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**A COMPARATIVE EVALUATION OF A 3.5" RING
VERSUS A 4.0" RING SEA SCALLOP DREDGE**

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A COMPARATIVE EVALUATION OF A RING VERSUS A 4.0" RING SEA SCALLOP DREDGE

MATERIALS AND METHODS

Data Collection

This study conducted seven research trips aboard the commercial scallop vessel *F/V Celtic* into three of the Georges Bank and Mid-Atlantic Closed Areas: three trips into Closed Area II (in July 2000, September 2000, and June 2001), two trips into the Hudson Canyon Closed Area (June and September 2001), and two trips into Closed Area I (both in October 2000). The goal was to evaluate the performance of the experimental gear in a variety of closed area fisheries, on different bottom types with different scallop distributions, similar to those expected under an area management scheme.

The experiment employed a paired design: two dredges – one fitted with 89 mm (3.5") rings and the other fitted with 102 mm (4.0") rings – deployed simultaneously and towed side-by-side from the port and starboard gallows. The dredges were 4.6 m (15') wide offshore New Bedford dredges, with bags configured as identically as possible, except for the dimensions of the rings themselves (Figure 1). At the midpoint of each trip, the crew traded the dredges. Fishing generally followed commercial practices, with the captain and crew selecting tow sites, tow durations, and size of culling, except that port and starboard catches were kept separate.

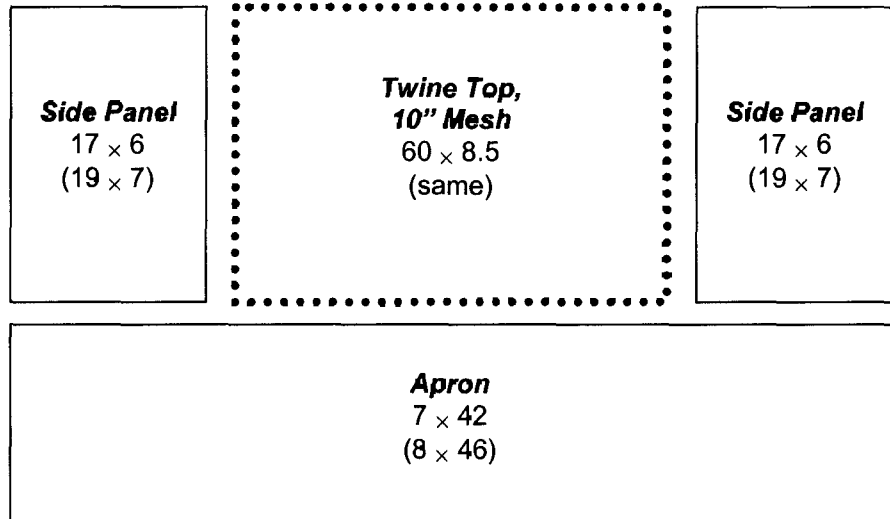
For each dredge the scientists collected data on (1) basket count (bushels of harvest size scallops deliberately retained by the crew for shucking and landing), (2) shell height frequency of all scallops including crew discards (width of the upper valve from the dorsal hinge to ventral extreme as measured on a standard NMFS measuring board and grouped into size classes of 5 mm intervals), (3) volume of “trash” (invertebrates and debris, in baskets), and (4) finfish bycatch frequencies (with the total length of all teleosts measured to the nearest centimeter; skates and other batoids were counted but not measured). For estimating shell height frequencies, the scientists took sub-samples, usually measuring two or three baskets of retained scallops per side and usually one quarter of the discards. Sub-sampling of discards was systematic, with discards always selected from the same region of the port and starboard piles on any given tow, but from an ever-changing region of the piles on successive tows. Trash was sub-sampled from the same portion of the pile as the discards. The captain or mate of the vessel recorded the vessel position at the start (brake set) and end (initiation of haulback) of each tow, as well as the tow duration, velocity, and heading.

Data Analysis

For each Closed Area, data on shell height and trash were analyzed in a paired fashion on a tow-by-tow basis, with paired t-tests on the means used to determine statistical significance. The catch of each size class of scallops by 102 mm rings relative to that of 89 mm rings was calculated both on a per tow basis and for each closed area as a whole.

Figure 1

TOP



BOTTOM

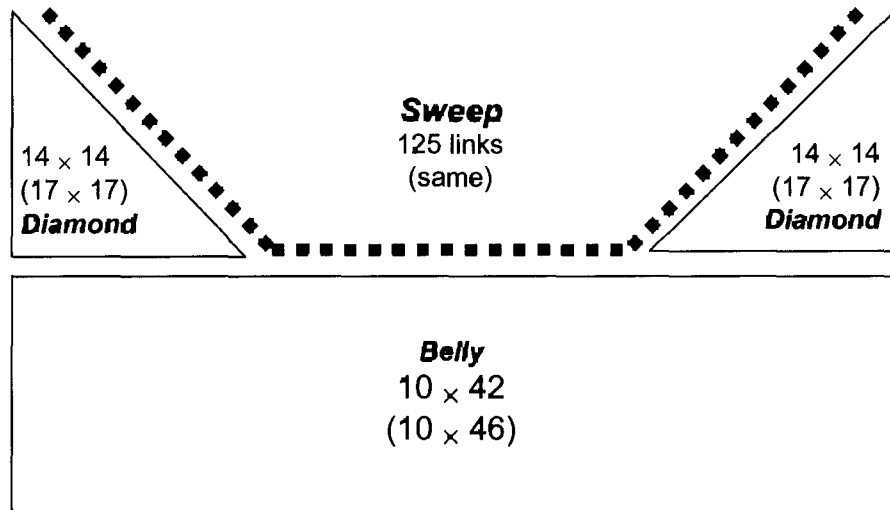


Figure 2

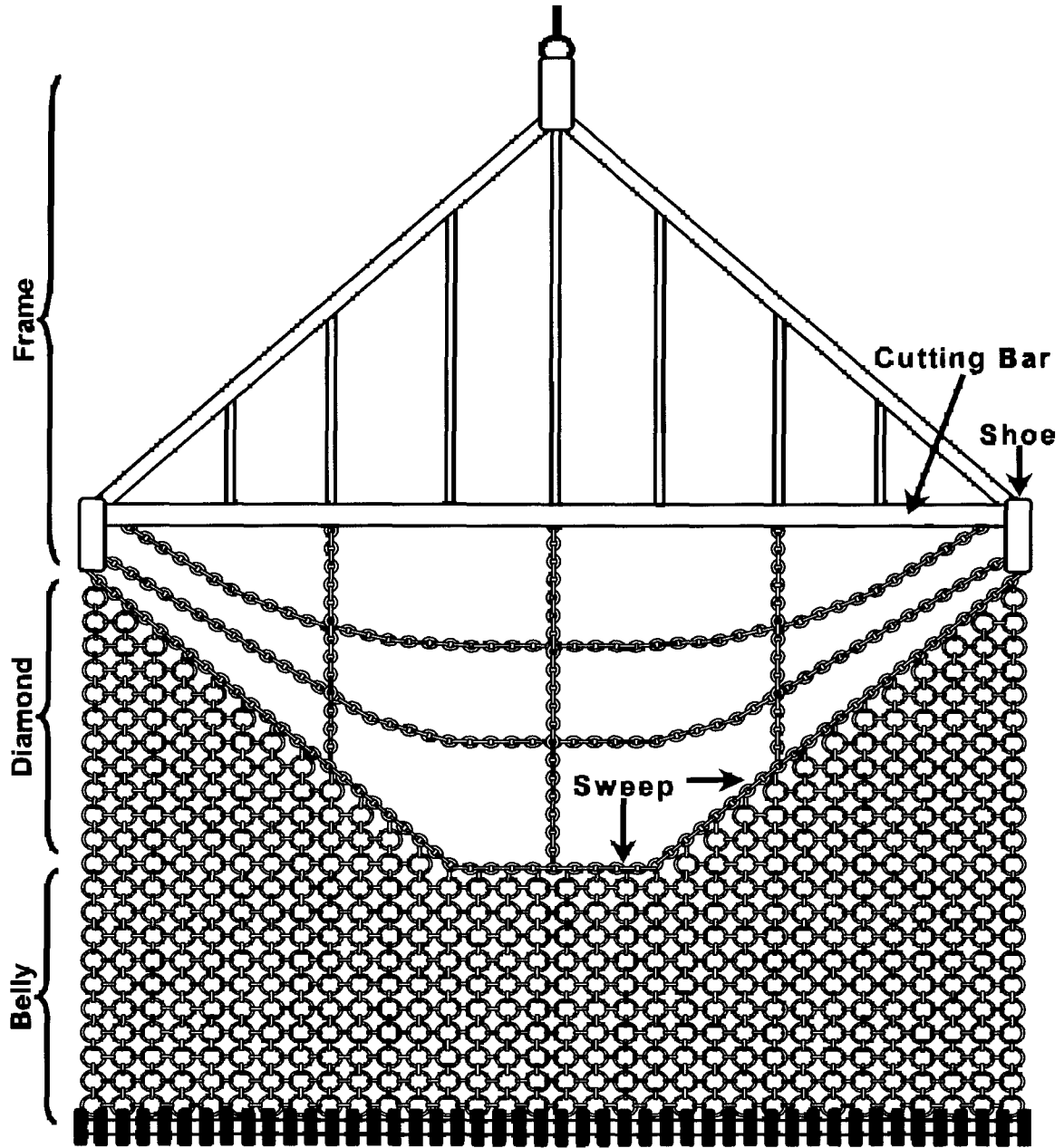


Figure 3

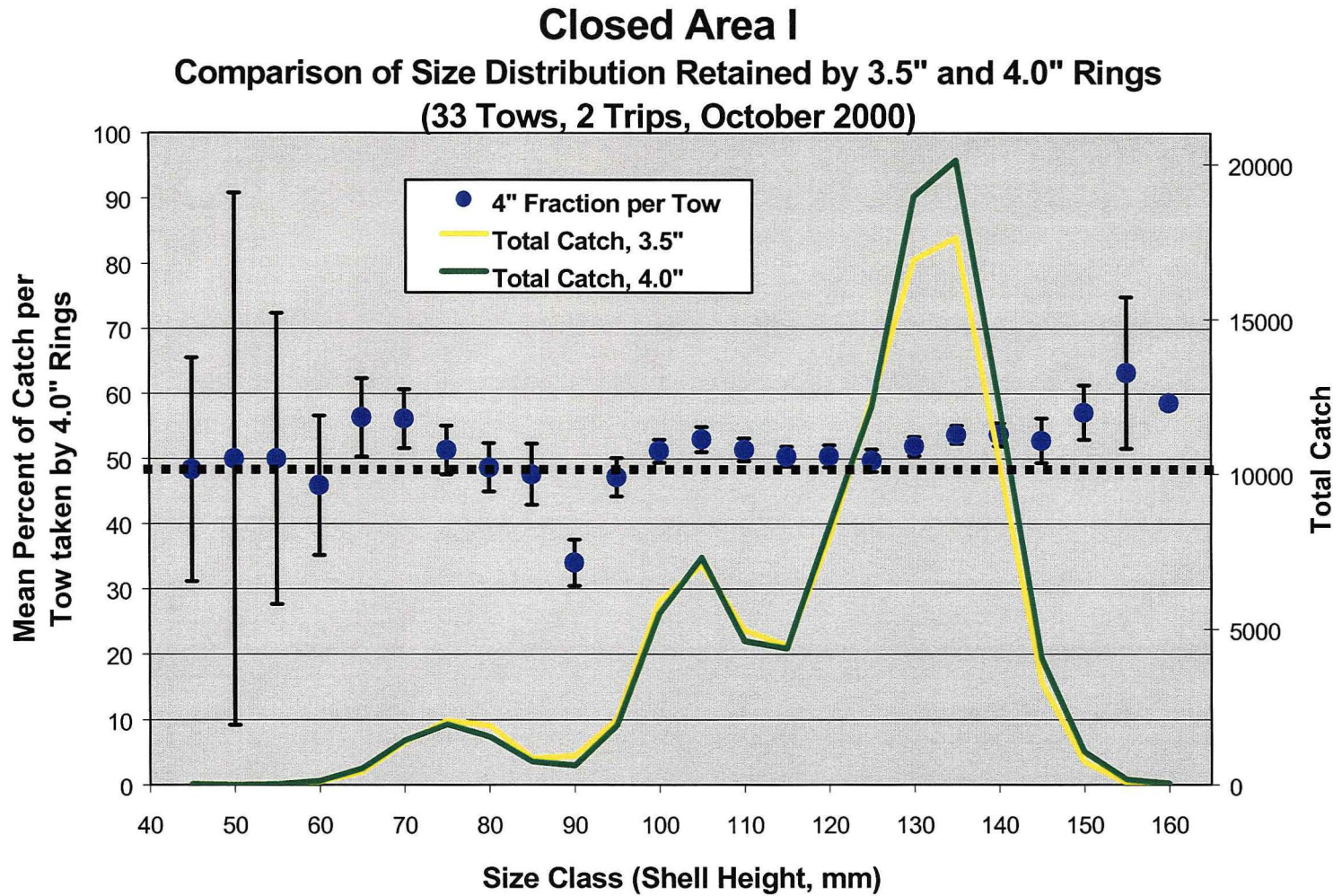


Table 1. Closed Area I Data

ShellHeight	MeanRelCatch	NumberTows	StandardError	TotalCatch3.5	TotalCatch4.0
45.00	48.33	5.00	17.16	32.00	28.00
50.00	50.00	3.00	40.82	8.00	4.00
55.00	50.00	6.00	22.36	16.00	20.00
60.00	45.88	16.00	10.72	104.00	128.00
65.00	56.32	28.00	6.04	424.00	536.00
70.00	56.11	32.00	4.55	1372.00	1440.00
75.00	51.27	32.00	3.72	2072.00	1948.00
80.00	48.61	33.00	3.71	1908.00	1548.00
85.00	47.55	33.00	4.68	860.00	760.00
90.00	34.00	33.00	3.55	940.00	628.00
95.00	47.13	33.00	2.95	2112.00	1920.00
100.00	51.12	33.00	1.76	5903.60	5502.53
105.00	52.92	33.00	1.94	7064.73	7311.48
110.00	51.33	33.00	1.75	4958.97	4609.67
115.00	50.30	33.00	1.51	4461.83	4378.45
120.00	50.32	33.00	1.69	7922.37	8281.55
125.00	49.65	33.00	1.72	12397.28	12190.93
130.00	51.86	33.00	1.47	16913.03	18967.60
135.00	53.65	33.00	1.38	17634.65	20119.38
140.00	53.66	33.00	1.79	10419.05	12282.42
145.00	52.72	33.00	3.45	3306.25	4085.97
150.00	57.06	33.00	4.21	735.97	1065.72
155.00	63.20	17.00	11.67	60.33	171.53
160.00	58.56	6.00	20.05	21.03	52.42

Figure 4

Closed Area II
Comparison of Size Distribution Retained by 3.5" and 4.0" Rings
(100 Tows, 3 Trips: July 2000, Sept 2000, & June 2001)

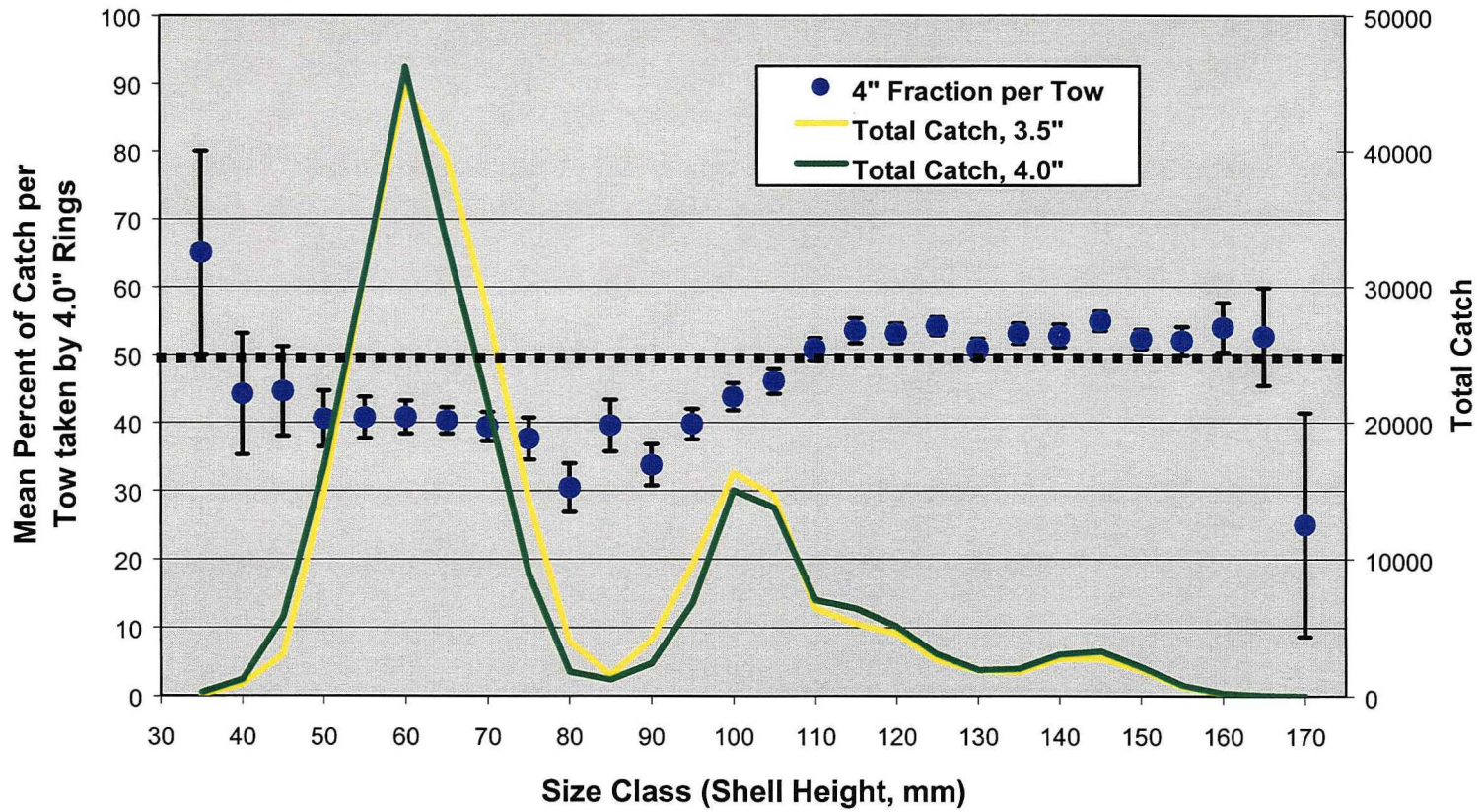


Table 2. Closed Area II Data

ShellHeight	MeanRelCatch	NumberTows	StandardError	TotalCatch3.5	TotalCatch4.0
35.00	65.00	10.00	15.00	104.00	261.00
40.00	44.19	21.00	8.88	859.00	1204.00
45.00	44.60	37.00	6.58	3024.00	5788.00
50.00	40.56	67.00	4.14	14803.00	16819.00
55.00	40.72	74.00	3.01	30894.00	31028.00
60.00	40.77	84.00	2.43	44718.00	46196.00
65.00	40.29	78.00	1.92	39712.00	33357.00
70.00	39.39	78.00	2.13	28200.00	21418.00
75.00	37.62	74.00	3.09	14294.00	8868.00
80.00	30.43	61.00	3.56	3974.50	1772.50
85.00	39.56	79.00	3.80	1547.63	1192.13
90.00	33.77	89.00	3.04	4141.28	2382.15
95.00	39.75	96.00	2.28	9596.36	6788.94
100.00	43.77	99.00	2.00	16287.23	14992.87
105.00	46.07	100.00	1.87	14582.84	13739.83
110.00	50.79	100.00	1.64	6399.43	7012.04
115.00	53.47	98.00	1.88	5231.97	6378.64
120.00	53.10	100.00	1.49	4533.99	5063.48
125.00	54.13	100.00	1.34	2588.88	3047.22
130.00	50.80	100.00	1.49	1849.83	1909.00
135.00	53.04	100.00	1.52	1772.78	1993.18
140.00	52.71	94.00	1.69	2722.63	3027.03
145.00	54.90	84.00	1.44	2727.45	3252.67
150.00	52.20	80.00	1.42	1913.33	2098.10
155.00	51.98	80.00	2.07	677.09	790.78
160.00	53.93	76.00	3.66	177.60	218.46
165.00	52.60	40.00	7.18	43.67	43.84
170.00	25.00	8.00	16.37	7.78	2.50

Figure 5

Hudson Canyon Closed Area
Comparison of Size Distribution Retained by 3.5" and 4.0" Rings
(58 Tows, 2 Trips, June & Sept 2001)

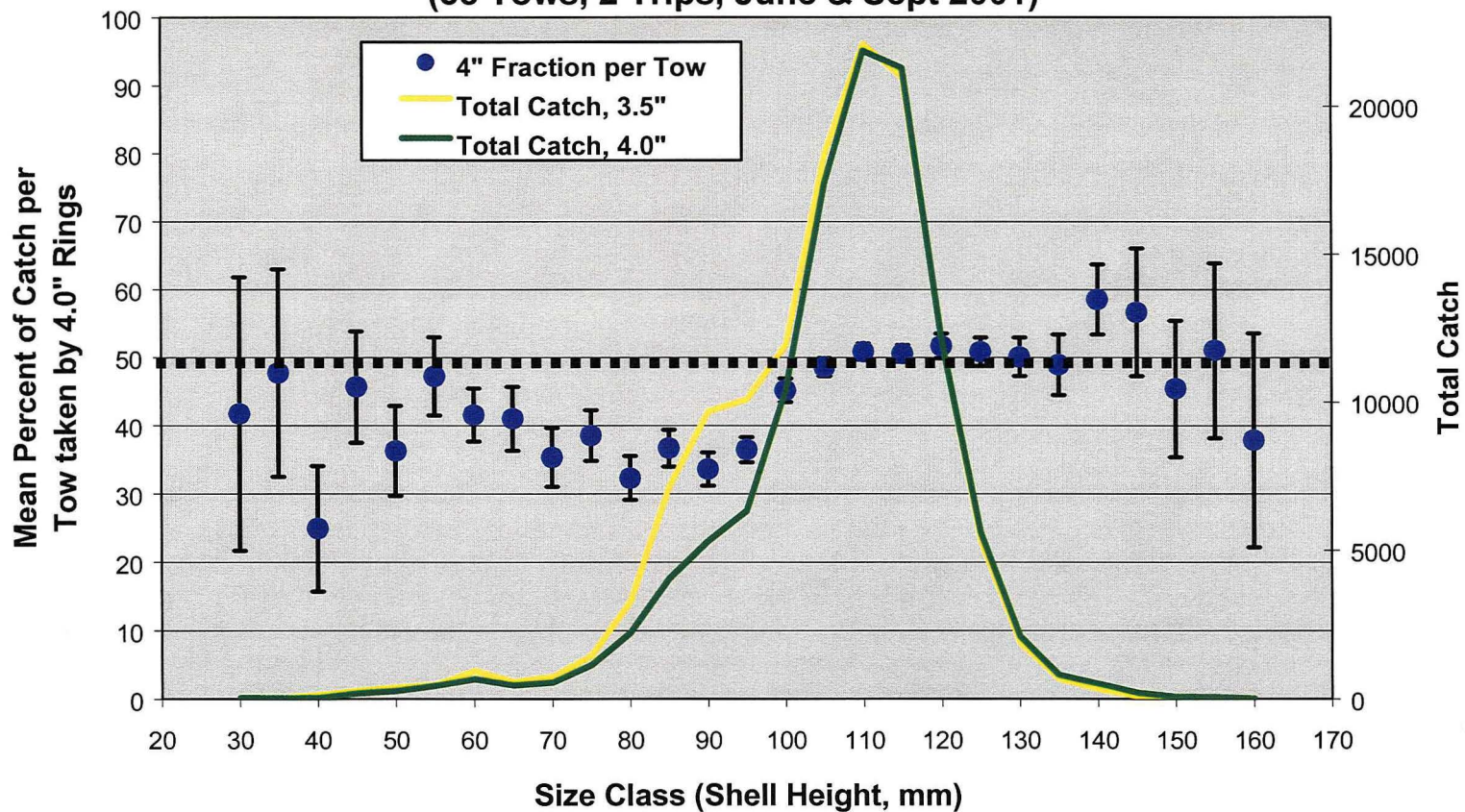


Table 3. HCCA Data

ShellHeight	MeanRelCatch	NumberTows	StandardError	TotalCatch3.5	TotalCatch4.0
30.00	41.74	6.00	20.08	56.40	41.00
35.00	47.73	11.00	15.25	48.00	36.00
40.00	24.89	15.00	9.16	132.00	44.00
45.00	45.67	23.00	8.17	280.00	196.00
50.00	36.28	34.00	6.59	396.00	284.00
55.00	47.22	39.00	5.77	488.00	460.00
60.00	41.55	39.00	3.89	956.00	672.00
65.00	40.99	42.00	4.68	586.00	468.00
70.00	35.34	41.00	4.30	751.00	562.00
75.00	38.52	46.00	3.71	1478.00	1152.00
80.00	32.29	49.00	3.21	3277.65	2229.00
85.00	36.67	51.00	2.72	7119.80	4050.23
90.00	33.58	56.00	2.44	9682.78	5314.68
95.00	36.43	57.00	1.85	10080.05	6319.48
100.00	45.15	58.00	1.74	11918.43	10364.53
105.00	48.56	58.00	1.31	18411.28	17415.35
110.00	50.84	58.00	1.16	22106.05	21870.30
115.00	50.59	58.00	1.21	20965.43	21283.90
120.00	51.69	58.00	1.83	12093.58	12093.78
125.00	50.83	58.00	2.11	5291.68	5576.43
130.00	50.09	53.00	2.85	1889.90	2115.43
135.00	48.92	41.00	4.47	673.45	821.28
140.00	58.53	39.00	5.18	336.05	523.85
145.00	56.65	21.00	9.40	91.98	212.50
150.00	45.39	15.00	10.01	93.60	81.50
155.00	51.03	14.00	12.87	40.03	59.93
160.00	37.84	8.00	15.71	27.73	19.55

Figure 6

Area I, Area II, and Hudson Canyon Combined
Comparison of Size Distribution Retained by 3.5" and 4.0" Rings
(7 Trips, 191 Tows: July 2000 - Sept 2001)

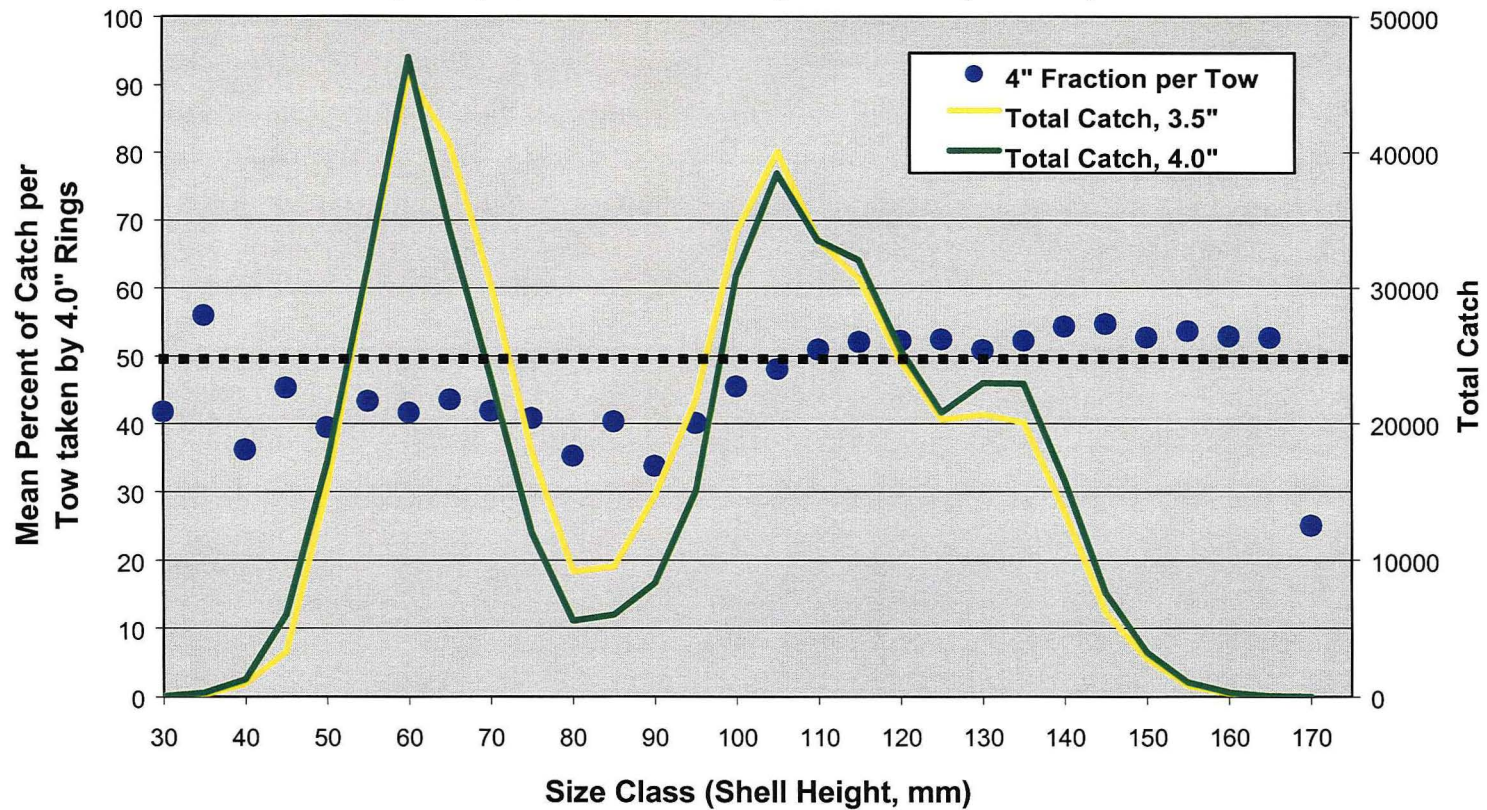


Table 4. Relative Catch, Per Tow

Shell Ht	Area II			Area I			Hudson Canyon			ALL COMBINED	
	Mean	# Tows	Expanded	Mean	# Tows	Expanded	MeanRel	# Tows	Expanded	Mean	# Tows
	RelCatch			RelCatch			RelCatch			RelCatch	
30	0	0	0		0	0	41.74	6.00	250.46	41.7	6
35	65.00	10.00	650	0	0.00	0	47.73	11.00	525	56.0	21
40	44.19	21.00	927.976	0	0.00	0	24.89	15.00	373.33	36.1	36
45	44.60	37.00	1650.1	48.33	5.00	241.667	45.67	23.00	1050.5	45.3	65
50	40.56	67.00	2717.69	50.00	3.00	150	36.28	34.00	1233.5	39.4	104
55	40.72	74.00	3013.15	50.00	6.00	300	47.22	39.00	1841.5	43.3	119
60	40.77	84.00	3424.36	45.88	16.00	734.091	41.55	39.00	1620.3	41.6	139
65	40.29	78.00	3142.94	56.32	28.00	1576.88	40.99	42.00	1721.4	43.5	148
70	39.39	78.00	3072.5	56.11	32.00	1795.47	35.34	41.00	1449.1	41.8	151
75	37.62	74.00	2784.17	51.27	32.00	1640.66	38.52	46.00	1772.1	40.8	152
80	30.43	61.00	1856.19	48.61	33.00	1604.07	32.29	49.00	1582.2	35.3	143
85	39.56	79.00	3125.5	47.55	33.00	1569.14	36.67	51.00	1870.2	40.3	163
90	33.77	89.00	3005.79	34.00	33.00	1121.9	33.58	56.00	1880.7	33.8	178
95	39.75	96.00	3816.39	47.13	33.00	1555.28	36.43	57.00	2076.4	40.0	186
100	43.77	99.00	4333.06	51.12	33.00	1686.8	45.15	58.00	2618.8	45.5	190
105	46.07	100.00	4606.97	52.92	33.00	1746.43	48.56	58.00	2816.3	48.0	191
110	50.79	100.00	5078.9	51.33	33.00	1693.81	50.84	58.00	2948.6	50.9	191
115	53.47	98.00	5239.94	50.30	33.00	1659.99	50.59	58.00	2934	52.0	189
120	53.10	100.00	5309.6	50.32	33.00	1660.64	51.69	58.00	2998.1	52.2	191
125	54.13	100.00	5413.29	49.65	33.00	1638.61	50.83	58.00	2948.2	52.4	191
130	50.80	100.00	5079.72	51.86	33.00	1711.54	50.09	53.00	2655	50.8	186
135	53.04	100.00	5303.91	53.65	33.00	1770.38	48.92	41.00	2005.8	52.2	174
140	52.71	94.00	4954.29	53.66	33.00	1770.7	58.53	39.00	2282.8	54.3	166
145	54.90	84.00	4611.5	52.72	33.00	1739.7	56.65	21.00	1189.7	54.6	138
150	52.20	80.00	4175.91	57.06	33.00	1883.07	45.39	15.00	680.85	52.7	128
155	51.98	80.00	4158.06	63.20	17.00	1074.4	51.03	14.00	714.36	53.6	111
160	53.93	76.00	4098.73	58.56	6.00	351.351	37.84	8.00	302.75	52.8	90
165	52.60	40.00	2104.02	0	0.00	0	0	0.00	0	52.6	40
170	25.00	8.00	200	0	0.00	0	0	0.00	0	25.0	8

Table 5. Total Catch, 3.5" & 4.0"

Shell Ht	Area II		Area I		Hudson Canyon		COMBINED	
	3.5"	4.0"	3.5"	4.0"	3.5"	4.0"	3.5"	4.0"
30	0	0	0	0	56.40	41.00	56	41
35	104.00	261.00	0	0	48.00	36.00	152	297
40	859.00	1204.00	0	0	132.00	44.00	991	1248
45	3024.00	5788.00	32.00	28.00	280.00	196.00	3336	6012
50	14803.00	16819.00	8.00	4.00	396.00	284.00	15207	17107
55	30894.00	31028.00	16.00	20.00	488.00	460.00	31398	31508
60	44718.00	46196.00	104.00	128.00	956.00	672.00	45778	46996
65	39712.00	33357.00	424.00	536.00	586.00	468.00	40722	34361
70	28200.00	21418.00	1372.00	1440.00	751.00	562.00	30323	23420
75	14294.00	8868.00	2072.00	1948.00	1478.00	1152.00	17844	11968
80	3974.50	1772.50	1908.00	1548.00	3277.65	2229.00	9160	5550
85	1547.63	1192.13	860.00	760.00	7119.80	4050.23	9527	6002
90	4141.28	2382.15	940.00	628.00	9682.78	5314.68	14764	8325
95	9596.36	6788.94	2112.00	1920.00	10080.05	6319.48	21788	15028
100	16287.23	14992.87	5903.60	5502.53	11918.43	10364.53	34109	30860
105	14582.84	13739.83	7064.73	7311.48	18411.28	17415.35	40059	38467
110	6399.43	7012.04	4958.97	4609.67	22106.05	21870.30	33464	33492
115	5231.97	6378.64	4461.83	4378.45	20965.43	21283.90	30659	32041
120	4533.99	5063.48	7922.37	8281.55	12093.58	12093.78	24550	25439
125	2588.88	3047.22	12397.28	12190.93	5291.68	5576.43	20278	20815
130	1849.83	1909.00	16913.03	18967.60	1889.90	2115.43	20653	22992
135	1772.78	1993.18	17634.65	20119.38	673.45	821.28	20081	22934
140	2722.63	3027.03	10419.05	12282.42	336.05	523.85	13478	15833
145	2727.45	3252.67	3306.25	4085.97	91.98	212.50	6126	7551
150	1913.33	2098.10	735.97	1065.72	93.60	81.50	2743	3245
155	677.09	790.78	60.33	171.53	40.03	59.93	777	1022
160	177.60	218.46	21.03	52.42	27.73	19.55	226	290
165	43.67	43.84	0.00	0.00	0.00	0.00	44	44
170	7.78	2.50	0.00	0.00	0.00	0.00	8	3

Table 6. Finfish Bycatch (All Trips Combined)

	Catch by 3.5" Rings	Catch by 4.0" Rings	Relative Catch
Yellowtail Flounder	3047	3048	0.0%
Yellowtail <30 cm	316	142	-55.1%
Witch Flounder (Gray Sole)	151	151	0.0%
Witch <35 cm	18	7	-61.1%
American Plaice	84	83	+1.2%
Plaice <35 cm	38	26	-31.6%
Winter Flounder (Blackback)	86	81	-5.8%
Monkfish (Goosefish)	971	992	+2.2%
Red Hake	479	395	-17.5%
Silver Hake	1119	944	-15.6%
Windowpane	275	288	+4.7%
Fourspot Flounder	1259	921	-26.8%
Sculpin	753	459	-39.0%
Sea Raven	84	62	-26.2%
Skates	11971	11525	-3.7%

Table 7. 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
Closed Area II	8.22	5.69	2.53	0	30.8%
Hudson Canyon	6.46	4.72	1.74	0.0001	26.9%
Closed Area I	4.87	4.08	0.79	0.0015	16.2%