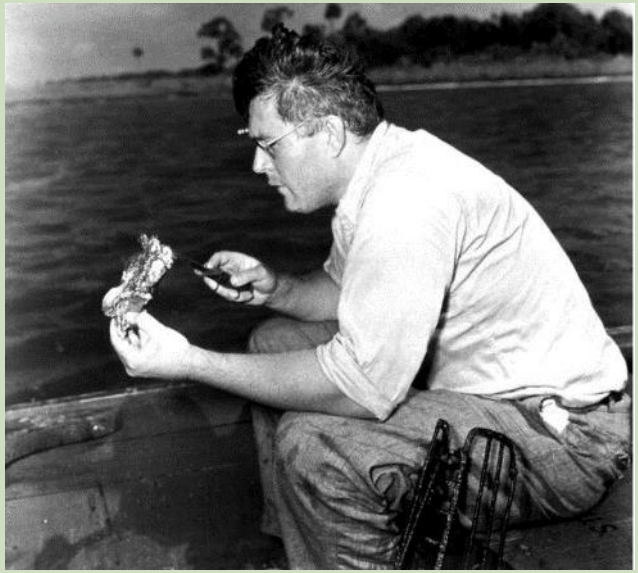
Restoration of oyster reefs and their ecological services in the Big Bend of Florida.

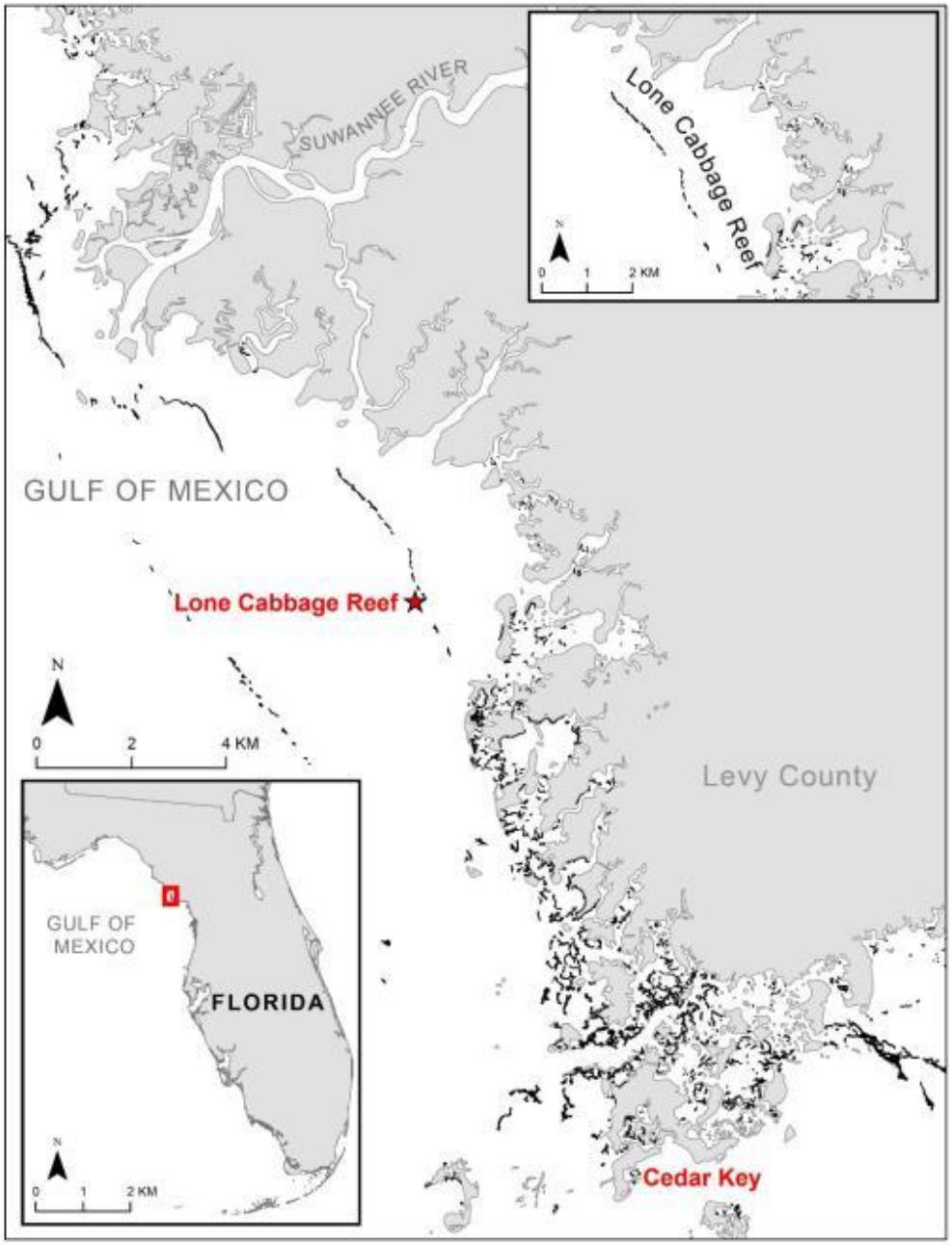
Peter Frederick, Bill Pine and
Leslie Sturmer
University of Florida

Background

Big Bend oysters provide
Benefits to people and the environment

Commercial fisheries, habitat for fish and wildlife, shoreline protection “ecosystem services”





Big Bend oysters are unique

reefs parallel to coast

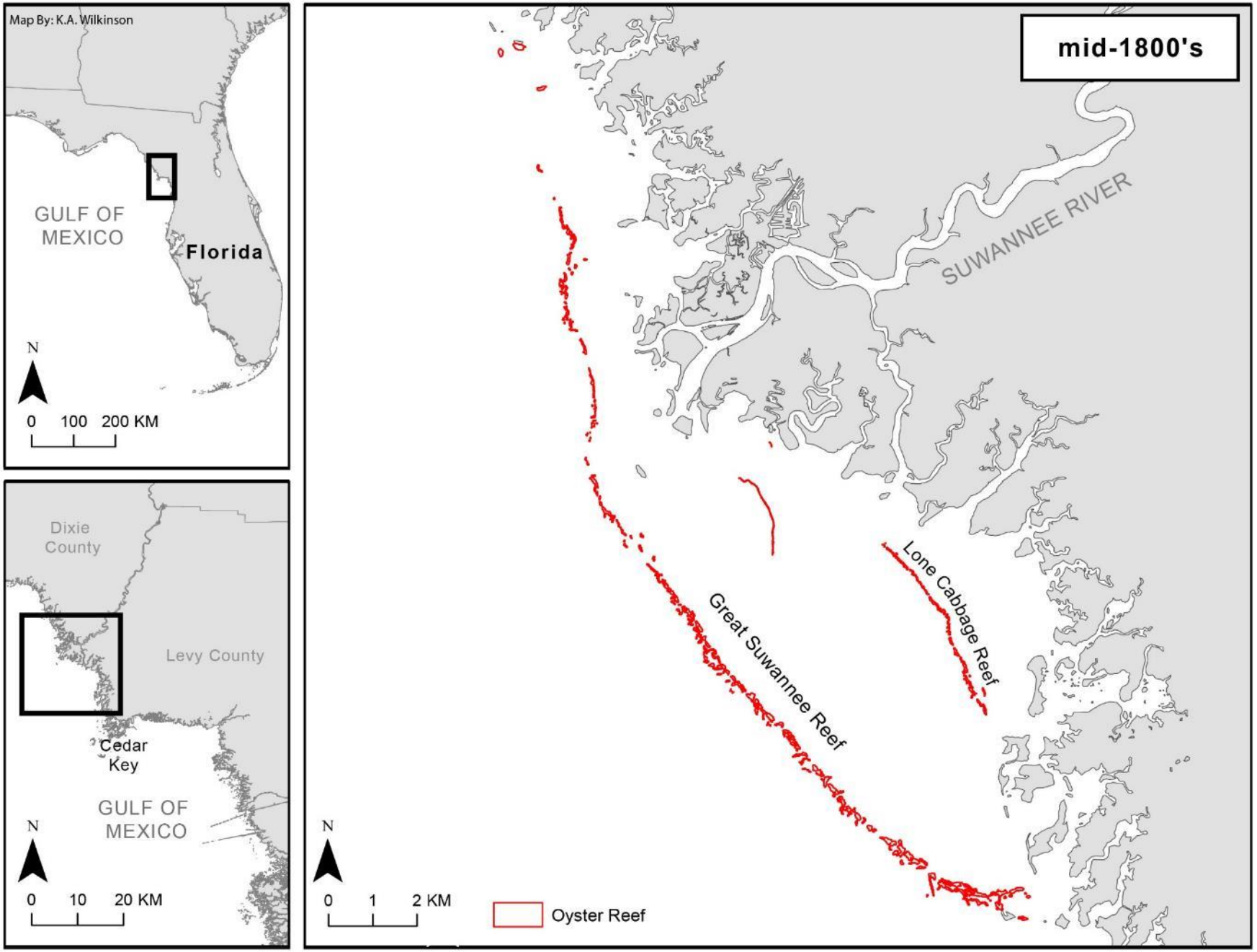
mostly intertidal

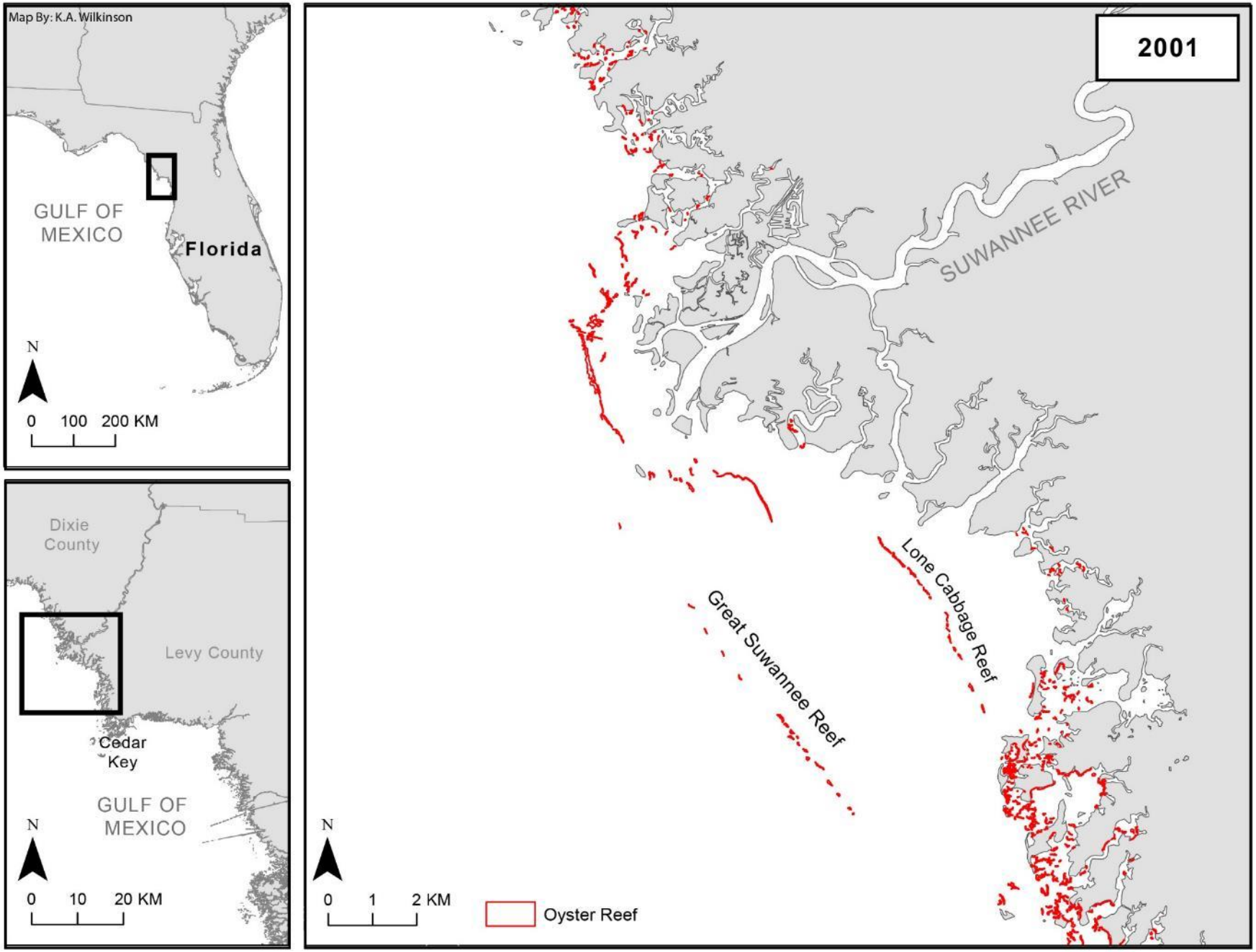
low energy coast

low sediment supply

no barrier islands

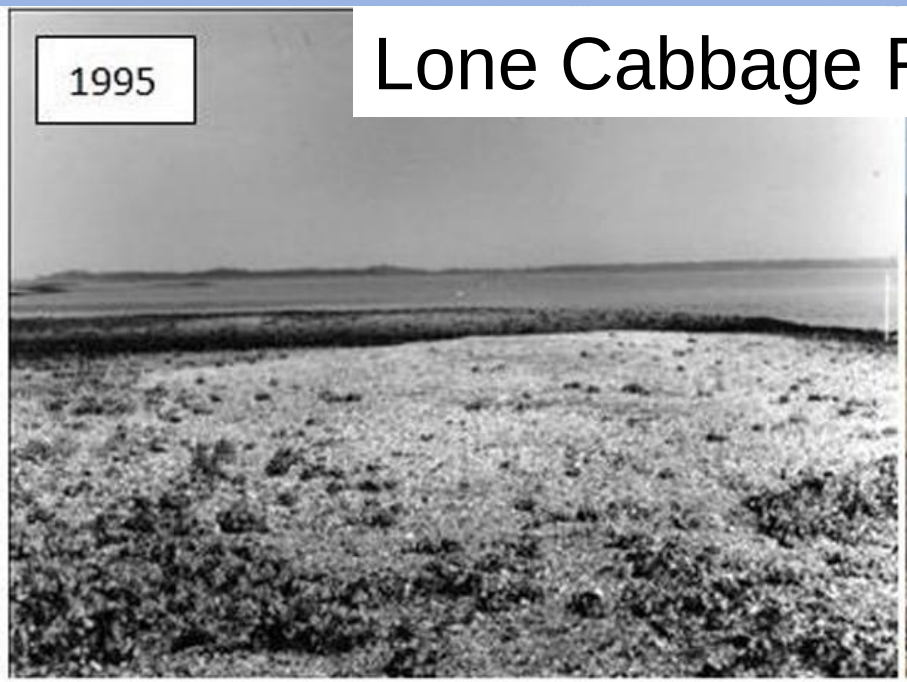
But oysters in the Big Bend have changed…


Map By: K.A. Wilkinson
GULF OF MEXICO
Florida
N
0 100 200 KM
Dixie County
Levy County
Cedar Key
GULF OF MEXICO
N
0 10 20 KM
mid-1800's
SUWANNEE RIVER
Lone Cabbage Reef
Great Suwannee Reef
N
0 1 2 KM
Oyster Reef

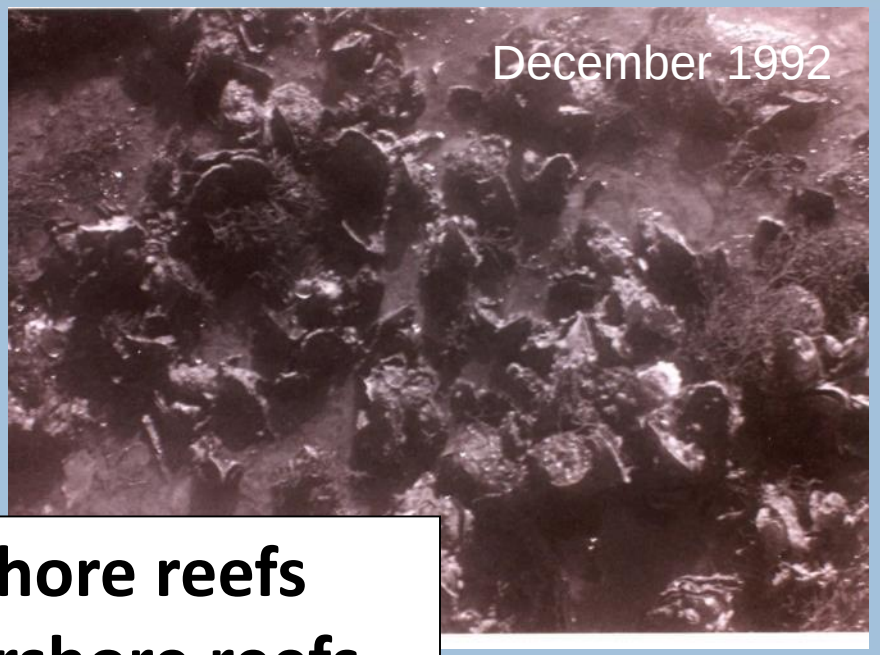

Map By: K.A. Wilkinson
GULF OF MEXICO
Florida
N
0 100 200 KM
Dixie County
Levy County
Cedar Key
GULF OF MEXICO
N
0 10 20 KM
2001
SUWANNEE RIVER
Lone Cabbage Reef
Great Suwannee Reef
N
0 1 2 KM
Oyster Reef


2010
Lone Cabbage Reef

Lone Cabbage Reef Complex



Great Suwannee Reef Complex



88% loss of offshore reefs
61% loss of nearshore reefs
50% loss of inshore reefs
In 30 years….
3,000-4,000 year history


Degraded bars are still eroding
7 inches in 2 years
DRINKING WATER

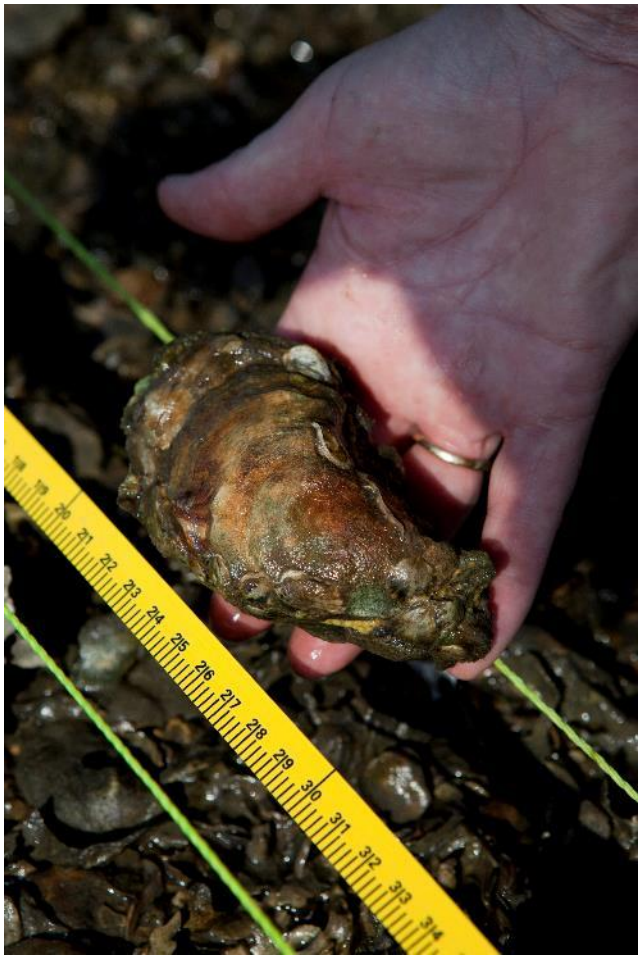
Why have oysters changed in the Big Bend?

Common threats to oysters and oyster reefs

- Overharvest
- Development & pollution
- Reductions in freshwater into estuaries
- Erosion from boat wakes & storms
- Disease/salinity relationships
- Contamination
- Changing climate (water temp, sea level, rainfall, storms)
- Ocean acidification

Oysters in the environment

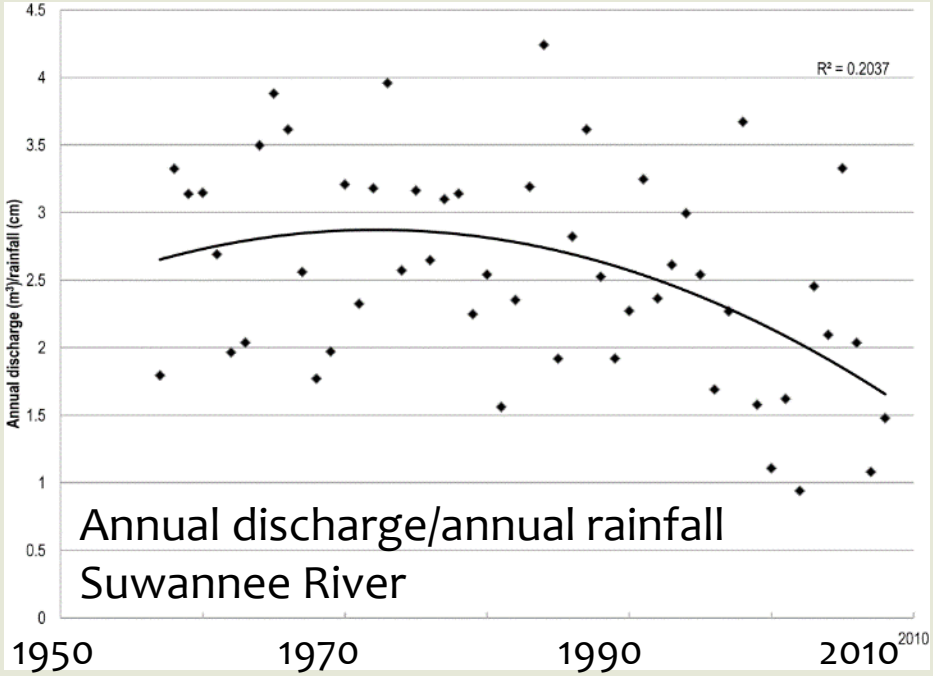
- We have been assessing oyster populations in the Big Bend since 2009
- Purpose to document changes in oyster populations in recent decades
- Inform management and restoration of oyster bars

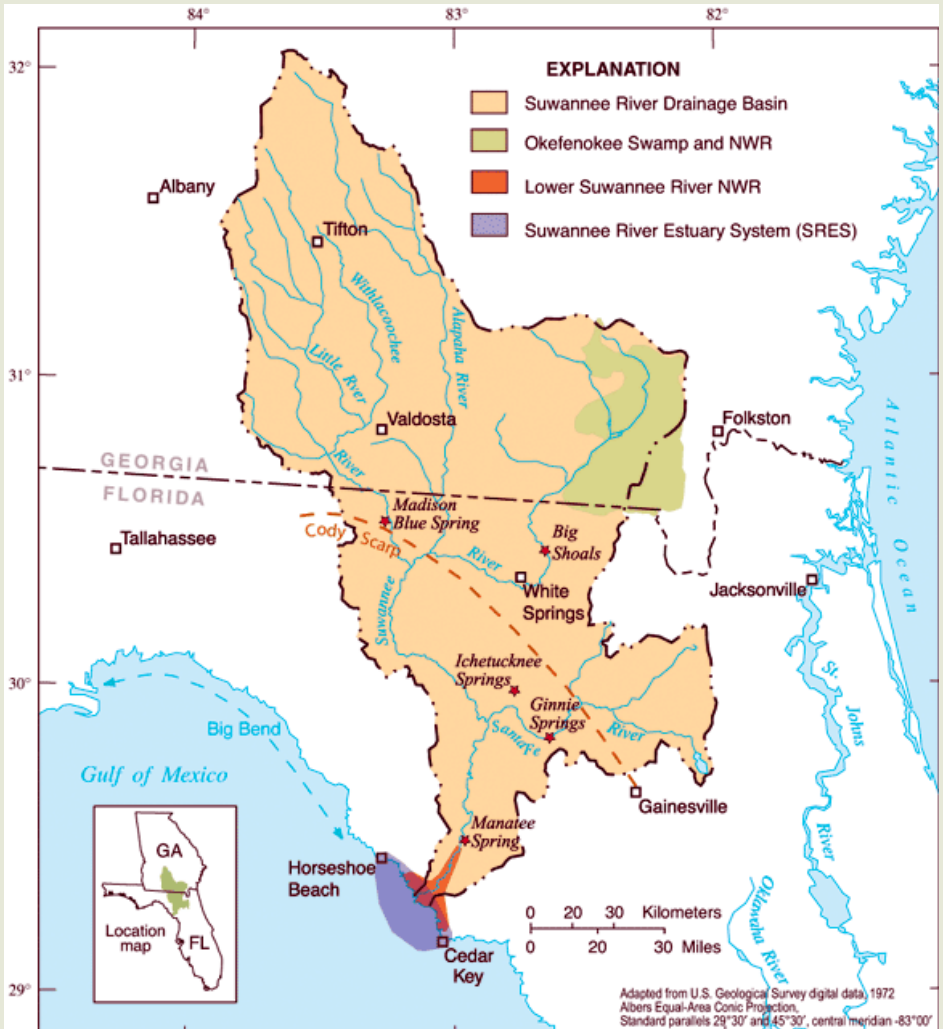


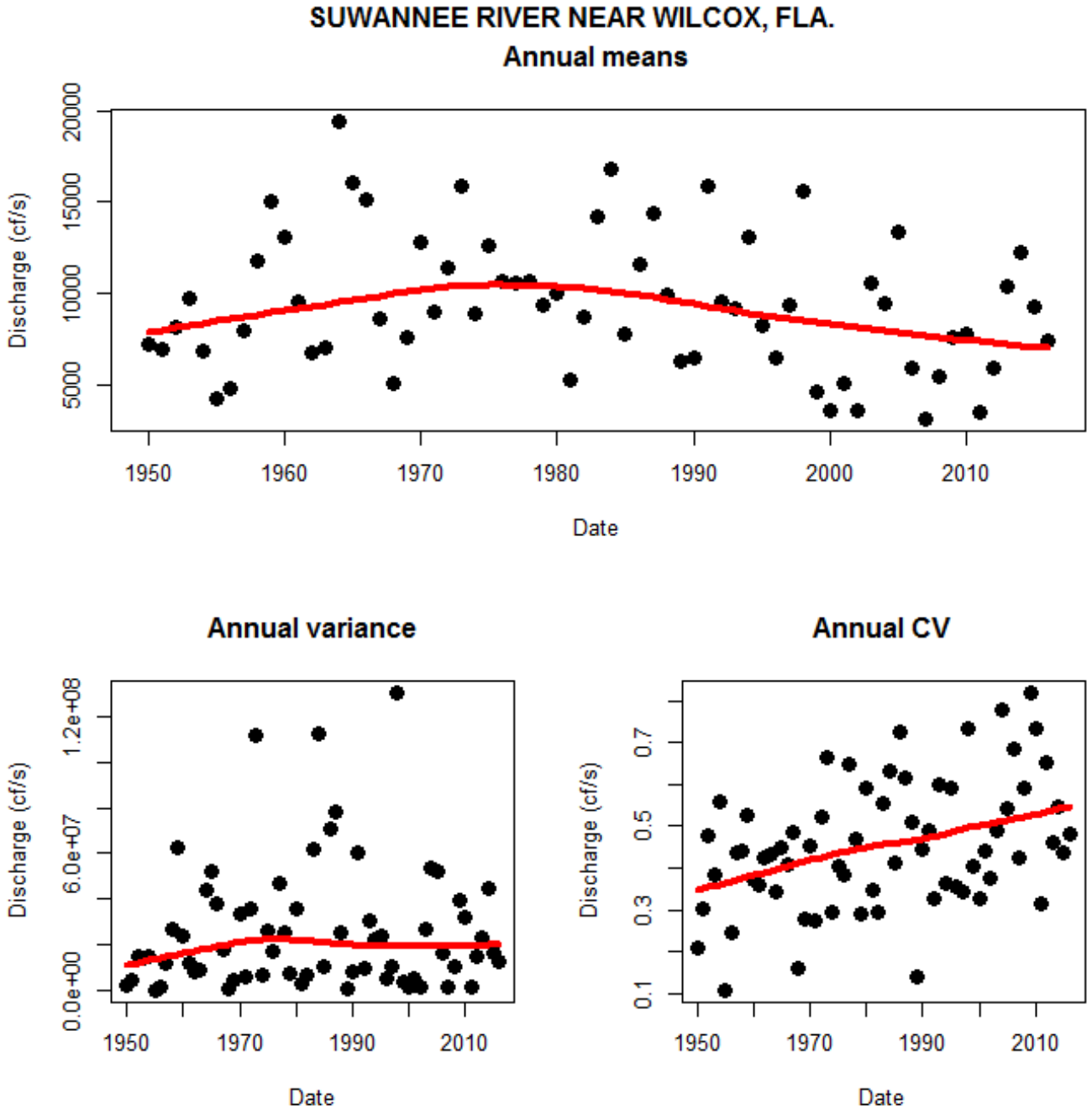
What we want

What is becoming more common

Trend towards less discharge per drop of rainfall in Suwannee basin






SUWANNEE RIVER NEAR WILCOX, FLA.
Annual means
Discharge (cf/s)
5000
10000
15000
20000
1950
1960
1970
1980
1990
2000
2010
Date
Annual variance
Discharge (cf/s)
0.0e+00
6.0e+07
1.2e+08
1950
1970
1990
2010
Date
Annual CV
Discharge (cf/s)
0.1
0.3
0.5
0.7
1950
1970
1990
2010
Date

Oyster reef feedback loops

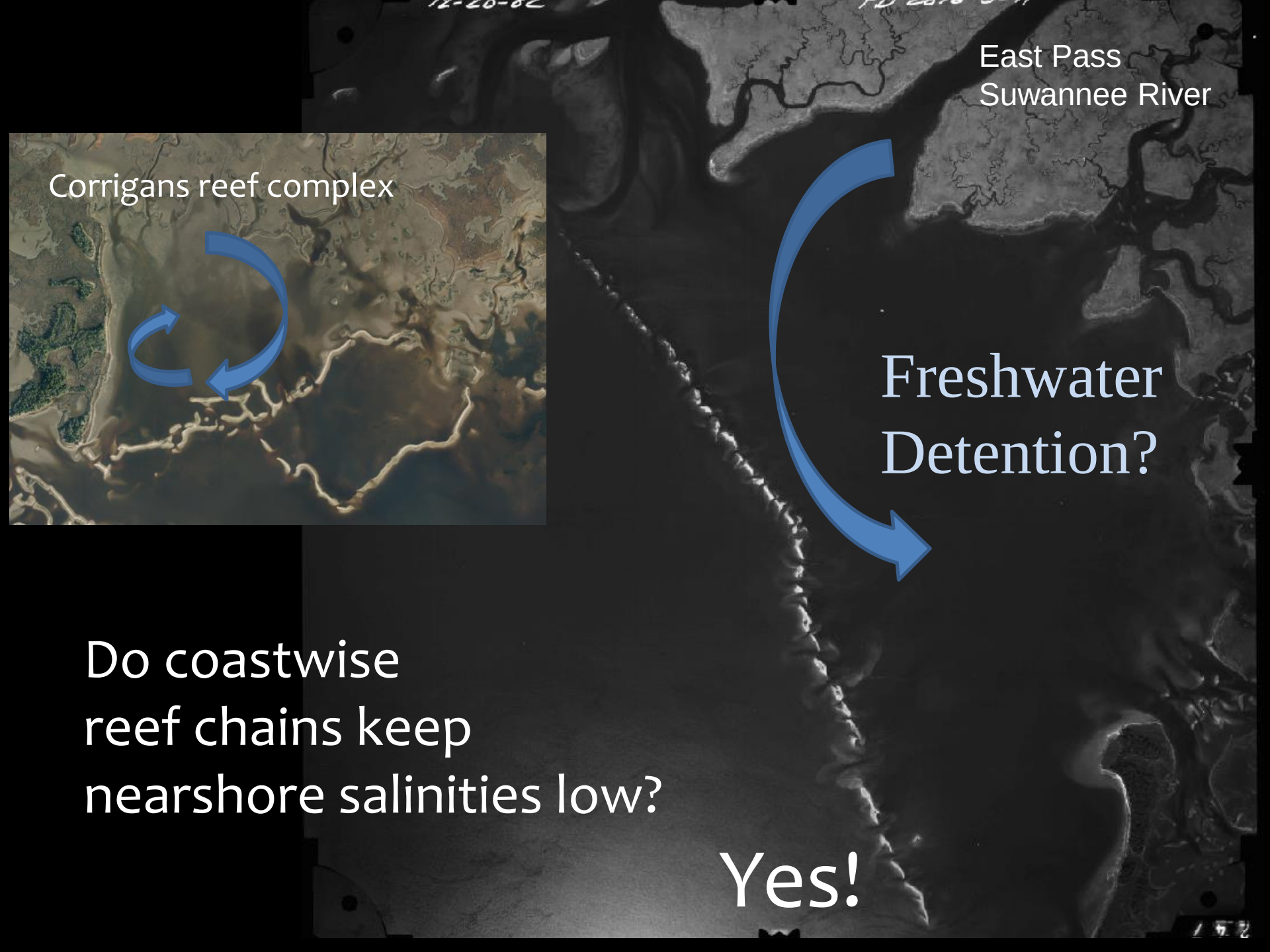
Upstream freshwater usage

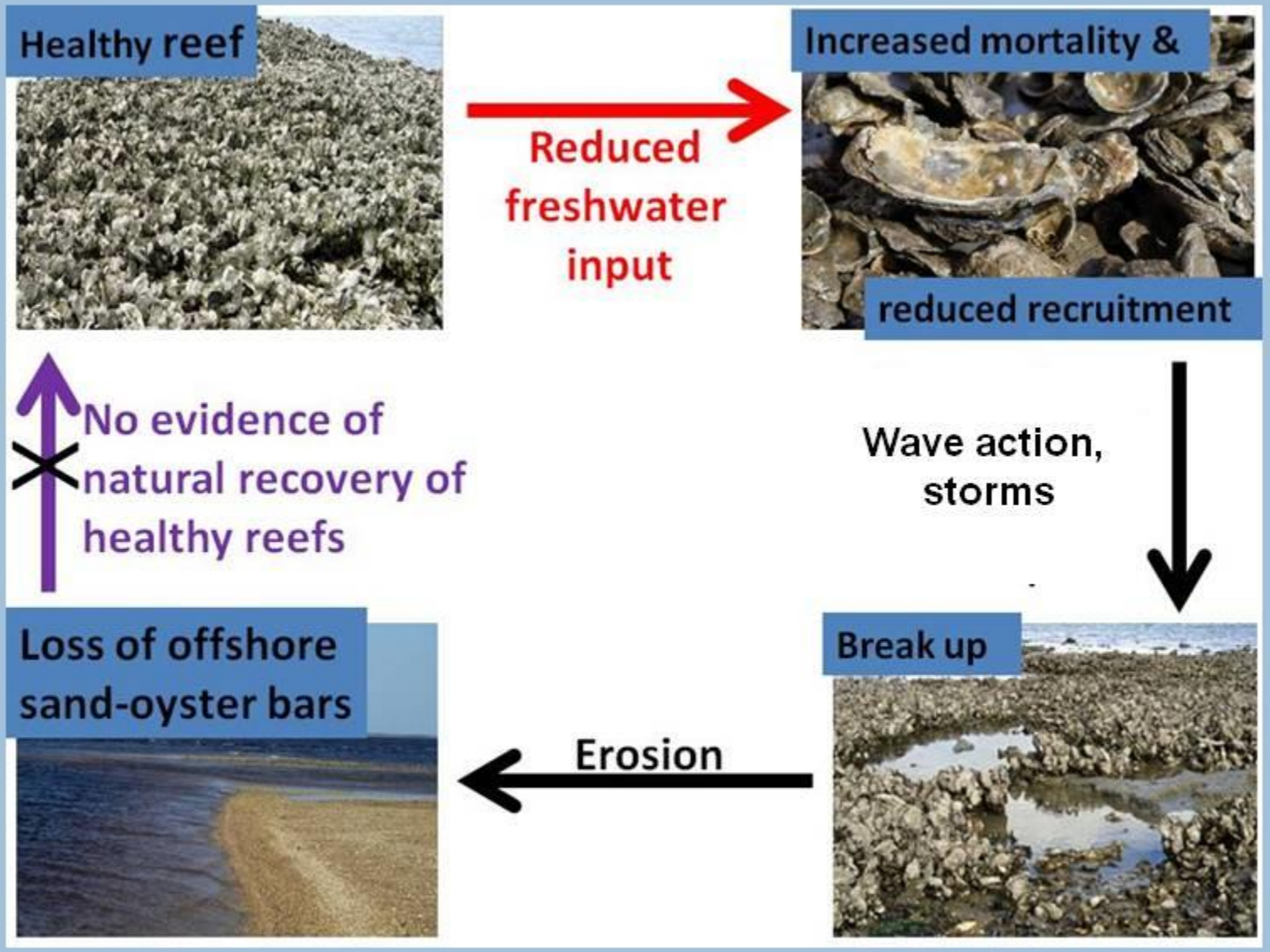
Increased salinity

Episodic mass mortality

Loss of substrate

No recruitment


East Pass
Suwannee River
Corrigans reef complex
Freshwater
Detention?
Do coastwise
reef chains keep
nearshore salinities low?
Yes!


Healthy reef
Reduced freshwater input
Increased mortality &
reduced recruitment
Wave action, storms
Break up
Erosion
Loss of offshore sand-oyster bars
No evidence of natural recovery of healthy reefs

We think we have lots of larvae and spat

The spat cannot survive without a place to settle

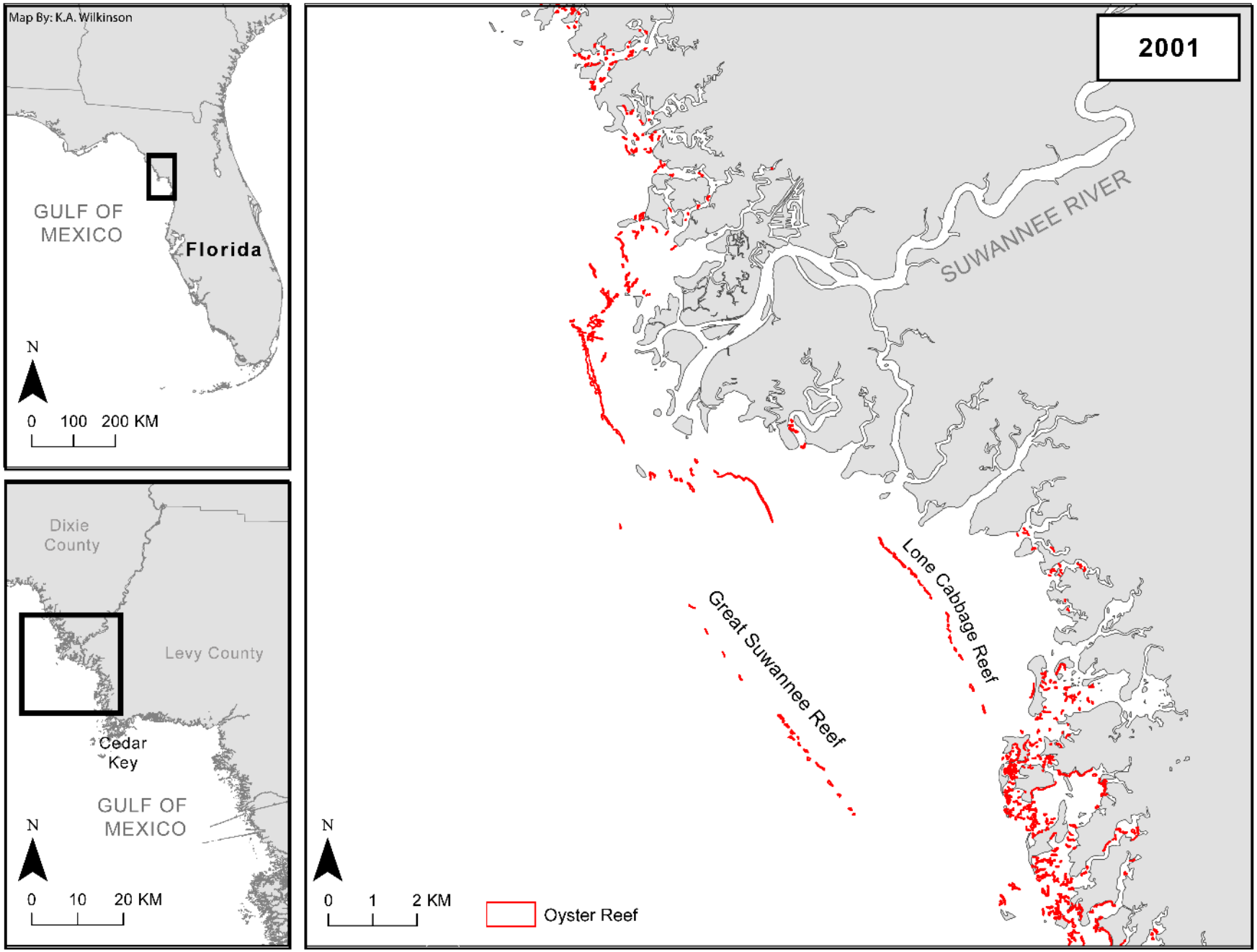
They cannot recolonize a degraded oyster bar
if it is nothing but shell hash

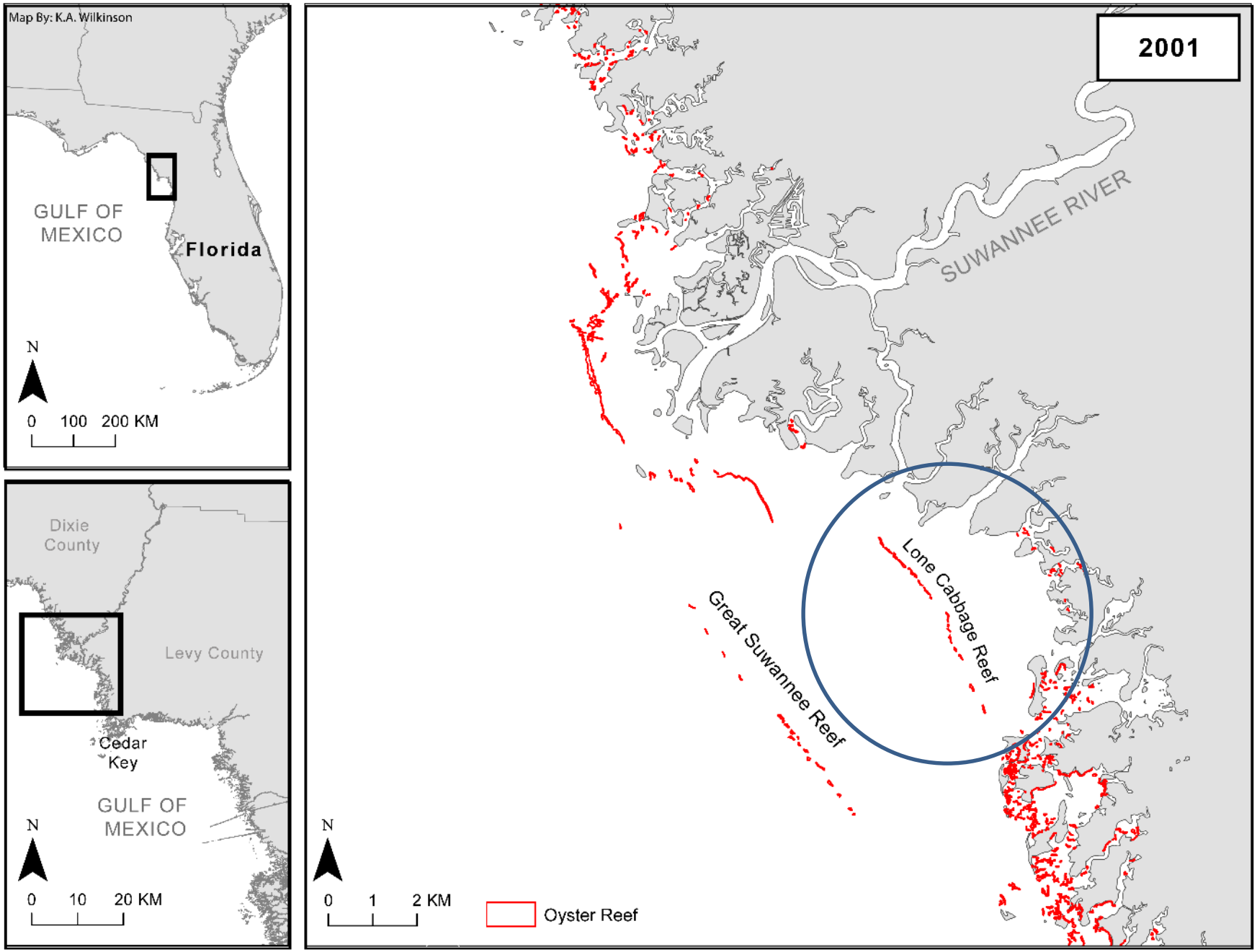
***Restoration hypothesis*:** Durable substrate allows repeated recolonization of reefs following episodic mass mortality events, leading to increased resilience

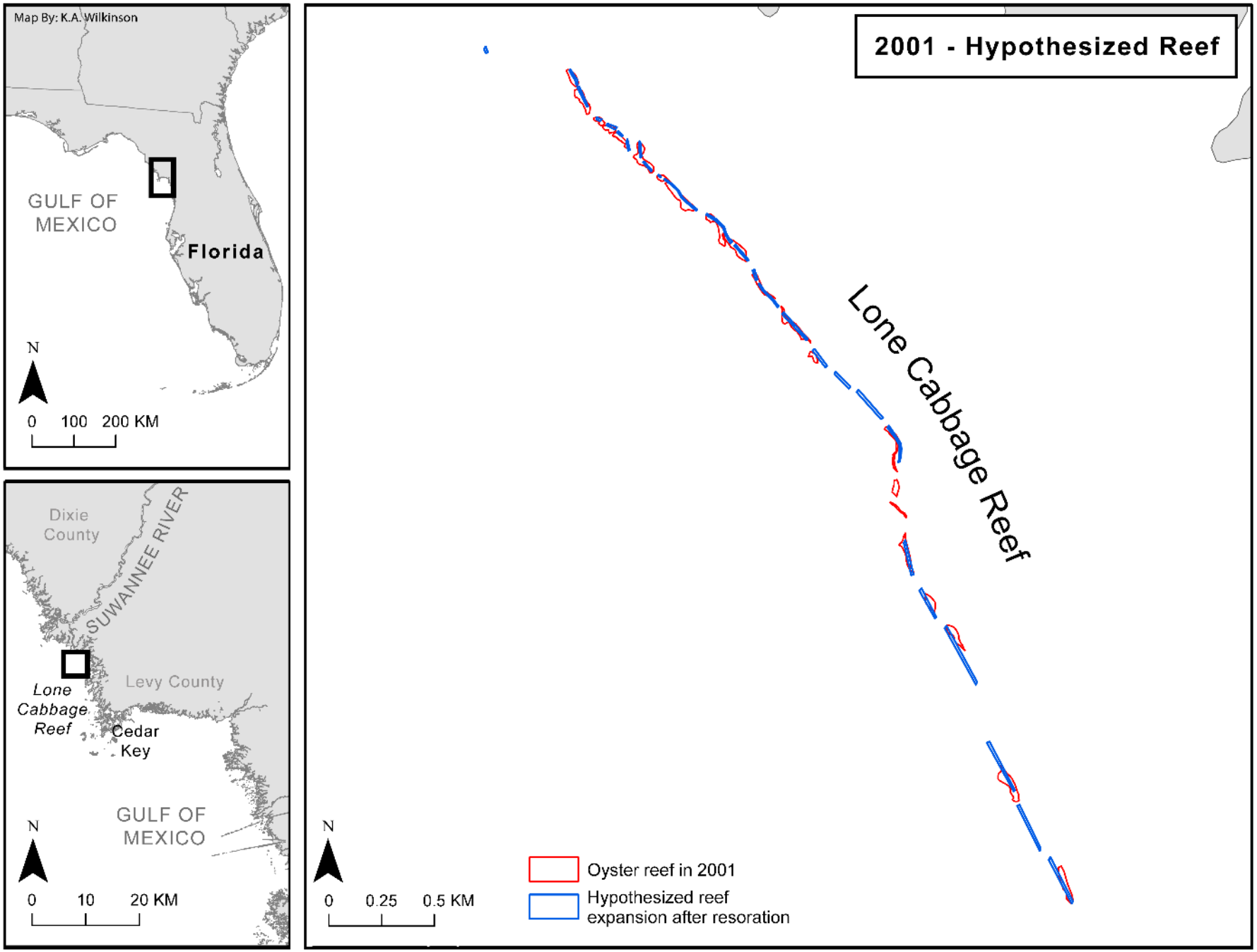
Intervene here

"Build it and they will come……
and go, and come, and go…."

Test project 2011-2013: Restoring Lone Cabbage reef using rocks and shell from clam bags

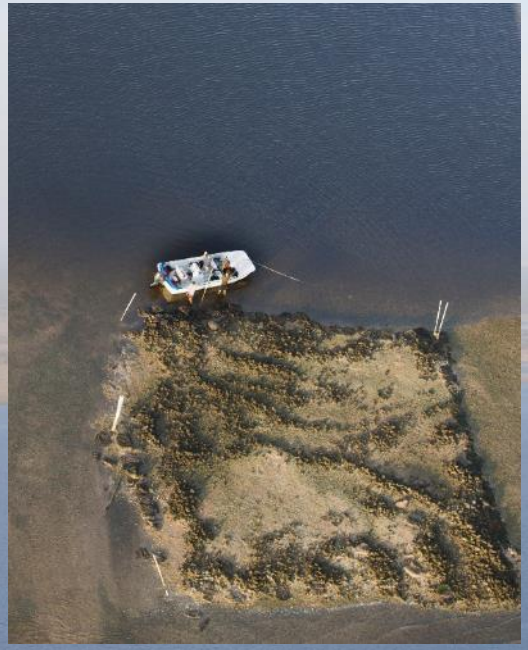

Map By: K.A. Wilkinson
GULF OF MEXICO
Florida
N
0 100 200 KM
Dixie County
Levy County
Cedar Key
GULF OF MEXICO
N
0 10 20 KM
2001
SUWANNEE RIVER
Lone Cabbage Reef
Great Suwannee Reef
N
0 1 2 KM
Oyster Reef


Map By: K.A. Wilkinson
GULF OF MEXICO
Florida
N
0 100 200 KM
Dixie County
Levy County
Cedar Key
GULF OF MEXICO
N
0 10 20 KM
2001
SUWANNEE RIVER
Lone Cabbage Reef
Great Suwannee Reef
N
0 1 2 KM
Oyster Reef


Map By: K.A. Wilkinson
GULF OF MEXICO
Florida
N
0 100 200 KM
Dixie County
SUWANNEE RIVER
Levy County
Lone Cabbage Reef
Cedar Key
GULF OF MEXICO
N
0 10 20 KM
2001 - Hypothesized Reef
Lone Cabbage Reef
N
0 0.25 0.5 KM
Oyster reef in 2001
Hypothesized reef expansion after resoration

Limerock boulders installed September 2013

Clambags and clam bag cultch added to reef in following months



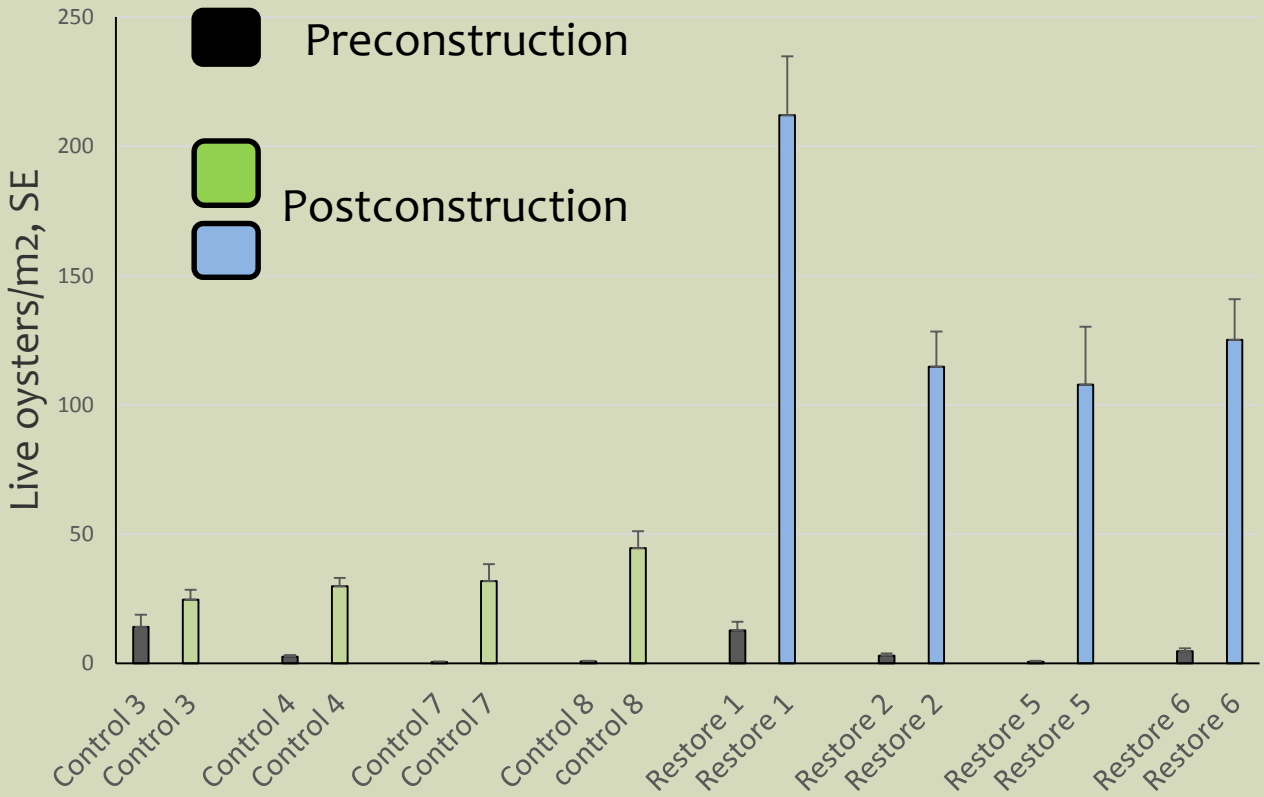
Control

Restore

Control

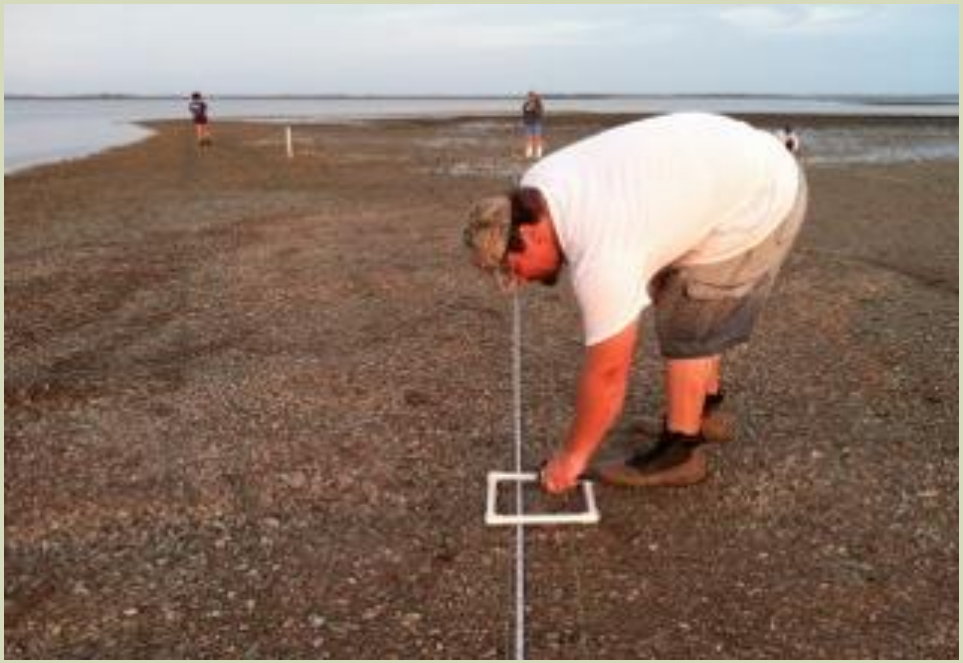
Restore

Oyster density



Oyster- cemented seam between rocks

Treatment	Before/after	Treatment effect
Control	64X increase	
Restoration	157X increase	9.2X increase over control



18 months

Conclusions

- Restoration with local materials can be accomplished
  Pilot study positive response in < 2 years.

- Freshwater detention important service

- Building evidence that restoring reefs affects multiple species

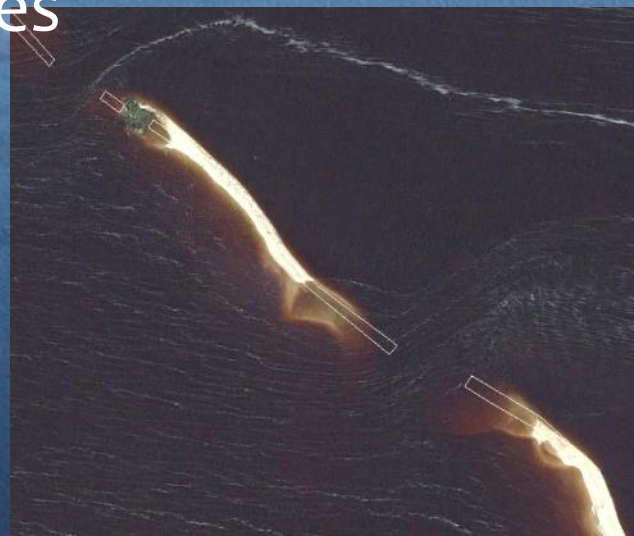
- Clear evidence of substrate limitation in the short term

- Long term response to droughts and storms?

“Recovery and resilience of oyster reefs in the Big Bend of Florida”

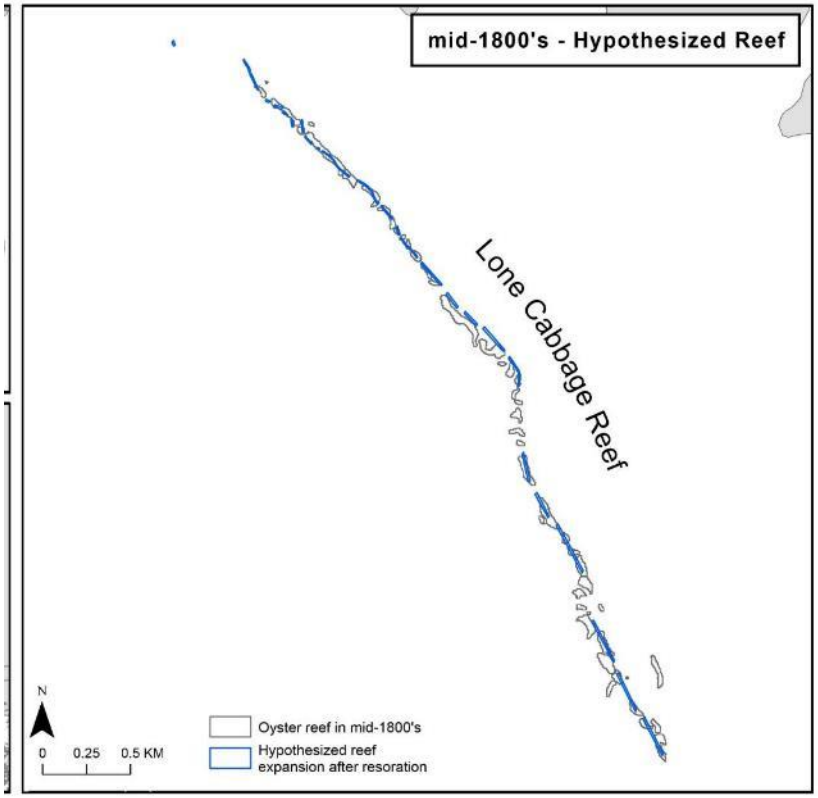
2017 – 2024

Limerock boulders topped with shell
Restoration of 12 ha, up to 3 miles of reef
Salinity buffering for up to 33 square miles
Resilience during low flow
Rapid recovery following low flow



Restore first near freshwater inputs

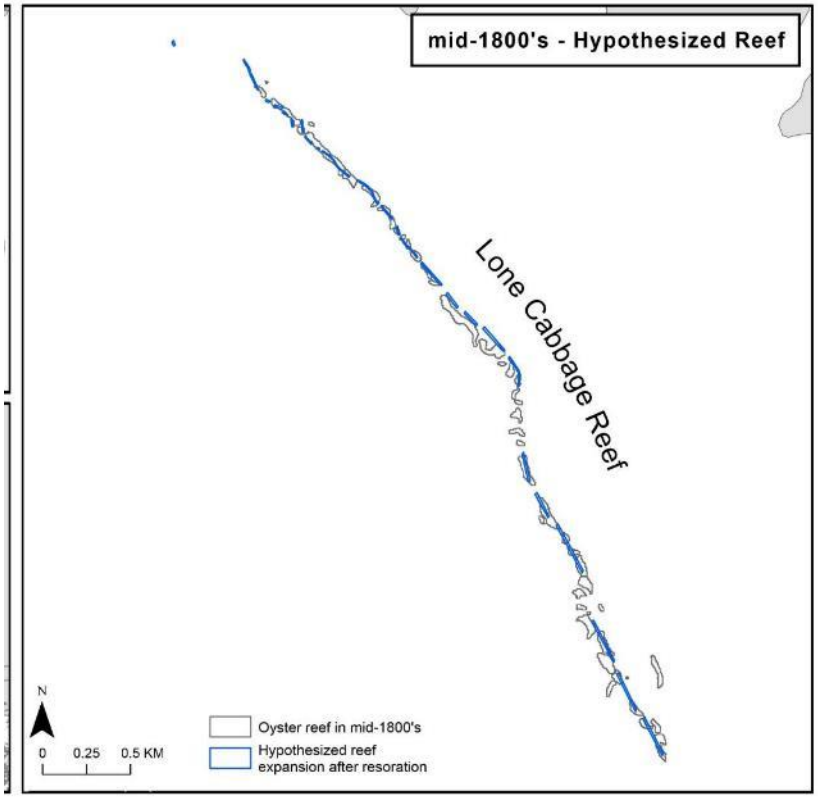
Rebuild Lone Cabbage Reef



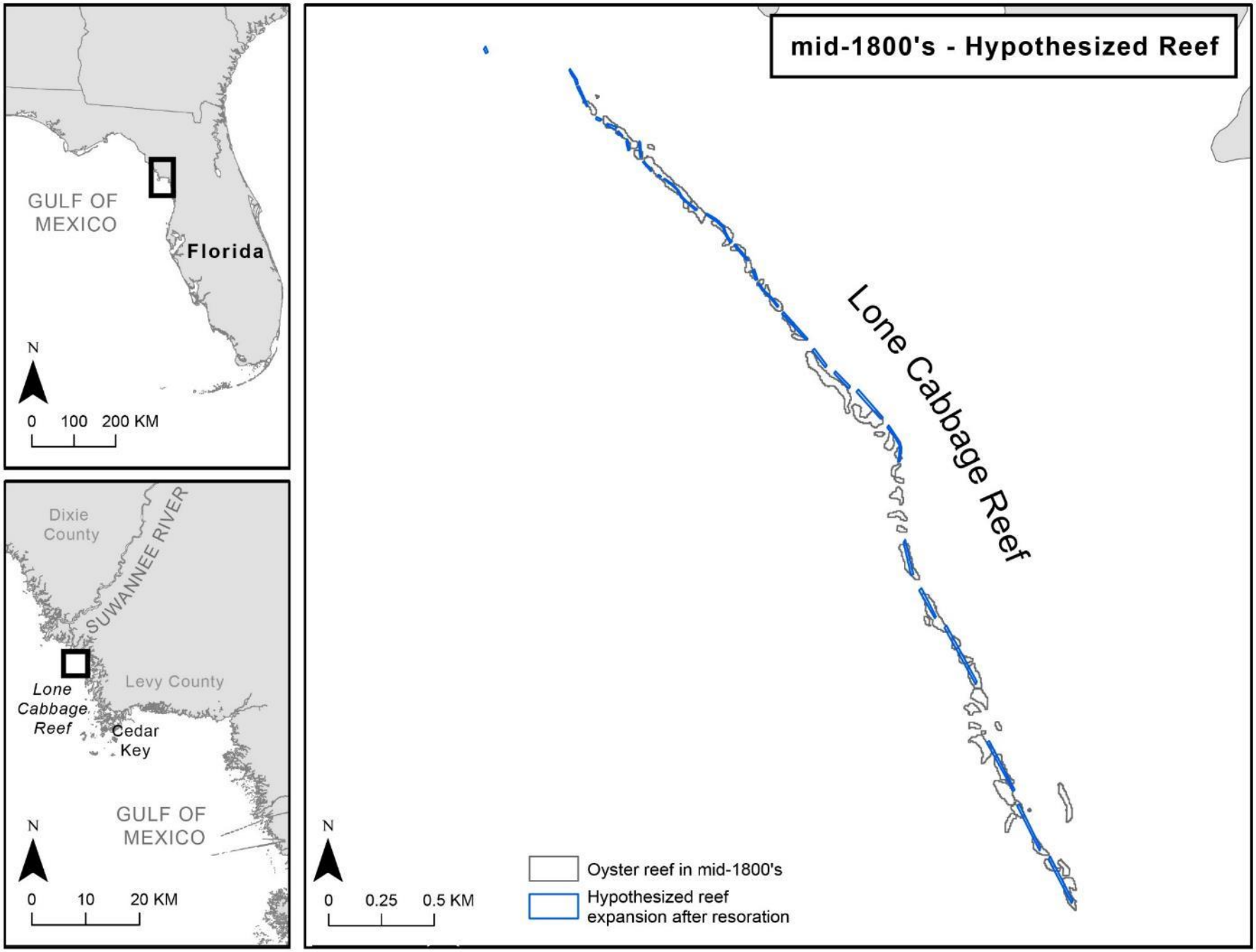
- Build a chain of reefs out of limerock boulders
- Gaps between each reef (similar to natural)
- Total length up to 3 miles
- Width on average about 50-ft
- Hopefully begin in fall 2018

- Work to be done by contractor

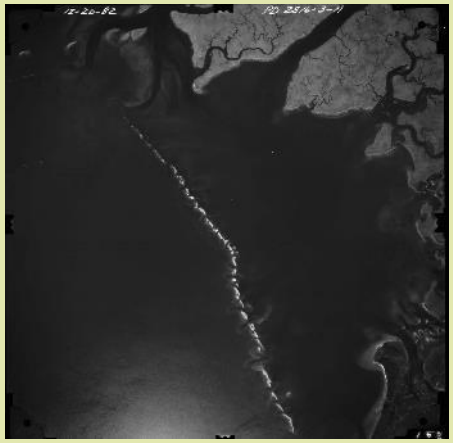
Rebuild Lone Cabbage Reef



- Rock will be covered with shell material
- Shell is likely going to be a mix of clam and oyster shell
- Will start after the rock construction is complete
- Work to be done by contractor

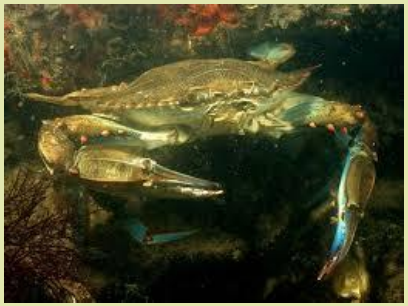

mid-1800's - Hypothesized Reef
Lone Cabbage Reef
GULF OF MEXICO
Florida
N
0 100 200 KM
Dixie County
SUWANNEE RIVER
Levy County
Lone Cabbage Reef
Cedar Key
GULF OF MEXICO
N
0 10 20 KM
N
0 0.25 0.5 KM
Oyster reef in mid-1800's
Hypothesized reef expansion after resoration

Restoration Predictions



1. New sites for oysters to settle and grow

2. Reef may die, but more likely to come back when good conditions return



3. Decreased salinities in Suwannee Sound and landward marshes.

4. Lower salinity estuarine areas benefit: finfish, shellfish, sea turtles, water quality…

Key Project Elements Years 1-8

Planning and Permitting → Monitoring of oysters and water quality → Construction → Assessment of oyster and water quality responses

Photos from UF/IFAS Tyler Jones

Opportunities to be involved

- More than 80% of the project funding will be completed by contractors

Opportunities to be involved

- Rock contract
  - Build reef to specifications as designed and permitted
  - Begin fall 2018
  - Process will follow standard State of Florida building and contracting guidelines
- Shell contract
  - Acquire and move shell to cover top of reef
  - Likely clam and maybe some oyster shell
  - Begin after rock construction complete
  - Process will follow standard State of Florida building and contracting guidelines

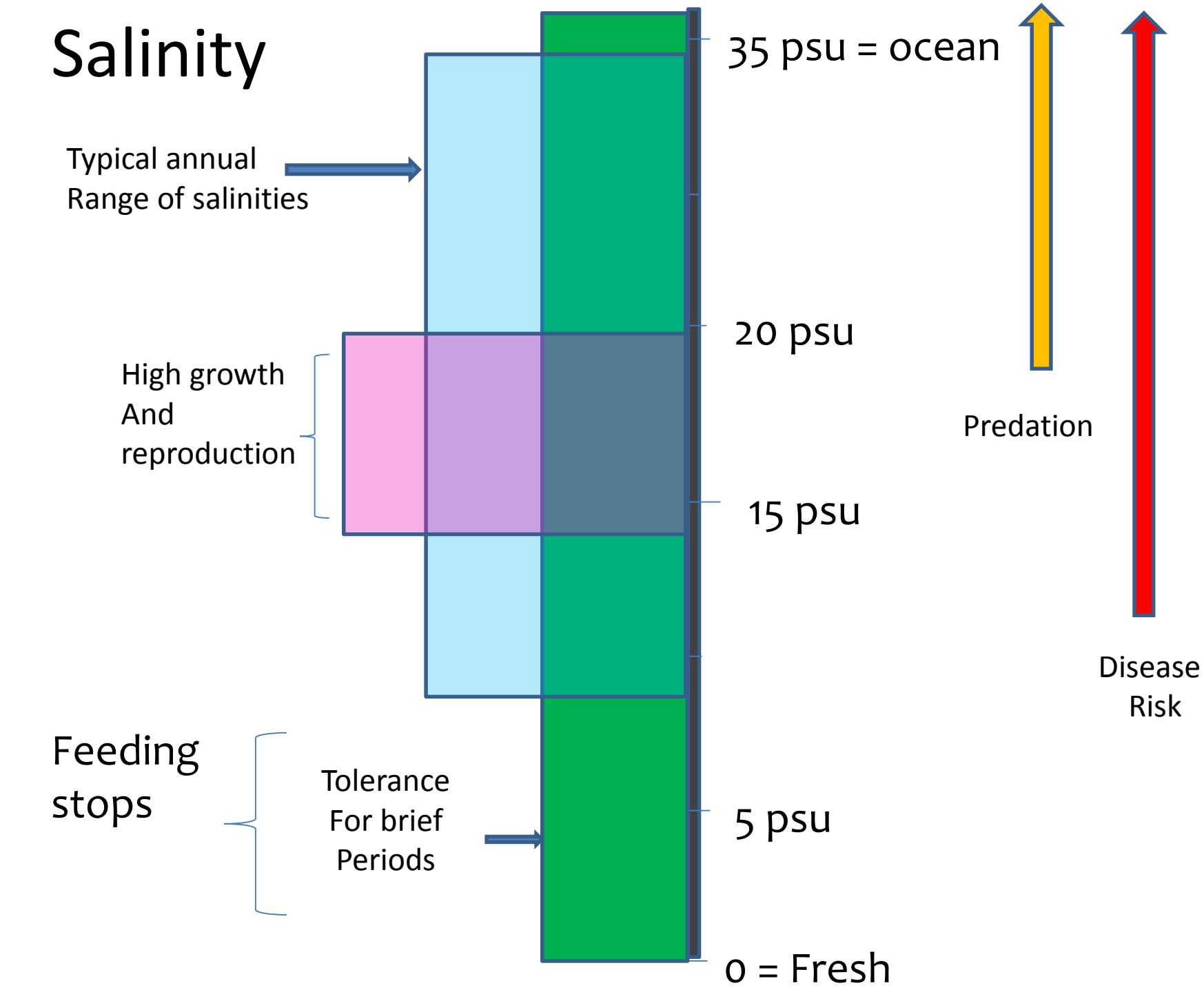
Questions? Thank you!

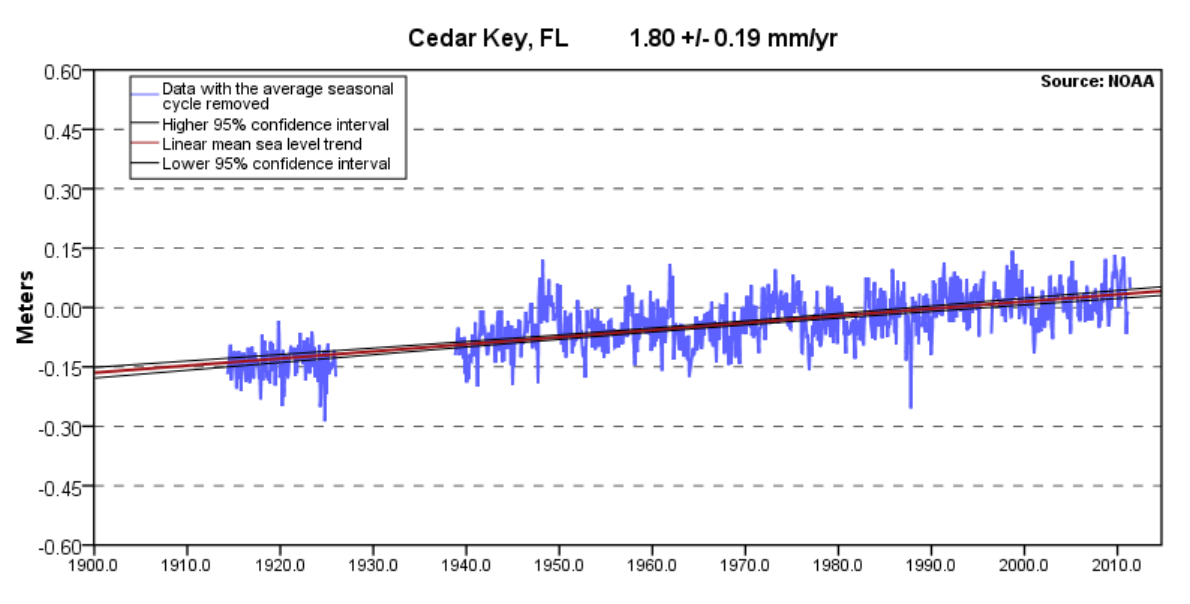
- Contact us
- Peter Frederick
  - 352 846 0565
- Bill Pine
  - 352 273 3650
- Leslie Sturmer
  - 352 543 5407
- Steve Beck

- Kevin Heinicka
  - 352 294 3802

- http://www.wec.ufl.edu/oysterproject

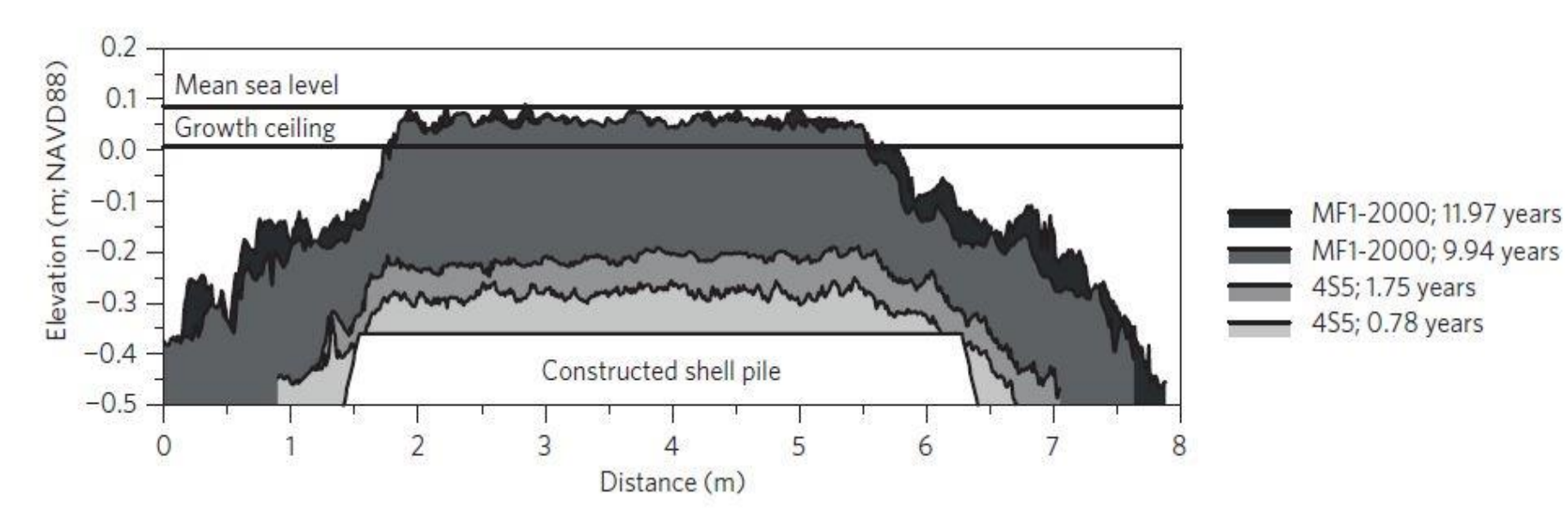
Salinity


35 psu = ocean
Typical annual
Range of salinities
20 psu
High growth
And
reproduction
15 psu
Predation
Disease
Risk
Feeding
stops
Tolerance
For brief
Periods
5 psu
0 = Fresh



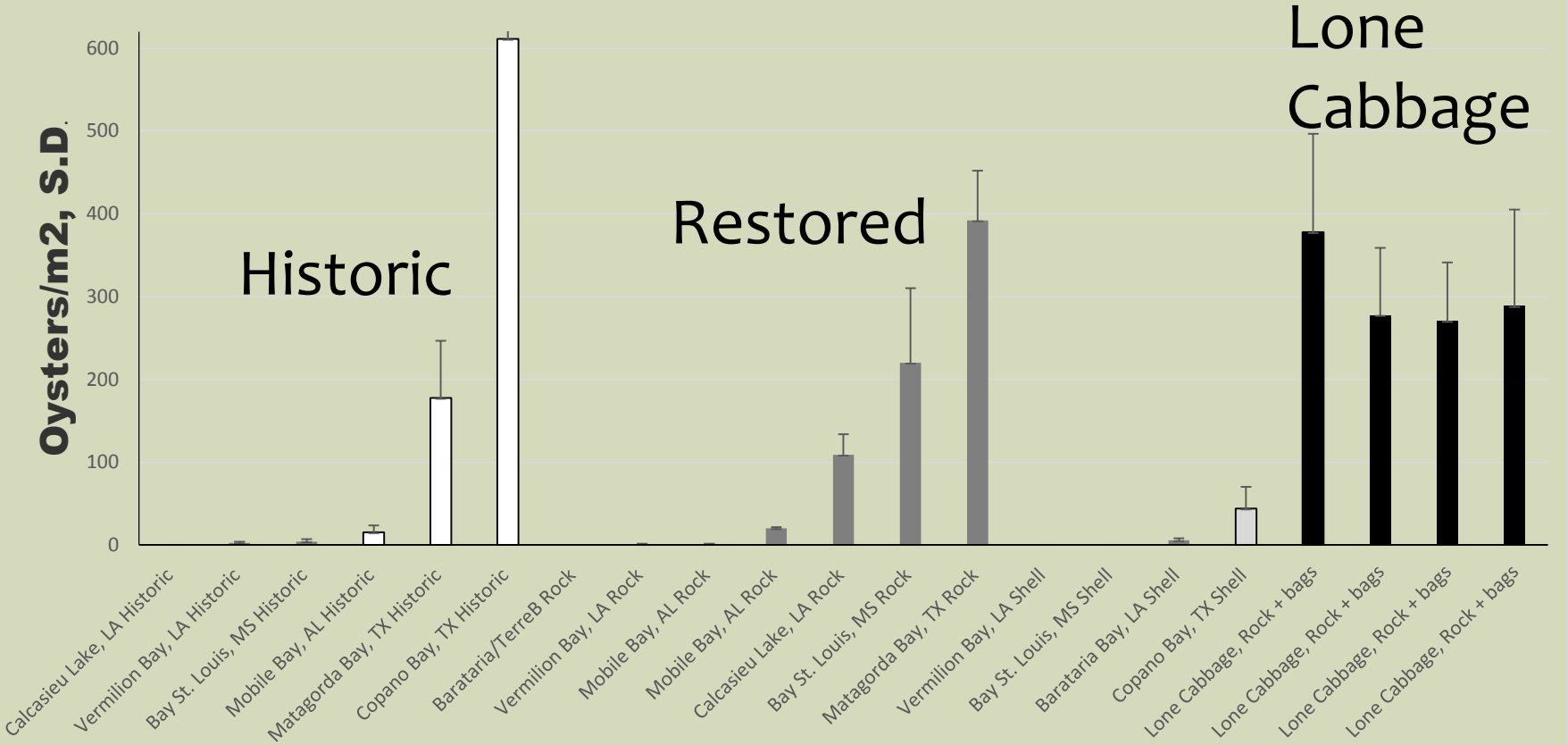
Flash news:

Oysters outgrow sea level rise!



Rodriquez, A.B. et al. 2014. Nature Climate Change DOI: 10.1038

Restoration Success - oyster density



Data from LaPeyre et al. 2014
Ocean & Coastal Management 89:20-28

Bags: 25% of area, 52% of oysters