Deep-water biogenic habitat in Pacific Canada: challenges to its conservation

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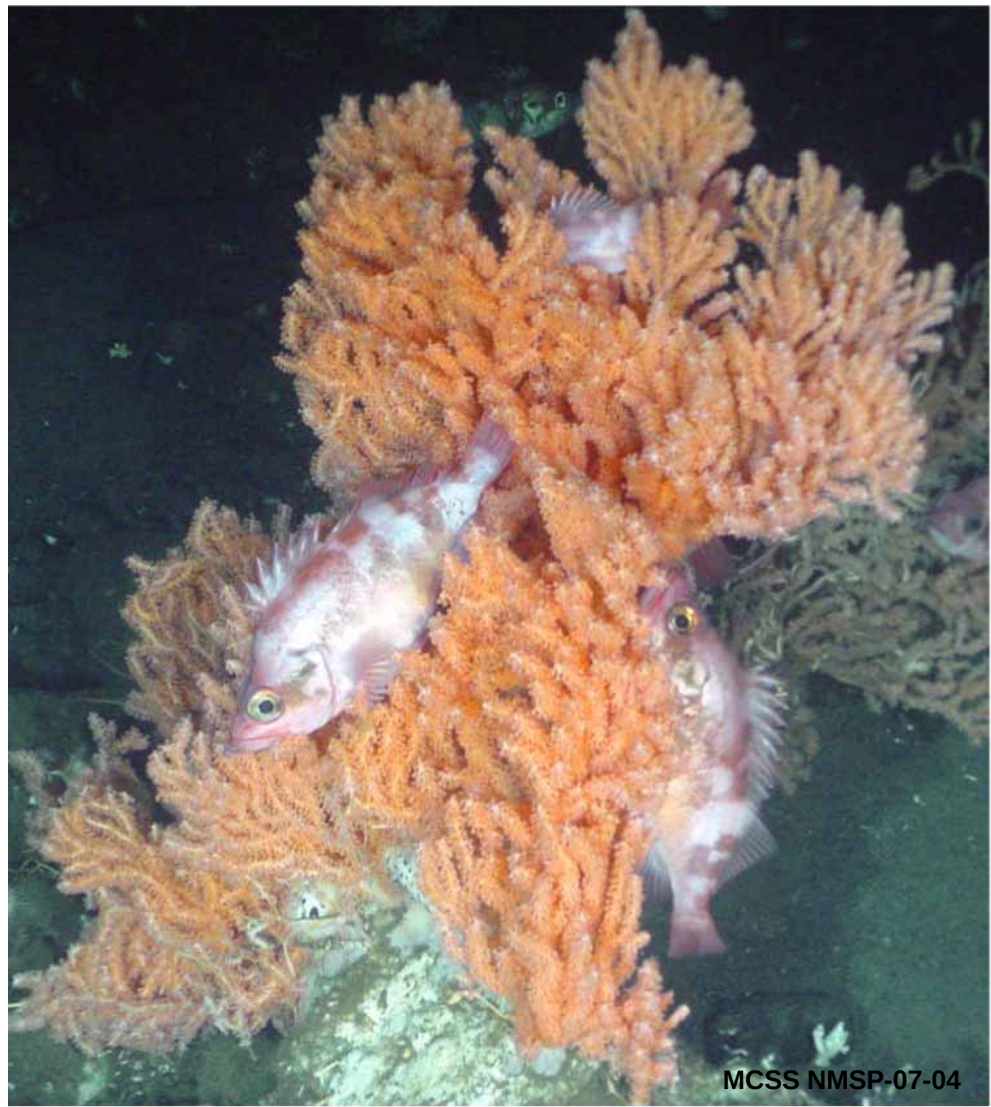
Shallow water Corals

Corals occurring in the photic zone are typically warm water, are often hermatypic (reef-building), and coexist in a symbiotic relationship with photosynthetic organisms called zooxanthellae, which are unicellular yellow-brown (dinoflagellate) algae that live symbiotically in the gastroderm of reef-building corals.

Cold-water corals

Unlike warm water corals, most cold water corals do not form symbiotic associations since they commonly exist below the photic zone and are thus azooxanthellate.

The majority of cold water corals are considered to be ahermatypic (non reef-building), but some hermatypic cold water coral species (e.g., *Lophelia* and *Dendrophyllia*) exist.



Cold-water corals

- Are some of the oldest living animals
- Are colonies of thousands of tiny animals
- Are found at all depths where trawling occurs, and likely deeper
- Have slow growth (1 - 2 cm per year)
- Are sensitive to physical disturbance (trawled coral forests / gardens will not recover in our lifetime)

BC Coral Taxonomy

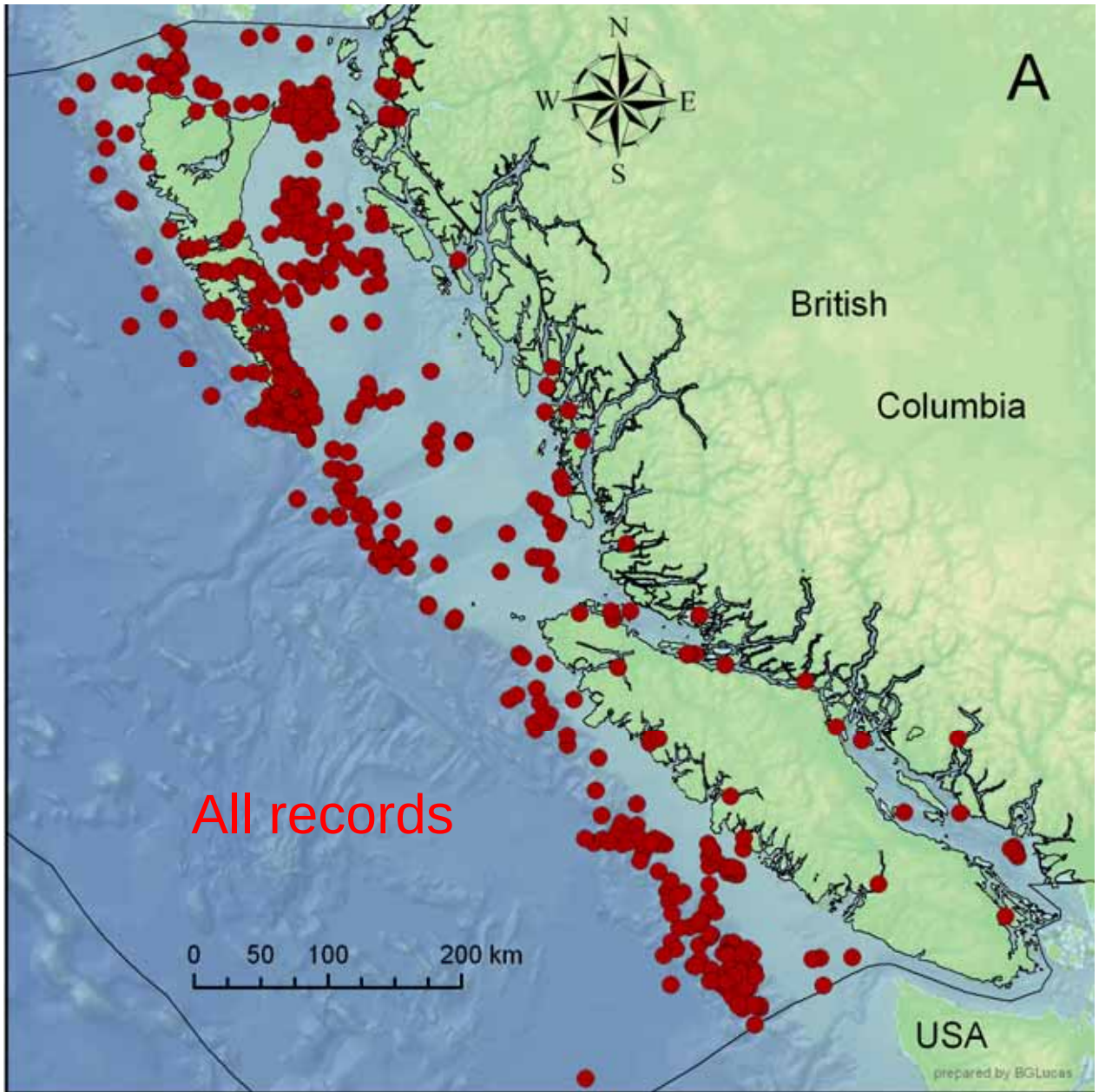
- **Taxonomic classification of the cold water corals found to date in Canadian Pacific waters includes representation from five Orders, 23 Families and 60 species of corals from British Columbian waters.**

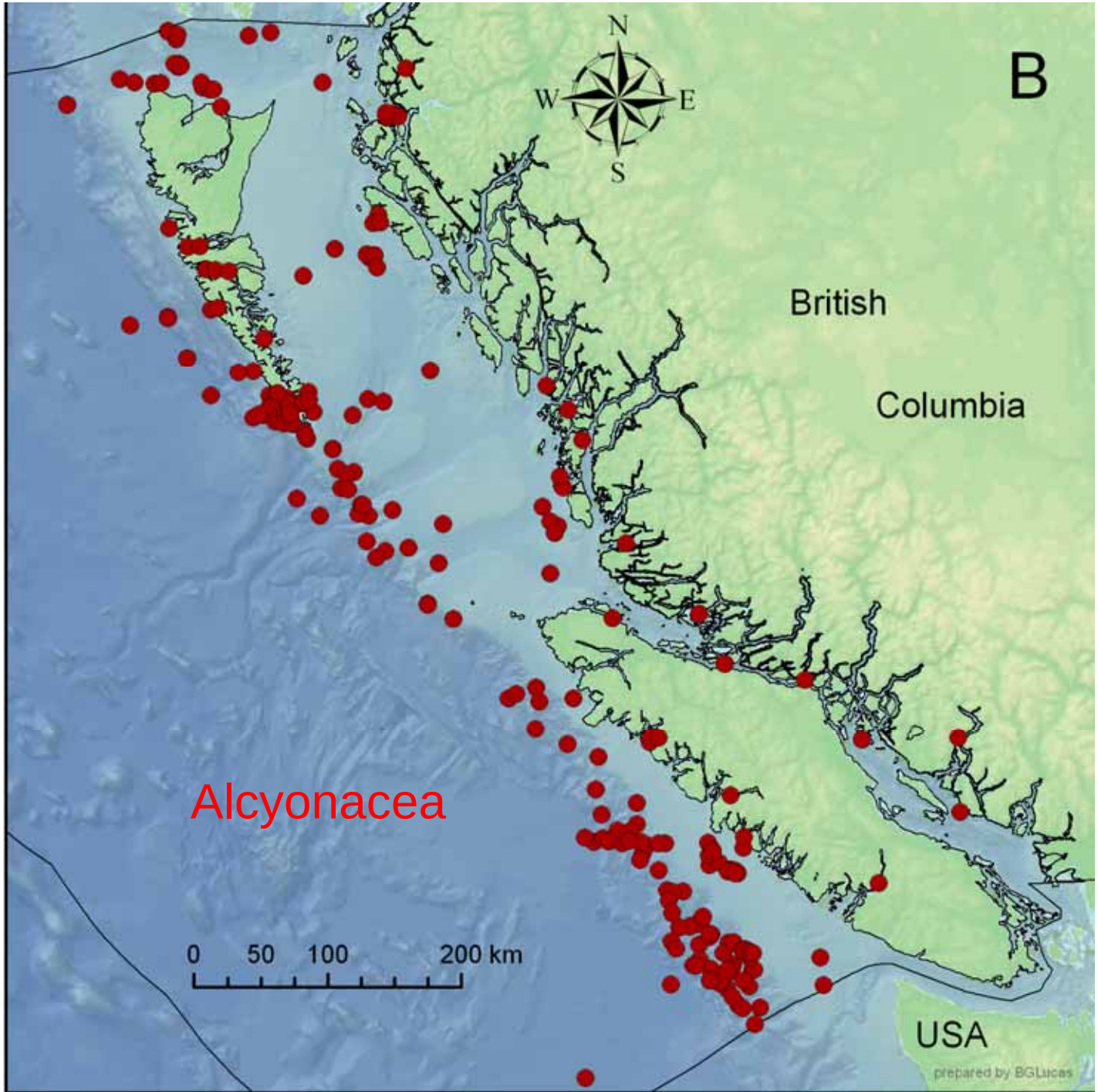
- **Including potential species in south-east Alaska, Gulf of Alaska sea mounts and Washington/Oregon, there are at least six Orders, 26 Families and 111 species. This includes an additional 53 species of corals from south-eastern Alaskan waters and Gulf of Alaska seamounts (Bob Stone, NOAA, Juneau, Alaska, USA, pers. comm.) and 27 species from Washington/Oregon (Curt E. Whitmire and M. Elizabeth Clarke, NOAA, Seattle, Washington, USA, pers. comm.).**

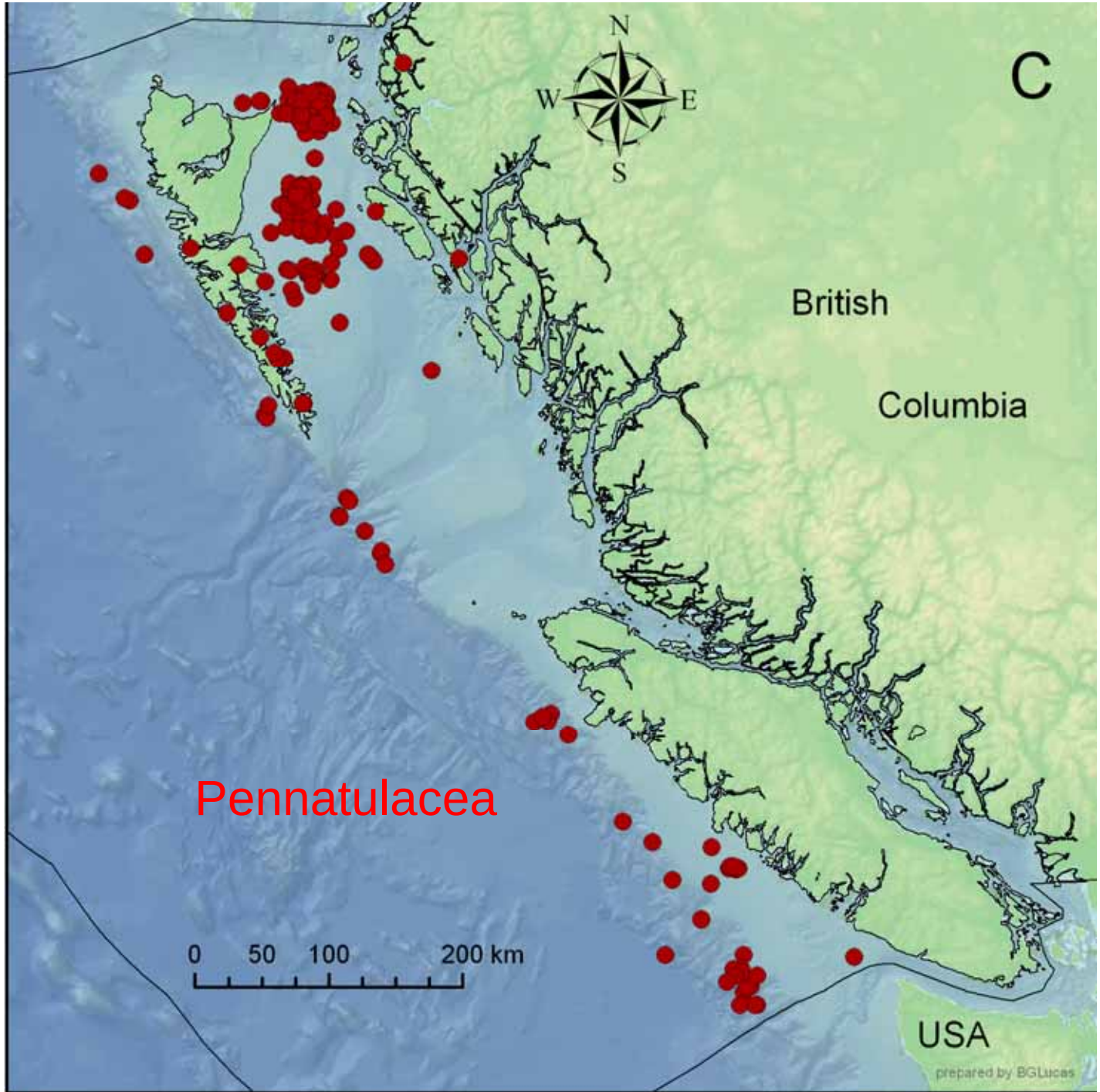
Phyllum Cnidaria	111 species
Class Anthozoa	
Subclass Alcyonaria	
Order Alcyonacea (soft corals and sea fans)	**44 species**
Alcyoniidae	
Nephtheidae	
Chrysogorgiidae	
Paragorgiidae (bubblegum trees)	
Acanthogorgiidae	
Plexauridae	
Paramuriceidae	
Primnoidae (red trees)	
Isididae (bamboo corals)	
Order Gorgonacea (gorgonians)	
Coralliidae (red or pink corals)	
Order Pennatulacea (sea pens and sea whips)	**28 species**
Order Stolonifera	**2 species**
Order Antipatharia (black corals)	**15 species**
Order Scleractinia (“stony” and cup corals)	**11 species**

Phyllum Cnidaria,	
Class Hydrozoa	
Order Filifera	
Stylasteridae **(fire corals)**	**11 species**

Locations of corals reported from British Columbia, Canada.




B
N
W
E
S
British
Columbia
Alcyonacea
0
50
100
200 km
USA
prepared by BGLucas


C
N
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British
Columbia
Pennatulacea
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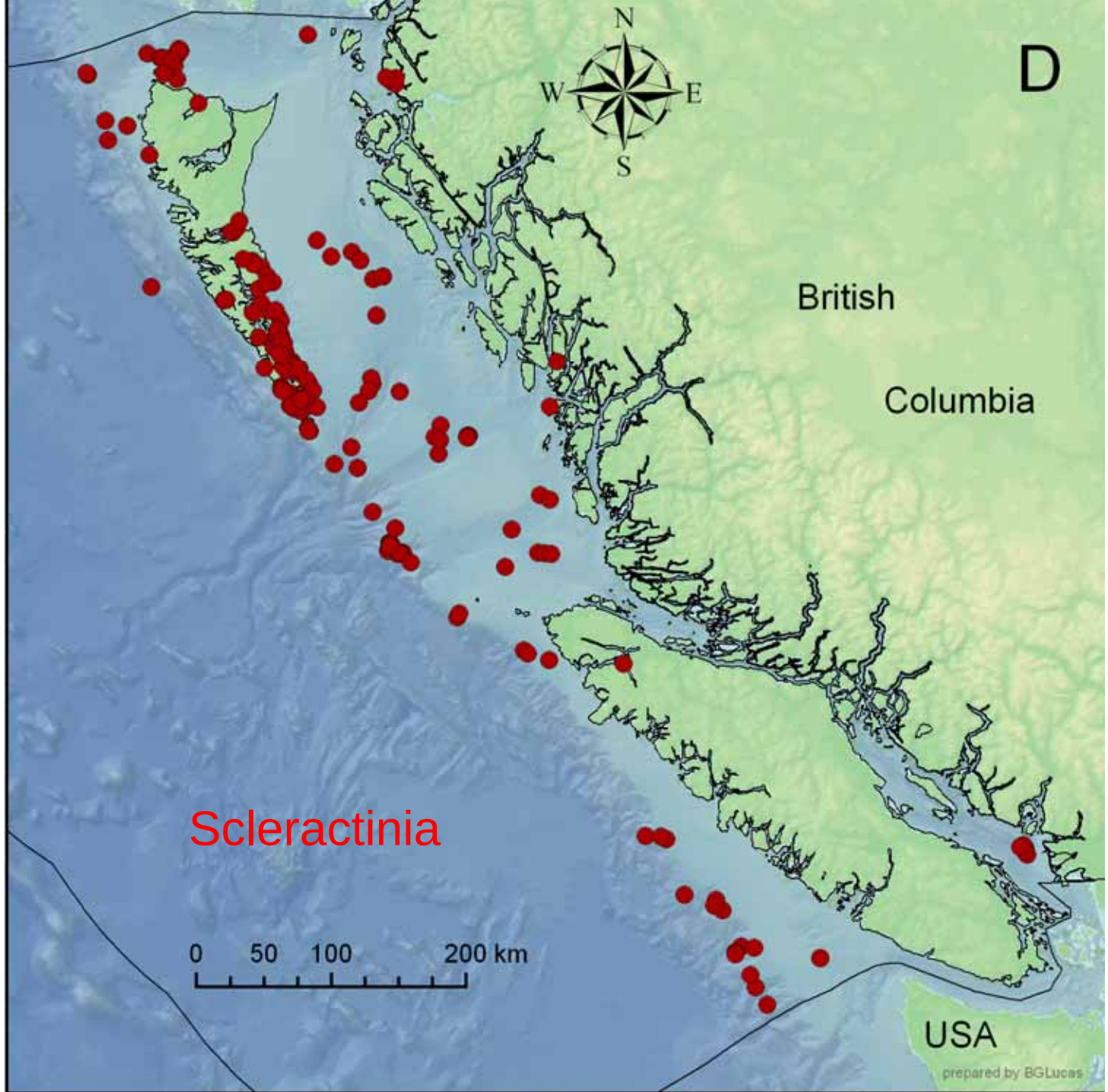
prepared by BGLucas


N
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D
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Columbia
Scleractinia
0 50 100 200 km
USA
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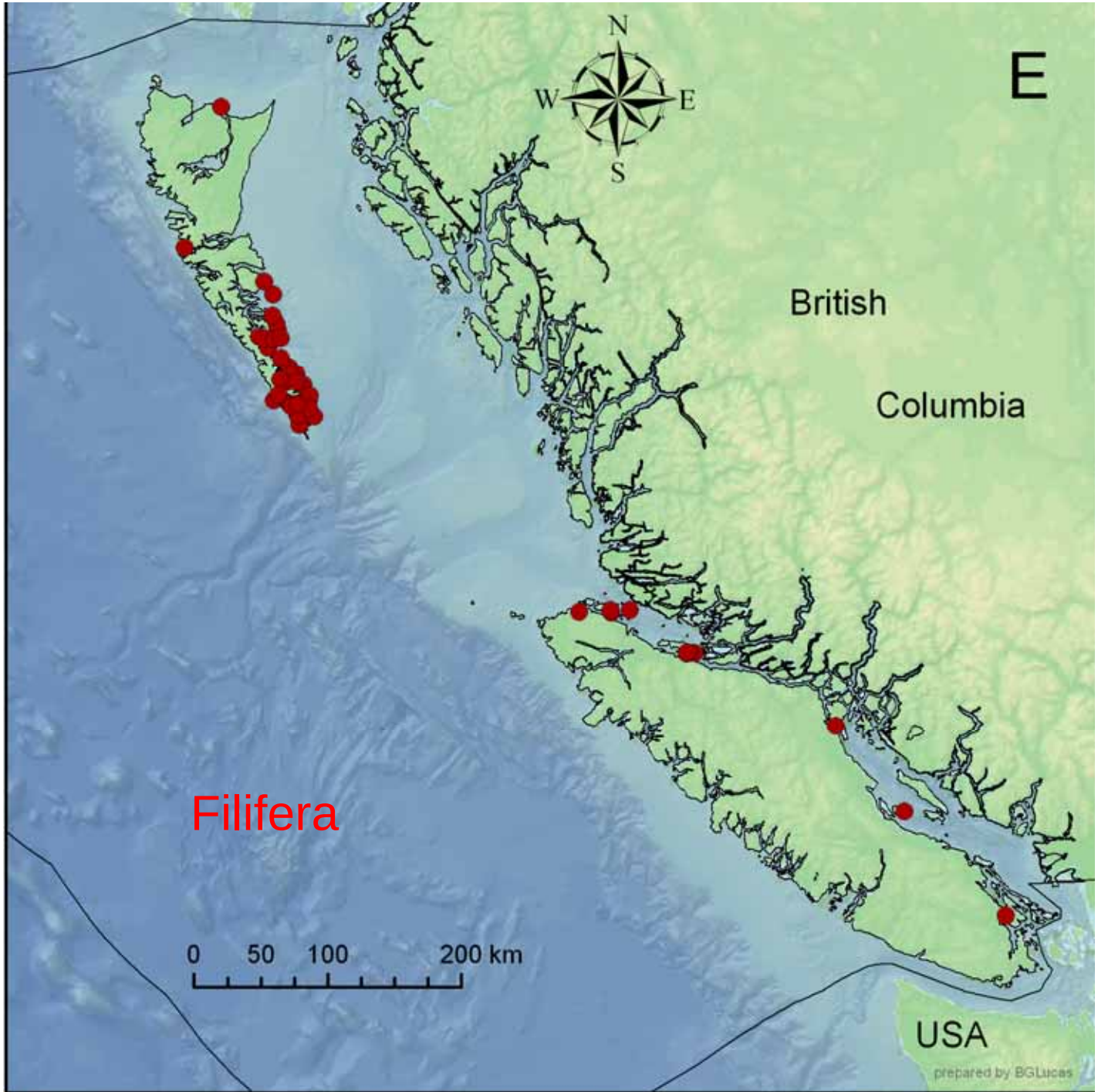

N
W
E
S
E
British
Columbia
Filifera
0 50 100 200 km
USA
prepared by BGLucas

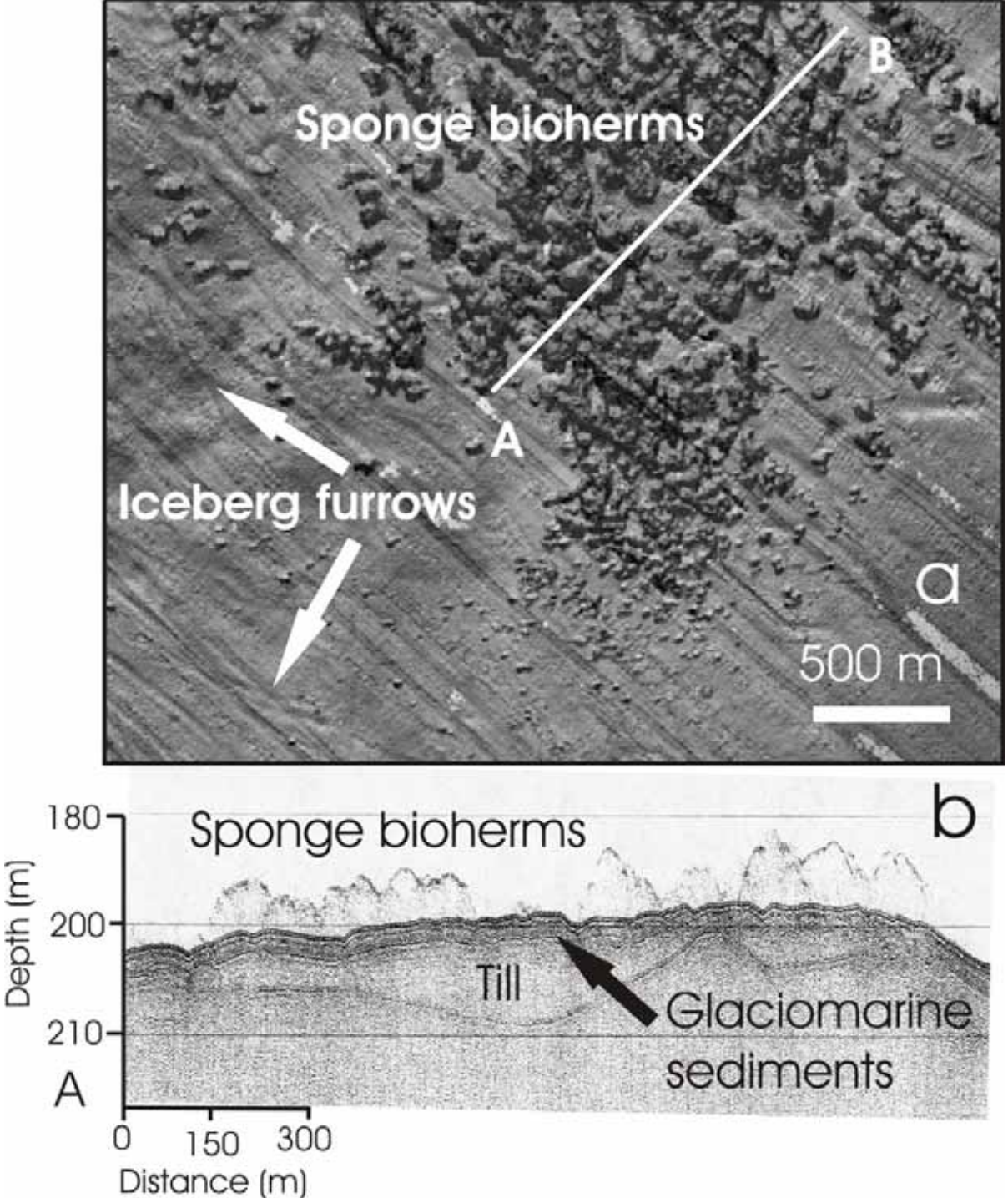
Dead *Lophelia pertusa* from a long-dead reef in the Strait of Georgia (Photos by K. Conway)

Hexactinellid, or “Glass”, Sponges

- **Hexactinellid sponges are one of four classes of sponges in the Phylum Porifera, and are exclusively found in the marine environment. Hexactinellids are characterised by skeletons composed of overlapping, siliceous, 6-rayed spicules called hexactines.**
- **Three species of the Order Hexactinosa are the primary framebuilders of described sponge reefs: *Heterochone calyx* (Schulze, 1887), *Farrea occa* (Bowerbank, 1862), and *Aphrocallistes vastus* (Schulze, 1887).**
- **Although these species are found in other marine areas of the world and are even common at other locations within British Columbia, the BC sponge reefs are the only documented examples of “living hexactinellid sponge reefs” in the world.**

Sponge Reef Characteristics

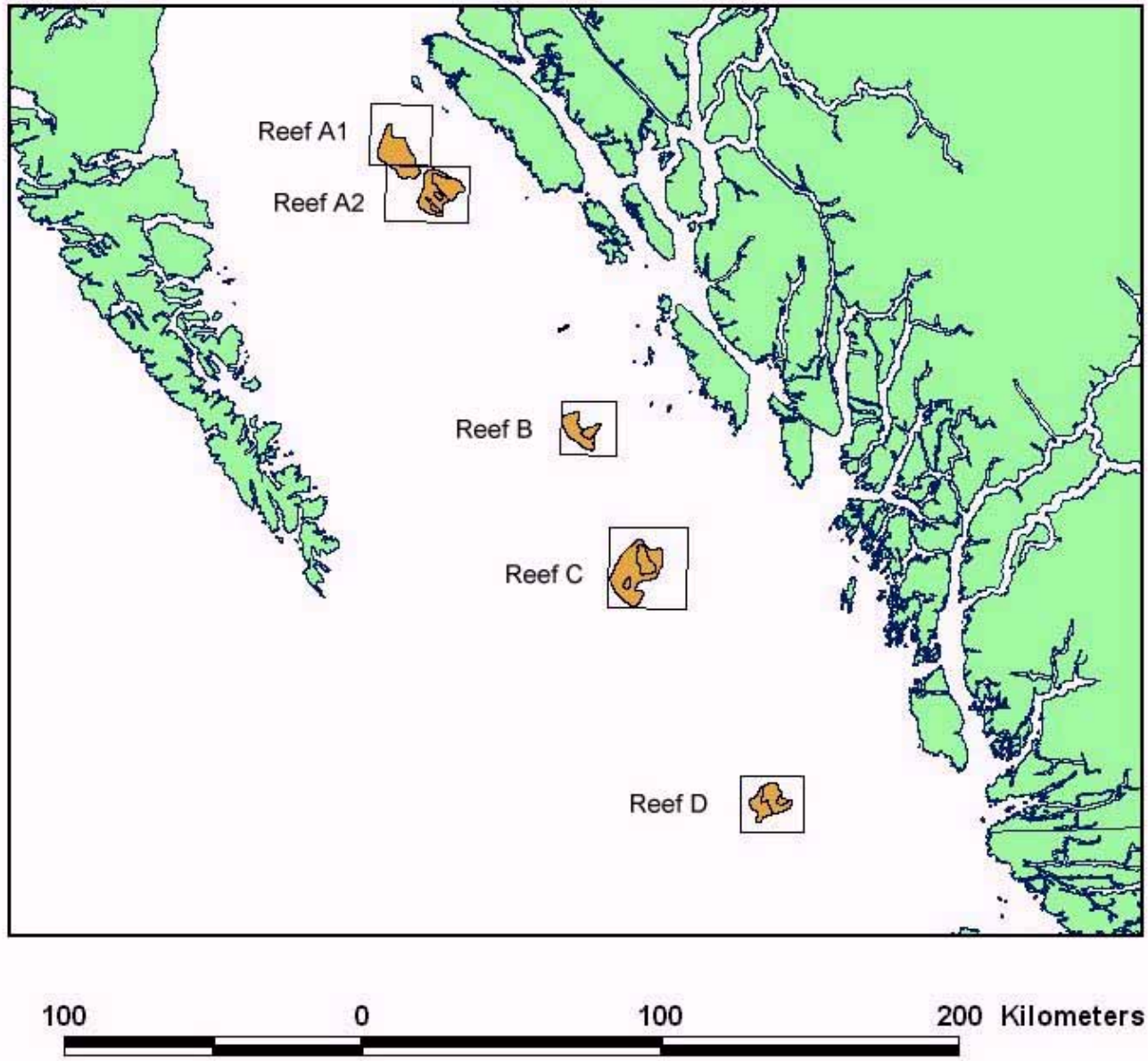
- **Large reef complexes are found in four locations in the seafloor troughs crossing the continental shelf of Queen Charlotte Sound and Hecate Strait at depths between 165 and 240 m, and in total cover an estimated area of over 1000 km^2.**
- **The reef complexes are formed of sponge bioherms (steep-sided reef mounds) up to 19 m in height, and biostromes (sheet-like accumulations) 2-10 m thick and up to several kilometres wide, with individual sponges up to 1.5 m in height above the substrate.**
- **Radiocarbon dating of two of the four cored bioherms suggests that the oldest date of reef formation ranges from approximately 9000 y BP (before present) to 2000 y BP.**



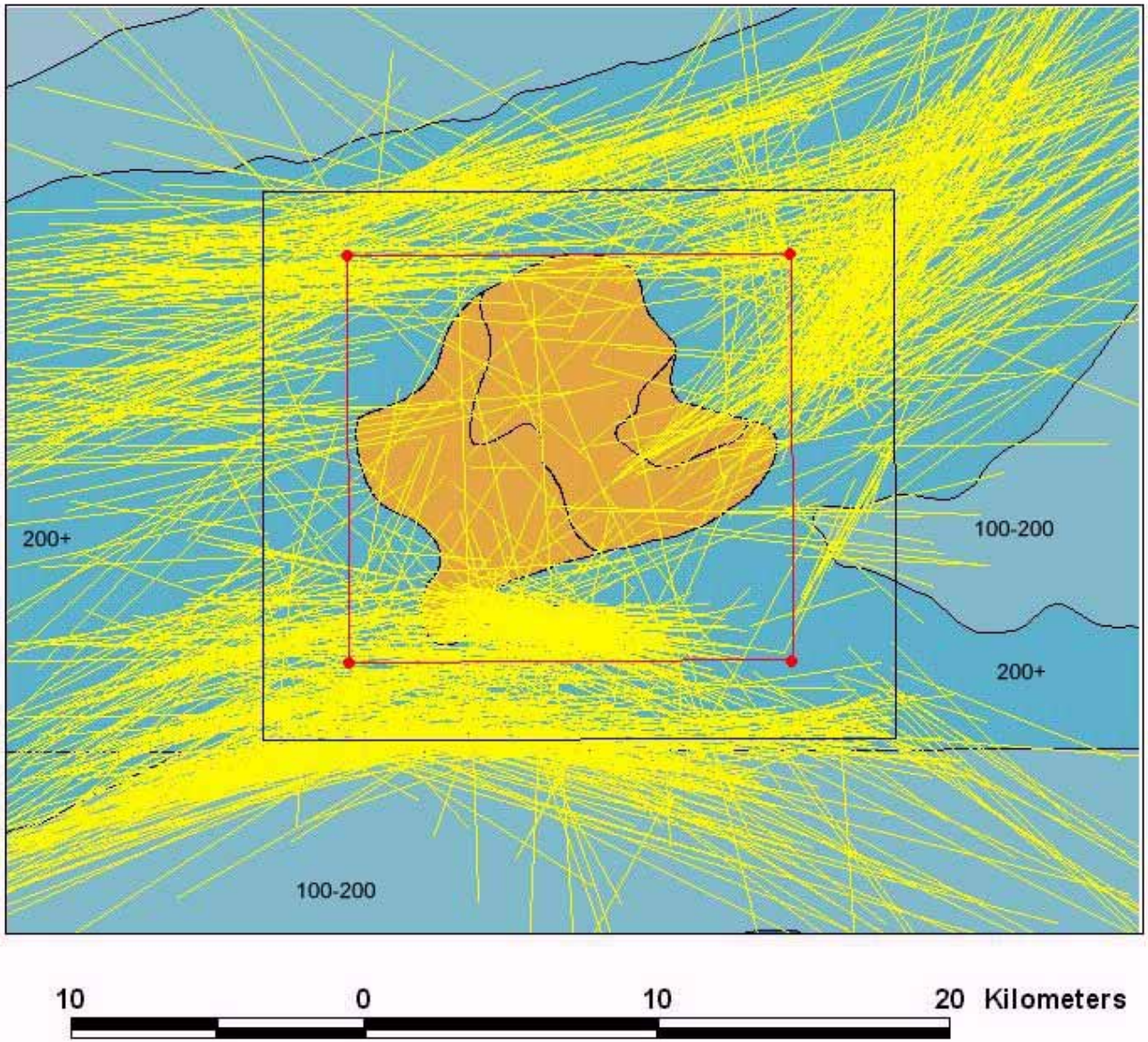
(from Conway et al. 2004)

Hexactinellid Sponge Reefs

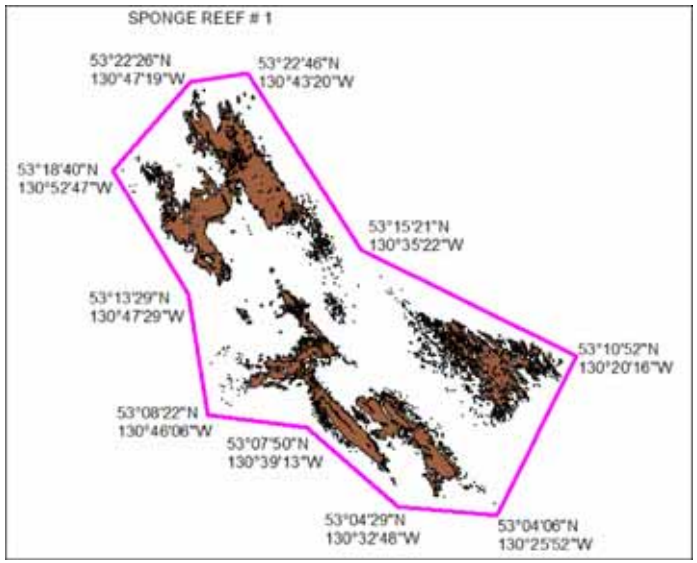
The dynamics of reef-building and the ecosystem that the reefs support have yet to be fully determined, with the only available biological data from limited submersible visual observations and fishery dependent observations and recordings.

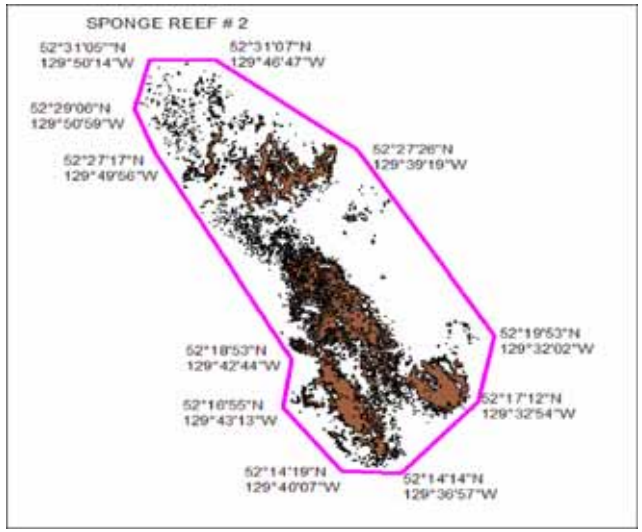

Reef A1
Reef A2
Reef B
Reef C
Reef D
100
0
100
200 Kilometers

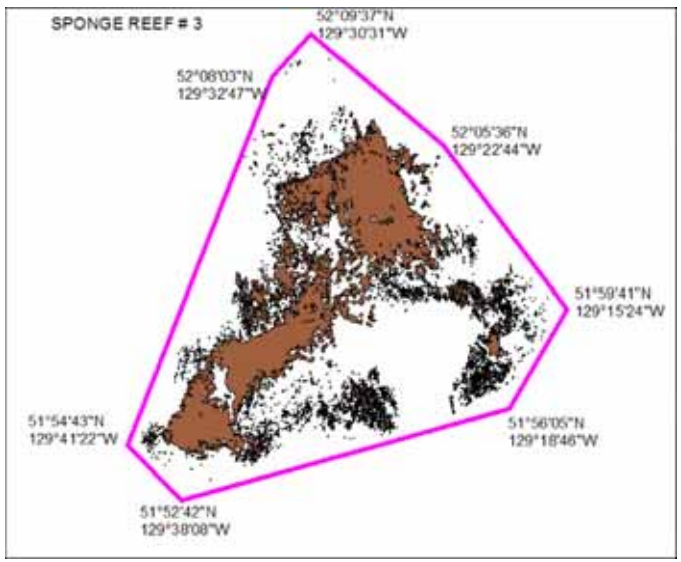
Impact of Trawling on Sponges

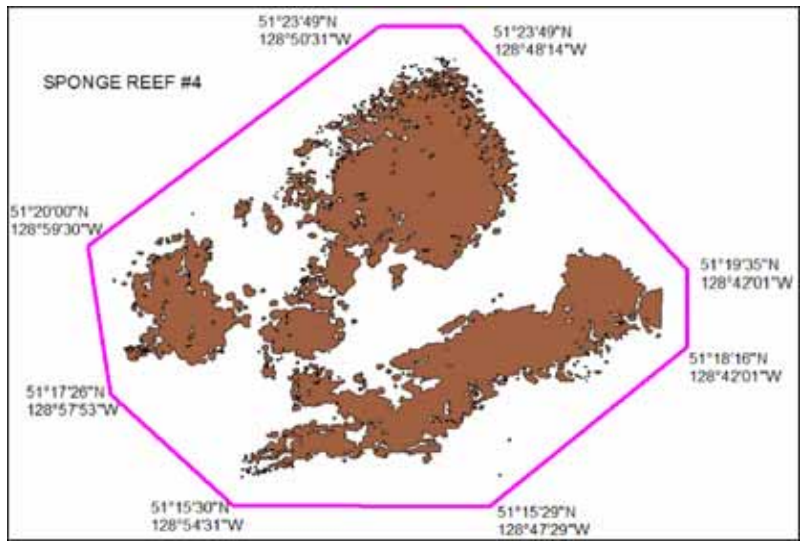

200+
100-200
200+
100-200
10
0
10
20 Kilometers

Current Trawl Closure Boundaries





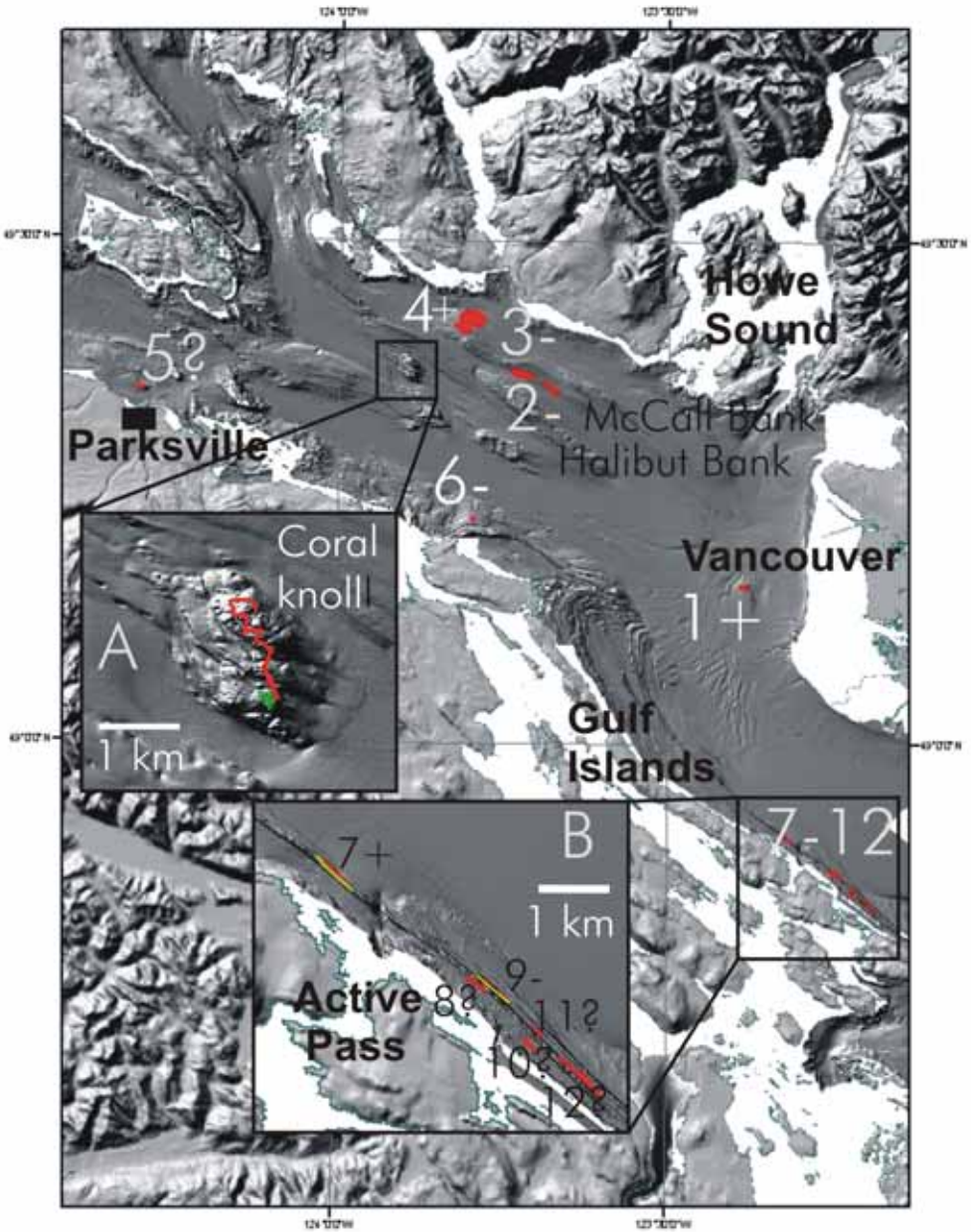




New Sponge Reef Locations

Strait of Georgia

(- signs = dead or badly damaged; ? = status unknown; + = healthy)



Sponge Reef Significance

- With increasingly more and more of the coast being surveyed with multibeam sonar, additional sponge bioherms are being discovered, and their rate of discovery suggests that many more likely exist and await discovery.
- The fact that inshore sponge reefs may be more common than previously realised and may be widely distributed should not infer that they do not all need protection, as biogenic habitat in the relatively homogenous deep-water environment is relatively rare.

- Like eelgrass and macrophyte beds in shallow water, concentrations of structural filter feeders in deep water should all be protected from all human disturbances to the greatest extent possible, as their roles or function in the overall ecosystem are likely substantial, or at least this should be assumed until proven otherwise.

Groundfish Trawl Bycatch Data

- **Beginning in 1996, 100% observer coverage became mandatory in BC's bottom trawl fishery.**

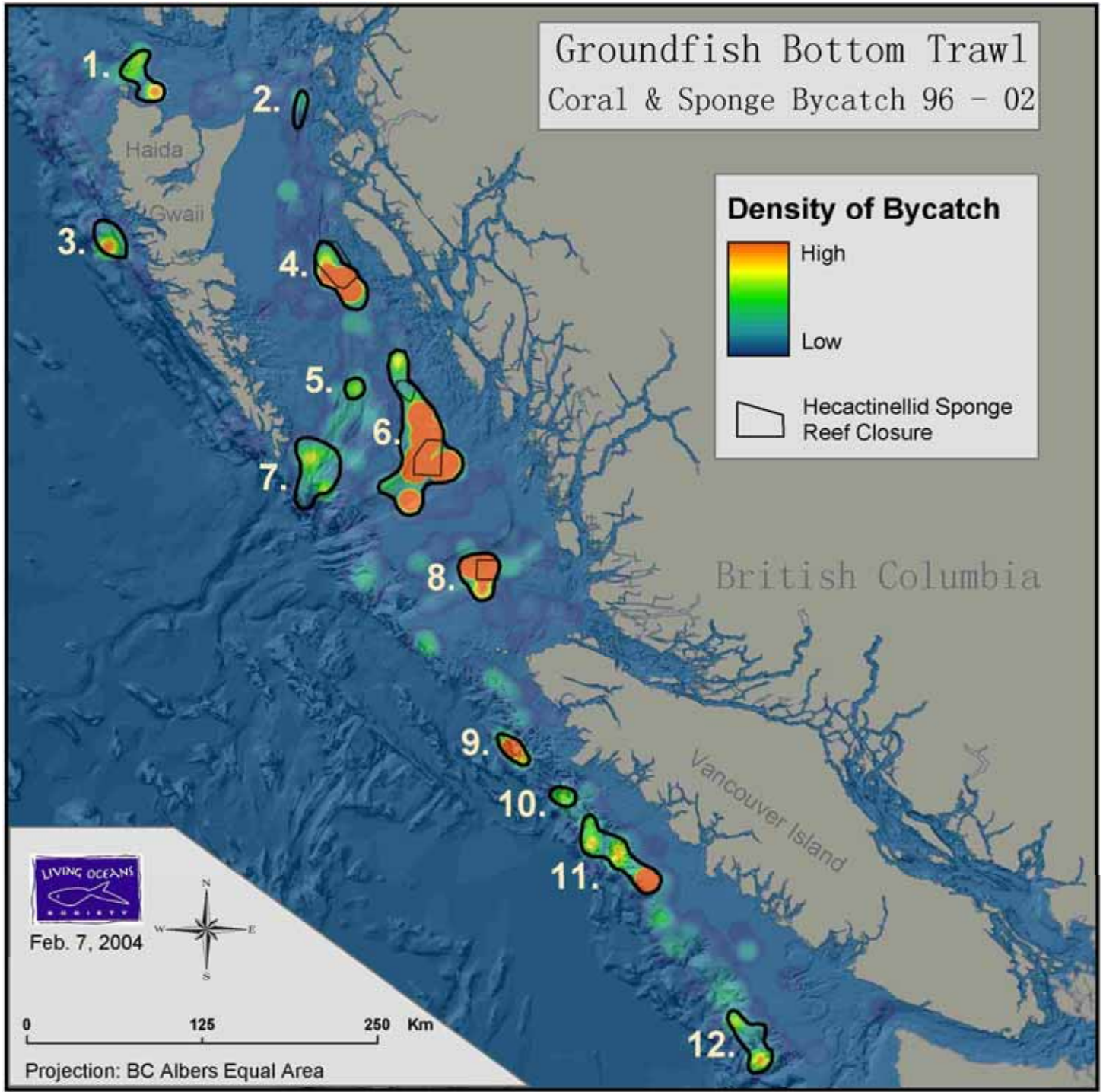
- **While corals and sponges have been recorded from that time, as non-commercial species they were not given much reporting emphasis, and training of observers on their taxonomic identification was minimal to non-existent.**

- **Furthermore, the reporting categories to choose from were not always easily transferable to a particular taxonomic family. For example, many observers in the 1990's did not realize that hexactinellid sponges were glass sponges, and recorded them either as stony corals or in the general catch-all "sponge" category.**

- **The median length of a bottom trawl in waters less than 500 m depth was calculated to be 10.0 km, for the years of 2001 and 2002.**

- **From density analysis of all mid-point coral and sponge trawl bycatch data, twelve areas captured 61.5% of all coral-sponge records. They account for 97% of all bycatch by weight, and 98.8% by CPUE.**

- **Closer examination revealed that the majority of bycatch was captured by the three areas that overlapped three of the hexactinellid sponge reefs; i.e., numbers 4, 6, and 8. These three areas, while just 16.3% of all coral-sponge records, accounted for 85.0% of bycatch by weight (92.3% by CPUE).**


Groundfish Bottom Trawl
Coral & Sponge Bycatch 96 - 02
Density of Bycatch
High
Low
Hecactinellid Sponge Reef Closure
1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.
Haida Gwaii
British Columbia
Vancouver Island
LIVING OCEANS SOCIETY
Feb. 7, 2004
N
W
E
S
0
125
250 Km
Projection: BC Albers Equal Area

When these three areas were removed from the analysis, the remaining nine areas captured 54.0% of remaining coral-sponge records, and 80.9% of bycatch by weight. While not as impressive as the overall values quoted before, which were heavily biased by the three hexactinellid reef areas, these still represent a respectable spatial efficiency, 13x better than random chance.

Measure	Three Hex CSPAs		Nine CSPAs evaluated on their own		All Coral Sponge Trawl Sets	
	Tows	%	Tows	%	Tows	%
Sets	590	17.3	1439	51.1	3404	100.0
Records	633	16.3	1758	54.0	3888	100.0
Catch (kg)	214798	85.0	30609	80.9	252626	100.0
CPUE	241402	92.3	16939	84.5	261440	100.0
adjusted CPUE	213240	90.0	19540	82.1	237034	100.0

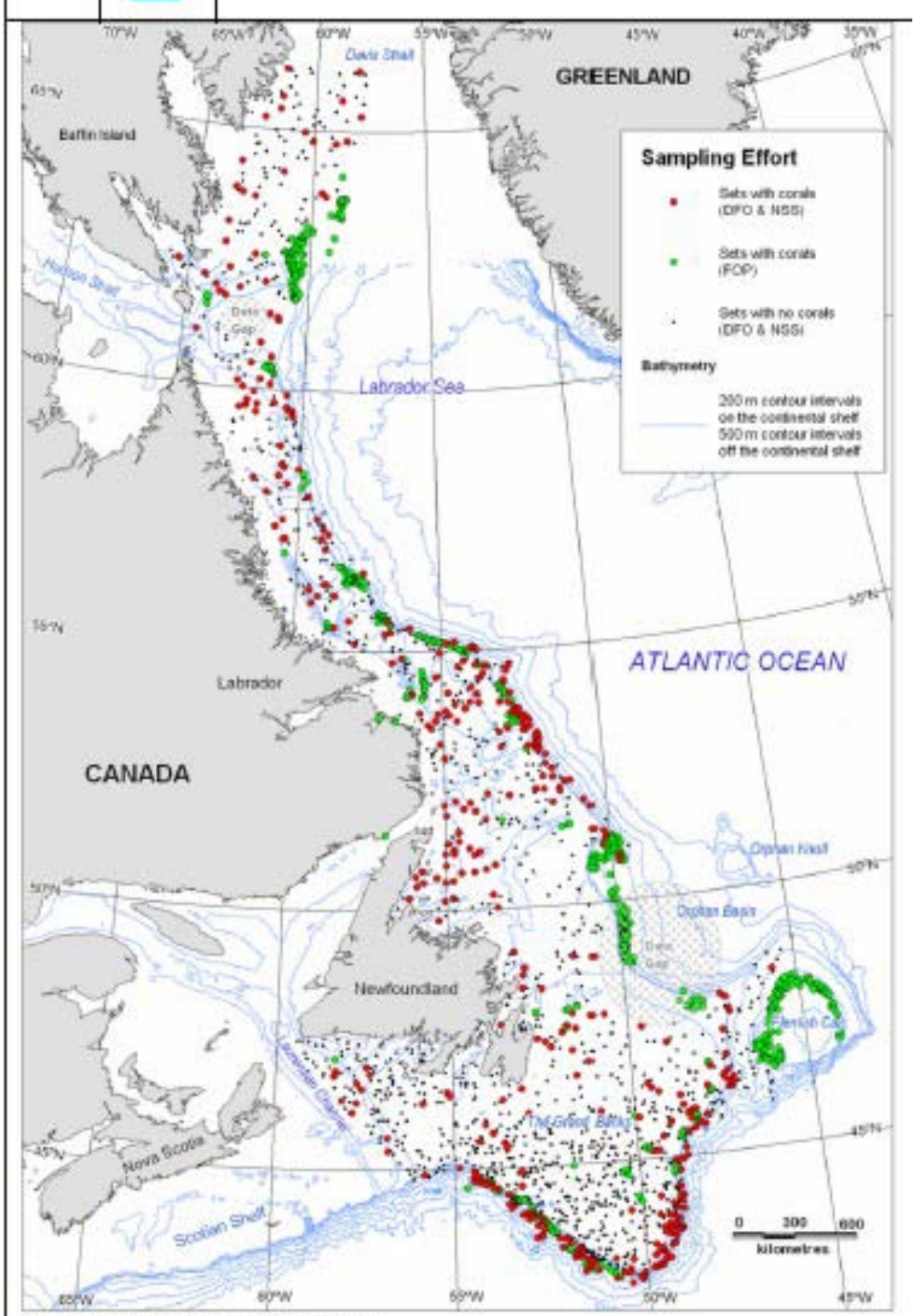
Diversity Analysis

- **The proposed potential 12 protected areas were examined to consider how well protection might have been provided to each coral-sponge taxonomic category in the observer database.**
- **Overall, results were promising – about 80% protection or higher per category. However, "Stony Corals" had only 64% protection and "Sea Pens" 47%. The lower sea pen value is because these species occur widely in areas not heavily trawled.**
- **However, these values should be interpreted cautiously. At best, these values only suggest that a diversity of organisms would be protected by minimising gear impacts in these areas. Detailed surveys of the specific sites shown would clarify the actual occurrences of species in the different groupings.**

Deep-water Biogenic Habitat Protection in Canada

Closures for corals:

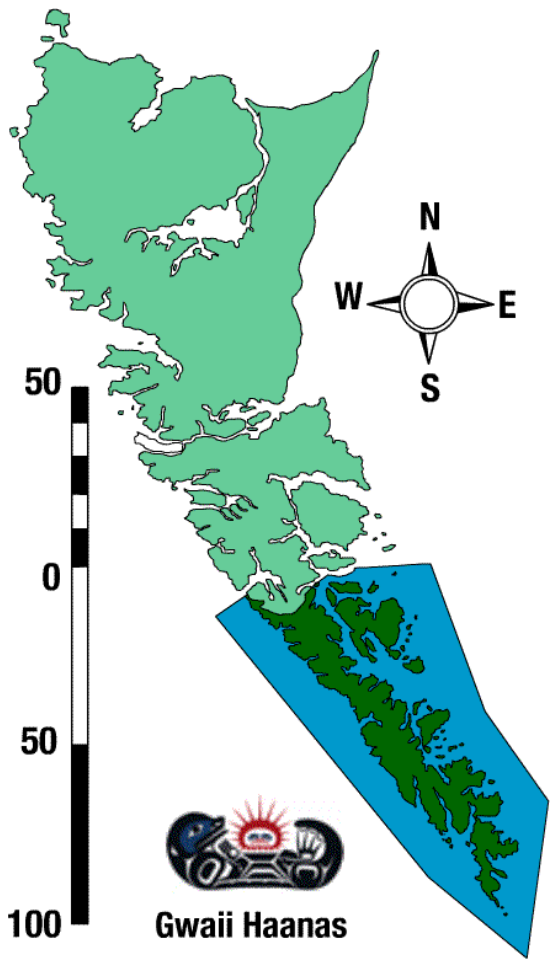
- **Atlantic Canada**
  - *Lophelia Conservation Area*: about 15 km2
  - *Northeast Channel Coral Conservation Area*: about 424 km2
  - *The Gully Marine Protected Area*: about 2,364 km2 (corals not present everywhere)
  - Canada's offshore trawling industry for shrimp and groundfish recently instituted a voluntary closure to protect coldwater corals off the coast of Baffin Island and the province of Newfoundland and Labrador. The 12,500-km2 coral protection zone will help prevent coral species from being taken as bycatch in trawl gear.



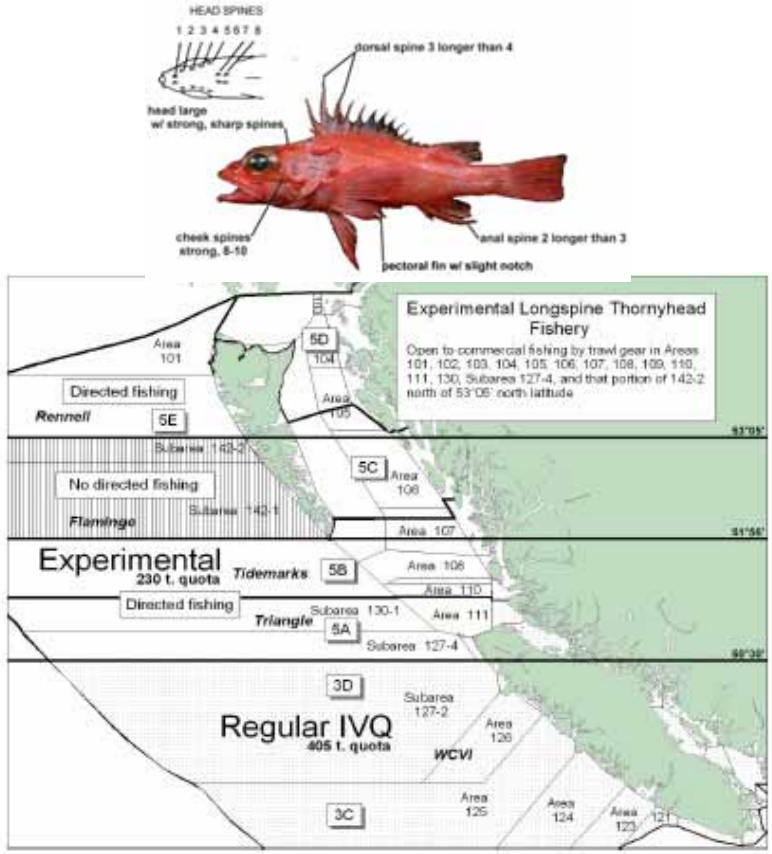
– **Pacific Canada**

- None for corals, although the four large sponge bioherm complexes in PNCIMA are closed to trawling
- The proposed Gwaii Haanas National Marine Conservation Area Reserve (NMCA) and the experimental thornyhead (*Sebastolobus* spp.) closure off the west coast of Gwaii Haanas may offer some protection, although coral concentrations in neither location have been proven to exist.

BC Closures that Should Protect Corals



Gwai Haanas NMCA

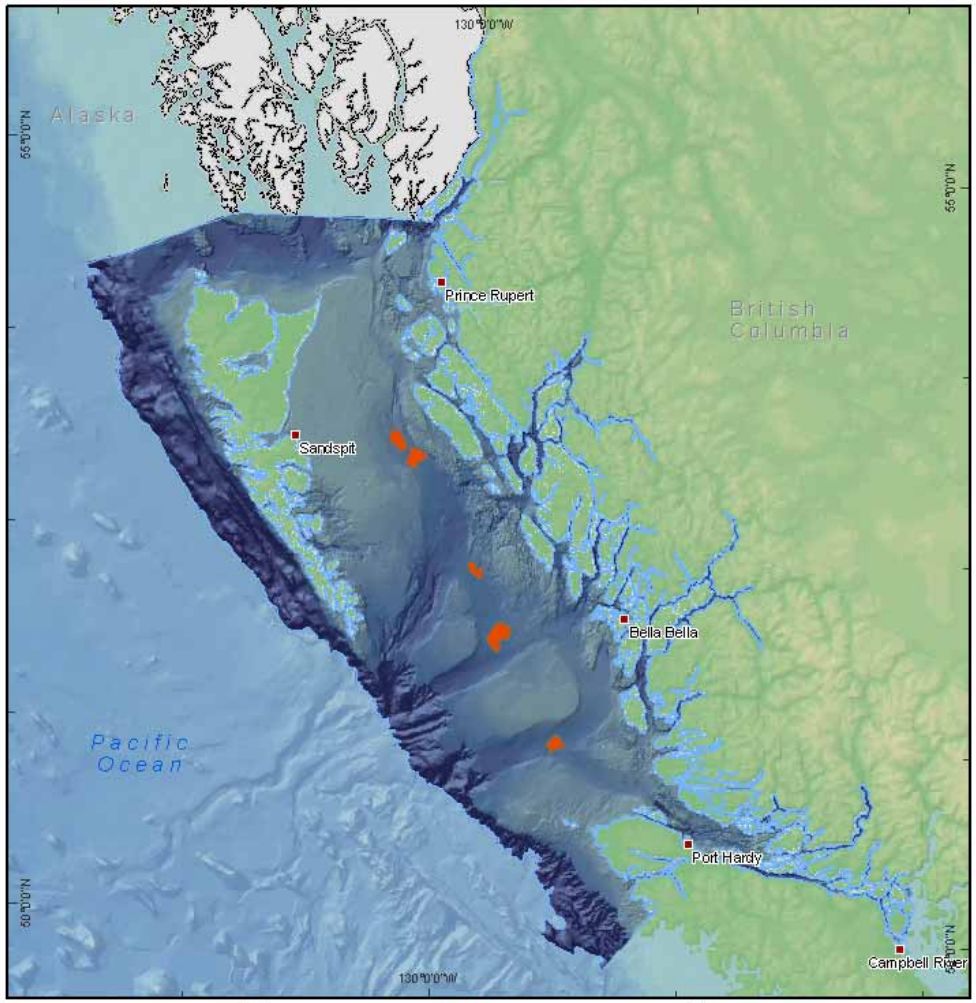


Experimental thornyhead closure

Map 23

Important Areas identified for sponge reef in PNCIMA

Ecologically / Biologically Significant Areas



Legend

Fisheries and Oceans Canada / Pêches et Océans Canada

- Communities
- PNCIMA Boundary
- Alaska

Sponge reef Important Areas - Score

- High
- Moderate
- Low

0 30 60 120 Km

Accompanying Document:
Clarke and Jamieson. Draft 2005. Identification of Ecologically and Biologically Significant Areas in the Pacific North Coast Integrated Management Area. Report to Oceans Canada.

Source Information:
Sponge reef location provided by Natural Resources Canada.
BC Basemap provided by BC Ministry of Sustainable Resource Management.
Pacific North Coast Integrated Management Area Boundary and Offshore Bathymetry provided by DFO.

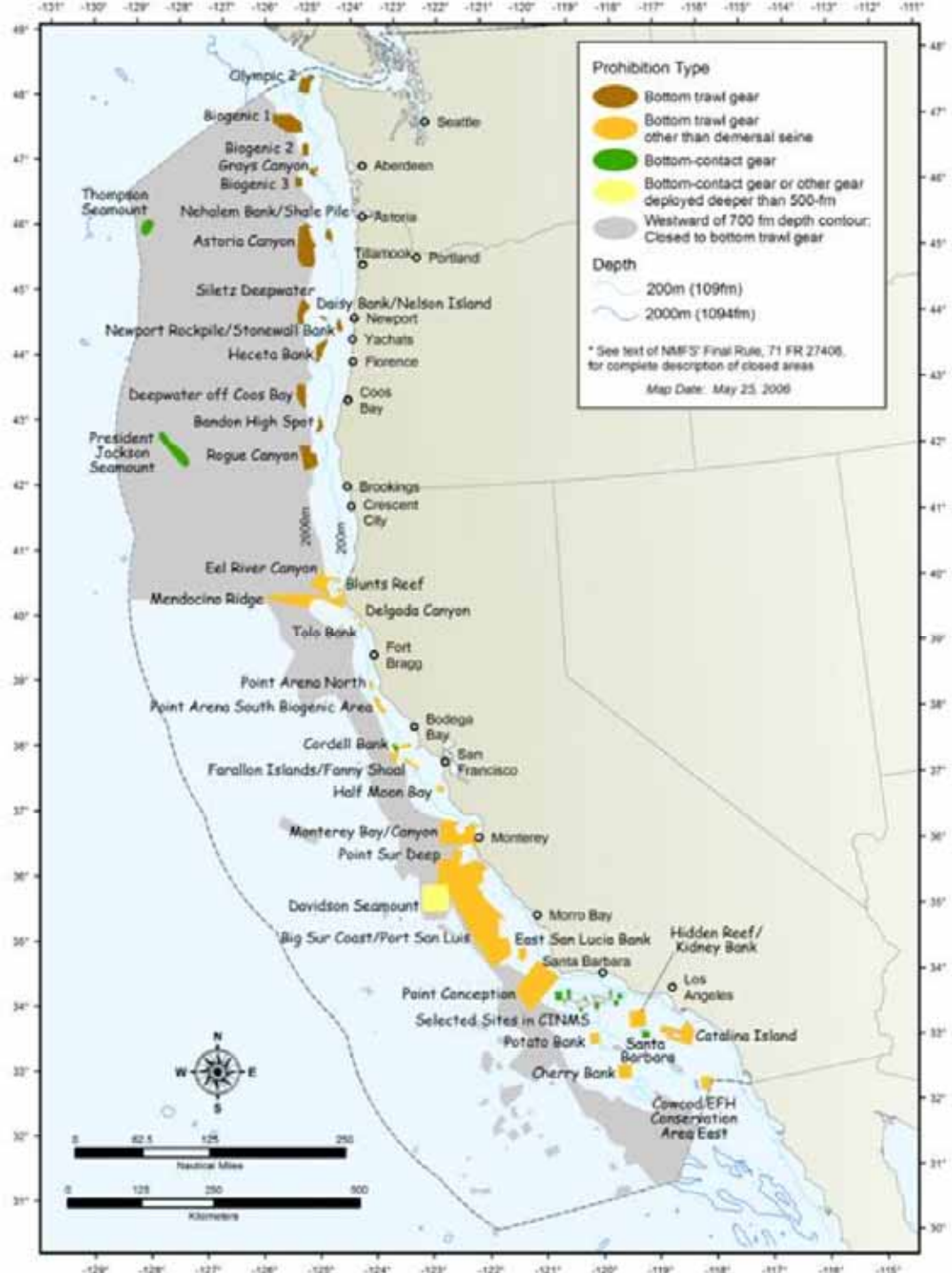
Projection: BC Albers, NAD 83
Production Date: December 1, 2005
Produced By: OHEB GIS Unit, DFO

Need for Expanded Sponge Closure Boundaries?

- Current boundaries relatively closely follow footprints of bioherms; some incursions may occur accidently.
- Concern is that while trawl incursions onto the reefs may be reduced, or even be non-existent (hard to tell, as some sponges are still being caught), trawling also increases suspended sediments, and this may negatively affect the filter-feeding sponges.
- A more conservative management approach would have expanded closure boundaries. A slight increase in the size of closures may not affect exploited fish landings much, because of fish mobilities.

Deep-water Biogenic Habitat Research and Conservation

1. No dedicated non-destructive surveys for deep-water corals have been conducted in BC to date, with most records from groundfish trawl catches and some research surveys.
2. There are currently no extensive precautionary depth restrictions for trawling, as occurs in both Alaska about (1,620,000 km2 near the Aleutian Islands) and off California-Washington.
3. Development of a BC coral-sponge conservation strategy was announced as a high priority by DFO two years ago, but to date, no draft document has been developed.


Prohibition Type
Bottom trawl gear
Bottom trawl gear other than demersal seine
Bottom-contact gear
Bottom-contact gear or other gear deployed deeper than 500-fm
Westward of 700 fm depth contour: Closed to bottom trawl gear
Depth
200m (109fm)
2000m (1094fm)
* See text of NMFS' Final Rule, 71 FR 27408, for complete description of closed areas
Map Date: May 25, 2006
Olympic 2
Biogenic 1
Biogenic 2
Grays Canyon
Biogenic 3
Thompson Seamount
Nehalem Bank/Shale Pile
Astoria Canyon
Siletz Deepwater
Daisy Bank/Nelson Island
Newport Rockpile/Stonewall Bank
Heceta Bank
Deepwater off Coos Bay
Bandon High Spot
President Jackson Seamount
Rogue Canyon
2000m
200m
Eel River Canyon
Mendocino Ridge
Tolo Bank
Point Arena North
Point Arena South Biogenic Area
Cordell Bank
Farallon Islands/Fanny Shoal
Half Moon Bay
Monterey Bay/Canyon
Point Sur Deep
Davidson Seamount
Big Sur Coast/Port San Luis
Point Conception
Selected Sites in CINMS
Potato Bank
Cherry Bank
Cowcod EFH Conservation Area East
East San Lucia Bank
Hidden Reef/ Kidney Bank
Catalina Island
Santa Barbara
Seattle
Aberdeen
Astoria
Tillamook
Portland
Newport
Yachats
Florence
Coos Bay
Brookings
Crescent City
Fort Bragg
Bodega Bay
San Francisco
Monterey
Morro Bay
Santa Barbara
Los Angeles
N
W
E
S
0 62.5 125 250
Nautical Miles
0 125 250 500
Kilometers

4. Closures have been established through Fishery Regulation for the four large sponge reef complexes, and these areas are expected to be seriously considered to be more rigourously protected as *Oceans Act* Marine Protected Areas if the proposed BC MPA network is in fact established over the next few years.
5. Because of their relatively small sizes (typically much less than 1 km2), the smaller isolated bioherms being found in inshore waters are much more vulnerable to destruction by activities such as trawling, particularly if they occur in areas of generally smoother bottom.

6. Some of the small sponge reefs recently discovered in the Strait of Georgia appear to have had the sponges on them mostly destroyed (K. Conway, pers. obs.), presumably by fishing activity, so immediate precautionary management regulations are needed to prevent future damage.

Explanations for the lack of expanded BC deep-water biogenic habitat protection?

1. Resource surveys to identify priority areas better are expensive, and ship time is limited.
2. There is still interest in trying to exploit “under-utilised” marine species, including some deep water species.
3. The BC groundfish trawl industry has yet to agree both to stopping expansion into new areas, and the establishment of precautionary management closures in poor-yield areas.
4. Senior regional resource managers have not set a clear timeframe for biogenic habitat conservation strategy deliverables, even though achieving action was stated to be a priority.