Research Priorities and Recommendations to Support Interjurisdictional Fisheries Management

ATLANTIC COBIA

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2020 Benchmark Stock Assessment Recommendations
Stock ID Workshop

Genetics

- Collect and analyze more samples from Jacksonville, Florida through Brunswick, Georgia along the Atlantic coast.
- Evaluate potential substructure within the Gulf of Mexico stock, including potential population substructure in Tampa Bay, along the Florida panhandle, and in the existing sample distribution gap off of Louisiana.
- Additional life history studies to document spawning locations outside of coastal South Carolina.
- Examine inshore versus offshore genetic structure in other states that harbor year-round inshore populations.
- Samples should be distributed temporally throughout the spawning season, which can vary by location. Samples obtained outside of the spawning season may not reflect the genetic stock being sampled, given observed movement of some individuals from spawning grounds.

Life History/Biology

- **More, randomly-collected age samples throughout the range of cobia**
  Cobia are exploited primarily by the charter boat fleet and private recreational fishery. Randomly collected biological samples of cobia from the recreational fishery will provide essential data inputs to stock assessments. Only 130 new age data points spanning 18 years from the GOM have been made available since SEDAR 28. The majority of all age samples were collected from South Carolina and Virginia. Most of those samples were from carcass collection programs from the recreational fishery, which may not be able to be used to characterize the fishery landings due to the non-random sample collection method.
- **Reproductive biological information throughout the range of cobia**
  No reproductive data exists for the east coast of Florida and the Florida Keys. More specific information on the locations of spawning is needed, and in particular from both estuarine and offshore waters. Estimates of fecundity need to be made throughout the

range of cobia. Since SEDAR 28, no significant additional reproductive sampling has been conducted. The majority of the data used in that assessment was published in 2001 and 2002 with some newer data from South Carolina. In SEDAR 28, it was noted that few fish were sampled at small sizes (ages 0-2) before they enter the fishery at age 3 and that even the 3year olds may have been the largest 3 year olds due to the size regulations. Relying on fishery dependent sampling, where the recreational minimum size limit is 33 inches FL in the Gulf of Mexico and increasing to 36 inches FL in the south Atlantic, results in only sampling fish likely to be mature. Additional sampling, particularly at smaller sizes and younger ages, would help to better define the steepness of the maturity curve and the proportion mature at age. Fish in this size range have traditionally been difficult to locate and sample so having information on fish at these sizes would also help to delineate habitat requirements for juvenile fish. It was also noted in the stock ID workshop that none of the samples collected for Brown-Peterson et al. (2001) were from the southeastern portion of Florida or the Florida Keys and sampling was likely minimal from the east coast of Florida in general. This data gap is important to fill, particularly given the acoustic tagging data that suggests the possibility of a resident Florida group and not having clear information on from where these east coast Florida fish recruit (e.g. are they migrants from other areas or is there reproduction occurring in this area?).

- **Information on larval dispersion is needed to elucidate stock structure of cobia**
  While larval data was submitted late to the workshop (see SEDAR 58 Working Paper S58-SID09), most of the larval data collected at this point comes from the Gulf of Mexico with less effort conducted in the Atlantic. While Cobia larvae were present in many of the Gulf of Mexico samples, very few positive Cobia larvae tows were observed in the South Atlantic. Previous work in South Carolina (Lefebvre and Denson 2012) and Chesapeake Bay (Joseph et al. 1964) suggest that Cobia on the east coast use some estuaries for spawning, although there is likely an offshore spawning contingent also. More information on larval presence/absence, particularly from the east coast of the United States, could help to better define where fish are spawning and suggest other unique spawning sub-groups. A better understanding of spawning locations may also allow for predictions on how and where larvae are dispersed, providing support for the observed genetic differences, and possibly helping to define the stock boundary area.
- **A fishery-independent survey is needed to monitor cobia and obtain biological information** on cobia below the minimum size limits imposed on the fishery.
- **Ecosystem studies are needed for cobia with regards to prey availability and energetics** to better understand growth differences of the species throughout its range.

Spatial Distribution

Movement Priorities

- Refine understanding of ATL-GOM boundary and zone of uncertainty by installing acoustic arrays between Canaveral FL and Brunswick GA, plus more tagging in this region.
- Try to detect overwintering fish by extending acoustic arrays to shelf break
- Determine spawning grounds by sampling for ripe adults/ichthyoplankton

- The Spatial Working Group felt that it was important to undertake another stock ID process in approximately three years, and before the next assessment, to incorporate data that is anticipated in the next few years (there are many acoustically-tagged cobia presently at large).

Telemetry

Stock boundary and zone of uncertainty

- Improve spatial resolution near the existing stock boundary (GA-FL line) by adding additional acoustic arrays between Canaveral FL and Brunswick GA.
- Tag additional fish in the same area and extend tagging to Savannah GA using acoustic, conventional, and PSAT tags, with distribution of tagging effort across seasons.

Onshore-offshore movement and overwintering

- Extend existing acoustic receiver arrays to the shelf break and add additional receiver arrays between Canaveral FL and Brunswick GA. In some cases this will mean that acoustic receivers cannot be deployed and recovered by divers, but there may be buoys that can be attached to. In addition, acoustic releases can be used to deploy and recover receivers in deep water, depending on presence of bottom-trawl fisheries or other hazards.
- PSAT tagging of fish from FL to VA, and northern GOM, to understand over-wintering habitat, which can provide locations where there are no receivers and no fishing effort.
- Since there is presently decreased fishing effort in the putative over-wintering areas (e.g., offshore), increased sampling in these areas could be useful.

Existing detection network

- It is very important that the existing acoustic network remains in place and functional, which will require ongoing funding and effort (e.g., Chesapeake Bay, Pensacola Bay, offshore areas of NC). Some of the existing receiver arrays may be in projects that are closing down, so there is some risk that portions of the tracking network will be removed in the near future (e.g., Navy array at Chesapeake Bay mouth).

Conventional tagging

- More conventional tagging data is needed in data poor areas of Georgia and North Florida, along with the Cape Canaveral area, where little recent tagging data is available. In areas where cobia are available for much of the year, programs should focus on tagging over multiple seasons to ensure that any differing movement behaviors are represented.
- Cooperative tagging programs exist in VA and NC and in GOM; increase cooperative tagging in SC, and begin tagging in GA and the FL east coast.
- Ideally, auxiliary experiments to estimate tag shedding (e.g. double tagging) and tag reporting (e.g. high and low reward tags) are done as part of new or ongoing conventional tagging studies. This auxiliary information allows for estimation of fishing and natural mortality rates from the conventional tag returns.

Other topics

- Analyze existing PSAT data to get environmental preferences, particularly for overwintering individuals.
- Use oceanographic databases to determine temperature for time-location detections of cobia in acoustic dataset, and fishery presence-absence survey data.
- Look for existing plankton survey data. Determine if new ichthyoplankton research is planned or possible.
- Establish/continue collection programs to help identify spawning locations in all regions. This would include collecting gonads, otoliths, and genetics. NC and SC are collecting from dock sampling programs (genetics) and carcass collection programs (gonads). Similar programs in other regions would yield useful data.

Overall

- In addition to the research recommendations above, the Panel recommends that cobia stock ID should be re-evaluated in three to five years.

Stock ID Review Workshop

- An enhanced understanding of the spatial distribution and interannual variability in recreational fishing effort is needed to understand if recent increases in landings have been driven by changes in stock abundance, effort, or spatial distribution of the exploited stocks. This appears to be a critical element to determine if recent harvest levels represent overfishing or a growing stock. The commercial landings data are minimally informative given short seasons, limited harvest allocations, and that most landings are the result of incidental catch during other targeted fisheries.
- Future research should further explore if discrete genetic stocks exist along the Atlantic Coast and Gulf of Mexico. Existing data supports at least some population substructure along the Atlantic Coast, and there are some indications of additional substructure along the Gulf Coast. Concerns were voiced from the public that local stocks may be overexploited under a coastwide management framework. If substructure occurs, the overall abundance of coastwide stocks are expected to show increased stability (e.g., a portfolio effect sensu Shindler et al. 2010), but overfishing of specific stocks may lead to reduced overall catch.
- Existing fishery independent surveys encounter few cobia, and offer little information on trends in abundance. It would be very beneficial to develop a survey design that characterizes temporal trends in the abundance of stocks. At the present, it is very difficult to distinguish changes in abundances versus changes in fishing effort.
- Genomic markers for stock delineation should be considered. The microsatellite studies to date estimated large effective population sizes, which suggests slow rates of neutral genetic drift among populations, especially if some gene flow occurs. As a result, relatively small levels of genetic differentiation exist between units, and the power of genetic assignment testing is limited. A genomic approach with a much larger number of SNP loci may offer enhanced resolution of stocks. In particular SNP loci that are under selection may show much higher levels of differentiation (and thus discriminatory ability)

than microsatellites. Several new population genomics approaches (e.g. Genotyping-bythousands and Rapture) and rapidly decreasing sequencing costs are making populationscale genomics increasingly tractable.

- Additional studies are needed to understand the migratory patterns of cobia, particularly during the winter months when offshore habitat use may be more prevalent. Studies using offshore receiver arrays or pop-off satellite archival tags may be particularly instructive. Stable isotope analysis of bony structures may also be informative.

Data Workshop

Life History Research Recommendations

Carcass donations

- Validate the carcass collection programs as representing the recreational fishery. E.g., Side-by-side comparison to a random port sampling program.
- State agencies should work together to achieve more consistency in their programs.
- Increase public education for the importance of the programs.
- Expand the geographic range of the donation sites.

Reproductive recommendations

- Histological processing of all gonad tissue to better estimate the maturity schedule of Atlantic cobia. In particular, focus on the fish aged 0 – 3 years and cover full geographic range of the species.
- Determine the contribution to the population from the inshore spawning stock and the offshore spawning stock.
- Obtain estimates of fecundity and periodicity of the Atlantic cobia stock.

Stock ID

- Use otolith chemistry techniques to elucidate the contribution of inshore and offshore spawned cobia to the Atlantic population.
- Expand genetics studies to refine the possible stock separation of the inshore and offshore segments of the population.

Tagging studies

- Direct tagging studies to obtain estimates of mortality
- Determine tag retention and reporting rates
- Hold a workshop to ensure consistent tagging methods across states at the program level.

Commercial Research Recommendations

- Programmatic funding should be allocated to expand existing observer coverage to ensure complete spatial coverage for the South Atlantic.
- Funding should be allocated towards the development of standardized map products.
- This includes various federal and state logbook grids from Maine to Texas.
- All grids need to include SDO registration.

- Includes translation tables between each grid.
- Creation of map products that compare commercial fishing effort between the CFLP and state trip ticket data.
- Develop statistically robust discard estimation techniques.
- Standardize how effort data are collected, processed, and utilized in relation to catch.
- There may be inconsistencies among commercial data sets for effort, since there is not a vessel permit required for cobia rather an individual catch limit.
- A single trip ticket may group multiple individual catches together with total effort, while multiple trip tickets may separate individual catch yet replicate the vessel effort.
- Create outreach strategies to further enhance the implementation plan for the commercial electronic logbook and include state partners. This will increase the data validity.
- This data collection effort will greatly improve reporting periodicity, reduce recall basis, provide increased spatial trends, provide more robust discard data, this list is endless, but should address where this data will fill in data gaps within a SEDAR
- The group recommends a workshop to establish a best practice for converting landings (e.g., gutted to whole weight).
- This workshop should address multiple species and jurisdictions.
- The group suggests that the partners include cobia in an RFP for updating federal and state specific conversion factors.
- The group recommends a workshop to establish a best practice for assigning uncertainty to landing series, as recommended in the best practices workshop.

Recreational Research Recommendations

- Increase proportion of fish with biological data within MRFSS sampling.
- Efforts are ongoing to collect more biological data such as length and weight for fish sampled within MRIP.
- Continue to develop methods to collect a higher degree of information on released fish (length, condition, etc.) in the recreational fishery.
- In 2016, Virginia developed a cobia permit data application that specifically collects information on released fish. Full description of this program can be found in section 4.3.4 of SEDAR 58.
- North Carolina is also working on a coast-wide discard application that could provide information in the future.
- Require mandatory reporting for all charterboats state and federal.
- Establishment of federal logbooks for charter captains that have valid federal finfish permits is pending approval and implementation is expected in summer of 2019.
- State logbook are still a work in progress with no current actions pending.
- Continue development of electronic mandatory reporting for for-hire sector.
- Southeast For-Hire Integrated Electronic Reporting (SEFHIER) is currently working to provide more robust for-hire data that is timely and can be integrated with existing programs.
- Continued research efforts to incorporate/require logbook reporting from recreational anglers.

- Two applications that have been created and are currently used by the recreational fishery along the Atlantic coast are My Fish Count and VA cobia permit. There is one pending application from North Carolina that will be a coast-wide application for released fish.
- Establish a review panel to evaluate methods for reconstructing historical landings (SWAS, FWS, etc.).
- FHWAR method was reviewed by assessment panels and established as "Best Practice" in SEDAR Data Best Practices procedural workshop.
- Quantify historical fishing photos for use in reconstructing recreational historical landings.
- SAFMC FIS funded 2018-2019
- Narrow down the sampling universe. Identify angler preference and effort. Require a reef fish stamp for anglers targeting reef fish, pelagic stamp for migratory species, and deep water complex stamp for deep-water species. The program would be similar to the federal duck stamp required of hunters. This would allow the managers to identify what anglers were fishing for.
- National Saltwater Angler Registry
- VA cobia permit
- Continue and expand fishery dependent at-sea-observer surveys to collect discard information, which would provide for a more accurate index of abundance.
- Continued in Atlantic but expansion is funding limited
- Research recommendations
- Improve recreational reporting applications –
- Standardized across states (i.e., Harbor Light Scamp app, My Fish Count app).
- Capable of capturing length with photo.
- Standardize carcass collection protocols across states.
- Increase recreational biological sampling (i.e., NC, GA).
- Increase citizen Science involvement in tagging and tissue collection efforts.

Indices research recommendations

- SEDAR 28 DW - Explore SEFIS video data as a potential fishery independent index of abundance for cobia.
- The SEFIS video data are collected in association with the chevron trap survey and were evaluated for use in SEDAR 58. This survey focuses on bottom species and takes place outside of the primary cobia season. Cobia have been observed on very few occasions (1-3%) in the videos. It is unlikely that this survey would provide a useful index of cobia abundance.
- SEDAR 28 DW - Using simulation analysis, evaluate the utility of including interaction terms in the development of a standardized index and identify the potential effects these interaction terms have on stock assessments.
- Simulation analyses evaluating the utility of including interaction terms in developing a standardized index, to our group's knowledge, have not been attempted for cobia.
- SEDAR 28 AW - Develop a fishery-independent sampling program for abundance of cobia and other coastal migratory species. Fishery -dependent abundance indices used in this assessment were uncertain in part due to the lack of an effective sampling methodology.

- No new fishery-independent surveys have been implemented for cobia and other coastal migratory species.
- Research Recommendations
- Develop a fishery-independent sampling program for abundance of cobia and other coastal migratory species.
- Improve MRIP coverage for rare event species
- Improve validation methods for SC Charter Logbook
- Improve effort definition of gear and target species within trips (mixed effort)

Discard mortality Research recommendations

- SEDAR 28-During discussion at the data workshop it was noted that the logbook categories for discards (all dead, majority dead, majority alive, all alive) are not useful for informing discard mortality. Consider simplified logbook language in regard to discards (e.g., list them as dead or alive).
- New recommendation based on same concern: The group recommends that the SEDAR send a recommendation to the Southeast Fisheries Science Center (SEFSC) Fisheries Statistics Division Director clarifying the discard disposition. The group also noted that obtaining adequate discard data is best achieved by collaboration with stakeholder and state/federal partners.
- SEDAR 28- Further research is needed on cobia release mortality.
- The discard mortality ad-hoc group addressed this recommendation from SEDAR 28 and agree that additional research is still needed on cobia release mortality.
- New SEDAR 58 recommendations:
- The group recommends continuing electronic tagging to estimate release mortality and total mortality. Increases in spatial coverage (i.e. receiver arrays) and the number of tags both spatially and temporally to increase the precision of mortality estimates. Furthermore, elucidating the effect of temperature on discard mortality through the use of temperature tags.
- The group recommends the use of conventional tagging. The tagging of telemetered fish informs the fates (i.e. harvest or catch and release of the telemetered fish). For all conventionally tagged fish, high value tags are need to estimate tag reporting rate and estimates of tag loss.
- The group recommends a SEDAR/council/state or regional management (ASMFC) sponsored tagging workshop to codify methodologies.

Ecosystem research recommendations

- Determine locations of all genetically distinct population segments
- Identify spawning aggregations and duration and timing of spawning
- Further characterize spawning habitat: salinity, water temperature, day length, habitat type (i.e. structured, vegetated, sandy)
- Identify the habitat of 0-2 year olds juveniles and sub-adults
- Determine habitat use during the winter
- Document the distribution and mechanism for transport of eggs, larvae and post-larvae

- Evaluate the impacts of increased temperature, increased eutrophication of estuarine and nearshore waters, and decreased salinity on egg, larvae and juvenile survival
- Evaluate the impacts of increased temperature, increased eutrophication of estuarine and nearshore waters, and decreased salinity on the food web supporting larvae and juveniles
- Determine factors affecting changes in growth, maturity at age, egg production, and sex ratio as temperature increases forcing a change in habitat use
- Identify threats to different life stages by invasive species
- Better understand the relationship between prey species and co-occurring species (blue crab, calico crab, hardhead catfish, eels, cownose rays etc.)
- Identify levels of pollutants (mercury, microplastics, ethinyl-estradiol) affecting cobia and determine the impacts on growth, maturity at age, egg production, sex ratio and behavior

Socio economic research recommendations

- Obtain better data (e.g., more comprehensive and timely) to estimate the annual economic impacts, net benefits, and economic contributions of recreational and commercial Atlantic cobia fishing on coastal communities and regions.
- Obtain cost and expenditure data for recreational fishing trips targeting cobia by fishing mode, for different states, and for anglers returning to private sites, who would not be sampled by the MRIP.
- Estimate willingness-to-pay associated with recreational cobia angling.

Assessment Process

- Develop a fishery independent sampling program for abundance of cobia and other coastal migratory species.
- Fishery dependent abundance indices used in this assessment were uncertain in part due to the lack of an effective sampling methodology.
- Implement a systematic age sampling program for the general recreational sector. Age samples were important in this assessment for identifying strong year classes but sample sizes were relatively small and disparate in time and space.
- Better characterize reproductive parameters including age at maturity, batch fecundity, spawning seasonality, and spawning frequency.
- Age-dependent natural mortality was estimated by indirect methods for this assessment of cobia. Telemetry- and conventional-tag programs for cobia should be maintained as they may prove useful for estimating mortality.
- Better characterize the migratory dynamics of the stock and the degree of fidelity to spawning areas.

Review Workshop

The RP reviewed the large list of research recommendations made by the DW and AW groups. The RP recommends that the following DA and AW research recommendations should be given high priority because of the importance to the stock assessment model:

- Because the fishery-dependent index ended in 2015, development of a new index, either fishery-dependent or preferably fishery-independent, should be given top priority.

Without an index of abundance, it is unlikely that stock status would be able to be estimated with any reliability in future. The RP recommend exploring other fisheries-dependent CPUE sources if available, developing fisheries-independent surveys such as egg/larvae surveys or close-kin methods, expanding analysis of the ten-year SERFS baited trap-video survey for cobia, or exploring the use of tag-data as potential indices of abundance.

- Given that age composition data are an important source of information for the assessment model, methods to increase sample size (such as expanding carcass collection locations and establishing similar programs in other states) should be implemented. In addition, development of sampling programs to collect size and age information on fish released in the recreational fishery should be a priority.
- The uncertainty in the stock status would be improved if better information on age-at-maturity and annual sex ratios were collected.
- Natural mortality is an important parameter that affects model estimates of recruitment and spawning stock biomass. The RP recommends that estimates of natural mortality be made using tagging data or other analytical approaches (e.g., meta-analysis, catch-curves, etc.) for use in the model or to ground-truth the life-history invariant method used currently.