

**COASTAL RECREATIONAL FISHING LICENSE
ANNUAL PERFORMANCE REPORT**

Recipient: Dr. Jeffrey A. Buckel, Dr. Joseph E. Hightower

DMF/CRFL Technical Monitor: Steve Poland

Grant Award #: NCSU Project ID# 556497 (NCDENR Task Order #5110)

Grant Title: Sources of Mortality and Movements of Weakfish Tagged in North Carolina

Grant Award Period: 07/01/13 – 06/31/18

Performance Reporting Period: 7/1/17 – 12/31/17 (6 months)

Project Costs:

| <u>Category</u> | <u>Expenditures</u> |
|------------------------|---------------------------------|
| Personnel | \$126,825 (\$16,731 encumbered) |
| Fringe | \$12,544 |
| Travel | \$5,785 |
| Supplies | \$106,101 |
| Current services | \$7,786 |
| Fixed charges | \$884 |
| Contractual | \$26,738 |
| Other | Tuition = \$26,310 |
| Total Direct | \$312,973 |
| Indirect | \$45,668 |
| TOTAL | \$358,642 |

Total Cumulative Expenditures: \$358,642

Total Remaining Balance: (\$399,827-\$358,642-\$16,731) = \$24,454

Description of Work:

List the project objectives or provide a brief description of the funded activity, giving enough detail to acquaint the reader with the project.

OBJECTIVES:

- 1) To estimate seasonal and annual rates of fishing and natural mortality for legal-size weakfish (>12" or 30.5cm TL).
- 2) To estimate seasonal and annual rates of natural mortality for weakfish in North Carolina tributaries.
- 3) To estimate movement and stock mixing of weakfish along the U.S. east coast.
- 4) To obtain and synthesize diet information for potential weakfish predators

Project Status/Work Accomplished:

For each objective, describe tasks scheduled for the reporting period and the activities undertaken to complete them. Describe the specific accomplishments, and list products (publications, web pages, data, technology, etc.) completed during the reporting period. Attach copies of the publications, as appropriate.

To date, a total of 3,881 weakfish have been tagged (2013=50, 2014=1409, 2015=1130, 2016=1052, and 2017=240). During fall 2017, we had two recreational tag returns. In total, we have had 142 tag returns with 26 being recaptured by commercial fisherman, 91 by recreational fisherman, and 25 by biologists. One fish was recaptured twice (1 and 17 days post-release), and a second fish was recaptured 3 times (10, 19, and 652 days post-release). Not including multiple recaptures, commercial fishermen harvested 22 weakfish and released 4 fish. Recreational fishermen harvested 47 weakfish and released 41. Biologists kept 11 fish for necropsies and released 14 fish. Upon recapture, 14 double tagged conventional fish lost 1 tag (ranging from 3 to 192 days). Approximately 93% or 129 out of 139 recaptures happened within 100 days of release. The 10 fish recaptures post 100 days ranged from 103 to 338 days post-release. Excluding biologist returns and pit tag only tagged weakfish, our return rate was 3.14%.

For the “predation of weakfish by dolphin” objective, a meeting in December with NOAA collaborators reviewed the project’s progress and assigned tasks. A literature search for regression parameters estimating fish prey length from otolith length for 12 prey items is ongoing. To date, the dataset consists of 215 dolphin stranding stomachs from 1998 to 2015. A total of 17 dolphins were censored from the dataset due to problems with the stomach samples (e.g. stomach scavenged by predators or stomachs combined). Weakfish were found in 59 dolphin stomachs and ranged in frequency from 1 to 184 specimens per stomach. A literature review on possible weakfish predators is currently ongoing. To date, we have researched the following 15 species: bluefish, striped bass, weakfish, bluefin tuna, goosefish, summer flounder, ribbonfish, cobia, striped searobin, inshore lizardfish, oyster toadfish, Atlantic sharpnose shark, smooth dogfish, blacknose shark, and dusky shark.

An array of ~35 acoustic receivers are deployed in Bogue Sound from Emerald Isle to Barden’s Inlet and were removed once in early August for yearly maintenance and then downloaded once more in October. As of our latest download, it appears that we have had no live detections of fish since March 7, 2017. Of the 211 telemetry-tagged released weakfish in Bogue Sound, a total of 154 transmitters have expired as of the end of December 2017. We will continue to maintain the array until all our weakfish tags have expired at the end of February 2018. We used a Cormack-Jolly-Seber model to estimate weakfish apparent survival, which accounts for losses from both mortality and emigration, based on detections from live weakfish. For every fish’s capture history, paired blind readers assigned deaths based on uncharacteristic weakfish speeds and the duration of tag stationarity at a location. The time periods for when these fish were dead, but still being detected were changed to non-detections for 44 fish. This was to meet the assumption that detections are from live fish only. Daily apparent survival estimates were estimated for each seasonal release (e.g. fall 2015, spring 2016, fall 2016) because the number of receivers in the array changed between releases. The daily phi decreased in a constant pattern from 0.99 to 0.86, 0.97 to 0.91, and 0.96 to 0.88 (fall 2015, spring and fall 2016; respectively). Daily detection probability from all batches ranged from 0.40 to 0.91. When the average daily rate for a time period is extrapolated on a seasonal basis, almost no weakfish are alive or not emigrated after a 90 day season.

In August 2017, a conference presentation titled “Estimating weakfish mortality rates using a combined telemetry and conventional tagging approach” was presented at the 147th Annual American Fisheries Society Meeting in Tampa, Florida. This project was presented in a symposium on “Using electronic tags to estimate vital rates” that the PI and graduate student Jacob Krause organized.

Deviations:

If there were changes to the goals/objectives during the reporting period, please detail the circumstance and nature of change. Explain any special problems or circumstances which

prevented the accomplishment of scheduled tasks. Describe actions to resolve problems encountered and provide the details of any changes made to goals and objectives of the project.

There were no deviations from our goals/objectives over the last six months.

Additional Guidance:

If your scope of work is broken into discrete jobs/tasks, please use the Job/Task titles as subheading under which to report accomplishments.

COASTAL RECREATIONAL FISHING LICENSE

SEMI-ANNUAL PERFORMANCE REPORT

Recipient: Michael Loeffler*

*Michael Loeffler was replaced by Stephen Poland, Fisheries Biologist NCDMF

Grant Award #: 2F40 F024

Grant Title: Improving Water Temperature Data Recording for Monitoring Spotted Seatrout Cold Stun Events

Grant Award Period: 7/1/15 – 6/30/18

Performance Reporting Period: 7/1/17 – 12/31/17

Project Costs:

Expenditures for the Period:

| <u>Category</u> | <u>Expenditures</u> |
|-----------------|---------------------|
| Personnel | |
| Fringe | |
| Travel | |
| Equipment | |
| Supplies | 4118.44 |
| Construction | |
| Contractual | |
| Other | |
| Total Direct | 4118.44 |
| Indirect | |
| TOTAL | 4118.44 |

Total Cumulative Expenditures: 4118.44

Total Remaining Balance: 9076.56

Description of Work:

List the project objectives or provide a brief description of the funded activity, giving enough detail to acquaint the reader with the project.

Anecdotal information and published research have demonstrated that cold stun events impact spotted seatrout. The fishery management plan for spotted seatrout includes recommendations to assist with future stock assessments of spotted seatrout that are specifically related to temperature and cold stun events. The recommendations include: determine the feasibility of including measures of

temperature or salinity into the stock-recruitment relationship, investigating the relationship of temperature with both adult and juvenile mortality, incorporate cold stun event information into the modeling of the population, and estimate or develop a model to predict the impact of cold stun events on local and statewide spotted seatrout abundance. To address these concerns, there is a need for a statewide water temperature logging program that will gather the information necessary to assist in determining the effects of cold water temperatures on spotted seatrout. These data will meet two management goals: 1) Fish, Objective 1 – through strategy F.1.3 by identifying and gathering life history and mortality information needed for stock assessment models for recreationally important species and 2) Habitat, Objective 2 – through strategy H.1.3 by contributing to Department of Environment and Natural Resources initiatives to improve comprehensive water quality monitoring. This information is necessary for the stock assessment of spotted seatrout where natural mortality due to cold stun events can have a large impact to the overall population and would fulfill research needs in the Spotted Seatrout Fishery Management Plan.

Project Status/Work Accomplished:

For each objective, describe tasks scheduled for the reporting period and the activities undertaken to complete them. Describe the specific accomplishments, and list products (publications, web pages, data, technology, etc.) completed during the reporting period. Attach copies of the publications, as appropriate.

Loggers are downloaded by Fisheries Management field staff from each office every 4-months during normal field operations. All offices completed the 4-month download by the end of November. Seven new stations were added statewide and 15 lost or stolen loggers were replaced during this reporting period. An additional purchase of 15 replacement loggers were during this time. Additions and updates to biological program documentation and standards are still underway to allow for the temperature data from the HOBO loggers to be upload to the Division Biological Database. Maintenance of HOBO stations was undertaken, as needed, during the reporting period.

Deviations:

If there were changes to the goals/objectives during the reporting period, please detail the circumstance and nature of change. Explain any special problems or circumstances which prevented the accomplishment of scheduled tasks. Describe actions to resolve problems encountered and provide the details of any changes made to goals and objectives of the project.

There were no deviation from the original goals/objective during the report period.

Additional Guidance:

If your scope of work is broken into discrete jobs/tasks, please use the Job/Task titles as subheading under which to report accomplishments.

Please report on the percent of completion of each separate job/task in your proposal.

CRFL Project Technical Monitor Progress Report and Data Review Sheet

Project #: 2016-F040

Principal Investigator: Troy Alphin

Project Name: A partnership for sustained fisheries management: development of a research fellowship program between NCDMF and UNCW

Yes No N/A

1. Did the PI do what was proposed for this reporting period?
2. Does the report follow the CRFL guidelines?
3. Is the project making sufficient progress towards completion on time?
4. Does the PI have sufficient justification for any deviations that occurred?
5. Did the PI provide the raw data along with a data dictionary with the progress report in accordance with required elements as specified in their contract, if due at this time? (All project documents can be seen on the DMF drive)
6. Is the level of spending appropriate for the amount of work completed?
7. Should the progress report be accepted as is by the CRFL program?

If the answer to #7 was NO, please include detailed reasons for rejecting the progress report and suggestions on how to make the report acceptable.

Reasons for rejection:

Items for corrections/modification:

Summary of progress during this period: Five undergraduate interns, one master's degree candidate, and 1 doctoral level student, have collected and reviewed articles for the database, collected tissue, liver and stomach samples from fishes captured by DMFs Project 915, and have also started an independent sampling regiment throughout the Cape Fear Estuary. Five target species (Red Drum, Black Drum, Atlantic Croaker, Spot, and Sheepshead) have been identified through coordination with NCDMF staff, and research has been focused on these species. A protocol has been developed to asses critical prey, gut fullness, prey species identification, prey diversity, and index of relative importance from predator stomach samples obtained through collaboration with NCDMF Program 915 field sampling.

DMF Technical Monitor: Joe Facendola

Signature: Joe Facendola

Date: 26 April 2018

COASTAL RECREATIONAL FISHING LICENSE

SEMI-ANNUAL PERFORMANCE REPORT

Recipient: DEQ/DMF Public Affairs

Grant Award #: 2016-P-041

Grant Title: Update and Reprint North Carolina Angler's Guide

Grant Award Period: July 1, 2016 - June 30, 2018

Performance Reporting Period: July 1, 2016 – Dec. 31, 2017

Project Costs:

Expenditures for the Period:

| Category | <u>Expenditures</u> |
|-----------------|----------------------------|
| Personnel | |
| Fringe | |
| Travel | |
| Equipment | |
| Supplies | |
| Construction | |
| Contractual | \$74,750.00 |
| Other | <u>\$0</u> |
| Total Direct | \$0 |
| Indirect | |
| TOTAL | \$74,750.00 |

Total Cumulative Expenditures: \$74,750.00

Total Remaining Balance: \$4,250.00

Description of Work: Update and reprint North Carolina Coastal Recreational Angler's Guide to provide a handy pocket guide that North Carolina recreational fishermen can use to help identify fish, connect the fun of fishing with the need for habitat and stock conservation practices, help the general public understand fisheries management and solicit voluntary support through ethical angling practices

Project Status/Work Accomplished: The DENR/DMF Public Affairs Section has held meetings with selected staff to solicit input on needed changes to the Angler's Guide. Changes were made and the guide was printed by Correction Enterprises and 78,750 copies of the digest were delivered to DMF at the State Fair in Raleigh and to the DMF Headquarters in Morehead City in October 2017. Staff continues to distribute the guide.

Deviations: *None*

COASTAL RECREATIONAL FISHING LICENSE

SEMI-ANNUAL PERFORMANCE REPORT

Recipient: DEQ/DMF Public Affairs

Grant Award #: 2017-P-057

Grant Title: NC Recreational Fishing Digest

Grant Award Period: July 1, 2017 - June 30, 2018

Performance Reporting Period: July 1, 2017 – Dec. 31, 2017

Project Costs:

Expenditures for the Period:

| <u>Category</u> | <u>Expenditures</u> |
|-----------------|---------------------|
| Personnel | |
| Fringe | |
| Travel | |
| Equipment | |
| Supplies | |
| Construction | |
| Contractual | \$0 |
| Other | <u>\$0</u> |
| Total Direct | \$0 |
| Indirect | |
| TOTAL | \$0 |

Total Cumulative Expenditures: \$0

Total Remaining Balance: \$37,600.00

Description of Work: Develop and publish a North Carolina Coastal Recreational Fishing Digest to include recreational guide with recreational size and bag limits in an expanded format and to provide sections on ethical angling practices, license and permit requirements, information on DMF recreational fishing programs and articles on timely issues impacting recreational fishermen.

Project Status/Work Accomplished: The DENR/DMF Public Affairs Section continued to distribute the 2017 edition of the digest. Staff also began reviewing the 2017 digest for needed revisions and writing articles for the 2018 edition due to the printer in March 2018 to be delivered in May 2018.

Deviations: None

COASTAL RECREATIONAL FISHING LICENSE

SEMI-ANNUAL PERFORMANCE REPORT

Recipient: Chip Collier*, North Carolina Division of Marine Fisheries (NCDMF); Keith Ashley*, Wildlife Resources Commission (WRC); Jot Owens, Cape Fear River Watch (CFRW)

**Chip Collier was replaced by Chris Stewart, Fisheries Biologist (DMF); * Keith Ashley was replaced by Kyle Rachels, District 4 Fisheries Biologist (WRC)*

Grant Award #: 2F40 F010

Grant Title: Mark Recapture Study to Determine Population Size of Cape Fear River Striped Bass

Grant Award Period: July 1, 2013 – June 31, 2018

Performance Reporting Period: July 1, 2017 – December 31, 2017

Project Costs: \$ 79,565

Expenditures for the Period:

| <u>Category</u> | <u>Expenditures</u> |
|-----------------|---------------------|
| Personnel | |
| Fringe | |
| Travel | |
| Equipment | \$ 46 |
| Supplies | \$ 2,096 |
| Construction | |
| Contractual | |
| Other | |
| Total Direct | |
| Indirect | |
| TOTAL | |

Total Cumulative Expenditures: \$ 2,142

Total Remaining Balance: \$ 15,939

Description of Work:

A mark-recapture study will provide data needed to assess the striped bass population size in the Cape Fear River and its tributaries including residency patterns, population size, and discard mortality. Striped bass will be tagged with PIT and Floy internal anchor tags by North Carolina Division of Marine Fisheries (NCDMF) and Wildlife Resources Commission (WRC) staff using electrofishing, gill nets, and hook and line gear. The anchor tags will enable recreational and commercial fishermen in areas outside the study area to report recaptured individuals. The PIT tags will be used to estimate the population size of striped bass based on the electrofishing surveys by the NCDMF and WRC. An estimate of discard mortality will be calculated for the recreational fishing sector by comparing recapture rates of the hook and line released striped bass with striped bass that were electroshocked.

Project Status/Work Accomplished:

This current semi-annual report covers a time period when directed sampling for this grant is not typically conducted; however, several electrofishing and strike netting trips were made to tag fish as part for the NCDMF Multi-Species Tagging Program (P366). A total of 34 striped bass were caught using electrofishing, runaround gillnet, as well hook and line gears during July through December 2017 (Table 1). Twenty-eight striped bass were tagged during the reporting period. Five fish were recaptured with both an anchor and PIT tags present as well as one hatchery fish was recaptured (anchor tag only). No fish were tagged by the WRC or recreational fishermen during this reporting period.

The data from the July - December 2018 sampling season has been entered into the NCDMF Biological Database (P366). Quality control (report 4's) of that data has also been completed. Supplies were ordered to be ready for the 2018 sampling season. Data from this grant is being prepared for the upcoming Estuarine Striped Bass Fishery Management Plan.

Accomplishments:

A final report was submitted in November 2013 and included the methods used to estimate population size in the Cape Fear River in R (version 3.0.1; R Core Team) and JAGS (version 3.4.0; Plummer 2003). The management measures enacted to protect and enhance Cape Fear River striped bass appear to be having a positive impact. Model results indicated that the spawning stock biomass has increased; however, the number of adult fish remains well below the target of 100,000 (Collier et al. 2013). A new boat, motor, and trailer were purchased in August 2014 and was used for the 2015 sampling season.

All the tagging information from 2013 to 2017 has been coded and uploaded to the NCDMF Biological Database. The tagging program is set to restart in January 2018. NCDMF staff will also assist with the 2018 Cape Fear River Watch Striped Bass Tournament.

Deviations:

The Principle Investigator (PI), Chip Collier, left the NCDMF in June 2014. Chris Stewart, NCDMF Biologist, took over as the lead PI. In July 2013, Keith Ashley retired from WRC and was replaced by Michael Fisk, WRC District 4 Fisheries Biologist. As of January 2017, Kyle Rachels will replace Michael Fisk.

As of January 2016, all striped bass tagged in this mark-recapture study have been recorded in NCDMF Program 366 (Multi-species Tagging Program). This program combines information for tagging programs that were previously documented separately by species.

No deviations occurred during this reporting period.

LITERATURE CITED

Collier, C., W. Smith, C. Stewart, S. Taylor. 2013. Mark Recapture Study To Determine Population Size of Cape Fear River Striped Bass. Final Report for Coast Recreational Fishing License Grant 2F25. North Carolina Division of Marine Fisheries, Morehead City.

Plummer, M. 2003. JAGS: A Program for Analysis of Bayesian Graphical Models Using Gibbs Sampling. Proceedings of the 3rd International Workshop on Distributed Statistical Computing (DSC 2003). < mcmc-jags.sourceforge.net/ >

R Core Team. 2013. R: A Language and Environment for Statistical Computing. Vienna, Austria. www.R-project.org

Table 1. Number of striped bass caught by agency that were not tagged (due to size), tagged, and recaptured. *CFRWSBT is the Cape Fear River Watch Striped Bass Tournament. **Recreational angler is Jot Owens (recaptures from public not included).

| Tagger | Not Tagged | Single Tagged | Double Tagged | Triple Tagged | Recap of Single Tag | Recap of Double Tag | Tag Replaced | Grand Total |
|----------------|------------|---------------|---------------|---------------|---------------------|---------------------|--------------|-------------|
| NCDMF | 0 | 1 | 27 | 0 | 1 | 5 | 0 | 34 |
| WRC | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CFRWSBT* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Recreational** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 1 | 27 | 0 | 1 | 5 | 0 | 34 |

**COASTAL RECREATIONAL FISHING LICENSE
ANNUAL PERFORMANCE REPORT**

Recipient: Dr. Jeffrey A. Buckel, Dr. Joseph E. Hightower

DMF/CRFL Technical Monitor: Steve Poland

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Deviations:

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Additional Guidance:

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COASTAL RECREATIONAL FISHING LICENSE

SEMI-ANNUAL PERFORMANCE REPORT

Recipient: Frederick S. Scharf, Jeffrey A. Buckel, Joseph E. Hightower, Tom Wadsworth, William E. Smith

Grant Award #: 2014-F-015, contract #5805

Grant Title: Estimating mortality for southern flounder using a combined telemetry and conventional tagging approach

Grant Award Period: July 1, 2014 – June 30, 2018

Performance Reporting Period: July 1, 2017 – December 31, 2017

Project Costs: \$456,059 awarded for four-year project

Expenditures for the Period:

| <u>Category</u> | <u>Expenditures</u> |
|-----------------|---------------------|
| Personnel | 22,990 |
| Fringe | 1,536 |
| Travel | 3,464 |
| Equipment | |
| Supplies | 2,094 |
| Construction | |
| Contractual | 5,880 |
| Other | 1,280 |
| Total Direct | 37,244 |
| Indirect | 5,586 |
| TOTAL | 42,830 |

Total Cumulative Expenditures: \$411,637

Total Remaining Balance: \$44,422

Description of Work:

- 1) To estimate seasonal and annual rates of natural mortality for southern flounder in a NC estuary.
- 2) To provide updated estimates of fishing mortality that can be used to ground truth stock assessments.
- 3) To examine spatial variability in natural and fishing mortality for southern flounder within NC.

Project Status/Work Accomplished:

Passive and active tracking data for telemetered southern flounder in the New River estuary were used to develop a capture history of observed fates for each individual fish. The capture history was incorporated into a multistate capture-recapture model to estimate instantaneous rates of fishing mortality (F), natural mortality (M), and emigration (E) at the estuary scale. Tag returns from the statewide tagging program were analyzed using a joint likelihood model to estimate mortality, reporting rate, and tag loss parameters. This method utilizes the instantaneous rates formulation of the Brownie tag return model to estimate F, M, and the low-reward tag reporting rate (λ) and an exponential decay model to estimate initial tag-retention and chronic tag loss parameters. After fitting the separate telemetry and tag-return models, a combined model was developed using both the telemetry and tag-return likelihood functions. In the combined model framework, F was estimated independently at the estuary (telemetry data) and state scale (tag returns) while M became a shared parameter across spatial scales. Estimates of emigration (E) from the telemetry data were used to inform the tag return likelihood by adjusting the number of conventionally tagged fish available for harvest. The best supported combined model estimated an average annual M of 0.84 and an average annual E of 1.26 with annual F values ranging from 0.49 – 1.61 at the estuary scale and 0.23 – 0.69 at the state scale from 2014 to 2016, respectively.

Conventional tagging of southern flounder continued throughout the summer and fall of 2017, with a total of 1439 fish released throughout the entire year as part of the joint tagging project. Of the 1439 fish released, 964 received a single low-reward tag, 328 received a high-reward tag, and 147 were double-tagged with low-reward tags. During 2017 fishermen reported recaptures of fish with 30 high-reward tags and 23 single low-reward tags, as well as 4 double-tagged fish. Of the 57 total returns, 43 fish were harvested and 14 were released after capture. Southern flounder harvest was comprised of 12 fish caught by commercial gill net, 3 fish caught by pound net, 1 fish caught by commercial gig, 1 fish caught by commercial trawl, 14 fish caught by recreational hook and line, and 12 fish caught by recreational gig. Fishermen caught and released 12 fish by recreational hook and line and 2 by commercial gill net. Time at large of all captured fish ranged from 2 to 541 days with an average \pm SD of 175 ± 134 days. Of the 30 high-reward tags returned, 17 were university-affiliated with 7 fish harvested and 1 fish caught and released by commercial gill net, 5 fish harvested and 1 fish caught and released by recreational hook and line, and 3 fish harvested by recreational gig. Time at large ranged from 31 to 335 days with an average \pm SD of 173 ± 88 days.

In addition to the multistate and joint likelihood modeling approaches, we performed several catch curve analyses to provide estimates of the total rate of loss ($Z' = F + M + E$) using catch-at-age and total catch data from the North Carolina Division of Marine Fisheries (NCDMF) fishery-independent gillnet survey. The purpose of these analyses was to provide an estimate of the total rate of loss from the estuarine population for comparison with the telemetry and combined model estimates of the total loss rate. Both data sets were collected from 2003-2013 and covered the central NC coast encompassing Pamlico Sound and the Pamlico, Pungo, and Neuse Rivers. Fish from the catch-at-age dataset were used to create year-specific age-length keys in order to assign ages to fish in the total catch based on length, which represents a random sample of stock age structure. Age-length keys were also season-specific separating fish caught in the first half and second half of the year to account for rapid growth of young-of-the-year (age-0) fish. To increase the contrast in southern flounder ages, each fish within a particular age group within a given year was assigned a partial age based on the quarter of the year in which the fish was caught (assuming a Jan. 1 birthday). The numbers per age group in each season were then pooled to generate a total number of individuals in each age group for

each year. We used weighted regression and Chapman-Robson estimator methods for analysis of ten annual cohorts of southern flounder. Estimates of the instantaneous total rate of loss (Z') from cohort-specific patterns of catch-at-age ranged from 1.10 – 2.69 with a mean (\pm SE) value of 1.93 ± 0.51 using weighted regression and 1.21 – 2.45 with a mean (\pm SE) value of 1.84 ± 0.42 using the Chapman-Robson estimator. The estimates of Z' generated by the catch curve analyses were similar in magnitude to the range of annual Z' estimates produced across all runs of the combined model at the state spatial scale (2.10 [2016] – 3.04 [2015]).

Results from the combined model analysis were presented at the 147th Annual Meeting of the American Fisheries Society in Tampa, Florida in August 2017. A manuscript containing the final analyses is currently in preparation. The discussion focuses on the contribution of this study to the literature on mortality estimation using telemetry and combined telemetry and conventional tagging approaches, addressing the challenges associated with using acoustic telemetry techniques to estimate vital rates in a relatively sedentary flatfish species, and the implications of updated mortality estimates and direct estimates of emigration for the management of southern flounder.

Deviations:

None

COASTAL RECREATIONAL FISHING LICENSE
SEMI-ANNUAL PERFORMANCE REPORT

Recipient: North Carolina Division of Marine Fisheries (Randy Gregory)

Grant Award #: 2F40 F016 and 2F40 F043

Grant Title: NC DMF Carcass Collection Program

Grant Award Period: July 1, 2014 – June 30, 2017

Performance Reporting Period: July 1, 2017 – December 31, 2017

Project Costs: 32,800.00

Expenditures for the Period:

| <u>Category</u> | <u>Expenditures</u> |
|-----------------|---------------------|
| Personnel | 0.00 (n/a) |
| Fringe | 0.00 (n/a) |
| Travel | 0.00 |
| Equipment | 0.00 |
| Supplies | 0.00 |
| Construction | 0.00 (n/a) |
| Contractual | 0.00 (n/a) |
| Other | <u>0.00</u> |
| Total Direct | 0.00 |
| Indirect | <u>0.00</u> |
| TOTAL | 0.00 |

Total Cumulative Expenditures: \$0

Total Remaining Balance: \$6,882

Description of Work:

The objective of this project is to develop a three-year statewide freezer carcass collection program in order to obtain fishery-dependant length, sex, and age samples of recreationally important finfish.

Project Status/Work Accomplished:

There are now 13 fully operational freezer sites accepting carcass donations (Table 1.). Two freezer sites were added to the program in late September. Staff from the Division has made scheduled checks to freezers to collect carcasses and resupply freezers with collection bags and information cards. Fish

samples collected from the freezers have been processed and entered into the biological database under program 930 (Table 2.). Rewards and letters thanking anglers for their participation are also being mailed.

Deviations:

A no cost extension was requested and granted to allow ample time to mail backordered angler awards.

Additional Guidance: Nothing additional at this time.

Table 1. Freezer and participating tackle shop locations.

| Tackle Shop | Location |
|---------------------------|----------------|
| Jennettes Pier | Nags Head |
| Fishing Unlimited | Nags Head |
| Frank and Fran's | Avon |
| East Side Bait and Tackle | Washington |
| Cape Pointe Marina | Harkers Island |
| Freeman's Bait and Tackle | Atlantic Beach |
| Dudley's Marina | Cedar Point |
| The Tackle Box | Southport |
| Frisco Rod and Gun | Frisco |
| Red Drum Tackle | Buxton |
| East Coast Sports | Surf City |
| Bait Barge | Wilmington |
| Tex's Tackle | Wilmington |

Table 2. Number of Fish Collected by Species

| Species | No. Collected |
|--------------------|----------------------|
| Atlantic Croaker | 1 |
| Black Drum | 11 |
| Black Sea Bass | 11 |
| Bluefish | 4 |
| Blueline Tilefish | 1 |
| Cobia | 4 |
| Gag Grouper | 2 |
| Gray Triggerfish | 25 |
| Gulf Flounder | 17 |
| Gulf Kingfish | 13 |
| Jolthead Porgy | 1 |
| King Mackerel | 3 |
| Knobbed Porgy | 4 |
| Queen Triggerfish | 1 |
| Red Drum | 57 |
| Red Porgy | 4 |
| Red Snapper | 27 |
| Scamp | 3 |
| Sheepshead | 10 |
| Southern Flounder | 37 |
| Southern Kingfish | 18 |
| Spanish Mackerel | 21 |
| Speckled Trout | 52 |
| Summer Flounder | 5 |
| Striped Bass | 1 |
| Striped Mullet | 1 |
| Weakfish | 28 |
| Whitebone Porgy | 2 |
| Vermillion Snapper | 8 |
| White Grunt | 3 |
| Total | 375 |

COASTAL RECREATIONAL FISHING LICENSE

SEMI-ANNUAL PERFORMANCE REPORT

Recipient: Jeffrey A. Buckel, Timothy A. Ellis, Jan R. McDowell

Grant Award #: NCSU Project ID#558061 & 571502 (NCDENR Task Order #5807 & 7134)

Grant Title: Stock structure of spotted seatrout: assessing genetic connectivity at northern latitudinal limits

Grant Award Period: July 1, 2014 – December 31, 2016 (remaining funds January 1, 2017 to June 30, 2018)

Performance Reporting Period: July 1, 2017 – December 31, 2017

Project Costs:

| <u>Category</u> | <u>Expenditures (old account & new account)</u> |
|------------------|---|
| Personnel | \$93,132 & \$12,432 |
| Fringe | \$16,533 & \$1,829 |
| Travel | \$8,789 & \$1,632 |
| Supplies | \$11,787 & \$0 |
| Current services | \$2,715 & \$0 |
| Fixed charges | \$0 & \$0 |
| Sub-Contractual | \$45,017 & \$0 |
| Other | |
| Total Direct | \$179,607 & \$15,893 |
| Indirect | \$26,941 & \$2,023 |
| TOTAL | \$206,548 & \$17,916 |

Total Cumulative Expenditures: \$206,548 (old account) & \$17,916 (new account)

Total Remaining Balance: \$0 in old account & \$2,982 remaining in new account

Description of Work:

List the project objectives or provide a brief description of the funded activity, giving enough detail to acquaint the reader with the project.

- 1) Estimate the level of genetic separation among spotted seatrout sampled across multiple large, widely distributed estuaries in NC during the summer spawning season.
- 2) Determine if the summer spawning population(s) of spotted seatrout in NC are genetically distinct from those of VA and SC.

- 3) Assay the genetic variation of several known large winter population(s) of spotted seatrout in NC and compare these results to those of Objective 2 in order to examine seasonality in stock mixing and to characterize stocks in NC overwintering estuaries.
- 4) Integrate the results of proposed genetic analyses with those of prior tagging research from NC, VA, and SC, to determine stock mixing rates and to identify stock boundaries for management.

Project Status/Work Accomplished:

For each objective, describe tasks scheduled for the reporting period and the activities undertaken to complete them. Describe the specific accomplishments, and list products (publications, web pages, data, technology, etc.) completed during the reporting period. Attach copies of the publications, as appropriate.

Objectives 1-4: Final statistical analyses are still underway, results are being summarized, and the final project report is being written.

Initial results show a strong genetic break between most of NC/VA and South Carolina. There are some fish collected in Cape Fear River and New River that show a South Carolina origin. The exchange between NC and VA fish during overwinter periods appears to lead to genetic homogeneity for those states but final analyses have not been completed.

Deviations:

If there were changes to the goals/objectives during the reporting period, please detail the circumstance and nature of change. Explain any special problems or circumstances which prevented the accomplishment of scheduled tasks. Describe actions to resolve problems encountered and provide the details of any changes made to goals and objectives of the project.

No changes were made to the goals/objectives during this reporting period.

COASTAL RECREATIONAL FISHING LICENSE

SEMI-ANNUAL PERFORMANCE REPORT

Recipient: Dr. Jeffrey A. Buckel

Grant Award #: NCSU Project ID# 570300 (NCDENR Task Order #6426)

Grant Title: Evaluation of changes in available spawning and nursery habitats for river herring in North Carolina

Grant Award Period: 7/1/2015-6/30/2018

Performance Reporting Period: 7/1/17 – 12/31/17 (6 months)

Project Costs:

| <u>Category</u> | <u>Expenditures</u> |
|-----------------|-------------------------------|
| Personnel | \$42,888 (\$7,027 encumbered) |
| Fringe | \$5,146 |
| Travel | \$6,247 |
| Equipment | 0 |
| Supplies | \$500 |
| Fixed | \$0 |
| Contractual | 0 |
| Other(tuition) | \$18,827 |
| Total Direct | \$73,608 |
| Indirect | \$7,975 |
| TOTAL | \$81,583 |

Total Cumulative Expenditures: \$81,583 (-\$7,027 encumbered)

Total Remaining Balance: \$91,246 - \$81,583 - \$7,027 = \$2,636

Description of Work:

- 1) To identify historic spawning and nursery river herring habitat.
- 2) To evaluate the impact of culverts on river herring spawning migration from historic NCDOT data.
- 3) To identify any habitat areas where spawning or juvenile river herring were once absent, but are now beginning to reappear or were once present, but are now absent.
- 4) To recommend areas of the state to prioritize for future sampling efforts.

Project Status/Work Accomplished:

The accomplishments over the last six months that addressed each objective are detailed below:

Steven Lombardo (graduate student) has been finalizing documents on the effects of riparian zone land cover and water quality on river herring habitat use and on climate effects on the phenology of river herring spawning migrations. He has given two presentations on his work; a presentation on river herring habitat use at the Albemarle Pamlico National Estuary Partnership (APNEP) Symposium in Raleigh, NC, and a comprehensive presentation on river herring habitat use and spawning migration phenology at the Alosa Task Force meeting hosted by Aaron Bunch and the Virginia Department of Game and Inland Fishes in Virginia Beach, VA. Findings show temporal shifts (egressing ~2 weeks earlier in recent decades) have occurred in both species runs, from the implementation of Program 150 to the present. Findings from the habitat analyses have shown variable effects of agriculture/silviculture and development on the presence of river herring. From 2007 to the present, river herring presence has been both positively and negatively associated with anthropogenic influences within the riparian zones of the Chowan R., Pasquotank R., Edenton Bay, Mackeys Creek, Yeopim R., Meherrin R., Perquimans R., Scuppernon R, and Little R. No watershed wide relationship with anthropogenic influences was observed for alewife, but a positive relationship with development was observed for blueback herring. This finding is likely to be confounded due to the negative relationship with upstream distance and development. Developed areas are typically found lower in the river systems or at the confluence of the highest ordered stream and the next lowest ordered stream. The probability of detecting fish passing through on their way to upstream spawning grounds is higher in these regions.

The completed documents, data, R code, Python Code, and GIS files will be transferred to the NCDMF upon completion of his in defense spring 2018.

Deviations:

There were no deviations from our proposed objectives.

COASTAL RECREATIONAL FISHING LICENSE

SEMI-ANNUAL PERFORMANCE REPORT

Recipient: Jeffrey A. Buckel

Grant Award #: NCSU Project ID# 570221 (NCDENR Task Order #6431)

Grant Title: Marine Fisheries Fellowship Program

Grant Award Period: 7/1/2015-6/30/2020

Performance Reporting Period: 7/1/17 – 12/31/17 (6 months)

Project Costs:

| <u>Category</u> | <u>Expenditures</u> |
|-----------------|---------------------|
| Personnel | \$75,495 (-13,846) |
| Fringe | \$7,746 |
| Travel | \$1,627 |
| Equipment | 0 |
| Supplies | \$1,355 |
| Construction | 0 |
| Contractual | 0 |
| Other | 0 |
| Total Direct | \$86,222 |
| Indirect | \$12,760 |
| TOTAL | \$98,983 |

Total Cumulative Expenditures: \$98,983

Total Remaining Balance: (\$157,037 - \$98,982-13,846 = \$44,208)

Description of Work:

- 1) To provide an educational opportunity for a graduate student to spend one year working for the NCDMF.
- 2) To provide support for management priorities of the NCDMF on a substantive issue related to fisheries biology, management, stock assessment or coastal habitat identification and protection.
- 3) To enhance technology transfer from NCDMF and NCSG research to the user community in the most effective and efficient manners.

Project Status/Work Accomplished:

The accomplishments over the last six months that addressed each objective are detailed below:

Marine Fisheries Fellow (2017-2018) – Thom Teears

Thom Teears applied data-limited approaches including catch-based (median catch & ORCS), depletion-based (DCAC & DB-SRA) and abundance-based (Simple, life-history analysis & F_{msy}/M) methods to the sheepshead catch time series. Tagging data of sheepshead indicated that sheepshead will migrate between states; therefore, the stock assessment was expanded to a coast-wide assessment to include sheepshead from Virginia to the Atlantic coast of Florida to ensure the fish stock was accurately assessed. Thom also developed estimates of input parameters based on the literature, management history and life-history of sheepshead. The results of this work were presented in a power point on July 11th to personnel from NC DMF (Laura Lee and Anne Markwith). Although the stock status from these data-limited approaches was determined (none showed any overfished or overfishing status), it was determined that there were enough data to conduct an age-based assessment.

Thom has been collaborating with fisheries scientists from VA, NC, SC, GA and FL in order to collect data from fisheries independent and dependent sources from surveys, commercial fishing databases, recreational fishing databases, age data, and tagging data in order to develop a data-moderate assessment using Stock Synthesis software. Thom has been graphing and preparing data using R software for input into Stock Synthesis and for creating abundance indices. Thom met with Jeff Buckel and Jim Morley on August 11th to discuss alternative data sources to further inform the stock assessment and to explore methods for standardizing abundance indices, estimating fecundity and characterizing juvenile habitat.

Thom has summarized and graphed eight length compositions, developed six nominal annual and monthly abundance indices, summarized Virginia tagging data, and presented the results in a power point on September 28th to NC DMF personnel (Laura Lee and Anne Markwith) and Steve Arnott from SC DNR.

Thom applied generalized linear models to standardize the SEAMAP index by season, created nominal annual adult and juvenile abundance indices for the DMF trawl survey, Pamlico gillnet survey, and the SC trammel net survey, and calculated selectivity for five fishery independent data sources. Thom also summarized and graphed SC age versus length data and graphed age and length data by gear type. These results were presented on November 8th in a power point to NC DMF personnel (Laura Lee and Anne Markwith), SC DNR personnel (Steve Arnott and Joey Ballenger).

Thom has summarized and tabulated the regulatory history by state, graphed the commercial landings and recreational harvest by state, standardized the SEAMAP index by season for juvenile and adult, standardized the SC trammel net index for adult and juvenile, summarized and graphed SC tagging data, acquired age data from Virginia, identified problems with DMF trawl survey for standardization, and researched and identified other data sources. Thom presented data-limited stock assessment results in a poster presentation at the annual Tidewater AFS conference on January 25th, 2018.

Thom has also begun a PhD program at NCSU under the advisement of Jeff Buckel and Jie Cao. In order to fund the PhD research, Thom has applied for a NMFS population dynamics fellowship grant and in preparing the grant proposal, identified seasonal heterogeneity in the sheepshead fishery based on the catch series and developed investigation methods to determine effects of seasonal heterogeneity on stock assessment. He also has identified spatial structure in the Atlantic coast-wide sheepshead population based on differences in biological parameters by state and developed investigation methods to determine effects of spatial structure on stock assessment. Thom has developed an investigation to determine how to optimize fishing mortality based on multiple user group priorities and intends to accomplish these objectives during his PhD by using sheepshead as the model species which will further inform the sheepshead stock assessment and improve the quality of the results.

Deviations:

There were no deviations from our proposed objectives.

COASTAL RECREATIONAL FISHING LICENSE
SEMI-ANNUAL PERFORMANCE REPORT

Recipient: North Carolina Division of Marine Fisheries (Randy Gregory)

Grant Award #: 2F40 F035

Grant Title: Validating and updating maturation schedules for better management of North Carolina fisheries

Grant Award Period: July 1, 2016 – June 30, 2019

Performance Reporting Period: July 1, 2017 – December 31, 2017

Project Costs:

Expenditures for the Period:

| <u>Category</u> | <u>Expenditures</u> |
|------------------|---------------------|
| Personnel (Temp) | 8,981 |
| Fringe | |
| Travel | 89 |
| Equipment | 70 |
| Supplies | 6,934 |
| Construction | |
| Contractual | |
| Other | <u>16</u> |
| Total Direct | 16,090 |
| Indirect | <u>0.00</u> |
| TOTAL | 16,090 |

Total Cumulative Expenditures: 16,090

Total Remaining Balance: 51,471

Description of Work:

The objective of this project is to collect and analyze maturity data from two target species; striped mullet and spotted seatrout. As well as 7 ancillary species; Atlantic croaker, black drum, kingfish species, red drum, river herring, sheepshead and southern flounder. These data will be used to improve the accuracy of NCDMF management targets and assessments of fishery stock viability for these species. To estimate current length – and age-at-maturity data for the target species and to generally assess the accuracy and quality of maturity data currently being collected by NCDMF.

Project Status/Work Accomplished:

Sample Collection:

The first year of sampling was successfully completed as of June 30th, 2017. Year two sample collection was begun on July 1, 2017. Samples were collected for striped mullet, one of the target species, as well as from three of the ancillary species; red drum, Atlantic croaker, and southern flounder. To date a total of 610 samples have been processed with more to come as work continues. Data for each species are broken down by field office and month of collection in Tables 1 through 4. Most samples were collected by existing Division programs, but some directed trips were taken to acquire fish in size categories not typically encountered. It is likely that directed trips will be required to adequately sample some of the species size categories since their capture through existing programs is unlikely.

Histology:

All histology slides for year one striped mullet and spotted seatrout have been prepared and are ready for reading by the biologists. Year two striped mullet and spotted seatrout samples as well as year one and two ancillary species samples are in progress. Training of the striped mullet and spotted seatrout biologists for histology slide reading was completed in October and data collection is underway for those species. Further training for the ancillary species biologists will occur in the near future. In addition, the whole mount samples have been processed and a protocol is being created for the striped mullet and spotted seatrout, with biologist training to follow in preparation for year three data collection and analysis.

Deviations:

The project biologist went on maternity leave beginning mid-October and returning mid-December. Due to this absence the histology samples were not taken to the NCSU Histology lab as scheduled in October, however, deliveries were resumed in November. A temporary technician was hired to process samples during this time.

Additional Guidance: Nothing additional at this time.

Table 1. Number of striped mullet gonad samples collected and processed as of December by each field office during the second year of sampling.

| Field Office | Month | | | |
|----------------|-----------|---------|----------|----------|
| | September | October | November | December |
| Elizabeth City | 0 | 0 | 0 | 0 |
| Manteo | 5 | 18 | 1 | 0 |
| Morehead City | 0 | 15 | 11 | 15 |
| Washington | 24 | 32 | 25 | 13 |
| Wilmington | 0 | 23 | 9 | 0 |
| Total | 29 | 88 | 46 | 28 |

Table 2. Number of red drum gonad samples collected and processed as of December by each field office during the second year of sampling.

| Field Office | Month | | |
|----------------|-------|--------|-----------|
| | July | August | September |
| Elizabeth City | 0 | 0 | 0 |
| Manteo | 3 | 21 | 13 |
| Morehead City | 2 | 0 | 0 |
| Washington | 0 | 1 | 0 |
| Wilmington | 4 | 1 | 7 |
| Total | 9 | 23 | 20 |

Table 3. Number of Atlantic croaker gonad samples collected and processed as of December by each field office during the second year of sampling.

| Field Office | Month | |
|----------------|-----------|---------|
| | September | October |
| Elizabeth City | 1 | 0 |
| Manteo | 22 | 3 |
| Morehead City | 1 | 0 |
| Washington | 18 | 11 |
| Wilmington | 0 | 19 |
| Total | 41 | 33 |

Table 4. Number of southern flounder gonad samples collected and processed as of December by each field office during the second year of sampling.

| Field Office | Month | | |
|----------------|-----------|---------|----------|
| | September | October | November |
| Elizabeth City | 12 | 21 | 12 |
| Manteo | 47 | 28 | 38 |
| Morehead City | 0 | 0 | 0 |
| Washington | 12 | 21 | 12 |
| Wilmington | 47 | 28 | 38 |
| Total | 12 | 21 | 12 |

**COASTAL RECREATIONAL FISHING LICENSE
SEMI-ANNUAL PERFORMANCE REPORT**

Recipient: DEQ/DMF Marine Patrol

Grant Award #: 2F40 F037

Grant Title: NC Marine Patrol Technology Grant

Grant Award Period: July 1 2016 – June 30, 2018

Performance Reporting Period: July1, 2017 – December 31, 2017

Project Costs:

Expenditures for the Period:

| <u>Category</u> | <u>Expenditures</u> |
|-----------------|---------------------|
| Personnel | |
| Fringe | |
| Travel | |
| Equipment | |
| Supplies | |
| Construction | |
| Contractual | \$15,225 |
| Other | |
| Total Direct | |
| Indirect | |
| TOTAL | \$15,225 |

Total Cumulative Expenditures: \$15,225

Total Remaining Balance: \$65,776

Description of Work:

To obtain funding to equip NCMP officers with a portable printer, and a smart phone with hotspot service to be used with a laptop computer, to provide high quality customer service for the fishing public. This will allow requests for information via phone conversation, or personal if on site, to take place real time and provide instant license verification and the capability to print any documents related to NC Department of Environment and Natural Resources' mission for public dissemination. A reduction in radio communication should also occur.

Project Status/Work Accomplished:

Staff purchased iPhone 6Plus smart phones with data / hotspot plans. Otterbox cases and screen protectors were also purchased. These devices were distributed to Marine Patrol officers. US Cellular and Verizon were the vendors approved due to adequate coverage throughout the state.

Officers have been making calls to the public assisting with fishery questions and to staff as well when needed. These devices have reduced call back times from the public greatly.

The GIS section provided instruction on “ESRI Collector” App that allows real-time GPS functionality for officers in the field to collect / verify data points for various gear, lines, and areas that are needed in their daily operations. This App has proven invaluable for taking data in the field. It also shows various open / closed areas for various fishing activity.

Portable printers and laptop mounts are under review at this time.

COASTAL RECREATIONAL FISHING LICENSE

SEMI-ANNUAL PERFORMANCE REPORT

Recipient: Frederick Scharf, Lee Paramore, Laura Lee

Grant Award #: 2016-F-038

Grant Title: A comprehensive evaluation of the North Carolina red drum juvenile abundance index: assessment of spatial and temporal persistence and the potential for a partial replacement design

Grant Award Period: July 1, 2016 – June 30, 2019

Performance Reporting Period: July 1, 2017 – December 31, 2017

Project Costs: \$195,331 for 3 years

Expenditures for the Period:

| <u>Category</u> | <u>Expenditures</u> |
|-----------------|---------------------|
| Personnel | \$36,875 |
| Fringe | \$ 3,514 |
| Travel | |
| Equipment | |
| Supplies | |
| Construction | |
| Contractual | |
| Other | |
| Total Direct | \$40,389 |
| Indirect | <u>\$ 5,859</u> |
| TOTAL | \$46,248 |

Total Cumulative Expenditures: \$60,945

Total Remaining Balance: \$65,595

Description of Work:

Objectives:

1. Analyze the North Carolina red drum juvenile abundance index (JAI) historical data to evaluate persistence (or lack thereof), both spatially and temporally.
2. Assess variability in the year class strength signal across fixed sampling stations to determine the relative contribution of individual sampling stations and their impact on

the year class signal.

3. Supplement the current fixed station survey with sampling at random stations in each of the main survey regions (NOBX, OBX, Pamlico River, Neuse River, New and White Oak Rivers) to evaluate the potential for a partial replacement survey design to reduce bias.

Project Status/Work Accomplished:

During July and August, additional analyses of the historical index were conducted and the results presented as a paper at the American Fisheries Society annual meeting held in Tampa, FL during August 20-24.

Presentation citation: Scharf, F.S., Simpson, E.S., Lee, L., and Paramore, L.M. 2017. Indexing juvenile red drum abundance in North Carolina estuaries: evaluating the potential for bias in a long-term survey. AFS annual meeting, Tampa, FL, August 2017.

The presentation outlined several analyses of the long-term survey. First, the use of median CPUE or the geometric mean CPUE yielded patterns that differed from the arithmetic mean CPUE during several years since 1991. For instance, the strong year class of 1997 revealed by the mean CPUE was not as strong as the 1998 year class when either the median or geometric mean CPUE was used. Also, the 2004 and 2005 year classes were both relatively stronger when the median or geometric mean CPUE was used compared to the arithmetic mean. Interestingly, the 2011 year class strength was dampened sharply when using the median CPUE, and each of the alternative indices predicted that 2016 was a better year class than predicted by the arithmetic mean. Second, the fraction of seine hauls with a positive occurrence of red drum (i.e., non-zero catches) was more closely correlated with the median CPUE than with the arithmetic mean CPUE. Lastly, the variance to mean ratio (the amount of overinflation in the distribution) demonstrated steep peaks during two supposed strong year classes (1997 and 2011) that each were influenced largely by catches at a single station. A manuscript that details these analyses is currently in preparation.

Beginning in September, statewide random sampling was completed for 2017 (study year 2) using the pool of possible random sites that had been adjusted during 2016 sampling. As during study year 1, NCDMF staff completed the random sampling simultaneous with sampling of the fixed stations in three of the survey regions (Northern and Southern Outer Banks, and the Pamlico River). UNCW researchers completed random sampling in the Neuse River, the White Oak River, and the New River. In total, the addition of random sampling increased the number of seine samples from 120 to ~240. All catch and environmental data were entered onto NCDMF data sheets specific for Program 123, and mailed to the Manteo office to be entered into the computer database. Patterns of red drum cpue will be assessed

between fixed and random stations during the upcoming spring. Additional adjustments to the random sampling design based on evaluation of the habitats visited will be discussed by the investigators, and implemented for 2018. These include potential removal of additional random sampling grids based on a lack of habitat suitability, as well as expansion of the spatial extent of the survey to areas that have not previously been sampled.

Deviations:

None

COASTAL RECREATIONAL FISHING LICENSE SEMI-ANNUAL PERFORMANCE REPORT

Recipient: Troy Alphin (Benthic Ecology Lab, University of North Carolina Wilmington)

Grant Award #: 2016-F040

Grant Title: A partnership for sustained fisheries management: development of a research fellowship program between NCDMF and UNCW

Grant Award Period: 7/1/16-6/30/19

Performance Reporting Period: 7/1/17-12/31/17

Project Costs: Year 1: \$57,488 Year 2: \$57,488 Year 3: \$57,488

Expenditures for the Period

| Category | Expenditures | |
|--------------|--------------|-----------|
| Personnel | \$11,653.57 | 26,579.20 |
| Fringe | \$264.65 | 314.28 |
| Travel | \$0.00 | 249.53 |
| Equipment | \$0.00 | |
| Supplies | \$1,271.28 | 2,706.61 |
| Construction | \$0.00 | |
| Contractual | \$0.00 | |
| Other | \$0.00 | 90.00 |
| Total Direct | \$13,189.50 | 29,939.62 |
| Indirect | \$1,978.92 | 4,490.96 |
| TOTAL | \$15,167.92 | 34,430.58 |

Total Cumulative Expenditures: \$30,102.68

Total Remaining Balance: \$84,873.32 (thru the end of Year 2) (note the budget was developed with a 3 year timeline. While UNCW has committed to matching the efforts of this project through that time period, the match is significantly reduced in year2 and year3. These funds are programed into the system so that all funds will be expended by the end of the project's 3 year timeline. Note: the highlighted #'s reflect expenditures through Feb 2018

UNCW has committed matching funds for this project for 3 years.

Description of Work:

- 1) Recruit and train advanced undergraduate and graduate (MS) students in applied fisheries research through participation in a research-based internship.

- 2) Develop a priority list of research topics through meetings with NCDMF biologic staff and the NCDMF Director. Meetings would serve to:
 - a. Identify target species
 - b. Identify existing data resources
 - c. Identify data gaps and information needs
 - d. Determine analytical approaches.
- 3) Provide data products to NCDMF and the recreational fishing community through student engagement in state fishery advisory committee and commission meetings.

Project Status/Work Accomplished: (as of 12-31-17)

- 1) Currently our program consists of five undergraduate interns and one master's degree candidate and 1 doctoral level student. Over the current period, the interns while still collecting and reviewing articles for the database and collecting tissue, liver and stomach samples from fishes captured by DMFs Project 915, they are also started the an intense sampling regiment throughout the Cape Fear Estuary (Bald Head Island to I-140). During this period, they made 50+ field sampling trips. The field sampling uses stratified random design with random sites in the upper, mid and lower sections of the Cape Fear River estuary. In addition to the randomized sites, the program also incorporates a series of fixed sites to help factor out inter-annual and seasonal variation. The program has visited 241 randomized sampling sites (3 locations were classified as "fixed sites" and visited every month), and conducted over XXX samplings, utilizing trawls, benthic sleds, seine nets, and sweep nets. The majority of these sampling events have been conducted at the marsh edges located near the mouths of tidal creeks. To date, approximately 20 species of juvenile fishes have been captured, including: 272 Spot (the majority in the upper estuary north of downtown Wilmington); 340 Atlantic croakers (also mostly above downtown); 1 sheepshead; and 0 black drum. We were also about to capture 27 juvenile croaker. NOTE: This has been a catch and release sampling.
- 2) The five-targeted species (Red Drum, Black Drum, Atlantic Croaker, Spot, and Sheepshead) continue to be our focus, but we have also been gathering information on the fishes' potential prey in reference to species, locations, and abundances. This information will become extremely useful as we begin dissecting the fishes' stomachs and identifying their diet composition.
- 3) A stomach dissection protocol was developed in summer and fall 2017. These methods are being used to identify critical prey, gut fullness, prey species identification, prey diversity, and index of relative importance from samples obtain through Program 915. The initial specimens targeted have been Sheepshead and red drum.
- 4) A data request has been submitted to DMF for specific specimen data, including weight, length, age (if applicable) for red drum and sheepshead. This data will be used to analyze prey importance by size class and capture location.
- 5) Data will be provided routinely, or as requested by NCDMF staff.

Deviations: None

Additional Guidance: If your scope of work is broken into discrete jobs/tasks, please use the Job/Task titles as subheading under which to report accomplishments. Please report on the percent of completion of each separate job/task in your proposal.

COASTAL RECREATIONAL FISHING LICENSE SEMI-ANNUAL PERFORMANCE REPORT

Recipient: Troy Alphin (Benthic Ecology Lab, University of North Carolina Wilmington)

Grant Award #: 2016-F040

Grant Title: A partnership for sustained fisheries management: development of a research fellowship program between NCDMF and UNCW

Grant Award Period: 7/1/16-6/30/19

Performance Reporting Period: 7/1/17-12/31/17

Project Costs: Year 1: \$57,488 Year 2: \$57,488 Year 3: \$57,488

Expenditures for the Period

| Category | Expenditures | |
|--------------|--------------|-----------|
| Personnel | \$11,653.57 | 26,579.20 |
| Fringe | \$264.65 | 314.28 |
| Travel | \$0.00 | 249.53 |
| Equipment | \$0.00 | |
| Supplies | \$1,271.28 | 2,706.61 |
| Construction | \$0.00 | |
| Contractual | \$0.00 | |
| Other | \$0.00 | 90.00 |
| Total Direct | \$13,189.50 | 29,939.62 |
| Indirect | \$1,978.92 | 4,490.96 |
| TOTAL | \$15,167.92 | 34,430.58 |

Total Cumulative Expenditures: \$30,102.68

Total Remaining Balance: \$84,873.32 (thru the end of Year 2) (note the budget was developed with a 3 year timeline. While UNCW has committed to matching the efforts of this project through that time period, the match is significantly reduced in year2 and year3. These funds are programmed into the system so that all funds will be expended by the end of the project's 3 year timeline. Note: the highlighted #'s reflect expenditures through Feb 2018

UNCW has committed matching funds for this project for 3 years.

Description of Work:

- 1) Recruit and train advanced undergraduate and graduate (MS) students in applied fisheries research through participation in a research-based internship.

- 2) Develop a priority list of research topics through meetings with NCDMF biologic staff and the NCDMF Director. Meetings would serve to:
 - a. Identify target species
 - b. Identify existing data resources
 - c. Identify data gaps and information needs
 - d. Determine analytical approaches.
- 3) Provide data products to NCDMF and the recreational fishing community through student engagement in state fishery advisory committee and commission meetings.

Project Status/Work Accomplished: (as of 12-31-17)

- 1) Currently our program consists of five undergraduate interns and one master's degree candidate and 1 doctoral level student. Over the current period, the interns while still collecting and reviewing articles for the database and collecting tissue, liver and stomach samples from fishes captured by DMFs Project 915, they are also started the an intense sampling regiment throughout the Cape Fear Estuary (Bald Head Island to I-140). During this period, they made 50+ field sampling trips. The field sampling uses stratified random design with random sites in the upper, mid and lower sections of the Cape Fear River estuary. In addition to the randomized sites, the program also incorporates a series of fixed sites to help factor out inter-annual and seasonal variation. The program has visited 241 randomized sampling sites (3 locations were classified as "fixed sites" and visited every month), and conducted over XXX samplings, utilizing trawls, benthic sleds, seine nets, and sweep nets. The majority of these sampling events have been conducted at the marsh edges located near the mouths of tidal creeks. To date, approximately 20 species of juvenile fishes have been captured, including: 272 Spot (the majority in the upper estuary north of downtown Wilmington); 340 Atlantic croakers (also mostly above downtown); 1 sheepshead; and 0 black drum. We were also about to capture 27 juvenile croaker. NOTE: This has been a catch and release sampling.
- 2) The five-targeted species (Red Drum, Black Drum, Atlantic Croaker, Spot, and Sheepshead) continue to be our focus, but we have also been gathering information on the fishes' potential prey in reference to species, locations, and abundances. This information will become extremely useful as we begin dissecting the fishes' stomachs and identifying their diet composition.
- 3) A stomach dissection protocol was developed in summer and fall 2017. These methods are being used to identify critical prey, gut fullness, prey species identification, prey diversity, and index of relative importance from samples obtain through Program 915. The initial specimens targeted have been Sheepshead and red drum.
- 4) A data request has been submitted to DMF for specific specimen data, including weight, length, age (if applicable) for red drum and sheepshead. This data will be used to analyze prey importance by size class and capture location.
- 5) Data will be provided routinely, or as requested by NCDMF staff.

Deviations: None

Additional Guidance: If your scope of work is broken into discrete jobs/tasks, please use the Job/Task titles as subheading under which to report accomplishments. Please report on the percent of completion of each separate job/task in your proposal.

COASTAL RECREATIONAL FISHING LICENSE

SEMI-ANNUAL PERFORMANCE REPORT

Recipient: Jeffrey A. Buckel, G. Todd Kellison, J. Christopher Taylor

Grant Award #: NCSU Project ID#571565 (CRFL: 2017-F-048)

Grant Title: Beaufort Bridgenet Ichthyoplankton Sampling Program: Addressing the Need for Fishery-Independent Juvenile/Larval Indices for Recreationally Important Species

Grant Award Period: July 1, 2017 – June 30, 2019

Performance Reporting Period: July 1, 2017 – December 31, 2017

Project Costs:

| <u>Category</u> | <u>Expenditures (old account & new account)</u> |
|------------------|---|
| Personnel | \$0 |
| Fringe | \$0 |
| Travel | \$0 |
| Supplies | \$2,559 |
| Current services | \$0 |
| Fixed charges | \$0 |
| Sub-Contractual | \$0 |
| Other | |
| Total Direct | \$2,559 |
| Indirect | \$384 |
| TOTAL | \$2,943 |

Total Cumulative Expenditures: \$2,943

Total Remaining Balance: \$50,532

Description of Work:

List the project objectives or provide a brief description of the funded activity, giving enough detail to acquaint the reader with the project.

- (1) Continue BBISP sampling through 2019
- (2) Process BBISP samples collected during fall 2013 through spring 2019
- (3) Incorporate the resulting larval abundance data into the existing BBISP dataset
- (4) Host a meeting with NCDMF stock assessment staff (and potentially ASMFC stock assessment staff) to convey the updated BBISP database.

Project Status/Work Accomplished:

For each objective, describe tasks scheduled for the reporting period and the activities undertaken to complete them. Describe the specific accomplishments, and list products (publications, web pages, data, technology, etc.) completed during the reporting period. Attach copies of the publications, as appropriate.

During the initial six month period of this project, weekly sampling of ichthyoplankton at Pivers Island began in October 2018 and has continued to date (objective 1). For objective 2, we have packaged (wooden crate and all appropriate absorbent safety packaging materials) backlogged samples for shipment to the Polish sorting center. The crate is scheduled for shipment to Poland in late February 2018. The larval database has been continuously updated (Objective 3) and data have been made available to assessment scientists (striped mullet for NC DMF) and academicians (Rebecca Asch, East Carolina University).

Deviations:

If there were changes to the goals/objectives during the reporting period, please detail the circumstance and nature of change. Explain any special problems or circumstances which prevented the accomplishment of scheduled tasks. Describe actions to resolve problems encountered and provide the details of any changes made to goals and objectives of the project.

No changes were made to the goals/objectives during this reporting period.

COASTAL RECREATIONAL FISHING LICENSE

SEMI-ANNUAL PERFORMANCE REPORT

Recipient: Jeffrey A. Buckel, Jacob R. Krause

Grant Award #: NCSU Project ID#581434 (CRFL: 2017-F-052)

Grant Title: Estimating survival and stock structure of cobia using telemetry and population genetics

Grant Award Period: July 1, 2017 – June 30, 2020

Performance Reporting Period: July 1, 2017 – December 31, 2017

Project Costs:

| <u>Category</u> | <u>Expenditures</u> |
|------------------|---------------------|
| Personnel | \$1,200 |
| Fringe | \$103 |
| Travel | \$875 |
| Supplies | \$55,271 |
| Current services | \$864 |
| Fixed charges | \$303 |
| Sub-Contractual | \$0 |
| Other | |
| Total Direct | \$58,616 |
| Indirect | \$8,667 |
| TOTAL | \$67,283 |

Total Cumulative Expenditures: \$67,283

Total Remaining Balance: (\$166,612– \$67,283) = \$99,329

Description of Work:

List the project objectives or provide a brief description of the funded activity, giving enough detail to acquaint the reader with the project.

- 1) To determine if cobia subpopulations (i.e., genetic differences, migration differences) exist along the east coast of North Carolina and Virginia.
- 2) To better refine the stock mixing area for southeastern US and Gulf of Mexico cobia stocks.
- 3) To estimate survival rates and detection probabilities of cobia along the southeast US coast.

Project Status/Work Accomplished:

For each objective, describe tasks scheduled for the reporting period and the activities undertaken to complete them. Describe the specific accomplishments, and list products (publications, web pages, data, technology, etc.) completed during the reporting period. Attach copies of the publications, as appropriate.

During the last six months, we have purchased all telemetry tags, conventional tags, and telemetry receivers for YR1 of this project. The deployment hardware for estuarine and ocean moorings has been purchased and moorings have been built. Many of these have been deployed in nearshore waters and the offshore receivers will be deployed in March 2018. An existing array of 35 telemetry receivers was maintained during the reporting period and are currently present to detect our telemetry tagged cobia as well as cobia tagged in other states. We have booked charter trips with cobia captains and will begin telemetry and conventional tagging of cobia in April 2018.

Deviations:

If there were changes to the goals/objectives during the reporting period, please detail the circumstance and nature of change. Explain any special problems or circumstances which prevented the accomplishment of scheduled tasks. Describe actions to resolve problems encountered and provide the details of any changes made to goals and objectives of the project.

There are no deviations to project goals/objectives to report at this time. All project tasks continue to be performed on schedule.

COASTAL RECREATIONAL FISHING LICENSE

SEMI-ANNUAL PERFORMANCE REPORT

Recipient: Jeffrey A. Buckel, James W. Morley

Grant Award #: NCSU Project ID#571562 (CRFL: 2017-F-053)

Grant Title: Developing indices of abundance, characterizing juvenile habitat and identifying major spawning areas for North Carolina sheepshead

Grant Award Period: July 1, 2017 – December, 2018

Performance Reporting Period: July 1, 2017 – December 31, 2017

Project Costs:

| <u>Category</u> | <u>Expenditures</u> |
|------------------|---------------------|
| Personnel | \$0 |
| Fringe | \$0 |
| Travel | \$0 |
| Supplies | \$0 |
| Current services | \$0 |
| Fixed charges | \$0 |
| Sub-Contractual | \$0 |
| Other | |
| Total Direct | \$0 |
| Indirect | \$0 |
| TOTAL | \$0 |

Total Cumulative Expenditures: \$0

Total Remaining Balance: (\$118,166– \$0) = \$118,166

Description of Work:

List the project objectives or provide a brief description of the funded activity, giving enough detail to acquaint the reader with the project.

- 1) Develop and evaluate annual indices of adult sheepshead abundance based on fisheries independent surveys.
- 2) Characterize juvenile sheepshead habitat using survey data and develop recommendations for expansion of DMF sampling programs for a JAI.
- 3) Identify major sheepshead spawning areas in NC and estimate fecundity.

Project Status/Work Accomplished:

For each objective, describe tasks scheduled for the reporting period and the activities undertaken to complete them. Describe the specific accomplishments, and list products (publications, web pages, data, technology, etc.) completed during the reporting period. Attach copies of the publications, as appropriate.

Objective 1: We have received data sets from NC DMF, SC DNR, and FL FWRI to create annual indices of abundance for juvenile and adult sheepshead. Data analysis to standardize for tow-specific attributes are underway.

Objective 3: To identify sheepshead spawning areas we will use a large trawl (30 m headrope) in nearshore NC ocean waters. The trawl is currently being rigged for fishing on the F/V Captain Jimmy (owned by Jimmy Gilliken, Radio Island, NC). The first trawling trip will occur in April 2018.

Deviations:

If there were changes to the goals/objectives during the reporting period, please detail the circumstance and nature of change. Explain any special problems or circumstances which prevented the accomplishment of scheduled tasks. Describe actions to resolve problems encountered and provide the details of any changes made to goals and objectives of the project.

There are no deviations to project goals/objectives to report at this time. All project tasks continue to be performed on schedule.

COASTAL RECREATIONAL FISHING LICENSE
SEMI-ANNUAL PERFORMANCE REPORT

Recipient: Michael S. Loeffler and Ami Staples

Grant Award #: 2F40 F054

Grant Title: NC Multi Species Tagging Program

Grant Award Period: July 1, 2017 – June 30, 2020

Performance Reporting Period: July 1, 2017 – December 31, 2017

Project Costs:

*Expenditures for the Period:**

| <u>Category</u> | <u>Expenditures</u> |
|------------------------|----------------------------|
| Personnel | \$ 18,407 |
| Purchased Services | \$ 510 |
| Equipment | \$ 0 |
| Supplies | \$ 6,845 |
| Other | \$ 0 |
| Total Direct | \$ 25,762 |
| Indirect | <u>\$ 0</u> |
| TOTAL | \$ 25,762 |

Total Cumulative Expenditures: \$ 25,762

Total Remaining Balance: \$ 168,205

Description of Work:

The fisheries management plans for southern flounder, spotted seatrout, striped bass, red drum, and cobia include research recommendations to estimate migration and mortality rates through tagging studies. North Carolina Division of Marine Fisheries (NCDMF) tagging programs have existed for some species, such as striped bass and red drum, for many years, but auxiliary studies must be completed to fully address all tag-return model assumptions and estimate population rates from tag-return data. Traditional assessments for species like spotted seatrout are difficult to interpret because assumed rates of natural mortality (M) may not be valid. Tag-return models provide direct estimates of fishing mortality (F) without relying on assumed rates of M . Tag-return estimates of F and M provide an independent check on traditional catch-based assessment models and can be combined with catch data in an integrated model to further increase precision and accuracy. This approach improved recent assessments of NC red drum stocks, providing stability to the age-structured model and vastly improving precision in population parameters. As a multi-species study, efforts to

maximize tagging opportunities and cost can be optimized. This proposal describes a three-year plan of work to implement a statewide, multispecies tag-return program, following consistent, valid study protocols that will eliminate inconsistencies among species while improving the ability to assess the current status of each species. The funded work includes four main components for each species: (1) tagging 1,000–1,500 individuals per year with standard reward tags, (2) double-tagging to assess tag loss, (3) high-reward tagging to assess reporting rates, (4) field experiments to estimate mortality related to capture and tagging, and (5) maintaining telemetry receivers and downloading data to assess migration movements and habitat use. The resulting tag-return data will provide independent estimates of F , M , and migration rate and can be combined with traditional stock assessments to improve precision in estimating both exploitation and biomass. The result will be better information available for management decisions.

Project Status/Work Accomplished:

Division staff (members of the tagging program work group) met twice during the performance reporting period. The first meeting was in August and major topics discussed included 1) volunteer tagger applications, 2) shock boat updates and training, and 3) 2018 State Fair preparations. To address the major topics, the following actions took place within the months after the meeting:

- 1) A volunteer tagger application was designed and implemented to standardize the process for gathering information about and accepting new volunteer taggers.
- 2) The electro-fishing boat was fitted with the necessary shocking and safety equipment. Staff are required to complete USFWS safety and techniques online training before operating the new shock boat.
- 3) The tagging program was invited to have a booth at the 2018 NC State Fair in the Division of Marine Fisheries tent. Staff designed program banners, information cards, reward item and tag type shadow boxes, and an interactive fishing game.

The second tagging program work group meeting was held in October. The main purpose of this meeting was to discuss the 2F40-F017 CRFL Grant completion report. However, ongoing tagging study objectives were thoroughly discussed for each species and tasks were divided among species leads and stock assessment scientists. After the meeting staff completed data entry for 2017, performed data quality checks and corrected errors, and worked closely with stock assessment scientists to determine the best analytical technique appropriate for the level of data available for each species.

From November 1 to December 31, Division staff processed and mailed 150 tag recapture reward packets to recreational and commercial fisherman who returned information on recaptured tagged fish: 47 striped bass, 51 red drum, 42 spotted seatrout, and 10 southern flounder. (All tag returns reported in this document are from fish tagged throughout the duration of the study period from July 1, 2014 to December 31, 2017.) Reward packets are made up of a personalized letter with information about

the fish, a certificate with map of the original and recapture location of the fish, and a reward item. Reward items are based on tag colors with yellow tags representing low reward items (\$5, hat, towel, or pin) and red tags worth \$100 as the high reward.

Division staff conducted multiple public outreach events on the tagging program, and the premier event in October was the North Carolina State Fair in Raleigh, NC. During this ten-day event, Division staff spoke to over 100,000 North Carolina residents of all ages. The tagging program featured a booth with informational signage, displays, and an interactive fishing game. Participants of the fishing game received tagging program promotional items for catching a tagged fish and learned about recreational fishing opportunities and programs.

Spotted Seatrout

NCDMF tagging was completed as scheduled. Both recreational guides and Division staff were very busy during the months of November and December when the spotted seatrout fishing season was at its peak. Three new recreational guides joined the tagging program and received training. A total of 797 spotted seatrout were tagged including 179 (22.5%) double tagged fish and 193 (24.2%) high reward tagged fish (Table 1). A total of 42 spotted seatrout tags were returned including 16 (38.1%) double tags and 15 (35.7%) high reward tags.

Southern Flounder

NCDMF tagging was completed as scheduled. During November, NCDMF staff participated in multiple flounder tagging trawls aboard the RV Carolina Coast in the Neuse and New rivers. Southern flounder were also captured and tagged during NCDMF independent gill net surveys. A total of 853 southern flounder were tagged including 86 (10.1%) double tagged fish and 134 (15.7%) high reward tagged fish (Table 1). A total of nine southern flounder recaptures were reported including one (11.1%) double tag and three (33.3%) high reward tags.

Striped Bass

NCDMF tagging was completed by Division and Wildlife Resources Commission staff. CRFL Grant 2014-F054 covers only high reward tags and the majority of tagging activity occurs from January to May. During the winter months of November and December, Division staff tagged 21 striped bass with single low reward tags and received 44 striped bass tag returns including six (13.6%) double tags and six (13.6%) high reward tags (Table 1).

Red Drum

NCDMF tagging was completed as scheduled. Both volunteer anglers and Division staff tagged 242 red drum including 45 (18.6%) double tagged fish and 28 (11.5%) high reward tagged fish. A total of 29 red drum tags were returned including five (17.2%) double tags and five (17.2%) high reward tags.

Cobia

NCDMF tagging was completed as scheduled. The peak season for cobia is April through June and only one cobia was double tagged during this reporting period and none were returned.

Telemetry

Acoustic VR2W receivers are deployed throughout the estuarine waters of NC. These arrays are maintained by various offices due to the geographic regions they are located within. The Elizabeth City office maintains the arrays in the Albemarle Sound and its tributaries, Manteo maintains the arrays at Oregon, Hatteras, and Ocracoke inlets, the Washington office maintains the arrays in the Neuse, Tar/Pamlico, and Pungo rivers, and the Wilmington Office maintains an array in the Cape Fear River. Maintenance and downloads of receivers has been completed as scheduled. The Washington office completed downloads of their array of 59 receivers during the months of August, November, and December. These downloads required 15 days to complete. The Wilmington office completed downloads from 10 receivers during the months of November and December over four days. Fifteen receivers were confirmed lost or defective; these receivers will be replaced in January and February 2018. In addition to downloads and maintenance, offices have purchased necessary supplies to complete required maintenance. These supplies include, shackles, buoys, stainless steel cables, swages, thimbles, etc.

The Elizabeth City and Manteo offices are using funds from a Section 6 grant currently but will switch over to these CRFL funds beginning March 1, 2018.

Deviations: A 3-month extension from Grant 2F40-F017 was permitted to allow utilization of remaining funds. This extension affected 2F40-F054 in the following ways: funds were only needed for Temp Bio I salary and the telemetry portion of the grant from July 1 through October 31, 2017. After October 31, 2017, full funding began as requested in the approved proposal.

Table 1. Conventional tag releases and returns by species from November 1 to December 31, 2017.

| Species | # Single Low Reward Releases | # Single High Reward Releases | # Double Releases | Total # Releases | # Single Low Reward Returns** | # Single High Reward Returns** | # Double Returns** | Total # Returns** |
|-------------------|---------------------------------------|--|----------------------|---------------------|--|---|-----------------------|----------------------|
| Spotted Seatrout* | 425 | 193 | 179 | 797 | 11 | 15 | 16 | 42 |
| Southern Flounder | 633 | 134 | 86 | 853 | 5 | 3 | 1 | 9 |
| Striped Bass* | 21 | 0 | 0 | 21 | 32 | 6 | 6 | 44 |
| Red Drum | 169 | 28 | 45 | 242 | 19 | 5 | 5 | 29 |
| Cobia | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| Total | 1,248 | 355 | 311 | 1,914 | 67 | 29 | 28 | 124 |

*Counts for species tagged by recreational guides and volunteer anglers are subject to change because submittal of tagging data is ongoing.

**Tag returns that occurred during November and December are from fish tagged throughout the duration of the study period from July 1, 2014 to December 31, 2018.

COASTAL RECREATIONAL FISHING LICENSE
ANNUAL PERFORMANCE REPORT

Recipient: North Carolina Department of Natural Resources / Division of Marine Fisheries

Grant Award #: 2H40-H017

Grant Title: North Carolina Oyster Shell Recycling Program: Shell as a Critical Habitat Phase 2

Grant Award Period: July 1, 2013 – Ongoing

Performance Reporting Period: July 1, 2017 – December 31, 2017

Expenditures for the Period:

| <u>Category</u> | <u>Expenditures</u> |
|--------------------------------------|---------------------|
| Postage, Freight, and Transportation | \$147 |
| Fuel | \$0 |
| Equipment | \$0 |
| Supplies | \$0 |
| Contractual | \$0 |
| | |
| Total | \$147 |

Total Cumulative Expenditures: \$ 147

Total Remaining Balance: \$ 3739

Description of Work:

The NC Oyster Shell Recycling Program was a state-funded, innovative recycling program designed to collect post-consumer oyster shells and place them back overboard to help turn the tide on declining oyster stocks. Discarded shells that would be used for landscaping, agriculture, construction projects, creation of driveways, or disposed of in landfills are now collected to create and enhance oyster habitat in an effort to ensure long-term viability of Eastern oyster populations in North Carolina waters.

On July 1, 2013, funding for the Oyster Shell Recycling Program was discontinued and the program became defunct. However, some recycling responsibilities have been absorbed by other programs within NCDMF's Habitat & Enhancement and Fisheries Management staff. Historically high yield recycling sites have been maintained, while low yield collections sites have been closed. Convenient drop-off locations with containers and bins at recycling centers are provided for individuals who may have 20 bushels or less from small oyster roasts. Collections of oyster shells from larger oyster roasts (i.e., church, community, civic organizations, and festivals) require the use of trailers or dump trucks. Staff coordinates pickup and delivery of shells to stockpile sites, enlisting help from solid waste disposal facilities and private waste companies

This grant was awarded to the oyster shell recycling program before the program went defunct. However, these funds are still needed to continue maintenance of high yielding recycling sites.

Project Status/Work Accomplished:

NCDMF's Oyster Sanctuary and Habitat Enhancement staff, in conjunction with Fisheries Management staff, is maintaining productive shellfish recycling sites but closing down areas which fail to produce considerable shell amounts.

Staff has been in contact with several agencies to discuss the future of the Oyster Shell Recycling Program. The North Carolina Coastal Federation has had several meetings with staff in the Habitat and Enhancement section to assess the possibilities of creating a private partnership between hauling companies and restaurant owners to most effectively recycle shell at a minimal cost to vendors and producers. NCDMF is also evaluating the most productive recycling sites and trying to centralize efforts to maximize the shell totals in those areas. Staff is also looking at cost benefits of hauling shell to stockpile areas instead of performing shell transport with shellfish rehabilitation resources.

Deviations:

On July 1, 2013, funding for the Oyster Shell Recycling Program was discontinued and the program became defunct. With the loss of state appropriations and a permanent staff member to coordinate the program, the focus of shellfish recycling changed. The ability to organize, coordinate, and communicate with volunteers and organizations became nearly impossible to continue with already limited staff. Instead, the program has shifted to make the collection sites more easily accessible for the public while preventing the need for DMF to transfer shells as often and collect more shells each visit. After the loss of a permanent staff member designated to the program, it was difficult for staff to attend festivals and fairs in order to promote the program and collect shell. However, with the use of strategically placed collection sites and informing the public of their locations, the program was still able to collect shells from various events.

COASTAL RECREATIONAL FISHING LICENSE

ANNUAL PERFORMANCE REPORT

Recipient: North Carolina Department of Natural Resources / Division of Marine Fisheries

Grant Award #: 2H40-H023

Grant Title: North Carolina Oyster Shell Recycling Program: Shell as a Critical Habitat Phase 3

Grant Award Period: July 1, 2014 – June 30, 2015

Performance Reporting Period: July 1, 2017 – December 31, 2017

Project Costs:

Expenditures for the Period:

| <u>Category</u> | <u>Expenditures</u> |
|-----------------|---------------------|
| Personnel | \$0.00 |
| Fringe | \$0.00 |
| Travel | \$0.00 |
| Equipment | \$0.00 |
| Supplies | \$0.00 |
| Construction | \$0.00 |
| Contractual | \$0.00 |
| Other | \$0.00 |
| Total Direct | \$0.00 |
| Indirect | \$0.00 |
| TOTAL | \$0.00 |

Total Cumulative Expenditures: \$0.00

Total Remaining Balance: \$14,915.00

Description of Work:

The NC Oyster Shell Recycling Program was a state-funded, innovative recycling program designed to collect post-consumer oyster shells from individuals and businesses and place them back overboard to help turn the tide on declining oyster stocks. Discarded shells that would be used for landscaping, agriculture, construction projects, creation of driveways, or disposed of in landfills are now collected to create and enhance oyster habitat in an effort to ensure long-term viability of Eastern oyster populations in North Carolina waters.

On July 1, 2013, funding for the Oyster Shell Recycling Program was discontinued and the program became defunct. However, some recycling responsibilities have been absorbed by other programs within NCDMF's Habitat & Enhancement and Fisheries Management staff. Historically high yield recycling sites have been maintained, while low yield collections sites have been closed. Convenient drop-off locations, with containers and bins at recycling centers,

are provided for individuals who may have 20 bushels or less from small oyster roasts. Collections of oyster shells from larger oyster roasts (i.e., church, community, civic organizations, and festivals) require use of trailers or dump trucks. Staff coordinates pickup and delivery of shells to stockpile sites, enlisting help from solid waste disposal facilities and private waste companies

This grant was awarded to the oyster shell recycling program before the program went defunct. However, the funds are still needed to continue recycling at high yielding recycling sites.

Project Status/Work Accomplished:

Funding from this grant was not necessary during this reporting period.

Deviations:

On July 1, 2013, funding for the Oyster Shell Recycling Program was discontinued and the program became defunct. With the loss of state appropriations and a permanent staff member to coordinate the program, the focus of shellfish recycling changed. The ability to organize, coordinate and communicate with volunteers and organizations became nearly impossible to continue with already limited staff. Instead, the program has shifted to make the collection sites more easily accessible for the public while preventing the need for DMF to transfer shells as often and collect more shells each visit.

**COASTAL RECREATIONAL FISHING LICENSE
SEMI-ANNUAL PERFORMANCE REPORT**

Recipient: North Carolina Department of Natural Resources / Division of Marine Fisheries

Grant Award #: 2H40-H024

Grant Title: Monitoring of Oyster Sanctuaries/Fish Habitat with Underwater Environmental Equipment

Grant Award Period: July 1, 2014 – Ongoing

Performance Reporting Period: June 1, 2017 – December 31, 2017

Expenditures for the Period:

| <u>Category</u> | <u>Expenditures</u> |
|------------------------|----------------------------|
| Fuel | \$0.00 |
| Freight/Shipping | \$0.00 |
| Travel | \$0.00 |
| Equipment | \$0.00 |
| Supplies | \$51.20 |
| Total | \$0.00 |

Total Cumulative Expenditures: \$51.20

Total Remaining Balance: \$35,760

Description of Work:

The North Carolina Division of Marine Fisheries (DMF) was provided a grant from the Coastal Recreational Fishing License Program (CRFL) to Monitor Oyster Sanctuaries/fish habitat with underwater environmental equipment.

The purchase of essential equipment for sampling and monitoring of potential sites for new development, as well as existing artificial reefs and oyster sanctuaries, will facilitate the enhancement of the Division's habitat programs. Incorporating environmental sampling equipment will enable the recording and observation of how oyster production correlates with water quality and water flow. The captured data will assist us in future site selection by identifying suitable habitats to support finfish and oyster survival and growth.

Conducting long-term monitoring will allow us to better understand how environmental changes can affect oyster habitat over time, and how the environmental changes impact essential fish habitat.

Project Status/Work Accomplished:

During this reporting period, water quality sondes have been swapped on 45-day intervals for data downloads and cleaning. These sites will be sampled continually until December 2017. The newly purchased sondes are currently being used for backups in the event of a sonde failure. Next year's sampling locations for 2018 have been determined. Efforts are being made to update and enhance program 909 and its associated database to allow the entry of these data. Efforts are also being made to ensure all data is accurate before being incorporated into the program 909 water quality monitoring database.

Deviations:

None to report

COASTAL RECREATIONAL FISHING LICENSE
SEMI-ANNUAL PERFORMANCE REPORT

Recipient: Ariane Peralta

Grant Award #: 6436

Grant Title: Linking water quality, food quality, and larval fish condition to determine strategic habitat area quality

Grant Award Period: 07/01/2017-06/30/2018

Performance Reporting Period: 07/01/2017-12/31/2017

Project Costs:

| Category | 07/01/2017-12/31/2017 Expenditures |
|-------------------------------------|---------------------------------------|
| Personnel (includes educational) | \$32,229.04 |
| Fringe | \$305.68 |
| Travel | \$2,343.70 |
| Equipment | \$0.00 |
| Supplies | \$69.60 |
| Construction | \$0.00 |
| Contractual | \$13,238.71 |
| Other (boat) | \$0.00 |
| Total Direct | \$48,186.73 |
| Indirect | \$7,049.07 |
| TOTAL | \$55,235.80 |

Expenditures for the Period: \$55,235.80

Total Remaining Balance: \$25,422

Description of Work

We proposed to sample two potential strategic habitat areas in the Chowan and Tar-Pamlico Rivers at ten sampling sites in order to assess the linkages between water quality, food quality, and larval fish condition. We sampled 10 locations in two river systems throughout the spring period of larval river herring residency (Table 1). We added four locations Lower Chowan, Holiday Island, Lower Tar and Blounts Bay to give us full coverage of the systems, and we will process all samples.

Table 1. Sampling locations in 2017.

| River | Location | Dates sampled 2017 |
|---------|--|---|
| Chowan | Rockyhock Creek, Lower Chowan, Holiday Island, Catherine's Creek, Wiccacon River | 7, 17, 30 – March 13, 21, 27 – April 10, 16, 24 – May |
| Tar | Tranters Creek, Lower | 9, 21 – March 11, 20, 28 – April 12, 17 – May |
| Pamlico | Blounts Bay, Blounts Creek, Pantego Creek/Pungo River | 9, 21 – March 11, 20, 28 – April 12, 17 – May |

Project Status/Work Accomplished

Activities

We performed a full suite of measurements during the 2017 field season. Results from these efforts are outlined in the 2017 mid-year report. Here, we present preliminary results from larval river herring collected using two-minute, pushnet tows from the 2016 and 2017 field season (Figure 1). These data have not been analyzed at the time of the mid-year report. Our only remaining laboratory analyses are to enumerate zooplankton from our 60 um mesh samples for 2016 and 2017. These should be completed by the end of January 2018.

Preliminary data



Figure 1: Deploying the pushnet on Catherine Creek for larval river herring collection.

The first appearance of river herring larvae on the Chowan River sites was March 28 at Holiday Island in 2016, and the rest of the sites on April 6 2016. In 2017, river herring were present at all sites by March 7 (Figure 2). Overall, we collected more larval river herring in 2016 than in 2017. Catherine Creek had the highest and second highest abundances in 2016 and 2017, respectively (Figure 2) The site near Holiday Island had the highest abundances of larval river herring in 2017, but had very low abundances in 2016 (Figure 2). Wiccacon Creek had the next highest abundances in both 2016 and 2017 (Figure 2).

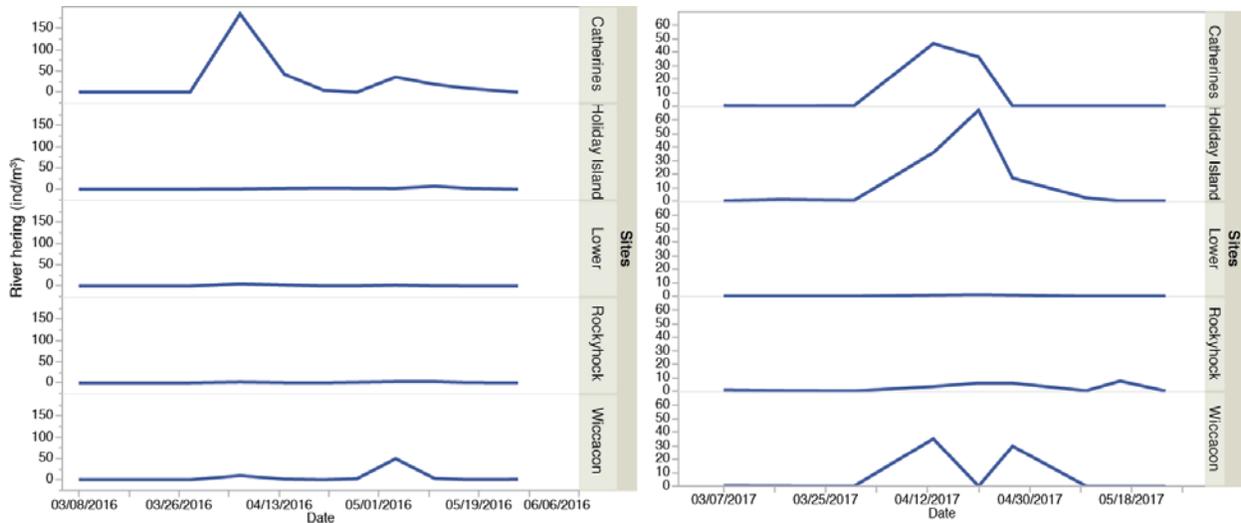


Figure 2: Larval fish abundances (individuals per m^3) for the Chowan River sites in 2016 (left) and 2017 (right) from the pushnet after a two-minute tow.

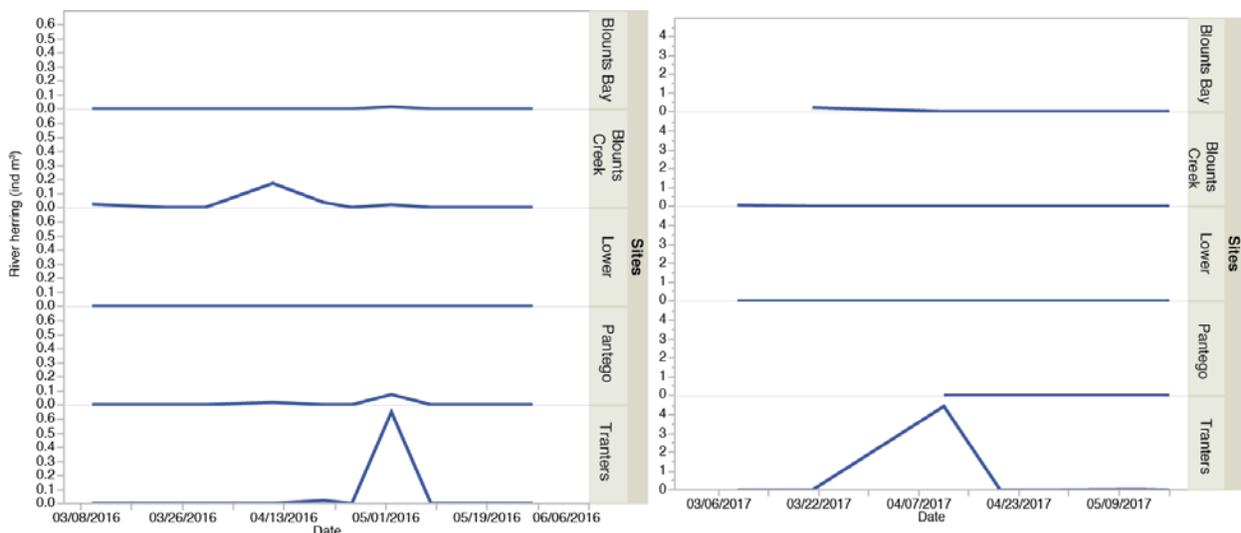


Figure 3: Larval fish abundances (individuals per m^3) for the Tar/Pamlico River sites in 2016 (left) and 2017 (right) from the pushnet after a two-minute tow.

Tar/Pamlico River sites had river herring larvae at the freshwater areas, and one juvenile river herring in Pantego River for 2016 (Figure 3). There were far fewer river

herring larvae in the Tar/Pamlico River system, but we did find river herring at three sites (Blounts Creek, Tranters Creek, and Lower Tar River at Washington). The first appearance of larval river herring in 2016 was on March 10 at Blounts Creek, and in 2017 on March 9 at Tranters Creek. The highest abundance in river herring larvae was in Tranters Creek both years (Figure 3). River herring had the highest abundance in Tranters on May 2, 2016, and April 11, 2017.

We saw differences in the timing and abundances of river herring population throughout the Chowan River that could be correlated to other factors we measured (data not shown). There were also differences in abundances between the years especially at the Chowan River site at Holiday Island. We found river herring larvae in the Tar/Pamlico River and its two tributaries, therefore even with low abundances, there is a population returning to spawn. However, we cannot say if these river herring larvae are recruited to the population with our data. We do know river herring are present at least for the last two years. This data will allow the understanding of how different river systems support the future of river herring in North Carolina.

Deviations

We have experienced no deviations at this time.

COASTAL RECREATIONAL FISHING LICENSE
SEMI-ANNUAL PERFORMANCE REPORT

Recipient: Charles H. Peterson, University of North Carolina at Chapel Hill, Institute of Marine Sciences; 3431 Arendell Street, Morehead City, NC 28557

Project Investigators: Charles H. Peterson & Carter S. Smith

Grant Award #: 6437

Grant Title: Quantifying fish enhancement and erosion protection provided by marsh sills: a “living shoreline” alternative to bulkheads and revetments

Grant Award Period: July 1, 2015 – June 30, 2018

Performance Reporting Period: July 1, 2017-- December 31, 2017

Project Costs:

Expenditures for the Period: 7/1/17 – 12/31/17

| <u>Category</u> | <u>Expenditures</u> |
|------------------------|----------------------------|
| Personnel | 5,788.46 |
| Fringe | 789.32 |
| Travel | 125.56 |
| Equipment | 0.00 |
| Supplies | 47.60 |
| Miscellaneous Services | 0.00 |
| Other | 600.00 |
| Total Direct | 7,350.94 |
| Indirect | <u>1,102.66</u> |

Total Cumulative Expenditures: \$74,852.09

Total Remaining Balance: \$9,709.91

Description of Work:

The overall goal for this project is to collect data on the fisheries support services and erosion protection provided by marsh sills as compared to bulkheads, revetments and natural marsh shorelines, in order to most effectively guide homeowners' choices and to inform regulatory agencies. This goal will be accomplished through the following interconnected objectives: to **(1)** compile the first multi-storm performance assessment of different shoreline stabilization techniques, by assessing shoreline damage along

North Carolina estuarine shores before and after Hurricane Matthew; **(2)** provide the first quantitative data on the habitat value of different introduced hard substrates and acquire the basis for inferences on the most advantageous material (oyster shell vs. marl vs. granite) for marsh sills to maximize use by recreational fishes and their prey; **(3)** collect data on recreationally important fishes (red drum, speckled trout, 2 species of flounder, sheepshead, spot, and croaker) and their crustacean prey (blue crab, stone crab, penaeid shrimps) using modified and natural shorelines; **(4)** conduct mesocosm experiments to experimentally test fish preferences among estuarine shorelines stabilized through different means versus natural marsh shorelines; and **(5)** produce an engaging and informative short film, which will be used as part of a larger public outreach campaign to inform owners of estuarine shoreline property in North Carolina and NC residents more broadly about how to make the best shoreline stabilization choices.

Project Status/Work Accomplished:

Hurricane damage assessments:

To evaluate the pre-storm condition of estuarine shorelines throughout NC, we have combined shoreline boat surveys with detailed site surveys across the coast of Eastern North Carolina.

Part I: For the boat surveys, three different estuarine shoreline stretches were evaluated in 2015 and 2016 for any existing storm damage (Figure 1), using a visual damage assessment protocol. These shoreline stretches were chosen because they represented a diversity of geographic and tidal regimes and because they each contained a bulkhead, natural marsh, and at least one marsh sill. These data were combined with data collected after Hurricanes Irene (2011) and Arthur (2014), which allowed for a multi-storm comparison of estuarine shoreline damage. The manuscript detailing these results was recently published in *Marine Policy* (see Publications below). We have re-evaluated the boat survey paths after Hurricane Matthew in October 2016, to complete the Before/After comparisons of hurricane damage. The three survey areas differed greatly in the amount of observed damage that could be attributed to Hurricane Matthew. In PKS and Oak Island, less than 5% of the bulkhead shoreline was damaged, whereas nearly 30% of the shoreline was damaged in OBX (Figure 2).

Part II: For the more finely detailed site evaluations, we conducted surveys at 30 estuarine sites between Manteo in the North and Southport in the South. The sites were geographically grouped within regions, so that 1 bulkhead, 1 natural marsh, and 1 rock sill were paired (a total of 9 sets of structures throughout the state). Additionally, 3 of the sets of structures also contained an oyster bag sill (Figure 3). These site surveys represent a significant and valuable expansion of what was originally proposed. They will allow us to quantitatively evaluate how the elevation and vegetation profiles at sites are changing over time. All sites were sampled during May and June 2015, May and June 2016, and May and June 2017. Additionally, a subset of the sites were sampled in October 2016 right after Hurricane Matthew passed by the NC coast. The sampling was

conducted by Carter Smith, Isabelle Neylan and David Kochan (field technicians), six UNC undergraduates, and in collaboration with NERRS coordinator Brandon Puckett. Our results suggest that not only are living shorelines better at resisting landward erosion during a storm event than bulkheads and natural marshes, but they can be just as effective as hardened shorelines at maintaining landward elevation over a two-year period without requiring any human intervention or repair (Figures 4 & 5). Furthermore, rock sill living shorelines are able to maintain marsh ecosystem functions by enhancing *S. alterniflora* stem densities over time when compared to natural marshes. This research is currently being prepared to submit to *Ecological engineering* in winter 2018.

DIDSON fish surveys:

After initial analysis of the GoPro footage from summer 2015, we determined that GoPros were ineffective at our sites because of unpredictable and high turbidity. We have chosen instead to use a Dual-frequency Identification Sonar (DIDSON) to observe fish abundance and biomass as well as behavior and habitat use along different estuarine shorelines. Using the accompanying DIDSON software we will get accurate abundance and biomass estimates for fish along different types of shorelines.

In summer 2017, we collected DIDSON video footage every two weeks (May-July) by statically deploying the DIDSON in front of replicate natural marshes, marsh sills, and bulkheads in Pine Knoll Shores and Beaufort, NC (Figure 6). To avoid any issues associated with water depth (the DIDSON needs a minimum water depth of approximately 0.5 m in order to image), we limited the sampling window to the two hours around high tide. We deployed the camera 5 meters from the structure or shoreline for 10 minutes (5 minutes of acclimation and 5 minutes of footage for analysis). Sites were sampled during the day, and all sites were additionally sampled once at night in late July. We also set 5 replicate minnow traps at each of the sites for a total 4-hour soak time to look at the species of fish that were found along each shoreline. We are currently processing and analyzing this data.

Mesocosm experiments: To evaluate relative foraging efficiency along different types of shorelines, we constructed shoreline mesocosms (1.5 x 2 x 0.5 m³) in experimental tanks behind the UNC Institute of Marine Sciences. We simulated five different shoreline treatments as follows: 1) natural marsh; 2) riprap revetment with no marsh; 3) bulkhead with no marsh; 4) oyster bag marsh sill; and, 5) rock marsh sill. We ran trials with Southern Flounder (predator) and pinfish (prey) to determine foraging efficiency and we used GoPros in the mesocosms to determine whether predator/prey fish behavior changed along different types of shorelines. We are in the process of analyzing these data.

Fyke net surveys: We collected fish abundance and biomass data as a function of shoreline type at four sites in North Carolina that were previously sampled by C.H. Peterson and R.K. Gittman and established as Before After Control Impact sites (Holly Ridge, Pine Knoll Shores, Hatteras, and Jones Island; Figure 3). At each site, two fyke nets were placed along a natural control marsh and two nets in the drop-downs or edges of an adjacent marsh sill (two oyster, two rock.) Nets were left to soak at night through one tidal cycle during spring tides for maximum tidal difference and all nekton

caught were measured and weighed. Each site was sampled once per month from June through September. In addition, elevation and vegetation data along with rugosity measurements of the sills were taken from each site to account for physical differences that may be influencing fish use of the different shorelines. Preliminary results suggest that rock sills show significant enhancement of fish and crustacean use within 7 years of construction, but no significant enhancement was detected with the oyster bag sills.

Short documentary film: We have collected many hours of GoPro footage of fieldwork to include in the film. We are also in the process of putting together a stop motion animation to be included in the film that illustrates some of the underlying concepts of the research.

Modifications:

The major deviations from our proposed work are an expansion of the hurricane surveys with the inclusion of detailed elevation and vegetation site surveys at 30 locations throughout the state. This is a valuable expansion, because it has allowed us to quantitatively assess how the vegetation and elevation of sites stabilized through different means are changing over time and after Hurricane Matthew. The other major deviation is that the GoPro fish surveys will now be completed using a DIDSON (Dual frequency Identification Sonar) instead of GoPros. The DIDSON (approximate value of \$200,000) is being loaned to us by Chris Taylor (NOAA's Beaufort Lab), and will significantly enhance our fish surveys by providing a much greater viewing depth and range, as well as abundance and biomass data for all recorded fish.

Outreach and Results Dissemination:

Media Coverage:

- “Measuring the Health of a Marsh” UNC Endeavors, August 2017. <http://endeavors.unc.edu/measuring-the-health-of-a-marsh/>
- Coastal Daybreak Radio Interview, June 2017. <https://youtu.be/TbpRG7YaPI8>
- “Living shorelines more cost effective way to control coastal erosion” WNCT News by Pierce Legeion, May 2017. <http://wnct.com/2017/05/29/new-research-living-shorelines-more-cost-effective-way-to-control-coastal-erosion/>
- “Living shorelines withstand Matthew’s force” Coastal Review Online, December 2016. <http://www.coastalreview.org/2016/12/living-shorelines-withstand-matthews-force/>
- “Living shorelines, a more natural approach to preventing coastal erosion” WNCT News by Pierce Legeion, May 2016. <http://wnct.com/2016/05/17/living-shorelines-a-more-natural-approach-to-preventing-coastal-erosion/>
- ‘PKS Soundfront Environmental Study’ *The Shoreline* by Barbara Milhaven, January 2016
- ‘UNC doctoral students study living shorelines’ *WCTI-12 News* by Chris Hoffman, July 2015 <http://www.wcti12.com/news/unc-doctoral-students-studies-living-shorelines/34186894>

Publications:

- Smith, C.S., R. K. Gittman, I. P. Neylan, S. B. Scyphers, J. Morton, F.J. Fodrie, J. H. Grabowski, C.H. Peterson. 2017. Hurricane damage along natural and hardened estuarine shorelines: using homeowner perspectives to promote nature based coastal protection. *Marine Policy* 81, 350-358.
- Smith, C.S., B. Puckett, R. K. Gittman, C.H. Peterson. Evaluating the performance of hardened versus natural shorelines during Hurricane Matthew (2016). In preparation for *Ecological Engineering*.

Presentations:

- Smith, C.S., C.H. Peterson. Using a social-ecological framework to investigate connections between shoreline hardening and perceptions of hurricane risk. Coastal Estuarine Research Federation Conference, Providence, RI, November 2017. Oral presentation.
- Smith, C.S. Using living shorelines to design sustainable and resilient coastlines. The Beaufort Ole Towne Rotary, Beaufort, NC, October 2017. Oral presentation.
- Smith, C.S., B. Puckett, R.K. Gittman, C. H. Peterson. Evaluating the performance of hardened versus living shorelines during Hurricane Matthew (2016). Benthic Ecology Meeting, Myrtle Beach, SC, April 2017. *Oral presentation*.
- Smith, C.S., R. K. Gittman, I. P. Neylan, S. B. Scyphers, J. Morton, F.J. Fodrie, J. H. Grabowski, C.H. Peterson. Addressing homeowner misperceptions about the effectiveness, durability, and cost of hardened shorelines: An analysis of hurricane damage in North Carolina. MarCo Marine Consortium Graduate Student Symposium, Beaufort, NC, March 2017. *Poster presentation*.
- Smith, C.S. Addressing misperceptions about the effectiveness, durability, and cost of hardened versus living shorelines. Restore America's Estuaries Summit, Living Shorelines Workshop, New Orleans, December 2016. Invited speaker and panelist.
- Smith, C.S., R. K. Gittman, I. P. Neylan, S. B. Scyphers, J. Morton, F.J. Fodrie, J. H. Grabowski, C.H. Peterson. Addressing homeowner misperceptions about the effectiveness, durability, and cost of hardened shorelines: An analysis of hurricane damage in North Carolina. Restore America's Estuaries Summit, New Orleans, December 2016. Poster presentation.
- Smith, C.S. Shore protection structure performance over multiple storms: A socioeconomic analysis. NC Department of Coastal Management Staff Living Shorelines Training, Beaufort, NC, December 2016. Invited speaker.
- Neylan, I. Assessing the habitat use and optimal construction of marsh sills through benthic infaunal community composition. NC Sea Grant Graduate Training Symposium. New Bern, NC, April 2016. Poster presentation.
- Smith, C.S. Hurricane damage along natural and engineered shorelines: An economic and environmental evaluation. *Benthic Ecology Meeting*. Portland, Maine, March 2016. Oral presentation.

- Neylan, I. Assessing the habitat use and optimal construction of marsh sills through benthic infaunal community composition. *Atlantic Estuarine Research Society Meeting*. Virginia Beach, VA, March 2016. Poster Presentation.
- Smith, C.S. Hurricane damage along natural and engineered shorelines: An economic and environmental evaluation. *Atlantic Estuarine Research Society Meeting*. Virginia Beach, VA, March 2016. Oral presentation.

Outreach:

- C. Smith presented on this research as part of a congressional briefing on living shorelines in Washington, DC in October 2017.
- C. Smith presented on preliminary results from this CRFL project at the North Carolina Department of Coastal Management Staff Living Shorelines Training
- Exploring Estuarine Shoreline Habitats Teacher's Workshop, July 2016
 - Isabelle Neylan and David Kochan (technicians) led a workshop on the methods and results of CRFL funded work for a group of ~30 NC science teachers.
- SciREN, February 2016.
 - C. Smith wrote a lesson plan about the funded work that adhered to NC 4-6th science standards, and disseminated the lesson plan to NC science teachers at a networking event.

Appendix

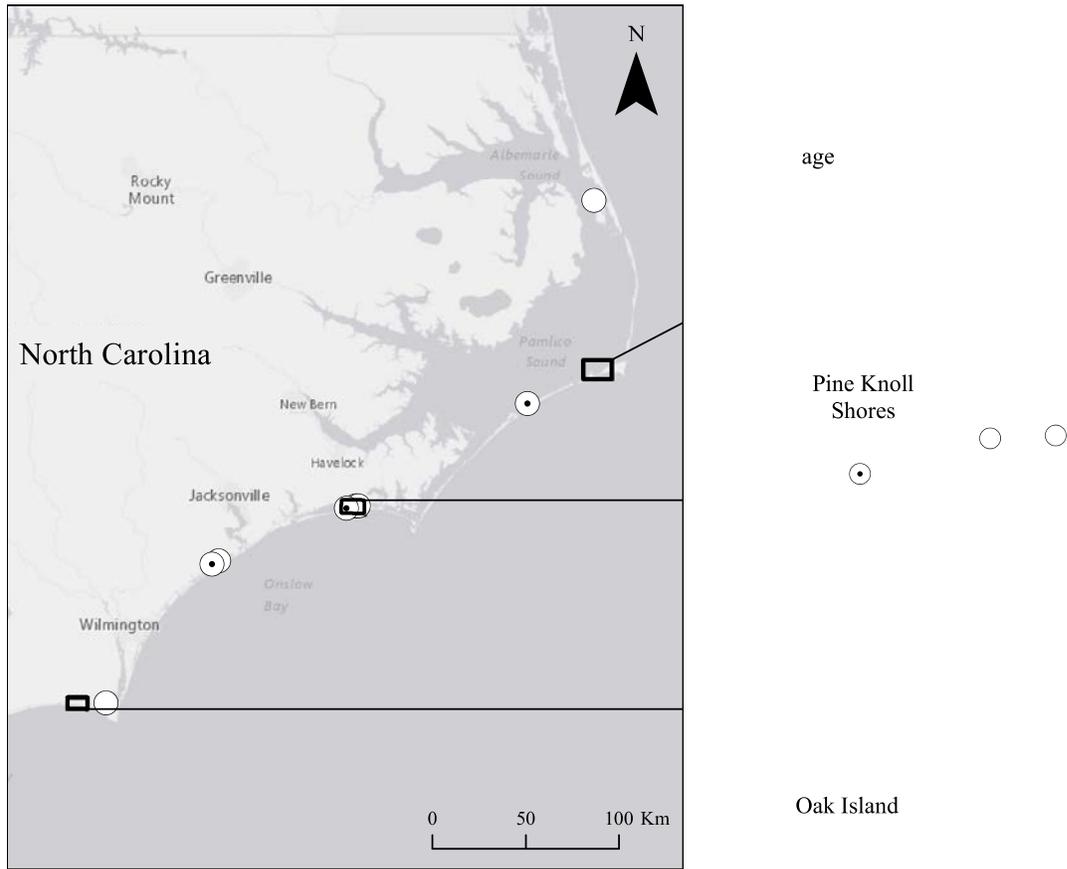


Figure 1. Shoreline boat survey tracks that were surveyed before and after Hurricane Matthew

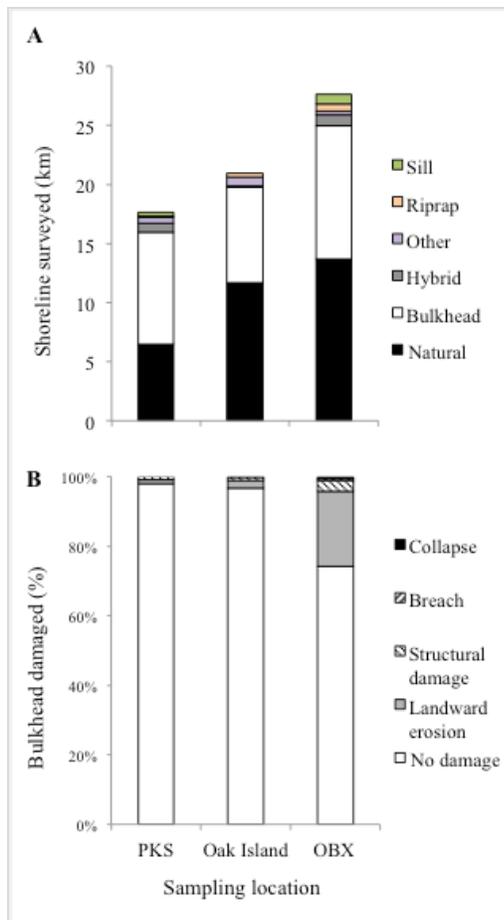


Figure 2. A) Total shoreline surveyed by region, and (B) percent of bulkheads damaged during Hurricane Matthew.

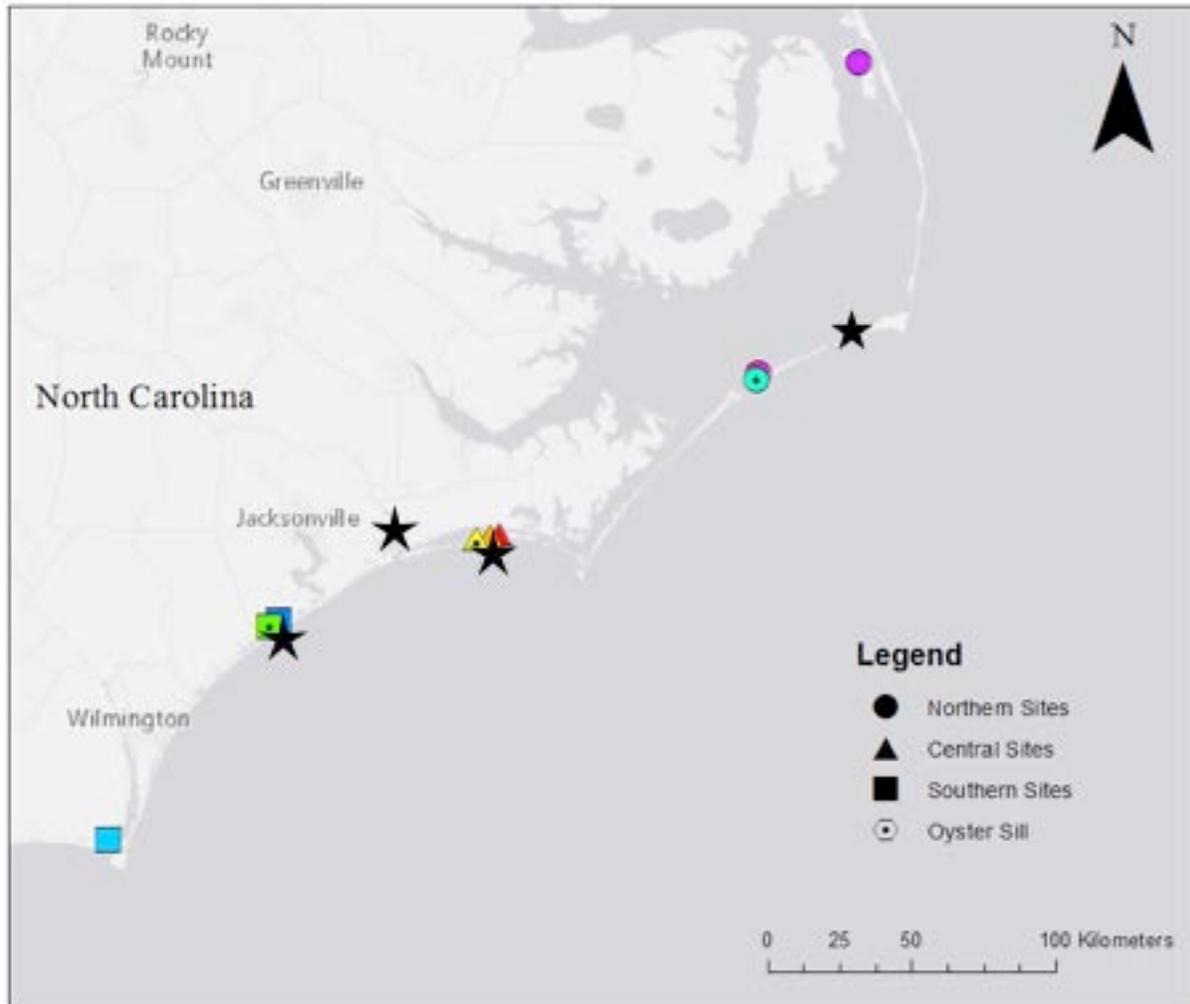


Figure 3. Locations of hurricane site surveys and fyke net sampling. Each solid colored shape represents 3 sites (1 bulkhead, 1 rock sill, and 1 natural marsh) and each dotted shape represents 4 sites (1 bulkhead, 1 rock sill, 1 oyster bag sill, and 1 natural marsh). Sites were surveyed in June 2015, May 2016 (before Hurricane Matthew), and October 2016 (after Hurricane Matthew). Black stars show the location of BACI fyke net sites, surveyed in summer 2016.

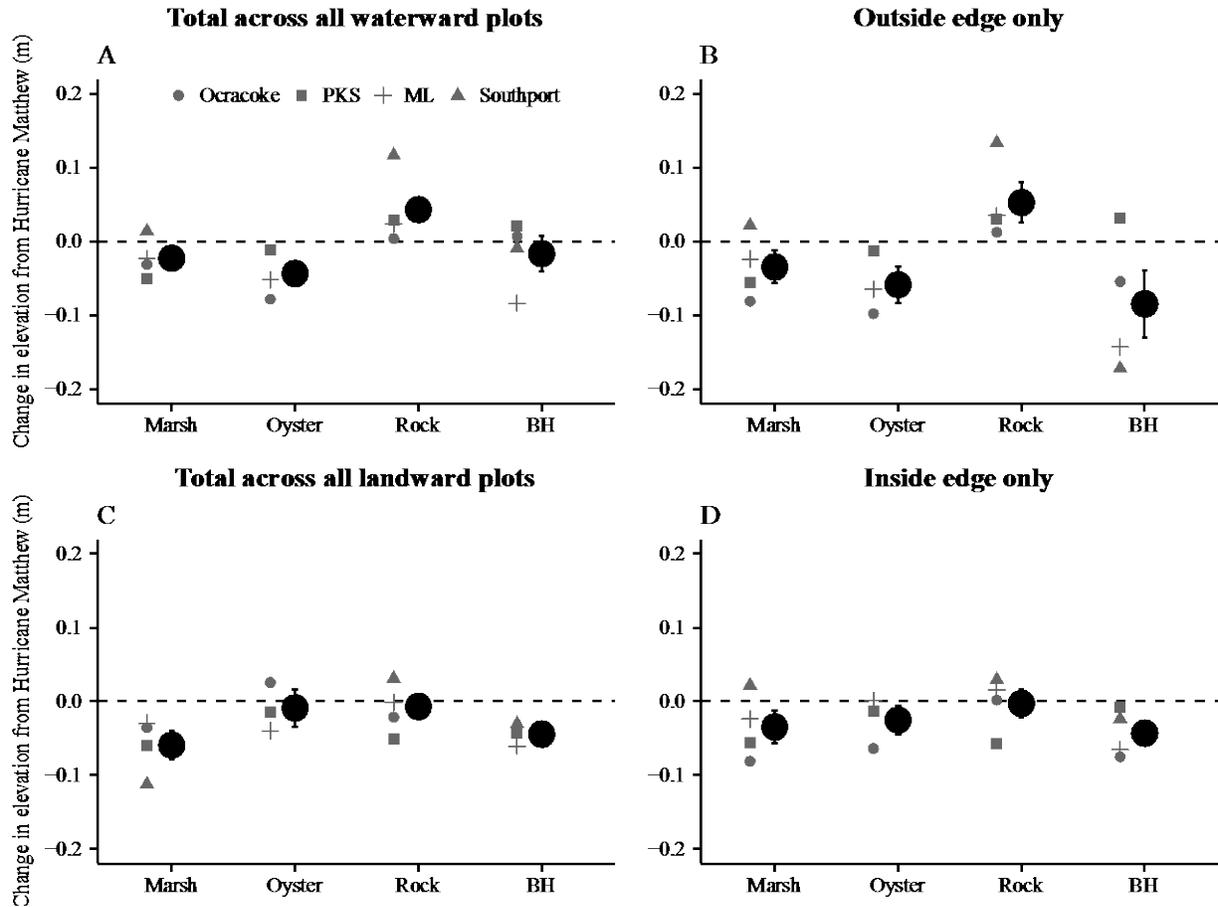


Figure 4. Change in absolute elevation by shoreline type from before (May/June 2016) to after Hurricane Matthew (October 2016). (A) Shows the total change across all waterward plots, and (B) show the change only at the outside edge plot. (C) Shows the total change across all landward plots, whereas (D) looks only at the change at the inside edge plot. The large black circles with error bars represent the average change in elevation (mean \pm SE) across all regions, and the gray shapes represent the average change in elevation within each individual region.

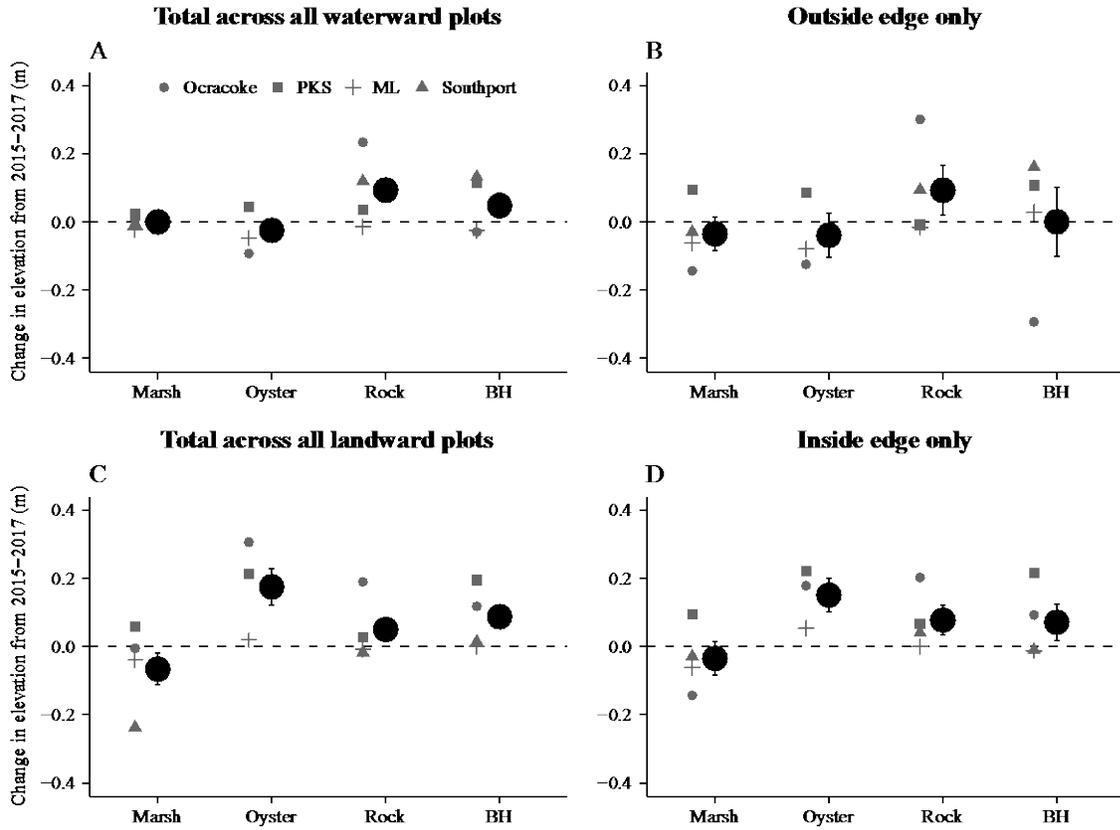


Figure 5. Change in absolute elevation as a function of shoreline type from 2015-2017. (A) Shows the total change in elevation across all waterward plots, and (B) shows the change in elevation at the outside edge plot only. (C) Shows the total change in elevation across all landward plots, and (D) shows the change at the inside edge plot only. The large black circles with error bars indicate the average change in elevation (mean \pm SE) across all regions, and the smaller gray shapes show the average for each individual site.

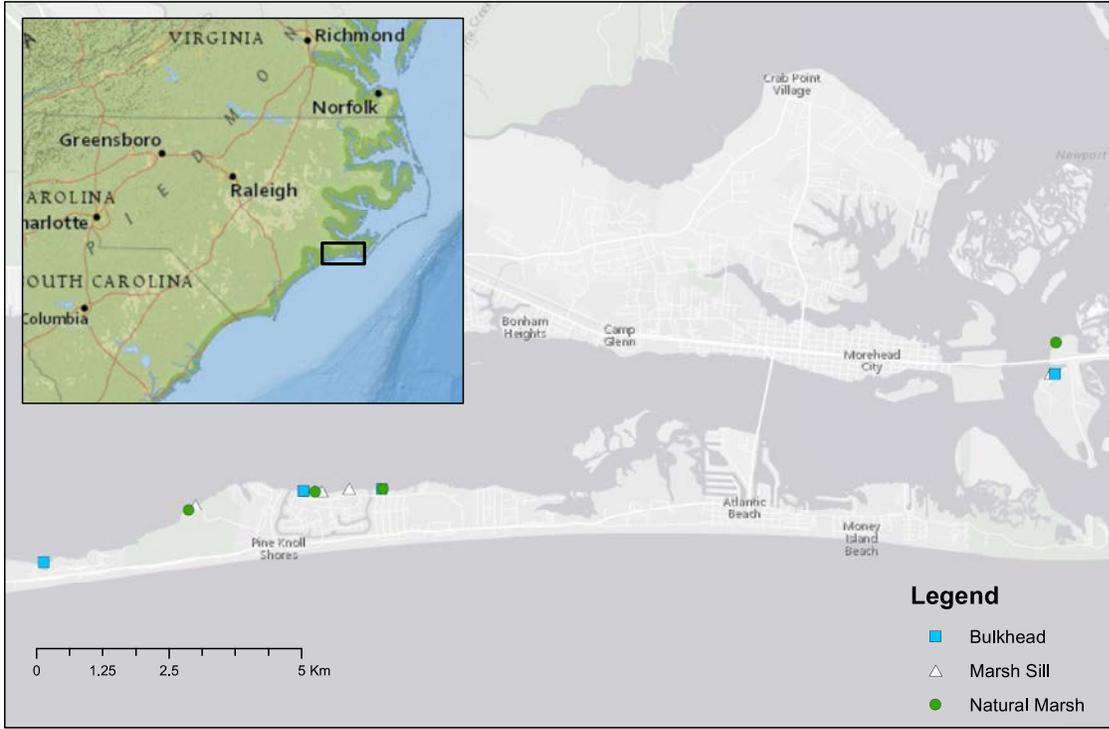


Figure 6. Map showing DIDSON sampling sites in Carteret county, NC.

CRFL Project Technical Monitor Progress Report and Data Review Sheet

Project #: 5104916

Principal Investigator: Johanna Rosman

Project Name: Understanding and predicting the frequency and duration of hypoxic exposure in fish habitats in the lower Neuse River estuary

Yes No N/A

1. Did the PI do what was proposed for this reporting period?
2. Does the report follow the CRFL guidelines?
3. Is the project making sufficient progress towards completion on time?
4. Does the PI have sufficient justification for any deviations that occurred?
5. Did the PI provide the raw data along with a data dictionary with the progress report in accordance with required elements as specified in their contract, if due at this time? (All project documents can be seen on the DMF drive)
6. Is the level of spending appropriate for the amount of work completed?
7. Should the progress report be accepted as is by the CRFL program?

If the answer to #7 was NO, please include detailed reasons for rejecting the progress report and suggestions on how to make the report acceptable.

Reasons for rejection: [Click here to enter text.](#)

Items for corrections/modification: [Click here to enter text.](#)

Summary of progress during this period: *The grant recipient continued to process field data measurements and refine models for environmental parameters. Deficiencies in the model have been identified and appropriate actions are being explored. The proposed work will be completed during the no-cost extension period.*

DMF Technical Monitor: Jordan Byrum

Signature:  6/6/18

COASTAL RECREATIONAL FISHING LICENSE
SEMI-ANNUAL PERFORMANCE REPORT

Recipient: Antonio B. Rodriguez

Grant Award #: 6442

Grant Title: Enhancing the quality of fish habitat and quantity of oysters by refining reef-restoration techniques

Grant Award Period: 07/01/2015 to 06/30/2018

Performance Reporting Period: 8/1/2017 to 01/01/2018

Project Costs:

Year 1: \$106,937; Year 2: \$107,077; Year 3: \$107,551; All Years: \$321,565

Expenditures for the Period:

| <u>Category</u> | <u>Expenditures</u> |
|-----------------|---------------------|
| Personnel | \$3,666.66 |
| Fringe | \$49.14 |
| Travel | \$99.43 |
| Equipment | \$0.00 |
| Supplies | \$2,043.87 |
| Construction | \$0.00 |
| Contractual | \$0.00 |
| Other | \$0.00 |
| Total Direct | <u>\$5,859.10</u> |
| Indirect | \$878.89 |
| TOTAL | <u>\$6,737.99</u> |

Total Cumulative Expenditures: \$6,737.99

Total Remaining Balance: \$100,813.01

Description of Work:

The aim of this study is to increase the success of oyster-reef restoration efforts across the state by quantifying those intertidal reef-exposure boundaries and subtidal-reef areas that optimize productivity, defined by oyster density and reef growth rate, and fish-habitat quality, defined by rugosity. Despite the fundamental nature of these data, no direct measures of oyster-reef growth exist for natural intertidal or subtidal reefs, which are crucial for linking oyster-reef condition to community-level fishery production. Thus, our study will provide useful information about oyster-reef habitat that is necessary for predicting the sustainability of the fishery, as well as augmenting the

ecosystem services the reef structure provides, in particular fish habitat. Natural intertidal reefs located adjacent to saltmarshes (fringing reefs) and on sandy and muddy bars (patch reefs), subtidal reefs, and NC oyster sanctuary reefs are the focus of this study that addresses three main objectives:

Objective 1. Develop guidelines for choosing intertidal oyster-reef restoration sites that maximize the potential for reef growth and restoration success across the different tidal ranges and landscapes that exist in NC.

Objective 2. Improve restoration of subtidal oyster reefs by measuring spatial variations in natural and restored-sanctuary oyster-reef growth rates and use derived morphologic information (relief) of reef areas that grow the fastest to guide future restoration efforts.

Objective 3. Enhance fish utilization of restored oyster reefs by providing construction guidelines that maximize habitat complexity (rugosity).

Project Status/Work Accomplished:

Publications:

Ridge, J.T., Rodriguez, A.B., and Fodrie, F.J., in preparation, Changes in the composition of oyster reefs as they transition from catching up to keeping up with sea-level.

Ridge, J.T., Rodriguez, A.B., and Fodrie, F.J., 2017, Evidence of exceptional oyster-reef resilience to fluctuations in sea level, Ecology and Evolution, v. 7, p. 10409-10420, <https://doi.org/10.1002/ece3.3473>.

Objective 1:

Task A: Deploy/maintain loggers (80% complete)- The water-level and barometric-pressure loggers in Back Sound (behind Shackleford Banks) and in the Shallotte River Estuary were downloaded twice. Water level logger data were compiled and we anticipate reading out the loggers one more time before the end of the project.

Task B: Intertidal reef scanning (70% complete)- Data from the second year of this project were processed, maps were created and measurements of reef growth were derived. No new scans have been collected in year 3. Weather has been an issue these past few months because we need to target spring tides with fair weather (no rain and temperatures above freezing) for reef scanning.

Task C: Intertidal reef densities (100 % complete)- No new progress with this task.

Objective 2:

Task A: Subtidal reef scanning (100% complete)-

Task B: Data processing; map generation (DEMs; 75% complete)- We have

produced digital elevation models for all of the intertidal oyster reefs included in the study and one subtidal reef.

Task C: Generate rugosity maps (100% complete)- We created 40 maps to use for extracting metrics of rugosity. Each map is a 1.0 m x 1.0 m digital elevation model with the camera located at the center point. Surface area was calculated for each site and used as a rugosity metric. Other metrics that will be incorporated into the analysis include (relief, location on the reef (distance from edge, elevation, and percent up the reef), and water depth during fish sampling.

Objective 3:

Task A. Fish surveying/collecting (100% complete)- In August and September, we deployed 7 cameras for 1.5 hours during the day and 1.5 hours at night on fringing and patch reefs and on a sand flat (control) in Core Sound. We have now collected a total of 95 videos. Those videos have been sampled for fish abundance and behavior. Currently, these data are being integrated with measures of rugosity. Preliminary results show that fish abundance is higher where fine-scale rugosity (decimeter scale) is intermediate.

Task B. Subtidal oyster densities (0% complete)- We will not be collecting subtidal oyster densities, because the sonar is not capable of measuring reef rugosity or growth.

Deviations:

No significant deviations to report. Because minnow traps did not work well for sampling fish on the intertidal reefs (they extend above the water line during the sampling period at some sites), we increased the number of camera deployments. The delay in funding forced students to move off of the project during the Fall of 2017. They returned to the project in December. We anticipate a short no-cost extension will be required to finish the data analysis and final report.

**COASTAL RECREATIONAL FISHING LICENSE
SEMI-ANNUAL PERFORMANCE REPORT**

Recipient: University of North Carolina at Chapel Hill, Office of Sponsored Research, 104 Airport Drive, Suite 2200 CB#1350, Chapel Hill, NC 27599-1350

Dr. F. Joel Fodrie (PI), Associate Professor, Institute of Marine Sciences & Department of Marine Sciences, University of North Carolina at Chapel Hill, 3431 Arendell Street, Morehead City, NC 28557, Phone: 252-726-6841 (ext 149), Email: jfodrie@unc.edu

Grant Award #: **2016-H-056**

Grant Title: Investigating rates of sedimentation in tidal creeks and resulting impacts on fishery production in primary and secondary nurseries

Grant Award Period: 07/01/2016– 6/30/2019

Performance Reporting Period: 07/01/2017 – 12/31/2017

Project Costs:

Expenditures for the Period:

| <u>Category</u> | <u>Expenditures</u> |
|-----------------|---------------------|
| Personnel | \$9,222.53 |
| Fringe | \$1,338.18 |
| Travel | \$393.02 |
| Equipment | |
| Supplies | \$581.99 |
| Construction | |
| Contractual | |
| Other | \$480.00 |
| Total Direct | \$12,015.72 |
| Indirect | \$1,802.38 |
| TOTAL | \$13,818.10 |

Total Cumulative Expenditures: \$13,818.10

Total Remaining Balance: \$78,071.90

Description of Work: The unifying objective for this research is to develop a greater understanding of the impacts of anthropogenic stressors (i.e., sedimentation) on benthic habitat structure and overall PNA function of tidal creeks. Fundamentally, we believe that investigating the habitat value of tidal creek PNAs impacted by sedimentation will fill important gaps in our understanding of finfish resilience in the face of growing coastal human populations. Our research scheme has 3 main components: (1) determine the historic and present status and morphology of tidal creeks, (2) assess the impacts of these changes on important benthic

habitats, and (3) assess the impacts of these changes on fishery production of recreationally targeted species.

Project Status/Work Accomplished:

Objectives 1 and 2: Between July 1 and December 31, 2017, land-use mapping and Pb-210 analyses were completed for four (Whiskey, Gales, Pages, and Sleepy) tidal creeks, for a total of nine (out of twelve) creeks. Land-use was mapped in ArcGIS by hand from all available USGS aerial photographs (providing dates of 1959, 1964, 1969, 1975, 1982, and 1993), and NOAA CCAP (Coastal Change Analysis Program) data was reclassified to match the hand-digitized land-use classification (providing dates of 1996, 2001, 2006, and 2010). Water level, temperature, and salinity data were continually collected from all twelve creeks. Sedimentation data from half of the creeks was presented at the Coastal and Estuarine Research Federation conference in Providence, RI, November 5-9, 2017. The three remaining tidal creeks were prepared for Pb-210 analysis and are expected to be analyzed by the end of January 2018. These continuing analyses will not result in any budget overruns for the project.

Objective 3: Carteret County – During each sampling interval, eight minnow traps and two crab pots were deployed at lower, middle, and upper sites in each creek during incoming and outgoing tides. Fyke nets were placed on the opposite side of creek from minnow traps at the lower creek site and set during incoming tides, then reversed and reset for outgoing tides. All sets were 2 hrs except when we needed to modify for time of day or weather. Trawling was completed within each creek with 5-12 trawls per site. Carteret County sites were sampled over two days each season (full sampling on both days). At the end of each day, we set 15-m gill nets in the upper, middle, and lower sections of each creek, and recovered the nets on the following morning. Typically, these were consecutive days however this was modified on occasion.

Wilmington – During each sampling interval, we used 10 minnow traps and two crab pots at each lower, middle, and upper site in each creek during incoming and outgoing tides. Fyke nets were placed on the opposite side of creek from minnow traps at the lower creek site and set during incoming tides, then reversed and reset for outgoing tides. All sets were 2 hrs except when we needed to modify for time of day or weather. Trawling was completed in the creeks as habitat allowed – in some creeks trawls were difficult due to narrow channels and punctuated oyster reefs. At the end of each day, we set 15-m gill nets in the upper, middle, and lower sections of each creek, and recovered the nets on the following morning. Wilmington sites were only sampled one day each season.

Sampling both incoming and outgoing tides was only possible on days with ~noon high tides, and as weather permitted.

Summer Sampling:

Carteret County - We visited all 6 CC sampling sites. We completed two consecutive days of sampling both incoming and outgoing tides in 4 of the 6 creeks. We were only able to get one incoming and one outgoing in Sleepy and Gales Creeks, respectively. We conducted trawls and gill-net sampling in all creeks we visited.

Wilmington- We were able to complete incoming and outgoing tide sampling in 3 out of the 6 creeks. In the remaining 3 creeks, sampling was only conducted on outgoing tides.

Fall Sampling:

Carteret County - We visited 4 creeks and completed incoming and outgoing sampling in 2 of these 4 creeks. In the other two creeks, we sampled outgoing tides only. We conducted trawls and gill-net sampling in all creeks we visited.

Wilmington - We visited 3 creeks during fall sampling. We sampled outgoing tides only in all 3 creeks. We conducted trawls and gill-net sampling in all creeks we visited.

Data: All data collected to date has been entered electronically and QAQCed.

COASTAL RECREATIONAL FISHING LICENSE
SEMI-ANNUAL PERFORMANCE REPORT

Recipient: Jessie C. Jarvis, Assistant Professor, University of North Carolina Wilmington, Wilmington, NC, jarvisj@uncw.edu

Brandon Puckett, Research Coordinator, North Carolina National Estuarine Research Reserve, Beaufort, NC, brandon.puckett@ncdenr.gov

W. Judson Kenworthy, Adjunct Faculty, University of North Carolina Wilmington, Wilmington, NC, jud.kenworthy@gmail.com

Grant Award #: 2017-H-059

Grant Title: Development of SAV Sentinel Sites in Southeastern NC

Grant Award Period: July 1, 2017 through June 30, 2018 (Year 1 of 3)

Performance Reporting Period: July 1, 2017 to December 30, 2017

Project Costs:

Expenditures for the Period:

| <u>Category</u> | <u>Expenditures</u> |
|-----------------|---------------------|
| Personnel | \$9,175.00 |
| Fringe | \$1,440.31 |
| Travel | \$825.57 |
| Equipment | \$35,120.22 |
| Supplies | \$6,921.10 |
| Construction | \$0.00 |
| Contractual | \$0.00 |
| Other | \$2,633.57 |
| Total Direct | |
| Indirect | \$8,417.32 |
| TOTAL | |

Total Cumulative Expenditures: \$64,533.09

Total Remaining Balance: \$14,813.53

Description of Work:

Submerged aquatic vegetation (SAV) are underwater flowering plants that deliver essential ecosystem services to coastal areas by providing refuge for fish and invertebrates, serving as food for water fowl, improving local water quality conditions and stabilizing sediment (Hughes et al. 2009). In North Carolina SAV directly affect recreational fisheries by providing nursery habitat for blue crab and red drum; serving as foraging grounds for spotted sea trout, gag grouper and summer flounder; providing spawning areas for spotted sea trout, grass shrimp and bay scallop; and serving as a refuge for bay scallop and hard clam. As such, SAV meadows are recognized as an essential fish habitat in North Carolina and by the National Marine Fisheries Service (Thayer et al. 1984, NCDEQ 2016).

Losses of SAV have direct negative impacts on associated faunal abundance, diversity and biomass (Hughes et al. 2009). Globally, declines of SAV are attributed to large-scale

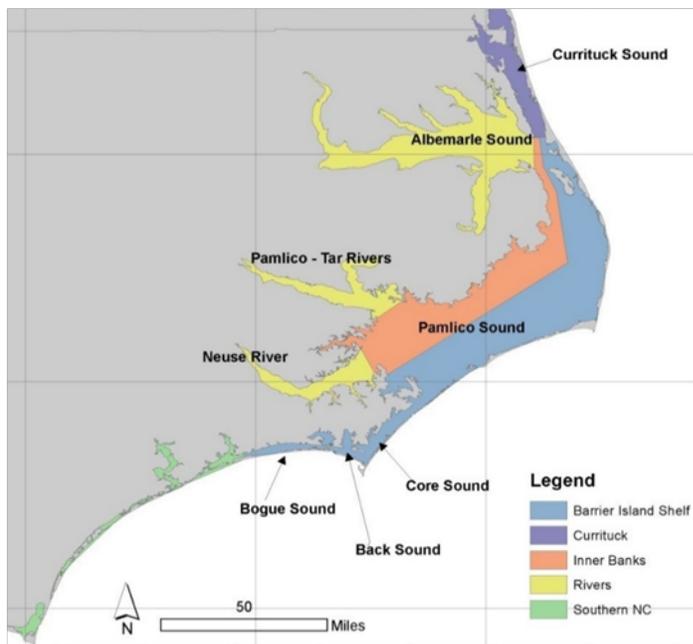


Figure 1. Geographical stratification of NC estuaries and river systems (Kenworthy et al. 2012).

changes in weather patterns (e.g. frequency and intensity of storms), regional changes in water quality and localized events (e.g. sedimentation due to development) (Waycott et al. 2009). While impacts on fishery species due to declines in SAV populations can occur rapidly (< 1 year), recovery from large scale SAV loss can take extended time periods (3-5 years), resulting in significant economic impacts on commercial and recreational fisheries (Hughes et al. 2002, Barbier et al. 2011, Ray et al. 2014). For example, in Massachusetts, Hughes et al. (2002) found that the abundance and biomass of nursery, resident and spawner fin-fish species decreased across estuarine systems in direct relationship to loss of SAV meadow area and biomass. The effects on the fish populations occurred before

SAV was completely lost; highlighting the need to detect changes and implement the appropriate corrective interventions prior to loss of SAV populations in order to support a diverse fish community.

This research is an extension of previously funded CRFL projects that focused on monitoring existing SAV resources in low salinity areas (Kenworthy et al. 2012). This project builds on those studies by focusing on high salinity communities and the development of sentinel site monitoring protocols and critically assessing their potential for practical application in other regions of NC that support SAV. With remote sensing, paired to situ water quality and biological monitoring, the results of this research will provide evidence for relationships between the status and changes SAV health and specific water quality parameters known to affect SAV growth, abundance and distribution. In addition, the results of this proposal will build on and

complement previous efforts to develop and improve monitoring protocols necessary for managing SAV.

Objectives: The goals of this research are to provide information and assistance to the Division of Marine Fisheries Habitat and Enhancement Section on the status and trends of SAV habitat by evaluating monitoring protocols at SAV sentinel sites in the barrier island shelf and southern NC coastal meadows (Fig. 1). We will evaluate SAV structural (e.g., species composition, shoot density, cover, biomass), physiological (e.g. Nitrogen content, C:N ratios, SAV growth) and resilience (e.g. seed bank viability) indicators with respect to site location and environmental quality (e.g., temperature, salinity, nutrients). We will use these indicators and relationships to develop monitoring protocols for the establishment of long-term permanent SAV sentinel sites.

Our specific objectives are to:

1. Select SAV sentinel sites in marine habitats in the barrier island shelf and southern NC zones (Fig. 1) using the CRFL funded 2015 SAV aerial survey results.
2. Quantify baseline conditions for SAV abundance and distribution using acoustic mapping protocols developed for NC SAV monitoring.
3. Establish water quality and benthic PAR monitoring stations at each SAV sentinel site.
4. Develop and implement transect based sampling protocols to quantify physiological, structural and resilience indicators for quantitatively characterizing SAV meadows.
5. Link changes in SAV health to environmental quality.
6. Modify, where necessary, water quality and SAV monitoring protocols according to results.

Project Status/Work Accomplished:

General Planning and Mobilization:

During this reporting period, we recruited and selected a UNCW Master in Marine Biology student to work on the grant, and purchased supplies and equipment to begin water quality and SAV monitoring. We had an initial project-planning meeting in July 2017 to discuss purchasing and field sampling logistics. Prior to field sampling, we established three SAV Sentinel sites in Back Sound, the New River, and Topsail (Fig. 2). Staff from UNCW and NC Rachel Carson Reserve initiated field sampling in

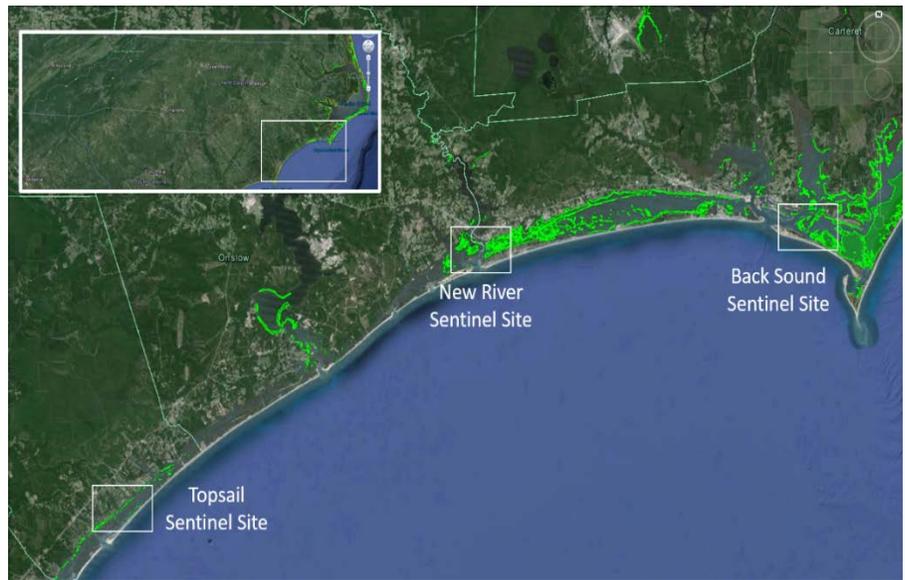


Figure 2. Locations for three sentinel sites in the Barrier Island Shelf (Back Sound) and Southern (New River and Topsail) regions. Green polygons represent 2009 SAV distribution (NCDMF unpublished data).

July, August and September. Sites were mapped for seagrass area in September and October using drone based aerial photography. We continued to collect monthly water quality samples for all months during this reporting period except for November 2017. Throughout the reporting period members of the team continued to analyze data and statistically evaluate power analysis methods for biomass, CHN, and productivity samples.

Objective 1: Select SAV sentinel sites in marine habitats in the barrier island shelf and Southern NC regions based on the CRFL funded 2015 SAV aerial survey results.

Task 1: We used aerial survey data of SAV distribution, funded in part by the Albemarle Pamlico National Estuary Partnership (APNEP) and CRFL programs, in July 2017 to select one sentinel site in each of the three NC sub-regions identified above (Fig. 2). Sentinel sites were selected based on the criteria defined by Kenworthy et al. (2012). Each site contained; 1) key physical and biological attributes that represent the larger ecosystem, 2) exhibited significant ecological value associated with the presence of key SAV species that are significantly important to ecosystem function, and 3) provided a high likelihood of detecting change in SAV structure, health and resilience attributed to potential temperature and light stressors.

Task 2: Within each sentinel site three monitoring areas were established (n = 3 monitoring areas per sentinel site; 9 total). Three transects varying in length from 50 – 290 m, depending upon meadow dimensions, were established within each monitoring area and marked with PVC poles (n = 3 transects per monitoring area, 9 per sentinel site; 27 total). All transects, monitoring areas, and sentinel sites will be maintained through the duration of the project (June 2019).

Products: GPS points were collected at the beginning and end of each transect in July 2017 and stored in an ARC-GIS database. Maps for each sentinel site were developed, for example, site 3 in Back Sound (Fig. 3). All sites will continue to be mapped bi-annually for the duration of the project.

Objective 2: Quantify baseline conditions for SAV abundance and distribution using acoustic mapping protocols developed for NC SAV monitoring.

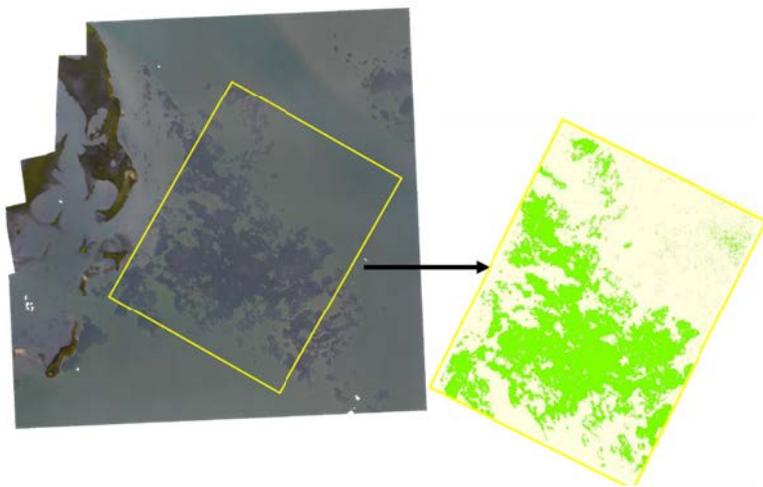


Figure 3. Preliminary drone imagery and processed data for NC SAV meadows using a Phantom4 done. Green area denotes seagrass cover.

Task 1: Modifications were needed to SAV mapping protocols due to limitations in water depth at all sampling sites. (see Objective 5). All monitoring areas were too shallow at high tide to maintain the minimum 0.5 m clearance between the top of the meadow and the transducer required for accurate measurements. (Kenworthy et al. 2012, Luczkovich et al. 2015). A drone

(UAV) was selected to map the meadows due to the high accuracy and low costs of UAV mapping compared to acoustic and aircraft based aerial survey methods (Ventura et al. 2016, Duffy et al. 2018). All sentinel sites were mapped in September and early October 2017.

Sites were mapped using a DJI Phantom4 drone equipped with a 4K UHD camera at a scale of 6 cm/pixel. Back Sound was flown on 9/14/17; New River monitoring sites 1 and 2 on 9/20/17; and Topsail on 10/19/17. We were unable to fly New River site 3 due to weather issues. Following data acquisition, all drone images were ortho-rectified to GPS coordinates collected with each image and stitched together to form a mosaic for each monitoring site using ERDAS IMAGINE 2015 software (Figure 3). Photo-interpreted images from all locations were ground-truthed and verified with transect data collected at each site in September 2017 as part of monthly SAV sampling protocols. Processing of imagery and ground-truth data will be completed following the May 2018 sampling.

Products: Images from each site and were stored in an ARC-GIS database. Photo-mosaic images have been generated for all sites for the fall 2017 sampling and are currently being analyzed for seagrass cover and compared to ground-truth data acquired on the transects. We are currently refining ground-truthing protocols for the drone imagery and will collect images again in May 2018.

Objective 3: Establish continuous environmental water quality and benthic PAR monitoring stations at each SAV sentinel site.

Task 1: We established an intensive water quality monitoring station in the New River in October 2017. The Yellow Spring Instruments EXO₂-data sonde (Yellow Springs International Inc.) collects chlorophyll a ($\mu\text{g L}^{-1}$), turbidity (NTU), dissolved oxygen (mg L^{-1}), colored dissolved organic matter (CDOM, $\text{ABS}_{440}, \text{m}^{-1}$), temperature ($^{\circ}\text{C}$) and salinity data every 15 minutes. The sonde was deployed and calibrated following NERRS SWMP water quality



Figure 4. Images of continuous water quality sampling sondes deployed at SAV sentinel sites (Left) YSI EXO₂-data sonde and protective monitoring cage prior to deployment in the New River site 2 in October 2017. (Right) Odyssey PAR logger and wiper unit prior to deployment. PAR loggers and wipers have been deployed at all SAV sentinel sites.

monitoring and data QAQC protocols (Figure 4).

Task 2: At all monitoring sites (n= 3 per sentinel site, 9 total) benthic temperature (°C) and light (PAR $\mu\text{mol m}^{-2} \text{s}^{-1}$) were quantified every 15 minutes with Hobo and Odyssey PAR sensors respectively (Figure 4). All sensors were placed in the middle of the meadow at each sentinel

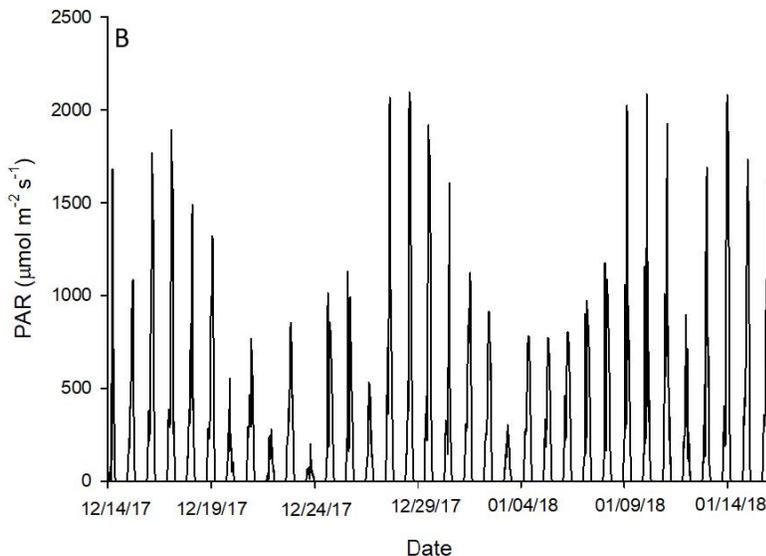
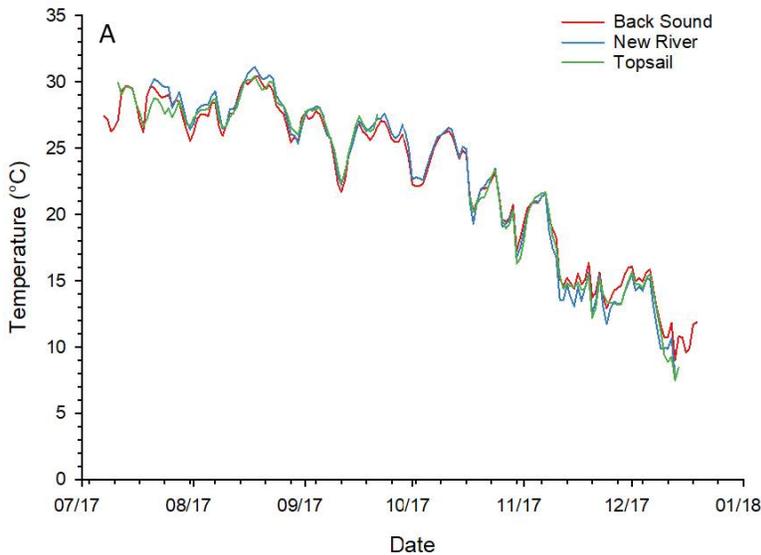


Figure 5. (A) Daily mean temperature data for each SAV sentinel site from July – December 2017 averaged across all monitoring locations. (B) Benthic PAR data collected at the Topsail monitoring site 2 from 12/14/17 through 1/17/18.

site and were exchanged monthly.

Temperature sensors were deployed beginning in July 2017 and PAR sensors were deployed in October following the completion of wiper unit construction. In addition to the continuous sampling, three water samples were collected monthly from each sentinel site for TSS (mg l^{-1}), chlorophyll *a* ($\mu\text{g l}^{-1}$) using standard methods.

Products: We have collected temperature and light data for all monitoring areas within each sentinel site (Figure 5). The only exception was Topsail monitoring site 3 where no light data was collected due to mechanical issues with the sampling equipment. We will continue to collect water quality data through June 2018. All data are being analyzed for temporal patterns and relationships with changes in SAV parameters.

Objective 4: Develop transect based sampling protocols to quantify physiological, structural and resilience indicators for SAV meadows.

SAV Physiological Indicators (collected monthly along transects from July – September 2017)
Task 1: SAV leaf and rhizome nitrogen content (%N) and C:N ratios were quantified from ten

individual shoots at randomly selected distances along each transect (n = 10 per transect, 30 per monitoring site, 90 per sentinel site, 270 total). Following collection, above and belowground biomass was dried at 60 °C until a constant weight is reached. The samples were then ground to a fine powder and stored in sealed glass vials at 4 °C until analyzed for carbon and nitrogen content using a CHN analyzer. Elemental content was calculated on a dry weight basis (i.e. mass of element /dry weight of sample x 100%).

SAV Structural Indicators (collected monthly along transects from July – September 2017)

Task 1: Visual observations of percent cover (%) and shoot density (shoots m⁻²) and water depth (m) were quantified in three 0.25 m⁻² quadrats every 10 meters along a transect for all SAV species (Figure 6). When present, SAV flowering shoot density (shoots m⁻²) was also quantified.

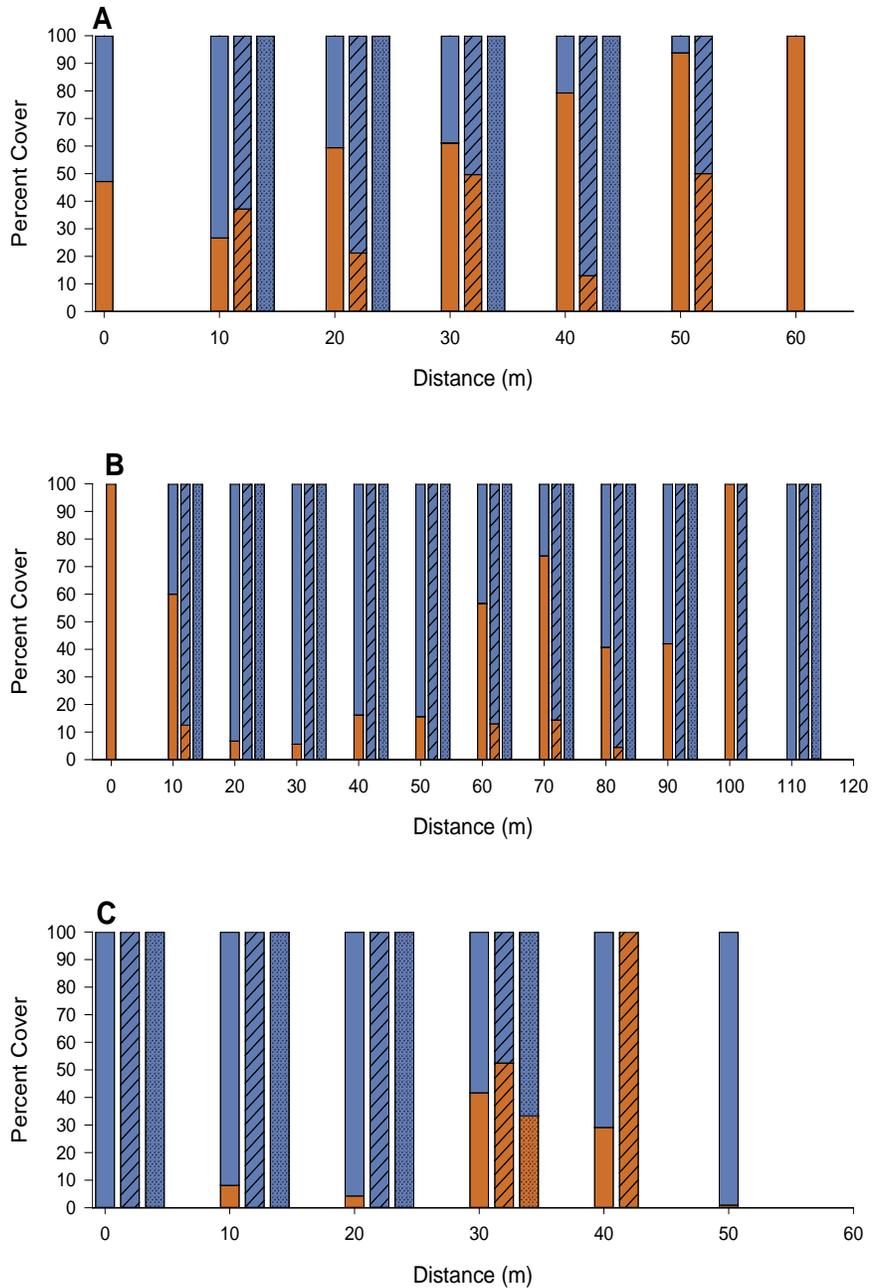


Figure 6. Mean SAV percent cover for Topsail monitoring site 1 (A), site 2 (B), and site 3 (C). Blue bars represent *Z. marina* and orange bars *H. wrightii*. Solid bars = July, hash marks = August, and dotted bars = September sampling data.

Task 2: SAV above and belowground biomass were quantified at each transect with a 22 cm diameter corer at three locations randomly dispersed within the sampling area (n = 4 per monitoring site, 12 per sentinel site, 36 total). All cores were rinsed in the field on a 1 cm mesh sieve to removed sediments and plant and root/rhizome material was stored at -80 °C until analysis. All plants within each sample were identified by species and then sectioned into above and below ground material.. All biomass samples were then dried in pre-weighed aluminum envelopes for five days at 60° C or until a constant dry weight was reached. Above and below ground biomass and shoot density data were then quantified for each species (biomass m⁻²), which will be scaled to area of the meadow (from mapping objective above) to estimate species total biomass for the entire meadow.

SAV Resilience Indicators (collected at all monitoring sites in August 2017)

Task 1: Samples for SAV meadow resilience including, measurements of SAV seed bank density (seeds m⁻²), and viable seed bank density (% of total seeds, viable seeds m⁻²) were collected in August 2017. Fifteen seed cores (10 dia x 10 cm depth) per transect (n = 45 per sentinel site) were collected and sieved (710 µm mesh). All SAV seeds were quantified and tested for viability using tetrazolium chloride methods (Conacher et al. 1994).

Task 2: *Zostera marina* shoot growth rates (mm day⁻¹) were calculated in August 2017 using the leaf plastochrone interval (P_L days) in 10 randomly selected 0.25 m² quadrats per monitoring site (Short and Duarte 2001). All *Z. marina* shoots within the quadrat were punctured at the base of the leaf sheaf and all *H. wrightii* shoots were cut to a 4 cm height. After 14 days all shoots were collected and taken back to the lab. The number of leaves per *Z. marina* shoot with and without puncture holes were counted (n = 10 per transect, 30 per sentinel site, 90 total) and the total length of *H. wrightii* shoots were measured. The plastochrone interval for *Z. marina* was calculated by dividing the time interval (T₁) by the number of new leaves produced (N). *Halodule wrightii* growth was calculated by subtracting 4 cm from the final leaf length and dividing the remaining length (mm) by the time interval (T₁).

Products: Both seed bank and growth rate data for August 2017 are currently being analyzed. Seed bank samples will be collected again in February 2018 and both seed bank and growth rate data will be collected in May 2018.

Objective 5: Link changes in SAV health to water quality conditions.

Task 1: All SAV health, resilience and water quality data will be analyzed with regression analysis using generalized linear mixed effects models or generalized additive mixed effects models with the appropriate distribution (Zuur et al. 2007). These models will be used to directly relate water quality conditions to SAV parameters identifying which water quality conditions are driving changes in SAV health.

Products: SAV health, resilience and water quality data are currently being analyzed. We will continue to collect SAV and water quality data in Years 2 and 3 of the project in order to meet this objective.

Objective 6: Modify, where necessary, water quality and SAV monitoring protocols according to results.

Task 1: Prior to SAV sentinel site selection, we proposed using acoustic methods developed for low salinity NC SAV meadows to map our high salinity sites. However, due to the shallow nature of all monitoring sites, we were not able to meet the 0.5 m minimum clearance requirement between the top of the SAV canopy and the transducer. The lack of clearance would increase the error in the mapping data making the SAV area measurements unreliable. To meet our objectives we used aerial imagery acquired with a Phantom4 drone to map all sites (except New River monitoring site 3) in September and October. The shallow, clear water conditions associated with our high salinity SAV sentinel sites makes these areas ideal for mapping with aerial imagery. The use of drones allows us to collect the aerial imagery without the expense of traditional aerial plane based surveys. We are currently refining our QAQC methodology for the drone imagery. This will be finalized by the end year 1 of the project.

Deviations:

While we did not deviate from our goals or objectives during the reporting period, we did have to change our methodology to map SAV area. We added a 6th objective to formalize our approach any future modifications to our proposed sampling methodology as we develop our sentinel site monitoring protocols.

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COASTAL RECREATIONAL FISHING LICENSE

SEMI-ANNUAL PERFORMANCE REPORT

Recipient: Anne Deaton and Casey Knight

Grant Award #: 2017-H-061

Grant Title: Developing methodology for assessing fish use in Strategic Habitat Areas

Grant Award Period: July 1, 2017 - June 30, 2019

Performance Reporting Period: July 1, 2017 – Dec 31, 2017

Project Costs: Awarded \$176,537 for Yr 1; \$139,717 for Yr 2; Total – \$316,253.90

Expenditures for the Period:

| <u>Category</u> | <u>Expenditures</u> |
|-----------------|---------------------|
| Personnel | 12,972.52 |
| Fringe | |
| Travel | 347.09 |
| Equipment | 2,853.98 |
| Supplies | 2,997.97 |
| Construction | |
| Contractual | 521.12 |
| Other | |
| Total Direct | |
| Indirect | |
| TOTAL | 19,692.68 |

Total Cumulative Expenditures: \$19,692.68

Total Remaining Balance: \$156,844.32 for Yr 1

Description of Work:

Identification of specific critical areas for recreational fishery species is a means of prioritizing conservation, enhancement, and restoration of habitats. This, in turn, will enhance recreational fishing opportunities in coastal North Carolina. The division completed a GIS-based spatial analysis in coastal watersheds to identify a network of high quality habitat areas, referred to as Strategic Habitat Areas (SHAs) in 2017. The analyses were done separately in four coastal regions. Field sampling is necessary to validate fish use and habitat condition of the selected SHAs and/or

refine the SHA boundaries as needed. This CRFL project is a pilot study within one region (White Oak River Basin, Region 3) to determine the most ecologically sound and effective method to verify the quality of SHAs. Field sampling of target fish species in or adjacent to three fish habitats (wetlands, SAV, and shell bottom) both inside and outside of SHAs will be conducted with several gear types.

Study objectives

- 1) Conduct extensive field sampling of target recreational fish species in three fish habitats inside and outside of Strategic Habitat Areas
- 2) Develop indicator metrics for validating Strategic Habitat Area nominations based on target species use and habitat metrics
- 3) Produce a standard operating procedure (SOP) for monitoring and potentially modifying Strategic Habitat Areas in the future based on indicator performance

Project Status/Work Accomplished:

Objective 1

Tasks for the first six months of this project were to refine sampling methodology and metrics, hire staff, purchase and construct necessary field equipment and supplies, and conduct test sampling. This has all been completed on schedule.

Using ArcMap, a one nautical mile square grid was overlaid on the sampling area (waters from Core Sound to Topsail Sound). Grids were designated as SHA (108) or non-SHA (69). ArcMap Sampling Design Tool will be used to randomly select SHA and non-SHA sites (grids) for each four week sampling period from February 15 – November 15.

One technician was hired in August to purchase and construct sampling gear. From October to November, the technician and PIs conducted preliminary sampling to test gear and sampling design as described in the proposal. During these two months, approximately eight SHA and seven non-SHA sites were sampled for over nine field days. Several problems were identified and corrected with minor modifications to the grid selection process and fish sampling design. A Standard Operating Procedure (SOP) and data sheets were developed to reflect the updated methodology. These will be incorporated into the Fisheries Information Management Systems (FIMSS) program documentation. An additional technician was hired in November and will begin in January to assist with sampling efforts.

At each site, fish sampling will be done using breeder traps, gill nets and bottom trawls. Where intertidal wetlands, oyster reef, and shallow SAV are present within a grid, four breeder traps will be set in each habitat type, alternating perpendicular and parallel orientation to the habitat edge. Four gill nets (2", 3", 4", 5" stretched mesh) will be set within 100 ft of shore where water depth is at least three ft at MLW. Breeder traps and gill nets will be set at low tide and soak for at least three and four hours, respectively. For both traps and gill nets, the collected fish will be identified to species and counted. Target species will be measured and weighed, and total

biomass of all fish will be recorded. Trawling will be done on a separate day on the falling tide. Because this is a pilot study to determine what gears will be the best way to characterize fish use that is also logistically feasible, modifications to the sampling methodology may still occur in the first few months of 2018 sampling.

Habitat metrics will be collected at low tide while traps and gill nets are soaking using quadrat sampling. Wetland metrics include habitat type (fringe or isolated), connectivity to other habitats, observable erosion, plant species, shoot count, maximum and average shoot height, and other fauna present. Oyster reef metrics include reef type (fringe or isolated), connectivity to other habitats, shellfish species present, percent cover shell, total number of live oysters, length of 30 oysters, rugosity, and other fauna present. SAV metrics include habitat type (fringe or isolated), connectivity to other habitats, SAV species present, percent cover, shoot density, maximum and average shoot height.

Objectives 2 and 3

For Objective 2, a literature review was done to determine the best fish and habitat sampling metrics. Sampling results are needed to finalize the most appropriate metrics. Similarly for Objective 3, the selected sampling design and methodology represents a preliminary SOP. Sampling results are needed to finalize the SOP.

Deviations:

There have been a few deviations to the proposed budget. The original proposal requested funding for a truck. However, an existing vehicle in the section became available for our use, and we therefore will not be purchasing a truck. We were also able to save money by purchasing a mapping grade GPS at a much lower cost than expected. We had to purchase a desktop computer that we had not budgeted for due to poor performance of the GIS software on the existing laptop. All sampling will be conducted with existing section vessels. We do not expect to need to use the larger R/V Carolina Coast, as proposed.

Preliminary sampling indicated that we will not be able to sample as many sites per day or four week period as originally proposed (35-45). Rather, approximately 20 random grids will be selected each period, stratified by SHA and non-SHA. However, because we are not stratifying stations by habitat type, as proposed, the statistical power should improve, allowing for the slightly lower number of samples. Power analysis will be conducted after the two months of sampling to verify if the sampling frequency will be satisfactory.

COASTAL RECREATIONAL FISHING LICENSE
SEMI-ANNUAL PERFORMANCE REPORT

Recipient: Dr. David B. Eggleston

Grant Award #: 2017-H-063

Grant Title: Evaluating Cultch Oyster Reefs as Essential Fish Habitat

Grant Award Period: 7/1/17—6/30/18 (Year 1 of 3)

Performance Reporting Period: 7/1/17-12/31/17

Project Costs: We were able to save \$ costs during this reporting period by using scholarship funds for the graduate student on this project, Ms. Olivia Caretti. The next reporting period will see a sharp increase in expenditures due to this scholarship ending.

Expenditures for the Period:

| <u>Category</u> | <u>Expenditures</u> |
|-----------------|---------------------|
| Personnel | \$13,522 |
| Fringe | \$2,164 |
| Travel | \$2,120 |
| Equipment | \$0 |
| Supplies | \$488 |
| Construction | \$0 |
| Contractual | \$0 |
| Other | \$1498 |
| Total Direct | \$19,792 |
| Indirect | <u>\$2,969</u> |
| TOTAL | \$22,761 |

Total Cumulative Expenditures: \$22,761

Total Remaining Balance: \$93,964

Description of Work:

As oyster populations have reach historic lows, restoration efforts have expanded worldwide, and there is increasing recognition of the role oyster reefs play in providing key ecosystem services such as removing excess nutrients, stabilizing shorelines and creating essential fish habitat (EFH). Coastal habitat management and policies require information on ecosystem services provided by structured habitats (e.g. oyster reefs, mangroves, seagrass, salt marshes, coral reefs). Oyster cultch planting provides oysters for commercial harvest (i.e. jobs), as well as key ecosystem services that have additional monetary value; however, we are unaware of any

information on the EFH value of oyster cultch-planting programs. **This study will determine the value of cultch reefs created by the NC DMF as essential fish habitat and quantify the contribution of cultch reefs to overall fish production per unit area.** Our overarching hypothesis is that oyster cultch sites will show enhanced production and diversity of certain recreationally important fish species compared to unstructured control sites, and that fish production and diversity will increase with the complexity of reef habitat. This study will investigate oyster cultch reefs that vary in habitat complexity. Our objectives are to: (1) create high-resolution seabed maps to quantify the complexity of these benthic habitats; (2) quantify estuarine fish production and diversity among the reef sites and unstructured control sites using a combination of: (i) gill nets, (ii) fish traps, and (iii) passive acoustic monitoring. The proposed study will (1) generate sound scientific information on the nature and value of ecosystem services provided by (restored) oyster reefs, and (2) support making informed, science-based decisions about the conservation, use and management of one of the State’s key estuarine restoration programs. The proposed study addresses two overarching Objectives and five Specific Strategies described in funding priorities for the NC CRFL program.

Milestone Schedule: This is a three-year project, however, to match the required reporting period we provide the Scope of Work for Year 1 only.

A). Scope of Work:

Year 1 will involve: (i) site reconnaissance, (ii) identification of experimental and control sites, (iii) quantifying fish production of cultch reefs (iv) characterizing the soundscape at all sites, (v) USV mapping of newly constructed cultch reefs, (vi) biological sampling of oysters on reefs to ground-truth the USV maps and rugosity metrics, and (vii) data analyses and report preparation.

B). Timeline:

| Task | Year 1: July 1, 2017- June 30, 2018 | | | | | | | | | | | | |
|--|-------------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
| | J | A | S | O | N | D | J | F | M | A | M | J | |
| Survey unstructured control and experimental sites | ■ | | | | | | | | | | | | |
| Gill nets and trap sampling | | ■ | | ■ | | | | | | | | | |
| Hydrophone deployment | | ■ | ■ | ■ | | | | | | | | | |
| Hydrophone data analyses | | ■ | | ■ | | | | | | | | | |
| Biological data processing and analysis | | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | |
| Deploy new cultch reefs of varying habitat complexity (NC DMF, NCSU/CMAST) | | | | | | | | ■ | ■ | ■ | ■ | ■ | |
| USV mapping (NCSU/CMAST) | | | | | | | | | | | | | ■ |
| SCUBA oyster sampling (NCSU/CMAST) | | | | | | | | | | | | | ■ |
| Performance report writing and submission (NCSU/CMAST) | | | | | | | ■ | ■ | | | | | |

Project Status/Work Accomplished:

Objective 1: Create high-resolution seabed maps of oyster cultch reefs to quantify

habitat complexity.

1. Map cultch reefs using the CMAST-NCSU Unmanned Surface Vehicle (USV). Initial mapping was completed in August 2017 following the construction of 6 oyster cultch reefs in southwest Pamlico Sound. Bathymetric maps were generated from side-scan sonar data during this reporting period (Fig. 1). Additional data analysis regarding reef rugosity is in progress.

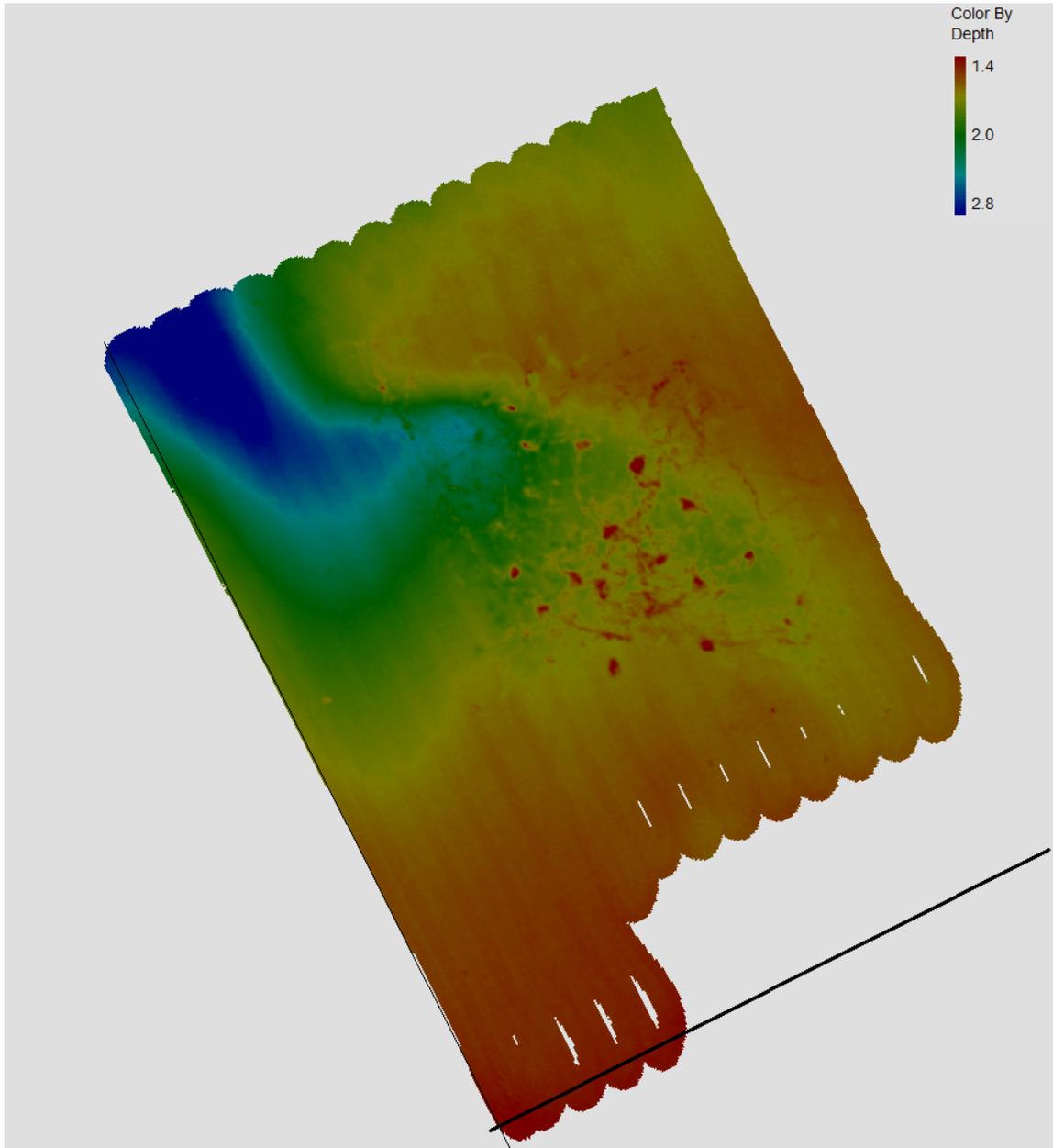


Figure 1. Bathymetry (m) of a newly planted cultch reef site constructed by the NC Division of Marine Fisheries in Bonner Bay NC. Red dots denote relatively shallow distribution of cultch oyster reefs. These data are being used to quantify the size and structure of these new habitats,

guide fish production and biodiversity sampling, as well as passive acoustic studies designed to monitor the success of these sites overtime.

Objective 2: Estimate oyster density and size-frequency over time.

Scuba divers sampled oyster cultch reefs during two sampling periods during the reporting time frame (August 2017 and October 2017). Divers collected oysters from the reef using 0.25 m² quadrats—oyster density and sizes were measured on board the research boat. The oysters were returned to the reef after counting. Sampling in August revealed sporadic oyster larval settlement, and sampling in October revealed sub-adult oyster densities that ranged up to 95 oysters/m² (Fig. 2).

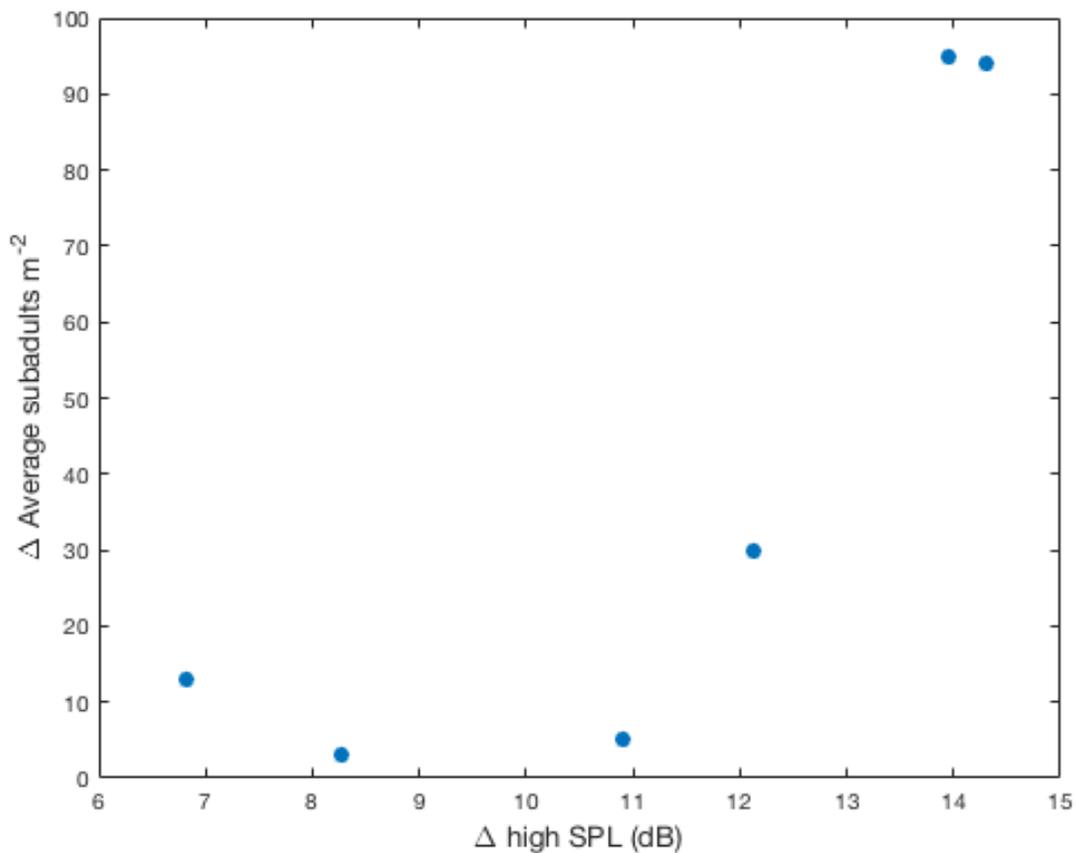


Figure 2. Relationship between average density of sub-adult oysters (25-75 mm shell height) sampled at 6 cultch-planted oyster reefs in SW Pamlico Sound, and the sound pressure levels (SPL) in decibals at high frequencies sounds associated with snapping shrimp snaps Lillis et al. 2013, 2014a). Our previous studies show that oyster larvae settle at significantly higher rates when exposed to the sounds of snapping shrimp, and also show that oyster reefs have unique sounds signatures compared to surrounding unstructured bottom, and these unique sounds are driven by the high-frequency snaps of shrimp (Lillis et al. 2014b).

Objective 3: Quantify estuarine fish production and diversity among the reef sites and

unstructured control sites using a combination of sampling methods.

(1). Measure fish abundance, diversity and biomass.

Fish were sampled over two periods during this reporting time frame (August 2017 and October 2017) by conducting (i) gill net and (ii) baited fish trap surveys at the six oyster cultch sites and two unstructured, control sites. Fish species were identified, counted, and measured to nearest mm standard length. Mean fish biomass was estimated using published length/weight regressions for each given species. Diversity was calculated using the Shannon Index (H), Pielou’s Evenness (J), Simpson’s Index (S) and species richness/Estimated Number of Species. Fish abundance was similar between unstructured and reef sites in August 2017, however as the reefs began to form after oyster larval settlement during summer 2017, fish diversity and biomass trended higher on reefs than unstructured habitat. The dominant demersal fish species included speckled trout, red drum, silver perch, and croaker/spot. Data collection will continue through 2018.

(2). Complement periodic fish sampling with continuous passive acoustic monitoring.

Hydrophones recorded the underwater soundscape during the reporting period as a means to (i) identify fish species presence and relative abundance via specific-specific fish calls, and on a continuous basis that is not possible via gill-net sampling, as well as (2) characterize how the sound frequencies and loudness changes as the reefs mature. Passive acoustic sampling was completed for the entire reporting period (July 2017 through mid-October 2017) to capture fish vocalizations associated with spawning choruses of many fish species (e.g. speckled trout, red drum, silver perch, etc.). Data were recorded and processed, and the identification of species specific calls in the soundscape is in progress. The data in Figure 3 shows the relationship between sound characteristics and habitat complexity.

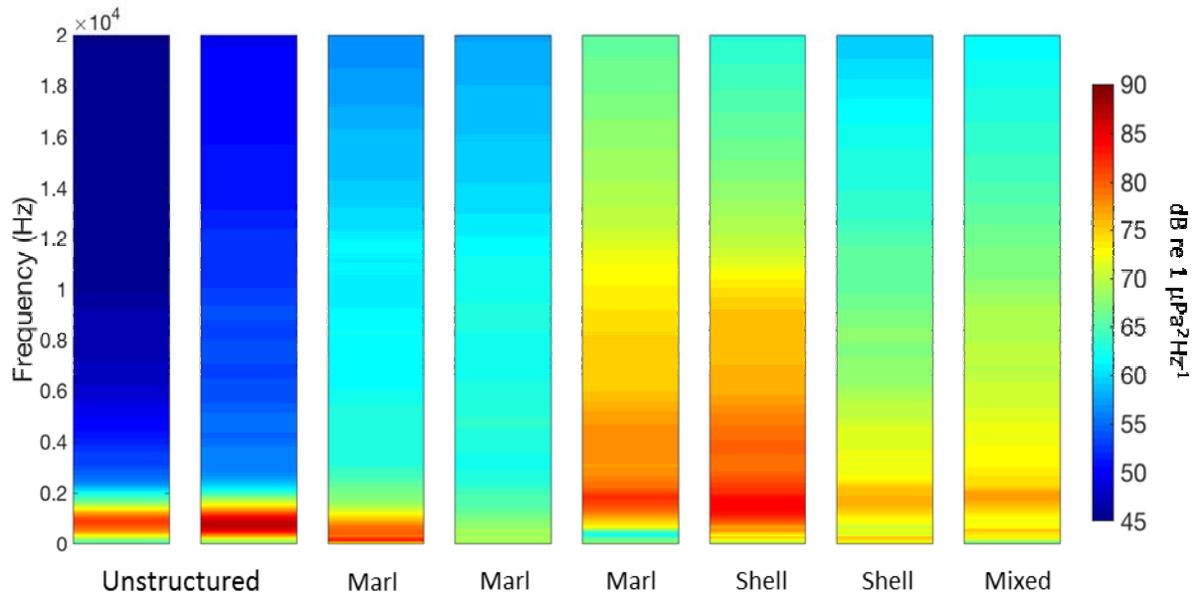


Figure 3. Average spectrogram for study sites that vary in habitat complexity—complexity increases from left to right. Marl and shell reefs demonstrate louder sounds at a broader

range of frequencies than unstructured sites or those composed mostly of marl.

Products

- (i) Ms Olivia Caretti is a PhD student at NC State University, and is working on this project as a part of her dissertation.
- (ii) Caretti, O.N., D.B. Eggleston, D.R. Bohnenstiehl. *Can soundscapes be used to monitor estuarine fish responses to oyster reef restoration?* Poster presentation. Albermarle-Pamlico National Estuarine Partnership Symposium, November 2017, Raleigh, NC.
- (iii) Project included on PI research webpage: <https://cmast.ncsu.edu/soundscapes/>
- (iv) Sound recordings used in graduate student led outreach activities (including NC State Packapalooza)
- (v) Presentation by D. Eggleston to NC Oyster Steering Committee, October 2017, NC Coastal Federation

Deviations.

None.

References.

- Lillis, A., D. B. Eggleston, and D. R Bohnenstiehl. (2013). Oyster larvae settle in response to habitat-associated underwater sounds. *PloSONE* 8(10): e79337.
doi:10.1371/journal.pone.0079337.
- Lillis, A., D. Eggleston, D. Bohnenstiehl. (2014a). Habitat-associated estuarine soundscapes: Distinct acoustic characteristics of sub-tidal oyster reefs compared to surrounding soft-bottom habitats. *Marine Ecology Progress Series*. 505:1-17.
- Lillis, A., D. Eggleston, D. Bohnenstiehl. (2014b). Soundscape variation from a larval perspective: the case for ambient habitat sound as a settlement cue for weakly swimming larvae. *Marine Ecology Progress Series* 509: 57-70.

COASTAL RECREATIONAL FISHING LICENSE
SEMI-ANNUAL PERFORMANCE REPORT

Recipient: David W. Johnston

Grant Award #: 2017-H-068

Grant Title: Rapid, high-resolution mapping of Coastal Strategic Habitats

Grant Award Period: July 1, 2017 through June 30, 2019

Performance Reporting Period: July 1, 2017 through December 31, 2017

Project Costs:

Expenditures for the Period:

| <u>Category</u> | <u>Expenditures</u> |
|-----------------|---------------------|
| Personnel | 24,078 |
| Fringe | 4,689 |
| Travel | 1,201 |
| Equipment | |
| Supplies | 1,510 |
| Construction | |
| Contractual | |
| Other | |
| Total Direct | 31,478 |
| Indirect | <u>4,722</u> |
| TOTAL | 36,200 |

Total Cumulative Expenditures: 36,200

Total Remaining Balance: \$84,990 (for 7/2017 to 6/2018 period)
\$205,868 (for total grant period)

Description of Work:

List the project objectives or provide a brief description of the funded activity, giving enough detail to acquaint the reader with the project.

The aim of this study is to increase the rate and resolution that we can map intertidal oyster reefs in our estuaries and then package this information in a way that will directly benefit recreational fishermen. Current methods of mapping intertidal oyster reefs in North Carolina rely on personal observation of reef extent and health by visiting as much of the more than 12,000 miles of estuarine shorelines that is accessible. Consequently, this process requires decades to complete, which may drastically delay response to environmental or human-driven changes that could be severely impacting an estuary and the resident oyster populations. Thus,

our study will provide useful information about the extent of important oyster-reef habitat, how it has changed over time, and changes occurring on yearly scales, which is necessary for predicting the sustainability of the fishery. Natural intertidal reefs located adjacent to saltmarshes (fringing reefs) and on sandy and muddy bars (patch reefs), subtidal reefs, and NC strategic habitat areas are the focus of this study that addresses **three** main objectives:

Objective 1: Create and verify calibration techniques to assess habitat extent and health using Unmanned Aircraft Systems (UAS) as a cost effective (low effort/low cost) mapping method. This will primarily benefit current maps of oyster reef coverage and density obtained in the last three decades. Additionally, concurrent data obtained on SAV and wetlands coverage and health as well as bathymetry will be compared to current maps and ground-truthed observations to assess UAS utility in these areas.

Objective 2: Map, monitor and assess oyster ecosystem health at four study sites representing important fishery areas along the North Carolina coast. These areas were determined by current designated Strategic Habitat Areas (or Strategic Coastal Habitats [SCHs]) and in consultation with the NCDMF Habitat Program Lead.

Objective 3: Provide informational habitat maps on a cross platform web application to enhance recreational fishing experiences and supplement maps with educational materials embedded within the application.

Project Status/Work Accomplished:

For each objective, describe tasks scheduled for the reporting period and the activities undertaken to complete them. Describe the specific accomplishments, and list products (publications, web pages, data, technology, etc.) completed during the reporting period. Attach copies of the publications, as appropriate.

Objective 1:

- Create and verify calibration techniques to assess habitat extent and health using Unmanned Aircraft Systems (UAS)
 - Task 1: Training of the postdoctoral associate on the project began in July, 2017. This included training on both rotary-wing and fixed-wing small unmanned aircraft and obtainment of a Part 107 Certification. 100% complete.
 - Task 2: Initial flights were conducted in Fall 2017 over areas of the Rachel Carson Reserve. Areas imaged included western Middle Marsh, Deep Creek, and the embayment between Town Marsh and Bird Shoal. Both fixed wing and rotary wing aircraft were operated and optical RGB and multispectral sensors were used for imaging. Flights were then processed through Pix4D software. See Figures 1-3. 100% complete.
 - Task 3: Ground truth samples were taken for oyster reefs to assess density and compare to GIS classification schemes. See Figure 4. Analyses of best classification methods are ongoing. 50% complete.

- Task 4: Preliminary comparisons from UAS derived elevation models have been compared with stock laser scans of oyster reefs in Middle Marsh. Additional comparisons of UAS oyster maps with terrestrial laser scans through the University of North Carolina at Chapel Hill Institute of Marine Sciences (subcontract) will be conducted in Spring 2018. 15% complete.
- SAV and wetlands coverage and health as well as bathymetry will be compared to current maps and ground-truthed observations to assess UAS utility.
 - Wetlands have been imaged as part of our initial study areas. 75% complete.
 - Additional flights and ground-truthing data will be collected for this aspect of Objective 1 during Spring 2018. 20% complete.

Objective 2:

- Map, monitor and assess oyster ecosystem health at four study sites representing important fishery areas along the North Carolina coast.
 - One study area (Rachel Carson Reserve) has been mapped with the initial flights. Mapping of all four study sites will commence in Spring 2018 and occur biannually through Spring 2019. 5% complete.

Objective 3:

- Provide informational habitat maps on a cross platform web application
 - Work to be completed during Year 2. 0% complete.

Deviations:

If there were changes to the goals/objectives during the reporting period, please detail the circumstance and nature of change. Explain any special problems or circumstances which prevented the accomplishment of scheduled tasks. Describe actions to resolve problems encountered and provide the details of any changes made to goals and objectives of the project.

Deviations to Objective 1:

- Create and verify calibration techniques to assess habitat extent and health using Unmanned Aircraft Systems (UAS)
 - In addition to UAS, the project team is exploring how well our processing techniques will work with new high resolution satellite imagery to broadly classify oyster reef extents across the North Carolina coast as a supplement to the more targeted UAS surveys.
 - Our main focus is using known methods of Object-Based Image Analysis (OBIA) for classifying habitats, but we are also exploring advanced methods like Convolutional Neural Networks that may be able to more reliably classify habitats across multiple datasets with little to no training.

Deviations to Objective 2:

- Map, monitor and assess oyster ecosystem health at four study sites representing important fishery areas along the North Carolina coast.
 - Proposal had initially scheduled mapping of all four study sites in the first 6 months. A combination of issues has delayed this until Spring 2018. These issues included 1) exceptionally high water during the early Fall causing a delay in our initial flights, 2) GPS difficulties with the aircraft resulting in scrapped missions, and 3) difficulty in finding a distinct spectral signature of oyster reefs from mudflat and interior marsh environments. We are currently developing solutions to each of these problems to reduce other delays and create a more robust package to deliver to DMF upon project completion.

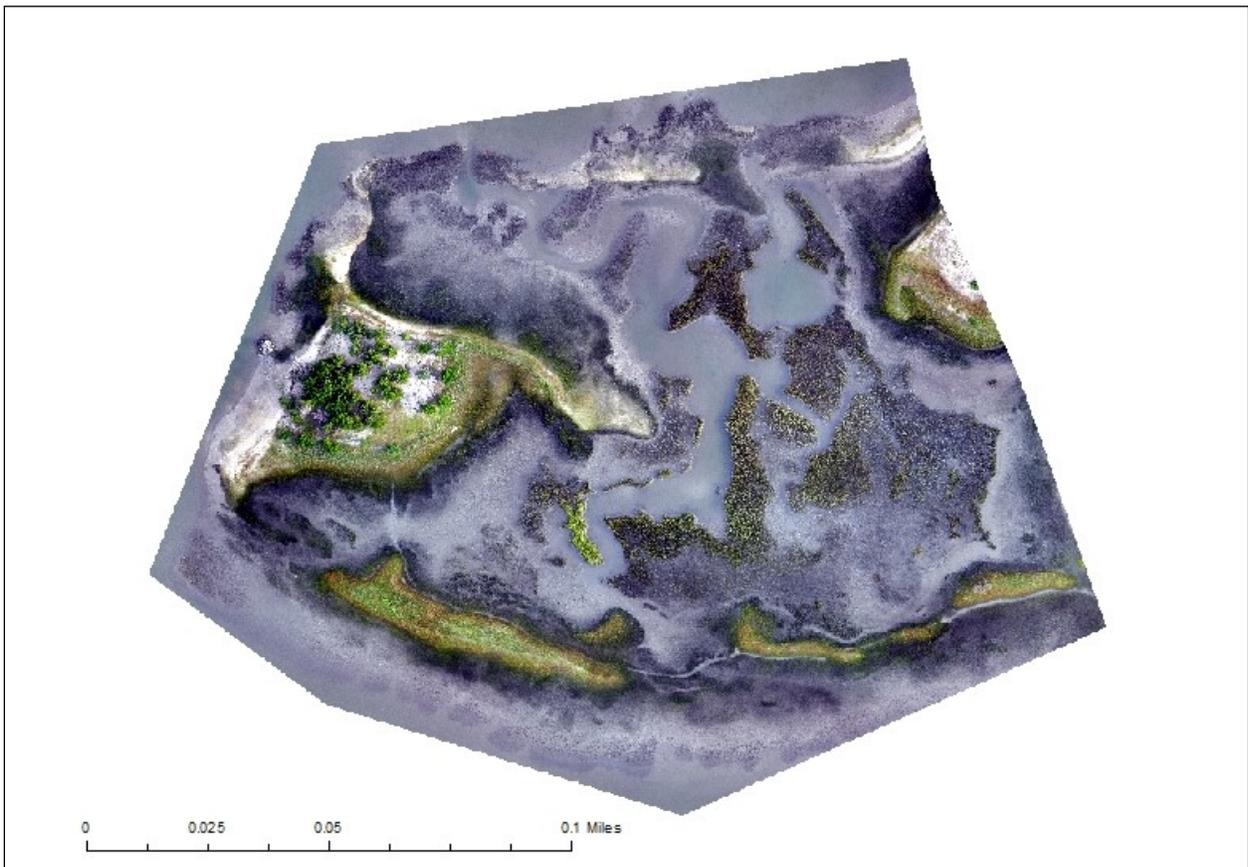


Figure 1. RGB orthomosaic of one section of the Rachel Carson Reserve used for initial methods assessment. Mosaic was created from an eBee flight and processed through Pix4D software. Full dataset for initial methods assessment encompasses Bird Shoal, Town Marsh, Deep Creek, and Middle Marsh.



Figure 2. Densified Point Cloud. Pix4D Mapper software generates a set of 3D points that reconstruct the model based on automatic tie points from individual UAS images. The X,Y,Z positions and color information are stored for each point.

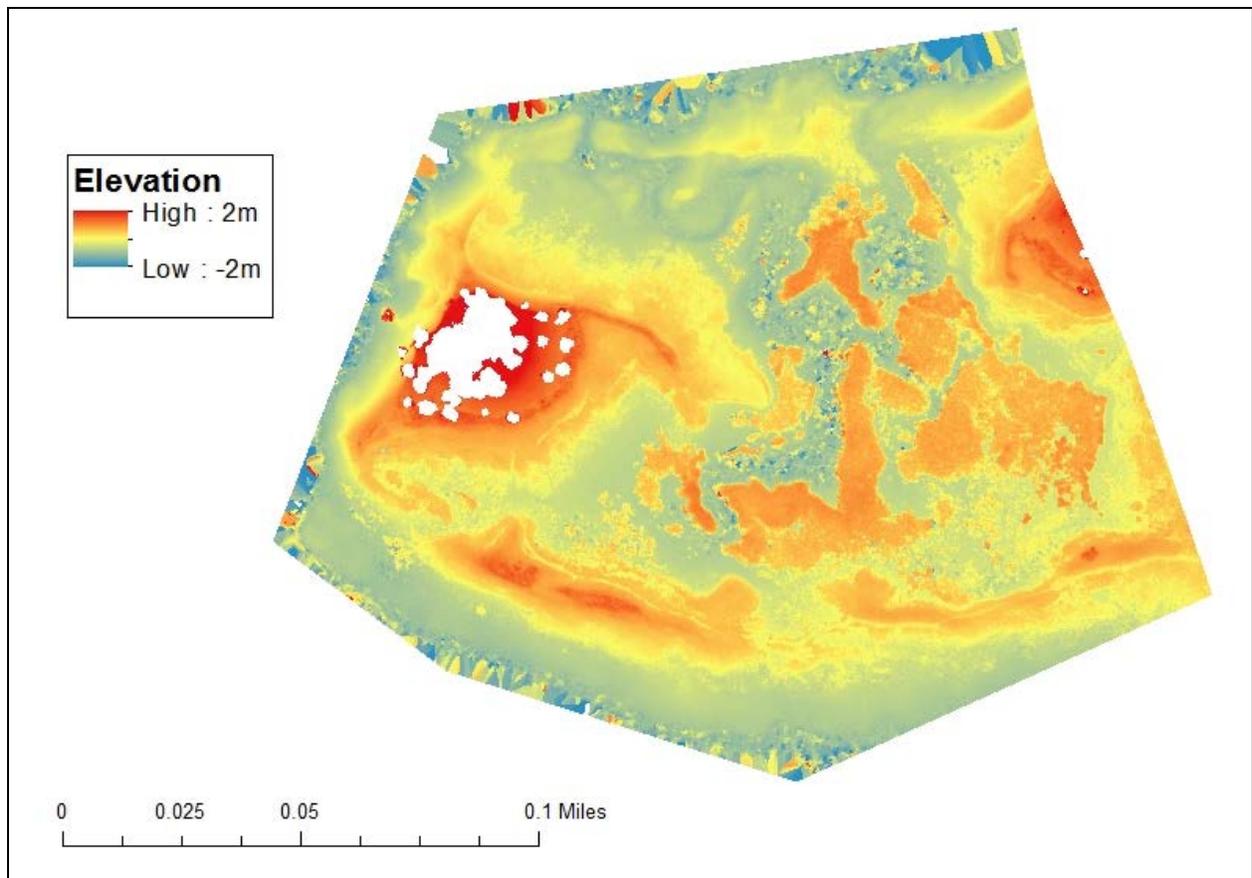


Figure 3. Digital surface model created through Structure from Motion (SfM) processing of drone imagery in Pix4D. Elevations are shown in North American Vertical Datum of 1988. Deep water causes anomalies in elevation, but SfM is able to extract shallow subtitle elevations.

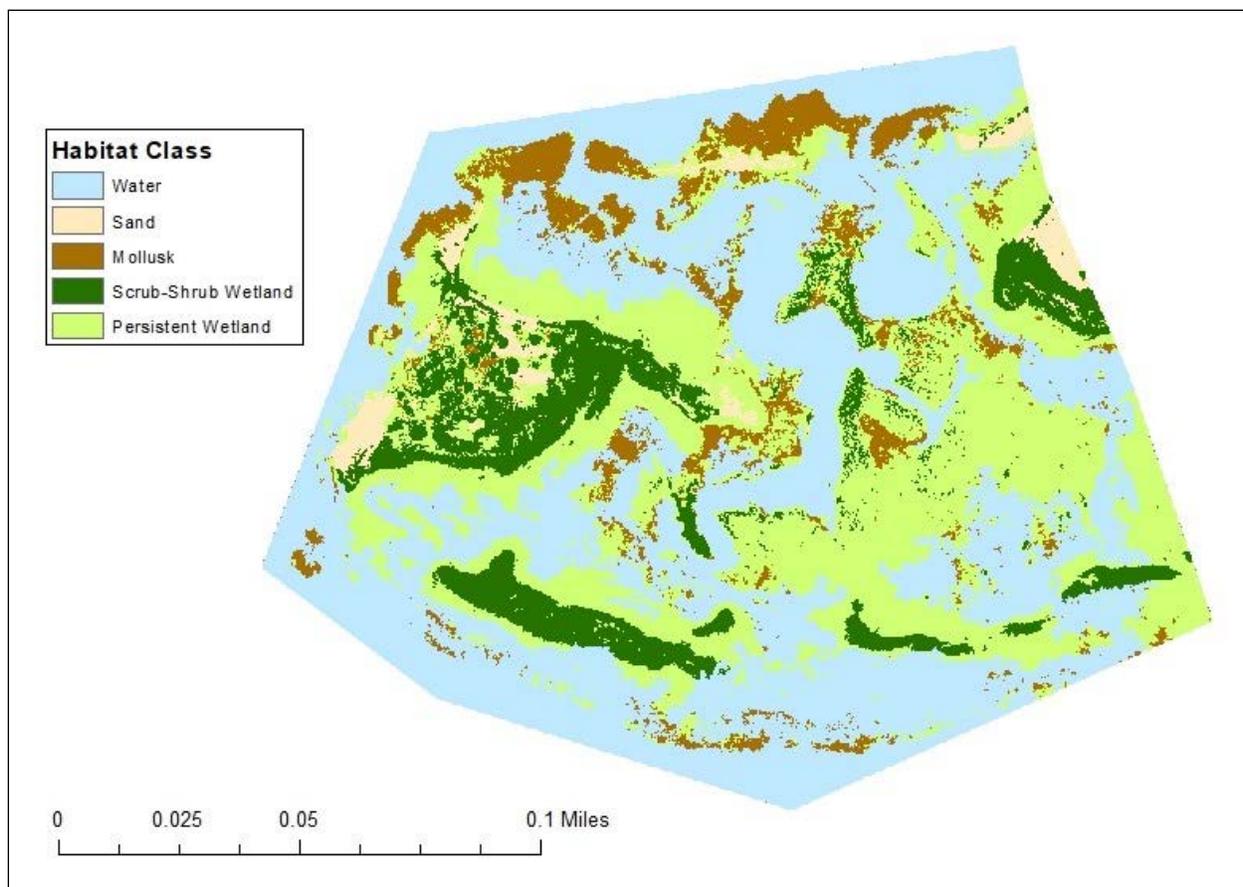


Figure 4. Initial classification of drone imagery using Object-Based Image Analysis in ArcGIS.

**COASTAL RECREATIONAL FISHING LICENSE
SEMI-ANNUAL PERFORMANCE REPORT**

Recipient: University of North Carolina at Chapel Hill, Office of Sponsored Research, 104 Airport Drive, Suite 2200 CB#1350, Chapel Hill, NC 27599-1350

Dr. F. Joel Fodrie (PI), Associate Professor, Institute of Marine Sciences & Department of Marine Sciences, University of North Carolina at Chapel Hill, 3431 Arendell Street, Morehead City, NC 28557, Phone: 252-726-6841 (ext 149), Email: jfodrie@unc.edu

Grant Award #: **2017-H-069**

Grant Title: Effects of isolated marsh islands and fringing mainland marshes on secondary production and food web dynamics in tidal estuaries

Grant Award Period: 07/01/2017– 6/30/2019

Performance Reporting Period: 07/01/2017 – 12/31/2017

Project Costs:

Expenditures for the Period:

| <u>Category</u> | <u>Expenditures</u> |
|-----------------|---------------------|
| Personnel | |
| Fringe | |
| Travel | |
| Equipment | |
| Supplies | \$3,939.38 |
| Construction | |
| Contractual | |
| Other | \$946.32 |
| Total Direct | \$4,885.70 |
| Indirect | \$732.87 |
| TOTAL | \$5,618.57 |

Total Cumulative Expenditures: \$5,618.57

Total Remaining Balance: \$80,129.43

Description of Work: The overarching objective is to determine how the edge-to-area ratio of marshes (isolated vs. fringing) impacts fish communities and the marshes' ability to function as a nursery habitat. Investigating the habitat value of wetlands of various size and edge to area ratios will elucidate how fish and decapod crustaceans will respond to changes in marsh structure from various anthropogenic stressors. More specifically, our objectives in year one include:

1. Determine the responses of fish and invertebrate communities (abundance and diversity) to gradients in overall habitat size and edge-to-area ratios to adjacent habitats through a variety of sampling methodologies (trawling, fyke nets, etc.)
2. Determine the condition of juvenile fish and crabs (spot, striped mullet and blue crabs) through lipid analysis and biomass measurements across marshes of different size and edge ratio.

Project Status/Work Accomplished:

To address the objectives listed above, our main focus for the first 6 months of this project was to collect fish and invertebrate community data, including abundance and biomass measurement through a variety of nets and traps from different marsh habitat types. We also worked to determine the condition of juvenile fish at each site through energy content (i.e. lipids and biomass). We collected data from 18 sites: 4 large marsh islands, 4 medium marsh islands 4 small marsh islands, 3 large mainland marshes and 3 small mainland marshes. Each site was sampled monthly from July through October for habitat characteristics such as marsh shoot density, shoot height and plant diversity as well as nekton abundance, biomass and diversity. We collected nekton data utilizing experimental gill nets, fyke nets, and minnow traps each sampling event. We made a total of 144 gill net sets, 144 fyke net sets, and 864 minnow trap sets. We collected over 7200 individuals across all sampling events.

During each sampling event, juvenile spot, striped mullet and pinfish less than 100mm in standard length (SL) were retained for energy content analysis. From October through early December all juvenile fish retained for energy content analysis were processed.

Deviations:

1. There was no trawling conducted for our fish and invertebrate sampling (although we have continued with a long-term (9-year) trawl survey of seagrass-associated fishes – including seagrass meadows that are and are not adjacent to marsh habitat). The depth of the water directly adjacent to the marsh platform was too shallow at all sites and was not conducive for trawl surveys.
2. For the lipid analysis we used pinfish instead of blue crab. Pinfish are highly abundant at all sites. Blue crabs were not able to be used with chosen methodology. The shell weight of the crabs would cause a bias and not accurately capture the energy content of the crabs. Instead, for blue crabs we used the ratio of carapace width to weight to evaluate condition.

FIGURES:

Marsh Sites



Figure 1. Site map of 18 marsh islands and mainland sites in Core Sound (A), Back Sound (B) and Bogue Sound (C).

Nekton Abundance

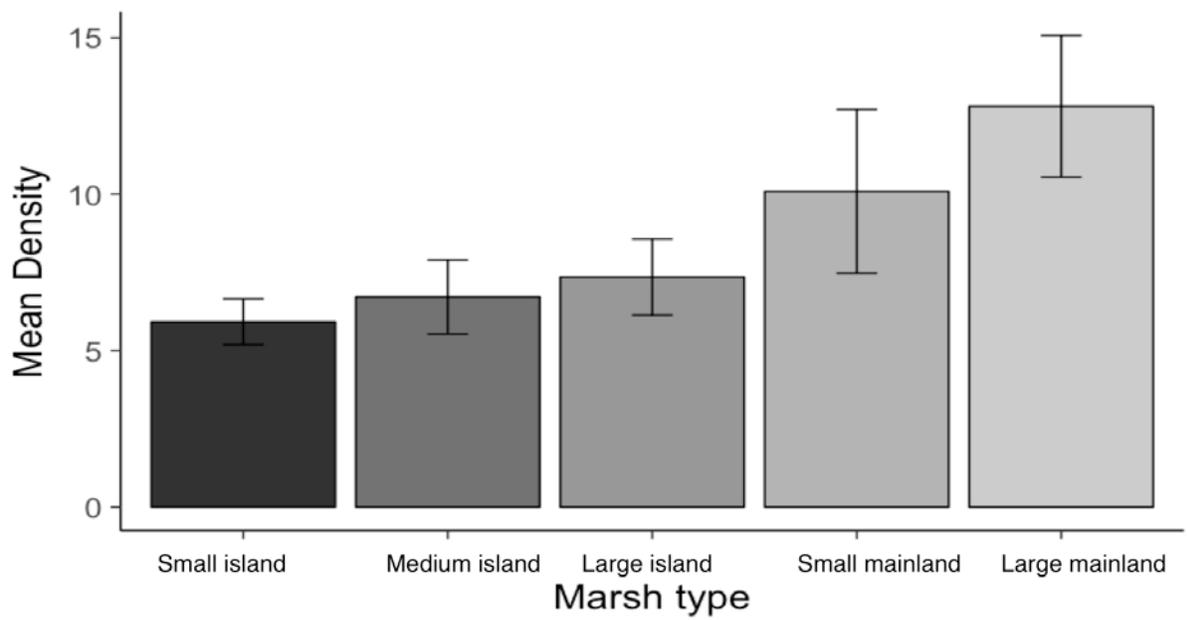


Figure 2. Comparison of nekton densities at all marsh types: large mainland, small mainland, large island, medium islands and small islands.

Juvenile Fish Energy Content

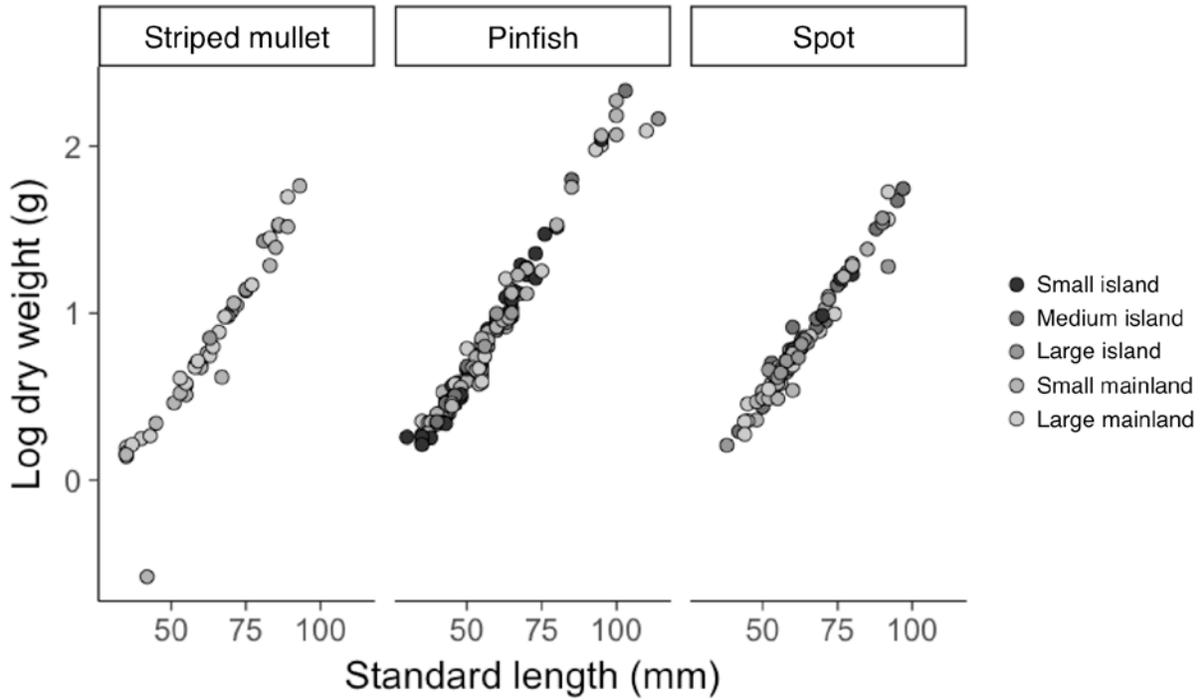


Figure 3. Energy content of 3 juvenile fishes (Striped mullet, Pinfish and Spot) by marsh type.

COASTAL RECREATIONAL FISHING LICENSE

SEMI-ANNUAL PERFORMANCE REPORT

Recipient: NCDMF
Holly White, Principal Investigator
Jordan Byrum, Principal Investigator

Grant Award #: 2H40 H070

Grant Title: Maintaining and expand long-term continuous water quality monitoring and improving comprehensive water quality analysis through the use of innovative software.

Grant Award Period: July 1, 2017-June 30, 2020

Performance Reporting Period: July 1, 2017-December 31, 2017

Project Costs:

Expenditures for the Period:

| <u>Category</u> | <u>Expenditures</u> |
|-----------------|---------------------|
| Personnel | *0 |
| Fringe | 0 |
| Travel | 0 |
| Equipment | 64,483.00 |
| Supplies | 513.11 |
| Construction | 0 |
| Contractual | 0 |
| Other | 0 |
| Total Direct | 0 |
| Indirect | 0 |
| TOTAL | 64,996.11 |

Total Cumulative Expenditures: 64,996.11

Total Remaining Balance: 83,996.89

*Due to December start date personnel expenditures will be reflected in the next performance report.

Objectives:

1. Acquire new multiparameter data sondes and loggers.
2. Maintain existing multiparameter data sondes and loggers.
3. Purchase water quality analysis software.
4. Hire an 11- month, temporary Biologist I, with water quality experience to complete a comprehensive water quality analysis on backlogged data, including incorporating post-calibration data to account for drift and increase precision of data.

5. Train staff on best management practices.

Project Status/Work Accomplished:

The following is a summary of accomplishments over the last six months that address each grant objective:

Objective 1: In July of 2017, the NCDMF ordered and received four new Yellow Springs Instruments (YSI) EXO2 multiparameter data sondes satisfying grant objective one, for Year-1 for the Albemarle Sound Long-term Water Quality Monitoring Program (Albemarle Program). We received a 15 percent discount on the order for trading in sonde bodies from the older 600 platform models that no longer functioned. This discount saved us approximately \$6,500 from the original estimated cost. Including the Year-1 purchased sondes, the Albemarle Program currently has eight EXO2 sondes deployed and five EXO2 sondes for backup, for when a sonde is replaced. Often, we replace multiple sondes in one day, so having enough backups is necessary and more cost effective for the Albemarle Program. There are two of the older platform sondes, 600XLM, deployed and three sondes that are serving as backups. The older sonde platform was discontinued by YSI in 2017, therefore in the next installment for Year-2 we will purchase four additional EXO2 sondes to replace the discontinued instruments.

Objective 2: NCDMF has continued to maintain data sondes and loggers through frequent deployment and retrieval of data sondes and downloads of data loggers. Additionally, monies acquired through this grant have been used to replace damaged probes and to purchase calibration standards to ensure proper calibration of the instruments.

Objective 3: In September of 2017, the NCDMF purchased the water quality analysis software, Aquarius, from the developer Aquatics Informatics. The software has been received and downloaded by NCDMF IT personnel. Following the initial download, Division IT staff has been working to get the software into the queue for install and test runs on the NCDMF server. IT is still in the preliminary steps of this process as additional IT staff time was needed for more pertinent matters on the server. The Aquarius software should be operational and both licenses installed on staff computers by February 2018. Licenses will be used by the temporary Biologist hired through this grant as well as a Biologist in Habitat Enhancement, to complete their initial training supplied with the software purchase.

Objective 4: The temporary Biologist I position was filled in December of 2017 by Jenn Anders. Since Aquarius is not operational Jenn has been working on completing a thorough quality assurance and control process (QA/QC) of the Albemarle Program data from 2008-2016 for stations 1, 2, and 16 in the Chowan River, as an exercise to familiarize herself with the Albemarle Sound data. These stations account for approximately 33 percent of all the backlogged data. To complete this task, she is primarily using excel to analyze the data until Aquarius is operational. The QA/QC process consisted of verifying water quality parameters,

including pH, DO, temperature, conductivity, and salinity for the three stations. Through this exercise she has been able to verify most of the raw data entered in the Biological Database (BDB) for these stations. Both stations 1 and 2 have approximately sixty thousand hourly records for the aforementioned parameters that have been QA/QC'd. Station 16 data consists of approximately thirty thousand hourly records from 2013-2016 that have also successfully been QA/QC'd. Jenn has also been working with staff to identify coding errors and missing sets of data for corrections and/or entry into the BDB.

Objective 5: Training staff on best management practices for Aquarius will begin after the Biologist has become familiar with the program. Additionally, as Jenn is completing QA/QC she is recording common errors occurring during data entry, these error types will be reviewed with field staff to ensure improved data quality.

Deviations:

There were no deviations from our proposed objectives.

COASTAL RECREATIONAL FISHING LICENSE SEMI-ANNUAL PERFORMANCE REPORT

Recipient: North Carolina Wildlife Resources Commission

Grant Award #: CRFL Grant Contract Number 4482

Grant Title: ADA Coastal Boating Access Projects

Grant Award Period: July 1, 2012 – June 30, 2018

Performance Reporting Period: July 1, 2017 – December 31, 2017

Project Costs: CRFL Grant Award Amount \$279,500.00

Expenditures for the Period:

| <u>Category</u> | <u>Expenditures</u> |
|-----------------|---------------------|
| Personnel | |
| Fringe | |
| Travel | |
| Equipment | |
| Supplies | |
| Construction | 0.00 |
| Contractual | |
| Other | |
| Total Direct | |
| Indirect | |
| TOTAL | \$0.00 |

Total Cumulative Expenditures: \$219,391.38

Total Remaining Balance: \$60,108.62

Description of Work: Project consists of construction/addition of ADA up fits to 25 identified coastal/joint water Boating Access Areas. ADA compliant up fits consist of parking, sidewalks, and/or assist trails. Based on current conditions the selected marine/joint water sites will require one to three of these elements for ADA compliance.

Project Status/Work Accomplished:

In total 16 projects have been completed:

1. Cedar Island BAA completed and reimbursed
2. Mann's Harbor BAA completed and reimbursed

| | |
|----------------------------|---------------------------------------|
| 3. Poplar Branch BAA | completed and reimbursed |
| 4. Snead's Ferry BAA | completed and reimbursed |
| 5. Willis landing BAA | completed and reimbursed |
| 6. Englehart BAA | completed and reimbursed |
| 7. Oriental BAA | completed and reimbursed |
| 8. Cowpen Landing | completed and reimbursed |
| 9. Gatesville BAA | completed and reimbursed |
| 10. San Souci BAA | completed and reimbursed |
| 11. Shell Rock Landing BAA | completed and reimbursed |
| 12. Swan Quarter BAA | completed and reimbursed |
| 13. Frying Pan BAA | completed and reimbursed |
| 14. Williamston BAA | completed and reimbursed |
| 15. Dawson's Creek BAA | completed and reimbursed |
| 16. Rose Bay BAA | completed- no need for reimbursement. |
| 17. East Lake Ferry BAA | completed and reimbursed |
| 18. Turkey creek BAA | completed and reimbursed |
| 19. Tunis BAA | completed and reimbursed |

Waiting on completion of 2 ADA projects-additional ADA up fits to Tunis BAA and West Onslow ADA. Projects scheduled for completion this spring.

Deviations: None

COASTAL RECREATIONAL FISHING LICENSE

SEMI-ANNUAL PERFORMANCE REPORT

Recipient: NCDMF Artificial Reef Program

Grant Award #: 2P40 P014

Grant Title: Enhanced Artificial Reef Guide

Grant Award Period:

Performance Reporting Period: July 1, 2017-December 31, 2017

Project Costs:

Expenditures for the Period:

| <u>Category</u> | <u>Expenditures</u> |
|-----------------|---------------------|
| Personnel | |
| Fringe | |
| Travel | |
| Equipment | |
| Supplies | |
| Contractual | \$121 |
| Other | |
| Total Direct | \$121 |
| Indirect | |
| TOTAL | \$121 |

Total Cumulative Expenditures: \$121

Total Remaining Balance: \$61,845

Description of Work:

There are three main goals of this project. 1. Enhance the webpage for the NC Artificial Reef Program which includes information on fishing activities, diving activities, and photos or videos of vessel and material deployments. 2. Design an interactive reef guide which includes GPS locations, interactive map of reef material, side scan images, and underwater photos. 2. Create five regional reef fishing guides for ocean and estuarine waters that will include fishing access for Artificial Reefs and Inshore Fishing/Oyster Reefs (IFOR).

Project Status/Work Accomplished:

Side-Scan

All side-scan operations were completed, prior to this reporting period.

Website

During the reporting period, we completed the new and improved artificial reef webpage (Figure 1). The website headings are: "Introducing North Carolina's Reef's", "About Our Reefs", "Oyster Sanctuaries", "Fishing North Carolina's Reefs", "Diving North Carolina's Reefs", "Etiquette and Ethical Angling", "Reef Fish", "History of North Carolina's Reefs", "Reef Materials", "Photo Gallery", "Contacts", and "Reef Survey." The new webpage can be found here:

<http://portal.ncdenr.org/web/mf/artificial-reefs-program>. These pages' focus on educating the public on what we do, how we do it, what materials are used, what fish utilize reef habitats, diving on reefs, fishing on reefs, etiquette of using NC's artificial reefs, and an interactive reef guide. We also included a short survey, that allows the general public to suggest new places for the NC DMF Artificial Reef Program to build reefs. It has questions regarding inshore and offshore location suggestions. We hope to use this information to help guide artificial reef siting efforts. The webpage officially released on 8/22/16 and received approximately 7,000 hits between then and January 1, 2017.

Interactive Artificial Reef Guide

The interactive reef guide is an online interactive planning tool and map guide for fishermen and divers to utilize. The interactive reef guide includes similar information to the printed reef guide, while presenting in a mapping format which is capable of supporting side-scan imagery. The interactive reef guide contains the Artificial Reef and Oyster Sanctuary GPS locations, and directions to the sites using nautical miles and bearings from the nearest buoy or inlet. Information regarding the deployed material includes the deployment date, description of the material, square footage, acreage, GPS coordinates, and side scan imagery, when available. The guide also includes hyperlinks to vessel histories (when available), locations of NCWRC Boating Access Areas and NOAA Navigational Charts.

During the reporting period, the interactive reef guide was finalized and uploaded to the new webpage, which was released on 8/22/16. The interactive reef guide can be accessed from the new Artificial Reef homepage <http://portal.ncdenr.org/web/mf/artificial-reefs-program> > then click on the "Interactive Reef Guide" link. Our program also developed 'how to' tutorials on how to use the interactive reef guide. All of this can be found on the NC DMF Artificial Reef home page.

We are working with the GIS staff to enable easy downloads of all the reef material coordinates in GPX format. This will allow anglers to easily load information into a GPS unit. Additionally, we are working with GIS staff to create a mobile application of the reef guide. This will allow offline use and use real time GPS

position for anglers to easily see the location of reef materials and other fishing locations nearby. Based on conversations at fishing clubs, these tools would be well utilized.

Printed Artificial Reef Guide

During the reporting period, the new Artificial Reef Guide was officially released and available to the public on August 22, 2016 (Figure 2, 3). The printed Artificial Reef Guide is composed of reef site maps and corresponding material data tables (Figure 3). The front cover features the winner of the photo competition that was held in previous reporting periods (Figure 2).

The reef guide is a weatherproof field guide, where each reef has a two-page spread (Figure 3). Page one incorporates a data table with material types, deployment dates, and GPS locations of reef materials. The second page is a colored material map that graphically depicts reef material locations. The background maps correspond to the closest inlet associated with the reef site. The material maps were generated using side-scan imagery that was digitized by the GIS specialist funded through the grant. Digitization utilized ESRI ArcMap 10.1 to create the material map of each reef site. These digitized maps are being used in the printed reef guides and in numerous other program related objectives. A pdf of the final reef guide can be found here: http://portal.ncdenr.org/c/document_library/get_file?uuid=24160156-4b96-49e6-9126-4fa488b49cbb&groupId=38337

Printing

During the reporting period, the artificial reef program has printed 14,900 copies, at the cost of \$93,199.79 through correction enterprises. As of 1/1/2018, we have approximately 5,000 copies left and plan to keep distributing them into the next reporting period.

As we move forward, we are considering the scale of a reprint. This information is all available online via the interactive reef guide, so the reprint may not be as large as the original printing.

Outreach

On 8/22/17, NC DMF put out a news release about the artificial reef guide. Since then, newspapers throughout the state have featured articles about the reef guide. Additionally, DEQ featured the reef guide on their Facebook page, and we have done 3 presentations at fishing clubs, where we have featured and passed out the reef guide. The reef program has also been involved in several public radio (NPR), Dr. Bogus, and other radio talk shows where we talked about the reef guide. At this time, we plan to put out another news release in mid-March 2017 to re-announcing the reef guide. We are choosing mid-March as it's the start of the major recreational fishing season in NC.

Distribution

Reef Guides are available for pick-up at all of the marine fisheries offices (Wilmington, Morehead City, Washington, Elizabeth City, and Manteo). Members of the public are encouraged to come into any marine fisheries office and pick up a reef guide,

free of charge. Also, businesses are allowed to contact the Artificial Reef Biologist directly, and request up to 2 boxes of reef guides at a time to distribute to their customers. As of 1/1/2017, there are approximately 8,000 copies left.

Deviations:

- As mentioned in the last several reports, it was decided that five printed regional guides would not only be excessive but would be a waste of resources. It is thought that a majority of people would likely take multiple guides, which would be less cost effective than having one Reef Guide. Therefore, a single North Carolina Artificial Reef Guide was created, that includes all regions defined in the 5 regional versions. Each region is identified by color coded tabs.

NCDEQ Employee Sign In

Division of Marine Fisheries

DMF - HOMEPAGE ▾ ABOUT DMF CONTACT DMF DMF OFFICES - Text +

DMF - Homepage

- Recreational Fishing
- Commercial Fishing
- Proclamations
- News Releases
- Information and Programs
- Observer Program
- **Artificial Reefs Program**
- Habitat and Enhancement
- Statistics, Reports and Data
- Stock Status Reports
- Fishery Management Plans
- Marine Fisheries Commission
- Educational Resources
- N.C. Marine Patrol
- Rules and Regulations
- Shellfish Sanitation and Recreational Water Quality
- Carcass Collection Program
- Employment Opportunities
- Vision Statement
- DMF Library Search



Introducing North Carolina's Reefs

The North Carolina Division of Marine Fisheries maintains 42 ocean artificial reefs and 20 estuarine reefs, 14 of which serve as oyster sanctuaries. Ocean reefs are located from 1/2 mile to 38 miles from shore and are situated so that they can be reached from every maintained inlet in the state. The estuarine sites are found in Pamlico Sound and its tributaries, the Chowan River and the New River. Estuarine reefs are designated with yellow class four or five buoys noting the reef site, a N.C. Division of Marine Fisheries sign, and a phone number. Oyster Sanctuaries are designated with white, class-four buoys or three-pile dolphin markers that identify the site as an oyster sanctuary.

| | | | |
|--|---|------------------------------------|---------------------------------------|
| Introducing N.C. Reefs | About Our Reefs | Oyster Sanctuaries | Fishing N.C. Reefs |
| Diving N.C. Reefs | Etiquette and Ethical Angling | Reef Fish | History of N.C. Reefs |
| Reef Materials | Photo Gallery | Contact | Reef Survey |



[Interactive Reef Guide](#)



[Interactive Reef Guide Tutorials](#)

2016 Reef Guide Publication Now Available

Don't forget to pick up the new 2016 Reef Guide at your nearest Division of Marine Fisheries office.

Figure 1. Screenshot of the new homepage for the NCDMF Artificial Reef Program.

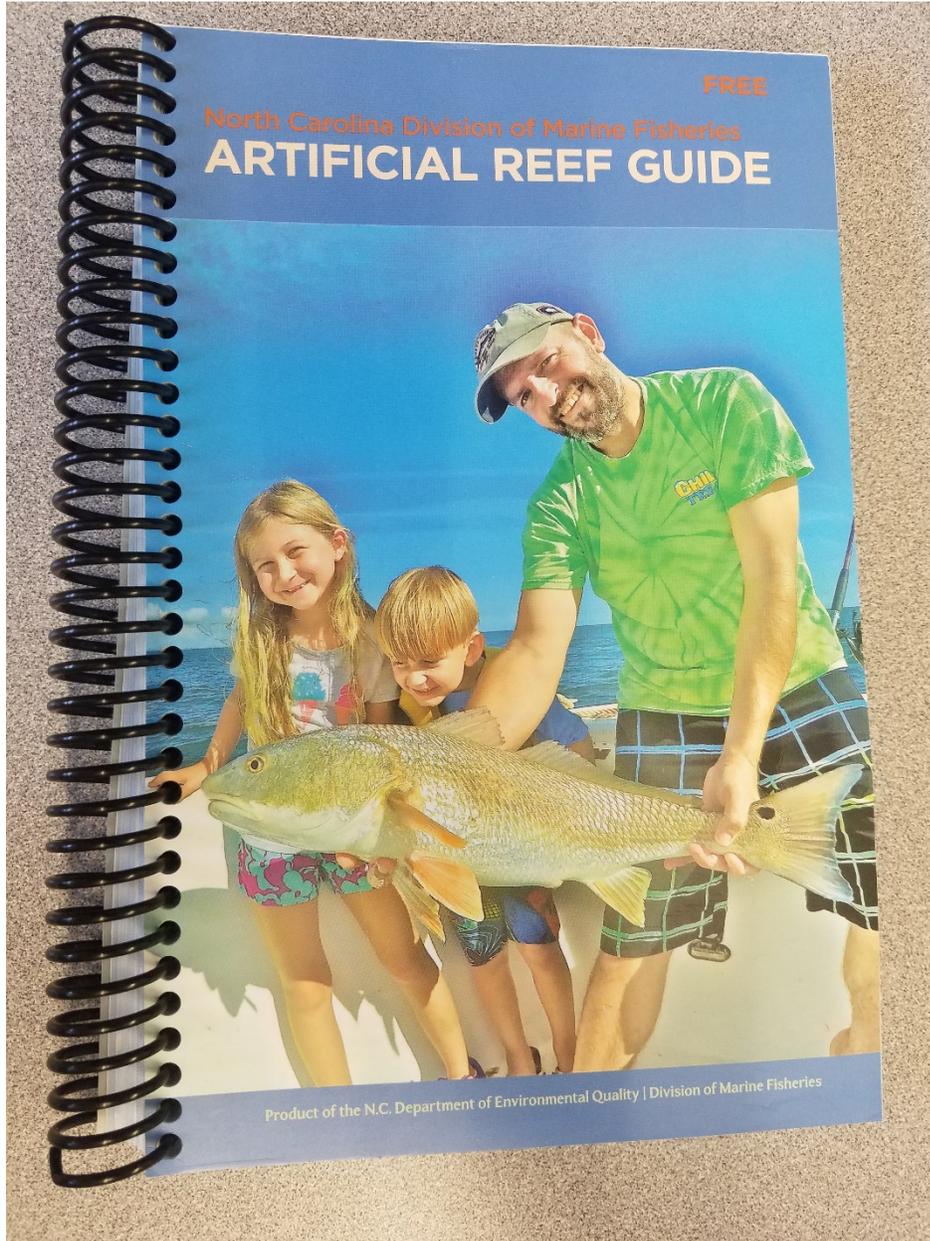


Figure 2. Picture of the new 132-page artificial reef guide. The book is water proof, and comes complete with a plastic binding for long-term use.

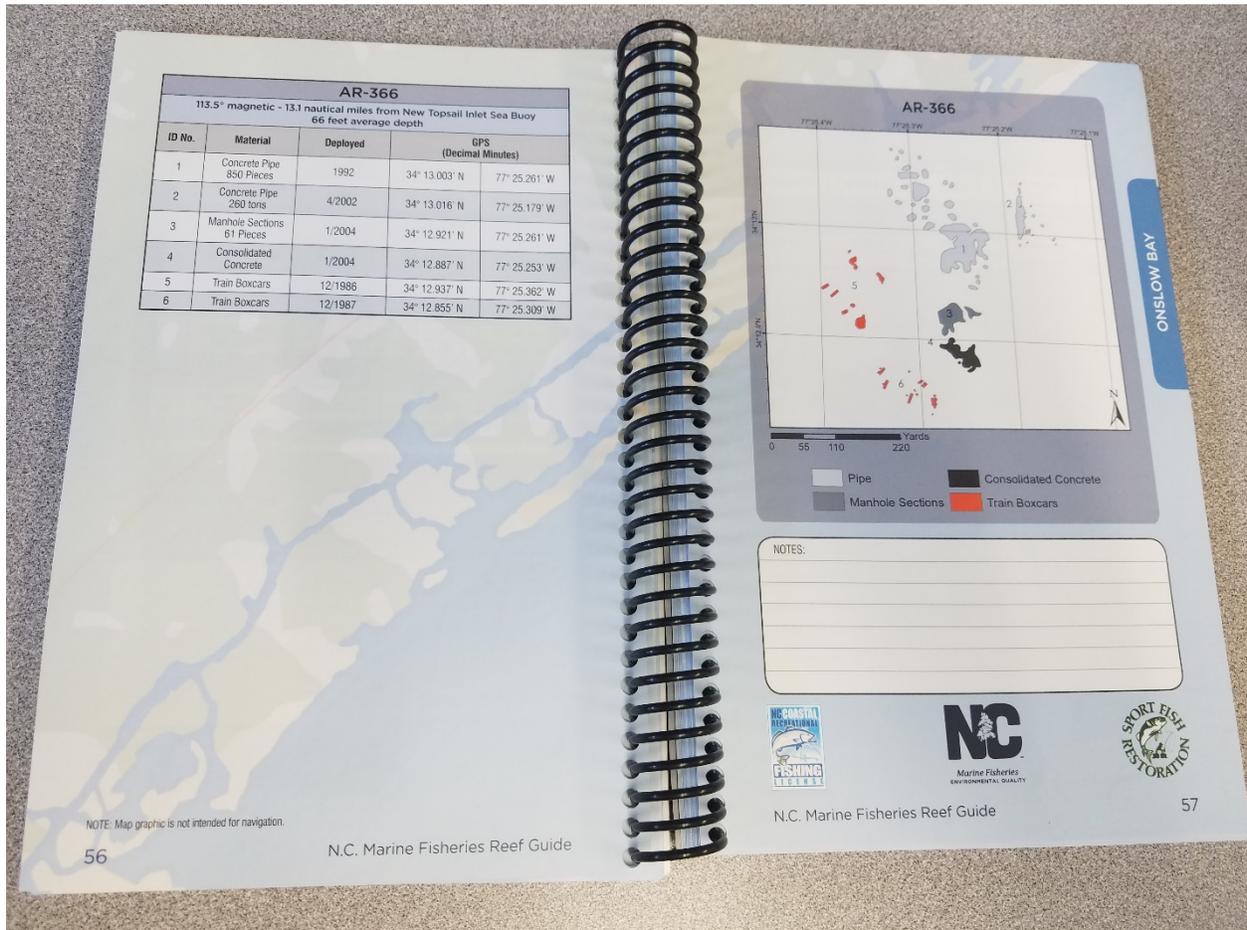


Figure 3. Picture of what the inside of the reef guide looks like. The left hand side features table information that corresponds to the map/figure on the right hand side of the page. Each reef has its own two-page spread.

Final

**COASTAL RECREATIONAL FISHING LICENSE
SEMI-ANNUAL PERFORMANCE REPORT**

Recipient: Take A Kid Fishing Foundation.Inc.

Grant Award #: 6444

Grant Title: North Carolina Marine Resources Fund (CRFL)

**Grant Award Period: July 1, 2016 – June 30, 2017, with an extension granted til
Sept 1, 2017**

Performance Reporting Period: September 2, 2017 – December 31, 2017

Project Costs: \$60,086.45

Expenditures for the Period: \$664.44

Total Cumulative Expenditures: \$60,086.45

Total Remaining Balance: 0

Description of Work:

The Take A Kid Fishing Foundation, Inc. is a North Carolina based nonprofit organization whose mission is to enrich the lives of disabled and disadvantaged youth through an opportunity to go saltwater fishing

The goal of the Foundation is to introduce fishing to children through their annual event. It provides "hands on" opportunities to children while teaching them about this healthy outdoor activity that they can enjoy throughout life. This opportunity provides youth with real world experiences in the sciences while fostering a love for the outdoors. It is through this educational experience that they are able to develop skills and are encouraged to become conservationist and teachers in their own communities. The Foundation and its volunteers strive to develop an understanding within of how they can and should maintain our fishing resources. They provide instruction on the many ways they can minimize their impact on our coastal environment by utilizing ethical angling practices while enjoying the outdoors.

Each year the Foundation and its many contributors work throughout the year raising funds and awareness in preparation for the event. Donations are solicited for supplies, services and funds. Invitations are extended to children's homes, city and county youth organizations and orphanages. Supplies are prepped to ensure they are in proper

working condition and volunteers are organized to assist. Services are contracted for in anticipation of the needs of approximately 800 children and their chaperones.

Project Status/Work Accomplished:

In 2017 the Take A Kid Fishing Foundation hosted 688 children and their chaperons. Attendees were assigned to fish from seven locations across the county, aboard head boats and fishing piers. In addition, a half day tour was provided to all pier participants. Tours included the NC Aquarium, the Renegade Pirate Ship or the Morehead City Ferry Services' ECO Tour.

Volunteers from organizations like the Carteret County Board of Realtors, NC Marine Fisheries, Big Foot Cooking Team, Big Rock Sports, Big Rock Blue Marlin Tournament, Sound Bank, West Carteret High School, National Charity League, RSM, Swansboro Rotary, Onslow Bay Saltwater Fishing and Civitan Clubs spent the day preparing and serving meals, rigging rods, teaching skills and sharing information on the importance of ethical angling practices and conservation in our ocean environment. Additional support was received from our many sponsors who provide a variety of goods and services needed throughout the event. Some of those goods included Solskyn Skin Care products (sun protection), Fish Bite bait, AARD hats and t-shirts, ice and food items for area cookouts. Eddie Cameron Construction, Big Rock Sports and Linda Rike Real Estate provided equipment, labor and trucks for the storage and distribution of all supplies. Pepsi, Harris Teeter, Walmart, Coke & Lowes Foods supplied bottled water & beverages. The Boddie Noel Corporation (Hardees) provided 576 breakfasts for those participants that were traveling in from out of town. Glad Tiddings Church provided their facility for all lunch preparations, in addition to granting the Foundation permission to order all food supplies through their commercial Sysco account. Area high school students volunteered their time to inspect, clean, repair and rig all 800 rods & reels prior to the event, in addition to assisting with supply distribution and providing hands on instruction during the event. These same students have pledged to provide additional support in 2018. The Swansboro Rotary Club hosted over 250+ participants & volunteers at their Swansboro Rotary Civic Center for an afternoon cookout. In addition they provided volunteers at the civic center and on the Emerald Isle boats and piers, financial support for bus and boat expenses, in addition to providing all of their cookout supplies. Big Foot Cooking Team hosted an additional 450+ participants & volunteers for a cookout in the Morehead City area at the Crystal Coast Civic Center.

The Foundation continued to work with NC Marine Fisheries & its many volunteers in educating participants on ethical angling practices through hands on instruction. Volunteers began each session with an introduction to fishing and water safety that continued throughout the day. They stressed the importance of using ethical angling practices while teaching skills. The kids were very excited to learn. Volunteers took time to talk with the children identifying species while providing information about their habitats, etc.

The Foundation shares its mission through the TAKF website. Encouraging others to create similar programs in their area while also providing information on fishing, ethical angling and conservation practices. Interested parties can find additional information on sponsorship and volunteer opportunities, make a donation, see photographs from events and contact us. The TAKF Website went through a much needed update in 2017 with plans for additional work in the coming year. In order to meet the needs of the participants', the Foundation continues its work to secure sponsorships that provide the needed services and in kind and cash donations that are utilized with the CRFL grant funds to support the organization throughout the year. Organizations like the National Charity League, Swansboro Rotary and Civitan Clubs, Raleigh & Onslow Bay Sports Fishing Clubs, Walmart, Harris Teeter, Lowes Foods, Big Rock Blue Marlin Tournament, Big Foot Cooking Team, Carolina Ice, Boddie Noel Corporation (Hardee's), Biscuit Kitchen, Sanitary Restaurant, Fish Bites, Carteret Craven Electric Foundation, Glad Tidings Church & West Carteret Cheerleaders, NC Marine Fisheries, NOAA, CMAST ,First Banks, Linda Rike Real Estate, Carteret County Board of Realtors, Big Rock Sports, Coke, Pepsi, Fish Bites, Coastal Builders, Eddie Cameron Construction, Solskyn (Suntan) Skin Care Products, Bare Bottom Fishing, Southern Express & Diamond City buses, AARD T-shirts, Sysco Foods, ,Kona Ice, NC Aquarium, NC Maritime Museum and our many area head boats & piers were just some of the many that joined with us in support of the 2017 event.

The TAKF event not only touches the lives of hundreds of disabled and disadvantaged youth, but it also benefits many of our youth. It is through volunteering that they see firsthand the importance of giving back to others. In addition it enables many of the homes & agencies to reward students for reaching academic and behavior goals. It also allows the Foundation to provide support to other well deserving organizations in their area like Hope Mission, who receives a donation from that day's catch to feed the homeless. Leftover suntan products are donated to junior life guard and Boy's and Girl's Club's summer programs while unused food supplies are given to local lunch box programs that feed under privilege children. Nothing goes to waste.

The Foundation is always looking for ways to share the joy of fishing with others. In 2017 the Foundation received a request to provide support to a group from "Little Houses of Hope". This Burlington, NC organization's mission is to promote breast cancer recovery by offering opportunities for survivors to reconnect and celebrate life. Survivors and their family members are treated to a fun filled week at the beach filled with activities that included a day of fishing sponsored by TAKF and the Bogue Inlet Pier.

Our goal is to continue providing children of NC with an opportunity to go saltwater fishing while also assisting others in the creation of similar programs throughout the US. The Foundation works to provide interested parties with information on how to find resources, organize, host and secure sponsorships for an event.

As this year ends, our 2018 preparations begin. Our date is set for Tuesday, July 24th. Save the date notices will be sent out to all sponsors, volunteers and participants. Space will be reserved on charter boats and fishing piers. Tours will be booked and cookout locations secured in anticipation of all our 2018 needs. New and renewed grant applications will be submitted to the NC Coastal Recreational Fishing License Grant Office, the Carteret Craven Electric and Big Rock Blue Marlin Tournament Foundation committees. Etc. Fund raising will continue through mail campaigns, solicitation for sponsorships and requests for monetary and in kind donations. Presentations will be made to groups interested in learning more about the Foundation's work, and how they too may volunteer and/or provide support. Articles will be submitted to area tournament books and other media, while continued updates will be made to the website. Cameron Construction and friends will begin work cleaning and repairing all rods and reels, while volunteer meetings will be scheduled with groups like the National Charity League to discuss event needs and responsibilities.

2018 has gotten off to a great start with the receipt of the following donations:

Big Rock Blue Marlin Tournament \$7,000

Raleigh Salt Water Sportfishing Club \$500

John Baron \$1,000

Swansboro Rotary Club renewed sponsorship commitment for the 2018 cookout & event

In addition to numerous memorial donations.

*The Foundation will work to seek out new participants from area children's homes and agencies for participation in 2018 in addition to **the following groups that participated in 2017::***

Wake Human Resources – Raleigh

Grace Helping People Start Over - Fayetteville

Peak Family (Autistic son)

Raleigh Police Dept Mentor Program – Raleigh

Central Children's Home – Oxford

NC Boy's & Girl's Home – Lake Waccamaw

Falcon Children's Home – Falcon

Boy's & Girls Club of Coastal Carolina – Morehead City

Havelock Boy's & Girls Club – Havelock

*Beaufort Boy's * Girl's Club - Beaufort*

Coastal Plains Boy's & Girls Club – Pitt County & surrounding areas

Craven County Dept of Social Services – New Bern

Finn Foundation – Pink Hill

Kennedy Children's Home – Kinston

*Nash County Dept of Social Service – Nashville, NC
Edgecombe County Dept of Social Services – Tarboro
Church of God Children’s Home – Black Mountain, NC
Sandridge & Richlands Elementary Boys and Girls Clubs – Onslow County*

Fishing Locations:

Head boats

Carolina Princess – Morehead City

Capt Stacy – Atlantic Beach

Crystal Coast Lady – Beaufort

Nancy Lee – Swansboro

Piers

Bogue Inlet Pier – Emerald Isle Pier

Old Beaufort Seaport Pier - Beaufort

Half day tours combined with a half day of pier fishing

NC Aquarium – Pine Knoll Shores

Morehead City Ferry ECO Tours – Morehead City

Renegade Pirate Ship – Beaufort

Deviations: None

Receipts are attached

Final Expenses for 2017 + Donations

| 2017 TAKF receipts | | | | | | |
|--------------------|---|--|----------|------------|---------|----------|
| Invoice date | Company | Description | Expense | Adjustment | In Kind | |
| Expenses | Grant Report 1 | | | | | |
| 1.29.17 | Staples | office supplies | | | | |
| 2.8.17 | us post office | roll of stamps | | | | |
| 2.9.17 | Crystal Coast Civic Center | Rental space | 850.00 | | | |
| 2.9.17 | Crystal Coast Civic Center - 2016 unpd ba | Rental space | 425.00 | | | |
| 2.10.17 | Carolina Princess | Boat rental | 2,500.00 | | 1000 | discount |
| 2.10.17 | Willis of Michigan, Inc. | BOD Insurance | 773.00 | | | |
| 2.11.17 | Nancy Lee | Boat rental | 1,250.00 | | 850 | discount |
| 2.13.17 | Beaufort Seaport Pier | Boat rental | 600.00 | | ? | discount |
| 2.14.17 | Capt Stacy | Boat rental | 2,500.00 | | 1000 | discount |
| 2.19.17 | Walmart | copy paper/office supplies | 35.62 | | | |
| 2.19.17 | Best Buy | Laptop, bag, mouse, software, warranty | 1,062.12 | | | |
| 3.12.17 | Blu Site Solutions | Port a John Rental | 147.66 | | | |
| 3.12.17 | Best Buy | ink cartridge | 46.96 | | | |
| 3.17.17 | Crystal Coast Lady Tours | Boat rental | 2,500.00 | | ? | discount |
| 3.18.17 | Party Suppliers | table covers for cookout | 83.43 | | | |
| 4.26.17 | CRI CPAs | Prep of tax forms | 30.00 | | | |
| 4.3.17 | Crystal Coast Lady Tours - Renegade | Boat rental | 2,100.00 | | ? | discount |
| 5.2.17 | Bogue Inlet Pier | pier rental | 600.00 | | | |
| 5.31.17 | US Post Office | postage | 2.03 | | | |
| 6.10.17 | Sams Club Membership Renewal | membership fee | 45.00 | | | |
| 6.6.17 | Staples | expanding folder | | | | |
| 7.1.17 | Staples | ink cartridge | 48.03 | | | |
| 7.2.17 | Drop Box -added space | photo storage | 99.00 | | | |
| 7.7.17 | Big Rock Sports - Bonine | Sea Sick Meds & equipment | 244.05 | | | |
| 7.9.17 | Costco | Snacks & food for cookout | 502.69 | | | |
| 7.11.17 | AmWINS Event Insur/Essex Insur | event insurance | 1,844.50 | | | |
| 7.12.17 | UPS | mail - Bonine | 27.67 | | | |
| 7.13.17 | Diamond limo | Bus transportation | 500.00 | | | |
| 7.14.17 | US Post Office | postage | 69.99 | | | |
| 7.14.17 | LOWES | BAGGIES | 10.63 | | | |

Dep rec.

| | | | | | |
|----------------|-----------------------------------|--|-----------|--------|----------|
| 7.16.17 | Morehead City Ferry ECO Tours (2) | 2 tours @ 700 each | 1,400.00 | | |
| 7.16.17 | Sams | Food for event | 155.09 | | |
| 7.18.17 | Fish Bites Bait | Bait - 200 bags @ 7.99ea | | 728 | donation |
| 7.18.17 | Hobby Lobby | table covers for cookout | 89.61 | | |
| 7.18.17 | Walmart | Bait coolers, packing tape, baggies for bait | 118.68 | | |
| 7.20.17 | Staples | Ink Cartridge | 90.18 | | |
| 7.20.17 | US Post Office | postage | 2.67 | | |
| 7.22.17 | Lowe's | Storage bins | 35.16 | | |
| 7.23.17 | Walmart | Gatoraide drink mix | 49.64 | | |
| 7.24.17 | Country Aire Rentals | tables, tent & chairs | 583.69 | | |
| 7.24.17 | Carolina Ice | Ice & 2 ice boxes | | 308 | donation |
| 7.24.17 | Lowe's Foods | Tomatoes for cookout | 22.01 | 25 | Donation |
| 7.24.17 | | | | | |
| 7.24.17 | Southern Express Bus Company | Bus transportation | 13,439.00 | | |
| 7.24-25.17 | Eddie Cameron Construction | Truck & Driver | | ? | donation |
| 7.24-25.17 | Big Rock Sports | Rental space, truck & driver, forklift | | ? | donation |
| 7.24-25.17 | Linda Rike Real Estate | truck rental | | ? | donation |
| 7.25.17 | Coke | product | | ?> | |
| 7.25.17 | Pepsi | product | | ? | |
| 7.25.17 | AARD | t-shirts | | ? | donation |
| 7.25.17 | Sanitary | Slaw - 1 gallon | | ? | |
| 7.25.17 | Kinston Hardees | breakfast | | 802.04 | donation |
| 7.25.17 | Beaulaville Hardees | breakfast for Finn group | | 163 | donation |
| 7.25.17 | Walmart | bottled water | | ? | donation |
| 7.25.17 | Solskyn Personal Care Products | Suntan Products | | 1,000 | donation |
| 7.25.17 | HT | bottled water | | 150 | donation |
| 7.25.17 | Country Biscuit | 30 breakfast - Craven DSS | | ? | donation |
| 7.25.17 | Cash | Tips for mates, pier staff & delivery boys | 2,746.13 | | |
| 7.25.17 | NC Aquarium | 80 Admission tickets - 100 guests | | ? | donation |
| 7.25.17 | Jim Dandy | Gas for vehicle delivering supplies | 22.38 | | |
| 7.25.17 | Jim Dandy | Gas for Linda Rike Truck delivering supplies | 35.62 | | |
| 7.28.17 | Kona Ice | Kiddie Kona Ice for lunches | 640.50 | | |
| 7.31.17 | US Post Office | Postage | 37.00 | | |
| 8.1.16-7.31.17 | Brayler Trailer Rental & delivery | 90.74 monthly charged to credit card | 816.66 | | |

| | | | | | | |
|--|-----------------------------------|--|-----------|--|--------------------|--|
| 8.1.17 | Sysco Foods | Cookout & lunch supplies | 2,093.29 | | | |
| 8.7.17 | US Post Office | PO Box Renewal & postage | 93.90 | | | |
| 8.13.17 | Big Rock Sports, LLC | Hats for 2017 & 2018 event | 4,575.00 | | | |
| | NC Dept of the Secretary of State | Solicitation License fee | 50.00 | | | |
| | Promo Candy | Hosting plan | | | | |
| | Walter's Bait/Cape Point | Bait - 250 bags @ 7.99ea | 350 | | | |
| 6.8.17 | CRI CPAs | Tax preparation | 675.00 | | | |
| | Christine Chadwick | Website & Social Media | | | | |
| | Director Travel | | 665.54 | | | |
| | Director Fee | | 12,800.00 | | | |
| | Total Report #1 | | | | \$60,484.13 | |
| | | | | | | |
| | | | | | | |
| Adjustments for Sept 2, 2017 grant report | Grant Report 1 | | | | | |
| | | | | | | |
| 2.19.17 | Best Buy | Laptop, bag, mouse, software, warranty | 1062.12 | | | |
| | | | | | | |
| Expenses | Grant Report 2 | | | | | |
| | Drop Box | 2nd storage fee | 99.00 | | | |
| | PayPal | Annual expenses | 103.94 | | | |
| | USPS | postage | 7.80 | | | |
| | Brayler Trailer | Storage unit rental | 453.70 | | | |
| | | | | | | |
| | <i>Total Report #2</i> | | | | 664.44 | |
| | | | | | | |
| | Subtotalled yearly expenses | | | | 61,148.57 | |
| | Less Depreciated laptop | | | | 1062.12 | |
| | Total Expenses for year | | | | \$60,086.45 | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Customer Account Detail

Monday, January 8, 2018 11:10 AM

Bray Trailers

Page 1
RHONOA

Customer: No.: CU01625, Date Filter: 01/01/17..12/01/17

| Customer | Date | Type | Document Number | Description | Transaction Amount | Transaction Currency | Open | Net Change | | Running Balance |
|----------|------------|-------------|-----------------|---|--------------------|----------------------|------|------------|--------------|-----------------|
| | | | | | | | | Debits | Credits | |
| CU01625 | | | | Take a Kid Fishing Foundation Phone: 252-241-4428 Contact: Teresa | | | | | | |
| | 12/31/2016 | | | Beginning Balance | | | | | | 181.46 |
| | 1/5/2017 | Invoice | RI032676 | Rental Order RO02613 | 80.74 | | No | 80.74 | | 272.22 |
| | 1/5/2017 | Payment | MCVISA00655 | MasterCard Settle - RI032676 | -80.74 | | No | | 80.74 | 181.46 |
| | 2/7/2017 | Invoice | RI033171 | Rental Order RO02613 | 80.74 | | No | 80.74 | | 272.22 |
| | 2/10/2017 | Payment | MCVISA00004 | MasterCard Settle - CU01625 | -272.22 | | No | | 272.22 (3mo) | |
| | 3/3/2017 | Invoice | RI033560 | Rental Order RO02613 | 80.74 | | No | 80.74 | | 90.74 |
| | 3/3/2017 | Payment | MCVISA01052 | MasterCard Settle - RI033560 | -80.74 | | No | | 80.74 | |
| | 4/4/2017 | Invoice | RI034030 | Rental Order RO02613 | 80.74 | | Yes | 80.74 | | 90.74 |
| | 4/20/2017 | Payment | MCVISA01340 | MasterCard Settle - CU01625 | -80.74 | | Yes | | 80.74 | |
| | 8/2/2017 | Invoice | RI034808 | Rental Order RO02613 | 80.74 | | Yes | 80.74 | | 90.74 |
| | 6/15/2017 | Payment | MCVISA01754 | MasterCard Settle - CU01625 | -80.74 | | Yes | | 80.74 | |
| | 7/9/2017 | Invoice | RI035497 | Rental Order RO02613 | 80.74 | | No | 80.74 | | 80.74 |
| | 7/3/2017 | Payment | MCVISA01009 | MasterCard Settle - RI035497 | -80.74 | | No | | 80.74 | |
| | 8/3/2017 | Invoice | RI035883 | Rental Order RO02613 | 80.74 | | No | 80.74 | | 80.74 |
| | 8/3/2017 | Payment | MCVISA02144 | MasterCard Settle - RI035883 | -80.74 | | No | | 80.74 | |
| | 9/6/2017 | Invoice | RI036458 | Rental Order RO02613 | 80.74 | | No | 80.74 | | 80.74 |
| | 9/6/2017 | Payment | MCVISA02376 | MasterCard Settle - RI036458 | -80.74 | | No | | 80.74 | |
| | 10/4/2017 | Invoice | RI036842 | Rental Order RO02613 | 80.74 | | No | 80.74 | | 80.74 |
| | 10/4/2017 | Payment | MCVISA02588 | MasterCard Settle - RI036842 | -80.74 | | No | | 80.74 | |
| | 11/2/2017 | Invoice | RI037377 | Rental Order RO02613 | 181.40 | | Yes | 181.40 | | 181.40 |
| | 11/14/2017 | Payment | MCVISA02603 | MasterCard Settle - CU01625 | -181.40 | | Yes | | 181.40 | |
| | 12/1/2017 | | | Ending Balance for CU01625 | | | | 988.14 | 1,179.62 | |
| | | 1 Customers | | 20 Entries | | Report Totals (USD) | | 988.14 | 1,179.62 | |

12/1/2017

JAN - NOW

+ 90.74 for Dec on credit card
 + 1,179.62 1-11

 1270.36 T for y

| | | | |
|--|--|---|--|
|  UNITED STATES POSTAL SERVICE® | | Click-N-Ship® | |
|  | | <small>usps.com</small> 9405 5036 9930 0098 2916 31 007# 0003 0012 7530 US POSTAGE \$7.80 | |
| <small>09/12/2017 3 lb 0 oz Mailed from 28557 062S0000001301</small> | |  | |
| PRIORITY MAIL 2-DAY™ | | | |
| TERESA HOLCOMBE TAKF PO BOX 1191 MOREHEAD CITY NC 28557-1191 | | Expected Delivery Date: 09/14/17 0024 | |
| Carrier -- Leave if No Response | | | |
| <div style="border: 1px solid black; padding: 5px; display: inline-block;"> R027 </div> | | | |
| SHIP FRANK BEST TO: BEST COMMERCIAL DEVELOPMENT LLC 2815 N WILLIAM ST STE 2A GOLDSBORO NC 27530 | | | |
| USPS TRACKING # | | | |
|  | | | |
| 9405 5036 9930 0098 2916 31 | | | |
| Electronic Rate Approved #038555749 | | | |



Cut on dotted line.

Instructions

- Each Click-N-Ship® label is unique. Labels are to be used as printed and used only once. DO NOT PHOTO COPY OR ALTER LABEL.
- Place your label so it does not wrap around the edge of the package.
- Adhere your label to the package. A self-adhesive label is recommended. If tape or glue is used, DO NOT TAPE OVER BARCODE. Be sure all edges are secure.
- To mail your package with PC Postage®, you may schedule a Package Pickup online, hand to your letter carrier, take to a Post Office™, or drop in a USPS collection box.
- Mail your package on the "Ship Date" you selected when creating this label.

Click-N-Ship® Label Record

| | |
|---|---|
| USPS TRACKING # : 9405 5036 9930 0098 2916 31 | |
| Trans. #: 414512860 Print Date: 09/12/2017 Ship Date: 09/12/2017 Expected Delivery Date: 09/14/2017 | Priority Mail® Postage: \$7.80 Total: \$7.80 |
| From: TERESA HOLCOMBE TAKF PO BOX 1191 MOREHEAD CITY NC 28557-1191 | |
| To: FRANK BEST BEST COMMERCIAL DEVELOPMENT LLC 2815 N WILLIAM ST STE 2A GOLDSBORO NC 27530 | |
| <small>* Retail Pricing Priority Mail rates apply. There is no fee for USPS Tracking® service on Priority Mail service with use of this electronic rate shipping label. Refunds for unused postage paid labels can be requested online 30 days from the print date.</small> | |

Receipt
Mail
TAKF



Thank you for shipping with the United States Postal Service!
 Check the status of your shipment on the USPS Tracking® page at usps.com

Take A Kid Fishing Foundation, Inc.
P.O. Box 1191, Morehead City, 28557 NC

Financial Statement from January 1, 2017 to December 31, 2017

| | Amounts in USD | |
|--------------------------------------|------------------|-----------------|
| Beginning Balance | | 1,670.58 |
| Ending Balance | | 1,417.20 |
| Beginning payables balance | | 0.00 |
| Ending payables balance | | 0.00 |
| | Debit | Credit |
| Sales Activity | | 4,220.00 |
| Payments received | 0.00 | 4,220.00 |
| Refunds sent | 0.00 | 0.00 |
| Fees | -103.94 | |
| Payment fees | -103.94 | 0.00 |
| Refunded fees* | 0.00 | 0.00 |
| Chargeback fees | 0.00 | 0.00 |
| Account Fees Invoice | 0.00 | 0.00 |
| Other fees | 0.00 | 0.00 |
| Dispute Activity | 0.00 | |
| Chargebacks & disputes | 0.00 | 0.00 |
| Dispute reimbursements | 0.00 | 0.00 |
| Transfers & Withdrawals | -4,369.44 | |
| Currency transfers | 0.00 | 0.00 |
| Transfers to PayPal account | 0.00 | 0.00 |
| Transfers from PayPal account | -4,369.44 | 0.00 |
| Purchase Activity | 0.00 | |
| Online payments sent | 0.00 | 0.00 |
| Refunds received | 0.00 | 0.00 |
| Debit card purchases | 0.00 | 0.00 |
| Debit card returns | 0.00 | 0.00 |
| Reserves and releases | 0.00 | 0.00 |
| Blocked Payments | 0.00 | 0.00 |
| Other Activity | | 0.00 |
| Money market dividends | 0.00 | 0.00 |
| Debit card cash back | 0.00 | 0.00 |
| Credit card cash back | 0.00 | 0.00 |
| Other | 0.00 | 0.00 |

Note: This is not an actual bill.

* Paypal refunds you fees for any fraudulent transactions or in cases when the refund happens within the first 2 days of the sale.

Dropbox Inc.

333 Brannan Street
San Francisco, CA 94107
United States
billing-support@dropbox.com

Receipt for tholcombe@bigrocksports.com

| Payment | Date | Amount | Receipt ID |
|------------------------------------|-------------|---------------|-------------------|
| mastercard ending in 3103 approved | 7/1/2017 | \$99.00 | H3N672QNN9SR |

| Description | Amount |
|---|----------------|
| Dropbox Plus - 1TB (7/1/2017 to 7/1/2018) | \$99.00 |
| Total | \$99.00 |

All amounts shown are in USD. This is not an invoice. No additional payment is required.

Dropbox Inc.
333 Brannan Street
San Francisco, CA 94107
United States
billing-support@dropbox.com

Receipt for tholcombe@ec.rr.com

| Payment | Date | Amount | Receipt ID |
|------------------------------------|-------------|---------------|-------------------|
| MasterCard ending in 4063 approved | 7/2/2017 | \$99.00 | CFZT1B5332MX |

| Description | Amount |
|---|----------------|
| Dropbox Plus - 1TB (6/23/2017 to 6/23/2018) | \$99.00 |
| Total | \$99.00 |

All amounts shown are in USD. This is not an invoice. No additional payment is required.

Coastal Recreational Fishing License:
Semi-Annual Performance Report

Recipient: Charles H. Peterson, University of North Carolina at Chapel Hill, Institute of Marine Sciences; 3431 Arendell Street, Morehead City, NC 28557

Project Investigators: Charles H. Peterson & Avery B. Paxton

Grant Award #: 6446

Grant Title: Improving the fish production of artificial reefs by testing the most widely-recognized and pressing questions about reef design and function

Grant Award Period: July 1, 2015 – June 30, 2018. The project end date was extended from June 30, 2017 to June 30, 2018 under a no-cost extension for year 2 of this grant.

Performance Reporting Period: July 1, 2017 – December 31, 2017

Project Costs: \$53,916.05

Expenditures for the Period:

| <u>Category</u> | <u>Expenditures</u> |
|------------------------|----------------------------|
| Personnel | \$5,456.57 |
| Fringe | \$ 380.21 |
| Travel | \$ 0.00 |
| Equipment | \$ 0.00 |
| Supplies | \$1,615.00 |
| Construction | \$ 0.00 |
| Contractual | \$ 0.00 |
| Other | <u>\$ 0.00</u> |
| Total Direct | \$7,451.78 |
| Indirect | <u>\$1,054.11</u> |
| TOTAL | \$8,505.89 |

Total Cumulative Expenditures: \$53,916.05

Total Remaining Balance: \$31,841.95

Description of Work:

Objective: The overall objective of this study is to increase the fish production of artificial reefs by understanding consequences of siting location and buffer zones widths of varying distance between artificial reefs and existing natural reefs, the efficacy of Atlantic Pods, and the effect of artificial reefs on water column productivity and soundscape characteristics indicative of spawning. The project is broken into three components with respective objectives:

1. *Buffer zone between artificial and natural reefs:* To determine how placing artificial reefs in close horizontal and vertical proximity to natural hard-bottom influences the habitat utilization by recreationally and commercially important fish species and to specifically evaluate the proposed 200 ft buffer between artificial reefs and natural reefs. Fish utilization of artificial reefs will be determined as a function of proximity to natural reefs and substrate relief.
2. *Effectiveness of Atlantic Pods:* To determine the efficacy of the novel artificial reef structures called “Atlantic Pods” by quantifying fish community development, as well as scouring, stability, and durability over time. Each of these attributes will be compared to other artificial reef structures of different shapes, sizes, and materials to determine which artificial structures perform the best as reef fish habitat.
3. *Aggregation vs. production – water column and soundscape:* To test innovative mechanisms of enhancing production to help address the question of whether artificial reefs aggregate or produce biomass of fishes, including how artificial reefs form supplemental habitat throughout the water column above and how artificial reefs create novel soundscapes.

Expected Results: The results of this project will increase the performance of and range of materials used for artificial reefs to generate more fish for the public, including both recreational and commercial fishermen. We also test long-standing hypotheses on aggregation and production and are confident that our novel approaches will show increased production through documenting the water column ‘footprints’ and frequency of spawning on artificial reefs. More specifically, this study will provide a comprehensive assessment of how artificial reefs enhance fisheries, with a focus on establishing scientifically based buffer zones between artificial and natural reefs, documenting the effectiveness of new Atlantic Pod artificial reef modules, and determining how artificial reefs influence the water column directly above and behind them as well as whether fish spawning sounds are present. These achievements will help fill knowledge gaps of how artificial reefs enhance fisheries and thereby improve the functionality of artificial reefs in the future.

Project Status & Work Accomplished:

1. *Buffer zone between artificial and natural reefs:* We have completed the buffer zone component of this project, including one full year (three seasons) of comprehensive sampling on artificial and natural reefs to determine an appropriate buffer zone, as well as a partial pilot season. Data processing and analysis are complete. We orally presented our findings at the Benthic Ecology Meeting in Myrtle Beach, SC during April 2017. In July 2017, we submitted a manuscript detailing our findings to the peer-reviewed journal *Marine Ecology Progress Series*. The manuscript was published in January 2018 in *Marine Ecology Progress Series* as:
R.C. Rosemond, A.B. Paxton, H.L. Lemoine, S.R. Fegley, and C.H. Peterson. 2018. Fish use of reef structures and adjacent sand flats: implications for selecting minimum buffer zones between new artificial reefs and existing reefs. *Marine Ecology Progress Series* 587: 187-199. DOI: doi.org/10.3354/meps12428.

The manuscript is attached.

2. *Effectiveness of Atlantic Pods*: We collected data on the effectiveness of Atlantic Pods as reef fish habitat seasonally during summer 2015, fall 2015, winter 2015-2016, and spring 2016, completing one year of sampling effort. Data processing is complete. Data analysis is complete. We presented preliminary results at the *Western Society of Naturalists* conference in CA during November 2016. We are currently preparing a manuscript on results from this component of the project. We are on schedule with the Atlantic Pod component.
3. *Aggregation vs. production – water column and soundscape*: We sampled the currents, zooplankton, fishes, and sharks in the water column beginning in May 2016 with improved technology (see Deviations below), and sampling concluded in September 2016; data analyses are underway. We have conducted five rounds of sampling for the soundscape. Data processing and analysis are ongoing for both components. In June 2017, we submitted a manuscript to the peer-reviewed journal *Ecological Engineering* on our findings from the video recordings obtained during the soundscape component of this project. The manuscript information is as follows:

Paxton, A.B., L.W. Revels, R.C. Rosemond, R. Gaesser, H.R. Lemoine, J.C. Taylor, and C.H. Peterson. *In review*. Convergence of fish community structure between a newly deployed and an established artificial reef along a five-month trajectory. *Ecological Engineering*.

We are on schedule for both the water column and soundscape components.

Outreach and Dissemination of Results: We have engaged in the following outreach initiatives to highlight this CRFL – funded research on NC reefs:

Published Manuscript in January 2018: R.C. Rosemond, A.B. Paxton, H.L. Lemoine, S.R. Fegley, and C.H. Peterson. 2018. Fish use of reef structures and adjacent sand flats: implications for selecting minimum buffer zones between new artificial reefs and existing reefs. *Marine Ecology Progress Series* 587: 187-199. DOI: doi.org/10.3354/meps12428.

Activity Leader, ‘Virtual dive on offshore reefs,’ UNC-IMS Open House / 70th Anniversary, Morehead City, NC, 21 October 2017 (~500 students)

Invited Scientist and Activity Coordinator, ‘Shipwrecks of NC form important fish homes’ NC Seafood Festival, Morehead City, NC, 6 October 2017 (~320 students)

Submitted Manuscript in June 2017: Paxton, A.B., L.W. Revels, R.C. Rosemond, R. Gaesser, H.R. Lemoine, J.C. Taylor, and C.H. Peterson. *In review*. Convergence of fish community structure between a newly deployed and an established artificial reef along a five-month trajectory. *Ecological Engineering*.

Invited Speaker, Brad Sneed Marine Sciences Academy, ‘What I love about being a marine scientist,’ June 2017 (~40 students)

Oral Presentation, *Benthic Ecology Meeting*, ‘Fish use of reef structures and surrounding sand habitat: implications for buffer zones between existing and new artificial reefs,’ Myrtle Beach, SC, April 2017

Oral Presentation, *Coastal Carolina Scientific Diving Association – Scientific Diving Symposium*, ‘Convergence of fish communities between a newly deployed and an established artificial reef occurred over five months and along a distinct trajectory,’ Beaufort, NC, March 2017.

Oral Presentation, *Coastal Carolina Scientific Diving Association – Scientific Diving Symposium*, ‘Inclusion of buffer zones between artificial reefs to more effectively enhance fisheries,’ Beaufort, NC, March 2017

Oral Presentation, *NC Marine & Coastal Consortium Graduate Student Symposium*, ‘Ecological effects of marine urbanization,’ Beaufort, NC, March 2017

Invited Scientist, Scientist advisor for temperate reef ecosystem projects for Patrick Goff’s middle school science students from Beaumont Middle School in Lexington, KY, March 2017 (~6 students)

Poster Presentation, *Western Society of Naturalists*, ‘Metal ships, concrete modules, and rocky reefs: Quantifying how reef type influences fish communities,’ Monterey, CA, November 2016.

[‘The science of North Carolina’s artificial reefs,’](#) Public Radio East, Down East Journal by Jared Brumbaugh, September 2016

Invited Scientists and Activity Coordinator, ‘Offshore Reefs – “What? We have Reefs off NC?”’ NC Seafood Festival, Morehead City, NC, 30 September 2016 (~150 students)

Invited Speaker, Duke Talent Identification Program, ‘The Underwater World,’ presentation on fish surveys and diving on reefs of NC, June 2016 (~20 students)

Invited Speaker, P.E.O. State Convention, ‘Passport to the Graveyard of the Atlantic,’ June 2016 (~400 people)

Oral Presentation, *International Temperate Reef Symposium*, ‘Existing natural and artificial temperate reefs provide valuable insights into future offshore renewable energy development,’ Pisa, Italy, June 2016

Oral Presentation, *East Carolina University, Biology Department - Research in Progress Seminar Series*, ‘Offshore energy development and reef fish,’ Greenville, NC, USA, April 2016

Oral Presentation, *Brown Bag Lunch Seminar*, ‘Offshore energy development – what about our reef fish?’ Morehead City, NC, USA, March 2016

[‘Shipwrecks off coast prove beneficial for marine life,’](#) WCTI-12 News by Jonathan Weant, November 2015

Invited Speaker, Beaufort Ole Towne Rotary Club, ‘Offshore Reefs: Secret Gardens of North Carolina,’ 14 December 2015 (~50 people)

Speaker, Carteret Community College C-STEP ‘Day at IMS,’ ‘A day in the life of a scientist studying offshore reefs of NC,’ 30 October 2015 (~10 people)

Invited Scientists and Activity Coordinator, ‘Offshore Reefs – “What? We have Reefs off NC?”’ NC Seafood Festival, Morehead City, NC, 2 October 2015 (~150 students)

Lesson Plan, ‘Ships, tires, and trains: What if we put them on the bottom of the ocean?’ developed with educators and presented during SciREN Triangle, September 2016 (~150 NC educators)

Lesson Plan, ‘SCUBA Dive into Sunken Treasure- Artificial Reefs!’ developed with educators and presented during SciREN Triangle, September 2016 (~150 NC educators)

Paxton and her research team have also taught lectures for an Estuarine and Coastal Ecology course and Scientific Diving Course at UNC-IMS in fall 2015 and fall 2016 and used offshore reef research as case studies. They plan to teach similar lectures in fall 2017.

Deviations:

1. *Buffer zone between artificial and natural reefs:* We did not sample AR-350 because of limited underwater visibility. The visibility was too low to conduct fish surveys, likely because this site is located at the mouth of the New River. We conducted three back-to-back 30m transects radiating away from artificial reefs, which allows evaluation of the proposed 200ft buffer zone. For the second and third sampling seasons, we modified these radiating surveys to allow depiction of smaller scale variation (15 m) in the fish community over distance. The surveys are evaluated as six 15-m transects and three 30-m transects to learn how spatial scales influence fish use of reef structures. Last, we maintained three rounds of seasonal fish and relief surveys but no longer focused on sediment surveys. Scouring was measured only around Atlantic Pods and Reef Balls. We still measured structural relief along structural and radiating transects for each subsite.
2. *Effectiveness of Atlantic Pods:* We replaced roving diver surveys with a roving diver and belt transect hybrid survey. This was done by laying a transect tape for 30 m x 4 m along the artificial reef structure, even if it didn’t follow a straight heading. The belt transect provides easily replicable data while the roving diver survey is more random and not repeatable. By combining the two methods to form a meandering belt transect we could more adequately sample reef structures such as Atlantic Pods, Reef Balls, and Pipes that often occur with expanses of sand between individual structures. We also mapped the exact location of the Atlantic Pods by collecting new side-scan sonar data. The NC DMF Artificial Reef Program provided us with four points, one point for each corner of the

rectangular area where Atlantic Pods were deployed. By collecting additional side-scan sonar, we pinpointed the exact location of each Atlantic Pod within each rectangle, allowing analyses of spatial distribution effects. We added a component of the project to compare Atlantic Pods to other artificial reef structures, such as Reef Balls, by also measuring their induced scour and stability. The buffer zone component of this project collected the remaining necessary data on fish and benthic community composition, as well as structural complexity. These comparisons will provide a better indication of how effective Atlantic Pods are as novel artificial reef structures.

3. *Aggregation vs. production – water column and soundscape:* We chose to delay our sampling effort of water column productivity until spring 2016 so we could have an extended, continuous sampling effort through early fall 2016. By waiting until spring 2016 to commence this sampling effort, we had the opportunity to improve upon the proposed research by using splitbeam fishery acoustics to more rigorously quantify the amount of zooplankton and planktivorous fishes in the water column above artificial reefs. We also used an ADCP to remotely sense the currents while surveying with the splitbeam system.

Appendix

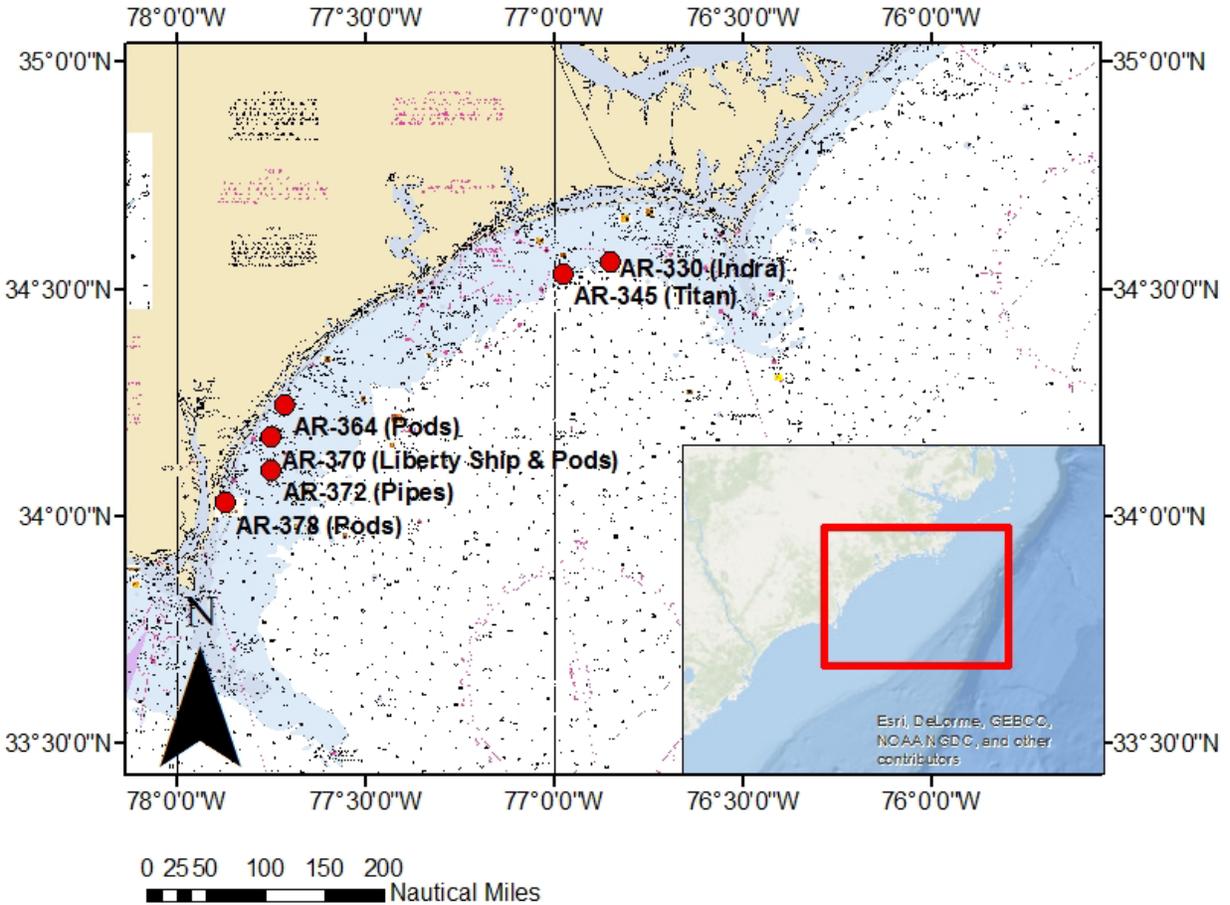


Figure 1: Location of artificial reef study sites in Onslow Bay, NC. Surveys for proximity and buffer zones of artificial reefs and natural reefs are conducted at all six reefs. Surveys on Atlantic Pod effectiveness are conducted on AR-364, AR-370, and AR-378.

Table 1: Twenty-eight study sites in Onslow Bay, NC used for buffer zone component. Site information and sampling dates.

| Site | Subsite | Structure Type | Structure Material | Reef Type | Deployment Year | Depth (ft) | Area (sqft) | Description | Longitude (DDM) | Latitude (DDM) | Distance to shore (miles) | Pilot Sampling Period (Summer 2016) | Sampling Period 1 (Fall) | Sampling Period 2 (Winter) | Sampling Period 3 (Spring) |
|------|--------------|----------------|--------------------|------------|-----------------|------------|-------------|---|-----------------|----------------|---------------------------|-------------------------------------|--------------------------|----------------------------|----------------------------|
| 330 | BARGE | SHIP | METAL | Artificial | 2009 | 64 | 3,800 | 200 FT Deck Barge TBM IX | 76 51.080 | 34 33.796 | 8.65 | N/A | 9/8/15 | 12/11/15 | 4/26/16 |
| 330 | H-UNITS | H-UNITS | CONCRETE | Artificial | 2000 | 65 | 3,600 | 45 "H" Units | 76 51.493 | 34 33.447 | 8.92 | N/A | 9/8/15 | 1/15/16 | N/A |
| 330 | INDRA | SHIP | METAL | Artificial | 1992 | 63 | 13,400 | 320 FT Landing Craft Repair Ship "INDRA" | 76 51.115 | 34 33.706 | 8.75 | 7/27/15 | 9/8/15 | 12/11/15 | 4/26/16 |
| 330 | PIPES | PIPES | CONCRETE | Artificial | 1990 | 64 | 35,800 | 822 Tons Concrete Pipe | 76 51.264 | 34 33.353 | 9.09 | 7/27/15 | 9/8/15 | 12/11/15 | N/A |
| 345 | CONC | PIPES | CONCRETE | Artificial | 1991 | 61 | 81,600 | Consolidated Concrete: 750 Pieces Concrete Pipe, 1500 Tons Manhole Sections | 76 58.417 | 34 32.292 | 8.95 | N/A | 10/15/15 | N/A | 4/21/16 |
| 345 | RB1 | REEF_BALLS | CONCRETE | Artificial | 2000 | 65 | 14,400 | 75 Reef Balls | 76 58.348 | 34 32.337 | 8.93 | N/A | 10/15/15 | 1/27/16 | 4/21/16 |
| 345 | RB2 | REEF_BALLS | CONCRETE | Artificial | 2000 | 62 | 5,300 | 50 Ultra Reef Balls and 1 Reef Ball | 76 58.605 | 34 32.397 | 8.77 | N/A | 10/15/15 | N/A | 4/21/16 |
| 345 | TITAN | SHIP | METAL | Artificial | 2004 | 64 | 2,600 | 116 FT Tug Boat "TITAN" | 76 58.494 | 34 32.142 | 9.08 | 7/17/15 | 10/15/15 | 1/27/16 | 4/21/16 |
| 364 | BARGE | SHIP | METAL | Artificial | 1997 | 53 | 16,900 | 297 FT HT-290 Barge | 77 42.888 | 34 14.794 | 2.25 | N/A | 9/21/15 | 12/10/15 | 3/9/16 |
| 364 | DOMES | DOMES | FIBERGLASS | Artificial | 1989 | 43 | 700 | Fiberglass Domes and Cubes | 77 42.822 | 34 14.966 | 2.17 | N/A | 9/21/15 | 12/10/15 | 3/10/16 |
| 364 | PIPES | PIPES | CONCRETE | Artificial | 1986 | 46 | TBD | Concrete Pipes | 77 42.998 | 34 14.662 | 2.25 | N/A | N/A | 12/10/15 | N/A |
| 364 | PODS | ATLANTIC_PODS | CONCRETE | Artificial | 2015 | 46 | TBD | 200 Concrete Pods | 77 43.008 | 34 14.634 | 2.26 | N/A | 9/21/15 | 12/10/15 | 3/15/16 |
| 364 | TUGBOAT | SHIP | METAL | Artificial | 1994 | 48 | 1,200 | 65 FT Tug "CAPTAIN JERRY" | 77 42.828 | 34 14.853 | 2.25 | N/A | 9/21/15 | 12/10/15 | 3/9/16 |
| 370 | BARGE | SHIP | METAL | Artificial | 1973 | 49 | 3,700 | 90 FT Barge | 77 45.530 | 34 10.502 | 2.60 | N/A | 9/9/15 | N/A | N/A |
| 370 | LIBERTYS HIP | SHIP | METAL | Artificial | 1974 | 51 | 28,600 | 440 FT Liberty Ship "ALEXANDER RAMSEY" | 77 45.113 | 34 10.514 | 2.99 | N/A | 9/3/15 | 12/9/15 | 3/10/16 |
| 370 | NR1 | NATURAL_REEF | ROCK | Natural | N/A | 48 | TBD | Natural Hardbottom | 77 44.727 | 34 10.706 | 3.34 | N/A | 9/9/15 | 12/8/15 | 3/10/16 |
| 370 | NR2 | NATURAL_REEF | ROCK | Natural | N/A | 50 | TBD | Natural Hardbottom | 77 44.675 | 34 10.613 | 3.40 | N/A | 9/9/15 | 12/8/15 | 3/11/16 |
| 370 | PIPES | PIPES | CONCRETE | Artificial | 2008 | 50 | TBD | 155 Tons Concrete Pipes | 77 45.397 | 34 10.562 | 2.71 | N/A | 9/3/15 | 12/8/15 | 3/11/16 |
| 370 | PODS | ATLANTIC_PODS | CONCRETE | Artificial | 2015 | 51 | TBD | 200 Concrete Pods | 77 45.373 | 34 10.537 | 2.74 | N/A | 9/15/15 | 12/8/15 | 3/15/16 |
| 372 | NR1 | NATURAL_REEF | ROCK | Natural | N/A | 60 | TBD | Natural Hardbottom | 77 45.120 | 34 06.418 | 5.62 | N/A | 9/2/15 | 12/3/15 | 3/17/16 |
| 372 | NR2 | NATURAL_REEF | ROCK | Natural | N/A | 54 | TBD | Natural Hardbottom | 77 45.067 | 34 06.158 | 5.78 | N/A | 9/2/15 | 12/9/15 | 3/15/16 |
| 372 | PODS | ATLANTIC_PODS | CONCRETE | Artificial | 2015 | 56 | TBD | 200 Concrete Pods | 77 44.882 | 34 06.490 | 5.80 | N/A | 9/2/15 | 12/9/15 | 3/16/16 |
| 372 | RB1 | REEF_BALLS | CONCRETE | Artificial | 2001 | 59 | 11,500 | 128 Reef Balls | 77 44.897 | 34 06.300 | 5.87 | N/A | 9/2/15 | 12/9/15 | 3/16/16 |
| 372 | TRAINCARS | TRAIN_CARS | METAL | Artificial | 1986 | 57 | 6,100 | Train Boxcars - in Multiple Pieces | 77 44.819 | 34 06.115 | 6.02 | N/A | 9/3/15 | N/A | 3/11/16 |
| 378 | NR1 | NATURAL_REEF | ROCK | Natural | N/A | 40 | TBD | Natural Hardbottom | 77 51.580 | 34 02.069 | 1.70 | N/A | 9/14/15 | 1/20/16 | 5/10/16 |
| 378 | PIPES | PIPES | CONCRETE | Artificial | 2008 | 38 | 11,600 | 115 Tons Consolidated Concrete | 77 52.260 | 34 01.905 | 1.13 | N/A | 9/14/15 | 1/21/16 | N/A |

| | | | | | | | | | | | | | | | |
|-----|------|-------------------|----------|------------|------|----|--------|-------------------|-----------|-----------|------|-----|---------|---------|---------|
| 378 | PODS | ATLANTIC_ PODS | CONCRETE | Artificial | 2015 | 45 | TBD | 200 Concrete Pods | 77 51.990 | 34 01.892 | 1.39 | N/A | 9/14/15 | 1/20/16 | 3/17/16 |
| 378 | RB1 | REEF_ BALLS | CONCRETE | Artificial | 2001 | 41 | 21,200 | 100 Reef Balls | 77 52.255 | 34 01.782 | 1.14 | N/A | 9/14/15 | 1/20/16 | 5/10/16 |

COASTAL RECREATIONAL FISHING LICENSE
SEMI-ANNUAL PERFORMANCE REPORT

Recipient: North Carolina Division of Marine Fisheries, Carole Willis

Grant Award #: 2P40 P035

Grant Title: Saltwater Fishing Tournament Efficiency Increase

Grant Award Period: July 1, 2015 through June 30, 2018

Performance Reporting Period: July 1, 2017 through December 31, 2017.

Expenditures for the Period:

| <u>Category</u> | <u>Expenditures</u> |
|------------------------|----------------------------|
| Personnel | n/a |
| Fringe | n/a |
| Purchased Services | \$2,015 |
| Travel | 0.00 |
| Equipment | 0.00 |
| Supplies | 0.00 |
| Construction | n/a |
| Contractual | n/a |
| Other | <u>n/a</u> |
| Total Direct | 0.00 |
| Indirect | <u>0.00</u> |
| TOTAL | 0.00 |

Total Cumulative Expenditures: \$2,015

Total Remaining Balance: \$26,534

Description of Work:

The objective of this grant is to enhance the experience of recreational anglers as they visit the North Carolina coast, interact with weigh stations, and receive their citations by developing more efficient processes within the North Carolina Saltwater Fishing Tournament.

Project Status/Work Accomplished:

Citation applications were collected from weigh stations (n=108) and are being entered in to the access database for printing and mailing to anglers. The Sportfishing Specialist worked with recreational anglers and weigh stations (tackle shops, piers, and marinas) collecting information from citation applications for 38

recreationally important species in North Carolina (Table 1.). Information collected included date, length (in), girth (in), weigh station and landings frequency. Weigh stations were also visited and given supplies for the season.

Table 1. Species included in the Saltwater Fishing Tournament

| <u>Species</u> | <u>Species</u> |
|-----------------|------------------------|
| Atlantic Bonito | Pompano |
| Amberjack | Porgy (Silver Snapper) |
| Barracuda | Red Drum |
| Bigeye Tuna | Sailfish |
| Black Drum | Sea Mullet |
| Blackfin Tuna | Shark |
| Black Sea Bass | Sheepshead |
| Blue Marlin | Spanish Mackerel |
| Bluefin Tuna | Spearfish |
| Bluefish | Speckled Trout |
| Cobia | Spot |
| Croaker | Striped Bass |
| Dolphin | Tarpon |
| False Albacore | Triggerfish |
| Flounder | Wahoo |
| Gray Tilefish | Weakfish |
| Grouper | White Marlin |
| Jack Crevalle | Yellowfin Tuna |
| King Mackerel | |

Deviations:

No deviations during this time frame.

COASTAL RECREATIONAL FISHING LICENSE
SEMI-ANNUAL PERFORMANCE REPORT

Recipient: North Carolina Wildlife Resources Commission

Grant Award #: CRFL Grant Contract Number 6799

Grant Title: West Onslow Boating Access Area

Grant Award Period: October 1, 2016 – April 1, 2018

Performance Reporting Period: July 1, 2017 – December 31, 2017

Project Costs: \$300,000

Expenditures for the Period:

Category Expenditures

Personnel

Fringe

Travel

Equipment

Supplies

Construction

Contractual

Other

Total Direct

Indirect

TOTAL

Total Cumulative Expenditures: \$0

Total Remaining Balance: \$300,000

Description of Work: – Remove existing concrete ramps and construct new ramps north of the existing launch area closer to the ICW. Clear shoreline and excavate at the end of the ramp to reach necessary depth to connect to channel. Replace existing dock with floating dock of 8' by 60'. Construct new paved parking areas with ADA accessible parking. The lot will have a minimum of 18 trailer spaces (10' by 40'), 4 single vehicle spaces and 1 ADA space (1 trailer). Maintenance dredging of the man-made canal has been permitted in the past and will be necessary as part of the project renovation. Approximately 36,000 sq. ft. of material will be removed; however, relocation of the boat ramps in the man-made channel closer to the ICW will eliminate the long-term need to maintenance dredge approximately 18,900 square feet of material. Total dredge

volume is unknown at this time and will be determined with future bathymetric survey and design. Turbidity curtains will be installed at the terminus of the man-made canal during maintenance dredging, and recommended in-water work moratoriums will be followed. The final maintenance dredging limits and volumes will be minimized to the greatest extent possible during the design and permitting process. Finally, after the existing ramp is removed, a natural shoreline will be reestablished in this location.

Project Status/Work Accomplished:

Design and permitting complete. Awarded dredging contract. This site has a Division of Coastal Management juvenile shrimp & finfish breeding area construction moratorium from April 1 – September 30. The renovation work could not fit into our construction schedule until now. Onslow Water and Sewer Authority (ONWASA) has just started their North Topsail Water Main Replacement Project. This project relocates the water main currently on the Highway 210 Bridge and directional drills the line under the Intracoastal Waterway and into a trench that runs through our parking area. The contractor for this project will be staging & working on our boat ramp site from December 1, 2017 through the end of February 2018.

We will be dredging the access canal in January 2018 and begin ramp construction and parking lot work in early March 2018. We should be done with the renovation of the ramp by the end of May 2018.

Requested no cost extension of 6/30/2018 due to unforeseen delay.

COASTAL RECREATIONAL FISHING LICENSE

SEMI-ANNUAL PERFORMANCE REPORT

Recipient: Oregon Inlet Artificial Reef Committee

Grant Award #: 7381

Grant Title: Establish new artificial reef in NC state waters off the coast of Dare County

Grant Award Period: December 1, 2017 to June 30, 2018

Performance Reporting Period: July 1 through December 30, 2017

Project Costs: \$371,000

Expenditures for the Period: None

| <u>Category</u> | <u>Expenditures</u> |
|-----------------|---------------------|
|-----------------|---------------------|

| | |
|-----------|--|
| Personnel | |
|-----------|--|

| | |
|--------|--|
| Fringe | |
|--------|--|

| | |
|--------|--|
| Travel | |
|--------|--|

| | |
|-----------|--|
| Equipment | |
|-----------|--|

| | |
|----------|--|
| Supplies | |
|----------|--|

| | |
|--------------|--|
| Construction | |
|--------------|--|

| | |
|-------------|--|
| Contractual | |
|-------------|--|

| | |
|-------|--|
| Other | |
|-------|--|

| | |
|--------------|--|
| Total Direct | |
|--------------|--|

| | |
|----------|--|
| Indirect | |
|----------|--|

| | |
|-------|--|
| TOTAL | |
|-------|--|

Total Cumulative Expenditures: \$0

Total Remaining Balance: \$371,000

Description of Work:

List the project objectives or provide a brief description of the funded activity, giving enough detail to acquaint the reader with the project.

Project Status/Work Accomplished:

For each objective, describe tasks scheduled for the reporting period and the activities undertaken to complete them. Describe the specific accomplishments, and list products (publications, web pages, data, technology, etc.) completed during the reporting period. Attach copies of the publications, as appropriate.



*Oregon Inlet Artificial Reef Committee
A 501(c)(7) Non-Profit, Tax Exempt, Unincorporated Association
OuterBanksAnglersClub.com/OregonInletArtificialReefCommittee*

Description of Work

In view of the fact that our contract period was recently instituted on December 1, 2017, and due to the intervening holidays, progress on our objectives was considerably limited during this one month reporting period. Much more positive activity has transpired since the beginning of the year, but that will necessarily be the subject of a subsequent performance report.

The very favorable activity which has occurred during the current reporting period involves the raising of matching funds, which will always remain a priority. The Oregon Inlet Artificial Reef Committee has received a commitment from Terry Stewart, President of TW's Bait and Tackle, Inc. for a donation in the amount of \$20,000. Such a contribution is significant and demonstrates the solid local support for our construction of a new artificial reef.

In addition, the Outer Banks Anglers Club has made the decision to establish the first annual Cobia Commotion Fishing Tournament. All proceeds will be dedicated to the construction and enhancement of AR-165. The inaugural date of this event is scheduled for June 2, 2018. It is anticipated this fundraising activity will generate a sustainable source of matching funds for years to come.

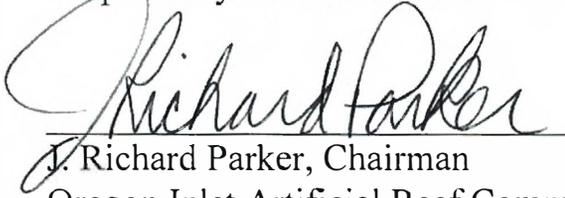
Project Status/Work Accomplished

The status of our project is basically on hold, awaiting the issuance of necessary permits. We have secured word from Frank Jennings, District Manager of the Division of Coastal Management that the CAMA Major Permit has a projected issuance date of March 26, 2018.

Since the terms and conditions of our grant award prohibit the expenditure of any funds until all required permits have been issued, our committee is in a holding pattern at the present time. Due to this delay, however, we anticipate having ample opportunity to locate suitable reef material and a desirable vessel to be utilized when the issuance of permits is completed. We can only hope this process will be expedited.

We are anxious to begin construction of AR-165.

Respectfully submitted this the 9th day of February, 2018.

A handwritten signature in black ink, reading "J. Richard Parker". The signature is written in a cursive style with a large initial "J" and "P".

J. Richard Parker, Chairman
Oregon Inlet Artificial Reef Committee
162 Gareth Circle
Manteo, North Carolina 27954

COASTAL RECREATIONAL FISHING LICENSE
SEMI-ANNUAL PERFORMANCE REPORT

Recipient: North Carolina Wildlife Resources Commission

Grant Award #: CRFL Grant Contract Number 7230

Grant Title: Manns Harbor Boating Access Area Paving Project

Grant Award Period: July 1, 2017 – June 30, 2018

Performance Reporting Period: July 1, 2017 – December 31, 2017

Project Costs: \$113,000.00

Expenditures for the Period:

| <u>Category</u> | <u>Expenditures</u> |
|-----------------|---------------------|
| Personnel | |
| Fringe | |
| Travel | |
| Equipment | |
| Supplies | |
| Construction | |
| Contractual | 0.00 |
| Other | |
| Total Direct | |
| Indirect | |
| TOTAL | |

Total Cumulative Expenditures: \$0

Total Remaining Balance: \$113,000.00

Description of Work: –Construct one new bay of trailer parking spaces. Pave existing gravel areas with asphalt and stripe parking areas. Parking areas will include a minimum of 75 parking spaces for vehicles with trailers, 6 single vehicle spaces, and 5 ADA accessible spaces.

Project Status/Work Accomplished:

Completed design and permitting. Awarded paving contract working with vendor to schedule project start date.

**COASTAL RECREATIONAL FISHING LICENSE
SEMI-ANNUAL PERFORMANCE REPORT**

Recipient: North Carolina Wildlife Resources Commission

Grant Award #: CRFL Grant Contract Number 7231

Grant Title: Beaufort Boating Access Area Paving Project

Grant Award Period: July 1, 2017 – June 30, 2018

Performance Reporting Period: July 1, 2017 – December 31, 2017

Project Costs: \$75,000.00

Expenditures for the Period:

| <u>Category</u> | <u>Expenditures</u> |
|-----------------|---------------------|
| Personnel | |
| Fringe | |
| Travel | |
| Equipment | |
| Supplies | |
| Construction | |
| Contractual | 0.00 |
| Other | |
| Total Direct | |
| Indirect | |
| TOTAL | 0.00 |

Total Cumulative Expenditures: \$0

Total Remaining Balance: \$75,000.00

Description of Work: – Pave existing gravel areas with asphalt and stripe parking areas. Parking areas will include a minimum of 30 parking spaces for vehicles with trailers, eight single vehicle spaces and 3 ADA accessible spaces.

Project Status/Work Accomplished:

Design complete. Engineer working on completing permitting. Project on schedule to be completed by spring or early summer.

**COASTAL RECREATIONAL FISHING LICENSE
SEMI-ANNUAL PERFORMANCE REPORT**

Recipient: Town of Oak Island

Grant Award #: 7232

Grant Title: Veterans Park Handicapped Accessible Fishing Access

Grant Award Period: 7/1/17- 6/30/18

Performance Reporting Period: January 2018

Project Costs: \$110,600.00

Expenditures for the Period:

| <u>Category</u> | <u>Expenditures</u> |
|-----------------|---------------------|
| Personnel | \$2,500 |
| Fringe | |
| Travel | |
| Equipment | |
| Supplies | |
| Construction | \$31,300 |
| Contractual | |
| Other | |
| Total Direct | |
| Indirect | |
| TOTAL | \$33,800 |

Total Cumulative Expenditures: \$33,800

Total Remaining Balance: \$76,800

Description of Work:

Veterans Park Handicapped Accessible Fishing Access-

This project consists of installation of an ADA accessible fishing pier, boardwalk along the existing bulkhead, and ADA accessible walkway from an existing parking lot at a Town of Oak Island park facility. (Note: Waterway Park was renamed to Veterans Park in 2015.)

Project Status/Work Accomplished:

-Architectural designs of the fishing tee and boardwalk were completed and RFP's were sent out to potential marine construction companies in the Oak Island regional area.

-Selection of a marine contractor by the Town of Oak Island through the bid process was completed in fall 2017.

-Necessary permits were obtained by Town staff including: Town of Oak Island work permits, and CAMA permits.

-Construction began in December on the project. Approximately 25% of the project construction is complete.

Deviations:

Modifications- The permitting CAMA officer made modifications in the size of the fishing tee. The original designs specified a 600' x 10' foot fishing tee area and a 70' long walkway to the end of the pier. During the permitting process, CAMA changed the fishing tee size to 10' x 40', and the walkway to 50' long.

Additional Guidance:

If your scope of work is broken into discrete jobs/tasks, please use the Job/Task titles as subheading under which to report accomplishments. Please report on the percent of completion of each separate job/task in your proposal.

**COASTAL RECREATIONAL FISHING LICENSE
SEMI-ANNUAL PERFORMANCE REPORT**

Recipient: Town of Swansboro

Grant Award #: Contract # 7233

Grant Title: CRFL P064 Bicentennial Park Recreational Fishing Pier Swansboro

Grant Award Period: July 1, 2017 – June 30, 2018

Performance Reporting Period: July 1, 2017 – January 22, 2018

Project Costs: Total contract amount: \$98,494

Expenditures for the Period:

Expenditures during this period have all been allocated to the CAMA Public Waterfront Access Grant.

| <u>Category</u> | <u>Expenditures</u> |
|-----------------|---------------------|
| Personnel | |
| Fringe | |
| Travel | |
| Equipment | |
| Supplies | |
| Construction | |
| Contractual | |
| Other | |
| Total Direct | |
| Indirect | |
| TOTAL | |

Total Cumulative Expenditures:

Total Remaining Balance:

Description of Work:

The Town of Swansboro is completing construction of an inshore recreational fishing pier at Bicentennial Park to serve residents and visitors to Swansboro as well as Onslow and Carteret Counties. The main objectives for this project are to:

- 1) Restore and improve opportunities for recreational anglers by providing a free and accessible public inshore fishing pier.
- 2) Enhance opportunities for recreational anglers by enlarging and improving the pier to serve greater numbers of fishermen, including individuals with disabilities. Staff anticipates that up to 10,000 recreational anglers will use the facility during the first year.
- 3) Provide an enhanced venue for a variety of environmental and recreational fishing outreach and educational activities sponsored by the Town of Swansboro Parks and Recreation Department in partnership with other organizations.

Project Status/Work Accomplished:

To date there are various planning and permit components of the project that have been completed. The Town worked with Crystal Coast Engineering to develop a design that would best suit the needs of the project while adhering to the CAMA permitting requirements based on the existing permit held for the site. A renewal of Major CAMA permit #112-05 to build the pier was issued in August 2017. In November 2017, the Town received approval through a letter of refinement to enlarge the 16x20 pier access and 21x75 dock platform to 18x22 and 23x77 respectively. The reason for the modification was to make the most of the concrete slat decking and reduce the amount of material wasted.

A request for proposals was disseminated January 11, 2018 and closed on January 29, 2018. Upon receipt of bids, Town staff will review them and select the most qualified marine construction business to build the project.

Deviations:

The Town of Swansboro received a grant from the Division of Coastal Management NC Public Beach and Waterfront Access Program to complete various components of the Bicentennial Park Enhancement project, to include fishing access pier replacement, installation of a trellis with swings, replacement of picnic tables and benches, as well as landscaping. The Town has worked with CAMA and CRFL to utilize the funds awarded to complete the project in unison.

To this point, all funds that have been spent have been charged to the CAMA grant.