Fisheries and Oceans Canada | Pêches et Océans Canada
Ecosystems and Oceans Science | Sciences des écosystèmes et des océans

Canadian Science Advisory Secretariat
Maritimes Region **Science Response 2015/013**

2014 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 4VWX and a small portion of 5Y, using a standardized protocol since 1970. Results of these surveys provide information on trends in abundance for most groundfish species in the Maritimes Region. While these data reflect trends in biomass and abundance and are a critical part of science-based stock assessments, a full assessment, including other sources of data, would be required to evaluate the impacts of management measures on population status. DFO Resource Management requested a review of the DFO RV survey information on the following list of fish stocks: 4Vn Atlantic Cod, 4VsW Atlantic Cod, 4X5Y Atlantic Cod, 4VW Haddock, 4X Haddock, 4VW White Hake, 4X White Hake, 4VWX Silver Hake, 4VWX+5 Pollock, Unit II Redfish, Unit III Redfish, 3NOPs4VWX+5 Atlantic Halibut, 4VW flatfish, 4X5Y flatfish, 4VW and 4X Smooth Skate, Thorny Skate, Barndoor Skate, Winter Skate, Little Skate, Atlantic Wolffish, Monkfish, Longhorn Sculpin, and 4VWX Spiny Dogfish. In addition, biomass trends relative to accepted biomass reference points were requested for White Hake (biomass for lengths>41cm) 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 industry stakeholders on recommendations for management measures, and to determine which stocks should be reviewed in more detail in 2015.

This Science Response Report results from the Science Response Process of November 21, 2014, on the Maritimes Research Vessel Survey Trends on the Scotian Shelf and Bay of Fundy.

Background

The DFO summer research vessel (RV) survey of the Scotian Shelf and Bay of Fundy has been conducted annually since 1970. The surveys follow a stratified random sampling design, and include 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 4VWX strata. Catch distribution plots for the entire summer RV survey area are provided for a suite of species which are commonly caught in the 4VWX groundfish fishery. Biomass index trends are shown for the area appropriate for each stock. Comparisons of 2013 and 2014 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 2012) are also included, using data from the geographic areas that are used in assessments for those stocks.

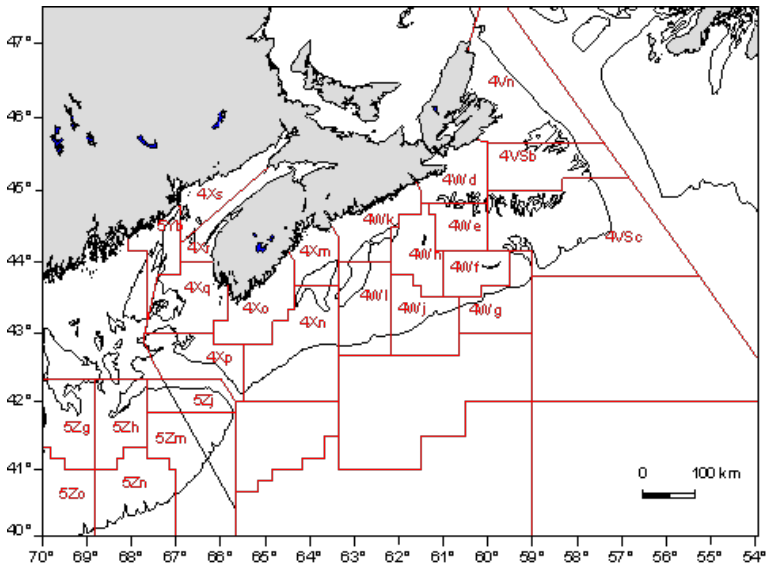

Figure 1: Northwest Atlantic Fisheries Organization (NAFO) Unit Areas.

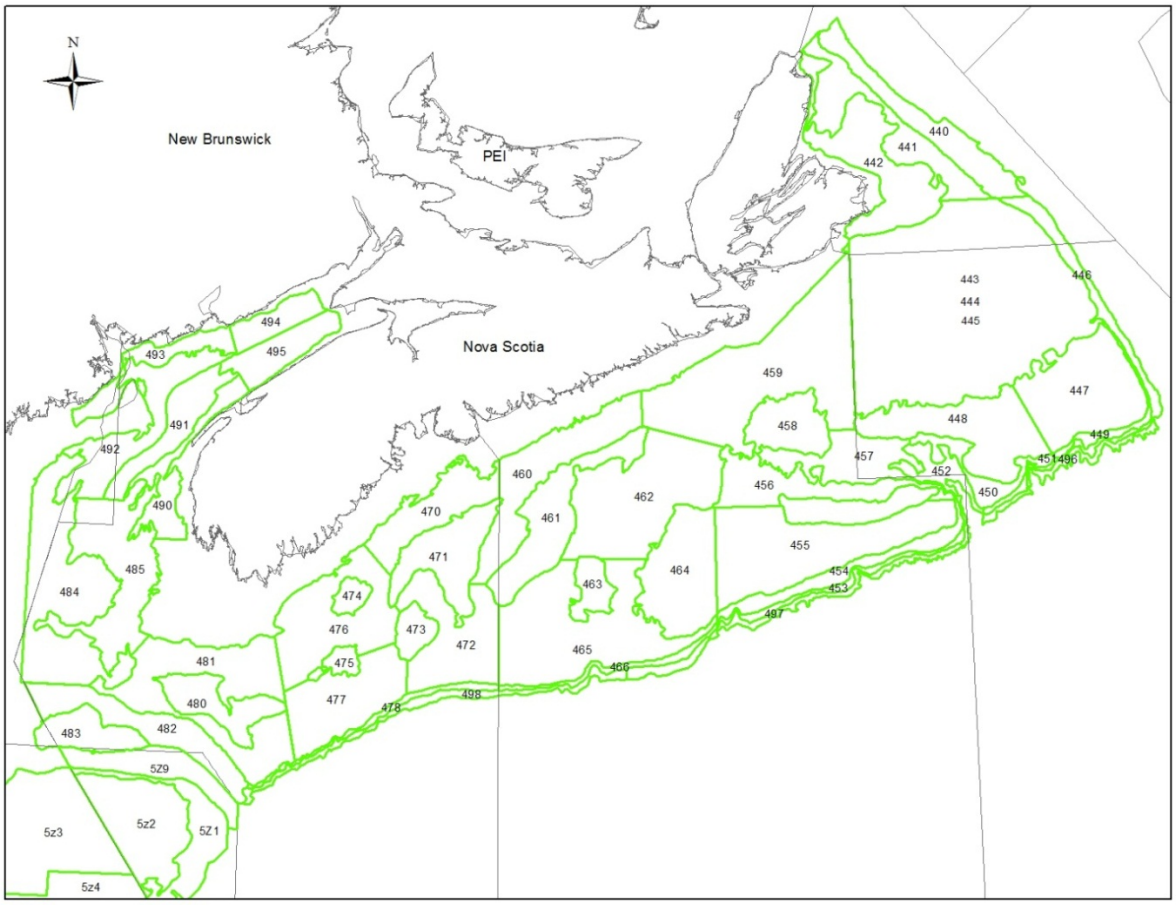

Figure 2. 2014 Summer RV Survey strata.

Analysis

The time-series of survey biomass indices are compared to averages for a series of time periods to provide historical context for biomass levels. The time periods used are a short-term 5 year average (2009-2013), a medium-term 15 year average (1999-2013), and the long-term survey average (1970-2013) (Table 1).

Table 1. RV survey biomass indices (tonnes) for species by stock/region for 2012, 2013, 2014 and averages for long-term (1970-2013), medium-term 15 year (1999-2013), and short-term 5 year (2009-2013) time periods.

Stock/Region	2012	2013	2014	1970-2013 Avg	1999-2013 Avg	2009-2013 Avg
4X Cod	3,268	2,058	2,513	20,131	8,745	5,422
4VsW Cod	4,708	9,525	23,393	50,843	16,781	27,670
4Vn Cod	1,561	966	2,388	15,066	4,467	4,587
4X Haddock	28,980	36,580	42,883	56,016	53,454	43,959
4VW Haddock	30,540	43,461	33,409	59,104	63,212	61,887
4X White Hake	7,934	7,443	9,644	18,338	11,422	11,780
4VW White Hake	1,933	2,868	3,159	9,805	4,998	4,263
4VWX Silver Hake*	48,166	35,461	60,364	35,927	28,034	42,348
Western Component Pollock	6,040	26,823	9,752	30,452	27,470	20,237
Eastern Component Pollock	35,968	33,006	13,654	30,557	27,258	53,281
Unit II Redfish	14,586	23,233	55,170	49,085	38,473	54,643
Unit III Redfish	203,943	77,123	76,917	115,572	127,018	182,642
4VWX Atlantic Halibut	7,685	8,656	8,531	3,520	4,934	7,569
4X Yellowtail Flounder	332	102	119	663	787	447
4VW Yellow tail Flounder	9,371	14,646	11,485	13,570	10,111	12,513
4X American Plaice	767	312	525	2,015	1,171	825
4VW American Plaice	7,900	19,559	3,369	23,773	15,712	12,385
4X Witch Flounder	731	869	1,592	1,801	1,384	1,289
4VW Witch Flounder	3,977	4,773	2,323	3,978	4,354	5,770
4X Winter Flounder	6,295	6,448	2,673	3,577	5,361	7,297
4VW Winter Flounder	556	426	431	892	535	571
4X Atlantic Wolffish	309	10	25	2,062	641	311
4VW Atlantic Wolffish	196	176	267	1,923	810	328
4X Monkfish	486	308	1,258	2,202	949	503
4VW Monkfish	738	760	454	3,166	1,098	847
4X Longhorn Sculpin	784	803	713	1,583	1,717	1,578
4VW Longhorn Sculpin	1,044	1,637	1,261	2,833	2,643	1,877
4X Barndoor Skate	1,235	985	2,879	458	1,095	1,409
4VW Barndoor Skate	564	1,169	712	263	344	684
4X Thorny Skate	166	323	372	3,872	860	253
4VW Thorny Skate	1,602	1,421	705	11,228	4,090	2,216
4X Winter Skate	1,784	998	323	1,000	821	1,139
4VW Winter Skate	97	277	460	3,650	758	386
4X Little Skate	1,272	1,467	521	807	976	1,104
4VW Little Skate	67	262	76	137	101	94
4X Smooth Skate	106	326	344	477	366	409
4VW Smooth Skate	240	49	40	459	169	170
4VWX Spiny Dogfish	44,310	259,461	133,384	127,523	167,039	79,617

* For Silver Hake, long term average is 1982-2013.

Atlantic Cod

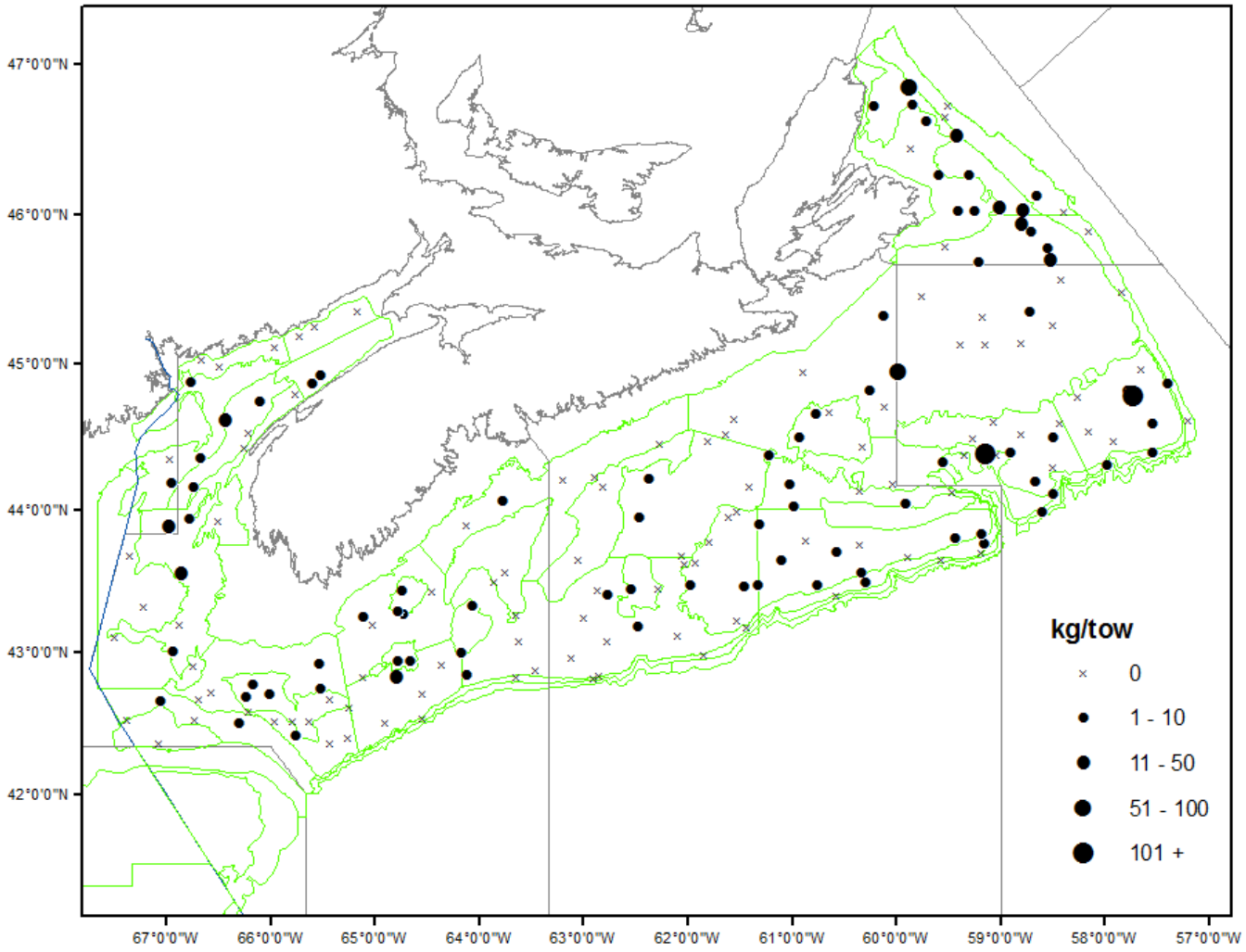

Figure 3a. Distribution of Atlantic Cod catches during the 2014 summer RV survey. Zero catch is represented by the x symbol. Black circles represent catches. The circle area is proportional to the catch size in kilograms per tow (kg/tow).

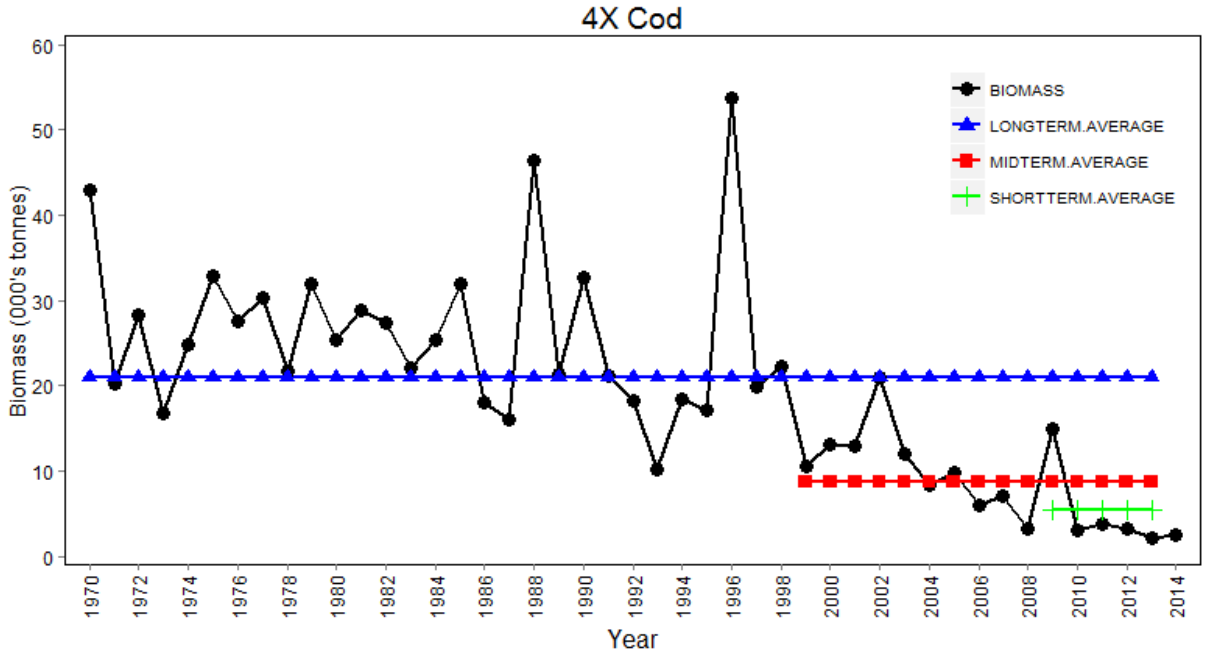

Figure 3b. Biomass index for Atlantic Cod in 4X from the summer RV survey represented by the black line with solid circles. The dark blue line with the solid triangles indicates the long-term survey average (1970-2013). The red line with the solid squares represents the medium-term 15 year average (1999-2013). The green line with the crosses represents the short-term 5 year average (2009-2013).

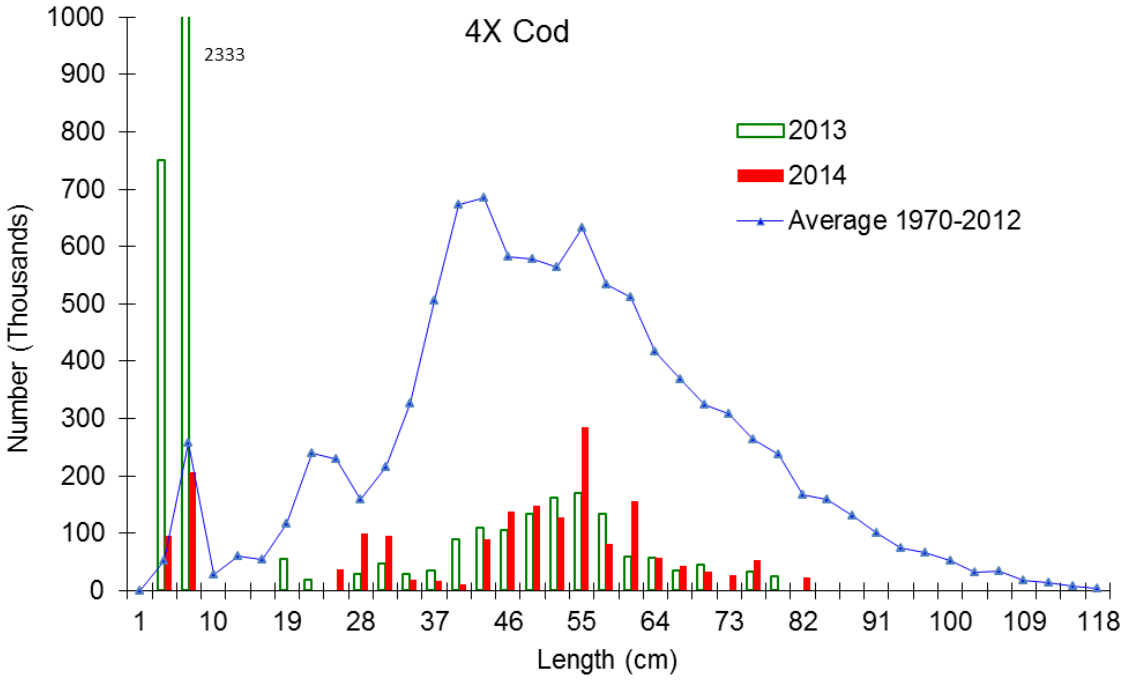

Figure 3c. Length frequency indices for Atlantic Cod in 4X from the summer RV survey. The solid red bars represent the number in thousands at length from the 2014 survey. The open green bars represent the number in thousands at length from the 2013 survey. The solid blue line with triangles represents the average number in thousands at length for the time period 1970-2012.

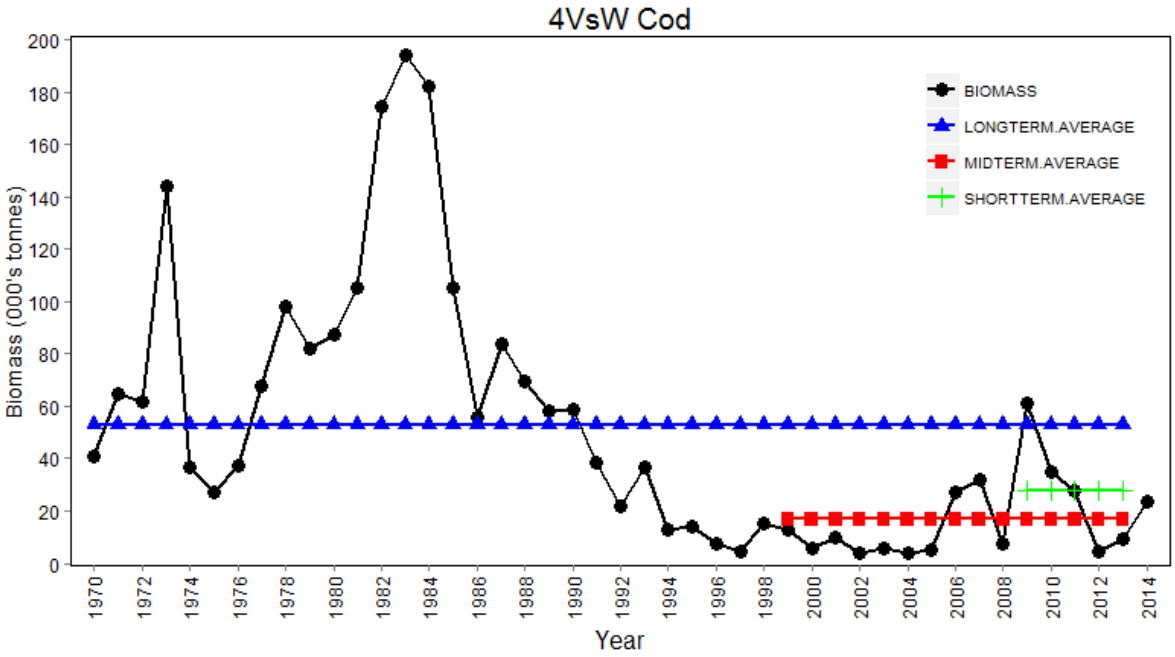

Figure 3d. Biomass index for Atlantic Cod in 4VsW from the summer RV survey represented by the black line with solid circles. The dark blue line with the solid triangles indicates the long-term survey average (1970-2013). The red line with the solid squares represents the medium-term 15 year average (1999-2013). The green line with the crosses represents the short-term 5 year average (2009-2013).

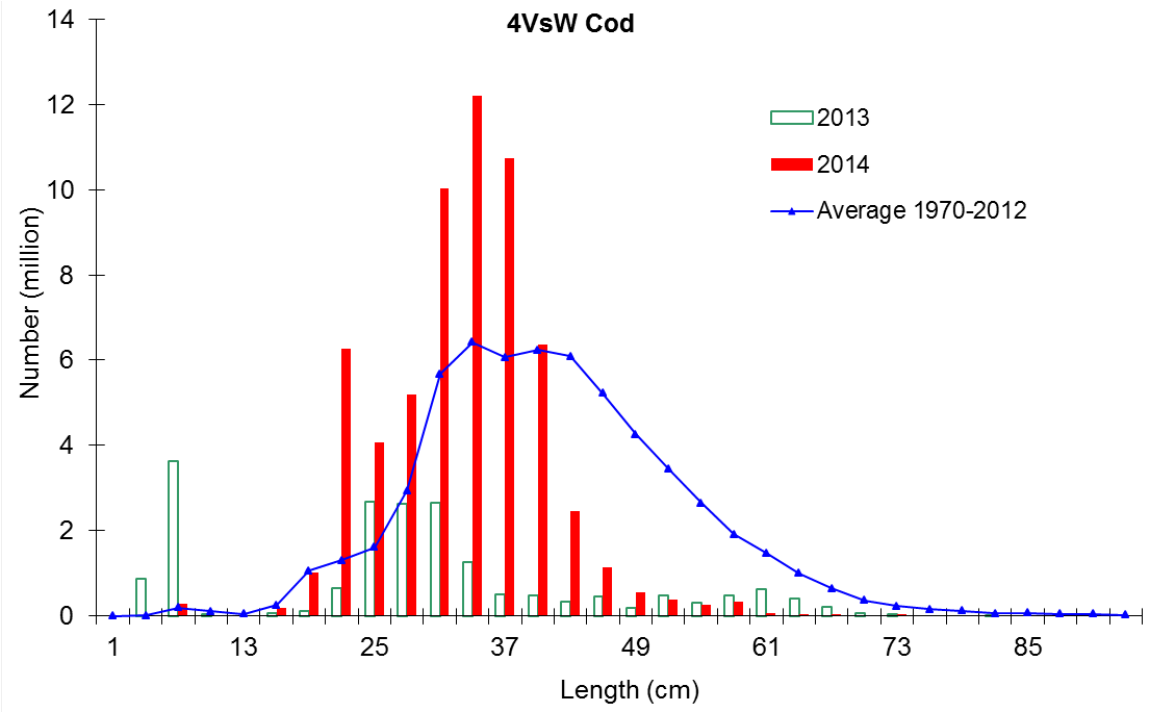

Figure 3e. Length frequency indices for Atlantic Cod in 4VsW from the summer RV survey. The solid red bars represent the number in millions at length from the 2014 survey. The open green bars represent the number in millions at length from the 2013 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2012.

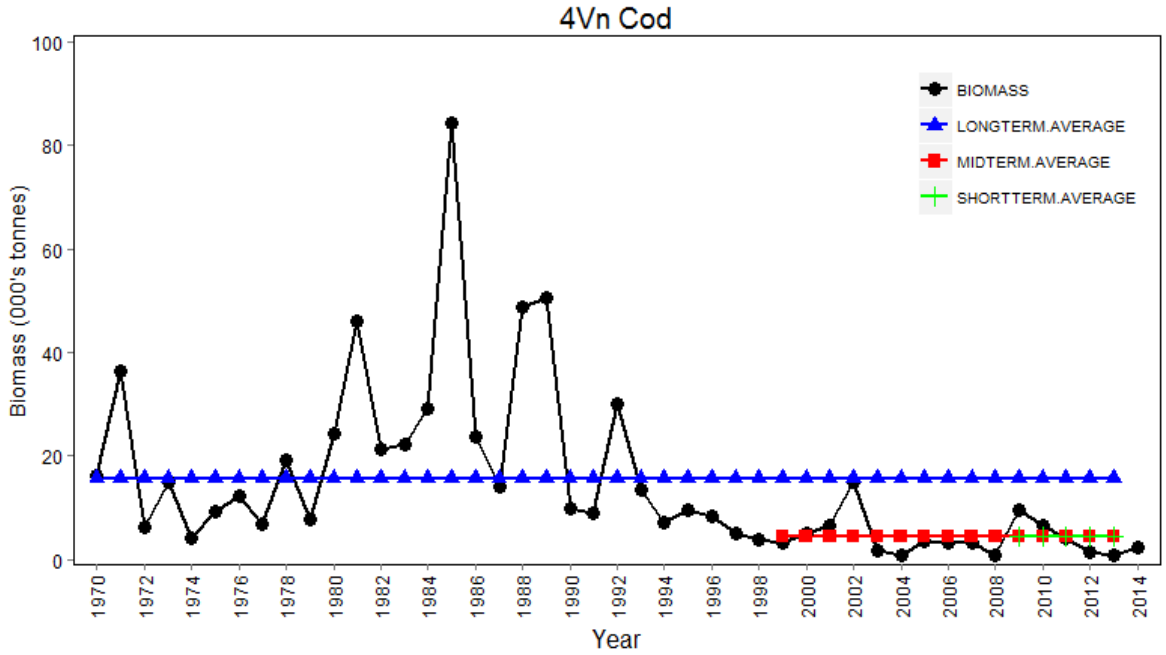

Figure 3f. Biomass index for Atlantic Cod in 4Vn from the summer RV survey represented by the black line with solid circles. The dark blue line with the solid triangles indicates the long-term survey average (1970-2013). The red line with the solid squares represents the medium-term 15 year average (1999-2013). The green line with the crosses represents the short-term 5 year average (2009-2013).

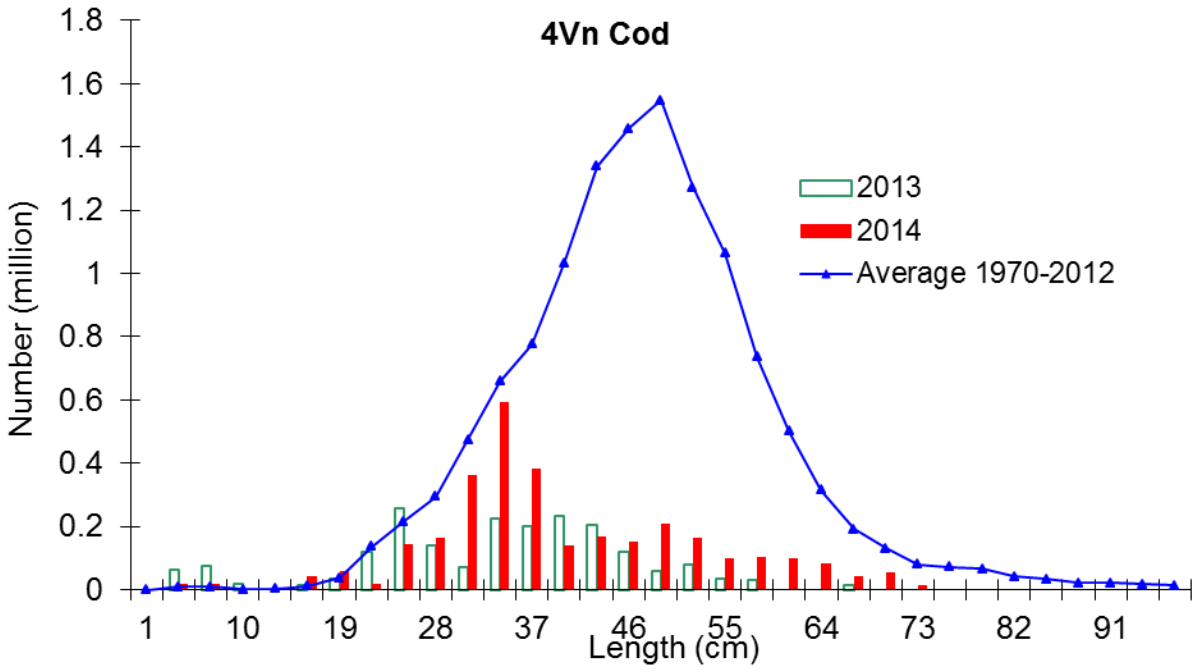

Figure 3g. Length frequency indices for Atlantic Cod in 4Vn from the summer RV survey. The solid red bars represent the number in millions at length from the 2014 survey. The open green bars represent the number in millions at length from the 2013 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2012.

Haddock

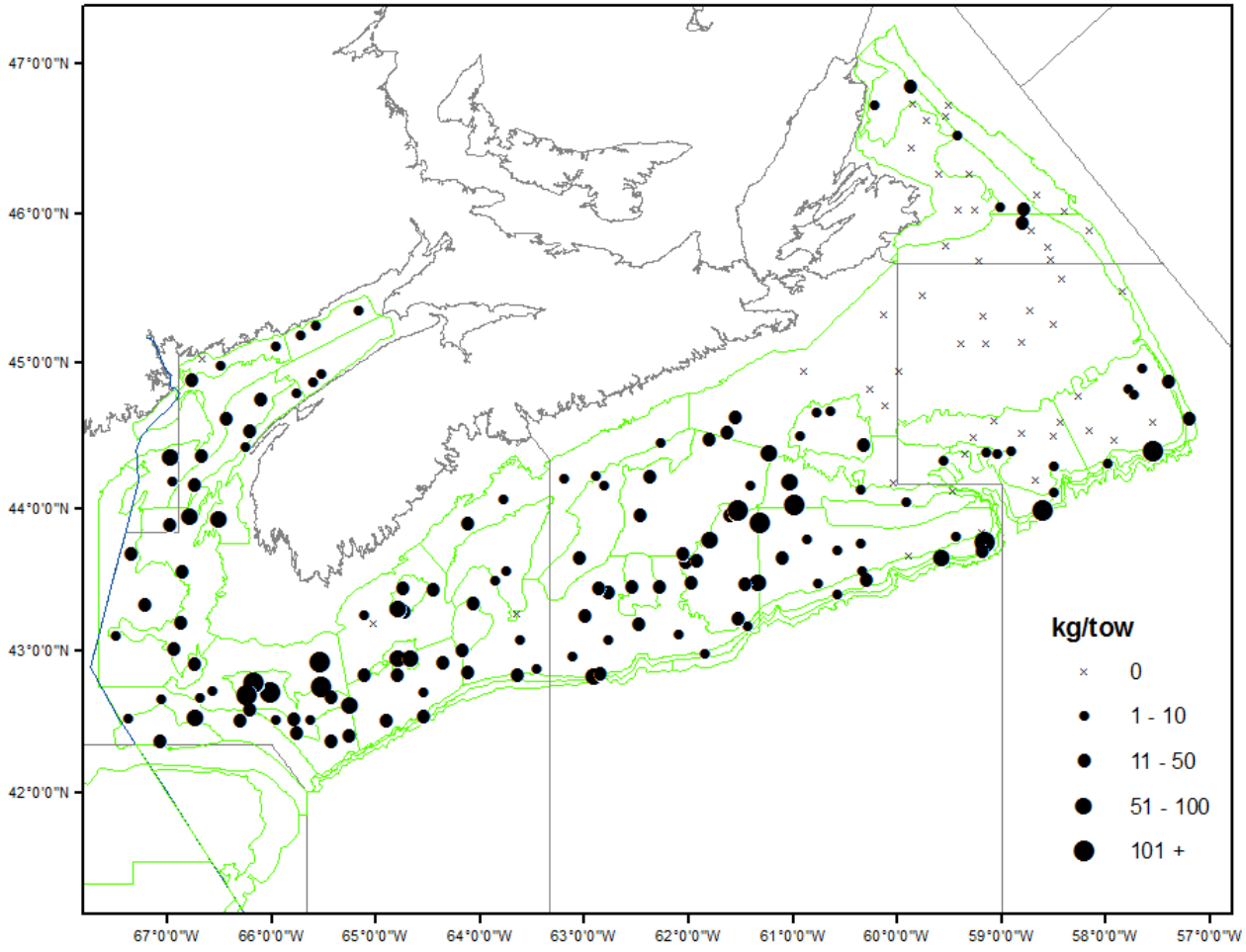

Figure 4a. Distribution of Haddock catches during the 2014 summer RV survey. Zero catch is represented by the x symbol. Black circles represent catches. The circle area is proportional to the catch size in kilograms per tow (kg/tow).

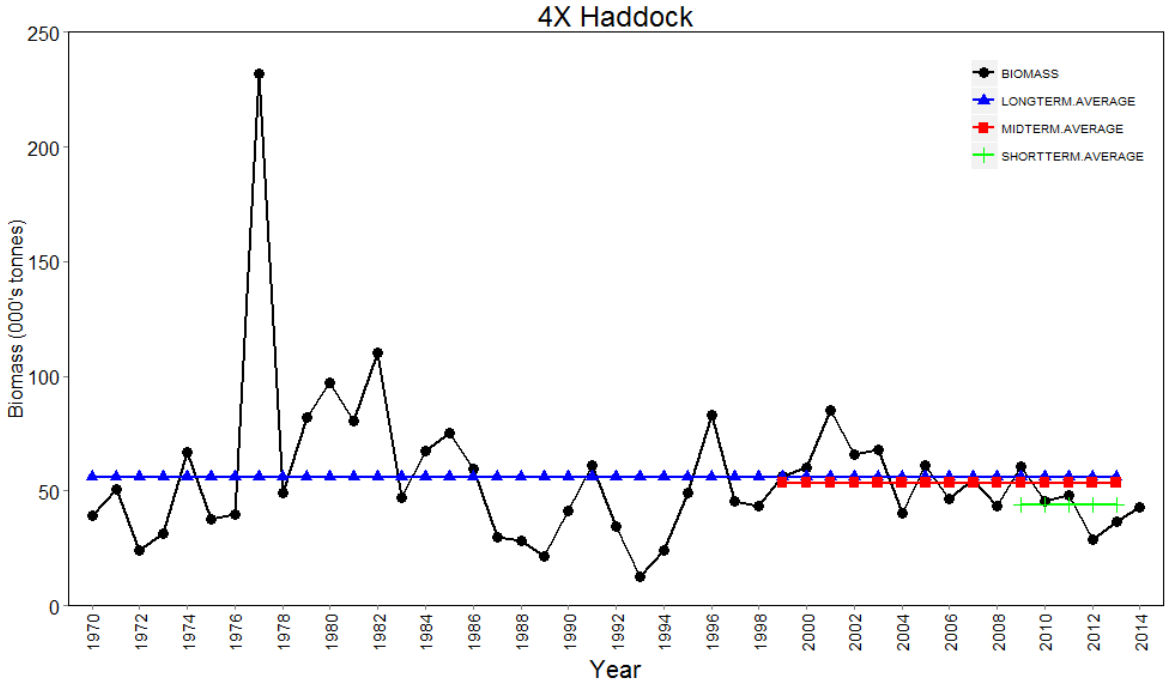

Figure 4b. Biomass index for Haddock in 4X from the summer RV survey represented by the black line with solid circles. The dark blue line with the solid triangles indicates the long-term survey average (1970-2013). The red line with the solid squares represents the medium-term 15 year average (1999-2013). The green line with the crosses represents the short-term 5 year average (2009-2013).

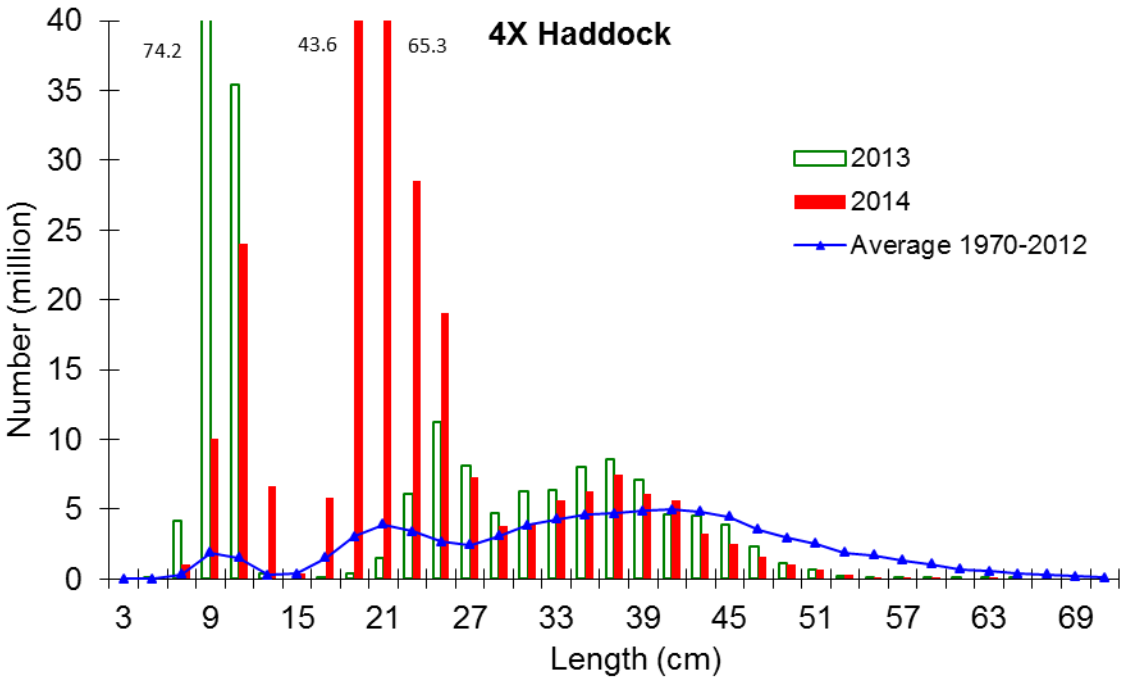

Figure 4c. Length frequency indices for Haddock in 4X from the summer RV survey. The solid red bars represent the number in millions at length from the 2014 survey. The open green bars represent the number in millions at length from the 2013 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2012.

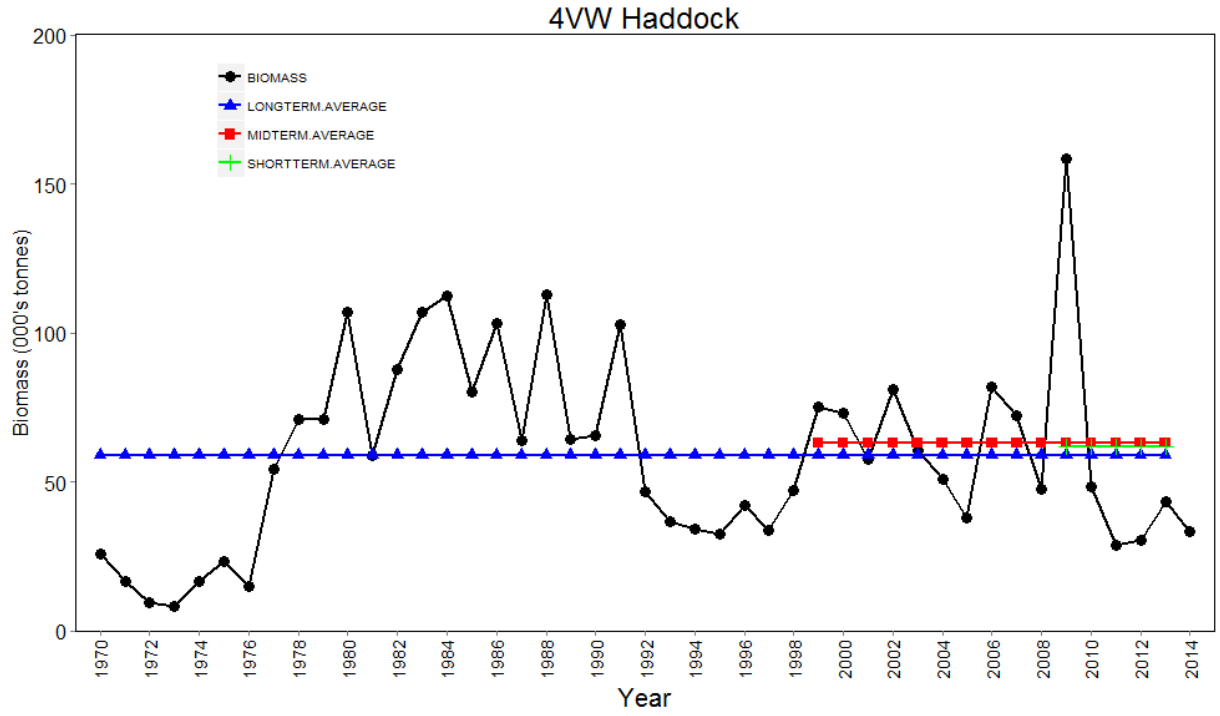

Figure 4d. Biomass index for Haddock in 4VW from the summer RV survey represented by the black line with solid circles. The dark blue line with the solid triangles indicates the long-term survey average (1970-2013). The red line with the solid squares represents the medium-term 15 year average (1999-2013). The green line with the crosses represents the short-term 5 year average (2009-2013).

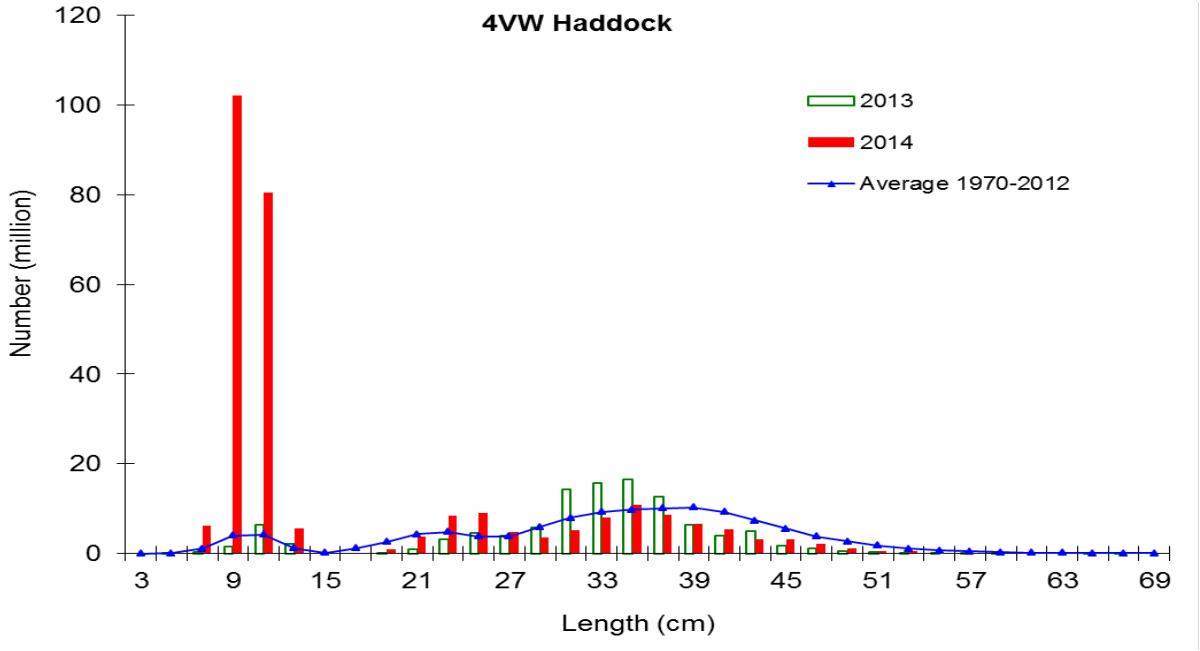

Figure 4e. Length frequency indices for Haddock in 4VW from the summer RV survey. The solid red bars represent the number in millions at length from the 2014 survey. The open green bars represent the number in millions at length from the 2013 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2012.

White Hake

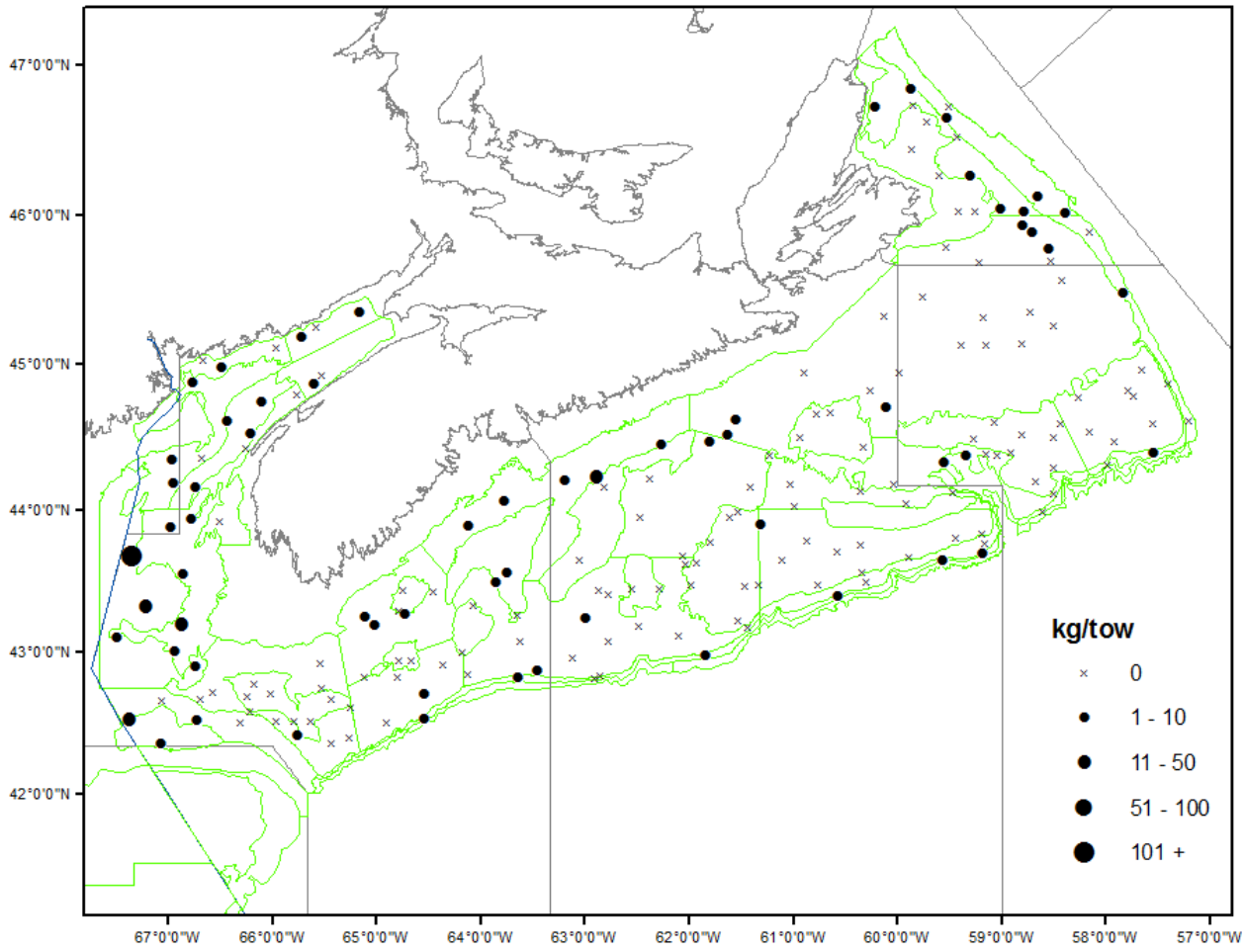

Figure 5a. Distribution of White Hake catches during the 2014 summer RV survey. Zero catch is represented by the x symbol. Black circles represent catches. The circle area is proportional to the catch size in kilograms per tow (kg/tow).

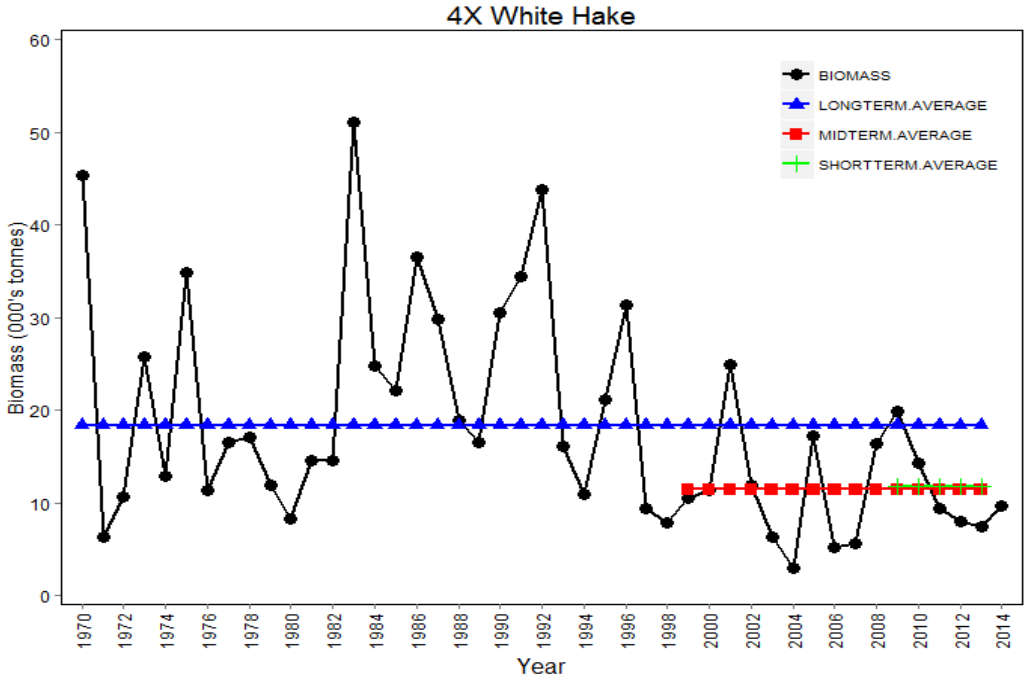

Figure 5b. Biomass index for White Hake in 4X from the summer RV survey represented by the black line with solid circles. The dark blue line with the solid triangles indicates the long-term survey average (1970-2013). The red line with the solid squares represents the medium-term 15 year average (1999-2013). The green line with the crosses represents the short-term 5 year average (2009-2013).

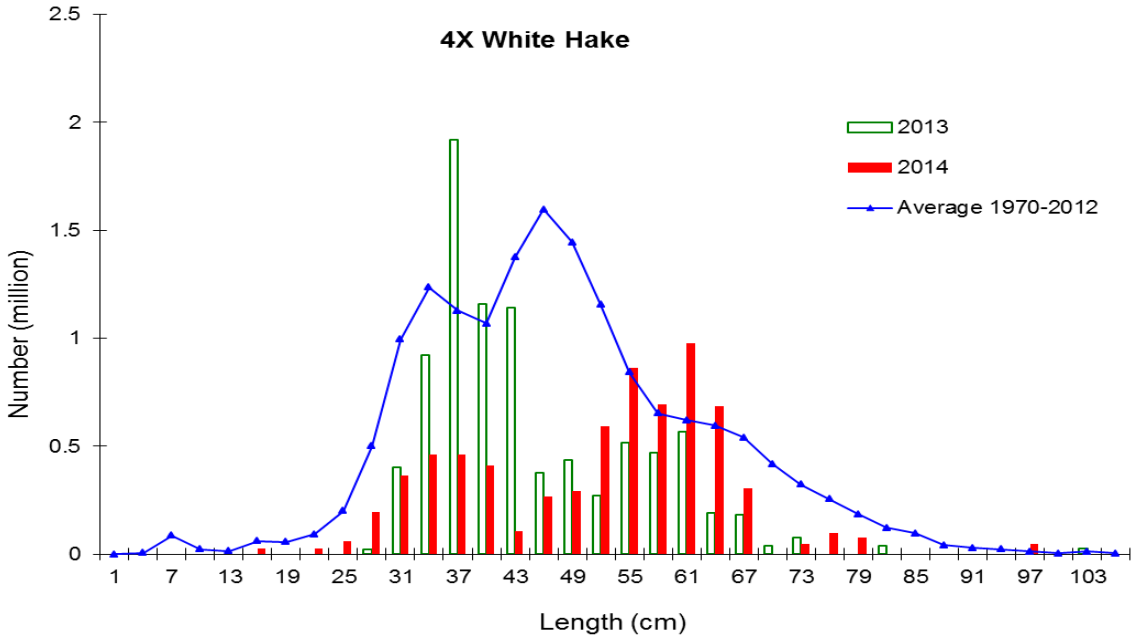

Figure 5c. Length frequency indices for White Hake in 4X from the summer RV survey. The solid red bars represent the number in millions at length from the 2014 survey. The open green bars represent the number in millions at length from the 2013 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2012.

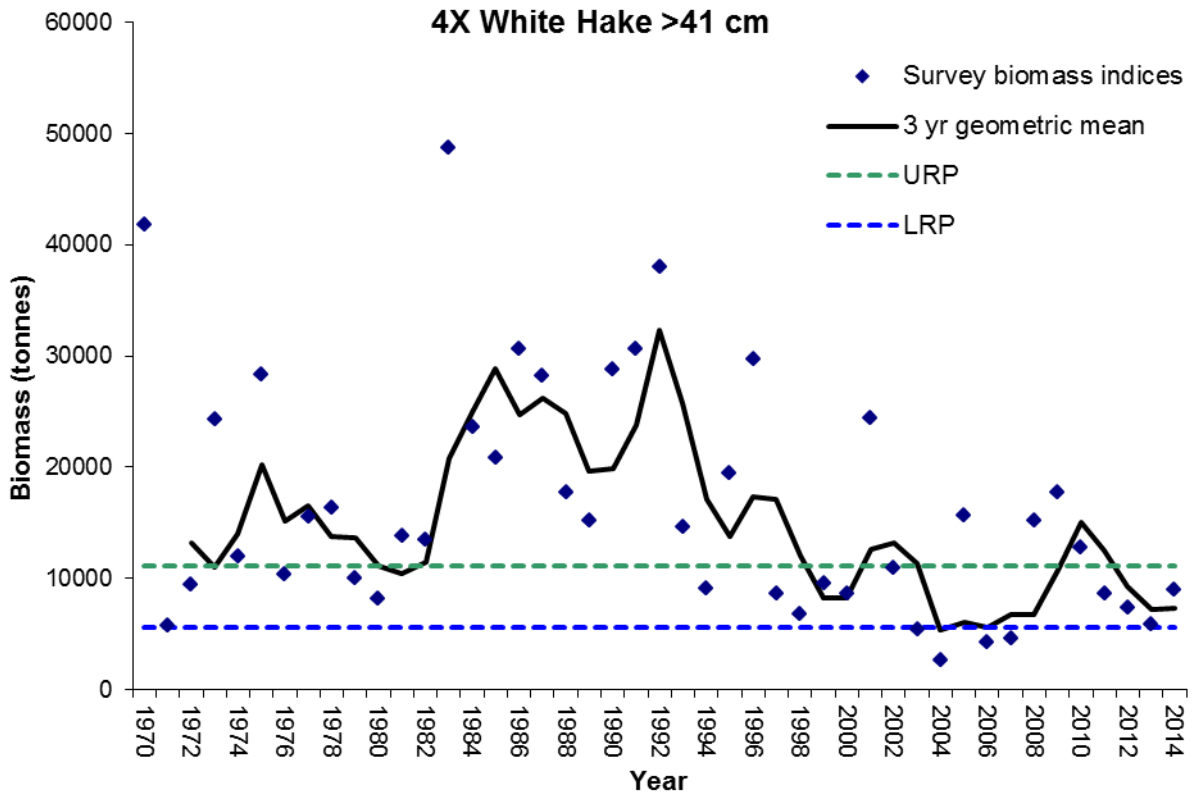

Figure 5d. Biomass index for 4X White Hake >41 cm from the summer RV survey represented by the dark blue diamonds. The solid black line represents the 3 year geometric mean. The dashed blue line represents the lower Limit Reference Point (LRP= 5,547 t) and the dashed green line represents the Upper Reference Point (URP= 11,093 t). The biomass value for 2014 for >41 cm White Hake is 9,035 t. The 3 year geometric mean value for 2014 is 7,294 t.

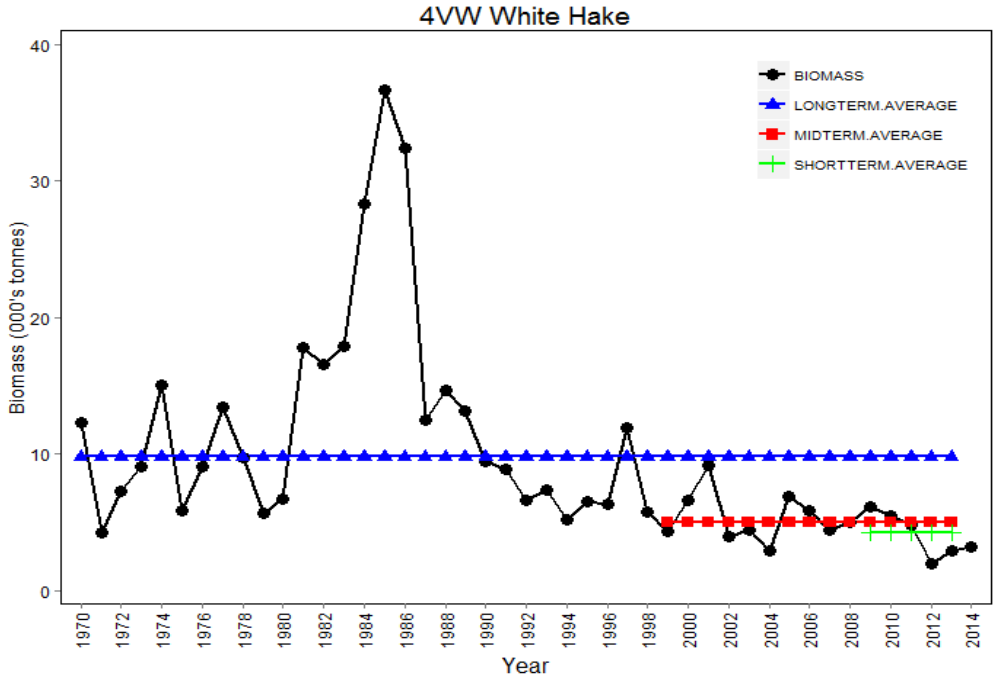

Figure 5e. Biomass index for White Hake in 4VW from the summer RV survey represented by the black line with solid circles. The dark blue line with the solid triangles indicates the long-term survey average (1970-2013). The red line with the solid squares represents the medium-term 15 year average (1999-2013). The green line with the crosses represents the short-term 5 year average (2009-2013).

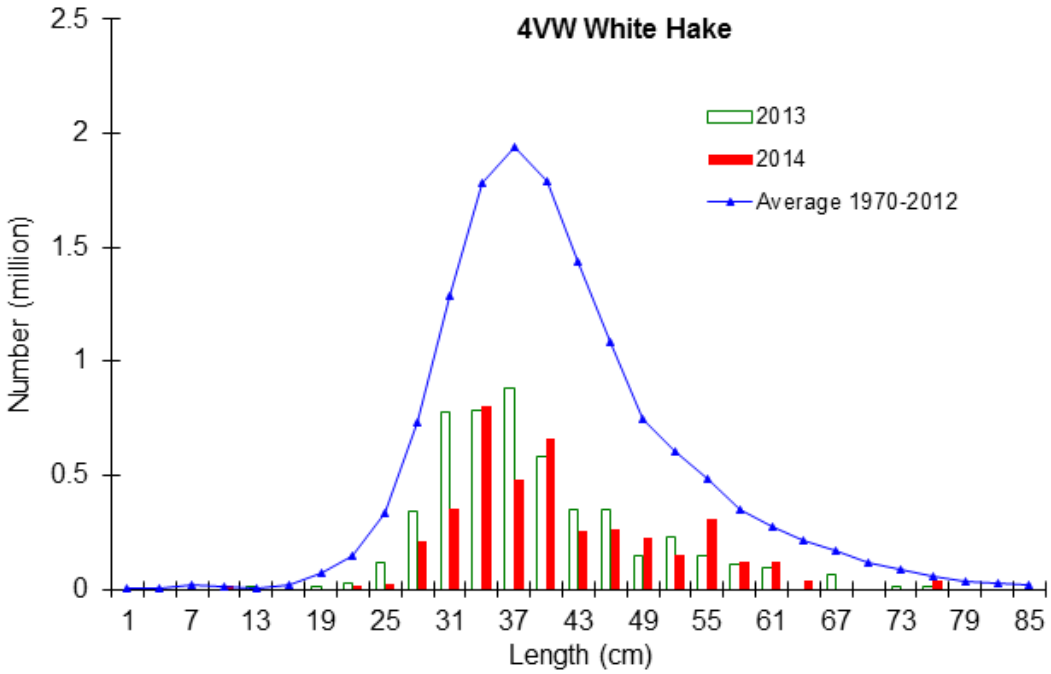

Figure 5f. Length frequency indices for White Hake in 4VW from the summer RV survey. The solid red bars represent the number in millions at length from the 2014 survey. The open green bars represent the number in millions at length from the 2013 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2012.

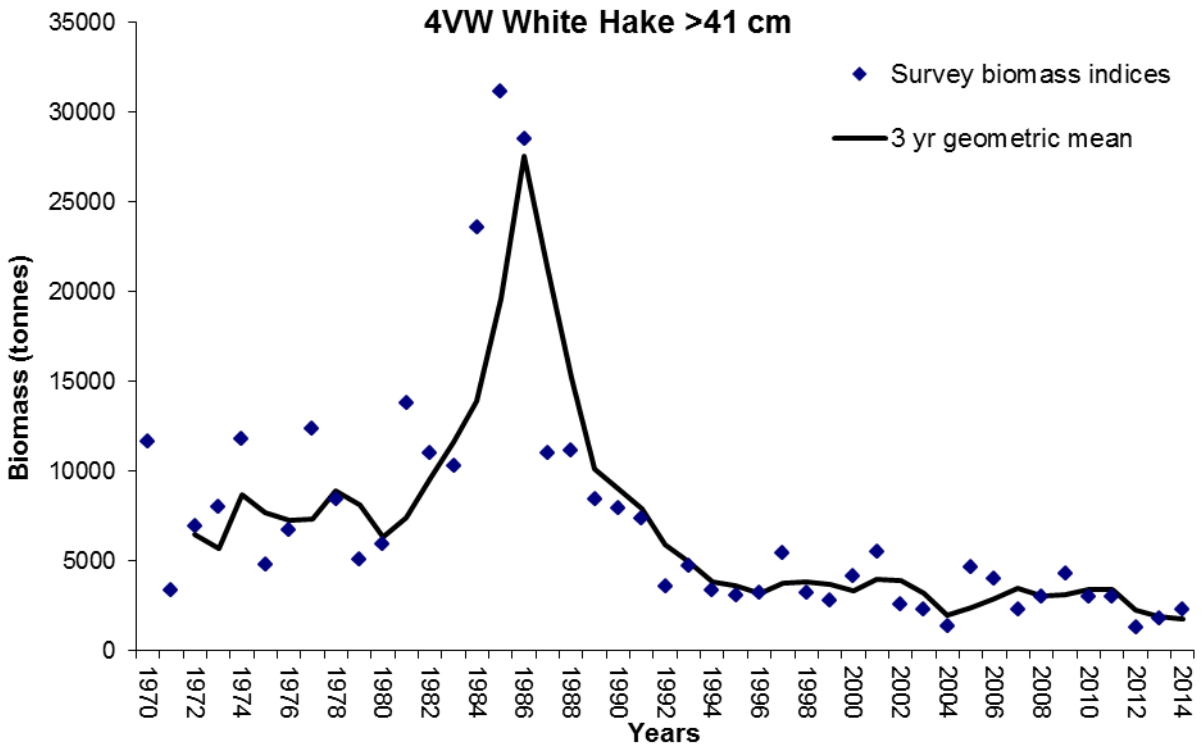

Figure 5g. Biomass index for 4VW White Hake >41 cm from the summer RV survey represented by the dark blue diamonds. The solid black line represents the 3 year geometric mean. The biomass value for 2014 for >41 cm White Hake is 2,330 t. The 3 year geometric mean value for 2014 is 1,765 t.

Silver Hake

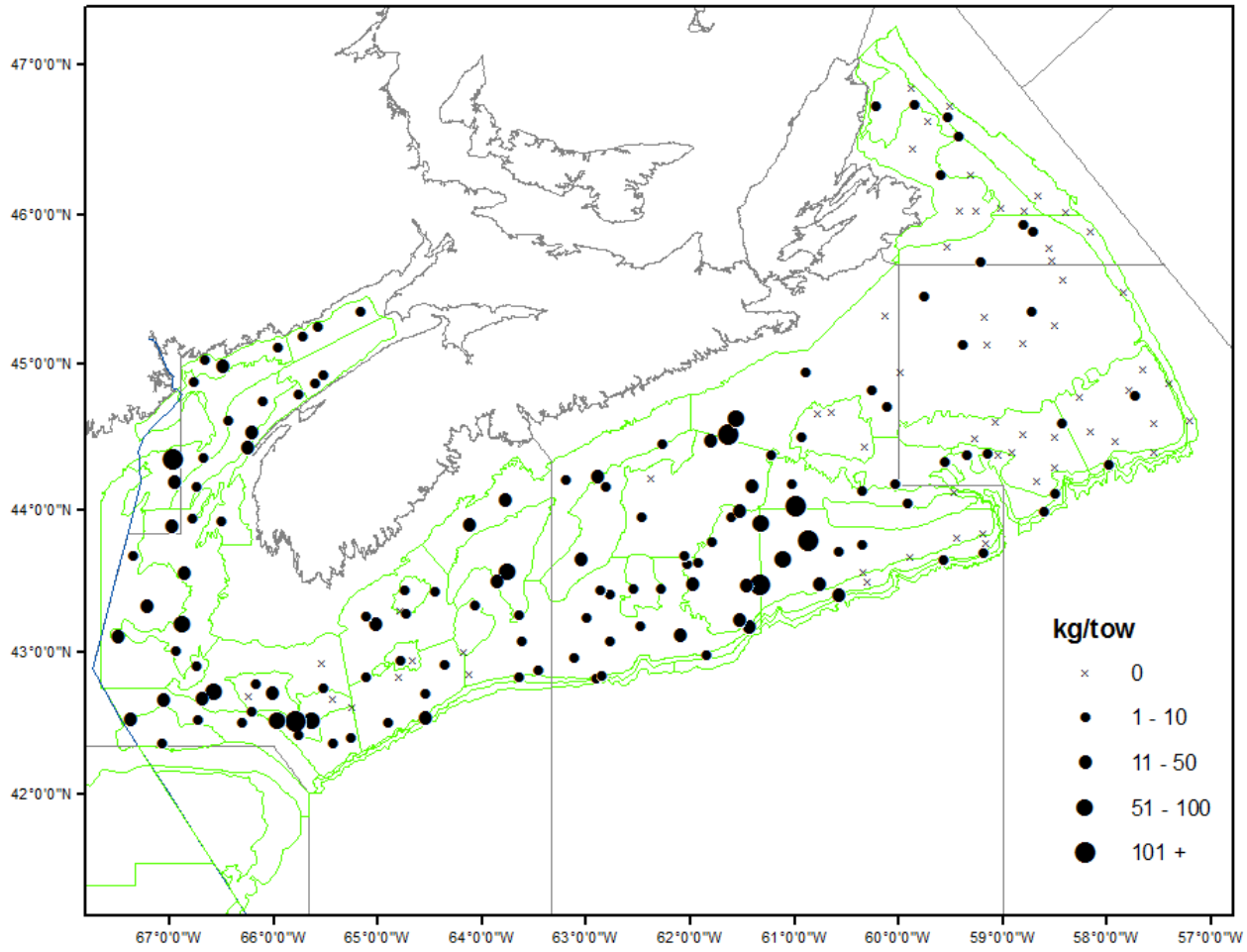

Figure 6a. Distribution of Silver Hake catches during the 2014 summer RV survey. Zero catch is represented by the x symbol. Black circles represent catches. The circle area is proportional to the catch size in kilograms per tow (kg/tow).

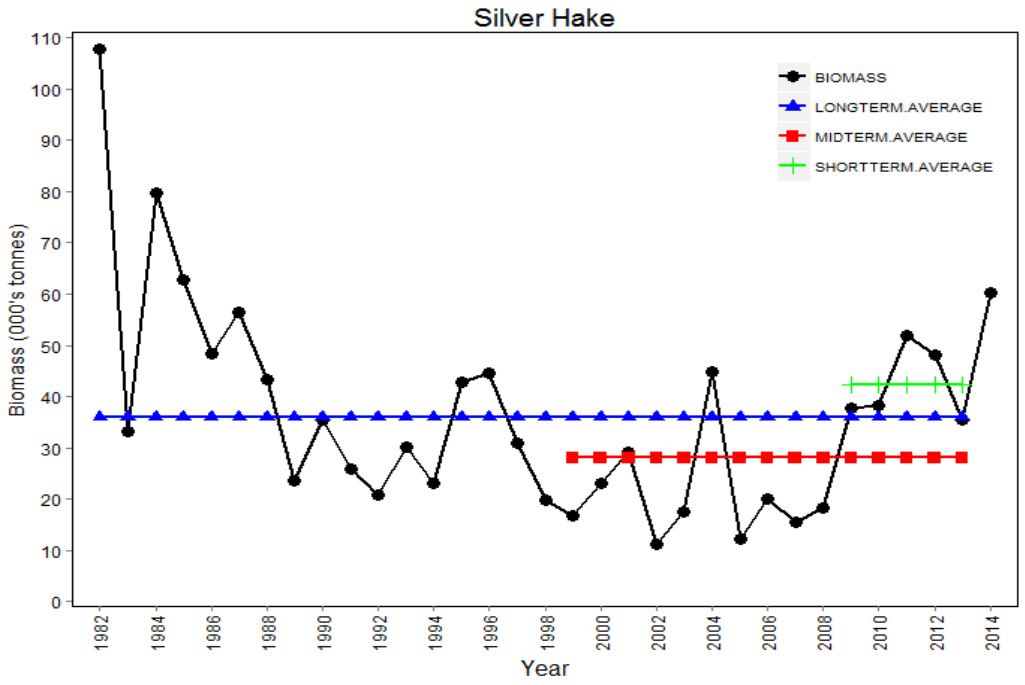

Figure 6b. Biomass index for Silver Hake in 4VWX (strata 440-483) from the summer RV survey represented by the black line with solid circles. The dark blue line with the solid triangles indicates the long-term survey average (1982-2013). The red line with the solid squares represents the medium-term 15 year average (1999-2013). The green line with the crosses represents the short-term 5 year average (2009-2013).

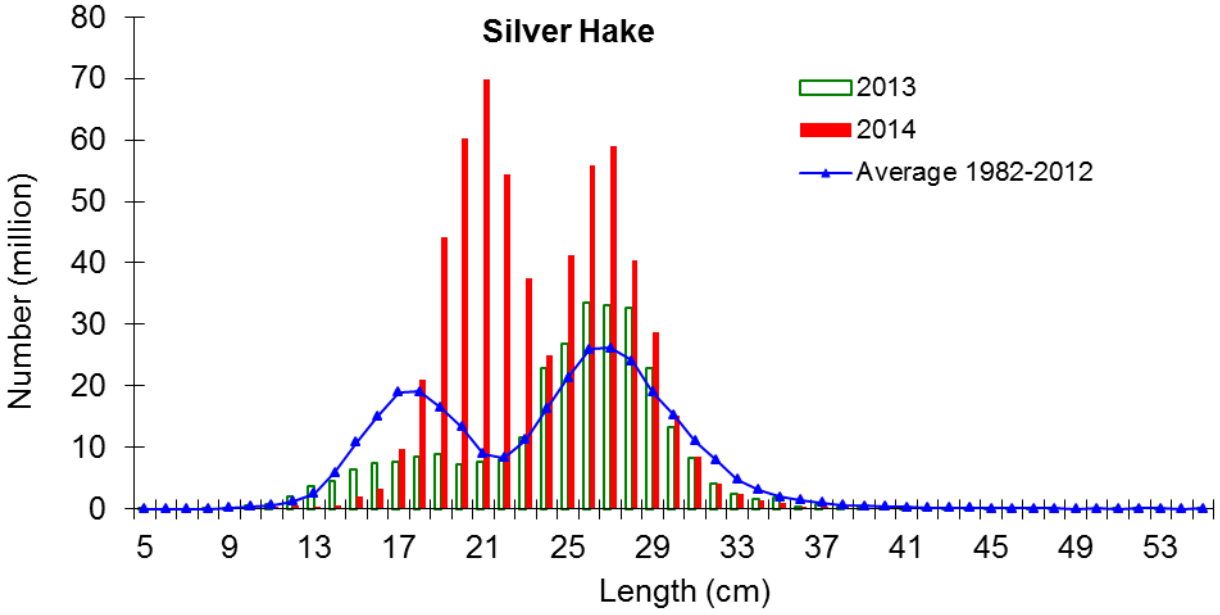

Figure 6c. Length frequency indices for Silver Hake in 4VWX from the summer RV survey. The solid red bars represent the number in millions at length from the 2014 survey. The open green bars represent the number in millions at length from the 2013 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1982-2012.

Pollock

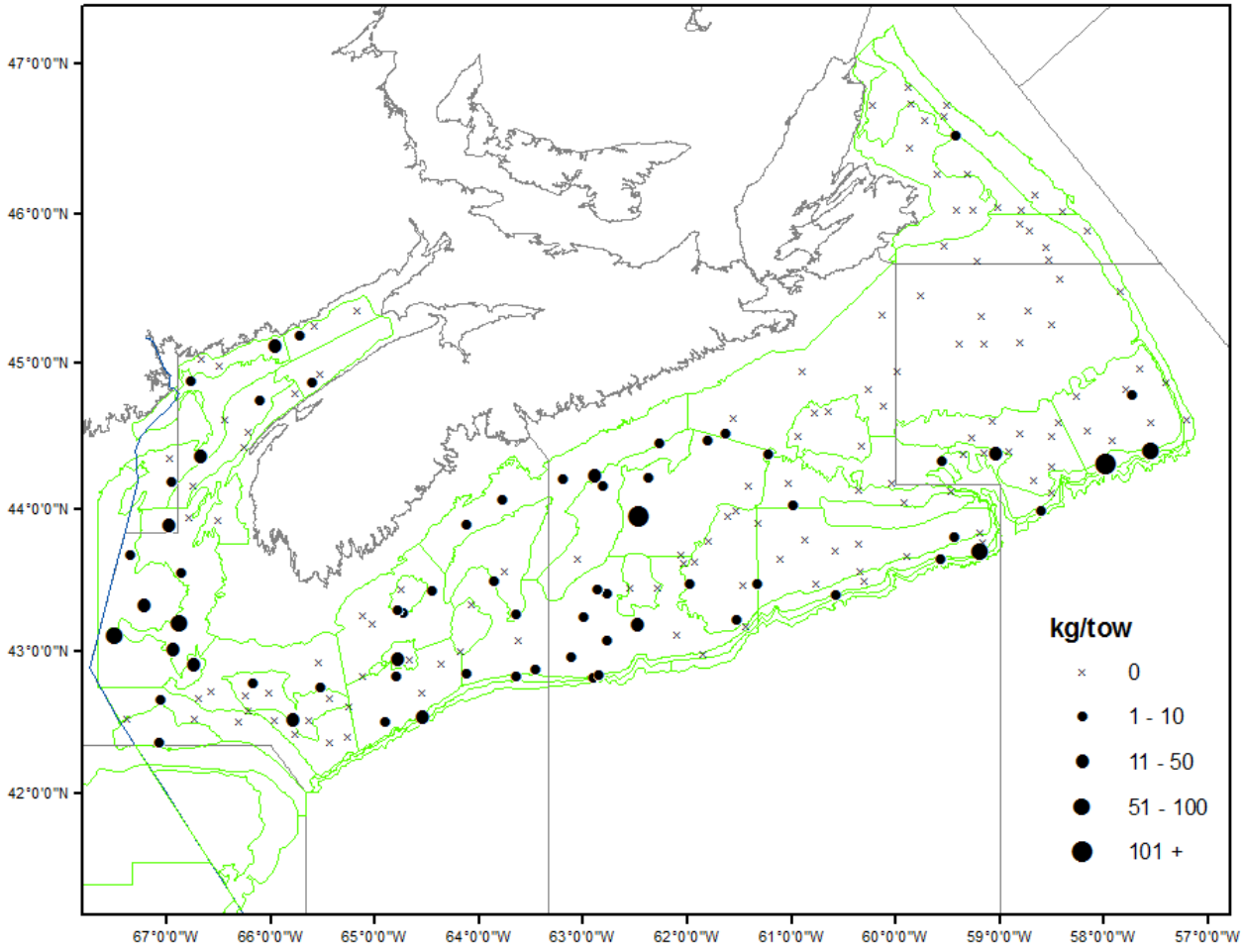

Figure 7a. Distribution of Pollock catches during the 2014 summer RV survey. Zero catch is represented by the x symbol. Black circles represent catches. The circle area is proportional to the catch size in kilograms per tow (kg/tow).

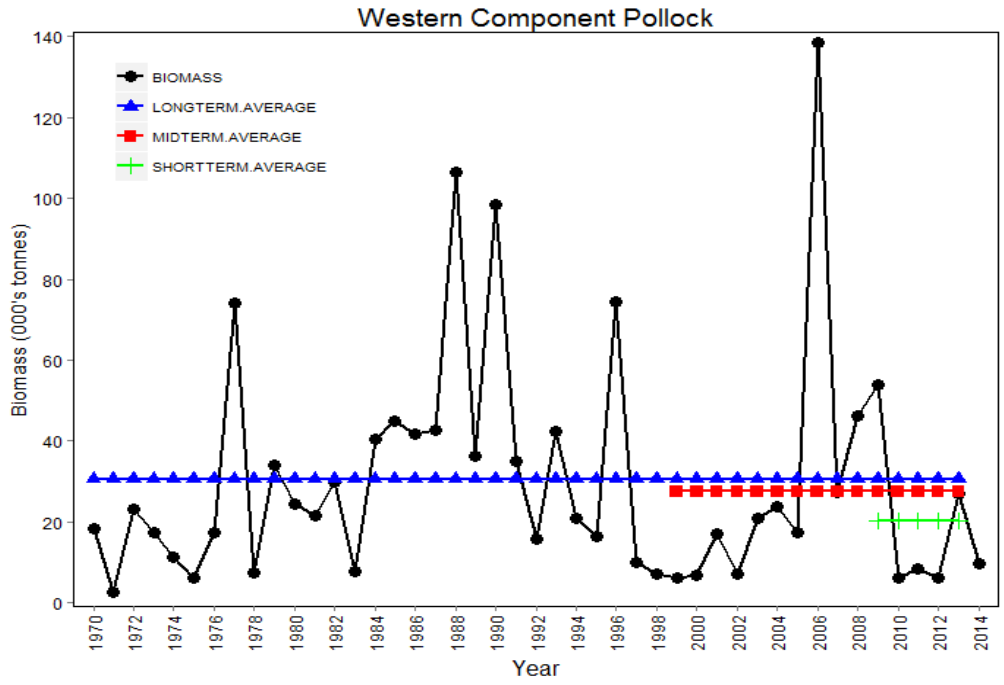

Figure 7b. Biomass index for Western Component Pollock (strata 474, 476, 480-495) from the summer RV survey represented by the black line with solid circles. The dark blue line with the solid triangles indicates the long-term survey average (1970-2013). The red line with the solid squares represents the medium-term 15 year average (1999-2013). The green line with the crosses represents the short-term 5 year average (2009-2013).

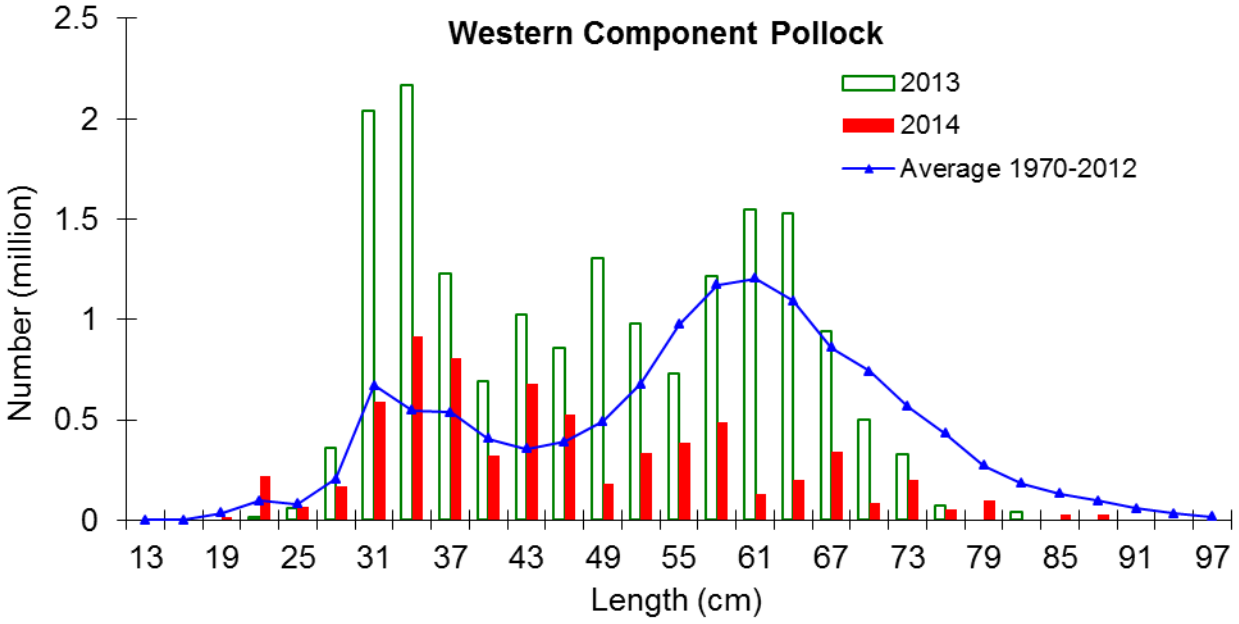

Figure 7c. Length frequency indices for Western Component Pollock from the summer RV survey. The solid red bars represent the number in millions at length from the 2014 survey. The open green bars represent the number in millions at length from the 2013 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2012.

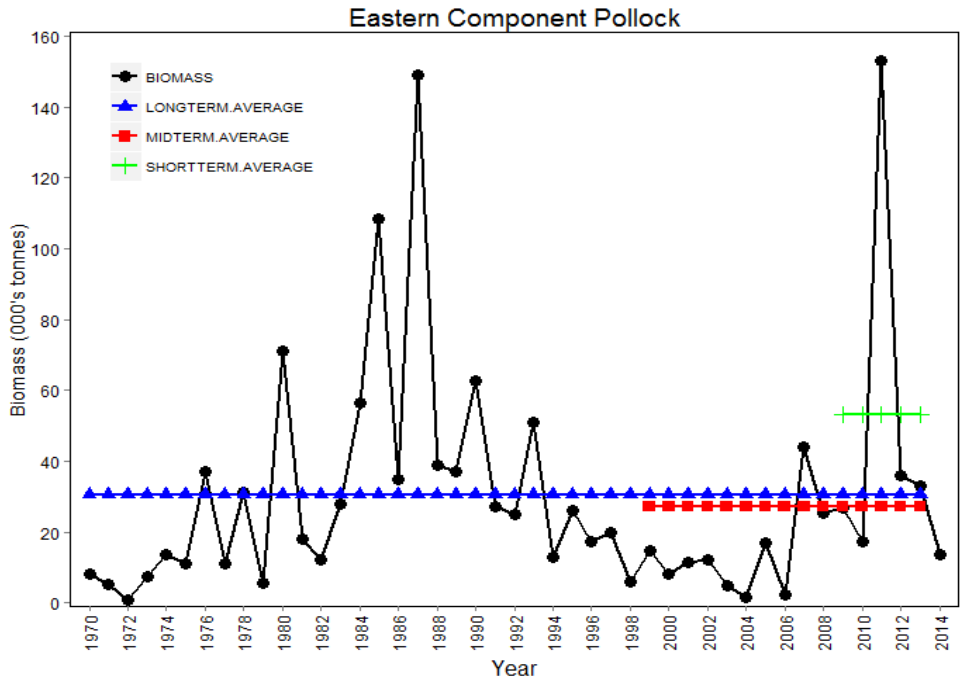

Figure 7d. Biomass index for Eastern Component Pollock (strata 440-473, 475, 477, 478) from the summer RV survey represented by the black line with solid circles. The dark blue line with the solid triangles indicates the long-term survey average (1970-2013). The red line with the solid squares represents the medium-term 15 year average (1999-2013). The green line with the crosses represents the short-term 5 year average (2009-2013).

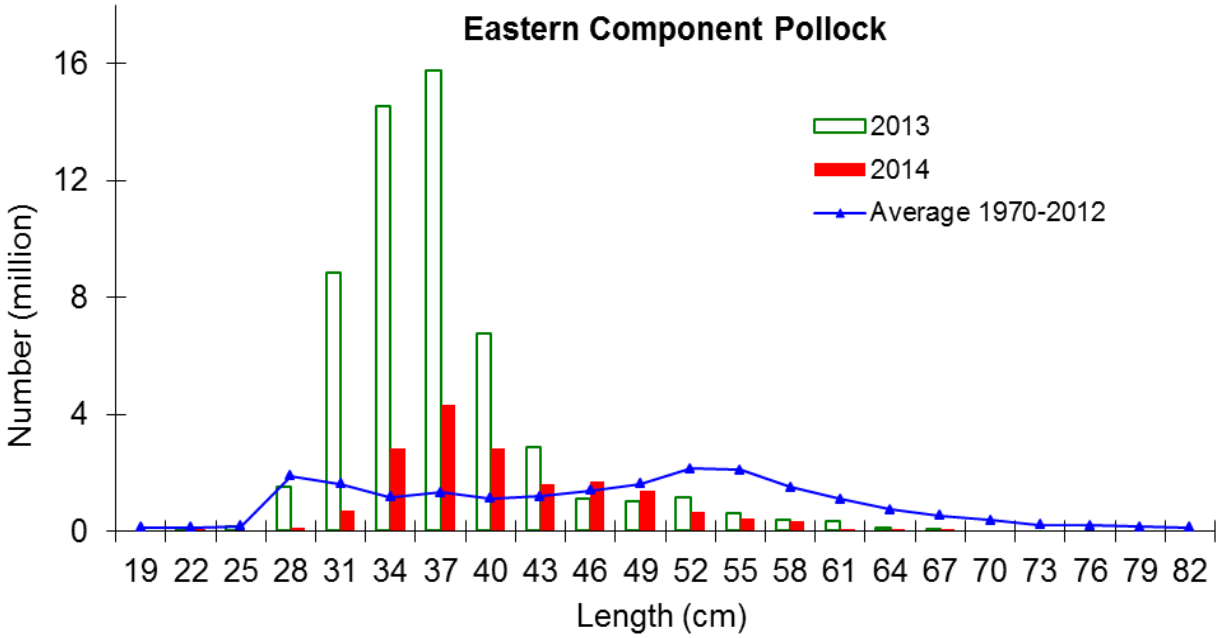

Figure 7e. Length frequency indices for Eastern Component Pollock from the summer RV survey. The solid red bars represent the number in millions at length from the 2014 survey. The open green bars represent the number in millions at length from the 2013 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2012.

Redfish

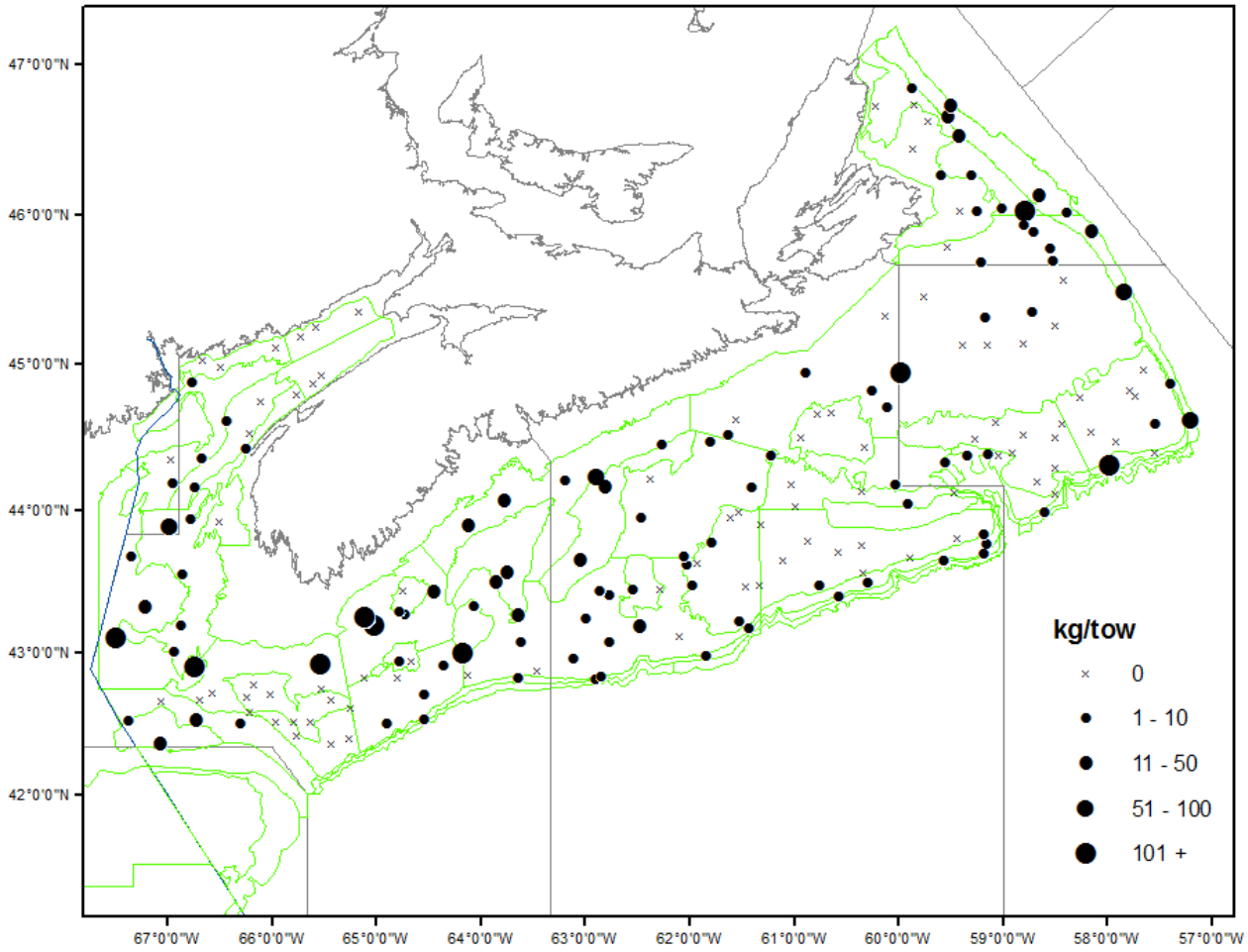

Figure 8a. Distribution of Redfish catches during the 2014 summer RV survey. Zero catch is represented by the x symbol. Black circles represent catches. The circle area is proportional to the catch size in kilograms per tow (kg/tow).

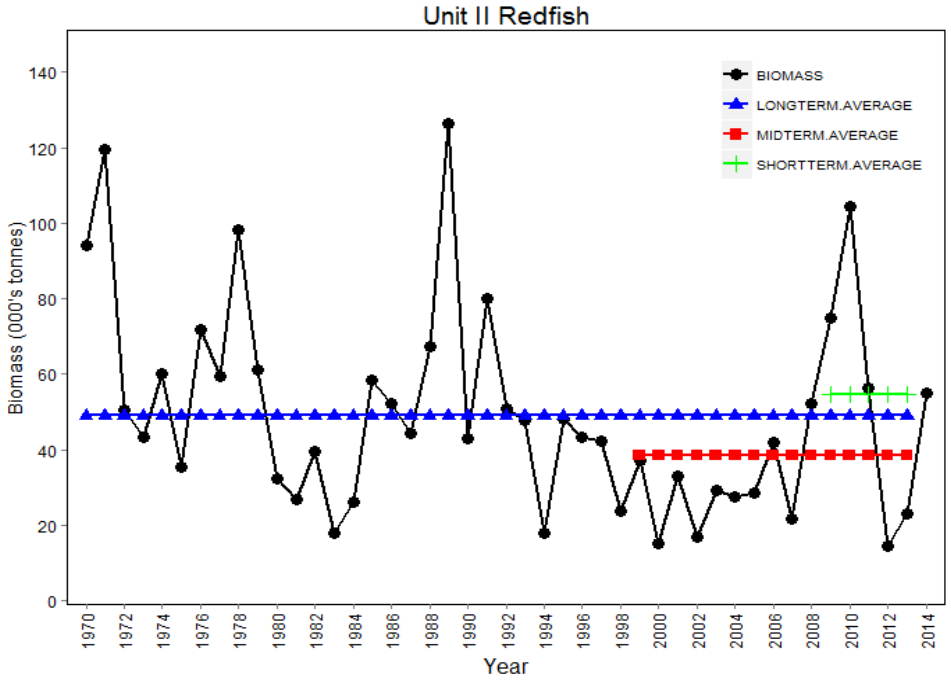

Figure 8b. Biomass index for Unit II Redfish (strata 440-456, 464)) from the summer RV survey represented by the black line with solid circles. The dark blue line with the solid triangles indicates the long-term survey average (1970-2013). The red line with the solid squares represents the medium-term 15 year average (1999-2013). The green line with the crosses represents the short-term 5 year average (2009-2013).

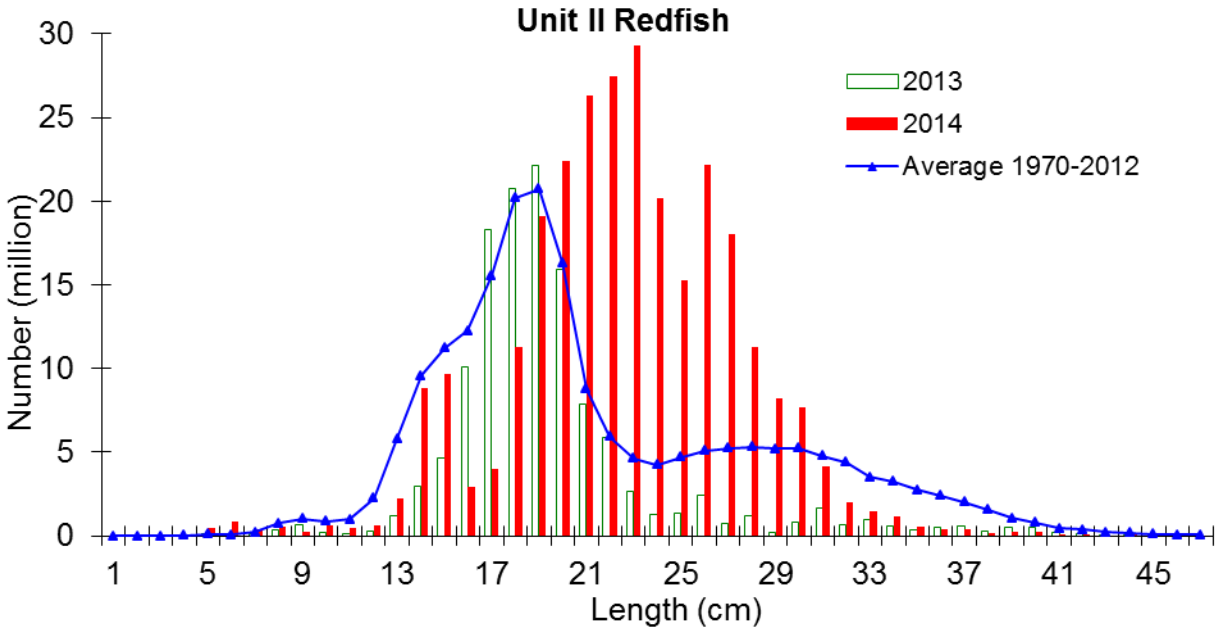

Figure 8c. Length frequency indices for Unit II Redfish from the summer RV survey. The solid red bars represent the number in millions at length from the 2014 survey. The open green bars represent the number in millions at length from the 2013 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2012.

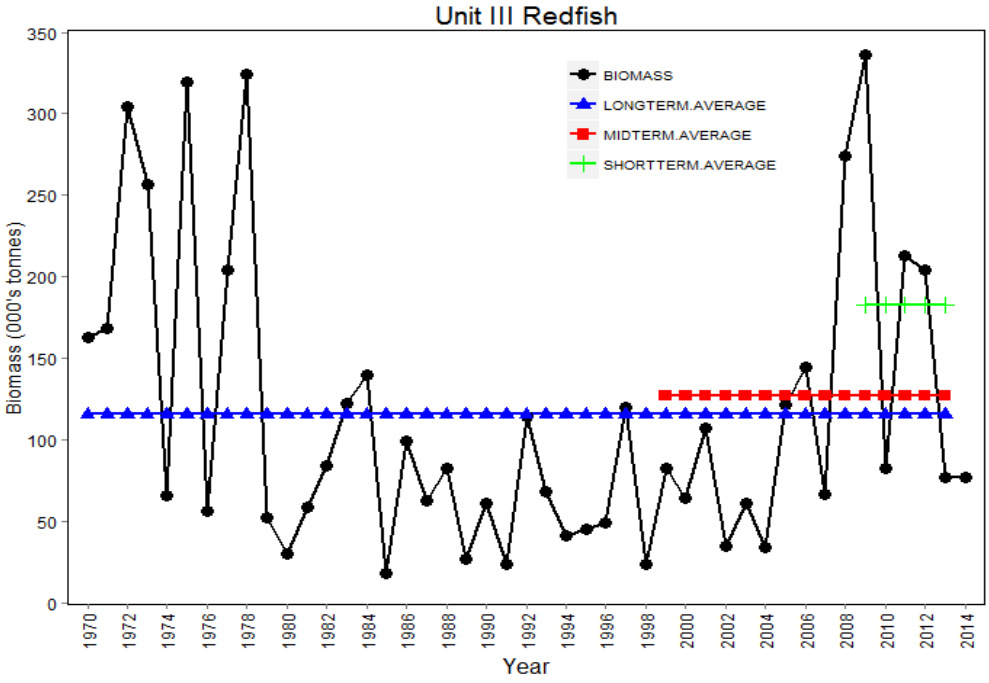

Figure 8d. Biomass index for Unit III Redfish (strata 457-463, 465-485) from the summer RV survey represented by the black line with solid circles. The dark blue line with the solid triangles indicates the long-term survey average (1970-2013). The red line with the solid squares represents the medium-term 15 year average (1999-2013). The green line with the crosses represents the short-term 5 year average (2009-2013).

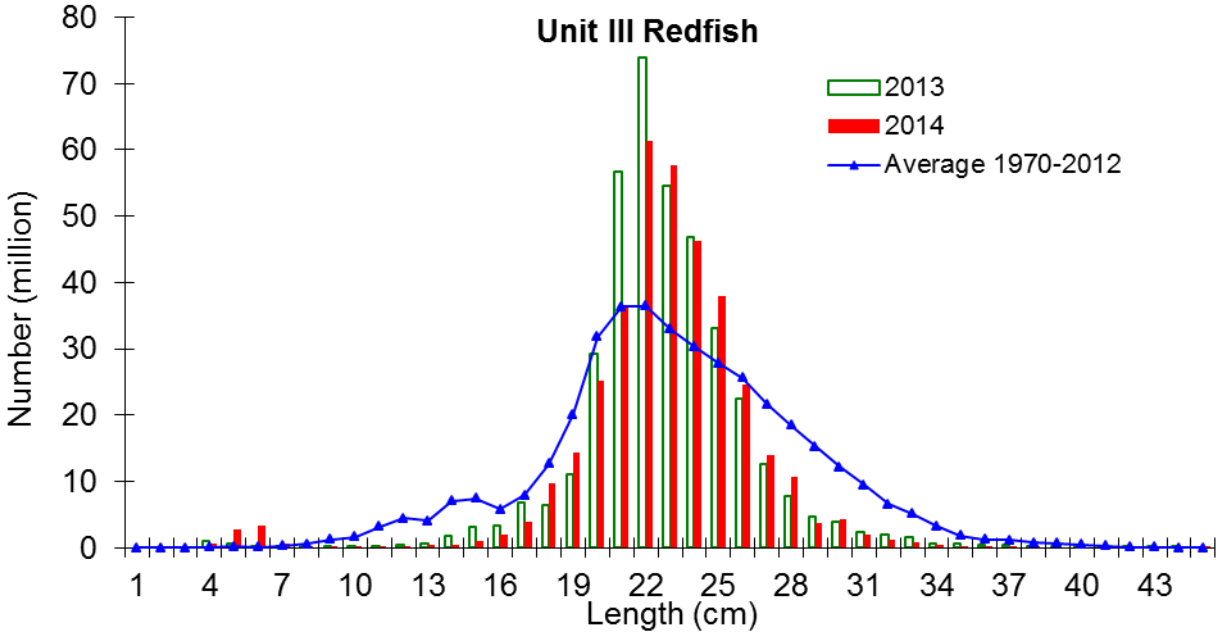

Figure 8e. Length frequency indices for Unit III Redfish from the summer RV survey. The solid red bars represent the number in millions at length from the 2014 survey. The open green bars represent the number in millions at length from the 2013 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2012.

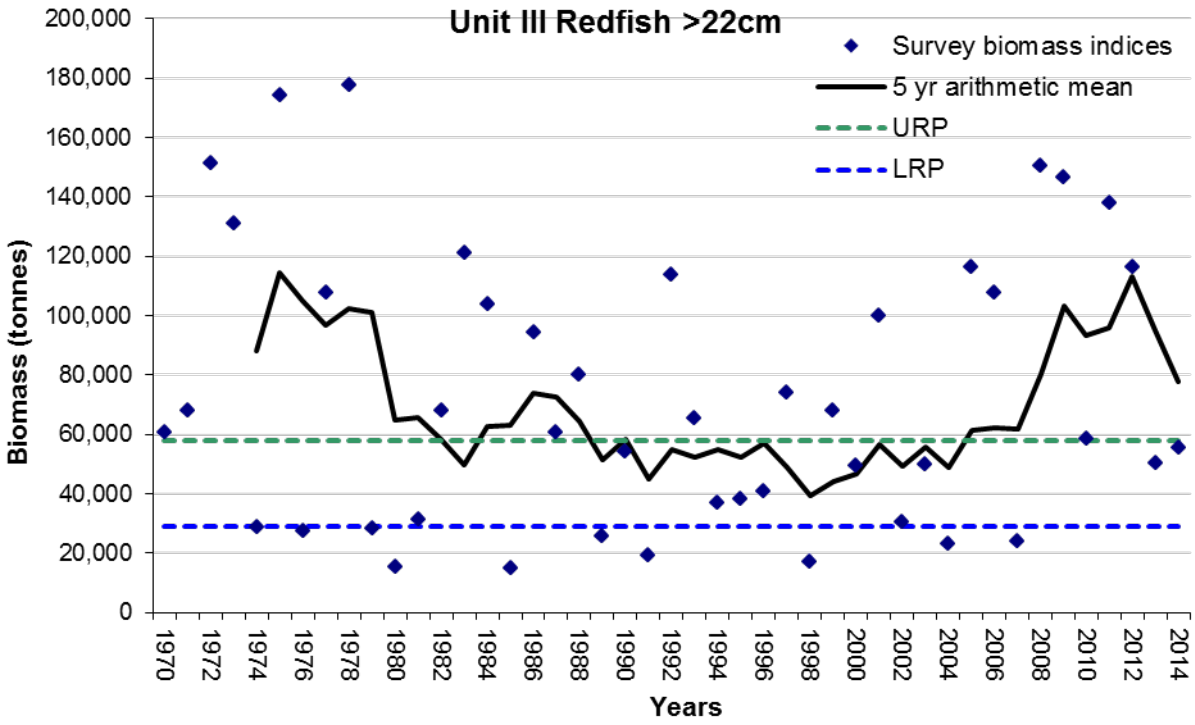

Figure 8f. Biomass index for Unit III redfish > 22cm from the summer RV survey represented by the dark blue diamonds. The solid black line represents the 5 year arithmetic mean. The dashed blue line represents the Limit Reference Point (LRP) and the dashed green line represents the Upper Reference Point (URP).

Atlantic Halibut

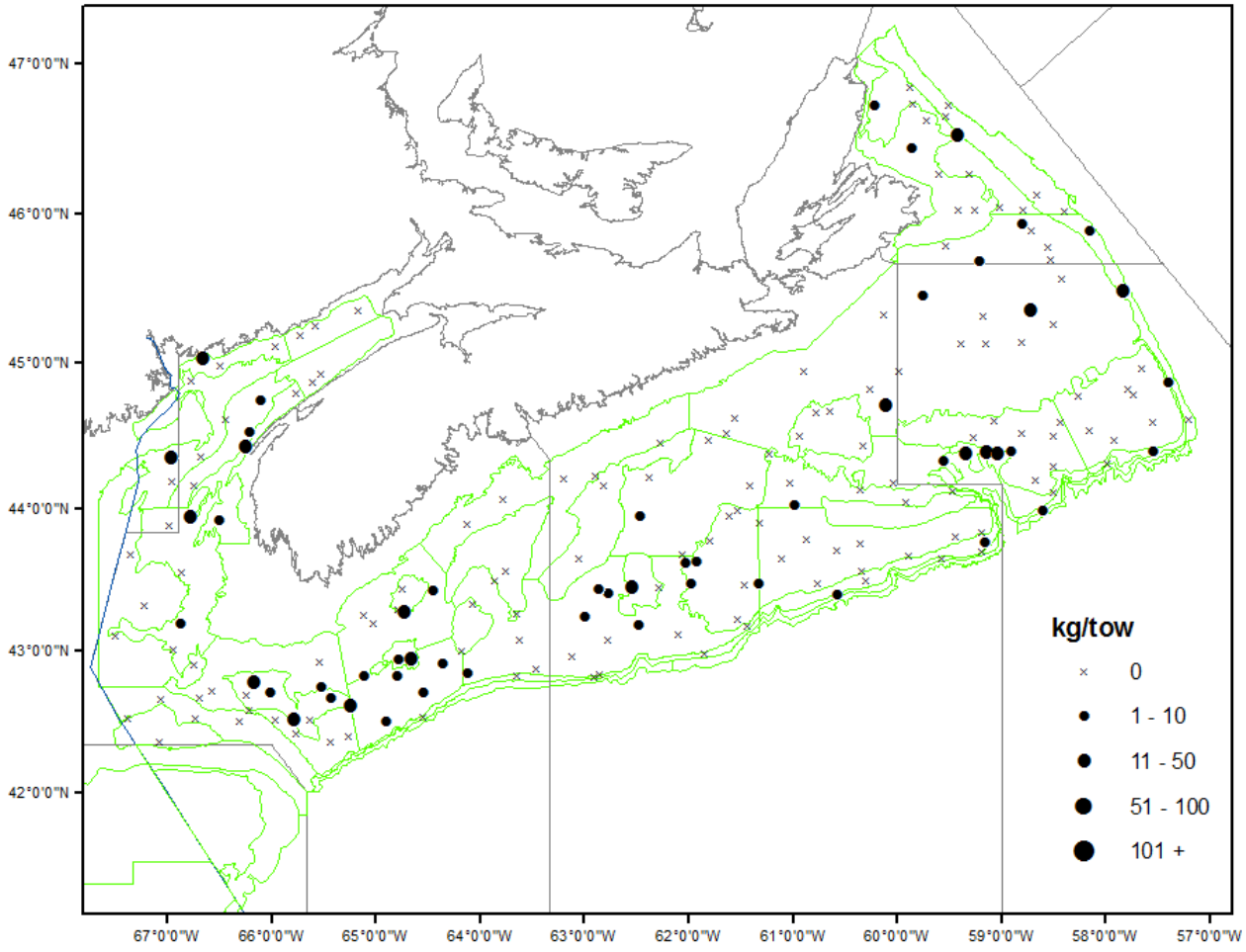

Figure 9a. Distribution of Atlantic Halibut catches during the 2014 summer RV survey. Zero catch is represented by the x symbol. Black circles represent catches. The circle area is proportional to the catch size in kilograms per tow (kg/tow).

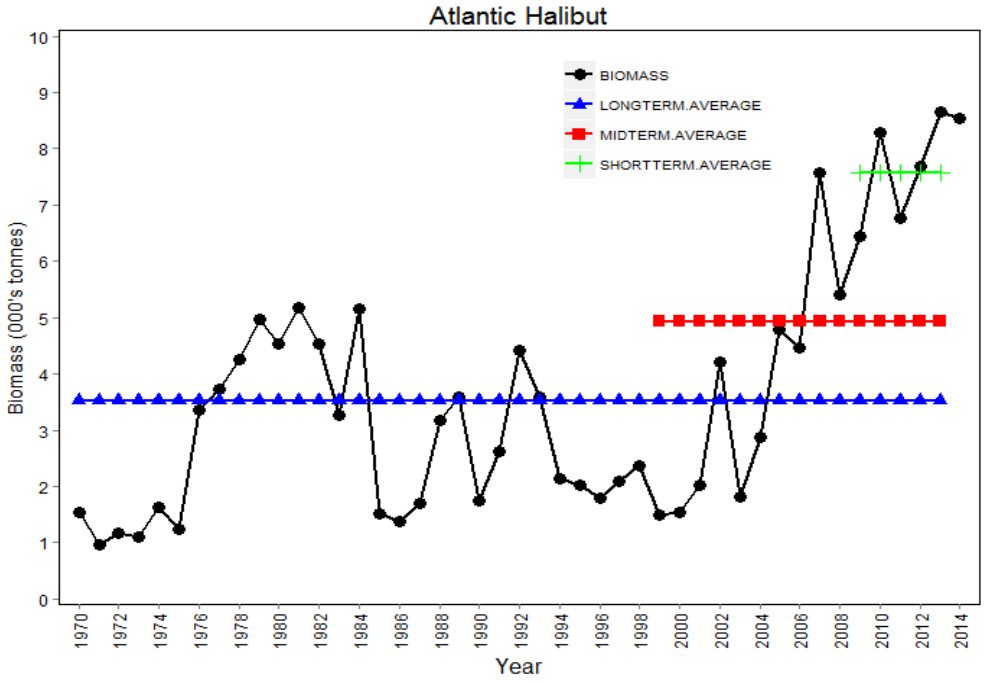

Figure 9b. Biomass index for Atlantic Halibut in 4VWX from the summer RV survey represented by the black line with solid circles. The dark blue line with the solid triangles indicates the long-term survey average (1970-2013). The red line with the solid squares represents the medium-term 15 year average (1999-2013). The green line with the crosses represents the short-term 5 year average (2009-2013).

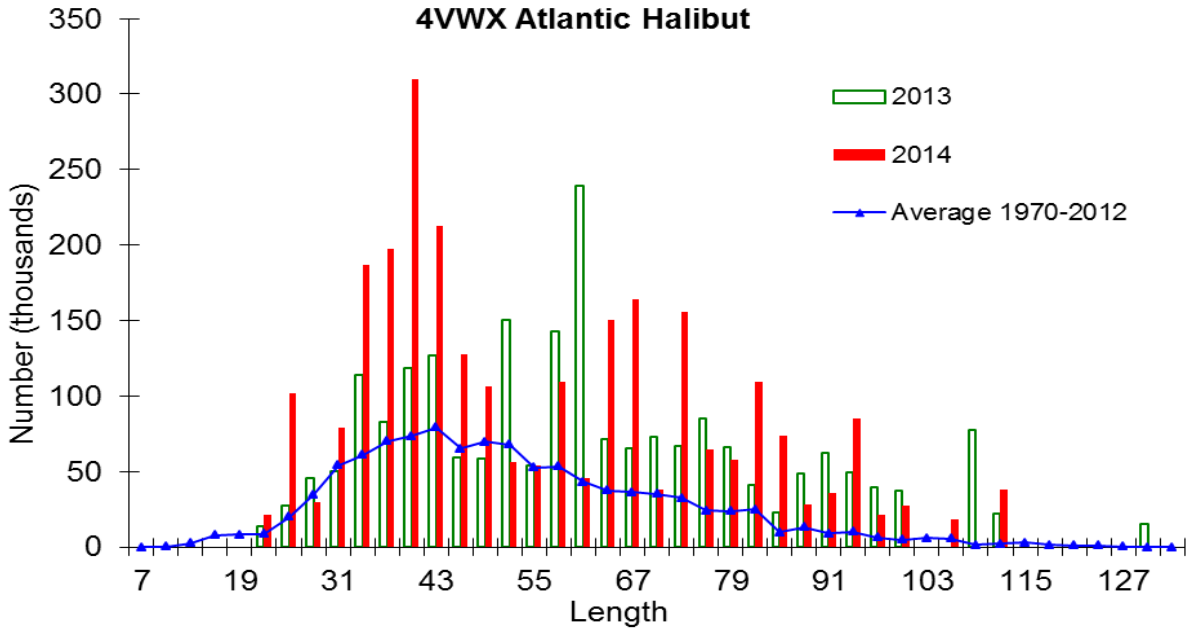

Figure 9c. Length frequency indices for Atlantic Halibut in 4VWX from the summer RV survey. The solid red bars represent the number in thousands at length from the 2014 survey. The open green bars represent the number in thousands at length from the 2013 survey. The solid blue line with triangles represents the average number in thousands at length for the time period 1970-2012.

Yellowtail Flounder

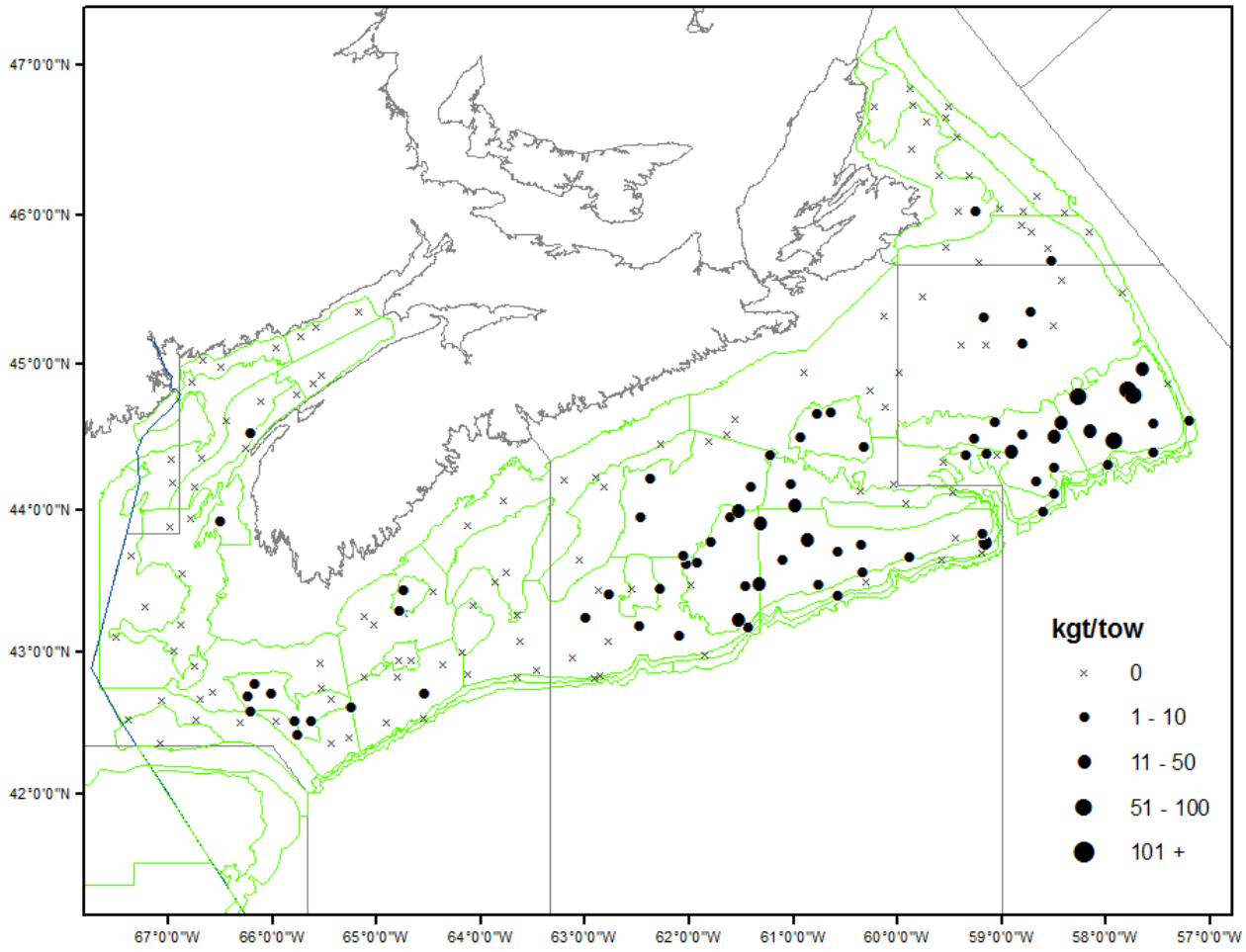

Figure 10a. Distribution of Yellowtail Flounder catches during the 2014 summer RV survey. Zero catch is represented by the x symbol. Black circles represent catches. The circle area is proportional to the catch size in kilograms per tow (kg/tow).

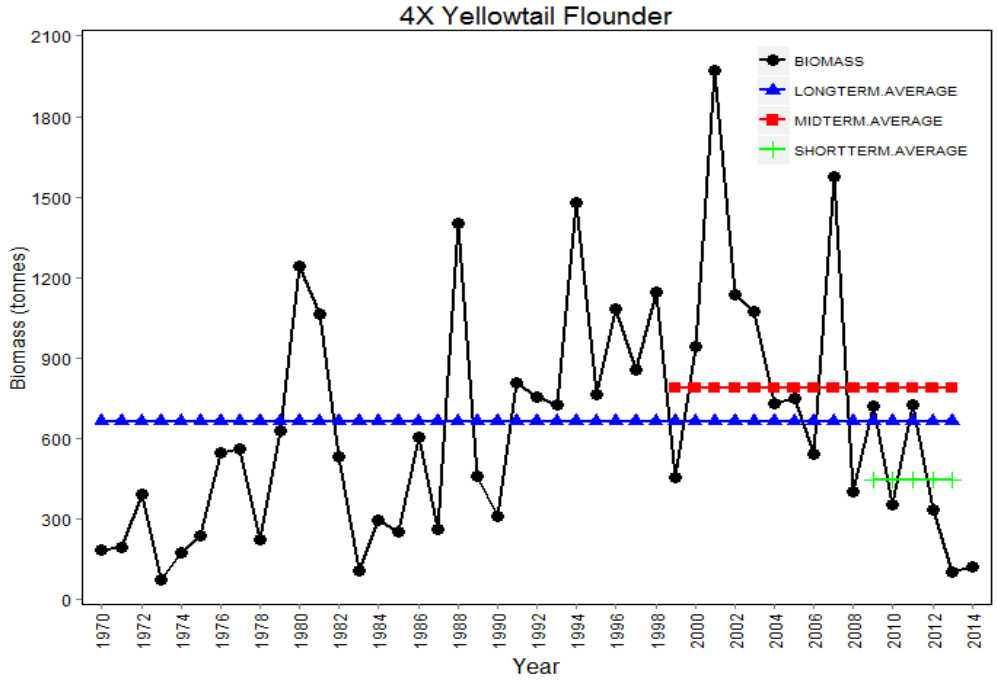

Figure 10b. Biomass index for Yellowtail Flounder in 4X from the summer RV survey represented by the black line with solid circles. The dark blue line with the solid triangles indicates the long-term survey average (1970-2013). The red line with the solid squares represents the medium-term 15 year average (1999-2013). The green line with the crosses represents the short-term 5 year average (2009-2013).

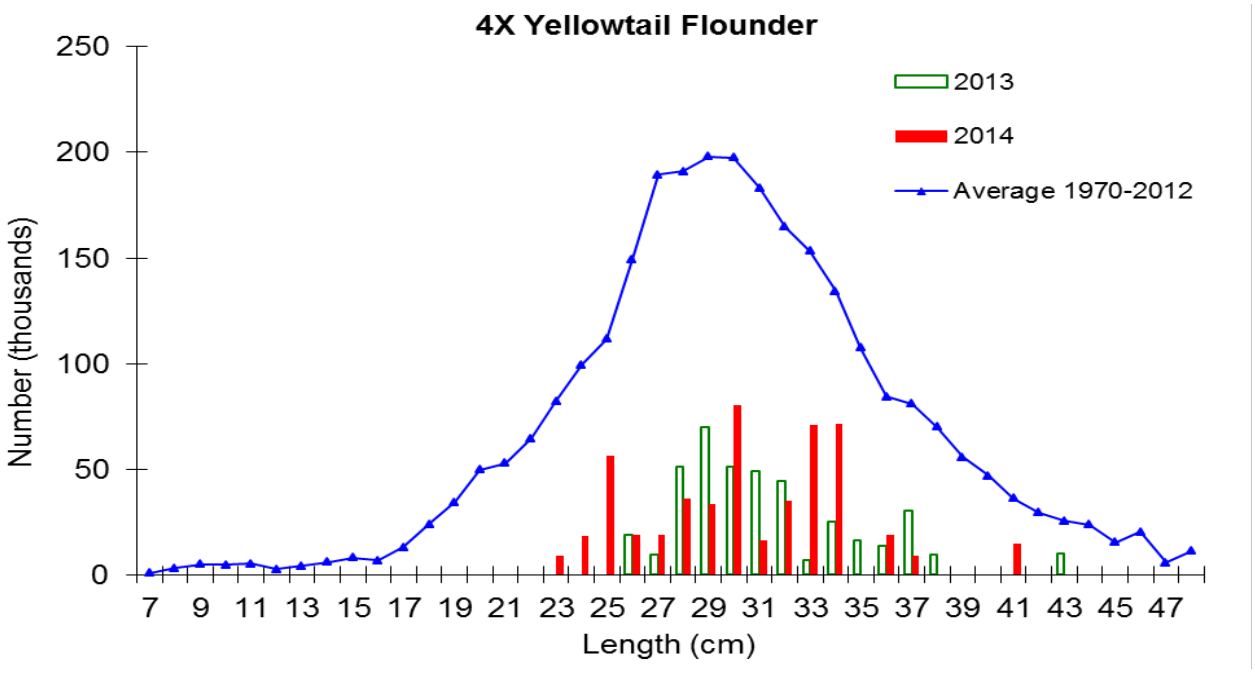

Figure 10c. Length frequency indices for Yellowtail Flounder in 4X from the summer RV survey. The solid red bars represent the number in thousands at length from the 2014 survey. The open green bars represent the number in thousands at length from the 2013 survey. The solid blue line with triangles represents the average number in thousands at length for the time period 1970-2012.

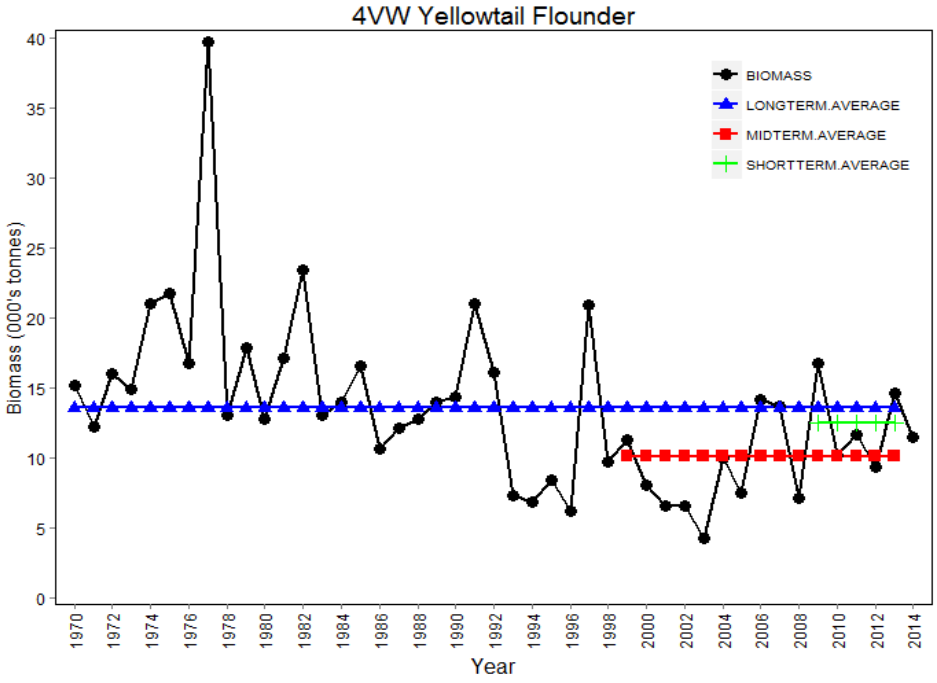

Figure 10d. Biomass index for Yellowtail Flounder in 4VW from the summer RV survey represented by the black line with solid circles. The dark blue line with the solid triangles indicates the long-term survey average (1970-2013). The red line with the solid squares represents the medium-term 15 year average (1999-2013). The green line with the crosses represents the short-term 5 year average (2009-2013).

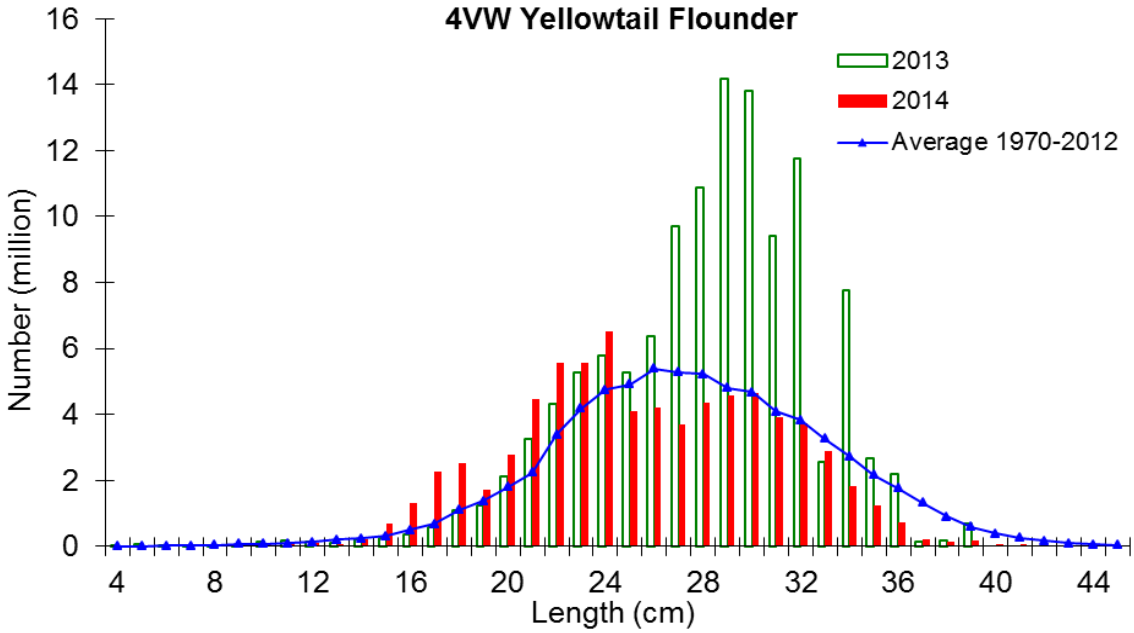

Figure 10e. Length frequency indices for Yellowtail Flounder in 4VW from the summer RV survey. The solid red bars represent the number in millions at length from the 2014 survey. The open green bars represent the number in millions at length from the 2013 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2012.

American Plaice

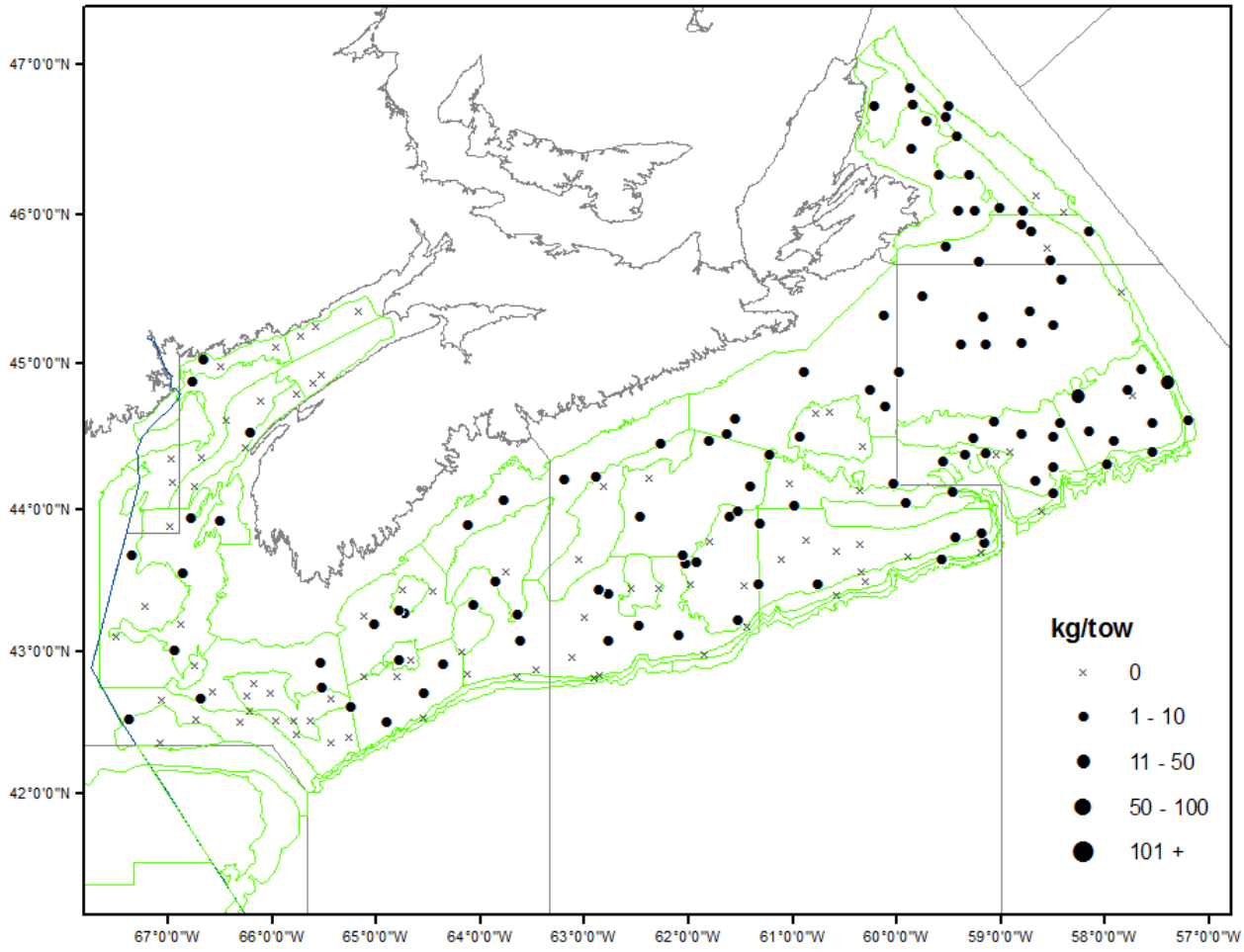

Figure 11a. Distribution of American Plaice catches during the 2014 summer RV survey. Zero catch is represented by the x symbol. Black circles represent catches. The circle area is proportional to the catch size in kilograms per tow (kg/tow).

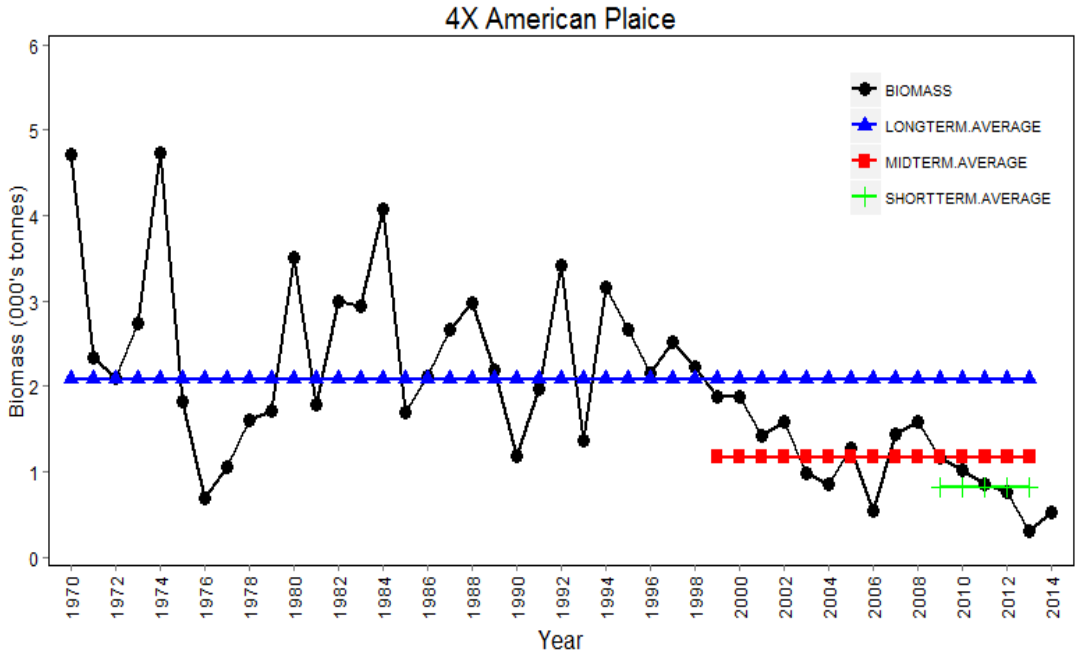

Figure 11b. Biomass index for American Plaice in 4X from the summer RV survey represented by the black line with solid circles. The dark blue line with the solid triangles indicates the long-term survey average (1970-2013). The red line with the solid squares represents the medium-term 15 year average (1999-2013). The green line with the crosses represents the short-term 5 year average (2009-2013).

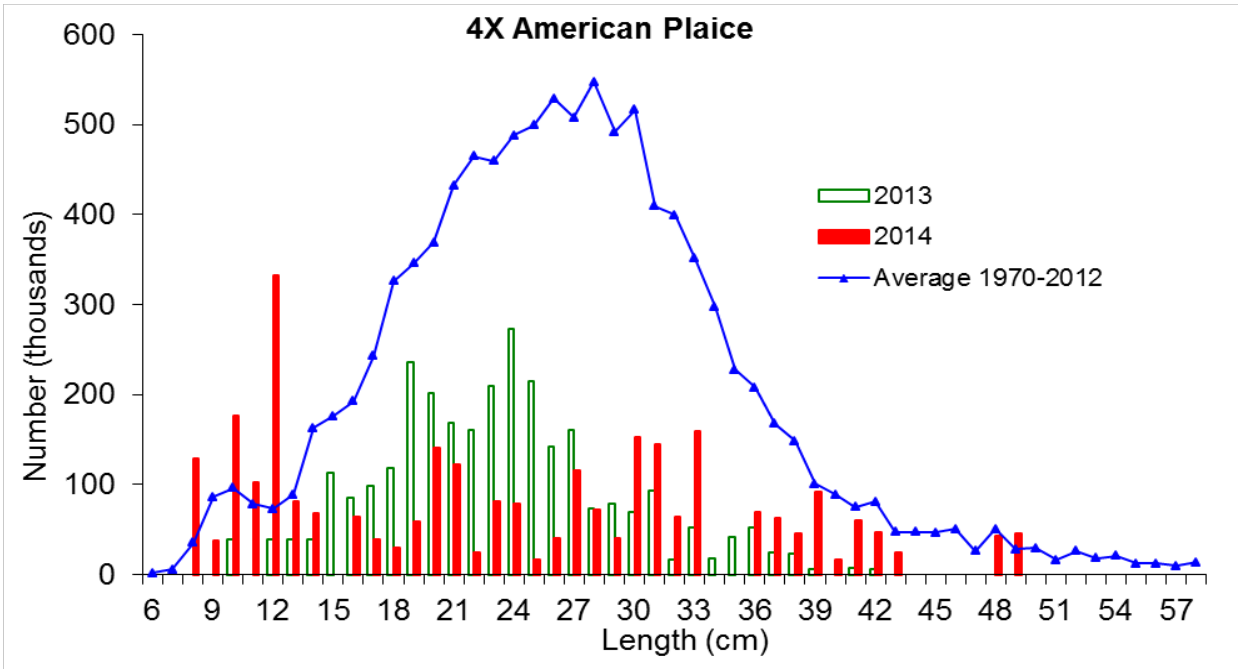

Figure 11c. Length frequency indices for American Plaice in 4X from the summer RV survey. The solid red bars represent the number in thousands at length from the 2014 survey. The open green bars represent the number in thousands at length from the 2013 survey. The solid blue line with triangles represents the average number in thousands at length for the time period 1970-2012.

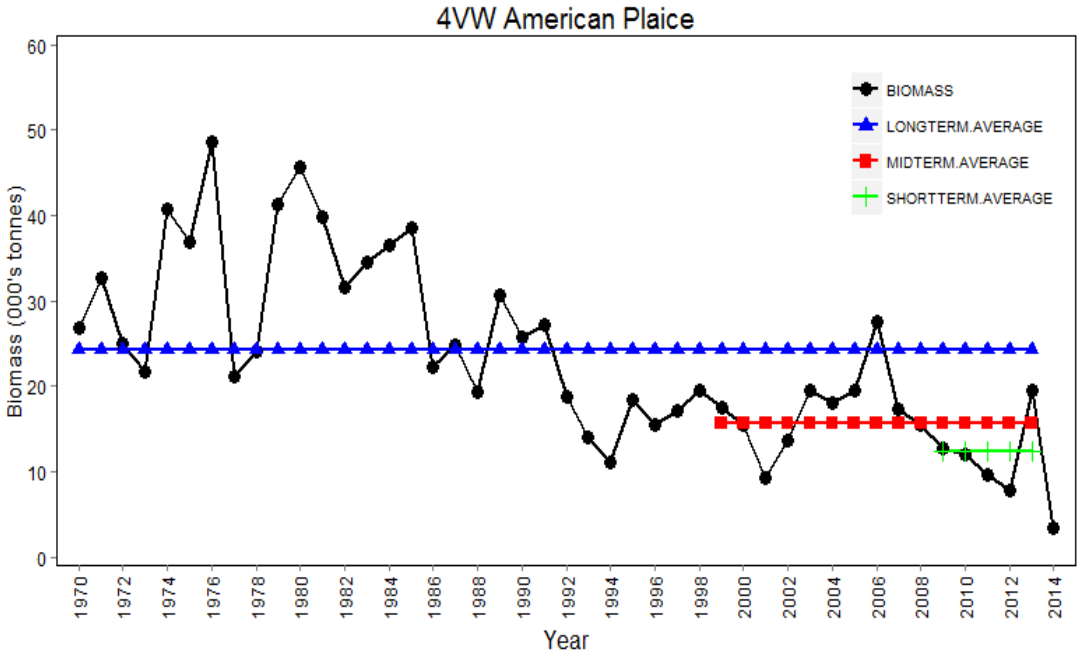

Figure 11d. Biomass index for American Plaice in 4VW from the summer RV survey represented by the black line with solid circles. The dark blue line with the solid triangles indicates the long-term survey average (1970-2013). The red line with the solid squares represents the medium-term 15 year average (1999-2013). The green line with the crosses represents the short-term 5 year average (2009-2013).

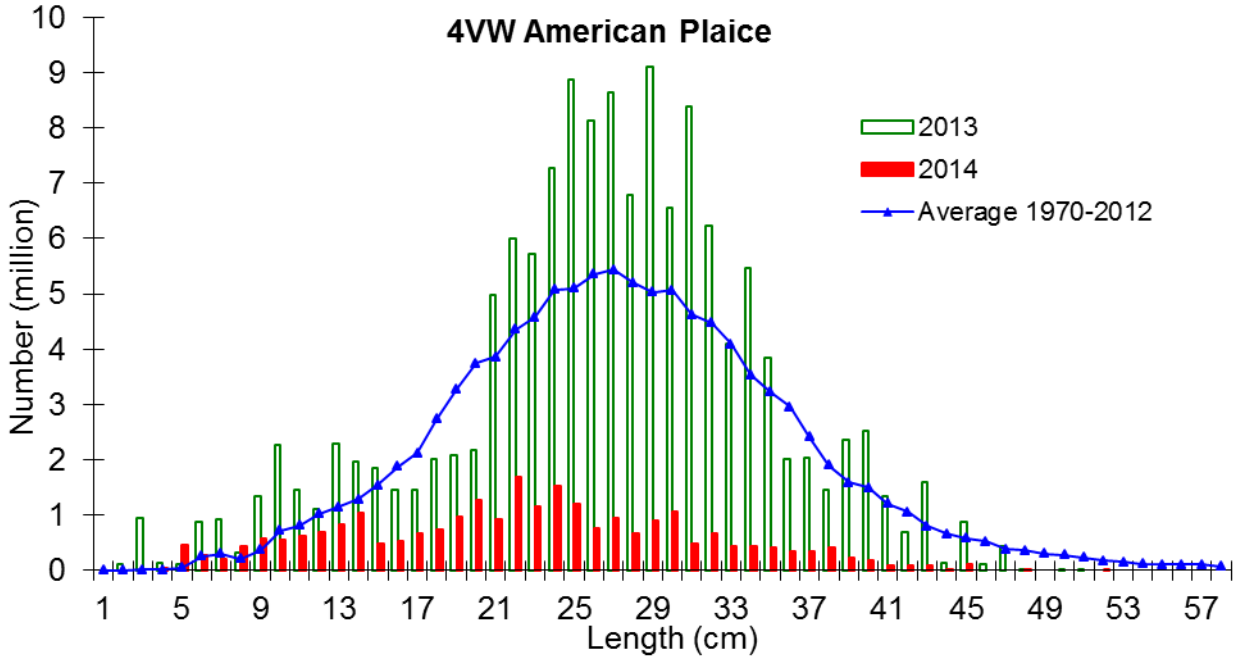

Figure 11e. Length frequency indices for American Plaice in 4VW from the summer RV survey. The solid red bars represent the number in millions at length from the 2014 survey. The open green bars represent the number in millions at length from the 2013 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2012.

Witch Flounder

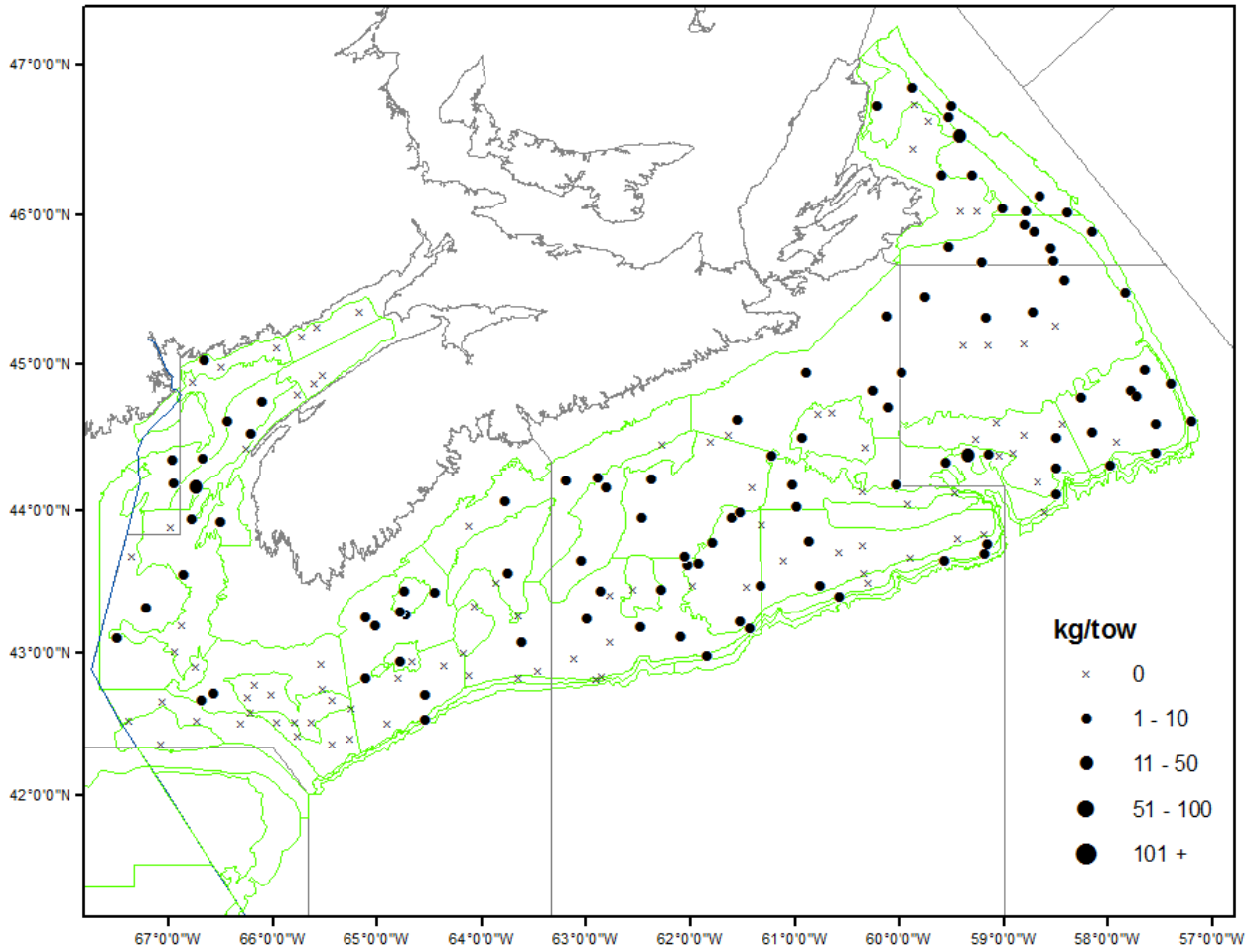

Figure 12a. Distribution of Witch Flounder catches during the 2014 summer RV survey. Zero catch is represented by the x symbol. Black circles represent catches. The circle area is proportional to the catch size in kilograms per tow (kg/tow).

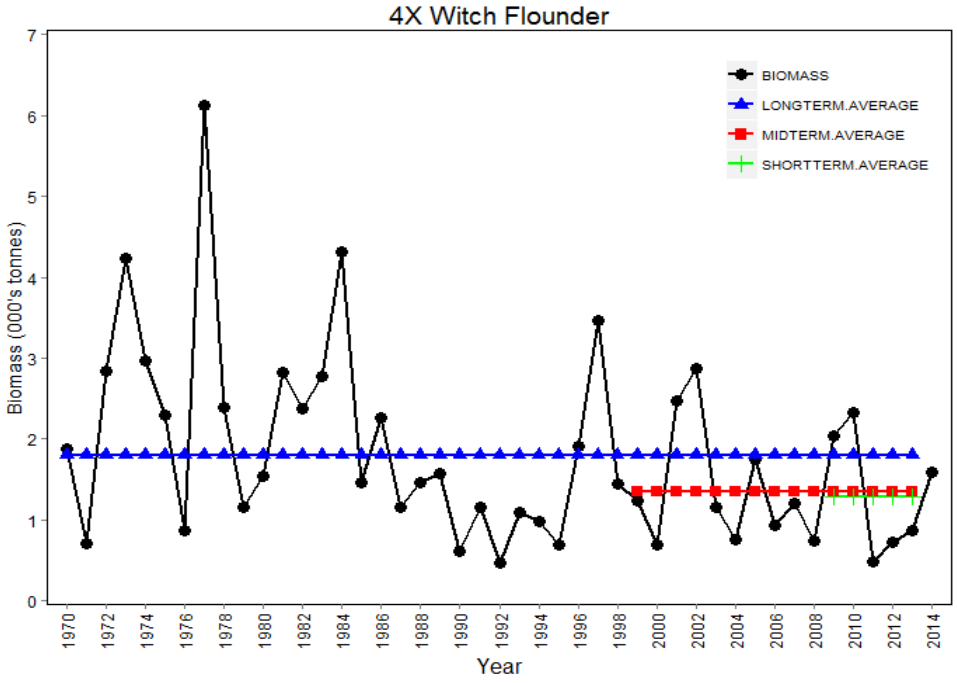

Figure 12b. Biomass index for Witch Flounder in 4X from the summer RV survey represented by the black line with solid circles. The dark blue line with the solid triangles indicates the long-term survey average (1970-2013). The red line with the solid squares represents the medium-term 15 year average (1999-2013). The green line with the crosses represents the short-term 5 year average (2009-2013).

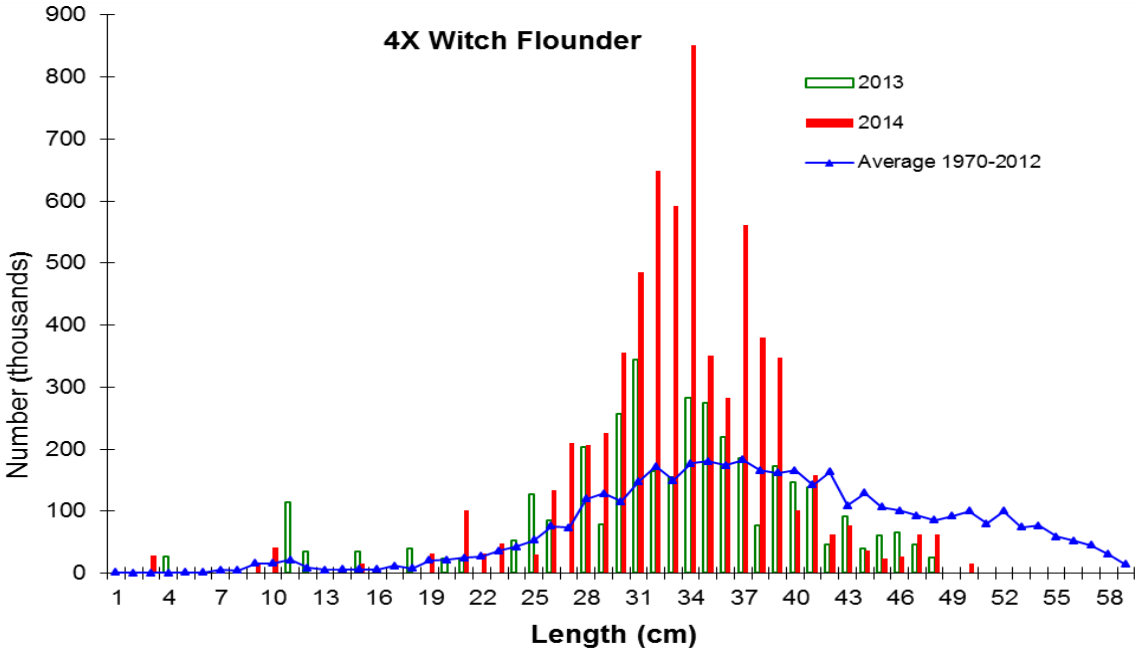

Figure 12c. Length frequency indices for Witch Flounder in 4X from the summer RV survey. The solid red bars represent the number in thousands at length from the 2014 survey. The open green bars represent the number in thousands at length from the 2013 survey. The solid blue line with triangles represents the average number in thousands at length for the time period 1970-2012.

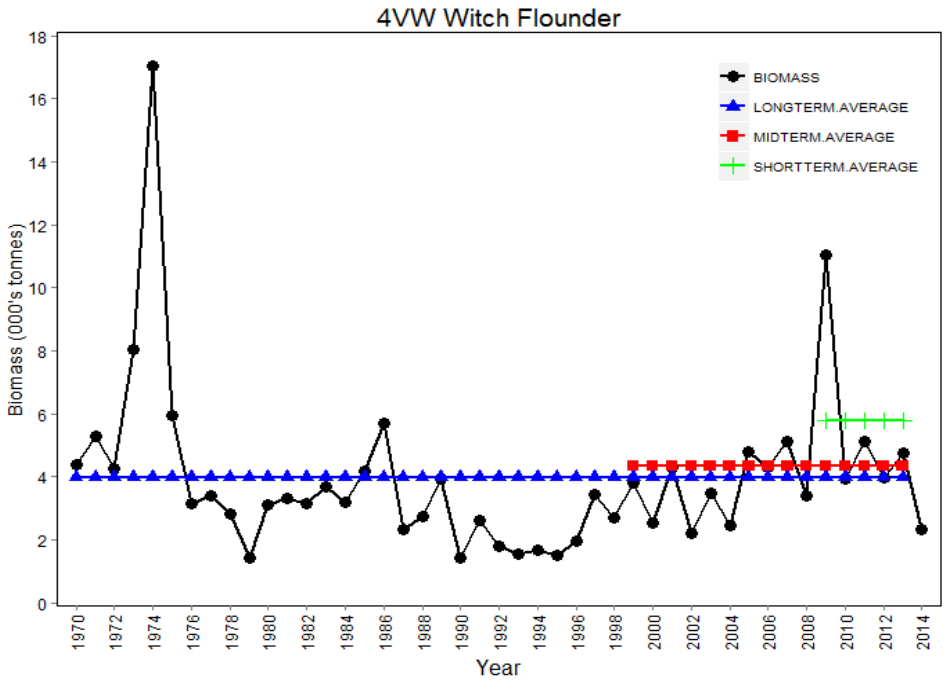

Figure 12d. Biomass index for Witch Flounder in 4VW from the summer RV survey represented by the black line with solid circles. The dark blue line with the solid triangles indicates the long-term survey average (1970-2013). The red line with the solid squares represents the medium-term 15 year average (1999-2013). The green line with the crosses represents the short-term 5 year average (2009-2013).

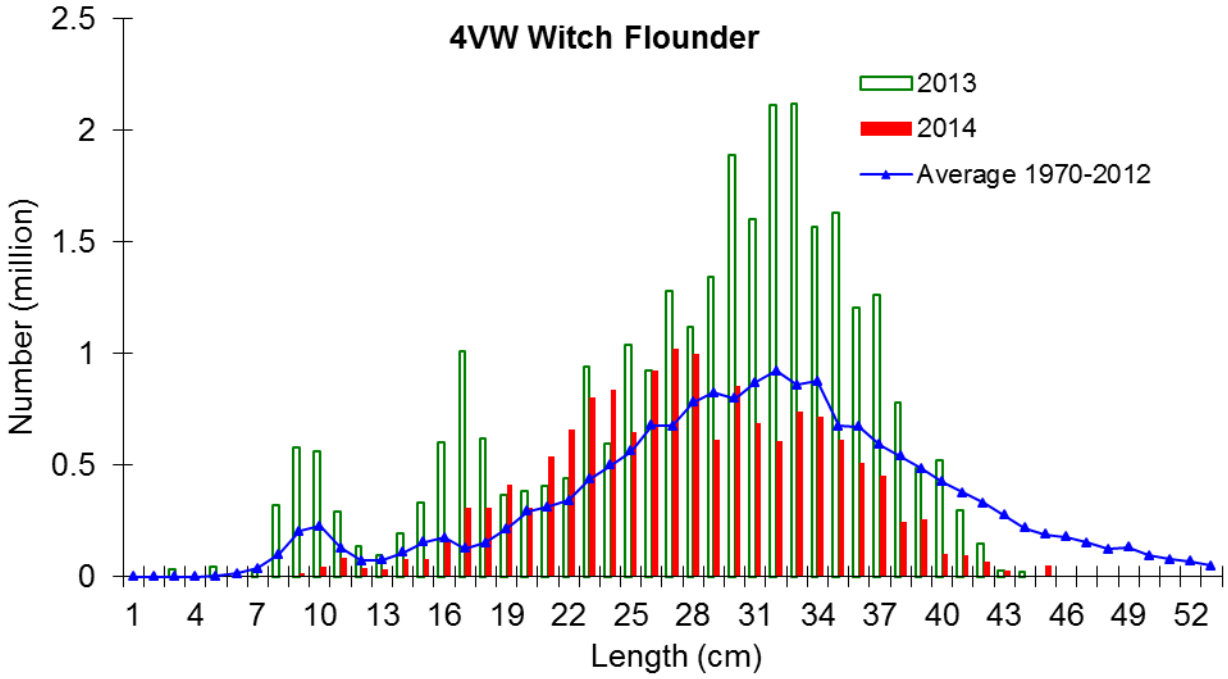

Figure 12e. Length frequency indices for Witch Flounder in 4VW from the summer RV survey. The solid red bars represent the number in millions at length from the 2014 survey. The open green bars represent the number in millions at length from the 2013 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2012.

Winter Flounder

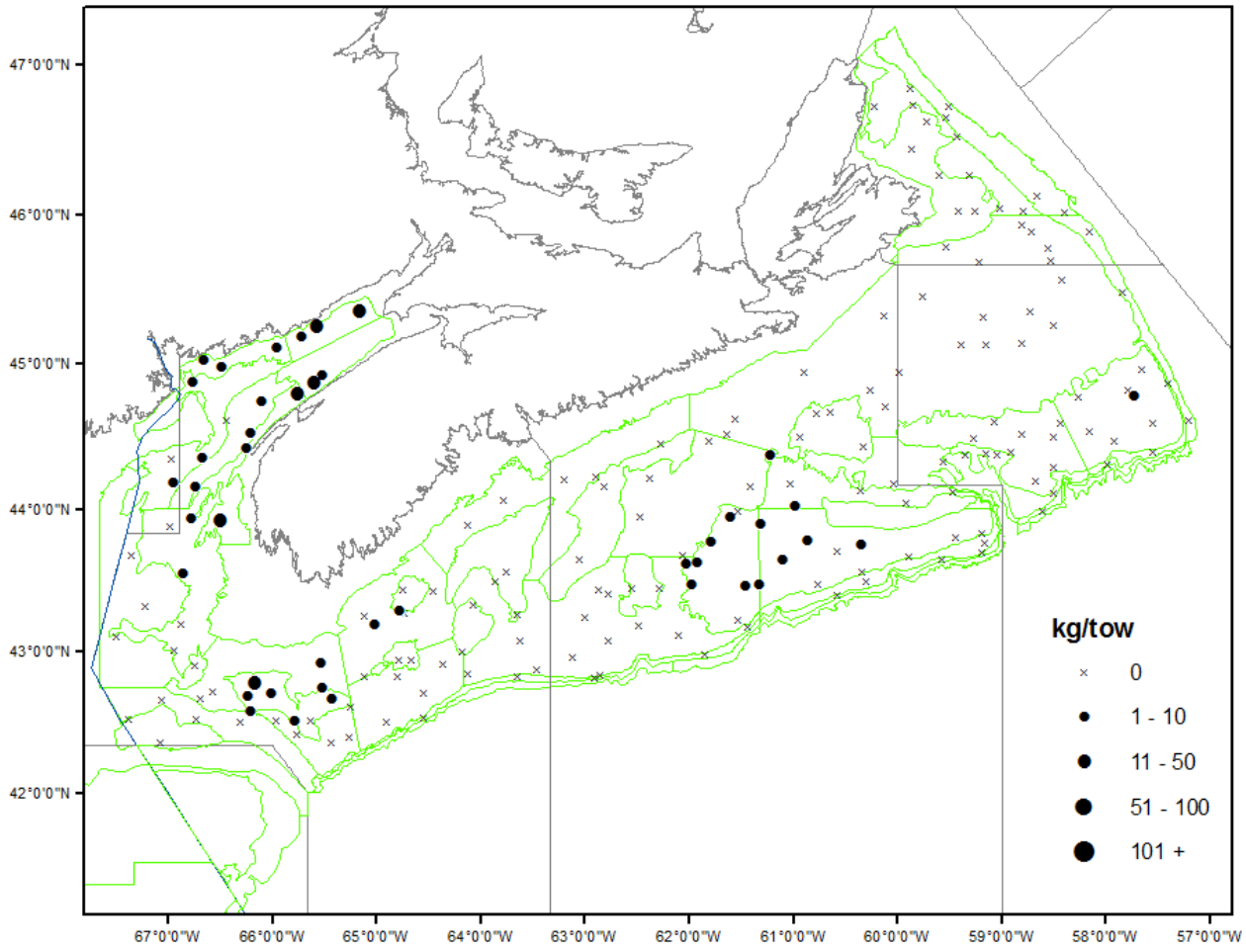

Figure 13a. Distribution of Winter Flounder catches during the 2014 summer RV survey. Zero catch is represented by the x symbol. Black circles represent catches. The circle area is proportional to the catch size in kilograms per tow (kg/tow).

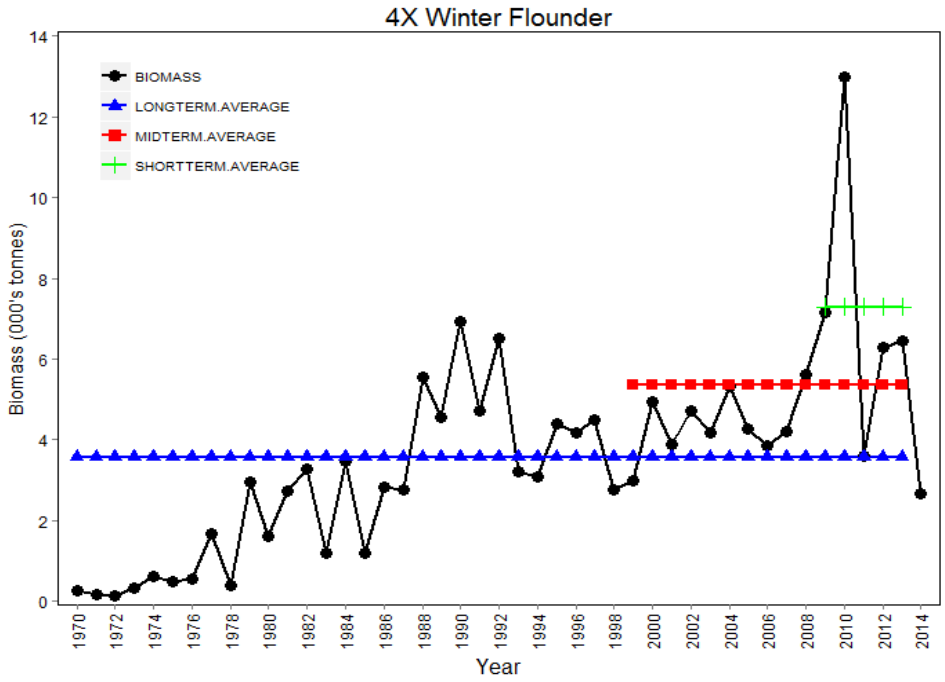

Figure 13b. Biomass index for Winter Flounder in 4X from the summer RV survey represented by the black line with solid circles. The dark blue line with the solid triangles indicates the long-term survey average (1970-2013). The red line with the solid squares represents the medium-term 15 year average (1999-2013). The green line with the crosses represents the short-term 5 year average (2009-2013).

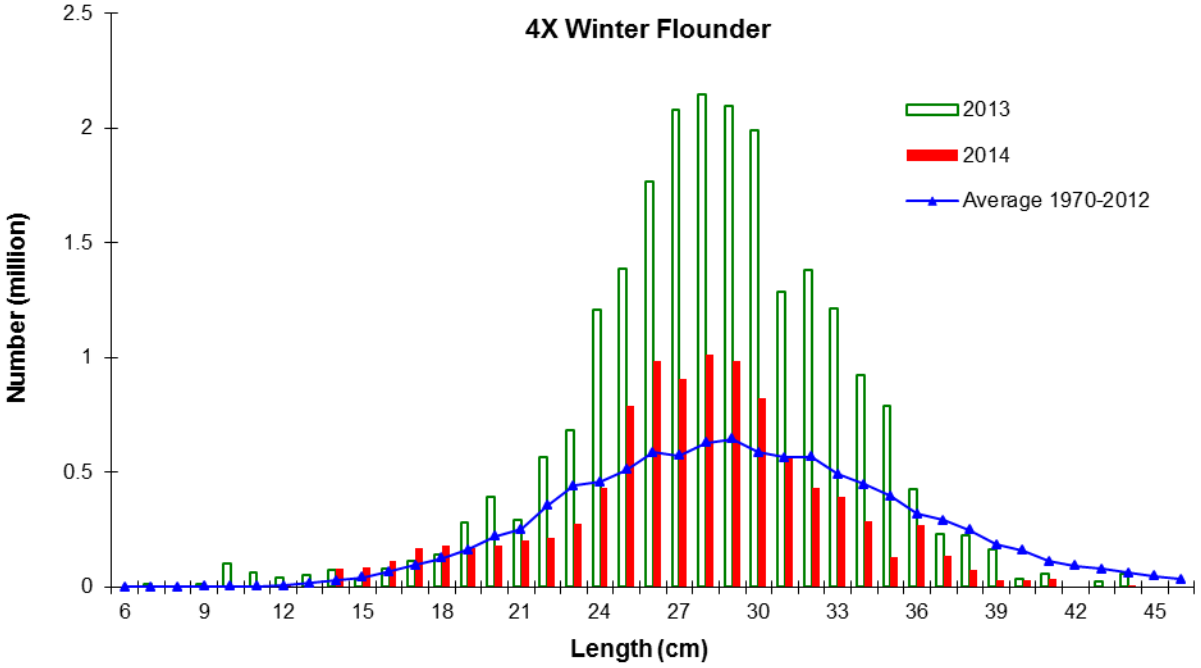

Figure 13c. Length frequency indices for Winter Flounder in 4X from the summer RV survey. The solid red bars represent the number in millions at length from the 2014 survey. The open green bars represent the number in millions at length from the 2013 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2012.

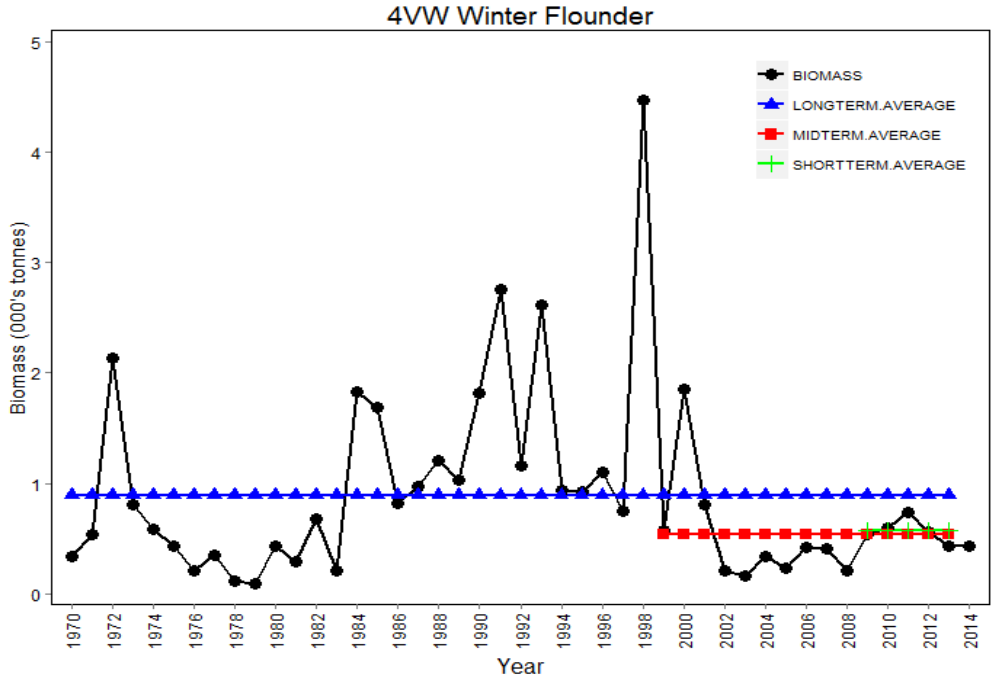

Figure 13d. Biomass index for Winter Flounder in 4VW from the summer RV survey represented by the black line with solid circles. The dark blue line with the solid triangles indicates the long-term survey average (1970-2013). The red line with the solid squares represents the medium-term 15 year average (1999-2013). The green line with the crosses represents the short-term 5 year average (2009-2013).

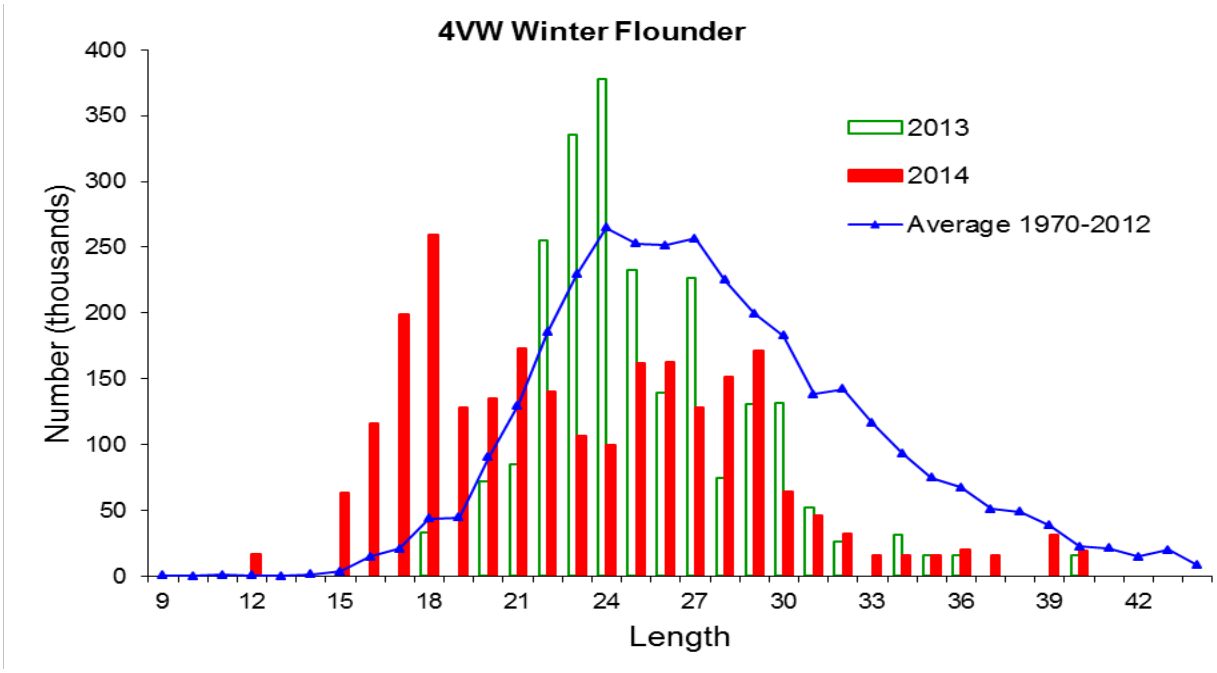

Figure 13e. Length frequency indices for Winter Flounder in 4VW from the summer RV survey. The solid red bars represent the number in thousands at length from the 2014 survey. The open green bars represent the number in millions at length from the 2013 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2012.

Atlantic Wolffish

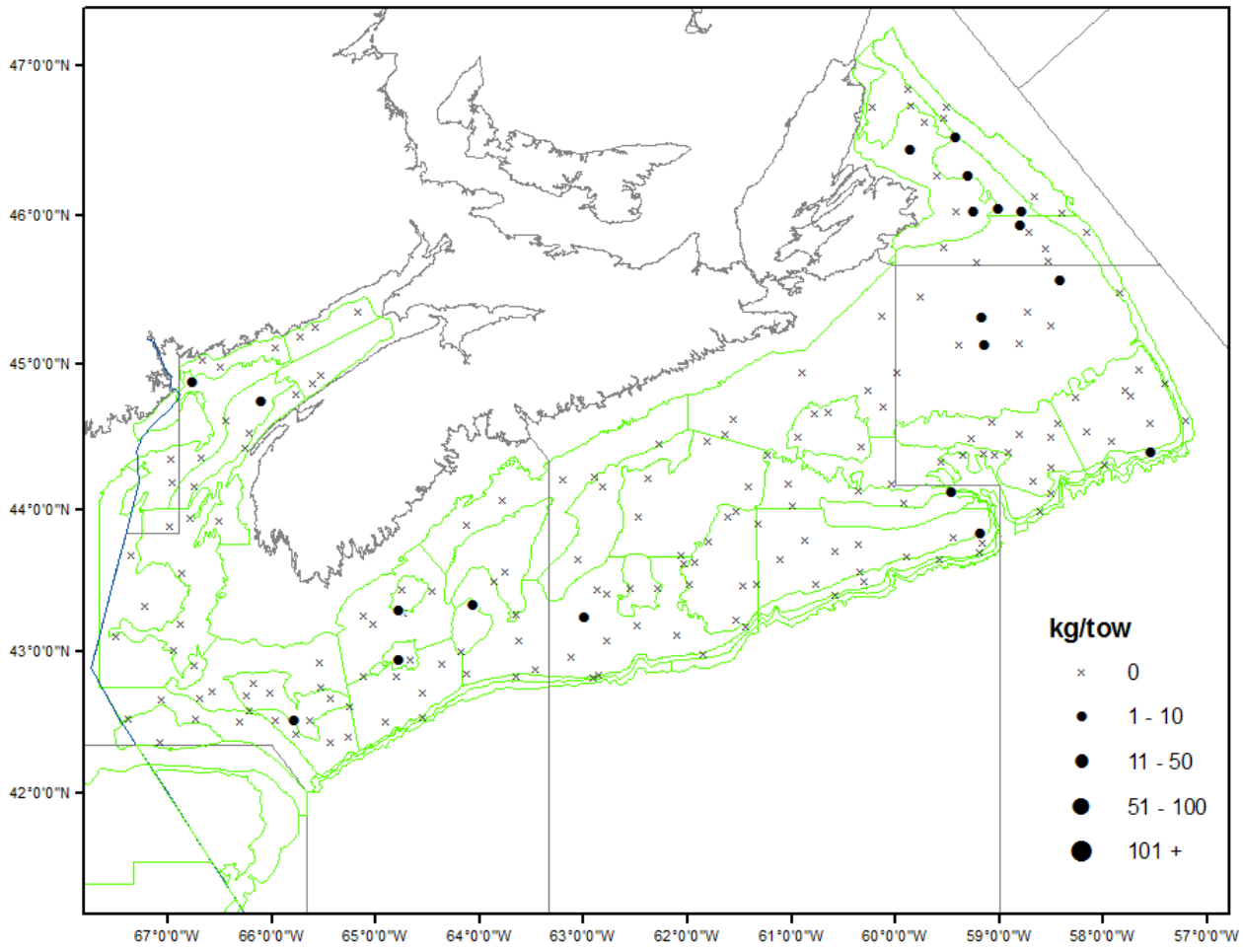

Figure 14a. Distribution of Atlantic Wolffish catches during the 2014 summer RV survey. Zero catch is represented by the x symbol. Black circles represent catches. The circle area is proportional to the catch size in kilograms per tow (kg/tow).

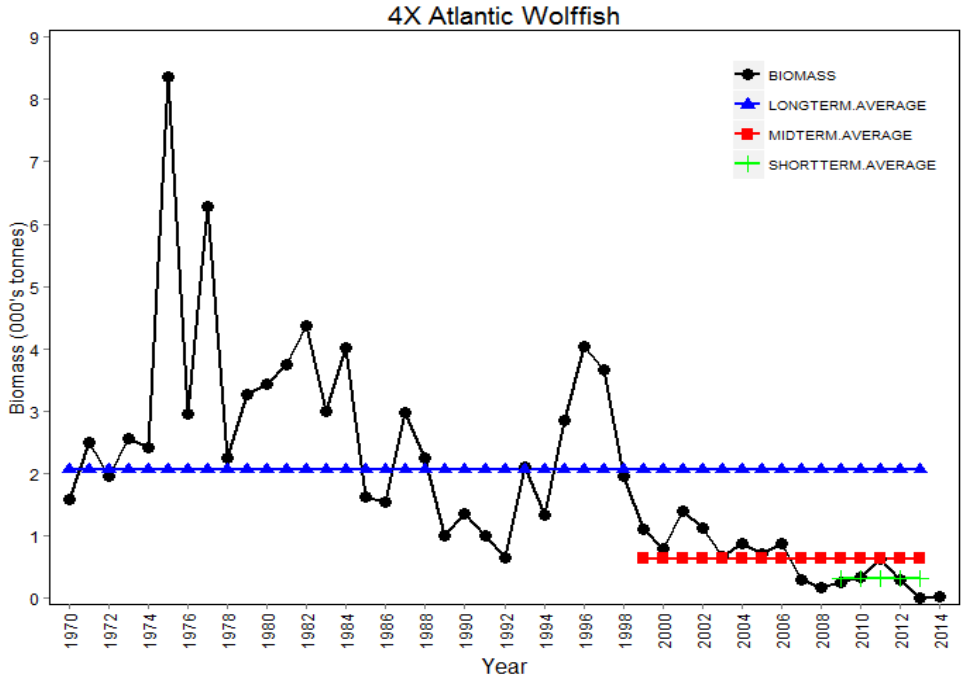

Figure 14b. Biomass index for Atlantic Wolffish in 4X from the summer RV survey represented by the black line with solid circles. The dark blue line with the solid triangles indicates the long-term survey average (1970-2013). The red line with the solid squares represents the medium-term 15 year average (1999-2013). The green line with the crosses represents the short-term 5 year average (2009-2013).

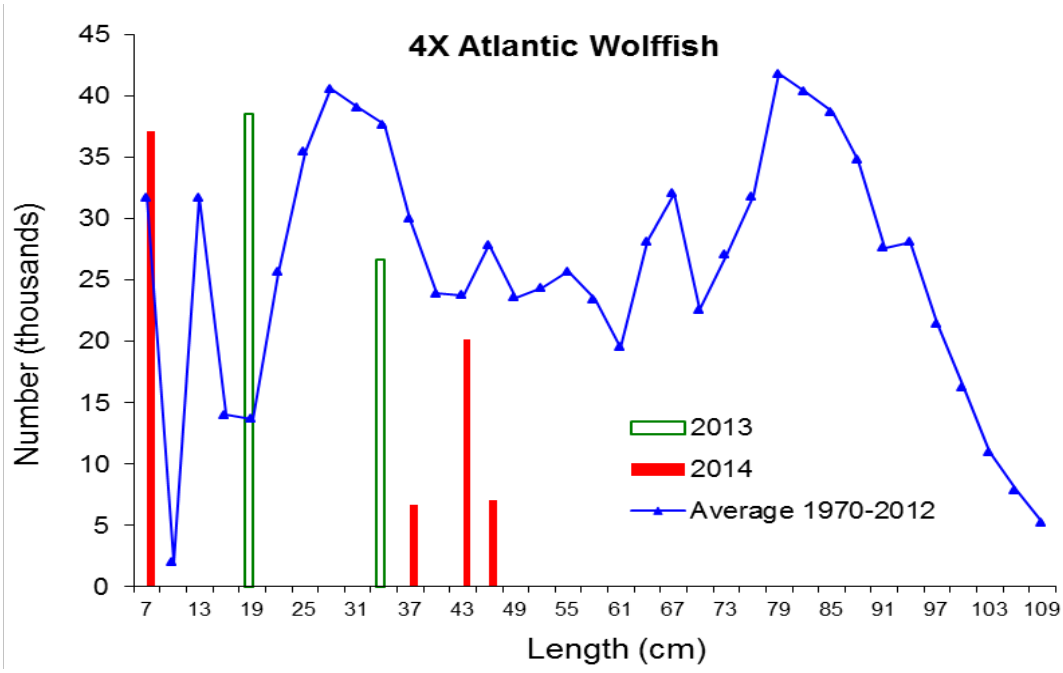

Figure 14c. Length frequency indices for Atlantic Wolffish in 4X from the summer RV survey. The solid red bars represent the number in thousands at length from the 2014 survey. The open green bars represent the number in thousands at length from the 2013 survey. The solid blue line with triangles represents the average number in thousands at length for the time period 1970-2012.

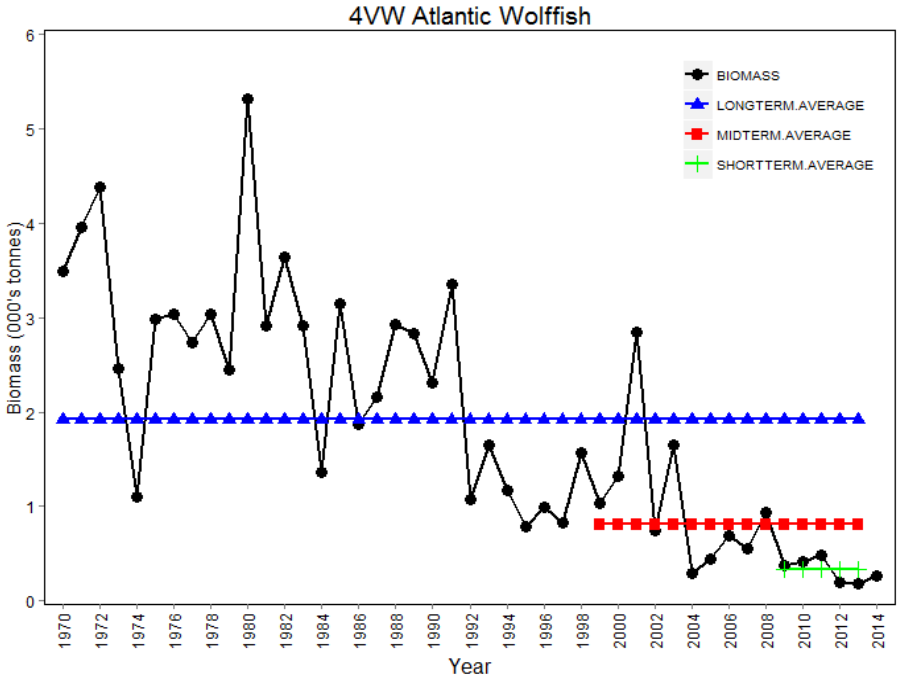

Figure 14d. Biomass index for Atlantic Wolffish in 4VW from the summer RV survey represented by the black line with solid circles. The dark blue line with the solid triangles indicates the long-term survey average (1970-2013). The red line with the solid squares represents the medium-term 15 year average (1999-2013). The green line with the crosses represents the short-term 5 year average (2009-2013).

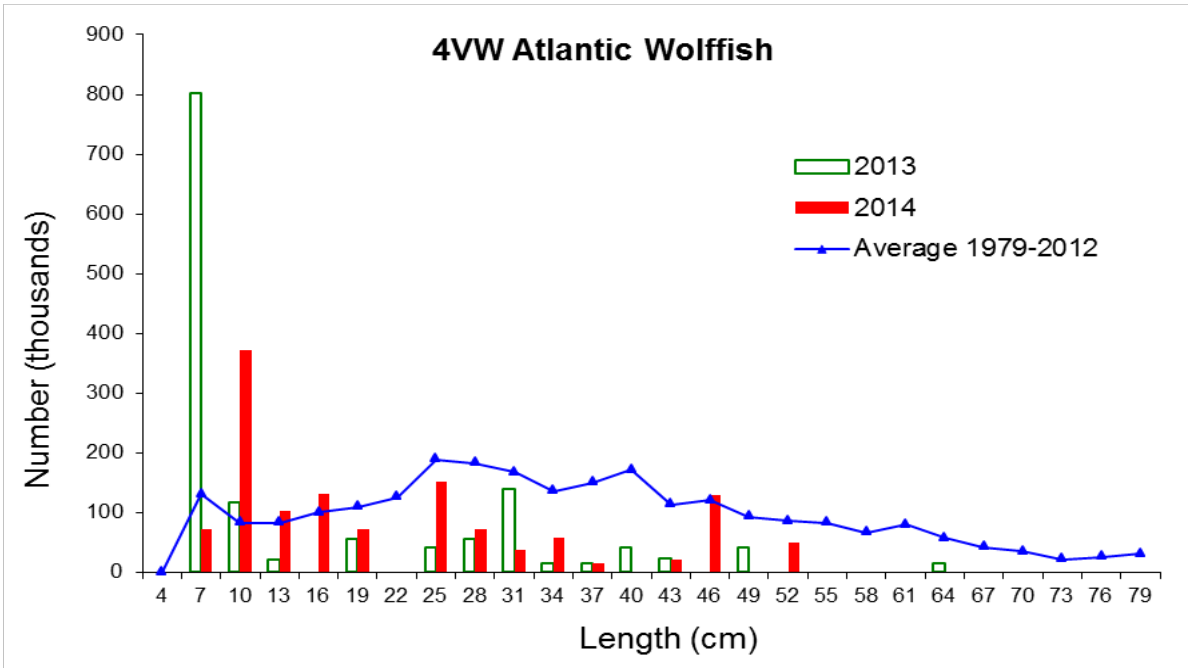

Figure 14e. Length frequency indices for Atlantic Wolffish in 4VW from the summer RV survey. The solid red bars represent the number in thousands at length from the 2014 survey. The open green bars represent the number in thousands at length from the 2013 survey. The solid blue line with triangles represents the average number in thousands at length for the time period 1970-2012.

Monkfish

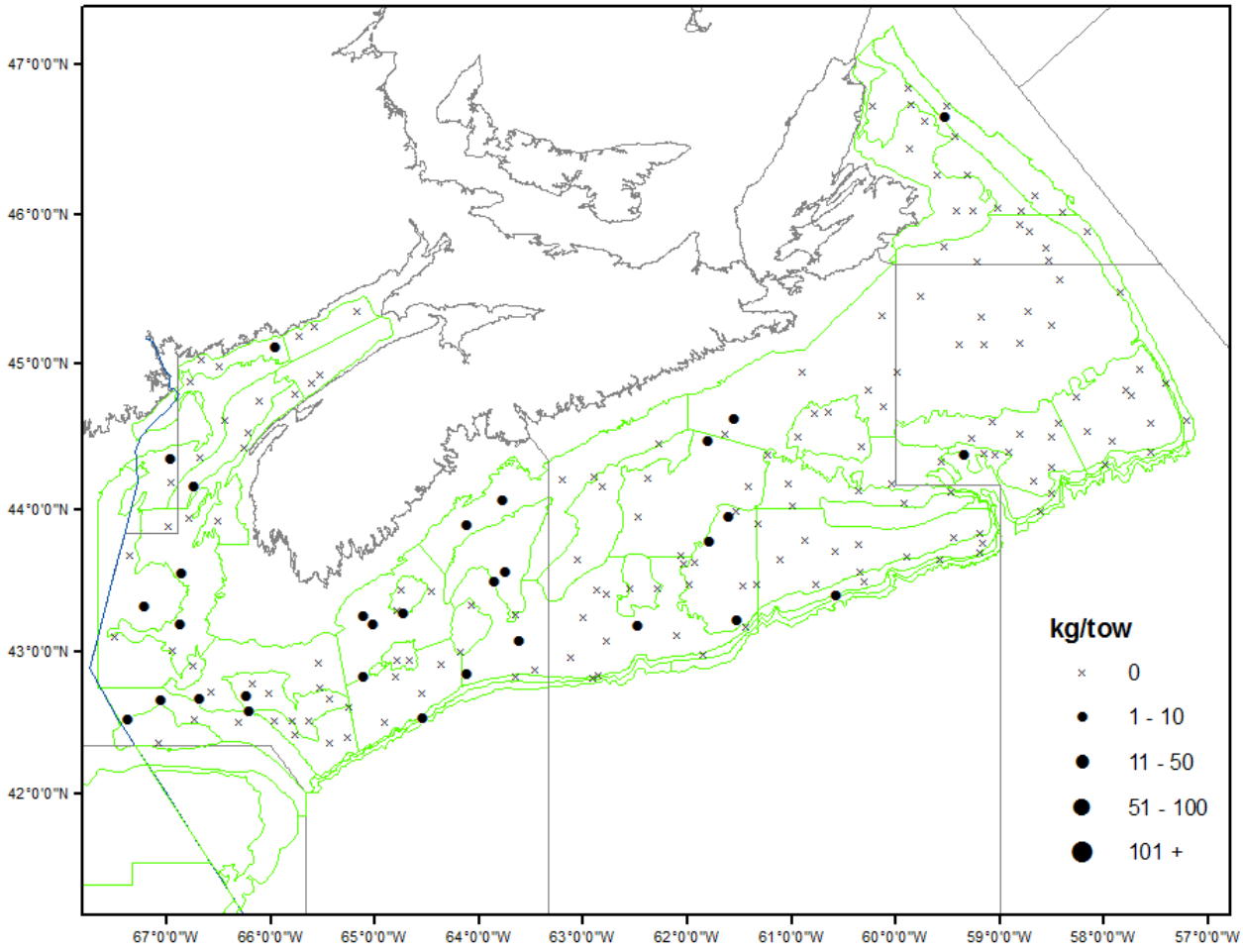

Figure 15a. Distribution of Monkfish catches during the 2014 summer RV survey. Zero catch is represented by the x symbol. Black circles represent catches. The circle area is proportional to the catch size in kilograms per tow (kg/tow).

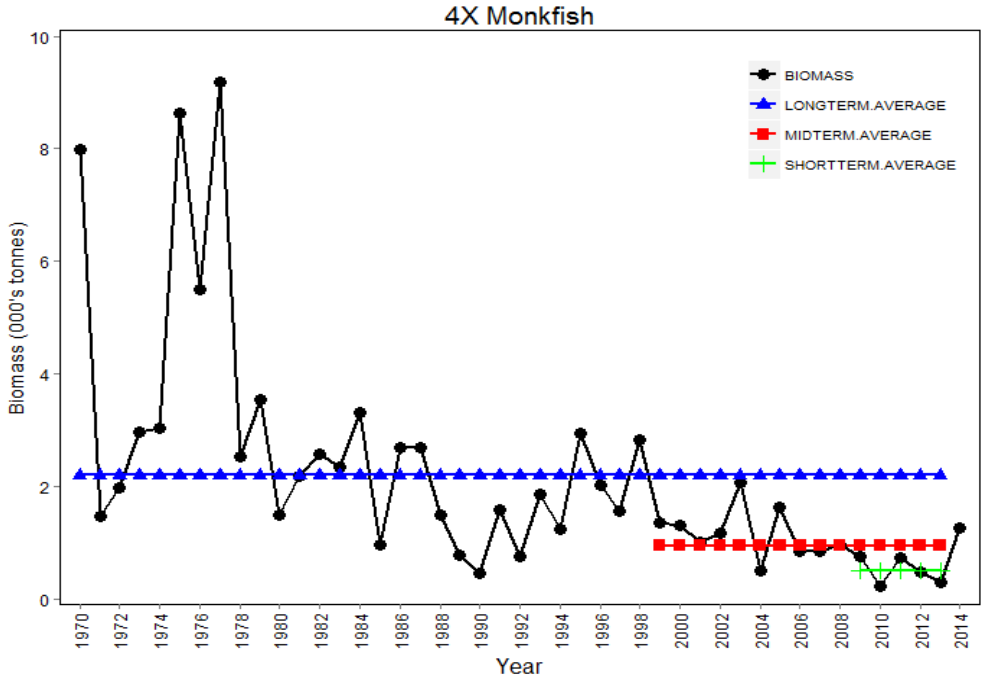

Figure 15b. Biomass index for Monkfish in 4X from the summer RV survey represented by the black line with solid circles. The dark blue line with the solid triangles indicates the long-term survey average (1970-2013). The red line with the solid squares represents the medium-term 15 year average (1999-2013). The green line with the crosses represents the short-term 5 year average (2009-2013).

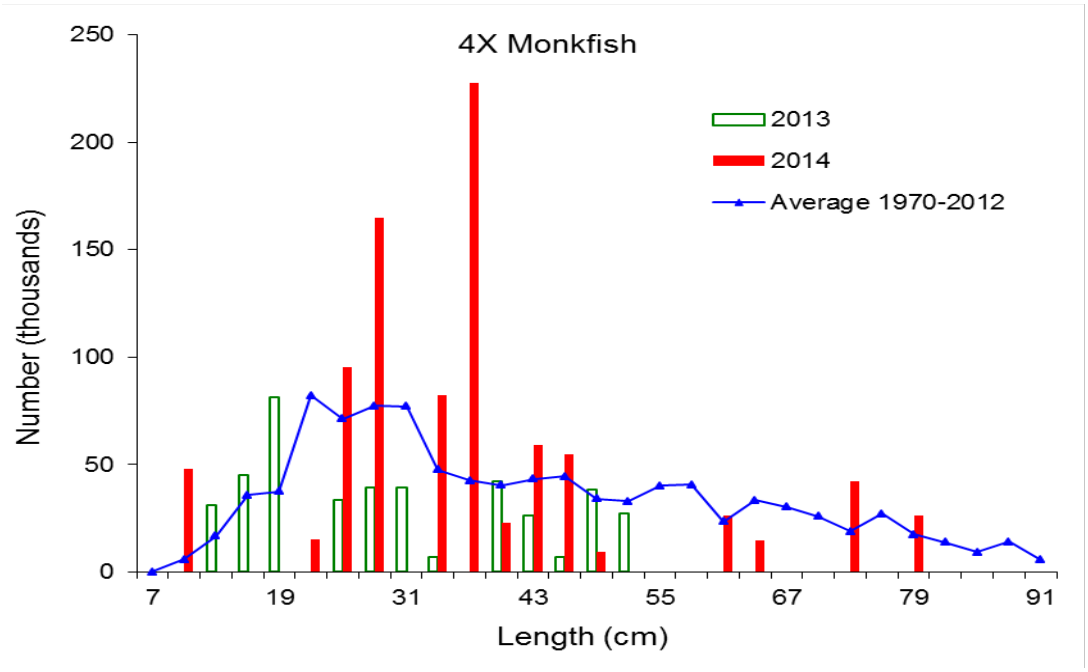

Figure 15c. Length frequency indices for Monkfish in 4X from the summer RV survey. The solid red bars represent the number in thousands at length from the 2014 survey. The open green bars represent the number in thousands at length from the 2013 survey. The solid blue line with triangles represents the average number in thousands at length for the time period 1970-2012.

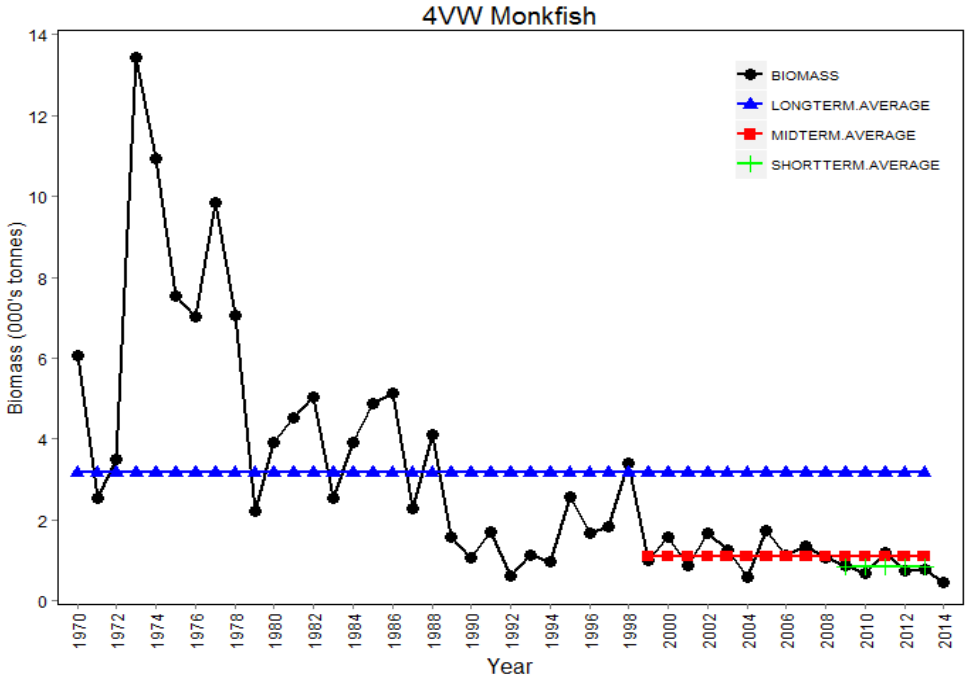

Figure 15d. Biomass index for Monkfish in 4VW from the summer RV survey represented by the black line with solid circles. The dark blue line with the solid triangles indicates the long-term survey average (1970-2013). The red line with the solid squares represents the medium-term 15 year average (1999-2013). The green line with the crosses represents the short-term 5 year average (2009-2013).

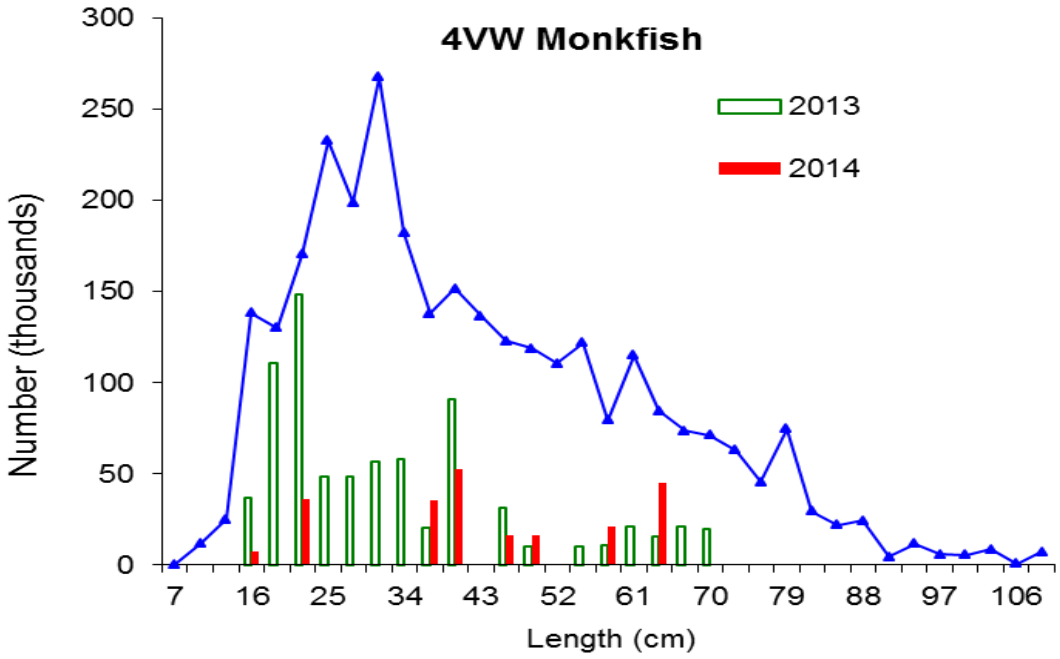

Figure 15e. Length frequency indices for Monkfish in 4VW from the summer RV survey. The solid red bars represent the number in thousands at length from the 2014 survey. The open green bars represent the number in thousands at length from the 2013 survey. The solid blue line with triangles represents the average number in thousands at length for the time period 1970-2012.

Longhorn Sculpin

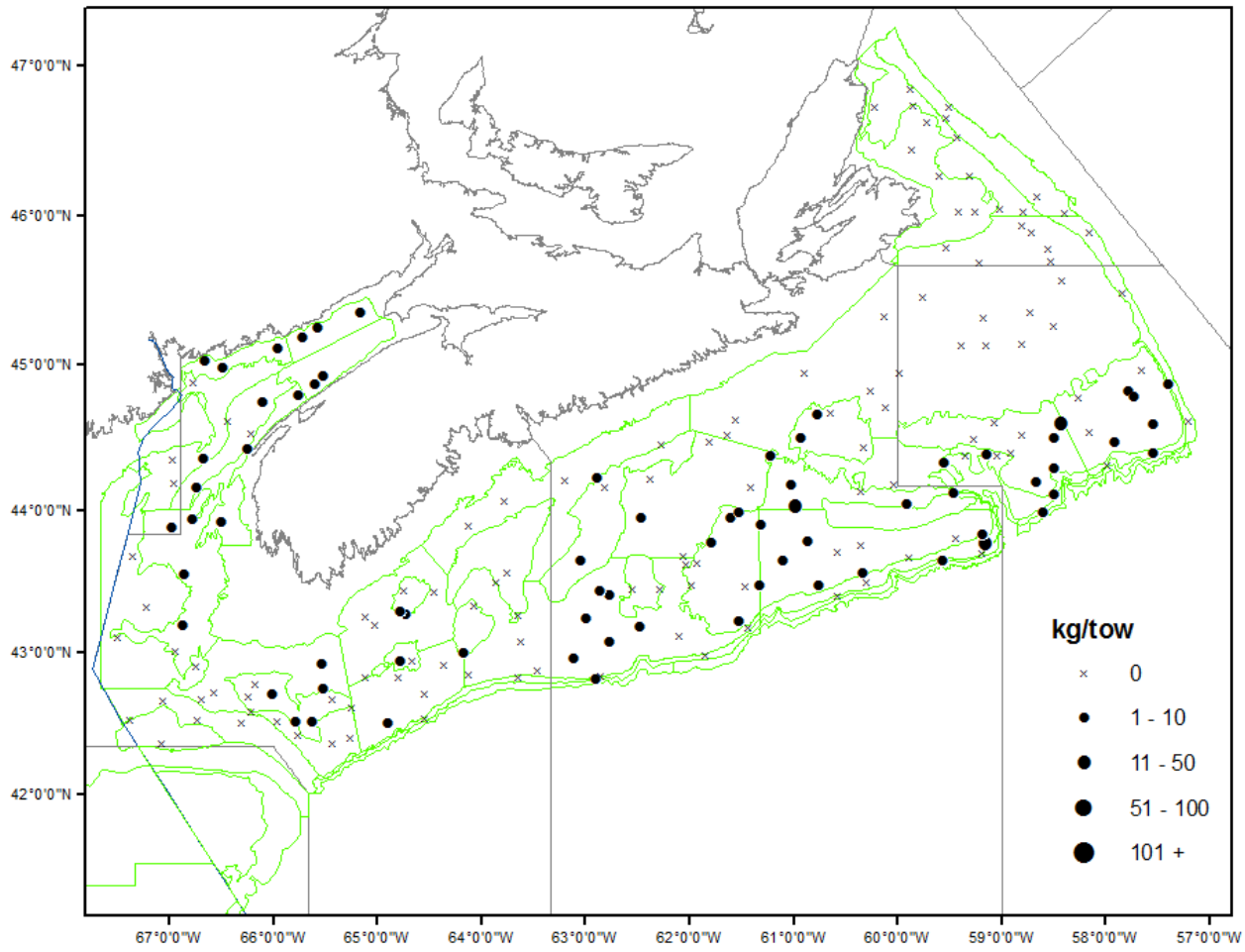

Figure 16a. Distribution of Longhorn Sculpin catches during the 2014 summer RV survey. Zero catch is represented by the x symbol. Black circles represent catches. The circle area is proportional to the catch size in kilograms per tow (kg/tow).

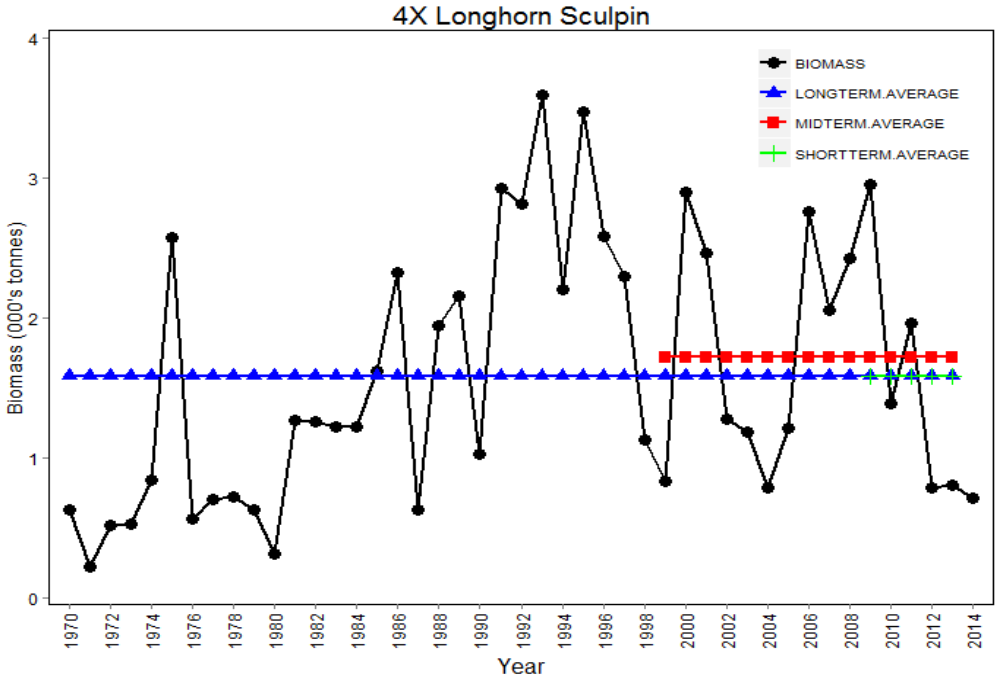

Figure 16b. Biomass index for Longhorn Sculpin in 4X from the summer RV survey represented by the black line with solid circles. The dark blue line with the solid triangles indicates the long-term survey average (1970-2013). The red line with the solid squares represents the medium-term 15 year average (1999-2013). The green line with the crosses represents the short-term 5 year average (2009-2013).

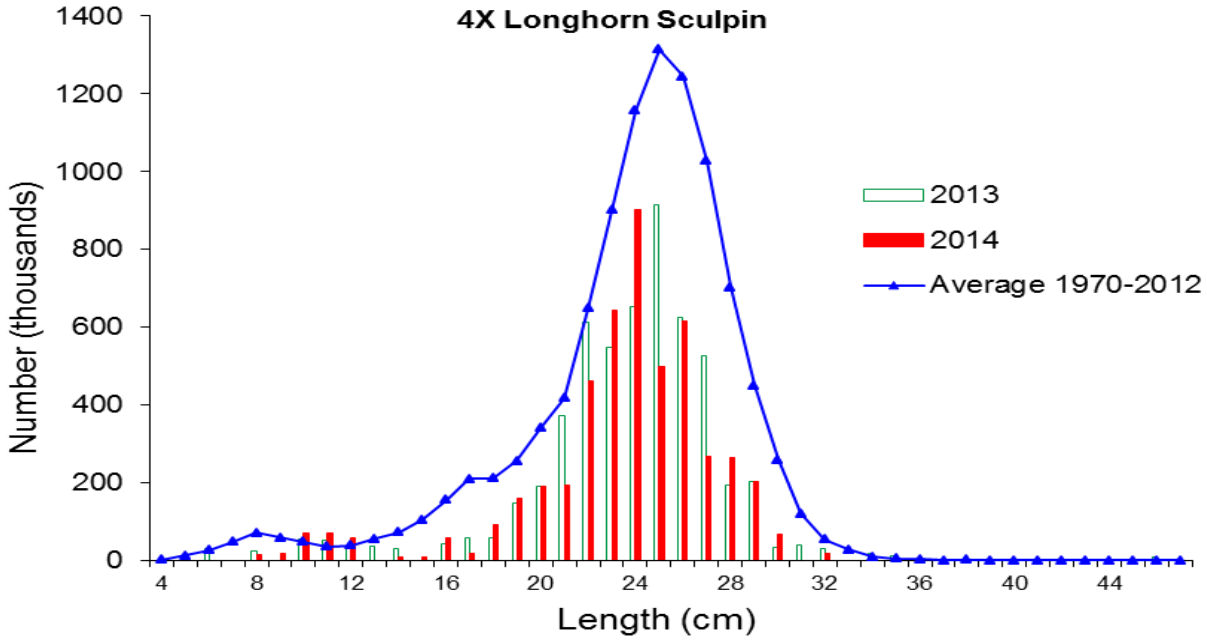

Figure 16c. Length frequency indices for Longhorn Sculpin in 4X from the summer RV survey. The solid red bars represent the number in thousands at length from the 2014 survey. The open green bars represent the number in thousands at length from the 2013 survey. The solid blue line with triangles represents the average number in thousands at length for the time period 1970-2012.

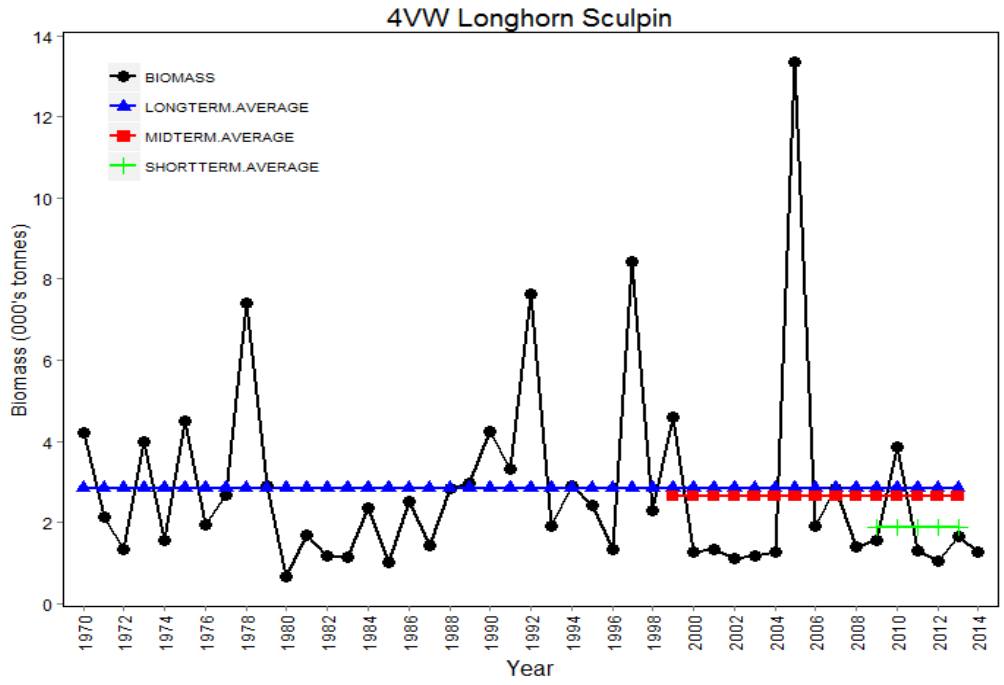

Figure 16d. Biomass index for Longhorn Sculpin in 4VW from the summer RV survey represented by the black line with solid circles. The dark blue line with the solid triangles indicates the long-term survey average (1970-2013). The red line with the solid squares represents the medium-term 15 year average (1999-2013). The green line with the crosses represents the short-term 5 year average (2009-2013).

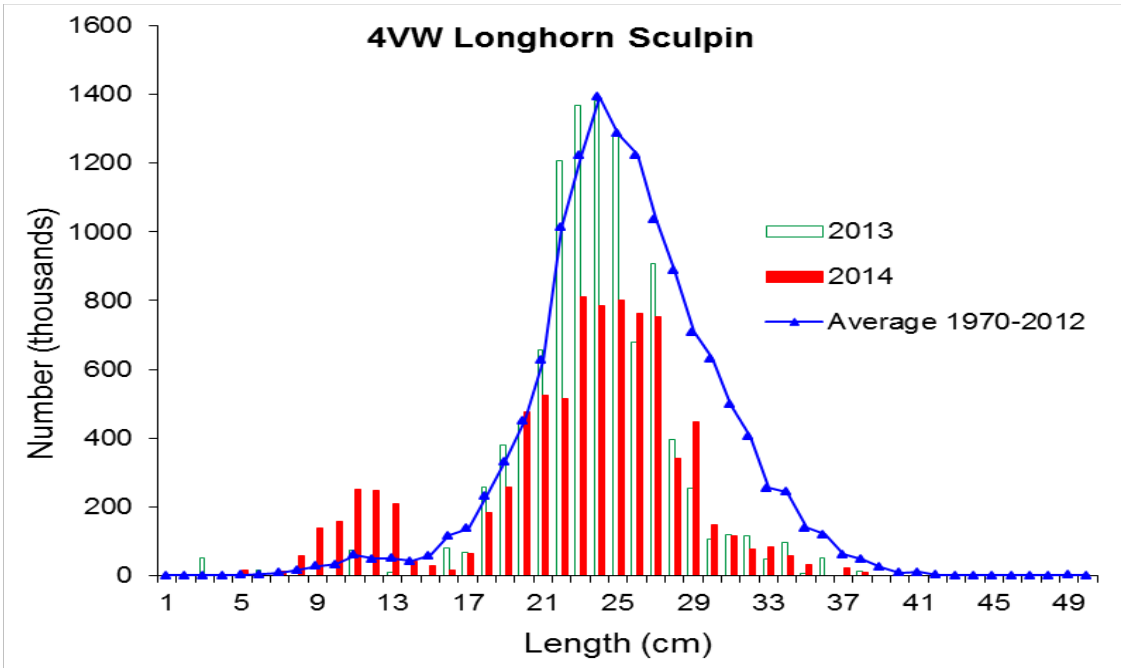

Figure 16e. Length frequency indices for Longhorn Sculpin in 4VW from the summer RV survey. The solid red bars represent the number in thousands at length from the 2014 survey. The open green bars represent the number in thousands at length from the 2013 survey. The solid blue line with triangles represents the average number in thousands at length for the time period 1970-2012.

Barndoor Skate

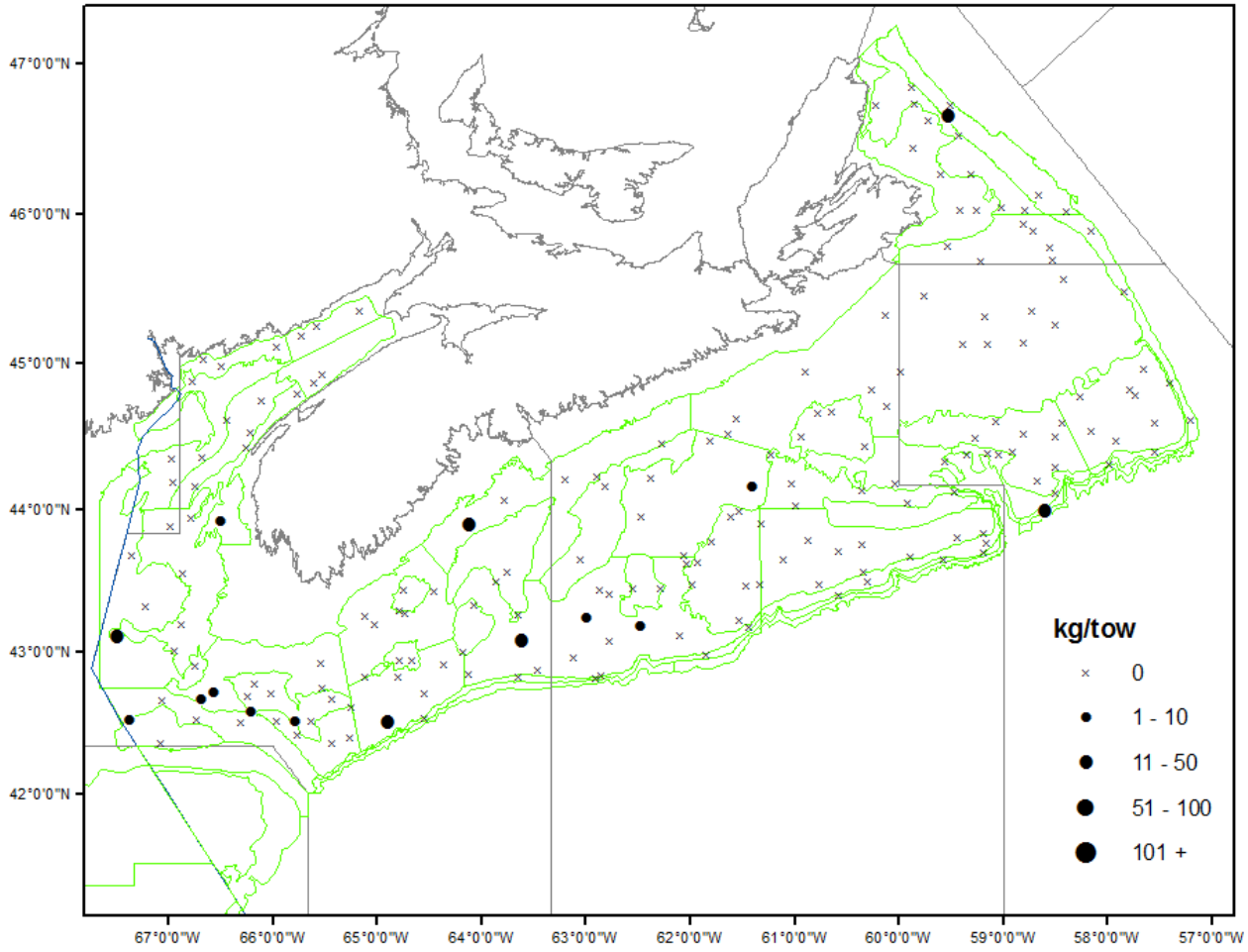

Figure 17a. Distribution of Barndoor Skate catches during the 2014 summer RV survey. Zero catch is represented by the x symbol. Black circles represent catches. The circle area is proportional to the catch size in kilograms per tow (kg/tow).

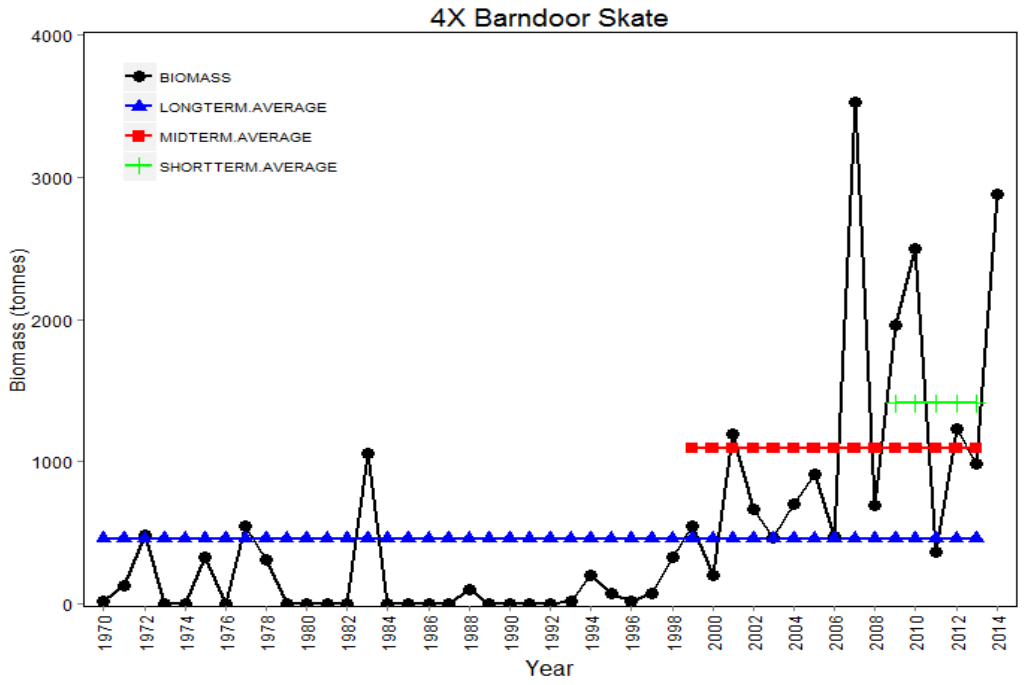

Figure 17b. Biomass index for Barndoor Skate in 4X from the summer RV survey represented by the black line with solid circles. The dark blue line with the solid triangles indicates the long-term survey average (1970-2013). The red line with the solid squares represents the medium-term 15 year average (1999-2013). The green line with the crosses represents the short-term 5 year average (2009-2013).

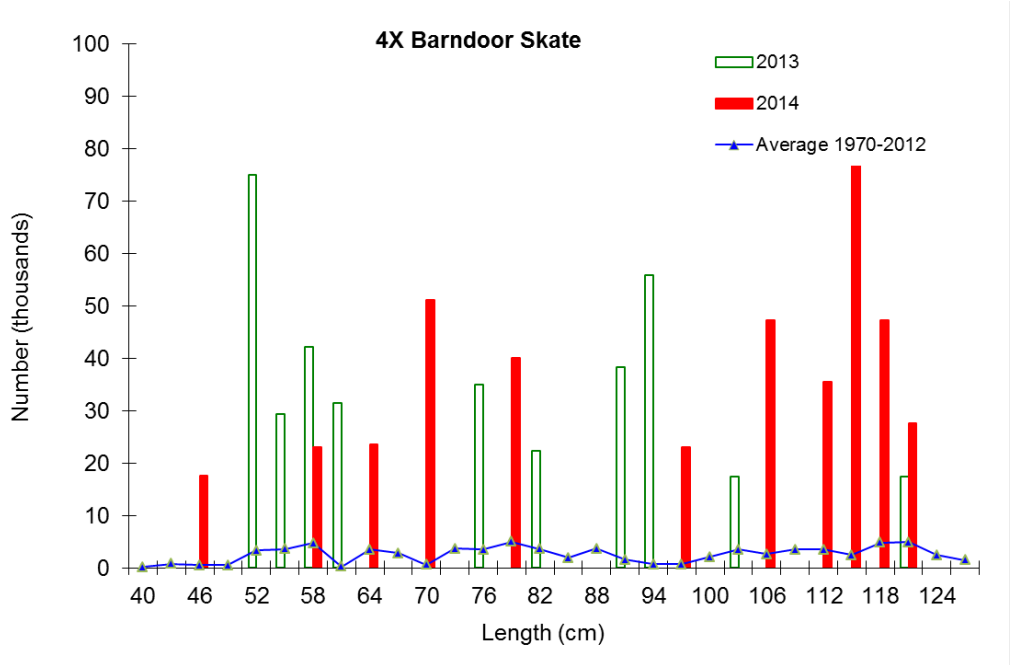

Figure 17c. Length frequency indices for Barndoor Skate in 4X from the summer RV survey. The solid red bars represent the number in thousands at length from the 2014 survey. The open green bars represent the number in thousands at length from the 2013 survey. The solid blue line with triangles represents the average number in thousands at length for the time period 1970-2012.

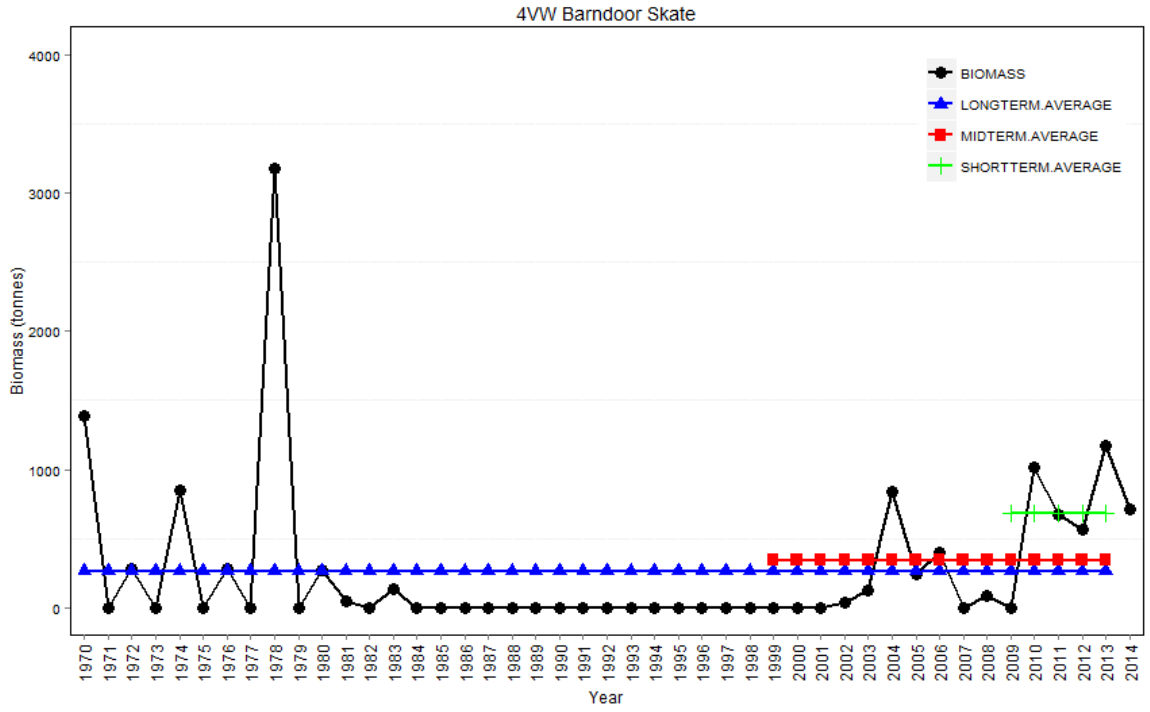

Figure 17d. Biomass index for Barndoor Skate in 4VW from the summer RV survey represented by the black line with solid circles. The dark blue line with the solid triangles indicates the long-term survey average (1970-2013). The red line with the solid squares represents the medium-term 15 year average (1999-2013). The green line with the crosses represents the short-term 5 year average (2009-2013).

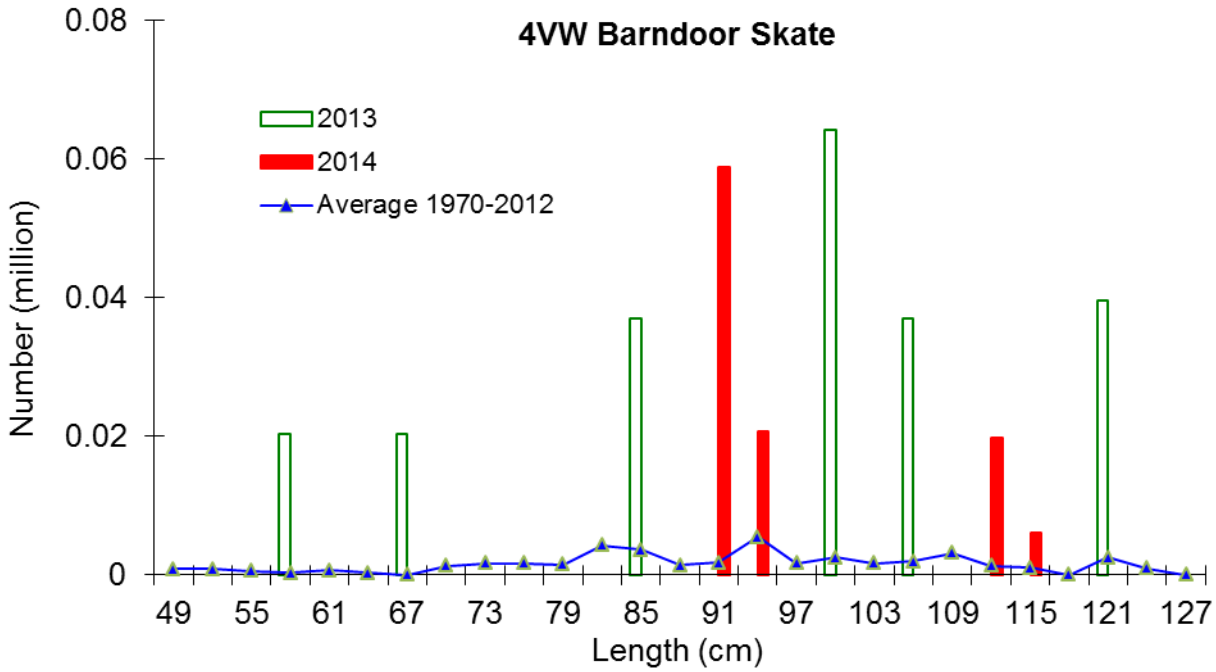

Figure 17e. Length frequency indices for Barndoor Skate in 4VW from the summer RV survey. The solid red bars represent the number in millions at length from the 2014 survey. The open green bars represent the number in millions at length from the 2013 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2012.

Thorny Skate

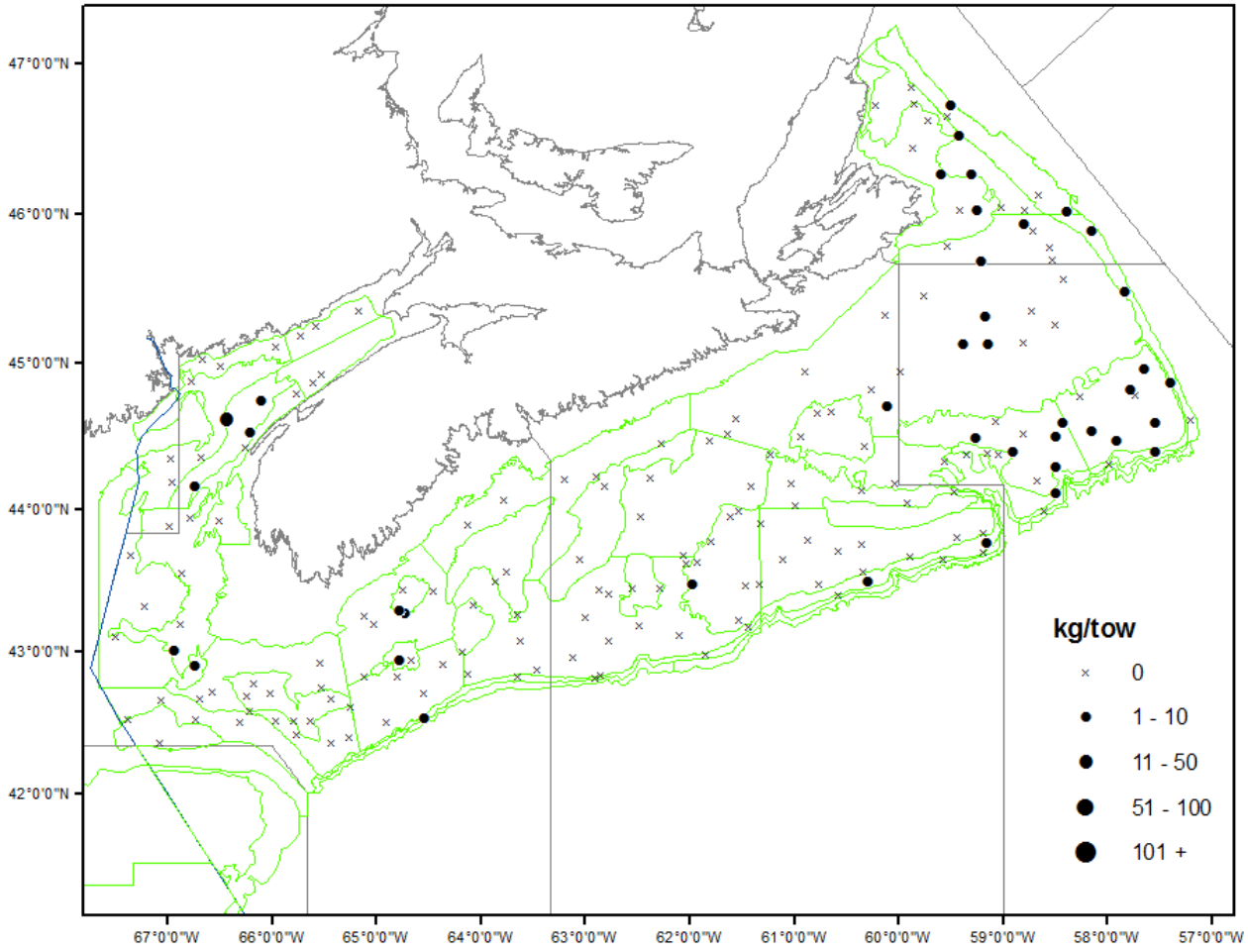

Figure 18a. Distribution of Thorny Skate catches during the 2014 summer RV survey. Zero catch is represented by the x symbol. Black circles represent catches. The circle area is proportional to the catch size in kilograms per tow (kg/tow).

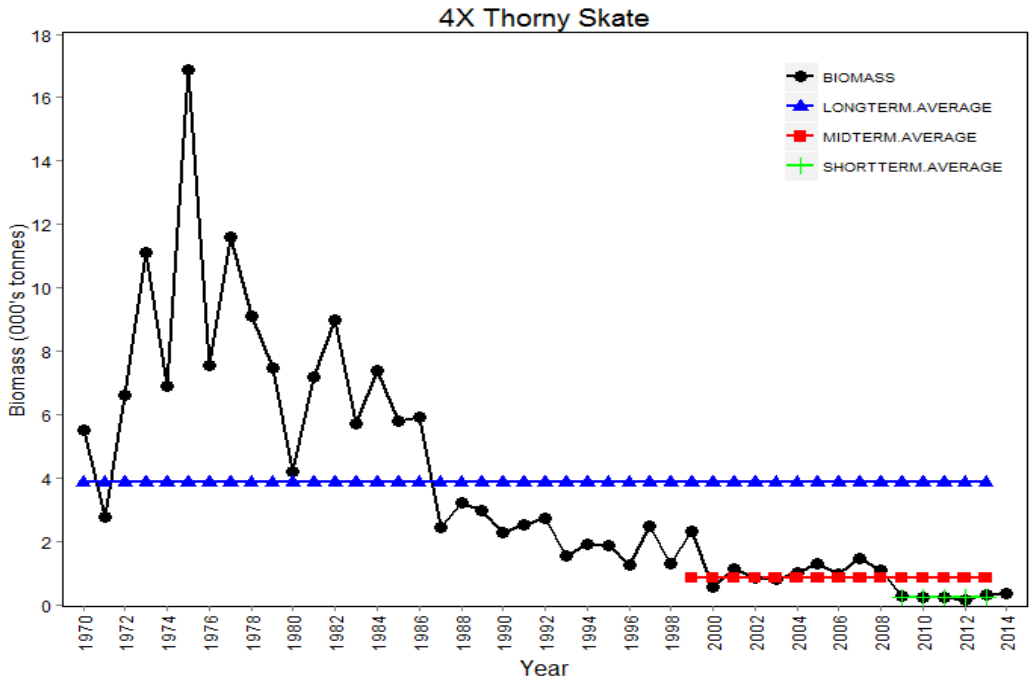

Figure 18b. Biomass index for Thorny Skate in 4X from the summer RV survey represented by the black line with solid circles. The dark blue line with the solid triangles indicates the long-term survey average (1970-2013). The red line with the solid squares represents the medium-term 15 year average (1999-2013). The green line with the crosses represents the short-term 5 year average (2009-2013).

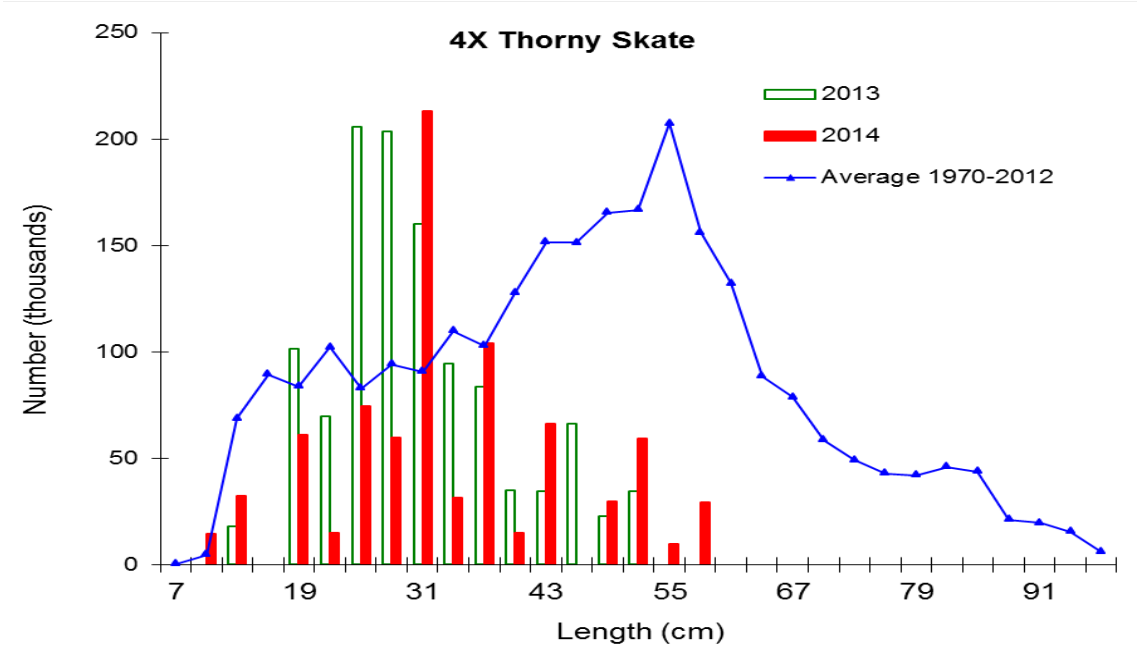

Figure 18c. Length frequency indices for Thorny Skate in 4X from the summer RV survey. The solid red bars represent the number in thousands at length from the 2014 survey. The open green bars represent the number in thousands at length from the 2013 survey. The solid blue line with triangles represents the average number in thousands at length for the time period 1970-2012.

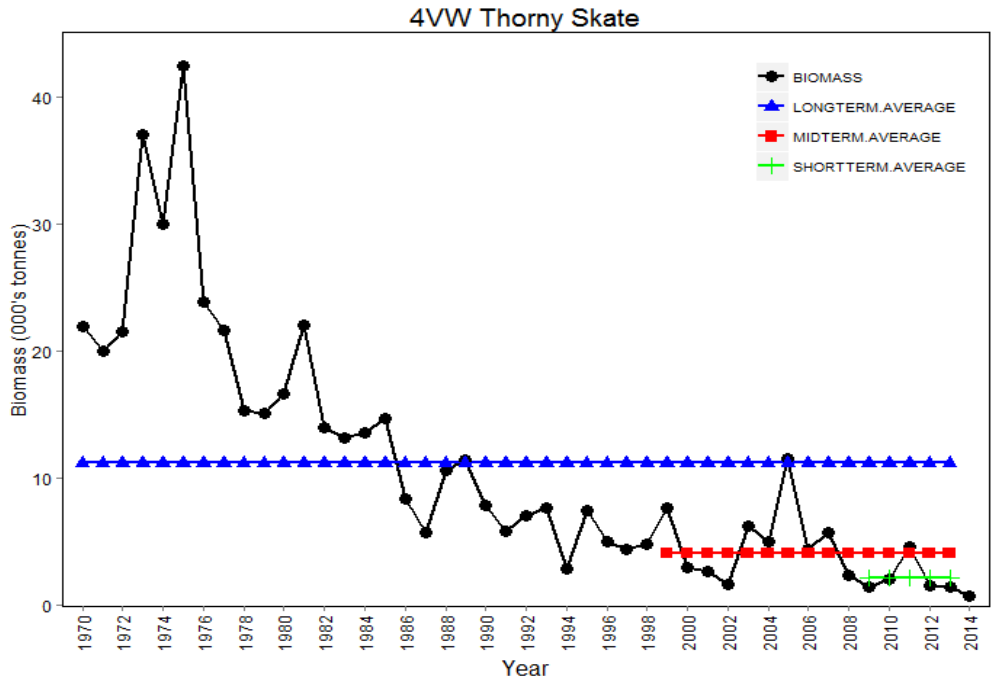

Figure 18d. Biomass index for Thorny Skate in 4VW from the summer RV survey represented by the black line with solid circles. The dark blue line with the solid triangles indicates the long-term survey average (1970-2013). The red line with the solid squares represents the medium-term 15 year average (1999-2013). The green line with the crosses represents the short-term 5 year average (2009-2013).

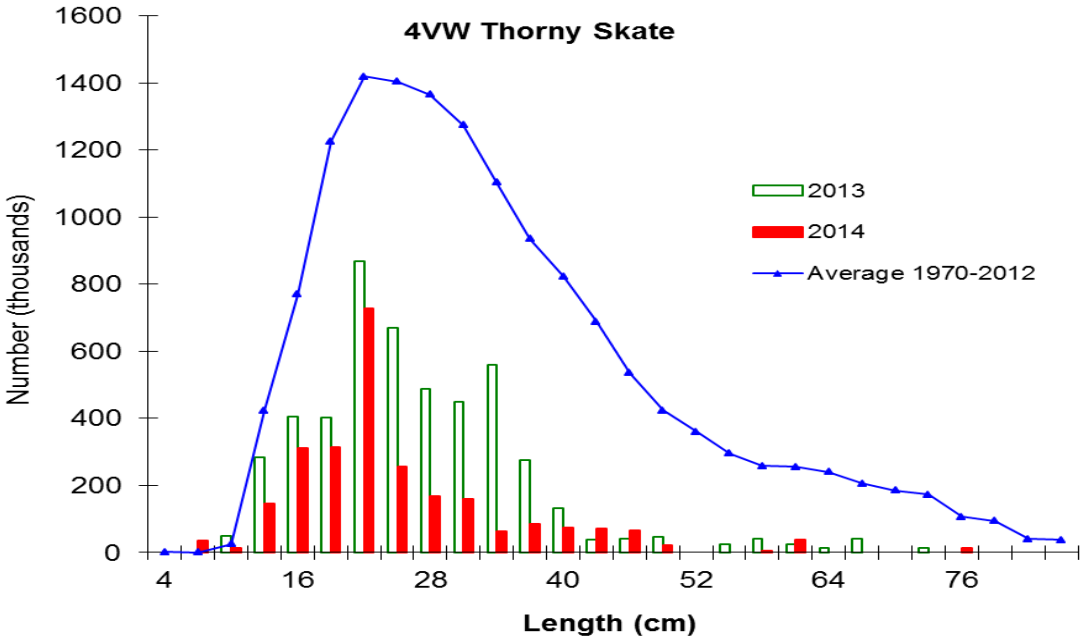

Figure 18e. Length frequency indices for Thorny Skate in 4VW from the summer RV survey. The solid red bars represent the number in thousands at length from the 2014 survey. The open green bars represent the number in thousands at length from the 2013 survey. The solid blue line with triangles represents the average number in thousands at length for the time period 1970-2012.

Winter Skate

Winter Skate and **Little Skate** cannot be reliably distinguished at lengths less than about 40cm. Given that the majority of the Winter and Little skates captured in the surveys are in this length range, the biomass trends are influenced by the contribution of fish for which identification is uncertain (for more information see McEachran and Musick 1973).

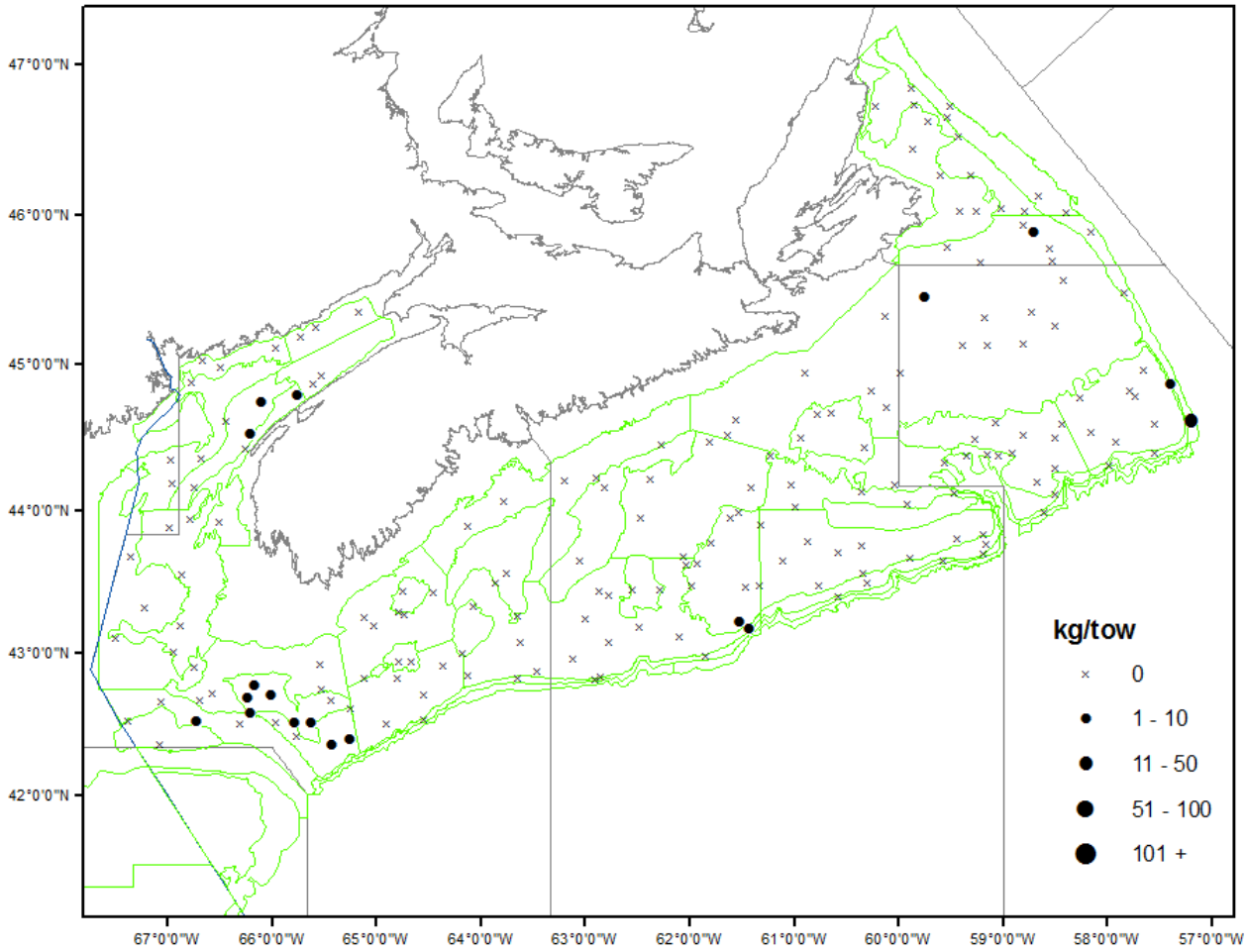

Figure 19a. Distribution of Winter Skate catches during the 2014 summer RV survey. Zero catch is represented by the x symbol. Black circles represent catches. The circle area is proportional to the catch size in kilograms per tow (kg/tow).

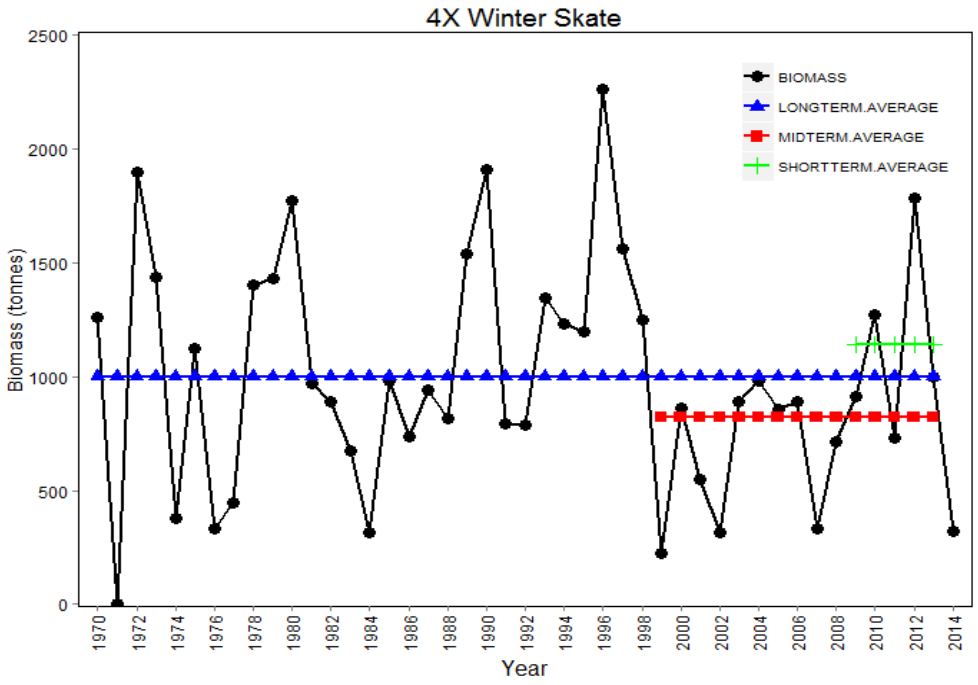

Figure 19b. Biomass index for Winter Skate in 4X from the summer RV survey represented by the black line with solid circles. The dark blue line with the solid triangles indicates the long-term survey average (1970-2013). The red line with the solid squares represents the medium-term 15 year average (1999-2013). The green line with the crosses represents the short-term 5 year average (2009-2013).

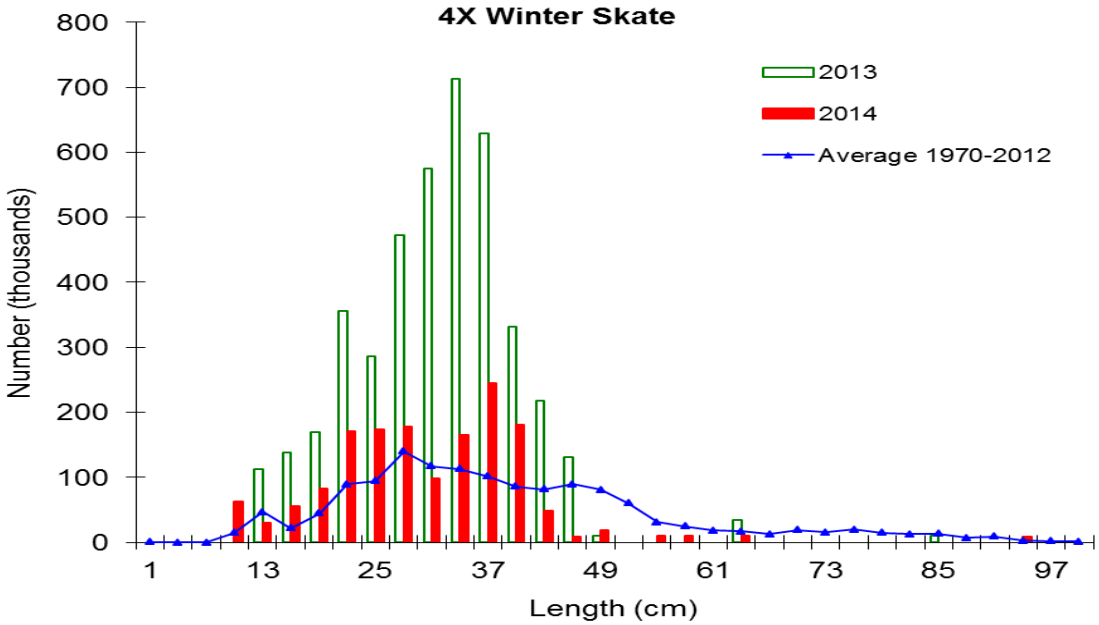

Figure 19c. Length frequency indices for Winter Skate in 4X from the summer RV survey. The solid red bars represent the number in thousands at length from the 2014 survey. The open green bars represent the number in thousands at length from the 2013 survey. The solid blue line with triangles represents the average number in thousands at length for the time period 1970-2012.

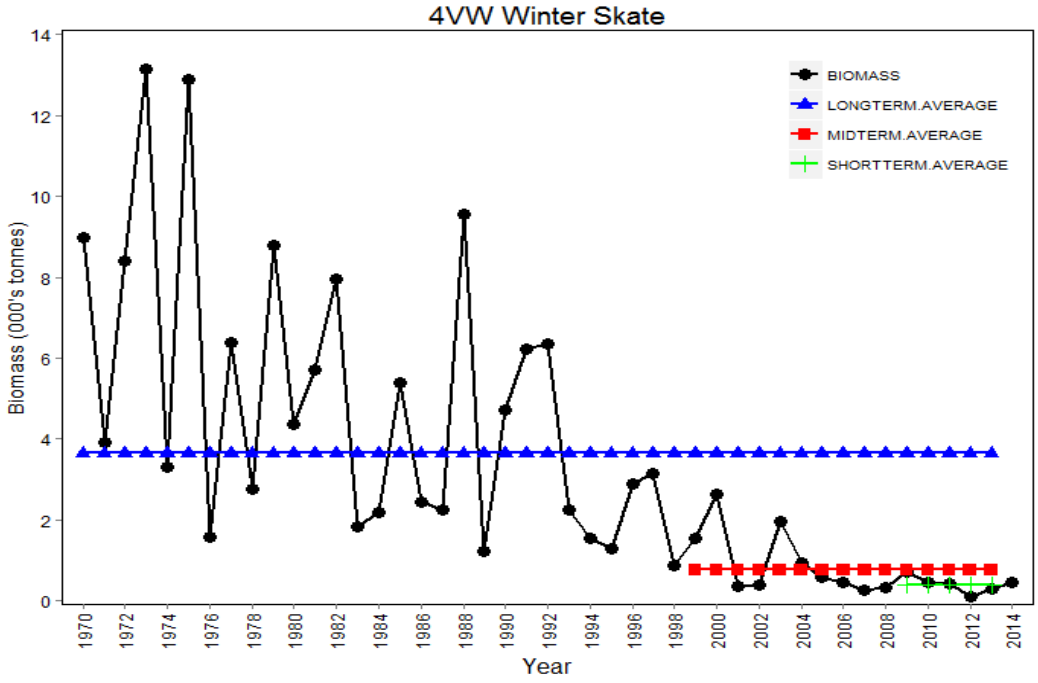

Figure 19d. Biomass index for Winter Skate in 4VW from the summer RV survey represented by the black line with solid circles. The dark blue line with the solid triangles indicates the long-term survey average (1970-2013). The red line with the solid squares represents the medium-term 15 year average (1999-2013). The green line with the crosses represents the short-term 5 year average (2009-2013).s

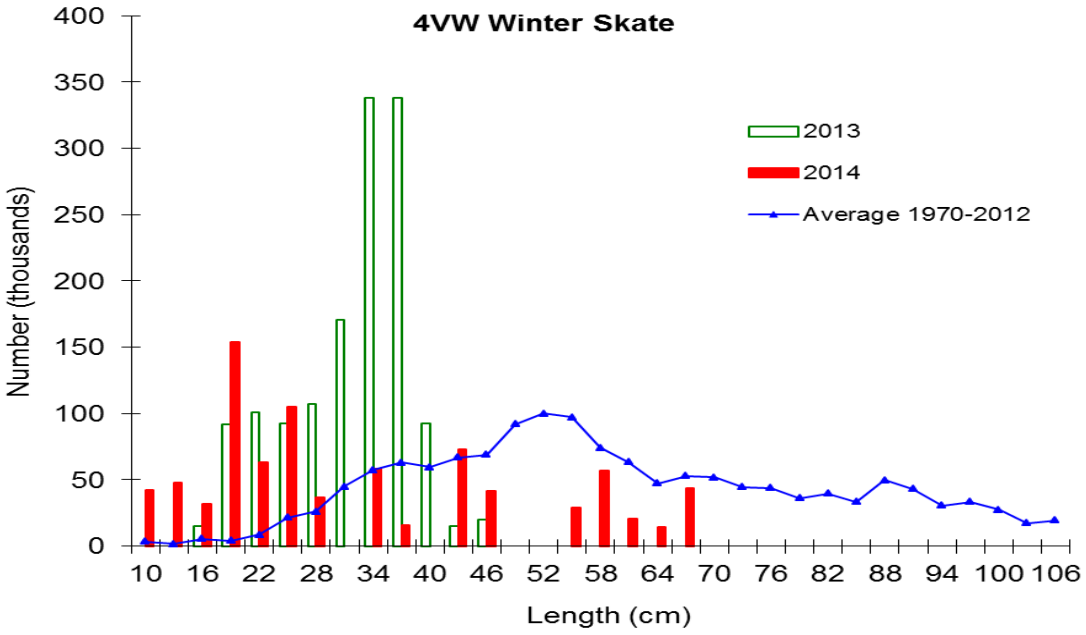

Figure 19e. Length frequency indices for Winter Skate in 4VW from the summer RV survey. The solid red bars represent the number in thousands at length from the 2014 survey. The open green bars represent the number in thousands at length from the 2013 survey. The solid blue line with triangles represents the average number in thousands at length for the time period 1970-2012.

Little Skate

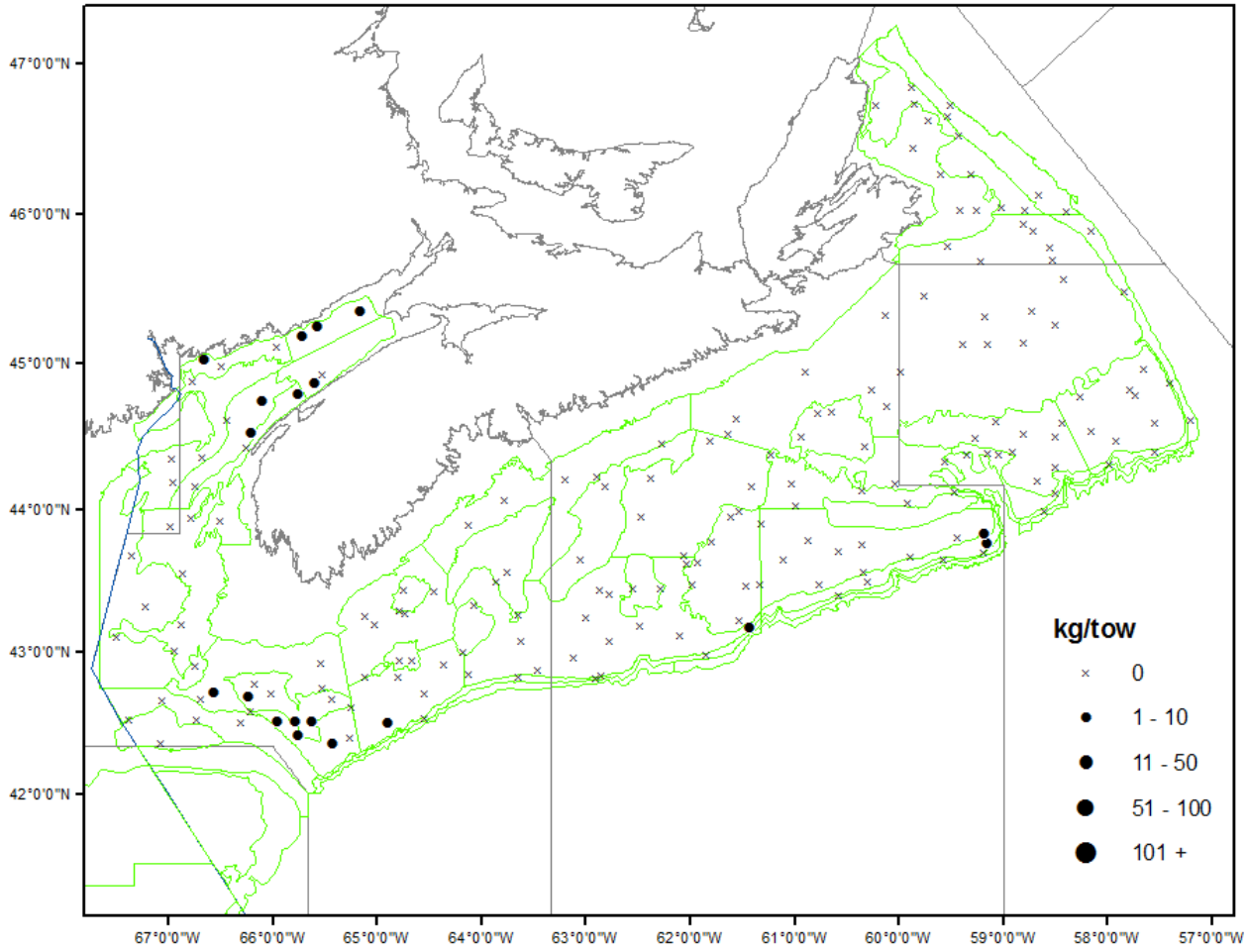

Figure 20a. Distribution of Little Skate catches during the 2014 summer RV survey. Zero catch is represented by the x symbol. Black circles represent catches. The circle area is proportional to the catch size in kilograms per tow (kg/tow).

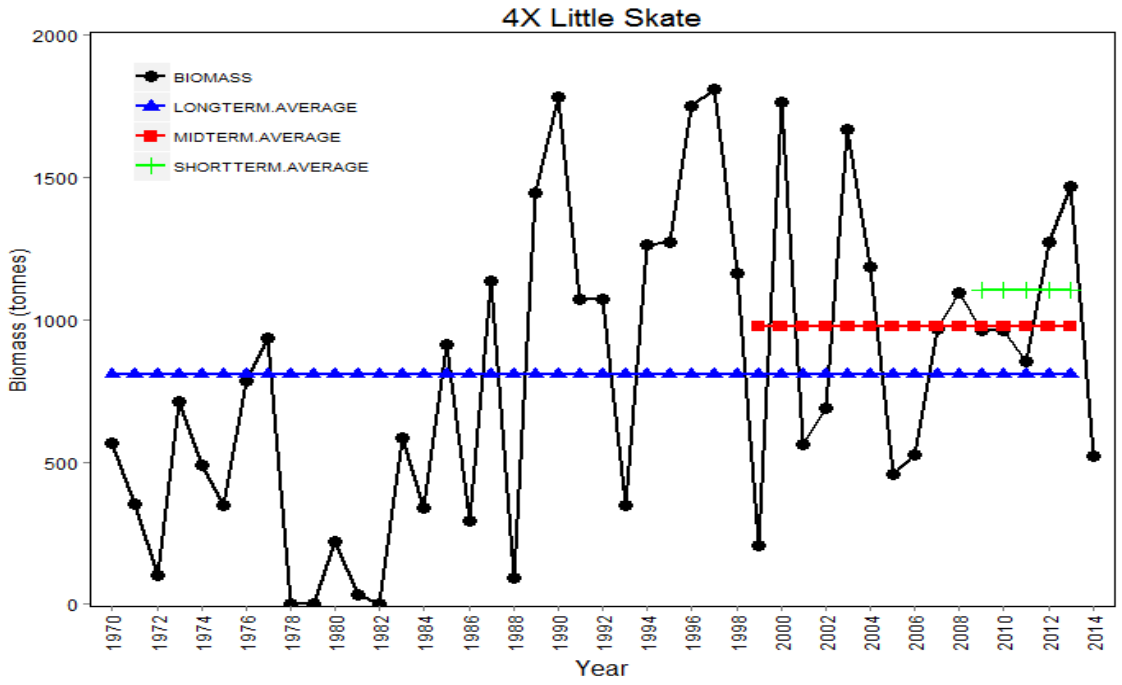

Figure 20b. Biomass index for Little Skate in 4X from the summer RV survey represented by the black line with solid circles. The dark blue line with the solid triangles indicates the long-term survey average (1970-2013). The red line with the solid squares represents the medium-term 15 year average (1999-2013). The green line with the crosses represents the short-term 5 year average (2009-2013).

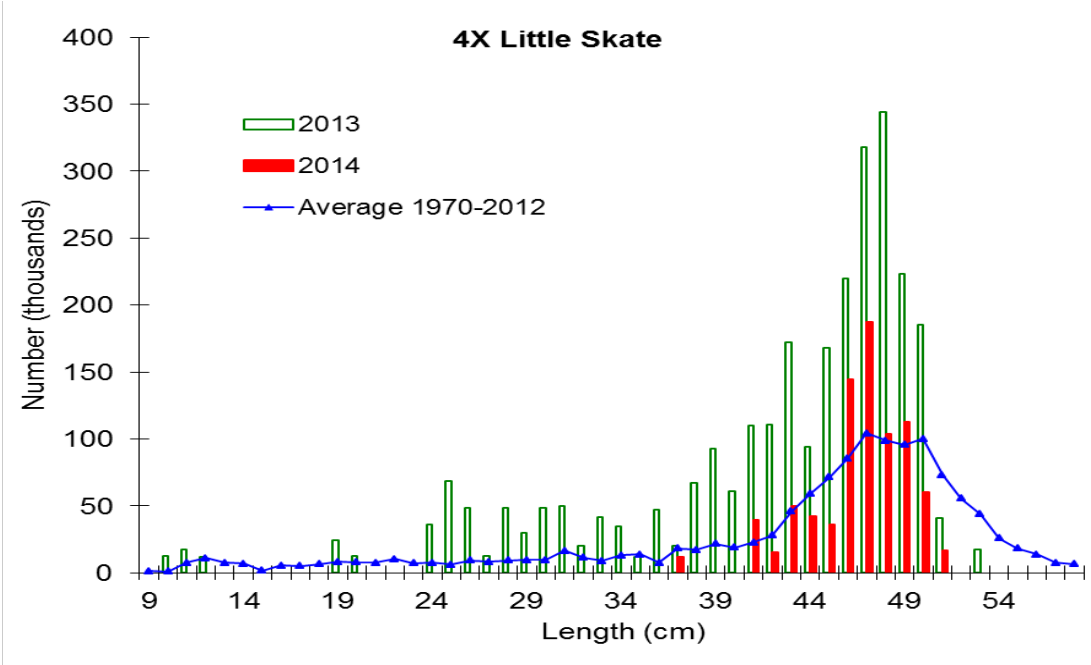

Figure 20c. Length frequency indices for Little Skate in 4X from the summer RV survey. The solid red bars represent the number in thousands at length from the 2014 survey. The open green bars represent the number in thousands at length from the 2013 survey. The solid blue line with triangles represents the average number in thousands at length for the time period 1970-2012.

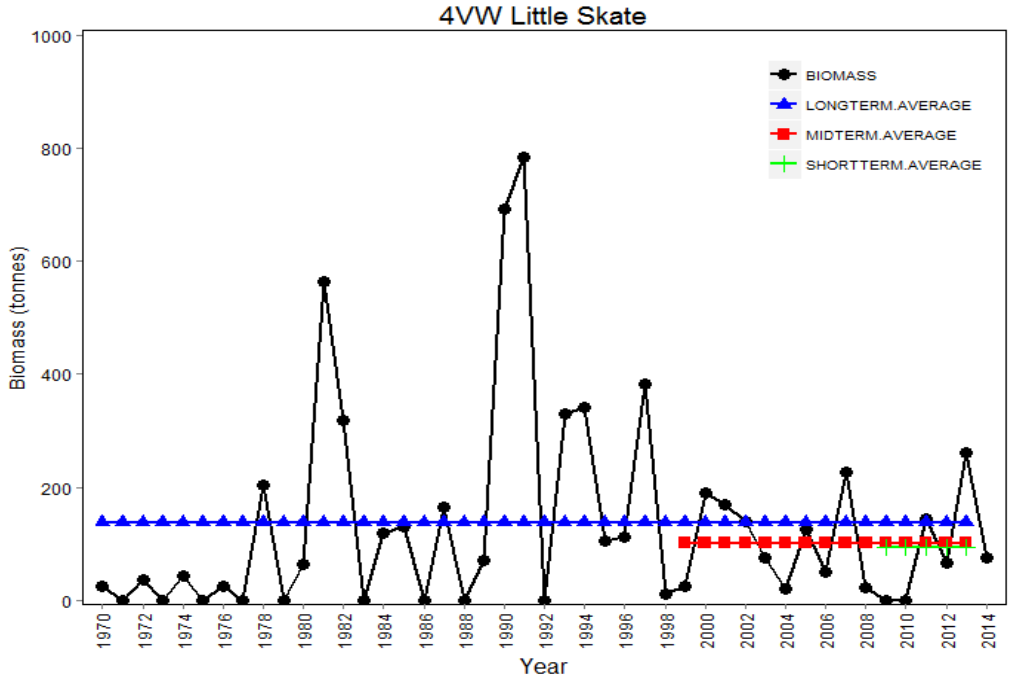

Figure 20d. Biomass index for Little Skate in 4VW from the summer RV survey represented by the black line with solid circles. The dark blue line with the solid triangles indicates the long-term survey average (1970-2013). The red line with the solid squares represents the medium-term 15 year average (1999-2013). The green line with the crosses represents the short-term 5 year average (2009-2013).

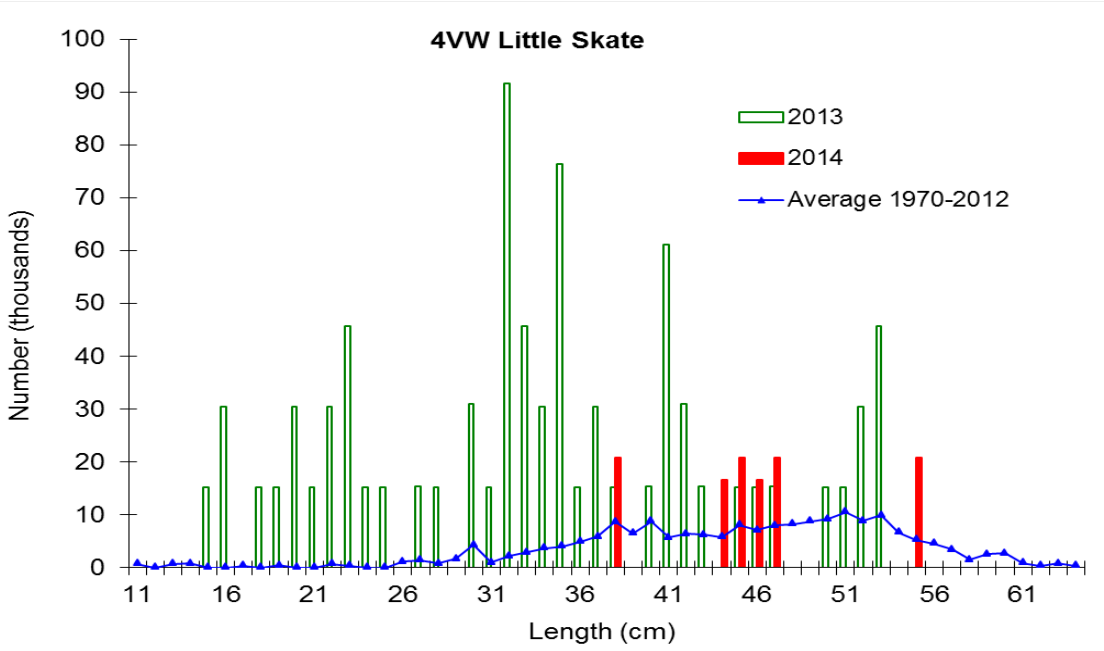

Figure 20e. Length frequency indices for Little Skate in 4VW from the summer RV survey. The solid red bars represent the number in thousands at length from the 2014 survey. The open green bars represent the number in thousands at length from the 2013 survey. The solid blue line with triangles represents the average number in thousands at length for the time period 1970-2012.

Smooth Skate

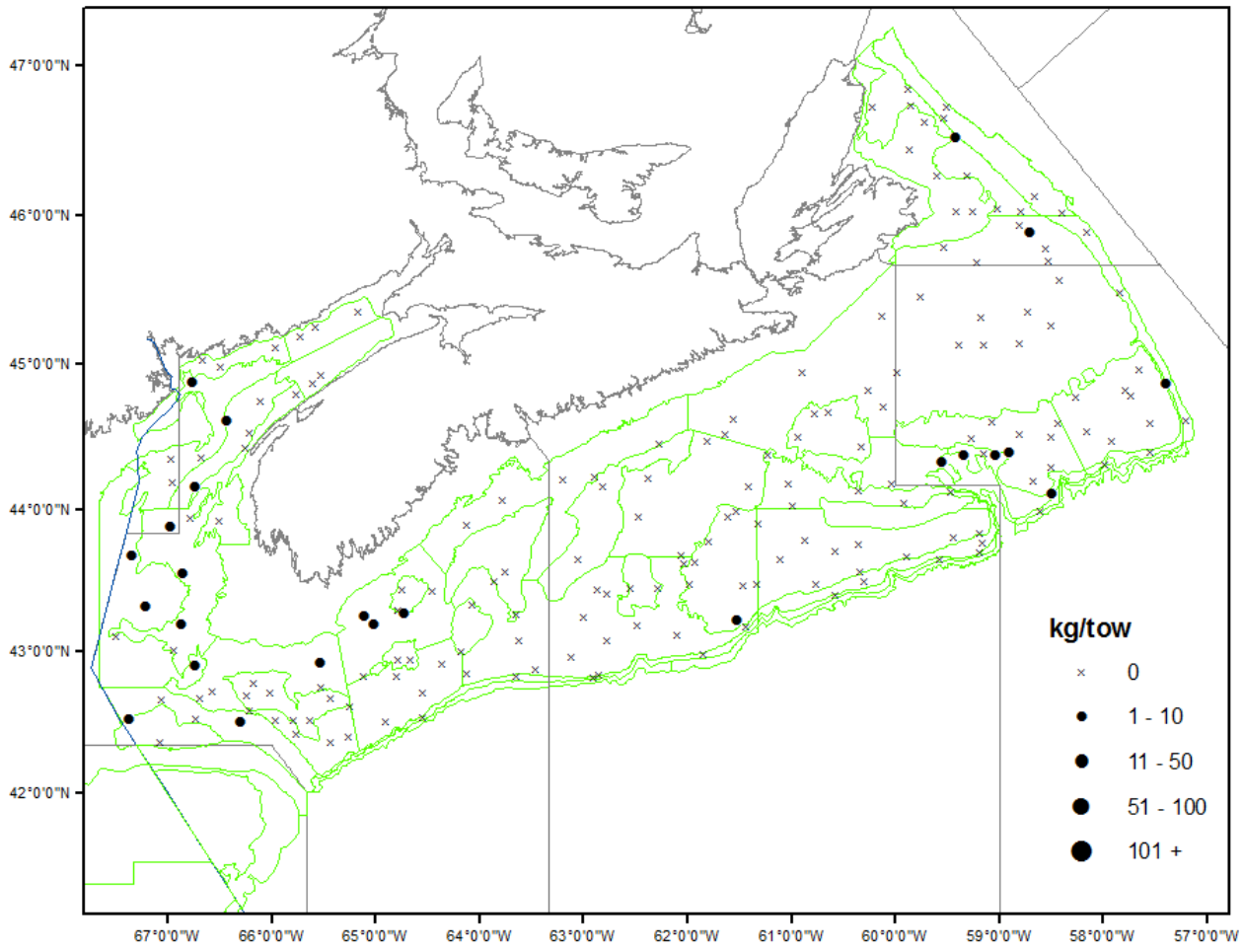

Figure 21a. Distribution of Smooth Skate catches during the 2014 summer RV survey. Zero catch is represented by the x symbol. Black circles represent catches. The circle area is proportional to the catch size in kilograms per tow (kg/tow).

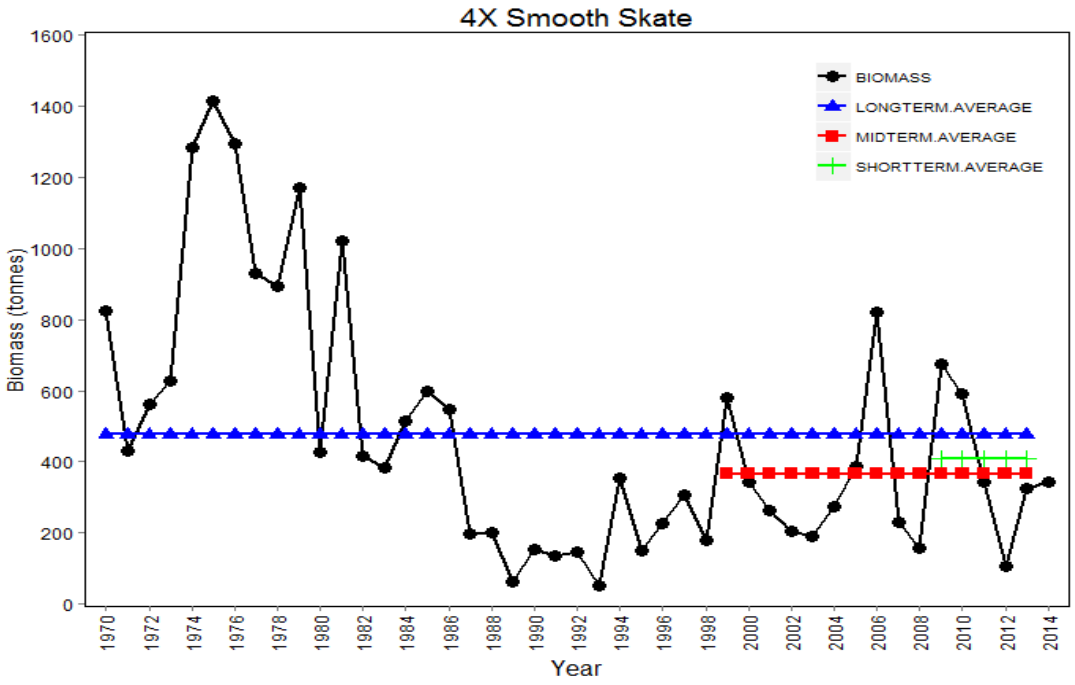

Figure 21b. Biomass index for Smooth Skate in 4X from the summer RV survey represented by the black line with solid circles. The dark blue line with the solid triangles indicates the long-term survey average (1970-2013). The red line with the solid squares represents the medium-term 15 year average (1999-2013). The green line with the crosses represents the short-term 5 year average (2009-2013).

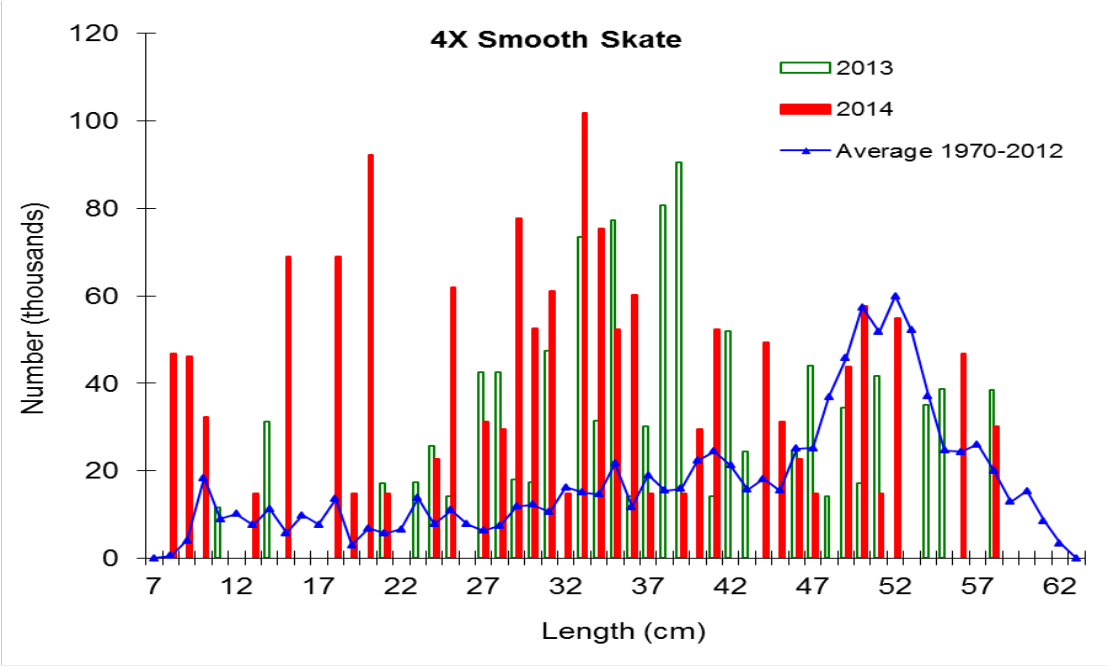

Figure 21c. Length frequency indices for Smooth Skate in 4X from the summer RV survey. The solid red bars represent the number in thousands at length from the 2014 survey. The open green bars represent the number in thousands at length from the 2013 survey. The solid blue line with triangles represents the average number in thousands at length for the time period 1970-2012.

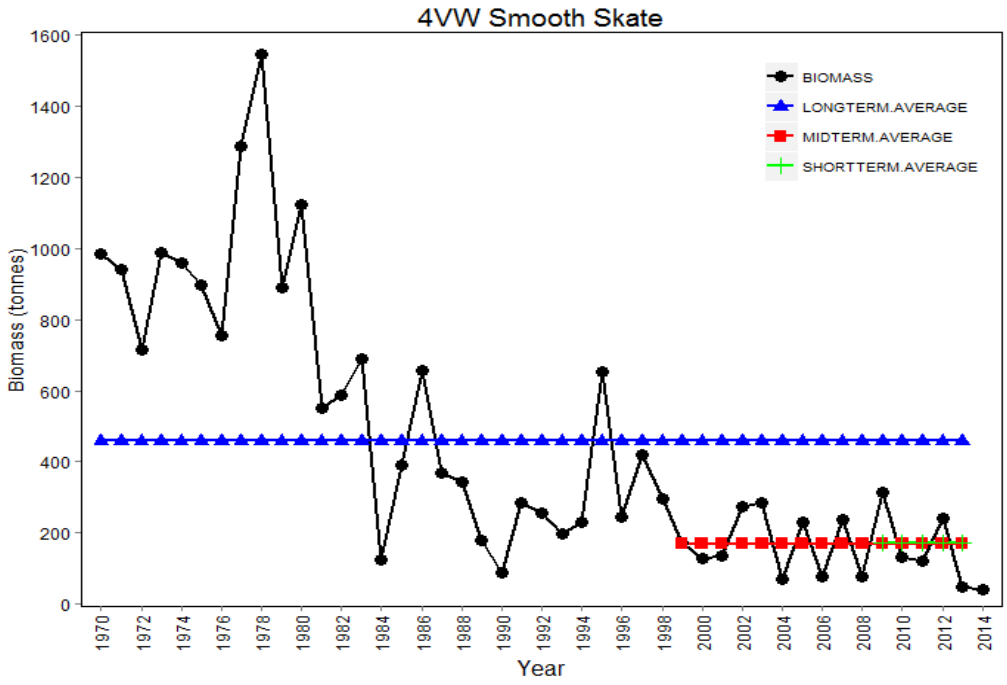

Figure 21d. Biomass index for Smooth Skate in 4VW from the summer RV survey represented by the black line with solid circles. The dark blue line with the solid triangles indicates the long-term survey average (1970-2013). The red line with the solid squares represents the medium-term 15 year average (1999-2013). The green line with the crosses represents the short-term 5 year average (2009-2013).

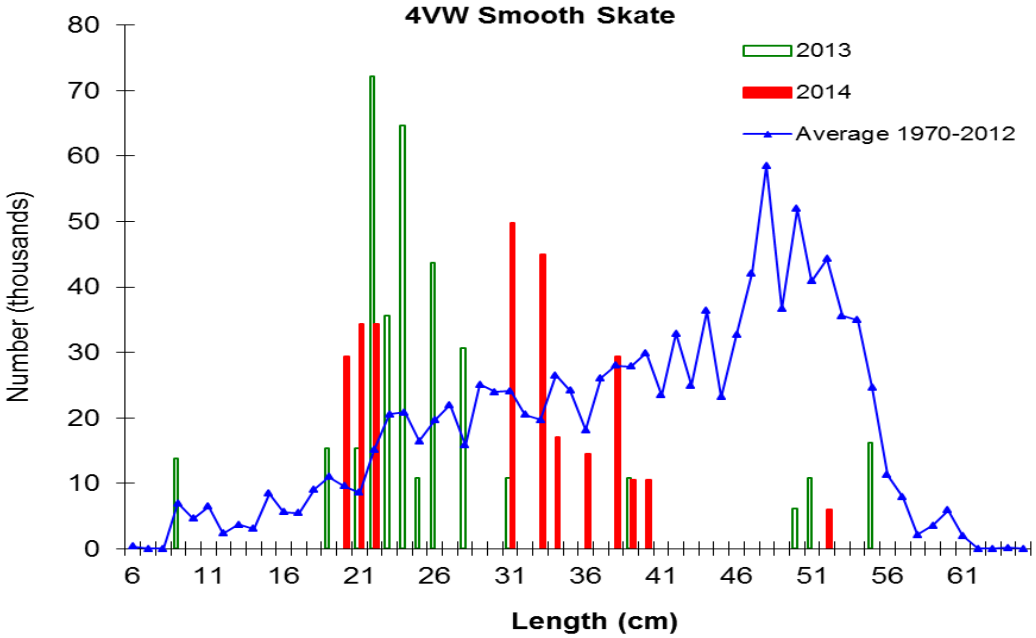

Figure 21e. Length frequency indices for Smooth Skate in 4VW from the summer RV survey. The solid red bars represent the number in thousands at length from the 2014 survey. The open green bars represent the number in thousands at length from the 2013 survey. The solid blue line with triangles represents the average number in thousands at length for the time period 1970-2012.

Spiny Dogfish

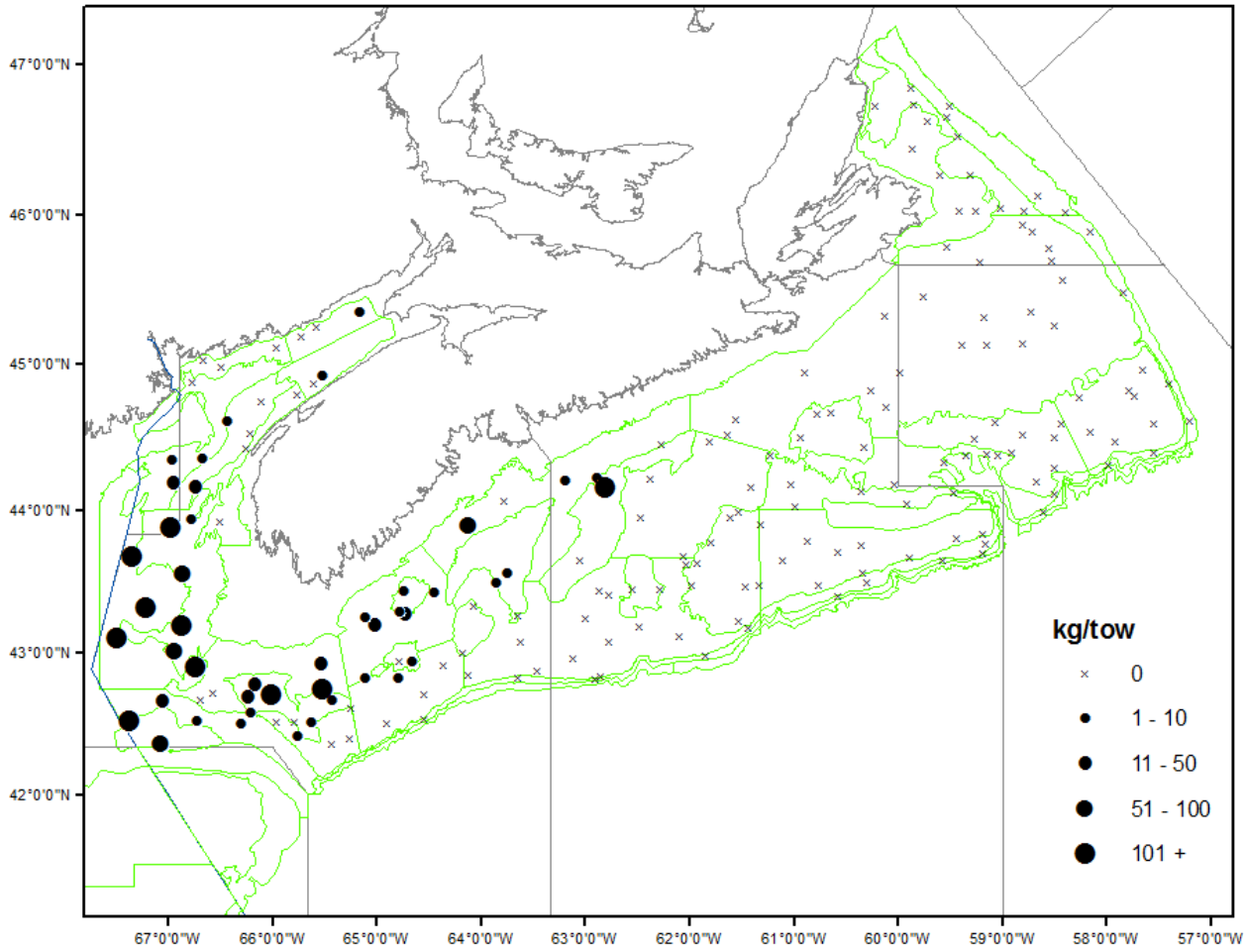

Figure 22a. Distribution of Spiny Dogfish catches during the 2014 summer RV survey. Zero catch is represented by the x symbol. Black circles represent catches. The circle area is proportional to the catch size in kilograms per tow (kg/tow).

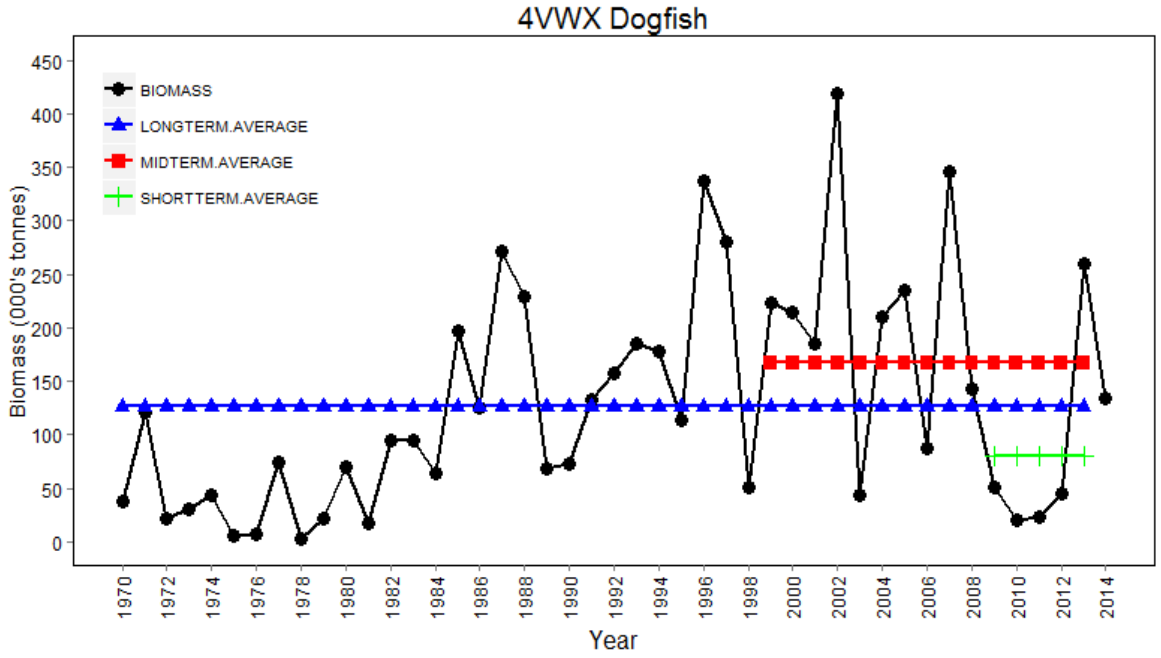

Figure 22b. Biomass index for Spiny Dogfish in 4VWX from the summer RV survey represented by the black line with solid circles. The dark blue line with the solid triangles indicates the long-term survey average (1970-2013). The red line with the solid squares represents the medium-term 15 year average (1999-2013). The green line with the crosses represents the short-term 5 year average (2009-2013).

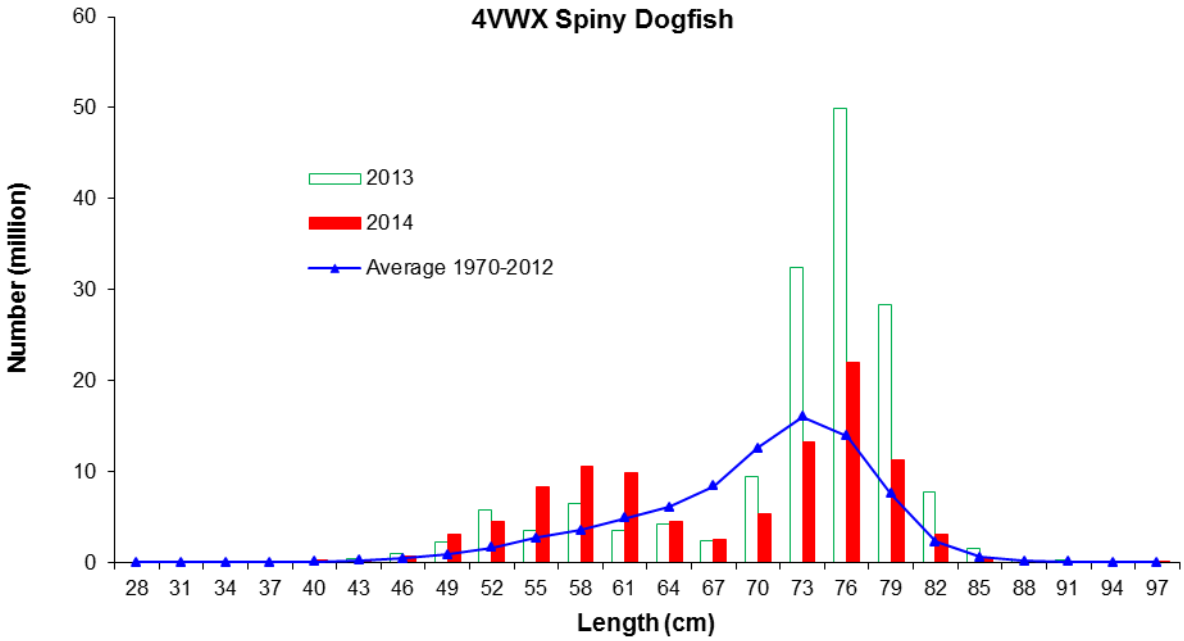

Figure 22c. Length frequency indices for Spiny Dogfish in 4VWX from the summer RV survey. The solid red bars represent the number in millions at length from the 2014 survey. The open green bars represent the number in millions at length from the 2013 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2012.

Conclusions

Biomass indices are compared with the averages over 3 time periods; short-term being most recent 5 year average, mid-term being most recent 15 year average and long-term being since the beginning of the survey series, or the period deemed appropriate for that particular species. A comparison of length frequency indices for 2013 and 2014 with the long-term average from the beginning of the survey series, or the period deemed appropriate for that particular species, to 2012 is also presented.

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Date: January 12, 2015

Sources of Information

Clark, D.S., and Emberley, J. 2011. Update of the 2010 Summer Scotian Shelf and Bay of Fundy Research Vessel Survey. Can. Data Rep. Fish. Aquat. Sci. 1238

McEachran, J.D., and Musick, J.A. 1973. Characters for Distinguishing Between Immature Specimens of the Sibling Species, *Raja erinacea* and *Raja ocellata* (Pisces: Rajidae). Copeia 1973: 238-250.

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ISSN 1919-3769

Correct Citation for this Publication:

DFO. 2015. 2014 Maritimes Research Vessel Survey Trends on the Scotian Shelf and Bay of Fundy. DFO Can. Sci. Advis. Sec. Sci. Resp. 2015/013.

Aussi disponible en français :

MPO. 2015. Tendances dans les relevés par navire scientifique sur le plateau néo-écossais et dans la baie de Fundy dans la région des Maritimes en 2014. Secr. can. de consult. sci. du MPO, Rép. des Sci. 2015/013.