

Preliminary Results of the 2014 Underwater Camera Survey of the Eastern Bering Sea Outer Shelf and Slope

An underwater camera survey image showing a large, flat, spotted ray resting on a dark seabed covered with numerous starfish. The ray is the central focus, with its body spread out and its tail visible. The seabed is densely populated with starfish, creating a textured background. The lighting is somewhat dim, typical of an underwater environment.

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Alaska Fisheries Science Center

RACE Seminar Series

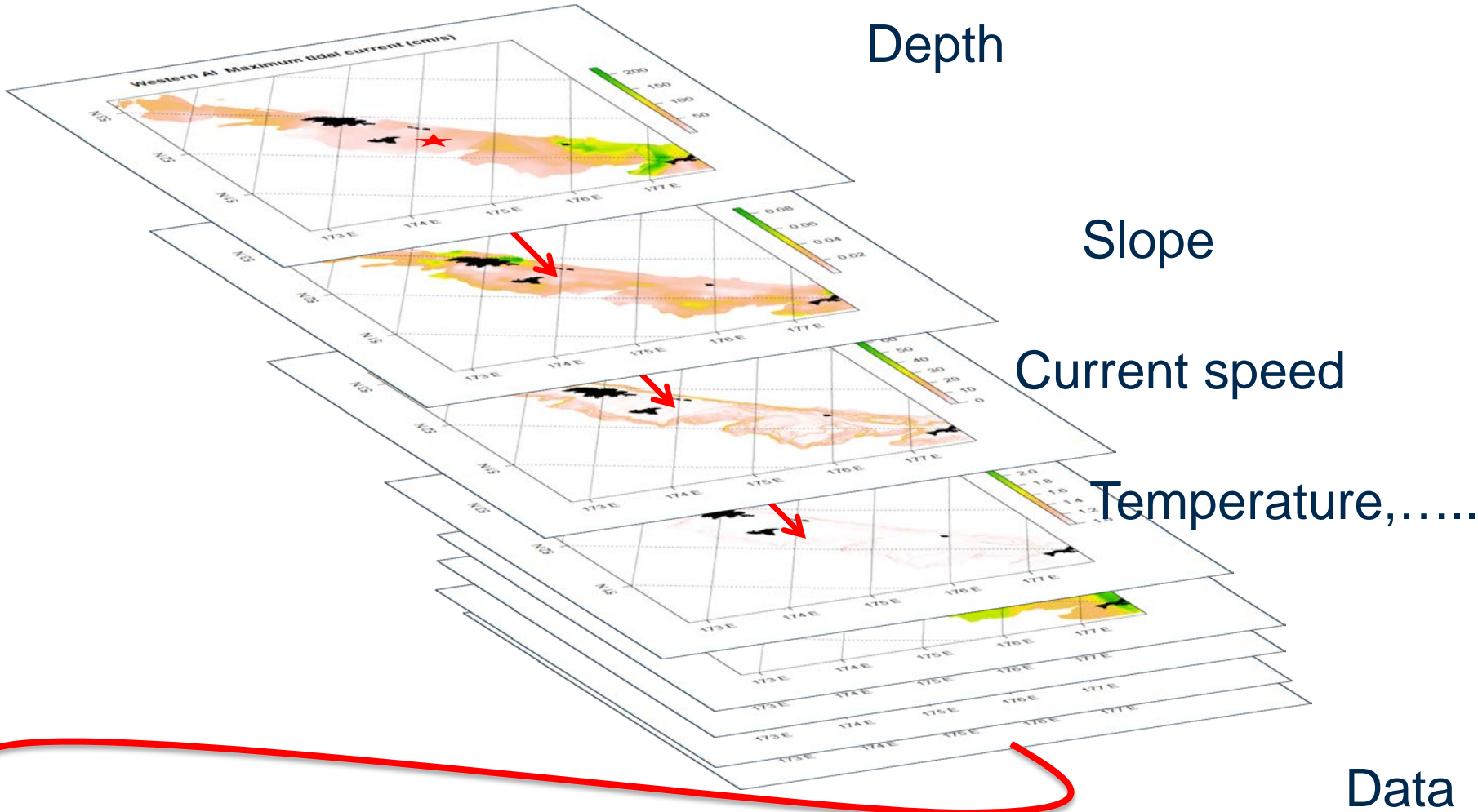
Seattle, WA

March 10, 2015

Background and Timeline

- April 2012
 - NPFMC requested analysis of existing data on the eastern Bering Sea slope and canyons
- June 2013
 - AFSC presented results of the analysis
 - ***Included predictive coral model***
- June 2013
 - NPFMC requests further analysis
 - ***NPFMC requests “groundtruthing” of coral model***
- October 2013
 - Further analysis presented
 - ***Plans for summer FY14 fieldwork presented***
- February 2014
 - EBS Canyons workshop – ***discuss of FY14 survey***

Method Part I. Data extraction



Eastings	Northings	Hauljoin	Cruise	Coral	All_spong	Upright_s	bathyt	rugt	slopet	tmaxt	colorkt	speedt	btempt	sedt	aspectt
-1724844	622375.9	1211155	200401	0.234757	-999	0	406	1.00051	1.77448	31.58791	541.9287	0.009334	3.792883	-3.04834	40.40086
-1737596	589496.8	1211159	200401	0.146251	-999	33.97403	90	1.000093	0.418171	118.024	561.1726	0.012461	4.562544	-3.1559	40.97159
-1738269	587606.1	1304609	200601	0.605925	-999	2.759369	93	1.000188	0.498922	118.3989	561.8009	0.012488	4.561443	-3.1596	42.47778
-1738261	587595.9	-6835	201001	0.048756	-999	0.513659	93	1.000188	0.521538	118.4221	561.8882	0.01249	4.56139	-3.15983	38.1242
-1723829	622375.4	31734	199101	0	-999	0.010858	391	1.000965	2.001224	30.39524	542.9734	0.009265	3.787413	-3.04834	38.01564
-1724063	620752.1	1145973	200201	0.028932	-999	0.51676	395	1.000624	1.864233	30.42523	543.6204	0.009114	3.787336	-3.04834	36.16538

Method Part II. Generalized Additive Modeling

$$y = s(\text{latitude}, \text{longitude}) + s(\text{depth}) + s(\text{temperature}) + s(\text{slope}) + s(\text{tide}) \\ + s(\text{current}) + s(\text{ocean_color}) + s(\text{grain_size}) + \varepsilon$$



Details:

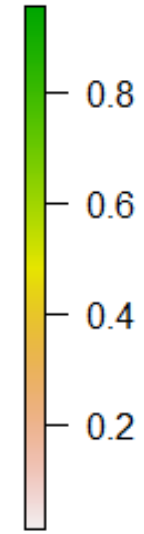
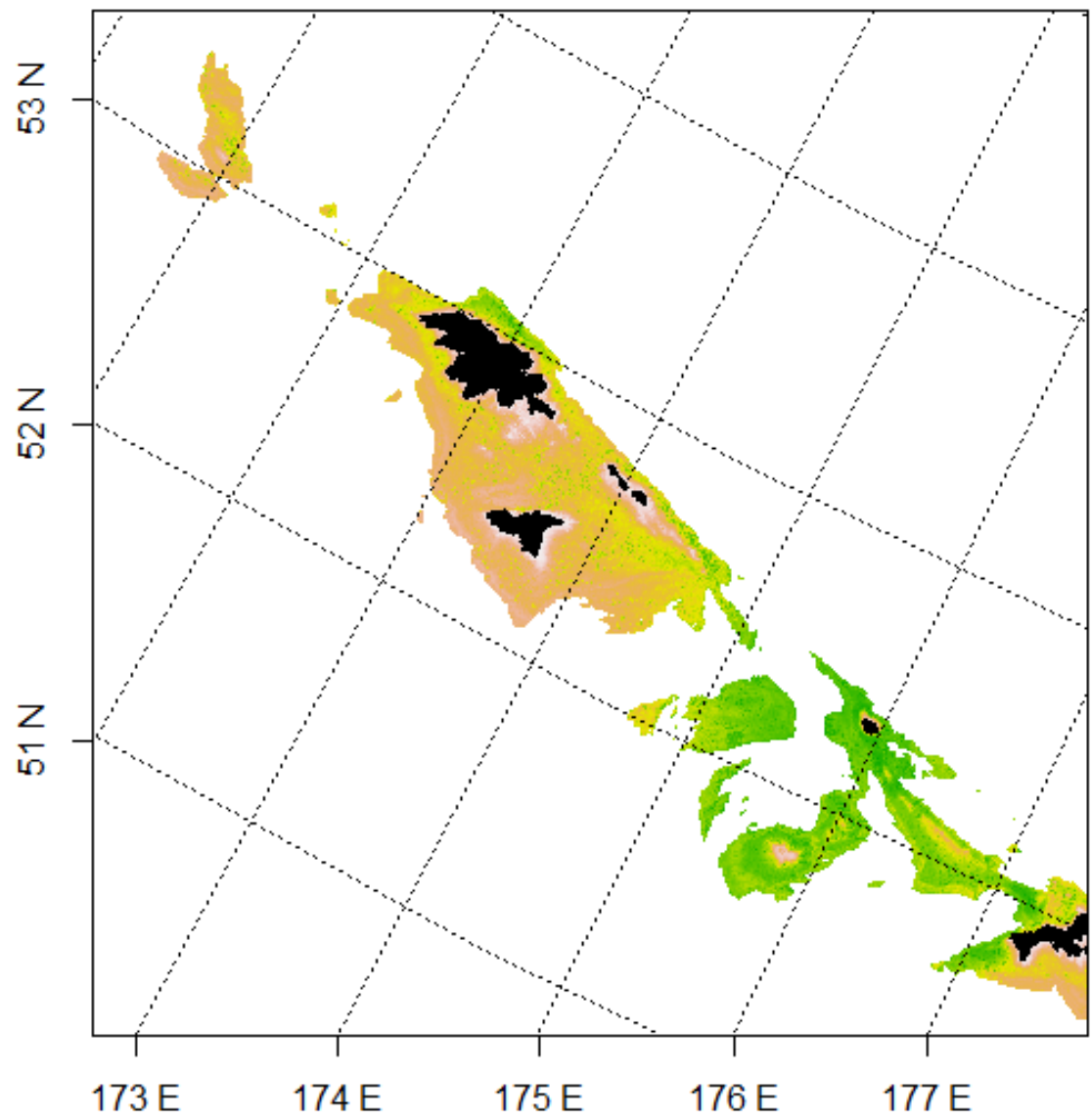
MGCV package in R

Presence-absence = Binomial distribution

$k = 30$ for bivariate term, 4 for univariate terms

Result

Western AI Coral presence



current

or

ope

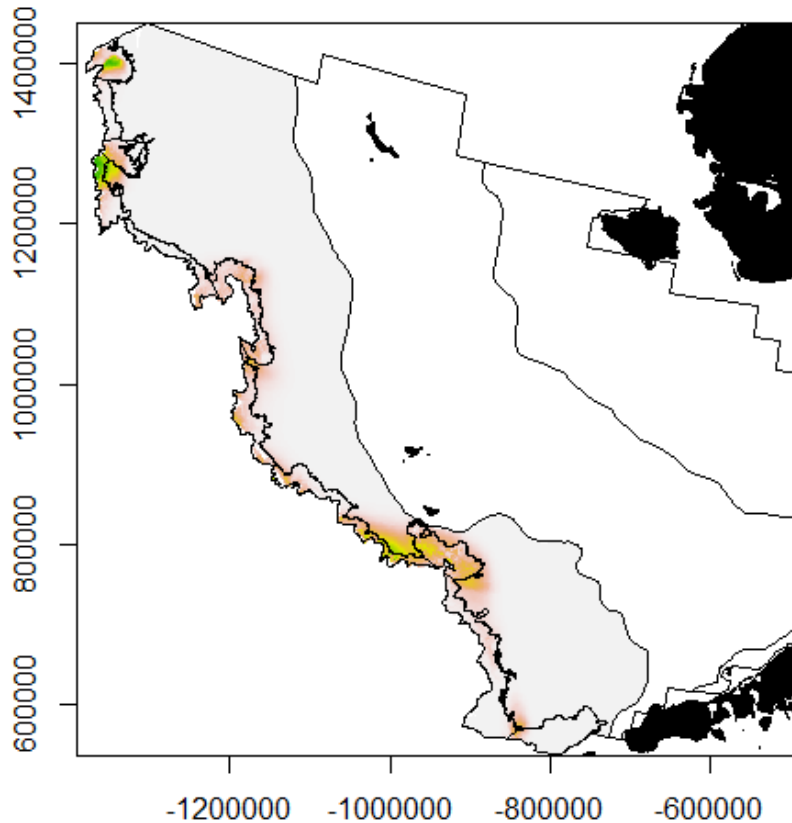
pe)

Best fit

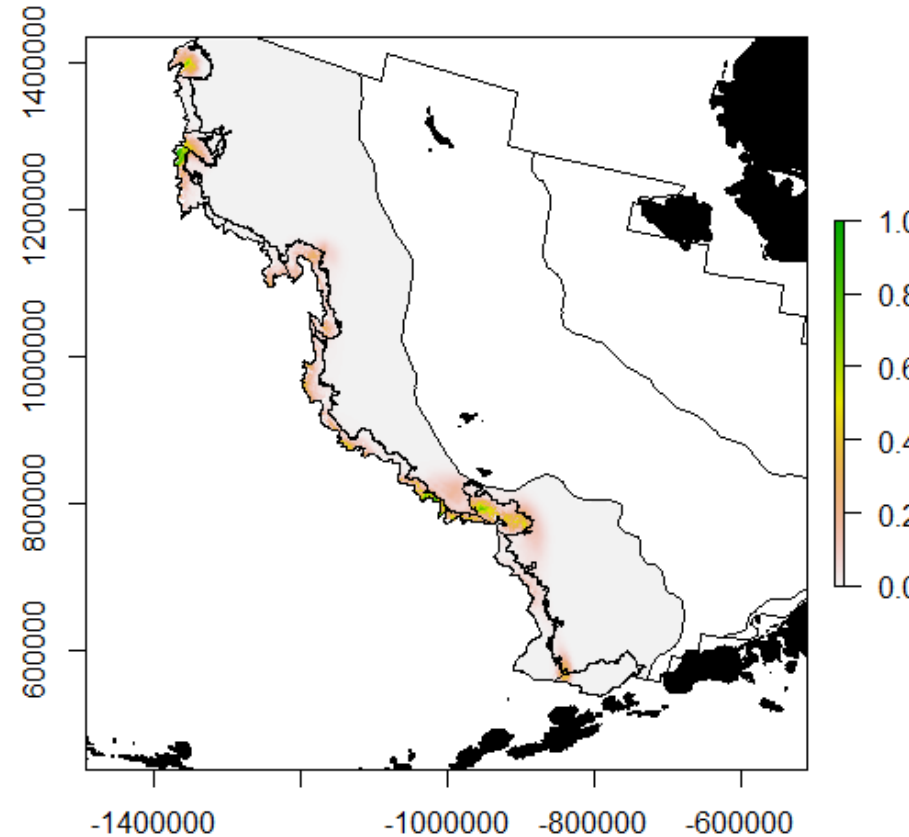
y =

Coral Models – eastern Bering Sea

Coral - Original



Coral - Refined



Differences –

1 km² grid vs. 1 ha grid

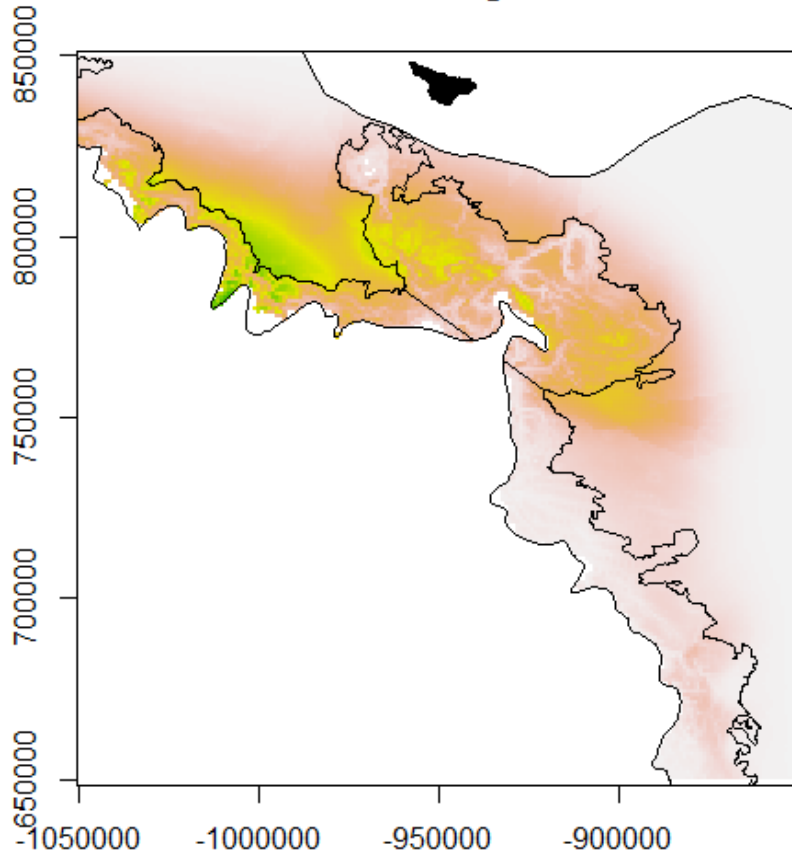
Net position corrected

Improved depth (Zimmermann and Prescott)

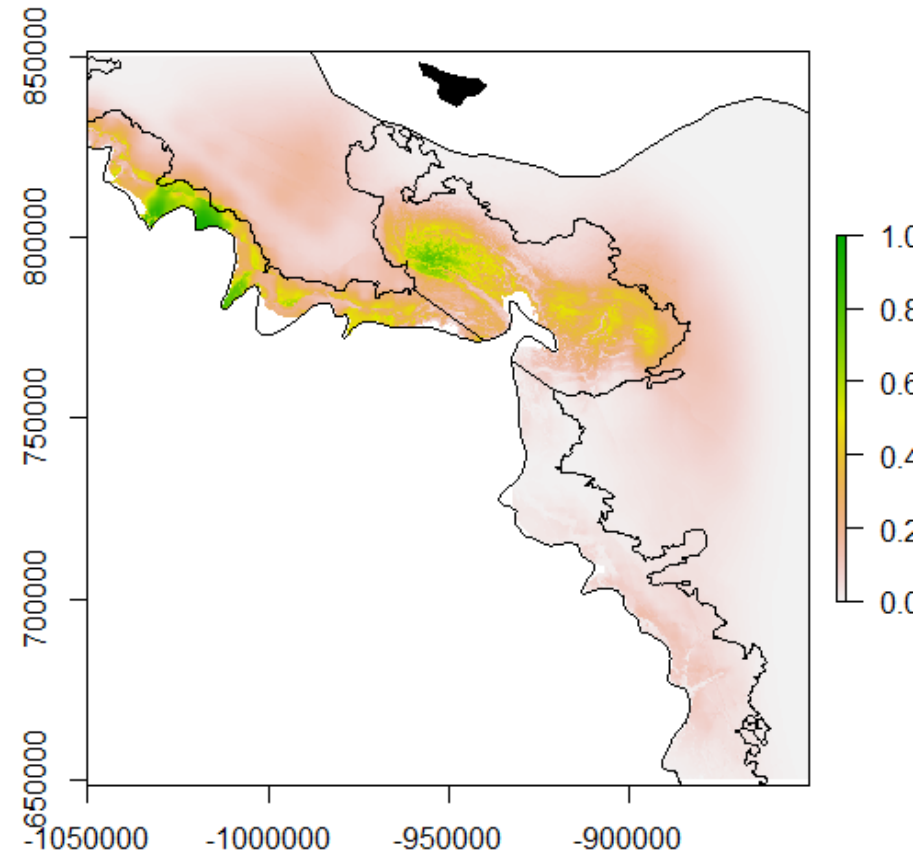
Slightly different variable formulation and significance in model

Coral Models – Pribilof Canyon

Coral - Original

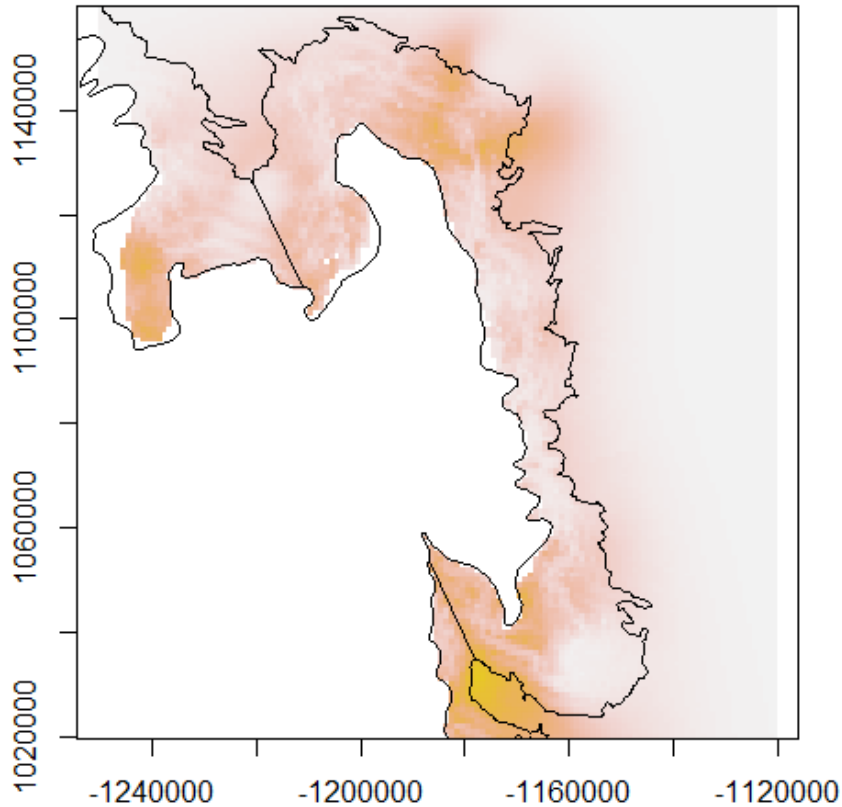


Coral - Refined

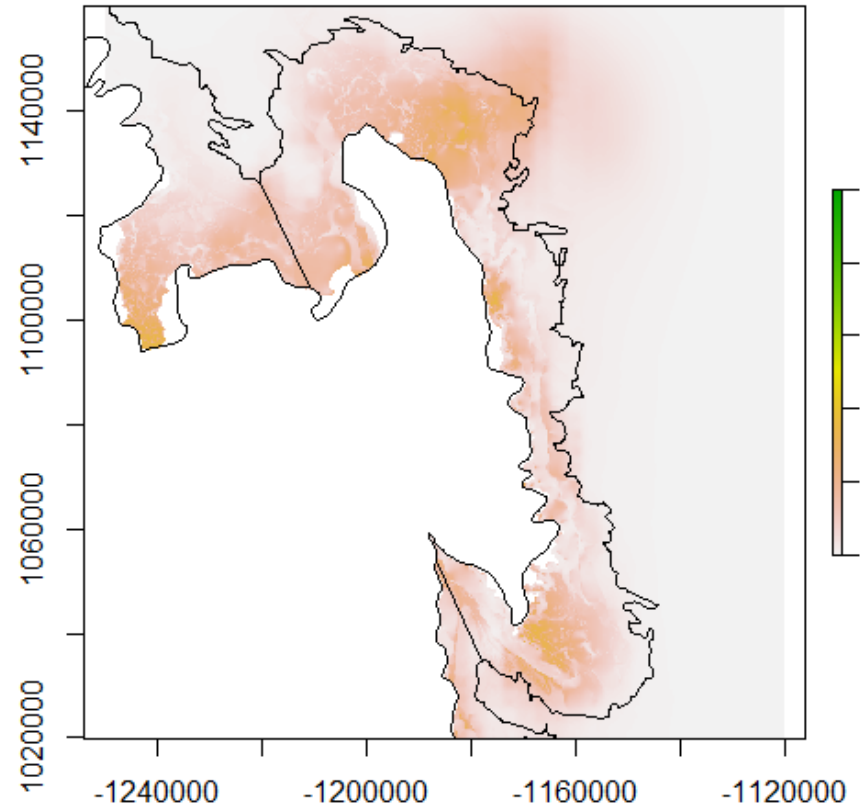


Coral Models – Zhemchug Canyon

Coral - Original

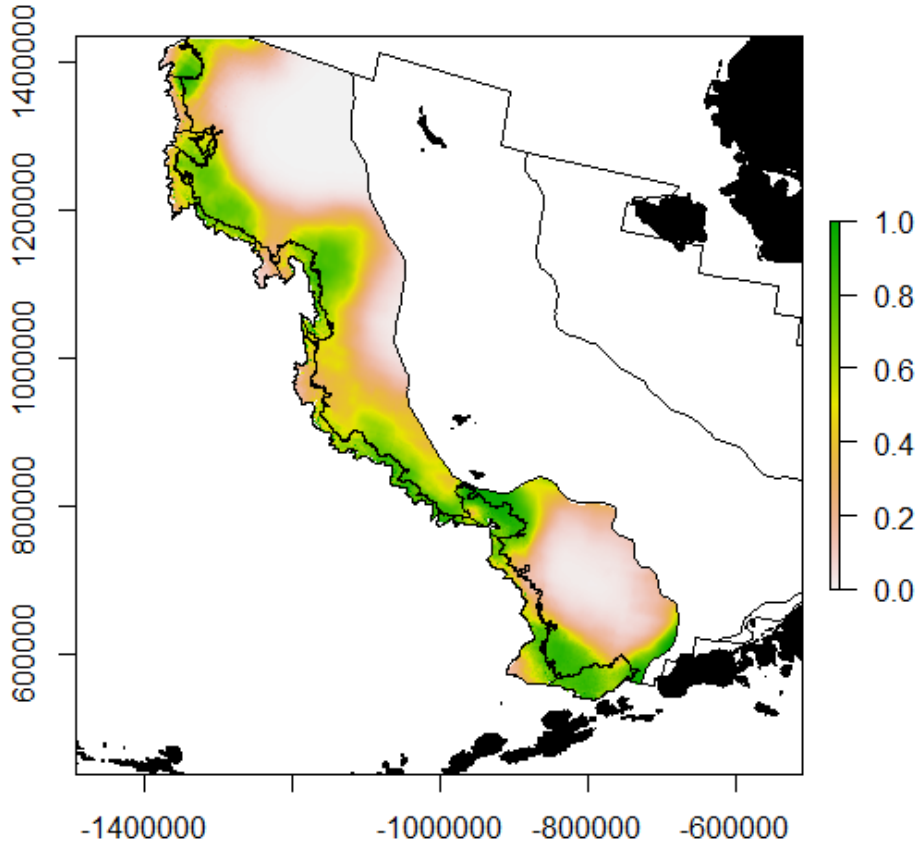


Coral - Refined

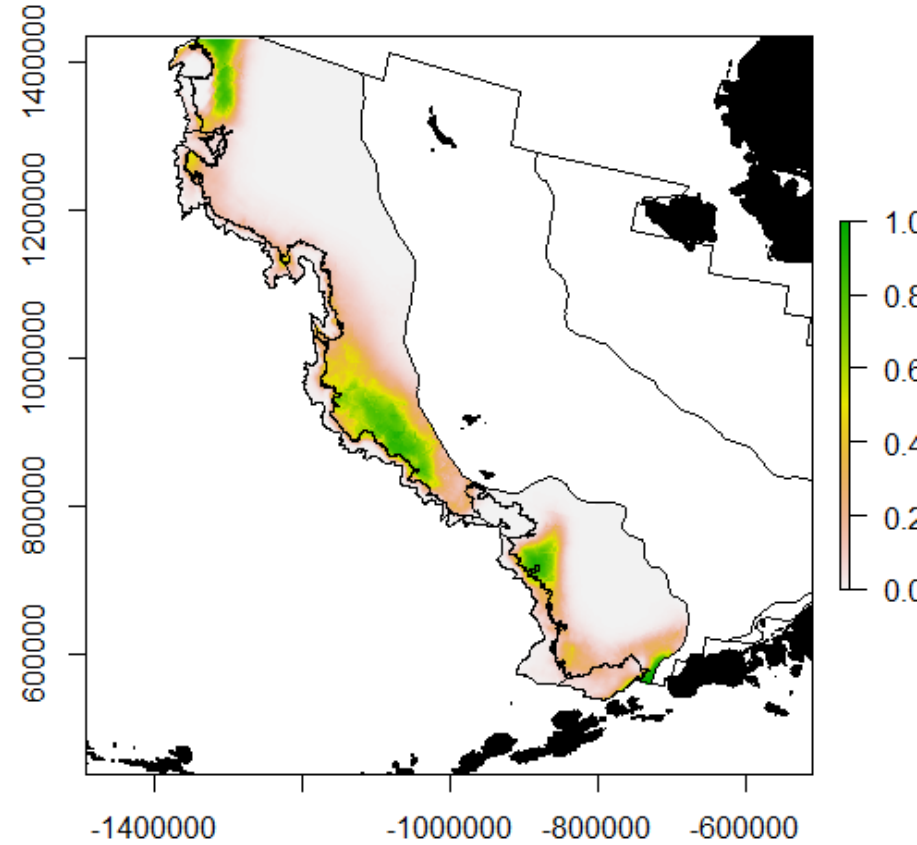


Sea Whip and Sponge Models

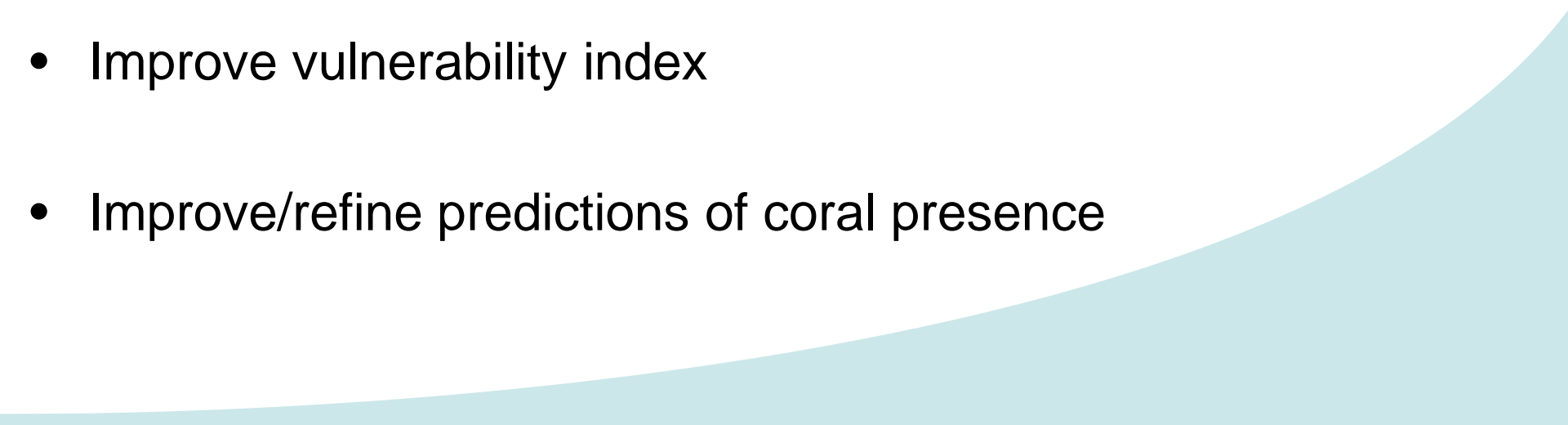
Sponge



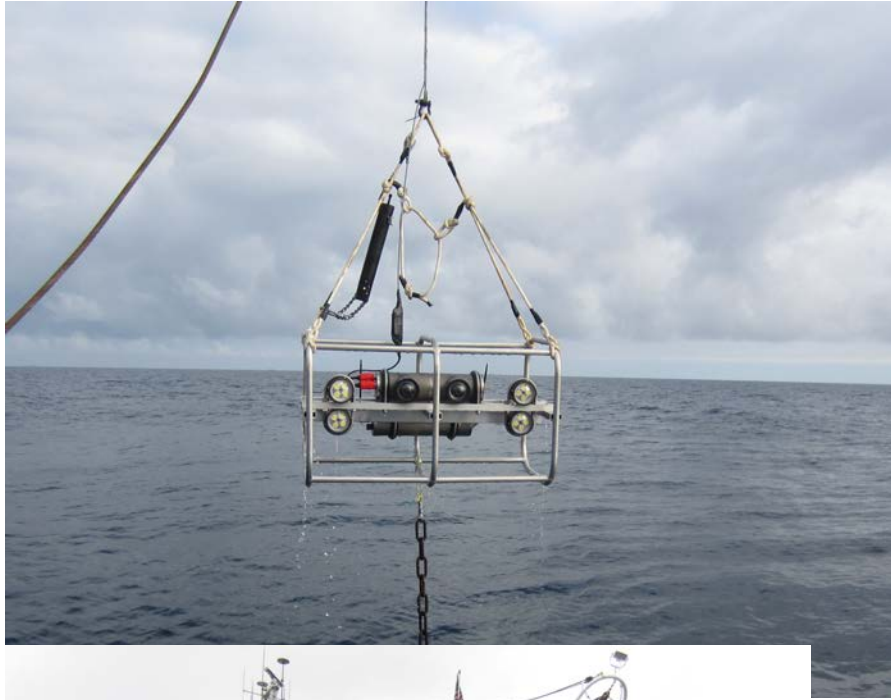
Whips Pens



Fieldwork objectives (NPFMC Motion)

- Validate model predictions
 - Acquire height and density data for coral
 - Identify the role of these coral as fish habitat
 - Document presence and degree of fishing gear effects
 - Improve vulnerability index
 - Improve/refine predictions of coral presence
- 

2014 fieldwork



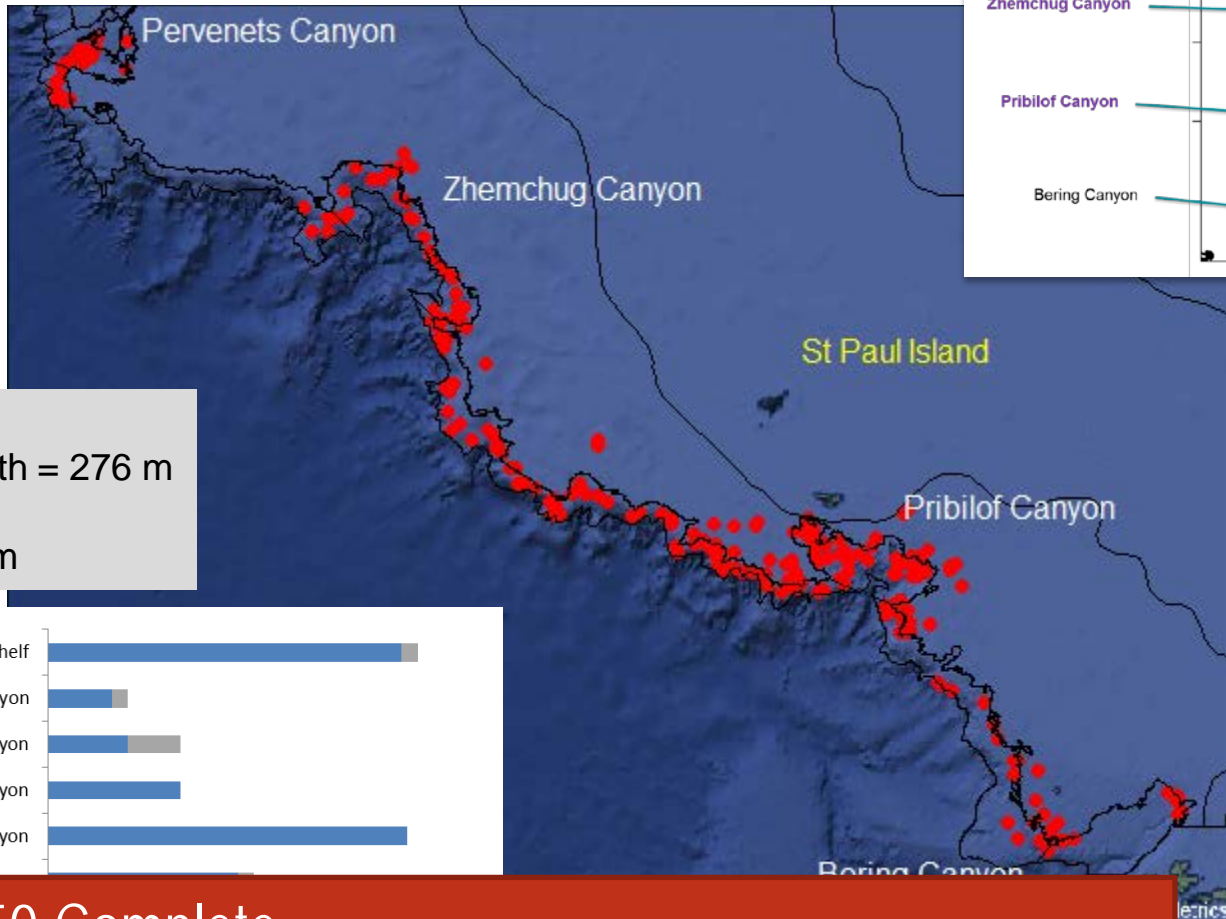
Stereo drop camera

15 minute tows

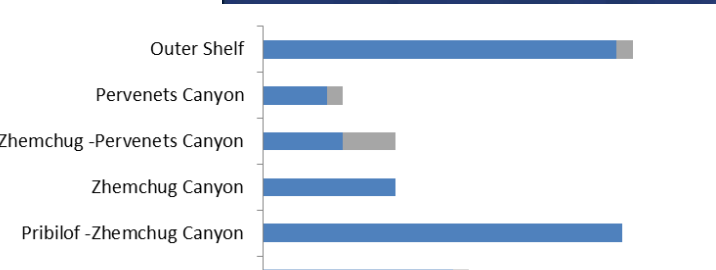
300 Randomly selected stations
more effort in areas of higher
probability (realized $n = 250$)

~225,000 paired seafloor images

2014 Sites



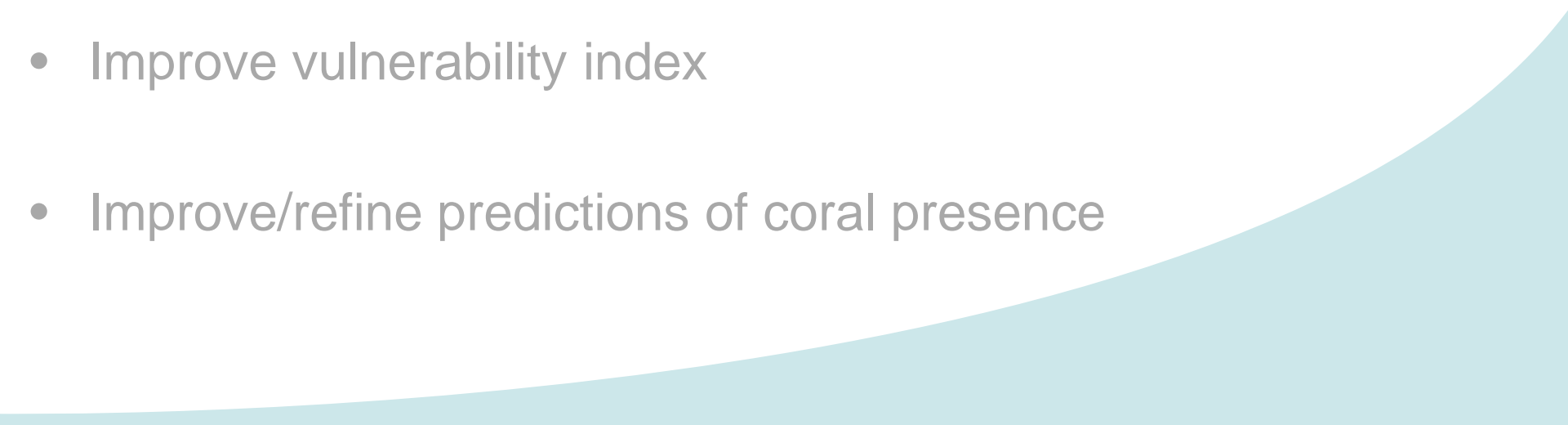
n = 250
 Median depth = 276 m
 Min = 91 m
 Max = 808 m



177 of 250 Complete
 (couple exceptions for sponge subsample)
 All transects have been viewed once
 All transects with coral have been included in presentation

3580 m² (mean = 1253 m²)

Fieldwork results

- **Validate model predictions**
 - Acquire height and density data for coral
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- 

Swiftia sp.
Total number = 535



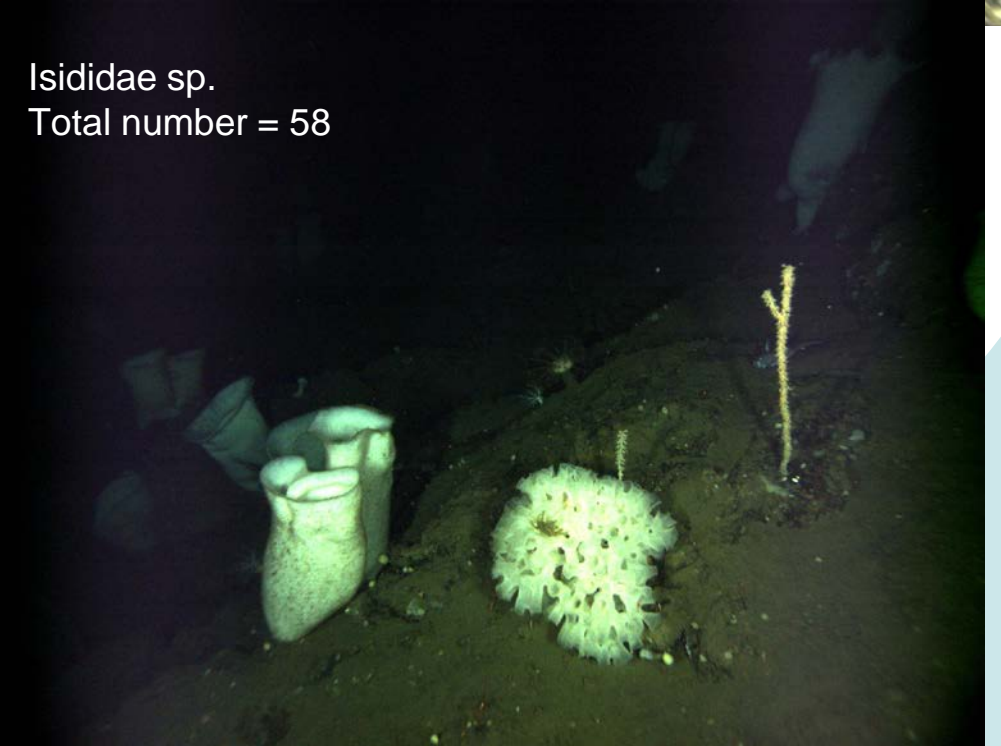
Primnoidae
Total number = 42



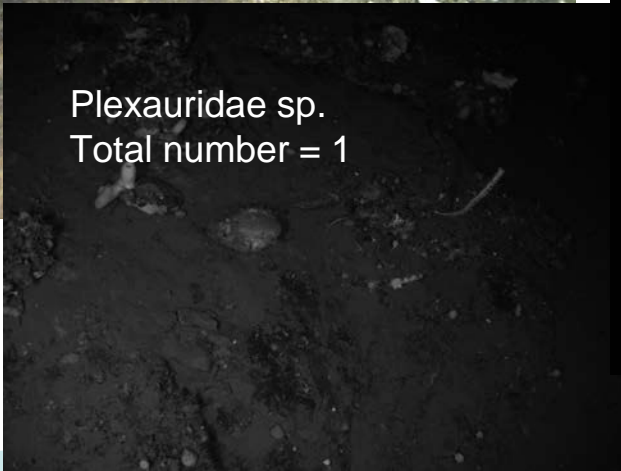
Plumarella sp.
Total number = 807



Isididae sp.
Total number = 58

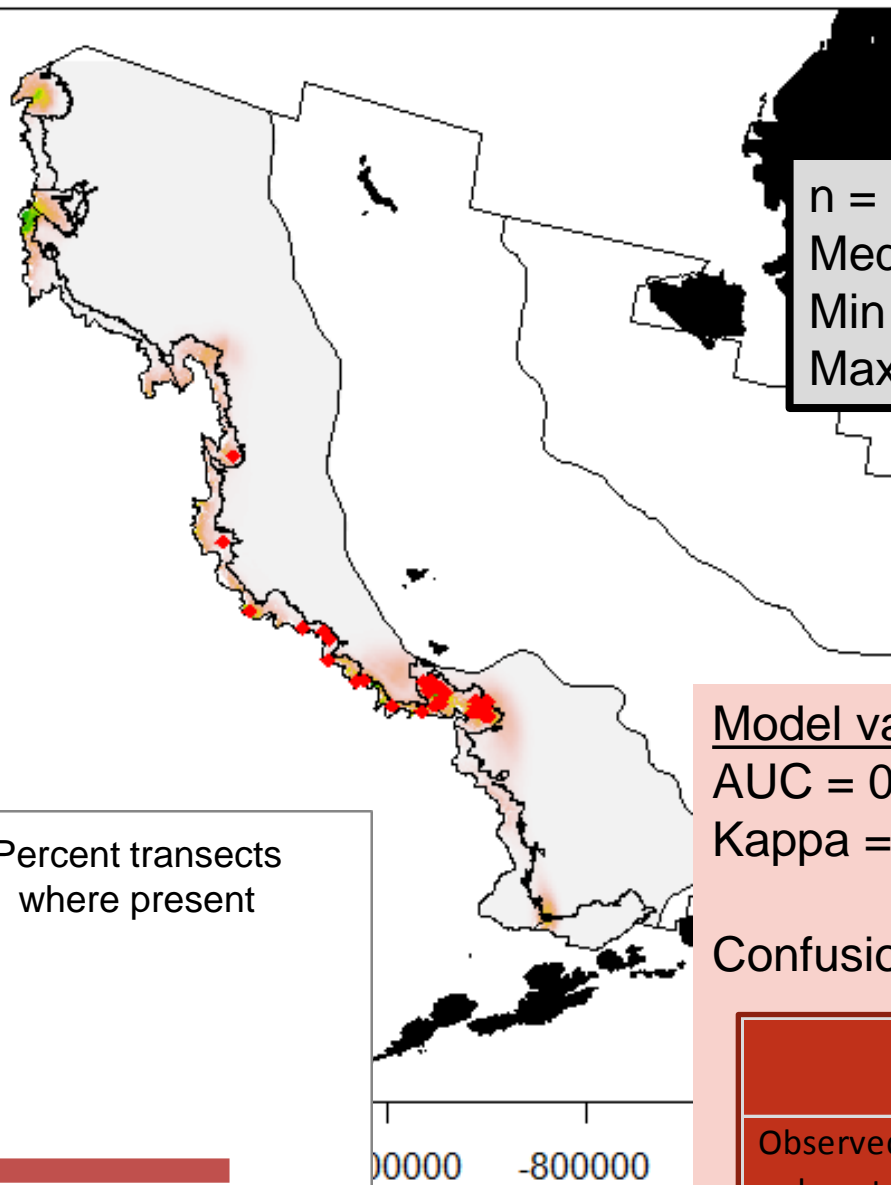


Plexauridae sp.
Total number = 1



Coral Results

1400
1200000
1000000
800000



n = 31 (12%)
Median depth = 446 m
Min = 201 m
Max = 763 m

0.6

0.4

Model validation

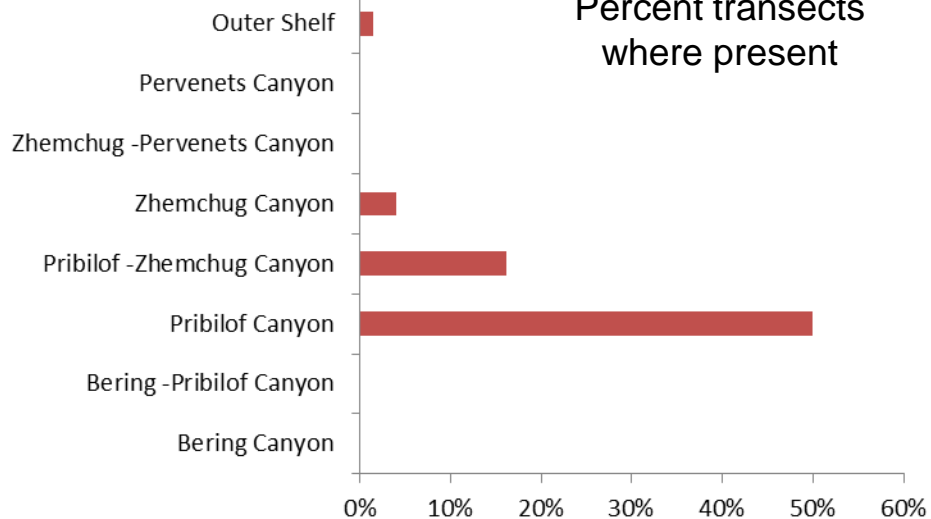
AUC = 0.73

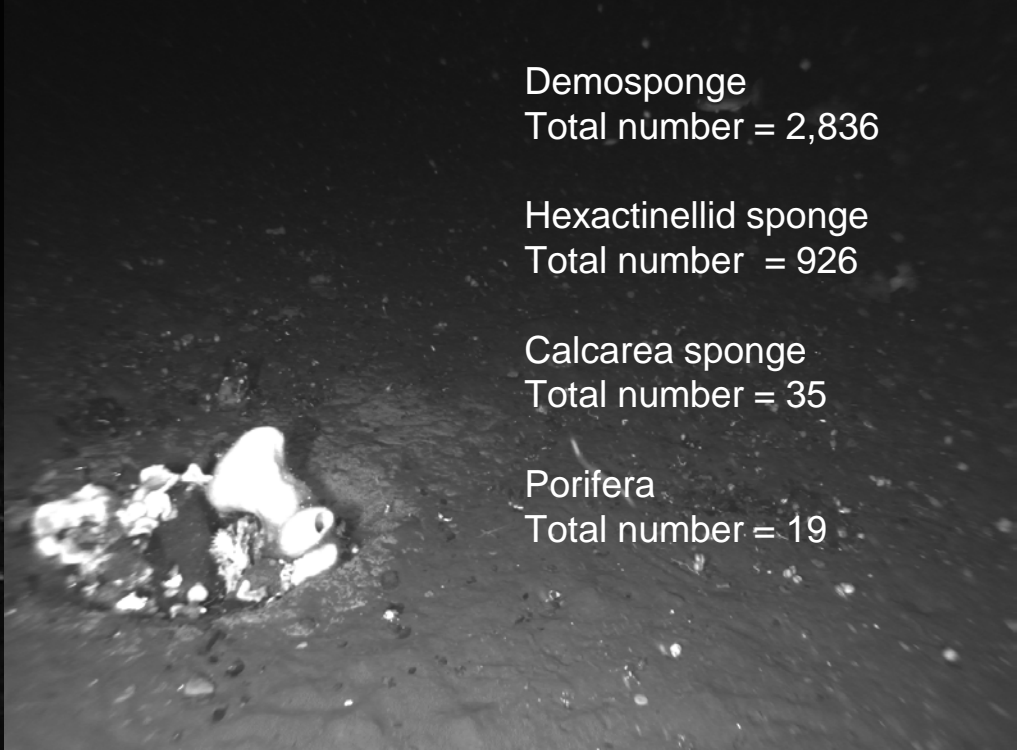
Kappa = 0.31

Confusion matrix ($t = 0.19$)

	Predicted absent	Predicted present
Observed absent	105	43
Observed present	8	23

Percent transects where present





Demosponge
Total number = 2,836

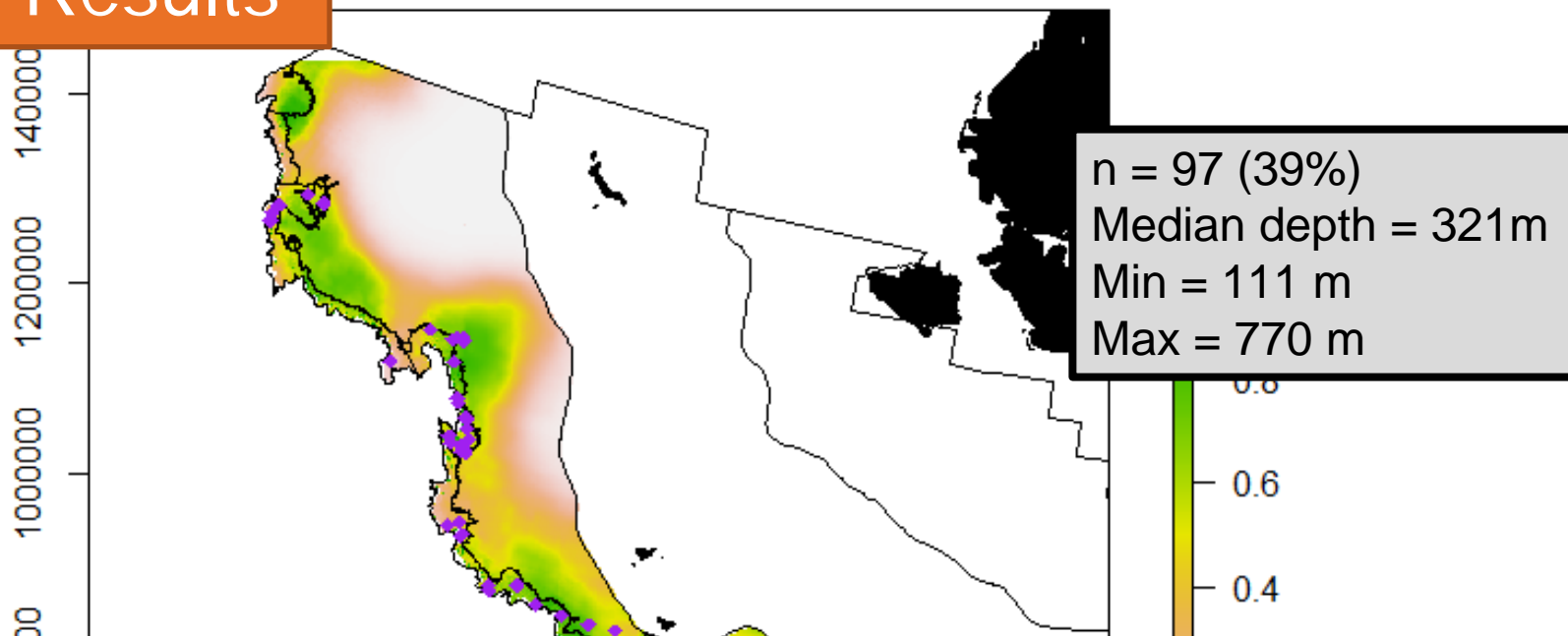
Hexactinellid sponge
Total number = 926

Calcarea sponge
Total number = 35

Porifera
Total number = 19



Sponge Results



Model validation

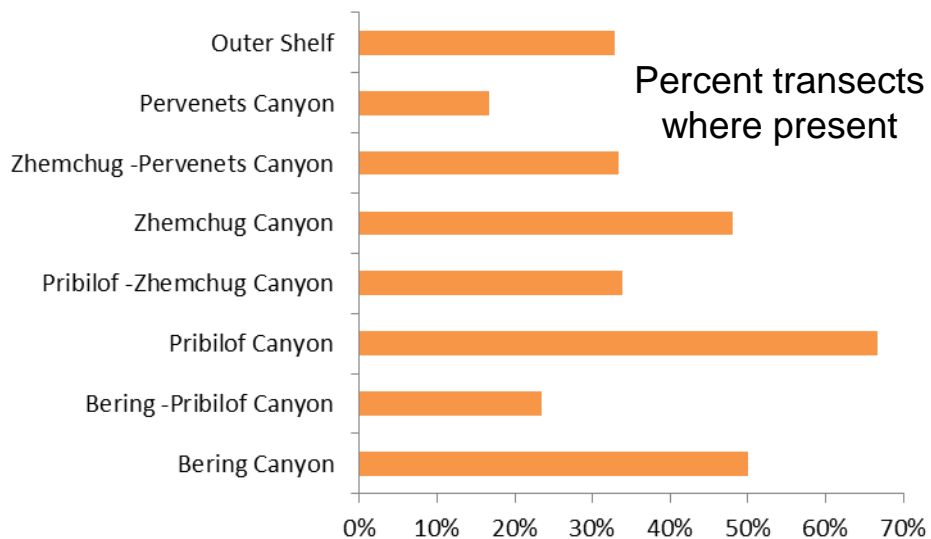
AUC = 0.61

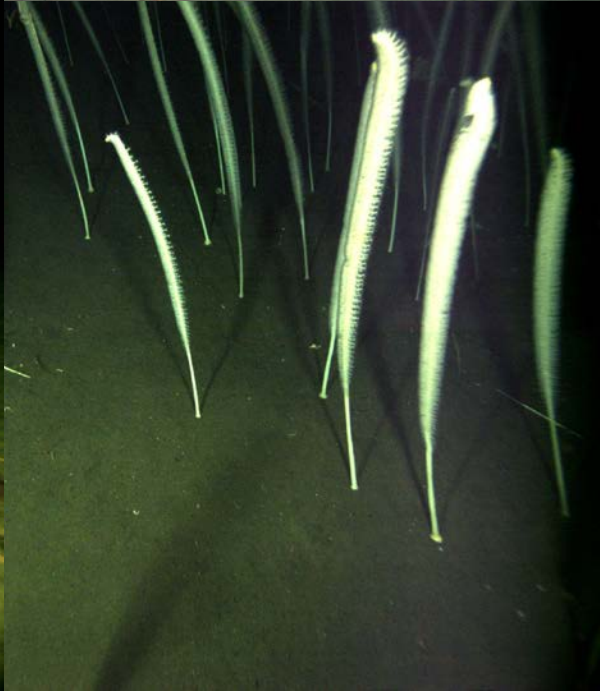
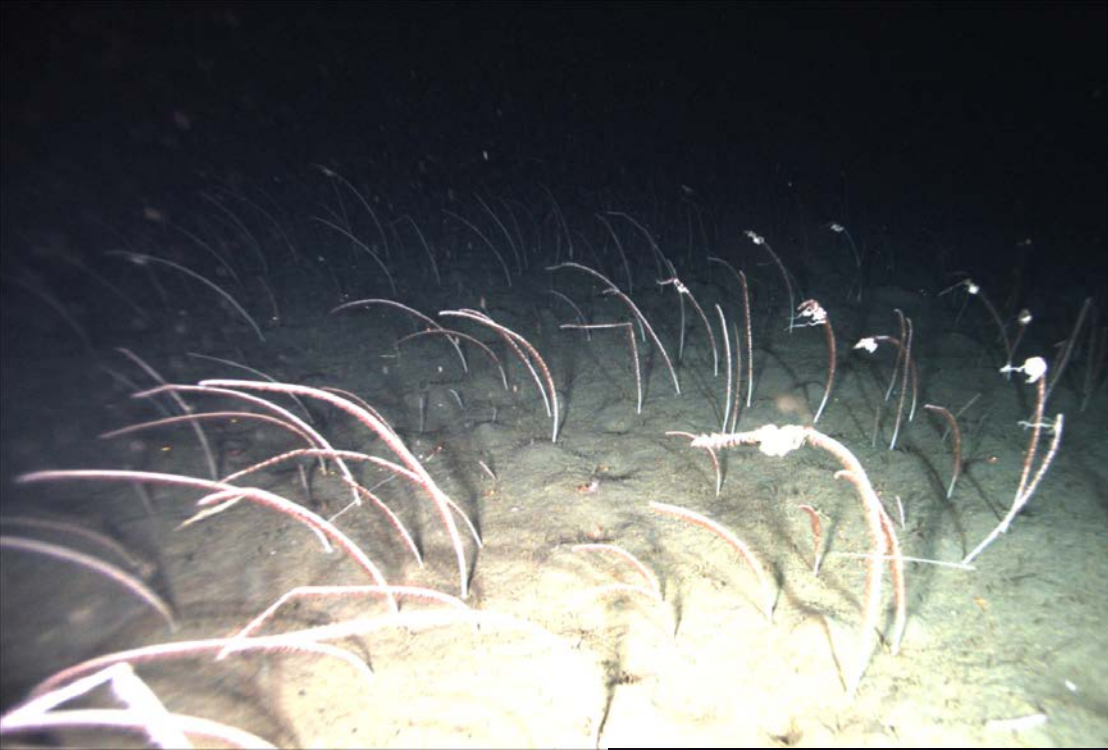
Kappa = 0.20

Confusion matrix ($t = 0.78$)

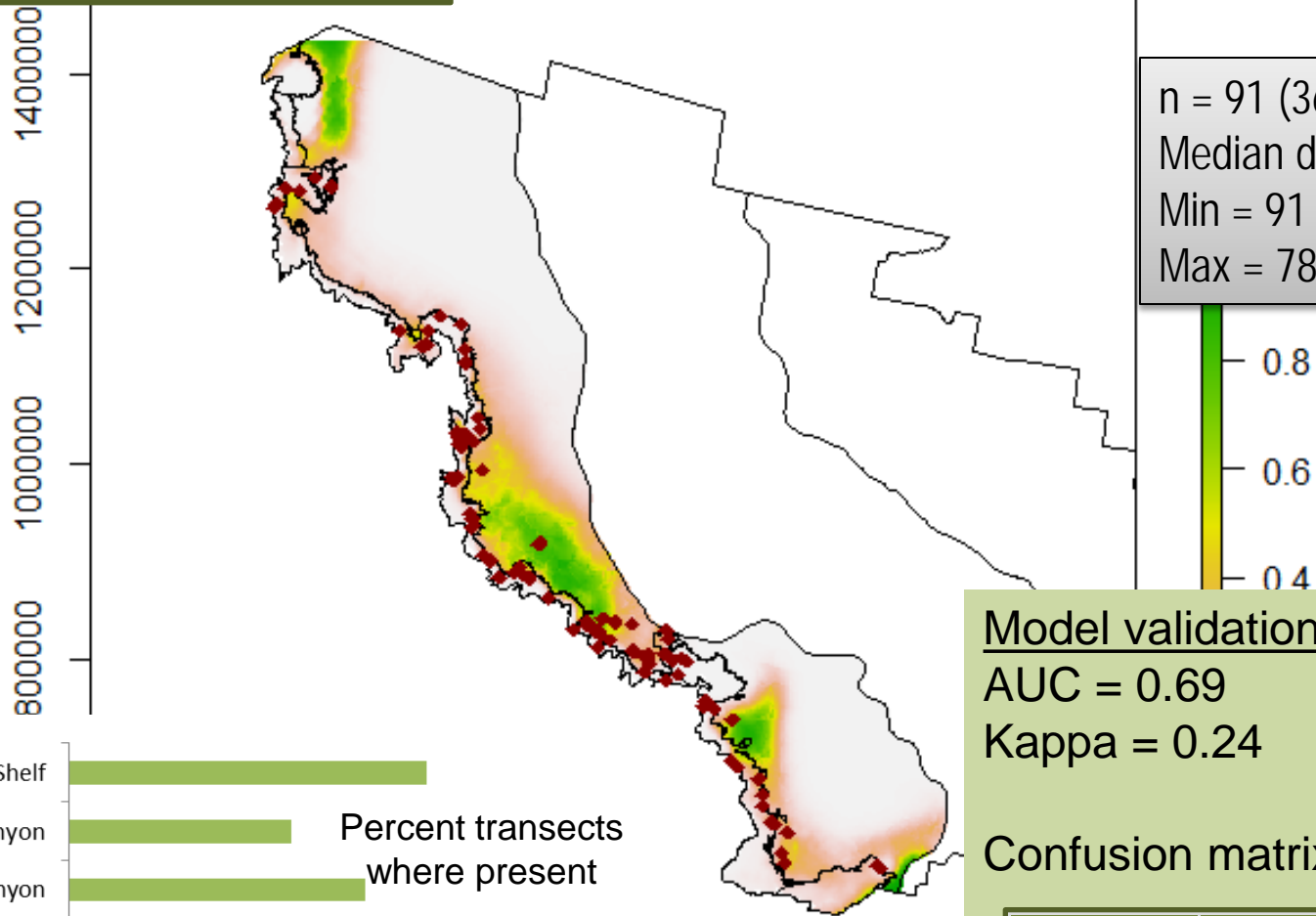
	Predicted absent	Predicted present
Observed absent	63	40
Observed present	31	45

Percent transects where present





Sea Whips Results



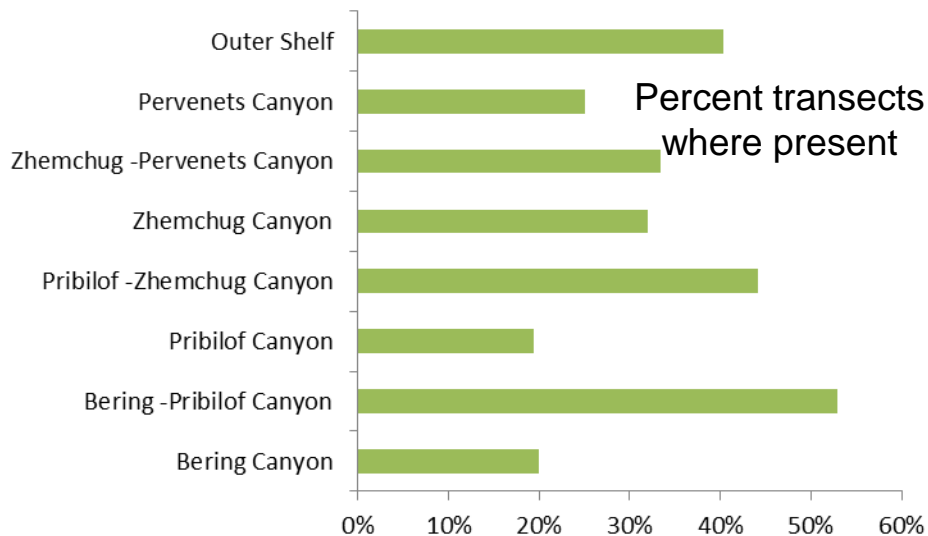
Model validation

AUC = 0.69

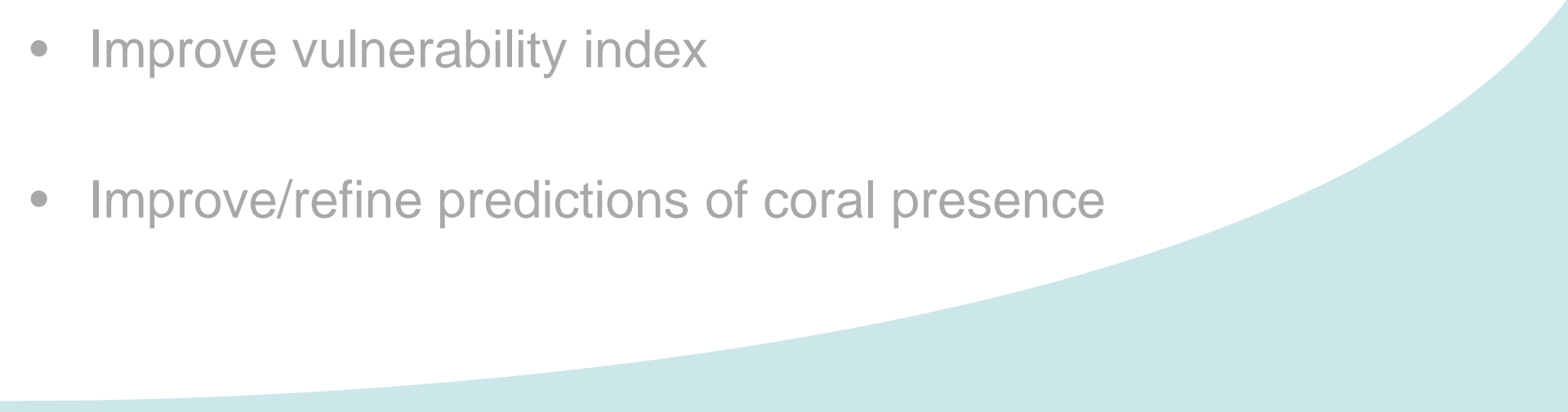
Kappa = 0.24

Confusion matrix ($t = 0.06$)

	Predicted absent	Predicted present
Observed absent	74	41
Observed present	25	39

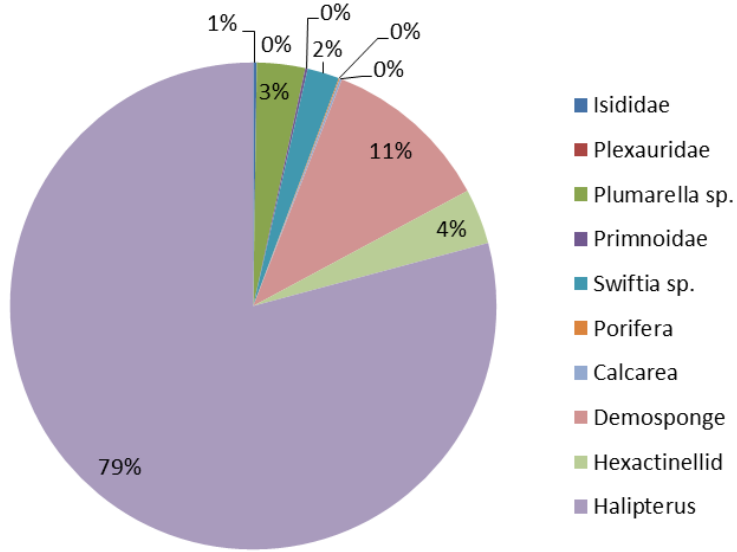


Fieldwork results

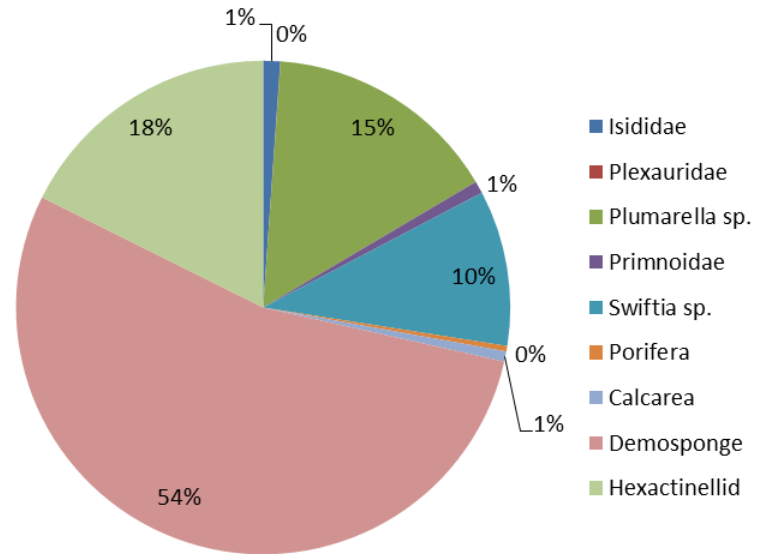
- Validate model predictions
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- 

Invertebrate data

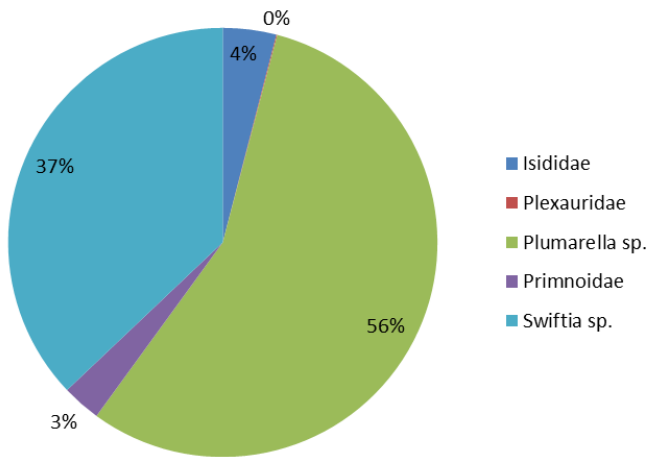
Invertebrates (n = 25,197)



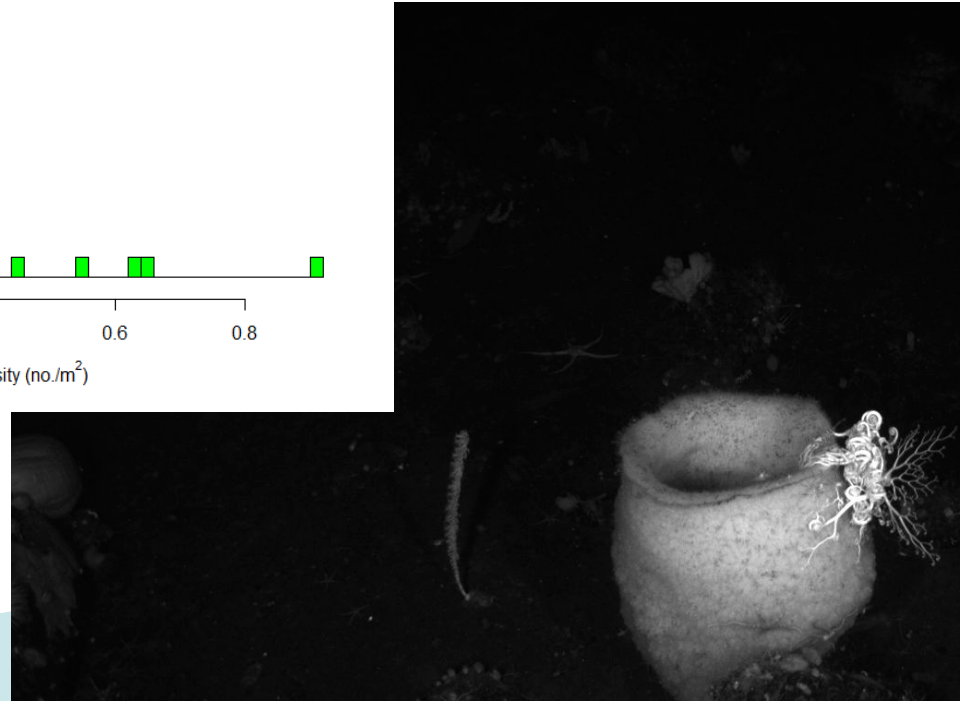
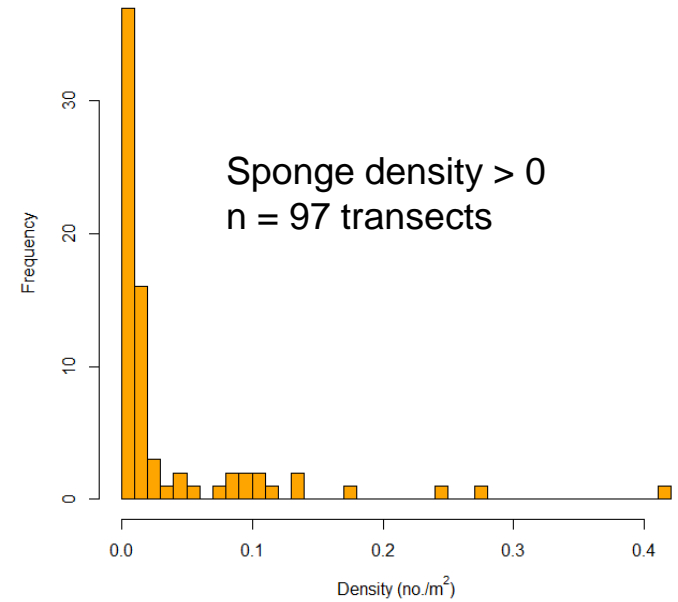
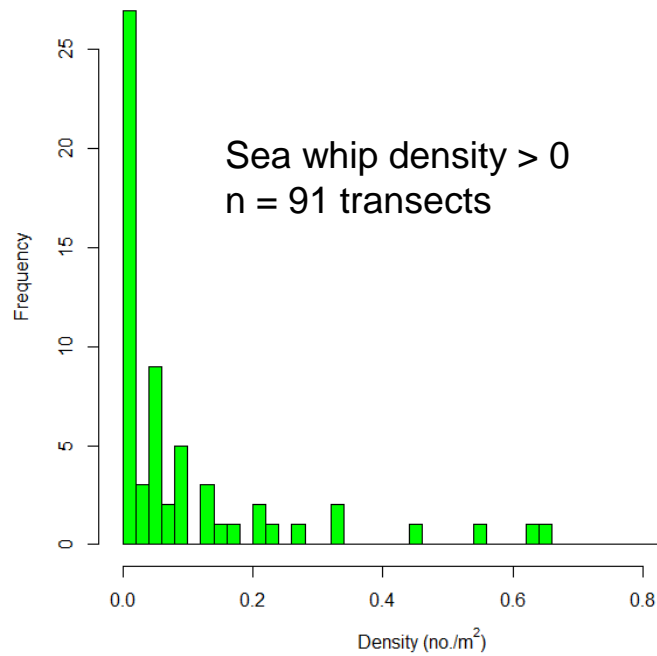
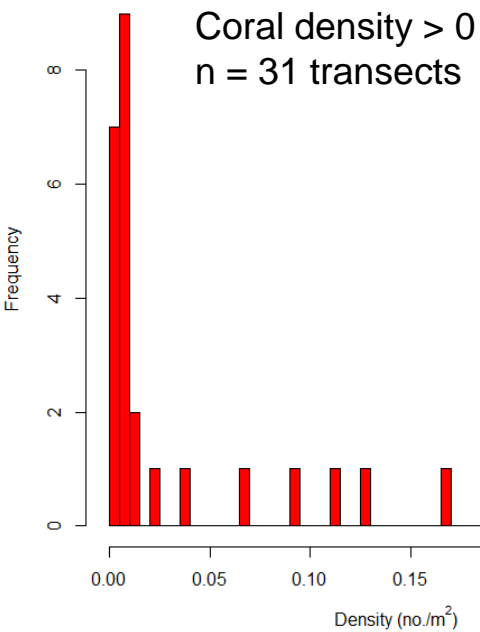
Invertebrates (no sea whips)



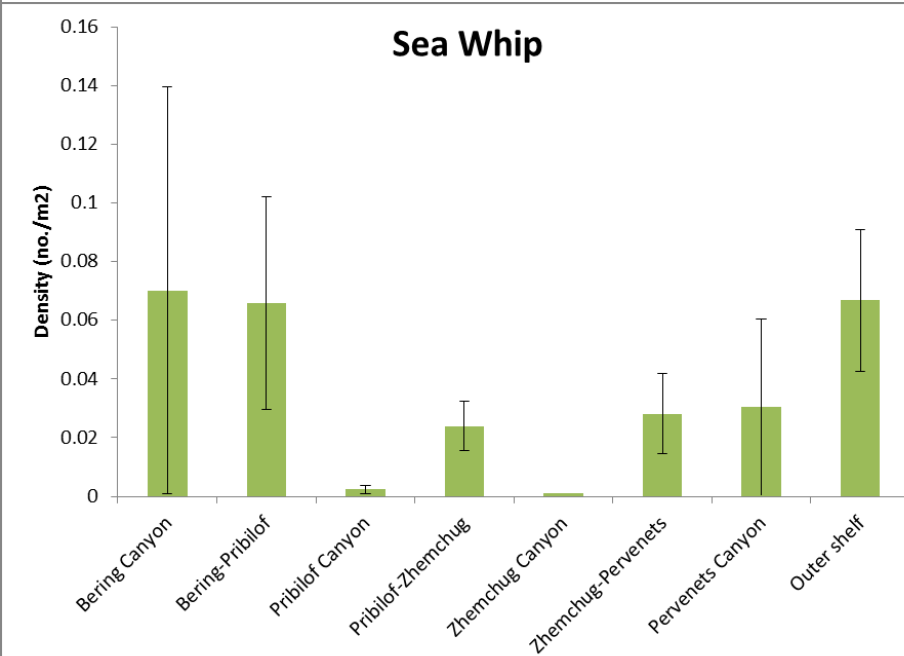
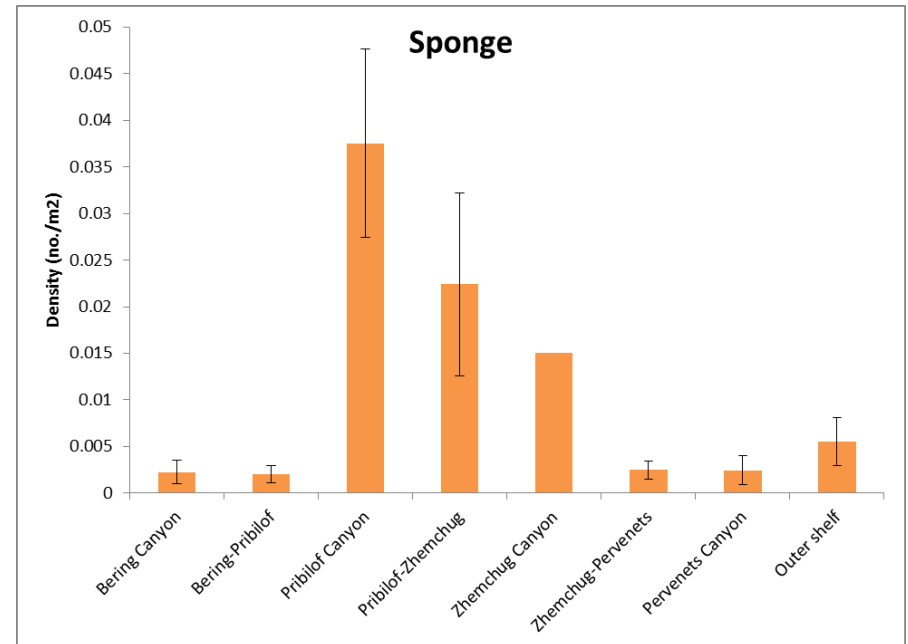
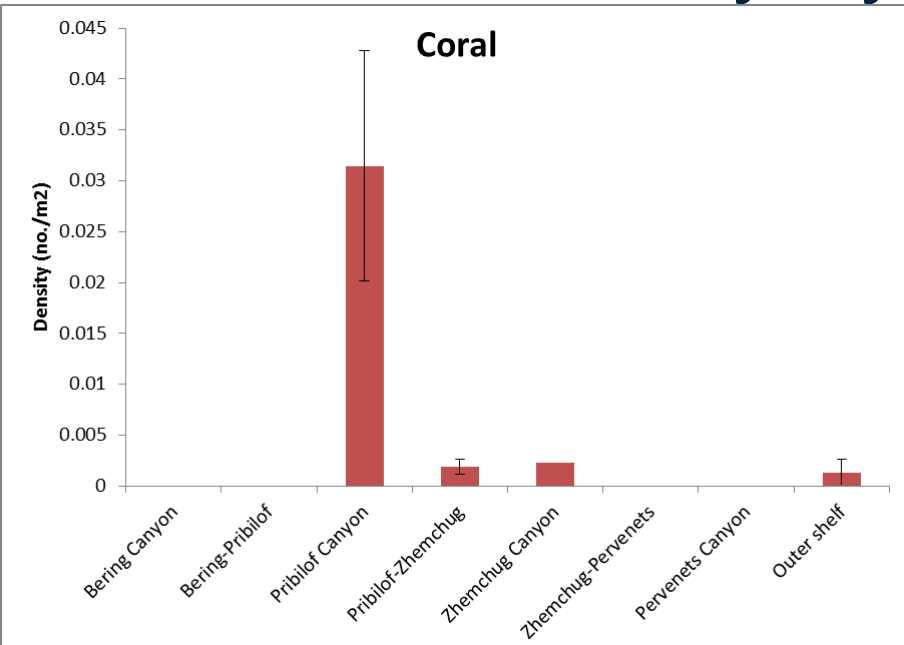
Coral only



Observed density Camera survey

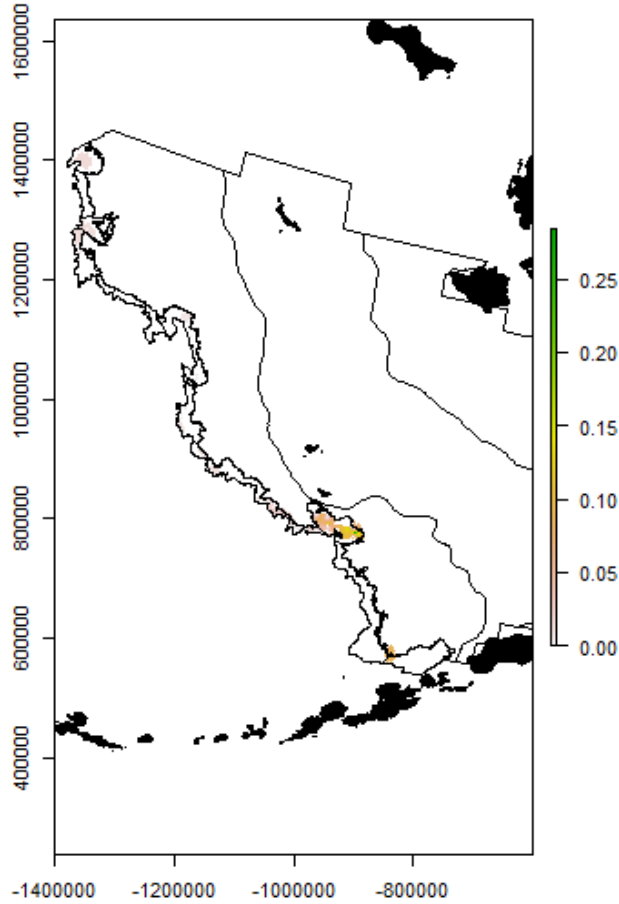


Observed density by area

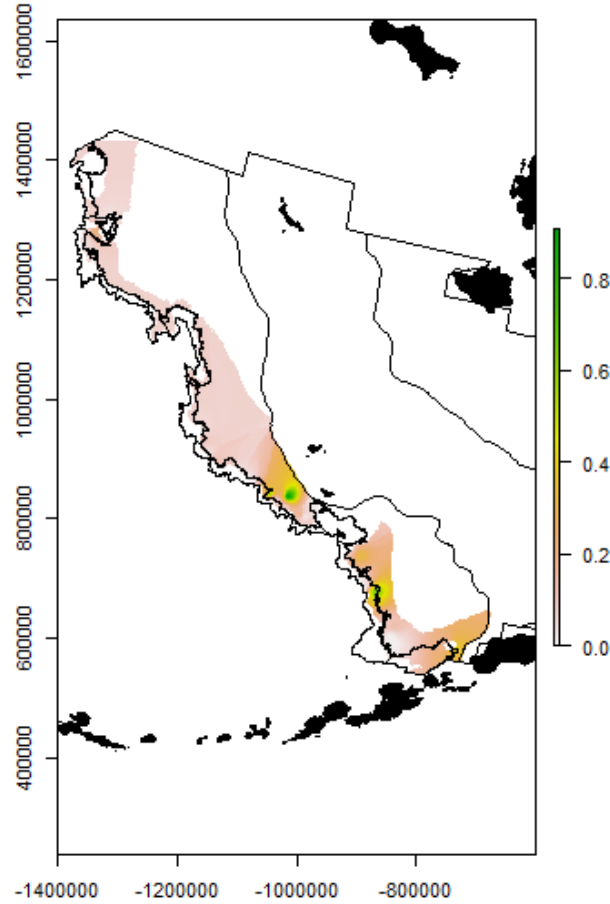


Maps of density (at predicted present)

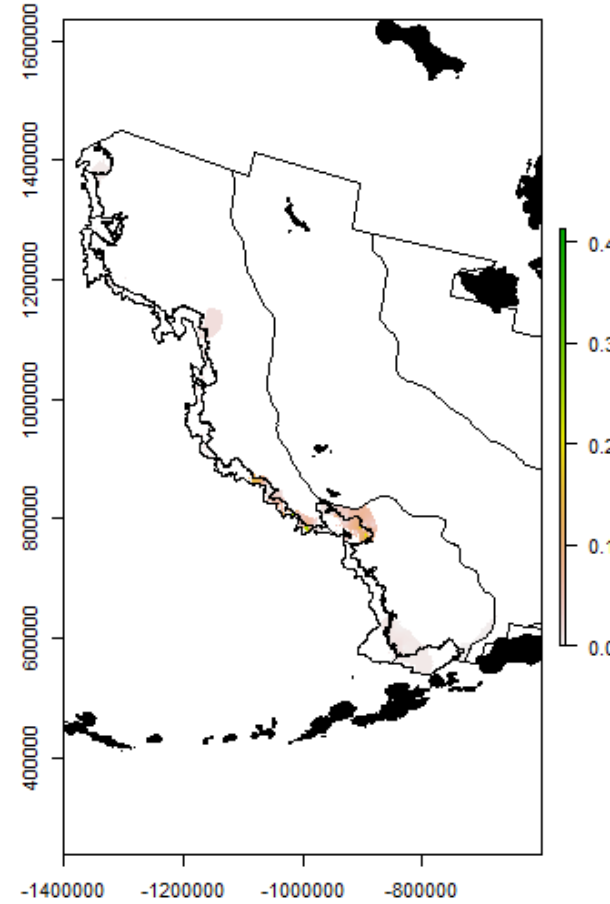
Coral Density



Sea Whip Density



Sponge Density

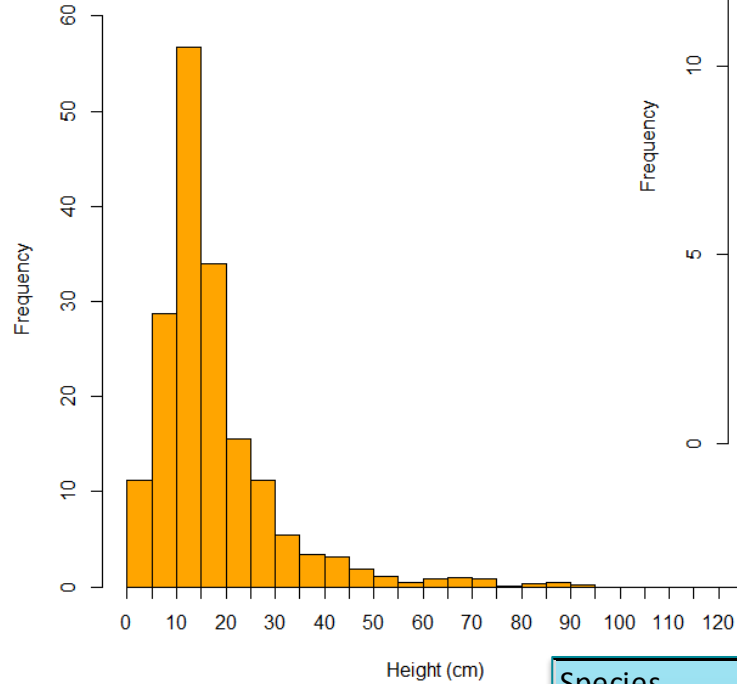


Height Frequency data

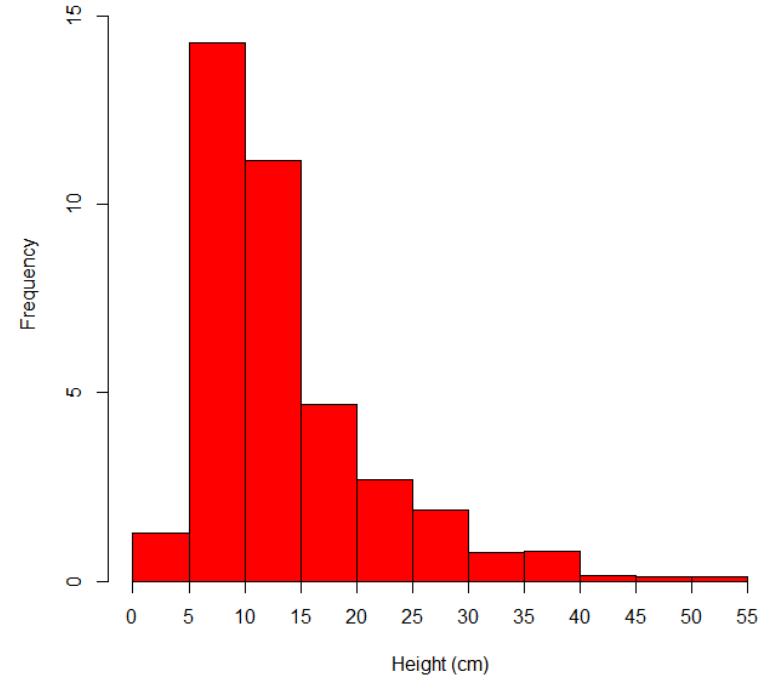


NOAA
FISHERIES

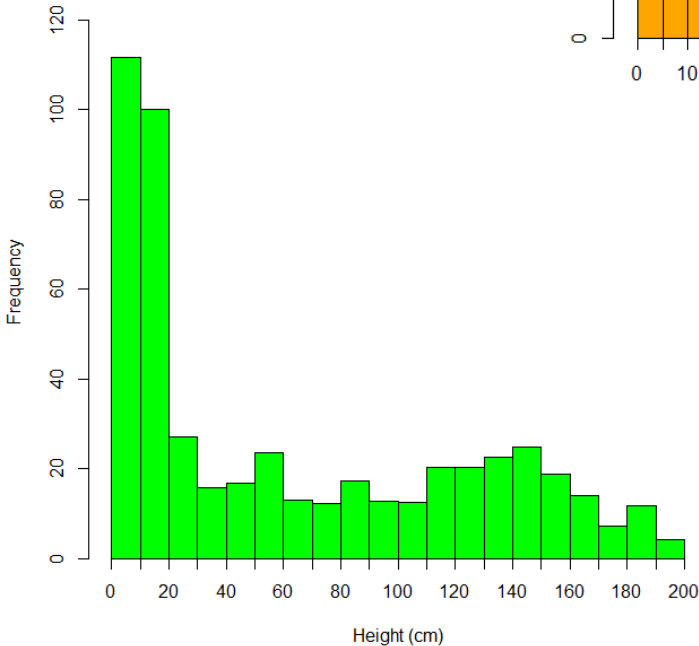
Sponge height



Coral height



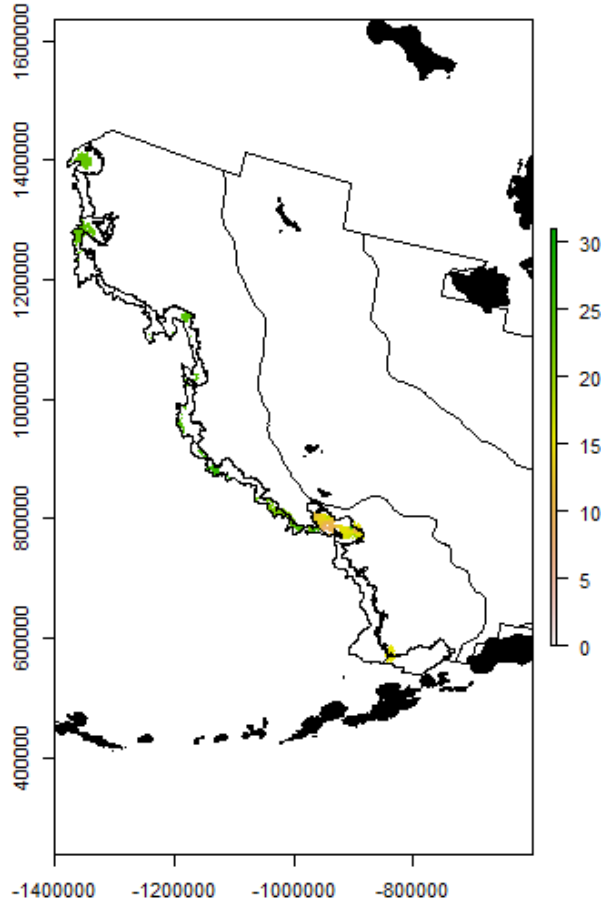
WhipsPens height



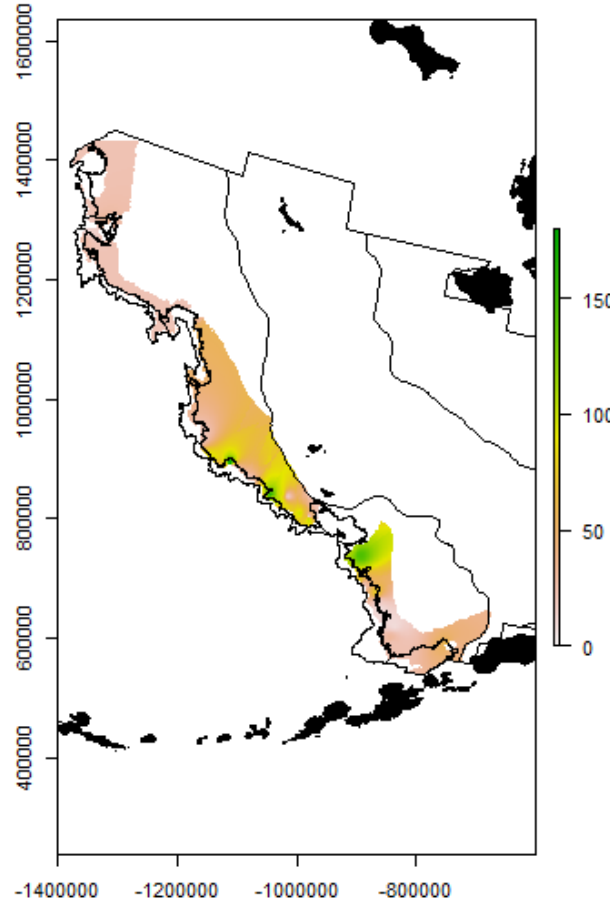
Species	Mean	SD	Min	Max
Plexauridae	16			
Plumarella aleutiana	12	7.2	6	22
Plumarella sp.	16	9.3	4	53
Primnoidae	13	11.5	4	47
Swiftia sp.	10	4.7	2	24
Porifera	14	1.4	13	15
Upright calcarea	12	2.5	9	18
Upright demosponge	13	8.4	1	85
Upright hexactinellid	25	18.5	2	119
Halipterus sp.	63	59.4	2	266

Maps of Height (at predicted present)

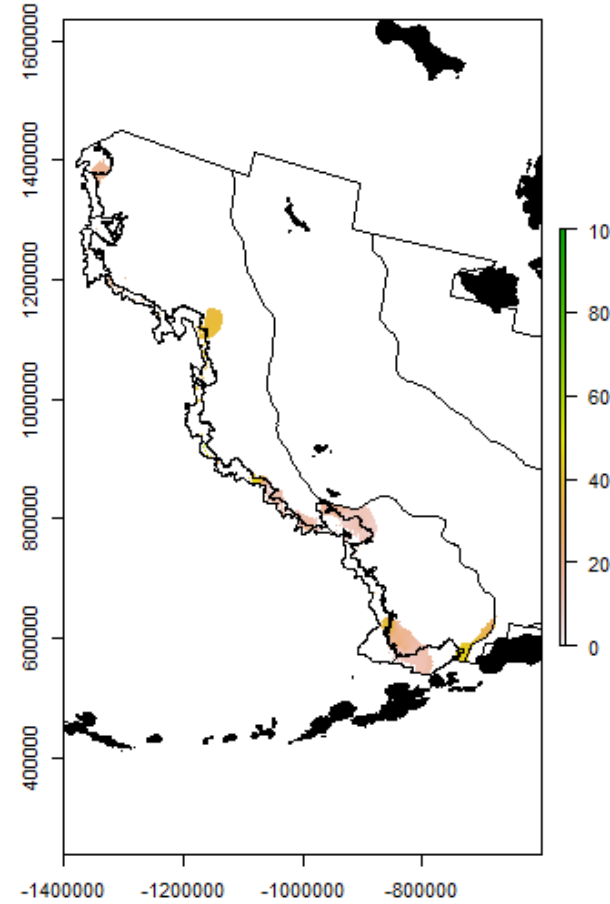
Coral Height



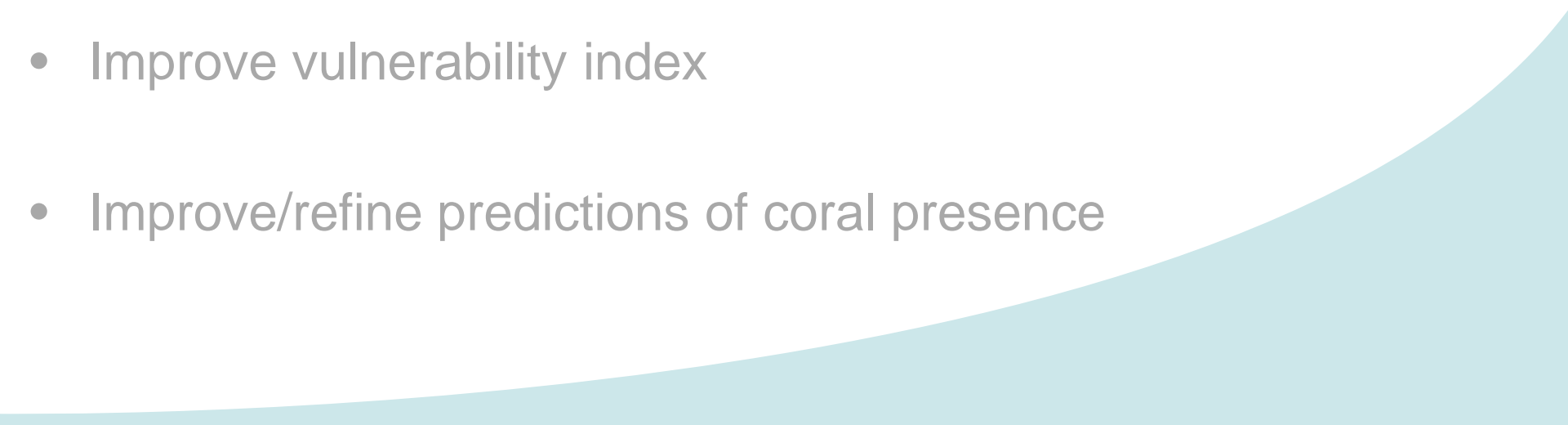
Sea Whip Height

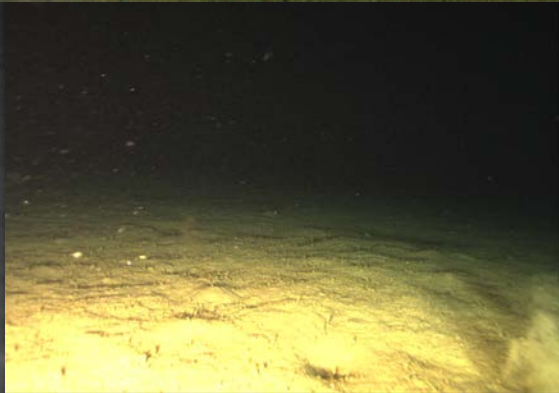


Sponge Height



Fieldwork results

- Validate model predictions
 - Acquire height and density data for coral
 - **Identify the role of these coral as fish habitat**
 - Document presence and degree of fishing gear effects
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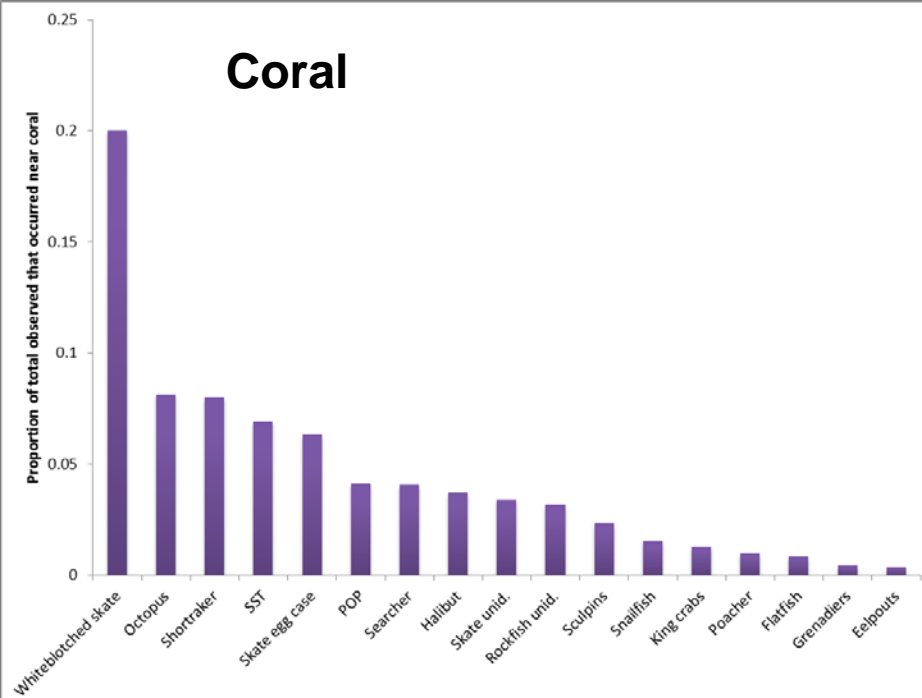
- Observed fishes and crabs = 7,362

- Dominated by

- Crabs
- Eelpouts
- Sculpins
- Poachers
- Snailfish
- Flatfish
- Grenadiers
- Skates
- SST
- Pacific ocean perch

Species or group	Number observed
Chionocetes	1545
Eelpout (Bothracara, Lycodes, unid.)	1433
Golden king crab	674
Snailfish unid.	398
Sculpin	387
Flatfish unid.	349
Poacher	302
Roundfish unid.	275
Giant grenadier	229
SST	217
Popeye grenadier	205
Rockfish unid.	190
POP	171
Skate egg case	142
Other decapod (Hyas, Oregonia, Pagurid, etc.)	136
Skate unid.	118
Atheresthes sp.	96
Grenadier unid.	90
Rex sole	53
Searcher	49
Pollock	45
Flathead sole	38
Octopus	37
Halibut	27
King crab unid.	26
Shortraker rockfish	25
Cod	19
Basket star	17
Sablefish	8
Bigmouth sculpin	7
Greenland turbot	7
Harlequin rockfish	7
Whiteblotched skate	5
Whitebrow skate	5
Alaska skate	4
Aleutian skate	4
Rougheye rockfish	4
Scarlet king crab	4
Deep sea sole	4
Blackspotted rockfish	3
Gadid unid.	3
ATF	1
Atka mackerel	1
Commander skate	1
Dover sole	

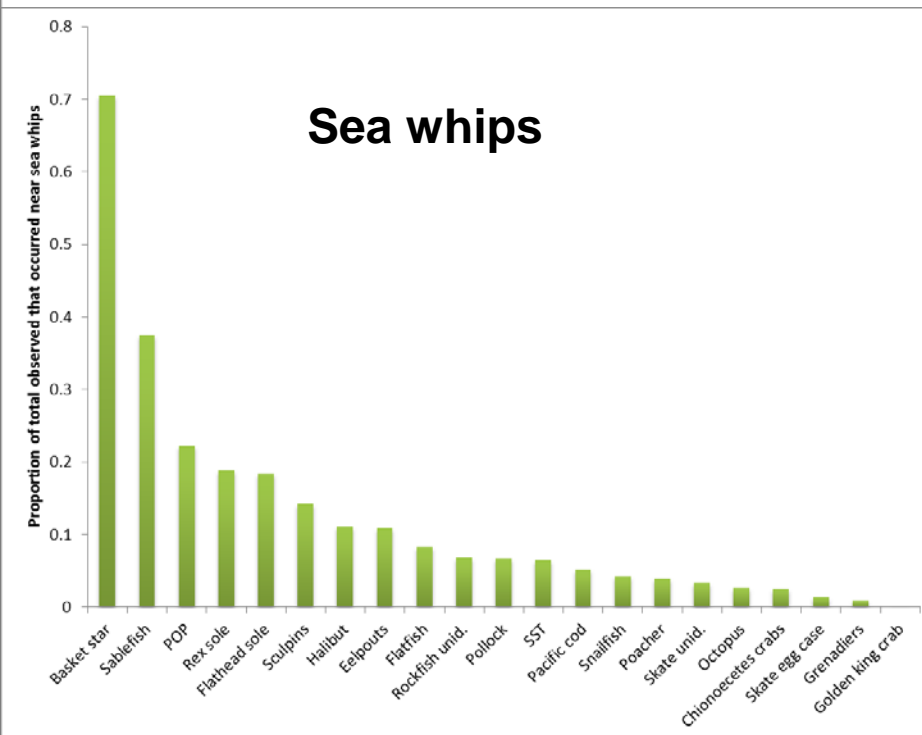
Coral



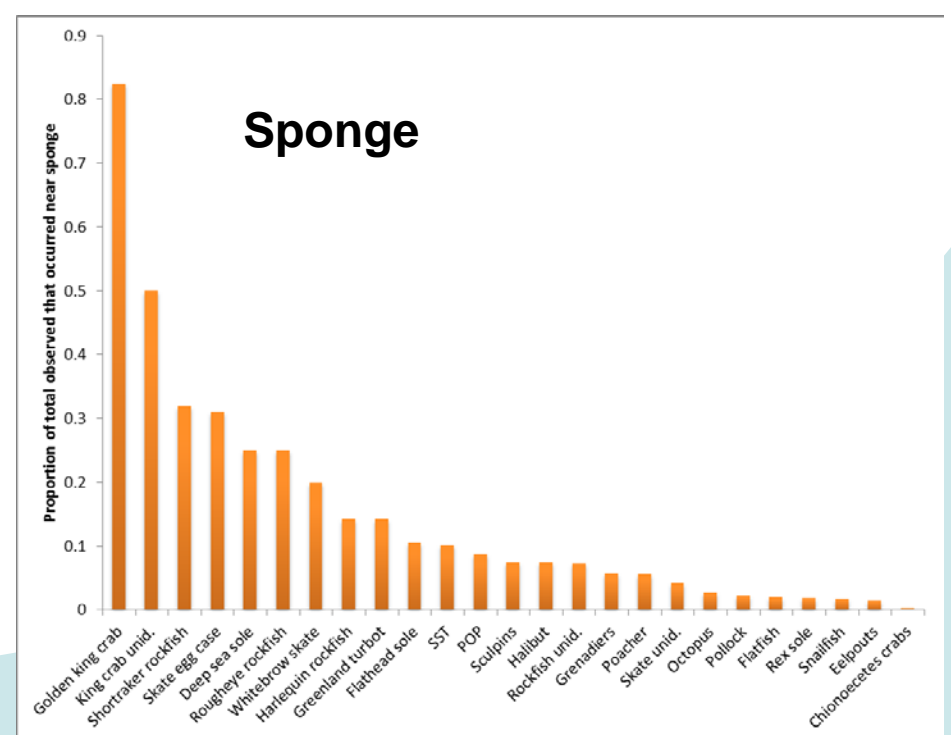
Fish occurring near invertebrates



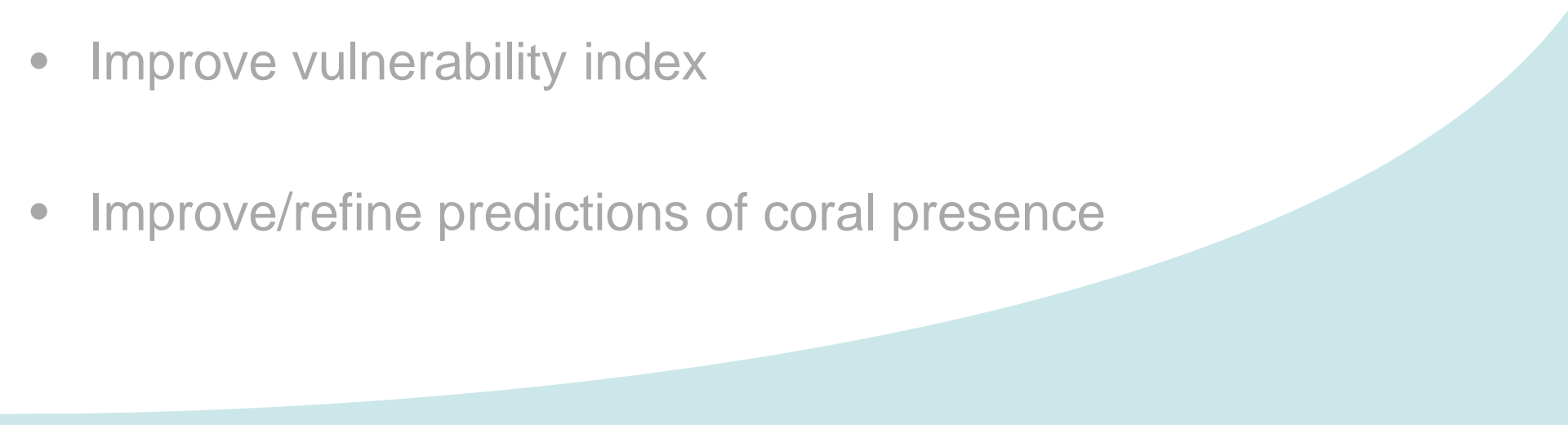
Sea whips

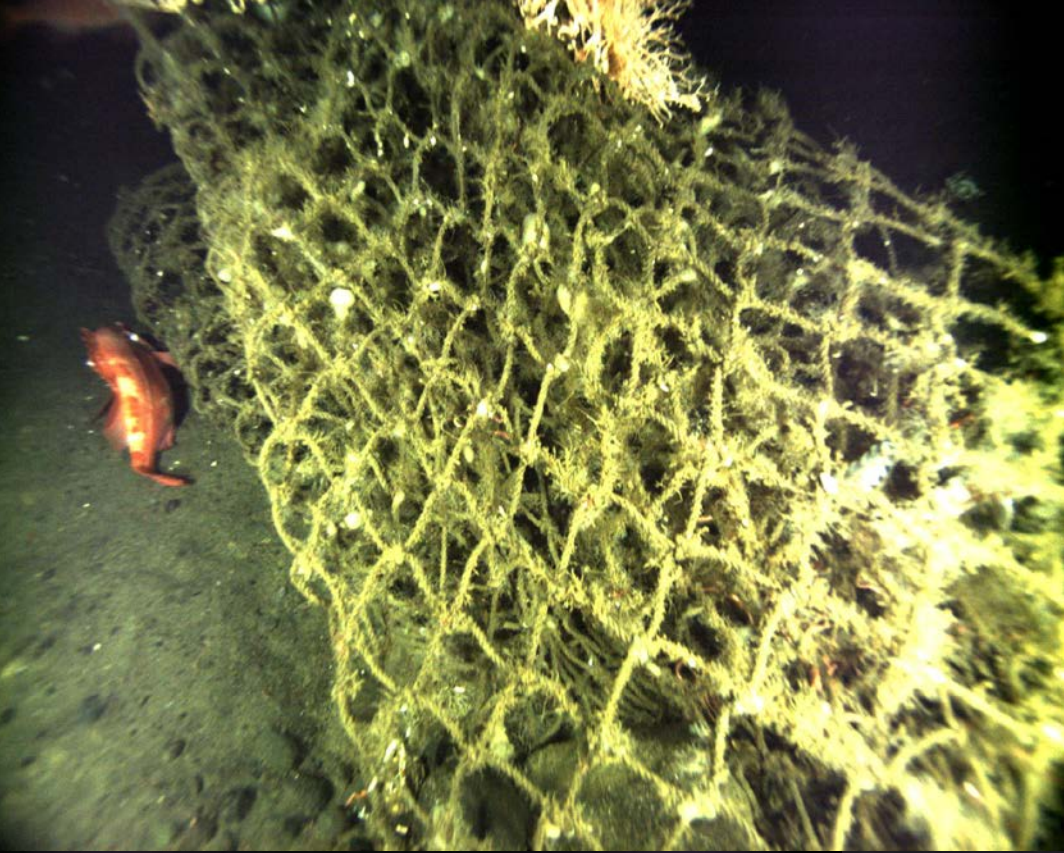


Sponge



Fieldwork results

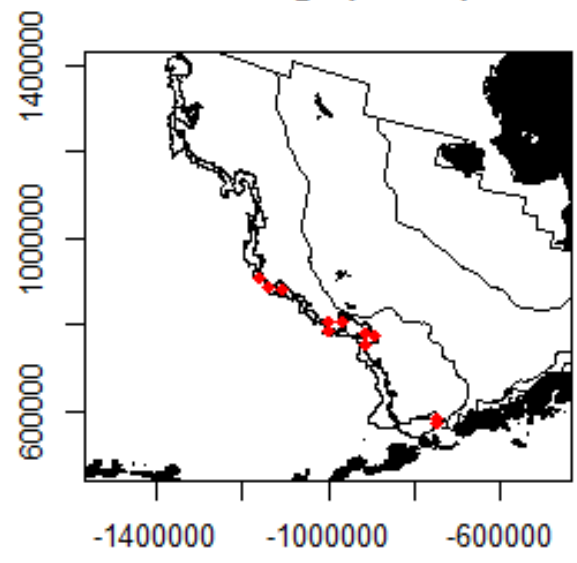
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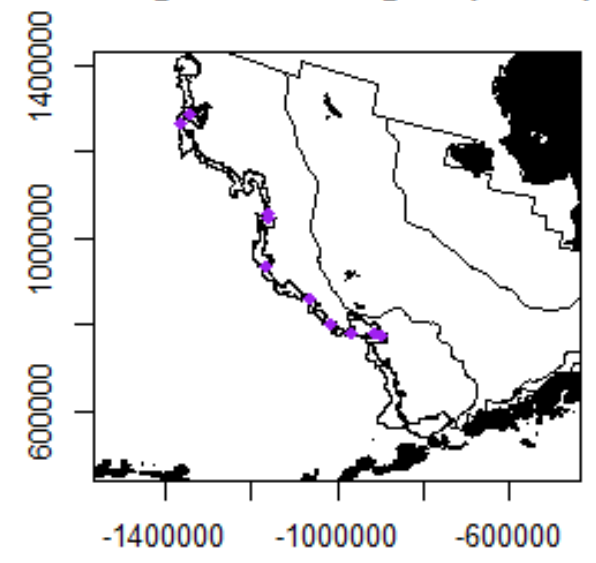
Evidence of humans



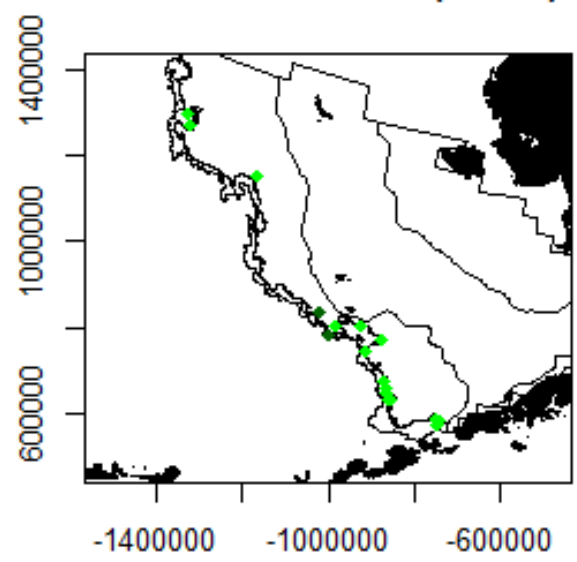
Garbage (n = 11)



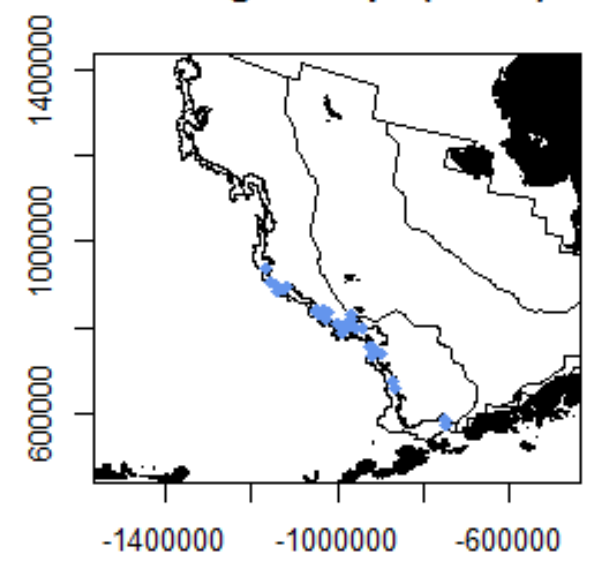
Longline or crab gear (n = 10)



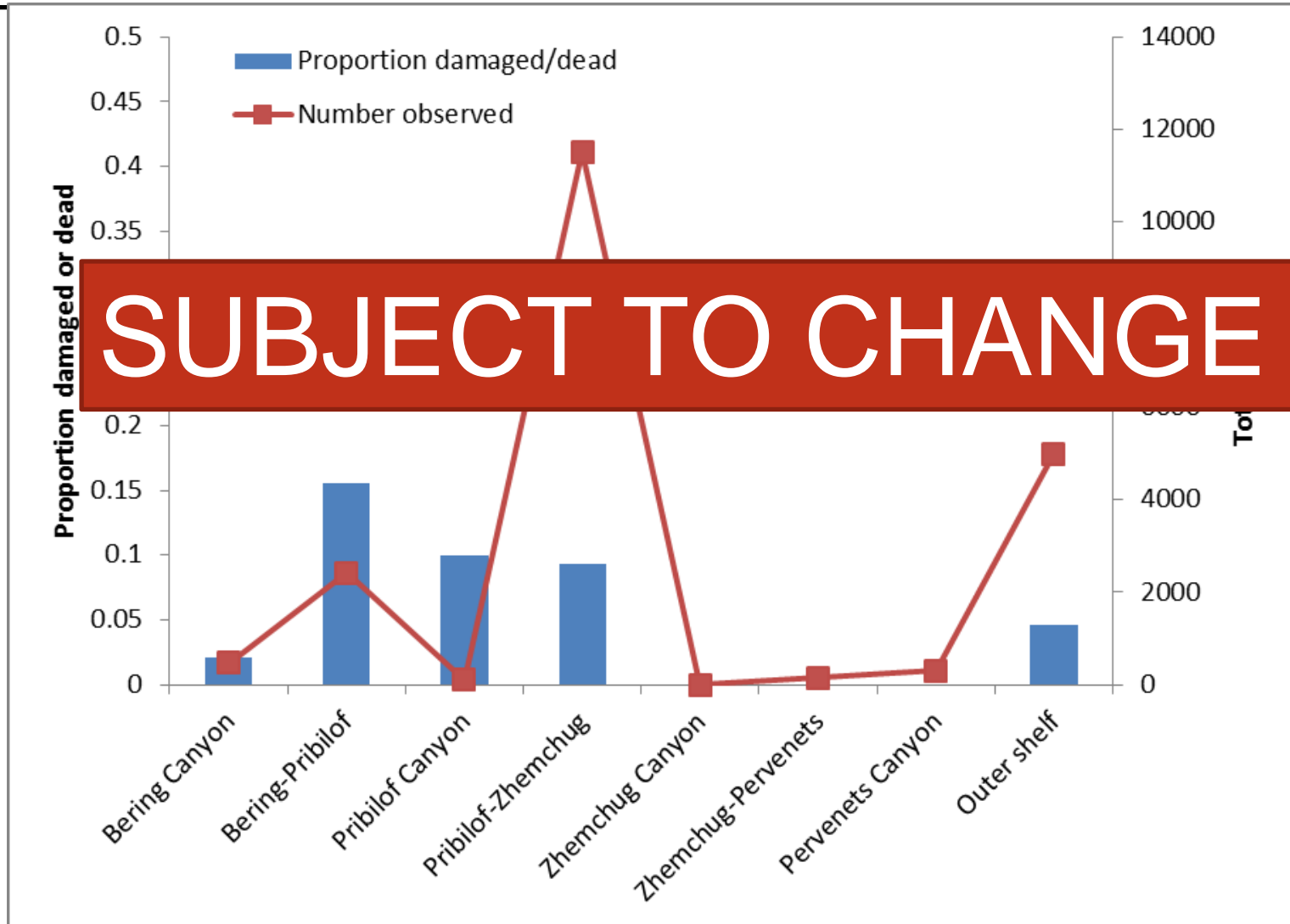
Trawl net or tracks (n = 20)



Damaged whips (n = 37)



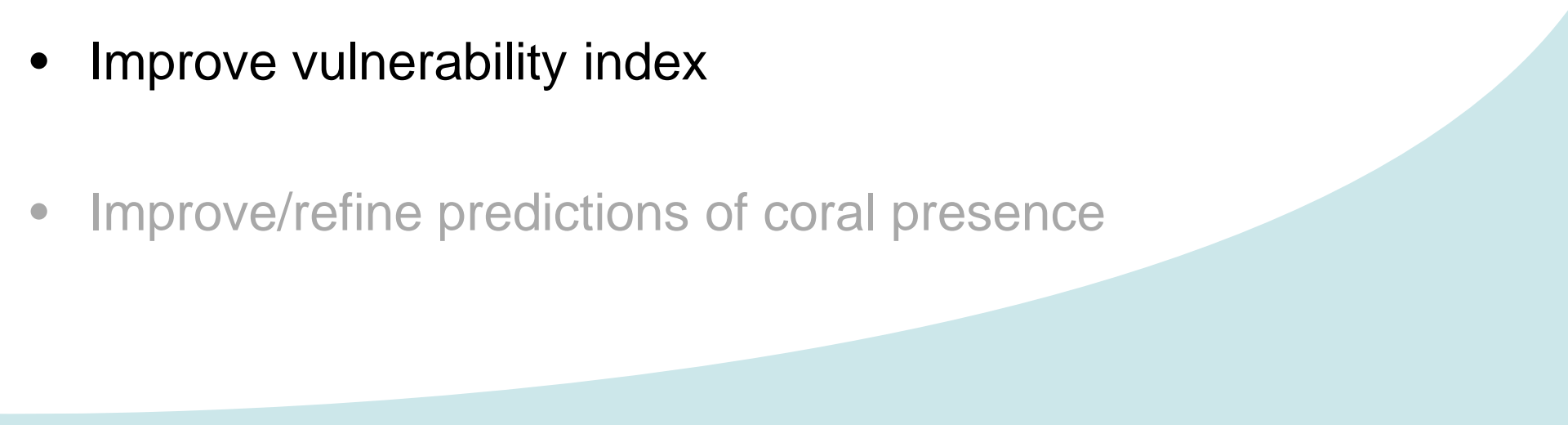
Observed damaged or dead sea whips



n = 19,948 sea whips

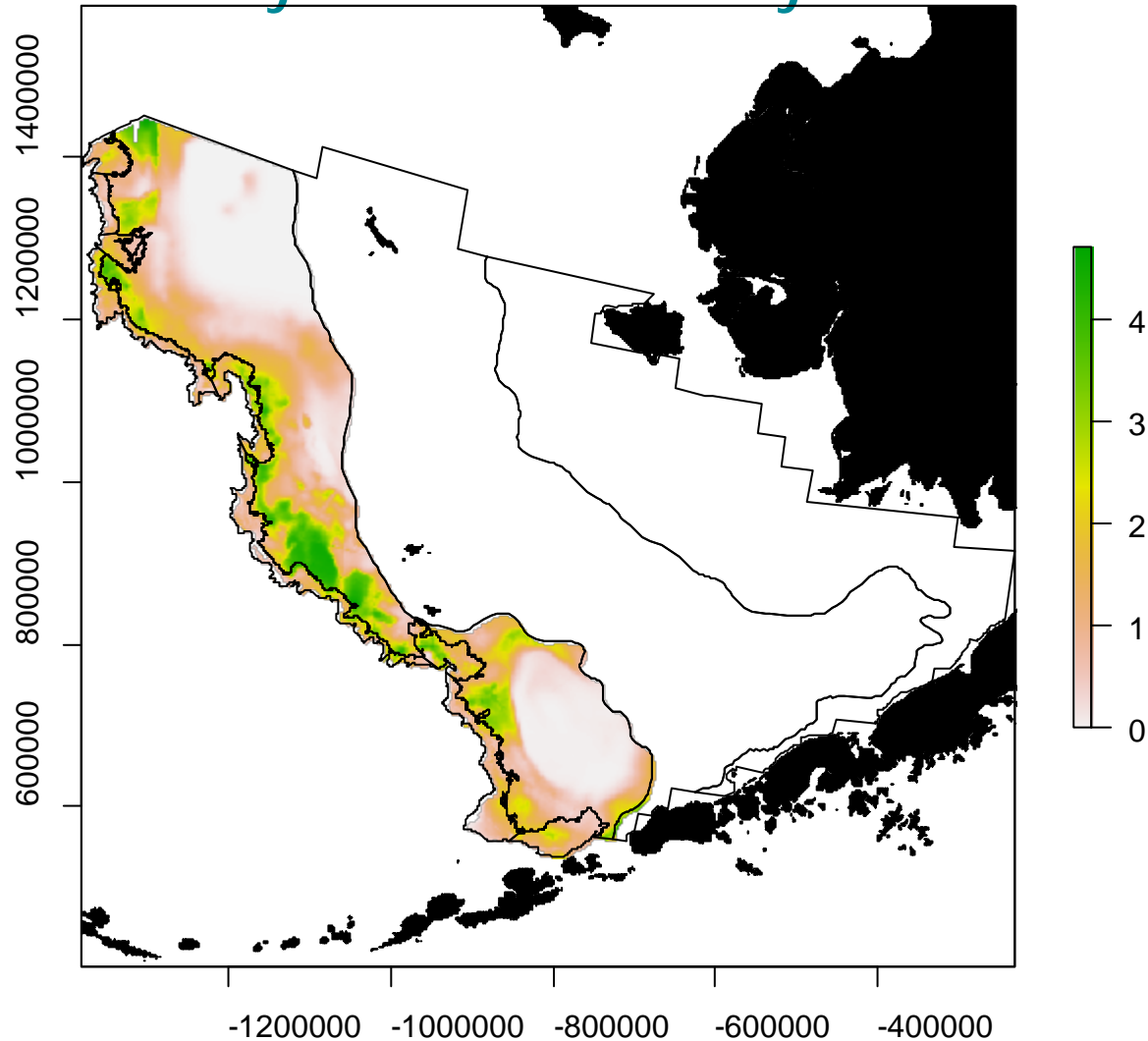
Overall: 8.5% were horizontal, damaged, or dead

Fieldwork results

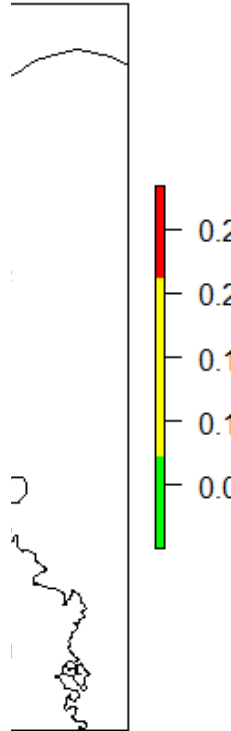
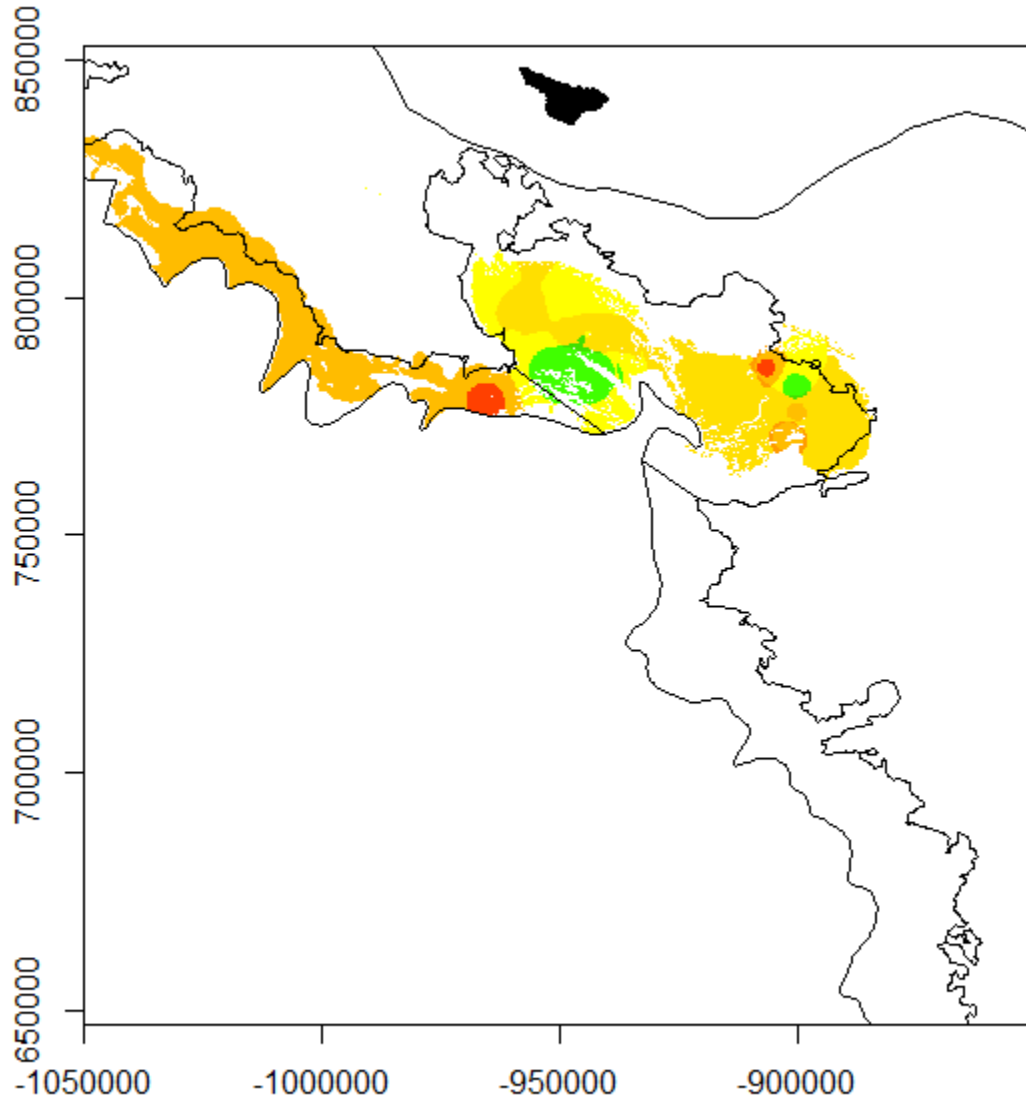
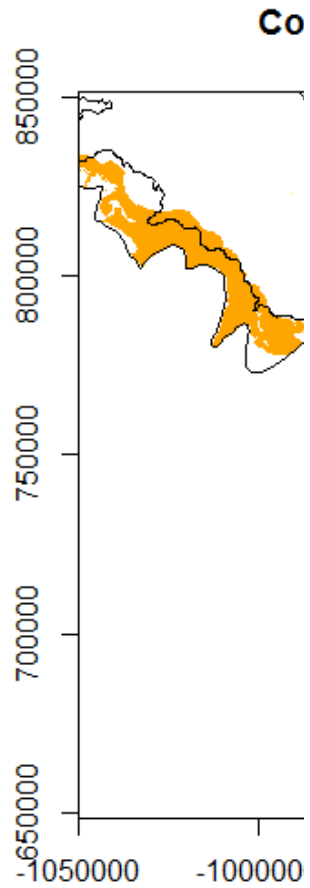
- Validate model predictions
 - Acquire height and density data for coral
 - Identify the role of these coral as fish habitat
 - Document presence and degree of fishing gear effects
 - **Improve vulnerability index**
 - Improve/refine predictions of coral presence
- 

Original vulnerability


$$V = \sum (\text{Vulnerability score} * \text{Probability of occurrence})$$



New vul

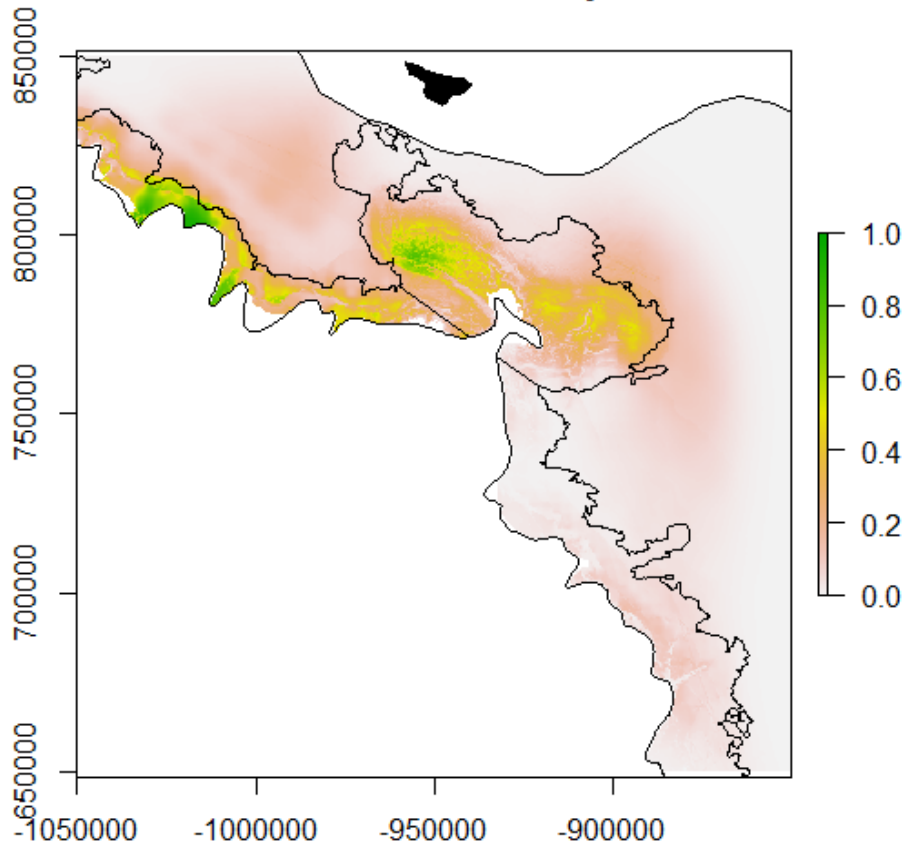


Fieldwork results

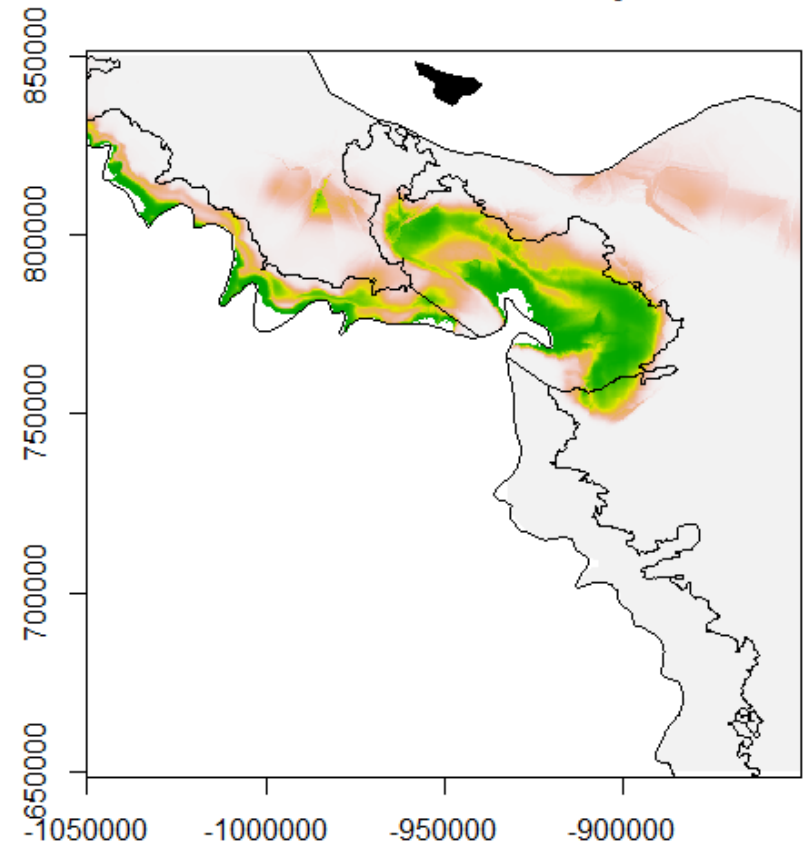
- Validate model predictions
 - Acquire height and density data for coral
 - Identify the role of these coral as fish habitat
 - Document presence and degree of fishing gear effects
 - Improve vulnerability index
 - **Improve/refine predictions of coral presence**
- 

Model Averaging

Coral - Trawl Survey

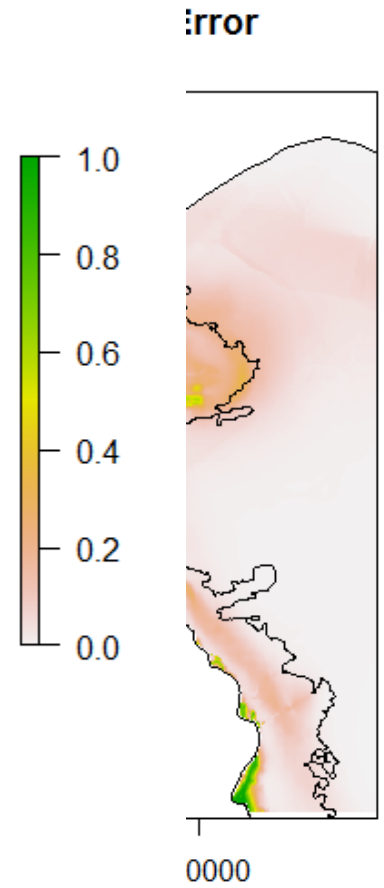
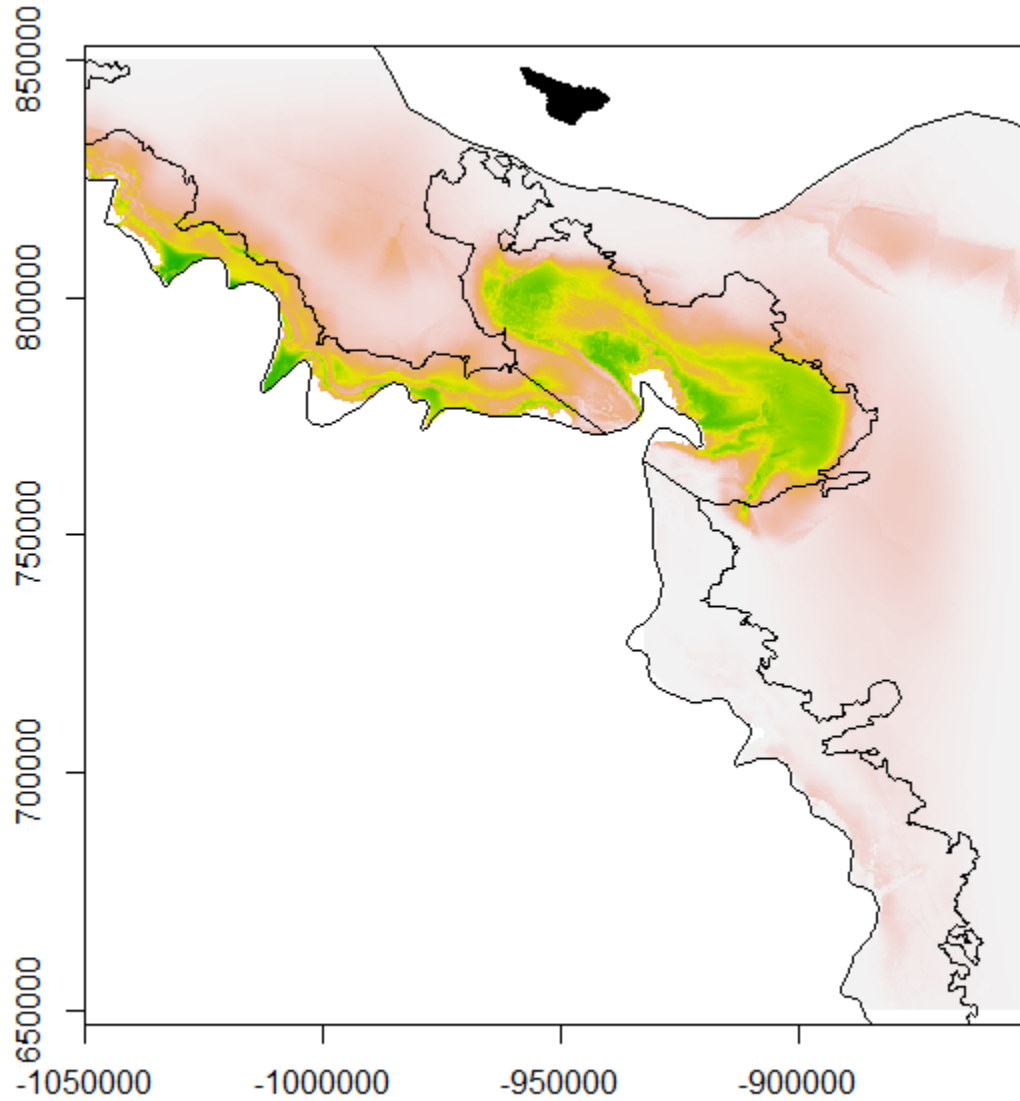
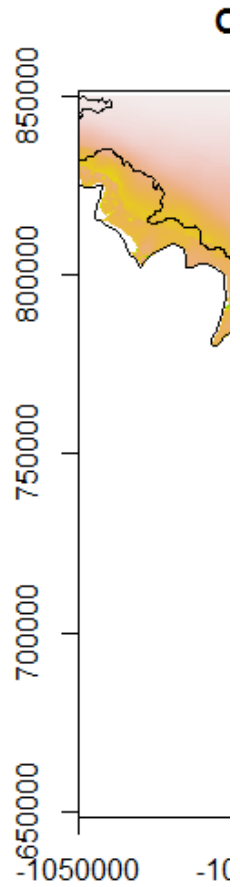


Coral - Camera Survey

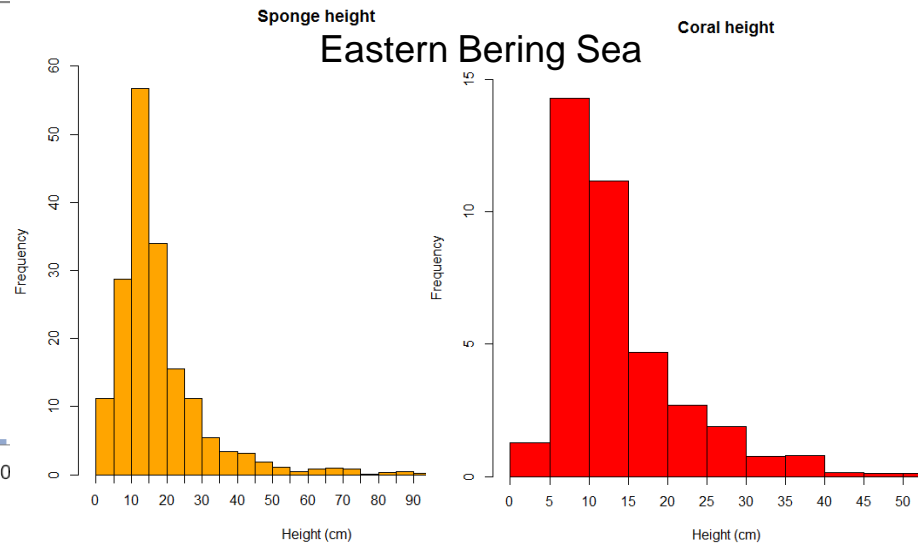
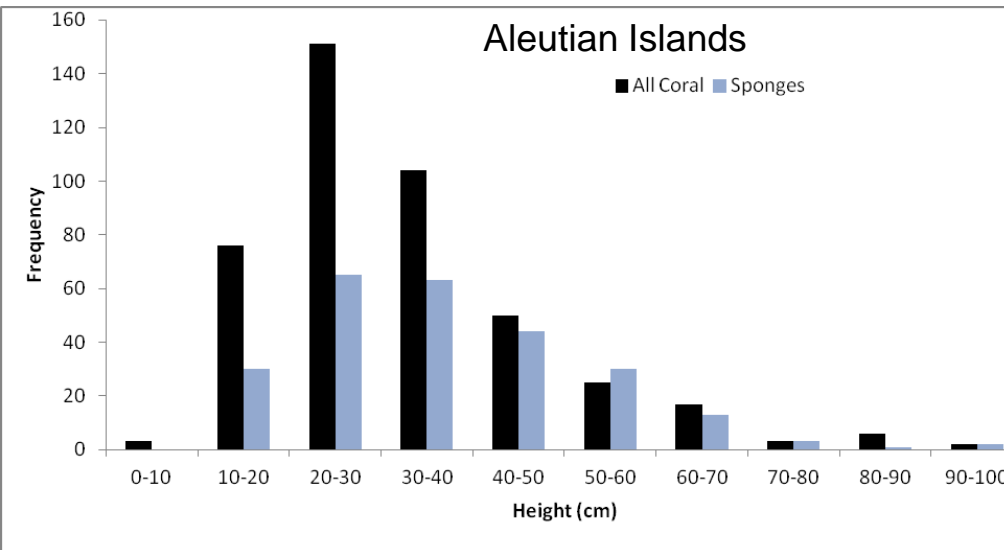
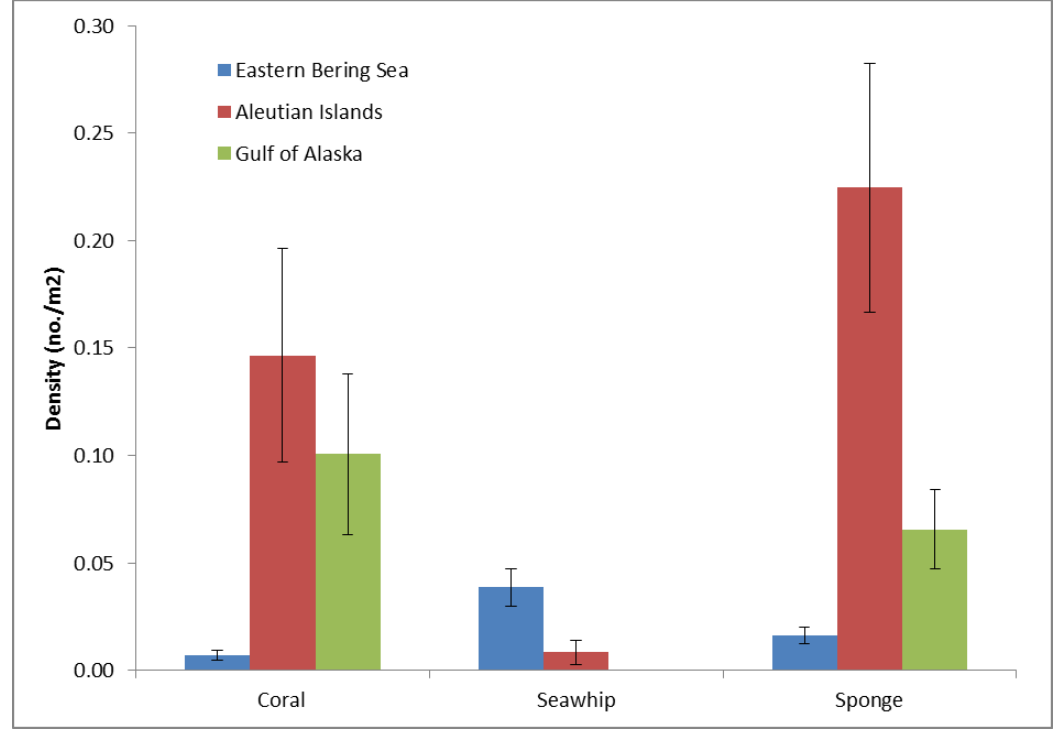


Mode

Unified Coral Model



Comparisons with other regions (w/ same randomized camera survey)



Cool and Interesting Items

- Snailfish and chionoecetes
- Skate nursery area
- Egg nests
- Short-tailed albatross



These are Preliminary Results (final at June NPFMC meeting)

- Coral occurrence was low throughout
 - Concentrated around Pribilof Canyon and to the northwest
 - Consistent with model results and other data (trawl, observer)
 - Densities were low even where they occurred
- Sponge & Sea Whips distributed more broadly
 - Consistent with model results and other data
 - Sponge densities were generally low
 - Sea whip densities were high in some locations (mostly shallower than 200 m)
- Other invertebrates = Anemones, Sea Cucumbers, Brittlestars
- Dominant fishes = POP, Grenadier, Pollock, ATF, Flatfish, Sculpins
 - Associations were minimal

Next Steps

- Image Analysis Plan
 - View all individual frames
 - Identify, count and measure all fish, coral, sponge and sea whips
- Update data with remaining transects
- Produce density models of invertebrates
- Model averaging for independent models based on
 - Trawl data
 - Camera data

Completion by June 2015



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