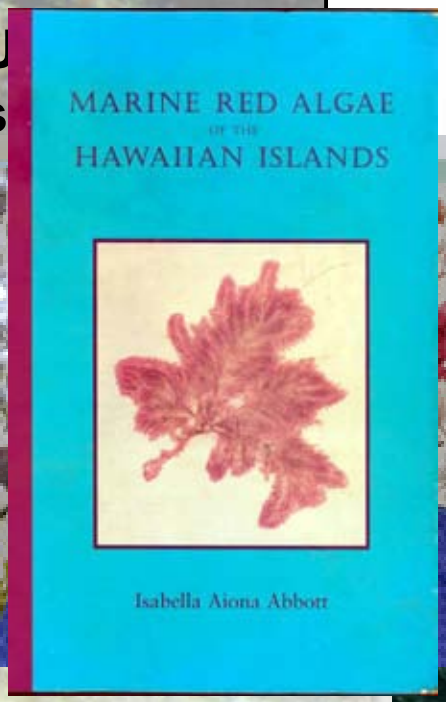
Marine Algal Diversity and Abundance in the Northwestern Hawaiian Islands (NWHI)

Dr. Peter S. Vroom
Ms. Kimberly N. Page-Albins
Ms. Molly A. V. Timmers

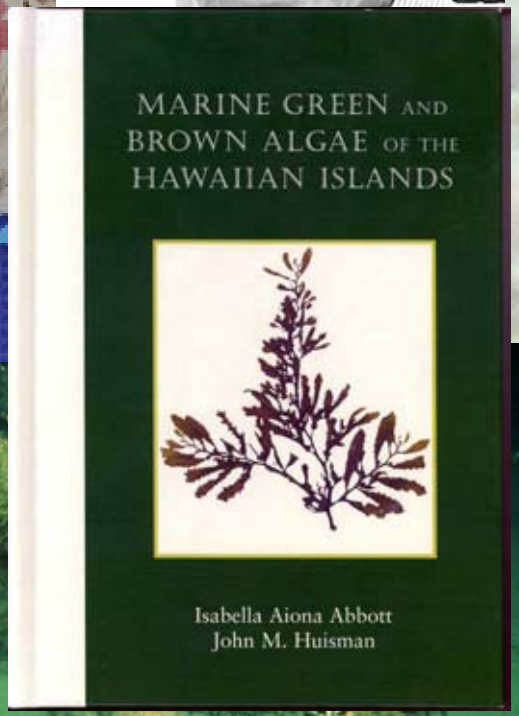
Joint Institute for Marine and Atmospheric Research,
NOAA Pacific Island Fisheries Science Center
Coral Reef Ecosystem Division

27 5:29 PM

History of algal research in the NWHI



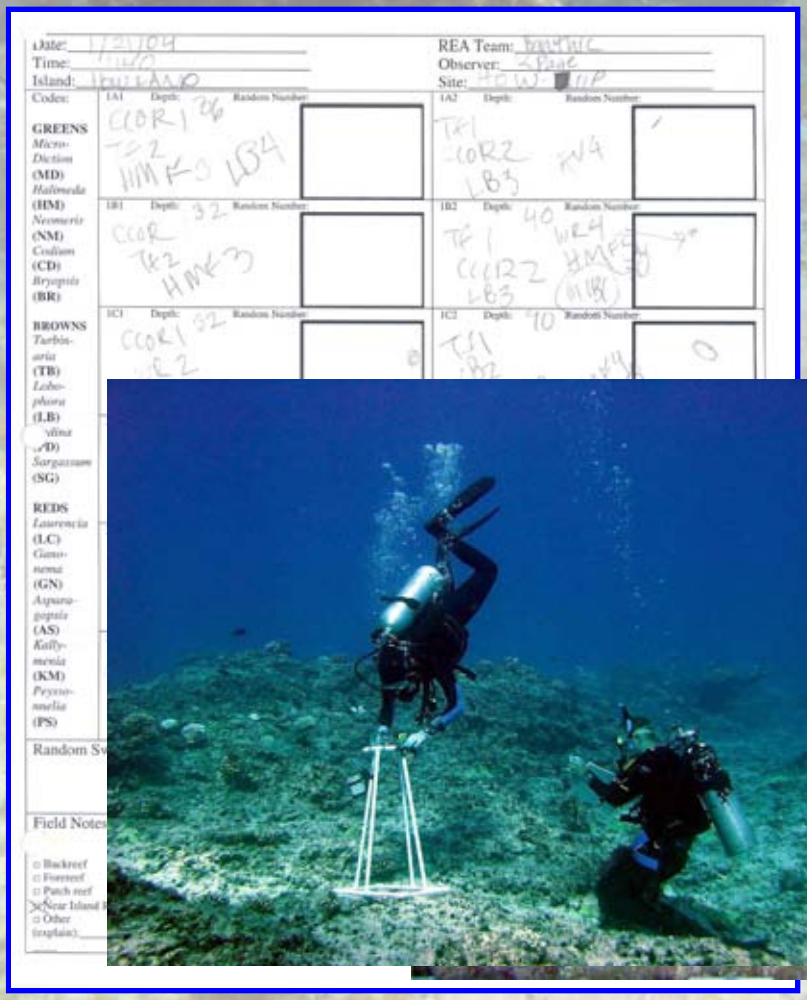
Roy Tsuda

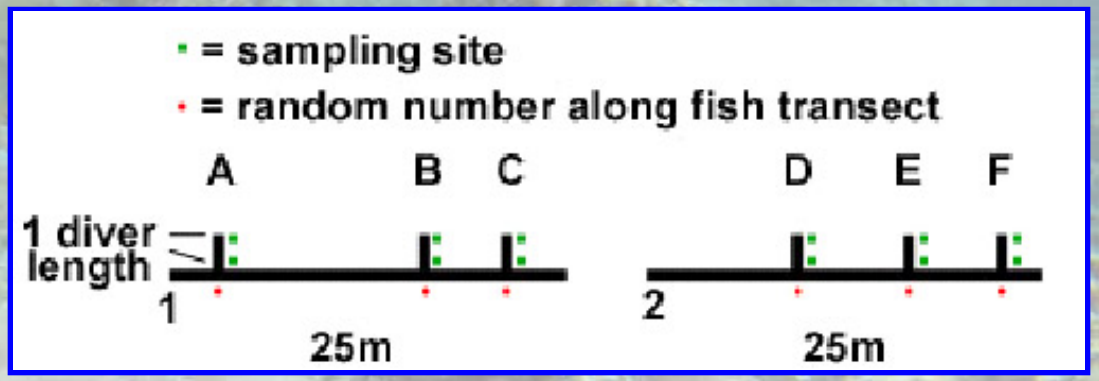


lobster trap covered with algae and invertebrates

- only ~12 algal papers in literature before 2002
- almost all algal samples collected off lobster traps, field studies rare
- ~ 205 species reported for NWHI, compared to ~485 species in main Hawaiian Islands

CRED algal sampling protocol instigated in 2002



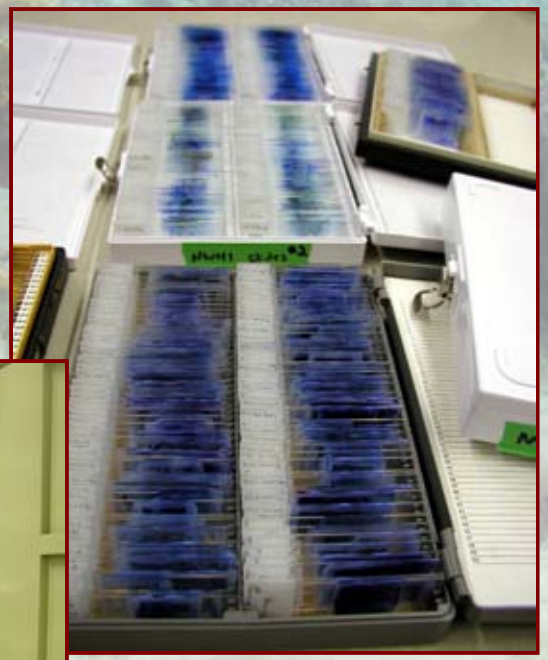


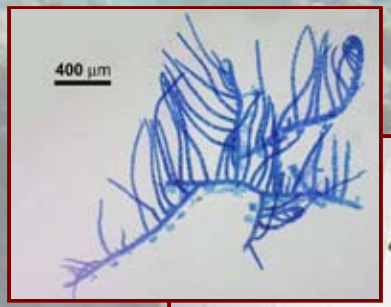
Algal data collected:

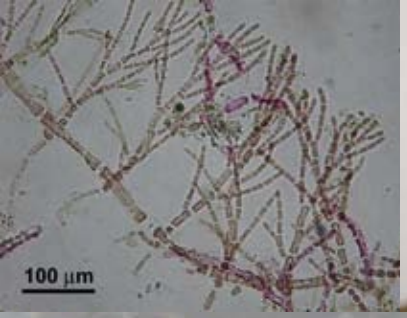
- digitial photoquadrat image
- map of photoquadrat image
- detailed species list of algae from photoquadrat
- ranked abundance of algal genera from each photoquadrat
- voucher specimens of each species in photoquadrat

Preskitt et al. (2004) A Rapid Ecological Assessment (REA) Quantitative Survey Method for Benthic Algae using Photo Quadrats with SCUBA. Pacific Science 58: 201-209.

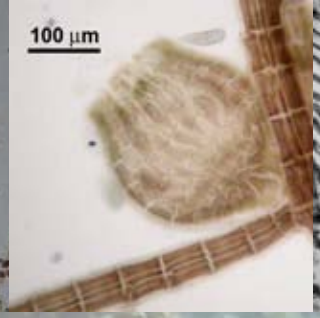
CRED Qualitative Algal Surveys: 2000 – present







Antithamnion antillarum



Polysiphonia scopularum

Caulerpella ambigua

CRED Qualitative Algal Analyses

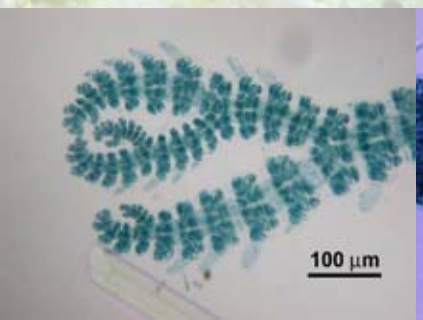
French Frigate Shoals

- 166 species reported
- 47% marcroalgal species, 53% turf or epiphyte species
- 2 species new to science
- 4 species new to Hawaiian archipelago

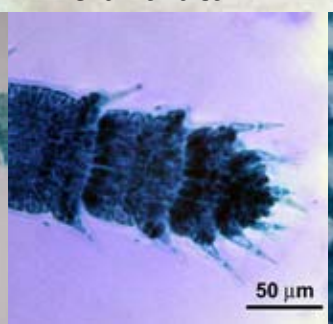
Gardner Pinnacles

- 75 species – 300% increase from Abbott (1989)
- 41% macroalgal species, 59% turf or epiphyte species

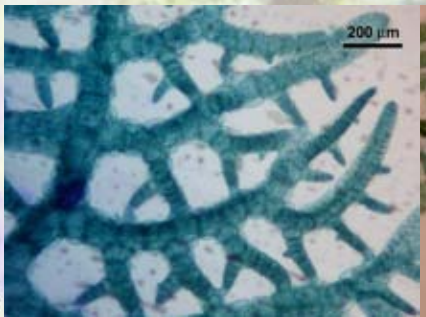
Ceramium fimbriatum



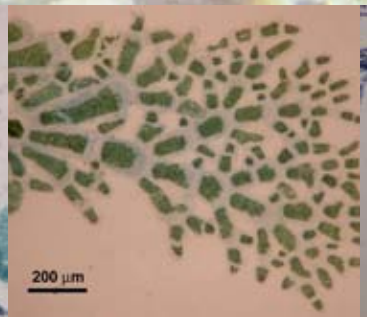
Centroceras clavulatum



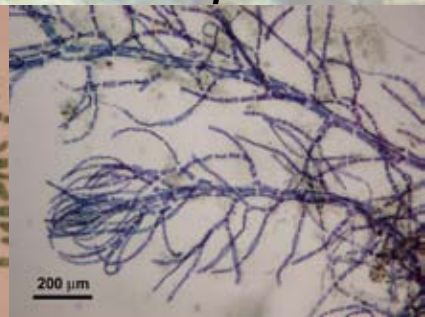
Vanvoorstia coccinea



Cladophora hawaiiensis



Heterosiphonia crispella



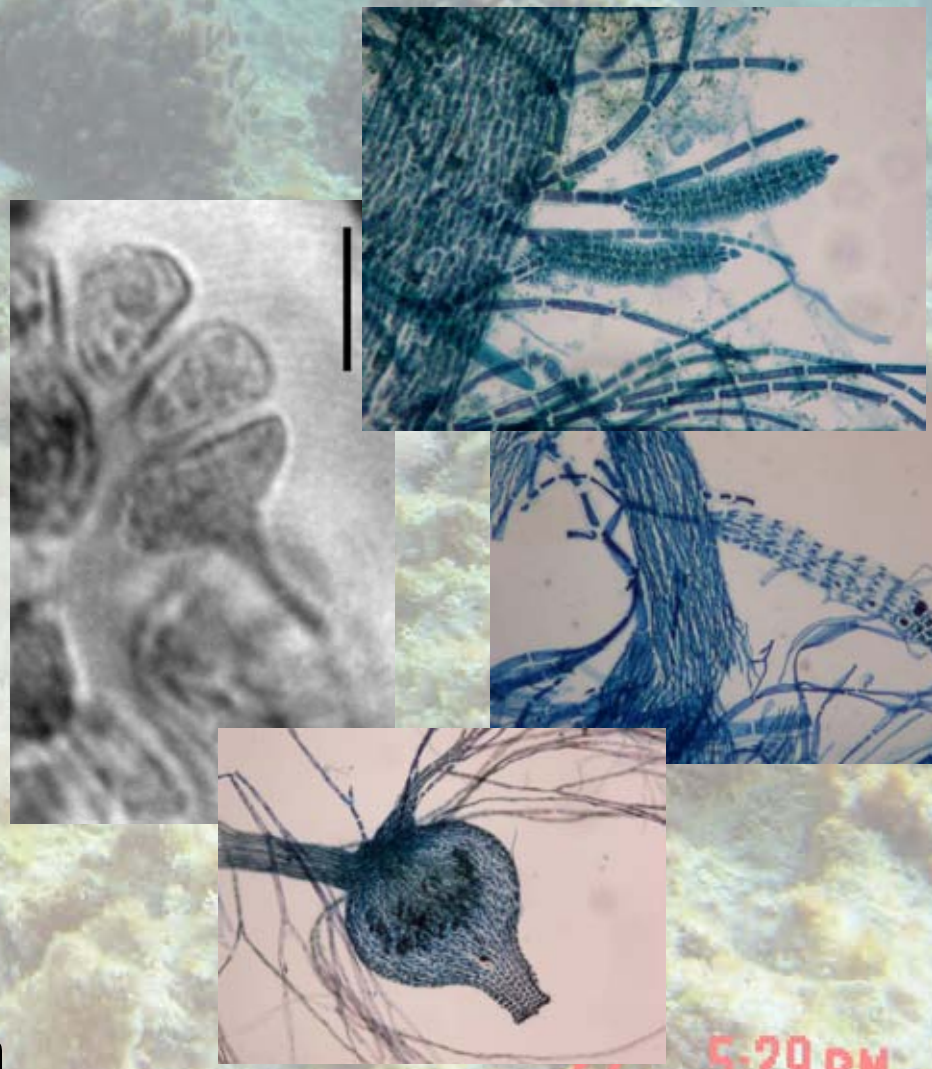
Species new to science

Acrosymphyton brainardii **Vroom & Abbott**

Scinaia huismanii **Vroom & Abbott**

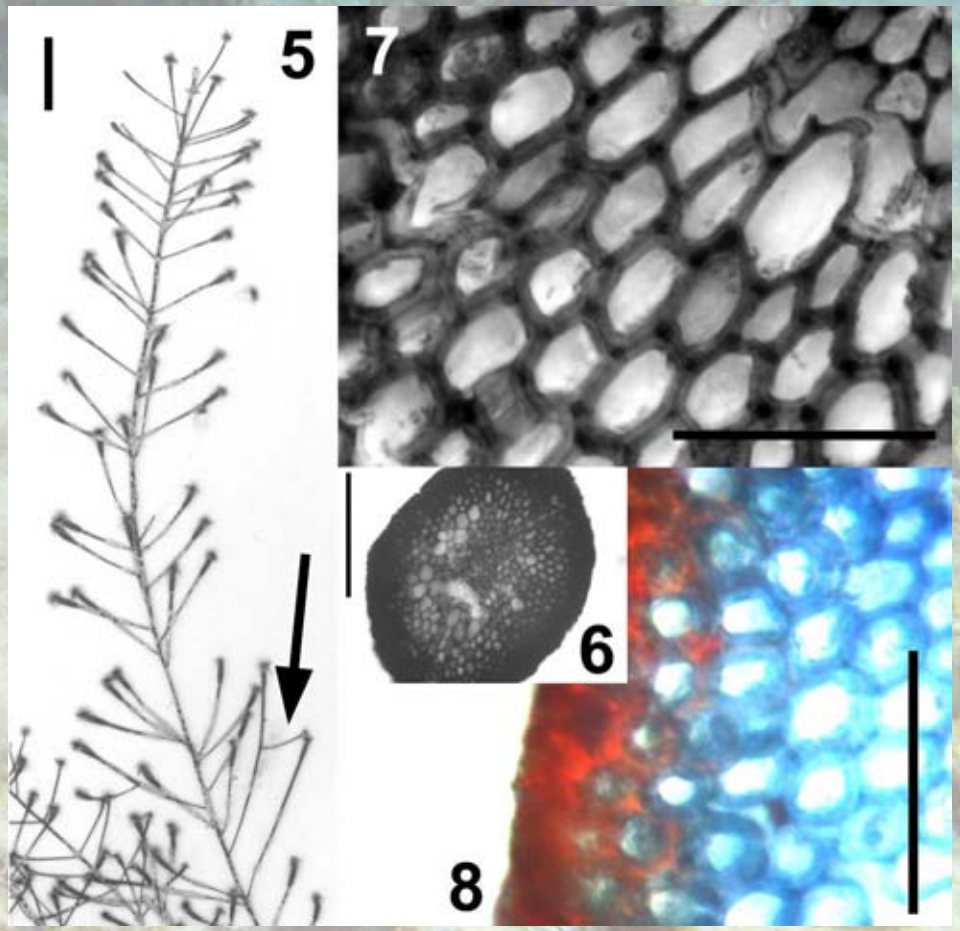
27 5:29 PM

Species new to science



***Dasya atropurpurea* Vroom**

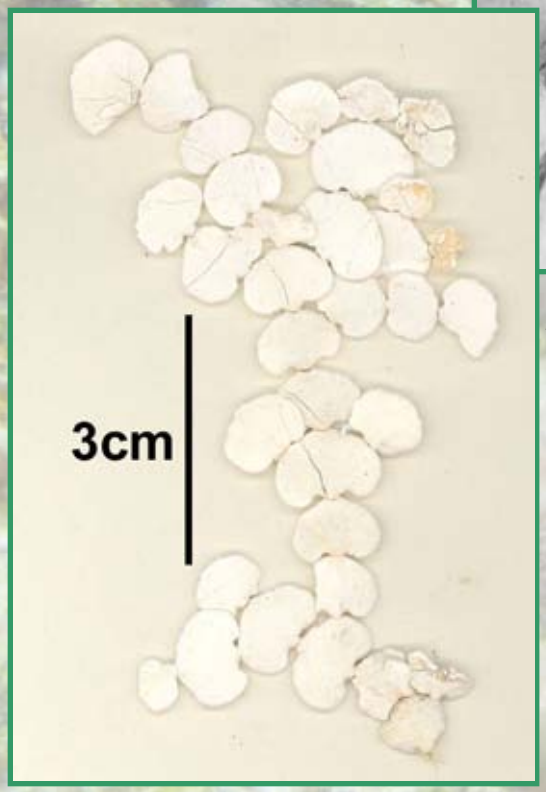
Species new to science



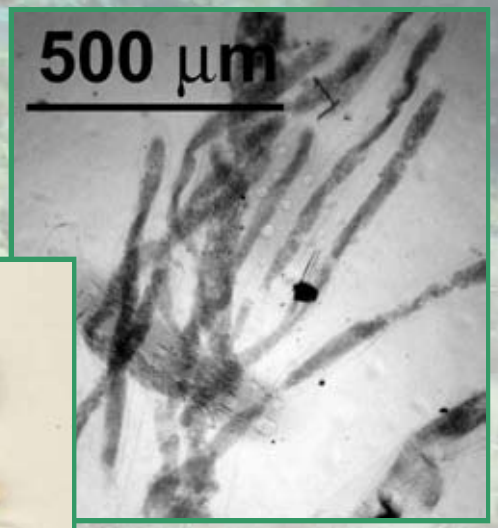
***Sporochnus* sp. Vroom & Abbott**

27 5:29 PM

Species new to the Hawaiian archipelago

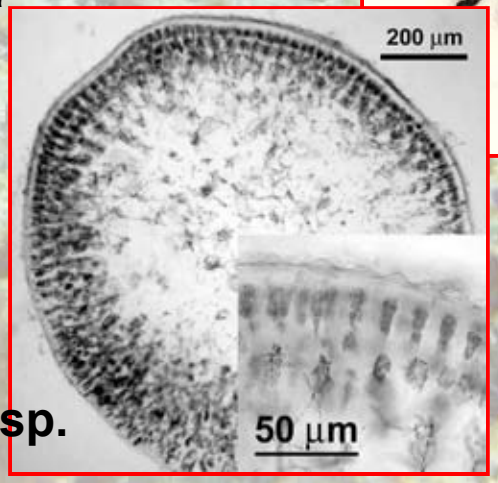


Halimeda distorta



Bryopsis indica

Gracilaria millardetii

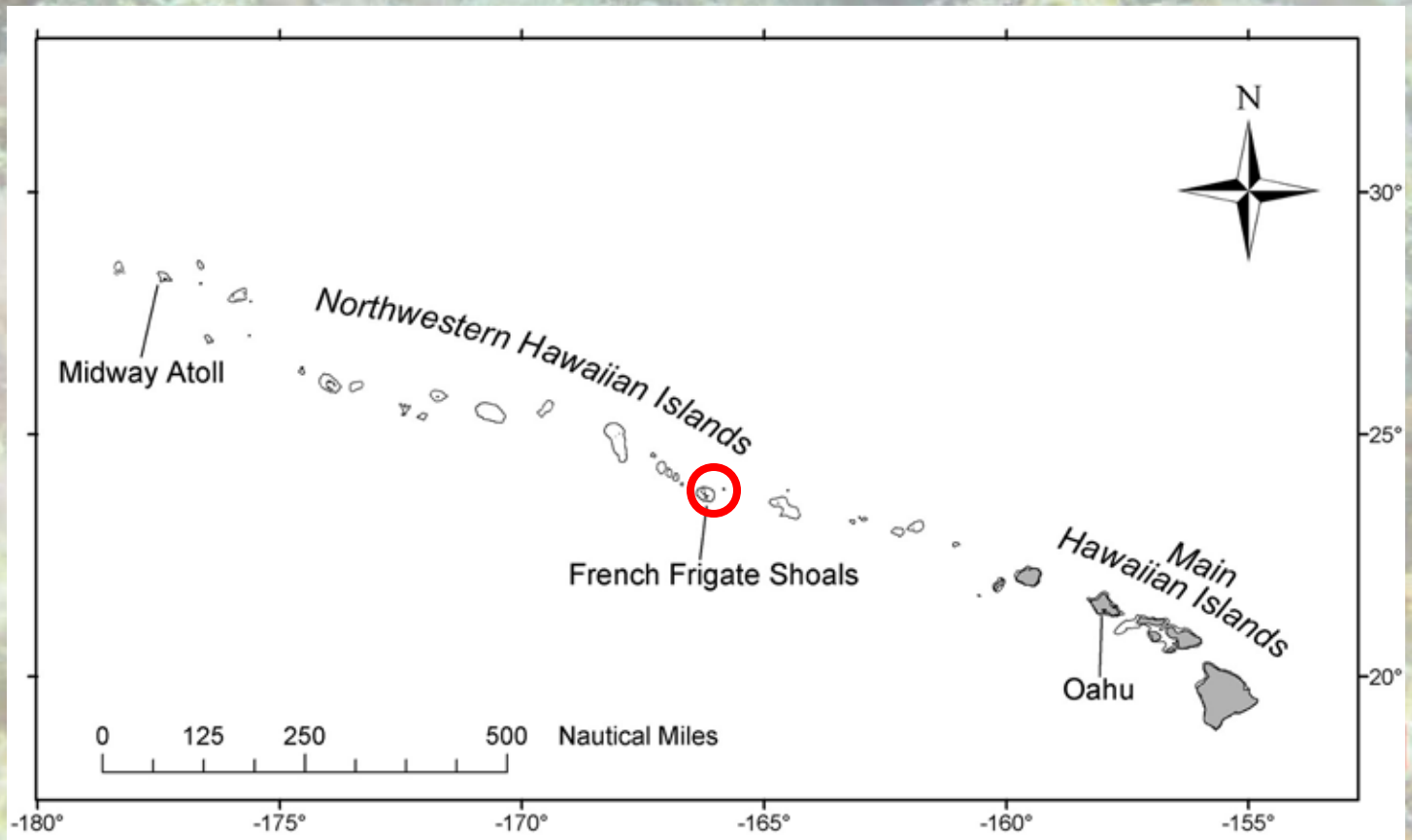


Laurencia sp.

27 5:29 PM

CRED Quantitative Spatial Algal Analyses

- How do sites differ spatially around an atoll, particularly in terms of algal communities?



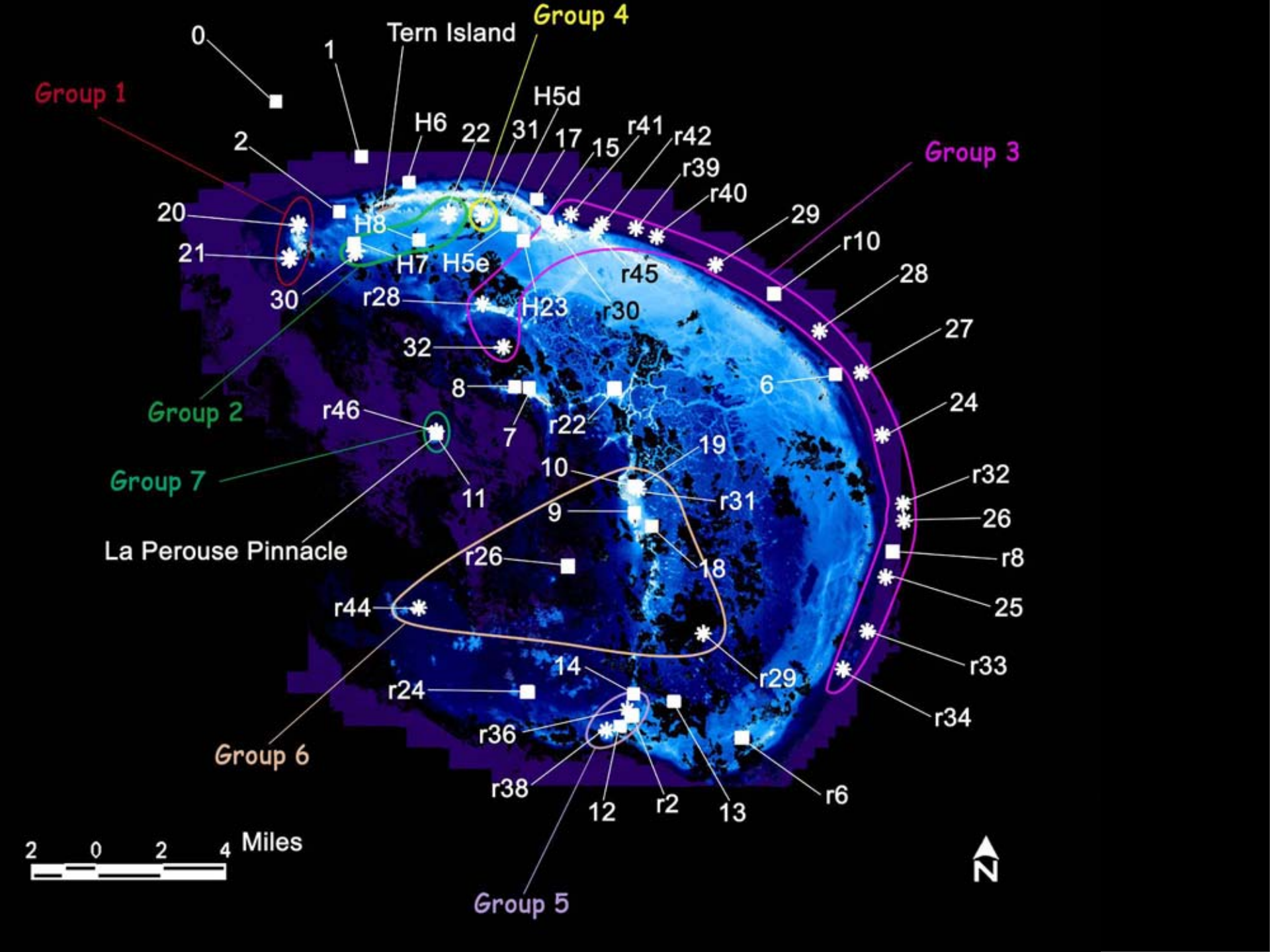
CRED Quantitative Spatial Algal Analyses

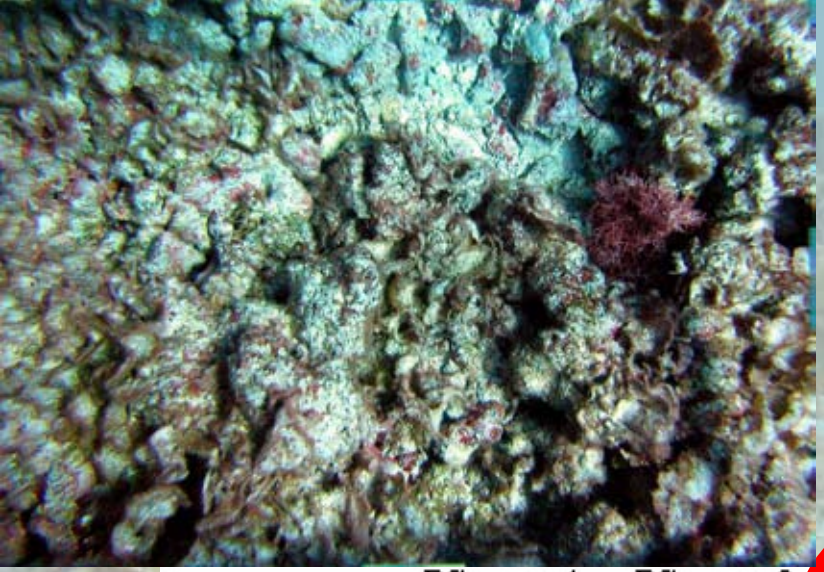
Using a combination of:

- **Multivariate statistics**
- **Multidimensional scaling (MDS) plots**
- **Field notes**
- **Geographic maps**

7 biogeographical groups were interpreted at FFS based on benthic species composition and geographic area

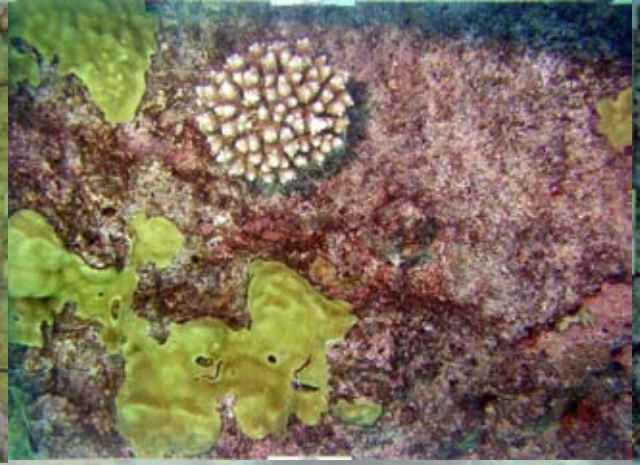
27 5:29 PM

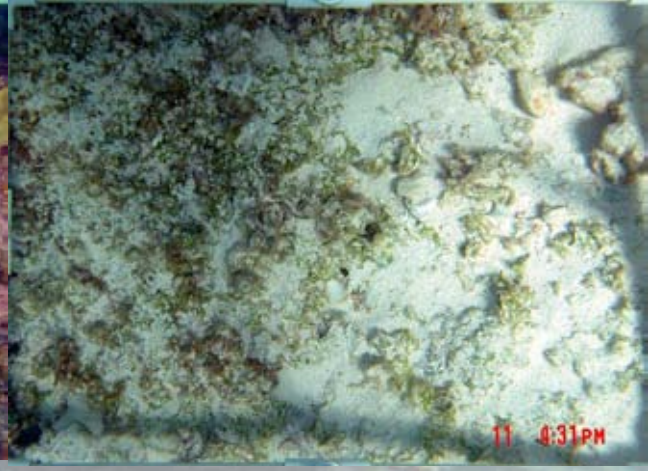

0
1
Tern Island
Group 4
Group 1
H5d
H6
22
31
17
15
r41
r42
r39
r40
2
Group 3
20
H8
29
r10
21
H7
H5e
r45
28
30
r28
H23
r30
27
32
6
8
7
r22
24
Group 2
r46
r32
Group 7
19
10
r31
11
9
26
La Perouse Pinnacle
r26
18
r8
r44
25
r29
r33
14
r24
r34
r36
Group 6
r38
12
r2
13
r6
Group 5
2 0 2 4 Miles
N



Biogeographic Group 3: 17 sites along fore- and back- reef regions

	BG group 1	BG group 2	BG group 3	BG group 4	BG group 5	BG group 6	BG group 7
Environment type	Back reef (n = 2)	Back, lagoonal reefs (n = 2)	Fore, back reefs (n = 17)	Lagoonal reef (n = 1)	Lagoonal reef (n = 2)	Lagoonal reef (n=3)	Basalt pinnacle (n=1)
Depth range	9.5-12.5 m	1.83-7.3 m	1.83-13.7 m	2.4-6.4 m	12.2-24.1 m	3.3-19.5 m	6 m
Scleractinian Coral	24.46 (11.14)	9.04 (12.79))	6.45 (6.38)	35.80	57.04 (10.31)	9.72 (0.61)	21.83
Algae	65.21 (0.06)	54.18 (18.99)	109.39 (14.68)	63.75	51.17 (12.02)	102.25 (8.30)	112.00
Turf	50.67 (6.01)	33.32 (4.22)	78.07 (8.06)	37.92	32.75 (8.72)	79.89 (2.14)	57.33
Coralline	9.33 (6.84)	2.76 (1.64)	15.45 (10.53)	20.5	18.25 (3.54)	19.28 (8.30)	49.00
Flesly Macroalgae	5.21 (0.77)	18.10 (16.40)	15.87 (9.23)	5.33	0.17 (0.24)	3.08 (0.44)	5.67
Sand	8.58 (11.55)	46.88 (5.83)	3.68 (2.80)	0.25	1.00 (0.12)	1.92 (1.46)	0.08
Other	1.75 (0.47)	1.63 (1.24)	1.61 (0.77)	7.50	1.88 (2.06)	1.97 (1.78)	1.67



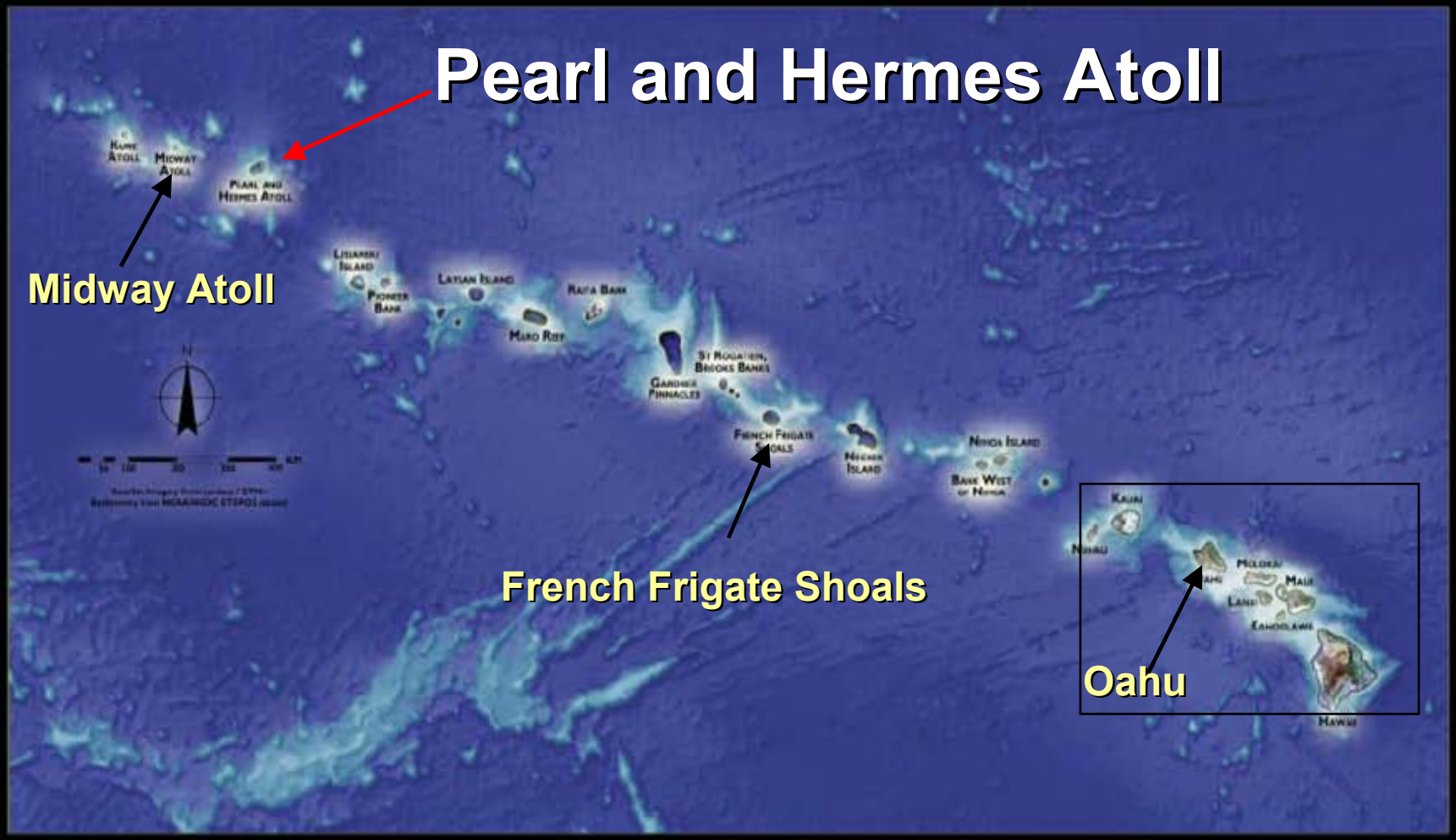


Group 5

Group 7

Group 2

	BG group 1	BG group 2	BG group 3	BG group 4	BG group 5	BG group 6	BG group 7
Environment type	Back reef (n = 2)	Back, lagoonal reefs (n = 2)	Fore, back reefs (n = 17)	Lagoonal reef (n = 1)	Lagoonal reef (n = 2)	Lagoonal reef (n=3)	Basalt pinnacle (n=1)
Depth range	9.5-12.5 m	1.83-7.3 m	1.83-13.7 m	2.4-6.4 m	12.2-24.1 m	3.3-19.5 m	6 m
Scleractinian Coral	24.46 (11.14)	9.04 (12.79))	6.45 (6.38)	35.80	57.04 (10.31)	9.72 (0.61)	21.83
Algae	65.21 (0.06)	54.18 (18.99)	109.39 (14.68)	63.75	51.17 (12.02)	102.25 (8.30)	112.00
Turf	50.67 (6.01)	33.32 (4.22)	78.07 (8.06)	37.92	32.75 (8.72)	79.89 (2.14)	57.33
Coralline	9.33 (6.84)	2.76 (1.64)	15.45 (10.53)	20.5	18.25 (3.54)	19.28 (8.30)	49.00
Flesly Macroalgae	5.21 (0.77)	18.10 (16.40)	15.87 (9.23)	5.33	0.17 (0.24)	3.08 (0.44)	5.67
Sand	8.58 (11.55)	46.88 (5.83)	3.68 (2.80)	0.25	1.00 (0.12)	1.92 (1.46)	0.08
Other	1.75 (0.47)	1.63 (1.24)	1.61 (0.77)	7.50	1.88 (2.06)	1.97 (1.78)	1.67

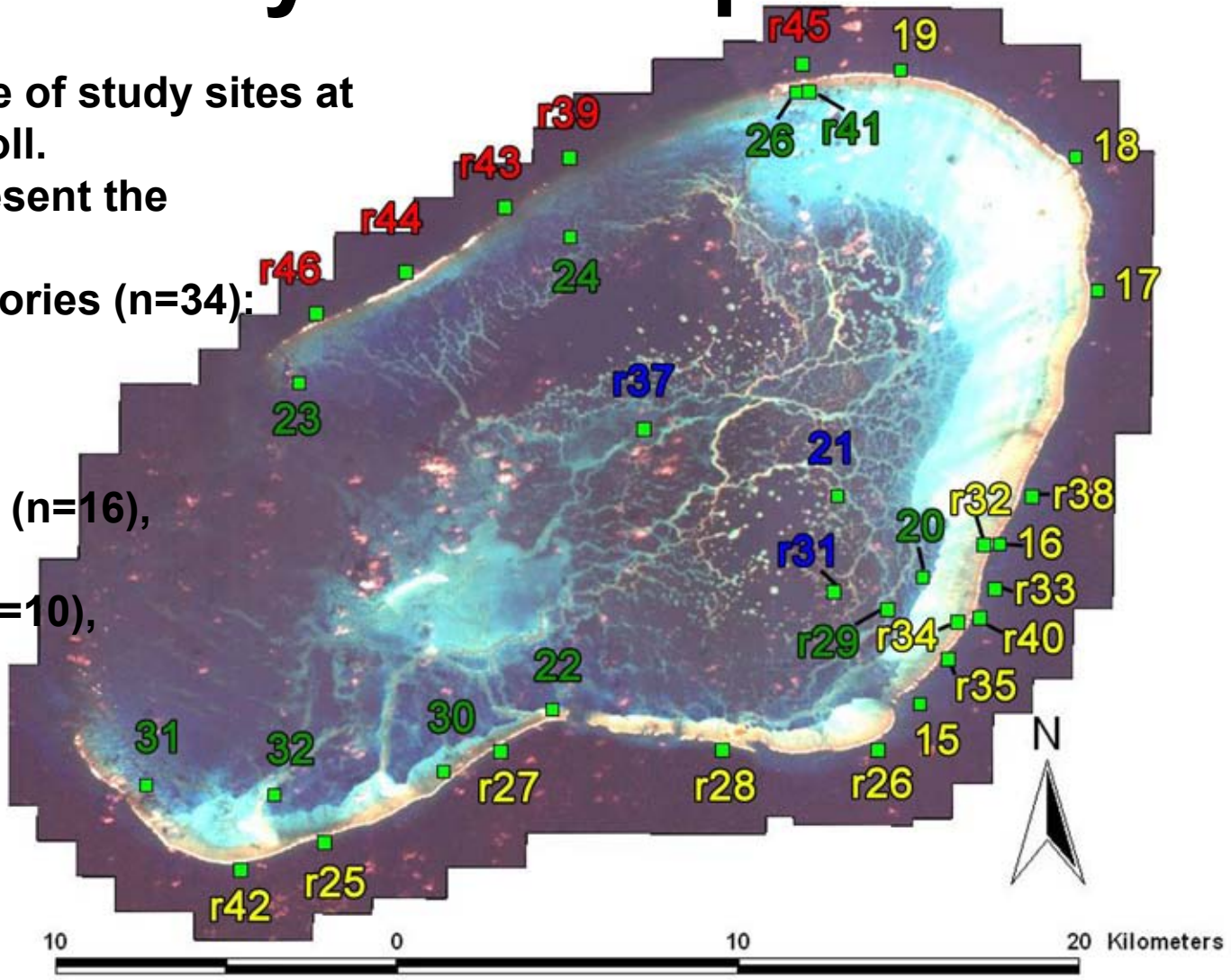


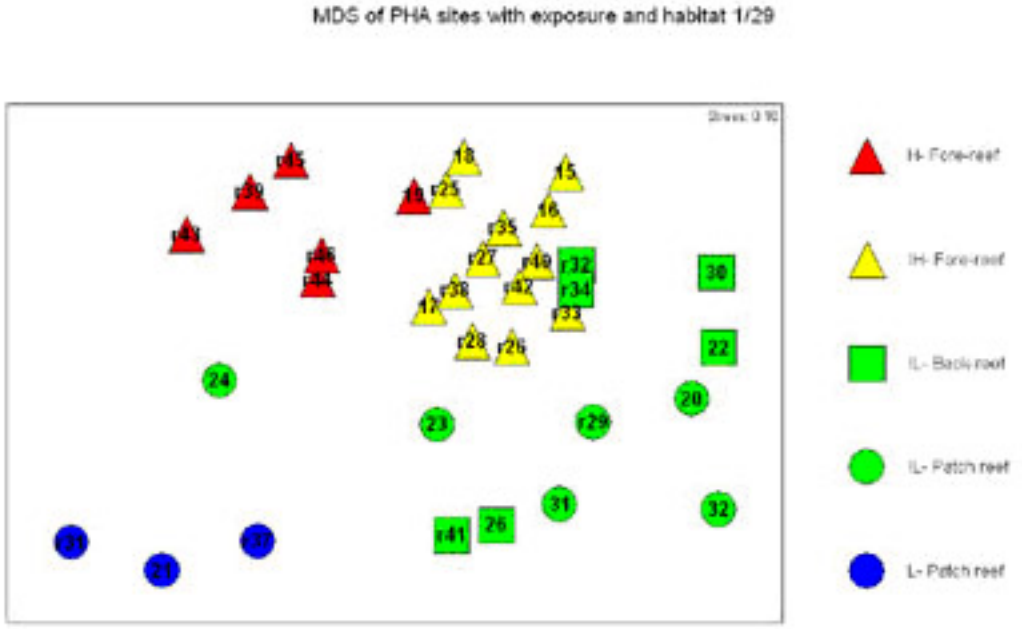
NORTHWESTERN ISLANDS AND BANKS OF THE HAWAIIAN ARCHIPELAGO

Are benthic communities structured by wave exposure?

Ikonos satellite image of study sites at Pearl and Hermes Atoll. Different colors represent the four different wave exposure categories (n=34):

red = high (n =5),
yellow =
intermediate- high (n=16),
green =
intermediate-low (n=10),
blue = low (n=3).





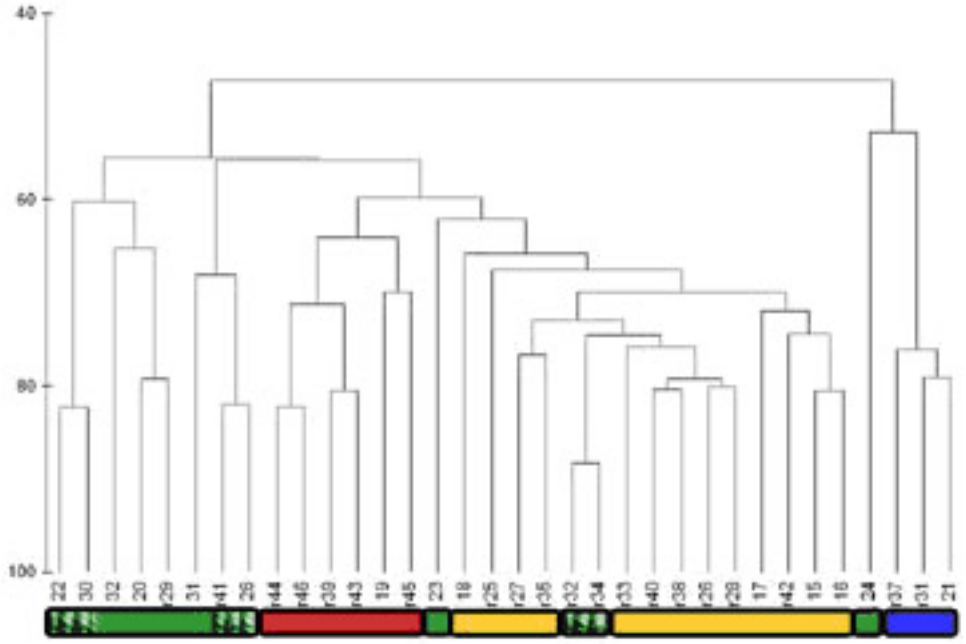
Relationship of sites at Pearl and Hermes Atoll based on benthic percent cover surveys

MDS ordination

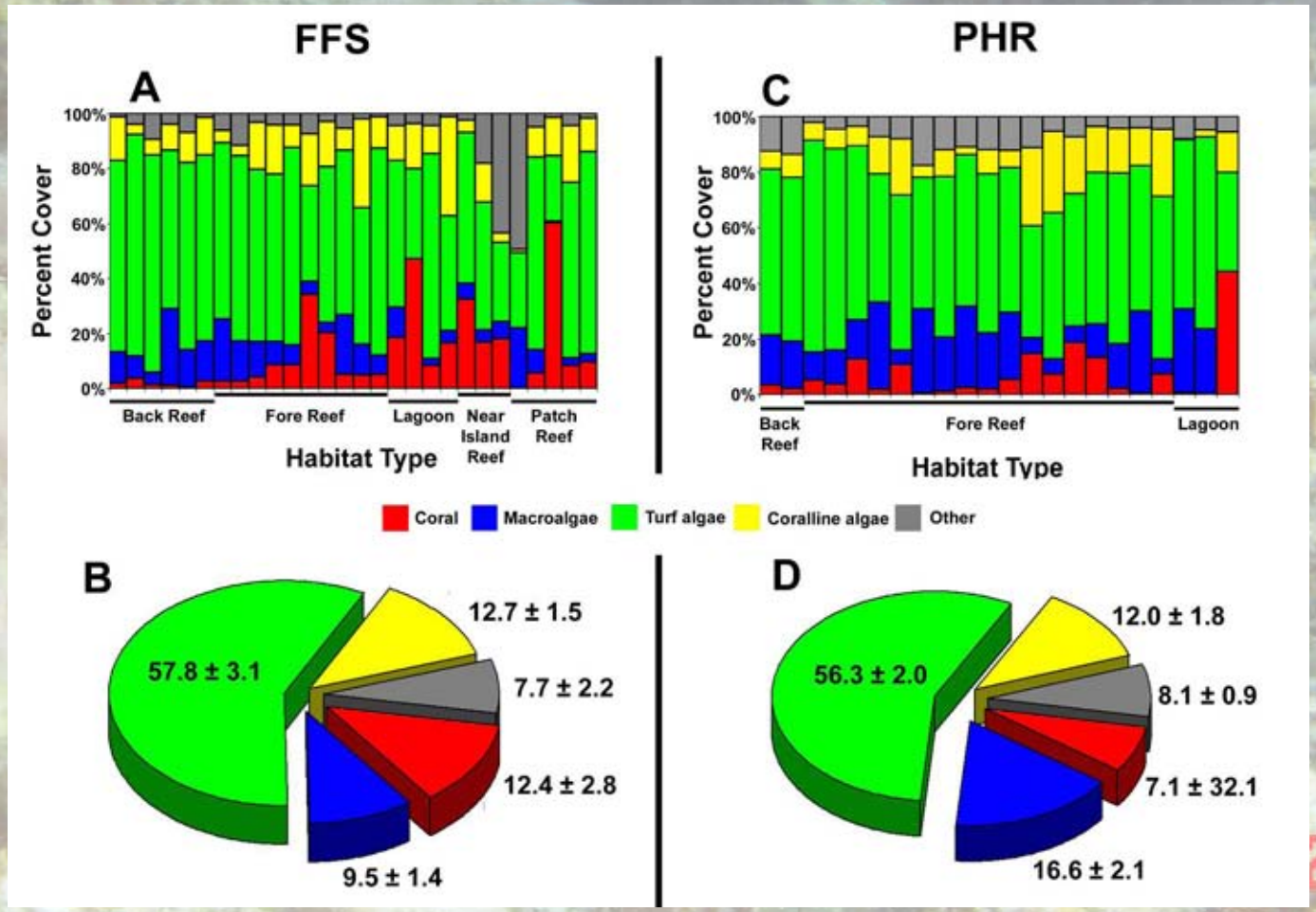
Cluster analysis

Different colors represent the four different wave exposure categories:

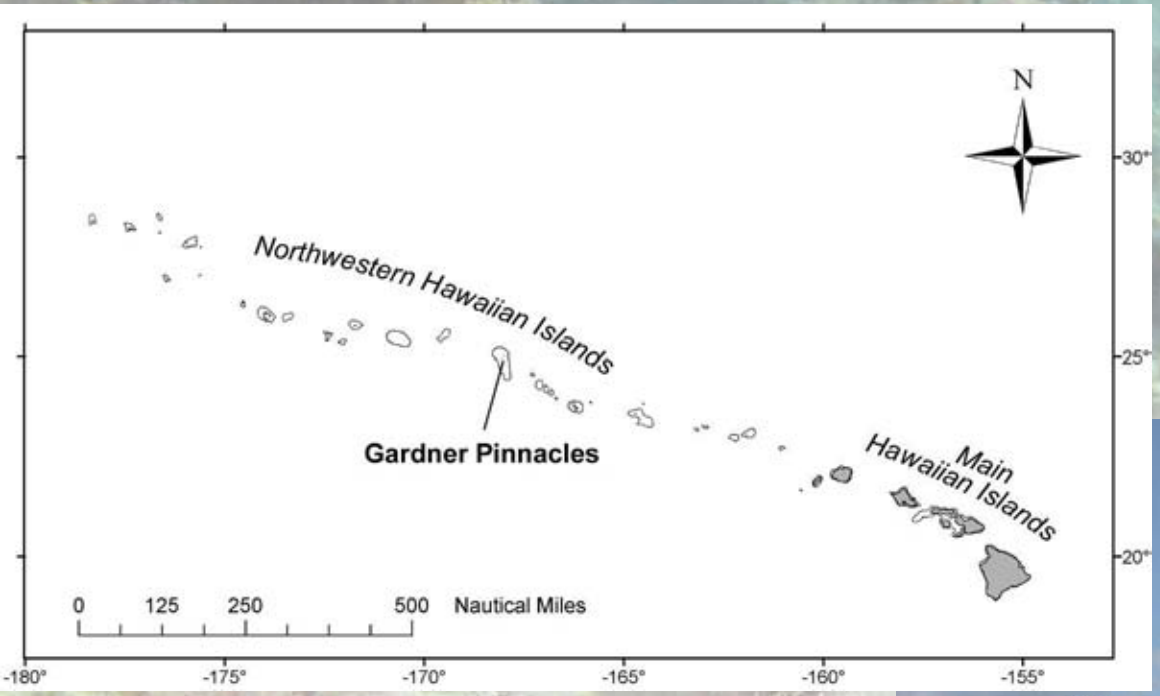
red = high,
yellow = intermediate- high,
green = intermediate-low,
blue = low.

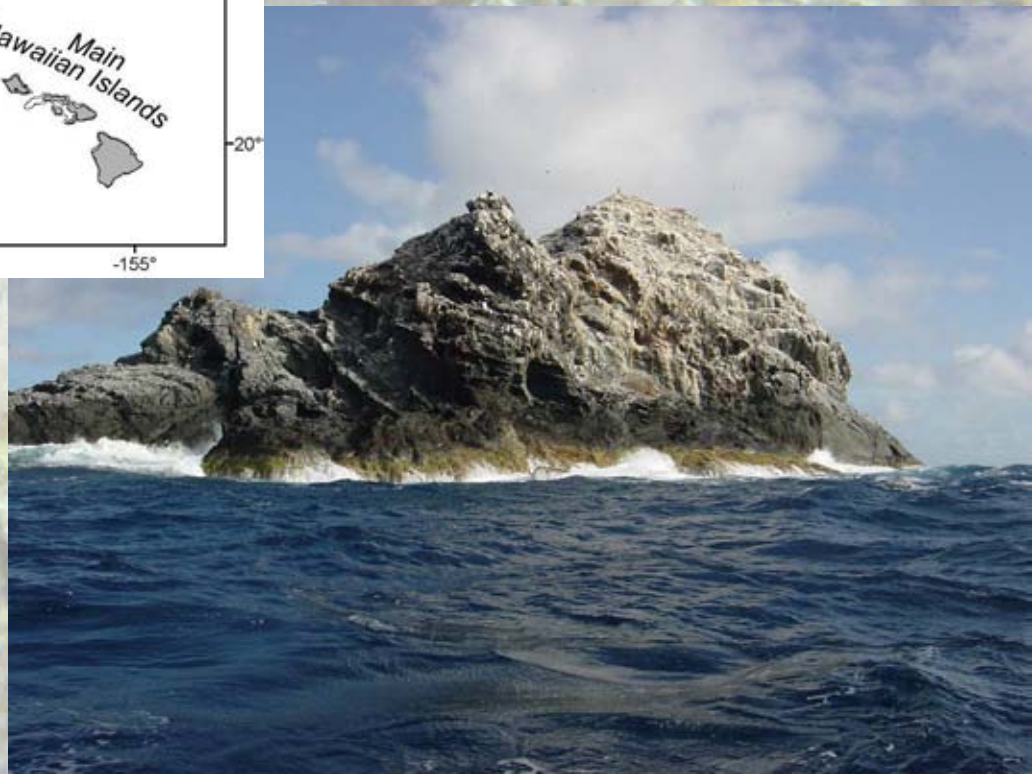


The Northwestern Hawaiian Islands contain algal dominated reefs



Temporal Analysis of Algal Communities at Gardner Pinnacles





Survey methods

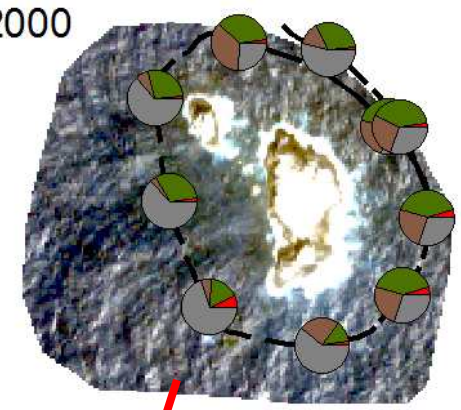
Towed Diver Surveys

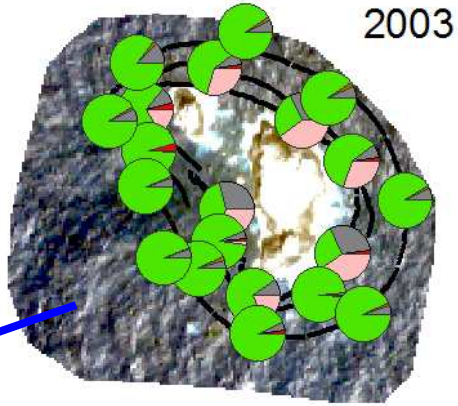
2000, 2003, 2004

Rapid Ecological Assessments -Photoquadrats

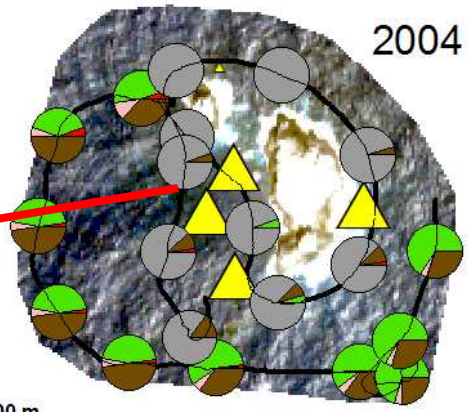
2003, 2004

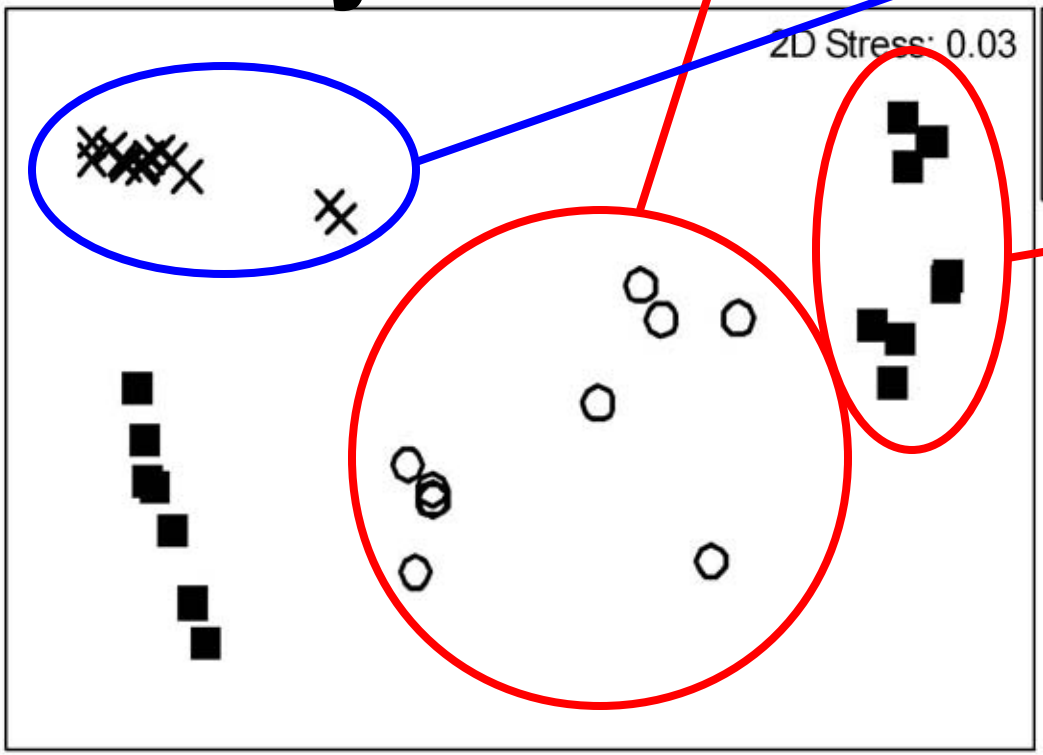
Towed REA Diver Surveys Surveys





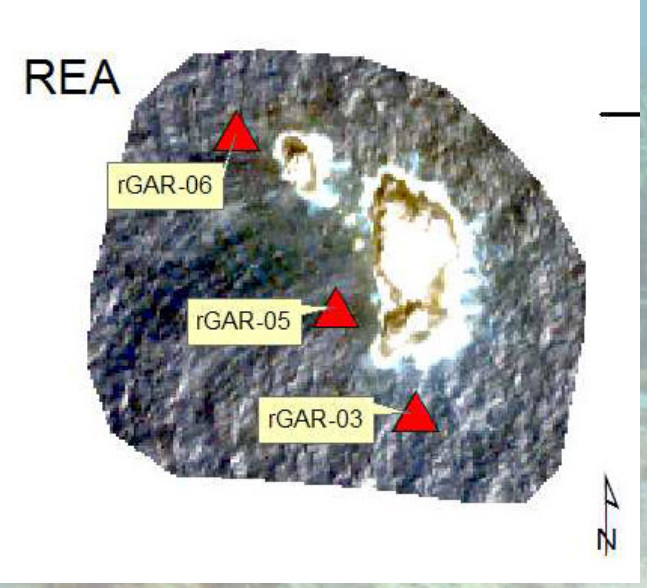
Live Coral
Algae (2000)
Macroalgae
Coralline
Sand
Turf algae
2003 and 2004
ins (25 - 50)
er Survey Track





250 500 m

- Distinct clusters by year
- 2004 separated based on location

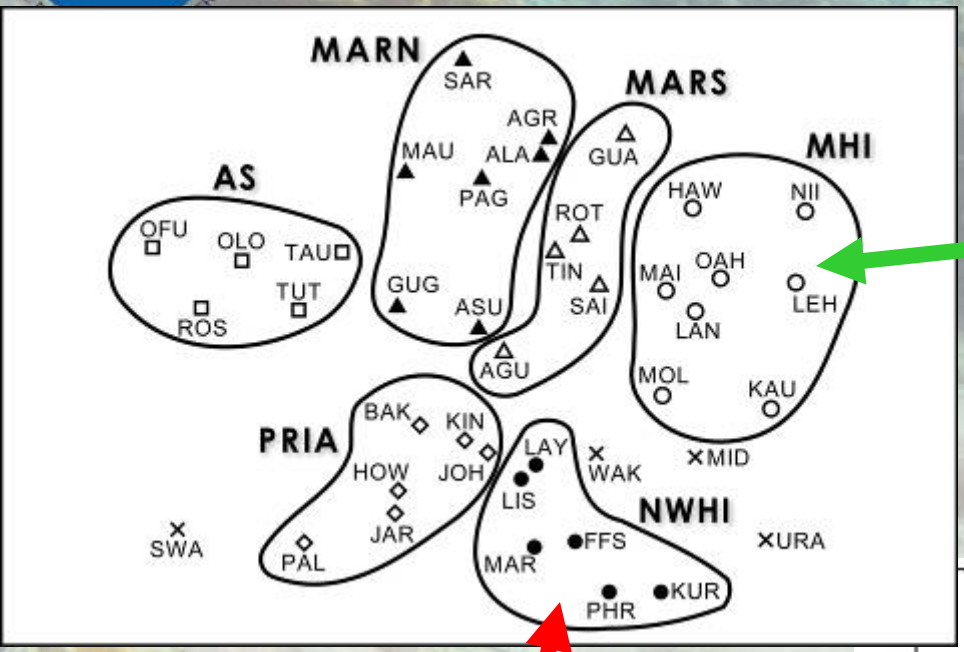


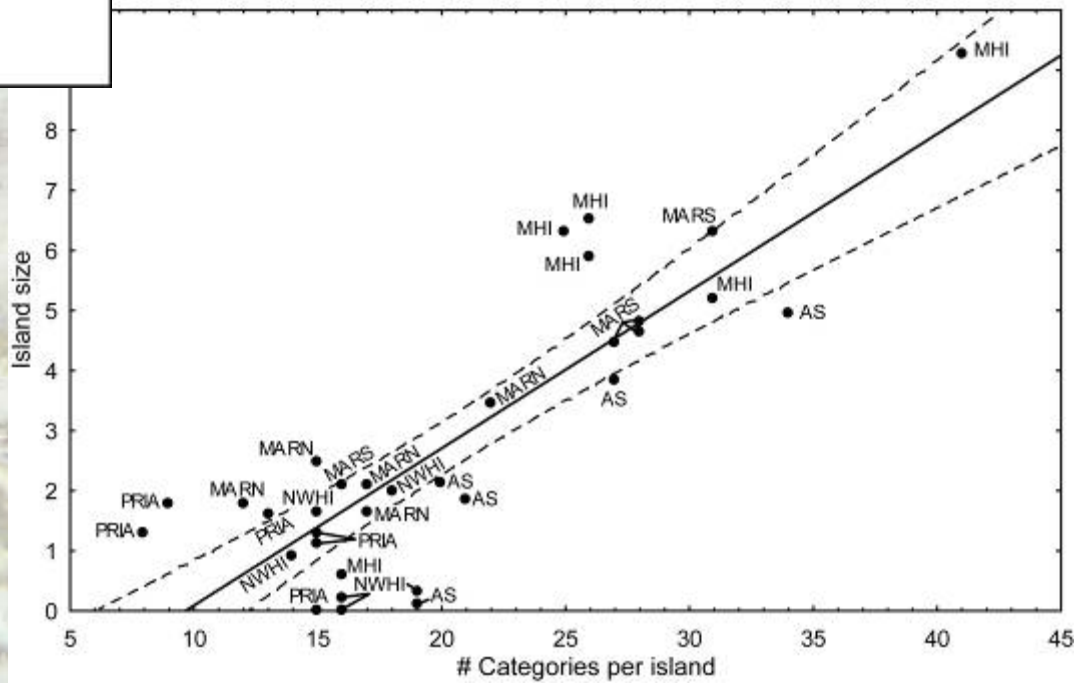
REA site surveys

	2003			2004		
	rGAR-03	rGAR-05	rGAR-06	rGAR-03	rGAR-05	rGAR-06
Turf algae	50.83	39.92	29.67	74.08	83.50	66.25
Microdictyon setchellianum	29.50	33.08	56.83	7.67	6.67	7.25
Corals						
Pocillopora meandrina	0.00	0.33	0.00	0.42	0.17	0.67
Porites lobata	3.00	8.00	3.58	5.92	2.00	5.50

27 5:29 PM

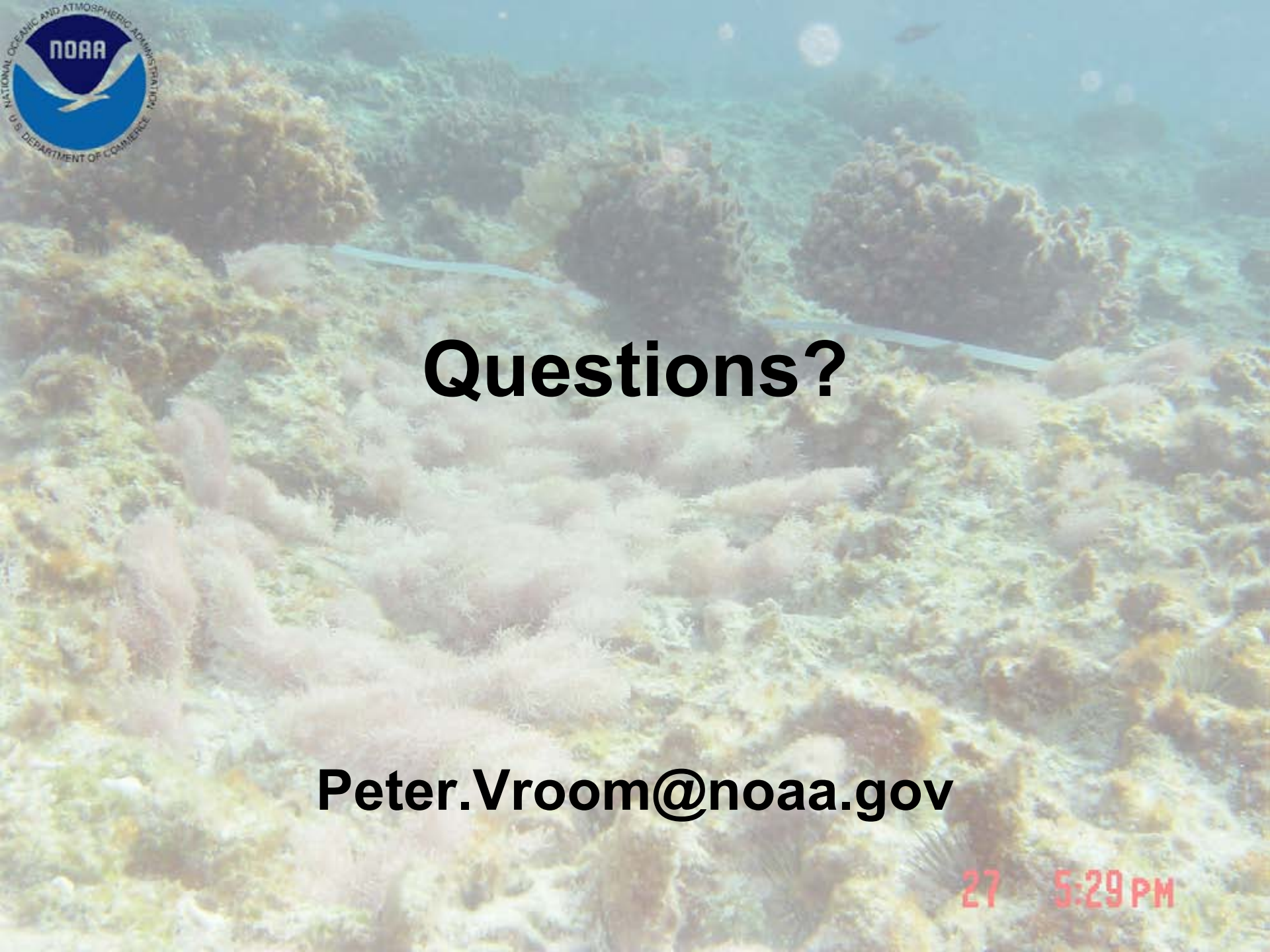
Pacific-wide Algal Comparisons





Future directions

- Papahānaumokuākea Marine National Monument has asked for a baseline study of algal populations to be completed.
- Taxonomic analysis of samples from majority of islands still incomplete.
- Data is in-hand for spatial and temporal analyses of algal communities. Funding being sought for completion of analyses.


Questions?
Peter.Vroom@noaa.gov
27 5:29 PM