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New preliminary data on VME encounters in NAFO Regulatory Area (Divs. 3MNO) from EU; EU-Spain and Portugal Groundfish Surveys (2022) and Canadian surveys (2022 Spring).

By

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1. Introduction

During the 15th NAFO Working Group on Ecosystem Science and Assessment (WGESA) virtual meeting new preliminary data on deep-water corals and sponges were presented from the 2022 EU; EU-Spain and Portugal and Canadian bottom trawl groundfish surveys. The data was 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, 2020). 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* sea squirts, 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.

2. Survey Data

During 2022, RV *Vizconde de Eza* only carried out two surveys in Division 3M and Divisions 3NO. In terms of the Canadian data, only the 2022 Spring data are presented, as no data were available for the NRA in the Fall of 2021. Therefore, data used in this study were collected from 3 surveys:

1. The EU-Spain and Portugal Flemish Cap groundfish survey, conducted by the IEO 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 -1470 m, with a total of 183 tows (182 valid; 1 no valid).

2. The EU-Spain 3NO groundfish survey, conducted by the Instituto Español de Oceanografía (IEO), sampled the Grand Bank of Newfoundland (NAFO Divs. 3NO) between 40 - 1460 m depth with a total of 114 tows (113 valid; 1 no valid).

3. The Canadian Multispecies Surveys, conducted by Fisheries and Oceans Canada (McCallum and Walsh, 1996), sampled the Grand Bank of Newfoundland (NAFO Divs. 3LNO) between mean depths of 45 - 727 m, with a total of 59 tows (58 valid; 1 invalid) (Spring 2022). For the Canadian surveys, a significant change took place in 2022. Fisheries and Oceans Canada has acquired two new fishing vessels (CCGS *Cabot* and CCGS *Jacques Cartier*), and a comparative fishing program is currently in place to assess equivalence of these vessels in relation to the older fleet (i.e., CCGS *Needler*, CCGS *Teleost*). The 2022 sets that fell within the NRA were conducted using both CCGS *Needler* (15% of all sets) and the new CCGS *Cabot* (85% of all sets, with one unsuccessful set). Since catchability between the two vessels (i.e., and previous surveys in the NRA) has not yet been assessed, caution should be taken when interpreting the data presented here.

There were a total of 297 bottom trawl tows carried out during 2022 EU; EU-Spain and Portugal groundfish in the NRA (Figure 1A). Two of those tows were not valid due to technical problems during the fishing operation. 110 hauls out of 295 valid tows have shown zero catches (i.e. no presence) of VME indicator species. This represents the 37.3% of the total valid hauls. A total of 59 tows were carried out in the NRA during the Spring 2022 Canadian surveys (Figure 1B). One of these was considered an unsuccessful (invalid) tow (Figure 1B).

A) B)

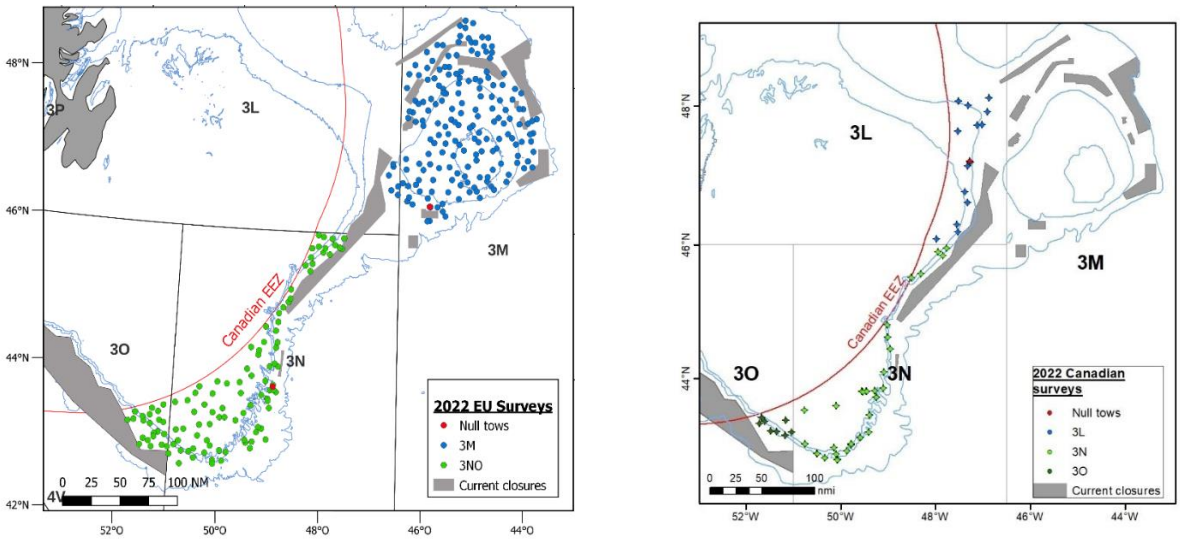

Figure 1. Distribution of sets (start positions) from A) 2022 EU; EU-Spain and Portugal groundfish survey (NAFO Divs. 3MNO) and B) 2022 Spring Canadian surveys (NAFO Divs. 3LNO).

Following previous methodologies used by WGESA, deep water corals were grouped by VME species groups and include: large gorgonians (Order Alcyonacea), small gorgonians (Order Alcyonacea), sea pens (Order Pennatulacea), black corals (Order Antipatharia), sponges and bryozoans are shown at the phylum level (Phylum Porifera and Phylum Bryozoa), *Boltenia* sea squirts are shown as *Boltenia* sp.

3. Results

Distribution maps of presence (non-significant catches) for sponges, large gorgonians, small gorgonians, sea pens, black corals, sea squirts, and bryozoans are presented below (Figures 2-8). Black

corals and bryozoans were not recorded during the Spring 2022 Fall Canadian surveys. Location of each record was assigned by start position of each tow for 2022 EU; EU-Spain (Durán Muñoz *et al*., 2020) and Canadian groundfish surveys (McCallum and Walsh 1996).

3.1 Sponges

EU; EU-Spain and Portugal *2022 Data*: Sponges were recorded, with non-significant concentrations (< 100 kg/tow), in 81 of the 295 valid tows (27.5% of the valid tows analyzed), with depths ranging between 128 - 1460 m (Figure 2A). One of the valid tows has a significant concentration of sponges (≥ 100 kg/tow).

Canadian surveys (DFO) 2022 Spring Data: Sponges were recorded in 34 of the 58 valid tows (58.6%), with mean depths ranging between 105 - 727 m (Figure 2B). There were no significant concentrations of sponges (≥ 100 kg/tow) in these tows (Figure 2B).

A) B)

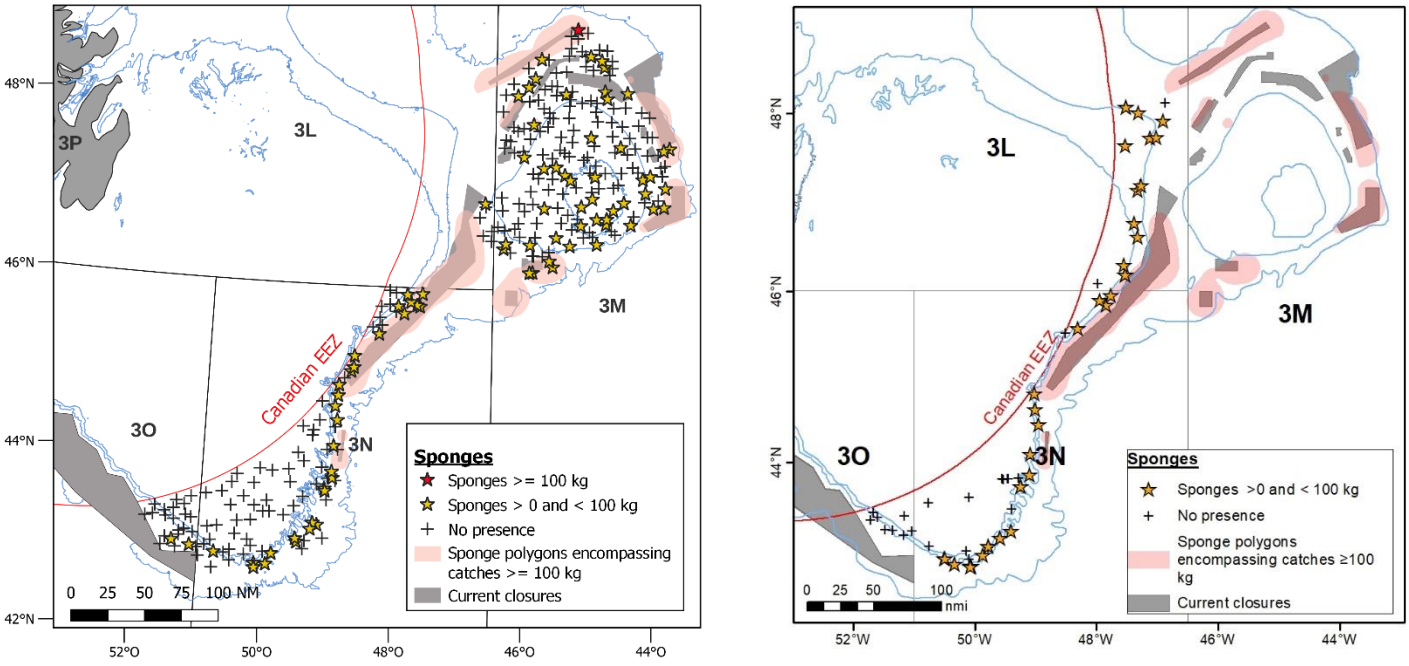

Figure 2. Distribution of catches of sponges in the study area from A) 2022 EU; EU-Spain and Portugal survey (NAFO Divs. 3MNO) and B) 2022 Spring Canadian surveys (NAFO Divs. 3LNO). Black crosses represent tows with no sponge catch recorded (no presence).

3.2 Large gorgonians

EU; EU-Spain and Portugal 2022 Data: Large gorgonians were recorded, with non-significant concentrations (< 0.6 kg/tow), in 9 of the 295 valid tows (3% of valid tows analyzed), with depths ranging between 607- 1405 m (Figure 3A). One of the valid tows had a significant concentration of large gorgonians (≥ 0.6 kg/tow).

Canadian surveys (DFO) 2022 Spring Data: Large gorgonians were recorded in 5 of the 58 valid tows (8.6% of total tows analyzed), at mean depths of 197 and 717 m (Figure 3B). There was 1 significant concentration of large gorgonians (≥ 0.6 kg/tow) in these tows, outside of the large gorgonians VME polygons (Figure 3B).

A) B)

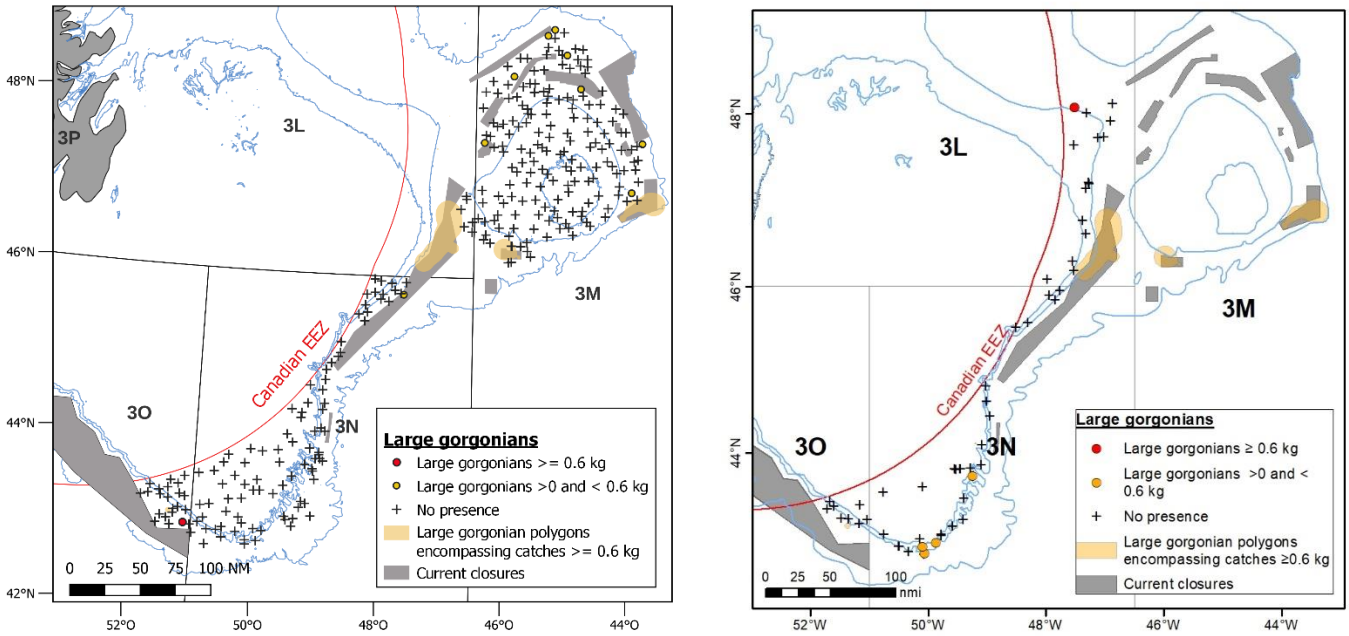

Figure 3. Distribution of catches of large gorgonians in the study area from A) 2022 EU; EU-Spain and Portugal (NAFO Divs. 3MNO) and B) 2020 Fall Canadian surveys (NAFO Divs. 3LNO). Black crosses represent tows with no large gorgonians catch recorded (no presence).

3.3 Small gorgonians

EU; EU-Spain and Portugal 2022 Data: Small gorgonians were recorded, with non-significant concentrations (< 0.2 kg/tow), in 39 of the 295 valid tows (13.2% of valid tows analyzed), with depths ranging between 482- 1470 m (Figure 4A). One of the valid tows had a significant concentration of small gorgonians (≥ 0.2 kg/tow).

Canadian surveys (DFO) 2022 Spring Data: Small gorgonians were recorded in 1 valid tow (1.7 % of total tows analyzed), from a mean depth of 727 m (Figure 4B). That concentration was significant (2.12 kg) and found within the small gorgonians VME polygon.

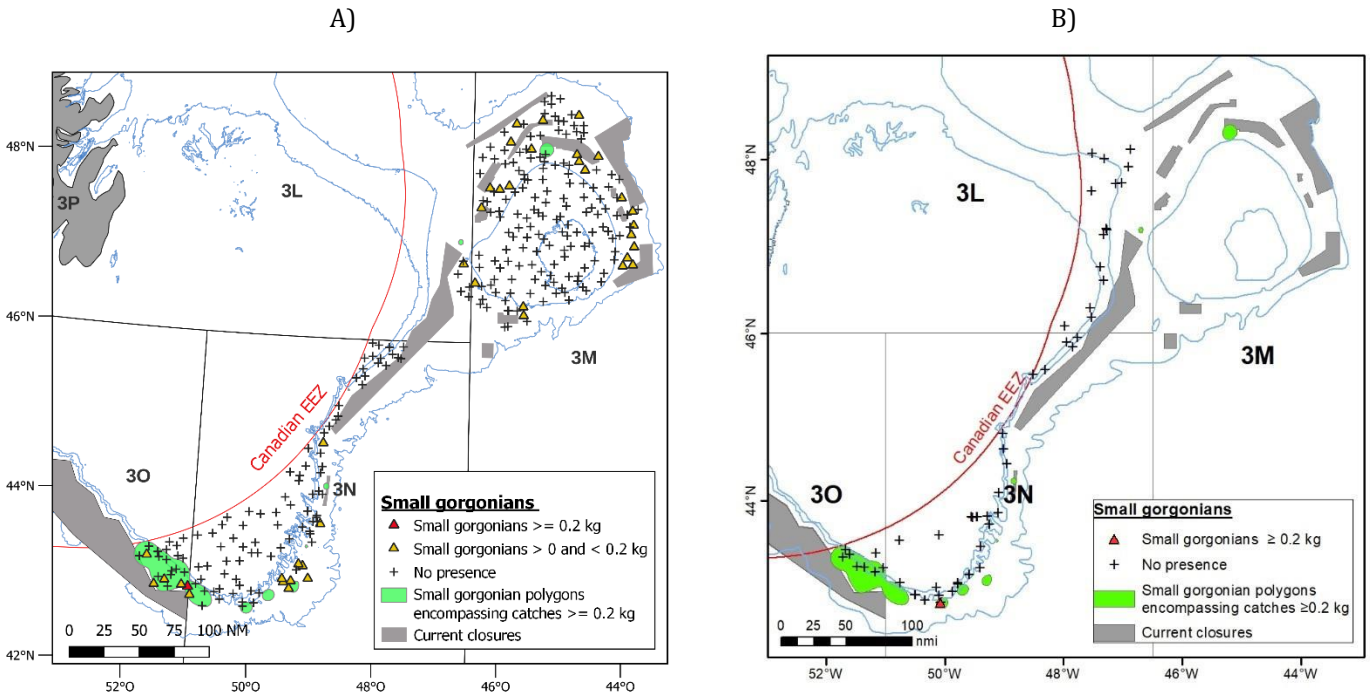

Figure 4. Distribution of catches of small gorgonians in the study area from A) 2022 EU; EU-Spain and Portugal survey (NAFO Divs. 3MNO) and B) 2022 Spring Canadian surveys (NAFO Divs. 3LNO). Black crosses represent tows with no small gorgonians catch recorded (no presence).

3.4 Sea pens

EU; EU-Spain and Portugal 2022 Data: Sea pens were recorded, with non-significant concentrations (<1.3 kg/tow), in 1 0 1 tows (34.2% of valid tows analyzed), with depths ranging between 221 - 1470 m (Figure 5A). One significant concentration (≥ 1.3 kg/tow) was recorded.

Canadian surveys (DFO) 2022 Spring Data: Sea pens were recorded in 12 of the 58 valid tows (20.7% of total tows analyzed), with mean depths ranging between 118 - 727 m (Figure 5B). No tows with significant concentrations of sea pens (≥ 1.3 kg/tow) were recorded within the NRA.

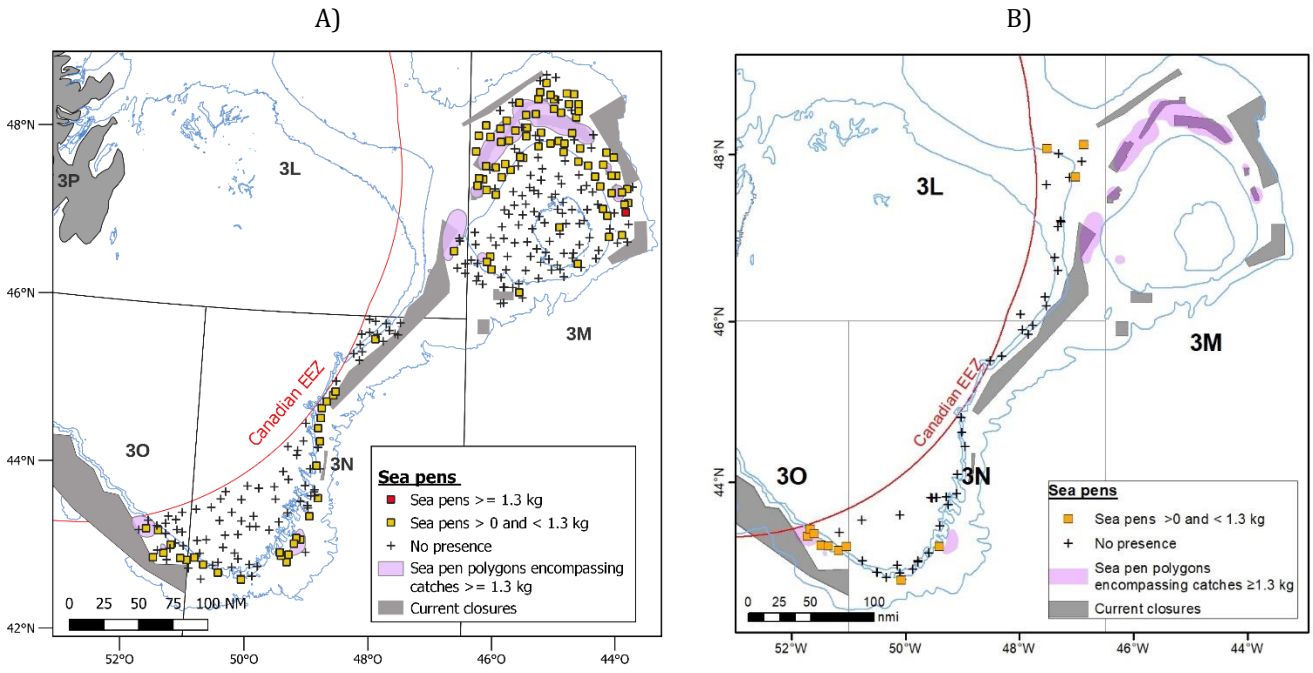

Figure 5. Distribution of catches of sea pens in the study area from A) 2022 EU; EU-Spain and Portugal survey (NAFO Divs. 3MNO) and B) 2022 Spring Canadian surveys (NAFO Divs. 3LNO). Black crosses represent tows with no sea pens catch recorded (no presence).

3.5 Black corals

EU; EU-Spain and Portugal 2022 Data: Black corals were recorded, with non-significant concentrations (< 0.4 kg/tow), in 18 tows (6.1% of valid tows analyzed), with depths ranging between 281 - 1336 m (Figure 6). One significant concentration (≥ 0.4 kg/tow) was recorded.

No black corals were recorded during the DFO 2022 Spring surveys.

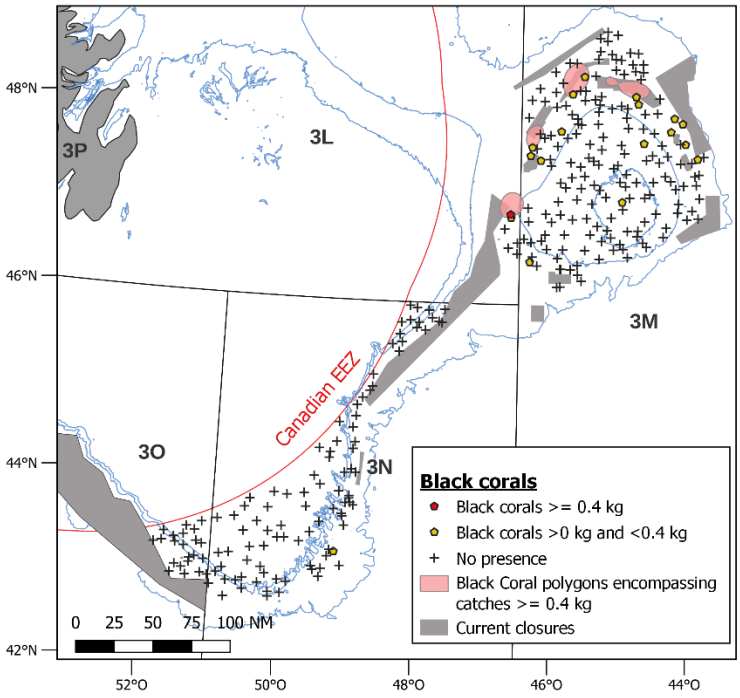

Figure 6. Distribution of catches of Black corals in the study area from the 2022 EU; EU-Spain and Portugal survey (NAFO Divs. 3MNO). No black corals were recorded during the 2022 Spring Canadian surveys (NAFO Divs. 3LNO). Black crosses represent tows with no Black coral catch recorded (no presence).

3.6 Sea squirts (*Boltenia ovifera*)

EU; EU-Spain and Portugal 2022 Data: Boltenia ovifera was recorded, with non-significant concentrations (< 0.35 kg/tow), in 1 tow (0.3% of valid tows analyzed), at a depth of 562 m (Figure 7A). Three significant concentrations (≥ 0.35 kg/tow) were recorded.

Canadian surveys (DFO) 2022 Spring Data: *Boltenia ovifera* was recorded in 5 of the 58 valid tows (8.6% of total tows analyzed), with mean depths ranging between 45 – 208 m (Figure 7B). Of these, a total of two tows had significant concentrations of *Boltenia* (≥ 0.35 kg), both of which were found inside the *Boltenia* VME polygon (Figure 7B). These significant concentrations were: 0.565 kg and 0.601 kg.

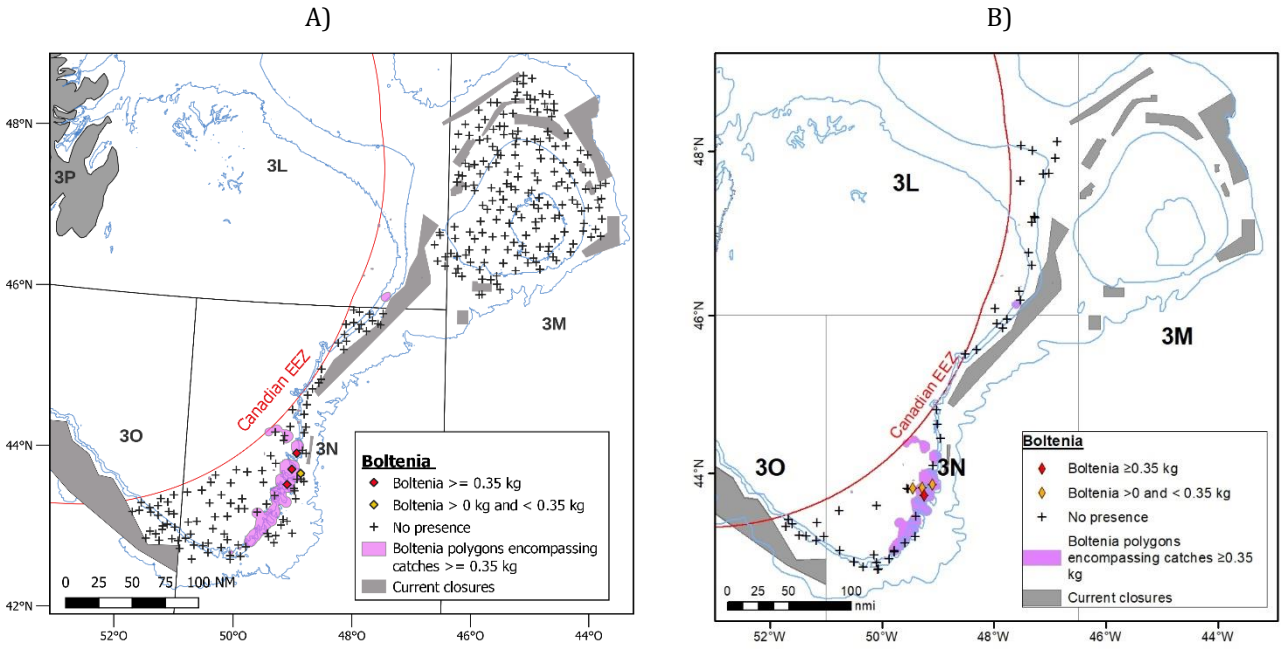

Figure 7. Distribution of catches of Sea squirts (*Boltenia ovifera*) in the study area from A) 2022 EU; EU-Spain and Portugal survey (NAFO Divs. 3MNO) and B) 2022 Spring Canadian surveys (NAFO Divs. 3LNO). Black crosses represent tows with no Sea squirts by-catch recorded (no presence).

3.7 Bryozoans

EU; EU-Spain and Portugal 2022 Data: Bryozoans were recorded, with non-significant concentrations (< 0.2 kg/tow), in 25 tows (8.5% of valid tows analyzed), with depths ranging between 49 - 1377 m (Figure 8A). Two significant concentrations (≥ 0.2 kg/tow) were recorded, being one of them in Flemish Cap at a depth of 1230 m in an area with no VME polygons and likely associated to a different species than *Eucratea loricata* that is found on the Tail. At-sea photos of this tow were checked during the meeting, but it was not possible to identify the bryozoan.

No bryozoans were recorded during the DFO 2022 Spring surveys.

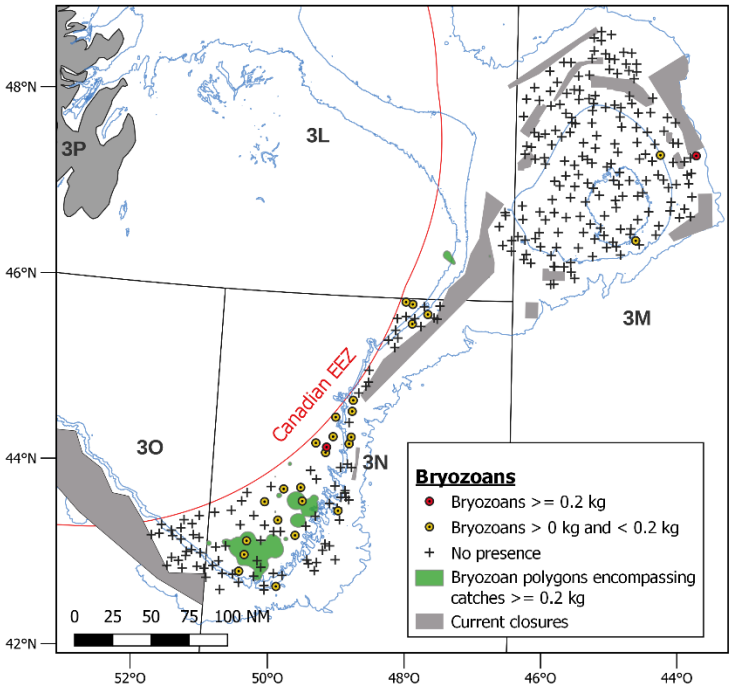

Figure 8. Distribution of catches of bryozoans in the study area from 2022 EU; EU-Spain and Portugal survey (NAFO Divs. 3MNO). Black crosses represent tows with no Bryozoans by-catch recorded (no presence).

Table 1. Summary of deep-water corals and sponges records for the NRA from 2022 EU; EU-Spain and Portugal surveys and 2022 Spring Canadian surveys. Calculations were performed using valid tows.

EU; EU-Spain and Portugal data 2022	Presence [Significant and Non-Significant] (# of valid tows)	% of valid tows	# of valid tows with Significant Concentrations	% of valid tows with Significant Concentrations	# of valid tows with Significant Concentrations inside VME corresponding polygon
Sponges	82	27.8%	1	0.34%	1
Large gorgonians	10	3.4%	1	0.34%	0
Small gorgonians	40	13.5%	1	0.34%	1
Sea pens	102	34.6%	1	0.34%	0
Black corals	19	6.4%	1	0.34%	1
Sea squirts (*B. ovifera*)	4	1.35%	3	1.00%	3
Bryozoans	27	9.15%	2	0.67%	0
Canadian data 2022 (Spring)					
Sponges	34	58.6%	0	0.00%	0
Large gorgonians	5	8.6%	1	1.72%	0
Small gorgonians	1	1.7%	1	1.72%	1
Sea Pens	12	20.7%	0	0.00%	0
Black corals	0	0.0%	0	0.00%	0
Sea squirts (*B. ovifera*)	5	8.6%	2	3.45%	2
Bryozoans	0	0.0%	0	0.00%	0

Table 2. Significant concentrations of VME indicator species in the NRA (Divs. 3MNO) with their corresponding depth (m) and weight (kg). Note that tow positions are expressed in decimal degrees (with two decimal places).

EU; EU-Spain and Portugal 2022 Surveys	Start position			
VME indicator species	**Latitude (N)**	**Longitude (W)**	**Depth (m)**	**Weight (kg)**
Sponges >=100 kg	49.95	-45.11	1405	405.33
Large gorgonians >=0.6 kg	42.96	-51.11	1460	1.903
Small gorgonians >=0.2 kg	42.94	-51.01	972	0.28
Sea pens >=1.3 kg	47.28	-43.71	717	1.485
Black corals >=0.4 kg	46.96	-46.65	790	0.76
Sea Squirts (*B.ovifera*) >= 0.35 kg	43.73	-49.20	217	4.17
	43.92	-49.13	172	1.008
	44.13	-49.06	121	0.387
Bryozoans >=0.2 kg	47.58	-43.58	1230	0.24
	44.34	-49.28	52	0.7

Canadian 2022 Spring Surveys	Start position			
VME indicator species	**Latitude (N)**	**Longitude (W)**	**Depth (m)***	**Weight (kg)**
Large gorgonians >=0.6 kg	48.07	-47.52	513	0.75
Sea squirts (*B.ovifera*) >= 0.35 kg	43.71	-49.25	188	0.565
	43.71	-49.24	197	0.601

*Mean depth

Acknowledgements

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