

**A METHOD TO REDUCE WINTER FLOUNDER RETENTION BY MINIMIZING
VARIABILITY IN DROP CHAIN PERFORMANCE IN THE INSHORE LOLIGO
SMALL MESH TRAWL FISHERY OFF LONG ISLAND, NY WITHIN THE WINTER
FLOUNDER STOCK AREA**

Part 1: Proof of Concept Program

Final project report to the Commercial Fisheries Research Foundation

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Summary of Research Findings

In an attempt to reduce fishing mortality and bycatch of winter flounder as well as contribute to the rebuilding of the overfished stock, Cornell Cooperative Extension (CCE) completed four days of experimental fishing aboard the F/V Caitlin and Mairead, using a standard small mesh squid net fitted with a 12" drop chain sweep. During the experiment, the headrope slack was adjusted by 6" increments from zero slack to 36" slack. Twenty-two successful hour long tows were conducted during this proof of concept project. Experimental sea trials were performed on August 4th, 5th, 17th and 18th, 2010. Experimental fishing was conducted in the Southern New England/Mid-Atlantic proposed small mesh drop chain area. The specific area of gear testing was performed along the southern coast of Long Island between Moriches and Shinnecock Inlet where an active commercial squid fishery was occurring.

Through this project we tested an alternative gear strategy to reduce winter flounder bycatch at the head of the net. This strategy included the use of a 12 inch drop chain sweep coupled with headrope adjustments of 6", 12", 18", 24", 30" and 36". Two replicate tows were performed for each increment. The objective of this proof of concept study was to develop a fishing gear strategy to maximize drop chain performance to reduce winter flounder bycatch in the inshore squid fishery while maintaining squid catch efficiency.

We tested the following hypotheses:

- 1) Slacking back the headrope creating more headrope height helps maintain drop chain opening for winter flounder escapement and does not affect the total catch of squid in the net.

The flume tank tests associated with this project performed by Jonathan Knight show that changing slack in the headrope impacts the ability of the drop chain to extend fully while still maintaining full contact with the bottom. Knight saw that as the headrope adjustments change slightly, the configuration of the drop chain sweep and its contact with the sea bed also changes (See Figure 1). Within this pilot study design we were able to collect data for 2 tows at each 6 inch adjustment. As a proof of concept, this project produced limited data relative to headrope slack and drop chain performance. However the project did provide important data and information relative to project goals that can be readily built upon for more rigorous analysis. Working with a limited data set presents some challenges relative to data analysis. In order to extract the most information from the data available, we performed a range of models for data analysis (See Table 1) that provided valuable insights at the pilot-scale.

Relative to the first hypothesis our data show that compared to zero slack, there was no significant difference in winter flounder catch/escapement across all 6 variations in headrope slack. However it is important to note that the winter flounder catches in this project were small and there was not much data to work with. Also, it may be that using a 12 inch drop chain, in and of itself, reduces winter flounder catch regardless of headrope slack (including 0). Preliminary results from a recent URI drop chain study also support this theory. One way to

increase the statistical power of the tests on winter flounder would be through increasing the number of replicate tows in this experimental design.

For the purposes of this proof of concept study, however, we elected to use all of the available data generated and combined all bottom dwelling fish under the term of “ demersals”. This category includes winter flounder, summer flounder, other flounders and all species of skates. We did this under the premise that they will display similar response behaviors to net tows as winter flounder since they primarily dwell on the sea floor. We further reduced the six levels of slack to a single level (experimental) and compared it with the control (zero slack) to improve statistical analysis. Analyzing this combined data set of “demersals” showed a significantly lower catch of demersals with headrope slack compared to no headrope slack. Increasing slack beyond zero increases the escapement of this combined suite of species. We speculate that this effect may be also indicative of the response for winter flounder had the data been more robust.

Data analysis of the squid catch shows that squid catch also had a significant reduction in total catch in the experimental headrope slack treatment compared to no headrope slack. Additional net testing is needed to better determine the particulars of this result.

We also looked at another combined data set called “crustaceans”. Crustaceans included lobsters, all true crabs and horseshoe crabs. This combined data set also showed a significant difference in lower total catch of crustaceans in the experimental headrope slack treatment compared to the control (no headrope slack). This indicates an additional benefit for the drop chain sweep – reduced catches of crabs. This can reduce crew effort to sort catch from crabs and has a possible ecological benefit as well.

- 2) By varying the amount of slack in the headrope it is possible to achieve optimum bilateral species impact.

Continued research is needed to determine the slack necessary to achieve optimum bilateral species impact. The data shows that across all adjustments of the headrope (6” – 36”) there is no significant difference between the control (0 slack) and any slack adjustments for winter flounder. However there is a significant difference between the control (0 slack) and all adjustments for squid, combined demersals and crustaceans. Squid catch was significantly affected by slacking the headrope ($t=2.46$, $df= 11$, $p=0.035$) leading to lower catch in the experimental treatment. A significant reduction in catch of demersal species was found in tows that lengthened the headrope ($t=3.6$, $df=11$, $p= 0.004$). There was also a highly significant difference between control (0 slack) vs. experimental treatment in crustacean catch (paired t-test, $df= 22$, $p<0.001$). However the limited data set produced by this proof of concept is not robust enough to determine which adjustment(s) of slack produced greater or less escapement of winter flounder, combined demersals or squid.

The flume tank tests performed by Jonathan Knight show that a 12” slack in the headrope allows for the drop chain to extend fully while still maintaining full contact with the bottom. Within this pilot study design we were able to collect data for 2 tows at each adjustment. Using the plots of total demersal catch by increment provided evidence of increased reduction for total demersal species at the 24” level (See Figure 2). This suggests optimum escapement of bottom dwelling

fish at a 24" slack in the headrope. Similarly, using the plots of total squid catch by increment provided evidence of less loss of squid (larger catch) at both the 24 inch adjustment and the 6 inch adjustment (See Figure 2). More replicate tows would allow for the determination of the optimal headrope slack that promotes winter flounder bycatch reduction while optimizing squid retention.

- 3) Behavioral analysis of squid reactions have shown that squid display swimming endurance in the forward part of the net (Glass et al 1999). This suggests that heightening the headrope may improve overall squid capture.

Video recording of drop chain performance needs to be further explored. Video was not available within the project constraints. Data collected during this small-scale project shows significance at the 95% level for squid catch between the control versus treatment. Squid catch was significantly reduced by slacking the headrope ($p=0.035$). Video documentation on further research will allow for squid behavior in reaction to the drop chain to be observed.

Statistical Analysis

As stated above, we performed a range of models for data analysis. These are summarized in Table 1. The paired t-test analysis was the most suitable statistical analysis for this experimental design. Further details of all the statistical models are provided in Attachment 2.

On Board Catch Processing

Our goal was to quantify differences in winter flounder retention between control and experimental nets (treatment). As such, total winter flounder for each tow was accurately weighed. Small catches allowed for all winter flounder to be sampled for length frequency. Since Loligo co-occur with the winter flounder, and we were looking at bycatch in the Loligo fishery, the total Loligo catch was also weighed on each tow and a length sample was obtained. The total weight of all species in each tow was also recorded by direct weights of the total catch, or for large catches, the entire catch was placed in baskets and a sub-sample of the baskets was weighed. Whiting was chosen as an additional priority species relative to its importance to the trawl fishery which may be impacted by winter flounder regulations. Actual total weights of whiting (*Merluccius bilinearis*) were obtained but whiting catch overall was minimal.

Coordination with Industry and Ease of Use of Experimental Gear

The success of cooperative research depends on industry involvement and collaboration. Coordination for this project went exceptionally well. The participation and expertise of Jonathan Knight (Superior Trawls) advanced the progress of the project. Mr. Knight offered his knowledge of gear design and fishing as well as constructing the drop chain sweep and designing the mechanism necessary to lengthen the headrope by various increments. The commitment from Captain David Aripotch and the F/ V Caitlin and Mairead was exceptional and all research procedures were followed. Scheduling of sea days went accordingly and crew cooperation was

exceptional. All partners openly accepted the introduction of an alternative gear design in an experimental setting. Thorough communication between all partners allowed for the education of proper experimental gear usage and scientific procedures to be performed with ease. CCE staff, the vessel captain, and crew were able to switch between control and experimental designs effectively and efficiently.

Problems Encountered

Commercial fisheries research is an extreme undertaking. Performing research with commercial fishing vessels, experimental gear and scientific equipment leaves many variables for problems to occur. Overall, this project went very well with only a few minor problems. Performing hour-long tows increases the quantity of sets and hauls in relation to normal fishing activity. We experienced a few foul sets when one of the legs broke, a shackle broke and the backstrap broke and became entangled in the propeller of the vessel. The readings for door spread from the vessel's door sensors were erratic due to battery power. Squid and winter flounder catches were relatively small. We coordinated with the local fleet to determine fishing area based on squid movements in the area. We fished directly with the fleet and reported similar catches. Squid movements have been irregular this year and catches have been lower than past years. This trend can be documented through the Loligo quota landings for the year. Landings for both trimester 1 & 2 have not reached the total allowable catch and squid has been under harvested compared to previous years.

Conclusions

Working within the proof of concept project design, the limited data reveals that there seems to be a significant reduction for both the "demersal" and "squid" total catch in the experimental headrope slack treatment when compared to the control (no slack). There was no significant difference with winter flounder. However this project did not use a control net without the drop chain sweep as a basic comparison. It may be possible that just the use of a drop chain sweep with any headrope adjustment (including 0) provides escapement of winter flounder. A recently study conducted by University of Rhode Island used a net with no drop chain sweep as a control in a study that compared a 12 inch drop chain sweep with a 12 inch slack in the headrope. Preliminary results from that study showed a 90% reduction in winter flounder bycatch in the net with the 12 inch drop chain. However, our pilot study revealed that the headrope adjustments may also affect squid retention. The URI study did not evaluate the effects of headrope adjustments on squid catch. Clearly, this study warrants further investigation into the potential effect on squid retention. By increasing the sample sizes we will be able to collect more data on both squid and winter flounder for more powerful statistical tests. Performing another project that compares a fixed sweep control net (no drop chain) to an experimental net with the drop chain and a headrope (at even and 2 incremental headrope lengths: 12" and 24") would be

particularly useful for such an assessment. Quantifying the magnitude of squid escapement is critical to the fishery.

Furthermore, the results of this pilot project revealed an additional conservation benefit through the reduction of crustacean catch when slacking the headrope. Reducing crustacean bycatch is also helpful to the fishery in terms of time efficiency and quality of the squid product.

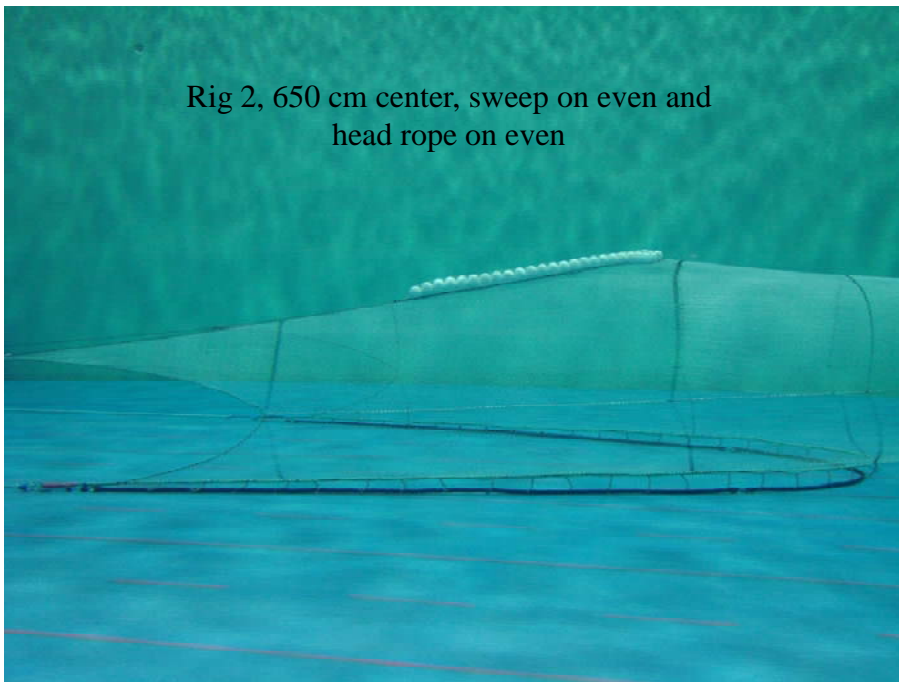
An increased number of tows are needed to launch this proof of concept project into an effective cooperative research design that will have the statistical strength necessary to recommend useful solutions. By expanding this project to include both offshore and inshore Loligo small mesh fisheries we can further our knowledge on the escapement of both winter flounder and Loligo squid. A fully developed project will allow for more days at sea that can be distributed by area and by season to focus on higher concentrations of winter flounder and Loligo co-occurrence. Underwater video documentation will help capture behavior of winter flounder and squid in relationship to drop chain performance. It is by the request of small mesh fishermen of Southern New England and the Mid-Atlantic that the 12” drop chain be fully tested year round in multiple small mesh fisheries both offshore and inshore before implementation of any kind. Upon completion of this project, interviews were conducted with participating partners in order to completely assess project results and further develop a strategy for the alternative gear concept (See Attachment 1). CCE would like to address these requests and concerns by moving forward with a comprehensive cooperative research project that will statistically dissect drop chain performance. Optimal function of the drop chain is necessary for both the rebuilding to the winter flounder stock and the economic viability and sustainability of the small mesh fishery.

A logical next step would be an operational testing of drop chain performance through a small mesh squid trawl demonstration fleet. Conceptually this approach could involve 4-6 commercial fishing vessels typical of the fleet testing the 12” drop chain performance in the small mesh squid fishery across fishing strata such as time, area and fishing practice. This would develop a robust assessment of drop chain performance across these variables collecting quantitative data and qualitative information during the commercial pursuit of squid. Ground truth testing experimental gear is the prime pathway forward. The proposed project goal and objectives are as follows: The project goal is to determine the functional performance of the 12” drop chain in the small mesh squid fishery as an effective method to reduce winter flounder bycatch while maintaining squid capture. The project objectives are: 1) Establish a small mesh trawl demonstration fleet to test the 12” drop chain in the commercial squid fishery. 2) Quantify 12” drop chain performance across fishing strata of time, area and fishing practice in the small mesh squid fishery. 3) Facilitate 12” drop chain with performance improving technology transfer through fleet demonstration leading to voluntary adoption of proven methods.

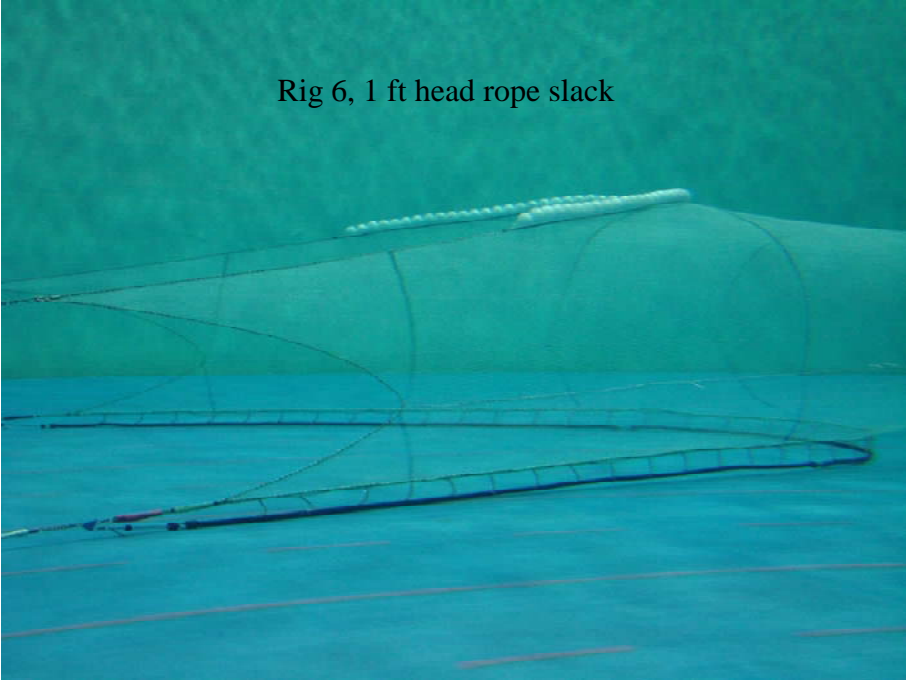
Figures

Figure 1

Headrope Adjustment Flume Tank Results



Rig 6, 1 ft head rope slack



Rig 7, 2 ft of head rope slack

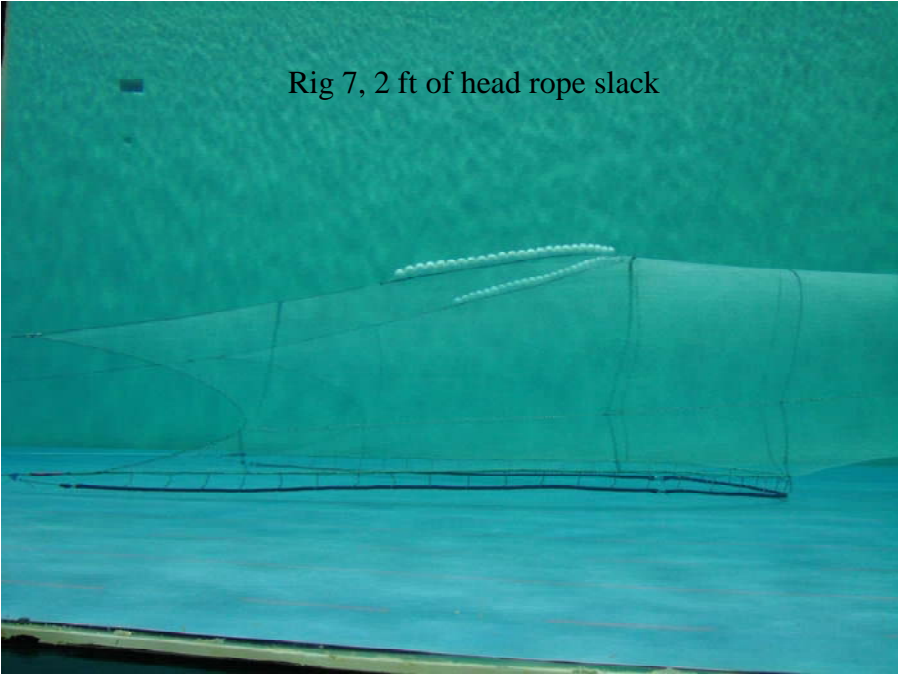
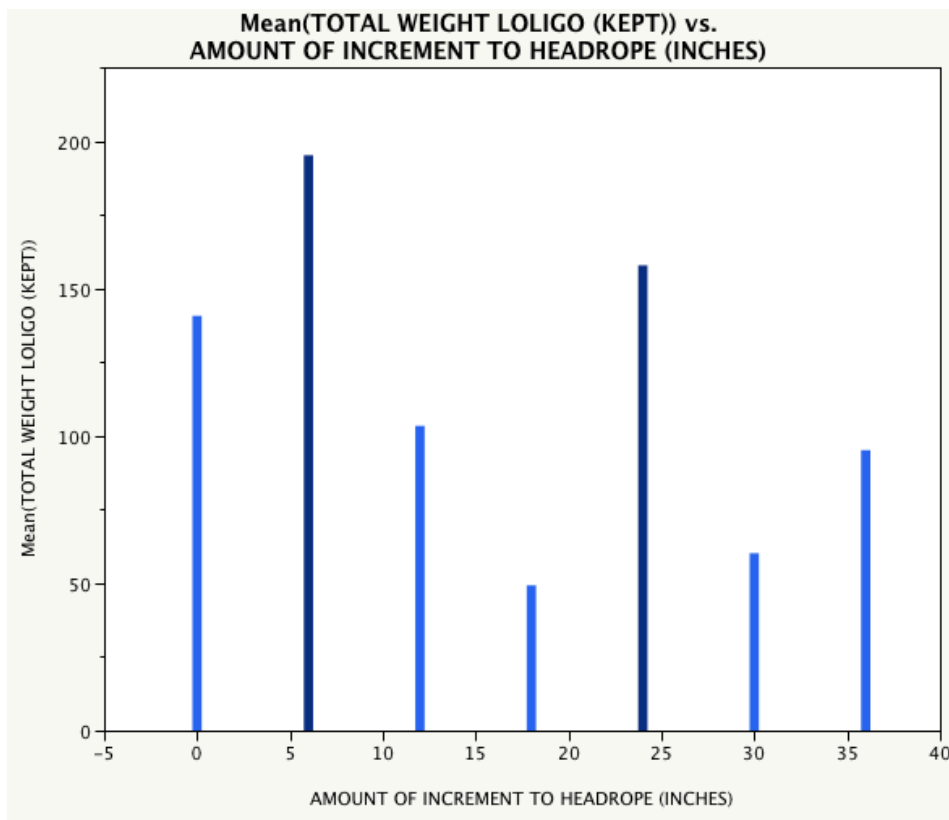
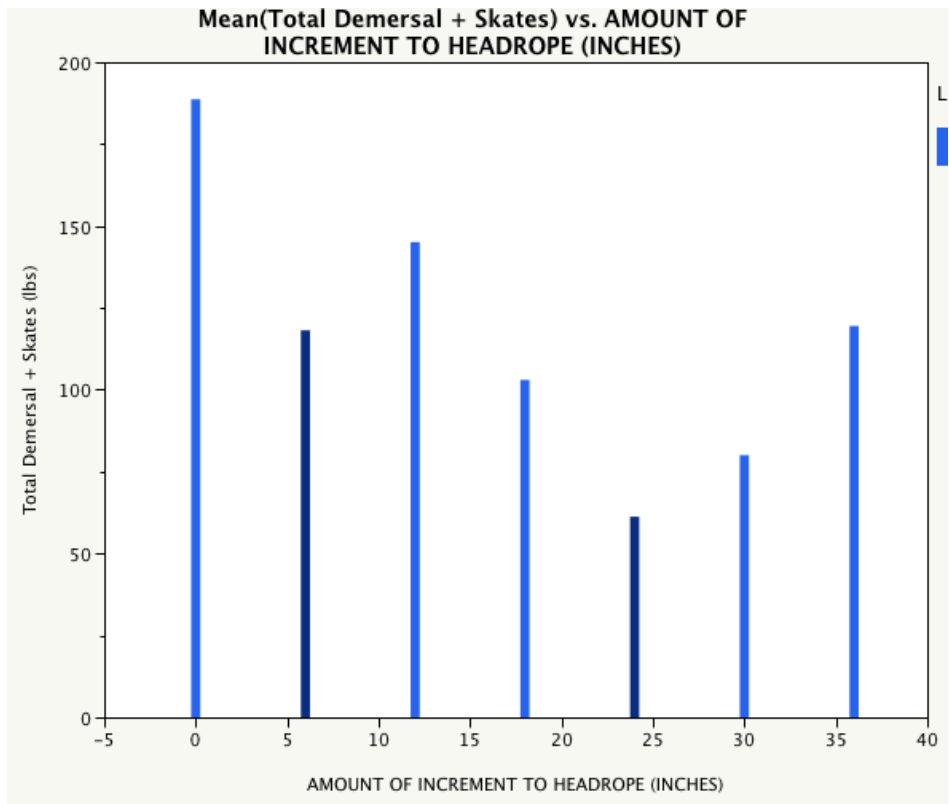


TABLE 1. Statistical Test	Model	Squid	Winter Flounder	Demersal + Skates	Comments
Linear Regression	-Squid pounds ~ slack -Winter flounder ~ slack -Demersal ~ slack (w/control) -Demersal ~ slack (control removed)	p=0.36 N.S.	p=0.18, N.S.	p=0.41, N.S. p=0.59, N.S.	Tests for overall linear trends between Pounds (Squid, Winter Flounder and Demersal) vs Slack for ALL levels of Slack (i.e. 0, 6, 12). The second Demersal test removed the control to determine if there was a trend in the levels of treatment alone. No significance was found for any of them. This statistical test is not optimized for the analysis of paired tows, but useful for data exploration. With increased data, however, this could be more powerful.
Welch 2-sample t-test	Control vs treatment for squid and winter flounder	p=0.5 N.S.	p=0.3, N.S.		Compares control vs. pooled treatment (slack) for Squid and then for Winter Flounder. No significance. This statistical test is not optimized for the analysis of paired tows.
ANOVA	Demersal ~ Treatment Demersal~as.factor (slack)			p=0.13, N.S. p=0.96, N.S.	Anova compared Demersal as a function of different treatment levels of Slack (Factor). Both tests were also, not significant. This statistical test is not optimized for the analysis of paired tows. Used primarily for data exploration. With increased data, however, this could be more powerful.
ANOVA, Log Transformed	Response: log(demersal +1)			p=0.10, N.S.	Total Demersal is not significant with Log transformed data, however, it would be at the 90% level. So, getting closer. With Skates added it might be close or even significant. Log transformed data did not improve the model.
Paired T-Tests	Control vs. Treatment using difference of paired samples	p=0.021 Significant	p=0.28, N.S.	p=0.0059. Highly Significant	Paired t-tests were significant for Squid, Not significant for Winter Flounder and highly significant for Demersal + Skates. However, we were not sure if the pairings were correct. We checked and the pairings were inappropriate (pair #7 was fouled and no data). The Paired t-tests are the most suitable statistical analysis for this experimental design (i.e. paired tows).
Wilcoxon signed Rank Test	Non-parametric Equivalent for Paired T-test	Did not run. Data was Normal	p=0.41, N.S.	p=0.0019 Highly Significant	Non-parametric Wilcoxon test on paired data was not significant on Winter Flounder, but Highly Significant for Demersal. Also, re-ran this test for Log transformed winter flounder data and was not significant. This is valid, but weaker test since it is non-parametric. The results are also consistent with paired-t test below.
Paired T-Tests with correct pairings	Control vs. Treatment using difference of paired samples. We ran 2 different pairing scenarios.	p=0.032 Sig. Or p=0.029, Sig.	p= 0.16 N.S. Or p=0.34 N.S.	p=0.004 Highly Significant OR p=0.009, Highly Sign.	Paired t-tests were significant for Squid, Not significant for Winter Flounder and significant for Demersal + Skates. This is the final test and both pairings produced similar results. The Paired t-tests are the most suitable statistical analysis for this experimental design (i.e. paired tows).

Figure 2



Attachment 1

Project Completion Interviews

Captain David Aripotch – F/V Caitlin and Mairead

Overall feelings about the drop chain performance were mixed due to low squid and winter flounder catches. Captain Aripotch recommends testing the drop chain over more adverse conditions with a higher volume of squid. He suggested testing the drop chain performance on different bottom types such as hard bottom, which occurs inshore along the beach versus soft/muddy bottom, which occurs in the bays, and along the outer shelf of the Hudson Canyon. Although we had similar catches to vessels fishing in the same area, Captain Aripotch believes escapement of squid can occur in the shallows of the inshore waters due to the visual exit of the raised footrope design as well as the direction of water flow that the drop chain creates. For this reason video documentation is needed to observe squid behavior and escapement through the 12” drop chain design. Captain Aripotch and other NY squid fishermen report higher winter flounder and squid interaction occurring in the spring (late April through June) along the southern coast of Long Island.

“It is common practice for us to slack the headrope during normal fishing activity to reduce bycatch when squid fishing. Similar results to drop chains can be observed through lengthening the headrope on fixed or adjustable sweep nets to allow the net to fish lighter on the bottom”.

Comments on project design received from Captain Aripotch include:

- Control net should have been net without drop chain sweep in order to capture complete squid escapement.
- It is more important to see overall escapement of squid both inshore and offshore before any regulatory decisions are made for drop chain usage in the small mesh fishery.

Captain Aripotch is interested in using the drop chain design while fishing offshore for squid in areas of scallop concentrations. He is actually going to continue to use the experimental drop chain sweep in this area to eliminate scallop bycatch. He is still concerned of squid escapement, but stated that on softer bottom the drop chain design may have more contact with the bottom. Squid behavior offshore is believed to be higher in the water column than inshore waters.

Captain Aripotch expressed interest in further testing of drop chain performance in the whiting fishery. Whiting fishing occurs mostly on soft bottom and winter flounder bycatch does occur during this fishery. Reduction of flatfish and skates will allow for a better quality whiting product, which in turn could result in a higher market price. A higher price will be of no benefit if the escapement of whiting is significant enough to reduce overall catch.

Jonathan Knight – Superior Trawls

Jon Knight provided the following comments and observations based on review of project activities and results. To begin there exist only marginal differences between the experimental and control's drop chain performance potential being tested. Putting aside the limiting factor relating to comparing incremental headrope slacking and given the number of tows, the overall results were promising. This view is based on the catch data reported which shows that bottom species escapement was achieved. Further that the fact that some statistical way forward to test the 24-inch slackening in broader context is warranted.

Knight noted that in a separate related drop chain test concurrently being conducted by URI an identical drop chain that includes a 12 inch slackening of the headrope was used as the test net. The control net was a standard 360x12cm small mesh squid net, same as the test trawl, without the drop chain described. According to Knight and Chris Brown, one of the participating fishermen, the drop chain as rigged was extremely effective in reducing winter flounder bycatch and the project targeted winter flounder. They noted that 10 to 12 Pt. Judith fishermen are now using the 12 inch drop chain and as a practical matter slack the headrope according to existing conditions i.e. bottom type, water depth, co-occurring species etc.

Knight observes and we concur that these two projects underscore the following:

- Drop chains are effective in reducing winter flounder bycatch.
- What is needed is a statistically valid evaluation across a broad spectrum of the commercial small mesh squid fishery.
- The control net would be a prototypical small mesh trawl rigged without a drop chain. The test net would be the same trawl with the 12 inch drop chain with two headrope slackening variability adjustments (12 inches and 24 inches).
- This work coupled with existing research involving drop chains in the whiting fishery conducted by Massachusetts Division of Fisheries would provide a comprehensive and definitive analysis of the suitability of drop chains including adjustments for performance variability as a prerequisite for industry adoption.

Attachment 2 – Data Analysis

Sullivan 10/7/2010

data.crab

```
crab treatment
1 4.80 CONTROL
2 1.50 EXPERIMENTAL
3 5.50 CONTROL
4 0.00 EXPERIMENTAL
5 21.62 CONTROL
6 0.00
7 18.80 CONTROL
8 0.50 EXPERIMENTAL
9 0.00 EXPERIMENTAL
10 0.00 EXPERIMENTAL
11 1.00 EXPERIMENTAL
12 12.80 CONTROL
13 0.00
14 13.00 CONTROL
15 1.30 EXPERIMENTAL
16 27.90 CONTROL
17 6.40 EXPERIMENTAL
18 1.00 CONTROL
19 1.00 EXPERIMENTAL
20 0.00
21 6.70 EXPERIMENTAL
22 9.90 CONTROL
23 1.00 EXPERIMENTAL
24 1.00 CONTROL
25 0.00 EXPERIMENTAL
26 2.40 CONTROL
```

```
t.test(data.crab[c(1,3,7,7,12,12,14,16,18,22,24,26),]$crab -
+ data.crab[c(2,4,8,9,10,11,15,17,19,21,23,25),]$crab)
```

One Sample t-test

```
data: data.crab[c(1, 3, 7, 7, 12, 12, 14, 16, 18, 22, 24, 26), ]$crab -
data.crab[c(2, 4, 8, 9, 10, 11, 15, 17, 19, 21, 23, 25), ]$crab
t = 4.0978, df = 11, p-value = 0.001766
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval:
4.21614 14.00053
sample estimates:
mean of x
```

9.108333

Sullivan 10/7/2010

lon. start	trip	tow	treatment	slack	time.start	time.end	lat.start
34.149	1	1	CONTROL	0	5:49	6:50	47.287
38.085	2	1 (REDO)	CONTROL	0	7:56	8:57	46.399
41.501	3	2	EXPERIMENTAL	6	9:40	10:40	45.500
37.657	4	3	CONTROL	0	11:20	12:21	46.673
41.229	5	4	EXPERIMENTAL	12	12:53	1:53	45.525
37.423	6	5	CONTROL	0	2:39	3:40	46.640
0.000	7	6	EXPERIMENTAL	18			0.000
38.829	8	1	CONTROL	0	6:18	7:20	46.291
42.064	9	2	EXPERIMENTAL	24	8:23	9:24	45.212
0.000	10	2 (LOST)	3 CONTROL	0			0.000
0.000	11	2 (LOST)	4 EXPERIMENTAL	30			0.000
0.000	12	2 (LOST)	5 CONTROL	0			0.000
41.249	13	6	EXPERIMENTAL	36	2:50	3:52	45.625
36.788	14	2 (MAKEUP)	7 EXPERIMENTAL	18	4:25	5:25	46.778
39.341	15	2 (MAKEUP)	8 EXPERIMENTAL	30	5:59	7:00	46.098
36.067	16	2 (MAKEUP)	9 CONTROL	0	7:32	8:33	46.705
32.735	17	3	CONTROL	0	6:17	7:19	47.015
35.752	18	3	2 EXPERIMENTAL	36	7:57	8:58	45.924
34.371	19	3	CONTROL	0	9:42	10:43	47.030
37.614	20	3	4 EXPERIMENTAL	30	11:15	12:15	46.013
33.854	21	3	5 CONTROL	0	12:47	1:48	46.384
36.729	22	3	6 EXPERIMENTAL	24	2:19	3:19	45.199
34.191	23	4	1 EXPERIMENTAL	18	5:48	6:48	46.543
37.782	24	4	2 CONTROL	0	7:25	8:26	45.322
34.674	25	4	3 EXPERIMENTAL	12	9:05	10:06	46.397
38.281	26	4	4 CONTROL	0	10:35	11:36	45.340
35.372	27	4	5 EXPERIMENTAL	6	12:27	1:28	45.418
39.082	28	4	6 CONTROL	0	2:00	3:00	44.671

One Sample t-test

data:
 data.squid[c(2, 4, 8, 8, 16, 16, 17, 19, 21, 24, 26, 28),]\$squid -
 data.squid[c(3, 5, 9, 13, 14, 15, 18, 20, 22, 23, 25, 27),]\$squid
 t = 2.4619, df = 11, p-value = 0.03157
 alternative hypothesis: true mean is not equal to 0
 95 percent confidence interval:

```

5.570089 99.546578
sample estimates:
mean of x
52.55833

>
> t.test(data.squid[c(2,4,8,16,17,19,21,24,26,28)],]$squid -
+ data.squid[c(3,5,9,14,18,20,22,23,25,27)],]$squid)

One Sample t-test

data: data.squid[c(2,4,8,16,17,19,21,24,26,28)],]$squid -
data.squid[c(3,5,9,14,18,20,22,23,25,27)],]$squid
t = 2.5904, df = 9, p-value = 0.02920
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval:
 4.564955 67.495045
sample estimates:
mean of x
36.03

> t.test(data.wflounder [c(2,4,8,8,16,16,17,19,21,24,26,28)],]$wflounder
-
+ data.wflounder [c(3,5,9,13,14,15,18,20,22,23,25,27)],]$wflounder
)

One Sample t-test

data: data.wflounder[c(2,4,8,8,16,16,17,19,21,24,26,28)],]$wflounder -
data.wflounder[c(3,5,9,13,14,15,18,20,22,23,25,27)],]$wflounder
t = 1.4917, df = 11, p-value = 0.1639
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval:
-0.9077575 4.7260909
sample estimates:
mean of x
1.909167

>
> t.test(data.wflounder [c(2,4,8,16,17,19,21,24,26,28)],]$wflounder -
+ data.wflounder [c(3,5,9,14,18,20,22,23,25,27)],]$wflounder )

One Sample t-test

data: data.wflounder[c(2,4,8,16,17,19,21,24,26,28)],]$wflounder
-
data.wflounder[c(3,5,9,14,18,20,22,23,25,27)],]$wflounder
t = 1.0107, df = 9, p-value = 0.3385
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval:
-1.449847 3.791847
sample estimates:
mean of x
1.171

Wilcoxon signed rank test with continuity correction

data: data.wflounder[c(2,4,8,8,16,16,17,19,21,24,26,28)],]$wflounder -
data.wflounder[c(3,5,9,13,14,15,18,20,22,23,25,27)],]$wflounder
V = 30, p-value = 0.4065
alternative hypothesis: true location is not equal to 0

Warning messages:
1: In wilcox.test.default(data.wflounder[c(2,4,8,8,16,16,17,19,21,24,26,28)],]$wflounder -
data.wflounder[c(3,5,9,13,14,15,18,20,22,23,25,27)],]$wflounder) :
cannot compute exact p-value with ties
2: In wilcox.test.default(data.wflounder[c(2,4,8,8,16,16,17,19,21,24,26,28)],]$wflounder -
data.wflounder[c(3,5,9,13,14,15,18,20,22,23,25,27)],]$wflounder) :
cannot compute exact p-value with zeroes
>
>
> wilcox.test(data.wflounder[c(2,4,8,16,17,19,21,24,26,28)],]$wflounder -

```

```

+       data.wflounder[c(3, 5, 9, 14, 18, 20, 22, 23, 25, 27), ]$wflounder )
      Wilcoxon signed rank test with continuity correction
data:  data.wflounder[c(2, 4, 8, 16, 17, 19, 21, 24, 26, 28), ]$wflounder
- data.wflounder[c(3, 5, 9, 14, 18, 20, 22, 23, 25, 27), ]$wflounder
V = 21, p-value = 0.7263
alternative hypothesis: true location is not equal to 0

Warning message:
In wilcox.test.default(data.wflounder[c(2, 4, 8, 16, 17, 19, 21, 24, 26, 28), ]$wflounder,
+ data.wflounder[c(3, 5, 9, 13, 14, 15, 18, 20, 22, 23, 25, 27), ]$wflounder) :
cannot compute exact p-value with zeroes

> t.test(data[c(2, 4, 8, 8, 16, 16, 17, 19, 21, 24, 26, 28), ]$demersal -
+ data[c(3, 5, 9, 13, 14, 15, 18, 20, 22, 23, 25, 27), ]$demersal )

      One Sample t-test
data:  data[c(2, 4, 8, 8, 16, 16, 17, 19, 21, 24, 26, 28), ]$demersal -
data[c(3, 5, 9, 13, 14, 15, 18, 20, 22, 23, 25, 27), ]$demersal
t = 3.5967, df = 11, p-value = 0.004194
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval:
 31.32077 130.10590
sample estimates:
mean of x
 80.71333

>

> t.test(data[c(2, 4, 8, 16, 17, 19, 21, 24, 26, 28), ]$demersal -
+ data[c(3, 5, 9, 14, 18, 20, 22, 23, 25, 27), ]$demersal )

      One Sample t-test
data:  data[c(2, 4, 8, 16, 17, 19, 21, 24, 26, 28), ]$demersal -
data[c(3, 5, 9, 14, 18, 20, 22, 23, 25, 27), ]$demersal
t = 3.3147, df = 9, p-value = 0.009016
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval:
 26.55094 140.68106
sample estimates:
mean of x
 83.616
cox.test(data[c(2, 4, 8, 8, 16, 16, 17, 19, 21, 24, 26, 28), ]$demersal -
+ data[c(3, 5, 9, 13, 14, 15, 18, 20, 22, 23, 25, 27), ]$demersal )

      Wilcoxon signed rank test
data:  data[c(2, 4, 8, 8, 16, 16, 17, 19, 21, 24, 26, 28), ]$demersal -
data[c(3, 5, 9, 13, 14, 15, 18, 20, 22, 23, 25, 27), ]$demersal
V = 78, p-value = 0.0004883
alternative hypothesis: true location is not equal to 0

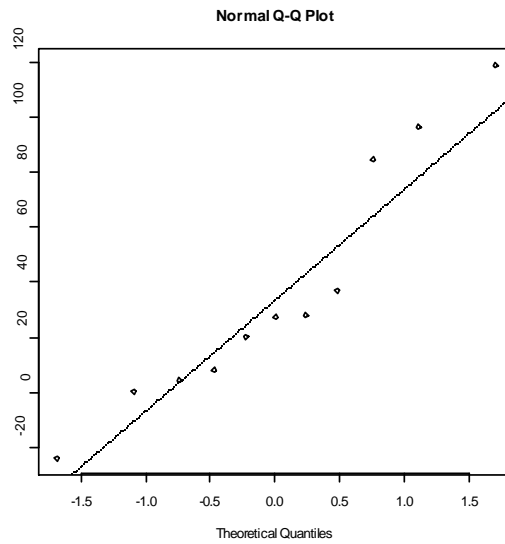
>
> wilcox.test(data[c(2, 4, 8, 16, 17, 19, 21, 24, 26, 28), ]$demersal -
+ data[c(3, 5, 9, 14, 18, 20, 22, 23, 25, 27), ]$demersal )

      Wilcoxon signed rank test
data:  data[c(2, 4, 8, 16, 17, 19, 21, 24, 26, 28), ]$demersal -
data[c(3, 5, 9, 14, 18, 20, 22, 23, 25, 27), ]$demersal
V = 55, p-value = 0.001953
alternative hypothesis: true location is not equal to 0

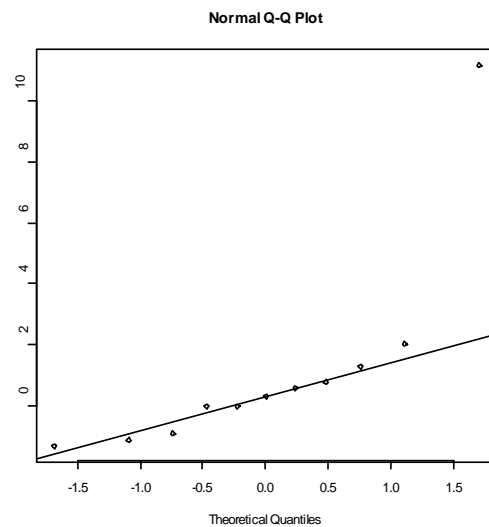
```

Sullivan 10/6/2010

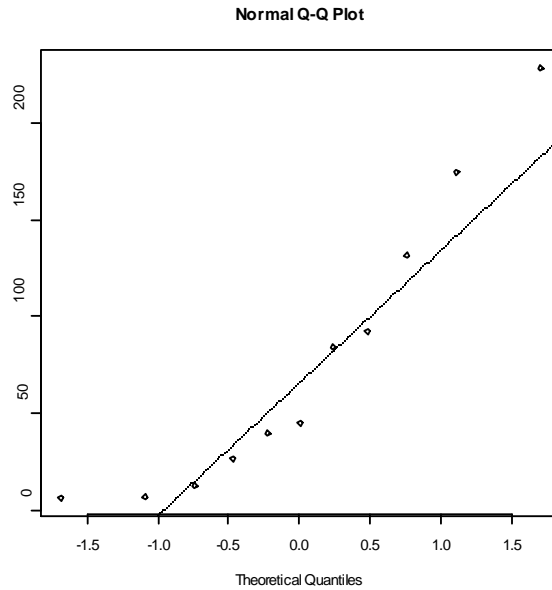
The figure below shows the QQ plot of the paired squid data. If the points fall on the line then the data are considered to be reasonably normal. I would consider the squid data to be normal.



The figure below shows the QQ plot of the winter flounder data. I would consider this to be normal too, with an outlier. That is why I also did a nonparametric approach and a log-transformed approach.



Below is the QQ plot for the demersal paired test. Slightly non normal.



```
> wilcox.test(data[c(2,4,6,8,16,17,19,21,24,26,28),]$demersal-
+ data[c(3,5,7,9,15,18,20,22,23,25,27),]$demersal)
```

Wilcoxon signed rank test

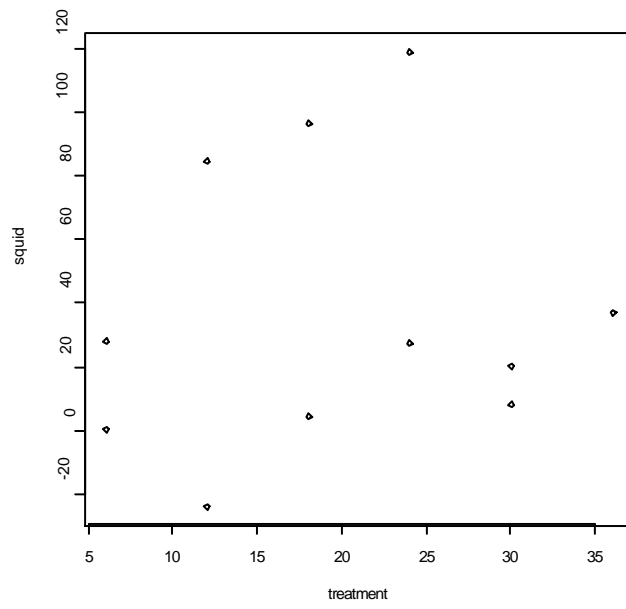
```
data: data[c(2, 4, 6, 8, 16, 17, 19, 21, 24, 26, 28), ]$demersal - data[c(3, 5, 7,
9, 15, 18, 20, 22, 23, 25, 27), ]$demersal
V = 66, p-value = 0.0009766
alternative hypothesis: true location is not equal to 0
```

Below is an ANOVA on the pairs by treatment group. Not significant.

```
> squid.pair = data.frame(
+ squid = c(data.squid[c(2,4,6,8,16,17,19,21,24,26,28),]$squid-
+ data.squid[c(3,5,7,9,15,18,20,22,23,25,27),]$squid),
+ treatment = c(6,12,18,24,30,36,30,24,18,12,6))
>
> anova(aov(squid~treatment,data=squid.pair))
Analysis of Variance Table
```

Response: squid

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
treatment	1	270	269.98	0.1237	0.7331
Residuals	9	19636	2181.78		



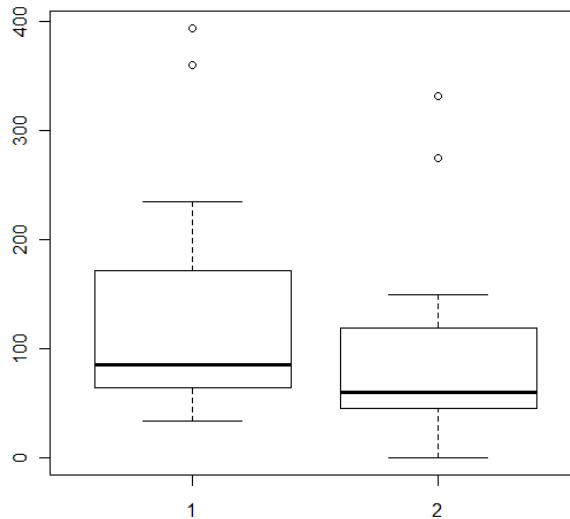
Sullivan 09/29/2010

Here is the analysis on squid.kept using the same treatment control partitioning as before. The result is a significant change in squid kept.

```
> data.squid =  
data.frame(squid=total$loligo.kept,treatment=total$treatment,slack=total$slack)  
>  
> data.squid = data.squid[c(-8,-18,-25),]  
>  
> t.test(data.squid[c(2,4,6,8,16,17,19,21,24,26,28),]$squid -  
+ data.squid[c(3,5,7,9,15,18,20,22,23,25,27),]$squid)
```

One Sample t-test

```
data: data.squid[c(2, 4, 6, 8, 16, 17, 19, 21, 24, 26, 28), ]$squid -  
data.squid[c(3, 5, 7, 9, 15, 18, 20, 22, 23, 25, 27), ]$squid  
t = 2.7275, df = 10, p-value = 0.02128  
alternative hypothesis: true mean is not equal to 0  
95 percent confidence interval:  
 6.717401 66.664417  
sample estimates:  
mean of x  
36.69091
```



Here is the analysis for winter flounder. This is not significant at the 0.05 level.

```

> # Winter flounder
>
> data.wflounder = data.frame(wflounder =total$wflounder
,treatment=total$treatment,slack=total$slack)
>
> data.wflounder = data.wflounder [c(-8,-18,-25),]
>
> t.test(data.wflounder [c(2,4,6,8,16,17,19,21,24,26,28),]$wflounder -
+ data.wflounder [c(3,5,7,9,15,18,20,22,23,25,27),]$wflounder )

```

One Sample t-test

```

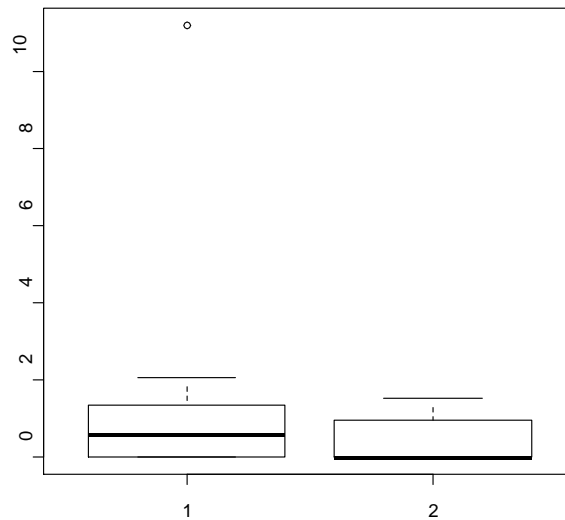
data: data.wflounder[c(2, 4, 6, 8, 16, 17, 19, 21, 24, 26, 28), ]$wflounder -
data.wflounder[c(3, 5, 7, 9, 15, 18, 20, 22, 23, 25, 27), ]$wflounder
t = 1.1302, df = 10, p-value = 0.2848
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval:
-1.150645 3.519736
sample estimates:
mean of x
1.184545

```

```

>
> mean(data.wflounder [c(2,4,6,8,16,17,19,21,24,26,28),]$wflounder -
+ data.wflounder [c(3,5,7,9,15,18,20,22,23,25,27),]$wflounder )
[1] 1.184545

```



There appears to be an outlier. Let me try a nonparametric test that is not as sensitive to outliers or the normality assumption.

Wilcoxon signed rank test with continuity correction

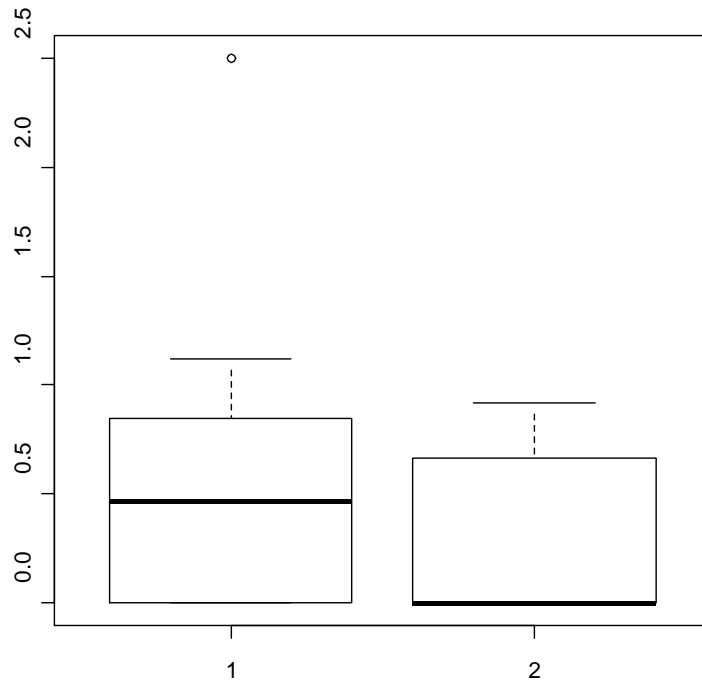
```
data: data.wflounder[c(2, 4, 6, 8, 16, 17, 19, 21, 24, 26, 28), ]$wflounder -
data.wflounder[c(3, 5, 7, 9, 15, 18, 20, 22, 23, 25, 27), ]$wflounder
V = 30, p-value = 0.4069
alternative hypothesis: true location is not equal to 0
>
```

Here I do a test on the log transformed data. Still not significant. Really, the winter flounder harvest is so low that it makes the analysis difficult.

```
> data.wflounder = data.frame(wflounder =log(total$wflounder+1)
,treatment=total$treatment,slack=total$slack)
>
> data.wflounder = data.wflounder [c(-8,-18,-25),]
>
> t.test(data.wflounder [c(2,4,6,8,16,17,19,21,24,26,28),]$wflounder -
+ data.wflounder [c(3,5,7,9,15,18,20,22,23,25,27),]$wflounder )
One Sample t-test
```

```
data: data.wflounder[c(2, 4, 6, 8, 16, 17, 19, 21, 24, 26, 28), ]$wflounder -
data.wflounder[c(3, 5, 7, 9, 15, 18, 20, 22, 23, 25, 27), ]$wflounder
t = 1.1489, df = 10, p-value = 0.2774
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval:
-0.3096653 0.9689189
sample estimates:
mean of x
0.3296268

>
> mean(data.wflounder [c(2,4,6,8,16,17,19,21,24,26,28),]$wflounder -
+ data.wflounder [c(3,5,7,9,15,18,20,22,23,25,27),]$wflounder )
[1] 0.3296268
```



Sullivan 09/24/2010

Paired T-tests

```
cbind(seq(dim(data)[1]),data)
seq(dim(data)[1]) demersal treatment slack
1      1  0.00 CONTROL 0
2      2 63.40 CONTROL 0
3      3 23.10 EXPERIMENTAL 6
4      4 49.25 CONTROL 0
5      5 36.30 EXPERIMENTAL 12
6      6 45.32 CONTROL 0
7      7  0.00 EXPERIMENTAL 18
9      8 28.10 CONTROL 0
10     9 20.90 EXPERIMENTAL 24
11    10  0.00 CONTROL 0
12    11  0.00 EXPERIMENTAL 30
13    12  0.00 CONTROL 0
14    13 27.85 EXPERIMENTAL 36
15    14  2.50 EXPERIMENTAL 18
16    15 31.20 EXPERIMENTAL 30
17    16 163.35 CONTROL 0
19    17 439.90 CONTROL 0
20    18 211.10 EXPERIMENTAL 36
21    19 135.70 CONTROL 0
22    20 128.90 EXPERIMENTAL 30
23    21 276.46 CONTROL 0
24    22 101.60 EXPERIMENTAL 24
26    23 202.50 EXPERIMENTAL 18
27    24 229.50 CONTROL 0
28    25 253.90 EXPERIMENTAL 12
29    26 338.40 CONTROL 0
30    27 212.70 EXPERIMENTAL 6
31    28 305.60 CONTROL 0
```

The numbers included correspond to the second column of numbers above

```
t.test(data[c(2,4,6,8,16,17,19,21,24,26,28)],]$demersal -
+ data[c(3,5,7,9,15,18,20,22,23,25,27),]$demersal)
```

One Sample t-test

```
data: data[c(2, 4, 6, 8, 16, 17, 19, 21, 24, 26, 28), ]$demersal -
      data[c(3, 5, 7, 9, 15, 18, 20, 22, 23, 25, 27), ]$demersal
```

t = 3.4759, df = 10, p-value = 0.005962
alternative hypothesis: true mean is not equal to 0

95 percent confidence interval:

27.82958 127.22133

sample estimates:

mean of x

77.52545

This indicates a average difference in the pairs of about 77.5 pounds.

If we do not pair them, then consider the following:

Sample Significance

Size Level (approx)

10 0.24

15 0.19

20 0.09

25 0.09

30 0.06

35 0.05

40 0.02

Sullivan 09/17/2010

Here we are looking at the effect of treatment on total demersal landings in pounds.

Exploratory 1 A linear model fitted to demersal landings as a function of headrope increment.

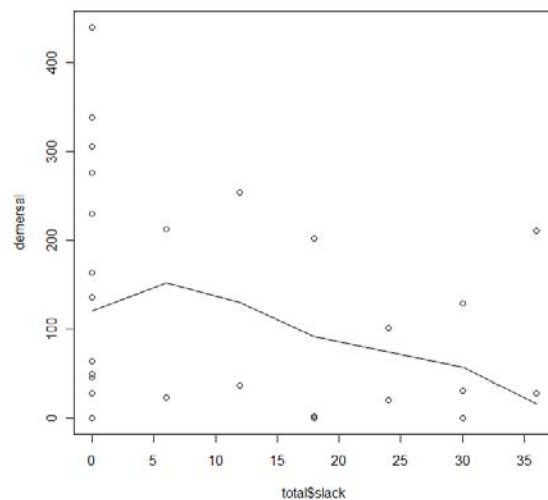
No significant effect. Note that if a value was blank in the data I set the value to zero.

Call:

```
lm(formula = demersal ~ slack, data = total)
```

Coefficients:

```
      Estimate Std. Error t value Pr(>|t|)
(Intercept) 121.777    28.047  4.342 0.000157 ***
slack       -1.492     1.771 -0.842 0.406430
Residual standard error: 123.6 on 29 degrees of freedom
Multiple R-squared: 0.02389, Adjusted R-squared: -0.00977
F-statistic: 0.7097 on 1 and 29 DF, p-value: 0.4064
```



Exploratory 2. I was curious to see if there was a linear relationship just among the treatment groups, so I did another regression, but without the controls.

This was also not significant.

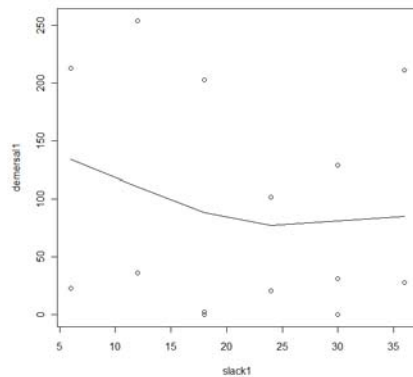
Call:

```
lm(formula = demersal1 ~ slack1)
```

Coefficients:

```
      Estimate Std. Error t value Pr(>|t|)
(Intercept) 119.811    61.886  1.936 0.0768 .
slack1      -1.416     2.626 -0.539 0.5996
Residual standard error: 96.39 on 12 degrees of freedom
Multiple R-squared: 0.02366, Adjusted R-squared: -0.0577
```

F-statistic: 0.2908 on 1 and 12 DF, p-value: 0.5996



Exploratory 3. While the linear might be the best approach to take, I also explored Analysis of Variance for the TreatmentXControl case and for each level of treatment (and control) as factors.

These were not significant.

```
> anova(aov(demersal~treatment,data=total))
Analysis of Variance Table
Response: demersal
      Df Sum Sq Mean Sq F value Pr(>F)
treatment 2  62426  31213  2.232 0.1261
Residuals 28 391560 13984
> anova(aov(demersal~as.factor(slack),data=total))
Analysis of Variance Table
Response: demersal
      Df Sum Sq Mean Sq F value Pr(>F)
as.factor(slack) 6  24604  4100.7  0.2292 0.963
Residuals      24 429382 17890.9
```

Exploratory 3: Just exploring... I found a significant relationship between demersal landings and air temperature.

```
> lm(formula = demersal[total$air.temp > 0] ~ air.temp, data = total[total$air.temp
>
> 0, ])
Coefficients:
      Estimate Std. Error t value Pr(>|t|)
(Intercept) -1876.52   888.70  -2.112  0.0463 *
```

air.temp 26.55 11.70 2.268 0.0335 *
Residual standard error: 113.5 on 22 degrees of freedom
Multiple R-squared: 0.1895, Adjusted R-squared: 0.1527
F-statistic: 5.145 on 1 and 22 DF, p-value: 0.03347

Sullivan 09/14/2010

Here is second analysis with the flounder data trip 3 tow 1.

Exploratory 1. Squid poundage vs. slack (i.e. 0 for control, then 6 through 36 inches). (Same as earlier draft.)

Call:

lm(formula = pounds ~ slack, data = squid)

Residuals:

Min	1Q	Median	3Q	Max
-112.77	-73.96	-51.12	49.06	256.63

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	149.473	31.685	4.717	0.000117 ***

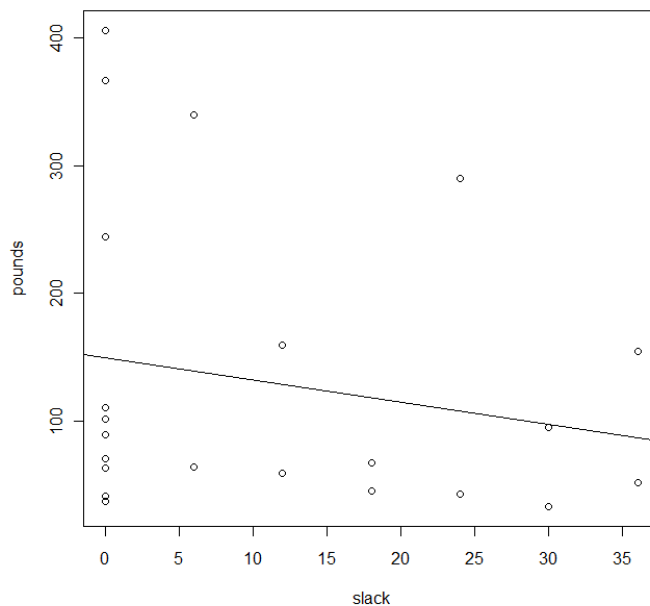
slack -1.730 1.877 -0.922 0.367115 # **Linear relationship not significant**

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 115.6 on 21 degrees of freedom

Multiple R-squared: 0.03889, Adjusted R-squared: -0.00688

F-statistic: 0.8497 on 1 and 21 DF, p-value: 0.3671



Welch Two Sample t-test

data: squid\$pounds[squid\$slack == 0] and squid\$pounds[squid\$slack > 0]
 t = 0.5795, df = 18.802, p-value = 0.5691 # Simple t-test on pooled categories
 not significant

alternative hypothesis: true difference in means is not equal to 0

95 percent confidence interval:

-74.81757 132.05848

sample estimates:

mean of x mean of y

145.4455 116.8250

Exploratory 2. Winter flounder poundage vs. slack (i.e. 0 for control, then 6 through 12 inches). (Updated.)

Call:

lm(formula = pounds ~ slack, data = wflounder)

Coefficients:

Estimate Std. Error t value Pr(>|t|)

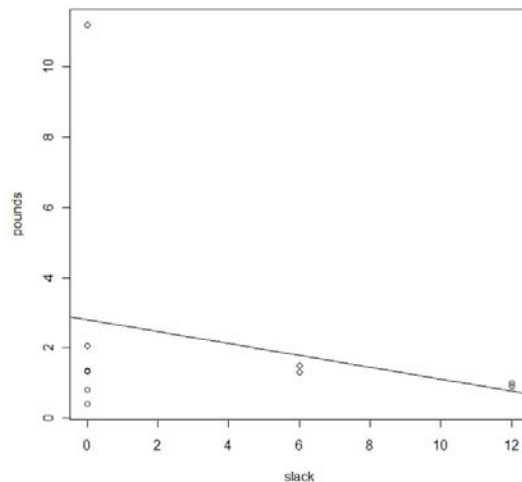
(Intercept) 2.4959 1.1606 2.151 0.060

slack -0.1396 0.2029 -0.688 0.509 # Linear relationship not significant

Residual standard error: 3.157 on 9 degrees of freedom

Multiple R-squared: 0.04998, Adjusted R-squared: -0.05558

F-statistic: 0.4735 on 1 and 9 DF, p-value: 0.5087



Welch Two Sample t-test

data: wflounder\$pounds[wflounder\$slack == 0] and
 wflounder\$pounds[wflounder\$slack > 0]

t = 0.9261, df = 6.106, p-value = 0.3895 # **Simple t-test on pooled categories not significant**

alternative hypothesis: true difference in means is not equal to 0

95 percent confidence interval:

-2.214883 4.930597

sample estimates:

mean of x mean of y

2.532857 1.175000

Nonparametric test

```
wilcox.test(wflounder$pounds[wflounder$slack==0],wflounder$pounds[wflounder$slack>0])
```

Wilcoxon rank sum test

data: wflounder\$pounds[wflounder\$slack == 0] and
wflounder\$pounds[wflounder\$slack > 0]

W = 14, p-value = 1 # **Wilcoxon Nonparametric test on pooled categories not significant**

alternative hypothesis: true location shift is not equal to 0

anova(aov(pounds~slack,data=wflounder))

Analysis of Variance Table

Response: pounds

Df Sum Sq Mean Sq F value Pr(>F)

slack 1 4.719 4.7193 0.4735 0.5087 # **Analysis of Variance with three levels (0,6,12) not significant**

Residuals 9 89.702 9.9669

So, no change in the above findings from the previous draft.

Note that above I also did a nonparametric test and an ANOVA, neither of which was significant.

Here are some other tests that Emerson requested.

Exploratory 3. Squid numbers vs. slack (i.e. 0 for control, then 6 through 36 inches).

To compute total numbers of squid caught I took the weight of the sample and divided by the number in the sample to get the average weight of the squid. I divided that into total weight to get total number.

To cut to the chase, nothing was significant.

```
> squid.N
```

```
slack snumber tpounds spounds
```

```
1 0 100 366.5 16.32
```

```
2 6 100 339.6 12.70
```

```

3  0  104 244.2 16.70
4  0  109 101.3 12.00
5  0  124 406.1 12.30
6  24 134 289.7 11.90
7  36 107 154.6 10.80
8  18 100  45.3  6.50
9  30 131  95.3 10.80
10 0  100 110.6 12.77
11 0  103  89.1 16.80
12 36 100  52.0 10.60
13 0  103  41.5 11.30
14 30 104  32.8 12.00
15 0  104  70.3 17.40
16 24 101  42.8 12.20
17 18 106  67.2 10.40
18 0  96  70.3 11.50
19 12 103  59.0 10.60
20 0  98  36.7  9.50
21 6  105  64.2 10.60
22 0  98  63.3 11.40

```

```

> squid.N$number = squid.N$pounds/(squid.N$pounds/squid.N$number) #tN
= tW/aveW

```

```

> anova(aov(tnumber~slack,data=squid.N))
Analysis of Variance Table

```

Response: tnumber

```

      Df Sum Sq Mean Sq F value Pr(>F)
slack  1  72900  72900  0.0645  0.802
Residuals 20 22593803 1129690

```

```

> summary(lm(tnumber~slack,data=squid.N))

```

Call:

```

lm(formula = tnumber ~ slack, data = squid.N)

```

Residuals:

```

      Min       1Q   Median       3Q      Max
-798.9 -632.5 -464.1  285.3 2916.8

```

Coefficients:

```

      Estimate Std. Error t value Pr(>|t|)
(Intercept) 1177.170   294.659   3.995 0.000712 ***
slack       -4.386    17.265  -0.254 0.802066
---

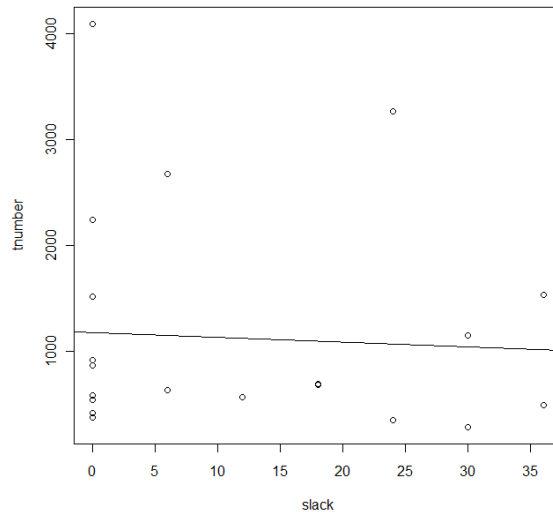
```

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1063 on 20 degrees of freedom

Multiple R-squared: 0.003216, Adjusted R-squared: -0.04662
F-statistic: 0.06453 on 1 and 20 DF, p-value: 0.802

```
> plot(tnumber~slack,data=squid.N)  
> abline(coef(lm(tnumber~slack,data=squid.N)))
```



```
>  
> # When pooled as a t test  
>  
t.test(squid.N$tnumber[squid.N$slack==0],squid.N$tnumber[squid.N$slack>0])
```

Welch Two Sample t-test

```
data: squid.N$tnumber[squid.N$slack == 0] and squid.N$tnumber[squid.N$slack  
> 0]  
t = 0.0314, df = 19.621, p-value = 0.9752  
alternative hypothesis: true difference in means is not equal to 0  
95 percent confidence interval:  
-933.7818 962.3233  
sample estimates:  
mean of x mean of y  
1136.459 1122.189
```

```
>  
wilcox.test(squid.N$tnumber[squid.N$slack==0],squid.N$tnumber[squid.N$slack>0])
```

Wilcoxon rank sum test

```
data: squid.N$tnumber[squid.N$slack == 0] and squid.N$tnumber[squid.N$slack  
> 0]
```

W = 58, p-value = 0.8977
alternative hypothesis: true location shift is not equal to 0

Exploratory 4. Winter flounder numbers vs. slack (i.e. 0 for control, then 6 and 12 inches).

To compute total numbers of winter flounder caught I took the weight of the sample and divided by the number in the sample to get the average weight of the flounder. I divided that into total weight to get total number.

Again, bottom line is these tests are not significant.

```
> flounder.N
  slack tpounds spounds snumber tnumber
1    6  1.30  1.30    1    1
2    0  1.35  1.35    2    2
3   12  1.00  1.00    1    1
4    0  1.32  1.32    2    2
5    0 11.20 11.20    6    6
6    0  0.60  0.60    1    1
7    0  2.06  2.06    3    3
8    0  0.80  0.80    1    1
9   12  0.90  0.90    1    1
10   6  1.50  1.50    4    4
11   0  0.40  0.40    1    1
> summary(lm(tnumber~slack,data=flounder.N))
```

Call:
lm(formula = tnumber ~ slack, data = flounder.N)

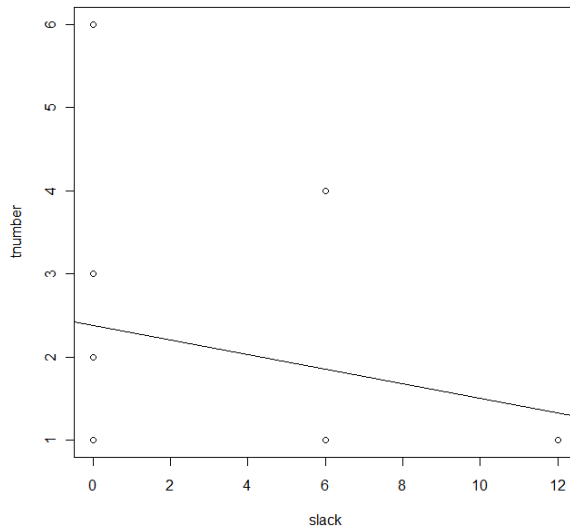
Residuals:
Min 1Q Median 3Q Max
-1.3784 -1.1149 -0.3784 0.1486 3.6216

Coefficients:
Estimate Std. Error t value Pr(>|t|)
(Intercept) 2.37838 0.61318 3.879 0.00374 **
slack -0.08784 0.10718 -0.820 0.43366

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1.668 on 9 degrees of freedom
Multiple R-squared: 0.06944, Adjusted R-squared: -0.03396
F-statistic: 0.6716 on 1 and 9 DF, p-value: 0.4337

```
> plot(tnumber~slack,data=flounder.N)
> abline(coef(lm(tnumber~slack,data=flounder.N)))
```



```
> anova(aov(tnumber~slack,data=flounder.N))
Analysis of Variance Table
```

Response: tnumber

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
slack	1	1.8686	1.8685	0.6716	0.4337
Residuals	9	25.0405	2.7823		

```
> # When pooled as a t test
```

```
>
```

```
t.test(flounder.N$tnumber[flounder.N$slack==0],flounder.N$tnumber[flounder.N$slack>0])
```

Welch Two Sample t-test

```
data: flounder.N$tnumber[flounder.N$slack == 0] and
flounder.N$tnumber[flounder.N$slack > 0]
```

```
t = 0.5291, df = 7.445, p-value = 0.6121
```

```
alternative hypothesis: true difference in means is not equal to 0
```

```
95 percent confidence interval:
```

```
-1.829651  2.901080
```

```
sample estimates:
```

```
mean of x mean of y
```

```
2.285714  1.750000
```

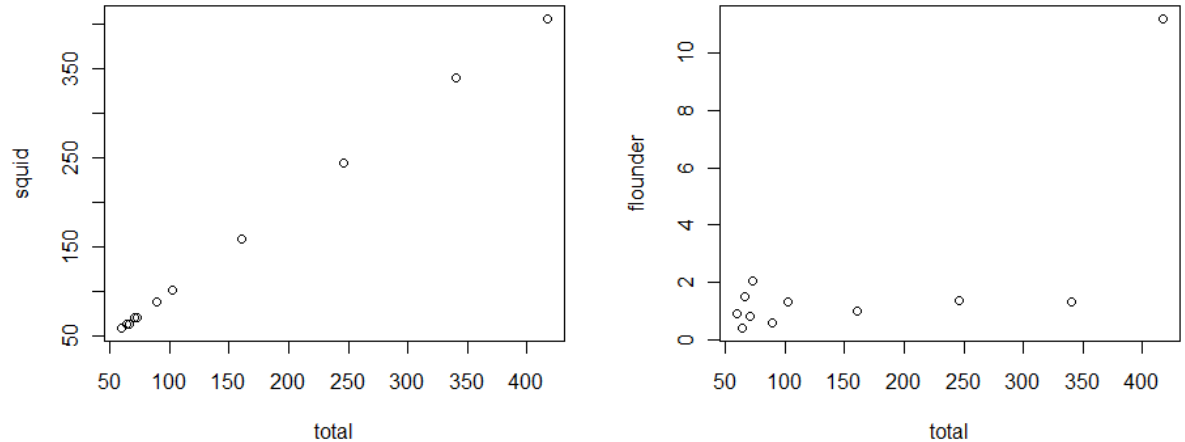
```
>
```

```
wilcox.test(flounder.N$tnumber[flounder.N$slack==0],flounder.N$tnumber[flounder.N$slack>0])
```

Wilcoxon rank sum test with continuity correction

data: flounder.N\$number[flounder.N\$slack == 0] and
 flounder.N\$number[flounder.N\$slack > 0]
 $W = 17.5$, p-value = 0.5353
 alternative hypothesis: true location shift is not equal to 0

Exploratory 5. Influence of total landings on winter flounder and squid landings.
 Basically squid dominate the picture. Not much of a relationship with flounder.

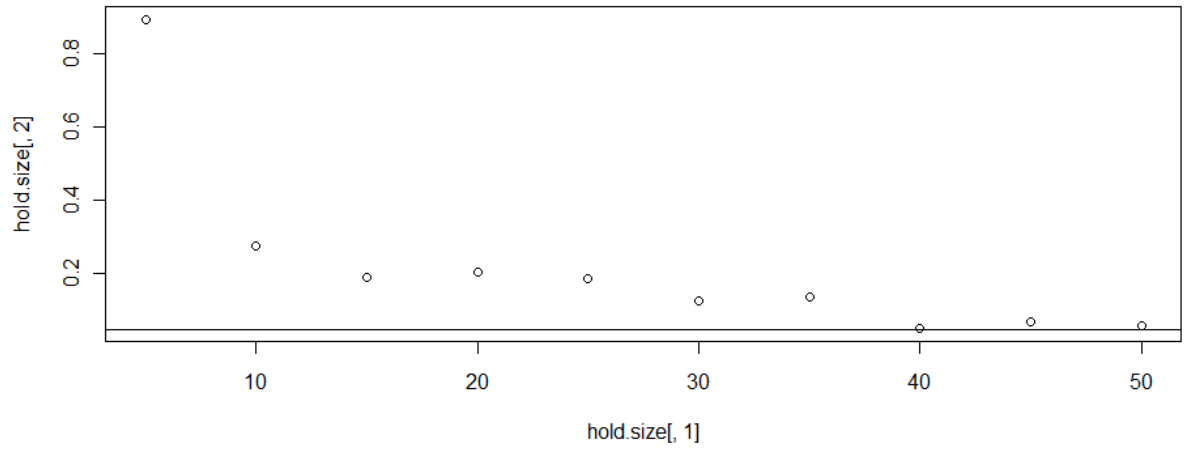


Exploratory 7. Another sample size analysis.

In the current data we are seeing about a 1.3 pound difference between the control and the 6,12 group. To make that statistically significant what sample size do we need.

We currently have a sample size of 7 controls and 2 each at the 6 and 12 level.

To be able to see a significant difference at this level (1.3 pounds) we will need about 40 observations in each group. Unless we sample in an area where the flounder numbers are greater, we won't be able to detect much of a difference at reasonable sample sizes.



Sullivan 09/12/2010

Here is an initial go at an analysis. We can explore other things, but this seemed to be the baseline set of hypotheses.

Exploratory 1. Squid poundage vs. slack (i.e. 0 for control, then 6 through 36 inches).

Call:

lm(formula = pounds ~ slack, data = squid)

Residuals:

Min	1Q	Median	3Q	Max
-112.77	-73.96	-51.12	49.06	256.63

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	149.473	31.685	4.717	0.000117 ***
slack	-1.730	1.877	-0.922	0.367115

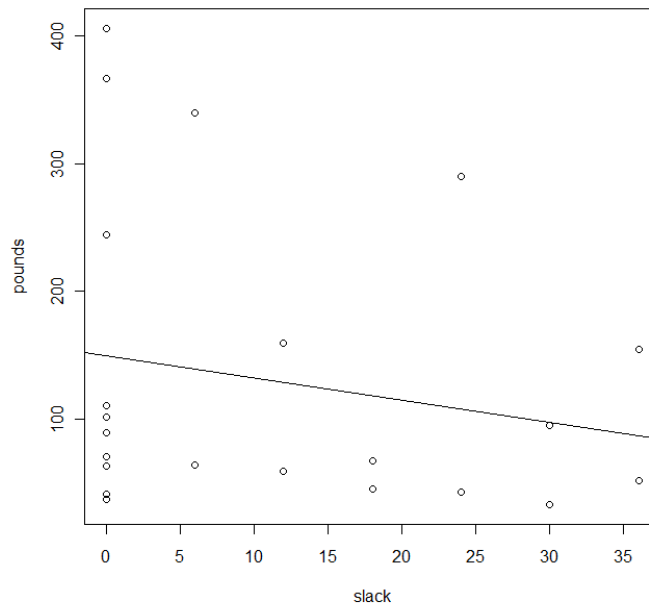
Linear relationship not significant

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 115.6 on 21 degrees of freedom

Multiple R-squared: 0.03889, Adjusted R-squared: -0.00688

F-statistic: 0.8497 on 1 and 21 DF, p-value: 0.3671



Welch Two Sample t-test

```
data: squid$pounds[squid$slack == 0] and squid$pounds[squid$slack > 0]
t = 0.5795, df = 18.802, p-value = 0.5691    # Simple t-test on pooled
```

categories not significant

alternative hypothesis: true difference in means is not equal to 0

95 percent confidence interval:

-74.81757 132.05848

sample estimates:

mean of x mean of y

145.4455 116.8250

Exploratory 2. Winter flounder poundage vs. slack (i.e. 0 for control, then 6 through 12 inches).

Note here that line 25 for flounder total and sample pounds is identical to line 26 for squid. If that is correct, then what follows is correct. In case it is not, I redo the analysis without that line below. (See attachment from 9/14/10 for analysis with corrected data)

Call:

```
lm(formula = pounds ~ slack, data = wflounder)
```

Residuals:

```
   Min     1Q  Median     3Q    Max
-14.0554 -13.1204 -5.1422 -0.3922  74.6446
```

Coefficients:

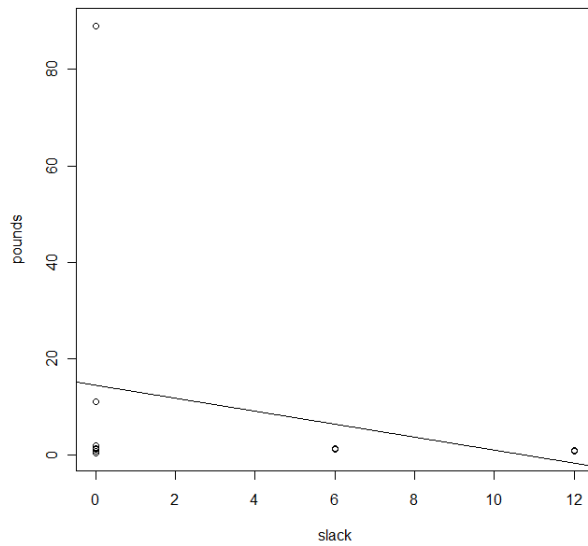
```
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  14.455     9.900   1.460  0.178
slack        -1.336     1.731  -0.772  0.460  # Linear relationship not
```

significant

Residual standard error: 26.93 on 9 degrees of freedom

Multiple R-squared: 0.06207, Adjusted R-squared: -0.04215

F-statistic: 0.5956 on 1 and 9 DF, p-value: 0.4601



Welch Two Sample t-test

```

data: wflounder$pounds[wflounder$slack == 0] and
wflounder$pounds[wflounder$slack > 0]
t = 1.1288, df = 6.001, p-value = 0.3021 # Simple t-test on pooled categories
not significant
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
-16.34768 44.34911
sample estimates:
mean of x mean of y
15.17571 1.17500

```

Exploratory 3. Winter flounder poundage vs. slack (i.e. 0 for control, then 6 through 12 inches). With line 25 data removed.

```

Call:
lm(formula = pounds ~ slack, data = wflounder[,-6, ])

```

```

Residuals:
  Min    1Q  Median    3Q   Max
-2.39219 -1.46469 -0.60453  0.03461  8.40781

```

```

Coefficients:

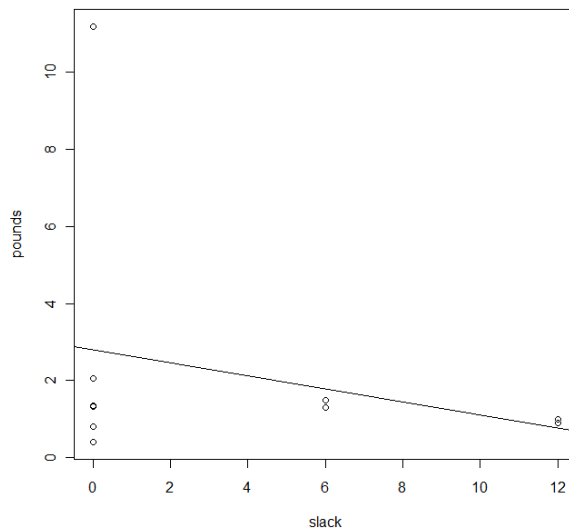
```

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	2.7922	1.2926	2.160	0.0628
slack	-0.1692	0.2154	-0.785	0.4548

Linear relationship is still not significant

 Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 3.27 on 8 degrees of freedom
 Multiple R-squared: 0.0716, Adjusted R-squared: -0.04445
 F-statistic: 0.617 on 1 and 8 DF, p-value: 0.4548



Welch Two Sample t-test

data: wflounder1\$pounds[wflounder1\$slack == 0] and
 wflounder1\$pounds[wflounder1\$slack > 0]
 t = 0.9939, df = 5.067, p-value = 0.3653 # **Simple t-test on pooled categories**

not significant

alternative hypothesis: true difference in means is not equal to 0
 95 percent confidence interval:
 -2.647861 6.007861
 sample estimates:
 mean of x mean of y
 2.855 1.175

