



# Nutrient Monitoring Program

## Results

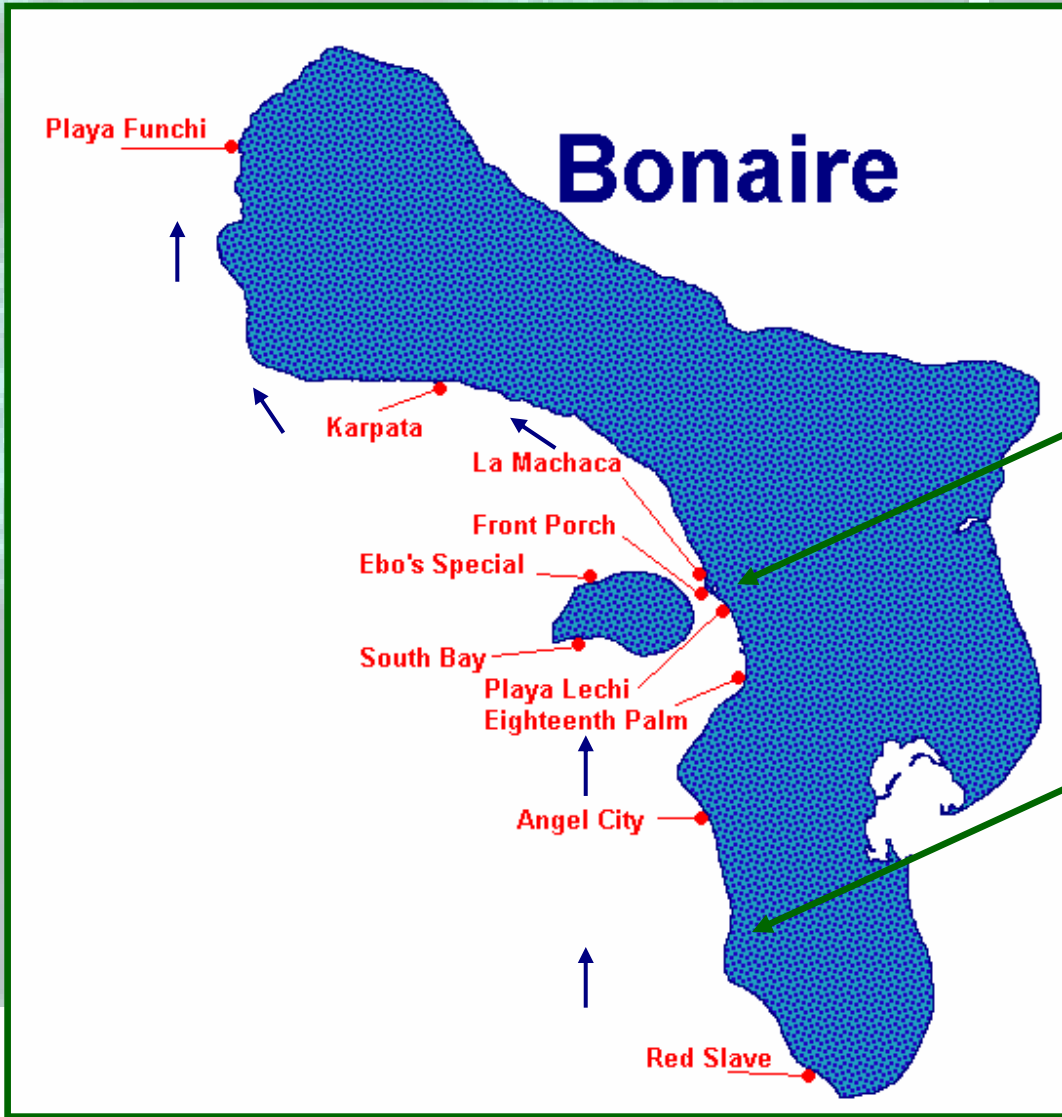
By Mark Wieggers

# Outline of the Presentation

- Results of Reef Cover
- Results of Chlorophyll  $\alpha$
- Results of  $\delta^{15}\text{N}$
- Results of Nutrients
- Conclusions

Nutrient Monitoring Program

# Order of the Data



Kralendijk

Salt  
Company

Nutrient Monitoring Program

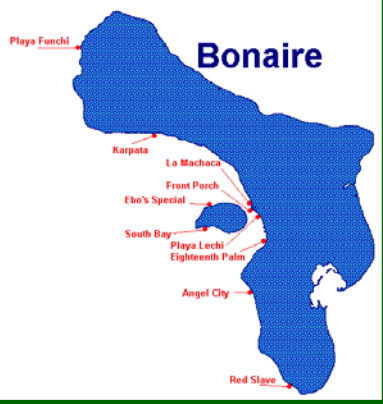
# Order of the Data



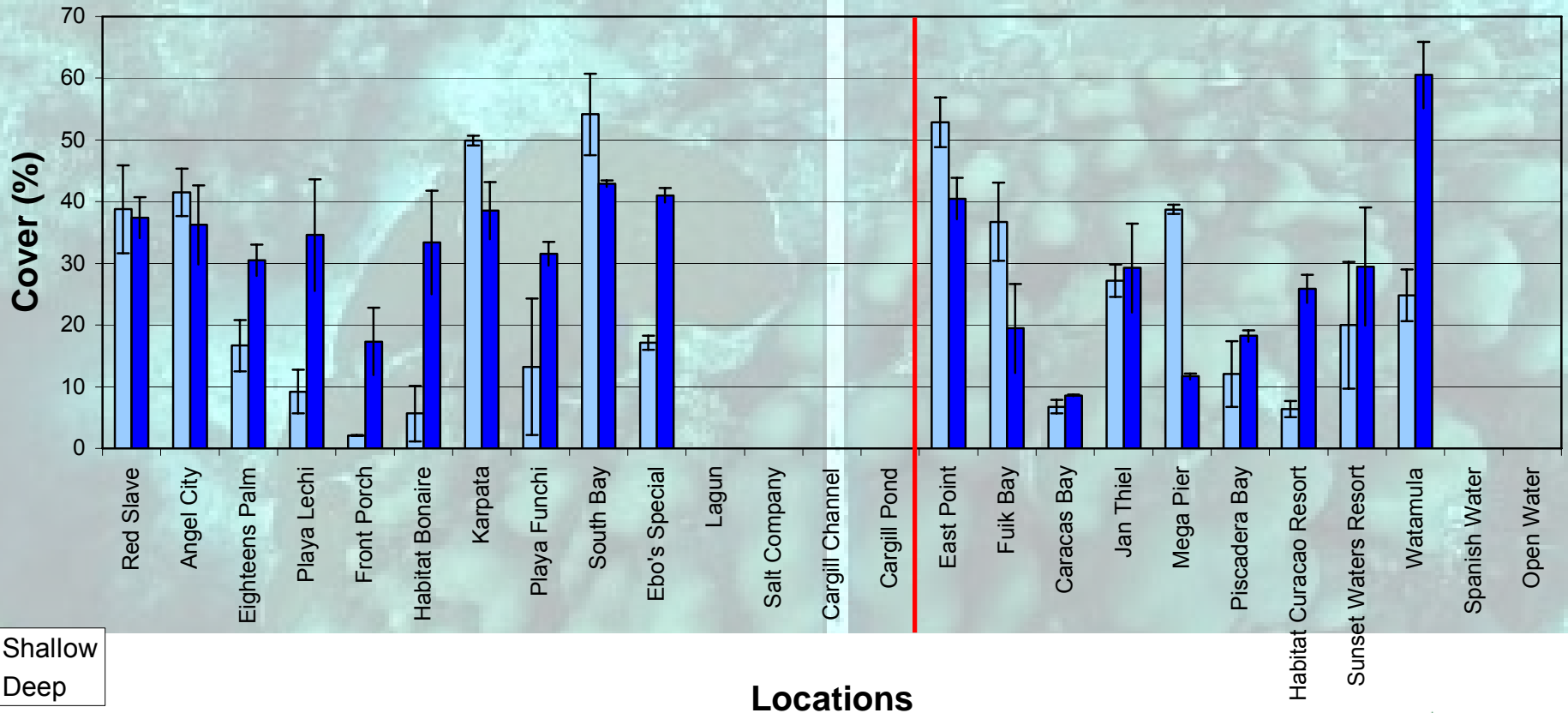
Willemstad

Nutrient Monitoring Program

# Results of Coral Cover

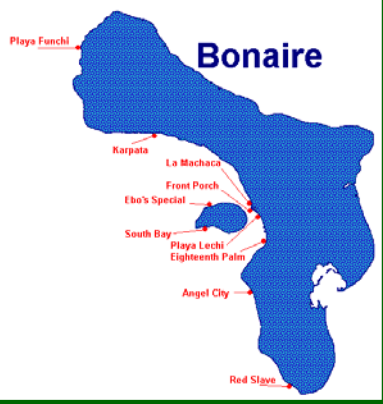


Tukey Test: 10 Groups

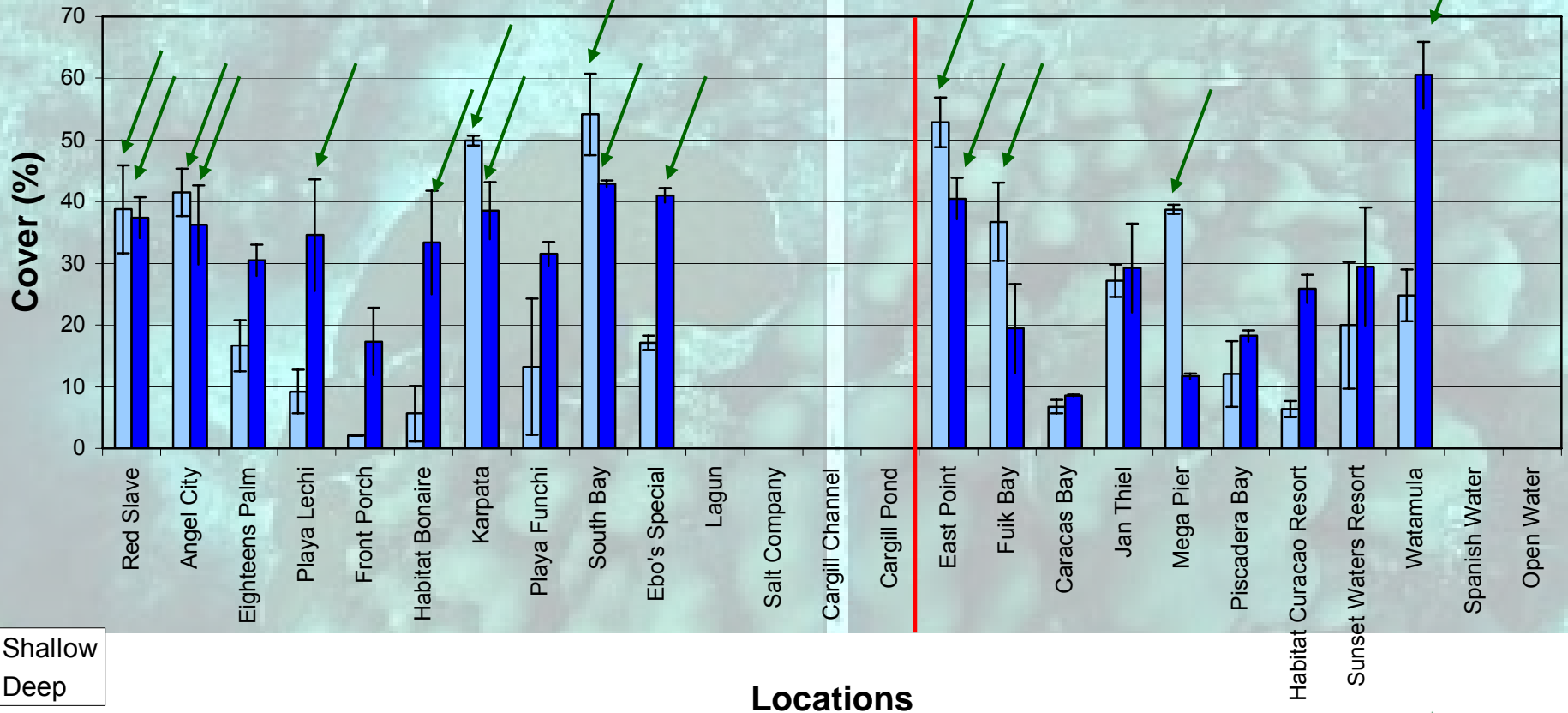


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# Results of Coral Cover

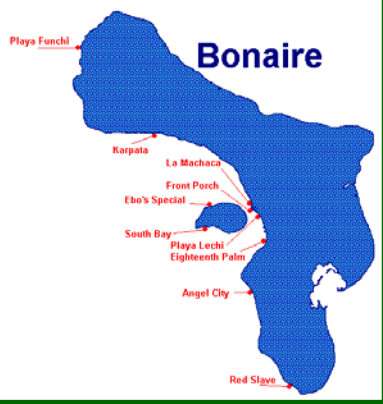


## Group 10

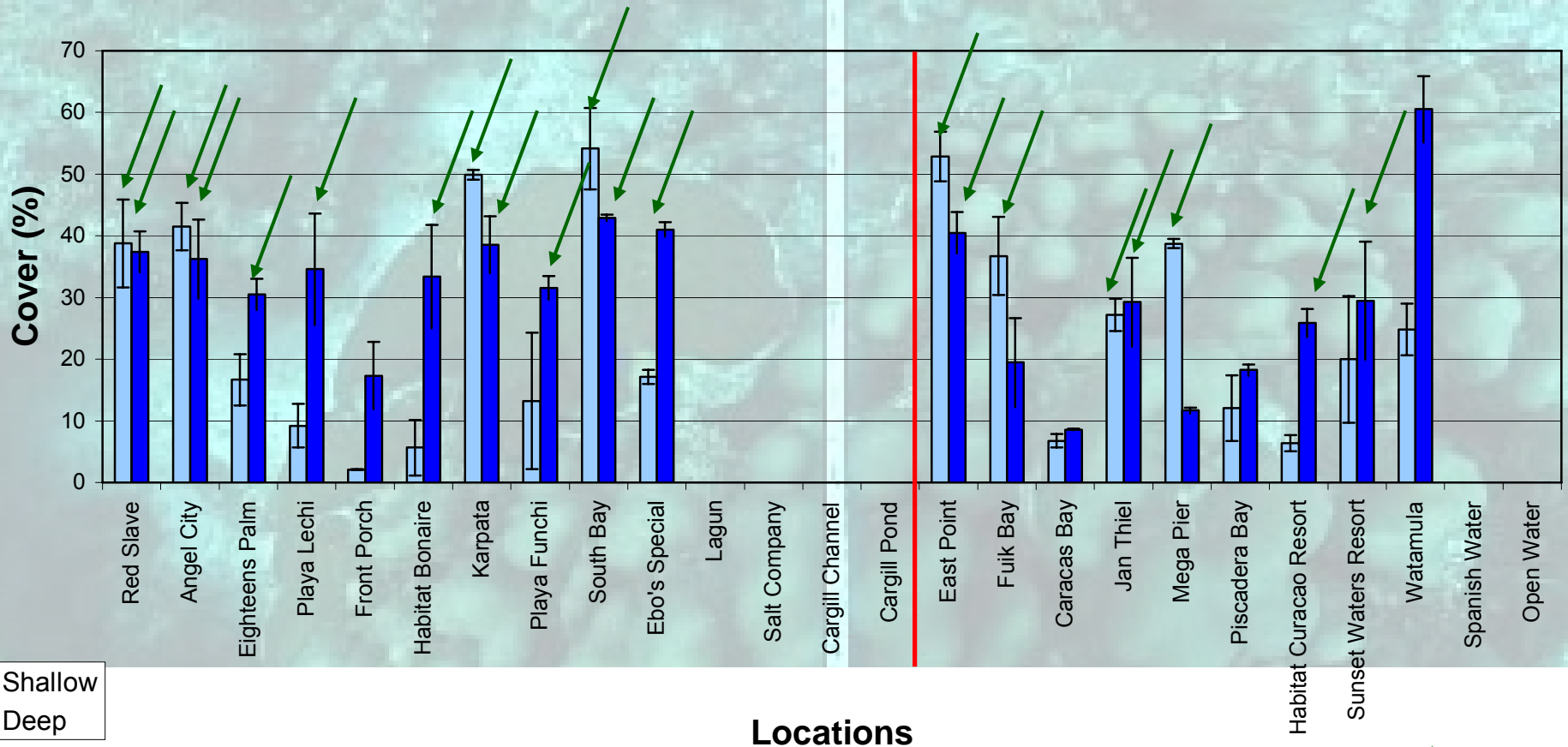


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# Results of Coral Cover

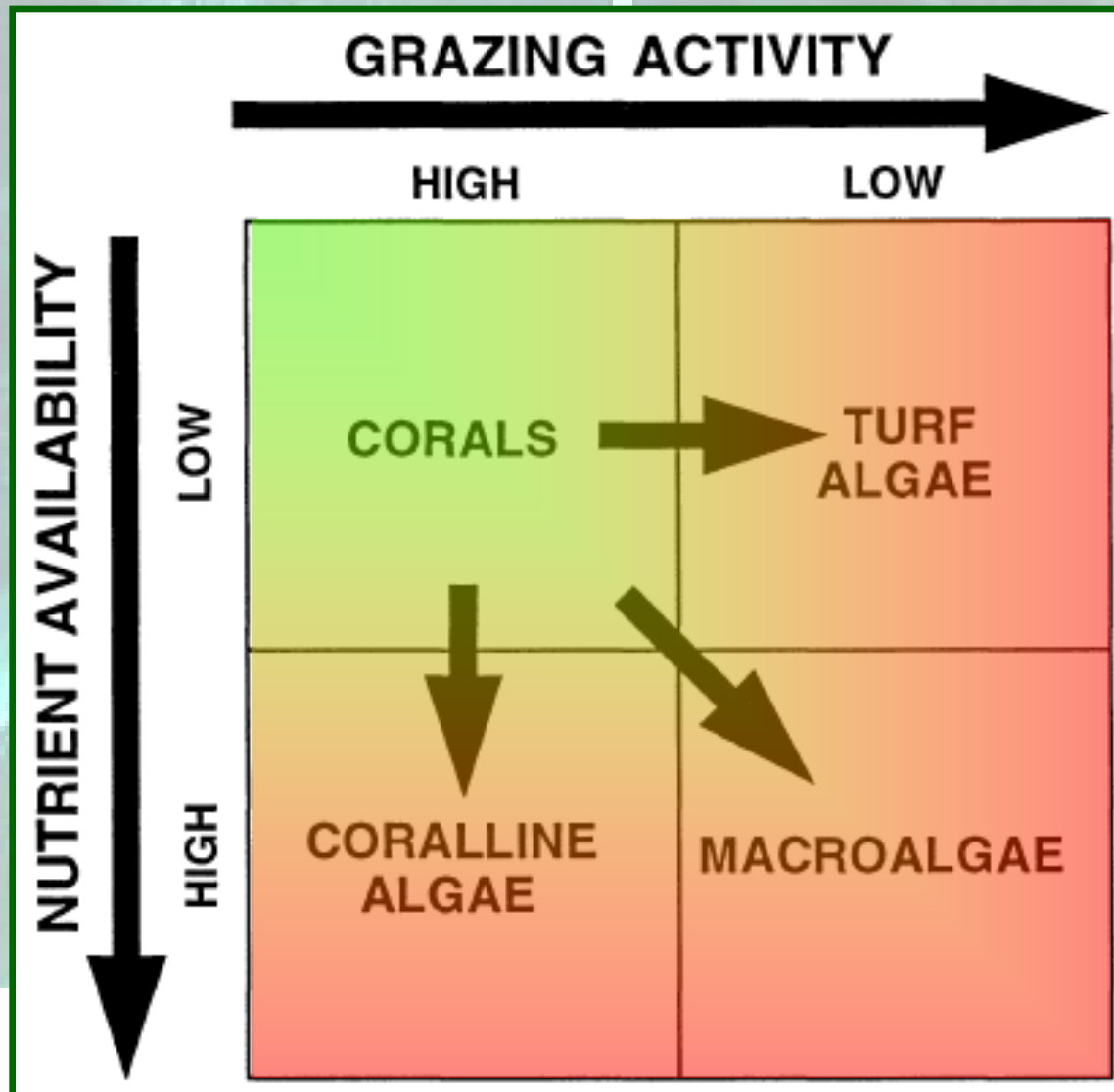


## Group 9

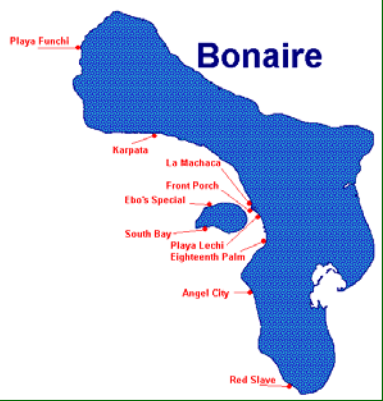


Nutrient Monitoring Program

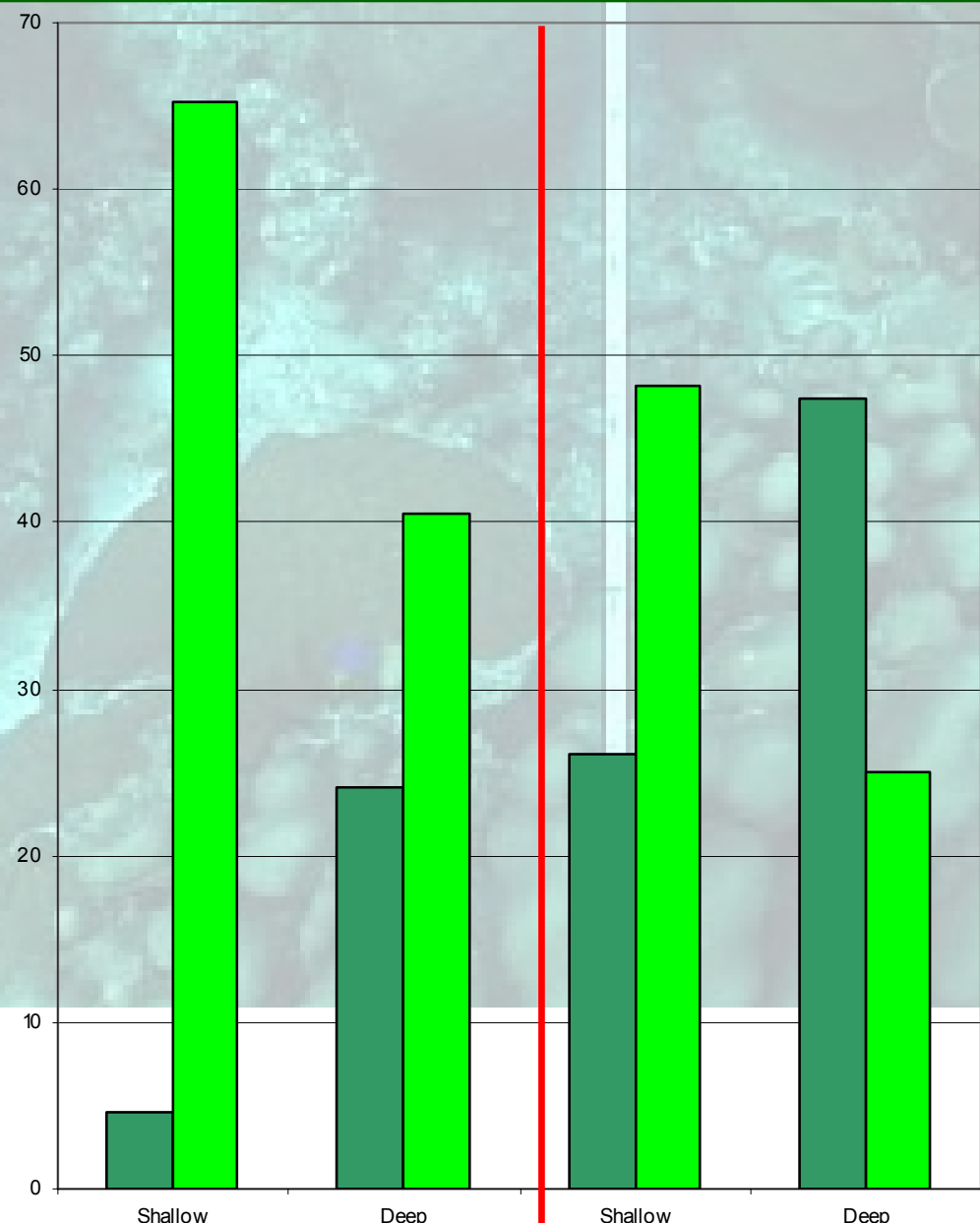
# Results of Algae Cover



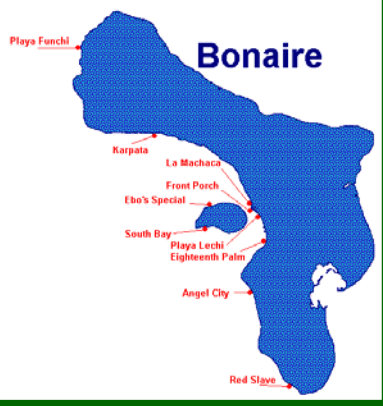
Nutrient Monitoring Program



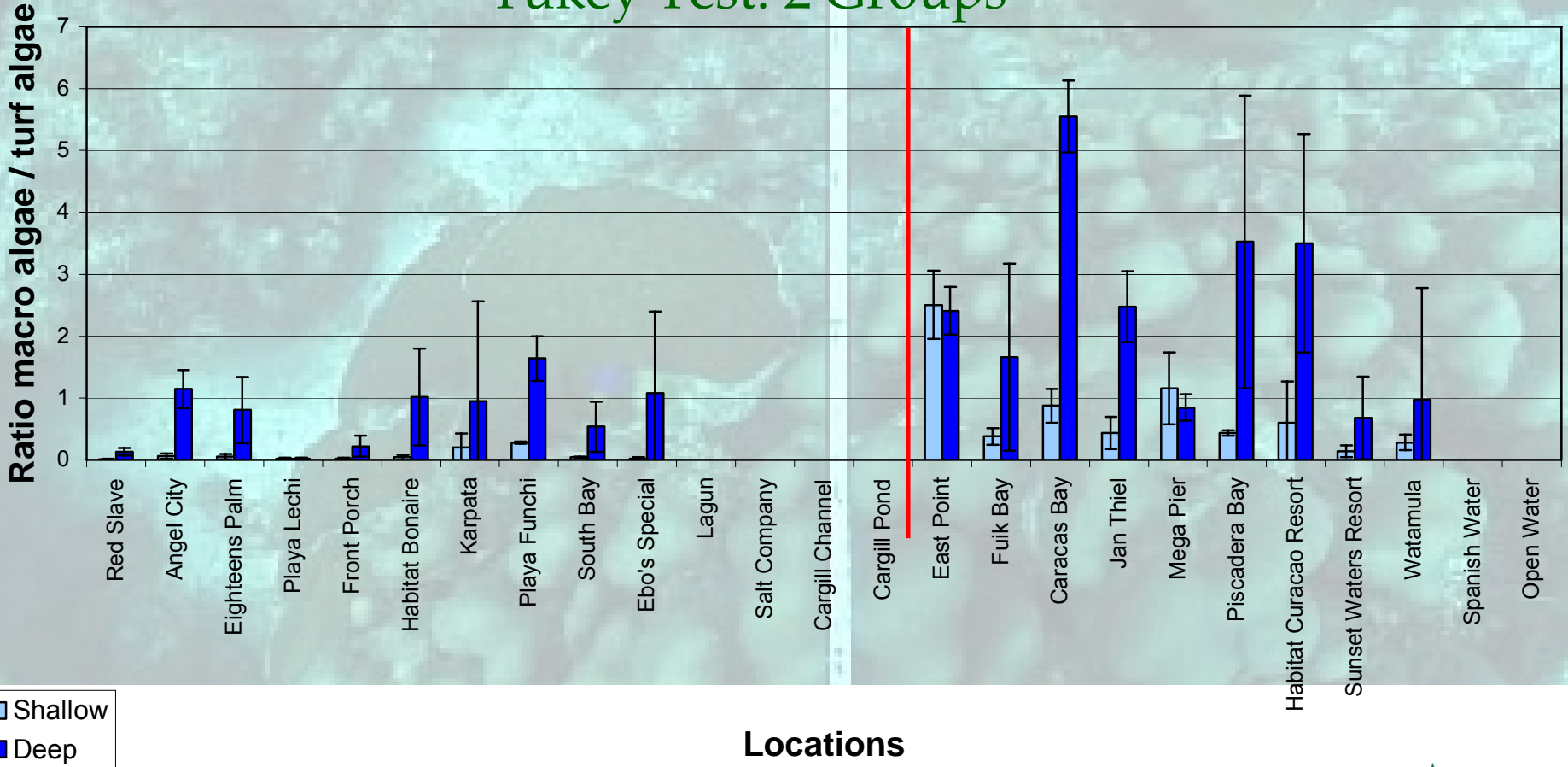
# Results of Algae Cover



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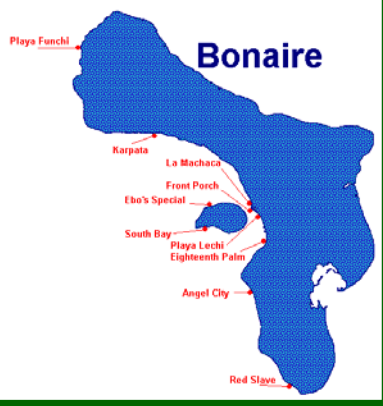


Tukey Test: 2 Groups

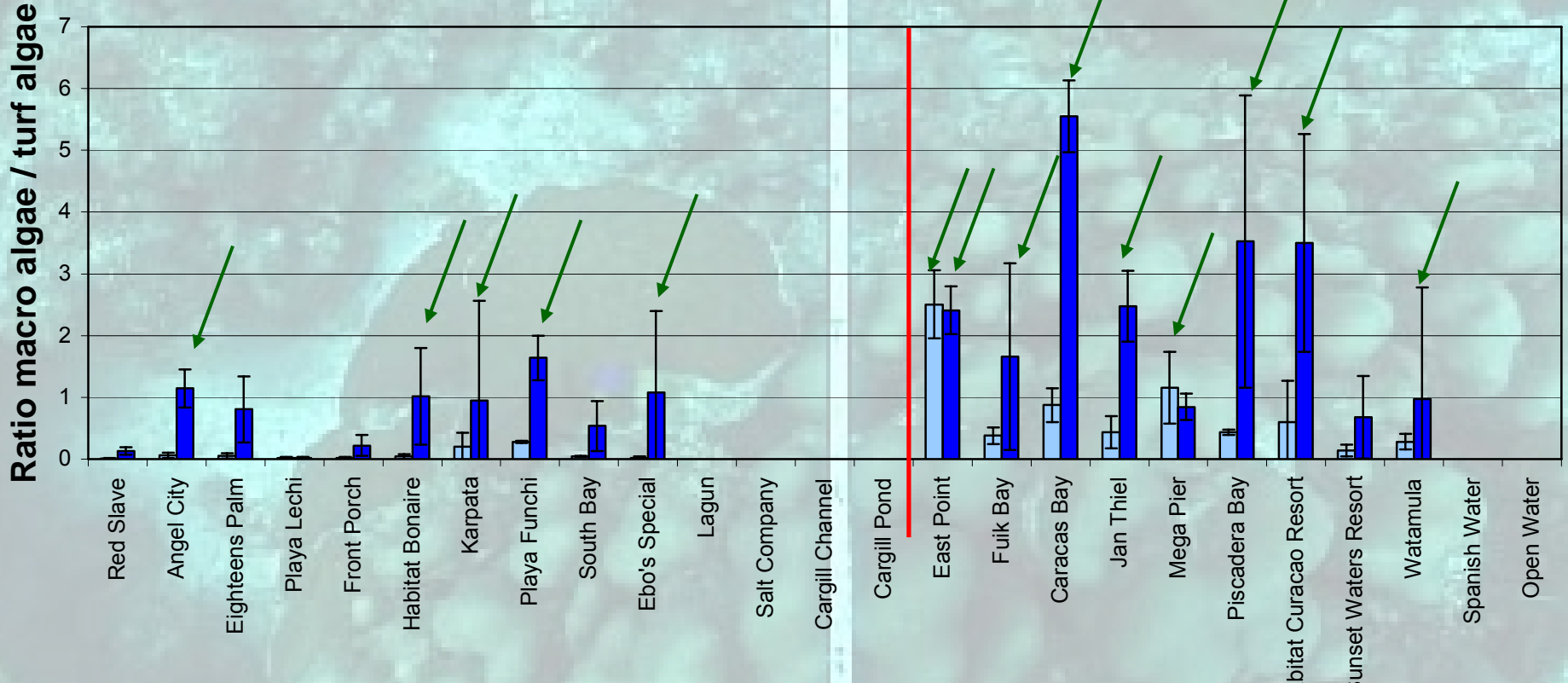


Nutrient Monitoring Program

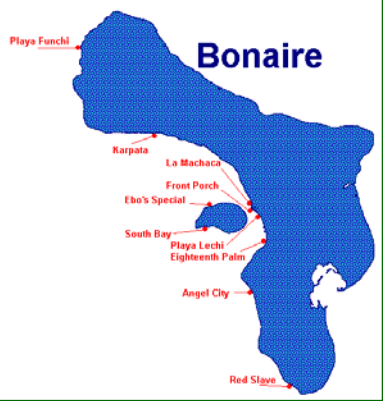
# Results of Algae Cover



## Group 2

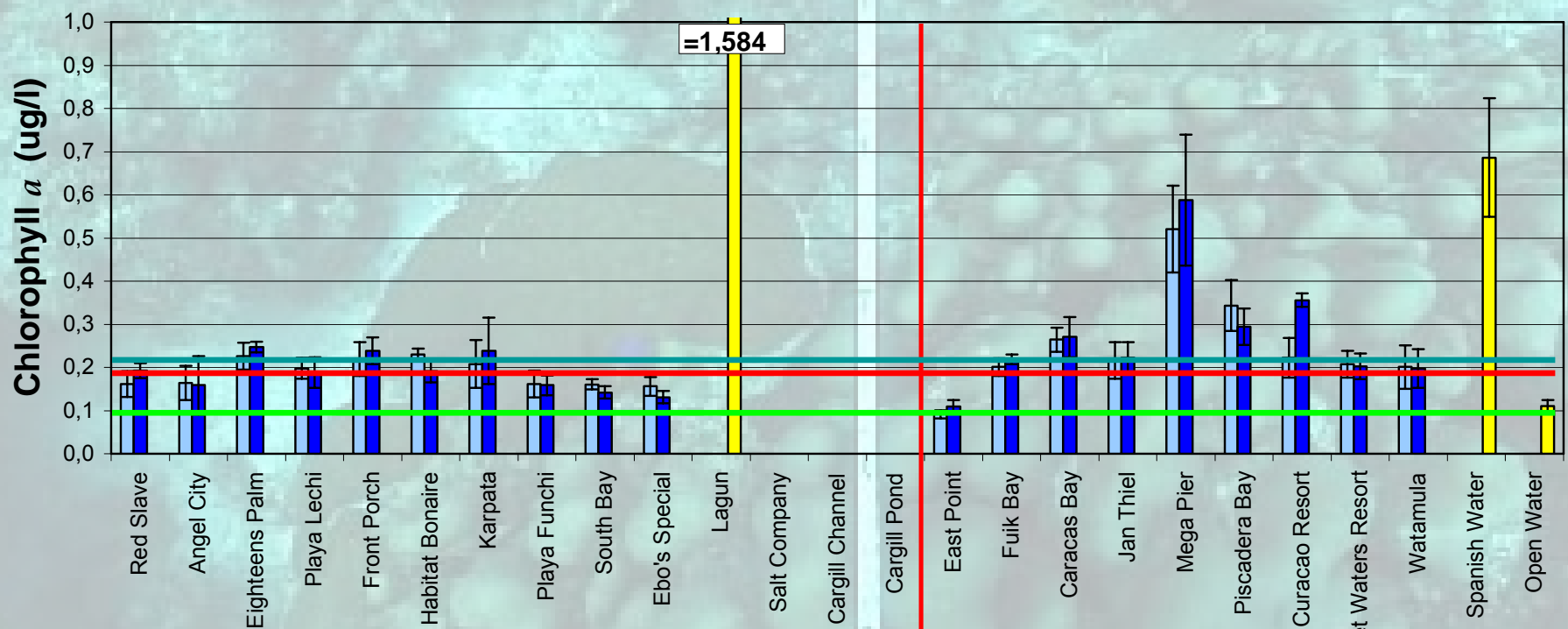


Nutrient Monitoring Program



# Results of Chlorophyll $a$

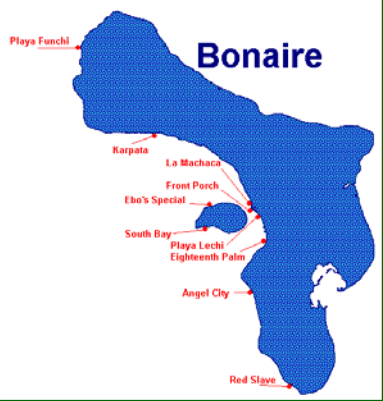
Tukey Test: 5 Groups



St. Lucia: 0,23

Locations

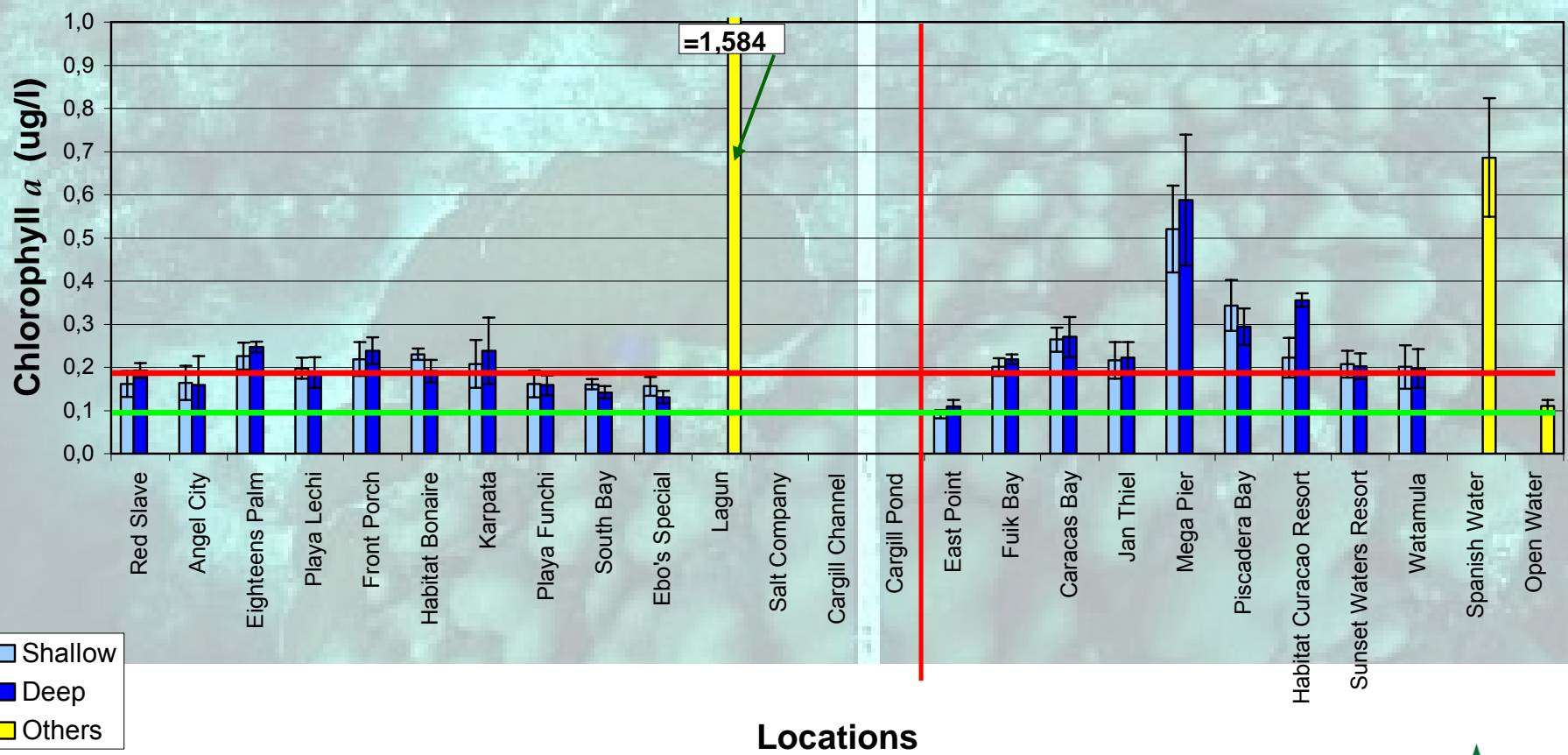
Nutrient Monitoring Program



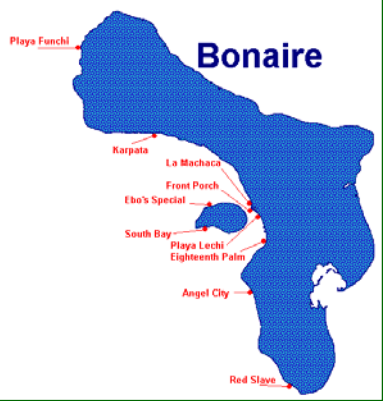
# Results of Chlorophyll *a*



Group 5



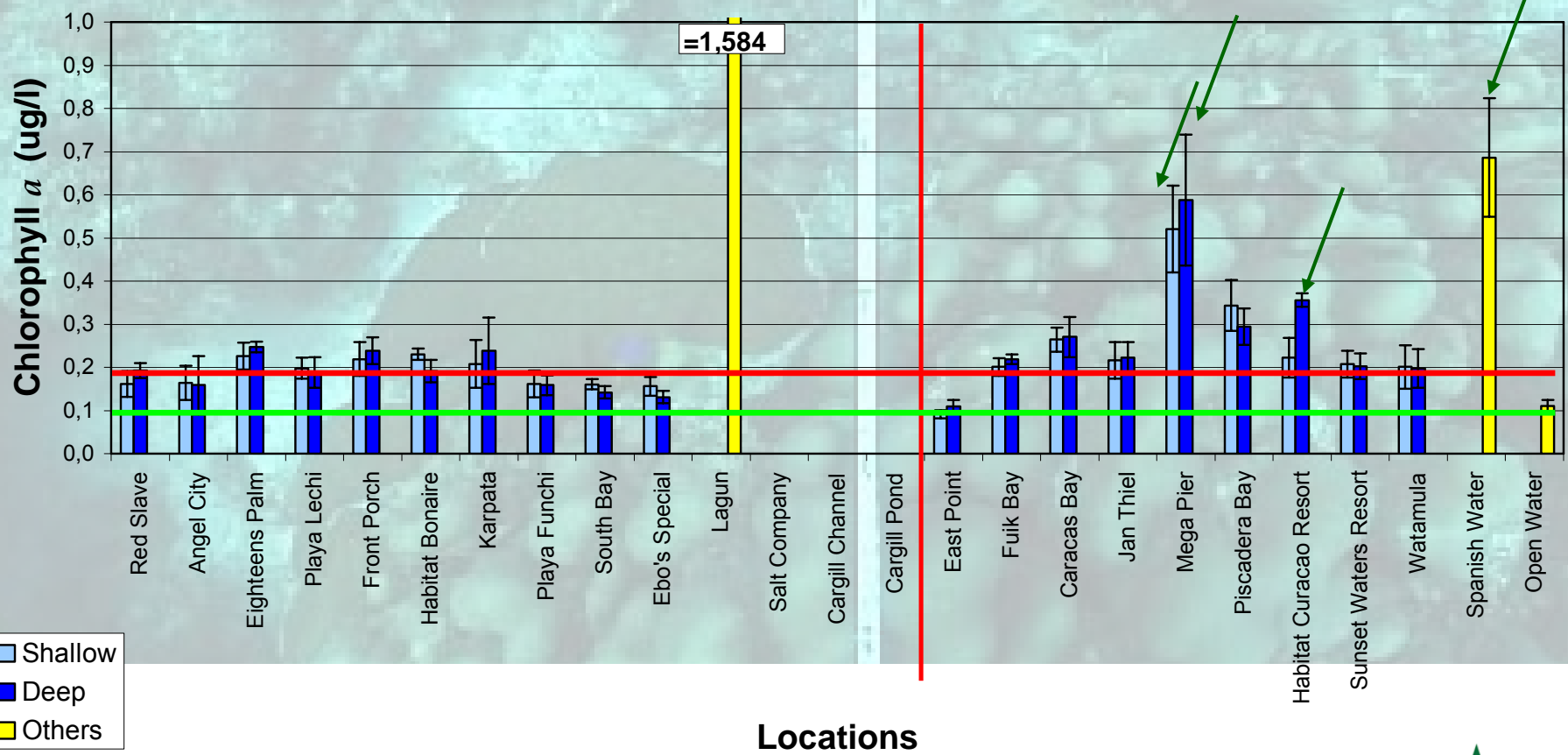
Nutrient Monitoring Program



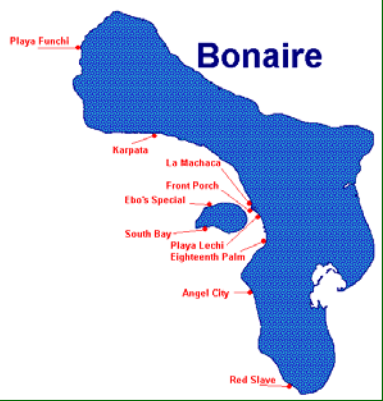
# Results of Chlorophyll *a*



## Group 4



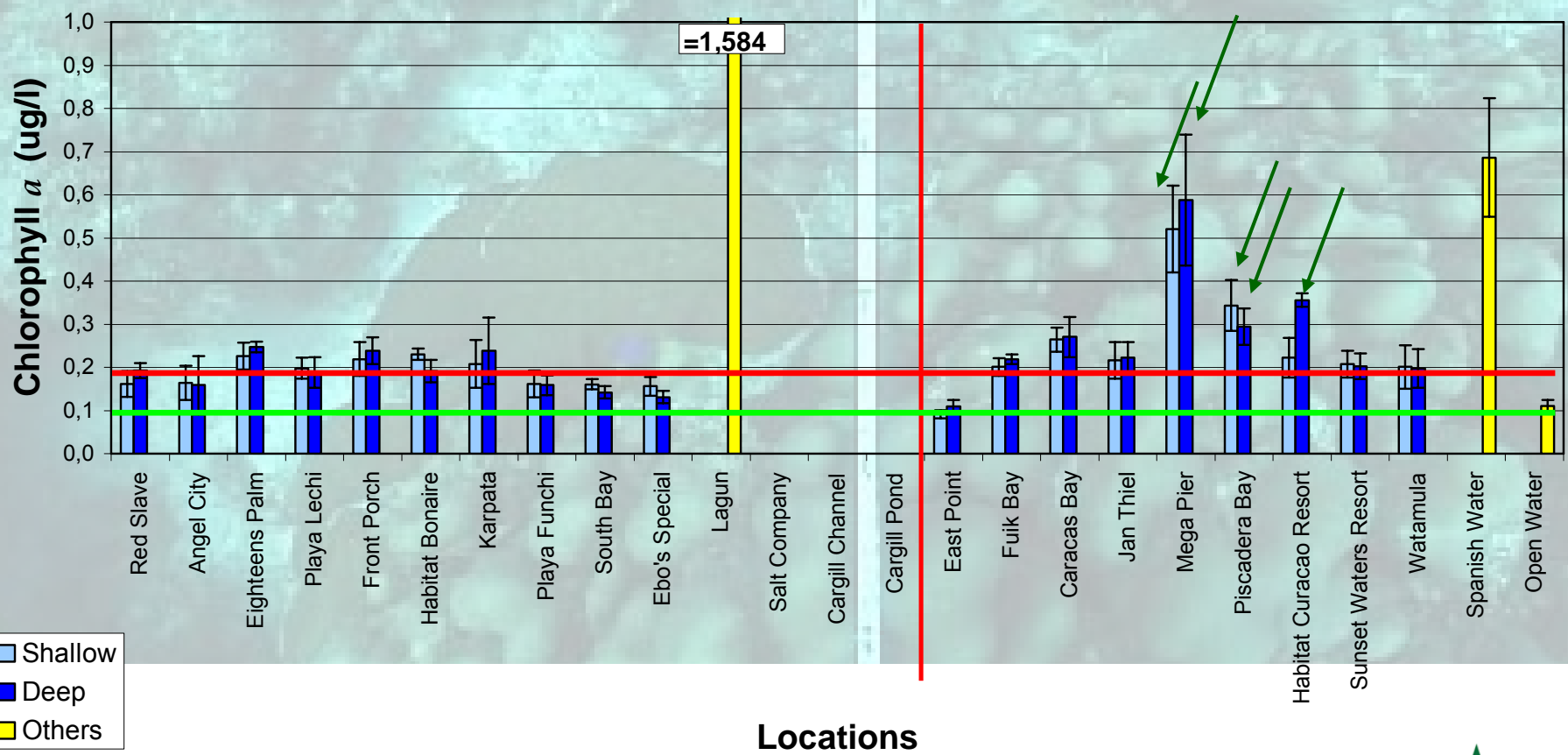
# Nutrient Monitoring Program



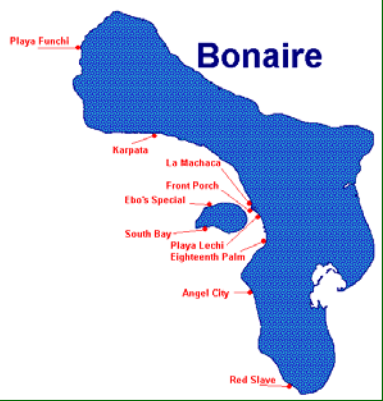
# Results of Chlorophyll *a*



## Group 3



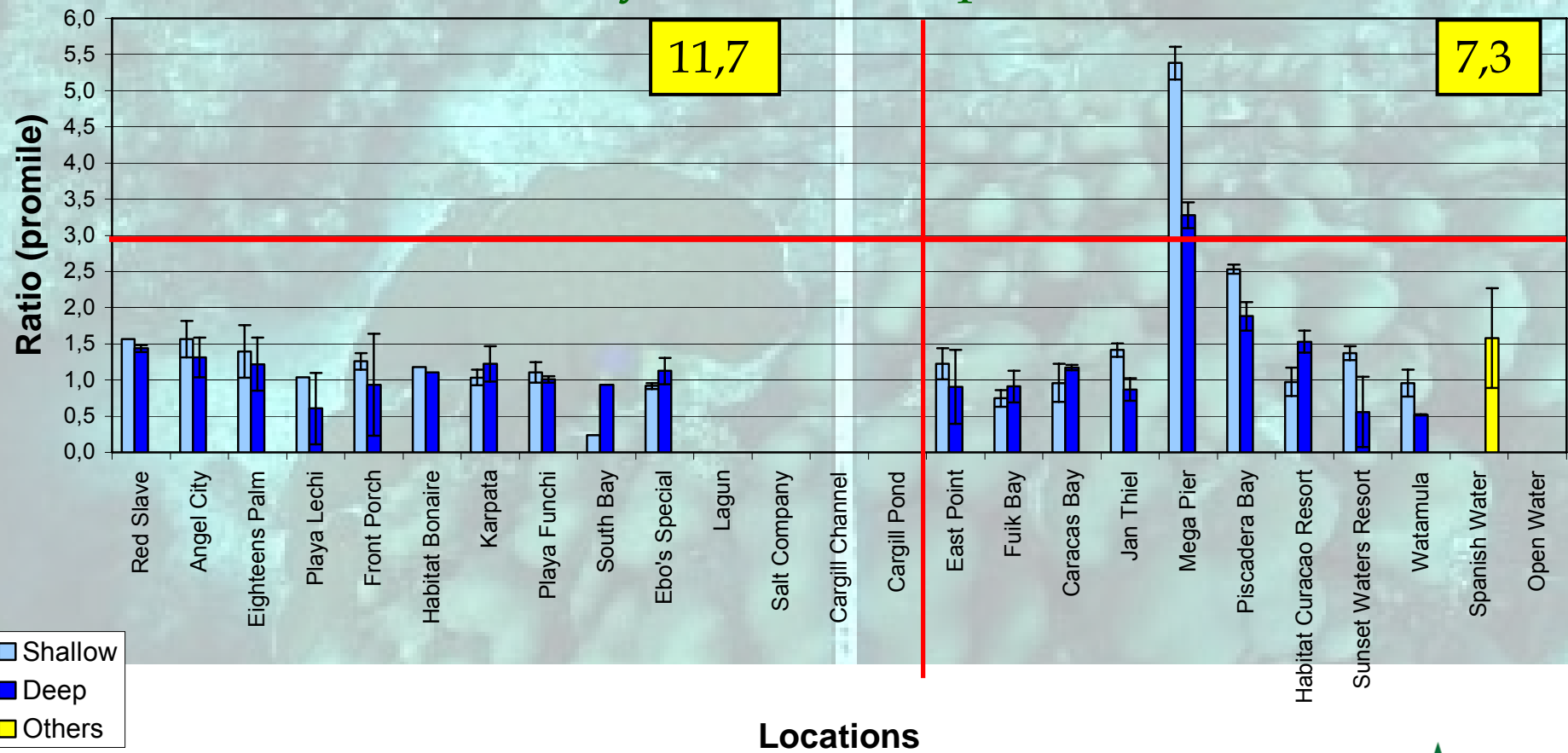
# Nutrient Monitoring Program



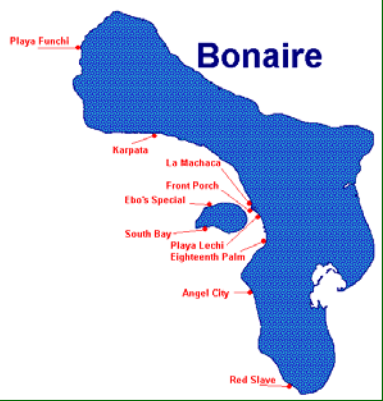
# Results of Isotope Ratio $^{15}\text{N}/^{14}\text{N}$



Tukey Test: 4 Groups



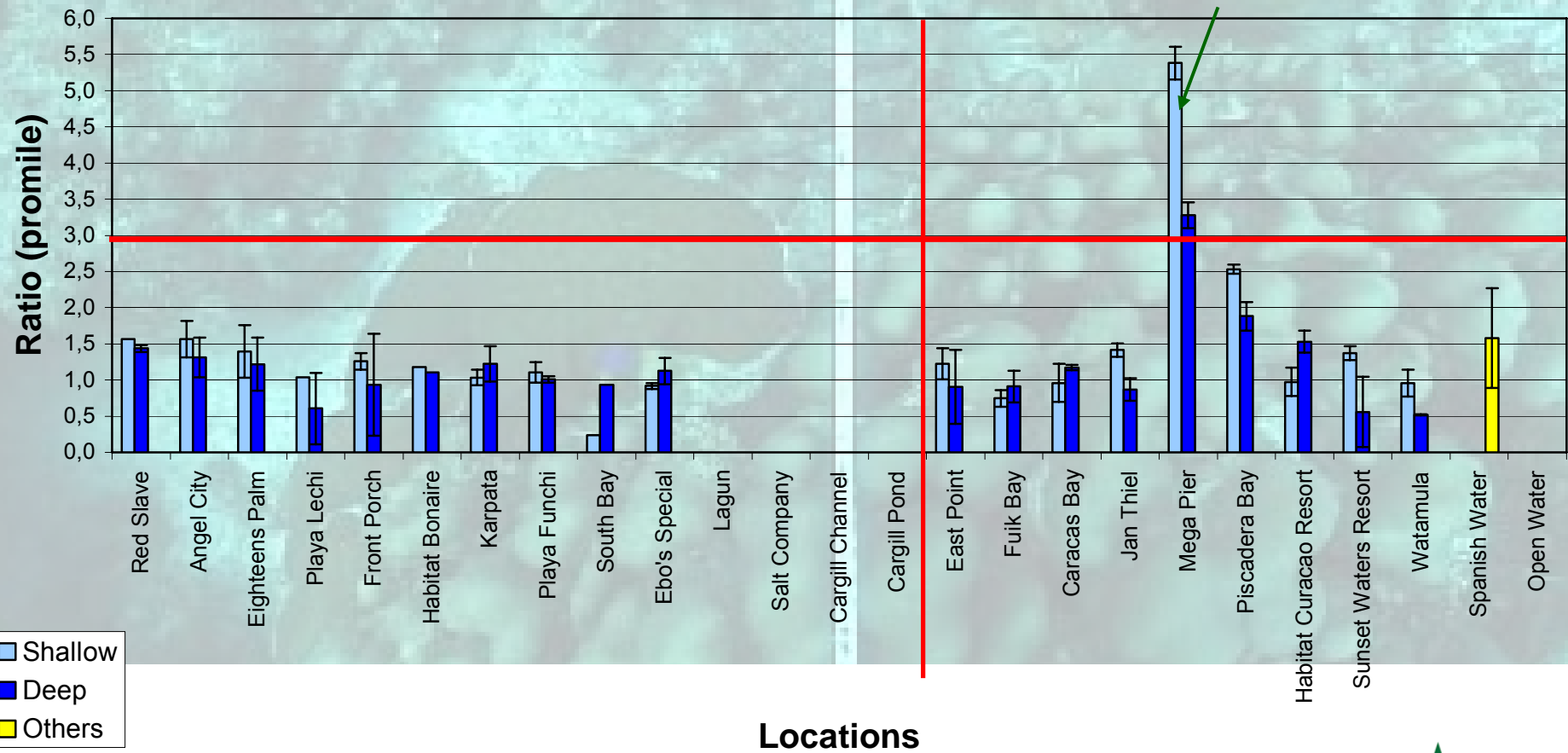
Nutrient Monitoring Program



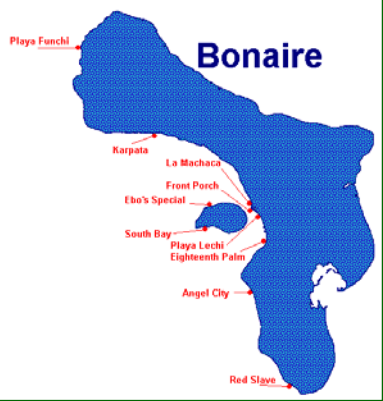
# Results of Isotope Ratio $^{15}\text{N}/^{14}\text{N}$



Group 4



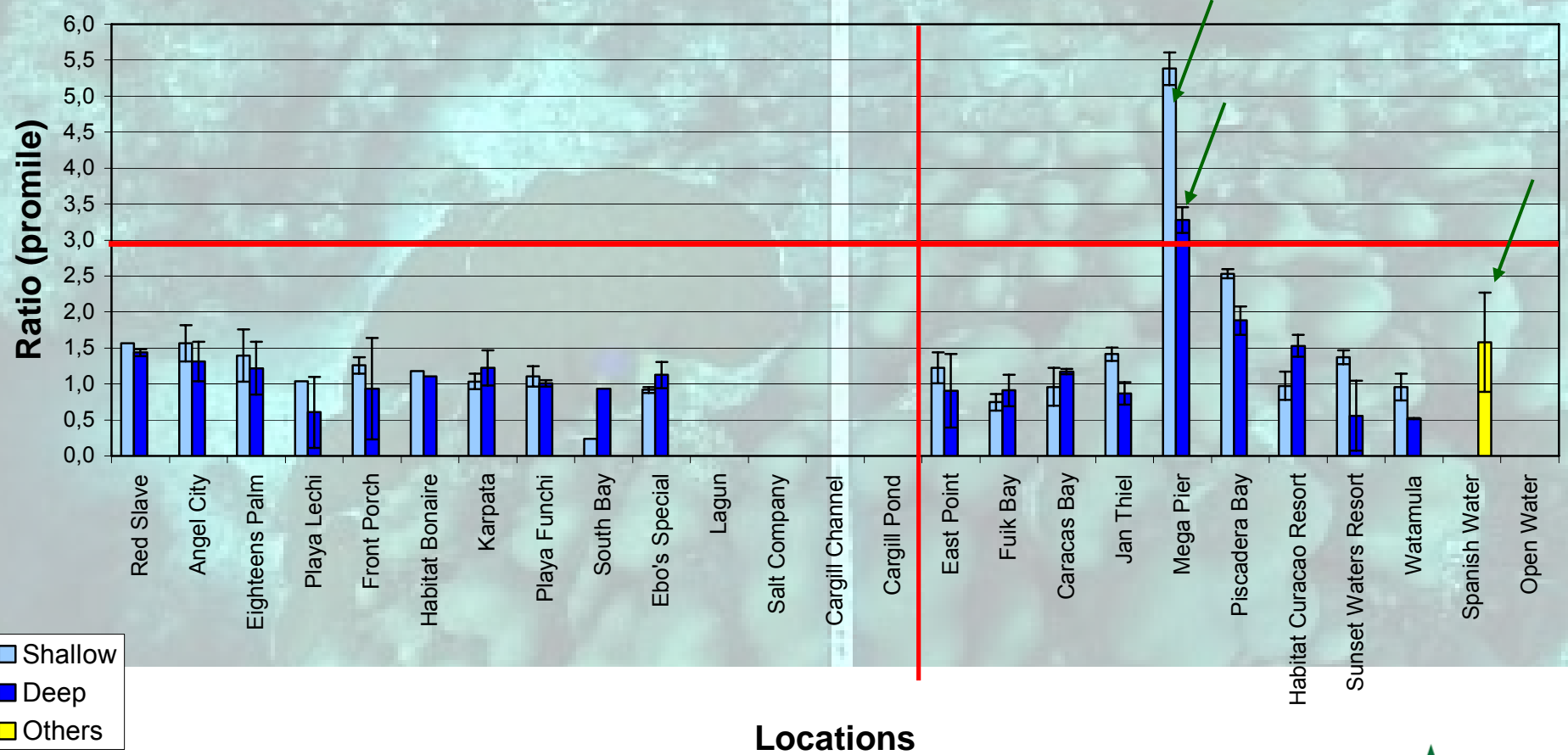
Nutrient Monitoring Program



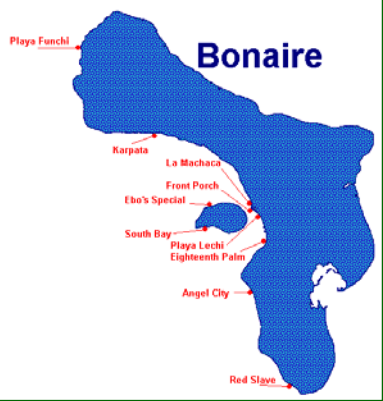
# Results of Isotope Ratio $^{15}\text{N}/^{14}\text{N}$



Group 3

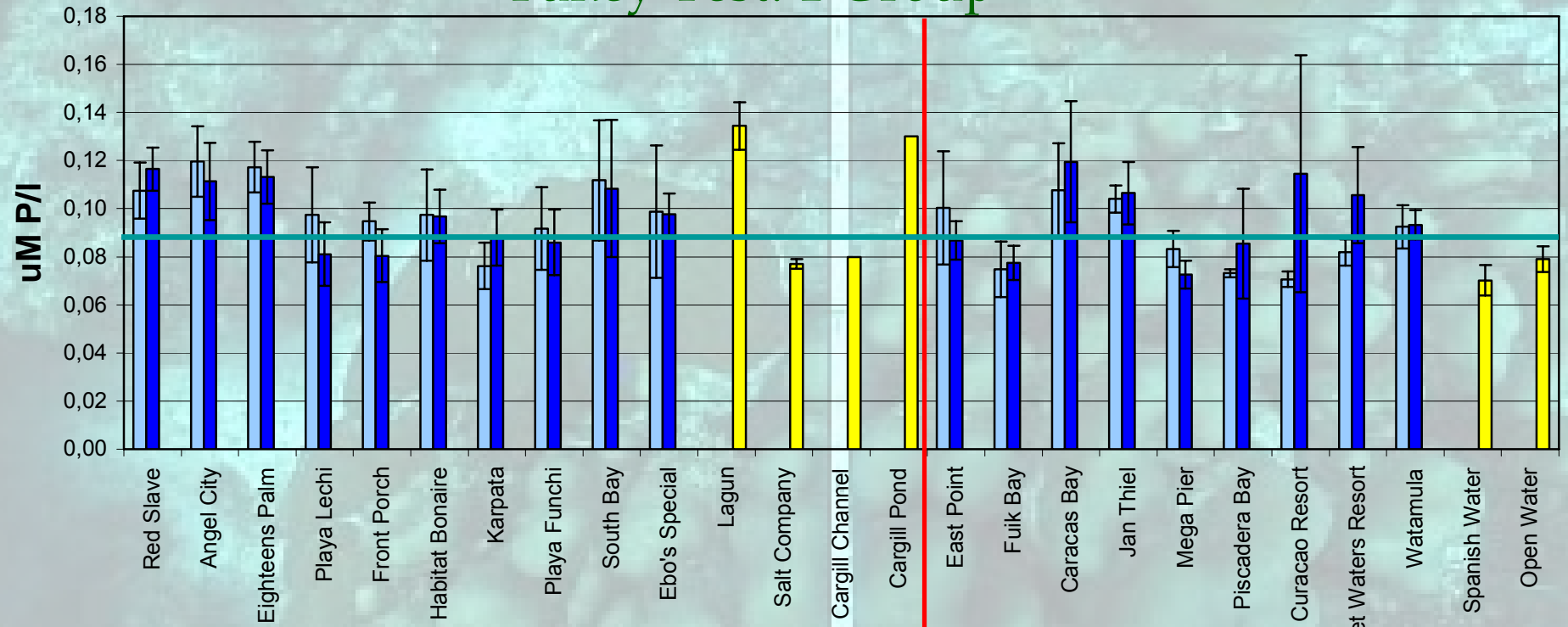


Nutrient Monitoring Program



# Results of PO<sub>4</sub>

Tukey Test: 1 Group



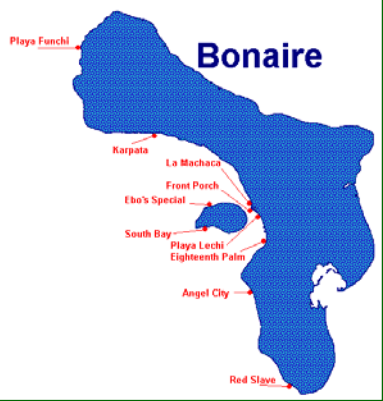
- Shallow
- Deep
- Others

St. Lucia: 0,09

Locations

Nutrient Monitoring Program

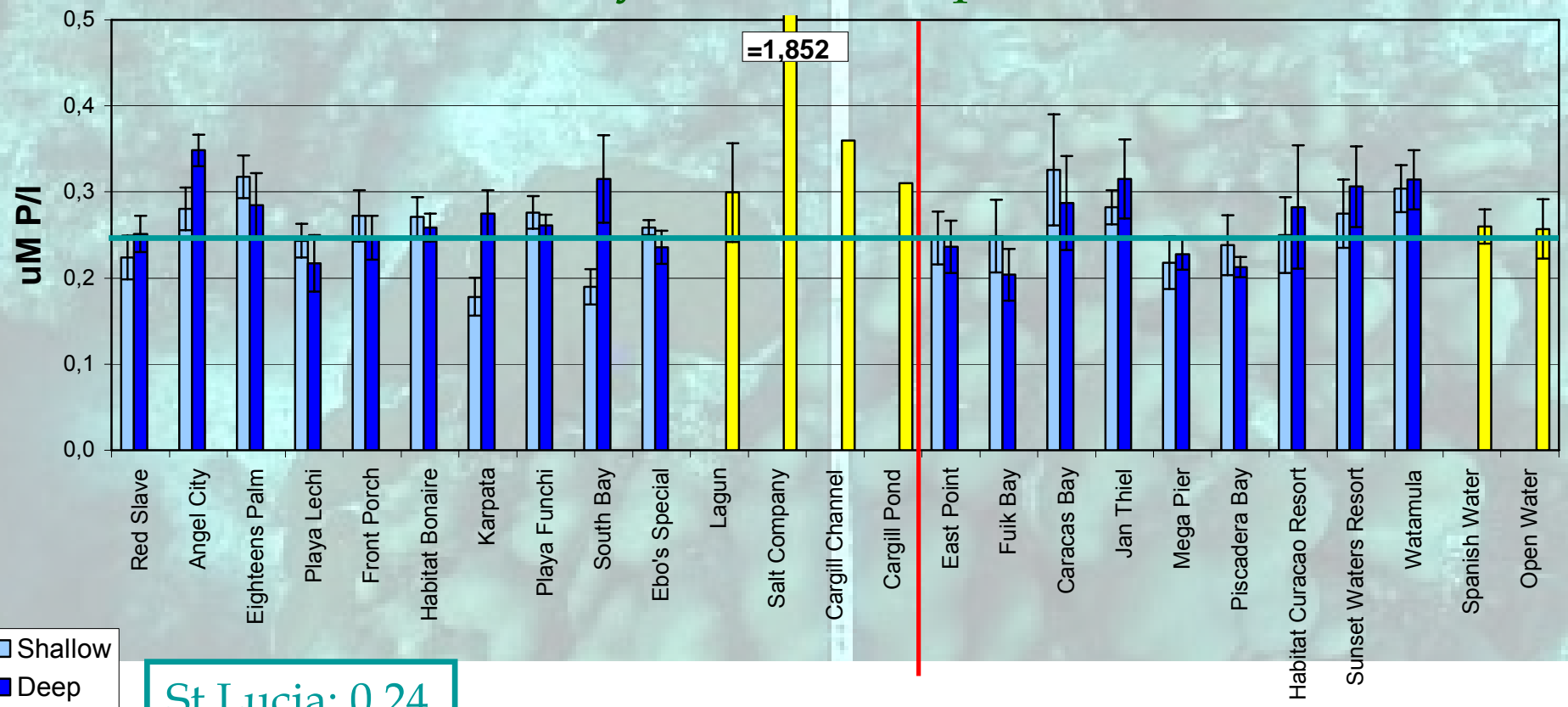




# Results of TDP



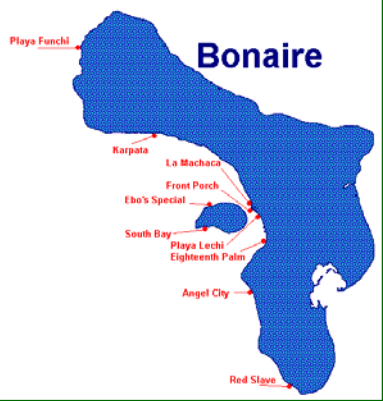
## Tukey Test: 2 Groups



St. Lucia: 0,24

Locations

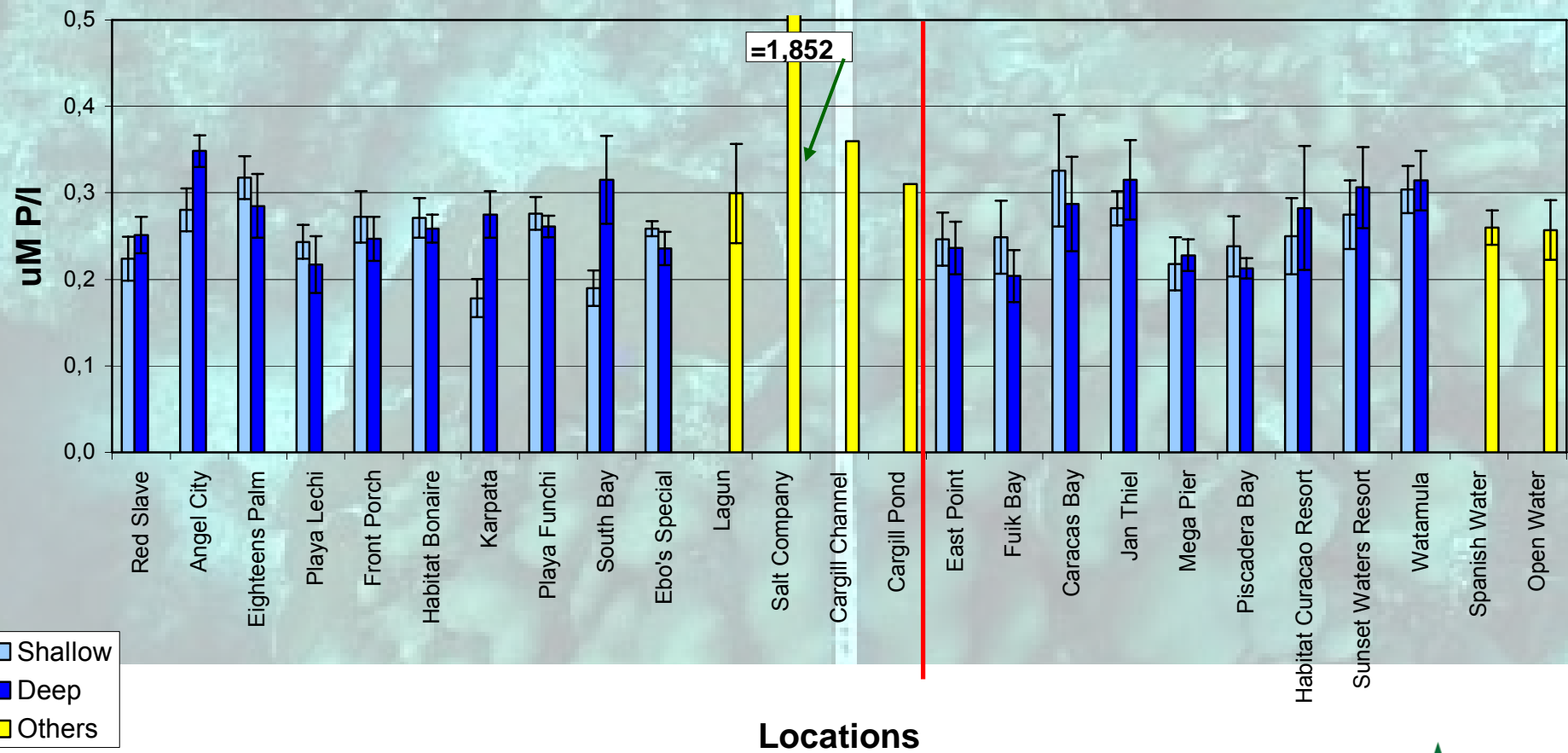
## Nutrient Monitoring Program



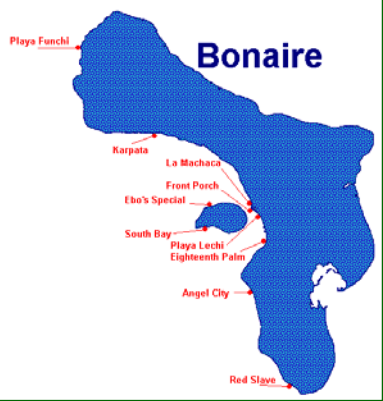
# Results of TDP



## Group 2



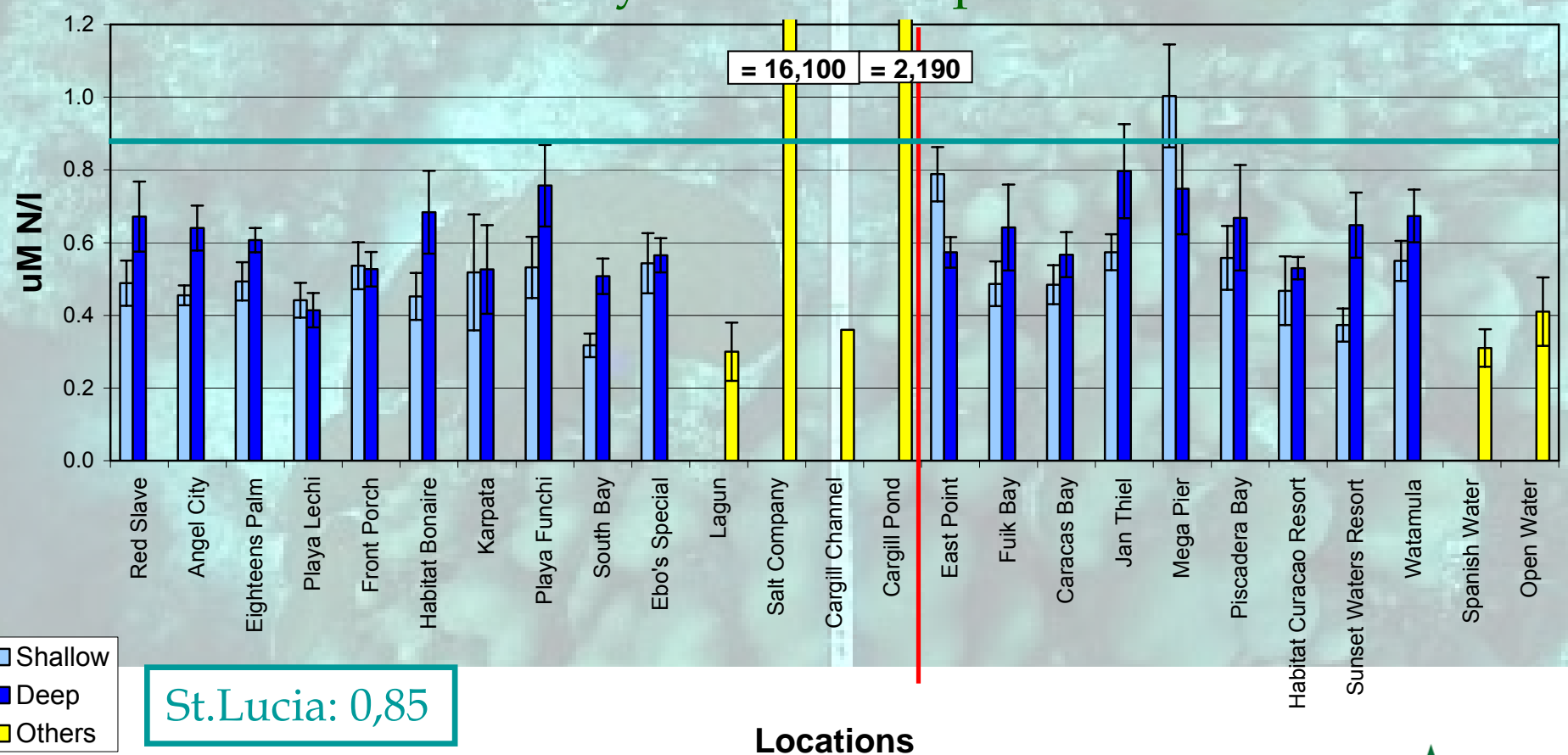
# Nutrient Monitoring Program



# Results of $\text{NO}_2$ plus $\text{NO}_3$



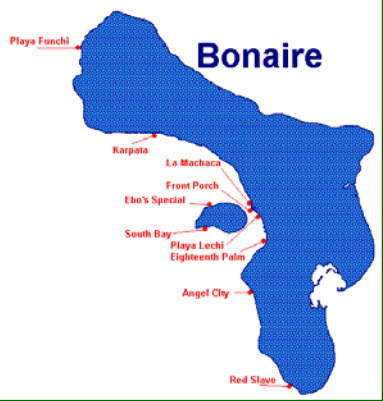
Tukey Test: 4 Groups



St. Lucia: 0,85

Locations

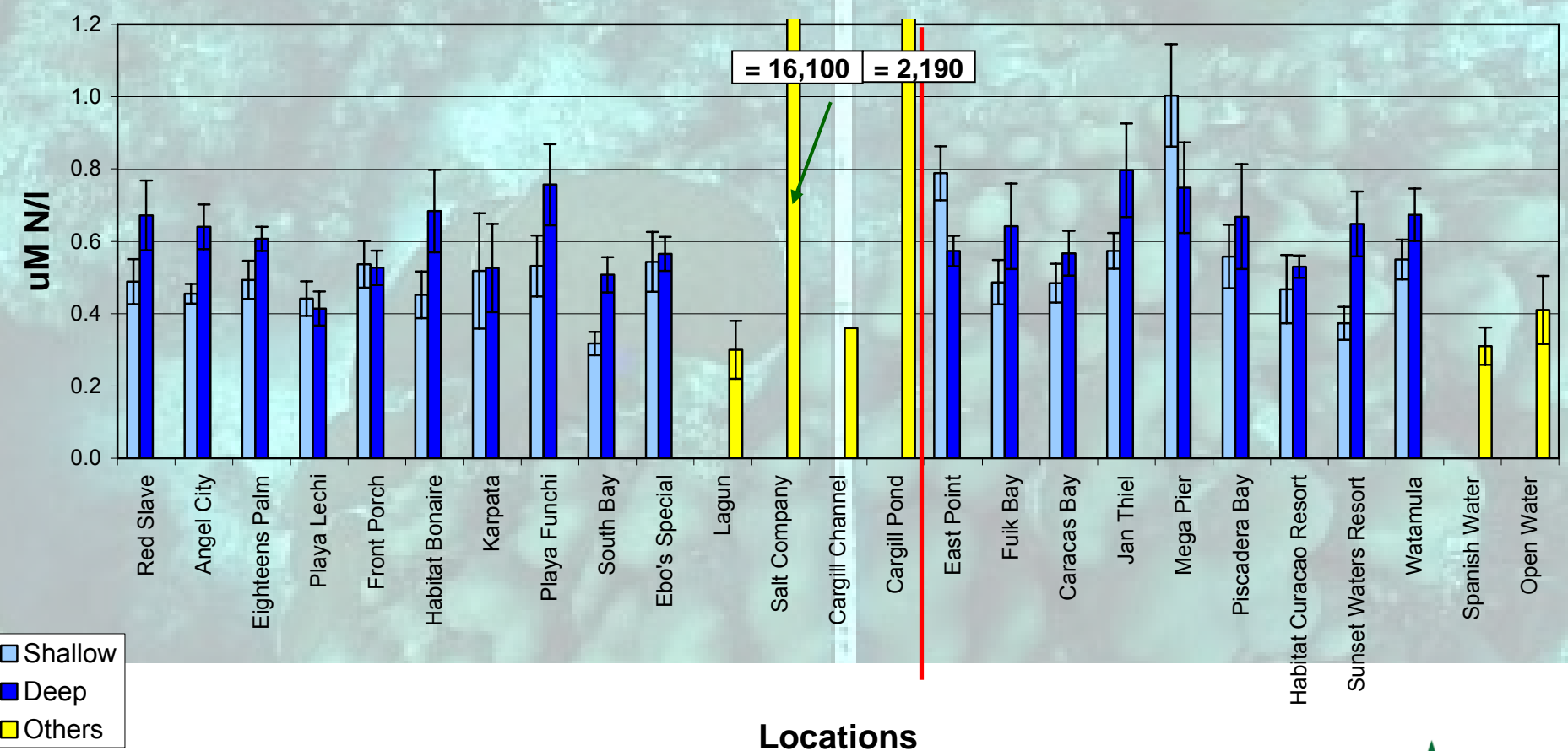
Nutrient Monitoring Program



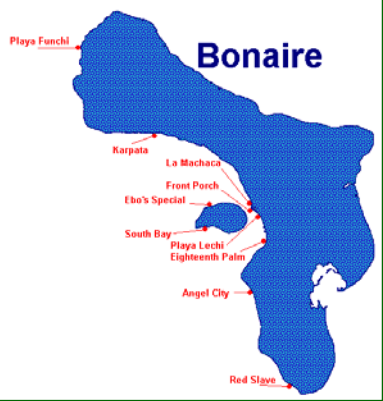
# Results of NO<sub>2</sub> plus NO<sub>3</sub>



## Group 4



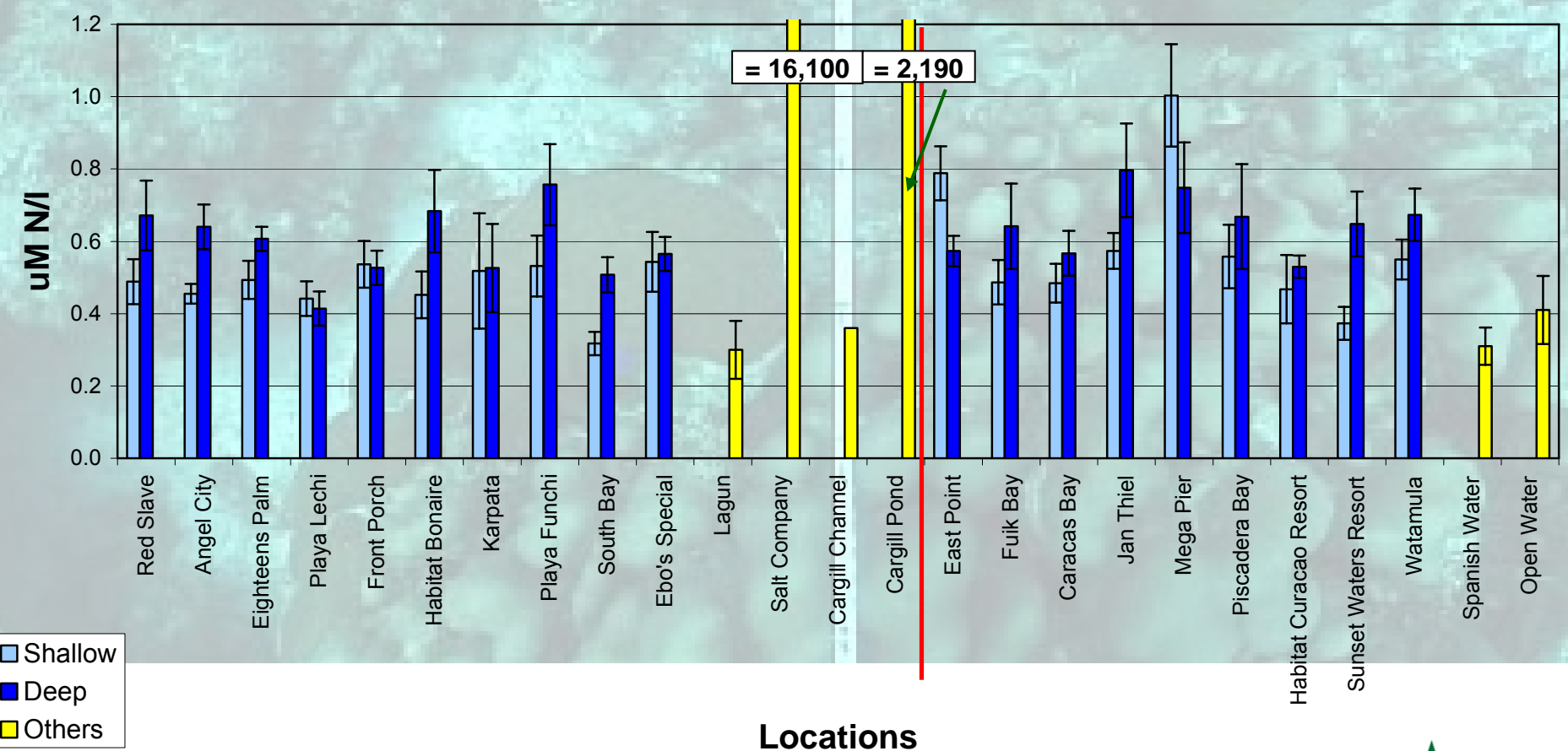
# Nutrient Monitoring Program



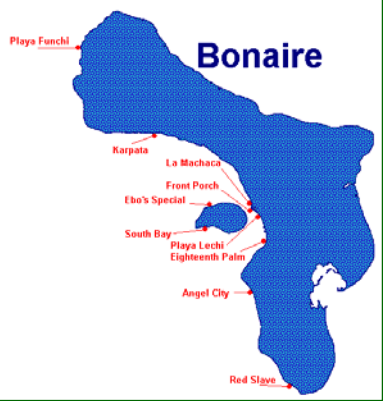
# Results of NO<sub>2</sub> plus NO<sub>3</sub>



## Group 3



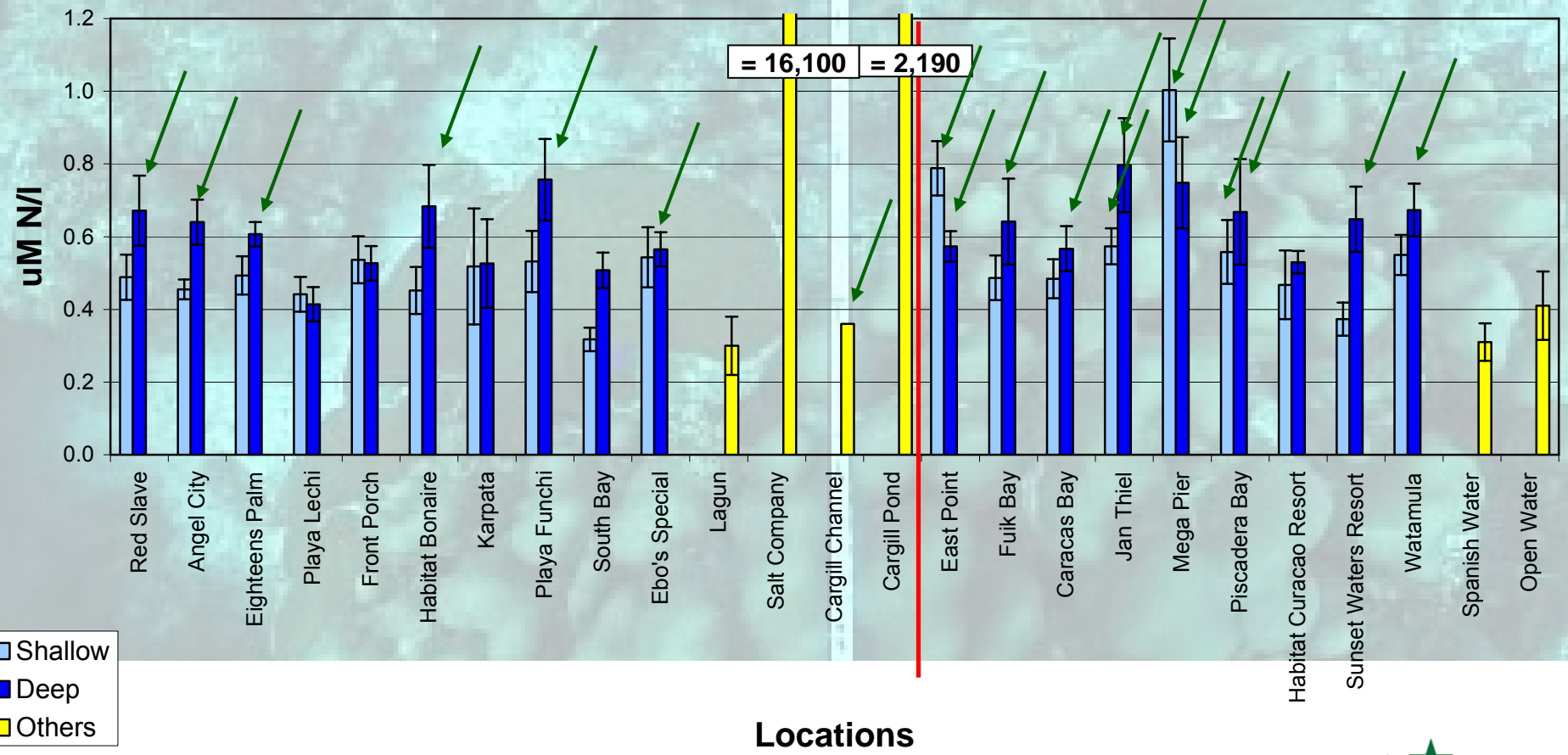
# Nutrient Monitoring Program



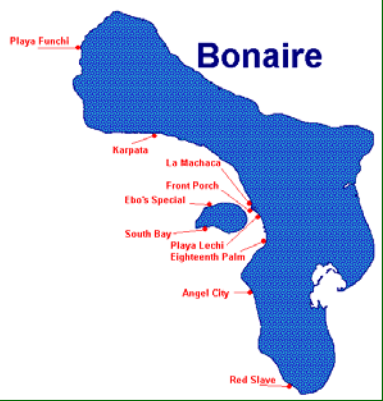
# Results of NO<sub>2</sub> plus NO<sub>3</sub>



## Group 2



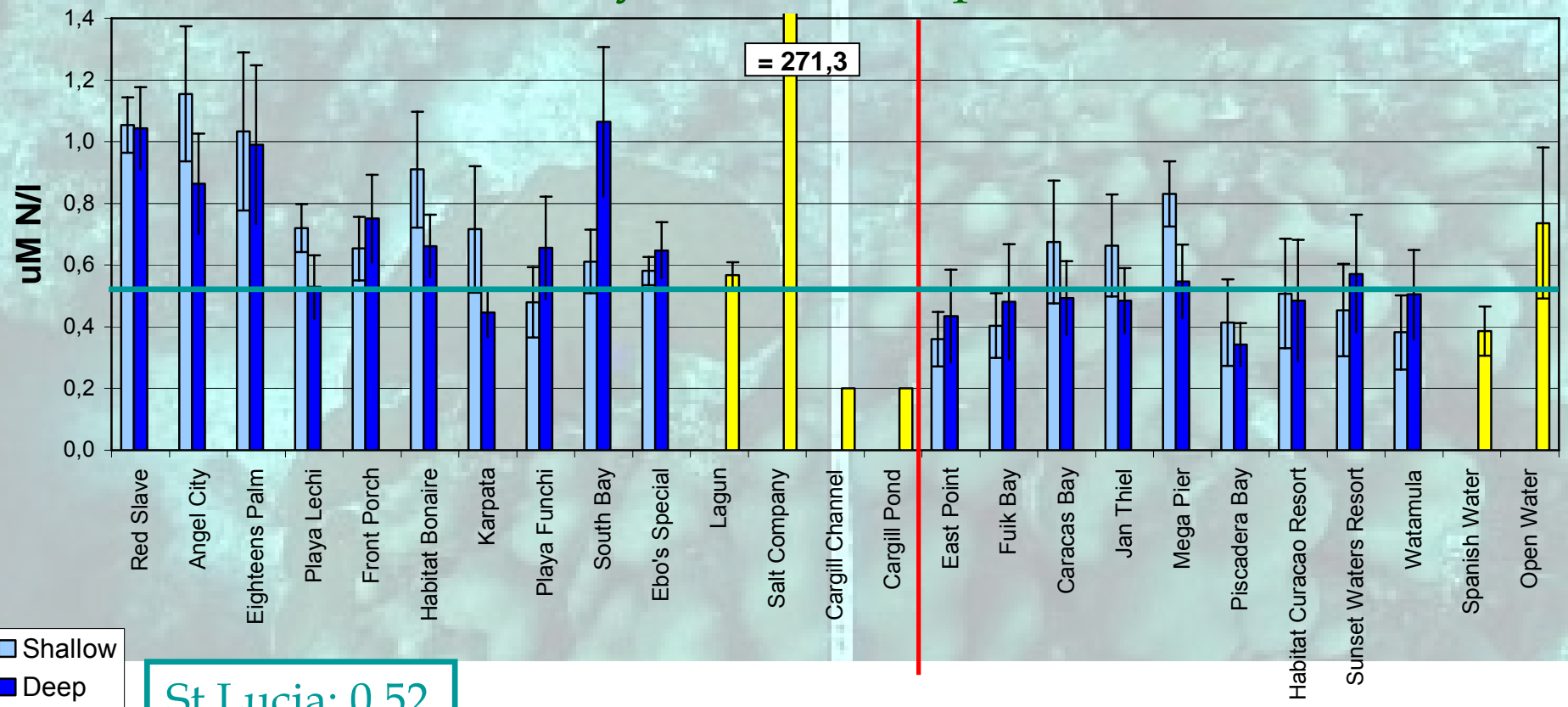
# Nutrient Monitoring Program



# Results of $\text{NH}_4$



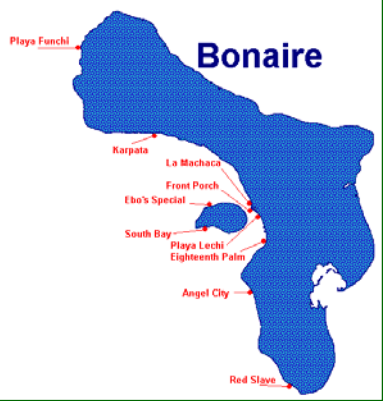
## Tukey Test: 2 Groups



St. Lucia: 0,52

Locations

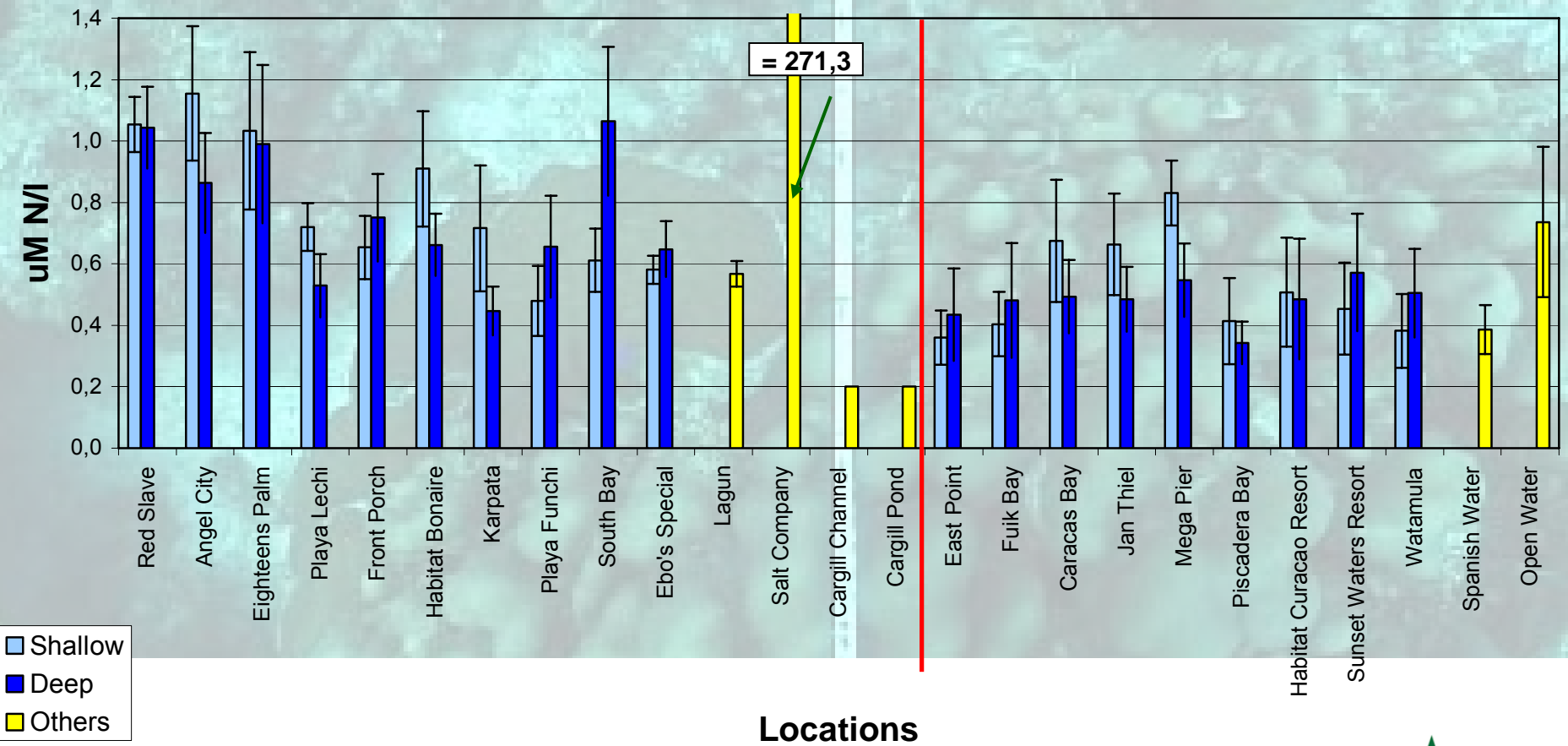
# Nutrient Monitoring Program



# Results of $\text{NH}_4$

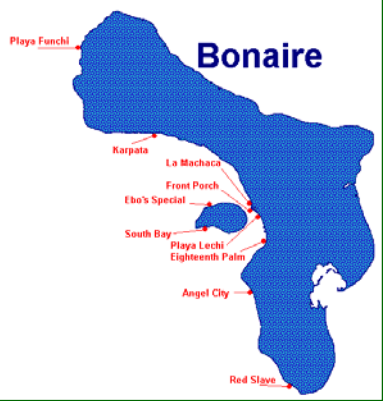


## Group 2

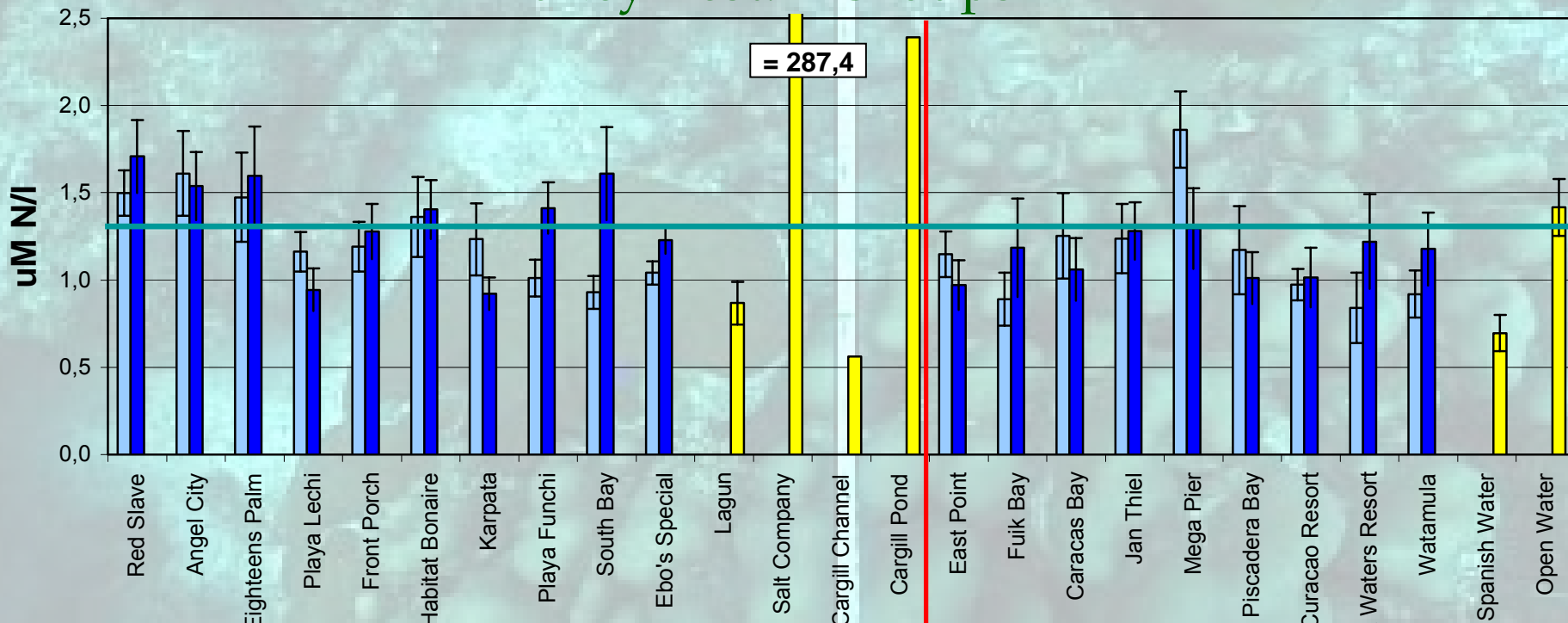


# Nutrient Monitoring Program

# Results of DIN



## Tukey Test: 2 Groups

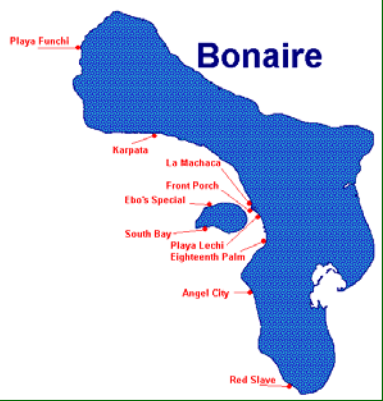


■ Shallow  
■ Deep  
■ Others

St. Lucia: 1,36

Locations

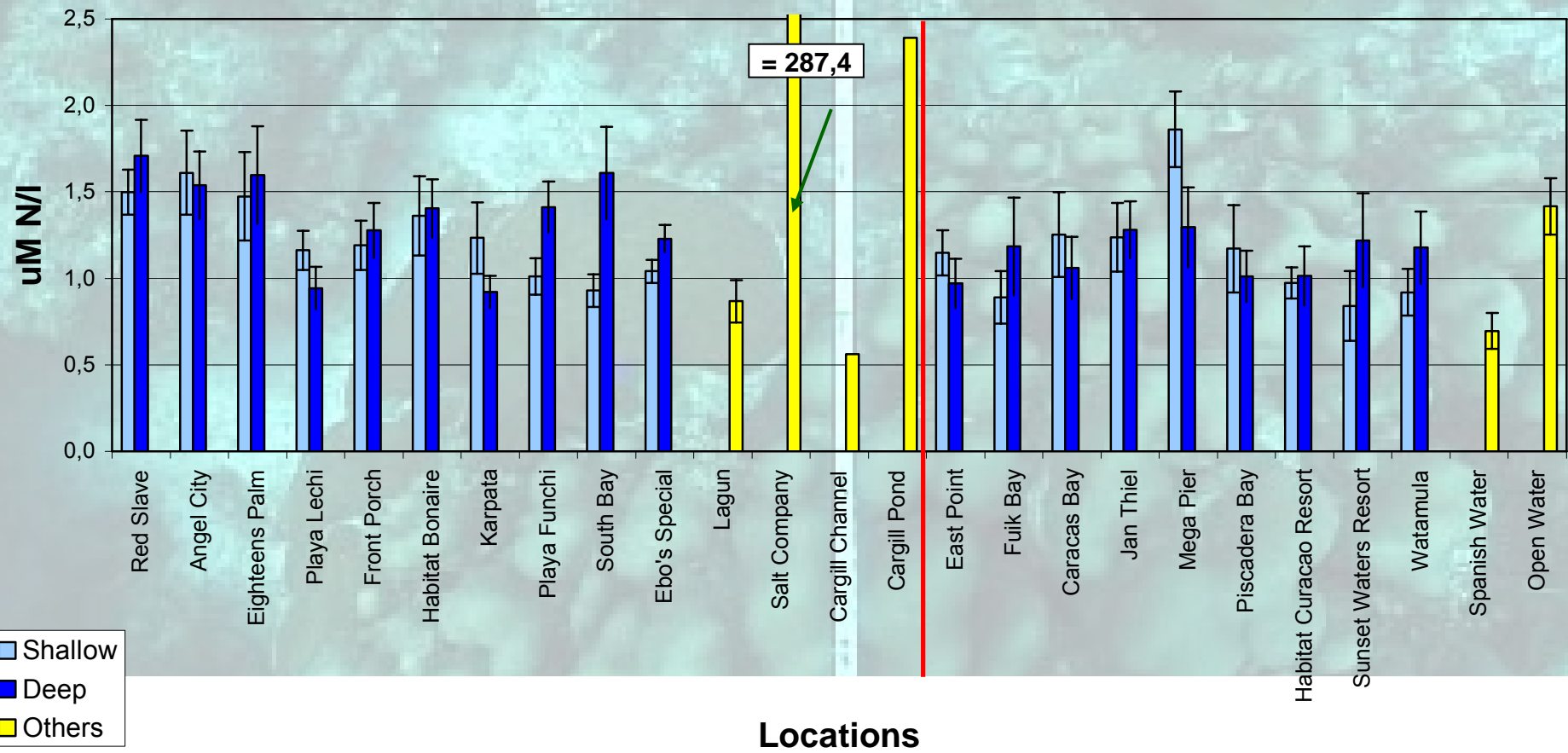
## Nutrient Monitoring Program



# Results of DIN



## Group 2



# Nutrient Monitoring Program

# Conclusions

## Salt Company Bonaire:

- High concentrations TDP and  $\text{NH}_4$
- Quick nitrification of  $\text{NH}_4$  to  $\text{NO}_x$
- High outflow of  $\text{NO}_2$  and /or  $\text{NO}_3$
- Southern 3 sites highest concentrations  $\text{PO}_4$  and  $\text{NH}_4$  of all in Bonaire



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# Conclusions

## Curacao vs. Bonaire

- Higher macroalgae cover in Curacao (5 times more at shallow)
- Higher chlorophyll a concentrations in Curacao
- Three highest isotope ratios found on Curacao
- Higher  $\text{NH}_4$  on Bonaire and higher  $\text{NO}_x$  on Curacao
- Reefs on Curacao appear to be more eutrophic

# Conclusions

Chlorophyll  $\alpha$  and Isotope Ratio  $^{15}\text{N}/^{14}\text{N}$ :

➤ Group of 4, possible 6, polluted sites

Mega Pier shallow

Mega Pier deep

Piscadera shallow

Spanish Water surface

Piscadera deep

Lagun surface

(outflow of landfill)

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# Conclusions

- Both Bonaire and Curacao are at or just above the nutrient thresholds for eutrophication of coral reefs
- Higher chlorophyll a and macroalgae cover on Curacao suggests higher land-based nutrient loads.
- Higher macro-/turf algae ratio may reflect higher grazing in Bonaire
- Continued long-term monitoring is of great importance for the future of our coral reefs.

# CONCLUSIONS

Bonaire's present situation is between the borders of healthy and polluted, careful policy and management are required.

Curacao's present situation is a little worse. Several sites like Mega Pier and Piscadera Bay are obvious polluted and passed the borders indicating a polluted reef.

# Any Questions?



Thanks to:  
All the volunteers  
STINAPA  
SMMA  
Dr. Brian Lapointe  
NOAA-NFWF  
WW2BW-NMSF  
UNEP-CEP  
SPA W

Nutrient Monitoring Program

