

Ecological characterization of Steller sea lion terrestrial sites

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Objectives

1. Compare oceanographic conditions near Steller sea lion terrestrial sites (rookeries and haulouts) to conditions elsewhere in their range
2. Assess whether terrestrial sites are concentrated in areas with similar oceanographic conditions

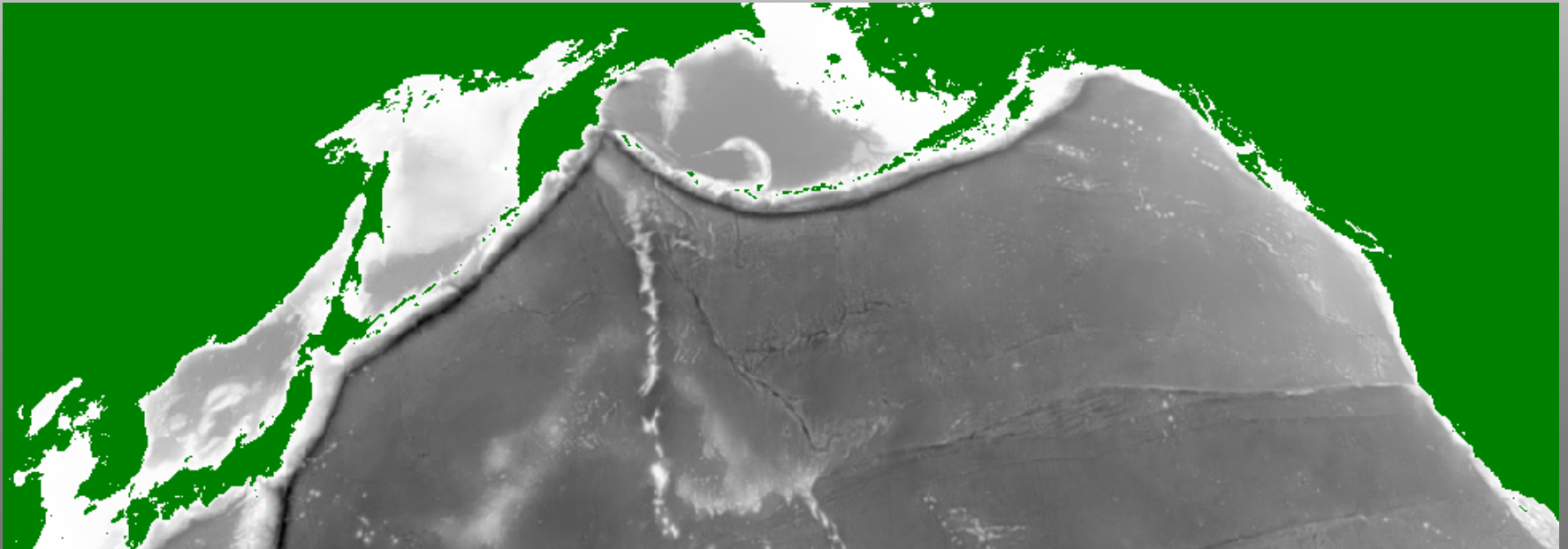
Earlier results

(eastern North Pacific only)

- Assessed depth, slope, & tidal flow within 1, 10, 20 and 50 nmi from sites
- Sites preferentially located in shallower, less steep, high flow, well-mixed regions
- Conditions closer to sites were better at predicting site locations

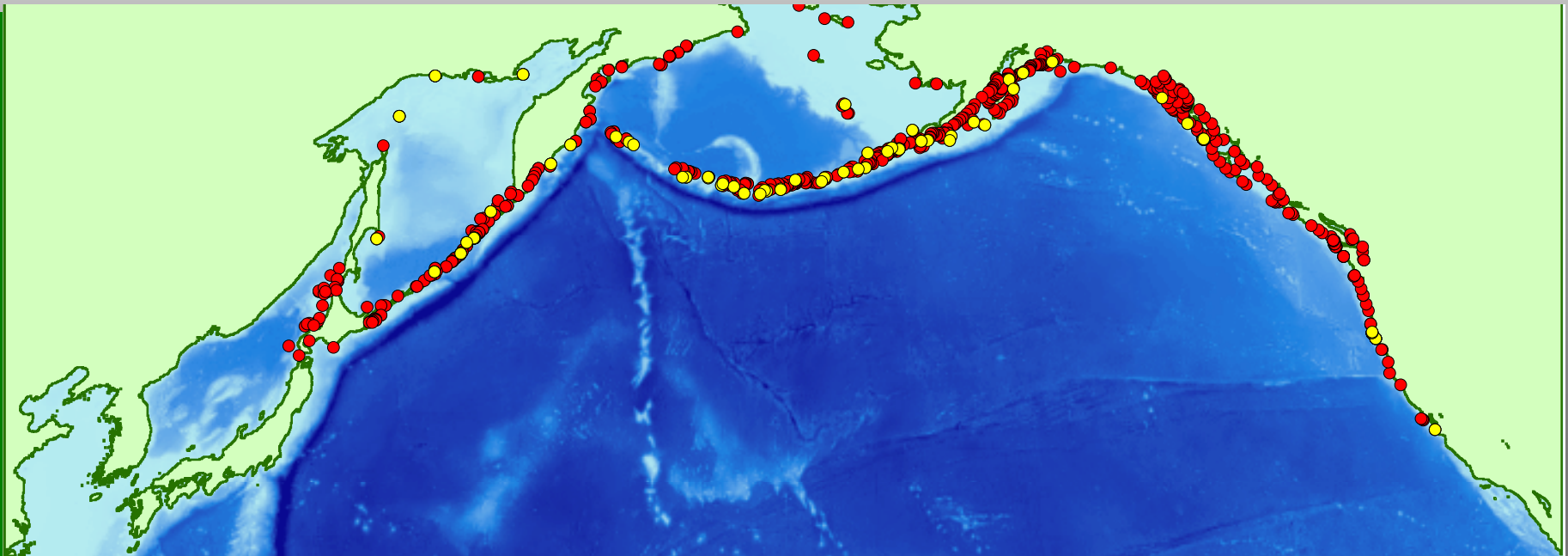
Main constraint

- Requires range-wide, comprehensive data
- Limited to remote sensing and models



Study area

- Spatially restriction based on temperature
- Seasonal restriction based on behavior



Data

Seasonal (summer/winter), 25 km² data set created from:

- Depth & slope
 - Smith and Sandwell global elevation model
- Chlorophyll & sea surface temperature
 - MODIS; seasonal; 4 km²; 2001-2004
- Winds & variance
 - QuikScat; monthly; 25 km²; 2001-2004

Methods – Part 1

comparing sites to coast

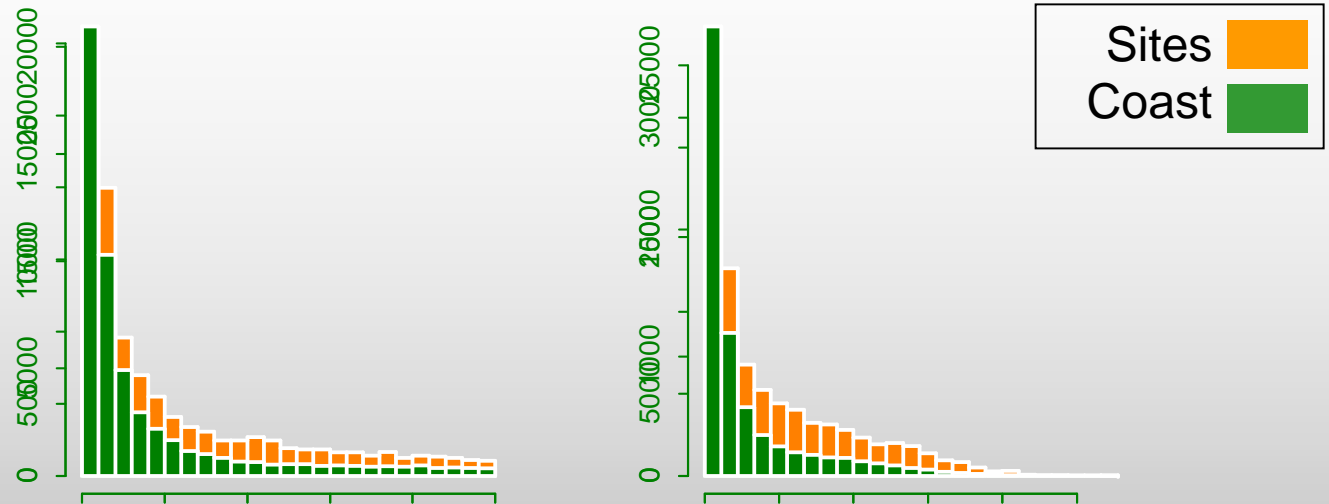
1. Restrict analysis to within 50 km of shore
2. Compare regions near sites to elsewhere
3. For summer, compare rookeries only
4. For winter, compare all sites
5. Differences between distributions was assessed using a re-sampling approach

Buffered study area - summer

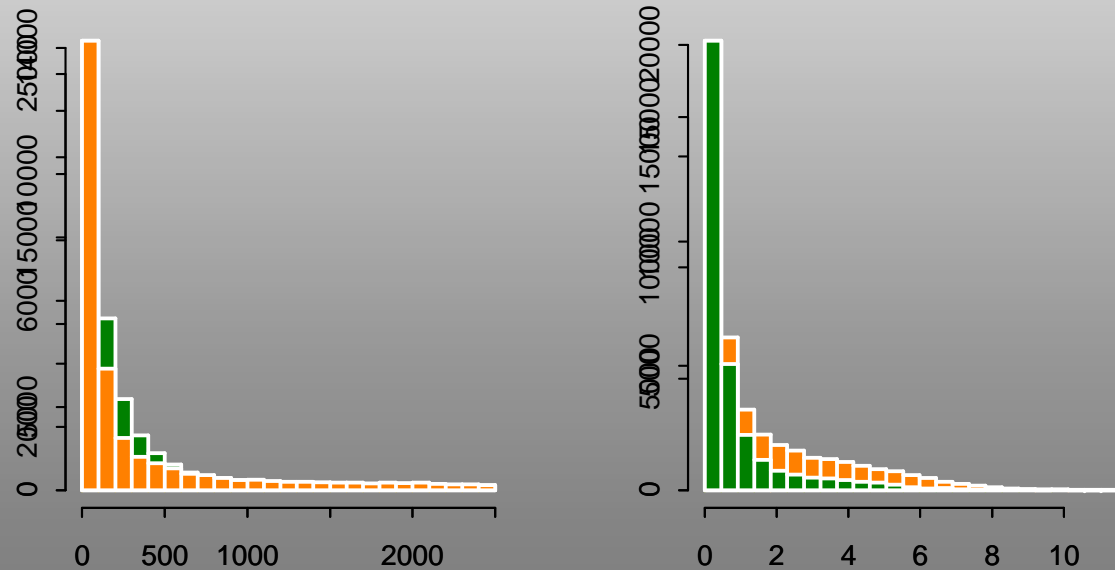


Depth and slope

Summer



Winter

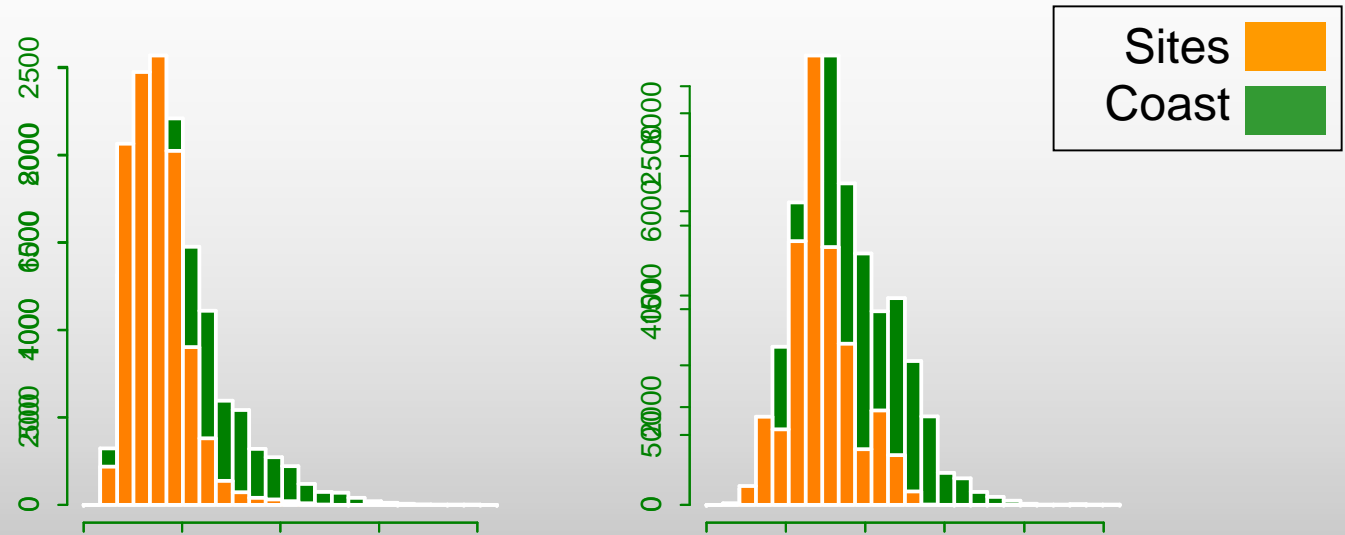


Depth

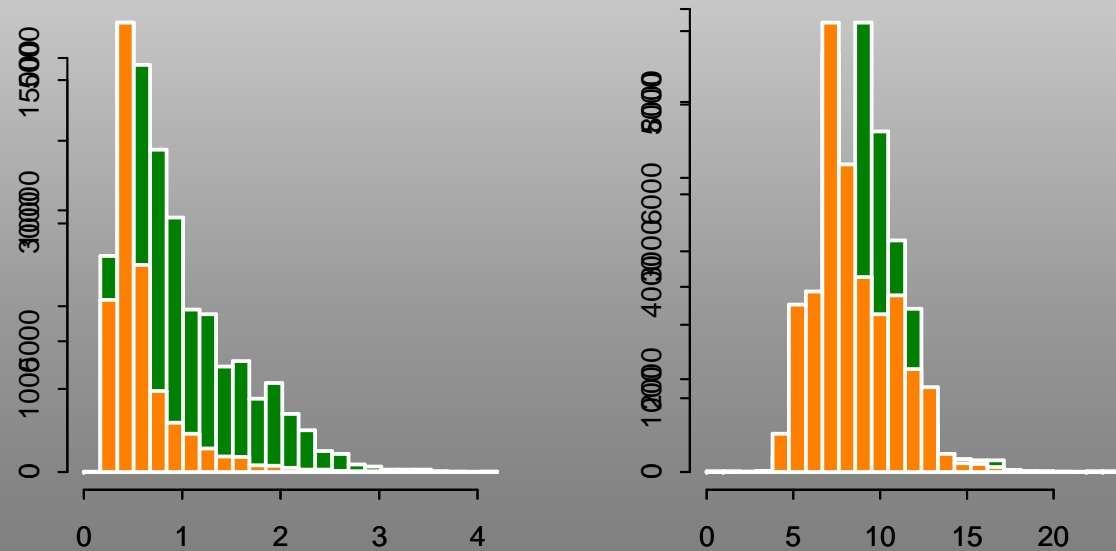
Slope

Chlorophyll and temperature

Summer



Winter

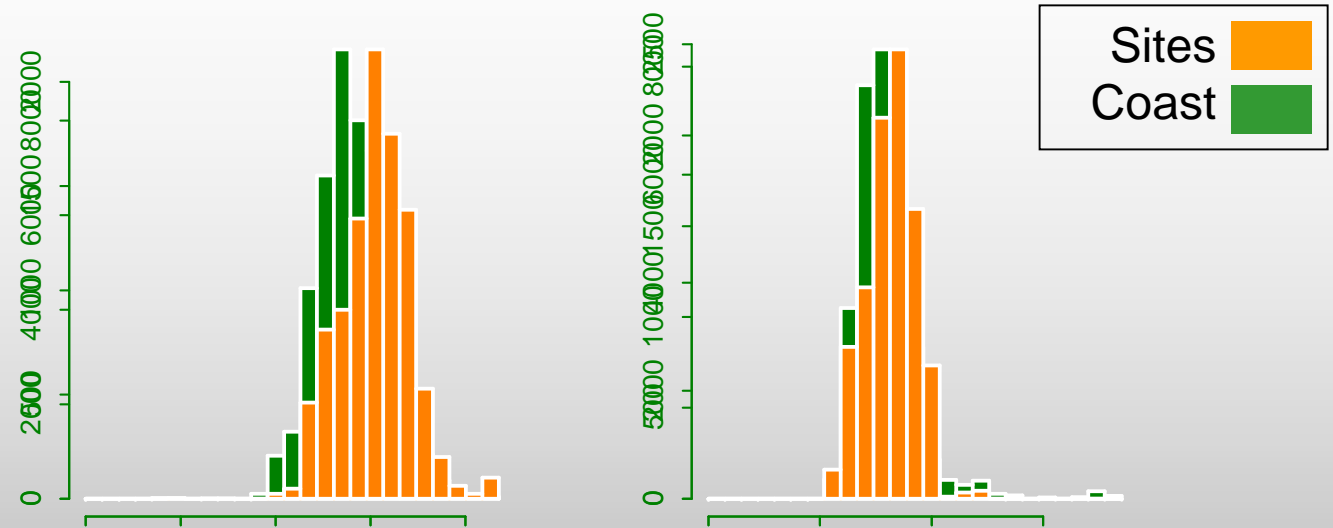


Chlorophyll

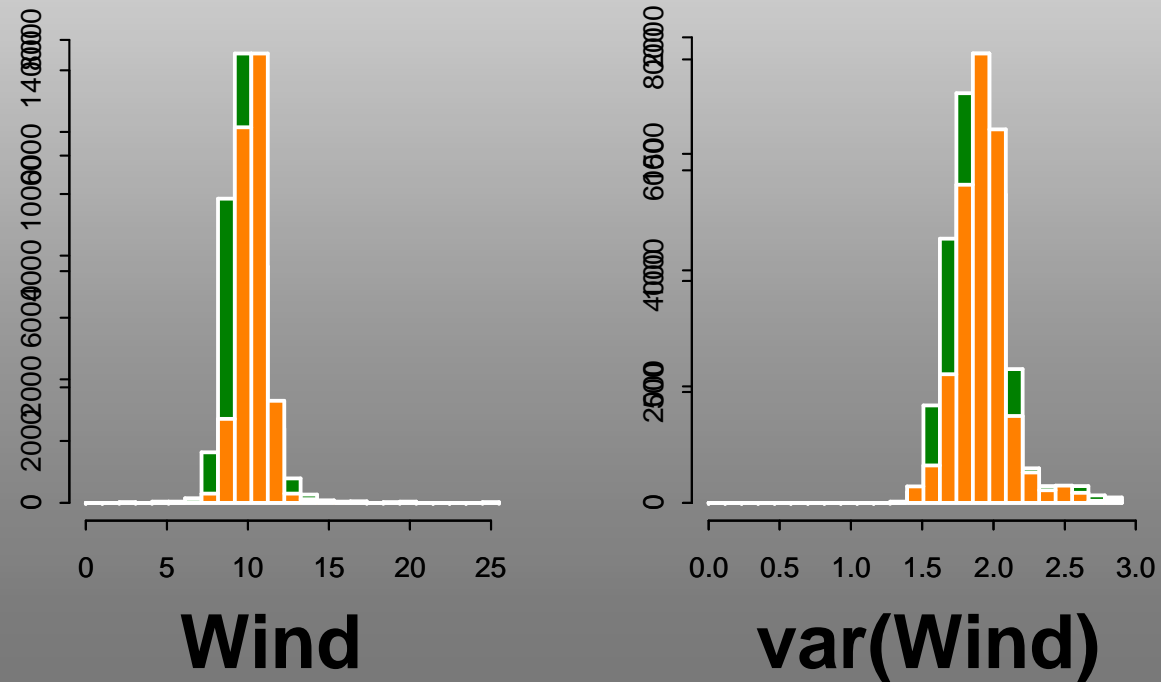
Temperature

Wind and wind variance

Summer



Winter



Significantly different?

- Pixels make for poor statistics
 - autocorrelated; large N
- Estimate significance via re-sampling:
 - Samples of 100 from each population (site and coastal) taken 1000 times
 - Examine distribution of p values
 - Use Wilcoxon test for depth, slope, & chl-a
 - Use t-test for SST, wind, & wind variance

Significance

(p-value distribution)

Min
Max
Median
Mean

	Depth	Slope	Chloro	SST	Wind	WVar
Summer	1.8e-7	7.0e-9	3.4e-9	0	0	1.3e-6
	0.99	0.97	0.37	0.14	0.089	1.0
	0.04	2.8e-3	2.4e-4	2.3e-5	5.6e-6	0.18
	0.13	0.031	8.7e-3	1.8e-3	8.1e-4	0.30
Winter	1.6e-4	6.3e-10	0	3.5e-6	0	4.7e-6
	1.0	0.99	0.019	0.99	0.49	1.0
	0.48	3.8e-3	1.1e-6	0.081	8.8e-4	0.24
	0.48	0.037	1.8e-4	0.19	0.021	0.34

Conclusions

- Regions around sea lion sites are significantly steeper, colder, windier, and less productive than average coastal conditions
- Rookeries are surrounded by waters significantly deeper than average

What you would expect living on an exposed rock on the edge of the Pacific!

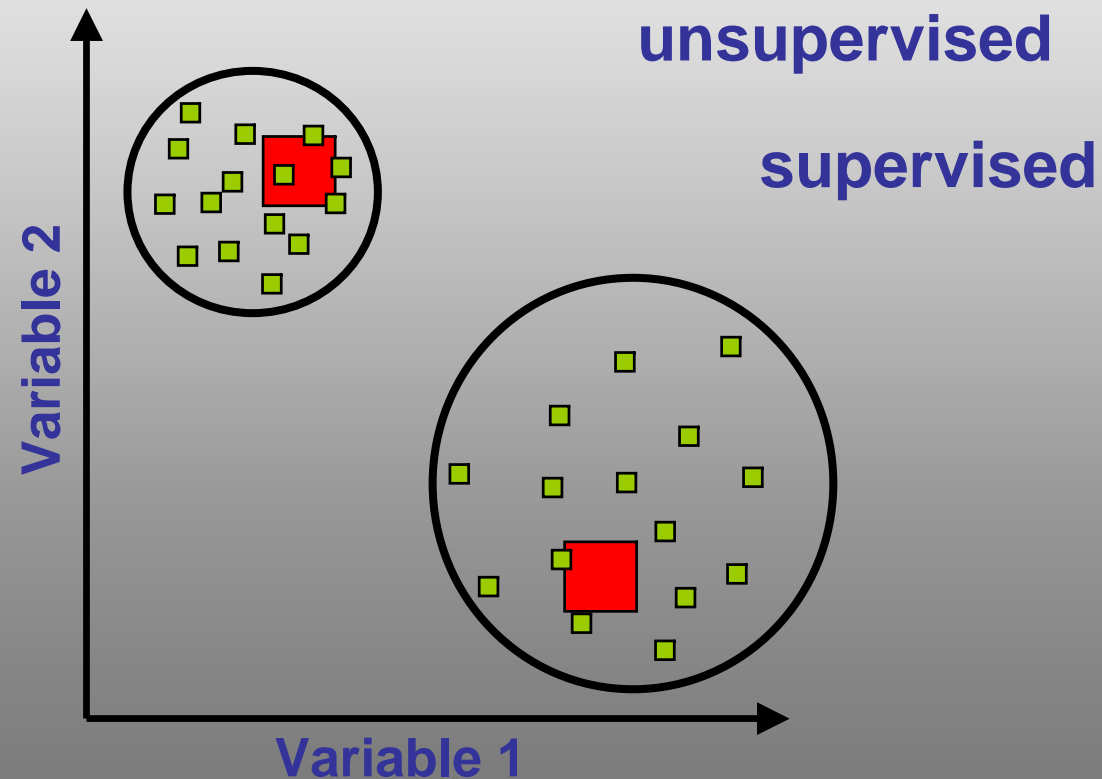
Methods – Part 2

Are sea lion sites concentrated in regions with similar oceanography?

1. Restrict analysis to depths < 2500 m
2. Use image classification to group pixels with similar values
3. Assess effects of variable combinations on classification
4. Assess whether distribution of rookeries is different from expected?

Approach

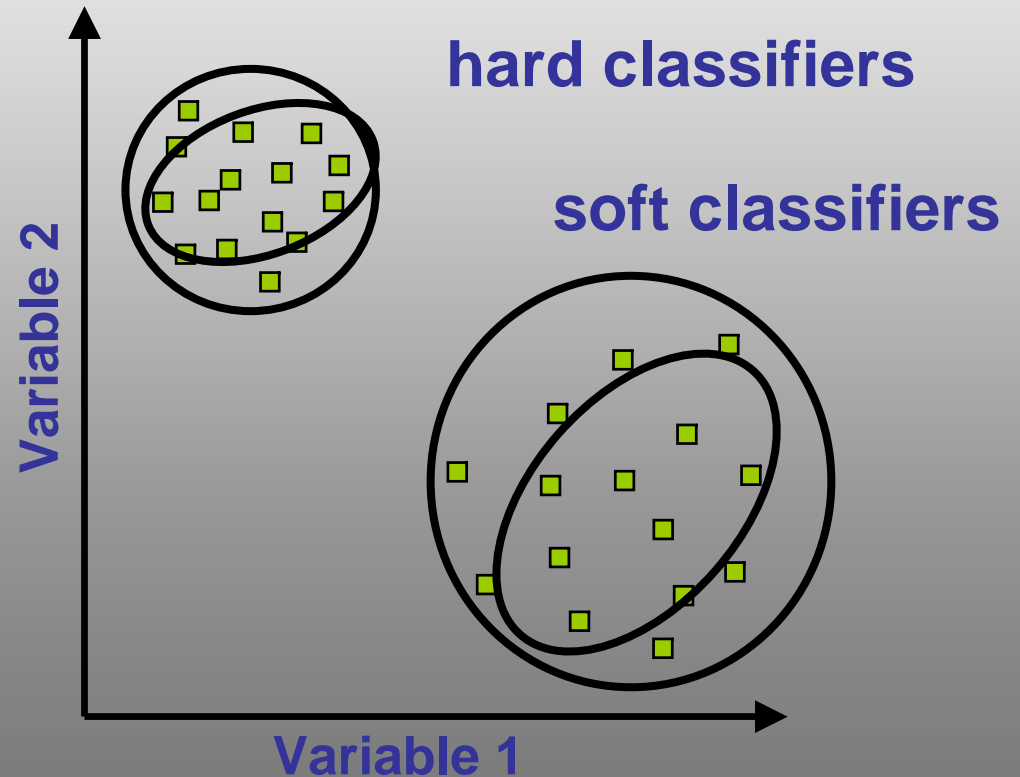
‘Classification’ algorithm identifies regions of similarity ...



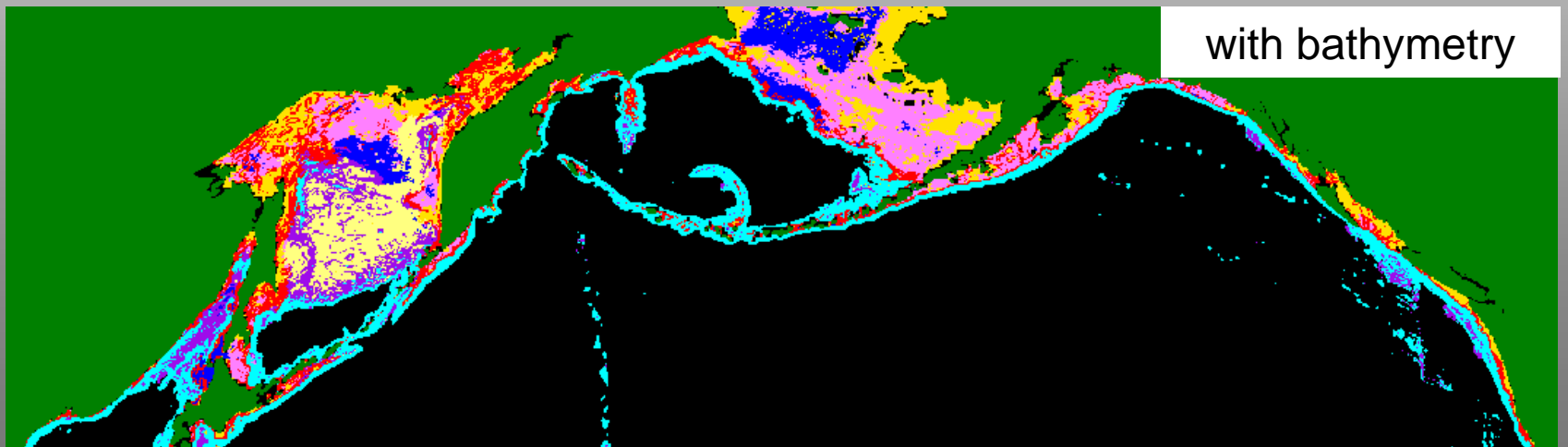
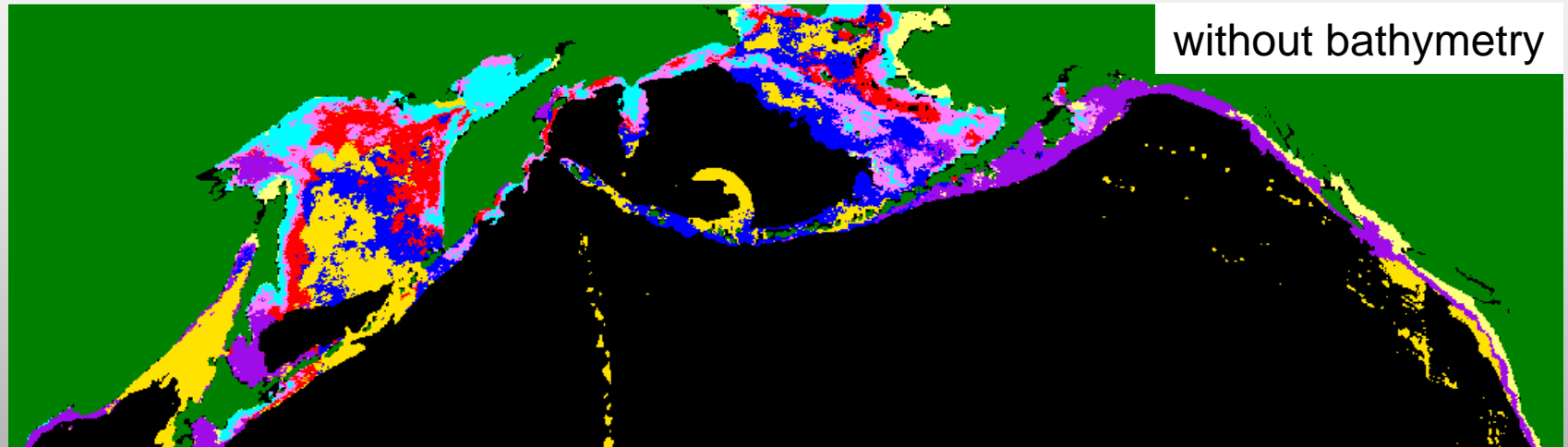
Approach

‘Classification’ algorithm identifies regions of similarity ...

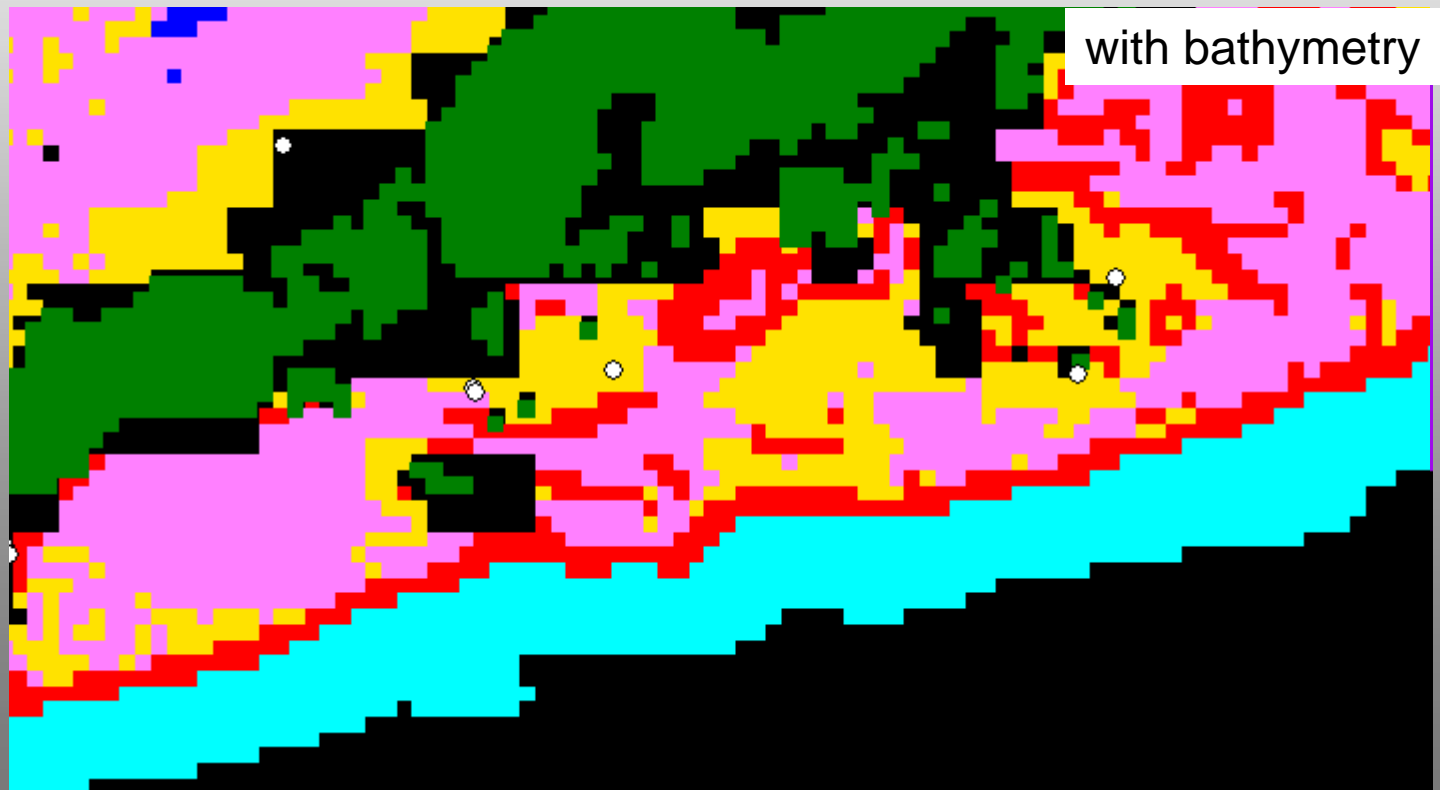
‘Isoclust’
unsupervised, hard classifier



Summer classification results ...



Effect of adding bathymetry

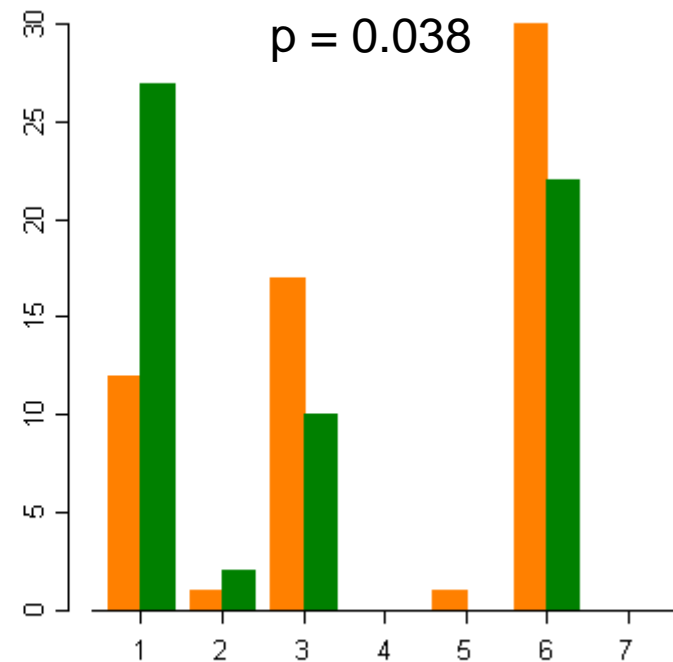
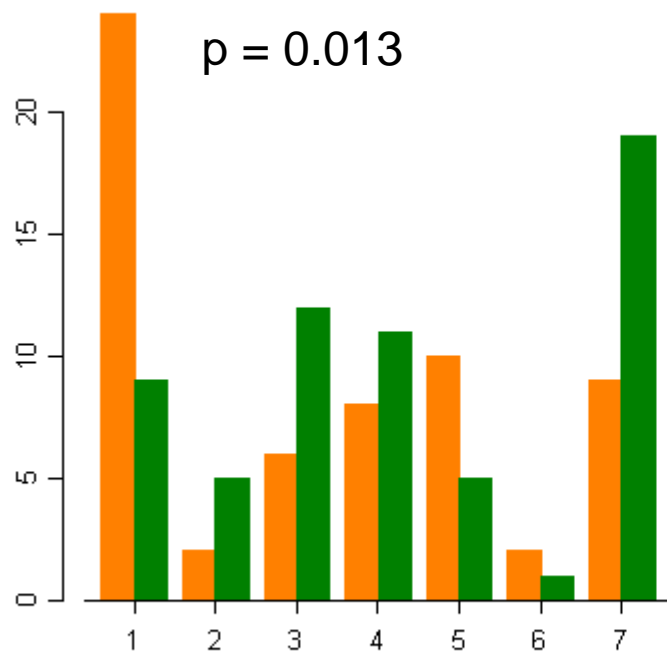


Rookery associations

Surface only



Incl. bathy

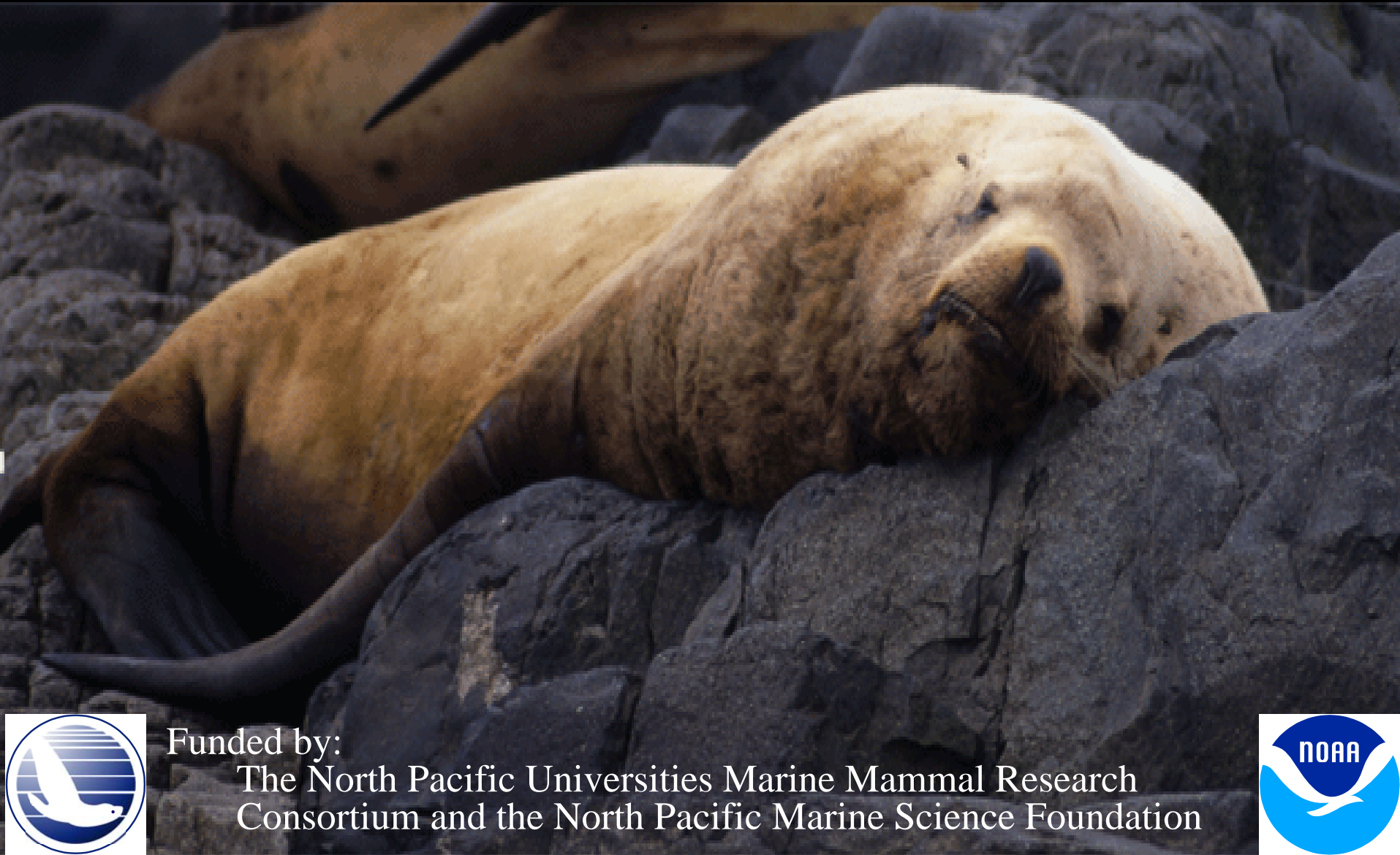


Cluster number

Conclusions – Part 2

- Regions identified through classification have biological significance
- Choosing scale & variables is challenging
- Effective application will require reflection on biological processes
- A quantitative, adaptable definition of “ecoregions” has great potential for ecosystem-based management

Thanks very much ...



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