NMFS cVMS Project to Modernize Shrimp Effort Data Collection

Southeast Fisheries Science Center

Dr. John F. Walter, III, Dr. John Quinlan, Jo Williams, Farron Wallace, Dr. Timothy J. Rowell

Motivation

- **Previous monitoring was conducted by NOAA Fisheries with cELB (cellular electronic logbook) devices**

  - **Recorded position information at 10-min intervals**

  - **Time and location recorded at each interval and ancillary data - used to estimate fishing effort**

  - **Data transmitted to NOAA Fisheries via 3G cellular networks**

- **Recent monitoring continued with cELB devices**

  - **2020 - 3G cellular network services discontinued, hindering data delivery**

  - **Fishers and personnel required to physically return/replace Secure Digital (SD) memory cards to retrieve cELB data**

  - **Lack of efficiency and timely delivery of data and analytical results; failing units**

- **Automatic transfer of position data deemed essential for future effort monitoring systems**

Project Objectives

- **Install** several new cellular VMS devices alongside cELBs on 5 volunteer commercial shrimp vessels

- **Monitor** the at-sea performance and cellular data transfer of new units in July/August 2023; 10-min intervals for full length of an average offshore trip

- **Estimate** effort from all devices using current Estimation of Commercial Shrimp Effort in the Gulf of Mexico algorithm (Dettloff 2023); calculations from raw/unfiltered data

- **Compare and present** effort results among devices (new and cELB) on unique vessels

Methodology

Palacios

- Five commercial shrimp vessels out of Palacios, Texas volunteered for participation

- The existing cELB and up to five new cellular units installed on each vessel (inc. a new cELB)

- Data collection during Texas opener July 15th - August 2023 for full length of average offshore trip at minimum

Methodology

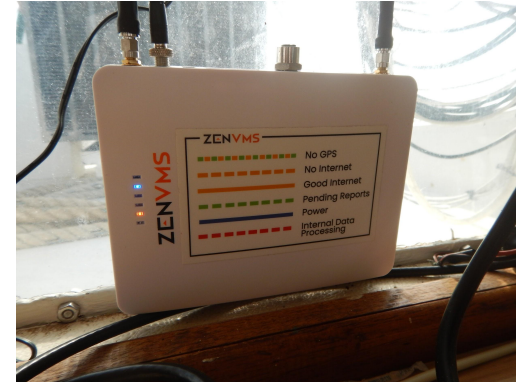**Boat Command**

Approved by ASMFC for lobster fishery

NEMO

Tracker One

Added due to availability

Zen

Approved for for-hire fisheries in Gulf of Mexico

*Nautic Alert Insights not available for this time period

Methodology

Installations						
Vessel ID	*Old cELB	*New cELB	Boat Command	NEMO	Tracker One	Zen
Vessel 1	✔	✔	✔	✔	✔	✔
Vessel 2	✔	✔	✔	✔	✔	✔
Vessel 3	✔	✔	✔	✔	✔	✔
Vessel 4	✔	✔	✔	✔	✔	✔
Vessel 5	✔	✔	✔	✔	**NA	✔

* An additional "New" cELB was installed on each vessel for redundancy to offset expected failures of old cELB units
**Unit would not initialize before installation

NOAA FISHERIES

Dettloff Algorithm for effort

Estimation of Commercial Shrimp Effort in the Gulf of Mexico

Kyle Dettloff

SEDAR87-DW-01

30 August 2023

Dettloff, K. 2023. Estimation of Commercial Shrimp Effort in the Gulf of Mexico. SEDAR87-DW-01. SEDAR, North Charleston, SC. 22 pp.

- Data filtered
  - Outside of Gulf of Mexico EEZ
  - Outside depth ranges
  - Duplicate timestamp, lat/long, vessel

- Effort calculated based on
  - Depth ranges of target species
  - Tows of duration > 1 hour)
  - Speed (Gaussian mixture distribution)
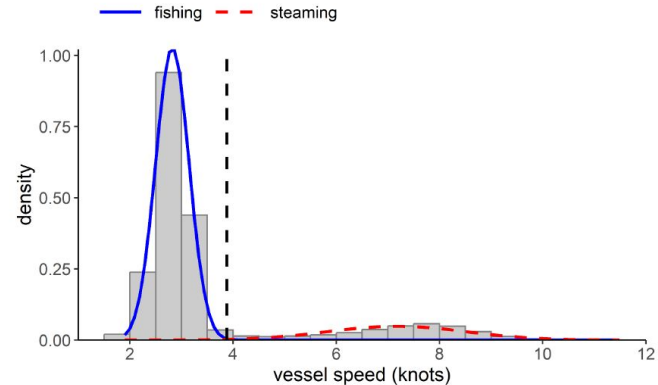
Figure 1: Distribution of cELB vessel speeds (2020) with fitted Gaussian mixture distribution.

Results

Valid Data						
Vessel ID	Old cELB	New cELB	Boat Command	NEMO	Tracker One	Zen
Vessel 1	✔	✔	✔	✔	✔	✔
Vessel 2	*Failed	✔	✔	✔	✔	✔
Vessel 3	✔	✔	✔	✔	✔	✔
Vessel 4	✔	✔	✔	✔	✔	✔
Vessel 5	**Failed	✔	✔	✔	***NA	✔

* SD memory card contained data but were repeated erroneous coordinates and 2014 datetimes
**SD memory card was empty upon retrieval
***Unit would not initialize before installation

Results

Disclaimer: Many of the following results will be focused on data determined to be valid by the current Estimation of Commercial Shrimp Effort in the Gulf of Mexico algorithm (Dettloff 2023). Some gaps reflect device performance, while other gaps reflect algorithm filtering due to vessel behavior (e.g., stationary periods) to remove periods not valid for inclusion in later effort estimates. The distinction between the two occurrences will be clarified as results are presented.

Results

					Vessel 1 Data Summary			
	Dates of recorded data (MM/DD)	[a]Combined Trip Dates (MM/DD)	Received data points (trip)	Possible data points (trip)	Received / Possible (trip)	Valid data points (trip)	Valid / Possible (trip)	Issues observed
Old cELB	07/03 - 08/23	07/19 - 08/21	4718	4732	100%	4623	98%	
New cELB	07/03 - 08/23	07/19 - 08/21	4718	4732	100%	4611	97%	
Boat Command	07/14 - 08/22	07/19 - 08/21	5020	4732	106%	4999	106%	>1 per 10-min interval
NEMO	07/14 - 08/04	07/19 - 08/21	1632	4732	34%	1581	33%	Error; reboot required
Tracker One	07/14 -08/24	07/19 - 08/21	1774	4732	37%	1731	37%	Gaps in data collection
Zen	07/19 - 08/21	07/19 - 08/21	4749	4732	100%	4727	100%	

[a] Two fishing trips conducted during this time period; 07/19 - 07/26, 07/28 - 08/21

*Received data points = number of data points retrieved from units via data portals, email, or memory card between trip start/end dates

**Possible data points = number of 10-min intervals that exist between trip start/end datetimes

***Valid data points = number of data points **assessed to be valid by the effort algorithm** between trip start/end datetimes;
   (duplicates, outside GOM waters, missing lat/lon were not valid)
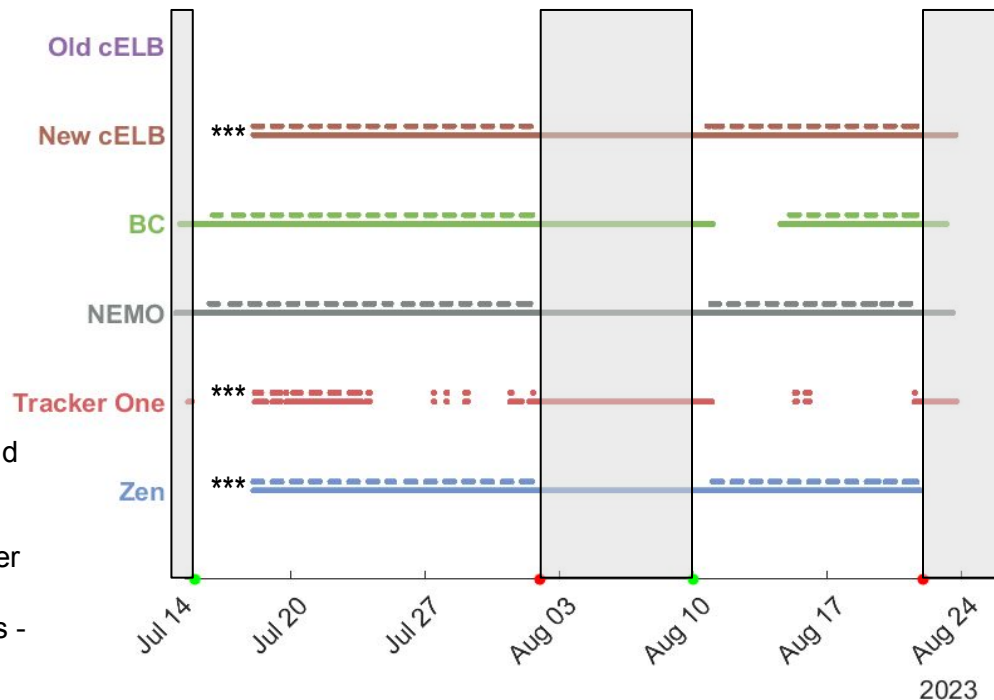
****Percentages rounded to nearest whole number

NOAA FISHERIES

Results

Two fishing trips plotted

Vessel 1

*NEMO gaps, error-required reboot.
**Tracker One had data gaps.

Time Series of output from Effort Algorithm (Dettloff 2023)

- Estimated Fishing Tows (upper)
- All **Valid** Data Recorded (lower)

🟢 Start of fishing trip

🔴 End of fishing trip

☐ In port

Results

Vessel 2 Data Summary								
	Dates of recorded data (MM/DD)	**ᵃCombined Trip Dates (MM/DD)**	**Received data points (trip)**	**Possible data points (trip)**	**Received / Possible (trip)**	**Valid data points (trip)**	**Valid / Possible (trip)**	**Issues observed**
Old cELB								
New cELB	07/03 - 08/23	07/15 - 08/21	4983	5326	94%	4982	94%	Off first 3 days-user error
Boat Command	07/14 - 08/22	07/15 - 08/21	5408	5326	102%	5407	102%	>1 per 10-min interval, gaps
NEMO	07/14 - 08/24	07/15 - 08/21	7007	5326	132%	7002	131%	>1 per 10-min interval
Tracker One	07/14 -08/24	07/15 - 08/21	3121	5326	59%	3099	58%	Gaps/Off first 3 days-user error
Zen	07/18 - 08/21	07/15 - 08/21	5048	5326	95%	5005	94%	Off first 3 days-user error

ᵃ Two fishing trips conducted during this time period; 07/15 - 08/01, 08/10 - 08/21

*Received data points = number of data points retrieved from units via data portals, email, or memory card between trip start/end dates

**Possible data points = number of 10-min intervals that exist between trip start/end datetimes

***Valid data points = number of data points **assessed to be valid by the effort algorithm** between trip start/end datetimes;
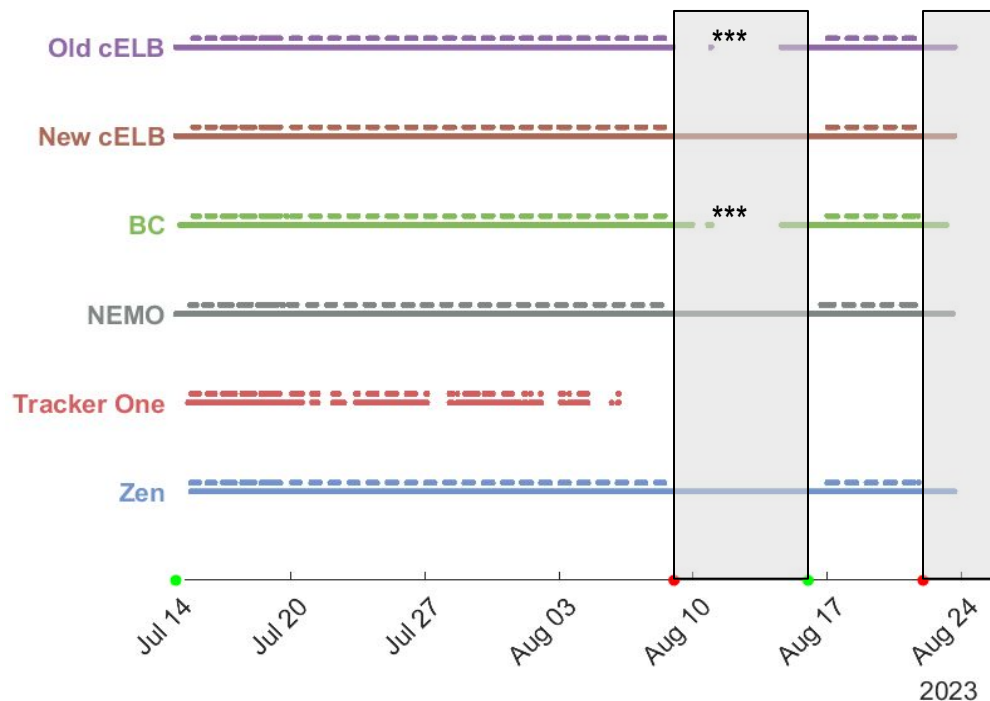   (duplicates, outside GOM waters, missing lat/lon were not valid)

****Percentages rounded to nearest whole number

NOAA FISHERIES

Results

Two fishing trips plotted

*** - User Error, Power Supply Turned off

*Old cELB had erroneous data
**Boat Command and Tracker One had missing data
***New cELB, Tracker One, and Zen were turned off first 3 days - user error

Time Series of output from Effort Algorithm (Dettloff 2023)
- Estimated Fishing Tows (upper)
- All **Valid** Data Recorded (lower)

🟢 Start of fishing trip

🔴 End of fishing trip

In port

Results

Vessel 3 Data Summary

	Dates of recorded data (MM/DD)	[a]Combined Trip Dates (MM/DD)	Received data points (trip)	Possible data points (trip)	Received / Possible (trip)	Valid data points (trip)	Valid / Possible (trip)	Issues observed
Old cELB	07/13 - 08/23	07/14 - 08/21	4669	5464	85%	4659	85%	Shut off-user error
New cELB	07/05 - 08/23	07/14 - 08/21	5451	5464	100%	5451	100%	
Boat Command	07/14 - 08/22	07/14 - 08/21	5167	5464	95%	5157	94%	Shut off-user error
NEMO	07/14 - 08/24	07/14 - 08/21	5745	5464	105%	5739	105%	>1 per 10-min interval
Tracker One	07/14 -08/06	07/14 - 08/21	2176	5464	40%	2156	39%	Gaps, Stopped early
Zen	07/14 - 08/23	07/14 - 08/21	5518	5464	101%	5479	100%	

[a] Two fishing trips conducted during this time period; 07/14 - 08/08, 08/16 - 08/21

*Received data points = number of data points retrieved from units via data portals, email, or memory card between trip start/end dates

**Possible data points = number of 10-min intervals that exist between trip start/end datetimes
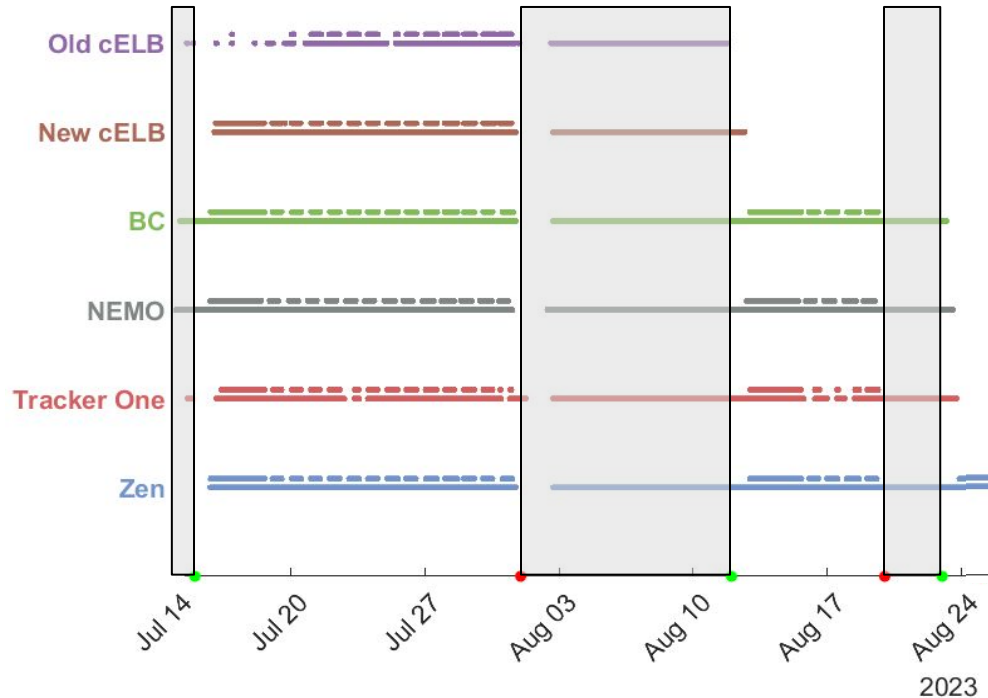
***Valid data points = number of data points **assessed to be valid by the effort algorithm** between trip start/end datetimes;
   (duplicates, outside GOM waters, missing lat/lon were not valid)

****Percentages rounded to nearest whole number

NOAA FISHERIES

Results

Two fishing trips plotted

*** - User Error, Power Supply Turned off

*Tracker One had missing data and stopped transmitting early
***Power supply cut off on Old cELB and Boat Command

Vessel 3

Time Series of output from Effort Algorithm (Dettloff 2023)
- Estimated Fishing Tows (upper)
- All **Valid** Data Recorded (lower)

● Start of fishing trip
● End of fishing trip

☐ In port

NOAA FISHERIES

Results

	Dates of recorded data (MM/DD)	[a]Combined Trip Dates (MM/DD)	Received data points (trip)	Possible data points (trip)	Received / Possible (trip)	Valid data points (trip)	Valid / Possible (trip)	Issues observed
Old cELB	07/11 - 08/11	07/15 - 08/19	3014	5013	60%	2803	56%	Stopped early
New cELB	07/04 - 08/12	07/15 - 08/19	3981	5013	79%	3691	74%	Stopped early
Boat Command	07/14 - 08/22	07/15 - 08/19	5263	5013	105%	4958	99%	
NEMO	07/14 - 08/24	07/15 - 08/19	5169	5013	103%	4785	95%	
Tracker One	07/14 -08/24	07/15 - 08/19	4476	5013	89%	4225	84%	Data gaps
Zen	07/15 - 08/25	07/15 - 08/19	5024	5013	100%	4720	94%	

Vessel 4 Data Summary

[a] Two fishing trips conducted during this time period; 07/15 - 07/31, 08/12 - 08/19
Excluded partial third trip starting 08/23 due to differences in the duration of data collection among vms units

*Received data points = number of data points retrieved from units via data portals, email, or memory card between trip start/end dates

**Possible data points = number of 10-min intervals that exist between trip start/end datetimes
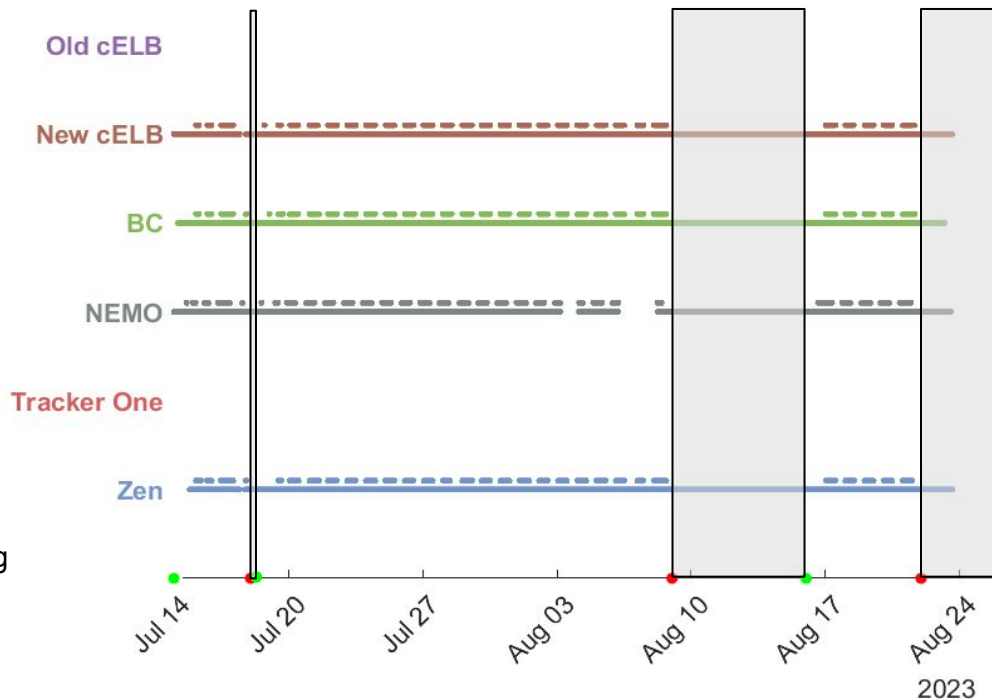
***Valid data points = number of data points **assessed to be valid by the effort algorithm** between trip start/end datetimes;
  (duplicates, outside GOM waters, missing lat/lon were not valid)

****Percentages rounded to nearest whole number

NOAA FISHERIES

Results

Two fishing trips plotted
Partial third - Zen

*Old cELB, New cELB, and Tracker One had missing data
**Zen dataset provided included extra days

Time Series of output from Effort Algorithm (Dettloff 2023)

- Estimated Fishing Tows (upper)
- All **Valid** Data Recorded (lower)

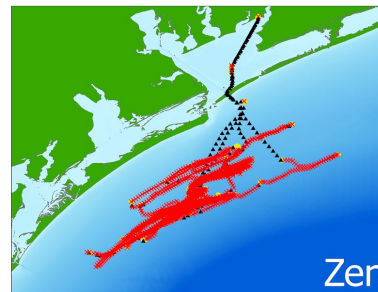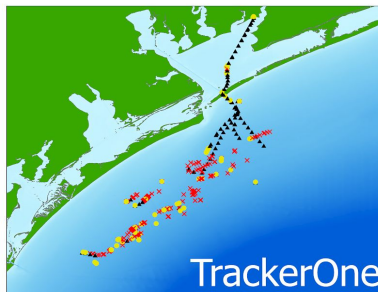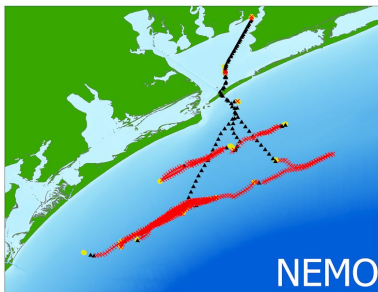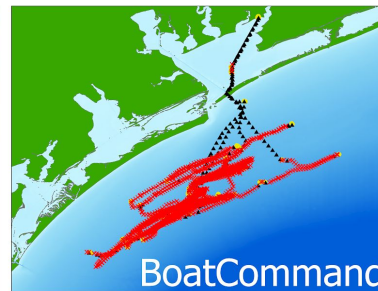🟢 Start of fishing trip

🔴 End of fishing trip

⬜ In port

NOAA FISHERIES

Results

Vessel 5 Data Summary

	Dates of recorded data (MM/DD)	ªCombined Trip Dates (MM/DD)	Received data points (trip)	Possible data points (trip)	Received / Possible (trip)	Valid data points (trip)	Valid / Possible (trip)	Issues observed
Old cELB								Unit failed
New cELB	07/05 - 08/23	07/14 - 08/21	5415	5471	99%	5405	99%	
Boat Command	07/14 - 08/22	7/14 - 08/21	5824	5471	106%	5815	106%	>1 per 10-min interval
NEMO	07/14 - 08/24	7/14 - 08/21	5033	5471	92%	5027	92%	Data gap mid-trip
Tracker One								Unit was not installed
Zen	07/14 - 08/23	7/14 - 08/21	5500	5471	100%	5373	98%	

ª Three fishing trips conducted during this time period; 07/14 - 07/17, 07/18 - 08/08, 08/16 - 08/21

*Received data points = number of data points retrieved from units via data portals, email, or memory card between trip start/end dates

**Possible data points = number of 10-min intervals that exist between trip start/end datetimes

***Valid data points = number of data points **assessed to be valid by the effort algorithm** between trip start/end datetimes; **(**duplicates, outside GOM waters, missing lat/lon were not valid)

****Percentages rounded to nearest whole number

NOAA FISHERIES

Results

Three fishing trips plotted

Vessel 5

Old cELB

New cELB

BC

NEMO

Tracker One

Zen

Jul 14   Jul 20   Jul 27   Aug 03   Aug 10   Aug 17   Aug 24

2023

*Old cELB did not record
**NEMO had missing data
***Tracker One not installed

Time Series of output from Effect Algorithm (Dettloff 2023)
- Estimated Fishing Tows (upper)
- All **Valid** Data Recorded (lower)

🟢 Start of fishing trip

🔴 End of fishing trip

☐ In port

Results

Two fishing trips plotted

Vessel 1

Old cELB

New cELB

BoatCommand

*NEMO gaps, error-required reboot.
**Tracker One had data gaps.

NEMO

TrackerOne

Zen
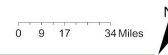
VESSEL_STATE
- 🟡 stopped_idling
- ▲ steaming
- ✕ fishing

0 5 10 20 Miles

N

NOAA FISHERIES

Results

Two fishing trips plotted

Vessel 2

Old cELB

New cELB

BoatCommand

NEMO

TrackerOne

Zen

*Old cELB had erroneous data
**Boat Command and Tracker One had missing data
***New cELB, Tracker One, and Zen were turned off first 3 days - user error

VESSEL_STATE

- 🟡 stopped_idling
- ▲ steaming
- ✕ fishing

NOAA FISHERIES

Results

Two fishing trips plotted

Vessel 3
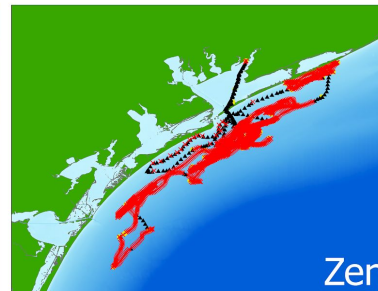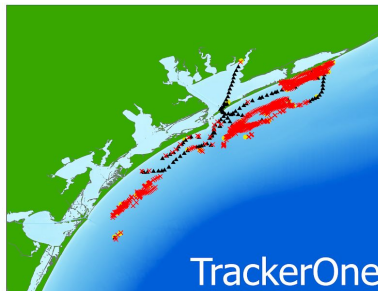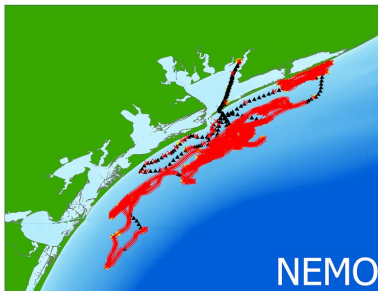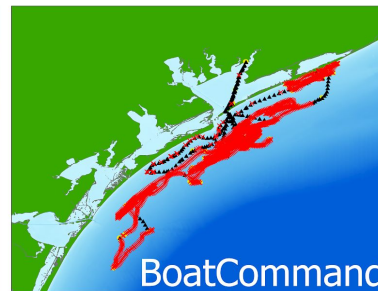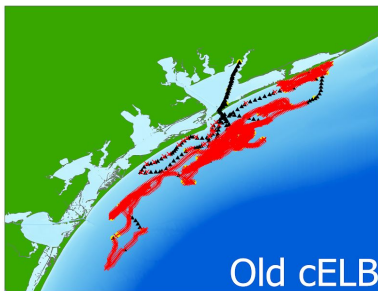
Old cELB

New cELB

BoatCommand

NEMO

TrackerOne

Zen

*Tracker One had missing data and stopped transmitting early
***Power supply cut off on Old cELB and Boat Command

VESSEL_STATE
● stopped_idling
▲ steaming
✕ fishing

Results

Two fishing trips plotted
Partial third - Zen
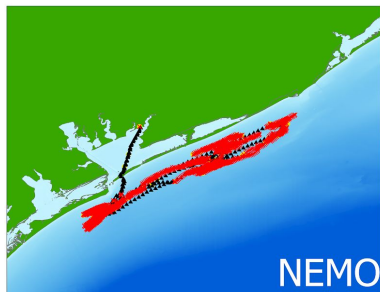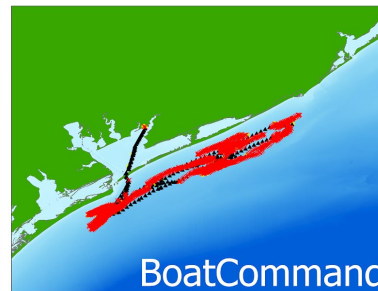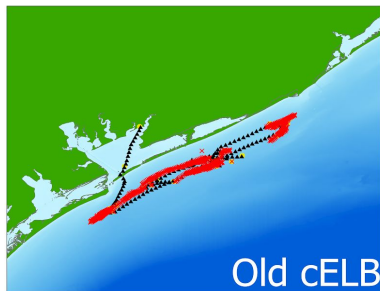
*Old cELB, New cELB, and Tracker One had missing data
**Zen dataset provided included extra days, hence extra southern tracks

Vessel 4

VESSEL_STATE
● stopped_idling
▲ steaming
✕ fishing

Results

Three fishing trips plotted

Vessel 5

Old cELB | New cELB | BoatCommand

NEMO | TrackerOne | Zen
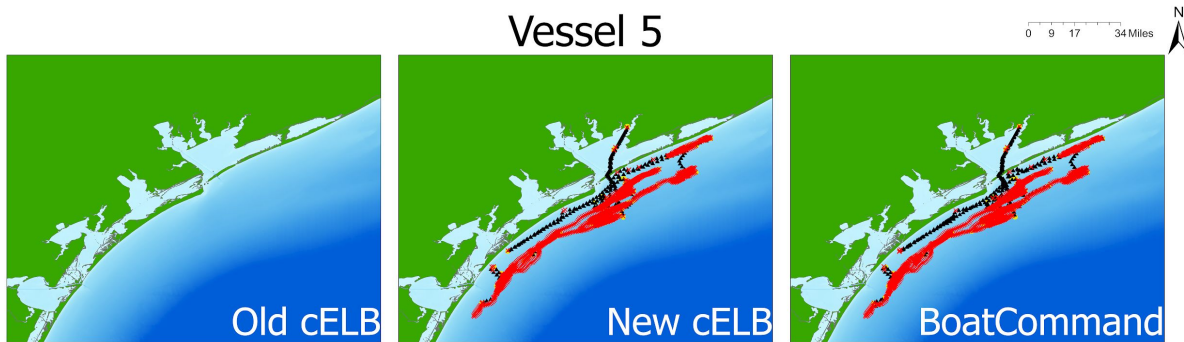
*Old cELB did not record
**NEMO had missing data
***Tracker One not installed

VESSEL_STATE
- 🟡 stopped_idling
- ▲ steaming
- ✗ fishing

0   9   17   34 Miles

N

Results

Estimated Effort (Tow Days)						
Vessel ID	Old cELB	New cELB	Boat Command	NEMO	Tracker One	Zen
Vessel 1	13.7	13.7	13.9	3.8	3.3	14
Vessel 2		11.8	10.9	12.4	2.1	11.9
Vessel 3	13.2*	13.2	13.4*	13.3	6.5	13.3
Vessel 4	4.9	8.3	12.8	12.5	10	14.2**
Vessel 5		11.6	11.8	10.2		11.8

Stopped transmitting early

Stopped recording early

Missing data (gaps)

Failed

Turned off first 3 days - user error

No issues

- Amount of valid data is one of main drivers of differences
- Boat Command, NEMO, and Zen similar when they functioned appropriately
- *Power supply cut off; occurred when not fishing
- **Longer dataset retrieved from vendor

NOAA FISHERIES

Database and API Development and Testing

NOAA constructed database and a new prototype Application Programming Interface (API) to enable vendors to push data to the SEFSC.

- For this project data were downloaded from vendor data portals by NMFS, except for Zen data which were emailed to NMFS by vendor

- Several vendors (Zen, NEMO, BC) successfully tested pushing data into the database during the at-sea testing phase using the API.

- The current plan is to entrain the vendors supporting the Early Adopter Program into this system so that data are automatically delivered directly to the SEFSC.

- Previously, data were transferred to NOAA via a manual mail-in process involving both fishers and SEFSC staff.

  - This project eliminates the need for that process.

Early Adopter Program

- Gulf States Marine Fisheries Commission is administering a contract to conduct the Early Adopter Phase of the Effort Modernization project.
- The goal of the 2-year program is for voluntary adoption of cellular VMS units on vessels with unit purchase, transmission fees and installation paid for.
- Currently no requirement on which units would be supported. However, vessel owners are encouraged to consider units that have demonstrated good performance.
- The contract has been awarded to LGL Ecological Research Associates
- Interested parties should contact Nathan Putman (nputman@lgl.com, Cell: 205-218-5276, Office: 979-846-7000).

Acknowledgements

NOAA FISHERIES

Questions

Supporting Materials

Additional Maps - Vessel 1 Boat Command
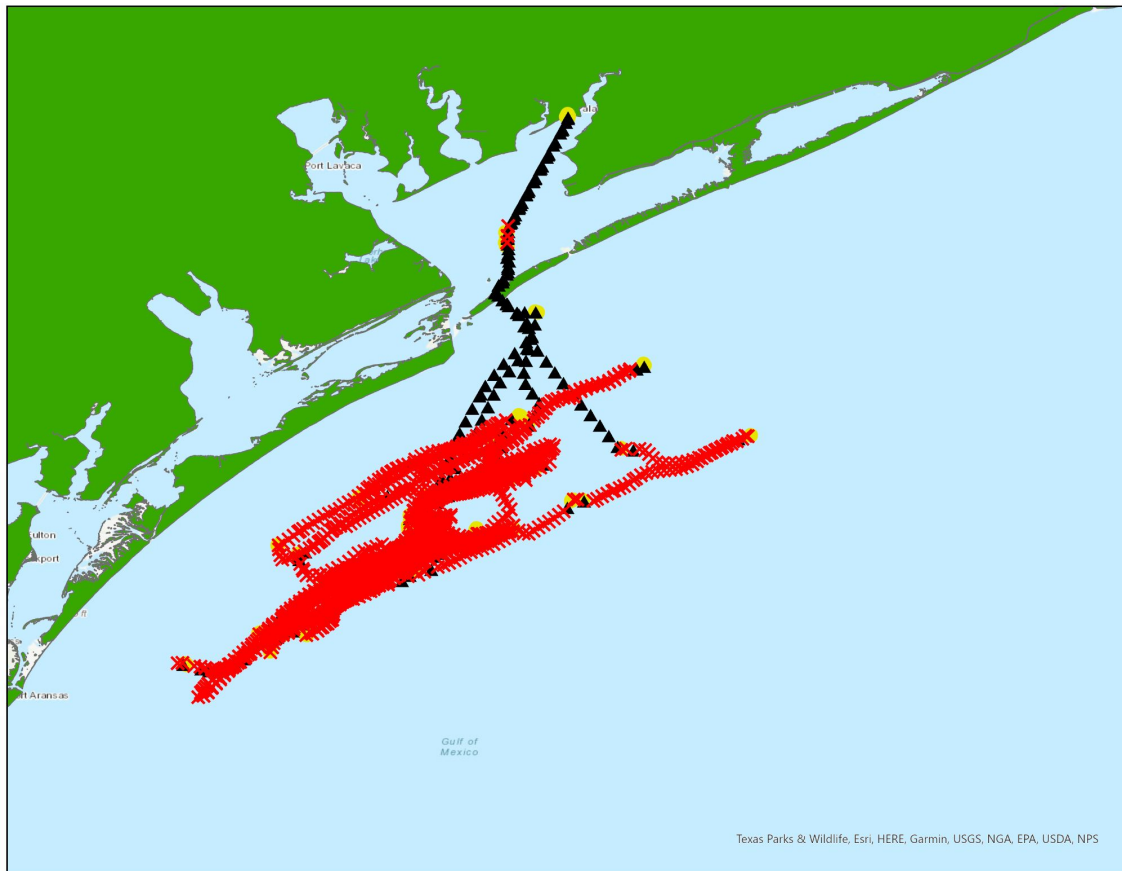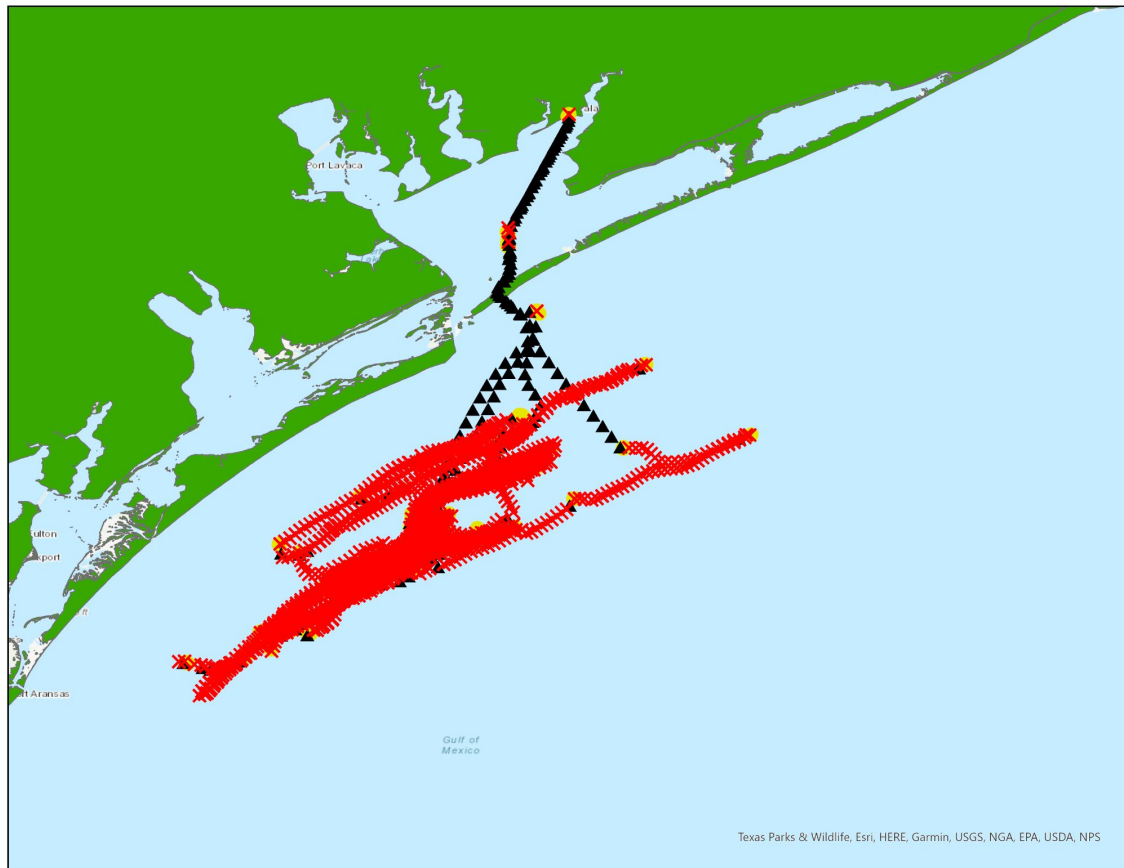
Additional Maps - Vessel 1 NEMO

*NEMO stopped transmitting data early, requiring a reboot that was not possible during this trial.

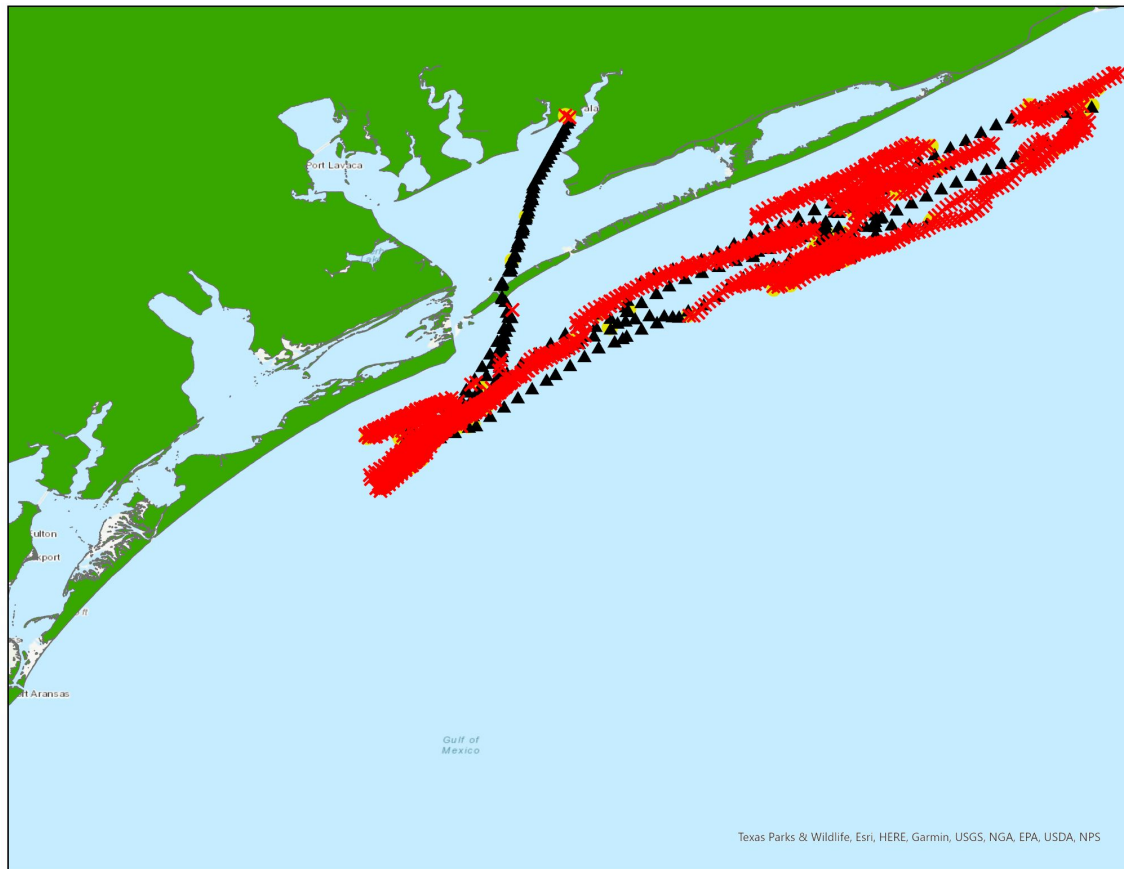VESSEL_STATE
- 🟡 stopped_idling
- ▲ steaming
- ✕ fishing

Esri, HERE, Garmin, USGS, NGA, EPA, USDA, NPS

NOAA FISHERIES
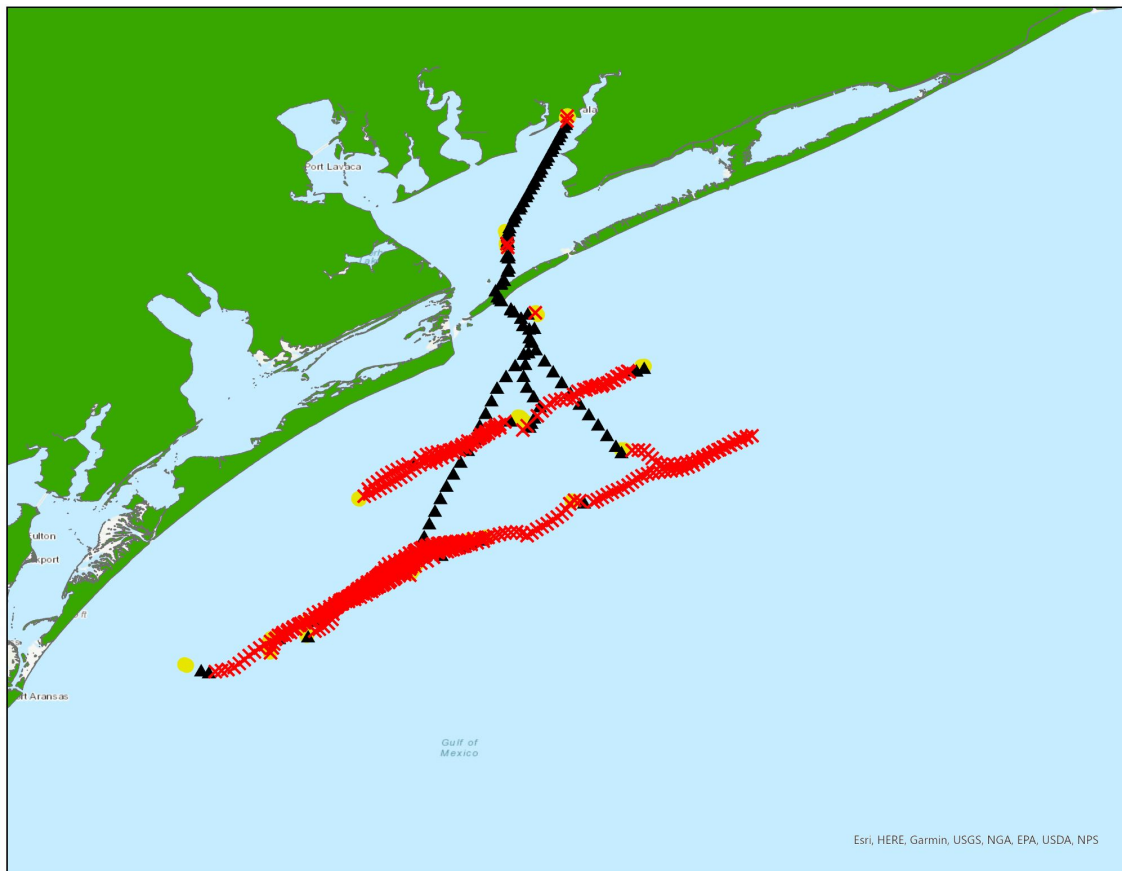
Additional Maps - Vessel 1 Zen

VESSEL_STATE
- 🟡 stopped_idling
- ▲ steaming
- ✕ fishing

Additional Maps - Vessel 4 Boat Command
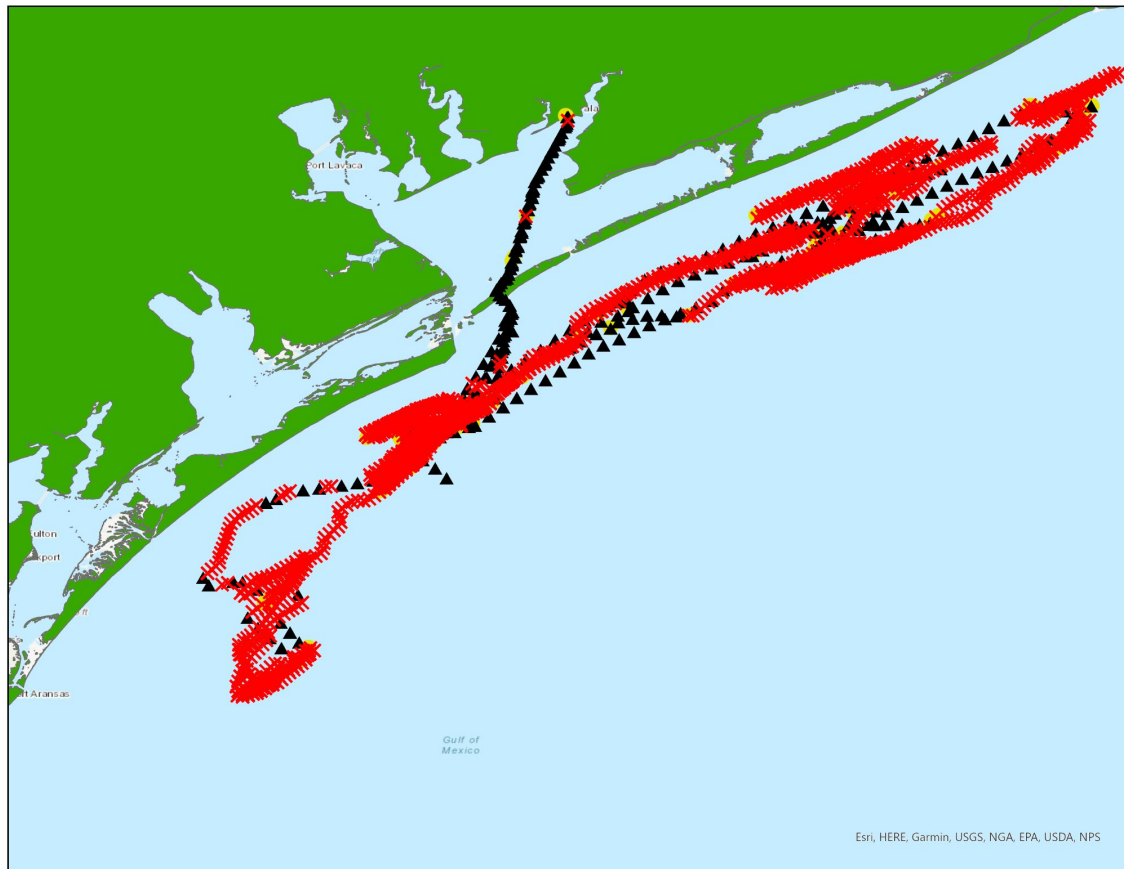
Additional Maps - Vessel 4 NEMO

VESSEL_STATE
- 🟡 stopped_idling
- ▲ steaming
- ✕ fishing

Additional Maps - Vessel 4 Zen
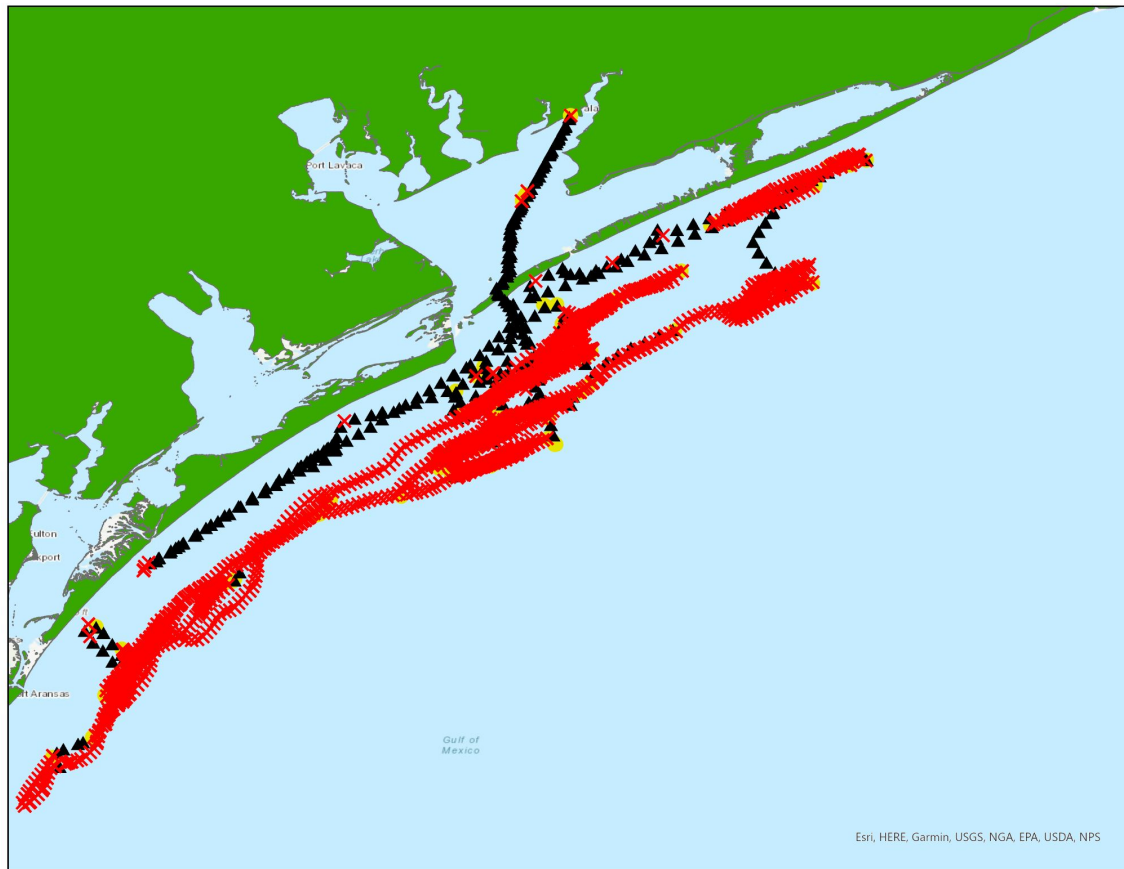
*Zen dataset provided by vendor included extra days, hence extra southern tracks
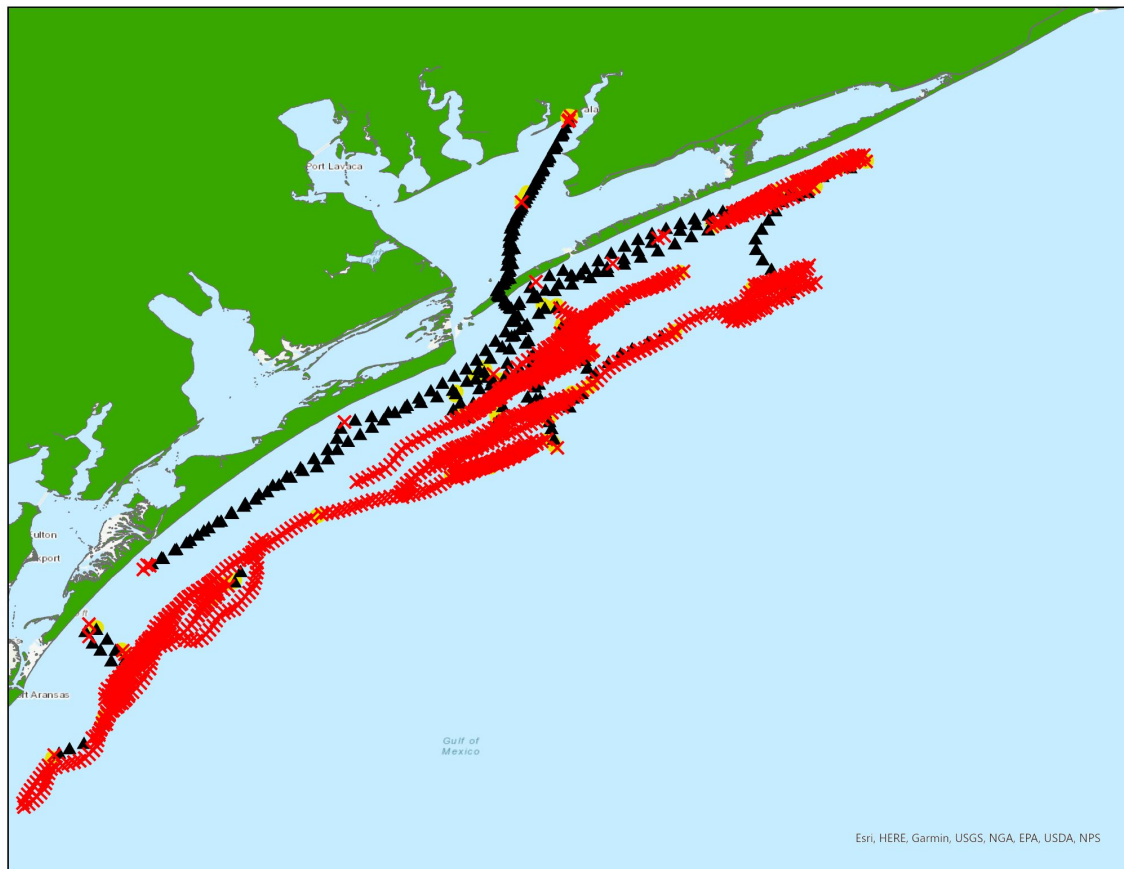

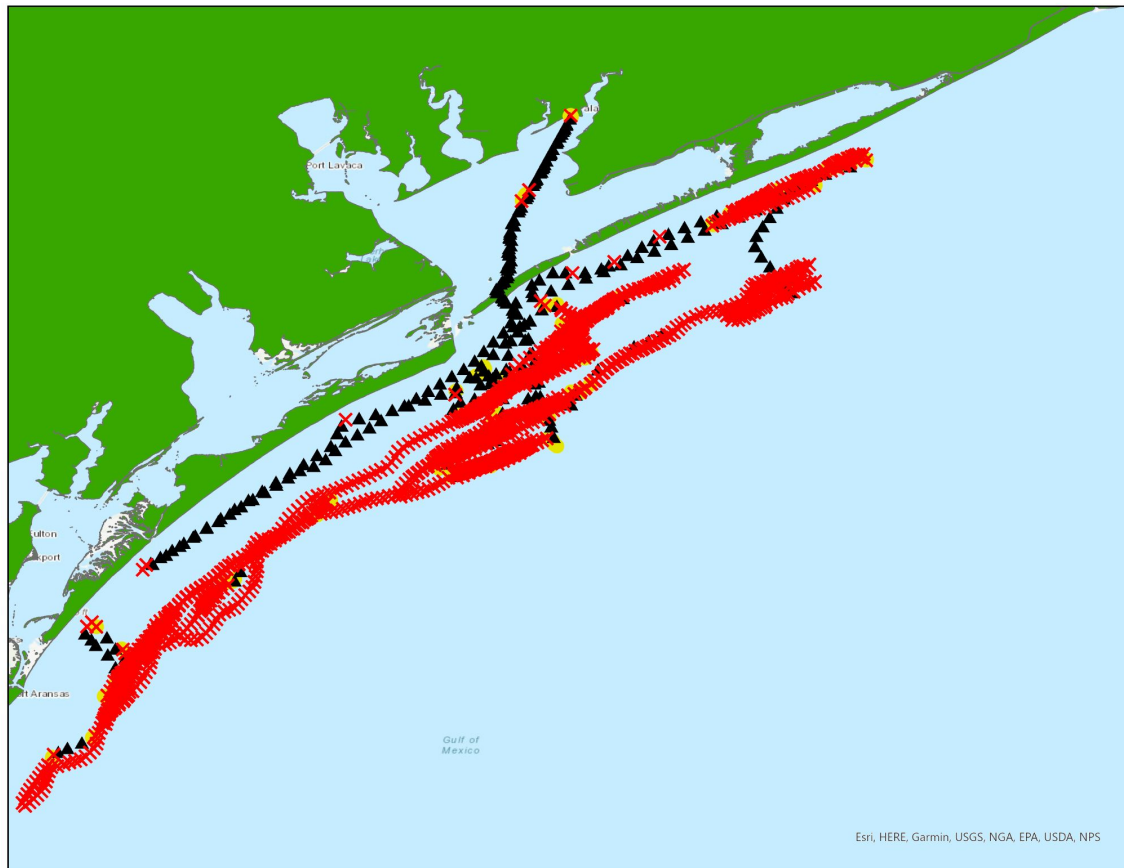VESSEL_STATE

● stopped_idling

▲ steaming

✕ fishing

VESSEL_STATE

● stopped_idling

▲ steaming

✕ fishing

Additional Maps - Vessel 5 NEMO

*NEMO had missing data

VESSEL_STATE
- 🟡 stopped_idling
- ▲ steaming
- ✕ fishing

Esri, HERE, Garmin, USGS, NGA, EPA, USDA, NPS

NOAA FISHERIES

Additional Maps - Vessel 5 Zen

Supporting Material

- Could not get Nautic Alert Insights from the vendor for test due to cost, but they are approved for many fisheries in US

- Boat Command from Viatrax & NEMO from Woods Hole Group both approved by ASMFC for Lobster fishery

- Zen from Atlantic Radio Telephone approved for for-hire fisheries in Gulf of Mexico

- Added Tracker Ones from Particle Industries due to availability and being economical