Cobia Research Along the Southeast US Coast

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SOUTH CAROLINA DEPARTMENT OF NATURAL RESOURCES

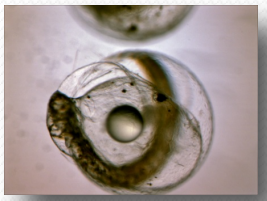
DNR

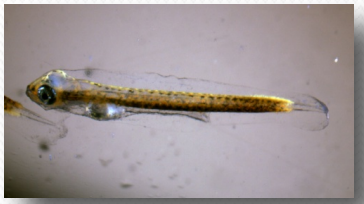
Cobia Research in SC

- SCDNR, Marine Resources Division
  - MRRI, OFM, CRO
- Marine Resources Research Institute
  - Denson, Darden, Brenkert, Yost, Perkinson, Walker, Jamison, O'Donnell, Farrae, Cushman, Watson, Levesque, Bridgham, Stokes, Katalinas
  - Lefebvre, Roumillat, Olney (VIMS), Gold, Renshaw…
  - Our products are data for stock assessments, peer reviewed literature, education and outreach

South Carolina Research

- Aquaculture (2000-present)
  - Captive spawning, larval rearing, growth, tolerances production
  - Stock Enhancement (2004-present)
- Fisheries (2005-present)
  - Tag-recapture, site fidelity, spawning, age-growth, reproduction, pop genetics
- Genetic tags, structure, population health





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Weirich, C.R., T.I.J. Smith, A.D. Stokes, M.R. Denson, and W.E. Jenkins. 2004. Pond rearing of larval and juvenile cobia, in the southeastern United States: initial observations. Journal of Applied Aquaculture 16(1-2):27-44.

Weirich, C.R., A.D. Stokes, T.I.J. Smith, W.E. Jenkins, and M.R. Denson. 2006. Outdoor tank and pond spawning of cobia in coastal South Carolina. Journal of Applied Aquaculture 18(3):1-16.

Lefebvre, L. and M.R. Denson. 2012. Inshore spawning of cobia in South Carolina. Fishery Bulletin.

Darden, T, M. Walker, K. Brenkert, J. Yost and M.R. Denson. 2013. Population Genetics of Cobia: Management Implications along the Southeastern U.S. Coast. Fishery Bulletin.

Questions

- *Where does SC get its cobia data?*
- *Cobia stock enhancement in SC, a success?*
- *What is a distinct population segment and why is it important?*
- *Did stocking create the distinct population segment?*
- *Do tag-return data support the genetic conclusions?*
- *Why are there conflicting reports in the literature regarding cobia stock structure along US Atlantic and Gulf Coast?*
- *Are cobia along the Atlantic coast similar? What can we learn about Atlantic coast cobia from SC Research?*

Where does SC get its cobia data?

- Charter Boat Captains
- Recreational anglers
- Tournaments
- Biologists

Genetic Research/ DNA Fingerprinting

- Microsatellite loci
- Neutral markers
- Determine hatchery fish released into the wild
- Identify stocks of fish
- Understand genetic health of population (inbreeding, how many spawners contributing)

Cobia stock enhancement in SC, a success?

- Experimental stocking
- Research Scale
- Hypothesis-driven research
- Responsible Approach to Marine Stock Enhancement

"A Responsible Approach to Marine Stock Enhancement"*

- *Stage I: Initial Appraisal and goal setting*
  - *1) Understand the role of enhancement within the fishery*
  - *2) Engage stakeholders*
  - *3) Quantitatively assess contributions of enhancement to fishery goals*
  - *4) Prioritize and select target species*
  - *5) Assess economic and social benefits and costs of enhancement*
- ***Stage II: Research and technology development: pilot studies***
  - ***6) Define enhancement system for the fishery***
  - ***7) Develop aquaculture system and rearing practices***
  - ***8) Use genetic resource management***
  - ***9) Use disease and health management***
  - ***10) Ensure that released hatchery fish can be identified***
  - ***11) Define optimal release strategies***
- *Stage III: Operational implementation and adaptive management*
  - *12) Devise effective governance arrangements*
  - *13) Define a fisheries management plan with goals and measures of success*
  - *14) Asses and manage ecological impacts*
  - *15) Use adaptive management*

**Lorenzen K., K.M. Leber, and H.L. Blankenship. 2010. Responsible Approach to Marine Stock enhancement: An Update. Reviews in Fisheries Science*

Waddell Center Stocking

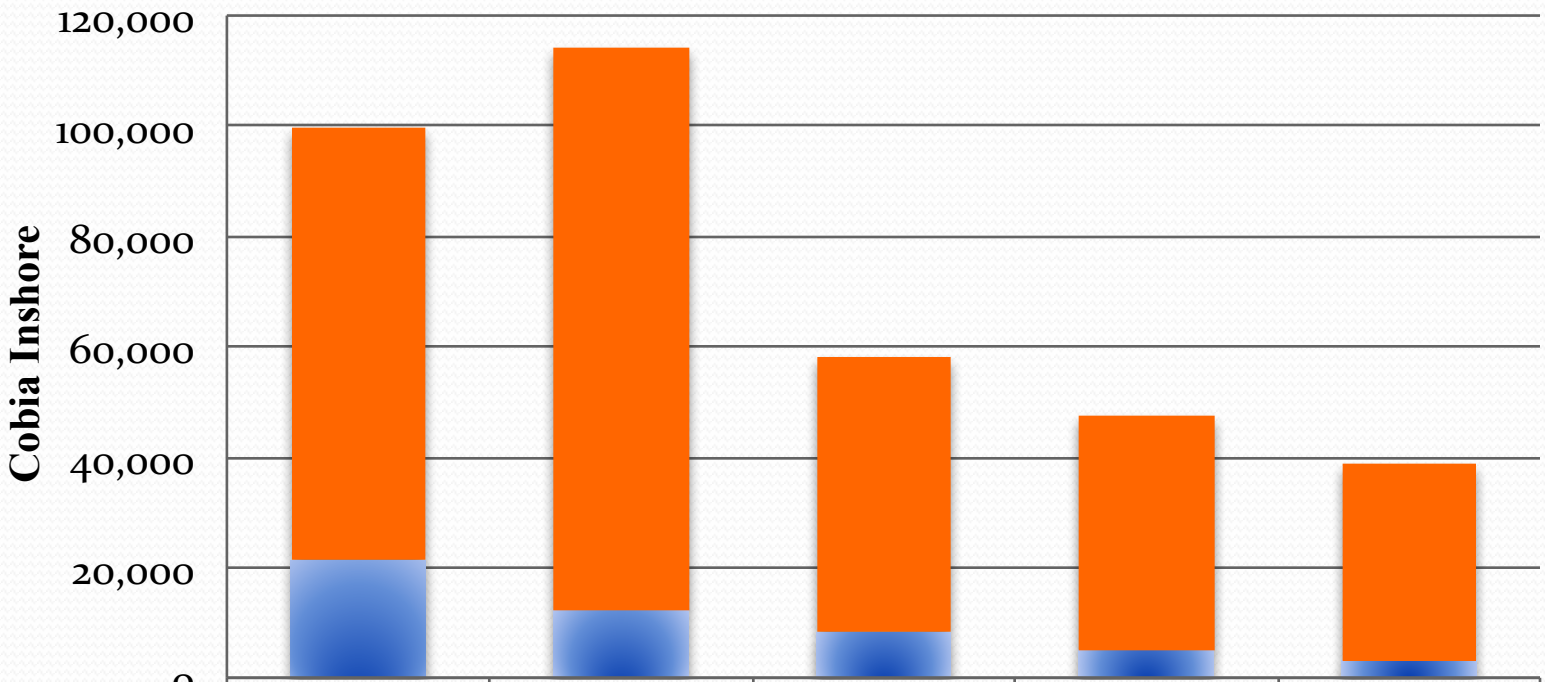
- Spawned from local wild broodstock
- Reared in ponds
- Large size range
- Externally tagged and genetically marked

Year class	Number released
2004	2,083
2005	6,184
2007	53,732
2008	2,054
2009	1,392
2012	4,048

Contribution to Wild Year Class

Stocking Year (#)	Sample Year							
	2008	2009	2010	2011	2012	2013	2014	2015
2005 (6,184)	0	0	9.1	0	0	0	0	0
2007 (53,732)	*	70.0	40.0	23.1	68.8	83.3	50.0	50.0
2008 (2,054)	*	*	0	3.4	0	0	0	0
2009 (1,392)	*	*	*	0	0	0	0	0
2012 (4,048)	*	*	*	*	*	*	*	100

Population Estimate of Inshore Cobia



	2010	2011	2012	2013	2014
Wild	78,325	102,003	50,122	42,336	35,567
Stocked	21,212	12,239	8,127	5,079	3,175

Overall 16% decline in spawning stock each year

Petersen estimates using stocked fish, recaptures identified through genetics and wild fish.

Success?

- Demonstrated natal homing
- Demonstrated spawning, rearing, transport
- Identified best size at release
- High contributions demonstrating stocked fish survival
- Suggests low wild population size
- Demonstrated that genetic tags are effective
- Potential tool for rebuilding population

Why are there conflicting reports in the literature regarding cobia stock structure along US Atlantic and Gulf Coast?

- Hrincevich 1993, Gold et al. 2013, Darden et al. 2014, SEDAR 28

- The differences are likely due to 2 factors
  - Small sample size for population characterization.
  - Samples collected when fish were not in spawning aggregations.

Cobia Sample Size Used in Genetic Comparisons

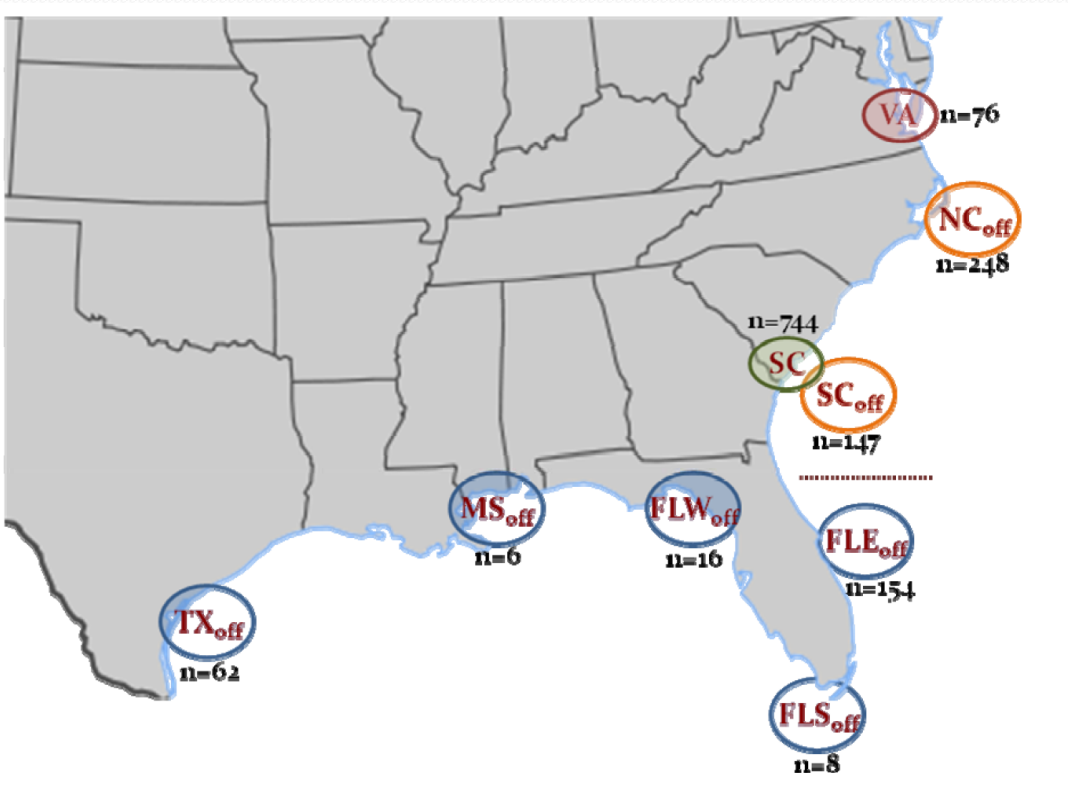
Hrincevich 2003	
Collected May-Sept	n
FL	10
MS	41
LA	10
VA	13
AL	6
TX	10

Gold et al. 2013	
Collected 2010-2011 (Summer)	n
Offshore VA	35
MS	46
LA	14
Taiwan	36

Darden et al. 2014	
Collected 2008-2009 (Apr-Jul)	n
VA inshore	35
NC offshore	146
SC inshore	212
SC offshore	126

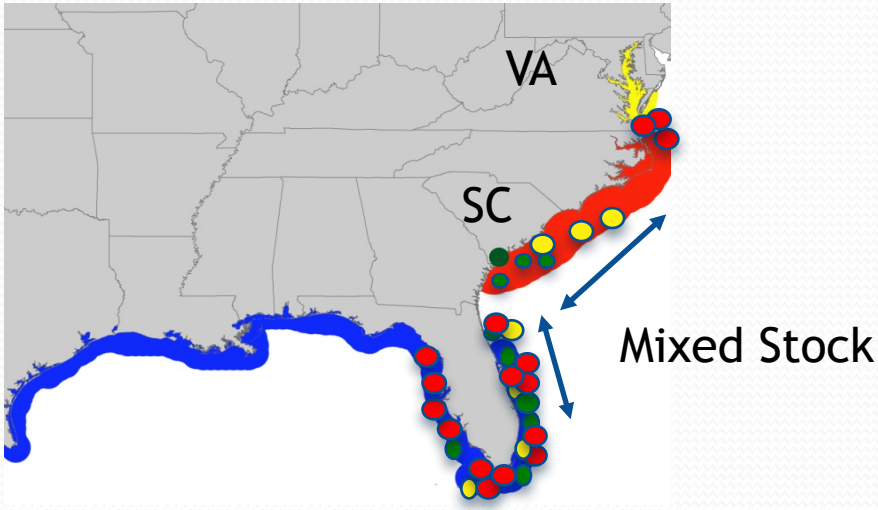
SEDAR 28 Darden DW01	
Collected 2004-2011 (spawning periods)	n
VA inshore ('06-'08)	76
NC offshore ('08-'10)	248
SC inshore ('04-'11)	744
SC offshore ('04-'11)	147
FLE offshore ('11)	154
FLS offshore ('10)	8
FLW offshore ('08)	16
MS offshore ('10)	6
TX offshore ('10)	62

Results of SEDAR Genetic Analyses Shows Different Segments to Population



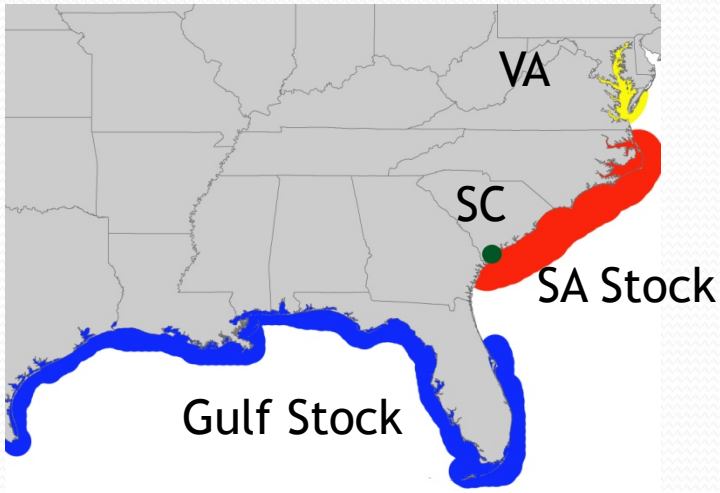
SEDAR28 Darden DW01

Sampling When Not Spawning



Collected outside of spawning

Sample When Spawning



Collected during spawning

What is a distinct population segment and why its important?

- A “DPS” forms when a group of fish spawn only with other fish from that same group for many years.
  - Usually spawning occurs in aggregations that are geographically or temporally separated.
  - Very little gene flow can occur for a DPS to persist.
  - Because of the separation its unlikely that fish from a different group will fill that niche.
  - Once a population is “fished out” it may not come back.

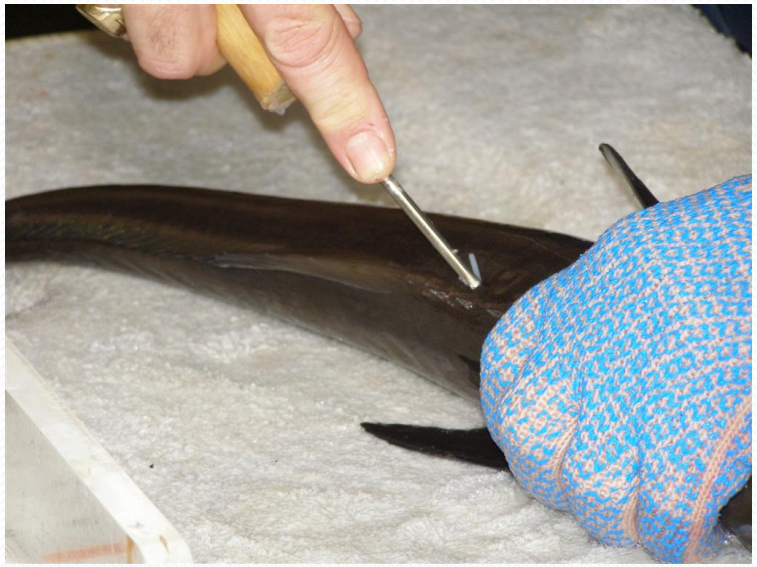
Did stocking create the distinct population segment?

- No, all stocked fish were identified genetically and removed from the structure analysis.
- The DPS's in SC and Chesapeake Bay may exist because the eggs and larvae are retained in the system for some period of time (imprinting).
- So far these are the only two examples of cobia DPSs we know of along the coast.

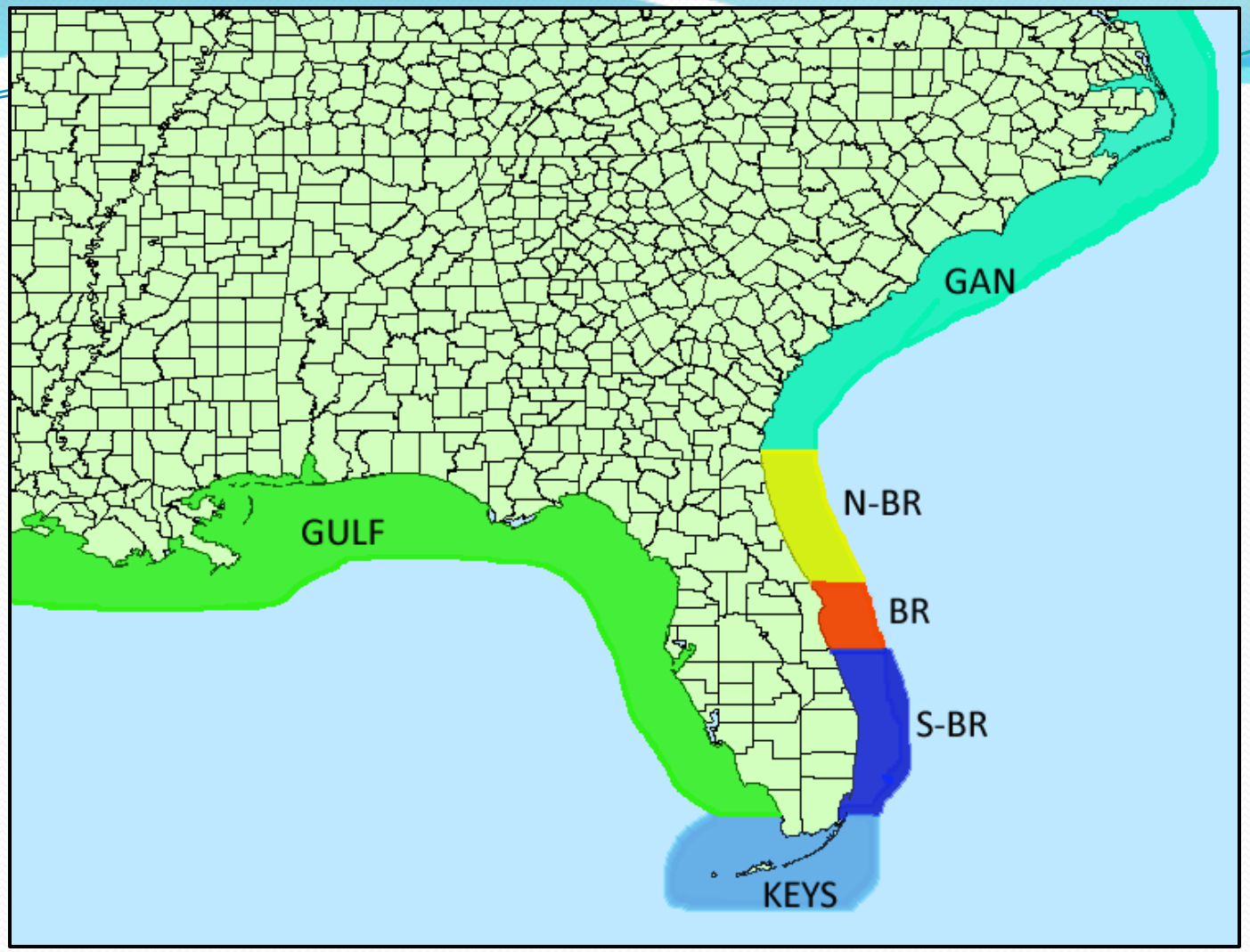
Do tag-return data support the genetic findings?

Datasets:

- Virginia Institute of Marine Science
- SCDNR
- Southeast Fisheries Science Center
- Mote Marine Laboratory
- Gulf Coast Research Laboratory



- Recreational anglers
- Similar tag types and time periods
- Similar size at tagging
- Tagged from Texas to Virginia
- At-large >30 days
- Pooled data: n=1394

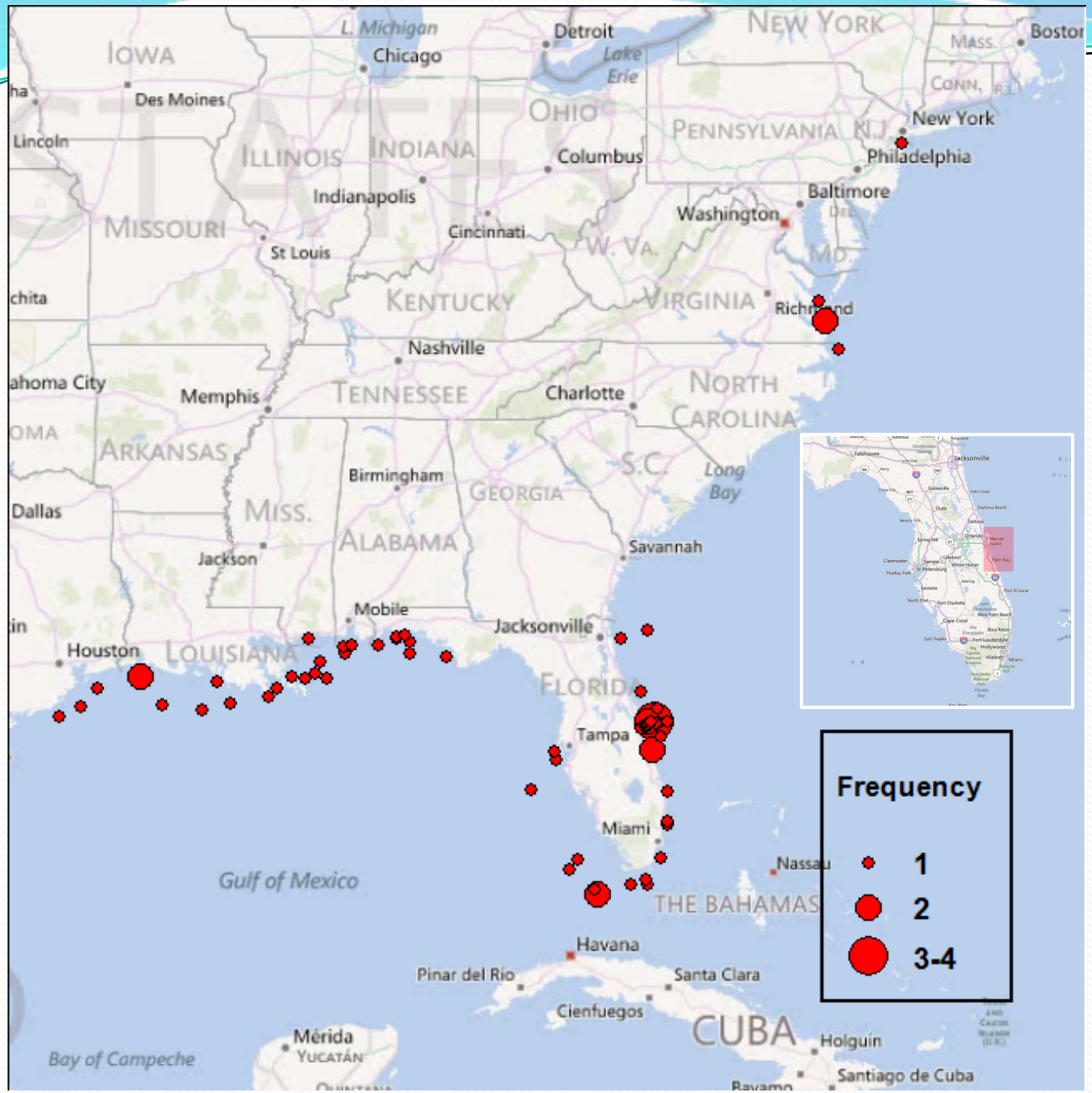


- Assigned to 6 different zones to assess movement
- Zone initially tagged/where recaptured
- Where necessary, coordinates assigned based on description

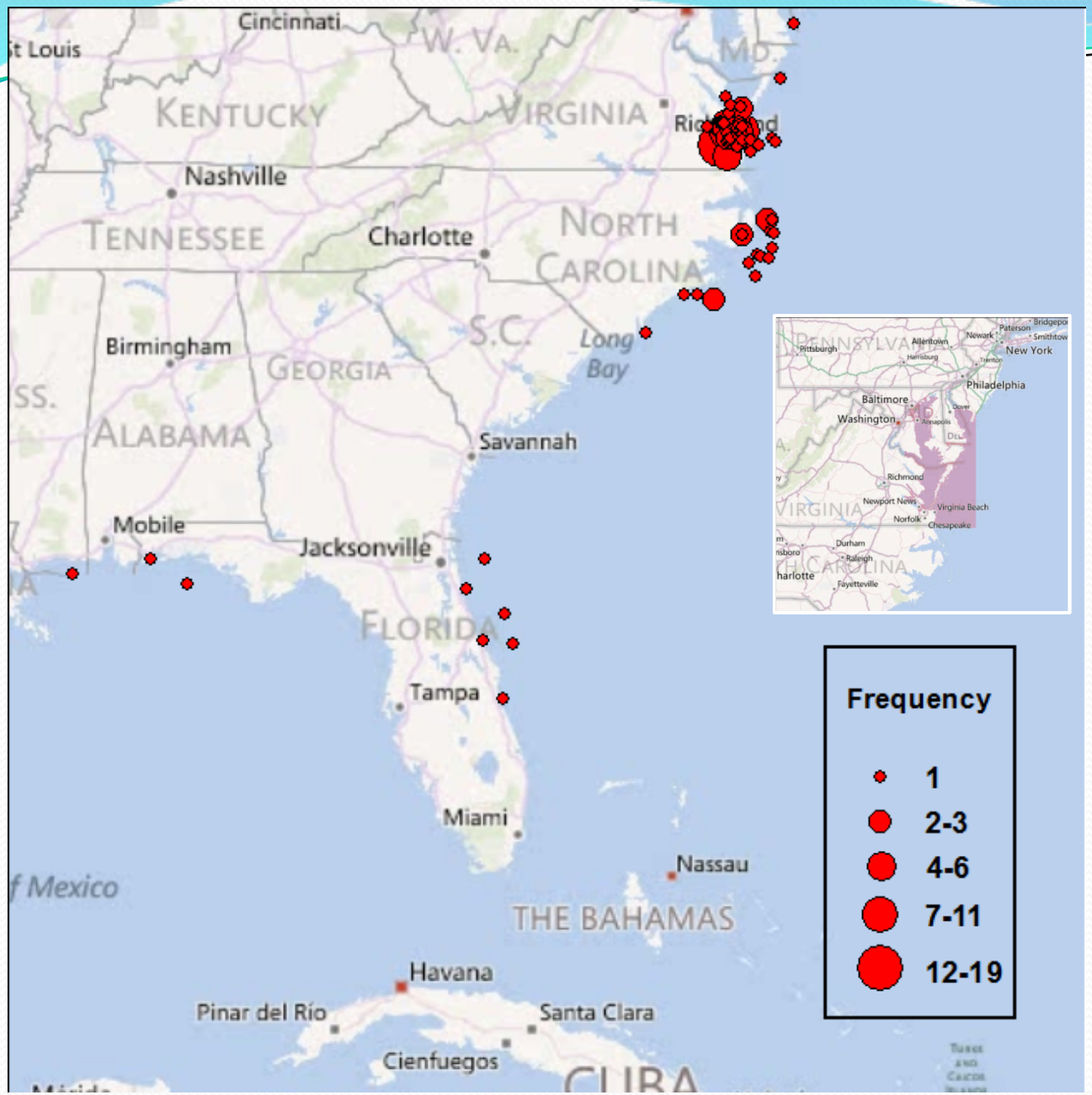
	Region Recap	GAN	N-BR	BR	S-BR	KEYS	GULF
Region Tagged	Recaps (n)						
GAN	274	252	9	6	2	0	5
N-BR	0	0	0	0	0	0	0
BR	70	5	2	21	3	7	32
S-BR	13	2	0	5	3	0	3
KEYS	182	0	0	3	3	48	128
GULF	855	10	14	13	35	143	640

	Region Recap	GAN	N-BR	BR	S-BR	KEYS	GULF
Region Tagged	Recaps (n)						
GAN	274	92%	3%	2%	1%	0%	2%
N-BR	0%	0%	0%	0%	0%	0%	0%
BR	70	7%	3%	30%	4%	10%	46%
S-BR	13	15%	0%	38%	23%	0%	23%
KEYS	182	0%	0%	2%	2%	26%	70%
GULF	855	1%	2%	2%	4%	17%	75%

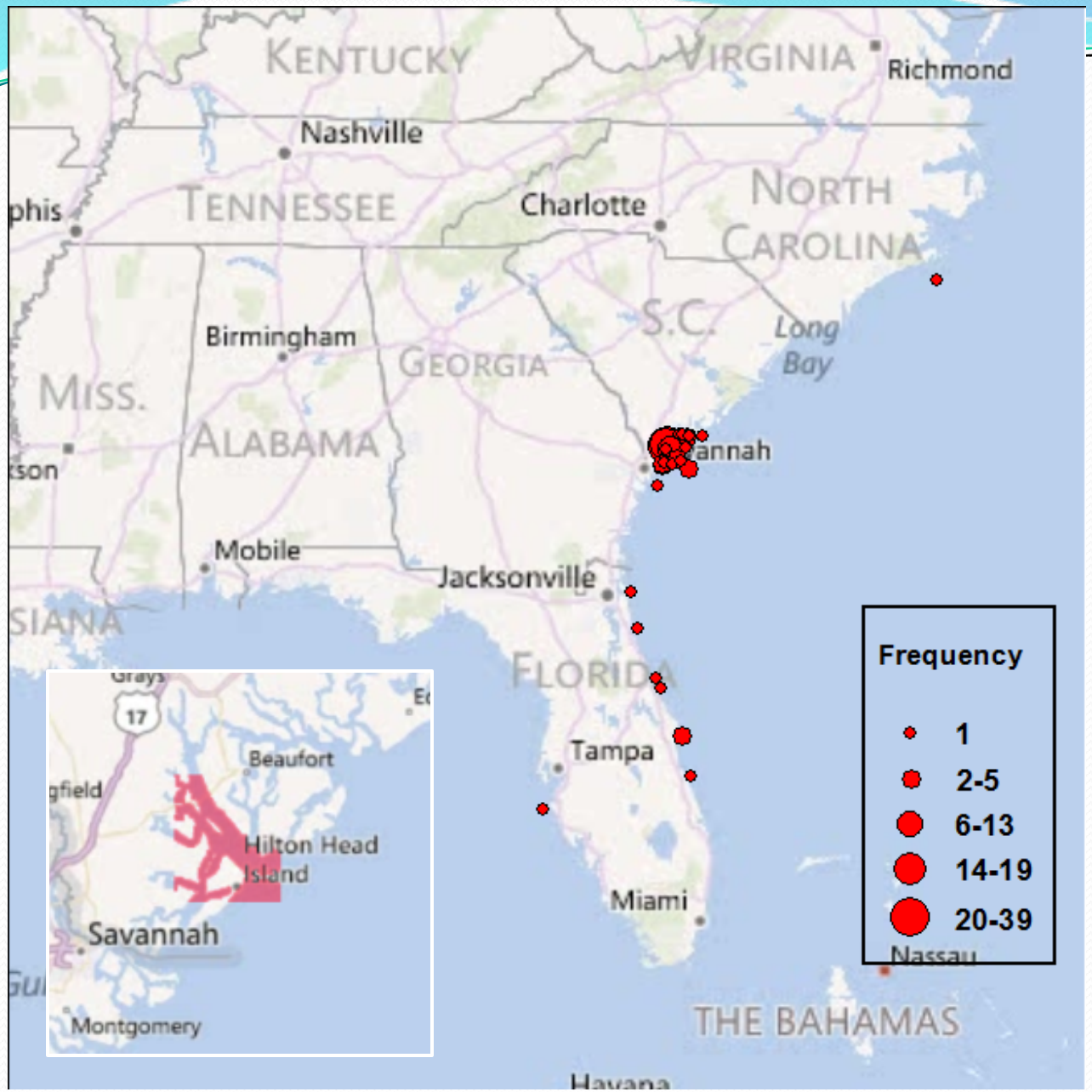
- 5/274 moved from GAN to GULF
- 10/855 moved from GULF to GAN
- No fish tagged in KEYS moved north of BR



- n=70
- 21 (30%) showed site fidelity
- 32 to Gulf
- 7 to Keys
- 8 moved north
- 1 Delaware Bay



- n=170
- 79% site fidelity
- NC (13%)
- BR/N-BR (4%)
- Gulf (1.8%)
- 7 tagged off NC, 4 recapped in VA



- n=116
- 104 (90%) showed site fidelity
- 10 recapped in BR or N-BR (9%)
- 1 to Gulf
- 1 off NC (tagged off Surfside Beach)

Do tag-return data support the genetic findings?

- The majority of fish tagged in GA and North are caught GA and North, a small percentage are seen south, 2% in Gulf.
- Fish tagged off Brevard County primarily move South and into the Gulf, 5% move North
- Fish tagged in Keys are only caught in Gulf or Keys.
- Fish tagged in Gulf are mostly caught back in the Gulf, 1% move into Georgia and North.
- These results are comparable to the genetic results.

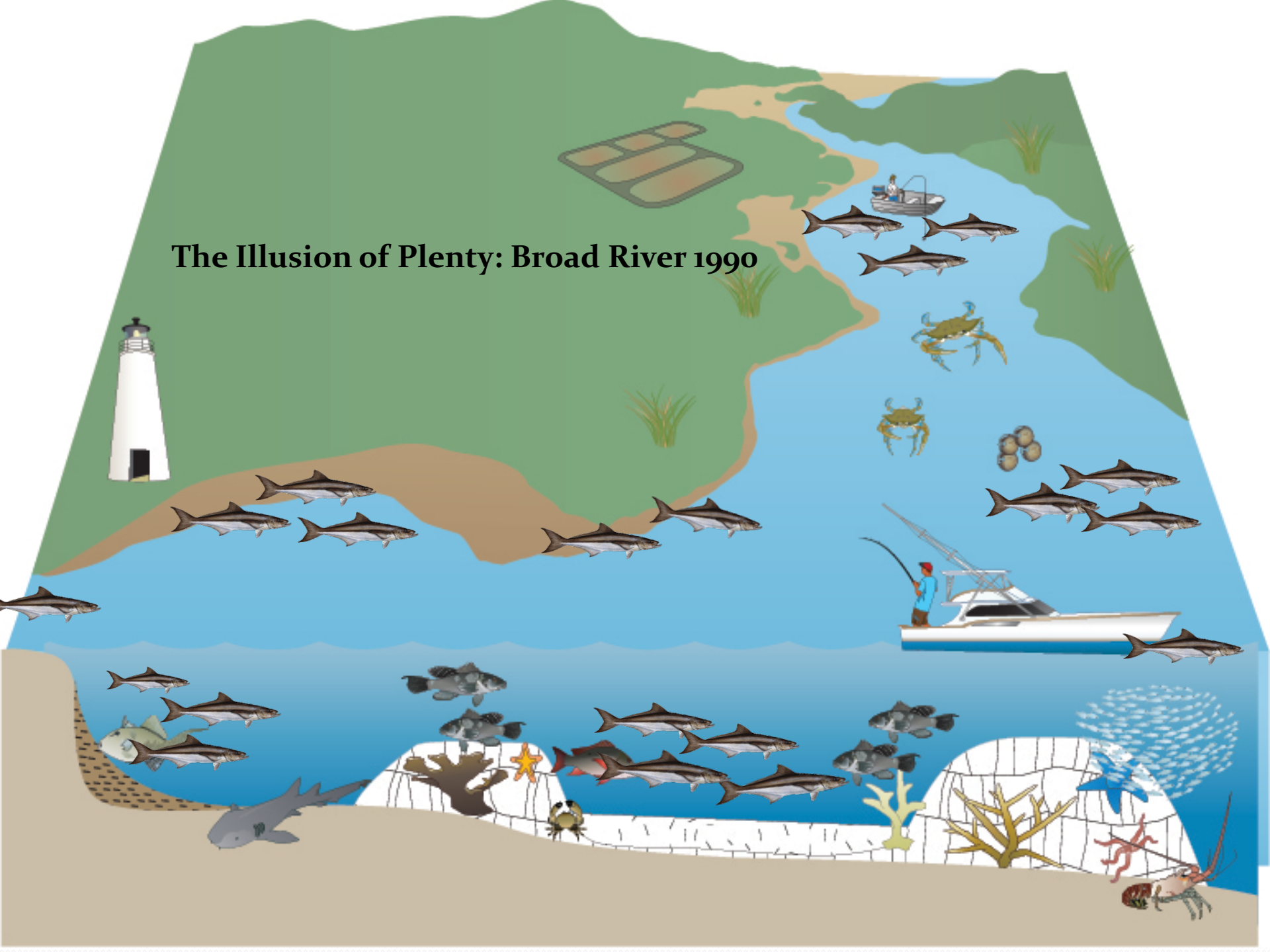
What does the SC DPS tell us about the health of the cobia population?

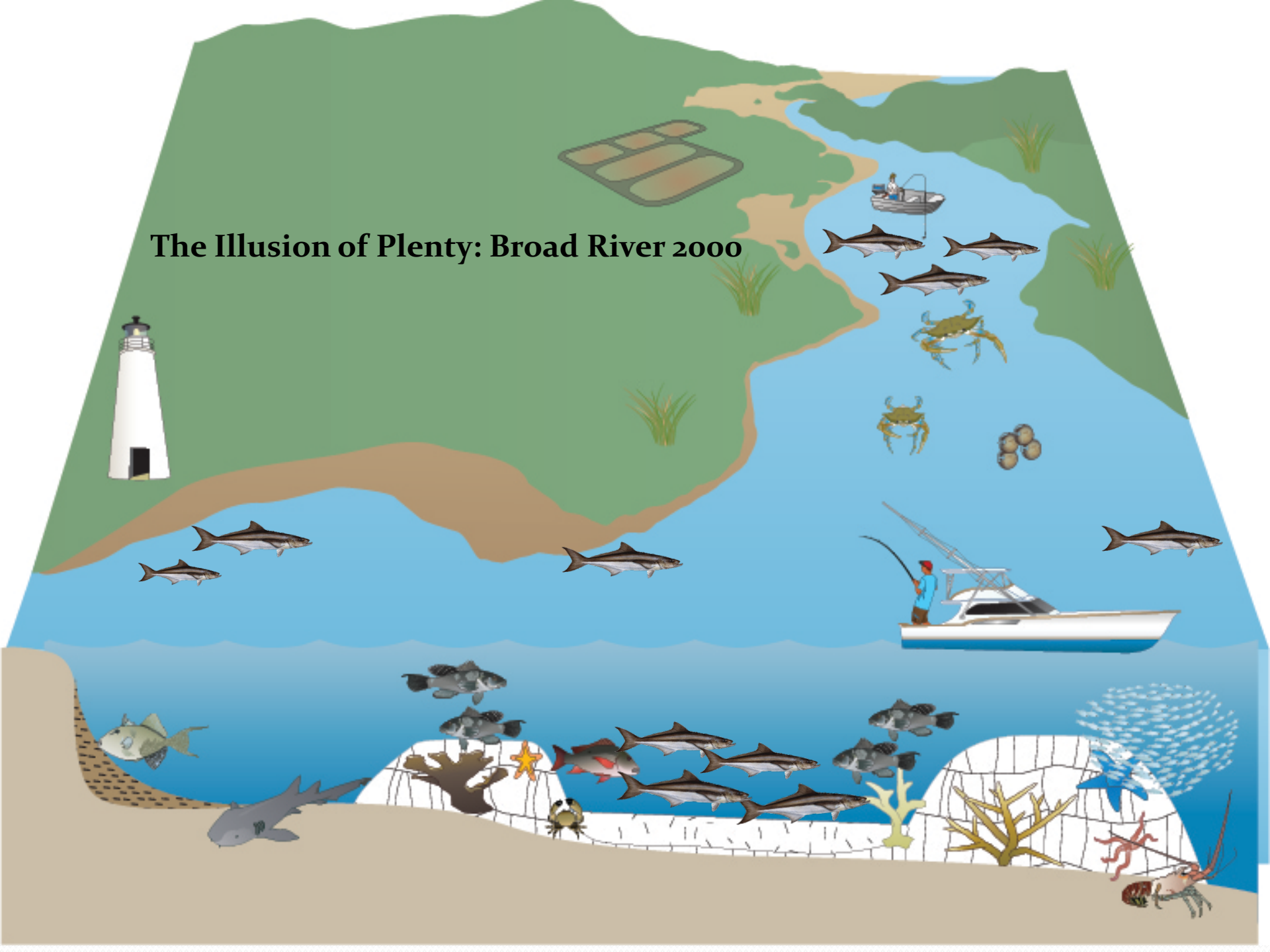
- Could the SC DPS be the canary in the coal mine?
- SCDPS is a small DPS close to shore, easy access.
- Undergoing significant fishing pressure while fish are in a spawning aggregation.
- Anglers know exactly when they will arrive (temperature) where to find them, what structure they like and what baits to use.
- Social media, and email makes sure everyone knows.

The Illusion of Plenty: Hyperstability

- Decrease in abundance when CPUE stays the same
  - Ex. when spawning aggregations are fished (Nassua grouper, salmon, cobia).
  - Ex. when fish form very large schools at known locations (cod, haddock, pollock).
  - Fishing appears to be good and then the bottom falls out.
  - You can detect hyperstability by rigorous long-term fisheries-independent random sampling.
    - No FI sampling for cobia
    - Compare to similar species/fisheries

*Hilborn and Walters 1992


The Illusion of Plenty: Broad River 1990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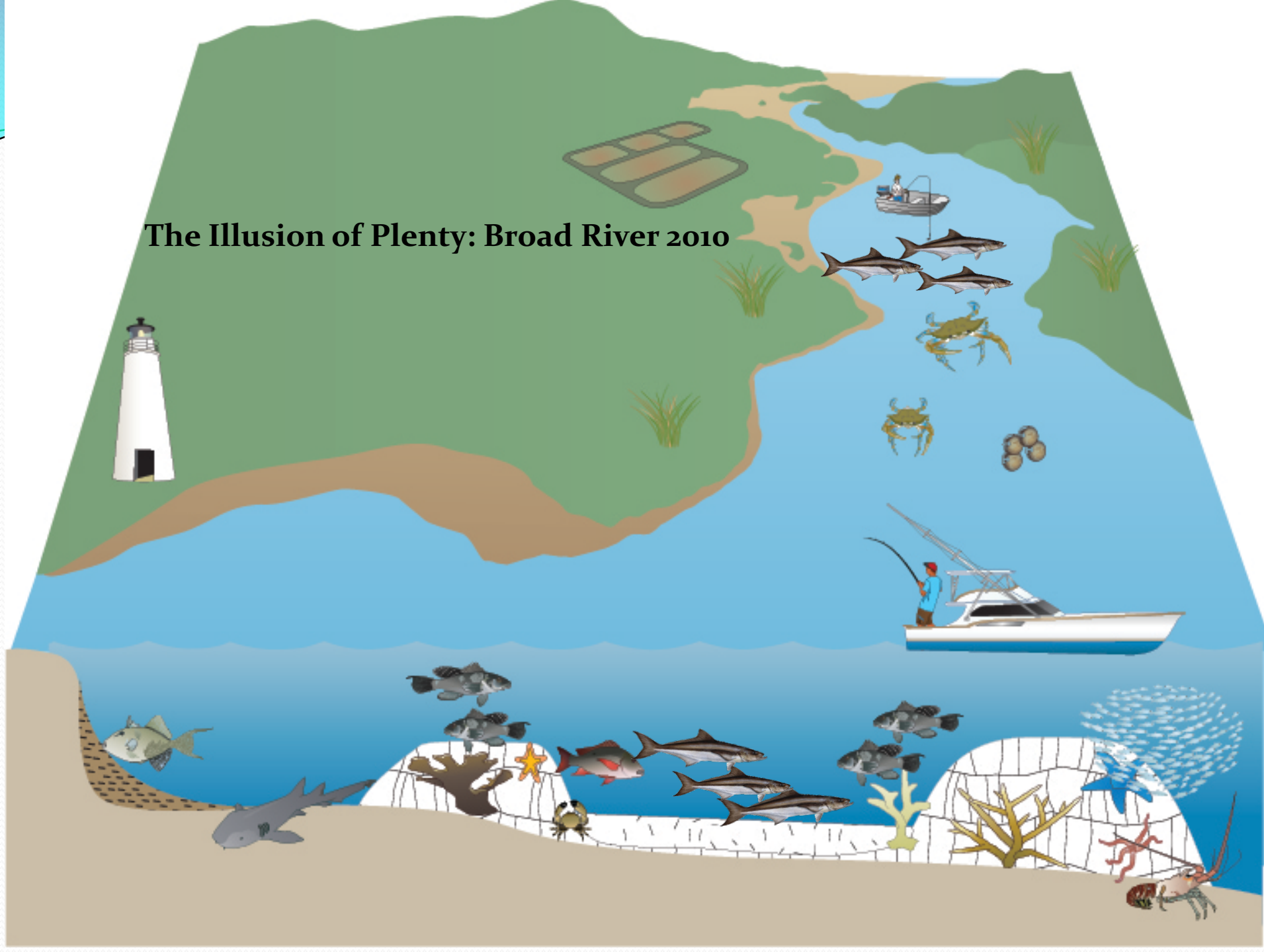
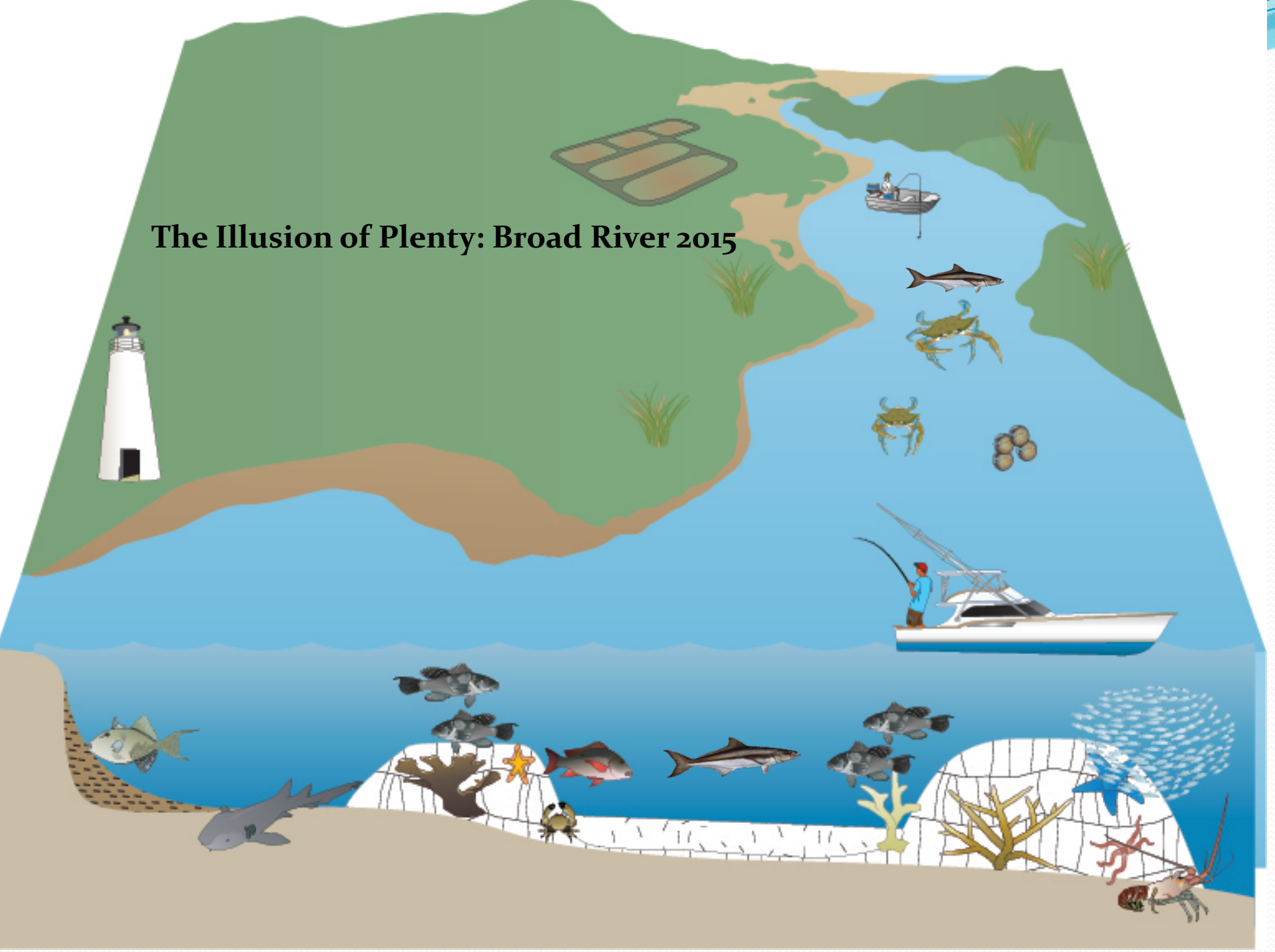
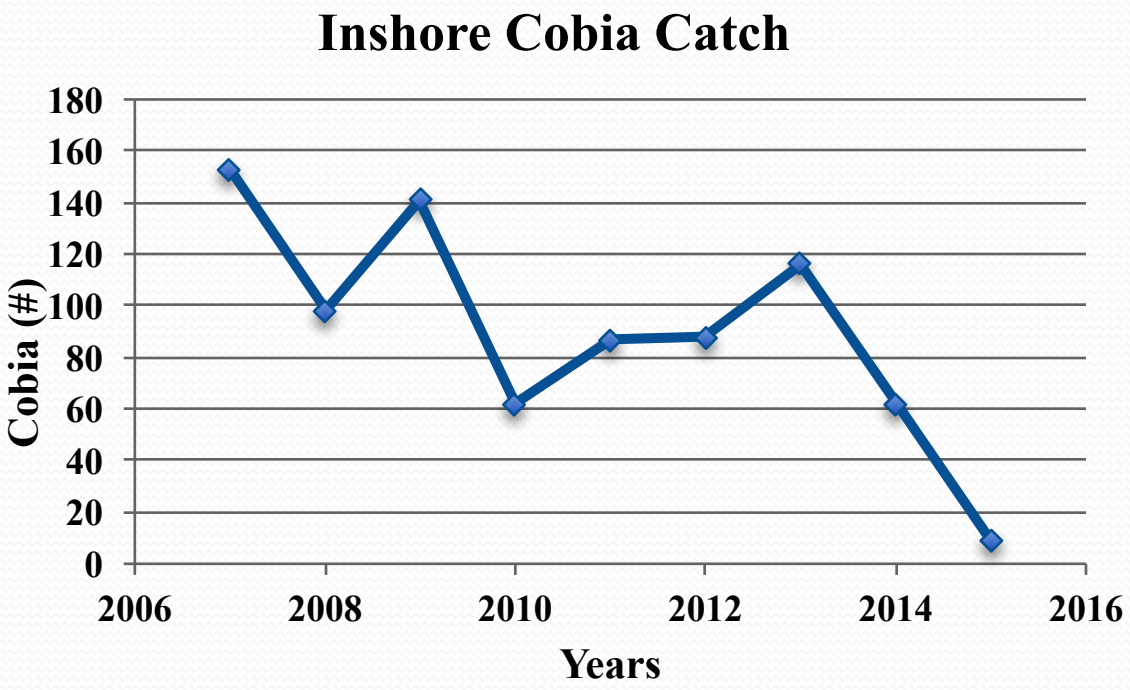

The Illusion of Plenty: Broad River 2010


The Illusion of Plenty: Broad River 2015

2015 Cobia Samples



Cobia caught inshore and collected by at tournaments and Charterboat Captains.

SC DPS

- Increasing fishing pressure
- Decreased catch
- Harder to catch fish (catch per angler hour low)
- Genetic metrics suggesting few adults were contributing to spawns
- Outcry from the charterboat captains and recreational anglers to manage more aggressively

How is SC Protecting its DPS?

- Recreational and charterboat captains chose:
  - Spawning season closure for first half of season for the DPS.
  - New boat and individual limits.
- Supportive stocking.
- Fisheries monitoring and genetic monitoring.

On-Going Research

- In SC we are continuing to collect life history and fishery information.
- We have completed a model to look at the effects of stocking and regulations on genetic health of the population.
- Telemetry to track movement, migration, and to discriminate between habitat used by different stocks.
- Use increased sample size from genetics to better understand stock structure along the Atlantic coast.
- Work with other states to conduct genetic analyses

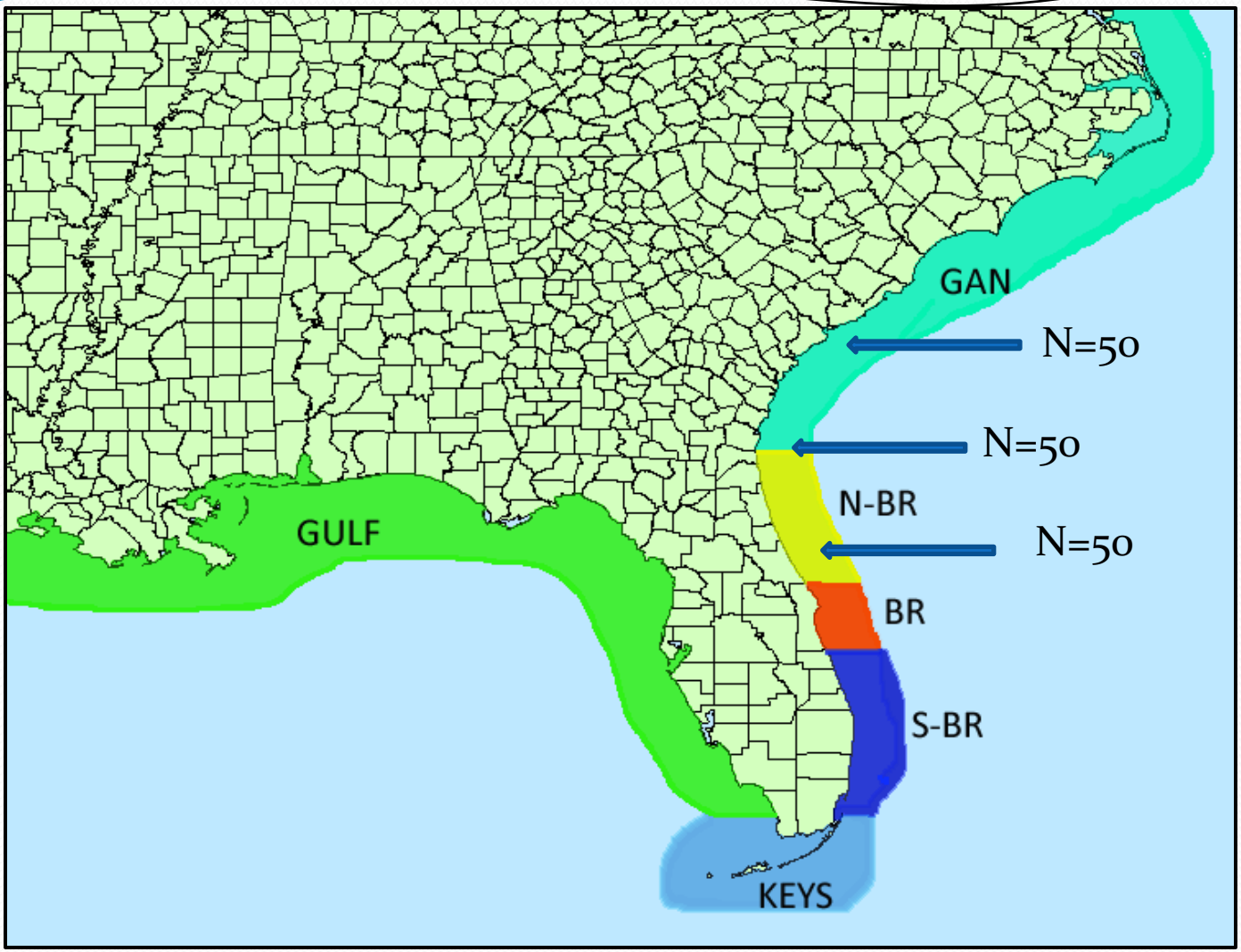
Acoustic Tagging

- Implant cobia with Vemco acoustic transmitters (tag life ~5 years)
- Collect genetic samples (fin clips)
- SCDNR, GADNR, Florida Fish and Wildlife Research Institute, and Kennedy Space Center
- Uses existing Vemco receiver arrays in South Atlantic and Gulf of Mexico
- Provides data on migratory patterns to evaluate stock structure

Location	Cobia Tagged
Offshore Hilton Head, SC	26
Inshore Hilton Head, SC	2
Offshore Tybee Island, GA	15
Offshore Cape Canaveral, FL	28
Offshore Jupiter, FL	37
Total	108

Year 2 Goals:

- Fill in gaps (northern FL, southern and central GA, northern SC)
- Collect and analyze fin clips
- Download receivers and analyze movements


GAN
N=50
N=50
N-BR
GULF
N=50
BR
S-BR
KEYS

Estimating survival and stock structure of cobia using telemetry and population genetics

Dr. Jeffrey A. Buckel, NCSU CMAST
Jacob Krause, NCSU CMAST
Collaborators:
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Mr. Randal W. Gregory, NC Division of Marine Fisheries
Dr. Tanya Darden, SC Department of Natural Resources
Mr. Joe Cimino, VA Marine Resources Commission
Project Title:
Estimating survival and stock structure of cobia using telemetry and population genetics

Questions?