



**SC WG ON THE ECOSYSTEM APPROACH TO FISHERIES MANAGEMENT – DECEMBER 2011**

**New data on deep-water corals and sponges from Spanish/EU and Canadian bottom trawl groundfish surveys in the NAFO Regulatory Area (Divs. 3LMNO): 2008-2010 period**

by

F.J. Murillo<sup>1</sup>, V. Wareham<sup>2</sup>, M. Sacau<sup>1</sup>, E. Román<sup>1</sup>, and P. Durán Muñoz<sup>1</sup>

<sup>1</sup>Instituto Español de Oceanografía, Vigo, Spain

<sup>2</sup>Department of Fisheries and Oceans, St. John's, Newfoundland and Labrador, Canada

**Abstract**

New data on deep-water corals and sponges are presented based on Spanish/EU and Canadian bottom trawl groundfish surveys for the period 2008-2010 in order to make these data available to the NAFO WGEAFM and improve the mapping of sensitive species in the NAFO Regulatory area (Divs. 3LMNO). “Significant” catches (according to the NAFO definition from groundfish surveys) of deep-water corals and sponges are provided and mapped together with the areas closed in 2010. Most of the significant catches of sponges (88%) are inside of the closed areas, meanwhile for corals the results are different according to the group considered. For large gorgonians the 40% are inside, for small gorgonians the 25% and for sea pens all the significant catches recorded are outside of the closed areas.

**Introduction**

During the years 2008 and 2009, the NAFO WGEAFM identified “significant” concentrations of corals and sponges in the NAFO Regulatory Area (Divs. 3LMNO) from groundfish trawl survey data. Significant concentrations of deep water corals were identified by a cumulative catch weight distribution method (NAFO 2008) and quantitative spatial analysis method was used for sponges (Kenchington et al. 2009, NAFO 2009).

From these studies, according with current NAFO criteria, different thresholds were selected for significant concentrations of coral and sponges as follows: 75 kg per tow for sponges, 2 kg per tow for large gorgonians, 0.2 kg per tow for small gorgonians; and 1.6 kg per tow for sea pens. These thresholds were used for the closure of eleven areas in the NRA in 2010 (NAFO 2010). After these closures, the same quantitative spatial analysis method used for sponges, was used for sea pens and a lower threshold (0.5 kg per tow) was proposed for significant locations (Murillo et al. 2010).

Between November 30<sup>th</sup> and December 9<sup>th</sup> 2011 the fourth NAFO WGEAFM meeting was held in Dartmouth (Canada). One of the terms of reference of the group was the *Update on identification and mapping of sensitive species and habitats in the NAFO area*. In order to make data available and improve the mapping of sensitive species in the NAFO area, new data on deep-water corals and sponges were presented based on Spanish/EU and Canadian bottom trawl groundfish surveys for the period 2008-2010. Since the coral and sponge closures were put in place new areas with significant concentrations have

emerged outside of the closures. This new information is also being used in the development of encounter protocols for sponges and sea pens for commercial groundfish trawling in the NRA (Kenchington et al. 2011).

## Material and Methods

Data used in this study come from four different bottom trawl groundfish surveys:

- 1) The Spanish 3NO Survey, carried out by the Instituto Español de Oceanografía (IEO), samples the Tail of the Grand Banks of Newfoundland (NAFO Divs. 3NO) between 40 and 1500 m depth.
- 2) The EU Flemish Cap Survey, carried out by the IEO together with the Instituto de Investigaciones Marinas (IIM) and IPIMAR (Portugal), samples all the Flemish Cap (NAFO Div. 3M), and currently a depth range between 130 and 1450 m.
- 3) The Spanish 3L Survey, carried out by the IEO, samples the Nose of the Grand Banks of Newfoundland and the Flemish Pass (NAFO Div. 3L) between 110 and 1450 m depth.
- 4) DFO NL Multispecies Surveys (NRA Divs. 3LMNO), carried out by Fisheries and Oceans, Canada between 32 and 1500 m.

Surveys 1 to 3 were carried out between May and August, using a random-stratified sampling design with standardized 30-minutes bottom trawls and vessel speed of 3 knots. The main objective of these surveys is the estimation of abundances and biomass indices of the main demersal species, and the demographic structure of their populations. A Campelen 1800 bottom trawl gear was used in the Flemish Pass and the Grand Banks of Newfoundland (Divs. 3LNO), whereas a Lofoten bottom trawl gear was used in the Flemish Cap (Div. 3M). Surveys 4 were carried out using a random-stratified sampling design with standardized 15-minutes bottom trawls and vessel speed of 3 knots. A Campelen 1800 bottom trawl gear was used.

Deep water corals and sponges were weighted (the biomass of massive sponge by-catches was extrapolated from samples or estimated visually, based on the observation of the volume of the codend) and recorded by scientific staff on board, and some samples were preserved to posterior studies in laboratory.

In order to follow the same groups previously used by WGEAFM, deep water corals were grouped in large gorgonians (Alcyonacea), small gorgonians (Alcyonacea), sea pens (Pennatulacea), and black corals (Antipatharia); and all the sponges were grouped together. Some of the species of corals and sponges present in the area have been previously published (Wareham and Edinger, 2007; Wareham 2009; Fuller 2011; Murillo et al. 2011; Murillo et al. 2012).

Data from the surveys undertaken in NAFO Regulatory Area (Divs. 3LMNO) during 2008-2010 period for corals and 2009-2010 (2008-2010 in 3L) for sponges are analysed in this document. A total number of 1628 (1128 Spain/EU and 500 Canada) bottom trawl hauls were studied in the area and period considered for corals and 1200 (839 Spain/EU and 361 Canada) for sponges. DFO NL Multispecies Surveys use to cover the Divisions 3LNO and sporadically the Division 3M, and for this reason, only the Spanish/EU surveys that cover uniformly the entire study area in the NRA (Divs. 3LMNO) have been used for the calculation of the percentage of presence for the different groups of corals and sponges.

Distribution maps of presence and significant catches of sponges, large gorgonians, small gorgonians, sea pens, and black corals following the thresholds defined before the closure of the areas (NAFO 2008, 2009) are presented in this document, based on data from RV surveys. Location of the corals and sponge records was assigned to the start position of the survey fishing tows. The coordinates and weight of the significant catches are provided in Table 1.

All the geographical databases were plotted using the UTM projected coordinate system (Zone 23N) to avoid distorting the data surfaces. Moreover, bathymetric curves were exported as shapefiles (ArcMap format) from CHS Canada.

## Results

### Sponges

Sponges were recorded in 547 of the tows (65.20% of the total tows conducted), mainly in the Flemish Pass, Flemish Cap and slope of the Grand Banks (Figure 1A) and significant catches ( $\geq 75$  kg/tow) were found in 25 tows, most of them in the areas identified previously as sponge grounds composed of large sponges of the Families Geodiidae and Ancorinidae in the Divisions 3LMNO of the NRA (ICES 2009; NAFO 2009, Murillo et al. 2012) that were closed in 2010. Of the total 25 tows (Figure 3), only 3 are outside of the closed areas and the sponge catch of these tows was between 115.79 and 313.21 kg with an average ( $\pm$  SD of the mean) of  $186.14 \pm 110.26$  kg. A significant ( $p$  value = 0.027 after Mann-Whitney U test) higher average of the significant catches of  $1724.92 \pm 2254.51$  kg were found inside of the closed areas with the higher values up to 10,000 kg in a tow in the south of Flemish Pass.

### Large gorgonians

Large gorgonians include the species *Acanthogorgia armata*, *Keratoisis* spp., *Paragorgia* spp., *Paramuricea* spp., and *Primnoa resedaeformis*, and were recorded in 58 of the tows (5.14% of the total tows conducted), mainly in the south of the Flemish Pass (Figure 1B) where 5 significant catches ( $\geq 2$  kg/tow) were found (Figure 3). Two of the 5 significant catches were inside of the closed areas and the other 3 very close to this area, but in shallower waters. These were catches of *Paragorgia arborea* and ranged between 2.74 and 23.50 kg per tow.

### Small gorgonians

Small gorgonians include the species *Acanella arbuscula*, *Anthothela grandiflora*, *Cryosogorgia* cf. *agassizii*, *Radicipes gracilis* and *Swiftia* sp. They were recorded in 96 of the tows (8.51% of the total tows conducted), mainly in the slope of the Grand Banks, in the Flemish Cap and Flemish Pass between 500 and 1000 m (Figure 1B). Eight significant catches ( $\geq 0.2$  kg/tow) were found and 6 of them (75%) outside of the closed areas (Figure 3) in the slope of the Grand Banks. Four of them between 0.22 and 0.65 kg with an average ( $\pm$  SD of the mean) of  $0.37 \pm 0.19$  kg are clustered in a small area in the southeast Grand Banks, above the 3O closure. All the significant catches are composed mainly of *A. arbuscula*.

### Sea pens

Sea pens were recorded in 427 of the tows (37.85% of the total tows conducted). They showed a horseshoe distribution around Flemish Cap and along the slope of the southeast Grand Banks (Figure 2A). According to the current NAFO threshold, significant catches ( $\geq 1.6$  kg/tow) were found in 10 tows, all of them in the proximities of the closed areas but outside (Figure 3). Five catches between 1.68 and 11.20 kg with an average ( $\pm$  SD of the mean) of  $5.48 \pm 3.57$  kg came from a narrow band in the northwest of

Flemish Cap between two closed areas. Figure 2A shows how the catches between 0.5 and 1.6 kg were distributed between the catches higher than 1.6 kg.

### Black corals

Black corals were recorded in 57 of the tows (5.05% of the total tows conducted). They were restricted to the Flemish Cap and Flemish Pas, also showing a horseshoe distribution around the Flemish Cap mainly between 500 and 1000 m depth (Figure 2B). No significant catch threshold was defined for black corals, however, most of the records of them were found outside of the current closures.

### **Discussion and conclusion**

Significant catches of sponges for the new data analyzed were found around the same areas that those obtained in 2009 (NAFO 2009) and only 3 of the 25 catches (12%) were found outside of the closed areas. Moreover, the significant catches found outside the closed areas had significant lower values than the catches found inside, suggesting that the areas where sponge grounds occur inside of the fishing footprint (NAFO 2010) are well known, although some improvements and modifications could be done, together with other data from the oncoming NEREIDA Project when the revision of the areas in 2014 will be done (NAFO 2012). In relation to deep water corals the results are different according to the group considered. For large gorgonians it seems that the significant catches found are close to those found in the past (NAFO 2008) and these areas should be refined in the future to incorporate these significant catches (one of 23.50 kg) to the closed areas. For small gorgonians most of the significant catches were localized outside of the closed areas and one cluster of them seems to show an interesting spot with 4 catches in the southeast of the Grand Banks above the 30 closure.

In the case of sea pens, all the new significant catches were recorded outside of the closed areas, but in the proximities of them. An area in the northeast of Flemish Cap with 5 significant catches between two areas closed in 2010 suggests that potential sea pens fields could exist along this narrow band and this data, together with other from the oncoming NEREIDA Project could be used when the revision of the areas in 2014 will be done (NAFO 2012).

There is a general concern about the environmental impacts of marine research on VMEs (OSPAR 2008). Despite that the NAFO areas known to have VMEs generally are avoided by the groundfish surveys (E. Roman, pers. comm.), some records of indicator species suggest that surveys could cause some degree of disturbance, particularly, in those grounds less used by the commercial fishery. In such grounds scientific activities could represent the main disturbance factor on sensitive habitats. This needs to be taken into account in order to establish sampling guidelines to prevent adverse effects on sensitive areas.

### **Acknowledgements**

This work was made possible with the support of the Instituto Español de Oceanografía (IEO) and the Spanish Government (Secretaría General del Mar). We are especially grateful to the scientific staff involved in NAFO surveys, and the heads of these surveys for facilitating the data collection and to the research vessels crews (RV “Vizconde de Eza”) for assistance at the sea. NAFO groundfish surveys are co-funded by the EU and the Spanish Government.

### **References**

Fuller SD. 2011. Diversity of marine sponges in the Northwest Atlantic. Thesis, (PhD). Dalhousie University, Halifax. 215 pp.

ICES. 2009. Report of the ICES-NAFO Working Group on Deep-Water Ecology (WGDEC), 9-13 March 2009. ICES Document CM 2009/ACOM: 23, 92 pp.

Kenchington, E., Cogswell, A., Lirette, C., and Murillo-Pérez, F.J. 2009. The use of density analyses to delineate sponge grounds and other benthic VMEs from trawl survey data. NAFO SCR Doc. 09/6, Serial No. N5626, 16 pp.

Kenchington, E., Murillo, F.J., Cogswell, A., and Lirette, C. 2011. Development of encounter protocols and assessment of significant adverse impact by bottom trawling for sponge grounds and sea pen fields in the NAFO Regulatory Area. NAFO SCR Doc. 11/75.

Murillo, F.J., Kenchington, E., Gonzalez, C., and Sacau, M. 2010. The use of density analyses to delineate significant concentrations of Pennatulaceans from trawl survey data. NAFO SCR Doc. 10/07, Serial No. N5753, 7 pp.

Murillo, F.J., Durán Muñoz, P., Altuna, A., and Serrano, A. 2011. Distribution of deep-water corals of the Flemish Cap, Flemish Pass, and the Grand Banks of Newfoundland (Northwest Atlantic Ocean): interaction with fishing activities. *ICES Journal of Marine Science* 68:319-332.

Murillo, F.J., Durán Muñoz, P., Cristobo, F.J., Ríos, P., González, C., Kenchington, E., and Serrano, A. 2012. Deep-sea Sponge Grounds of the Flemish Cap, Flemish Pass and the Grand Banks of Newfoundland (Northwest Atlantic Ocean): distribution and species composition. *Marine Biology Research*. In press.

NAFO. 2008. Report of the NAFO SC Working Group on Ecosystem Approach to Fisheries Management (WGEAFM). Response to Fisheries Commission Request 9.a. Scientific Council Meeting, 22-30 October 2008, Copenhagen, Denmark. NAFO SCS Doc. 08/24, Serial No. N5592, 19 pp.

NAFO. 2009. Report of the NAFO SC Working Group on Ecosystem Approach to Fisheries Management (WGEAFM). Response to Fisheries Commission Request 9.b and 9.c. Scientific Council Meeting, 4-18 June 2009, Dartmouth, Canada. NAFO SCS Doc. 09/6, Serial No. N5627, 26 pp.

NAFO. 2010. NAFO Conservation and Enforcement Measures. NAFO/FC Doc. 10/1, Serial No. N5740, 95 pp.

NAFO. 2012. NAFO Conservation and Enforcement Measures. NAFO/FC Doc. 12/1, Serial No. N6001, 100 pp.

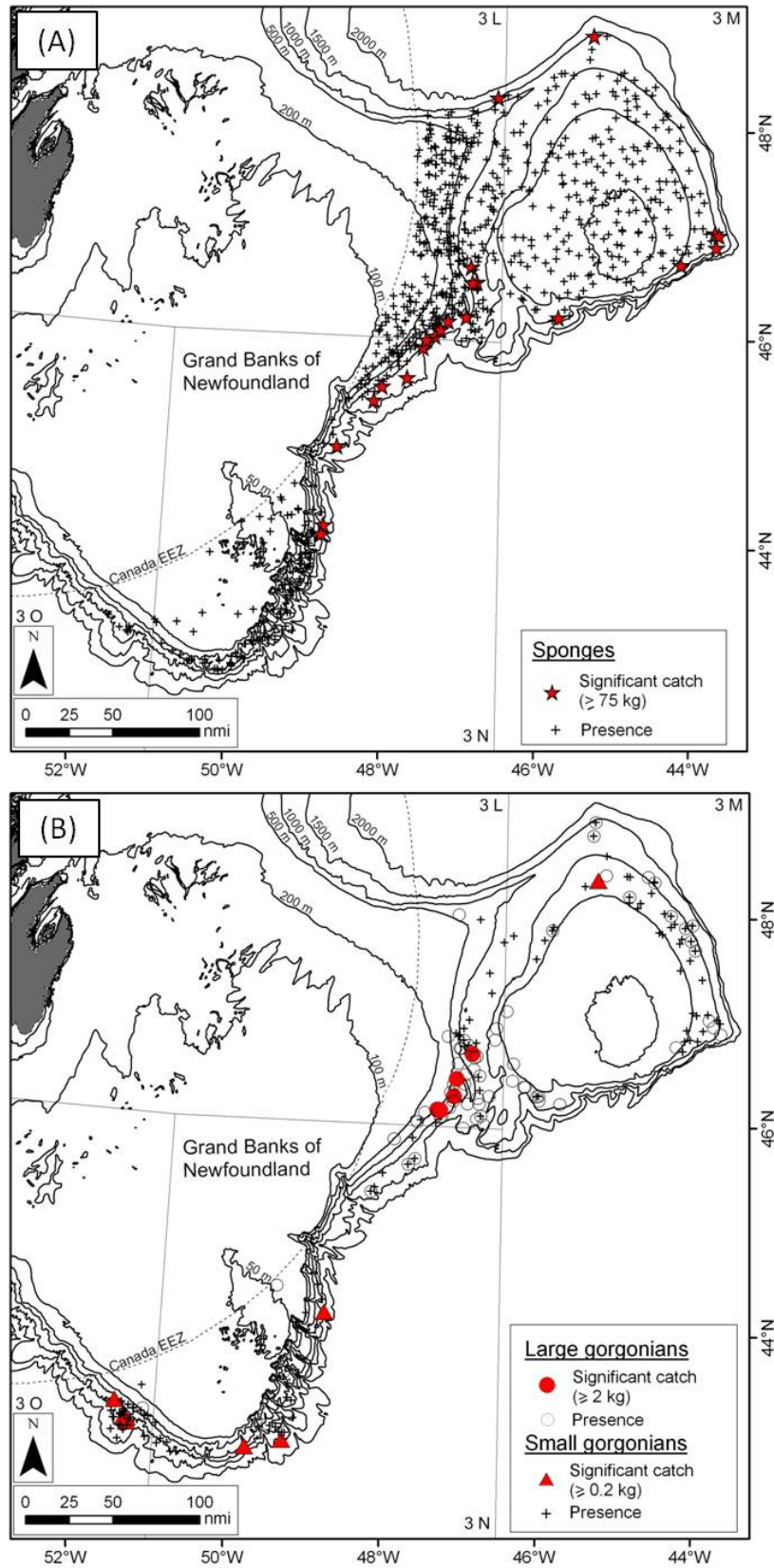
OSPAR. 2008. OSPAR Code of conduct for responsible marine research in the deep seas and high seas of the OSPAR Maritime Area. Number: 2008-0, 3 pp.

Wareham, V.E. 2009. Updates on deep-sea coral distribution in the Newfoundland Labrador and Arctic regions, Northwest Atlantic. In *The Ecology of Deep-sea Corals of Newfoundland and Labrador Waters: Biogeography, Life History, Biogeochemistry, and Relation to Fishes*, pp. 3–22. Ed. by K. Gilkinson, and E. Edinger. Canadian Technical Report of Fisheries and Aquatic Sciences, 2830. 136 pp.

Wareham, V.E., and Edinger, E.N. 2007. Distribution of deep-sea corals in the Newfoundland and Labrador region, Northwest Atlantic Ocean. In *Conservation and Adaptive Management of Seamount and Deep-sea Coral Ecosystems*, pp. 289–313. Ed. by R.Y. George, and S.D. Cairns. Rosenstiel School of Marine and Atmospheric Sciences, University of Miami. 323 pp.

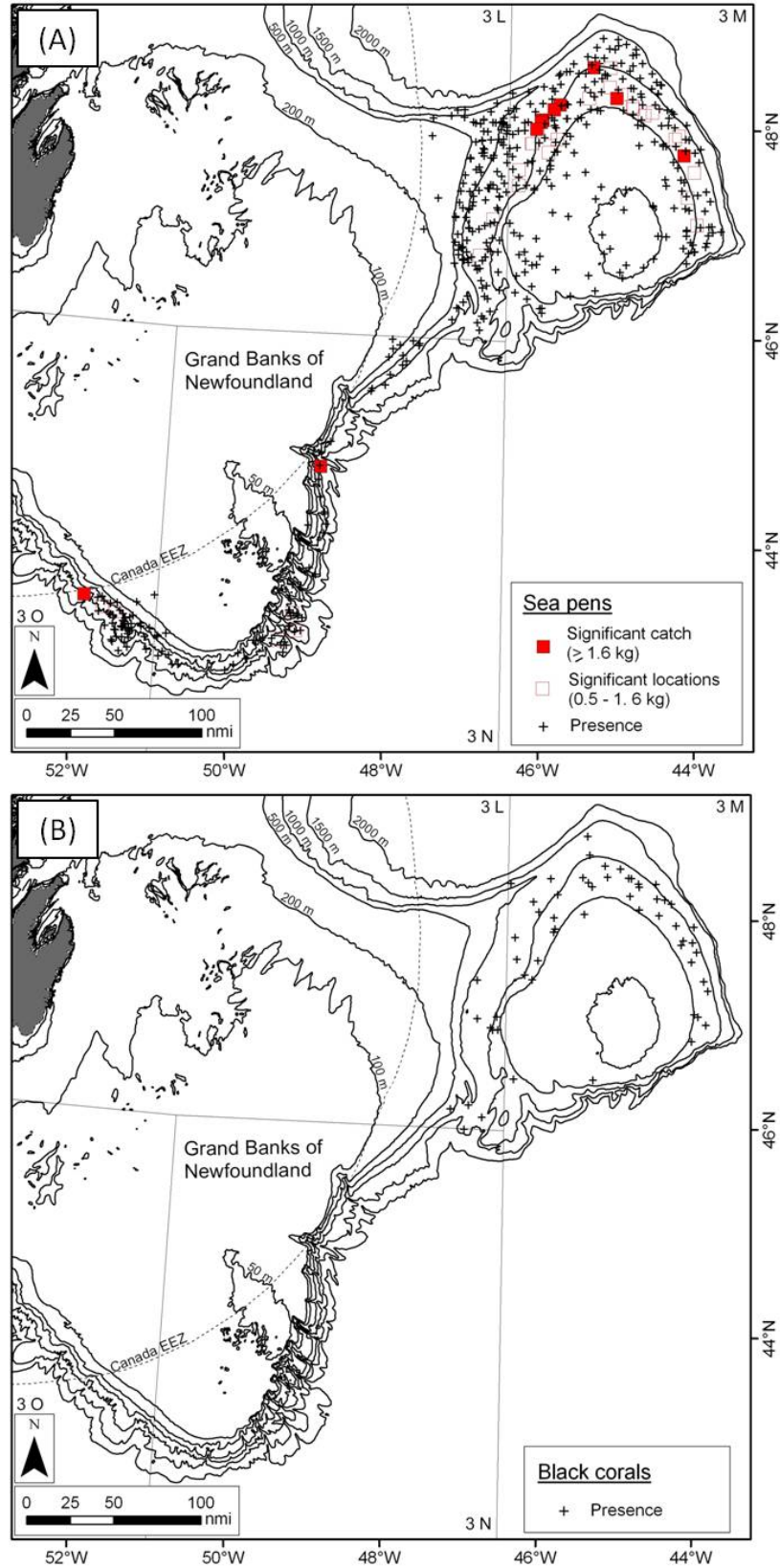
**Table 1.** Start and end positions of tows with corals and sponges catches above the threshold defined as significant catch (NAFO 2008, 2009) in the NRA (Divs. 3LMNO) outside of the closed areas with their corresponding weight.

Country	Year	Start position		End position		VME species	Weight (kg)
		Latitude (N)	Longitude (W)	Latitude (N)	Longitude (W)		
Spain/EU	2008	46° 34' 16.799"	46° 50' 50.399"	46° 35' 31.200"	46° 51' 28.800"	Sponge	313.210
Spain/EU	2010	46° 14' 32.399"	45° 42' 42.599"	46° 14' 39.001"	45° 44' 58.200"		129.423
Spain/EU	2010	46° 44' 38.400"	44° 00' 24.001"	46° 43' 39.601"	44° 02' 04.801"		115.790
Canada	2010	46° 18' 18.000"	47° 10' 22.800"	46° 17' 34.800"	47° 10' 19.200"	Large gorgonian	23.500
Canada	2008	46° 10' 19.200"	47° 23' 52.800"	46° 09' 54.000"	47° 24' 25.200"		7.450
Canada	2009	46° 28' 19.200"	47° 08' 31.200"	46° 28' 30.000"	47° 07' 55.200"		2.740
Canada	2009	43° 02' 24.000"	51° 20' 06.000"	43° 01' 58.800"	51° 19' 04.800"	Small gorgonian	0.650
Canada	2010	43° 14' 34.800"	51° 30' 46.800"	43° 13' 55.200"	51° 30' 43.200"		0.320
Canada	2008	43° 04' 40.800"	51° 23' 13.200"	43° 05' 06.000"	51° 24' 00.000"		0.280
Canada	2009	43° 04' 22.800"	51° 20' 13.200"	43° 04' 58.800"	51° 20' 52.800"		0.220
Canada	2009	42° 52' 30.000"	49° 47' 24.000"	42° 52' 48.000"	49° 46' 37.200"		0.200
Canada	2009	42° 57' 18.000"	49° 18' 43.200"	42° 56' 42.000"	49° 18' 25.200"		0.200
Spain/EU	2008	48° 15' 56.880"	45° 47' 04.920"	48° 14' 46.320"	45° 49' 16.320"	Sea pen	11.200
Spain/EU	2008	48° 07' 09.120"	46° 01' 23.880"	48° 05' 49.200"	46° 02' 42.000"		6.100
Spain/EU	2010	48° 01' 54.599"	46° 06' 42.599"	48° 00' 27.601"	46° 07' 10.801"		4.294
Spain/EU	2008	48° 13' 03.720"	45° 51' 56.880"	48° 11' 57.120"	45° 53' 35.520"		4.103
Spain/EU	2010	44° 45' 00.601"	48° 56' 36.600"	44° 46' 05.999"	48° 57' 31.799"		3.686
Spain/EU	2008	47° 46' 37.920"	44° 01' 22.080"	47° 48' 05.400"	44° 02' 19.680"		2.292
Spain/EU	2009	48° 37' 18.120"	45° 18' 05.400"	48° 37' 35.400"	45° 15' 40.320"		2.085
Spain/EU	2008	43° 23' 17.999"	51° 56' 51.601"	43° 23' 26.401"	51° 58' 46.200"		1.949
Spain/EU	2008	48° 19' 42.600"	44° 58' 21.720"	48° 20' 12.480"	45° 00' 29.520"		1.746
Spain/EU	2009	48° 05' 46.320"	46° 02' 56.400"	48° 04' 34.320"	46° 04' 14.880"		1.681



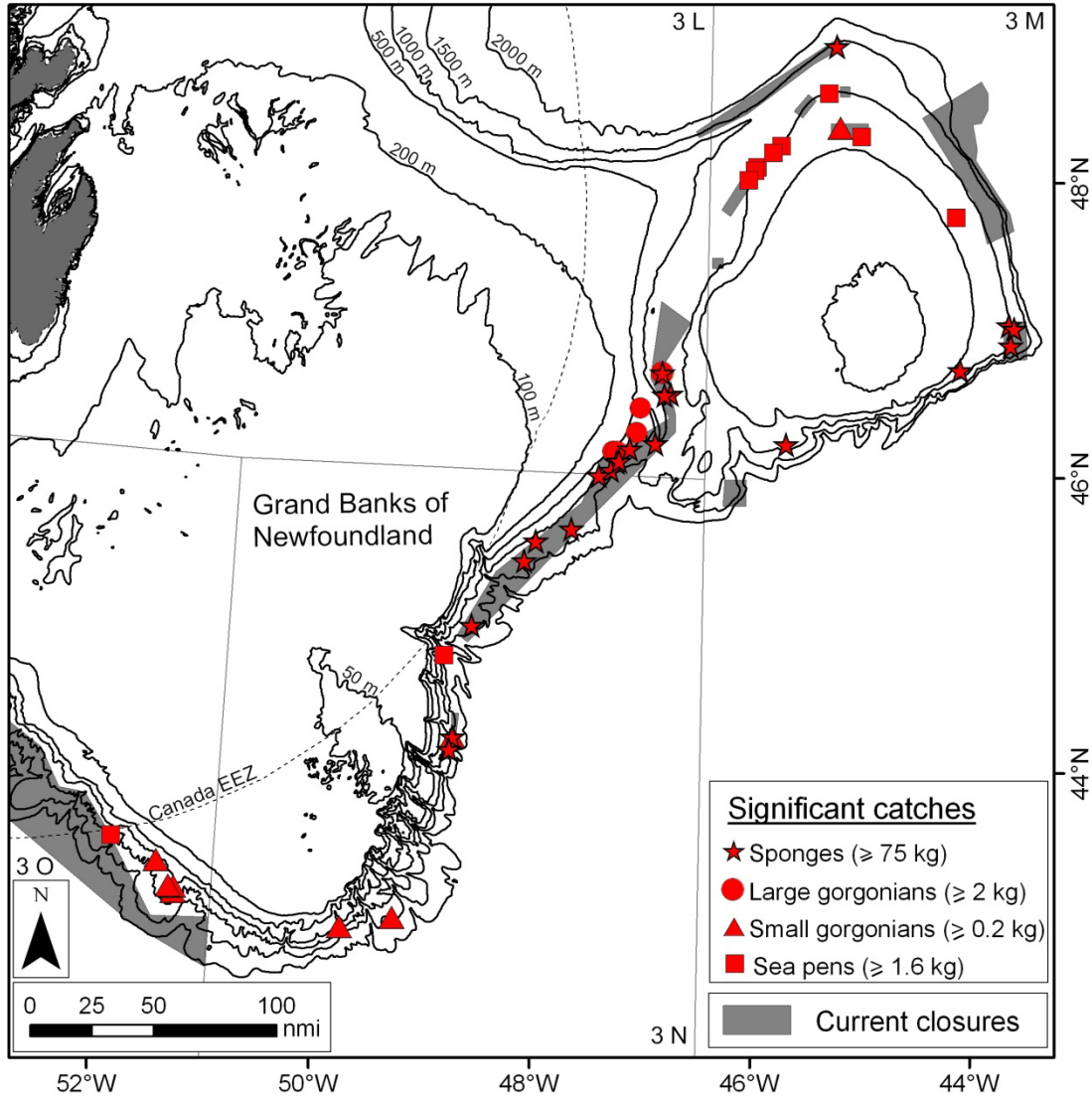
**Figure 1.** Distribution of significant catches and presence of sponges (A) and large and small gorgonians (B) in the study area (NAFO Divs. 3LMNO).





**Figure 2.** Distribution of significant catches and presence of sea pens (A) and black corals (B) in the study area (NAFO Divs. 3LMNO).





**Figure 3.** Distribution of significant catches of deep-water corals and sponges in the study area (NAFO Divs. 3LMNO). The location of all areas currently closed to protect significant concentrations of corals and sponges in the NRA (Divs. 3LMNO) are also indicated (NAFO 2012).