WORKSHOP REPORT

Cooperative monitoring program for spawning aggregations in the Gulf of Mexico: an assessment of existing information, data gaps and research priorities

Submitted to:

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NOAA RESTORE Act Science Program

Ecological Research Associates, Inc.

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Cooperative monitoring program for spawning aggregations in the Gulf of Mexico: an assessment of existing information, data gaps and research priorities

RESTORE Act Science Program Funded Workshop
October 4-5 2016

NOAA Fisheries Southeast Regional Office
263 13th Avenue S.
St. Petersburg, FL 33701

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Cooperative monitoring program for spawning aggregations in the Gulf of Mexico: an assessment of existing information, data gaps and research priorities

Funding: NOAA RESTORE Act Science Program

Dates: 4-5 October 2016

Location: NOAA Fisheries Southeast Regional Office
263 13th Avenue S.
St. Petersburg, FL 33701

Overall Workshop Objective: A diverse group of stakeholders will review, critique, and vet draft project outputs and define research and monitoring priorities for spawning aggregations in the Gulf of Mexico.

Report Objective: This report is designed to summarize the main conclusions resulting from the workshop including identified data gaps, feedback on project components and outputs, and suggestions for future research and monitoring. The final workshop agenda is provided as Appendix 1. We have not attempted to provide a comprehensive summary of all discussions, nor of the products associated with the project, since these will emerge subsequently as products themselves.

Summary of Participation: Originally planned for only 16 participants, the workshop generated a great deal of interest and we were able to accommodate over 30 participants that broadly represented commercial and recreational fishing interests, academic research institutions, non-government conservation organizations, and state and federal scientists and resource managers (see cover photo). In addition, we had participation from Mexico and the Seychelles. The complete list of attendees is provided in Appendix 1. Several workshop participants mentioned the value of having participation from this diverse group of stakeholders – particularly fishermen and scientists. Side meetings and social events included several additional fishermen and NOAA staff from SERO.

Frank Parker offered these concluding remarks during the workshop:

- Understanding the where and when of spawning aggregations is a crucial step in understanding how the physics interact with the biology to generate fish production in the Gulf. This larger understanding is one of the goals of the Science Program.
- Achieving this goal requires an integrated network of academic, state, federal and independent scientists, managers, and users working together.
- This project serves as a great example of what we mean by ecosystem science and the developing networks to support the evolution and application of that science. The outcomes of this workshop have great potential to be applied.

Summary of Highest Priority Workshop Findings and Recommendations

Data gaps

1. With the exception of a few coastal species, there is a near total lack of information on the location of spawning aggregations for most focal species in the Gulf of Mexico, which greatly impedes monitoring, assessment, and management efforts.
2. A unified bathymetric coverage for the Gulf of Mexico is still lacking but would greatly enhance our ability to predict, identify, monitor, assess, and manage important spawning aggregation sites, particularly those sites that house multiple species of commercial or recreational importance.
3. Data on the behavioral dynamics of spawning aggregations (e.g. timing, dimensions, durations, abundance, fish movements) and fine-scale, spatio-temporal interactions between spawning aggregations and fisheries is lacking for many species of recreational, commercial, and conservation importance but critical for management.

Recommendations for Research and Monitoring

1. Work with fishermen to identify and characterize where and when focal species are spawning in the Gulf of Mexico.
2. Improve metrics that allow for integration of productivity parameters associated with spawning aggregations (e.g. spawning potential ratio estimates that include non-fatal impacts of fishing on reproductive output) with stock assessments.
3. Create a unified bathymetric coverage for the Gulf of Mexico.
4. Create a network of instrumented monitoring sites at known multi-species spawning aggregation sites in the Gulf of Mexico. Biological and physical oceanographic data should be collected at these sites and made public via a data portal, e.g. GCOOS.

Recommendations for Fisheries Management

1. Engage constituents from all sectors (commercial, private recreational, charter/for-hire, and headboat) to improve understanding of reef fish spawning ecology and the fisheries significance of spawning aggregations.
2. Present results of this project to the Gulf of Mexico Fisheries Management Council.
3. In collaboration with fishermen, provide sufficient information to allow the Council to improve temporal protection for spawning or develop a framework for spatial protection of spawning sites through the FMC process following the precedent set by the South Atlantic Fisheries Management Council's Amendment 36 (SAFMC 2016).
4. Locate and characterize spawning areas for key species (particularly multi-species sites) and recommend them for protection in large enough areas to allow recovery and resilience.
5. Incorporate predicted reproductive success from aggregations into existing stock assessment frameworks, potentially through scalars for SPR or total egg production.
6. Improve stock assessments by incorporating spawning aggregation metrics where appropriate (e.g. abundance-scaled indices of reproductive output from aggregations) as a metric for spawning success.

Keynote Presentation: Dr. Chris Koenig, Florida State University

Dr. Koenig provided excellent context for the workshop based on his extensive career in studying spawning aggregations in the Gulf of Mexico. The presentation offered a summary of his work and the ecology and management of species studied (Gag, Goliath Grouper, and several others). Some of the key points from his talk included:

1. Given the critical importance of spawning aggregations to sustainable fish populations and fisheries, scientists and fishermen must work together to document and conserve spawning aggregations as the timing and location of these events in the Gulf of Mexico is still largely unknown to scientists.
2. Many fish species tend to spawn at sites associated with shelf edges, hard structure, and vertical relief. Some fish (e.g. large male Gag) remain year round at these sites while others migrate there for spawning.
3. Many fishermen are supportive of large marine reserves that protect spawning areas for species they target, because they have witnessed the benefits such protections have provided to their catches and revenues.
4. Large reserves provide areas that help replenish stocks, but they also allow scientists to conduct research necessary to illustrate the dynamics of the aggregations and the benefits of the reserves.

Focal Species List and Process of Selection

Chris Biggs offered a brief summary of the detailed process by which we arrived at a list of 28 focal species for a detailed analysis (Figure 1). Participants understood and supported the process as transparent and logical though several species were suggested as possible additions. Given limited time and resources for the analysis, our team accepted these suggestions without committing to complete all of the analyses. Our goal is to provide a first cut and template for analysis that will help to highlight species for which spatial or temporal management based on spawning timing and behavior may be particularly relevant. Some of the key conclusions gleaned from the presentation and discussions of participants included:

Figure 1: Selected focal species for this project

Common name	Scientific name
Black Grouper	*Mycteroperca bonaci*
Gag Grouper	*Mycteroperca microlepis*
Gray Triggerfish	*Balistes capriscus*
Greater Amberjack	*Seriola dumerili*
Hogfish	*Lachnolaimus maximus*
Nassau Grouper	*Epinephelus striatus*
Red Drum	*Sciaenops ocellatus*
Red Grouper	*Epinephelus morio*
Red Snapper	*Lutjanus campechanus*
Snowy Grouper	*Hyporthodus niveatus*
Vermilion Snapper	*Rhomboplites aurorubens*
Yellowedge Grouper	*Hyporthodus flavolimbatus*
Warsaw Grouper	*Hyporthodus nigritus*
Goliath Grouper	*Epinephelus itajara*
Tilefish	*Lopholatilus chamaeleonticeps*
Mutton Snapper	*Lutjanus analis*
Cubera Snapper	*Lutjanus cyanopterus*
Yellowmouth Grouper	*Mycteroperca interstitialis*
Speckled Hind	*Epinephelus drummondhayi*
Yellowfin Grouper	*Mycteroperca venenosa*
Spanish Mackerel	*Scomberomorus maculatus*
King Mackerel	*Scomberomorus cavalla*
Scamp	*Mycteroperca phenax*
Almaco Jack	*Seriola rivoliana*
Southern Flounder	*Paralichthys lethostigma*
Spotted Seatrout	*Cynoscion nebulosus*
Black Drum	*Pogonias cromis*
Sheepshead	*Archosargus probatocephalus*

1. Participants understood and supported the process of species selection.
2. Participants recognized that additional data were needed to help support the inclusion of species that are not federally managed in the Gulf of Mexico.
3. Additional species were suggested for analysis including: menhaden, black sea bass, permit, bonefish, tarpon, mullet, and gray snapper.
4. The project team recognizes the value of these species and will try to balance our available time and resources for analysis of chosen and newly suggested species.

Bathymetric Data Compilation, Draft Products and Interactive Website

Dr. Shin Kobara presented compelling evidence of the linkages between benthic geomorphology and the presence of spawning aggregations for many reef fish species that occur in the Gulf of Mexico. Nonetheless, the actual locations of spawning aggregations for many reef species have not yet been identified. Recognizing the vast geographic area of the Gulf, the lack of consistent bathymetric data coverage, and the diversity of studies underway from various institutions, Kobara has compiled existing data sources into a GIS database and will is making this data available on the GCOOS (Gulf Coast Ocean Observing System) website (Figure 2).

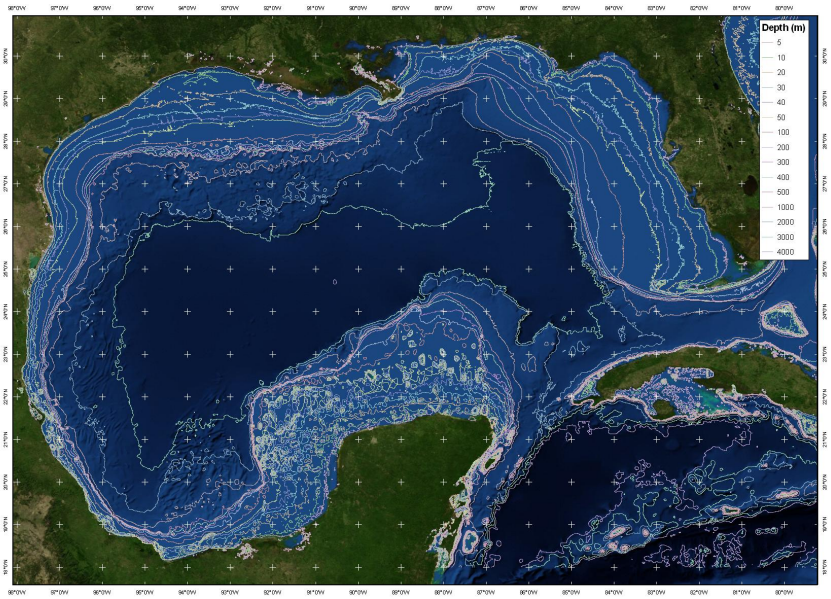

Figure 2: Bathymetric map of the Gulf of Mexico available from the GCOOS data portal showing contours between 5 and 4000 m.

Kobara has also built and demonstrated an interactive website designed to share the results from this project – making them publicly available and easily accessible.

The website includes interactive access to the entire bibliographic database (Figure 3), species profiles, and summary data on spawning seasonality, spawning type, age and growth parameters, etc. Some key points gleaned from the presentation and the comments of participants included:

1. There was broad consensus praise for the draft website and interactive bibliography. Participants highlighted the value of these tools for aggregation researchers, students, conservationists, managers, and a broad community of workers with an interest in the research, fisheries, or management of the focal species.
2. Participants had suggestions on ways to improve the interactive site and to make it more widely available.

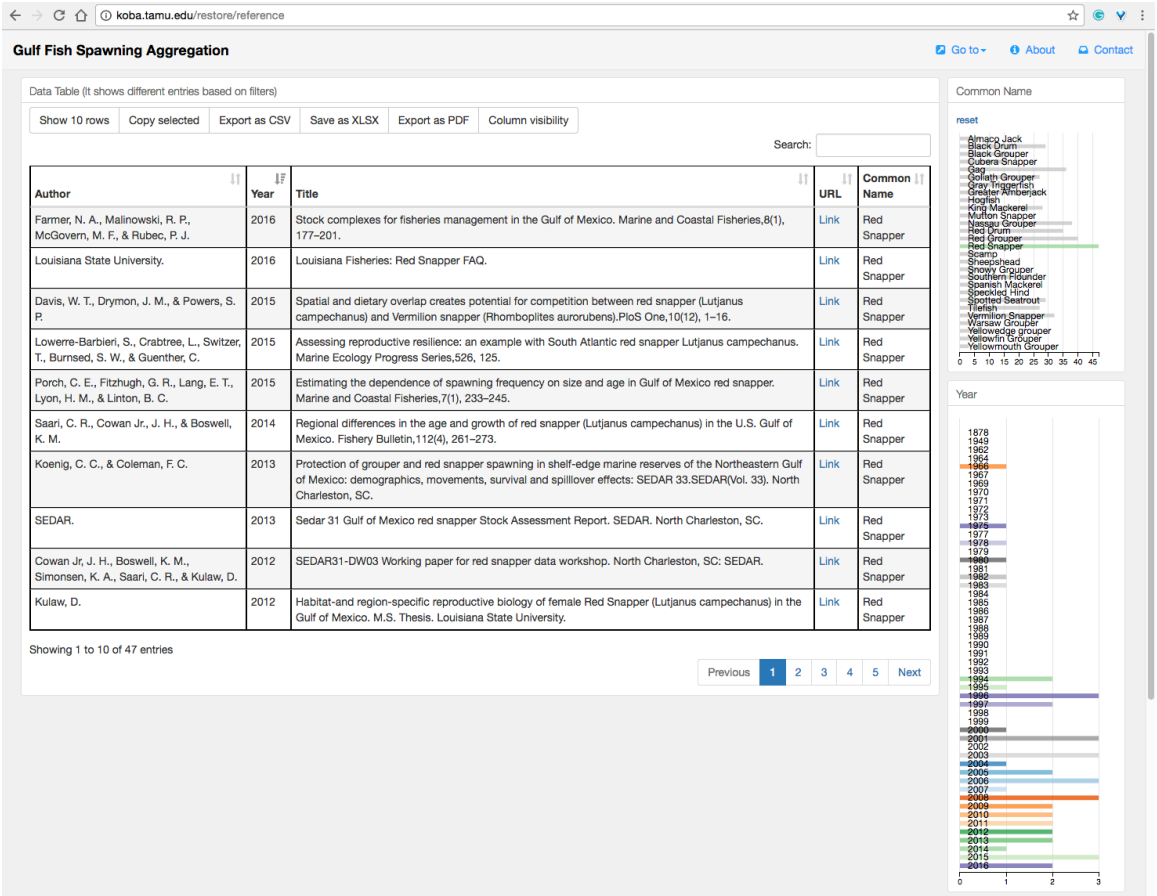

Figure 3: A draft sample page from the interactive bibliographic website is shown above. Individual references are listed in a table and can be sorted by author, year of publication, title and common name of the species. Summary data are shown in bar charts including the number of publications for each species sorted by year. Users can filter results interactively (e.g. by year or species) to produce a customized bibliographic reference list.

3. A unified bathymetric data set for the Gulf of Mexico is a product that holds great value for predicting, verifying, monitoring, assessing, and managing spawning aggregations in the region.
4. A unified bathymetric data set for the Gulf of Mexico is a product that will have extreme value for all other RESTORE projects and many other initiatives and institutions.

Data Sources, Species Profiles, and Bibliography

Brad Erisman presented a list of more than 650 publications, reports, books and book chapters, databases, regional monitoring programs, and current research projects (e.g. other RESTORE projects) from which information has been or will be mined for relevant information on the biology, spawning behavior, and fisheries for the 28 focal species. Chris Biggs and Brad Erisman then presented an impressive set of biological and fisheries data compiled for the focal species. These data included age, growth, and reproductive parameters used in stock assessments and most importantly, summaries of the known information regarding spawning seasons and locations. It also included information on monthly trends in the commercial and recreational landings of each species in relation to its spawning season as a basic metric of the relative importance of spawning aggregations to annual fisheries production. Some summary points from the presentation and feedback from participants were as follows:

1. There was consensus support for the data sources mined for the project, but a few suggestions were made on additional sources of information of potential value.
2. When the draft table (Figure 4) showing the spawning seasons for key species was shown to the group, there was immediate recognition that "most fishing effort occurs during peak spawning time for most species" (stated emphatically by participant and fisherman, Shane Cantrell)
3. Another important consensus reached during this session was that spawning locations for most areas and most species are largely unknown in the Gulf of Mexico, as is information on the behavioral, spatial, and temporal dynamics of spawning aggregations of most species and how they interact with fishing effort.
4. Data generated from this project will be very useful for stock assessments and for managers, conservationists, fishermen, students, and other scientists.
5. SPR calculations and other current metrics of stock productivity used in stock assessments are inherently flawed and do not account for the complex reproductive biology of exploited species.

Species	Common Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mycteroperca microlepis	Gag												
Epinephelus morio	Red Grouper												
Sciaenops ocellatus	Red Drum												
Lutjanus campechanus	Red Snapper												
Rhomboplites aurorubens	Vermilion Snapper												
Seriola dumerili	Greater Amberjack												
Mycteroperca bonaci	Black Grouper												
Balistes capriscus	Gray Triggerfish												
Lachnolaimus maximus	Hogfish												
Epinephelus striatus	Nassau Grouper												
Hyporthodus flavolimbatus	Yellowedge Grouper												
Hyporthodus niveatus	Snowy Grouper												
Seriola rivoliana	Almaco Jack												
Lutjanus cyanopterus	Cubera Snapper												
Mycteroperca phenax	Scamp												
Epinephelus drummondhayi	Speckled Hind												
Lopholatilus chamaeleonticeps	Tilefish												
Mycteroperca venenosa	Yellowfin Grouper												
Mycteroperca interstitialis	Yellowmouth Grouper												
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Lutjanus analis	Mutton Snapper												
Hyporthodus nigritus	Warsaw Grouper												
Scomberomorus maculatus	Spanish Mackerel												
Scomberomorus cavalla	King Mackerel												
Cynoscion nebulosus	Spotted Seatrout												
Archosargus probatocephalus	Sheepshead												
Paralichthys lethostigma	Southern Flounder												
Pogonias cromis	Black Drum												

Figure 4: This draft table of spawning times by species illustrates the spawning season in the Gulf of Mexico in grey and the peak spawning season inside the Gulf in black for each species. This is a draft and should not be used or reproduced until a final version is available. It is presented for illustrative purposes only.

Vulnerability Analysis:

Brad Erisman offered a session to explain a vulnerability analysis we are in the process of completing for each selected species. The analysis is adapted from one developed by Jan Robinson. The session began with a presentation by Jan that provided an overview of his vulnerability analysis framework, one that is analogous in structure and process to traditional Productivity-Susceptibility Analyses (PSAs) but augmented to focus specifically on spawning aggregation fisheries in data-poor situations. The analysis includes a suite of intrinsic (biological) and extrinsic (fishing related) factors that have been demonstrated to influence the vulnerability of aggregation-spawning fishes to fishing. After providing a summary of results on the majority of intrinsic factors based on existing information, workshop participants were offered the opportunity to provide scores and feedback on three parameters that require expert knowledge since the information is not explicitly available elsewhere: (1) spawning aggregation type; (2) magnitude of density change between spawning and non-spawning periods; and (3) aggregation duration (for a single spawning period). The second half of the session involved explanations and feedback on the rubric used to score and complete the analysis associated with extrinsic factors (e.g. fisher knowledge of aggregation sites, existing

spatial regulations for aggregations). The main conclusions and outcomes based on the presentations, exercises, and feedback of participants were as follows:

1. Even among experts, there are significantly different perspectives among those representing different agencies or regions, on what constitutes a spawning aggregation and the different types of aggregations. This variation presented challenges in species evaluations.
2. The basic idea of the analyses made sense to the participants but most participants lacked the data to be able to evaluate or parameterize values for each species. Despite this challenge, test analyses of 3 intrinsic parameters did produce results that indicated a reasonable consistency in the scoring of focal species among participants (Figure 5).
3. There was a striking difference between data availability within US Gulf of Mexico waters versus that for most aggregation fisheries elsewhere in the world. We have excellent landings and effort data and few data on the timings and locations of spawning aggregations, while most aggregation fisheries are in the opposite situation.
4. The rubric and parameters associated with extrinsic analysis was far more complex than initially anticipated. The rubric requires streamlining and weighting values by seasonal catch during the spawning season the Gulf of Mexico. Care must be taken to avoid double-counting, as many variables are highly correlated.

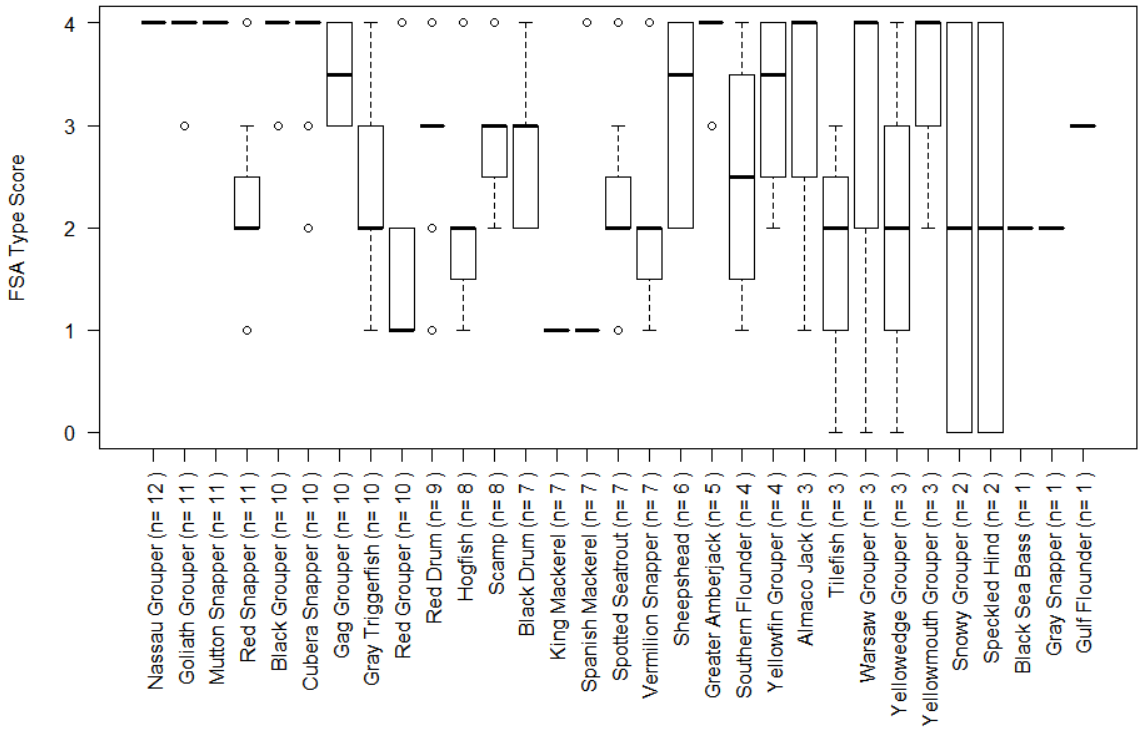

Figure 5. Participant scores of aggregation type where 4) transient spawner, 3) mixed, 2) resident, 1) does not aggregate to spawn and 0) don't know. Participants show strong agreement that Nassau grouper, Goliath Grouper and Mutton Snapper are transient spawners but show less confidence and less agreement on other species.

Cooperative Monitoring Protocol

Will Heyman presented a draft version of a cooperative monitoring protocol for spawning aggregations for use in the Gulf of Mexico. Heyman pointed out that given reduced budgets for research and assessments and increasing interest in fishermen in helping to manage resources sustainably, there is large and increasing need for cooperative research. Since fishers typically have knowledge of the FSA times and locations we designed a protocol that will allow fishers and scientists working together to collect robust field data to characterize spawning sites. The protocol provides standardized and repeatable methods (e.g. drop cameras, biological sampling, catch and effort, etc.) and data sheets for use by teams of fishers and scientists. Iterative use of the techniques could be used for monitoring. Several of the techniques within the protocol are presently in use in a variety of locations for characterization and monitoring (e.g. Mexico and Belize). Summary comments and recommendations from this section included:

1. There is a big need to characterize sites in the Gulf of Mexico, given that so few are actually known. This protocol should be valuable in guiding characterization efforts.
2. Participants were generally supportive of the characterization aspects of the protocols with some suggestions for additions but generally considered that longer term monitoring aspects may require additional techniques and focus before adoption.
3. Participants recommend finalizing the protocol for characterization and suggest that monitoring needs should be expanded in subsequent iterations.

Implications for Fisheries Management and Research Priorities

Will Heyman led discussions on implications of the work presented in the workshop for fisheries management. Similar discussions focused on research priorities. Discussions focused on the lack of known and characterized sites on one hand and the need to incorporate reproductive information into stock assessments on the other. Participants highlighted that current methods used to calculate spawning potential ratios (SPR) or total egg production are poor predictors of stock productivity and inadequately measure the impacts of fishing on productivity. There was a fair bit of overlap in the recommendations that emerged from these sessions. Recommendations are divided below into management actions and research priorities.

Fisheries Management:

1. Since so few sites are actually known, fishermen and scientists should work together to characterize additional sites and these should be recommended for protection.
2. Develop an adaptive regulatory framework to protect spawning areas. The South Atlantic Council's Amendment 36 provides a useful template.

Research Priorities

1. Develop scalars that could incorporate reproductive behaviors, timing, and parameters into existing stock assessment frameworks and models.
2. Evaluate the use of artificial reefs, especially oil and gas platforms as spawning sites for focal species.

Appendix 1: Workshop Agenda and Participants

Workshop: Cooperative monitoring program for spawning aggregations in the Gulf of Mexico: an assessment of existing information, data gaps and research priorities

Program: NOAA RESTORE Act Science Program

Dates: 4-5 October 2016

Location: NOAA Fisheries Southeast Regional Office
263 13th Ave S, St. Petersburg, FL

Overall Workshop Objective: A diverse group of stakeholders will review, critique, and vet draft project outputs and define research and monitoring priorities for spawning aggregations in the Gulf of Mexico.

Draft products include:

1. List of 28 focal species for spawning ecology and fisheries research
2. Summary tables for focal species related to spawning ecology and fisheries
3. Process to assess vulnerability for focal species (intrinsic and extrinsic factors)
4. Interactive bibliography and other resources available for focal species
5. Bathymetric data and spawning aggregation site information
6. Interactive website that houses the compiled data and products
7. Cooperative monitoring protocol for spawning aggregations

Workshop Outputs:

1. Review of draft products
2. Recommendations for future research and monitoring
3. Workshop Report

Workshop Sessions:

October 4, 2016 9:00 AM – 5:00 PM
October 5, 2015 9:00 AM – 12:00 PM

WORKSHOP AGENDA

Tuesday October 4, 2016

8:30 Breakfast (provided) and check in

PART 1: Introduction

- 9:00 Welcome and Introductions (Will Heyman)
- 9:10 Project Overview (Brad Erisman)
- 9:20 Keynote: Science/management of spawning aggregations (Chris Koenig)
- 9:55 Presentation on species selection process (Chris Biggs)
- 10:15 Discussion and feedback (Facilitator: Nick Farmer)
- 10:40 Coffee break

Part II: Presentation of draft products

- 11:00 Presentation on data mining methods and sources (Brad Erisman)
- 11:10 Presentation of draft products and interactive website (Shin Kobara)
- 11:30 Discussion and feedback (Facilitator: Nick Farmer)
- 12:15 Lunch (provided)

Part III: Vulnerability analysis

- 1:30 Introduction to vulnerability session (Brad Erisman)
- 1:35 Presentation on vulnerability framework (Jan Robinson)
- 1:55 Presentation and feedback on biological criteria (Brad Erisman)
- 2:45 Coffee break
- 3:00 Presentation and feedback on fisheries criteria (Brad Erisman)

Part IV: Project Implications for fisheries management

- 3:45 Fisheries management implications (Facilitator: Will Heyman)
- 5:00 Day 1 concluding remarks (Frank Parker)

7:00 Dinner/Social

Wednesday October 5, 2016

8:30 Breakfast (provided) and check in

Part V: Cooperative research and monitoring

- 9:00 Presentation of cooperative monitoring protocol (Will Heyman)
- 9:20 Discussion on cooperative monitoring (Facilitator: Nick Farmer)
- 10:00 Discussion on future research priorities (Facilitator: Will Heyman)
- 11:30 Closing remarks (Frank Parker)

List of participants

1 Nick Farmer (SERO)
2 Sue Barbieri (FWRI/UF)
3 Shin Kobara (GCOOS)
4 Chris Biggs (UT)
5 Brad Erisman (UT, SCRFA)
6 Will Heyman (LGL)
7 Erin Reed (UT)
8 Chris Koenig (USF)
9 Wayne Werner (Fisherman, LA)
10 Kevin Boswell (FIU)
11 Jan Robinson (World Bank, SCRFA)
12 Stuart Fulton (COBI, Mexico)
13 Shane Cantrell (CFA)
14 James Loscasio (Mote Marine Lab)
15 Barb Kirkpatric (GCOOS)
16 Benny Gallaway (LGL)
17 Tom Weatly (Pew)
18 Holly Binns (Pew)
19 Arnaud Gruss (RSMAS/GOMEWOW)
20 Alejandro Acosta (FWC)
21 Alexis Trotter (FWRI/UF)
22 Frank Parker (NOAA RESTORE)
23 Steve Giordano (SERO)
24 Frank Helies (SERO)
25 Tom Weatly (Pew)
26 Robert Ellis (FWC FWRI)
27 Caitlin Young (NAS)
28 Laura Crabtree (FWRI)
29 Hayden Staley (UF/FWRI)
30 Kerry Faherty-Walia (FWC/FWRI)

Partial participation

31 Scott Hickman (Fisherman, TX)
32 Buddy Guindon (Fish Dealer, TX)
33 Don DeMaria (Fisherman, FL)
34 Steve Murawski (USF)
35 Rick DeVictor (SERO)
36 G.P. Schmall (FGBNMS)
37 Brad Gorst (Fisehrmen, FL)