

**Distribution,
Abundance,
Recruitment,
and Genetic Affinities
of Corals on Platforms
in the Gulf of Mexico**

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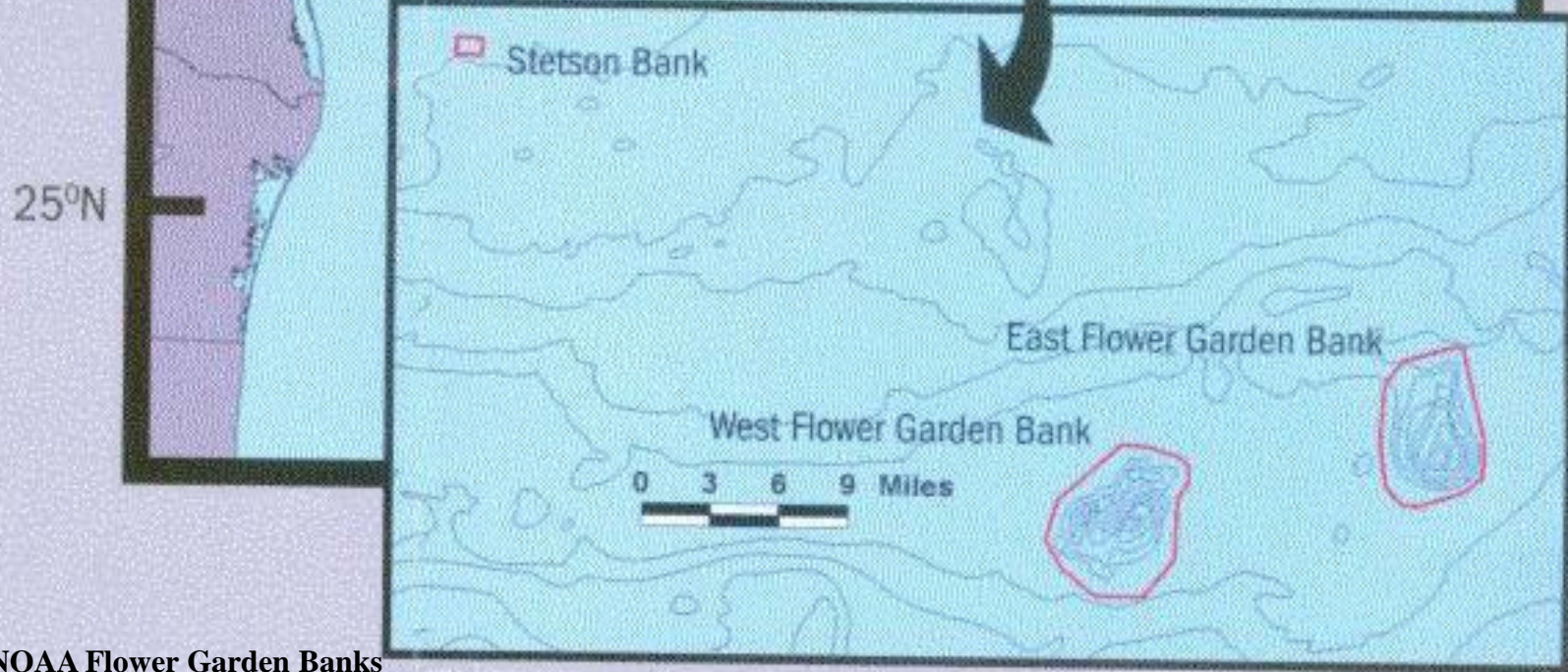
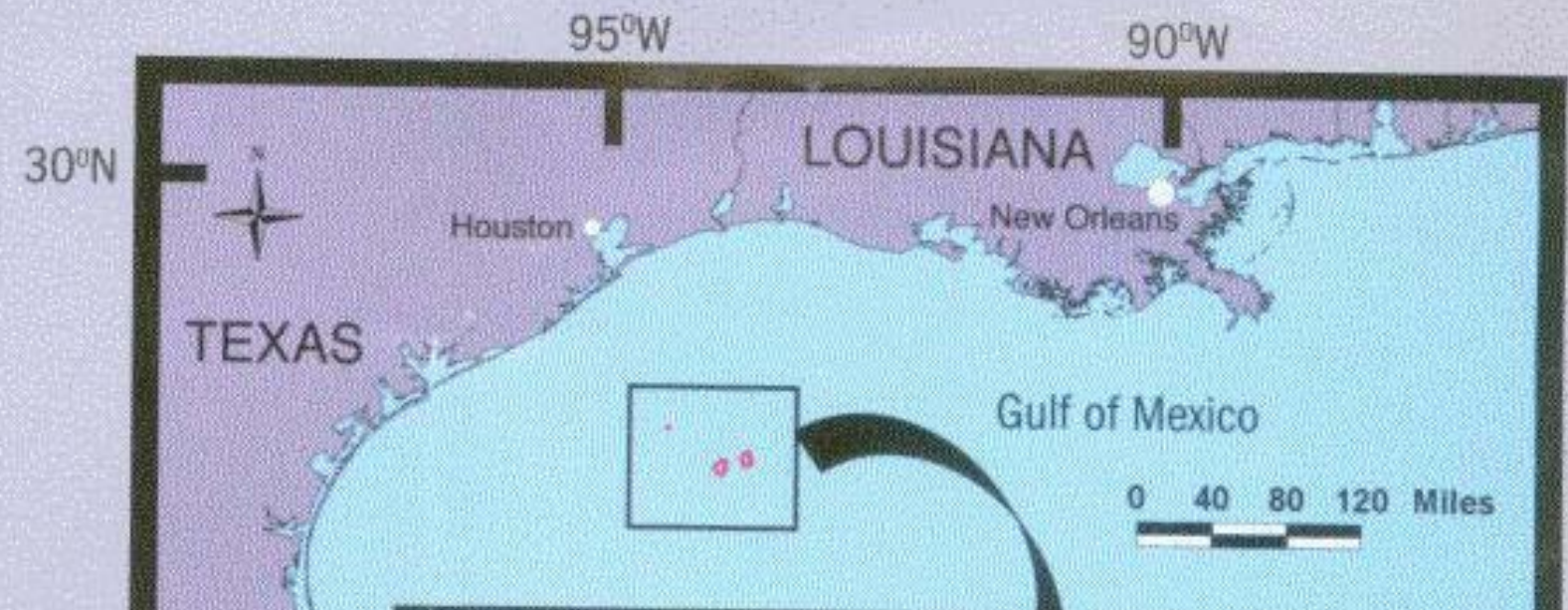
**⁵Genetics Laboratory
Department of Pharmaceutical Sciences
University of New England -- Maine
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Bureau of Ocean Energy Management,
Regulation and Enforcement (BOEMRE)
Herndon, VA**

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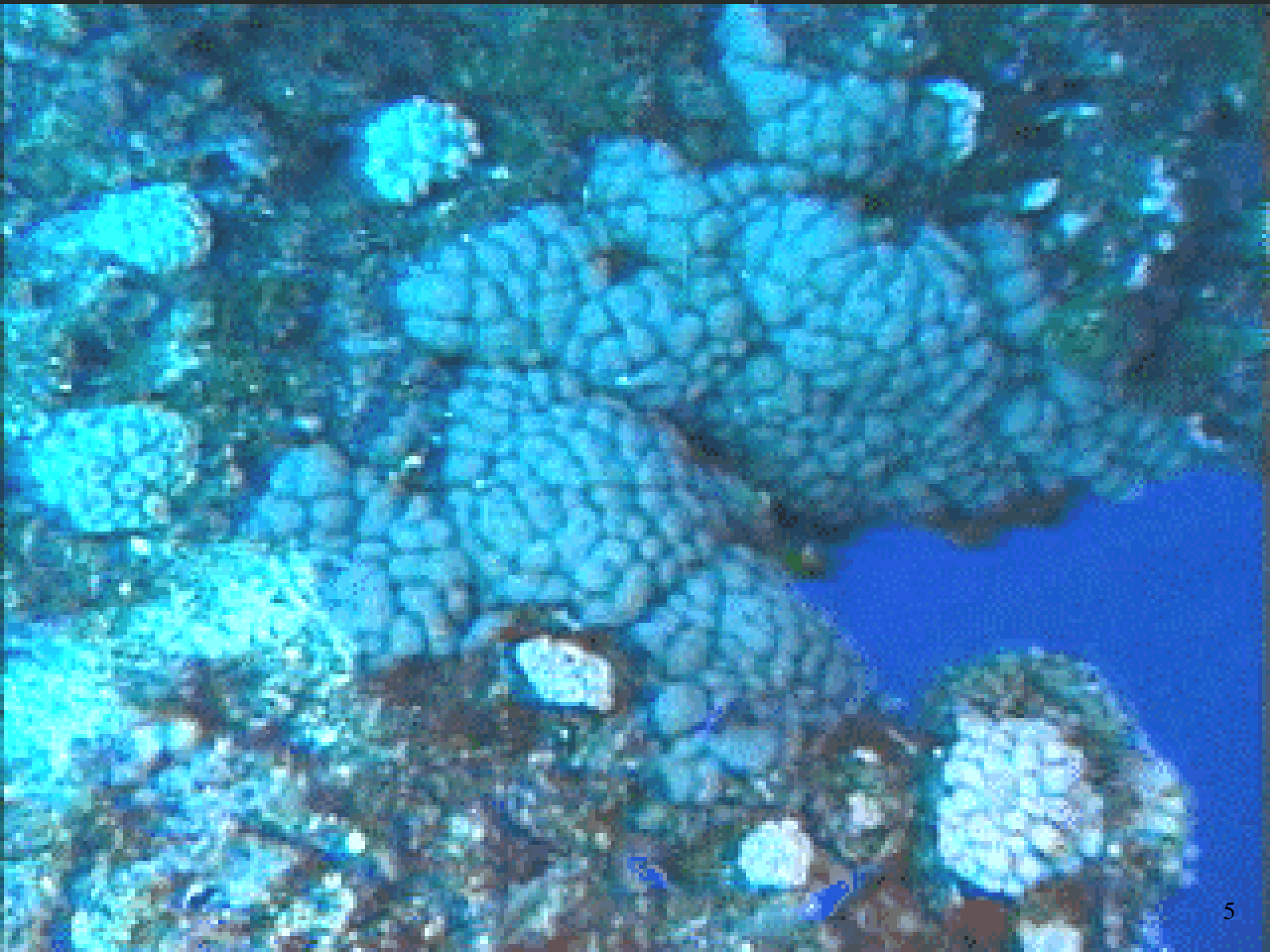
* Current Address



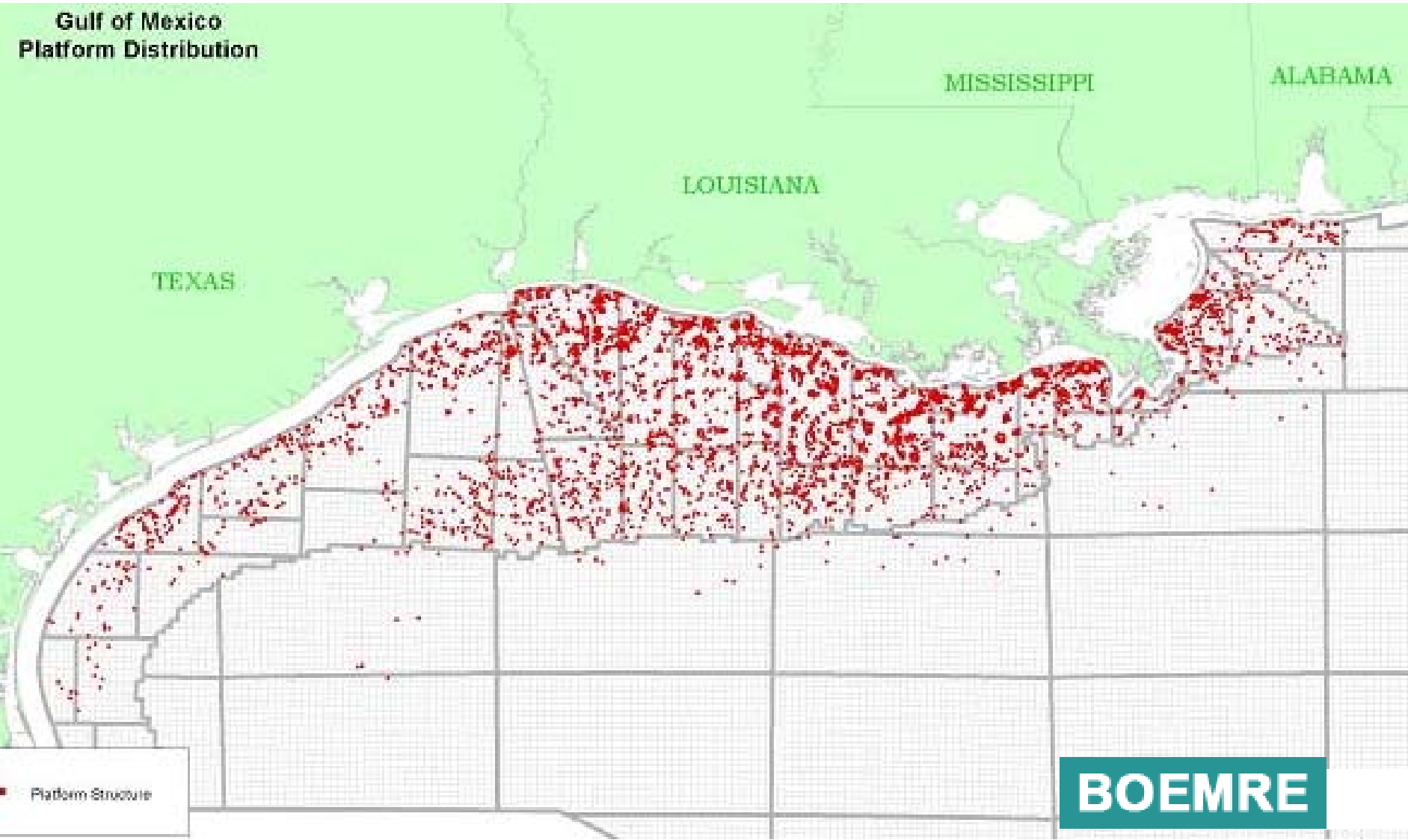
**NOAA Flower Garden Banks
National Marine Sanctuary**

— Flower Garden Banks National Marine Sanctuary boundaries





Gulf of Mexico Platform Distribution



Questions

Phase I

- **To what degree have corals colonized platforms – around FGB and in NW Gulf?**
- **Relationship between coral population/community characteristics and distance from FGB?**
- **Recruitment patterns on these platforms vs. FGB?**
- **What are the genetic affinities of coral populations between the FGB and neighboring platforms?**

Questions (cont.)

Phase II

- **What are the coral distribution and abundance patterns on platforms throughout the northern GOM?**
- **Genetic affinities between coral populations throughout the norther GOM – at the macro-scale?**

Questions (cont.)

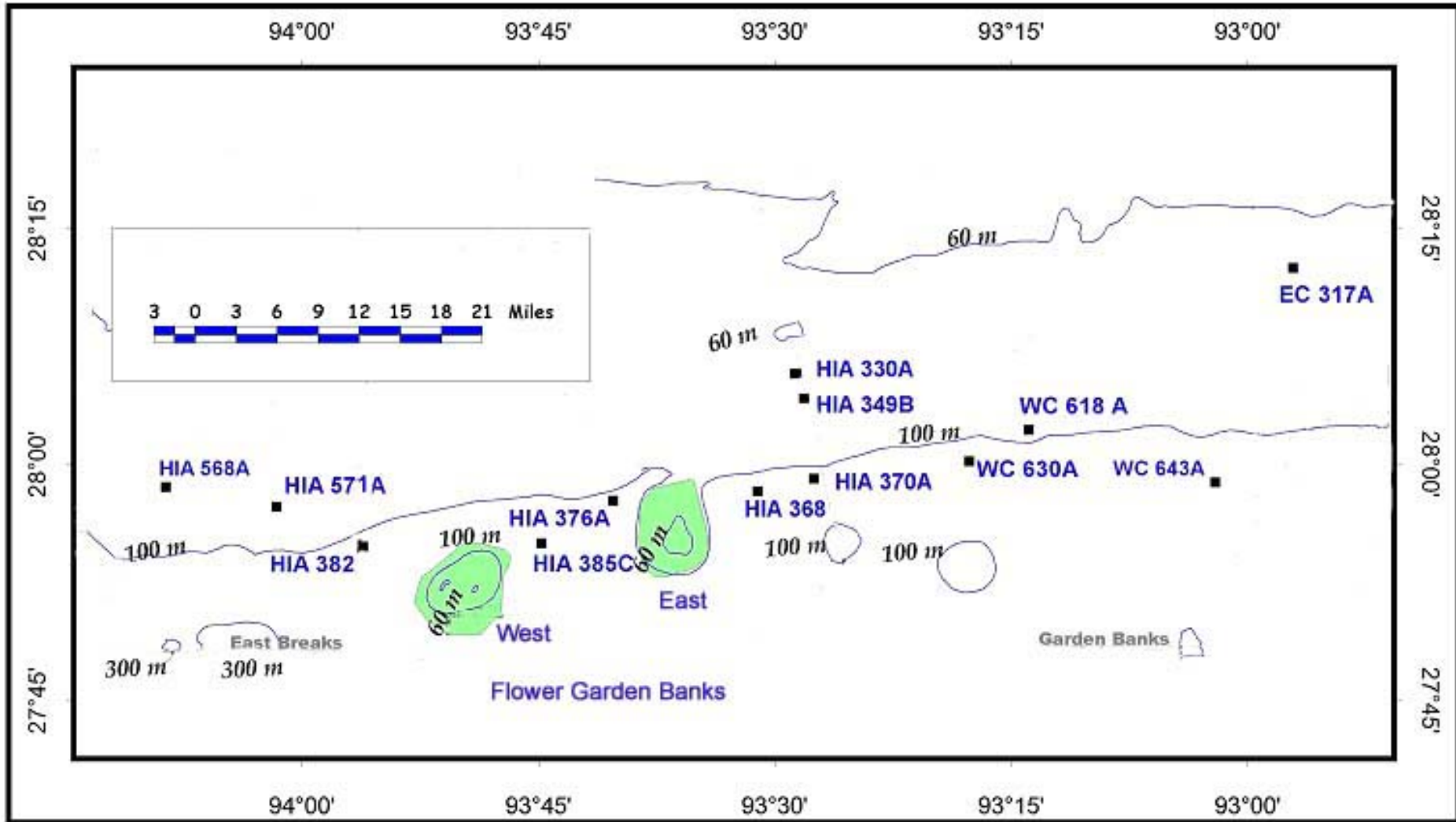
Phase III

- **Are toppled R2R structures facilitating coral community development in the northern GOM?**
- **Do these coral communities vary from those on standing oil/gas platforms?**



www.LoveCards.com

Phase I Sites



Coral Species Observed

- *Colphyllia natans*
(Houttuyn)
- *Diploria strigosa* (Dana)
- *Madracis decactis*
(Lyman)
- *Madracis formosa* (Wells)
- *Millepora alcicornis*
(Linnaeus)
- *Montastrea cavernosa*
(Linnaeus)
- *Oculina diffusa* (Lamarck)
- *Phyllangia americana*
(Edwards & Haime)
- *Porites astreoides*
(Lamarck)
- *Stephanocoenia intercepta*
(Lamarck)
- *Stephanocoenia
mechelinii* (Edwards &
Haime)
- *Tubastrea coccinea*
(Lesson)

Madracis decactis

J. Collins



Diploria strigosa





*Montastraea
cavernosa*

Tubastraea coccinea

Dinah Rogers,
Times-Picayune



Oculina diffusa



Phyllangia americana (Milne-Edwards & Haime)



For all coral species –

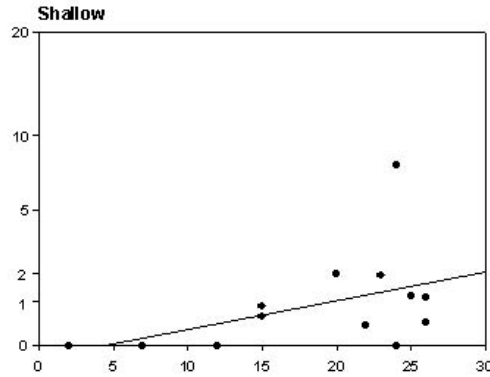
No significant relationship between distance from the FGB and –

- **Abundance**
- **Species Diversity**

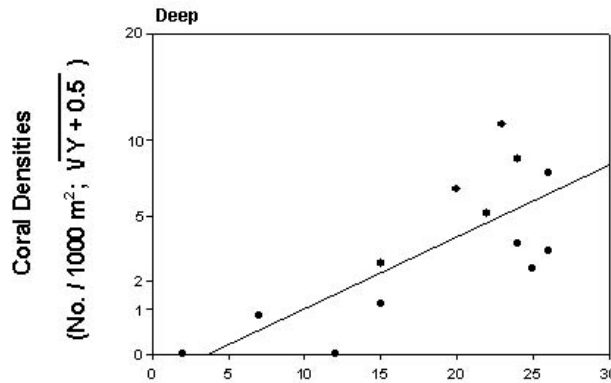
Within ~60 km of the FGB

Shallow

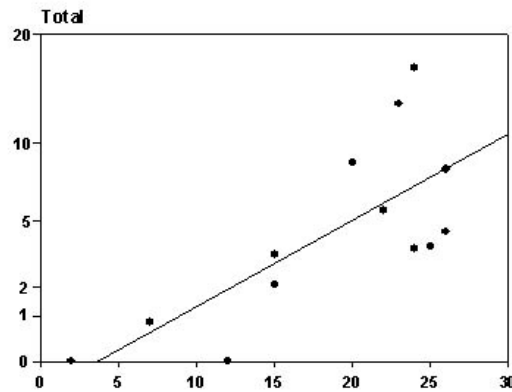
Coral Density



Deep



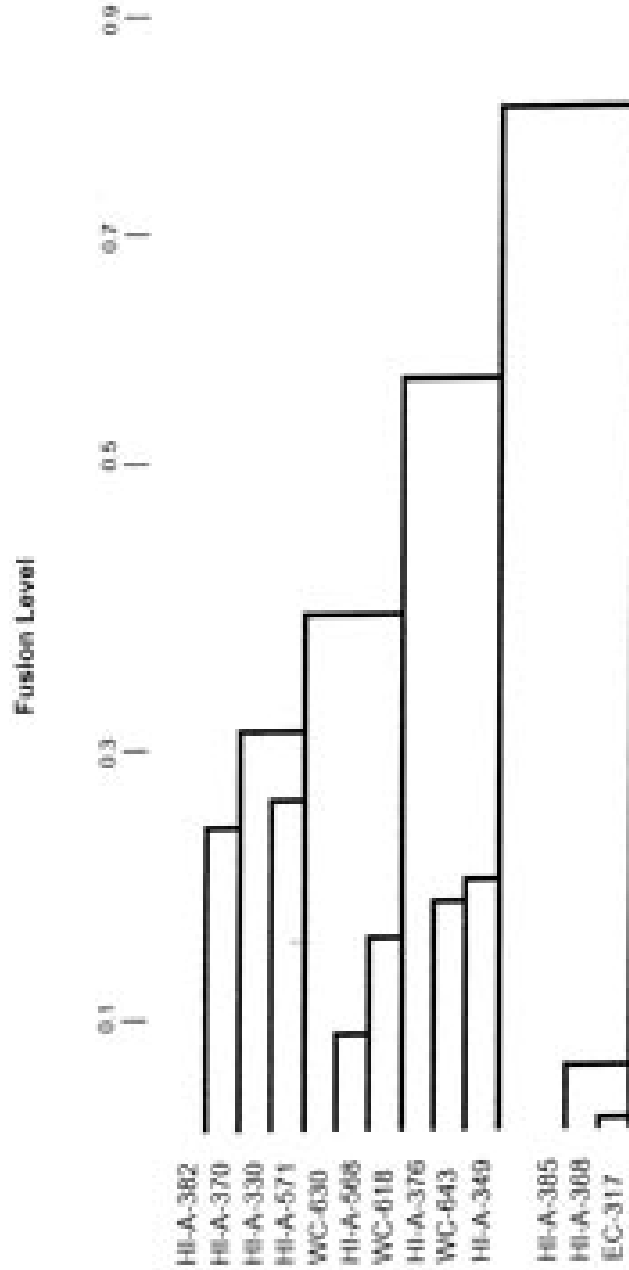
Total



Hermatypic Corals

Coral Density vs. Platform Age

**Fusion
Level**

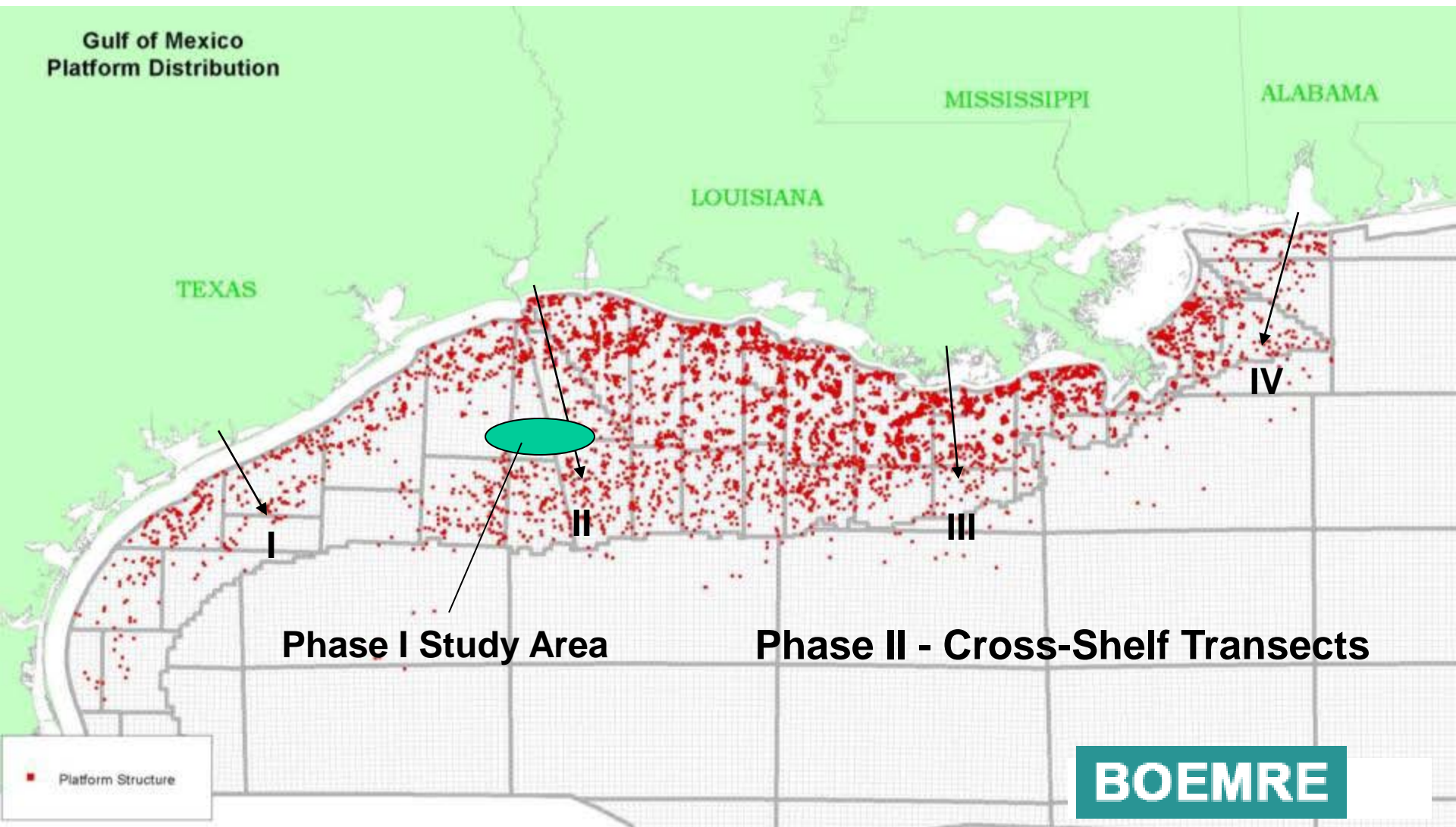


Platform Number

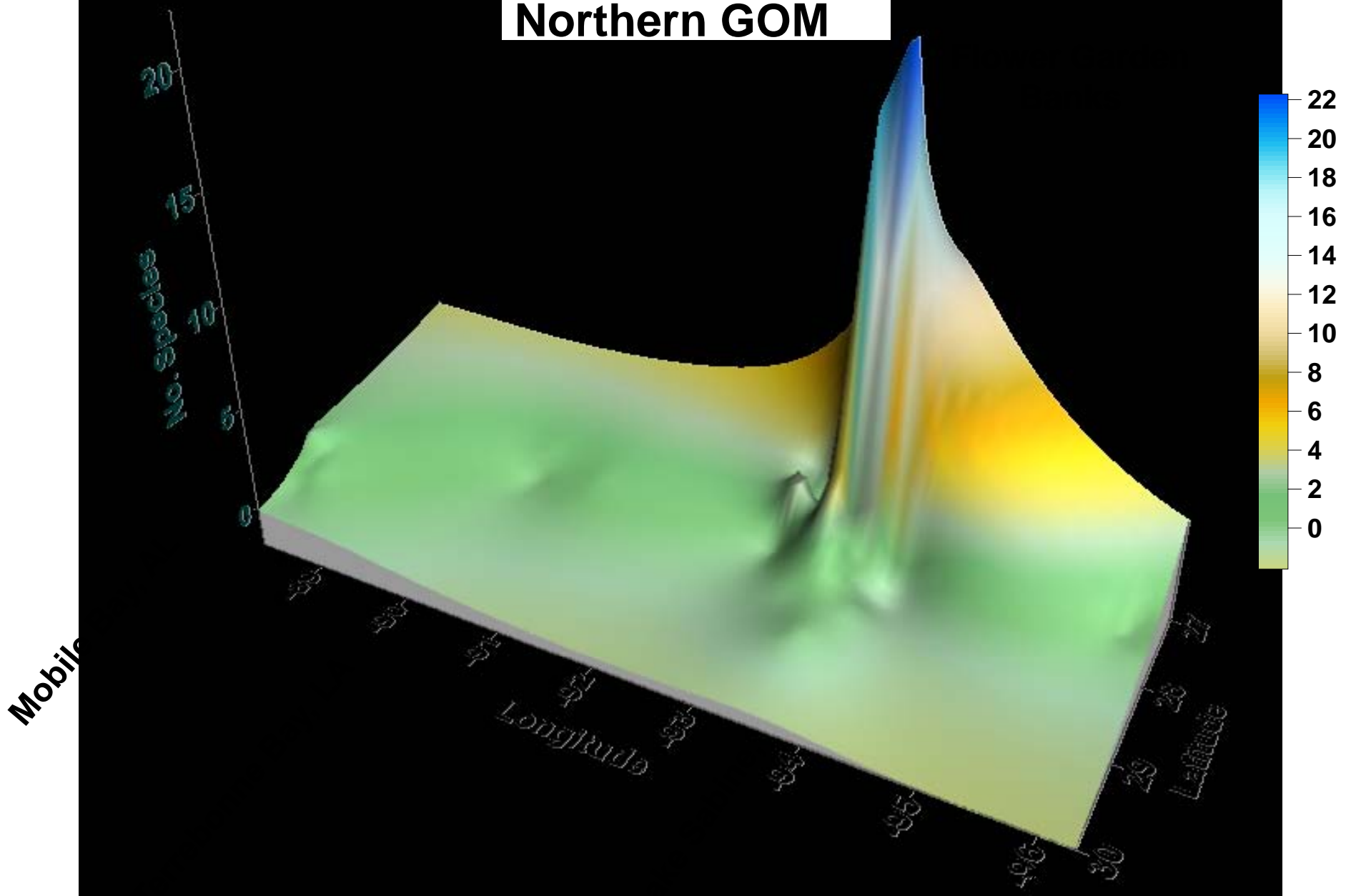
**Coral
Community Structure**

**Associations
Between Platforms**

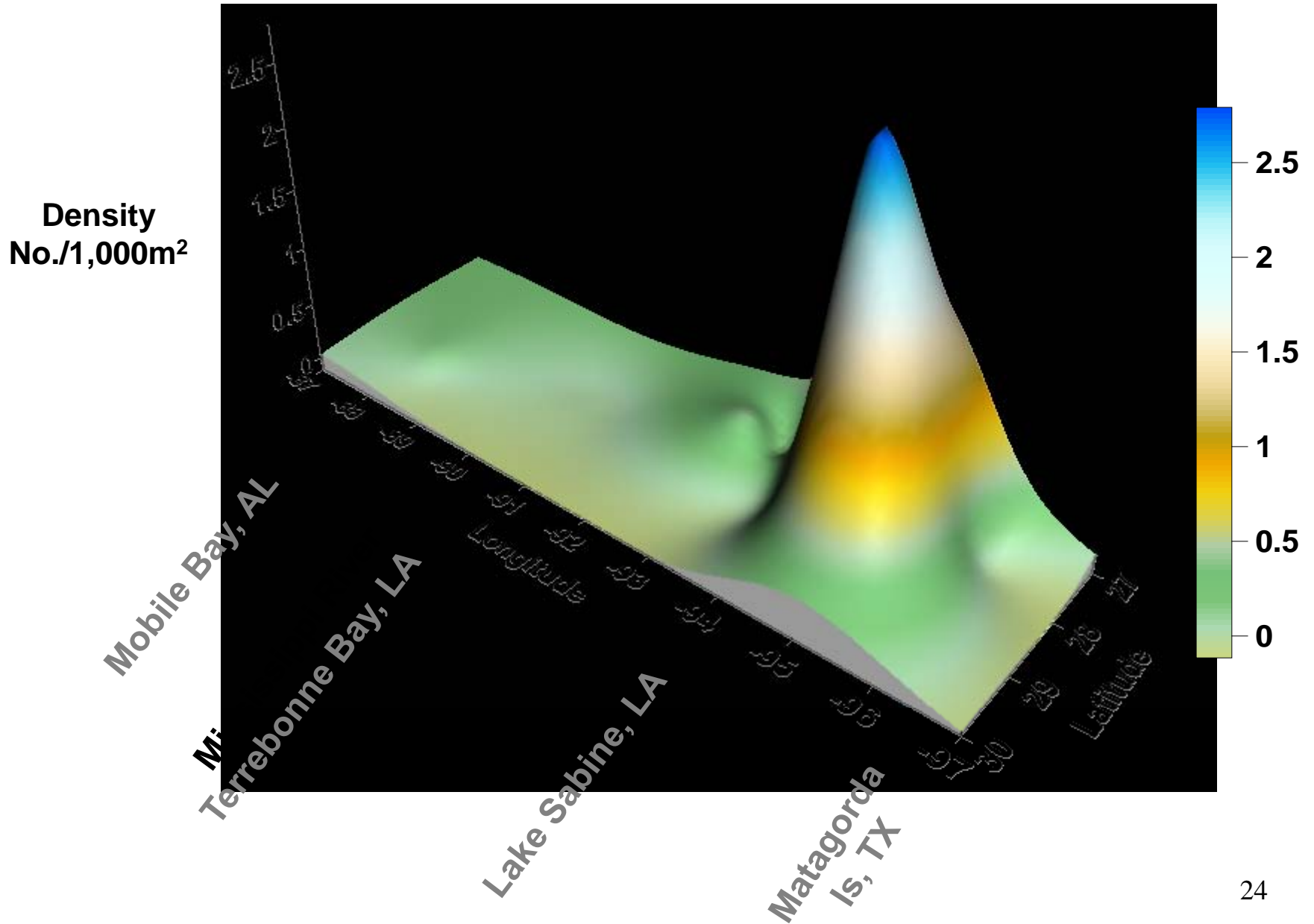
Phase II – Complete Northern GOM Study



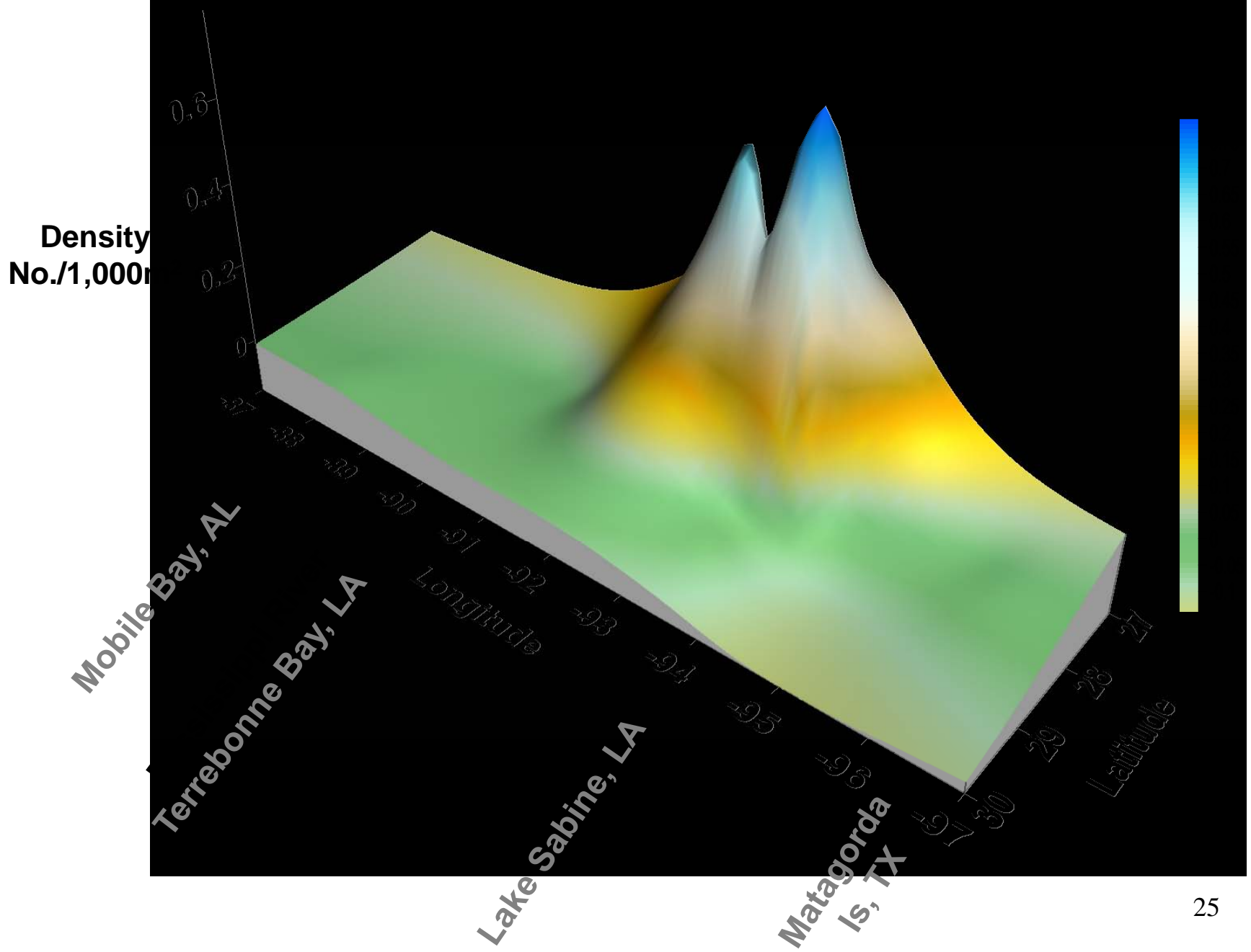
Northern GOM



Total Hermatypic Coral Density – Northern GOM

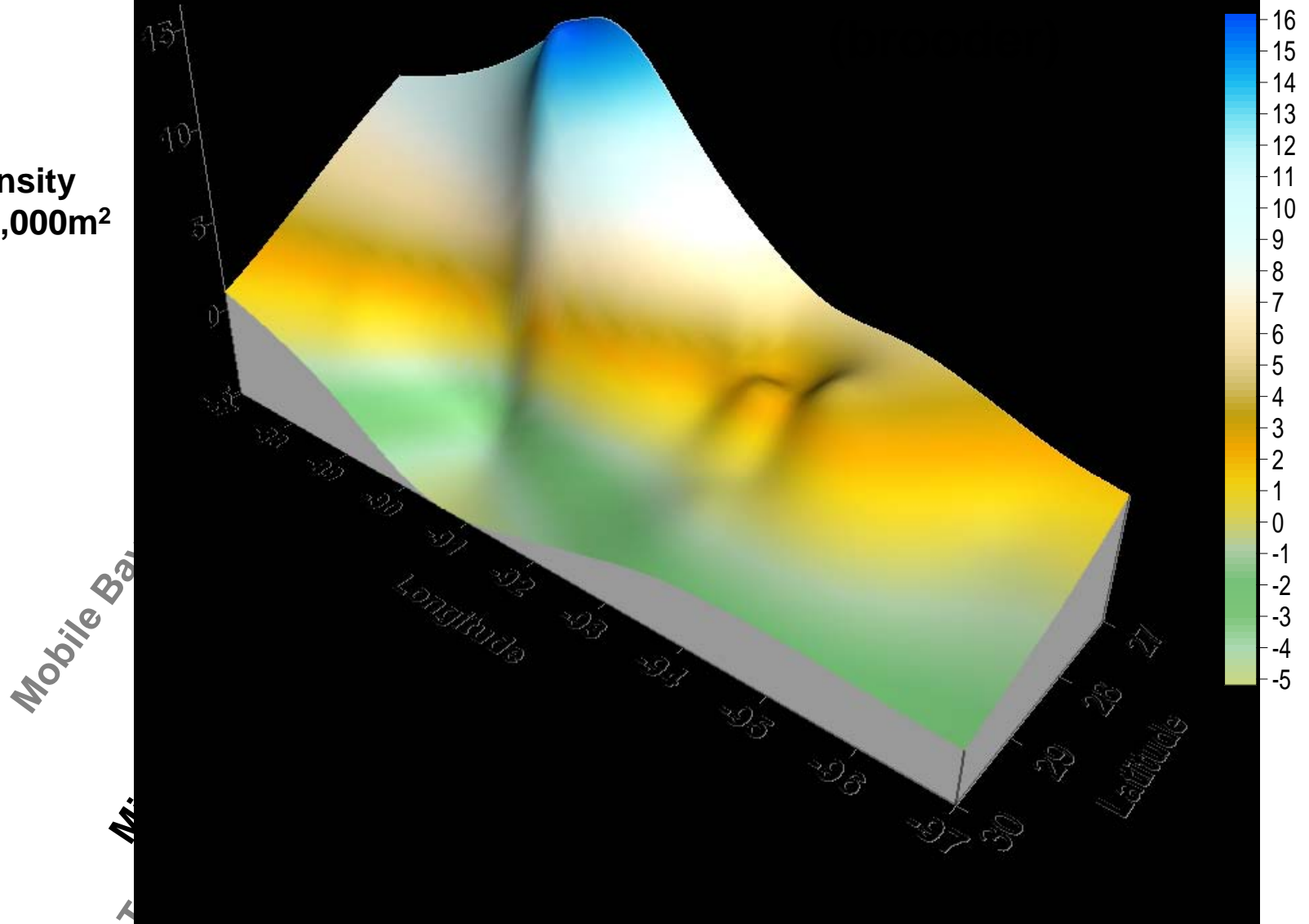


Diploria striosa Density – Northern GOM



Madras Lake (1991) Density Profile - North - 00M

Density
No./1,000m²



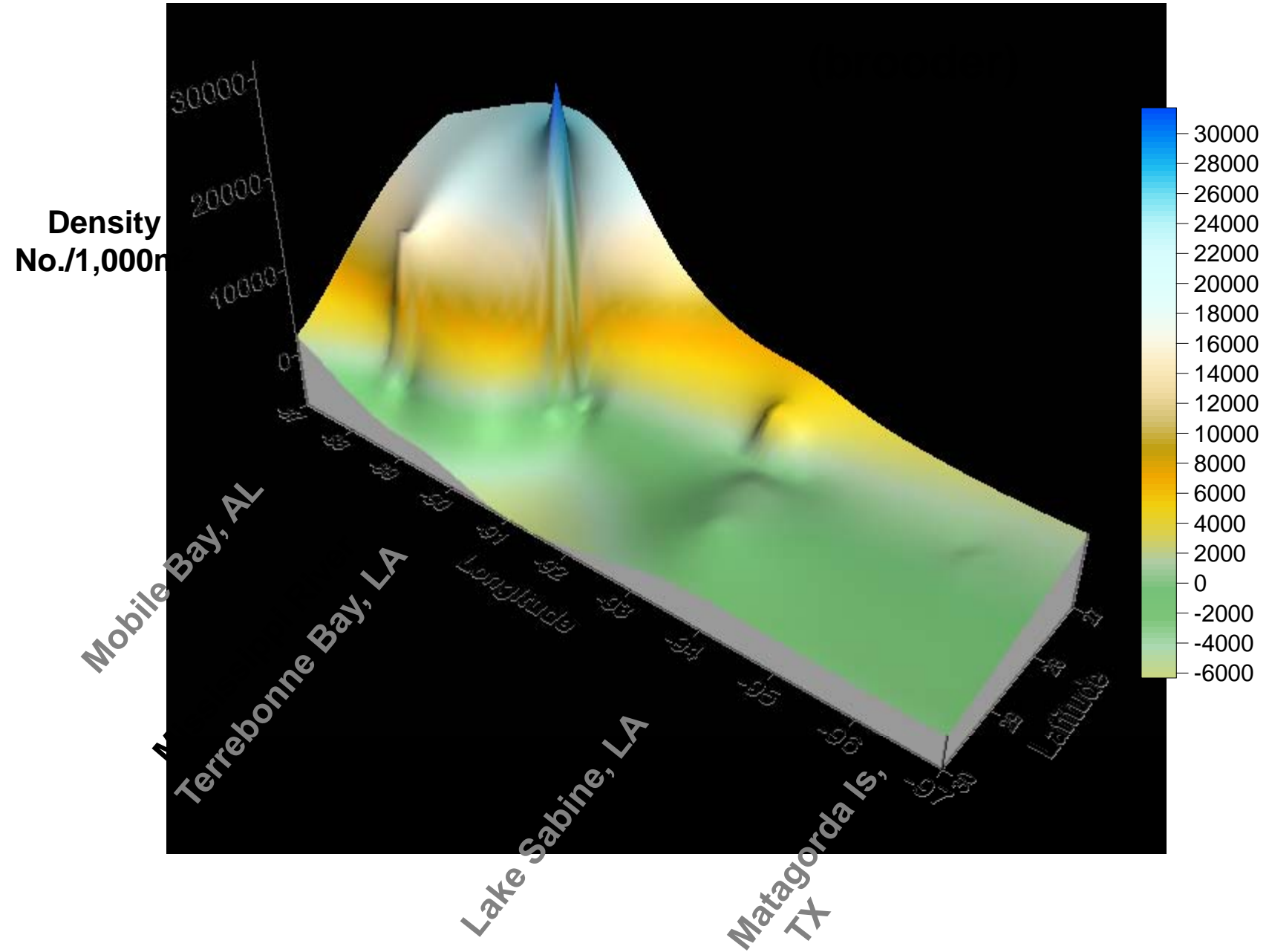
Mobile Bay

M:
T

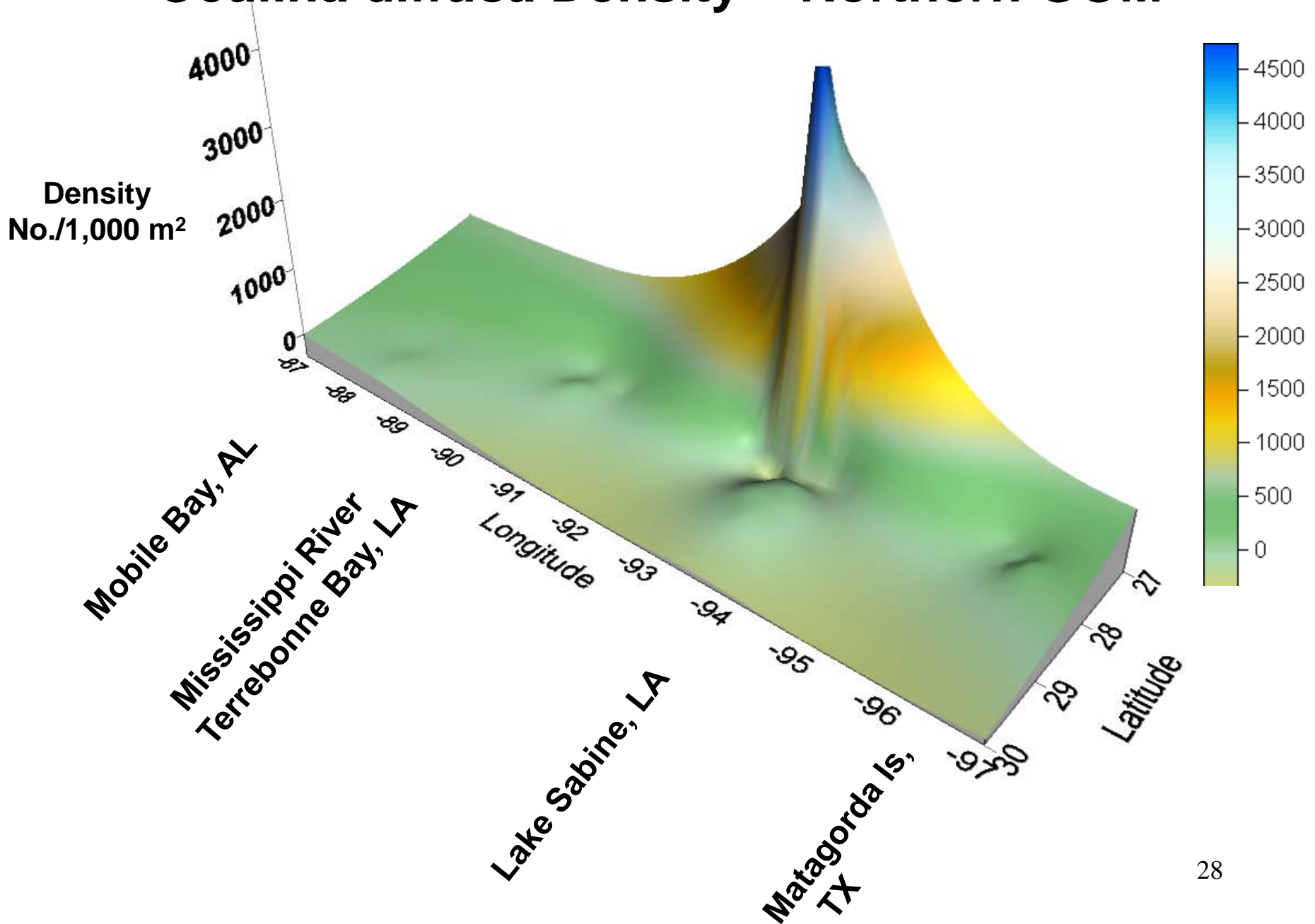
Lake

Matagon
TX

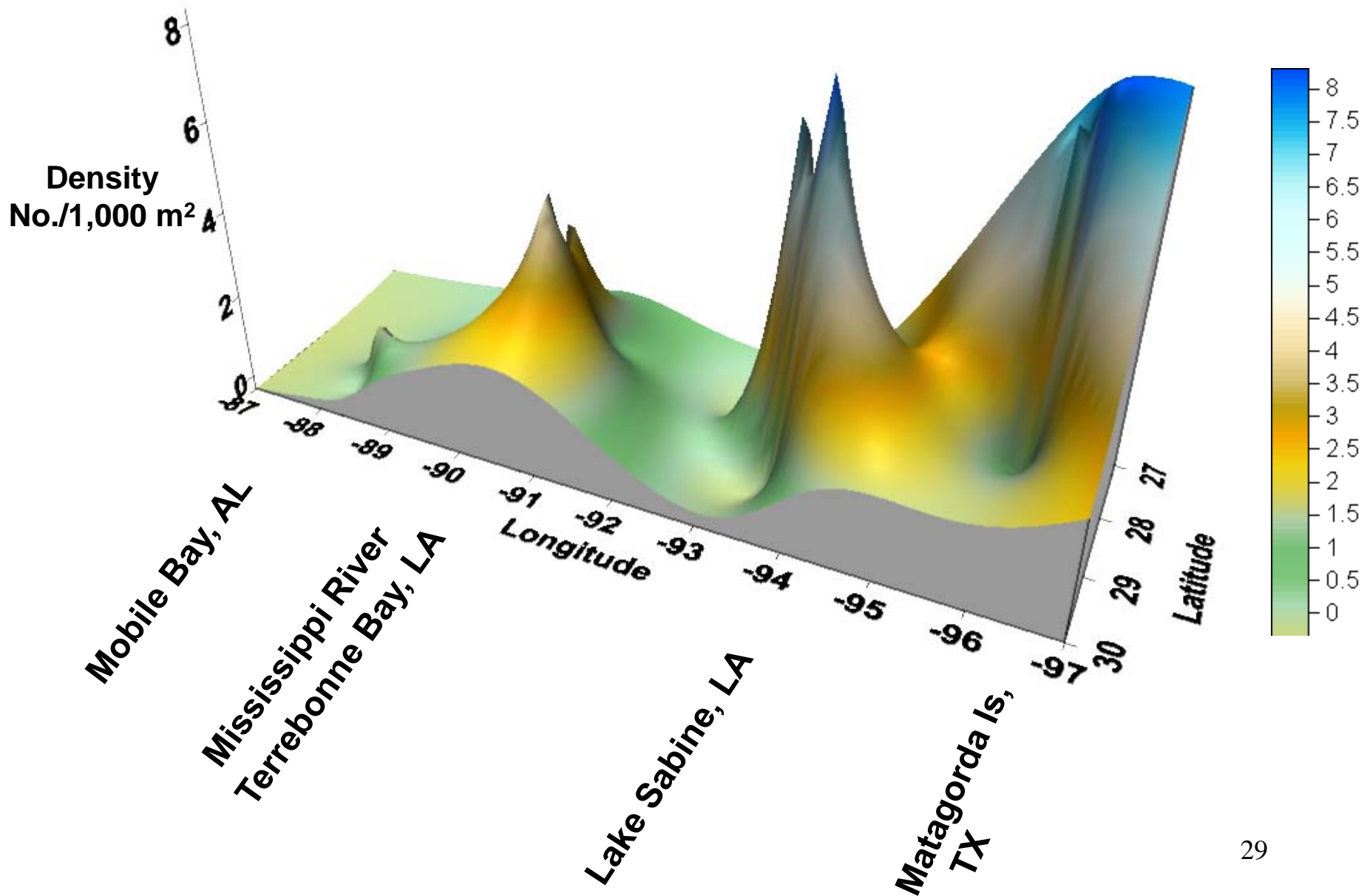
Tubastraea coccinea Density – Northern GOM



Oculina diffusa Density – Northern GOM



Phyllangia americana Density – Northern GOM



**Genetic Affinities between Platforms –
Molecular Genetics
Phases I & II**

Genetic Affinities between Adult Corals

Diploria strigosa (Broadcast Spawner) and *Madracis decactis* (Brooder)

- On the Flower Garden Banks
- On surrounding platforms
- Individual comparisons – from the perspective of each point as a source

Diploria strigosa
(broadcast spawner)

- **High self-recognition**
- **Low cross-recognition**
- **Low gene flow**
- **High self-seeding**

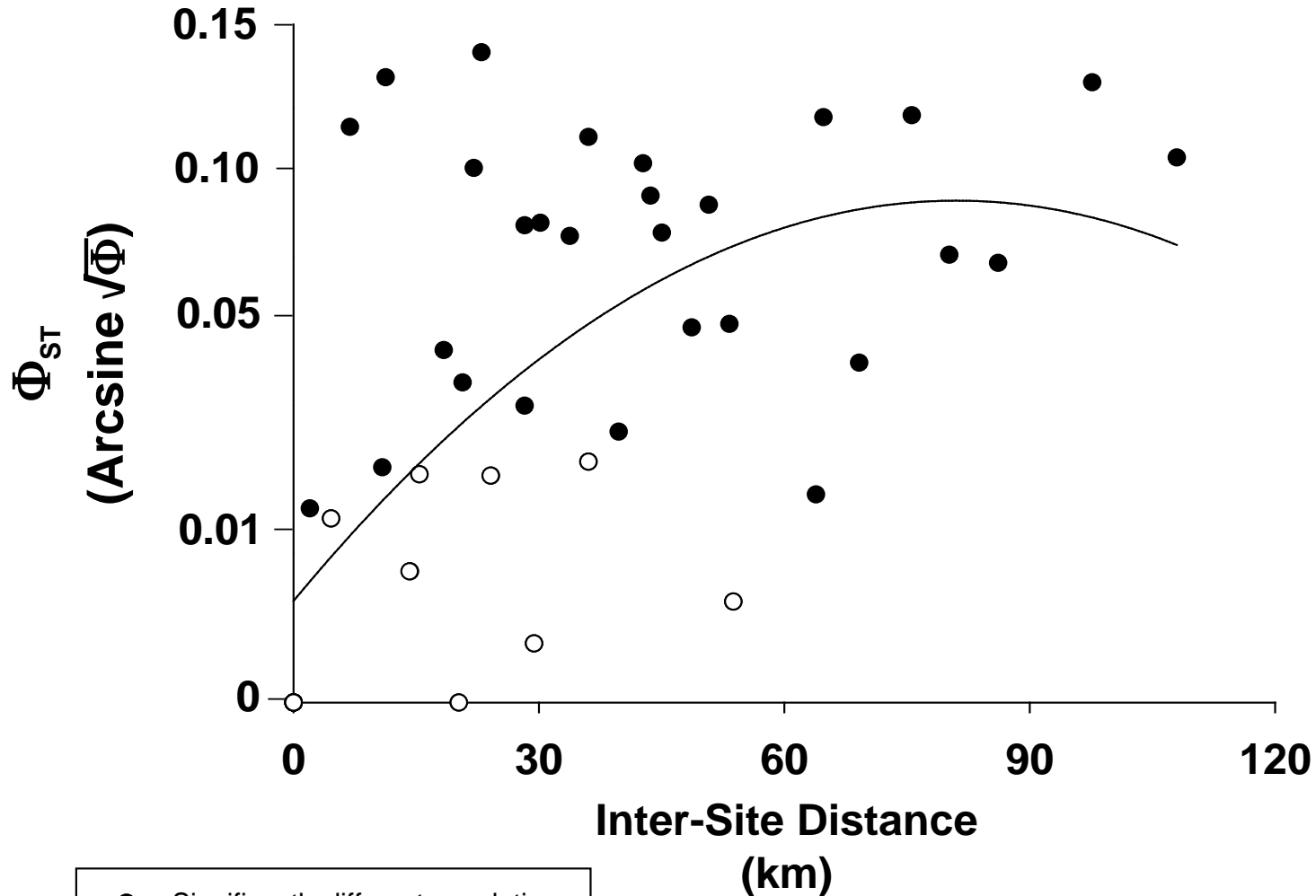
Madracis decactis

(brooder)

- **Moderate self-recognition**
- **Cross-recognition**
- **Higher gene flow**
- **Self-seeding still evident**

AMOVA Results

Genetic Distance (Φ_{ST}) between Populations vs. Inter-Site Distance *Madracis decactis*

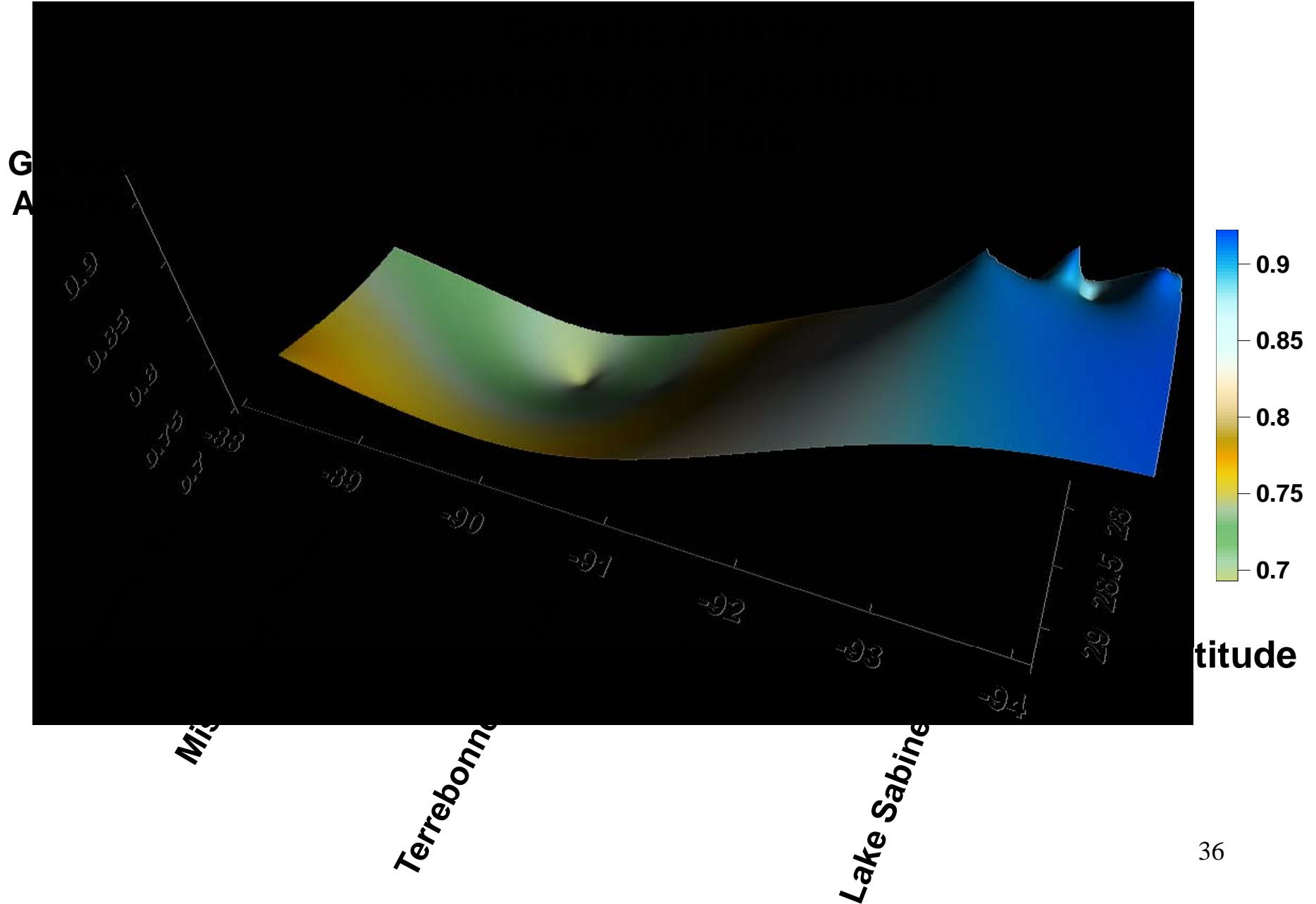


● Significantly different populations
○ n.s.
— 2^o polynomial regression

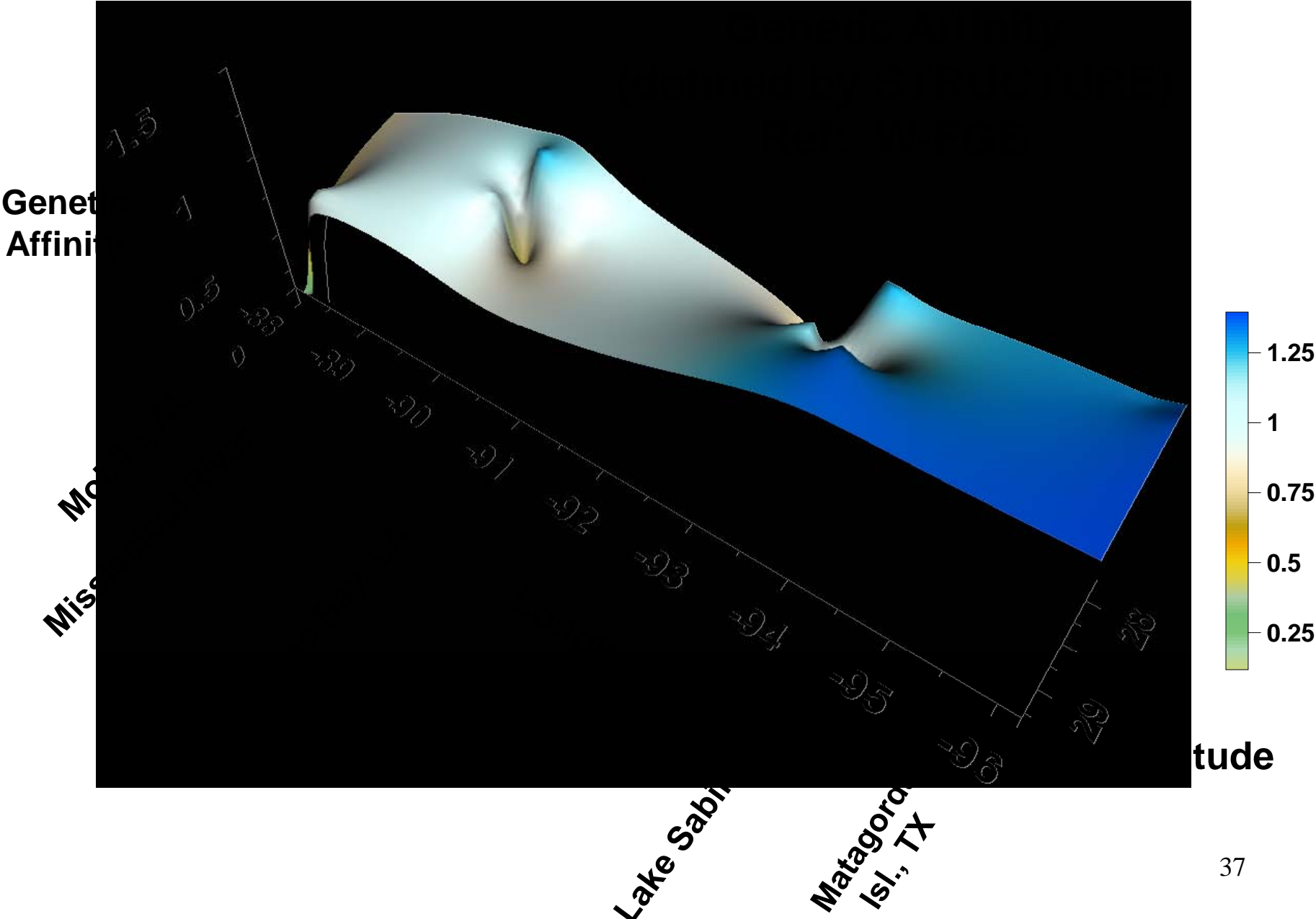
Phase II

Genetic Affinity of Corals on Platforms throughout the Northern GOM

Madracis decactis



Tubastraea coccinea



Madracis decactis (brooder)

Transects III & IV

AFLPOP Analysis, Log-Likelihood = 1

Allocated to ↓	Percentage (%) of Colonies			
	(W. of Miss. River)			(E. of Miss. River)
	ST-295	ST-297	ST-292	MP - All
ST-295	99.3%	0	0	0
ST-277	0	100	0	0
ST-292	0.1	0	99.4	0
MP - All	0	0	0	100
None	0.6	0	0.6	0

Tubastraea coccinea (brooder)

Transects III & IV – (E)

AFLPOP Analysis, Log-Likelihood = 1

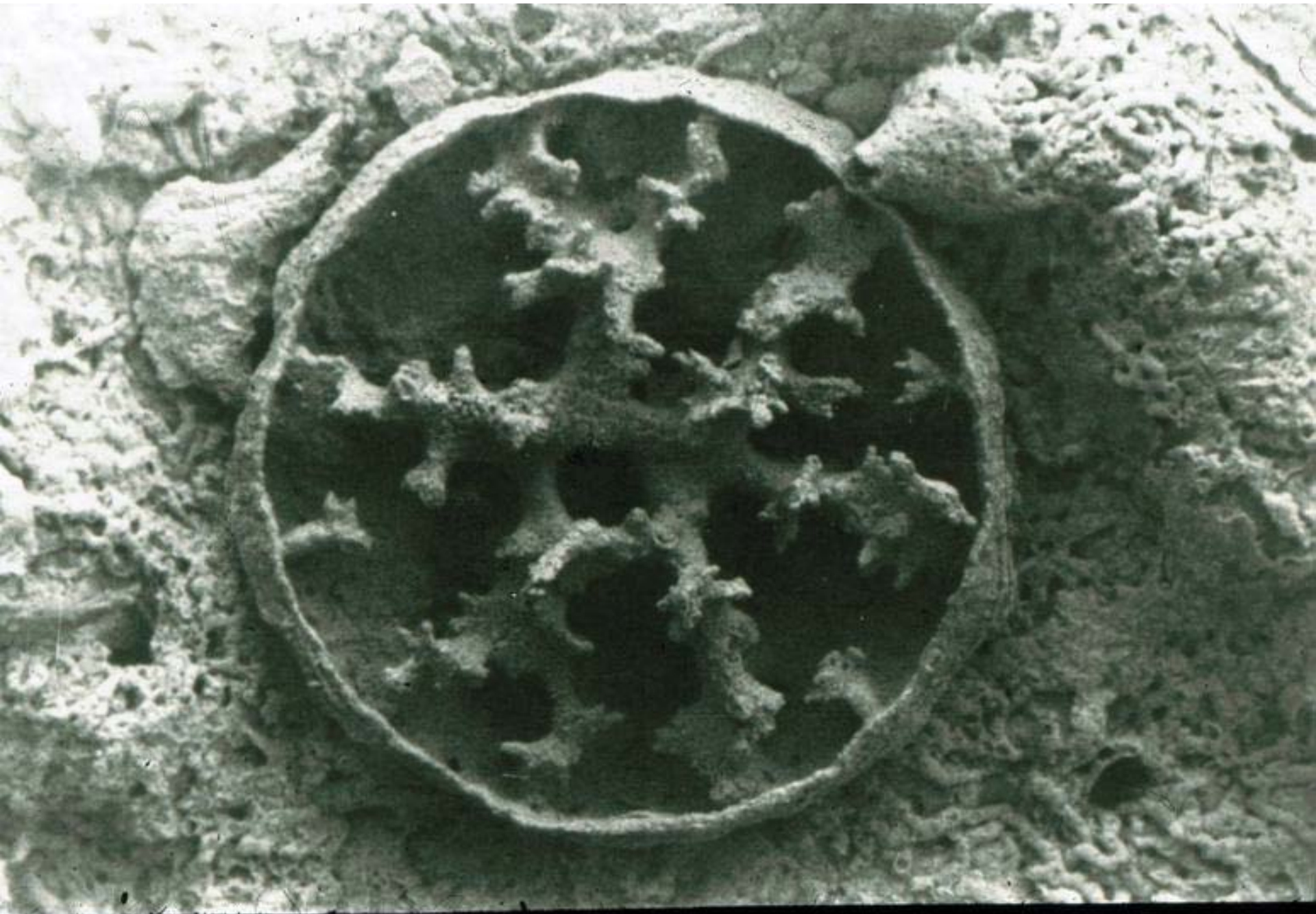
Allocated to ↓	Percentage (%) of Colonies on these Platforms ↓					
	(W. of Miss. River)	(E. of Miss. River)				
	ST & SS pops	MP-144	MP-236	MP-265	MP-288	MP-289
ST & SS pops	100%	0	0	0	0	0
MP-144	0	21.4	0	0.8	0.2	0.4
MP-236	0	0.4	98.4	0	0	0
MP-265	0	1.6	0	58.6	0	0
MP-288	0	1	0	0	82.8	0.2
MP-289	0	2.2	0	0	0	57.8
None	0	73.4	1.6	40.6	17	41.6

$N_i = 500, 10x$

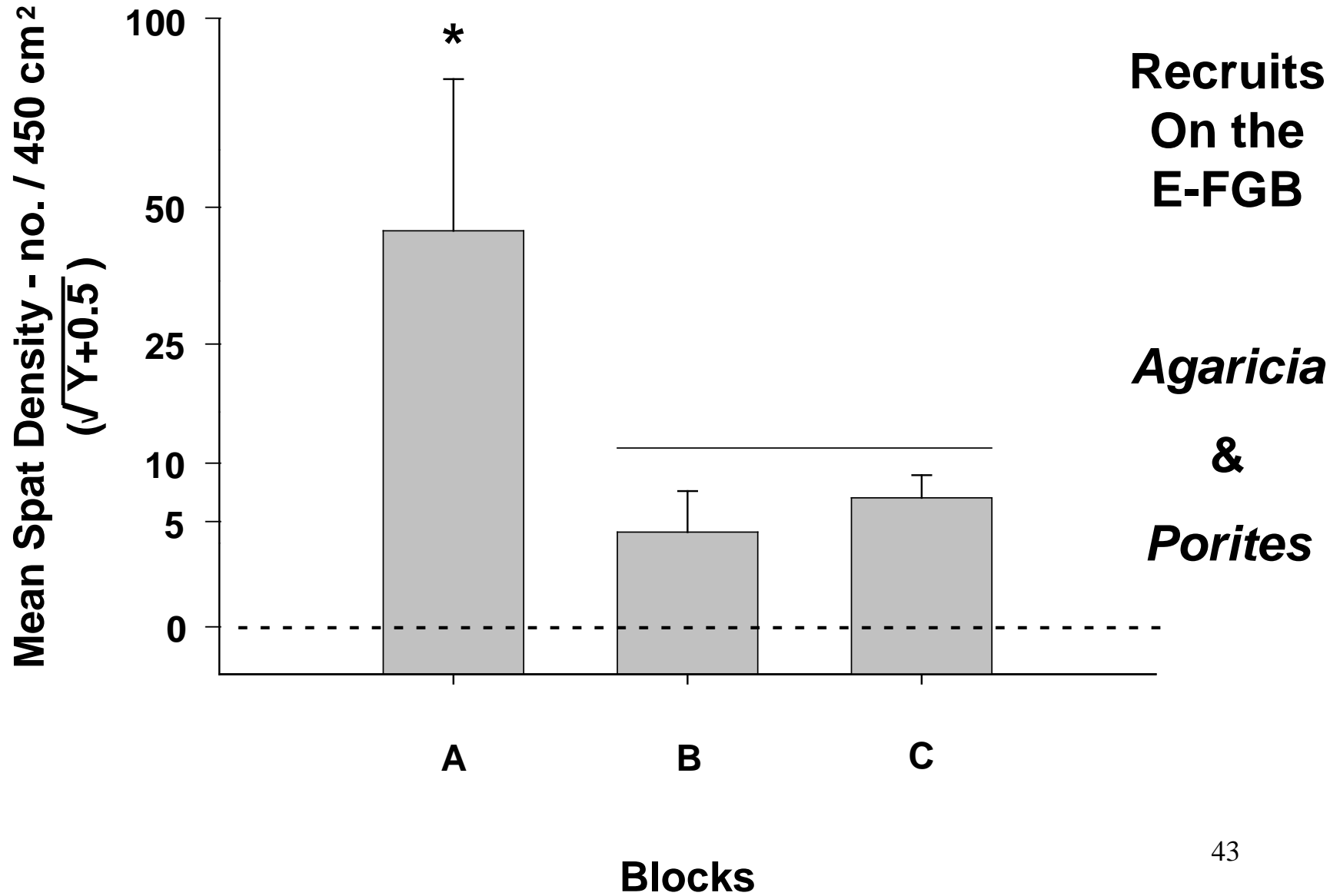
Coral Recruitment
on the Flower Garden Banks
vs.
the Platforms



METRIC 1



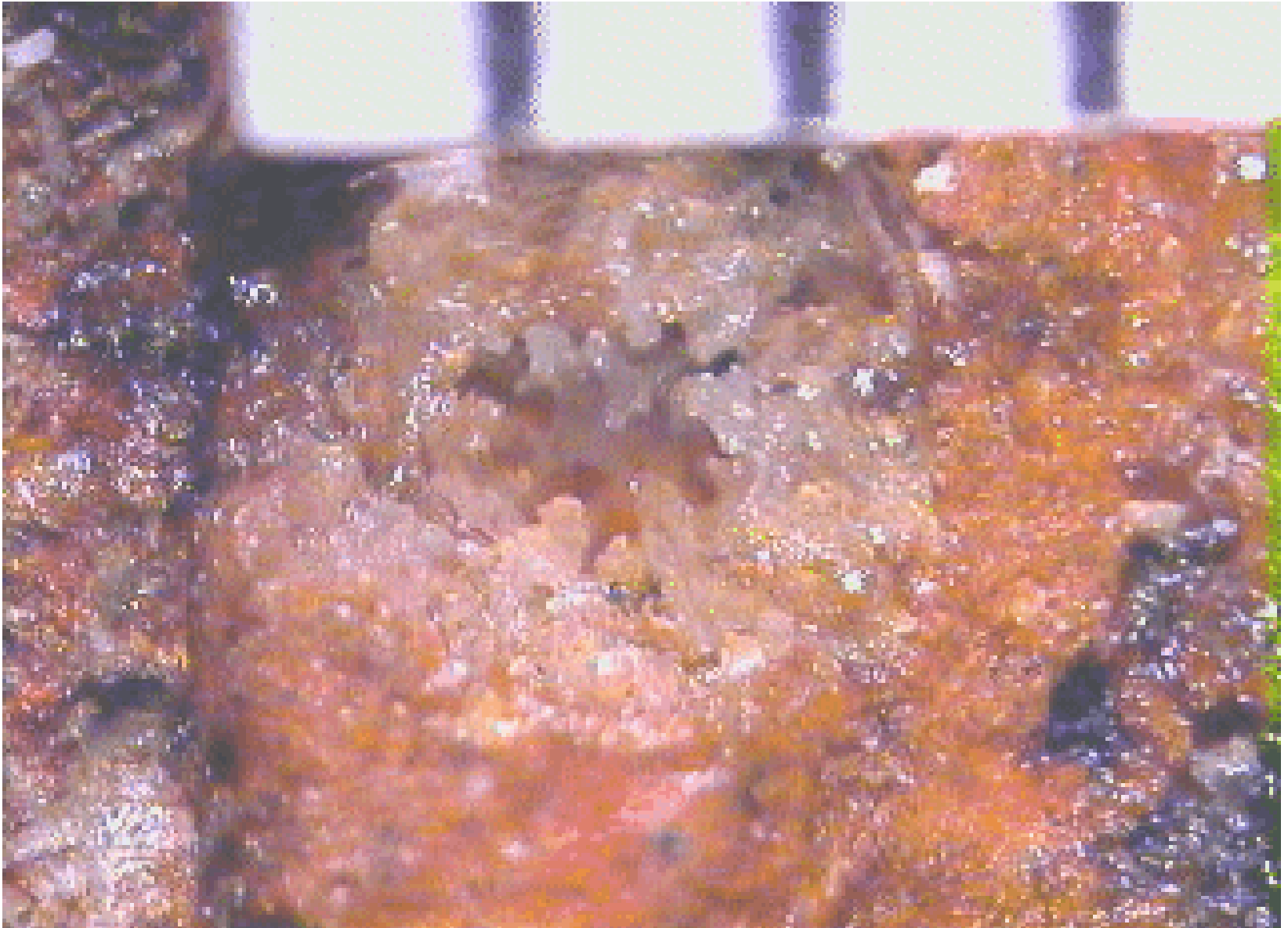
East Flower Garden Bank Total Coral Spat



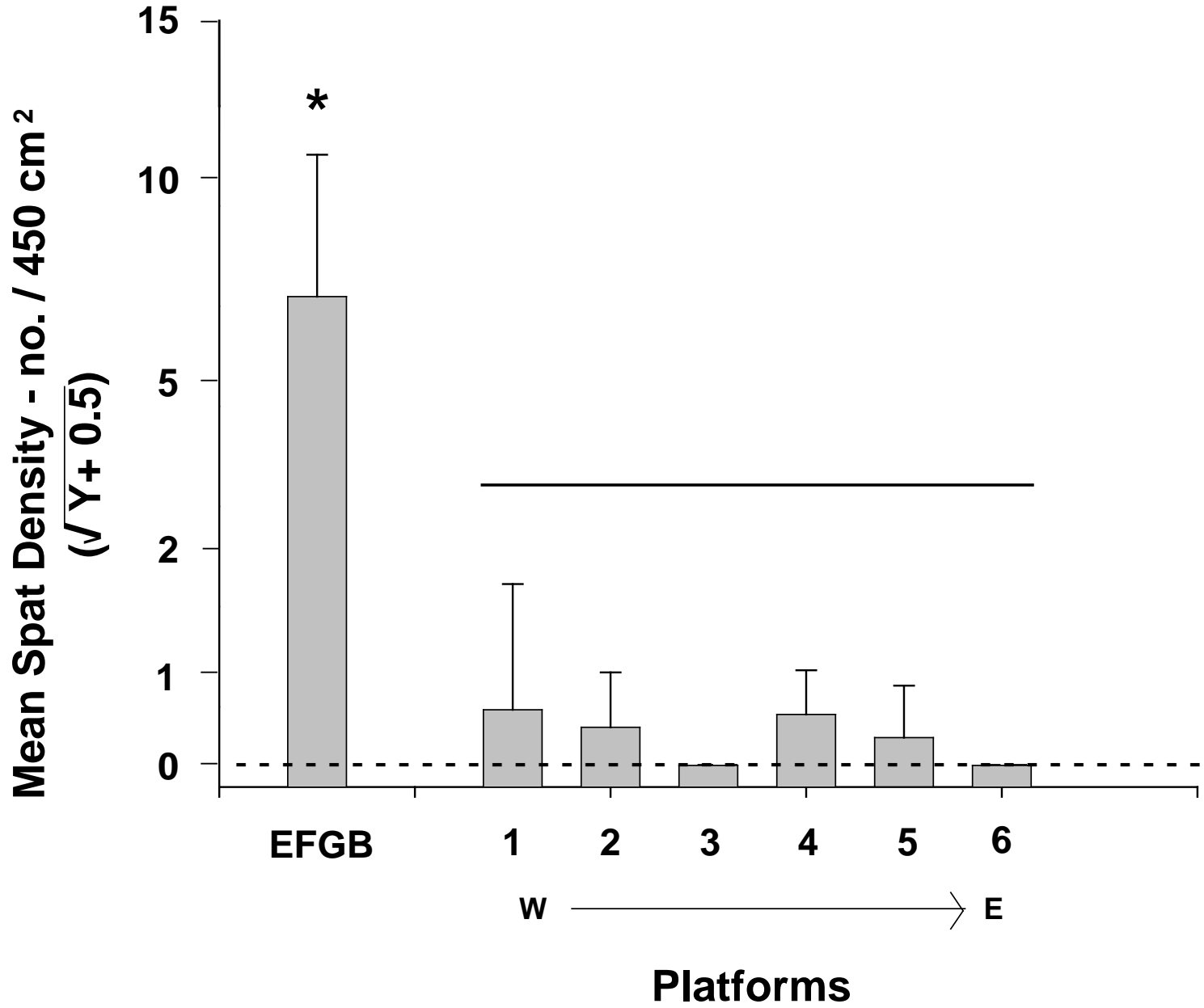
***Tubastrea coccinea* (Lesson 1829)**



***Madracis decactis* (Lyman 1859)**



East Flower Garden Bank vs. Platforms Total Coral Spat - Combined Depths



Coral Settlement on GOM Platforms

- **FGB**
 - **Recruitment levels typical of a healthy coral reef**
 - **Species composition also typical**
- **Platforms**
 - **Recruitment levels atypical**
 - **Recruitment is rare; approximates a Poisson distribution**
 - **Species composition of recruits highly atypical**

Phase III

Coral Community Development on

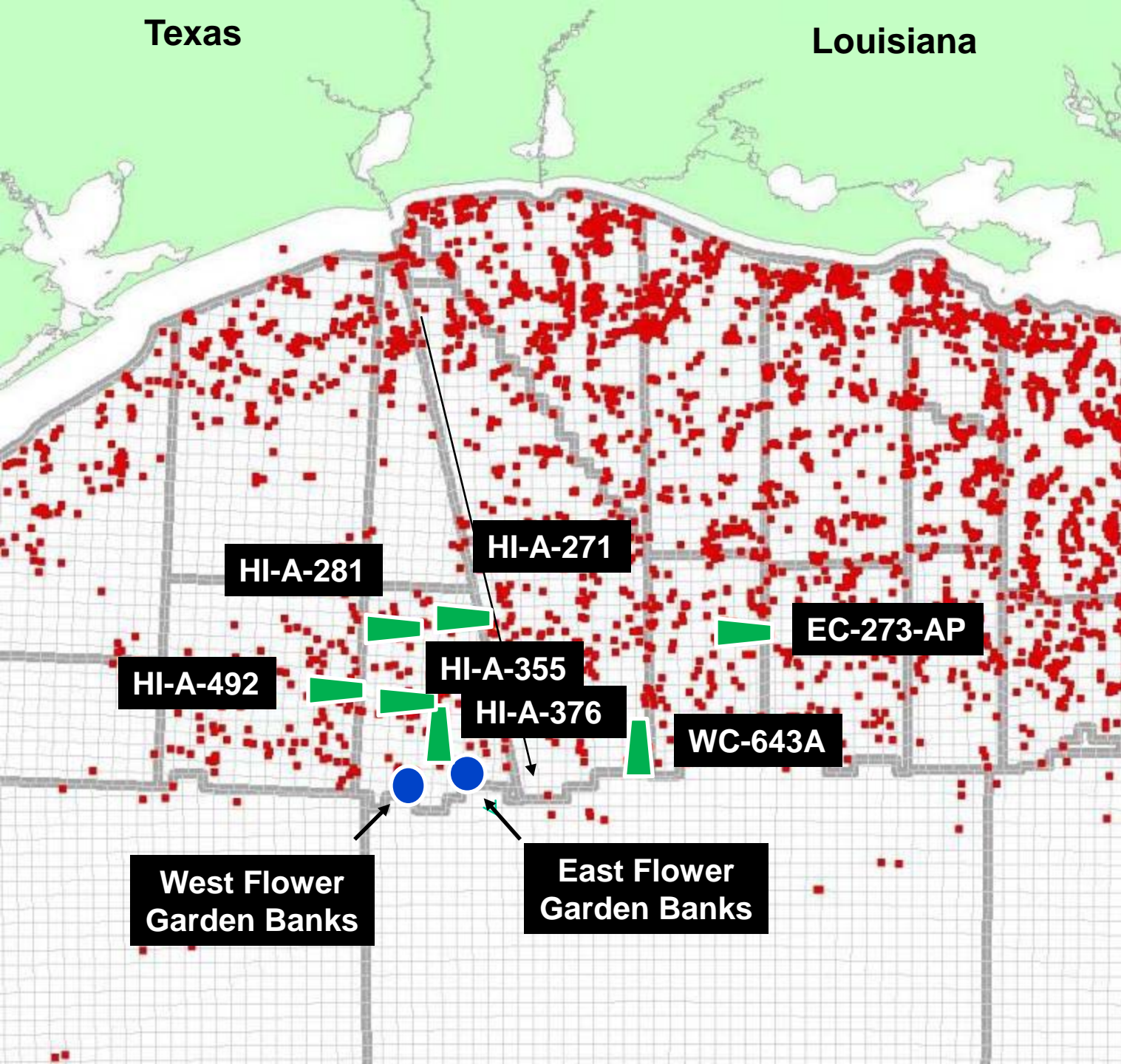
Rigs-to-Reefs Structures

vs.

Standing Platforms



<http://www.gomr.mms.gov/homepg/regulate/environ/rigs-to-reefs/artificial-reefs.html>



Texas

Louisiana

Location of Study Sites

HI-A-281

HI-A-271

EC-273-AP

HI-A-492

HI-A-355

HI-A-376

WC-643A

West Flower Garden Banks

East Flower Garden Banks

▲ = Platform

■ = R2R Structure

SeaBotix LBV-300 ROV



- MMS
- ARACAR

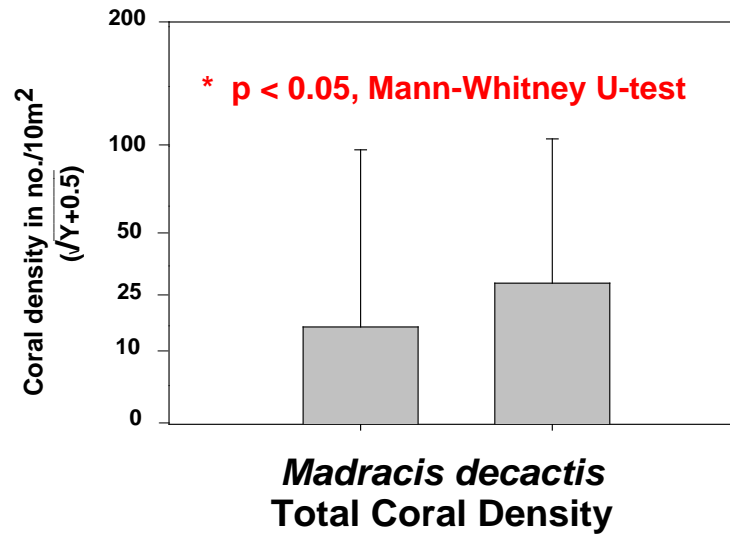


LUMCON

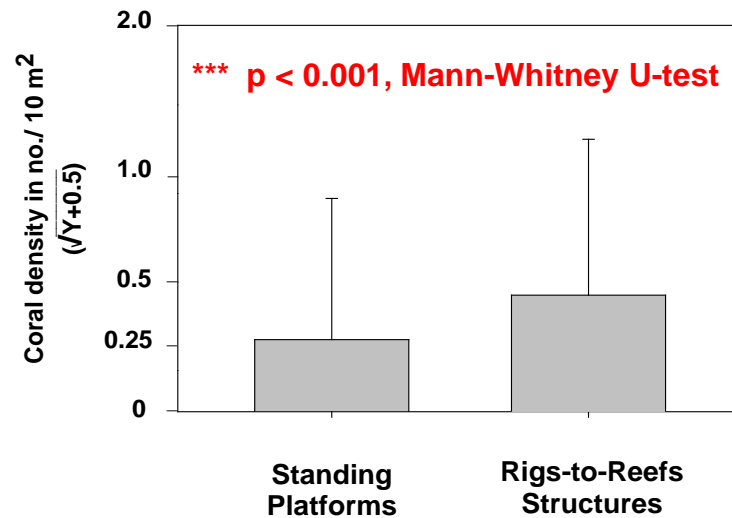
http://farm1.static.flickr.com/151/421351546_01b924e454.jpg?v=0

Coral Density – Standing Platforms vs. R2R Structures

***Tubastraea
coccinea***

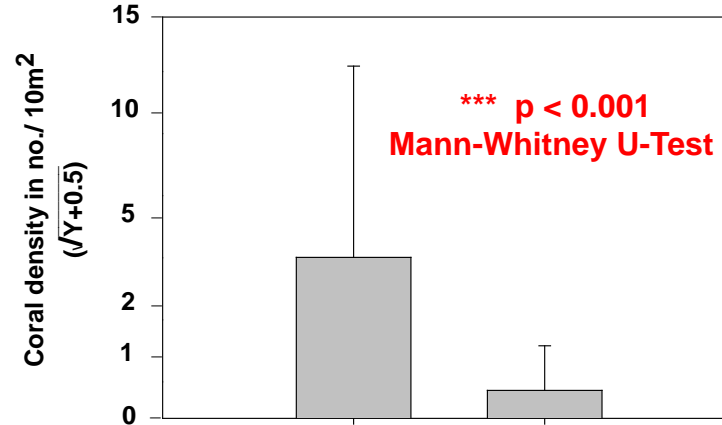


***Madracis
decactis***

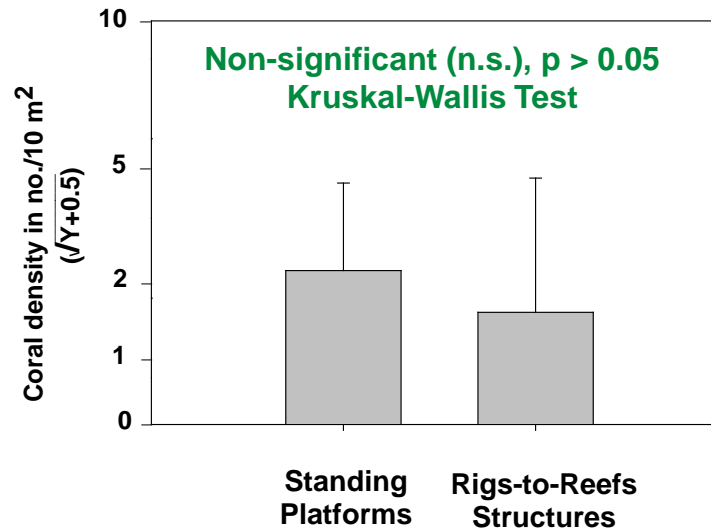


Coral Density – Standing Platforms vs. R2R Structures

Phyllangia americana



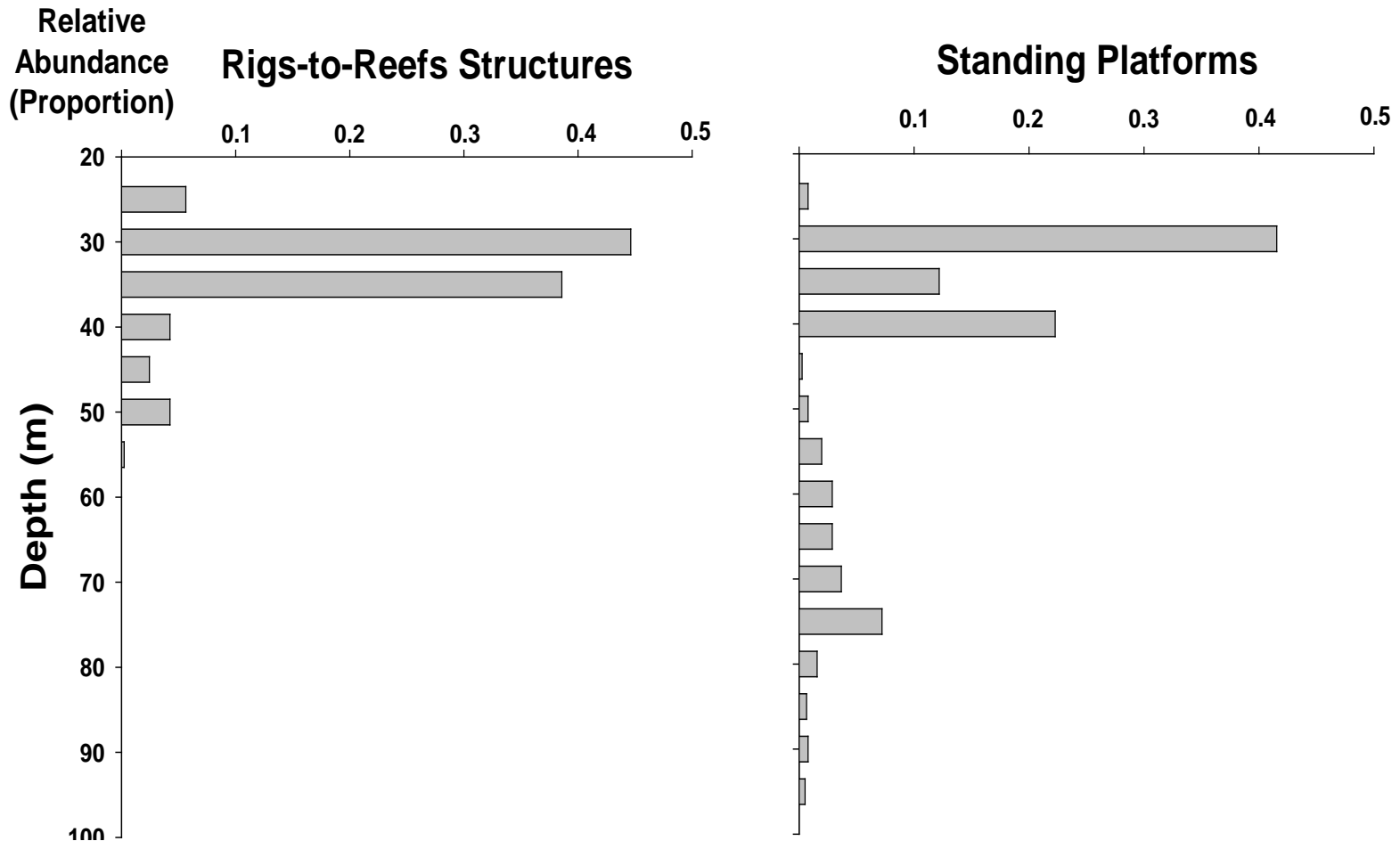
Oculina diffusa



- ***Tubastraea*** – higher densities on R2R structures
- ***Madracis*** – same pattern
- ***Phyllangia americana*** – higher on standing platforms
- ***Oculina diffusa*** – no difference
- **Species-specific**

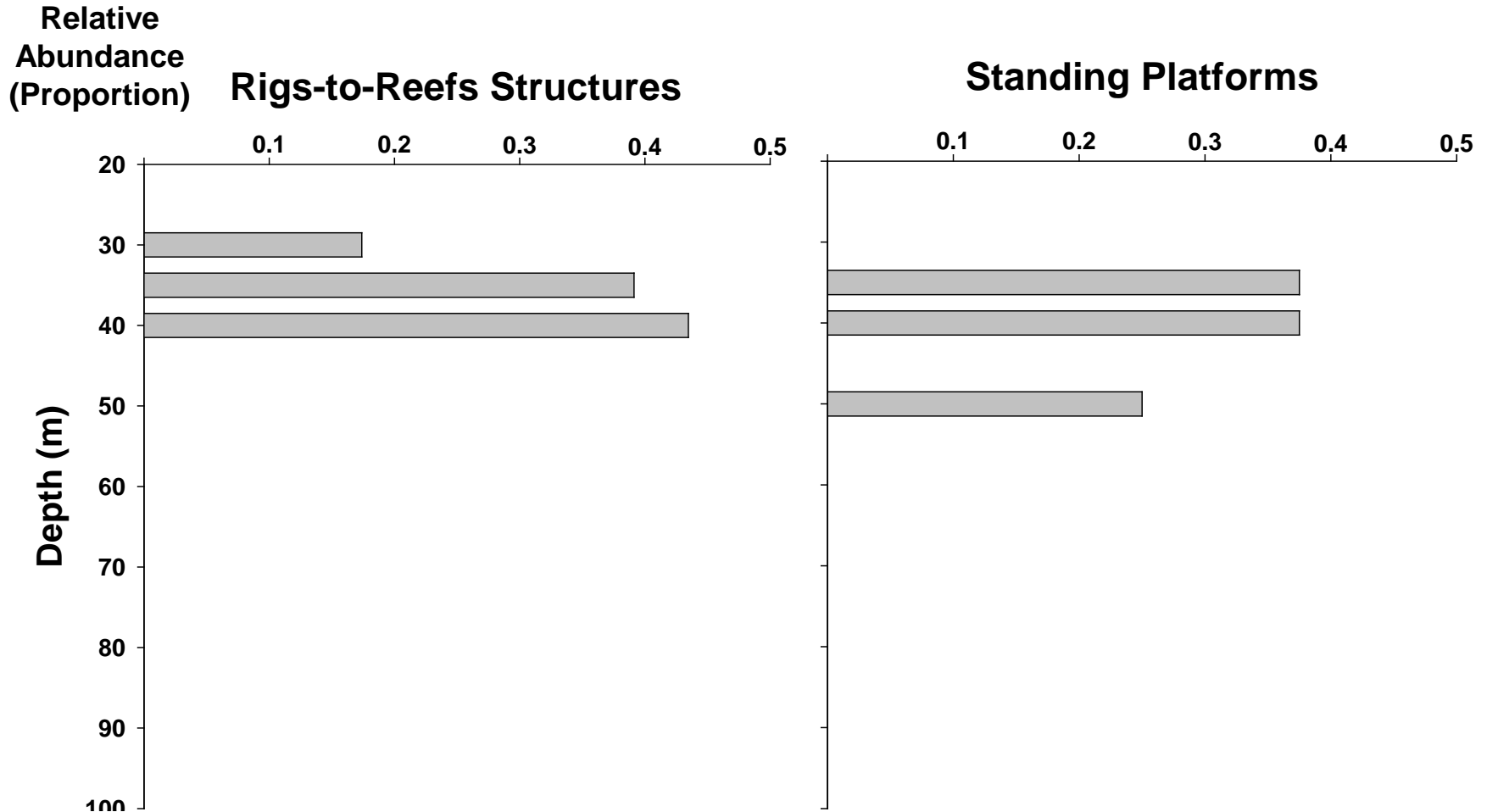
Depth-Distribution of Corals
on
R2R and Standing Platforms

Depth Distribution All Corals



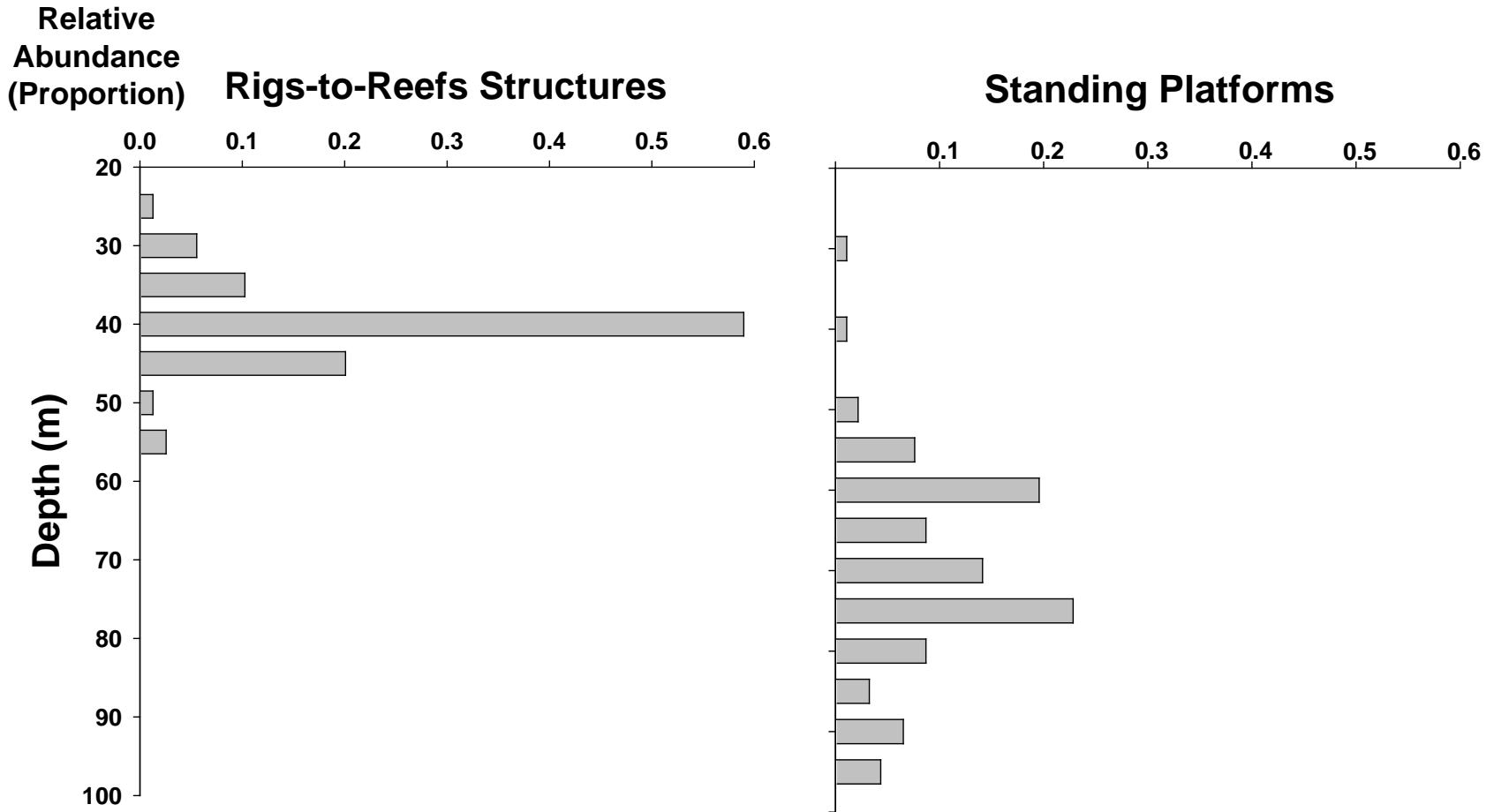
p < 0.001, G-test of Independence

Depth Distribution *Madracis decactis*



$p > 0.05$, n.s., G-test of Independence

Depth Distribution *Oculina diffusa*



$p < 0.001$, G-test of Independence



Conclusions

- **Flower Garden Banks – high species diversity compared to surrounding platforms**
- **11 spp. on platforms – Dominants: *Madracis decactis*, *Diploria strigosa*, and *Montastraea cavernosa***
- **Increase in coral abundance and species diversity with platform age**

Conclusions (cont.)

- **FGB Coral settlement rates – normal, high, and variable**
 - **Typical species for healthy Caribbean reefs**
- **Platform recruitment rates – very low**
 - **Atypical species composition**

Conclusions (cont.)

- **Corals have colonized platforms throughout the northern GOM**
- **Hermatypic diversity and densities high at shelf edge; low inshore – near Mississippi River plume**
- **Brooders are more effective dispersers than broadcasters**

Conclusions (cont.)

Genetic Affinities – Meso-Scale

- *Diploria strigosa* (broadcaster) –
 - Limited colonization of nearby platforms
- *Madracis decactis* (brooder) –
 - Broader colonization

Conclusions (cont.)

Genetic Affinity Split – East and West of the Mississippi River Now Confirmed to be a Geographic Barrier

- These two sections of the Gulf are genetically distinct.
- *Madracis decactis* shows very high self-allocation / site-fidelity
- *Tubastraea coccinea* shows evidence of higher gene flow/dispersal – within a section, but no dispersal across the Mississippi mouth.

Conclusions (cont.)

- *Tubastraea coccinea* – higher on R2R structures
- *Madracis decactis* – hermatype – same pattern
- *Phyllangia americana* – opposing pattern – higher on standing platforms
- *Oculina diffusa* – same on R2R and standing platforms

Conclusions (cont.)

- **Depth distributions**
 - All corals shallower on R2R
 - *Madracis decactis* limited to shallows on R2R and standing platforms
 - *Oculina diffusa* – deep distribution on standing platforms



Acknowledgments

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- S. Jensen

Apache Oil

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Coastal Oil & Gas

Devon Oil

- B. Gary
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- V. Mile
- B. Moody

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Forcenergy/Forest Oil

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Kerr-McGee Oil & Gas

- C. Bradford

Merit Energy

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& const.)

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- D. Dowdy
- G. Rainey
- T. Sebastian
- G. Speyrer (diving)

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- L. Logan
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And many more

Reference

Humann, P. and N. Deloach. 2002. Reef Coral Identification, Florida Caribbean Bahamas, Including Marine Plants. Jacksonville, Florida: New World Publications. P. 164.