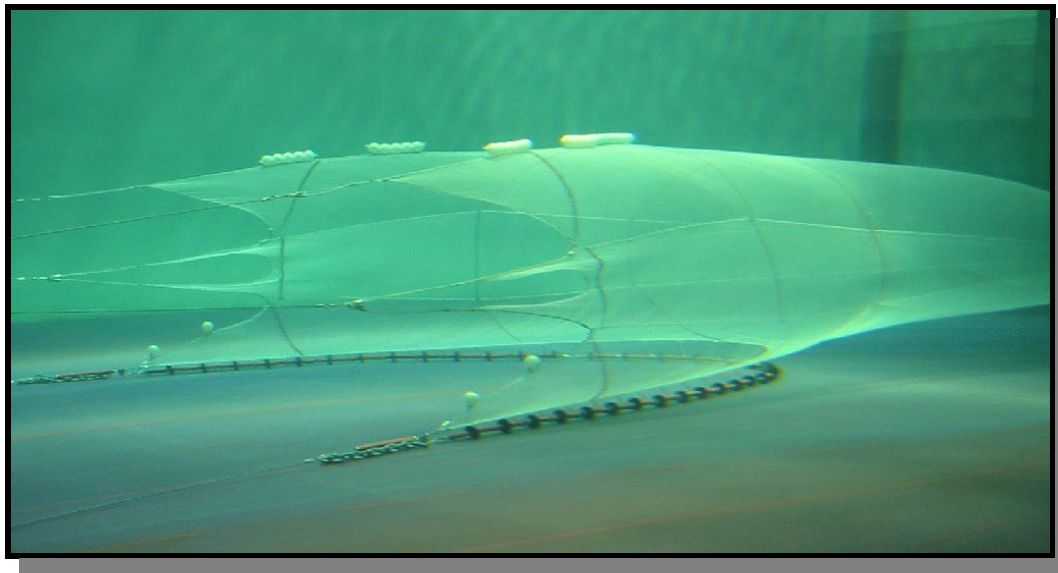




**UNIVERSITY OF NEW HAMPSHIRE
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Report

**Reducing Seabed Contact of Trawling:
Design and model test of a semi-pelagic shrimp trawl for the pink shrimp fishery**



Submitted to:



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

September 13, 2002

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by

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Summary. Bottom trawling alters physical and biological structure of the seabed. While effect of alteration on benthic ecosystem and fish population has yet to be clarified, reducing alteration would be viewed positively by all concerned with the marine environment and fishery. This project is the first phase of the project “Reducing Seabed Impact of Trawling”. This initial phase involved gear design and model tests of a semi-pelagic shrimp trawl with its doors off bottom while leaving the trawl on the bottom. Tank tests have resulted a new three-bridle trawl with longer bridles. Tests showed that the semi-pelagic trawl was able to stay in contact with the seabed when trawl doors were at height as much as 30' off bottom. A follow-up project to test the new semi-pelagic shrimp trawl at sea in Gulf of Maine pink shrimp fishery has been planned for the next shrimp fishing season.

1. INTRODUCTION

Trawling is one of the major fishing methods for harvesting groundfish, flatfish, and shellfish in New England waters. According to Dorsey and Pederson (1998), area swept by trawls in the Gulf of Maine equals to the area of the gulf itself, ie. every square metre of the gulf is swept once every year. Concentrated trawling areas such as Georges Bank have reported to have been swept three to four times every year in recent years. There are many, often contradictory, opinions and results regarding the effect of trawling on fish population and biodiversity, but generally on the negative side. With the Essential Fish Habitat requirement in the 1996 Sustainable Fishery Act, evaluation of the effect of trawling on fish habitats and devising means to reduce negative effects become priority in fisheries research.

The International Council for the Exploration of the Sea (ICES) Working Group on Ecosystem Effect of Fishing Activities (ECO) and Working Group on Fishing Technology and Fish Behaviour (FTFB) have been examining trawling effect for many years. ICES FTFB meetings held in St. John's Newfoundland in 1999 and in Haarlem Netherlands in 2000 discussed extensively the alteration of seabeds caused by towed gears such as bottom trawls, beam trawls and shellfish dredges, and potential impact of these alterations (ICES, 1999; 2000). Researchers in ICES member

countries including those in the United States were encouraged to initiate or continue studies to evaluate impact or to reduce the potential impact of towed fishing gears on the seabed. In the United States, reducing seabed impact of fishing operations and protecting essential fish habitat are required in Sustainable Fishery Act (SFA). While physical alterations of the seabed by towed gears are evident, the effect of the alterations on benthic organisms and recovery rates of the alteration are variable depending on location, depth, and natural disturbance in the area. The researchers are making effort to quantify the effects and to devise means to reduce alterations and their impact on the ecosystem.

The most recent publication “Effect of Trawling and Dredging on Seafloor Habitat” by National Research Council (NRC, 2002) documented various effect of trawling and dredging. One of the recommendations by NRC’s Committee on Ecosystem Effects of Fishing is to modify gear designs and operations to reduce seabed contact during fishing. The Committee further pointed out that development of new low impact gear should use fishermen’s knowledge and experience to “ensure mitigation strategies are practical, enforceable, and acceptable to the fishing community” (NRC, 2002, p6). In addition, National Marine Fisheries Services (NMFS), in partnership with the American Fisheries Society, will be convening a symposium on benthic impact of fishing this fall to bring together researchers from various states and countries and to summarise our understanding and status of the subject.

Bottom trawls towed over the seabed may leave marks as a result of trawl doors, footgear components, chafing mats, and other gear components coming in contact with the sea floor. The degree and extent of marks vary with the type of gear and its rigging, types of seabed, and operating methods. Biological impacts of these marks on benthic organisms and commercial species may depend on the energy level of currents and other water motion and upwelling on the fishing grounds, sensitivity of the area, and species composition.

Several studies have been completed and many are ongoing concerning the potential impact of fishing with bottom trawls on the seabed and marine habitat. A recent conference held under the auspice of MIT Sea Grant summarized progresses in this country (Dorsey and Pederson, 1998). While impact of the physical alterations of the seabed by bottom trawls on benthic organisms are not well understood, and varies with many factors, lessening the potential effect will be welcomed by all concerned with the issue.

The overall objective of the project was to eliminate seabed contact of trawl doors by using a pair of pelagic trawl door operating off the seabed while keeping ground gear of the trawl on the seabed, thus maintaining the same harvesting efficiency. The project will involve redesigning of the front part of a commercial shrimp trawl, choosing a pair of midwater trawl doors through flume tank simulations and commercial evaluation. The specific objectives of this project are:

- ◆ Evaluate gear design and flume tank test results of a semi-pelagic shrimp trawl and to produce a practical design and rigging plan of a prototype semi-pelagic shrimp trawl;
- ◆ To fabricate/select a prototype gear including a pair of midwater trawl doors suitable for an inshore shrimp trawler of 45-55'.

2. METHODOLOGY

2.1 Gear Design and Rigging

The otter trawl is the primarily fishing gear for harvesting shrimps in the world. Of shrimp trawling operations, the bottom otter trawl, with both trawl doors and the trawl on the seabed, is the most important gear. Bottom trawls were developed for harvesting groundfish species. Sand clouds and bridles connecting the doors and the wingends herd fish toward the mouth of the trawl. Therefore good bottom contact of the door and the bridle are very important for efficient harvesting of groundfish species, especially flatfish species. Shrimp, on the other hand, cannot be herded by sand clouds and wires due to poor swimming ability. The mouth area of the trawl determines, in large extent, the amount of shrimps caught. Therefore, a trawl system with the trawl door off bottom and the trawl on the bottom should not reduce the capture efficiency of the gear, but it would reduce disturbance of seabed by the trawl door. Such trawling system is called semi-pelagic trawl (Exhibit 1). In addition, pelagic trawl doors working off-bottom offer good lift to drag ratio and can save fuel during trawling.

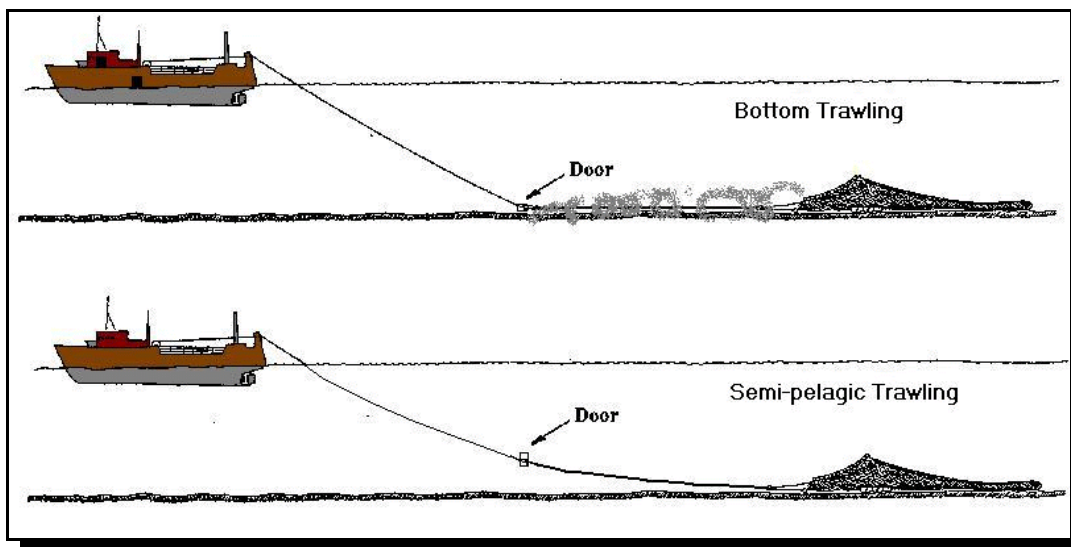


Exhibit 1. Illustration of bottom trawling and semi-pelagic trawling.

Based on the above concept, a four-panel trawl modified from a typical shrimp trawl used in Gulf of Maine inshore shrimp fishery was designed (Exhibit 2).

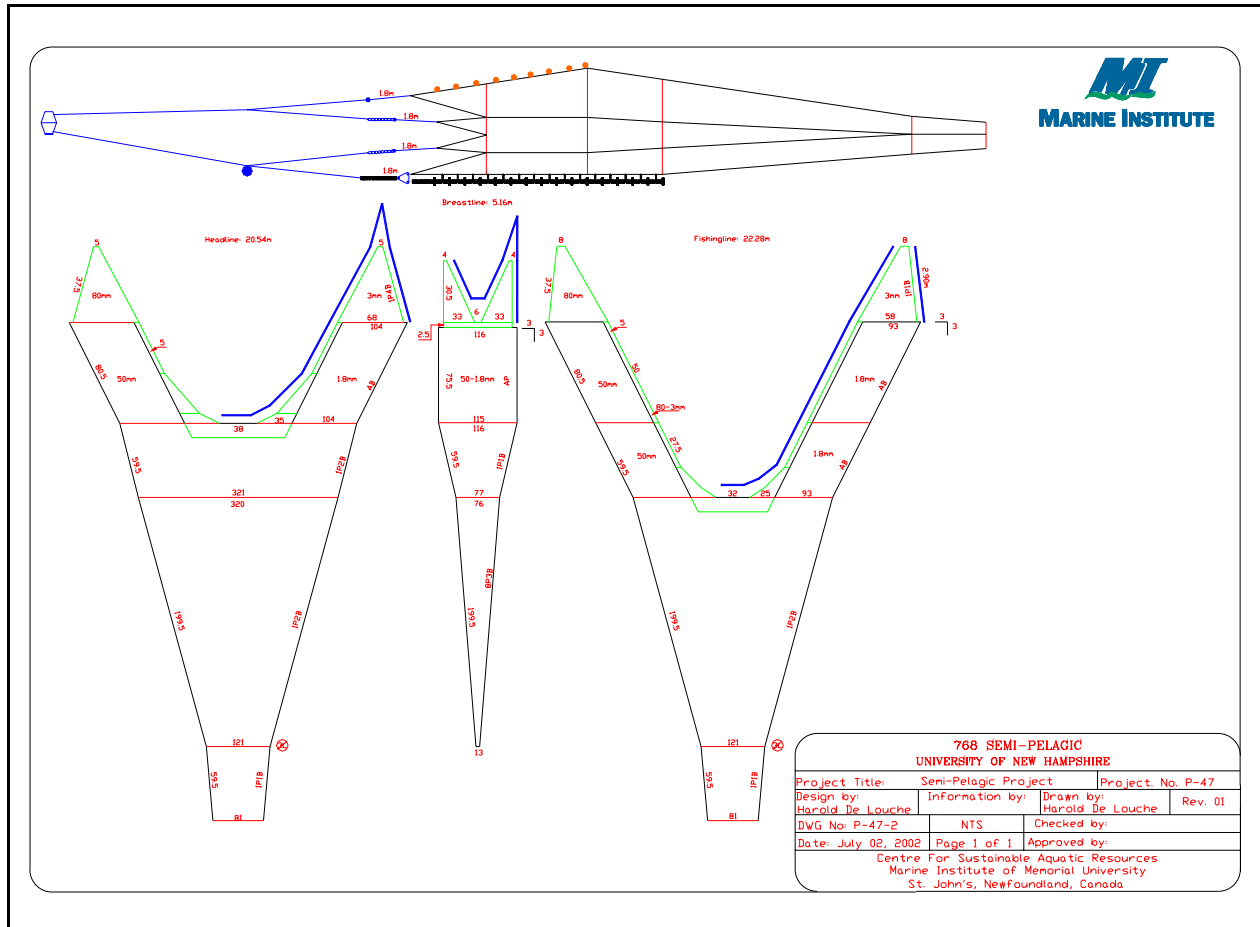


Exhibit 2. Exhibit 2. A net plan of the modified semi-pelagic shrimp trawl for the Gulf of Maine pink shrimp fishery to reduce seabed contact during trawling.

2.2 Tank testing

A 1:5 scale trawl model was constructed by the staff at the Fisheries and Marine Institute of Memorial University of Newfoundland, and was subsequently tested at its world-class flume tank. We were to determine a combination of bridle lengths, weights, floats, and towing speeds, at which the trawl would be steadily on bottom, while the door is at a distance from the bottom. A total of twelve rigs was tested during a two-day test period in June of 2002. Mr. George Littlefield, and Dr. Pingguo He participated in flume tank tests in Newfoundland.

3. RESULTS

The tests were carried out with respect to a change in towing speed from 2.0 knots to 2.6 knots, and with a change of door height of up to 30' off bottom. The distance of the footrope (sweep) off bottom, along with headline height, wingend height, door spread, and drag forces of the trawl system were measured. We were to achieve a stable footgear ground contact with a large range of door height variation. To achieve that, we found that we need to:

- ✓ Extend the length of the bridle from 60' to 150'
- ✓ Move the 100 lbs of chain weights from the end of the lower mini-bridle to the end of lower wing

We also found that three mini-bridles would be more suitable for the trawl instead of initial four-mini bridles. The wingend will be accordingly redesigned to match the three-mini-bridle system. The final rig is illustrated in Exhibit 3 and also shown as photograph in Exhibit 4.

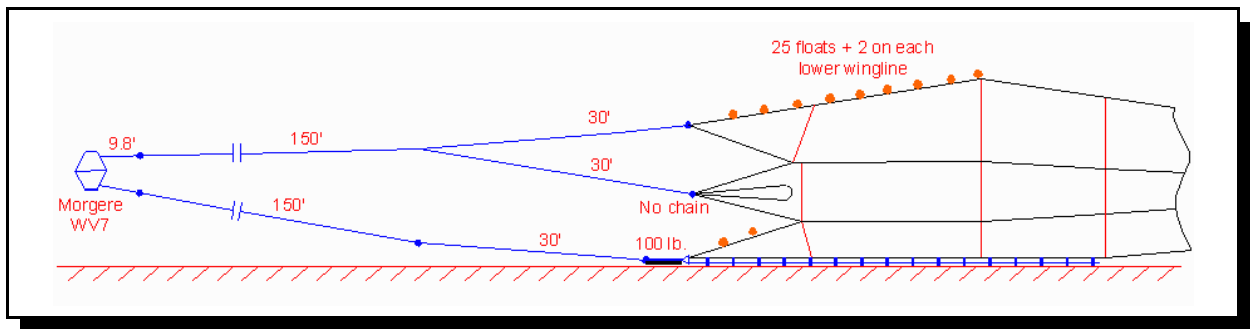


Exhibit 3. The final rig of the new semi-pelagic shrimp trawl.

4. FURTHER WORKS

Reducing Seabed contact of trawls is a long term project, with the ultimate aim to have trawls “flying” just off bottom for all near-bottom species. The next phase of the current project is to conduct sea trials of the modified semi-pelagic shrimp trawl during the next shrimp fishing season. We will compare catch rates of the modified trawl with the existing commercial shrimp trawl of the same vessel class. Future projects include design and testing trawls with a lighter footgear, and trawls with its footgear off bottom while its doors on the bottom. We will also involve design and tests of other alternative gears which are less intrusive to the seabed communities for harvesting traditional species instead of trawls.

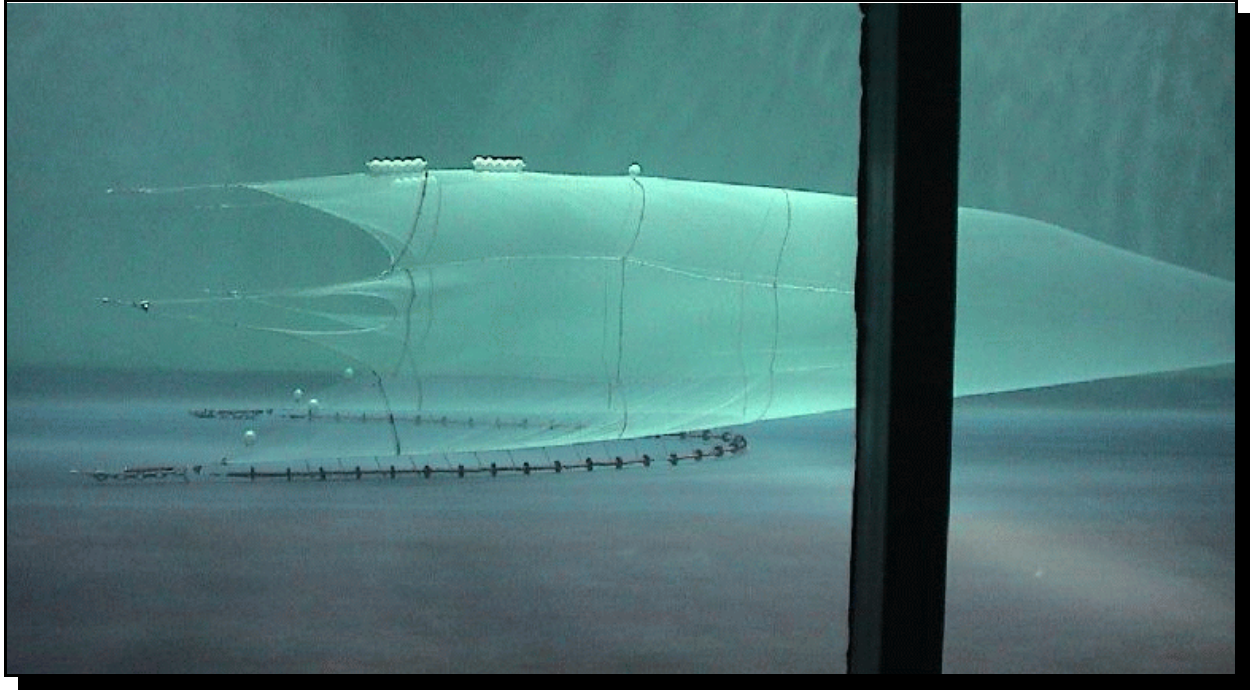


Exhibit 4. The semi-pelagic shrimp trawl model seen in the flume tank at the Memorial University of Newfoundland. The trawl doors which fly off the bottom are on the left of the trawl and not seen in this photo.

5. ACKNOWLEDGMENTS

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