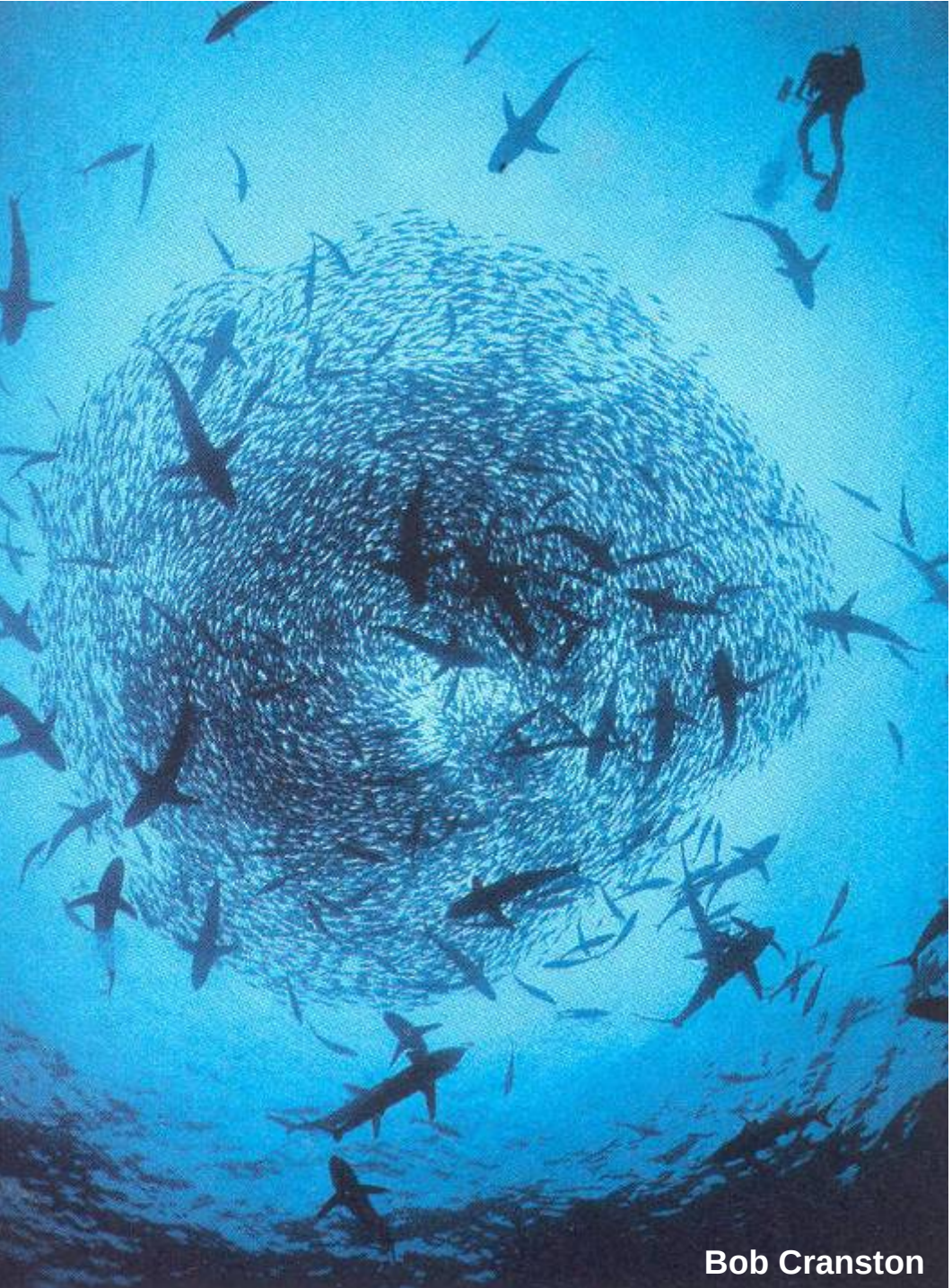

Coral Distribution, Abundance, and Genetics in the Northern Gulf of Mexico: Role of the Flower Garden Banks and Oil/Gas Platforms

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Department of Oceanography & Coastal Sciences,
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Department of Pharmaceutical Sciences, University of Buffalo

G.S. Boland
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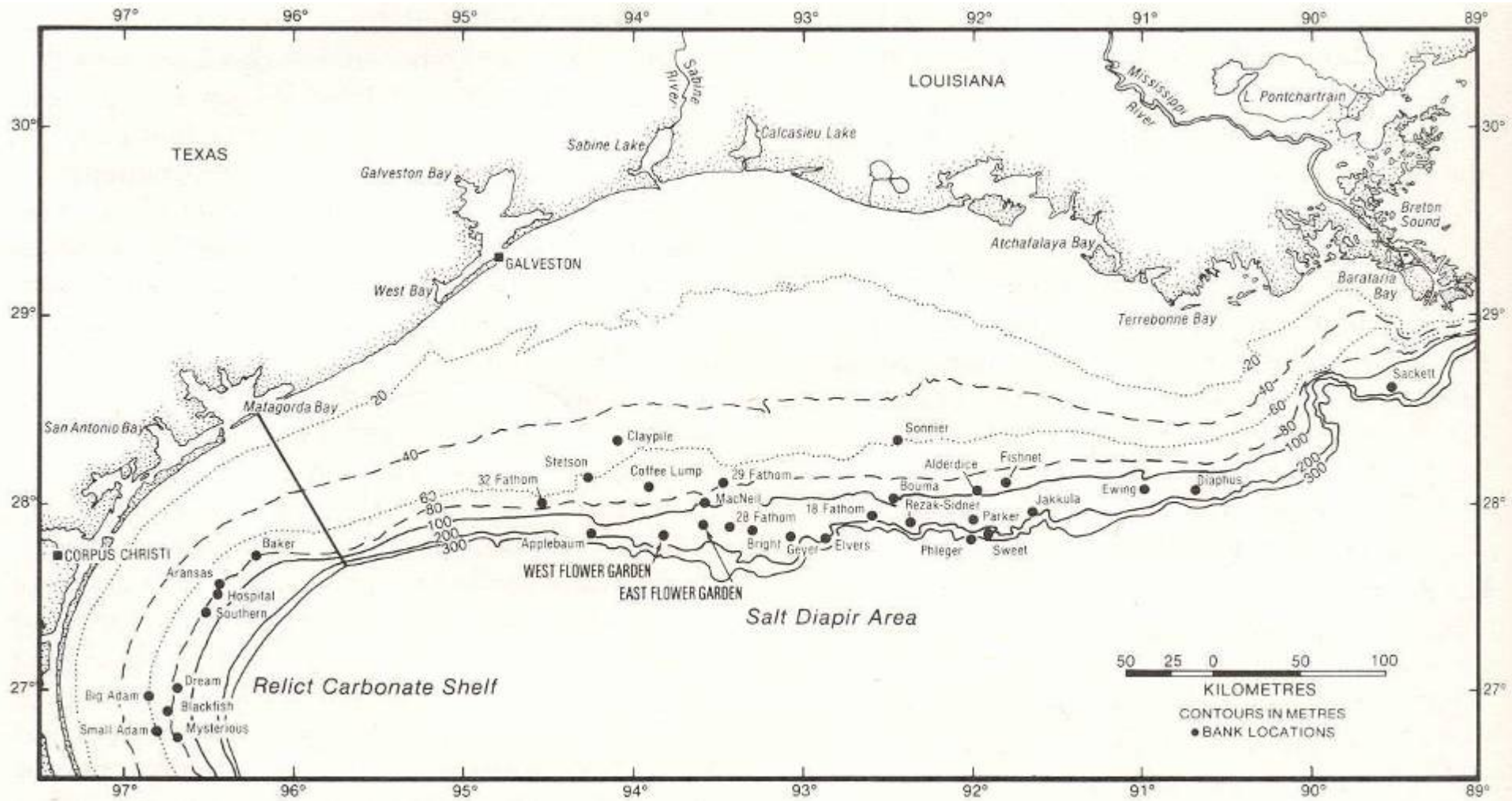
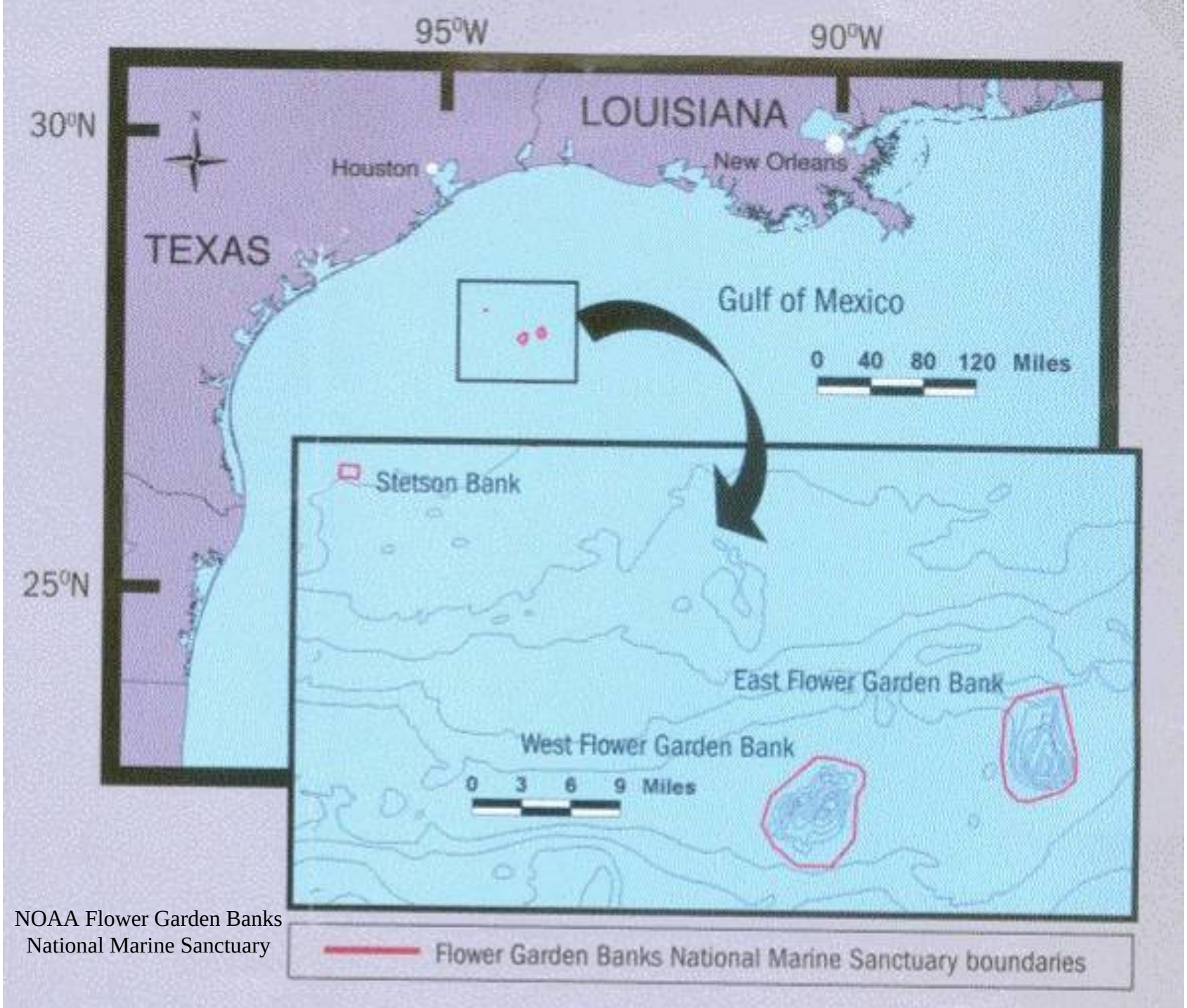
A. Lirette
Louisiana Universities Marine Consortium (LUMCON)

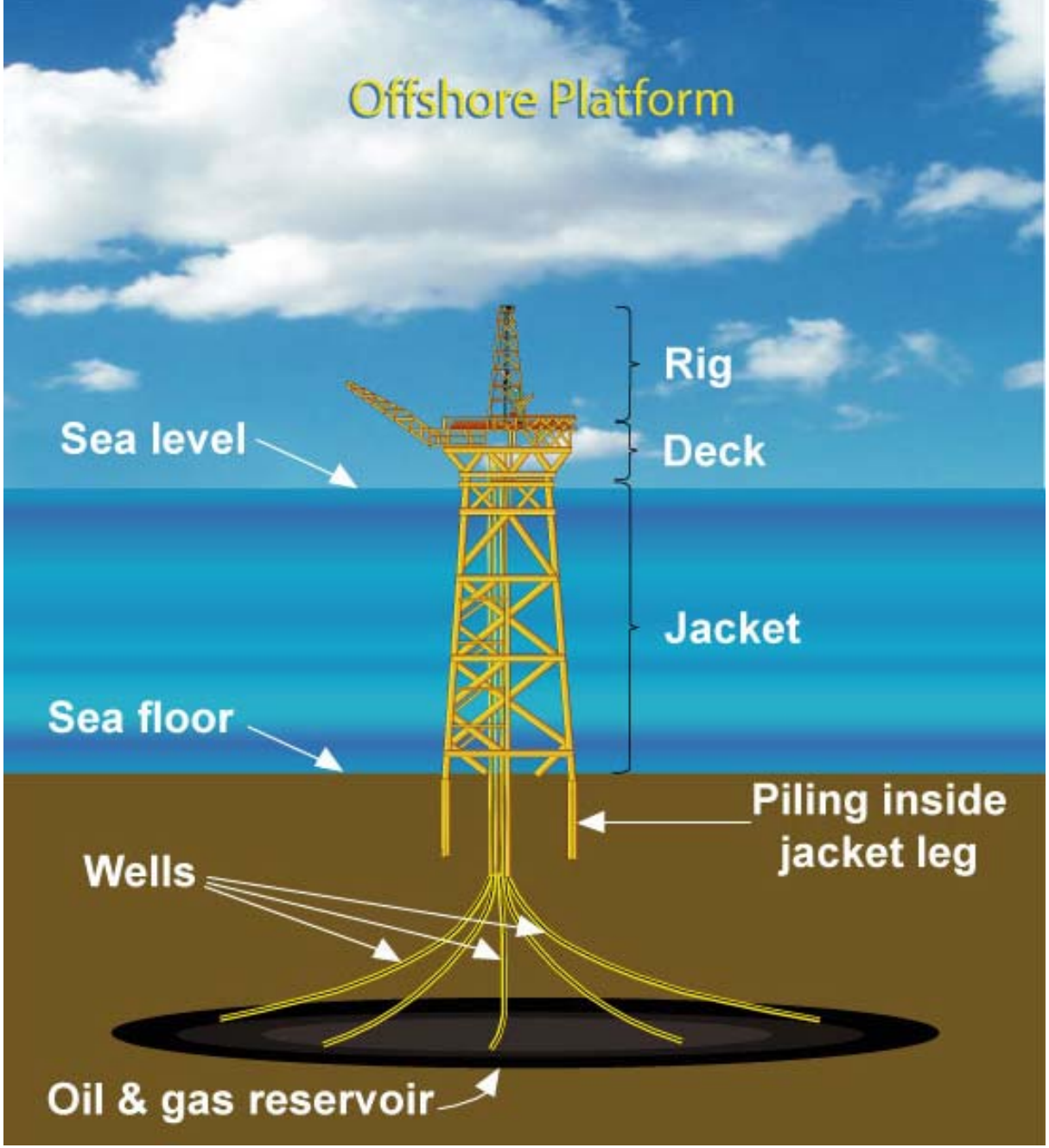


From Rezak et al. (1985)

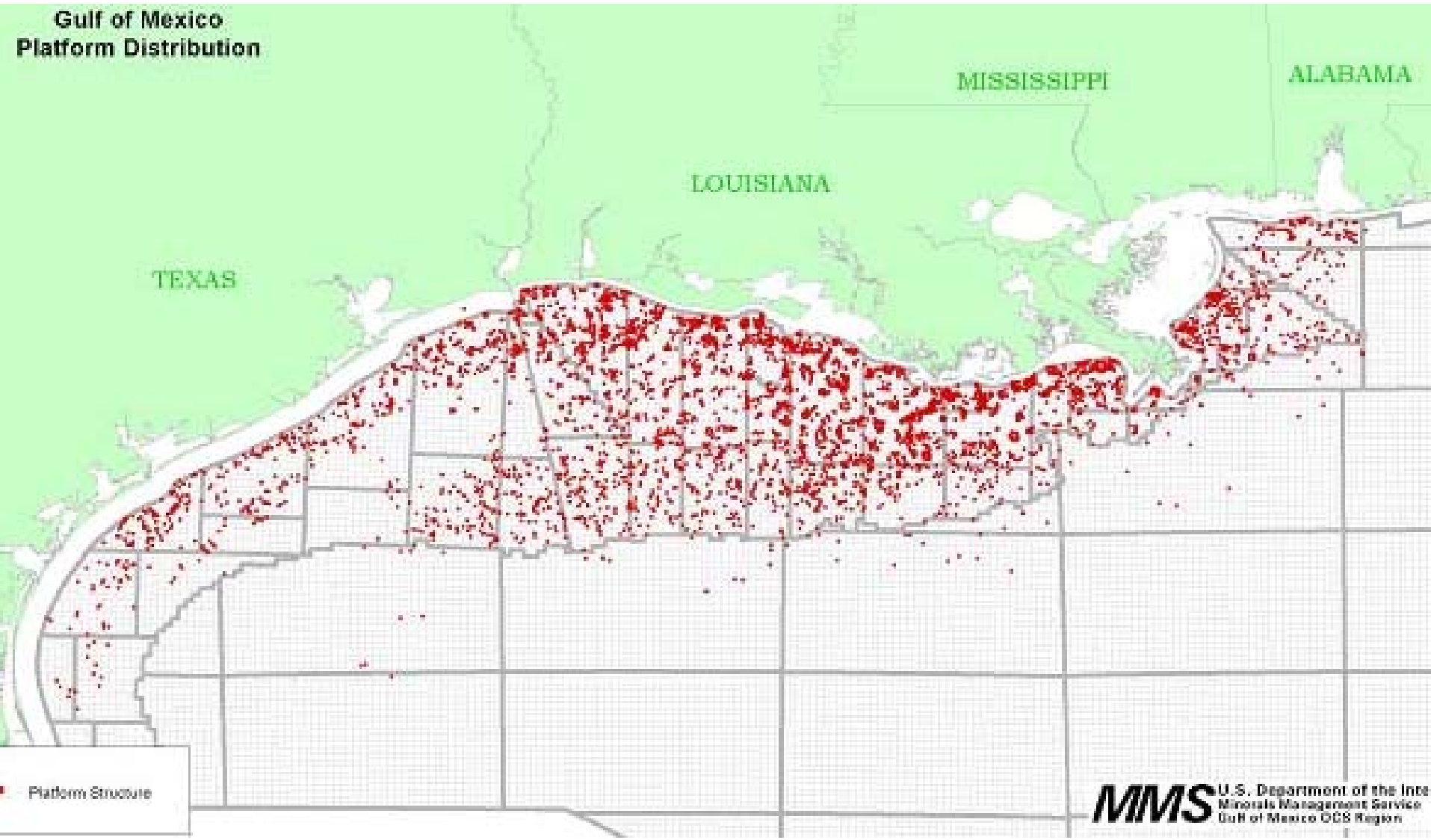


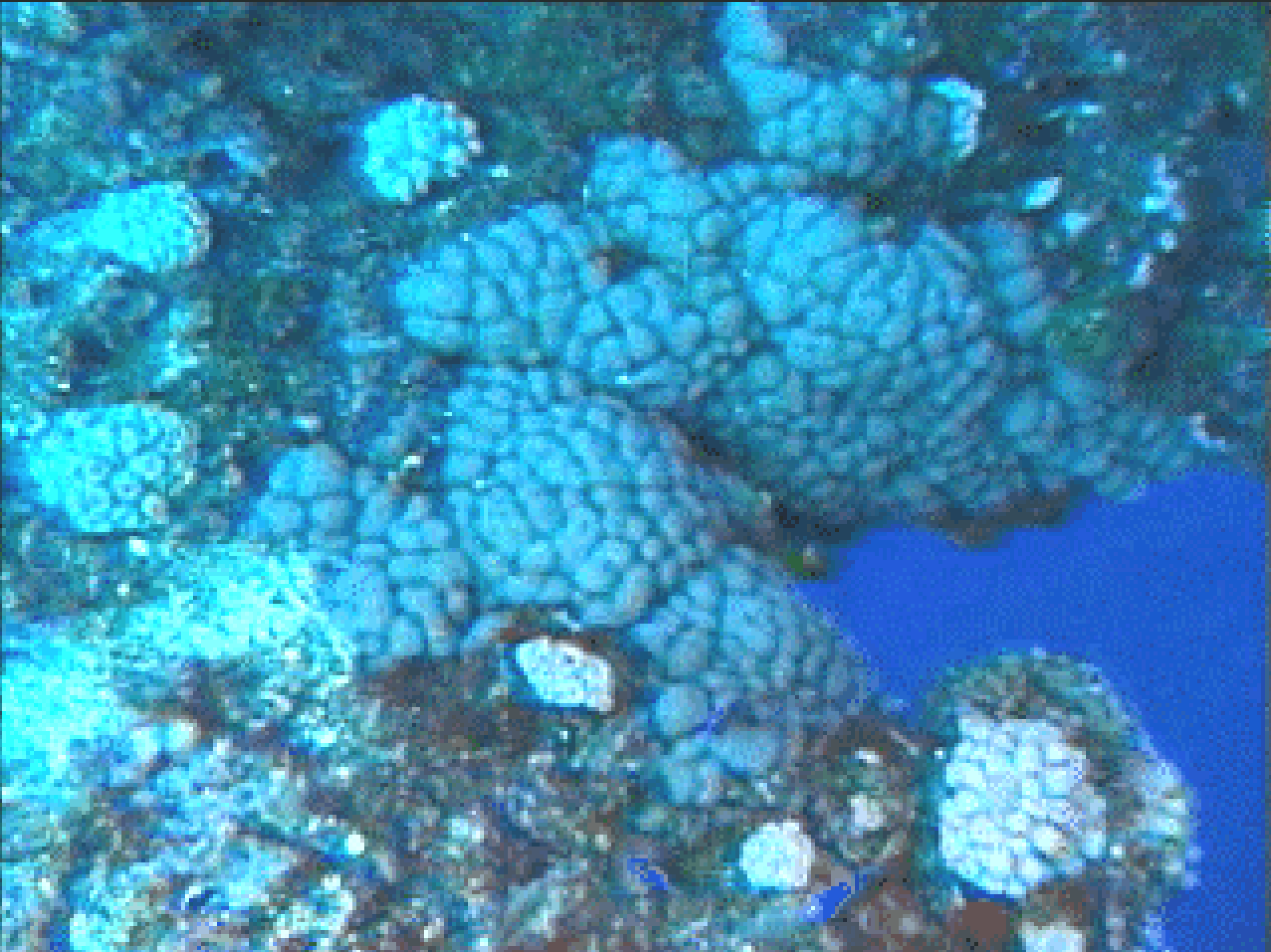
NOAA Flower Garden Banks National Marine Sanctuary

Carl Maples - http://www.carlmaples.com/TODCO_Rig_75.html



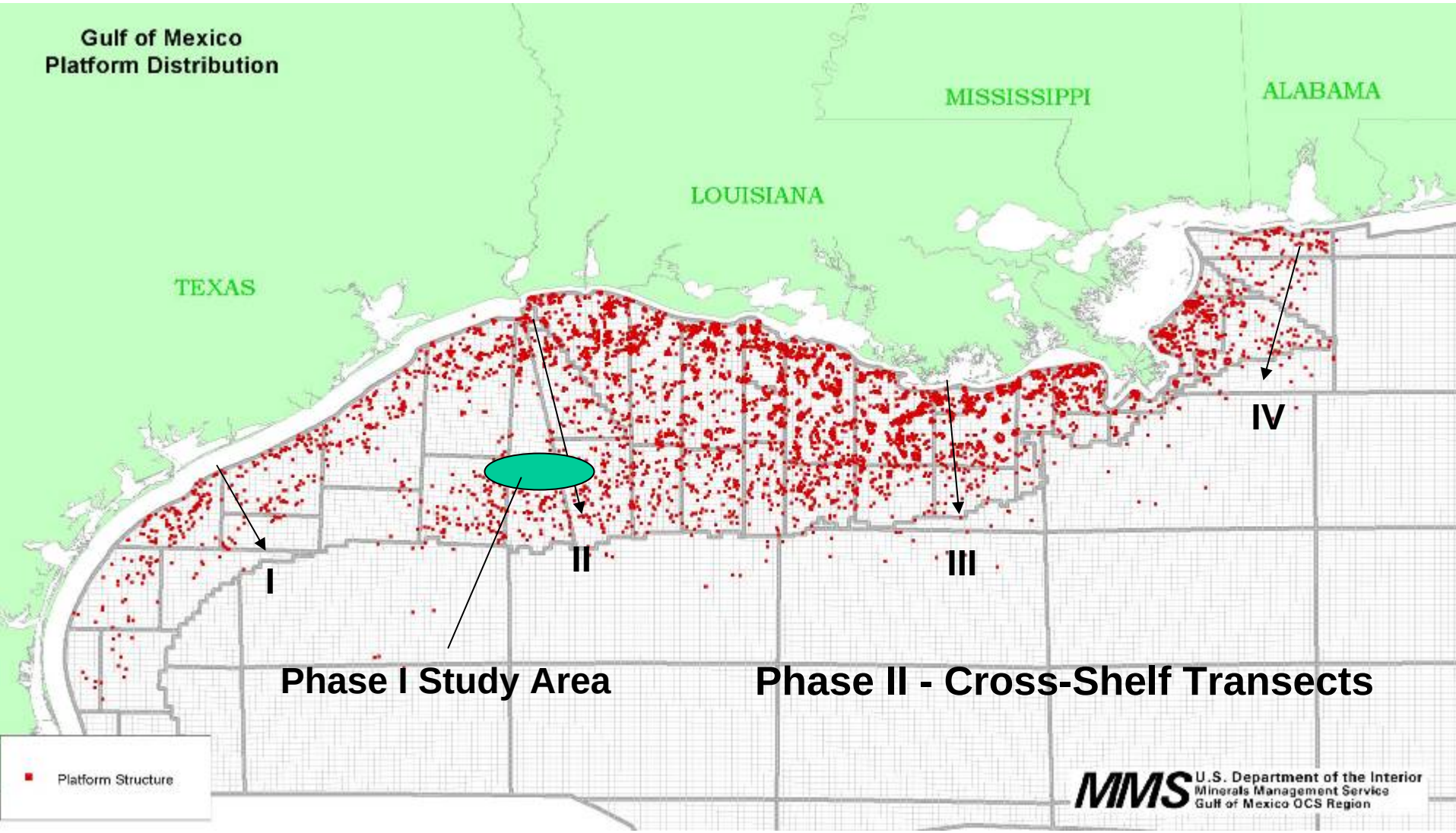
http://www.consrv.ca.gov/dog/picture_a_well/offshore_platform.htm


Gulf of Mexico
Platform Distribution
MISSISSIPPI
ALABAMA
LOUISIANA
TEXAS
Platform Structure
MMS
U.S. Department of the Inte
Minerals Management Service
Gulf of Mexico OCS Region



Questions

- What is the range of coral occurrence in the N. Gulf of Mexico on oil/gas platforms?
- How diverse are they?
- How abundant are they?
- What are their patterns of distribution?
- What are their genetic affinities?


Gulf of Mexico
Platform Distribution
MISSISSIPPI
ALABAMA
LOUISIANA
TEXAS
I
II
III
IV
Phase I Study Area
Phase II - Cross-Shelf Transects
Platform Structure
MMS
U.S. Department of the Interior
Minerals Management Service
Gulf of Mexico OCS Region

Madracis decactis

J. Collins

Diploria strigosa

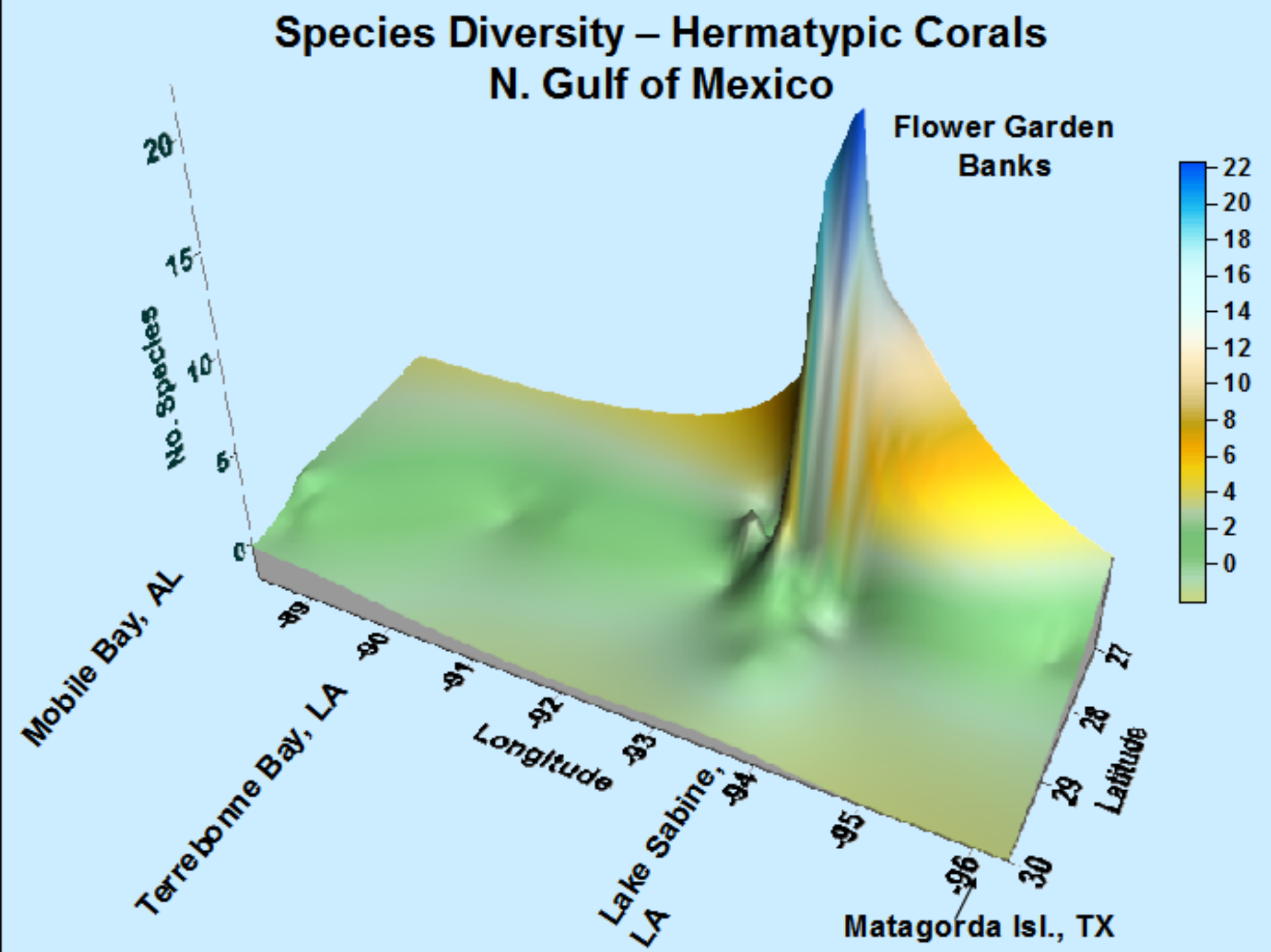
http://www.coastalzonebelize.org/prog05.html#

Montastraea cavernosa

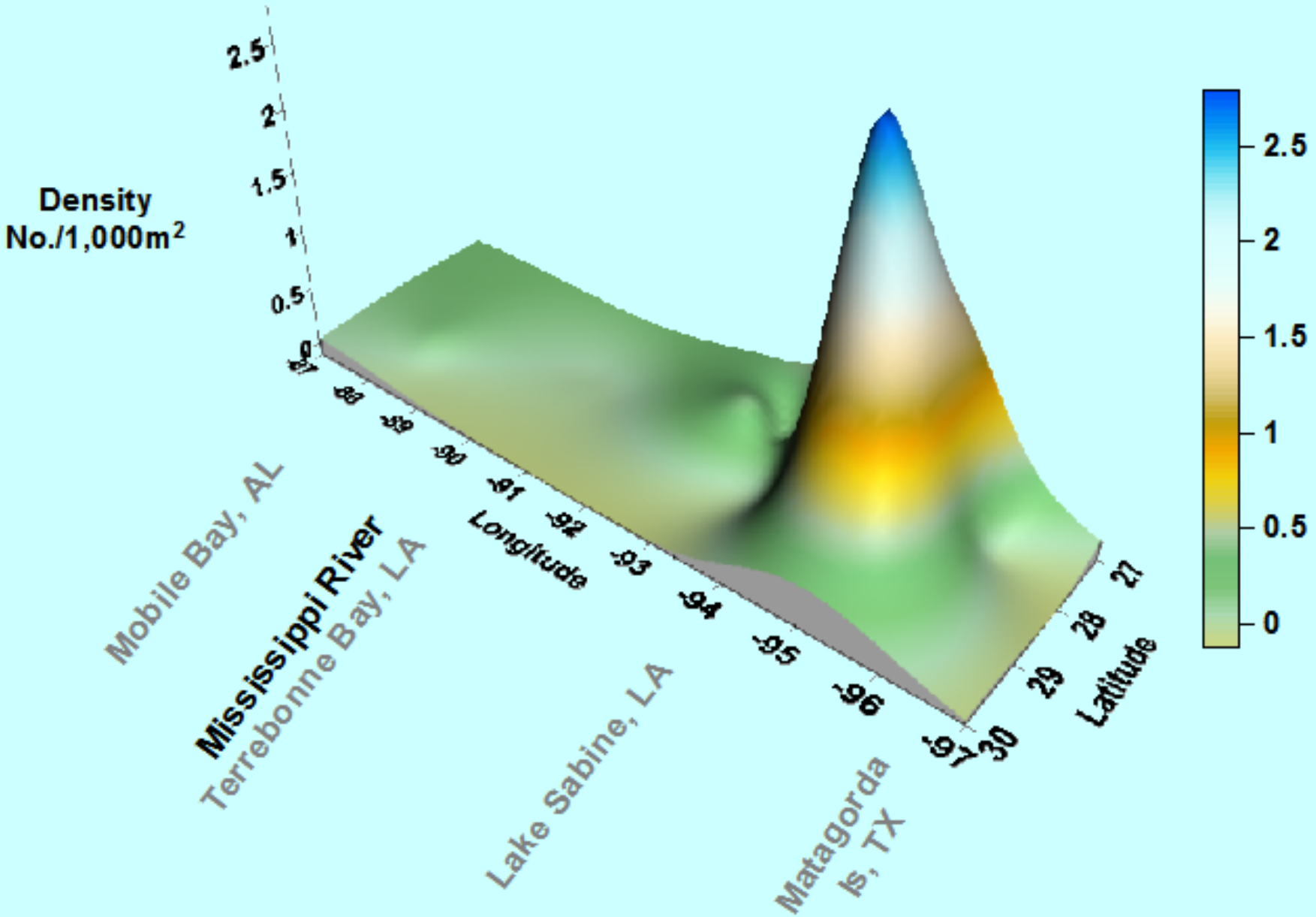
Steve Gittings

Tubastraea coccinea

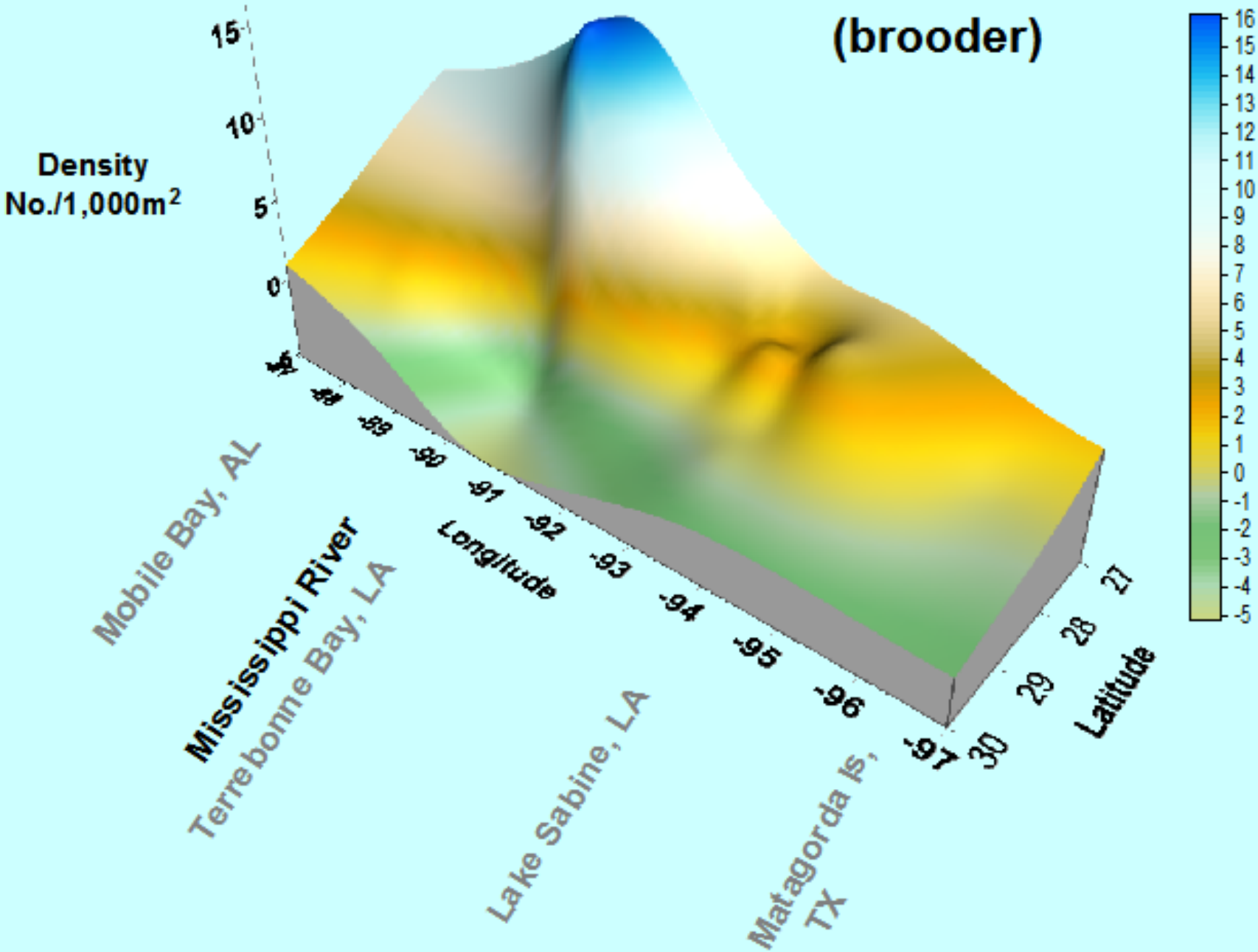
Dinah Rogers, Times-Picayune


Species Diversity – Hermatypic Corals
N. Gulf of Mexico
Flower Garden Banks
No. species
0
5
10
15
20
Mobile Bay, AL
Terrebonne Bay, LA
Lake Sabine, LA
Matagorda Isl., TX
Longitude
-89
-90
-91
-92
-93
-94
-95
-96
Latitude
27
28
29
30
22
20
18
16
14
12
10
8
6
4
2
0

Total Hermatypic Coral Density – N. Gulf of Mexico

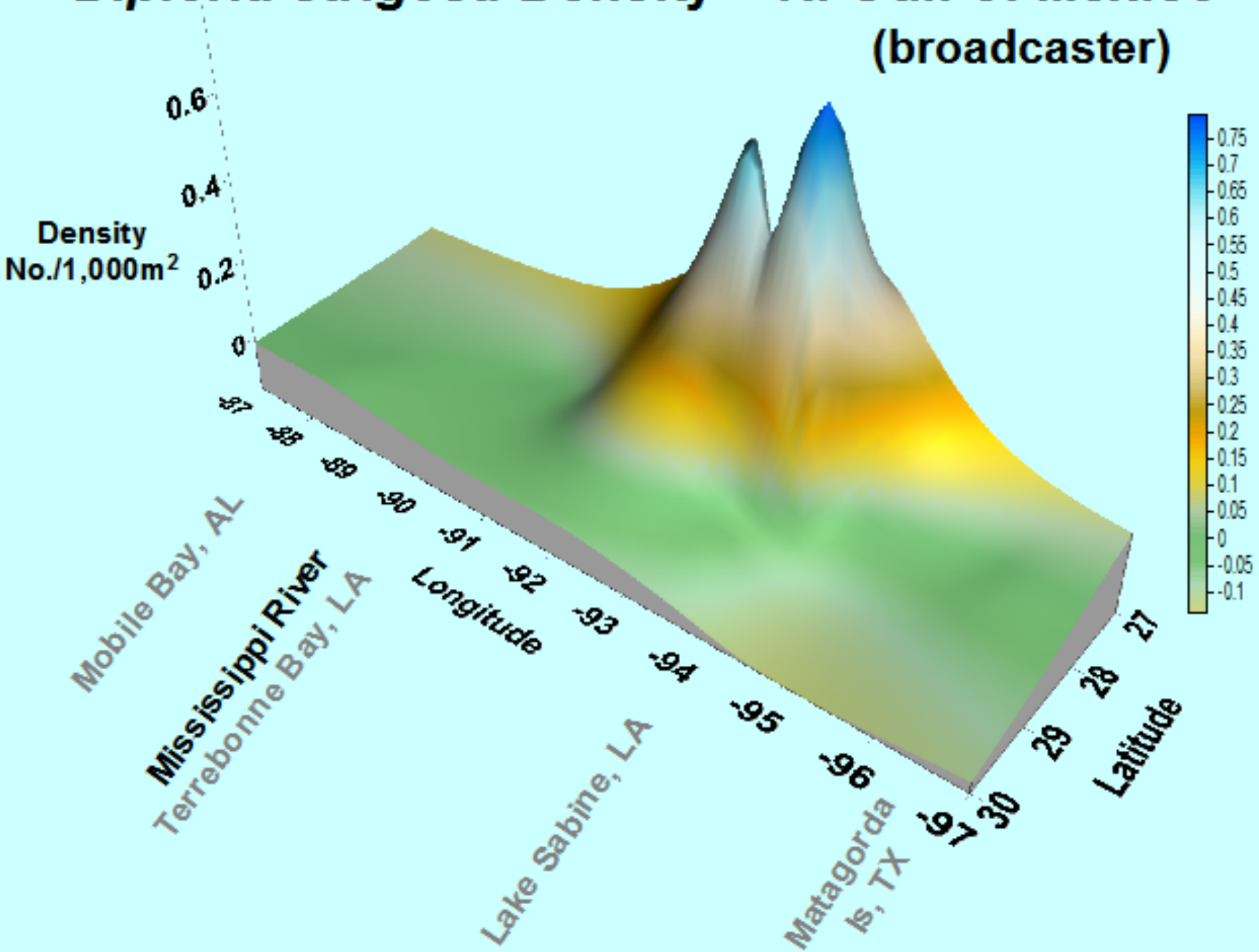


Madracis decactis Density – N. Gulf of Mexico



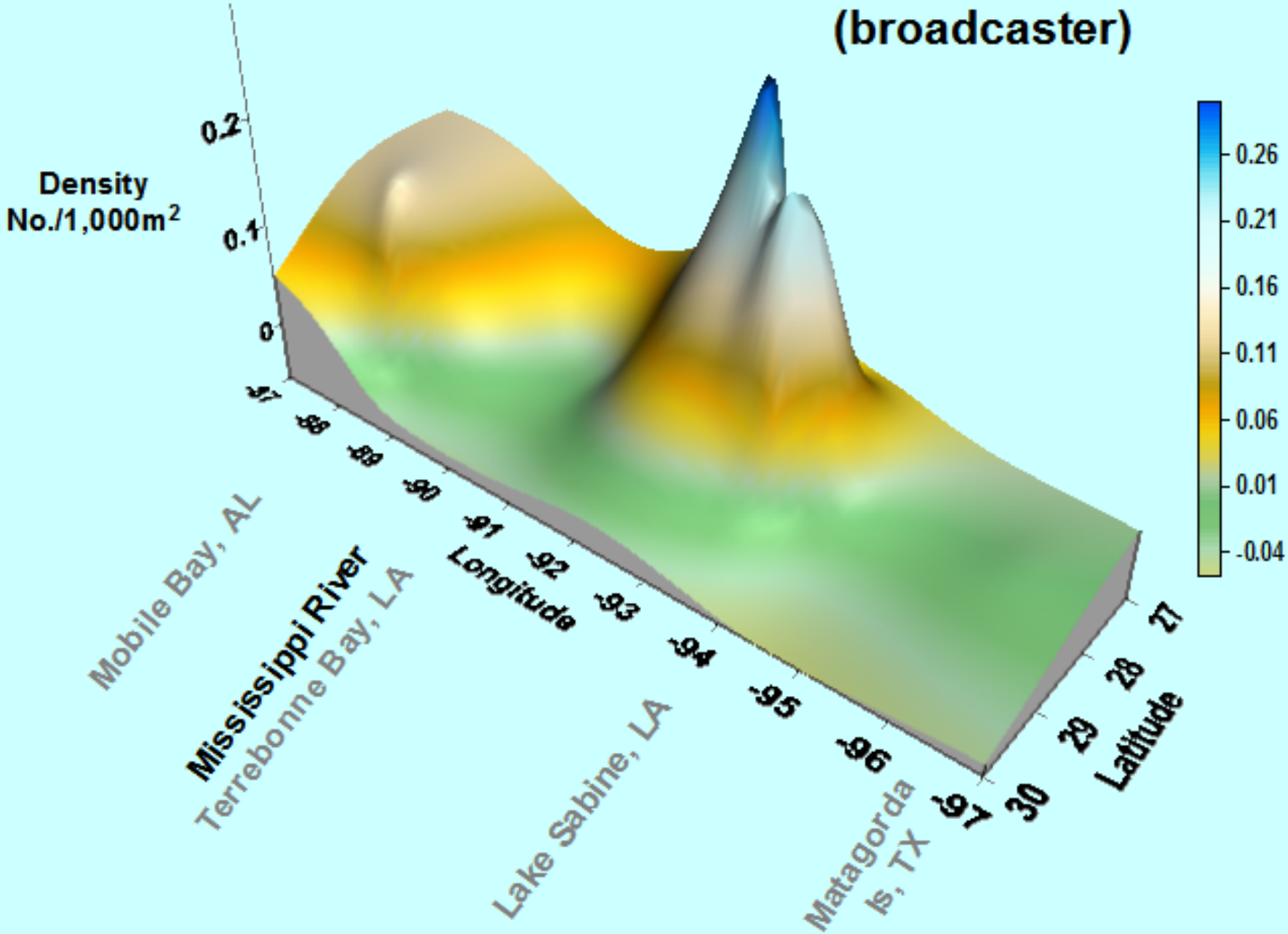
Diploria strigosa Density – N. Gulf of Mexico

(broadcaster)

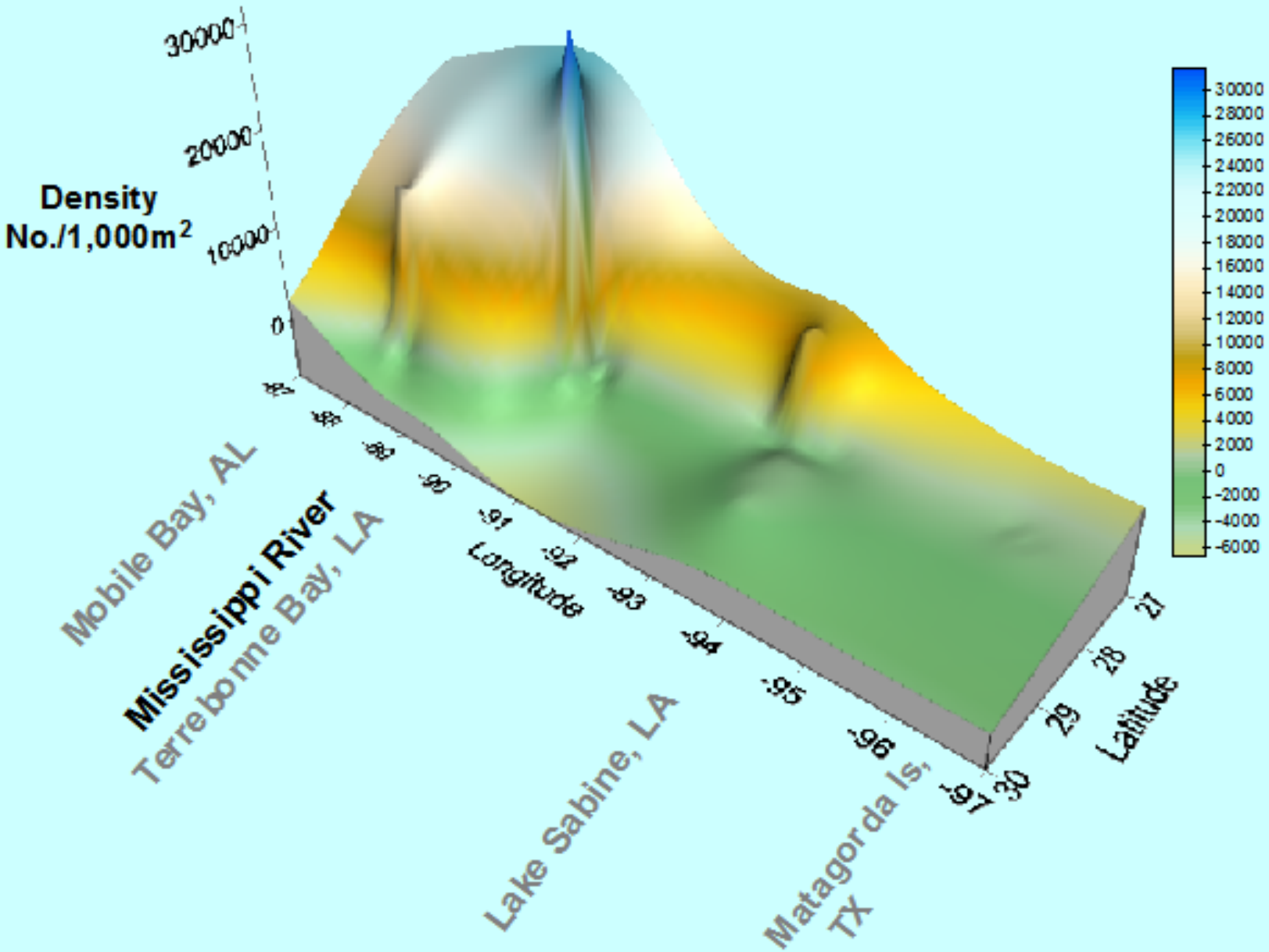


Montastraea cavernosa Density – N. Gulf of Mexico

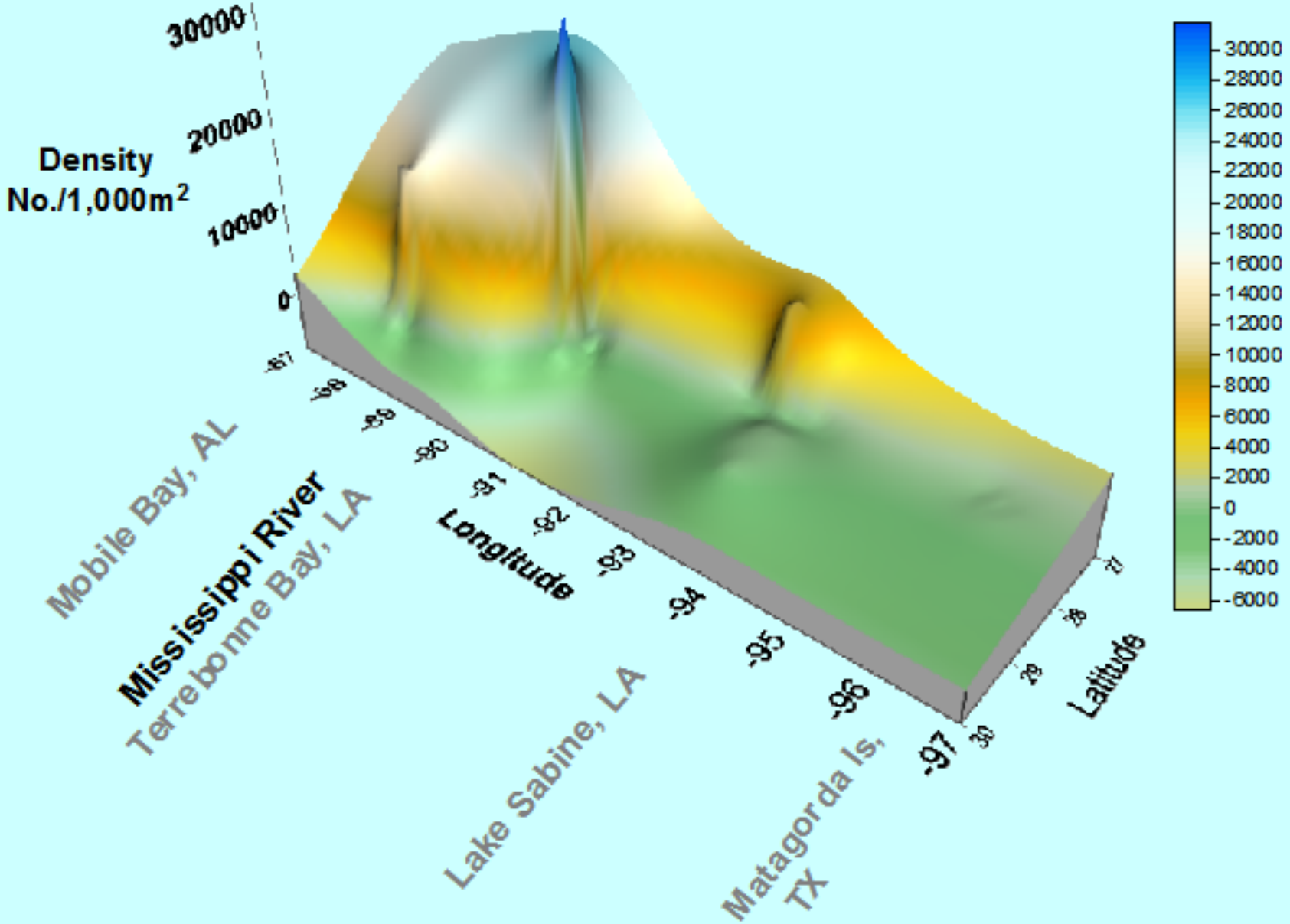
(broadcaster)



Total Coral Density – N. Gulf of Mexico

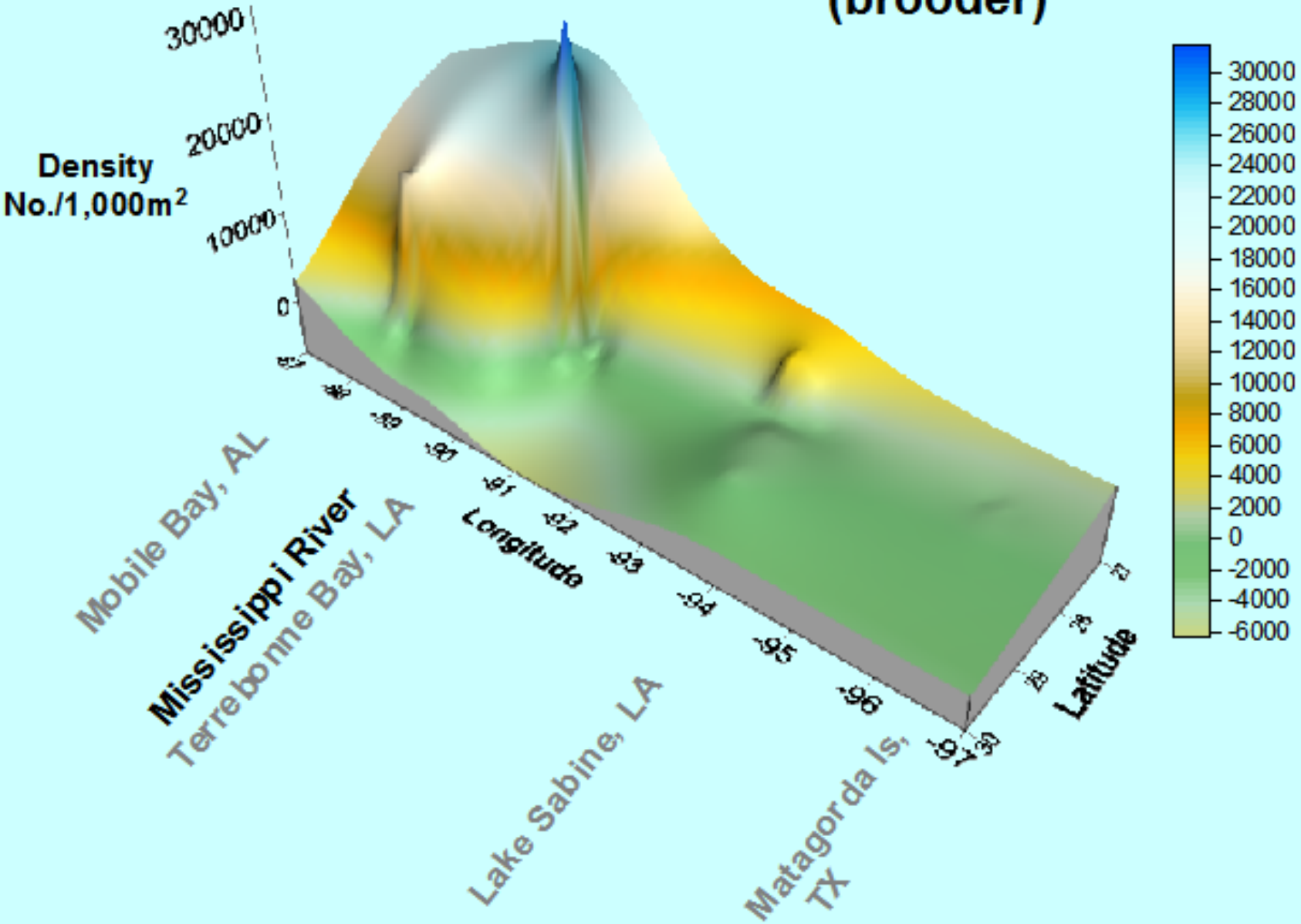


Total Ahermatypic Coral Density
N. Gulf of Mexico

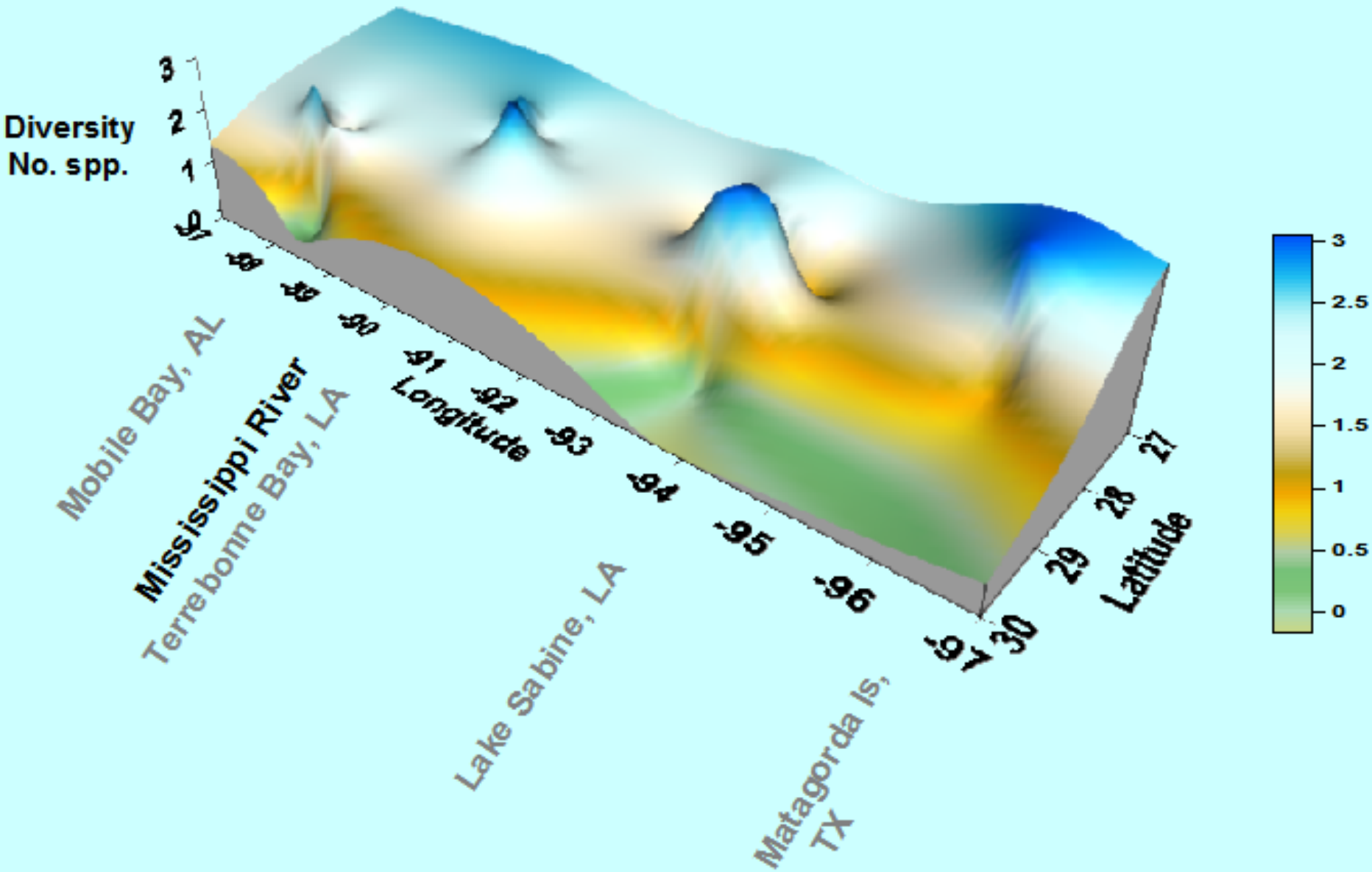


Tubastraea coccinea Density – N. Gulf of Mexico

(brooder)



Ahermatypic Coral Diversity – N. Gulf of Mexico




James Watt

Amplified Fragment Length Polymorphisms (AFLP)

- PCR based – No prior sequence information required for primer design
- Highly polymorphic – unlimited number of markers available
- Assay loci genome-wide
- Stringent control for zooxanthellar DNA contamination

Bensch and Åkesson 2005

Molecular Genetic Analyses

- **AMOVA**

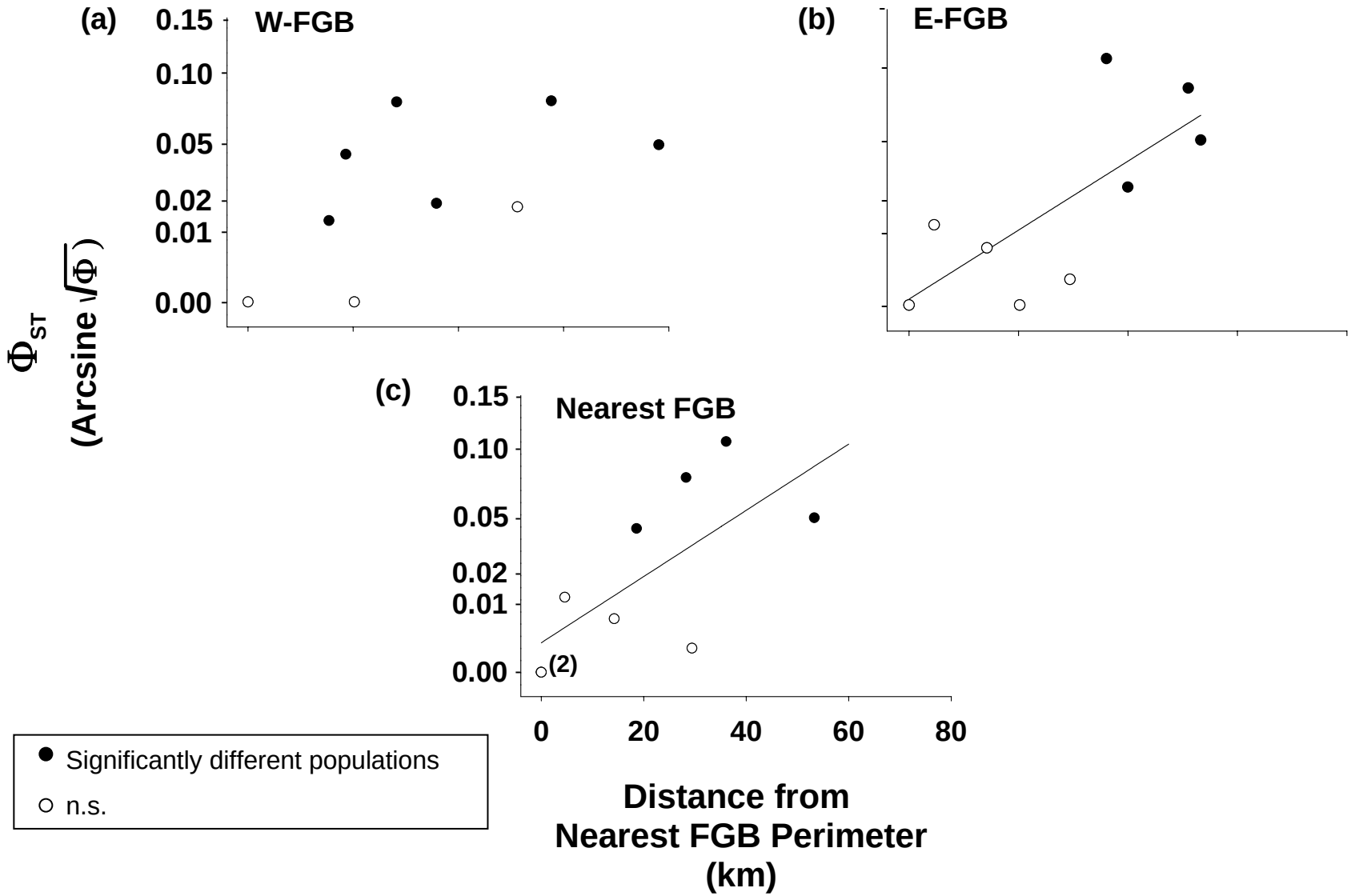
- **AFLPOP – A genetic assignment method**

  - **Calculates log-likelihood values for individual assignments, based upon marker frequencies**

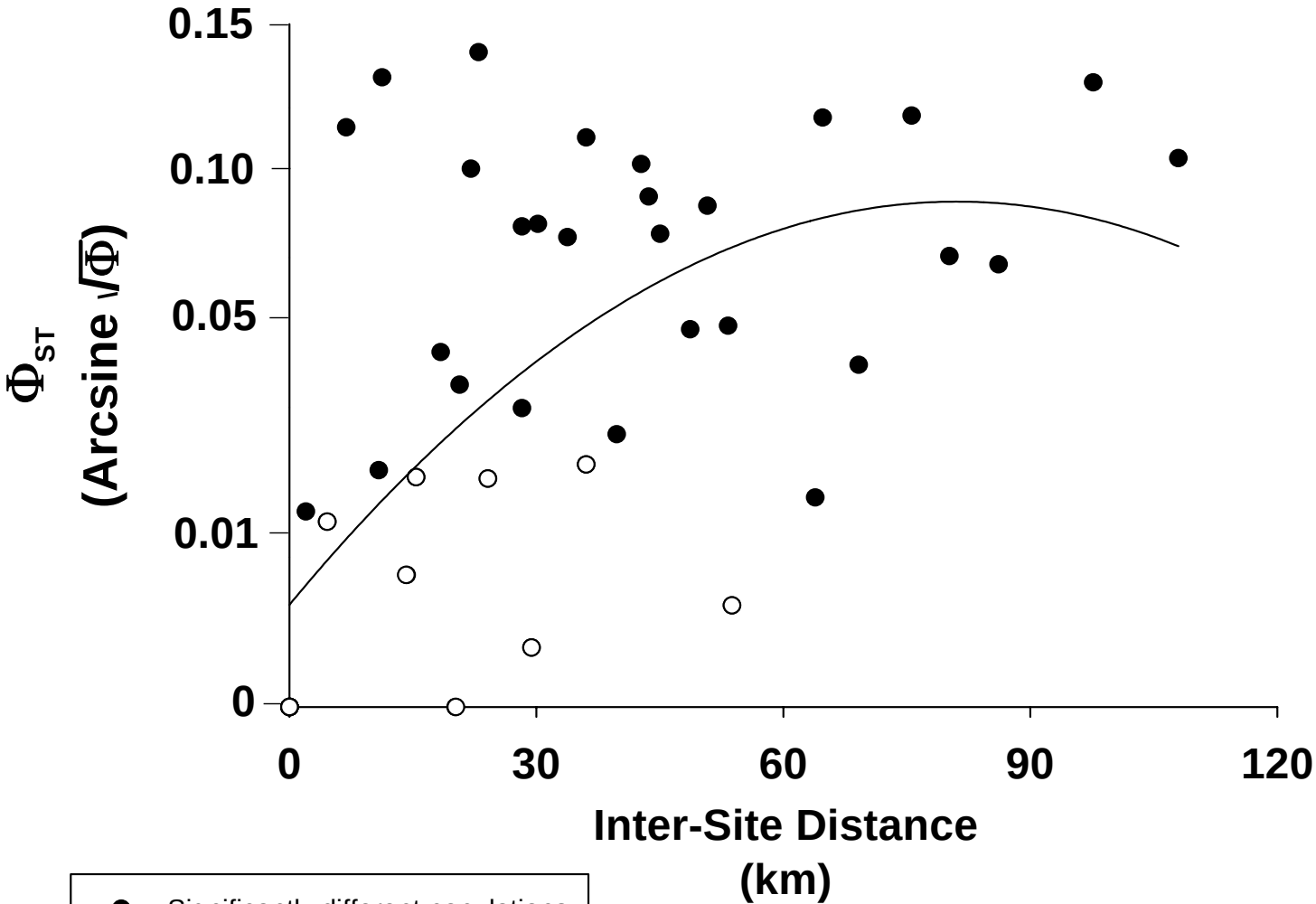
  - **Simulations based upon 500 permutations, repeated 10X**

- **STRUCTURE – Another assignment method**

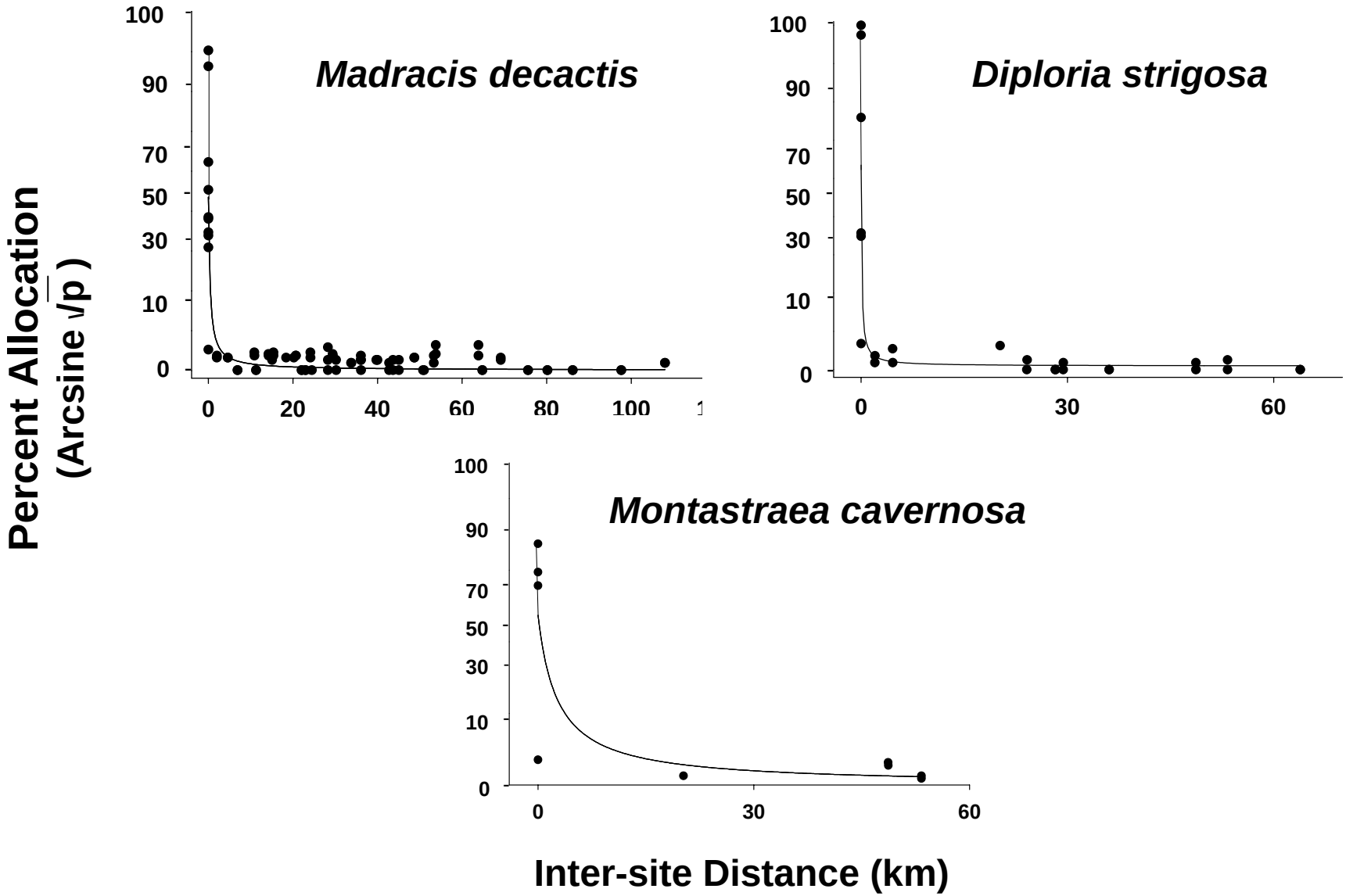
AMOVA Results
Genetic Distance (Φ_{ST}) between Populations
vs. Distance from FGBs
Madracis decactis



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



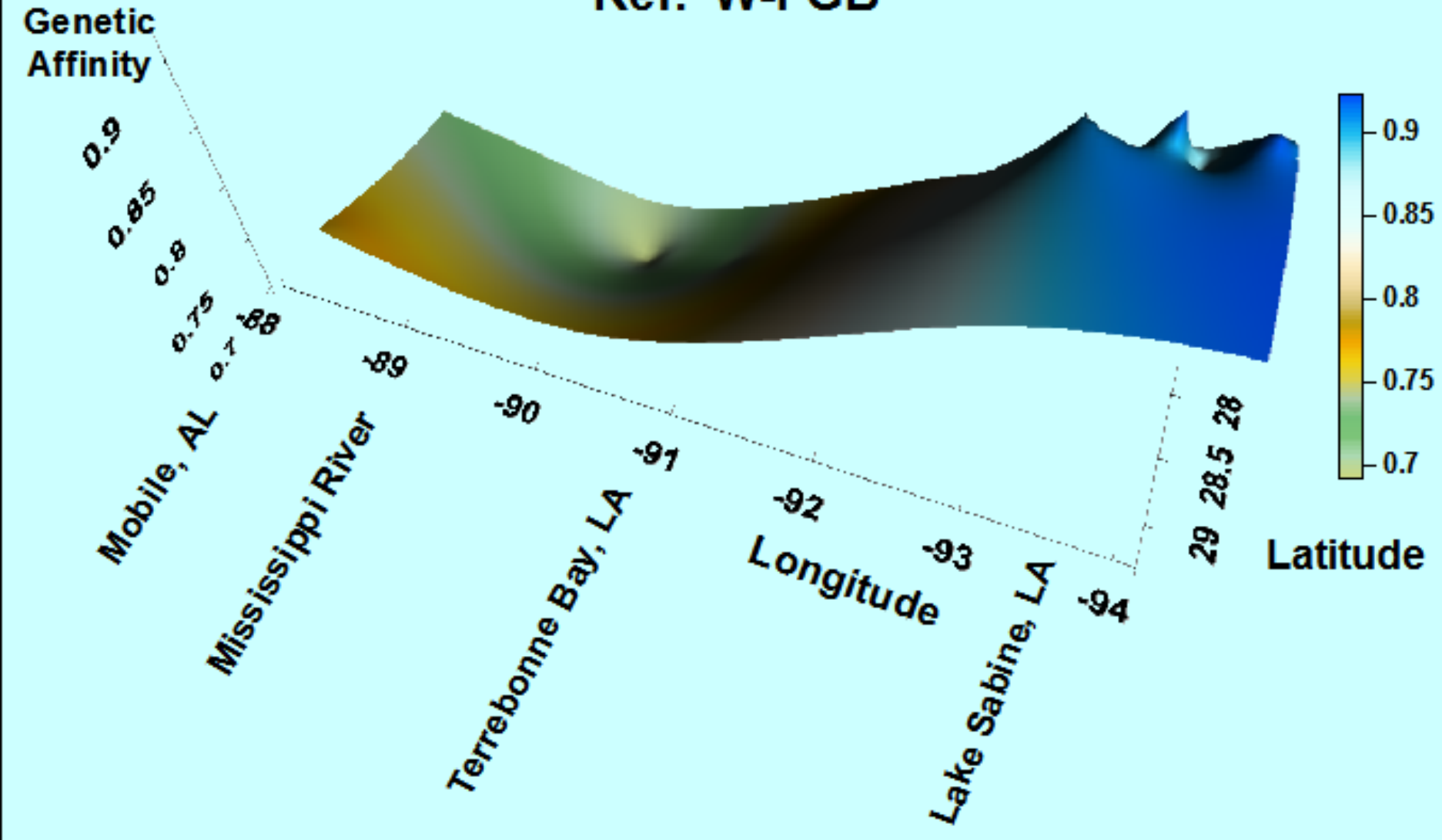
AFLPOP Analysis
Allocation of Colonies to Sites
vs. Inter-site Distance

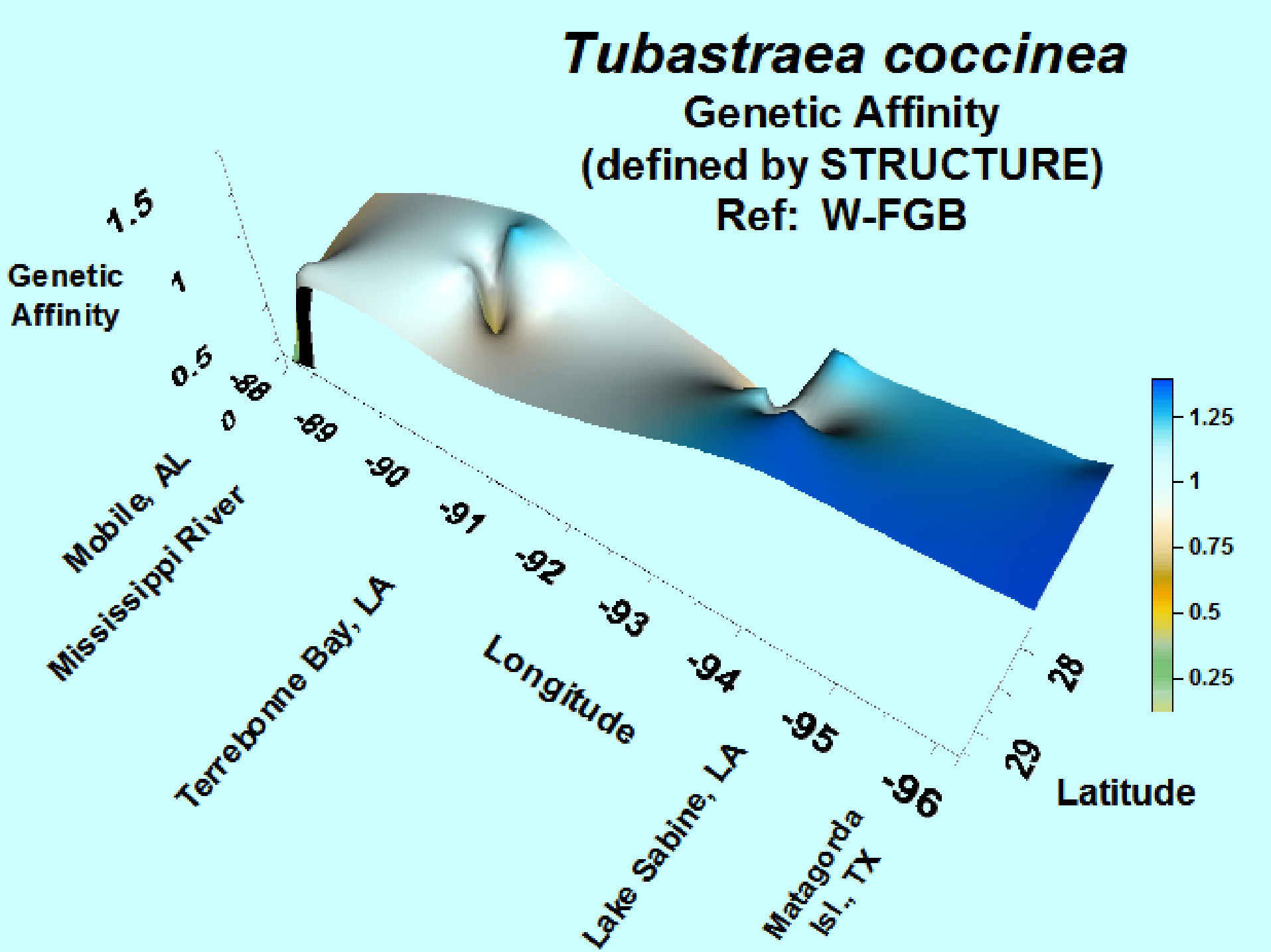


Genetic Affinity of Corals across the N. Gulf of Mexico

Madracis decactis

Genetic Affinity
(defined by STRUCTURE)
Ref: W-FGB




Tubastraea coccinea
Genetic Affinity
(defined by STRUCTURE)
Ref: W-FGB
Genetic Affinity
1.5
1
0.5
0
-88
-89
-90
-91
-92
-93
-94
-95
-96
Longitude
28
29
Latitude
Mobile, AL
Mississippi River
Terrebonne Bay, LA
Lake Sabine, LA
Matagorda Isl., TX
1.25
1
0.75
0.5
0.25

Tubastraea coccinea (brooder)

Transects III & IV – (E)

AFLPOP Analysis, Log-Likelihood = 1

	Percentage (%) of Colonies on these Platorms ⇩					
	(W. of Miss. River)			(E. of Miss.River)		
Allocated to	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
MP236	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

Madracis decactis (brooder)

Transects III & IV – (E)

AFLPOP Analysis, Log-Likelihood = 1

	Percentage (%) of Colonies			
	(W. of Miss. River)			(E. of Miss. River)
Allocated to ⇩	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

Conclusions

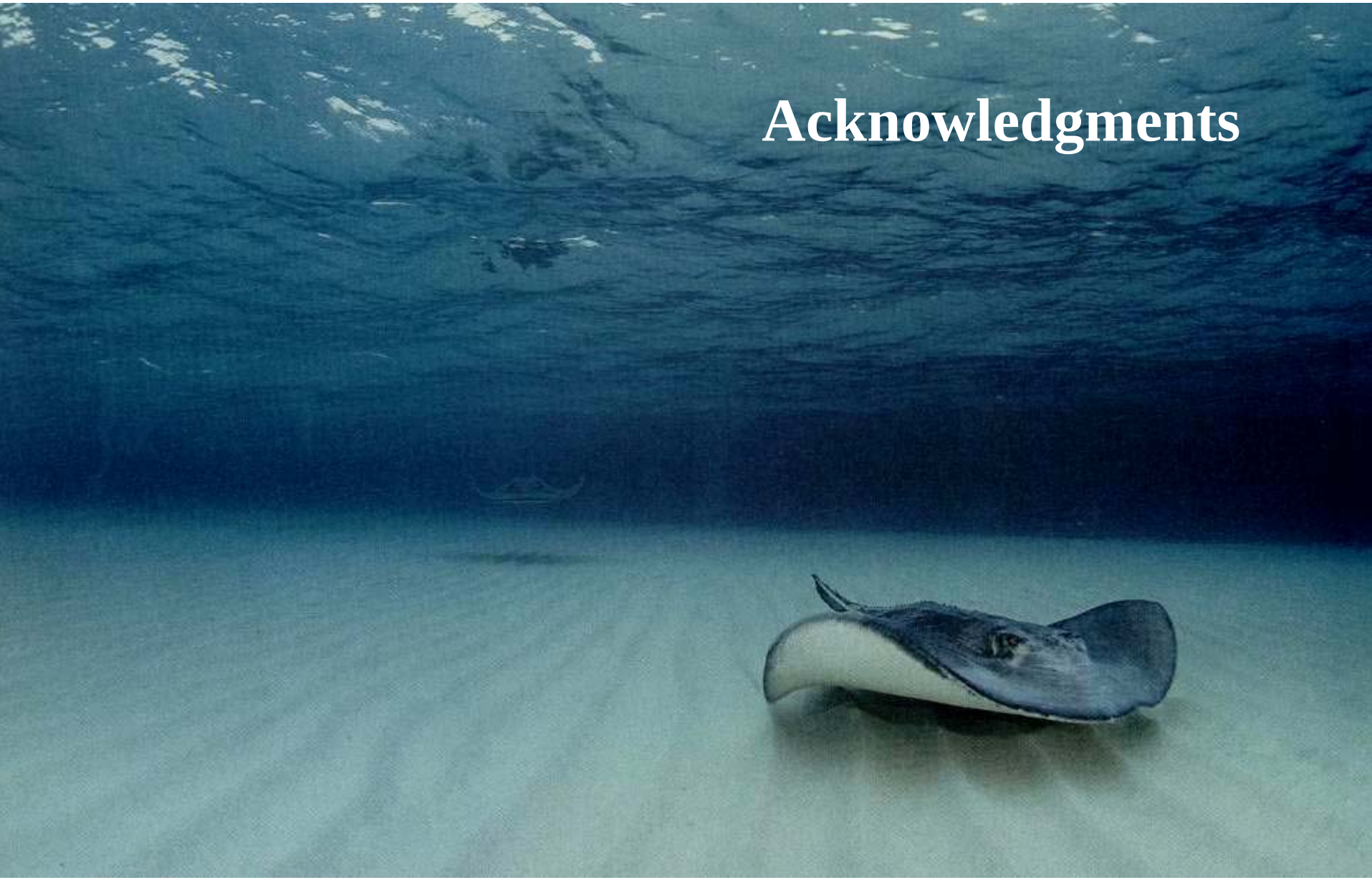
- **Flower Garden Banks = coral diversity peak**

- **Dominant hermatypes:**
  - ***Madracis decactis***
  - ***Diploria strigosa***
  - ***Montastraea cavernosa***

- **Dominant ahermatype**
  - ***Tubastraea coccinea***

- **Corals have colonized platforms throughout the N. Gulf of Mexico**
- **Hermatypic diversity and densities high at shelf edge**
- **Diversity low inshore – near Mississippi River plume**
- **Brooders are more effective dispersers than broadcasters**

- ***Madracis*** **– evidence for spread from FGB**
- ***Tubastraea*** **– higher genetic affinity cross N. Gulf**
- **Central sector and E. Gulf of Mexico – genetically distinct**
  - **Mississippi River – biogeographic barrier**
- ***Madracis decactis*** **– very high self-allocation/site-fidelity**
- ***Tubastraea coccinea*** **– higher gene flow/dispersal – within a sector**



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- S. Hathcock
- S. Jensen

Apache Oil

- J. Bordelon,
- G. Thibodaux

Coastal Oil & Gas

Devon Oil

- B. Gary
- R. Hebert
- V. Mile
- B. Moody

Dominion Exploration & Production

- B. Ventura
- K. Schlogel
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El Paso Energy

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- S. Lesiker

Forcenergy/Forest Oil

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Kerr-McGee Oil & Gas

- C. Bradford

Merit Energy

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- T. Kilpatrick
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- G. Rainey
- T. Sebastian
- G. Speyrer (diving)

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- C. Chauffe
- T. Empey
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- D. Marcel

And many more

References

Bensch, S. and M. Åkesson. 2005. Ten years of AFLP in ecology and evolution: Why so few animals? Molecular Ecology 14(10)2899–2914.

Rezak, R., T.J. Bright, and D.W. McGrail. 1985. Reefs and banks of the northwestern Gulf of Mexico: Their geological, biological, and physical dynamics. New York: John Wiley and Sons. 259 pp.