COMPARISON OF CATCH AND BYCATCH WITH BEAM AND OTTER TRAWLS IN THE NORTHEAST SHRIMP FISHERY

A report to

Northeast Consortium

by

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Abstract

A 17 ft beam trawl was built and tested for the possible application of this gear in the northeast shrimp fishery. The 1.75-inch mesh net was fitted with a Nordmore grate and towed from the fishing vessel Ocean Reporter out of Rockport, Massachusetts during the months of January through March, 2004. Seven additional vessels reported their catch and bycatch while towing for shrimp using standard otter trawls during the same time period and in the same general area as the vessel using the beam trawl.

The beam trawl had a significantly lower catch rate for shrimp than the vessels using standard otter trawls (mean, 82 lbs/hr vs. 270 lbs/hr). This was in part due to the relative size of the gear since the opening of the beam trawl was 17 ft and that for the otter trawls ranged from 28 – 34 ft. Percent bycatch (by weight) for the beam trawl was 13.6% whereas that for the otter trawl fleet was 10.7%. There was a wide variation in bycatch rate among the 7 vessels using the otter trawl (0.4 – 16.5%). Composition of the bycatch differed with a higher percentage of groundfish in the beam trawl and a higher percentage of pelagic fish in the otter trawl(s). Fuel consumption was greatly reduced with the use of the beam trawl. The gear is inexpensive to make and can be used with a single warp and from small vessels with lower horsepower. Further modifications might make this gear useful under specific conditions, near hard bottom, or where fixed gear is deployed. Additional research that could be done would be an evaluation the relative impact of the lightweight beam trawl versus the standard otter trawl on the benthic environment.

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Introduction

Beam trawling is a historic method of fishing that date back to the days of sail. The oldest of trawling methods, the name is due to the beam (or pole) used to keep the mouth of the net open. With the introduction of power-driven vessels the beam trawl was largely replaced by the otter trawl, which sweeps a larger area and is kept open by otter boards or "doors". Original beam trawls were very heavy (up to 7 tons) and, in some habitats, had a significant impact on the sea floor (Bergman and Hup, 1992). Over the last 20 years much lighter versions of the beam trawl have been developed and used in shrimp fisheries in Denmark, Belgium (Polet, 2000), the Pacific coast of North America (Love and Bishop, 2002) and elsewhere.

The shrimp fishery is in the northeast is a relatively clean fishery in terms of bycatch, partly due to the recent requirement of the Nordmore grate in the nets. However any improvement in fishing methods in the Gulf of Maine that further reduce bycatch and bottom habitat impact will help maintain and improve stocks of commercial fish. Bottom trawl gear, without modification, is not very selective and catches a wide range of species.

Approximately 15 years ago, a group of fishermen from Gloucester and Rockport, Massachusetts reported good results when they used beam trawls to catch both scallops and multi-species in areas where otter trawls couldn't be deployed. In one case a pair of 22' beam trawls were towed from the F/V Gypsy Rose and very high catches of shrimp were achieved. This alternate method was tried for just a single season and the results were not officially documented. An advantage claimed was a reduction in fuel bills and the fact that only one main towing warp was needed also reduced overall expenses. This study was initiated by a group of local fishermen who had learned that the performance of beam trawls in the Danish shrimp fishery appeared to be adaptable to the Gulf of Maine.

Project Objectives

Objectives of the project were to test the applicability of the beam trawl to the Gulf of Maine shrimp fisheries and to determine whether using a beam trawl instead of an otter trawl for shrimp fishing would reduce the amount of bycatch caught.

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+ Seven participating vessels (appendix)

Methods

A modified, lightweight version of a standard beam trawl was constructed based on a design obtained from Danish fishery gear specialists Thomas Moth-Poulsen and Ullrich Hansen (Figures 1-3). The 2 ft high frame was lightweight aluminum and the bottoms of the skids were fitted with 6" x ½ " polyurethane board to reduce digging. The 1.75-inch mesh net was fitted with a Nordmore grate with rolling stainless steel grate bars and used in regular shrimp fishing operations for 14 days. The net was in compliance with all state and federal fishing regulations.

In January, 2004, the beam trawl was installed on the F/V Ocean Reporter captained by Bill Lee of Rockport. Hydraulic performance of the net was first evaluated using underwater video in test runs filmed in shallow, clear water in Ipswich Bay. An independent evaluation of the gear by a fisherman who was not otherwise involved in this study is included in the Appendix. During each experimental trawl, the location, depth, speed, and duration of tow were recorded on provided data sheets (see Appendix). On all but two occasions, a camera was mounted on the top of the beam to monitor the behavior of shrimp and other species entering or attempting to avoid the net. On one trip a small net was fixed to the top of the beam to determine whether shrimp were escaping over beam. After haul back, the catch was sorted and weighed and the bycatch also identified and weighed.

Supplemental data was collected from 7 other participating fishing vessels towing the standard otter trawl currently used by the fleet (also fitted with a Nordmore grate). A biologist met with respective captains to provide them with data sheets and instructions on the collection of data. The biologist accompanied several of the vessels during trawling activity. 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 on a total of eight days. Average tow duration and speed for the fleet using the otter trawl was 4.5 hrs at 2.5 knots. On the Ocean Reporter, the beam trawl was towed at speeds from 2.5 – 3.0 knots for an average of 4.9 hours. During the last few tows with the beam trawl, some modifications were made which included removing the chain off the sweep to minimize catch of groundfish, and letting more cable out so the gear could be towed faster.

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). The complete data set is available from NEC.

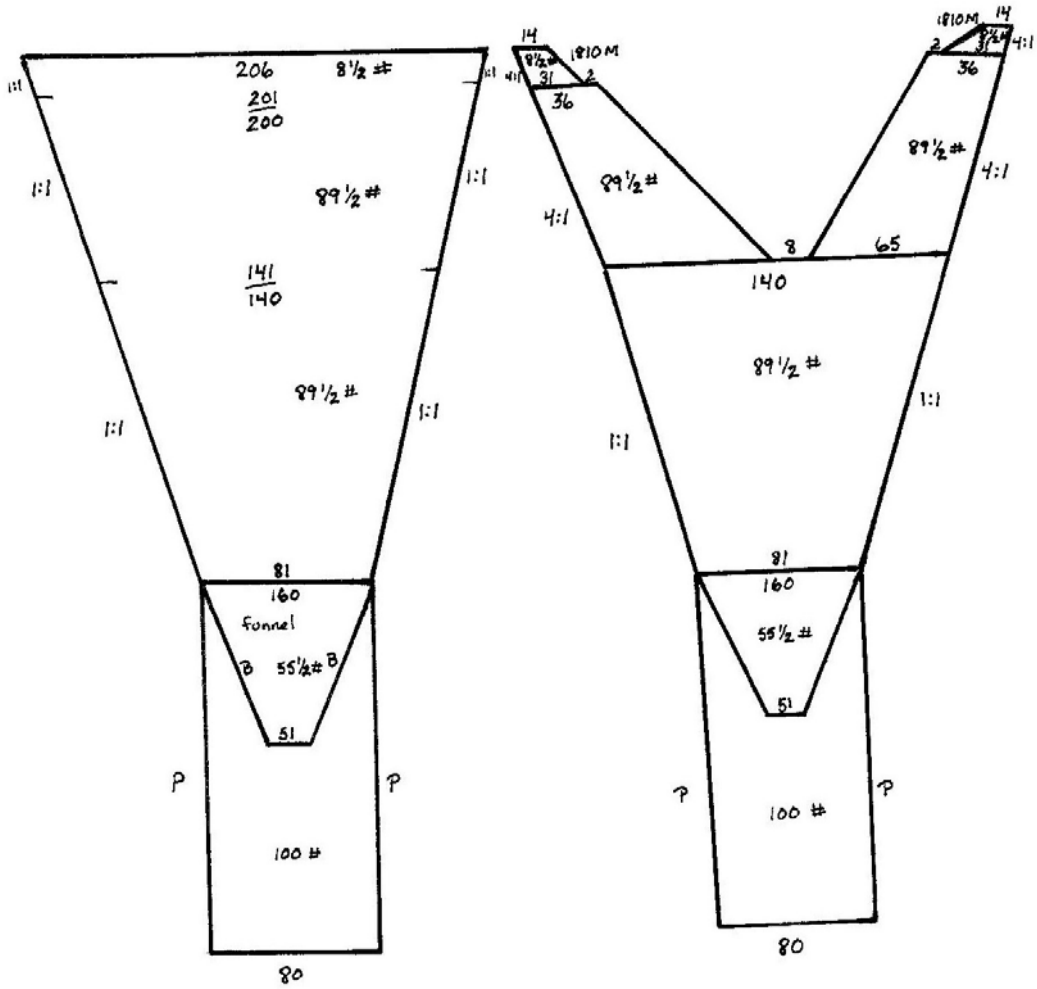
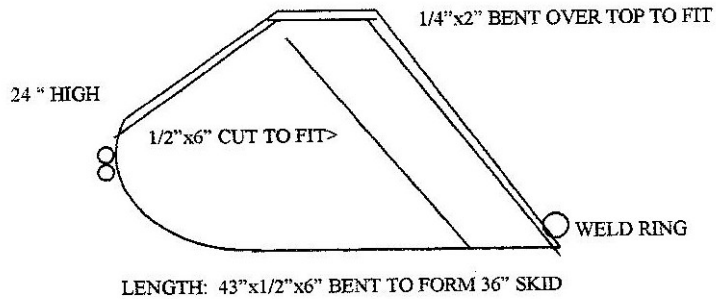
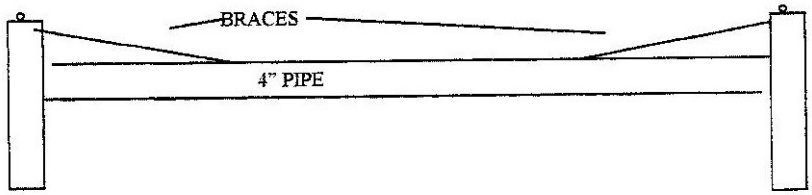


Figure 1: Dimensions of the Net

- Bottom of the skids fitted with 6"x30" polyurethane to reduce bottom digging and benthic disturbance.
- Escape vents after the funnel to reduce fin fish.
- Rolling stainless steel Nordmore Grate bars to help fin fish escape and to keep shrimp from clogging the grate.

  light weigh aluminum and polyurethane Nordmore Grate frame





MATERIALS LIST FOR SHRIMP BEAM TRAWL

- 7'-1/2" X 6" Flat bar per skid
- 6'-1/4" X 2 " Flat bar per skid
- 4" Steel pipe the length of beam (16 feet)
- Chain eyes, shackles and two 16 foot tow bridles
- 60 inches of 6"x1/2" polyurethane board

<u>Figure 2:</u> Low Impact Shrimp Beam Trawl

16 Foot Beam Trawl for Shrimp
33' Footrope
all 10/30 $1^{7/8}$ inch inside mesh

F/V Ocean Reporter
Levin Marine Supply
(508) 992-4707
December 2003

Figure 3: Setting out beam trawl

Figure 4: Beam trawl and Nordmore grate

Results

Beam trawl versus otter trawl

A total of 8 fishing vessels participated in the study, sampled on 14 days (28 boat-days) for a total of 314.47 hours and provided 69 data sheets (examples in the Appendix). The average day included 4.5 hours of towing.

The Ocean Reporter, using the beam trawl, caught 5,290 lbs of shrimp during the 14 days of trawling. Catch rate was 82.2 lbs shrimp per hour towed. Bycatch of fish and invertebrates was 723 lbs or 12% of the shrimp catch and was caught at a rate of 11.2 lbs/hr. Other vessels towing the otter trawl were active on from 2 – 12 days and the total catches ranged from 1,968 to 12,423 lbs of shrimp (total 65,671 lbs) with a fleet average rate of 270.1 lbs /hr. Total bycatch varied from 7.7 to 2529 lbs (total 7321 lbs) with a mean of 28.4 lbs/hr. Bycatch weight was 10.7% of the shrimp catch (Table 1).

Mean catch per hour towed per day sampled is illustrated in Figures 5 and 6. Average weight of shrimp caught/hr by the standard otter trawl was greater than the average weight of shrimp caught by the beam trawl on every day of sampling. One factor was the relative size of the beam trawl, which was 17 ft whereas the otter trawls used by the fleet ranged from 28 to 34 ft wide. Figure 5 shows the percent bycatch for the respective gear on each day that fishing was reported. There was considerable variation in percent bycatch for both the beam and otter trawls. On five days, bycatch was lower than the fleet average with the otter trawl, and on 6 six days, bycatch with the beam trawl was higher. The overall mean bycatch percent for the beam trawl was influenced by 3 individual days in January and February when bycatch was very high (24% - 28%). On the remaining trips, bycatch with the beam trawl ranged from 5% to 14%.

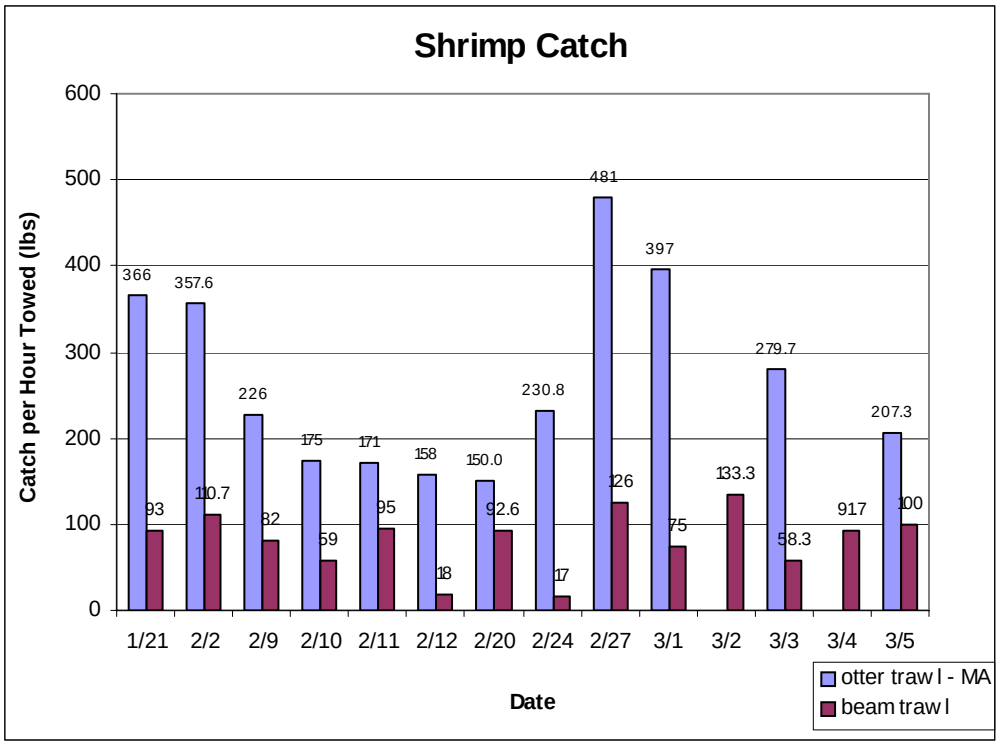
Table 1. Comparative Catch Rates of Trawls

Average shrimp catch – otter = 278.4 lbs/hr

Average shrimp catch – beam = 73.7 lbs/hr

Average bycatch – otter =30 lbs/hr (10.7%)

Average bycatch – beam = 11.2 lbs/hr (13.6%)



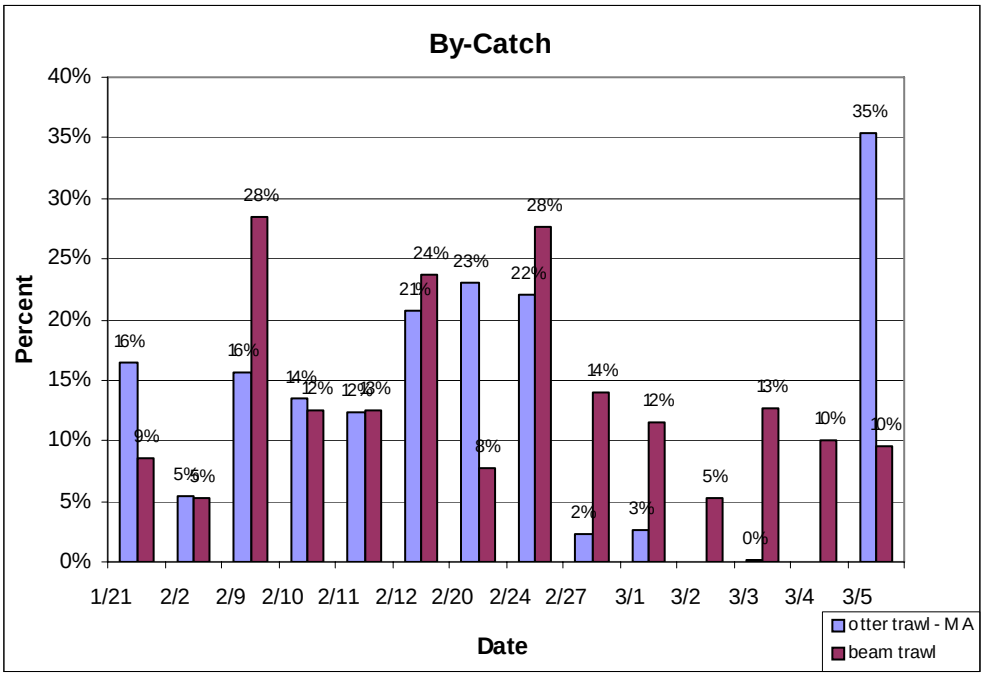
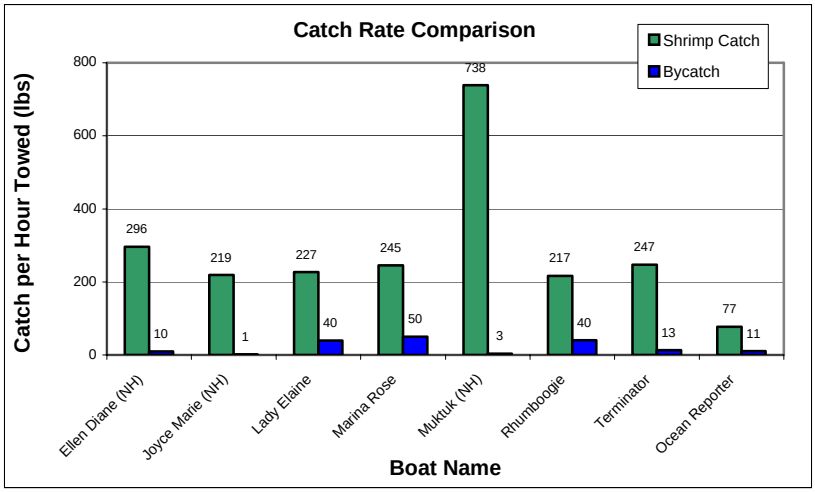
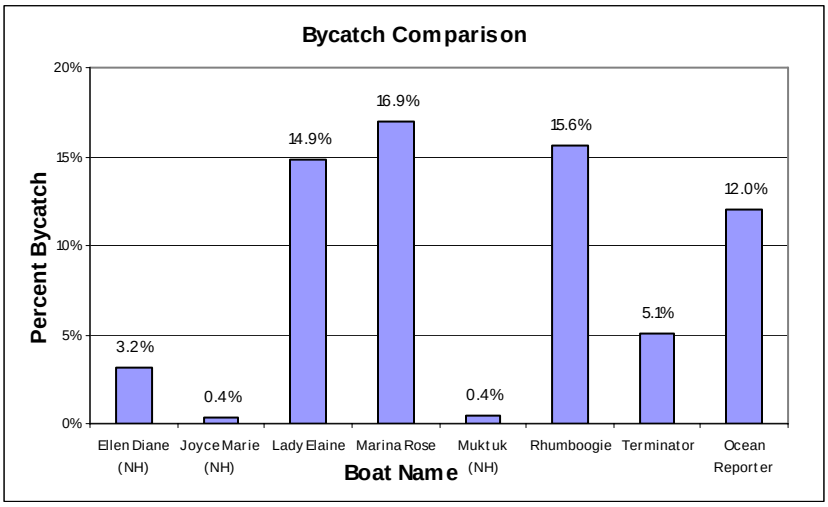
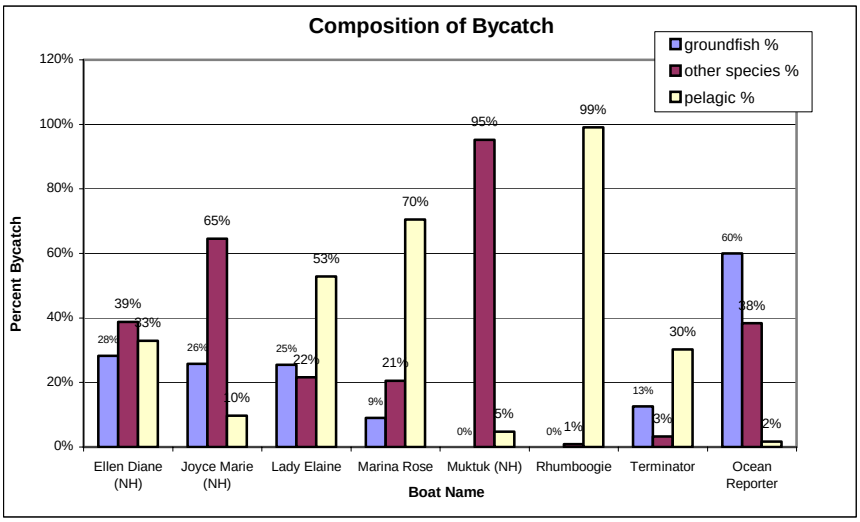


Figure 5: Catch and Bycatch Comparison of Beam and Otter Trawls







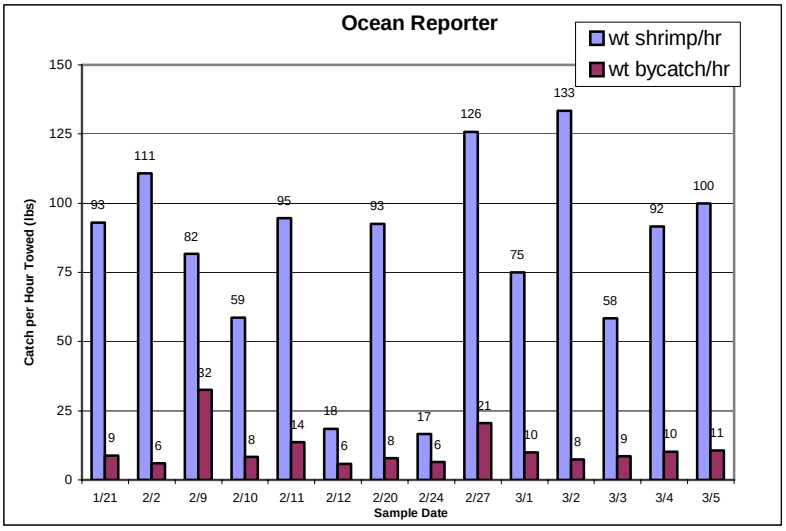
<u>Figure 6:</u> Catch, Bycatch and Bycatch Compostion of the Otter Trawl Fleet

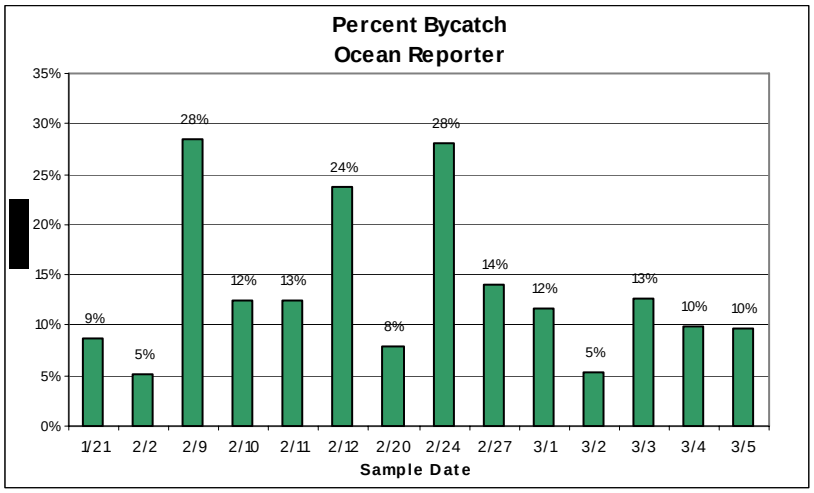
Variation among boats

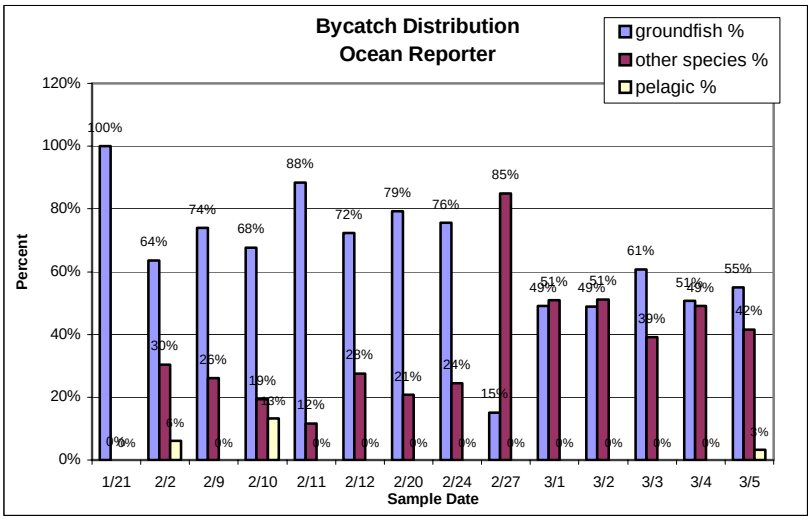
Catch and bycatch varied considerably among vessels and from day to day for each vessel (Figures 7 – 14). A very large number of tows would be needed to identify statistically significant differences, something beyond the scope of this development project. With the beam trawl shrimp catch rate varied from 16.6 lbs/hr on February 27 to a maximum of 133.3 lbs per hour on March 2, 2004. Average catch rate of shrimp on otter trawl vessels for the study period ranged from 244 to 725 lbs/hr. Daily variation of individual vessel catch is indicated by reports from the vessel Rhumboogie, which caught 60 lbs/hr in 5 hours of trawling on February 11, and 567 lbs/hr in 2.5 hours of trawling on February 27.

Variation in mean bycatch rates between vessels was significant and ranged from 0.4% to 16.9% (Figure 6). Most vessels also showed variation 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 of 0.5% or less (Joyce Marie and Muktuk) fished on only two days. One other vessel, the Ellen Diane, had a low bycatch rate of from 2.2 to 3.9% over four days fishing. Four of the otter trawl vessels fished on ten days or more and only one of these (Terminator) had a fairly consistently low rate of bycatch (1.8 – 9.0%; average 5.1%). Variation in bycatch rate among other vessels that fished on at least ten days (Rhumboogie, Marina Rose, and Lady Elaine) was much higher, ranging from 0.1% to 41% (averages 12.6% to 14.9%). However, each of these vessels had at least four days when bycatch rates were less than 5%. On the days when bycatch rates were high, analysis of the catch composition showed that the main components of the bycatch on these occasions were pelagic species. These data suggest chance encounters with schooling species such as whiting and herring (see below).

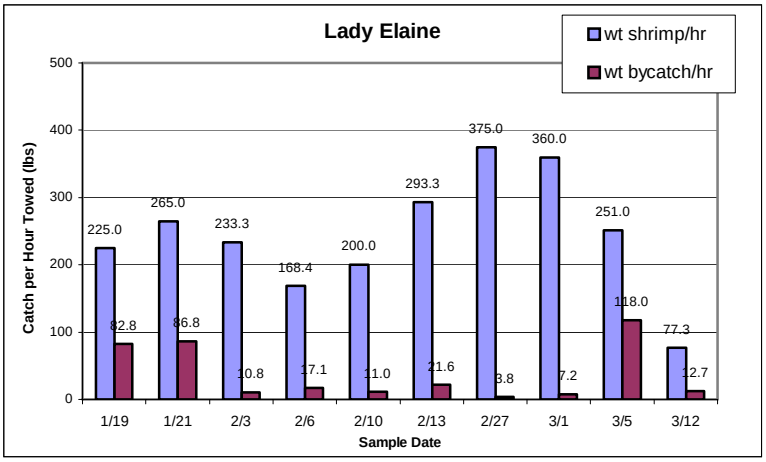
Bycatch with the beam trawl on the Ocean Reporter varied from 5.2 to 28.4% with an overall average of 12% over the 14 days fishing. This is in the range of the otter trawl vessels that fished on ten days or more.

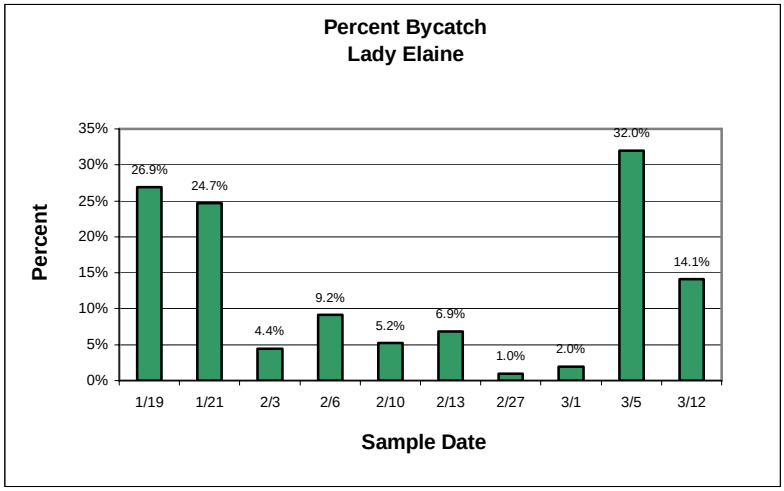


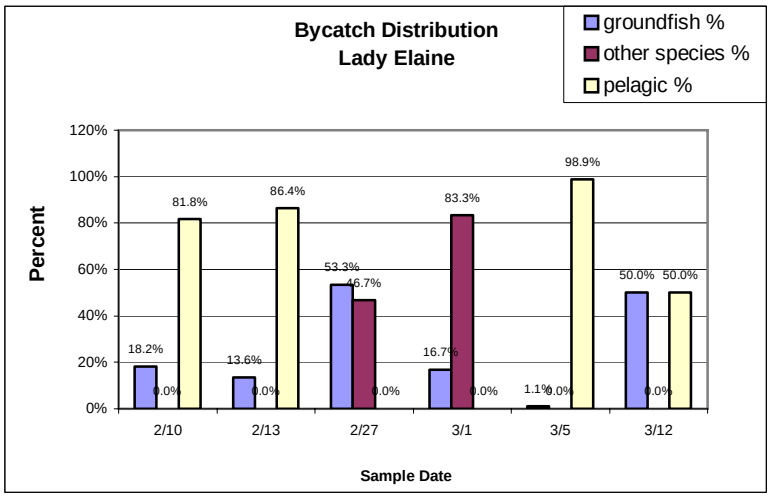




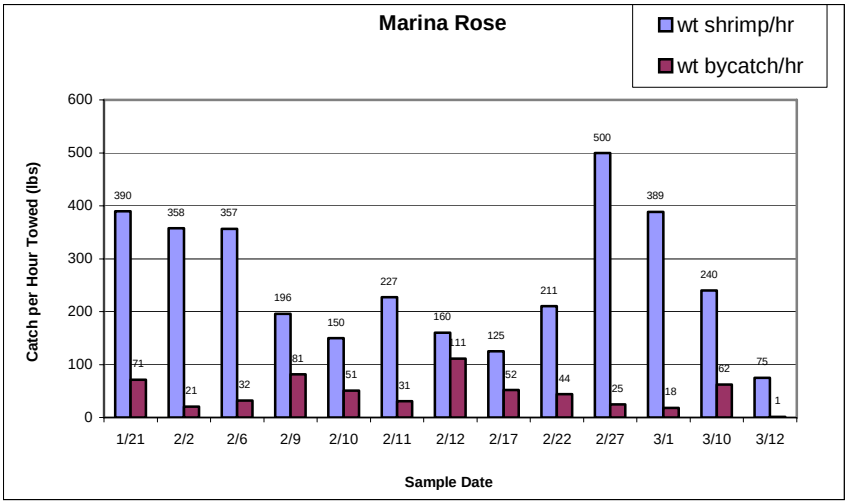
<u>Figure 7:</u> Daily Catch and Bycatch Composition of Ocean Reporter

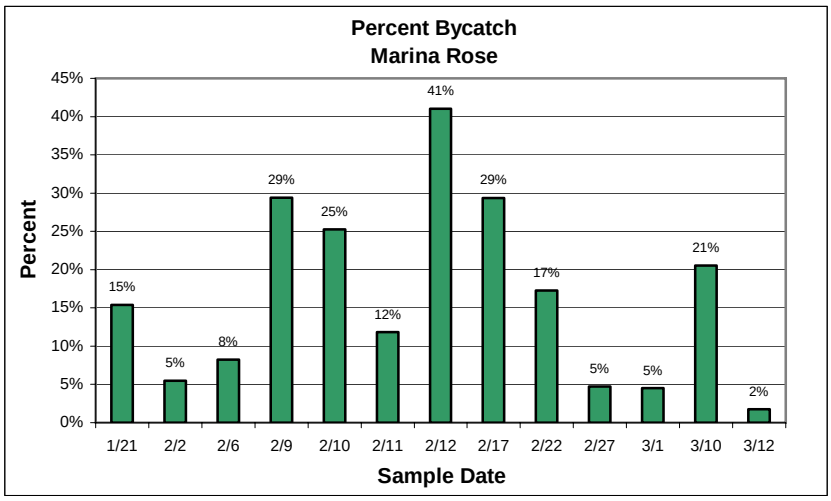


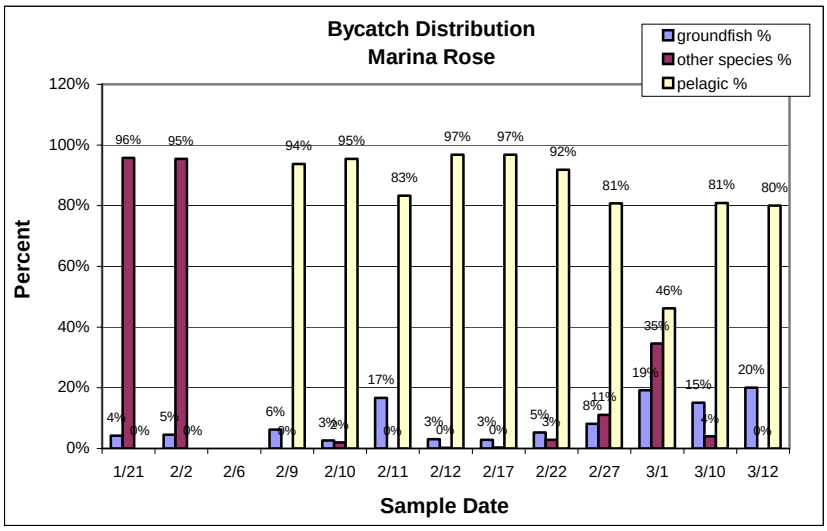




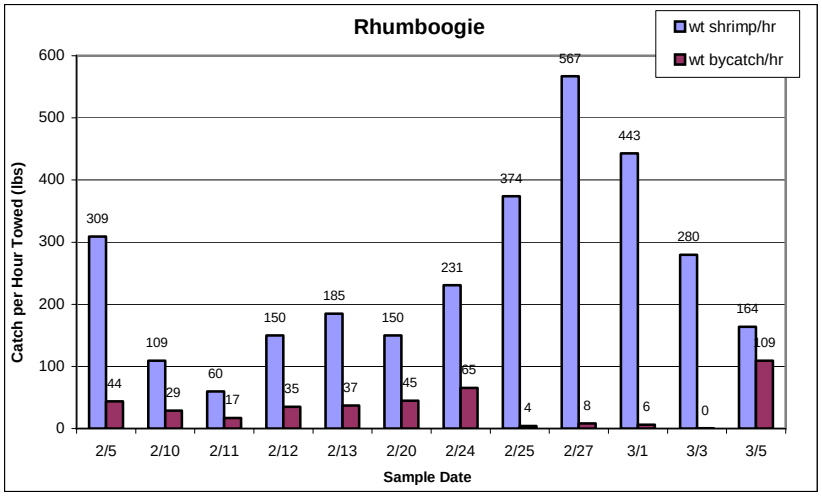
<u>Figure 8:</u> Daily Catch and Bycatch Composition of Lady Elaine

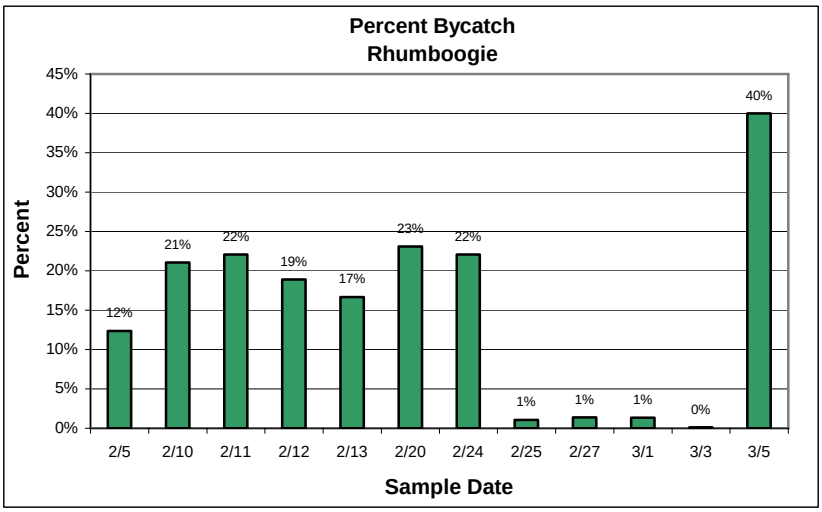


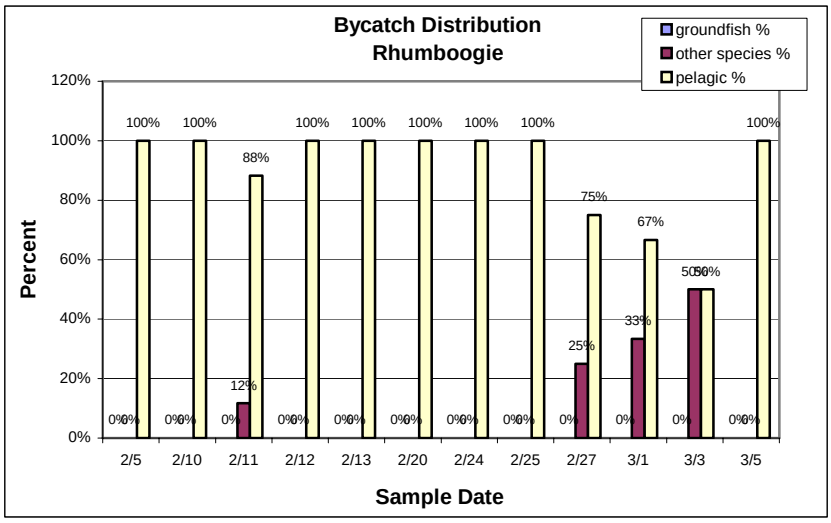




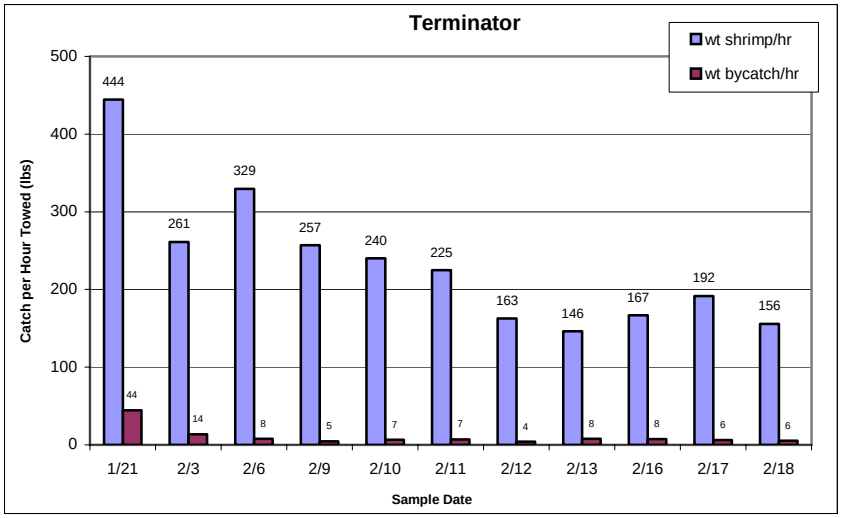
<u>Figure 9:</u> Daily Catch and Bycatch Composition of Marina Rose

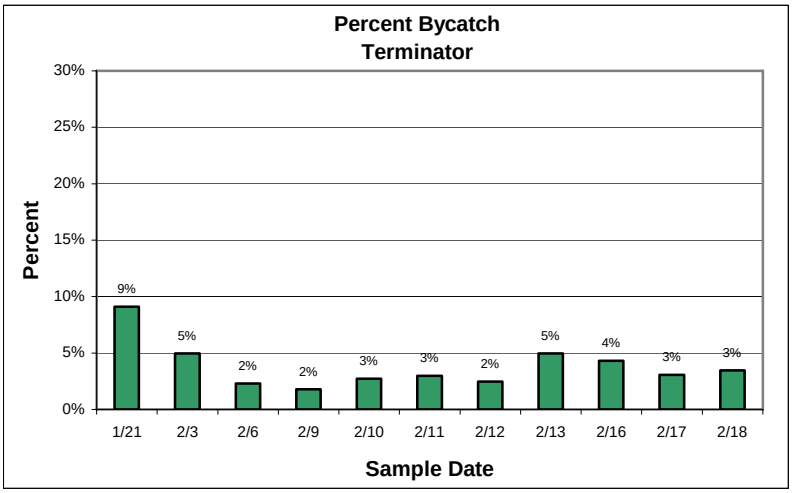


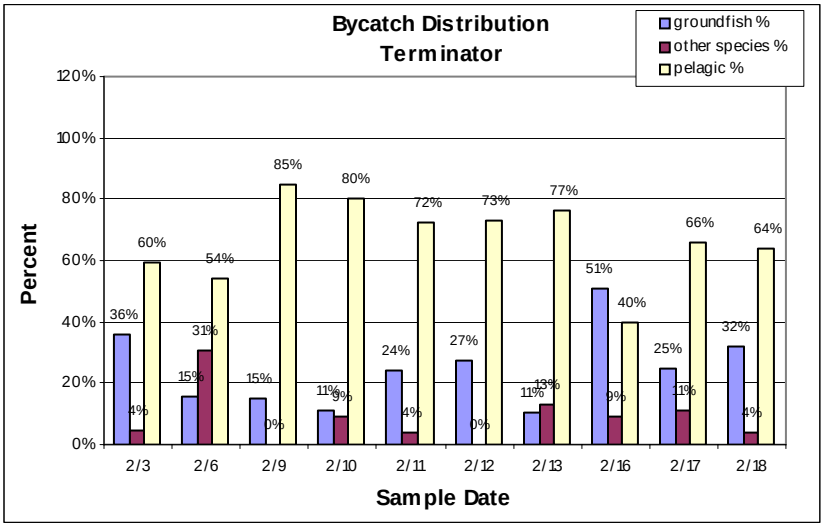




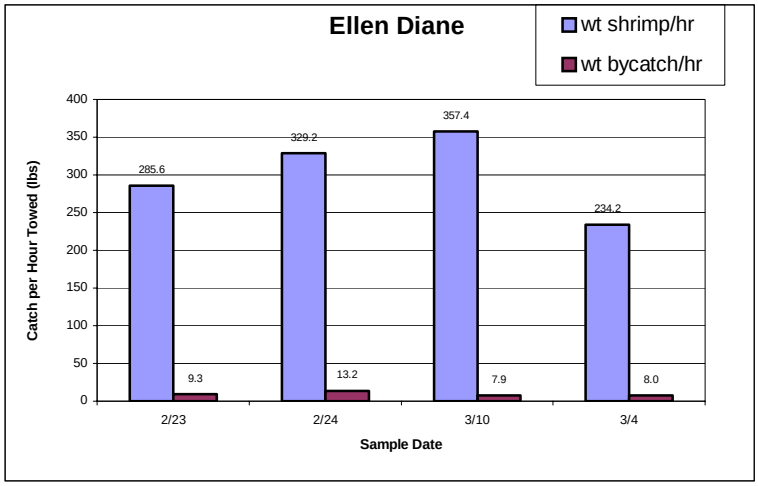
<u>Figure 10:</u> Daily Catch and Bycatch Composition of Rhumboogie

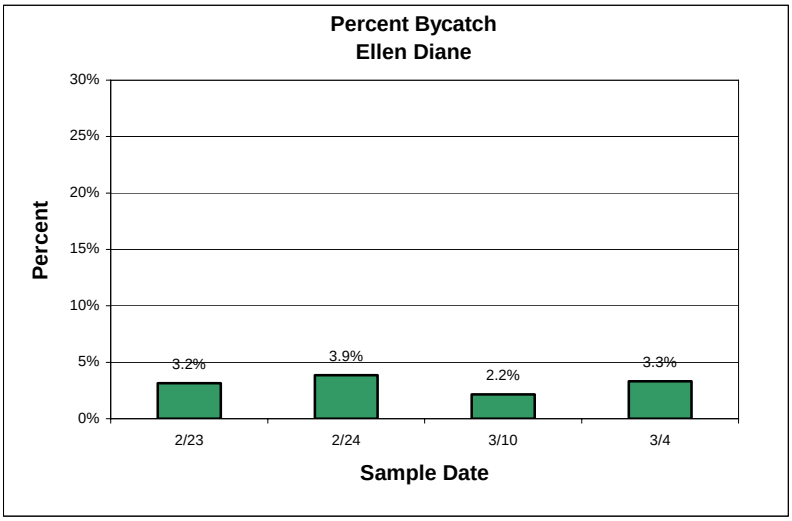


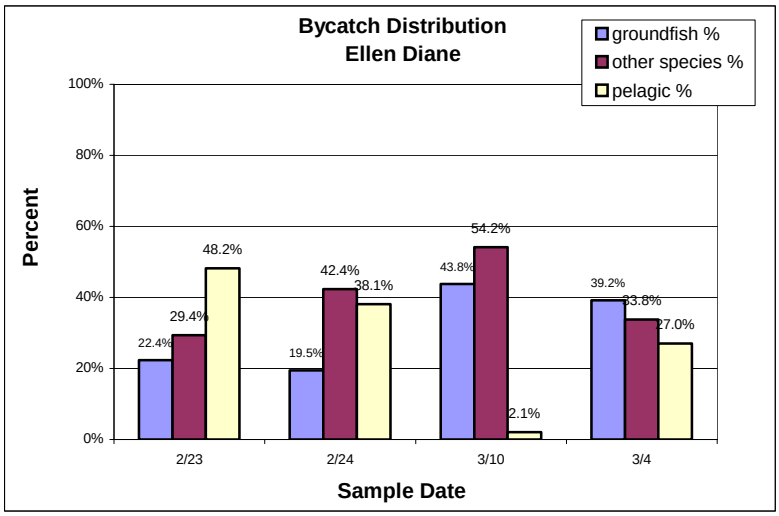




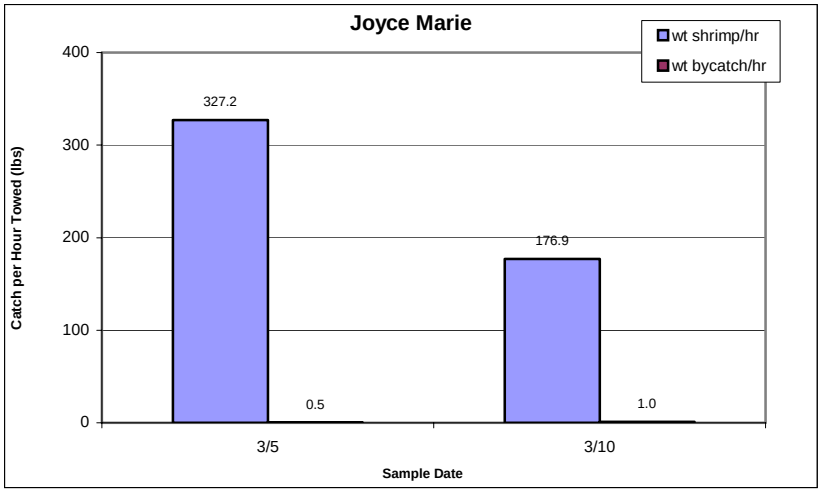
<u>Figure 11:</u> Daily Catch and Bycatch Composition of Terminator

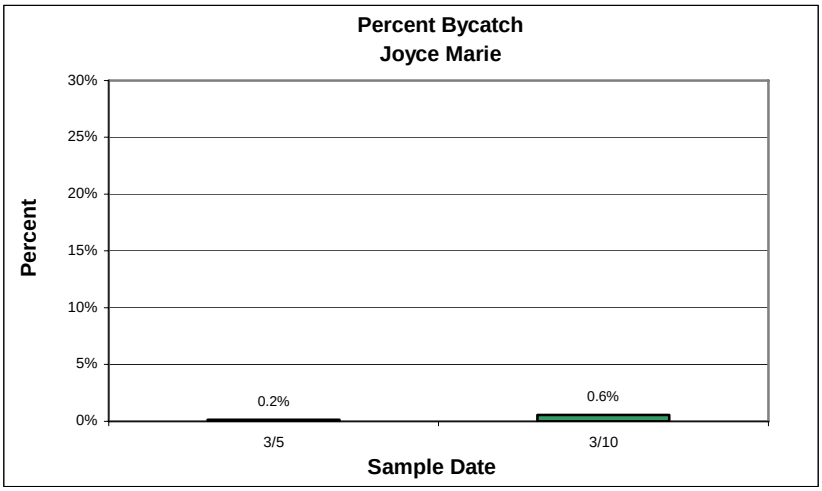


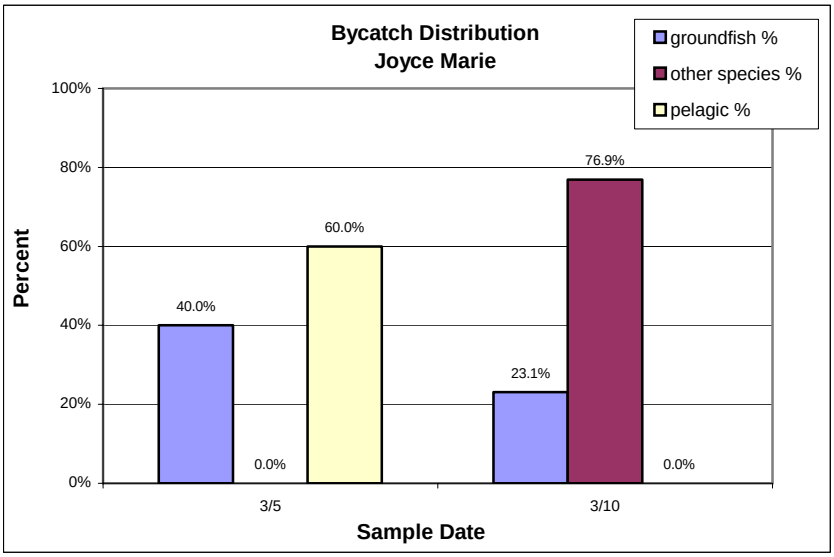




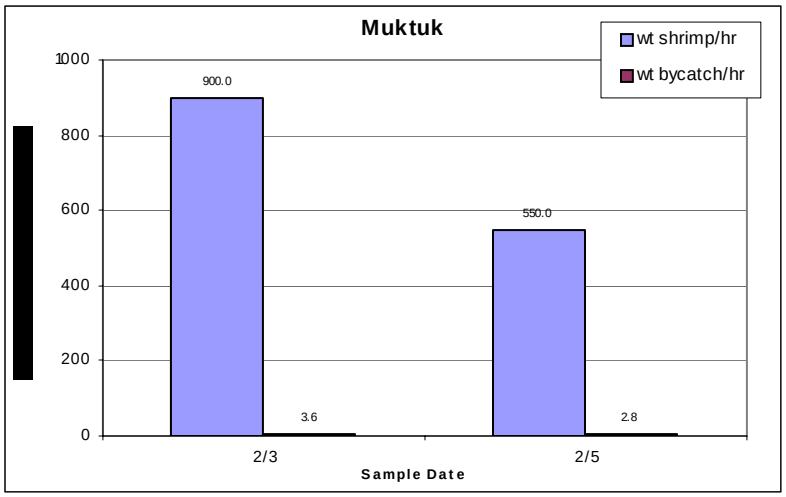
<u>Figure 12:</u> Daily Catch and Bycatch Composition of Ellen Diane

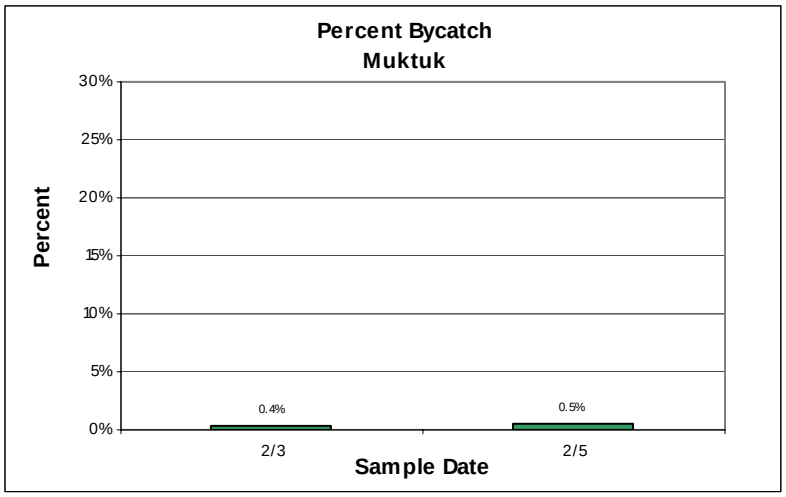


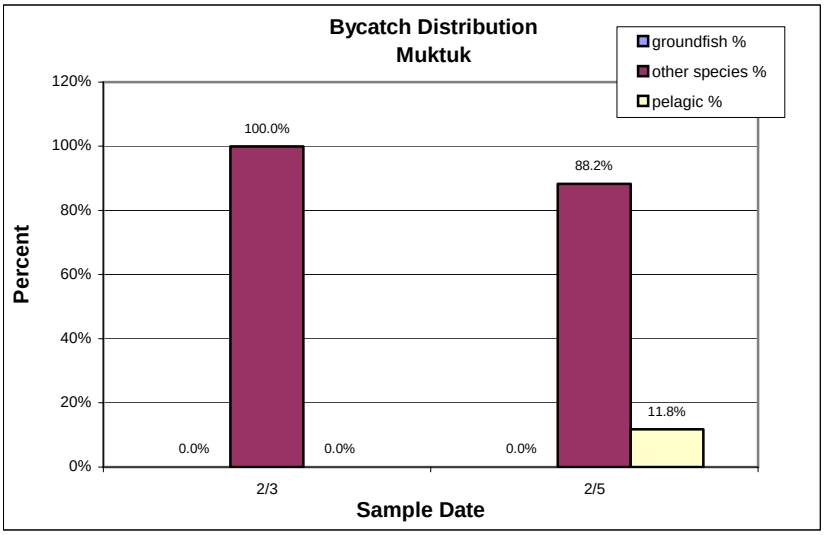




<u>Figure 13:</u> Daily Catch and Bycatch Composition of Joyce Marie







<u>Figure 14:</u> Daily Catch and Bycatch Composition of Muktuk

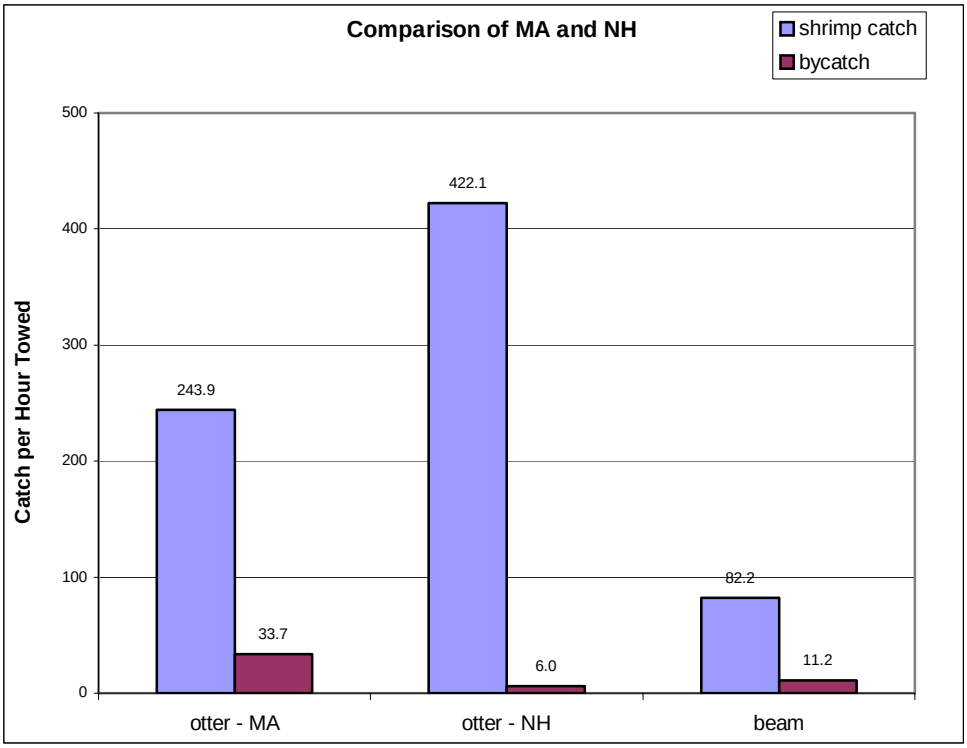
Composition of Bycatch

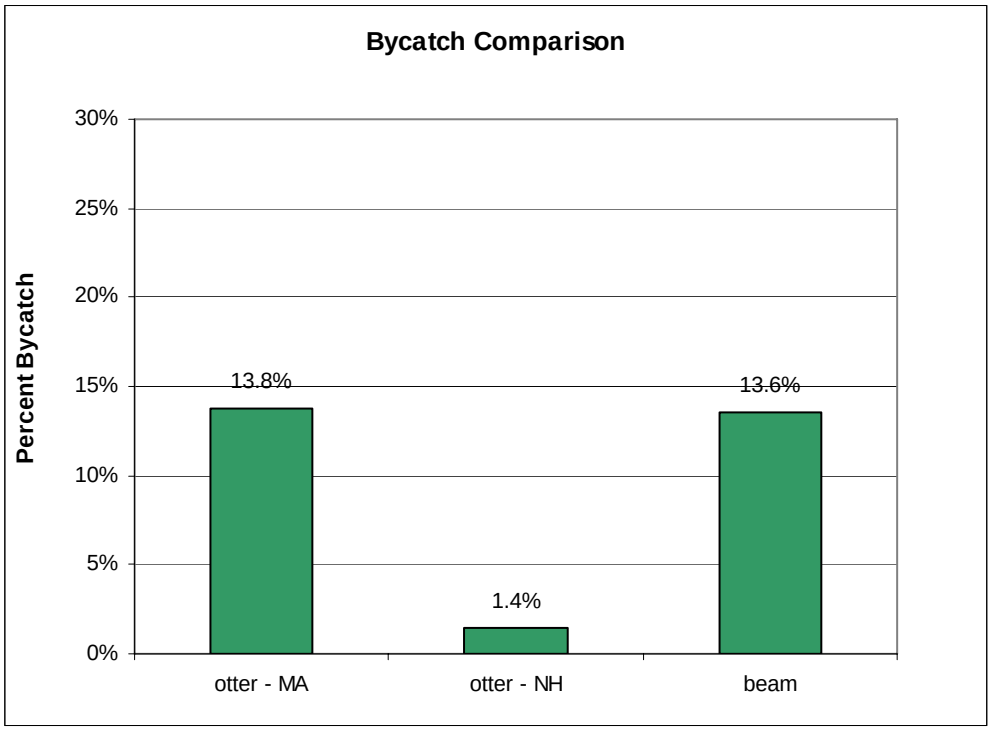
The beam trawl had a consistently low bycatch of pelagic species such as herring and whiting. The relative percentages of groundfish, other species (mostly invertebrates) and pelagics were 64.3%, 34.1% and 1.6% respectively. In contrast, overall composition of bycatch for otter trawls was 14.5% groundfish, 20.9% other species, and 64.6% pelagics. In all cases when bycatch rates were above 15% with the otter trawl, more than 80% of the bycatch consisted of pelagics. In these cases, the actual catch rates of pelagics ranged from 75 to 600 lbs per hour. This suggests that the nets encountered schools of either whiting or herring and that many fish were not able to escape through the opening above the Nordmore grate.

Geographical Factors

Four of the otter trawl vessels fished with the Ocean reporter (beam trawl) 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 8 days there was a marked difference in the bycatch rate and composition of bycatch (Figure 15). Bycatch for the three New Hampshire vessels was extremely low and evenly divided between groundfish, other species and pelagics (approximately 30% each). The vessels, Ellen Diane, Joyce Marie and Muktuk, out of Hampton, New Hampshire, had bycatch rates of from 0.4% to 3.1%. Vessels out of Rockport, Massachusetts ranged from 0.5% to 16.5% with an overall average of 13.8%. 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 55.4 hours of trawling (total) by the New Hampshire vessels.

Catch per hour towed was 243.9 lbs/hr for the Rockport vessels and 422.1 lbs/hr for the New Hampshire vessels (Figure 15). The overall average for New Hampshire vessels was heavily influenced by the two days of results for Muktuk, which reported 900 lbs/hr on January 3rd and 550 lbs/hr on January 5, 2004. These were the two highest catch rates for any vessel in the study.





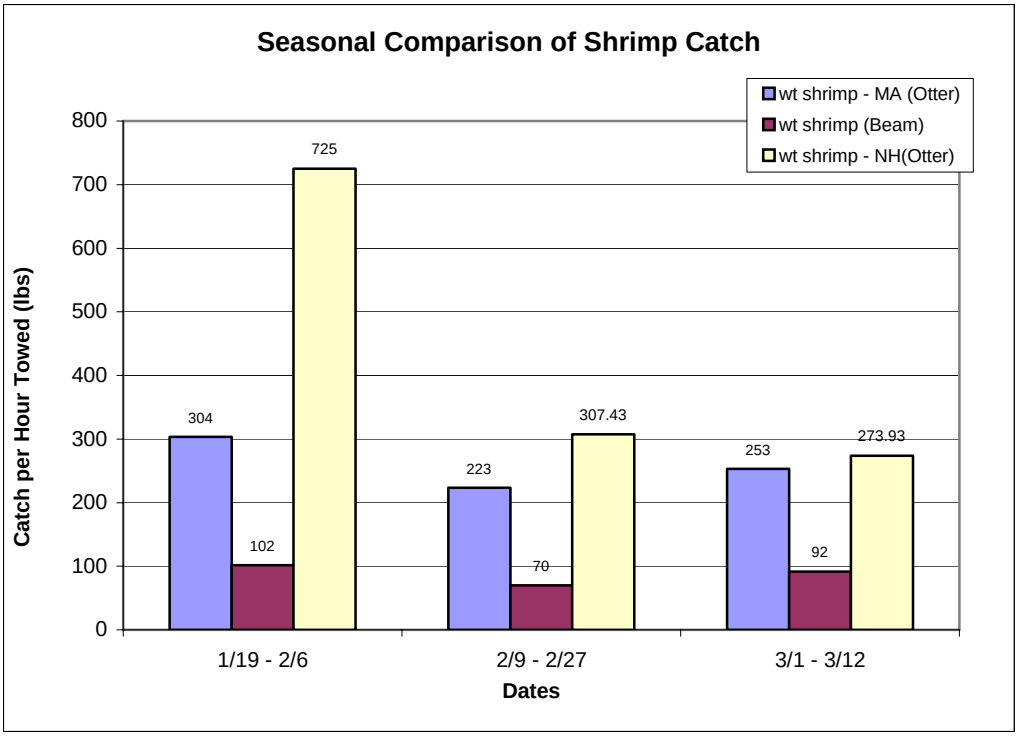
<u>Figure 15:</u> Comparison of Catch and Bycatch for New Hampshire and Massachusetts Vessels

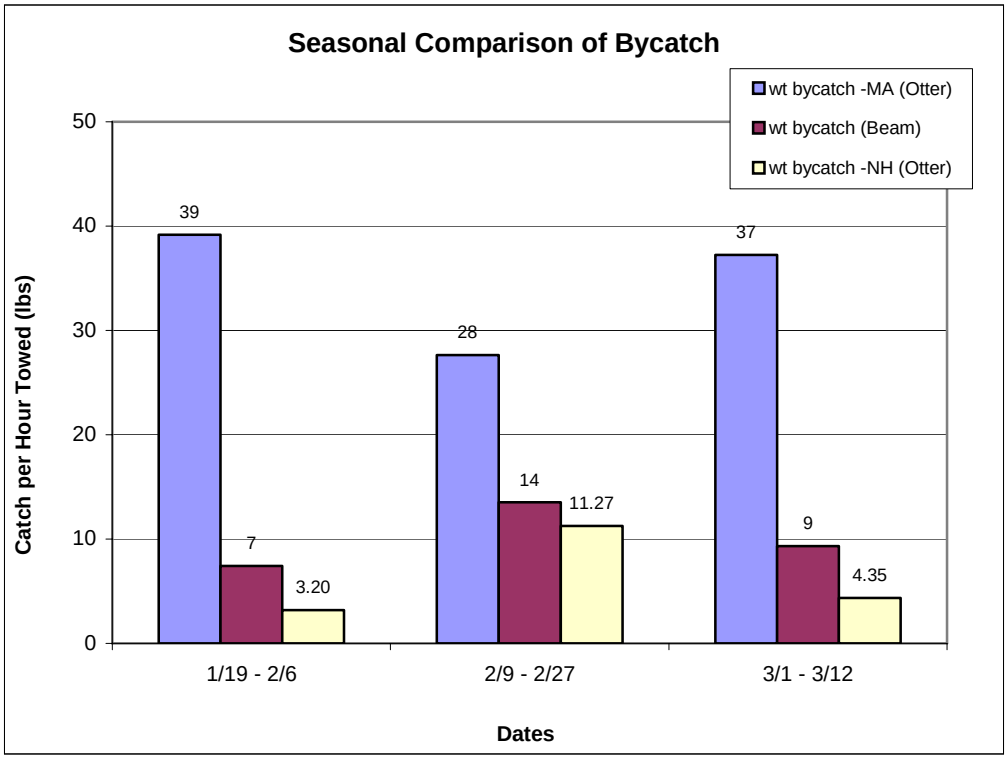
Seasonal Trend

Data was separated into 3 time periods to examine any seasonal trend in catch and bycatch rates. The first included the initial two weeks of the shrimp fishing season from January 19 to February 6, 2003. The second period included the remainder of the month of February and the last included the first two weeks in March.

The catch per hour of shrimp for both the beam and otter trawls by the vessels operating out of Rockport was fairly consistent though the study period. Otter trawl vessels ranged from 304 lbs/hr in the first time period (late January – early February) to 253 lbs/hr in March. The beam trawl catch ranged from 102 to 70 lbs/hr. In the first time period (January 1 – February 6) the only New Hampshire vessel that fished was Muktuk, which averaged 525 lbs/hr for two days. In the remaining time period catch rates of the other two New Hampshire vessels, although slightly higher (274 – 307 lbs/hr) did not differ significantly from those of the Rockport vessels.

Bycatch rates were consistently higher throughout the time periods for the Rockport boats (28 – 39 lbs/hr) vs. the New Hampshire vessels (3.2 – 11.7 lbs/hr). The difference was due either to the habitat trawled, gear type, or the occurrence of school of pelagics such as whiting and herring.





<u>Figure 16:</u> Monthly Comparison of Catch and Bycatch

Discussion

This was a Northeast Consortium development project (maximum $25,000) and funding only allowed 14 days of testing with the beam trawl. There was therefore very limited opportunity to make adjustments to improve the catch rate. Some minor modifications were made such as reducing the weight of the sweep, which was too heavy in the initial stages. Other variations that could be tried in the future are to raise the beam 2 inches to reduce the groundfish bycatch, and towing at faster speeds (up to 4 kts).

The gear is easily adaptable to small boats and could be an alternate fishing method for scallop boats since only a single wire is required. Towing with a single wire means more maneuverability, allowing vessels to trawl closer to hard bottom and areas where fixed gear prevents otter trawl activity. The opening of the net remains constant in size during turns and trawling performance is better in soft muddy bottoms (Rose et al. 2002). Significant cost reductions (compared to trawling) include the cost of the gear itself. There are no doors, the net is smaller and only one wire is needed. Vessels having restricted warp capacity can fish in deeper waters since only about half the amount of warp is needed compared to gear where doors are used. Fuel costs will be significantly lower since the horsepower required to tow this light modified beam across the surface is much less than that needed to pull heavy doors which sink into the bottom. In one period of three days, the Ocean Reporter used 106 gallons of fuel while beam trawling, whereas historical records for this boat show typical usage of 70 – 80 gallons/day towing an otter trawl.

One issue that was not addressed in this project is the relative bottom disturbance of a lightweight beam trawl, such as built for this study, versus the otter trawl(s) currently used by the fleet. This would take a separate project specifically designed for that purpose.

Partnerships

There was a high level of interest among those fishermen from the area who are involved in shrimp fishing. Seven vessels were involved in the collection of data for shrimp fishing with otter trawls for comparison. All who participated will receive a summary version of the results of this study.

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Rose, C., A. Carr, R. Ferro, R. Fonteyne, and P. MacMullen. 2002. Unpublished manuscript. The characteristics and function of commercial fishing gears; how these relate to their effects on seafloor habitats and the pursuit of ways to minimize effects. Manuscript submitted to the NOAA/USGS Symposium on Effects of Fishing Activities on Benthic Habitats, Tampa, Florida, November 2002.

Appendix

List of participating fishermen and vessels

Reported catch by vessel

Independent evaluation of beam trawl

Examples of daily trip reports

Participating Fishing Vessels:

F/V Ellen Diane, Capt. Dave Goethel
F/V Lady Elaine, Capt. Dennis O'Connell
F/V Muktuk, Capt. Mike Pike
F/V Marina Rose, Capt. Bob Fisher
F/V Rhumboogie, Capt. Jason Pollison
F/V Special K, Capt. Jack Ketchopulos
F/V Terminator, Capt. Paul Theriault