

# Characterization of Bycatch for the Menhaden Purse Seine Fishery Occurring off the Coast of Louisiana



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# Outline

- 1 Objectives & Study Design
- 2 Excluder Devices & Bycatch Sources
- 3 Chute Bycatch
- 4 Retained Bycatch
- 5 Rollover Bycatch
- 6 Sampling Effort
- 7 Fate Study



# ① Objectives & Study Design



# Objectives & Study Design

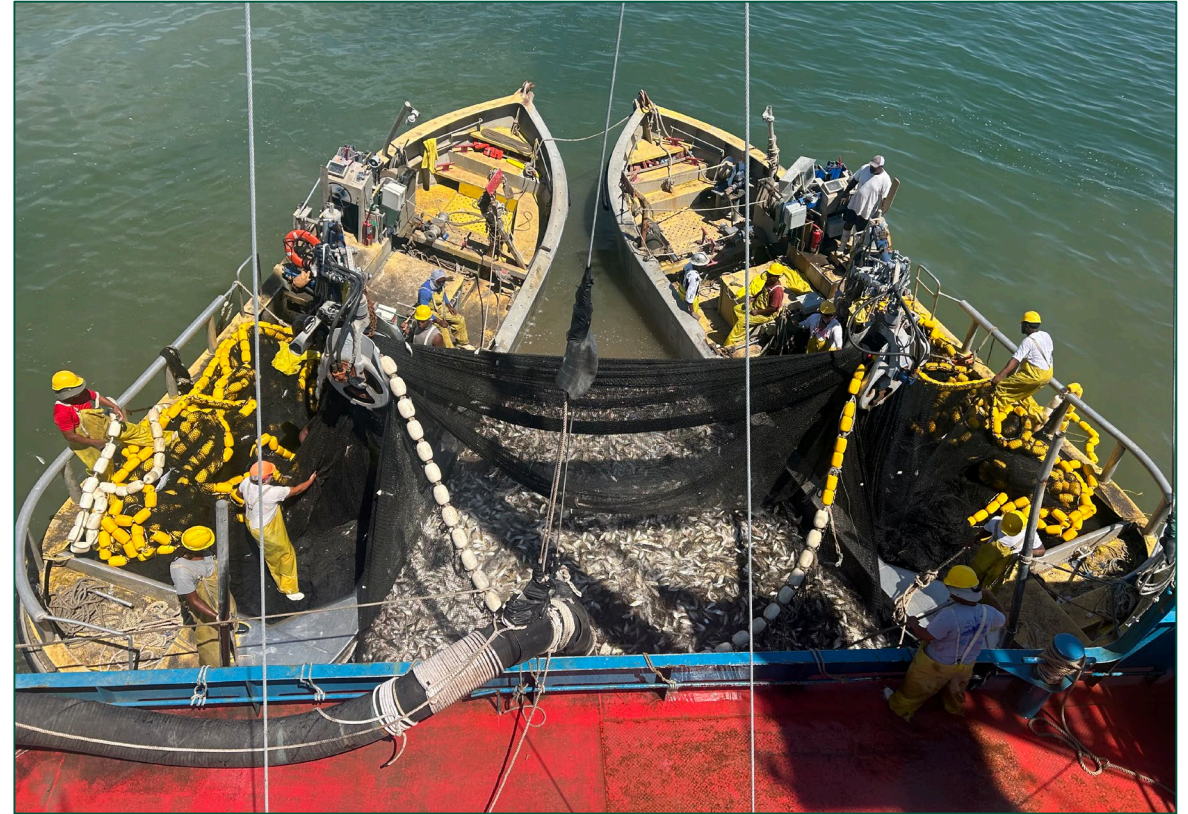
**Primary objective:** provide scientifically robust estimates of bycatch that covers >2% of the total sets across the entire 28-week purse seine season (LA state waters & adjacent federal waters).

1. Estimate the quantity (numerical abundance & total weight) and species composition of bycatch.
2. Estimate species-specific size (length and weight) distributions, as well as sex ratios.
3. Estimate near-term mortality rates (“fate”) of released bycatch species.
4. Record “vitality” of each fish tested in the fate studies via Reflex Action Mortality Predictors (RAMP); includes ~5 reflexes that are typically present in vigorous individuals.



# Objectives & Study Design

1. Stratified random design across plants and months to allow for spatio-temporal patterns in bycatch to be rendered.
2. Area stratification represented by sampling boats operating out of the three processing plants:
  - Empire, LA (Daybrook)
  - Abbeville, LA (Omega)
  - Moss point, MS (Omega)
3. Samples have been stratified across the seven months (April-October) to address seasonality.



# Study Design – Run Boats

1. Study design uses “run boats” or “tenders” to sample the fleet. These vessels do not fish, but pump catch from sets made by other boats.
2. F/V Vermilion (Abbeville), F/V Grand Calliou (Moss Point), and F/V Kittiwake (Empire).
3. Benefits to using run boats:
  - Access to a greater number of sets to sample
  - More space for observers & survival tanks
  - Sampled sets are more statistically independent
4. Sampling occurs from purse nets only (e.g., not vessel holds or at the plants).
5. Team of 4 to 6 fisheries observers sample bycatch onboard a run boat from each of the three plants monthly.

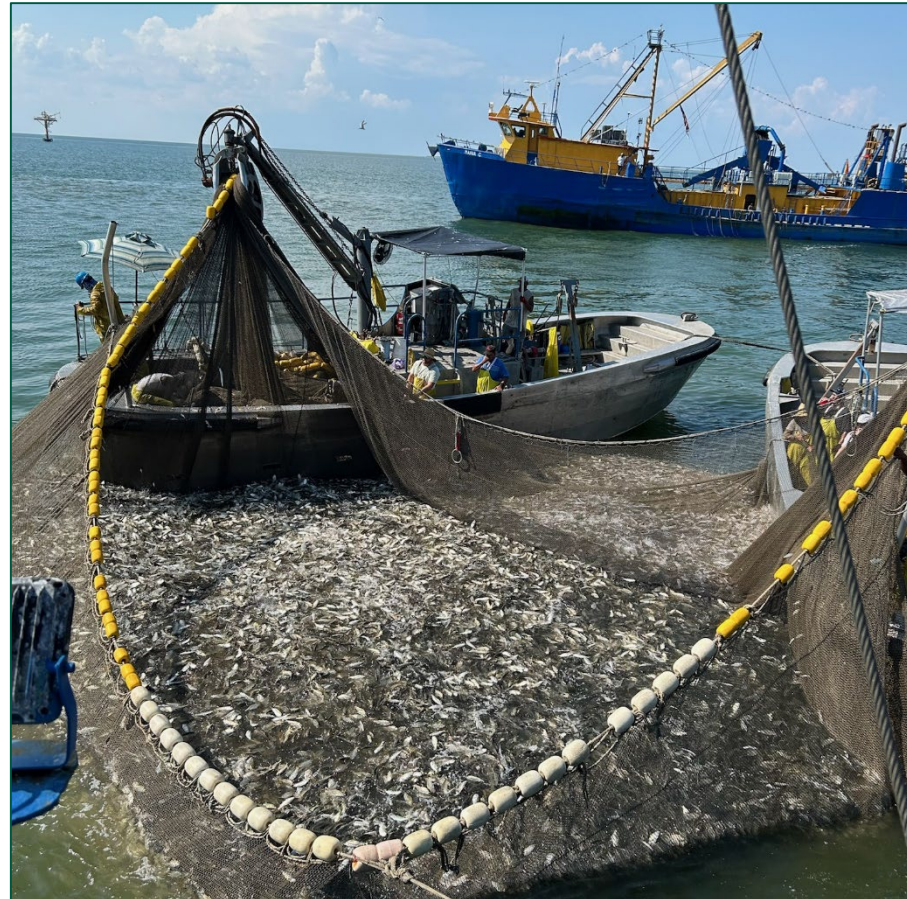
**What happens to bycatch is the same regardless of whether a set is pumped by a runboat or the steamer that made the set.**

**“Fishing boats fish the fish, run boats fish the fleet”**





## ② Excluder Devices & Bycatch Sources



# Bycatch Excluder Devices

Two primary types of bycatch excluder device:

Hose Cage



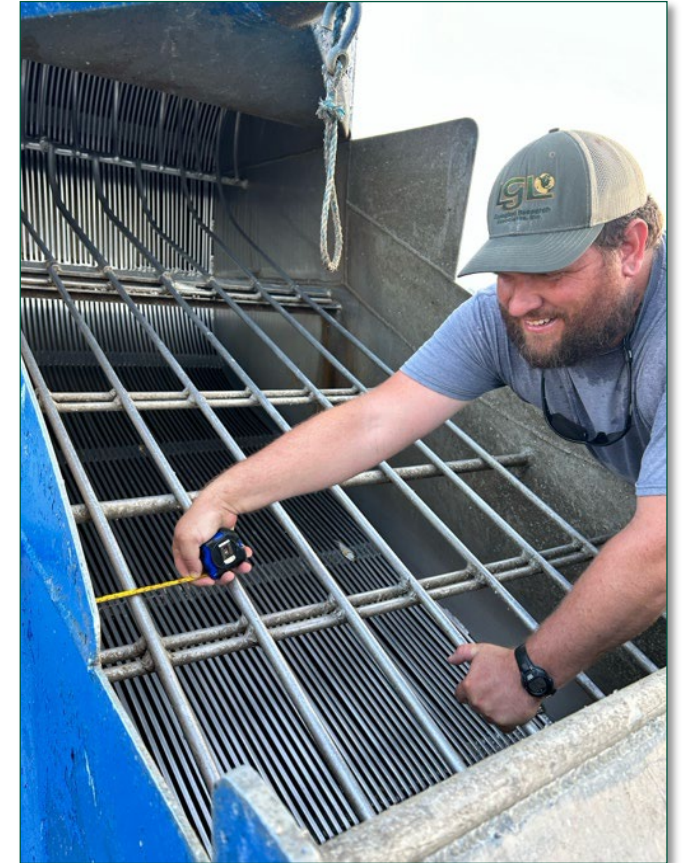
Excluder Grate





# Bycatch Excluder Devices

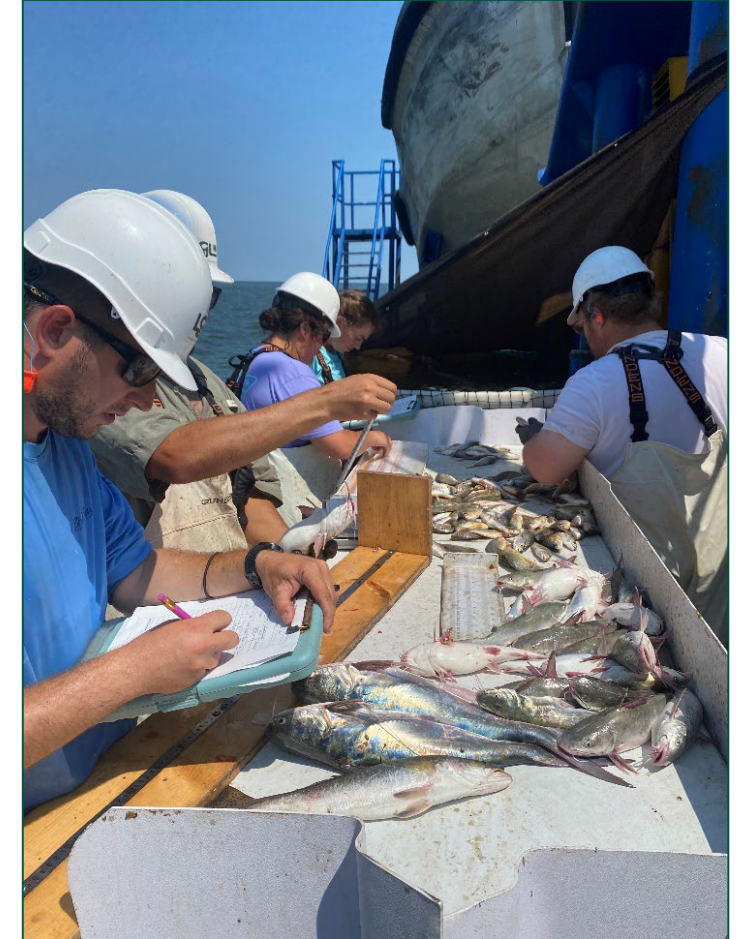
- LGL has measured all bycatch exclusion devices on all fishing vessels



# Main Areas of Bycatch Sampling

Bycatch can occur in three primary ways:

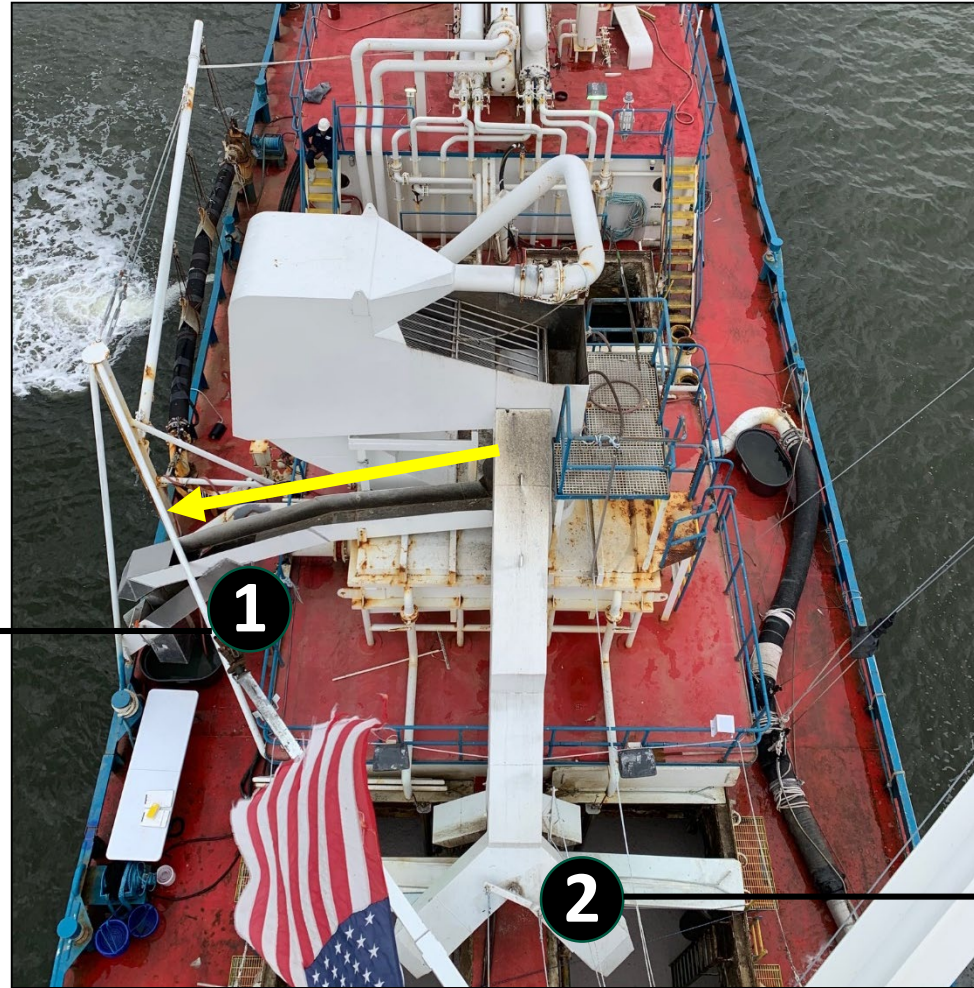
1. Chute bycatch: larger individuals that enter the hose cage but are separated from the catch by the excluder grate that sends them down a release chute.
2. Retained bycatch: smaller individuals that pass through the grate and end up in the hold along with targeted catch.
3. Rollover bycatch: large fish remaining in the seine once the pumping process is complete and rolled over the cork line for release.





# Main Areas of Bycatch Sampling

## 1 Chute Bycatch



## 2 Retained Bycatch

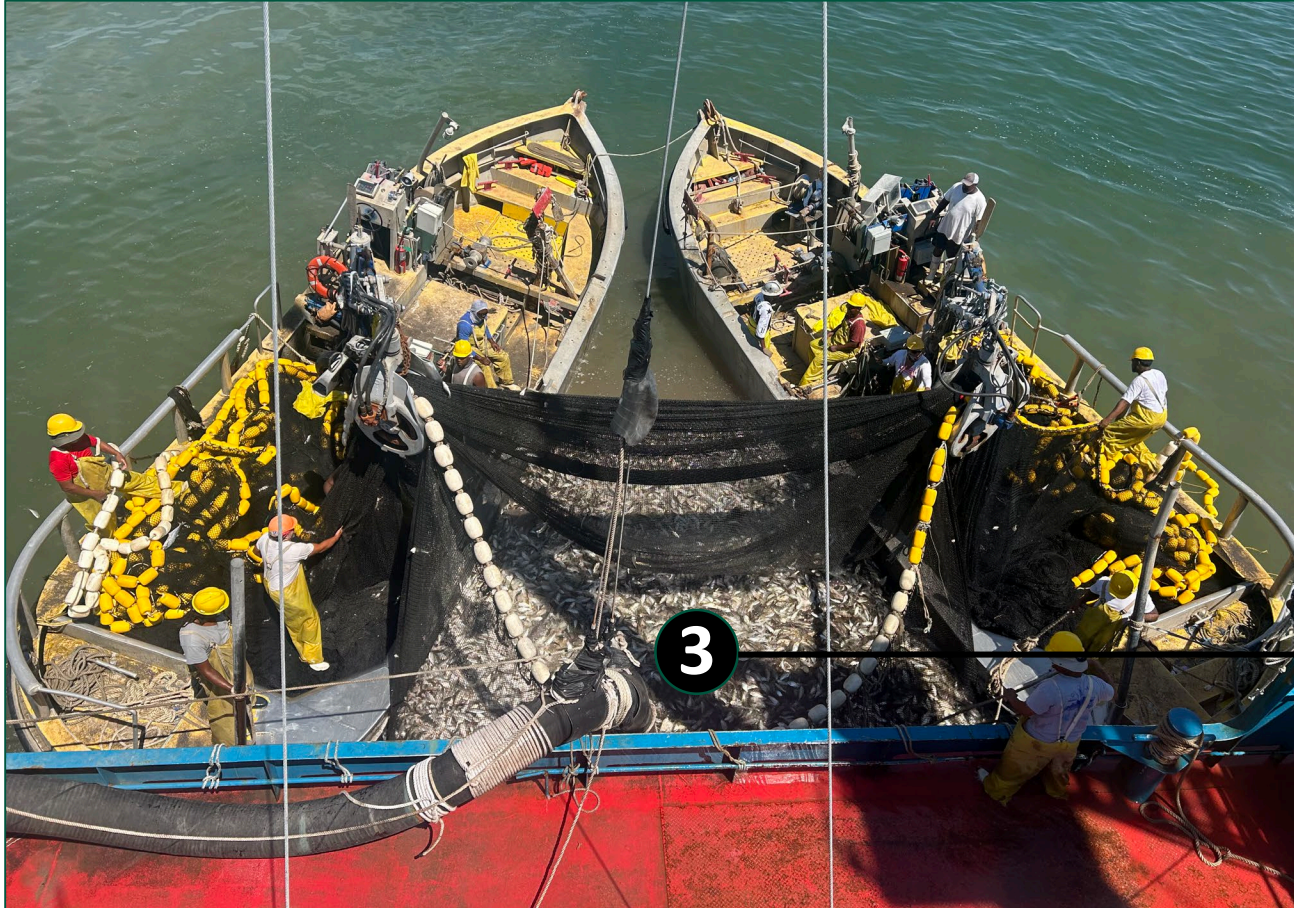




# Main Areas of Bycatch Sampling (cont.)

3

Rollover Bycatch





### ③ Chute Bycatch



# Chute Bycatch Sampling

- Chute bycatch is diverted to temporary holding tanks during the sampling of each set.
- The entire set's chute bycatch is then sorted and enumerated; a subset is measured for length and weight.

F/V Vermillion



F/V Kittiwake



F/V Grand Calliou





## ④ Retained Bycatch



# Retained Bycatch Sampling

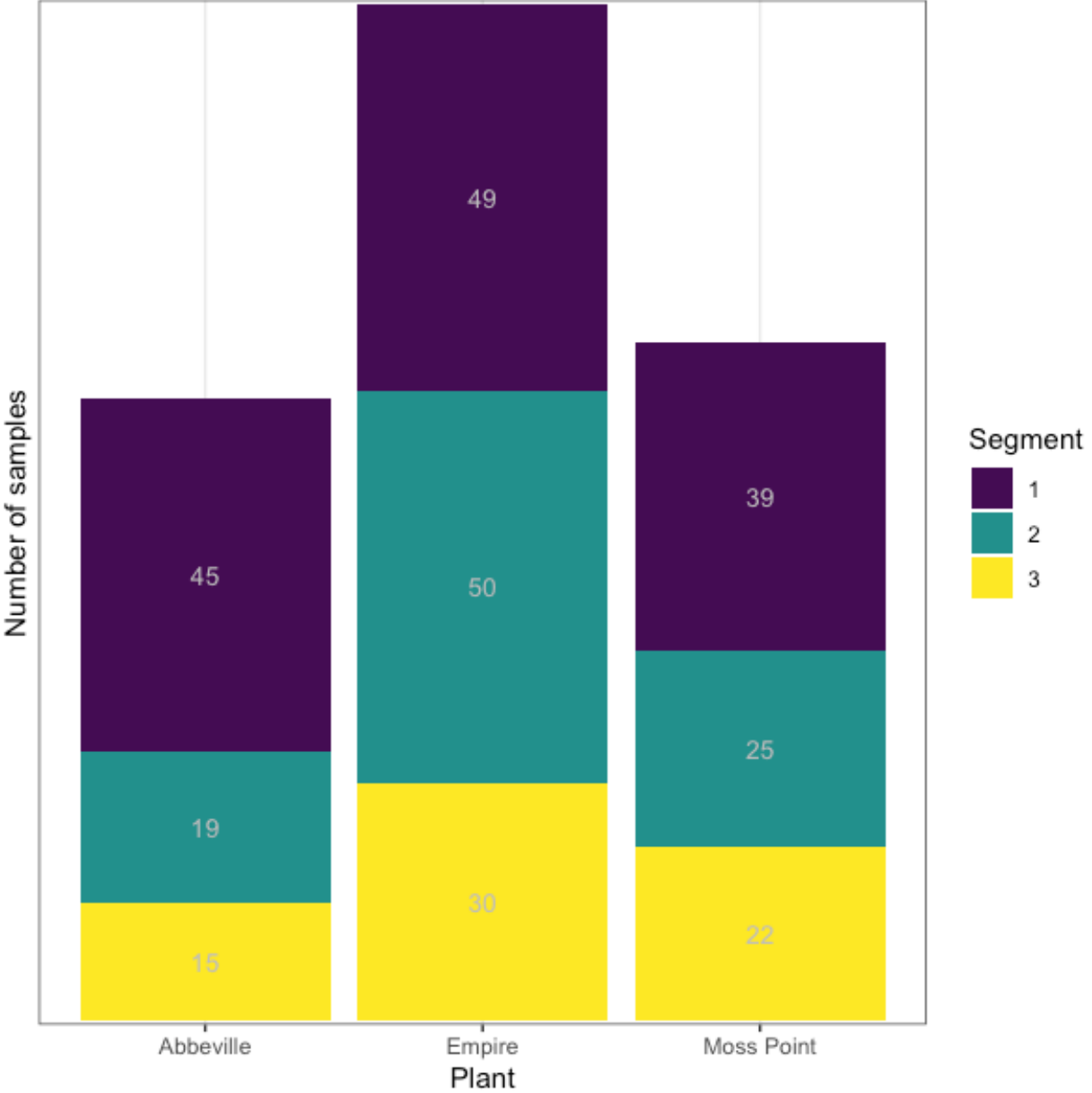
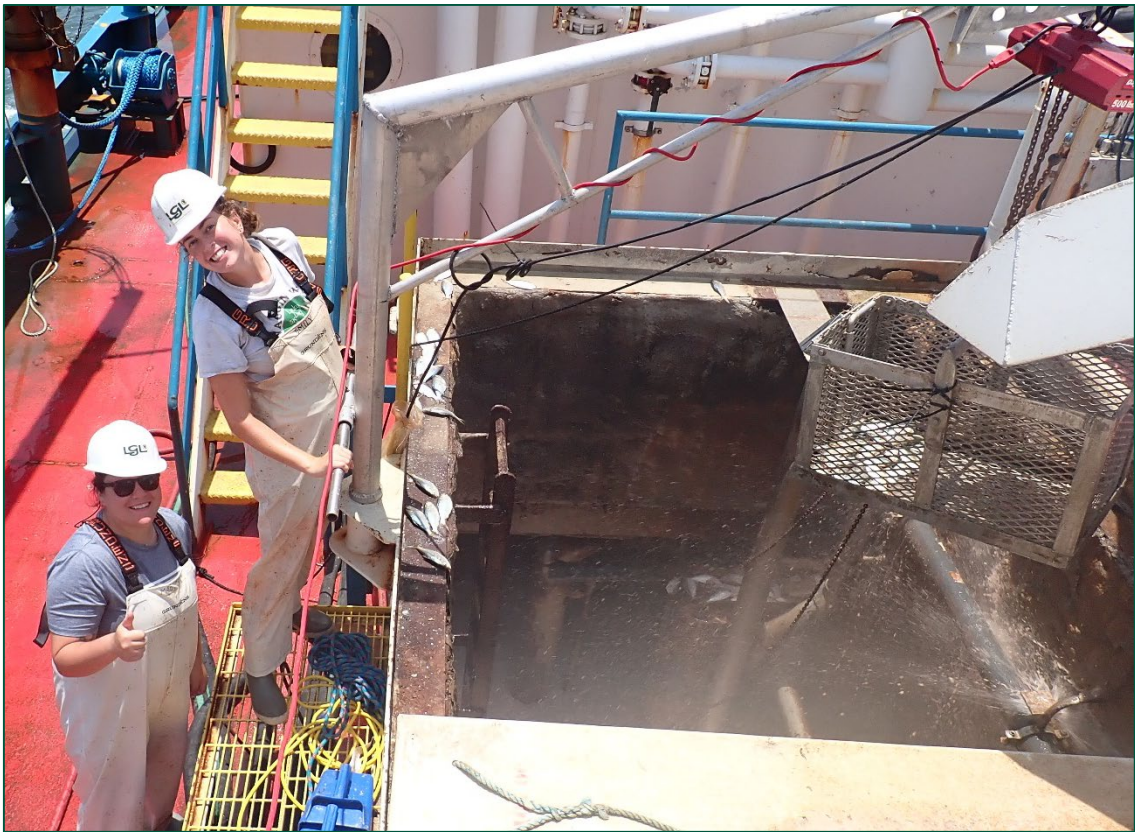
1. Vessels are pumping >15,000 standard menhaden into the hold per minute.
2. Thus, subsampling via basket, davit and electric winch is required.
3. Basket samples hold ~130 kg (287 lbs), or 500-1000 menhaden (depending on menhaden size).
4. Statistically, 403 menhaden are required for 90% confidence of being no more than 5% off in multinomial response (i.e., each species represented as a % of the bycatch).





# Retained Bycatch Segments

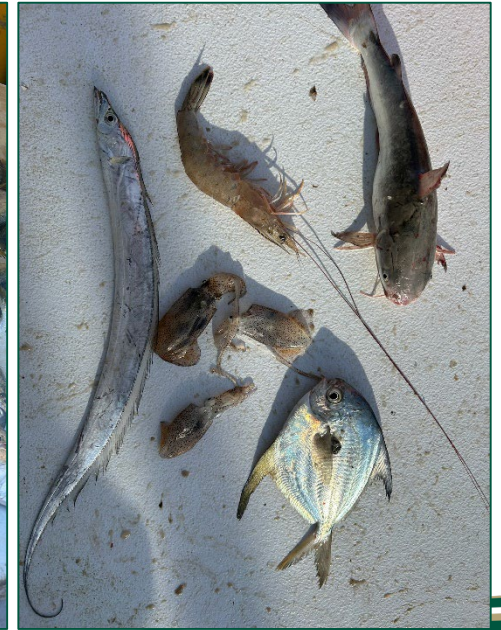
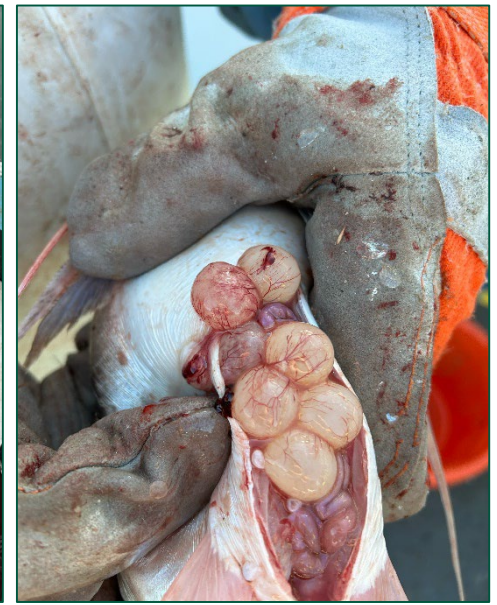
Sampling partitioned across 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> segment of the set. Segment to be sampled is randomly chosen prior to pumping the set.





# Retained Bycatch Sorting

1. Catch sorted by observers.
2. All menhaden are separated and weighed in 8-9 baskets (~15 kg each). Menhaden are counted from two baskets.
3. First 30 specimens of each bycatch species measured (FL & TL) and weighed.
4. All bycatch is enumerated & weighed.
5. Subset of bycatch is sexed.



# Cross Verification Via Video Sampling--Analysis

1. Subsampling of the retained bycatch is supplemented with video monitoring of the entire pumping operation.
2. High speed GoPro cameras (240 frames per second) on all four holds.
3. Specialized shade/fan boxes to prevent cameras from overheating.
4. Videos analyzed in BORIS behavioral software. Counts and approximate lengths for all bycatch species large enough to be detected.

**Spanish Mackerel**



**Black Drum**



**Juvenile Sharks**



**Gafftopsail Catfish**





# Cross Verification Via Video Analysis--Reasoning

1. From subsampling: The subsample of catch + bycatch observed in the basket must be expanded to the entire catch to estimate the total retained bycatch for a given set.
2. From video sampling: All species are not be equally visible in the videos from the four holds. However, certain larger individuals of some species are amenable to enumeration via video sampling. Counts of these verification species (e.g., black drum, Spanish mackerel, gafftopsail catfish, etc.) should be a near census for each set.
3. Verification: For these verification species, video estimates of bycatch should match the expanded subsampled estimates from the baskets. There may be discrepancies for an individual set, but across the study the two methods should yield similar retained bycatch estimates for those species and sizes selected for verification. If so, then the accuracy of subsampled estimates for other species/size combinations not countable with videos will be bolstered.



## ⑤ Rollover Bycatch





# Rollover Bycatch

- Enumerated in real time by observers.
- Counts are verified by videos from overhead cameras (the same as those described for the retained bycatch).
- Either all or a subset of all species are measured for length, weighed, and sexed.

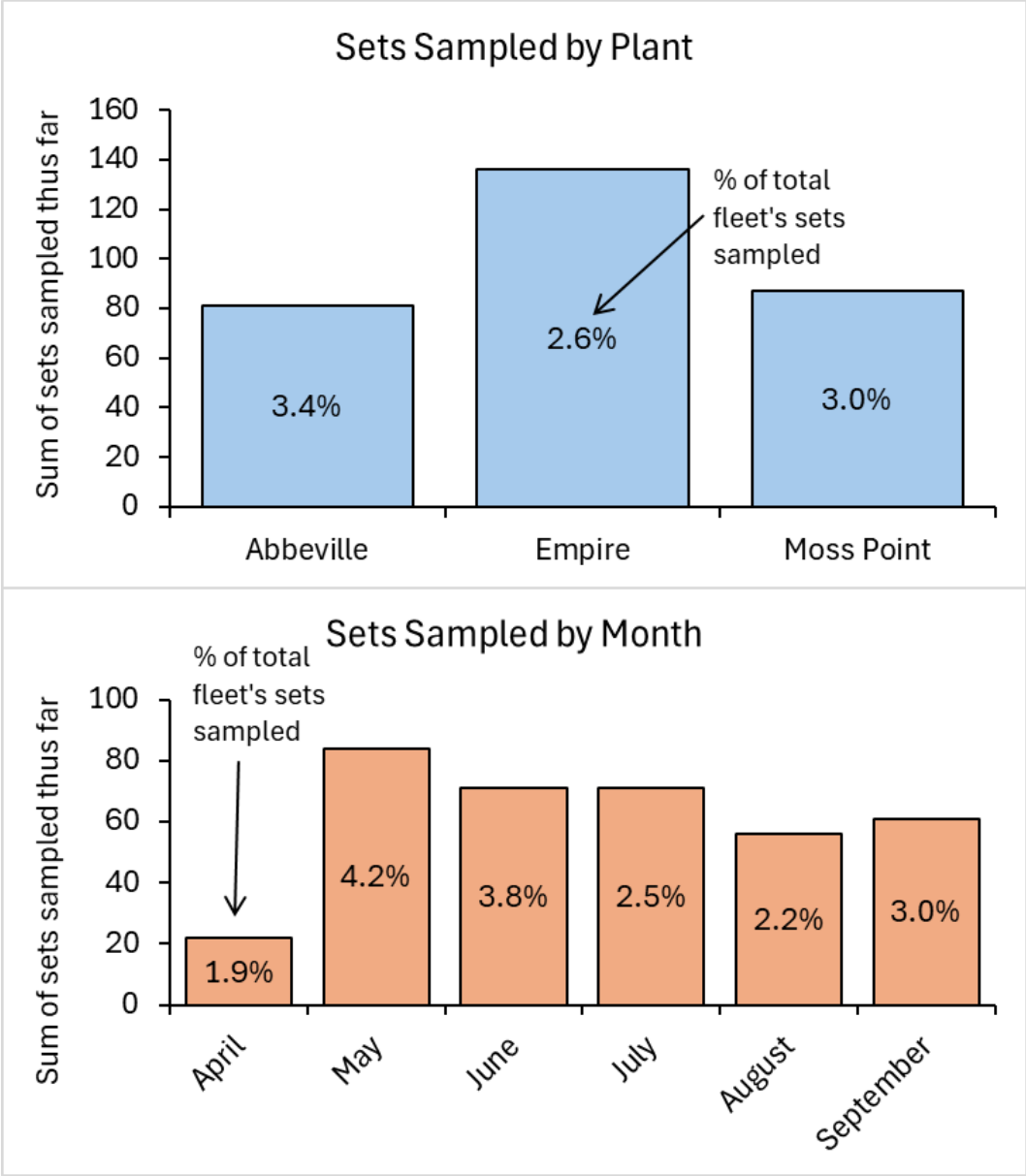




## ⑥ Sampling Effort & Distribution



**Sampling Effort Goal:** >2% sets sampled across season  
**Progress:** 2.91% sets sampled so far (N=365)

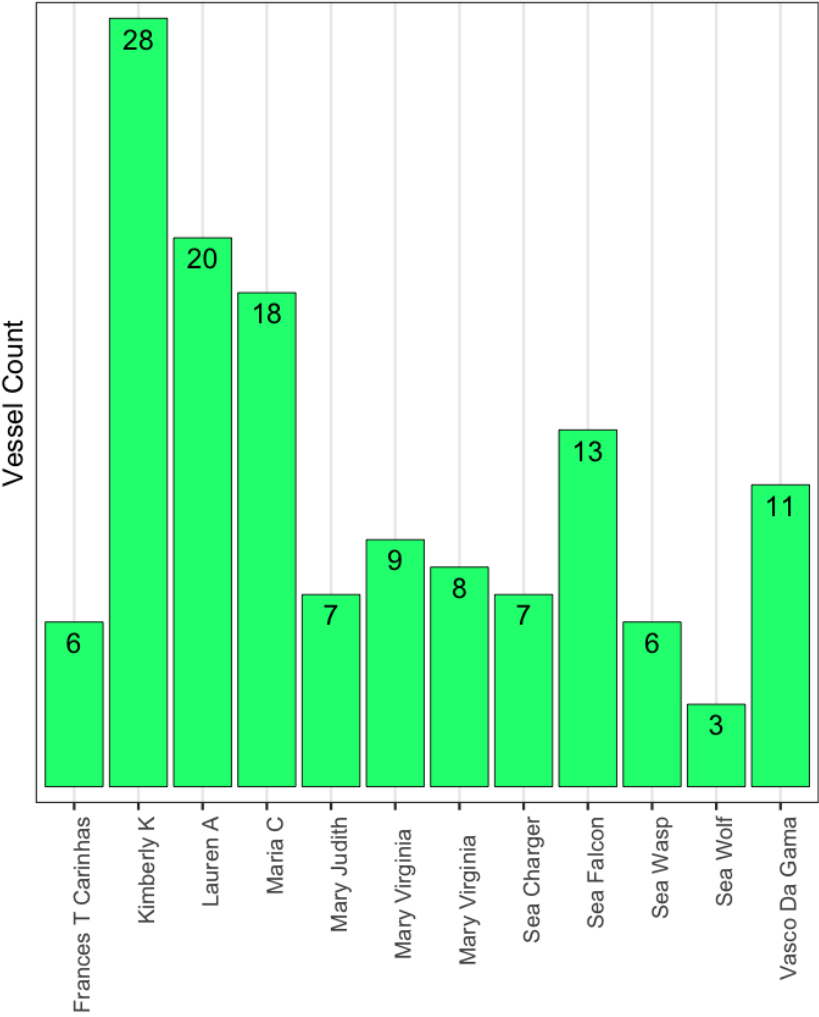


Plant	Month	Total Number of Sets Fished	Sets Sampled	Percent Effort Sampled
Abbeville	April	191	3	1.57%
Moss Point	April	324	8	2.47%
Empire	April	655	11	1.68%
Abbeville	May	224	27	12.05%
Moss Point	May	680	20	2.94%
Empire	May	1100	37	3.36%
Abbeville	June	247	16	6.48%
Moss Point	June	662	22	3.32%
Empire	June	979	33	3.37%
Abbeville	July	714	14	1.96%
Moss Point	July	898	24	2.67%
Empire	July	1253	33	2.63%
Abbeville	August	744	21	2.82%
Moss Point	August	629	13	2.07%
Empire	August	1162	22	1.89%
Abbeville	September	599	11	1.84%
Moss Point	September	553	26	4.7%
Empire	September	909	24	2.64%

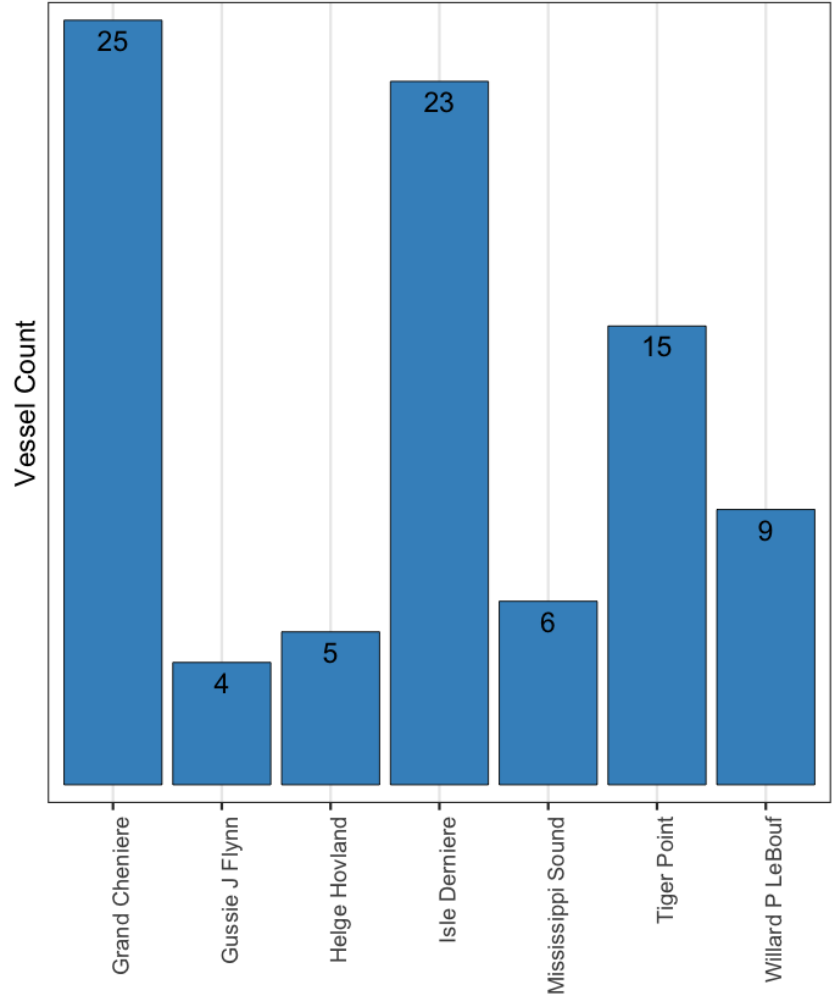


# Sampling by Fishing Vessel & Plant (through August)

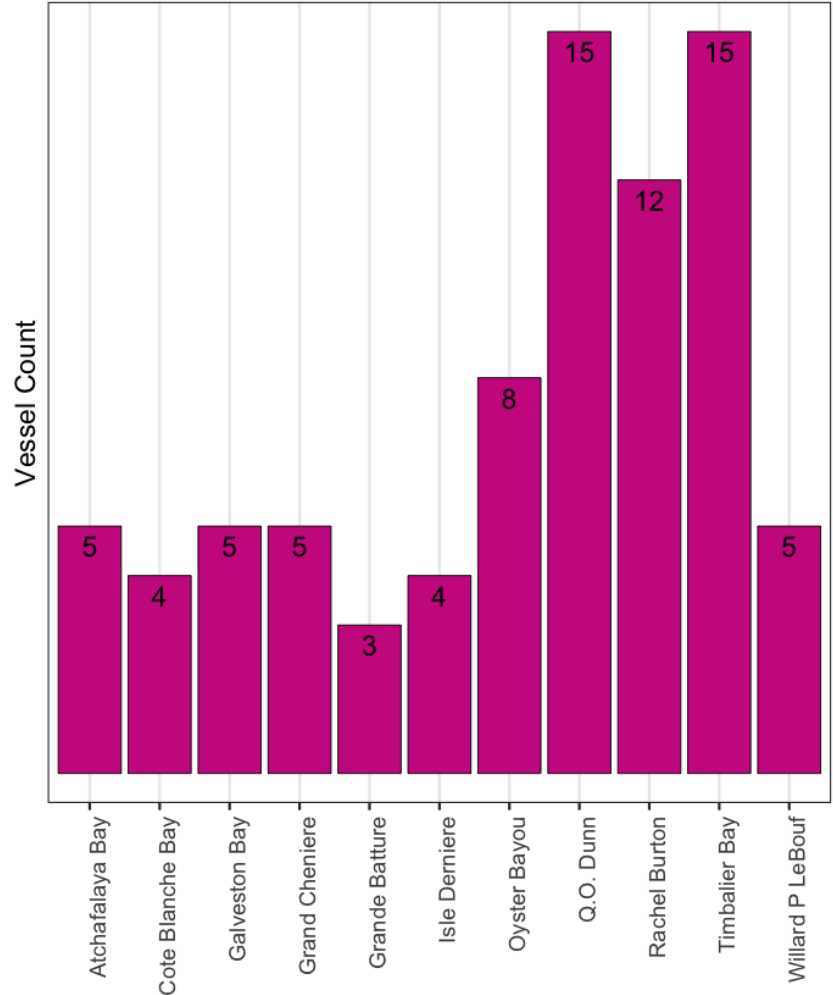
Empire



Moss Point



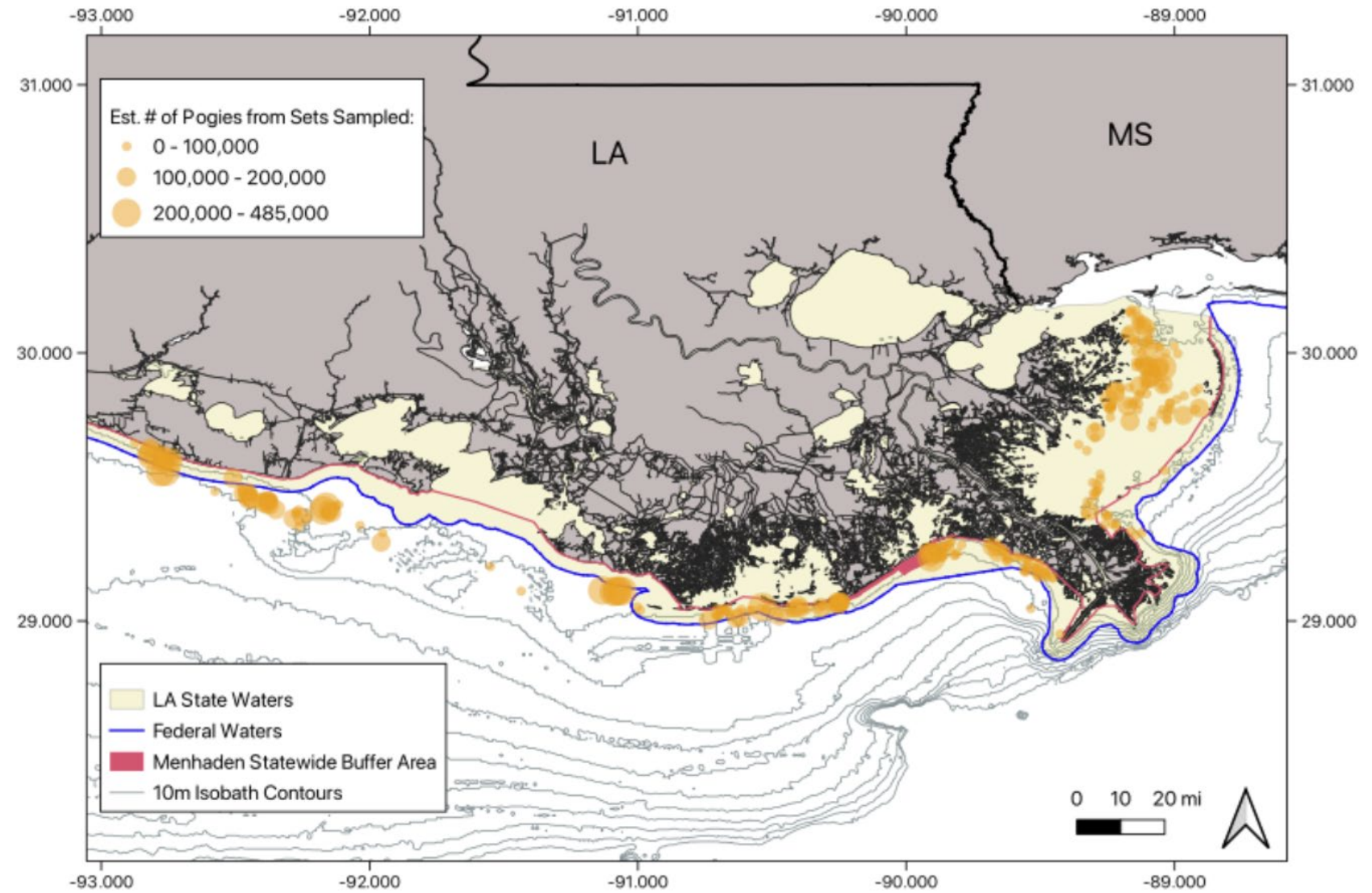
Abbeville



- Every vessel in the fleet sampled at least 3 times

# Spatial Distribution

- 304 Sets Sampled through Aug 2024
- All sets within LA state waters or adjacent federal waters
- Menhaden catch from sampled sets has ranged from ~2,500 to 458,000 individuals





# Set Metadata and Environmentals

- For each set the following metadata are collected:
  - Location
  - Captain's Est. number of menhaden
  - Water depth
  - Surface water temp, salinity, DO, and turbidity in the general area not affected by the fishery.
  - Surface water temp and DO immediately adjacent to the set being sampled.



## 7 Survival Study

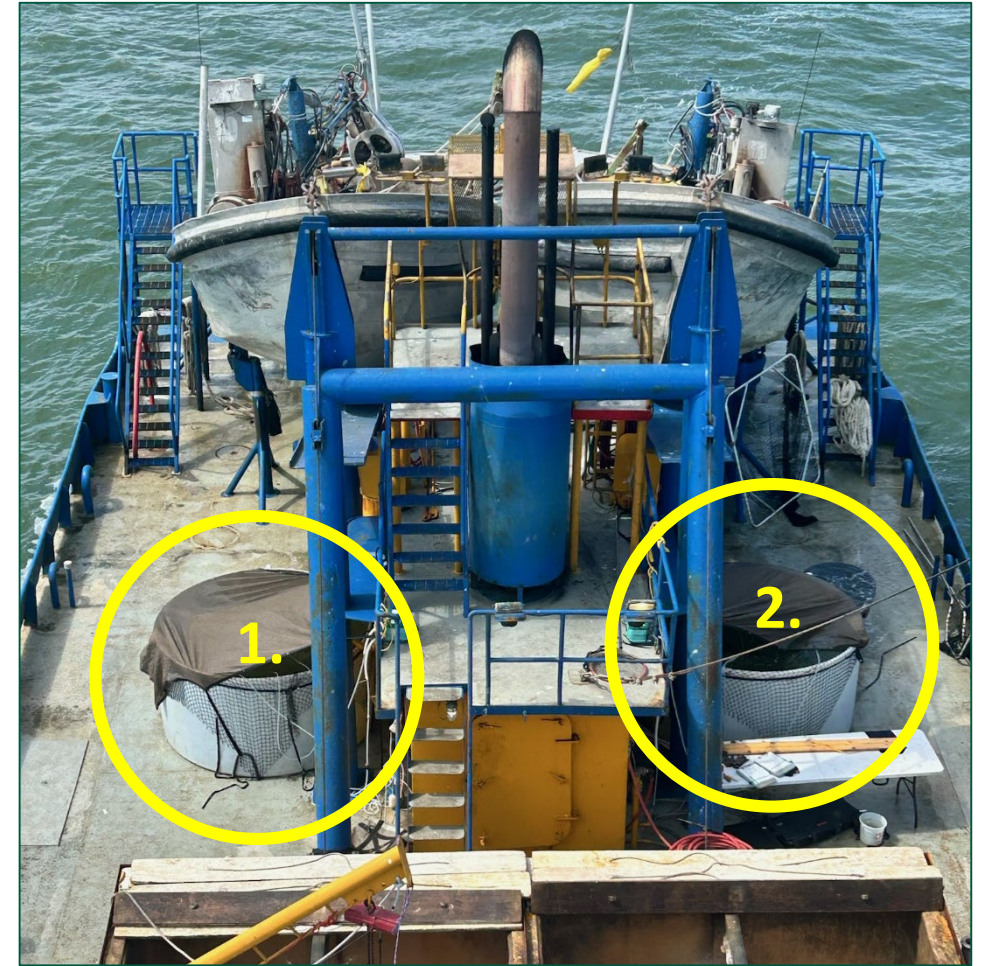




# Survival Study

**Objective 3:** Estimate near-term mortality rates (“fate”) of released bycatch species (chute & rollover).

1. Species: red drum, black drum and gafftopsail catfish.
2. 24-hour holding study with two 1,200-gallon tanks onboard the F/V Vermillion and F/V Kittiwake.
3. Flow-through system, shading, and additional aeration and flow (when needed).
4. Stocking density: 1lb fish per 10 gallons. Equivalent to 5-10 adult drum depending on size/species.
5. DO, Temperature, Salinity loggers in tanks for the duration of experiments.
6. Sea surface water environmentals are periodically checked to ensure tank conditions are similar to ambient.



# Survival Study

**Objective 4:** Record “vitality” of each fish tested in the fate studies via Reflex Action Mortality Predictors (RAMP).

- 1. Includes ~5 reflexes that are typically present in vigorous individuals. Used in other purse seine fisheries to predict fate (Raby et al 2015).
- 2. Rapid ~10 second assessment at start of 24-hr period. If a fish is too vigorous to handle and assess, it is assigned an unimpaired status for all reflexes.

Reflex	Description
HEAD COMPLEX	Regular pattern of ventilation (out of water).
VOR (vestibular ocular response)	Fish turned on its side lengthwise. An unimpaired VOR is characterized by the fish’s eye rolling to maintain level pitch, tracking the handler.
BODY FLEX	Tested by holding the fish out of water using two hands wrapped around the middle of the body. If the fish actively attempts to struggle free it is characterized as unimpaired.
TAIL GRAB	An unimpaired response is characterized by the fish attempting to burst-swim immediately upon contact with the caudal fin.
ORIENTATION	Each fish is placed upside-down just below the surface: an unimpaired orientation reflex occurs if the fish rights itself within ~3 s.





# Survival Study

**Objective 3:** Estimate near-term mortality rates (“fate”) of released bycatch species.

1. Fish measured, weighted and fate determined at the end of the 24 hr period.
2. Fish that survived are released double tagged with dart tags.
3. No fish recaptures yet (Note: some releases occurred at the docks).



# Survival Study Sample Sizes from Chute and Rollover Bycatch

## Chute

Month	Red drum	Black Drum	Gafftopsail Catfish
April		2	2
May	6	6	6
June	3	16	13
July	1		13
August	7	3	11
Total :	17	27	45

## Rollover

Month	Red drum	Black Drum	Gafftopsail Catfish
April	10	6	
May	34	17	
June	13	31	1
July	19		1
August	34	4	2
Total :	110	58	4



# Acknowledgements

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