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DuPaul, W. D., Rudders, D. B., & Kerstetter, D. (1999) Results of Modifications to Sea Scallop Dredge Twine Tops to Facilitate the Reduction of Finfish Bycatch: Georges Bank Closed Area II Experimental Fishery September-October 1998. Marine Resource Report No. 99-4. Virginia Institute of Marine Science, College of William and Mary. <http://dx.doi.org/doi:10.21220/m2-xkk1-af80>

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**RESULTS OF MODIFICATIONS TO SEA SCALLOP DREDGE TWINE TOPS
TO FACILITATE THE REDUCTION OF FINFISH BYCATCH:
GEORGES BANK CLOSED AREA II EXPERIMENTAL FISHERY
SEPTEMBER–OCTOBER 1998**

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VIMS Marine Resource Report No. 99-4

**Revised
March 23, 1999**

The Experimental Fishery on Georges Bank Area II was a cooperative effort on the part of the National Marine Fisheries Service, CMAST – UMASS Darmouth, Virginia Institute of Marine Science and the Fisheries Survival Fund, New Bedford, Massachusetts.

RESULTS OF MODIFICATIONS TO SEA SCALLOP DREDGE TWINE TOPS TO FACILITATE THE REDUCTION OF FINFISH BYCATCH

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Introduction

Finfish bycatch has historically been a part of the sea scallop fishery throughout its entire range. While the capture of finfish by sea scallop dredges varies temporally, spatially, and with regard to species composition, the numbers of fish captured can be significant (DuPaul, 1995). Recent gear modification efforts have endeavored to reduce the capture of finfish in scallop dredges. Modifications to reduce the bycatch of finfish have focused on the manipulation of both the dimensions, mesh size, and orientation of the twine top of the dredge (Cooper, C.G., 1995 unpublished data; Henriksen, *et. al*, 1997; DuPaul, 1998 unpublished data).

The need to reduce finfish bycatch has become increasingly evident during recent developments in the closed areas on Georges Bank. In 1994, portions of Georges Bank totaling approximately 5,000 square miles were closed to mobile gears to foster the rebuilding of depleted groundfish stocks. In an attempt to quantify the scallop resource in Closed Area II which had been left undisturbed for 4.5 years, an experimental fishery was conducted during the summer of 1998. Due to concerns with finfish bycatch during the experimental fishery, the mesh size of the twine top was increased from the currently mandated 5.50 inches to 8 inches for the six vessels participating in the experiment. In addition to the increase in mesh size, two twine top experiments were conducted in an attempt to better evaluate the reductions in finfish bycatch.

Materials and Methods

The F/V Thor conducted two twine top experiments from September 17 to October 1, 1998. The study area consisted of portions of Georges Bank in and adjacent to Closed Area II. Commercial sea scallop dredge vessels are well suited for this experimental design due to the fact that vessels simultaneously tow two identical dredges. One dredge configuration is held constant as a "control" while the other is modified as the experimental configuration. In both experiments, the starboard dredge utilizing the 8 inch diamond twine top was held constant as the control against which other twine top configurations were compared.

Experiment #1

Both twine tops in the first experiment consisted of a 65 mesh x 12 mesh panel of 8 inch diamond mesh. The orientation of the meshes on the starboard or "control" dredge was with the diamond running longitudinally to the direction of dredge movement. This configuration is referred to as the "diamond." The port or experimental dredge took that same piece of twine top material and oriented it at 90 degrees relative to the diamond configuration. The twine top hung this way resulted in the formation of square openings relative to the direction of movement of the dredge. This configuration is referred to as "square." For both configurations, each individual mesh was made up of four, 4 inch sides.

Experiment #2

The second experiment again utilized a 65 mesh x 12 mesh panel of 8 inch diamond mesh hung on the diamond on the starboard dredge as a control. The experimental dredge for this experiment consisted of a panel of 12 inch diamond mesh twine top. This panel was oriented on the square, and each individual mesh was made up of four, 6 inch sides. This experiment consisted of stations that were located outside of the boundary of Closed Area II.

Sampling Protocol

While at sea, the catch from each tow was sorted according to dredge configuration. Finfish were then separated by species, counted and measured to the nearest centimeter. Sea scallops were also sorted for a measure of total volume, and if necessary, a sub-sample was taken. Shell height frequency measurements in 5 mm intervals were recorded using a NMFS sea scallop measuring board.

Data Analysis

The raw data was compiled in a Microsoft Excel (1997) spreadsheet. Tows that were designated as "good" (i.e. no hangs, flips, riders, etc.) were analyzed to yield total numbers of finfish captured (by species) and length frequency distributions for sea scallops, yellowtail flounder, blackback flounder, windowpane flounder, barndoor skates and monkfish. Determinations were made of average catch per tow, and average catch per hour of towing time for all tows. A two tailed paired t-test was used to test for statistically significant differences in catch per tow between the two gear configurations. This test was performed on the catch data for all tows and for tows in which fish of a particular species were captured.

Results

Experiment #1

The first experiment that compared the catches of the 8 inch square twine top to the 8 inch diamond twine top consisted of 224 tows inside the boundaries of Closed Area II. There were a total of 36:56 hours of towing time included in the analysis. Tow times ranged from 1 to 27 minutes.

A species compilation of the catch frequency for each dredge configuration is shown in Figure 1. A total of 26 different species of finfish and invertebrates were documented. The analysis of yellowtail flounder (Figure 2) indicated no statistically significant difference in the number of yellowtail flounder captured for all tows ($p=0.233$) and for tows in which yellowtail flounder were present ($p=0.230$). The analysis of blackback flounder (Figure 3) also indicated no statistically significant difference in the number of blackback flounder captured for all tows ($p=0.670$) and for tows in which blackback flounder were present ($p=0.671$). The analysis of windowpane flounder (Figure 4) indicated a statistically significant difference in the number of windowpane flounder captured for all tows ($p<0.000$) and for tows in which windowpane flounder were present ($p<0.000$). The analysis of monkfish (Figure 5) again indicated no statistically significant difference in the number of monkfish captured for all tows ($p=0.503$) and for tows in which monkfish were present ($p=0.504$). The analysis of barndoor skates (Figure 6) indicated no statistically significant difference in the number of barndoor skates captured for all tows ($p=0.239$) and for tows in which barndoor skates were present ($p=0.289$).

Analysis of sea scallop harvest is shown in Figure 7. Results indicate no statistically significant difference in the number of scallops captured per tow for all scallops ($p=0.769$) and for scallops equal to or greater than 70 mm shell height ($p=0.774$) between the 8 inch square and 8 inch diamond dredge configurations.

Experiment #2

The second experiment comparing the catches of the 12 inch square twine top to the 8 inch diamond twine top consisted of 34 tows in an area adjacent to the boundary of Closed Area II. There were a total of 9:22 hours of towing time included in the analysis. Tow times ranged from 1 to 70 minutes.

A species compilation of the catch frequency for each dredge configuration is shown in Figure 8. A total of 18 different species of finfish and invertebrates were documented. The analysis of yellowtail flounder (Figure 9) indicated no statistically significant difference in the number of yellowtail flounder captured for all tows ($p=0.082$) and for tows in which yellowtail flounder were present ($p=0.082$). The analysis of blackback flounder (Figure 10) indicated a statistically significant difference in the number of blackback flounder captured for all tows ($p=0.004$) and for tows in which blackback flounder were present ($p=0.001$). The analysis of windowpane flounder

(Figure 11) also indicated a statistically significant difference in the number of windowpane flounder captured for all tows ($p=0.003$) and for tows in which windowpane flounder were present ($p=0.001$). The analysis of monkfish (Figure 12) indicates a statistically significant difference in the number of monkfish captured for all tows ($p=0.041$) and for tows in which monkfish were present ($p=0.040$). Limited numbers of barndoor skates (12" square-3 animals, and 8" diamond-2 animals) prevented further analysis of the bycatch of that species.

The analysis of sea scallop harvest is shown in Figure 13. Results indicate a statistically significant difference in the number of scallops captured per tow for all scallops ($p<0.000$) and for scallops equal to or greater than 70 mm shell height ($p<0.000$) between the 12 inch square and the 8 inch diamond twine top configurations.

Conclusions

Manipulations of the dimensions, mesh size, and orientation of the twine tops on commercial sea scallop dredges have been demonstrated to be an effective means to reduce the bycatch of some finfish species. With the exception of windowpane flounder, results from the first experiment in this study indicate that the orientation of an 8 inch twine top hung either on the square or the traditional diamond seem to offer little relative difference in relation to finfish escapement. The diamond twine top dredge did capture 92 fewer yellowtail flounder, however the differences were not statistically significant due to high tow to tow variability. The orientation of the twine top did not result in bycatch reductions for most other species encountered, specifically monkfish, barndoor skates, and blackback flounder. There was also little difference in the catches of sea scallops between the two dredge configurations. A paucity of small scallops did not allow for an assessment to be made on the basis of the effect of the twine top configurations on the capture of pre-recruit scallops (<70 mm shell height).

Results from the second experiment, which compared a 12 inch square twine top with an 8 inch diamond, demonstrated drastic differences between the two dredge configurations. Bycatch of a majority of species was reduced by the use of a 12 inch square mesh. Again, high between tow variability contributed to the lack of statistical significance for yellowtail flounder in experiment #2. Analysis of other commercially important finfish species demonstrated substantial reductions in catch in the experimental dredge. Sea scallops were also significantly reduced in the experimental dredge. It must be noted, however, that scallop abundance in the open area was very low relative to that found inside the closed area. Results from experiment #2 relative to scallops may not be representative of what may be encountered within the boundary of the Closed Area.

Differing combinations of twine top dimensions and orientation may indeed produce an effective means to finfish bycatch reduction. Finding the correct configuration that maximizes finfish escapement and scallop capture efficiency will require additional experimentation.

Literature cited

Cooper, C. G. 1995. pers. comm.

DuPaul, W.D., J.C. Brust, and J.E. Kirkley. 1995. Bycatch in the United States and Canadian Sea Scallop Fishery. *In*: Solving Bycatch: Considerations for Today and Tomorrow. Seattle, Washington.

Henriksen, S., E. Welch, S. Therrien, R. Smolowitz, P.J. Struhsaker, C. Goudey, and H. Kite-Powell. 1997. Results of gear modification tests to reduce bycatches of commercial finfish in sea scallop dredges. SER Enterprises contract report to NOAA for Award No. NA66FD0026.

Figure 1 Summary of finfish and invertebrate bycatch aboard the F/V Thor in Closed Area II during September/October 1998. The comparison was made between an 8" twine top hung on the square on the port dredge versus an 8" twine top hung on the diamond on the starboard dredge. A total of 224 tows with 36.56 hours of towsing time were analyzed.

	8" square	8" diamond
Skates	6628	6744
Barndoor skates	39	29
Blackback flounder	450	469
Yellowtail flounder	874	780
American plaice	0	2
Grey sole	9	12
Summer flounder	29	14
4 spot flounder	147	175
Monkfish	160	173
Longhorn sculpin	516	530
Red hake	145	160
Silver hake	14	13
Windowpane flounder	518	656
Sea raven	56	60
Lobster	35	37
Pout	4	9
Herring	1	0
Red-banded sculpin	1	0
Spiny dogfish	1	3
Sea robin	3	2
Cunner	1	4
Cod	12	16
Haddock	5	0
Unidentified flatfish	2	1
Ballyhoo	0	1
Squid	2	1

Figure 2 Comparison of yellowtail flounder catches from the F/V Thor in Closed Area II during September/October 1998. The comparison was made between an 8" twine top hung on the square on the port dredge versus an 8" twine top hung on the diamond on the starboard dredge. A total of 224 tows with 36:56 hours of towing time were analyzed. Statistical differences were tested for with a paired t-test at the $\alpha=0.05$ level.

Yellowtail Flounder	8" square	8" diamond	Significant difference $\alpha=0.05$
total caught	874	780	
#/tow (all tows)	3.90	3.48	no ($p=0.233$)
#/hour towing time (all tows)	23.66	21.11	
#/tow (tows in which yellowtail were present)	7.94	7.09	no ($p=0.230$)
#/hour towing time (tows in which yellowtail were present)	48.08	42.91	

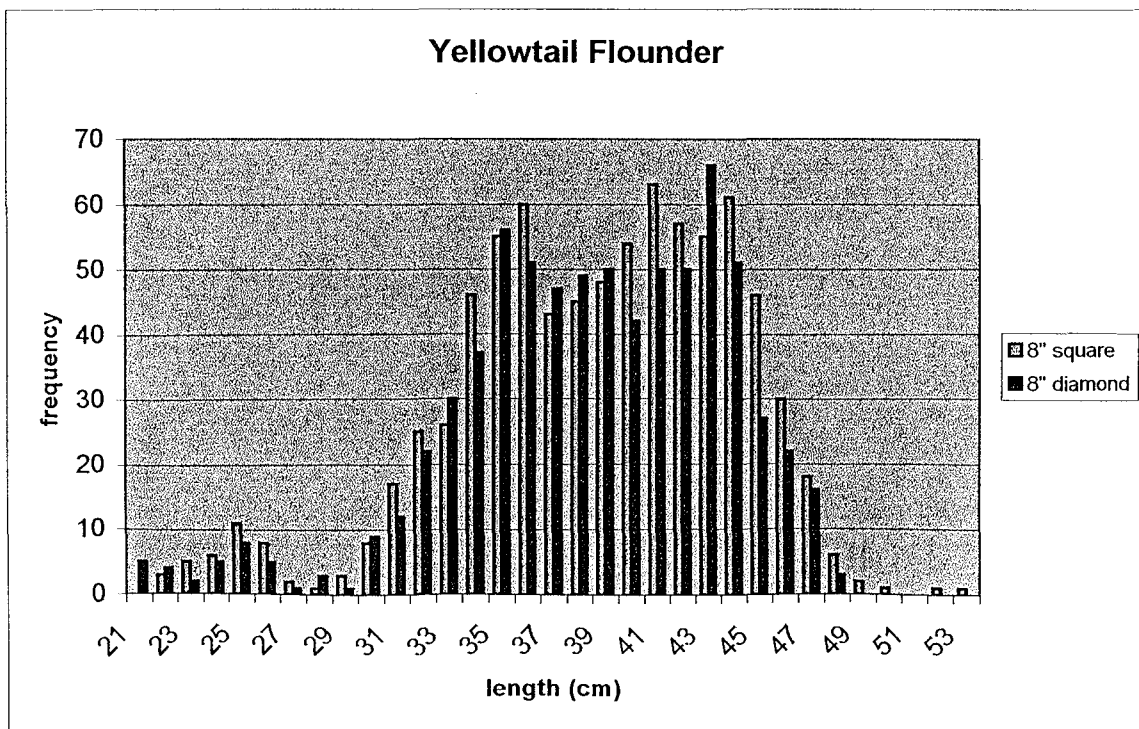


Figure 3 Comparison of blackback flounder catches from the F/V Thor in Closed Area II during September/October 1998. The comparison was made between an 8" twine top hung on the square on the port dredge versus an 8" twine top hung on the diamond on the starboard dredge. A total of 224 tows with 36:56 hours of tows were analyzed. Statistical differences were tested for with a paired t-test at the $\alpha=0.05$ level.

Blackback Flounder	8" square	8" diamond	Significant difference $\alpha=0.05$
total caught	450	469	
#/tow (all tows)	2.01	2.09	no (p=0.670)
#/hour tows time (all tows)	12.18	12.70	
#/tow (tows in which blackback were present)	3.10	3.23	no (p=0.671)
#/hour tows time (tows in which blackback were present)	18.82	19.62	

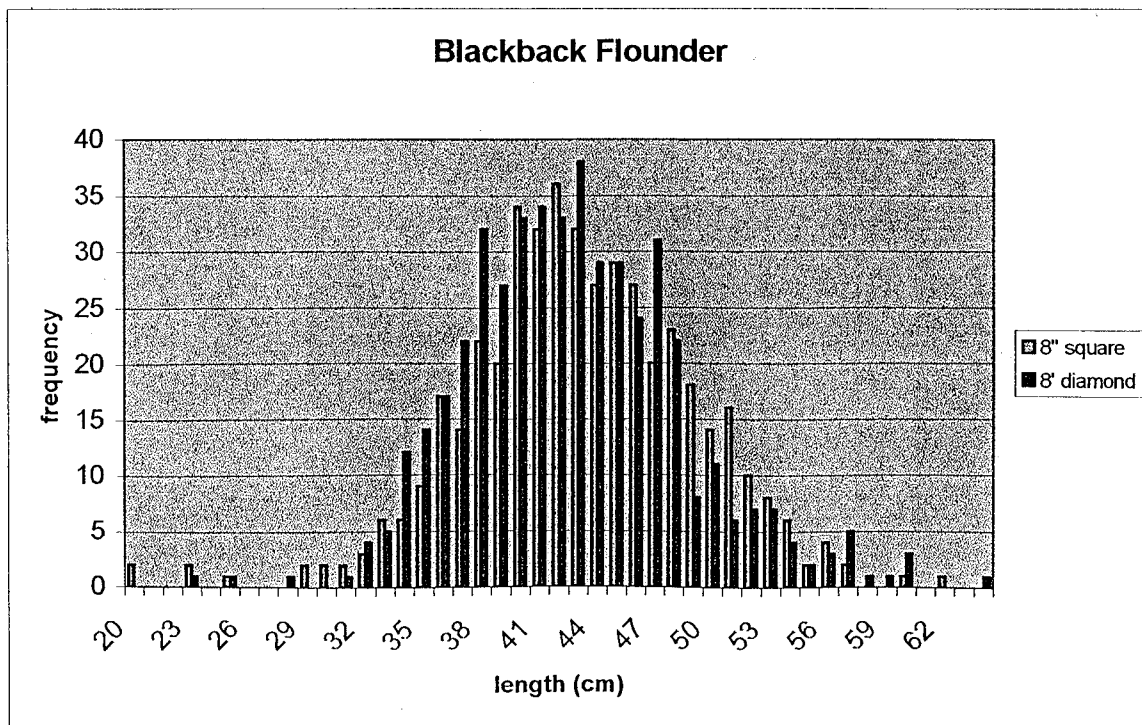


Figure 4 Comparison of windowpane flounder catches from the F/V Thor in Closed Area II during September/October 1998. The comparison was made between an 8" twine top hung on the square on the port dredge versus an 8" twine top hung on the diamond on the starboard dredge. A total of 224 tows with 36:56 hours of towing time were analyzed. Statistical differences were tested for with a paired t-test at the $\alpha=0.05$ level.

Windowpane Flounder	8" square	8" diamond	Significant difference $\alpha=0.05$
total caught	518	656	
#/tow (all tows)	2.31	2.93	yes ($p=0.000$)
#/hour towing time (all tows)	14.02	17.76	
#/tow (tows in which windowpane were present)	4.21	5.33	yes ($p=0.000$)
#/hour towing time (tows in which windowpane were present)	24.76	31.36	

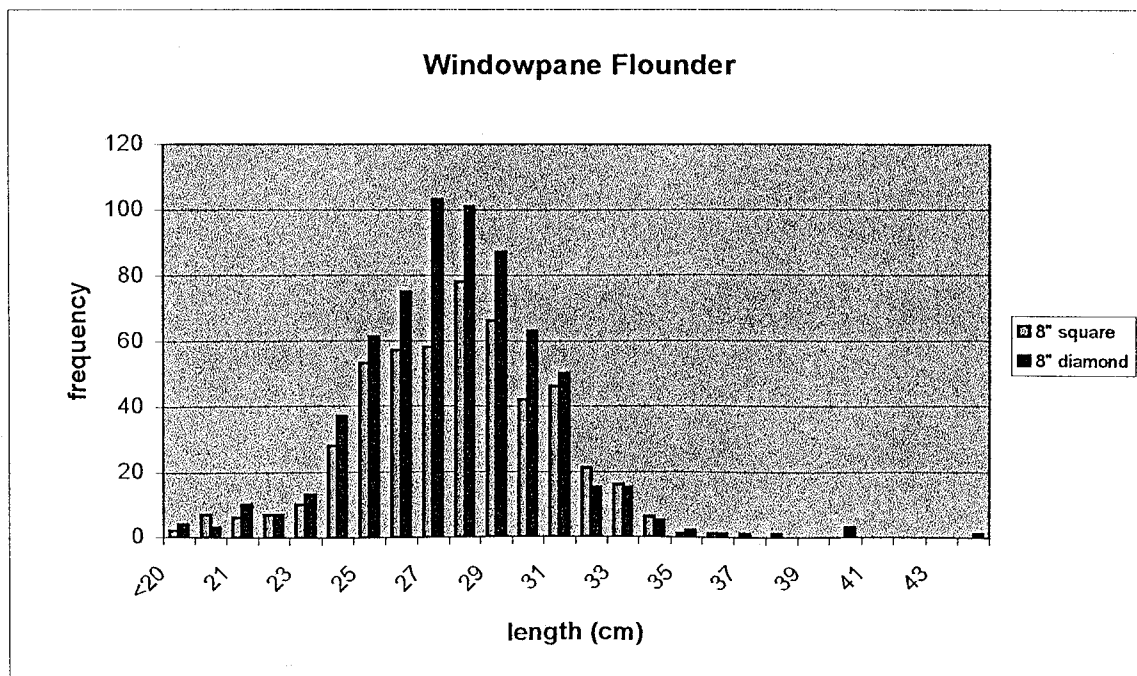


Figure 5 Comparison of monkfish catches from the F/V Thor in Closed Area II during September/October 1998. The comparison was made between an 8" twine top hung on the square on the port dredge versus an 8" twine top hung on the diamond on the starboard dredge. A total of 224 tows with 36:56 hours of tows time were analyzed. Statistical differences were tested for with a paired t-test at the $\alpha=0.05$ level.

Monkfish	8" square	8" diamond	Significant difference $\alpha=0.05$
total caught	160	173	
#/tow (all tows)	0.72	0.78	no ($p=0.503$)
#/hour tows time (all tows)	4.33	4.68	
#/tow (tows in which monkfish were present)	1.26	1.36	no ($p=0.504$)
#/hour tows time (tows in which monkfish were present)	7.64	8.27	

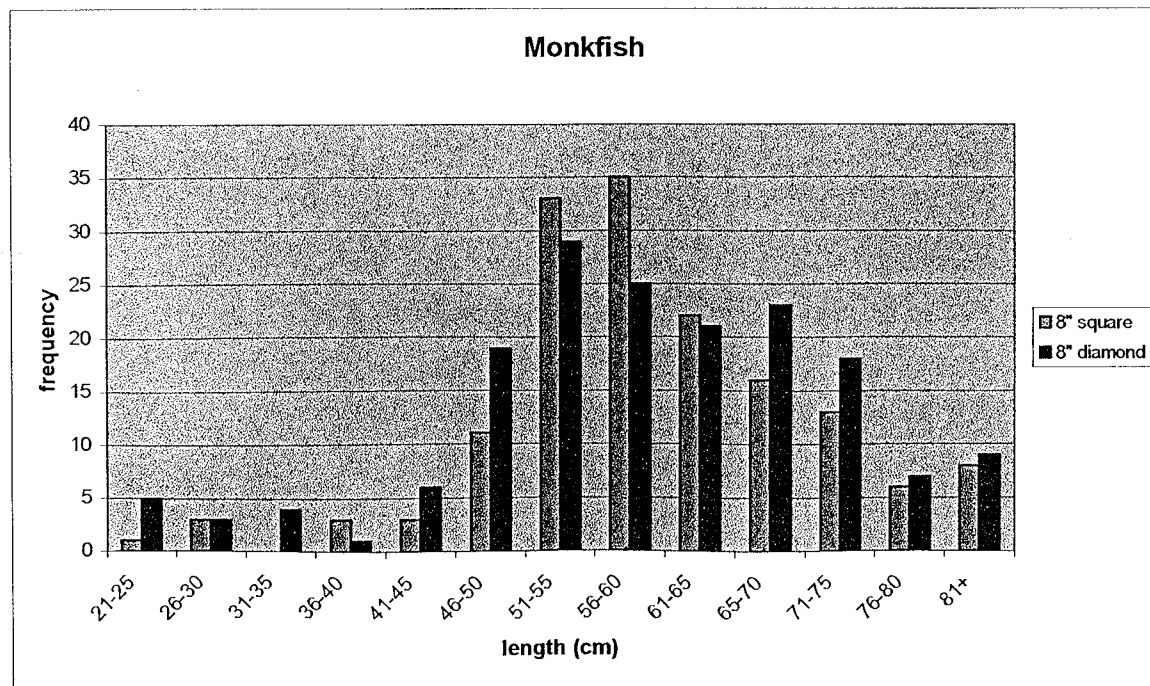


Figure 6 Comparison of barndoor skate catches from the F/V Thor in Closed Area II during September/October 1998. The comparison was made between an 8" twine top hung on the square on the port dredge versus an 8" twine top hung on the diamond on the starboard dredge. A total of 224 tows with 36.56 hours of towsing time were analyzed. Statistical differences were tested for with a paired t-test at the $\alpha=0.05$ level.

Barndoor Skates	8" square	8" diamond	Significant difference $\alpha=0.05$
total caught	39	29	
#/tow (all tows)	0.17	0.12	no ($p=0.239$)
#/hour towsing time (all tows)	1.06	0.79	
#/tow (tows in which barndoor were present)	0.69	0.52	no ($p=0.289$)
#/hour towsing time (tows in which barndoor were present)	4.19	3.12	

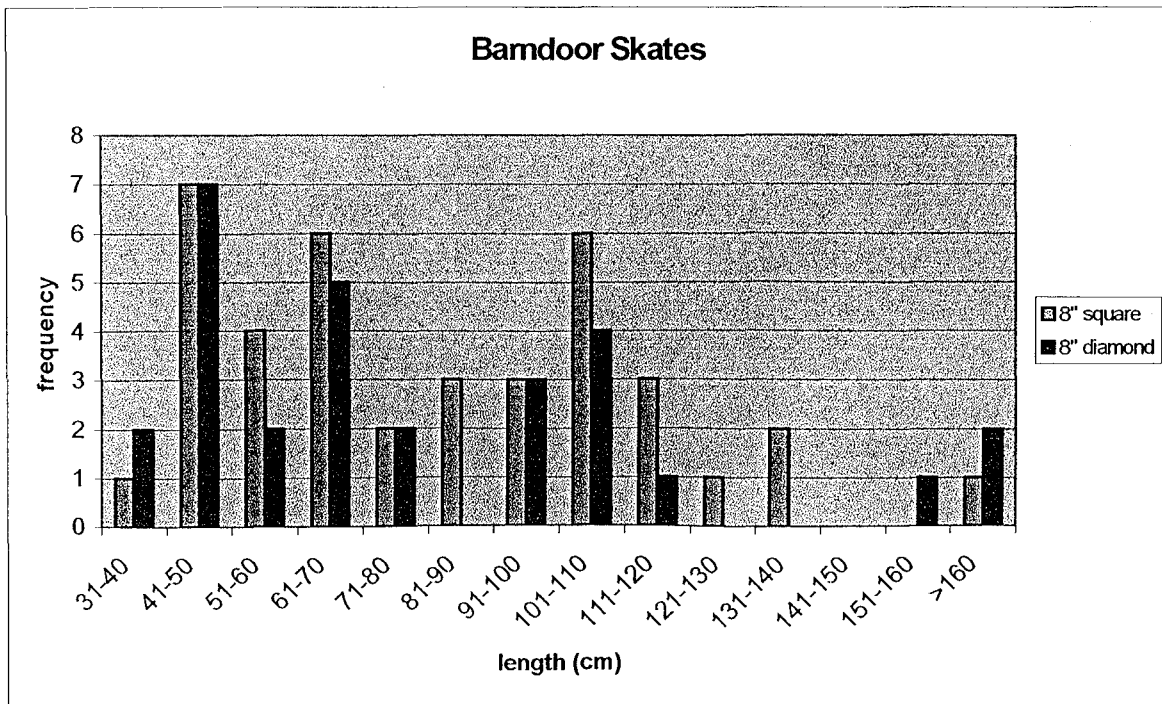


Figure 7 Comparison of sea scallop catches from the F/V Thor in Closed Area II during September/October 1998. The comparison was made between an 8" twine top hung on the square on the port dredge versus an 8" twine top hung on the diamond on the starboard dredge. A total of 224 tows with 36.56 hours of towsing time were analyzed. Statistical differences were tested with a paired t-test at the $\alpha=0.05$ level.

Sea Scallops	total caught	#/tow	Significant difference $\alpha=0.05$
8" square all scallops	74087.5	425.8	no (p=0.769)
8" diamond all scallops	75476.0	433.8	
8" square scallops >70 mm	73286.5	421.2	no (p=0.774)
8" diamond scallops >70 mm	74640.87	428.9	

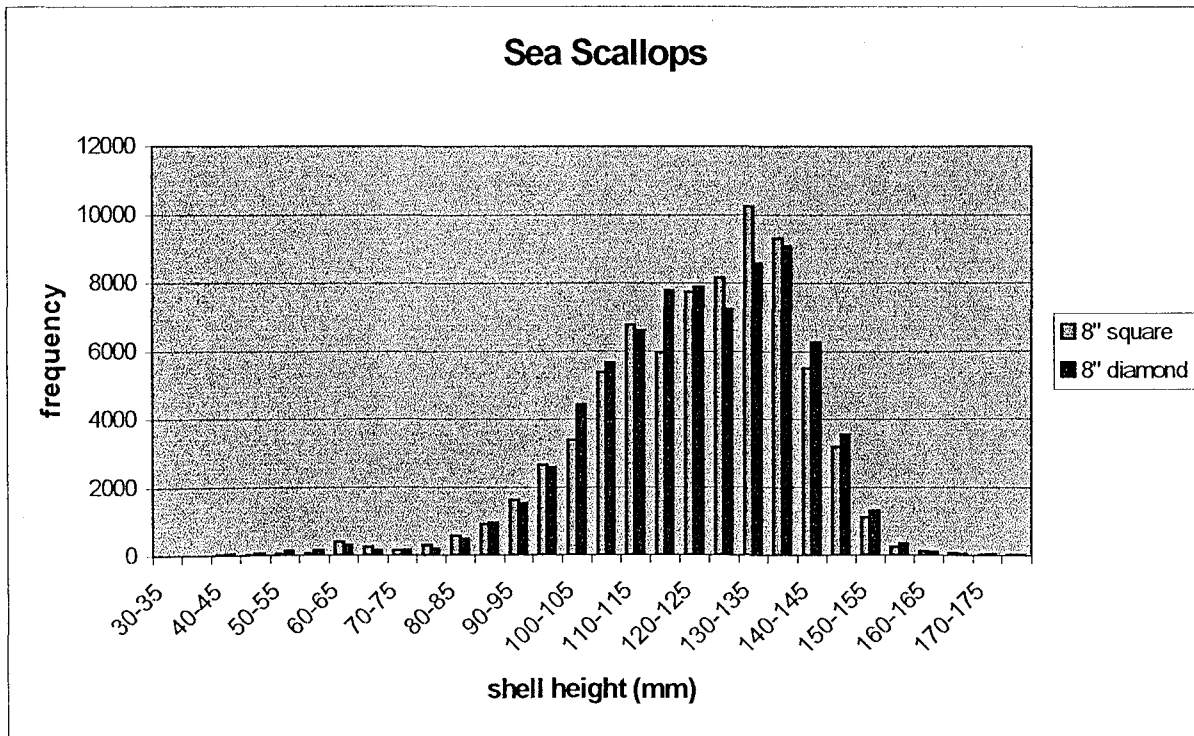


Figure 8 Summary of finfish and invertebrate bycatch aboard the F/V Thor in the open area adjacent to Closed Area II during September/October 1998. The comparison was being made between an 12" twine top hung on the square on the port dredge versus an 8" twine top hung on the diamond on the starboard dredge. A total of 34 tows with 9:22 hours of towing time were analyzed.

	12" square	8" diamond
Skates	983	1524
Barndoor skates	3	2
Blackback flounder	165	475
Yellowtail flounder	118	219
American plaice	1	5
Grey sole	1	1
4 spot flounder	27	55
Monkfish	72	145
Longhorn sculpin	38	74
Red hake	16	15
Silver hake	3	4
Windowpane flounder	28	77
Sea raven	4	16
Lobster	3	2
Pout	0	2
Ballyhoo	0	2
Squid	0	2
Octopus	0	1

Figure 9 Comparison of yellowtail flounder catches from the F/V Thor in the open area adjacent to Closed Area II during September/October 1998. The comparison was made between an 12" twine top hung on the square on the port dredge versus an 8" twine top hung on the diamond on the starboard dredge. A total of 34 tows with 9:22 hours of tows were analyzed. Statistical differences were tested for with a paired t-test at the $\alpha=0.05$ level.

Yellowtail Flounder	12" square	8" diamond	Significant difference $\alpha=0.05$
total caught	118	219	
#/tow (all tows)	3.47	6.44	no (p=0.082)
#/hour tows time (all tows)	12.59	23.37	
#/tow (tows in which yellowtail were present)	5.13	9.52	no (p=0.082)
#/hour tows time (tows in which yellowtail were present)	15.67	29.08	

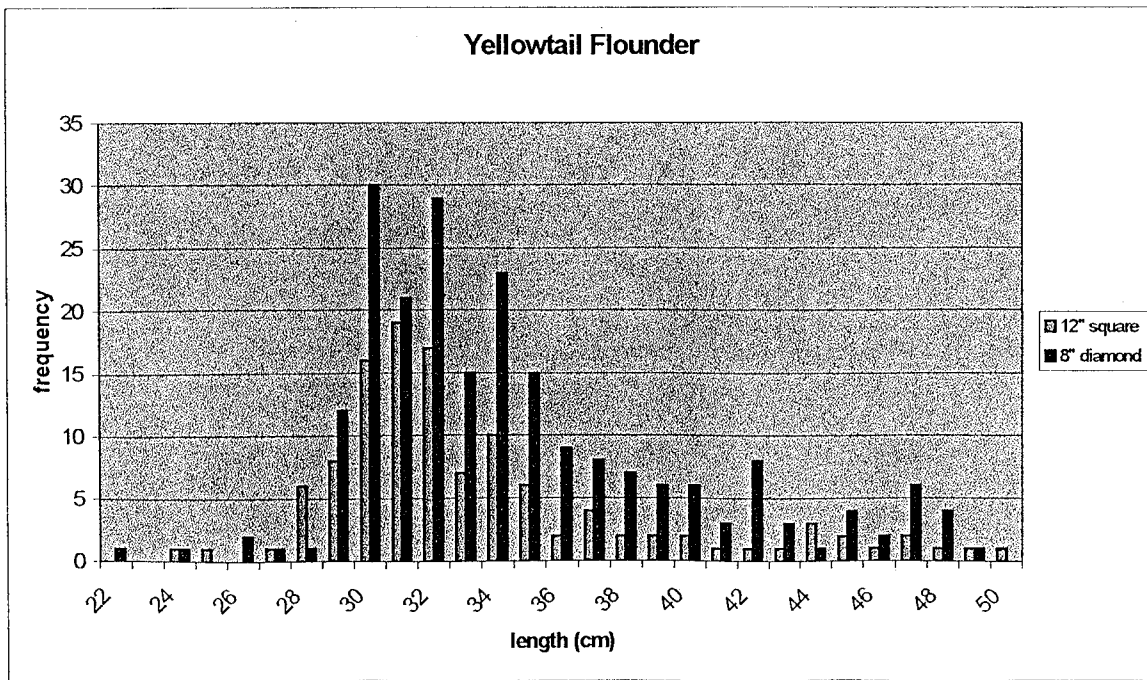


Figure 10 Comparison of blackback flounder catches from the F/V Thor in the open area adjacent to Closed Area II during September/October 1998. The comparison was made between an 12" twine top hung on the square on the port dredge versus an 8" twine top hung on the diamond on the starboard dredge. A total of 34 tows with 9:22 hours of towing time were analyzed. Statistical differences were tested for with a paired t-test at the $\alpha=0.05$ level.

Blackback Flounder	12" square	8" diamond	Significant difference $\alpha=0.05$
total caught	165	475	
#/tow (all tows)	4.85	13.97	yes (p=0.004)
#/hour towing time (all tows)	17.61	50.71	
#/tow (tows in which blackback were present)	13.75	39.58	yes (p=0.001)
#/hour towing time (tows in which blackback were present)	55.0	158.33	

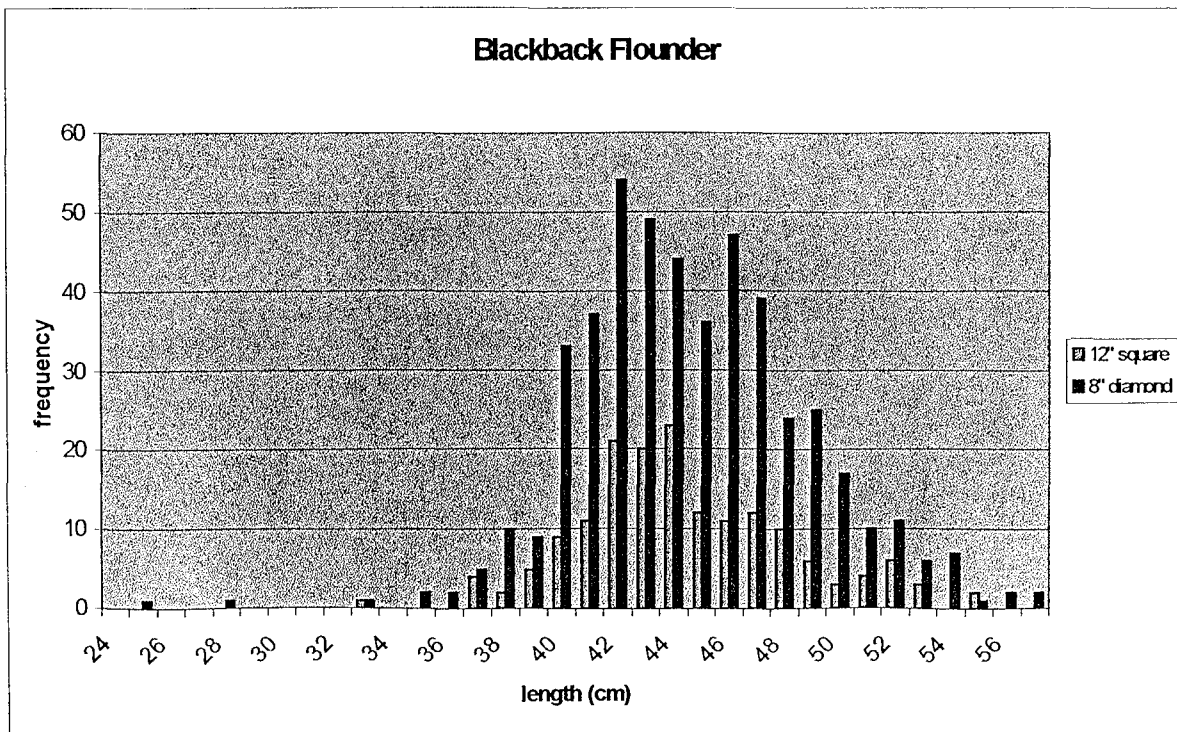


Figure 11 Comparison of windowpane flounder catches from the F/V Thor in the open area adjacent to Closed Area II during September/October 1998. The comparison was made between an 8" twine top hung on the square on the port dredge versus a 12" twine top hung on the diamond on the starboard dredge. A total of 34 tows with 9.22 hours of towing time were analyzed. Statistical differences were tested for with a paired t-test at the $\alpha=0.05$ level.

Windowpane Flounder	12" square	8" diamond	Significant difference $\alpha=0.05$
total caught	28	77	
#/tow (all tows)	0.82	2.26	yes ($p=0.003$)
#/hour towing time (all tows)	2.98	8.21	
#/tow (tows in which windowpane were present)	2.15	5.92	yes ($p=0.001$)
#/hour towing time (tows in which windowpane were present)	10.44	28.73	

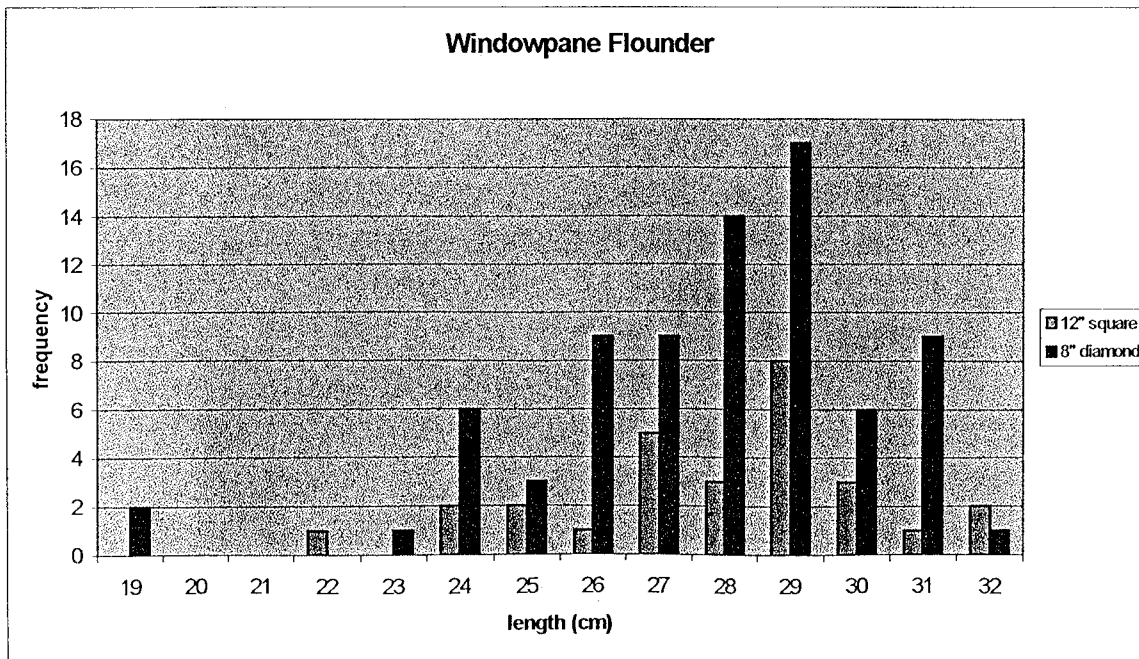


Figure 12 Comparison of monkfish catches from the F/V Thor in the open area adjacent to Closed Area II during September/October 1998. The comparison was made between an 8" twine top hung on the square on the port dredge versus an 8" twine top hung on the diamond on the starboard dredge. A total of 34 tows with 9:22 hours of towing time were analyzed. Statistical differences were tested for with a paired t-test at the $\alpha=0.05$ level.

Monkfish	12" square	8" diamond	Significant difference $\alpha=0.05$
total caught	72	145	
#/tow (all tows)	2.11	4.26	yes ($p=0.041$)
#/hour towing time (all tows)	7.68	15.48	
#/tow (tows in which monkfish were present)	2.88	5.80	yes ($p=0.040$)
#/ hour towing time (tows in which monkfish were present)	9.14	18.42	

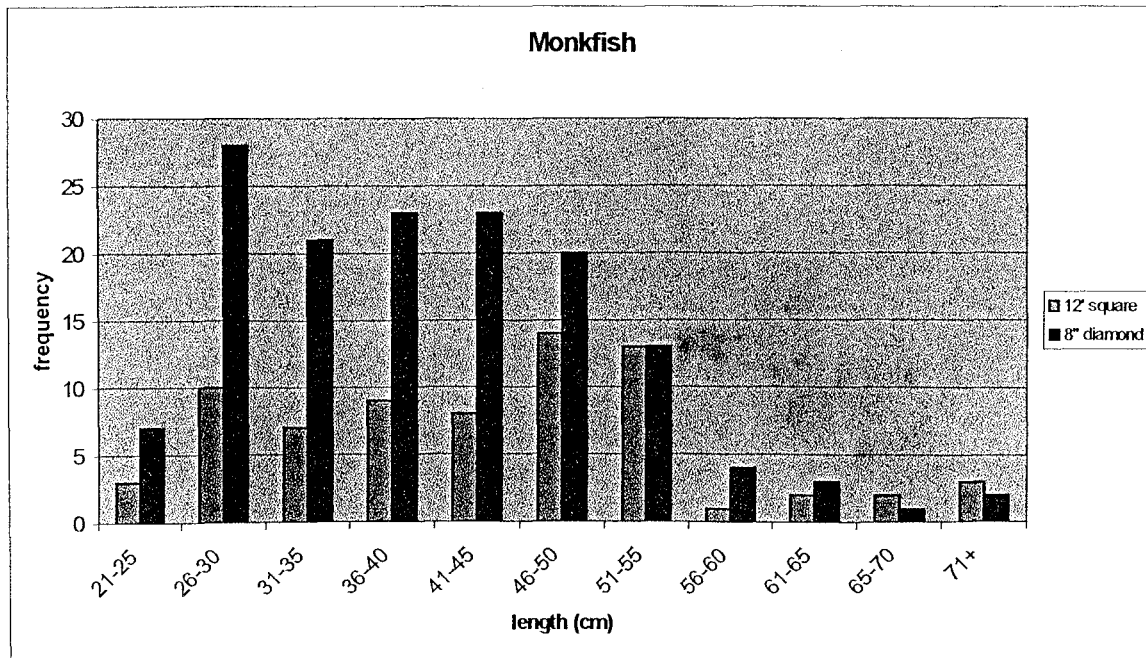


Figure 13 Comparison of sea scallop catches from the F/V Thor in the open area adjacent to Closed Area II during September/October 1998. The comparison was made between an 12" twine top hung on the square on the port dredge versus an 8" twine top hung on the diamond on the starboard dredge. A total of 34 tows with 9:22 hours of tows were analyzed. Statistical differences were tested for with a paired t-test at the $\alpha=0.05$ level.

Sea Scallops	total caught	#/tow	Significant difference $\alpha=0.05$
12" square (all scallops)	2248.9	66.1	yes (p=0.000)
8" diamond (all scallops)	2911.8	85.6	
12" square (scallops >70 mm)	2190.9	69.6	yes (p=0.000)
8" diamond (scallops >70 mm)	2820.8	82.9	

