



STOCK STATUS UPDATE OF 4VWX HERRING FOR THE 2019/2020 FISHING SEASON

Context

Maritimes Fisheries and Oceans Canada (DFO) Resource Management has requested that DFO Science provide an update on the science advice for North Atlantic Fisheries Organization (NAFO) Divisions 4VWX Atlantic Herring¹ (*Clupea harengus*) management unit in support of the 2019/2020 fishery. The last full assessment of the 4VWX Herring stock was conducted in March 2018 (DFO 2018), and an update was conducted in May 2019 (DFO 2020). The biological and fishery information for the 4VWX Herring stock forms the basis for establishing harvest levels for the 2019/2020 fishery, as required in the Integrated Fisheries Management Plan (IFMP). A review and update of biological and fishery information for the 4VWX Herring stock are provided in this Science Response.

This Science Response Report results from the Science Response Process of April 23, 2020, on the Stock Status Update of Herring in Northwest Atlantic Fisheries Organization (NAFO) Fishing Area 4VWX.

Background

The 4VWX Herring management unit contains a number of spawning areas, separated to various degrees in space and time. For the purposes of evaluation and management, the 4VWX Herring fishery is divided into four components (see the Appendix for map of place names):

- Southwest Nova Scotia/ Bay of Fundy (SWNS/BoF) spawning component (includes Scots Bay, German Bank, and Trinity Ledge),
- Offshore Scotian Shelf spawning component (includes The Patch and Western Hole),
- Coastal Nova Scotia (NS) spawning component (includes South Shore, Eastern Shore, and Cape Breton), and
- Southwest New Brunswick (SWNB) migrant juveniles (NB weirs).

Each component, except SWNB migrant juveniles, has several spawning areas, and there is mixing of fish among spawning components outside of the spawning period. The Total Allowable Catch (TAC) for the SWNS/BoF was 35,000 t in 2019. The Offshore Scotian Shelf has an allocation of 12,000 t, and the coastal NS fishing areas have allocations based on the recent 5-year average of observed Spawning Stock Biomass (SSB²).

The 2003 (Evergreen) Scotia-Fundy Herring IFMP set out principles, conditions, and management measures for the 4VWX Herring fisheries (DFO 2003). The main principle stated in the plan is “the conservation of the herring resource and the preservation of all of its

¹ Throughout this document, 4VWX Atlantic Herring is referred to as 4VWX Herring.

² Throughout this document, Spawning Stock Biomass (SSB) refers to the spawning stock biomass observed at the time of the acoustic surveys.

spawning components”. The three conservation objectives are: to maintain the reproductive capacity of Herring in each management unit, to prevent growth overfishing, and to maintain ecosystem integrity/ecological relationships (“ecosystem balance”). Progress against these conservation objectives was evaluated during the March 2018 assessment (DFO 2018). A review of the assessment framework was conducted in 2006/2007 (DFO 2007), followed by another framework meeting in 2011 to review assessment models. An analytical model was not chosen at that time; however, recommendations for the assessment methodology were provided (DFO 2011). In 2012, a Limit Reference Point (LRP) for the SWNS/BoF Herring spawning component (German Bank and Scots Bay) was defined as the 2005–2010 average acoustic survey biomass (371,067 t), below which the risk of serious harm is unacceptable (Clark et al. 2012). At the 2018 assessment, revisions to the method for estimating acoustic SSB turnover on the Scots Bay and German Bank spawning grounds was presented and accepted. This revision resulted in revised SSB estimates over the entire time series, including the LRP of 316,316 t³ (DFO 2018). The total SSB in these two areas is estimated based on the 3-year moving average of acoustic biomass with respect to this LRP (DFO 2018).

Landings from the Herring fishery in 4VWX have always been dominated by purse seine (e.g., 81–99%, 1981–2019). Other gear types include weir, gillnet, shutoff, and trap net.

Analysis and Response

Landings

The landings for the period October 15, 2018, to October 14, 2019, (the 2018/2019 quota year) were 29,104 t against a TAC of 35,000t for the SWNS/BoF component (Table 1).

Table 1. Reported landings (rounded to thousands of tonnes) and total allowable catch for the 4VWX Herring management unit by component from 2010 to 2019 with decadal averages from 1970 to 2009.

Year	Avg. 1970–79	Avg. 1980–89	Avg. 1990–99	Avg. 2000–09	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
4WX SWNS/BoF TAC ¹	106	106	112	69	55	50	50	50	50	50	50	42.5	42.5	35
4WX SWNS/BoF ¹	131	131	96	66	46	50	48	47	50	49	50	39	40	29
4VWX Coastal NS ²	<1	<1	4	7	6	4	3	4	5	5	8	8	10	13
Offshore Scotian Shelf ²	38	<0.1	13	6	12	10	1	2	<0.1	2	1	4	3	6
SW New Brunswick ²	26	24	24	15	11	4	1	6	2	<0.2	4	2	12	5
Total Landings	172	155	137	93	74	68	52	58	57	56	63	53	65	53

¹ - Quota year from October 15th of the preceding year to October 14th of the current year

² - Calendar year from January 1st to December 31st

Additional landings of 24,230 t were taken in the non-quota stock components (outside the SWNS/BoF area) for a total of 53,334 t for all of 4VWX. Landings for SWNB weirs and shutoffs were lower in 2019 (5,055 t) compared to 2018 (a ten year high of 11,574 t) (Table 1). Landings were higher for the Offshore Scotian Shelf and remained below the 12,000 t allocation for the area. Within the SWNS/BoF component, catches were 17% lower (drop to 19%) from the German Bank Fishing Box (Appendix 1). There has been a concerted effort by the purse seine fleet to keep the percentage of the TAC caught in this box below 40% since 2014. Landings by defined fishing grounds were lower relative to 2018 from Grand Manan, Long Island, German Bank, and Seal Island, and were higher from N.B Coastal, Trinity Ledge, Lurcher, and Gannet Dry Ledge.

³ Due to calculation error, this value was revised to 317,846 t.

Southwest Nova Scotia/Bay of Fundy

Age Structure

The 2019 fishery landings (by number) were dominated by Age 3 fish (58%) with Age 4 (12%), Age 5 (12%), and Age 6 (12%) making up the other larger age groups (Figure 1). Most 3-year old fish were taken from the fishing grounds of Grand Manan Banks, Grand Manan, New Brunswick (N.B.) Coastal, Long Island Shore, and Trinity Ledge. This age group makes up 88–90% of the landings (by number) on the Grand Manan, Grand Manan Banks, and N.B. Coastal fishing grounds. On Scots Bay and German Bank, the landings had a wider range of mature (ages 3+) fish ages, with Age 5 and Age 6 making up 46% and 53% of landings, respectively. The percentage-by-numbers of Age 4 and Age 5 in the catches was greatest in the months of August and September.

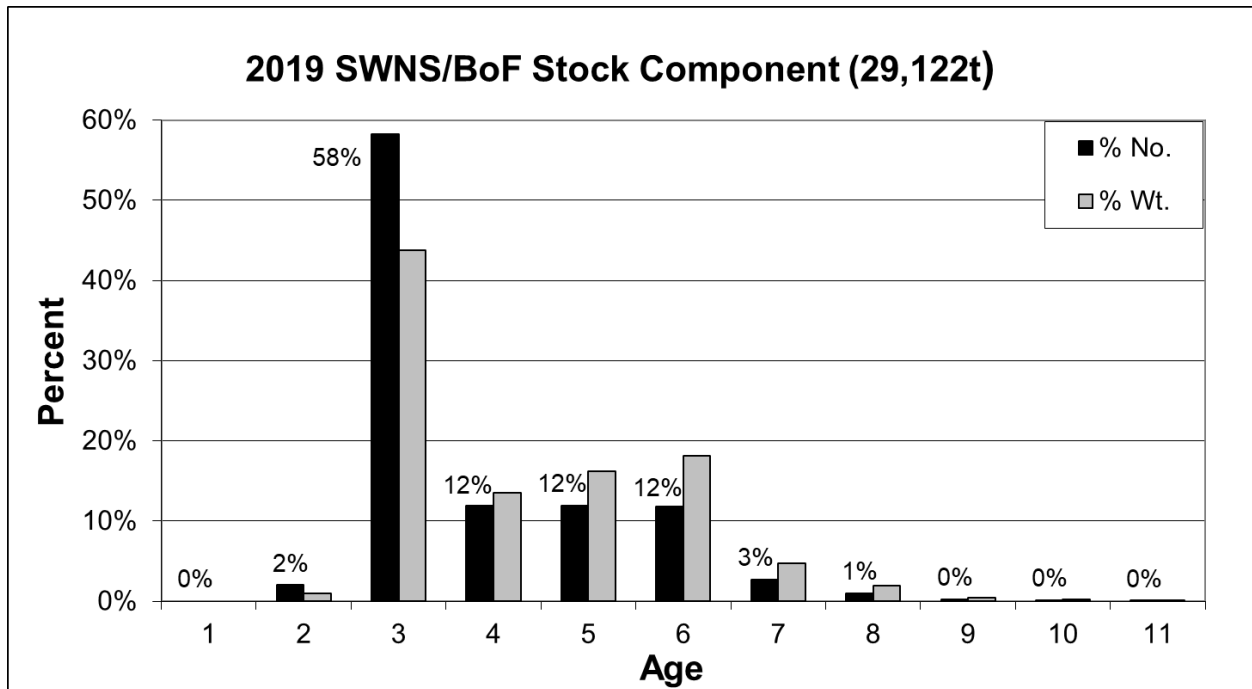


Figure 1. Fishery catch-at-age (percentage numbers and percentage weight) for Southwest Nova Scotia/Bay of Fundy spawning component (2018–2019 quota year).

An important feature of the 2019 catch-at-age is the dominance of Age 3 (58%) with apparent tracking from the dominant Age 2 in 2018 (45%) (Figure 2). Age 6 fish remain relatively abundant within the age structure (12%), an increase from 2018 where Age 6 fish made up only 5% by number. Based on the age structure, the total number of fish removed by the fishery in 2019 was estimated to be 272 million fish, which is 36% less than in 2018. In 2019, Age 2 fish landings by number were 2% of the total landings, compared to 45% of the total landings in 2018. This represents the lowest number of Age 2 fish landed in the fishery since 1980.

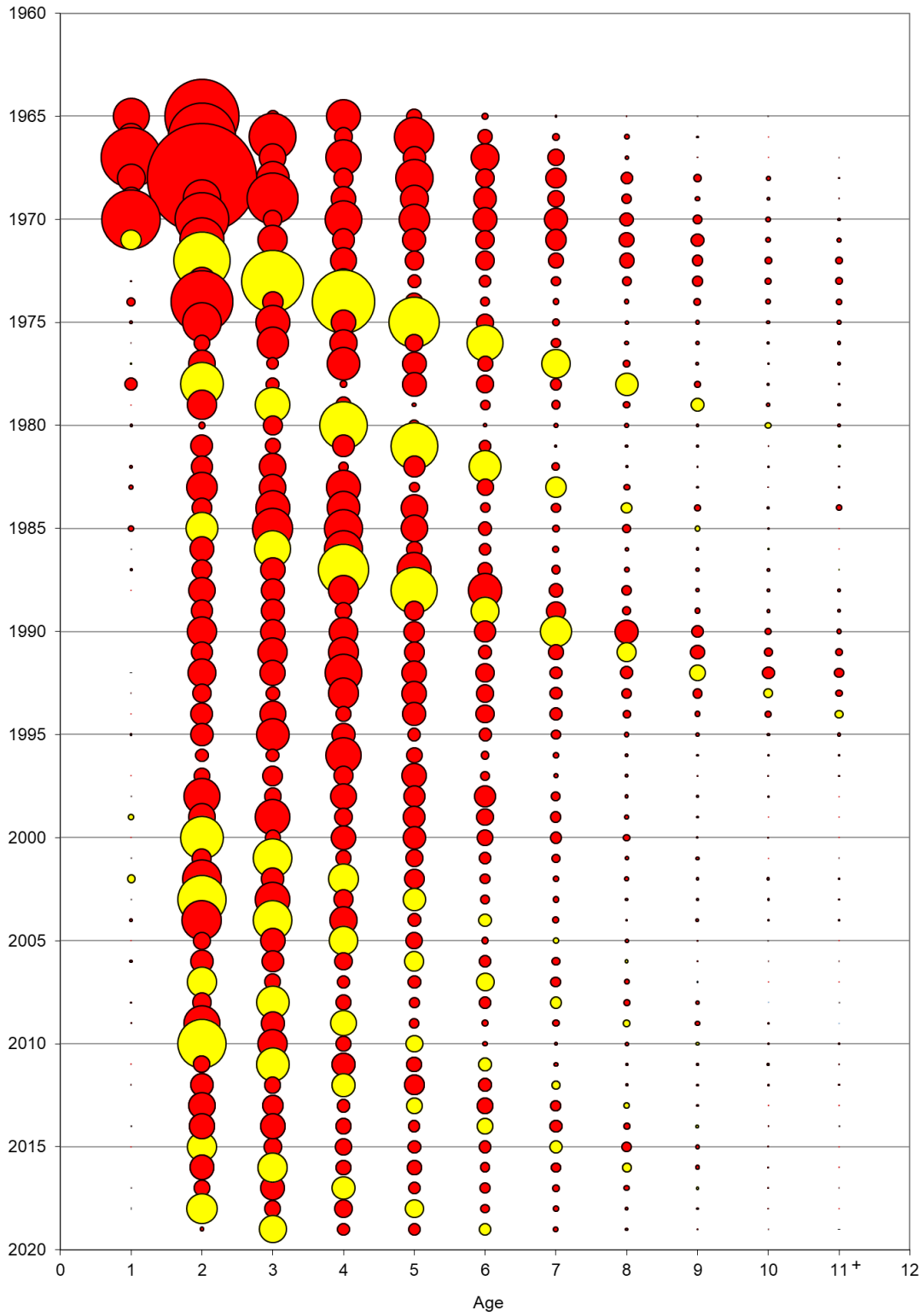


Figure 2. Numbers-at-age in the commercial landings for Southwest Nova Scotia/Bay of Fundy spawning component from 1965–2019 by quota year. The size of the bubble is proportional to the numbers by age and year. Selected year-classes from 1970, 1976, 1983, 1998, 2001, 2005, 2008, 2013, and 2016 are shown in yellow.

Maritimes Region

Acoustic Surveys

The results of the 2019 acoustic surveys for the SWNS/BoF component are summarized in Table 2. Inbox and outbox refer to survey tracks within and outside the designated survey boxes, respectively. There were 8 surveys in Scots Bay, 7 on German Bank, 6 on Seal Island, 5 on Trinity Ledge, and 6 in the Spectacle Buoy area. A seventh survey conducted near Spectacle Buoy was excluded because it was conducted less than 10 days after the previous survey.

The overall acoustic biomass estimates (Scots Bay, Trinity Ledge, Spectacle Buoy, and German Bank) was 322,895 t (95% C.I.: +/- 17,243 t), which is higher than the 251,368 t (95% C.I.: +/- 26,331 t) estimated in 2018. The overall acoustic biomass estimate is 11% below the long-term average (1999–2019) of 363,631 t, which is up from 31% below in 2018. Most of the increase in biomass was observed on German Bank, with 147,138 t (95% C.I.: +/-33,519 t) in 2019 up from the historic low of 94,869t (95% C.I.: +/-22,297t) in 2018. The 2019 German Bank biomass estimate is still 40% below the long-term average (1999–2019). There was little change in the total biomass estimate for Scots Bay; however, the percentage of the total biomass documented outside of the survey box was high (40%) relative to past years. For a second year, surveys were completed on Seal Island, and 30,277 t (95% C.I.: +/-6,966t) was documented. The highest biomass since 1999, 19,528t (95% C.I.: +/-4,532 t), was documented on Trinity Ledge.

Table 2. Acoustic surveys spawning biomass index for Southwest Nova Scotia/Bay of Fundy spawning component average for 1999–2004 and biomass for 2005 to 2019 (rounded to thousands of tonnes).

Location	Avg. 1999 - 2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Avg. 2005 - 2019	Avg. 1999 - 2019
Scots Bay (inbox)	121	20	31	45	21	72	37	91	123	59	187	228	98	133	129	80	38	99
Scots Bay (outbox)	0	0	0	1	0	5	10	32	38	8	4	21	3	9	10	53	4	15
Scots Bay total	121	20	31	46	21	78	47	123	161	66	191	249	101	142	140	133	40	108
German Bank (inbox)	304	219	250	440	214	323	192	249	219	200	188	140	163	166	95	147	273	240
German Bank(outbox)	-	-	4	4	2	1	16	9	7	9	2	-	-	-	-	-	6	6
German Bank total	304	219	254	444	216	324	208	258	226	209	190	140	163	166	95	147	278	242
German + Scots	425	239	285	490	237	402	255	381	387	275	381	390	264	308	235	280	318	350
Trinity Ledge	9	11	16	3	1	2	2	7	3	1	5	1	1	14	7	20	6	7
Spec Buoy (spring)	1	1	-	-	-	-	2	0	-	-	-	-	-	-	-	-	1	1
Spec Buoy (fall)	88	-	-	-	-	-	-	-	-	-	-	-	-	9	10	23	-	26
Overall Stock Area	523	251	301	493	237	403	259	388	390	276	386	390	265	330	251	323	324	364
Seal Island	6	-	10	-	-	-	-	1	-	-	-	-	-	-	21	30	10	11
Browns Bank	45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	26
Total All Areas	573	251	311	493	237	403	259	390	390	276	386	390	265	330	272	353	327	371
Overall SE (t)	19	27	17	29	21	22	8	20	8	15	20	14	9	13	13	8		
Overall SE (%)	5%	13%	6%	7%	10%	6%	4%	6%	2%	6%	5%	4%	4%	5%	5%	2%		

* Note: Average 2005–2010 = Limit Reference Point (German Bank and Scots Bay total only). Number for Scots Bay and German Bank are adjusted for turnover.

- = no data for that year in that category

Zero = surveys conducted but the numbers recorded were either 0 or less than 500 t (rounds to 0 thousand t)

Table 6. Observations and conclusions on short-term rebuilding plan objectives for SW Nova Scotia / Bay of Fundy spawning component in 2019.

Short term Rebuilding Plan Objectives	2019: Observations and Conclusions
Rebuild the Herring resource to an interim target of the 2001–2004 SSB level	Not being met. Stock remains below the LRP.
Have a statistically significant positive trajectory in the reference point indicator;	Not being met.
Limit small fish removals to increase productivity of the resource	The removal of small fish continues to be a concern as 58% of landings (by number) are Age 3, of which only approximately 50% have reached sexual maturation.
Maintain spatial and temporal objectives related to spawning grounds	This objective is mostly being met. There is continued spawning both temporally and spatially on German Bank and in Scots Bay and some improvements on Trinity Ledge and Seal Island.
Maintain biomass of each component	There was little change in German Bank and Scots Bay. There continues to be an increasing trend in Scots Bay since 2005 and a decreasing trend on German Bank since 2007.

Offshore Scotian Shelf Spawning Component

There was an increase in the landings from the offshore banks from 2,926 t in 2018 to 5,896 t, well below the allocation limit of 12,000 t. In the absence of recent information about stock status, there is no basis for evaluating the current catch allocation of 12,000 t. Structured acoustic surveys are needed to obtain data on the stock in the offshore area.

Coastal Nova Scotia (South Shore, Eastern Shore and Cape Breton) Spawning Component

The SSB for the Eastern Shore area increased to the highest of the time series at 141,198 t, while there was a decrease in the biomass estimates for the Little Hope/Port Mouton area to 92,019 t, which remains high. There has been no research or acoustic surveys completed in the Bras d'Or Lakes since 2000.

Southwest New Brunswick Migrant Juveniles

The landings in the weir and shut-off fishery decreased to 4,823 t. The degree to which this reflects abundance is unknown.

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Appendix

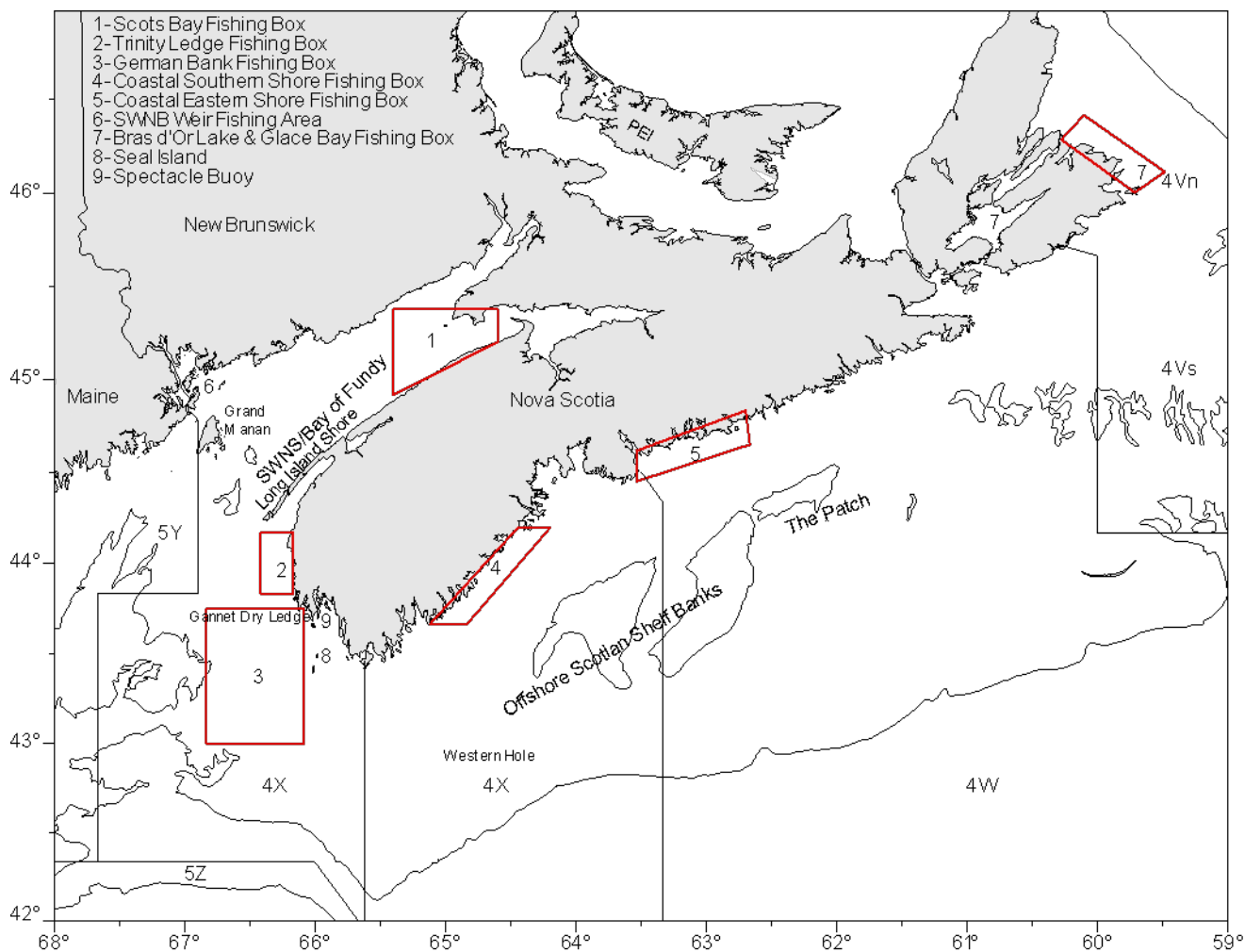


Figure A1. Place names and fishing locations for Southwest Nova Scotia/Bay of Fundy, coastal NS (South Shore, Eastern Shore, Cape Breton), Offshore Scotian Shelf, and SWNB weirs. The vertical line between the two 4X labels indicates the outer boundary of the SWNS/BoF stock component.

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