Fish Spawning Aggregations and Fisheries in the Gulf of Mexico:

Interactions, Data Gaps and Research Priorities

NOAA RESTORE Act Science Program

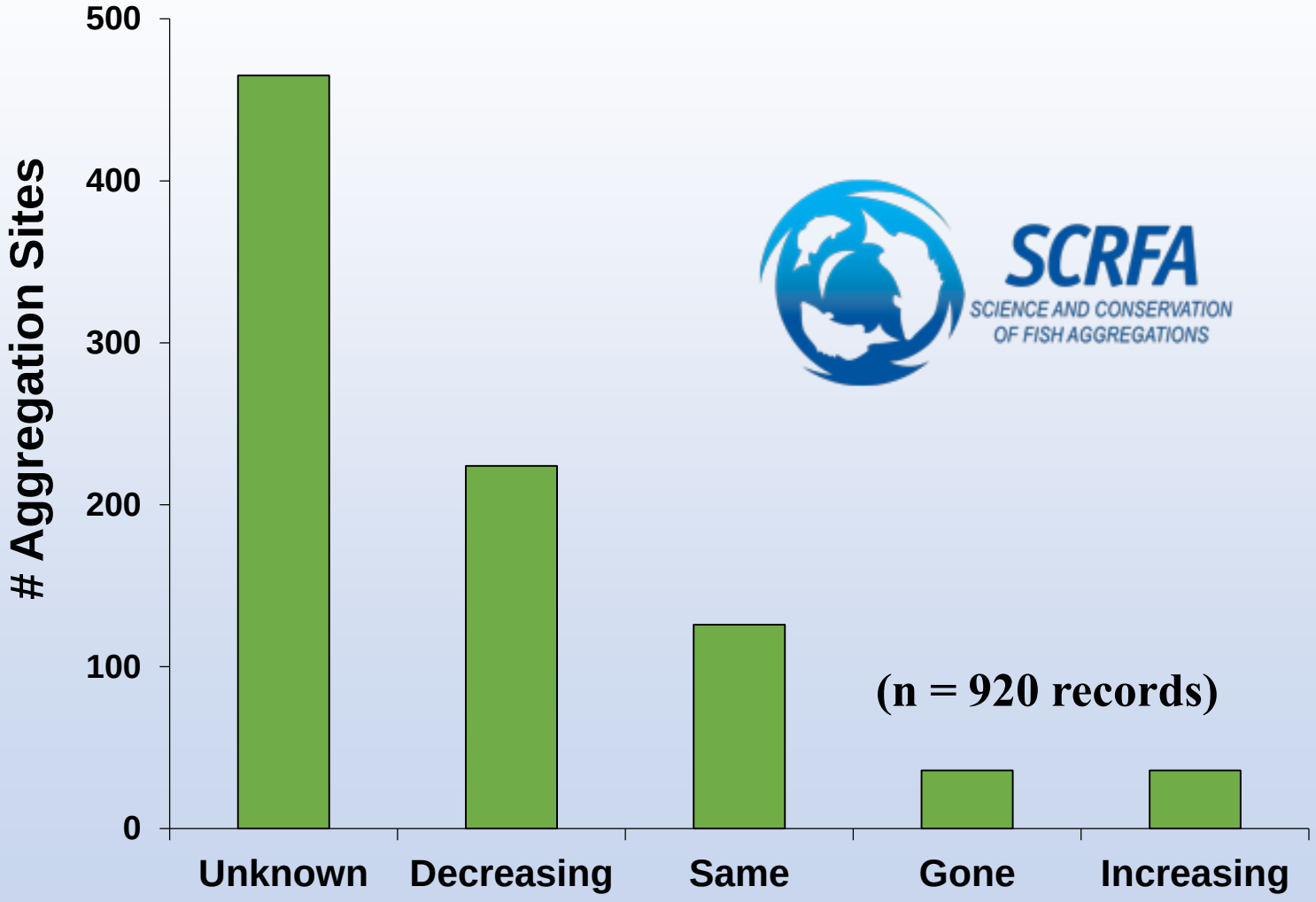
Christopher Biggs, Brad Erisman, Will Heyman, Shinichi Kobara, Nick Farmer, Susan Lowerre-Barbieri, Mandy Karnauskas, Jorge Brenner

Fish Spawning Aggregations (FSAs)

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

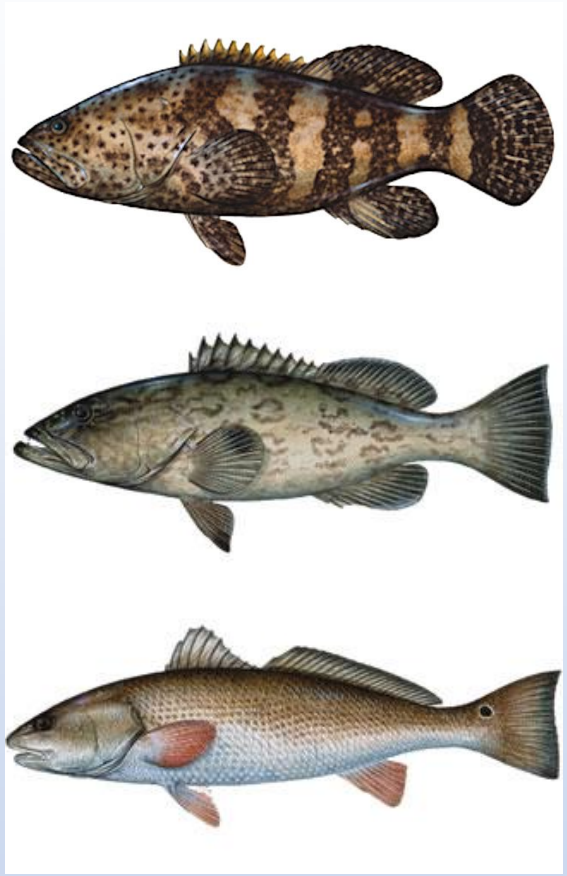
Global Status of Fish Spawning Aggregations

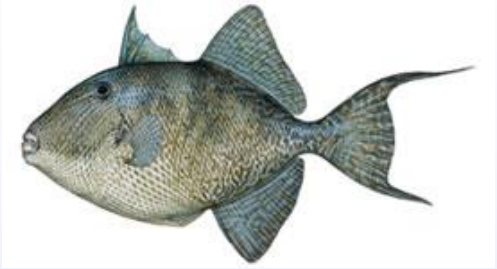
Only 34% of documented sites are managed



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

Many commercially and recreationally important species 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[1], Christopher C. Koenig[1,2] & L. Alan Collins[2]
[1] *FSU/NMFS Institute for Fishery Resource Ecology, Department of Biological Science, Florida State University, Tallahassee, FL 32306-2043, U.S.A.*
[2] *National Marine Fisheries Service, 3500 Delwood Beach Road, Panama City, FL 32408-7499, U.S.A.*

Data Portal Updated

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

Objective # 1

Compile and evaluate existing **information** on fish spawning aggregations in the GOM

Which Species to Include?

>600 Species in the GoM

Fisheries Management Plan — 12

Fisheries and Conservation Importance — 12

Coastal Species — 4

28 Species

Almaco Jack

Black Drum

Black Grouper

Cubera Snapper

Gag

Goliath Grouper

Gray Triggerfish

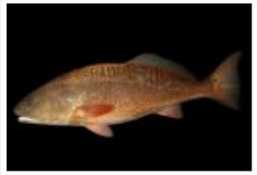
Greater Amberjack

Hogfish

King Mackerel

Mutton Snapper

Nassau Grouper



Red Drum

Red Grouper

Red Snapper

Scamp

Sheepshead

Snowy Grouper

Southern Flounder

Spanish Mackerel

Speckled Hind

Spotted Seatrout

Tilefish

Vermilion Snapper

Warsaw Grouper

Yellowedge Grouper

Yellowfin Grouper

Yellowmouth Grouper

800 References & Resource database

gcoos3.tamu.edu/restore/

(Click here to download the full dataset in Excel file)

Citation for Data set (Excel file)
Biggs, C., B. Erisman, W. Heyman, S.Kobara, N. Farmer, S. Lowerre-Barbieri, M. Karnauskas, and J. Brenner. (2017). Cooperative monitoring program for spawning aggregations in the Gulf of Mexico: References. Version 2017.4. Available from GCOOS Web site: http://geo.gcoos.org/restore/references

Data Table (It will show different entries based on filters. Click a bar chart to filter data)

Show 25 rows | Copy selected | Export as CSV | Save as XLSX | Export as PDF | Column visibility

Search:

Author	Year	Title	URL	Common Name
Able, K. W., Grimes, C. B., & Jones, R. S.	1993	Temporal and spatial variation in habitat characteristics of tilefish (Lopholatilus chamaeleonticeps)off the east coast of Florida.Bulletin of Marine Science,53(3), 1013–1026.	Link	Tilefish
Addis, D., Chagaris, D., Muller, R. G., Murphy, M. D., Hop, J. O., & Tyler-jedlund, M.	2015	Florida ' s Inshore and Nearshore Species : 2015 Status and Trends Report. St. Petersburg, FL: Florida Fish and Wildlife Conservation Commission.	Link	Other
Aguilar-Perera, A.	1994	Preliminary observations of the spawning aggregation of Nassau grouper, Epinephelus striatus, at Mahahual, Quintana Roo, Mexico.Proceedings of the 43rd Gulf and Caribbean Fisheries Institute,43, 112–122.	Link	Nassau Grouper
Aguilar-Perera, A.	2006	Disappearance of a Nassau grouper spawning aggregation off the southern Mexican Caribbean coast. Marine Ecology Progress Series,327(1), 289–296.	Link	Nassau Grouper

Life History Parameters

Max Age (years)	Max Weight (kg)	Max Length (cm)	K vB Growth Coeff.	L_{inf} Asympt. Length (cm)	t_0 Age at Length 0 (yrs)	Age at Maturity (mo)	Length at Maturity (cm)	M Natural Mortality

The Royal Society

Life history correlates of responses to fisheries exploitation

Simon Jennings*, John D. Reynolds and Suzanne C. Mills

School of Biological Sciences, University of East Anglia, Norwich NR4 7TJ, UK

FISH and FISHERIES, 2004, **5**, 255–276

Methods of assessing extinction risk in marine fishes

Nicholas K Dulvy[1], Jim R Ellis[1], Nicholas B Goodwin[2], Alastair Grant[3], John D Reynolds[2] & Simon Jennings[1]

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Available online at www.sciencedirect.com

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Biological Conservation 124 (2005) 97–111

BIOLOGICAL CONSERVATION

www.elsevier.com/locate/biocon

A fuzzy logic expert system to estimate intrinsic extinction vulnerabilities of marine fishes to fishing

William W.L. Cheung *, Tony J. Pitcher, Daniel Pauly

Fisheries Centre, The University of British Columbia, Lower Mall Research Station, 2259 Lower Mall, Vancouver, BC, Canada V6T 1Z4

Received 8 September 2004

Spawning Behavior Parameters

Aggregation Type (1-4)	Spawning Season Duration (mo)	Density Change (1-6)

Robinson, J. (2015). *Understanding the Causes of Vulnerability to Fishing in Reef Fishes that Aggregate*. Australian Research Council Centre of Excellence for Coral Reef Studies, James Cook University.

Life History & Spawning Behavior Parameters

Common Name	Aggregation Type (1-4)	Spawning Season Duration (mo)	Density Change (1-6)	Max Age (years)	Max Weight (kg)	Max Length (cm)	K vB Growth Coeff.	L_{inf} Asympt. Length (cm)	t_0 Age at Length 0 (yrs)	Age at Maturity (mo)	Length at Maturity (cm)	M Natural Mortality
Almaco Jack	3	5	3	22	60	160	0.13	163.00	0.830	53	81	NA
Black Drum	3	7	4	58	51	150	0.17	113.60	-0.129	60	65	0.06
Black Grouper	4	5	4	33	100	150	0.14	133.40	-0.903	78	85.6	0.14
Cubera Snapper	4	4	6	22	57	160	0.16	120.00	-0.300	24	61.5	0.15
Gag Grouper	4	4	3	31	37	145	0.13	127.80	-0.067	42	54.3	0.13
Goliath Grouper	4	5	3	37	363	250	0.09	222.10	-0.684	72	120	0.12
Gray Triggerfish	2	4	4	15	6	30	0.14	58.97	-1.660	18	16.9	0.27
Greater Amberjack	3	4	3	15	81	190	0.14	143.60	-0.954	27	78.8	0.25
Hogfish	2	8	2	23	10	91	0.11	84.89	-1.329	11	15.2	0.18
King Mackerel	1	5	2	24	42.3	184	0.19	115.41	-2.596	48	60	0.17
Mutton Snapper	4	4	5	40	15.6	94	0.17	86.10	-1.320	48	49.9	0.11
Nassau Grouper	4	3	6	29	27	100	0.13	76.00	-1.120	60	40	0.18
Red Drum	3	4	4	42	45	160	0.32	88.10	-1.290	48	68	0.16
Red Grouper	1	5	2	29	23	125	0.13	82.90	-1.202	34	29.2	0.14
Red Snapper	2	5	2	48	23	100	0.19	85.64	-0.395	24	23	0.10
Scamp	3	6	3	31	13	107	0.09	77.20	-4.400	24	33.2	0.15
Sheepshead	4	3	5	20	9.6	92	0.36	46.30	-0.420	24	30	0.15
Snowy Grouper	2	7	3	35	30	122	0.09	106.46	-2.884	60	60	0.19
Southern Flounder	4	4	5	8	9.3	91.5	0.28	65.20	-1.317	24	40	0.36
Spanish Mackerel	1	6	2	11	5.9	101	0.61	56.00	-0.500	8	30.1	0.30
Speckled Hind	3	6	3	45	30	110	0.12	88.80	-1.800	79	53.2	0.15
Spotted Seatrout	2	6	3	12	7.9	70	0.32	68.70	-0.260	12	23	0.30
Tilefish	1	6	2	40	26	125	0.13	83.00	-2.140	24	34.4	0.13
Vermilion Snapper	2	6	2	26	3	63	0.33	34.40	-0.795	24	13.8	0.25
Warsaw Grouper	3	2	3	41	198	235	0.05	239.40	-3.620	49	81	NA
Yellowedge Grouper	3	10	3	85	20	115	0.06	100.45	-4.576	96	54.7	0.07
Yellowfin Grouper	4	3	4	15	19	100	0.12	89.00	0.750	44	54	0.26
Yellowmouth	4	12	3	28	9	84	0.08	82.80	-7.500	36	42.5	0.23

Life History & Spawn Behavior Parameters

Common Name	Aggregation Type (1-4)	Spawning Season Duration (mo)	Density Change (1-6)	Max Age (years)	Max Weight (kg)	Max Length (cm)	K vB Growth Coeff.	L_{inf} Asympt. Length (cm)	t_0 Age at Length 0 (yrs)	Age at Maturity (mo)	Length at Maturity (cm)	M Natural Mortality
Almaco Jack	3	5	3	22	60	160	0.13	163.00	0.830	53	81	NA
Black Drum	3	7	4	58	51	150	0.17	113.60	-0.129	60	65	0.06
Black Grouper	4	5	4	33	100	150	0.14	133.40	-0.903	78	85.6	0.14
Cubera Snapper	4	4	6	22	57	160	0.16	120.00	-0.300	24	61.5	0.15
Gag Grouper	4	4	3	31	37	145	0.13	127.80	-0.067	42	54.3	0.13
Goliath Grouper	4	5	3	37	363	250	0.09	222.10	-0.684	72	120	0.12
Gray Triggerfish	2	4	4	15	6	30	0.14	58.97	-1.660	18	16.9	0.27
Greater Amberjack	3	4	3	15	81	190	0.14	143.60	-0.954	27	78.8	0.25
Hogfish	2	8	2	23	10	91	0.11	84.89	-1.329	11	15.2	0.18
King Mackerel	1	5	2	24	42.3	184	0.19	115.41	-2.5			
									-1.3			
									-1.1			
									-1.2			
									-1.2			
Red Snapper	2	5	2	48	23	100	0.19	85.64	-0.3			
Scamp	3	6	3	31	13	107	0.09	77.20	-4.4			
Sheepshead	4	3	5	20	9.6	92	0.36	46.30	-0.4			
Snowy Grouper	2	7	3	35	30	122	0.09	106.46	-2.8			
Southern Flounder	4	4	5	8	9.3	91.5	0.28	65.20	-1.3			
Spanish Mackerel	1	6	2	11	5.9	101	0.61	56.00	-0.5			
Speckled Hind	3	6	3	45	30	110	0.12	88.80	-1.8			
Spotted Seatrout	2	6	3	12	7.9	70	0.32	68.70	-0.2			
Tilefish	1	6	2	40	26	125	0.13	83.00	-2.140	24	34.4	0.13
Vermilion Snapper	2	6	2	26	3	63	0.33	34.40	-0.795	24	13.8	0.25
Warsaw Grouper	3	2	3	41	198	235	0.05	239.40	-3.620	49	81	NA
Yellowedge Grouper	3	10	3	85	20	115	0.06	100.45	-4.576	96	54.7	0.07
Yellowfin Grouper	4	3	4	15	19	100	0.12	89.00	0.750	44	54	0.26
Yellowmouth	4	12	3	28	9	84	0.08	82.80	-7.500	36	42.5	0.23

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

Chris:
Chris:
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342=0.1896 (fl keys)
343=0.079, (s. fl=0.259, key largo-key west=0.562, Marquesas key=0.166, dry tortugas=0.113)
344=0.094 (offshore, 0.5614 nearshore)
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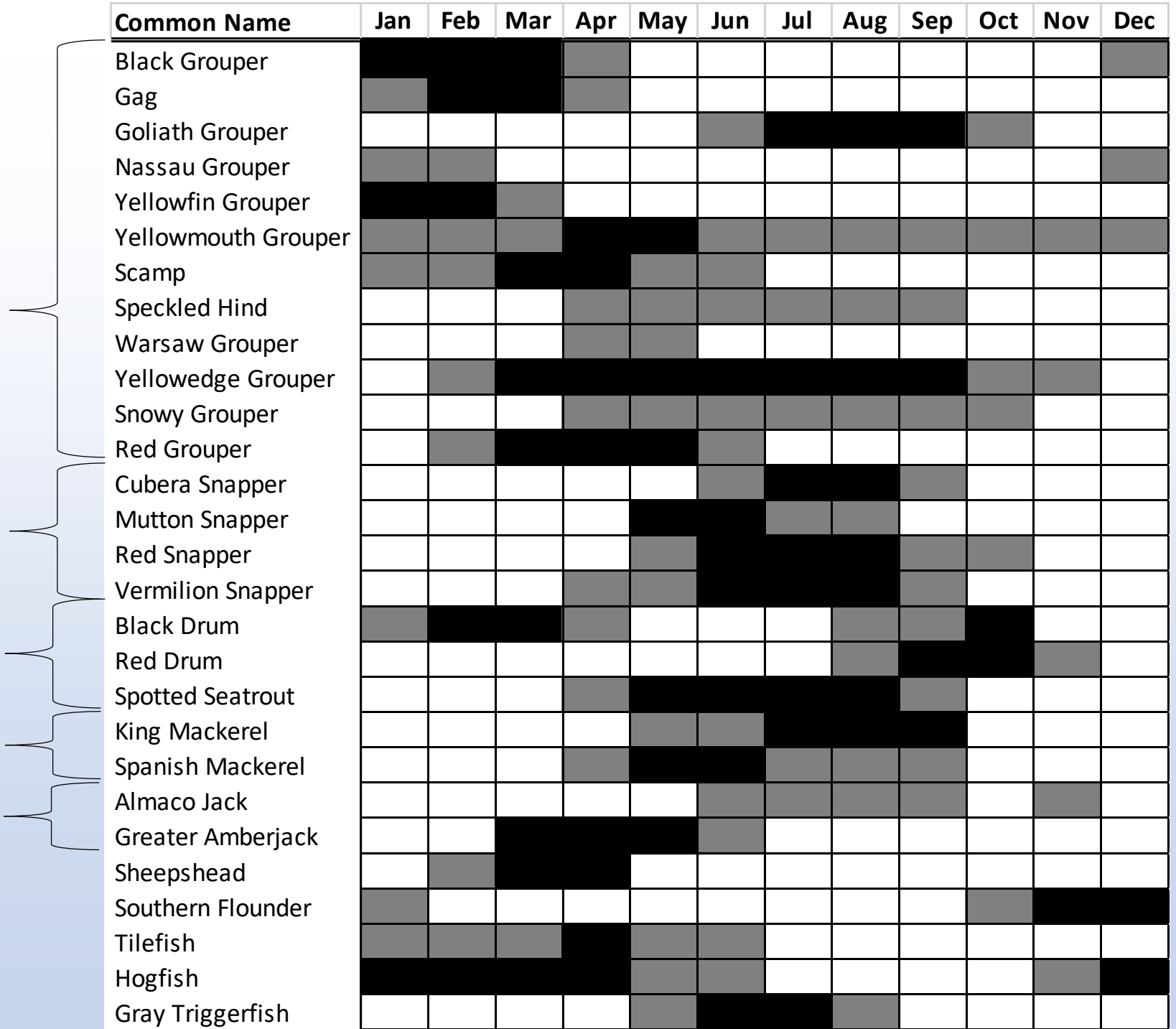
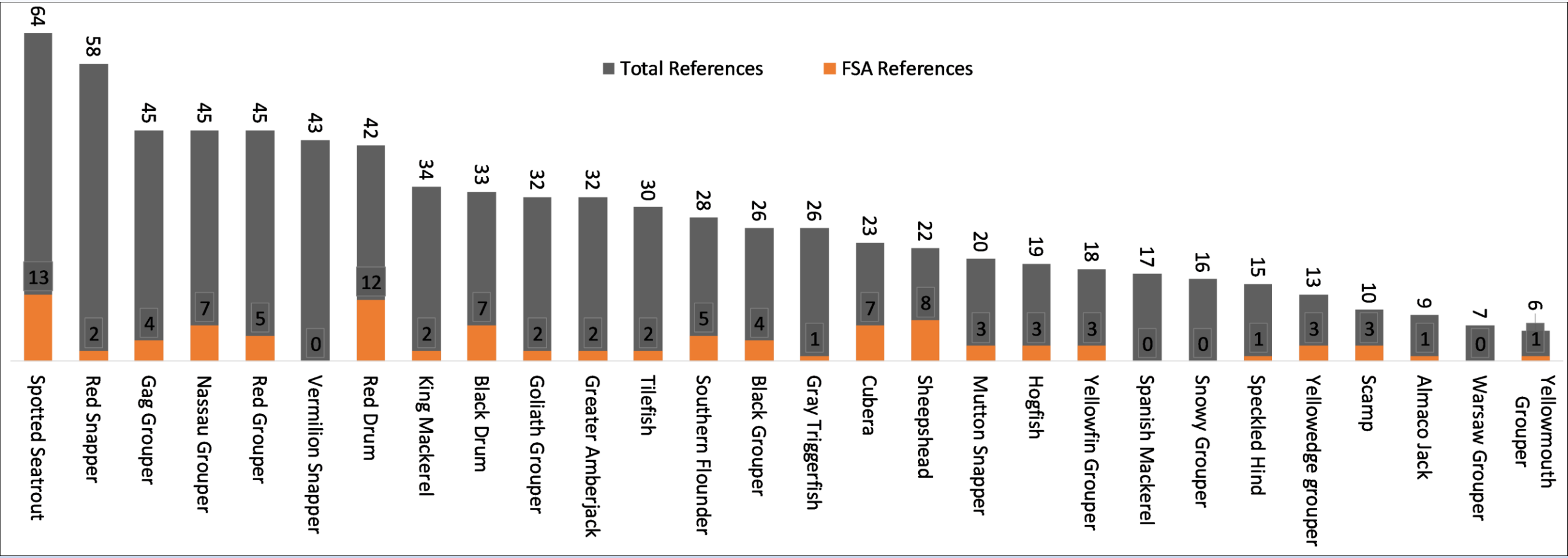
346=0.19 (keys)
289=0.98

Spawning Seasons in the Gulf of Mexico

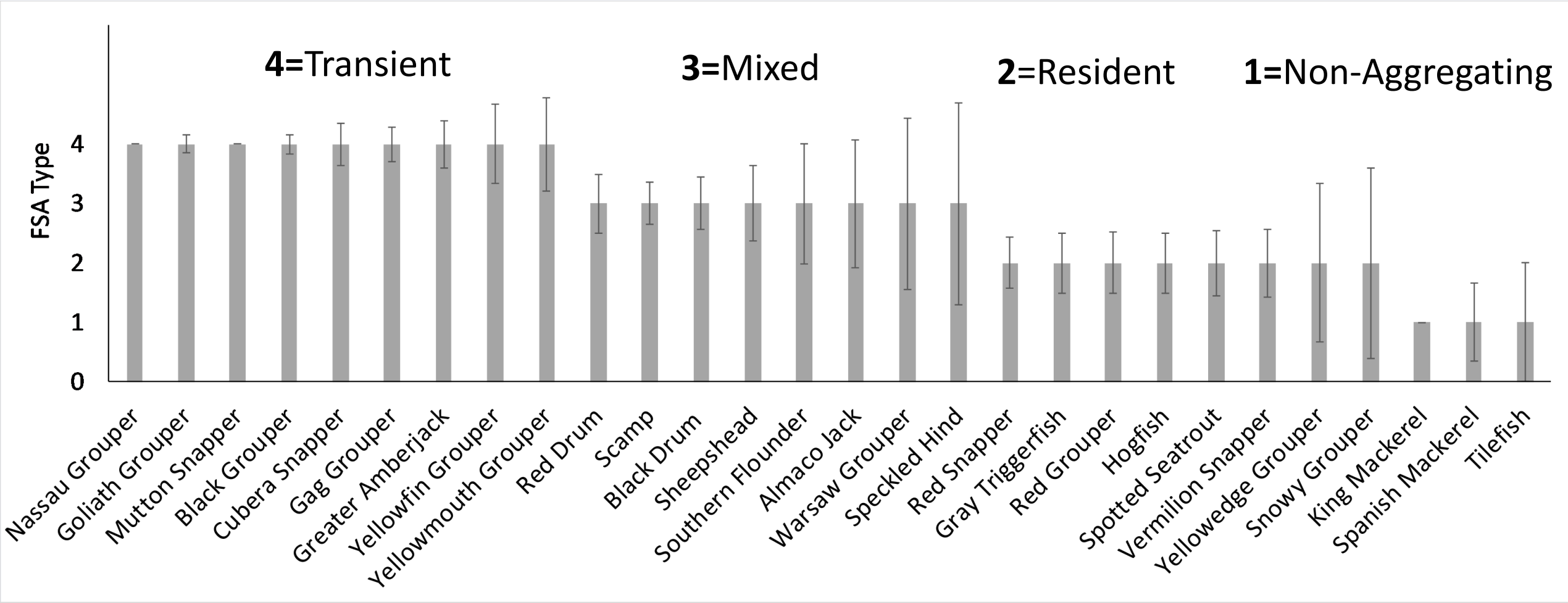


- 800 References- Few studies on FSA behavior



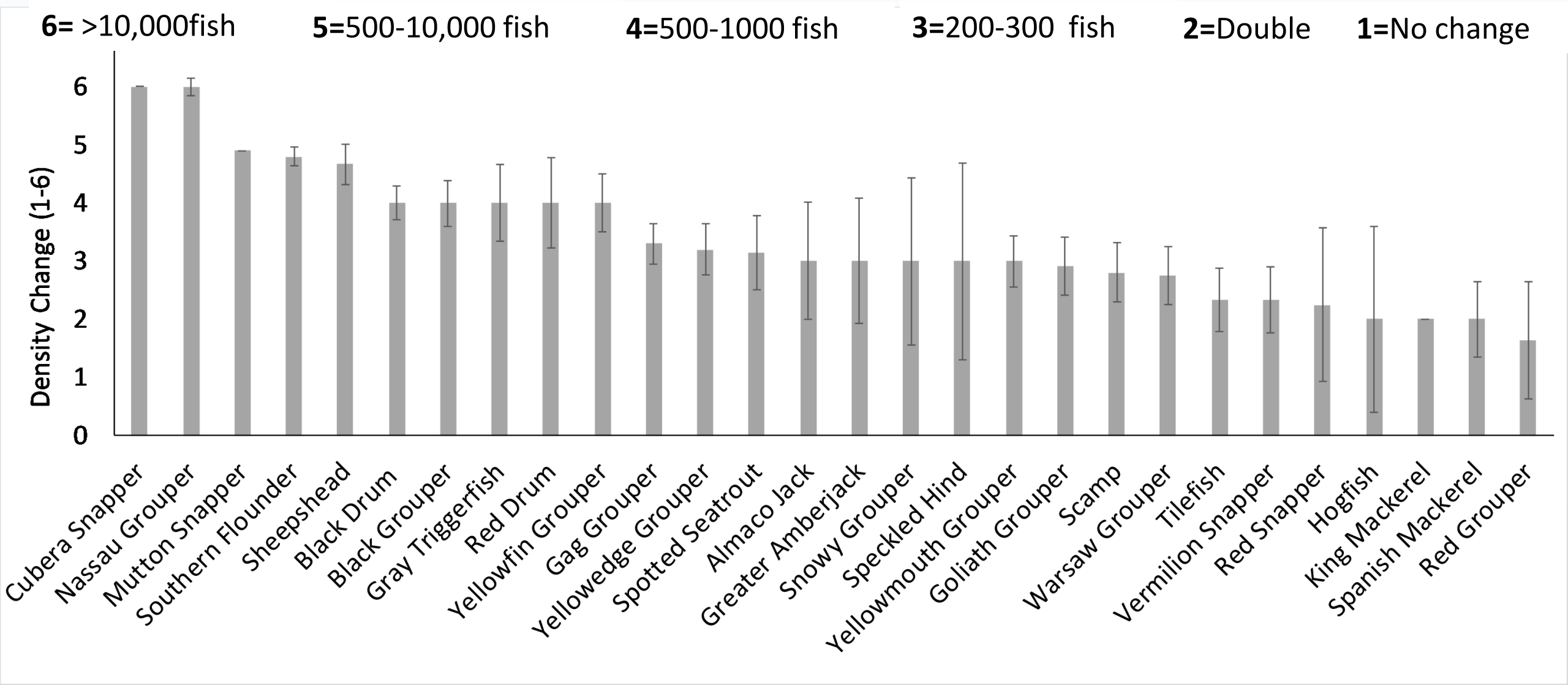
Spawning Aggregations Workshop
October 4-5 2016, NOAA SERO

General consensus for transient aggregations- uncertainty for others

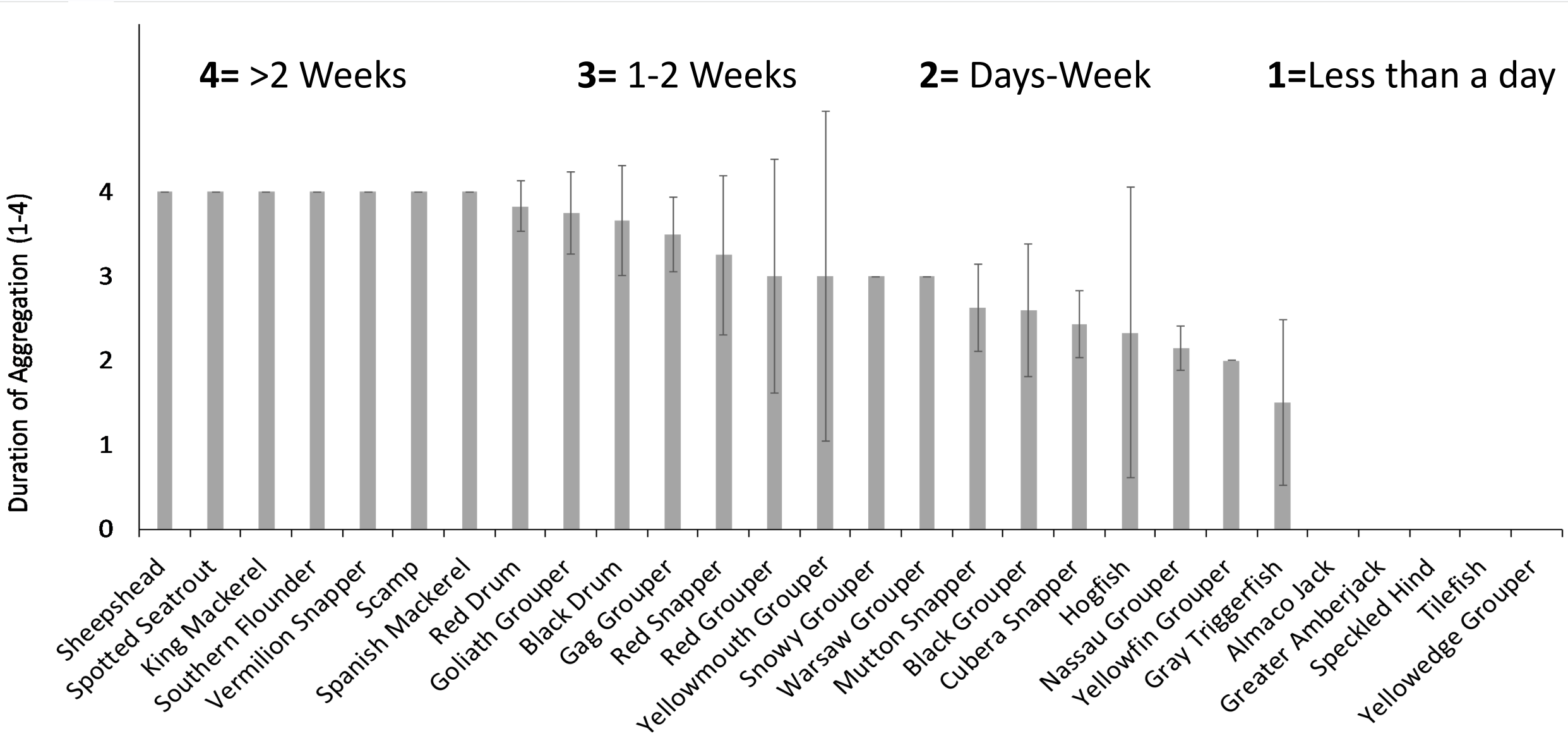


Density change is known for a few species

6= >10,000fish **5=**500-10,000 fish **4=**500-1000 fish **3=**200-300 fish **2=**Double **1=**No change



Duration of aggregations is largely unknown



Major Data Gaps

1. Locations of spawning aggregations in the Gulf of Mexico
2. Information on behavioral dynamics of FSAs in space and time
3. Understanding of the resident-transient spectrum

Objective

2. Assess the **vulnerability** and temporal interactions of **FSAs** with **fishing**

Predicting vulnerability of FSAs to overfishing

Intrinsic Indicators

Productivity- Life History

Spawning Behavior

Extrinsic Indicators

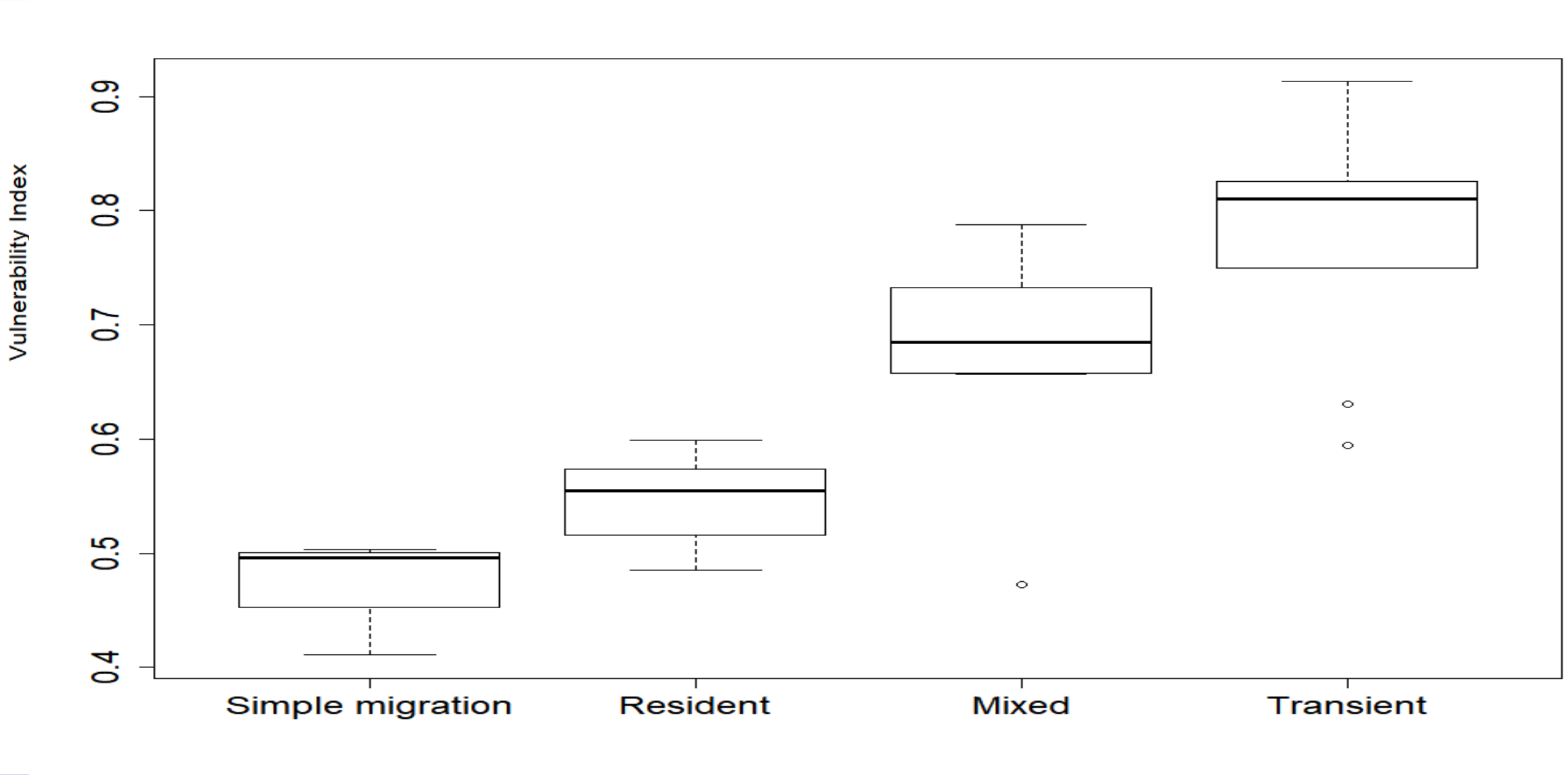
Fisheries Management

-catch limits

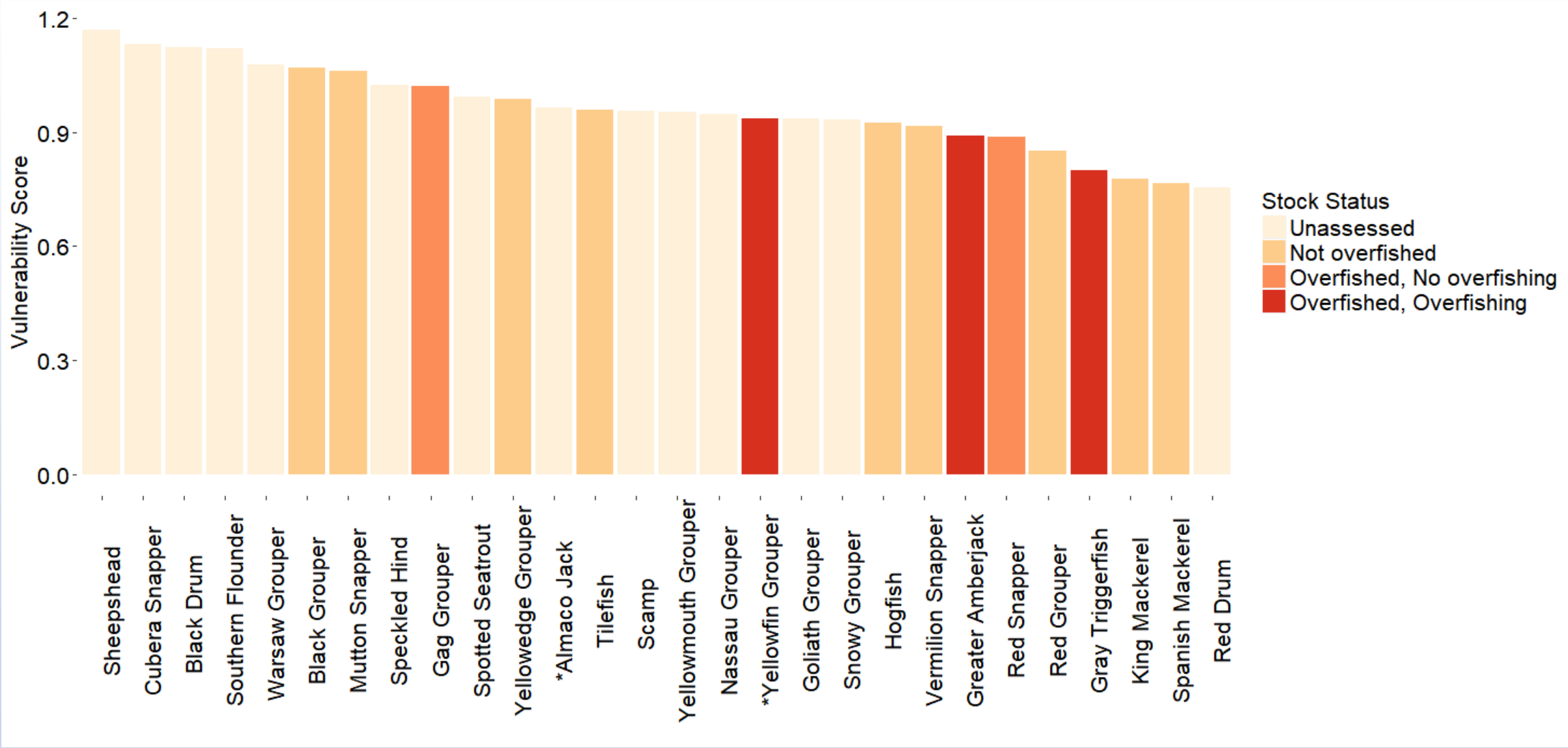
-seasonal/site closures

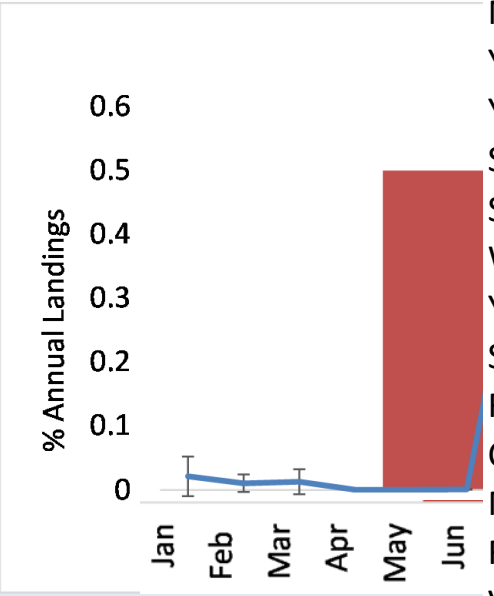
Robinson, J. (2015). *Understanding the Causes of Vulnerability to Fishing in Reef Fishes that Aggregate*. Australian Research Council Centre of Excellence for Coral Reef Studies, James Cook University.

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



The most vulnerable species have not been assessed





Common Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Black Grouper	■	■	■	▒								▒
Gag	▒	■	■	▒								
Goliath Grouper						▒	■	■	■	▒		
Nassau Grouper	▒	▒										▒
Yellowfin Grouper	■	■	▒									
Yellowmouth Grouper	▒	▒	▒	■	■	▒	▒	▒	▒	▒	▒	▒
Scamp	▒	▒	■	■	▒	▒						
Speckled Hind				▒	▒	▒	▒	▒	▒			
Warsaw Grouper				▒	▒							
Yellowedge Grouper		▒	■	■	■	■	■	■	■	▒	▒	
Snowy Grouper				▒	▒	▒	▒	▒	▒	▒		
Red Grouper		▒	■	■	■	▒						
Cubera Snapper						▒	■	■	▒			
Mutton Snapper					■	■	▒	▒				
Red Snapper					▒	■	■	■	▒	▒		
Vermilion Snapper				▒	▒	■	■	■	▒			
Black Drum	▒	■	■	▒				▒	▒	■		
Red Drum								▒	■	■	▒	
Spotted Seatrout				▒	■	■	■	■	▒			
King Mackerel					▒	▒	■	■	■			
Spanish Mackerel				▒	■	■	▒	▒	▒			
Almaco Jack						▒	▒	▒	▒		▒	
Greater Amberjack			■	■	■	▒						
Sheepshead		▒	■	■								
Southern Flounder	▒									▒	■	■
Tilefish	▒	▒	▒	■	▒	▒						
Hogfish	■	■	■	■	▒	▒						■
Gray Triggerfish					▒	■	■	▒				

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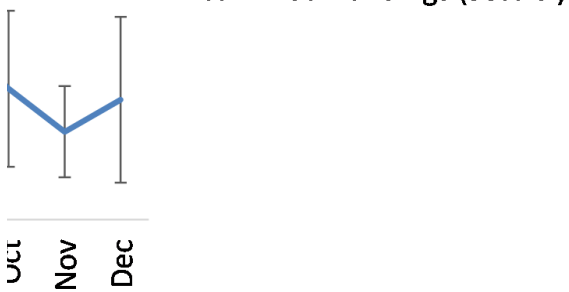
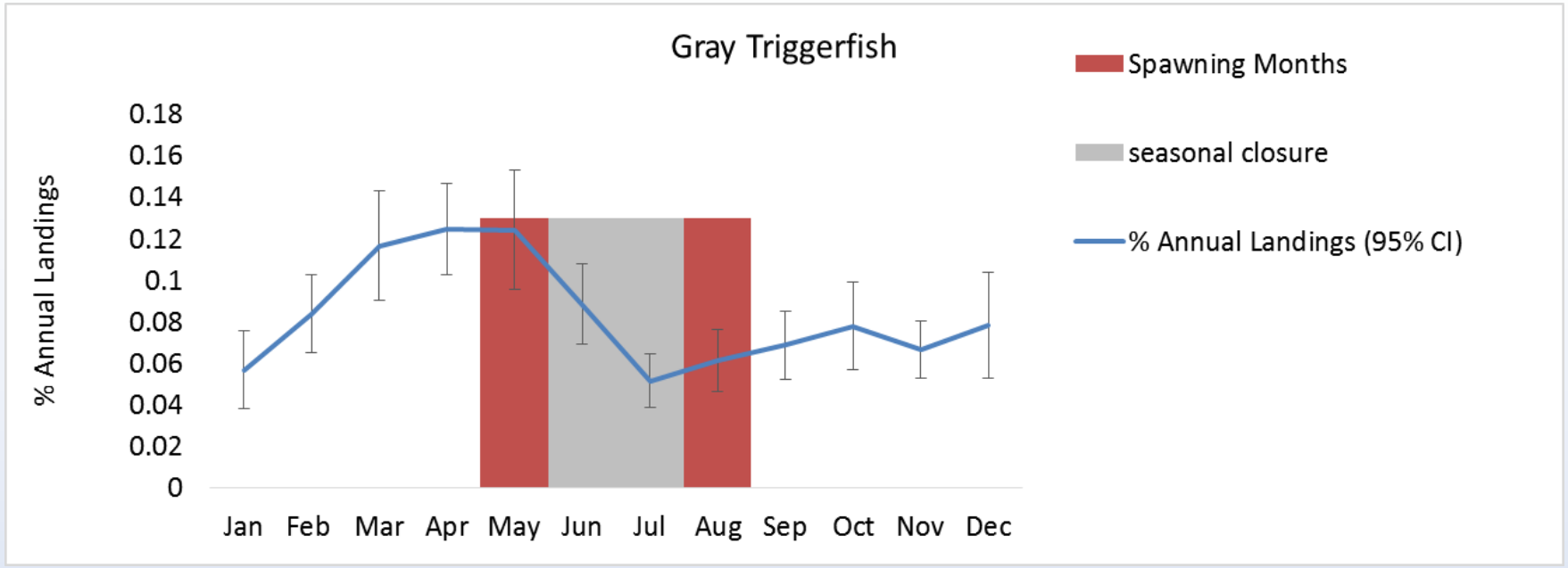
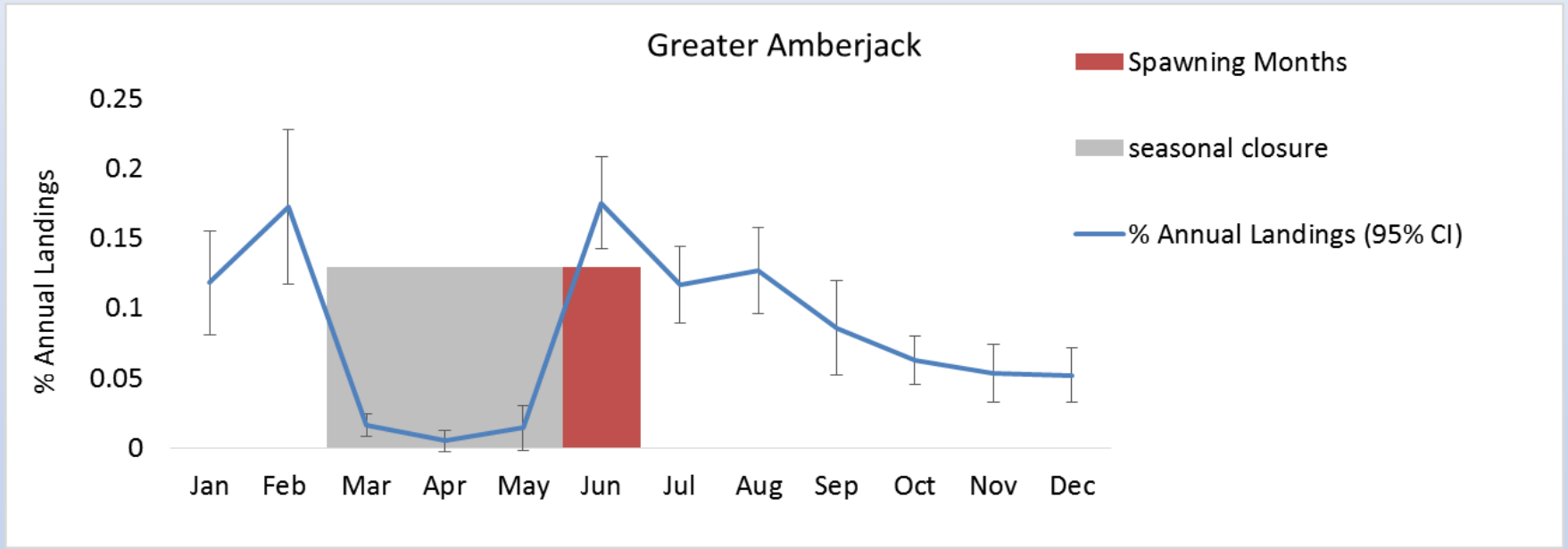


Seasonal Closures Work





No Seasonal Closures for Many Commercial Fisheries

Common Name	Catch limits (1-4)	Gear measures (1-4)	Seasonal Restrictions (0-4)	Site closures (1-4)
Gag Grouper	2	2.5	4	2
Red Grouper	2	2.5	4	2
Red Drum		1	1	Closed
Red Snapper	2	2.5	4	2
Vermilion Snapper	3	2.5	4	2
Greater Amberjack	1	3.5	3	2
Black Grouper	2	2.5	4	2
Gray Triggerfish	1	3.5	2	2
Hogfish	3	3.5	4	2
Nassau Grouper		1	1	Closed
Yellowedge Grouper	3	2.5	4	2
Snowy Grouper	3	2.5	4	2
Almaco Jack	4	3.5	4	2
Cubera Snapper	3	2.5	4	2
Scamp	2	2.5	4	2
Speckled Hind	3	2.5	4	2
Tilefish	4	3.5	4	2
Yellowfin Grouper	2	2.5	4	2
Yellowmouth Grouper	3	2.5	4	2
Goliath Grouper		1		Closed
Mutton Snapper	3	2.5	4	2
Warsaw Grouper	3	2.5	4	2
Spanish Mackerel	2	2	4	2
King Mackerel	1	2	4	2
Spotted Seatrout	4	4	4	2
Sheepshead	4	4	4	2
Southern Flounder	4	4	4	2
Black Drum	4	4	4	2

Research and Management Priorities

1) Identify areas of vulnerability

2) Identify, characterize, and assess key spawning areas

3) Improve stock assessments by incorporating spawning dynamics

4) Develop management frameworks

gcoos3.tamu.edu/restore/

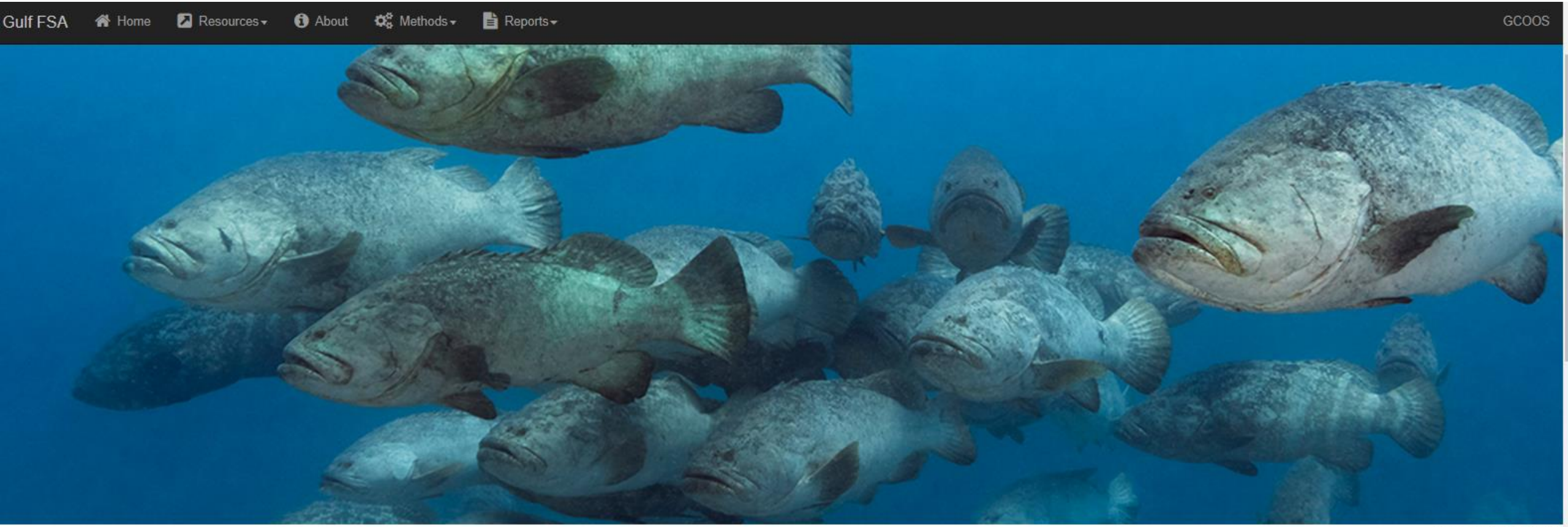


Image credit: Walt Sterns

Welcome

This data portal offers the best available data and information relevant to the biology, fisheries, monitoring and management of spawning aggregations for important fish species in the Gulf of Mexico and serves as the basis for a cooperative, Gulf-wide conservation and monitoring program.

The site was funded by the NOAA RESTORE Act Science Program.

About us »

For more information, please contact Chris Biggs (cbiggs@utexas.edu)

NOAA RESTORE Act Science Program

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

THE UNIVERSITY OF TEXAS MARINE SCIENCE INSTITUTE

LGL Ecological Research Associates, Inc.

GCOOS GULF OF MEXICO COASTAL OCEAN OBSERVING SYSTEM

NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION U.S. DEPARTMENT OF COMMERCE

UF UNIVERSITY of FLORIDA

The Nature Conservancy Protecting nature. Preserving life.

Coastal Fisheries Research Program UT Marine Science Institute

Intrinsic	Weight
Productivity	0.293
Aggregation Type	0.261
Density	0.232
Aggregation Duration	0.215
Extrinsic	
Access to Fishery	0.081
Catch Limits	0.2148
Gear Measures	0.1137
Seasonal Restrictions	0.3
Site Closures	0.2906