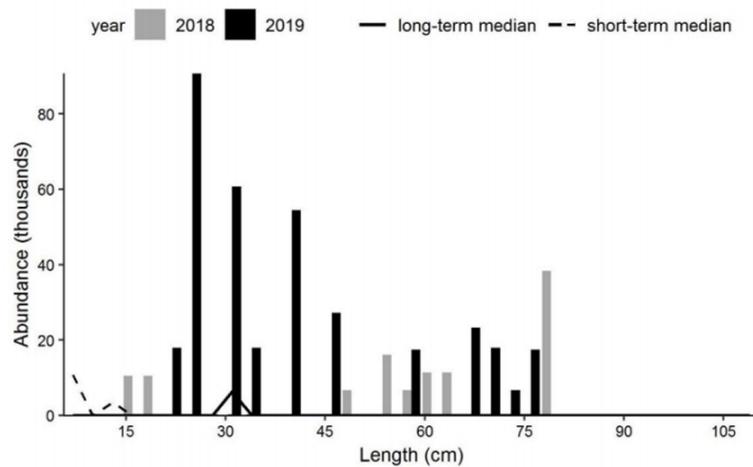


Figure 15c. Length frequency indices for Atlantic Wolffish in 4X from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 66. 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 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

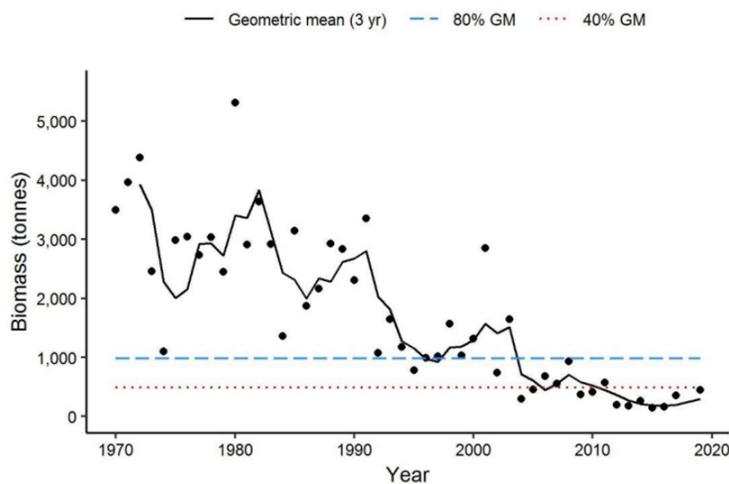


Figure 15d. Biomass index for Atlantic Wolffish in 4VW from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2017), respectively. The black dots represent the biomass index for that year.

Figure 67. Biomass index for Atlantic Wolffish in 4VW 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 (1970–2017), respectively. The black dots represent the biomass index for that year.

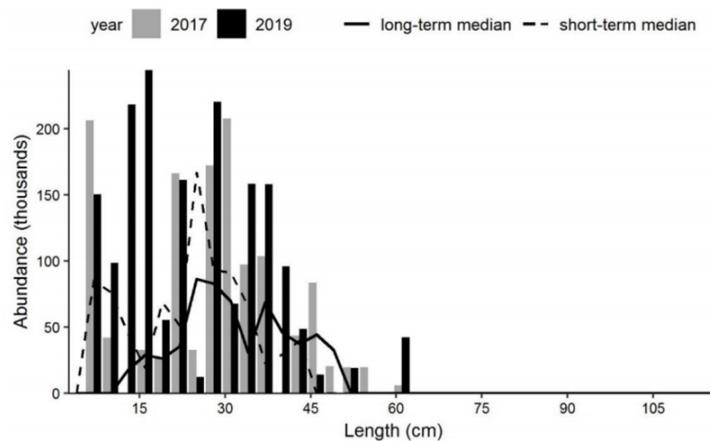


Figure 15e. Length frequency indices for Atlantic Wolffish in 4VW from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 68. Length frequency indices for Atlantic Wolffish in 4VW from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Monkfish

Monkfish (*Lophius americanus*) catches were scattered through much of the survey area in 2019. The biomass index in 2019 for 4X declined in 2019, but the 3-yr GM remains above 80% of the long-term GM. The indices at length were generally above both the long-term and short-term medians. Biomass indices have been close to 40% of the long-term mean in 4VW for the last 10 years, with very few fish in the catch again in 2019.

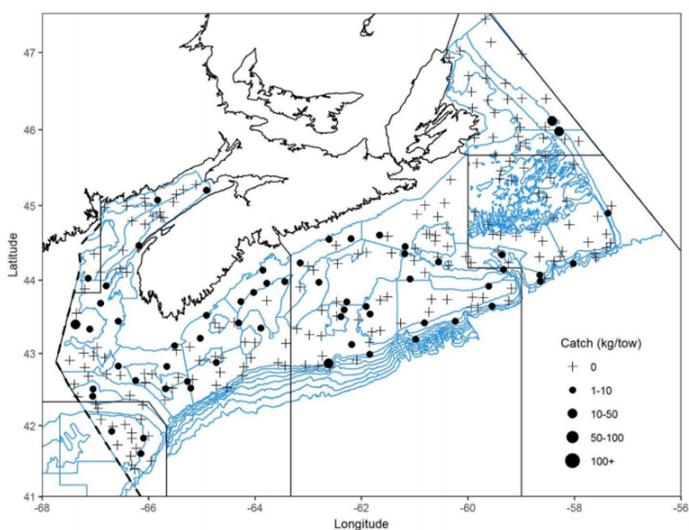


Figure 16a. Distribution of Monkfish catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

Figure 69. Distribution of Monkfish catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

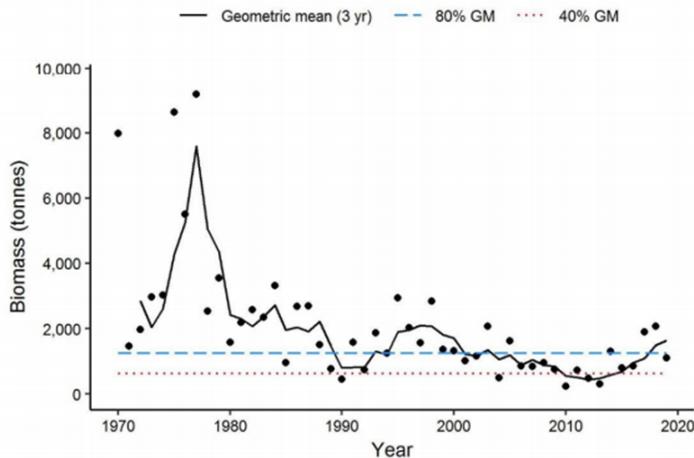


Figure 16b. Biomass index for Monkfish in 4X from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2018), respectively. The black dots represent the biomass index for that year.

Figure 70. 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 (1970–2018), respectively. The black dots represent the biomass index for that year.

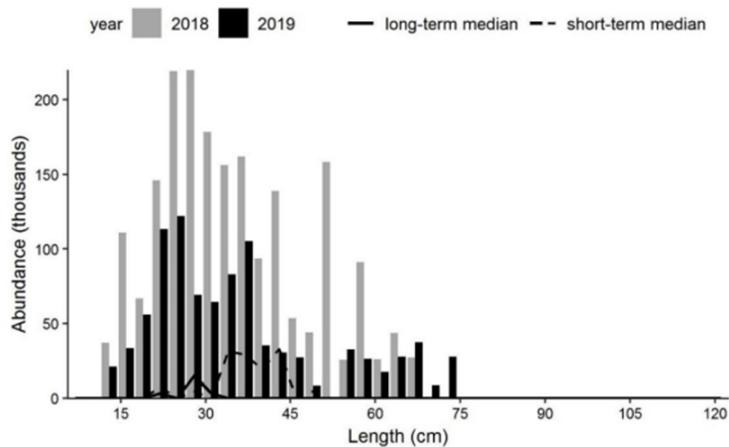


Figure 16c. Length frequency indices for Monkfish in 4X from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 71. Length frequency indices for Monkfish in 4X from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

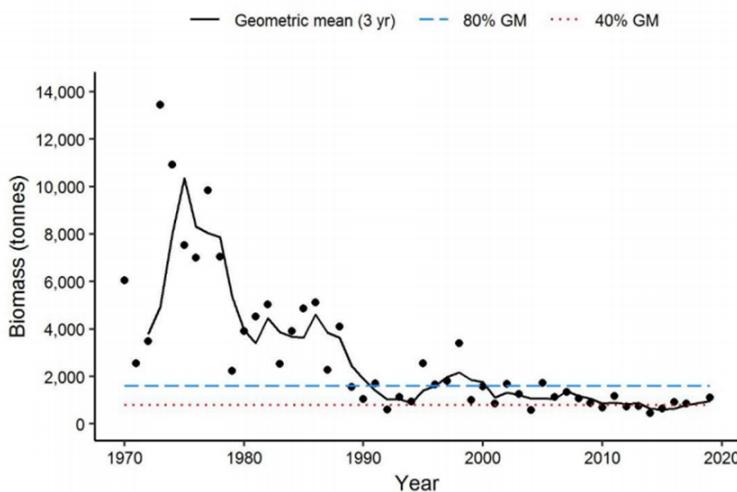


Figure 16d. Biomass index for Monkfish in 4VW from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2017), respectively. The black dots represent the biomass index for that year.

Figure 72. Biomass index for Monkfish in 4VW 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 (1970–2017), respectively. The black dots represent the biomass index for that year.

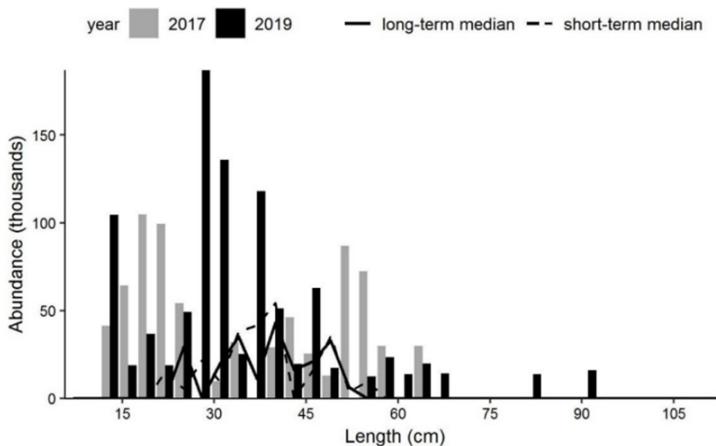


Figure 16e. Length frequency indices for Monkfish in 4VW from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 73. Length frequency indices for Monkfish in 4VW from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Longhorn Sculpin

Longhorn Sculpin (*Myoxocephalus octodecemspinosus*) are caught primarily on the Scotian Shelf banks and in the Bay of Fundy. The 3-yr GM biomass index is below 80% of the long-term mean in both 4X and 4VW. Indices at length are below the long-term median values for most lengths above 25 cm in 4X, and above 20 cm in 4VW.

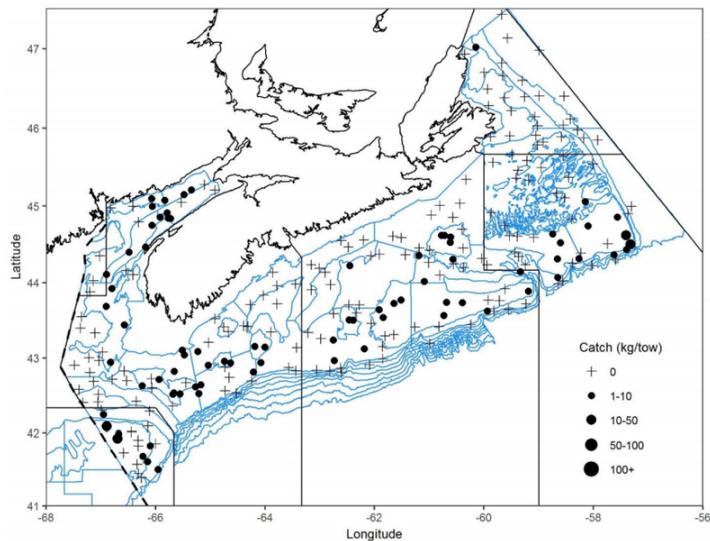


Figure 17a. Distribution of Longhorn Sculpin catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

Figure 74. Distribution of Longhorn Sculpin catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

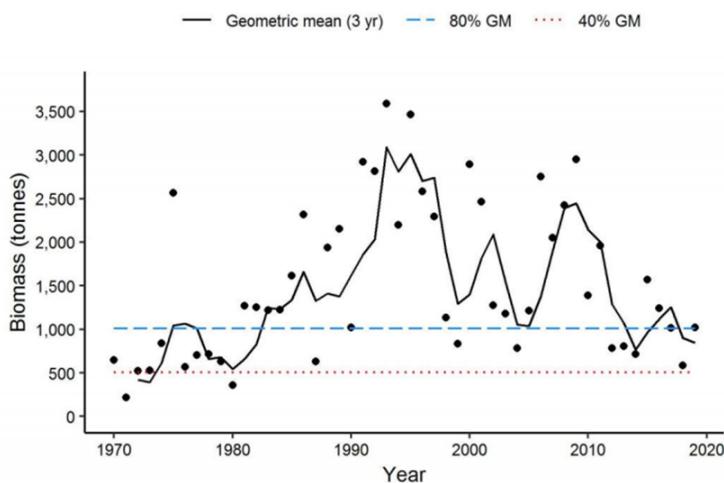


Figure 17b. Biomass index for Longhorn Sculpin in 4X from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2018), respectively. The black dots represent the biomass index for that year.

Figure 75. 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 (1970–2018), respectively. The black dots represent the biomass index for that year.

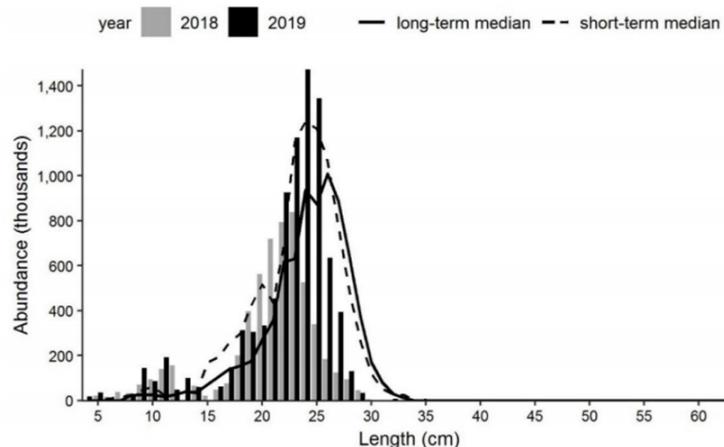


Figure 17c. Length frequency indices for Longhorn Sculpin in 4X from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 76. 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 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

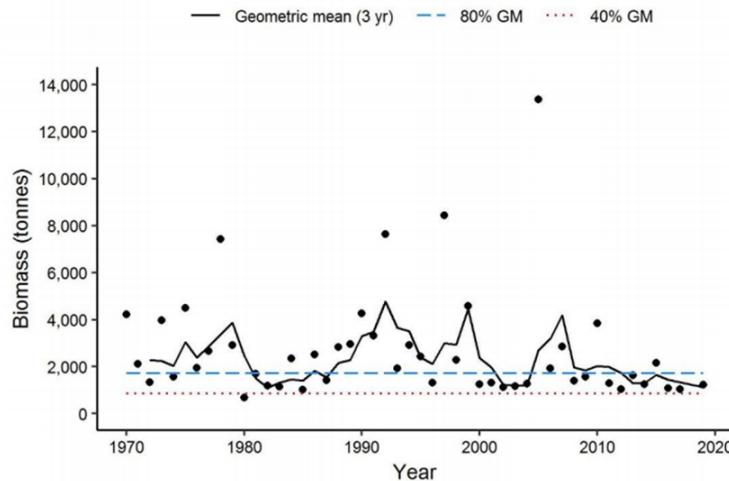


Figure 17d. Biomass index for Longhorn Sculpin in 4VW from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2017), respectively. The black dots represent the biomass index for that year.

Figure 77. Biomass index for Longhorn Sculpin in 4VW 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 (1970–2017), respectively. The black dots represent the biomass index for that year.

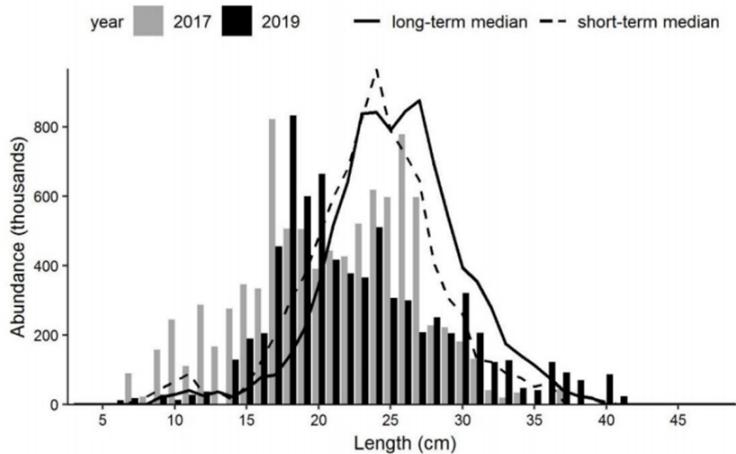


Figure 17e. Length frequency indices for Longhorn Sculpin in 4VW from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 78. Length frequency indices for Longhorn Sculpin in 4VW from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Barndoor Skate

Barndoor Skate (*Dipturus laevis*) were caught primarily at the western end of the survey area. There were none caught in 4VW in 2019. The 3-yr mean of the biomass index remains among the highest in the series for 4X in 2019, while in 4VW, with none caught in 2019, the 3-yr GM is low. Prior to 1998, catches are close to zero for all sizes of Barndoor Skates, so the medians are zero for all lengths. In 2019, fish were caught at lengths ranging from 39 to 127 cm.

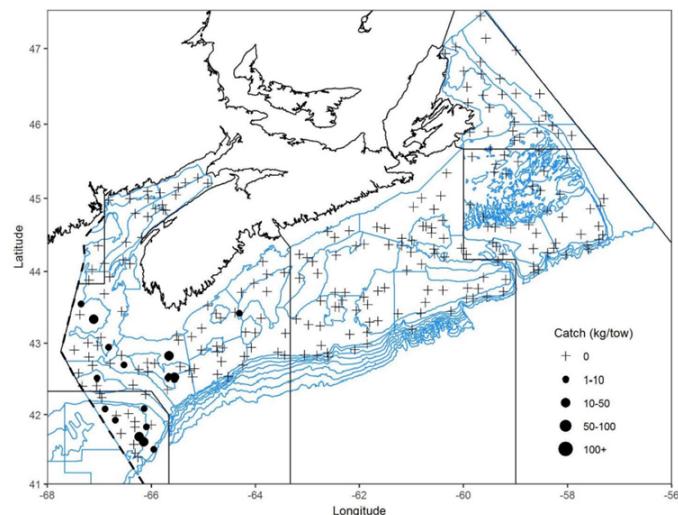


Figure 18a. Distribution of Barndoor Skate catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

Figure 79. Distribution of Barndoor Skate catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

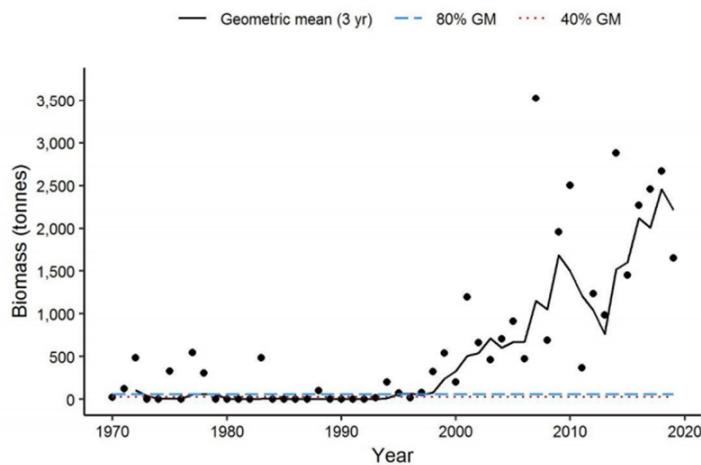


Figure 18b. Biomass index for Barndoor Skate in 4X from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2018), respectively. The black dots represent the biomass index for that year.

Figure 80. 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 (1970–2018), respectively. The black dots represent the biomass index for that year.

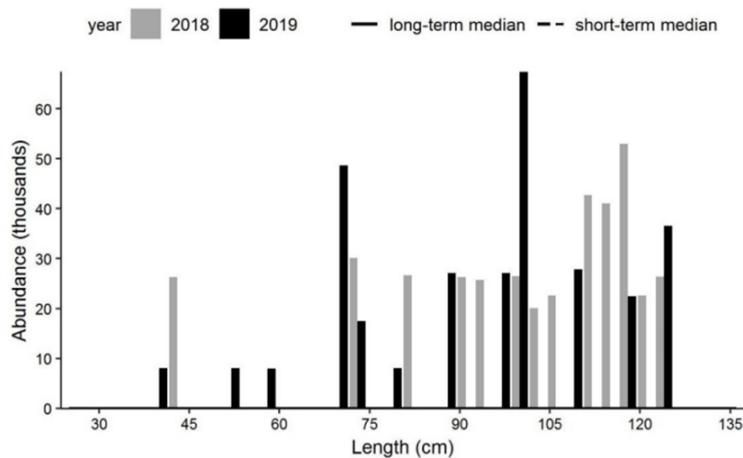


Figure 18c. Length frequency indices for Barndoor Skate in 4X from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 81. 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 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

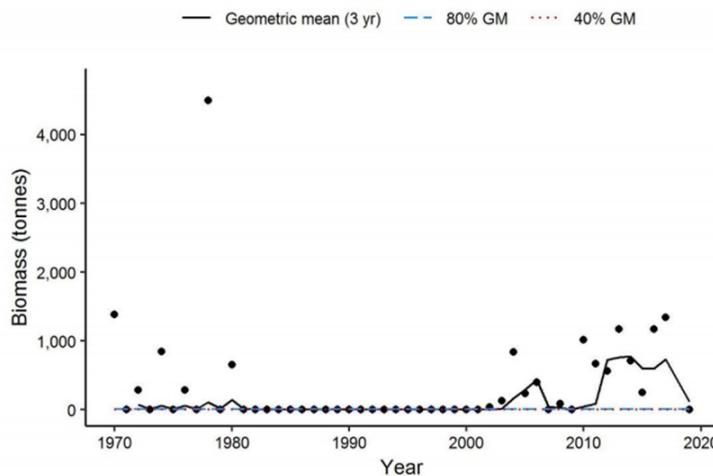


Figure 18d. Biomass index for Barndoor Skate in 4VW from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2017), respectively. The black dots represent the biomass index for that year.

Figure 82. Biomass index for Barndoor Skate in 4VW 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 (1970–2017), respectively. The black dots represent the biomass index for that year.

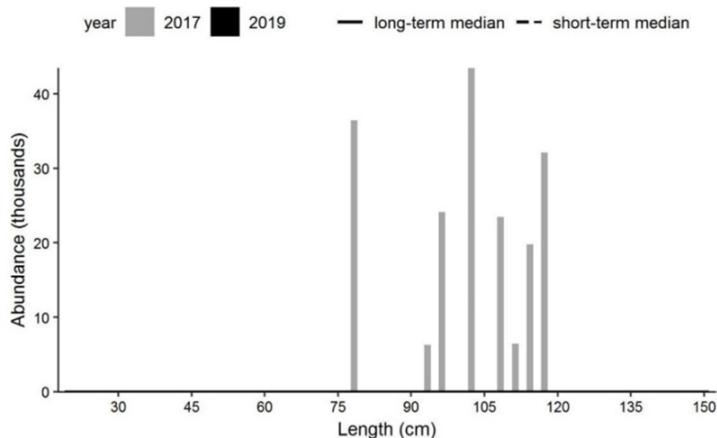


Figure 18e. Length frequency indices for Barndoor Skate in 4VW from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 83. Length frequency indices for Barndoor Skate in 4VW from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Thorny Skate

Thorny Skate (*Amblyraja radiata*) catches in 2019 were restricted primarily to 4V. The biomass index for 4X in 2019 was among the lowest in the series. In 4VW, the biomass index was the highest since 2011 but remains below 40% of the long-term GM.

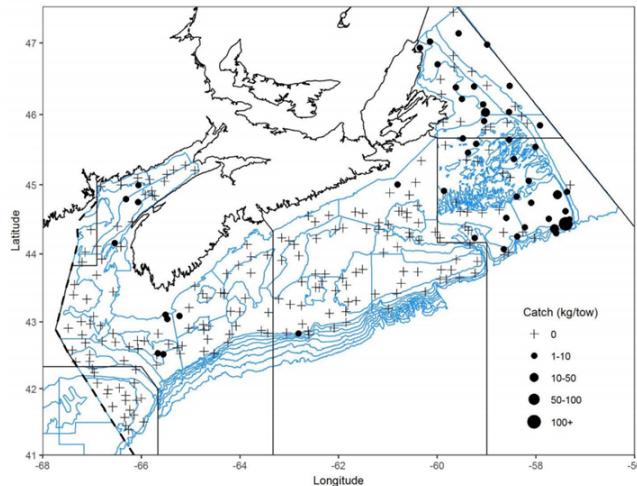


Figure 19a. Distribution of Thorny Skate catches during the 2019 DFO Summer RV Survey including the Laurentian channel and Georges Bank. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

Figure 84. Distribution of Thorny Skate catches during the 2019 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.

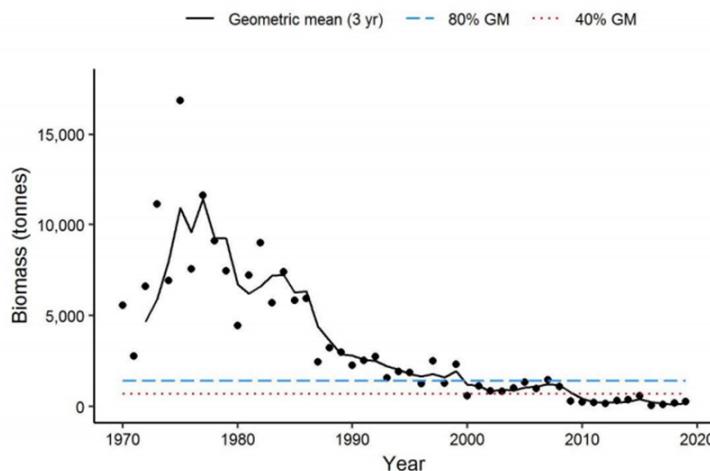


Figure 19b. Biomass index for Thorny Skate in 4X from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2018), respectively. The black dots represent the biomass index for that year.

Figure 85. 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 (1970–2018), respectively. The black dots represent the biomass index for that year.

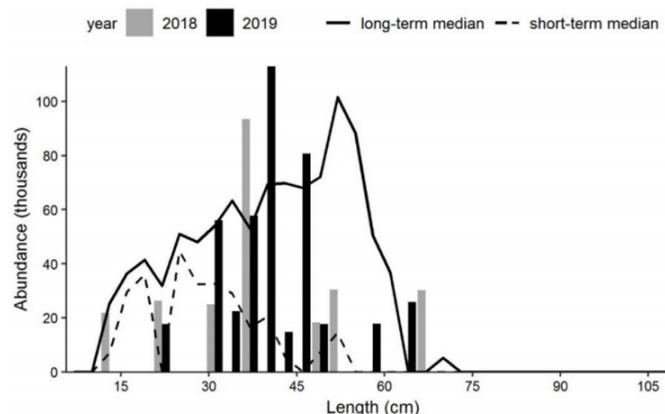


Figure 19c. Length frequency indices for Thorny Skate in 4X from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 86. 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 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

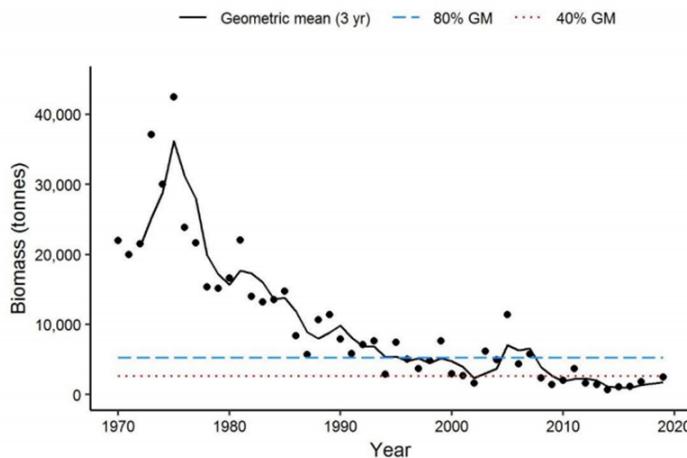


Figure 19d. Biomass index for Thorny Skate in 4VW from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2018), respectively. The black dots represent the biomass index for that year.

Figure 87. Biomass index for Thorny Skate in 4VW 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 (1970–2018), respectively. The black dots represent the biomass index for that year.

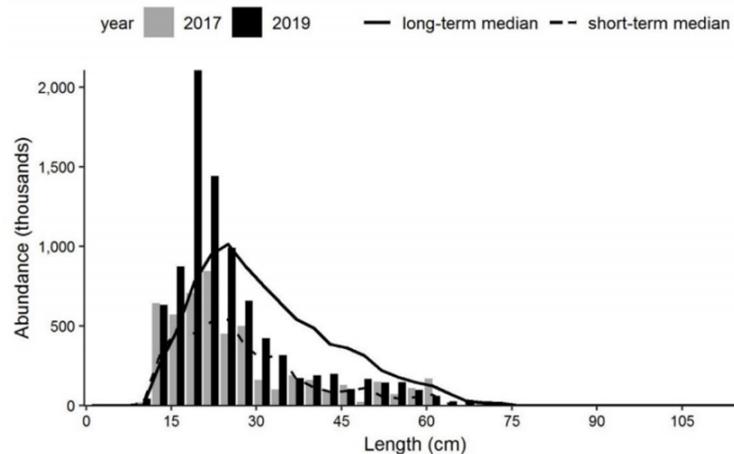


Figure 19e. Length frequency indices for Thorny Skate in 4VW from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 88. Length frequency indices for Thorny Skate in 4VW from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

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 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, Browns Bank and in the Bay of Fundy in 2019. The 3-yr GM biomass index in 4X dropped below 80% of the long-term GM in 2019. In 4VW, the 3-yr GM biomass index is below 40% of the long-term GM and among the lowest in the time series.

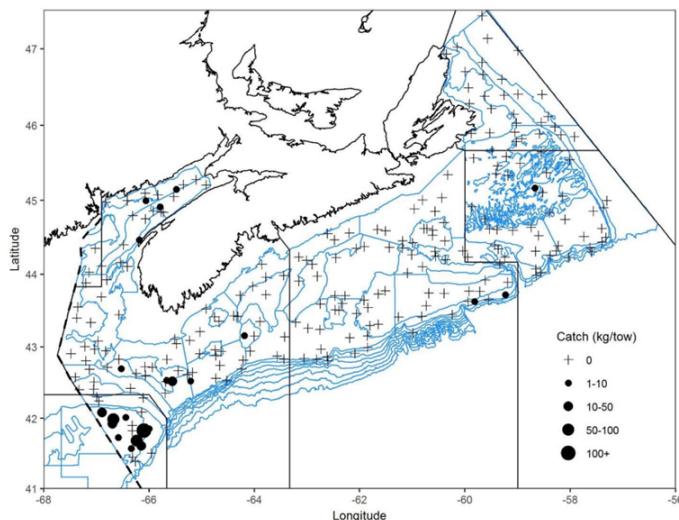


Figure 20a. Distribution of Winter Skate catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

Figure 89. Distribution of Winter Skate catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

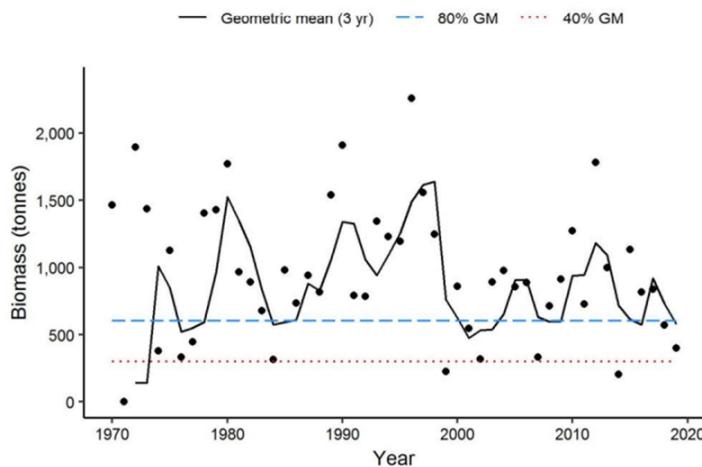


Figure 20b. Biomass index for Winter Skate in 4X from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2018), respectively. The black dots represent the biomass index for that year.

Figure 90. Biomass index for Winter 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 (1970–2018), respectively. The black dots represent the biomass index for that year.

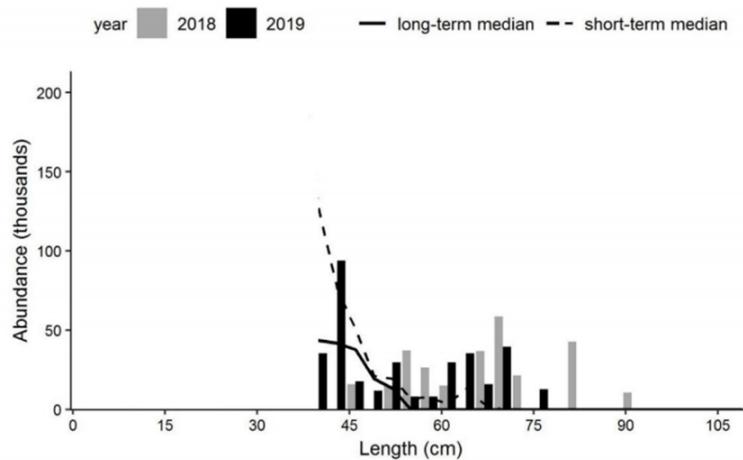


Figure 20c. Length frequency indices for Winter Skate in 4X from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 91. Length frequency indices for Winter Skate in 4X from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

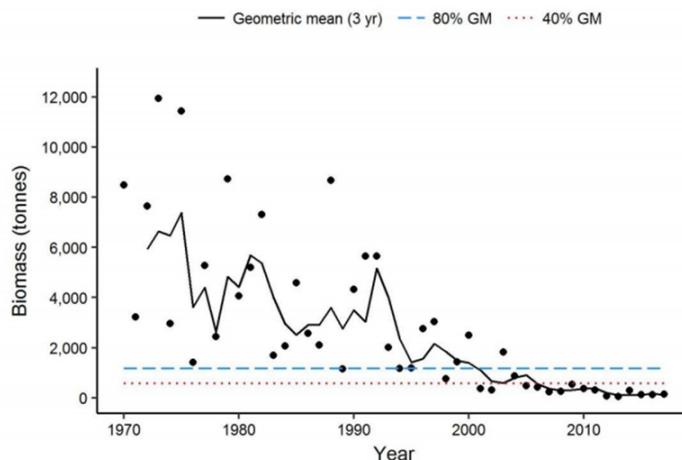


Figure 20d. Biomass index for Winter Skate in 4VW from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2017), respectively. The black dots represent the biomass index for that year.

Figure 92. Biomass index for Winter Skate in 4VW 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 (1970–2017), respectively. The black dots represent the biomass index for that year.

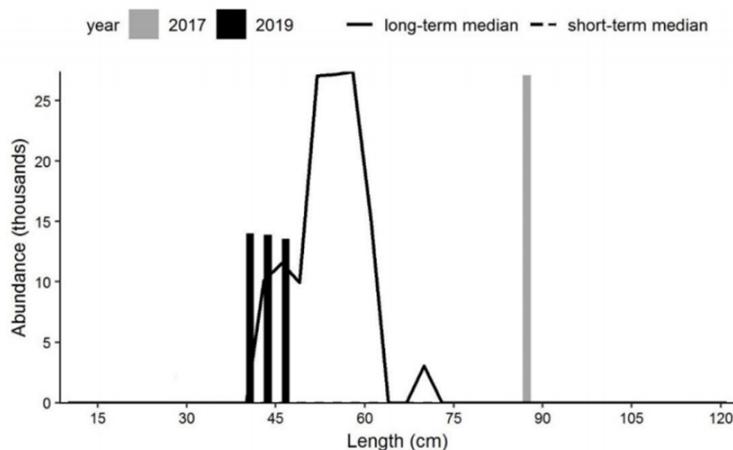


Figure 20e. Length frequency indices for Winter Skate in 4VW from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 93. Length frequency indices for Winter Skate in 4VW from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Little 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 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 are caught primarily in Western 4X and on Georges Bank. The biomass index for 4X in 2019 remained high, and abundance indices remained high for Little Skate for most lengths. The geographic range of Little Skate does not extend far into 4VW. In 4VW, the median catch at most lengths for the survey indices was zero and the biomass indices were very low.

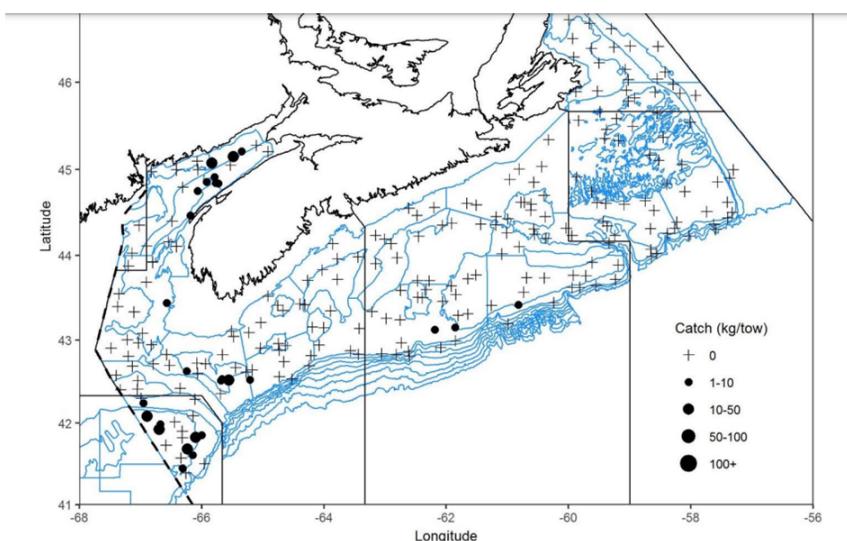


Figure 21a. Distribution of Little Skate catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

Figure 94. Distribution of Little Skate catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

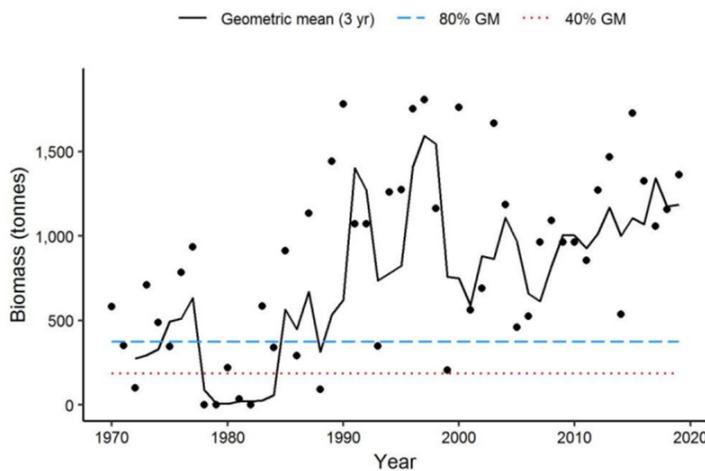


Figure 21b. Biomass index for Little Skate in 4X from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2018), respectively. The black dots represent the biomass index for that year.

Figure 95. 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 (1970–2018), respectively. The black dots represent the biomass index for that year.

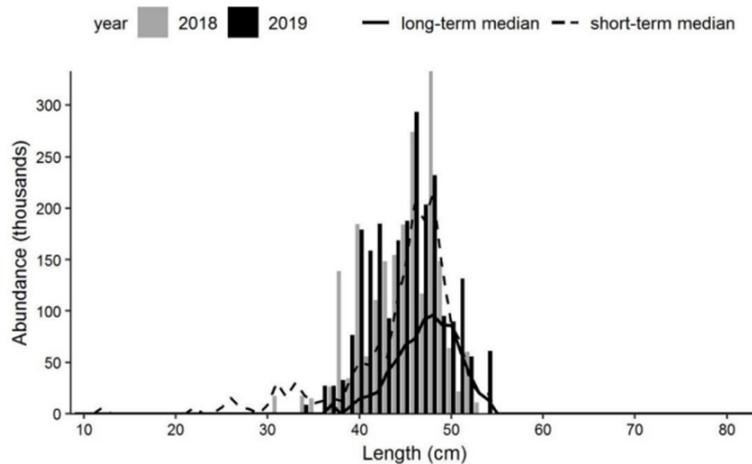


Figure 21c. Length frequency indices for Little Skate in 4X from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 96. 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 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

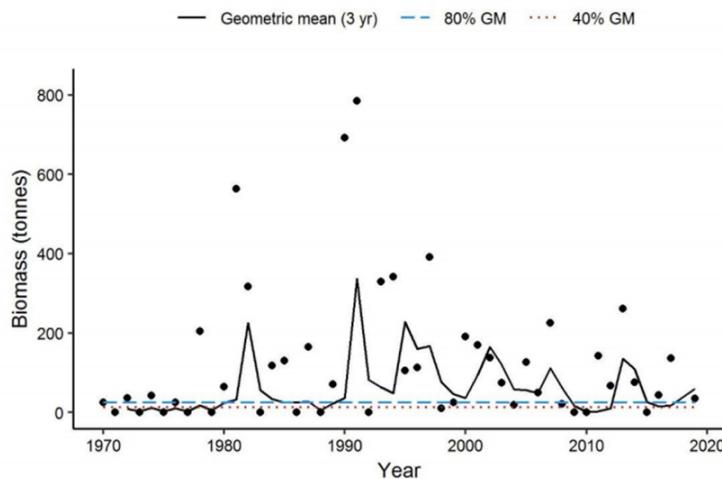


Figure 21d. Biomass index for Little Skate in 4VW from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2017), respectively. The black dots represent the biomass index for that year.

Figure 97. Biomass index for Little Skate in 4VW 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 (1970–2017), respectively. The black dots represent the biomass index for that year.

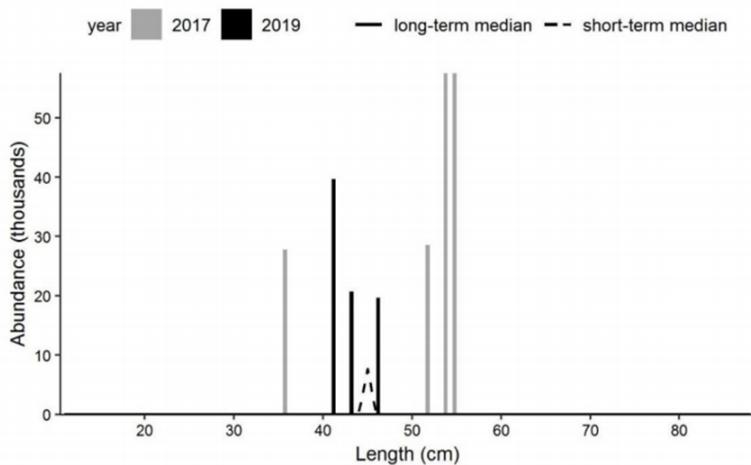


Figure 21e. Length frequency indices for Little Skate in 4VW from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 98. Length frequency indices for Little Skate in 4VW from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Smooth Skate

Smooth Skate (*Malacoraja senta*) are caught at the eastern and western ends of the survey area. In 4X, the biomass index appears to have increased from a low in the early 1990s and has fluctuated around 80% of the long-term mean in recent years. The biomass index in 4VW was above 40% of the long-term GM in 2019. Few large Smooth Skate were caught in either 2017 or 2019, but the indices were well above the long-term GM between 20 and 30 cm.

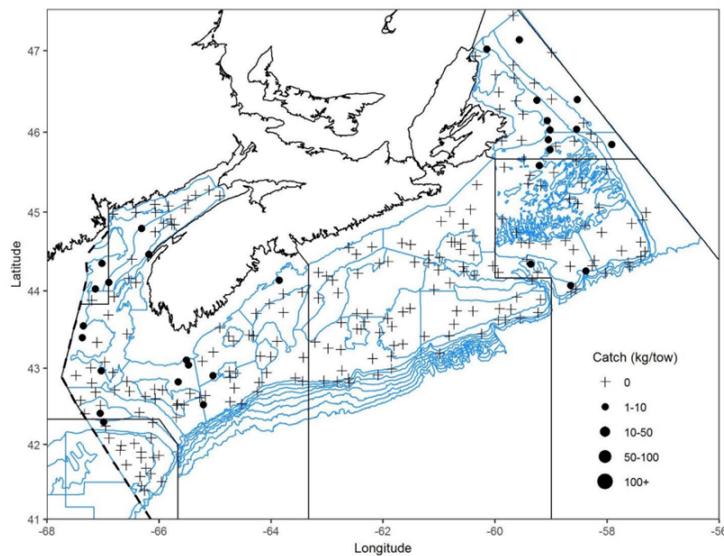


Figure 22a. Distribution of Smooth Skate catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

Figure 99. Distribution of Smooth Skate catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

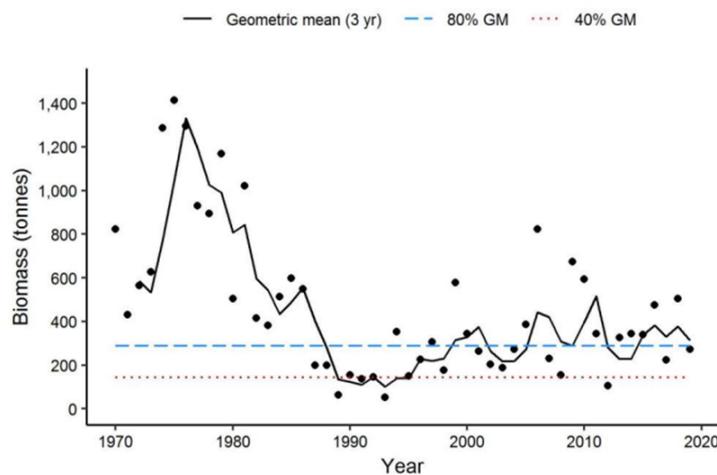


Figure 22b. Biomass index for Smooth Skate in 4X from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2018), respectively. The black dots represent the biomass index for that year.

Figure 100. 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 (1970–2018), respectively. The black dots represent the biomass index for that year.

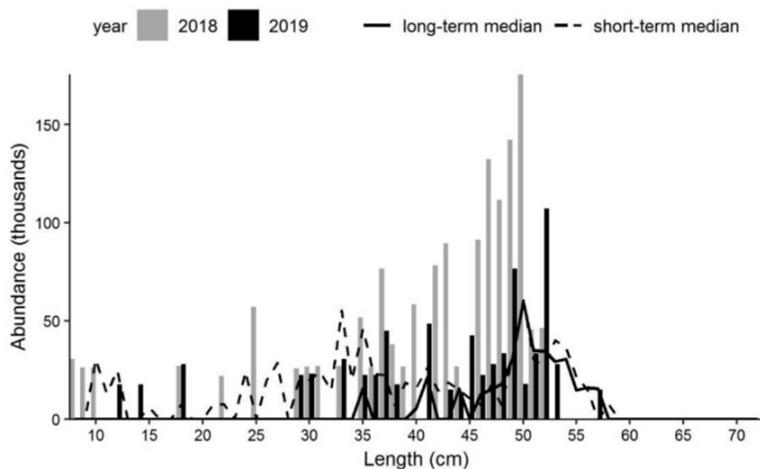


Figure 22c. Length frequency indices for Smooth Skate in 4X from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–017.

Figure 101. 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 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–017.

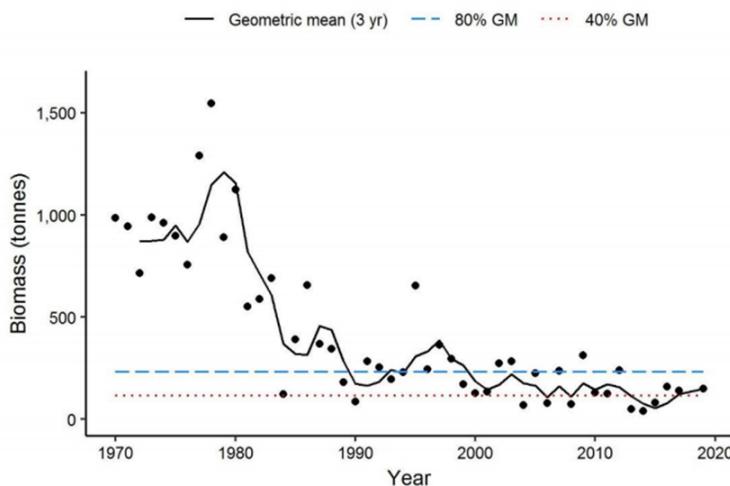


Figure 22d. Biomass index for Smooth Skate in 4VW from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2017), respectively. The black dots represent the biomass index for that year.

Figure 102. Biomass index for Smooth Skate in 4VW 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 (1970–2017), respectively. The black dots represent the biomass index for that year.

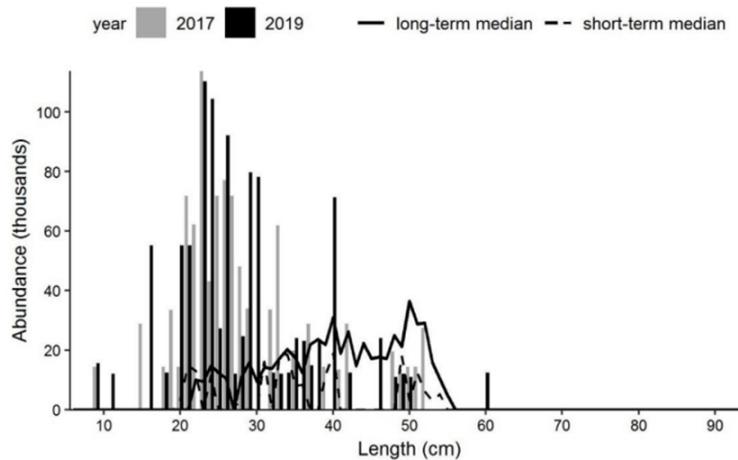


Figure 22e. Length frequency indices for Smooth Skate in 4VW from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 103. Length frequency indices for Smooth Skate in 4VW from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Spiny Dogfish

Spiny Dogfish (*Squalus acanthias*) are well distributed in 4X, on Georges Bank and in the western end of 4W. The largest catch of Dogfish in 2019 (806 kg) was taken in 4W. This is the first year where the largest catch of Dogfish from the survey came from 4VW and is also the largest catch in 4VW in the survey time series.

Inter-annual variability in survey catch is high for Spiny Dogfish. The 3-yr GM biomass index is above 80% of the long-term GM in 2019. The indices at length are at or above the median values at all lengths. The Spiny Dogfish population extends across the Canada-US boundary, with the majority of the population in US waters in most years.

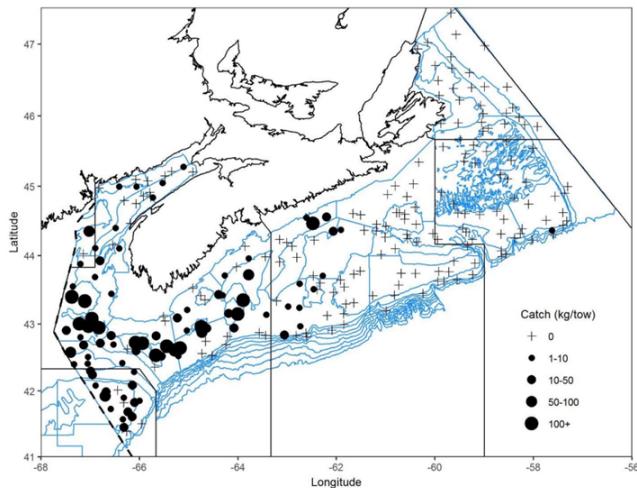


Figure 23a. Distribution of Spiny Dogfish catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

Figure 104. Distribution of Spiny Dogfish catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

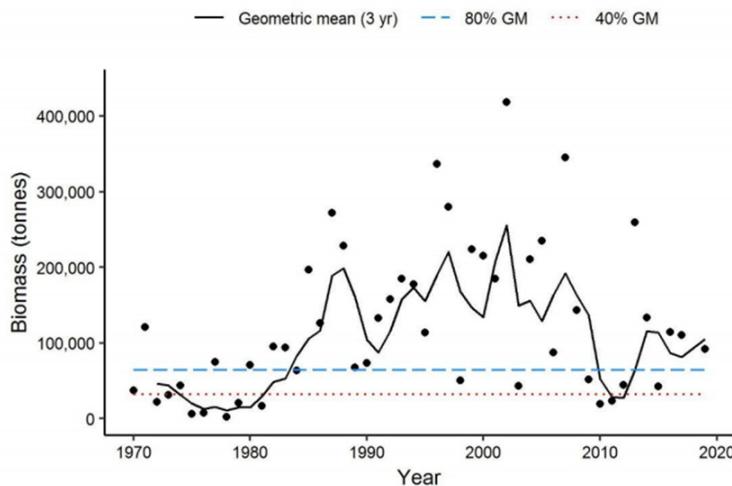


Figure 23b. Biomass index for Spiny Dogfish in 4VWX from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2017), respectively. The black dots represent the biomass index for that year.

Figure 105. Biomass index for Spiny Dogfish in 4VWX 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 (1970–2017), respectively. The black dots represent the biomass index for that year.

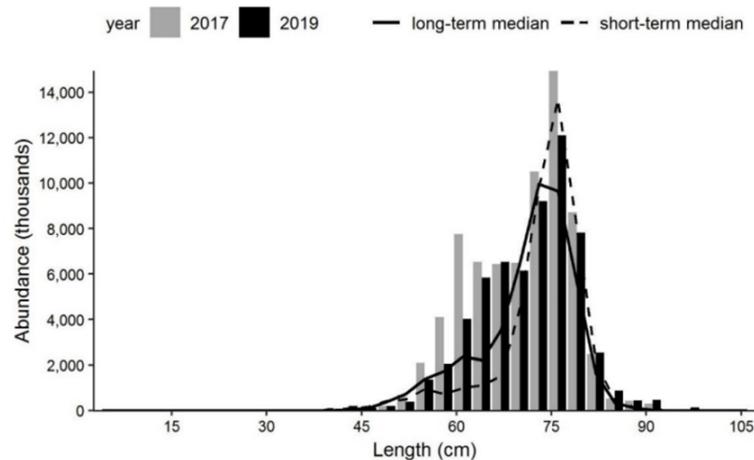


Figure 23c. Length frequency indices for Spiny Dogfish in 4VWX from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 106. Length frequency indices for Spiny Dogfish in 4VWX from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

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 2011) did not differentiate them.

Red Hake were caught throughout 4X and 4W in 2019 but are seldom found in 4V. The short-term median numbers at length are generally higher than the long-term median in both 4X and 4VW, indicating a general increase in abundance. The indices at length in 2019 are generally above the short-term median values in both areas. In 4VW, the biomass index has been increasing since about 2010. In 2019, the 3-yr GM biomass index is the highest recorded since 1989.

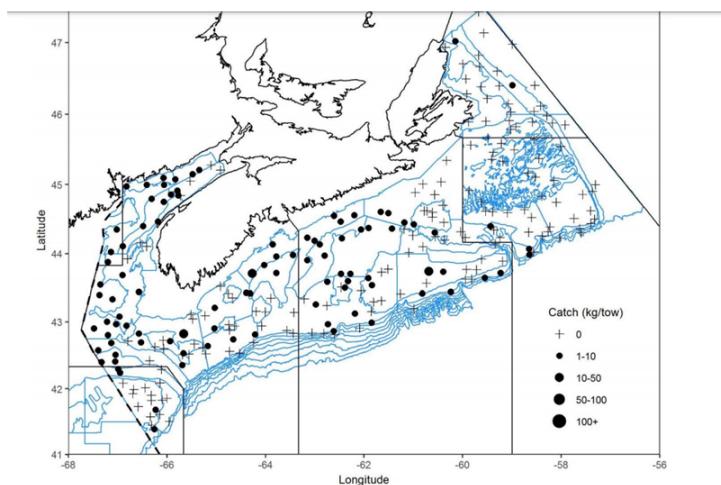


Figure 24a. Distribution of Red Hake catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

Figure 107. Distribution of Red Hake catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

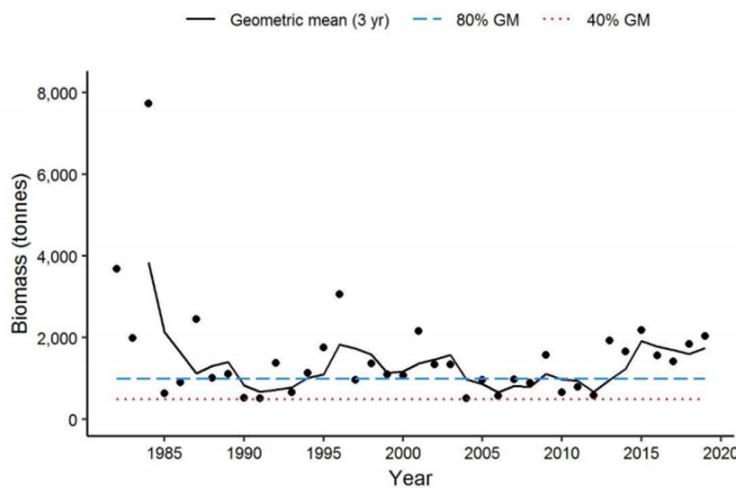


Figure 24b. Biomass index for Red Hake in 4X from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2018), respectively. The black dots represent the biomass index for that year.

Figure 108. 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 (1970–2018), respectively. The black dots represent the biomass index for that year.

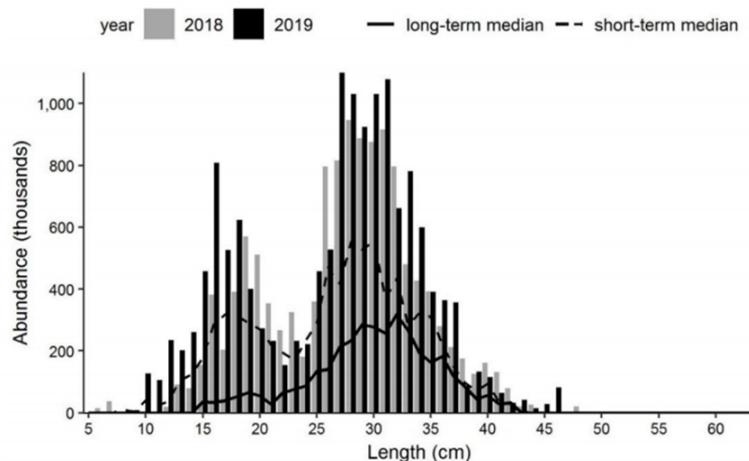


Figure 24c. Length frequency indices for Red Hake in 4X from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 109. 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 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

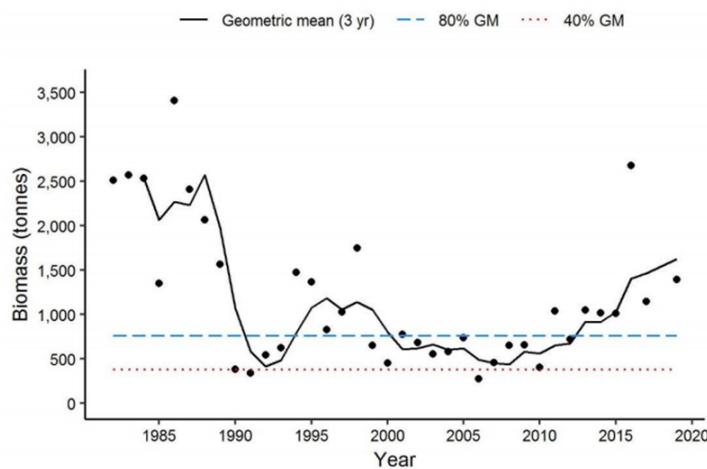


Figure 24d. Biomass index for Red Hake in 4VW from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2017), respectively. The black dots represent the biomass index for that year.

Figure 110. Biomass index for Red Hake in 4VW 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 (1970–2017), respectively. The black dots represent the biomass index for that year.

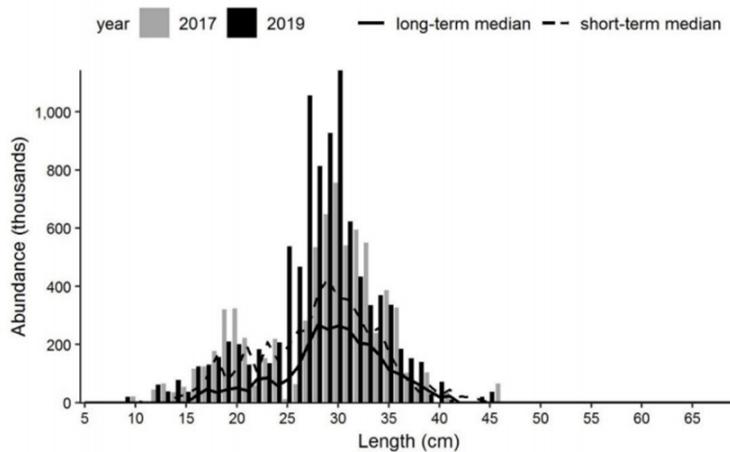


Figure 24e. Length frequency indices for Red Hake in 4VW from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 111. Length frequency indices for Red Hake in 4VW from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Sea Raven

Sea Raven (*Hemitripterus americanus*) are caught primarily on the banks and in the Bay of Fundy, with the largest sets taken in the Bay and on Banquereau. In 4X, the 2019 biomass index and the 3-yr GM biomass index are both the lowest in the time series. The indices at length are below the short-term median for most lengths. In 4VW, the survey biomass index remains above 80% of the long-term GM. The indices at length are above the long-term median for most lengths.

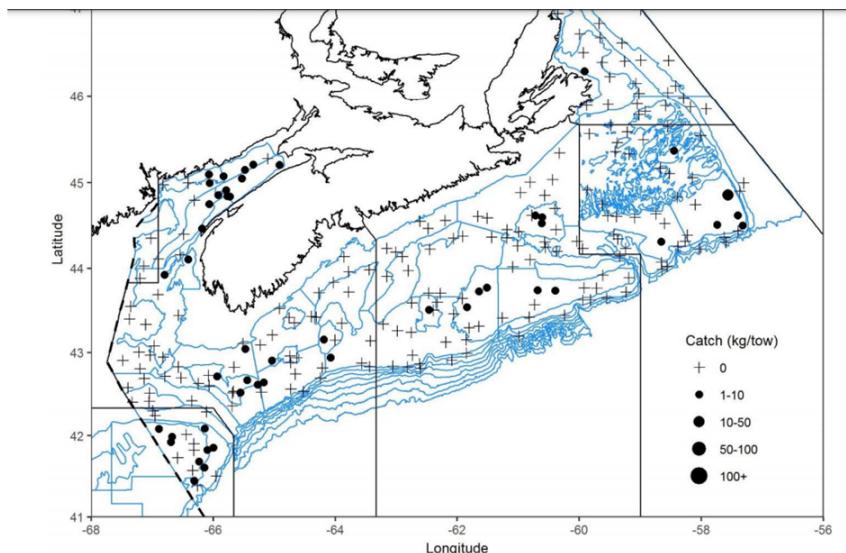


Figure 25a. Distribution of Sea Raven catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

Figure 112. Distribution of Sea Raven catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

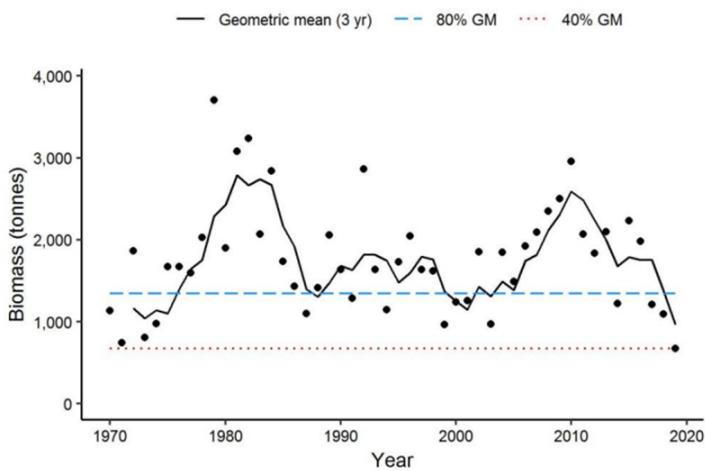


Figure 25b. Biomass index for Sea Raven in 4X from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2018), respectively. The black dots represent the biomass index for that year.

Figure 113. 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 (1970–2018), respectively. The black dots represent the biomass index for that year.

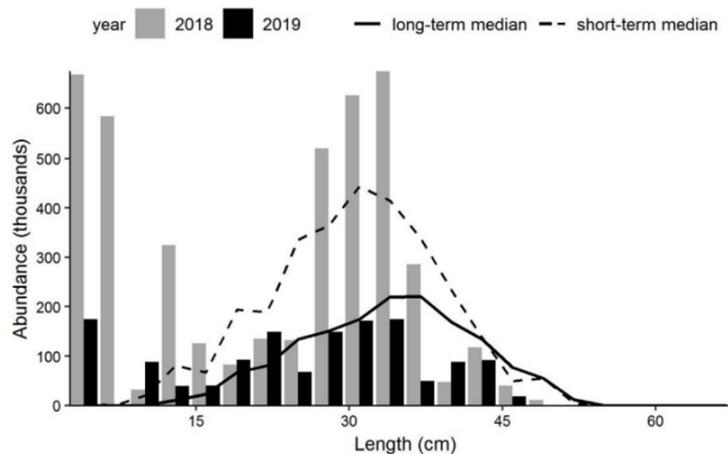


Figure 25c. Length frequency indices for Sea Raven in 4X from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 114. 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 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

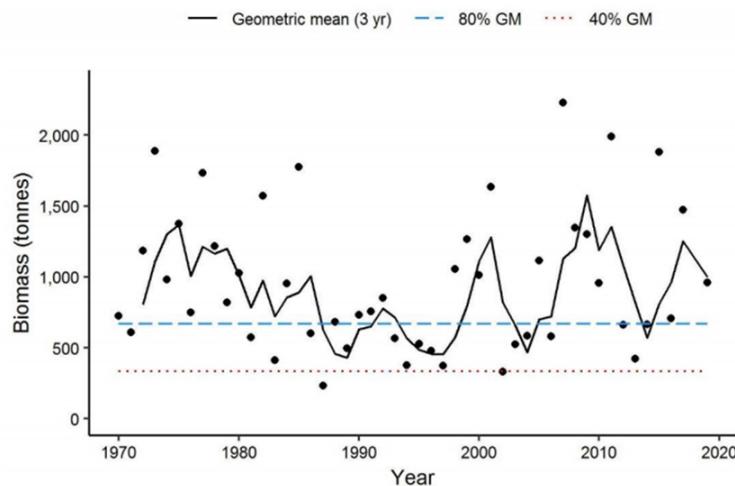


Figure 25d. Biomass index for Sea Raven in 4VW from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2017), respectively. The black dots represent the biomass index for that year.

Figure 115. Biomass index for Sea Raven in 4VW 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 (1970–2017), respectively. The black dots represent the biomass index for that year.

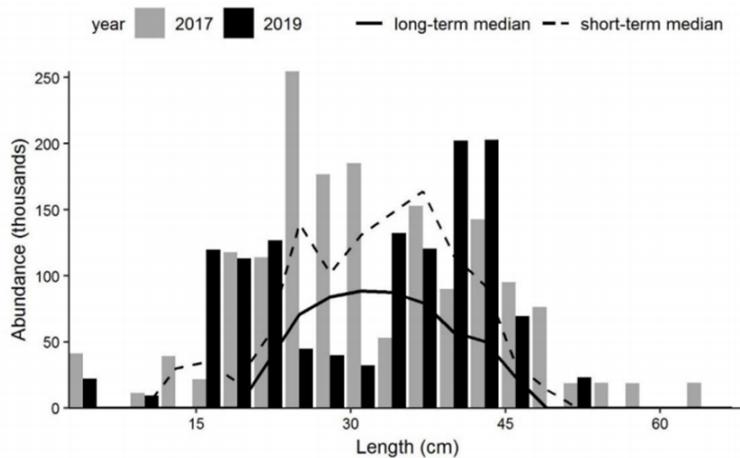


Figure 25e. Length frequency indices for Sea Raven in 4VW from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 116. Length frequency indices for Sea Raven in 4VW from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Ocean Pout

Ocean Pout (*Zoarces americanus*) were caught in only a few sets in 2019. The 3-yr GM biomass indices have been below 40% of the long-term mean for the last 6 years in 4X and at or below the long-term GM since 2002 in 4VW. Catches of larger Ocean Pout are very low relative to the median values in 4X.

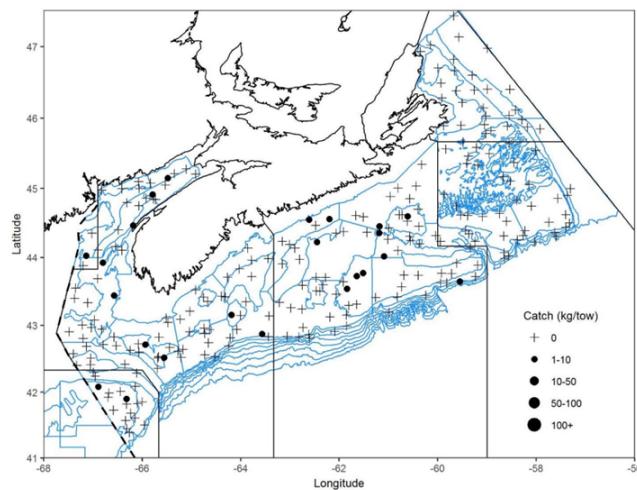


Figure 26a. Distribution of Ocean Pout catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

Figure 117. Distribution of Ocean Pout catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

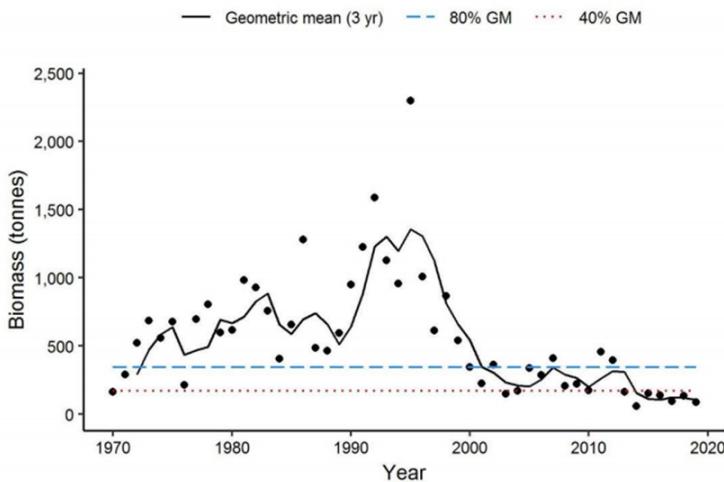


Figure 26b. Biomass index for Ocean Pout in 4X from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2018), respectively. The black dots represent the biomass index for that year.

Figure 118. 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 (1970–2018), respectively. The black dots represent the biomass index for that year.

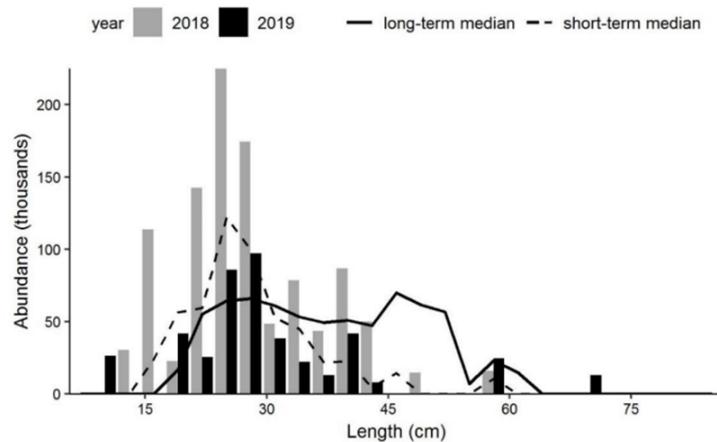


Figure 26c. Length frequency indices for Ocean Pout in 4X from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 119. 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 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

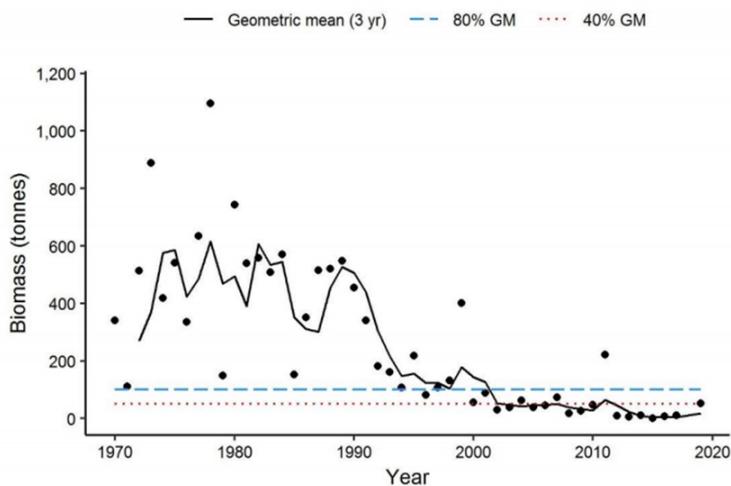


Figure 26d. Biomass index for Ocean Pout in 4VW from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2017), respectively. The black dots represent the biomass index for that year.

Figure 120. Biomass index for Ocean Pout in 4VW 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 (1970–2017), respectively. The black dots represent the biomass index for that year.

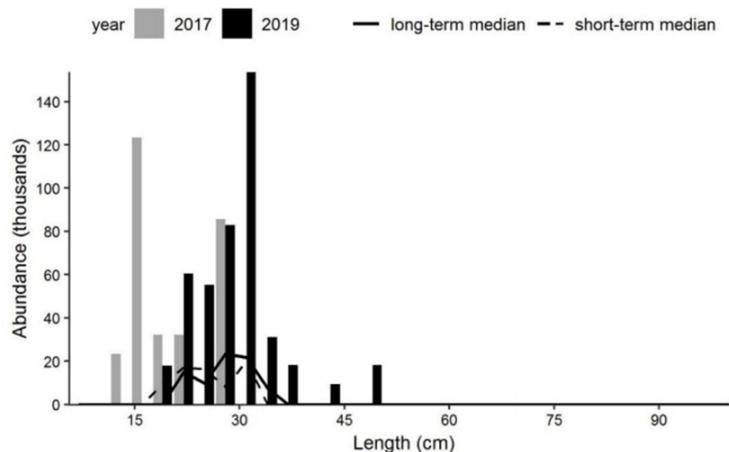


Figure 26e. Length frequency indices for Ocean Pout in 4VW from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 121. Length frequency indices for Ocean Pout in 4VW from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2017 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

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. In 2019, they were caught regularly in these areas, and they were also caught in strata 440 and 446 in the Laurentian Channel for the first time in the survey series. 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. Since they are found primarily in deeper strata, several of which have been added to the survey coverage since 1996, their biomass index is higher when 5Z9 and strata 496–498 are included.

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. In 2018, indices at length are generally similar to the short-term median values, while in 2019 indices are higher for smaller fish.

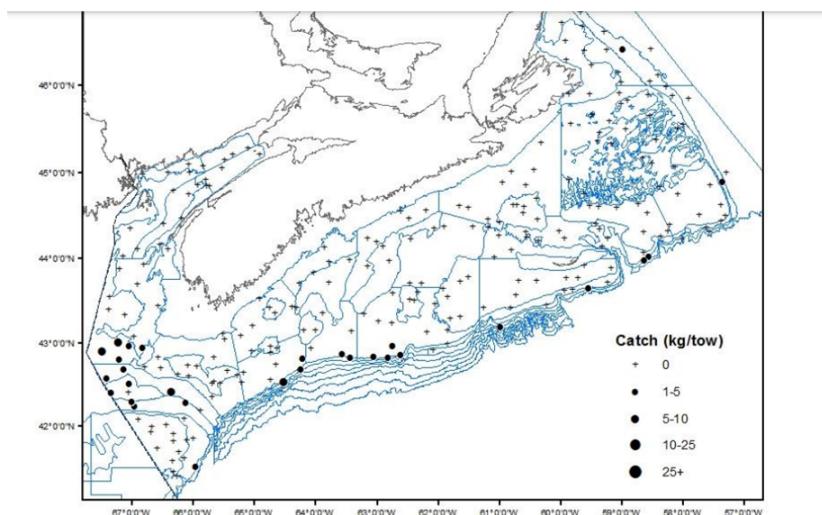


Figure 27a. Distribution of Blackbelly Rosefish catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

Figure 122. Distribution of Blackbelly Rosefish catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

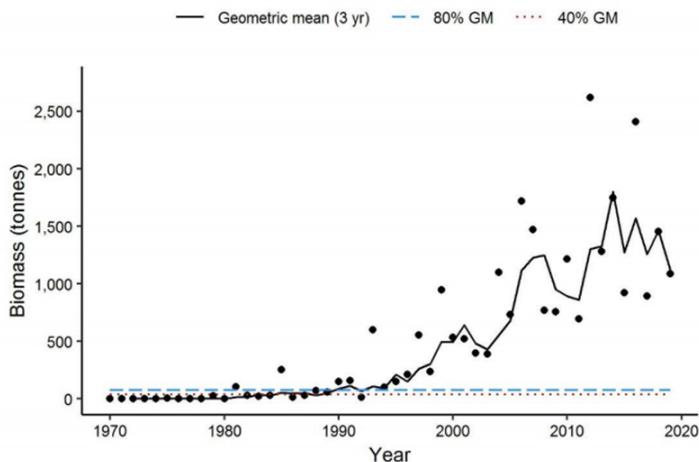


Figure 27b. Biomass index for Blackbelly Rosefish in 4VWX from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The dashed blue and red lines represent 80% and 40% of the long-term geometric mean (1970–2018), respectively. The black dots represent the biomass index for that year.

Figure 123. Biomass index for Blackbelly Rosefish in 4VWX 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 (1970–2018), respectively. The black dots represent the biomass index for that year.

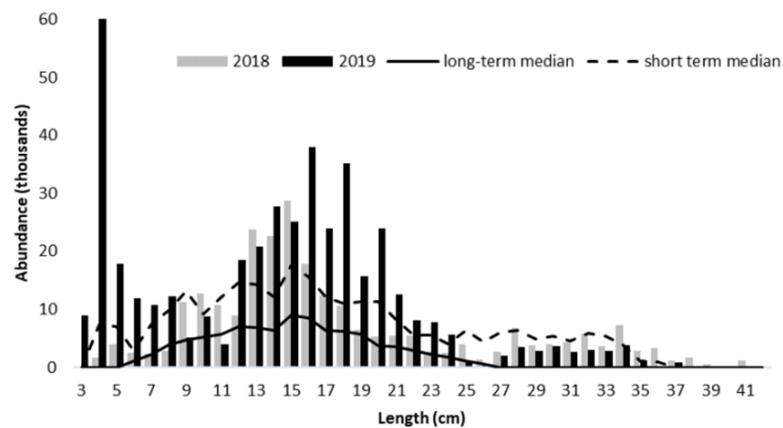


Figure 27c. Length frequency indices for Blackbelly Rosefish in 4VWX from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

Figure 124. Length frequency indices for Blackbelly Rosefish in 4VWX from the DFO Summer RV Survey. Black bars represent the number in thousands at length from the 2019 survey. Grey bars represent the number in thousands at length from the 2018 survey. The solid black line represents the median in thousands at length for the time period 1970–2017. The dashed black line represents the median in thousands at length for the time period 2008–2017.

John Dory

John Dory (*Zenopsis conchifer*) are caught during the summer 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. 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. 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.

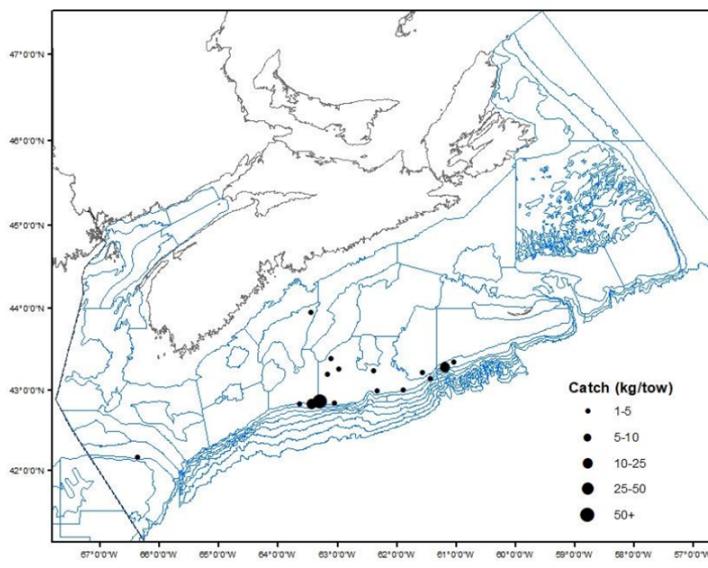


Figure 28a. Distribution of John Dory catches during the DFO Summer RV Surveys from 2015–2019. Black circles represent catches. The circle area is proportional to the catch size.

Figure 125. Distribution of John Dory catches during the DFO Summer RV Surveys from 2015–2019. Black circles represent catches. The circle area is proportional to the catch size.

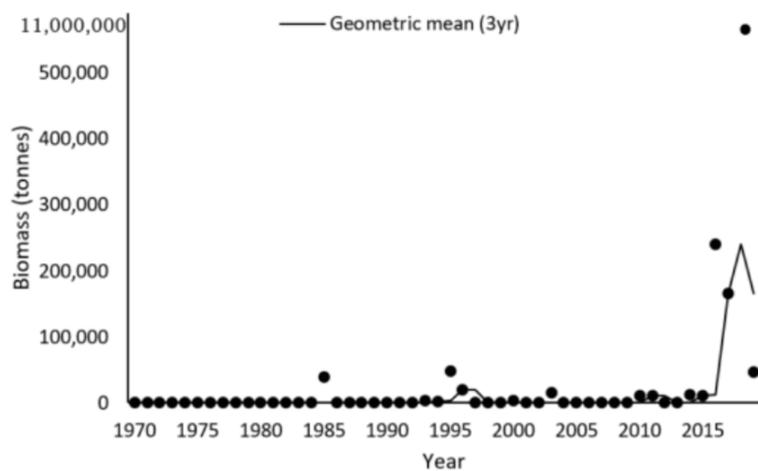


Figure 28b. Biomass index for John Dory in 4VWX from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The black dots represent the biomass index for that year.

Figure 126. Biomass index for John Dory in 4VWX from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The black dots represent the biomass index for that year.

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. The biomass indices for Shortfin Squid since 2017 have been among the highest observed in the time series. In 2019, the biomass index for Shortfin Squid was exceeded only by redfish among species caught in the survey.

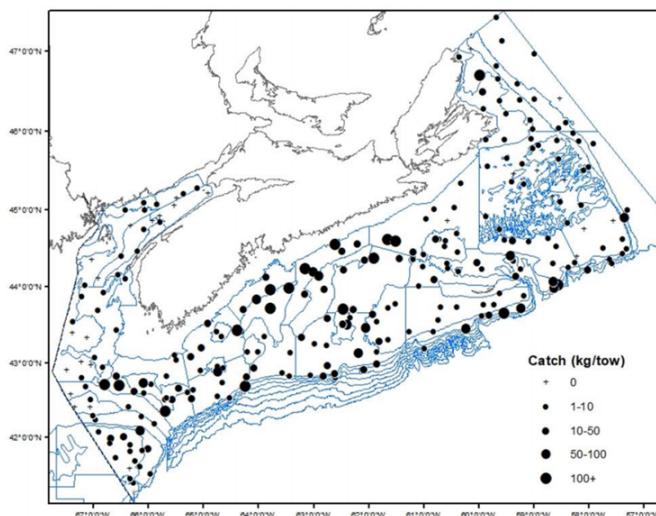


Figure 29a. Distribution of Shortfin Squid catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

Figure 127. Distribution of Shortfin Squid catches during the 2019 DFO Summer RV Survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

Other Species

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

Triggerfish (*Balistes capriscus*) are common off Florida and in other sub-tropical waters on both sides of the Atlantic. They are a demersal fish and should be susceptible to capture by a bottom trawl; however, only one specimen has ever been caught in the 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 RV survey may not be a suitable for providing useful information on distribution or abundance for this species.

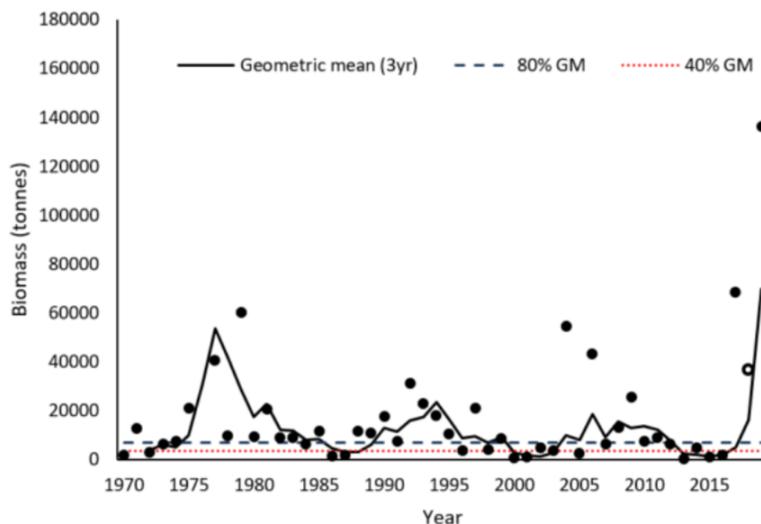


Figure 29b. Biomass index for Shortfin Squid in 4VWX from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The black dots represent the biomass index for that year. The open circle represents the biomass index estimated for 2018.

Figure 128. Biomass index for Shortfin Squid in 4VWX from the DFO Summer RV Survey. The three-year geometric mean biomass index is represented by the solid black line. The black dots represent the biomass index for that year. The open circle represents the biomass index estimated for 2018.

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

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.

Temperature

The average bottom temperature recorded during the summer survey time series is 5.7 °C. This varies annually, but since 2012, bottom temperatures have, in general, been the warmest in the series (Figure 30). Bottom temperature varies greatly across the area covered, ranging from below 2°C to above 11°C. This variation in temperature influences species assemblage dynamics over the area. The warmest waters are found in the Fundian Channel, along the edge of the Scotian Shelf, in the central Scotian Shelf and in shallow waters around Sable Island.

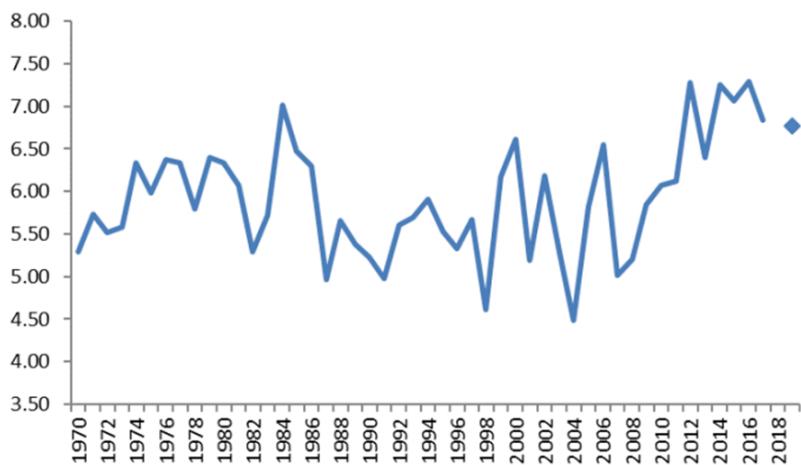


Figure 30. Average annual bottom temperature (°C) from the DFO Summer RV Survey in 4VW.

Figure 129. Average annual bottom temperature (°C) from the DFO Summer RV Survey in 4VW.

Conclusions

In 2019, 258 successful bottom trawl tows were conducted out of the 280 stations initially selected, and all standard strata in the survey area were sampled at least at the minimum acceptable level. In addition, sampling was completed at the Halifax hydrographic station four times. Roughly four days of survey time were lost to vessel equipment and maintenance issues, leading to reduction in sampling in some large strata and also in 4V, which is generally sampled late in the survey.

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. In 4X, there is high inter-annual variability in total biomass index. There is no clear trend in biomass over time; however, the last three years have all been relatively low, so the 3-yr

GM for 2019 is the lowest since the 1980s. The big drop in 2019 is primarily due to low catches of redfish.

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.

Abundance indices for Age 0 4X Haddock were the highest in the time series in 2018, but this has not carried through to 2019 where there is no indication of strong year-classes for either Age 0 or 1.

The overall biomass in 4X is low in 2019. While this is driven primarily by a decline in the 4X redfish biomass index, biomass indices have also declined for many other species, including 4X Haddock and Dogfish.

For 4X Cod, 4X American Plaice, and 4X Sea Raven, biomass indices are the lowest in the time series, as is the case for 4Vn Cod and 4VW White Hake.

Biomass indices for White Hake in 4X and 4VW remain in the Critical Zone in 2019, 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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