Evaluation of the Large Mesh Belly Panel in Small Mesh Fisheries as a Method to Reduce Yellowtail and Windowpane Flounder Bycatch on Georges Bank

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Project Purpose

- The project addressed yellowtail and windowpane flounder bycatch concerns on Georges Bank by evaluating the effectiveness of a standard net modified with a large mesh belly panel to reduce bycatch of these species in deep water while targeting squid and whiting

- The project was proposed by GB small mesh fishermen as means to pursue gear certification to be used for yellowtail and windowpane bycatch avoidance in GB small mesh fisheries when Accountability Measures are triggered.
- Based on similar inshore work conducted by CCE and funded through CFRF

Project Summary

- F/V Karen Elizabeth (Point Judith, RI), a twin-trawl vessel, was chartered to conduct all at-sea research.

- The vessel towed the control trawl (3-bridle 4-seam standard box trawl) and experimental trawl (box trawl modified with the large mesh belly panel) simultaneously. Comparisons were based on paired differences in catch by species.

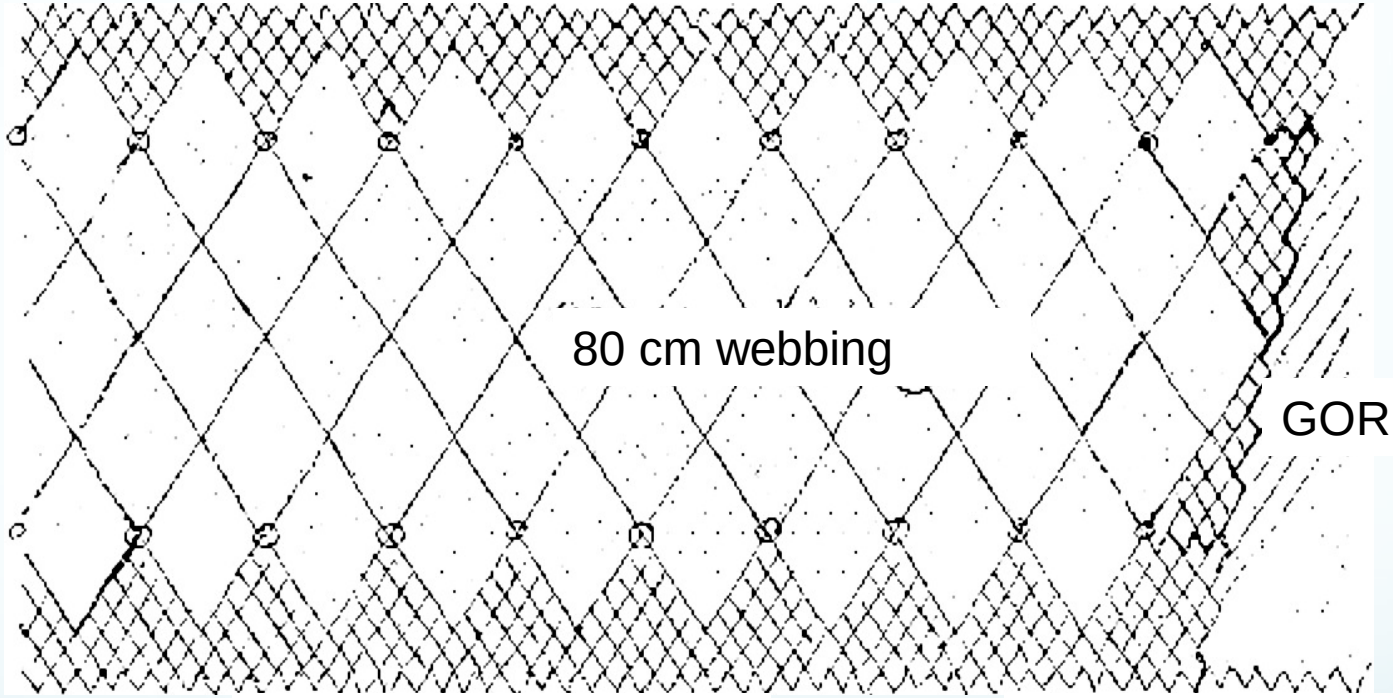
- Four species were analyzed including yellowtail flounder, windowpane flounder, squid and whiting

Sketch of Large Mesh Belly Panel

356 x 16cm
80cm large mesh 1st bottom belly

126 – 16cm meshes

16cm sawtooth



115 – 16cm meshes

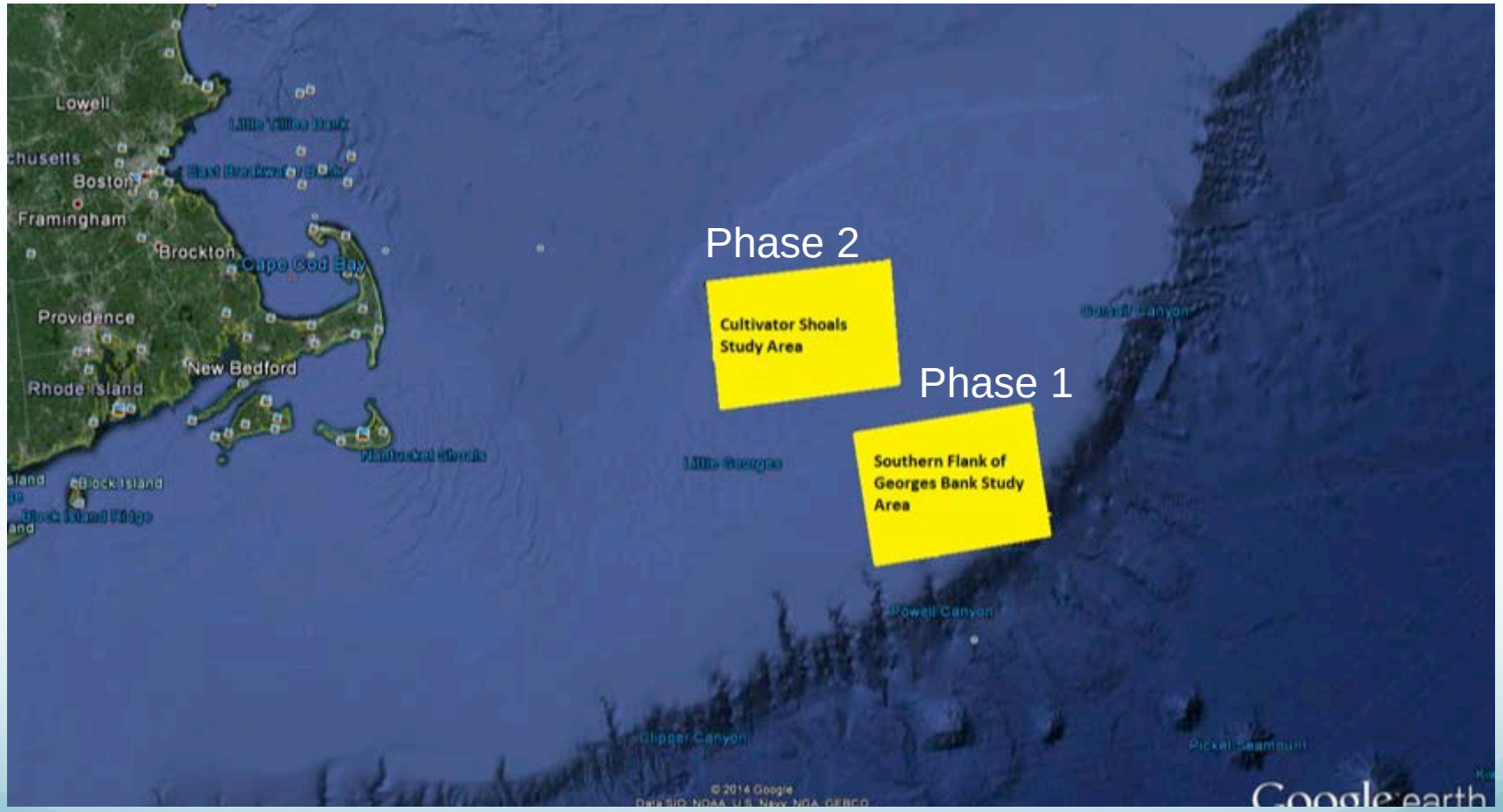
16cm sawtooth

The large mesh panel was made of 80cm (32”) mesh 6mm poly webbing, 2 meshes deep X 16 meshes wide sewn into the standard 16cm (6”) mesh of the belly. With the ‘saw-toothing’ of the 16cm mesh, this yields an effective opening of 3 full meshes deep, a total of about 8’ of large mesh. The panel attaches five 16cm meshes (approx. 2.5’) behind the footrope and goes from gore to gore (22 meshes wide or approx. 30’).

Large Mesh Belly Panel

A net diagram is included in the report as is a description on how to scale the construction of the belly panel for different size nets.

Project Locations



Phase 1 Summary

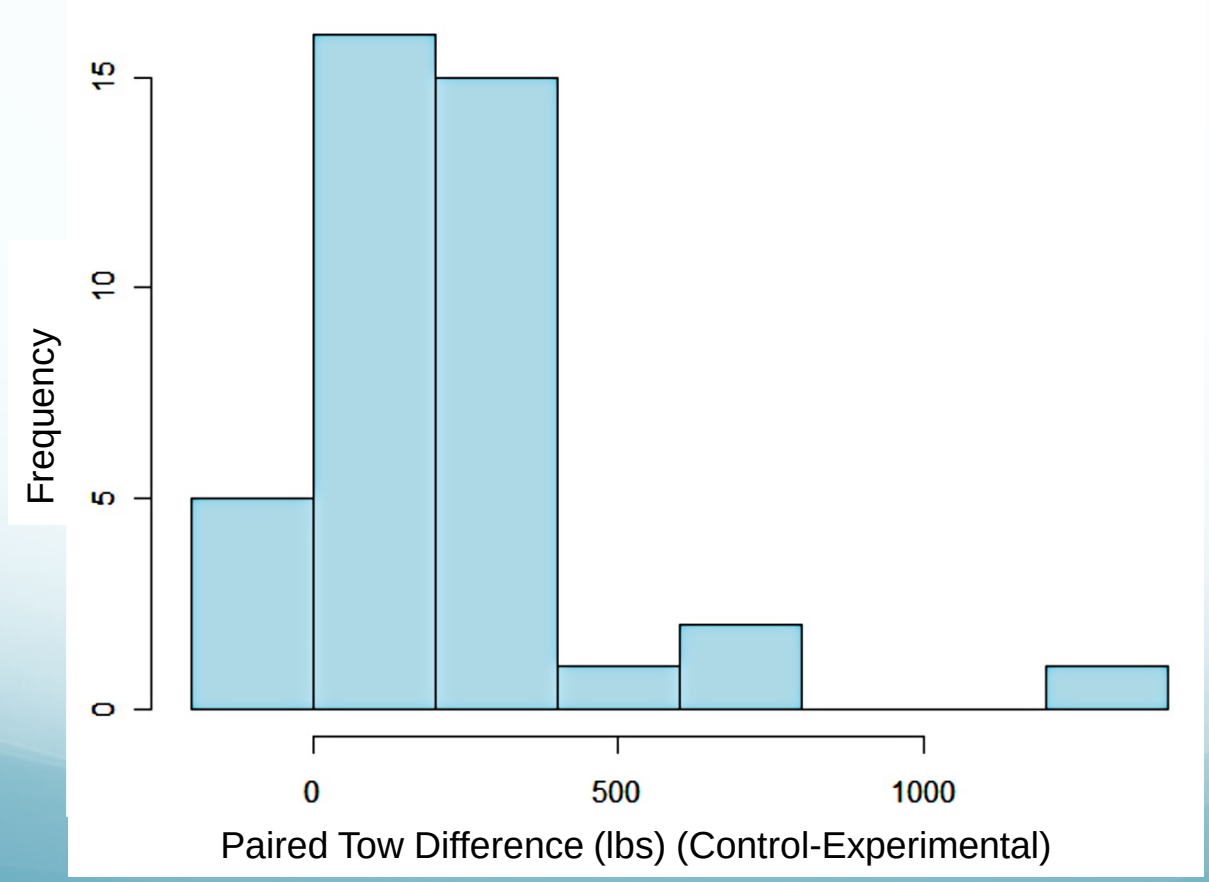
- Phase 1 of the project was conducted in January 2014 at the Southern Flank of Georges Bank, near Munson Canyon
- 40 paired tows were completed in one 6-day trip
- Squid was the target species
- All tows were 30 minutes in length
- Tows occurred during both the day & night

Phase 1 Results – Yellowtail Flounder

The large mesh belly panel significantly reduced the quantity of yellowtail bycatch.

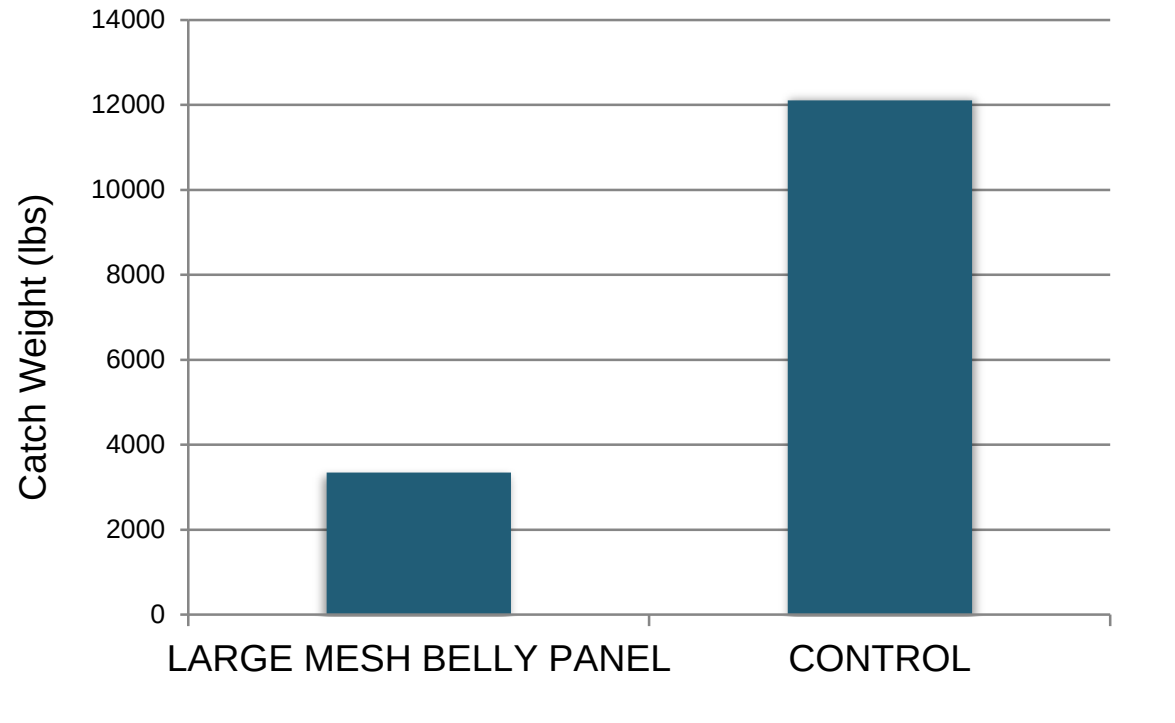
Paired t-test results showed a significant difference in catch weight between the control and experimental net (**p=<0.0001**).

Distribution of Paired Tow Differences for Yellowtail Flounder



Phase 1 Results – Yellowtail Flounder

Total Catch Weight of Yellowtail Flounder (lbs) in the Experimental and Control Net for All Tows Combined



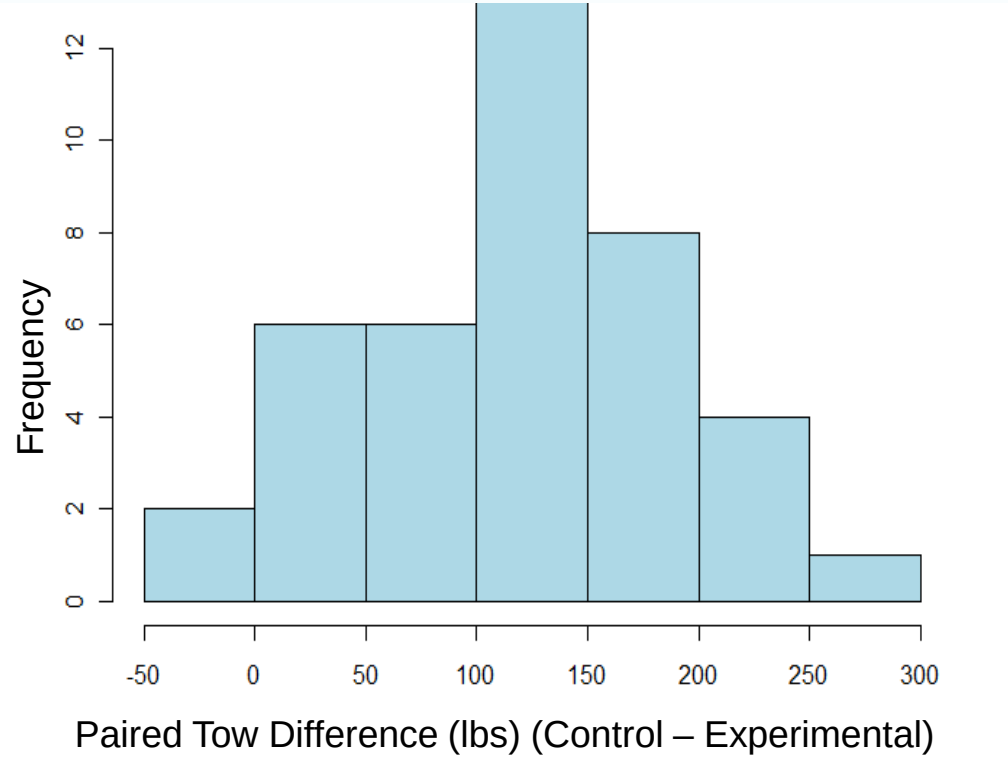
The large mesh belly panel reduced yellowtail flounder bycatch by **72.3%**.

Phase 1 Results – Windowpane Flounder

The large mesh belly panel significantly reduced the quantity of windowpane bycatch.

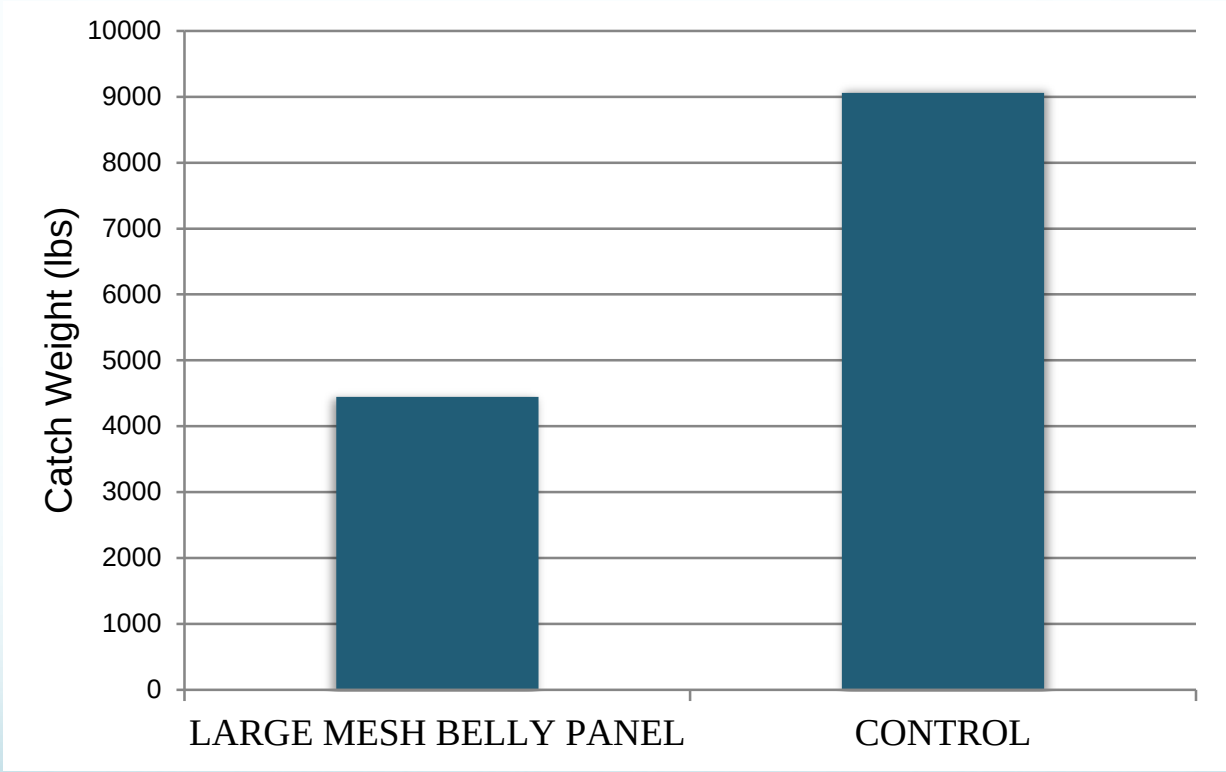
Paired t-test results showed a significant difference in catch weight between the control and experimental net (**p=<0.0001**).

Distribution of Paired Tow Differences for Windowpane Flounder



Phase 1 Results - Windowpane Flounder

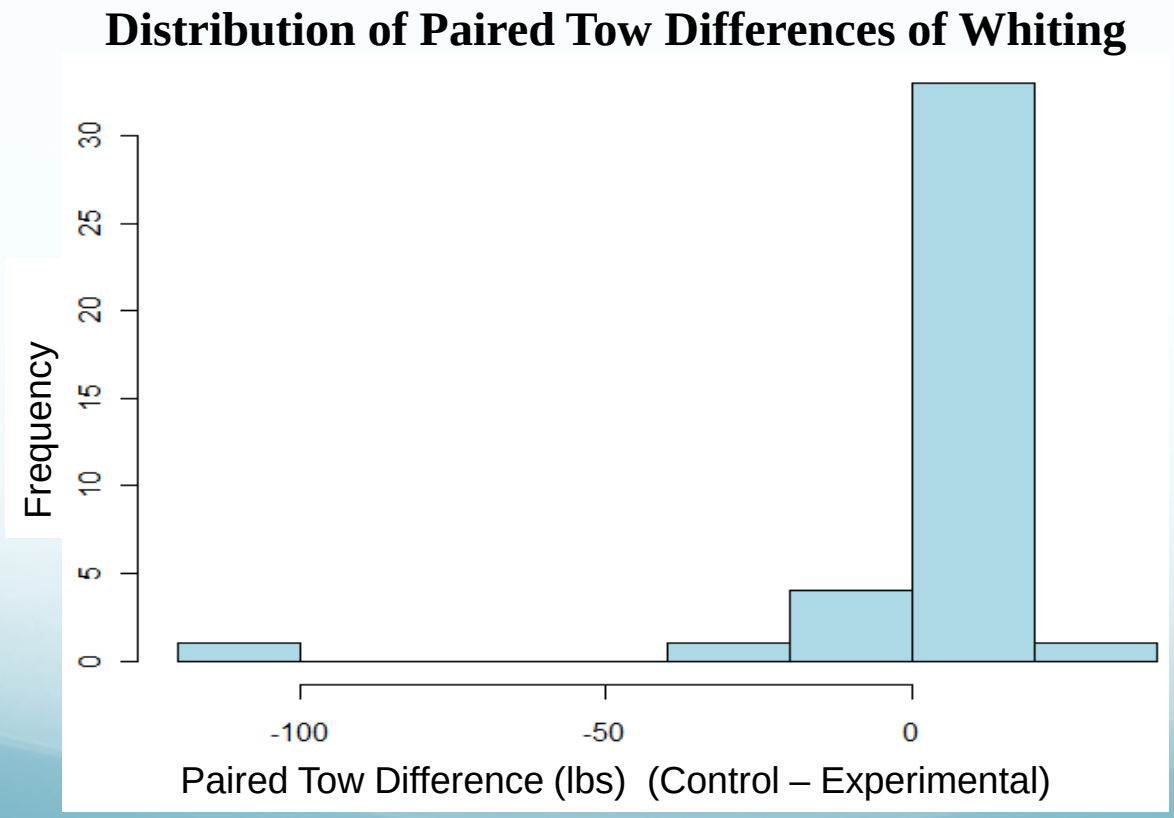
Total Catch Weight of Windowpane Flounder (lbs) in the Experimental and Control Nets for All Tows Combined



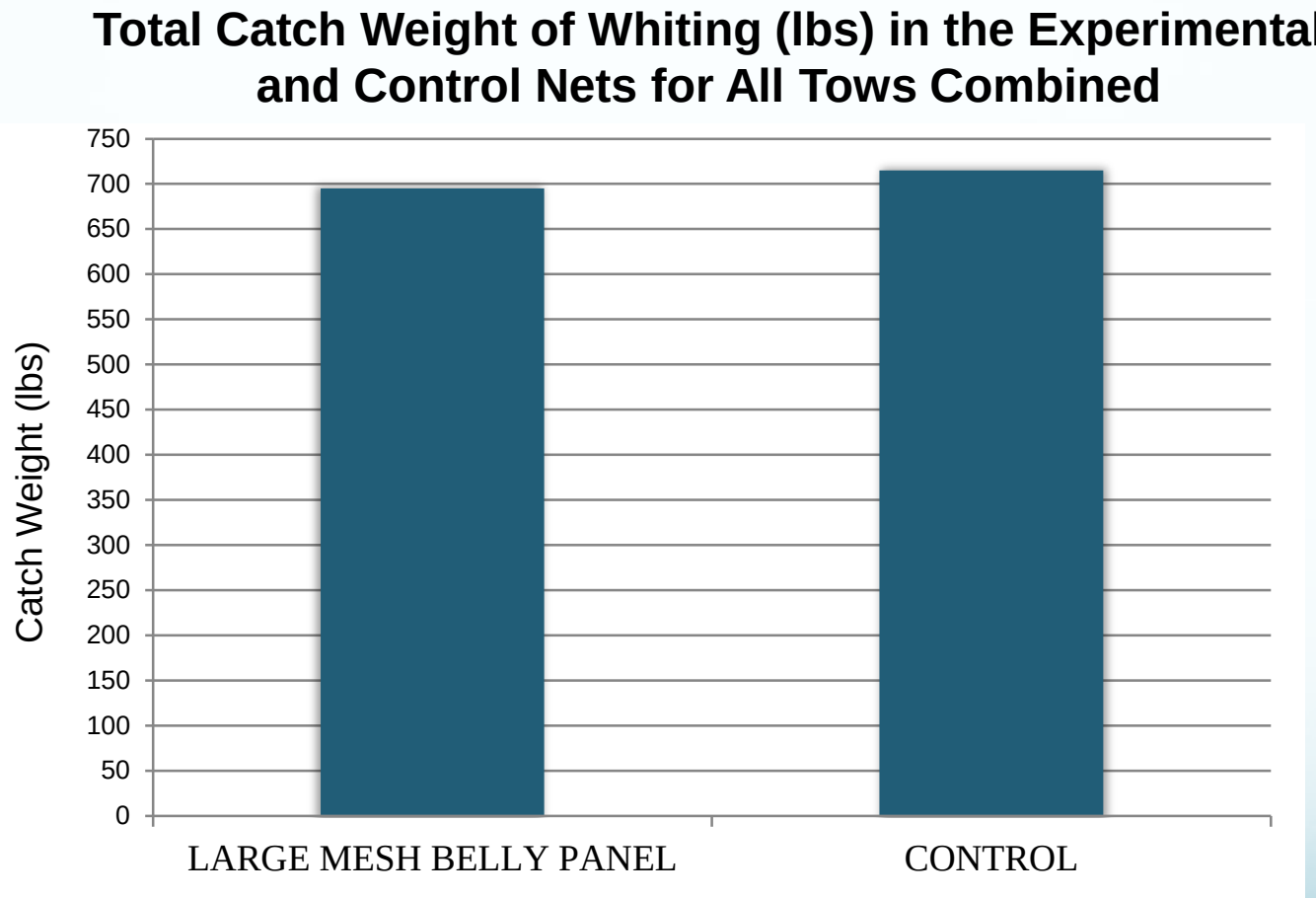
The large mesh belly panel reduced windowpane flounder bycatch by **50.9%**.

Phase 1 Results - Whiting

Paired t-test results showed no significant difference in whiting catch between the control net and the net modified with the large mesh belly panel **(p=0.8817)**.



Phase 1 Results - Whiting



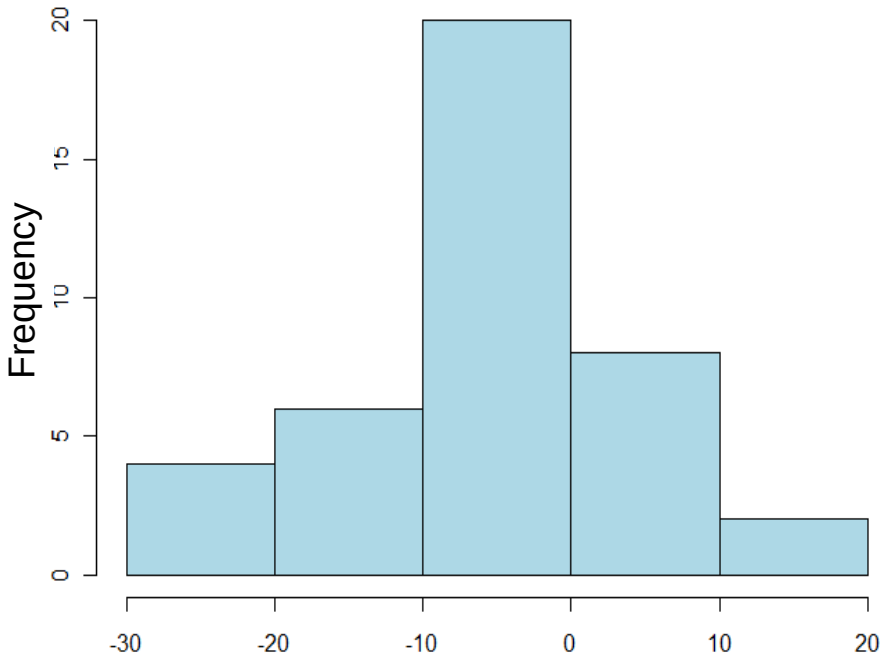
Retention of whiting was maintained using the large mesh belly panel net.

Phase 1 Results - Squid

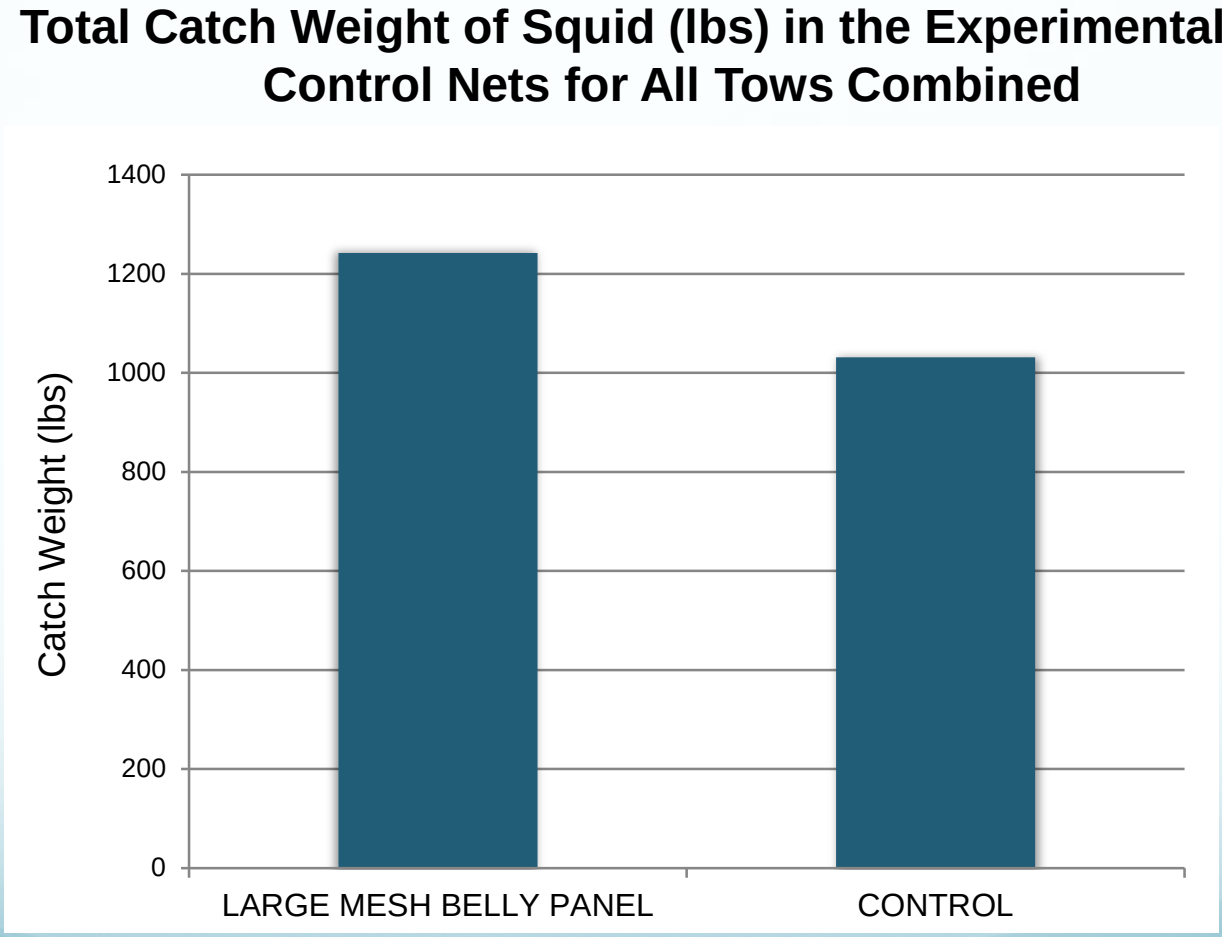
Paired t-test results showed a significant difference in the catch weight between the control and experimental net (**p = 0.0022**).

The experimental net retained more squid than the control net. Although this may be a statistically significant result for this project, it is probably not biologically or commercially significant. The mean of the paired differences was only 5 lbs.

Distribution of Paired Tow Differences for Squid



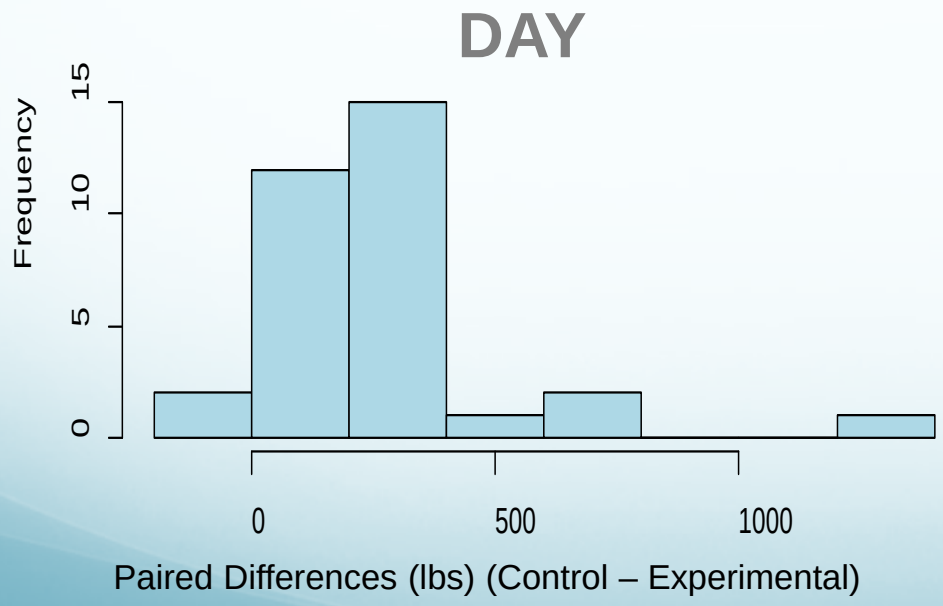
Phase 1 Results - Squid

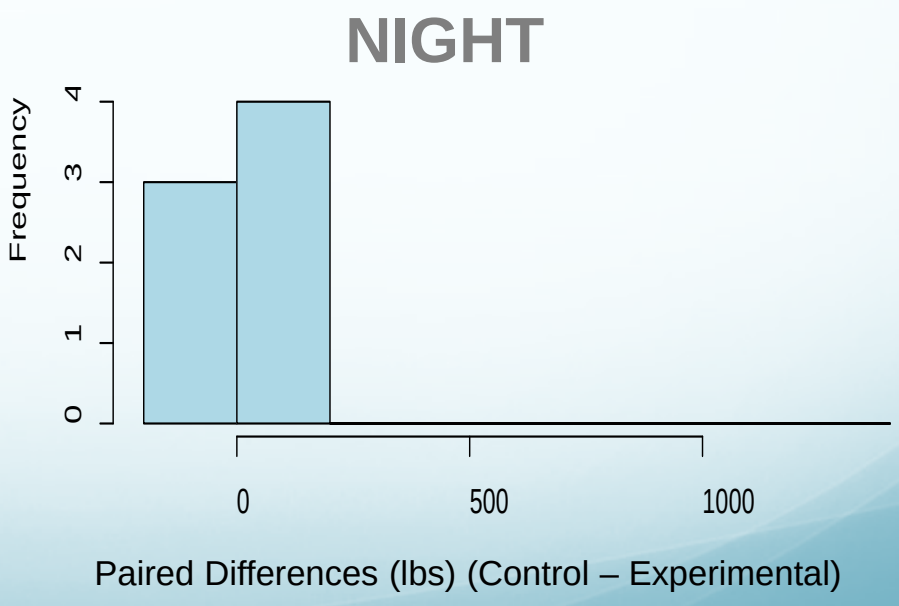


Phase 1 Other Effects
Day Vs. Night - Yellowtail

Experimental fishing occurred both day and night. Data was analyzed for differences between day/night catches.

Paired Tow Differences for Yellowtail Flounder Catch





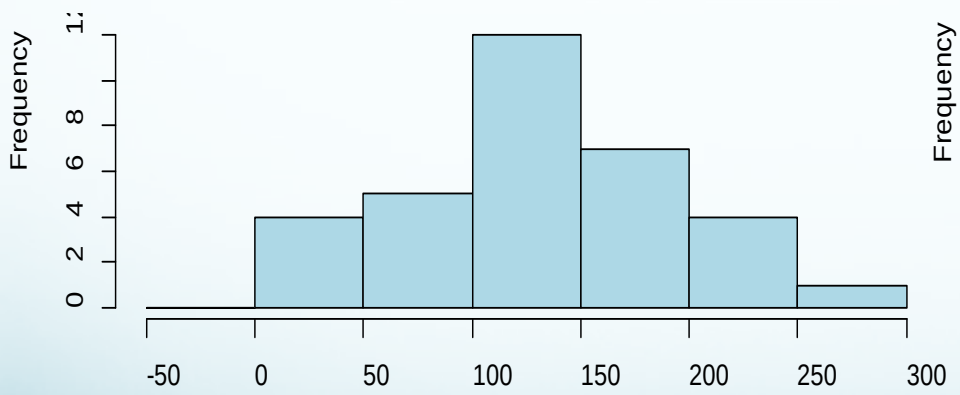
Phase 1 Day Vs. Night Results Yellowtail

- T-test results showed a significant difference in the catch weights between the control and experimental nets during day tows (**p-value <0.0001**). Non-parametric bootstrap analysis provided similar results.
- The t-test results showed a non-significant result for catch differences at night (**p-value = 0.08757**). However, the non-parametric bootstrap analysis returned a significant result (**p-value = 0.026**). The data are Gaussian, so the t-test is the more appropriate statistic to use.
- Only 5 night tows caught yellowtail. Night-time results on their own are therefore lacking statistical strength.

Phase 1 Day Vs. Night Windowpane Flounder

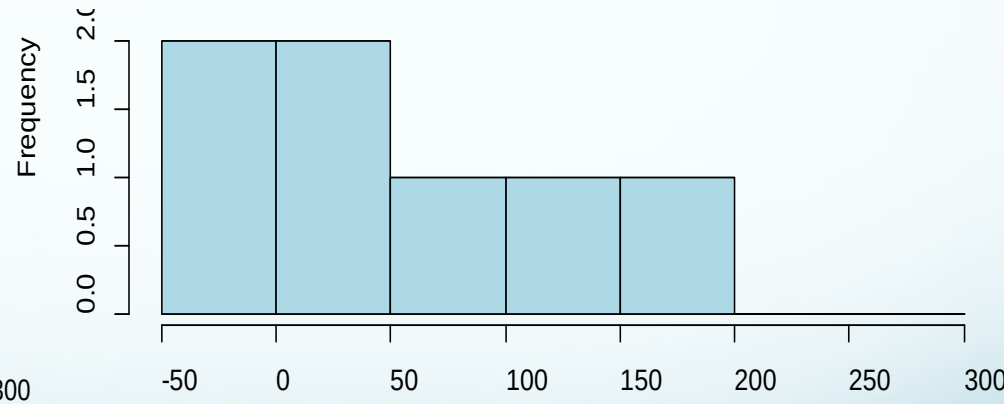
Paired Tow Differences for Windowpane Flounder Catch

DAY



Paired Differences (lbs) (Control – Experimental)

NIGHT



Paired Differences (lbs) (Control – Experimental)

Phase 1 Day Vs. Night Results Windowpane Flounder

- T-test results showed a significant difference in the catch weight between the control and experimental net during day tows (**p-value <0.0001**). Non-parametric bootstrap analysis provided similar results.
- T-test results showed a non-significant result for catch differences at night (**p-value = 0.07701**). However, the non-parametric bootstrap analysis returned a significant result (**p=0.008**). The data are Gaussian, so the t-test is the more appropriate statistic to use.
- 7 night tows caught windowpane, 2 of which caught less than one pound. Night-time results on their own are therefore lacking statistical strength.

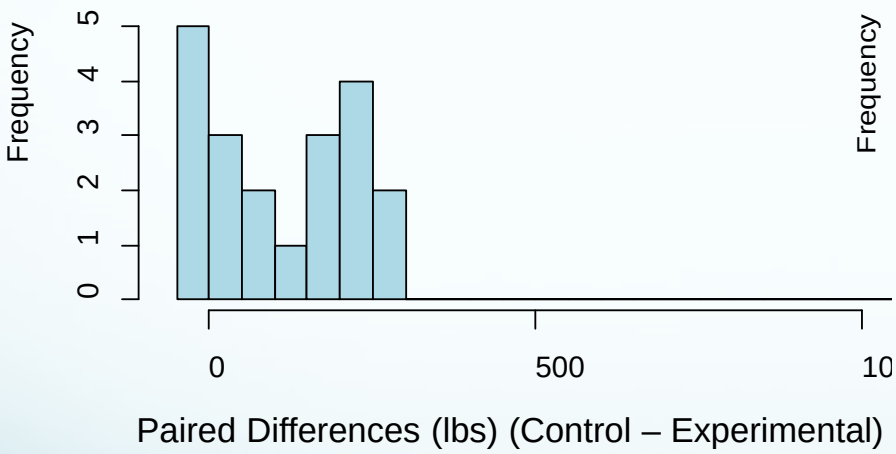
Phase 1 Other Effects - Side (Port vs. Starboard)

- We looked at yellowtail and windowpane flounder catches on each side of the vessel separately to see if the results were different based on which side of the vessel the control or experimental net was fished on.
- The experimental and control nets were switched once during the experiment in order to randomize for side.
- We performed t-tests and non-parametric bootstrap analysis on the paired tow differences in catch for side.

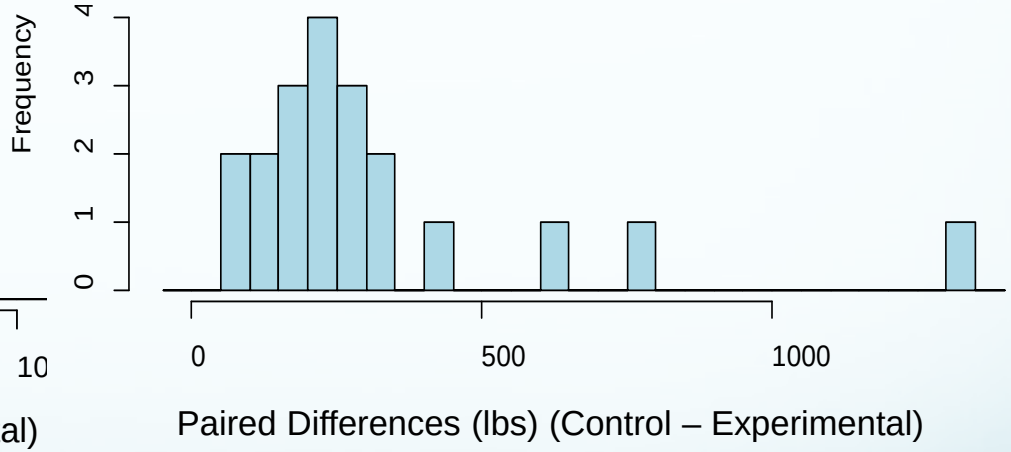
Phase 1 Side Results Yellowtail

Paired Tow Differences for Yellowtail Flounder Catch

Control Net on the Port Side



Control Net on the Starboard Side

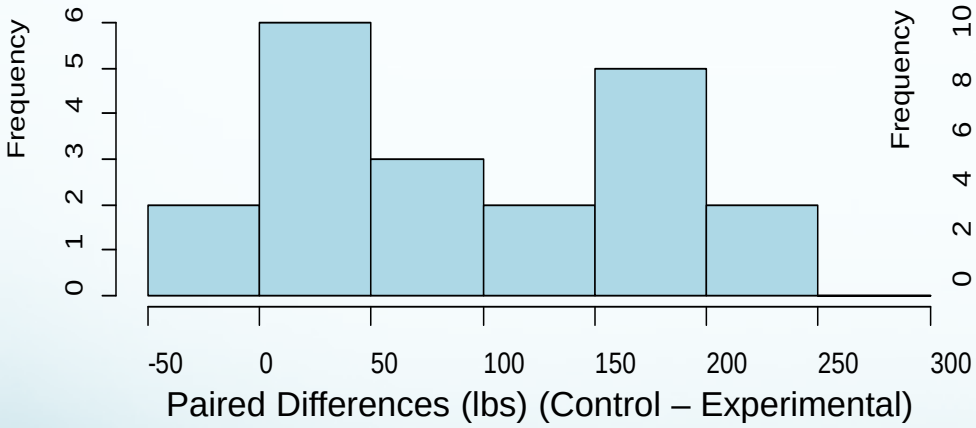


T-test results showed a significant difference in the catch weight between the control and experimental nets when the control net was on the port side (**p-value =0.0002087**) and a significant difference when the control net was on the starboard side (**p-value <0.0001**). Non-parametric bootstrap analysis provided similar results.

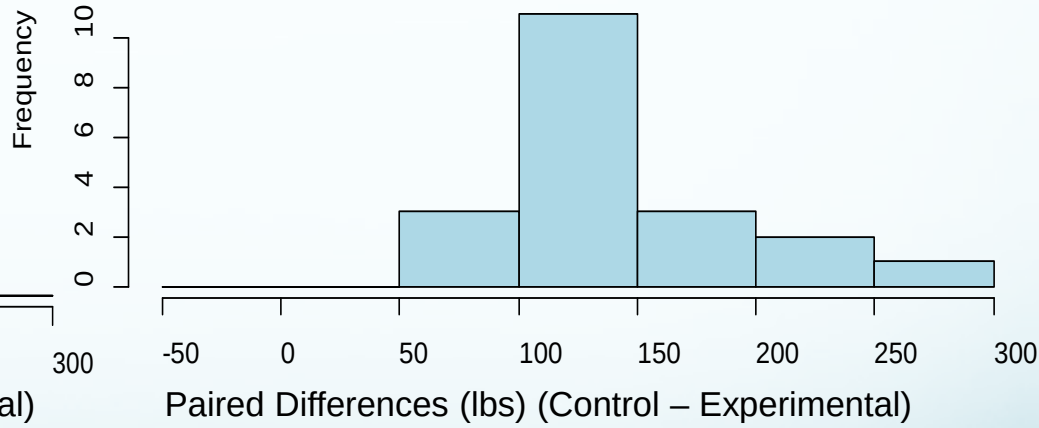
Phase 1 Side Results
Windowpane

Paired Tow Differences for Windowpane Flounder Catch

Control Net on the Port Side



Control Net on the Starboard Side



T-test results showed a significant difference in the catch weight between the control and experimental nets when the control net was on the port side (**p-value<0.0001**) and a significant difference when the control net was on the starboard side (**p-value <0.0001**). Non-parametric bootstrap analysis provided similar results.

Phase 1 Door Spread Summary

- We tested to see if there was a statistically significant difference in door spread between the control and experimental nets at the start of the tow and the end of the tow.
- T-test results showed no significant difference in door spread at the start of the tow (**p-value = 0.5554**) or at the end of the tow (**p-value = 0.2809**).
- Since there is no statistically significant difference in door spread, there is no reason to analyze actual catch as a function of door spread. Door spread has no effect.

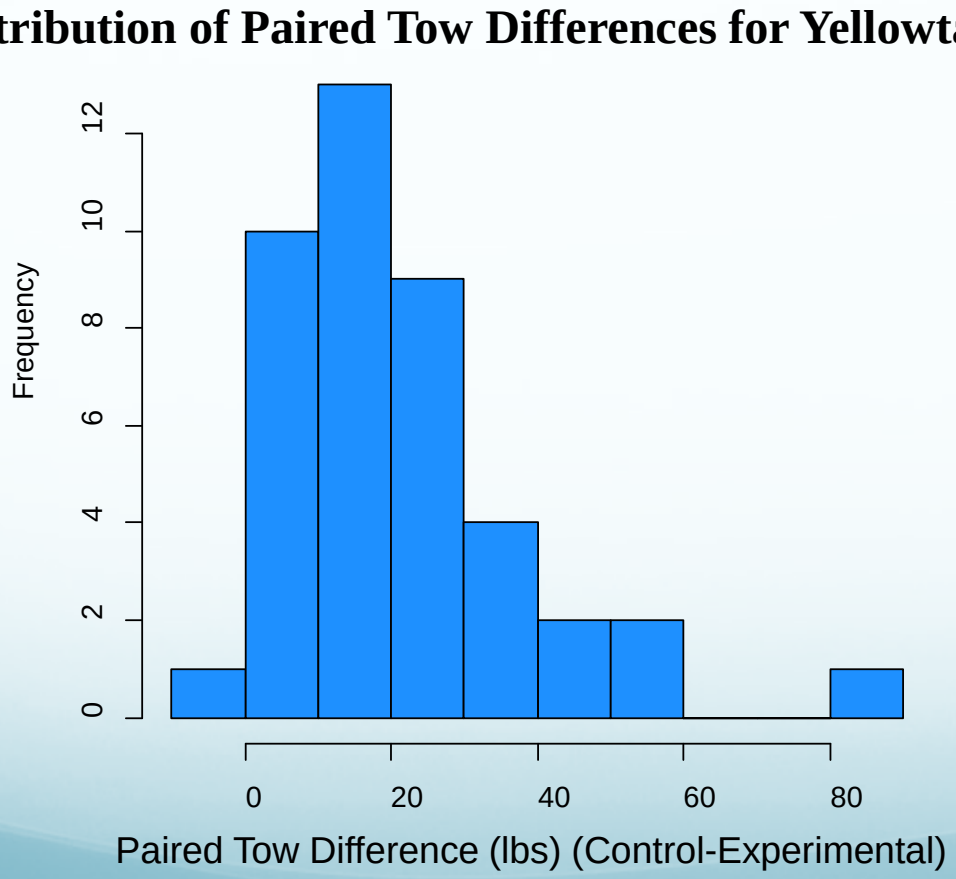
Phase 2 Summary

- Phase 2 of the project was conducted in August 2014 on the Northern Area of Georges Back designated as Cultivator Shoals
- 42 paired tows were completed in one 5-day trip
- Whiting was the target species
- Tows were 15 minutes in length and occurred during both the day & night

Phase 2 Results – Yellowtail Flounder

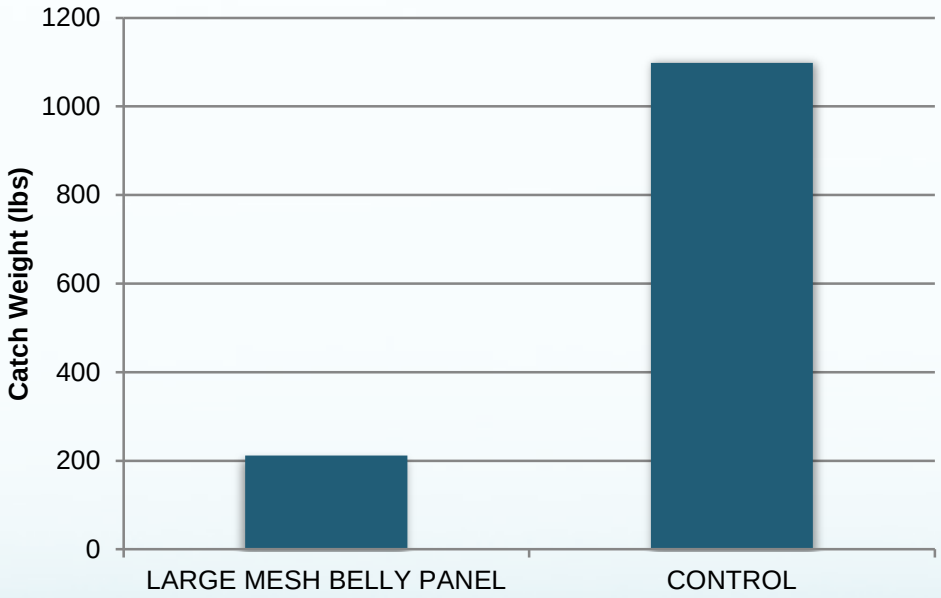
The large mesh belly panel significantly reduced the quantity of yellowtail bycatch.

Paired t-test results showed a significant difference in catch weight between the control and experimental net (**p=<0.0001**).



Phase 2 Results – Yellowtail Flounder

Total Catch Weight of Yellowtail Flounder (lbs) in the Experimental and Control Net for All Tows Combined

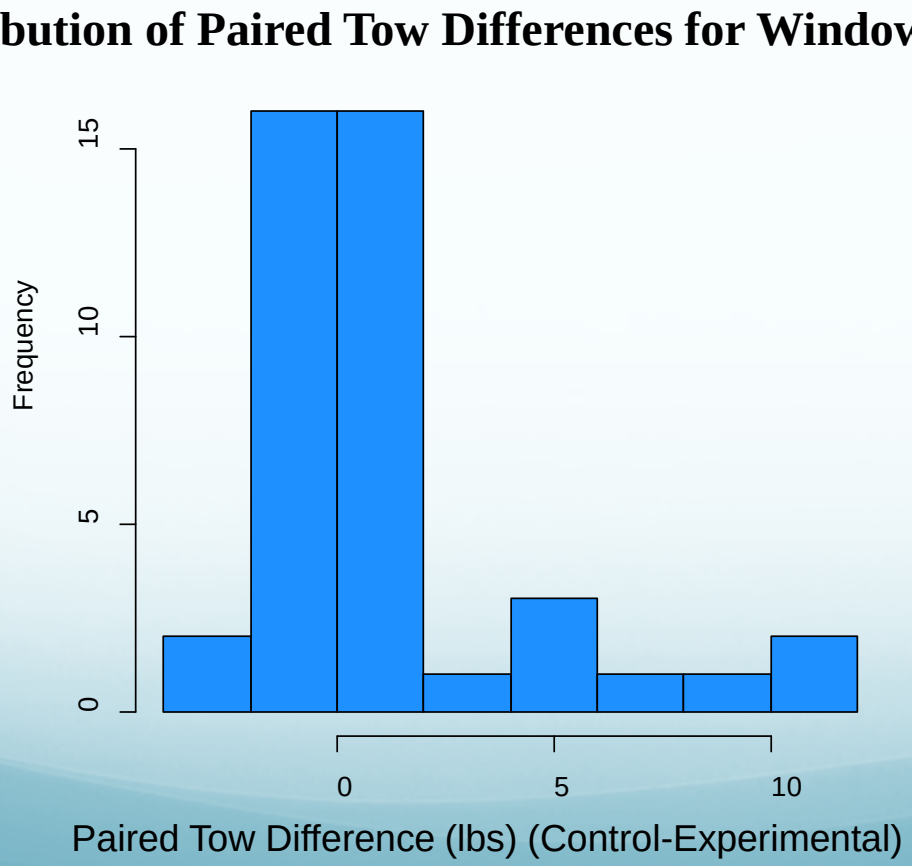


The large mesh belly panel reduced yellowtail flounder bycatch by **80.7%**.

Phase 2 Results - Windowpane Flounder

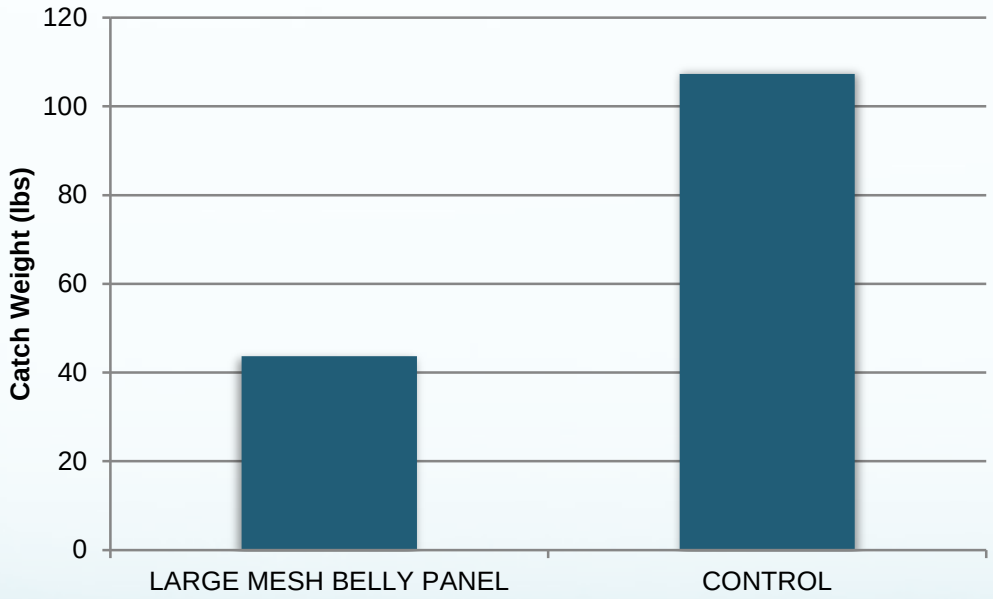
The large mesh belly panel significantly reduced the quantity of windowpane bycatch.

Paired t-test results showed a significant difference in catch weight between the control and experimental net (**p=0.0023**).



Phase 2 Results - Windowpane Flounder

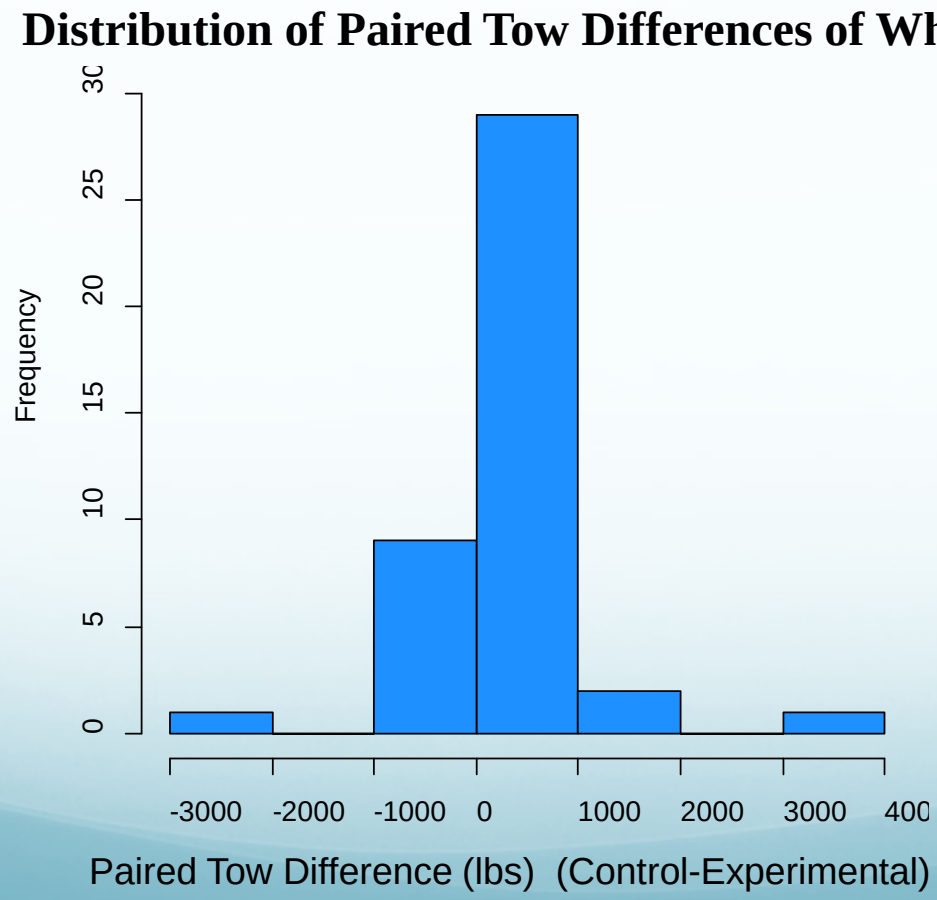
Total Catch Weight of Windowpane Flounder (lbs) in the Experimental and Control Nets for All Tows Combined



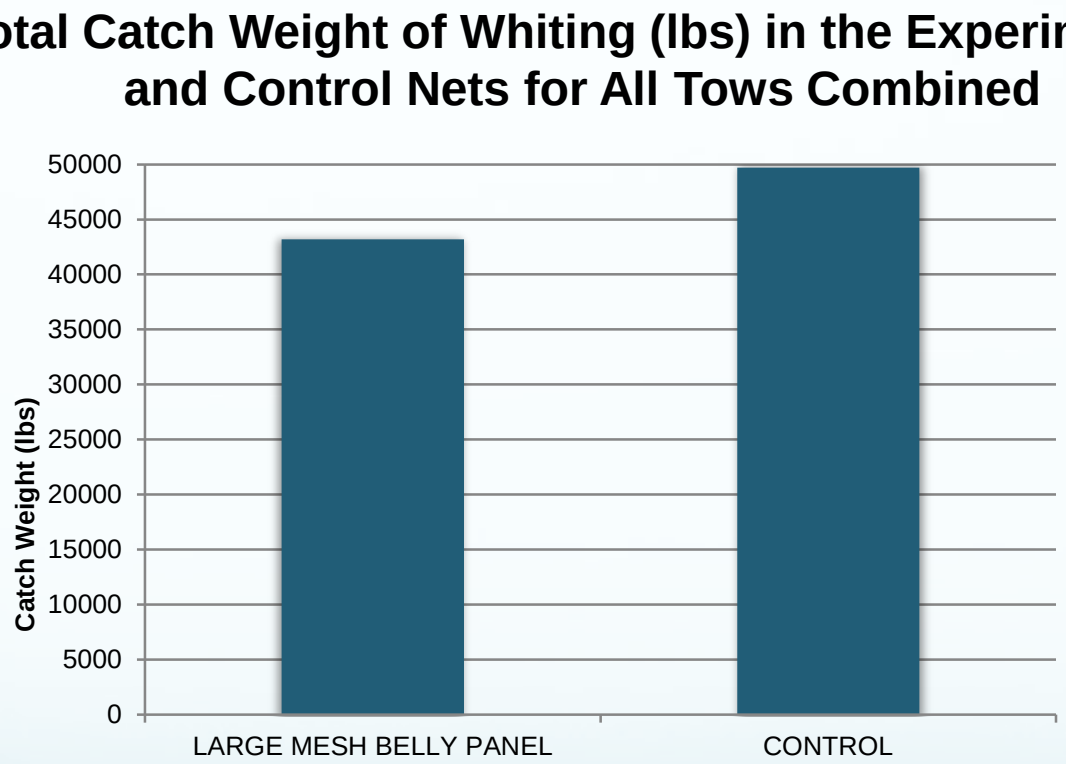
The large mesh belly panel reduced windowpane flounder bycatch by **59.3%**.

Phase 2 Results - Whiting

Paired t-test results showed no significant difference in the catch weight between the control and experimental net (**p = 0.1787**).



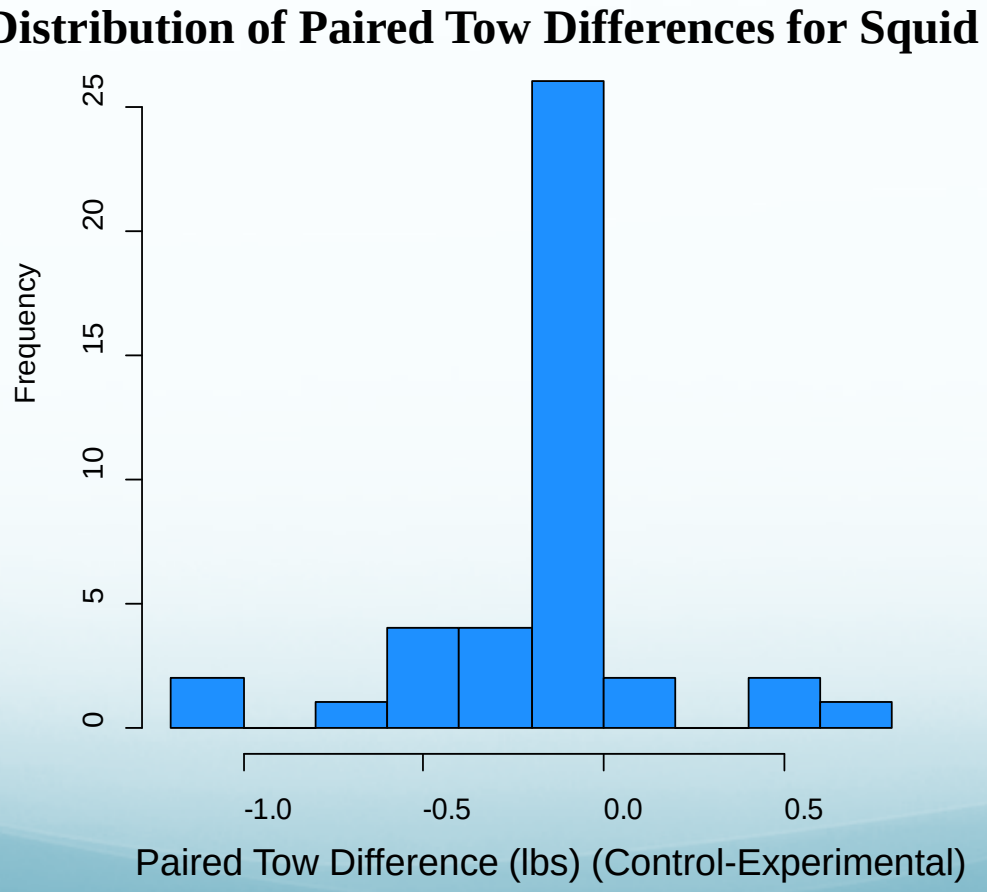
Phase 2 Results - Whiting



Retention of whiting was maintained using the large mesh belly panel net.

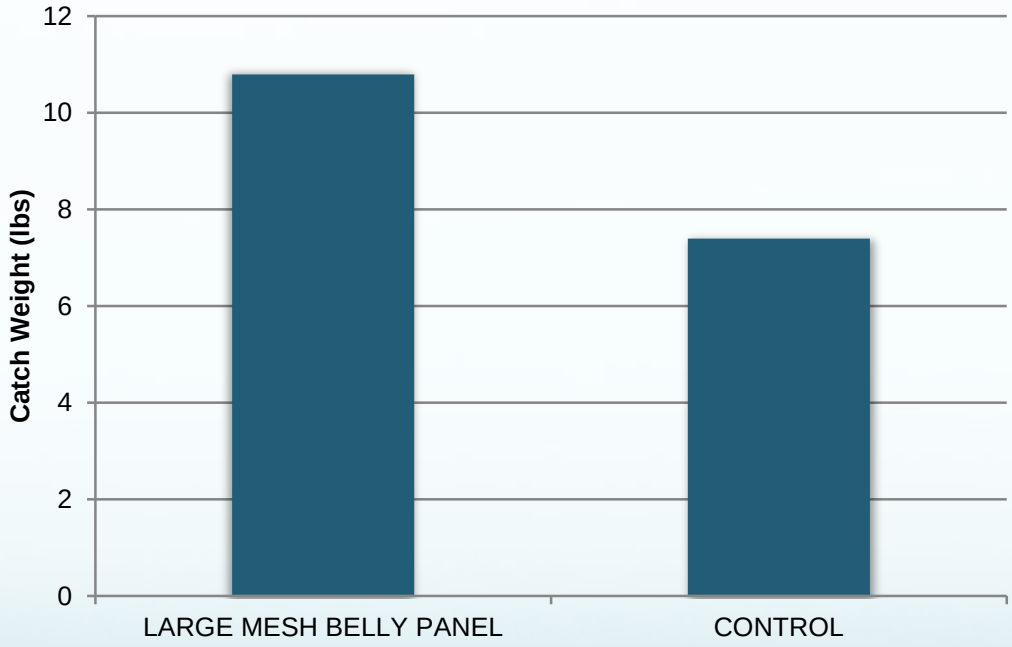
Phase 2 Results - Squid

Paired t-test results showed no significant difference in the catch weight between the control and experimental net (**p = 0.1339**).



Phase 2 Results - Squid

Total Catch Weight of Squid (lbs) in the Experimental and Control Nets for All Tows Combined



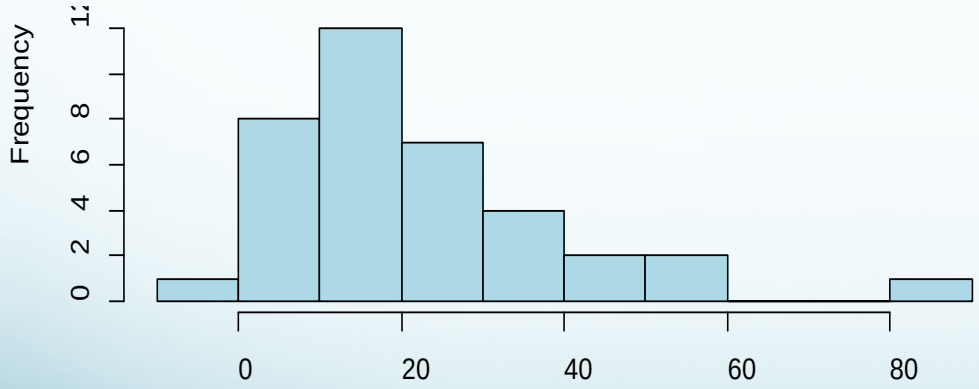
Retention of squid was maintained using the large mesh belly panel net.

Phase 2 Other Effects
Day Vs. Night - Yellowtail

Experimental fishing occurred both day and night. Data was analyzed for differences between day/night catches.

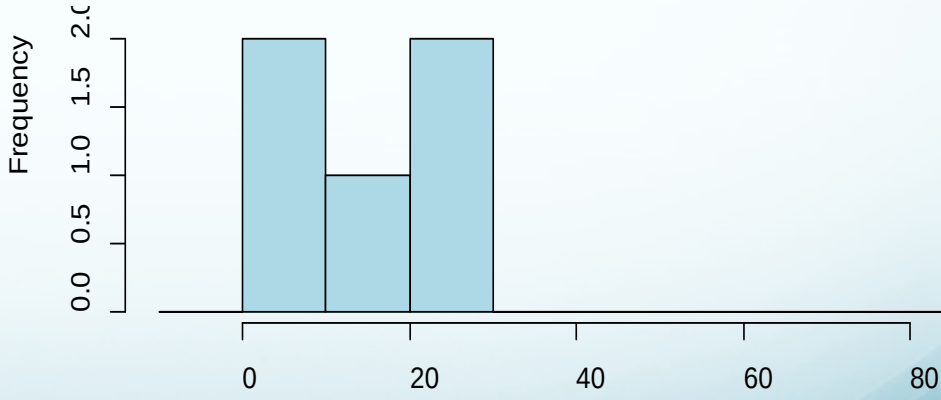
Paired Tow Differences for Yellowtail Flounder Catch

DAY



Paired Differences (lbs) (Control – Experimental)

NIGHT



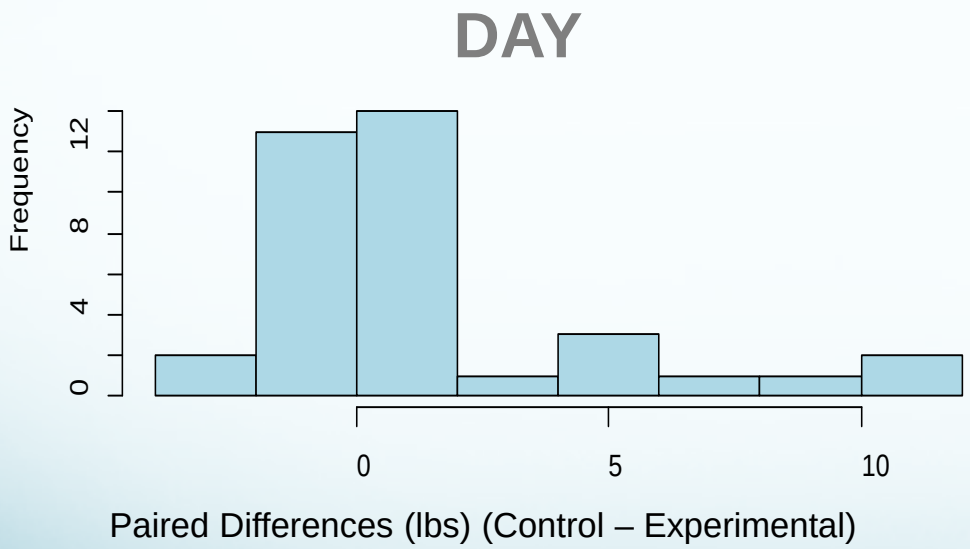
Paired Differences (lbs) (Control – Experimental)

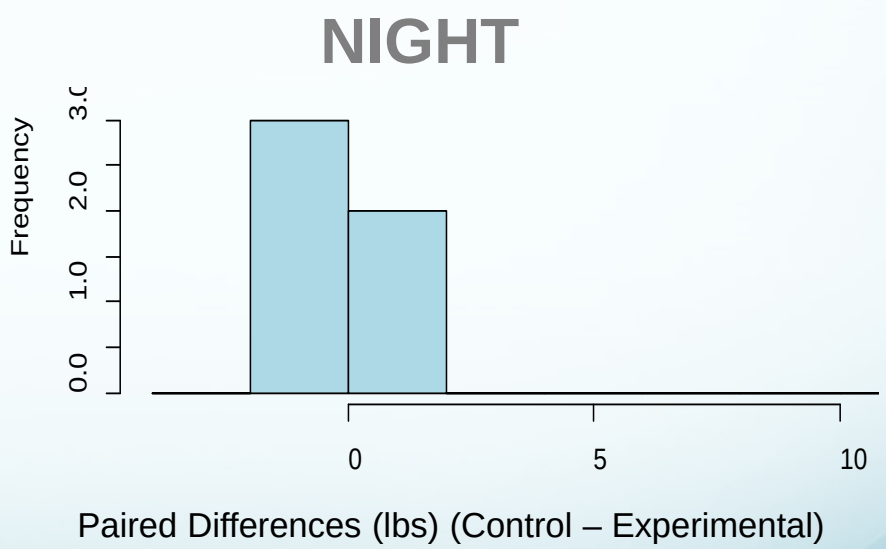
Phase 2 Day Vs. Night Results Yellowtail

- T-test results showed a significant difference in the catch weight between the control and experimental net during day tows (**p-value <0.0001**) and a significant difference during night tows (**p-value = 0.02717**). Non-parametric bootstrap analysis provided similar results.
- Only 5 tows occurred at night. Night-time results on their own are therefore lacking statistical strength.

Phase 2 Day Vs. Night Windowpane Flounder

Paired Tow Differences for Windowpane Flounder Catch





Phase 2 Day Vs. Night Results Windowpane Flounder

- T-test results showed a significant difference in the catch weight between the control and experimental net during day tows (**p-value = 0.0033**).
- There was no significant difference in the catch weight between the control and experimental net during the night tows (**p-value = 0.2122**). Non-parametric bootstrap analysis provided similar results.
- Only 2 night tows caught windowpane flounder. Night-time results on their own are therefore lacking statistical strength.

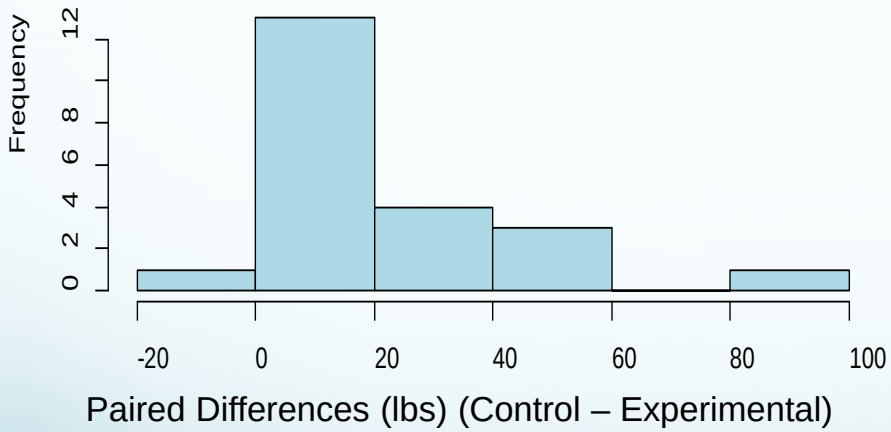
Phase 2 Other Effects - Side (Port vs. Starboard)

- We looked at yellowtail and windowpane flounder catches on each side of the vessel separately to see if the results were different based on which side of the vessel the control or experimental net was fished on.
- The experimental and control nets were switched twice during the experiment in order to randomize for side.
- We performed t-tests and non-parametric bootstrap analysis on the paired tow differences in catch for side.

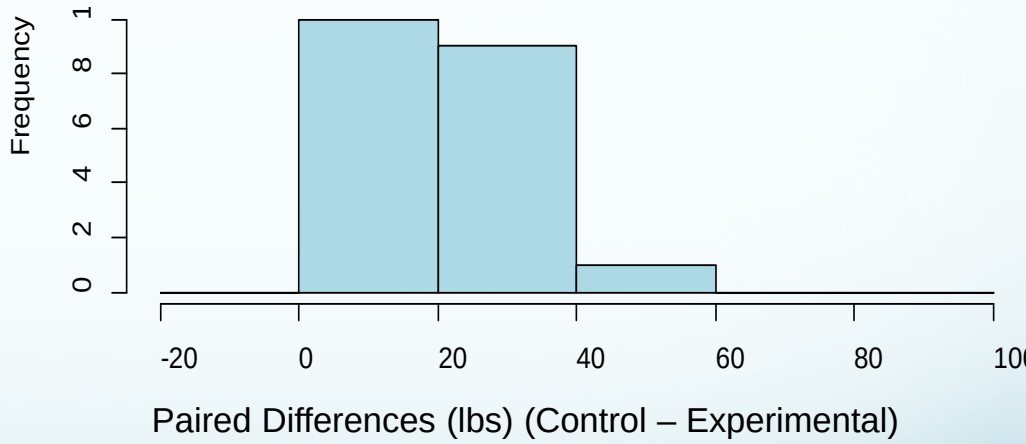
Phase 2 Side Results
Yellowtail

Paired Tow Differences for Yellowtail Flounder Catch

Control Net on the Port Side



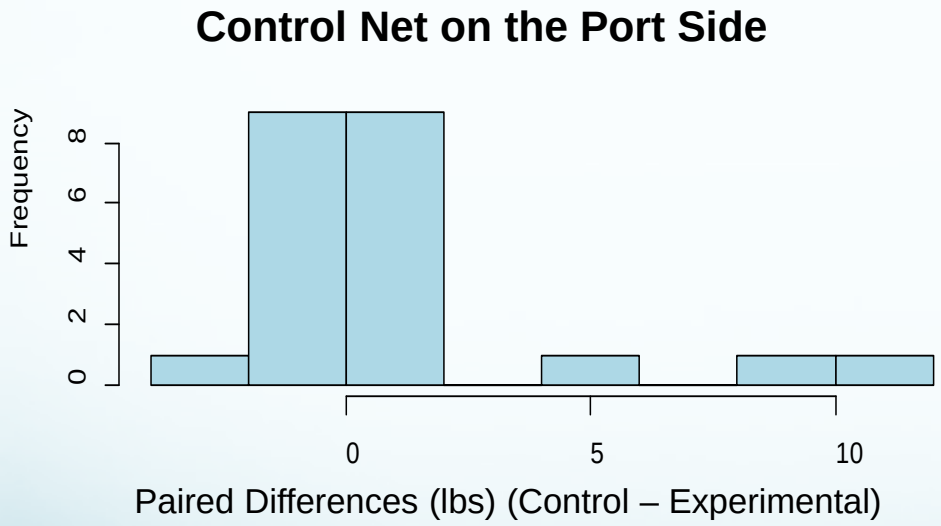
Control Net on the Starboard Side

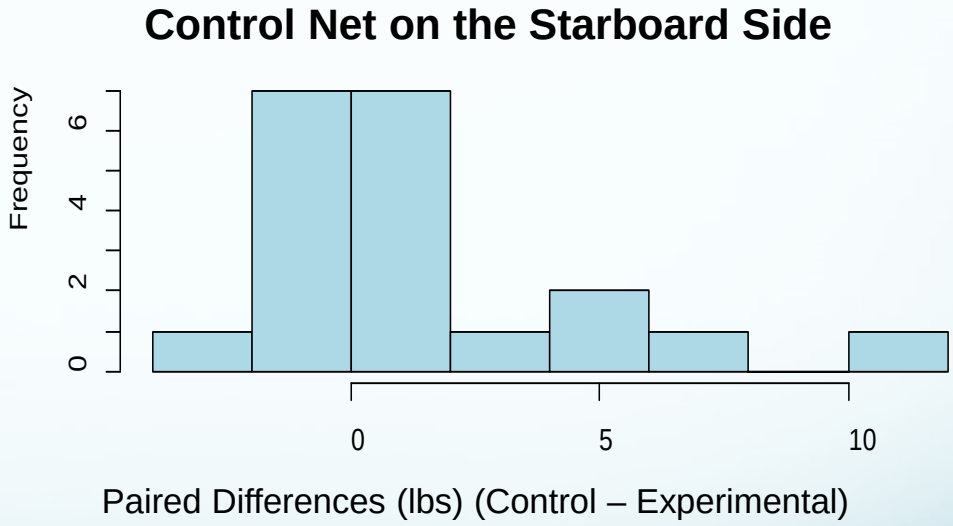


T-test results showed a significant difference in the catch weight between the control and experimental nets when the control net was on the port side (**p-value =0.00036**) and a significant difference when the control net was on the starboard side (**p-value <0.0001**). Non-parametric bootstrap analysis provided similar results.

Phase 2 Side Results
Windowpane

Paired Tow Differences for Windowpane Flounder Catch





Phase 2 Side Results Windowpane

- T-test results showed a nearly significant difference in the catch weights between the control and experimental nets when the control net was on the port side (**p-value =0.061**). However, bootstrap analysis of the same data yielded a significant result **(p-value = 0.012**). The Shapiro-Wilk test for normality indicated that the data is not Gaussian. Therefore, the bootstrap is the more appropriate test and the catch difference is significant.

- There was a significant difference in the catch weights between the control and experimental nets when the control net was on the starboard side (**p-value =0.01616**). Non-parametric bootstrap analysis provided similar results.

Phase 2 Door Spread Summary

- We tested to see if there was a statistically significant difference in door spread between the control and experimental nets at the start of the tow and the end of the tow.
- T-test results showed no significant difference in door spread at the start of the tow (**p-value = 0.07014**) or at the end of the tow (**p-value = 0.0897**).
- Since there is no statistically significant difference in door spread, there is no reason to analyze actual catch as a function of door spread. Door spread has no effect.

Summary of Results

Species	Phase 1	Phase 2
Yellowtail Flounder	Significant reduction (72.3%)	Significant reduction (80.7%)
Windowpane Flounder	Significant reduction (50.9%)	Significant reduction (59.3%)
Whiting	No Statistical Difference in catch between control and experimental nets	No Statistical Difference in catch between control and experimental nets
Squid	Statistical difference. Mean of the differences is 5 lbs.	No Statistical Difference in catch between control and experimental nets

Possible additional effects of day/night, side and door spread do not have an effect on the above results.

Based on these results, should the large mesh belly panel gear technology be approved as an Accountability Measure in the small mesh Georges Bank fisheries?

Acknowledgements

- NMFS Northeast Cooperative Research Program
- F/V Karen Elizabeth – Captain Chris Roebuck and Crew, Point Judith, RI
- Superior Trawl Inc. – Jonathan Knight, Pt. Judith, RI
- Squid Trawl Network Project Advisory Committee, Working Group, Planning Group and members