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SCIENTIFIC COUNCIL MEETING – NOVEMBER 2024

New preliminary data on VME encounters in NAFO Regulatory Area (Divs. 3LMNO) from EU: EU-Spain and Portugal Groundfish Surveys (2024) and Canadian surveys (Fall 2023 & Spring 2024).

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Abstract

New preliminary data on deep-water corals and sponges from the 2024 EU, EU-Spain, and Portugal, as well as the 2023-2024 Canadian bottom trawl groundfish surveys, have been made available to improve the mapping of Vulnerable Marine Ecosystems (VMEs) indicator species in the NAFO Regulatory Area (Divs. 3LMNO). The results include distribution maps of new records of presence (both non-significant and significant catches) of VME indicator species by VME species group. Additionally, the species composition of VME taxa for significant catches has been included.

1. Introduction

During the 17th NAFO Working Group on Ecosystem Science and Assessment (WGESA) blended meeting (virtual and in presence) meeting new preliminary data on deep-water corals and sponges were presented from the 2024 EU: EU-Spain and Portugal and 2023-2024 Canadian bottom trawl groundfish surveys. These data were made available to the NAFO WGESA to improve mapping of Vulnerable Marine Ecosystem (VME) indicator species in the NAFO Regulatory Area (Divs. 3LMNO).

During the 6th meeting of the NAFO Scientific Council WGESA, new quantitative spatial analyses were applied for corals and sponges for all the available data within the NAFO Regulatory Area (NAFO, 2013). Outcomes from those analyses produced the following thresholds for VME indicator species: 75 kg per tow for sponges, 0.6 kg per tow for large gorgonians, 0.15 kg per tow for small gorgonians, and 1.4 kg per tow for sea pens. Based on these thresholds, deep-water coral and sponge catches were identified and mapped, and overlaid with the current closed areas and VME polygons. New thresholds and VME polygons were presented at the 12th WGESA meeting using additional data since 2013 (NAFO, 2019). These are: 100 kg per tow for sponges, 0.6 kg per tow for large gorgonians, 0.2 kg per tow for small gorgonians, 1.3 kg per tow for sea pens, 0.35 kg for *Boltenia ovifera*, 0.2 kg for bryozoans and 0.4 kg for black corals. Therefore, VME polygons illustrated on the figures below are the modified ones, accepted by SC.

In response to feedback from the 16th WG-ESA meeting in 2023, we started investigating temporal trends in the occurrence of VME indicator groups in EU:Spain/Portugal and Canadian RV groundfish survey trawl sets conducted in the NRA. These data were presented in a separate SCR (Neves et al., 2024).

2. Survey Data

During 2024, RV *Vizconde de Eza* carried out three surveys in Division 3L, Division 3M, and Divisions 3NO. In terms of the Canadian data, the Fall 2023 & Spring 2024 data are presented. Therefore, data used in this study were collected from 4 surveys:

1. The EU-Spain and Portugal Flemish Cap groundfish survey, conducted by the Instituto Español de Oceanografía (COV-IEO, CSIC) together with the Instituto de Investigaciones Marinas (IIM) and Instituto Português do Mar e da Atmosfera (IPMA), sampled the Flemish Cap (NAFO Div. 3M) between 128 - 1428 m depth, with a total of 186 tows (181 valid).

2. The EU-Spain 3NO groundfish survey, conducted by the Instituto Español de Oceanografía (COV-IEO, CSIC), sampled the Grand Bank of Newfoundland (NAFO Divs. 3NO) between 45 - 1460 m depth, with a total of 116 tows (112 valid).

3. The EU 3L groundfish survey, conducted by the Instituto Español de Oceanografía (COV-IEO, CSIC), sampled Div. 3L between 117 - 1482 m depth, with a total of 95 tows (94 valid).

4. The Canadian Multispecies Surveys, conducted by Fisheries and Oceans Canada (DFO) (McCallum and Walsh, 1996), sampled the Grand Bank of Newfoundland (NAFO Divs. 3LNO) between mean depths of 39 - 1404 m, with a total of 134 tows (126 valid) (Fall 2023 & Spring 2024). For the Canadian surveys, a significant change took place in 2022. DFO is transitioning from the CCGS *Teleost* and CCGS *Alfred Needler* to new vessels, the CCGS *Capt Jacques Cartier* and CCGS *John Cabot* for its annual spring (Div. 3LNOPs) and fall (Div.2HJKLMNO) multispecies survey. The MV *Calvert* was also used as part of the comparative fishing. The new vessels use the same fishing protocols as previous (Needler and Teleost), but minor modifications have been made to the trawl (Wheeland L. et al., 2023). The Fall 2023 sets that fell within the NRA were conducted using the CCGS *Cabot* (35% of all sets, with one unsuccessful set), CCGS *Jacques Cartier* (51% of all sets, with one unsuccessful set), and CCGS *Teleost* (14% of all sets, with one unsuccessful set). The Spring 2024 sets that fell within the NRA were conducted using the CCGS *Cabot* (61% of all sets, with four unsuccessful sets), and MV *Calvert* (39% of all sets, with one unsuccessful set). Conversion factors between these vessels are not available for corals, bryozoans, and *Boltenia* sp. (*i.e., Boltenia ovifera*), because the available data were insufficient for their development. For this reason, caution should be taken when interpreting the data presented here based on the new vessels. For sponges, on the other hand, analysis of the CCGS *Teleost-Cartier/Cabot* comparison (Fall 2021-2022, 2HJ3KL) and CCGS *Needler-Cabot* comparison (Fall 2021-2022, Fall 3KL) indicated no significant difference in catchability of sponges, and conversion factors do not need to be applied for this taxa (DFO, 2024, In press). Data collected with each of the new vessels contained VME records. For the CCGS *Cabot* these correspond to 18 sets with sponges in Fall 2023, and 43 sets with sponges and 17 sets with bryozoans in Spring 2024 (one of which contained significant concentrations). For the CCGS *Cartier*, these correspond to 12 sets with bryozoans, seven sets with sea squirts (two of which contained significant concentrations), and 34 sets with sponges in Fall 2023. The MV *Calvert* recorded two sets with bryozoans and 19 sets with sponges in Spring 2024, none of which contained significant concentrations of these VME indicators. Due to operational constraints, data on corals collected during the Fall 2023 & Spring 2024 Canadian surveys were not available for this report and will be presented at WG-ESA in 2025.

There were a total of 397 bottom trawl tows carried out during 2024 EU: EU-Spain and Portugal groundfish survey in the NRA (Figure 1A). Ten of those tows were not valid due to technical problems during the fishing operation. 139 hauls out of 387 valid tows have shown zero catches (*i.e.,* no presence) of VME indicator species. This represents 35.92% of the total valid hauls. A total of 134 tows were carried out in the NRA during the Fall 2023 & Spring 2024 Canadian surveys (Figure 1B). Eight of these were considered unsuccessful (Figure 1B). Out of all sets, there were 12 tows done inside the VME closures (seven during EU: EU-Spain surveys, five during Canadian surveys).

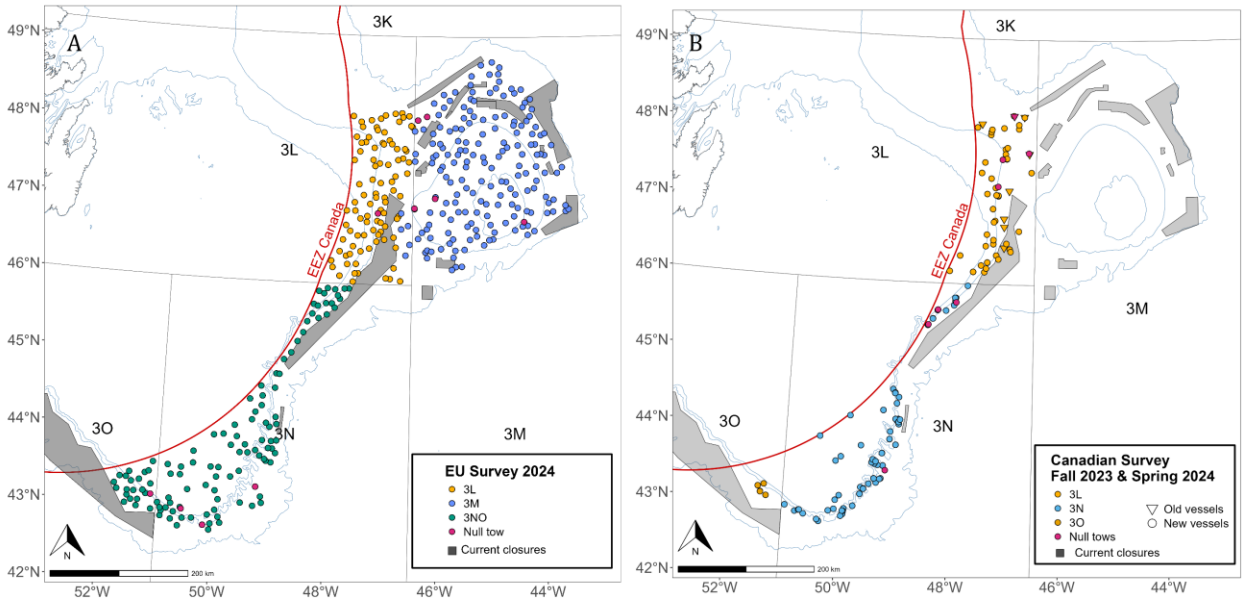

Figure 1. Distribution of sets (start positions) from A) 2024 EU: EU-Spain and Portugal groundfish survey (NAFO Divs. 3LMNO) and B) Fall 2023 & Spring 2024 Canadian surveys (NAFO Divs. 3LNO).

Following previous methodologies used by WGESA, deep water corals were grouped by VME species groups and include: large gorgonians and small gorgonians (Orders Scleralcyonacea and Malacalcyonacea; McFadden et al. (2022)), sea pens (Superfamily Pennatuloidea; McFadden et al. (2022)), black corals (Order Antipatharia), sponges and bryozoans (Phyla Porifera and Bryozoa), and *Boltenia ovifera* (Class Ascidiacea) shown as "Sea squirts".

3. Results

Distribution maps of presence (non-significant and significant catches) for sponges, large gorgonians, small gorgonians, sea pens, black corals, sea squirts, and bryozoans are presented below (Figures 2-8). Location of each record was assigned by start position of each tow for all surveys (Durán Muñoz et al., 2020; McCallum and Walsh, 1996).

3.1. Sponges

EU: EU-Spain and Portugal 2024 Data: Sponges were recorded in 142 of the 387 valid tows (36.7% of valid tows analyzed), at mean depths between 45 and 1482 m (Figure 2A). There were four significant catches of sponges (≥ 100 kg/tow) in these tows (Figure 2A), two of which fell within the VME polygons for sponges (Table 2). Inside VME closures, sponges were recorded in 3 of the 7 valid tows (43%), one of which had a significant catch of sponges. In the sets with significant catch, specimens were identified as belonging to the Suborder Astrophorina (Table 2).

Canadian (DFO) Fall 2023 & Spring 2024 Data: Sponges were recorded in 121 of the 126 valid tows (96.03% of valid tows analyzed), at mean depths between 48 and 1404 m (Figure 2B). There were no significant catches of sponges (≥ 100 kg/tow) in these tows (Figure 2B). Inside VME closures, sponges were recorded in all 5 of the valid tows, none of which had significant catches of sponges.

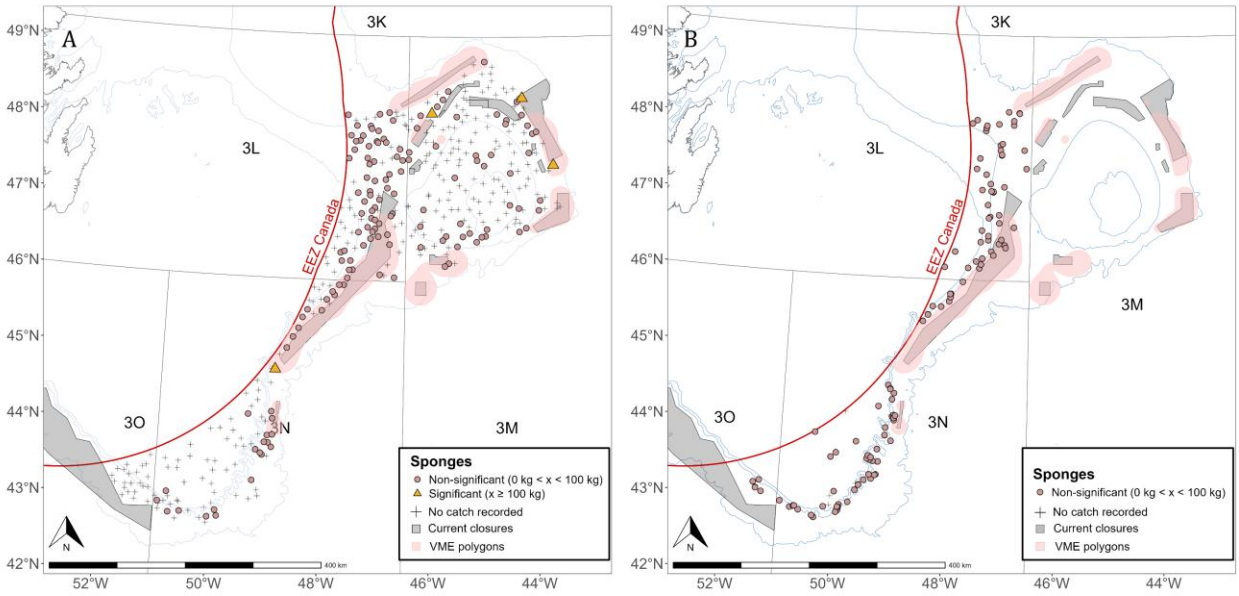

Figure 2. Distribution of catches of sponges in the study area from A) 2024 EU: EU-Spain and Portugal surveys (NAFO Divs. 3LMNO) and B) Fall 2023 & Spring 2024 Canadian surveys (NAFO Divs. 3LNO). Black crosses represent tows with no sponge by-catch recorded (no presence). Yellow triangles and coloured points represent tows with significant and non-significant catches of sponges, respectively.

3.2. Large gorgonians

EU: EU-Spain and Portugal 2024 Data: Large gorgonians were recorded in 9 of the 387 valid tows (2.33% of valid tows analyzed), at mean depths between 228 and 1332 m (Figure 3). There was one significant catch of large gorgonians (≥ 0.6 kg/tow) in these tows (Figure 3), which fell outside the VME polygons for large gorgonians. No large gorgonians were recorded inside VME closures during the EU 2024 surveys. In the set with significant catch, specimens were identified as *Paragorgia arborea* (Table 2).

Canadian (DFO) Fall 2023 & Spring 2024 Data: Data for large gorgonians are not available for the DFO Fall 2023 & Spring 2024 surveys.

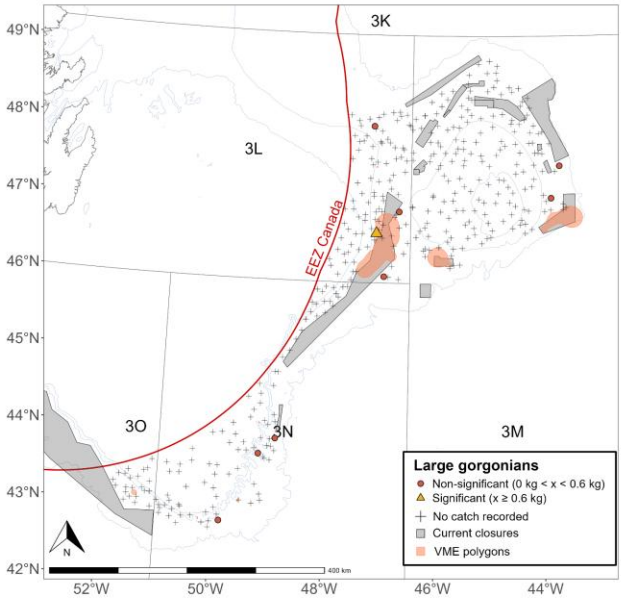

Figure 3. Distribution of catches of large gorgonians in the study area from 2024 EU: EU-Spain and Portugal surveys (NAFO Divs. 3LMNO). Black crosses represent tows with no large gorgonian by-catch recorded (no presence). Yellow triangles and coloured points represent tows with significant and non-significant catches of large gorgonians, respectively.

3.3. Small gorgonians

EU: EU-Spain and Portugal 2024 Data: Small gorgonians were recorded in 67 of the 387 valid tows (17.31% of valid tows analyzed), at mean depths between 65 and 1440 m (Figure 4). There were five significant catches of small gorgonians (≥ 0.2 kg/tow) in these tows (Figure 4), two of which fell within the VME polygons for small gorgonians (Table 2). Inside VME closures, small gorgonians were recorded in 4 of the 7 valid tows (57%), and there was one significant catch, with specimens identified as *Radicipes* sp. and *Acanella arbuscula* (Table 2).

Canadian (DFO) Fall 2023 & Spring 2024 Data: Data for small gorgonians are not available for the DFO Fall 2023 & Spring 2024 surveys.

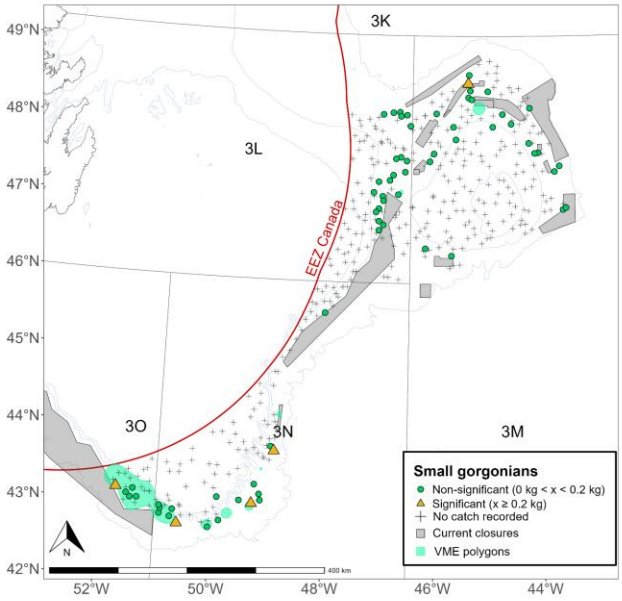

Figure 4. Distribution of catches of small gorgonians in the study area from 2024 EU: EU-Spain and Portugal surveys (NAFO Divs. 3LMNO). Black crosses represent tows with no small gorgonian by-catch recorded (no presence). Yellow triangles and coloured points represent tows with significant and non-significant catches of small gorgonians, respectively.

3.4. Sea pens

EU: EU-Spain and Portugal 2024 Data: Sea pens were recorded in 156 of the 387 valid tows (40.31% of valid tows analyzed), at mean depths between 103 and 1482 m (Figure 5). There was one significant catch of sea pens (≥ 1.3 kg/tow) in these tows (Figure 5), which fell within the VME polygons for sea pens (Table 2). Inside VME closures, sea pens were recorded in 4 of the 7 valid tows (57%), and there were no significant catches of sea pens in these tows. In the set with significant catch, specimens were identified as *Anthoptilum* sp. (Table 2).

Canadian (DFO) Fall 2023 & Spring 2024 Data: Data for sea pens are not available for the DFO Fall 2023 & Spring 2024 surveys.

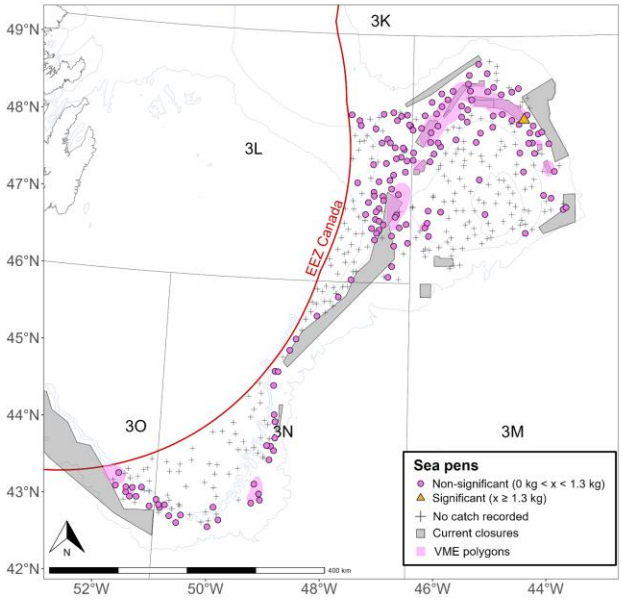

Figure 5. Distribution of catches of sea pens in the study area from 2024 EU: EU-Spain and Portugal surveys (NAFO Divs. 3LMNO). Black crosses represent tows with no sea pen by-catch recorded (no presence). Yellow triangles and coloured points represent tows with significant and non-significant catches of sea pens, respectively.

3.5. Black corals

EU: EU-Spain and Portugal 2024 Data: Black corals were recorded in 49 of the 387 valid tows (12.66% of valid tows analyzed), at mean depths between 212 and 1460 m (Figure 6). There were no significant catches of black corals (≥ 0.4 kg/tow) in these tows (Figure 6). No black corals were recorded inside VME closures or VME polygons for black corals during the EU 2024 surveys.

Canadian (DFO) Fall 2023 & Spring 2024 Data: Data for black corals are not available for the DFO Fall 2023 & Spring 2024 surveys.

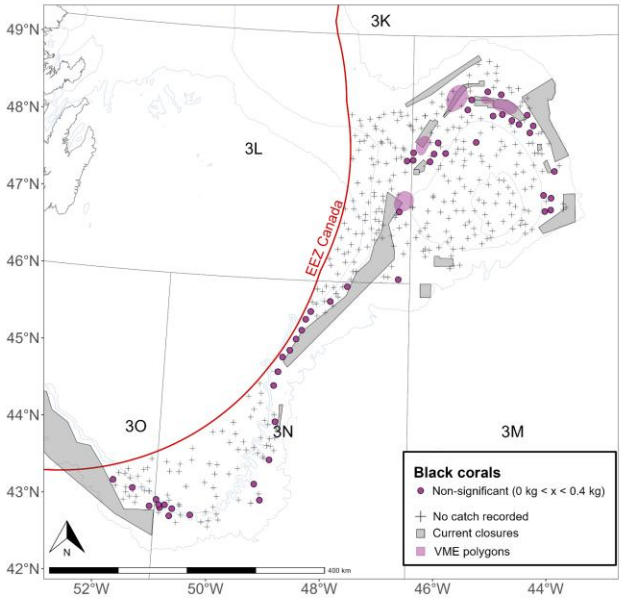

Figure 6. Distribution of catches of black corals in the study area from 2024 EU: EU-Spain and Portugal surveys (NAFO Divs. 3LMNO). Black crosses represent tows with no black coral by-catch recorded (no presence). Yellow triangles and coloured points represent tows with significant and non-significant catches of black corals, respectively.

3.6. Boltenia sp.

EU: EU-Spain and Portugal 2024 Data: *Boltenia* sp. were recorded in 9 of the 387 valid tows (2.33% of valid tows analyzed), at mean depths between 50 and 228 m (Figure 7A). There were three significant catches of *Boltenia* sp. (≥ 0.35 kg/tow) in these tows (Figure 7A), two of which fell within the VME polygons for *Boltenia* sp. (Table 2). No *Boltenia* sp. were recorded inside VME closures during the EU 2024 surveys. In the sets with significant catch, specimens were identified as *Boltenia ovifera* (Table 2).

Canadian (DFO) Fall 2023 & Spring 2024 Data: *Boltenia* sp. were recorded in 7 of the 126 valid tows (5.56% of valid tows analyzed), at mean depths between 50 and 223 m (Figure 7B). There were two significant catches of sea squirts (≥ 0.35 kg/tow) in these tows (Figure 7B), both of which fell within the VME polygons for *Boltenia* sp. (Table 2). No *Boltenia* sp. were recorded inside VME closures during the Canadian Fall 2023 & Spring 2024 surveys. In the sets with significant catch, specimens were identified as *Boltenia ovifera* (Table 2).

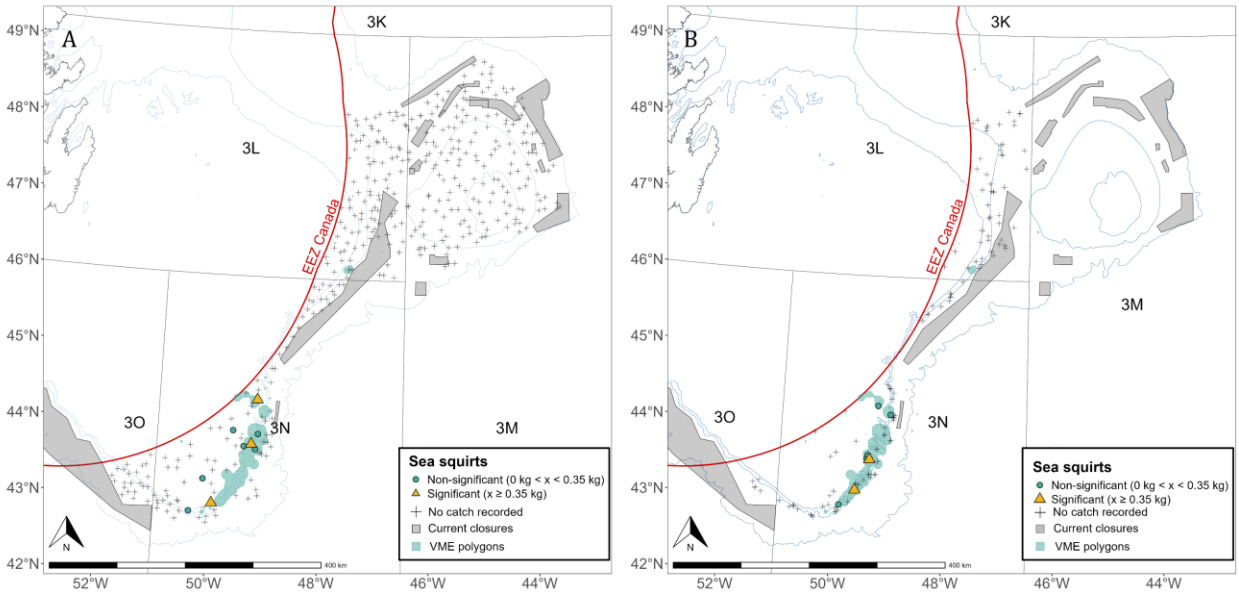

Figure 7. Distribution of catches of sea squirts in the study area from A) 2024 EU: EU-Spain and Portugal surveys (NAFO Divs. 3LMNO) and B) Fall 2023 & Spring 2024 Canadian surveys (NAFO Divs. 3LNO). Black crosses represent tows with no *Boltenia* sp. by-catch recorded (no presence). Yellow triangles and coloured points represent tows with significant and non-significant catches of sea squirts, respectively.

3.7. Bryozoans

EU: EU-Spain and Portugal 2024 Data: Bryozoans were recorded in 32 of the 387 valid tows (8.27% of valid tows analyzed), at mean depths between 112 and 1277 m (Figure 8A). There were no significant catches of bryozoans (≥ 0.2 kg/tow) in these tows (Figure 8A). Inside VME closures, bryozoans were recorded in 2 of the 7 valid tows conducted inside VME closures (29%), and there were no significant catches of bryozoans in these tows. It should be noted that during EU surveys, snags and gear breakages are documented, and this information is used in subsequent years to help avoid gear damage. In Divisions 3NO, bryozoans are often found near rocky areas with a high risk of net damage, which are intentionally avoided during the survey.

Canadian (DFO) Fall 2023 & Spring 2024 Data: Bryozoans were recorded in 31 of the 126 valid tows (24.6% of valid tows analyzed), at mean depths between 39 and 670 m (Figure 8B). There was one significant catch of bryozoans (≥ 0.2 kg/tow) in these tows (Figure 8B), all of which fell outside the VME polygons for bryozoans. Inside VME closures, bryozoans were recorded in 1 of the 5 valid tows conducted inside VME closures (20%), and there were no significant catches of bryozoans in these tows. In the set with significant catch, specimens were identified at the phylum level (Bryozoa) (Table 2).

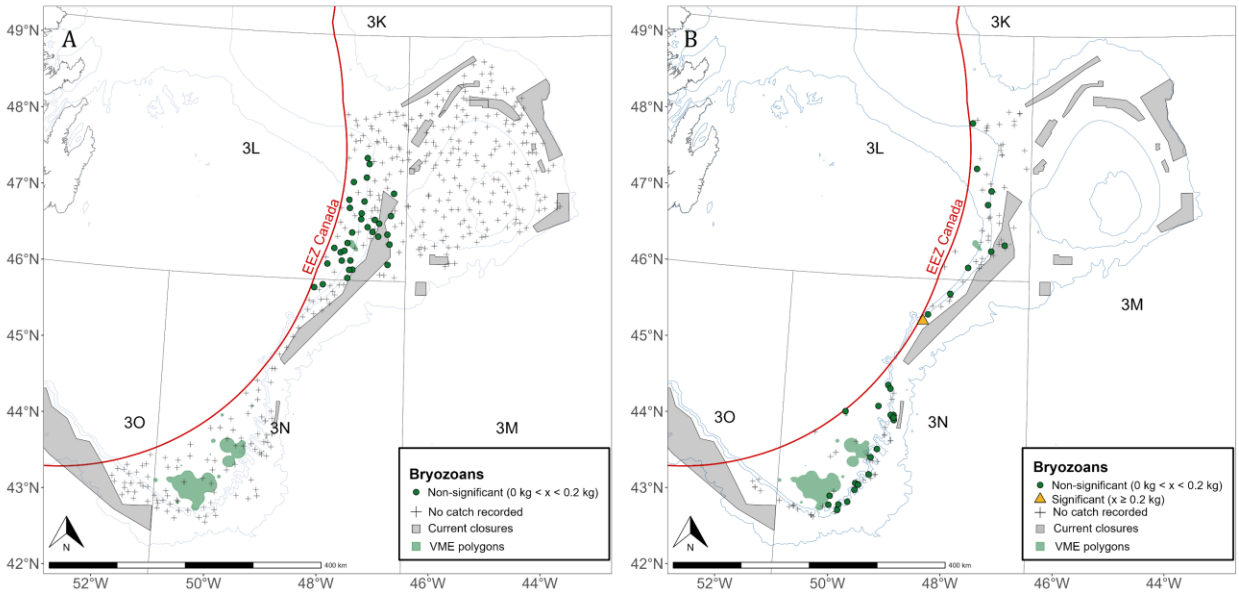

Figure 8. Distribution of catches of bryozoans in the study area from A) 2024 EU: EU-Spain and Portugal surveys (NAFO Divs. 3LMNO) and B) Fall 2023 & Spring 2024 Canadian surveys (NAFO Divs. 3LNO). Black crosses represent tows with no bryozoan by-catch recorded (no presence). Yellow triangles and coloured points represent tows with significant and non-significant catches of bryozoans, respectively.

Table 1. Summary of deep-water coral and sponge records for the NRA from 2024 EU: EU-Spain and Portugal surveys and Fall 2023 & Spring 2024 Canadian surveys. Calculations were performed using valid tows. Corals for Canadian surveys were not available at this time.

VME	Presence [Significant and Non-Significant] (# of valid tows)	% of valid tows with presence	# of valid tows with Significant Concentrations	% of valid tows with Significant Concentrations	# of valid tows with Significant Concentrations inside VME corresponding polygon	# of valid tows inside VME closures [Significant and Non-significant]
EU: EU-Spain and Portugal						
Sponges	142	36.7%	4	1.03%	2	3
Large gorgonians	9	2.3%	1	0.26%	0	0
Small gorgonians	67	17.3%	5	1.29%	2	4
Sea pens	156	40.3%	1	0.26%	1	4
Black corals	49	12.7%	0	0.00%	0	0
Sea squirts	9	2.3%	3	0.78%	2	0
Bryozoans	32	8.3%	0	0.00%	0	2
Canada						
Sponges	121	96.0%	0	0.00%	0	5
Large gorgonians	NA	NA	NA	NA	NA	NA
Small gorgonians	NA	NA	NA	NA	NA	NA
Sea pens	NA	NA	NA	NA	NA	NA
Black corals	NA	NA	NA	NA	NA	NA
Sea squirts	7	5.6%	2	0.02%	2	0
Bryozoans	31	24.6%	1	0.01%	0	1

Table 2. Significant catches of VME indicator taxa in the NRA (Divs. 3LMNO) with their corresponding depth (m) at start tow position and weight (kg). Note that the start tow positions are expressed in decimal degrees of latitude and longitude (to one decimal place).

VME indicator species	Species ID	Latitude	Longitude	Depth (m)	Weight (kg)
EU: EU-Spain and Portugal					
Sponges >= 100 kg	Astrophorina	48.2	-46.0	1180	179.998
Sponges >= 100 kg	Astrophorina	48.4	-44.2	1380	627.660
Sponges >= 100 kg	Astrophorina	47.5	-43.6	1026	1135.056
Sponges >= 100 kg	Astrophorina	44.8	-48.9	1460	112.310
Large gorgonians >= 0.6 kg	*Paragorgia arborea*	46.6	-47.1	622	0.638
Small gorgonians >= 0.2 kg	*Radicipes* sp.[1]	48.6	-45.4	1078	0.326
Small gorgonians >= 0.2 kg	*Acanella arbuscula*	43.8	-48.9	1321	0.297
Small gorgonians >= 0.2 kg	*Acanella arbuscula*	43.0	-49.3	1280	0.290
Small gorgonians >= 0.2 kg	*Acanella arbuscula*	42.7	-50.6	1327	0.398
Small gorgonians >= 0.2 kg	*Acanella arbuscula*	43.2	-51.7	1427	0.607
Sea pens >= 1.3 kg	*Anthoptilum* sp.[2]	48.2	-44.3	809	1.760
Sea squirts >= 0.35 kg	*Boltenia ovifera*	43.8	-49.3	129	1.200
Sea squirts >= 0.35 kg	*Boltenia ovifera*	43.0	-49.9	103	0.560
Sea squirts >= 0.35 kg	*Boltenia ovifera*	44.4	-49.2	58	0.362
Canada					
Sea squirts >= 0.35 kg	*Boltenia* sp.[3]	43.2	-49.6	184	0.384
Sea squirts >= 0.35 kg	*Boltenia* sp.[3]	43.6	-49.4	192	2.660
Bryozoans >= 0.2 kg	Bryozoa	45.4	-48.5	629	0.220

[1] Likely of *Radicipes gracilis*, although it may belong to a species complex, and other future taxa may be named.

[2] May be of *Anthoptilum grandiflorum*, *A. murrayi*, and other unknown taxa.

[3] Canadian survey database codes records use *Boltenia* sp., which refers to the ascidian species *Boltenia ovifera*.

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References

DFO. (2024). Newfoundland & Labrador Comparative Fishing Analysis – Part 1. In *DFO Can. Sci. Advis. Sec. Sci. Advis. Rep.* 2024/002. (Erratum: August 2024).

DFO. (In press). Newfoundland & Labrador Comparative Fishing Analysis – Part 2. In *DFO Can. Sci. Advis. Sec. Sci. Advis. Rep.*

Durán Muñoz, P., Sacau, M., García-Alegre, A., and Román, E. (2020). Cold-water corals and deep-sea sponges by-catch mitigation: Dealing with groundfish survey data in the management of the northwest Atlantic Ocean high seas fisheries. *Marine Policy*, *116*(103712). https://doi.org/10.1016/j.marpol.2019.103712

McCallum, Barry R., and Walsh, S. J. (1996). Groundfish survey trawls used at the Northwest Atlantic Fisheries Centre, 1971-present. NAFO SCR Doc., 96/50.

McFadden, C. S., Van Ofwegen, L. P., and Quattrini, A. M. (2022). Revisionary systematics of octocorallia (Cnidaria: Anthozoa) guided by phylogenomics. Bulletin of the Society of Systematic Biologists, 1(3). https://doi.org/10.18061/bssb.v1i3.8735

NAFO. (2013). Report of the 6th Meeting of the NAFO Scientific Council Working Group of Ecosystem Science and Assessment (WGESA) [Formerly WGEAFM]. *NAFO SCS Doc.*, *13/24. Serial no. N6277*.

NAFO. (2019). Report of the 12th Meeting of the NAFO Scientific Council Working Group of Ecosystem Science and Assessment (WGESA) [Formerly WGEAFM]. *NAFO SCS Doc.*, *19/25. Serial no. N7027*.

Neves, B.M., Command, R.J., Abalo-Morla, S., Sacau, M., Hayes, V., Durán-Muñoz, P. (2024). Preliminary temporal trends in VME encounters in NAFO Regulatory Area (Divs.3LMNO) from EU: EU-Spain and Portugal Groundfish Surveys and Canadian RV Surveys (2008-2022). NAFO SCR Doc. 24/065.

R Core Team. (2024). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing. https://www.R-project.org/

Regular, P., and Rogers, B. (2023). NAFOdown: An r markdown template for producing NAFO scientific council documents. https://github.com/nafc-assess/NAFOdown

Wheeland L., Trueman S., and R., R. (2023). Coverage of the 2022 Canadian (Newfoundland and Labrador Region) Multi-Species RV Bottom Trawl Survey with notes on Comparative Fishing. *NAFO SCR Doc.*, *23/042*.

Colophon

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#>  askpass             1.2.0   2023-09-03 [1] CRAN (R 4.4.0)
#>  bit                 4.0.5   2022-11-15 [1] CRAN (R 4.4.0)
#>  bit64               4.0.5   2020-08-30 [1] CRAN (R 4.4.0)
#>  bookdown            0.40    2024-07-02 [1] CRAN (R 4.4.1)
#>  cachem              1.1.0   2024-05-16 [1] CRAN (R 4.4.0)
#>  cli                 3.6.2   2023-12-11 [1] CRAN (R 4.4.0)
#>  colorspace          2.1-0   2023-01-23 [1] CRAN (R 4.4.0)
#>  cowplot             1.1.3   2024-01-22 [1] CRAN (R 4.4.0)
#>  crayon              1.5.2   2022-09-29 [1] CRAN (R 4.4.0)
#>  crul                1.4.2   2024-04-09 [1] CRAN (R 4.4.0)
#>  curl                5.2.1   2024-03-01 [1] CRAN (R 4.4.0)
#>  data.table          1.15.4  2024-03-30 [1] CRAN (R 4.4.0)
#>  devtools            2.4.5   2022-10-11 [1] CRAN (R 4.4.1)
#>  digest              0.6.35  2024-03-11 [1] CRAN (R 4.4.0)
#>  dplyr             * 1.1.4   2023-11-17 [1] CRAN (R 4.4.0)
#>  ellipsis            0.3.2   2021-04-29 [1] CRAN (R 4.4.0)
#>  evaluate            1.0.0   2024-09-17 [1] CRAN (R 4.4.1)
#>  fansi               1.0.6   2023-12-08 [1] CRAN (R 4.4.0)
#>  farver              2.1.2   2024-05-13 [1] CRAN (R 4.4.0)
#>  fastmap             1.2.0   2024-05-15 [1] CRAN (R 4.4.0)
#>  flextable         * 0.9.6   2024-05-05 [1] CRAN (R 4.4.0)
#>  fontBitstreamVera   0.1.1   2017-02-01 [1] CRAN (R 4.4.0)
#>  fontLiberation      0.1.0   2016-10-15 [1] CRAN (R 4.4.0)
#>  fontquiver          0.2.1   2017-02-01 [1] CRAN (R 4.4.0)
#>  forcats           * 1.0.0   2023-01-29 [1] CRAN (R 4.4.0)
#>  fs                  1.6.4   2024-04-25 [1] CRAN (R 4.4.0)
#>  gdtools             0.3.7   2024-03-05 [1] CRAN (R 4.4.0)
#>  generics            0.1.3   2022-07-05 [1] CRAN (R 4.4.0)
#>  gfonts              0.2.0   2023-01-08 [1] CRAN (R 4.4.0)
#>  ggplot2           * 3.5.1   2024-04-23 [1] CRAN (R 4.4.0)
#>  ggridges            0.5.6   2024-01-23 [1] CRAN (R 4.4.0)
#>  ggthemes            5.1.0   2024-02-10 [1] CRAN (R 4.4.1)
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#>  glue                1.7.0   2024-01-09 [1] CRAN (R 4.4.0)
#>  gtable              0.3.5   2024-04-22 [1] CRAN (R 4.4.0)
#>  hms                 1.1.3   2023-03-21 [1] CRAN (R 4.4.0)
#>  htmltools           0.5.8.1 2024-04-04 [1] CRAN (R 4.4.0)
#>  htmlwidgets         1.6.4   2023-12-06 [1] CRAN (R 4.4.0)
#>  httpcode            0.3.0   2020-04-10 [1] CRAN (R 4.4.0)
#>  httpuv              1.6.15  2024-03-26 [1] CRAN (R 4.4.0)
#>  jsonlite            1.8.8   2023-12-04 [1] CRAN (R 4.4.0)
#>  knitr               1.48    2024-07-07 [1] CRAN (R 4.4.1)
#>  labeling            0.4.3   2023-08-29 [1] CRAN (R 4.4.0)
#>  later               1.3.2   2023-12-06 [1] CRAN (R 4.4.0)
#>  lifecycle           1.0.4   2023-11-07 [1] CRAN (R 4.4.0)
#>  lubridate         * 1.9.3   2023-09-27 [1] CRAN (R 4.4.0)
#>  magick              2.8.3   2024-02-18 [1] CRAN (R 4.4.0)
#>  magrittr            2.0.3   2022-03-30 [1] CRAN (R 4.4.0)
#>  memoise             2.0.1   2021-11-26 [1] CRAN (R 4.4.0)
#>  mime                0.12    2021-09-28 [1] CRAN (R 4.4.0)
#>  miniUI              0.1.1.1 2018-05-18 [1] CRAN (R 4.4.0)
#>  munsell             0.5.1   2024-04-01 [1] CRAN (R 4.4.0)
#>  NAFOdown          * 0.0.1   2024-09-26 [1] Github (nafc-assess/NAFOdown@b
5689f8)
#>  officedown          0.3.3   2024-07-16 [1] CRAN (R 4.4.1)
#>  officer             0.6.6   2024-05-05 [1] CRAN (R 4.4.0)
#>  openssl             2.2.0   2024-05-16 [1] CRAN (R 4.4.0)
#>  pillar              1.9.0   2023-03-22 [1] CRAN (R 4.4.0)
#>  pkgbuild            1.4.4   2024-03-17 [1] CRAN (R 4.4.0)
#>  pkgconfig           2.0.3   2019-09-22 [1] CRAN (R 4.4.0)
#>  pkgload             1.3.4   2024-01-16 [1] CRAN (R 4.4.0)
#>  profvis             0.4.0   2024-09-20 [1] CRAN (R 4.4.1)
#>  promises            1.3.0   2024-04-05 [1] CRAN (R 4.4.0)
#>  purrr             * 1.0.2   2023-08-10 [1] CRAN (R 4.4.0)
#>  R6                  2.5.1   2021-08-19 [1] CRAN (R 4.4.0)
#>  ragg                1.3.2   2024-05-15 [1] CRAN (R 4.4.0)
#>  Rcpp                1.0.12  2024-01-09 [1] CRAN (R 4.4.0)
#>  readr             * 2.1.5   2024-01-10 [1] CRAN (R 4.4.0)
#>  remotes             2.5.0   2024-03-17 [1] CRAN (R 4.4.0)
#>  rlang               1.1.3   2024-01-10 [1] CRAN (R 4.4.0)
#>  rmarkdown           2.28    2024-08-17 [1] CRAN (R 4.4.1)
#>  rstudioapi          0.16.0  2024-03-24 [1] CRAN (R 4.4.0)
#>  rvg                 0.3.4   2024-08-27 [1] CRAN (R 4.4.1)
#>  scales              1.3.0   2023-11-28 [1] CRAN (R 4.4.0)
#>  sessioninfo         1.2.2   2021-12-06 [1] CRAN (R 4.4.1)
#>  shiny               1.8.1.1 2024-04-02 [1] CRAN (R 4.4.0)
#>  showtext            0.9-7   2024-03-02 [1] CRAN (R 4.4.1)
#>  showtextdb          3.0     2020-06-04 [1] CRAN (R 4.4.1)
#>  stringi             1.8.4   2024-05-06 [1] CRAN (R 4.4.0)
#>  stringr           * 1.5.1   2023-11-14 [1] CRAN (R 4.4.0)
#>  sysfonts            0.8.9   2024-03-02 [1] CRAN (R 4.4.1)
#>  systemfonts         1.1.0   2024-05-15 [1] CRAN (R 4.4.0)
#>  textshaping         0.3.7   2023-10-09 [1] CRAN (R 4.4.0)
#>  tibble            * 3.2.1   2023-03-20 [1] CRAN (R 4.4.0)
#>  tidyr             * 1.3.1   2024-01-24 [1] CRAN (R 4.4.0)
#>  tidyselect          1.2.1   2024-03-11 [1] CRAN (R 4.4.0)
#>  tidyverse         * 2.0.0   2023-02-22 [1] CRAN (R 4.4.0)
#>  timechange          0.3.0   2024-01-18 [1] CRAN (R 4.4.0)
#>  tzdb                0.4.0   2023-05-12 [1] CRAN (R 4.4.0)
#>  urlchecker          1.0.1   2021-11-30 [1] CRAN (R 4.4.1)
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#>  usethis              2.2.3   2024-02-19 [1] CRAN (R 4.4.0)
#>  utf8                 1.2.4   2023-10-22 [1] CRAN (R 4.4.0)
#>  uuid                 1.2-0   2024-01-14 [1] CRAN (R 4.4.0)
#>  vctrs                0.6.5   2023-12-01 [1] CRAN (R 4.4.0)
#>  vroom                1.6.5   2023-12-05 [1] CRAN (R 4.4.0)
#>  withr                3.0.1   2024-07-31 [1] CRAN (R 4.4.1)
#>  xfun                 0.47    2024-08-17 [1] CRAN (R 4.4.1)
#>  xml2                 1.3.6   2023-12-04 [1] CRAN (R 4.4.0)
#>  xtable               1.8-4   2019-04-21 [1] CRAN (R 4.4.0)
#>  yaml                 2.3.8   2023-12-11 [1] CRAN (R 4.4.0)
#>  zip                  2.3.1   2024-01-27 [1] CRAN (R 4.4.0)
#>
#>  [1] C:/Users/commandr/AppData/Local/R/win-library/4.4
#>  [2] C:/Program Files/R/R-4.4.1/library
#>
#> ──────────────────────────────────────────────────────────────────────────────
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