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Maritimes Region

Canadian Science Advisory Secretariat Science Response 2024/021

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 Management 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 2023 (DFO 2023).

The objectives of this Science Response are to update the status of the SFA 29 West Scallop stocks in 2023, evaluate the bycatch of non-target species from available information for the 2023 fishery, and evaluate the consequence of various potential harvest levels for the 2024 fishery.

This Science Response Report results from the regional peer review of February 13, 2024, on the Stock Status Update of Scallop in Scallop Fishing Area (SFA) 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 (e.g., Nasmith et al. 2016).

In this update, Scallop removals include all commercial landings from SFA 29 West and Food, Social, and Ceremonial (FSC) catch by Scallop drag. 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 that portion of SFA 29 West of longitude 65°30′W continuing north to Scallop Production Area 3 at latitude 43°40′N (Figure 1). 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).

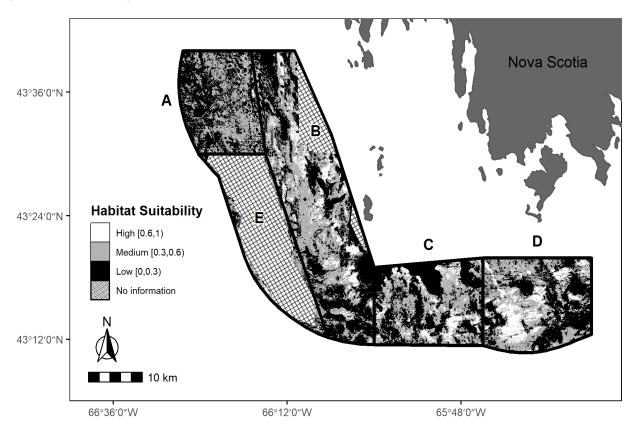


Figure 1. The SFA 29 West Subareas A to E. Shaded areas show habitat suitability probability categories: Low in black, Medium in grey, and High in white (see Brown et al. 2012). Note: SFA 29 extends along the shoreline to Cape North in Cape Breton.

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 2023, a total of 128.9 tonnes (t) were landed against the TAC of 135 t. There was an additional FSC catch of 11.4 t, which does not count against the TAC (Figure 2).

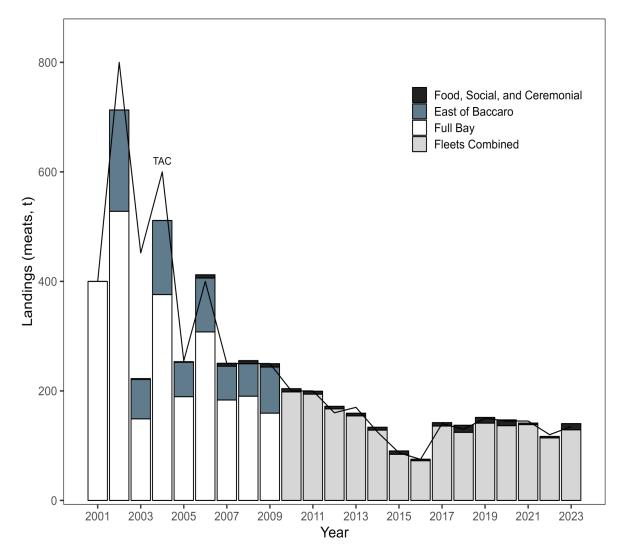


Figure 2. Annual Scallop landings (meats, t) from 2001 to 2023 for Scallop Fishing Area 29 West and the Total Allowable Catch (TAC, black line). Note that the Food, Social, and Ceremonial landings do not count against the TAC.

In 2023, 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 (DFO 2015, 2016, 2017, 2018, 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 18.4 kg/h in 2023 and 13.1 kg/h in 2022. In Subarea B, the catch rate was 62.8 kg/h in 2023 and 35.8 kg/h in 2022. In Subarea C, the catch rate was 63.7 kg/h in 2023 and 30.2 kg/h in 2022. In Subarea D, the catch rate was 108.4 kg/h in 2023 and 81.0 kg/h in 2022. In Subarea E, the catch rate was 42.9 kg/h in 2023 and 24.2 kg/h in 2022.

For the EoB Fleet in Subarea A, the catch rate calculated from fishing logs was 17.9 kg/h in 2023 and there was no fishing in 2022. In Subarea B, the catch rate was 47.8 kg/h in 2023 and the 2022 catch rate cannot be reported due to *Privacy Act* considerations. In Subarea C, the

catch rate was 68.2 kg/h in 2023 and 42.3 kg/h in 2022. In Subarea D, the catch rate from 2023 cannot be reported due to *Privacy Act* considerations and the catch rate was 55.2 kg/h in 2022. No fishing occurred in Subarea E in 2023 or 2022.

Research Survey

Scallop condition (meat weight given shell height) in 2023, as measured by the SFA 29 West Inshore Scallop Survey was the highest observed in the time series (Figure 3). Although, changes in commercial size Scallop abundance between 2022 and 2023 ranged from a decline of 22% (Subarea B) to an increase of 26% (Subarea C), biomass densities increased by 23%–53%; the increase in biomass was primarily driven by condition (Figure 3). It is noted that significant declines (up to 24%) in Scallop condition between subsequent years has previously been observed.

The distribution of commercial, recruit, and pre-recruit size Scallop abundances were patchy throughout SFA 29W (Figures 4–6).

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 2023, commercial size abundances were 135.5 per tow, recruit size abundances were 9.5 per tow, and pre-recruit size abundances were 103.3 per tow, recruit size abundances were 49.4 per tow.

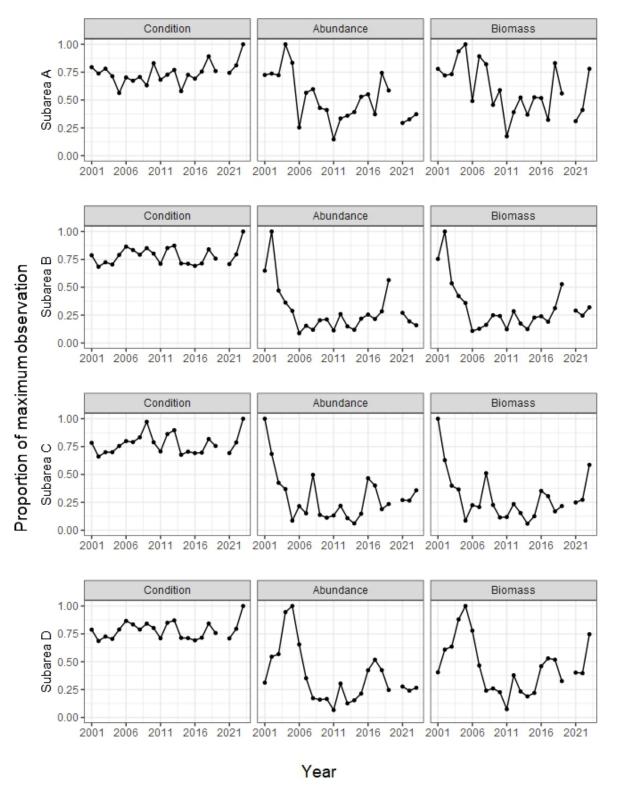


Figure 3. Survey indices of Scallop condition, abundance, and biomass presented as proportions relative to the time-series maximum for SFA 29 West Subareas A–D. Abundance and biomass indices are for the Medium habitat suitability area for Subareas A and the High habitat suitability area for Subareas B, C, and D. There was no survey in 2020.

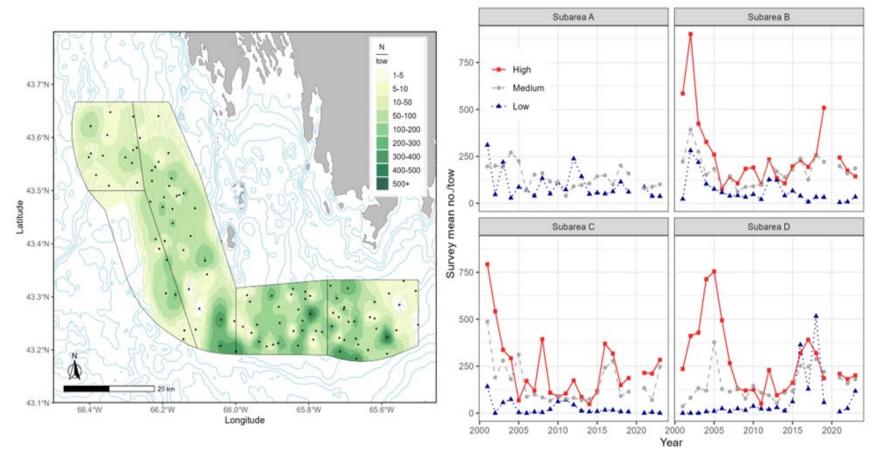


Figure 4. Commercial Scallops (≥ 100 mm shell height). On left: spatial density (numbers/tow) distribution from the 2023 survey for SFA 29 West. Points represent tow locations. On right: mean number per tow by subarea from 2001 to 2023 for Low (dark blue triangles), Medium (grey circles), and High (red squares) categories of habitat suitability. There was no survey in 2020.

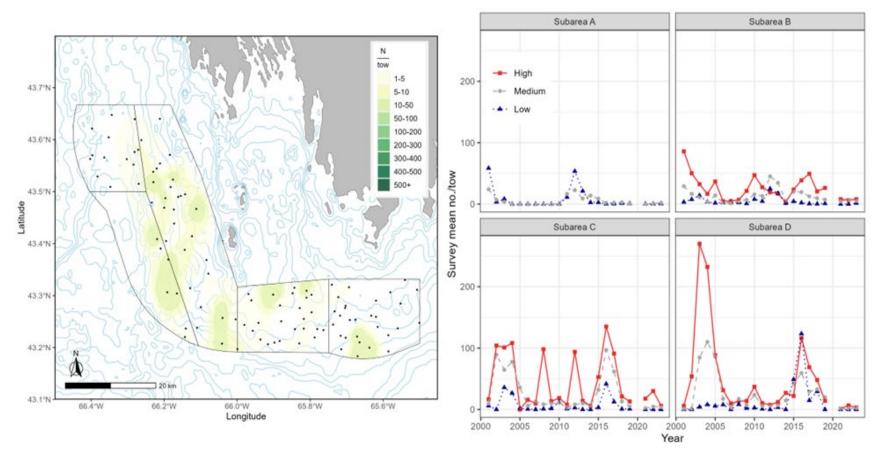


Figure 5. Recruit Scallops (90–99 mm shell height). On left: spatial density (numbers/tow) distribution from the 2023 survey for SFA 29 West. Points represent tow locations. On right: mean number per tow by subarea from 2001 to 2023 for Low (dark blue triangles), Medium (grey circles), and High (red squares) categories of habitat suitability. There was no survey in 2020.

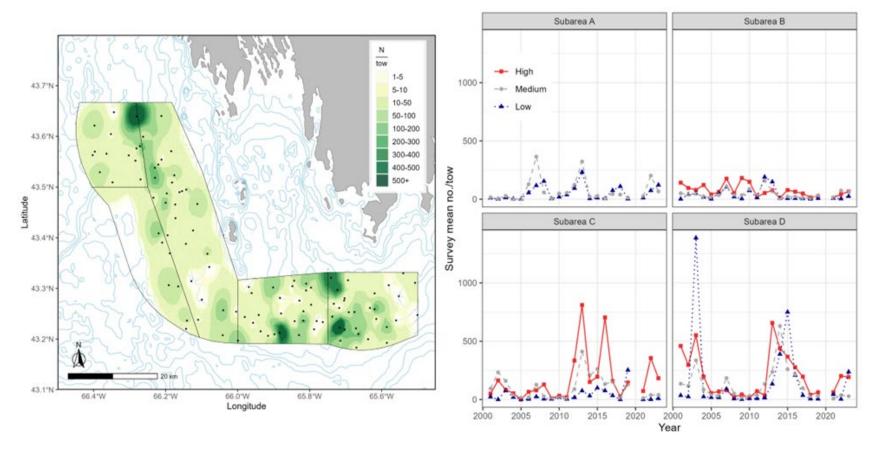


Figure 6. Pre-recruit Scallops (< 90 mm shell height). On left: spatial density (numbers/tow) distribution from the 2023 survey for SFA 29 West. Points represent tow locations. On right: mean number per tow by subarea from 2001 to 2023 for Low (dark blue triangles), Medium (grey circles), and High (red 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 for Subareas A to D using the habitat suitability categories from Brown et al. (2012). 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 7); 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 (proportion) 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 2023, commercial biomass density was 1.9 t/km^2 in the Medium habitat category. In Subarea B, in 2023, commercial biomass density was 3.3 t/km^2 in the High habitat category and above D_{MSY} . In Subarea D, in 2023, commercial biomass density was 6.1 t/km^2 in the High habitat category and above D_{MSY} . In Subarea D, in 2023, commercial biomass density was 6.1 t/km^2 in the High habitat category and above D_{MSY} . (Figure 7).

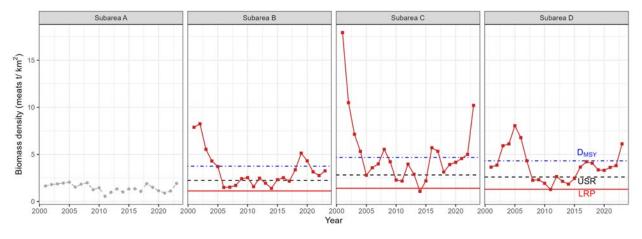


Figure 7. Commercial biomass densities (t/km²) in SFA 29 West. In Subarea A the Medium suitability category is shown, while the High suitability categories are shown for Subareas B, C, and D. The limit reference points (LRPs) are indicated by the solid (red) line and upper stock references (USRs) indicated 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 LRPs and USRs are 1.12 t/km² and 2.24 t/km² for Subarea B, 1.41 t/km² and 2.82 t/km² for Subarea C, and 1.3 t/km² and 2.6 t/km² for Subarea D, respectively. The D_{MSY} values are 3.75, 4.68, 4.32 t/km² for Subareas B, C, and D, respectively.

Exploitation

In Subarea A, in 2023, the exploitation (proportion) was 0.03 in the Medium habitat category. In Subarea B, in 2023, the exploitation was 0.06 in the High habitat category. In Subarea C, in

2023, the exploitation was 0.08 in the High habitat category. In Subarea D, in 2023, the exploitation was 0.05 in the High habitat category (Figure 8).

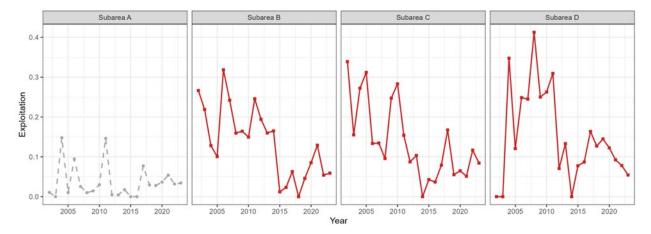


Figure 8. Model estimates of exploitation (proportion) for the Medium habitat category in Subarea A, and for the High habitat category in Subareas B, C, and D in SFA 29 West.

Natural mortality

In 2023, in Subareas A, B, and C, the natural mortality (instantaneous) model estimates were above their respective long-term medians (2001–2022) and above their respective 5-year means. In Subarea D, the natural mortality (instantaneous) model estimate was below its long-term median (2001–2022) and below its 5-year mean (Figure 9). In Subarea A, in 2023, natural mortality was 0.56 in the Medium habitat category. In Subarea B, in 2023, natural mortality was 0.34 in the High habitat category. In Subarea C, in 2023, natural mortality was 0.19 in the High habitat category. In Subarea D, in 2023, natural mortality was 0.11 in the High habitat category (Figure 9).

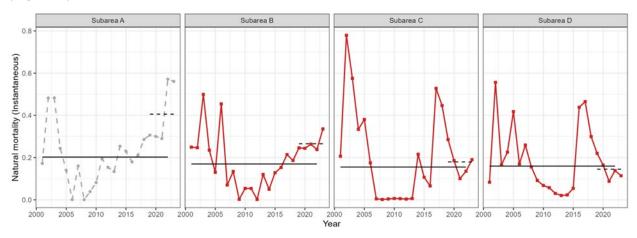


Figure 9. Modelled natural mortality (instantaneous rate) in SFA 29 West. In Subarea A the Medium suitability category is shown, while the High suitability categories are shown for Subareas B, C, and D. The 5-year (2019–2023) mean natural mortality is indicated by the dashed black line and the long-term median (2001–2022) is indicated by the solid black line.

Harvest Level Scenarios and Considerations for 2024

The basis for harvest advice is one-year projections from the models. Model projections use current year estimates of growth, recruit abundance, and natural mortality is the average over the last 5 years (2019–2023) within each subarea. However, in 2023, Scallop condition, which impacts growth rate (Nasmith et al. 2016), was the highest in the time series (38%, 27%, 32%, and 27% higher than the long-term medians for Subareas A, B, C, and D, respectively). The basis for science advice to management assumes condition is unchanged from the current year (Nasmith et al. 2016); however, if Scallop condition declines in 2024 it is likely that the harvest scenario tables presented in this document (Tables 1–4) will overestimate the actual biomass (Figure A1). Given that condition has largely driven the 2023 biomass increase, that condition is well above historically observed values in each subarea, and that significant change in Scallop condition between subsequent years has previously been observed, caution is advised when setting the removal limits for 2024–25.

In Subareas C and D, the stocks are above D_{MSY} ; the current Harvest Control Rule (HCR) permits maximum exploitation rates of 0.17 and 0.22, respectively. This HCR was developed under the assumption that increasing biomass densities would be driven by increases in the abundance (number) of Scallop. As shown by Figure 3, this was not the case in 2023. Caution is, therefore, advised when using these HCRs as a decline in Scallop condition could result in exploitation rates exceeding the HCR removal reference rate (Figure A1).

An example of how to interpret the harvest scenarios in Tables 1–4 is presented using Table 2 for Subarea B. In this Subarea, a total subarea catch of 57 t corresponds to an exploitation of 0.06 (6%) in the High habitat category, this is projected to result in a 21.3% biomass increase in the High habitat category, and the probability of a biomass increase in the High habitat category is 0.66. This is associated with a predicted 10.2% biomass increase in all of Subarea B; the associated probability of biomass increase for all of Subarea B is 0.63. After 57 t of catch is removed, the probability of being above the LRP is 0.98, and the probability of being above the USR is 0.84.

Table 1. Harvest scenario table for SFA 29 West Subarea A to evaluate 2024 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.

	Medium Habitat Suitability Category			Whole Subarea		
		Expected	Pr.	Expected	Pr.	
Catch (t)	e	% Change	Increase	% Change	Increase	
0	0	-15.3	0.34	-6.8	0.42	
6	0.03	-16.0	0.34	-7.7	0.41	
12	0.05	-16.9	0.33	-8.5	0.40	
19	0.07	-17.8	0.32	-9.6	0.38	
25	0.10	-18.9	0.31	-10.7	0.37	

Table 2. Harvest scenario table for SFA 29 West Subarea B to evaluate 2024 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).

		High Habit	Whole Subarea				
		Expected	Pr.			Expected	Pr.
Catch (t)	e	% Change	Increase	Pr. > LRP	Pr. > USR	% Change	Increase
0	0	29.2	0.70	0.98	0.86	12.7	0.66
19	0.02	26.6	0.69	0.98	0.85	11.8	0.65
38	0.04	24.1	0.67	0.98	0.85	11.2	0.64
57	0.06	21.3	0.66	0.98	0.84	10.2	0.63
76	0.08	19.7	0.65	0.98	0.83	9.4	0.62

Table 3. Harvest scenario table for SFA 29 West Subarea C to evaluate 2024 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).

		High Habit	Whole Subarea				
		Expected	Pr.			Expected	Pr.
Catch (t)	e	% Change	Increase	Pr. > LRP	Pr. > USR	% Change	Increase
0	0	13.9	0.59	> 0.99	0.97	15.5	0.66
28	0.02	13.6	0.59	> 0.99	0.97	14.8	0.65
56	0.05	11.8	0.58	> 0.99	0.97	14.0	0.65
85	0.07	9.0	0.56	0.99	0.97	12.7	0.63
113	0.10	8.7	0.56	0.99	0.97	12.5	0.63
141	0.12	7.1	0.55	0.99	0.97	11.4	0.62
169	0.14	5.8	0.54	0.99	0.97	10.4	0.61
197	0.16	3.4	0.52	0.99	0.96	10.0	0.61
226	0.18	3.3	0.52	0.99	0.96	8.7	0.59

Table 4. Harvest scenario table for SFA 29 West Subarea D to evaluate 2024 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).

·		High Habitat Suitability Category					Whole Subarea	
		Expected	Pr.			Expected	Pr.	
Catch (t)	e	% Change	Increase	Pr. > LRP	Pr. > USR	% Change	Increase	
0	0	19.9	0.69	> 0.99	0.98	-4.3	0.43	
19	0.02	18.7	0.68	> 0.99	0.97	-5.0	0.41	
37	0.05	17.4	0.67	> 0.99	0.97	-6.0	0.40	
56	0.07	15.5	0.65	> 0.99	0.97	-6.9	0.38	
75	0.09	14.5	0.64	> 0.99	0.97	-7.2	0.37	
93	0.11	13.0	0.63	> 0.99	0.97	-7.9	0.36	
112	0.14	11.5	0.62	> 0.99	0.97	-8.6	0.35	
131	0.16	9.7	0.60	> 0.99	0.96	-9.6	0.33	
149	0.18	8.0	0.58	> 0.99	0.96	-10.2	0.32	
168	0.20	6.0	0.56	> 0.99	0.96	-10.7	0.31	
187	0.22	4.1	0.54	> 0.99	0.95	-11.8	0.29	

Bycatch Considerations

In 2023, there were 29 active vessels in the fishery and 7 trips observed corresponding to 20 observed days. Of the 7 observed trips, complete data from 5 observed trips were usable for this assessment. The discard rates of all species in the 2023 fishery are presented in Table 5. All species are within ranges of discards observed in previous years. For data prior to 2023, see past Stock Status Updates for SFA 29 West (e.g., DFO 2019, 2020).

Table 5. Inshore Scallop discard rates for bycatch species in SFA 29 West for 2023. 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 2023 are shown.

Species	Rate	Species	Rate	Species	Rate
American Lobster	0.032	Jonah Crab	0.228	Sea Cucumber	0.006
Atlantic Cod	< 0.001	Little, Winter Skate	0.031	Sea Raven	0.003
Atlantic Rock Crab	0.001	Longhorn Sculpin	0.021	Sea Scallop	0.327
Haddock	< 0.001	Monkfish	0.023	Unidentified Flounder	< 0.001
Hermit crab	0.004	Sculpins	0.033	Winter Flounder	< 0.001

Conclusions

In 2023, commercial biomass densities in Subareas B, C, and D are above their respective USRs, with Subarea C and D being above their respective D_{MSYs}. 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 2024. In 2023, Scallop condition was well above historically observed values; this resulted in substantial increases in biomass densities across SFA 29 West without concomitant increases in abundance in these areas. If condition declines in 2024 then the realized exploitation rates will be higher than in the tables presented here. Given condition has largely driven the 2023 biomass increase, that condition is well above historically observed values in each subarea, and that significant change in Scallop condition between subsequent years has previously been observed, caution is advised when setting the removal limits for 2024–25.

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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, t) for Scallop Fishing Area (SFA) 29 West from 2019 to 2023. Asterisk (*) indicates preliminary data. Note that the Food, Social, and Ceremonial landings do not count against the TAC.

Year	TAC (t)	Commercial Landings (t)	FSC Landings (t)	Total Landings (t)
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
2023*	135	128.9	11.4	140.3

Table A2. Catch Limits, commercial Scallop fishery landings, and landings for Food, Social and Ceremonial purposes (FSC) (meats, t) for Scallop Fishing Area (SFA) 29 West Subareas from 2019 to 2023. The Catch Limits for Subareas A and E are sometimes combined. Dash (-) indicates no catch. Asterisk (*) indicates preliminary data. Note that the Food, Social, and Ceremonial landings do not count against the Catch Limits.

Year	Subarea	Catch Limit (t)	Commercial Landings (t)	FSC Landings (t)	Total Landings (t)
2019	Α	10	6.8	=	6.8
	E	15	2.2	-	2.2
	В	35	41.2	-	41.2
	С	15	15.0	-	15.0
	D	75	76.0	10.5	86.5
2020	Α	10	6.6	-	6.6
	E	15	0.0	-	0.0
	В	75	54.9	-	54.9
	С	15	20.4	-	20.4
	D	30	54.6	10.6	65.2
2021	Α	10	8.1	-	8.1
	E	15	0.0	-	0.0
	В	75	67.4	-	67.4
	С	15	17.3	-	17.3
	D	30	45.7	2.8	48.5
2022	Α	10	6.4	-	6.4
	Е	15	6.0	-	6.0
	В	25	26.3	-	26.3
	С	40	34.5	-	34.5
	D	30	41.0	2.7	43.7
2023*	Α	10	10.2	-	10.2
	E	15	11.7	-	11.7
	В	28	29.0	-	29.0
	С	50	46.2	-	46.2
	D	32	31.8	11.4	43.2

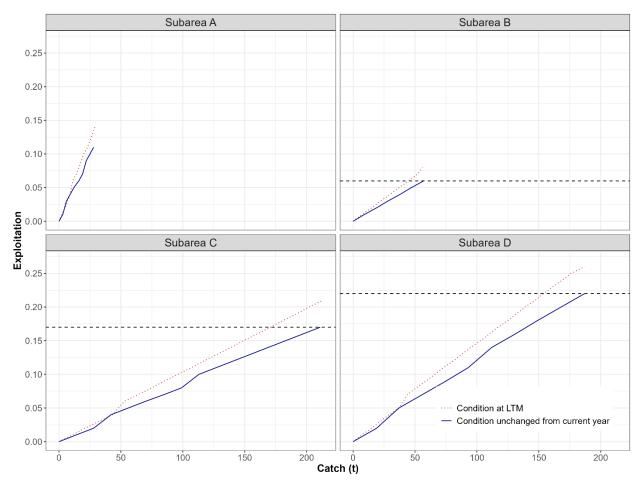


Figure A1. Catch (tonnes) and Exploitation scenarios for SFA 29 West subareas A–D for the 2024–25 fishing season assuming Scallop condition is unchanged from the current year (blue solid line, Tables 1–4), and if condition declines to the Subarea's respective long-term median (LTM; dotted red line). The black horizontal dashed lines indicate the removal reference exploitations, where Subarea B is 0.06, Subarea C is 0.17, and Subarea D is 0.22. There is no removal reference exploitation for Subarea A.

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