

# Cooperative Monitoring Program for Spawning Aggregations in the Gulf of Mexico:

An assessment of existing information, data gaps, and research priorities

## NOAA RESTORE Act Science Program

Brad Erisman, Will Heyman, Shinichi Kobara, Christopher Biggs, Nick Farmer,  
Susan Lowerre-Barbieri, Mandy Karnauskas, Jorge Brenner



Ecological Research Associates, Inc.



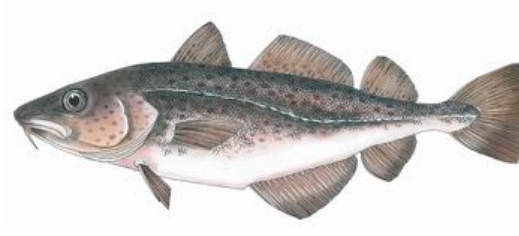
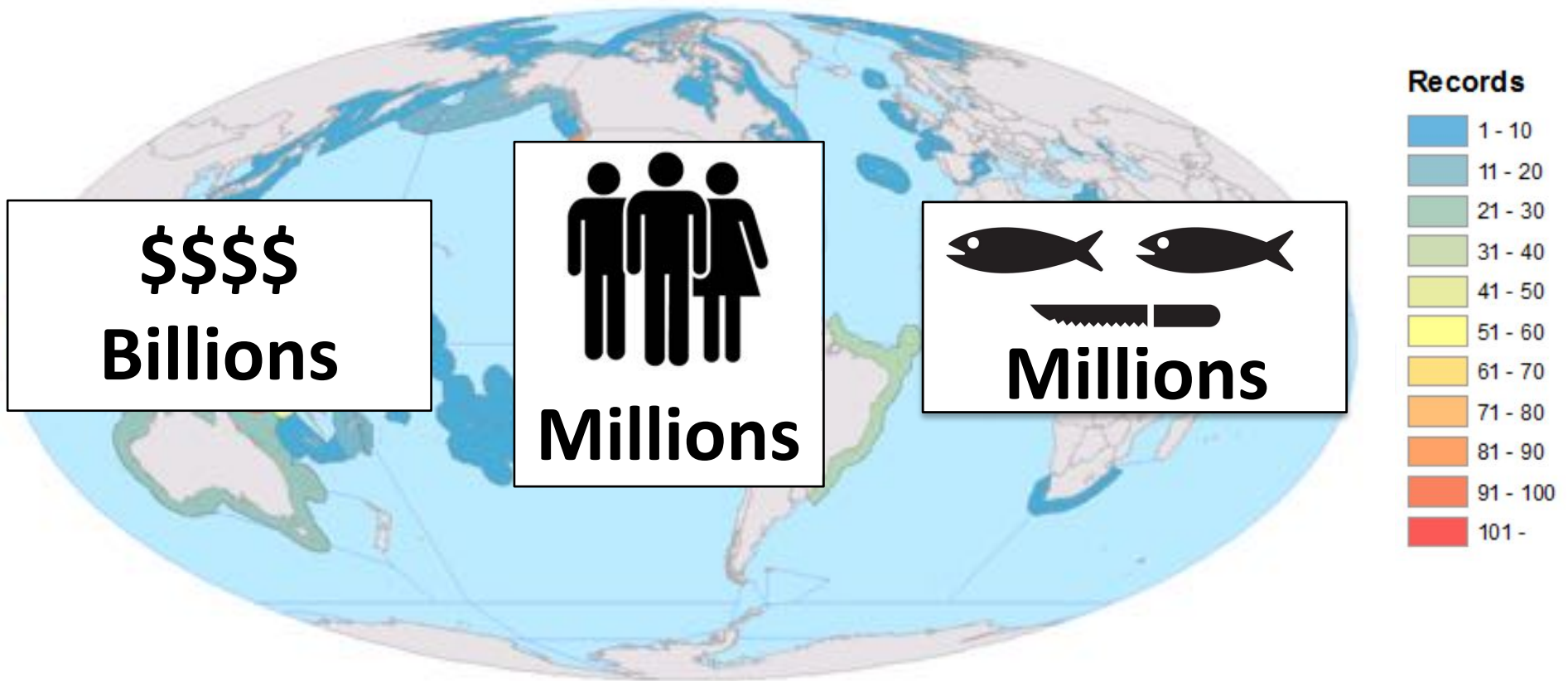
# Fish Spawning Aggregations (FSAs)

Temporary, large gatherings of fish that form for the sole purpose of reproduction and are predictable in time and space



# Fish Spawning aggregations are a global phenomenon

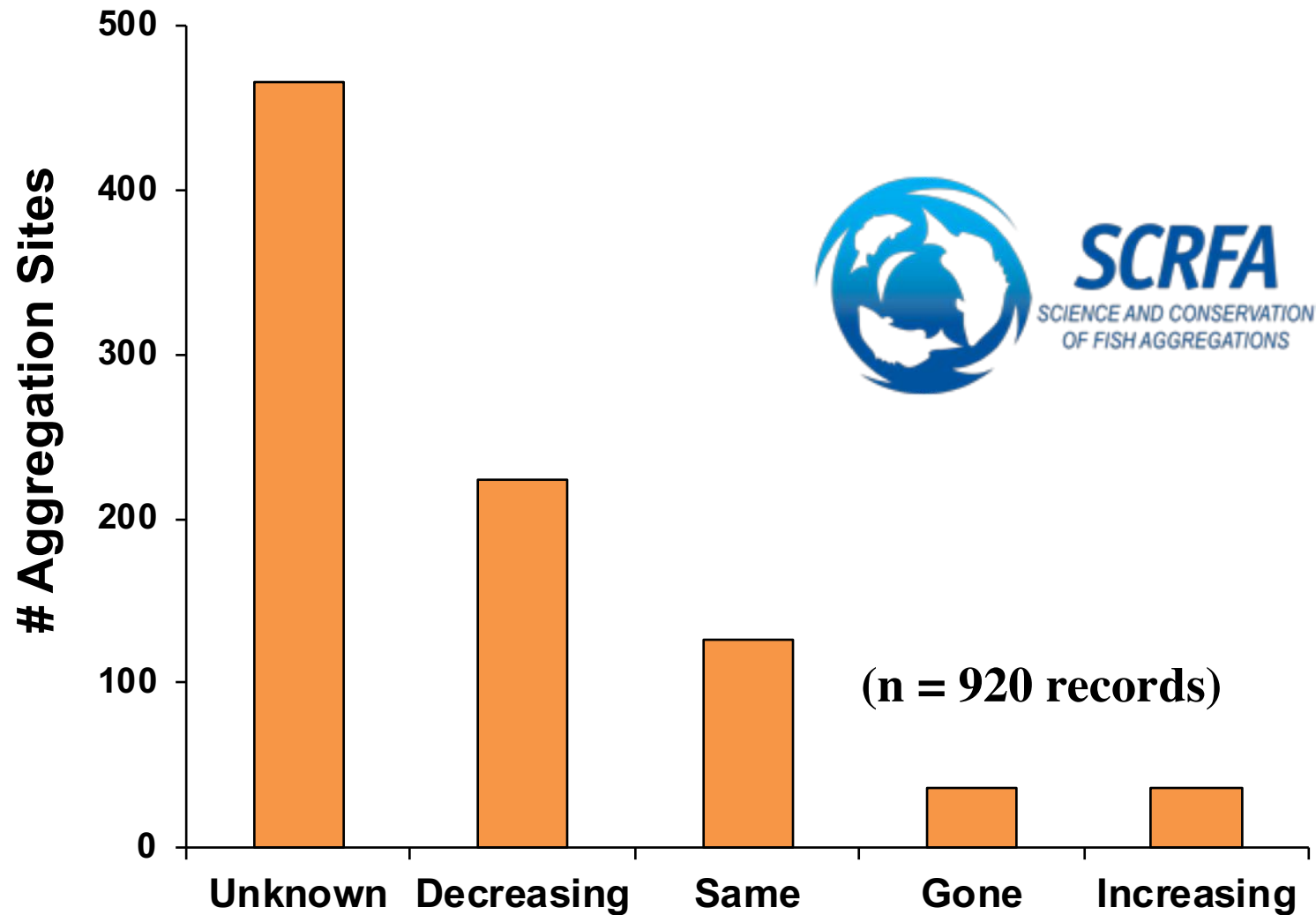
920 records, 5 oceans, 54 countries, 44 families, 307 species



(Erisman et al. 2015, Fish & Fisheries)

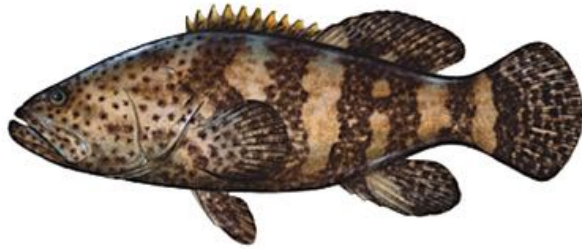
# Global Status of Fish Spawning Aggregations

Only 34% of documented sites are managed

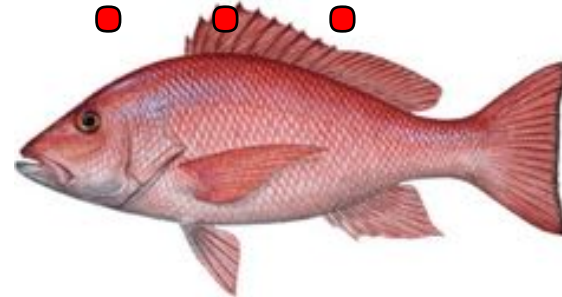


(Russell et al. 2014; Erisman et al. 2015)

# Many species of exploited and protected fishes are known to or likely form FSAs In the Gulf of Mexico



???



...BUT it is one of the world's least studied areas for the biology and fisheries of FSAs

# There is a wealth of scientific information on the biology and fisheries of aggregating species in the Gulf of Mexico

## Reproductive styles of shallow-water groupers (Pisces: Serranidae) in the eastern Gulf of Mexico and the consequences of fishing spawning aggregations

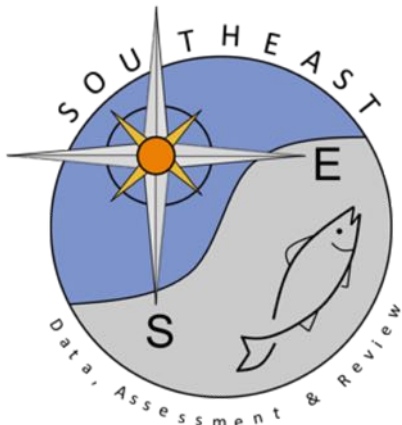
Felicia C. Coleman<sup>1</sup>, Christopher C. Koenig<sup>1,2</sup> & L. Alan Collins<sup>2</sup>

<sup>1</sup> FSU/NMFS Institute for Fishery Resource Ecology, Department of Biological Science, Florida State University, Tallahassee, FL 32306-2043, U.S.A.

<sup>2</sup> National Marine Fisheries Service, 3500 Delwood Beach Road, Panama City, FL 32408-7499, U.S.A.



The 2015 stock assessment of Red Drum, *Sciaenops ocellatus*, in Florida



A banner for the GCOOS (Gulf of Mexico Ocean Observing System) Data Portal. It features the GCOOS logo on the left, the text "Data Portal Updated" in the center, and a map of the Gulf of Mexico on the right with a "Click to read more" link below it.

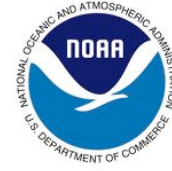
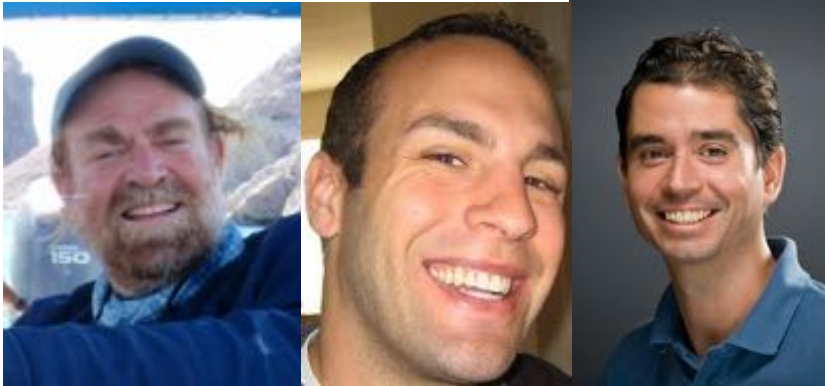
**Fishers have extensive knowledge and information on the timing and locations of FSAs and related fishing activities**



# NOAA RESTORE Act Science Program

Gulf Coast Ecosystem Restoration Science, Observation, Monitoring and Technology Program

## Project Team



## GULF RESEARCH PROGRAM

INNOVATE | EDUCATE | COLLABORATE

### Acknowledgments:

Scott Hickman (CFA)

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Todd Kellison  
(NOAA Fisheries/SEFSC – Beaufort)

John Froeschke (GMFMC)

Martin Russell (SCRFA)

NOAA Southeast Regional Office

Many, many fishermen



# Objectives

1. **Compile** and evaluate existing **information** on fish spawning aggregations in the GOM as the basis to design a cooperative monitoring program for FSAs.
2. Engage in a comprehensive **outreach and data-sharing** program to ensure all data and project outputs are available to inform management and conservation efforts.

# Stepwise process identified 28 focal species

(1) FSA Score

(2) FMP and FSSI lists

(3) Fisheries and Conservation Importance

(4) Coastal Species (state waters)

Common Name	FSA score (1-4)	FMP (y=1, n=0)	FSSI (y=1, n=0)	Avg. comm. landings(2009-2013) (lbs)	Avg. rec. landings (2009-2013) (N)	IUCN (1-5)	Comm. rank	Rec. rank	Fishery Index (Sum of FMP, FSSI, IUCN, Comm. rank, Rec. rank)	FSA + Fishery Index
Black Grouper	4	1	1	46855	5530	2	1.18	1.18	6.36	10.36
Gag Grouper	3	1	1	620534	1835929	1	1.3	1.37	5.67	8.67
Gray Triggerfish	2	1	1	74997	364994	3	1.21	1.3	7.51	9.51
Greater Amberjack	3	1	1	481954	272351	1	1.29	1.29	5.58	8.58
Hogfish	2	1	1	36203	133271	3	1.14	1.28	7.42	9.42
Nassau Grouper	4	0	1	0	0	4	0	0	6	10
Red Drum	3	1	1	0	0	1	0	0	3	6
Red Grouper	3	1	1	4992180	2657260	2	1.37	1.38	6.75	9.75
Red Snapper	2	1	1	3773741	2812127	3	1.36	1.39	7.75	9.75
Snowy Grouper	3	1	1	153962	9102	3	1.25	1.19	7.44	10.44
Vermilion Snapper	2	1	1	2581867	10084	0	1.34	1.2	4.54	6.54
Yellowedge Grouper	3	1	1	742028	656	3	1.32	1.08	7.4	10.4
Warsaw Grouper	3	1	0	97402	943	5	1.23	1.12	8.35	11.35
Goliath Grouper	4	1	0	0	3	5	0	1.02	7.02	11.02
Tilefish	3	1	0	376649	876579	4	1.28	1.35	7.63	10.63
Mutton Snapper	4	1	0	77736	3956	3	1.22	1.17	6.39	10.39
Cubera Snapper	4	1	0	1307	929	3	1.04	1.11	6.15	10.15
Yellowmouth Grouper	4	1	0	421	194	3	1.03	1.06	6.09	10.09
Speckled Hind	1	1	0	41720	1311	5	1.17	1.14	8.31	9.31
Yellowfin Grouper	4	1	0	1511	801	2	1.05	1.09	5.14	9.14
Spanish Mackerel	3	1	0	1506135	4298114	1	1.33	1.4	4.73	7.73
King Mackerel	3	1	0	3604244	403641	1	1.35	1.32	4.67	7.67
Scamp	3	1	0	246538	70454	1	1.27	1.25	4.52	7.52
Almaco Jack	3	1	0	36277	15341	1	1.15	1.23	4.38	7.38
Southern Flounder	3	0	0	0	0	2	0	0	2	5
Spotted Seatrout	2	1	0	0	0	1	0	0	2	4
Black Drum	3	0	0	0	0	1	0	0	1	4
Sheepshead	3	0	0	0	0	1	0	0	1	4

# Online bibliography and resource database of 800 references with relevant biological and fisheries information

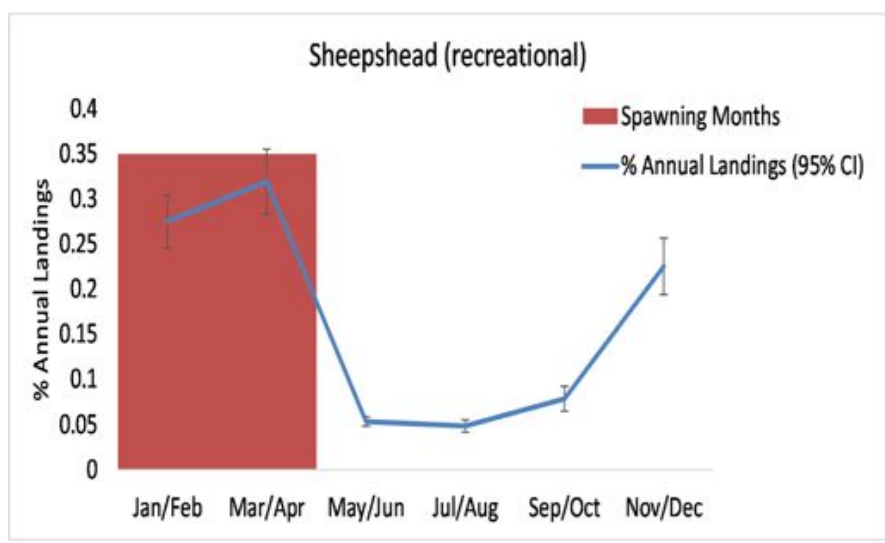
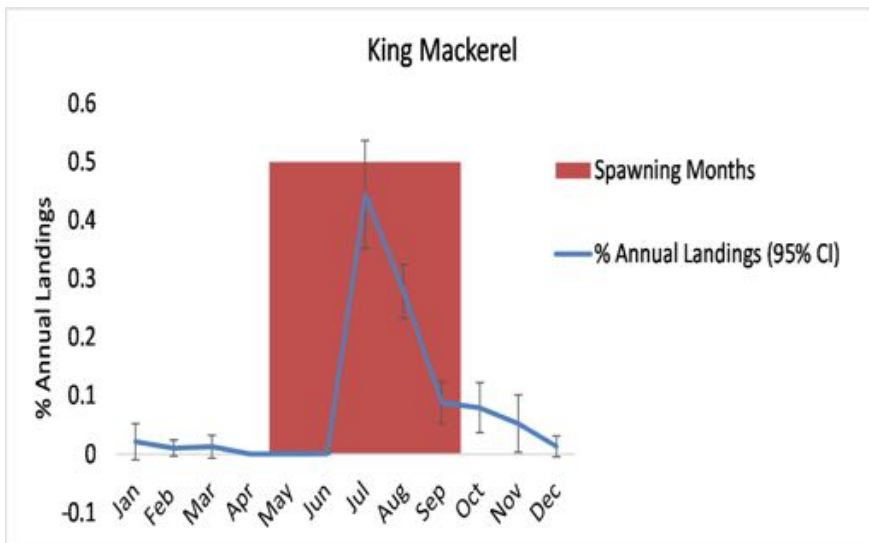
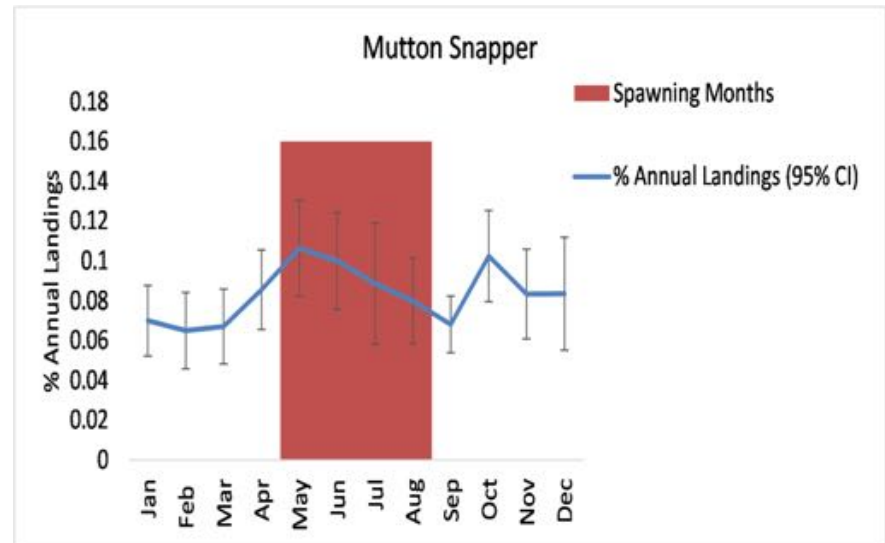
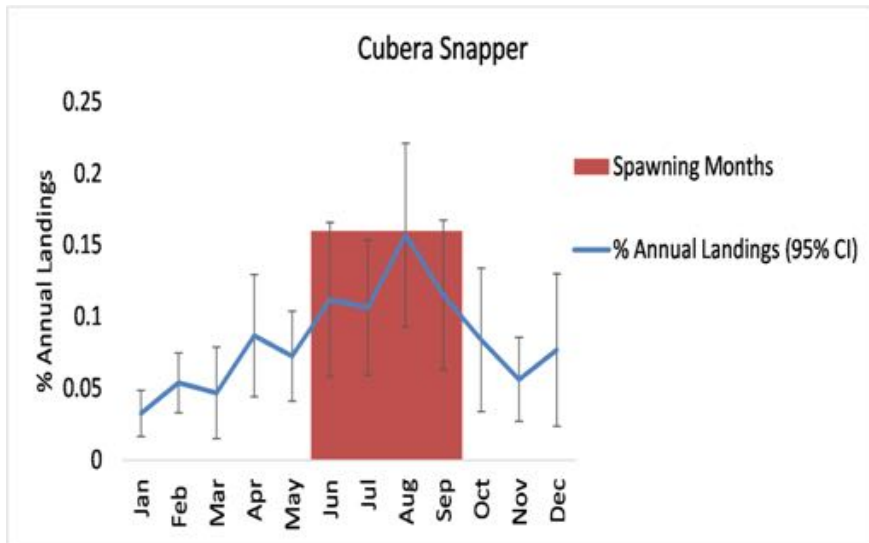
- Peer-reviewed Manuscripts
- Technical Reports
- Stock Assessments

The screenshot displays the 'Gulf Fish Spawning Aggregation' website. The main content is a table of references with columns for Author, Year, Title, URL, and Common Name. The table lists 10 entries, including works by Farmer et al. (2016), Louisiana State University (2016), Davis et al. (2015), Lowery-Barber et al. (2015), Forch et al. (2015), Saari et al. (2014), Koenig et al. (2013), SEDAR (2013), Cowan Jr. et al. (2012), and Kulaw, D. (2012). To the right of the table is a 'Common Name' filter with a search box and a list of species names, including 'Red Snapper' which is highlighted. Below the table, there is a 'Showing 1 to 10 of 47 entries' indicator and a pagination control showing 'Previous 1 2 3 4 5 Next'.

Author	Year	Title	URL	Common Name
Farmer, N. A., Malneval, R. P., McGovern, M. F., & Rubec, R. J.	2016	Stock complexes for fisheries management in the Gulf of Mexico. <i>Marine and Coastal Fisheries</i> , 8(1), 177-201.	Link	Red Snapper
Louisiana State University.	2016	Louisiana Fisheries Red Snapper FAQ.	Link	Red Snapper
Davis, W. T., Drymon, J. M., & Powers, S. P.	2015	Spatial and dietary overlap creates potential for competition between red snapper ( <i>Lutjanus campechanus</i> ) and Vermilion snapper ( <i>Thrombocetes aurantipes</i> ). <i>PLoS One</i> , 10(12), 1-18.	Link	Red Snapper
Lowery-Barber, S., Crabtree, L., Switzer, T., Burnsed, S. W., & Quentler, C.	2015	Assessing reproductive resilience: an example with South-Atlantic red snapper <i>Lutjanus campechanus</i> . <i>Marine Ecology Progress Series</i> , 526, 125.	Link	Red Snapper
Forch, G. E., Fitzhugh, G. R., Lang, E. T., Lyon, H. M., & Litton, B. C.	2015	Estimating the dependence of spawning frequency on size and age in Gulf of Mexico red snapper. <i>Marine and Coastal Fisheries</i> , 7(1), 233-245.	Link	Red Snapper
Saari, C. R., Cowan Jr., J. H., & Boswell, K. M.	2014	Regional differences in the age and growth of red snapper ( <i>Lutjanus campechanus</i> ) in the U.S. Gulf of Mexico. <i>Fishery Bulletin</i> , 112(4), 261-273.	Link	Red Snapper
Koenig, C. G., & Coleman, F. C.	2013	Protection of grouper and red snapper spawning in shelf-edge marine reserves of the Northeastern Gulf of Mexico: demographics, movements, survival and spillover effects. <i>SEDAR 33 SEDAR(Vol. 33)</i> , North Charleston, SC.	Link	Red Snapper
SEDAR.	2013	Sedar 31 Gulf of Mexico red snapper Stock Assessment Report. <i>SEDAR</i> , North Charleston, SC.	Link	Red Snapper
Cowan Jr, J. H., Boswell, K. M., Simonsen, K. A., Saari, C. R., & Kulaw, D.	2012	SEDAR31-DWG3 Working paper for red snapper data workshop. North Charleston, SC: SEDAR.	Link	Red Snapper
Kulaw, D.	2012	Habitat and region-specific reproductive biology of female Red Snapper ( <i>Lutjanus campechanus</i> ) in the Gulf of Mexico. M.S. Thesis. Louisiana State University.	Link	Red Snapper



# Contribution of spawning to fisheries production (1997-2016)



# Life history and behavioral parameters associated with vulnerability

General Information			Intrinsic Indicators									
Common Name	Genus	Species	Aggregation Type (1-4)	Spawning Season Months	Spawning Season Duration (1-4)	Max Age (years)	K vB Growth Coeff.	L <sub>∞</sub> Asympt. Length (cm)	Age at Maturity (mo)	M Nat. mort.	Density Change (1-6)	
Gag Grouper	Mycteroperca	Mycteroperca microlepis	4	JMA	3	33	0.1342	127.795	42	0.1342	3	
Red Grouper	Epinephelus	Epinephelus morio	1	FMAMJ	3	29	0.1251	82.9	33.6	0.14	2	
Red Drum	Sciaenops	Sciaenops ocellatus	3	AuSON	3	42	0.32	88.1	48	0.16	4	
Red Snapper	Lutjanus	Lutjanus campechanus	2	MaJuJAuS	3	48	0.191852	85.6374	24	0.1	2	
Vermilion Snapper	Rhomboplites	Rhomboplites aurorubens	2	AMaJuJAuS	3	26	0.3254	34.4	24	0.25	2	
Greater Amberjack	Seriola	Seriola dumeril	3	MAMaJu	3	15	0.144798	143.6	27	0.25	3	
Black Grouper	Mycteroperca	Mycteroperca bonasus	4	GMMA	3	33	0.1432	133.4	78	0.136	4	
Gray Triggerfish	Balistes	Balistes capricus	2	MaJuJAu	3	15	0.14	58.97	18	0.27	4	
Hogfish	Lachnolaimus	Lachnolaimus maximus	2	NDJFMAMaJu	2	23	0.1057	84.85	10.8	0.179	2	
Nassau Grouper	Epinephelus	Epinephelus striatus	4	GF	4	29	0.13	76	36	0.081	6	
Yellowedge Grouper	Hyporhamphus	Hyporhamphus flavolimbatus	3	FMAMaJuJAuSON	1	85	0.059	100.45	114=0.1057	0.0811	3	
Snowy Grouper	Hyporhamphus	Hyporhamphus niveus	2	AMaJuJAuSO	2	35	0.094	106.462	139=0.0811	0.079	3	
Almaco Jack	Seriola	Seriola rivoliana	3	AuJAuS W	3	15	0.144798	143.6	27	0.25	3	
Cubera Snapper												
Scamp												
Speckled Hind												
Tilefish												
Yellowfin Grouper												
Yellowmouth Grouper												
Goliath Grouper	Epinephelus	Epinephelus itajara	4	AuJAuSO	3	37	0.0937	222.1	340=0.079	0.098 (cuba)	3	
Mutton Snapper	Lutjanus	Lutjanus analis	4	MaJuJAu	3	40	0.165	86.1	342=0.1896 (0 keys)	0.079 (s. f=0.238, key largo-Marquesas key=0.166, dry tortugas)	3	
Warsaw Grouper	Hyporhamphus	Hyporhamphus nigritus	3	AMa	4	43	0.05	239.4	344=0.094 (offshore, 0.5614 near)	0.128	3	
Spanish Mackerel	Scomberomus	Scomberomus maculatus	1	AMaJuJAuS	3	11	0.61	56	113=0.128	0.0798	2	
King Mackerel	Scomberomus	Scomberomus cavalle	1	MaJuJAuS	3	24	0.1875	125.41	345=0.19 (keys)	0.174	2	
Spotted Seatrout	Cynoscion	Cynoscion nebulosus	2	AMaJuJAuS	3	12	0.32	68.7	289=0.98	0.3	3	
Sheepshead	Archosargus	Archosargus probatocephalus	4	FMA	4	20	0.36	45.3	12	0.15	5	
Southern Flounder	Paralichthys	Paralichthys lethostigma	4	ONDI	3	8	0.28	65.2	24	0.362	5	
Black Drum	Pogonias	Pogonias cromis	3	JMA AuSO	3	58	0.167	113.6	60	0.069	4	

Each cell contains an indexed list of data and references used to generate the final value of each parameter

114=0.1057  
 139=0.0811  
 340=0.079  
 341=0.098 (cuba)  
 342=0.1896 (0 keys)  
 343=0.079 (s. f=0.238, key largo-Marquesas key=0.166, dry tortugas)  
 344=0.094 (offshore, 0.5614 near)  
 113=0.128  
 345=0.0798  
 346=0.19 (keys)  
 289=0.98

Index #	Common Name	Species	In Text
2	Gag	<i>Mycteroperca microlepis</i>	Brule et al. (2003)
3	Gag	<i>Mycteroperca microlepis</i>	Koenig & Coleman (1998)
4	Gag	<i>Mycteroperca microlepis</i>	Koenig et al. (1996)
5	Gag	<i>Mycteroperca microlepis</i>	Coleman et al. (1996)
6	Gag	<i>Mycteroperca microlepis</i>	Sedar 33 (2014)
7	Gag	<i>Mycteroperca microlepis</i>	Sedar 10 (2006)
9	Red Grouper	<i>Epinephelus morio</i>	Burgos et al. (2007)
10	Red Grouper	<i>Epinephelus morio</i>	Brule et al. (1999)
11	Red Grouper	<i>Epinephelus morio</i>	Goodyear & Schirripa (1993)
12	Red Grouper	<i>Epinephelus morio</i>	Sedar 42 (2015)
13	Red Drum	<i>Sciaenops ocellatus</i>	Murphy & Taylor (1990)
14	Red Drum	<i>Sciaenops ocellatus</i>	Lowere-Barbieri et al. (2008)
15	Red Drum	<i>Sciaenops ocellatus</i>	Johnson & Funicelli (1991)
16	Red Drum	<i>Sciaenops ocellatus</i>	Sedar 44 (2015)
17	Red Drum	<i>Sciaenops ocellatus</i>	Mercer (1984)
18	Red Snapper	<i>Lutjanus campechanus</i>	Jackson et al. (2006)
19	Red Snapper	<i>Lutjanus campechanus</i>	Collins et al. (1996)
20	Red Snapper	<i>Lutjanus campechanus</i>	Sedar 31 (2013)
21	Vermilion Snapper	<i>Rhomboplites aurorubens</i>	Grimes & Huntsman (1980)
22	Vermilion Snapper	<i>Rhomboplites aurorubens</i>	Sedar 17 (2008)
23	Vermilion Snapper	<i>Rhomboplites aurorubens</i>	Sedberry et al. (2006)
24	Greater Amberjack	<i>Seriola dumerili</i>	Harris et al. (2007)
25	Greater Amberjack	<i>Seriola dumerili</i>	Sedar 33 (2014)
26	Black Grouper	<i>Mycteroperca bonaci</i>	Sedar 19 (2010)
27	Black Grouper	<i>Mycteroperca bonaci</i>	Domeier & Colin (1997)
28	Black Grouper	<i>Mycteroperca bonaci</i>	Brule et al. (2003)
29	Black Grouper	<i>Mycteroperca bonaci</i>	Paz & Sedberry (2008)
30	Gray Triggerfish	<i>Balistes capriscus</i>	Briggs (1958)

**Reference list  
provided on a  
separate  
worksheet**

# Metadata provided on a separate worksheet

Parameter Type	Parameter	Description
General Info	<b>FMP</b>	Fisheries Management Plan management unit
General Info	<b>Common Name</b>	American Fisheries Society Common Name
General Info	<b>Genus</b>	Genus
General Info	<b>Species</b>	Species
Intrinsic Parameters	<b>Aggregation Type (1-4)</b>	The degree to which the species forms transient or resident aggregations, a qualitative characterization. FSA score (Transient=4; Mixed= 3; Resident =2; Simple Migratory Spawner, Doesn't aggregate to spawn, or don't know whether aggregates to spawn=1)
Intrinsic Parameters	<b>Spawning Season Months</b>	Months of spawning, with <b>peak months in bold</b> . (J, F, M, A, Ma, Ju, Jl, Au, S, O, N, D)
Intrinsic Parameters	<b>Spawning Season Duration (1-4)</b>	Scales the duration of the spawning season ranging from 1-3 months = <b>4</b> , 4-6 months = <b>3</b> , 7-9 months = <b>2</b> and 9-12 months = <b>1</b> , with shorter spawning seasons conferring higher vulnerability to aggregation fishing
Intrinsic Parameters	<b>Max age (years)</b>	Maximum age in years (longevity)
Intrinsic Parameters	<b>K (vB Growth Coefficient)</b>	von Bertalanffy growth coefficient
Intrinsic Parameters	<b>L<sub>inf</sub> (Asymptotic Length, cm)</b>	Asymptotic length for von Bertalanffy growth equation, expressed in cm
Intrinsic Parameters	<b>Age at Maturity (months)</b>	Age at 50% Maturity in months
Intrinsic Parameters	<b>M (Natural Mortality)</b>	Death rate per year not associated to fishing
Intrinsic Parameters	<b>Density Change (1-6)</b>	Based on order of magnitude comparisons between peak spawning aggregation densities and population densities during non-spawning period. Scale distinguishes between species that are solitary, grouping or schooling for non-reproductive functions. Larger density changes confer higher vulnerability to aggregation fishing. No change in densities between spawning and non-spawning periods = <b>1</b> ; density doubles from solitary to few to ca. 10 fish (clustering of polygynous groups) = <b>2</b> ; density increases from small groups to 100-200 fish = <b>3</b> ; density increases from small groups to 500-1000 fish = <b>4</b> ; density increases from small groups to 1,000-10,000 fish = <b>5</b> ; density increases from small groups to >10,000 fish = <b>6</b>
Intrinsic Parameters	<b>Aggregation Duration (1-4)</b>	Scales the duration of spawning aggregations ranging from less than one day to more than two weeks, with longer durations conferring higher vulnerability to aggregation fishing




Species Profile - RESTORE

koba.tamu.edu/restore/Sheepshead

Gulf FSA | [Home](#) | [About](#) | [Links](#)

Choose Species -

## Sheepshead



Source: Smithsonian Tropical Research Institute

- [Shorefishes of the Greater Caribbean](#)
- [FishBase](#)
- [IUCN](#)
- [FWC](#)

*Archosargus probatocephalus*

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### Habitat and Distribution

This species occurs along coasts and in estuaries and brackish water in the western Atlantic from Nova Scotia to Brazil, including the entire Gulf of Mexico.

### Spawning season in the Gulf of Mexico

Spawning occurs from February through April in the Gulf of Mexico, with peak spawning activity in March to mid-April in most areas.

### Spawning Patterns

Sheepshead migrate to form spawning aggregations of hundreds to several thousands of individuals at the mouth of channel passes and offshore reefs and at platforms.

### Fishing Patterns in Relation to Spawning

This species is caught commercially, recreationally, and incidentally throughout the Gulf of Mexico. In the Gulf, Sheepshead rank among the most important inshore recreational fisheries, and landings peak from February to April when fish aggregate to spawn at jetties and channel passes.

### Management of Spawning Aggregations

Sheepshead are managed independently by state regulatory commissions in the US Gulf of Mexico. Currently, no management measures exist in the US Gulf of Mexico that specifically target the protection of spawning. However, current fishery regulations for the species include minimum size limits, daily catch (bag) limits, and gear restrictions (e.g. bans on use of gill nets). In Mexico in the southern Gulf, no species-specific management regulations exist for commercial fisheries targeting Sheepshead.

### Threats to Aggregations

Intense harvesting of Sheepshead during the spawning season by recreational and commercial fishers has persisted for decades throughout the Gulf of Mexico, and while significant declines have been documented in some areas (e.g. Louisiana), stocks and fisheries are thought to be sustainable. Moreover, the degree to which Sheepshead are vulnerable to aggregation fishing has not yet been assessed.

### Research and Management Priorities

While numerous studies have been conducted on the reproductive biology and life history of Sheepshead in the Gulf of Mexico and elsewhere, very little information is available on the behavioral dynamics of spawning or the potential impacts of targeted fishing of spawning aggregations on Sheepshead stocks and fisheries.

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**About**

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- Reports
- About us

**FSA**

- Species Profile
- Spawning season
- Monitoring Protocol
- Life history
- Vulnerability
- Reference

**Developer**


  
 GCOOS  
 Department of Oceanography 3148 TAMU  
 College Station, TX 77843-3148  
 +1 879-845-2800  
 [Mail to Developer](#)

### Species



Aimaco Jack



Black Drum



Black Grouper



Black Sea Bass



Bonefish



Cubers Snapper



Gag



Goliath Grouper



Gray Snapper



Gray Triggerfish



Greater Amberjack



Hogfish



King Mackerel



Mutton Snapper



Nassau Grouper



Parrot



Red Drum



Red Grouper



Red Snapper



Scamp



Sheepshead



Snowy Grouper



Southern Flounder



Spanish Mackerel



**Cooperative Research and Monitoring  
Protocols for Fish Spawning Aggregations  
in the Wider the Gulf of Mexico**



**A Product of the  
RESTORE Act Science Program**



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GULF PSA

GO TO: ABOUT GOCS

score

# FISH SPAWNING AGGREGATIONS IN THE GULF OF MEXICO

Capacities monitoring program for fish spawning aggregations in the Gulf of Mexico

## Goal

This project will compile and evaluate existing information on fish spawning aggregations in the Gulf of Mexico as the basis to design a cooperative, Gulf-wide conservation and monitoring program focused on fish spawning aggregations.

[MORE DETAILS](#)

## Documents

**Monitoring Protocol**  
Download Gulf-Caribbean-wide reef fish spawning aggregation protocol

**Methodology**  
You can check how we evaluated

**Report**  
You can download a final report

**Map**  
You can see Bathymetry and Habitat Map

## Spawning information

### Species Profiles

### Spawning Seasons

### Life History Parameters

### Vulnerability Parameters

### Species Selection Process

### References

## Let's Get In Touch!

Are you interested in? That's great! Send us an email and we will get back to you as soon as possible!

[Contact Us](#)

# Spawning Aggregations Workshop October 4-5 2016, NOAA SERO



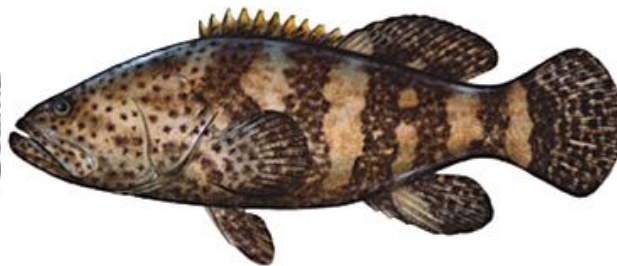
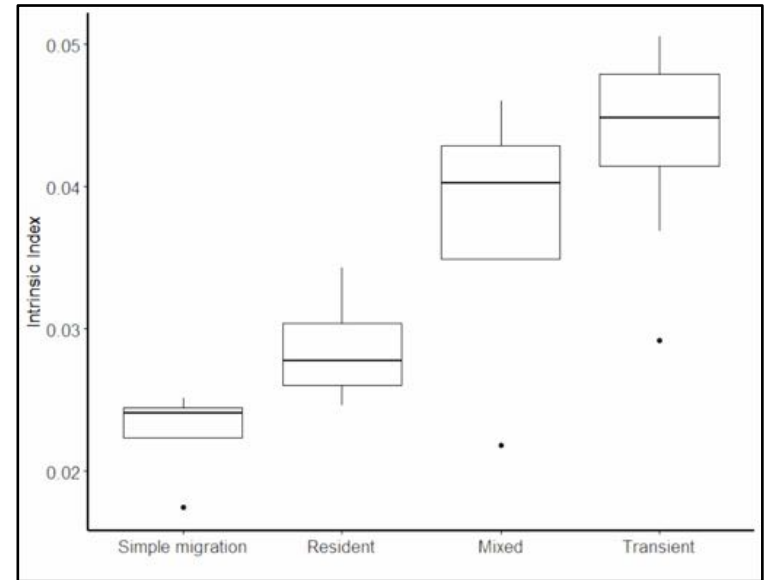
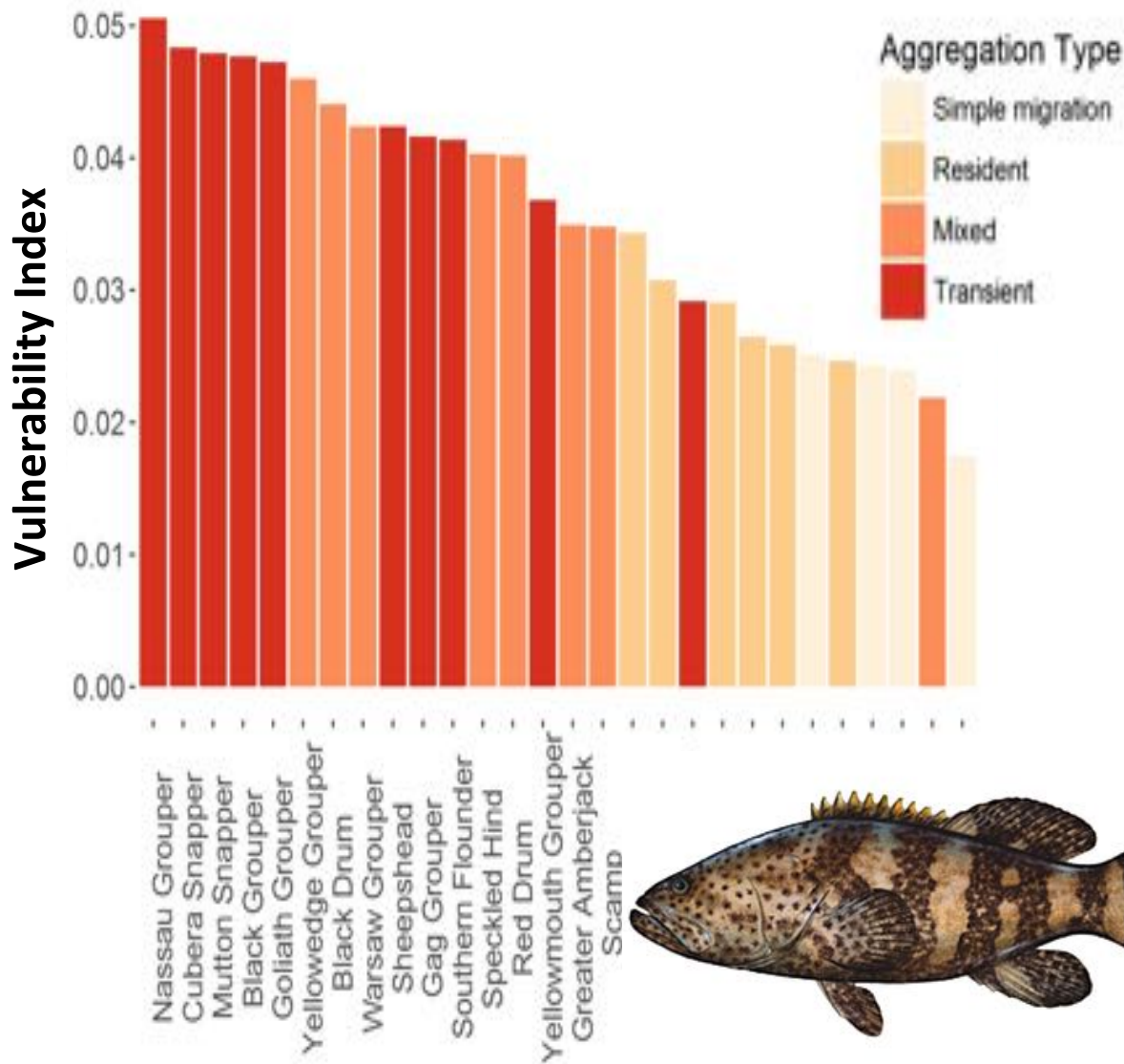
# Major Data Gaps

1. Near total lack of information on locations of spawning aggregations in the Gulf of Mexico
1. Very little information on behavioral dynamics and characterizations of aggregations in space and time
2. Commercial fishing effort targets the spawning season of most species

# Research and Management Priorities

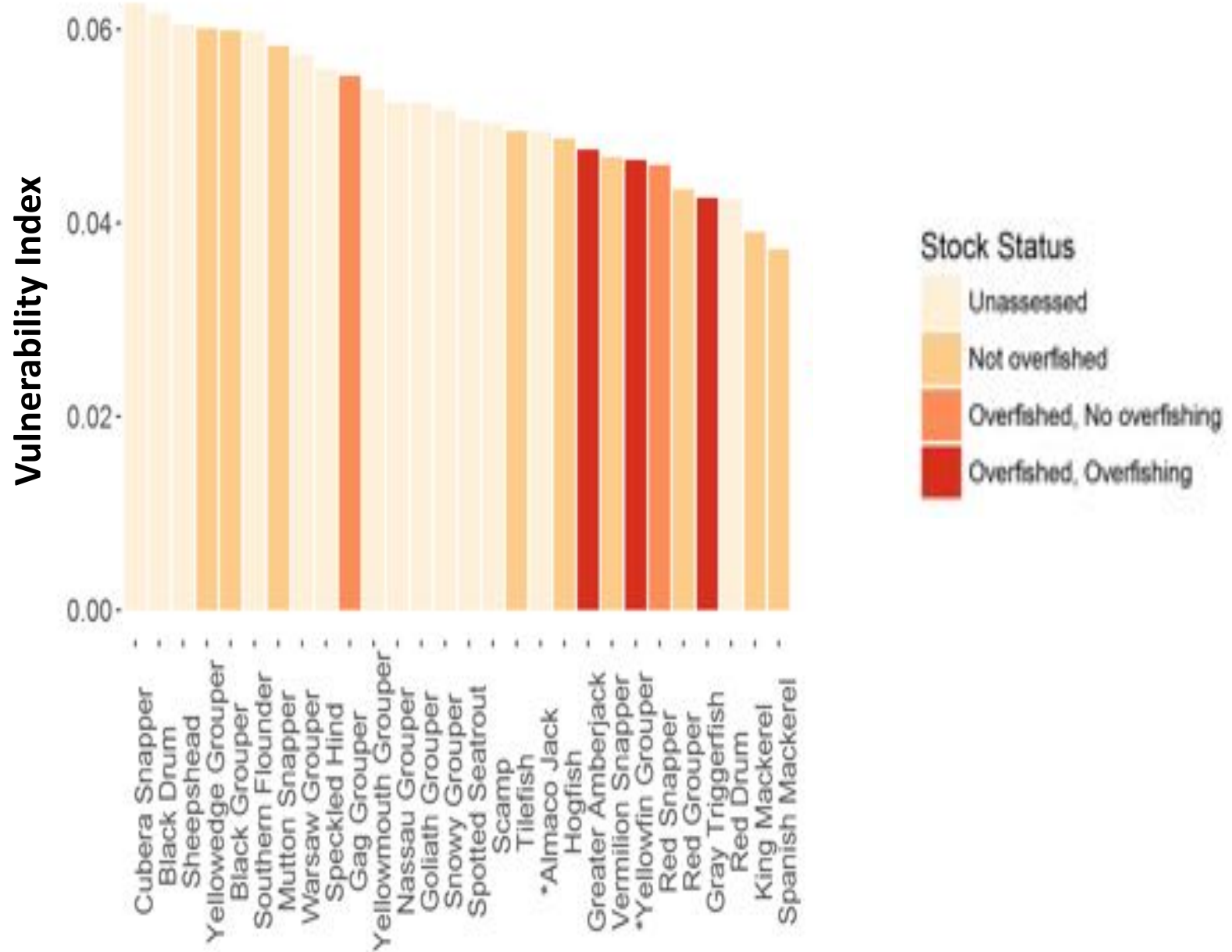
- 1) Mine existing data to assess interaction strengths between fishing and spawning and **identify areas of vulnerability**
- 2) Work collaboratively with commercial and recreational fishers to identify, **characterize, and assess key spawning areas**
- 3) **Improve stock assessments** by incorporating spawning dynamics into existing assessment models
- 4) Develop **management frameworks** through the Fisheries Management Council Process

# Species that form transient spawning aggregations are more vulnerable to fishing pressure





# The most vulnerable species have not been assessed

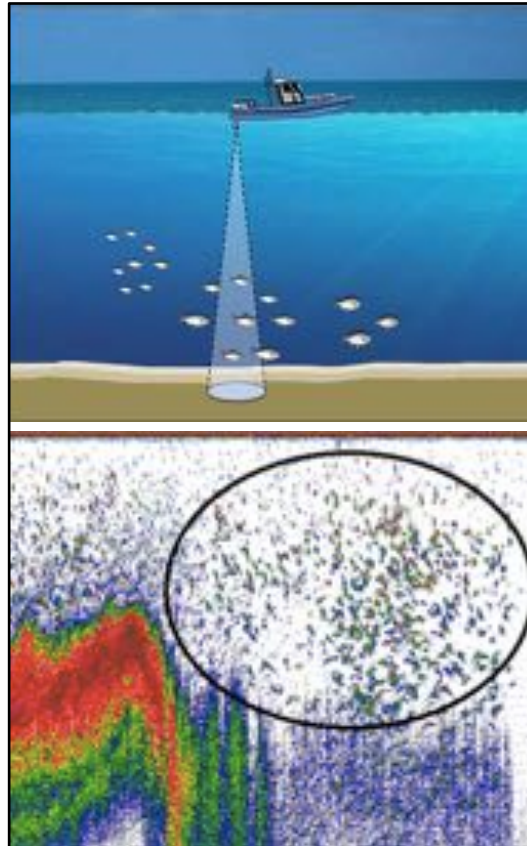
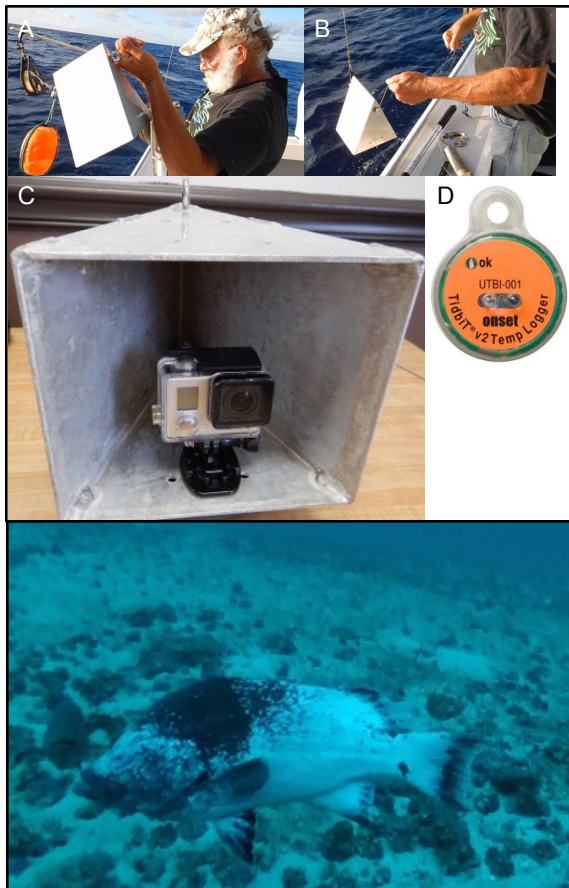


# Compiling Bathymetric Data to Locate Key Spawning Aggregation Sites



# NEXT STEPS...

Partner with fishermen to locate, characterize, assess, and monitor important FSA sites





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