Proposal for funding made to the
Coordinating Council and the Operations Committee
Atlantic Coastal Cooperative Statistics Program
1050 N. Highland St., Ste. 200 A-N
Arlington, VA 22201

FY21: SAFIS Expansion of Customizable Fisheries Citizen Science Data Collection Application

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August 17, 2020

Atlantic Coastal Cooperative Statistics Program
1050 N. Highland St. Ste. 200 A-N
Arlington, VA 22201

We are pleased to submit the proposal titled, "FY21: SAFIS Expansion of Customizable Fisheries Citizen Science Data Collection Application". This application is being submitted as year 2 of the FY20: SAFIS Expansion of "SAFMC Release" and "NC DMF Catch U Later" Discard Reporting Applications" funded project. This proposal has been revised from the original proposal submitted on June 11, 2020. Reviewers did not provide specific questions for this proposal, but Project PI's made sure the guidance provided to all proposals was addressed in this revised version.

The FY21 proposal builds on the work that will be completed through the FY20 project but also incorporates some new objectives. A summary of the FY21 proposal objectives are below, highlighting the changes in scope of work.

- The FY21 proposal will continue data collection for the SAFMC Release project using the ACCSP release reporting tool developed via the FY20 project.
- The FY21 proposal will continue the development of the integrated, customizable fisheries data application. As part of the FY20 project, scoping meetings will be held with ACCSP, Harbor Light Software, and ACCSP partners and technical committee representatives to begin planning for the development of this app. These meetings will identify the project scope and approach, as well as, identify data fields to include in the future app. Using the information gained from the FY20 scoping meetings, the FY21 project proposes to expand the data collection fields available in the customizable app both within and beyond discard reporting to support development of citizen science and other non-traditional data collection projects among partners.
- The FY21 proposal includes a survey of SAFMC Release project participants to help inform the expansion of the customizable app and improve volunteer engagement.
- The FY21 proposal will work to develop a socio-economic project based on input from the FY20 scoping meetings to push the flexibility of the app beyond biological data collection.

- The FY21 proposal's primary program priority remains biological sampling (90%). However, the secondary module has changed from catch and effort (10%) to socio-economic (10%).
- The FY20 proposal was submitted by SAFMC and NCDMF. The FY21 proposal is being submitted by SAFMC. Although NCDMF is not a partner on the FY21 proposal, they have provided a letter of support (see Appendix 1).

Before submission of the initial proposal in June, project PI's consulted with ACCSP staff and decided to submit this as a maintenance proposal since it built on the FY20 project. During their July 2020 review, the Operations Committee and Advisors did not note concern about this proposal being submitted as a maintenance proposal with the changes in scope identified above.

Best,

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Applicant Name: South Atlantic Fishery Management Council (SAFMC)

Project Title: **FY21: SAFIS Expansion of Customizable Fisheries Citizen Science Data Collection Application**

Project Type: Maintenance

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Requested Award Amount: $114,792

Requested Award Period: One year upon receipt of funds

Submission Date: August 17, 2020

OBJECTIVES:
- Continue development and construction of an integrated, customizable fisheries data application to provide more efficient data collection and reduce future needs for individual applications.
- Continue data collection under the ACCSP release reporting tool via the SAFMC Release project.
- Expand the data collection fields available in the customizable app both within and beyond discard reporting to support development of citizen science and other non-traditional data collection projects among partners.

NEED:
Fishery managers often consider the biology and sustainability of a fish stock alongside socio-economic values of the resource and fishery when developing fishery management plans. Unfortunately, there are long-standing data gaps which, if researched, could be useful in developing an improved management strategy. Due to limited funding, some organizations have started to collect data using non-traditional methods, such as citizen science, to help address those needs. Examples of this can be seen in recent efforts by the South Atlantic Fishery Management Council's (SAFMC) *Scamp Release* project and North Carolina Division of Marine Fisheries' (NCDMF) *Catch U Later* project that work with fishermen to collect information to better characterize Scamp Grouper and flounder discards, respectively, via the use of mobile applications.

Catch and release mortality has been an increasing component of the total mortality experienced by many stocks. Because released fish are not available for sampling by typical dockside monitoring programs, and observer coverage ranges from limited in commercial and for-hire fisheries to non-existent in private recreational fisheries in the South Atlantic region, there is often no information available to characterize these losses for stock assessment modeling. As a result, improving information on released fish is a common stock assessment research need and is often a top priority in agency research plans. In the ACCSP request for 2021 proposals, information on releases and discards as well as APAIS/MRIP independent biological sampling for recreational fisheries are the #2 and #4 priorities, respectively. Discard characterization and information on discard reduction practices are priorities in the South Atlantic Fishery Management Council's (SAFMC) Research and Monitoring Plan for 2020-2025 and for the SAFMC's Citizen Science Program.

The SAFMC developed the reporting application *SAFMC Release* through its Citizen Science Program to provide information on released Scamp Grouper to be considered for use in an upcoming stock assessment and for future management. *SAFMC Release* provides a streamlined approach for fishermen to provide a picture of discarded fish along with additional details such as length, release location and depth, condition, and use of barotrauma mitigation techniques. Because there is a severe lack of details on discarded fish across all fishery sectors, this app was developed for and is being promoted to all sectors - commercial, for-hire, and private recreational fisheries. The NCDMF has developed *Catch U Later,* a reporting app for recreational discards to enable the separation of flounder

releases into individual species, to collect information on the size of released fish, and information on capture location. Data collected from the *Catch U Later* application will be used to determine the ratio of constituent flounder species within generic flounder discards.

ACCSP and Harbor Light Software have been key partners in the development of both projects with ACCSP providing a portal for data submission and warehousing and Harbor Light Software programming both applications. While both the SAFMC and NCDMF projects are quite different, there is a strong similarity in the tools – the apps – used by each. The SAFMC and NCDMF's FY20 ACCSP project, "SAFIS Expansion of SAFMC Release and NCDMF Catch U Later Discard Reporting Applications", will combine these two apps under the ACCSP umbrella into a single discard reporting tool that can be adapted by other partners in the future. It will expand the species that can be reported through the application to all shallow-water grouper (Red, Gag, Black, Scamp, Yellowfin and Yellowmouth Groupers; Red Hind; Rock Hind; Coney and Graysby) for *SAFMC Release* and to flounder, Red Drum, kingfish (*Menticirrhus* spp.), and trout (e.g. Spotted Seatrout and Weakfish) for NCDMF's *Catch U Later*.

Collecting information on released fish is just one of the challenges faced by ACCSP partners that can be addressed through innovative electronic tools. Given the astounding proliferation of electronic tools in the form of smartphone apps impact nearly all aspects of people's lives today, and the willingness of the public to openly share information and experiences, it is not surprising that apps are increasingly viewed as a promising approach for collecting fisheries data. Electronic applications offer obvious benefits to the challenge of collecting fisheries data not available to traditional sampling efforts. They can be developed to address nearly any fisheries data collection need, reduce data entry errors, improve timeliness, and lower labor demands as has been shown in the transition of MRIP APAIS from paper to electronic data collection. The relative ease with which applications can now be developed may be good for finding innovative solutions to gather data, but it carries the risk of excessive "stovepiping" that results in unique data streams that are difficult to coordinate with other data streams. There is also the risk that a multitude of highly specific applications will impose excessive maintenance costs and lead to confusion amongst the fishing and scientific communities. Therefore, oversight and intentional design are required to ensure that applications collect valid information and that the data collected can be used in management, both of which are core elements in the SAFMC's Citizen Science Program. The SAFMC Citizen Science Program is uniquely situated to address design and data quality concerns through its existing structure to review and support citizen science project development, and to provide coordination through its regional partnerships and infrastructure.

The SAFMC's Citizen Science program was developed over the course of several years with the guidance of a wide array of stakeholders and partners. The program's overall approach is to support projects that fill data gaps and address research needs; to complement existing programs and partnerships; to foster fishermen and scientist collaboration; and to have intentional project design so there is a direct application of the data for use in management or stock assessments. As part of this intentional design, projects supported by the program are encouraged to form a design team of diverse stakeholders (e.g. fishermen, scientists, managers, etc.) to provide guidance throughout the development and implementation of a project. Scientist input is critical to ensure projects are designed so that data collected can meet its intended use and fishermen or other stakeholders input helps ground projects in reality to ensure data collection methods are feasible. Through the development of its

infrastructure, the program has also developed project support resources available through the SAFMC's website.

Funding for citizen science is often limited and developing a comprehensive and flexible app that can be used to collect information from a variety of sources would be extremely helpful in reducing costs for different projects, reducing time needed to create an app from the ground up, and increasing consistency in data fields and structure. The SAFMC and NCDMF's FY20 ACCSP project will begin planning for the development of a comprehensive and flexible reporting tool that could be applied to a variety of fisheries data issues. This is a complex undertaking that would build off the release reporting tool to allow reporting of more data types (e.g. other biological, socio-economic, etc.) collected through non-traditional methods, such as citizen science. The long-term goal is to develop a menu-driven tool that partners could use to easily create a customized app by selecting specific data fields, without the need to develop stand-alone apps for each new project or data challenge. Through FY20 project funding, scoping meetings will be held in 2020-2021 with ACCSP, Harbor Light Software, and ACCSP partners and technical committee representatives to develop a list of data needs and objectives for the integrated, flexible app. These meetings will identify the project scope and approach, as well as, identify data fields to include in the future app. Meetings will focus on data fields necessary to expand the discard reporting tool to better meet partner needs and then identify other data collection needs partners would like to pursue via citizen science and/or other non-traditional methods. For example, the SAFMC Citizen Science Program's research priorities include developing projects to collect additional biological samples (age, maturity, and/or genetic samples) from recreational fisheries, as well as, collecting information on fishing infrastructure throughout the South Atlantic region – both of which could potentially benefit from the development of the customizable application proposed in this project. ACCSP's Recreational Technical Committee is planning to begin discussions on citizen science or voluntary data collection standards for recreational fisheries which will also help inform these scoping meetings.

This proposal will continue data collection on released fish using the ACCSP customized release reporting tool via the *SAFMC Release* project. Using the information gained from the FY20 scoping meetings, the proposal will also expand this tool into an integrated, customizable fisheries data collection application to support citizen science and other non-traditional data collection projects for partners moving forward. The SAFMC's Citizen Science Program is in position to lead and coordinate efforts with other partners in the development of this flexible fisheries citizen science application.

RESULTS AND BENEFITS:
The result of this project will be to provide a customizable fisheries data collection tool set designed for citizen science that is flexible and scalable to meet different partner and management needs and is able to support multiple projects that can be configured to address specific questions across fisheries sectors and jurisdictions. This will reduce costs to develop a new app to collect important data, reduce time for creating a new app which could take over 6 months to create (half of the grant award time period), and improve consistency across apps from multiple agencies for data fields.

This proposal will build on the work done in the FY20 proposal, which aims to create a basic framework for a customizable fisheries app, prototyping support for projects which implement the

existing data collection needs of *SAFMC Release* and NCDMF *Catch U Later* applications. The intent of this proposal is to create a "Project Builder" application that works with an expanded list of data collection fields to build project-specific data collection interfaces. The list of new data fields to be supported will address the needs of newly identified data collection projects in addition to the output of the FY20 scoping process that also addresses the needs of the SAFMC's Citizen Science Program. Project partners anticipate that this framework will be further improved and expanded through future projects. Developing the Project Builder within the SAFIS system will ensure it meets ACCSP data quality and accessibility standards, and it is compatible with existing data collection programs, available to all partners, and kept up to date.

The release reporting application developed through the FY20 project was envisioned as the first step in the development of the customized data collection tool. This project will build an innovative released fish information platform, consisting of a core application used by anglers with iOS and Android functionality for both phones and tablets, and specific profiles, created by the Project Builder interface, tailored to unique projects.

Observer funding across most fisheries along the Atlantic Coast has never been adequate, likely never will be, and many fisheries, such as the private recreational or the commercial snapper grouper hook and line, are challenging to sample through conventional observer techniques due to their sheer volume of participants and small vessels. Although a few specific fisheries are highlighted in this project, the proportion of catch attributed to releases is increasing in many popular fisheries along the Atlantic Coast, indicating that other ACCSP partners likely share the needs addressed by this project. The FY20 scoping meetings will help us understand how the ACCSP discard reporting tool could be further adapted to meet partner discard needs. Additionally, it will identify other citizen science and non-traditional data collection needs shared by ACCSP partners that could be built into this tool.

Partners would benefit by being able to create and use an electronic tool without incurring extensive development costs which could be extremely helpful for citizen science or other voluntary data collection programs where resources are often limited. More funds would be available for volunteer engagement which is critical for project success and is labor intensive. It would also give partners more flexibility in responding to timely research and management needs by allowing them to build and deploy project specific apps quickly. ACCSP would benefit by reducing the need for continual API and report development. A generic tool of this type could prove particularly useful as ACCSP moves from the traditional catch and effort data sources and into warehousing the next tier of fisheries data - biological and socio-economic. ACCSP staff were involved in the development of this proposal. If funded, database structures will be built or modified in SAFIS and the Data Warehouse and adequate storage is available to support this project.

Primary Program Priority Addressed by this Project
The customizable reporting application and the supporting project builder tool developed through this project will continue and further expand a tool to collect biological information on the component of catch that is released, addressing the 2021 Request for Proposal priority 1b and Recreational Technical Committee priority 2. The applications will collect biological and fishery data that is independent of APAIS/MRIP, addressing Recreational Technical Committee priority 4.

The specific benefits to each data type and the rank of the target species within priority matrices included in the app, are addressed for the continuation of the SAFMC project component. The FY20 project scoping meetings will identify additional biological data collection needs for released fish, as well as needs for different types of fisheries data (e.g. other biological and/or socio-economic data) to be incorporated into the app to support future partner projects.

Primary Program Priority: Biological Sampling: 90%
For the SAFMC module, biological information will continue to be collected on released shallow-water groupers (Red, Gag, Black, Scamp, Yellowfin and Yellowmouth Groupers; Red Hind; Rock Hind; Coney and Graysby). in both commercial and recreational fisheries. Scamp, Gag, and Red Grouper are in the top 25% of the biological sampling priority matrix. The commercial snapper-grouper hook and line fleet is #5 in the bycatch priority matrix. The *SAFMC Release* module includes:
- Data Collected for each trip: trip type (commercial, recreational, headboat, charter), date, user (ACCSP ID)
- Data Collected for each fish released: species (user's determination), length (based on ACCSP standards), location, depth, time, fate (dead or alive release), hook type, use of barotrauma mitigation (descending device, venting, line cut), and photograph (to validate and evaluate user IDs and lengths)
- Users may also file a 'no fish released' report

Secondary Module as a by-product: Socio-economic: 10%
This project will work to develop a socio-economic project based on input from the FY20 project scoping meetings to push the flexibility of the app beyond biological data. The specific project idea will be identified during the scoping meetings, developed through the SAFMC's Citizen Science Program, and use ACCSP's socio-economic standards as guidance. The Project Builder will be used to develop the data collection tool for the project.

Stock Assessment and Management Benefits and Impact:
By continuing data collection on discarded fish through the *SAFMC Release* project, as well as expanding the opportunity for other partners to collect data on released fish, the positive impact of this project to stock assessments could be substantial and realized by several ACCSP partners. Stock assessments rely upon accurate information on total catch and removals from the stock and accurately allocating those removals to year classes. For fish that are landed, these requirements can be addressed through straightforward methods such as catch reporting or creel surveying to estimate removals and dockside sampling to collect length measurements and age samples (used by methods such as age-length keys to assign fish to age classes). Surveying and dockside sampling approaches cannot work when the fish are released on the water. Using the South Atlantic as an example that is in no way unique, no information is available to classify the size composition of released fish in the commercial snapper grouper hook and line fleet, the private recreational fleet, or the charter fleet. In some areas, fisheries observers are used to collect information on released fish. Observer coverage is limited due to high cost. Moreover, even if funding were available, logistics and liabilities remain a concern for some

fisheries such as the commercial hook and line snapper grouper fishery which is prosecuted mostly by small vessels, and private recreational fisheries. Extremely limited observer coverage is available for the headboat fleet (primarily funded through ACCSP), but changes in fleet size and behavior raise concerns about the validity of such data to characterize removals from other fishery sectors. This lack of information is a major source of assessment uncertainty, as assumptions must be made to assign released and discard fish into length and thus age classes for the stock assessment.

In years past the lack of accurate information on discarded fish was not a major assessment concern or source of uncertainty, as landed fish generally accounted for the majority of stock removals. However, this is changing as regulations and fishing behavior are leading to increased discarding. For example, in the recent assessment of Red Drum (SEDAR 44[1]), the Review Panel noted catch and release fishing was increasing and as a result estimated total removals from the stock was increasingly sensitive to discard mortality rates and discard losses. The Panel also questioned the validity of an assumption that the length frequency of discarded fish was similar to tagged fish. The assumption was necessary due to the lack of any data on the size of released fish that could be used to assign mortalities from release to appropriate length classes. There are several reasons why such an assumption may be invalid and a source of bias in the assessment results, but the total lack of data precludes even an effort to determine the direction of bias or magnitude of uncertainty. The Review Panel considered this data lack significant and an important issue in the Red Drum assessment.

Consider another example of the target fish of this study. The most recent assessment (SEDAR 53[2]) indicated that over fifty percent of the fishing mortality experienced by Red Grouper is due to discard losses. Given that this stock was found to be overfished and overfishing was occurring, these discard removals are significant, and therefore the assumptions made regarding their size composition are critical. In this instance, the length composition and selectivity for the discard losses was based on observer records from the headboat fishery and it was assumed that these data were representative of all fishery sectors. As noted above, there are no data to test this assumption so its impact on assessment uncertainty and bias is unknown.

A similar lack of information exists to classify the depth where fish are captured and released and the use of barotrauma reducing actions such as venting or descending. Depth and barotrauma reduction are significantly correlated with release mortality rates, but it is difficult to refine the overall release mortality rate applied for a stock assessment without finer scale information on released fish.

Small improvements in estimates of discard mortality, based on data rather than assumption, can result in large changes in the estimated removals from a fish stock. Based on the results of ACCSP-funded headboat observer studies, as cited in the 2019 Recreational Technical Committee proposal, the Red Snapper release mortality was reduced from 37% to 28.5% due to the use of circle hooks. Applying this percentage change to the estimated 2018 MRIP discards reduces the discard losses to the population by 274,000 fish. This is quite a difference when considered in light of the allowable 2018

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[1] SEDAR. 2015. SEDAR 44 – Atlantic Red Drum Stock Assessment Report. SEDAR, North Charleston SC. 890 pp. available online at: http://sedarweb.org/sedar-44.

[2] SEDAR. 2017. SEDAR 53 – South Atlantic Red Grouper Assessment Report. SEDAR, North Charleston SC. 159 pp. available online at: http://sedarweb.org/sedar-53.

recreational harvest of 29,656 fish. This is also relevant for flounder given the current method applies a ratio of observed catch, which is not an accurate representation of released fish. The ability to accurately characterize discards could substantially improve stock assessments and management decisions.

The ==SAFMC's Snapper Grouper== Regulatory Amendment 29, which requires descending devices on-board vessels fishing for or possessing snapper grouper species, ==was recently implemented in July 2020.== Federal law requires comparing the No Action alternative (not requiring) with proposed management actions. Having information on usage of descending devices would have benefited the analysis for impacts of requiring a descending device both in the cost to anglers and for estimating changes in the estimate of discard mortality. Luckily, most stakeholders regarded this as a positive management action but quantitative information on fishing practices that can be collected through a flexible data collection app could be used to make more informed decisions on the impact of management actions.

Data Delivery Plan:
==Data collection projects will be defined by the Project Builder application and will be stored in SAFIS, where they can be downloaded and interpreted by the angler application on a phone or tablet. The angler application will collect data and deliver that data directly to ACCSP through an API, building on the existing API that currently accepts data from== *SAFMC Release* ==and== *Catch U Later*==. Data can be entered by anglers when no internet connection is available and later uploaded to SAFIS when a connection exists.==

APPROACH:

Task A: SAFMC Release Survey (SAFMC)
Work with contractor/graduate student to conduct a survey of *SAFMC Release* participants to get feedback on the *SAFMC Release* app itself and the transition to the customizable ACCSP release app developed during the FY20 project. Survey results will help inform the expansion of the customizable app in this proposal and be used to better design the app and improve volunteer engagement.

Task B: Further build and add enhancements to the existing ACCSP release customizable reporting application to allow partners to develop separate project profiles using menu driven options identified through FY20 scoping meetings.

Harbor Light Software
● Create a Project Builder application which allows partners to create new data collection projects. Set up separate profiles for specific projects identified in the FY20 scoping meetings to be addressed in the app. The project profiles will ensure users are asked questions relevant to the project that matches their trip.
● Architect the angler application to be more flexible in supporting the additional data fields and project definition needs that other partners may have.
● Add additional species and data fields per FY20 scoping meetings.

- Investigate and incorporate into the application, new technologies which assist the accurate determination of length from photographs taken by the mobile devices hosting the application.
- Modification of communication with the ACCSP-provided API to ensure proper communication of data between the client application and ACCSP databases. ACCSP databases will store transaction records as well as photographs.
- Incorporate analytics data to gain insights into usage patterns of the application such as geographic usage of the application or ease of use of particular features. Similarly, incorporate error reporting features to proactively be alerted to reliability issues with the application after it has been deployed.
- QA/QC the application before releases.
- Manage the deployment of the application directly to beta users, and ultimately maintaining a presence in the Google Play Store and Apple App Store.
- Provide second-tier technical support for issues found with the application, including correcting errors found in the implementation of the required feature.
- Investigate features and or modifications which increase the continued use of the application by the citizen science community.

SAFMC
- QA/QC and test application.

ACCSP
- Build appropriate API or modify existing API as needed.
- Update and/or build reports as needed and allow easy access to photos that are linked to the trip records.

Task C: Public Outreach (SAFMC)
- Recruit new participants to further participation in the existing project, *SAFMC Release*, and apply engagement strategies to retain current participants.
- Recruit participants for new citizen science project identified during FY20 scoping meetings.
- Notify ACCSP partners of the new SAFIS application.

Task D: SAFIS Application Deployment (ACCSP)
- SAFIS application deployed.
- Reports available in Data Warehouse to view/download data.

Task E: Data collection, QA/QC, and analysis (SAFMC)
- Data successfully submitted via app to SAFIS/Data Warehouse.
- SAFMC provide QA/QC for data collected through their projects; edit/correct as necessary.
- Data made available for assessment and management, as necessary.
- Continue to explore long term solutions for addressing QA/QC and validation needs of the data (e.g. photographic and species identification), considering volunteers and citizen science approaches.

Metadata
Additional information will be recorded during the project to ensure data collected on released fish through the *SAFMC Release* project is properly addressed in management and stock assessment analyses. This includes regulations, such as seasons and bag limits that directly affect release rates; location and trip type; depth; use of descending devices.

GEOGRAPHIC LOCATION:
The SAFIS application will collect data in coastal South Atlantic waters from North Carolina through the East Coast of FL to the FL Keys via the *SAFMC Release* component. The geographic scope of the project includes all ACCSP partners in all regions, as they will be able to use or modify the application to meet specific project needs. NCDMF and the Rhode Island Division of Marine Fisheries have provided letters of support for the project (see Appendix 1).

FUNDING TRANSITION PLAN:
Project contains a defined end point. This is a one-year project.

MILESTONE SCHEDULE:

Table 1. Milestone Schedule

Task	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
SAFMC Release participant survey/evaluation	x	x	x									
Create app enhancements to existing base code and develop project builder	x	x	x	x	x	x						
Update API and reports	x	x	x	x	x	x						
Feedback from users & incorporating changes/fixes in application				x	x	x	x	x				
Public/Partner Outreach					x	x	x	x	x	x		
SAFIS Application Deployment							x					
Data Collection, QA/QC & Analysis	x	x	x	x	x	x	x	x	x	x		
Semi and Annual Report Writing						x				x	x	x

PROJECT ACCOMPLISHMENTS MEASUREMENTS:

Table 2. Project Accomplishments Measurements

Project Component	Goal	Measurement
SAFMC Release participant survey	Collect feedback on SAFMC Release app and on the transition to the customizable ACCSP release app	Survey complete and feedback collected from user group
Create and add enhancements to SAFMC Application	Modify existing applications to general framework; develop and build Project Builder; gather general feedback	SAFIS application modified based on FY20 scoping meetings and Project Builder complete; updated application tested and ready for deployment
Public Outreach	Continue to promote *SAFMC Release* project and recruit users for new project identified through FY20 scoping meetings	New users recruited and current users retained for *SAFMC Release* project; new users recruited for new project identified through FY20 scoping meetings
SAFIS Application Deployment	Have application easily accessible and available	Application accessible through app stores
Data Collection, QA/QC, and Analysis	Users continue to submit data through the app for *SAFMC Release* project and for the new project identified during FY20 scoping meetings	QA/QC completed; data available for management and stock assessment, as needed

FY21 COST SUMMARY (BUDGET):

Item	ACCSP Share	Partner Share	Total
PERSONNEL COSTS			
SAFMC Personnel Julia Byrd, Citizen Science Program (10%) Chip Collier, Deputy Director (5%)		$8,156 $5,656	$8,156 $5,656
SAFMC Project Coordinator	$45,760		$45,760
Graduate student to conduct survey work	$2,400		$2,400
Indirect Costs (20%)	$9,632		
CONTRACT			
Contractor Software Development	$55,000		$55,000
SUPPLIES			
Recruitment/Retention Promotional Items	$2,000		$2,000
TOTAL	**$114,792**	**$13,812**	**$128,604**
Percentage	**89.3%**	**10.7%**	**100%**

FY21 BUDGET NARRATIVE:

Personnel ($57,792): Personnel funds of $45,760 will be used by SAFMC to hire a Project Coordinator to help oversee the *SAFMC Release* project and help develop and implement the new project identified during the FY20 scoping meetings. Personnel cost is estimated at $22/hour for a year (2080 hours).

Additionally, $2,400 will be used to contract with a graduate student to conduct a survey of *SAFMC Release* participants to get their feedback on the overall app and the transition to the customizable ACCSP release app. Survey results will help inform the expansion of the customizable app in this proposal and be used to better design the app and improve volunteer engagement. Costs are estimated for 120 hours of work at $20/hour.

Indirect charges of 20% are applied to personnel charges for a total of $9,632.

Contractual ($55,000): Harbor Light Software will provide software development services to enhance the *Release + Catch U Later* application developed in FY20, and to build a "Project Builder" application, which allows project owners to create customizable data collection applications. Harbor Light Software will test the software prior to release and manage the applications in the app stores. Costs are based on estimates of 270 hours of software development at $170/hour and 180 hours of QA/QC at $50/hour.

Supplies ($2,000): SAFMC will utilize supply funds to print promotional materials (e.g. wallet cards, postcards) to recruit users for the *SAFMC Release* project and the new project identified during the FY20 scoping meetings. Funds will also be used to purchase small promotional items (e.g. fishing towels, measuring tapes) to help increase recruitment and retention of participants.

FY20 COST SUMMARY (BUDGET):

Item	ACCSP Share	Partner Share	Total
PERSONNEL COSTS			
SAFMC Personnel Julia Byrd, Citizen Science Program (10%) John Carmichael, Deputy Director (5%)		$7,800.00 $6,961.20	$14,761.20
SAFMC QA/QC process part time position	$24,000		$24,000.00
NC DMF Personnel Drew Cathey, Biologist II (10%) Chris Wilson, Biologist Supervisor (5%)		$4,710.10 $3,277.80	$7,987.90
NC DMF QA/QC process part time position	$24,000		
CONTRACT			
Contractor Software Development	$45,000		$45,000
SUPPLIES			
Recruitment/Retention Promotional Items	$500	$1000	$1500
TRAVEL			
In-person meeting	$25,000		$25,000
TOTAL	**$118,500.00**	**$23,749.10**	**$142,249.10**
Percentage	**83%**	**17%**	**100%**

Yellow highlighted comments indicate sections that help with the ranking process.
Green highlighted comments indicate changes made to the initial proposal.

FY20 BUDGET NARRATIVE:

Personnel ($48,000): Personnel funds will be used by SAFMC and NC DMF to each hire   QA/QC process part time position. Personnel cost is estimated at $20/hour for a total of 1200 hours for each position. The positions will assist with Task D: Data Collection, QA/QC, and Data Analysis. Job duties will include assisting with QA/QC and exploring long term solutions for addressing QA/QC and validation needs of the photographic and species identification data, considering volunteers and citizen science approaches.

Supplies ($500): SAFMC will utilize supply funds to print promotional materials (e.g. wallet cards, postcards) to inform users of transition to new SAFIS application and recruit new users. Funds will also be used to purchase small promotion items (e.g. fishing towels, measuring tapes, etc.) to help increase recruitment and retention rates of participants.

Contractual ($45,000): Harbor Light Software will develop the application software, using the software written for the existing *SAFMC Release* and *NC DMF Catch U Later* applications as core reference with enhancements for branding, additional species, modifications to the ACCSP API and flexibility for supporting different data collection profiles. Harbor Light will also provide second-tier technical support, management of the deployment of the application through respective app stores, perform technical feasibility analysis of image-based length determination technologies and identify architectural enhancements to support a wider range of data collection applications.

Travel ($25,000): Travel funds will be used for the in-person workshop associated with Task E to develop needs and objectives for an integrated, flexible application. Workshop will be two days with approximately 20 participants. Estimated costs include meeting space ($5000), participant travel ($10,000) and lodging, per diem, and miscellaneous participant costs ($10,000).

Table 3. Maintenance Project History

Fiscal Year	Title	Cost	Results
2020	SAFIS Expansion of "*SAFMC Release*" and "*NC DMF Catch U Later*" Discard Reporting Applications	$118,500	This project will: combine two similar released fish reporting applications (*SAFMC Release* and *NC DMF Catch U Later*) into ACCSP SAFIS as a single, flexible and customizable release and discard reporting tool that is available to other partners; expand the SAFIS application to increase the species that can be reported; begin planning for development of an integrated, customizable data collection application Funds have recently been received for this project - so work is just starting to get underway. Project partners have met to discuss the overall timeline and impacts COVID-19 may have on the project. Work combining the SAFMC Release and Catch U Later apps will begin in the upcoming months. The SAFMC has begun to revise volunteer training materials for the species expansion to all shallow water grouper. An organizing committee has been formed to begin planning for the FY20 scoping workshop. Due to COVID-19, this in-person workshop will likely transition to a series of virtual meetings.
2021 - proposed	SAFIS Expansion of Customizable Fisheries Citizen Science Data Collection Application	$114,792 - proposed	This application proposes to: continue development and construction of an integrated, customizable fisheries data application; continue data collection under the ACCSP release reporting tool via SAFMC Release project; and expand the data collection fields available in the customizable app both within and beyond discard reporting to support development of citizen science and other non-traditional data collection projects among partners.

Yellow highlighted comments indicate sections that help with the ranking process.
Green highlighted comments indicate changes made to the initial proposal.

<div align="center">**Summary of Proposal for Ranking**</div>

Proposal Type: Maintenance

Primary Program Priority: Biological Sampling - 90%
- The released fish reporting application incorporated in SAFIS will provide a tool for collecting biological information on the component of catch that is released, addressing 2020 Request for Proposals priority 1b and Recreational Technical Committee priority 2. The applications will collect biological and fishery data that is independent of APAIS/MRIP, addressing Recreational Technical Committee priority 4.
- For the SAFMC module, biological information will be collected on released shallow water groupers, in both commercial and recreational fisheries. Scamp, Gag, and Red Grouper are in the top 25% of the biological sampling priority matrix. The commercial snapper-grouper hook and line fleet is #5 in the bycatch priority matrix.

Data Delivery Plan:
- Data collection projects will be defined by the Project Builder application and will be stored in SAFIS, where they can be downloaded and interpreted by the angler application on a phone or tablet. The angler application will collect data and deliver that data directly to ACCSP through an API, building on the existing API that currently accepts data from *SAFMC Release* and *Catch U Later*. Data can be entered by anglers when no internet connection is available and later uploaded to SAFIS when a connection exists.

Project Quality Factors:
- **Multi-partner/Regional impact including broad applications:** This project will continue the development and construction of an integrated, customizable fisheries data collection application. It will expand the data collection fields available in the app both within and beyond discard reporting to support development of citizen science and other non-traditional data collection projects among partners. The geographic scope of the project includes all ACCSP partners in all regions, as they will be able to modify the application to meet specific project needs. The *SAFMC Release* component collects data through the South Atlantic and across all sectors for species with significant release mortality concerns. NCDMF and the Rhode Island Division of Marine Fisheries have provided letters of support for this project (see Appendix 1).

- **Contains funding transition plan:** Project contains a defined end point. This is a one-year project.

- **In-kind contribution:** 10.7%

- **Improvement in data quality/quantity/timeliness**
  - Provides improvement in data quality and quantity.
  - There is currently no data available to assign released shallow water groupers to length classes other than limited commercial and headboat observer effort. *SAFMC Release* collects data on the length of released shallow-water grouper for commercial, for-hire, and recreational fishermen.

Yellow highlighted comments indicate sections that help with the ranking process.
Green highlighted comments indicate changes made to the initial proposal.

- There is limited information available to classify the depth where fish are captured and released and the use of barotrauma reducing actions such as venting or descending. Depth and barotrauma reduction are significantly correlated with release mortality rates. The data collected through *SAFMC Release* provides finer scale information on released fish which can help refine the overall release mortality rate applied for a stock assessment.
  - The development of the customizable application and Project Builder would allow partners to create and use an electronic tool without extensive development costs which would be helpful for citizen science or other voluntary data collection programs where resources are often limited. It would allow more funds to be available for volunteer engagement which can improve data quality and is critical for project success.

- **Potential secondary module as a by-product: Socio-economic - 10%.** This project will work to develop a socio-economic project based on input from the FY20 project scoping meetings to push the flexibility of the app beyond biological data. The specific project idea will be identified during the scoping meetings, developed through the SAFMC's Citizen Science Program, and use ACCSP's socio-economic standards as guidance. The Project Builder will be used to develop the data collection tool for the project.

- **Impact on stock assessment**
  Stock assessment impacts are significant. Assessments rely upon accurate catch data for individual species, accurate assignment of catches to length and thus age classes, and accurate accounting of total population removals including release mortality. This project may help provide such information for fisheries for which it is now lacking.

Other Factors:
- **Properly prepared**
  This proposal follows the guidelines under the ACCSP Funding Decision Process Document.

- **Merit**
  The project is innovative, applying rapidly developing electronic reporting technology to the problem of obtaining critical biological information for released fish. It continues the development and construction of a customizable application that will support citizen science and other non-traditional data collection projects for partners moving forward. Partners would benefit be being able to create and use an electronic tool without incurring extensive development costs, and it would give partners more flexibility in responding to timely research and management needs by allowing them to build and deploy project specific apps quickly.

Summary of Proposal for Ranking – Abridged Version

- **Achieved Goals:** The FY20 project will: combine two similar released fish reporting applications (*SAFMC Release* and *NC DMF Catch U Later*) into ACCSP SAFIS as a single, flexible and customizable release and discard reporting tool that is available to other partners; expand the SAFIS application to increase the species that can be reported; begin planning for development of an integrated, customizable data collection application. Funds for the FY20 project have recently been received, so work is just starting to get underway. Project partners have met to discuss the overall timeline and impacts COVID-19 may have on the project. Work combining the SAFMC Release and Catch U Later apps will begin in the upcoming months. The SAFMC has begun to revise volunteer training materials for the species expansion to all shallow water grouper. An organizing committee has been formed to begin planning for the FY20 scoping workshop. Due to COVID-19, this in-person workshop will likely transition to a series of virtual meetings.

  The FY 21 proposal will: continue development and construction of an integrated, customizable fisheries data application; continue data collection under the ACCSP release reporting tool via SAFMC Release project; and expand the data collection fields available in the customizable app both within and beyond discard reporting to support development of citizen science and other non-traditional data collection projects among partners.

- **Data Delivery Plan:** Data collection projects will be defined by the Project Builder application and will be stored in SAFIS, where they can be downloaded and interpreted by the angler application on a phone or tablet. The angler application will collect data and deliver that data directly to ACCSP through an API, building on the existing API that currently accepts data from *SAFMC Release* and *Catch U Later*. Data can be entered by anglers when no internet connection is available and later uploaded to SAFIS when a connection exists.

- **Level of Funding:** This proposal is year 2 of the "FY20: SAFIS Expansion of "SAFMC Release" and "NC DMF Catch U Later" Discard Reporting Applications" project. Funding for the FY21 proposal decreased from the FY20 project by approximately 3%.

- **Properly Prepared:** This proposal follows the guidelines under the ACCSP Funding Decision Process Document.

- **Merit:** The project is innovative, applying rapidly developing electronic reporting technology to the problem of obtaining critical biological information for released fish. It continues the development and construction of a customizable application that will support citizen science and other non-traditional data collection projects for partners moving forward. Partners would benefit be being able to create and use an electronic tool without incurring extensive development costs, and it would give partners more flexibility in responding to timely research and management needs by allowing them to build and deploy project specific apps quickly.

Yellow highlighted comments indicate sections that help with the ranking process.

Green highlighted comments indicate changes made to the initial proposal.   20

Appendix 1.

ROY COOPER
Governor

MICHAEL S. REGAN
Secretary

STEPHEN W. MURPHEY
Director

To Whom it may concern,

The utility of collaboration with recreational stakeholders for sector specific data collection is gaining attention as a method to address limitations in recreational fisheries data collection. The development of emerging technologies, specifically electronic data capture using phone and tablet applications, is at the forefront of these efforts. The North Carolina Division of Marine Fisheries (NCDMF) is currently collaborating with the South Atlantic Fishery Management Council (SAFMC), Atlantic Coast Cooperative Statistics Program (ACCSP), and Harbor Light Software to develop a phone application for the collection of discard data to address acute data limitations that are vital for management.

North Carolina Division of Marine Fisheries routinely works with stakeholders within our tagging program to address data limitations for multiple species and recognizes the potential to expand these efforts through additional data collection streams. The establishment of a statistically valid methodology that incorporates data collected by stakeholders could prove invaluable for the continued assessment of multiple stocks. As these pilot investigations are evaluated it is likely that fishery managers outside of North Carolina will seek to apply these techniques to address data limitations for both state and federally managed species. The ability to establish standardized data elements that can be mixed and matched within a mobile reporting application will serve to greatly reduce the cost and time required on the front end of project development. Additionally, the centralization of citizen science data warehousing within the ACCSP will facilitate access among partners.

North Carolina Division of Marine Fisheries fully supports the continued evaluation of enhancing data collection through partnerships with recreational stakeholders and feel that the current investigation could potentially provide an invaluable asset for the management of recreational fisheries.

Sincerely,

Barbara Y. Lupton, Deputy Director
NC Division of Marine Fisheries

RHODE ISLAND

DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

DIVISION OF MARINE FISHERIES

Three Fort Wetherill Road
Jamestown, Rhode Island 02835

To Whom it May Concern,

      The Rhode Island Division of Marine Fisheries is writing this letter in support of the project proposal "FY21 SAFIS Expansion of Customizable of Fisheries Citizen Science Data Collection Application" submitted to the Atlantic Coast Cooperative Statistics Program (ACCSP) by the South Atlantic Marine Fishery Council (SAMFC) for consideration for funding in FY2021. Citizen science projects like this one have coastwide utility and has interest in Rhode Island. Additionally, project fits into the NOAA Fisheries recreational strategic plan as well as being a great way to engage stakeholders and encourage by in to Recreational Fisheries management. If implemented it would a great tool to roll out for use by Rhode Island anglers.

Sincerely,

John Lake
Supervising Biologist, RIDMF

Cc: Michael Bucko, APAIS Coordinator RIDMF
Scott Olszewski, Deputy Chief, RIDMF
Conor McManus, Deputy Chief, RIDMF

JULIA ISOBEL BYRD

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North Charleston, SC 29405   Email: julia.byrd@safmc.net

EDUCATION: UNIVERSITY OF CHARLESTON, SC, Charleston, SC
-**Masters of Environmental Studies**, focus on environmental and marine biology,
December 2004

WAKE FOREST UNIVERSITY, Winston-Salem, NC
-**Bachelor of Science** in **Biology**, Minor in **Environmental Studies**, May 2000

WORK EXPERIENCE:
Citizen Science Program Manager, South Atlantic Fishery Management Council (SAFMC; March 2019 – present)
- Provide programmatic leadership and support for the SAFMC's Citizen Science Program
- Develop and deliver training programs to work with participants to design and implement citizen science projects
- Foster collaboration between researchers, scientists, and fishermen to support projects
- Develop grant proposals for citizen science projects and assist program partners in developing grants
- Serve as PI or co-PI on grant supported citizen science projects addressing SAFMC research priorities
- Assist in developing and delivering outreach materials and training related to the Citizen Science Program and projects
- Communicate scientific, technical issues to a variety of audiences
- Build relationships with fishery professionals and stakeholders throughout the Southeast U.S. to develop Program partnerships and help engage more people in the SAFMC's Citizen Science Program
- Staff lead for Citizen Science Projects Advisory Committee and Operations Committee
- Supervise Citizen Science personnel (staff and students) working on citizen science projects

Southeast Data Assessment and Review (SEDAR), South Atlantic Fishery Management Council (SAFMC)
SEDAR Coordinator (August 2012 – February 2019)
- Plan, coordinate and manage SEDAR stock assessment projects and procedural workshops. Duties include project management, work planning, timeline development, brainstorming strategies, problem solving, event planning, and facilitation.
- Chair and/or facilitate SEDAR stock identification, data, assessment, and procedural workshops. Experience includes facilitating variety of group discussions engaging scientists, managers, fishermen, and other stakeholders in order to lead groups through productive discussions and explore different points of view.
- Build relationships with fishery professionals and stakeholders throughout the Southeast U.S. to help engage more people in the SEDAR Stock Assessment Program.
- Communicate scientific, technical issues to a variety of audiences
- Lead re-design of the SEDAR website and serve as SEDAR webmaster.
- Assist with coordination and facilitation of SAFMC's Snapper Grouper Visioning Project
- Assist with the development of the SAFMC's Citizen Science Program. Duties included helping coordinate and facilitate SAFMC's Citizen Science Workshop, helping develop SAFMC's Citizen Science Blueprint, and assisting the Citizen Science Program Manager in developing infrastructure for the Program.
- SAFMC's representative on the Atlantic Coastal Cooperative Statistics Program Operations Committee
- Instructor for Marine Recreational Education Program, Southeast – Science Workshop 2017
- Participate in SCDNR's in-water sea turtle regional abundance and health assessment survey as Chief Scientist or Scientific Crew

South Carolina Department of Natural Resources, Office of Fisheries Management (OFM)
Wildlife Biologist III (August 2005 – August 2012)
- Supervise and coordinate OFM's recreational fisheries dependent data collection and biological sampling, including survey design, field activities, data analysis, report writing, and grants administration
- Provide technical assistance including periodic summaries of fishery and habitat data, and reports requested through routine monitoring of marine resources landings and survey data
- Serve as PI or co-PI on grant supported projects that focus on monitoring, research, or assessment activities designed to provide data necessary to marine fisheries resource managers and decision makers

- Conduct presentations for advisory committees, the general public, and other scientists on a variety of fisheries management and conservation issues
- Analyze commercial and recreational fisheries data from a variety of internal and external data sources
- Work on developing state legislation and public outreach for SCDNR initiatives
- Serve on the SCDNR's Rules and Regulations and Accountability Report Committees providing key outreach materials for the general public and the SC legislature
- Participate and serve as a Chief Scientist for SCDNR's in-water sea turtle regional abundance and health assessment survey
- Develop and manage databases for a variety of fisheries information
- Liaison between SCDNR's State Finfish Survey and the National Marine Fisheries Service Marine Recreational Information Program
- Protected Species liaison for OFM
- Coordinate and respond to NOAA Fisheries proposed rules published in the Federal Register
- SCDNR liaison for the National Saltwater Angler Registry
- SCDNR liaison for the Marine Recreational Information Program
- Help organize and participate in outreach and educational events
- Supervise, develop, and coordinate saltwater commercial and for-hire licensing data QA/QC
- Supervise biologists and hourly employees
- Participate in SEDAR data workshops

TRAINING:
- Smithsonian's Communication & Facilitation Skills for Conservation Managers Course, April 2019
- Management Assistance Team (MAT) Facilitation Skills and More: A Course for Achieving Optimal Results
- Technology of Participation (TOP) Facilitation Methods
- NOAA Coastal Service Center Planning and Facilitating Collaborative Meetings
- Well's National Estuarine Research Reserve Coastal Training Program Collaborative Learning Workshop
- NOAA Coastal Service Center Project Design and Evaluation Workshop
- NOAA Coastal Service Center Public Issues and Conflict Management Workshop
- University of Maryland's Communicating Science Effectively Workshop
- NOAA Coastal Service Center Community Based Social Marketing Workshop
- Basic and Advanced Microsoft Access Training Workshop
- Atlantic States Marine Fisheries Commission Basic Stock Assessment Workshop
- Atlantic States Marine Fisheries Commission Maximum Likelihood Modeling Workshop
- Atlantic States Marine Fisheries Commission Mock Data & Assessment Workshops

PROFESSIONAL MEMBERSHIPS:
- SC Chapter of the American Fisheries Society
- ACCSP Recreational Technical Committee (2010-2012; Vice Chair 2011-2012)
- MRIP Angler Registry Database Work Group (2008-2012)
- ACCSP Operations Committee (2015-present)

SELECTED TECHNICAL PUBLICATIONS AND PRESENTATIONS:
- Byrd, J., J. Carmichael, and J. Neer. 2017. The Importance of Peer Review in SEDAR Stock Assessments. American Fisheries Society Annual Meeting, Tampa, FL. (Oral presentation)
- VonHarten, A. and J. Byrd. 2016. Building a Fishery Citizen Science Program in the U.S. South Atlantic to Improve Management and Policy. 4th International Marine Conservation Congress. (Oral presentation and helped facilitate focus group.)
- Carmichael, J., A. VonHarten, and J. Byrd. 2016. Efforts to Develop a South Atlantic Fishery Management Council Citizen Science Program. NOAA Fisheries Quantitative Ecology and Socioeconomics Training Program Webinar Series. (webinar presentation)
- SEDAR. 2015. SEDAR Procedural Workshop 7: Data Best Practices. SEDAR, North Charleston, SC. 151pp. (editor)
- Byrd, J., B. Floyd, E. Hiltz, M. Reichert, and M. Collins. 2009. Characterization of the mudminnow fishery in South Carolina. South Carolina Department of Natural Resources, Final Report to US Fish and Wildlife Service. 29p.

William R. Collier, II (Chip)

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Current Positions:
Deputy Director for Science and Statistics, South Atlantic Fishery Management Council
Adjunct Graduate Faculty, College of Charleston, Marine Biology Graduate Program

Education:
PhD, Marine Biology, 2017, University of North Carolina Wilmington
B.S., Fisheries Science, 1998, North Carolina State University

Current Research Interests:
Assessing marine protected areas, age and growth of coastal fishes, release mortality, marine fisheries management, stock structure of marine fishes, fishery-dependent data collection, deep-sea coral ecosystems

Professional Experience:
Deputy Director for Science, 2019-Current South Atlantic Fishery Management Council
Fishery Biologist, 2014-2019, South Atlantic Fishery Management Council
Adjunct Faculty, 2018-Current, College of Charleston
Acting Deputy Director for Management, 2017 (two-month assignment),
District Manager, 2012-2014, North Carolina Division of Marine Fisheries
Biologist Supervisor, 2010-2012, North Carolina Division of Marine Fisheries
Fisheries Biologist, 2005-2010, North Carolina Division of Marine Fisheries
Research Assistant, 2008-2010, University of North Carolina Wilmington

Principal Publications:
Spencer, E., C. Collier, K. Dick, B. Fitzgerald. *In Prep*. Snapper Grouper Fisher Perceptions of Electronic Reporting in South Atlantic.

Collier, C., B. Fitzgerald, K. Dick. 2019. MyFishCount Completion Report: A pilot project on electronic reporting for private recreational fishermen in the South Atlantic region. South Atlantic Fishery Management Council, Charleston, SC 109p.

Odell, J., D.H. Adams, B. Boutin, W. Collier II, A. Deary, L.N. Havel, J.A. Johnson, Jr., S.R. Midway, J. Murray, K. Smith, K.M. Wilke, M.W. Yuen. Atlantic Sciaenid Habitats: A review of utilization, threats, and recommendations for conservation, management, and research. Atlantic States Marine Fisheries Commission Habitat Management Series #14. Arlington, VA. 144p.

Collier, C., J. Perry, G. Wright, and J. Facendola. 2013. Testing the utility of otolith morphometrics to detect stock structure for snapper grouper species. Completion Report for Grant Award NA10NMF4740143, NC Division of Marine Fisheries, Morehead City, NC. 37p.

Collier, C., and C.B. Stewart. 2010. Age sampling of the commercial snapper grouper fishery and age description of the black sea bass fishery in North Carolina. Completion Report for Grant # NA06NMF4330057. NC Division of Marine Fisheries, Morehead City, NC. 70 p.

Collier II, W.R., F.C. Rohde, J.H. Schoolfield, and C.B. Stewart. 2008. Assessment of fish populations in the lower Cape Fear River, 2002-2007. Completion Report for Grant # NA16FW1543.   NC Division of Marine Fisheries, Morehead City, NC.

NCDMF. 2008. North Carolina Kingfish (*Menticirrhus* spp.) Fishery Management Plan. Collier, W.R. and J.H. Schoolfield (editors). NC Division of Marine Fisheries, Morehead City, NC