



STOCK STATUS UPDATE FOR SCALLOP (*PLACOPECTEN MAGELLANICUS*) IN SCALLOP FISHING AREA 29 WEST OF LONGITUDE 65°30'

Context

Harvesting Scallop in SFA 29 West includes commercial and Food, Social, and Ceremonial (FSC) harvesting. Advice on the status of Scallops in Scallop Fishing Area (SFA) 29 west of longitude 65°30' (herein referred to as SFA 29 West) is requested annually by Fisheries and Oceans Canada (DFO) Maritimes Resource and Aboriginal Fisheries Branch to estimate risk of different harvest scenarios and to help determine a Total Allowable Catch (TAC) for the commercial component of the fishery. The last full assessment of SFA 29 West was conducted in 2015 (DFO 2015, Sameoto et al. 2015); updates have been conducted since. The last update was in March 2022 (DFO 2022).

The objectives of this Science Response are to update the status of the SFA 29 West Scallop stocks in 2022, evaluate the consequence of various potential harvest levels for the 2023 fisheries, and evaluate the bycatch of non-target species from available information from the 2022 fishery.

This Science Response Report results from the regional peer review of March 22, 2023, on the Update of Stock Status for Scallop in Scallop Fishing Area 29 West of 65°30'.

Background

The SFA 29 West commercial fishery operates under an Individual Transferable Quota (ITQ) and a TAC, has occurred since 2001, and generally runs from the third week of June to the end of August. Post-fishery surveys in September/October are conducted annually by DFO Science. FSC harvesting also occurs in SFA 29 West, but these removals do not count against the TAC. The current survey design uses the Scallop habitat suitability map developed by Brown et al. (2012). Habitat suitability represents a relative scale of suitable Scallop habitat, with the lowest suitable habitat indicated by 0 and the highest suitable habitat indicated by 1. These probabilities are grouped into three categories defined by the following ranges: Low [0, 0.3), Medium [0.3, 0.6), and High [0.6, 1.0). The population dynamics of commercial and recruit Scallops are modelled using the state-space habitat-based assessment model as defined by Smith et al. (2015). Throughout this update, Scallops with a shell height of 100 mm and greater are referred to as commercial size. Scallops with a shell height of 90–99 mm are referred to as recruits and are expected to grow to commercial size in the following year. Scallops with a shell height of less than 90 mm are considered pre-recruits. Since there was no survey in 2020, the indices used as input for the models in 2020 are imputed using the 2019 and 2021 values; this approach is consistent with methods used to address missing information in previous years for other inshore Scallop stocks (Nasmith et al. 2016).

In this update, Scallop removals include all commercial landings and FSC catch by scallop drag from SFA 29 West. Landed recreational and FSC catch by dip netting, diving, tongs, and hand

are not available and not accounted for in the assessment. However, recreational catch from this area is expected to be minimal (Sameoto et al. 2022).

Description of the Fishery

Scallop Fishing Area 29 encompasses a large area inside the 12-mile territorial sea, from the south of Yarmouth (latitude 43°40'N) to Cape North in Cape Breton. This update refers to only the portion of SFA 29 West of longitude 65°30'W continuing north to Scallop Production Area 3 at latitude 43°40'N (Figure 1). The commercial fishery in this area is fished by the Full Bay (FB) Fleet and the inshore East of Baccaro licence holders who are authorized to fish in SFA 29 West (hereafter referred to as the EoB Fleet). The fishery is managed using limited entry, seasonal closures, minimum shell height, and meat count. The TACs are set, and landings are reported in terms of meat weights (adductor muscles).

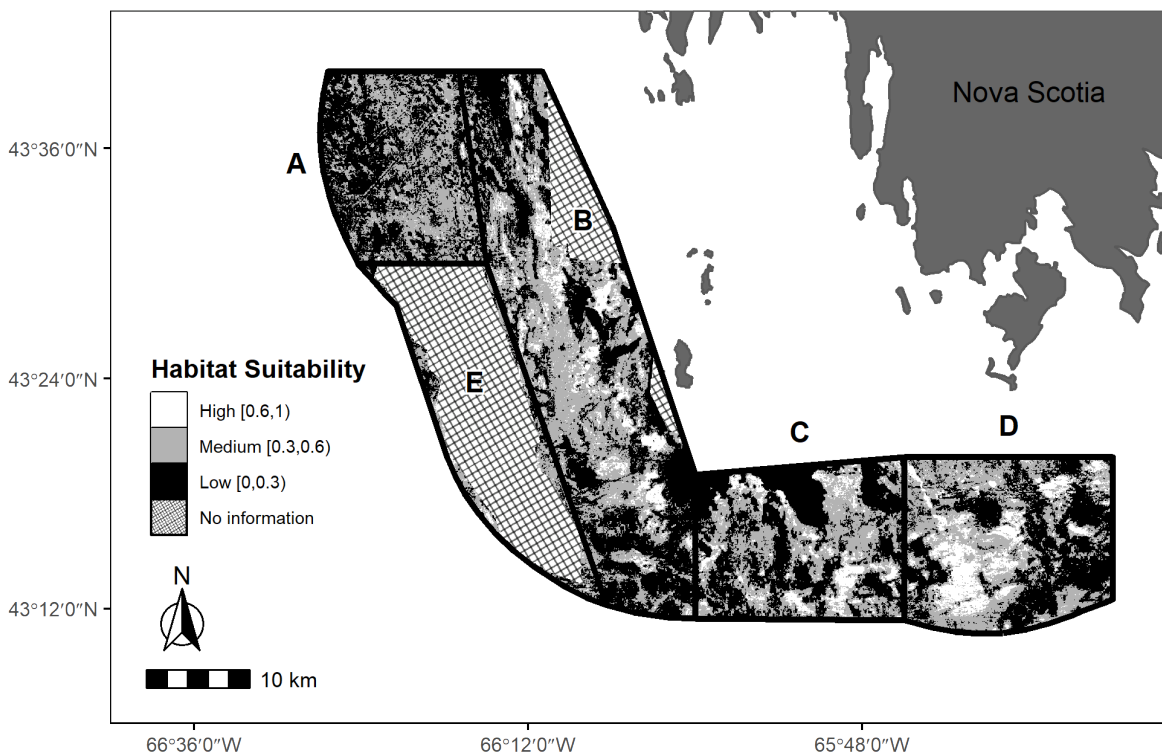


Figure 1. The SFA 29 West Subareas A to E. Shaded areas show habitat suitability probability categories: Low in black, Medium in grey, and High in white (see Brown et al. 2012). Note: SFA 29 extends along the shoreline to Cape North in Cape Breton.

Analysis and Response

Commercial Fishery

Since 2002, the TAC has been shared between the FB and EoB fleets. As of 2010, the TAC and landings are reported for both fleets combined. In 2022, a total of 114.2 tonnes (t) were landed

against the TAC of 120 t. There was an additional FSC catch of 2.7 t, which does not count against the TAC (Figure 2).

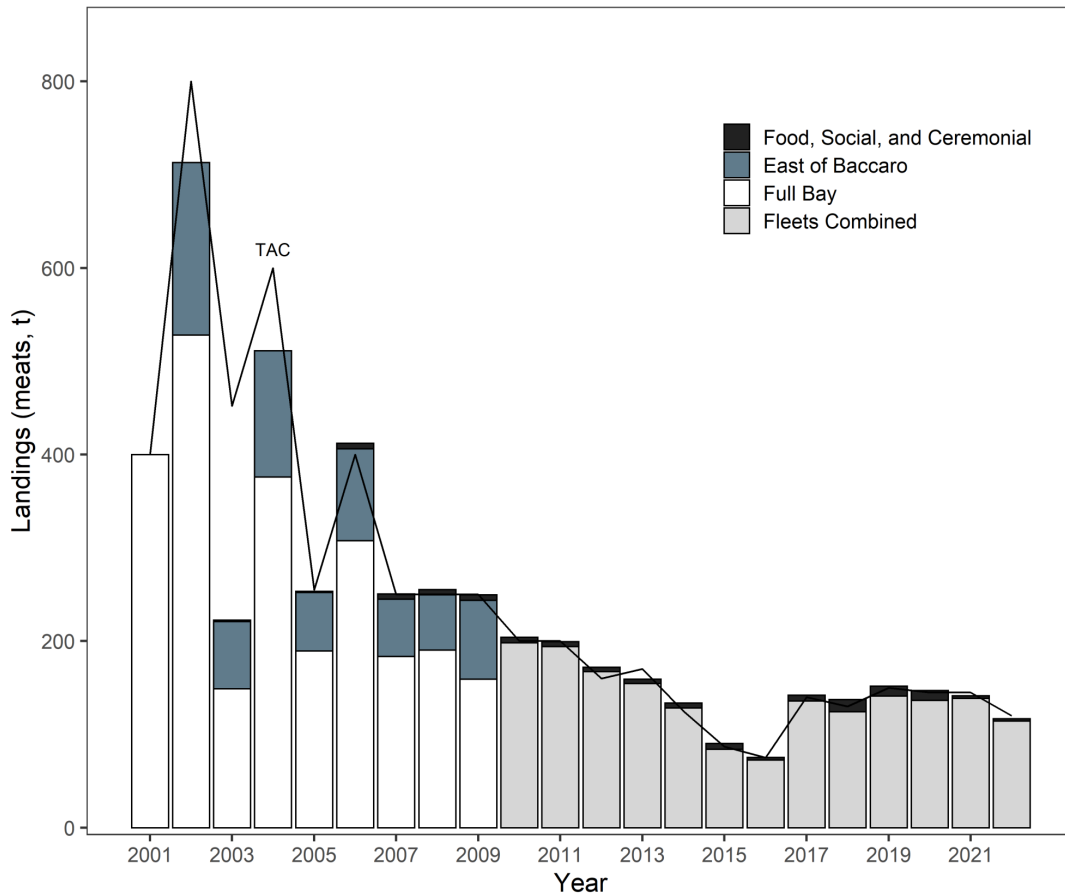


Figure 2. Annual Scallop landings (meats, t) from 2001 to 2022 for Scallop Fishing Area 29 West and the Total Allowable Catch (TAC, black line). Note that the Food, Social, and Ceremonial landings do not count against the TAC.

In 2022, all subareas (A–E) in SFA 29 West were open and were fished (Tables A1–A2). For Subarea A, commercial biomass has been projected to decline annually since 2015, even with zero catch in this Subarea (e.g., DFO 2015, 2019). The fishery in Subarea A was closed in 2015 and 2016, and since 2017 has adopted a fishing plan that includes a dedicated catch limit and vessels fishing Subarea A cannot fish another subarea during the same trip.

For the FB fleet, in Subarea A, the catch rate calculated from fishing logs was 13.1 kg/h in 2022 and 11.7 kg/h in 2021. In Subarea B, the catch rate was 35.8 kg/h in 2022 and 29.0 kg/h in 2021. In Subarea C, the catch rate was 30.2 kg/h in 2022 and 32.7 kg/h in 2021. In Subarea D, the catch rate was 81.0 kg/h in 2022 and 78.6 kg/h in 2021. In Subarea E, the catch rate was 24.2 kg/h in 2022 and no fishing occurred in Subarea E in 2021.

For the EoB Fleet, there was no fishing in Subarea A in 2022 and 2021. In Subarea B, the catch rate from 2022 cannot be reported due to *Privacy Act* considerations and catch rate in 2021 was 32.3 kg/h. In Subarea C, the catch rate was 42.3 kg/h in 2022 and 36.1 kg/h in 2021. In Subarea D, the catch rate was 55.2 kg/h in 2022 and catch rate in 2021 cannot be reported due to *Privacy Act* considerations. No fishing occurred in Subarea E in 2022 or 2021.

Research Survey

The distribution of commercial, recruit, and pre-recruit size Scallop abundances were patchy throughout SFA 29 West (Figures 3–5).

Subarea E was not surveyed between 2005–2012, as it was considered a marginal area and less of a survey priority. Since 2012, a small number of stations (5–8 per year) have been surveyed each year a survey took place. Since 2014 the tows have been allocated within a portion of Subarea E known to have been historically fished; therefore, trends in survey abundance in Subarea E may not be indicative of trends in the Subarea as a whole. In 2022, commercial size abundances were 103.3 per tow, recruit size abundances were 9.8 per tow, and pre-recruit size abundances were 49.4 per tow. In 2021, commercial size abundances were 147.8 per tow, recruit size abundance were 2.7 per tow, and pre-recruit size abundances were 40.9 per tow.

Throughout SFA 29 West, scallop condition (defined as meat weight, in grams, of a 100 mm shell height Scallop) at the time of the 2022 survey ranged from 11.6 g (Subarea A) to 12.6 g (Subarea C). During the 2021 survey, scallop condition ranged from 10.6 g (Subarea A) to 11.0 g (Subarea C).

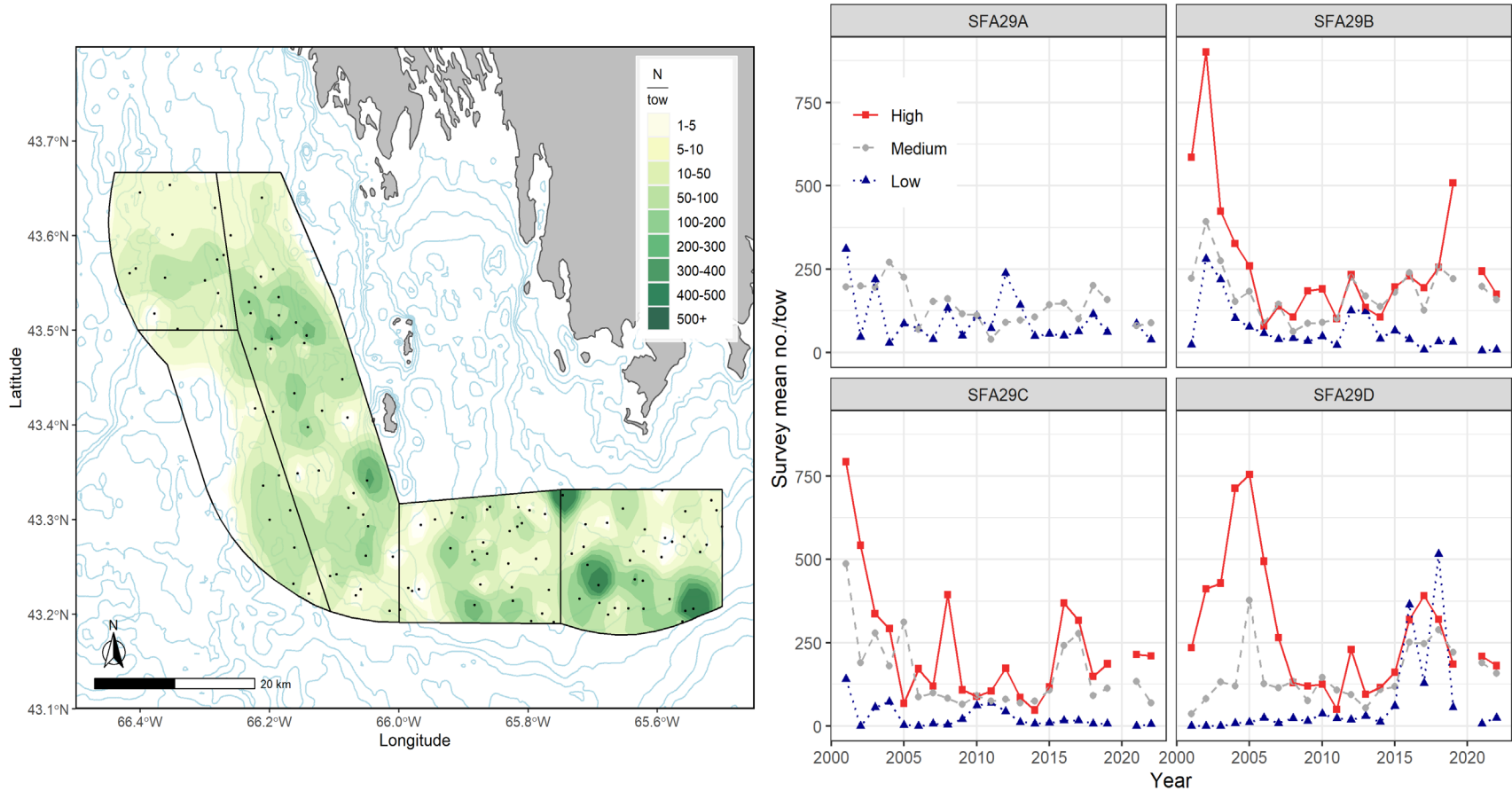


Figure 3. Commercial Scallops (≥ 100 mm shell height). On left: spatial density (numbers/tow) distribution from the 2022 survey for SFA 29 West. Points represent tow locations. On right: mean number per tow by subarea from 2001 to 2022 for Low (dark blue triangles), Medium (grey circles), and High (red squares) categories of habitat suitability. There was no survey in 2020.

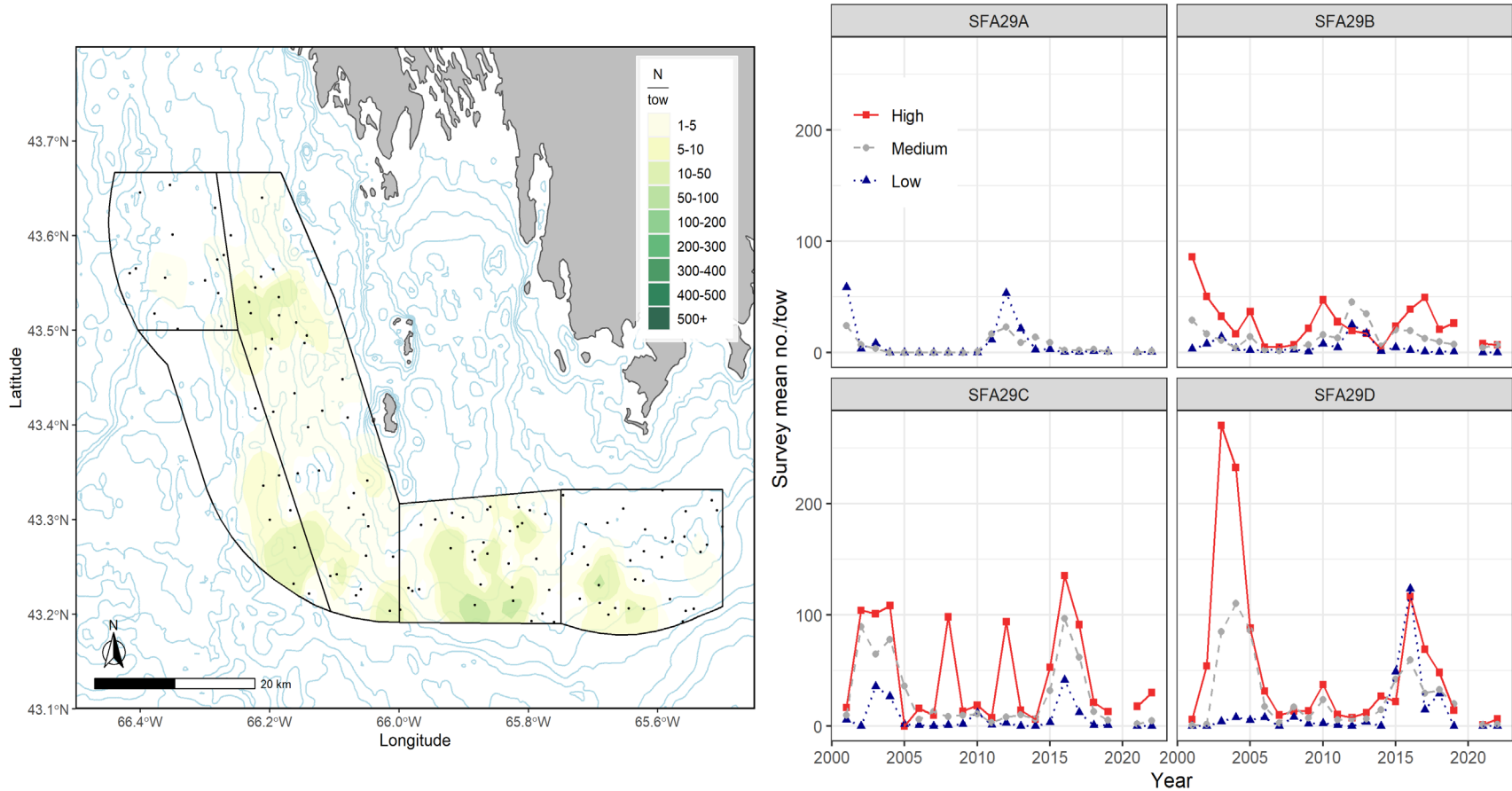


Figure 4. Recruit Scallops (90–99 mm shell height). On left: spatial density (numbers/tow) distribution from the 2022 survey for SFA 29 West. Points represent tow locations. On right: mean number per tow by subarea from 2001 to 2022 for Low (dark blue triangles), Medium (grey circles), and High (red squares) categories of habitat suitability. There was no survey in 2020.

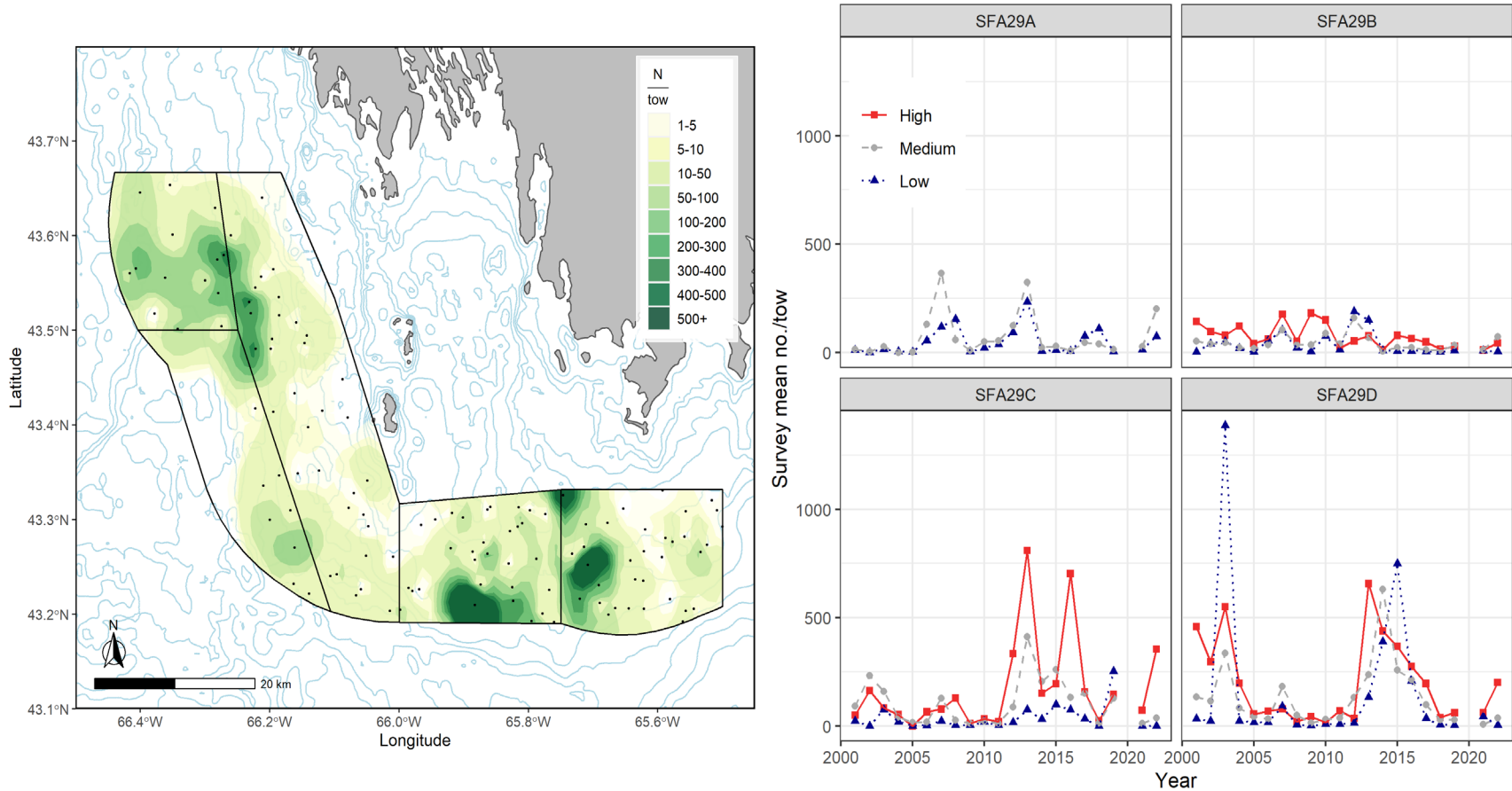


Figure 5. Pre-recruit Scallops (< 90 mm shell height). On left: spatial density (numbers/tow) distribution from the 2022 survey for SFA 29 West. Points represent tow locations. On right: mean number per tow by subarea from 2001 to 2022 for Low (dark blue triangles), Medium (grey circles), and High (red squares) categories of habitat suitability. There was no survey in 2020.

Assessment Model

The state-space habitat-based population model accepted at the framework assessment in February 2014 (Smith et al. 2015) was fit within each habitat suitability category for Subareas A to D. The model was fit to the commercial catch, effort derived from vessel monitoring systems, and survey data. Subarea E is not covered by the habitat suitability map and is not modelled.

Indicators of the Stock Status

The index associated with stock productivity for the DFO precautionary approach for SFA 29 West is commercial biomass density (t/km^2) in the Medium habitat suitability area for Subarea A and the High habitat suitability areas of Subareas B, C, and D (Figure 6); exploitation is managed in these associated habitat areas (Smith and Sameoto 2016). Removal references and Harvest Control Rules (HCRs) are established for Subareas B, C, and D. There are no reference points for Subareas A or E. If the biomass density is above the respective biomass density at Maximum Sustainable Yield (where $D_{MSY} = 3.75, 4.68, 4.32 t/km^2$ for Subareas B, C, and D, respectively), then the maximum exploitation would be 0.16, 0.17, and 0.22, for Subareas B, C, and D, respectively. If the biomass density is below D_{MSY} , then the maximum exploitation would be 0.06, 0.06, and 0.09 for Subareas B, C, and D, respectively. In Subarea A, in 2022, commercial biomass density was $0.9 t/km^2$ in the Medium habitat category. In Subarea B, in 2022, commercial biomass density was $2.6 t/km^2$ in the High habitat category and above the USR. In Subarea C, in 2022, commercial biomass density was $4.8 t/km^2$ in the High habitat category and above both the USR and D_{MSY} . In Subarea D, in 2022, commercial biomass density was $3.4 t/km^2$ in the High habitat category and above the USR (Figure 6).

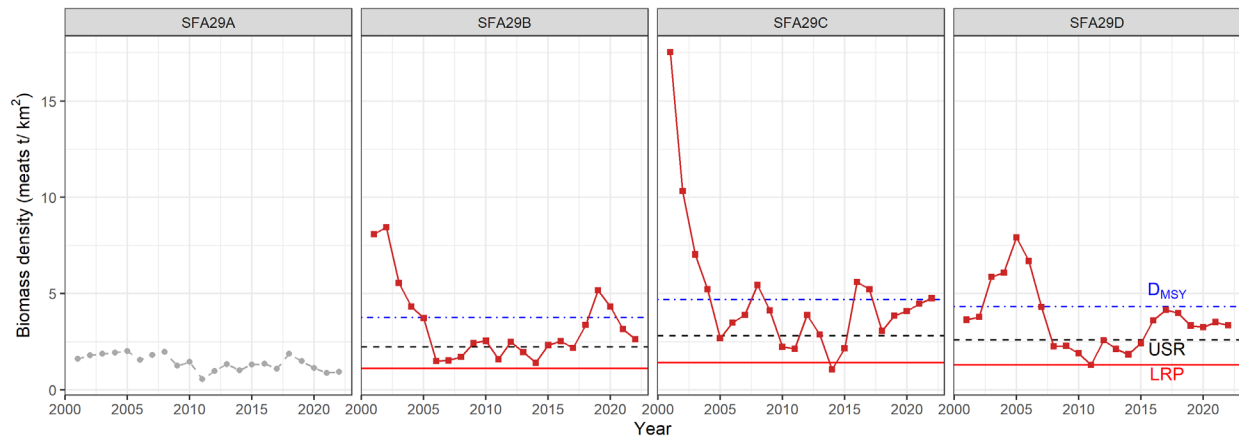


Figure 6. Commercial biomass densities (t/km^2) in SFA 29 West. In Subarea A the Medium suitability category is shown, while the High suitability categories are shown for Subareas B, C, and D. The Limit Reference Points (LRPs) are indicated by the solid (red) line and Upper Stock References (USRs) indicated by the dashed (black) line and the density associated with Maximum Sustainable Yield (D_{MSY}) is indicated by the dot-dashed (blue) line for Subareas B, C, and D. The LRP and USRs are $1.12 t/km^2$ and $2.24 t/km^2$ for Subarea B, $1.41 t/km^2$ and $2.82 t/km^2$ for Subarea C, and $1.3 t/km^2$ and $2.6 t/km^2$ for Subarea D, respectively. The D_{MSY} values are $3.75, 4.68, 4.32 t/km^2$ for Subareas B, C, and D, respectively.

Exploitation

In Subarea A, in 2022, the exploitation was 0.04 (4%) in the Medium habitat category. In Subarea B, in 2022, the exploitation was 0.06 (6%) in the High habitat category. In Subarea C,

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in 2022, the exploitation was 0.12 (12%) in the High habitat category. In Subarea D, in 2022, the exploitation was 0.09 (9%) in the High habitat category (Figure 7).

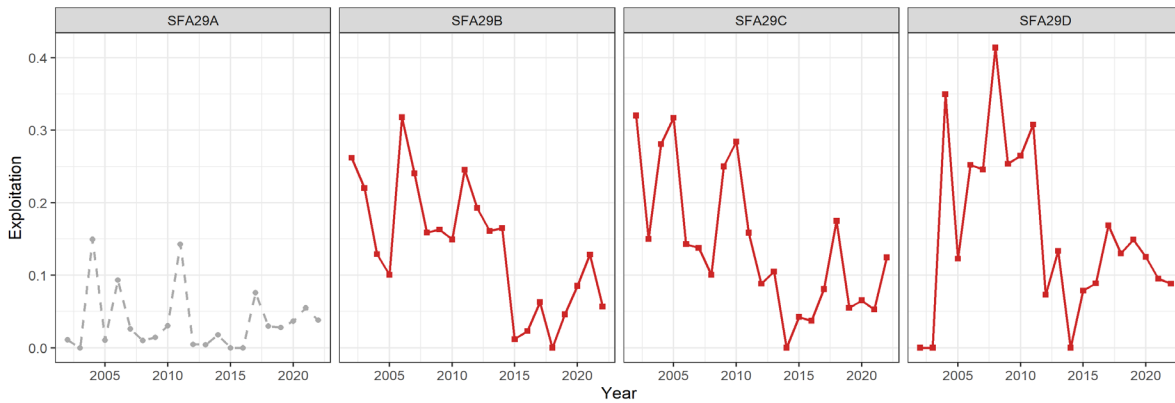


Figure 7. Model estimates of exploitation for the Medium habitat category in Subarea A, and for the High habitat category in Subareas B, C, and D in SFA 29 West.

Natural mortality

In 2022, in Subareas A and B, the natural mortality (instantaneous) model estimates were above their respective long-term medians (2001–2021) and above (Subarea A) and at (Subarea B) their respective 5-year means. In Subareas C and D, the natural mortality (instantaneous) model estimates were below their respective long-term medians (2001–2021) and below their respective 5-year means (Figure 8). In Subarea A, in 2022, natural mortality was 0.63 in the Medium habitat category. In Subarea B, in 2022, natural mortality was 0.25 in the High habitat category. In Subarea C, in 2022, natural mortality was 0.15 in the High habitat category. In Subarea D, in 2022, natural mortality was 0.14 in the High habitat category (Figure 8).

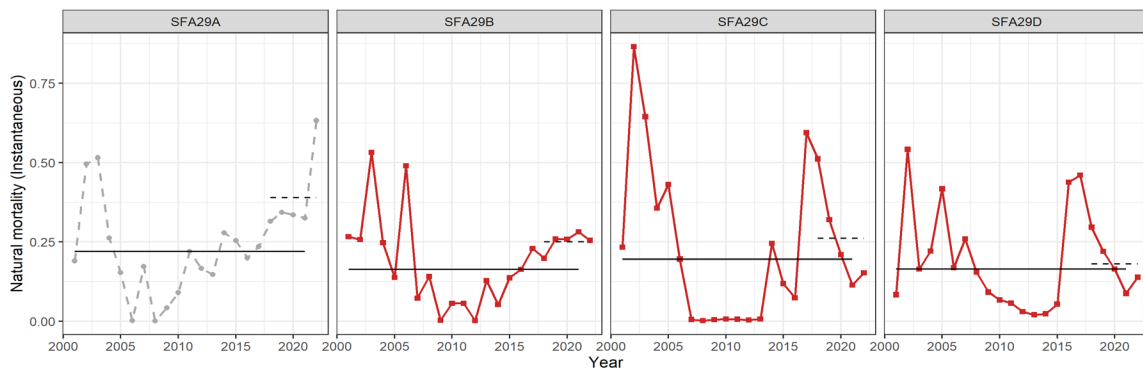


Figure 8. Modelled natural mortality (instantaneous rate) in SFA 29 West. In Subarea A the Medium suitability category is shown, while the High suitability categories are shown for Subareas B, C, and D. The 5-year (2018–2022) mean natural mortality is indicated by the dashed black line and the long-term median (2001–2021) is indicated by the solid black line.

Harvest Level Scenarios for 2023

Catch scenarios for the 2023 fishing season for Subareas A–D are presented in Tables 1–4. Model projections assume 2022 estimates of growth, recruit abundance, and that natural mortality is the mean over the last 5 years (2018–2022) within each subarea. An example of

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how to interpret the catch scenarios in Tables 1–4 is presented using Table 2 for Subarea B. In this Subarea, a total Subarea catch of 28 t corresponds to an exploitation of 0.06 (6%) in the High habitat category, this is projected to result in a 3% biomass decrease in the High habitat category, and the probability of a biomass increase in the High habitat category is 0.47. This is associated with a predicted 0.4% biomass decline in all of Subarea B; the associated probability of biomass increase for all of Subarea B is 0.49. After 28 t of catch is removed, the probability of being above the LRP is 0.91, and the probability of being above the USR is 0.60.

Table 1. Catch scenario table for SFA 29 West Subarea A to evaluate 2023 total subarea catch levels in terms of exploitation (e), expected changes in biomass (%), and probability (Pr.) of biomass increase. Note, Subarea A has no High suitability habitat.

Catch (t)	Medium Habitat Suitability Category			Whole Subarea	
	e	Expected % Change	Pr. Increase	Expected % Change	Pr. Increase
0	0	-19.4	0.34	-14.5	0.35
2	0.02	-21.0	0.33	-16.0	0.34
5	0.04	-22.3	0.32	-17.2	0.33
7	0.06	-24.3	0.30	-19.1	0.31
10	0.08	-25.6	0.29	-20.3	0.30
12	0.10	-27.3	0.28	-21.8	0.28
15	0.12	-28.9	0.26	-23.5	0.26
17	0.14	-30.2	0.25	-24.7	0.25
20	0.16	-31.9	0.24	-26.2	0.24
22	0.18	-33.5	0.22	-27.8	0.22

Table 2. Catch scenario table for SFA 29 West Subarea B to evaluate 2023 total subarea catch levels in terms of exploitation (e), expected changes in biomass (%), probability (Pr.) of biomass increase, and probability of being above the Limit Reference Point (LRP: 1.12 t/km²) and Upper Stock Reference (USR: 2.24 t/km²).

Catch (t)	e	High Habitat Suitability Category				Whole Subarea	
		Expected % Change	Pr. Increase	Pr. > LRP	Pr. > USR	Expected % Change	Pr. Increase
0	0	2.6	0.52	0.93	0.63	2.8	0.54
9	0.02	0.5	0.50	0.92	0.62	1.4	0.52
19	0.04	-1.7	0.49	0.92	0.61	0.8	0.51
28	0.06	-3.0	0.47	0.91	0.60	-0.4	0.49
38	0.08	-6.2	0.45	0.91	0.58	-1.8	0.48
47	0.10	-7.7	0.44	0.90	0.57	-2.5	0.47
56	0.12	-9.9	0.42	0.89	0.55	-3.5	0.45
66	0.14	-12.2	0.40	0.89	0.53	-4.7	0.44
75	0.16	-14.0	0.38	0.88	0.52	-6.0	0.42
85	0.18	-15.7	0.36	0.88	0.51	-6.9	0.41

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Table 3. Catch scenario table for SFA 29 West Subarea C to evaluate 2023 total subarea catch levels in terms of exploitation (e), expected changes in biomass (%), probability (Pr.) of biomass increase, and probability of being above the Limit Reference Point (LRP: 1.41 t/km²) and Upper Stock Reference (USR: 2.82 t/km²).

Catch (t)	e	High Habitat Suitability Category				Whole Subarea	
		Expected % Change	Pr. Increase	Pr. > LRP	Pr. > USR	Expected % Change	Pr. Increase
0	0	9.1	0.55	0.95	0.79	17.1	0.66
6	0.02	8.4	0.55	0.95	0.79	16.6	0.66
12	0.04	5.9	0.53	0.95	0.78	15.2	0.64
18	0.06	2.0	0.51	0.94	0.78	13.4	0.63
25	0.08	0.8	0.50	0.94	0.77	11.5	0.61
31	0.10	-1.1	0.49	0.94	0.76	10.1	0.60
37	0.12	-1.9	0.49	0.93	0.76	9.2	0.59
43	0.14	-5.0	0.47	0.93	0.74	7.5	0.58
49	0.16	-7.1	0.46	0.93	0.73	5.3	0.55
55	0.18	-9.5	0.44	0.92	0.72	4.4	0.54

Table 4. Catch scenario table for SFA 29 West Subarea D to evaluate 2023 total subarea catch levels in terms of exploitation (e), expected changes in biomass (%), probability (Pr.) of biomass increase, and probability of being above the Limit Reference Point (LRP: 1.3 t/km²) and Upper Stock Reference (USR: 2.6 t/km²).

Catch (t)	e	High Habitat Suitability Category				Whole Subarea	
		Expected % Change	Pr. Increase	Pr. > LRP	Pr. > USR	Expected % Change	Pr. Increase
0	0	5.5	0.55	0.96	0.73	-5.3	0.43
8	0.02	3.9	0.54	0.96	0.72	-6.1	0.41
15	0.04	1.6	0.51	0.96	0.70	-7.1	0.40
23	0.06	-0.1	0.50	0.95	0.69	-8.3	0.38
31	0.08	-2.0	0.48	0.95	0.68	-9.3	0.36
38	0.10	-4.4	0.45	0.95	0.65	-10.5	0.35
46	0.12	-6.3	0.43	0.95	0.64	-11.4	0.34
54	0.14	-8.6	0.41	0.94	0.62	-12.7	0.32
61	0.16	-10.5	0.39	0.93	0.61	-13.6	0.31
69	0.18	-12.5	0.37	0.93	0.59	-14.9	0.29
77	0.20	-15.0	0.34	0.92	0.57	-15.8	0.28
84	0.22	-16.7	0.32	0.92	0.56	-16.8	0.27
92	0.24	-19.2	0.30	0.91	0.53	-18.5	0.25

Bycatch Considerations

In 2022 there were no observed trips in the 2022 SFA 29 West scallop fishery. In 2021, there were observed trips, but the data associated with these trips were not available in time for the assessment (DFO 2022). Therefore, the data from observed trips from the 2021 SFA 29 West scallop fishery are presented here. In 2021, there were 33 active vessels in the fishery, 614 observed tows, 26 observed days, and 5 trips observed. The discard rates of all species in the 2021 fishery are presented in Table 5. Most species are within ranges of discards observed in previous years; however, 2021 was the first year that Sea Lamprey discards were recorded (Table 5). For data prior to 2021, see past Stock Status Updates for SFA 29 West (e.g., DFO 2019, 2020).

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Table 5. Inshore Scallop discard rates for bycatch species in SFA 29 West for 2021. Discard rates are the weight of discards (kg) observed divided by the weight of Scallops (kg, meats) landed during the observed trips. Only species that were caught in 2021 are shown.

Species	Rate	Species	Rate	Species	Rate
American Lobster	0.050	Longhorn Sculpin	0.003	Seaweed	0.018
American Plaice	< 0.001	Monkfish	0.017	Sponges	0.003
Atlantic Cod	< 0.001	Sculpins	< 0.001	Starfish	0.007
Atlantic Rock Crab	0.037	Sea Anemone	< 0.001	Thorny Skate	0.004
Common Mussels	0.012	Sea cucumber	0.003	Whelks	0.002
Hermit Crab	0.004	Sea Lamprey	< 0.001	Winter Flounder	0.001
Jonah Crab	0.035	Sea Raven	0.008	Yellowtail Flounder	0.001
Little, Winter Skate	0.017	Sea Scallop	0.465		

Conclusions

In 2022, commercial biomass densities in Subareas B, C, and D are above their respective USRs, with Subarea C being above its D_{MSY} . The stocks in Subareas B, C, and D are considered to be in the Healthy Zone. Indications for Subareas A and E are that the commercial abundance is relatively stable at the current level of removals. For Subarea A, biomass declines are predicted even if no catch is taken in 2023. This is partially due to the elevated natural mortality in the subarea (> 0.2 since 2014) and the continued low levels of recruitment.

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Appendix

Table A1. Total Allowable Catch (TAC), commercial scallop fishery landings, and landings for Food, Social, and Ceremonial purposes (FSC) (meats, tonnes) for Scallop Fishing Area (SFA) 29 West from 2018 to 2022. Asterisk (*) indicates preliminary data. Note that FSC landings do not count against the TAC.

Year	TAC (t)	Commercial Landings (t)	FSC Landings (t)	Total Landings (t)
2018	130	124.3	13.1	137.4
2019	150	141.2	10.5	151.7
2020	145	136.5	10.6	147.1
2021	145	138.5	2.8	141.3
2022*	120	114.2	2.7	116.9

Table A2. Catch Limits, commercial scallop fishery landings, and landings for Food, Social, and Ceremonial purposes (FSC) (meats, tonnes) for Scallop Fishing Area (SFA) 29 West Subareas from 2018 to 2022. The Catch Limits for Subareas A and E are sometimes combined. Dash (-) indicates no catch. Asterisk (*) indicates preliminary data. Note that FSC landings do not count against the Catch Limits.

Year	Subarea	Catch Limit (t)	Commercial Landings (t)	FSC Landings (t)	Total Landings (t)
2018	A	10	8.7	-	8.7
	E	20	12.8	-	12.8
	B	0	0.0	-	0.0
	C	50	46.8	-	46.8
	D	50	56.0	13.1	69.1
2019	A	10	6.8	-	6.8
	E	15	2.2	-	2.2
	B	35	41.2	-	41.2
	C	15	15.0	-	15.0
	D	75	76.0	10.5	86.5
2020	A	10	6.6	-	6.6
	E	15	0.0	-	0.0
	B	75	54.9	-	54.9
	C	15	20.4	-	20.4
	D	30	54.6	10.6	65.2
2021	A	10	8.1	-	8.1
	E	15	0.0	-	0.0
	B	75	67.4	-	67.4
	C	15	17.3	-	17.3
	D	30	45.7	2.8	48.5
2022*	A	10	6.4	-	6.4
	E	15	6.0	-	6.0
	B	25	26.3	-	26.3
	C	40	34.5	-	34.5
	D	30	41.0	2.7	43.7

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