

**COMPARISON OF CATCH AND BYCATCH
WITH THE ADDITION OF ESCAPE HOLES
TO OTTER TRAWL NETS
IN THE NORTHEAST SHRIMP FISHERY**

A report to

Northeast Consortium

**Bill Lee
Melissa Hall
Allan Michael**

**Cape Ann Fisheries Institute
25 Pleasant St
Rockport MA 01966**

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Abstract

Small escape holes made from cut pieces of 6-inch PVC pipe were sewn into the net in front of the Nordmore grate in a standard shrimp net used in the northeast fishery. Preliminary tests had provided video of fish escaping through these holes during active trawling. A series of tows, with and without these holes in the nets were made from the vessels the Ocean Reporter and the Marina Rose. Seven other participating boats from Rockport, Massachusetts and Hampton, New Hampshire towed standard gear at the same time and in the same general area. Catch and bycatch was weighed and identified to provide a direct quantitative comparison of the percentage bycatch with and without the escape holes.

Mean catch rate for vessels using nets without rings was 235.5 lbs shrimp/hr with a bycatch rate of 16.7 lbs/hr or 6.6%. For the two vessels with escape rings installed in the nets, the catch rate was 228.6 lbs shrimp/hr with a bycatch of 27.5 lbs/hr or 10.7 %. The data was confounded by the large variation in bycatch rates among vessels and the limited number of tows. The experimental vessels encountered schools of pelagics (whiting or herring) on some days which heavily influenced results. One vessel, the Marina Rose appeared to show a significant reduction in bycatch rate from 19.4% without the rings to 9.4% with the escape rings installed. The other vessel, the Ocean Reporter had a bycatch rate of 7.5% without rings and 11.3% with the rings. A high catch of pelagics on several days during the tests with rings influenced results from this vessel.

A further complication to the study was a discrepancy in bycatch rates between vessels operating out of Hampton, New Hampshire and those out of Rockport, Massachusetts. The New Hampshire vessels had lower overall bycatch rates, which could be due to the area trawled, or performance of the gear. A similar study in the previous year had documented a lower catch of pelagics by the New Hampshire vessels. Future studies should involve a larger number of tows from one or two vessels.

LIST OF FIGURES

	<u>Page</u>
1. Shrimp net with escape rings.....	5
2. Catch and Bycatch Comparison with and without rings.....	9
3. Catch, Bycatch and Bycatch Composition of Otter Trawl Fleet.....	10
4. Daily Catch and Bycatch Composition of Ocean Reporter without rings.....	11
5. Daily Catch and Bycatch Composition of Ocean Reporter with rings.....	12
6. Daily Catch and Bycatch Composition of Marina Rose without rings.....	13
7. Daily Catch and Bycatch Composition of Marina Rose with rings.....	14
8. Daily Catch and Bycatch Composition of Ellen Diane.....	15
9. Daily Catch and Bycatch Composition of Lady Elaine.....	16
10. Daily Catch and Bycatch Composition of Lady Regina.....	17
11. Daily Catch and Bycatch, Muktuk.....	18
12. Daily Catch and Bycatch Composition Rhumboogie.....	19
13. Daily Catch and Bycatch Composition of Special K.....	20
14. Comparison of Catch and Bycatch of New Hampshire and Massachusetts Vessels	22
15. Seasonal Comparison of Catch and Bycatch	23

TABLES

1. Daily Catch and Bycatch by Vessel.....	8
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Objectives

For the past several years Captain Bill Lee has been involved in a variety of studies videotaping fish behavior inside nets and cod ends. During the last 12 months he experimented with the installation of small lateral holes in a standard otter trawl used for to catch shrimp. These holes were made from cut pieces of standard 6-inch PVC pipe and sewn into the net in front of the grate. Fish, including those that would pass through the grate, react to the grate as they come out of the funnel, turn around and start swimming at the same speed as the net. Videos clearly show fish swimming along in front of the grate and out these escape vents (see Figure 1). Vents of differing colors were tried. Fish did not respond to green or grey colored rings but reacted positively to white colored vents to get outside the net (see photographs included). The object of this study was to compare the bycatch rates in nets with and without escape rings in normal fishing activities during the shrimp season.

Participants

Captain Bill Lee
25 Pleasant St.
Rockport MA 01960
oceanreporter@adelphia.net

Melissa Hall, B.S.
16 Laurel Lake Rd.
Royalston Ma 01368
melis4ro@earthlink.net

Allan Michael, Ph.D.
ADM Associates
5 Field Rd.,
Magnolia Ma 01930
admichael@adelphia.net

Captain/ Fishing Vessel

Bob Fisher – Marina Rose

Dennis O,Connell – Lady Elaine

Domenic Pike – Muktuk

Jack Ketchopulos – Special K

David Goethel – Ellen Diane

Jack Pollison – Rhumboogie

Paul Sargent – Joyce Marie

George Littlefield – Lady Regina

Methods

Rings from white PVC pipe were cut and installed in a standard otter trawl used to catch shrimp (Figure 1). This net was used in the normal commercial fishing mode. For each trawl (typically 2 - 3 hours) the location, depth, speed and duration of tow was recorded. At the end of each tow, the catch (lbs) of shrimp was evaluated and the bycatch identified, and weighed. Other vessels performed commercial shrimp operations in the same area at the same time using the standard otter trawl currently used by the fleet. Captains were offered a nominal fee to report catch and bycatch in the same manner. The data was converted into catch per unit effort and a

comparison made, between the two trawls on catch rates and relative amounts and types of bycatch. A biologist met with respective captains to provide them with data sheets and instructions on the collection of data. These vessels operated in the same general area of Ipswich Bay and, in many cases, on the same day(s) as the Ocean Reporter.

Most tows were made in an area off Rockport Massachusetts at depths ranging from 56 to 76 meters. Three vessels out of Hampton, New Hampshire reported their catch from a little further north for a total of 13 boat/days. Average tow duration and speed for the fleet using the otter trawl was 2.2 hrs at 2.5 knots. On the Ocean Reporter, the trawl was towed at speeds from 2.5 – 3.0 knots for an average of 1.6 hours.

The data was summarized at ADM Associates, converted to catch-per-hour towed, and examined for differences in catch rates of shrimp and bycatch. Bycatch was separated into three categories; groundfish (hake, skates, flounders etc), pelagic fish (herring, whiting) and others (invertebrates such as starfish, crabs and scallops)

Results

Rings vs. no rings

A total of 9 fishing vessels participated in the study, sampled on 17 days (53 boat-days) for a total of 250.8 hours and provided 40 data sheets. The average day included 4.7 hours of towing.

The Ocean Reporter and Marina Rose combined, using the modified net with rings, caught 9813 lbs of shrimp during the 15 days of trawling. Mean catch rate was 228.6 lbs shrimp per hour towed. Bycatch of fish and invertebrates was 1180 lbs or 12% of the shrimp catch and was caught at a rate of 27.5 lbs/hr. Other vessels towing the otter trawl were active on from 1 - 7 days and the total catches ranged from 1,080 to 11,570 lbs of shrimp (total 67,775 lbs) with a fleet average rate of 235.5 lbs /hr. Total bycatch varied from 7.7 to 2529 lbs (total 4796 lbs) with a mean of 16.7 lbs/hr. Bycatch weight was 10.7% of the shrimp catch (Table 1).

Table 1. Comparative Catch Rates of Trawls

Average shrimp catch – no rings = 235.5 lbs/hr

Average shrimp catch – rings = 228.6 lbs/hr

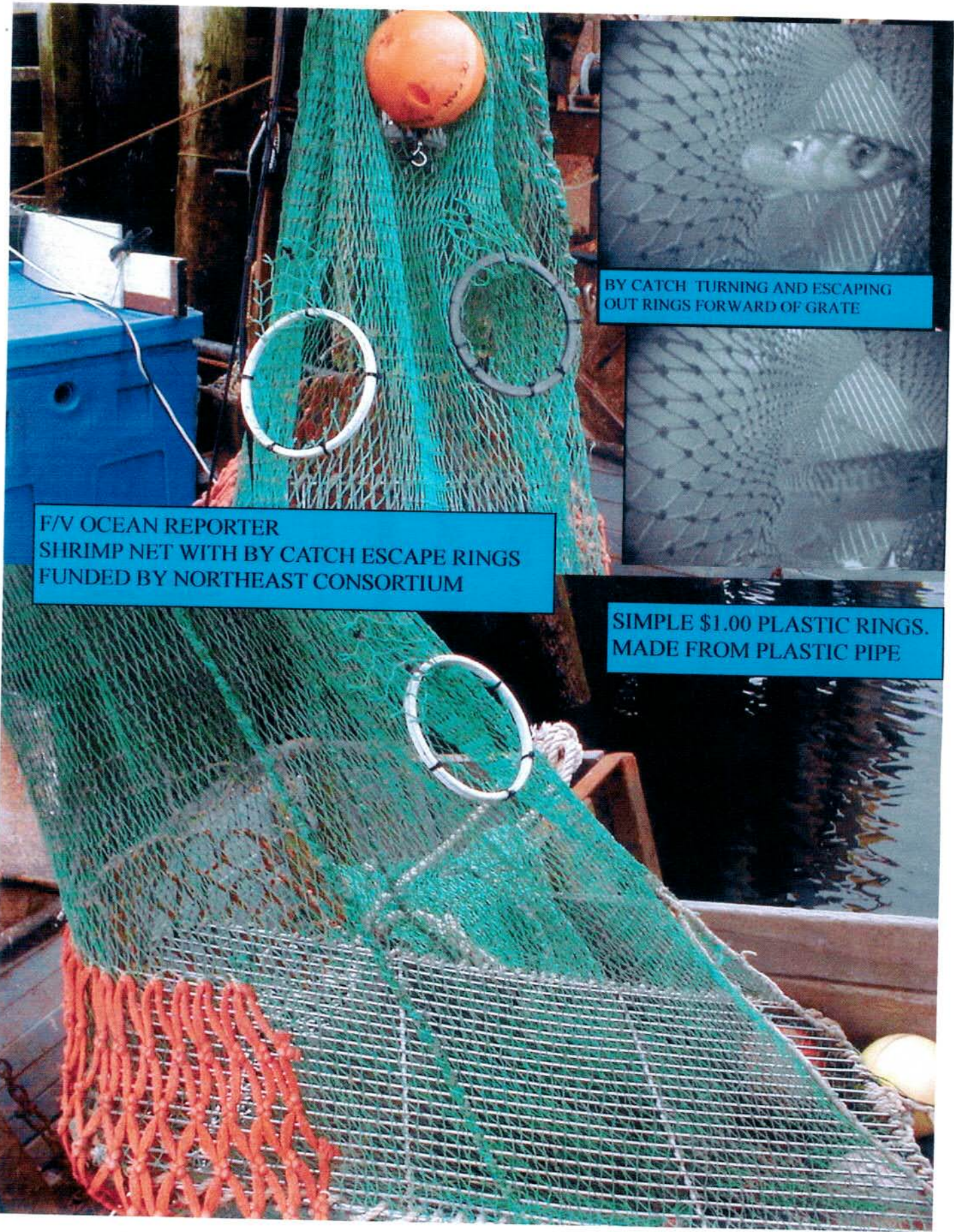
Average bycatch – no rings = 16.7 lbs/hr (6.6%)

Average bycatch – rings = 27.5 lbs/hr (10.7%)

Catch and bycatch varied considerably among vessels and from day to day for each vessel (Figures 3 - 13). A very large number of tows would be needed to identify statistically significant differences, something beyond the scope of this development project. Figure 2 indicates that shrimp catch on vessels without rings ranged from 71 to 444 lbs/hr while on the two vessels with rings, catch rates varied from 142 to 390 lbs/hr. Bycatch rates ranged from 15 to 21% for the standard nets while the nets with rings had bycatch rates of from 8 to 55%. The high bycatch rates for the tows with rings were heavily influenced by the catch of pelagics. The Ocean reporter and the Marina-Rose each encountered schools of pelagics (herring or whiting) during tows on one day and caught more bycatch than shrimp. If the data for three days when high pelagic catch occurred were excluded, the bycatch rate would be 13.4% for the Marina Rose, and 9.1% for the Ocean Reporter.

Other factors compound this investigation. One is that vessels working out of New Hampshire had significantly lower bycatch rates than the fleet from Rockport. This is evidenced in Figure 3 – 13 and was reported in the data from the previous year (2004) when a comparison of a beam trawl and otter trawls were made (Lee et al., 2005). The New Hampshire boats ranged from 0.3% – 2% bycatch while the Rockport fleet ranged from 3 to 19%. Two explanations were offered in the previous study. One is that the New Hampshire boats fish on a slightly different bottom type – presumed to be sandier, and the catch composition data shows much lower numbers of pelagics in the bycatch. Another possibility is that the trawl gear of some vessels might be inherently more suitable for avoiding bycatch.

Variation in mean bycatch rates between vessels was significant and ranged from 0.4% to 16.9% (Figure 6). Most vessels also showed changes in bycatch rates from day to day, which may be due to areas fished, movement of bycatch species or variations in the performance of the gear. Two vessels that reported very low bycatch rate were the Ellen Diane out of Hampton, NH (1.9 – 2.8% and Muktuk based out of the same port (0.2 – 0.5%). Variation in bycatch rate among vessels that fished out of Rockport showed a much wider range. The Lady Elaine reported a range of from 2% to 21% for bycatch over five days of fishing. In section of the data (Table 1) shows that the high bycatch rate on 2/28/2005 for this vessel was due to 230 lbs of pelagics



F/V OCEAN REPORTER
SHRIMP NET WITH BY CATCH ESCAPE RINGS
FUNDED BY NORTHEAST CONSORTIUM

BY CATCH TURNING AND ESCAPING
OUT RINGS FORWARD OF GRATE

SIMPLE \$1.00 PLASTIC RINGS.
MADE FROM PLASTIC PIPE

Figure 1. Shrimp net with escape rings

Table 1. Catch Results By Vessel

date	Boat Name	# of Tows	Time Towed	wt shrimp	wt shrimp/hr	wt by-catch	wt bycatch/hr	% bycatch	groundfish	other species	Pelagic
2/7/2005	Ellen Diane	4	8.90	2150	241.6	62	7.0	2.8%	14	15	33
2/8/2005	Ellen Diane	3	9.00	2000	222.2	38	4.2	1.9%	12	9	17
2/16/2005	Ellen Diane	3	6.10	2400	393.4	52	8.5	2.1%	12	15	25
2/18/2005	Ellen Diane	3	8.75	2525	288.6	55	6.3	2.1%	11	27	17
2/23/2005	Ellen Diane	4	8.95	2495	278.8	71	7.9	2.8%	23	29	19
	avg	3.40	8.34	2314.00	284.92	55.60	6.79	2.3%	14.40	19.00	22.20
	sum	17	41.7	11570	277.5	278	6.7	2.3%	72	95	111
2/9/2005	Joyce Marie	2	6.00	1080	180.0	42	7.0	3.7%	9.5	13	19.5
2/8/2005	Lady Elaine	1	4.50	350	77.8	65	14.4	15.7%	12	15	38
2/14/2005	Lady Elaine	1	3.00	850	283.3	28	9.3	3.2%			
2/18/2005	Lady Elaine	2	4.00	800	200.0	24	6.0	2.9%			
2/28/2005	Lady Elaine	2	5.50	900	163.6	233	42.4	20.6%	3	0	230
3/7/2005	Lady Elaine	2	7.50	1400	186.7	32.5	4.3	2.3%	6.5	0	26
	avg	1.60	4.90	860.00	182.28	76.50	15.29	8.2%	7.17	5.00	98.00
	sum	8	24.5	4300	175.5	382.5	15.6	8.2%	21.5	15	294
2/1/2005	Lady Regina	3	7.50	2250	300.0	10	1.3	0.4%	3	3.5	3.5
2/8/2005	Lady Regina	3	7.00	1175	167.9	9	1.3	0.8%	3	1	5
2/24/2005	Lady Regina	3	7.50	800	106.7	6.5	0.9	0.8%	2	1.5	3
2/28/2005	Lady Regina	3	7.50	1900	253.3	30.5	4.1	1.6%	4.5	5	21
	avg	3.00	7.38	1531.25	206.96	14.00	1.89	0.9%	3.13	2.75	8.13
	sum	12	29.5	6125	207.6	56	1.9	0.9%	12.5	11	32.5
1/4/2005	Marina Rose	1	2.00	600	300.0	100.5	50.3	14.3%	88	4.5	8
1/19/2005	Marina Rose	2	4.50	640	142.2	151	20.1	19.1%	117	5	29
2/1/2005	Marina Rose	3	4.60	1415	307.6	62	13.5	4.2%	48.5	11.5	2
2/8/2005	Marina Rose	3	4.50	900	200.0	154	34.2	14.6%	9	11	134
2/14/2005	Marina Rose	2	2.10	570	271.4	14	6.7	2.4%	2	5	7
2/28/2005	Marina Rose	4	2.50	140	56.0	526	210.4	79.0%	3.5	3.5	519
3/7/2005	Marina Rose	4	4.00	533	133.3	146.75	36.7	21.6%	14	5	127.75
	avg	2.71	3.46	685.43	201.50	164.89	53.12	19.4%	40.29	6.50	118.11
	sum	19	24.2	4798	198.3	1154.25	47.7	19.4%	282	45.5	826.75
2/9/2005	Marina Rose-R	3	4.4	1000	227.3	94	21.4	8.6%	5	0	89
2/14/2005	Marina Rose-R	1	2	330	165.0	15	7.5	4.3%	4	3	8
2/16/2005	Marina Rose-R	4	2	880	440.0	108.5	54.3	11.0%	6	65	37.5
2/18/2005	Marina Rose-R	3	2	218	109.0	36.5	18.3	14.3%	4.5	6.5	25.5
2/24/2005	Marina Rose-R	2	1.5	380	253.3	36.75	24.5	8.8%	4.5	6.5	25.75
	avg	2.60	2.38	561.60	238.92	58.15	25.17	9.4%	4.80	16.20	37.15
	sum	13	11.9	2808	236.0	290.75	24.4	9.4%	24	81	185.75
2/1/2005	Muktuk	3	9.00	2100	233.3	10	1.1	0.5%	10	0	0
2/8/2005	Muktuk	3	8.40	2000	238.1	7	0.8	0.3%	7	0	0
2/16/2005	Muktuk	3	7.50	2200	293.3	5	0.7	0.2%	5	0	0
2/23/2005	Muktuk	3	7.50	1900	253.3	3	0.4	0.2%	3	0	0
	avg	3.00	8.10	2050.00	254.52	6.25	0.75	0.3%	6.25	0.00	0.00
	sum	12	32.4	8200	253.1	25	0.8	0.3%	25	0	0
2/16/2005	Ocean Reporter	4	2.50	850	340.0	82.5	33.0	8.8%	22.5	40	20
2/18/2005	Ocean Reporter	4	4.10	1000	243.9	56	13.7	5.3%	18	13	25
2/24/2005	Ocean Reporter	2	1.50	330	220.0	31.5	21.0	8.7%	10	12	9.5
3/25/2005	Ocean Reporter	1	2.00	650	325.0	60	30.0	8.5%	18	1	41
	avg	2.75	2.53	707.50	282.23	57.50	24.41	7.5%	17.13	16.50	23.88
	sum	11	10.1	2830	280.2	230	22.8	7.5%	68.5	66	95.5
1/4/2005	Ocean Reporter-R	2		1100	na	132	na	10.7%	126.5	5.5	
1/19/2005	Ocean Reporter-R	2	3.25	700	215.4	81	24.9	10.4%	34	11	36
2/1/2005	Ocean Reporter-R	3	3.6	1600	444.4	76	21.1	4.5%	39	13	24
2/8/2005	Ocean Reporter-R	3	4.5	820	182.2	99.25	22.1	10.8%	43	17	39.25
2/9/2005	Ocean Reporter-R	3	3.4	1050	308.8	62	18.2	5.6%	24	14	24
2/14/2005	Ocean Reporter-R	3	4.1	750	182.9	80	19.5	9.6%	42.5	25.5	12
2/28/2005	Ocean Reporter-R	2	1.03	95	92.2	176	170.9	64.9%	3.5	3.5	169
2/28/2005	Ocean Reporter-R	2	1.47	130	88.4	94	63.9	42.0%	8	6	80
3/7/2005	Ocean Reporter-R	4	4	570	142.5	53	13.3	8.5%	20	14	19
3/8/2005	Ocean Reporter-R	1	2.67	190	71.2	36	13.5	15.9%	13	11	12
	avg	2.50	3.11	700.50	192.01	88.93	40.82	11.3%	25.22	12.78	46.14
	sum	25	28.02	7005	250.0	889.25	31.7	11.3%	353.5	120.5	415.25
1/10/2005	Rhumboogie	2	5.00	1975	395.0	55	11.0	2.7%			
1/13/2005	Rhumboogie	2	5.00	1351	270.2	85	17.0	5.9%			
2/8/2005	Rhumboogie	2	5.50	1200	218.2	95	17.3	7.3%	0	50	45
2/9/2005	Rhumboogie	2	5.50	1750	318.2	65	11.8	3.6%	0	25	40
	avg	2.00	5.25	1569.00	300.39	75.00	14.27	4.6%	0.00	37.50	42.50
	sum	8	21	6276	298.9	300	14.3	4.6%	0	75	85
2/8/2005	Special K	2	6.50	1000	153.8	25.7	4.0	2.5%	2.2	0	23.5
2/14/2005	Special K	1	3.00	1400	466.7	8	2.7	0.6%	1	0	7
2/16/2005	Special K	1	3.00	1600	533.3	15	5.0	0.9%	2	0	13
2/18/2005	Special K	2	5.00	750	150.0	39.5	7.9	5.0%	2	6	25.5
2/23/2005	Special K	1	4.00	400	100.0	54.3	13.6	12.0%	6.5	23	24.8
	avg	1.40	4.30	1030.00	280.77	28.50	6.62	2.7%	2.74	5.80	18.76
	sum	7	21.5	5150	239.5	142.5	6.6	2.7%	13.7	29	93.8

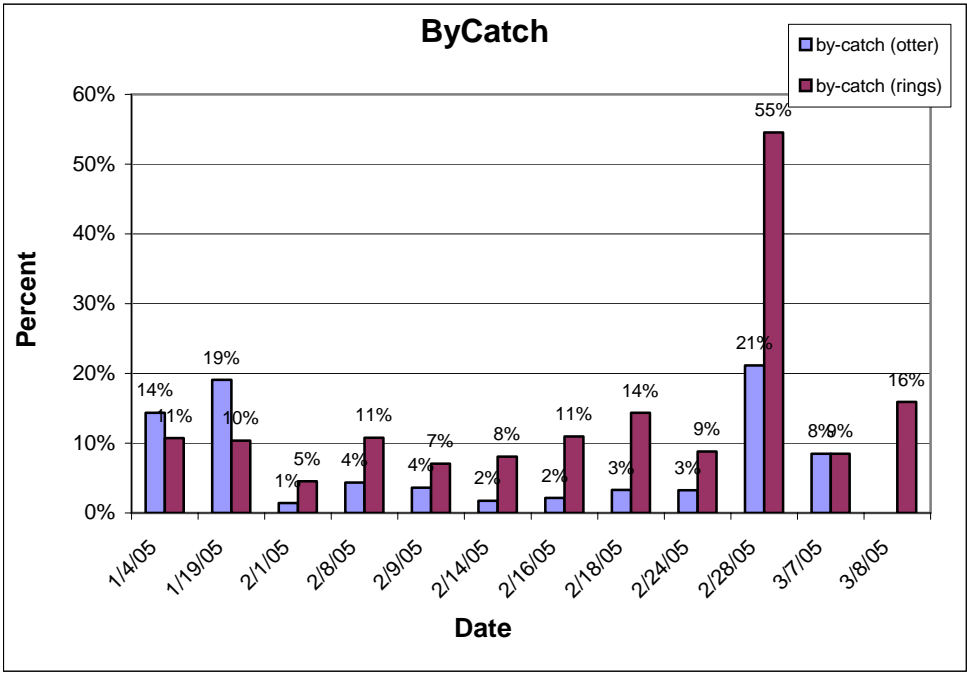
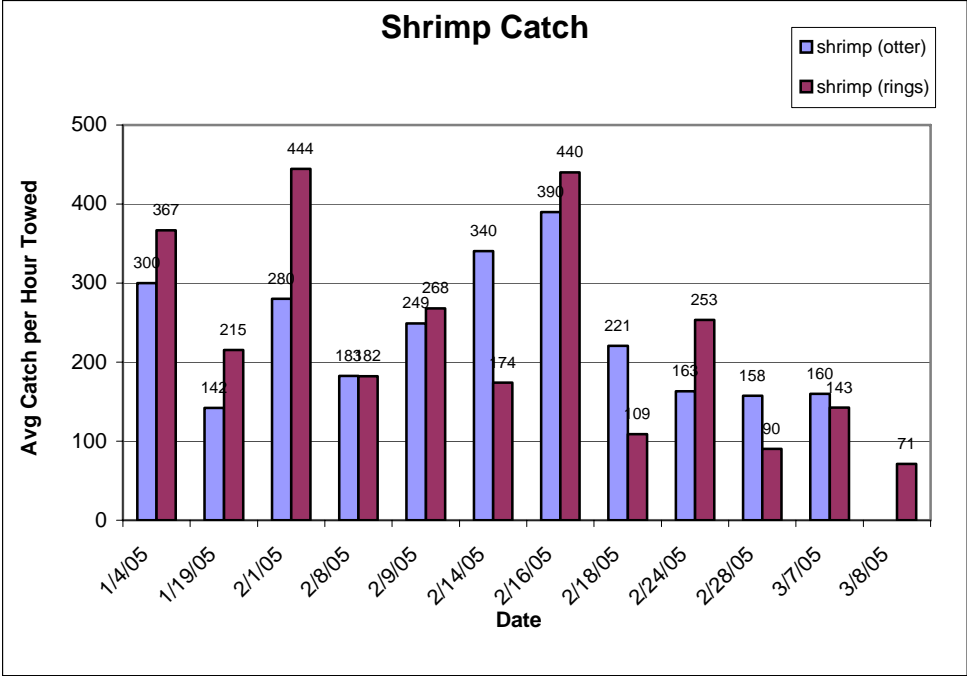


Figure 2: Daily Fleet Catch and Bycatch Comparison with and without Rings

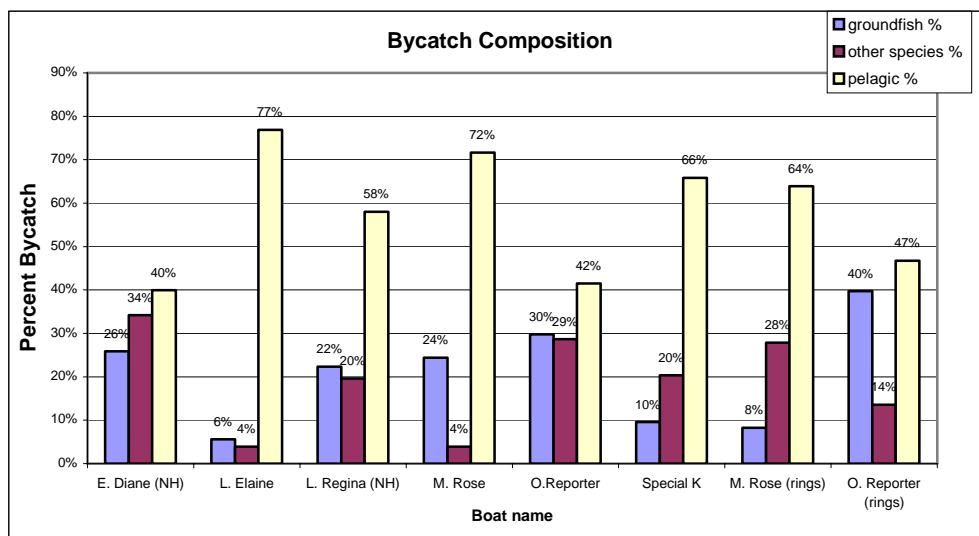
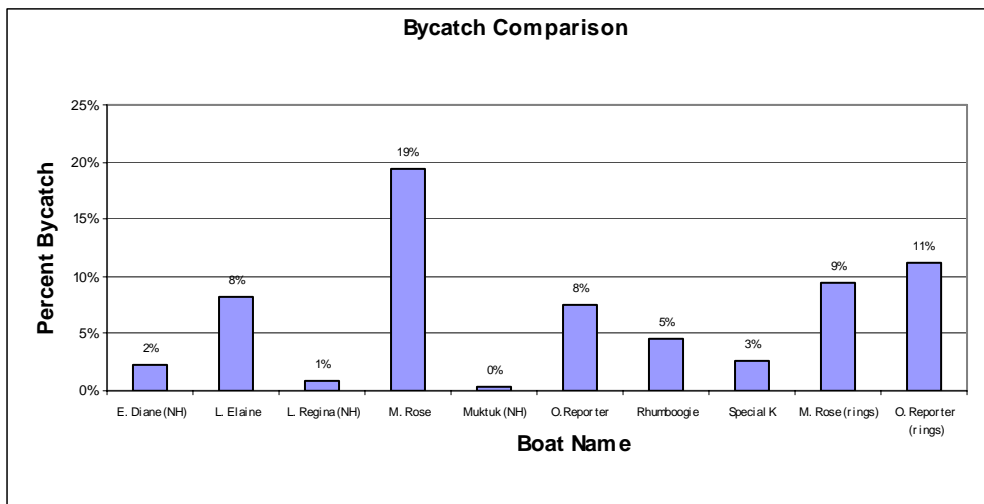
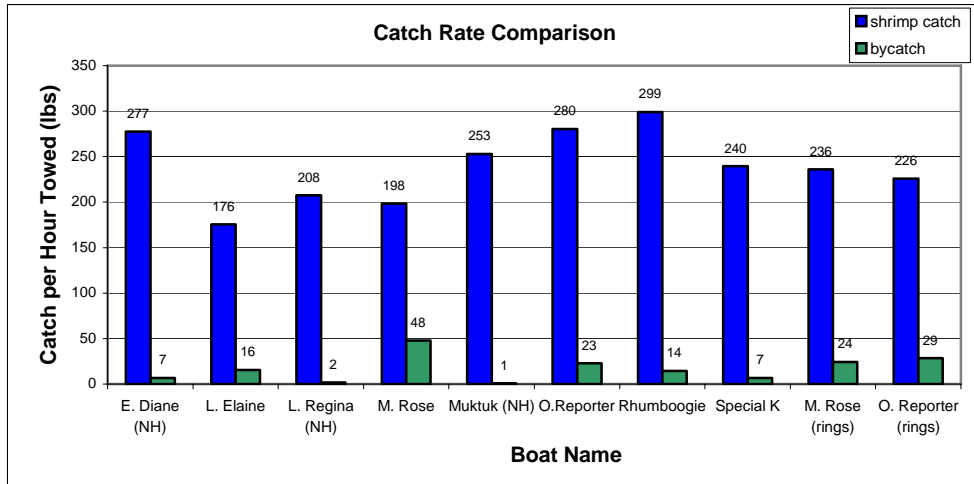


Figure 3: Catch, Bycatch and Bycatch Composition of Otter Trawl Fleet

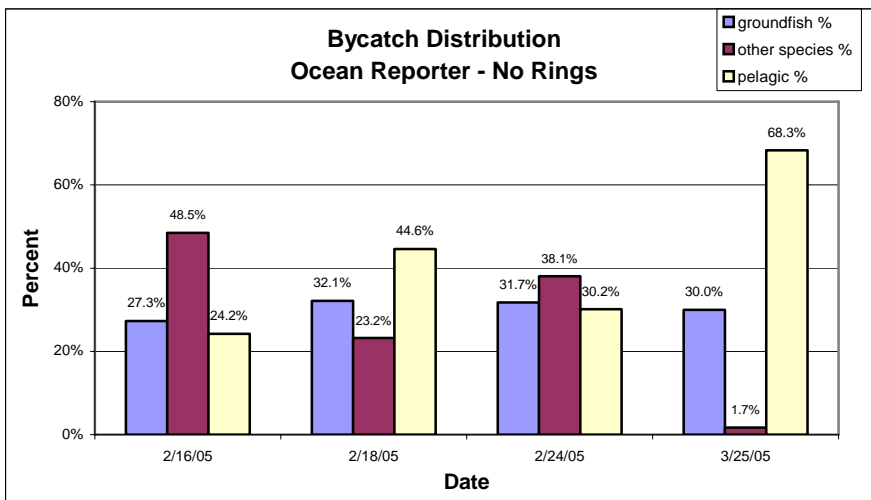
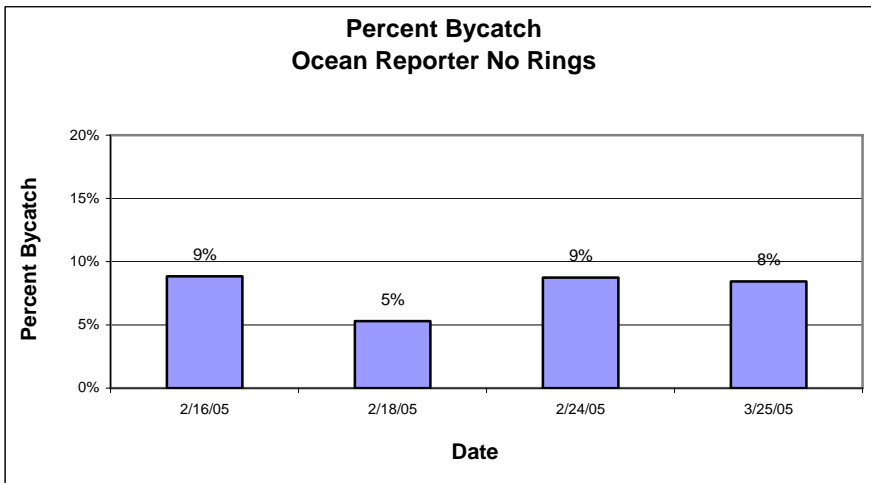
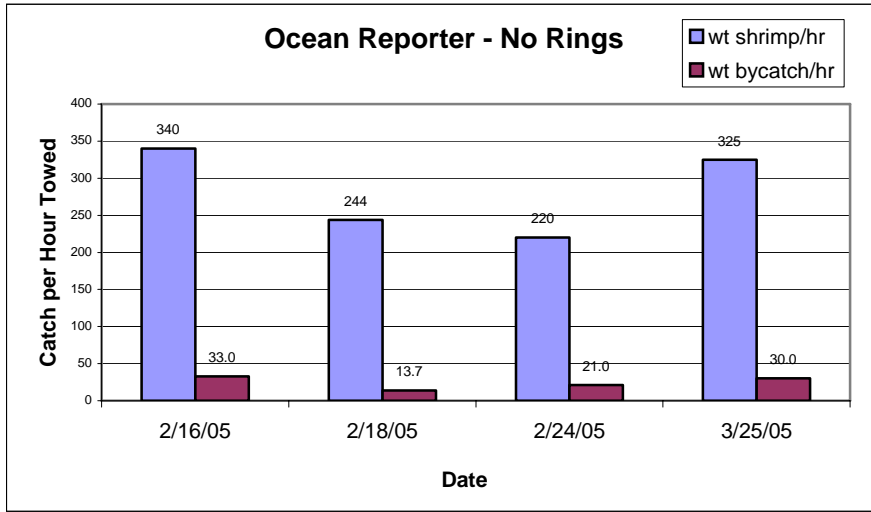


Figure 4: Daily Catch and Bycatch Composition of Ocean Reporter without escape rings

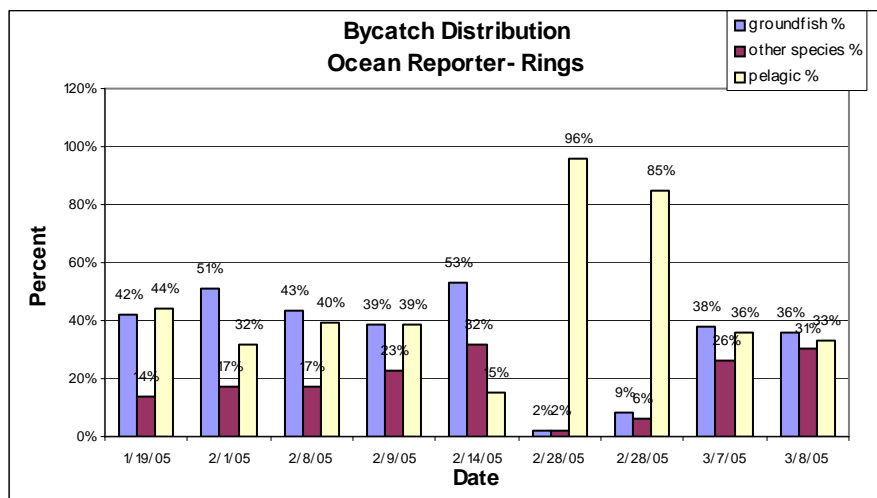
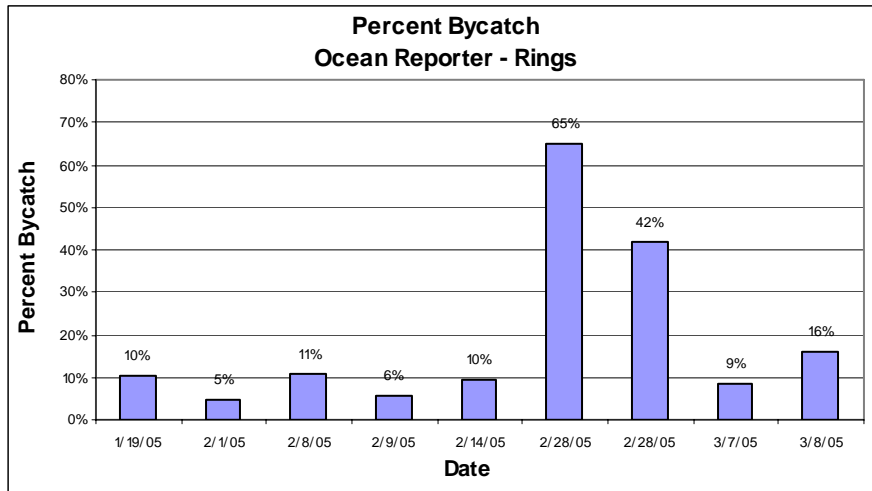
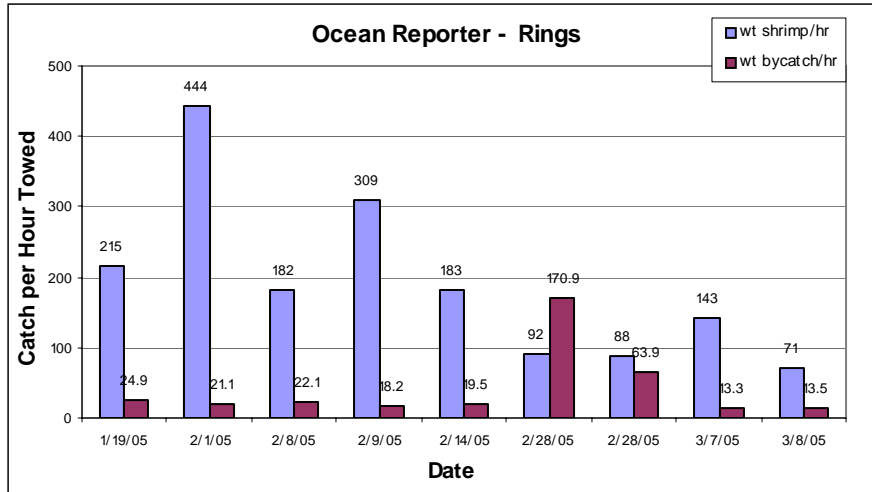


Figure 5: Daily Catch and Bycatch Composition of Ocean Reporter with escape rings

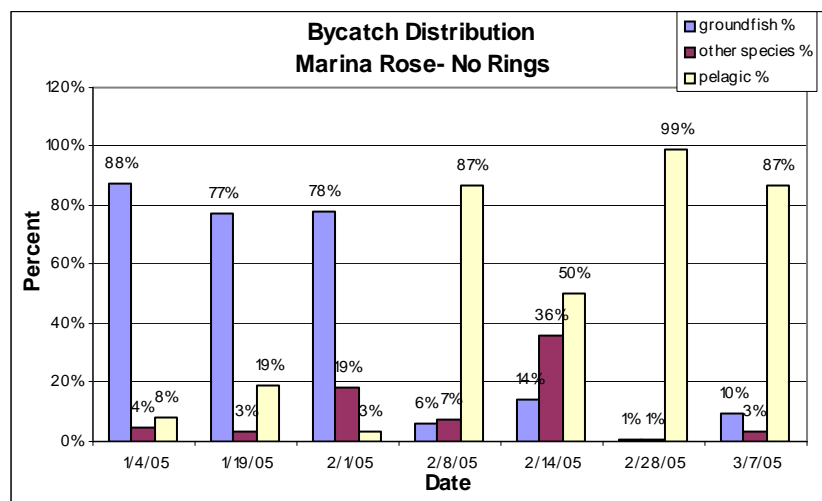
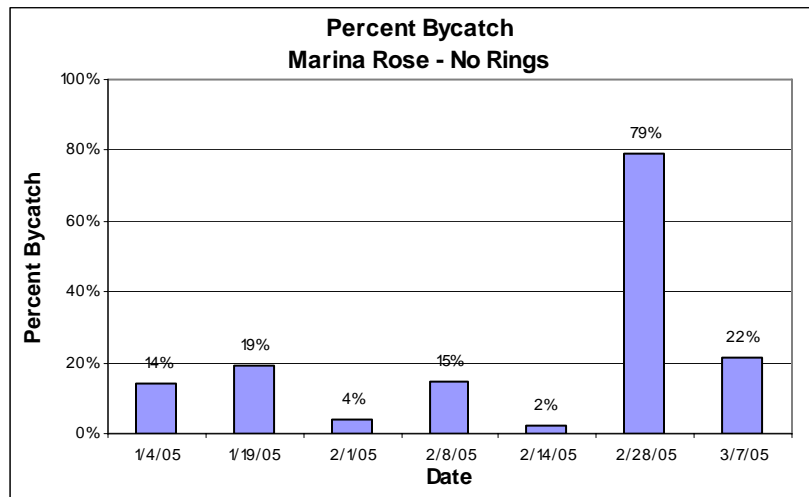
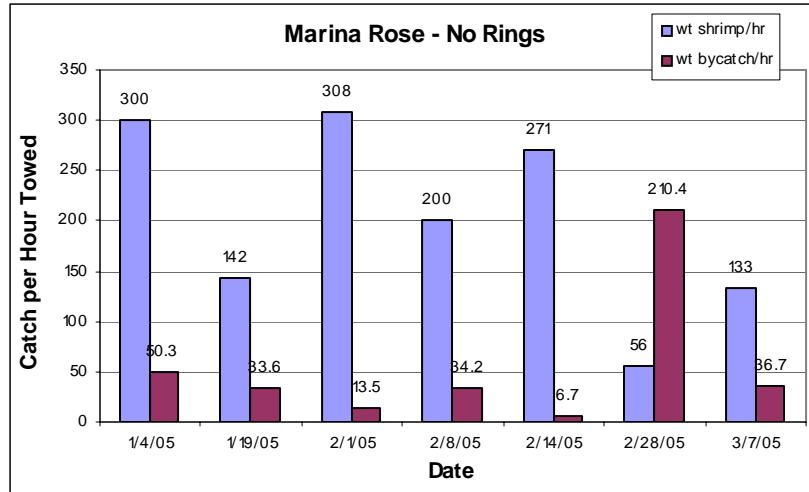


Figure 6: Daily Catch and Bycatch Composition of Marina Rose without escape rings

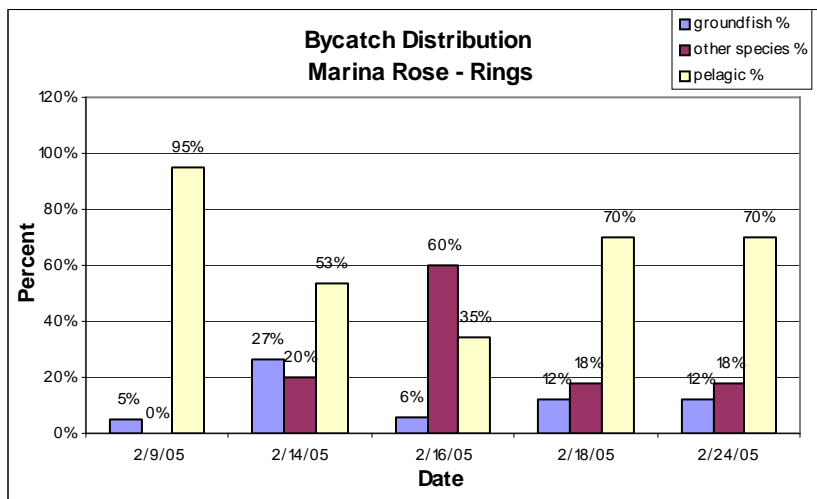
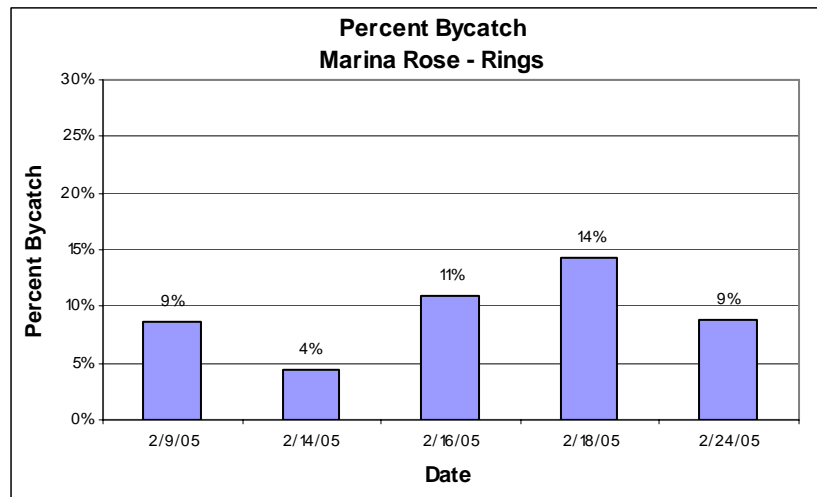
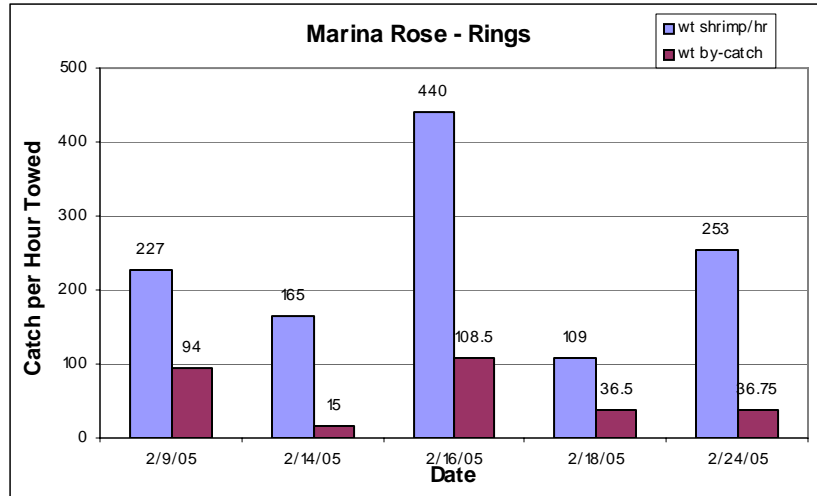


Figure 7: Daily Catch and Bycatch Composition of Marina Rose with escape rings

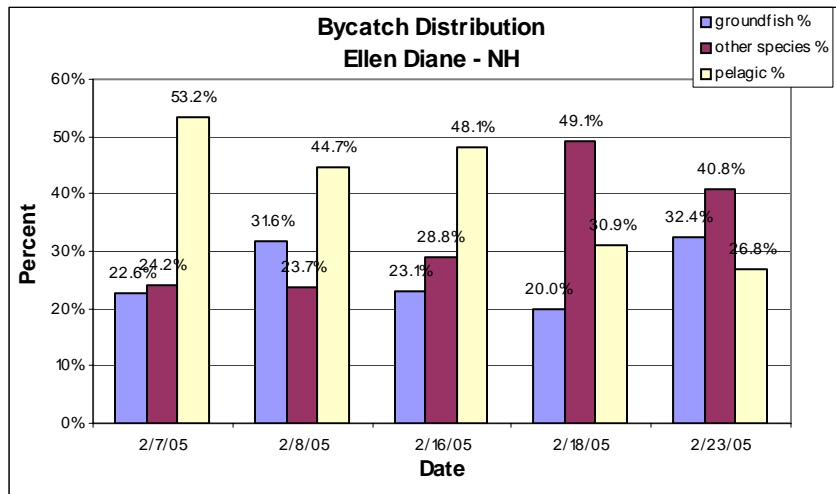
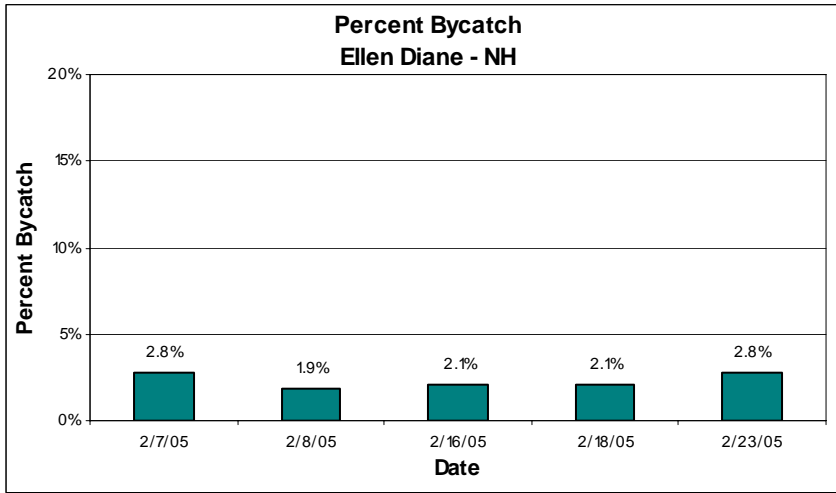
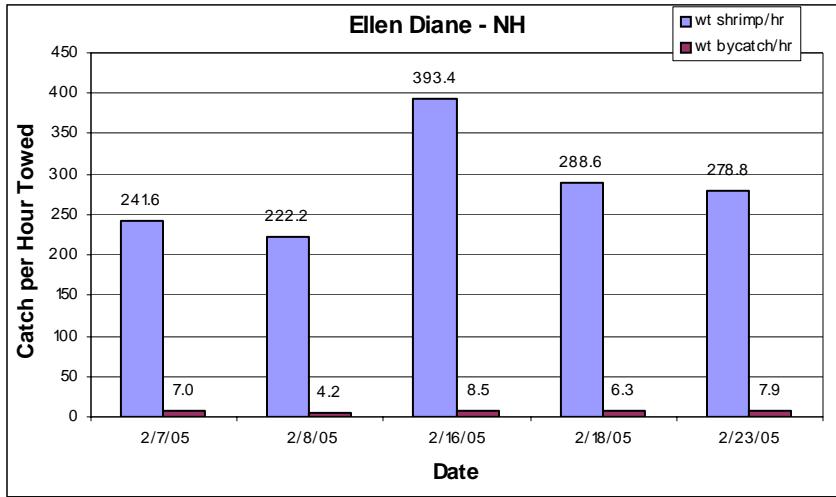


Figure 8: Daily Catch and Bycatch Composition of Ellen Diane

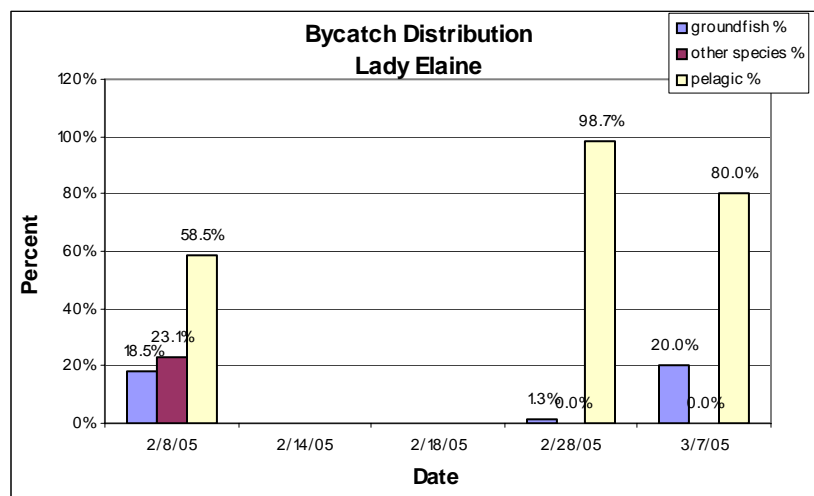
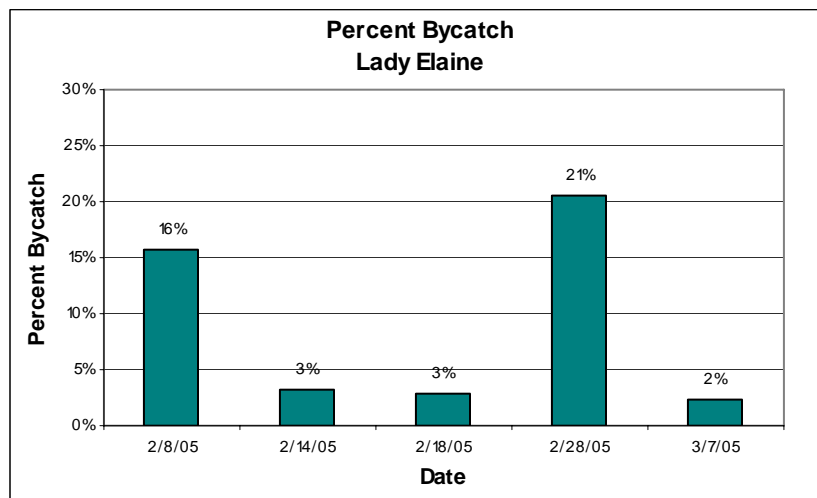
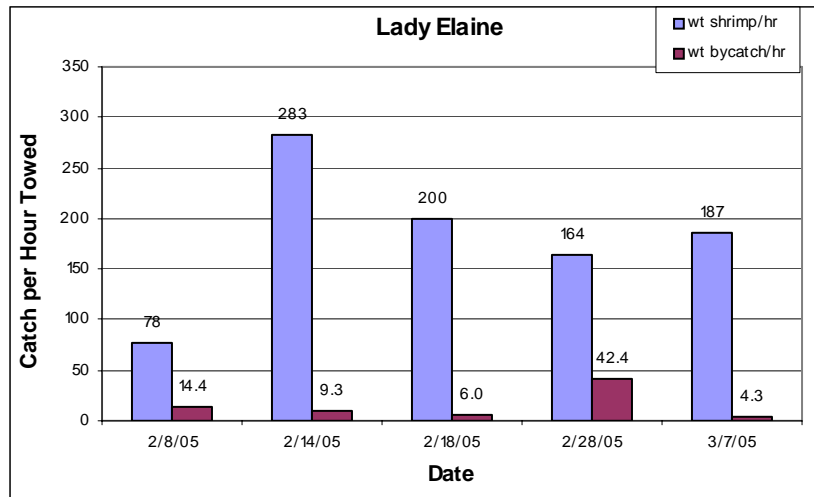


Figure 9: Daily Catch and Bycatch Composition of Lady Elaine

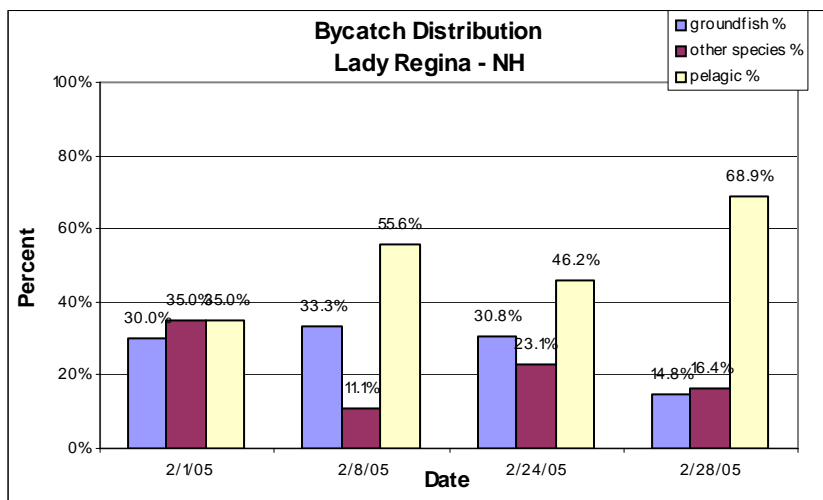
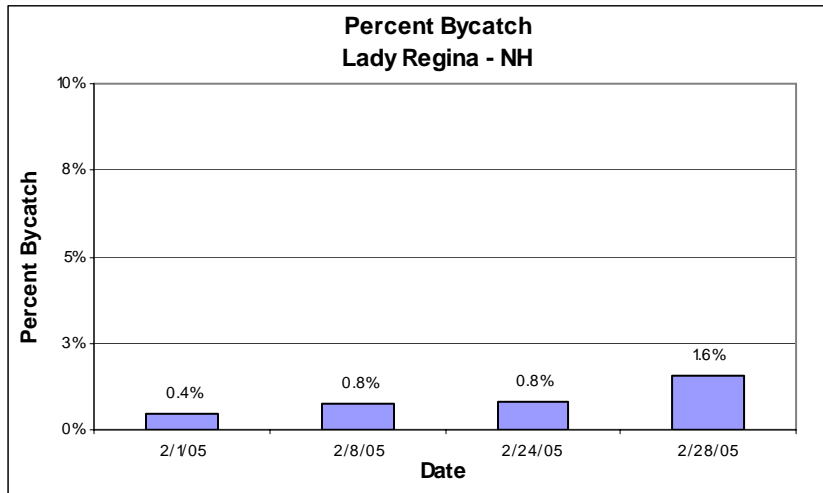
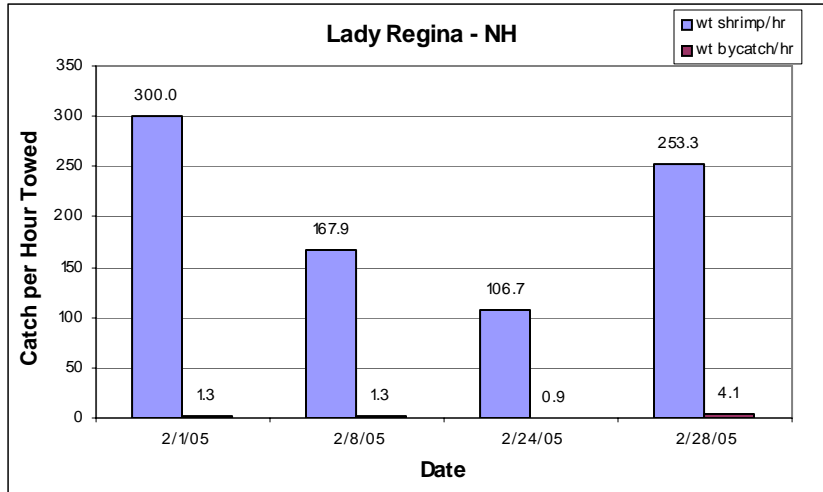


Figure 10: Daily Catch and Bycatch Composition of Lady Regina

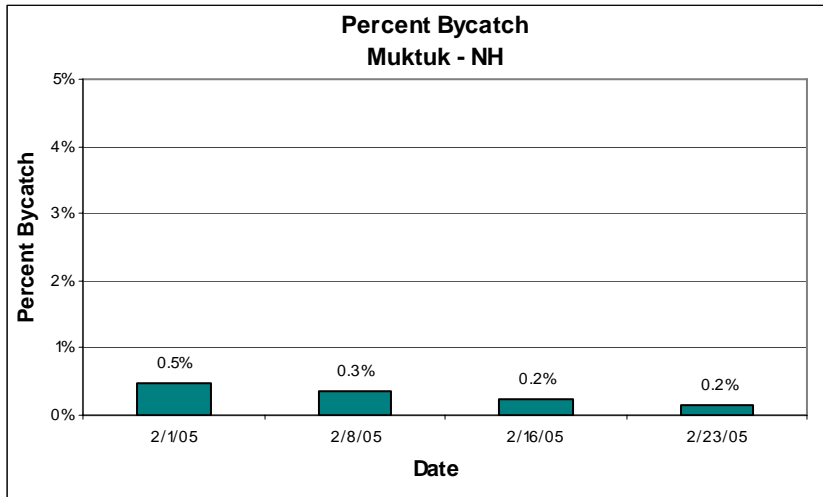
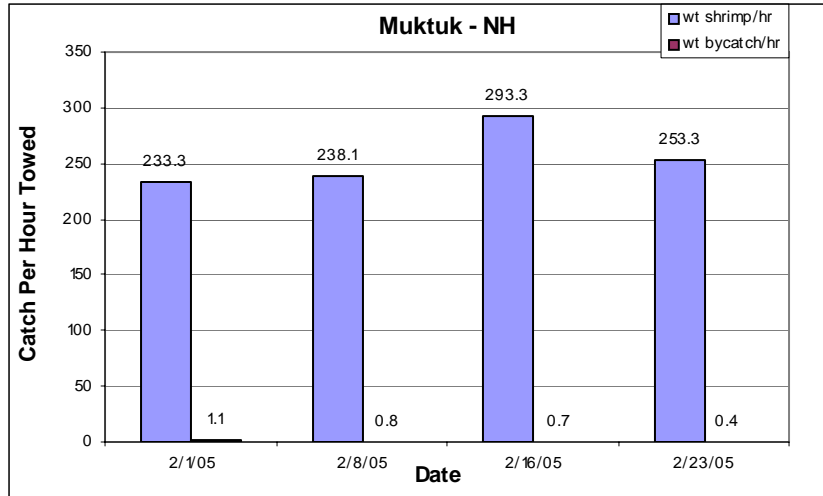


Figure 11: Daily Catch and Bycatch of Muktuk

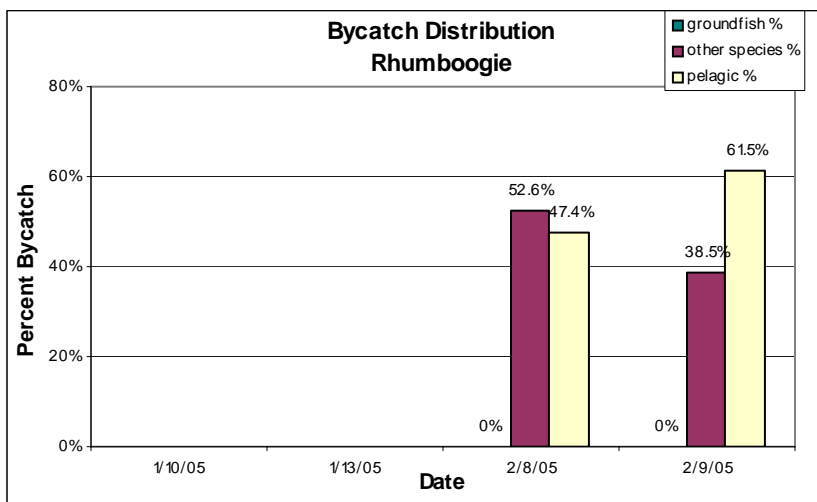
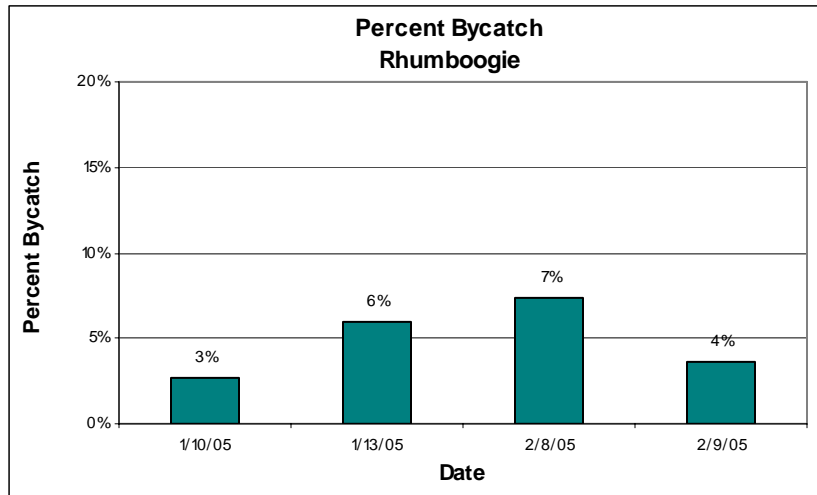
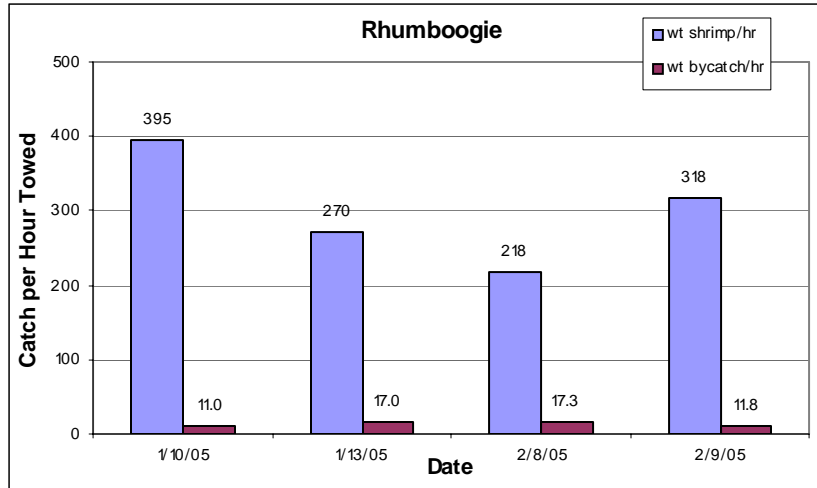


Figure 12: Daily Catch and Bycatch Composition of Rhumboogie

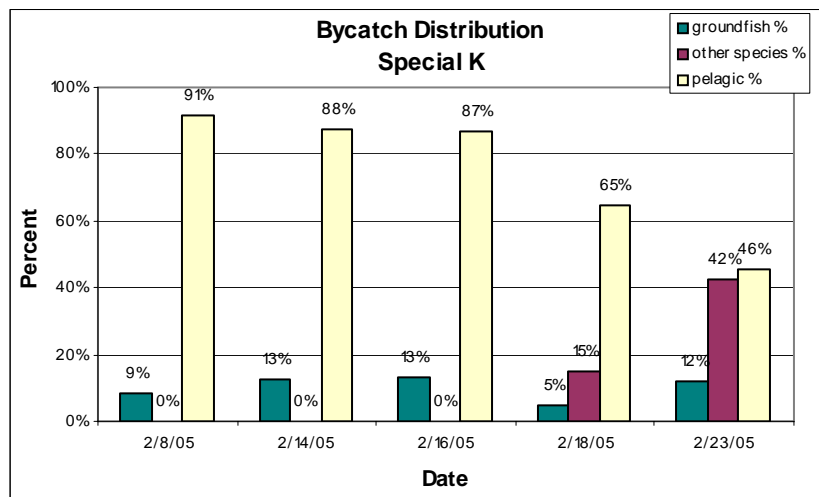
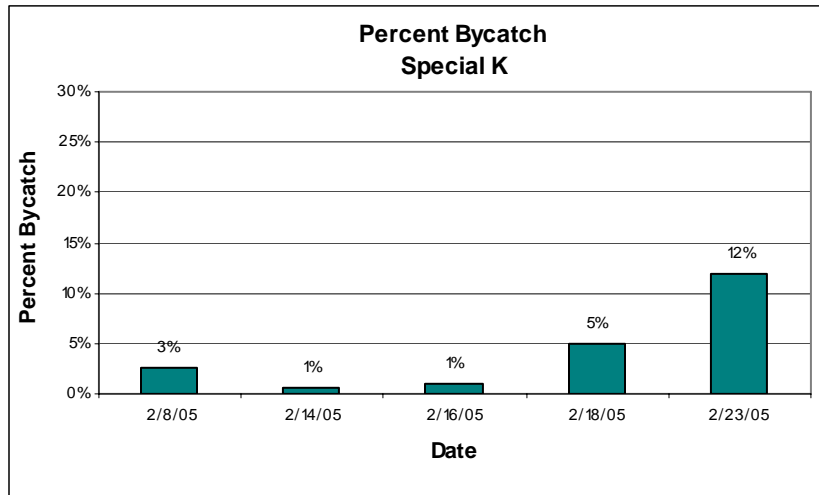
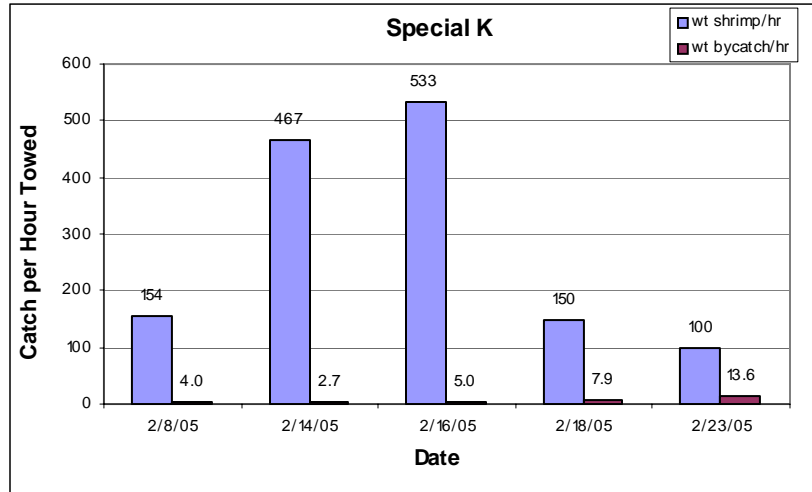


Figure 13: Daily Catch and Bycatch Composition of Special K

Composition of Bycatch

For both the nets with and without escape rings the primary bycatch was pelagics (whiting and herring) which comprised from 40 to 77% of the total. Overall, there were similar amounts of groundfish and others (invertebrates such as crabs, starfish etc.) in the bycatch of the fleet during the study period (6 – 40% for groundfish and 4 – 34% for others). Figures that appear to show high levels of groundfish (e.g. Figure 6; Marine Rose without rings) were based on low overall bycatch rates (4 – 19%).

Geographical Factors

Five of the otter trawl vessels fished with the Ocean reporter in a relatively small area just to the north of Rockport Massachusetts. Three vessels based in Hampton, New Hampshire, fished further north in Ipswich Bay. While these vessels fished on a total of just 13 boat/days there was a marked difference in the bycatch rate (Figure 14). Bycatch for the three New Hampshire vessels (Ellen Diane, Lady Regina and Muktuk) was extremely low (0.2 – 2.8%). There was insufficient data to determine whether the lower bycatch off the New Hampshire coast was due to performance of the gear, or the habitat (bottom type) in the area trawled. The large numbers of pelagics (whiting, herring), which were encountered in a few tows by the boats out of Rockport, were not found during the 42.4 hours of trawling (total) by the New Hampshire vessels. The largest weight of bycatch caught in one day among the New Hampshire boats was 62 lbs after 8.9 hrs of towing when 2,150 lbs of shrimp was hauled in. In contrast, the Rockport boat Marina Rose had 151 lbs of bycatch to 640 lbs of shrimp on one occasion and the Lady Elaine had 233 lbs of bycatch with 900 lbs of shrimp on another. This pattern was seen in the previous study with these boats which involved a comparison of a beam trawl with otter trawls in shrimp fishing (Lee et al., 2005.)

Seasonal Factors

Data was separated based on months to determine whether any trends could be found with respect to catch or bycatch (Figure 15). Bycatch rates varied from 4% in January to 8% in March for the otter trawl fleet, and for the net with rings, from 8% in January, 12% in February, to 10% in March. These differences are not significant due to the small numbers of samples. Shrimp catch for the fleet without escape rings declined from 275 lbs/hr in January to 191 lbs/hr in March. On the two vessels using the escape rings, catch rate was 345 lbs/hr in January and dropped to 114 lbs/hr in March. The decline in shrimp landings per hour towed through the period is probably due to the seasonal movement of shrimp in and out of the region.

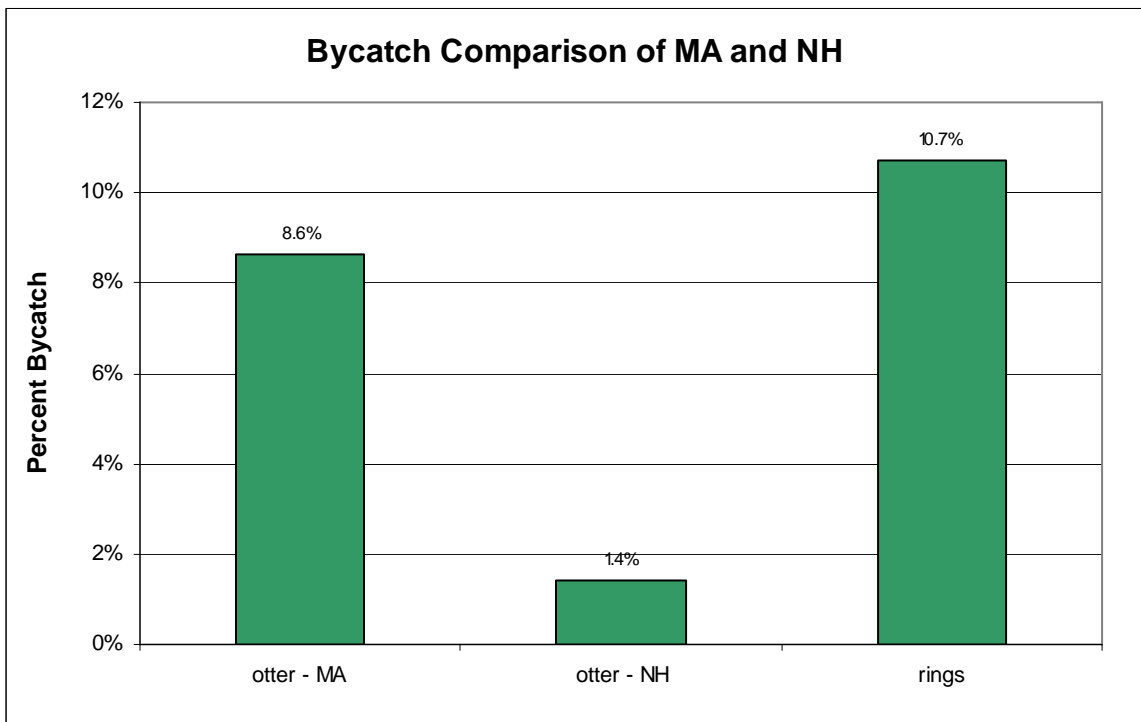
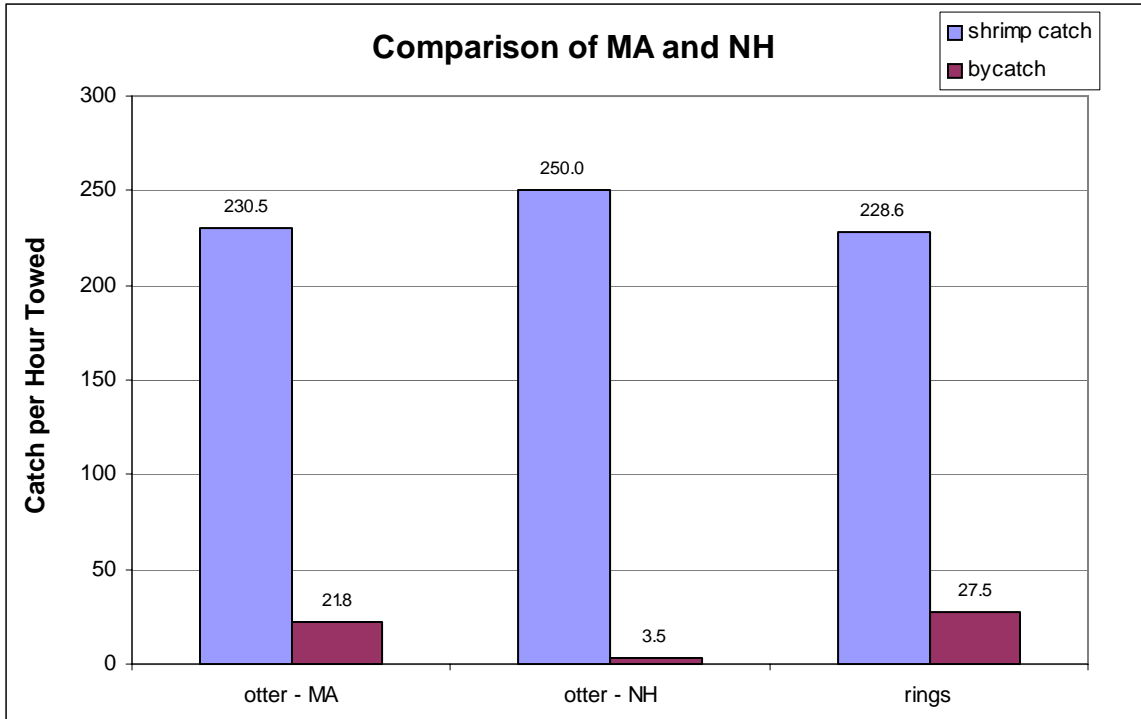


Figure 14: Comparison of Catch and Bycatch for New Hampshire and Massachusetts Vessels

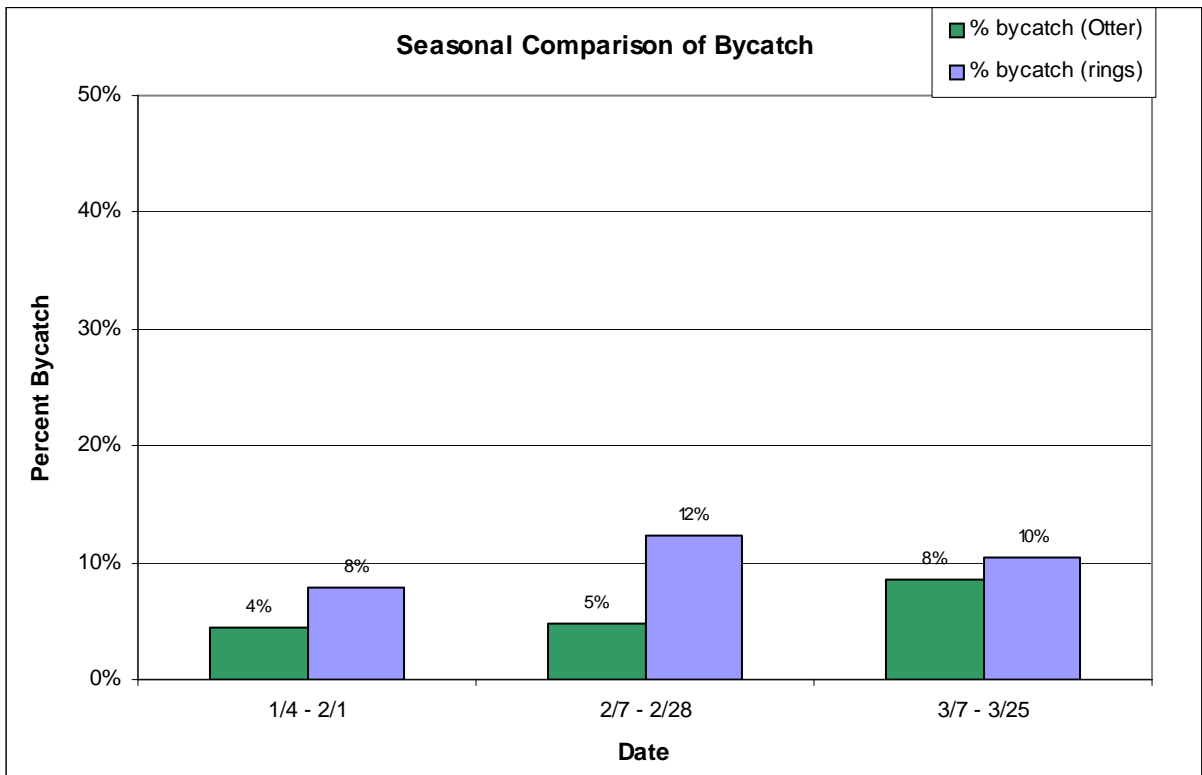
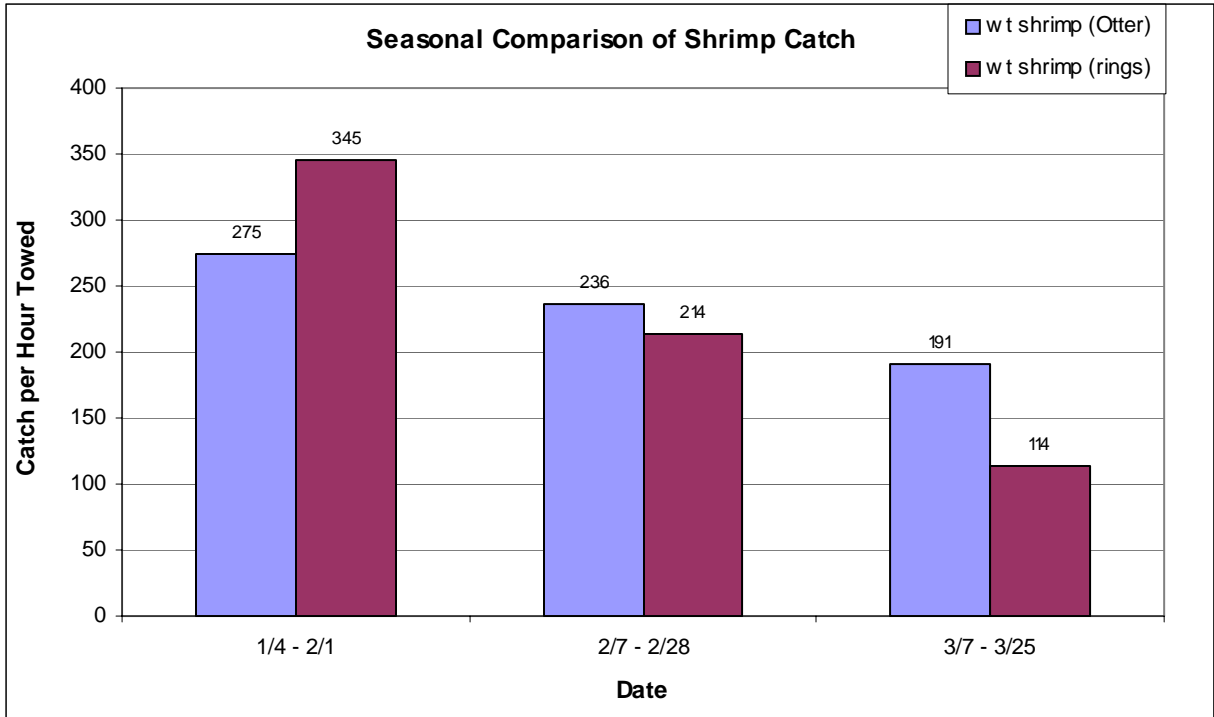


Figure 15: Seasonal Comparison of Catch and Bycatch

Project Comments – Captain Bill Lee

Unlike the study in 2004 with the beam trawl, where fishermen were eager to participate, there was more reluctance to fill out catch reports and some captains chose to not participate at all. Others would only fill out 5 slips so they would not receive a 1099. There was widespread thought that the bycatch reports would be used to reduce the allowable shrimp catch.

Due to the lack of participants, Captain Bob Fisher on the F/V Marina Rose was hired to do side-by-side comparisons for several days. In spite of the fact that a lot of bycatch was caught on the Ocean Reporter, I still feel that the escape rings still have potential in all fisheries and warrant further investigation. The size of this study did not allow for all of the adjustments necessary to really give the rings a chance to work. The bycatch reduction with rings on the Marina Rose appeared to be significant.

In the short amount of time we observed them, it is clear that the color of the rings was a contributing factor. Fish responded more to the white rings in deep water, suggesting they were more visible. In future studies, more first hand observation is necessary on participating vessels. This time around we did not feel we were given the most accurate data.

References

Lee, B., M. Hall and A. Michael, 2005. Comparison of Catch and Bycatch with Beam and Otter Trawls in the Northeast Shrimp Fishery. Report to Northeast Consortium. 25 pp + app.