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Final Report

Modifications to the Nordmore Grid to Reduce Finfish Bycatch in Shrimp Trawls

Submitted to:

The Northeast Consortium
142 Morse Hall
University of New Hampshire
Durham, NH 03824

July 2008 **UNH-FISH-REP-2008-045**

Final Report

Modifications to the Nordmore Grid to Reduce Finfish Bycatch in Shrimp Trawls

by

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Submitted to

The Northeast Consortium
The University of New Hampshire,
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1. PROJECT TITLE

Modifications to the Nordmore Grid to Reduce Finfish Bycatch in Shrimp Trawls

2. PROJECT LEADER

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3. OTHER KEY PROJECT PARTICIPANTS

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4. SUMMARY

This developmental project tested a modified Nordmore grid to reduce finfish bycatch. The modification involved the removal of netting in front of the grid to facilitate escape of finfish. The project involved comparative fishing trials of the modified grid with a commercially-used Nordmore grid. Eighteen tows were completed in four fishing days. Though statistically not significant due to variations in catch composition and small number of tows, the modified grid rigging caught more shrimps per tow (17%) than the regular grid. There was no difference in the size (count) of shrimps caught between the standard and modified grid. Bycatch of primarily regulated species was very low during the test period (average <1.0% of total catch), a reduction of juvenile cod, winter flounder and American plaice was observed in the modified grid. The difference was statistically different in the American plaice bycatch (average 28 individuals per tow vs. 11 per tow, $P<0.01$). Modifications to the grid section include more escape areas for fish and shellfish. Easier escape of fish and shellfish reduces grid blockages which may have resulted in higher shrimp catch. A follow up project to replace the netting with ropes has been funded with sea trials completed.

5. RATIONALE

The use of Nordmore Grid in shrimp trawls has reduced finfish bycatch tremendously in shrimp fisheries in the North Atlantic. However, Nordmore Grid cannot reduce small fish which pass through the 1" space between the bars in the Gulf of Maine pink shrimp fishery. Small fish such as whiting, flounders, smelts and herring are often caught as bycatch in various quantities. In a separate shrimp trawl project carried out by the principal investigator during the past winter, an average of 13 lbs of bycatch was caught for every 100 lbs of shrimp (He & Littlefield, 2003), though the majority of bycatch was less valuable species such as whiting and red hake. Various

projects have been carried out to reduce small shrimps and small fish, but with very limited success. Square meshes stay open even with loads in the codend. Square mesh shrimp codend was reported to reduce small fish bycatch such as capelin in Gulf of St. Lawrence (H. DeLouche, Fisheries and Marine Institute, pers. comm.). Square mesh panels installed in part of the codend reduce small fish catch bycatch species in the Australian shrimp fishery (Broadhurst & Kennelly, 1994). Square meshes are difficult to repair and handle. Diamond mesh codend with water-borne kites which assist to open the meshes were also tested. Though analysis is still preliminary, the effect on reducing fish and small shrimps by the kite-assisted codend seemed not statistically significant (He et al. 2005). We therefore propose to test a modified grid rigging with more escape openings in front of the grid. Reducing small fish in shrimp fisheries is very importance in groundfish conservation, and can also improve economic performance as a result of less sorting and better shrimp quality.

6. OBJECTIVES

The objective of the proposed research was to test a rigging design for the Nordmore grid to reduce fish bycatch. The proposed research was to involve:

- Modify the rigging of the existing Nordmore grid.
- Conducting full scale trials with the modified grid rigging onboard a commercial trawler in Gulf of Maine;
- Evaluate the design or its modification for potential of more extensive sea and/or flume tank tests.

This report describes the methods and preliminary result of the developmental project, and recommends future works for bycatch and small shrimp reduction in the Gulf of Maine pink shrimp fishery.

7. STUDY APPROACH

7.1 The modified grid

Fish species arriving at the Nordmore grid usually pause and large fish which could not swim through the 1" spacing would exit through the top opening of the existing grid. Small fish may

swim through the grid and end up in the codend. Skates, lobsters and crabs may be pressed against the grid. Shrimps, with poor swimming capability, usually pushed through the spaces between the grid bars. Animals on the grid reduce grid sorting ability and may result in the loss of shrimp. Extra openings on the side and in front of the Nordmore grid would provide more ample escape opportunity for fish and shellfish (eg. lobsters) species. Similar designs in turtle exclude devices (TED) in the Gulf of Mexico shrimp fishery showed promise in releasing juvenile snappers to escape through the side openings (John Watson, NMFS SEFSC, pers. comm.). We followed the similar principle and modified the Nordmore grid as seen in Exhibit 1.

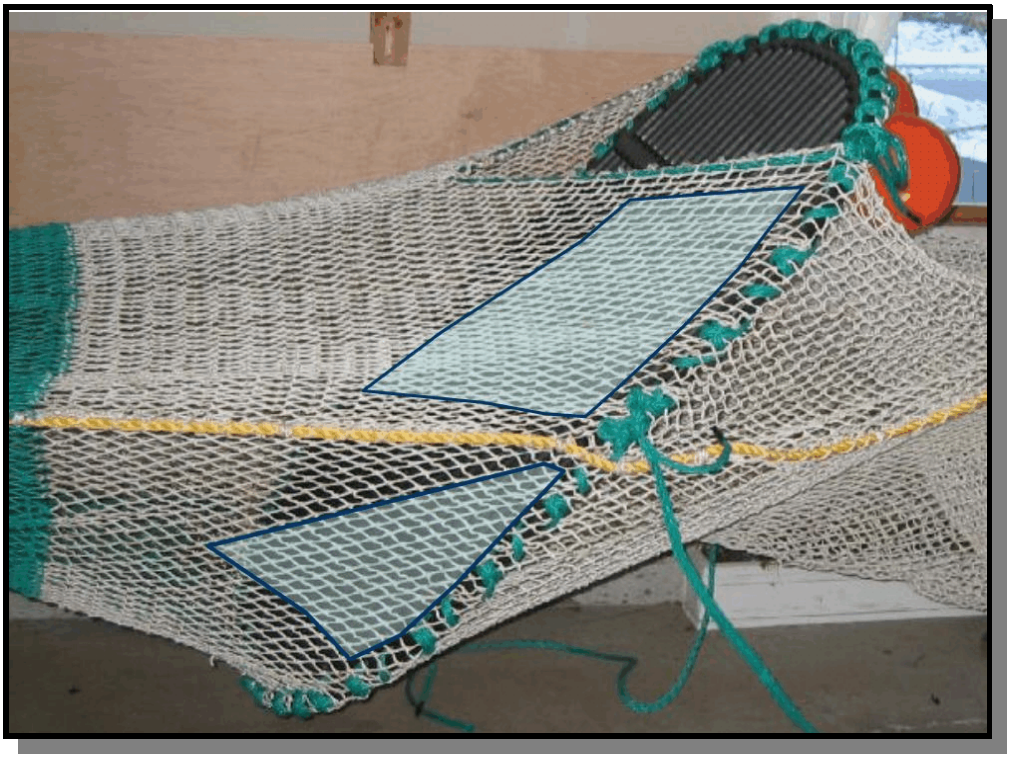

Exhibit 1. The Nordmore grid showing cutaway sections to allow easier escapement of fish and shellfish.

7.2 Sea trials

Sea trials were conducted onboard F/V "North Star" owned and operated by Capt. Vincent Balzano, the industry partner (Exhibit 2). The sea trials compared the new design (modified grid) with the existing Nordmore grid (standard grid) and evaluated catch of target species (pink shrimp, *Pandalus borealis*) and bycatch and size composition. The same commercial trawl (880 mesh shrimp trawl) was used for both grids. Grid and the codend behind it were switched

randomly during the four day trials. The codends which were made of nylon netting with mesh sizes of 45 mm were identical. Both grids were made of high density polyethylene material (HDPE) and were machine-cut to form spacings between the bars exactly 25 mm (1"). They were rigged at the same grid angle of 48 degrees, and with three 8" floats on the top of the grid.

The trawl was towed at regular speed of 2.4 knots. Tow duration was one hour to increase the number of tows. Four fishing days were completed to evaluate the potential of the modified grid. Fishing was conducted off Portland, ME during the month of March 2005.

Exhibit 2. F/V “North Star”, a 45' shrimp trawler, used during the experimental fishing.

For the modified grid, four large holes were cut, below and above the gore, on both sides, in front of the grid (Exhibit 3). The cutaway of the netting did not affect operation of the gear during deployment and retrieval.

7.3 Data analysis

Catches were sorted by species. All shrimps were weighed to near 0.5 kg. Three samples of about 1 kg were taken to the shore to determine average size (counts per pound). Bycatch species were separated, measured and weighed. During analysis bycatch species were grouped into four categories as follows:

Exhibit 3. The modified grid being retrieved.

Primary controlled species (PCS):

- Atlantic cod (*Gadus morhua*)
- haddock (*Melanogrammus aeglefinus*)
- yellowtail flounders (*Pleuronectes ferruginea*)
- American plaice, dab (*Hippoglossoides platessoides*)
- witch flounder, grey sole (*Glyptocephalus cynoglossus*)
- windowpane (Scophthalmus aquosus)
- winter flounder, blackback *(Pleuronectes americanus*)

Other controlled species (OCS):

- silver hake, whiting (*Merluccius bilinearis)*
- red hake (*Urophycis chuss*)

monkfish, goosefish (*Lophius americanus*)
ocean pout *(Macrozoarces americanus)*
redfishes (*Sebates spp*)
Atlantic herring (*Clupea harengus*)

Lobster:

American lobster *(Homarus americanus*)

Trash species:

sea raven (*Hemitripterus americanus*)
longhorn sculpin (*Myoxocephalus octodecemspinosus*).

Statistical analysis was carried out for species with substantial numbers (American plaice, Atlantic herring and American lobster) using student's t test.

8. PARTNERSHIP

The project has been a true partnership between Capt. Vincent Balzano of F/V " North Star" and Dr. Pingguo He of University of New Hampshire. Input from Capt. Balzano was invaluable to the success of this project and the continuing project followed.

9. RESULTS

Of the 18 tows, eight were made with the standard grid and 10 were made with the modified grid. Average shrimp catches were 131 kg (288 lbs) per hour tow for the standard grid compared with 153 kg (337 lbs) per hour for the modified grid, an increase of 17%. However, the difference is not statistically different due to small number of tows (t test, $P>0.1$). The size of shrimp caught was similar, average 38.1 counts per pound for the standard grid compared with 39.1 counts for the modified grid.

Bycatch was quite low during the experimental period, with total bycatch range from less 1% to as high as 8%. The modified grid caught less bycatch species of all four categories as seen in Exhibit 4.

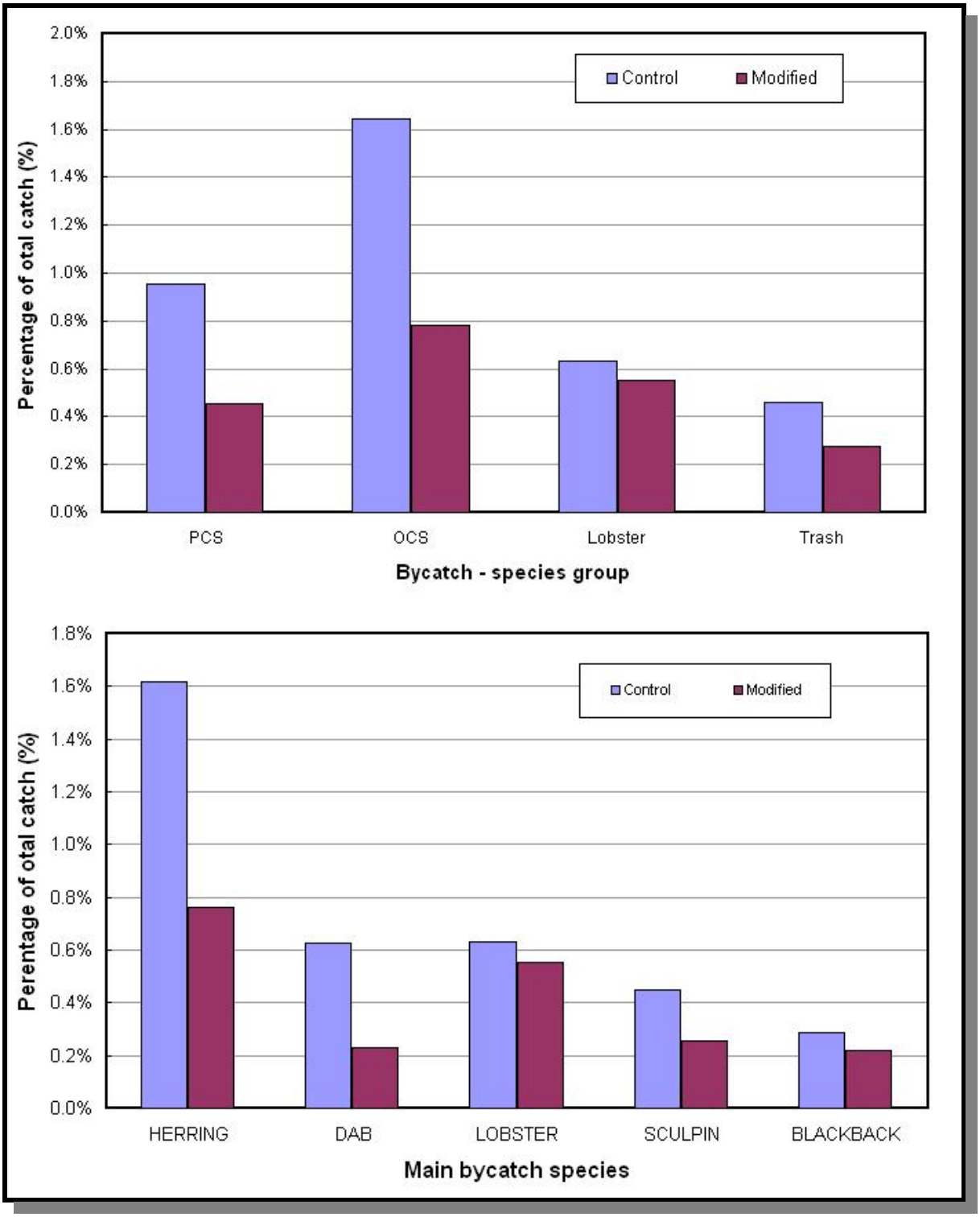

Exhibit 4. Comparison of the amount of bycatch (as percentage of total catch) between the standard grid and the modified grid. Top: species groups, bottom, major species. PCS - primary controlled species, OCT - other controlled species, Trash - trash species.

The modified grid resulted in less than half of the primary controlled species (PCS) compared with the standard grid, though both grids produced less than 1% of PCS in weight. The primary species was mainly consisted of juvenile American plaice. The modified grid resulted in significantly less American plaice both by number or by weight (per tow) (t test, $P<0.01$). Other controlled species was mainly consisted of Atlantic herring. Though the modified grid caught less herring (average 123 vs. 82 per tow), the difference is not statistically significant. The same is true for lobsters and trash fishes.

The modified grid worked very well in terms operation, shrimp catch and bycatch reduction. It is somewhat surprising to see an increase of shrimp catch, though not statistically significant. The increase in shrimp catch may be due to less blockages of bycatch species on the grid as a result of more openings for fish and shellfish (lobsters) to escape. Reduction in bycatch species was expected as the extra openings would provide more escape opportunity for all finfish species, as well as lobsters.

We are very encouraged that shrimp seemed not being lost with extra openings in front of the grid. It was considered feasible to remove all or most of netting in front of the grid to further assist escape of fish and lobsters. The concept was proposed to the Northeast Consortium for a continuing project and was funded. The result of that project will be available in a separate report.

10. IMPACTS AND APPLICATIONS

Limited number of tow showed great potential of modifying the Nordmore grid to further reduce bycatch fish and shellfish species during trawling for pink shrimps in Gulf of Maine. Similar rigging, or their further modifications would provide opportunities to reducing bycatch to the minimum. With surging of young classes of haddocks on George Bank as reported by NMFS surveys, and in Gulf of Maine as revealed by this author when conducting mesh size experiment in 2004 (He, unpublished), there is a great possibility that juvenile haddock could become a major bycatch species in shrimp trawls in the next a few years. This research team, together with Maine Department of Marine Resource, the major play in shrimp research and management, has proposed further works in optimizing finfish and small shrimp bycatch reduction devices in

shrimp trawls to assist in groundfish recovery, and preserving shrimp resources.

11. RELATED PROJECT

A proposal on modified shrimp grid to reduce bycatch and small shrimps was proposed by the research partner and was subsequently funded by the Northeast Consortium. That project continues this development project. Sea trials of that project have been completed and data are being analyzed. The results are very encouraging with significant reduction in small shrimps and finfish bycatch. The research team, partnering with others in the shrimp industry is proposing to optimize the shrimp size sorting grid design and to foster adoption of the technology in the industry.

12. ACKNOWLEDGMENT

The project was supported by the Northeast Consortium, a join initiative of the University of New Hampshire, University of Maine, Massachusetts Institute of Technology and Woods Hole Oceanographic Institution. Crew of F/V "North Star" provided valuable contribution to the operation and sampling of the catch. Rachel Hamilton of UNH participated sea trials.

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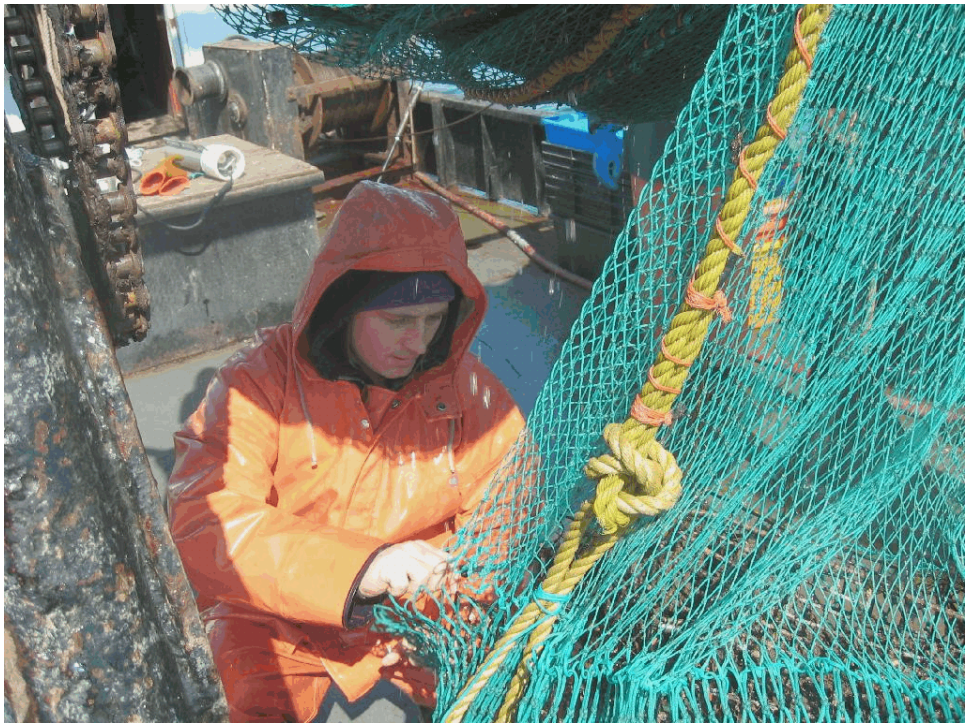
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