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Executive Summary

The purpose of this Technical Memorandum is to inform stakeholders of the results of a 2015 pilot project conducted by the Southeast Fisheries Science Center (SEFSC) to assess the feasibility of transitioning two of its commercial paper logbook programs to a single electronic program. In addition to the electronic format, several other changes were also proposed. One proposed change was the scale of effort reporting for trips taken on vessels possessing one or more of the following commercial fishing permits issued by the Southeast Regional Office (SERO): Gulf of Mexico Reef Fish, South Atlantic Snapper Grouper, King and Spanish Mackerel, Shark, and Atlantic Dolphin/Wahoo (hearafter referred to as Coastal permits). We also evaluated the ability of electronic logbooks to record higher precision geographic fishing locations from fishers. These proposed changes would standardize the requirements for the Coastal commercial logbook to the current Highly Migratory Species (HMS) commercial logbook, also managed by the SEFSC. The SEFSC HMS logbook report must be returned to the SEFSC for all commercial fishing trips on vessels possessing Atlantic Tuna Longline or SERO-issued Swordfish permits (hereafter referred to as HMS permits). The proposed changes would effectively unite the two SEFSC commercial logbook programs to have identical data elements and precision, improving the utility of the data products.

Following the conclusion of the pilot project, council stakeholders directed the SEFSC logbook staff to make many changes included in the original proposal and to consider other delivery methods than those used in this pilot project. These changes have been accommodated, but the majority will not be discussed in this report.

The SEFSC conducted the pilot project from April-November of 2015 and evaluated the collective software and hardware options for electronically submitting the proposed logbook requirements (hereafter referred to as elogbooks). Because the proposed reporting changes would align the two SEFSC commercial logbook programs, a diversity of coastal and HMS commercial fishers were recruited to participate. Eight laptops (15 inch Dell Latitude E6530) and three tablets (iPad2) were deployed on a total of 11 vessels, and one vessel used an existing onboard PC. Three elogbook vendors each produced an elogbook version for the pilot program. Of the 12 vessels, nine submitted elogbook data in some capacity. From those nine vessels, 58 elogbook reports were completed with trip duration ranging from 1-17 days. Gears employed included bandit reel, hand line, longline (reef and pelagic), buoy, and fish traps, also referred to as “pots”.

An important goal of the commercial pilot project was to collect user feedback. At the conclusion of this pilot project, the most frequent feedback received from project participants concerned the hardware. They widely considered the laptops too cumbersome for many of the vessels in the pilot program. After the conclusion of the pilot project, some vendors prioritized software development for personal devices such as phones and tablets. A choice of several options will likely significantly reduce burden on commercial fishers with hardware costs, data transmission rates, and ease of use.

Another important goal of the pilot project was to evaluate the collection of fishing effort and catch for each set within a fishing trip coastal commercial gear types. This is in contrast to the current paper coastal logbooks, which solicit total effort and catch values for the entire trip. The commercial HMS paper logbook already solicits set level information. Pilot project participants provided feedback on the changes for typical commercial fishing behavior. Perceptions seem to correlate to the amount of time spent using the hardware and the amount of prior experience with set-level reporting. Participants using a gear type that can be naturally defined as a "set" were less likely to have issues with set-level reporting. The negative perceptions of set-level reporting were strongest with participants using hook-and-line/hand line (non-bandit), who do not typically refer to fishing behavior as a "set." For these or other gears, a "sub-trip" level of reporting may be more appropriate.

After extensive discussions with the Gulf of Mexico and South Atlantic Fishery Management Councils, set-level reporting will not initially be mandatory for trips on vessels possessing commercial Coastal permit(s). However, the SEFSC intends to continue discussions with industry members and council representatives to transition the commercial logbooks towards higher resolution fishing event definitions.

The pilot study also demonstrated the general ability for elogbooks to collect increased spatial resolution of fishing effort and catch. Elogbook reports from SEFSC pilot participants showed vessels fishing commercially in multiple areas during the same trip, information that is often not captured on the trip-level paper logbooks. One example from the pilot demonstrated a vessel fishing in three separate areas over a two-week trip. In this example, the current paper logbook would only instruct the captain to report a single area, corresponding to the location where the majority of catches of a given species occurred. Elogbooks also have the ability to use precise GPS coordinates (DDMM.0000) to log fishing location(s). Under current reporting standards, a vessel fishing an area at 27 degrees latitude could be anywhere in a 4,246 square mile area. Using the pilot's GPS standards, the electronic logbook would decrease the uncertainty to around 31 square feet at the same latitude. Higher resolution spatial and temporal fishing information can be used to inform ecological models, single-species stock assessments, and provide more detailed scientific data used in forming fisheries policy.

Overall, the pilot project demonstrated that elogbooks are a feasible platform to collect required logbook catch and effort information for SERO-permitted Southeast Coastal and HMS commercial fishing trips. Electronic logbook software has the ability to provide a significant improvement in data collection for the commercial sector that current paper logbooks cannot provide. Developing the data collection standards in coordination with the Atlantic Coastal Cooperative Statistics Program will lead to more streamlined logbook reporting along the East Coast and across fishing sectors, i.e., recreational-commercial and Northeast-Southeast dually permitted vessels. This meets a request from stakeholders to limit reporting burden (NMFS/GARFO 2019).

Table of Contents

Background

The Southeast Fisheries Science Center (SEFSC) conducted a pilot program to test the feasibility of electronic reporting on commercial fishing trips for permit owners who are currently required to submit SEFSC paper logbooks. Permit owners possessing Southeast Regional Office (SERO)-issued commercial coastal permits (hereafter, Coastal permits) [1] are required to report fishing trip, effort, and catch information on Southeast Coastal Logbooks when engaged in commercial fishing. Likewise, permit owners possessing commercial permits for HMS fisheries[2] (hereafter, HMS permits) are required to report trip, effort, and catch information on the HMS trip summary and set form logbooks along with weight tally records (individual dressed weights). Testing of commercial electronic logbooks (elogbooks) began in April 2015 and continued through November 30, 2015. The purpose of this Technical Memorandum is to brief the various fishery management councils, the data collection committees, and the public on the findings of the Southeast commercial elogbook pilot program.

Installation

For this pilot project, we evaluated commercial elogbook systems that had the ability to use GPS location devices to record fishing information. Thus, the elogbooks contained a hardware component in addition to the three software versions created by different vendors (discussed below). An important aspect for this pilot project was to evaluate the installation process for both the hardware and the software. Our goal was for the installation process to be minimally invasive, and to have flexibility of elogbook location, including removal without a technician present. Participating vessels had a varying amount of cabin space and electrical capabilities. This provided us with varying installation scenarios that are likely inclusive of the majority of commercial fishing vessels in the Southeast.

Volunteer recruitment began in the fall of 2014 and continued on an as-needed basis. Approaching the April installation date, 11 volunteers provided 15 vessels for the pilot program. The vessels consisted of nearly all major commercial fishing gear types, targeting a large variety of fisheries in the Southeast. The volunteers included three vessels from the commercial HMS logbook program. Installation of the elogbook hardware occurred over several months beginning in April 2015. Initially, the installation was planned to take three weeks. However, several factors prevented us from meeting the 3-week schedule. As the installation date approached, several vessel owners informed the SEFSC that they did not want to participate in the pilot program. Most notable were buoy gear fishers in the South Florida area. Also, a regulatory fishing closure in the Gulf of Mexico halted participation of a pelagic longline vessel docked in Louisiana.

[1] SERO-issued commercial Snapper-Grouper/Reef Fish, Mackerel, Dolphin-Wahoo, and Coastal Shark Fisheries

[2] SERO-issued Swordfish, Atlantic Tuna Longline, and Shark permits

Vessel Information

Eight laptops and three tablets were deployed on 11 vessels. One additional vessel used an existing onboard Personal Computer. On these 12 vessels, commercial fishing activity used: bandit reel, hand line, longline (reef and pelagic), buoy, and trap (fish). Three of the vessels were considered "mixed gear" vessels, as they used several fishing gears during the course of the pilot project.

Participating Software Vendors

Three vendors produced commercial elogbook versions for the pilot program. These were OLSPS Marine, Electric Edge Systems Group Inc., and Harbor Light's Atlantic Coastal Cooperative Statistics Program (ACCSP). In this report, the OLSPS Marine software will be referred to as the Olrac Dynamic Data Logger (OlracDDL). The Electric Edge Systems software is called Fishing Activity and Catch Tracking Systems (FACTS). The Harbor Lights version will be referred to as ACCSP.

Two different hardware platforms were provided to participants during this pilot, an iPad2 and a 15-inch Dell Latitude E6530 laptop. Three vessels received iPads, which only ran the ACCSP version of the commercial elogbook. Other vessels in this pilot program used their own onboard computers, and we installed a version of the elogbook on those whenever possible. We provided all remaining commercial fishing vessels with the Dell laptop, using the FACTS or OLSPS elogbook versions, which operated exclusively on Windows operating systems.

Installation Process and Technical Information

Operators participated with our staff when deciding the best location for elogbook devices. Turbulence-related accidents were a concern for the iPads and laptop computers due to their mobile nature. In some vessels, even those with enclosed wheelhouses, saltwater intrusion was another concern for deciding the location of the hardware. Given the space constraints on the participating vessels, hardware connections were as flexible as possible to accommodate the needs of the individual vessel operator. All hardware components under evaluation needed a consistent power supply. All pilot fishing vessels had 12-volt battery power and some have DC to AC inverters providing 115VAC. Providing power to the elogbook hardware from the vessels' 12-volt batteries was the only option available on all vessels in the study. 12-volt DC power was provided through maritime-quality sockets as is typical on fishing vessels. We implemented fused circuit protection wherever practical.

The commercial elogbooks required two primary sources of data: manual data entry of fishing characteristics and real-time location captured via a Global Positioning Systems (GPS) enabled device. Some vessels already possessed and utilized a GPS unit for fishing activities, prior to the pilot project. On those vessels, location data was directly provided to the elogbook software by integrating the existing vessel GPS as a data input to the elogbook device. Vessels without pre-existing GPS units were provided with an external USB-GPS receiver, which could also directly link to the device operating the elogbook software.

On the vessels with pre-existing GPS systems, the units were manufactured by either Garmin or Furuno. On some vessels, although functional GPS units were available, the necessary connecting cable from the GPS unit was absent. This pilot project revealed that it is imperative to know what connectors and cables are available on board the vessel. When the correct connections for the GPS were not available, we needed to order the proper cable prior to installation.

For vessels using laptops, an additional device was necessary to import the data from the pre-existing GPS unit to the computer. GPS data coming from maritime GPS units, such as those used in this pilot project, is serial data as per the appropriate electrical standards of NMEA 0183 (National Marine Electronics Association) or NMEA 2000. This serial data stream has the ability to feed directly into any desktop legacy 9-pin connector serial port. However, the 9-pin connector serial port was longer available on the laptops used in this project, so the serial GPS data needed to be transferred through a USB port. To achieve this conversion, we used a Trendnet TU-S9 device to convert the serial GPS data into the correct format via the USB port.

As the commercial pilot program progressed, we discovered that both FACTS and the OlracDDL versions of the commercial elogbook software, operating on Windows laptops, worked well with certain external USB-GPS receivers (described in detail below), which could be used instead of connecting the laptop to the pre-existing vessel GPS unit. The USB-GPS receivers are very compact and very capable GPS receivers operating through the USB port of a personal computer. By using these "standalone" GPS receivers, elogbook installation can forgo some of the problems experienced by integrating laptops with the vessels' pre-existing GPS, providing several advantages. An elogbook system using the USB-GPS receiver was more portable. Additionally, using the USB-GPS receiver also solved the problems we encountered when the pre-existing GPS signal was shared by multiple applications, including the elogbook.

We tested two specific USB-GPS receiver models in the commercial elogbook pilot program: the GlobalSat BU353-S4 USB GPS Receiver and the Garmin 18x USB GPS. Both are approximately 2" by 2" discs by 0.8". The Dell laptop's USB port could not handle the electrical power requirements of the GlobalSat unit, but worked well with the Garmin unit. The other laptop brands did not exhibit this electrical power limitation.

Other general issues encountered during installation during the pilot study are summarized below. In general, these comments may not be relevant outside the pilot study, but are included here to document the challenges that were met during this effort. Overall, we learned that GPS installation or integration was not a one-size-fits-all process, and sometimes required improvisation.

Technical issues during pilot commercial elogbook installation:

1) Vessels with a pre-existing GPS used the data for additional systems such as a chart-plotter or navigation software. Sharing the signal sometimes caused interference between the elogbook software and the chart-plotter software. One solution was to use virtual GPS port splitter software, which is available as shareware or by license. Although this worked, there were limitations. The port splitter software required starting the two applications in a specific sequence. An alternate option is to use separate GPS sources (such as a USB-GPS receiver) for the systems.

2) GPS data output is designed to go to only one device (computer). Therefore, when integrated with a vessel's pre-existing GPS systems, the elogbook laptop added additional consumption of the serial data signal, which reduced the voltage. In the pilot program installation, we tried to minimize interference with the existing chart plotter. In a non-trial scenario, we discovered that this could be handled numerous ways. One method added a small "modem splitter". Another method used a USB hub, so that the data was routed to the chart plotter and to the elogbook via separate USB ports. Note: USB is simply a faster, universal version of the standard serial data.

3) In one installation, although the pre-existing GPS was already in use, the unit had an additional, redundant GPS port available. The unused connector was available for the elogbook, but it required an additional cable. We purchased the necessary cable to complete the installation.

Trip Descriptions

Of the 12 vessels with hardware installed, nine vessels submitted elogbook data in some capacity. A total of 58 trips were completed with days at sea ranging from 1 to 17. Following the completion of the fishing trip, participants submitted elogbooks via Wi-Fi networks, or by physically connecting the laptop to a network. Data file size for transmission ranged from 1 Kb (the average for single day trips) to 14Kb for a trip lasting 17 days. Further vessel and gear information can be found in **Appendix A**.

Commercial elogbook Participant Feedback

One objective of the commercial elogbook pilot program was to test versions of elogbook software, and then use feedback from the participants to revise elogbook technical specifications so that the specific needs of Southeast commercial fisheries are met while ensuring the burdens of reporting are as low as possible. During the pilot, participants provided regular feedback, which we made available to the software vendors. The vendors could make any changes they felt were necessary to meet requirements or make improvements to the user interface. It is important to note that not all feedback will go into the operational version. The SEFSC intends to allow vendors to develop a product, which will be assessed for approval, and then marketed to

commercial fishers by the vendors in the Southeast. Approval will be contingent on meeting the technical specifications established by the SEFSC.

Hardware

The most frequent feedback from the pilot program participants concerned the hardware. Participants widely considered the laptops too large or cumbersome for many of the vessels. Perception of the hardware also depended on the familiarity of the user with computers in general. Some captains for vessels in the pilot program relied on already-installed computers to run navigational software. For these vessels, we installed the elogbook software on existing computers instead of providing a new laptop or tablet. Feedback from these fishers focused on the software aspects of the elogbooks, rather than the hardware.

Participant perception of the hardware also varied by the target fishery and the gear used. For example, due to the nature of buoy gear fishing, participants using this gear type interacted with the laptop few times during a trip. This fishing behavior has a well-defined set, with gear typically soaking for several hours, which was familiar to all of pilot participants using buoy gear. Therefore, the data collection instructions allowed these captains to stow the laptop for the majority of the trip. In comparison, vertical line fishers (Hook and Line - handline, rod and reel, or bandit) had to interact with the laptop frequently due to the proposed new definition of a fishing set (described in the *Set-Level Collection* section of this publication). Also, this gear type captures a wide variety of species, which need to be individually entered for each set. Vertical line fishers voiced more frustration with the hardware mobility limitations. Fishers using bandit reel gear were often present in the wheelhouse while fishing was conducted, and these participants were able to pay relatively more attention to the elogbook.

Many participants indicated that the elogbook software should be on a tablet. Both vendors that were running primarily on laptops were informed early in the pilot program that fishers were asking for mobile versions of the software. The differences in using a laptop or PC versus using a mobile version for this pilot project can be found in **Appendices B and C**. Some users may prefer using laptops or desktop computers due to their familiarity with those devices as well as existence of a personal computer already in use on the vessel. As noted in the installation review, some vessels in the pilot program were already using a computer to run navigational software. We determined that integrating elogbook software with these platforms would not be difficult to do. However, a large portion of the fleet may find it more convenient to run the commercial elogbook on a self-contained unit like a tablet or smartphone, which is more portable.

Software

Prior to the launch of the pilot, SEFSC staff proposed technical specifications and delivered these requirements to the vendors. Another priority of the commercial elogbook pilot program was to field test the user interface of available software versions specific to the Southeast commercial fishing fleet's needs. Pilot participants provided feedback on a regular basis, including the desire for:

- More efficient navigation through the user interface
- Ability to search quickly when scrolling through lists of values, such as species
- Autofilling fields that do not typically change between sets or trips
- Display settings to accommodate night fishing

There are some potential differences in the wants/needs of the industry versus the needs of the SEFSC. Technical specifications for the commercial elogbook have continued to evolve following the conclusion of this pilot project, with consideration given to preferences of fishers while meeting the reporting requirements of management councils.

Set-level Collection

Multispecies commercial fisheries are common in the Southeast. The ability to collect and use more detailed catch and effort data for stock management can be an advantage when navigating the challenges facing Southeast commercial fisheries. With more detailed fishery-dependent data, scientists are better able to disaggregate a fishery into fleet segments (Bastardie 2010); however, increased detail requirements can also lead to increased reporting burden on fishers.

On the paper logbook, commercial fishers using coastal fishing permits issues by SERO are asked to report their gear deployments, fishing time, and catch aggregated "per trip." The new proposed set-level reporting would ask the fishers to report the same items "per set." The commercial fishing pilot participants generated substantial feedback on the new proposed definitions for set-level reporting (**Table 1**). Participants with HMS commercial permits already had experience with reporting at a set-level (as per the current paper logbook), while some of the participants using coastal commercial permits did not. Perceptions correlated to prior experience and the amount of time spent on the software. For example, participants using buoy gear interacted with the program very little and have prior set-level reporting experience, therefore they had very little trouble with the information that was required.

Participants using gears that are deployed in what could logically be described as a "set" were less likely to have issues with the new set-level reporting. These gears involve fishing behavior that allows gear to soak undisturbed for a given time, without movement or interaction with the fisher. Traps, longlines, and gillnets all fall into this category. Conversely, hook and line gear requires frequent manipulation, so fishers do not typically refer to fishing behavior as a "set".

The negative feedback on set-level reporting was strongest for participants using hook and line gear. For the pilot project, we gave direction to participants defining what was considered a "set" for hook and line gear (**Table 1**). However, recording the number and frequency of these pre-determined fishing events was problematic for some hook and line fishers. For instance, over the course of the pilot project, we documented instances where hook and line fishing vessels made several, very short "test sets" before initiating a significant fishing event. These "test sets" were usually only 5-10 minutes long, and participants reported that recording gear deployment and retrieval for these events was burdensome. Another typical

fishing behavior for this gear employs a tactic of drifting over a reef several times, each time removing all gear from the water and returning to the initial location where the set began. Again, these types of sets lasted a very short amount of time. Pilot participants indicated that these fishing behaviors are common, and recording a set every time the gear is removed from the water is simply too burdensome.

With this feedback, our staff re-defined the reporting instructions for these gears. The new definition was scaled to a sub-trip level for hook and line – other, and manual (**Table 2**). Under the revised definition, a fishing event would end when there is a *significant* stoppage of active fishing or when a new gear is deployed. Furthermore, fishers would be required to log a new fishing event at least once every 24 hours, if the fishing activity is constant over more than one day. This sub-trip level reporting is still an improvement spatially and temporally from the current trip level reporting used in commercial coastal fishing paper logbooks. We also recommend this revised definition for cast net fishing, based on known fishing behavior. Very few fishers report cast-net fishing commercially so we were unable to seek feedback from this sector of commercial fishers for the pilot study.

For fishers using the bandit reel and buoy gears, fishing behavior was more naturally suited to "set" reporting. A typical bandit reel set in the pilot lasted 3-6 hours and a fisher would make 5-9 sets over a 4-day trip. Furthermore, no specific issues from set-level reporting within this gear type were reported.

Electronic Data Entry

All versions of the commercial fishing elogbook used for the pilot project had features that were intended to reduce the data entry burden on fishers. For example, fishers could pre-select a "favorites" list of commonly used gear, bait, and target species, allowing for quick access during reporting. Autofilling was another feature that was tested to varying degrees by using the three software versions.

Each elogbook version varied in the extent to which data fields could be autofilled using the previous entry, compared to fields requiring entry for each new set or trip. The pilot project participants expressed interest in autofilling nearly all of the effort data fields between sets. These fields include target species, hook size and type, bait type used, and gear type among others. However, discussions within the SEFSC suggested that careful consideration should be taken for this feature to ensure that the correct information is collected. For example, on the OlracDDL, the *Target Species* field is autofilled with the information from the previous set. Even though this is a required field, it was very inconspicuous and could easily be overlooked. This was evident in the pilot logbooks that were submitted from this software vendor. For many of the reports submitted, the target species never changed and some reports indicated that the reported target species was not even caught. Given that the target species for Southeast commercial fishing can change between sets for a given trip, we recommend that this field not be autofilled. However, a list of "favorite" target species could be pre-loaded to limit time spent on this field. This and other examples illustrated the need for explicit designation of which fields can and cannot be autofilled for the final technical specifications of the commercial elogbook.

Hail weight vs. Paper Logbook Weight

The current paper logbook for commercial coastal fishing directs fishers to log the whole or gutted weight (in lbs.) for all fish sold or kept for personal use. With the current paper system, discarded catches are reported on a separate logbook. The elogbook will make it easier for fishers to report a hail weight (defined as an estimated whole weight in lbs. for unprocessed catch) for each species caught in a set, which can potentially include discarded catches in addition to the landings. Discard reporting was not a requirement during the pilot study, however elogbooks have the potential to reduce the reporting burden for discard reporting. The estimated nature of the hail weight definition can potentially create differences in total landings that are sold (and reported by dealers) versus the weight reported by fishers in their elogbooks. These differences are expected and the SEFSC has procedures to reconcile landings for scientific analysis.

For the pilot project, commercial fishers were asked to report twice for each trip. They provided an elogbook report and a traditional paper logbook. There was no clear pattern in the commercial elogbook pilot study of captains over- or under-estimating landings, as both occurred regularly and varied between trips. The comparison indicated that hail weights provided using elogbooks were similar to the landings reported using the paper logbooks, and they were also similar to landings reported by the dealers. Fishers routinely estimated hail weight within 10% of the paper logbook reported catch.[3] Only three trips estimated hail weight with a difference of more than 15% of the paper logbook reported catch, and the largest gap between hail weight and paper logbook weight during the pilot was 21%.

For abundance indices, it is more beneficial to look at the hail weight per set (or unit of effort) than to focus solely on the landings totals of a trip. Trip-level reporting must assume that landings are uniform for the fishing time reported (Mion et al., 2015; Bastardie et al., 2010; Gerritsen et al., 2011). For example, on the current coastal paper logbook form, total fishing time for a reef longline trip is calculated by the "average time in hours that the hooks were in the water" multiplied by the number of sets in the trip (2016 Southeast Coastal Fisheries Trip Report). Within fishing areas reported, catch and effort must be averaged, potentially reducing analysts' ability to accurately determine any spatial variation in abundance that may be present (Mion et al., 2015; Hintzen et al., 2012). For gears that lack natural sets (and thus have more effort assumptions); this can be even more problematic. The proposed refinement of commercial effort and catch reporting assessed in this pilot project would allow scientists to reduce uncertainty in abundance estimates.

Set-level Location

Coastal paper logbooks currently require commercial fishers to report one area fished per species on the trip level to be compliant with reporting requirements, even if multiple areas are

[3] Elogbook hail weight was compared to paper logbooks and the dealer landings for the reported trip. Dealer reported landings were identical or nearly identical to paper logbooks for vessels reporting a trip during the pilot. Occasionally, a few pounds were reported on paper logbooks for catch that was not sold.

fished. The paper logbook instructs fishers to report the area where the majority of the given species were caught, with areas corresponding to 1x1 degree grids. The use of onboard commercial elogbooks, integrated with GPS receivers, has the ability to significantly increase the precision of the spatial data collected and determine whether fishing took place in multiple areas.

Analysis of elogbook data from this pilot project showed that commercial fishing sometimes does take place in multiple areas per trip for a single target species. This information would not be captured on the coastal commercial paper logbook, unless the vessel began catching a different species. One example from the pilot demonstrated that a vessel reported fishing in three separate areas over a two-week trip, but only reported one area on the paper logbook. Over the course of the pilot, there was no consistent pattern of vessels fishing in single or multiple areas on a trip. Vessels that fished over multiple areas for some trips may only fish in one area the next trip and vice versa.

The HMS commercial fishing paper logbook already solicits fishers to report location for the start of a fishing set at a higher precision than the coastal commercial paper logbook. The paper HMS logbooks require fishers to report the decimal degrees and decimal minutes (DDMM) where fishing gear was deployed. We compared paper and elogbook location information for HMS commercial fishing and we found the two to be highly similar. The additional requirements proposed in this pilot project would also require all commercial fishers to report the time and location of the end of the fishing event.

As expected, this pilot project illustrated that commercial fishing vessels on multi-day trips have a higher likelihood of fishing in multiple areas compared to their counterparts on single day trips. To get an idea of the potential magnitude of previously unreported fishing areas for the entire fleet, we assessed historic paper logbook data. For the years 2014-2015, multi-day trips lasting four or more days comprised 13% of all commercial logbook reports and 46% of days-at-sea for the coastal commercial fishing fleet. Trips lasting six or more days comprised 7% of all reported trips and 33% of total days-at-sea. The proposed reporting changes assessed in this pilot project illustrate the potential for a significant increase in the amount of fishing locations reported per commercial fishing trip.

Overall, major improvements in the precision of the spatial data would be one of the largest benefits that could be gained from using electronic logbooks for any fleet. Fishery-dependent data with concurrently recorded geo-spatial data presents a novel opportunity to analysts, researchers, and managers (Gerritsen et al., 2011). Commercial fishing vessels often travel large distances over a trip or even in a day in search of fish (Russo et al., 2015). Under current reporting standards for SERO coastal commercial fishing permits, a vessel fishing in a 1X1 degree grid area at 27 degrees latitude could be anywhere in a 4,246 square mile area. Furthermore, that uncertainty increases if the vessel fishes in additional unreported areas over the duration of the trip. Using the GPS standards (DDMM.0000) proposed in this pilot project, uncertainty would decrease to around 31 square feet at the same latitude. Additionally, information provided by the elogbooks will show the location of the beginning and end of each

set for the majority of gears. This information would improve the uncertainty of current biological models, ultimately improving stock assessment methods (Bastardie 2010).

As of 2015, there were 1700+ SERO-permitted coastal and HMS fishing vessels actively fishing. The reporting changes proposed in this pilot project would allow for comparisons between other data collection methods, such as the observers program, for commercial fisheries. The type of data collected by elogbooks has the potential to be closely aligned with those collected by observers, effectively increasing the frequency and the spatial extent of known data collection methods (Mion 2015). Another benefit of such detailed data is the identification of specific hotspot fishing locations and species interactions. This type of analysis can aid in identifying essential fish habitat, spawning aggregations, and migration patterns of commercially important or endangered/threatened species. (C. Moore, 2016).

Apportionment

This pilot project also proposed changes to the apportionment reporting of trip landings for commercial fishing with Coastal permits. The current coastal paper logbook instructs fishers to report only one dealer, to whom the majority of landings were sold. The commercial elogbook in this pilot project allowed for more flexibility in landings apportionment, with multiple dealers allowed, which would bring the coastal commercial reporting closer to that which is already in place for the commercial HMS logbooks. These changes generated several rounds of discussion between the SEFSC staff and the commercial elogbook software vendors, with input from the commercial pilot participants. Commercial pilot participants using both HMS and Coastal permits were asked to apportion their catch between dealers when there were multiple, and report if any was kept for personal use. The data collected within the apportionment section of elogbooks in this pilot were: species landed, apportionment amount, disposition, grade, dealer sold to, and date and time sold (**Table 3**). The total of all landings in the apportionment section was required to match the sum of estimated hail weights for every set, per species retained.

To reduce recall bias, commercial fishers in this pilot project were instructed to submit electronic logbook reports before selling their fish. This is another proposed change from the current paper logbook instructions, which require reporting within 7 days of landing. The new instructions led to confusion because commercial fishers are not always certain which dealer(s) would ultimately purchase their catch, or if any "leftovers" would be kept for personal use. Participants had trouble understanding why they apportioned the estimated hail weight when it did not match the precise weight sold, as weighed by the dealer. Also, during the course of this pilot project, all of the commercial participants sold to one dealer exclusively, and they expressed dissatisfaction with having to re-enter apportionment information for all catches sold to the same dealer.

This feedback led to discussions among the SEFSC staff, resulting in an overhaul of the apportionment section for future commercial elogbooks. We determined that final landings specific to a trip can be acquired from dealer reports. As a result, future elogbooks may instruct

fishers to report the *intended* dealer for catches kept for the purpose of sale. Furthermore, we determined that the market grade of landings was not necessary as a commercial logbook field. The reporting deadline for the final elogbook instructions will be set by the Gulf and South Atlantic fishery management councils, and may affect the apportionment instructions.

Cost of Electronic Logbooks to the Southeast Fleet

Cost is an important consideration for implementing a new reporting system such as the proposed elogbooks for commercial fishing. In the Southeast, fishing behavior, target species, operating costs, and revenue vary enormously between vessels, subsequently affecting the owner's ability to purchase a new reporting mechanism. The following is a generalized description of the major cost considerations for commercial elogbooks for vessels with SERO-issued Coastal permits, using data available for 2014. Economic analysis for commercial HMS operations are outside the scope of this summary.

Fleet Revenue

Using the most recent complete annual data set at the time of analysis, in 2014 the Southeast coastal fleet had 3,893 vessels with SERO commercial coastal fishing permits. Of those, 2,127 did not report a commercial coastal fishing logbook report in 2014, leaving 1,787 vessels for which we can estimate the varying levels of revenue. Estimated revenue was determined by calculating total landings by species for each vessel, and then multiplying those landings by the average price per pound by state. Landings information was derived from the coastal fisheries logbook program (CFLP) and the value of the landings from the Accumulated Landings System (ALS).[4]

Results from the CFLP and ALS analysis show a wide range of estimated revenues for vessel owners with coastal commercial permits. Given the relatively small-scale nature of many Southeast commercial fisheries, this is to be expected. In our analysis, 55% of federally permitted commercial fishing vessels generate revenues above $10,000, and slightly more than 25% of vessels that took at least one trip in 2014 had revenues of more than $50,000. At the time of this analysis, 270 vessels (15%) had estimated annual revenues of more the $100,000.

The 2014 revenue estimates imply that many permitted vessel owners do not participate in the commercial fisheries full-time or even every year. These data indicate that for a large percentage of vessel operators in the Southeast, income derived from commercial fishing is likely only a portion of the operator's annual income. Another major component likely comes from for-hire fishing (over 20% of vessels with commercial Coastal permits also have a SERO-issued for-hire permit). More specifically, analysis of a random sample of the commercial coastal fleet showed that about a tenth of vessel owners have both types of permits, and derive more than

[4] Summarized from analysis by Christopher Liese and Elizabeth Overstreet. Estimated revenue for federally permitted commercial vessels here does not include any income from participation in HMS, for-hire, or state managed fisheries etc.

half of reported income from charter fishing. Another important factor for Southeast commercial fisheries is a large investment from the owner in the form of labor. 2014 paper logbooks reported that 85% of commercial fishing vessels comprising 86% of days-at-sea were operated by the owner, revealing an important labor component when it comes to operational costs.

Dues to the large overlap in vessel owners engaged in commercial and for-hire fishing, there is a need to recognize the cost considerations of the SERO for-hire logbook program in addition to the commercial requirements. Southeast for-hire vessels adopted mandatory electronic reporting in 2021. To reduce cost and reporting confusion, development of elogbook software to accommodate both types of reporting will be prioritized. Data requirements between the elogbook versions would differ, though a singular device with alternate interfaces depending on the type of fishing trip would reduce the cost and burden to fishers. Creating multiple interfaces on a singular device would best work by consolidating elogbook submission protocols across the two fishing sectors. This has mostly been accomplished by consolidating reporting interfaces using the ACCSP API (Application Programming Interface). There will be different reporting requirements between the sectors, but those requirements should not affect the data formats and structure.

Cost of elogbooks and Associated Hardware

Implementing the proposed changes in this commercial elogbook pilot project would shift a proportion of the data entry costs from the SEFSC to the industry. The exact cost to the industry will depend on several key factors, including the software version chosen, the cost of elogbook platforms (phones/tablets/PCs), and the supporting hardware. Cost differences in the elogbook software versions may differ due to the integrated features ('bells and whistles') above what is required by the SEFSC. These features might include spatial tracking of deployed gear, detailed access to catch histories and locations, and user interface features that facilitate better elogbook interactions.

The cost estimates reported here are based on a range of scenarios in which vessels in the Southeast may need to upgrade or include elogbook licensing and hardware in order to submit logbooks electronically. We do not include scenarios where a vessel owner owns multiple vessels, or a dealer covers the costs of licensing for its fleet vessels. Furthermore, the licensing costs are estimates based on the availability in other markets or disseminated to the SEFSC. All estimates provided to the SEFSC were considered non-binding and subject to change. Licensing costs are not specific due to the proprietary nature of the information.

Hardware costs (**Tables 5, 6, 7**) are given in a range from mid/low-end to high-end costs and reflect an ordinary range of PC laptops, tablets, and supporting hardware (wires, USB-GPS receivers etc.) at the time of this pilot project. Estimates for the cost of labor for installation were based on costs during the pilot and can vary. We do not include the costs of pre-existing GPS units, chart-plotters, or any other vessel electronics (i.e., VMS units and depth finders) in the price estimates. Finally, elogbook versions that ran on tablets did not need supporting hardware as the tablet is a self-contained unit capable of producing GPS locations.

Data Transmission Costs

Transmitting logbooks electronically provides near real-time access to catch and effort data. In this commercial pilot program, nearly all elogbooks were submitted via at-dock or home Wi-Fi, or by physically connecting the laptop to a network. However, with advances in cellular coverage and technology, mobile elogbook devices now have the ability to connect to 4G/5G networks, allowing for data transmission through cellular networks. Sending data through a cellular network would require fishers to use personal or company data. In this pilot project, vendors packaged the trip data files in a way to minimize the data size, thus an elogbook submission would have a nearly negligible effect on cost with respect to most current cellular data plans. The average file size of a commercial elogbook report during the pilot was 3.37 Kb. All single day trips were one Kb or less in file size. The average data file size for a multi-day trip (2-17 days in pilot) was 5.31 Kb. During our analysis of the historical paper logbook trip submissions, the average coastal commercial fishing vessel makes 3.5 trips a month. On average, there were two trips exceeding one day per vessel/month (1.96) in the historical paper logbook database. An average vessel took 4.25 trips lasting one day per month. We estimated that vessels on multiday trips would be using on average 10.4 Kb a month and vessels taking day trips would use an average of 4.25 Kb of data a month by submitting elogbooks via personal cellular plans.

Some software versions in this pilot project have the ability to be integrated with vessel monitoring systems (VMS), which have their own satellite transmission capabilities. However, no vessel participating in this pilot project contained a VMS model that was compatible with the elogbook versions under assessment, and therefore, satellite transmission costs are outside the scope of this analysis. Not all vessels participating in Southeast commercial fisheries are required to use VMS units. At the time of this pilot project, there were no plans to stipulate VMS compatibility as a requirement for Southeast commercial elogbooks. Expanding Wi-Fi options, increased cellular coverage, and relatively small data file sizes would contribute to lessening the burden for industry to submit elogbooks in a timely manner.

FMB Staff Conclusions and Recommendations

This pilot project demonstrated that electronic logbooks are a feasible platform to collect commercial catch and effort fishing information in the Southeast coastal and HMS commercial fisheries, with a large potential to increase the value of the data for scientific purposes. Electronic reporting is more timely and has the potential to screen errors before they arrive to NOAA databases. This elogbook pilot program also gave the SEFSC insight into hurdles specific to the fisheries and fleets of the Southeast. Circumstances such as cabin space and protection, familiarity with laptops and tablets, and the ability to integrate data entry into fishing activity were all evaluated. Furthermore, commercial fishing pilot participants had the opportunity to provide input on the development of the operational version of the elogbook interfaces. As a result of this pilot project, the SEFSC staff have developed recommendations to guide the Regional Fishery Councils, stakeholders, and the public.

elogbook Platform (Hardware)

A large portion of the feedback received during the pilot pertained to the hardware. The majority of participants in the pilot study used a government-issued 15.6-inch laptop. The feasibility of using laptop computers mainly related to two factors: a relatively large, protected wheelhouse, and fishing behavior that employed long set times. GPS and power connections limit the portability of the laptop. Vessels that have a pilot who is continuously monitoring the wheel reported fewer issues with the laptops.

For vessels where using a laptop is problematic, the use of mobile devices should be employed. Mobile devices provide numerous advantages including longer battery life, portability, inclusion of GPS, and increased durability when used with a protective case. Vessels and gear types ideally suited to use a mobile version include smaller vessels with a less-protected wheelhouse, small crews, and fishing activities with relatively shorter sets. Drawbacks to using mobile devices possibly include reduced data editing capability from lack of physical keyboard and smaller screen sizes.

For both PC and mobile devices, a number of data transmission scenarios are possible. Hardware can connect to the internet via Wi-Fi or reports can also be sent via cellular networks. Furthermore, some future elogbook versions may have the ability for submission via onboard VMS units, if the manufacturer wishes to develop this functionality.

Set-level Data Collection

Given that HMS fisheries are already reporting on a set-level, little is expected to change with the introduction of elogbook reporting. Logbook reporting for commercial coastal fishing, on the other hand, will have the opportunity to transition to the more spatially and temporally specific set-level data entry. During the pilot, the only gear type that proved problematic in terms of quality of data collected, as well as excessive burden to fishers, was for commercial hook-and-line gear. From discussions with fishers and among SEFSC staff, we determined that for these gear types, along with cast nests, effort reporting could be re-defined to a "sub-trip" level. In other words, commercial fishers would be instructed to report at least one effort per 24-hour period on a multi-day trip. This revised definition of a fishing event could gain support from the commercial industry while still improving the quality of catch/effort data. A description of typical fishing events for pilot participants, along with notes on hail weight vs. logbook accuracy can be found in **Appendix A**.

Standardizing Logbook Reporting

The development of logbook data collection standards, in coordination with ACCSP, will streamline reporting along the US East Coast and across fishing sectors. This development has applications for "One-Stop Reporting", where vessels with several types of permits (i.e. recreational-commercial permits, or Northeast-Southeast dually permitted vessels) could receive compliance for multiple programs by submitting a single document. This meets requests from stakeholders to limit reporting burden (NMFS/GARFO 2019). It would also reduce confusion for participants.

Transition to Commercial Electronic Logbooks in the Southeast

At the time of this pilot project, paper versions of coastal and HMS commercial logbooks are mailed via USPS annually, and incoming reports are received and opened daily at the SEFSC. Logbooks are then organized and mailed off for manual data entry, and then loaded into the Unified Data Processing System (UDP), which is maintained by the SEFSC. Logbooks with missing data, potential errors, or discrepancies are then flagged for further validation. Once fully validated, logbook data are accessible to staff and analysts. A commercial logbook report containing no errors will be processed into UDP in around two weeks from the time it arrives at the FMB. Should the logbook need to be reviewed and then corrected by a vessel owner, the process can take between 4-6 weeks or longer.

Elogbooks can shorten this time in three ways. Firstly, elogbooks circumvent the length of time it takes to receive or submit a logbook through the mail. Secondly, they reduce the amount of back-end validation needed from SEFSC staff by preventing invalid responses (or blanks) from being submitted by the user. And lastly, elogbooks have the ability to allow users to correct errors via the application software.

Commercial Permit Compliance

All paper logbooks that are currently submitted count toward a permit owner's monthly compliance for renewing their permit. Commercial permit owners must be relatively up to date with either fishing logbook reports or "No Fishing" reports to renew their permit. Both forms must be complete and free of errors. We recommend that the same standards apply to elogbooks. ACCSP has entered into an information sharing legal agreement with SERO that will allow permit owners using an ACCSP portal to be linked to their corresponding permits. All subsequent commercial elogbook submissions can be used for permit compliance and, provided forms are free of error, fishers can be given near real time credit for their submission.

While the elogbook data collection systems described in this report offer many advantages to fishers as well as data users, we believe that only a portion of the commercial fishing fleet will voluntarily convert to electronic reporting. Cost considerations as well as the familiarity with computers/tablets will likely prevent many captains or permit owners from becoming early adopters. A gradual implementation of elogbooks (transition period) would not impact ongoing analyses or stock assessments.

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Tables

Table 1. Pilot definition of fishing event for hook and line and cast net gears.

GEAR	SET DEFINITION
HOOK AND LINE - OTHER	Fishing event begins when the first hook is placed in the water. Event ends when all lines are brought onboard and effort is moved to a new area of water or a different gear is deployed.
HOOK AND LINE - MANUAL (i.e. hand, rod and reel)	
HOOK AND LINE - POWERED (i.e. electric, hydraulic, bandit)	
HOOK AND LINE - BUOY	
TROLLING, GREENSTICK	
TROLLING, OTHER (i.e. rod & reel, hand, bandit, etc.)	
CAST NETS	

Table 2. Revised List of Gears and Set Definitions. Revised Fishing Event Definitions are Highlighted

GEAR	SET DEFINITION
SEINE, PURSE	Fishing event is defined as a set. A set begins when gear is first placed in water and ends when gear has been completely removed from the water.
TRAWL, UNCLASSIFIED	
TRAWL, OTTER	
TRAWL, MIDWATER PAIR	
POTS, CRAB	Fishing event begins when the first trap is dropped and ends when all traps have been removed from the water.
TRAPS, FISH	
TRAPS, SPINY LOBSTER	
TRAPS, OTHER	
GILL NETS, OTHER	Fishing event is defined as a set. A set begins when gear is first placed in the water and ends when gear has been completely removed from the water.
GILL NETS, DRIFT	
GILL NETS, STRIKE	
GILL NETS, ANCHOR	
HOOK AND LINE - OTHER	Fishing event is on a Sub-trip level (24hours). An event begins when first hook is placed in the water. Event ends when there is a significant stoppage of fishing effort or new gear is deployed. At least one event must be recorded every 24 hours, if actively fishing.
HOOK AND LINE - MANUAL (i.e. hand, rod and reel)	

HOOK AND LINE - POWERED (i.e. electric, hydraulic, bandit)	Fishing event is defined as a set. A set begins when the first hook is placed in the water. Event ends when all lines are brought onboard and effort is moved to a new area of water or a different gear is deployed.
HOOK AND LINE - BUOY	
TROLLING, GREENSTICK	
TROLLING, OTHER (i.e. rod & reel, hand, bandit, etc.)	
LONGLINE, PELAGIC	Fishing event is defined as a set. A set begins when the first hook is placed in the water and ends when the last hook has been removed from the water.
LONGLINE, REEFFISH	
LONGLINE, SHARK	
LONGLINE, OTHER	
CAST NETS	Fishing event is on a Sub-trip level (24hours). Fishing event begins when the first cast is made. Event ends when there is a significant stoppage of fishing effort or new gear is deployed. At least one event must be recorded every 24 hours, if actively fishing.
HARPOONS, SWORDFISH	Fishing event begins when fisher(s) begin actively looking and ends when search ends.
SPEAR/GIG (NON-DIVING)	Fishing begins when diver(s) enter water and ends when last diver exits water.
DIVING, POWER DEVICE	
DIVING, NON-POWER DEVICE (NET, SPEAR, HAND)	
OTHER	

Table 3. Pilot Apportionment Section Data Fields

Species	Amount landed	Disposition	Grade	Dealer Info	Date Sold	Sold Time

Table 4. A. Post Pilot Apportionment Section Data Fields for Catch Sold

B. Final Apportionment Section Data Fields for Catch Not-Sold

A.

Species	Dealer Info	Date Sold

B.

Species	Amount Kept	Disposition	Date landed

Table 5. Cost of hardware and Installation per Pilot Vessel

Computer	Cost (time of purchase)	USB-GPS Receiver	Misc. Hardware	Installation Costs (3-4 hrs)	Total Hardware/Install
Dell Latitude	$1,100	$50	$30	$200	$1,380
iPad2	$629	$0	$50	$0	$679

Table 6. Mid/Low end Hardware First Year Cost to Fleet for Vessels with at least One Trip in 2014

Mid/Low End Hardware			
Yearly License	**Hardware & Install**	**Cost per Vessel**	**Total Active Fleet Cost**
$0	$400	$400	$714.80
$700	$400	$1,100	$1,965.70
$1,300	$400	$1,700	$3,037.90

Table 7. High end Hardware First Year Cost to Fleet for Vessels with at least One Trip in 2014

High End Hardware			
Yearly License	**Hardware & Install**	**Cost per Vessel**	**Total Active Fleet Cost**
$0	$1,380	$1,380	2,466.06
$700	$1,380	$2,080	3,716.96
$1,300	$1,380	$2,680	4,789.16

Appendices

Appendix A. Pilot Vessel Fishing Practices by Gear Type

Gear	Typical trip length (Days)	Average sets in a trip	Average length of sets	Notes on accuracy of elogbook vs. Logbook
Powered Hook and line (Bandit)	3-5	5-10	2-6 hours	There was a decent level of accuracy between the elogbook and Logbook. Occasionally a fish would end up being sold and reported on logbook that was not entered into the elogbook. These instances would represent 3-5 fish out of thousands of pounds.
Reef Longline	9-17	10-35	3-5 hours	Reef longline produced similar results to the longline. Catch is harvested hook by hook and few (if any species) are not accounted for. Hail weight will vary by vessel, however, the pilot participant was fairly accurate at giving a hail.
Hand Line/Rod and Reel	2-5	12-60	0:10-1:00 hours	No issues reported. All species in elogbook were accounted for in Logbook.
Buoy (HMS)	1	1	10-11 hours	This fishery yielded expected results when comparing elogbook hail to logbook. The fishery currently reports on a set level and as such, no issues were mentioned. Volume of catch reduced compounded inaccuracy with hail weight.

Trap (Fish)	1-2	1-3	2-5 hours	Pilot participants tended to overestimate hail compared to logbook. All species in elogbook were accounted for in Logbook.
Coastal Longline (shark)	1	2-3	2-3 hours	For this gear, participant only reported discards.

Appendix B. Comparison of hardware installation and use options

Hardware	GPS Integration	Fishing Integration	At Sea Viability
Laptop (PC)	Integrated with an on board GPS or with an external GPS receiver. Multiple software applications utilizing GPS will need multiple sources or virtual GPS splitter installed.	Use of a laptop or PC is relatively immobile. Some fishers will have to constantly enter the wheelhouse to log data. However, for captains who man the wheel during a set, this is less of an issue. Some vessels use PC's or laptops with navigational software. Elogbooks can run on the same computer and limit number of devices used.	Laptops generally require longer wiring as space may limit ideal placement. Many protected cabins still have considerable water infiltration that could degrade the laptop and wiring. Many vessels in the Southeast do not have room or provide adequate protection for laptops.
Tablet (mobile)	Fully contained unit. Most newer model tablets have an internal GPS chip. Other options include Bluetooth connection to on-board GPS. Some Windows based tablets can already use pilot versions of the elogbook.	Mobile versions can more easily be moved around vessel. Provides a more versatile option for smaller vessels with relatively small crews. Crew members actively fishing can more easily fish and collect data.	There are a number of waterproof cases currently on the market that adequately protect tablets. Fully self-contained units require fewer connections and can be stowed easily when not in use. GPS signal can be acquired nearly anywhere on vessel.

Appendix C. Comparison of hardware data collection and feedback

Hardware	**Data Collection Capabilities**	**Data Transmission**	**Pilot participants feedback**
Laptop (PC)	Data collection is generally superior to tablets. The computing power and the ability to navigate through software is an advantage. Editing data entered, relatively larger screens, and the use of keyboard are advantages. Fishers have the ability to quickly change screens and use other software applications within the PC.	Data transmission can be completed through any internet connection or with some VMS units. There are a number of laptops on the market that have 4G capability allowing the transmission through the cellular network. Wi-Fi at dock or tethering a cell phone to the laptop also allow for data transmission.	Preference of laptop use varied among vessel type, gear type, and prior laptop experience. Vessels with enclosed wheelhouses with a pilot manning the wheel had few issues with a laptop if sufficient space available. If the above conditions were met with no room for a large laptop, a tablet was preferred. Furthermore, length of set influences preferences as well. The longer a fishing event, the less a fisher needed to interact with the laptop.
Tablet (mobile)	Presents specific challenges to data collection. Lack of a physical keyboard makes data editing more difficult, especially in tough conditions. Navigating through a tablet may be more difficult. Relatively smaller screens, especially if on a hand held device.	Tablets and mobile devices can submit data via Wi-Fi and through the cellular network if 3G/4G enabled.	Most fishers indicated that a mobile version of the elogbook should be made available. Limited cabin space or non-enclosed wheelhouses limit the functionality of a laptop. Relatively smaller crews and fishing activities that require more interaction with the software tend to want a tablet over a laptop. Specific feedback for what they would like to see has been sent to vendors for their consideration.