

Bacterial Abundance & Diversity in the Mangroves



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Goals/Objectives

Past Year Objectives (Exploratory Studies)

- I. Determine Abundance and Diversity of Bacterial Communities Associated with the Dominant Nutrient Limitation Gradient (Wet).
- II. Identify the Response of Bacterial Communities to Nutrient Fertilization Treatments *in situ* (Wet).

Upcoming Year's Objectives (Exploratory and Explanatory Studies)

- I. Determine the Abundance and diversity of Bacterial Communities Associated with the Dominant Nutrient Limitation Gradient (Dry).
- II. Identify Nutrient Status of Bacterial Cells with Respect to the Nutrient Limitation Gradient and Fertilization Treatments.
- III. Associate the Activity of Bacteria Communities with Respect to Bacterial Biomass and Community Structure.
- IV. Identify Keystone Bacterial "Species" Associated With Nutrient Limitation Gradient and Fertilization Treatments, Test Hypotheses That These "Species" Responsible for the Maintenance of Bacterial Mediated Ecosystem Equilibrium.

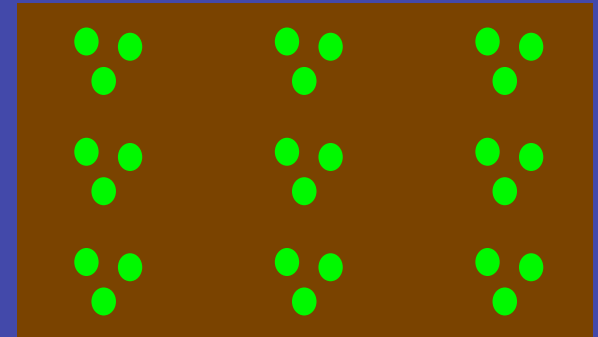
Approach

Collection of Sediment Cores (~ 30 cm)

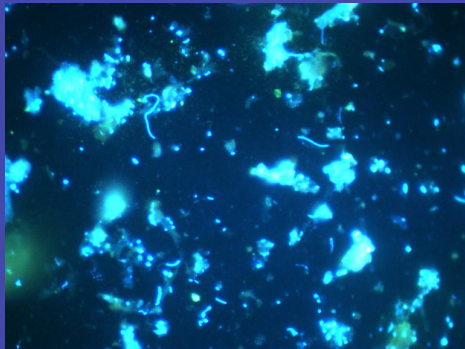


P-fertilized
Unfertilized (control)
N-fertilized

Fringe Transition Dwarf

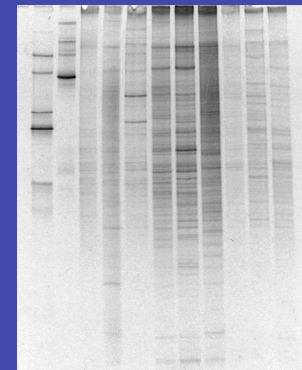


Bacterial Abundance and Cell Biovolume
Direct Microscopic Counts



Convert to Estimates in Units of:
Carbon, Nitrogen, and Phosphorus

Diversity and Structure of Bacterial Communities
DGGE (16S rDNA)



DATA GENERATED

Bacterial Cell Counts (Depth Profiles)

- Unfertilized Areas (Fringe, Transition, Dwarf Zones) From Boa Flats, Dock, and The Lair Sites, Also Man of War Cay
- Depths (0-1 cm, 1-3 cm, 3-5 cm, 5-10 cm, 10 - ~30 cm)
- Fertilized Transects in Boa Flats Site

- Data Expressed as Cells/g sediment and converted to units of: Cells/g, gC/M³, gN/M³, and gP/M³

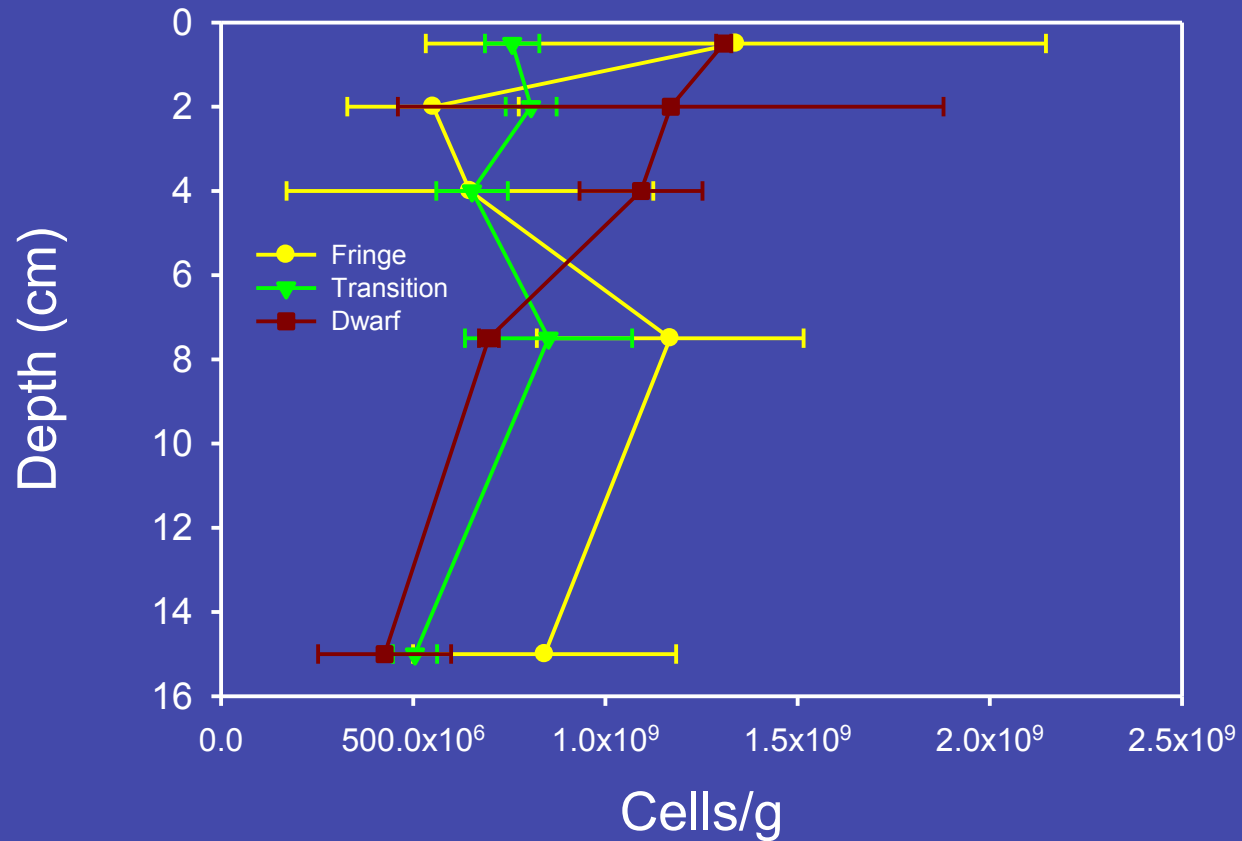
Bacterial Community Diversity

- Denaturing Gradient Gel Electrophoresis Gels
Comparisons of Community Structure Between Sites, Dates, Depths, & Fertilization Treatments.

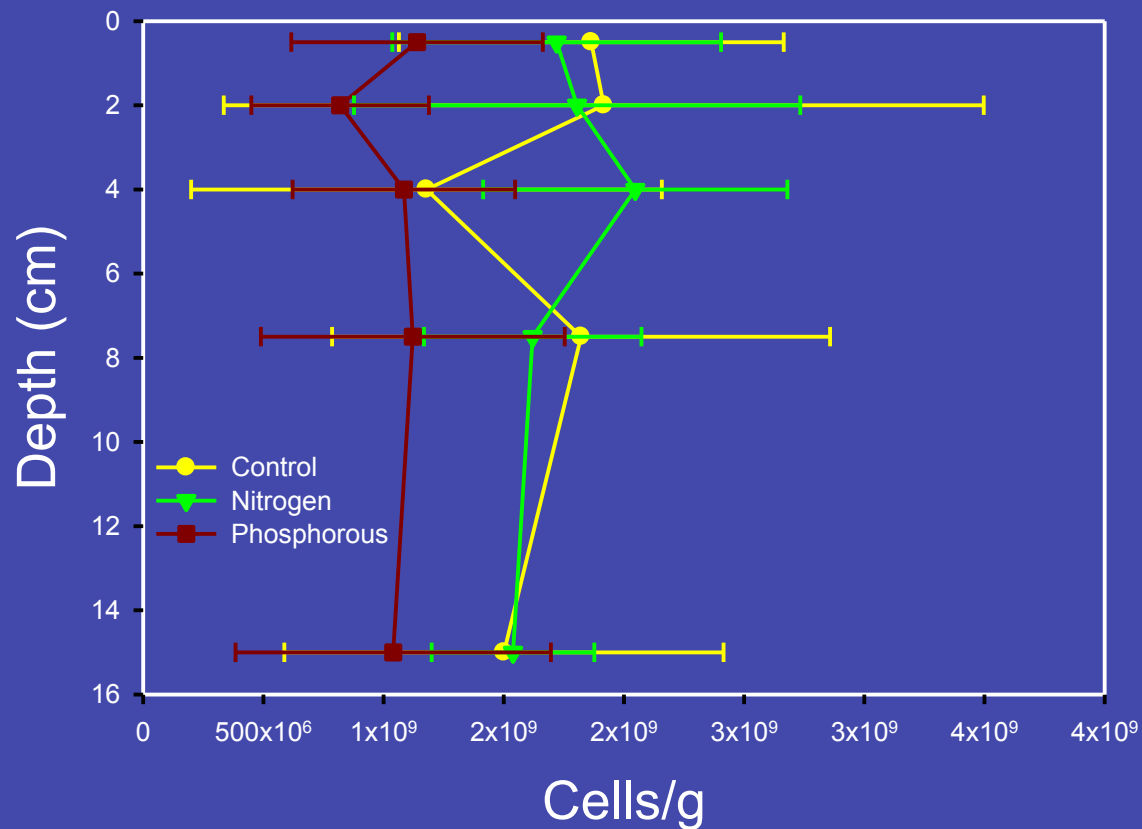
- Data Expressed as a Community Similarity Index. Identification of Groups “Species” of Bacteria that are Similar or Different Between Comparisons.

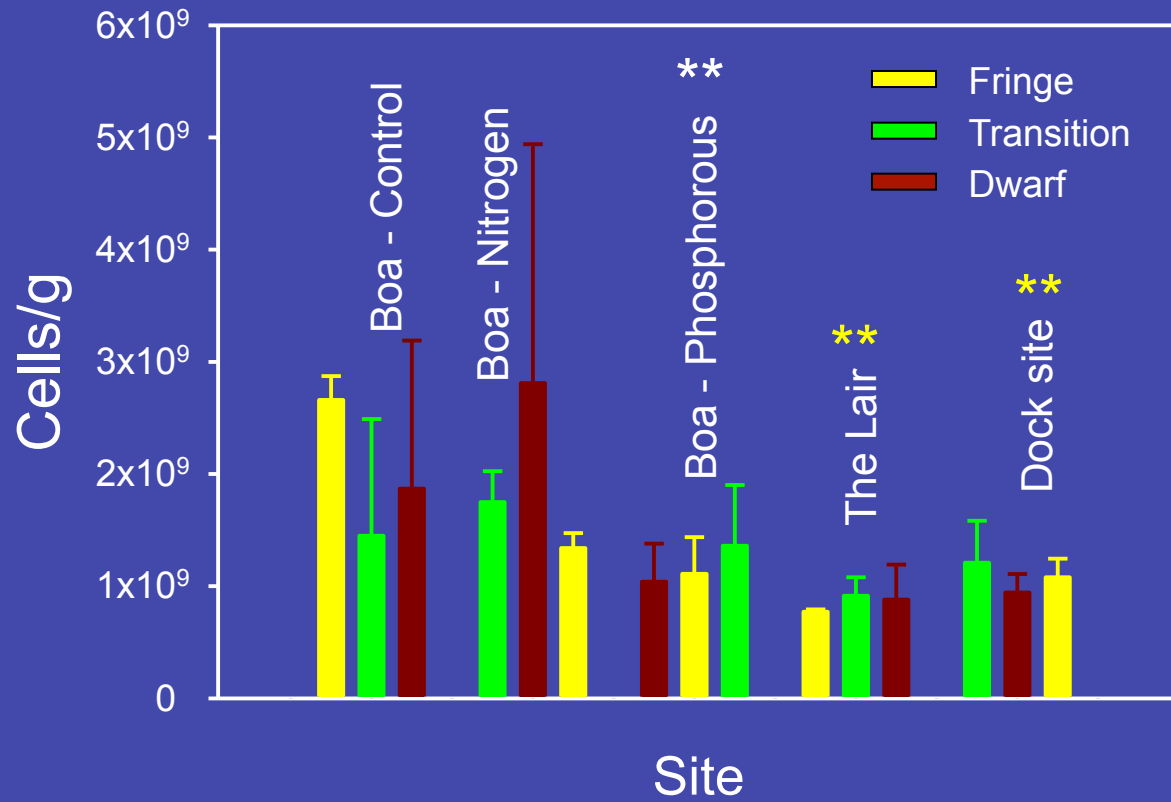
- ❖ **Extracted Total DNA from All Samples Available**

Cell Abundance – BOA Flats site (Wet Season)

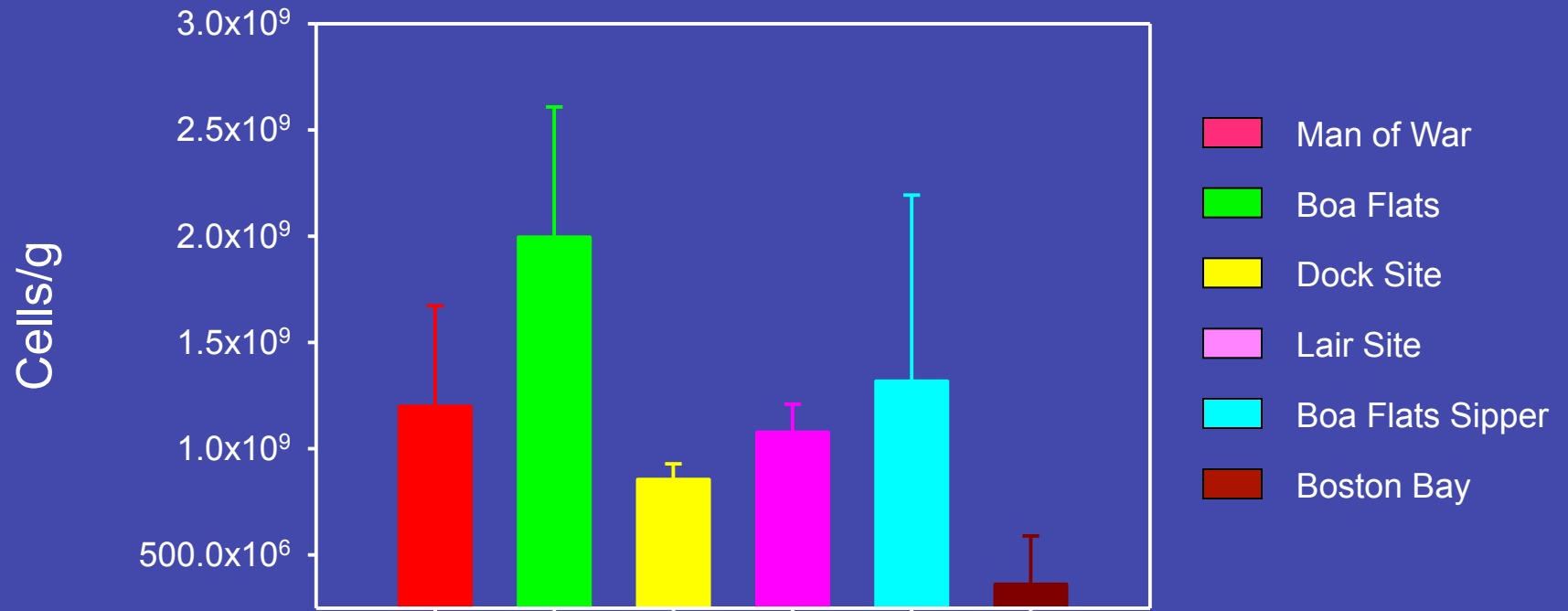


Fertilization Effects Boa Flats Site – Wet Season

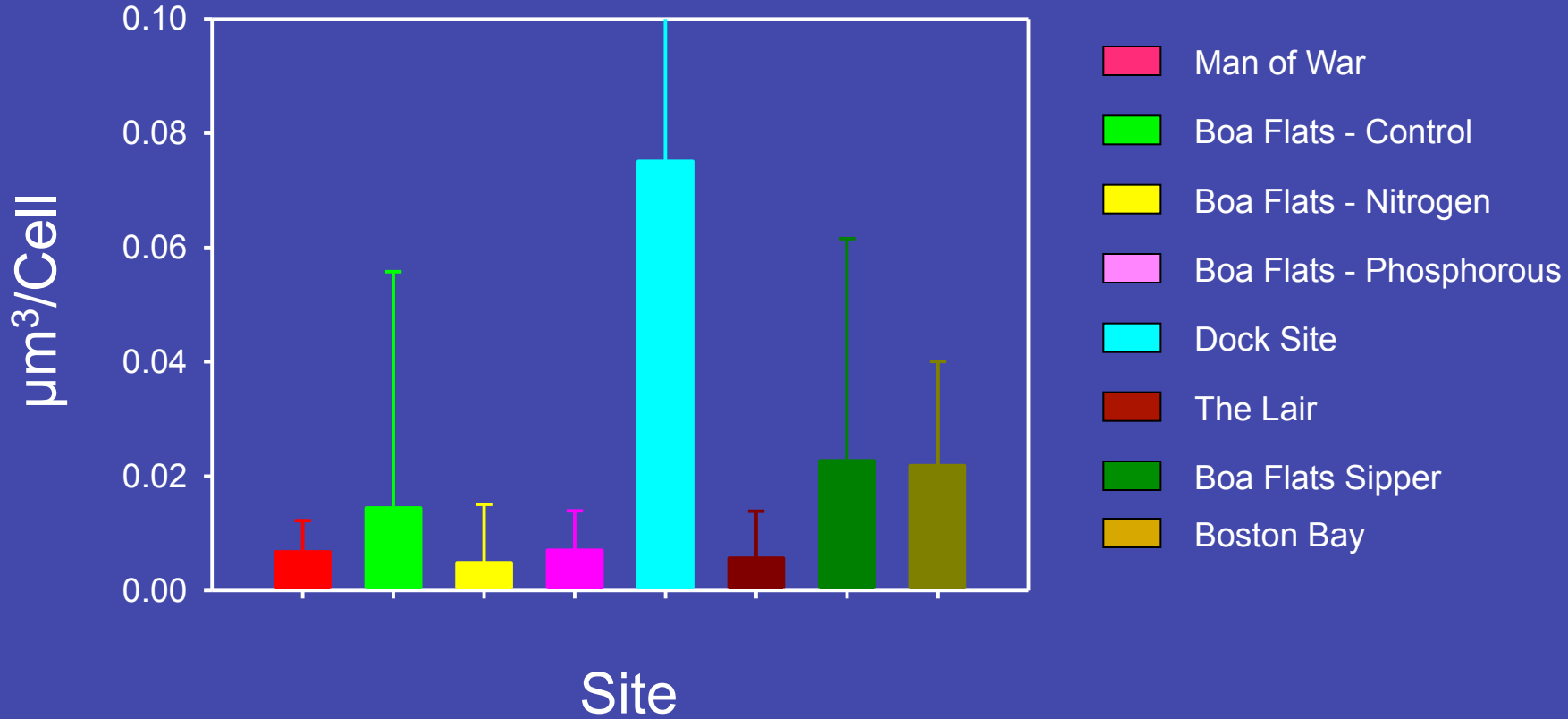


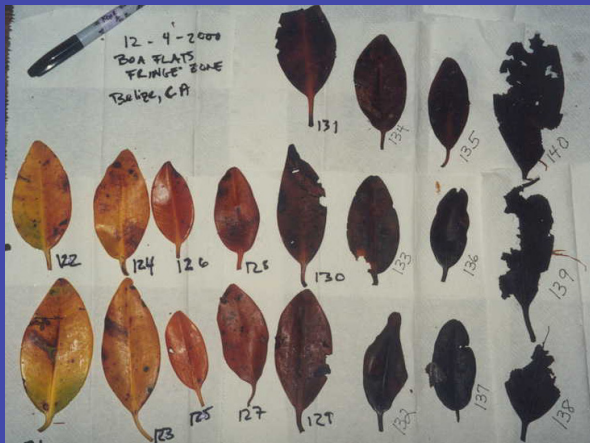


Depth Integrated Cell Abundance July 2001 (wet season)



Average Cell Biovolume Wet Season



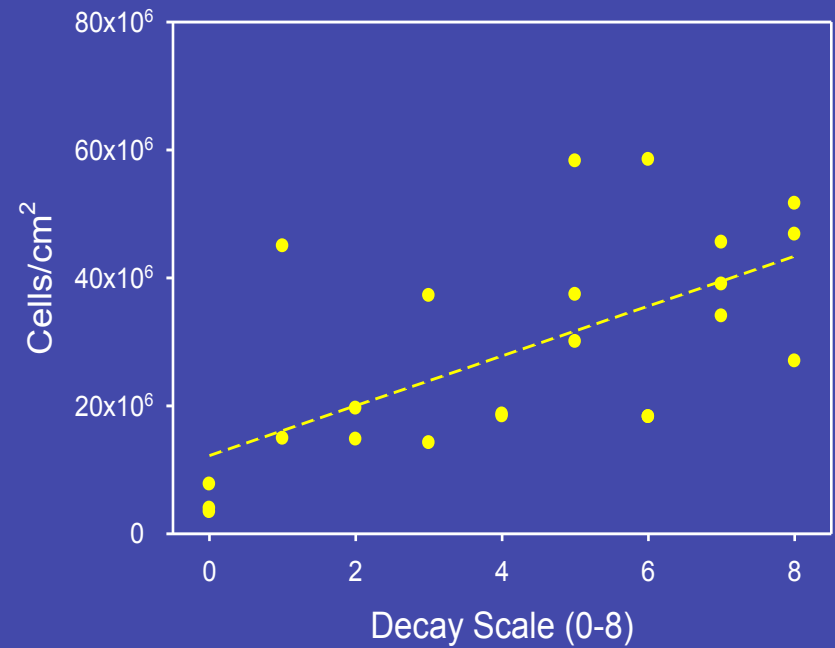
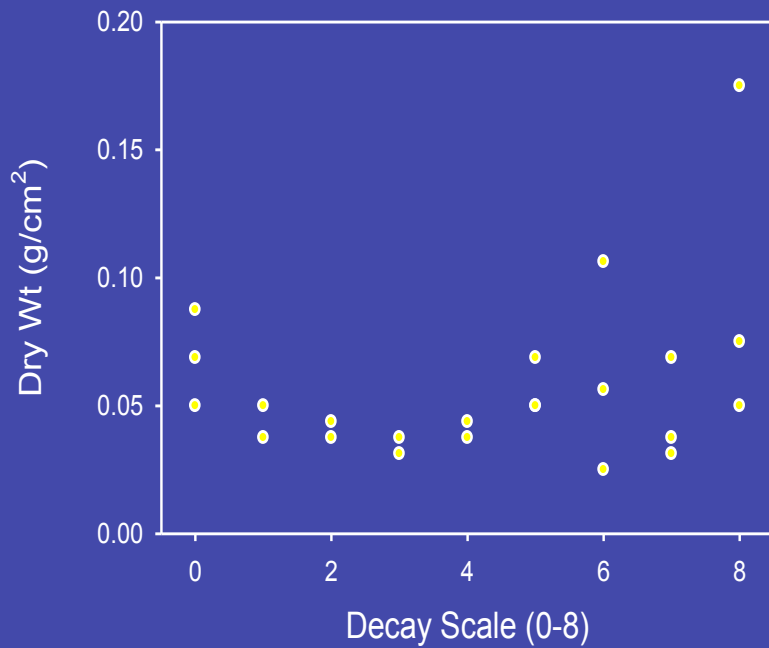


1 2 3 4 5 6 7 8



1 2 3 4 5 6 7 8

0



Estimated Bacterial C, N, and P Biomass in Twin Cays Peat Sediment

	Cells/g	Cells/M ³	gC/M ³	gN/M ³	gP/M ³
Boa Flats (C)	1.67 (1.07) x 10 ⁹	3.34 (2.1) x 10 ¹⁴	13.35 (2.57)	4.00 (2.57)	0.93 (0.60)
Boa flats (N)	1.60 (0.61) x 10 ⁹	3.2 (1.2) x 10 ¹⁴	12.81 (4.89)	3.84 (1.47)	0.90 (0.34)
Boa Flats (P)	1.17 (0.56) x 10 ⁹	2.34 (1.1) x 10 ¹⁴	9.35 (4.49)	2.80 (1.35)	0.65 (0.31)
Dock/Lair	0.97 (0.44) x 10 ⁹	1.9 (0.9) x 10 ¹⁴	7.73 (3.54)	2.32 (1.06)	0.54 (0.25)
Leaves	5.03 (2.4) x 10 ⁶	On Tree	2.0 (0.9)x10 ⁻³	6.0 (2.8)x10 ⁻⁴	1.4 (0.7)x10 ⁻⁴
	3.24 (1.5) x 10 ⁷	On Ground	1.3 (0.6)x10 ⁻²	3.9 (1.8)x10 ⁻³	9.1 (4.2)x10 ⁻⁴

Estimated Sediment Density 0.2g/cm³

Leaves per/cm²

fgC/cell = 40; fgN/cell = 12; fgP/cell = 2.8

[Vrede et al (2002) Appl Environ Microbiol 68: 2965-2971] for C-starved cells

Bacterial Community Structure

Versus:

Depth

Tree Zone

Date

Fertilization Treatment

Site



Tina Walters



Jean Danforth



0-1

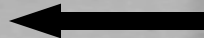
1-3

3-5

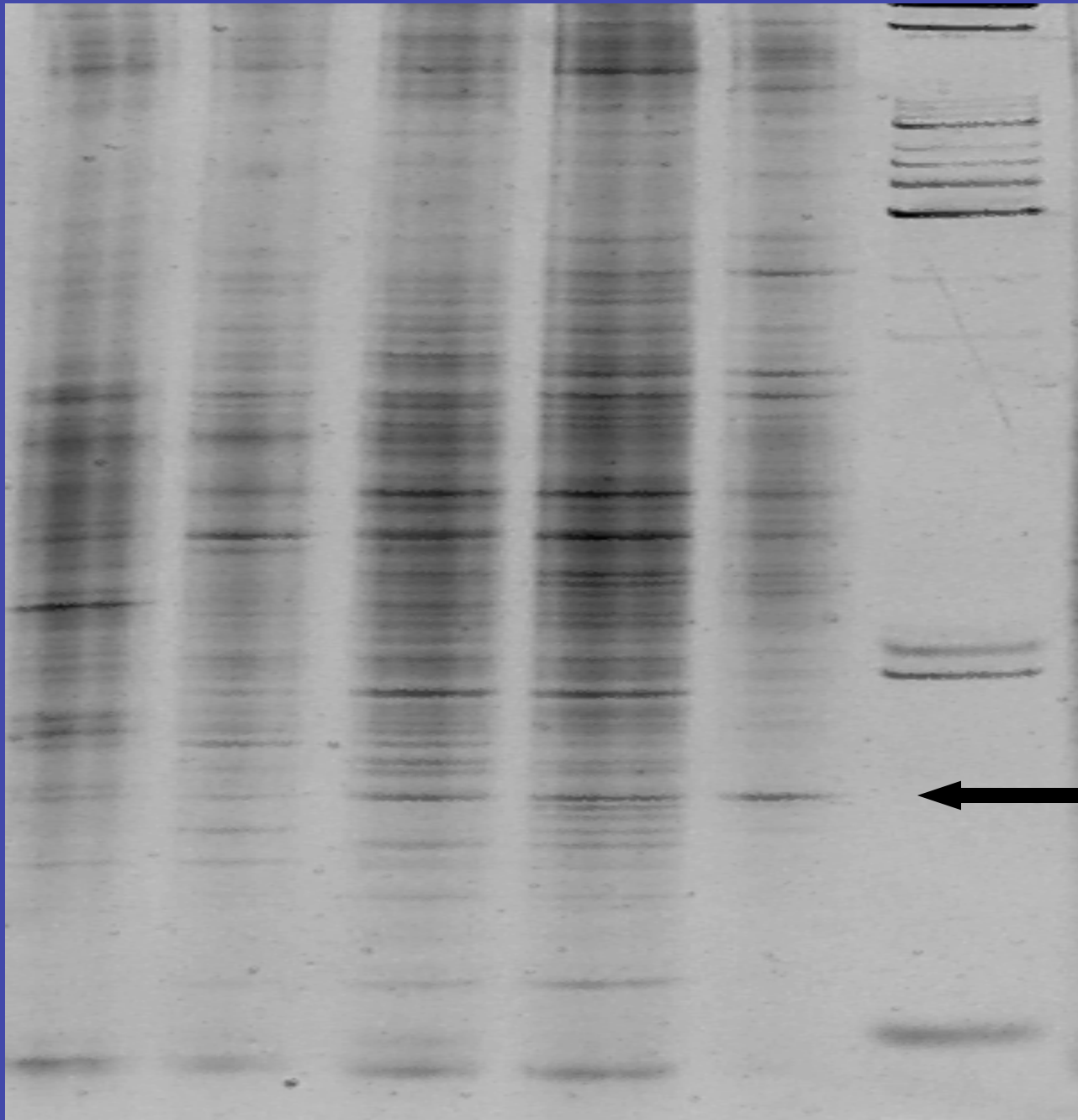
5-10

10-30

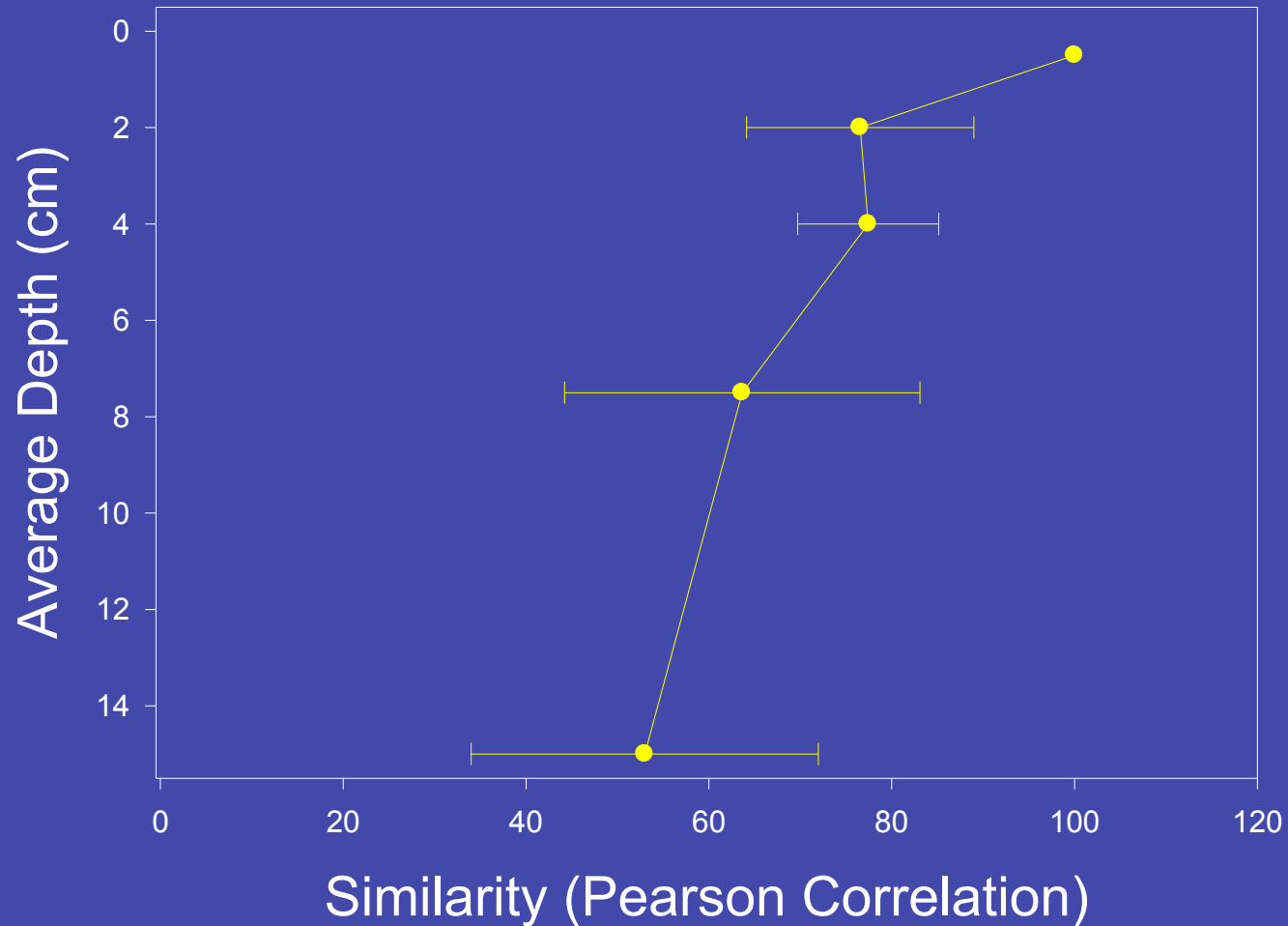
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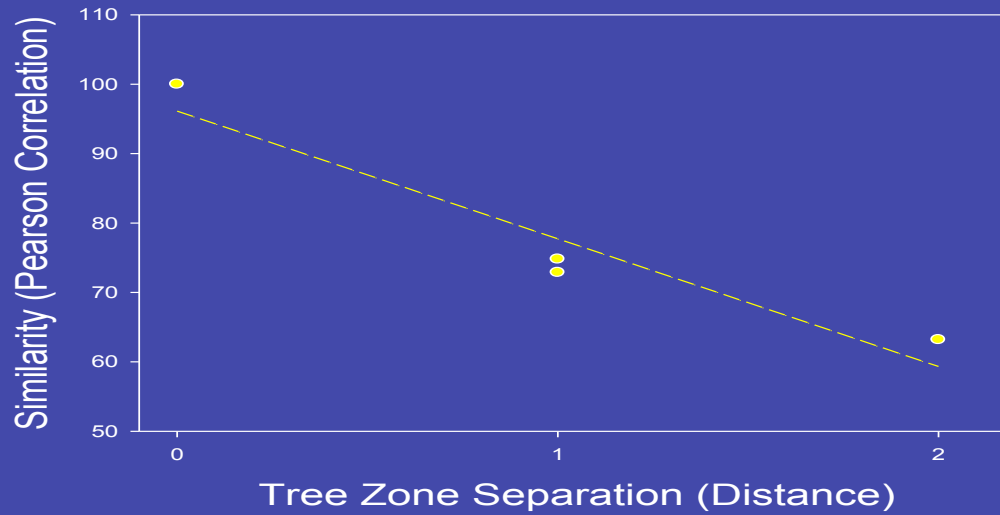
13 – 34 Bands
Average = 19



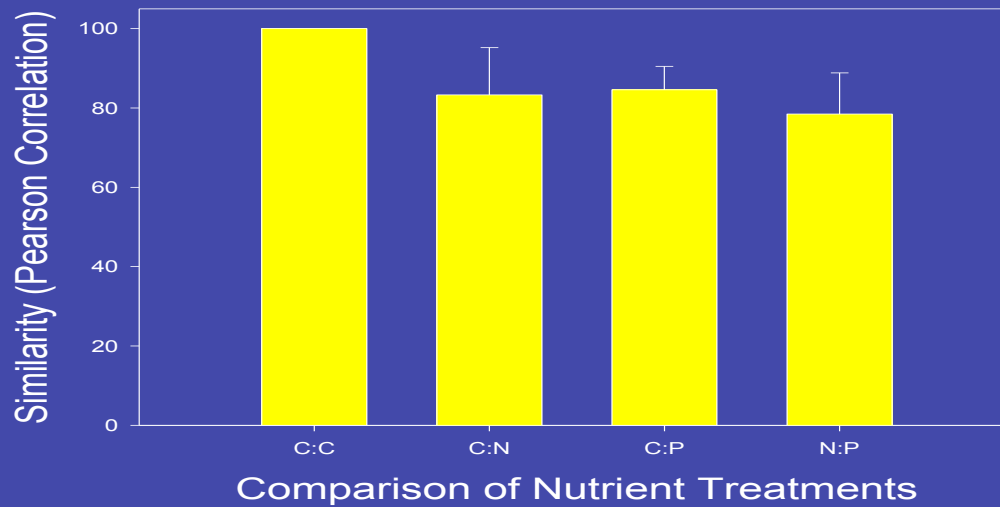
Community Structure Vs. Depth (Surface vs Other Depths)



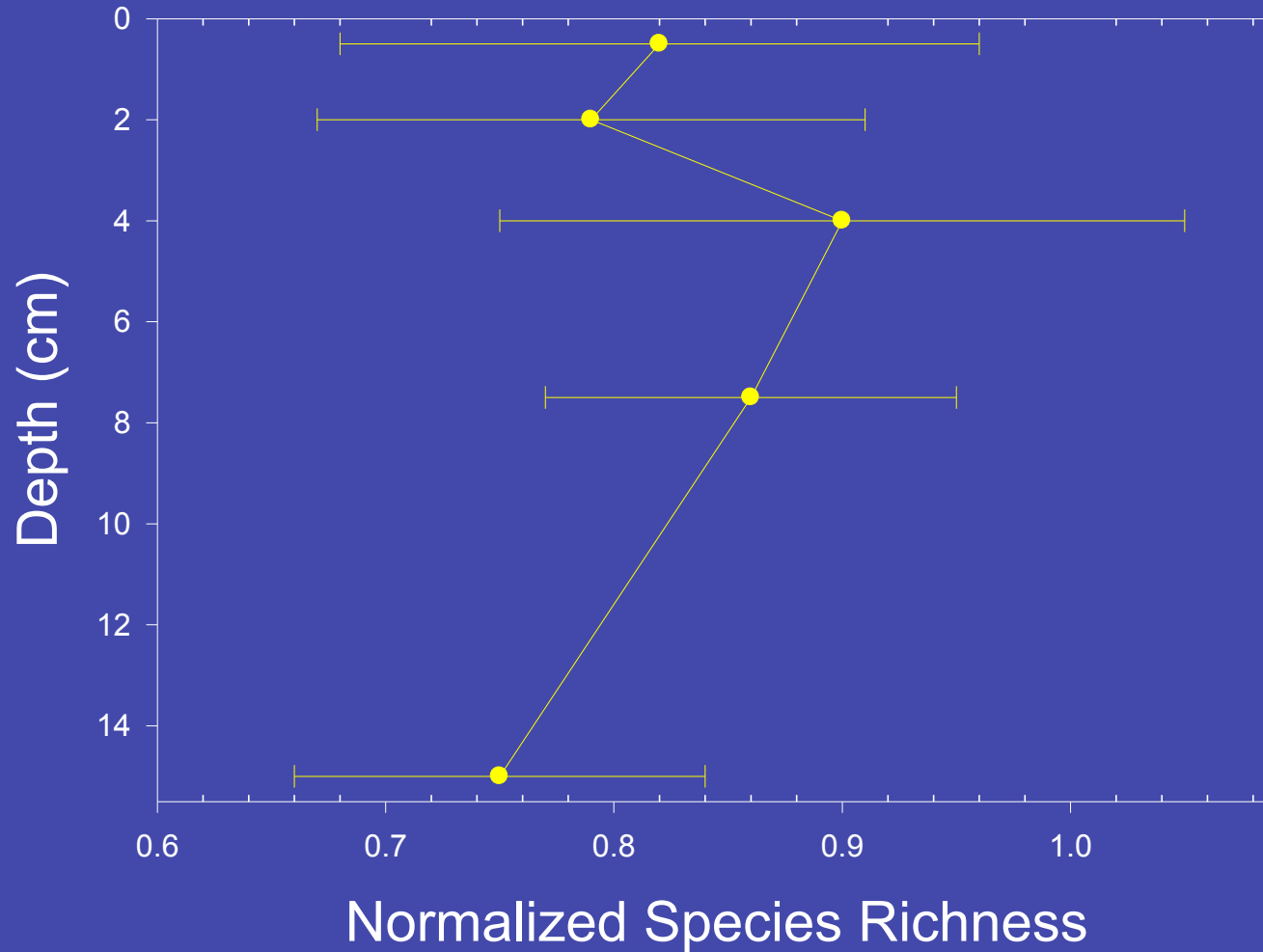
Community Structure vs Tree Zone



Community Structure vs Fertilization



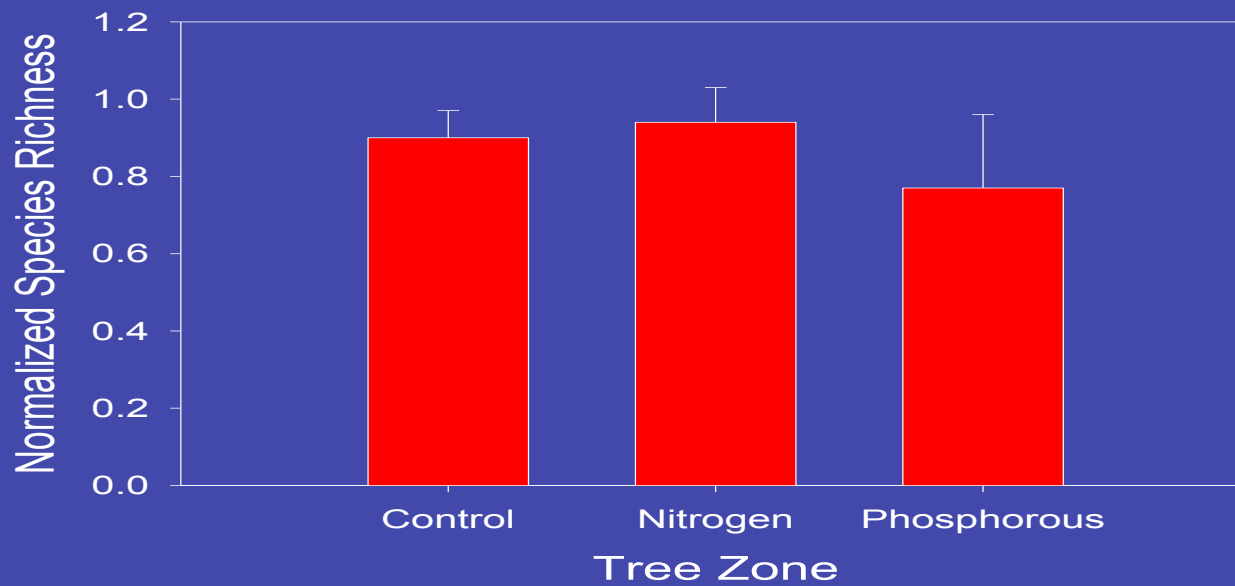
Species Richness vs Depth



Species Richness Vs. Tree Zone



Species Richness Vs. Fertilization Treatment



Bacterial Abundance & Biomass

Sediments

1 – 2 x 10⁹ cells/g
(7.7 – 13.4 gC/M³; 2.3 – 4 gN/M³; 0.65 – 0.93 gP/M³)

Leaves

3 – 5 x 10⁶ cells/cm² (On Tree)
2.5 – 4.5 x 10⁷ cells/cm² (On Ground)

- **Slight Decline in Cell Abundance with Depth**
- **Cell Abundance Variable With Site (Nutrient Limitation??)**
- **Minimum Impact of Fertilization (??? Phosphorous) – Carbon Limitation?**
- **Small Cells (0.006-0.075 μm³/cell)**

Bacterial Diversity

Community Similarity

- Decreases with Depth Separation
(Surface vs 15-30 cm ~ 55% similar)
- Decreases with Zone Separation
(Fringe ~ 65% similar to Dwarf;
Dwarf & Fringe ~ 75% similar to Transition)
- Between Fertilization Treatments ~ 80%

Species Richness

- High in 10 30 cm
- Not Effected By Fertilization
- Not Effected By Zone

Continuing Questions

What Is Limiting Bacterial Abundance (Carbon)?

Identity of Organisms That Differentiate Bacterial Communities Associated With:

1. Depth
2. Tree Zone
3. Fertilization Treatment

Total Community Activity & Turnover Rates?

Community Structure and Identity of Leaf & Wood Degrading Bacterial Communities?