Certification Barriers

- Data produced by the federal observer program appears to be fairly robust based on the relatively low coefficients of variation for many of the most common bycatch species.

- Coverage rate is low, at most a 2% coverage rate for the fishery, and the most recent bycatch data is from 2010 (updated 2020 manuscript ,but still grouped).

- Observer program utilizes a "modified characterization protocol" resulting in data that contains large categories of unidentified finfish and invertebrates that prevent full identification of non-target species to the specifications required by sustainability certifications.

NFWF and FIS Saltwater, Inc. Proposals Awarded Expand the Use & Improve the Utility of EM Data in the Gulf of Mexico Shrimp Trawl Fishery

Southeast Regional Electronic Technology Implementation Plan. Improve dealer access to information to support sustainability goals.

Collaboration with NOAA to take steps that EM data meets management needs for monitoring protected species interactions and critical bycatch species, and that it can be easily integrated with existing observer data. The data will also be used to provide industry with a means of validating supply chain traceability and sustainability claims.

EM Research in the Southeast-Gulf Shrimp (Earlier)

- Relatively low observer coverage coupled with the rarity of smalltooth sawfish captures results in low reliability in the estimate of take

- To this end, EM technology is currently being advocated for monitoring smalltooth bycatch from the shrimp trawl fishery operating in US southwestern Florida waters

Source: Carlson and Scott-Denton, 2010

EM/ML Research in the Southeast

- Current shrimp observer coverage rate is low (~2% of the annual commercial effort)

- Bycatch estimates of rare events (e.g., protected species interactions) require large sample sizes

  - *For example, sample size estimates required for an observed sawfish with a coefficient of variation (CV)=0.3 were calculated at 11,380 tow hours / year*

- Applying the current average cost per sea day, results in a prohibitive cost of about $1,000,000 to increase observer coverage in the eastern GOM alone

- In light of the costs associated with observer coverage and given the rare event takes, increasing observer coverage to refine take estimates is not practical

- Using ML tools in conjunction with Electronic Monitoring (EM) provides a valid alternative to increased observer coverage (Alaska, NP, NE).

EM Research in the Southeast

- Pairwise comparison of EM video to data collected by observers (animals >2 lbs.) overall detection rate of ~88%. Early pilots

- Augment observer coverage; US observer programs using cameras and/or observers. Used in other regional programs. (Alaska, NP, NE)

- Combination of increased samples and cameras (EM, ML) to improve estimates.

Objectives

1. Can EM video provide sufficient images to account for smalltooth sawfish & other large bycatch?
2. Are EM images clear enough for species level ID?
3. Are results from video monitoring similar to on-board observer?

EM in the US

. Limited resources ($$$$) for observers coverage.
 ~2% of the vessels covered by SE observers /yr. in shrimp and reef sectors.

EM System

U.S. Electronic Monitoring Programs

Electronic monitoring (EM) is being piloted and implemented across the U.S. to expand and improve fisheries-dependent data collection, while reducing costs and increasing the timeliness of information. EM is used to audit logbook data, monitor compliance with discard requirements, and collect information on discards and bycatch. The programs on this map are listed in three categories: Operating under regulations; operating under an exempted fishing permit (EFP) and/or being developed by a Fishery Management Council (FMC); and operating as a pilot project.

For more information, visit fisheries.noaa.gov/national/fisheries-observers/electronic-monitoring.

Alaska

Under Regulation
- Bering Sea and Aleutian Island (BSAI) Non-Pollock Trawl Catcher/Processor (C/P)
- Bering Sea Pollock Trawl C/P and Motherships
- Central Gulf of Alaska Rockfish Trawl C/P
- BSAI Pacific Cod Longline C/P
- Small Boat Fixed Gear (Longline and Pot)
- Halibut Deck Sorting Trawl C/P

Under FMC Development or EFP
- Pollock Trawl Catcher Vessels

West Coast

Under FMC Development or EFP
- Whiting Mid-Water Trawl
- Fixed Gear IFQ
- Non-Whiting Mid-Water Trawl
- Groundfish Bottom Trawl

Pilot Project
- Nearshore Rockfish

Pacific Islands

Pilot Project
- Pelagic Longline—Hawaii Deep and Shallow Set

Greater Atlantic

Under FMC Development or EFP
- Northeast Multispecies
- Herring Mid-Water Trawl

Pilot Project
- Northern Gulf of Maine Scallop
- Northeast Multispecies For-Hire

Atlantic HMS

Under Regulation
- Pelagic Longline

Southeast

Pilot Project
- Snapper-Grouper
- Gulf of Mexico Shrimp
- Menhaden
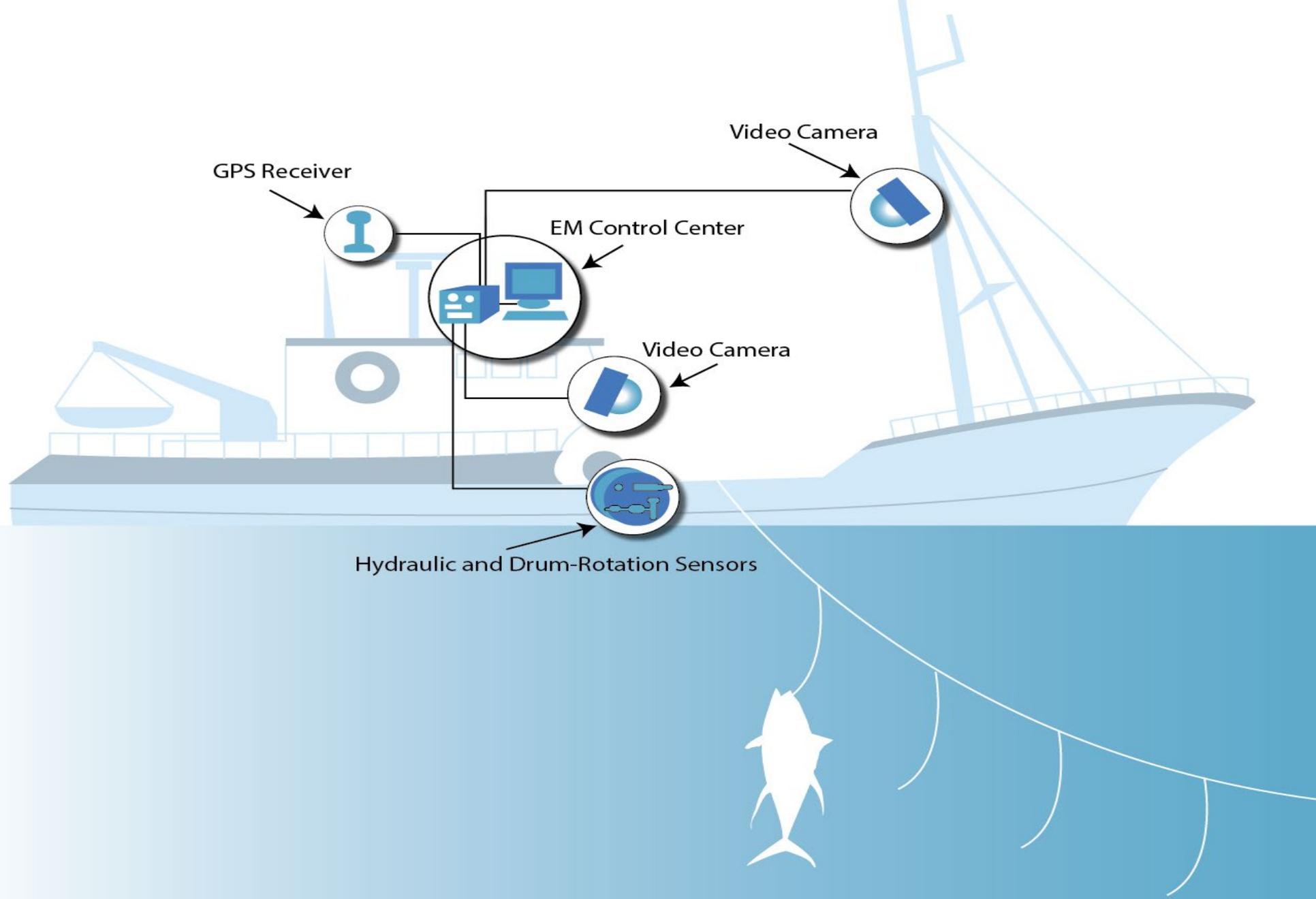
GPS Receiver

Video Camera

EM Control Center

Video Camera

Hydraulic and Drum-Rotation Sensors

Electronic Monitoring Unit

Electronic Monitoring Unit Processor and Monitor

No Audio

Camera Placement

Saltwater Inc. (SI) Unit Components

- Processor (Linux™ software)
- 2 encrypted 1tb hard drives
- GPS
- 3-5 IP cameras (3.6mm) w/LED's (can use up to 8) – activated during events
- hydraulic sensor
- rotation sensor(s)
- monitor
- waterproof keyboard w/mouse

Vessel Screen Display (Version O2)

Hauling 1	OK	Processing 1	OK	Processing 2	OK	Processing 3	OK	Processing 4	OK

Primary Reel Rotation	OK	Secondary Reel	OK	Primary Reel Pressure	OK
0.0 RPM		0.0 RPM		205.3 PSI	

Event Log	Storage	OK
2019-03-08 00:11:43:858 UTC: System started.	100% remaining	

System	GPS	OK
Current status: Vessel in transit	29° 18.6165' N, 94° 47.4442' W	

System Test | Manual Recording | End Trip   Night Mode
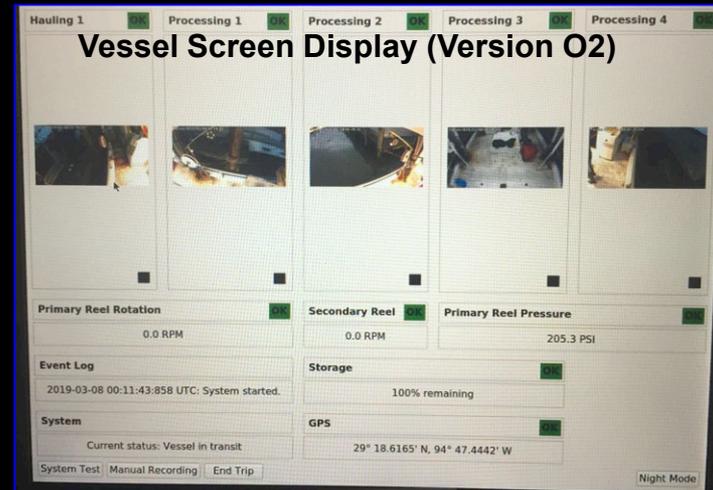
EM Research in the Southeast

The EM system - comprised of a control box, 3-5 cameras, a rotation sensor ("sensor"), GPS receiver, keyboard, and a monitor. Other than the sensor and cameras, the entire system was installed in the wheelhouse of each vessel (~1ft 8 in; 0.5m)

The control box is equipped with open-source software[7] and two hard-drive bays with removable 2 terabyte drives that stores all video and sensor data during each trip.

EM Research in the Southeast

Camera Placement

**Saltwater Inc. (SI)
Unit Components**

- Processor (Linux™ software)
- 2 encrypted 1tb hard drives
- GPS
- 3-5 IP cameras (3.6mm) w/LED's
  (can use up to 8) –
     activated during events
- hydraulic sensor
- rotation sensor(s)
- monitor
- waterproof keyboard w/mouse

-Saltwater Inc. (technicians) work with the Captain
as to the placement of cameras; address privacy and other
concerns, and are available for troubleshooting equipment
questions (via phone, email, text, dock).

- Installation and maintenance provided by Saltwater (via
federal research awards) while the equipment is on board and
in use.

- Data aggregated (3) – unless Owner provides permission.

EM Equipped Vessel

sensor and cameras

GPS Antenna

Cameras

Rotation Sensor

Electronic Monitoring Unit

Keyboard & Monitor

Sensor Processing Unit

Hydraulic Sensor

Boat 110VAC or 12VDC
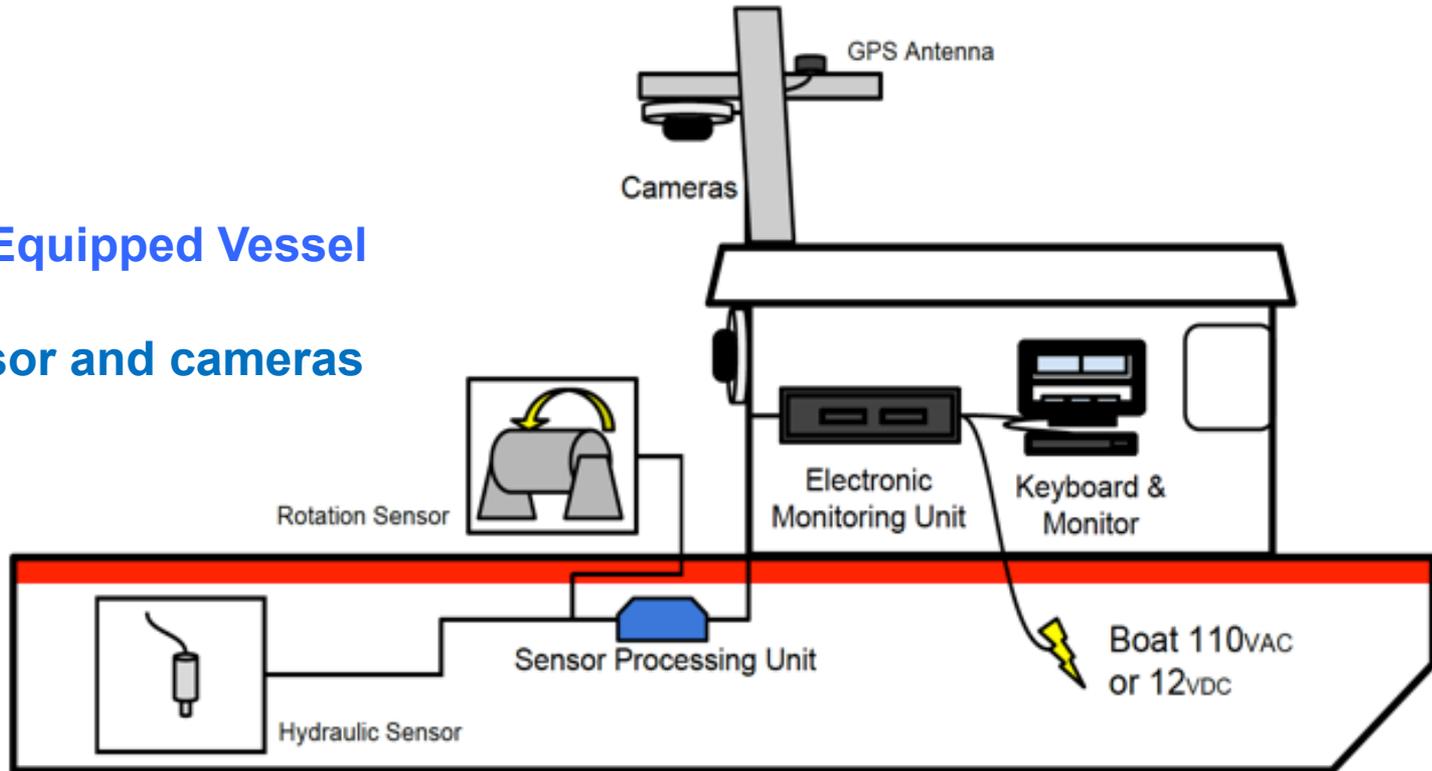
Saltwater Inc.
Electronic Monitoring

The sensor is mounted on the winch of the fishing vessel, and when the winch is activated to set and haul the gear, the sensor sends a reading back to the control box. Sensor output is read by the on-board software, which determines if the vessel engaged in fishing activity. Starts video feed during haulback (i.e., not on for 24 hrs.).

EM Research in the Southeast

The monitor in the wheelhouse allows the Captain to see, in real-time, the status of the sensor, position of the vessel, data storage status, when the system is recording, and what is being recorded from each camera.
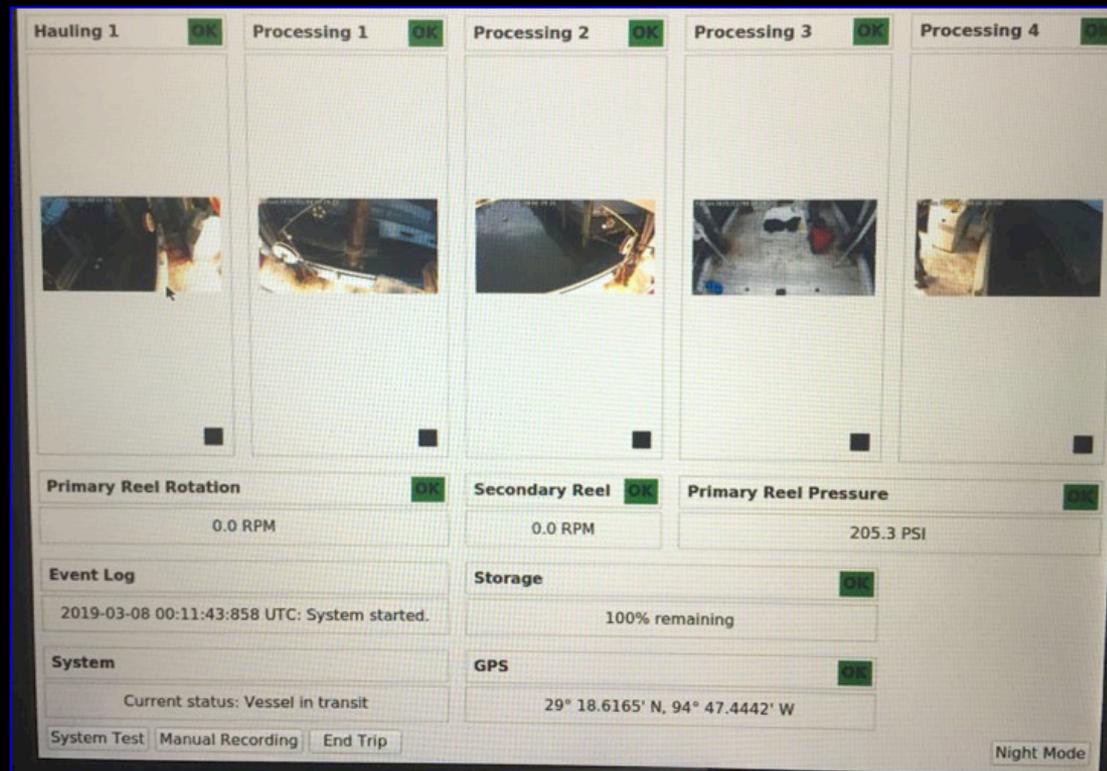
# EM Outputs Through Monitors in Wheelhouse

Integrated onboard system

Vessel Tracks

Events = Set, Soak, Hauls
red = species annotations
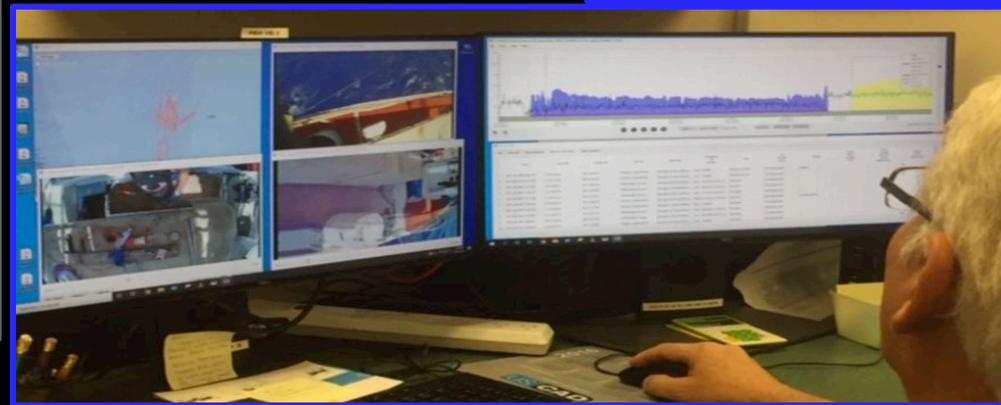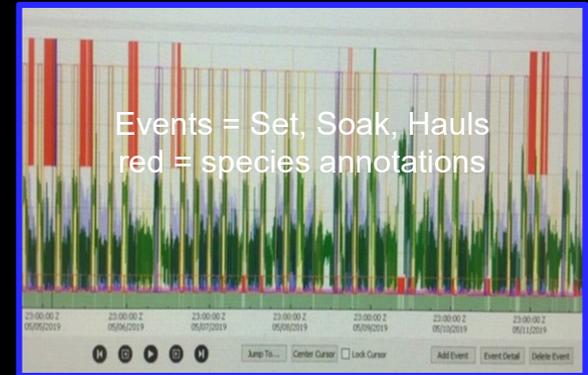
Saltwater, Inc.

Vessel Trip Review Example

1 Event
(Set, Soak, Haul)
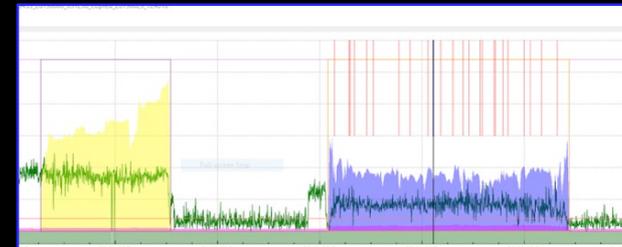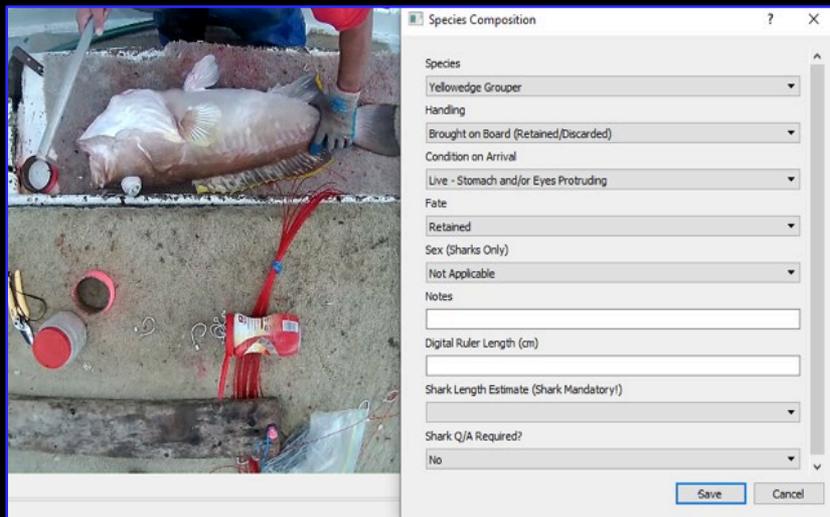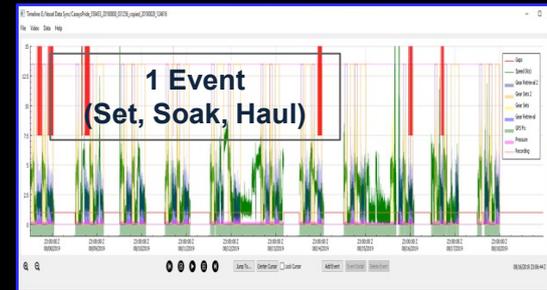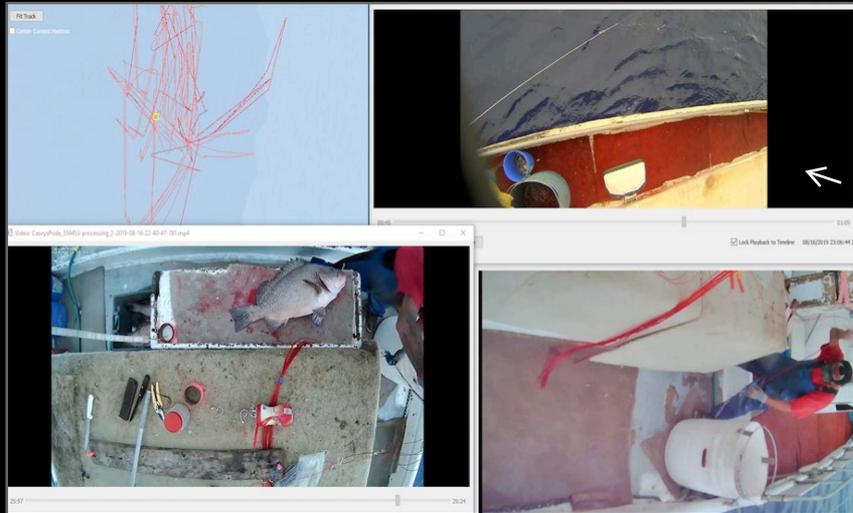
Species
Annotation
Drop Down Menu

Current Research in the GOM Reef Fish Fishery-
Mote Marine Lab and Saltwater Inc.
## Bandit and Longline (20 Volunteer Vessels)

Current Research in the GOM Shrimp Fishery-Saltwater Inc.

Current Research in the GOM Shrimp Fishery-Saltwater Inc.

# Current Research in the GOM Shrimp Fishery-Saltwater Inc.
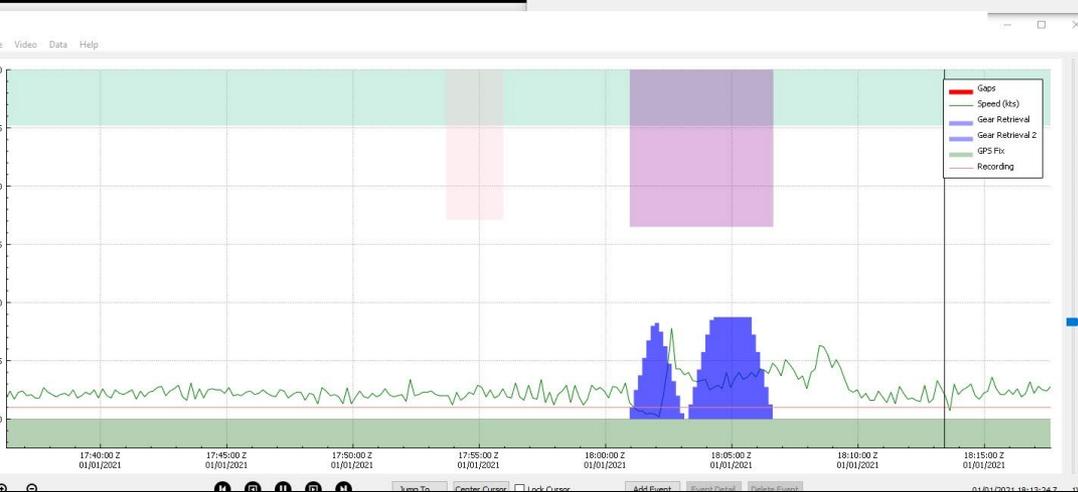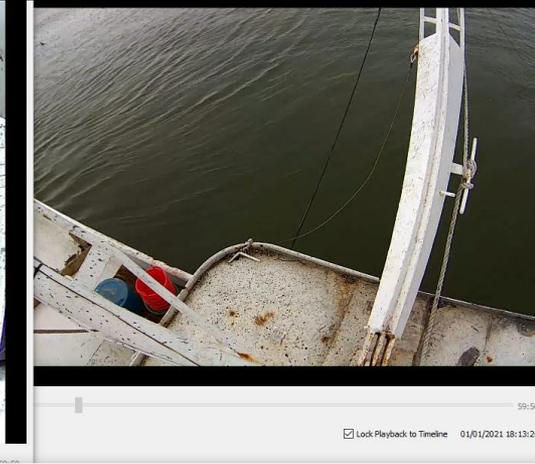
Current Research in the GOM Shrimp Fishery-Saltwater Inc.

- ML systems are trained using thousands of still photos (observers) or relevant video data (EM pilots) as inputs for detection and classification of fisheries species.
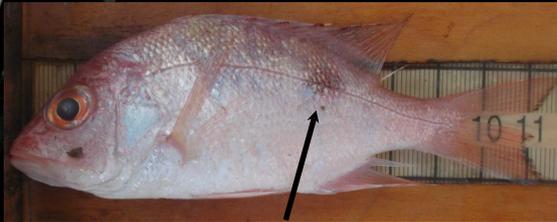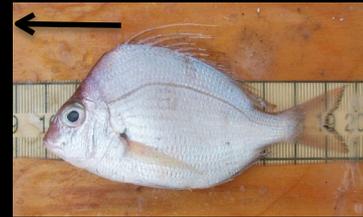
Early steps in the ML training is annotation, which links a description of the specimen of interest in the still photo or video to image and loads the tagged/labeled image into the ML software.

- Depending on if the species is of high interest, several thousand photo/annotations are required to train the ML algorithm. Depending on the desired level of precision and testing, a thousand more photo/annotations needed.

EM Research in the Southeast

- Using these annotations, and many more to be collected, the SEFSC Galveston and Mississippi Laboratories in collaboration with the Shrimp Industry, Saltwater, Mote Marine Lab, Northern Gulf Institute's researchers and engineers, AFSC, and many more, will re-train Alaska Fisheries Science Center image analysis machine learning algorithms for species characterization in the southeastern shrimp fishery.

- 100 K photo/image + label/description (annotations), load into ML training set/software, …retrain as "fish detector" for SE. …training computer to recognize an image to learn features of a species …. loading repeatedly different images of the same species.

To Consider

Tremendous potential to bring these awards and knowledge together to achieve common goals…sustainability certification and improve bycatch estimation methods for Shrimp Fishery.