View metadata, citation and similar papers at core.ac.uk

brought to you by CORE

provided by College of William & Mary: W&M Publish

W&M ScholarWorks

Reports

7-1-2002

Final Contract Report "Performance of a 4" Ring Scallop Dredge in the Context of an Area Management Strategy"

William D. DuPaul
Virginia Institute of Marine Science

Follow this and additional works at: https://scholarworks.wm.edu/reports

 Part of the Aquaculture and Fisheries Commons

Recommended Citation

DuPaul, W. D. (2002) Final Contract Report "Performance of a 4" Ring Scallop Dredge in the Context of an Area Management Strategy". Marine Resource Report No. 2002-08. Virginia Institute of Marine Science, College of William and Mary. http://dx.doi.org/doi:10.21220/m2-9n6e-jy86

This Report is brought to you for free and open access by W&M ScholarWorks. It has been accepted for inclusion in Reports by an authorized administrator of W&M ScholarWorks. For more information, please contact scholarworks@wm.edu.

Final Contract Report

"Performance of a 4" Ring Scallop Dredge in the Context of an Area Management Strategy"
Award No. NA16FM1648

Research TAC Set-Aside
Hudson Canyon/Virginia Beach
Scallop Exemption Program,
Closed Area Access

Submitted by

William D. DuPaul
Virginia Institute of Marine Science
College of William and Mary
Gloucester Point, Virginia 23062

Submitted to

Joyce M. Lacerda
National Marine Fisheries Service
EASC Route: F/NERX1
One Blackburn Drive
Gloucester, Massachusetts 01930

VIMS Marine Resource Report No. 2002-08

July 2002

Final Contract Report

"Performance of a 4" Ring Scallop Dredge
in the Context of an Area Management Strategy"
Award No. NA16FM1648

Preface

This research project award from the Research TAC Set-Aside Program was one of three separate awards to evaluate the performance of 4" ring scallop dredges. For all three awards, the research objectives, sampling protocols and data analyses were identical and are being treated as one experiment. Consequently, the final reports for each project may contain data from the other awards. However, each award budget and accounting of expenditures remained separate.

A peer reviewed paper is in preparation. In addition, the results of this research will be presented at the 94th Annual Meeting of the National Shellfisheries Association being held in Mystic, Connecticut in April 2002. Of considerable importance, all the data obtained from the three research TAC set-aside awards has been presented to the Sea Scallop Plan Development Team and has been included in fishing mortality and yield per recruit models under development at the National Marine Fisheries Service (NMFS), Northeast Fisheries Science Center (NEFSC) in Woods Hole, Massachusetts.

Summary

Under this award, two research trips were conducted in the Hudson Canyon Closed Area (HCCA) aboard the F/V *Celtic*, a 94' western rigged scallop vessel operating out of port of New Bedford, Massachusetts. The first trip was conducted on June 2-7, 2001 and the second on September 22-29, 2001. Paired tow catch data was obtained from a total of 58 tows. The timing of the trips permitted gear evaluations at the beginning of an area opening when large (>115 mm) scallops were available and targeted and later, when the availability of large scallops was more limited. This study allowed the comparison of 4" ring scallop dredges in an area that was closed for scallop management purposes and closed for 3+ years and the Closed Areas on Georges Bank that were closed for 6+ years to protect groundfish stocks.

The results from this study were somewhat similar to those conducted in the Georges Bank Closed Area but differed enough to draw some different conclusions about area management strategies. Results from the first trip indicate that the 4" ring dredge performed equally well compared to the 3.5" ring dredge when the majority of scallops exceeded 115 mm; different results were obtained during the second trip where catch rates were less (vs) for the 4" ring dredge.

As in other studies, the 4" ring dredge fished "cleaner" with significant reductions in "trash" (invertebrates and debris) for both trips of 22.7% and 34.2% respectively. Differences in the amount of finfish by catch was not significant.

The overall results obtained from this study continue to be supportive of the use of a 4" ring scallop dredge in recently opened closed areas. However, the results indicate that the closure would have been more effective in realizing optimum yield form the resource if the closure lasted another year. During both trips, there was a significant number of scallops discarded by the crews in an attempt to obtain larger scallop meats at around 15 MPP.

Materials and Methods

Under this award, three research trips were conducted in the Hudson Canyon Closed Area. Please refer to Figure A. Trips were conducted from June 2-7, 2001 and September 22-29, 2001. Catch data was obtained from 58 tows. The project employed a paired tow experimental design: two dredges, one with 3.5" (89 mm) rings and other with 4" (101 mm) rings towed simultaneously, side-by-side. The dredges were 15' (4.6 m) wide offshore New Bedford style dredges with bags, sweep chains, twinetops and chafing gear configured identically as possible (please refer to Figures B, C, D and E).

For each sampled tow, catch data was collected for each dredge. Catch data included sea scallop catch in volume (baskets), shell height in 5 mm intervals for sub-samples of total catch, scallops retained and scallops discarded, finfish bycatch species by number and size, and the volume of invertebrate trash and rubble. Bridge logs recorded date, time of tow, duration of tow, location of tow, water depth and weather conditions. Bridge logs and catch data were matched by corresponding tow number. Port and starboard dredges were switched mid-way through the trip mitigate for any side-to-side bias.

Results

The research results obtained under this award are grouped according the project objectives as stated in the original proposal.

Objective 1. The examine the relative size selectivity of a 4" ring scallop dredge versus a 3.5" ring dredge for scallops retained and discarded.

The catch data for the two trips in the Hudson Canyon Closed Area is presented in Tables 1, 2 and 3 and Figures F, G, H. Data from both trips indicated that the 4" ring caught significantly fewer scallops in the 75-100 mm range. The results are similar to those from the previous trips in the Georges Bank Closed Areas. It is another indication that the scallops in that size range, ages between 3 and 4 years, are provided a better level of protection due to the selectivity of the 4" ring dredge. Scallops in this particular size range have much of their growth potential yet to be realized and if protected, can contribute to the management objective of

maximizing optimal yield from the resource under an area management strategy. As seen with the gear trials in the Georges Bank Closed Areas, the 4" ring dredge performs equally or better with scallops at a greater than 115 mm. (Refer to Table 3). However, because of the fewer, large (>125 mm) scallops in the HCCA, increased in dredge efficiency were not fully realized. At the time of the second trip (September 2001) most of the larger scallops were already harvested. The SH frequency of the scallops showed a marked reduction of scallops >120 mm by September 2001. (Refer to Figures F, G and H).

Objective 2. To determine the relative difference in bycatch and trash retained by a 4" ring dredge versus a 3.5" ring dredge.

One of the primary assumptions about the characteristics of a 4" ring dredge was that it would probably reduce the amount of 'trash' caught by the dredge. The term "trash" for this study includes all invertebrates and shell. The inadvertent harvest of invertebrates and shell with attached epifauna has importance where concerns about habitat and bycatch are voiced.

Data on "trash"is presented in Table 4 and Figure I. There was a significant reduction in the amount of "trash" retained by the 4" ring scallop dredge. Mean reductions of 23% to 34% were similar to reductions observed in Georges Bank Closed Area II. Reductions in the amount of trash retained by the 4" ring dredge may be a factor for the increase in scallop harvest efficiency observed during the course of the gear trials.

The relative differences in finfish bycatch is presented in Table 5. No significant differences in the amount of finfish bycatch was observed except for 4-spot flounder.

Objective 3. To determine the relative efficiency of a 4" ring dredge versus a 3.5" ring dredge in the context of quantities of scallops landed (retained).

A measure of relative efficiency is the amount of scallops captured and retained by the crew for each dredge for a particular tow or swept area. This particular measure of efficiency is subject to the additional variable of crew culling practices and has to be predicted on the assumption that culling practices are the same for each dredge. Another measure is to examine the number and weight of scallops landed for each dredge above a certain size; in this case, scallops equal to or greater than 115 mm were included. This is the size for 100% retention by the 4" ring dredge.

Catch rates in baskets of scallops are presented in Table 6 and 7. Catch rates in kilograms of scallop meats for each dredge is presented in Table 8 and 9. By all measures, the 4" ring dredge was more efficient than the 3.5" ring dredge during the first trip in the HCCA. Although the increase was modest, around 8% by landed weight, the results still indicate that in resource areas where there is any abundance of scallops >115 mm, the 4" ring performs well. During the second trip into the HCCA, the 4" ring resulted in a 7% reduction in landed weight relative to the 3.5" ring dredge. Here, the majority of the scallops in the resource area were in the 100-115 mm

size range and the reduction in catch (lbs.) can be attributed to the reduction in scallops harvested in the 100-110 mm size range but would have been retained by the crew if caught.

Objective 4. To incorporate information on selectivity and efficiency into models for area management strategies in the context of increases in yield per recruit, gains in fecundity or spawning stock biomass.

All harvested data for scallops and finfish bycatch under this award from the HCCA, along with the data from all three awards, has been sent to the National Marine Fisheries Service (NMFS), Northeast Fisheries Science Center (NEFSC) in Woods Hole, Massachusetts for incorporation into the models for the scallop population on Georges Bank and Mid-Atlantic Closed Areas. Preliminary results have been presented to the SSPDT for review. These results will be available for inclusion into the Draft Supplement Environmental Impact Statement for Amendment 10 to the Sea Scallop Fisheries Management Plan which is now under development.

List of Entities

All of the work on 4" rings was conducted on the F/V *Celtic*, a 96' steel-hulled scallop vessel operating from the port of New Bedford, Massachusetts. The F/V *Celtic* is owned and operated by Capt. Charles Quinn.[1]

Fishing operations, gear storage and logistical support was provided by Eastern Fisheries, New Bedford, Massachusetts.

---

[1]F/V *Celtic*
Quinn Fisheries
14 Hervey Tichon Avenue
New Bedford, MA 02740

Permit # 410146
Registration # 591971

List of Figures

Figure A. Closed areas under the Multispecies Fishery Management Plan and the Sea Scallop Fishery Management Plan.

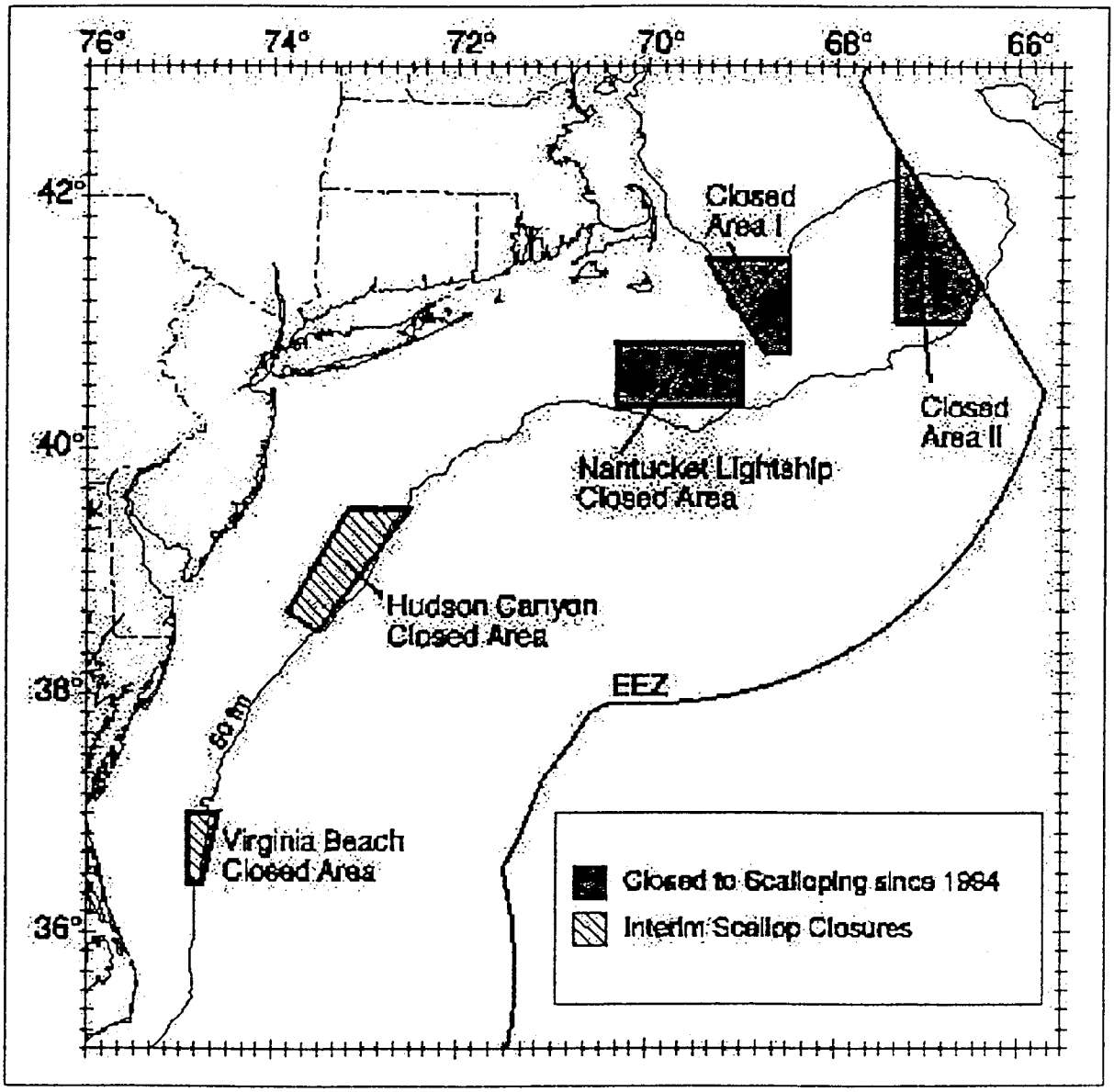


Figure B. The underside of a New Bedford scallop dredge. Chafing gear absent.

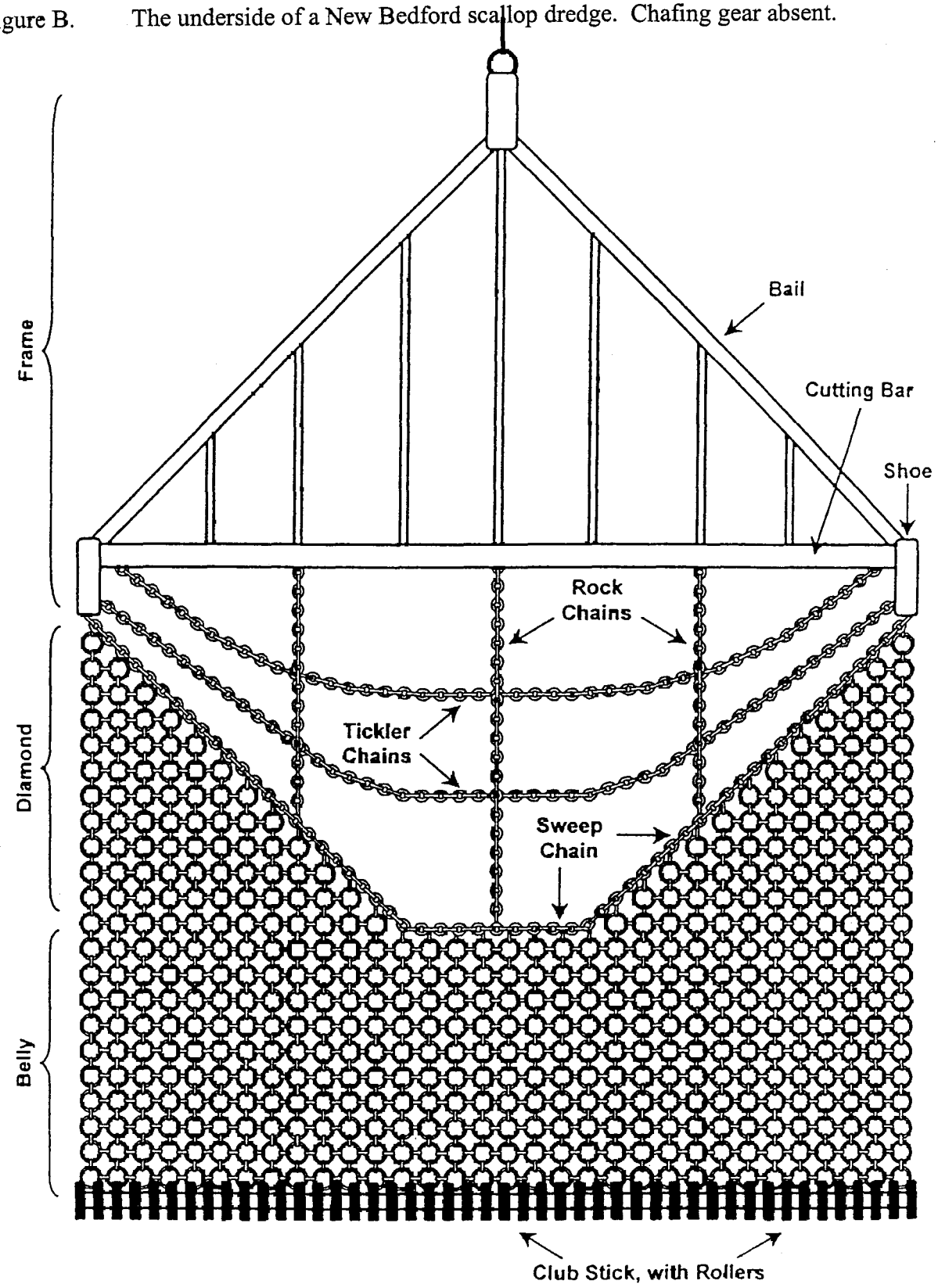


Figure C. The topside of a New Bedford scallop dredge.

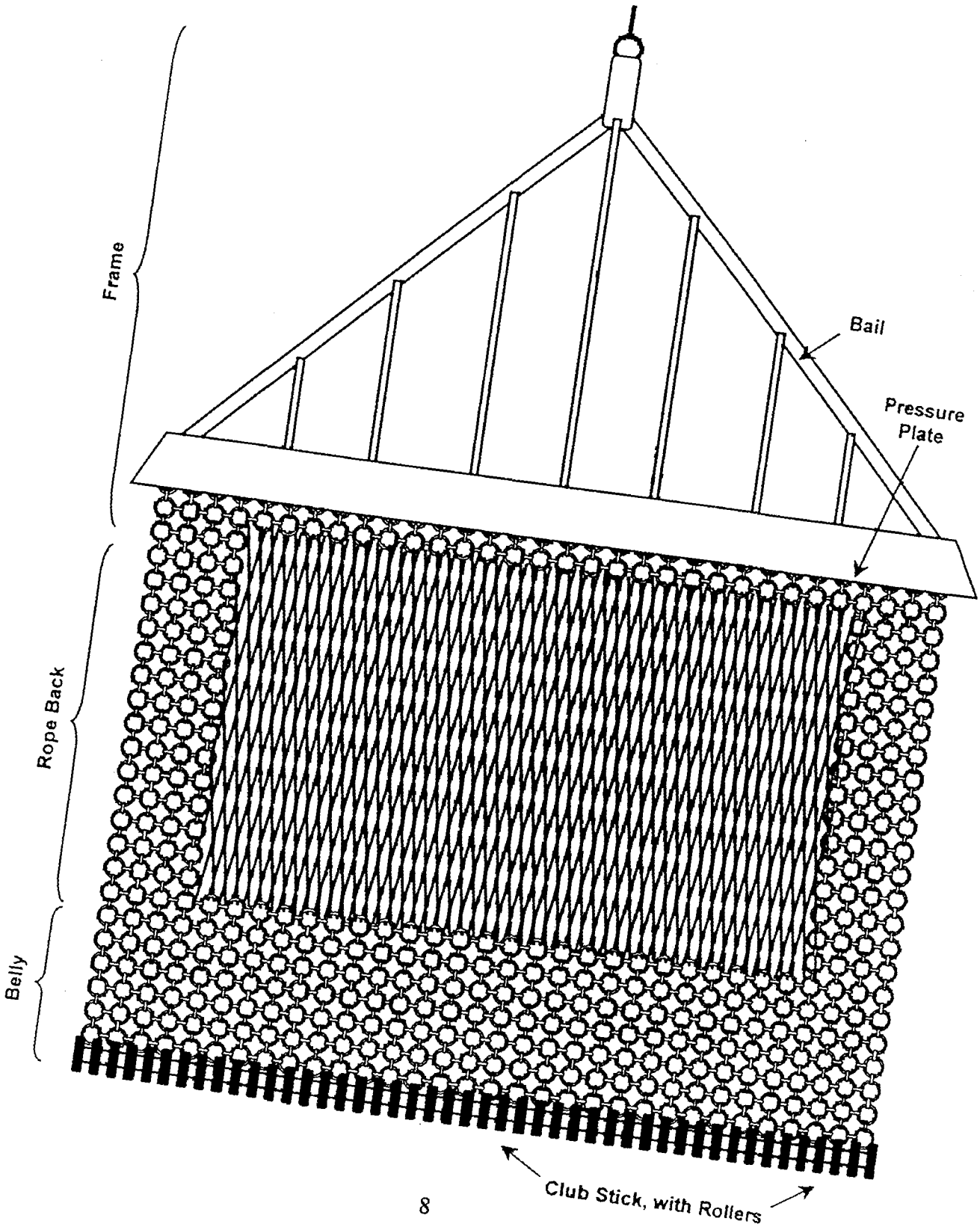


Figure D. Four inch rings with split links. When lying flat, the inter-ring space is approximately 4.5" (115 mm). Note, however, that by twisting and pulling the rings, one can cause the inter-ring space to gape as wide as 6.75" (170 mm). During towing, therefore, the inter-ring space probably fluctuates as the rings and links shift about. The corresponding dimensions for 3.5" rings are an inter-ring space of about 4" flat (100 mm), with a maximum forced gape of 5" (130 mm). Note also that the number of split links between the rings will vary, and this, too, affects the gape of the inter-ring space.

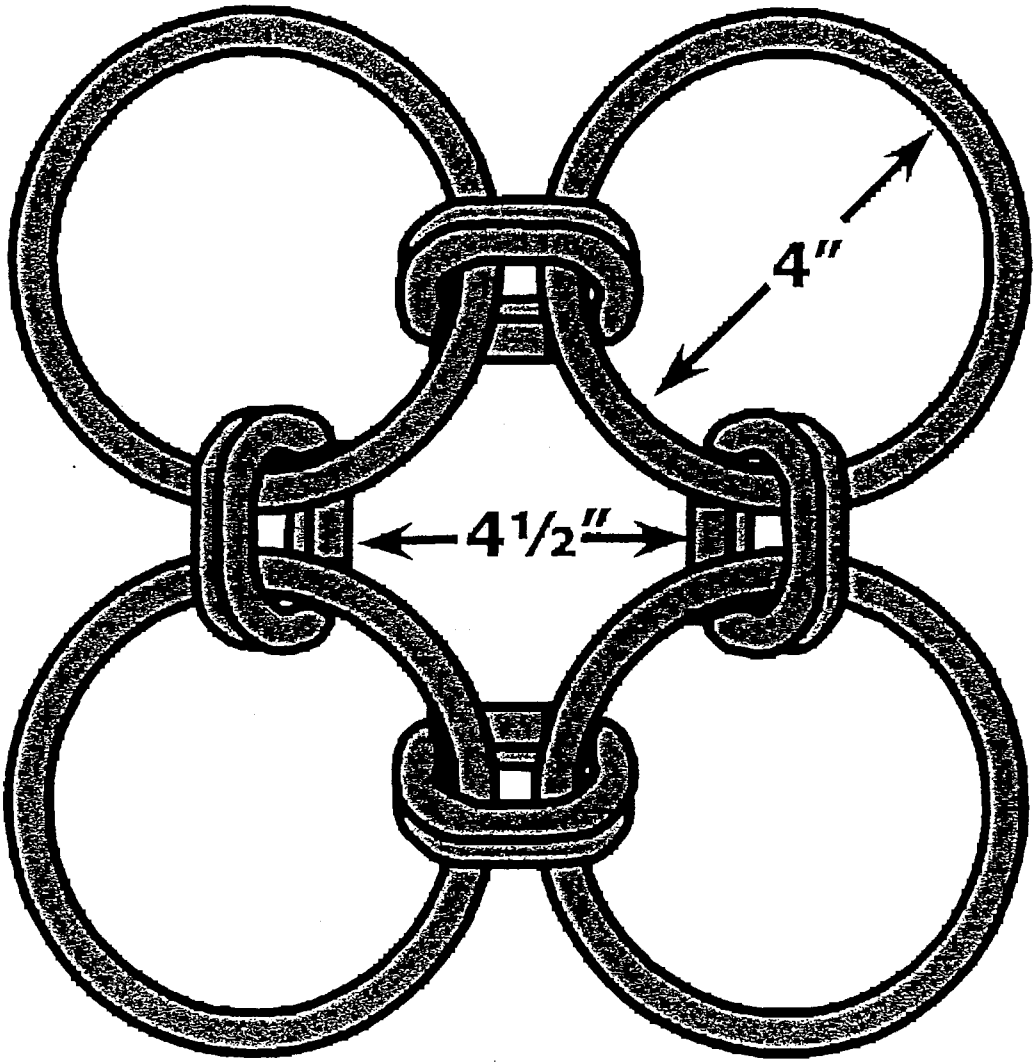
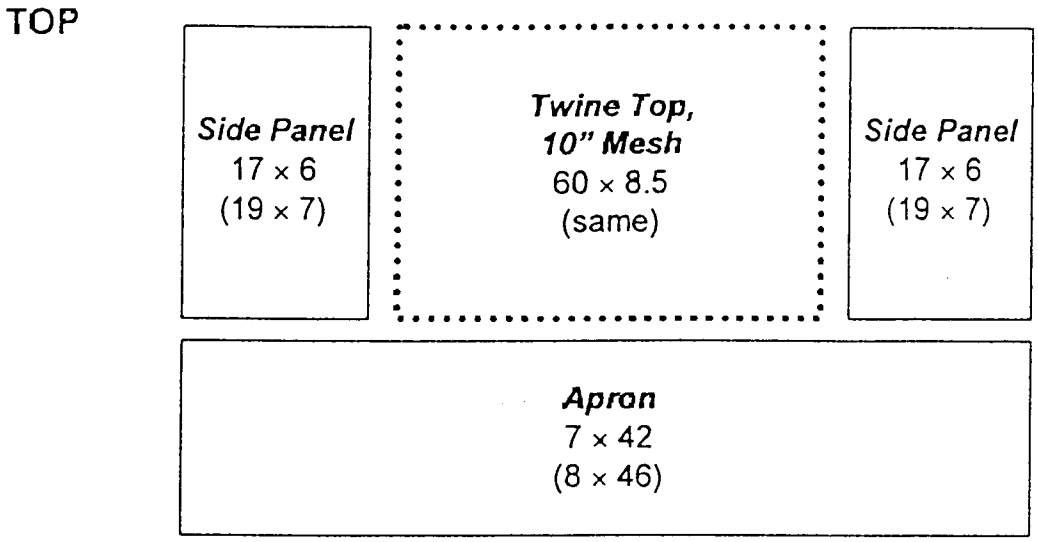


Figure E. Schematic diagram of bag with four inch rings. Dimensions are given in ring counts (fore-to-aft length X width across), with corresponding counts for 3.5" bag in parentheses. Although the ring counts differ between the two dredges, the actual lengths and widths are approximately identical. Twine top counts are in the number of meshes, each 10" X 10". Sweep counts are in the number of chain links.



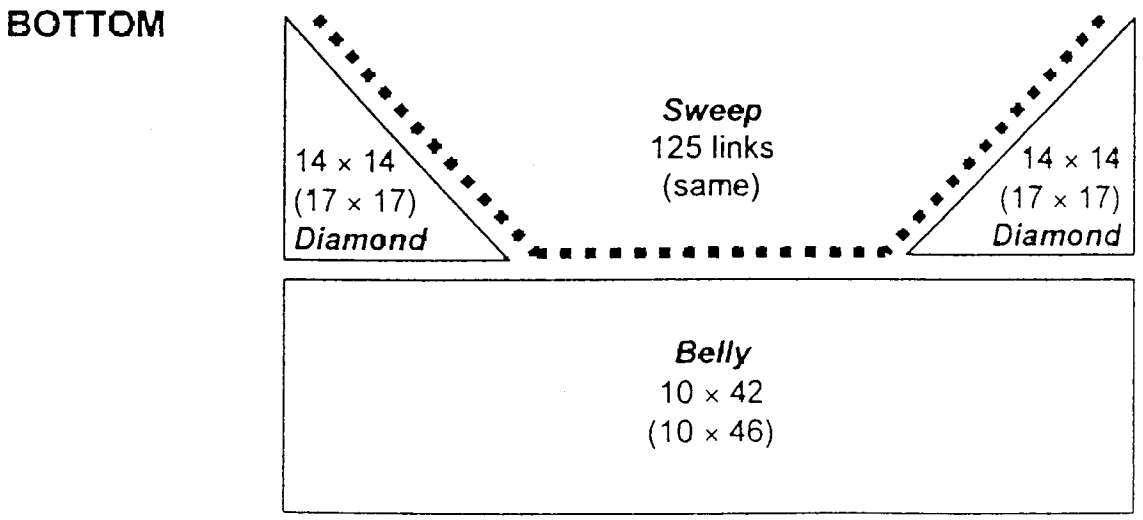


Figure F.

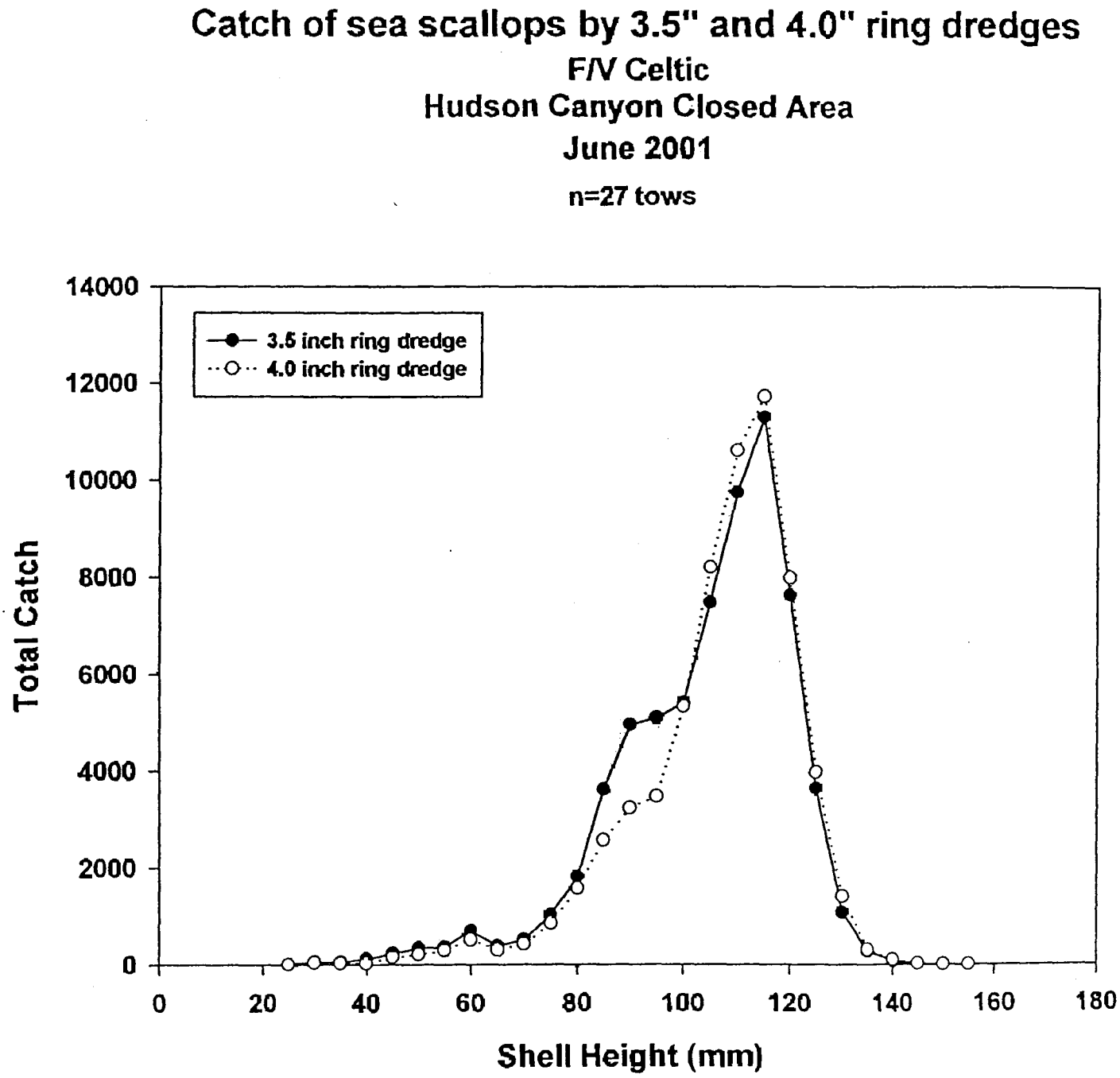

Catch of sea scallops by 3.5" and 4.0" ring dredges
F/V Celtic
Hudson Canyon Closed Area
June 2001
n=27 tows
3.5 inch ring dredge
4.0 inch ring dredge
Total Catch
14000
12000
10000
8000
6000
4000
2000
0
0
20
40
60
80
100
120
140
160
180
Shell Height (mm)

Figure G.

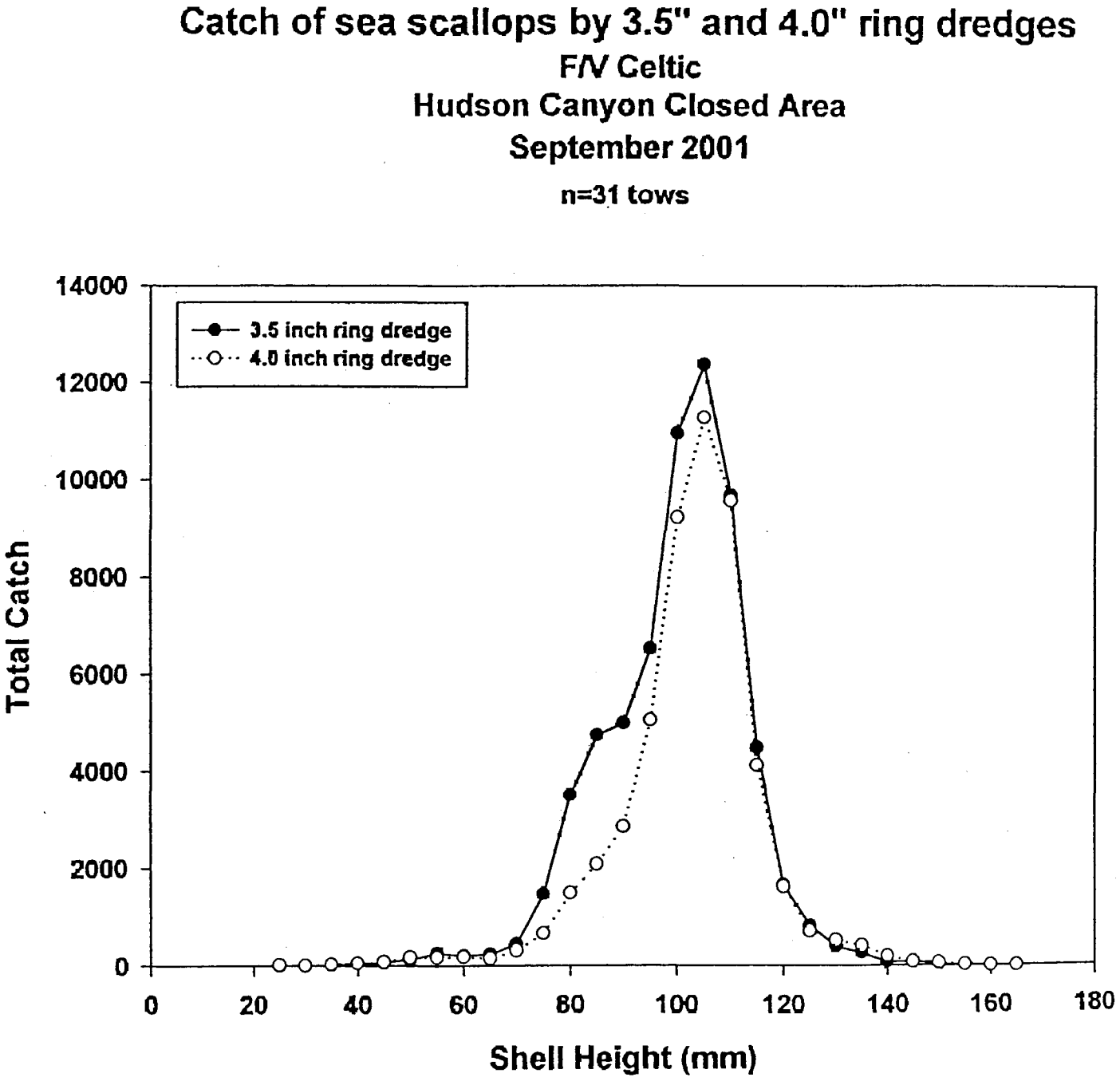
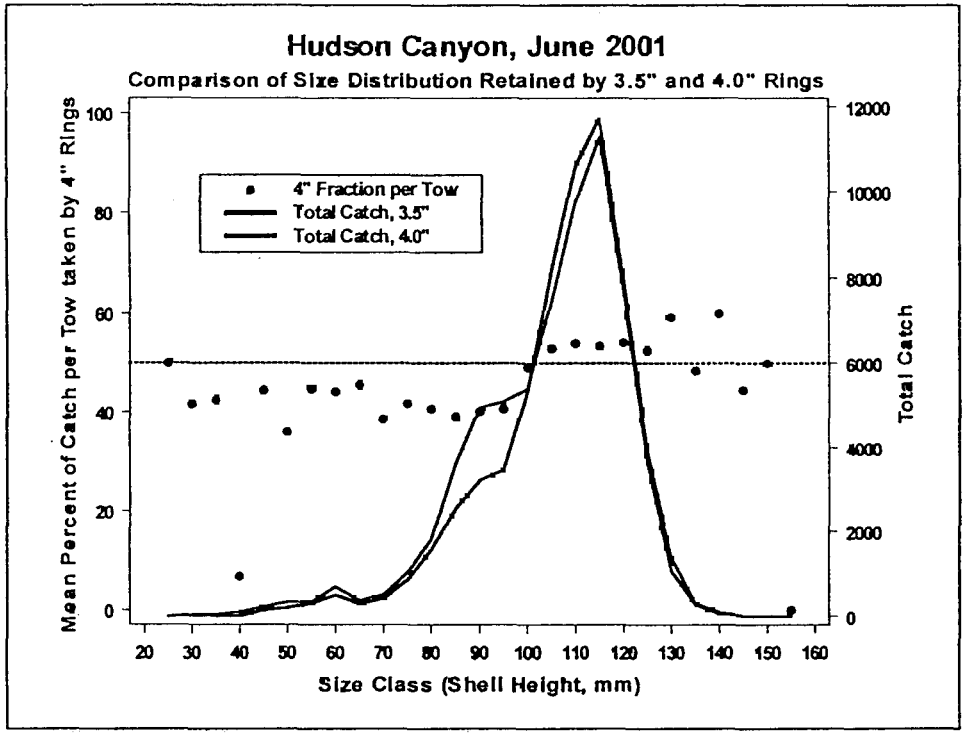

Catch of sea scallops by 3.5" and 4.0" ring dredges
F/V Celtic
Hudson Canyon Closed Area
September 2001
n=31 tows
3.5 inch ring dredge
4.0 inch ring dredge
Total Catch
Shell Height (mm)
14000
12000
10000
8000
6000
4000
2000
0
0
20
40
60
80
100
120
140
160
180

Figure H. Comparison of both total catch and catch per tow by 4" versus 3.5" rings on the Hudson Canyon trips. The 4" Fraction per Tow data points reflect the percent of the total catch *per tow* at each size class that on average was taken by the 4"rings. Values below 50% indicate lower catch rates by the 4" rings relative to the 3.5" rings, which in most cases reflects superior escapement. Values above 50% indicate higher catch rates by the 4" rings relative to the 3.5" rings, which in most cases reflects superior harvest efficiency.



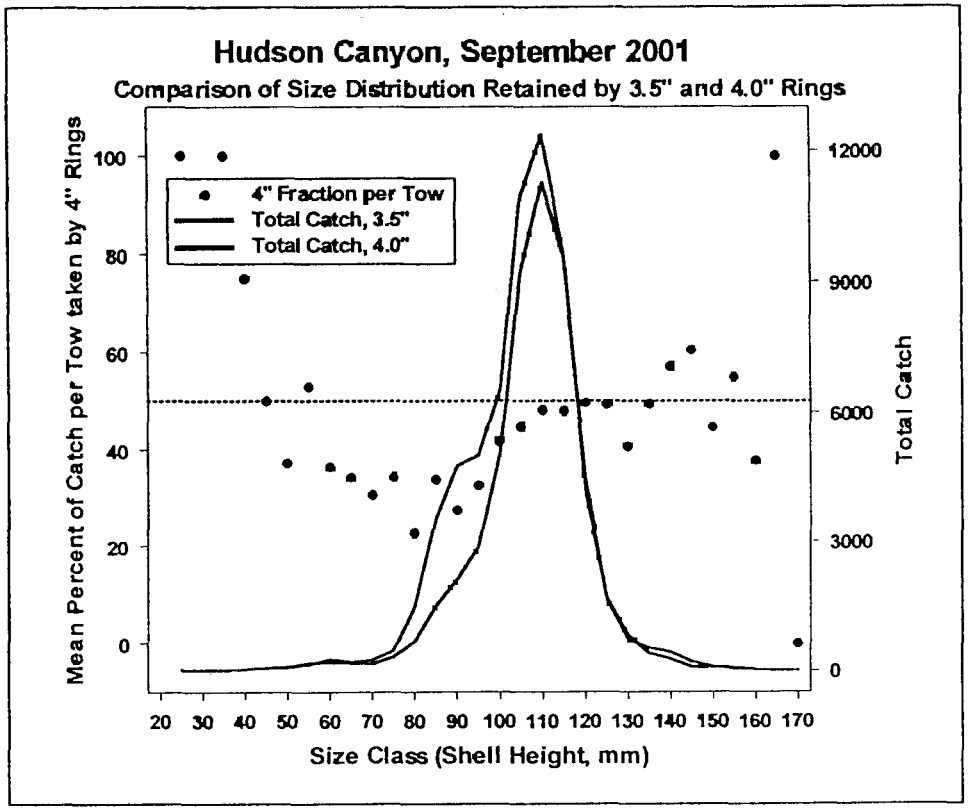
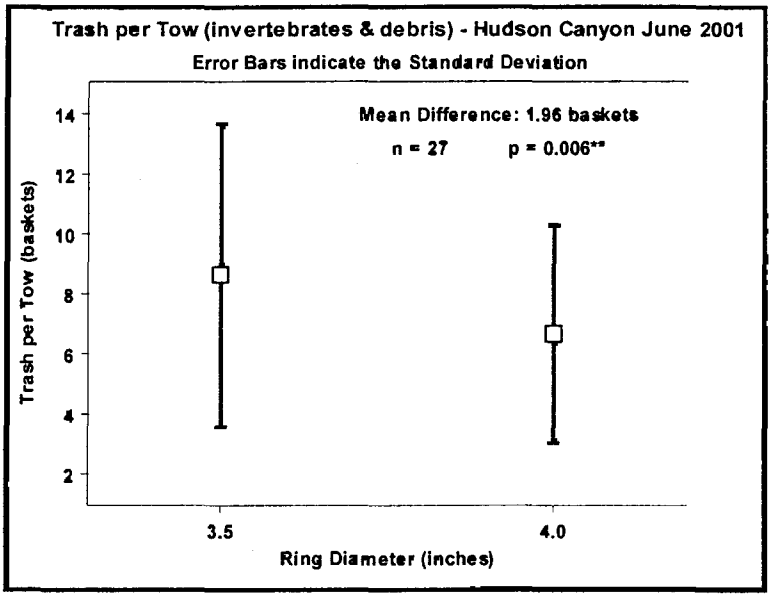
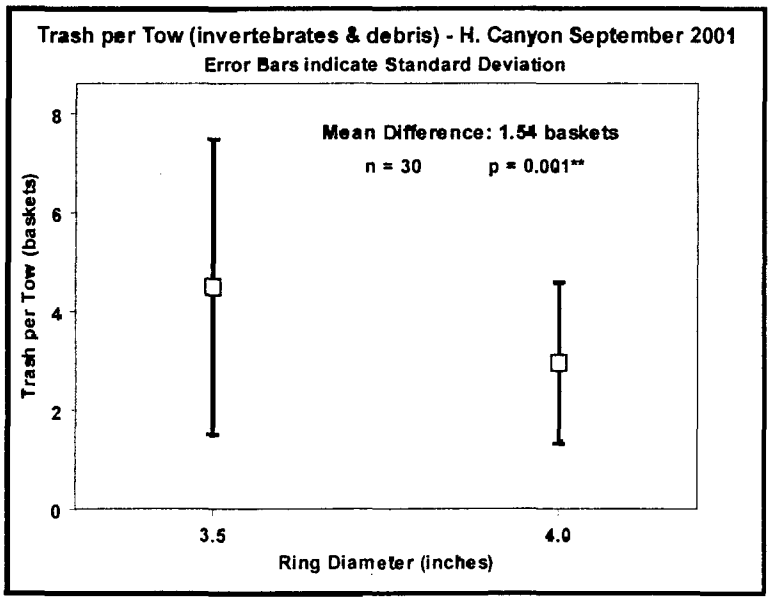


Figure I. Baskets of invertebrate trash per tow for the HCCA trips. Error bars indicate the standard deviation. Significant differences determined by a one-tailed paired T-test.





List of Tables

Table 1.

Total catches of sea scallops using the standard 3.5 inch ring dredge versus an experimental 4.0 inch ring dredge. Data represents the results from 27 comparative tows aboard the F/V *Celtic* during June of 2001 in the Hudson Canyon Closed Area.

Shell Ht (mm)	Catch 3.5"	Catch 4.0"
30	56	41
35	48	28
40	116	16
45	232	148
50	332	204
55	360	288
60	696	504
65	384	292
70	516	416
75	1028	844
80	1806	1561
85	3612	2556
90	4945	3226
95	5088	3463
100	5401	5315
105	7470	8204
110	9739	10600
115	11293	11725
120	7618	7985
125	3625	3959
130	1067	1405
135	273	300
140	72	108
145	21	17
150	6	3
155	2	0

Table 2.

Total catches of sea scallops using the standard 3.5 inch ring dredge versus an experimental 4.0 inch ring dredge. Data represents the results from 31 comparative tows aboard the F/V *Celtic* during September of 2001 in the Hudson Canyon Closed Area.

Shell Ht. (mm)	Catch 3.5"	Catch 4.0"
25	0	16
35	0	8
40	16	28
45	48	48
50	64	80
55	128	172
60	260	168
65	202	176
70	235	146
75	450	308
80	1471	668
85	3508	1494
90	4738	2089
95	4992	2857
100	6517	5049
105	10942	9211
110	12367	11271
115	9672	9559
120	4476	4109
125	1666	1617
130	823	711
135	400	522
140	264	416
145	71	195
150	88	79
155	38	60
160	28	20
165	0	8
170	4	0

Table 3.

Relative Catch of Optimal Size Scallops (115+ mm, Age 6+)

	Number of Tows Sampled	Optimal Scallops, Total 3.5"	Optimal Scallops, Total 4.0"	Percent Increase with 4.0"	Mean Difference per Tow	p-value (paired t-test)
Area II, July 2000	53	15,233	18,031	18.4%	52.8**	0.0002
Area II, Sept 2000	24	4,568	5,051	10.6%	20.1**	0.0018
Area II, June 2001	23	4,446	4,743	6.7%	13.0*	0.038
H. Canyon, June 2001	27	23,978	25,501	6.4%	56.4^{ns}	0.092
H. Canyon, Sept 2001	31	17,529	17,295	0.0%	-7.6^{ns}	0.57
Area I, Oct 2000a	17	41,789	49,168	17.7%	434.1**	0.0051
Area 1, Oct 2000b	16	32,083	32,440	1.1%	22.3^{ns}	0.43
Lightship, Aug 2001	6	14,801	17,255	16.6%	409**	0.0097

Relative Catch of Pre-optimal Size Scallops (<115 mm)

	Number of Tows Sampled	Pre-optimal Scallops, Total 3.5"	Pre-optimal Scallops, Total 4.0"	Percent Reduction with 4.0"	Mean Difference per Tow	p-value (paired t-test)
Area II, July 2000	53	179,096	171,014	4.5%	-152.5^{ns}	0.27
Area II, Sept 2000	24	28,224	16,591	41.2%	-484.7**	0.0001
Area II, June 2001	23	25,817	25,219	2.3%	-26.0*	0.021
H. Canyon, June 2001	27	41,834	37,709	9.9%	-152.8*	0.015
H. Canyon, Sept 2001	31	45,937	33,789	26.4%	-391.9**	0
Area I, Oct 2000a	17	17,579	15,979	9.1%	-94.1^{ns}	0.15
Area 1, Oct 2000b	16	10,212	10,405	-1.9%	+12.0^{ns}	0.63
Lightship, Aug 2001	6	2,151	2,688	-25.0%	+89.5^{ns}	0.91

Table 4. Comparison of volume of trash.

Trash (Invertebrates and Debris)

Trip	Mean Trash per Tow Retained by 3.5" Rings (baskets)	Mean Trash per Tow Retained by 4.0" Rings (baskets)	Mean Difference per Tow	p – value (paired t test)	Mean Percent Reduction in Trash
Area II, July 2000	**5.94**	**4.67**	**1.27****	**0.003**	*21.4%*
Area II, Sept 2000	**14.42**	**8.60**	**5.82****	**0**	*40.4%*
Area II, June 2001	**6.79**	**4.92**	**1.88****	**0.0003**	*27.7%*
Hudson Canyon, June 2001	**8.63**	**6.67**	**1.96****	**0.0063**	*22.7%*
Hudson Canyon, September 2001	**4.50**	**2.96**	**1.54****	**0.001**	*34.2%*
Area I, Oct 2000a	**4.10**	**3.54**	**0.57***	**0.04**	*13.9%*
Area I, Oct 2000b	**5.73**	**4.69**	**1.04****	**0.0087**	*18.2%*

Table 5.

Finfish Bycatch Totals

Species	Area II July 2000		Area II Sept 2000		Area II June 2000		H. Canyon June 2001		H. Canyon Sept 2001		Area I Oct 2000		Lightship Aug 2001		*Totals*	
	3.5"	4.0"	3.5"	4.0"	3.5"	4.0"	3.5"	4.0"	3.5"	4.0"	3.5"	4.0"	3.5"	4.0"	3.5"	4.0"
Yellowtail Flounder	1069	998	1118	1131	788	830	0	0	12	11	39	43	21	35	*3047*	*3048*
Yellowtail <30 cm	54	22	194	76	66	41	0	0	0	0	2	3	0	0	*316*	*142*
Witch Flounder (Grey Sole)	41	46	2	1	107	104	1	0	0	0	0	0	0	0	*151*	*151*
Witch <35 cm	4	1	2	0	11	6	1	0	0	0	0	0	0	0	*18*	*7*
American Plaice	21	18	6	4	46	52	7	7	2	0	0	0	2	2	*84*	*83*
Plaice <35 cm	13	5	4	0	14	18	5	3	2	0	0	0	0	0	*38*	*26*
Winter Flounder (Blackback)	4	3	12	9	1	0	0	0	8	4	47	52	14	13	*86*	*81*
Monkfish (Goosefish)	87	132	157	159	147	138	111	148	424	373	40	34	5	8	*971*	*992*
Red Hake	112	64	75	33	75	81	18	22	188	185	11	9	0	1	*479*	*395*
Silver Hake	321	241	129	81	494	422	0	0	157	192	18	8	0	0	*1119*	*944*
Windowpane	50	53	55	70	56	61	0	0	52	34	62	68	0	2	*275*	*288*
Fourspot Flounder	193	139	397	277	197	211	47	31	361	214	60	47	4	2	*1259*	*921*
Sculpin	141	74	323	189	200	121	0	0	0	0	79	69	10	6	*753*	*459*
Sea Raven	12	11	12	4	37	28	0	0	1	0	20	14	2	5	*84*	*62*
Skates	740	744	4103	4083	1711	1672	1086	1103	3520	3117	607	584	204	222	*11971*	*11525*

Table 6.

Catch and Catch Rates for Scallops Retained by the Crew (Sampled Tows Only)

	Towing Time	Number of Retained Scallops, 3.5"	Number of Retained Scallops, 4.0"	Percent Retained by 4.0" Bag	Catch Rate per Minute, 3.5"	Catch Rate per Minute, 4.0"	Catch Rate Improvement
Area II, July 2000	**3,107 minutes**	**23,344**	**26,353**	***53.0%***	**7.5**	**8.5**	***12.9%***
Area II, Sept 2000	**1,269 minutes**	**5,158**	**5,776**	***52.8%***	**4.1**	**4.6**	***12.0%***
Area II, June 2001	**1,367 minutes**	**28,161**	**26,933**	***48.9%***	**20.6**	**19.7**	***- 4.4%***
H. Canyon, June 2001	**1,578 minutes**	**41,884**	**44,782**	***51.7%***	**26.5**	**28.4**	***7.2%***
H. Canyon, Sept 2001	**2,330 minutes**	**44,806**	**40,470**	***47.5%***	**19.2**	**17.4**	***-9.4%***
Area I, Oct 2000a	**119 minutes**	**37,900**	**44,287**	***53.9%***	**318.5**	**372.2**	***16.9%***
Area 1, Oct 2000b	**114 minutes**	**26,739**	**27,621**	***50.8%***	**234.6**	**242.3**	***3.3%***
Lightship, Aug 2001	**13 minutes**	**12,696**	**15,411**	***54.8%***	**962**	**1,168**	***21.4%***

Table 7.

Catch and Catch Rates for Scallops Discarded by the Crew (Sampled Tows Only)

	Towing Time	Number of Discards, 3.5"	Number of Discards, 4.0"	Percent Retained by 4.0" Bag	Discards per Minute, 3.5"	Discards Rate per Minute, 4.0"	Discard Rate Reduction
Area II, July 2000	3,107 minutes	170,985	162,690	48.8%	52.4	55.0	4.9%
Area II, Sept 2000	1,269 minutes	27,634	15,866	36.5%	21.8	12.5	42.5%
Area II, June 2001	1,367 minutes	2,922	2,306	44.1%	2.14	1.69	21.1%
H. Canyon, June 2001	1,578 minutes	23,928	18,804	44.0%	15.2	11.9	21.4%
H. Canyon, Sept 2001	2,330 minutes	18,660	10,614	36.3%	8.0	4.6	42.5%
Area I, Oct 2000a	119 minutes	21,468	20,860	49.3%	180.4	175.3	2.8%
Area 1, Oct 2000b	114 minutes	15,556	15,236	49.5%	136.5	133.7	2.1%
Lightship, Aug 2001	13 minutes	4,256	4,532	51.6%	322.4	343.3	-6.5%

Table 8.

Meat Weights in Kilograms (Trip Totals, Sampled Tows Only)

	Discards, 4"	Discards, 3.5"	Retained, 4"	Retained, 3.5"
CA II, July 2000	622.9	725.1	727.4	636.0
CA II, Sept 2000	111.4	188.6	217.1	190.6
CA II, June 2001	33.4	41.4	545.3	542.9
HC, June 2001	215.4	265.1	1021.0	944.6
HC, Sept 2001	121.8	206.7	885.4	952.7
CA I, Oct 2000a	338.7	338.0	1397.0	1165.2
CA I, Oct 2000b	273.0	284.1	887.0	857.7
NL, Aug 2001	101.3	106.5	655.2	546.7

Meat Weights in Pounds (Trip Totals, Sampled Tows Only)

	Discards, 4"	Discards, 3.5"	Retained, 4"	Retained, 3.5"
CA II, July 2000	1370.4	1595.2	1600.3	1399.2
CA II, Sept 2000	245.1	414.9	477.6	419.3
CA II, June 2001	73.5	91.1	1199.7	1194.4
HC, June 2001	473.9	583.2	2246.2	2078.1
HC, Sept 2001	268.0	454.7	1947.9	2095.9
CA I, Oct 2000a	745.1	743.6	3073.4	2563.4
CA I, Oct 2000b	600.6	625.0	1951.4	1886.9
NL, Aug 2001	222.9	234.3	1441.4	1202.7

* Shell height:meat weight conversions from NEFSC1999 (SARC Report, 29th SAW).

Table 9.

Harvest Weights (Sampled Tows Only)

	Harvest Weight, 3.5" Rings * Pounds (Kilograms)	Harvest Weight, 4.0" Rings Pounds (Kilograms)	Percent Increase with 4.0" Rings
Area II, July 2000	1399 (636)	1600 (727)	14.4%
Area II, Sept 2000	419 (191)	478 (217)	14.1%
Area II, June 2001	1194 (543)	1200 (454)	0.5%
H. Canyon, June 2001	2078 (945)	2246 (1021)	8.1%
H. Canyon, Sept 2001	2096 (953)	1948 (885)	-7.1%
Area I, Oct 2000a	2563 (1165)	3073 (1397)	19.9%
Area 1, Oct 2000b	1887 (858)	1951 (887)	3.4%
Lightship, Aug 2001	1203 (547)	1441 (655)	19.8%

* Shell height:meat weight conversions from NEFSC1999 (SARC Report, 29th SAW).