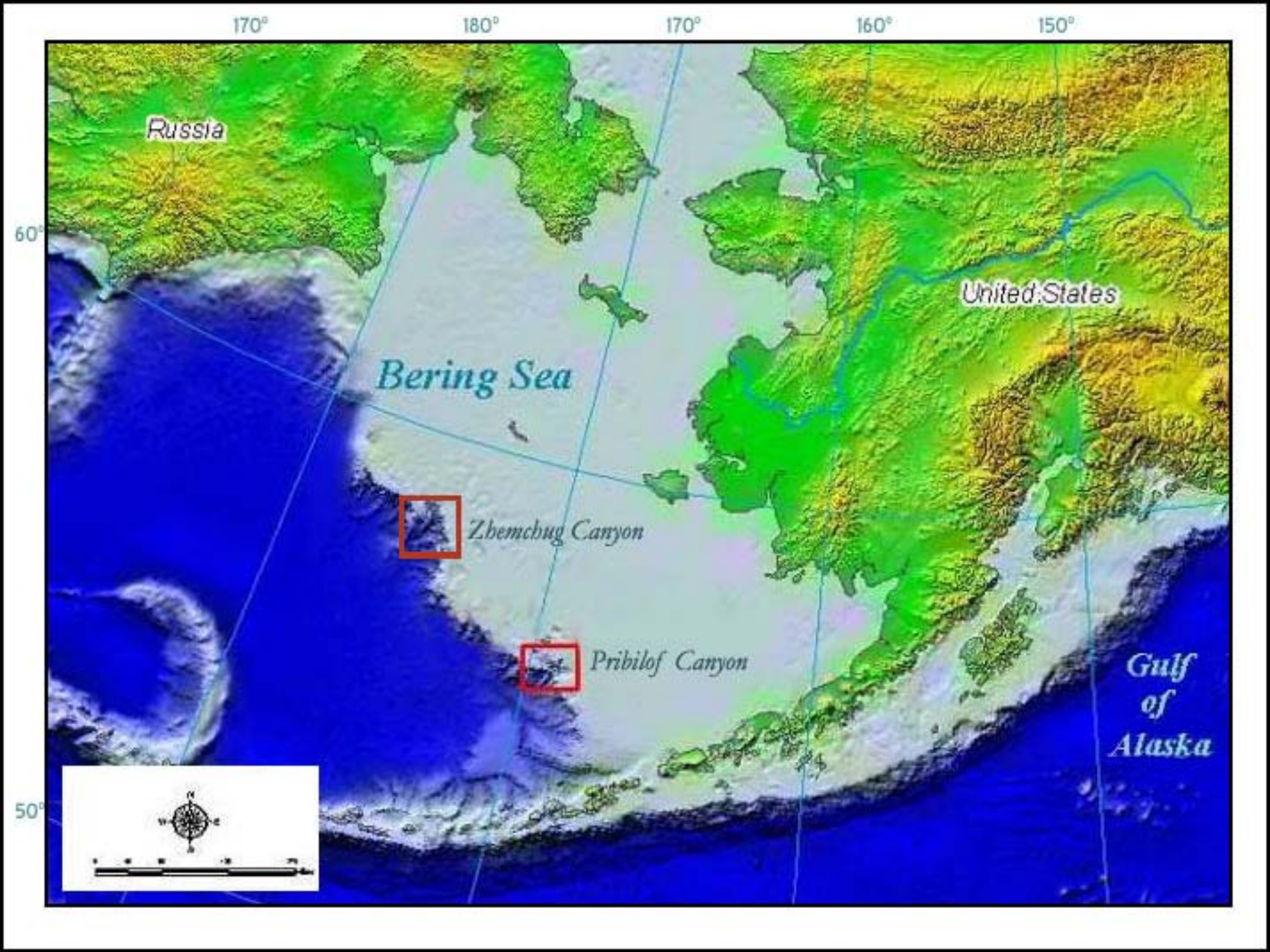
Deep Sea Corals in the World's Largest Underwater Canyons:

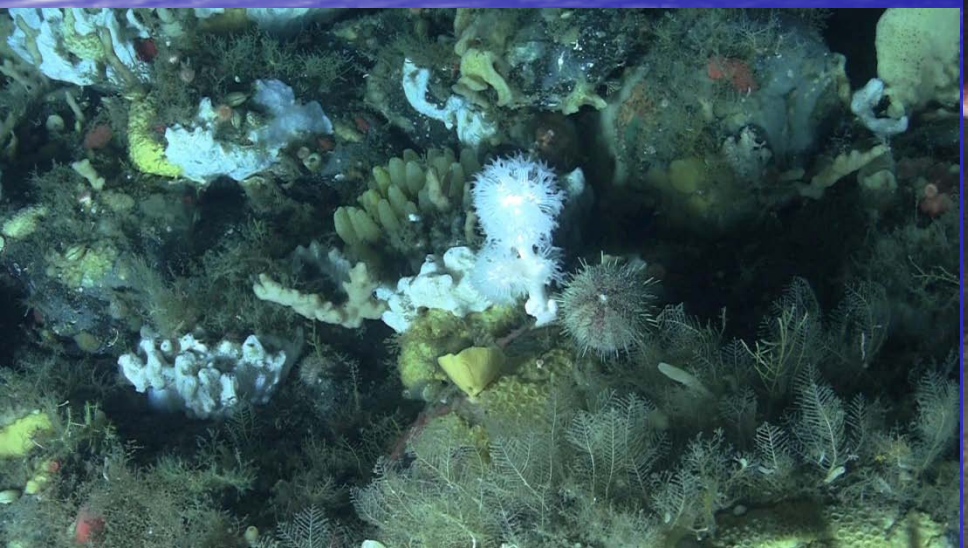
Will New Data Lead to New Conservation Measures in the Bering Sea?


170°
180°
170°
160°
150°
60°
50°
Russia
United States
Bering Sea
Zhemchug Canyon
Pribilof Canyon
Gulf of Alaska

"...the Council adopts the SSC's recommendation to gather more information on the Bering Sea Slope canyons and suggests this be named a top priority for NPRB research."

Coral Provisions in MSA

- Locate, map, and reduce impacts to corals
- Report to Congress on steps taken to identify, monitor, and protect deep sea coral areas



NOAA Strategic Plan for Deep-Sea Coral and Sponge Ecosystems: Conservation and Management Objectives

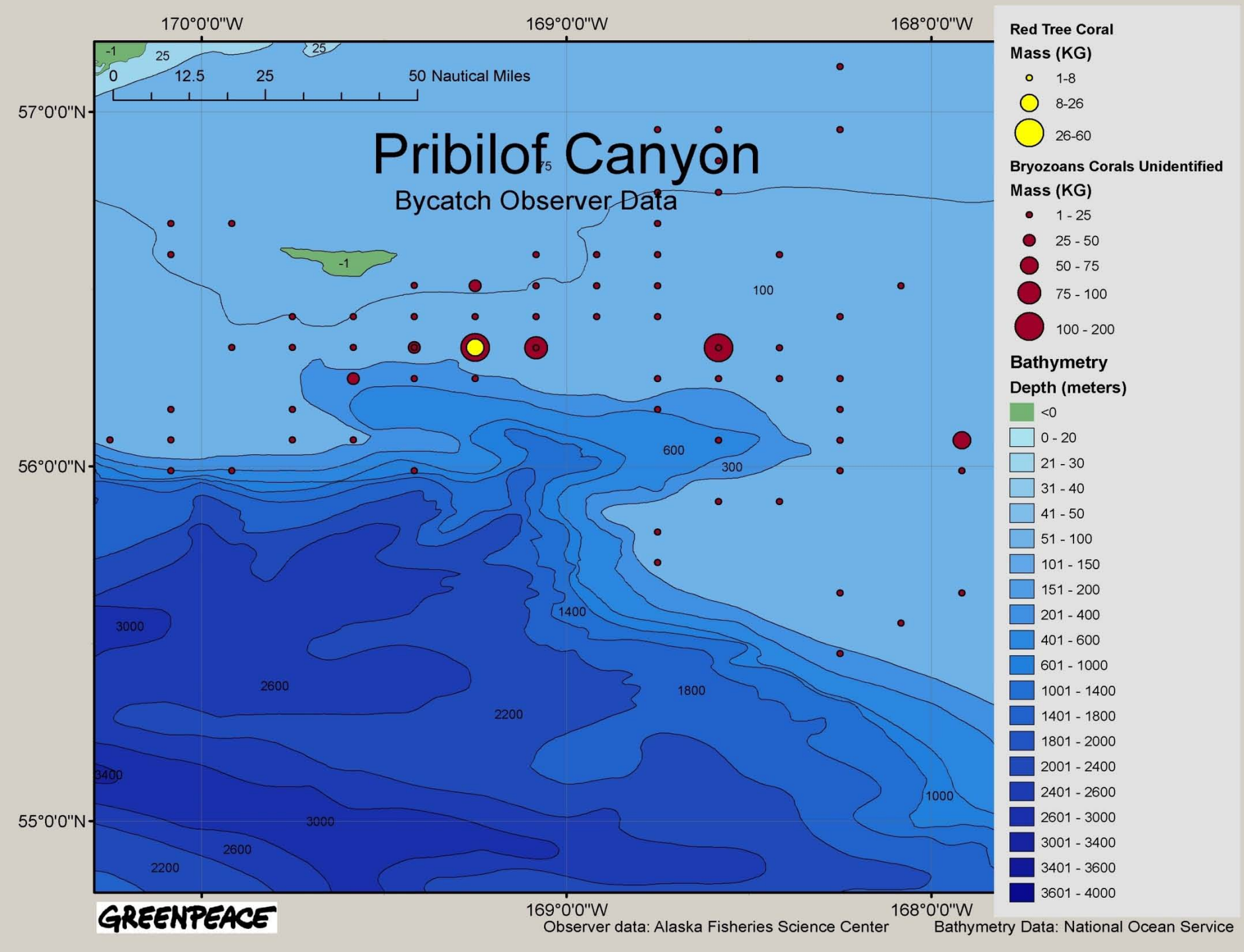
- Protect areas containing known deep-sea coral or sponge communities from impacts of bottom-tending fishing great.
- Develop regional approaches to further reduce interactions between fishing gear and deep-sea corals and sponges.
- Assess and encourage avoidance or mitigation of adverse impacts of non-fishing activities on deep-sea coral and sponge ecosystems.
- Provide outreach and coordinated communications to enhance public understanding of these ecosystems.

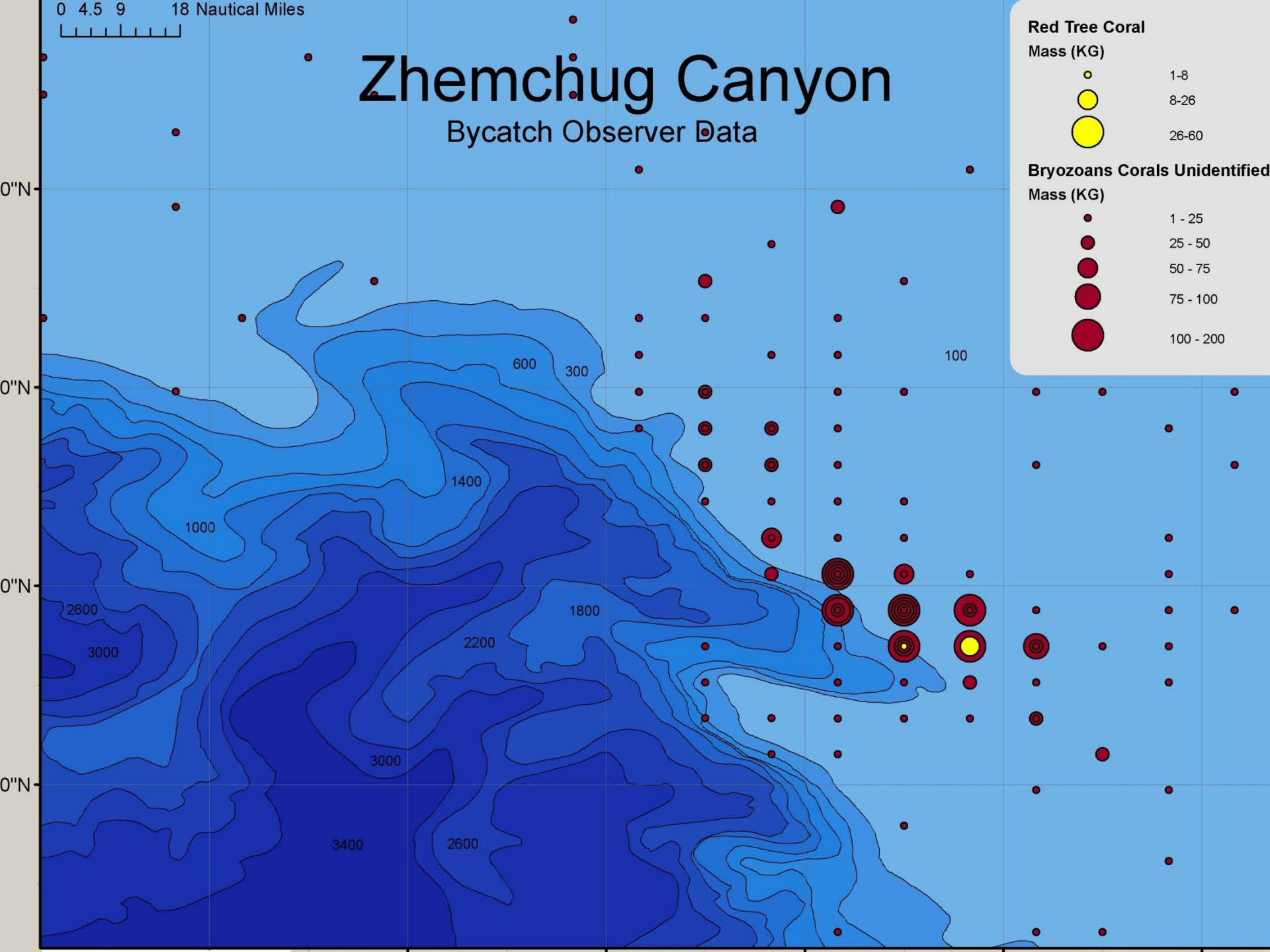
NOAA's Report to Congress on the Implementation of the Deep Sea Coral Research and Technology Program

"The shelf break and upper slope, including areas of Pribilof and Zhemchug Canyons, contain areas of deep sea corals that currently have no special protections."

Knowledge to Date

- NOAA whitepaper
- Observer bycatch data
- NGO proposals and testimony
- NOAA Pribilof Canyon ROV study
- NOAA survey of Zhemchug Ridges
- NOAA trawl and longline surveys
- Sea bird & marine mammal forage data


170°0'0"W
169°0'0"W
168°0'0"W
57°0'0"N
56°0'0"N
55°0'0"N
0
12.5
25
50 Nautical Miles
Pribilof Canyon
Bycatch Observer Data
Red Tree Coral
Mass (KG)
1-8
8-26
26-60
Bryozoans Corals Unidentified
Mass (KG)
1 - 25
25 - 50
50 - 75
75 - 100
100 - 200
Bathymetry
Depth (meters)
<0
0 - 20
21 - 30
31 - 40
41 - 50
51 - 100
101 - 150
151 - 200
201 - 400
401 - 600
601 - 1000
1001 - 1400
1401 - 1800
1801 - 2000
2001 - 2400
2401 - 2600
2601 - 3000
3001 - 3400
3401 - 3600
3601 - 4000
GREENPEACE
Observer data: Alaska Fisheries Science Center
Bathymetry Data: National Ocean Service

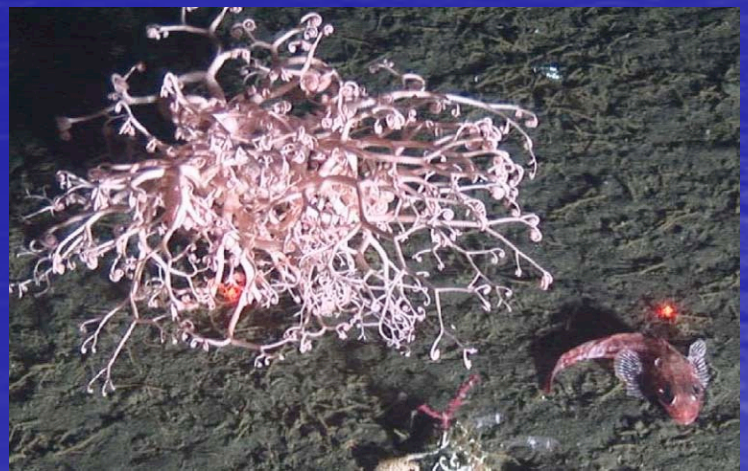

0 4.5 9 18 Nautical Miles
Zhemchug Canyon
Bycatch Observer Data
Red Tree Coral
Mass (KG)
1-8
8-26
26-60
Bryozoans Corals Unidentified
Mass (KG)
1 - 25
25 - 50
50 - 75
75 - 100
100 - 200
0"N
0"N
0"N
0"N
600
300
100
1400
1000
2600
3000
1800
2200
3000
3400
2600

Goals

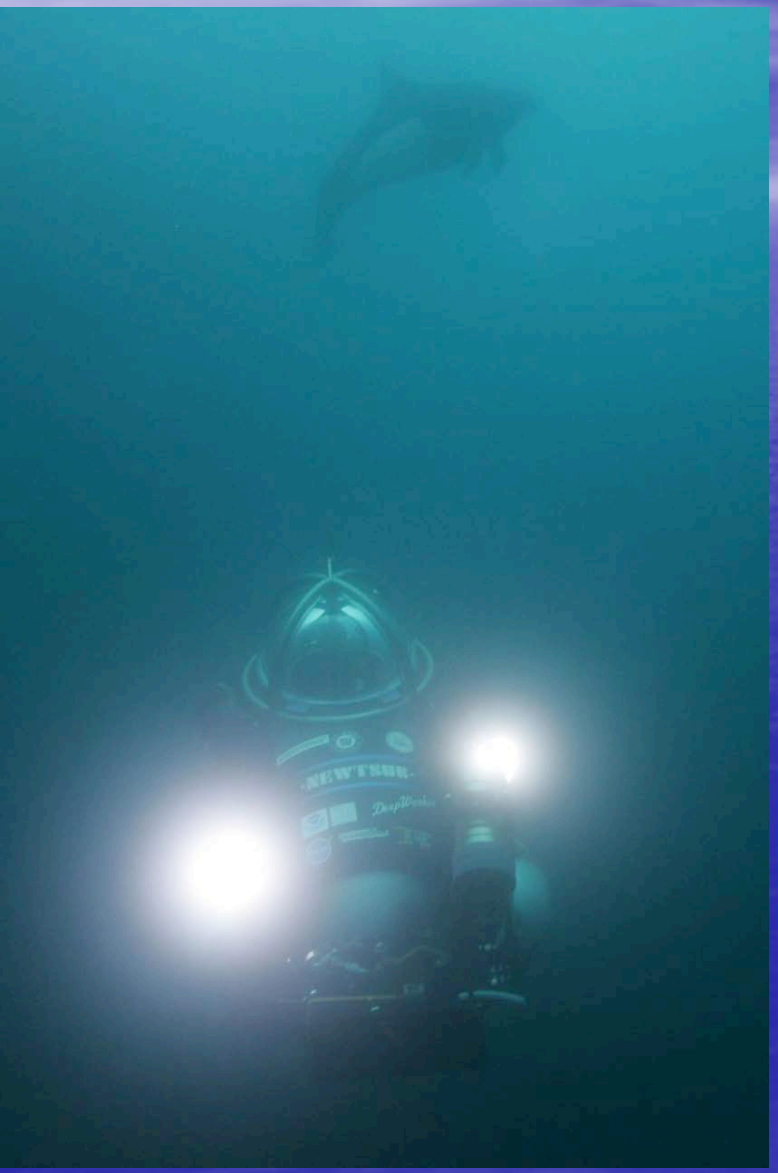
1) Coral and sponge abundance (and diversity)

2) Associations of fishes with corals and other habitat structure

3) Document fishing impacts

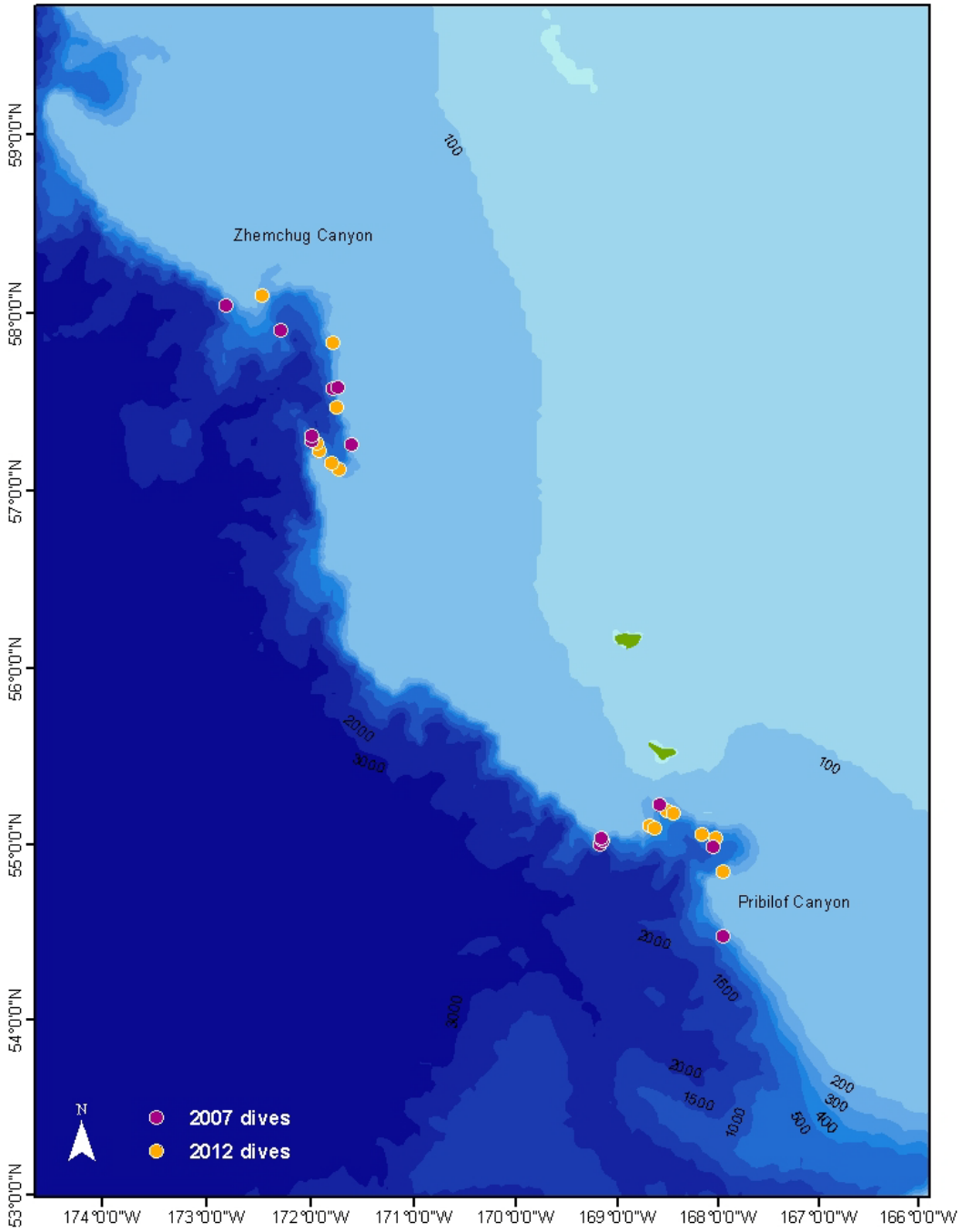


DeepWorker Submersibles



- 100-550m depth
- Upslope at constant heading
- Video camera at 30º from horizontal at widest zoom
- Paired scaling lasers
- 7,209 frames, ~30,000 m sq.

Transect locations from 2007 (purple) and 2012 (orange)



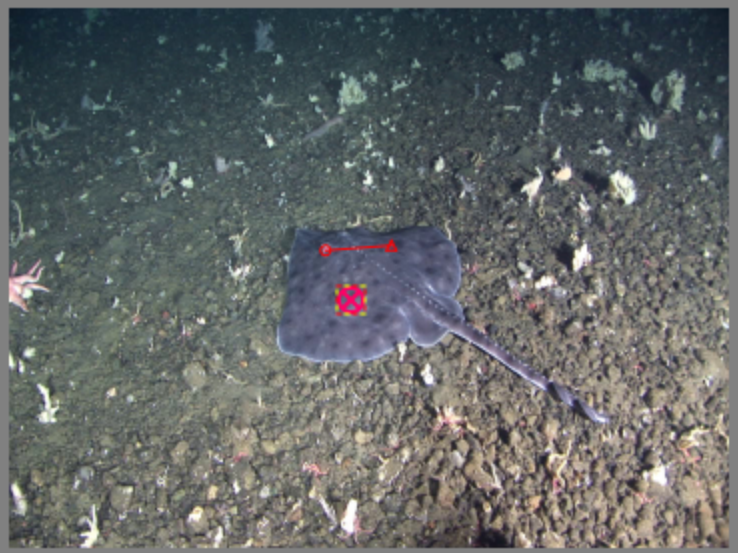
ol Selection

ool	Name
oral - unk gorgonian	
oral - Gersemia	
oral - unk coral	
oral - Caryophyllia alas...	
ponge - Aphrocallistes ...	
ponge - Heterochone c...	
ponge - Farrea occa	
ponge - white barrel	
ponge - unk sponge	
sh - POP	
sh - shortraker	
sh - rockfish	
sh - juv rockfish	
sh - shortspine	
sh - arrowtooth flounder	
sh - rex sole	
sh - flatfish	
sh - pacific cod	
sh - sablefish	
sh - giant grenadier	
sh - atka mackeral	
sh - skate	
sh - prowfish	

aphical annotations [2]

Show on all pages

ame	Type
[1] resol...	line
[2] Fish -...	Fish - skate
[1] C...	point



Channels

Red: ch 1 (Red)

Green: ch 2 (Green)

Blue: ch 3 (Blue)

more...

Live enhancement

Enhancement: None

Negative

Brightness/Contrast

Levels (Histogram adjustment)

Scale: [1:4]

(-) 1:1 (+)

Page 1/1

Initial < >

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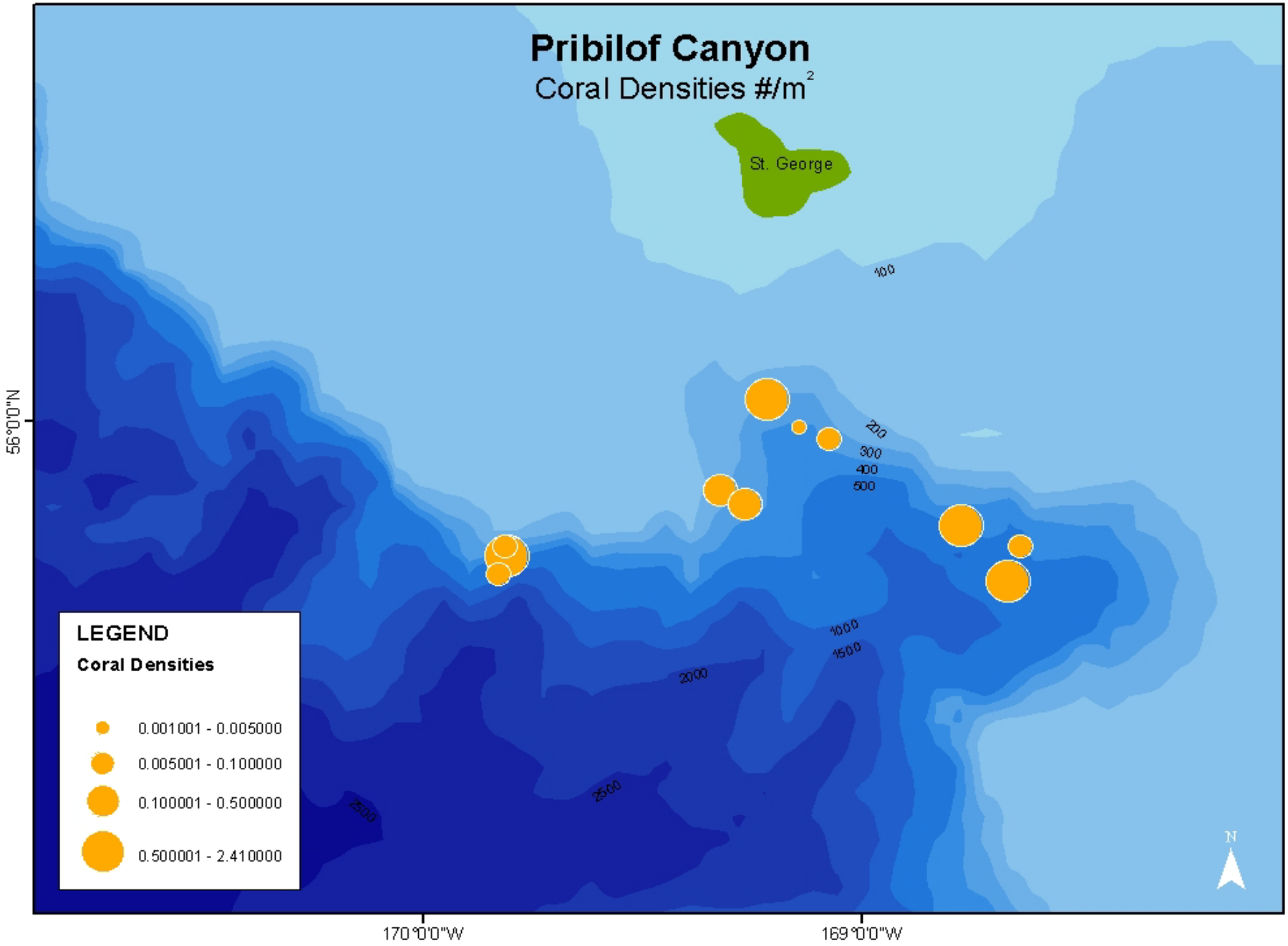
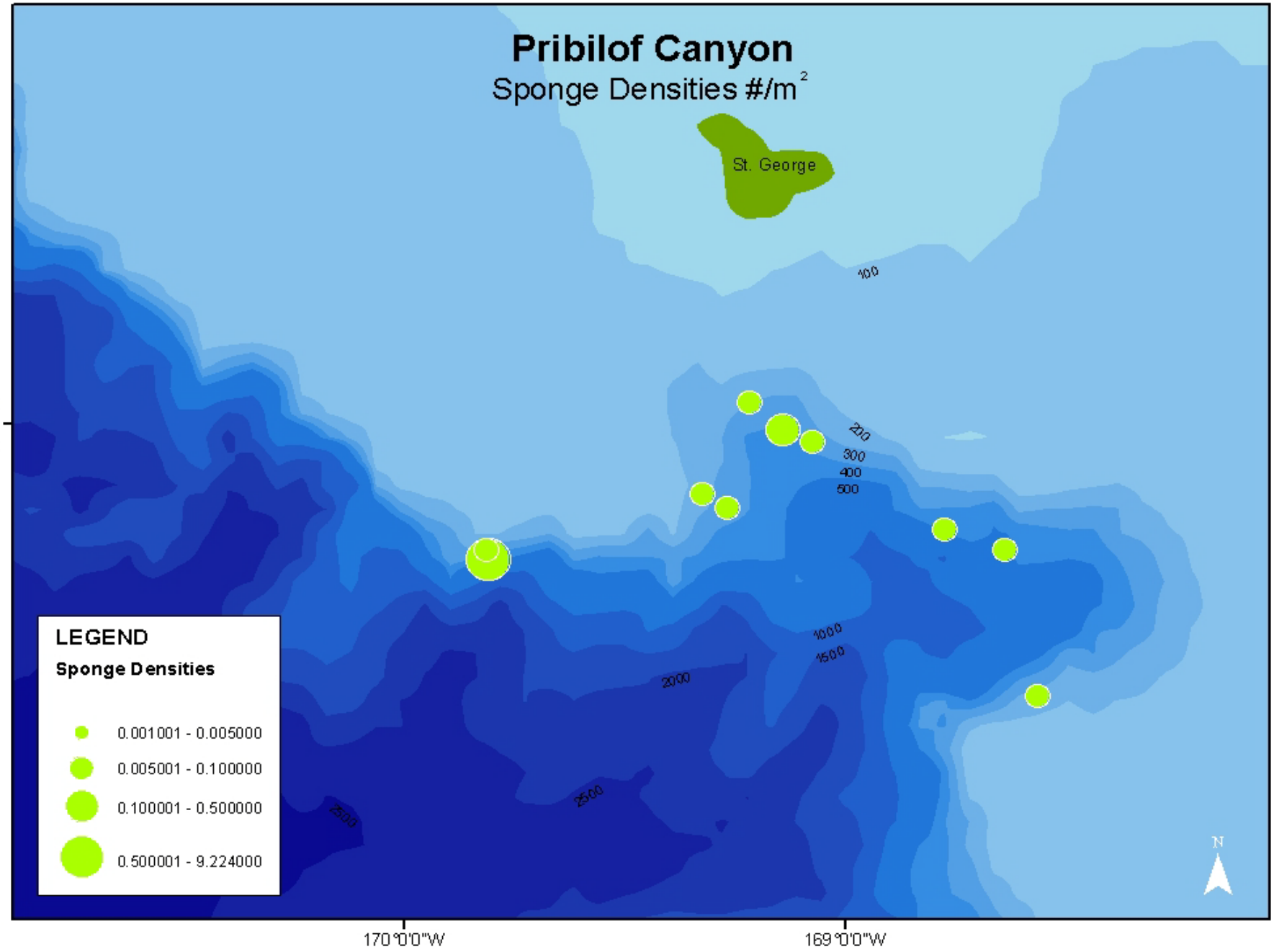
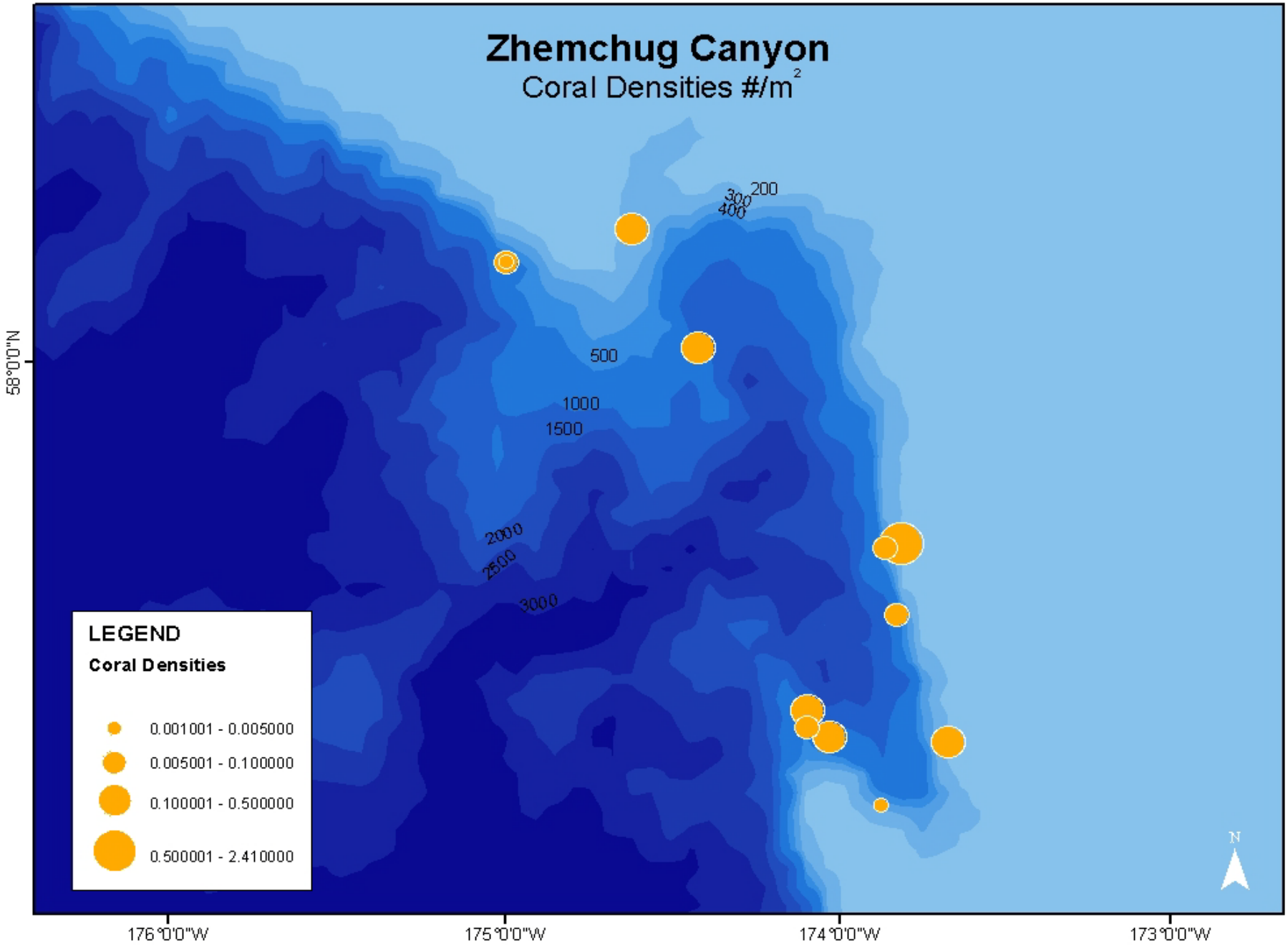
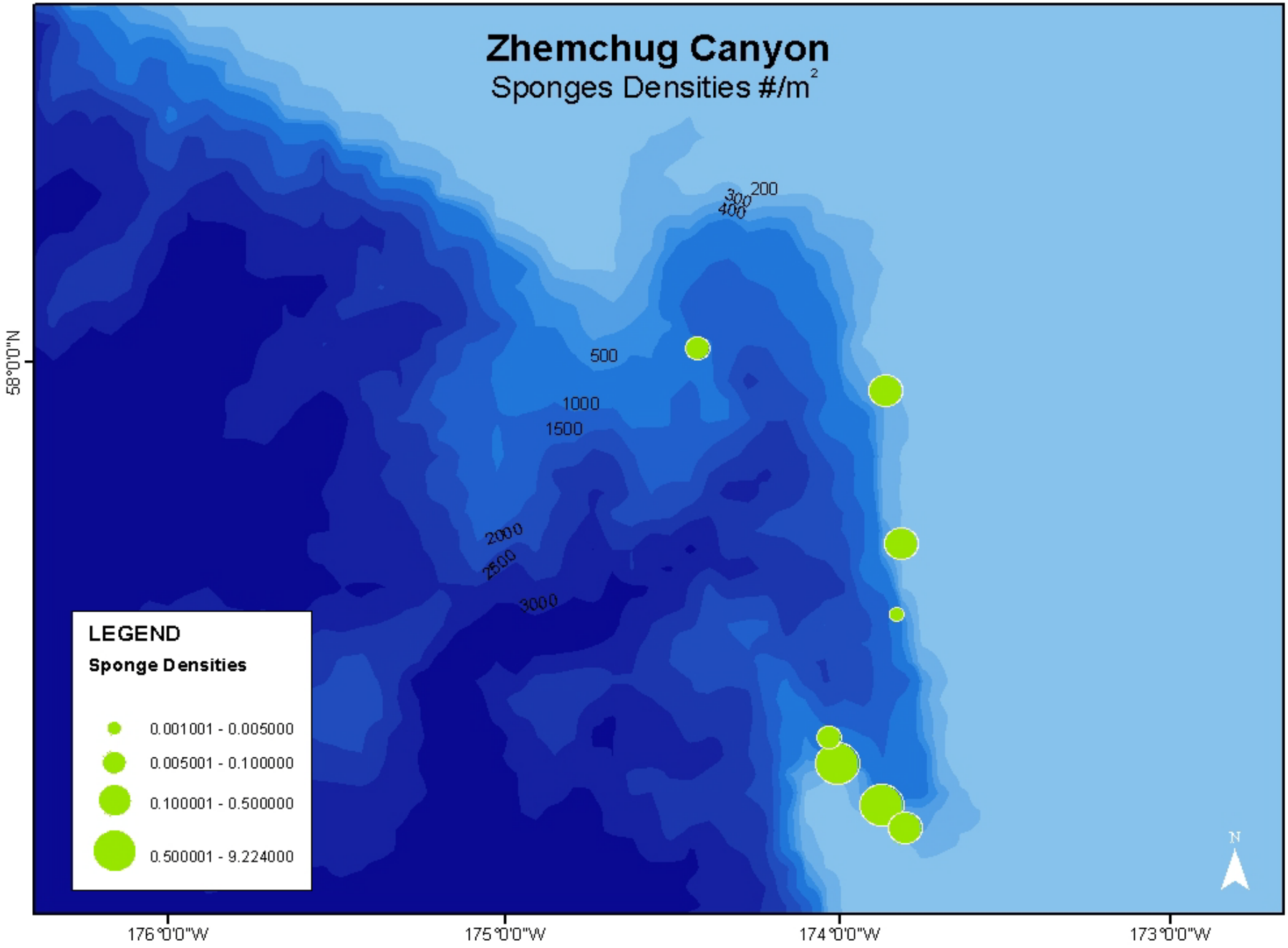
file_path	E:/beringSea/output/dive6b
heap	

Prev Next

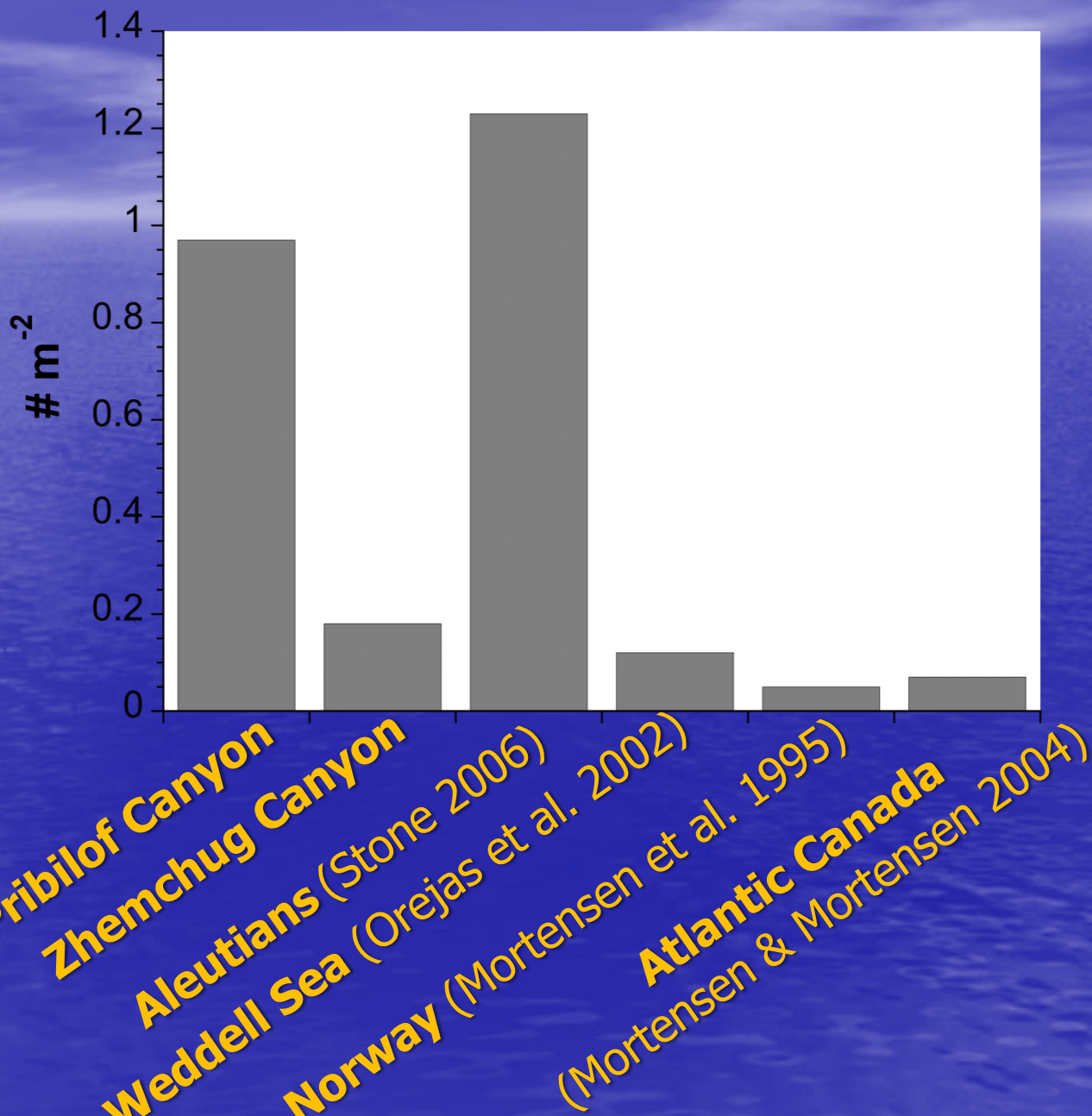

Pribilof Canyon
Coral Densities #/m2
St. George
400
200
300
400
500
1000
1500
2000
2500
2500
LEGEND
Coral Densities
0.001001 - 0.005000
0.005001 - 0.100000
0.100001 - 0.500000
0.500001 - 2.410000
N
56°0'0"N
170°0'0"W
169°0'0"W


Pribilof Canyon
Sponge Densities #/m2
St. George
400
200
300
400
500
1000
1500
2000
2500
2500
LEGEND
Sponge Densities
0.001001 - 0.005000
0.005001 - 0.100000
0.100001 - 0.500000
0.500001 - 9.224000
N
56°0'0"N
170°0'0"W
169°0'0"W

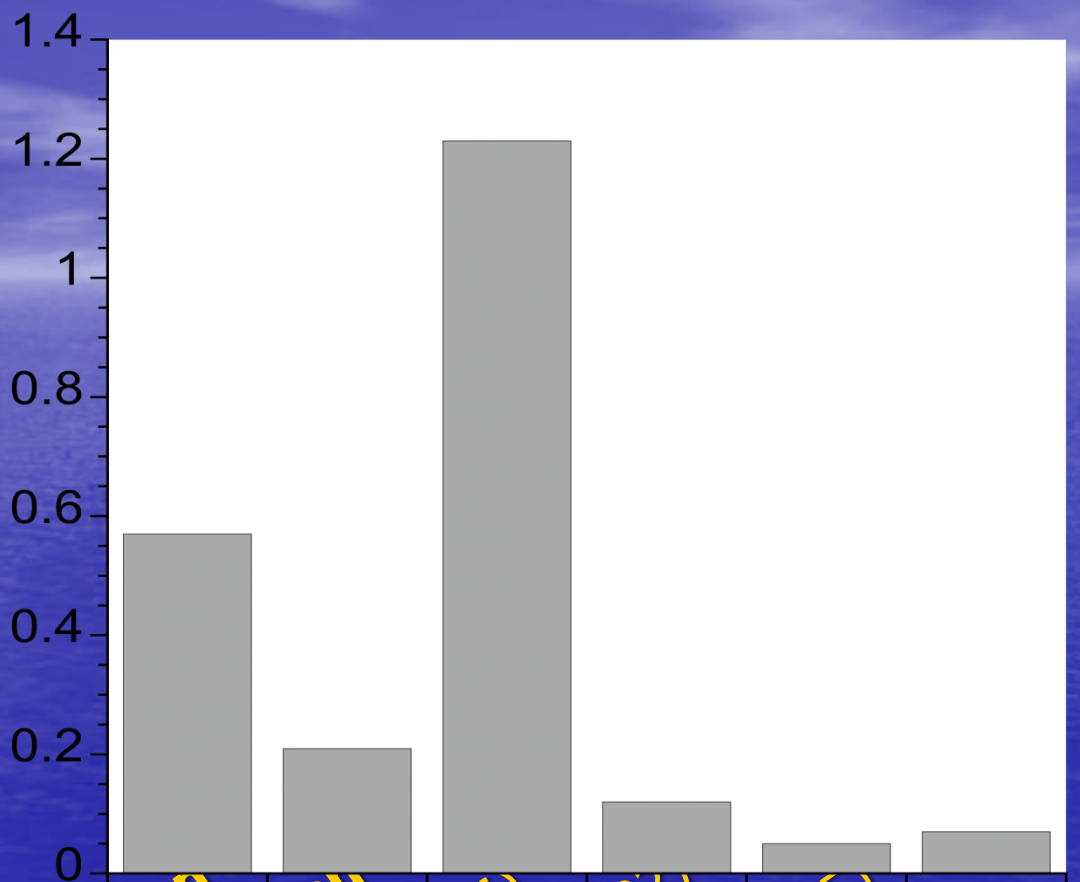

Zhemchug Canyon
Coral Densities #/m2
200
300
400
500
1000
1500
2000
2500
3000
LEGEND
Coral Densities
0.001001 - 0.005000
0.005001 - 0.100000
0.100001 - 0.500000
0.500001 - 2.410000
N
58°0'0"N
176°0'0"W
175°0'0"W
174°0'0"W
173°0'0"W


Zhemchug Canyon
Sponges Densities #/m2
200
300
400
500
1000
1500
2000
2500
3000
LEGEND
Sponge Densities
0.001001 - 0.005000
0.005001 - 0.100000
0.100001 - 0.500000
0.500001 - 9.224000
N
58°0'0"N
176°0'0"W
175°0'0"W
174°0'0"W
173°0'0"W

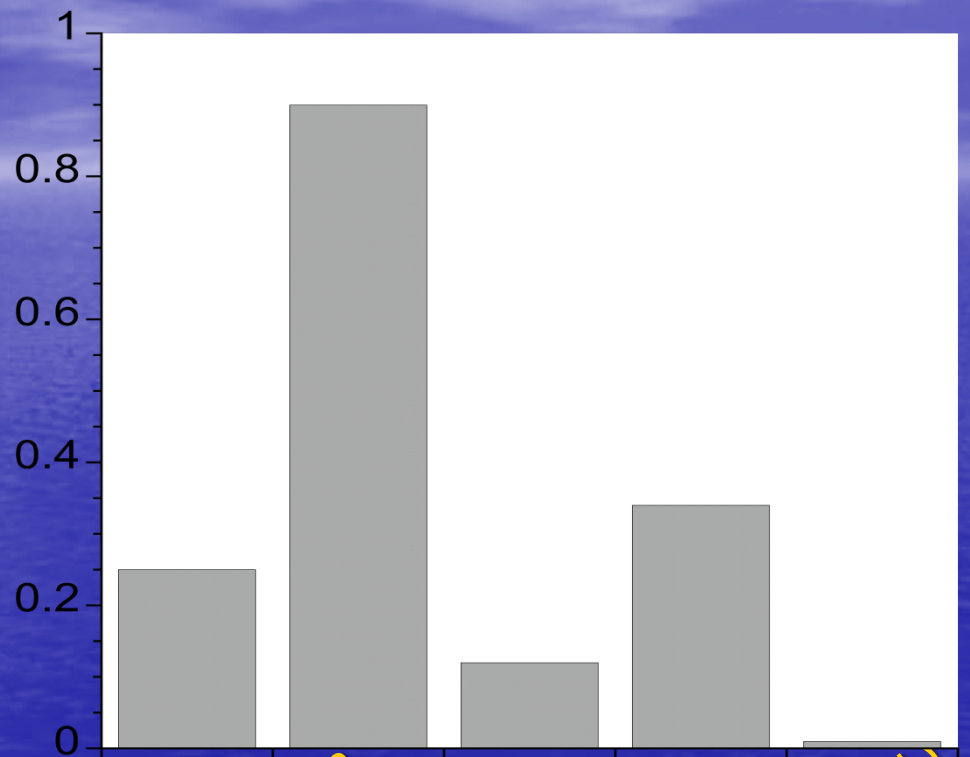
Total coral abundance



Total coral abundance



Total sponge abundance



Pribilof Canyon

Zhemchug Canyon

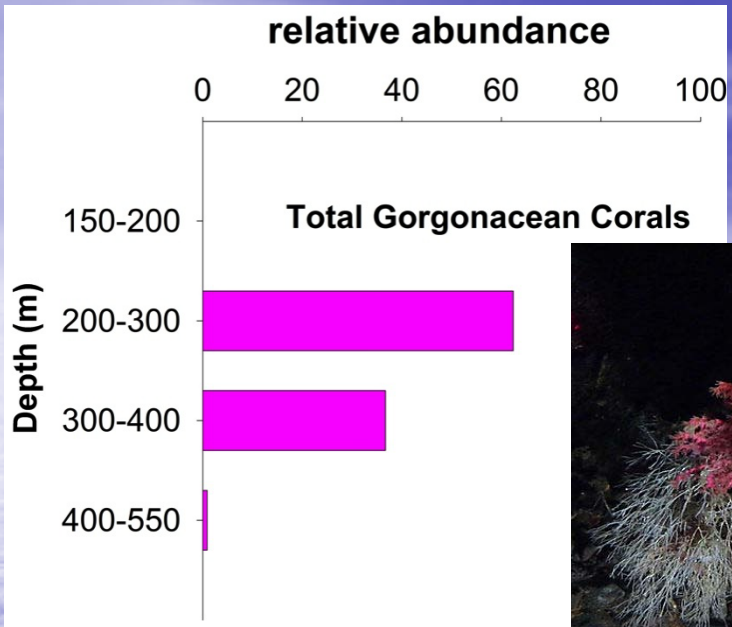
Gulf of Alaska (Freese et al 1999)

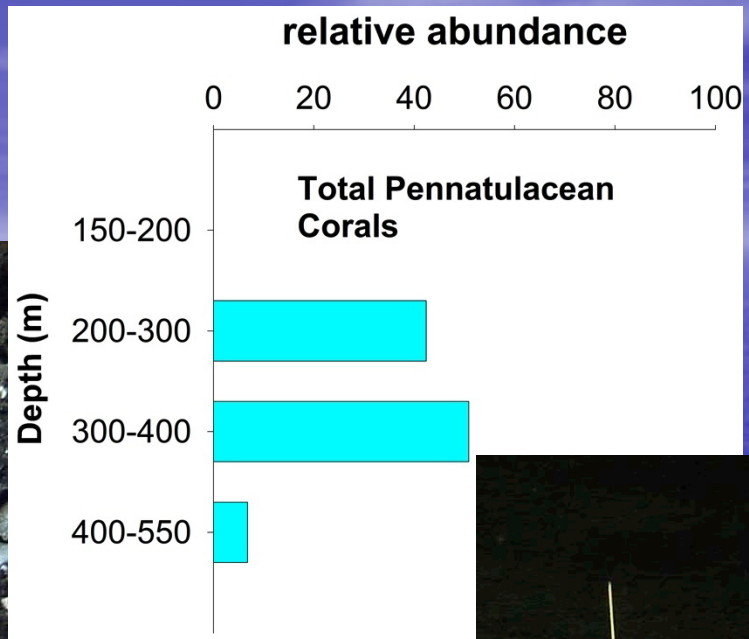
Porcupine Seabight

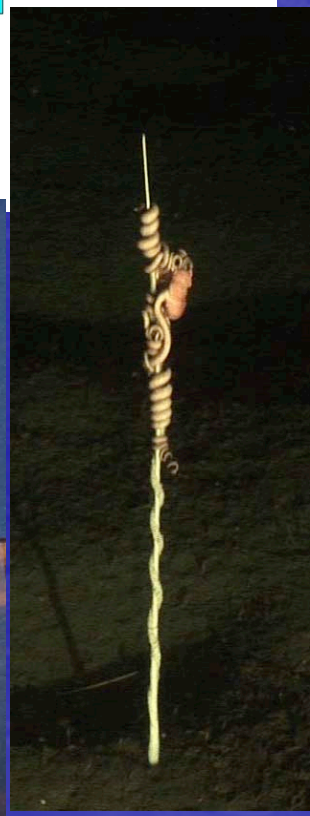
(Rice et al 1990)

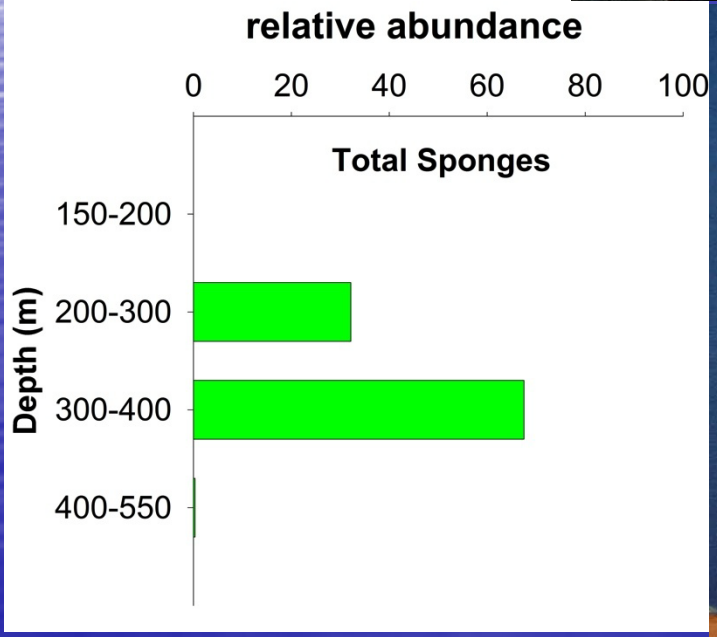
California (Beaulieu et al. 2001)

Depth distribution of corals and sponges









Habitat associations

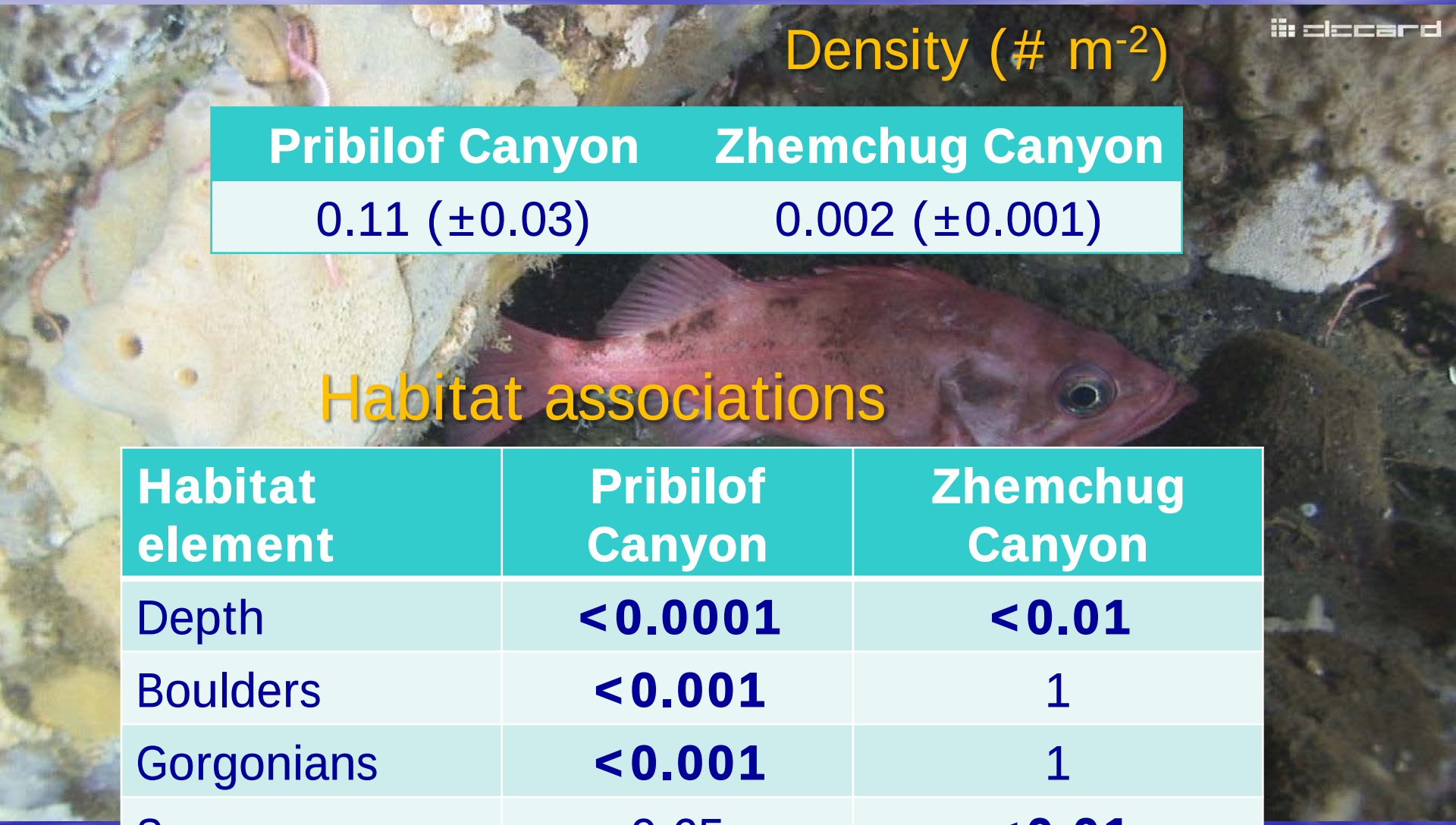
Logistic regression

Dependent (habitat) variables:

- Depth
- Boulders
- Gorgonian corals
- Pennatulacean corals
- Sponges

Null hypothesis: Fish A is no more likely to occur in a frame in which corals are present than one in which corals are absent.

Pacific ocean perch (*Sebastes alutus*)



Density (# m^{-2})

Pribilof Canyon	Zhemchug Canyon
0.11 (±0.03)	0.002 (±0.001)

Habitat associations

Habitat element	Pribilof Canyon	Zhemchug Canyon
Depth	**<0.0001**	**<0.01**
Boulders	**<0.001**	1
Gorgonians	**<0.001**	1
Sea pens	0.65	**<0.01**
Sponges	**0.01**	1

Shortraker & rougheye rockfish (*Sebastes* spp.)

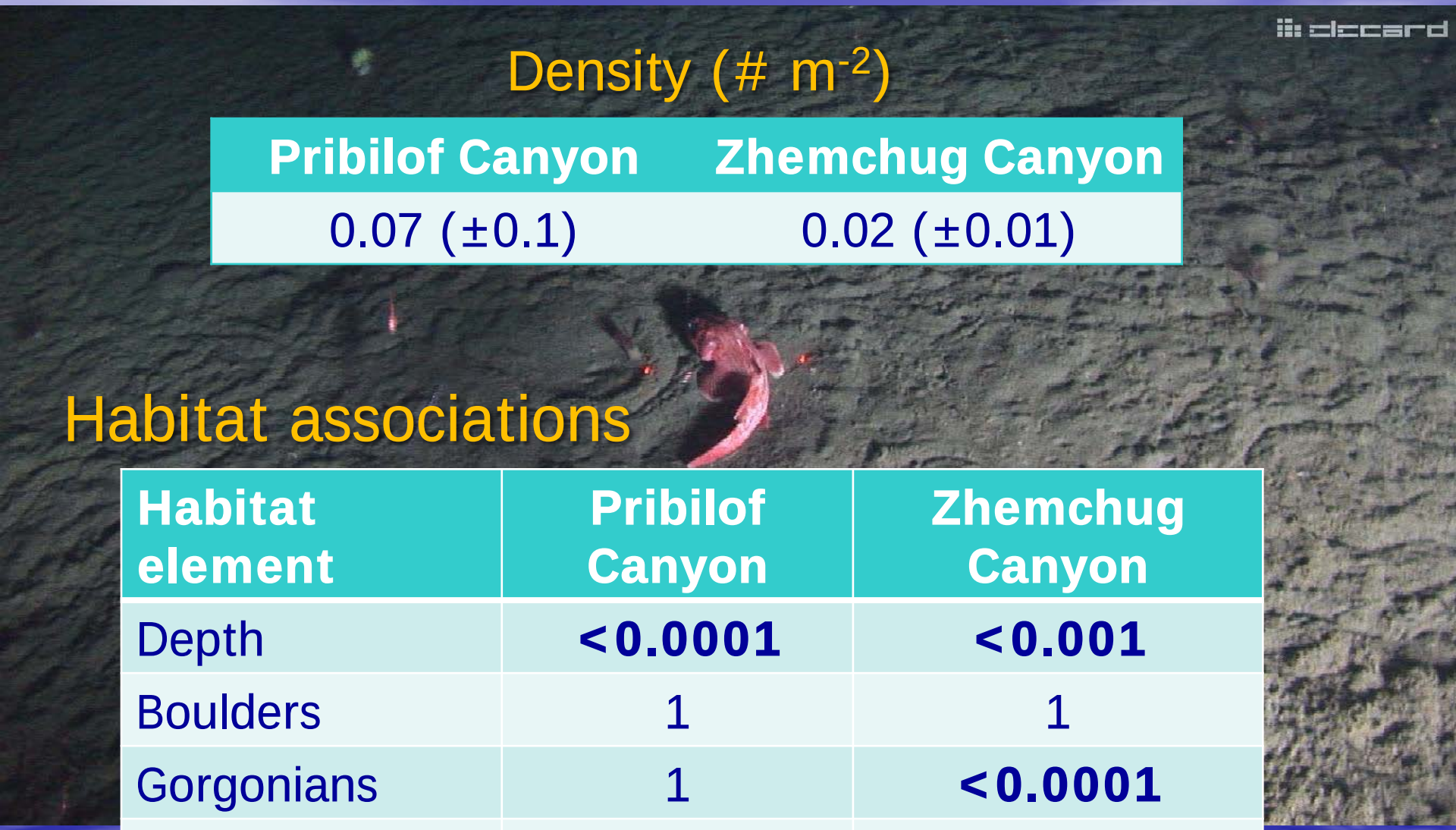
Density (# m^{-2})

Pribilof Canyon	Zhemchug Canyon
0	0.02 (±0.02)

Habitat associations

Habitat element	Pribilof Canyon	Zhemchug Canyon
Depth	-	**0.001**
Boulders	-	**<0.0001**
Gorgonians	-	**0.03**
Sea pens	-	0.32
Sponges	-	1

Shortspine thornyhead (*Sebastolobus alascanus*)



Density (# m^{-2})

Pribilof Canyon	Zhemchug Canyon
0.07 (±0.1)	0.02 (±0.01)

Habitat associations

Habitat element	Pribilof Canyon	Zhemchug Canyon
Depth	**<0.0001**	**<0.001**
Boulders	1	1
Gorgonians	1	**<0.0001**
Sea pens	0.67	**<0.0001**
Sponges	1	0.44

Total Rockfish

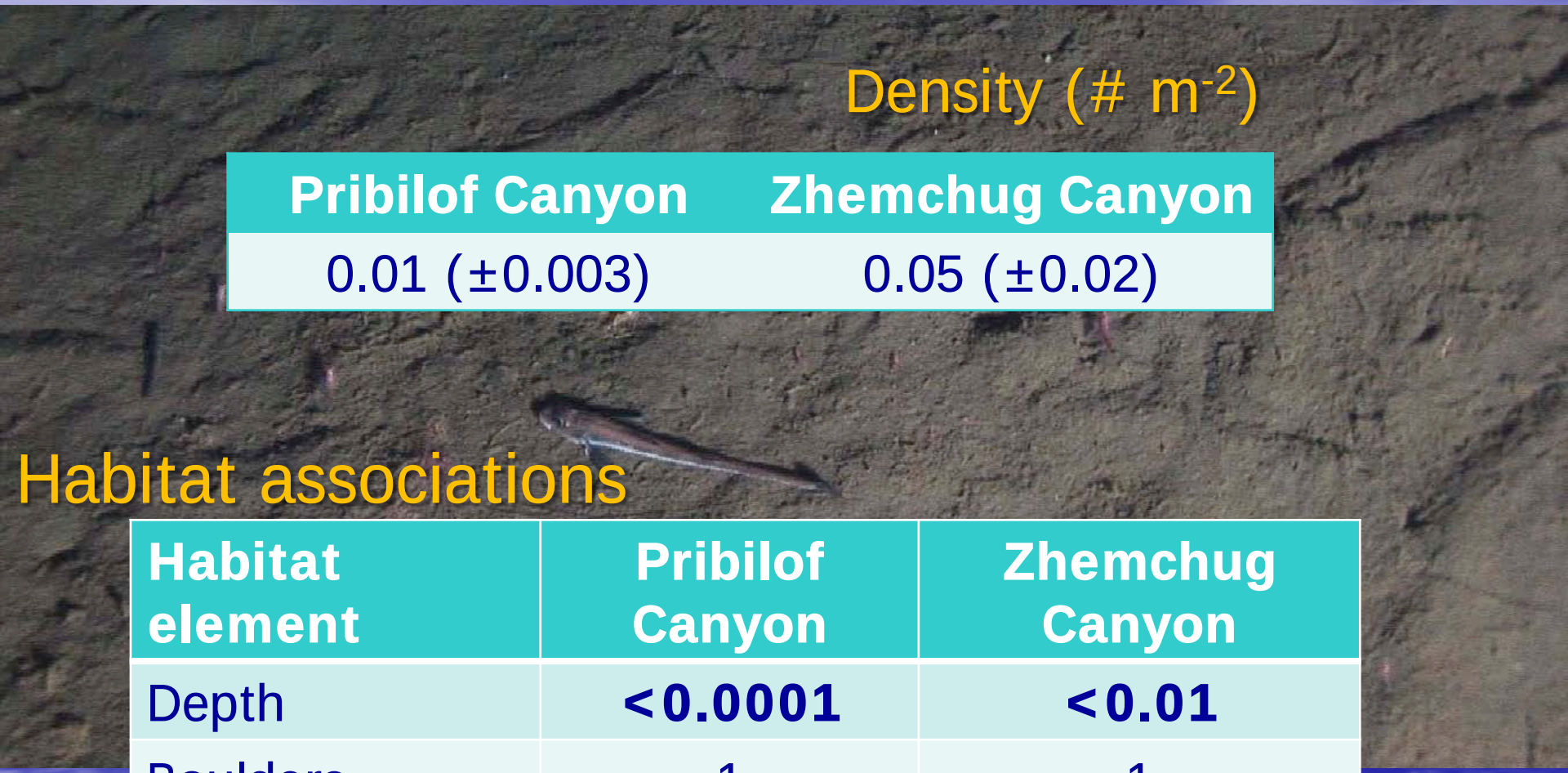
Density (# m^{-2})

Pribilof Canyon	Zhemchug Canyon
0.18 (±0.1)	0.04 (±0.02)

Habitat associations

Habitat element	Pribilof Canyon	Zhemchug Canyon
Depth	**<0.0001**	**<0.001**
Boulders	**0.001**	**<0.0001**
Gorgonians	**0.001**	**<0.0001**
Sea pens	0.14	**0.0007**
Sponges	**0.04**	0.22

Poachers (Agonidae)



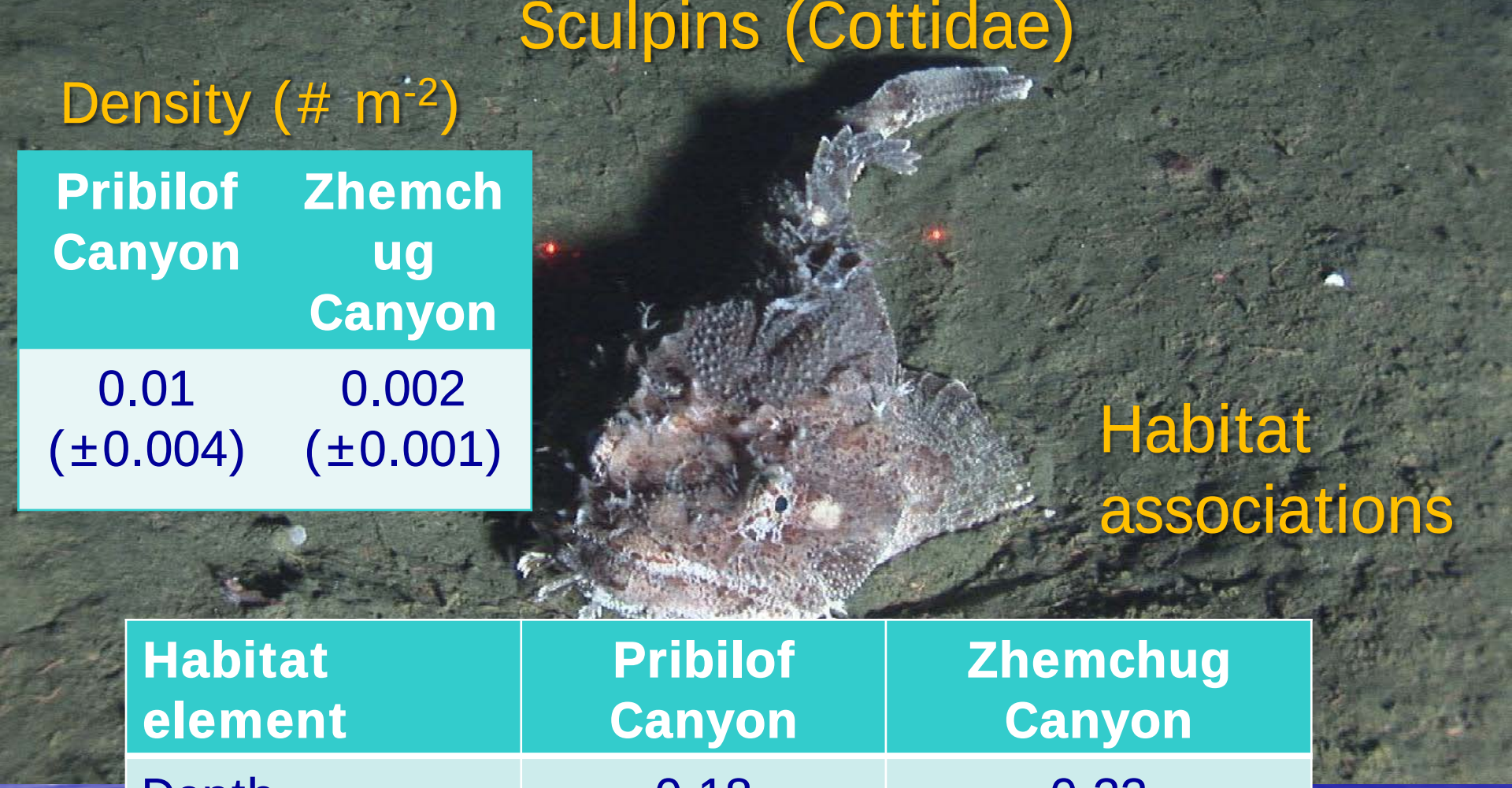
Density (# m^{-2})

Pribilof Canyon	Zhemchug Canyon
0.01 (±0.003)	0.05 (±0.02)

Habitat associations

Habitat element	Pribilof Canyon	Zhemchug Canyon
Depth	**<0.0001**	**<0.01**
Boulders	1	1
Gorgonians	**0.04**	0.11
Sea pens	0.75	0.37
Sponges	0.27	0.27

Sculpins (Cottidae)



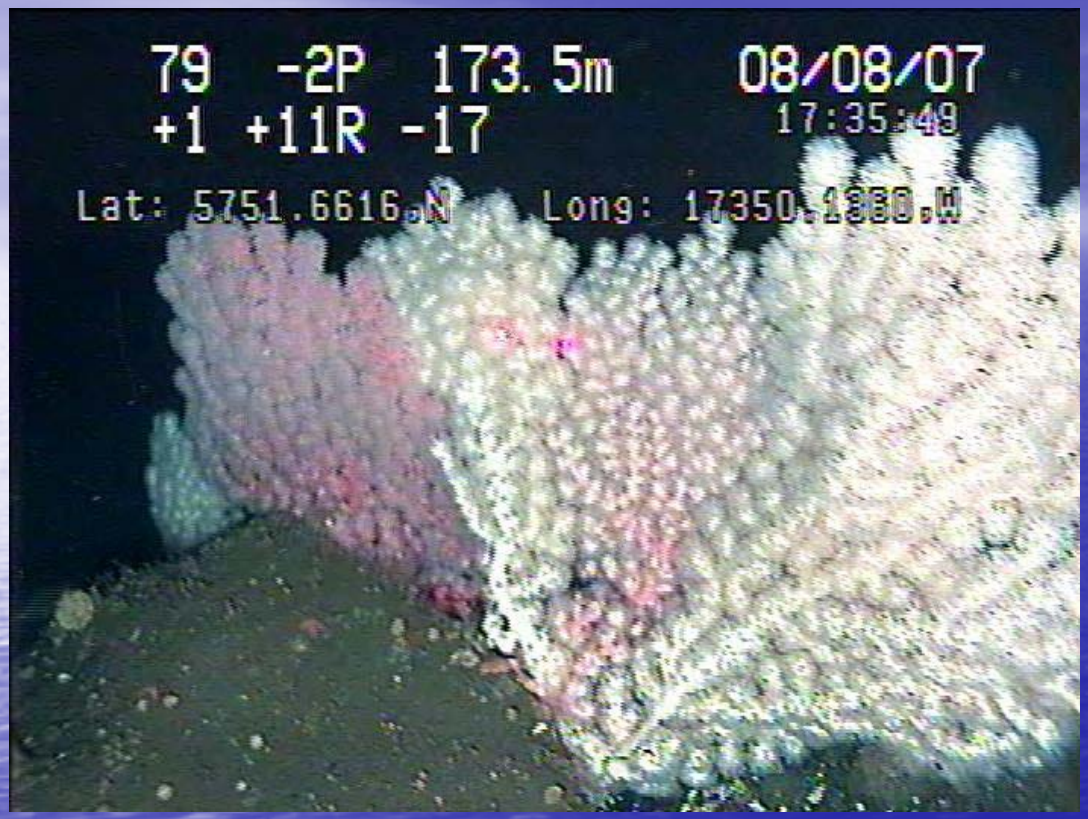
Density (# m^{-2})

Pribilof Canyon	Zhemchug Canyon
0.01 (±0.004)	0.002 (±0.001)

Habitat associations

Habitat element	Pribilof Canyon	Zhemchug Canyon
Depth	0.18	0.33
Boulders	0.67	0.85
Gorgonians	**0.04**	0.22
Sea pens	0.17	0.11
Sponges	0.71	0.53

Intrinsic value of corals – Auster (2005



- Long-lived (100's-1000's of years)
- Sensitive to disturbance
- Recover slowly

Auster PJ (2005) Are deep-water corals important habitats for fishes? In: Freiwald A, Roberts JM, editors. Cold-water Corals and Ecosystems. Berlin Heidelberg: Springer-Verlag. pp. 747-760.

Fishing disturbance

2007 - 13 observations

2012 - 79 observations

2007- 0.26% of video frames analyzed = 28.8 m^2

2012- 1.77% of video frames analyzed = 364.4 m^2

Zhemchug skate nursery

Site	Depth (m)	Egg cases m^{-2}	Survey method
Pervenets Canyon	316	0.33	trawl
Pervenets Canyon	320	0.08	trawl
Pervenets Canyon	337	0.05	trawl
Bering Canyon	145	0.8	trawl
Bering Canyon	380	0.06	trawl
Bristol Canyon	156	0.01	trawl
Zhemchug Canyon	217	0.6	trawl
Pribilof Canyon	205	0.02	trawl
Zhemchug Canyon	205	**22.5**	video

Trawl data from Hoff 2010

No Existing Protections for Bering Sea Shelf Break/Slope Canyons

- Commercially important
- Biologically productive
- Marine mammal / seabird foraging areas
- Vulnerable seafloor habitats
- Nursery areas
- Unidentified species
- Deepwater refuges
- Cultural significance

Benefits of Marine Reserves

- Increase abundance, average size, reproductive output and genetic diversity
- Enhance fishery yield in adjacent areas
- Provide simple and cost-effective management regime
- Guard against uncertainty and reduce probability of overfishing and fishery collapse
- Protect endangered species and marine mammals
- Provide basis for ecosystem-based management
- Increase habitat quality, species diversity and community stability
- Provide experimental control sites for monitoring and assessing relative impacts of fishing and climate change
- Improve public awareness, education and understanding

Thank you!

jhocevar@greenpeace.org