

Developing an Improved Dredge for Standardized Surveys of the Sea Scallop Resource

Final Report

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Executive Summary

The project's objective was to design and conduct preliminary testing of an eight foot wide scallop survey dredge to be used by NMFS and others for assessing the sea scallop resource and associated species. The design and testing procedures were developed as a part of the Sea Scallop Advisory Panel (SSAP) process. The project has been performed in two phases. The first phase, the design and fabrication of a prototype survey dredge and bag, utilized expert opinion of fishermen and scientists to suggest improvements to the gear. The prototype gear was tested and tuned on two fishing trips on a commercial vessel; F/V Celtic. A third trip, the second phase, was completed on the F/V Celtic which tested the sensitivity of the new dredge to changes in speed and towing wire scope. On December 20, 2008 there was a meeting of the SSAP where all the survey work of this year was reviewed. Several suggestions came out of the meeting including a recommendation for some additional field testing. A fourth trip to test the impact of the turtle/rock chain configuration was conducted in April, 2008.

In general, the new dredge uses the basic frame/bale design as the old survey dredge but with the addition of bale wheels and an attachment plate for turtle chains. There were several changes to the bag design, twine top, and the introduction of a turtle/rock chain mat. The changes were made to have the dredge fish more consistent than the previous design. The initial testing indicates that the dredge fishes with comparable efficiency, species, and size selectivity of the older design but that the turtle/rock chains may be problematic regarding consistency in fishing. Much more extensive testing needs to be conducted over the range of habitats in the sampled stratum.

Status of Project Goals and Objectives

Task: To design and construct a survey dredge that can fish in a consistent manner, with minimum wear and risk of damage, over varied seabeds and in areas with different scallop densities. The dredge needs to be easy to maintain and duplicate.

Status: The survey dredge has been designed and tested in the Mid-Atlantic scallop grounds and all indications are that it will meet the target objectives of easy maintenance and consistent operation. Testing suggests that the bale wheel should be moved to raise the bale height in order to improve the consistency of operation.

Task: To develop operational procedures that will optimize the catch of the desired species and size ranges.

Status: We tested two different speeds (3.8 and 4.5 knots) and two different scopes (3:1 and 4:1) after a preliminary review of a wider range of speeds and scope. The dredge seems to be more efficient at the slower speed and more stable at the higher scope. There is no indication that size selectivity of scallops changes under these test conditions. Moving the bale wheel to raise the bale may improve the catch efficiency at the higher scope thus better achieving our objectives.

Task: To conduct a statistically significant number of tows to evaluate the gear and operational procedure.

Status: The number of tows conducted has yielded statistically significant results for the limited conditions we chose for testing under the time constraints of this project. One parameter we did extensively test, that the SSAP thought would be important, was the impact of the turtle/rock chain mat on catch. The use of these chains may be problematic.

Task: To document electronically detailed drawings of the final dredge design.

Status: CAD drawings have been completed.

Introduction

During recent years, management demands for better fishery independent scallop survey data have been increasing and there has been more survey activity, partially supported by Research Set-Asides (RSA) and/or cooperative industry funding. New technology has also become available that could augment, expand, or replace portions of surveys that are now conducted. The activation of NMFS new research vessel, the R/V Bigelow, in 2008 initiated a re-examination of the present lined-dredge survey and possible modifications to produce more timely and precise data to support area rotation scallop management.

The Northeast Fisheries Science Center (NEFSC) scallop dredge survey has provided critical information for the assessment and management of sea scallops for over 25 years. Over the past decade, it has been one of the primary sources of information on the efficacy of rotational areas as a management tool. More recently it has served as a basis for the development and evaluation of area-based management policies. In addition, cooperative industry data from SMAST and VIMS have been very instrumental for setting more precise area-specific TACs and for estimating swept-area abundance from dredge survey number per tow indices. Many new technologies are now sufficiently developed to allow routine implementation during surveys. Based on the economic value and the ecosystem effects of the fishery, and the importance of benthic habitat monitoring, it is appropriate that the Councils and the NEFSC begin a comprehensive review of the scallop survey as it relates to other sources of information and the timing of available survey results vs. the demand for those results for adaptive management. To this end, the Council has formed a Scallop Survey Advisory Panel (SSAP).

The original purpose of the SSAP was to provide advice on the conduct of fishery independent scallop surveys by federal, state, and cooperative research enterprises, considering the management demands and the availability of fishery dependent data which is incorporated into assessments and management analyses. Subjects and issues for the SSAP consideration were raised by fishery management Councils, fishery stakeholders, non-governmental scientific organizations or the Northeast Fisheries Science Center. Advice generated by the SSAP will be directed to the New England and Mid-Atlantic Fishery Management Councils and the NEFSC. The original leadership on the SSAP consists of Ronald Smolowitz as Chair and Jim Kendall as Vice Chair. Changes have been made to the original membership and terms of reference of the SSAP but not in time to impact this research project.

The new SSAP may in the future review the design, timing, and analysis of the NMFS scallop survey program and its integration with cooperative industry, state, or academic surveys, and its integration with other sources of fishery independent data with the goal of providing to the NEFMC timely resource assessments. A key component of this process is to examine the existing scallop survey gear and make needed improvements. There have been concerns that the survey dredge has not been rigged properly during surveys. The fishing industry has provided a number of suggestions for gear and operational changes that this project evaluated by testing. This project, a partnership of government, academia and industry, worked to modify and optimize the survey dredge and provide the results to the SSAP.

Methods

Project Management:

The engineering PI on this project is Ronald Smolowitz of Coonamessett Farm. Besides being Chair of the original Scallop Survey Advisory Panel, he designed the scallop survey dredge currently in use by NMFS. The scientific PI on this project is Bill Dupaul of the VIMS. Both researchers have extensive experience in conducting comparison fishing experiments and scallop surveys. The two PI's worked closely with SSAP and industry members that have years of scallop fishing experience which include Jim Kendall, Gabe Miranda, Ronnie Shrader, Eddie Welch, and Charlie Quinn. SSAP members from NMFS NEFSC, Vic Nordahl and Dvora Hart, collaborated on the project providing survey and data analysis expertise. The method for identifying project goals and objectives was a series of three SSAP meetings which will be summarized in this report.

Design Procedure:

The first step in the design process was to host several meetings of the SSAP and other interested parties to discuss the survey process in general and what options should be tested. The first meeting of the SSAP took place on March 2, 2007 and the meeting is summarized in the results section. A second meeting, on June 28, 2007, identified a number of areas for design improvement. These include the use of a wheel on the bale, changes in shoe design, pressure plate size, twine top configuration, hanging of the sweep chain, and re-hanging of the bag. The group was able to reach a consensus on a dredge design for testing and identified issues where testing was needed to obtain more information.

The second step in the design procedure was to actually construct the new dredge and bag. Under the lead of Vic Nordahl and Charlie Quinn, the NMFS survey dredge frame underwent several modifications. The scallop bag and twine top also underwent numerous rigging changes until a final design was achieved which met with overall approval by the project participants.

Field Testing:

The completed prototype dredge was tested against the old survey dredge on the F/V Celtic on two trips; Celtic 2007-3 (55 comparisons) and Celtic 2007-4 (45 comparisons). A third trip, Celtic 2007-5 (53 comparisons), compared two scopes and two speeds for impacts on catch. A fourth trip, Celtic 2008-1 (88 comparisons), compared new dredges with and without the chain mat.

During this project, on all tows the entire scallop catch was counted in bushel baskets and, in most cases, a minimum of a one basket sub-sample measured in 5 mm increments. The fish catch was counted and measured, in one cm increments, by species. The catch of benthos was sampled following standard NMFS survey protocols. All scallops and all fish were returned to the sea. Sub-sampling on some of the very large tows, that contained many seed scallops and benthos, was problematic. The data was examined with and without those tows in the analyses.

Project Funding:

Four compensation trips, to pay for the research, were completed as follows:

Date	Vessel	Poundage	Project Income
4/4/07	F/V Westport	21,689	\$31,586.14
4/18/07	F/V Celtic	21,337	\$33,747.82
5/1/07	F/V Diligence	21,654	\$31,791.86
8/30/2007	F/V Friendship	21,600	\$25,865.32
	Total:		\$122,991.14

In a related study, the final design of the survey dredge developed by this project and approved by the SSAP was used as one of the survey dredges in a parallel project lead by VIMS (DuPaul, Rudders and Smolowitz). In that project, two survey dredges were used in a shadow survey with the NMFS annual scallop survey. One dredge was the NMFS standard survey dredge and the other was the modified survey dredge as tested in this project. Those preliminary results were also evaluated at the December 20, 2007 meeting of the SSAP.

Results

This section will report on the results of the four F/V Celtic trips to test the new dredge design. Unless otherwise noted in this section, the new dredge changes consisted of the modifications explained below.

The following list identifies the changes:

1. Modifications to the ring bag:

- Rings [2" by 5/16"] and links [5/16"] remained unchanged.
- Bottom Ring Bag changed to 16 by 32 (across); it was 15 x 32.
- Diamonds remained the same.
- Hanging rings off bail replaced with a 3 x 32 skirt of rings to hang twine top.
- Apron remained 18 by 32.
- Extensions (side pieces) widened from 3 by 17 to 6 by 17.
- Three ring diamond, in corner of the extension and the skirt, was added.

Functionally, the extensions were widened and stepped down from the skirt in a more simplistic way. Everything hangs better off the frame than it did before. The sweep was connected with varying sizes of ¼ inch dog chain. This allows for a more flowing attachment.

2. Change of twine top:

The old 4.5- inch nylon twine top was replaced with double twine poly-ethylene 12 cm mesh and hung with a more appropriate number of meshes (53 by 12.5 meshes). Hanging is by two meshes per ring on skirt and knotted in place with ½ inch nylon rope.

3. Turtle/rock chain mat added to be used over entire sampling area.

- Fabricated out of 3/8 inch case hardened normal link chain.
- 7 up and downs and 4 ticklers
- Shackled to frame on new mounting bracket welded to aft side of cutting bar.
- Chains connected at each crossing with 5/16 scallop links; shackled to sweep.
- Chain spacing fairly uniform; all under 14-inch x 14-inch regulations.

4. Wheel attachment:

We recycled 16-inch rollers from the Yankee 36 trawl as a set of wheels on the bale gooseneck of dredge. Set up in commercial fashion with removable pin.

5. New mounting bracket for inclinometers:

A new pipe type mounting bracket was installed to protect inclinometer during dredge operations.

The new dredge frame was constructed and was outfitted with the new bag. Hans Bendiksen, a fishing gear specialist who has certification in computer assisted design (CAD), worked on a set of drawings of the dredge as it evolved. The CAD program will also be used to make design choices in the future using structural and hydrodynamic analytical programs.

F/V Celtic Trip 2007-3:

This trip commenced on May 14, 2007 and returned on May 18, 2007. A total of 55 tow pairs were completed; 53 were able to be used in the analysis. The area towed extended from south of Block island to the Hudson Canyon and was mostly sand bottom. The Bridge Data Log can be found in Appendix Table 1. The purpose of this trip was to examine the impact of turtle/rock chains and wheels on the new dredge compared to the standard dredge. The catch data can be found in Appendix 2; scallop length frequencies in Appendix 3. The statistical analyses can also be found in the Appendices.

The first set of twelve tows compared the new dredge, with bale wheels and turtle/rock chains, to the standard survey dredge that had no chains or wheels. The scallop catch was the same in both gears. On certain bottom, with lots of shell, the new dredge tended to catch less “trash”, 39.7% less, consisting primarily of empty shells. The new dredge did catch more skates and monkfish but further testing would be required to determine significance since our tow numbers and catch were low. The new dredge may have caught more of the smaller sized scallops, 35-60 mm, than the standard dredge.

The second set of ten tows, 13-22, compared the new dredge, with chains but no wheels, against the standard dredge. In this series of tows the new dredge caught 19.4% more scallops than the standard dredge. The new dredge still tended to catch less “trash” (27.7%) where shell was the most common component. Skate catch was about the same.

The third series of ten tows, 23-32, compared the new dredge, outfitted with chains, with and without wheels. The dredges seemed to fish the same except for one tow, #26, where the dredge without the wheels caught more of the larger sized scallops and also more skates. There were no statistical differences in catch components.

The fourth series of thirteen tows, 33-45, had the standard dredge moved to the port side of the vessel and compared it with the new dredge that had wheels and chains as in the first tow series. These tows were conducted in a bottom that had significant catches of sand dollars. The scallop and skate catch was about the same but the new dredge caught statistically more sand dollars and fourspot flounder (86%).

The last series of ten tows, 46-55, again had the standard dredge on the port side and compared it to the new dredge which had wheels but no chains. Again, the scallop and skate catch was about the same but the new dredge tended to catch more trash (70%) and fourspot flounder.

Overall, when all the data is grouped, the new dredge fishes the same with the exception of trash (64% more benthos) and fourspot flounder (56.4%).

F/V Celtic Trip 2007-4:

This trip commenced on June 11, 2007 and returned on June 14, 2007. A total of 45 tow pairs were completed; 43 were able to be used in the analysis. The area towed extended from south of Block island to the Hudson Canyon and was mostly sand bottom. The Bridge Data Log can be found in Appendix Table 1. The purpose of this trip was to examine the need for a liner and to choose a twine top mesh size. The catch data can be found in Appendix 2.

The first series of fifteen tows, 56-70, compared the new dredge, with a 4.5-inch twine top, with and without a liner. The dredge without the liner caught more scallops overall; primarily in the size ranges above 80 mm. The lined dredge caught more of the smaller size classes; between 35-70 mm (Appendix Table 3). The lined dredge may have caught more trash (18.3%) and fewer skates (27.3% less).

The second series of ten tows, 71-80, switched the dredges between vessel sides. Again the unlined dredge caught more of the larger size scallops (>70 mm) but lost most of the smaller scallops below 65 mm (Table 1). The lined dredge caught more trash (118.6%) and fourspot flounder.

The third series of ten tows, 81-91, compared the new dredge with no liner and a 6-inch twine top to a new dredge with a liner and a 4.5-inch twine top. The unlined dredge with the larger twine top caught few small scallops and many larger scallops than the lined dredge. The trash catch in the lined dredge was about three times that of the unlined dredge but skate catch was about the same.

The last series of ten tows, 92-101, repeated the previous test but with the dredges switched. The results were similar to the previous test.

Table 1: Scallop Length Frequency Data F/V Celtic 2007-4

	liner/4.5"			no liner/4.5"		
Tow numbers	56-70	71-80	Sum	56-70	71-80	Sum
Shell Height (mm)						
25-29	0	4	4	0	0	0
30-34	1	18	19	1	0	1
35-39	5	93	98	1	0	1
40-44	7	277	284	4	5	9
45-49	27	416	443	4	6	10
50-54	34	426	460	20	28	48
55-59	47	319	366	36	24	60
60-64	41	115	156	15	35	50
65-69	20	59	79	11	36	47
70-74	7	61	68	9	81	90
75-79	9	167	176	3	175	178
80-84	8	178	186	13	221	234
85-89	8	281	289	28	269	297
90-94	18	308	326	24	323	347
95-99	39	246	285	61	301	362
100-104	84	202	286	130	233	363
105-109	91	156	247	148	256	404
110-114	69	119	188	113	157	270
115-119	48	173	221	106	131	237
120-124	33	54	87	70	57	127
125-129	23	37	60	72	38	110
130-134	13	24	37	30	14	44
135-139	12	6	18	51	3	54
140-144	4	5	9	39	4	43
145-149	5	0	5	8	0	8
150-154	1	0	1	3	0	3
Total	648	3629	4277	998	2397	3395

F/V Celtic Trip 2007-5:

This trip commenced on October 16, 2007 and returned on October 21, 2007. A total of 53 tow pairs were completed; 52 were able to be used in the analysis. The area towed extended from south of Block island to the Hudson Canyon and was mostly sand bottom. The Bridge Data Log can be found in Appendix Table 1. The purpose of this trip was to examine the impact of towing speed and scope on catch. The catch data can be found in Appendix Table 2.

The first three tows had the new dredge, with an inclinometer and video camera, towed at various speeds (3-6 knots) and scopes (3:1 and 4:1) to examine bale elevation and dredge stability (The inclinometer plots can be found in the Appendices.) The remaining tows were conducted at either 3.8 knots or 4.5 knots. In each tow pair one dredge had a 3:1 scope and the other had 4:1 scope. The results, Table 2, show higher scallop catches at the 3.8 knot speed and shorter scope (14.1% more scallops by #). At 4.5 knots the shorter scope caught 18% more scallops by number and 14.7% more trash but the skate catch was 24.7% less. There does not seem to be a difference in the length frequency distribution of the smaller size classes of scallops but there is an indication

that more of the larger scallop size classes are caught with the shorter scope. No statistically significant differences were found when comparing 3.8 versus 4.5 knots at either scope. The statistical analysis can be found in the Appendices.

Table 2 Catch comparisons for F/V Celtic 2007-5

3.8 Knots	3:1							4:1						
Tow #	scallops bu	scallops #	Trash	skates	fourspot	YT	monk	scallops bu	scallops #	Trash	skates	fourspot	YT	monk
Totals	13.2	2722	187.5	298	218	7	11	11.95	2399	194.5	348	253	7	15
Avg	0.60	123.73	8.52	13.55	9.91	0.32	0.50	0.54	109.05	8.84	15.82	11.50	0.32	0.68
4.5 Knots	3:1							4:1						
Totals	10.7	2150	216.5	257	208	13	14	8.85	1831	185	326	225	14	20
Avg	0.49	97.73	9.84	11.68	9.45	0.59	0.64	0.40	83.23	8.41	14.82	10.23	0.64	0.91
Total Corr.	9	1815	183	217	176	11	12	7	1545	156	275	190	12	17
Swept area correction			0.844											
% 4.5 to 3.8	81%	79%	115%	86%	95%	186%	127%	74%	76%	95%	94%	89%	200%	133%

F/V Celtic Trip 2008-1:

This trip commenced on April 9, 2008 and returned on April 14, 2008. A total of 88 tow pairs were completed; all 88 were able to be used in the analysis. The area towed extended from south of Block island to the Elephant Trunk Area and was mostly sand bottom. The Bridge Data Log can be found in Appendix Table 1. The purpose of this trip was to examine the impact of the turtle/rock chain configuration on catch. The catch data can be found in Appendix Table 2.

The first set of paired tows, 1 thru 18, had 7 x 4 chains rigged on survey dredge #9 on the port side and survey dredge #12 without chains on starboard. The chain rigged dredge caught significantly fewer scallops, 22.9% less but caught 70.8% more fourspot flounder. The dredges then exchanged sides for tow pairs 19 thru 40 and had similar results; 31% less scallops, 24.2% less trash (benthos) but 33.7% more fourspot. When both data sets are combined, tows 1-40, the scallops in the chain rigged dredges were 29.8% less by bushels, 26.1% less by numbers, and trash was 22.5% less. Fourspot were 53.5 % higher with chains but no other fish species had significant enough numbers to demonstrate any difference between dredges.

For tows 41 to 81 we moved the chains to the other dredge and found similar results. The dredge with chains caught 18.0% less scallops when measured by bushels, 12.8% less by numbers, and 6.3% less trash. The chains caught 22.2% more fourspot. All the statistical results can be found in the Appendices. We conducted several different analyses to avoid bias due to the difficulty of sampling some of the large catches but there was no significant change in the results. When all tows, 1-81 are combined we have the chain dredge with 20.7% less scallop bushels, 15.5% less scallops by number, 17.1% less trash, and 31.2% more fourspot. We found no significant differences in catches of skate, grey sole, fluke, or monkfish. The catch of yellowtail flounder was very low.

Tows 82-88 tested a different chain configuration; 5 up and downs x 3 ticklers. We were having great difficulty dumping the large catches from the 7 x 4 chain rigged dredge. It was time consuming and dangerous. The 7 x 4 chains left openings in the chain mat that roughly measured 11-inches square. By reducing the number of chains we increased the openings to about 14-inches and made dumping a little easier. We only had 7 tow pairs and there was no significant difference between the 5 x 3 chains and the dredge with no chains.

During the trials we suspected that the type of trash component may have been impacting the outcome of the trials so we conducted a post-experiment analysis of the tows grouped by the major trash components. The first grouping was sand/mud and we only had three tow pairs in this category so there were no significant results.

The second group was sand dollars and we had 19 tow pairs where this was the primary benthos caught. There was an indication that these tows may average 10% less scallops with chains and there was significant 22.2% less sand dollars with the chains. The next grouping was sand dollars and sulfur sponge (aka, monkey dung). We only had 7 tow pairs in this category but there was a significant difference in scallop catch; the chains caught 61.8% less scallop bushels and 44.2% less scallops by numbers. The trash component was also 26.1% less with chains.

There were 14 tow pairs that were almost pure scallops. The chain equipped dredges caught 19.2% less scallop bushels and 13.5% less scallops by number. Since the trash component was low by definition there were no significant results. Starfish dominated 22 tow pairs and there was a lower scallop catch with the chains but it was not significant at the 0.05 level. Starfish was significantly less by 10% with chains. The last grouping was starfish and sand dollars; there was 11.7% less scallop bushels, 13.2% scallops by numbers, and 14.6% less starfish/sand dollars.

Discussion

The general consensus of the SSAP was that major changes were not needed to the standard NMFS survey dredge frame. The two changes that were made, that could potentially change the fishing characteristics of the dredge, were the addition of two bale wheels located at the nose of the dredge and the addition of a steel plate for the attachment of the rock/turtle chain mat. An inclinometer bracket was also installed on the frame but was not expected to impact fishing characteristics.

The bale wheels are now commonly found on commercial scallop dredges. Fishermen believe that these wheels aid the dredge in going over boulders. We opted for wheels because we felt it would allow the dredge to fish in a more consistent manner by preventing the nose of the dredge dropping too low. This could occur on uneven bottom, in heavy weather, and if too much towing wire (scope greater than desired) is set out from the vessel. The wheels were mounted on the survey dredge in a manner that did not lift the bale very much from the near horizontal position the dredge would normally take during a tow. The wheel axel could have been mounted below the bale, lifting the bale up higher, which probably would have altered the fishing characteristics of the dredge when compared to the standard survey dredge. In the present position it may help the dredge fish more consistently on occasion, but this can not be quantified with the limited testing available to this project.

The new chain plate is a flat steel piece welded to the back of the cutting bar. It contains holes for the attachment of the up and down chains of the chain mat. Initially the holes were spaced about 11-inches apart for the 7 x 4 chains. We found this spacing to be too small so new holes were made at 14 inch spacing for the 5 x 3 chains. The addition of the chain plate itself may alter the

fishing characteristics of the dredge as the plate tends to streamline the water flow over and behind the cutting bar. This flow streamlining was observed during flume tank tests but the actual impact on dredge efficiency and selectivity is unknown and probably very subtle.

There were a number of changes made to the dredge bag and how the bag was attached to the dredge frame. While these changes, in the eyes of the participating fishermen, made the dredge bag “look right”, there was no significant difference in efficiency and selectivity between the new dredge without chains and the existing survey dredge. Again, the limited testing of this project is not enough to fully calibrate any differences.

The next issue we examined was the need for a small mesh liner in the survey dredge. We believe the liner causes the dredge to fill up early in the tow, depending on the type of benthos present on the substrate (referred to as the trash component of the catch), thus altering the dredge efficiency. This was in fact verified; an unlined dredge is more efficient on retaining larger scallops. However, the losses of the pre-recruit sized scallops were very significant even with the two inch ring bag. The conclusion is that a liner is needed for the survey dredge.

We then went on to examine the sensitivity of the dredge to changes in towing speed and scope. We chose to test the existing survey parameters of 3.8 knot towing speed and 3:1 scope against increasing the speed to 4.5 knots and increasing the scope to 4:1. The dredge was found to fish best at the existing speed and scope based on catch. The dredge bale has a greater angle of attack in the tow direction at 3.8 knots and 3:1 scope thus the cutting bar is slightly higher off the bottom. However, if you examine the inclinometer data (see Appendices), the dredge seems to be more stable at the higher scope. Controlling speed seems to be more important than controlling scope with the new wheel equipped dredge as speed change had a greater impact on catch. Both speed and scope are easy to maintain at the desired levels so this should not be an issue relative to sampling consistency.

The last issue we examined was the impact of putting rock/turtle chains on the new dredge. NMFS has felt rock chains are needed in certain boulder-strewn strata on the western side of the Great south Channel and in recent years have performed surveys with chains. Protected species managers want the dredge to contain turtle chains, a chain mat with less than 14-inch openings, even though no turtles have been caught in the 30 year history of the NMFS scallop survey. Since the latter requirement would be for most of the survey strata we opted for a combined set of chains; 7 up and downs and 4 ticklers. The openings between the chains were 9-11 inches. It immediately became apparent that with the type of benthos caught in a lined survey dredge, dumping became a difficult procedure on many stations in our mid-Atlantic test area.

The biggest issue with chains, from a survey stand point, is that they added a great amount of inconsistency to the sampling. We found that the dredge when equipped with chains could be anywhere from 12% to 30% less efficient in catching scallops than the dredge without chains. We found the difference to be a function of the type and quantity of benthos encountered during the tow. Video observations show the chains can drag benthos and bulldoze substrate but we are not sure this is the mechanism that results in lower catch. Regardless, we do not think the goal of consistency can be achieved using a chain equipped survey dredge and recommend against the use of chains.

The project’s objective was to design and conduct preliminary testing of an eight foot wide scallop survey dredge to be used by NMFS and others for assessing the sea scallop resource and associated species. We achieved our objective and if the new dredge will be used for surveys, calibration studies need to be conducted over a range of scallop survey strata.

Appendix A: Scallop Survey Advisory Panel Meeting Summary Falmouth, MA , March 2, 2007

Participants:

Panel members: Mr. Ron Smolowitz (chair), Mr. Richard Taylor, Mr. Glen Nutting, Mr. Victor Nordahl, Dr. Dvora Hart, Mr. Andrew Applegate, Mr. Charles Quinn, Dr. Russell Brown, Mr. Brad Harris (substitute for Dr. Stokesbury), Mr. Dan Cohen

Council and NOAA Fisheries staff: Ms. Stacy Rowe, Ms. Erin Kupcha, Ms. Diana Cowan, Mr. Chris Pickett

Others: Mr. Dave Rudders. Mr. Ed Welch, Msr. Cate O'Keefe

Agenda items:

The panel met to review and further develop a draft discussion document, describing the current status of survey technology, issues related to future surveys, and recommendations. The panel was to be updated on recent progress on the prototype survey dredge and planned field testing later this summer. At the end of the meeting, the panel was to reconvene at the Pocasset warehouse to examine the most recent version of the prototype survey dredge.

Meeting summary

The meeting opened with a discussion on the panel's consensus that a scallop dredge would be a necessary component of future scallop surveys. NMFS scientists made a pitch for continuation of the dredge survey because of the 25 year time series used in the assessments and because the dredge allowed examination of samples at the surface, for example measurement of meat weight and gonad condition. SMAST scientists pointed out that the grid sampling design shelf-wide video survey has been conducted annually since 2003 and the results have been peer-reviewed and published. There are also plans to test new technologies for scallop surveys via experiments that shadow the dredge survey.

The panel then began discussing the types of information about marine resources that might be gathered during a scallop survey, using various existing and potential technologies. These technologies include a survey dredge, various types of video/camera devices, and sonar. The types of data that could be used to assess the scallop resource and the health of the ecosystem included scallop abundance, scallop meat weight and size frequency, scallop health and gonad condition, predation and species association, finfish abundance and size (particularly for species like monkfish, yellowtail flounder and skates that are often captured by the dredge), benthic characteristics (substrate and biota), and fishing effects.

The various sampling technologies lent themselves better to collecting certain types of data than others. The strengths of each type of sampling technology were outlined and will be included in a future revision of the draft discussion document.

One of the important considerations is sampling efficiency and cost. The panel reviewed the requirements and costs associated with dredge, drop camera, and towed camera survey technologies conducted on NMFS, UNOLS, and/or commercial scallop vessels for conducting broad-scale, shelf-wide surveys and for conducting surveys targeting specific areas, like the Elephant Trunk Area. Panelists agreed that there was a tradeoff between the amount and types of

data that may be collected on various platforms and costs. The factors identified by the panel will be incorporated into the draft discussion document.

Mr. Nordahl reported on recent progress to develop a re-designed prototype survey dredge. The purpose of this effort was to develop a dredge configuration that would be more reliable and consistent than the existing survey dredge configuration. RSA projects led by Mr. Smolowitz and Dr. DuPaul would be utilized to field test and fine tune the new prototype dredge, comparing the performance against the existing survey dredge and a commercial dredge.

Mr. Nordahl said that considerable progress had been made while working with Mr. Quinn, Mr. Donnelly, and Mr. Taylor at Mr. Quinn's workshop in Fairhaven. During this time, the ring bag had been reconfigured so that it hung better, the twine top had been changed and re-hung, 16" rollers had been added to the bail, a new inclinometer bracket had been designed, the sweep chain had been shortened, and rock chains had been incorporated.

Mr. Nordahl felt that the dredge was very close to being ready for field testing. The panel later examined the new dredge and all felt that it was a big improvement and there were no major issues that would prevent the dredge from working optimally.

The panel agreed that field testing should be done with and without a mesh liner, with sufficient replicates to estimate and compare catch variability with the prototype and control dredges. It was also agreed that the prototype dredge should use a 7 foot club stick, that the prototype dredge will have turtle chains on all tows, that tow time will be altered during testing to examine how tow time affects catch, and that various scopes will be tested.

The plan is to conduct field testing on commercial vessels during RSA funded projects during 2007, followed by calibration studies using the R/V Albatross and UNOLS or commercial vessels in 2008. This schedule would make the prototype dredge fully operational for conducting the scallop survey in 2009.

The panel briefly discussed recommendations for sampling designs and protocols, term of reference 3. It was agreed that there would be a time series problem if the dredge survey sampling design were radically altered. Basically, the same statistical design should be continued for consistency. The optimal design for other surveys, to survey a small area with photographs or video for example, might be conducted with other designs that are suitable for the sampling method. Panelists felt it is important to collect data for other species and detect seasonal differences in abundance and/or meat weight as well.

Brief discussion of term of reference 5 (other data sources for the management specification process) occurred. The panel thought that it would be useful for the observer program to collect information on scallop meat weight and gonad condition. It was noted that the observer program had begun collecting more data on scallop length frequency and meat weight. Seasonal changes could be factored into TAC setting to better reflect the actual meat weight of caught scallops in areas that have specific seasons. The panel also agreed to recommend that NMFS further develop a comprehensive electronic VTR system that uses the VMS equipment to allocate reported catch by area.

Appendix B: Scallop Survey Advisory Panel Meeting Summary Coonamesett Farm, 20 December 2007

INTRODUCTIONS BY PARTICIPANTS:

Mark Buron (Eastern Fisheries), Victor Nordahl (NEFSC), Sarah Pautske (NEFMC), Deirdre Boelke (NEFMC), Corrin Flora (NMFS Observer Program), Jim Kendall (NBSC), Paul Rago (NEFSC), William DuPaul (VIMS), Ron Smolowitz (Cfarm), Dvora Hart (NEFSC), Amber York (WHOI), Scott Gallagher (WHOI), Susan McBride (Cfarm), Matt Weeks (Cfarm), Cate O'Keefe (SMAST), Brad Harris (SMAST), David Rudders VIMS), Michael Marino (SMAST), Andrew Applegate (NEFMC), Richard Taylor .

Ron opens meeting: Talks will give updates on what has been accomplished this year as well as identify goals for the future. Purpose of meeting is also to discuss what to do as a group to ensure good surveys.

PRESENTATION 1: DAVID RUDDERS

VIMS shadowed the Albatross which is being decommissioned, forcing dredge survey to choose new vessel. There is a need to examine how to interface with NMFS survey. The RSA RFPs have not yet been issued. VIMS want to do something in DELMARVA area since it is closed under the RSA program when it is announced. VIMS is not sure there is a need to resurvey those areas that are closed that they have worked in already.

VIMS UPDATE

The dredge survey and calibration experiment have been conducted. These were cooperative closed area surveys. The surveys used NMFS Standard dredge and a 14 or 15 ft commercial dredge. The primary objective was to estimate exploitable biomass. A secondary objective was to estimate size selectivity for Scallops. An important question: **Do turtle chains make a difference?** VIMS is currently compiling multi-year fish information; enough data to look at a few species - Monkfish, Yellow Tail Flounder, maybe others.

The R/V Albatross annually conducts a synoptic survey of the entire sea scallop resource - this vessel is being retired in 2008. Why is calibration important? He answer is to retain the continuity of the time series so that the information is applicable to the management of sea scallop fishery. When you change a vessel, calibration is critical. VIMS used industry vessels to calibrate against the R/V Albatross in case data from an industry vessel may be needed to replace her. VIMS used a paired tow design with the F/V Nordic Pride and the F/V Celtic shadowing the R/V Albatross. They fished the prototype dredge which is in development and the standard NMFS survey dredge. This process yielded data for calibration plus comparison between prototype and standard dredge.

Data were interpreted as showing that the standard dredge is more efficient than the prototype dredge. The prototype uses chains and may not work as well on soft bottom.

DISCUSSION: Dvora: Concerned about gear decision. A priority item to analyze is which one to use. Not necessarily which one is more efficient. The object is **which one is more reliable, more consistent with catches**, think about how you might analyze that for next year.

Dave: The question of whether there is a **difference in size selectivity is a more serious concern over efficiency**. Dvora: The next number of months needs to focus on both of these questions.

From the first leg of the study, over sand bottom in the Mid-Atlantic, shell height frequency was examined graphically between gears and showed probably (not analyzed statistically yet) no difference in size selectivity but efficiency was definitely different. From the second leg of the study on Georges Bank, again the data showed similarity in size selectivity between gears, however, the difference in gear efficiency was reduced.

PRESENTATION 2: KEVIN STOKESBURY

The scallop survey objectives include obtaining spatially specific estimates of abundance and density, size distribution, recruitment and natural mortality as well as benthos mapping and assessment of gear impacts. The characteristics of the survey are that it is a cooperative, inexpensive, technologically simple and non-invasive technique so there is no impact to the environment and no special permits are required. The gear, deployed from the stern of a research vessel, is the video pyramid (described in detail) and the study is a centric systematic survey multistage sampling design.

Sampling is conducted in May to July. Data are used to measure exploitable biomass. Stock areas are defined by NMFS and NEFMC. Fourteen million pounds of exploitable biomass were observed in SMAST survey region outside of NMFS areas. They propose to conduct fine scale surveys in future.

This year the industry steering committee wants to do the surveys again. The funding for ships, crew and other support has already been received. Closed areas surveys, e.g., Nantucket Lightship areas, were completed this year and they intend to survey again using unexpended funds. Showed views of bottom, Elephant Trunk closed areas, showing seed scallops attached to larger scallops.

DISCUSSION: Ron described what Matt saw recently on a trip on the F/V Westport in November, a huge catch of 10 mm scallops in Elephant Trunk. Some debate about age of scallops at 10mm and what spawning period they might have derived from ensued among Dvora, Bill and Ron. It was probably spring-spawn according to Dvora and Bill. Bill has not been seeing much growth between August and November. Ron described large landings reported by commercial fishery occurring off New Jersey in a big area that has not been included in NMFS survey or VIMS. Dvora responds saying the survey goes inside Hudson canyon and more inshore but agrees that there is **a need to talk about modifying the survey area** – discussion has been on back burner. Jim has been talking with industry people, learned that the Elephant Trunk yield right now is about 50 percent better than what they expected to see at this time. November is usually a lower month. Larger variability observed. Dvora states that sometimes there are winter blooms in the Atlantic and if there is a good food supply at that time, numbers will increase. Jim wonders if it is temperature related - the results are being seen at the marketplace. Ron has information that agrees with Jim's offering - Hudson Canyon is also yielding better than expected and major behavioral changes in fish are being observed as well.

PRESENTATION 3: DVORA HART

DISCUSSION: Dvora mentions going to dealers but there are no shell height data. Jim feels that large interannual variation is to be expected and that it is difficult to draw any conclusions from these "strange" observations. Ron wonders if phytoplankton is playing a role. Dvora states that they are looking at phytoplankton some now.

FEDERAL SURVEY

Some things are up in air. It is almost certainly the last year to use the R/V Albatross for the scallop survey in 2008. They might get it for a few days to do some comparisons. So, this is the last year of time series that began in 1979 (some data are used from 1975 on). Survey yields scallop numbers, shell height and meat weight as well as the abundance of finfish, sea stars, crab, and lobster associated with the scallop beds and oceanographic data. Some cooperative work was accomplished this year using the F/Vs Katherine Marie, Nordic Pride and Celtic.

Biomass is heaviest in the Elephant Trunk and Northern Edge of Georges Bank. Biomass is also heavy around the corner of the Lightship area and Delmarva. Survey extends west in Hudson Canyon off New Jersey to about 40 meters - they are **trying to bring the survey more inshore to 27 meters**.

DISCUSSION: Ron wants them to fill in where they are missing sample sites. Commercial fleets are fishing off Jersey and landing large volumes of scallops. Dvora agrees.

The Hudson Canyon Special Access Area is closed next year. Georges Bank pattern is typical –all one stock. Survey data show that the best recruitment since 2001 occurred in 2007. The most important thing about the survey is that it is a very long time series. **Most important thing is that we do not lose this time series so the calibration project is critical.** Mid-Atlantic data show that landings and biomass co-relate well except in years where Elephant Trunk was closed. In both Mid-Atlantic and Georges Bank, there have been dramatic increases in biomass since the beginning of the survey except when closures affected the relationship between biomass and landings. Other things going on too - poor recruitment with high landings has decreased biomass. Even so, biomass is better than it had been. Shell height distribution showed large increase in the number of large scallops in recent years with less middle sized individuals in both the Mid-Atlantic and Georges Bank, however really big scallops (140 plus) do not occur much in the Mid-Atlantic. In Mid-Atlantic, recruitment improved over time whereas, recruitment in Georges Bank is sporadic, big pulses. Examining differences in scallop biomass between open and closed areas showed that biomass has increased in the Mid-Atlantic, but in some areas more so when they were closed. The differences on Georges Bank between open and closed areas are more obvious and large.

The F/V Kathy Marie towed the HABCAM while the F/V Nordic Pride and the F/V Celtic duplicated the R/V Albatross tows using modified and standard survey dredges. With these data they can estimate both dredge and vessel effects.

Looking to the future, the scallop survey will not be able to use the R/V Bigelow. They are seriously looking to use the University of Delaware's vessel the R/V Hugh Sharp. They may start sampling one or two months earlier beginning in 2008. Main data are shell height and meat weight which will be different due to the reduced growth time, however, management decision can be made more easily because timing of meetings and data availability always caused conflict in past. They can use observer data to fill in the comparative base line.

Assuming the R/V Hugh Sharp is going to be used there is the question of whether to change gear. Since they will only have the R/V Albatross for a few days in 2008, they would like to use the F/Vs Celtic and Nordic Pride to shadow the R/V Sharp with both dredges and HABCAM equipment. In 2009 they would like to complete the building and testing of the new technologies (Optical and

Acoustic – multi-beam etc.) so that by 2010 they can combine the survey equipment. They hope to transition back to a NOAA vessel like the R/V Pisces but it will not be available until 2011.

DISCUSSION: Victor comments that we can only report what we are told to report. We only have 36 days on the R/V Sharp. The budget resolution just passed. Dvora says sorry to say we can't say this is exactly what we will do but we are trying to work outside of budget issue. Want to use same vessel for a number of years. NMFS is looking to get R/V Pisces equipped for high tech scallop/habitat survey.

PRESENTATION 4: SCOTT GALLAGER

HABCAM project targets variety of areas of the east coast, Hudson Canyon, Elephant Trunk, Gulf of Maine and Georges Bank. This is a very cooperative effort plus many partners and end users. Trying to understand the processes that shape and control benthic communities; substrate, water masses, plankton, etc. Data show that thermal fronts are co-located with juvenile scallops. Post-settlement mortality, etc., effects the distribution but they feel that the thermal fronts are part of the larvae delivery mechanism. They used the F/V Kathy Marie out of New Bedford. The bottom vehicle is the HABCAM and during two of the four 2007 RSA cruises- a second vehicle with either multibeam or sidescan instruments was towed aft of the imaging system while maintaining an exact altitude from the bottom. A multi-beam mounted on ship itself gives more data, but at lower resolution. HABCAM sampling allows you to examine 260,000 m sq per day versus dredge sampling which can cover only 107,000 m sq per day and HABCAM sampling gives you data in "real time". The acoustic instruments had coverage of up to 46,000,000 sq meters per 12 hour day

Processing the optical data for analysis consists of three separate operations: light field and color correction (and here we are approaching "real-time), segmentation (meaning identification and automated counting of target taxa such as scallop, starfish, and fishes), and mosaicing. The images are translated in order to correct for errors introduced by roll and pitch of the towed camera.. Then adjacent images are "stitched" together digitally to form the long mosaic strips. The study provides classification of organisms, their abundances and distributions, as well as bottom mapping with concurrent acoustic information. In their example, Cod, Plaice and flatfish were identified and showed the highest density associated with high frequency sand ridges. Amber is developing a training set of images available over the web for use in classifying images – students are already using it for distributions in their own work. Classification is challenging - light field is non-uniform. They use a filter to correct for the non-uniformity and then another process brings out the true color. Then what they call segmentation separates out the individual animals from the noisy background. They state the process gives them 73-87% accuracy. This technique is moving us toward automated scallop and fish counts and provides better habitat definition. They found as many as 20-25 scallops per square meter in patchy distribution. Patchiness really counts in understanding population. A 9,000 meter (5 mile) strip was examined in the Elephant Trunk where it was found that unless sampled at an interval of less than 300 meters, the scallop population was not described accurately.

DISCUSSION: Dvora feels there is a need to address use of this for future sampling protocol. Scott shows that they can achieve a stable mean in three transects vs. needing nine by dredging. Richard contributes that there is no advantage to pulling the gear and steaming to a new station. Leave it in the water. Dvora asks how you best choose a path to optimize, to get your best estimate. Parallel to bathymetry, zigzag etc? There are things that have to be ironed out when this gets translated into an operational mode. Someone

asked about the issue of having all the equipment on a single vessel vs. multiple vessels. Dvora hopes to use just one for economic reasons and others. These details are important tasks for the next year or two. She is grateful to Scott et al. for developing HABCAM system because her job is to implement. Michael questions when to implement. Dvora expects 2010. David comments on how some organisms disappear from field of view – avoidance. Scott and Amber respond that they see this and have not firmed up how to quantify those occurrences. Amber sees flatfish scoot off. Dvora doesn't think flatfish are likely to behave that way that they would be more likely to burrow. Ron interjects that you'd be surprised by the behaviors you see. Need to continue.

PRESENTATION 5: RICHARD TAYLOR

HABCAM system sampling is doing something that will be more powerful than a depletion estimate. We will be able to compare dredge data with visual data. Also, be able to see “noise” between the R/V Albatross and HABCAM as a function of how far apart and how oriented.

DISCUSSION: Andrew states that HABCAM being able to run over exact same ground would be good for doing comparative statistics. Scott agrees. Richard feels it is the core of the issue. They lost one unit with damaged tow wire, though it was recovered without damage. Scott offers that the cost is \$200,000 for gear with all that equipment. It is agreed that wire should be checked and replaced frequently. Dvora's ppt plot presents that over 50 percent of the total scallop biomass is in three areas, HAPC, Elephant Trunk and Hambone (area not open in CA1), 21% in areas that are not available to industry. These areas are of great importance for survey.

Spending a day with advanced sonar – what other data can you collect? The sonar collected data at the rate of 4,000,000 square meters per hour, delineating areas of sand gravel and rocks. Additionally they images cloud masses of fish and “feed”, sometimes you can fly under them but usually they are little shrimp like creatures, amphipods and euphausiids. Jim Kendall offered that clouds seen in SMAST data ended up being Herring spawn. These are the promises- of advanced technology. The major challenge of the method is that the more advanced systems require outside technicians, and the technologies are entirely dependent on each electronic subsystem working flawlessly. Working with these are future goals.

Ron states that certain things are more for research as opposed to survey. Habitat – do we need to have extensive research in order to meet goals of survey? In order to manage scallops we need to understand scallops. Dvora comments on future ability to associate scallops with acoustic features and map those features combined with knowledge of substrate.

PRESENTATION 6: VICTOR NORDAHL

Vic is reporting on the RSA for developing an improved dredge for standardized surveys of the sea scallop resource. Task was to construct a dredge that can fish in a consistent manner, with minimum wear and risk of damage over seabeds and in areas with different scallop densities. Needs to be easy to maintain and duplicate. Five standard dredge frames were built by Eastern Fisheries for two RSA projects. Goal to develop operational procedures that optimize the catch of the desired species at particular size ranges. Conduct statistically significant number of tows, etc. We completed modifications to prototype prior to field testing for RSA project in spring 2007. We completed testing of prototype dredge prior to summer NEFSC survey and VIMS shadow survey. We plan to finalize drawings fishing procedures construction and repair protocols and analyses before February. Still needs a little work.

In 2006 they focused on modifying six characteristics of the standard gear. Used Yankee trawl rollers as bale wheels, added a steel hanging bracket on backside of the cutting bar for attachment of turtle/rock chains, and designed and attached a new inclinometer bracket. Lengthened bottom bag, sweep chain links reduced for hanging properly, diamonds were same, apron reduced, extensions were widened, skirt replaces 3" hanging ring with rings facing out instead of in like industry so they do not hang up on the liner. Twine top not stretched. Commercial fishermen laugh at the size of the prototype dredge, but they need to be able to catch small scallops prior to commercial size so it suites the goal. Those who have used it are happy. Haven't analyzed the data completely – Ron will speak on that. Vic showed some data.

DISCUSSION: Jim Kendall offers that the dredge looks right! Dvora states that people testing from FDA need dredge sampling for those kinds of data. Dave liked the performance of the dredge. We decided to incorporate the 1.5 inch liner. We had camera on dredge during some testing. Wanted to observe some stability in the data to see what scope is best. From his perspective the fishing is more stable with more scope. Brings up bale with more scope but doesn't stop catching. On R/V Albatross they use 3:1 and they are finding 4:1 may be better. Most efficient is slower speed with less scope. Behavior of fish differs and is important in interpreting catch. Liner is essential he feels. Lose scallops with larger mesh twine top. We may want to change position of wheel to optimize efficiency. Ron hands out data with averages of 23 tows. The data comparing scope and speed is very consistent. Dvora states that what we've seen is that the catch is going to be determined by the towpath. Ron states that there is a swept area correction to address that issue. We still need to look more closely at size frequency – why are they losing more scallops at higher speed if towing faster gives you a better sample. Dvora wanted to look at reducing the time of tow but you see instability at the beginning of a tow. Tows made off New York, Montauk down towards the tower. Ron suggests that more stability at 4:1 means you need to change the angle of orientation of the dredge. Still have money in this RSA – would like an extension and reexamine the speed/scope issue. Andrew says there is a need to examine noise and selectivity of size. Seems counterintuitive that you are catching less but if catching more consistently, this may be good. Ron states that they have enough tows to look at length frequency. Scallops swim like crazy. Why are they losing them when towing faster? Twine top has liner, basically double twine; liner plus 4.5 inch mesh. Richard points out that of the RSA money left over – only half has been used. Need to make it so "they" are not allowed to do that. Need that for finishing these investigations. Ron says there is about \$50,000 left over in the survey dredge RSA project.

WHAT TO DO TODAY? Ron directs discussion to address what the assembled panel can compile for future goals and recommendations - what do we want to tow?

Bill: Survey in closed area always needs to use a commercial dredge.

Dvora: Whatever is used on federal survey should use the same thing, Prototype & Survey dredge

Paul: Should switch gear and vessel at once?

Ron: How do you test?

Bill: **Effects of turtle chains not fully tested.** Don't have measurement. If going to use a NMFS dredge that uses turtle chains need to know this.

Paul: Past work studies rock chains in rocky area – paired study but not side by side.

Ron: Go down in spring and **tow one with and one without turtle chain.**

Dvora: Regarding transitioning to a new vessel, if you are going to change dredge configuration, this is the time to do it. The formal advisory panel should continue asking these questions and answering them in preparation for new vessel. There is also the question of towing wire size.

Ron: Covered in the noise.

Richard: Thinks it is an enormous factor.

Andrew: Suggests using HABCAM to compare dredges.

Dvora: Not analyzed yet, but on survey there were a number of tows done w/triple comparison with standardized effort standard and prototype with HABCAM between.

Ron: NMFS has decided we are going to use turtle chains. Go down in March and figure out what is being lost but that is not really going to matter because other gear will be used to deal with that.

Bill: If going to use commercial vessels for surveys, have to get beyond bureaucracy. Why do we have to put turtle chains on a research vessel?

Dvora: No one from regional office here to address that.

Andrew: What happens when that approval comes through and some special interest group comes in with a suit?

Dvora: We have done over 15,000 tows in 30 years and never caught a turtle.

Ron: 7000 tows at 15 minutes in turtle habitat; at that rate you should only have caught 2 turtles- one turtle every thousand hours. Trawls are better turtle catchers than dredges.

Andrew: Making this higher priority than wheel?

Vic: Dredges behave differently in different weather. Need to also be looking at commercial data. A lot of possibilities to figure out

Ron: Spring work 5 or 6 days -With or without chains? Get 90 tows in.

Vic: **Move wheels now and just focus on the chains.**

Dvora: Wheel could be worked out – design studying it with survey when it commences. We understand individual elements but what about whole package. VIMS has comparison tows. 2008 work gets at whole package. VIMS use side by side dredge comparisons.

Vic: Underlying is our desire to maintain bridge between new and original survey.

Dvora: Fool with wheel until you get to survey time. Then have a choice. **All needs to be in place for new time series.**

Paul: Had the R/V Albatross been able to do 2008, would the new dredge have been used?

Dvora: No, they would use old to keep time series. She would prefer not fooling with it later.

Ron: Designed dredge in 1979 and they decided during test series not to test any more - got stuck with what they had designed that far. These changes will put you ahead of where you were.

SUMMARY

The Panel reached consensus on the following points:

1. **There is a need to continue a dredge survey into the future.**
2. **The gear and vessel should be changed at the same time.**
3. **The existing RSA project should examine the new dredge with and without the turtle/rock chains.**
4. **The wheel should be moved on the new dredge to lift the bale.**
5. **Final changes should be made before the next survey.**
6. **The survey strata should be re-examined to include areas where the scallop fishery is taking place inshore of the existing strata particularly in the Mid-Atlantic.**

Appendix Table 1 Bridge Data Log F/V Celtic 2007-3

			Time	Tow Time	Start Position		End Position		Speed	Depth	Wire out	Vessel	Catch (bu)		
Trip	Date	Tow #	Start	Minutes	LORAN				Knots	Fathoms	Fathoms	Heading	port	stbd	Comments
Celtic 2007-3	5/15/2007	1	1422	15	26390.6	43062.0	26387.0	43070.0	3.8	37.5	115	030	0.8	1	
Celtic 2007-3	5/15/2007	2	1510	15	26381.7	43083.1	26380.5	43092.0	3.8	33	100	030	1	0.5	
Celtic 2007-3	5/15/2007	3	1540	15	26378.0	43097.0	26374.2	43107.0	3.8	34	100	030			Twine top hung up
Celtic 2007-3	5/15/2007	4	1609	15	26372.0	43112.8	36370.0	43124.0	3.8	35	105	020	0.75	0.8	
Celtic 2007-3	5/15/2007	5	1641	15	26368.4	43132.8	26366.8	43140.5	3.8	36	110	015	0.9	1.1	
Celtic 2007-3	5/15/2007	6	1710	15	26364.0	43149.0	26361.0	43159.0	3.8	36	110	015	1.8	2.3	
Celtic 2007-3	5/15/2007	7	1755	15	26357.0	43170.8	26352.6	43178.9	3.8	36	120	040	1	1.2	
Celtic 2007-3	5/15/2007	8	1828	15	26348.2	43188.5	26344.2	43195.4	3.8	39	120	035	2	1.5	
Celtic 2007-3	5/15/2007	9	1908	15	26335.8	43208.5	26330.0	43216.6	3.8	39	120	040			stbd side backjob
Celtic 2007-3	5/15/2007	10	1934	15	26327.0	43221.0	26321.6	43228.6	3.8	39	120	040	0.7	0.7	
Celtic 2007-3	5/16/2007	11	0610	15	26313.8	43237.5	26309.7	43244.6	3.8	37	110	045	0.3	0.5	
Celtic 2007-3	5/16/2007	12	0642	15	26305.4	43252.6	26301.3	43259.1	3.8	30	90	045	0.7	0.25	
Celtic 2007-3	5/16/2007	13	0715	15	26297.2	43265.8	26293.0	43272.4	3.8	32	90	045	0.5	0.5	removed wheels
Celtic 2007-3	5/16/2007	14	0747	15	26287.4	43279.8	26282.0	43286.0	3.8	31	90	045	1	0.9	
Celtic 2007-3	5/16/2007	15	0817	15	26276.0	43293.0	26270.8	43299.7	3.8	33	100	045	1.5	1.5	
Celtic 2007-3	5/16/2007	16	0852	15	26264.0	43306.9	26258.0	43313.0	3.8	37	110	045	1.8	1.5	
Celtic 2007-3	5/16/2007	17	0928	15	26252.0	43320.4	26243.9	43330.4	3.8	36	110	045	2.5	2	
Celtic 2007-3	5/16/2007	18	1005	15	26239.2	43337.3	26235.0	43346.0	3.8	37	110	030	1	1.2	
Celtic 2007-3	5/16/2007	19	1037	15	26231.9	43352.4	26231.9	43358.8	3.8	37	110	350	0.25	0.25	
Celtic 2007-3	5/16/2007	20	1100	15	26229.8	43363.4	26232.0	43372.1	3.8	37	110	350	0.5	0.33	
Celtic 2007-3	5/16/2007	21	1130	15	26229.2	43380.1	26233.8	43388.8	3.8	36	110	355	0.66	0.5	
Celtic 2007-3	5/16/2007	22	1153	15	26232.0	43393.2	26234.6	43401.8	3.8	36	110	355	0.9	0.8	
Celtic 2007-3	5/16/2007	23	1245	15	26234.0	43423.3	26236.3	43432.0	3.8	33	100	015	0.33	0.33	
Celtic 2007-3	5/16/2007	24	1310	15	26235.0	43439.0	26235.8	43448.1	3.8	32	100	030	0.33	0.33	
Celtic 2007-3	5/16/2007	25	1334	15	26237.0	43451.7	26240.2	43459.9	3.8	32	100	025	0.33	0.33	
Celtic 2007-3	5/16/2007	26	1358	15	26239.8	43464.8	26241.0	43473.8	3.8	33	100	020	1.1	0.8	

Appendix Table 1 Bridge Data Log F/V Celtic 2007-3

			Time	Tow Time	Start Position		End Position		Speed	Depth	Wire out	Vessel	Catch (bu)		
Trip	Date	Tow #	Start	Minutes	LORAN				Knots	Fathoms	Fathoms	Heading	port	stbd	Comments
Celtic 2007-3	5/16/2007	27	1422	15	26241.5	43478.8	26245.0	43487.7	3.8	33	100	015	0.5	0.5	
Celtic 2007-3	5/16/2007	28	1449	15	26245.0	43493.7	26245.7	43503.4	3.8	33	100	025	0.5	0.5	
Celtic 2007-3	5/16/2007	29	1520	15	26245.8	43513.7	26244.9	43521.2	3.8	30	90	030	0.25	0.25	
Celtic 2007-3	5/16/2007	30	1544	15	26244.3	43525.6	26240.0	43534.0	3.8	28	85	030	0.25	0.25	
Celtic 2007-3	5/16/2007	31	1610	15	26239.9	43539.0	26238.4	43546.8	3.8	28	85	035	0.33	0.33	
Celtic 2007-3	5/16/2007	32	1635	15	26237.8	43551.6	26234.9	43559.5	3.8	28	85	035	0.33	0.33	
Celtic 2007-3	5/16/2007	33	1724	15	26229.8	43576.5	26225.3	43587.0	3.8	27	85	045	0.5	0.33	
Celtic 2007-3	5/16/2007	34	1758	15	26221.6	43593.0	26215.0	43599.9	3.8	28	85	055	0.33	0.33	
Celtic 2007-3	5/16/2007	35	1828	15	26209.0	43603.7	26202.5	43608.7	3.8	29	90	055	0.5	0.5	
Celtic 2007-3	5/16/2007	36	1853	15	26199.2	43612.4	26194.1	43618.0	3.8	29	90	055	0.15	0.25	
Celtic 2007-3	5/17/2007	37	0555	15	26182.3	43627.6	26179.7	43633.6	3.8	28	90	040	0.15	0.15	
Celtic 2007-3	5/17/2007	38	0630	15	26177.4	43638.9	26172.5	43643.6	3.8	27	85	060	0.15	0.15	
Celtic 2007-3	5/17/2007	39	0705	15	26172.8	43649.1	26168.6	43655.0	3.8	26	85	060	0.5	0.5	
Celtic 2007-3	5/17/2007	40	0735	15	26166.5	43660.5	26162.9	43666.1	3.8	27	85	060	1	0.8	
Celtic 2007-3	5/17/2007	41	0805	15	26158.0	43688.0	26150.0	43669.2	3.8	26	80	055	0.5	0.5	
Celtic 2007-3	5/17/2007	42	0827	15	26146.0	43669.7	26137.0	43671.0	3.8	26	80	060	0.6	0.8	
Celtic 2007-3	5/17/2007	43	0850	15	26133.9	43671.5	26124.7	43668.6	3.8	27	80	138	0.8	0.7	
Celtic 2007-3	5/17/2007	44	0913	15	26120.0	43666.6	26111.5	43661.0	3.8	27	80	145	1	0.9	
Celtic 2007-3	5/17/2007	45	0940	15	26099.0	43648.0	26100.0	43649.0	3.8	28	85	150	0.25	0.15	
Celtic 2007-3	5/17/2007	46	1015	15	26098.0	43648.3	26086.9	43625.6	3.8	29	90	185	0.25	0.25	
Celtic 2007-3	5/17/2007	47	1045	15	26084.0	43620.5	26074.2	43621.7	3.8	30	90	100	0.15	0.15	
Celtic 2007-3	5/17/2007	48	1110	15	26068.2	43622.3	26507.0	43623.0	3.8	30	90	100	0.25	0.25	
Celtic 2007-3	5/17/2007	49	1139	15	26047.6	43624.0	26037.0	43625.0	3.8	30	90	035	0.5	0.5	
Celtic 2007-3	5/17/2007	50	1208	15	26030.9	43627.4	26026.7	43635.4	3.8	32	90	035	1	0.8	
Celtic 2007-3	5/17/2007	51	1237	15	26025.0	43641.9	26026.8	43653.9	3.8	30	90	035	0.33	0.33	
Celtic 2007-3	5/17/2007	52	1309	15	26025.5	43660.1	26025.0	43669.0	3.8	29	90	030	0.15	0.15	
Celtic 2007-3	5/17/2007	53	1337	15	26024.2	43676.4	26020.1	43683.2	3.8	27	85	030	1.1	1.1	
Celtic 2007-3	5/17/2007	54	1408	15	26020.0	43683.3	26008.1	43695.4	3.8	26	80	048	1.1	1	
Celtic 2007-3	5/17/2007	55	1438	15	26001.8	43702.1	25996.3	43708.1	3.8	27	80	050	1.1	1.1	

Appendix Table 1 Bridge Data Log F/V Celtic 2007-4

			Time	Tow Time	Start Position		End Position		Speed	Depth	Wire out	Vessel	Catch (bu)		
Trip	Date	Tow #	Start	Minutes	LORAN				Knots	Fathoms	Fathoms	Heading	port	stbd	Comments
Celtic 2007-4	6/12/2007	56	0649	15	25994.1	43704.5	25999.7	43698.7	3.9	25	80	ssw	0.5	0.25	
Celtic 2007-4	6/12/2007	57	0726	15	26002.9	43695.5	26012.9	43691.9	3.9	27	80	sw	0.25	0.5	
Celtic 2007-4	6/12/2007	58	0758	15	26020.8	43683.8	26024.6	43676.6	3.9	27	80	sw	0.5	1	
Celtic 2007-4	6/12/2007	59	0830	15	26024.0	43669.1	26025.0	43660.8	3.9	27	80	s	0.2	0.25	
Celtic 2007-4	6/12/2007	60	0900	15	26026.1	43653.7	26027.5	43645.5	3.9	30	90	s			
Celtic 2007-4	6/12/2007	61	0930	15	26026.0	43638.3	26028.0	43630.3	3.9	31	90	s	0.5	0.25	
Celtic 2007-4	6/12/2007	62	1218	15	26216.7	43546.9	26226.5	43552.0	3.9	28	80	nnw	0.25	0.25	
Celtic 2007-4	6/12/2007	63	1252	15	26235.1	43558.8	26237.0	43550.8	3.9	27	80	sw	0.25	0.5	
Celtic 2007-4	6/12/2007	64	1317	15	26238.8	43556.1	26240.3	43538.0	3.9	28	80	ssw	0.25	0.5	
Celtic 2007-4	6/12/2007	65	1342	15	26240.3	43533.4	26241.3	43524.8	3.9	27	80	s	0.25	0.5	
Celtic 2007-4	6/12/2007	66	1410	15	26242.4	43518.0	26243.4	43509.5	3.9	28	80	s	0.25	0.5	
Celtic 2007-4	6/12/2007	67	1438	15	26242.5	43503.3	26242.9	43494.8	3.9	30	90	s	0.25	0.5	
Celtic 2007-4	6/12/2007	68	1507	15	26241.6	43486.5	26238.4	43477.4	3.9	33	100	s	0.75	1	
Celtic 2007-4	6/12/2007	69	1537	15	26237.8	43472.8	26236.1	43463.8	3.9	35	110	s	0.25	0.5	
Celtic 2007-4	6/12/2007	70	1600	15	26236.8	43456.9	26232.8	43448.5	3.9	34	100	s	0.25	0.5	
Celtic 2007-4	6/12/2007	71	1820	15	26256.2	43311.1	26262.5	43305.2	3.9	36	110	sw	1.5	1.25	switched sides
Celtic 2007-4	6/12/2007	72	1850	15	26267.3	43298.4	26272.9	43291.8	3.9	37	110	sw	1.75	2	
Celtic 2007-4	6/12/2007	73	1920	15	26280.4	43284.1	26286.3	43276.7	3.9	32	100	sw	1.5	1.75	
Celtic 2007-4	6/12/2007	74	1950	15	26290.7	43270.0	26295.6	43262.9	3.9	31	100	sw	1.25	1.25	
Celtic 2007-4	6/12/2007	75	2018	15	26299.4	43256.7	26303.8	43249.0	3.9	32	100	sw	1	1	
Celtic 2007-4	6/12/2007	76	2045	15	26307.6	43242.1	26312.2	43234.5	3.9	38	110	225	1	0.25	
Celtic 2007-4	6/12/2007	77	2117	15	26318.0	43227.0	26324.8	43219.7	3.9	35	110	235	0.75	0.5	

Appendix Table 1 Bridge Data Log F/V Celtic 2007-4

			Time	Tow Time	Start Position		End Position		Speed	Depth	Wire out	Vessel	Catch (bu)		
Trip	Date	Tow #	Start	Minutes	LORAN				Knots	Fathoms	Fathoms	Heading	port	stbd	Comments
Celtic 2007-4	6/12/2007	78	2144	15	26327.7	43214.4	26333.1	43207.7	3.9	39	120	230	1	0.75	
Celtic 2007-4	6/12/2007	79	2220	15	26341.3	43193.7	26346.4	43186.5	3.9	38	120	240	1.25	1.25	
Celtic 2007-4	6/12/2007	80	2252	15	26350.2	43176.6	26355.6	43167.4	3.9	37	110	240	1	0.5	
Celtic 2007-4	6/13/2007	81	0605	15	26354.5	43169.5	26350.6	43175.7	3.9	36	110	060	0.5	0.75	
Celtic 2007-4	6/13/2007	82	0652	15	26345.7	43187.8	26341.0	43194.6	3.9	37	120	052			
Celtic 2007-4	6/13/2007	83	0724	15	26341.7	43192.8	26346.9	43186.0	3.9	38	120	210	1.25	1.25	
Celtic 2007-4	6/13/2007	84	0821	15	26333.1	43208.4	26327.5	43215.0	3.9	39	120	ne	0.5	1	
Celtic 2007-4	6/13/2007	85	0857	15	26324.0	43220.0	26318.9	43227.7	3.9	38	110	ne	0.75	0.75	
Celtic 2007-4	6/13/2007	86	0938	15	26311.7	43235.2	26307.5	43242.4	3.9	37	110	ne	0.75	0.5	
Celtic 2007-4	6/13/2007	87	1012	15	26304.0	43250.0	26299.2	43256.9	3.9	30	100	ne	0.5	0.75	
Celtic 2007-4	6/13/2007	88	1042	15	26296.2	43263.4	26291.2	43270.0	3.9	31	100	ne	1.5	1	
Celtic 2007-4	6/13/2007	89	1117	15	26286.0	43285.9	26280.6	43283.8	3.9	30	100	ne	1.25	1.25	
Celtic 2007-4	6/13/2007	90	1152	15	26273.1	43291.9	26267.0	43299.6	3.9	33	100	ne	1.25	1.75	
Celtic 2007-4	6/13/2007	91	1228	15	26262.1	43306.1	26256.1	43312.1	3.9	36	100	ne	1.5	1.75	
Celtic 2007-4	6/13/2007	92	1532	15	26235.9	43465.3	26238.0	43474.2	3.9	35	100	ne	0.25	1	
Celtic 2007-4	6/13/2007	93	1558	15	26238.6	43479.1	26242.6	43488.2	3.9	34	100	ne	0.25	1	
Celtic 2007-4	6/13/2007	94	1630	15	26242.9	43495.6	26242.4	43503.9	3.9	32	100	ne	0.5	0.75	
Celtic 2007-4	6/13/2007	95	1656	15	26242.5	43509.4	26242.4	43520.2	3.9	30	80	ne	0.25	0.5	
Celtic 2007-4	6/13/2007	96	1727	15	26241.5	43525.4	26241.1	43534.2	3.9	27	80	nne	0.25	0.25	
Celtic 2007-4	6/13/2007	97	1753	15	26240.1	43538.0	26238.7	43548.3	3.9	28	80	ne	0.25	0.25	
Celtic 2007-4	6/13/2007	98	1820	15	26237.9	43551.3	26235.8	43559.3	3.9	28	80	ne	0.25	0.25	
Celtic 2007-4	6/13/2007	99	2249	15	26024.6	43676.8	26021.2	43684.0	3.9	27	80	ne	1	1.25	
Celtic 2007-4	6/13/2007	100	2333	15	26015.0	43685.5	26007.0	43396.3	3.9	26	80	ne	1	1	

Appendix Table 1 Bridge Data Log F/V Celtic 2007-5

			Time	Tow Time	Start Position		End Position		Speed	Depth	Wire out (fms)		Vessel	Catch (bu)		
Trip	Date	Tow #	Start	Minutes					Knots	Fathoms	Port	Stbd	Heading	port	stbd	Comments
Celtic 2007-5	10/17/2007	1	1600	15	41-00.9	71-29.2	40-57.6	72-27.8	var	24.8	var		210	n/a	n/a	spd/scope test
Celtic 2007-5	10/17/2007	2	1808	15	40-48.7	71-31.5	40-46.2	71-32.6	var	33.6	var		222	n/a	n/a	spd/scope test
Celtic 2007-5	10/17/2007	3	2011	15	40-44.5	71-43.2	40-44.4	71-45.7	var	32.9	var		285	n/a	n/a	spd/scope test
Celtic 2007-5	10/18/2007	4	0629	15	40-43.0	71-53.8	40-42.3	71-54.7	3.8	24	100	75	237	0.5	1	
Celtic 2007-5	10/18/2007	5	0708	15	40-41.5	71-56.0	40-40.8	71-58.5	3.8	27	110	80	239	0.6	0.75	
Celtic 2007-5	10/18/2007	6	0737	15	40-40.5	71-57.5	40-39.6	71-58.5	4.5	25	75	100	239	0.5	0.75	
Celtic 2007-5	10/18/2007	7	0802	15	NG											lost port drag
Celtic 2007-5	10/18/2007	8	1214	15	40-38.2	71-59.4	40-37.2	71-59.8	4.5	27		80	240		0.1	only stbd drag
Celtic 2007-5	10/18/2007	9	1239	15	40-37.5	71-00.3	40-38.4	71-01.0	4.5	27		110	345		0.2	
Celtic 2007-5	10/18/2007	10	1305	15	40-38.2	71-01.2	40-37.6	71-01.6	3.8	27		110	226		0.1	
Celtic 2007-5	10/18/2007	11	1300	15	40-37.5	72-02.0	40-38.2	72-02.8	3.8	28		80	339		0.1	
Celtic 2007-5	10/18/2007	12	1425	15	40-35.1	72-00.3	40-34.1	72-00.7	4.5	29		120	207		0.1	
Celtic 2007-5	10/18/2007	13	1450	15	40-34.3	72-01.0	40-35.3	72-01.7	4.5	29		100	342		0.1	
Celtic 2007-5	10/18/2007	14	1530	15	40-33.1	72-03.2	40-32.2	72-03.1	3.8	29		100	179		0.1	
Celtic 2007-5	10/18/2007	15	1555	15	40-32.3	72-03.4	40-33.2	72-04.0	3.8	30		120	343		0.1	
Celtic 2007-5	10/18/2007	16	1730	15	40-28.2	72-15.9	40-27.7	71-17.3	4.5	30		90	259		0.1	
Celtic 2007-5	10/18/2007	17	1755	15	40-28.2	72-17.2	40-29.0	72-16.2	4.5	30		120	057		0.1	
Celtic 2007-5	10/19/2007	18	0739	15	40-43.5	72-53.1	40-42.5	72-53.6	4.5	25	100	80	208	0.2	0.7	two dredges
Celtic 2007-5	10/19/2007	19	0811	15	40-43.0	72-53.9	40-44.1	72-54.3	4.5	25	80	100	000	0.3	0.2	
Celtic 2007-5	10/19/2007	20	0840	15	40-44.1	72-54.5	40-43.2	72-54.6	3.8	26	80	100	203	0.4	0.2	
Celtic 2007-5	10/19/2007	21	0908	15	40-42.8	71-54.9	40-41.9	71-35.0	3.8	25	100	80	207	0.6	0.9	
Celtic 2007-5	10/19/2007	22	0940	15	40-42.3	71-54.7	40-43.3	71-54.2	4.5	25	80	100	036	0.8	0.7	
Celtic 2007-5	10/19/2007	23	1047	15	40-44.0	71-53.7	40-44.0	71-54.0	4.5	27	100	80	213	0.3	0.5	
Celtic 2007-5	10/19/2007	24	1117	15	40-43.4	71-53.8	40-44.2	71-53.3	3.8	25	100	80	042	0.2	0.4	
Celtic 2007-5	10/19/2007	25	1142	15	40-44.2	71-53.2	40-43.2	71-53.3	3.8	25	80	100	209	0.4	0.4	
Celtic 2007-5	10/19/2007	26	1212	15	40-43.5	71-53.3	40-44.5	71-55.6	4.5	25	100	80	345	0.2	0.2	
Celtic 2007-5	10/19/2007	27	1238	15	40-44.5	71-53.9	40-43.6	71-54.8	4.5	25	80	100	236	0.5	0.5	
Celtic 2007-5	10/19/2007	28	1320	15	40-43.4	71-55.1	40-42.4	71-55.2	3.8	25	80	100	205	0.6	0.4	
Celtic 2007-5	10/19/2007	29	1345	15	40-42.0	71-55.2	40-41.0	71-55.4	3.8	26	100	80	197	0.2	0.4	
Celtic 2007-5	10/19/2007	30	1410	15	40-41.1	71-55.2	40-42.1	71-54.5	4.5	26	80	100	055	0.6	0.4	
Celtic 2007-5	10/19/2007	31	1435	15	41-42.1	71-54.3	71-41.1	71-54.7	4.5	26	100	80	207	0.4	0.5	
Celtic 2007-5	10/19/2007	32	1500	15	41-41.2	71-54.9	41-42.1	71-55.4	3.8	26	100	80	345	0.1	0.2	
Celtic 2007-5	10/19/2007	33	1524	15	41-42.4	71-55.9	41-44.6	71-56.5	3.8	25	80	100	233	0.3	0.5	

Appendix Table 1 Bridge Data Log F/V Celtic 2007-5

[illegible]

Appendix Table 1

Bridge Data Log

F/V Celtic 2008-1

Trip	Date	Tow #	Time	Tow Time	Start Position		End Position		Speed	Depth	Wire out	Vessel
			Start	Minutes	Lat	Long	Lat	Long	Knots	Fathoms	Fathoms	Heading
Celtic 2008-1	4/10/2008	1	0940	15	40-35-012	72-10-680	40-34-702	72-11-870	3.9	28	85	274
Celtic 2008-1	4/10/2008	2	1016	15	40-33-555	72-14-480	40-33-040	72-15-500	3.8	28	85	245
Celtic 2008-1	4/10/2008	3	1045	15	40-31-920	72-16-100	40-31-080	72-16-168	3.8	27	85	190
Celtic 2008-1	4/10/2008	4	1121	15	40-28-960	72-17-770	40-28-000	72-18-000	3.8	30	90	217
Celtic 2008-1	4/10/2008	5	1148	15	40-27-370	72-18-722	40-26-500	72-19-280	3.9	31	90	219
Celtic 2008-1	4/10/2008	6	1213	15	40-25-967	72-19-670	40-25-146	72-20-140	3.8	30	90	215
Celtic 2008-1	4/10/2008	7	1240	15	40-24-583	72-20-520	40-23-690	72-21-130	3.8	30	90	214
Celtic 2008-1	4/10/2008	8	1419	15	40-13-000	72-28-780	40-12-550	72-29-257	3.8	32	90	240
Celtic 2008-1	4/10/2008	9	1445	15	40-11-765	72-29-530	40-11-160	72-30-470	3.8	33	100	237
Celtic 2008-1	4/10/2008	10	1510	15	40-10-880	72-31-047	40-10-206	72-31-675	3.9	34	100	254
Celtic 2008-1	4/10/2008	11	1536	15	70-09-570	72-32-075	40-08-780	72-32-708	3.8	33	95	215
Celtic 2008-1	4/10/2008	12	1600	15	40-08-339	72-33-057	40-07-400	72-33-791	3.8	32	95	229
Celtic 2008-1	4/10/2008	13	1626	15	40-07-040	72-34-140	40-06-273	72-34-844	3.8	30	90	228
Celtic 2008-1	4/10/2008	14	1650	15	40-05-861	72-35-180	40-05-112	72-35-940	3.8	30	90	228
Celtic 2008-1	4/10/2008	15	1713	15	40-04-750	72-36-208	40-04-060	72-36-927	3.8	30	90	231
Celtic 2008-1	4/10/2008	16	1755	15	40-01-557	72-36-990	40-00-630	72-37-200	3.8	31	90	204
Celtic 2008-1	4/10/2008	17	1820	15	40-00-155	72-37-202	39-59-360	72-37-977	3.8	32	95	205
Celtic 2008-1	4/10/2008	18	1902	15	39-57-357	72-37-314	39-56-430	72-36-747	3.9	32	95	170

Celtic 2008-1	4/11/2008	19	0657	15	39-09-950	73-03-033	79-10-735	73-02-271	3.8	38	115	049
Celtic 2008-1	4/11/2008	20	0722	15	39-10-478	73-02-488	39-09-000	73-03-369	3.8	35	115	238
Celtic 2008-1	4/11/2008	21	0806	15	39-08-440	73-05-181	39-07-670	73-06-305	3.8	37	115	237
Celtic 2008-1	4/11/2008	22	0848	15	39-05-827	73-07-633	39-04-950	73-08-170	3.8	39	120	219
Celtic 2008-1	4/11/2008	23	0925	15	39-03-786	73-09-070	39-03-727	73-10-379	3.8	39	120	282
Celtic 2008-1	4/11/2008	24	1012	15	39-03-000	73-13-980	39-02-690	73-15-230	3.8	38	120	264
Celtic 2008-1	4/11/2008	25	1037	15	39-02-511	73-15-988	39-02-450	73-17-215	3.9	37	115	283
Celtic 2008-1	4/11/2008	26	1103	15	39-02-333	73-18-050	39-02-312	73-19-350	3.8	37	115	277

Appendix Table 1

Bridge Data Log

F/V Celtic 2008-1

Trip	Date	Tow #	Time	Tow Time	Start Position		End Position		Speed	Depth	Wire out	Vessel
			Start	Minutes	Lat	Long	Lat	Long	Knots	Fathoms	Fathoms	Heading
Celtic 2008-1	4/11/2008	27	1132	15	39-02-259	73-20-783	39-02-217	73-22-176	3.9	33	100	279
Celtic 2008-1	4/11/2008	28	1208	15	39-02-012	73-24-557	39-01-930	73-25-830	3.8	31	90	277
Celtic 2008-1	4/11/2008	29	1328	15	38-58-317	73-29-530	38-57-589	73-30-316	3.8	27	80	227
Celtic 2008-1	4/11/2008	30	1355	15	38-57-169	73-31-142	38-56-595	73-32-144	3.8	28	80	253
Celtic 2008-1	4/11/2008	31	1422	15	38-56-386	73-32-799	38-55-878	73-33-789	3.8	27	80	251
Celtic 2008-1	4/11/2008	32	1445	15	38-55-652	73-34-338	38-55-464	73-35-618	3.8	26	75	271
Celtic 2008-1	4/11/2008	33	1510	15	38-55-350	73-36-400	38-55-168	73-37-000	3.8	23	70	271
Celtic 2008-1	4/11/2008	34	1536	15	38-54-800	73-38-817	38-54-000	73-39-731	3.8	25	70	255
Celtic 2008-1	4/11/2008	35	1605	15	38-53-808	73-40-608	38-53-233	73-41-590	3.8	23	70	247
Celtic 2008-1	4/11/2008	36	1630	15	38-52-358	73-42-400	38-52-350	73-43-447	3.8	24	70	265
Celtic 2008-1	4/11/2008	37	1655	15	38-52-030	73-43-788	38-51-214	73-44-530	3.8	25	75	228
Celtic 2008-1	4/11/2008	38	1733	15	38-49-438	73-43-514	38-48-700	73-42-787	3.8	28	85	156
Celtic 2008-1	4/11/2008	39	1759	15	38-48-230	73-42-367	38-47-482	73-41-619	3.8	28	85	160
Celtic 2008-1	4/11/2008	40	1825	15	38-46-971	73-41-070	38-46-107	73-40-920	3.8	28	85	215
Celtic 2008-1	4/12/2008	41	0635	15	38-32-496	73-54-055	38-33-236	73-53-266	3.8	29	90	057
Celtic 2008-1	4/12/2008	42	0712	15	38-33-987	73-52-555	38-34-773	73-51-785	3.8	30	90	055
Celtic 2008-1	4/12/2008	43	0753	15	38-35-735	73-50-935	38-36-574	73-49-978	3.8	30	90	059
Celtic 2008-1	4/12/2008	44	0835	15	38-37-709	73-48-484	38-38-218	73-47-547	3.8	30	90	076
Celtic 2008-1	4/12/2008	45	0903	15	38-38-806	73-46-658	38-39-119	73-45-569	3.8	30	90	075

Celtic 2008-1	4/12/2008	46	0935	15	38-39-761	73-44-111	38-39-945	73-43-005	3.8	30	90	087
Celtic 2008-1	4/12/2008	47	1012	15	38-40-724	73-41-980	38-41-213	73-40-917	3.8	30	90	058
Celtic 2008-1	4/12/2008	48	1419	15	38-47-616	73-36-036	38-48-300	73-35-200	3.8	28	90	058
Celtic 2008-1	4/12/2008	49	1458	15	38-49-377	73-33-858	38-50-040	73-32-972	3.8	31	90	060
Celtic 2008-1	4/12/2008	50	1537	15	38-50-926	73-31-782	38-51-561	73-30-800	3.9	31	90	064
Celtic 2008-1	4/12/2008	51	1612	15	38-52-325	73-29-508	38-52-912	73-28-530	3.9	32	90	068
Celtic 2008-1	4/12/2008	52	1651	15	38-54-325	73-26-630	38-54-923	73-25-604	3.8	34	105	062
Celtic 2008-1	4/12/2008	53	1734	15	38-56-995	73-23-630	38-57-723	73-22-962	3.8	34	105	051
Celtic 2008-1	4/12/2008	54	1817	15	39-00-540	73-22-186	39-01-460	73-22-145	3.9	34	105	016
Celtic 2008-1	4/13/2008	55	0700	15	39-50-158	72-54-276	39-50-889	72-53-217	3.8	33	100	062

Appendix Table 1

Bridge Data Log

F/V Celtic 2008-1

Trip	Date	Tow #	Time	Tow Time	Start Position		End Position		Speed	Depth	Wire out	Vessel
			Start	Minutes	Lat	Long	Lat	Long	Knots	Fathoms	Fathoms	Heading
Celtic 2008-1	4/13/2008	56	0730	15	39-51-442	72-51-952	39-51-935	72-50-817	3.8	30	90	095
Celtic 2008-1	4/13/2008	57	0758	15	39-51-750	72-49-902	39-51-968	72-48-436	3.8	30	90	095
Celtic 2008-1	4/13/2008	58	0826	15	39-52-175	72-46-875	39-52-346	72-45-625	3.8	30	90	097
Celtic 2008-1	4/13/2008	59	0856	15	39-52-290	72-44-077	39-52-113	72-42-870	3.9	30	90	116
Celtic 2008-1	4/13/2008	60	0927	15	39-51-832	72-41-267	39-51-585	72-40-068	3.8	32	95	117
Celtic 2008-1	4/13/2008	61	1000	15	39-51-058	72-38-334	39-50-720	72-37-190	3.8	32	95	129
Celtic 2008-1	4/13/2008	62	1035	15	39-50-235	72-35-597	39-50-839	72-34-702	3.8	32	95	128
Celtic 2008-1	4/13/2008	63	1130	15	39-52-816	72-32-204	39-53-507	72-31-116	3.8	37	112	066
Celtic 2008-1	4/13/2008	64	1208	15	39-54-700	72-29-782	39-55-695	72-29-499	3.8	36	105	048
Celtic 2008-1	4/13/2008	65	1330	15	39-58-660	72-29-000	39-59-648	72-30-300	3.8	36	105	200
Celtic 2008-1	4/13/2008	66	1400	15	39-58-780	72-29-875	39-57-925	72-29-908	3.8	35	105	198
Celtic 2008-1	4/13/2008	67	1430	15	39-56-955	72-29-850	39-56-030	72-29-845	3.8	0.35	105	151
Celtic 2008-1	4/13/2008	68	1506	15	39-54-377	72-30-154	39-53-400	72-30-302	3.8	35	105	151
Celtic 2008-1	4/13/2008	69	1548	15	39-50-703	72-30-758	39-49-667	72-30-809	3.8	35	105	199
Celtic 2008-1	4/13/2008	70	1632	15	39-47-384	72-32-384	39-46-893	72-33-304	3.8	34	100	250
Celtic 2008-1	4/13/2008	71	1714	15	39-45-732	72-36-565	39-45-331	72-37-695	3.8	33	100	260
Celtic 2008-1	4/13/2008	72	1748	15	39-44-548	72-39-198	39-43-611	72-39-786	3.8	38	115	230
Celtic 2008-1	4/13/2008	73	1819	15	39-42-555	72-40-948	39-41-999	72-41-950	3.8	37	115	237
Celtic 2008-1	4/14/2008	74	0700	15	38-38-138	73-40-289	38-37-472	73-41-296	3.8	31	90	248

Celtic 2008-1	4/14/2008	75	0735	15	38-36-723	73-42-582	38-36-011	73-43-881	3.8	31	90	250
Celtic 2008-1	4/14/2008	76	0820	15	38-34-026	73-46-140	38-33-178	73-46-791	3.8	31	90	226
Celtic 2008-1	4/14/2008	77	0905	15	38-30-095	73-48-678	38-29-405	73-49-325	3.8	33	100	225
Celtic 2008-1	4/14/2008	78	0943	15	38-27-800	73-51-576	38-27-392	73-52-630	3.8	32	100	256
Celtic 2008-1	4/14/2008	79	1015	15	38-26-680	73-54-595	38-26-294	73-55-728	3.8	31	95	261
Celtic 2008-1	4/14/2008	80	1050	15	38-26-255	73-56-084	38-27-130	73-55-715	3.8	31	90	055
Celtic 2008-1	4/14/2008	81	1132	15	38-28-917	73-54-561	38-29-753	73-53-826	3.8	31	90	058
Celtic 2008-1	4/14/2008	82	1350	15	38-37-950	73-45-638	38-38-656	73-44-820	3.8	31	90	057
Celtic 2008-1	4/14/2008	83	1433	15	38-41-073	73-42-406	38-41-709	73-41-674	3.8	30	90	055
Celtic 2008-1	4/14/2008	84	1515	15	38-43-652	73-39-470	38-44-351	73-38-564	3.8	31	90	060
Celtic 2008-1	4/14/2008	85	1552	15	38-45-580	73-36-505	38-46-100	73-35-416	3.8	32	95	072
Celtic 2008-1	4/14/2008	86	1633	15	38-47-551	73-32-575	38-48-060	73-31-445	3.8	32	95	069
Celtic 2008-1	4/14/2008	87	1710	15	38-39-624	73-29-806	38-50-203	73-28-909	3.8	31	95	049
Celtic 2008-1	4/14/2008	88	1748	15	38-52-280	73-28-335	38-53-248	73-28-370	3.8	32	95	049

Appendix Table 2

Catch Data

F/V Celtic 2007-3

Port	New Dredge w/wheels & chains								Stbd	Standard dredge							
Tow #	scallops	scallops	Trash	skates	grey sole	fourspot	Yellowtail	monk		scallops	scallops	Trash	skates	grey sole	fourspot	Yellowtail	monk
	(bu)	#	bu							(bu)	#	bu					
1	0.8	253	1.2	3	0	2	0	1		1	262	0.75	3	0	1	0	0
2	1	173	0.75	10	0	0	0	1		0.5	100	0.75	8	0	0	0	0
4	0.75	152	0.75	6	0	2	0	0		0.8	189	0.8	3	0	1	0	0
5	0.9	275	0.75	4	0	0	0	1		1.1	275	0.75	6	0	2	0	1
6	1.8	845	1	4	0	1	0	2		2.3	995	1.5	6	0	2	0	0
7	1	137	3	15	0	6	0	1		1.2	168	4	6	0	1	0	3
8	2	506	2.5	5	0	0	0	2		1.5	405	6	2	0	1	0	1
10	0.7	166	2	0	2	1	0	5		0.7	104	5	0	1	5	0	2
11	0.3	51	3	4	2	0	0	0		0.5	50	6	2	1	2	0	1
12	0.7	116	0.75	2	1	0	0	3		0.25	48	0.5	1	0	1	0	1
Totals	9.95	2674	15.7	53	5	12	0	16		9.85	2596	26.1	37	2	16	0	9

Appendix Table 2

Catch Data

F/V Celtic 2007-3

Port	New Dredge w/chains but no wheels								Stbd	Standard dredge							
Tow #	scallops	scallops	Trash	skates	grey sole	fourspot	Yellowtail	monk		scallops	scallops	Trash	skates	grey sole	fourspot	Yellowtail	monk
	(bu)	#	bu							(bu)	#	bu					
13	0.5	92	0.5	1	1	0	0	0		0.5	82	0.75	1	0	0	0	1
14	1	182	0.5	0	0	0	0	0		0.9	164	0.5	5	0	1	0	0
15	1.5	321	4.5	5	0	0	0	0		1.5	283	3.5	9	0	1	0	0
16	1.8	434	3	13	0	2	0	1		1.5	334	4.75	9	2	4	0	0
17	2.5	660	1	4	0	1	0	3		2	510	0.5	2	0	1	0	1
18	1	228	2.75	6	0	7	0	2		1.2	236	7	10	0	1	0	1
19	0.25	39	1.5	4	0	1	0	1		0.25	35	3	0	0	0	0	0
20	0.5	59	3.5	4	0	1	0	0		0.33	45	6	8	0	2	0	0
21	0.66	80	3.5	10	1	6	0	1		0.5	48	4	5	2	1	0	1
22	0.9	159	2.75	5	1	8	0	0		0.8	150	2.5	7	0	1	0	1
Total	10.61	2254	23.5	52	3	26	0	8		9.48	1887	32.5	56	4	12	0	5

Appendix Table 2

Catch Data

F/V Celtic 2007-3

Port	New Dredge w/chains but no wheels								Stbd	New Dredge w/wheels & chains							
Tow #	scallops	scallops	Trash	skates	grey sole	fourspot	Yellowtail	monk		scallops	scallops	Trash	skates	grey sole	fourspot	Yellowtail	monk
	(bu)	#	bu							(bu)	#	bu					
23	0.33	57	1	6	0	1	1	0		0.33	62	1	8	0	1	0	2
24	0.33	71	1	9	0	0	0	1		0.33	60	1	11	0	2	0	0
25	0.33	64	1.25	9	0	1	0	0		0.33	74	1.25	12	0	0	0	1
26	1.1	143	3	30	2	1	1	0		0.8	105	3	10	0	5	0	0
27	0.5	69	1.25	7	1	0	0	0		0.5	64	1	6	0	2	0	0
28	0.5	62	3.75	14	0	5	1	1		0.5	86	4	5	0	1	0	0
29	0.25	32	4.5	17	0	1	0	2		0.25	43	4.5	13	0	0	0	0
30	0.25	31	7.25	20	0	1	1	0		0.25	31	7.75	11	0	1	0	0
31	0.33	48	8.75	5	0	0	3	0		0.33	40	9	10	0	2	0	0
32	0.33	43	9.5	11	0	5	0	0		0.33	44	11	17	0	5	2	0
Total	4.25	620	41.3	128	3	15	7	4		3.95	609	43.5	103	0	19	2	3

Appendix Table 2

Catch Data

F/V Celtic 2007-3

Port	Standard dredge								Stbd	New Dredge w/wheels & chains							
Tow #	scallops	scallops	Trash	skates	grey sole	fourspot	Yellowtail	monk		scallops	scallops	Trash	skates	grey sole	fourspot	Yellowtail	monk
	(bu)	#	bu							(bu)	#	bu					
33	0.5	56	9	23	0	15	0	1		0.33	38	23	18	0	25	1	0
34	0.33	47	10	26	0	15	0	0		0.33	48	38.5	30	0	35	0	0
35	0.5	64	2	15	1	15	0	0		0.5	88	2	33	0	22	1	3
36	0.15	29	25	17	0	7	0	2		0.25	41	42	22	0	14	1	0
37	0.15	23	8.5	14	1	21	1	0		0.15	19	41	15	0	28	0	0
38	0.15	23	16	12	1	20	2	2		0.15	18	38	12	1	20	1	1
39	0.5	48	9	23	1	15	1	1		0.5	55	21	22	1	25	1	3
40	1	132	3.5	11	0	16	2	0		0.8	96	11	12	0	32	1	1
41	0.5	65	2	26	0	9	1	2		0.5	68	6	15	0	13	2	1
42	0.6	96	0.75	25	0	3	0	1		0.8	120	0.75	30	0	11	1	0
43	0.8	127	1.75	40	0	12	5	7		0.7	102	2	46	1	24	2	5
44	1	220	3	19	1	10	1	2		0.9	131	3	15	0	31	1	1
45	0.25	35	4.25	14	0	5	1	2		0.15	19	9	18	0	24	4	1
Totals	6.43	965	94.8	265	5	163	14	20		6.06	843	237	288	3	304	16	16

Appendix Table 2

Catch Data

F/V Celtic 2007-3

Port	Standard dredge								Stbd	New Dredge w/wheels & no chains							
Tow #	scallops	scallops	Trash	skates	grey sole	fourspot	Yellowtail	monk		scallops	scallops	Trash	skates	grey sole	fourspot	Yellowtail	monk
	(bu)	#	bu							(bu)	#	bu					
46	0.25	33	1.5	20	0	2	0	3		0.25	34	2.5	12	0	4	3	0
47	0.15	30	5.5	8	0	7	1	1		0.15	42	17	11	0	17	0	1
48	0.25	44	6	7	0	7	0	2		0.25	38	14	7	0	14	2	1
49	0.5	48	1.75	12	0	8	0	1		0.5	42	13	12	0	5	0	1
50	1	89	3.5	8	0	4	0	2		0.8	85	4	9	2	5	0	4
51	0.33	46	4.5	23	3	18	3	5		0.33	53	10.5	29	0	21	2	1
52	0.15	29	3.75	14	0	5	1	0		0.15	27	9.25	19	0	9	0	1
53	1.1	176	9	26	0	14	7	3		1.1	206	15	26	0	9	1	6
54	1.1	168	5	48	0	8	1	0		1	146	7	27	0	5	2	2
55	1.1	208	40	23	0	4	0	1		1.1	199	45	8	0	3	3	1
Totals	5.93	871	80.5	189	3	77	13	18		5.63	872	137	160	2	92	13	18

Appendix Table 2

Catch Data

F/V Celtic 2007-4

Port	New Dredge w/liner & 4.5" twine top								Stbd	New Dredge w/ no liner & 4.5" twine top							
Tow #	scallops	scallops	Trash	skates	grey sole	fourspot	Yellowtail	monk		scallops	scallops	Trash	skates	grey sole	fourspot	Yellowtail	monk
	(bu)	#	bu							(bu)	#	bu					
56	0.5	104	12.5	20	0	11	5	2		0.25	124	12.5	26	0	14	1	2
57	0.25	43	8.5	10	0	13	2	1		0.5	75	9	4	0	5	0	2
58	0.5	105	7	37	0	9	2	2		1	160	7	44	0	11	10	1
59	0.2	21	13.3	12	0	7	0	1		0.25	32	13.5	27	0	8	3	1
60	0.1	5	10.5	12	0	11	1	1		0.1	10	10.8	13	0	6	1	1
61	0.25	48	10.5	1	0	5	0	0		0.5	87	7	6	0	7	0	0
62	0.25	13	11.5	8	0	1	0	0		0.25	23	7.5	8	0	4	0	1
63	0.25	51	13	5	0	2	1	0		0.5	48	13	18	0	1	1	3
64	0.25	30	14	8	0	3	0	0		0.5	48	13	6	0	5	0	0
65	0.25	24	11	11	0	3	0	0		0.5	55	13	4	0	5	0	0
66	0.25	36	11	12	0	4	0	0		0.5	38	8.5	17	0	8	1	0
67	0.25	16	6.25	6	0	6	0	2		0.5	50	5	12	0	6	0	1
68	0.75	87	7	6	0	4	0	1		1	140	1.5	11	1	4	0	1
69	0.25	11	7	6	0	2	0	0		0.5	50	0.75	13	2	6	0	0
70	0.25	60	2.5	3	0	6	0	1		0.5	60	1	7	0	1	0	0
Totals	4.55	654	146	157	0	87	11	11		7.35	1000	123	216	3	91	17	13

Appendix Table 2

Catch Data

F/V Celtic 2007-4

Port	New Dredge w/ no liner & 4.5' twine top								Stbd	New Dredge w/liner & 4.5' twine top							
Tow#	scallops	scallops	Trash	skates	grey sole	fourspot	Yellowtail	monk		scallops	scallops	Trash	skates	grey sole	fourspot	Yellowtail	monk
	(bu)	#	bu							(bu)	#	bu					
71	1.5	359	2	14	0	3	0	0		1.25	285	3	6	0	1	0	1
72	1.75	334	2	6	0	0	0	2		2	1070	2	9	0	4	0	0
73	1.5	278	1	3	0	1	0	1		1.75	794	1.75	2	0	0	0	0
74	1.25	206	0.5	3	0	3	0	0		1.25	426	1	3	0	1	0	2
75	0.9	135	0.5	2	0	1	0	1		1	237	0.75	4	0	4	0	1
76	1	123	3	4	5	0	0	2		0.25	43	5.5	6	0	2	0	1
77	0.75	160	2	1	0	1	0	1		0.5	107	5.5	9	0	3	0	3
78	1	298	1.5	3	0	3	0	1		0.75	279	3.75	3	0	5	0	0
79	1.25	361	1	2	0	1	0	0		1.25	400	3	3	0	4	0	1
80	1	143	1.25	10	0	1	0	0		0.5	103	6	5	0	2	0	0
Totals	11.9	2397	14.8	48	5	14	0	8		10.5	3744	32.3	50	0	26	0	9

Appendix Table 2

Catch Data

F/V Celtic 2007-4

Port	New Dredge w/ no liner & 6" twine top								Stbd	New Dredge w/liner & 4.5" twine top							
Tow #	scallops	scallops	Trash	skates	grey sole	fourspot	Yellowtail	monk		scallops	scallops	Trash	skates	grey sole	fourspot	Yellowtail	monk
	(bu)	#	bu							(bu)	#	bu					
81	0.5	103	1	10	0	2	0	0		0.75	97	6	3	0	2	0	0
82		0									0						
83	1.25	250	1	7	1	3	0	0		1.25	256	4.5	8	0	2	0	0
84	0.5	232	1.5	5	0	2	0	0		1	418	3.5	2	0	5	0	0
85	0.75	129	0.75	6	2	2	0	2		0.75	150	5.5	3	2	2	0	1
86	0.75	79	1	2	1	0	0	0		0.5	69	5	9	1	2	0	0
87	0.5	84	0.5	6	0	0	0	1		0.75	209	1.5	3	0	1	0	0
88	1.5	182	0.5	3	0	2	0	0		1	339	1.25	9	0	2	0	0
89	1.25	390	2	2	0	1	0	0		1.25	340	0.75	2	0	4	0	0
90	1.25	244	2	7	0	0	0	1		1.75	212	1.75	13	0	4	0	0
91	1.5	195	1.5	10	0	3	0	1		1.75	73	5.5	12	0	3	0	0
Totals	9.75	1888	11.8	58	4	15	0	5		10.75	2163	35.3	64	3	27	0	1

F/V Celtic 2007-4[illegible]

Appendix Table 2

Combined Catch Data

F/V Celtic 2007-4

	New Dredge w/liner & 4.5" twine top										New Dredge w/ no liner & 4.5" twine top								
Tow #	scallops	scallops	Trash	skates	grey sole	fourspot	Yellowtail	monk			scallops	scallops	Trash	skates	grey sole	fourspot	Yellowtail	monk	
	(bu)	#	bu								(bu)	#	bu						
56	0.5	104	12.5	???	0	11	5	2			0.25	124	12.5	26	0	14	1	2	
57	0.25	43	8.5	10	0	13	2	1			0.5	75	9	4	0	5	0	2	
58	0.5	105	7	37	0	9	2	2			1	160	7	44	0	11	10	1	
59	0.2	21	13.3	12	0	7	0	1			0.25	32	13.5	27	0	8	3	1	
60	0.1	5	10.5	12	0	11	1	1			0.1	10	10.8	13	0	6	1	1	
61	0.25	48	10.5	1	0	5	0	0			0.5	87	7	6	0	7	0	0	
62	0.25	13	11.5	8	0	1	0	0			0.25	23	7.5	8	0	4	0	1	
63	0.25	51	13	5	0	2	1	0			0.5	48	13	18	0	1	1	3	
64	0.25	30	14	8	0	3	0	0			0.5	48	13	6	0	5	0	0	
65	0.25	24	11	11	0	3	0	0			0.5	55	13	4	0	5	0	0	
66	0.25	36	11	12	0	4	0	0			0.5	38	8.5	17	0	8	1	0	
67	0.25	16	6.25	6	0	6	0	2			0.5	50	5	12	0	6	0	1	
68	0.75	87	7	6	0	4	0	1			1	140	1.5	11	1	4	0	1	
69	0.25	11	7	6	0	2	0	0			0.5	50	0.75	13	2	6	0	0	
70	0.25	60	2.5	3	0	6	0	1			0.5	60	1	7	0	1	0	0	
71	1.25	285	3	6	0	1	0	1			1.5	359	2	14	0	3	0	0	
72	2	1070	2	9	0	4	0	0			1.75	334	2	6	0	0	0	2	
73	1.75	794	1.75	2	0	0	0	0			1.5	278	1	3	0	1	0	1	
74	1.25	426	1	3	0	1	0	2			1.25	206	0.5	3	0	3	0	0	
75	1	237	0.75	4	0	4	0	1			0.9	135	0.5	2	0	1	0	1	
76	0.25	43	5.5	6	0	2	0	1			1	123	3	4	5	0	0	2	
77	0.5	107	5.5	9	0	3	0	3			0.75	160	2	1	0	1	0	1	
78	0.75	279	3.75	3	0	5	0	0			1	298	1.5	3	0	3	0	1	
79	1.25	400	3	3	0	4	0	1			1.25	361	1	2	0	1	0	0	
80	0.5	103	6	5	0	2	0	0			1	143	1.25	10	0	1	0	0	
Totals	15.05	4398	178	187	0	113	11	20			19.25	3397	138	264	8	105	17	8	

Appendix Table 2

Combined Catch Data

F/V Celtic 2007-4

	New Dredge w/liner & 4.5" twine top										New Dredge w/ no liner & 6" twine top								
	scallops	scallops	Trash	skates	grey sole	fourspot	Yellowtail				scallops	scallops	Trash	skates	grey sole	fourspot	ellowta	monk	
	(bu)	#	bu								(bu)	#	bu						
81	0.75	97	6	3	0	2	0	0			0.5	103	1	10	0	2	0	0	
82		0										0							
83	1.25	256	4.5	8	0	2	0	0			1.25	250	1	7	1	3	0	0	
84	1	418	3.5	2	0	5	0	0			0.5	232	1.5	5	0	2	0	0	
85	0.75	150	5.5	3	2	2	0	1			0.75	129	0.75	6	2	2	0	2	
86	0.5	69	5	9	1	2	0	0			0.75	79	1	2	1	0	0	0	
87	0.75	209	1.5	3	0	1	0	0			0.5	84	0.5	6	0	0	0	1	
88	1	339	1.25	9	0	2	0	0			1.5	182	0.5	3	0	2	0	0	
89	1.25	340	0.75	2	0	4	0	0			1.25	390	2	2	0	1	0	0	
90	1.75	212	1.75	13	0	4	0	0			1.25	244	2	7	0	0	0	1	
91	1.75	73	5.5	12	0	3	0	0			1.5	195	1.5	10	0	3	0	1	
92	0.25	11	3	1	0	2	0	0			1	124	1	9	0	1	0	0	
93	0.25	46	5.75	11	0	4	0	0			1	142	0.5	10	0	1	0	2	
94	0.5	64	8.75	2	0	6	0	1			0.75	90	3	4	0	3	0	1	
95	0.25	28	13	11	0	6	0	0			0.5	36	1	8	0	1	1	1	
96	0.25	45	13	11	0	3	0	0			0.25	38	5	14	0	1	0	0	
97	0.25	20	12.5	5	0	2	0	0			0.25	31	5	10	0	3	0	0	
98	0.25	24	14	1	0	2	0	0			0.25	21	4	8	0	2	0	0	
99	1	177	15.5	25	0	6	0	1			1.25	158	5	51	0	2	1	0	
100	1	150	14.5	27	0	11	1	0			1	142	3	19	0	5	4	2	
101	1	172	15.5	24	0	16	0	1			1.5	232	7	19	0	5	1	0	
Totals	15.75	2900	151	182	3	85	1	4			17.5	2902	46.3	210	4	39	7	11	

Appendix Table 2

Catch Data

F/V Celtic 2007-5

3.8	3:1							4:1							
Tow #	scallops	scallops	Trash	skates	fourspot	Yellowtail	monk		scallops	scallops	Trash	skates	fourspot	Yellowtail	monk
	bu	#	bu						bu	#	bu				
4	1	182	10	12	12	1	0		0.5	81	8	16	14	1	0
5	0.6	115	8	17	7	0	0		0.75	107	8	17	13	0	0
10									0.1	31	6	17	5	1	0
11	0.1	23	5	16	7	1	0								
14	0.1	4	11	0	4	2	1								
15									0.1	7	12	1	5	0	0
20	0.4	60	10.5	28	9	0	2		0.2	35	11	27	13	1	0
21	0.9	134	7.5	20	13	0	1		0.6	94	9	12	18	0	1
24	0.4	68	12	10	12	0	1		0.2	36	13	20	13	0	3
25	0.4	74	12	15	14	1	2		0.4	71	13	19	5	0	0
28	0.6	98	14	12	8	0	0		0.4	82	11	16	13	1	1
29	0.4	75	10	20	10	0	0		0.2	68	11	36	16	0	0
32	0.2	51	10	20	8	0	0		0.1	40	10.5	24	16	0	0
33	0.3	80	8	16	12	0	0		0.5	108	8.5	10	12	0	0
36	0.6	97	12	17	15	1	0		0.5	95	10	13	13	0	1
37	0.2	48	10	15	5	0	0		0.3	64	15.5	8	10	1	1
40	0.8	151	8.5	10	9	0	1		0.8	144	8	10	12	0	0
41	0.5	141	4	9	8	0	1		0.7	155	3	7	5	1	0
42	1	226	5	18	11	0	1		1	239	6	23	12	0	2
43	0.9	232	6.5	11	7	0	0		1	247	7	17	10	0	0
48	0.9	216	8	9	8	0	0		0.8	110	9	9	9	0	0
49	0.9	202	3	6	20	0	0		0.8	176	3	12	11	0	3
50	1	201	7	8	6	0	1		1	179	9	13	11	0	1
51	1	244	5.5	9	13	1	0		1	230	3	21	17	1	2
Totals	13.2	2722	188	298	218	7	11		11.95	2399	195	348	253	7	15
Avg	0.60	123.73	8.52	13.55	9.91	0.32	0.50		0.54	109.05	8.84	15.82	11.50	0.32	0.68

Appendix Table 2

Catch Data

F/V Celtic 2007-5

4.5	3:1								4:1						
Tow #	scallops	scallops	Trash	skates	fourspot	Yellowtail	monk		scallops	scallops	Trash	skates	fourspot	Yellowtail	monk
	(bu)	#	bu						(bu)	#	bu				
6	0.5	102	6	12	7	0	0		0.75	132	6	9	22	0	0
8	0.1	26	8	15	9	0	1								
9									0.2	26	5	14	8	0	3
12									0.1	14	10	4	4	2	2
13	0.1	12	12	3	6	0	0								
16	0.1	25	5	17	5	0	0								
17									0.1	23	3	13	4	2	0
18	0.7	113	14	7	7	1	1		0.2	51	12	15	7	2	1
19	0.3	75	16	18	13	3	0		0.2	43	12	17	10	1	0
22	0.8	125	13	15	19	1	0		0.7	113	10	20	8	1	0
23	0.5	81	12	10	6	0	0		0.3	61	14	26	11	0	0
26	0.2	56	13.5	13	11	1	0		0.2	43	12	20	11	3	0
27	0.5	71	13	14	12	0	1		0.5	49	12	31	7	0	1
30	0.6	106	15	11	12	2	0		0.4	72	8	11	6	0	0
31	0.5	72	11	13	8	1	2		0.4	74	10	13	16	1	3
34	0.6	107	16	8	8	0	0		0.5	85	16	17	15	0	0
35	0.7	126	10	14	9	0	3		0.3	67	9	13	10	0	1
38	0.4	123	4	11	4	0	0		0.6	179	3	4	9	0	0
39	0.6	99	8	6	12	0	3		0.4	78	6	13	11	0	3
44	0.2	53	9.5	10	13	0	1		0.2	35	7	13	11	1	0
45	0.3	53	8	7	8	0	0		0.2	42	7.5	8	9	0	1
46	0.6	229	5.5	18	9	2	0		0.7	206	5.5	17	11	1	3
47	0.9	219	7	16	14	1	1		0.8	224	5	20	10	0	1
52	0.9	121	5.5	7	11	0	1		0.5	87	7	12	14	0	0
53	0.6	156	4.5	12	5	1	0		0.6	127	5	16	11	0	1
Totals	10.7	2150	217	257	208	13	14		8.85	1831	185	326	225	14	20
Avg	0.49	97.73	9.84	11.68	9.45	0.59	0.64		0.40	83.23	8.41	14.82	10.23	0.64	0.91

Appendix Table 2 Catch Data F/V Celtic 2008-1

Port	New Dredge #9 with 7 x 4 chains									Stbd	News Dredge #12 no chains			
Tow #	scallops	scallops	Trash	skates	grey sole	fourspot	Yellowtail	fluke	monk		scallops	scallops	Trash	skates
	(bu)	#	bu								(bu)	#	bu	
1	0.1	18	6.5	12	0	9	0	0	0		0.33	51	6.25	18
2	0.1	17	6.75	8	1	4	2	0	0		0.1	13	5.25	8
3	0	5	16	18	0	11	0	1	0		0	10	25	11
4	0.1	10	10.5	15	0	10	1	0	1		0.1	14	4.5	9
5	0.1	17	9	17	1	11	0	1	3		0.1	22	11	24
6	0.1	11	7	9	0	3	0	0	1		0.1	22	15	5
7	0.1	20	11	8	0	9	1	0	0		0.25	49	17.5	5
8	0.2	28	4.5	25	0	6	0	1	0		0.2	33	4.25	13
9	0.1	16	9	5	0	8	0	0	2		0.1	19	12	10
10	0.1	49	5	6	0	15	0	1	1		0.1	58	4.5	11
11	0.1	14	4.25	10	0	4	0	0	1		0.1	27	6	5
12	0.1	50	5	17	0	8	1	0	0		0.1	63	6	10
13	0.1	98	6.25	7	0	8	0	0	0		0.1	156	8	10
14	0.1	189	7	20	0	7	0	0	0		0.1	164	7.5	16

15	0.1	108	2	28	0	8	0	1	1		0.2	72	4	23
16	0.3	92	3	38	0	18	0	0	0		0.3	109	4	41
17	0.8	860	2	21	0	7	0	1	0		1	1258	3	16
18	0.7	684	6.75	5	0	6	0	1	0		1	884	9	7
Totals	3.3	2286	122	269	2	152	5	7	10		4.28	3024	153	242

Appendix Table 2

Catch Data

F/V Celtic 2008-1

Stbd	New Dredge #9 with 7 x 4 chains									Port	News Dredge #12 no chains							
Tow #	scallops	scallops	Trash	skates	grey sole	fourspot	Yellowtail	fluke	monk		scallops	scallops	Trash	skates	grey sole	fourspot	Yellowtail	fluke
	(bu)	#	bu								(bu)	#	bu					
19	1.3	399	1.75	2	0	9	0	0	2		2	518	1.5	6	0	5	0	0
20	1.5	404	1.5	6	0	9	0	1	5		2.2	638	2	7	0	7	0	2
21	1.5	413	2	8	0	3	0	0	1		2.5	680	2	12	1	7	0	1
22	0.8	181	2.25	5	1	17	0	0	4		1.5	311	4	14	2	8	0	0
23	1	292	3	11	0	9	0	0	3		1.9	509	3.5	10	0	7	0	0
24	0.1	19	4.5	2	0	6	0	1	2		0.1	28	5	1	0	8	0	0
25	0.1	17	6	2	1	13	0	0	1		0.5	83	8	2	0	13	0	1
26	0.4	129	4.5	2	0	19	0	0	3		0.7	150	5	4	0	20	0	0
27	1.4	526	4.5	21	0	6	0	0	1		1.4	494	5.5	15	0	8	0	0
28	0.8	360	4.25	13	1	10	0	1	0		1.1	440	5	13	0	4	0	0
29	0.6	264	6.75	4	0	2	0	1	0		0.8	262	7.5	4	0	0	0	0
30	0.25	108	7	8	0	2	0	0	0		0.25	85	9	2	0	2	0	1
31	0.2	95	13	6	0	5	0	0	0		0.3	125	10.5	5	0	1	0	0
32	0.1	18	6	2	0	3	0	0	2		0.1	65	11	2	0	2	0	0
33	0.1	40	7.5	3	0	0	0	0	0		0.2	72	9	0	0	0	0	0
34	0.2	84	10.3	2	0	0	0	1	2		0.3	116	15	3	0	1	0	0
35	0.2	92	11.3	3	0	2	0	0	1		0.3	143	14	3	0	1	0	0
36	0.25	130	11.3	4	0	0	0	2	0		1.1	268	19.5	10	0	0	0	0
37	0.25	100	13.5	4	0	1	0	1	0		1	274	21	3	0	0	0	0
38	0.2	46	8	4	3	3	0	0	2		0.5	70	11.5	7	0	0	0	0
39	1.7	296	5.25	12	0	5	0	0	1		2	438	7.5	12	0	3	0	0
40	4	580	6.25	17	0	11	0	2	3		3.8	517	8	17	1	4	0	0
Total	16.95	4593	140	141	6	135	0	10	33		24.55	6286	185	152	4	101	0	5

Appendix Table 2

Catch Data

F/V Celtic 2008-1

Port	New Dredge #12 with 7 x 4 chains									Stbd	New Dredge #9 no chains								
Tow #	scallops	scallops	Trash	skates	grey sole	fourspot	Yellowtail	fluke	monk		scallops	scallops	Trash	skates	grey sole	fourspot	Yellowtail	fluke	
	(bu)	#	bu								(bu)	#	bu						
41	7.25	979	4	5	1	8	0	1	0		9	1296	4.5	3	0	9	0	0	
42	36	5256	1	1	0	4	0	0	1		40	5400	1	2	0	5	0	0	
43	12.8	1830	5	4	0	11	0	1	0		23.2	3480	5.5	6	0	8	0	0	
44	0.8	99	6.5	50	0	24	0	0	1		1.1	124	8	43	0	18	0	1	
45	5.75	822	4.5	28	0	19	0	0	0		6.8	938	4	33	0	18	0	0	
46	22	3300	1	9	0	5	0	1	3		30	4290	1	17	0	3	0	0	
47	35.5	4793	1	1	0	8	0	1	2		41	6191	1	1	0	3	0	0	
48	1.75	303	3	4	0	5	0	2	0		1.25	180	4	4	0	3	0	1	
49	1.3	992	6.5	5	0	7	0	0	2		1.3	913	6	8	1	4	0	0	
50	4	5386	2	6	1	6	0	0	1		4.5	6241	3	5	0	6	0	0	
51	4	3702	1	9	0	6	0	0	1		4	4464	1.8	1	0	8	0	1	
52	4	1613	2.3	10	0	5	0	0	0		4	1585	1.8	15	0	6	0	3	
53	2.3	1566	2.5	22	1	11	0	1	4		1.9	1180	2.5	16	0	8	0	3	
54	1.1	217	6.5	13	0	9	0	1	2		1.1	244	7.5	13	0	12	0	2	
Total	138.6	30858	46.8	167	3	128	0	8	17		169.15	36526	51.6	167	1	111	0	11	

Appendix Table 2

Catch Data

F/V Celtic 2008-1

Port	New Dredge #12 with 7 x 4 chains									Stbd	New Dredge #9 no chains								
Tow #	scallops	scallops	Trash	skates	grey sole	fourspot	Yellowtail	fluke	monk		scallops	scallops	Trash	skates	grey sole	fourspot	Yellowtail	fluke	
	(bu)	#	bu								(bu)	#	bu						
55	0.2	62	11	9	0	6	0	0	0		0.3	59	10.3	7	0	6	0	0	
56	0.2	70	8	1	0	18	0	0	1		0.4	123	9.5	4	0	5	0	2	
57	0.1	80	12.5	9	0	2	0	0	1		0.15	92	13	8	0	5	0	0	
58	0.1	63	12	8	0	9	0	1	1		0.15	93	14.5	11	0	3	0	1	
59	0.7	219	10	8	0	6	0	1	0		0.8	303	10.3	3	0	2	0	0	
60	0.25	245	6.25	4	0	11	0	0	0		0.25	304	7	6	0	11	0	0	
61	1.25	1193	6.25	2	0	5	0	1	1		1.6	1456	6.4	8	0	1	0	3	
62	7	9716	0	9	0	14	0	1	0		7.5	9570	0	8	0	14	0	1	
63	0.5	206	2.5	6	2	13	0	2	1		0.8	429	3	23	0	15	0	1	
64	0.3	354	1	4	0	11	0	2	0		0.9	567	1.5	12	0	7	0	1	
65	0.1	34	5.25	6	1	16	0	0	0		0.2	42	6	6	0	15	0	1	
66	0.2	41	5.75	12	0	15	0	0	0		0.2	49	5	3	1	15	0	0	
67	0.5	114	5.5	13	0	15	0	0	0		0.7	159	5.25	9	0	25	0	0	
68	0.6	1298	0.8	16	0	12	0	0	0		0.5	1416	0.8	17	0	8	0	0	
69	0.9	1050	1.2	17	0	17	0	1	2		1.3	1144	1.3	5	0	7	0	0	
70	1	576	0.8	5	0	10	0	1	1		1.1	732	0.8	5	0	2	0	1	
71	0.7	241	5	1	4	13	0	5	2		0.8	239	4.25	2	2	7	0	1	
72	0.3	96	4.5	4	2	12	0	0	0		0.3	101	5	5	1	11	0	0	
73	0.2	97	8	0	0	8	0	0	1		0.2	71	8	0	0	9	0	0	
Totals	15.1	15755	106	134	9	213	0	15	11		18.15	16949	112	142	4	168	0	12	

Appendix Table 2

Catch Data

F/V Celtic 2008-1

Stbd	New Dredge #12 with 7 x 4 chains									Port	New Dredge #9 no chains								
Tow#	scallops	scallops	Trash	skates	grey sole	fourspot	Yellowtail	fluke	monk		scallops	scallops	Trash	skates	grey sole	fourspot	Yellowtail	fluke	
	(bu)	#	bu								(bu)	#	bu						
74	6	1128	1.5	13	0	6	0	1	0		5.75	1006	1.8	13	0	3	0	0	
75	13.5	2255	1.5	16	0	6	0	2	0		13.75	2475	1.5	13	0	3	0	1	
76	36	6480	1	2	0	2	0	0	0		43	6966	1	5	0	5	0	1	
77	25.25	4848	1	6	0	2	0	0	0		36	6444	1	6	0	8	0	0	
78	10.6	1495	1	8	0	3	0	0	0		13.5	1836	1	4	0	6	0	0	
79	6.75	716	1.5	4	0	5	0	0	1		17.8	2332	3	10	0	6	0	0	
80	10.8	1544	2.5	24	0	5	0	1	2		11.1	1610	2.5	16	0	2	0	0	
81	20.1	2874	1	9	0	4	0	1	0		24	3096	1	14	0	5	0	0	
Totals	129	21340	11	82	0	33	0	5	3		164.9	25765	12.8	81	0	38	0	2	

Appendix Table 2

Catch Data

F/V Celtic 2008-1

Stbd	New Dredge #12 with 5 x 3 chains									Port	New Dredge #9 no chains								
Tow#	scallops	scallops	Trash	skates	grey sole	fourspot	Yellowtail	fluke	monk		scallops	scallops	Trash	skates	grey sole	fourspot	Yellowtail	fluke	
	(bu)	#	bu								(bu)	#	bu						
82	10	1620	4	27	0	15	0	1	0		125	2063	3.25	35	1	4	0	0	
83	24	2544	1	5	0	5	0	0	1		26.5	2491	1	4	0	6	0	0	
84	22	304	7	13	0	12	0	0	1		21	286	9.5	25	1	8	0	0	
85	4.9	642	6.5	1	0	6	0	0	2		8.1	996	7	1	0	3	0	0	
86	16	1856	1	9	0	2	0	2	6		18.75	2250	1	4	0	5	0	0	
87	1.5	658	1	7	0	7	0	1	0		1.4	504	0.9	7	0	4	0	1	
88	5	1493	2	11	1	8	0	1	0		4	707	2	10	0	8	0	1	
Totals	63.6	9117	225	73	1	55	0	5	10		73.35	9297	24.7	86	2	38	0	2	

Appendix Table 3 Scallop Length Frequency Data F/V Celtic 2007-3

F/V Celtic 2007-3																						
Port: New dredge with 7 x 4 turtle chains and wheels																						
Stbd: Standard dredge																						
Tow #	1	1	2	2	4	4	5	5	6	6	7	7	8	8	10	10	11	11	12	12	Total Sum	
Side	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd
# Bushel Measured	all	all	all	all	all	all	all	all	1	1	all	1	1	1	all	all	all	all	all	all		
Total # Bushels	0.8	1	1	0.5	0.8	0.8	0.9	1.1	1.8	2.33	1	1.2	2	1.5	0.66	0.66	0.33	0.5	0.66	0.25		
Shell Height (mm)																						
35-39							1														1	0
40-44	1						0	2	2	2											3	4
45-49	3						2	2	11	5											16	7
50-54	6						5	2	9	7											20	9
55-59	2		2			2	7	3	16	5					1				1		29	10
60-64	2		0		5	0	4	4	0	19		1	2	0	2		1		1		17	24
65-69	8	2	0		2	3	1	7	27	16	1	1	2	0	2	2	0		0		43	31
70-74	12	11	1	1	0	2	26	16	137	112	2	1	14	5	18	2	0	1	0		210	151
75-79	13	15	2	0	4	0	64	48	308	275	4	0	28	23	28	6	5	1	0		456	368
80-84	30	25	3	2	6	8	56	63	200	273	0	1	62	39	21	9	2	2	1	1	381	423
85-89	64	65	13	6	21	18	23	26	54	103	3	1	136	78	10	11	5	1	3	0	332	309
90-94	39	51	23	19	33	37	24	11	11	37	9	2	112	114	8	3	5	2	6	3	270	279
95-99	12	18	32	20	29	36	12	13	11	26	16	13	40	57	6	4	3	3	11	8	172	198
100-104	8	17	23	12	17	14	6	14	16	12	13	11	30	20	11	5	3	3	11	2	138	110
105-109	15	25	18	16	4	17	12	28	7	19	25	28	24	12	7	5	4	6	18	9	134	165
110-114	16	14	31	8	9	24	12	28	13	9	24	26	20	14	8	10	4	6	23	6	160	145
115-119	20	15	18	11	11	15	9	3	9	58	22	55	20	20	14	18	8	9	21	11	152	215
120-124	1	2	5	1	2	8	6	4	4	0	6	8	14	2	7	16	3	0	6	5	54	46
125-129	1	2	2	3	5	3	2	1	5	12	7	14	2	8	12	8	5	7	11	0	52	58
130-134				1	4	2	3		5	5	4	5		8	11	3	3	5	2	1	32	30
135-139							1				1	0		5		1		3	1	1	3	10
140-144												1				1		1		0	0	3
145-149																				0	0	0
150-154																				1	0	1
Total	253	262	173	100	152	189	275	275	845	995	137	168	506	405	166	104	51	50	116	48	2674	2596

Appendix Table 3

Scallop Length Frequency Data

F/V Celtic 2007-3

F/V Celtic 2007-3																						
Port: New dredge with 7 x 4 turtle chains without wheels																						
Stbd: Standard dredge																						
Tow #	13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22	22	Total	Sum
Side	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd
# Bushel Measured	all	all	all	all	1	1	1	1	1	1	1	1	all	all	all	all	all	all	all	all		
Total # Bushels	0.5	0.5	1	0.9	1.5	1.5	1.8	1.5	2.5	2	1	1.2	0.25	0.25	0.5	0.33	0.66	0.5	0.9	0.8		
Shell Height (mm)																						
35-39																					0	0
40-44																					0	0
45-49																					0	0
50-54																					0	0
55-59				3	2																3	2
60-64				5	3																5	3
65-69		1	1	2						2											1	5
70-74		0	0	0				3		2	1	1							2		3	6
75-79	1	0	0	2		9	9	3	13	2	3	1							12	5	38	22
80-84	4	1	4	2	14	20	9	14	35	22	4	2	1				1	1	9	11	81	73
85-89	5	2	9	18	23	24	45	27	80	88	26	7	0	1	2		4	0	22	22	216	189
90-94	8	6	27	12	42	27	117	69	140	114	46	29	5	2	2		2	1	17	5	406	265
95-99	19	10	30	24	51	51	117	102	220	160	52	53	0	0	3	2	3	4	8	12	503	418
100-104	7	13	26	26	59	53	88	62	128	84	35	55	3	3	2	1	5	4	14	21	367	322
105-109	11	8	22	16	63	47	29	24	35	24	29	29	8	2	4	2	7	6	20	26	228	184
110-114	17	12	15	28	35	27	5	15	3	8	15	20	6	3	3	2	9	5	23	18	131	138
115-119	10	12	27	13	26	18	9	8	3	4	13	25	8	9	3	2	13	5	12	11	124	107
120-124	6	9	6	0	2	0	0	0	0		2	0	1	9	11	12	12	8	9	12	49	50
125-129	3	2	5	6	3	2	6	0	0		1	8	5	4	17	14	11	7	7	5	58	48
130-134	1	4	2	6	3	2		3	0		1	5	1	2	10	10	9	7	2	2	29	41
135-139		1		3		3		2	3			1	1		2		3		1		10	10
140-144		1		0				2									1		1		2	3
145-149				1																	0	1
150-154																					0	0
Total	92	82	182	164	321	283	434	334	660	510	228	236	39	35	59	45	80	48	159	150	2254	1887

Appendix Table 3

Scallop Length Frequency Data

F/V Celtic 2007-3

F/V Celtic 2007-3																						
Port: New dredge with 7 x 4 turtle chains without wheels																						
Stbd: New dredge with 7 x 4 turtle chains with wheels																						
Tow #	23	23	24	24	25	25	26	26	27	27	28	28	29	29	30	30	31	31	32	32	Total Sum	
Side	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd
# Bushel Measured	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all		
Total # Bushels	0.33	0.33	0.33	0.33	0.3	0.33	1.1	0.8	0.5	0.5	0.5	0.5	0.25	0.25	0.25	0.25	0.33	0.33	0.33	0.33		
Shell Height (mm)																						
35-39																					0	0
40-44																					0	0
45-49																			1		1	0
50-54																	2		3		5	0
55-59													1	1	1		1		2		5	1
60-64						1							2	0	0		2		2	4	6	5
65-69						0							1	0	0	2	1	1	4	1	6	4
70-74	1					1							0	0	1	1	0	1	0	2	2	5
75-79	0			3	2	4	1	1				1	0	1	0	0	0	0	0	0	3	10
80-84	0			2	2	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0	5	3
85-89	1	2	2	1	2	2	4	0	0	3	0	0	1	0	1	0	0	0	0	1	11	9
90-94	0	2	3	0	2	5	4	6	3	2	3	3	1	1	1	0	0	0	1	1	18	20
95-99	3	2	1	2	4	4	10	5	4	1	1	2	1	0	3	0	0	0	0	2	27	18
100-104	6	3	5	6	4	7	14	14	9	5	2	8	0	3	1	0	1	0	1	1	43	47
105-109	5	15	16	11	19	14	11	22	16	8	4	8	1	1	0	0	1	1	2	0	75	80
110-114	16	22	15	12	11	14	17	14	7	12	14	14	3	1	1	0	1	0	0	0	85	89
115-119	21	13	17	16	9	15	22	17	13	9	16	22	6	8	1	1	1	3	0	2	106	106
120-124	3	2	7	5	5	2	23	7	9	12	11	17	5	6	4	2	5	4	0	4	72	61
125-129	1	0	4	2	3	1	20	9	3	6	8	9	3	7	3	10	10	8	4	3	59	55
130-134		0	1		1	4	15	8	4	5	2	1	4	4	6	3	8	5	3	5	44	35
135-139		1					1	2				1	2	4	5	5	4	5	3	6	15	24
140-144													0	4	1	3	4	4	12	6	17	17
145-149													0	2	1	4	4	6	5	4	10	16
150-154													1		1		1	2		2	3	4
155-159																	2				2	
Total	57	62	71	60	64	74	143	105	69	64	62	86	32	43	31	31	48	40	43	44	620	609

F/V Celtic 2007-3

Port: Standard dredge																																
Stbd: New dredge with 7 x 4 turtle chains with wheels																																
Tow #	33	33	34	34	35	35	36	36	37	37	38	38	39	39	40	40	41	41	42	42	43	43	44	44	45	45	Total	Sum				
Side	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd		
# Bushel Measured	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all						
Total # Bushels	0.5	0.33	0.33	0.33	0.3	0.5	0.2	0.25	0.2	0.2	0.2	0.2	0.5	0.5	1	0.8	0.5	0.5	0.6	0.8	0.8	0.7	1	0.9	0.25	0.2						
Shell Height (mm)																																
35-39																															0	0
40-44					1																										0	1
45-49				0																											0	0
50-54	2			3																										2	3	
55-59	1	1	4	1																										5	2	
60-64	1	1	0	3											1															1	5	
65-69	1	2	0	2		1									0						1				1				1	7		
70-74	0	2	0	0		0									0					2	0	1	1	1	0				4	3		
75-79	0	0	0	0		0									0					1	2	1	3	0	3				2	8		
80-84	1	0	0	0	3	3	2	2					1		0	4			1	3	5	0	1	4	3	1			18	16		
85-89	0	0	1	1	0	13	1	1				1	0		0	1	3		0	2	4	1	2	10	12	2			19	36		
90-94	0	0	1	2	0	4	0	0	1	1	1	1	0		1	3	1	1	3	1	0	0	1	8	8	2	2		18	23		
95-99	1	1	1	0	2	7	0	1	0	0	0	0	0		0	2	3	1	0	1	0	2	0	18	7	4	0	32	19			
100-104	1	0	1	1	6	4	0	2	0	0	0	0			4	2	2	3	0	5	3	12	7	22	8	2	1	54	32			
105-109	3	2	4	1	3	3	0	5	2	1	2	2	1	3	14	8	11	6	13	10	18	19	23	17	2	1	96	78				
110-114	3	3	1	1	5	8	5	5	1	1	3	1	9	4	17	11	18	13	26	27	44	29	35	25	2	3	169	131				
115-119	3	1	4	4	14	15	7	2	0	3	3	3	8	14	30	21	18	18	31	37	42	23	52	17	6	5	218	163				
120-124	5	3	7	5	15	19	6	9	3	2	1	3	14	16	36	21	8	20	10	15	4	12	25	18	4	3	138	146				
125-129	11	4	7	11	7	6	7	8	5	5	3	1	7	6	18	18	3	7	0	13	2	4	11	8	5	1	86	92				
130-134	3	7	3	3	8	3	1	3	4	3	4	1	6	5	4	4	2		1	3			4	2	2	1	42	35				
135-139	3	3	8	6	1	2		2	4	3	2	2	3	1	0	3							4	0	3	1	28	23				
140-144	8	3	5	2				0	2		3	3			1	1							0	1		0	19	10				
145-149	7	3		1				1	1			1											3	1		1	11	8				
150-154	2	2																									2	2				
155-159																											0	0				
Total	56	38	47	48	64	88	29	41	23	19	23	18	48	55	132	96	65	68	96	120	127	102	220	131	35	19	965	843				

Appendix Table 3

Scallop Length Frequency Data

F/V Celtic 2007-3

F/V Celtic 2007-3																						
Port: Standard dredge																						
Stbd: New dredge with wheels and no chains																						
Tow #	46	46	47	47	48	48	49	49	50	50	51	51	52	52	53	53	54	54	55	55	Total Sum	
Side	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd
# Bushel Measured	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all		
Total # Bushels	0.25	0.25	0.2	0.2	0.3	0.25	0.5	0.5	1	0.8	0.33	0.33	0.2	0.2	1.1	1.1	1.1	1	1.1	1.1		
Shell Height (mm)																						
35-39																					0	0
40-44																					0	0
45-49						1										1					1	1
50-54				1	0					1						2	1		1		2	4
55-59				0	0					0					1	1	1	2	1		3	3
60-64				0	0	1				0		1			1	0	2	3	0		3	5
65-69				0	0	0				0		1			0	0	2	1	0	2	2	4
70-74				0	0	0				0		0			0	2	0	0	1	0	1	2
75-79				0	0	0		1		0		2			0	1	0	0	1	0	1	4
80-84				0	1	0		0	1	0		1			2	0	0	0	0	0	4	1
85-89	2	1		0	0	2	1	0	2	0	4	0	1	1	7	3	1	1	0	4	18	12
90-94	0	2	1	2	2	1	0	0	0	1	1	1	1	2	2	13	2	2	6	4	15	28
95-99	2	1	3	2	2	1	0	2	5	1	4	1	5	2	27	20	19	16	14	22	81	68
100-104	0	3	4	2	1	1	2	2	6	9	2	7	6	9	57	72	36	36	47	35	161	176
105-109	2	2	1	2	5	2	9	4	11	8	5	5	4	3	32	49	50	35	82	69	201	179
110-114	7	6	7	6	5	5	2	2	6	12	5	6	4	3	9	14	14	13	37	40	96	107
115-119	8	6	3	11	6	3	5	2	2	7	6	7	2	3	12	3	11	16	9	7	64	65
120-124	3	5	1	4	6	3	4	2	5	3	3	6	1	1	4	5	9	9	2	4	38	42
125-129	4	2	1	3	2	3	3	3	12	2	4	2	3	0	4	5	11	3	1	8	45	31
130-134	4	3	5	4	3	2	8	11	17	16	9	4	0	2	6	2	3	1	2	2	57	47
135-139	1	2	1	4	7	12	9	10	12	15	1	6	1	1	6	6	1	4	0	2	39	62
140-144		1	1	1	2	2	5	3	6	7	2	3	0		3	4	3	3	3		25	24
145-149			2		1				4	3			1		2	3	0	0	1		11	6
150-154															1		2	0			3	0
155-159																		1			0	1
Total	33	34	30	42	44	38	48	42	89	85	46	53	29	27	176	206	168	146	208	199	871	872

Appendix Table 3

Scallop Length Frequency Data

F/V Celtic 2007-4

F/V Celtic 2007-4																														
Port: New dredge with liner & 4.5" twine top																														
Stbd: New dredge with no liner & 4.5" twine top																														
Tow#	56	56	57	57	58	58	59	59	60	60	61	61	62	62	63	63	64	64	65	65	66	66	67	67	68	68	69	69	70	70
Side	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd
# Bushel Measured	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all
Total # Bushels	0.5	0.25	0.25	0.5	0.5	1	0.2	0.25	0.1	0.1	0.5	0.25	0.25	0.25	0.25	0.5	0.25	0.5	0.25	0.5	0.25	0.5	0.25	0.50	0.75	1.00	0.25	0.50	0.25	0.50
Shell Height (mm)																														
25-29																														
30-34											1					1														
35-39	3										2					1														
40-44	3	2		1							2					0		1											2	
45-49	2	2	1		1						6	1			2	0	2	1			1				1				11	
50-54	2	3	1	3	1						5	9	2		5	0	3	4	2		0		1	1	0				12	
55-59	6	2	5	6	1	2					6	5	3	1	10	7	6	3	3	5	6	1	0	4	1					
60-64		1	4	3		3		1			5	2	1	0	13	3	5	0	4	1	7	1	1	0	1					
65-69			1		1	1					1	2	2	1	8	2	3	2	2	3	2	0		0	0					
70-74					1	1						0	1		3	1	2	2		1		1		1	0					2
75-79		1			2	1					1	0			1			0		1					2				3	0
80-84		2			4	6					1	2						0		0					1	3			2	0
85-89		5		1	4	5	1	2	1		1	5		1				1		0					0	1		1	1	6
90-94	2	5		2	8	3	3				1	1		2				0		2	1				2	4		1	1	4
95-99	8	13	2	8	16	19	2	1	1	1	0	2		1		3	1	1		0	1				4	6	2	3	2	3
100-104	19	28	10	14	27	34	6	10		3	3	8		0	3	1		2	1	2	0	2	2	1	8	13	1	5	4	7
105-109	34	36	5	18	23	34	8	6		2	4	8		0	0	3		1	0	3	0	1	1	2	9	14	1	7	6	13
110-114	13	17	10	3	8	26		4			3	6		1	0	0		2	0	1	1	3	2	8	21	23	2	11	9	8
115-119	2	2	1	3	4	9	1	2	1		1	3	1	1	1	6	2	2	2	5	3	5	3	15	21	34	1	9	4	10
120-124	5	2	1	2	1	5		1	2		0	3	0	3	1	2	0	9	3	7	5	5	4	9	9	13	1	4	1	5
125-129	3	2	1	5		5		2			1	3	1	4	1	2	1	8	1	4	3	3	2	7	5	22	2	5	2	0
130-134	1	1	1	1				1		1	2	5	0	2	1	1	2	1	2	4	2	8		2	2	3	0	0		0
135-139	1			3	3	1				1	2	17	1	4	0	4	1	5	1	4	2	5				2	1	4		1
140-144				2		3		1		1		5	0	2	0	8	2	3	0	8	2	3				2				1
145-149						2		1		1			0		2	2			3	2										
150-154													1			1				2										
Total	104	124	43	75	105	160	21	32	5	10	48	87	13	23	51	48	30	48	24	55	36	38	16	50	87	140	11	50	60	60

Appendix Table 3

Scallop Length Frequency Data

F/V Celtic 2007-4

F/V Celtic 2007-4																												
Port: New dredge with no liner & 4.5" twine top																												
Stbd: New dredge with liner & 4.5" twine top																												
Tow #	71	71	72	72	73	73	74	74	75	75	76	76	77	77	78	78	79	79	80	80							Total Sum	
Side	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd					Port	Stbd		
# Bushel Measured	all	all	1/2	1/2	1/2	1/2	all	1/2	all	all	all	all	all	all	all	all	all	1/2	all	all								
Total # Bushels	1.50	1.25	1.75	2.00	1.50	1.75	1.25	1.25	1.00	1.00	1.00	0.25	0.75	0.50	1.00	0.75	1.25	1.25	1.00	0.50								
Shell Height (mm)																												
25-29				4																					0	4		
30-34				16		2																			0	18		
35-39		3		74		14		2																	0	93		
40-44	1	1	4	196		50		26		4															5	277		
45-49		3	4	218	2	138		38		19															6	416		
50-54		2	16	160	6	184	1	50	1	30						4									28	426		
55-59		1	6	90	6	116	4	72	5	36			1	1	2	2					1				24	319		
60-64		0	8	8	14	46	1	28	3	17			4	2	3	10	2	4		0					35	115		
65-69	4	1	2	4	2	14	2	10	0	10	3	1	8	3	8	10	5	6	2	0					36	59		
70-74	2	2	2	2	0	0	0	2	0	1	0	0	26	10	31	29	18	10	2	5					81	61		
75-79	5	1	8	12	2	2	1	0	0	2	10	0	38	26	69	83	39	38	3	3					175	167		
80-84	18	9	8	16	4	4	3	2	0	4	9	0	13	17	86	66	78	58	2	2					221	178		
85-89	53	38	16	24	16	12	8	4	2	4	8	2	11	14	52	42	91	130	12	11					269	281		
90-94	96	84	54	50	34	14	19	18	12	3	5	4	10	5	23	26	57	88	13	16					323	308		
95-99	96	67	60	40	48	42	21	20	17	16	5	4	4	3	6	5	36	40	8	9					301	246		
100-104	52	38	46	50	40	36	26	28	19	19	10	0	12	6	2	1	11	14	15	10					233	202		
105-109	21	16	64	48	30	36	53	10	33	12	18	5	6	2	1	2	10	8	20	17					256	156		
110-114	5	5	20	30	34	16	26	32	18	19	12	4	7	1	4	2	6	0	25	10					157	119		
115-119	4	5	10	22	22	32	24	54	10	24	22	9	3	10	2	1	6	2	28	14					131	173		
120-124	2	4	0	2	6	18	9	14	11	10	14	1	7	2	4		1	2	3	1					57	54		
125-129		3	2	4	12	6	5	10	2	6	5	5	5	2	0		1		6	1					38	37		
130-134		1	2			10	3	4	1	1	2	5	3	2	1				2	1					14	24		
135-139		1	2			2		0	0			1	0	0					1	2					3	6		
140-144								2	1			2	2	1					1						4	5		
145-149																									0	0		
150-154																									0	0		
Total	359	285	334	1070	278	794	206	426	135	237	123	43	160	107	298	279	361	400	143	103					2397	3629		

Appendix Table 3

Scallop Length Frequency Data

F/V Celtic 2007-4

F/V Celtic 2007-4																										
Port: New dredge with no liner & 6" twine top																										
Stbd: New dredge with liner & 4.5" twine top																										
Tow #	81	81	82	82	83	83	84	84	85	85	86	86	87	87	88	88	89	89	90	90	91	91		Total Sum		
Side	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd		Port	Stbd	
# Bushel Measured	all	all	n/a	n/a	1/2	1/2	all	all	all	all	all	all	all	all	all	all	all	all	all	1/4	1/2	1/2				
Total # Bushels	0.5	0.75	NG		1.25	1.25	0.50	1.00	0.75	0.75	0.75	0.50	0.50	0.75	1.50	1.00	1.25	1.25	1.25	1.75	1.50	1.75				
Shell Height (mm)																										
10-14																		1						0	1	
15-19																		2						0	2	
20-24																		1						0	1	
25-29																		0						0	0	
30-34								2										1		2				0	5	
35-39								2						2		1		2		10		1		0	18	
40-44								3						3		10		22		25		2		0	65	
45-49								0						12		32	1	61	1	39	1	1		3	145	
50-54		1				2		2		2				17		57	12	117	1	49	0	3		13	250	
55-59		0				0		9		5				31	4	40	11	114	0	17	1	1		16	217	
60-64		4				4	2	18		2			1	21	3	37	33	17	0	2	0	0		39	105	
65-69		2				6	13	20		5		2	0	12	0	13	12	2	0	1	1	0		26	63	
70-74		2			6	0	30	72	4	15	1	0	0	0	0	5	2		2	0	2	1		47	95	
75-79	3	3			16	24	73	125	8	29	1	2	1	0	2	0	1		3	1	4	0		112	184	
80-84	4	3			32	28	67	78	5	14	2	2	2	2	3	1	10		7	1	11	2		143	131	
85-89	6	3			68	78	28	54	13	7	2	2	6	4	6	1	20		20	1	22	9		191	159	
90-94	5	4			50	62	9	24	13	4	5	1	6	6	8	5	22		36	10	52	9		206	137	
95-99	10	4			26	18	4	4	3	5	3	4	12	17	26	14	42		48	13	57	21		231	91	
100-104	11	15			18	8	2	2	6	5	10	4	9	18	26	28	43		53	10	18	12		196	95	
105-109	18	9			8	4	1	0	13	3	10	10	17	16	32	20	41		33	11	9	5		182	76	
110-114	11	25			12	12	2	0	10	14	5	7	8	17	23	25	36		22	14	7	3		136	117	
115-119	25	19			12	4	1	1	23	13	11	17	13	13	30	20	44		11	3	6	3		176	94	
120-124	5	2			0	0		0	14	17	17	4	5	3	12	11	26		4	2	1			84	35	
125-129	3	1			2	4		1	9	4	8	5	4	8	6	9	18		3	1	3			56	46	
130-134	2					2		1	7	3	4	5		2	1	8	10							24	22	
135-139									1	1		4		3		1	5							6	11	
140-144										2				1		1	1							1	3	
145-149														1										0	3	
150-154																								0	0	
155-159																								0	0	
Total	103	97	0	0	250	256	232	418	129	150	79	69	84	209	182	339	390	340	244	212	195	73		1693	2144	

Appendix Table 3

Scallop Length Frequency Data

F/V Celtic 2007-4

F/V Celtic 2007-4																									
Stbd: New dredge with no liner & 6" twine top																									
Port: New dredge with liner & 4.5" twine top																									
Tow #	92	92	93	93	94	94	95	95	96	96	97	97	98	98	99	99	100	100	101	101					
Side	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd				Total	Sum
# Bushel Measured	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all				Port	Stbd
Total # Bushels	0.25	1.00	0.25	1.00	0.50	0.75	0.25	0.50	0.25	0.25	0.25	0.25	0.25	0.25	1.00	1.25	1.00	1.00	1.00	1.50					
Shell Height (mm)																									
10-14																								0	0
15-19																								0	0
20-24																								0	0
25-29																								0	0
30-34																								0	0
35-39																								0	0
40-44																	3		2	1				5	1
45-49									1		1		1		1		1		1					6	0
50-54							2		5		2		2		1		7		2					21	0
55-59					2		6		3	1	6	3	2	1	2		8		3					32	5
60-64			1		2	1	1		5	2	0		4	2	1		5	6						19	11
65-69			0		0	0	0		1	3	1		4	0	1		2							9	3
70-74			1		0	0	0		3	2			1	2	1		1			1				7	5
75-79			2		2	0	1		0	0				1	0		0			0				5	1
80-84			0	1	0	0	0	1	0	0				0	0		0			1				0	3
85-89			2	2	0	1	0	0	0	0				1	3	5	2		2	0				9	9
90-94		2	2	4	2	1	0	0	0	2					1	3	4	5	4	4				13	21
95-99		5	2	8	2	3	0	0	1	0					22	10	1	4	22	11				50	41
100-104	2	13	3	5	2	4	1	0	1	0					52	29	49	20	40	34				150	105
105-109	4	20	15	22	5	6	0	1	0	0				2	47	44	36	39	56	70				163	204
110-114	0	19	6	35	7	12	1	1	1	2				0	22	34	9	33	24	63				70	199
115-119	1	32	3	34	14	27	3	3	5	1				1	5	7	4	10	7	27				42	142
120-124	2	16	3	14	8	15	4	6	5	4	2	3	1	1	3	2	5	6	3	6				36	73
125-129	2	8	4	7	10	9	4	8	6	7	2	4	2	3	2	8	6	6	1	6				39	66
130-134		6	2	5	8	6	0	8	1	4	1	8	0	2	3	2	2	3	3	5				20	49
135-139		0		2		4	4	5	3	6	1	5	1	2	2	7	2	2	2	2				15	35
140-144		3		2		1	1	1	3	4	3	6	4	2	3	4	1	3		1				15	27
145-149				1				1	0		0	1	0	0	2	2	2	5						4	10
150-154								0	0		0	1	2	1	3	1								5	3
155-159								1	1		1													2	1
Total	11	124	46	142	64	90	28	36	45	38	20	31	24	21	177	158	150	142	172	232				737	1014

F/V Celtic 2007-5[illegible]

Appendix Table 3

Scallop Length Frequency Data

F/V Celtic 2008-1

F/V Celtic 2008-1																												
Port: New dredge #9 with 7 x 4 chains																												
Stbd: New dredge with no chains																												
Tow#	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13	13		
Side	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd		
	chain	none	chain	none	chain	none	chain	none	chain	none	chain	none	chain	none	chain	none	chain	none	chain	none	chain	none	chain	none	chain	none		
Total # Bushels	0.1	0.33	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.25	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
# Bushel Measured	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all	all
Shell Height (mm)																												
<25																			1									
25-29																			0							1		
30-34															1				1	1						6		
35-39							1									2			1	2	1	1	2	4	6	4	5	
40-44																1			1	13	4	0	1	13	13	18	13	
45-49																1	1			3	11	1	4	10	12	28	23	
50-54																			4	0	1	2	12	7	17	33		
55-59																				1		1	5	9	13	41		
60-64														1						0				1	2	13		
65-69																			1	1							3	
70-74													1						1	4		1					1	
75-79									2						2	2	2		6	7	1	2			1	1		
80-84		1									3	6		1	1	2	0		7	10		0	1	1	1	6		
85-89		0	1	1							0	2	3	5	2	0	1		1	2		4	3	2	3	6		
90-94		0		0					1		1	0	6	7	1	0	1		1	0		0		3		0		
95-99	1	0		0		1	1		2		0	1	2	5	0	0	0	1	0	0	1	0		0		0		
100-104	0	5		0		1	2		0	1	0	0	0	1	4	2	0	1	3	0		1		0		2		
105-109	1	9		1		1	0	2	0	1	1	1	2	6	3	9	1	2	1	1		1		1		0		
110-114	1	8	2	3		0	1	2	3	2	0	1	1	1	2	3	1	5	0	5		1		1		2		
115-119	4	11	4	1		1	2	4	3	4	2	0	0	0	2	4	0	2	2	7	2	0	1	0		1		
120-124	6	5	4	2	2	4	3	4	4	4	2	1	0	4	5	3	3	2	2	2	4	3	0	0	1	3		
125-129	4	8	3	3	2	1		1	2	7	2	8	1	1	5	3	3	1		2	1	4	1	3	2	1		
130-134	1	3	2	1	1	1		1	2	1		1	1	6		1	2	1			1			2	1	1		
135-139		0	0	1								1	2	9			0	1			1			2		1		
140-144		1	1										1	2			1											
145-149																												
150-154																												
Total	18	51	17	13	5	10	10	14	17	22	11	22	20	49	28	33	16	19	49	58	14	27	50	63	98	156		

F/V Celtic 2008-1

Port Newdredge with no chains																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
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Appendix Table 3

Scallop Length Frequency Data

F/V Celtic 2008-1

Port: New dredge #12 with 7 x 4 chains																										
Stbd: New dredge with no chains																										
Tow #	41	41	42	42	43	43	44	44	45	45	46	46	47	47	48	48	49	49	50	50	51	51	52	52	53	53
Side	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd
	chain	none	chain	none	chain	none	chain	none	chain	none	chain	none	chain	none	chain	none	chain	none	chain	none	chain	none	chain	none	chain	none
Total # Bushels	7.25	9	36	40	12.8	23.2	0.8	1.1	5.75	6.8	22	30	35.5	41	1.75	1.25	1.3	1.3	4.2	4.8	4.3	4.8	4.2	3.8	2.3	1.9
# Bushel Measured	1	1	1	1	1	1	all	all	1	1	1	1	1	1	0.5bu	0.5bu	1	1	0.22	0.22	.33bu	.33bu	.33bu	.33bu	.33bu	.33bu
Shell Height (mm)																										
<25																	13	12	38	22		14				
25-29																	0	0	19	0		0				
30-34															3	1	39	12	0	0		0			14	17
35-39															20	14	39	36	134	131	26	0	63	11	35	23
40-44															69	33	208	156	611	655	374	101	151	137	152	148
45-49												30			74	52	247	264	1795	2204	1135	374	202	342	338	211
50-54												0			65	28	170	168	1662	1746	1187	1339	63	125	179	137
55-59												0			31	16	65	72	649	633	245	1354	50	0	48	11
60-64												0			4	4	0	12	19	87	13	590	50	46	14	6
65-69												0			1	1	13	12	57	0	65	29	151	80	55	17
70-74												0	107		0	4	27	5	134	87	90	43	265	182	124	63
75-79		18	36			23		1			44	0	0		1	2	20	9	96	284	271	173	365	228	166	200
80-84		18	108		51	46	1	0	12	7	66	150	178	205	1	6	18	17	38	240	90	173	76	228	138	68
85-89	15	72	180	80	13	46	1	1	6	34	22	120	107	205	1	2	3	16	0	65	90	115	63	34	69	23
90-94	0	18	108	40	38	70	6	10	29	27	176	150	249	410	1	0	2	4	0	0	0	72	13	11	41	17
95-99	73	54	684	320	102	139	4	2	29	27	396	540	639	984	0	0	7	11	38	44	39	0	50	46	62	74
100-104	65	135	576	760	192	278	3	14	52	109	374	330	639	738	1	2	17	14	57	44	26	29	38	46	48	108
105-109	138	180	1044	560	230	394	14	9	109	129	506	540	639	902	6	2	16	16	38		39	14	13	46	41	40
110-114	123	207	1080	1280	307	742	15	19	178	136	484	900	959	984	1	2	24	15			0	29		23	28	17
115-119	189	225	540	880	320	626	14	25	173	109	440	720	710	615	4	3	15	14			13	14			14	
120-124	160	144	612	840	294	441	17	15	92	184	418	360	284	656	7	4	25	18								
125-129	109	135	252	440	218	464	19	20	132	156	242	300	249	369	8	5	16	22								
130-134	65	81	36	200	51	209	3	5	6	14	132	150	36	82	4	4	7	8								
135-139	44	0			13		2	2	6	7				41	3		1									
140-144		9						1																		
145-149																										
150-154																										
155-159																										
Total	979	1296	5256	5400	1830	3480	99	124	822	938	3300	4290	4793	6191	303	180	992	913	5386	6241	3702	4464	1613	1585	1566	1180

F/V Celtic 2008-1

Rot Newdrage#12with7x4chains																											
Slot Newdragewithrochains																											
Tow#	55	55	56	56	57	57	58	58	59	59	60	60	61	61	62	62	63	63	64	64	65	65	66	66	67	67	
Side	Rot	Slot	Rot	Slot	Rot	Slot	Rot	Slot	Rot	Slot	Rot	Slot	Rot	Slot	Rot	Slot	Rot	Slot	Rot	Slot	Rot	Slot	Rot	Slot	Rot	Slot	
	chain	nore	chain	nore	chain	nore	chain	nore	chain	nore	chain	nore	chain	nore	chain	nore	chain	nore	chain	nore	chain	nore	chain	nore	chain	nore	
Total #Burels	02	03	02	04	01	015	01	015	07	08	025	025	75	8	7	75	05	08	03	08	01	02	02	02	05	07	
#Burel Measured	all	all	all	all	all	all	all	all	all	all	all	all	1	1	025	025	50%	33%	all	33%	all	all	all	all	all	all	
Sell Height (mm)																											
<25	1		1					3					8						1	3						3	
25-29	0		1	3			1	1					0		28				7	12	1				5	13	
30-34	3	1	0	6	6	1	0	2	7	3	3	4	8	8	168	300	16	15	18	18	1		1		11	19	
35-39	6	2	3	2	3	3	0	3	3	1	3	5	15	8	952	1030	30	75	38	45	4		1		5	8	
40-44	3	1	4	7	5	1	2	0	6	6	8	9	30	40	140	1920	54	111	91	150	6	1	1		2	1	
45-49	2	2	5	3	7	4	1	3	9	6	18	32	98	80	2884	3000	14	42	73	117	3	2					
50-54	8	2	5	4	4	5	8	6	10	11	56	98	165	200	2632	1950	16	6	26	39	1						
55-59	0		11	12	10	9	7	6	16	33	84	87	428	336	952	780	0	0	18	3	0						
60-64			3	10	11	18	12	17	26	45	42	20	205	288	112	60	0	3	1	0	0				2		
65-69			2	2	2	2	1	9	9	22	0	2	23	24	0	30	4	18	7	4	1		1		2		
70-74			1	0	0	0	0	1	1	2	0	0	8	8	56	60	8	21	15	26	0				1		
75-79			1	1	1	0	2	0	1	5	2	1	3	38	48	140	210	4	9	10	14	1			0	1	
80-84			0	6	11	3	2	4	5	16	25	6	14	60	168	196	90	0	9	2	4	0			1	1	
85-89	2	1	6	11	4	15	6	11	41	67	6	11	68	120	112	0	4	0	3	2	1		2	1	0	3	
90-94	3	5	4	15	9	8	6	9	35	53	2	0	8	40	0	0	4	12	5	9	0	3	2	2	11	6	
95-99	2	1	4	3	0	10	1	5	13	7	1	1	0	8	0	0	10	6	11	17	0	3	3	7	8	28	
100-104	2	4	0	0	2	0	0	1	1	2	2	2	8	0	0	30	6	30	8	46	3	7	9	11	26	21	
105-109	3	4	2	3	0	2	1	0	1	1	1	3	8	8	28	30	12	48	9	39	4	9	12	7	17	25	
110-114	5	3	2	2	2	1	2	2	2	0	1	2	8	32	0	30	14	15	8	15	4	6	5	10	14	16	
115-119	5	4	4	5	1	2	2	0	4	4	6	0	15	0	28	0	4	3	2	3	4	6	4	5	7	10	
120-124	3	6	5	4	4	1	3	2	3	2	4	4		8	0	30	4	3	1	1		3		3	1	3	
125-129	6	12		8	4	2	1	4	6	4	1	4		24	0		2	3				2		1	1	1	
130-134	2	4		6	2	1	4	1	3	5		2		8	28									2			
135-139	4	5		5	0	2	1	1	2	0		1															
140-144	1	1			0	1				2																	
145-149	1				1																						
150-154																											
155-159																											
Total	62	59	70	123	80	92	63	98	219	308	245	304	1193	1456	976	950	206	429	354	557	34	42	41	49	114	159	

Appendix Table 3

Scallop Length Frequency Data

F/V Celtic 2008-1

Stbd: New dredge #12 with 7 x 4 chains																			
Port: New dredge with no chains																			
Tow #	74	74	75	75	76	76	77	77	78	78	79	79	80	80	81	81			
Side	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd	Port	Stbd			Port
	none	chain	none	chain	none	chain	none	chain	none	chain	none	chain	none	chain	none	chain			none
Total # Bushels	5.75	6	13.8	13.5	43	36	36	25.3	13.5	10.6	17.8	6.75	11.1	10.8	24	20.1			
# Bushel Measured	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
Shell Height (mm)																			
<25									14	21	18							31	21
25-29									54	42	0							54	42
30-34									27	11	0							27	11
35-39									14	0	0							14	0
40-44									14	32	18	7						31	39
45-49									0	0	0	0						0	0
50-54									14	0	0	0						14	0
55-59	6								0	0	0	0						6	0
60-64	0								0	0	0	0						0	0
65-69	0	6		14		36			0	0	0	0			24			24	56
70-74	0	0	14	14	43	0		25	0	11	18	14			0			75	63
75-79	6	24	55	14	86	0	108	76	27	11	0	7			24			306	131
80-84	17	48	28	14	172	72	396	152	14	0	0	7	11		0			637	292
85-89	58	114	110	95	387	324	324	354	68	0	36	20	22	11	48	101		1052	1018
90-94	109	156	261	162	516	216	540	556	41	32	36	0	67	65	96	161		1665	1347
95-99	121	114	289	324	602	936	1584	783	95	64	142	61	78	65	288	382		3198	2728
100-104	132	144	371	324	1161	1260	1152	859	338	127	89	61	222	162	456	402		3921	3338
105-109	161	156	399	324	1505	1548	972	1086	203	180	374	108	178	238	456	563		4247	4202
110-114	127	138	289	392	903	1152	792	556	284	413	498	122	289	302	432	442		3613	3517
115-119	155	108	399	216	1247	648	468	253	419	286	534	142	300	292	648	241		4169	2185
120-124	63	48	124	257	301	144	72	101	176	159	392	81	266	292	408	382		1802	1463
125-129	40	60	69	81	0	108	36	51	41	64	125	61	89	86	96	101		495	611
130-134	6	12	55	27	43	36				42	53	27	78	32	120	60		355	237
135-139	6		14										11			40		31	40
140-144																		0	0
145-149																		0	0
150-154																		0	0
155-159																		0	0
Total	1006	1128	2475	2255	6966	6480	6444	4848	1836	1495	2332	716	1610	1544	3096	2874		25765	21339

Skate Length Frequency Data

F/V Celtic 2007-3[illegible]

Skate Length Frequency Data

F/V Celtic 2007-3[illegible]

F/V Celtic 2007-3[illegible]

F/V Celtic 2007-3[illegible]

F/V Celtic 2007-3[illegible]

Appendix Table 4

Skate Length Frequency Data

F/V Celtic 2007-4

Length	Port	New Dredge w/liner and 4.5" twine top																						Stbd	New Dredge w/no liner and 4.5" twine top																				
(cm)	Tow #	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	Totals	Tow #	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	Totals											
11-15		3	1	2		1			1	1	1						10		6			1	1										8												
16-20		1	2		2	1		1			1						8		1	1	2	1	1	2						1			9												
21-25		7	3	10	3	5				1	3			1		1	34		8	2	9	14	5			3			2	2	1	1	47												
26-30		2	1	8	3	2	1					2	1	2	1		23		2	1	12	2	2	1		1	1		2	1	1	2	1	29											
31-35				3	1				1					1	1		7				3	3		1		2			2	1	1	2	2	17											
36-40			1	3	1			1	1	2		1					10				2			2	1								5												
41-45		6	1	9	1	2		6	2	2	5	4	3	1	1	1	44		6		11	3	2	1	5	6	4	3	8	6	4	4	1	64											
46-50		1	1	2	1	1				2	1	5	2	1	3	1	21		3		5	3	2	1	1	5	1	1	5	2	2	4	2	37											
51-55																																													
56-60																																													
Totals		20	10	37	12	12	1	8	5	8	11	12	6	6	6	3	157		26	4	44	27	13	6	8	18	6	4	17	12	11	13	7	216											

Appendix Table 4

Skate Length Frequency Data

F/V Celtic 2007-4

Length	Port	New Dredge w/no liner and 4.5" twine top													Stbd	New Dredge w/liner and 4.5" twine top												
(cm)	Tow #	71	72	73	74	75	76	77	78	79	80		Totals		Tow #	71	72	73	74	75	76	77	78	79	80		Totals	
11-15																											0	
16-20		2											2						1								1	
21-25		3	1		1						2		7			1	2								1		4	
26-30					1		1			1	2		5				1		3			1	1		2		8	
31-35		1	3								1		5					1				1					2	
36-40		1					1	1	1				4				1					1	1				3	
41-45		5	2	1	1	1	2		1	1	1		15			3	1	1	1		4	4		2	1		17	
46-50		2		2		1			1		4		10			2	4	1			2	2	1	1	1		14	
51-55													0						1								1	
56-60																												
Totals		14	6	3	3	2	4	1	3	2	10		48		0	6	9	2	3	4	6	9	3	3	5		50	

Appendix Table 4

Skate Length Frequency Data

F/V Celtic 2007-4

Length (cm)	Port Tow #	New Dredge w/no liner and 6" twine top											Totals	Stbd Tow #	New Dredge w/liner and 4.5" twine top											Totals
		81	83	84	85	86	87	88	89	90	91				81	83	84	85	86	87	88	89	90	91		
11-15													0								1		1			2
16-20													0					1					2	2		5
21-25		2									5		7		1				2		2		1	2		8
26-30		1		1		2	1			1	2		8			1			3	1	2		2	5		14
31-35		4			1			1		2	2		10			1			1			1	2			5
36-40		1											1				1			1		1				3
41-45			3	1	3		1	2	1	1	1		13		1	4				2		1	2	1		11
46-50		2	4	3	2		3		1	3			18		1	2	1	3	2		3		2	2		16
51-55							1						1													
56-60																										
Totals		10	7	5	6	2	6	3	2	7	10		58	0	3	8	2	3	9	3	9	2	13	12		64

Appendix Table 4

Skate Length Frequency Data

F/V Celtic 2007-4

Length	Port	New Dredge w/liner and 4.5" twine top													Stbd	New Dredge w/no liner and 6" twine top												
(cm)	Tow #	92	93	94	95	96	97	98	99	100	101	Totals			Tow #	92	93	94	95	96	97	98	99	100	101	Totals		
11-15										2	4	6														0		
16-20									1		2	3												1		1		
21-25						1		1	3	6	4	15				1	1		2			9		2		15		
26-30		1	4		1	2			3	1	4	16			1	1			2			11	1	2		18		
31-35						2			1	5	2	10			1	1	1	1			2	5	3	2		16		
36-40									1	3		4										4		1		5		
41-45			3	2	4	4	3		10	3	2	31				4	1	4	8	5	4	10	3	3		42		
46-50			3		6	2	2		6	7	6	32			7	3	1	3	2	5	2	12	12	8		55		
51-55			1									1														0		
56-60																												
Totals		1	11	2	11	11	5	1	25	27	24	118				9	10	4	8	14	10	8	51	19	19		152	

F/V Celtic 2007-5[illegible]

Appendix Table 5

Fourspot Length Frequency Data

F/V Celtic 2007-3

Length	Port	New Dredge w/wheels and chains															Stbd	Standard													
(cm)	Tow #	1	2	4	5	6	7	8	10	11	12		Totals		Tow #	1	2	4	5	6	7	8	10	11	12		Totals				
11-15													0																0		
16-20													0																0		
21-25		1		1		1	5						8			1		1		1	1	1	5	1	1			12			
26-30		1							1				2					2	1									3			
31-35							1						1															0			
36-40				1									1											1				1			
41-45													0															0			
46-50													0															0			
51-55													0															0			
56-60													0															0			
Totals		2	0	2	0	1	6	0	1	0	0		12			1	0	1	2	2	1	1	5	2	1			16			

Appendix Table 5

Fourspot Length Frequency Data

F/V Celtic 2007-3

Length	Port	New Dredge w/o wheels													Stbd	Standard											
(cm)	Tow #	13	14	15	16	17	18	19	20	21	22		Totals		Tow #	13	14	15	16	17	18	19	20	21	22		Totals
11-15													0														0
16-20													0														0
21-25						1	3				6		10					1									1
26-30					2		4	1	1	5	2		15					2	1	1		2	1				7
31-35										1			1				1	1	1					1			4
36-40													0														0
41-45													0														0
46-50													0														0
51-55													0														0
56-60													0														0
Totals		0	0	0	2	1	7	1	1	6	8		26			0	1	1	4	1	1	0	2	1	1		12

Appendix Table 5

Fourspot Length Frequency Data

F/V Celtic 2007-3

Length	Port	New Dredge w/o wheels															Stbd	New dredge w/wheels																	
(cm)	Tow #	23	24	25	26	27	28	29	30	31	32		Totals		Tow #	23	24	25	26	27	28	29	30	31	32		Totals								
11-15													0														0								
16-20													0							1							1								
21-25		1					1				1		3			1	2		3		1		1	2	1		11								
26-30				1	1		2				2		6						2	1					2		5								
31-35							2	1	1		2		6												2		2								
36-40													0														0								
41-45													0														0								
46-50													0														0								
51-55													0														0								
56-60													0														0								
Totals		1	0	1	1	0	5	1	1	0	5		15			1	2	0	5	2	1	0	1	2	5		19								

Fourspot Length Frequency Data

F/V Celtic 2007-3

Length	Port	Standard dredge																Stbd	New dredge w/wheels															
(cm)	Tow #	33	34	35	36	37	38	39	40	41	42	43	44	45		Totals		Tow #	33	34	35	36	37	38	39	40	41	42	43	44	45		Totals	
11-15																					4													
16-20		2			3	2	1									8			2	5		3	8	2	2	3	1	1		1	1		29	
21-25		1	3	2	1	4	8	3		1		1	1	2		27			11	6	3	4	4	2	5	3		1	1	1	4		45	
26-30		8	8	11	2	10	7	8	8	5	1	6	8	2		84			10	16	14	1	9	11	14	15	10	5	16	22	16		159	
31-35		4	3	2		5	4	2	7	3	2	4	1	1		38			2	8	5	2	6	1	4	8	2	3	6	7	2		56	
36-40			1		1			2	1			1				6						1	4		3		1	1		1		11		
41-45																0																0		
46-50																0																0		
51-55																0																0		
56-60																0																0		
Totals		15	15	15	7	21	20	15	16	9	3	12	10	5		163			25	35	22	14	28	20	25	32	13	11	24	31	24		300	

Appendix Table 5

Fourspot Length Frequency Data

F/V Celtic 2007-3

Length	Port	Standard Dredge															Stbd	New dredge w/wheels & no chains											
(cm)	Tow #	46	47	48	49	50	51	52	53	54	55		Totals		Tow #	46	47	48	49	50	51	52	53	54	55		Totals		
11-15																									1		1		
16-20								1	2		1		4			1	2			1	1	2	4	1			12		
21-25			3	1	3	1	5	2	4	5	2		26			1	6	9	1		5		2		1		25		
26-30		1	4	4	4	3	8	1	4	3	1		33			1	8	5	2	2	9	3	3	2	1		36		
31-35					1		5	1	2				9			1	1		1	1	4	3		2			13		
36-40		1		2					2				5						1	1	2	1					5		
41-45													0														0		
46-50													0														0		
51-55													0														0		
56-60													0														0		
Totals		2	7	7	8	4	18	5	14	8	4		77		0	4	17	14	5	5	21	9	9	5	3		92		

Appendix Table 5

Fourspot Length Frequency Data

F/V Celtic 2007-4

Length	Port	New Dredge w/liner and 4.5" twine top																						Stbd	New Dredge w/no liner and 4.5" twine top																					
(cm)	Tow#	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70		Totals		Tow#	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70		Totals									
11-15										1		1						2			1			1													2									
16-20		2	6	1	1	3	1		1				1	1				17			8	1	3	3	3	1			2			1					22									
21-25		2	4	4	3	3	2		1	1	3		1	2	1	6		33			2	2	4	4	3	3			1		4	4	2	2	1		32									
26-30		6	2	4	3	4	1	1		1		2		1	1			26			1	1	3			3	3	1	2	3	4	1	1	3		26										
31-35		1	1			1	1					1	4					9			2		1			1			2			1	1			8										
36-40																		0				1														1										
41-45																		0																			0									
46-50																		0																			0									
Totals		11	13	9	7	11	5	1	2	3	3	4	6	4	2	6		87			14	5	11	8	6	7	4	1	5	5	8	6	4	6	1		91									

Appendix Table 5

Fourspot Length Frequency Data

F/V Celtic 2007-4

Length (cm)	Port Tow #	New Dredge w/no liner and 4.5" twine top											Totals	Stbd Tow #	New Dredge w/liner and 4.5" twine top											Totals
		71	72	73	74	75	76	77	78	79	80	71			72	73	74	75	76	77	78	79	80			
11-15																									0	
16-20												0													0	
21-25		1		1					3	1		6		1	3		1	3	1	2	4	2	1		18	
26-30					3	1		1			1	6			1		1	1	1	1	2				7	
31-35		2										2											1		1	
36-40												0													0	
41-45												0													0	
46-50												0													0	
Totals		3	0	1	3	1	0	1	3	1	1	14		0	1	4	0	1	4	2	3	5	4	2		26

Appendix Table 5

Fourspot Length Frequency Data

F/V Celtic 2007-4

Length	Port	New Dredge w/no liner and 6" twine top												Stbd	New Dredge w/liner and 4.5" twine top											
(cm)	Tow #	81	83	84	85	86	87	88	89	90	91	Totals		Tow #	81	83	84	85	86	87	88	89	90	91	Totals	
11-15												0													0	
16-20												0					1						1		2	
21-25		1	2					1	1		2	7				1	1	1	1	1	2	4	3	2	16	
26-30			1	2	1			1			1	6			1	1	3		1					1	7	
31-35		1			1							2			1			1							2	
36-40												0													0	
41-45												0													0	
46-50												0													0	
Totals		2	3	2	2	0	0	2	1	0	3	15		0	2	2	5	2	2	1	2	4	4	3	27	

Appendix Table 5

Fourspot Length Frequency Data

F/V Celtic 2007-4

Length	Port	New Dredge w/liner and 4.5" twine top														Stbd	New Dredge w/no liner and 6" twine top												
(cm)	Tow #	92	93	94	95	96	97	98	99	100	101		Totals		Tow #	92	93	94	95	96	97	98	99	100	101		Totals		
11-15			1	1						1			3												1		1		
16-20				1				1		3	2		7							1					1		2		
21-25		2	3	1	4		1		2	6	5		24					2			1	1	1	2	1		8		
26-30				3		3	1	1	2	1	6		17							1		1	1	2	1		6		
31-35					1				1		2		4			1	1		1		1			1			5		
36-40					1				1		1		3					1							1		2		
41-45													0														0		
46-50													0														0		
Totals		2	4	6	6	3	2	2	6	11	16		58			1	1	3	1	1	3	2	2	5	5		24		

Fourspot Length Frequency Data

F/V Celtic 2007-5

3.8 knots																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							</
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Monkfish Length Frequency Data

F/V Celtic 2007-3

Length	Port	New Dredge w/wheels and chains																Stbd	Standard												
(cm)	Tow #	1	2	4	5	6	7	8	10	11	12			Totals			Tow #	1	2	4	5	6	7	8	10	11	12		Totals		
16-20														0															0		
21-25														0												1			1		
26-30						1		1						2								1							1		
31-35						1					1			2						1		1		1					3		
36-40			1								1			2								1							1		
41-45					1			1	1					3												1			1		
46-50							1		3		1			5											1				1		
51-55		1							1					2															0		
56-60														0															0		
61-65														0									1						1		
66-70														0															0		
71-75														0															0		
>76-80														0															0		
													Total	16													Total		9		

Monkfish Length Frequency Data

F/V Celtic 2007-3[illegible]

Monkfish Length Frequency Data

F/V Celtic 2007-3

Length	Port	New Dredge w/o wheels													Stbd	New dredge w/wheels													
(cm)	Tow #	23	24	25	26	27	28	29	30	31	32		Totals		Tow #	23	24	25	26	27	28	29	30	31	32		Totals		
16-20													0														0		
21-25													0														0		
26-30													0														0		
31-35													0														0		
36-40													0				1										1		
41-45		1											1														0		
46-50								2					2		2												2		
51-55													0														0		
56-60													0														0		
61-65													0														0		
66-70													0								1						1		
71-75													0														0		
>76-80													0														0		
												Total	3												Total	4			

Appendix Table 6

Monkfish Length Frequency Data

F/V Celtic 2007-3

Length	Port	Standard dredge																Stbd	New dredge w/wheels															
(cm)	Tow #	33	34	35	36	37	38	39	40	41	42	43	44	45			Totals		Tow #	33	34	35	36	37	38	39	40	41	42	43	44	45		
16-20																	0																	0
21-25											1	1					2								1									1
26-30												1					1				1				1				1	1				4
31-35												1					1																	0
36-40										1							1																	0
41-45					1					1							2								1	1			1					3
46-50		1			1							1					3																	0
51-55								1						1			2												2					2
56-60							2					3					5				2						1				1			4
61-65													1	1			2							1				1						2
66-70													1				1																	0
71-75																	0																	0
>76-80																	0																	0
														Total			20															Total		16

Monkfish Length Frequency Data

F/V Celtic 2007-3[illegible]

Appendix Table 6

Monkfish Length Frequency Data

F/V Celtic 2007-4

Length	Port	New Dredge w/liner and 4.5" twine top																						Stbd	New Dredge w/no liner and 4.5" twine top																				
(cm)	Tow #	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	Totals		Tow #	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	Totals										
11-15																	0																	0											
16-20																	0																	0											
21-25				1													1																	0											
26-30																	0														1			1											
31-35						1											1					1												1											
36-40					1												1									1								1											
41-45																	0			1			1				1							3											
46-50		2												1	1		4			1						1								2											
51-55				1												1	2				1													1											
56-60																	0				1					1								2											
61-65			1											1			2				1													1											
66-70																	0																	0											
71-75																	0													1				1											
76-80																	0																	0											
81-85																	0																	0											
86-90																	0																	0											
91-95																	0																	0											
Totals		2	1	2	1	1	0	0	0	0	0	0	2	1	0	1	11			2	2	1	1	1	0	1	3	0	0	0	1	1	0	0	13										

Appendix Table 6

Monkfish Length Frequency Data

F/V Celtic 2007-4

Length	Port	New Dredge w/no liner and 4.5" twine top														Stbd	New Dredge w/liner and 4.5" twine top												
(cm)	Tow #	71	72	73	74	75	76	77	78	79	80		Totals		Tow #	71	72	73	74	75	76	77	78	79	80		Totals		
11-15																											0		
16-20													0											1			1		
21-25													0														0		
26-30							1						1					1			1						2		
31-35								1					1					1									1		
36-40									1				1														0		
41-45			1										1			1				1							2		
46-50				1		1							2														0		
51-55													0								1						1		
56-60			1				1						2					1									1		
61-65													0														0		
66-70													0														0		
71-75													0														0		
76-80													0														0		
81-85													0														0		
86-90													0														0		
91-95													0								1						1		
Totals		0	2	1	0	1	2	1	1	0	0		8		0	1	0	0	2	1	1	3	0	1	0		9		

Appendix Table 6

Monkfish Length Frequency Data

F/V Celtic 2007-4

Length	Port	New Dredge w/no liner and 6" twine top														Stbd	New Dredge w/liner and 4.5" twine top												
(cm)	Tow #	81	83	84	85	86	87	88	89	90	91		Totals		Tow #	81	83	84	85	86	87	88	89	90	91		Totals		
11-15													0														0		
16-20													0														0		
21-25													0														0		
26-30							1						1					1									1		
31-35					1								1														0		
36-40					1								1														0		
41-45													0														0		
46-50										1	1		2														0		
51-55													0														0		
56-60													0														0		
61-65													0														0		
66-70													0														0		
71-75													0														0		
76-80													0														0		
81-85													0														0		
86-90													0														0		
91-95													0														0		
Totals		0	0	0	2	0	1	0	0	1	1		5		0	0	0	0	1	0	0	0	0	0	0		1		

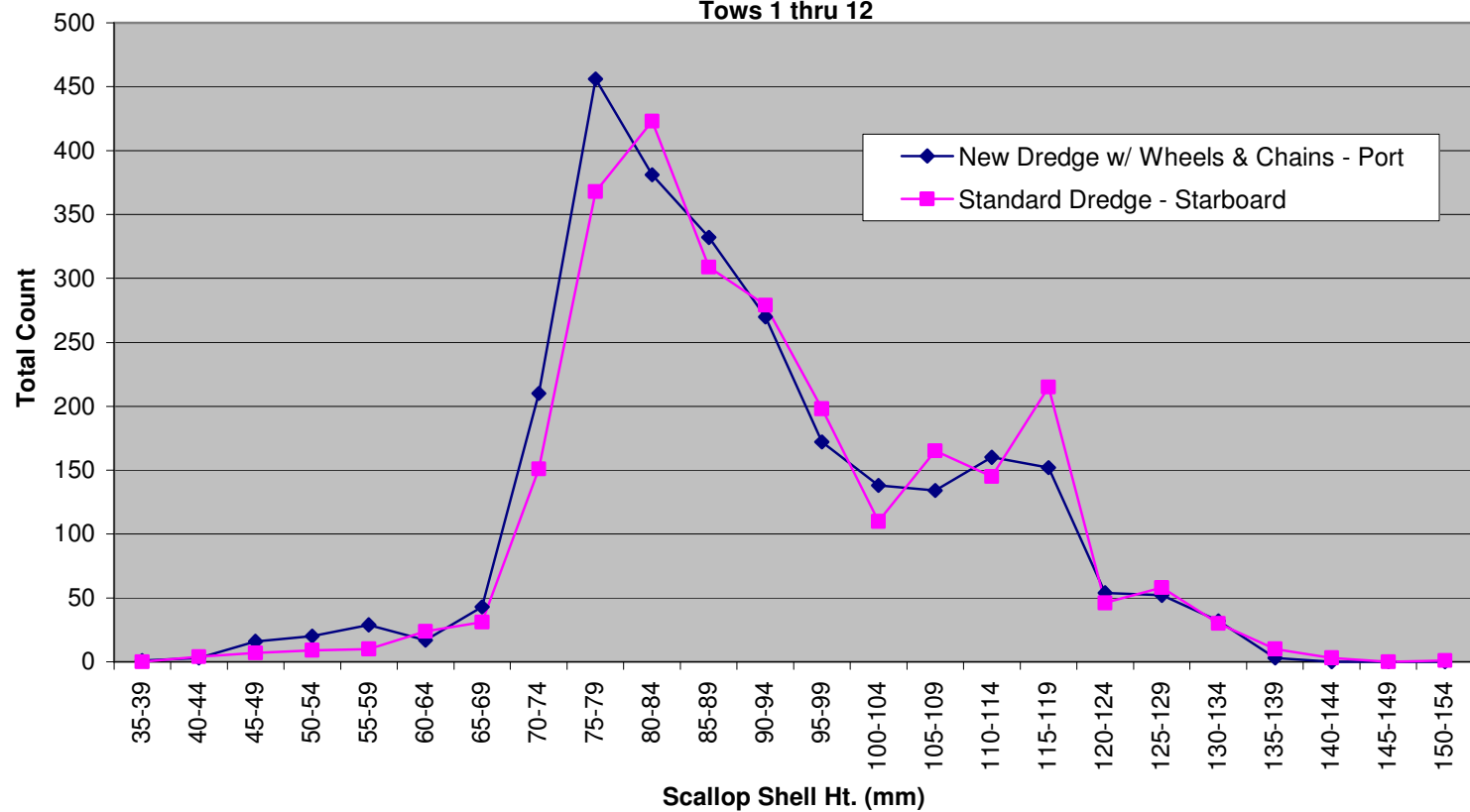
Appendix Table 6

Monkfish Length Frequency Data

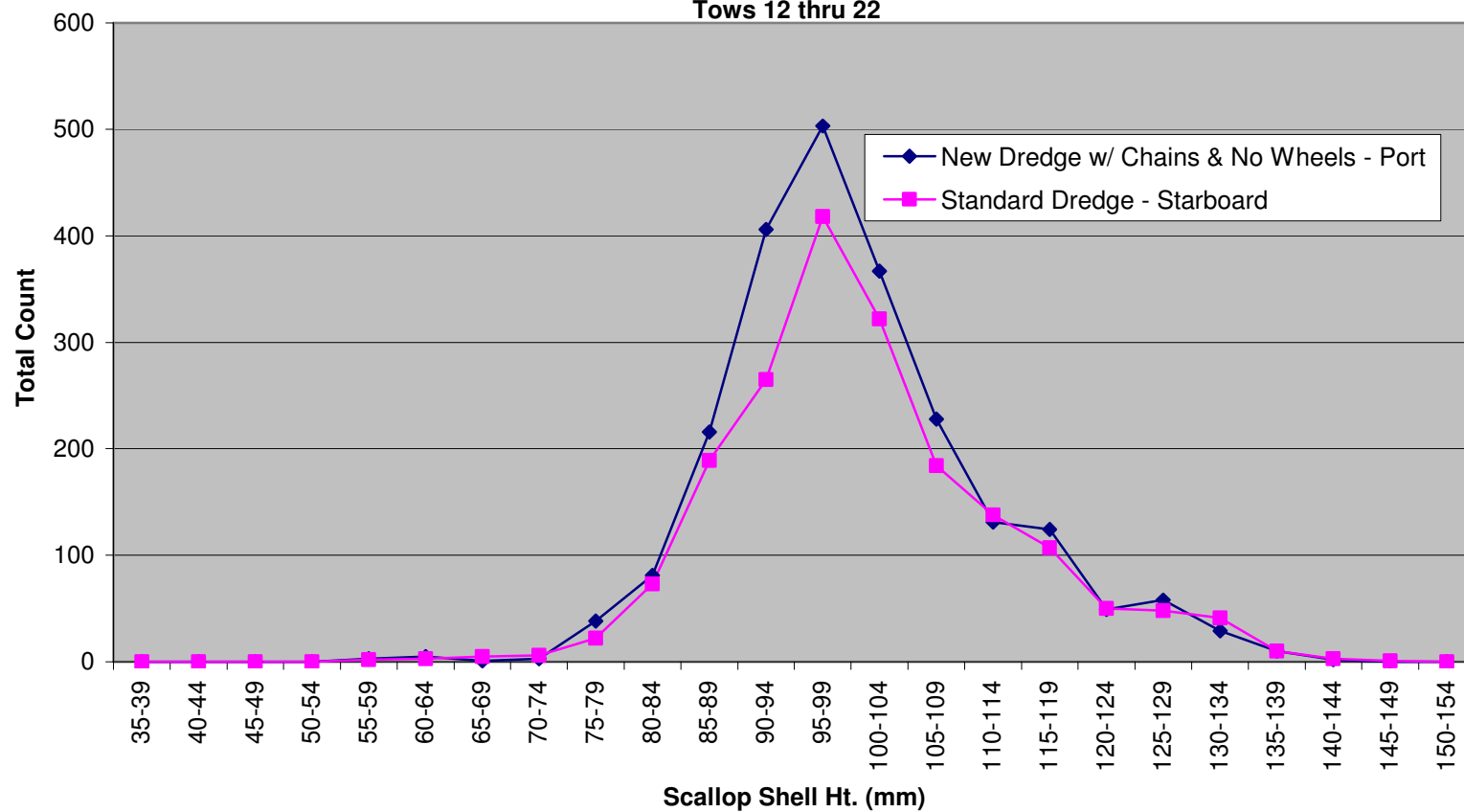
F/V Celtic 2007-4

Length	Port	New Dredge w/liner and 4.5" twine top													Stbd	New Dredge w/no liner and 6" twine top												
(cm)	Tow #	92	93	94	95	96	97	98	99	100	101		Totals		Tow #	92	93	94	95	96	97	98	99	100	101		Totals	
11-15													0														0	
16-20													0														0	
21-25													0														0	
26-30													0														0	
31-35													0														0	
36-40													0					1									1	
41-45				1									1														0	
46-50													0				1	1									2	
51-55													0														0	
56-60										1			1											2			2	
61-65											1		1														0	
66-70													0														0	
71-75													0				1										1	
76-80													0														0	
81-85													0														0	
86-90													0														0	
91-95													0														0	
Totals		0	0	1	0	0	0	0	1	0	1		3			0	2	1	1	0	0	0	0	2	0		6	

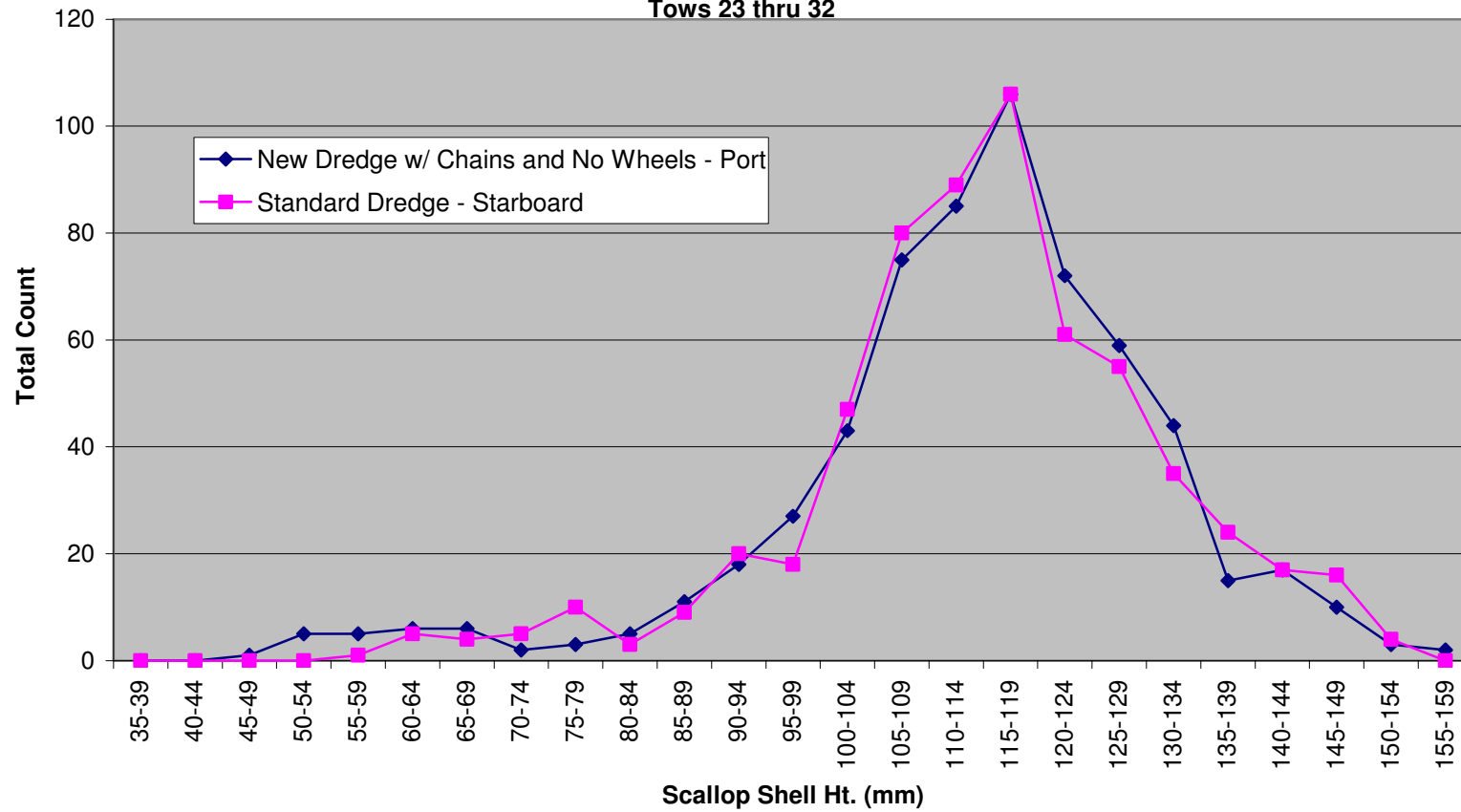
Celtic-2007-3
Scallop Shell Height Frequency
Data Set 1
Tows 1 thru 12



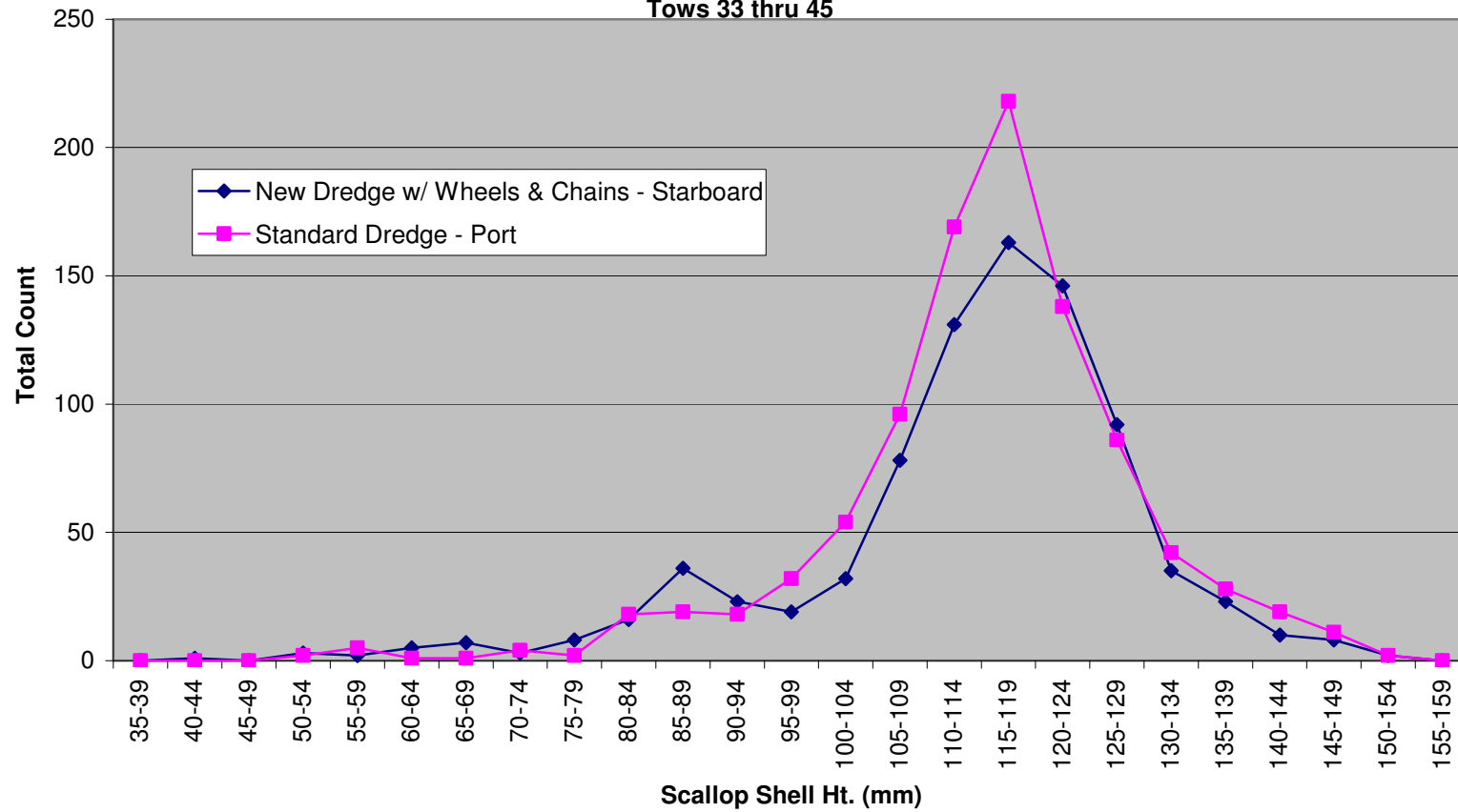
Celtic-2007-3
Scallop Shell Height Frequency
Data Set 2
Tows 12 thru 22



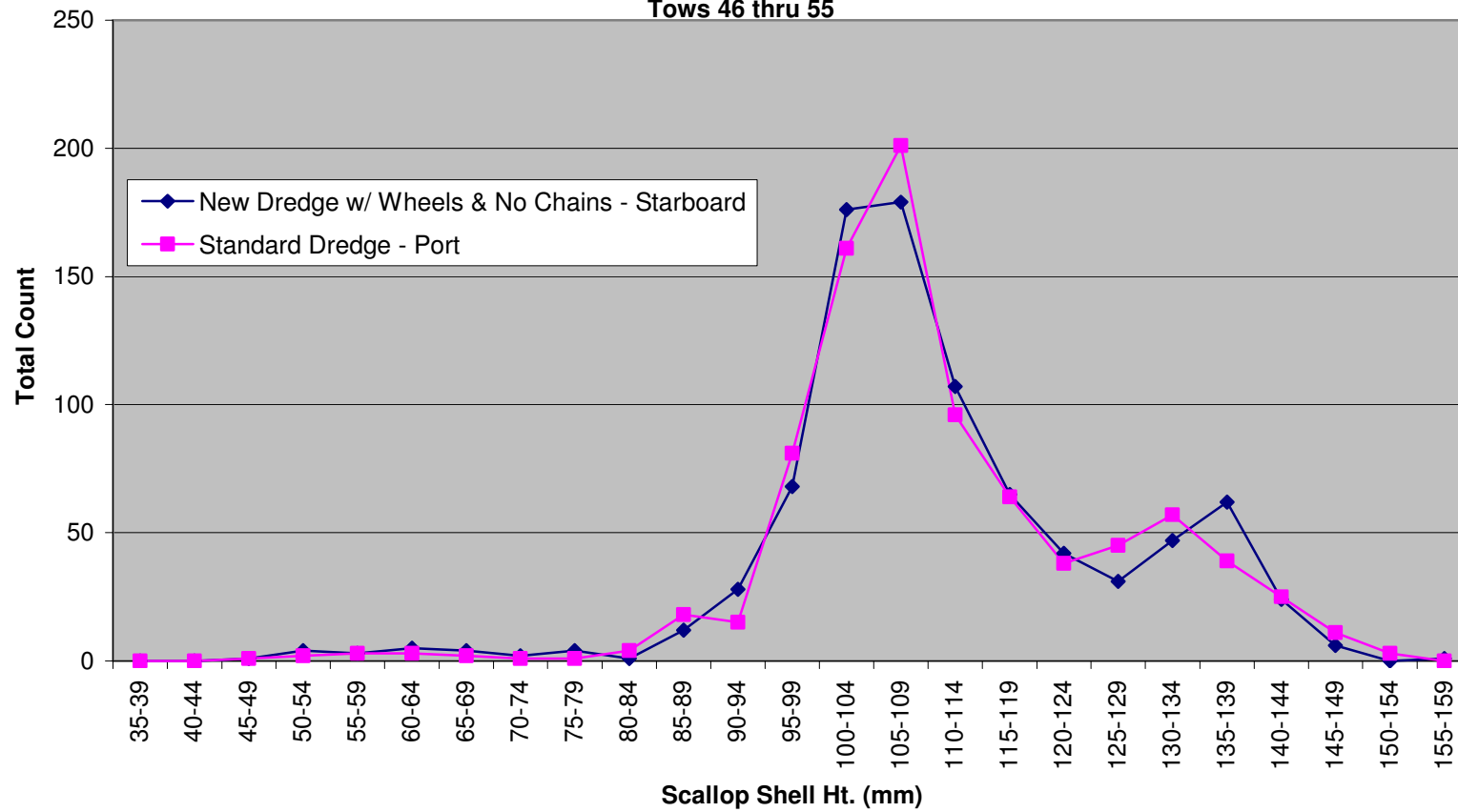
Celtic-2007-3
Scallop Shell Height Frequency
Data Set 3
Tows 23 thru 32



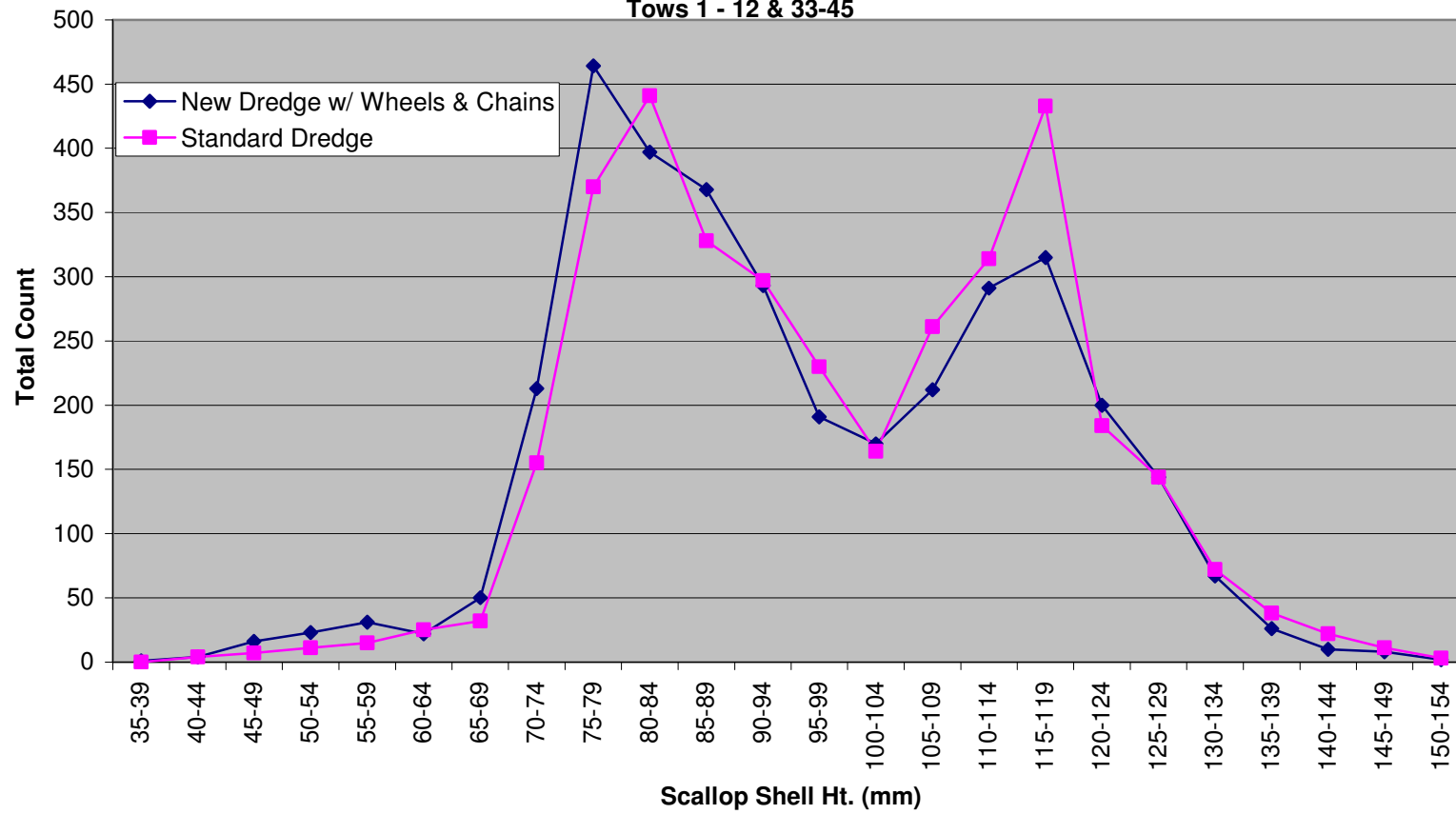
Celtic-2007-3
Scallop Shell Height Frequency
Data Set 4
Tows 33 thru 45



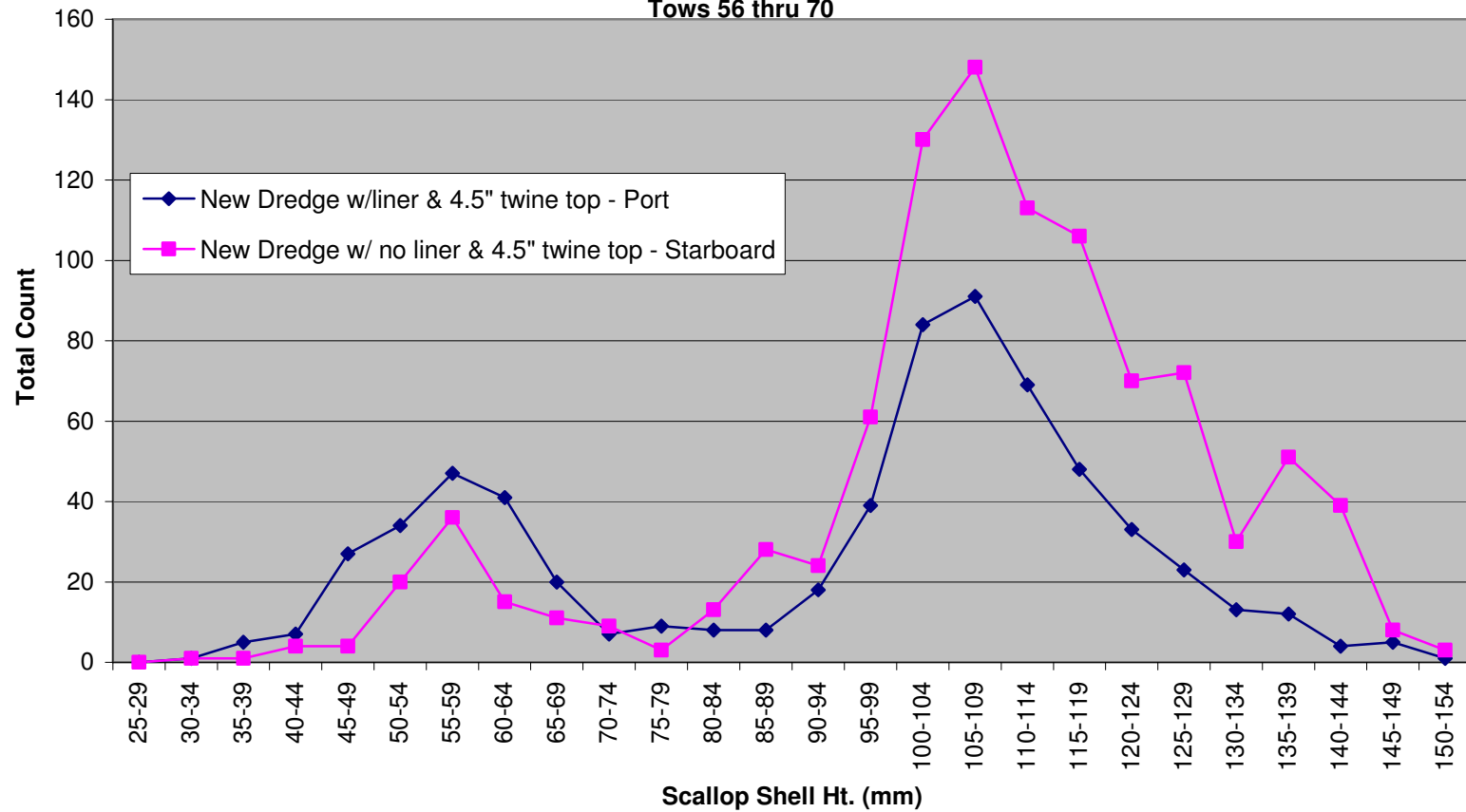
Celtic-2007-3
Scallop Shell Height Frequency
Data Set 5
Tows 46 thru 55



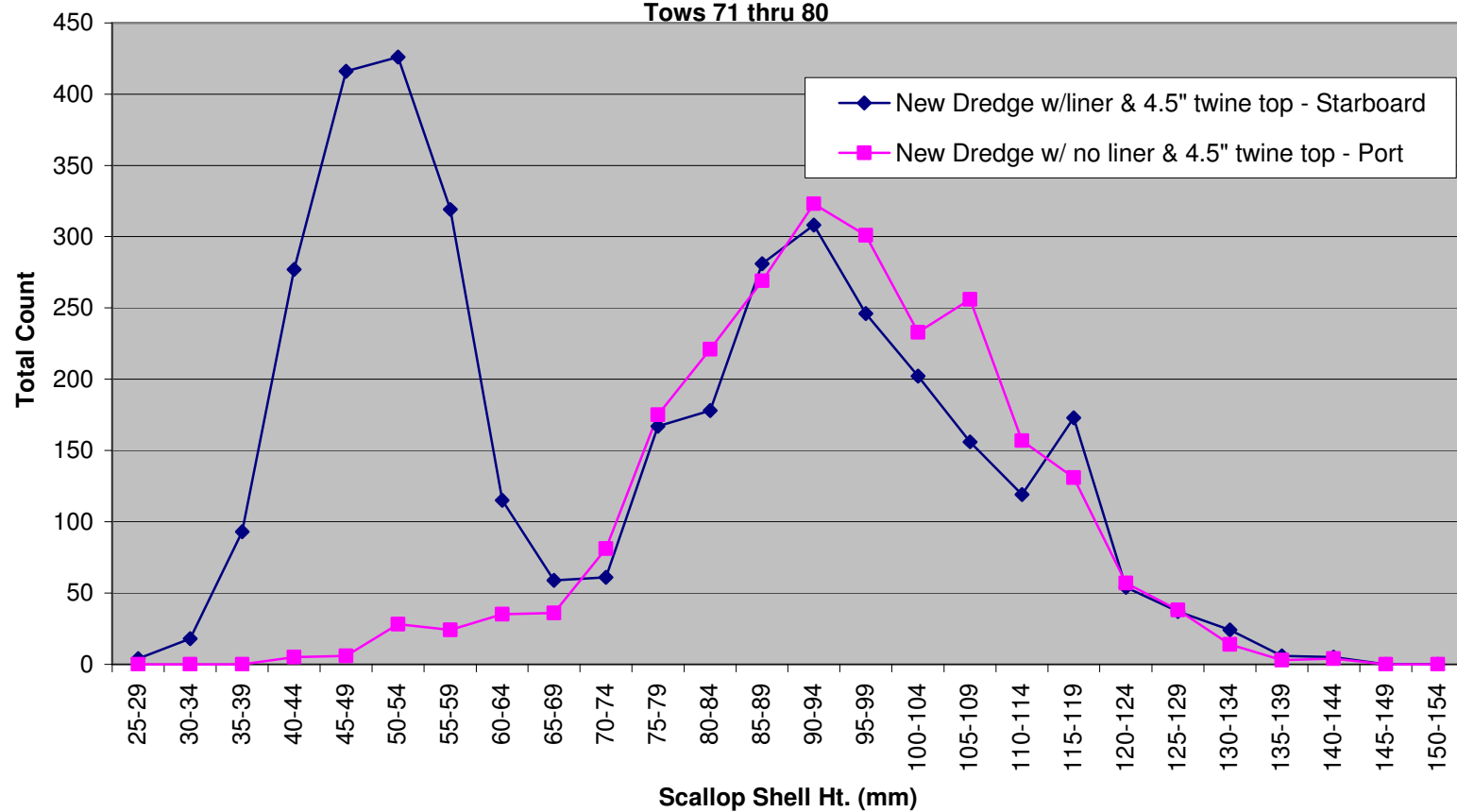
Celtic-2007-3
Scallop Shell Height Frequency
Data Set 6
Tows 1 - 12 & 33-45



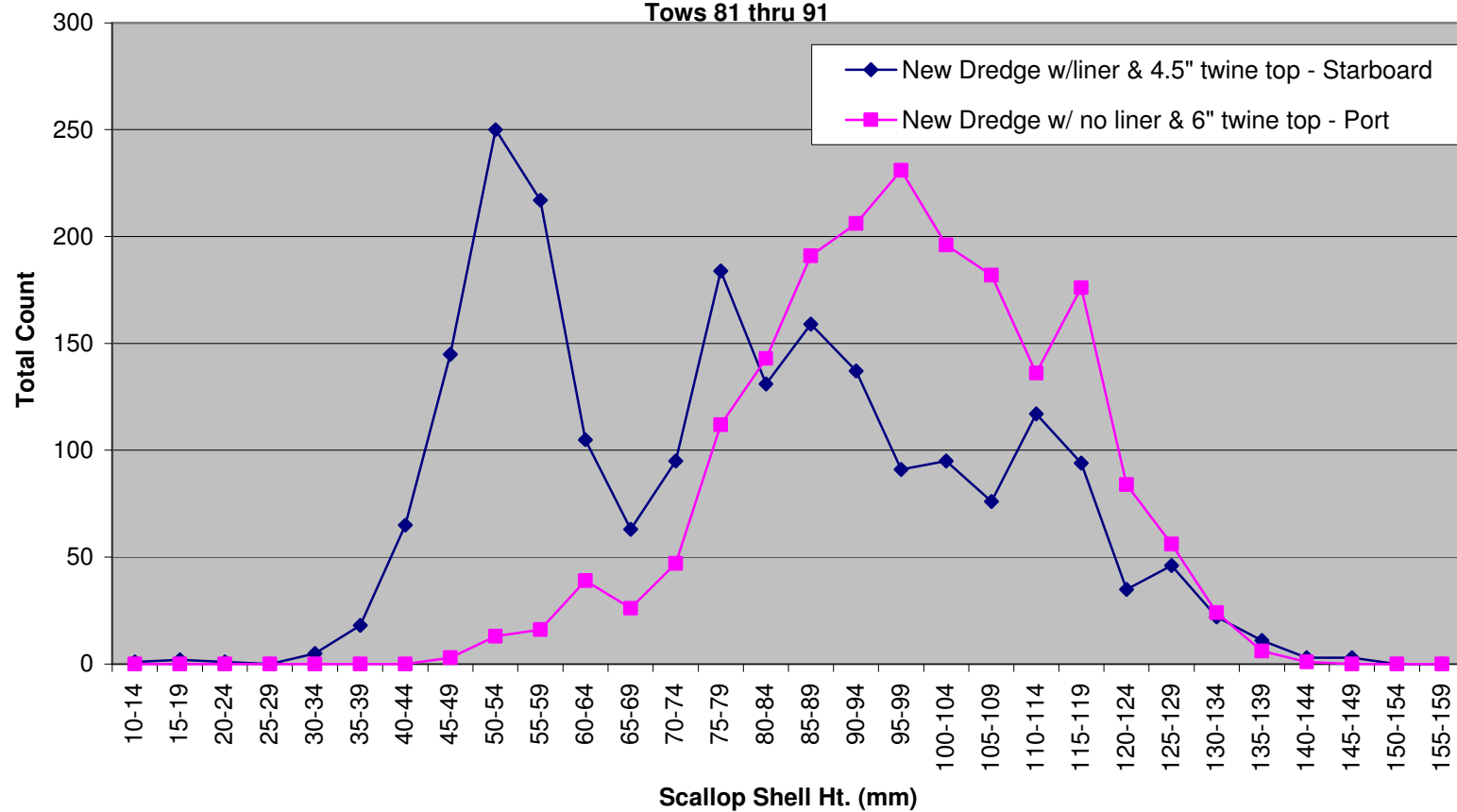
Celtic-2007-4
Scallop Shell Height Frequency
Data Set 1
Tows 56 thru 70



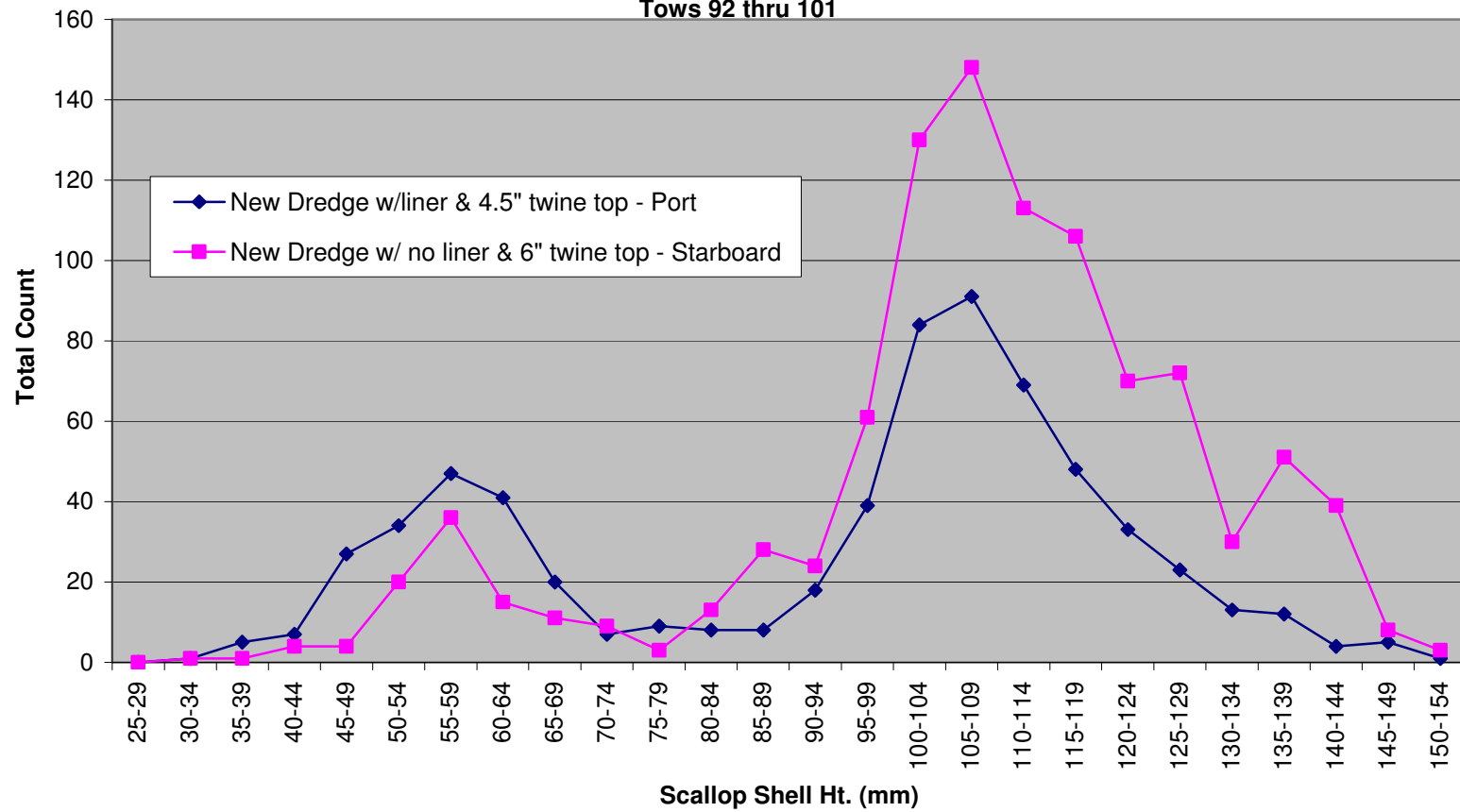
Celtic-2007-4
Scallop Shell Height Frequency
Data Set 2
Tows 71 thru 80



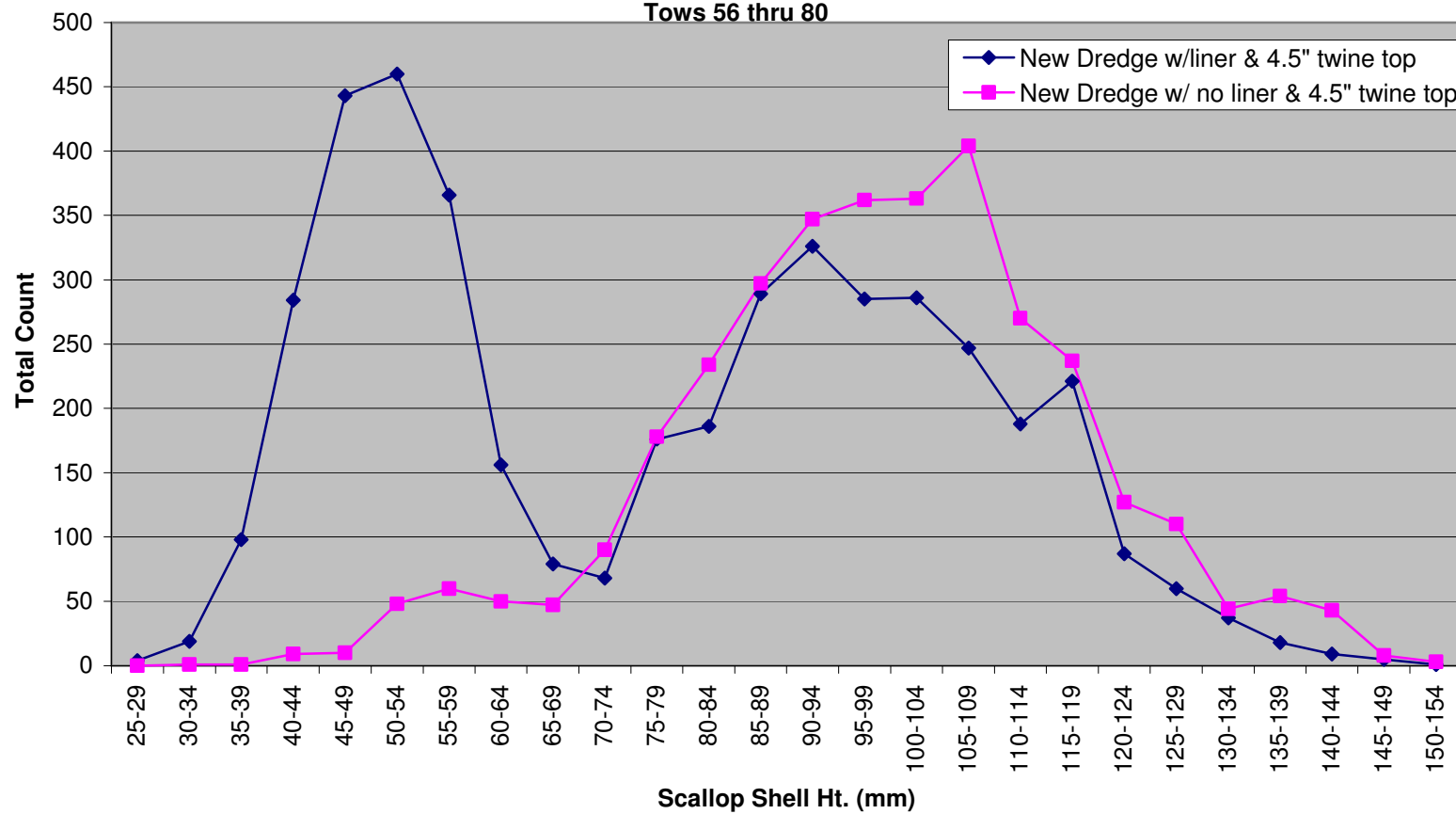
Celtic-2007-4
Scallop Shell Height Frequency
Data Set 3
Tows 81 thru 91



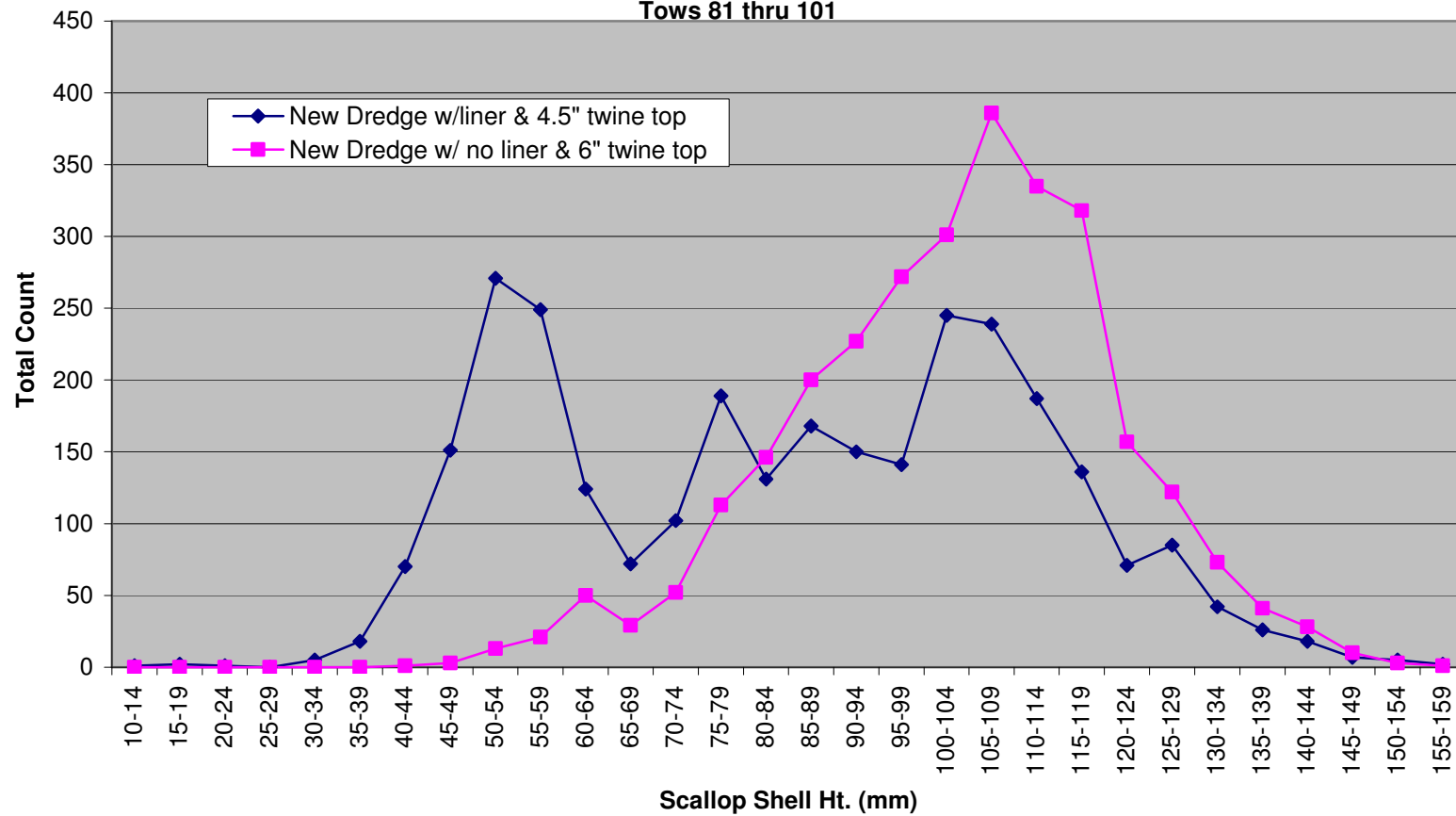
Celtic-2007-4
Scallop Shell Height Frequency
Data Set 4
Tows 92 thru 101



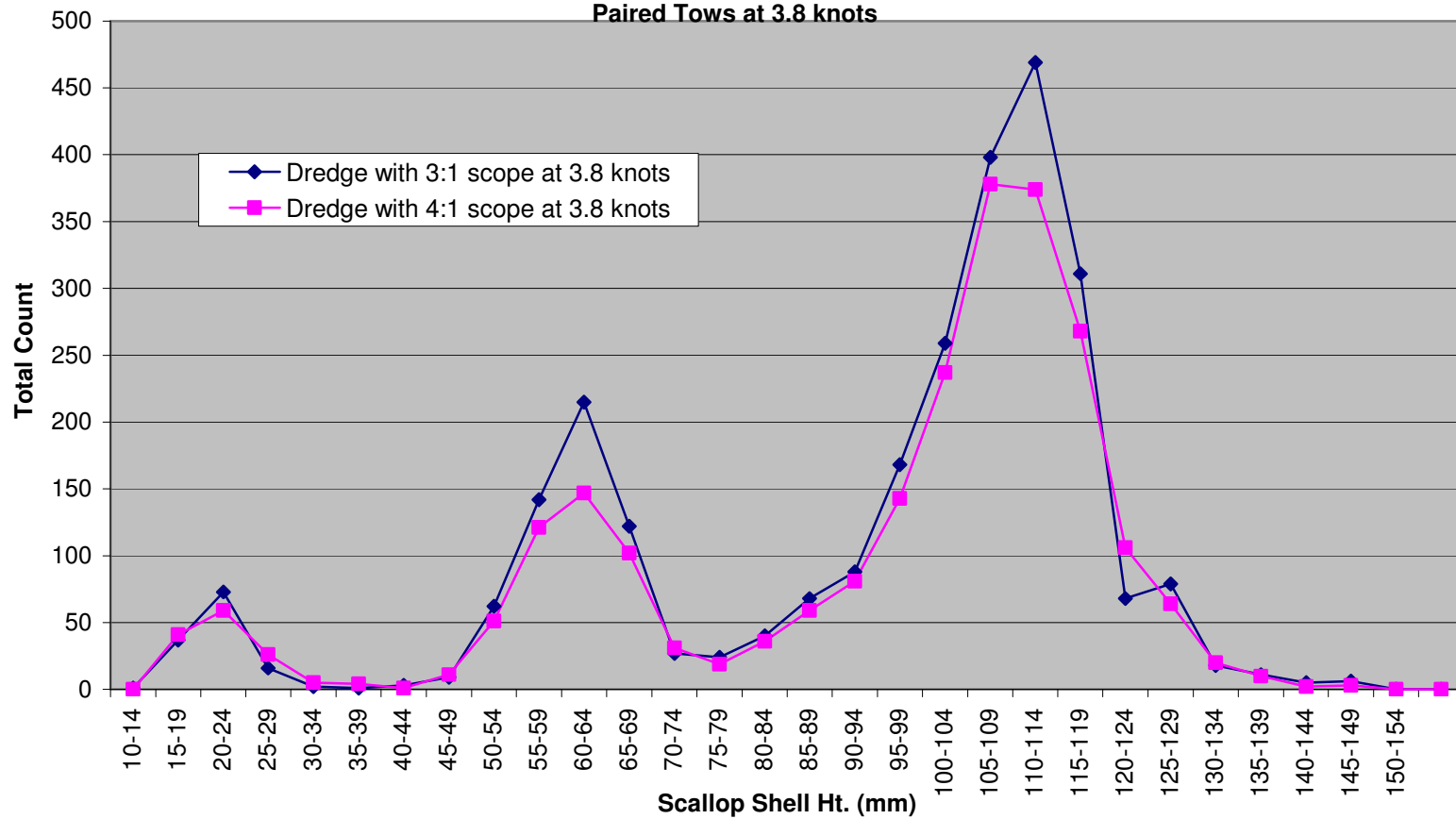
Celtic-2007-4
Scallop Shell Height Frequency
Data Set 5
Tows 56 thru 80



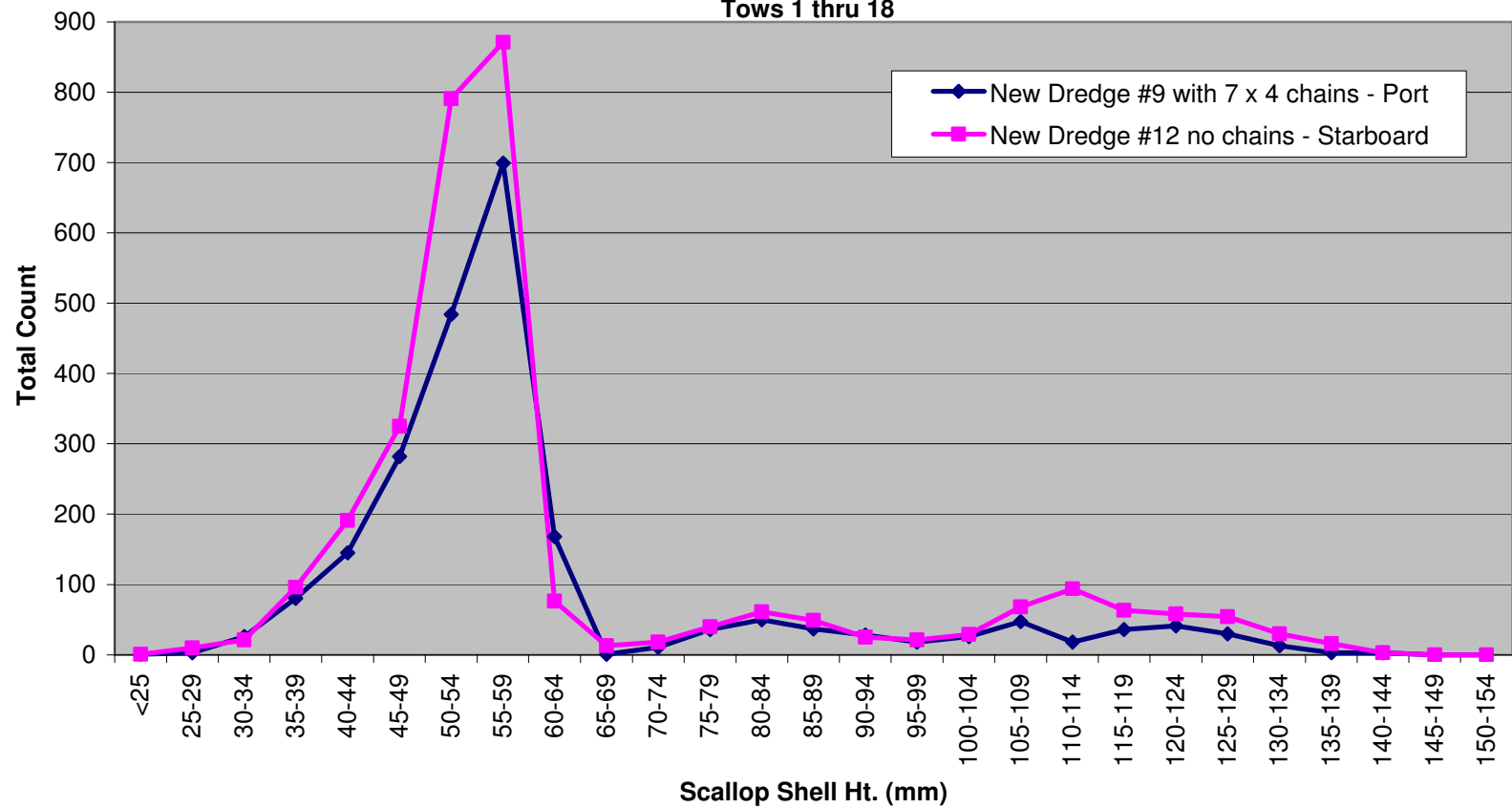
Celtic-2007-4
Scallop Shell Height Frequency
Data Set 6
Tows 81 thru 101



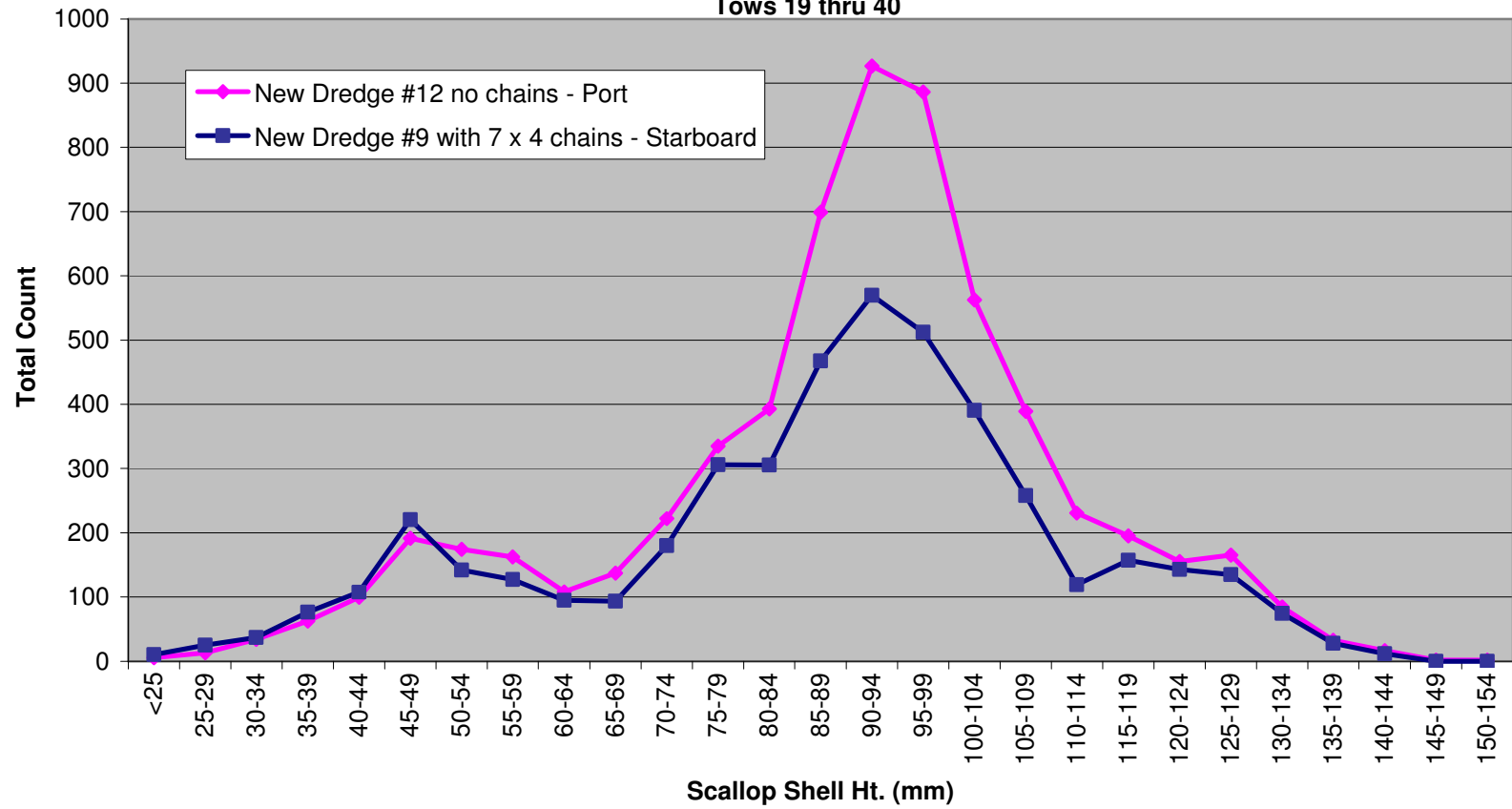
Celtic-2007-5
Scallop Shell Height Frequency
Data Set 1
Paired Tows at 3.8 knots



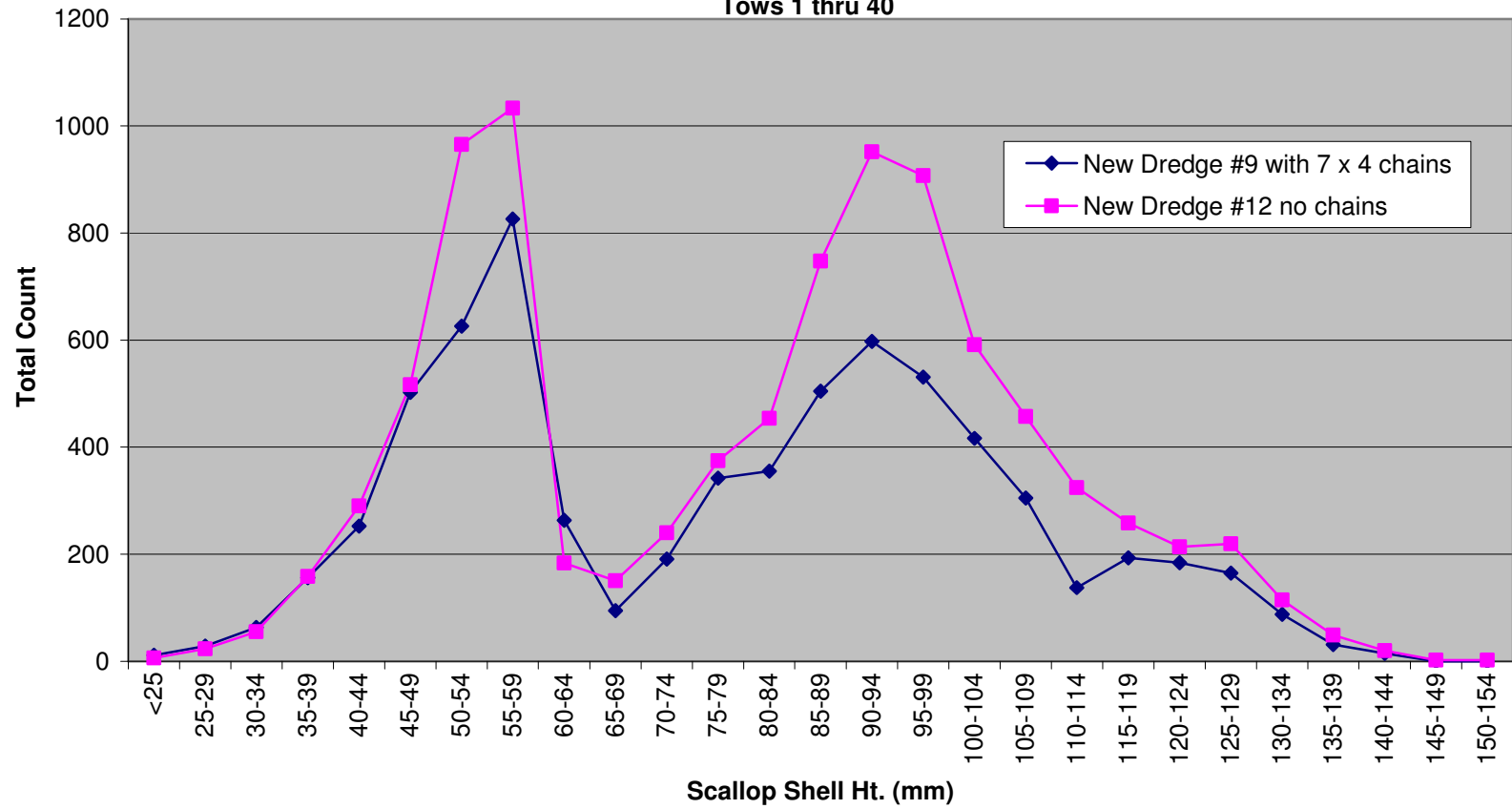
Celtic-2008-1
Scallop Shell Height Frequency
Data Set 1
Tows 1 thru 18



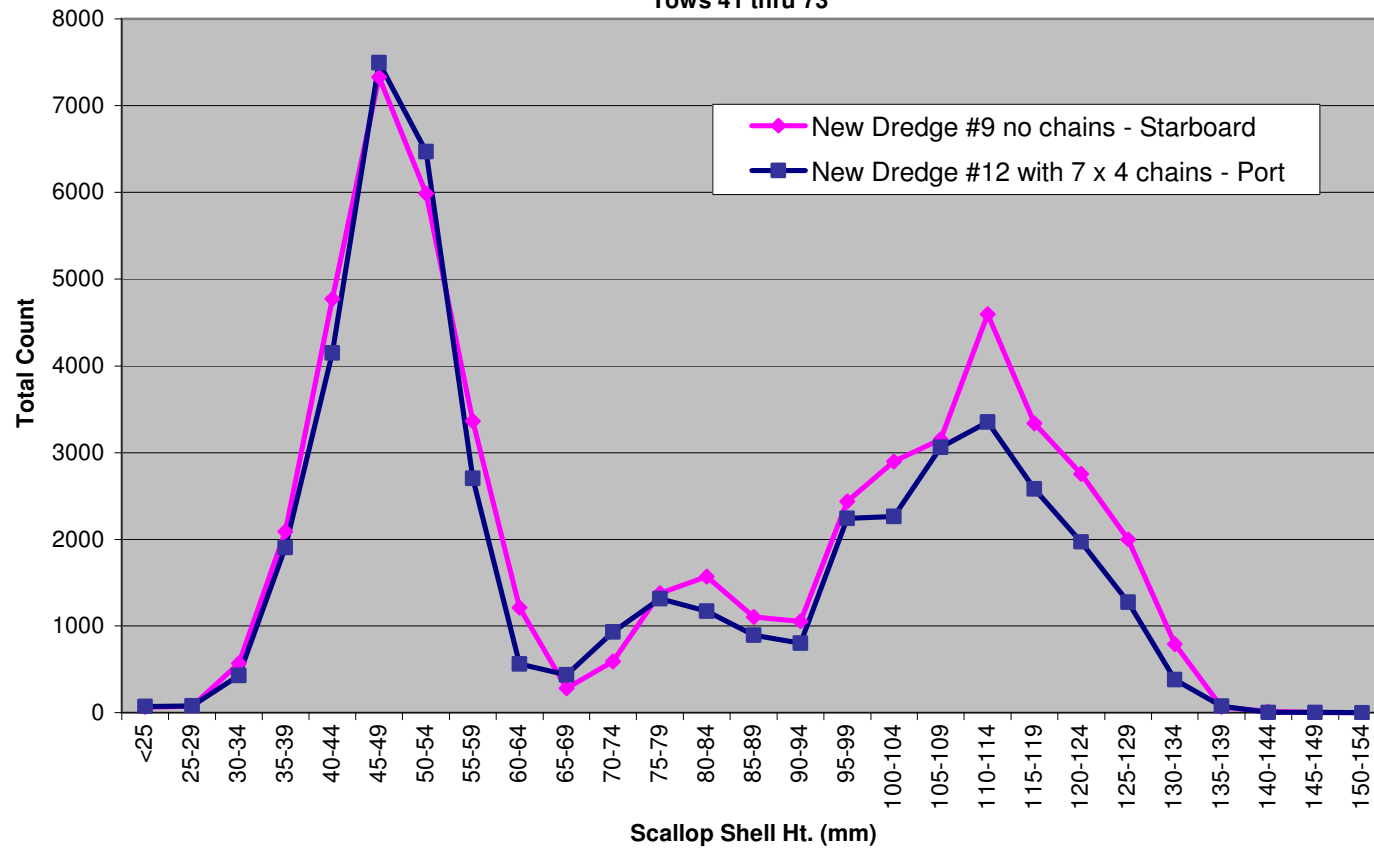
Celtic-2008-1
Scallop Shell Height Frequency
Data Set 2
Tows 19 thru 40



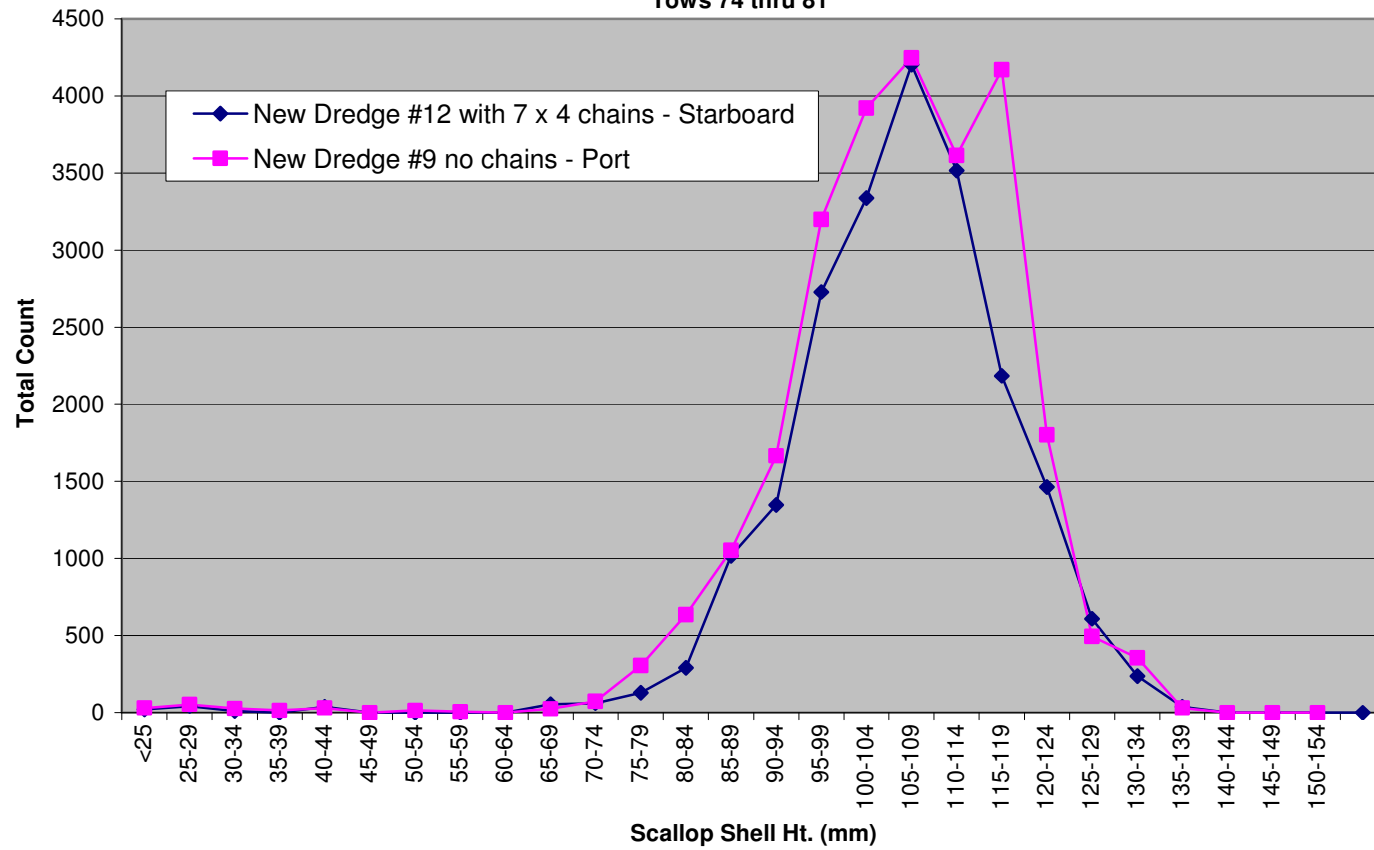
Celtic-2008-1
Scallop Shell Height Frequency
Data Set 3
Tows 1 thru 40



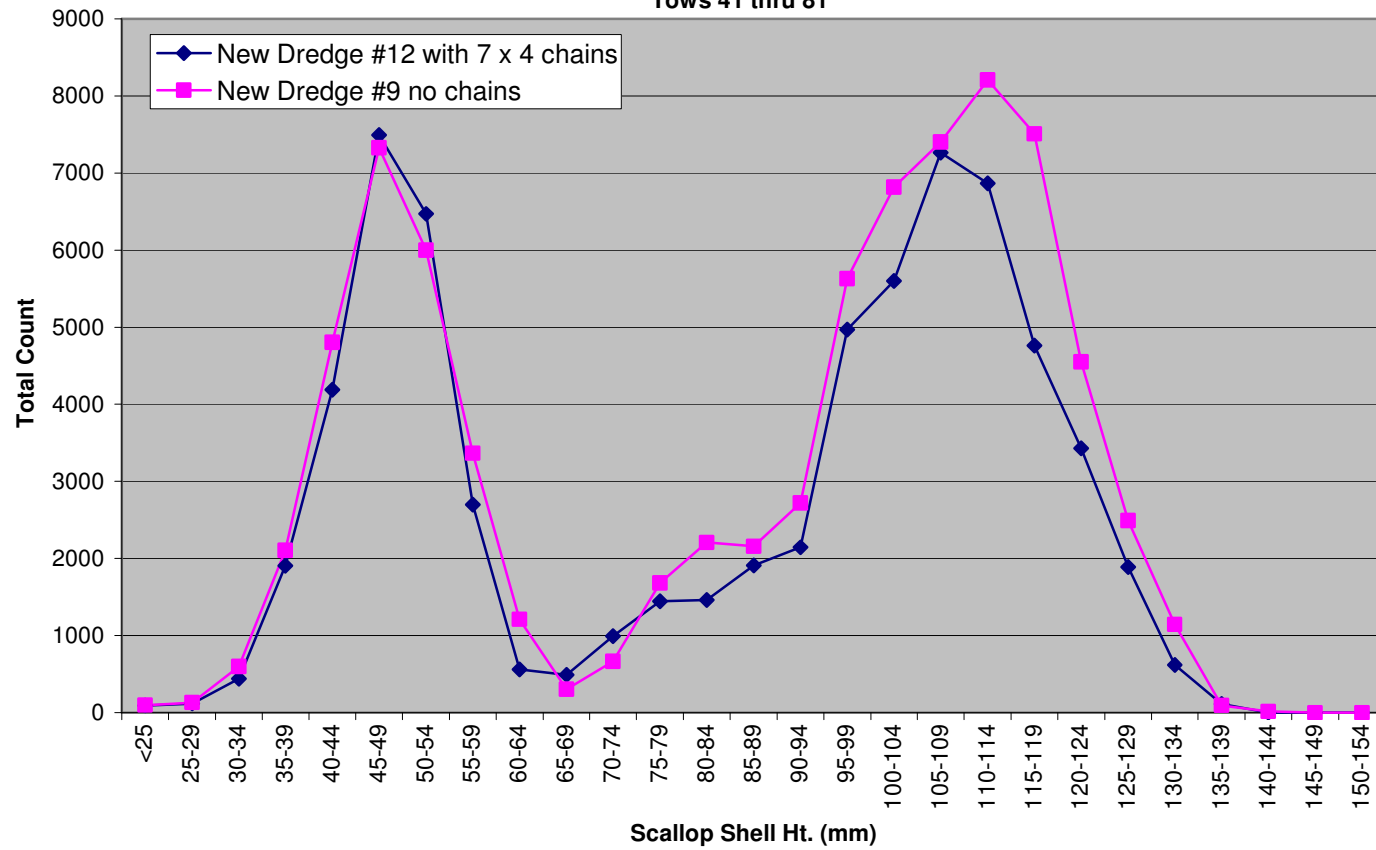
Celtic-2008-1
Scallop Shell Height Frequency
Data Set 4
Tows 41 thru 73



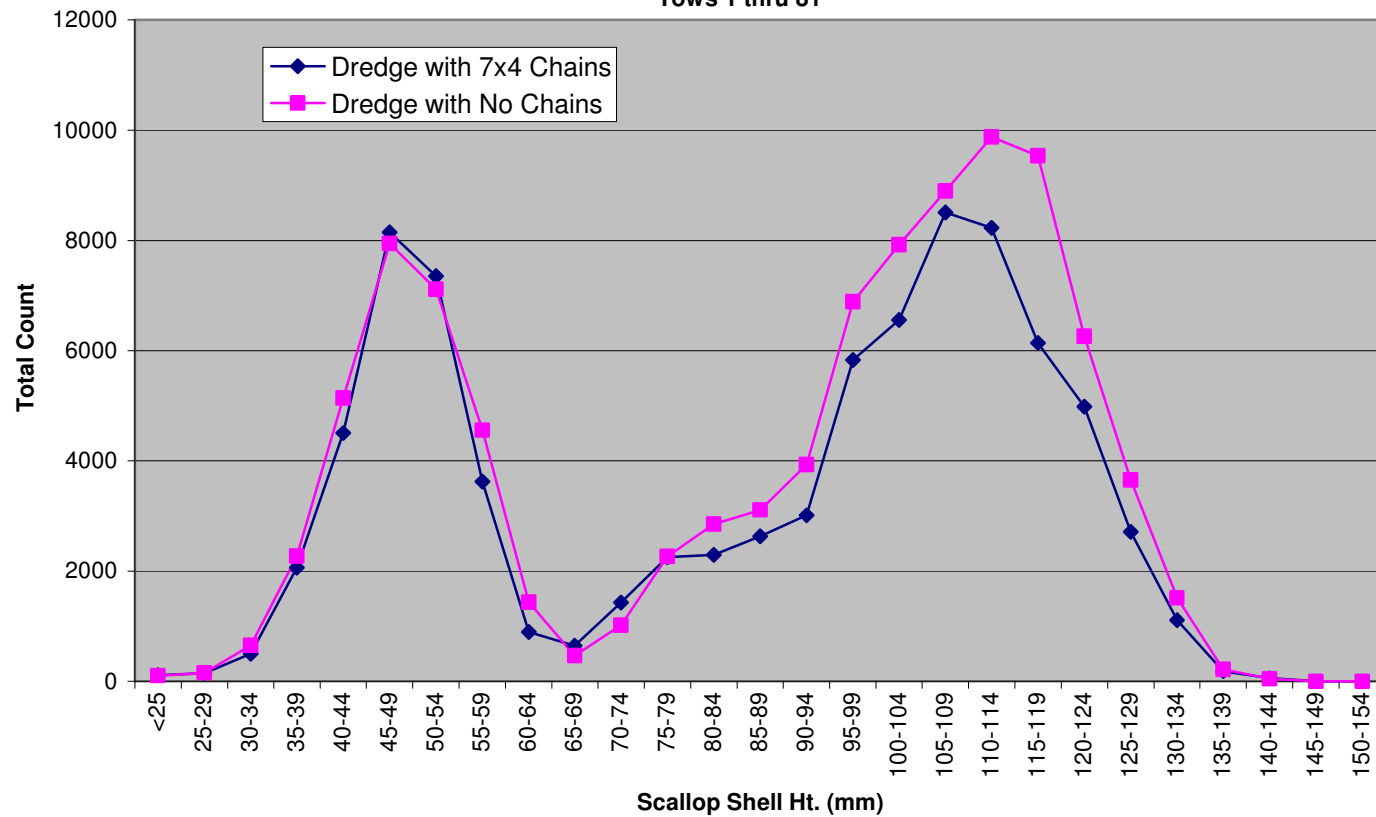
Celtic-2008-1
Scallop Shell Height Frequency
Data Set 5
Tows 74 thru 81



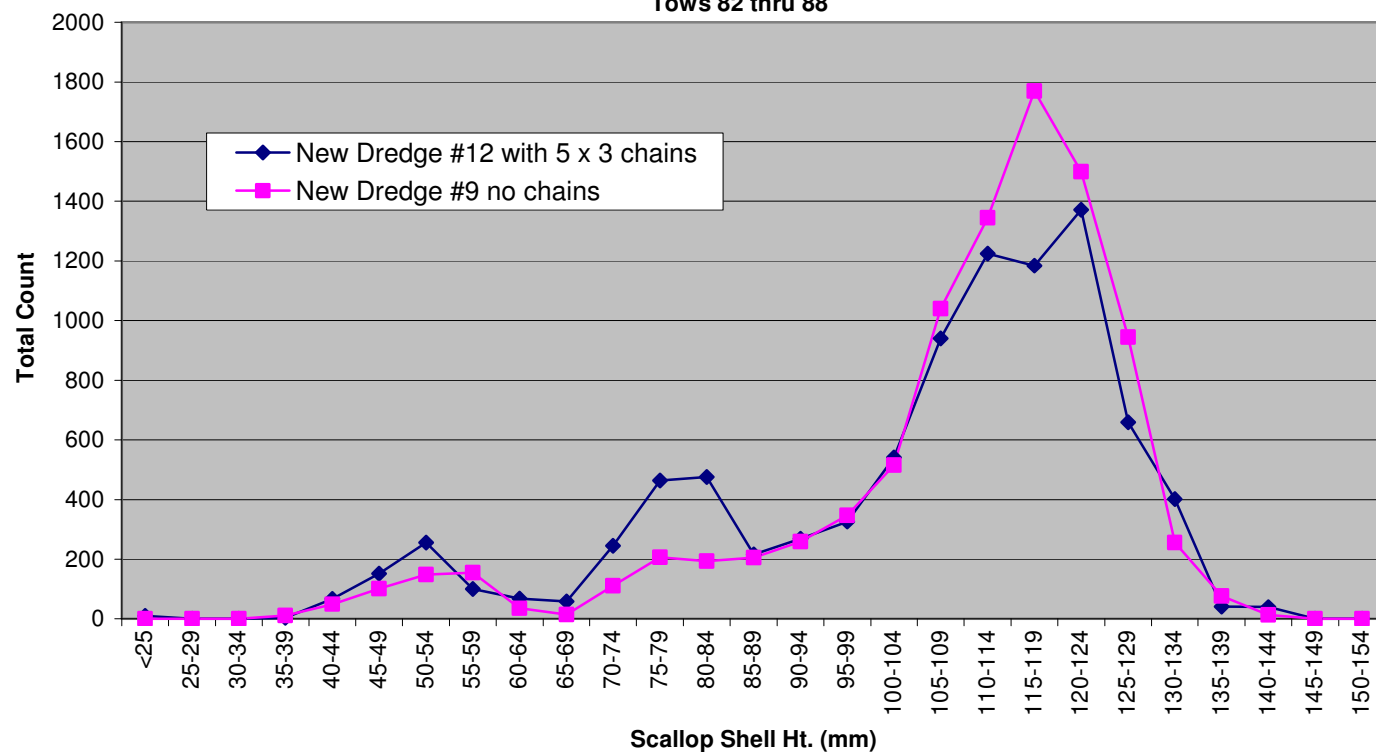
Celtic-2008-1
Scallop Shell Height Frequency
Data Set 6
Tows 41 thru 81



Celtic-2008-1
Scallop Shell Height Frequency
Data Set 7
All Tows Before Modification to Chain Configuration
Tows 1 thru 81



Celtic-2008-1
Scallop Shell Height Frequency
Data Set 8
Tows with 5x3 Chain Configuration
Tows 82 thru 88



Descriptive Statistics and t-Test: Paired Two Sample for Means

[illegible]

Descriptive Statistics and t-Test: Paired Two Sample for Means

[illegible]

Descriptive Statistics and t-Test: Paired Two Sample for Means

[illegible]

Descriptive Statistics and t-Test: Paired Two Sample for Means

[illegible]

Descriptive Statistics and t-Test: Paired Two Sample for Means

[illegible]

Descriptive Statistics and t-Test: Paired Two Sample for Means

[illegible]

Descriptive Statistics and t-Test: Paired Two Sample for Means

[illegible]

Descriptive Statistics and t-Test: Paired Two Sample for Means

[illegible]

Celtic-2007-4 Data Set 2

New Dredge w/ no liner & 4.5" twine top - Port

New Dredge w/liner & 4.5" twine top - Starboard

Paired Tows 71 thru 80

Descriptive Statistics and t-Test: Paired Two Sample for Means

Species	Scallop (bu)		Scallop (count)		Trash (bu)		Skate		Grey Sole		Fourspot Fld.		Yellowtail Fld.		Monk	
<i>Dredge</i>	<i>liner</i>	<i>No Liner</i>	<i>liner</i>	<i>No Liner</i>	<i>liner</i>	<i>No Liner</i>	<i>liner</i>	<i>No Liner</i>	<i>liner</i>	<i>No Liner</i>	<i>liner</i>	<i>No Liner</i>	<i>liner</i>	<i>No Liner</i>	<i>liner</i>	<i>No Liner</i>
Total Count	10.50	11.90	3744	2397	32.25	14.75	50	48	0	5	26	14	0	0	9	8
% Difference in Count	-11.8%		56.2%		118.6%		4.2%		-100.0%		85.7%		#DIV/0!		12.5%	
Mean	1.1	1.2	374.4	239.7	3.2	1.5	5.0	4.8	0.0	0.5	2.6	1.4	0.0	0.0	0.9	0.8
Standard Error	0	0	103	31	1	0	1	1	0	1	1	0	0	0	0	0
Median	1	1	282	242	3	1	5	3	0	0	3	1	0	0	1	1
Mode	1	1	N/A	N/A	3	2	3	3	0	0	4	1	0	0	1	0
Standard Deviation	1	0	326	97	2	1	2	4	0	2	2	1	0	0	1	1
Sample Variance	0	0	106022	9347	4	1	6	17	0	3	3	1	0	0	1	1
Kurtosis	-1	-1	1	-2	-1	0	-1	2	null	10	-1	-1	null	null	1	-1
Skewness	0	0	1	0	0	1	1	2	null	3	0	1	null	null	1	0
Range	2	1	1027	238	5	3	7	13	0	5	5	3	0	0	3	2
Minimum	0	1	43	123	1	1	2	1	0	0	0	0	0	0	0	0
Maximum	2	2	1070	361	6	3	9	14	0	5	5	3	0	0	3	2
Confidence Level(95.0%)	0.40	0.23	232.93	69.16	1.37	0.56	1.78	2.96	0.00	1.13	1.18	0.84	0.00	0.00	0.71	0.56
Variance	0.32	0.10	106022.27	9347.12	3.69	0.62	6.22	17.07	0.00	2.50	2.71	1.38	0.00	0.00	0.99	0.62
Observations	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Pearson Correlation	0.88		0.59		0.64		0.20		null		-0.14		null		-0.17	
Hypothesized Mean Difference	0		0		0		0		0		0		0		0	
df	9		9		9		9		9		9		9		9	
α	0.05		0.05		0.05		0.05		0.05		0.05		0.05		0.05	
t Stat	-1.37		1.52		3.59		0.14		-1.00		1.77		null		0.23	
P(T<=t) two-tail	0.20		0.16		0.01		0.89		0.34		0.11		null		0.82	
t Critical two-tail	2.26		2.26		2.26		2.26		2.26		2.26		null		2.26	

Descriptive Statistics and t-Test: Paired Two Sample for Means

[illegible]

Descriptive Statistics and t-Test: Paired Two Sample for Means

[illegible]

Descriptive Statistics and t-Test: Paired Two Sample for Means

[illegible]

New Dredge w/ no liner & 6" twine top
New Dredge w/liner & 4.5" twine top
Paired Tows 81 thru 101 (excluding tow 2)
Descriptive Statistics and t-Test: Paired Two Sample for Means

[illegible]

Descriptive Statistics and t-Test: Paired Two Sample for Means

[illegible]

Paired Tows with 3:1 scope at 4.5 knots

Descriptive Statistics and t-Test: Paired Two Sample for Means

[illegible]

[illegible]

[illegible]

New Dredge #9 with 7 x 4 chains - Port
New Dredge #12 no chains - Starboard

Descriptive Statistics and t-Test: Paired Two Sample for Means

[illegible]

Descriptive Statistics and t-Test: Paired Two Sample for Means

[illegible]

Paired Tow 1 thru 40

Descriptive Statistics and t-Test: Paired Two Sample for Means

[illegible]

Celtic-2008-1 Data Set 4

New Dredge #12 with 7 x 4 chains - Port

New Dredge #9 no chains - Starboard

Paired Tows 41 thru 73

Descriptive Statistics and t-Test: Paired Two Sample for Means

Species	Scallop (bu)		Scallop (count)		Trash (bu)		Skate		Grey Sole		Fourspot Fld.		Yellowtail Fld.		Fluke		Monk	
Dredge	chains	no chains	chains	no chains	chains	no chains	chains	no chains	chains	no chains	chains	no chains	chains	no chains	chains	no chains	chains	no chains
Total Count	153.65	187.30	46613	53475	153.10	163.40	301	309	12	5	341	279	0	0	23	23	28	25
% Difference in Count	-18.0%		-12.8%		-6.3%		-2.6%		140.0%		22.2%		null		0.0%		12.0%	
Mean	4.7	5.7	1412.5	1620.5	4.6	5.0	9.1	9.4	0.4	0.2	10.3	8.5	0.0	0.0	0.7	0.7	0.8	0.8
Standard Error	2	2	375	408	1	1	2	2	0	0	1	1	0	0	0	0	0	0
Median	1	1	354	567	5	5	6	6	0	0	10	7	0	0	0	0	1	0
Mode	0	1	N/A	N/A	1	1	4	8	0	0	11	8	0	0	0	0	0	0
Standard Deviation	9	11	2157	2345	3	4	10	9	1	0	5	6	0	0	1	1	1	1
Sample Variance	84	122	4651903	5500414	12	14	92	85	1	0	25	31	0	0	1	1	1	2
Kurtosis	7	5	6	3	0	0	10	5	10	10	0	1	null	null	9	1	2	10
Skewness	3	2	2	2	1	1	3	2	3	3	1	1	null	null	3	1	1	3
Range	36	41	9682	9528	13	15	50	43	4	2	22	24	0	0	5	3	4	6
Minimum	0	0	34	42	0	0	0	0	0	0	2	1	0	0	0	0	0	0
Maximum	36	41	9716	9570	13	15	50	43	4	2	24	25	0	0	5	3	4	6
Confidence Level(95.0%)	3.25	3.92	764.78	831.61	1.22	1.31	3.41	3.27	0.30	0.16	1.78	1.96	0.00	0.00	0.36	0.34	0.36	0.43
Variance	84.03	122.21	4651903.26	5500414.26	11.87	13.56	92.30	85.30	0.74	0.20	25.17	30.63	0.00	0.00	1.03	0.91	1.01	1.50
Observations	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33
Pearson Correlation	0.99		0.98		0.98		0.83		0.67		0.68		null		0.19		0.27	
Hypothesized Mean Difference	0		0		0		0		0		0		0		0		0	
df	32		32		32		32		32		32		32		32		32	
α	0.05		0.05		0.05		0.05		0.05		0.05		0.05		0.05		0.05	
t Stat	-2.40		-2.74		-2.50		-0.25		1.88		2.53		null		0.00		0.39	
P(T<=t) two-tail	0.02		0.01		0.02		0.80		0.07		0.02		null		1.00		0.70	
t Critical two-tail	2.04		2.04		2.04		2.04		2.04		2.04		null		2.04		2.04	

Descriptive Statistics and t-Test: Paired Two Sample for Means

[illegible]

Descriptive Statistics and t-Test: Paired Two Sample for Means

[illegible]

Descriptive Statistics and t-Test: Paired Two Sample for Means

[illegible]

Descriptive Statistics and t-Test: Paired Two Sample for Means

[illegible]

All Tows Before Modification to Chain Configuration

Control = Dredge with no chains

Paired Tows 1 thru 73

Subsampled Tows 74 - 81 Excluded

Descriptive Statistics and t-Test: Paired Two Sample for Means

[illegible]

Descriptive Statistics and t-Test: Paired Two Sample for Means

[illegible]

Celtic-2008-1 Data Set 9

Bottom Characteristic = Mud/Sand

Experimental = Survey Dredge with 7x4 Chains

Control = Survey Dredge with No Chains

Descriptive Statistics and t-Test: Paired Two Sample for Means

Species	Scallop (bu)		Scallop (count)		Trash (bu)	
<i>Dredge</i>	<i>7x4 Chains</i>	<i>No Chains</i>	<i>7x4 Chains</i>	<i>No Chains</i>	<i>7x4 Chains</i>	<i>No Chains</i>
Total Count	0.40	0.40	123	104	27.50	24.50
% Difference in Count	0.0%		18.3%		12.2%	
Mean	0.1	0.1	41.0	34.7	9.2	8.2
Standard Error	0	0	28	18	1	2
Median	0	0	16	19	9	8
Mode	0	0	N/A	N/A	N/A	N/A
Standard Deviation	0	0	49	32	1	4
Sample Variance	0	0	2361	996	2	14
Kurtosis	null	null	null	null	null	null
Skewness	2	2	2	2	1	0
Range	0	0	87	57	3	8
Minimum	0	0	10	14	8	5
Maximum	0	0	97	71	11	12
Confidence Level(95.0%)	0.14	0.14	120.70	78.41	3.13	9.32
Variance	0.00	0.00	2361.00	0.00	1.58	14.08
Observations	3	3	3	3	3	3
Pearson Correlation	1.00		1.00		-0.56	
Hypothesized Mean Difference	0		0		0	
α	0.05		0.05		0.05	
df	2.00		2.00		2.00	
t Stat	null		1.46		0.38	
P(T<=t) two-tail	null		0.28		0.74	
t Critical two-tail	null		4.30		4.30	

Celtic-2008-1 Data Set 10

Bottom Characteristic = Sand Dollar

Experimental = Survey Dredge with 7x4 Chains

Control = Survey Dredge with No Chains

Descriptive Statistics and t-Test: Paired Two Sample for Means

Species	Scallop (bu)		Scallop (count)		Trash (bu)	
<i>Dredge</i>	<i>7x4 Chains</i>	<i>No Chains</i>	<i>7x4 Chains</i>	<i>No Chains</i>	<i>7x4 Chains</i>	<i>No Chains</i>
Total Count	8.60	9.70	4908	5580	139.75	179.65
% Difference in Count	-11.3%		-12.0%		-22.2%	
Mean	0.5	0.5	258.3	293.7	7.4	9.5
Standard Error	0	0	78	88	1	1
Median	0	0	108	156	7	8
Mode	0	0	N/A	N/A	6	6
Standard Deviation	1	1	340	385	3	5
Sample Variance	0	0	115424	148125	10	25
Kurtosis	1	-1	3	4	2	4
Skewness	1	1	2	2	1	2
Range	2	2	1188	1446	13	21
Minimum	0	0	5	10	3	4
Maximum	2	2	1193	1456	16	25
Confidence Level(95.0%)	0.24	0.25	163.75	185.50	1.52	2.42
Variance	0.26	0.26	115423.67	148124.78	9.89	25.13
Observations	19	19	19	19	19	19
Pearson Correlation	0.94		0.98		0.84	
Hypothesized Mean Difference	0		0		0	
df	18		18		18	
α	0.05		0.05		0.05	
t Stat	-1		-1.79		-3.11	
P(T<=t) two-tail	0.18		0.09		0.01	
t Critical two-tail	2.10		2.10		2.10	

Celtic-2008-1 Data Set 11

Bottom Characteristic = Sand Dollar/Spong

Experimental = Survey Dredge with 7x4 Chains

Control = Survey Dredge with No Chains

Descriptive Statistics and t-Test: Paired Two Sample for Means

Species	Scallop (bu)		Scallop (count)		Trash (bu)	
Dredge	7x4 Chains	No Chains	7x4 Chains	No Chains	7x4 Chains	No Chains
Total Count	1.30	3.40	619	1109	78.75	106.50
% Difference in Count	-61.8%		-44.2%		-26.1%	
Mean	0.2	0.5	88.4	158.4	11.3	15.2
Standard Error	0	0	8	30	1	1
Median	0	0	84	123	11	15
Mode	0	0	N/A	N/A	11	N/A
Standard Deviation	0	0	22	79	2	4
Sample Variance	0	0	492	6225	3	15
Kurtosis	-1	-1	1	-1	1	0
Skewness	-1	1	1	1	-1	0
Range	0	1	67	182	6	12
Minimum	0	0	63	92	8	10
Maximum	0	1	130	274	14	21
Confidence Level(95.0%)	0.06	0.37	20.51	72.97	1.63	3.61
Variance	0.00	0.16	491.95	6224.95	3.13	15.24
Observations	7	7	7	7	7	7
Pearson Correlation	0.83		0.85		0.69	
Hypothesized Mean Difference	0		0		0	
df	6		6		6	
α	0.05		0.05		0.05	
t Stat	-2		-3.02		-3.52	
P(T<=t) two-tail	0.06		0.02		0.01	
t Critical two-tail	2.45		2.45		2.45	

Celtic-2008-1 Data Set 12

Bottom Characteristic = Scallops

Experimental = Survey Dredge with 7x4 Chains

Control = Survey Dredge with No Chains

Descriptive Statistics and t-Test: Paired Two Sample for Means

Species	Scallop (bu)		Scallop (count)		Trash (bu)	
Dredge	7x4 Chains	No Chains	7x4 Chains	No Chains	7x4 Chains	No Chains
Total Count	231.70	286.80	53562	61896	16.80	19.90
% Difference in Count	-19.2%		-13.5%		-15.6%	
Mean	16.6	20.5	3825.9	4421.1	1.2	1.4
Standard Error	3	4	659	666	0	0
Median	12	17	3501	4377	1	1
Mode	4	4	#N/A	#N/A	1	1
Standard Deviation	12	15	2467	2493	1	1
Sample Variance	156	226	6087886	6215255	0	1
Kurtosis	-1	-2	1	0	2	1
Skewness	1	0	1	0	0	1
Range	32	39	9000	8564	2	3
Minimum	4	4	716	1006	0	0
Maximum	36	43	9716	9570	2	3
Confidence Level(95.0%)	7.22	8.67	1424.61	1439.44	0.32	0.47
Variance	156.22	225.51	6087886.13	6215254.90	0.30	0.67
Observations	14	14	14	14	14	14
Pearson Correlation	0.97		0.97		0.78	
Hypothesized Mean Difference	0		0		0	
df	13		13		13	
α	0.05		0.05		0.05	
t Stat	-4		-3.61		-1.59	
P(T<=t) two-tail	0.00		0.00		0.14	
t Critical two-tail	2.16		2.16		2.16	

Celtic-2008-1 Data Set 12b

Bottom Characteristic = Scallops

Experimental = Survey Dredge with 7x4 Chains

Control = Survey Dredge with No Chains

Subsampled Tows 74 - 81 Excluded

Descriptive Statistics and t-Test: Paired Two Sample for Means

Species	Scallop (bu)		Scallop (count)		Trash (bu)	
Dredge	7x4 Chains	No Chains	7x4 Chains	No Chains	7x4 Chains	No Chains
Total Count	112.50	131.00	33766	37741	8.30	9.60
% Difference in Count	-14.1%		-10.5%		-13.5%	
Mean	16.1	18.7	4823.7	5391.6	1.2	1.4
Standard Error	6	7	955	918	0	0
Median	7	8	4793	5400	1	1
Mode	4	4	#N/A	#N/A	1	1
Standard Deviation	15	18	2527	2428	1	1
Sample Variance	222	306	6387846	5897298	1	1
Kurtosis	-2	-2	2	2	0	1
Skewness	1	1	1	0	0	0
Range	32	37	8103	7985	2	3
Minimum	4	4	1613	1585	0	0
Maximum	36	41	9716	9570	2	3
Confidence Level(95.0%)	13.77	16.19	2337.47	2245.93	0.70	0.87
Variance	221.54	306.32	6387845.57	5897297.62	0.57	0.89
Observations	7	7	7	7	7	7
Pearson Correlation	0.99		0.97		0.83	
Hypothesized Mean Difference	0		0		0	
df	6		6		6	
α	0.05		0.05		0.05	
t Stat	-2		-2.58		-0.94	
P(T<=t) two-tail	0.07		0.04		0.38	
t Critical two-tail	2.45		2.45		2.45	

Celtic-2008-1 Data Set 13

Bottom Characteristic = Starfish

Experimental = Survey Dredge with 7x4 Chains

Control = Survey Dredge with No Chains

Descriptive Statistics and t-Test: Paired Two Sample for Means

Species	Scallop (bu)		Scallop (count)		Trash (bu)	
Dredge	7x4 Chains	No Chains	7x4 Chains	No Chains	7x4 Chains	No Chains
Total Count	43.75	62.10	9144	12269	83.00	92.25
% Difference in Count	-29.5%		-25.5%		-10.0%	
Mean	2.0	2.8	415.6	557.7	3.8	4.2
Standard Error	1	1	118	167	0	0
Median	1	1	194	275	4	4
Mode	0	0	N/A	N/A	5	5
Standard Deviation	4	5	554	783	2	2
Sample Variance	12	28	307117	613264	3	3
Kurtosis	5	11	2	9	-1	0
Skewness	2	3	2	3	0	0
Range	13	23	1813	3452	6	7
Minimum	0	0	17	28	1	2
Maximum	13	23	1830	3480	7	8
Confidence Level(95.0%)	1.56	2.36	245.71	347.21	0.72	0.81
Variance	12.44	28.41	307116.72	613263.85	2.62	3.32
Observations	22	22	22	22	22	22
Pearson Correlation	0.96		0.90		0.92	
Hypothesized Mean Difference	0		0		0	
df	21		21		21	
α	0.05		0.05		0.05	
t Stat	-2		-1.81		-2.78	
P(T<=t) two-tail	0.09		0.08		0.01	
t Critical two-tail	2.08		2.08		2.08	

Celtic-2008-1 Data Set 14

Bottom Characteristic = Starfish/Sand Dollar

Experimental = Survey Dredge with 7x4 Chains

Control = Survey Dredge with No Chains

Descriptive Statistics and t-Test: Paired Two Sample for Means

Species	Scallop (bu)		Scallop (count)		Trash (bu)	
Dredge	7x4 Chains	No Chains	7x4 Chains	No Chains	7x4 Chains	No Chains
Total Count	17.95	20.33	6480	7467	69.05	80.90
% Difference in Count	-11.7%		-13.2%		-14.6%	
Mean	1.2	1.4	432.0	497.8	4.6	5.4
Standard Error	0	0	109	127	1	1
Median	1	1	296	438	5	5
Mode	0	0	17	N/A	1	1
Standard Deviation	2	2	423	491	3	3
Sample Variance	3	3	178562	241026	7	11
Kurtosis	4	6	-1	-1	-1	0
Skewness	2	2	1	1	0	0
Range	6	7	1281	1403	8	11
Minimum	0	0	17	13	1	1
Maximum	6	7	1298	1416	9	12
Confidence Level(95.0%)	0.89	0.99	234.01	271.88	1.48	1.84
Variance	2.61	3.21	178562.00	241025.60	7.15	11.04
Observations	15	15	15	15	15	15
Pearson Correlation	0.99		0.98		0.92	
Hypothesized Mean Difference	0		0		0	
df	14		14		14	
α	0.05		0.05		0.05	
t Stat	-2		-2.23		-2.30	
P(T<=t) two-tail	0.06		0.04		0.04	
t Critical two-tail	2.14		2.14		2.14	

Celtic-2008-1 Data Set 15

Bottom Characteristic = Starfish

Experimental = Survey Dredge with 5x3 Chains

Control = Survey Dredge with No Chains

Descriptive Statistics and t-Test: Paired Two Sample for Means

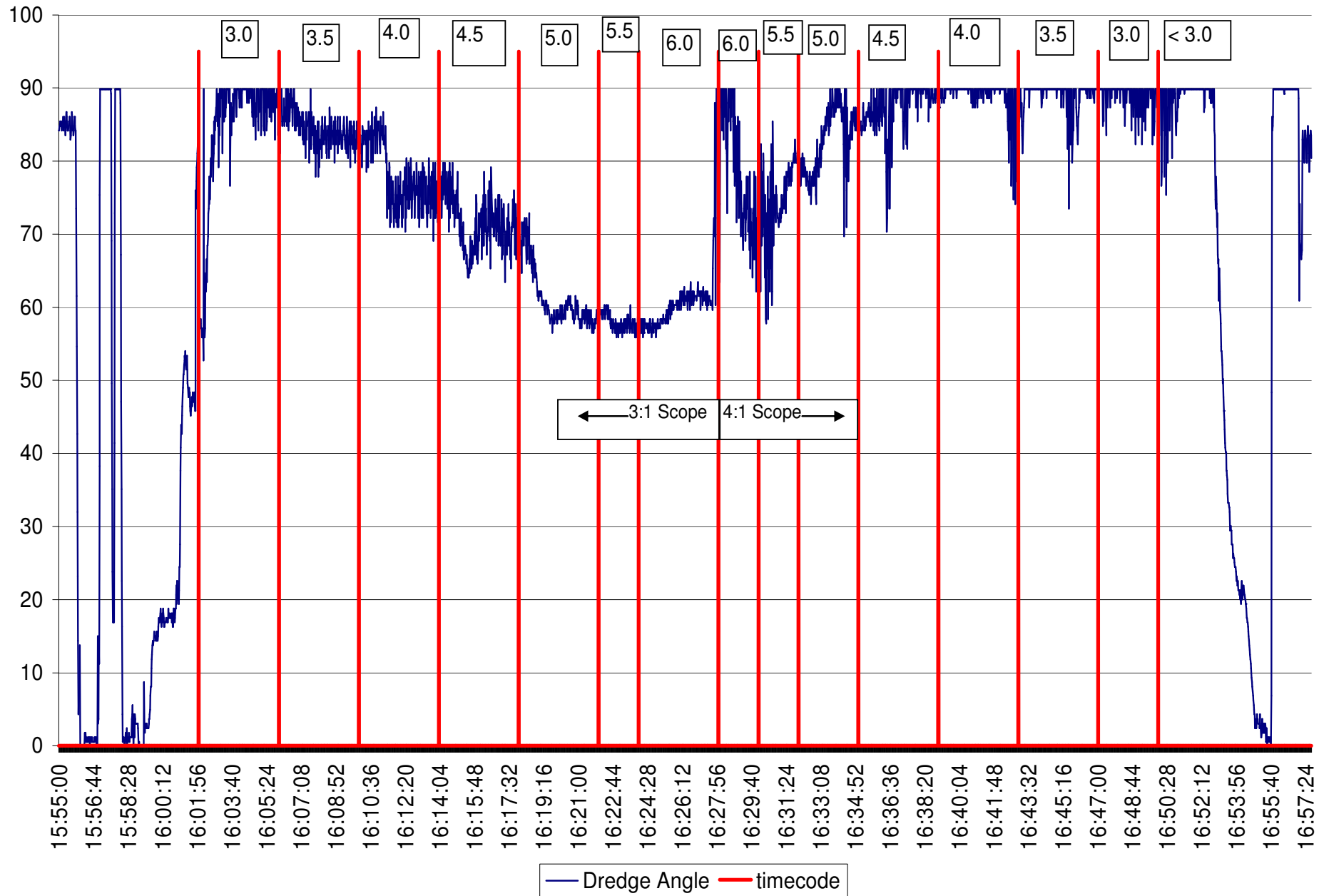
Species	Scallop (bu)		Scallop (count)		Trash (bu)	
Dredge	5x3 Chains	No Chains	5x3 Chains	No Chains	5x3 Chains	No Chains
Total Count	18.60	24.10	3224	3849	18.50	20.65
% Difference in Count	-22.8%		-16.2%		-10.4%	
Mean	4.7	6.0	806.0	962.3	4.6	5.2
Standard Error	2	3	283	396	1	2
Median	4	5	650	750	5	5
Mode	N/A	N/A	N/A	N/A	N/A	N/A
Standard Deviation	4	5	567	792	3	4
Sample Variance	15	28	321133	626699	8	15
Kurtosis	1	-3	3	1	-1	-3
Skewness	1	1	1	1	-1	0
Range	9	11	1316	1777	6	9
Minimum	2	1	304	286	1	1
Maximum	10	13	1620	2063	7	10
Confidence Level(95.0%)	6.14	8.37	901.72	1259.68	4.38	6.10
Variance	14.87	27.68	321133.33	626698.92	7.56	14.67
Observations	4	4	4	4	4	4
Pearson Correlation	0.98		0.96		0.96	
Hypothesized Mean Difference	0		0		0	
df	3		3		3	
α	0.05		0.05		0.05	
t Stat	-2		-1.09		-0.77	
P(T<=t) two-tail	0.21		0.36		0.50	
t Critical two-tail	3.18		3.18		3.18	





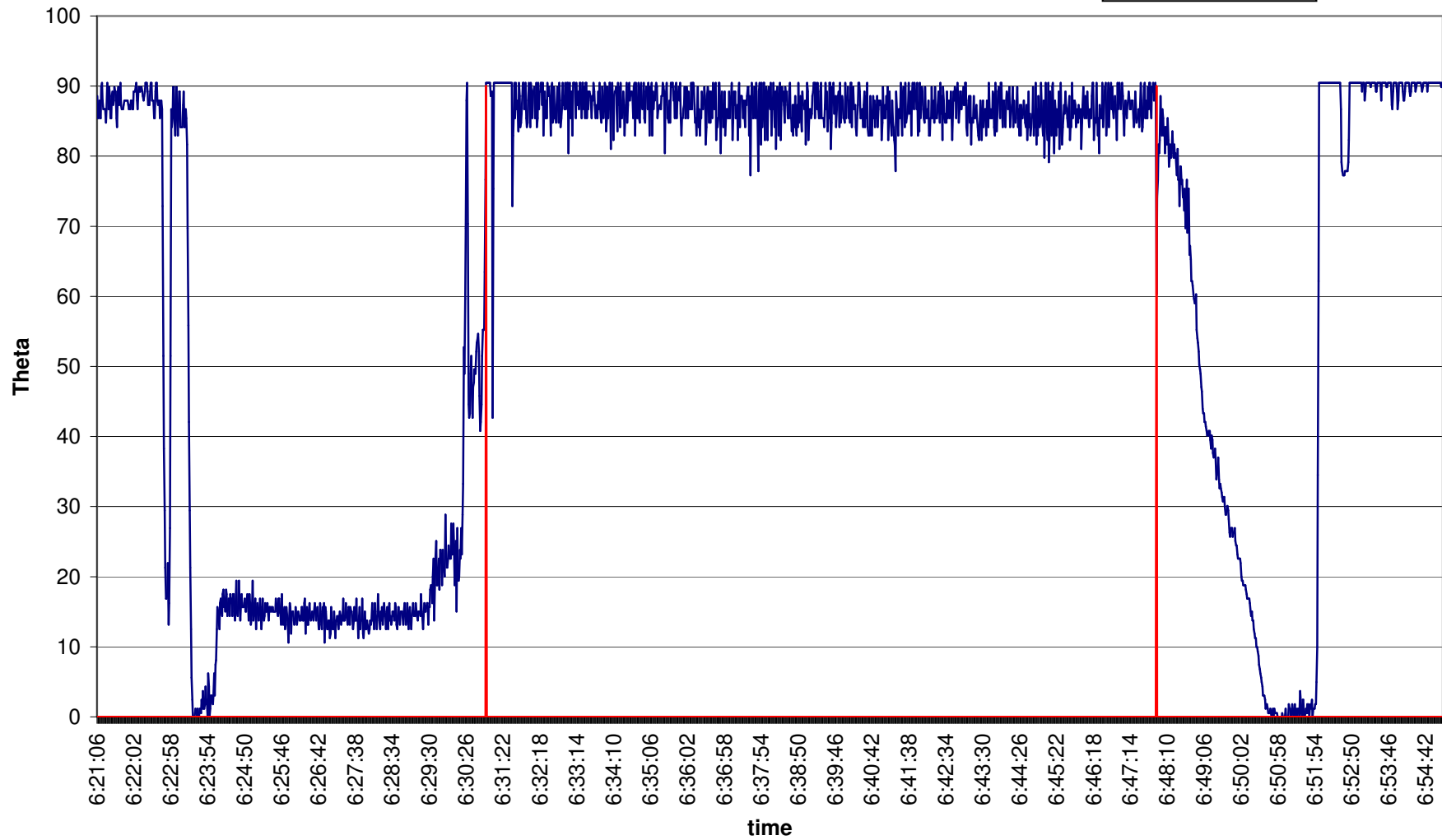


**Celtic Oct 2007 Prototype Dredge Comparisons:
Tow #1 (Starboard Dredge) 25 fathoms**



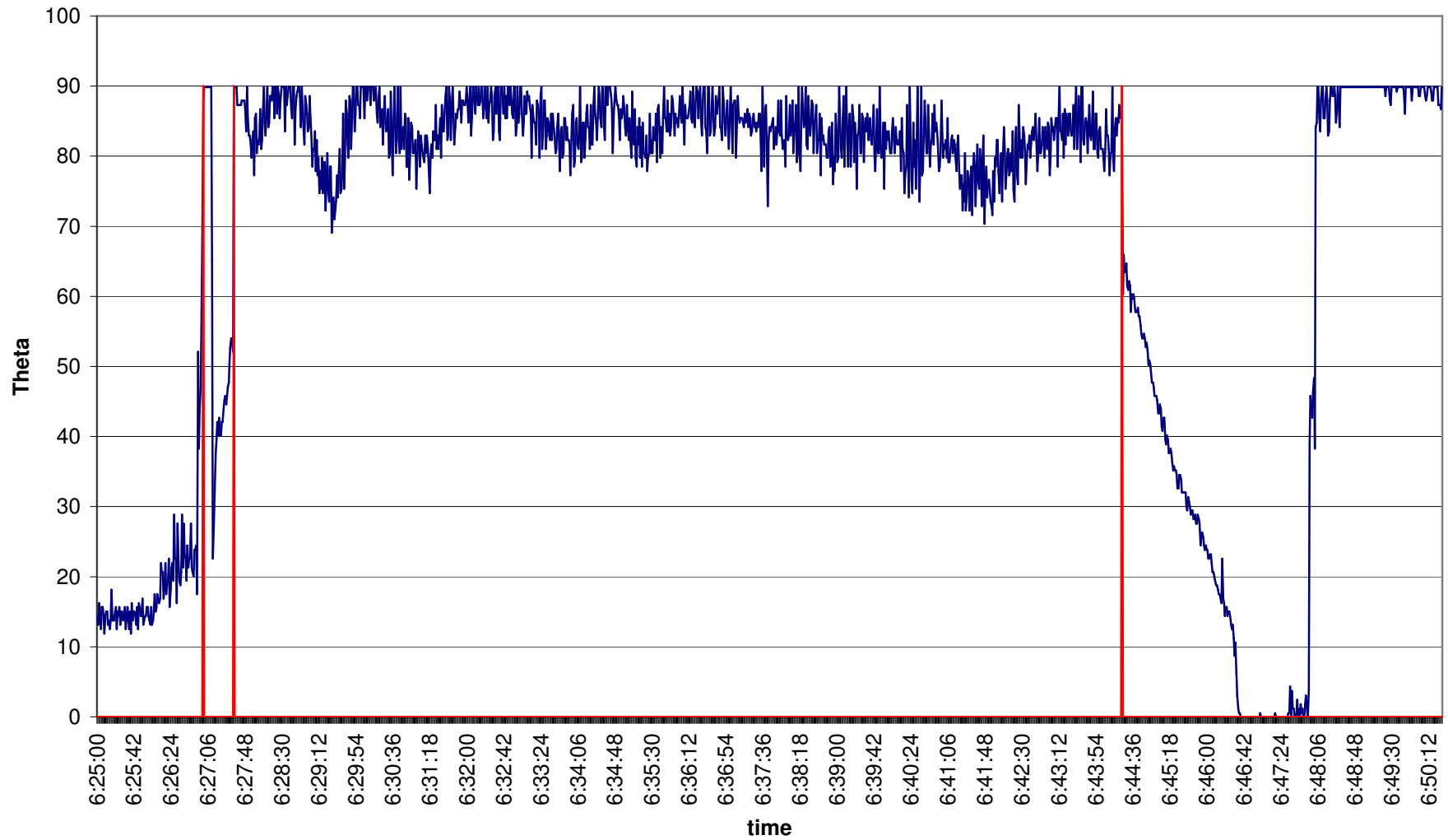
Celtic Oct 2007 Pair #1: Station 4
Port Side / 4:1 scope / 3.8 knts / depth 24 fm

Angle Mean = 87.01
S.D. = 3.07



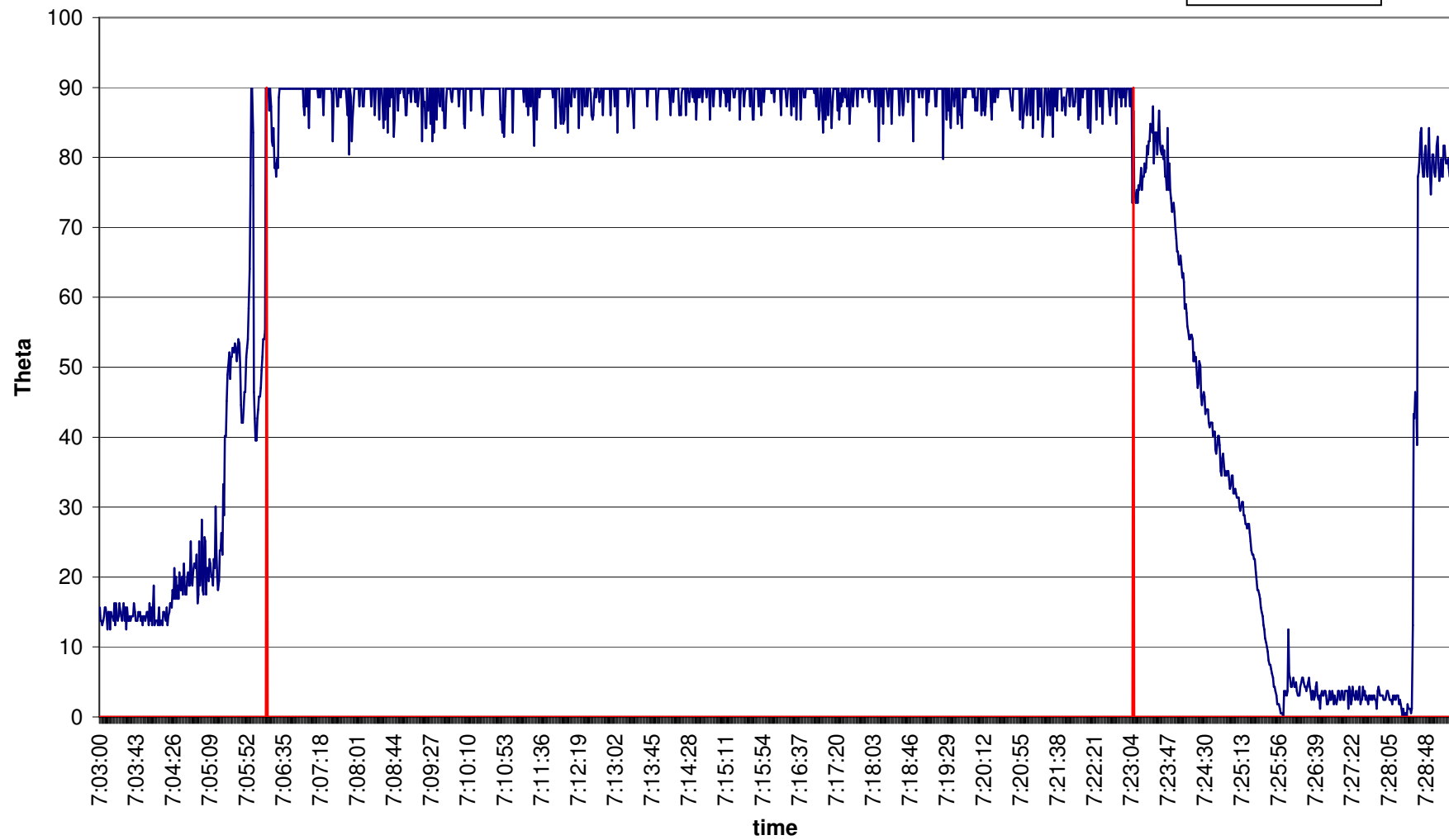
Celtic Oct 2007 Pair #1: Station 4
Stbd Side / 3:1 scope / 3.8 knts / depth 24 fm

Angle Mean = 83.7
S.D. = 4.17



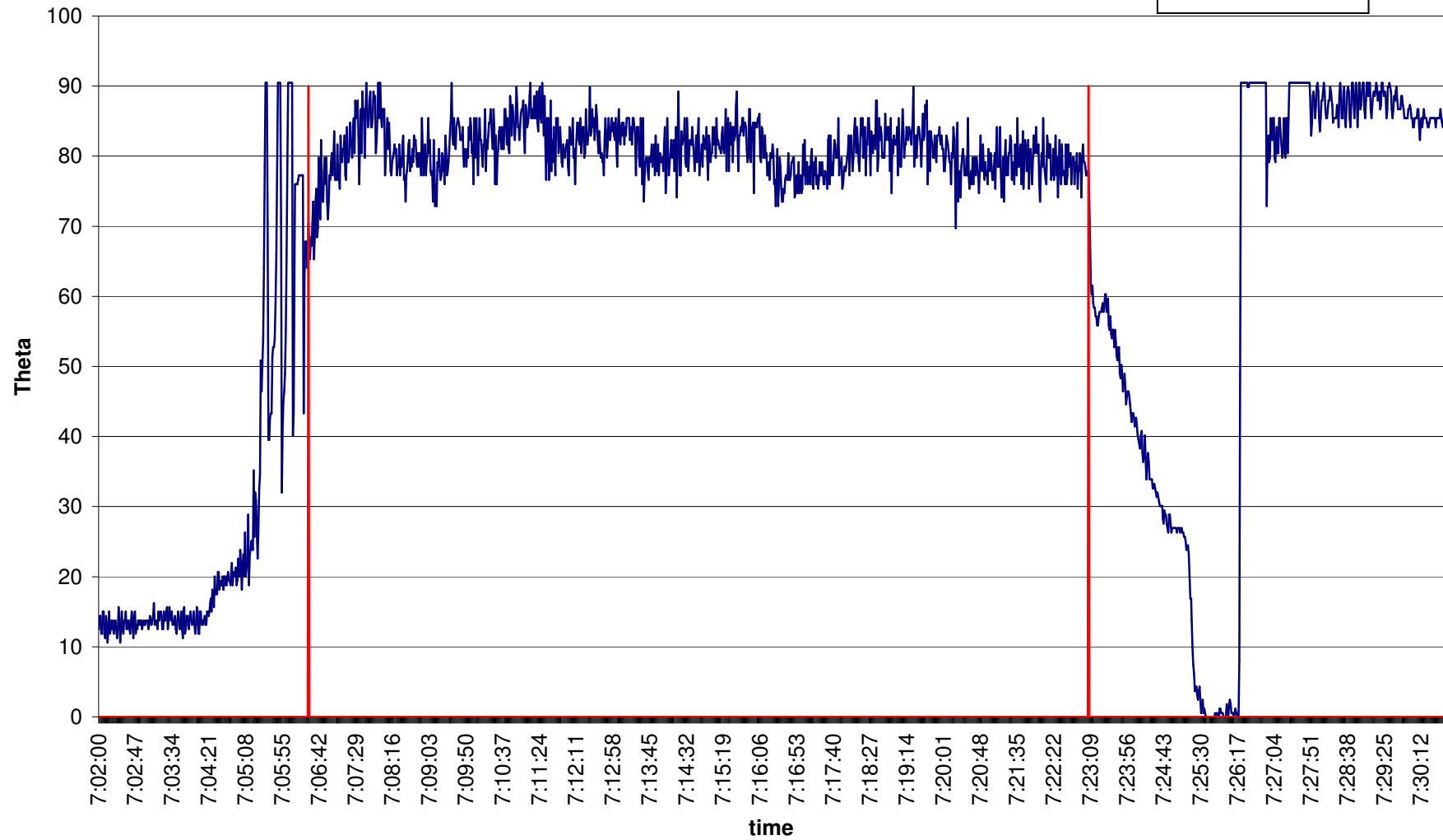
Celtic Oct 2007 Pair #2: Station 5
Stbd Side / 4:1 scope / 3.8 knts / depth 27 fm

Angle Mean = 88.8
S.D. = 2.20



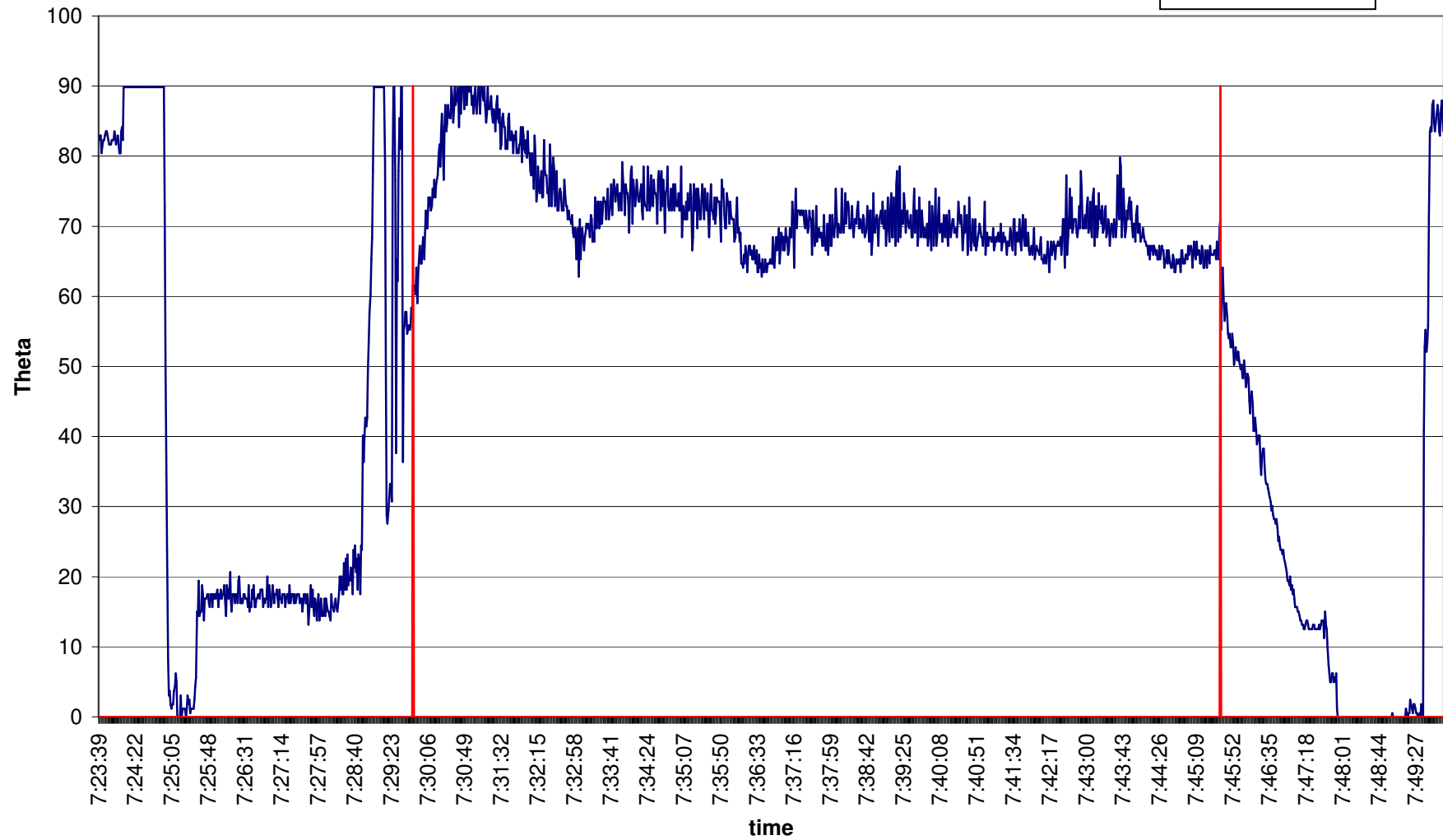
Celtic Oct 2007 Pair #2: Station 5
Port Side / 3:1 scope / 3.8 knts / depth 27 fm

Mean = 80.83
S.D. = 3.75



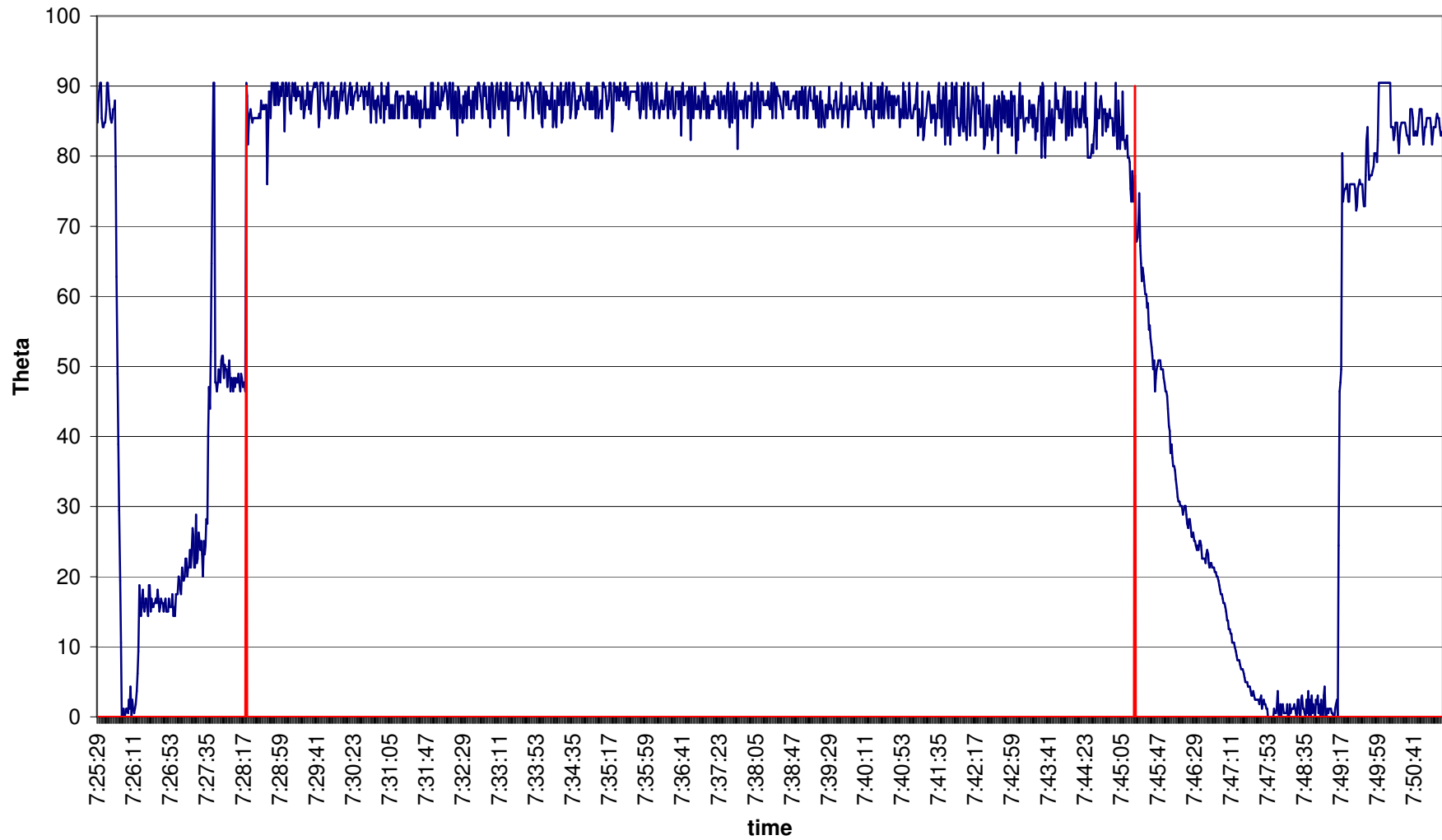
Celtic Oct 2007 Pair #3: Station 6
Stbd Side / 3:1 scope / 4.5 knots / depth 25 fm

Angle Mean = 71.86
S.D. = 6.09



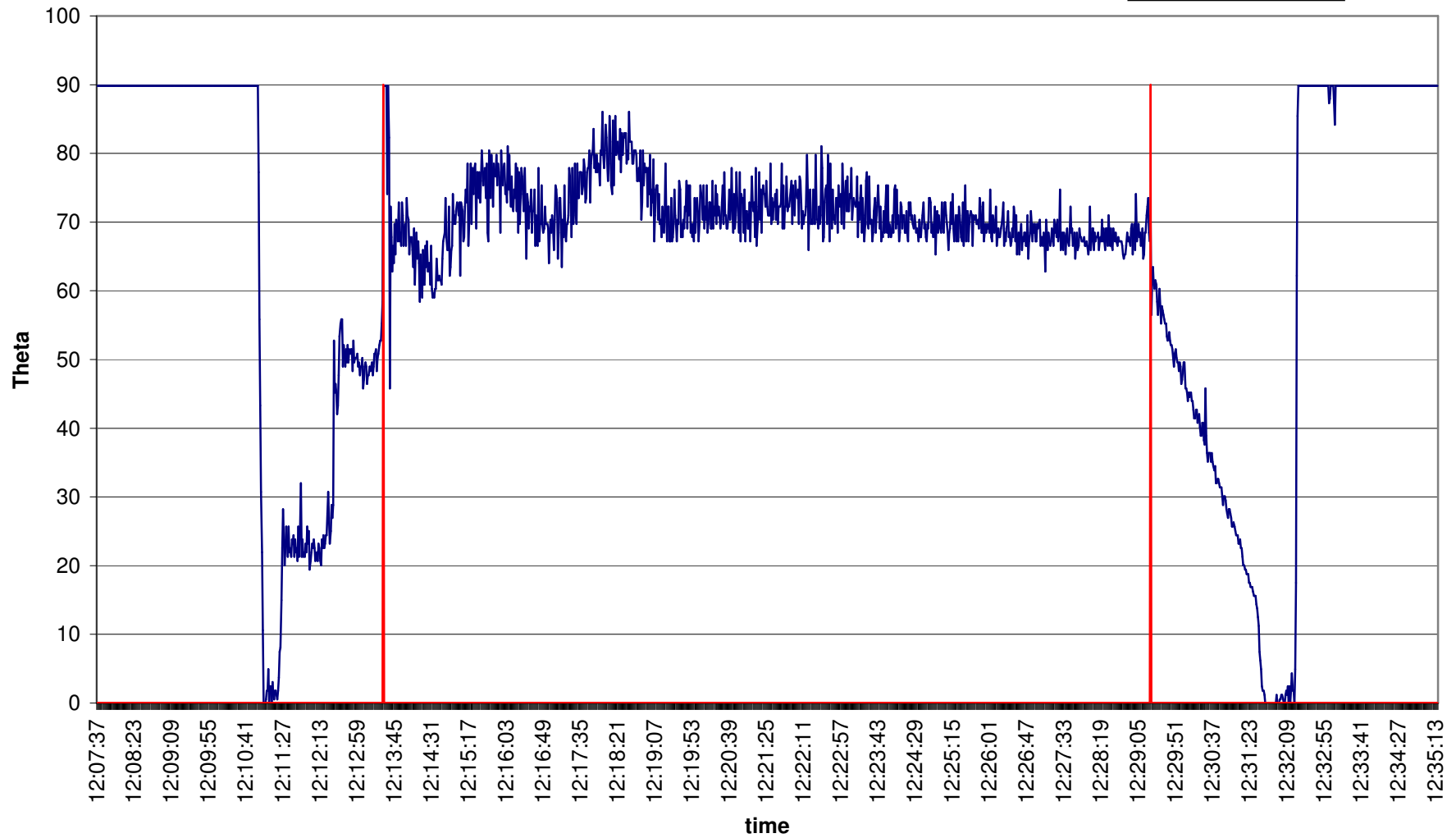
Celtic Oct 2007 Pair #3: Station 6
Port Side / 4:1 scope / 4.5 knots / depth 25 fm

Angle Mean = 87.21
S.D. = 2.47



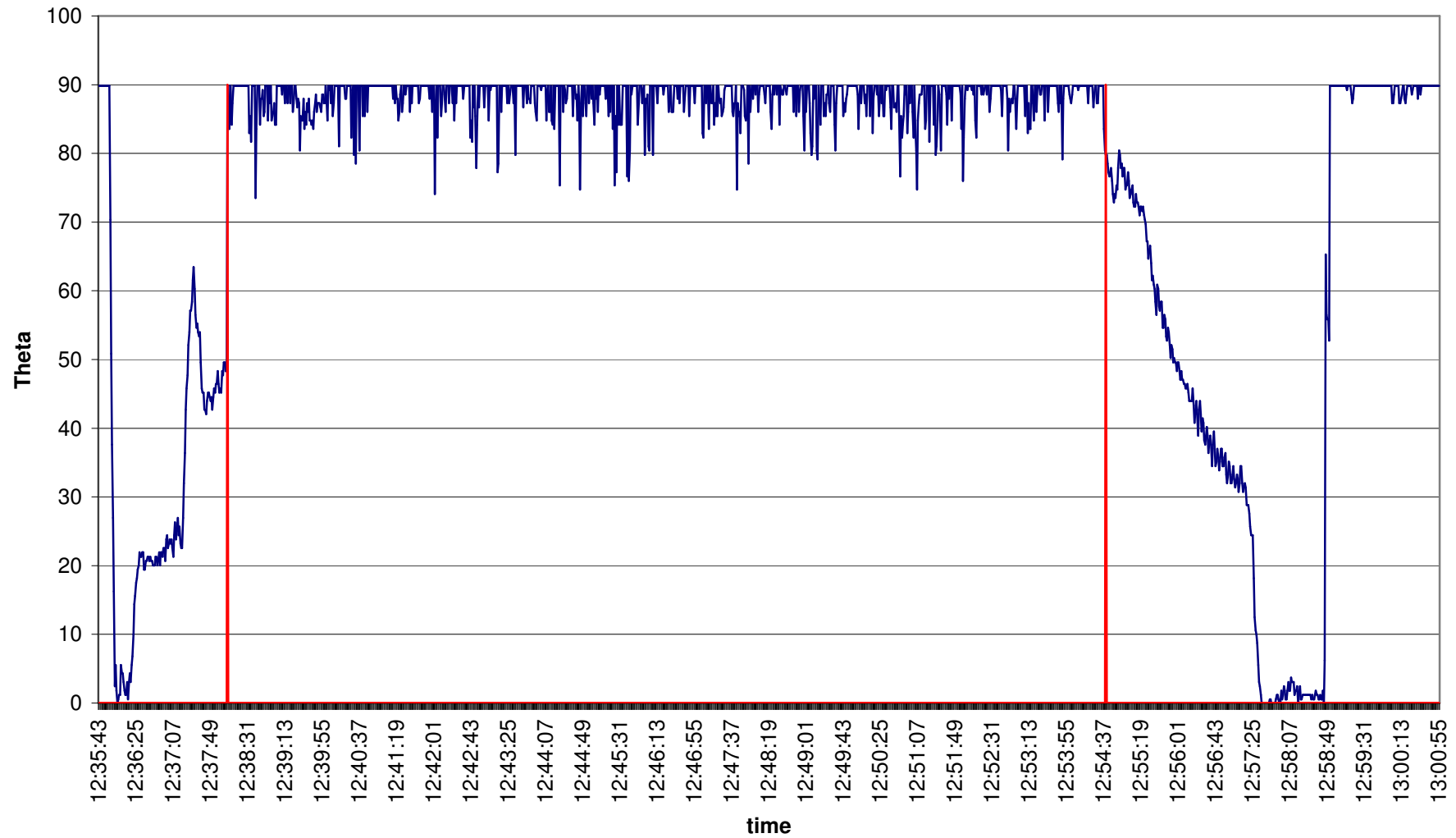
Celtic Oct 2007: Station 8
Stbd Side / 3:1 scope / 4.5 knots / single dredge

Angle Mean = 71.30
S.D. = 4.81



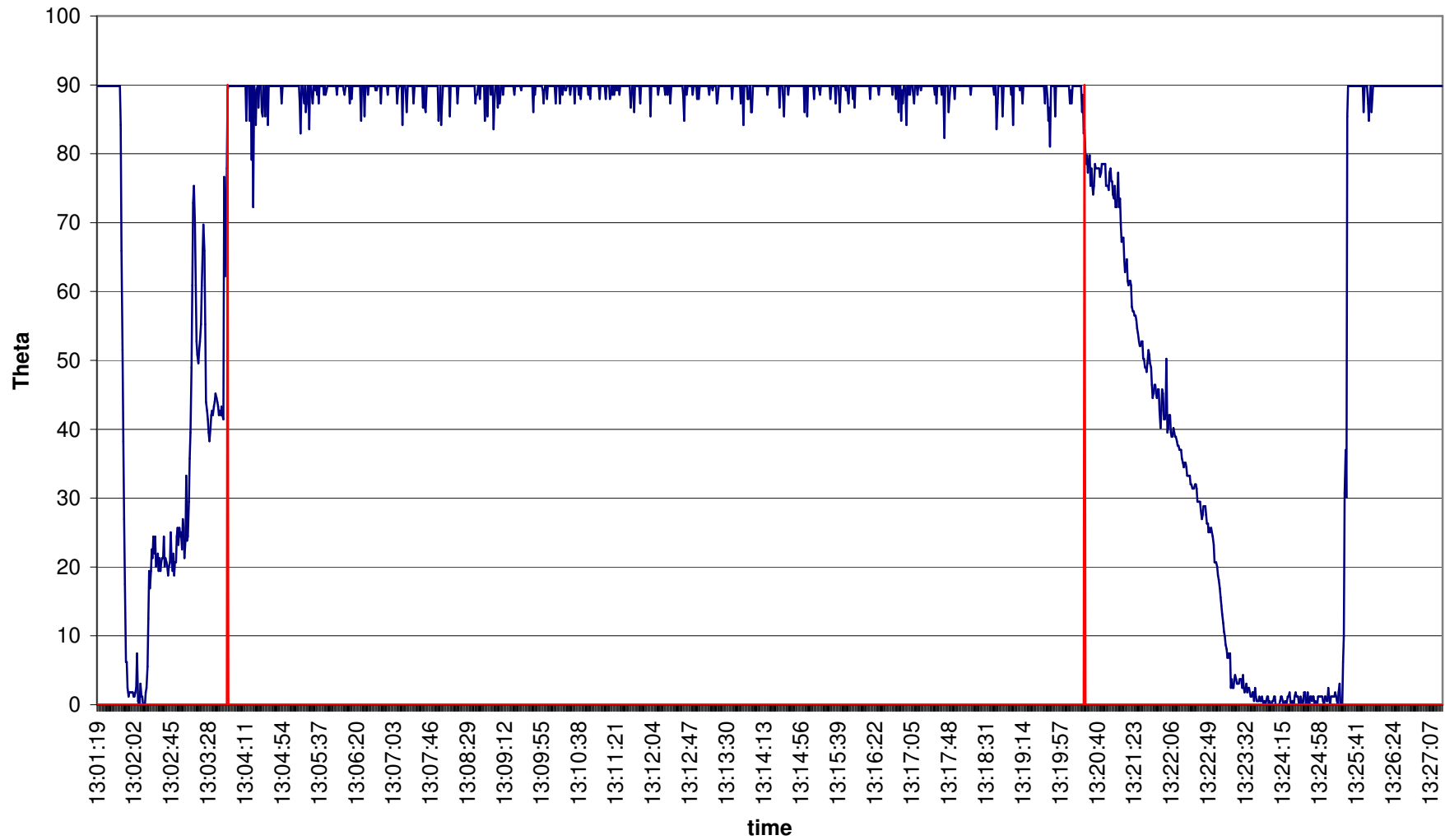
Celtic Oct 2007: Station 9
Stbd Side / 4:1 scope / 4.5 knots / single dredge

Angle Mean = 88.17
S.D. = 2.80



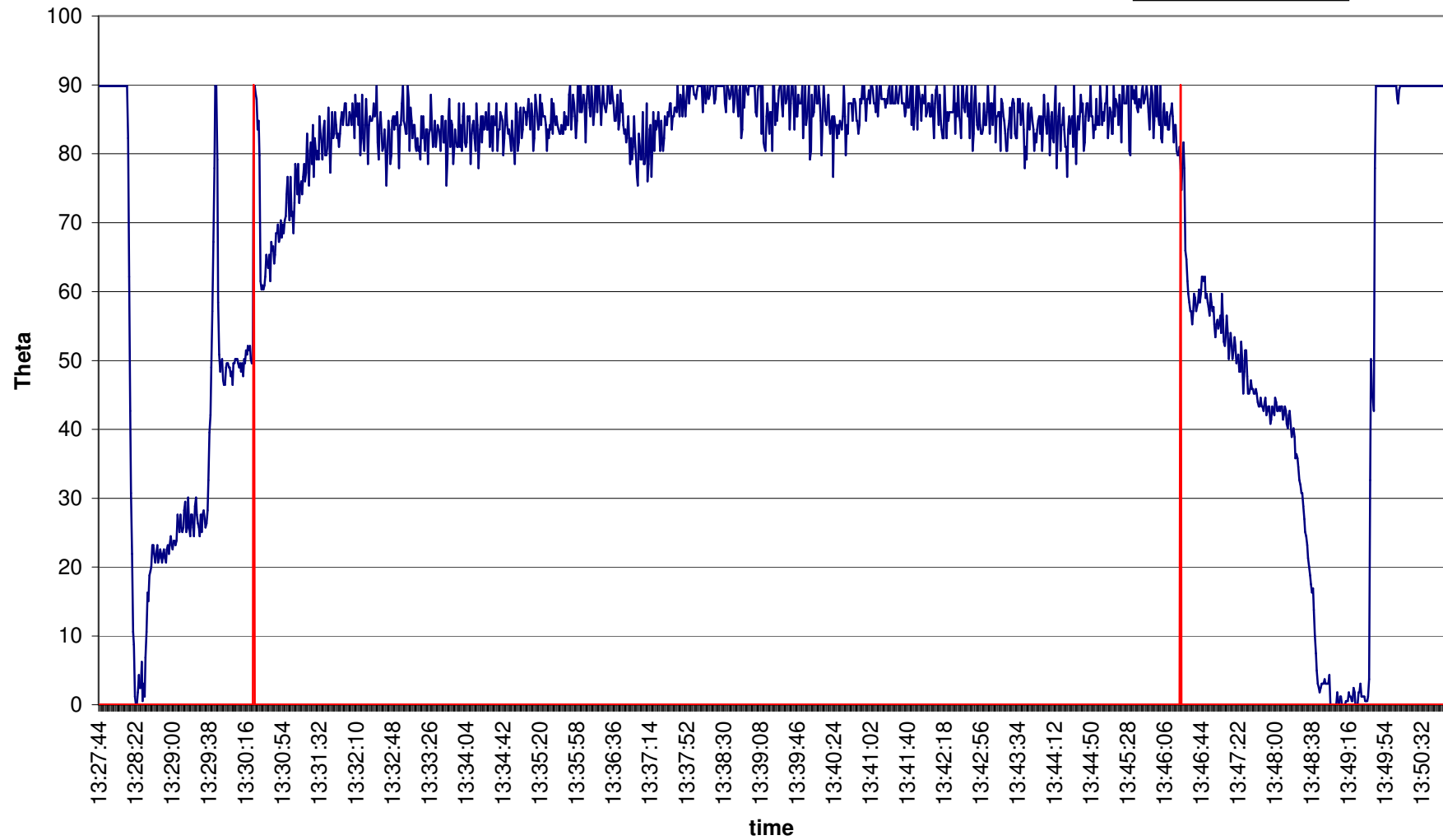
Celtic Oct 2007: Station 10
Stbd Side / 4:1 scope / 3.8 knots / single dredge

Angle Mean = 89.35
S.D. = 1.36



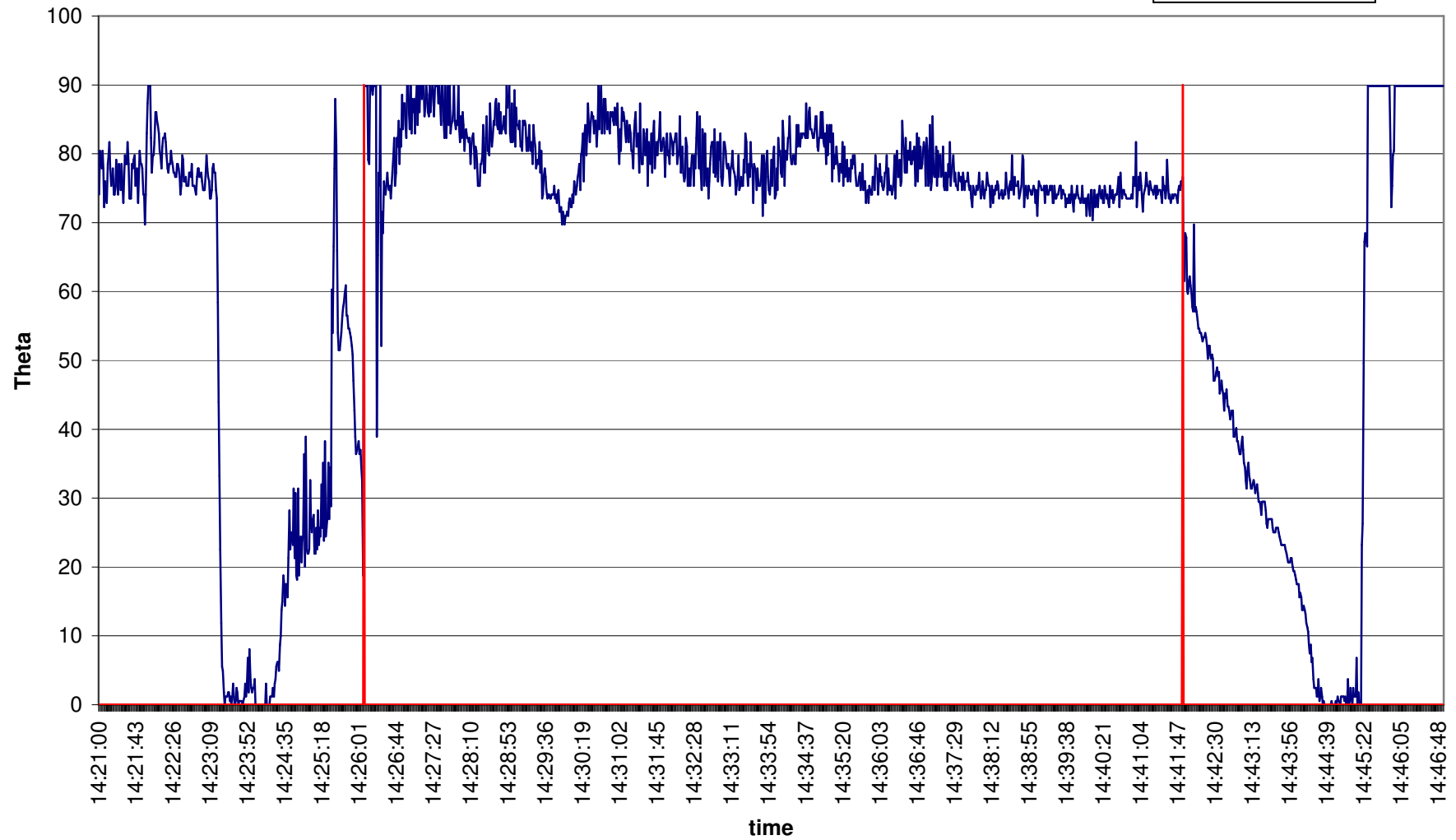
Celtic Oct 2007: Station 11
Stbd Side / 3:1 scope / 3.8 knots / single dredge

Angle Mean = 84.57
S.D. = 4.79



Celtic Oct 2007: Station 12
Stbd Side / 3:1 scope / 4.5 knots / single dredge

Angle Mean = 78.76
S.D. = 5.06



Celtic Oct 2007: Station 13
Stbd Side / 4:1 scope / 4.5 knots / single dredge

Angle Mean = 87.48
S.D. = 3.15

