Project Period 1/01/2022 - 12/31/2023

Project Location Description (from Proposal) Coastal Rhode Island

Project Summary (from Proposal) Test the accuracy and utility of an electronic gear location marking application in both mobile and fixed gear fisheries in New England to help refine the buoyless gear marking application. Project will increase the ability of electronic gear location marking to contribute to the reduction of gear conflicts and the transition to ropeless gear to reduce the number of gear entanglements of North Atlantic Right Whales.

Project Status and Accomplishments This project was completed in collaboration with the fishing industry and leveraged the Commercial Fisheries Research Foundation's (CFRF) South Fork Wind Farm Fisheries Monitoring Surveys. The project was successful in using the Trap Tracker app to mark the location of fixed survey gear, collect data on the accuracy of the app's location marking, collect data and feedback from mobile gear fishers on the utility and feasibility of using the app during mobile gear fishing, and evaluate the potential for the app to help minimize gear conflicts. We made nearly 1,000 individual comparisons between the set locations of survey gear as marked on Trap Tracker and haul locations as marked on a GPS and found an average difference and standard deviation of 68.96 ± 44.63 m (226.36 ± 146.43 feet). In addition, feedback from mobile gear fishermen identified the Trap Tracker's unreliable location tracking ability, reliance on cell service, and lack of real-time gear location updates as the biggest issues when using the app. Overall, the data collected by this project are important in understanding barriers that need to be overcome for the fishing industry to be able to rely on gear location marking apps, as well as in identifying recommendations that can be adapted to help overcome some of these barriers.

Lessons Learned This project provided a basic understanding of the accuracy and utility of Trap Tracker, an electronic gear location marking application (app), that was developed for use with on demand fishing gear. We collected data on nearly 1,000 individual comparisons between fishing gear locations as marked on Trap Tracker at the time of deployment and GPS-marked locations of the same gear at the time of haul back. The average difference in locations found with these comparisons was 68.96 ± 44.63 m (226.36 ± 146.43 feet). This level of accuracy is not high enough to allow fishermen to set gear in close enough proximity or allow mobile gear fishers to safely fish in areas with fixed gear without resulting in gear conflicts. These results indicate that effort should be devoted to improving the accuracy of Trap Tracker before the app is implemented at-scale. In addition, mobile gear fishermen tested the app in real world fishing scenarios and provided feedback on its perceived accuracy and helpfulness. The results indicated that there was a general perception of Trap Tracker not being accurate or helpful in its current state, resulting in a strong need to update the app, and likely update gear marking technology in general, for there to be a solid path forward for Trap Tracker or other gear location marking apps to be helpful for mobile gear fisheries in identifying the location of fixed gear and avoiding gear conflicts. Specifically, feedback from participants indicates that gear location marking apps must be able to geo-locate and work well at sea at all times, have greater accuracy, not rely on cell service, and include real time updates of gear locations. An unexpected outcome of this study was the fact that the Trap Tracker app was unable to geo-locate and track mobile vessels at sea over 40% of the time. Without a reference point of the vessel's location, the app is unhelpful in determining the location of marked fixed gear in relation to the vessel. Gear marking technology must be able to consistently operate at sea in real-world fishing scenarios if fishermen are expected to incorporate such technology into their fishing operations. Participants in this study expressed high levels of frustration in trying to get the app to work, and both participants and project staff attempted all basic troubleshooting (e.g. closing the app and reloading it, logging out and back in, turning the tablet on and off, letting the tablet load prior to leaving the dock, attempting to get satellite signal in open air, etc.) that would be feasible for fishermen to do at sea when trying to use the app while also actively fishing. Further, as mentioned above, the tablet was often able to geo-locate the vessel's position in other apps (Navionics Boating app), at the same time that the Trap Tracker app was unable to identify the location of the vessel at sea. This is a major issue that must be addressed before the app can be useful to mobile gear fishermen. In addition, marking the location of gear when it is deployed from the boat, rather than the actual location of gear on the seafloor, results in

Under Review

gear location marking that is inherently wrong at the outset; gear can then continue to move on the seafloor as a result of tides, currents, etc., and this was a major concern for participants. Because of this, participants noted that gear marking technology must display real-time, accurate locations of gear in order for them to trust and be able to rely on such technology. Further, if gear marking apps continue to require connectivity, cellular service signal boosters must be able to provide service further offshore than the WeBoost booster that was tested in this study; however, all participants agreed that satellite internet was a more feasible option moving forward. Overall, despite a consensus that the Track Tracker app had many issues that need to be fixed and a general distrust in the app, as well as concerns regarding gear location marking in general, participants in this study noted that if the app were updated to rely on satellite rather than cellular signal, included the recommendations provided from the mobile gear testing, and included automatic, real-time updates of the chart and gear locations (i.e. tracking the location of gear after it is deployed), it had the potential to help identify the location of fixed gear and reduce gear conflicts in the future.

Under Review

Activities and Outcomes

Funding Strategy: Capacity, Outreach, Incentives
Metric: FIF - Incentives - # participants in compliance
Required: Optional
Description: Number of participants complying with an incentive agreement developed through the project. Specify and describe the type of agreement that participants will be complying with in the "Notes" section.

Starting Value	0.00 # participants in compliance
Value To Date	5.00 # participants in compliance
Target value	5.00 # participants in compliance

Note: In total, 5 mobile gear vessels participated in the mobile gear trials for this project. All 5 vessels completed at-sea trials, the final questionnaire, and the debriefing meeting at the end of the project.

Funding Strategy: Planning, Research, Monitoring
Metric: FIF - Monitoring - # of trips monitored
Required: Optional
Description: Enter the number of fishing trips monitored using EM/ER technology over the grant period. In the "Notes", please specify total number of trips taken.

Starting Value	0.00 # of trips monitored
Value To Date	61.00 # of trips monitored
Target value	57.00 # of trips monitored

Note: The Trap Tracker app was used to mark the location of the CFRF's fixed survey gear (ventless lobster traps, fish pots, and gillnets) and collect accuracy data on 61 survey trips in 2022. In addition, the app was used to mark the location of survey gear on approximately an additional 50 trips in 2023; however, these trips are not included in the Value to Date as accuracy data were not recorded and the gear was marked for the purpose of continuing the mobile gear testing, which required an additional year compared to the original proposal.

Funding Strategy: Planning, Research, Monitoring
Metric: FIF - Monitoring - # vessels in monitoring program
Required: Optional
Description: State the number of vessels directly engaged/participating in monitoring program(s).

Starting Value	0.00 # vessels in monitoring program
Value To Date	6.00 # vessels in monitoring program
Target value	7.00 # vessels in monitoring program

Note: The 2022 CFRF surveys were comprised of 7 total vessels conducting gillnet (2), ventless lobster trap (3), fish pot (1), and beam trawl (1) surveys. Of the two gillnet vessels, one captain opted out of participating in the fixed gear trials for this project due to his opposition of ropeless gear. This was unanticipated as the minimum permission needed would be to allow CFRF to use the tablet on his vessel. As this was not part of the vessel's original work agreement for the wind farm surveys, the CFRF respected this decision. As a result, the maximum number of vessels in the monitoring program was updated to be proposed at 6 rather than 7 in the June 2023 interim report. This did not affect the ability to

Under Review

achieve the other tracking metrics as originally proposed.

Funding Strategy: Capacity, Outreach, Incentives
Metric: FIF - Outreach/ Education/ Technical Assistance - # govt entities participating
Required: Recommended
Description: Number of muicipalities or governments (local, state, federal) participating in the project. In the "Notes" section, please briefly list the entities and how they are participating.

Starting Value	0.00 # gov't entities participating
Value To Date	1.00 # gov't entities participating
Target value	1.00 # gov't entities participating

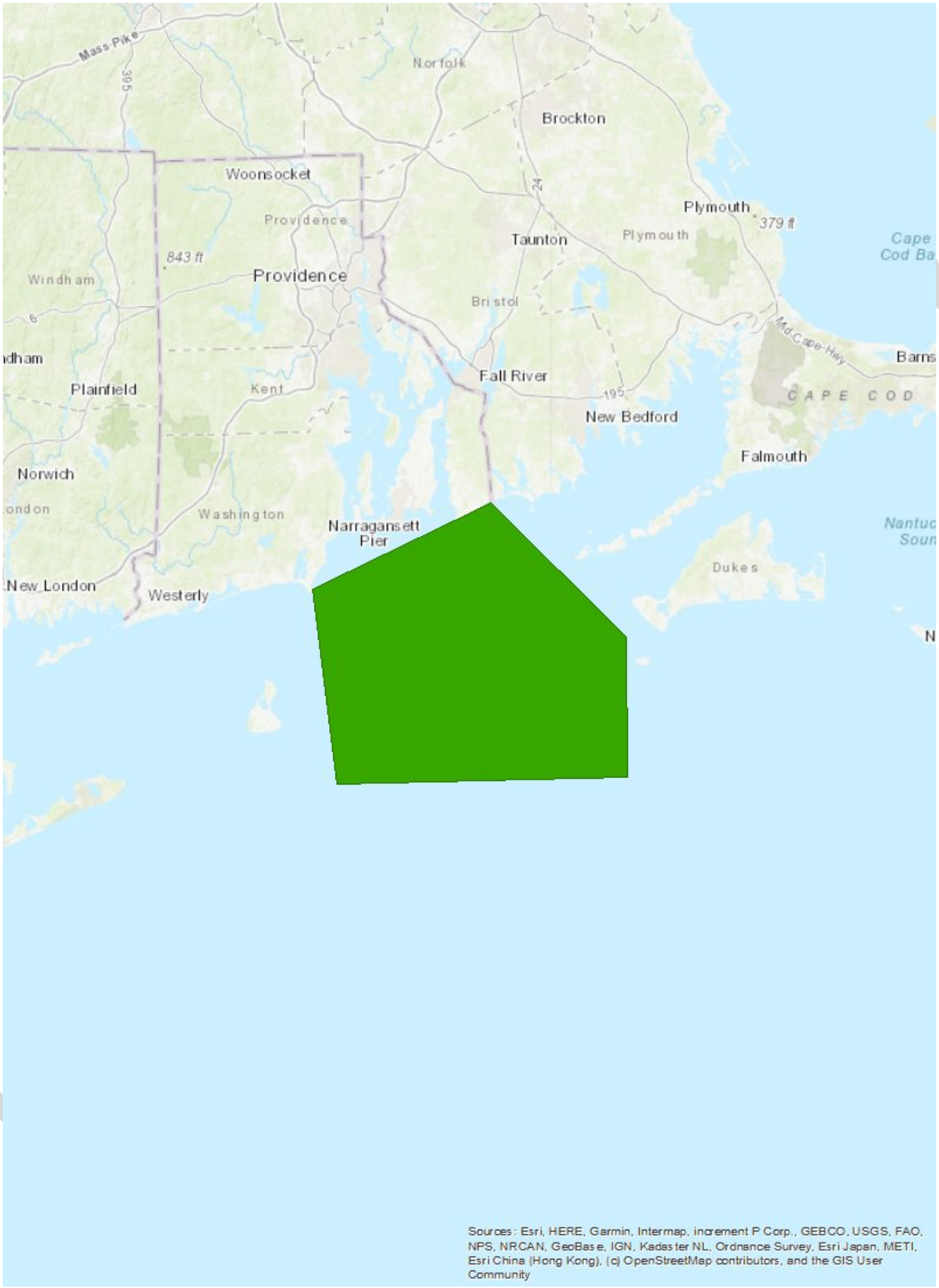
Note: Henry Milliken and Eric Matzen, scientists from NOAA NEFSC participated in this project in an advisory/supportive role. Project staff held a project kickoff meeting with NOAA to refine project protocols and discuss goals on March 30th, 2022. Project staff also met with Eric Matzen on January 5th, 2023 at the Port of Galilee in Point Judith, Rhode Island, for a ropeless gear demonstration and discussed the project's progress and preliminary results. Both Henry Milliken and Eric Matzen were sent copies of the project's two interim reports as well as general project updates, the final questionnaire for this project for input before dissemination to project participants, and they were also sent a copy of this final report.

Funding Strategy: Capacity, Outreach, Incentives
Metric: FIF - Outreach/ Education/ Technical Assistance - # people reached
Required: Recommended
Description: State the number of people such as fishermen, reached by outreach, training, or technical assistance activities. Use the "Notes" section to identify the type of outreach or assistance, and level of engagement had with people reached.

Starting Value	0.00 # people reached
Value To Date	1965.00 # people reached
Target value	500.00 # people reached

Note: This is a minimum estimate, based on the sum of social media post views and assuming a 50% open rate for newsletters; the estimate does not include how many people were reached through the webpage or in person events. On March 30th, 2022, the CFRF released its quarterly newsletter, which contained a section introducing this project. The newsletter was emailed to a list of over 1,500 people. In 2022, two postings were made on the CFRF's Facebook page, which received about 750 views. In February 2023, an additional post was made to the CFRF's Facebook page, which received 415 views. The project results were also featured in the March 2024 CFRF newsletter, which was emailed to a list of over 1,700 people. The project webpage was maintained throughout the reporting period. In addition, project staff attended the Maine Fishermen's Forum in March 2023 and Senator Sheldon Whitehouse's annual Environment, Energy, and Oceans Leaders Day in December 2023, and a project overview flyer was featured at the CFRF's outreach booth at both events.

Under Review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Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

The following pages contain the uploaded documents, in the order shown below, as provided by the grantee:

Upload Type	File Name	Uploaded By	Uploaded Date
Final Report Narrative - Marine	CFRF_NFWF_Final Report_March 2024_Narrative_Final.pdf	Bethoney, N.David	03/29/2024
Photos - Jpeg	Appendix 8_Example screenshot of the Trap Tracker application's chart screen.jpg	Bethoney, N.David	03/29/2024
Other Documents	Appendix 1_Mobile gear instruction binder template.pdf	Bethoney, N.David	03/29/2024
Other Documents	Appendix 2_Mobile gear data sheet pdf.pdf	Bethoney, N.David	03/29/2024
Other Documents	Appendix 3_Final Survey.pdf	Bethoney, N.David	03/29/2024
Other Documents	Appendix 4_Final Meeting Presentation.pdf	Bethoney, N.David	03/29/2024
Other Documents	Appendix 5_Summarized Final Survey Responses.pdf	Bethoney, N.David	03/29/2024
Other Documents	Appendix 6_Project Outreach Flyer.pdf	Bethoney, N.David	03/29/2024
Other Documents	Appendix 7_Example map showing Trap Tracker versus GPS locations.pdf	Bethoney, N.David	03/29/2024

The following uploads do not have the same headers and footers as the previous sections of this document in order to preserve the integrity of the actual files uploaded.

Under Review

Final Programmatic Report Narrative

Instructions: Save this document on your computer and complete the narrative in the format provided. The final narrative should not exceed ten (10) pages; do not delete the text provided below. Once complete, upload this document into the online final programmatic report task as instructed. **Please note** that this narrative will be made available on NFWF's Grants Library and therefore should provide brief context for the need of your project and should not contain unexplained terms or acronyms.

Project Purpose:

To reduce entanglement in fishing gear by North Atlantic Right Whales, there has been a movement towards the development of on demand (also known as 'ropeless') fishing systems. However, one pressing issue that needs to be addressed is vetting the technology that allows fishermen to record and communicate the location of gear that does not have surface buoys. Without an adequate marking and communication tool, gear retrieval and conflicts with mobile gear threaten the viability of several fisheries. Several gear location marking applications (apps) have been developed to fill this need, yet information on the accuracy, utility, and willingness of fishermen to use such an app, is still unclear. This project tested one such app, EdgeTech's Trap Tracker, with the project goals to 1) Collect data on the accuracy of the location of deployed gear that is marked on an electronic gear location marking app, 2) Test the utility of an electronic gear location marking app to reduce gear conflicts amongst fishers, and 3) Determine the perception of helpfulness and feasibility of fishermen using electronic gear location marking apps.

1. Summary of Accomplishments

In four to five sentences, provide a brief summary of the project's key accomplishments and outcomes that were observed or measured. This can be duplicative to the summary provided in the reporting 'field' or you can provide more detail here.

This project was completed in collaboration with the fishing industry and leveraged the Commercial Fisheries Research Foundation's (CFRF) South Fork Wind Farm Fisheries Monitoring Surveys. The project was successful in using the Trap Tracker app to mark the location of fixed survey gear, collect data on the accuracy of the app's location marking, collect data and feedback from mobile gear fishers on the utility and feasibility of using the app during mobile gear fishing, and evaluate the potential for the app to help minimize gear conflicts. We made nearly 1,000 individual comparisons between the set locations of survey gear as marked on Trap Tracker and haul locations as marked on a GPS and found an average difference and standard deviation of 68.96 ± 44.63 m (226.36 ± 146.43 feet). In addition, feedback from mobile gear fishermen identified the Trap Tracker's unreliable location tracking ability, reliance on cell service, and lack of real-time gear location updates as the biggest issues when using the app. Overall, the data collected by this project are important in understanding barriers that need to be overcome for the fishing industry to be able to rely on gear location marking apps, as well as in identifying recommendations that can be adapted to help overcome some of these barriers.

2. Project Activities & Outcomes

Activities

- Describe the primary activities conducted during this grant and explain any discrepancies between the activities conducted from those that were proposed.

Fixed Gear Trials

Accuracy data collection was conducted from May through December 2022 on 61 trips that were part of CFRF's wind farm monitoring ventless lobster trap, gillnet, and fish pot surveys. On these trips, CFRF staff used the Trap Tracker app to mark the start (when the first trap of the trawl left the vessel) and end (when the last trap of the trawl left the vessel) deployment locations of gillnet strings and trap/pot trawls when they were set for research purposes. When possible, environmental data, including Beaufort sea state, cloud cover, and the presence or absence of fog, as well as general comments on the app were also recorded at the time of gear deployment. A handheld Garmin etrex10 GPS was used to

Under Review

record the start (when the first trap of the trawl was hauled to the vessel) and end (when the last trap of the trawl was hauled to the vessel) locations of the same gear at haul-back.

After every monitored survey, the locations of survey gear marked in Trap Tracker were uploaded to the EdgeTech cloud database so that other users of the app, including this project's mobile gear participants, could download and view the marked locations when fishing at-sea. The fixed gear data were then entered into an Access database and data that were unusable for individual comparisons were excluded. Reasons for exclusion included human errors, such as forgetting to mark the location at the correct time and clicking the wrong station number at deployment, technological errors, such as delays in the tablet or app loading, battery issues, tablet overheating or updating, or the Trap Tracker app being unable to geolocate, or when data was only recorded for the set or haul locations for unknown reason. Quality control/assurance checks were made on the final data using ArcGIS to ensure data was entered correctly and all data points were paired (i.e. each Trap Tracker location was paired with a GPS location). This resulted in 979 individual comparisons for which the deployment locations of the survey gear as marked in the Trap Tracker app were compared to the haul locations as marked by the GPS to determine the accuracy of the Trap Tracker app. The results of these comparisons from the fixed gear trials are included in the Outcomes section of this report below. From May through November 2023, the Trap Tracker app was used strictly to mark the locations of the CFRF's ventless lobster trap and fish pot surveys to continue mobile gear testing; no additional individual comparison data was collected in 2023.

Mobile Gear Testing

In addition to testing the Trap Tracker app on the CFRF's beam trawl survey, five mobile gear captains participated in the at-sea mobile gear testing for this project from June 2022 through October 2023. We originally estimated that we could recruit 5-10 fishermen to participate in this incentive program. However, as previously described in interim reports, it was more difficult than originally thought to find willing participants for this study due to the controversial nature of the topic of on demand fishing. As a result, we extended the project by one year and increased the stipends for participants and were ultimately able to achieve the minimum target value of participants.

Participants were provided with tablets that had been set up with the Trap Tracker app preinstalled and prepaid annual subscriptions. Originally, participants were provided with Samsung Tab A tablets, as these are the standard tablets used in many of the Commercial Fisheries Research Foundation's research projects. After the first year of the project, however, there were many issues with the app working, as discussed below, so project staff decided to have two participants use iPad tablets instead to see if these tablets worked more consistently due to their different operating system. In addition, each tablet was equipped with the Navionics Boating app and prepaid subscriptions, which is necessary to connect to the Trap Tracker app for Trap Tracker to display a marine chart. Participants were also provided with a WeBoost cellular signal booster with a marine antenna and all other necessary accessories. The model of the cell booster was chosen in consultation with NOAA scientists.

Participants were trained by project staff in data collection protocols and were given a binder with a complete training manual (Appendix 1). Participants were asked to test the Trap Tracker app on up to 10 days at sea. For each testing day, participants used the Trap Tracker app when they were either fishing in or transiting through the areas in which CFRF survey gear was marked on the app and attempted to locate the gear on the app's chart as well as visually. To do this, participants had to update the Trap Tracker app using cell service to download the locations of marked fixed gear within a 25-mile radius (at the beginning of the project; this radius was later increased by the app developer), which then showed up on the app's chart when the vessel was within a 5-mile radius of the marked gear location. Because much of the marked fixed gear was greater than 25 miles from the location at which the vessels were departing, this required that participants use cell service hotspots to transfer cellular service from their mobile phones to the tablet while at sea. The cell service booster was meant to increase the distance from shore at which participants had cell service. Participants were asked to fill out a datasheet (Appendix 2) on each training day to record location, gear type, environmental data (Beaufort Sea State, cloud coverage, wind speed/direction, fog presence or absence, and estimated visibility), and where the tablet was used (inside or on deck). Participants then answered a series of 5 questions regarding the accuracy and helpfulness of the app and cell booster and were able to provide any general comments, feedback, or recommendations based on their experience. They were also asked to take a screenshot of the Trap Tracker chart screen if any fixed gear was viewable. Participants were paid a stipend for each day of testing they completed or attempted. Completed datasheets were sent to project staff and entered into a spreadsheet for summarization.

Multiple participants had issues with the app working (described in more detail below), and project staff were available to answer questions and meet with participants at the dock to help troubleshoot these issues. Troubleshooting often involved

Under Review

turning the tablet off and back on, updating apps, updating tablet software, logging out and back into the Trap Tracker app, and, when none of that worked, providing the participant with a different tablet and app to try. The results of this mobile gear at-sea testing are included in the Outcomes section of this report below.

Final Questionnaire

An 18-question survey was developed to gain further insight into project participants' experience using the Trap Tracker app and cell booster (Appendix 3). The survey was sent to NOAA scientists who were given the opportunity to provide input before being sent to participants to complete. In total, all 5 mobile gear participants, as well as one survey captain who has used Trap Tracker on his vessel, completed the questionnaire. The results and major takeaways from these responses are included in the Outcomes section of this report below.

Debriefing Meetings/Conversations

This project originally proposed to hold a final debriefing meeting with all project participants and NOAA scientists to discuss the utility of the app and future directions. The goals of the meeting were to provide the opportunity for a more thorough discussion and for the project team to ask for further clarification or expansion on certain opinions communicated via the at-sea testing and final surveys. The meeting was originally scheduled for December 14th, 2023; however, for several reasons, the project team decided to alter plans and have one-on-one debriefing conversations with participants rather than one final meeting. First, over half of the participants ended up going offshore to fish on the day of the scheduled meeting or were otherwise unable to attend. Marine forecasts and fishing schedules are difficult to predict, and this was deemed unavoidable. In addition, after further discussing the project goals, the project team decided that one-on-one conversations were more appropriate as they would allow each participant to expand on their individualized experience and would likely feel comfortable providing more input as compared to simply attending a meeting. To be consistent during each conversation, all participants were shown the same presentation (Appendix 4). The thought exercise that was originally proposed for this project was included in the presentation and was completed in each conversation. In total, individual debriefing conversations were completed with all 5 mobile gear participants, as well as the same survey captain who completed the questionnaire described above. Notes were taken by project staff during each meeting, and the feedback gathered from these conversations is included in the Outcomes section of this report below.

Outcomes

- Describe progress towards achieving the project outcomes as proposed. and briefly explain any discrepancies between your results compared to what was anticipated.
- Provide any further information (such as unexpected outcomes) important for understanding project activities and outcome results.

The major proposed outcomes of this project included quantifying the accuracy of the Trap Tracker app, using feedback from app testing trials to propose recommendations for improvement, and increasing the number of fishermen who are familiar with electronic gear location marking apps. The project achieved the outcome of introducing more fishermen to gear marking apps through the CFRF surveys and training the five participating mobile gear captains. In addition, the project achieved the goal of collecting sufficient location data to quantify the accuracy of the app. We originally estimated that the project could collect data for 800 individual comparisons between the start and end locations of deployed gear as marked on the Trap Tracker app compared to the location of gear as marked by a GPS at haul-back. This metric has been achieved and exceeded, as the fixed gear trials resulted in 979 individual comparisons. Finally, the data collected are useful in helping to identify what needs to be done to improve the utility of gear marking apps for use by both mobile and fixed gear vessels. More detailed outcomes and results from each component of this project are described below.

Fixed Gear Trials

As mentioned above, the fixed gear trials resulted in 979 individual comparisons between the location of deployed gear as marked by the Trap Tracker app and the location of the gear at haul-back as marked by a handheld GPS. Overall, there was an average difference and standard deviation of 68.96 ± 44.63 m (226.36 ± 146.43 feet) between the Trap Tracker-marked set locations and GPS-marked haul locations (Figure 1).

Under Review

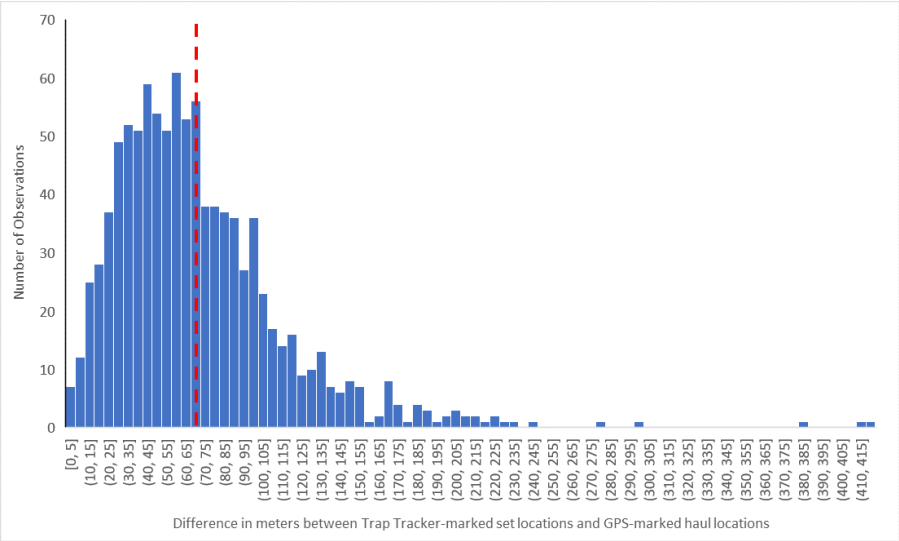


Figure 1. Histogram of individual comparisons between Trap Tracker-marked set locations and GPS-marked haul locations. The red dashed line indicates the average difference.

To further explore the distribution of the data, data were then grouped into 50-m bins, and the number and percentage of observations in each bin are shown in Figure 2. The majority (82.3%) of observations had a difference of less than or equal to 100 m between the Trap Tracker-marked set location and the GPS-marked haul location (Figure 2). There were 17 observations with a difference of > 200 m. Project staff identified a potential storm event that may have resulted in the discrepancies in five of these comparisons with > 200 m difference; the other twelve of these observations had no obvious cause for the large difference between the Trap Tracker and GPS locations.

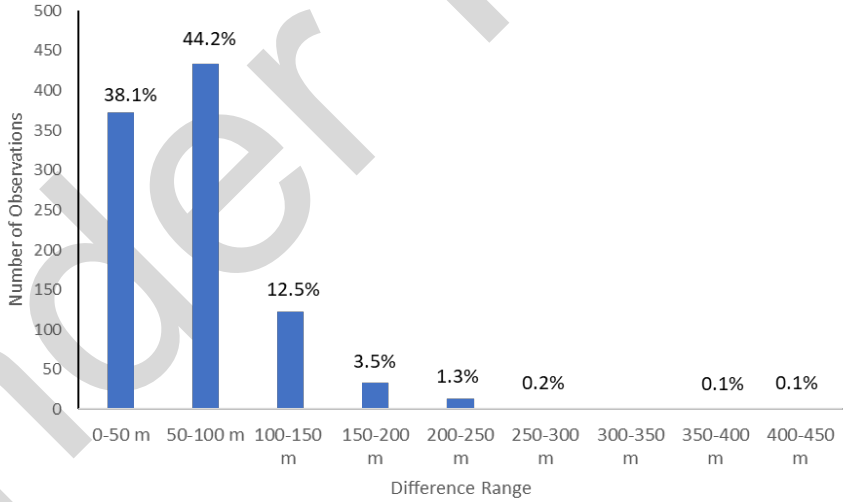


Figure 2. Number and percentage of observations of individual comparisons between Trap Tracker-marked set locations and GPS-marked haul locations grouped into 50-m bins (n=979).

Data were evaluated to determine if there were trends in the difference between Trap Tracker and GPS locations that may be related to environmental factors, such as the presence of fog and Beaufort sea state (which were recorded at the time of gear deployment when the location was marked using Trap Tracker). The average difference between Trap Tracker and GPS locations was 61.3 ± 33.6 m when fog was present (n=127) versus 70.1 ± 45.9 m when fog was absent (n=852). A two-tailed, two-sample t-test assuming unequal variances indicated this difference was significant (p=0.01); however, given the high degree of overlapping variation and the fact that the presence of fog was only recorded at the time of gear deployment, this factor does not appear to provide a realistic explanation for the difference between Trap Tracker and

Under Review

GPS locations. Beaufort sea state also had a significant effect on the difference in location (Kruskal Wallis test, $p<0.005$); however, there were no clear trends in the average difference between Trap Tracker and GPS locations among sea states (Figure 3), and a Dunn's post-hoc test with Bonferroni corrections indicated that only sea states 2 and 3 and 2 and 6 significantly differed. As a result, and because sea state was only recorded at the time of deployment, we conclude this factor also does not appear to provide a realistic explanation for the difference between Trap Tracker and GPS locations.

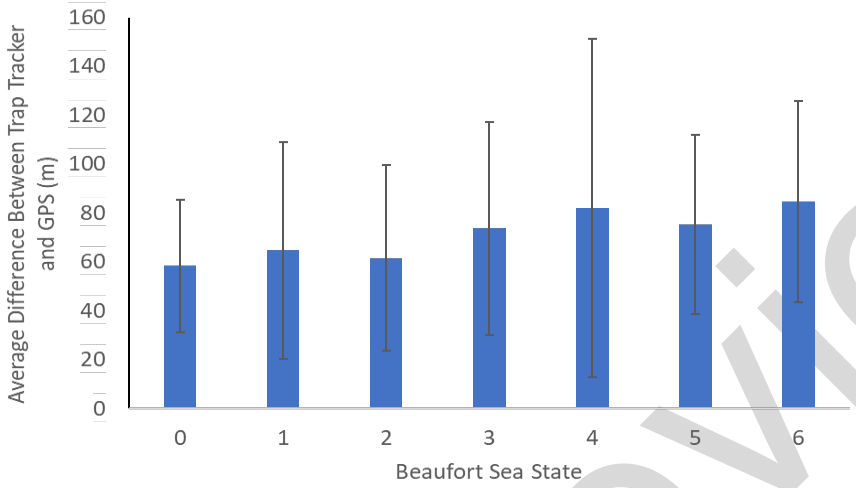


Figure 3. Average difference between Trap Tracker-marked set locations and GPS-marked haul locations grouped by Beaufort sea state. Error bars represent standard deviation.

Similarly, soak time (recorded in days) had a significant effect on the difference in location between Trap Tracker and GPS (Kruskal Wallis test, $p<0.001$). However, once again there was no clear trend in the difference between Trap Tracker and GPS locations among soak times (Figure 4), and a Dunn's post-hoc test with Bonferroni corrections indicated only a soak time of 18 days was significantly different from soak times of 4, 5, and 24 days. Due to the lack of a clear trend, we conclude this factor also does not appear to provide a realistic explanation for the difference between Trap Tracker and GPS locations.

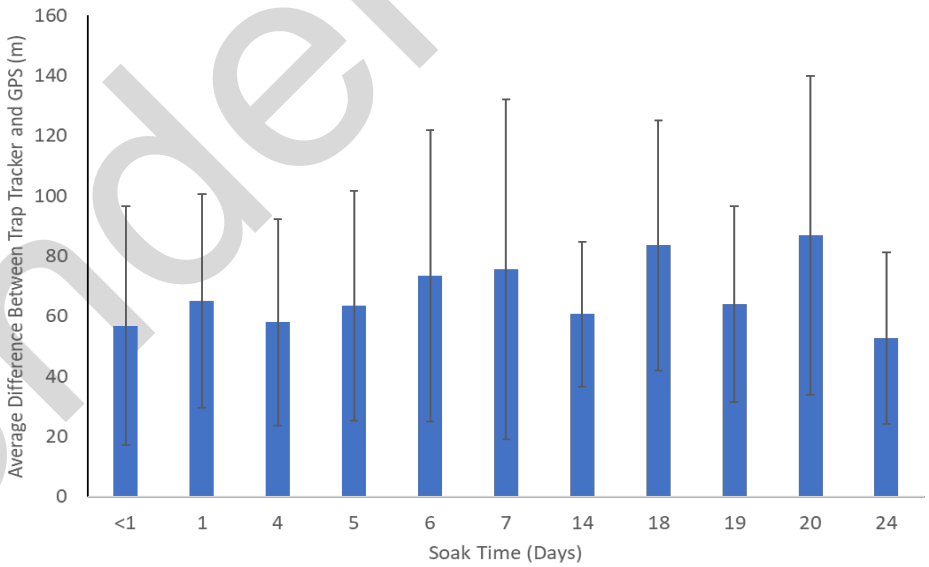


Figure 4. Average difference between Trap Tracker-marked set locations and GPS-marked haul locations grouped by gear soak time rounded to the nearest day. Error bars represent standard deviation.

The differences between Trap Tracker and GPS locations in this study could be due to several factors. First, it is important to note there were many instances where the Trap Tracker app experienced issues such as delays in loading/geo-locating

Under Review

when trying to mark the location of gear. Unfortunately, because the Trap Tracker locations were marked on ongoing, fast-paced surveys, the exact number of instances where this happened was not quantified and this information is the result of personal communications/feedback from survey staff. These instances resulted in the gear location being marked after the first or last trap had been deployed, rather than at the exact time and location of trap deployment, and thus, was likely the cause of many of the discrepancies between the Trap Tracker and GPS locations. It is also important to note the Trap Tracker app relied on the tablet's internal GPS, and the tablet and GPS units could have relied on different satellites or had different calibrations. This is a limitation of this study and likely contributed to the different locations marked by Trap Tracker and the GPS units. However, different fishing vessels use different GPS units, and based on feedback during this project, fishermen are not likely to ever solely rely on a tablet for GPS or gear marking capabilities. As a result, our results are likely reflective of a real-world scenario despite these limitations. Finally, because Trap Tracker marks the location when gear is released from the boat rather than the location of gear when it lands on the seafloor, and the location at which deployed gear hits the seafloor is dependent on factors such as tides, currents, boat speed and direction, etc., the locations as marked on Trap Tracker are inherently different than the actual location of marked gear.

Mobile Gear Testing

In total, 41 mobile gear testing days and datasheets were completed by mobile gear fishermen both as part of the CFRF's beam trawl survey and incentive program. An unexpected outcome is that the app did not work well enough to fully test it at sea on at least 18 occasions (44% of testing days) due to the app's GPS/chart not tracking the vessel at all or after it left the dock, which made it impossible to see where the vessel was in relation to marked gear, or the app never showing marked gear once at sea. Interestingly, on several occasions, participants loaded the Trap Tracker app at home before going to the vessel. The app was able to geo-locate and track their location in their home as well as in their vehicle while transiting to the vessel. However, once they arrived at the vessel and left the dock, the app still showed them as being on land and never updated to be able to locate their position at sea. In addition, on several occasions when this happened, it was noted or communicated to project staff that the Navionics Boating app, which had to be downloaded and connected to Trap Tracker on each tablet for Trap Tracker to display a marine chart, was still able to geo-locate and track the location of the vessel at sea. In addition, these occasions happened when the app was used both inside the vessel's wheelhouse as well as on deck in open air. This suggests the issues were not due to the tablet's internal GPS, but rather related to the Trap Tracker app specifically. This issue did not appear to differ between Samsung Tab A tablets and Apple iPads, and some vessels consistently experienced this issue (one vessel was never able to get the app to work despite being provided with multiple tablets to use), while others only had tracking issues some of the time. Only one vessel experienced the app being able to track its location at sea at all times. Even when the app did track locations at sea, there were often issues such as a lack of a heading/bearing line, or delays in tracking the location of the vessel while transiting, which caused participants to have to exit out of the app and reload it in order for their location on the chart to update.

Results from the rated answers for mobile gear testing days are shown in Table 1. In general, the majority of responses indicated the Trap Tracker app did not show an accurate location of marked fixed gear, it did not provide a better understanding of the fixed gear the vessels were interacting with than they would have had without it, the weather and sea conditions did not affect how useful the Trap Tracker app was, the cell service booster was not helpful, and the information provided on the Trap Tracker app did not affect the captain's decision making. There are several important things to note about this data. First, comments provided for question 4 regarding the helpfulness of the cell service booster indicated a consensus that even on occasions where the booster was found to be helpful, the added cell service was not enough to be able to update the app far enough offshore as would is needed in many real-world fishing scenarios. In addition, in many cases, the vessels testing the app were transiting through the area of marked gear rather than actively fishing, and all instances where the information on the app influenced decision making ('Yes' response to question 5) were from the CFRF's beam trawl survey, in which mobile gear tows are conducted near the marked gear. This suggests the responses to this question could have been different if all vessels were actively towing around marked gear. Unfortunately, it was impossible to recruit only mobile gear vessels that fished in that area.

Participants were also able to provide general comments and feedback on mobile gear testing days. Most comments regarded the app's lack of ability to track the vessel. Additional feedback suggests fishermen would need to be able to use satellite internet rather than cellular service to update that app to feel comfortable using it offshore and/or on multi-day trips. Several additional recommendations were provided as ways to improve the Trap Tracker app, including improving the GPS capabilities and ensuring the app was always able to track the vessel and show a heading line, including a scale bar on the chart, including latitude and longitude and/or TD loran lines on the chart, adding the option to view the bearing and distance from the vessel to marked gear locations, adding the ability to see what kind of gear was marked (e.g. traps

Under Review

versus gillnets), adding the ability to view gear in a radius greater than 5 miles (the app's current gear viewing radius), and having the ability to download the locations of marked gear in a radius greater than 25 miles when leaving to fish offshore (which was the app's current download radius at the time of testing; this has since been increased), and adding the ability to mark mobile gear tow paths on the Trap Tracker app.

Table 1. Ranked question responses from the mobile gear testing trials.

Question	Response Options and Number of Responses				
	0 (Not Accurate/No/Not Helpful)	1 (Somewhat Accurate/Somewhat Better/Somewhat)	2 (Moderately Accurate/Moderately Better/Moderately)	3 (Very Accurate/Yes/Yes)	No Response
1. How accurate was the app in determining the location and orientation of fixed gear compared to using only visual cues (i.e. buoys)?	18	4	6	4	9
2. Did the app provide a better understanding of the fixed gear that you would be interacting with today than you would have had without it?	26	4	4	3	4
3. Did the weather and sea conditions affect how useful the app was?	32	0	1	2	6
	No	**Yes**	**No Response**		
4. Did the cell service booster help/ how far out did you have service?	20	13	8		
5. Did you make any decisions based on information provided on the app? (i.e. Was the location or direction of one or more tow dependent on the location of fixed gear as recorded on the app? If so, how did the app help?)	27	3	10		

Unfortunately, due to the many instances (>44% of testing days) where the app did not work well enough to test at sea and low replication of different environmental conditions, we are unable to thoroughly or statistically explore how environmental conditions, such as sea state, fog presence or absence, etc., affected the accuracy and utility of the app to participants. For example, on testing days when the app was working enough to test at sea, there were only two instances where fog was present. In addition, participants recorded information on estimated wind speed and direction and descriptive classifications of visibility; since Beaufort sea state is a standardized way to characterize ocean conditions based on both wind and wave characteristics, this is the only environmental condition explored further in this report.

Briefly, based on visual exploration and for summary purposes only, for days when the app worked well enough to test at sea, there did not appear to be a strong relationship in participants' perception of the app's accuracy based on Beaufort sea state; for all sea states recorded (0 through 5), the average ranked response to question 1 in Table 1 (accuracy) ranged from 1 to 2.5, and there was not a trend of higher accuracy scores with lower sea states as expected (Figure 5a). Results are similar for average ranked responses to question 2 in Table 1 (helpfulness seeing fixed gear), and there was no trend of the app being more helpful in higher sea states as expected (Figure 5b).

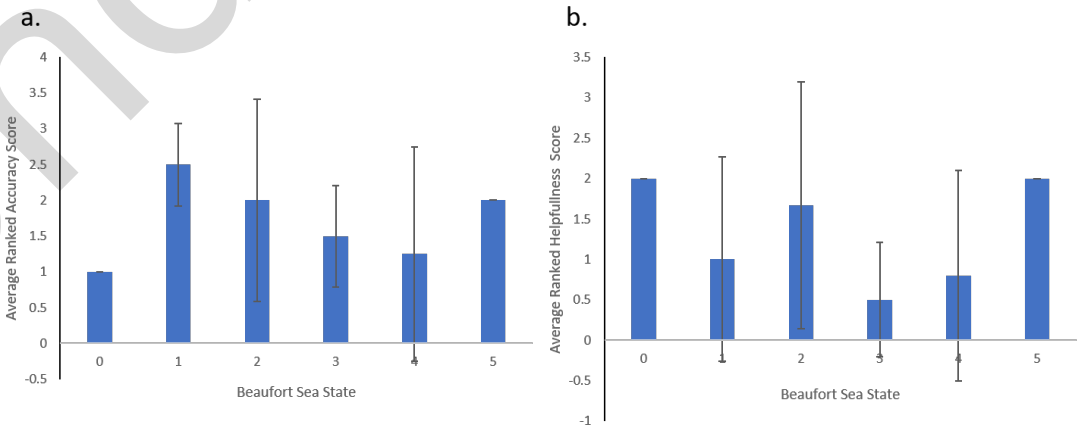


Figure 5. a) Average ranked accuracy responses on a scale of 0 (not accurate) to 5 (very accurate) for each Beaufort sea state experienced during mobile gear testing. b) Average ranked helpfulness responses on a scale of 0 (not helpful) to 5 (very helpful). Error bars represent standard error and are absent in cases of n = 1.

Under Review

Final Questionnaire

Summarized individual responses from the final questionnaire for each participant are included in Appendix 5. Overall, the lessons learned from the final questionnaire are consistent with the information gathered from the mobile gear at-sea testing. One major takeaway from the survey is that despite that app being generally user-friendly and easy to use, there were many problems with participants being able to get Trap Tracker to work well enough to be useful in identifying the location of fixed gear and potentially avoiding gear conflicts. The biggest challenges when using the app were its inability to always track the location of the vessel as well as its reliance on cellular service to update gear locations (especially considering that the cell service signal booster was not helpful in extending cell service range). When the app did work properly and there was enough cell service to update locations at sea, several participants found it to be generally accurate and somewhat helpful; however, there was still a wide range of responses that reflected the varying degrees of success each participant had with using Trap Tracker. Participants consistently indicated the cellular service booster did not work well or provide enough added coverage to help with using the app offshore. In addition, participants were concerned about a lack of real-time updates of marked gear. For example, fixed gear that is marked using Trap Tracker may move as a result of environmental conditions such as tides, storms, etc., yet the location that is shown on Trap Tracker does not change with the actual location of the gear. In addition, sometimes fixed gear may be hauled and redeployed on the same day that a mobile gear vessel is fishing in the same location of the fixed gear, yet the fixed gear vessels are unable to update the new locations of their gear in real-time due to a lack of cell service offshore.

Debriefing Meetings/Conversations

The individual debriefing meetings provided additional detail and a bigger-picture view of participants' experiences using the Trap Tracker app, general opinions on ropeless gear, gear marking, and gear conflicts, and concerns about each of these topics for the future. In general, after reviewing the data that had been collected from the mobile gear at-sea testing and the final questionnaire, feedback from individual project participants was consistent with their individual experiences and the data they had previously submitted.

In addition to reviewing data and feedback, participants were asked to complete a thought exercise to gauge their confidence in the Trap Tracker app and whether/how the information provided on the app may influence decision-making. The thought exercise consisted of an example Trap Tracker chart output showing marked fixed gear that was stated to be in the locally known typical direction of fixed gear that is set in the area shown (North to South). The chart also included marked gear set in a direction that is atypical for that area (West to East). Participants were asked if they would trust the output and whether it would influence their decision-making. The majority of participants indicated they would have concerns regarding the reliability of the output on the app and would not immediately trust that gear was set in both directions. One participant suggested that the atypical marked gear could be "dummy sets" (i.e. fishers could mark locations where gear was not actually set to 'save' the space), while another suggested they would attempt to radio other nearby vessels to confirm the location of marked gear. All mobile gear participants suggested that, if possible, they would try to go around the gear in question out of an abundance of caution; however, several participants noted that they would not go around the gear if 1) fishing was going well and towing around the marked gear in question would reduce catch, or 2) there were environmental barriers ("hangs") in the alternative towpath that could cause damage to their gear. Overall, this thought exercise demonstrates that participants have a general distrust of the gear marking app and a consistent opinion that electronic gear marking would not be as reliable as surface buoys in avoiding gear conflicts.

Similar to above, one of the biggest barriers identified in the conversations was the reliance of apps such as Trap Tracker on cell service, which is not feasible when fishing offshore or on multi-day trips. Other barriers identified were once again the inability of the app to show real-time updates of the location of marked gear, the low perceived accuracy of the app, and the practicality of using the app during regular fishing activities. There was also concern about the wider fishing industry's views on on demand gear, gear marking apps, etc., as well as privacy issues (i.e. fixed gear fishers not wanting to share the locations of their gear).

3. Lessons Learned

Describe the key lessons learned from this project, such as the least and most effective conservation practices or notable aspects of the project's methods, monitoring, or results. How could other conservation organizations adapt similar strategies to build upon some of these key lessons about what worked best and what did not?

Under Review

This project was successful at providing a basic understanding of the accuracy and utility of a gear location marking app that was developed for use with on demand fishing gear. The key lessons learned from each component of this study are discussed below.

The fixed gear trials provided an understanding of how accurately the locations of gear marked on Trap Tracker reflected the actual locations of gear at haul back. The average difference in locations found in this study was 68.96 ± 44.63 m (226.36 ± 146.43 feet), which is not accurate enough to allow fishermen to set gear in close enough proximity or allow mobile gear fishers to safely fish in areas with fixed gear without resulting in gear conflicts. A recent study aimed to identify requirements for a gear location marking system to be used with on demand gear by surveying stakeholders (fishermen from multiple fisheries, regulators, enforcement, scientists, engineers, manufacturers, and members of non-governmental organizations) (Baumgartner et al. 2021[1]). The results of that study determined that gear location marking systems must have a location accuracy of ~8 meters (25 feet) for fisheries to be able to operate in areas with a high density of fishing effort; areas with less dense fishing effort may be able to operate with an app that only had an accuracy of ~15-30 meters (50-100 feet). In this study, there were only 108 instances out of 979 total instances (11% of observations) in which the difference between the Trap Tracker-marked set location and GPS-marked haul location were less than or equal to 25 meters; there were 373 out of 979 instances (38%) where this difference was less than or equal to 50 meters. The results of our study indicate that Trap Tracker does not come close to currently meeting either of these requirements, and effort should be devoted to improving accuracy before the app is implemented at-scale.

The mobile gear components of this project, including the at-sea trials, final questionnaire, and debriefing conversations, indicated that there was a general perception of the app not being accurate or helpful in its current state, resulting in a strong need to update the app, and likely update gear marking technology in general, for there to be a solid path forward for Trap Tracker or other gear location marking apps to be helpful for mobile gear fisheries in identifying the location of fixed gear and avoiding gear conflicts. Specifically, feedback from participants indicates that gear location marking apps must be able to geo-locate and work well at sea at all times, have greater accuracy, not rely on cell service, and include real time updates of gear locations. An unexpected outcome of this study was the fact that the Trap Tracker app was unable to geo-locate and track mobile vessels at sea over 40% of the time. Without a reference point of the vessel's location, the app is unhelpful in determining the location of marked fixed gear in relation to the vessel. Gear marking technology must be able to consistently operate at sea in real-world fishing scenarios if fishermen are expected to incorporate such technology into their fishing operations. Participants in this study expressed high levels of frustration in trying to get the app to work, and both participants and project staff attempted all basic troubleshooting (e.g. closing the app and reloading it, logging out and back in, turning the tablet on and off, letting the tablet load prior to leaving the dock, attempting to get satellite signal in open air, etc.) that would be feasible for fishermen to do at sea when trying to use the app while also actively fishing. Further, as mentioned above, the tablet was often able to geo-locate the vessel's position in other apps (Navionics Boating app), at the same time that the Trap Tracker app was unable to identify the location of the vessel at sea. This is a major issue that must be addressed before the app can be useful to mobile gear fishermen.

In addition, as mentioned above, marking the location of gear when it is deployed from the boat, rather than the actual location of gear on the seafloor, results in gear location marking that is inherently wrong at the outset; gear can then continue to move on the seafloor as a result of tides, currents, etc., and this was a major concern for participants. The suggestion from participants that gear marking technology must display real-time, accurate locations of gear also agrees with the findings of Baumgartner et al. 2021[1], which identified as a requirement of any gear location marking system the need to be able to provide an accurate location of gear even if the gear moves after being set. There has been recent work on acoustic positioning systems that allow for real-time, underwater tracking of the location of fixed gear without vertical lines, and this is likely a more promising path forward for gear location marking than a gear location marking app that relies solely on surface GPS positioning and cellular service. Further, if apps continue to require connectivity, cellular service signal boosters must be able to provide service further offshore than the WeBoost booster that was tested in this study; however, all participants agreed that satellite internet was a more feasible option moving forward.

Overall, despite a consensus that the Track Tracker app had many issues that need to be fixed and a general distrust in the app, as well as concerns regarding gear location marking in general, participants in this study noted that if the app were updated to rely on satellite rather than cellular signal, included the recommendations provided from the mobile gear testing above, and included automatic, real-time updates of the chart and gear locations (i.e. tracking the location of gear

[1] Baumgartner, M., Baumwell, L., Baker, E., and Brillant, S. 2021. Workshop on Buoyless Fishing Gear Location Marking Methods. Report on Stakeholder Engagement Meetings. A report to the Ropeless Consortium, ropeless.org. 26 pages. https://ropeless.org/wp-content/uploads/sites/112/2021/08/GearLocationMarkingStakeholderReport_Aug2021.pdf

Under Review

after it is deployed, such as through acoustic positioning), it had the potential to help identify the location of fixed gear and reduce gear conflicts in the future.

4. Dissemination
Briefly identify any dissemination of project results and/or lessons learned to external audiences, such as the public or other conservation organizations. Specifically outline any management uptake and/or actions resulting from the project and describe the direct impacts of any capacity building activities.

Upon receipt of the final award agreement, project staff established a project webpage (https://www.cfrfoundation.org/gear-location-marking), which was maintained throughout the award period. On March 30th, 2022, the CFRF released its quarterly newsletter, which contained a section introducing this project. The newsletter was emailed to a list of over 1,500 people. In 2022, two postings about the project were made on the CFRF's Facebook page, which received about 750 views. In February 2023, an additional post was made to the CFRF's Facebook page, which received 415 views. The project results are also being featured in the upcoming March 2024 CFRF newsletter, which will be sent to over 1,700 subscribers. In addition, project staff attended the Maine Fishermen's Forum in March 2023 and Senator Sheldon Whitehouse's annual Environment, Energy, and Oceans Leaders Day in December 2023, and a project overview flyer was featured at the CFRF's outreach booth at both events (Appendix 6). Finally, this final report is being shared with NOAA scientists, and CFRF will be available to answer questions and provide clarification as needed.

Overall, the methods and results of this project have been disseminated to the fishing industry, the public, and government scientists. Specifically, through CFRF's outreach initiatives, this project has reached nearly 2,000 people via social media posts, newsletters, and in-person events. The audience for these initiatives included members of the fishing industry, scientists, academics, government workers, and the general public. In addition, by working with NOAA scientists and sharing this final report with them, the project results can be used to directly inform future decisions regarding gear location marking concerning gear conflicts in general as well as concerning a transition to ropeless fishing gear.

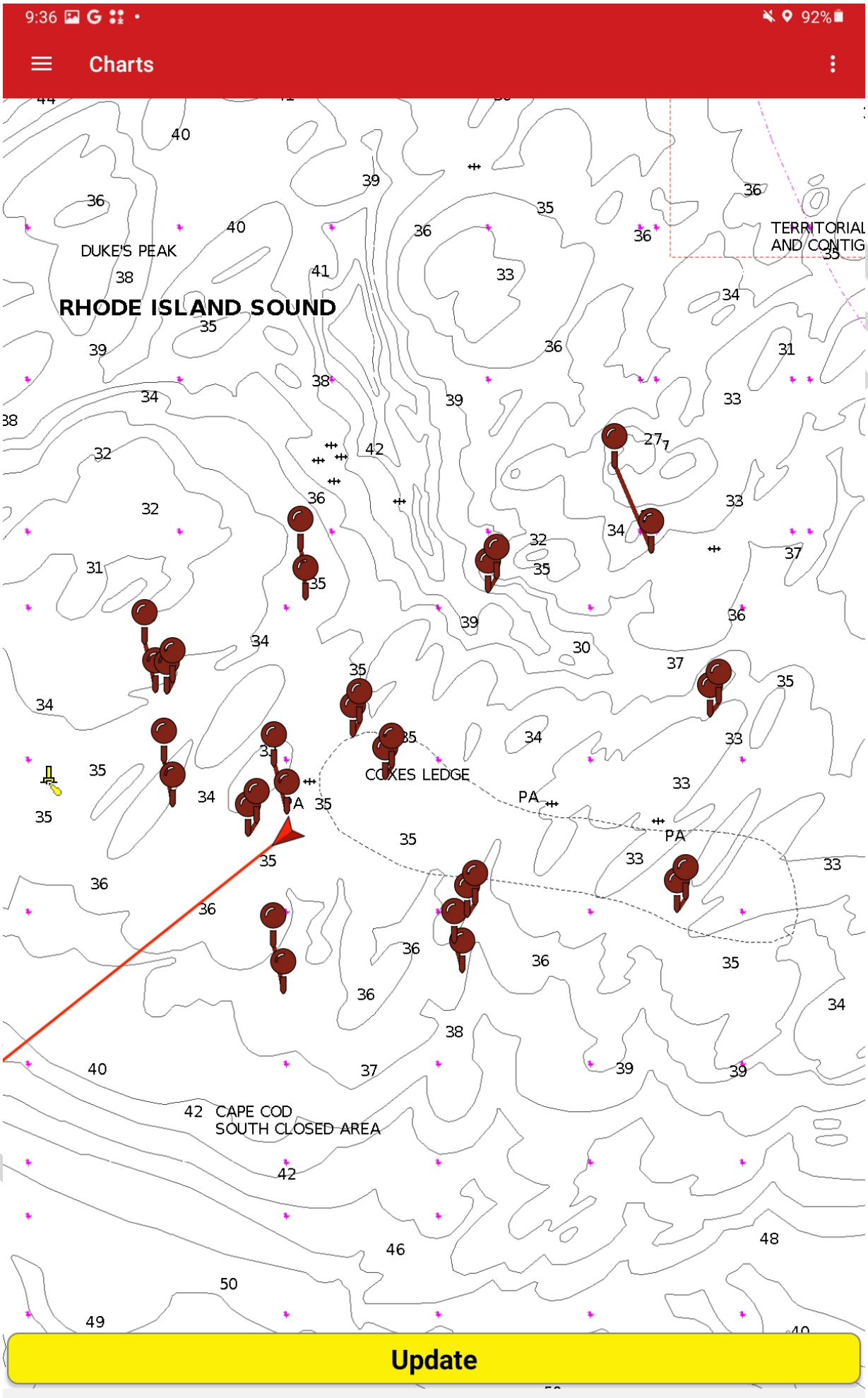
5. Project Documents
Include in your final programmatic report, via the Uploads section of this task, the following:

- 2-10 representative photos from the project. Photos need to have a minimum resolution of 300 dpi. For each uploaded photo, provide a photo credit and brief description below;
- Report publications, PowerPoint (or other) presentations, GIS data, brochures, videos, outreach tools, press releases, media coverage;
- Any project deliverables per the terms of your grant agreement.

Appendix 1: Template of the instruction manual and training binder provided to mobile gear testing participants.
Appendix 2: Blank datasheet that was filled out by mobile gear testing participants for each at-sea testing day completed.
Appendix 3: Blank final questionnaire administered to project participants.
Appendix 4: Presentation given during each debriefing conversation.
Appendix 5. Summarized final questionnaire responses.
Appendix 6: Project briefing outreach flyer presented at the Maine Fishermen's Forum and Senator Sheldon Whitehouse's 2023 Energy, Environment, and Oceans Leaders Day.
Appendix 7: Photo 1- An example map showing Trap Tracker versus GPS start and end locations for two fixed gear trawls. Credit: CFRF
Appendix 8: Photo 2- Example screenshot of the Trap Tracker application's chart showing fixed gear locations during a mobile gear testing day submitted by one of the project participants. Credit: CFRF

POSTING OF FINAL REPORT: *This report and attached project documents may be shared by the Foundation and any Funding Source for the Project via their respective websites. In the event that the Recipient intends to claim that its final report or project documents contains material that does not have to be posted on such websites because it is protected from disclosure by statutory or regulatory provisions, the Recipient shall clearly mark all such potentially protected materials as "PROTECTED" and provide an explanation and complete citation to the statutory or regulatory source for such protection.*

Under Review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92%
Charts
RHODE ISLAND SOUND
DUKE'S PEAK
TERRITORIAL
AND CONTIG
COXES LEDGE
PA
CAPE COD
SOUTH CLOSED AREA
Update

Project Overview

Project Description:

- This project will test an electronic gear location marking application (app), which was designed to mark the location of ropeless fishing gear
- This area is closed seasonally except to ropeless gear, but there has been little consideration about the gear conflicts ropeless systems may cause. This survey will provide much needed information on the accuracy and utility of an electronic gear location marking app.

Participant Responsibilities and Requirements:

- Each F/V participant will be provided with a tablet with an electronic gear location marking app and a cell service signal booster (each F/V must have a smartphone onboard)
- Each F/V will be asked to use the app during their regular fishing activities to compare the location and orientation of fishing gear marked in the app to visible fixed gear buoys in the water
- Each F/V is asked to use the app on up to 10 different fishing days between May and October 2023 and at the end of each survey day answer 5 questions on the utility and usefulness of the Trap Tracker app
- Each F/V is also asked to complete a final questionnaire and attend a final workshop to discuss their input on the app

Under Review

Contact Info

Project: Testing an Electronic Gear Location Marking Application

F/V:
Captain:
Address:
Phone:

CFRF Contact List

Name	Phone	Email	Position
David Bethoney	(401) 515-4662	dbethoney@cfrfoundation.org	CFRF Executive Director
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Katie Viducic	(201) 566-2286	kviducic@cfrfoundation.org	CFRF Research Biologist

Under Review

Table of Contents

Under Review

Beaufort Sea State Scale			
Beaufort Value	**Windspeed (kts)**	**Wind Description**	**Sea Condition**
0	< 1	Calm	Sea surface is mirror-like.
1	1-3	Light Air	Ripples, no crests
2	4-6	Light Breeze	Small wavelets, crests glassy, no breaking.
3	7-10	Gentle Breeze	Large wavelets, crests begin to break, scattered whitecaps.
4	11-16	Moderate Breeze	Small waves 1 - 4ft, numerous whitecaps.
5	17-21	Fresh Breeze	Moderate waves 4 - 8 ft, many whitecaps, some spray.
6	22-27	Strong Breeze	Larger waves 8 - 13ft, whitecaps, more spray.
7	28-33	Near Gale	Sea heaps up, waves 13 - 19ft, white foam streaks blow off breaks.
8	34-40	Gale	Moderately high waves 18 - 25ft, crests break into spindrift, foam blown in streaks.
9	41-47	Strong Gale	High waves 23 - 32ft, seas begin to roll, dense streaks of foam, visibility may be reduced.
10	48-55	Storm	Very high waves 29 - 41ft, overhanging crests, sea white, heavy rolling, visibility reduced.
11	56-63	Violent Storm	Exceptionally high waves 37 - 52ft, foam patches covering sea, visibility reduced.
12	64+	Hurricane	Air filled with foam, waves over 45ft, sea completely white with driving spray, visibility greatly reduced.

Under Review

To Turn on / Unlock Tablet

1. If the tablet is off, press and hold the lock button (top button on right side of tablet)
2. To unlock tablet:
    a. Press the lock button (top button on the right side of tablet)
3. Swipe your finger up from the bottom of the screen

TrapTracker Login Password

User ID/Email:
Password:

Under Review

Data Collection Instructions

Before Leaving Dock

1. Connect tablet to Wi-Fi, or use a Wi-Fi hotspot from your phone to the tablet (see pages 12 -13)
2. Open Trap Tracker app  (see pages 14-18 for app and tablet instructions)
3. Click the side menu (at the top left of tablet) → Select "Charts"
4. Click "Update" (yellow bar at bottom of screen, see page 16)
5. This downloads all currently marked gear locations within a 25-mile radius (the app will only show 5 miles at a time on map)

On Steam Out

1. Use the Trap Tracker app as a supplement to visual cues and in your typical decision- making process regarding the location and direction of tows
2. Keep clicking "Update" on Trap Tracker as far out as you have service with the cell booster
   - Note how far offshore you are able to get service with versus without using the booster
3. Complete the top portion of the data sheet recording:
   - Vessel Name
   - Date & Time
   - Where are you using the tablet (inside/on deck)
   - Gear you are fishing
   - Location
   - Beaufort Sea State
   - Cloud coverage (%)
   - Wind (kts/direction)
   - Tide
   - Fog present (YES/NO)
   - Visibility (about how far out can you see buoyed gear?)
   - Comments

When you come across marked gear

(*The app will only show marked gear when you come within 5 miles*)

1. **Take a Screenshot of the Trap Tracker app showing the area of marked gear** (click on the buoy icon to show coordinates, then on the right-hand side of tablet press the top and bottom button simultaneously)
2. At the end of the day, **complete the daily questionnaire** (bottom portion of data sheet)

Under Review

Cell Booster Registration and Important Information

BEFORE USE, you **MUST REGISTER THIS DEVICE** with your wireless provider. Many wireless providers, including AT&T, Sprint, T–Mobile, Verizon, and many others, have agreed to allow the operation of consumer signal boosters that meet the FCC's requirements.

This is a CONSUMER device.

BEFORE USE, you **MUST REGISTER THIS DEVICE** with your wireless provider and have your provider's consent. Most wireless providers consent to use of signal boosters. Some providers may not consent to the use of this device on their network. If you are unsure, contact your provider.

You **MUST** operate this device with approved antennas and cables as specified by the manufacturer. Antennas **MUST** be installed at least 20 cm (8 inches) from any person.

You **MUST** cease operating this device immediately if requested by the FCC or a licensed wireless service provider.

WARNING. E911 location information may not be provided or may be inaccurate for calls served by using this device.

Cell Booster Registration

Verify that your provider has given permission (e.g., AT&T, Sprint, T–Mobile, Verizon), or else get permission from your wireless provider to use it.
Register your booster with your wireless provider **before turning it on**. Each wireless provider that gives permission for boosters to be used must provide a free registration system.

Please visit https://www.fcc.gov/ for more information

Service Provider Contact Information:

Verizon: Call 1.877.596.7577, 8:30 a.m. - 5:00 p.m. EST, M-F.
At & T: http://attsignalbooster.com/
T-mobile: Call 1.800.937.8997
Sprint: Call 1.888.211.4727
US Cellular: visit https://www.uscellular.com/support/fcc-booster-registration

Under Review

Cell Booster Installation

Do Not Turn On Until You Register This Device With Your Cell Service Provider.
See Page 7.

Tips:

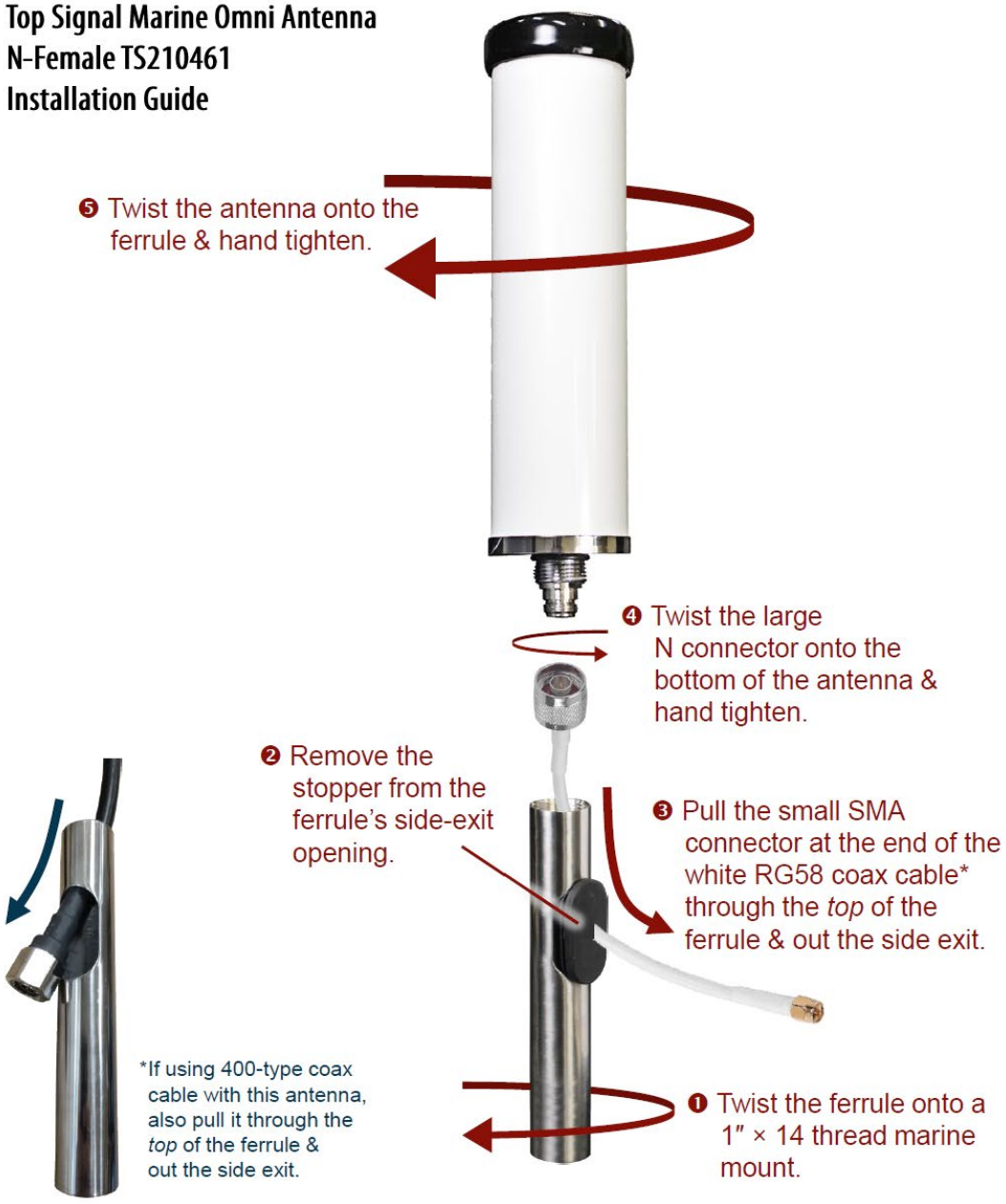
- Try to install antenna a few feet away from other antennas, radar domes, etc.
- Antenna should be vertically oriented
- Do not pinch or coil cable
- For best performance the marine antenna should have as much vertical separation from the inside antenna as possible
- Do not turn on at the dock (turning on close to cell towers can reduce cell service until a great enough distance is reached)

Under Review

top signal

The Power To Stay Connected

Top Signal Marine Omni Antenna N-Female TS210461 Installation Guide

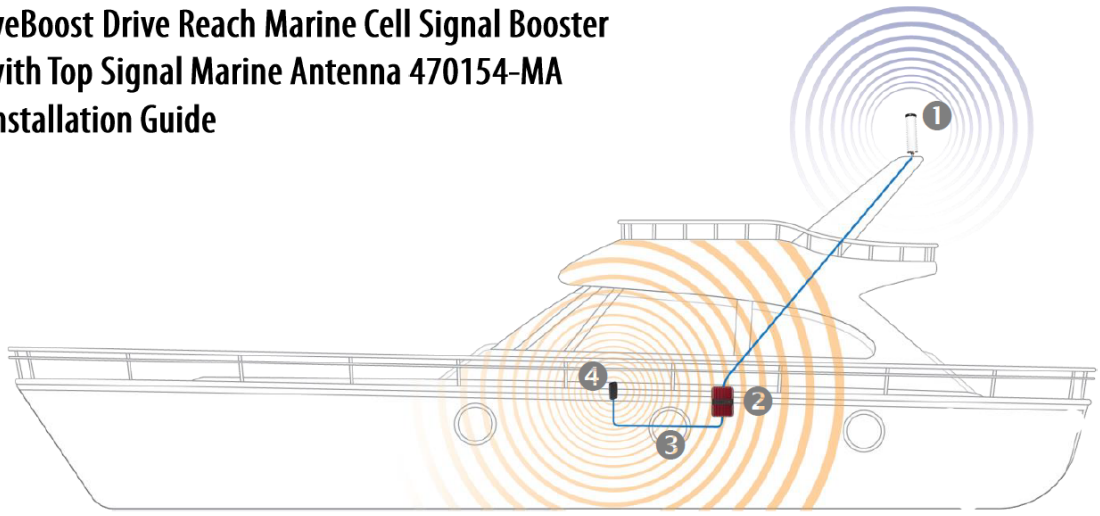


top signal

TS023009

The Power To Stay Connected

weBoost Drive Reach Marine Cell Signal Booster with Top Signal Marine Antenna 470154-MA Installation Guide



There are **four main components** to install in your boat:

1. ***The outside marine antenna with ferrule and coax cable***

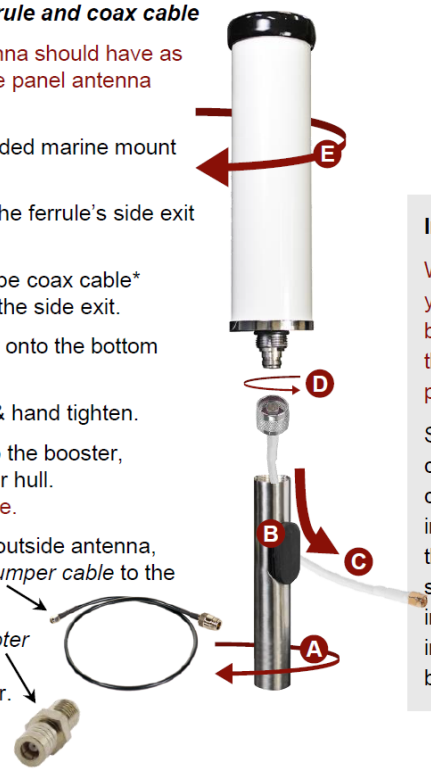
   For best performance, the marine antenna should have as much vertical separation from the inside panel antenna as possible.

   - **A** Attach the ferrule to a 1″ × 14 threaded marine mount (like the Shakespeare 4190).
   - **B** Remove the silicone stopper from the ferrule's side exit opening.
   - **C** Pull one end of the RG58 or 400-type coax cable* through the *top* of the ferrule & out the side exit.
   - **D** Twist the cable's large N connector onto the bottom of the antenna & hand tighten.
   - **E** Twist the antenna onto the ferrule & hand tighten.

   Run the coax cable from the antenna to the booster, securing the cable to the mast, tower, or hull.
   Do not pinch, kink, loop, or coil the cable.

   *If you run 400-type coax cable for the outside antenna, attach the *N-female/SMA-male RG58 jumper cable* to the end near the booster.

   Use the *SMA-female/SMB-female adapter* to connect the end of the cable to the OUTSIDE ANTENNA port on the booster.



Installation tip:

We strongly recommend that you do a "soft installation" before permanently mounting the antennas and pulling cables.

Sail to an area with weak cell signal, then lay out and connect all the components inside your boat. Power up the booster and check the signal you receive from the inside antenna. Compare your internet data speeds with the booster off and the booster on.

Continued on the back side…

v.20220222

top signal

The Power To Stay Connected

2 ***weBoost Drive Reach signal booster***

The booster needs to be placed where it has access to a 12-volt DC power socket.

An AC power adapter (850015) can be used to power the booster from a 120-volt AC power outlet. A hardwire power supply (950079) can connect it directly to a 12-volt marine battery. These optional power supplies are available at *PowerfulSignal.com*.

3 ***Inside coax cable***

This system includes a 10-foot length of flexible LMR195 coax cable with SMA-male connectors.

Connect one end of the cable to the booster's INSIDE ANTENNA port, using the *SMA-female/SMB-female adapter* →

Connect the other end to the panel antenna, using the *SMA/N adapter* →

Do not pinch, kink, loop, or coil the cable.

4 ***Inside directional panel antenna.***

This antenna broadcasts in the direction its front face is pointed.

It stands upright on any flat surface and can be moved to where you need cell signal most inside your vessel. You can also mount it to walls or ceilings with the included bracket and hardware or with Command® Strips or similar adhesives.

Cellular Hotspot Set Up

A Personal Hotspot lets you share the cellular data connection of your phone and tablet (Wi-Fi + Cellular) when you don't have access to a Wi-Fi network.

Set up Personal Hotspot on iPhone

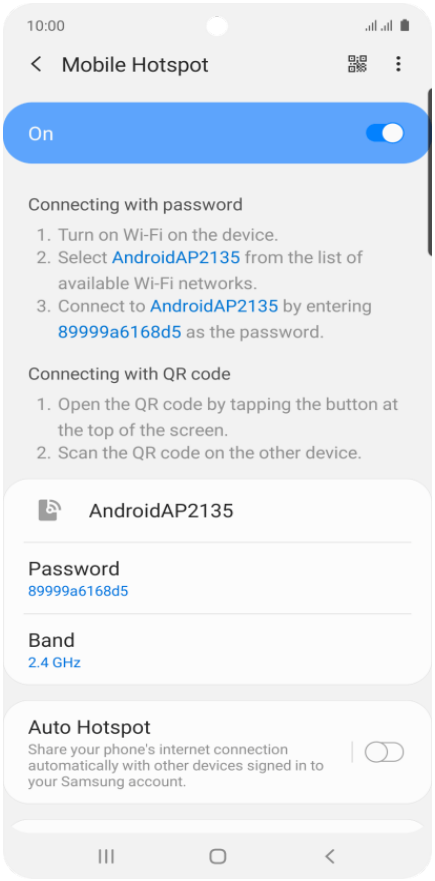
1. Go to Settings > Cellular > Personal Hotspot or Settings > Personal Hotspot
2. Tap the slider next to **Allow Others to Join**
3. Note the password to enter on the tablet

Set up Personal Hotspot on Android Phone

1. Go to Settings > Network & Internet > Hotspot & tethering > Wi-Fi hotspot
2. Tap the slider next to **Wi-Fi hotspot**
3. Note the password to enter on the tablet

Set up Personal Hotspot on Samsung Phone

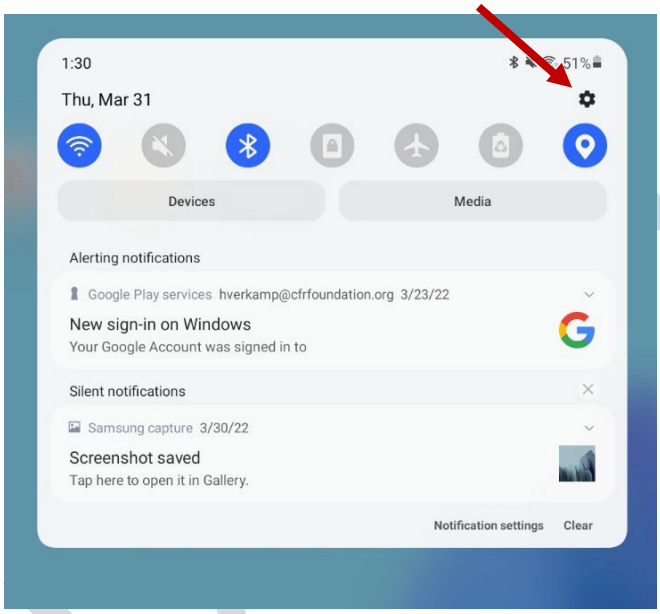
1. Go to Settings > Connections > Mobile Hotspot and Tethering > Mobile Hotspot
2. Tap the slider next to **Mobile Hotspot.**
3. Note the password to enter on the tablet

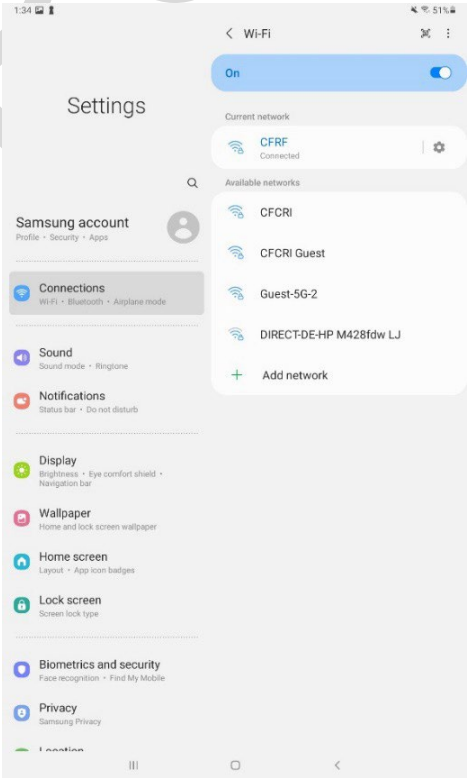


Peer Review

Connect to Tablet

1. On the Tablet swipe your finger down from the top of the screen
2. On the top right-hand corner select the gear widget (see below)
3. Settings > Connections > Wi-Fi
4. Pick your phone's hotspot name
5. Enter your phone's hotspot password
6. Click Connect
7. Once connected, you can use cellular data on the tablet to update Trap Tracker
8. The booster is supposed to extend the distance offshore that you can still get service on your phone and be able to hotspot the service to the tablet, but **this only works when your smartphone is within 2-5 feet of the cell booster antenna**



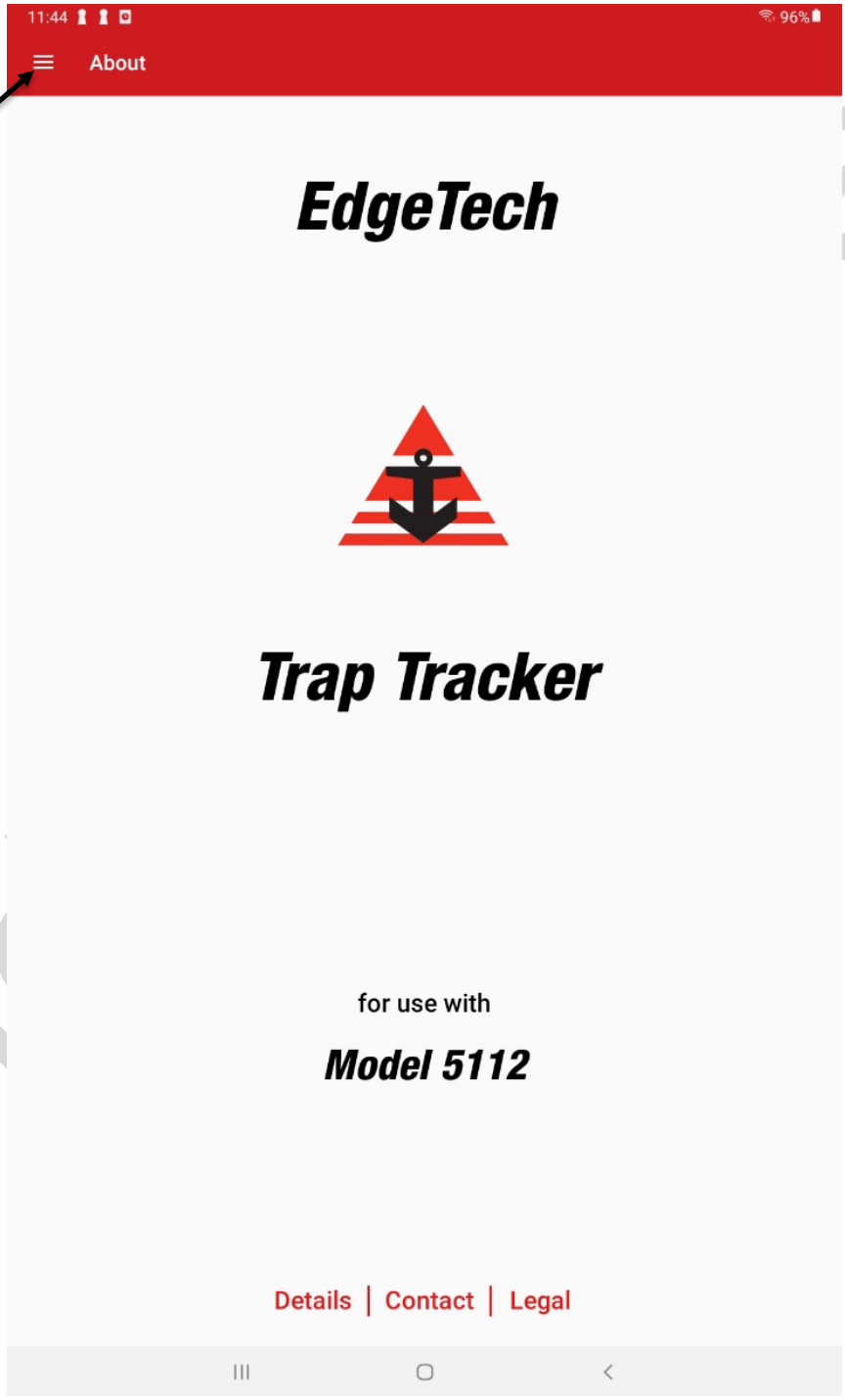


Review

Using Trap Tracker App

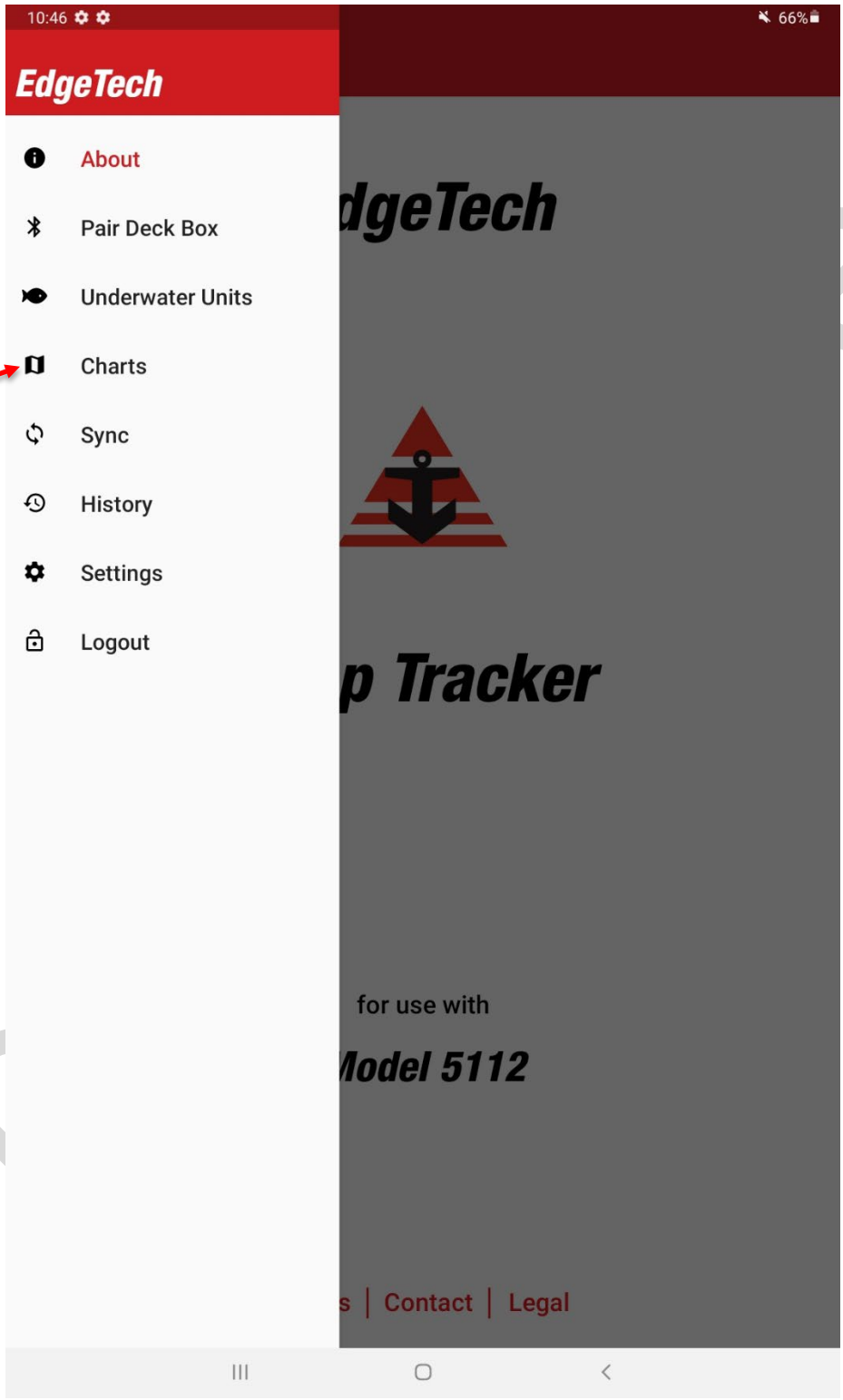
Click on the Trap Tracker App Icon to open the app

- This brings you to the app home screen



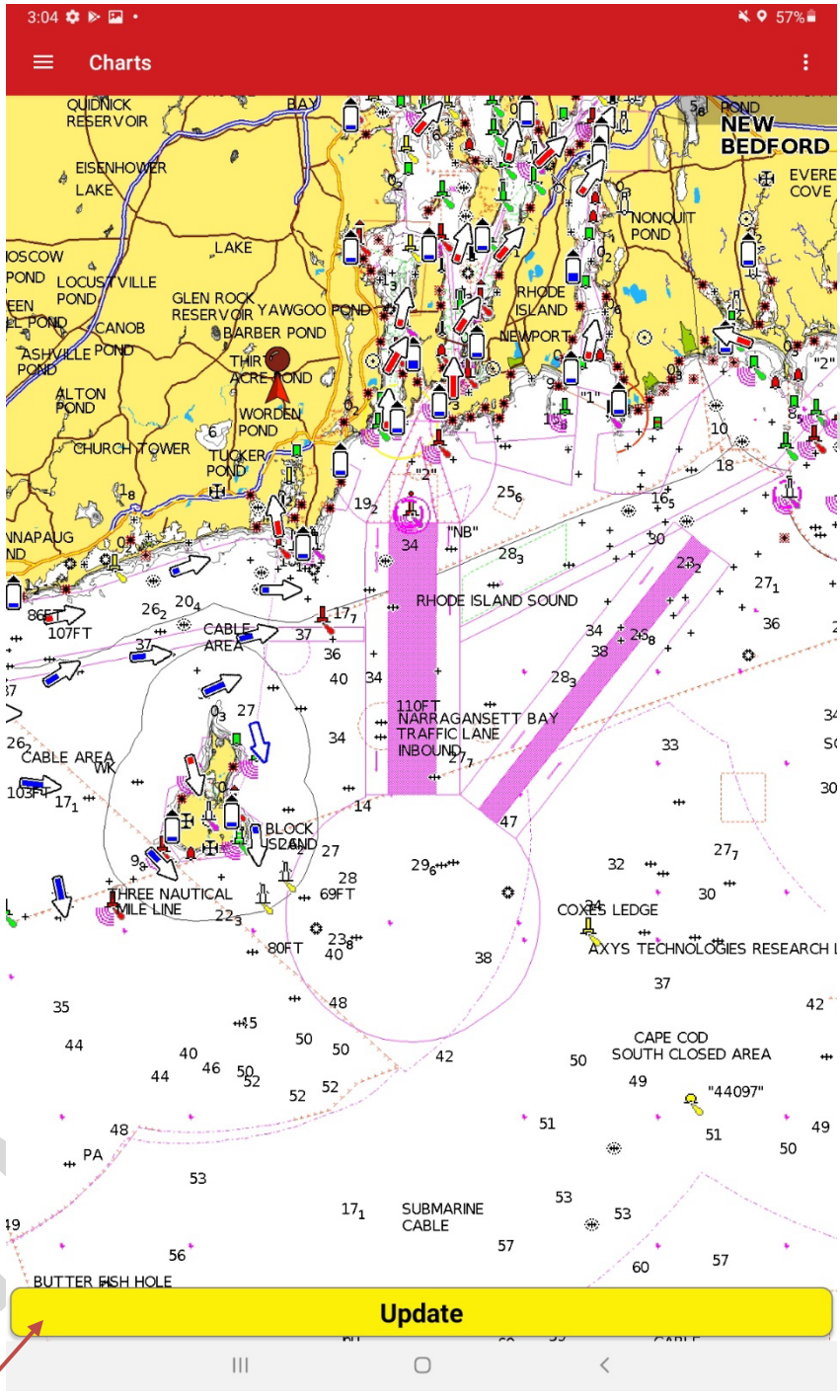
Uncontrolled when printed

Side Menu Options



Under Review

Update Chart



Click periodically to update on your steam out

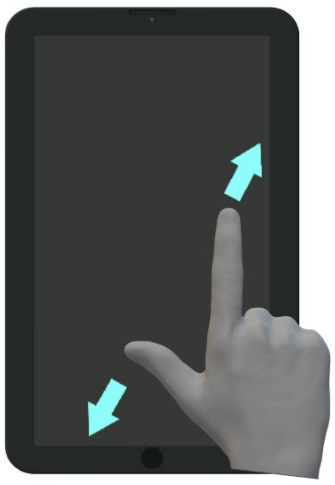
(Updating will load gear up to 25 miles away from your location; gear will only be visible within 5 miles)

Under Review

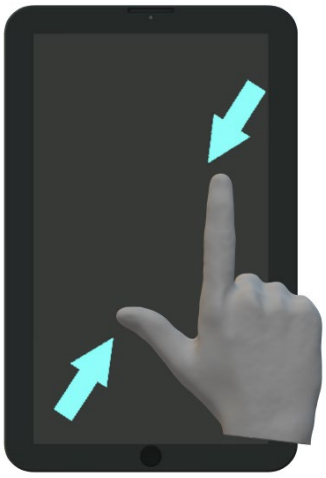
Touch Screen

- Use your pointer finger to move the map around
- Zoom in - Use your pointer finger and thumb to touch the screen and slide both fingers outward
- Zoom out - Use your pointer finger and thumb to touch the screen and slide both fingers inward

Zoom out



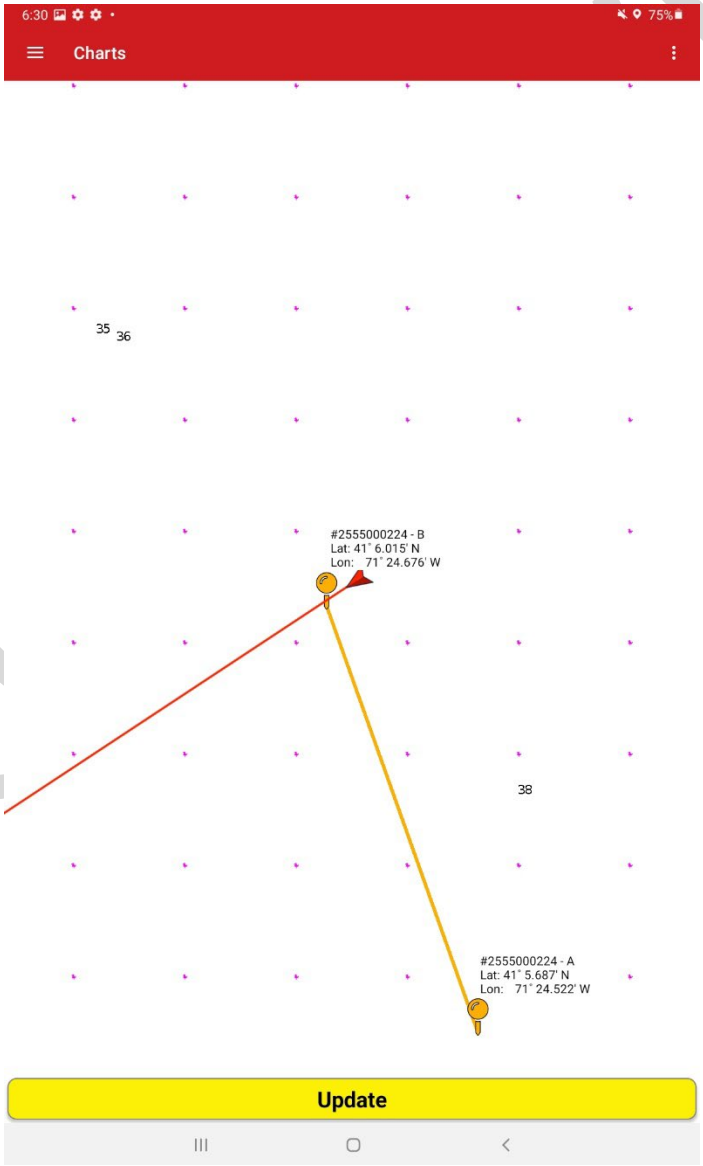
Zoom in



Under Review

Taking a Screen Shot of Marked Gear

- Click the side menu tab in the app
- Go to “Charts”
- Zoom in to the marked gear you see in the app
- Tap on the yellow buoy icon so the ID# and Location is showing
    - The screen should look similar to below
- Take a screen shot
    - Press the top and bottom buttons located on the right side of the tablet simultaneously



Under review

Appendix 2

Vessel Name:	Beaufort Sea State (see chart attached):
Date and time:	Cloud coverage (%):
Gear you are fishing:	Wind (kts/direction):
Location:	Tidal Stage (incoming, outgoing, slack):
Where are you using the tablet (on deck/inside):	Fog present (YES/NO):
Comments:	Visibility (about how far out can you see buoyed gear?):
	Take a Screenshot of the Trap Tracker app chart (on the right of the tablet, press the top and bottom button simultaneously)
Question	Answer
1. How accurate was the app in determining the location and orientation of fixed gear compared to using only visual cues (i.e. buoys)?	0- Not accurate 1- Somewhat accurate 2- Moderately accurate 3- Very accurate
2. Did the app provide a better understanding of the fixed gear that you would be interacting with today than you would have had without it?	0- No 1- Somewhat better 2- Moderately better 3- Yes
3. Did the weather and sea conditions affect how useful the app was?	0- No 1- Somewhat 2- Moderately 3- Yes
4. Did the cell service booster help/ how far out did you have service?	Not helpful Helpful (If helpful, how far offshore? _____)
5. Did you make any decisions based on information provided on the app? (i.e. Was the location or direction of one or more tow dependent on the location of fixed gear as recorded on the app? If so, how did the app help?)	
6. General feedback / Any comments on the pros and cons of using the app:	

Under Review

This is the final survey for the project, "Leveraging wind farm development to test the accuracy and utility of a gear location marking application". Please fill out the survey virtually or print and complete it and then send your answers to Hannah Verkamp by email (hverkamp@cfrfoundation.org) or text message (479-965-5018) by November 20th. You will be paid a $300 stipend for completing the full survey.

Name:

Vessel Name:

Gear Type (Fixed or Mobile):

1. **In a few sentences, please describe your overall experience using the Trap Tracker application.**
    a. Open answer

2. **What was the biggest challenge you faced when using the application?**
    a. Open answer

3. **Is the application easy to use?**
    a. Rate 1 (not at all easy) to 5 (very easy)

4. **How helpful was the application in identifying the location/orientation of fixed gear trawls?**
    a. Rate 1 (not helpful at all) to 5 (very helpful)

Under Review

5. **How accurate was the application in identifying the specific location of fixed gear buoys?**
    a. Rate 1 (not accurate at all) to 5 (very accurate)

6. **What features do you like most about the application?**
    a. Open answer

7. **What features do you like the least about the application?**
    a. Open answer

8. **How much better does the application allow you to understand the location and orientation of fixed gear compared to using visual cues (i.e. seeing the location of buoys) only?**
    a. Rate 1 (not helpful at all) to 5 (very helpful)

Under Review

9. **If ropeless gear was being used in your fishing area, would this application help avoid deployed ropeless gear?**
    a. Yes or no, please explain

10. **What features would you add to make the application more useful?**
    a. Open answer

11. **How far out did the cellular service signal booster allow you to update gear location data on the application? Was this a significant improvement to the range at which you typically receive cellular service?**
    a. Open answer

12. **Does your vessel have a way to connect to Wi-Fi via satellite or another device that allows you to download/update data while out of cellular service range? If no, would you be willing to purchase such a device if it allowed you to view the location of other deployed gear while offshore in near real-time?**
    a. Yes or no, please explain

Under Review

13. **Beyond having an accurate gear location marking application available to you, what other concerns or specific needs must be addressed before you would feel comfortable fishing in a location with only ropeless fixed gear?**
    a. Open answer

14. **If using virtual gear marking in the future, would you rather have a separate display for this information, or have it integrated into your existing chart plotter?**
    a. Open answer

15. **Without the application, do you typically try to plan ahead to reduce or avoid interactions/conflicts with other fisher's fixed gear? If so, how?**
    a. Open answer

16. **Did using the application allow you to better plan your trawl/tow locations to minimize gear conflicts? Did its usefulness in this regard depend on weather and sea conditions?**
    a. Yes or no, please explain

Under Review

17. **How often could you see yourself using this application during your typical fishing activities?**
    a. Open answer

18. **What would your ideal distance be for being able to see the location of fixed gear and plan your tows?**
    a. Open answer

Under Review

Electronic Gear Marking Project

Mobile Gear Trials Data Summary and Final Recommendations

Under Review

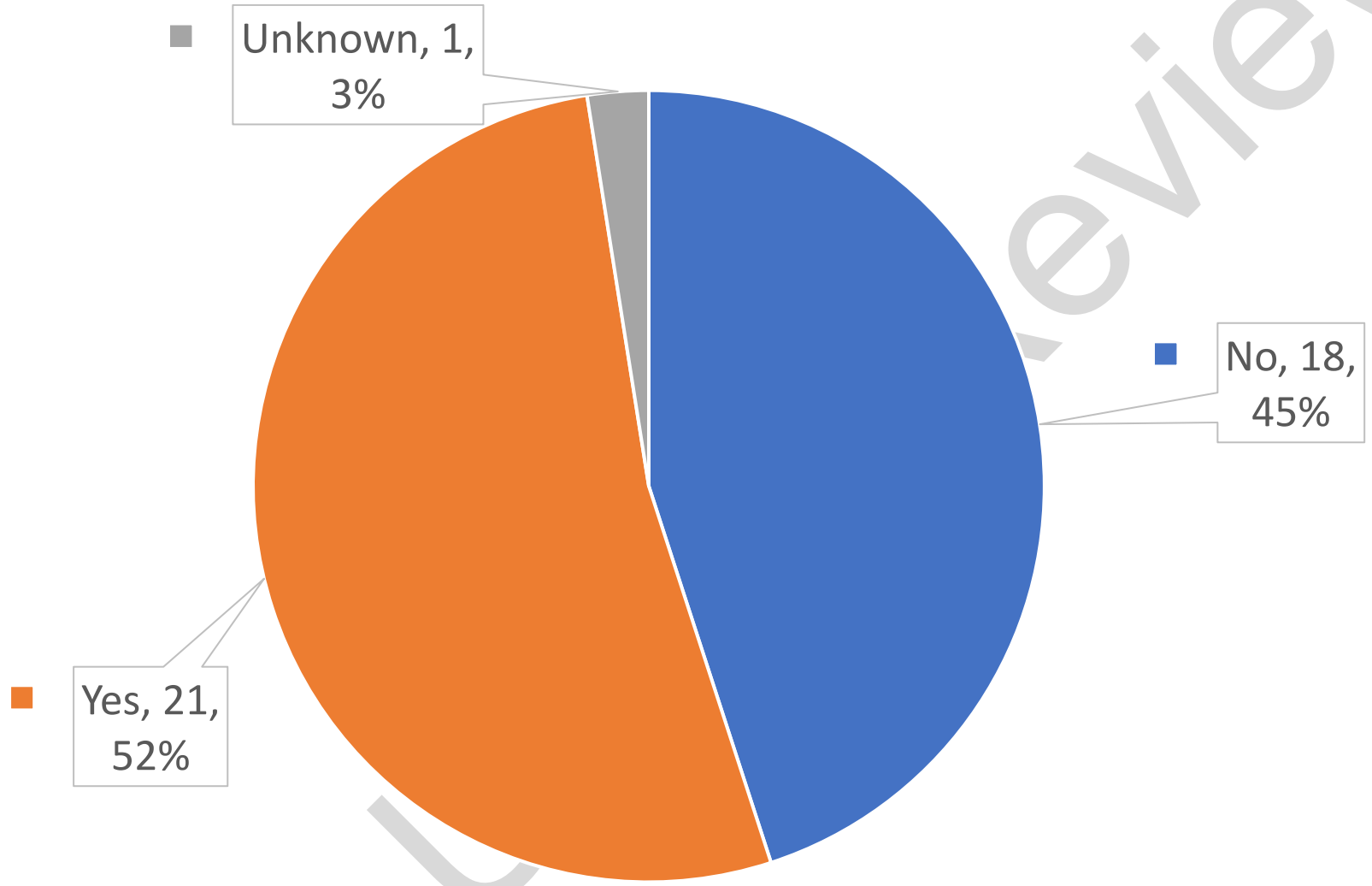
Introduction

- Project Goals: Test the accuracy and helpfulness of an electronic gear location marking application (Trap Tracker) to help avoid gear conflict

- Methods
  - Fixed Gear
    - Using the app to mark SFWF survey gear
  - Mobile Gear
    - 5 mobile vessels
    - At-Sea Trials
    - 40 testing days
  - Survey/Questionnaire

Under Review

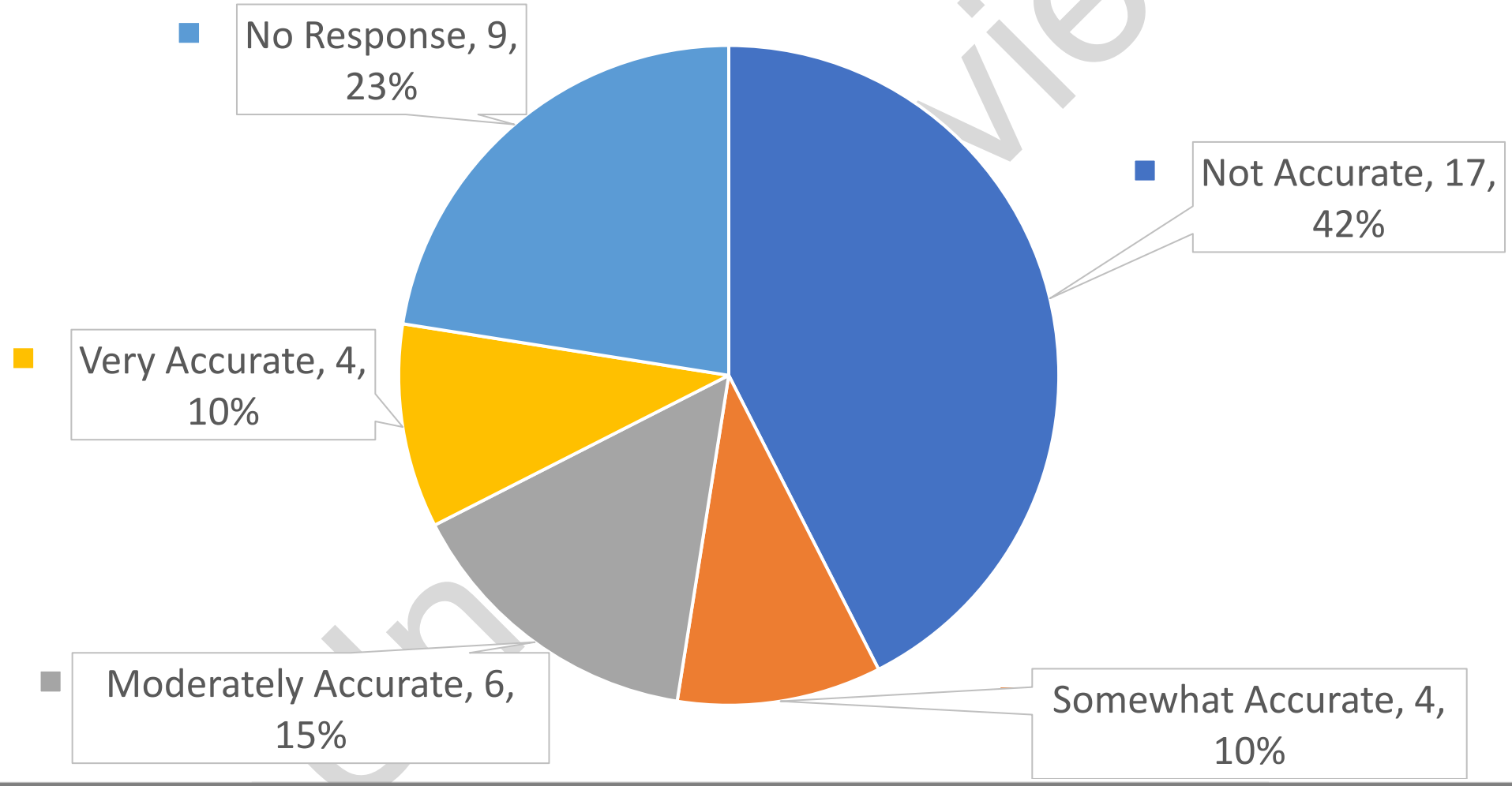
Did the App work well enough to complete at-sea testing?



- Biggest issue: app did not track boat once it left dock, which made it impossible to gauge accuracy, etc.
- Without seeing where you are on the chart in relation to gear, the app is relatively useless

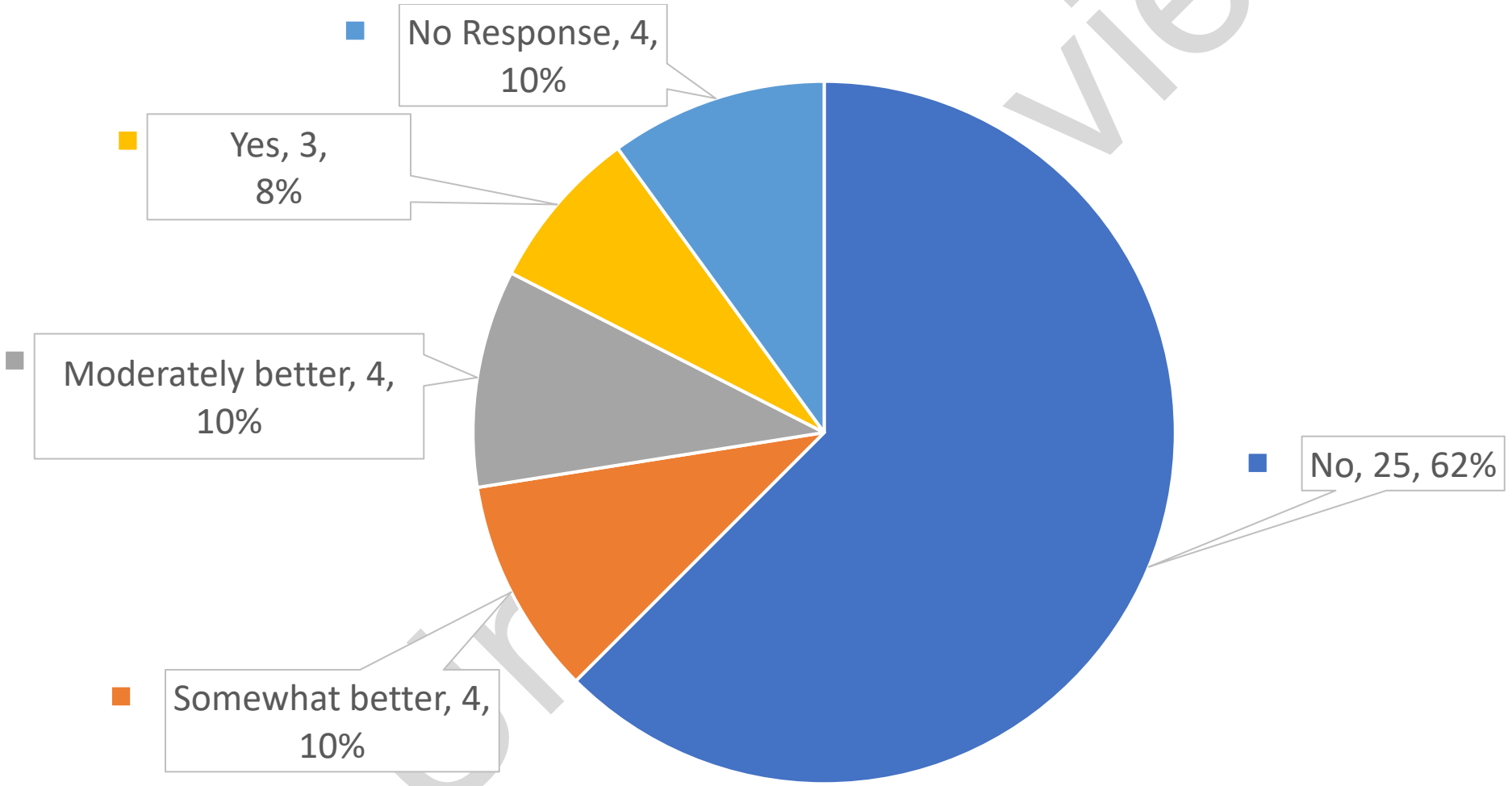
Under review

1. How accurate was the app in determining the location and orientation of fixed gear compared to using only visual cues (i.e. buoys)?



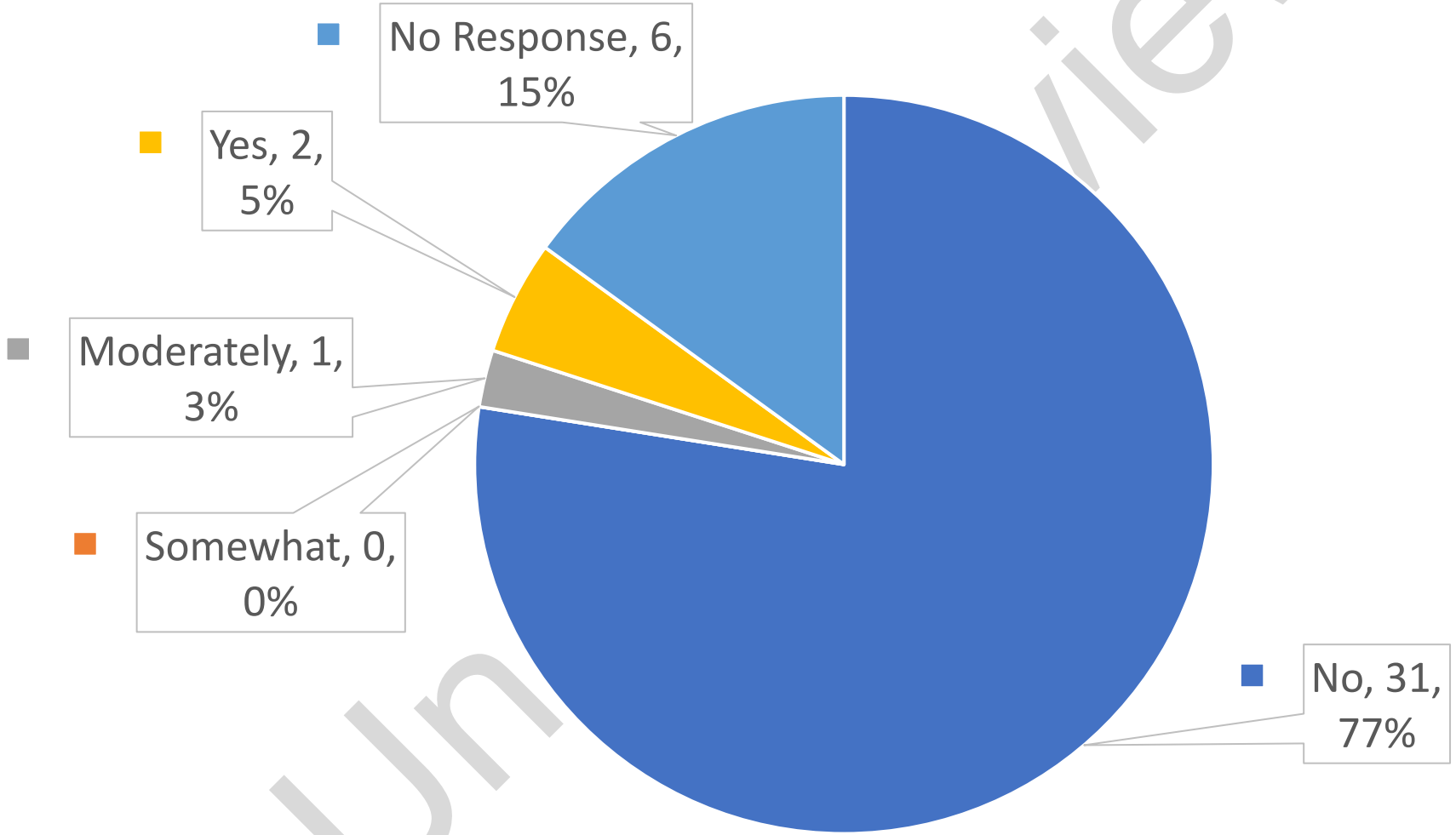
Preview

2. Did the app provide a better understanding of the fixed gear that you would be interacting with today than you would have had without it?



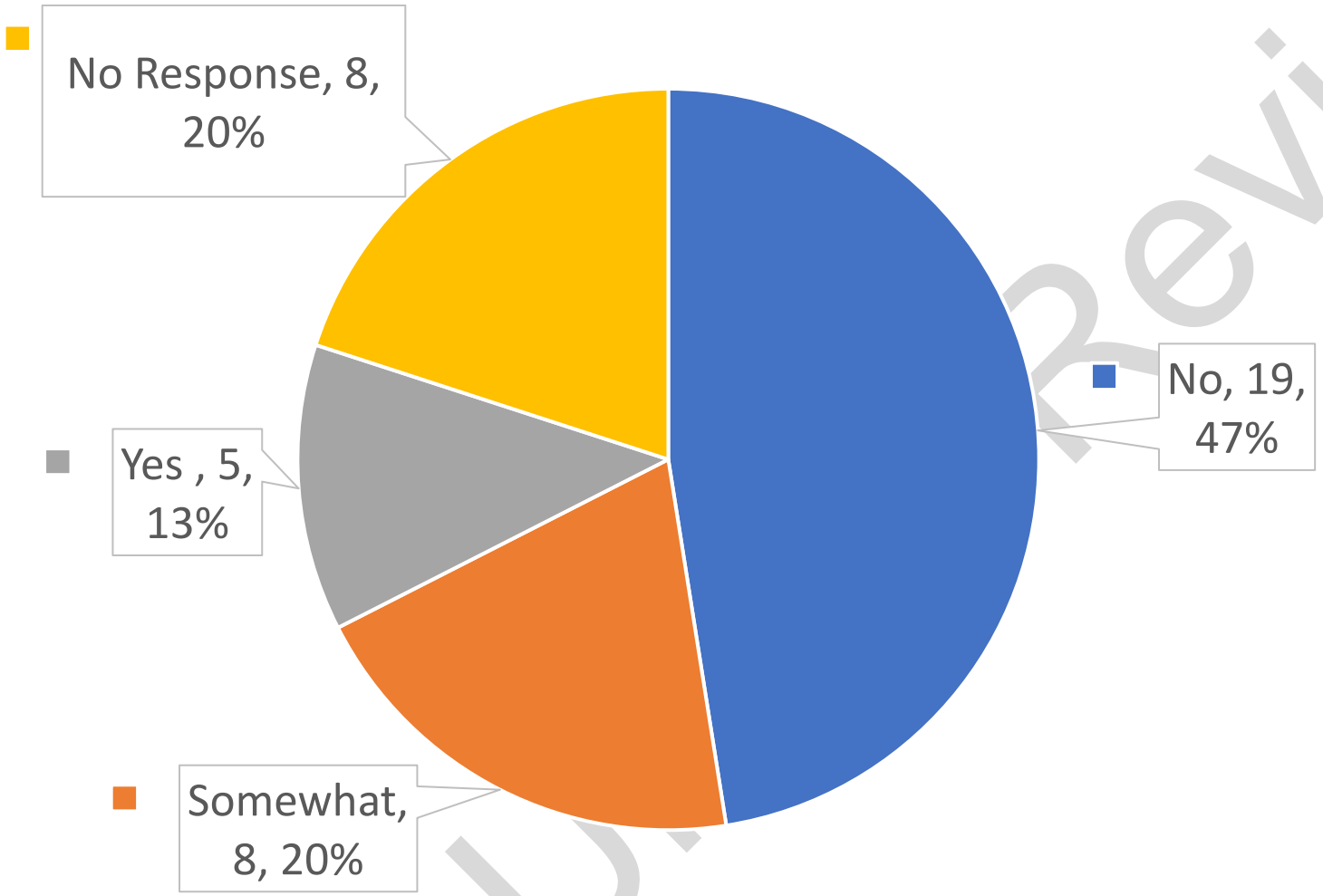
Draft for review

3. Did the weather and sea conditions affect how useful the app was?



Unofficial view

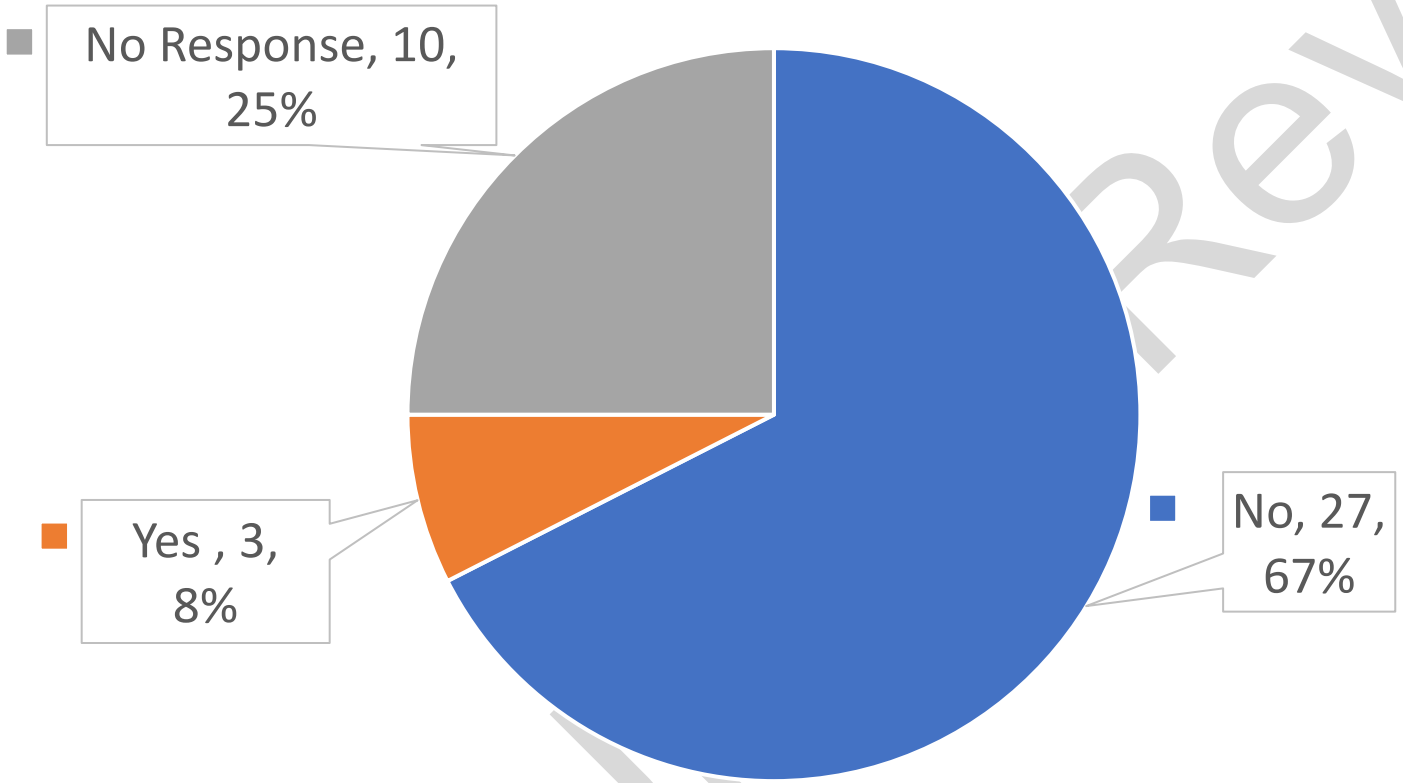
4. Did the cell service booster help/ how far out did you have service?



- From comments, these boosters only seemed to help add up to ~4 miles
- General consensus that the booster was not helpful enough for what is needed to make the app useful
- Lots of comments on the need for better internet or alternatives (e.g. satellite) to be able to upload the app offshore

Under Review

5. Did you make any decisions based on information provided on the app? (i.e. Was the location or direction of one or more tow dependent on the location of fixed gear as recorded on the app? If so, how did the app help?)



- Most people just transiting through
- All 'YES' responses were from our beam trawl surveys, when we were fishing right inside the areas with marked fixed gear

Under Review

Survey Results Summary

Major Takeaways

1. The app would be very helpful in supporting the use of ropeless gear if there was more reliable service.
2. A consistent concern was the app not being able to account for drifting or incorrectly set and recorded gear.
3. There was a strong interest in developing an integrated display within participants' existing electronics to reduce number of screens and increase efficiency.
4. The app would not make planning ahead more efficient or easier based on its current performance.
5. The process of having to manually refresh and update one's location made the use of the app tedious and more challenging.

Under Review

Survey Results Summary

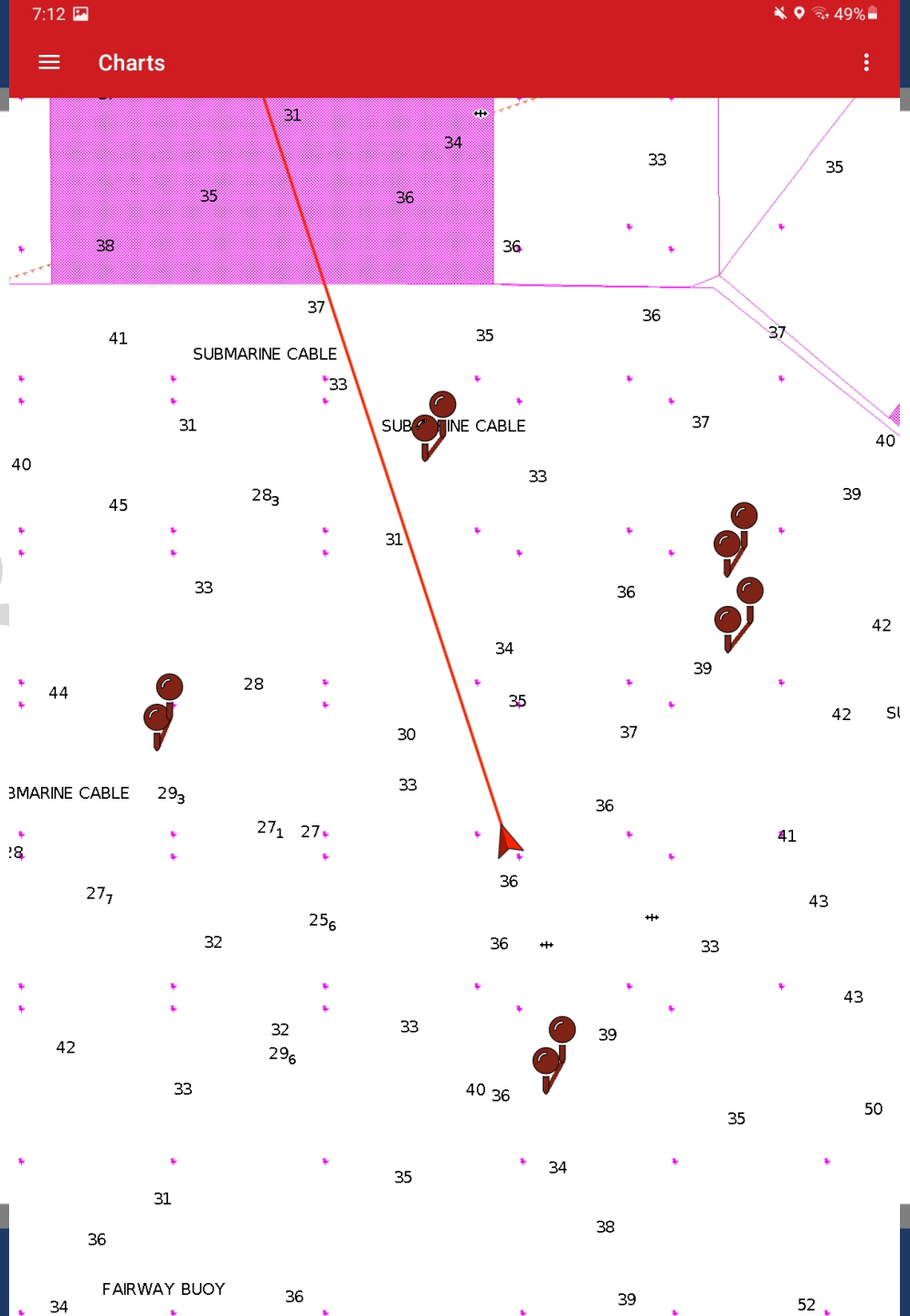
- **Positives & Likes:**
  - Enjoyed the map with heading, tide features, and charts
  - Could see location of gear using the app during poor weather conditions
  - App was generally user friendly when connected to cell service
  - Scored fairly accurately when connected to service

- **Negatives & Dislikes:**
  - Didn’t position correctly or wasn’t 100% reliable
  - Significantly limited by cell reception/service
  - App displayed a limited range once loaded
  - Had to manually update app as location moved

Under Review

Exercise – Hypothetical Ropeless Situation

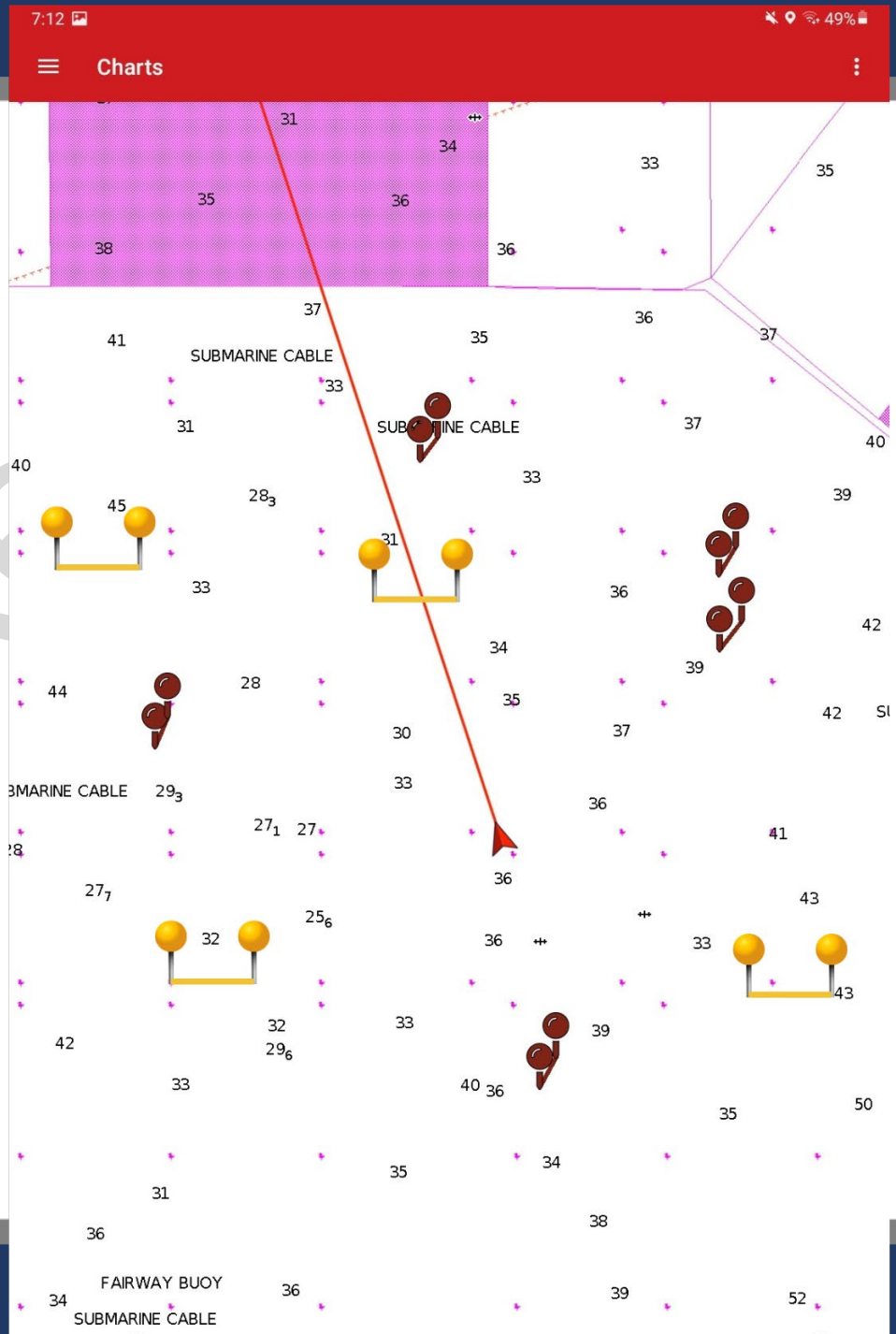
- Going through an area where lobster gear is typically set SW → NE



Under R

Exercise – Hypothetical Ropeless Situation

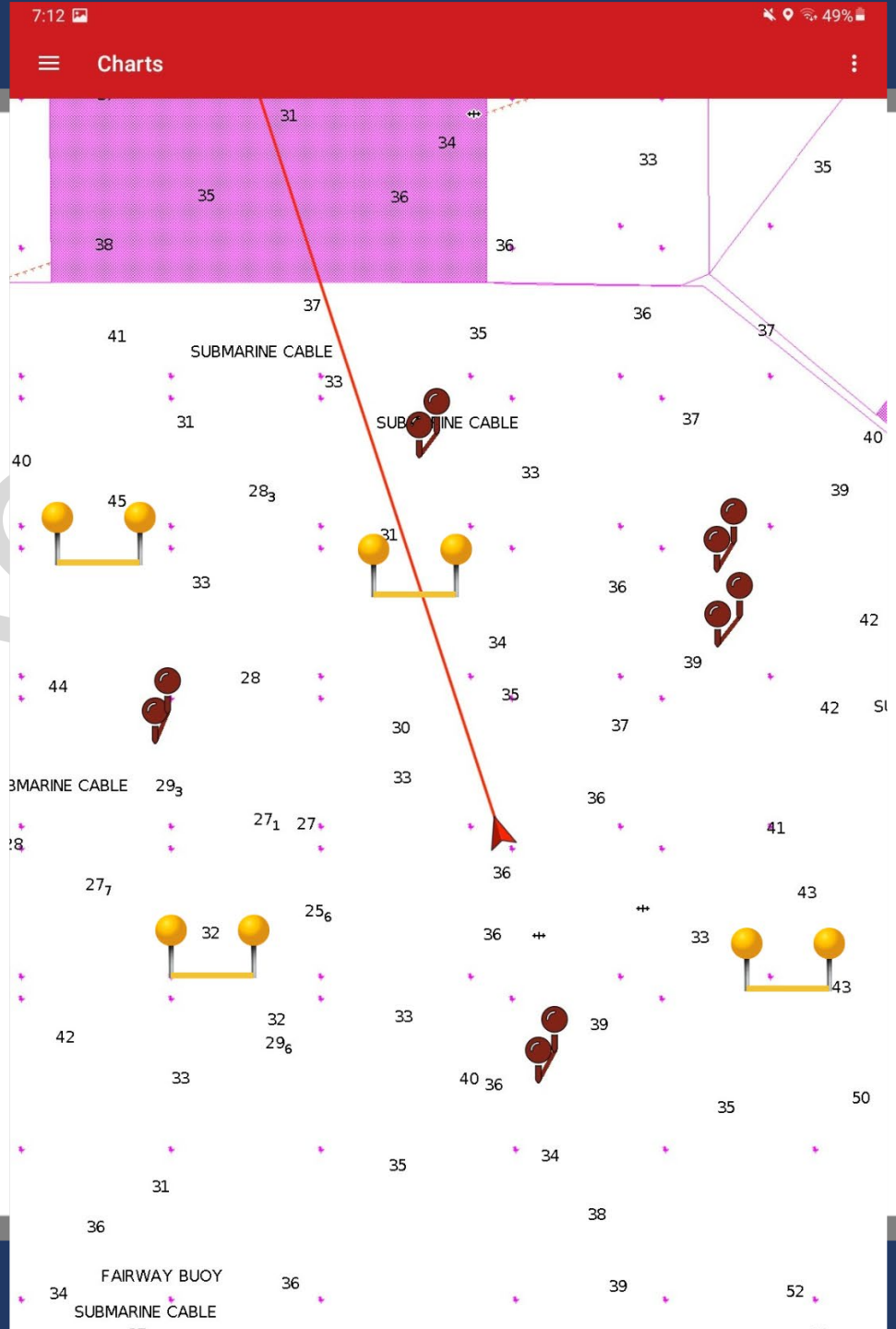
- Going through an area where lobster gear is typically set SW → NE
- But this time you also see gear on Trap Tracker set W → E



Under Re

Exercise – Hypothetical Ropeless Situation

- Would you trust this output, or assume the trawls are set in the usual direction and the app is wrong?
- Would this information affect your decision-making?
  - If so, how?



Under Re

Trap Tracker Gear Marking Recommendations

- Chart- add scale bar, lat/long, …?
- Distance for the app to download and show the locations of marked gear
  - Was 25 miles, now 250 miles- is this enough?
  - Still can't see gear until you get within 5 miles of it- is this enough?
- Ability to track mobile gear tow lines
- Anything else to add?

Under Review

Path Forward

- Do you think GPS-based gear marking (like Trap Tracker) is a feasible solution if there is a transition to ropeless gear?
- If some of your recommendations were integrated into the app, would it be easy and helpful to use this kind of technology in your regular fishing activities?
- Opinions on how a transition to ropeless gear would affect gear conflicts?
- Biggest concerns and barriers to a transition to ropeless gear?

Under Review

Appendix 5

Participant #	GearType	1. In a few sentences, please describe your overall experience using the Trap Tracker application. (open answer)	2. What was the biggest challenge you faced when using the application? (open answer)	3. Is the application easy to use? (Rate 1 (not at all easy) to 5 (very easy))	4. How helpful was the application in identifying the location/orientation of fixed gear trawls? (Rate 1 (not helpful at all) to 5 (very helpful))	5. How accurate was the application in identifying the specific location of fixed gear buoys? (Rate 1 (not accurate at all) to 5 (very accurate))	6. What features do you like most about the application? (Open answer)	7. What features do you like the least about the application? (Open answer)
1	Mobile	App never positioned properly	App didn't work and didn't positoin	1	1	1	None	It never worked
2	Mobile	Found the app was prone to glitches and loading issues. When I could get the app to update it worked very well.	Phone service/distane; also the app was not 100% reliable or able to work when used	5	5	4	The 'real time' map with heading and tide; also liked that the gear with lat ong and end to end is marked	relies on cell service
3	Mobile	The app was easy to use and navigate thourgh but never had any luck getting it to work once we left the dock	Having the app track us after we left the dock; I never got it to show any gear either; not sure if it was a service thing and it just wasn't enough to upload or not	5	1	NA, never got it to work	NA, never got it to work	Never got it to work
4	Mobile	When it worked it was nice; cell phone limits was main issue	cell phone limits	5	5	4	On bad weather days when picking up cell service we could see gear on app	Range
5	Mobile	Overall okay but annoying with lack of east update/refresh, sometimes slow on sat. link	cell service, updates, refresh, occasional sat service issues	4	4	4	charts	lack of easy refresh, lack of plot ability for mobile gear, lack of immediate update, lack of range, esp with gear placement
6	Fixed	Mostly using app with on demand gear. Fair amount of fails when setting gear on app	currently more work beyond normal electronics. No updating is no good	2	1 (not ability to get on top of gear)	1	only like may be using it with on demand gear	lots of work with start/stop compared to normal electronics

Under Review

Appendix 5

Participant #	8. How much better does the application allow you to understand the location and orientation of fixed gear compared to using visual cues (i.e. seeing the location of buoys) only? (Rate 1 (not helpful at all) to 5 (very helpful))	9. If ropeless gear was being used in your fishing area, would this application help avoid deployed ropeless gear? (Yes or no, please explain)	10. What features would you add to make the application more useful? (Open answer)	11. How far out did the cellular service signal booster allow you to update gear location data on the application? Was this a significant improvement to the range at which you typically receive cellular service? (Open answer)	12. Does your vessel have a way to connect to Wi-Fi via satellite or another device that allows you to download/update data while out of cellular service range? If no, would you be willing to purchase such a device if it allowed you to view the location of other deployed gear while offshore in near real-time? (Yes or no, please explain)
1	1	No	Issue starlinks to users so the information can be live	Didn't work well; no significant improvement	Yes; starlink
2	5	Yes, because of lat/long and end/end marked on app	Auto-update as you go instead of clicking	No, very spotty service	Yes, if I was hooked to startlink it would work better and in more real time
3	1	No because it never worked properly	Even thorugh I did not get it to work but if I did I am not sure anything would make it better it seemed to be very simple and to the point	Didn't seem to help with loading data for the app but I did seem to gain a few miles with my cell service from it	No it does not; Yes possibly buy a device if we start to see more gear in scallop grounds
4	3 (always have idea if gear placed correctly on zeros and fives but can get crowded if they double set)	yes, however next step is using internet on boats for full offshore service	internet	There was improvement, however area southeast of Block Island to south of Nomads is traditionally low phone service	Yes, starlink
5	3 (ok but visual is best, both would be great)	not sure really, lobstermen will need to be more attentive to mobile gear grounds	refresh better	only added a couple miles at best; better service or wifi/sat service is needed	No, if grant provided I'd buy a starlink system
6	1 (using on a tablet screen is very difficult)	yes and no, a trawl/mark drawn is obviously there but there is a lag in real time updates which is no help	needs to be able to tie into current electronics on boat	no advantage at all, attempted to hot spot with phone and only worked sometimes	no, if provided for me would attempt to use

Under Review

Appendix 5

Participant #	13. Beyond having an accurate gear location marking application available to you, what other concerns or specific needs must be addressed before you would feel comfortable fishing in a location with only ropeless fixed gear? (Open answer)	14. If using virtual gear marking in the future, would you rather have a separate display for this information, or have it integrated into your existing chart plotter? (Open answer)	15. Without the application, do you typically try to plan ahead to reduce or avoid interactions/conflicts with other fisher's fixed gear? If so, how? (Open answer)	16. Did using the application allow you to better plan your trawl/tow locations to minimize gear conflicts? Did its usefulness in this regard depend on weather and sea conditions? (Yes or no, please explain)	17. How often could you see yourself using this application during your typical fishing activities? (Open answer)	18. What would your ideal distance be for being able to see the location of fixed gear and plan your tows? (Open answer)
1	Information must be real time	Separate	No	No	Often if it worked and we were in an area where gear conflict was a possibility	Exact location
2	Nothing as long as info stays in real time faster	Integrated into existing	Yes, look for highflyers or buoys, or from previous knowledge of gear being in the area	Not applicable, only steaming thorugh the area	Never fished these areas with mobile gear; if it was integrated would be awesome; using app was tedius waiting for it to connect to phone and didn't update quick enough	1-2 miles
3	Would feel better knowing that if fexed gear had drifted and was not in the location on the app and I had hit it by accident that I owuldn't be help responsible for it	See both on the boat	Yes if the vessel who has gear out are in the area themselves we try to contact via VHF and get numbers of where their gear is located	No it did not because it never worked properly	All the time if we were fishing in an area with a lot of fixed gear or just frequently check it to make sure nothing is in the area if just moving around a lot	1/10 of a mile; comes down to how many scallops and if a lot, will move accordingly and get as close as possibile if needed to catch
4	As long as gear still placed right shouldn't be a problem	Small screen would be nice, maybe both options. When heavy traffic using AIS and chart plotting the screens can get crowded	Yes stay between zeros and fives	Yes if enough rain cell reception would be worse	always if lobster gear is around	all the way to gear conflict areas. The seaonsal fishing and closed areas too
5	can't say, need buoys for id of gear, tide and other issues (i.e. storing) will make accuracy NULL	both. I can't have anoter screen to attend to- I'm working not sitting bored in a chair	yes, go elsewhere if needed or reconfigured tow sets			
6	gear interactions	integrated, some electronics allow multiple views	yes do avoid all the time, educated as the where edges are and seasonal changes in where gear is placed	NA	hope not to need	believe would need more than 5 miles

Under Review

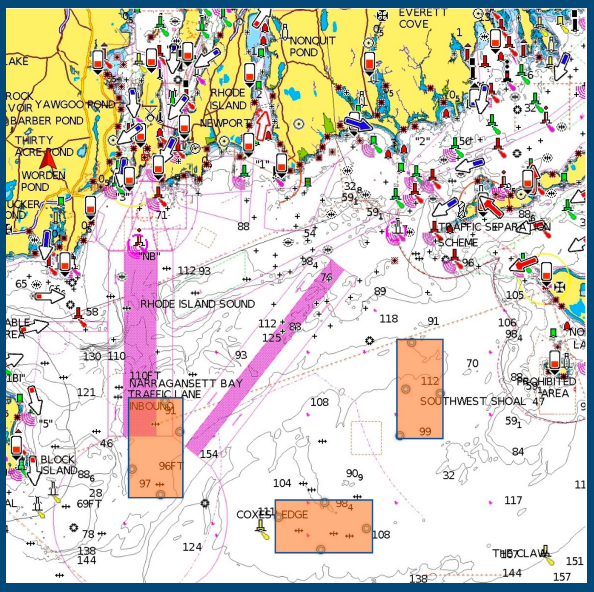
Appendix 6

Testing an Electronic Gear Location Marking Application

General Description

The Commercial Fisheries Research Foundation (CFRF) is collaborating with fishermen to test an electronic gear location marking application (app), which was designed to mark the location of ropeless fishing gear. Ropeless fishing gear systems aim to reduce the number of vertical lines in the water. However, a transition to these systems is threat to sustainable fisheries. One issue that needs to be addressed is vetting the technology that allows fishers to record and identify the location of deployed gear that does not have surface buoys. Without an adequate marking tool, gear retrieval and conflicts with mobile gear threaten the viability of several fisheries. There is currently a lack of data on the accuracy, helpfulness, and feasibility of using these apps.

Project Location



Project Goals

Accuracy

Collect data on the accuracy of the location and orientation of deployed gear that is marked on an electronic gear location marking app

Utility

Test the utility of an electronic gear location marking app to reduce gear conflicts amongst fishers

Feasibility

Determine the perception of helpfulness and feasibility of fishermen using electronic gear location marking apps

Data Collection

The CFRF uses the Trap Tracker app to mark the location of fixed lobster trap, fish pot, and gillnet gear used in the South Fork Wind Farm Fisheries Monitoring surveys. The location of deployed gear marked on Trap Tracker is compared to the actual GPS location of gear at haul-back to determine the accuracy of the app.

Mobile gear fishermen use the Trap Tracker app to help determine the location of the fixed survey gear during fishing activities. They then provide feedback and opinions on the perceived accuracy and helpfulness of the app.

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NATIONAL FISH AND WILDLIFE FOUNDATION NFWF

Appendix 7


41°10'0"N
Trawl 1
Trawl 2
Legend
GPS Start
GPS End
Trap Tracker Start
Trap Tracker End
0 50 100 200 Meters
71°20'0"W