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The Status of Iceland Scallop (*Chlamys islandica)* in the Canada-France Transboundary Zone (CORE area) of St. Pierre Bank in 2017

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Foreword

This series documents the scientific basis for the evaluation of aquatic resources and ecosystems in Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

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ABSTRACT

Populations of Iceland Scallop (*Chlamys islandica*) off Newfoundland and Labrador are typically found in waters from 50 to 200 m, usually on hard bottom with variable substrate composition, consisting largely of sand, gravel, shell fragments, and stones. The directed fishery for Iceland Scallop started on St. Pierre Bank in 1989 and peaked at 6,000 t in 1992. Prior to 1996 the entire catch was taken by Canada. A decision by an International Court of Arbitration in 1992 resulted in jurisdictional changes over the disputed waters south of Newfoundland and St. Pierre and Miquelon. Following that decision, an annual total allowable catch (TAC) level has been established for an area called the “Transboundary Zone” or simply the “CORE”. Joint TACs have been in place for the CORE since 1995. France and Canada are allocated a fixed percentage of the TAC: 70% and 30%, respectively. A Canadian research survey in September 2017 resulted in a minimum dredgeable biomass estimate of 1,200 t which is among the lowest in the survey time series, and a decrease of approximately 60% since 2009. The mean shell height was found to be consistently higher in Canadian waters than in French waters and an average meat count of 85 scallop/500 g from the 2017 survey was the highest in the survey time series. Predatory sea stars were observed at the lowest level in the survey time series and the annual natural mortality estimate was also the lowest in the survey time series.

INTRODUCTION

SPECIES BIOLOGY

Iceland Scallop (*Chlamys islandica*) is widely distributed within the subarctic but is also found in fishable aggregations as far south as the coast of Massachusetts. Populations off Newfoundland and Labrador (NL) are usually found at depths of 50–200 m, predominantly on hard substrates, consisting largely of sand, gravel, shell fragments, and stones (DFO 2001). Iceland Scallop is a filter-feeder, consuming plankton and detritus, and is associated with areas of strong currents. To reside in such areas, the scallop is attached to the substrate by a byssal thread. Unlike other scallops, the byssus is maintained to the adult stage.

Iceland Scallop are dioecious (having separate sexes), become sexually mature at 3–6 years of age, and fully recruit to the commercial fishery at 60 mm shell height (about age 9). Spawning in NL waters begins in April-May and is thought to be initiated by short-term variation in temperature. Eggs are externally fertilized and larvae are planktonic for as long as 10 weeks before settling to the bottom, possibly at considerable distances from the spawning adults. Iceland Scallop frequently live more than 25 years, but seldom exceed 100 mm in shell height (DFO 2010).

THE FISHERY

Directed fishing for Iceland Scallop started in 1989 and peaked at 6,000 t in 1992 (Table 1, Fig. 1). Prior to 1996 the entire catch was taken by Canada. In 1992, the decision by an International Court of Arbitration resulted in jurisdictional changes over the disputed waters to the south of Newfoundland and St. Pierre and Miquelon. Following the decision, an annual catch level (TAC) was established for an area called the “Trans-boundary Zone” or simply the “CORE” (Fig. 2). France and Canada are allocated fixed percentages of the TAC at 70% and 30%, respectively. Joint TACs were first established for the CORE in 1995 at 2,800 t (840 t in Canada). However, less than 10% of the TAC was taken in each year from 1995-97. There was no fishing between 1997 and 2016, with minimal fishing activity in the CORE area in 2017 (Fig 1). A TAC of 100 t (30 t in Canada) was allocated in 1999–2000, increased to 400 t (120 t in Canada) in 2001, and further increased to 1,650 t (495 t in Canada) in 2006, where it has remained since.

METHODOLOGY

THE FISHERY

The fishery landings data are based on dockside monitoring reports, commercial logbooks, and purchase slips from buyers. The harvesters report the daily catch for each week of the fishery.

RESEARCH VESSEL SURVEYS

Survey Design

Fisheries and Oceans Canada (DFO) resource assessment surveys were conducted from 1990–93 using the *MV Gadus Atlantica*, in 1996 and 1998 using the *CCGS Teleost*, in 2005 using the *CCGS Wilfred Templemen*, and in 2009 and 2017 using the *CCGS Alfred Needler*. A resource assessment survey was carried out by Department of Biological Resources and Environment, France (IFREMER) in 2011 on the *Marcel Angie* (20-m commercial vessel). All of these surveys were conducted using a stratified random sampling scheme, whereby

stratification was based on area and depth, and sets were optimally allocated in proportion to stratum-specific areas and variance of the previous survey catch rates.

The survey area was reduced in 1991 and the strata were redrawn to focus on aggregations of scallops in the north. Strata were redrawn again in 1993 to accommodate the new Canada-France boundary. All subsequent surveys used this stratification scheme (Fig. 3). One exception to note in 1993, stratum 14 was included in the minimum dredgeable biomass (MDB) estimate using the STRAP analysis (Table 3).

The sets allocated for the 2017 resource assessment survey were based on the variance in catch from the 2009 survey (Table 2).

Sets were optimally allocated to minimize the variance of the mean for a fixed sample size in a stratified random sampling scheme according to Cochran (1977):

$$n_h = \frac{n\, A_h\, S_h}{\sum (A_i\, S_i)}$$

Where, n_h = number of sets in stratum 'h', n = total number of sets available, A_h = area of stratum 'h', S_h = variance in stratum 'h', A_i = area of each stratum, and S_i = variance in each stratum.

Fishing Methods

A 12-ft New Bedford scallop dredge equipped with 3" rings and interconnected with 3-top and 4-bottom link configuration was used in the surveys from 1990-98. Since 2005, an 8-ft dredge has been used with the same ring and link configuration. The standard tow length was 1.0 nm with the 12-ft dredge and 0.5 nm with the 8-ft dredge. Towing speed was approximately 3 knots with a warp (wire length) to depth ratio of 3:1. For the Canadian resource assessment surveys all catch results were standardized to an 8-ft dredge swept area so the results were comparable throughout the survey time series. The scallop survey carried out by IFREMER in 2011 used a 10-ft New Bedford scallop dredge (Foucher and Goraguer 2012), and the results from this survey were not standardized to an 8-ft dredge swept area. All tows passed through the allocated position with tow direction being random except if the position was too close to the stratum border or an obstruction, then the direction was chosen so that the tow could be completed within the stratum and/or to avoid the obstruction.

Sampling

Upon completion of each tow, the total catch was sorted by species, numerated, and weighed. Live scallops were bushelled into baskets and weighed whole. Depending on the volume of the catch and anticipated steam time to the next fishing station, either the whole catch or a randomly selected weighed subsample was set aside for individual shell-height measurements to the nearest mm. Individual shell height and meat weight information was also collected in each stratum. Cluckers (empty persistent paired valves still attached at the hinge line) were separately sorted, weighed, counted, and measured. Clucker weights and the weight of residual debris (e.g., sand, broken shell fragments, and pebbles) were removed from sampled and total catch weights.

In addition, predatory sea stars were sorted by species and sampled for individual weight and length. The length of each sea star was measured from the mouth to the end of the longest arm to the nearest mm. Commercial finfish such as Atlantic Cod (*Gadus morhua*) and American Plaice (*Hippoglossoides platessoides*) were also sampled for length, sex, and stomach contents were examined for the presence of juvenile scallops. Each station was not occupied until the

sampling from the previous set was completed. This guards against water loss in the scallops which can affect the weights recorded, subsequently affecting biomass estimates.

BIOMASS

In previous Iceland Scallop assessments, survey MDB and abundance indices for Iceland Scallop and sea stars were calculated using STRAP analyses (Smith and Somerton 1981). In the present assessment, Ogive Mapping (Ogmap) (Evans 2000) was introduced as the spatial expansion platform to determine the MDB and abundance estimates for Iceland Scallop for each survey in each stratum. Ogmap is a spatial expansion method that is used to extrapolate across poorly sampled areas and in some years produces narrower confidence intervals compared to STRAP analyses. All surveys were standardized to 0.5 nm tow. The MDB estimates based on STRAP and Ogmap analyses from the Canadian scallop surveys that took place between 1993 and 2017 were displayed in a line plot to show the comparative trends. The overall MDB estimate results for the CORE area included the 2011 French survey results. Although the summary results from the 2011 French survey were included in this report for the CORE area (strata 11,12, 21–25) based on STRAP analysis, the raw data from the survey were not provided and therefore results for the commercial strata could not be calculated and displayed.

Biomass estimates were inflated by inclusion of epibionts (organisms that live on the surface of another living organism) in the catch weight. However, this would not affect trends in biomass because epibionts abundance is assumed to be consistent between years.

MEAT YIELDS AND COUNTS

During the Canadian resource assessment surveys, Iceland Scallop were collected to determine biological meat yields (%), average meat weight (g), and meat counts (number of meats / 500g) in representative strata which varied each year (Table 5).

Biological meat yield is given by the formula:

$$x = \frac{meat\ weight\ (g)}{round\ weight\ (g)}\ X\ 100$$

Meat count is given by the formula:

$$x = \frac{500\ (g)}{meat\ weight\ (g)}\ X\ sample\ (n)$$

SIZE STRUCTURE

The shell height data from the Canadian resource assessment surveys in 1998, 2005, 2009, and 2017 were used to determine the abundance at length in 1-mm groups determined with STRAP analysis for each stratum within the Canadian and French zones, respectively. Length frequency distributions were generated to display these results. Ogmap analysis was not used to determine the abundance at length estimates. STRAP and Ogmap MDB and abundance trends were considered comparable and therefore only one method (STRAP) was used. However, in future Iceland Scallop assessments, Ogmap will be used for the abundance at length estimates.

The shell height data were also used to calculate the average mean shell height (mm) for all strata within the CORE area combined, as well as for the strata within Canadian, and French zones, respectively. These results were presented in line plots to compare trends.

NATURAL MORTALITY

Natural mortality of Iceland Scallop was computed over the survey time series directly from occurrence of cluckers (Dickie 1955) according to the equation:

$$M = 1 - e\left(\frac{C}{t}\right)\left(\frac{1}{L}\right) * 365$$

Where M = annual mortality rate, C = number of cluckers in a sample adjusted to account for tow-induced disarticulation (number of cluckers*1.211) (Naidu 1988), L = number of live scallops in a sample, and t = average time in days (210.8) required for natural clucker disarticulation (Mercer 1974).

RESULTS

THE FISHERY

There was no fishing between 1997 and 2016, with minimal fishing activity in the CORE area in 2017.

BIOMASS

The MDB estimates based on both STRAP and Ogmap analyses were examined to compare trends (Tables 3, 4). The MDB estimates from the Canadian resource assessment surveys from 1993 to 2017 showed similar trends for both analyses (Fig. 4).

The 2017 MDB Ogmap estimate of 1,200 t is among the lowest in the survey time series, and reveals a decrease of approximately 60% since 2009 (Table 4, Fig. 5). Although the 2017 MDB estimate was based on all strata, only a few strata contained the bulk of the scallop biomass, and most of the fishing effort was concentrated in these strata in the past. These main “commercial” strata (11-12, 21- 23) (Fig. 3) usually account for 70–80% of the entire Iceland Scallop biomass in the CORE area (Tables 3, 4). In the commercial strata, the MDB decreased throughout the 1990s to a low of 600 t in 1998 and then increased in 2005 and 2009, due mainly to an increase in MDB in the Canadian zone (Figs. 6, 7). The biomass estimate in the commercial strata declined again in 2017 to 874 t (Table 4, Fig. 8).

Between 1993 and 1998, MDB decreased in the French zone and has ranged from 900 t in 2005 to 300 t in 2017 (Fig. 6). The overall MDB decreased from 2009 to 2017 in the CORE area which seems to be driven by the decline of biomass in the Canadian zone (Figs. 5, 6). The percentage of the MDB in the Canadian zone in 2017 is estimated at 56% (Fig. 6).

MEAT YIELDS AND COUNTS

Biological meat yields were collected in strata 12, 22, 23 in the 2017 resource assessment survey. Overall, the meat yield showed little change with 11.5% in 2009 and 11.2% in 2017 (Fig. 9, Table 5).

The meat count based on the Canadian surveys increased from 68 meats/500 g in 2009 to 85 meats/500 g in 2017 (Fig 10). The 2017 meat count is the highest in the survey time series, and indicates a reduced yield as there has been no major change in scallop size within the designated areas.

SIZE STRUCTURE

The length frequency distributions display the size structure for the strata combined within the Canadian (strata 11–12) and French (strata 22–25) zones (Fig.11). The size of scallop in the Canadian zone showed no apparent change, with a mean shell height consistently close to 80 mm throughout the survey time series (Fig.12, Table 6). It is also evident from the length frequency distributions that the scallop in the Canadian zone were larger than scallop observed in the French zone, where the mean shell height was 65 mm in 2009 and 70 mm in 2017 (Fig.11, Table 6).

The abundance at length in the length frequency distribution shows that the overall abundance was highest in 2005 and 2009, and that the abundance of small Iceland Scallop in the French zone was higher than the abundance of small scallop in the Canadian zone in 2009, and 2017 (Fig. 11).

NATURAL MORTALITY

The overall natural mortality index gradually increased between 1992 and 1996 from 0.19 to 0.52 and then peaked at a high of 0.88 in 1998. Since then, the mortality index has decreased to 0.12 and 0.07 in 2009 and 2017, respectively (Fig. 13, Table 7). This is the lowest in the survey time series and is likely associated with the low biomass of predatory sea stars.

PREDATION

In the early to mid-1990s a high abundance of predatory sea stars contributed to significant mortality in Iceland Scallop in the CORE Area (Lawrence et al. 1997; Naidu et al. 2001). Biomass of all sea star species increased to a high of 1,600 t (MDB) in 1998, when Iceland Scallop biomass was at its lowest (Fig. 14). In the CORE Area, biomass of the two main predatory sea star species (*Leptasterias polaris* and *Crossaster papposus)*, increased from 1993–98, then decreased to the lowest level in the survey time series in 2017 (Fig.14).

CONCLUSIONS

The biomass estimate has declined from 3,390 t in 2005 to 1,200 t in 2017, largely due to a decrease in biomass in the Canadian zone. The 2017 survey meat count of 85/500 g was the highest in the survey series despite no major change in scallop size within the designated areas, indicating reduced yield. The 2017 natural mortality index was at a time series low of 0.07, which is associated with the lowest level of predatory sea stars observed since the start of the fishery.

There are currently no established reference points by which to determine stock status in relation to a Precautionary Approach Framework.

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TABLES

Table 1. Total allowable catch (TAC) and removals for Iceland Scallop in the northern portion of St. Pierre Bank. Note 2017 was not presented as the Rule of Five guidelines applies for this particular year.

-	TAC (t, round)			Removals (t, round)			Non-CORE
-	**Canada**	**France**	**Total**	**Canada**	**France**	**Total**	**Removals**
1989	*No distinction between*			36	0	36	0
1990	*Canadian or French zones*			507	0	507	0
1991	*Boundary dispute before*			755	0	755	0
1992	*An international court*			5,967	0	5,967	0
International Boundary decision June, 1992							
1993	-	-	-	0	0	0	667
1994	-	-	-	0	0	0	440
1995	840	1,960	2,800	230	0	230	831
1996	975	2,275	3,250	158	148	306	302
1997	630	1,470	2,100	4	118	122	5,245
1998	630	1,470	2,100	0	0	0	2,792
1999	30	70	100	0	0	0	1,198
2000	30	70	100	0	0	0	1,148
2001	120	280	400	0	0	0	498
2002	120	280	400	0	0	0	478
2003	120	280	400	0	0	0	87
2004	120	280	400	0	0	0	38
2005	120	280	400	0	0	0	1,992
2006	495	1,155	1,650	0	0	0	136
2007	495	1,155	1,650	0	0	0	6
2008	495	1,155	1,650	0	0	0	3
2009	495	1,155	1,650	0	0	0	2

-	TAC (t, round)			Removals (t, round)			Non-CORE
-	Canada	France	Total	Canada	France	Total	Removals
2010	495	1,155	1,650	0	0	0	-
2011	495	1,155	1,650	0	0	0	-
2012	495	1,155	1,650	0	0	0	-
2013	495	1,155	1,650	0	0	0	-
2014	495	1,155	1,650	0	0	0	-
2015	495	1,155	1,650	0	0	0	-
2016	495	1,155	1,650	0	0	0	-
2017	495	1,155	1,650	-	0	0	-

Table 2. Distribution of survey sets by strata, areas, and intensity of coverage in the 2017 resource assessment survey for Iceland Scallop in the CORE area of St. Pierre Bank.

Stratum	Mean Depth (m)	Area(nmi^2)	No. of Sets completed	No. of sets/nmi^2
10	-	17.9	2	0.11
11	73.7	51.6	12	0.23
12	52.9	38.6	20	0.52
21	89.0	13.6	2	0.15
22	55.2	60.0	5	0.08
23	85.2	23.8	19	0.80
24	77.5	17.0	2	0.12
25	58.6	46.6	7	0.15
Total	**70.3**	**269.1**	**69**	**0.50**

Table 3. Minimum dredgeable biomass (MDB) estimates (using STRAP Analysis) for the CORE area and the main commercial strata (based on Canadian scallop survey data and 2011 IFREMER scallop survey).

Year	CORE Area (n. mi^2)	CORE MDB (t, 1,000s)	Commercial Strata Area (n. mi^2)	Commercial Strata MDB (t, 1,000s)	Commercial Strata % of Total MDB
1993	414.1[c]	4.836	187.6	3.674	76
1996	269.1[d]	2.246	187.6	2.171	97
1998	269.1[d]	0.777	187.6	0.764	98
2005	269.1[d]	2.165	187.6	2.073	96
2009	251.2[e]	2.899	187.6	2.714	94
2011	269.1[d]	1.778	187.6	1.154	65
2017	251.2[e]	1.376	187.6	1.127	82

Strata utilized:
[c] 10, 11, 12, 14, 21, 22, 23, 25

[d] 10, 11, 12, 21, 22, 23, 24, 25
[e] 11, 12, 21, 22, 23, 24, 25

Table 4. MDB estimates (using Ogmap analysis) for the CORE area and the main commercial strata (based on Canadian resource assessment survey data).

Year	CORE Area (n. mi^2)	CORE MDB (t, 1,000s)	Commercial Strata Area (n. mi^2)	Commercial Strata MDB (t, 1,000s)	Commercial Strata % of Total MDB
1993	269.1[d]	7.34	187.6	4.98	68
1996	269.1[d]	2.51	187.6	1.88	75
1998	269.1[d]	0.8	187.6	0.6	75
2005	269.1[d]	2.77	187.6	2.17	78
2009	251.1[e]	3.39	187.6	2.2	65
2017	251.1[e]	1.2	187.6	0.87	73

Strata utilized:
[d] 10, 11, 12, 21, 22, 23, 24, 25
[e] 11, 12, 21, 22, 23, 24, 25

Table 5. Biological meat yields, average meat weights, and meat counts of Iceland Scallop in the CORE area of St. Pierre Bank over the survey time series (1996–2017).

Year	Stratum	Number Sampled	Whole wt. (kg)	Meat wt (g)	Yield %	Avg. meat wt. (g)	Meat Count (#/500g)
1996	11	310	20.87	2,407	11.53	7.8	64.4
-	22	504	33.75	4,520	13.39	9	55.8
-	25	79	7.3	1,022	14	12.9	38.6
-	**Total**	**893**	**61.92**	**7,949**	**12.84**	**8.9**	**56.2**
2005	11	118	8.44	1,172	13.9	9.9	50.3
2009	11	250	18.13	1,814	10.01	7.26	69
-	12	50	3.59	490	13.8	9.8	51
-	22	100	5.91	706	11.9	7.06	71
-	23	50	2.09	304	14.6	6.08	82
-	**Total**	**800**	**29.72**	**3,314**	**11.2**	**7.36**	**68**
2017	12	30	1.94	216	11	7.1	69
-	22	50	2.56	252	9.8	5.0	99
-	23	145	6.93	850	12	5.7	85
-	**Total**	**225**	**11.43**	**1,318**	**11.5**	**5.9**	**85.4**

Table 6. Shell height (mm) for Iceland Scallop over the survey time series (1998, 2005, 2009, 2017) in the CORE area.

AREA/ZONE	Year	Number sampled	Average	Maximum	Minimum
Canada	1998	383	74.51	75.34	73.68
	2005	905	79.63	80.16	79.11
	2009	836	79.31	79.84	78.79
	2017	281	79.26	80.34	78.18
France	1998	824	71.16	72.06	70.25

AREA/ZONE	Year	Number sampled	Average	Maximum	Minimum
	2005	271	73.61	75.09	72.12
	2009	958	65.33	66.13	64.54
	2017	254	69.61	70.70	68.53

Table 7. Stratum-specific natural mortality estimates for Iceland Scallop in the CORE area, computed from ratio of cluckers to live scallops. Clucker numbers are adjusted by a factor of 1.221 to allow for tow-induced disarticulation.

Stratum	1992	1993	1996	1998	2005	2009	2017
10	-	-	0.02	0.00	0.00	-	-
11	-	0.17	0.16	0.22	0.14	0.14	0.06
12	-	-	0.00	0.00	0.19	0.18	0.21
21	-	0	0.34	0.00	0.00	0.19	0.00
22	-	0.2	0.59	0.97	0.49	0.10	0.15
23	-	0.41	0.00	0.45	0.31	0.04	0.02
24	-	-	0.99	0.98	0.00	0.00	0.00
25	-	0.44	0.89	1.00	0.15	0.11	0.09
Overall	**0.17**	**0.19**	**0.50**	**0.88**	**0.21**	**0.12**	**0.07**

FIGURES

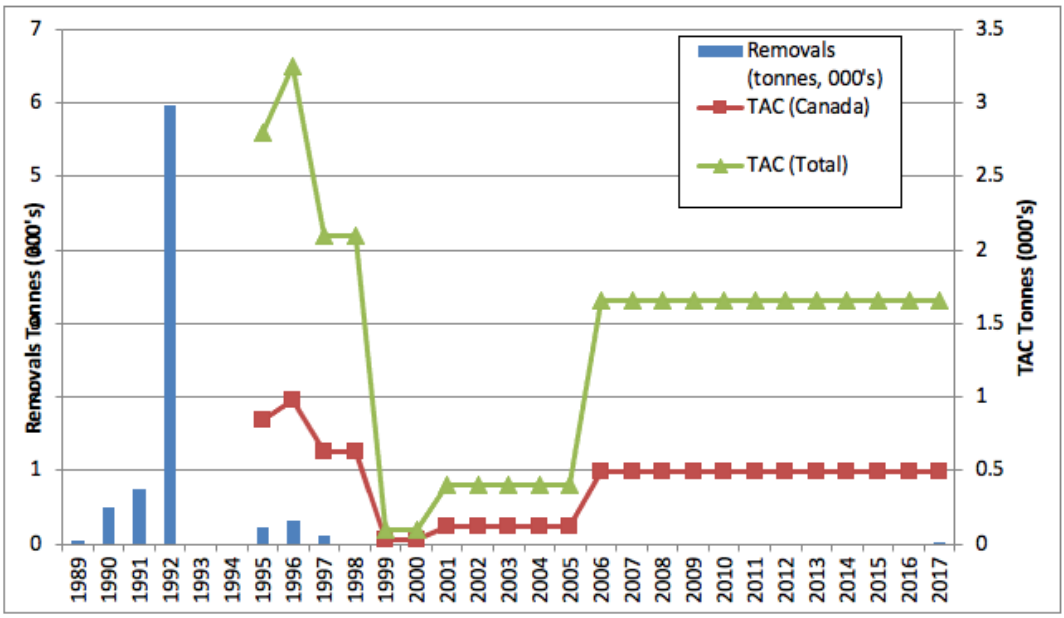

Figure 1. Total TACs, Canadian TACs and total removals for Iceland Scallop in the northern portion (Canada-France Transboundary [CORE] Zone) of St. Pierre Bank.

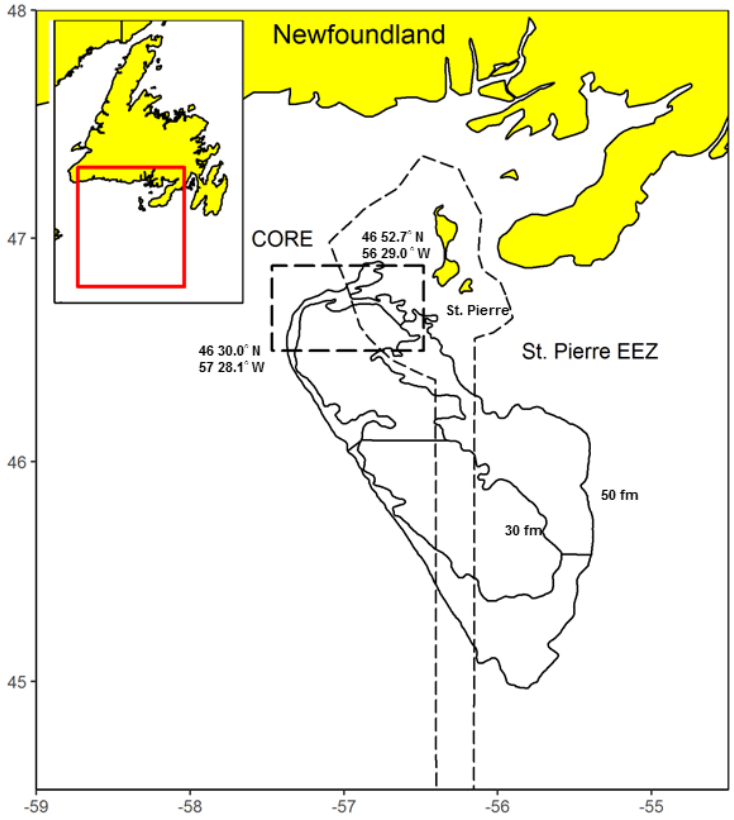

Figure 2. Northern St. Pierre Bank showing the Canada-France Transboundary (CORE) Zone and French Economic Exclusive Zone (EEZ).

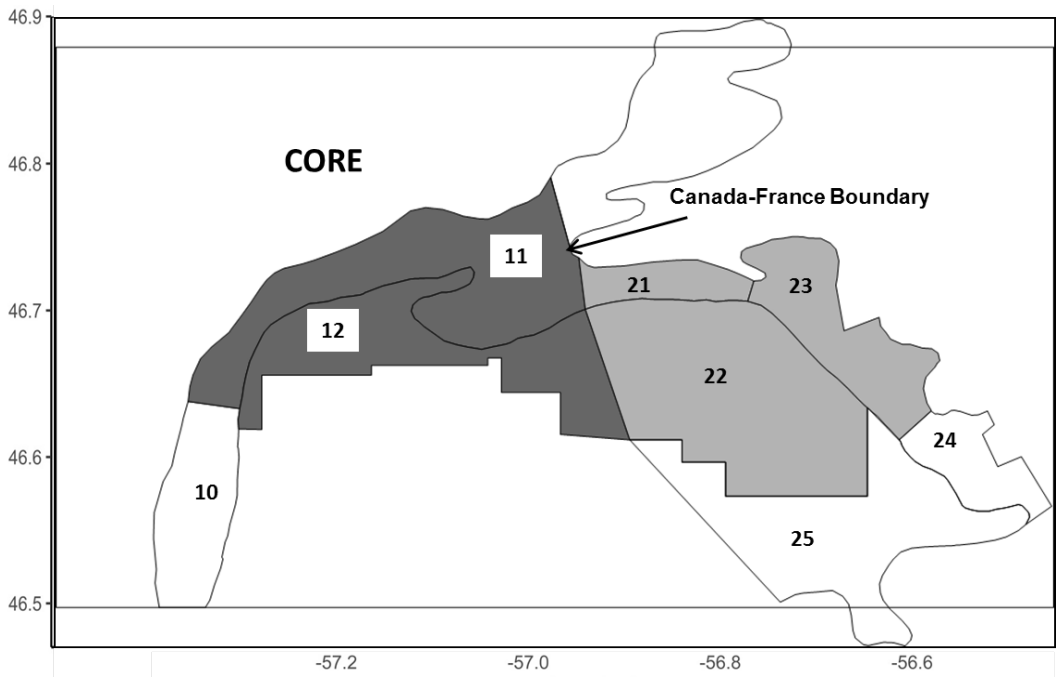

Figure 3. Map of strata on the Northern St. Pierre Bank, highlighting the main "commercial" strata for Iceland Scallop in the Canadian zone (strata 11, 12) and the French zone (strata 21, 22, 23) with shading of the Canada-France Transboundary (CORE) Zone.

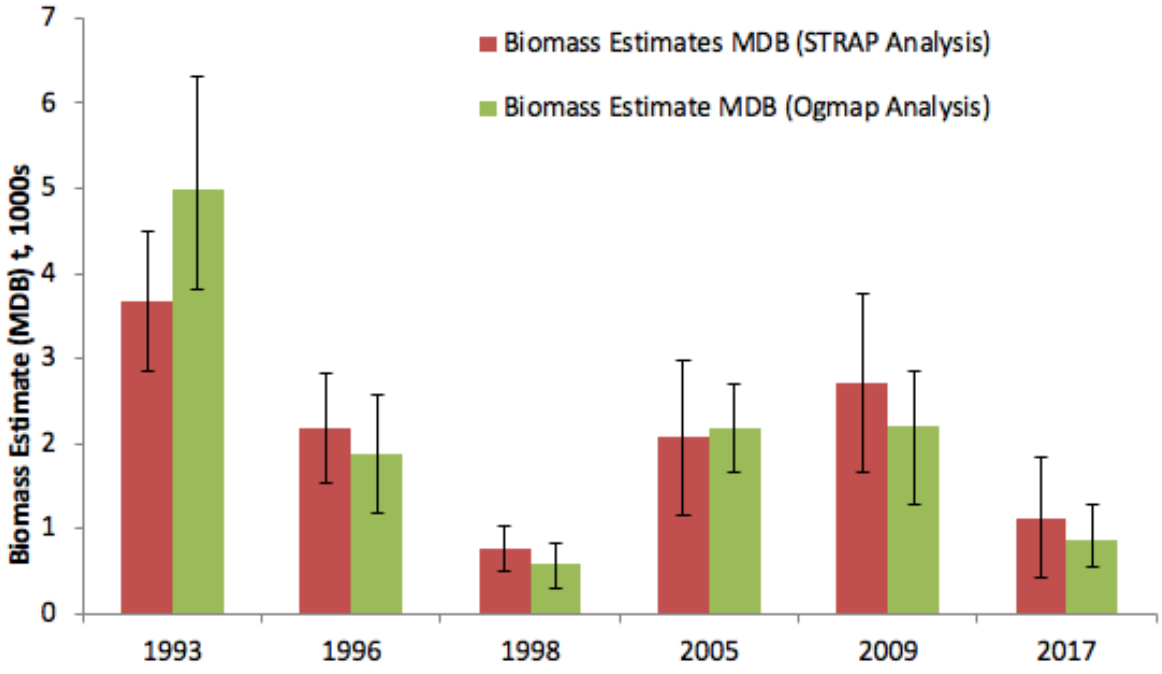

Figure 4. Comparison of the MDB estimates based on Ogmap analysis and STRAP analysis from the Canadian scallop surveys between 1993 and 2017 for the main commercial strata (strata 11–12, 21–23) with 95% confidence intervals.

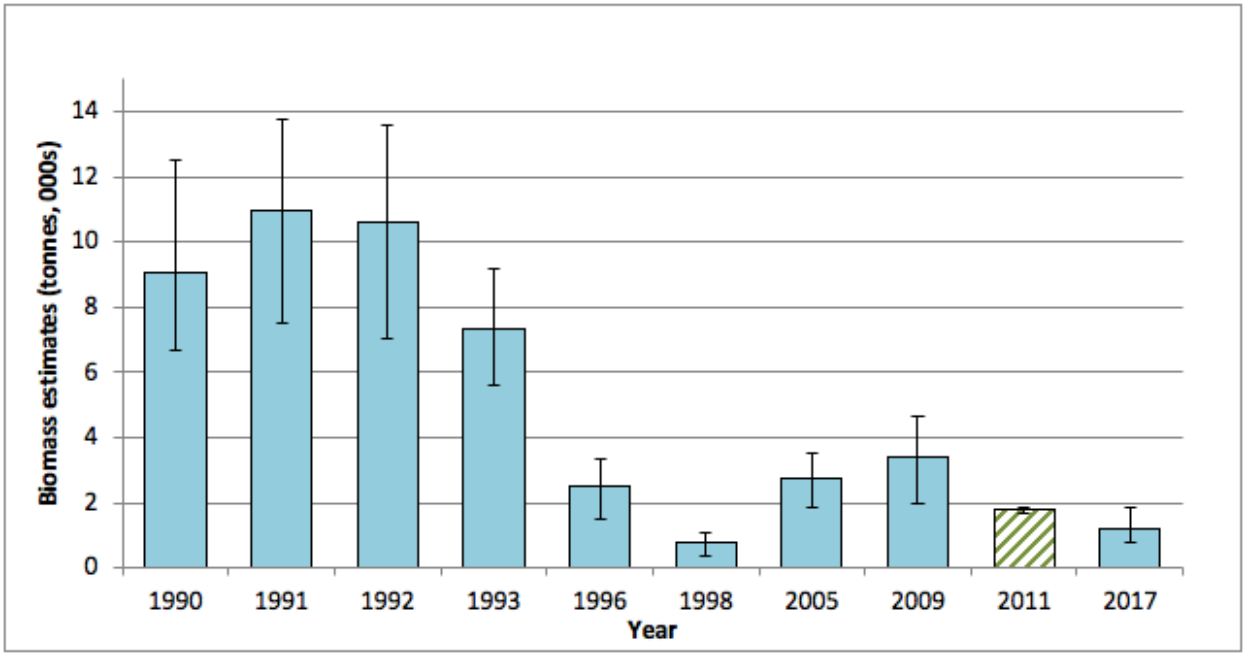

Figure 5. MDB estimates from all the strata within the Canada-France Transboundary (CORE) Area (strata 10–12, 21–25) from the Canadian resource assessment surveys and 2011 France resource assessment survey. Note the 2009 and 2017 biomass estimates do not include stratum 10.

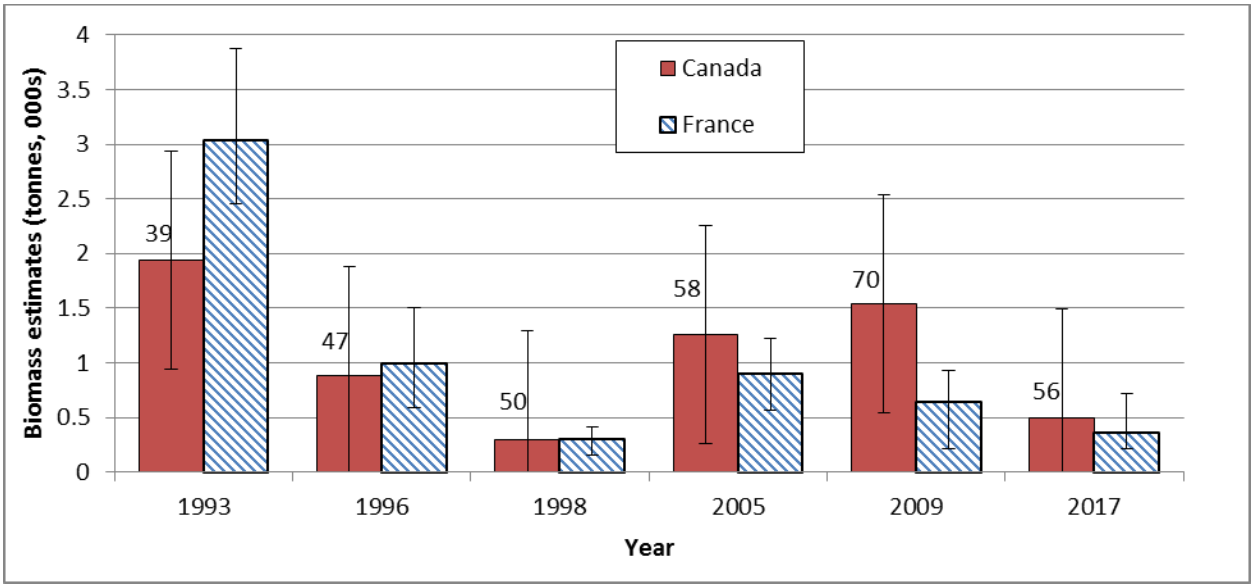

Figure 6. MDB estimates from commercial strata in the Canadian zone (strata 11–12) and the French zone (strata 21–23) based on the Canadian resource assessment surveys between 1993 and 2017. Note the numbers above the Canadian zone represent the percent of total MDB estimate within the Canadian zone.

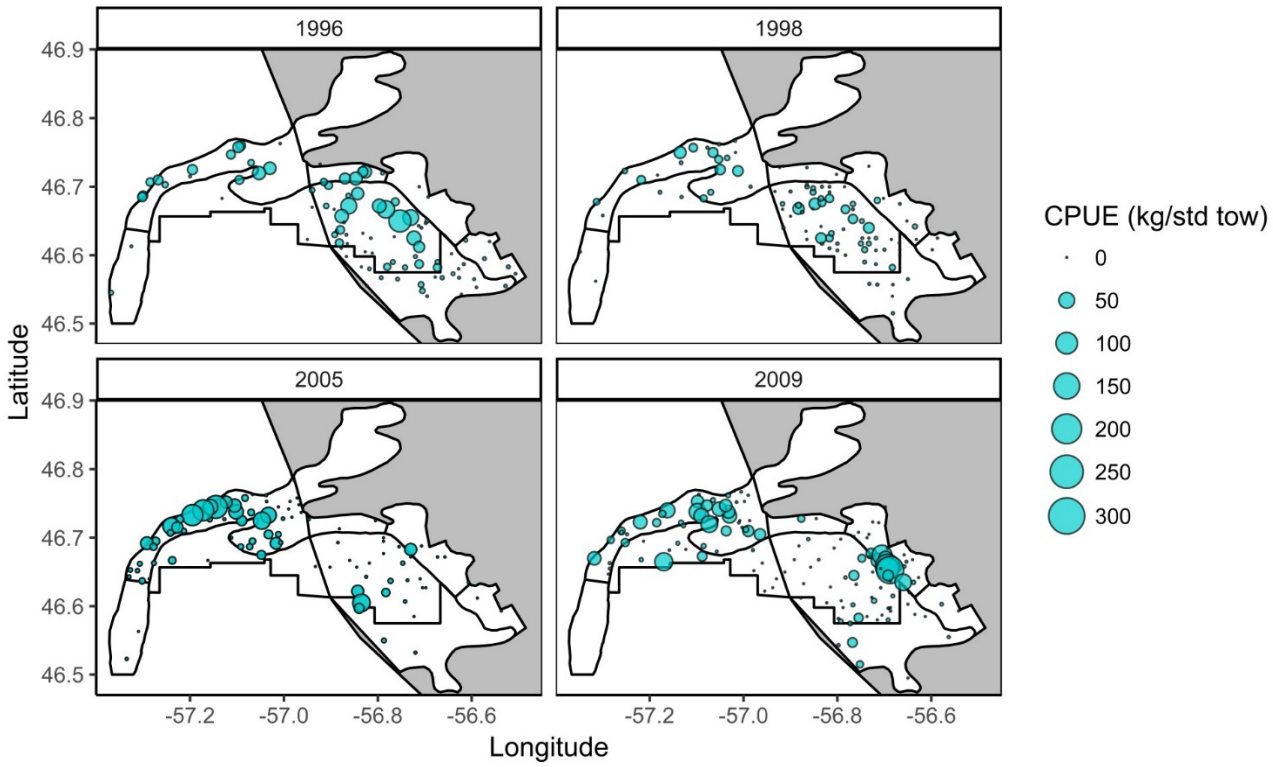

Figure 7. The location of Iceland Scallop catch rates (kg/std tow) in the Canada-France Transboundary (CORE) Area based on Canadian resource assessment surveys in 1996, 1998, 2005, and 2009.

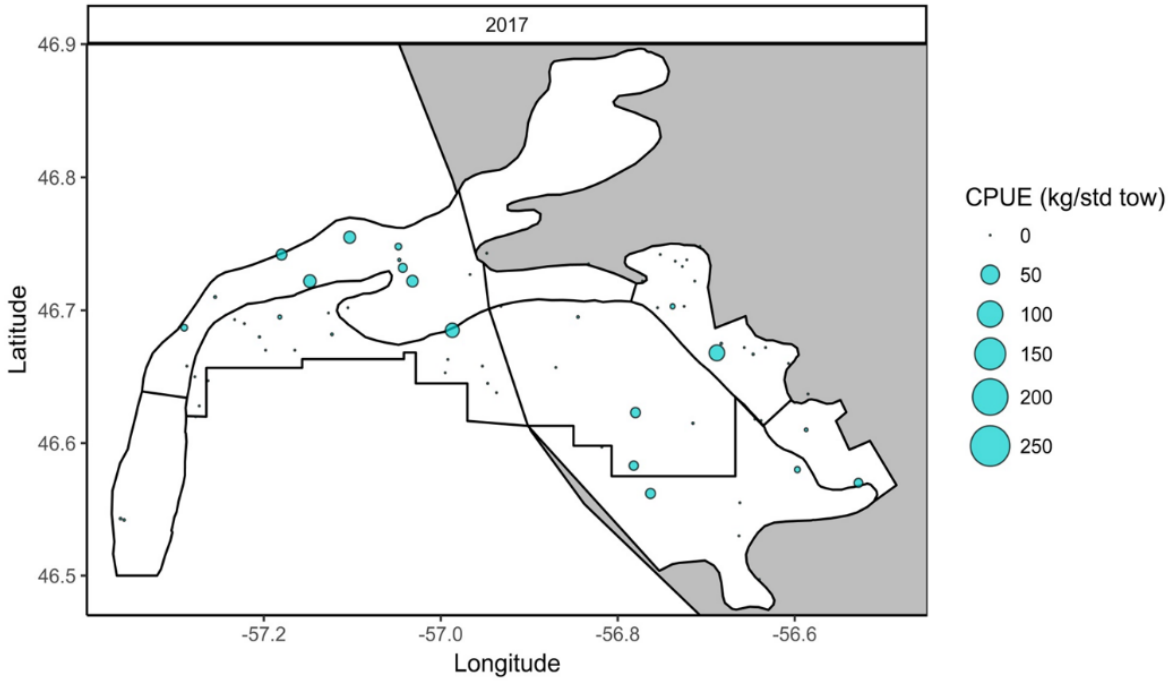

Figure 8 The location of Iceland Scallop catch rates (kg/std tow) in the Canada-France Transboundary (CORE) Area based on Canadian resource assessment survey in 2017.

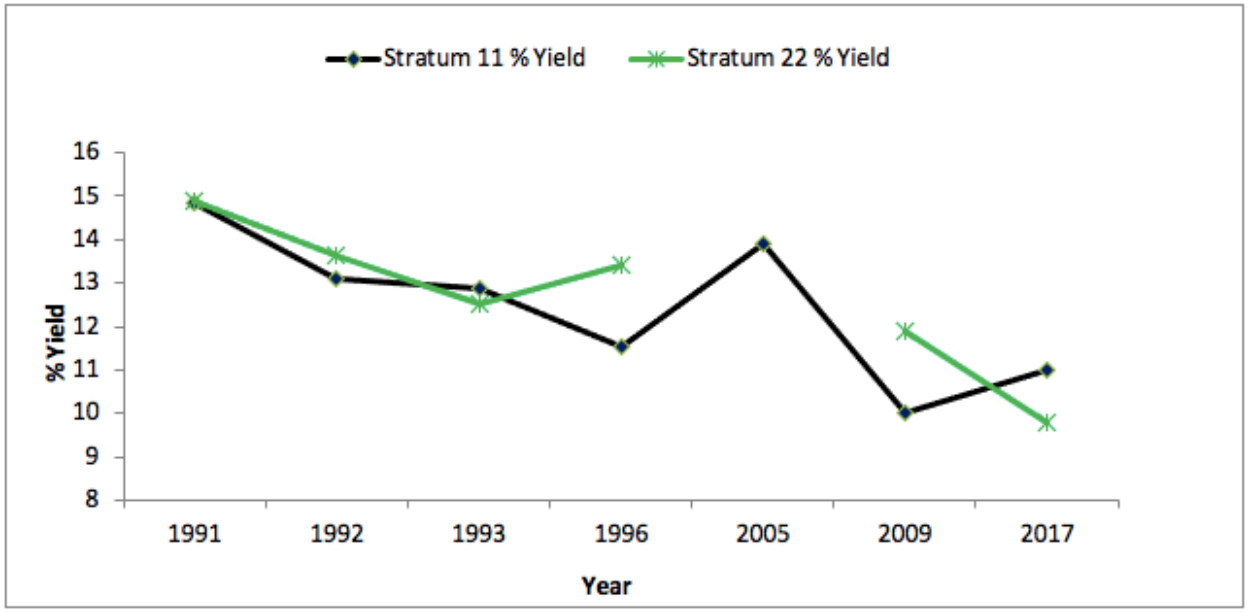

Figure 9. Biological meat yields (% yield) in strata 11 and 22 based on Canadian resource assessment surveys in the Canada-France Transboundary (CORE) Area from 1990 to 2017. Note in 2017 meat yield samples were collected in stratum 12 (lighter shade bar) instead of stratum 11.

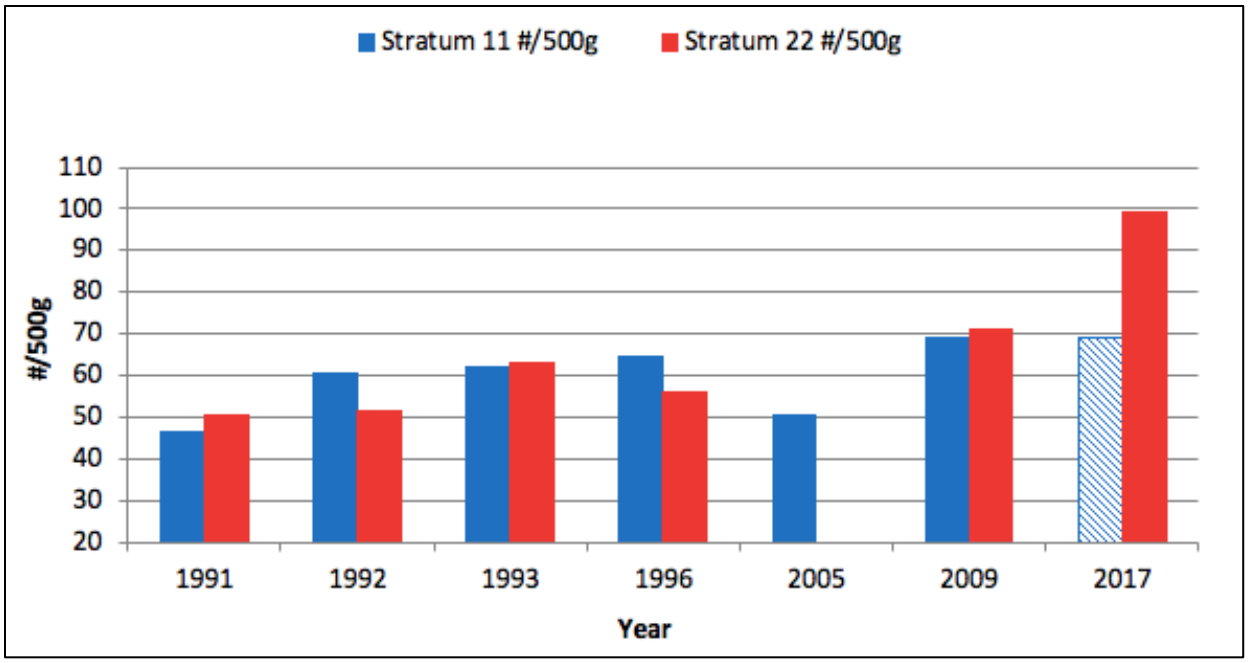

Figure 10. Meat counts (# of meats per 500 g) in strata 11 and 22 (reference strata) based on Canadian resource assessment surveys in the Canada-France Transboundary (CORE) Area from 1990 to 2017. Note in 2017 meat yield samples were collected in stratum 12 (lighter shade bar) instead of stratum 11.

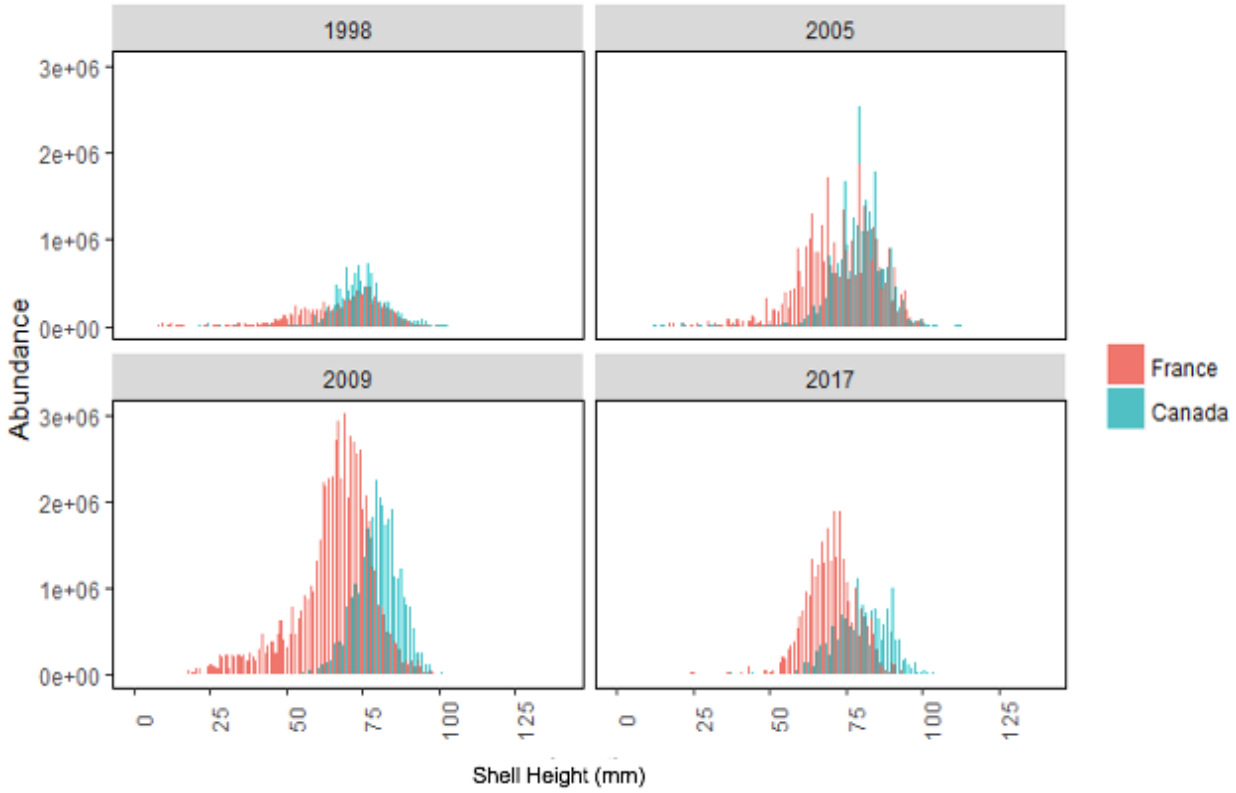

Figure 11. Abundance at length (shell height) in 1998, 2005, 2009 and 2017 in Canadian (strata 11–12) and French (strata 21–25) zones.

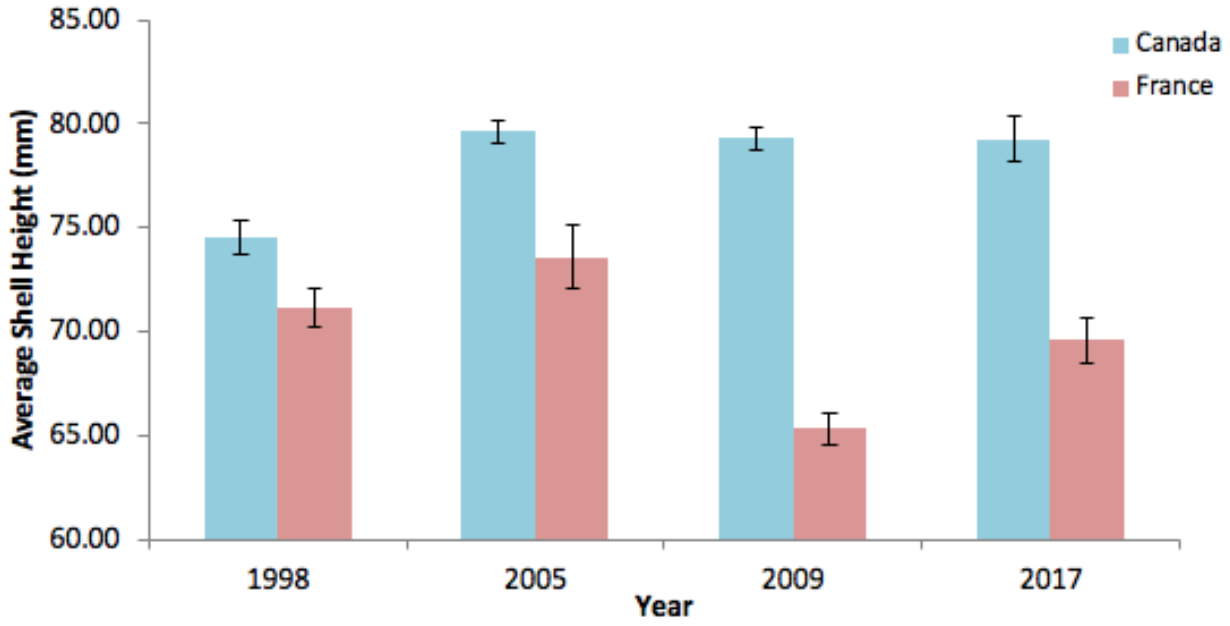

Figure 12. Average shell height (mm) of Iceland Scallop in the Canada-France Transboundary (CORE) Area (Canadian and French zones) based on Canadian research surveys from 1998 to 2017.

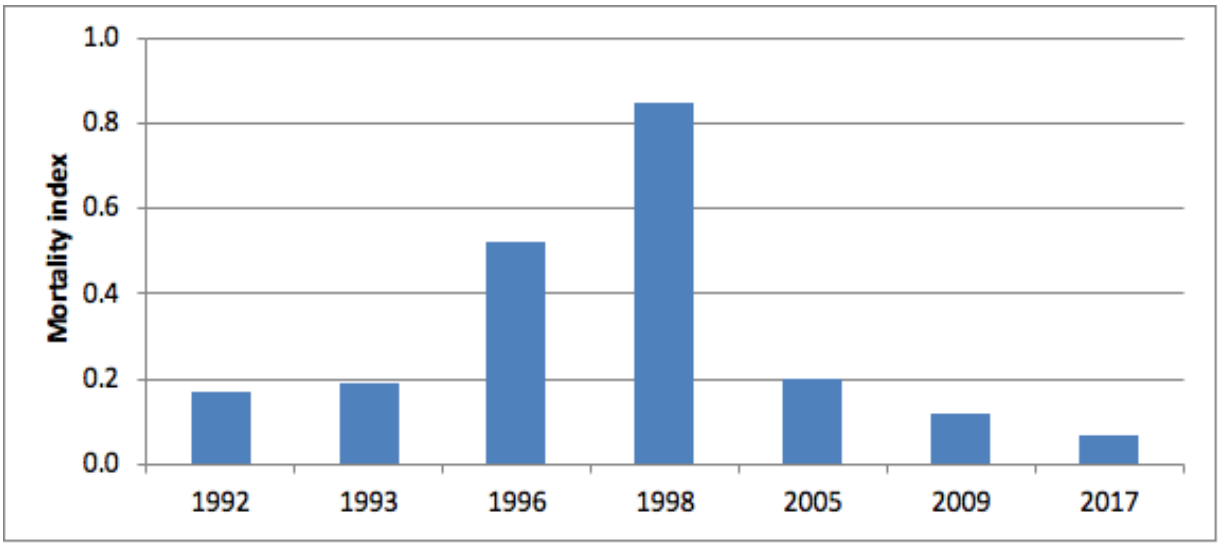

Figure 13. Mortality index for Iceland Scallop the Canada-France Transboundary (CORE) Area, based on Canadian research scallop surveys from 1992 to 2017.

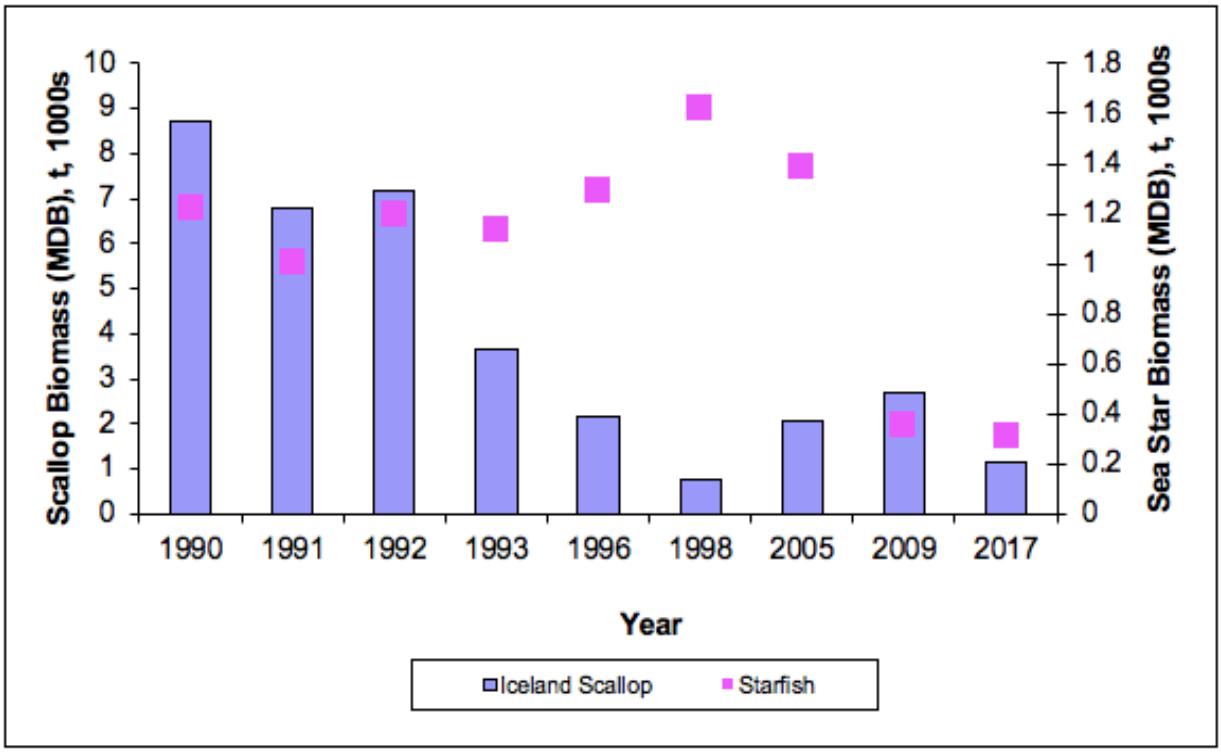

Figure 14. Iceland Scallop and sea star MDB estimates based on Canadian research surveys in the Canada-France Transboundary (CORE) Area from 1990 to 2017.