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Research Document 2010/090 | **Document de recherche 2010/090**

Distribution of cold-water coral, sponges and sponge reefs in British Columbia with options for identifying significant encounters

Répartition des coraux, éponges et récifs d'éponges d'eaux froides en Colombie-Britannique avec options aux fins de repérage des rencontres importantes.

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ISSN 1499-3848 (Printed / Imprimé)
ISSN 1919-5044 (Online / En ligne)

Canada

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Correct citation for this publication:

Finney, J.L., and P. Boutillier. 2010. Distribution of cold-water coral, sponges and sponge reefs in British Columbia with options for identifying significant encounters. DFO Can. Sci. Advis. Sec. Res. Doc. 2010/090. vi + 9 p.

ABSTRACT

British Columbia (BC) is home to a diversity of cold-water coral and sponges as well as globally unique hexactinellid (glass) sponge reefs. This paper summarizes the known distribution of cold-water coral, sponges, and sponge reefs in BC waters. It also provides options for identifying significant encounters with these animals during commercial fishing activity based on recorded catch weights.

RÉSUMÉ

On retrouve en Colombie-Britannique (C.B.) une diversité de coraux, d'éponges et des récifs d'éponges hexactinellides (siliceuses) uniques au monde. Le présent article résume la répartition connue des coraux, éponges et récifs d'éponges d'eaux froides en Colombie-Britannique. Il offre en outre des options aux fins du repérage des rencontres importantes avec ces animaux en cours d'activités de pêche commerciale au moyen des poids de capture enregistrés.

INTRODUCTION

British Columbia (BC) is home to a diversity of cold-water coral and sponges as well as globally unique hexactinellid (glass) sponge reefs. This paper summarizes the known distribution of cold-water coral, sponges, and sponge reefs in BC waters. It also provides options for identifying significant encounters with these animals during commercial fishing activity based on recorded catch weights.

METHODS

KNOWN CORAL AND SPONGE LOCATIONS

A database of 5,553 coral records and 10,689 sponge records was compiled using data from primary literature, museums, online databases, DFO survey data and commercial observer records. Records had differing levels of taxonomic classification, and not all records were confirmed by an expert. The coral records represent 97 species from 25 families and 5 orders, while the sponge records represent over a hundred species from 55 families and 22 orders.

KNOWN SPONGE REEF LOCATIONS

BC is home globally unique hexactinellid sponge reefs. Sponge reefs were originally discovered in Queen Charlotte Sound in the late 1980s, and new reefs are still being discovered all along the BC coast. The most up-to-date locations of all known hexactinellid sponges were obtained from Natural Resources Canada (NRCan) (Robert Kung, Institute of Ocean Sciences, Sydney, BC, pers. comm.). The files are missing a small sponge reef location in Portland Canal that has not yet been digitized (Robert Kung, pers. comm).

THRESHOLD SELECTION TO IDENTIFY SIGNIFICANT ENCOUNTERS

Records from the PacHarvTrawl database (at-sea-observer records from commercial groundfish trawl fishing vessels) were subset from the larger database of corals and sponges. Coral records from the PacHarvTrawl database that were within 2 km of known sponge reef locations or that were observed prior to 2001 (the year that observers began receiving specialized training on identifying corals) were excluded to reduce the chances of a misidentified record being analysed. In total there were 2,696 records of coral, and 4,438 records of sponges from the commercial groundfish trawl fishery. Coral records were broken down by taxonomic order (three in total: Alcyonacea, Pennatulacea, and Scleractinia). Sponge records were only identified as “sponge”, and so could not be broken down into smaller taxonomic groupings.

Several scenarios were considered as possible conservation thresholds for known commercial encounters with cold-water coral and sponges:

1. All encounters with corals and sponges are considered significant;

2. Encounters that are equal to or greater than the 50^{th} percentile weight for catch distribution in commercial tows for each taxonomic group are considered significant;

3. Encounters that are equal to or greater than the 75^{th} percentile weight for catch distribution in commercial tows for each taxonomic group are considered significant;

4. Encounters that are equal to or greater than the 80th percentile weight for catch distribution in commercial tows for each taxonomic group are considered significant; and

5. Encounters that are equal to or greater than the 90th percentile weight for catch distribution in commercial tows for each taxonomic group are considered significant.

The study area was defined as the region within the Exclusive Economic Zone (EEZ) of Pacific Canada and less than 2450 m depth. Additional areas with coral or sponge records were included as necessary. The study area was divided up into 1 km-by-1 km grid cells. There was a total of 239,400 grid cells in the study area. For each scenario, grid cells that contained at least one historical commercial encounter with corals or sponges that was considered significant were flagged as containing significant benthic attributes. In all cases, grid cells containing sponge reefs were considered significant areas.

RESULTS

KNOWN CORAL AND SPONGE LOCATIONS

The source and number of records of coral and sponge are summarized in Table 1.

Records of Alcyonacea are mainly concentrated along the shelf break, in Dixon Entrance, Chatham Sound, and along Moresby, Mitchell's and Goose Island Gullies (Figure 1). Alcyonacea tend to be found in water shallower than 1250 m with a median depth of 369 m (Figure 2). Catch weights range from 0.001 to 1,043.3 kg with a median value of 1.8 kg (Table 2).

There are records of Anthoathecatae throughout BC waters, and they tend to be found closer to shore (Figure 1). Twelve records are located at the southern tip of the Queen Charlotte Islands. Anthoathecatae tend to be found in shallower water (median depth of 27 m), though one record was reported at 2,079 m (Figure 2). Only 1 record has weight reported (0.1 kg, Table 2).

Records of Antipatharia were concentrated along the shelf break (Figure 1) and tend to be found in deep water (median depth of 1,219 m, Figure 2). Only 17 records have reported weights ranging from 0.001 to 3.5 kg (Table 2).

Records of Pennatulacea can be found throughout BC waters (Figure 1). Pennatulids tend to be found in water shallower than 250 m with a median depth of 143 m (Figure 2). Reported catch weights range from 0.001 to 907.2 kg (median 0.5 kg, Table 2).

Records of Scleractinia can be found throughout BC waters, though they tend to be clustered along the shelf break, and in Moresby, Mitchell's, and Goose Island Gullies (Figure 1). Scleractinia tend to be found in water shallower than 1000 m, with a median depth of 228 m. Reported catch weights range from 0.001 to 1,360 kg (median 1.0 kg, Table 2).

Sponges can be found throughout BC waters (Figure 1) and tend to be located in water shallower than 1000 m (median depth of 206 m, Figure 2). Catch weights range from 0.001 to 11,249.3 kg (median weight of 1.8 kg, Table 2).

KNOWN SPONGE REEF LOCATIONS

Sponge reefs have been discovered throughout BC. Approximately 33 small reefs have been located in the Strait of Georgia and together cover nearly 11 km^2 (Figure 3). Four large areas containing large and small sponge reefs have been identified in Queen Charlotte Sound and Hecate Strait covering approximately 390 km^2 (Figure 3).

THRESHOLD SELECTION TO IDENTIFY SIGNIFICANT ENCOUNTERS

In all cases known sponge reefs were considered significant areas. Using the 1 km-by-1 km grid cells, a total of 1,313 km^2 are considered significant because of sponge reefs. For each scenario, the total area identified as significant, and the area identified as significant for each taxonomic group are summarized in Table 4. When all encounters with corals and sponges are considered significant, a total of 4,990 km^2 are flagged as having significant encounters. That area is reduced to 2,118 km^2 when the 75^{th} percentile weight is used, and 1,590 km^2 when the 90^{th} percentile weight is used.

DISCUSSION

This paper has summarized the known distribution of cold-water coral, sponges, and sponge reefs in BC waters and provided options for identifying significant encounters with these animals during commercial fishing activity. The options presented are not the only options available, and others should be considered. For example, different thresholds could be selected for different taxa based on their vulnerability to damage from fishing activity. Alcyonaceans and antipatharians are likely to be more sensitive than most pennatulaceans, therefore managers may decide that all encounters with alcyonaceans and antipatharians are significant, while only those equal to or above the 75^{th} percentile weight are significant for pennatulaceans. Other metrics such as diversity could also be considered. For example, a single trawl may catch several taxa of concern (e.g., sponges, alcyonaceans, and pennatulaceans), but in amounts below the selected threshold. However, the encounter may still be considered significant due to the diversity of sensitive taxa. Selecting appropriate thresholds to identify significant encounters with cold-water corals, sponges, and sponge reefs is a crucial component of any management strategy designed to protect vulnerable marine ecosystems.

TABLES

Table 1. Summary of the number of records of coral and sponge in BC. Number of records are broken down by taxonomic order (in the case of coral), as well as by research vessel (RV) records (i.e. from tanner crab, shrimp trawl, and groundfish trawl surveys), commercial records (i.e., observer records from the groundfish trawl fishery), and all other sources.

	Total records	RV records	Commercial records	Other sources
Corals				
Alcyonacea	1,903	979	787	137
Anthoathecatae	63	3	0	60
Antipatharia	111	77	0	34
Pennatulacea	2,882	1,671	1,017	194
Scleractinia	594	335	147	112
Sponges	10,689	3,808	4,438	2,443

*Table 2. Percentile weights (kg) of the catch distribution of **all records** with reported weights for 5 orders of coral and all sponges.*

	n records	50th	75th	80th	90th	min	max
Corals							
Alcyonacea	1,535	1.81	6.80	9.07	22.67	0.001	1043.27
Anthoathecatae	1	0.10	0.10	0.10	0.10	0.1	0.10
Antipatharia	17	0.05	0.20	1.00	1.50	0.001	3.50
Pennatulacea	2,229	0.45	0.45	0.90	4.07	0.001	907.19
Scleractinia	424	1.00	4.53	6.80	13.60	0.001	1,360.79
Sponges	7,798	1.8	4.5	9.1	22.7	0.001	11,249.3

*Table 3. Percentile weights (kg) of the catch distribution of all **commercial records** with reported weights for 5 orders of coral and all sponges.*

	n records	mean	50th	75th	80th	90th	min	max
Corals								
Alcyonacea	787	12.73	2.25	6.80	9.07	22.67	0.44	1043.27
Anthoathecatae	0	-	-	-	-	-	-	-
Antipatharia	0	-	-	-	-	-	-	-
Pennatulacea	1,017	1.77	0.45	0.45	0.45	2.26	0.44	226.79
Scleractinia	147	16.99	1.36	4.53	6.80	9.07	0.44	1,133.98
Sponges	4,438	49.7	2.3	9.1	11.3	45.4	0.4	11,249.3

Table 4. The area (km^2) considered significant for each scenario (all; 50^{th} percentile weight; 75^{th} percentile weight; 80^{th} percentile weight; and 90^{th} percentile weight).

	Scenario				
	All	50^{th} %	75^{th} %	80^{th} %	90^{th} %
Total	4,990	2,766	2,118	2,050	1,590
Sponge reefs	1,313	1,313	1,313	1,313	1,313
All sponges	2,724	1,101	503	496	192
All coral	1,474	1,132	968	923	195
Alcyonacea	634	356	195	162	80
Pennatulacea	841	748	748	748	102
Scleractinia	129	68	42	26	16

FIGURES

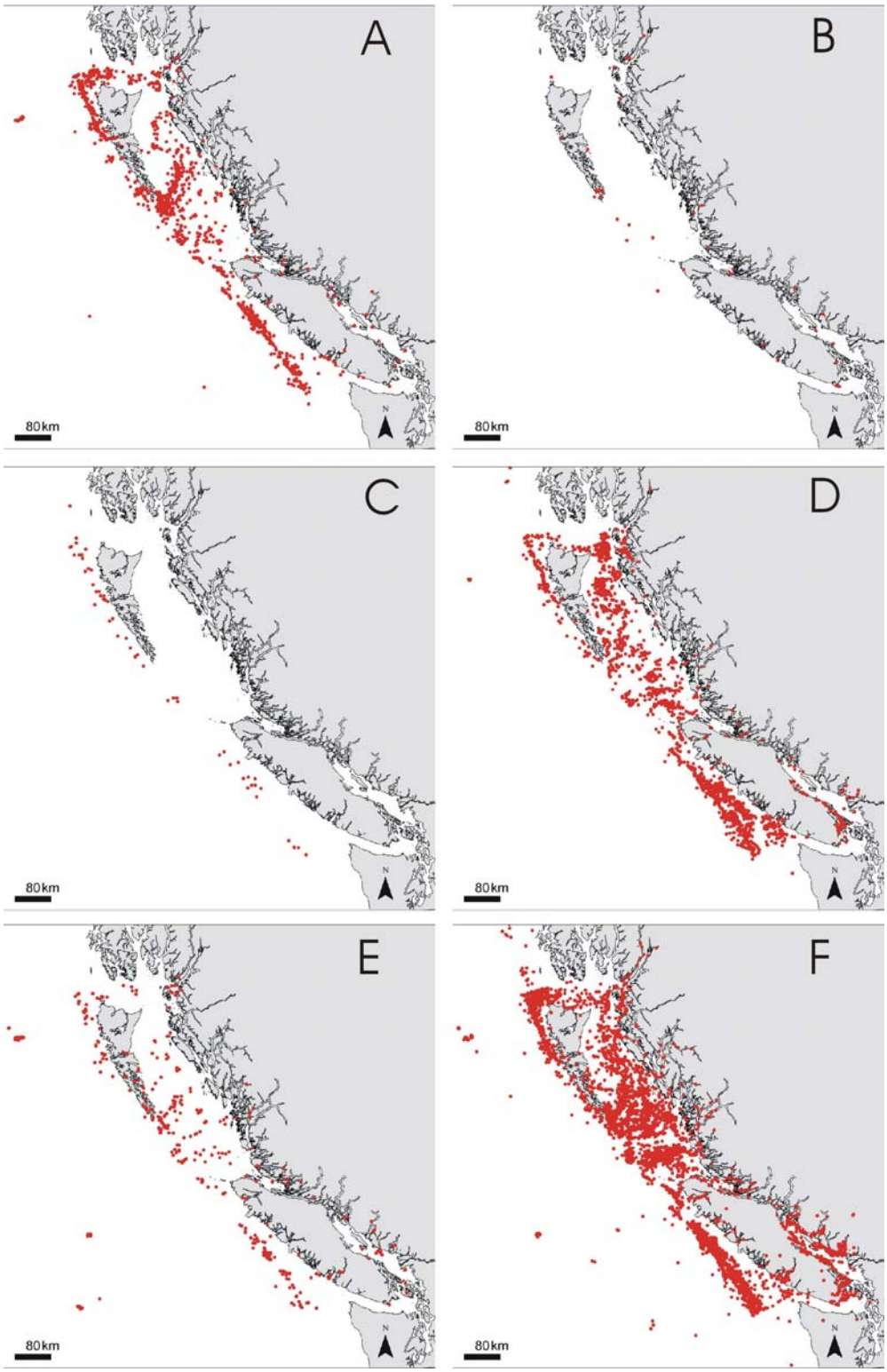

Figure 1 Distribution of records for (A) Alcyonacea; (B) Anthoathecatae; (C) Antipatharia; (D) Pennatulacea; (E) Scleractinia; and (F) sponges.

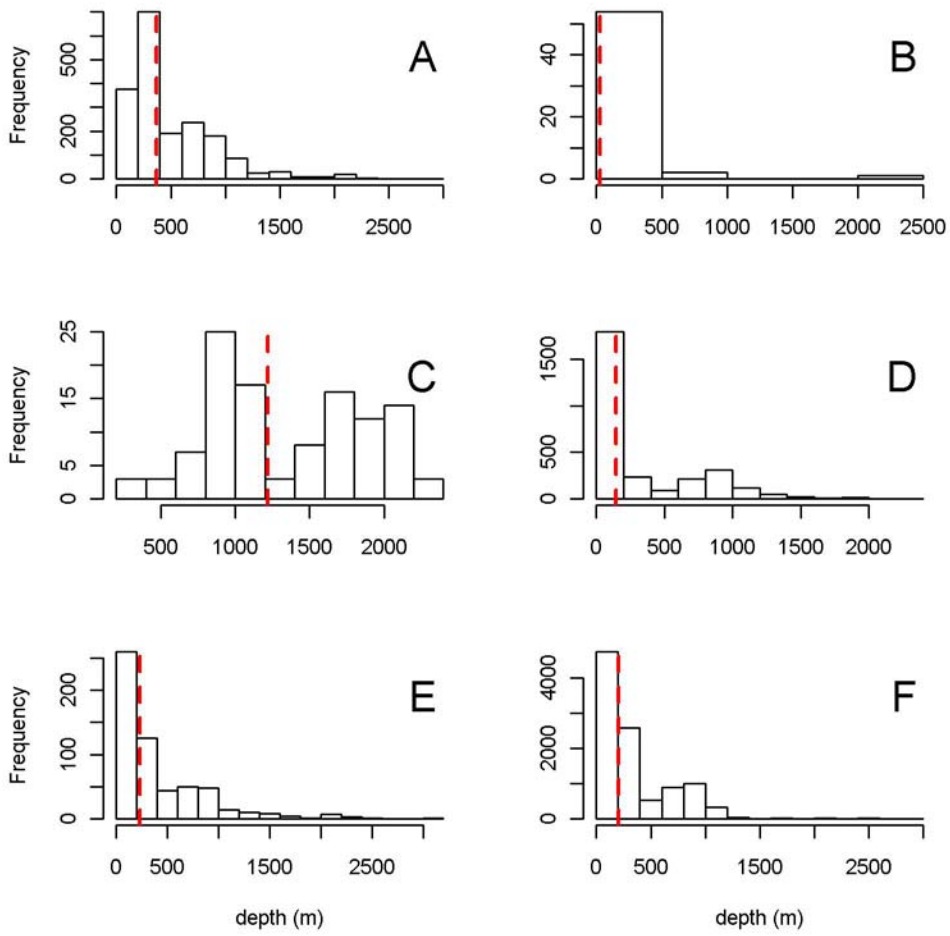

Figure 2 Depth distribution of records for (A) Alcyonacea; (B) Anthoathecatae; (C) Antipatharia; (D) Pennatulacea; (E) Scleractinia; and (F) sponges. Vertical red dotted lines represent median values.

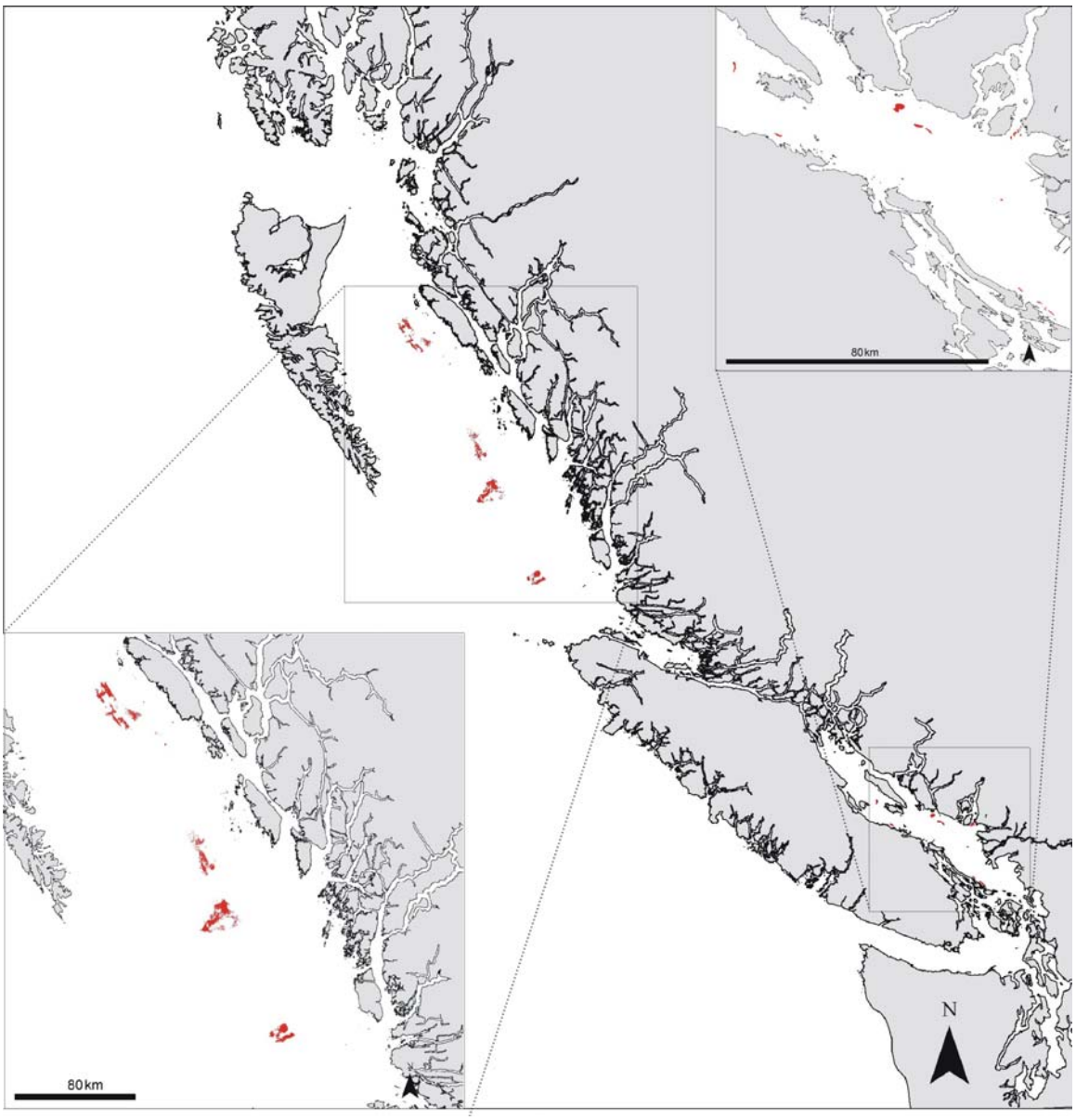

Figure 3. Location of known sponge reefs in BC.

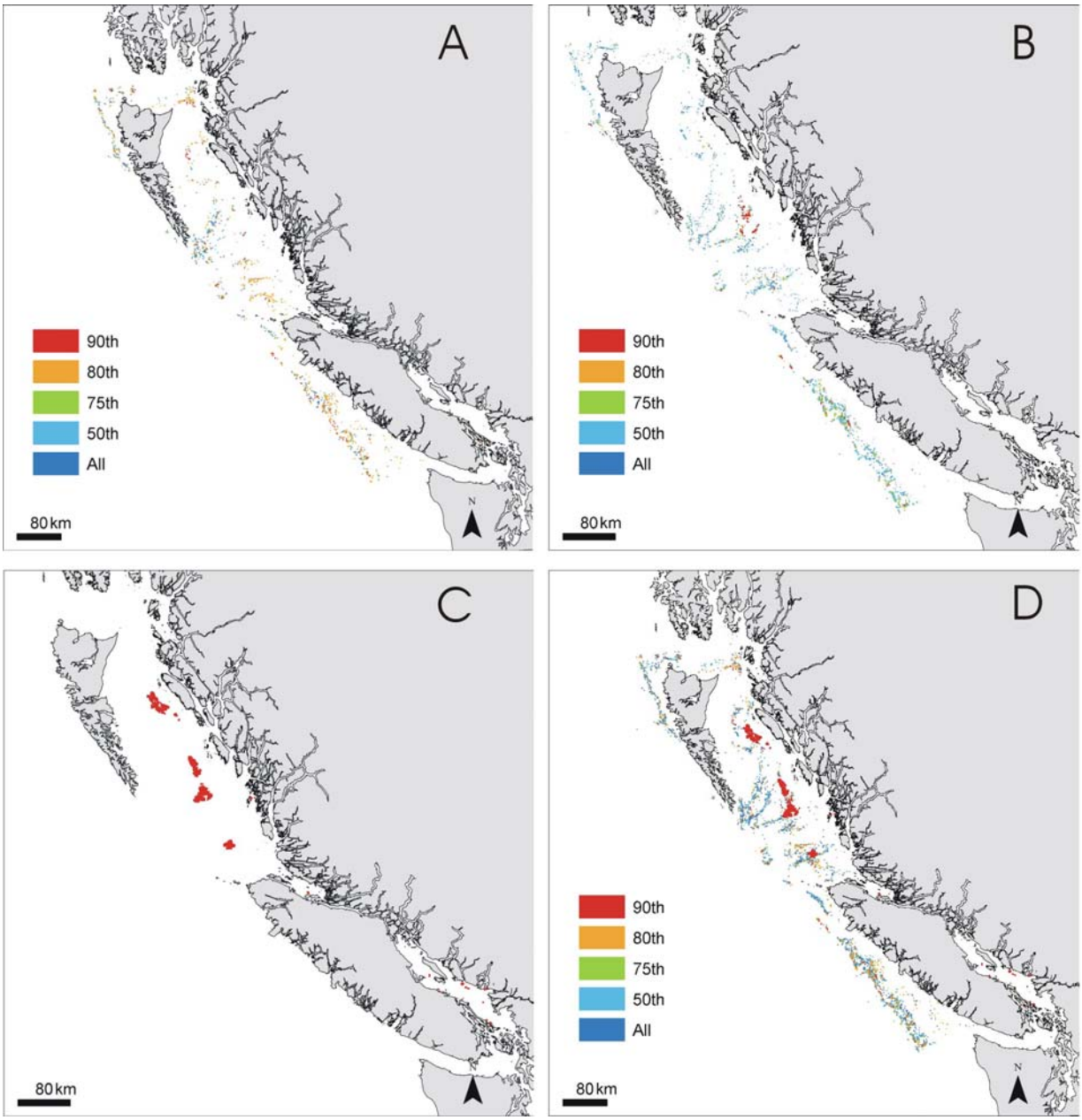

Figure 4. Spatial distribution of areas identified as having significant encounters with (A) corals; (B) sponges; (C) sponge reefs; and (D) corals, sponges, and sponge reefs. Colours indicate the different scenarios used (i.e., all encounters are significant, and encounters equal to or above the 50th, 75th, 80th, or 90th percentile weight of the catch distribution are significant).