Project Title: Engaging the Fishing Community to Understand Disease and Reproductive Dynamics of the Atlantic Sea Scallop (*Placopecten magallanicus*).

Grant Recipient: Commercial Fisheries Research Foundation (CFRF). PO Box 278 Saunderstown, RI 02874. Phone (401) 515-4892. Website www.cfrfoundation.org/

Award Period: November 1, 2022 – February 28, 2024 **Reporting Period:** Final Report

Principal Investigator: Dr. N. David Bethoney, Executive Director

Report Prepared By: Douglas Brander, Research Biologist; Linus Stoltz, Data Manager; Dr. N. David Bethoney

Project Summary: A changing climate is impacting the ecology of the Atlantic sea scallop through the emergence of diseases and changes in reproductive dynamics**.** In this project, a fishery dependent approach to collect data that tracks these conditions through space and time was piloted. A data collection tool was developed, in the form of an app, that can be downloaded and operated by members of the scallop fishing community. The app, ScallApp, was designed as a self-instructed, quick to use tool. During the completed pilot phase scallopers were able to consistently collect timestamped and geolocated disease and gonad stage data along with images of individual scallops. To manage the images and sampling session data collected at sea, a database was constructed. The database allowed the researchers to process the images and assign a 'verified' status to app users that submitted correctly identified biological parameters in sequential sampling sessions. These verified data submissions were then fed to a data portal that creates interactive distribution maps for use by the broader fishing industry, as well as fisheries scientists, managers, and educators. The components of this project provide a comprehensive infrastructure that can be utilized by a broader fleet of participating fishermen to collect images throughout the year, across the range of the resource, and contribute to a near real-time understanding of environmental impacts to sea scallop biology.

Background: The Atlantic sea scallop (*Placopecten magellanicus*) is the second most valuable fishery in the United States, with over $670 million in landings in 2021. A changing climate, however, has begun and will continue to impact the biology of the species through the emergence of diseases and changes in reproductive dynamics. In response, the Northeast Fisheries Science Center (NEFSC) Cooperative Research Branch and the Commercial Fisheries Research Foundation (CFRF) came together to pilot a collaborative research program to track the distribution and incidence of sea scallop grey meats, nematodes, shell blister disease, and reproductive status to understand the impact of climate change and inform management of the nation's most valuable fishery. This research aims to better comprehend Atlantic sea scallop health by engaging fishermen to collect data utilizing the Research Fleet approach.

This current project built upon the strengths of an earlier CFRF project, titled "Empowering fishermen to collect essential data: Piloting the Research Fleet approach in the Atlantic sea scallop fishery." That project piloted a program aimed at collaborating with the scallop fishing industry to develop a cost and time effective at-sea data collection platform and sampling protocols to enable the fishing fleet to collect biological data from scallops year-round. An app was developed for that project, and it was modeled after those that have been used to successfully collect data from other CFRF Research Fleet projects, namely the Lobster-Jonah crab, Black Sea Bass, Whelk, and Shelf Research Fleets. The data collected through the app included shell heights, images of the individual scallops sampled, highlighting the meat and gonad, as well as documentation of disease conditions, if present.

Project Objectives: The general project objectives included: 1.) Develop protocols and equip scallopers with a custom-built smartphone app to easily collect biological scallop data at-sea; 2.) Engage fishermen in collaborative research methods, increasing knowledge and resilience within the fishing community; 3.) Increase fishery-dependent data collection within the Atlantic sea scallop fishery to better inform fisheries management on scallop health and reproductive condition. The specific deliverables associated with there objectives were 1.) Creation of an interactive map of distribution of grey meats, nematodes, shell disease, and reproductive status (management and fishermen tool), 2.) Weekly project updates between project partners 3.)

Presentations to Councils, 4.) Data made publicly available, 5.) Recommendations for full-scale implementation of this pilot project, 6.) Publication.

Methods:

Initial Application Development

An initial meeting was conducted with the project team, including the software developer, to plan the creation of the new custom-built smart phone application (app) for use in this project. An emphasis was placed on creating a simple, quick to use app that also provided capability to wirelessly submit data (including photos) and verify the accuracy of the information submitted. The following list includes key considerations that were considered prior to the development of the app:

- Narrowing down to the most essential data parameters to be collected
- Simple training materials and sampling protocols
- Simple and efficient app workflow
- Functional graphics and instructional/informative content
- Distribution of software updates
- Verification of user submitted data
- Privacy concerns
- Data management infrastructure

From the initial meeting, data collection parameters and user functions were prioritized. This included defining what would be collected, how collection would be conducted by app users, and how this information would link to broader application. The key subjects defined were:

App set-up: A means of distributing the app to a limited audience was needed. Simple downloading instructions and key app set-up features were incorporated, namely enabling the app to use the phone to collect location information.

User Profile: User identification was incorporated into the app and input was required as part of the set-up process, which then assigned the user with a unique User ID number. The user is prompted to enter their name, phone number and email address, as well as vessel name(s).

Location and *Time/Date:* These values are automatically recorded by the device when the app user initiates a Sample Session. The app utilizes the device's GPS functions to collect latitude/longitude position when the app is in use.

eVTR Number: It was decided to include this as an optional feature. The sampler may opt not to include this value for privacy concerns, or for any reason. If completed it allows the capability to associate the app data to any trip level data that the fisherman reports to NOAA.

Biological Sampling: In the app, there is a *Start Sampling* button which initiates the recording of the selected data parameters outlined in this section (i.e. time and location), and intuitively guides the user through the app workflow.

Scallop Gonad Classification: A primary data collection point for the user includes the classification of gonad stages from non-standardized images collected by app users. A set of images was included in the app workflow to serve as graphic examples of an idealized gonad stage for the app user to compare with the individual scallop in-hand. The classifications selected were narrowed to include developing, ripe, spent, and resting. Additionally, an 'unknown' option is included. The app user is required to select one of the options, and the camera function is enabled. The user snaps a photo and is then directed to the next screen in the workflow. The user is not able to progress to the next screen without including a gonad classification and photo.

Identify Scallop Diseases. The second key function of the app includes documenting disease conditions of particular concern when and where they are encountered. The disease chosen were gray meats, nematodes, shell blister, no-disease, and optional photo. The camera becomes enabled, and a photo is required only when gray meats, nematodes, or shell blister are selected. All these options may be selected. If none of these conditions is observed, 'no-disease' is selected, and no photo is required to advance out of the workflow.

Optional Photographs and Optional Comments: These features were incorporated to allow the flexibility for the user to include a photo or comment for something that did not fit with the graphic examples of each biological parameter being tracked. Or, if the captain happens upon something of particular interest, that can be documented, as well.

User Verification: A user verification process was considered as an important feature to allow for efficient data collection for the app user, as well as efficient data processing for the data end users. Images submitted by app users are reviewed for image quality, sample quality, and accuracy of the classification of the target biological parameters. Only data from verified sample sessions are fed to external maps.

Database Construction: The need for server-side tools was recognized in the process of developing the app. A database was developed by which ScallApp user submitted data could be managed and utilized.

Interactive Distribution Map: Data sharing strategies included the development of an R-Shiny app that included an interactive distribution map. This tool would be made available to scientists, fisheries management, and the fishing industry.

Project Participant Selection and Field Testing

An open solicitation was initiated, inviting members of the scallop fishing industry to participate in testing this app and methodology. From the pool of applicants, ten captains were selected to participate. Among the information collected on the vessel application was a question was included to inquire about the type of device the captain owned. Owning a smartphone and familiarity with phone functions and app use was sought as a prerequisite for participation. A stipend was offered as compensation, whereby participants could earn up to a total of $1,000 for participation in the project.

Testing was broken into two phases. All testing was conducted by commercial scallopers during commercial fishing trips. An initial group was chosen to serve as beta testers to trial the app before it was made available to the rest of the project participants. The first version of the app was available on the Android platform and was offered to the beta group by email invite only. The BETA testers were instructed to use ScallApp 5 times during regular fishing activities within the first month of testing and then to use the app at least 5 more times shortly after. Once their sampling was completed, they were asked to complete a short questionnaire to evaluate features in ScallApp. The following questions were identified in coordination with the software developer and these helped to evaluate the user's perspective on the functionality and ease of use:

Beta-test Questionnaire

1. We would like to know about your first impressions of the app.
    a. How was the 'User Profile' set up, did any server synchronization errors appear?
    b. Were the 'How to Sample Scallops' instructions section clear and understandable?
    c. What was your impression of the info content in the 'About ScallApp' section?
2. Please tell us about your impressions of the working portion of the app where you collected data.
    a. What did you think of the sampling session workflow when working through the app?
    b. Did you use the Info buttons; Did you find them useful/clear?
    c. Were the photo examples of scallop reproductive stages and disease conditions representative of what you see while fishing? If no, what would work better?
    d. Did you experience any delay or errors in collecting your location? (Did the location count down timer initiate; did the data enter as 0/0?)
    e. Please tell us some detail about your sampling station (; ex. Steel cutting box, wood/fiberglass box, open to sky, etc)
3. Were you able to successfully upload data?
4. Did the app seem to work as expected? (The app was designed to be self-explanatory) If not, please describe difficulties that you experienced.
5. How would you rate the overall ease of use of the app? (1-10 scale?)
6. Do you mind if your answers are made public?

The goal was to have versions of ScallApp developed for both Android and iOS platforms, and to become available through the Google Play store and the App Store, respectively. The full-test participants were further broken into two groups to ensure both the Android and iOS version, which was developed later, were tested. The goal was for these testers to download the app on their own and complete an expanded set of questions (Appendix 1).

Results:

<u>ScallApp Workflow</u>

Details on the field testing and feedback results are provided in preceding sections. The following provides the best ScallApp workflow developed through the iterative field-testing process and generally the workflow experienced by fishermen:

The instructions provided direct ScallApp users to begin by following the prompts for setting up the app, including allowing the app to collect location data. Once this is done, the new user is directed to set up the User Profile (Figure 1). Instructions include setting up a profile while on WiFi as a unique user identification number would then be assigned to this device and User Profile and communication with the CFRF database would be necessary during this phase.

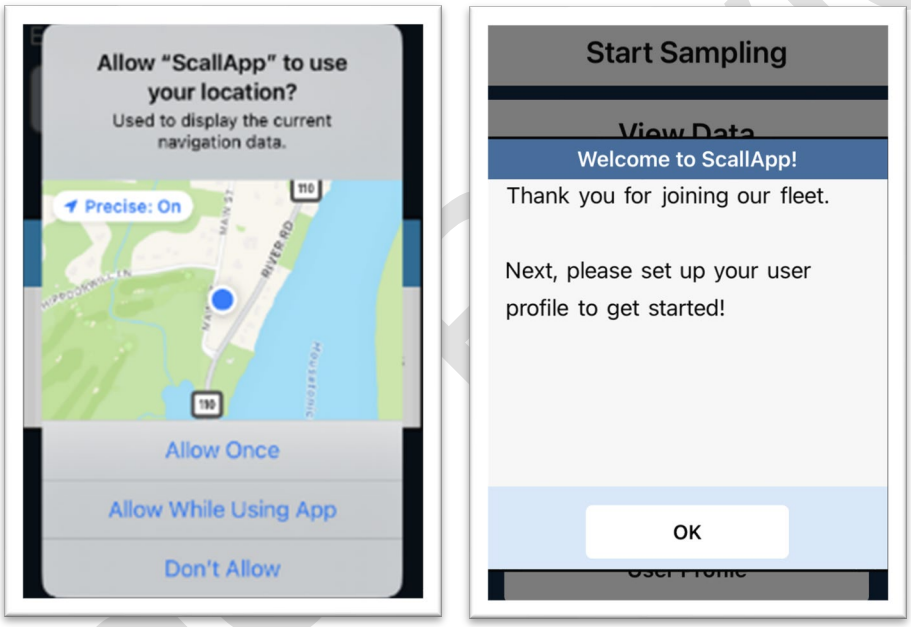

Figure 1. App set-up prompts to allow location data collection and User Profile set up

After this point, all training and informative content is included within the app. The buttons on the app home screen direct the user to the desired content (Figure 2). The instructional and informative content are included in the smaller buttons on the lower half of the screen. The User Profile button was placed lower on the home screen, as it is generally only accessed once, during the set-up process. The larger buttons toward the top of the screen direct the user through the app workflow during sampling sessions.

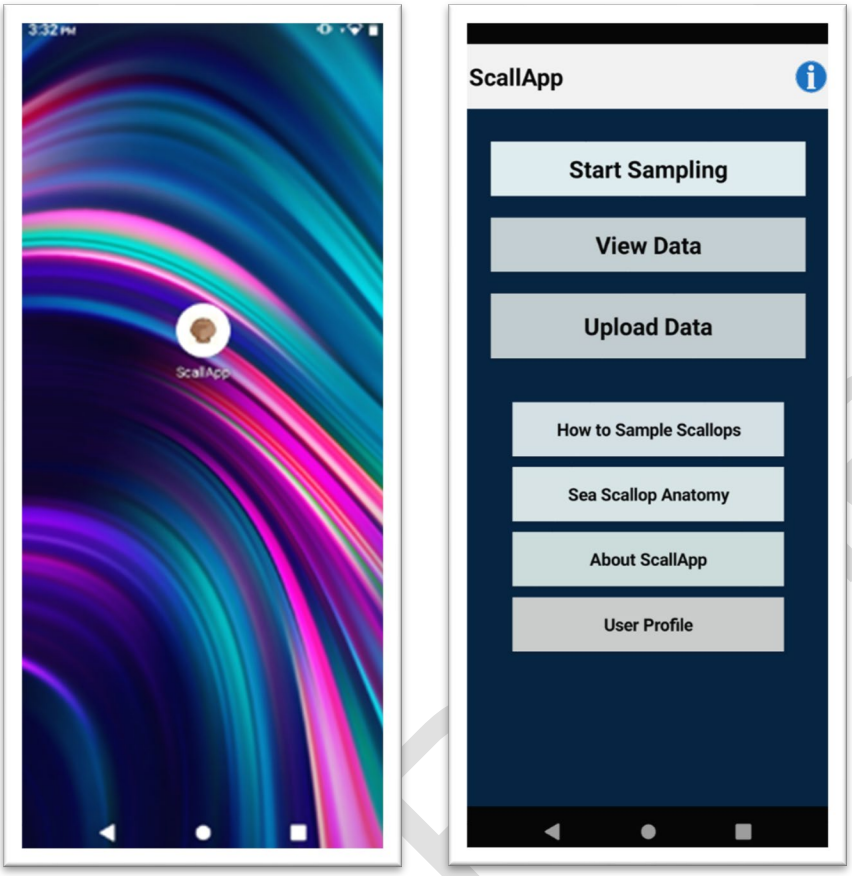

Figure 2 The ScallApp Icon and app home screen. Screen shots from Android phone.

Informative content is included in the 'About ScallApp' and 'Sea Scallop Anatomy' sections. These sections include some general background information about the project goals, as well as the process of becoming a 'Verified User,' details of data uploading (including how updates are administered), contact information, and photo credits (Figure 3). An additional feature was built into the app for providing informative content. An information icon is found on many pages and many functions throughout the app. It was intended to be a helpful tool to answer some basic questions related to particular topics, e.g., the user can click on the icon in the sample session workflow for abbreviated instructions for the sampling protocols for individual scallops (e.g. top right, Figure 2). The instructions for conducting a sample session are included in the 'How to Sample Scallops' page. The data collection protocols were narrowed down to a short list of the essential parameters to be collected. The instructions walk the user through a sample session in a straightforward, step-wise format

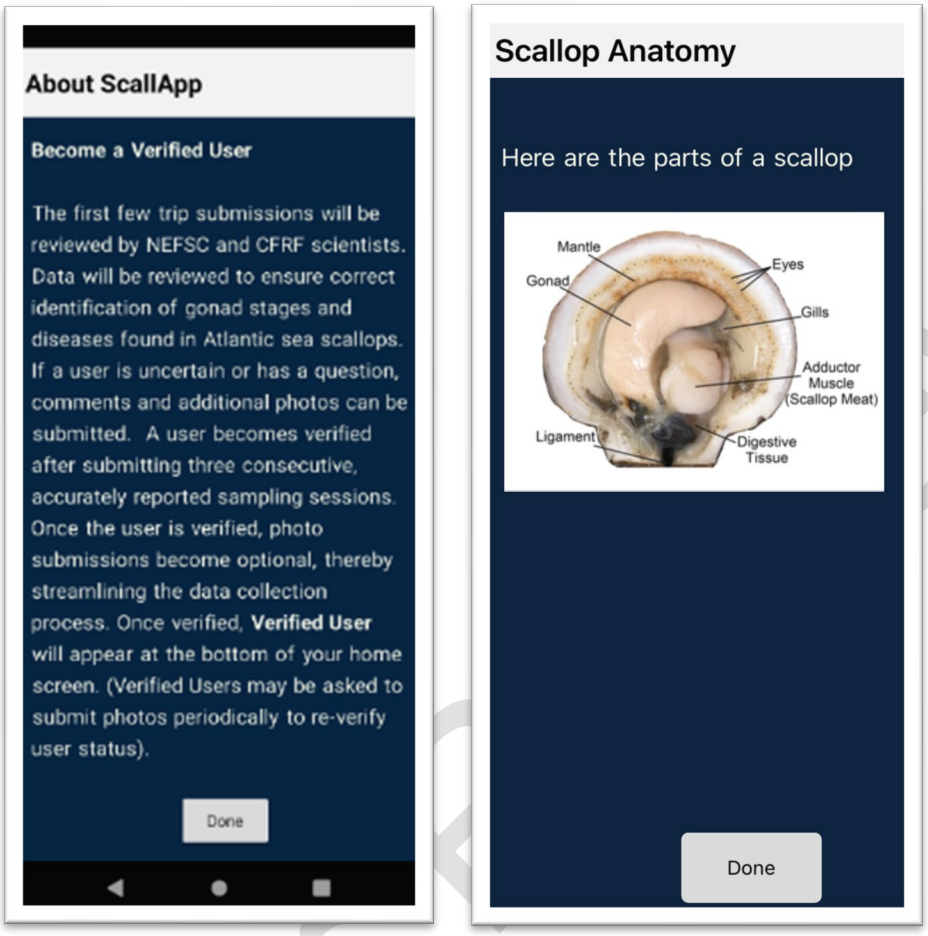

Figure 3. The 'About ScallApp' page includes information about becoming a 'Verified User,' left. 'Sea Scallop Anatomy' page graphic, right. Screen shots from Android phone.

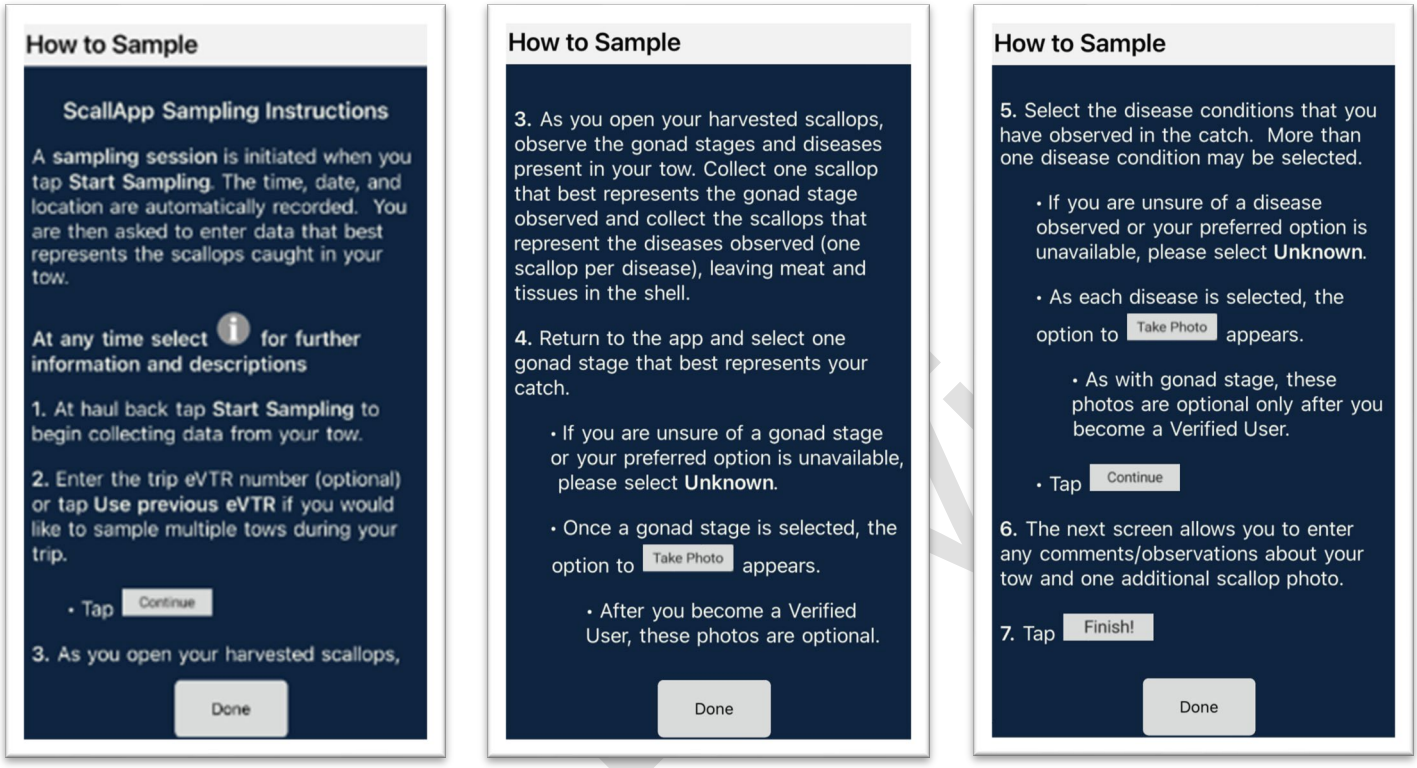

Figure 4. 'How to Sample Scallops' step-wise instructions page. Screen shots from iOS phone.

When the user feels they are ready to sample, they hit the “Start Sampling” button. When this button is pressed the user has the option to enter a Vessel Trip Report Number. After that screen, ScallApp automatically records the location, date, and time as the user selects the gonad condition and scallop diseases that best represent their catch (Figure 5). Users can only select one gonad stage but can select multiple diseases pictured. After these selections, the user can add optional comments and photos or “Finish” their session. The exact workflow depends on if a user is “unverified” or “verified". Users learn the difference between these two user types when they read the “About ScallApp” section. “Unverified” users must submit photos with gonad and disease type selected. Once their sampling sessions are complete, a scientist can review the data and the images to see if they match. This is to ensure app users (fishermen) are accurately identifying the scallop conditions present in their catch. Once “verified” the user will be able to use the app more freely and provide images only if they please. Verification occurs remotely at the discretion of the managing scientists. If implemented over the long term, users should be

periodically “reverified” so that the project team can evaluate the ability to correctly identify changing scallop conditions over time, while also periodically verifying incoming data.

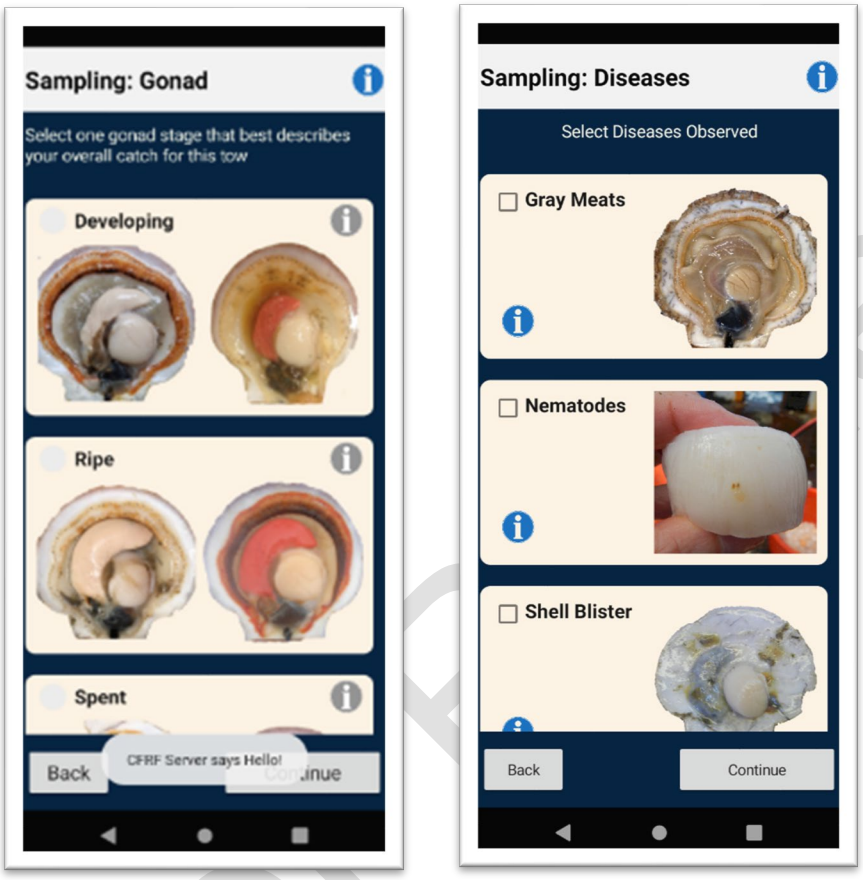

Figure 5. Recording observed biological parameters, including gonad stage classification and presence of disease conditions. Screen shots from Android phone.

After conducting a sampling session, a user can submit any completed session by connecting to a WiFi or cellular network and hitting the “Upload Data” button. Several server-side tools were developed to facilitate ScallApp data upload and general functionality. ScallApp connects to the new Amazon Web Service CFRF server for all functions; user create and update, verification, data upload and new version installs. Establishing this required creating a database and accompanying tables on the existing CFRF MySQL server, configuring a File Transfer Protocol server on the cloud-based virtual machine, writing a file processor to ingest telemetered data, and configuring an Apache web server to route requests from ScallApp to the MySQL database. The suite of server-side tools work in tandem to facilitate data flow from the deck to the database. For example, ScallApp now connects to the server each time it’s started. Therefore, if

a user sets up their account when not online, when they are next online and start the app it will sync the account with the server. Further, it will prevent the user from uploading data until their account is properly set up and messages the user about the error occurring. Future server-side objectives include evaluating the tools when more data and users are invited to participate in data collection and establishing tools for CFRF staff to verify images of unverified users.

ScallApp Testing

ScallApp for both the Android and iOS platforms were developed and tested through the course of this project. Of the ten project participants selected for the project, only one owned an Android device. Most of the product development occurred on the Android platform and early versions of the app were only available for Android devices. For this reason, CFRF purchased two Android phones, which were loaned out on a rotating basis. Altogether, there were 20 iterations of ScallApp released.

Beta testing was completed in the spring of 2024. The three participants submitted data from 41 sampling sessions. Overall feedback was positive with two of the three participants experiencing no difficulties. The third encountered an error message while taking photos of scallops. It included text about not being able to connect to the server and sent him back to the home screen. This revealed a process in the app programing that resulted in the camera closing if the memory available on the phone was minimal. This problem was eventually resolved. The biggest concern was around how fast a sampling session was completed and the time needed to register a GPS signal. This concern was apparent during the beta testing as only 11 sessions had GPS positions. To address this, ScallApp was updated with a GPS countdown feature. If the GPS position is missing when selecting “Finish,” ScallApp pauses for fifteen seconds while showing a countdown to collect the GPS position.

The Full-test period for ScallApp began in July 2023, and wrapped up with the last app user submissions coming through to the CFRF database at the beginning of December. Project participants were asked to conduct ten sample sessions using the app, during normal fishing trips. However, several participants submitted well more than the ten sample sessions for which they could get paid. This resulted in 134 Sample Session uploads, with 279 photo submissions in total.

Five of those full-test participants used the Android version of the app, and the last two participants used the iOS version. There were some difficulties encountered by the initial full-test participants while attempting to download the app. When attempting to trouble-shoot the issues encountered, it was found that it was necessary to log out of the Gmail account, log out of the Play Store, then log back in to both. It became confusing and time consuming. Since most of the Full-test participants were Apple phone owners, CFRF was providing the participants with loaned Android devices, on which it was decided to have the app already downloaded, but not opened. This way, the user would follow prompts to allow location data collection and User Profile set-up.

For the last five full-test participants, the use of the app worked quite well. The last project participants included three Android users and two iOS users. For these last app testers, no app errors occurred. However, for one of these users, there were still challenges collecting location data when starting a sample session. The app built-in delay function largely worked well. In this case the app user moved on to the deck for a clear view of the sky, which worked well. The issue seems to be that the device cannot always acquire the GPS signal while inside the super-structure of steel vessels. There were some delays to our making this iOS version available for testing, due to the need for an approved privacy policy. Once we were approved by Apple, introductory emails were sent to the remaining two participants, including instructions for downloading the app from the App Store. Both users found it easy to download and use the app, and these last two users reported the smoothest overall experience with ScallApp from the whole pool of participants.

App User Feedback

Effort was made to elicit feedback from app users and maintain communication as much as the individual project participant was willing. There were six Limited Access (LA) and four Limited Access General Category (LAGC) captains. Two of the LA captains had Starlink satellite internet, allowing them to communicate regularly during multi-day trips. This was very convenient and fortunate, as both captains were experiencing error messages with the issued Android phones. CFRF staff were able to communicate issues with the software developer and this allowed most problems to be resolved while the captains were still at sea. For the LAGC vessels, communication and troubleshooting would occur between day trips. For the final two full

testers (on the iOS platform), there were no errors. Regular communication between CFRF staff, the software developer, and the project participants turned out to be one of the keystones to the success of the app development for this project.

Exit questionnaires were conducted for each project. From these it was discovered early on that users were experiencing error messages at times, again some related to the app and some related to the CFRF issued Android devices. Once these issues were resolved, it was found that the average time to conduct a single sample session was only a few minutes. It might take a few moments longer if the user must move out on deck to allow the device to acquire the GPS signal, as mentioned above. But, overall, because of the ease of use and efficient workflow, this does not seem to have been much of an inconvenience, based on user feedback. As we homed in on some of the glitches in earlier iterations of the app, users reported that the downloading of the app, app instructions and informational content, workflow, and uploads were easy to follow and conduct.

There were mixed opinions concerning the photo examples of gonad stages provided in the Sample Session portion of the app. This is where the user is required to select the gonad stage that most matches what is seen in the scallop being sampled. Some users reported that they found that the photo examples were “really good” representations of what they were seeing. Others said that they found these somewhat confusing. We offered four gonad stages to choose from, including: developing, ripe, spent, and resting, as well as an ‘Unknown’ selection. All of these require a photo be taken to continue in the sample session workflow. Two users suggested including more detailed descriptions and maybe more photo examples in the sample session workflow, or possibly in the Info icons.

From early sample session submissions during the beta-test phase, it was recognized that the sampling protocols for individual scallops needed refining. Figure 6 includes beta-test phase examples of images that were considered difficult and ultimately unverifiable. Images remained unverified when soft tissue hindered the view of the full gonad or meat. Additionally, sand or mud can obscure these features. Reviewing submissions promptly and offering feedback to captains in a timely way resolved these issues.

Figure 6. Unverified images with view of gonad or meat obscured.

Of 134 gonad classifications, 68 were verified positively. It should be noted, however, that some of these photos could not be verified because the gonad was not fully visible in the image, or there was too much sand in the scallop (Figure 6), or the photo was blurry. Ripe and resting gonads were often classified correctly (examples in Figure 7). Differentiating between a developing gonad vs a spent (spawning) gonad proved challenging (Figure 8). The image reviewer's experience has been that these latter classifications can be challenging and somewhat subjective at times. A crude analysis of the number of correct classifications from each gonad stage selection indicates that this is an area that needs further improvement.

Figure 7. Verified gonad classifications. Ripe gonad left and resting gonad right. While the resting gonad shown at left is rounded and plump, it appears to be mostly water-filled and sex is not determined.

Figure 8. Unverified gonad classifications. Image at left classified as developing, but exhibits characteristic emptied follicles and patchy coloration of the spent stage. The image at right was classified as spent, but exhibits granular appearance of the developing stage.

As for the incidence of scallops with diseases that we were documenting, including nematodes, gray meats, and shell blister, only 12 examples of any of these conditions were observed and reported through the course of the sampling season. However, of those 12 photo submissions, all were correctly classified. This appears to be a more straightforward set of parameters to identify (Figure 9).

Figure 9. Verified disease conditions reported. Gray meat at left, shell blister at right.

Several app users indicated that they thought that including shell height of the sampled scallops would be of value, which would require the issuing of a small measuring board. Some of the participants also expressed interest in exploring a means to capture meat yield during sample sessions. This happens to be something we are testing in another project, the Image-based Research Fleet, www.cfrfoundation.org/scallop-research-fleet. This goes with the mentality of having two programs that engage different numbers of fishermen to collect different levels of data. For app users, and other scallopers that we have been in contact with that work southern New England and the mid-Atlantic, there was strong concern over the incidence of generally poor-quality meat and low meat yields, as well as the incidence of large catches of clappers, during the height of the 2023 fishing season. They expressed a desire to develop a means to report on these conditions when encountered.

A topic for which we received mixed opinions was the means of compensation for participating when ScallApp is taken to the next phase. Most seemed to favor RSA (Research Set Aside quota) weight, some thought a lottery could be attractive and others were strongly against the idea of a lottery, a couple found the set dollar-amount for each session to be fair. All ten said they would participate on a voluntary basis (with one of those qualifying his statement, saying that it depends on how long it takes to complete a Sample Session).

Data Dissemination

Part of the data sharing schema for this project includes feeding verified data reference points into an R-Shiny app. This is an interactive distribution map wherein one can select a biological parameter of interest and associate that with a time frame (Figure 10). This is intended to be a publicly available tool for use by scientists, fisheries management, and the fishing industry and can be accessed through this link (https://cfrf.shinyapps.io/scallapp-dashboard/).

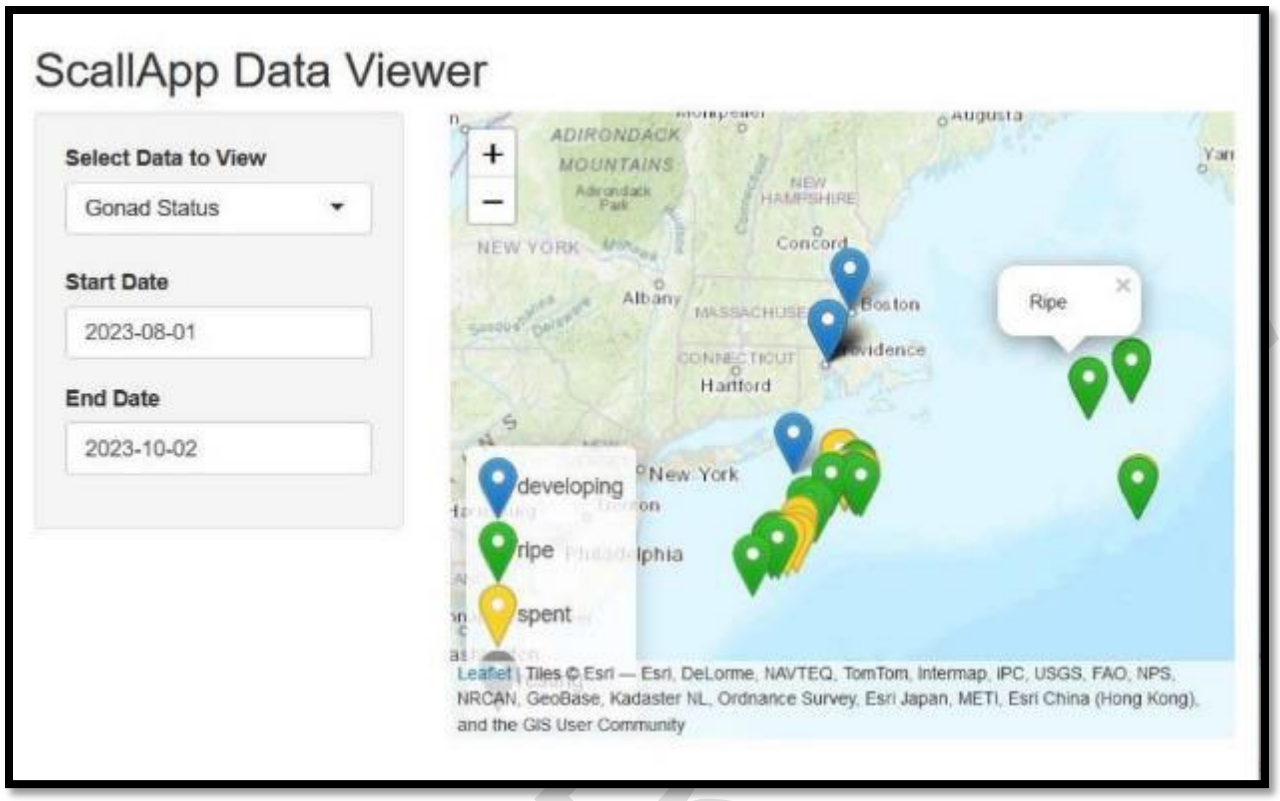

Figure 10. The R-Shiny interactive distribution map plots verified data points from ScallApp.

Throughout the project, there has been steady communication between CFRF staff, NEFSC Cooperative Research Branch staff and Research Fleet participants. These included regular email communications about project progress and in-person meetings. Dock visits with fishermen including the exchange of information, troubleshooting, and distributing materials was a top priority and frequently activity. The CFRF maintained a project webpage, which includes the project goals and a brief overview of the sampling protocols and results. The project was featured in the January 2023 CFRF newsletter, which is sent to a list of over 1,700 subscribers, including members of the local seafood and fishing community. The project results will be featured in the upcoming March 2024 newsletter. The project title and a link to the project website were included in all CFRF newsletters during the project period. The project was featured in five posts across the CFRF's Facebook and Instagram pages, which have a combined audience of over 2,600 followers. The following presentations were also made to external groups:

- September 19, 2023 – Environmental Defense Fund Climate and Fisheries Webinar Series, A. Mercer, NEFSC
- September 28, 2023 – National Cooperative Research Annual Meeting, A. Mercer, NEFSC
- October 4, 2023 – Mid Atlantic Fishery Management Council meeting, A. Mercer, NEFSC
- January 9, 2024 – American Fisheries Society Southern New England Chapter Conference, D. Brander, CFRF
- January 21, 2024 – New England Fishery Management Council Meeting, A. Mercer, NEFSC
- February 5, 2024 – NOAA Fisheries Northeast Cooperative Research Summit, D. Bethoney, CFRF

Recommendations for full-scale implementation

ScallApp is available as a developmental application requiring direct invitation for download through the Google Play and Apple stores. The intent is for it to be available through these stores as a regular, free app for widespread and open use. Before this can be done several key recommendations for full-scale implementation need to be addressed. The deliverables to address these issues are:

- A new version of ScallApp that at least captures meat quality data
- Refinement of the verification process
- Security and monitoring enhancements
- Development of a compensation or incentive structure

The original focus of ScallApp was to track gonad stage and disease presence. However, many of the reports of fishermen focus on meat quality that are not necessarily associated with disease. It is apparent that a way to standardize meats described as ‘stringy,’ ‘weak,’ and ‘sickly’ through linkage to images with defined categories would be beneficial. Therefore, a new version of ScallApp with a meat quality data collection page will be created. Similar to the gonad and disease collection pages images of at least 3 meat quality options will be selected from. Other updates such as improved messaging and additional functional changes may also be made possible.

The current verification process is inadequate for processing a large number of images on an efficient and reliable scale. During the pilot phase CFRF or NEFSC staff downloaded images, viewed them in PowerPoint, and then manually edited the ScallApp database to reflect needed changes. The pilot phase created the mechanisms and app-database linkage for verification, but creation of a streamlined approach to use these abilities was outside of the project scope. To address this a simple, web-based interface will be developed that allows an image-checker to easily view and check images. The webpage will be linked to the app database so that all data associated with an image is brought into the interface and all changes made within the interface automatically occur within the database. Further, standardized protocols for image checking will be developed to ensure consistency across image checkers. Lastly, an audit process will be developed to assess the veracity of the reported biological parameters by users over time. For example, randomly selecting a fraction of verified users to submit images or require re-verification after a certain amount of time or data submissions.

An unfortunate reality of freely available apps Is abuse by bad-faith actors. It's hard to think who may want to subvert ScallApp, but not being prepared is risky. Subversions include, but are not limited to, people who crash apps through bot attacks, purposeful submission of bogus data, or attempts to access the underlying database through the app. Safeguards such as spatially limiting where the app can be used or downloaded, limiting submissions within timeframes, challenge texts before use permission and other more intensive approaches can be implemented to reduce the risk of bad actors. In consultation with the app developer and Google and Apple support we will identify the level and type of safeguards needed for ScallApp and implement them.

There is motivation to use ScallApp for free, but a compensation or incentive structure would help produce stronger motivation for consistent use. Linking ScallApp use to Research Set-Aside quota could provide this incentive. We propose to develop a weighted lottery system like what was used to support the River herring bycatch avoidance program as a long-term incentive (Bethoney et al 2017). This program was active for approximately 10 years, with the latter half of

the program funded through the Atlantic herring Research Set-Aside program. As the Atlantic herring quota was cut, there was not enough Research Set-Aside quota to distribute meaningful amounts to each participant. A lottery was created to select three participants that would receive quota each year. All participants were entered into the lottery, but their probability of selection was weighted by their bycatch, tow reporting, and portside sampling rates. If ScallApp persists we expect use to increase and cost to decrease, resulting in a similar scenario where only a small portion of participants could receive quota if the amount was to be meaningful. Metrics such as sessions completed, or images submitted could be used to develop weighting for a lottery of Research Set-Aside allocation that incentivizes use. The ultimate scheme will be developed in consultation with the users of ScallApp during this project phase and the project Steering Committee.

References:

Bethoney, N.; Bradley P. Schondelmeier; William S. Hoffman. Bridges to best management: Effects of a voluntary bycatch avoidance program in a mid-water trawl fishery. J. Marine Policy. Sept 2017. 83:172-178.

Hennen, Daniel R.; Deborah R. Hart. Shell height-to-weight relationships for Atlantic sea scallops (*Placopecten magellanicus*) in offshore U.S. waters. J. of Shelllfish Research. 2012. 31(4)1133-1144.

Sarro, Christopher L.; Kevin D.E. Stokesbury. Spatial and temporal variation in the shell height/meat weight relationship of sea scallop (*Placopecten magellanicus*) in the Georges Bank fishery. J. of Shellfish Research. 2009. 28(3): 497-503.

Siemann, Liese; Luisa Garcia. Optimizing the Georges Bank scallop fishery by maximizing meat yield and minimizing bycatch. Coonamessett Farm Foundation, Inc. Scallop RSA Share Day, 2019.

Acknowledgements:

Thanks to Anna Mercer, Cooperative Research Branch (CRB) chief, for leading the broader project “All Eyes on Scallops: Engaging the Fishing Community to Understand Climate Impacts on the Nation’s Most Valuable Fishery” that this effort was a part of. Thanks to the NEFSC Co-PIs on the CRB team, including Emma Fowler, Giovanni Gianesin, Jacob Wilson,

Deborah Hart, Jessica Blaylock and George Maynard for input on project development, data collection protocols, R-Shiny app development and help in communicating with the scallop fishery. Thanks to Don Coxe for his software design expertise and Katie Viducic for her hard work in the design phase. Thanks to our project partners among the scallop fishing fleet, including Mike Marchetti, Rui Branco, Jake Wiscott, Brady Lybarger, Jesse Lybarger, Tome McNulty, Shawn Machie, Zachary Bennet, Mike Cox, Corey Karch, and Chris Wright. Project funding from the Atlantic States Marine Fisheries Commission made this project possible through NOAA Award Number NA22NMF4540361.

Appendix 1: Full-testing documents

Download and instructions

Most of the Full-test project participants were iPhone owners. For this reason, the CFRF purchased and distributed two Android phones for the participants to use during at-sea sampling sessions. Only the most minimal of instructions were provided to allow the user to get started. One aim of the project was to determine if sampling and any other instructions could be effectively self-taught through the app. This emailed set of start-up instructions invited the participant to obtain ScallApp from the Google Play Store through a limited invite for internal testing. A separate set of instructions was later issued to invite two of the project participants to download the iOS version. As these last two project participants used their own iOS devices, the instructions for Android phone use were excluded.

ScallApp Full-Testing Guidelines

Getting started:

Thank you for participating in this project and welcome to ScallApp! Your input in this preliminary testing phase will be important for us as we continue to develop this application. You have been granted access to the app through the Google Play Store using the email address that you recently provided. Please be sure to use that particular email to access the download. The app is designed to be self-explained, without need for training. All instructions for set-up, use, and data upload are included within the app. During this early testing phase, we ask that you please utilize all of the functions and features in the app, and Upload Data as often as possible. This includes using the optional features, such as optional photos, comments, and eVTR entry, as well as info buttons. We need you to test these features so that we may evaluate our protocols and troubleshoot any possible problems.

Phone Passcode: 9999, press the green arrow (enter) button

Please be sure you are connected to Wi-Fi or cellular service when setting up your User Profile and uploading data!

Download ScallApp to your smart phone

- Go to: https://play.google.com/apps/internaltest/47003....
- Enter User Profile Information while on WiFi
- Follow instructions and prompts for set up of the app
- Upload trip data when WiFi or cell service is available

Full Testing Phase (June-September 2023):

- Use of ScallApp at least 10 times during regular fishing activities
- Utilize all available features and data entry fields through the course of the testing phase
- Ideally testing will be spread over multiple trips through September 2023, but that is not necessary (particularly if your season will come to an end soon)
- If you encounter an error message, please take a screen shot. To do this, press and hold the volume down (-) and power buttons simultaneously. The larger button on the right side of the phone is Power. And please include a comment in the app when an error message appears.

Contact Information:

Douglas Brander, CFRF Research Biologist
203-444-4596
dbrander@cfrfoundation.org

Full-test Questionnaire

1. We would like to know about your first impressions of the app.
    a. How was the set-up process for 'User Profile, did any server synchronization errors appear?'
    b. Were the 'How to Sample Scallops' instructions section clear and understandable?
    c. What was your impression of the info content in the 'About ScallApp' and Scallop Anatomy sections?

2. Please tell us about your impressions of the working portion of the app where you collected data.
    a. How was the sampling session workflow when working through the app?
    b. Did you use the Info buttons? Did you find them useful/clear?
    c. Were the photo examples of scallop reproductive stages and disease conditions representative of what you see while fishing? If no, what do you think would work better?
    d. Did you experience any delay or errors in collecting your location? (Did the location count down timer initiate; did the data enter as 0/0?)
    e. Please tell us some detail about your sampling station (ex. Steel cutting box, wood/fiberglass box, open to sky, etc)

3. About how much time did each sampling session take? Was this a reasonable amount of work and time?

4. Were you able to successfully Upload trip data?

5. How would you rate the overall ease of use of the app? (1-10 scale?)

6. Did the app seem to work as expected? (The app was designed to be self-explanatory.) If not, please describe difficulties that you experienced

7. In a Phase II study, what would be fair compensation for participation?
    a. Would you be willing to participate in a voluntary project that continues to collect data using this method?
    b. Can you recommend captains to participate in a possible Phase II study?

8. Would you like to see any other factors added to future data collection?

9. Do you mind if your comments are made public? Do you have privacy concerns about sharing your data?