

SEFSC proposal to modernize shrimp effort data collection

Southeast Fisheries Science Center, 5/11/2023

Background

Electronic effort recording and transmitting devices are an integral component of managing Gulf of Mexico shrimp fisheries. This estimated fishing effort data helps support annual shrimp stock abundance assessments, allows the shrimp fishing to comply with Section 7 of the Endangered Species Act, and the Magnuson-Stevens Fishery Management and Conservation Act.

Effort recording devices (ERDs) or vessel monitoring systems (VMS) are largely synonymous hardware units that record time stamped position of a vessel and then transmit that position either by satellite or cellular service. Historically, a VMS called the cellular Electronic Logbook (cELB) transmitted time/location data to the National Marine Fisheries Service (NMFS) when a shrimp vessel was in range of a 3G cellular network. Using these data, NMFS categorized vessel activity (i.g., towing, steaming, stopped) based on speed estimates calculated from vessel time/location. This information fed into calculations of fishing effort (tow days). All of these calculations were conducted using a NMFS algorithm designed to estimate shrimp fishing effort for Gulf vessels.

However, 3G cellular technology became obsolete around the end of 2020. At this point, cELB communications for reporting vessel time/location data to NMFS were no longer functional. This now requires a cumbersome, manual process to collect the cELB Secure Digital Memory Card (SD-card) from each vessel.

To meet a number of congressional and legal mandates, the SEFSC and the Gulf of Mexico Fishery Management Council are required to develop a modernized shrimp effort data collection program (see mandates, below). This document outlines a three-pronged approach to meet this objective of having a modern effort data collection and transmission program in place by 2025.

Mandates:

FY23 Omnibus: Gulf of Mexico Shrimp Fishing Effort- Within funds for Fisheries Data Collections, Surveys, and Assessments, the agreement provides \$850,000 for NMFS, in consultation with the Gulf of Mexico Fishery Management Council and shrimp industry stakeholders, to continue the development and implementation of the newly approved Electronic Logbook program (ELB) that archives vessel position and automatically transmits scientific shrimp fishing effort data via cellular service to NMFS.

[2020 Shrimp Biological Opinion](#). “RPM 1: Monitoring F/SER2 must ensure that future fisheries effort monitoring is conducted at equivalent (or greater) levels as conducted over the past 10 years”

[Amendment 18](#) Modifying the Shrimp Effort Threshold. Final Shrimp Amendment 18 to the Fishery Management Plan for the Shrimp Fishery of the Gulf of Mexico, U.S. Waters

Proposal

We propose a three-part approach to achieve a modernized electronic location recording program to monitor trawling effort in the Gulf of Mexico shrimp fishery by 2025:

1. **Phase-out 3G cELB system (2023-2024):** Provide additional SD cards, antennae and other 3G cELB hardware necessary to support the manual retrieval of SD cards from vessels originally selected for 3G units until the 3G program is phased out by 2025. Industry will provide in-kind support in the form of personnel to facilitate collection of data from vessels and to support the existing chip mail-in requirement. This is simply an interim, temporary action to ensure the integrity of the historical dataset while transitioning to the subsequent phases, complying with the directive of continuing the development and implementation of a new program.
2. **Testing (2023):** Implement side-by-side testing of type-approved cVMS units and cELB currently in use to inform rulemaking regarding “*NMFS will perform at-sea trials...*” which includes hardware and software requirements to inform the Framework Action. This will only be possible through active industry participation to identify volunteer vessels and support outfitting shrimp vessels. Testing would need to be completed by the end of 2023, after which the Council would proceed with finalizing the Framework Action based on the best information available at that time. At the end of testing, the volunteer vessels would become the initial early adopters, keeping the installed devices at no cost. Funding available through the attached spend plan would support installation of cVMS devices and monthly fees during the testing period.
3. **Install or Early Adopter phase (2023-2024):** Following testing, develop a contract to support reimbursement, install and deployment of units that collect position data for estimating shrimp trawling effort on approximately 100-200 vessels, prior to rulemaking. Units deployed on shrimp vessels would support either alternatives 2 or 3 in the Council’s Framework Action, while also meeting the terms of the Shrimp BiOP RPM#1 to achieve equal or greater effort monitoring. The contract would support reimbursement for installation of the devices and monthly fees for 2 years. This reimbursement is separate from and independent of the existing NMFS type-approved VMS reimbursement process. Likely, the units used in the testing would be supported, and other potential units could also be considered including those type-approved for the Atlantic States Marine Fisheries Commission (ASMFC) lobster fishery effort data collection program, or other units that become available during the early adopter program.

The three-pronged approach would support either Framework Action alternatives 2 (NMFS VMS type-approval) or 3 (alternative effort collection process) in Action 1. The major difference between alternatives 2 and 3 is in how the data are transmitted to the Science Center: either through the existing NMFS VMS type-approval

(<https://www.fisheries.noaa.gov/national/enforcement/noaa-fisheries-type-approved-vms-units>) where the data goes through NMFS Office of Law enforcement or directly through a

separate process. The NMFS type approval process includes both hardware, software. The details and cost-benefits of either approach will need to be considered with further work on the Framework Action with the decision on a preferred alternative to be made by the Council before submission to NOAA Fisheries. The detailed spend plan is shown in **Table 1**.

A key consideration regarding cost/benefits before the Council as well as industry participants is that alternative 2 (e.g. utilizing the NMFS' VMS type-approval process <https://www.fisheries.noaa.gov/national/enforcement/noaa-fisheries-type-approved-vms-unit>) would likely still allow for reimbursement for the purchase of the hardware as long as agency funds are still available. Alternative 3 would, under current funding levels, require that vessel owners shoulder the costs of purchase, installation and transmission. This is one of the rationales that should make early adoption under the install phase of the proposal beneficial to shrimp industry participants.

During the **Testing** and **Install** phases, the effort data would be sent directly from the vendors to the SEFSC through a secure file transfer protocol. The Science Center could absorb the costs of obtaining and housing a limited amount of data for the Testing and Install phases using existing servers. For the operational phase of the effort data collection it remains unclear as to whether this will be sufficient for operational processing of a much larger volume of data but the testing and install phases will provide the key information to inform what the Agency costs could eventually be.

Overall Timeline:

2023: Begin phase-out of 3G units, Test cVMS and other non-type approved cellular devices, Install units successfully passing testing (during and after testing) on ~100-200 vessels.

2024: Rulemaking and final action on Framework Amendment, install on more vessels.

2025: Amendment goes into effect and implementation of new program, 3G system phased out. Install on remaining vessels (possible OLE reimbursement or fleet covers costs)

Table 1. Shrimp FY23 Spend plan

1. Shrimp Effort Algorithm Vetting Meeting and related travel.	\$3,000
2. Contract for Rebuilding Shrimp Data Management System/Application	\$120,000
3. SEFSC Data Management and program administration.	\$41,000
4. Hardware/Travel costs for testing of 3 cVMS on five vessels.	\$30,000
5. Application Development Staff. Staff time will go to developing the system to collect and process data from the unit vendors for the testing and install phases and to evaluate costs for a longer-term solution.	\$82,000
6. Outreach to shrimpers (20% of 1 SEFSC staff working with industry)	\$27,000
7. Contract for early adopter program to include installation, 2 years of cellular data and reimbursement for units. Minimum requirement would be to outfit 150 vessels. During the early adopter program the data would be transferred directly to the SEFSC from the unit vendors.	\$360,000
8. Management & Administrative (M&A) costs (22% reduction of 850K)	\$187,000
Total programmatic funds available	\$663,000
Total	\$850,000 (663,000 with M&A)

Cost Explanation

1. Agency costs to support staff travel to participate in the Shrimp Effort Algorithm Meeting and present at the Shrimp AP.
2. Rebuild Shrimp Data Management System, which includes integration with GSMFC trip ticket database, GSS database, spatial layers to incorporate depth information, and automated processing necessary to support the new effort algorithm, landings by area/depth, bycatch estimation, automated inputs for stock assessments.
3. Support for staff time taken from other programs to support Gulf shrimp effort, including: inventory control of cELBs, compliance monitoring and communication with industry to resolve SD card submission issues, extending new effort algorithm to historical information, shipping of supplies to industry.

4. Travel and hardware costs for testing/comparing cELB and cVMS on five vessels. During the testing phase data would be transmitted directly from the cVMS vendor to the SEFSC.
5. Ongoing maintenance and support for new applications, including: development of specifications, software upgrades, system security upgrades, server maintenance, maintenance of technical specifications and Application Programming Interface for location tracking vendors. This would specifically also include staff time to cost-out a route for direct submission of effort data from vendors to the SEFSC which would support Framework Action Alternative 3.
6. Support for staff time to support outreach to industry to recruit industry volunteers for early adopter program and assist with resolving compliance.
7. This would be for a contract to administer the Early Adopter program. The goal would be to support reimbursement for purchase, professional installation and 2 years of data transmission for cellular position recording devices for volunteers in the shrimp fishery. Position recording devices could be any of the three considered in the initial testing. It may also be possible to consider units approved in the ASMFC Lobster fishery, as well as other units that become available during the early adopter program. This program would begin the process of making the effort data collection program equal to or greater than the existing 3G system, while outfitting volunteer vessels prior to rulemaking. During the Early Adopter program the data would be transmitted directly from the vendors to the SEFSC.
8. Mandated costs associated with Management & Administration: budget development, contract execution, tracking expenditures and facilities.

2. Testing details

The request from the Council is as follows: *“for the SEFSC conduct side-by-side testing of the current cellular electronic logbook (cELB) units and the three following cVMS units as well as any other cVMS units that NMFS considers appropriate for testing: the Woods Hole NEMO unit that is hard-wired to the vessel, such that it is not exclusively reliant on solar-power; the Atlantic Radio Telephone ZEN VMS LTE unit; the Nautic Alert Insight X3 unit. Testing should be completed on at least five shrimp vessels in the Gulf for the length of an average offshore trip. The Council also requests that the data from these tests then be processed through the new shrimp effort algorithm developed by the National Marine Fisheries Service and presented to the Council at a future meeting.”*

This will only be possible through active industry participation to identify volunteer vessels and support outfitting shrimp vessels. Testing would need to be completed by the end of 2023, after which the Council would proceed with finalizing the framework action based on the best information available at that time. At the end of testing, the volunteer vessels would become the initial early adopters keeping the installed devices at no cost. NMFS initially considered full observer coverage for the testing, but this was cost prohibitive.

Testing plan

The plan is to conduct testing on five commercial shrimp fishing vessels in the Gulf of Mexico. Three different effort recording devices (**Table 2**) plus the existing 3G ELB units will be tested during a full fishing trip (port to port). The cVMS will record time-stamped (i.e., month, day, year, hour minute, second) location (i.e., latitude and longitude) data at ten-minute intervals. The vessels shall be engaged in fishing operations at-sea for at least 18 days and possibly longer depending on trip duration during the tests. **Table 3** describes the necessary timeline for testing. Should it not be possible to find five volunteer vessels for the testing, the Council will need to make decisions with the best data available to it at that time.

During the testing the electronic effort data will be sent directly to the SEFSC by the vendors. Data from each cVMS vendor must be transferred to NMFS for analyses at the end of the testing period. It is preferable that routine data transmission during the trip occur to ensure data quality (e.g., ping rates that are not at 10-minute intervals) is monitored during the trips. NMFS personnel will physically collect SD-cards as needed and will aid in an exchange of the existing SD-card with a new one at the end of the trip. NMFS personnel will also remove extra cVMS units with the vessel retaining one unit to become part of the early-adopter program. The Science Center can absorb the costs of obtaining, housing, and processing a limited amount of data for the Testing phase.

If it is not feasible to equip a vessel with all cVMS under consideration, a subset of two or more devices will be selected for the vessel while ensuring adequate testing of all three devices in the overall study. Vessel owners will have input into which devices they will allow on their vessels. If the number of volunteer vessels are not sufficient, NMFS will request the volunteering vessels to allow swapping out of alternate devices for testing.

For the vessel testing fleet, cVMS will be delivered to the vessel owners/operators and installed by SEFSC staff or qualified installers. The cVMS will draw all power from the vessel's electrical system – solar-powered cVMS are not suitable for this project. cVMS units provided to the vessels for testing shall be returned to NMFS at the end of the testing period or may be retained by the vessel owner as part of the early adopter program.

Initially SEFSC felt that to keep data between vessels consistent, the five volunteer vessels participating in this testing program should target the same species (i.e., brown shrimp) which might suggest the use of vessels targeting brown shrimp from near the NMFS laboratory in Galveston, Texas. This will also facilitate cVMS installation, data transfer, and return of cVMS to NMFS Galveston lab staff. However, should volunteer vessel opportunities become available in other locations, particularly those close to an existing SEFSC lab such as Pascagoula, these will be good options as well. Although not mandatory, vessel operators will be asked to record set and haul time during a trip. These observations will provide an independent assessment of vessel activity for comparison against VMS-derived activity categorization and allow SEFSC to evaluate overall effort accuracy.

Testing Cost Assumptions

Assumptions:

- Fishing vessels are volunteers
- cELB, SEFSC, and Boat Command VMS are provided at minimal cost
- VMS installation and retrieval are at minimal cost
- Data transfer (manually or via cell network) to NMFS is included in per unit cost

- Cost of data analyses covered by NMFS

Table 1- VMS identified for testing by the GMFMC.

Unit	Manufacturer	Info
NEMO	Woods Hole Group	https://thoriumvms.com/nemo
Zen VMS LTE	Atlantic Radio Telephone	https://www.atlanticrt.com/zenvms-lte-vesselmonitoring-system.html
Insight XS VMS	Nautic Alert	https://nauticalalert.com/noaavms/
cELB (existing 3G units)	Unused 3G ELB units	These would be provided by NMFS
Other units type approved in lobster fishery	Particle Tracker One, Succorfish, BoatCommand, Network Innovations/hiSky, Viatrax	See ASMFC type-approvals

Table 2. Timeline for testing ^{1/}

Activity	Estimated Time Needed	Potential Dates (not based on working days)
Securing VMS from vendors	21 days (at least 2.5 week lead time is known for one vendor)	June 4 to June 24
Installation of VMS units	7 days	June 25 to July 1
At-sea testing	min 18 days	July 15 to Aug 1
Retrieval of data	7 days	Aug 1 - 8
Return of extra VMS, vessel should keep at least one unit to be part of the 'early adopters'	7 days (not included in time estimate)	Aug 8 - 15 July 31 to August 6
Data analysis and presentation development	21 days	Aug 1 to August 21
Present to Gulf Council	1	October 23-26
Total Time	81 days	

1/ Deployment dates will correspond with Gulf shrimp fishery reopening in July and volunteer vessel schedules.

Data Analyses

A primary motivator of these tests is to maintain consistent, comparable shrimp-fishing effort time series to support shrimp abundance stock assessments and address other regulatory mandates. Therefore, the main analysis of all VMS data from the tests will consist of the estimation of fishing effort (i.e., tow days) using the NMFS 'Dettloff' shrimp effort algorithm. Because the NMFS algorithm contains error checking, activity characterization, and effort calculation subroutines, raw data from the VMS will be used. Data will not be prescreened and corrected for various problems such as duplicates, missing

observations, etc. This will allow a direct assessment of the suitability of the VMS data from each system for NMFS effort calculations.

Additional analyses will be conducted to assess:

- Proportion of ping drop-outs/bad data (e.g., 99.999 latitude/longitude)
- Activity classified from VMS data and recorded by vessel captains
- GPS location data across VMS while vessel is stationary (e.g., in port)
- Tow-by-tow estimates of distance and time covered during a tow by VMS

To provide for visual inspection of the performance of the VMS, a series of graphical comparisons will be made by overlaying the track lines and locations derived from the data of each system on a given vessel. These track lines can be coded with respect to vessel activity from the captains (if available) and/or algorithm categorization.

Conclusions and additional considerations:

The three-part approach outlined above should meet the various mandates that allow the shrimp fishery to operate and modernize effort data collection. As seen in the recent offshore wind siting, comprehensive effort data is absolutely critical to fairly represent the needs of the shrimp fishery.

As we embark on this approach, there are several additional points that we should consider.

First, the original 3G system was intended to provide a random sample of vessels, however the subset of vessels has never been updated. To bring effort data collection up to modern standards would mean that every vessel in the fishery would have an equal requirement to report data. At minimum this would require redrawing the random sample repeatedly, similar to how observer coverage operates to support universal coverage. Equity and fairness considerations would also dictate that all vessels should shoulder similar costs and requirements for providing effort data. Hence the fishery should consider that all vessels may eventually be drawn into the sample either in the short-term or long-term and that the entire fleet of federally (SPGM) permitted vessels will likely need to consider effort recording devices to remain in compliance with data collection requirements under current fishing regulations.

Secondly, the shrimp fishery does not have electronic dealer reporting. This could be a key additional consideration that would allow electronic pairing of effort data with catch data by species. This would facilitate requests from the Council for catch and effort data by species, stock assessments and more timely and efficient reporting by dealers.