



**UNIVERSITY OF NEW HAMPSHIRE
INSTITUTE FOR THE STUDY OF EARTH, OCEANS AND SPACE
OCEAN PROCESS ANALYSIS LABORATORY
DURHAM, NH 03824**

Annual Progress Report

**Further Tests of Low Vertical Profile Gillnets
for Flounders in Gulf of Maine**



Submitted to:



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

July, 2007

UNH-FISH-REP-2007-041

Further Tests of Low Vertical Profile Gillnets for Flounders in Gulf of Maine

by

Pingguo He

(Principal Investigator)

with assistance from Tracey Smith and Sean Maxwell

University of New Hampshire 137 Morse Hall, Durham, NH 03824.

Tel. (603) 862-3154, Fax. (603) 862-0243, Email: pingguo.he@unh.edu

In association with

Industry Partners:

Randy Gauron - F/V “Capt. Al”, Hampton, NH,

Steve Welch - F/V “Holly & Abby”, Scituate, MA

Peter Inniss, F/V “Barbara & Lynn”, Portland, ME

and

Collaborator

Michael Pol, Massachusetts Division of Marine Fisheries, Pocasset, MA

Submitted to

The Northeast Consortium

The University of New Hampshire

142 Morse Hall, Durham, NH 03824

July, 2007

You may cite this report as:

He, P. *et al.* (2007). Further tests of low vertical profile gillnets for flounders in Gulf of Maine. Progress report submitted to the Northeast Consortium. University of New Hampshire, Durham, NH. UNH-FISH-REP-2007-041. 16 p.

UNH-FISH-REP-2007-041

Project Title: Further Tests of Low Vertical Profile Gillnets for Flounders in Gulf of Maine

Project leader: Pingguo He
University of New Hampshire 137 Morse Hall, Durham, NH 03824.
Tel. (603) 862-3154, Fax. (603) 862-0243, Email: pingguo.he@unh.edu

Other key participants:

Industry Partners: Randy Gauron - F/V “Capt. Al”, Hampton, NH,
Steve Welch - F/V “Holly & Abby”, Scituate, MA
Peter Inniss, F/V “Barbara & Lynn”, Portland, ME

Collaborator: Michael Pol, Massachusetts Division of Marine Fisheries
Pocasset, MA

Assistants: Tracey Smith and Sean Maxwell, University of New Hampshire

Summary

This project will test three types of low profile flounder gillnet to reduce cod catch in the Gulf of Maine (GOM). The three designs of low vertical profile gillnets were 12 meshes deep (MD) and 8 MD and with different floatation and hanging ratios. These nets are compared with regular 25 MD cod gillnets, foam-core flounder nets and the tie-down flounder nets. The nets with lower vertical profiles have been shown to reduce cod catch while maintaining comparable flounder catch in a previous experiment though overall catch rates were low. The nets have been tested in Maine and New Hampshire, and will be tested in Massachusetts to demonstrate their suitability under different fishing conditions. The preliminary data from sea trials just completed seem to confirm earlier findings. Low profile nets may also reduce probability of entanglement of porpoise and other marine mammals in gillnets.

Rationale

The recent report of the New England Fisheries Management Council indicated tremendous increases in overall biomass of twelve managed groundfish stocks in the northeast of the United States. Unfortunately, Atlantic cod (*Gadus morhua*) stocks, both in the Gulf of Maine (GOM) and on Georges Bank, are still “overfished” and still experience “overfishing” (Howard, 2003). Various management measures implemented and/or being considered are aimed at reducing the mortality

of cod thereby aiding quicker recovery of the stocks. One of the measures proposed and implemented in Amendment 13 to the Northeast Multispecies Management Plan is to reduce fishing effort by reducing Days-At-Sea (DAS) and by creating so-called “B” DAS. Under proposed measures, fishermen may use regular “B” DAS to target “healthier” stocks with minimum catch and discard of depressed stocks such as GOM and Georges Bank cod (NEFMC 2004). This project addresses this situation to design and test low vertical profile gillnets suitable for “B” DAS use in inshore GOM targeting flounder species: American plaice, greysole and winter flounder.

Amendment 13 called for a daily cod landing limit of 800 pounds with Framework 41B reducing the limit to 600 pounds. At times, regular gillnets can land far more than the landing limit, resulting in discards of excess fish. Use of gillnets with less catching power for cod will thus reduce this type of regulatory discard. Flounders stay relatively closer to the seabed than cod. Winter flounders on the fishing grounds were never observed to rise more than 0.6 m off the seabed (He, 2003). Though other flounder species may have different behaviors, they are all considered bottom-affinitive. Therefore a low vertical profile net may be able to catch as many flounder as gillnets of high vertical profiles, and less cod.

The National Marine Fisheries Service has taken bycatch and discard of overfished stocks very seriously with strategic plans to understand and reduce bycatch of these species or stocks (NOAA, 2003; 2004). Development of species selective fishing gear has been considered one of the approaches to reduce bycatch or unintended catch during fishing operations. This proposal addresses this research priority and seeks funding to carry out a cooperative research project to further test species selective low vertical profile gillnets targeting flounders while avoiding Atlantic cod.

Low vertical profile nets also have potential to reduce interaction with and subsequent entanglement of marine mammals. A study of incidental mortality of harbor porpoises (*Phocoena phocoena*) in a gillnet fishery in the lower Bay of Fundy indicated that the vast majority of porpoises (96%) were caught by the upper two-thirds of the regular groundfish gillnet net of 25 meshes deep (Trippel *et al.*, 1996). The proposed low vertical profile nets will be about one-third the height of the regular gillnet used in the Gulf of Maine and in the Bay of Fundy. The use of low vertical profile nets may therefore drastically reduce the harbor porpoise mortality in the gillnet fishery, although we do not propose to test this aspect of the gear.

It is therefore envisaged that a successful low vertical profile gillnet will be able to maintain flounder catch while reducing catch of cod, providing an option for use as a “B” DAS gear. Use of the lower vertical profile net will also result in less cod discard. The new gillnet will contribute to the effort of reducing marine mammal interactions in the Northeastern USA.

The University of New Hampshire (UNH) and Massachusetts Divisions of Marine Fisheries (DMF) have independently carried out gillnet projects aiming at reducing cod catch in Gulf of Maine in the past couple of years and with varying degrees of success. We have joined our efforts to continue the low profile gillnet project so that a commercially viable cod-avoiding gillnet can be demonstrated in a variety of fishing conditions. This report describes progress of the project carried out with industry partners from Maine, New Hampshire and Massachusetts.

Review of Previous Work

Several studies have been attempted to reduce catch of cod in gillnets by rigging nets to reduce the vertical profile. They include dual-leadline nets, tied-down nets and/or nets with fewer meshes in depth. The 8 meshes deep (MD) low profile gillnet tested by UNH and two other experimental gillnets tested by DMF, both with support from the Northeast Consortium, have demonstrated possibilities of reducing cod catch while maintaining flounder catch compared with regular commercial gillnets (He, & Gauron, 2003; Pol, *et al.* 2003; He, 2006). Similar research was carried out in Newfoundland (Springle, 2002; 2003) in conjunction with mesh size selectivity studies for the fishery targeting American plaice (*Hippoglossoides platessoides*).

Pingguo He, the principal investigator, received cooperative research funding from the Northeast Consortium in 2002 to study a lower vertical profile gillnet and its ability to reduce cod catch. In that project, four types of two low profile nets of 8 MD and 12 MD were compared with regular 25 MD cod nets and 25 MD tie-down flounder nets (He & Gauron, 2003). Fishing was carried out in the western Gulf of Maine off New Hampshire in 2002 and 2003. The results indicate that the 8 MD nets caught slightly more flounders while cod catch was only about 25% of the standard cod net (Exhibit 1). However, flounder catch rates of the 8 MD nets were low compared with those of the tie-down flounder nets. The project also found, however, that the tie-down nets were much “dirtier” with much more bycatch of other demersal fish and shellfish, such as lobsters, crabs, and sculpin. The tie-down nets also caught smaller cod compared with other three net types. An alternative to

the tie-down net for harvesting flounders is thus desirable to reduce bycatch of these non-commercial species. However, the alternative nets must have comparable flounder catch rates for commercial viability. Therefore, one of the objectives of this further research is to improve flounder catch of the new cod-avoiding gillnet such as the low vertical profile nets. For gear rigging variations, the amount of buoyancy and hanging ratio are two of the important factors affecting catch efficiency (Angelsen et al., 1979; Angelsen, 1981; Stewart, 1987). We are thus proposing to test the low vertical profile nets by varying buoyancy on the headline and the hanging ratio.

	Std	Tie-down	12 MD	8 MD	8 MD vs. Std	8 MD vs. Tie-down	8 MD vs. 12 MD
Cod	31.5	10.5	13.6	7.7	***	**	***
Flounders	3.7	11.2	4.6	5.3	8	***	NS
Monkfish	2	3.5	1.9	1.8	NS	***	NS
White hake	4.9	2.7	1.8	1.2	***	***	NS
Lobster	1.4	4.6	1.5	1.3	NS	***	NS
Rock crab	1.2	2.5	1	0.9	NS	***	NS
Dogfish	37.9	21.3	25.6	25.5	**	P>0.05	NS
Skates	1	4.2	0.5	0.5	*	***	NS
Sea raven	0.8	1.6	0.5	0.7	NS	*	NS

*** P<0.001, ** P<0.01, * P<0.05, NS: non-significant (P>0.05), +: marginally significant (P=0.05)

Exhibit 1. Mean number of fish or shellfish caught per five-net fleet of different types during forty comparative fishing sets. STD – the standard cod net, Tie-down – the tie-down flounder net, 12 MD and 8 MD – the 12 meshes deep and the 8 meshes deep experimental net (He, 2006).

Michael Pol, the co-investigator of the project, and his colleagues at the Massachusetts Division of Marine Fisheries (Pol, *et al.*, 2003) tested some innovative gillnets to reduce cod catch with funding from the Northeast Consortium. Their rigging, designed by gillnet fisherman Robert MacKinnon, included a dual-leadline gillnet, and a flounder gillnet with weight added to the headline at regular

intervals. Both experimental nets were designed to reduce the vertical profile of the net to take advantage of close-to-bottom behavior of flounders. In comparison to the standard flatfish net for Massachusetts (using a foam-core headrope), both experimental nets were successful in reducing the catch of legal size cod (Exhibit 2). Additionally, the sizes of yellowtail, winter, and undersized cod were all similar between the standard foam-core net and the experimental nets. Adoption of either the dual leadline or the weight-added net would decrease bycatch of cod while preserving flatfish catch rates. These results further supported the hypothesis that lowering the profile of gillnets reduces cod catch while maintaining catches of flatfishes.

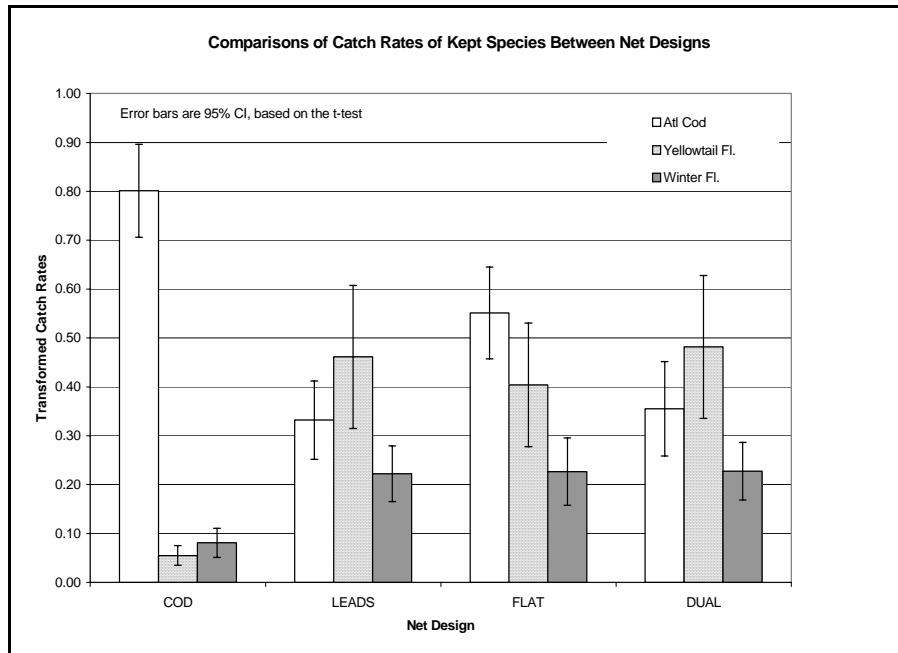


Exhibit 2. Comparison of kept species between net types (Pol *et al.*, 2003).

Scandinavian countries have a long tradition of fishing gillnets and have one of the most developed gillnet fisheries in the western world. Flounder gillnets used in Denmark and Scandinavian countries usually have 8-14 meshes in depth and are very much different from the high profile cod-nets which are 15-35 MD, and up to 55 MD for fishing on top of wrecks (T. Moth-Poulsen, pers. comm.). Flounder nets are usually hung slacker with a hanging ratio (which is a measurement of the “slackness” of the net) between 0.24 and 0.28, compared with those for cod and other roundfish which are usually 0.5. These flounder nets are very species selective and have very little bycatch of cod (Moth-Poulsen, 2003; Madsen *et al.*, 1999). These nets are developed by the industry and

used commercially because they are more economically feasible than tall nets in the directed flounder fishery.

Project Objectives

The overall objective of the project is to design and test low vertical profile gillnets to reduce catch of cod in the flounder gillnet fishery in the Gulf of Maine. The experimental gillnets will target flatfish species very close to the bottom. The specific objective of this project is to conduct sea trials on two types of experimental gillnets and compare catch of target and bycatch species with three existing gillnets involving three fishing vessels from three different states in the Gulf of Maine. The results from three different locations will provide more evidence of suitability of experimental low profile gillnets for the Gulf of Maine multispecies fishery. Further, this project will determine catch rates for tie-down gillnets. Basic information on the performance of these types of nets is lacking and represents a large data gap in our management of gillnet fisheries.

Approaches and Experimental Design

Fishing Gear and Operations.

F/V “Barbara & Lynn” - Portland, ME

Five types of nets were fished off Portland, ME onboard F/V “Barbara & Lynn”. The gears were:

- 25R - 25 MD regular cod net, regular (50%) hanging ratio, regular floatation (1 float/fm)
- 25 TD - 25 MD tie-down net, regular (50%) hanging ratio, 50% floatation (1float/2 fm). 4’ tie-down twine every 12’ (2 fm), at the floats.
- 12 - 12 MD tie-down nets, 24” tie-down twines every 12’ , 50% of regular floatation (1 floats/2 fm).
- 8S - Slackly hung 8 MD net, 30% hanging on the headrope, 33% hanging on the footrope. Headrope was 48 fm long and the footrope was 52 fm long when rigged. The stretched net length will be about 160 fm. 50% of regular floatation (1 floats/2 fm). 24” tie-down twine every 12’.
- 8 R - Regular hung 8 MD net, regular (50%) hanging ratio top & bottom, 50% of

regular floatation (1 float every 2 fm). 24" tie-down twine every 12'.

All nets were made with #12 monofilament nylon, 6 ½" mesh size and was dark green in color. All nets were 50 fm hung length, except for 8S which was 48 fm in the headrope and 52 fm on the footrope.

Ten nets, two each type were connected in a fleet. There was a 10 fm rope between the net. The net sequence were rotated to give each types of net similar opportunity on the end or in the middle of a fleet. Six fleets of net were fished each day. A total of fifteen days were fished with two day in the rolling closure area.

F/V "Capt. Al", Hampton, NH:

Five types of nets were fished off Hampton, NH onboard F/V "Capt. AL". The gears were:

- 25R - 25 MD regular cod net, regular (50%) hanging ratio, regular floatation (1 float/fm)
- 25 TD - 25 MD tie-down net, regular (50%) hanging ratio, 50% floatation (1float/2 fm). 4' tie-down twine every 12' (2 fm), between the floats.
- 25 FC - 25 MD foam-core net. ½" foam-core as headline, no additional floats.
- 8S - Slackly hung 8 MD net, 30% hanging on the headrope, 33% hanging on the footrope. Headrope was 48 fm long and the footrope was 52 fm long when rigged. The stretched net length will be about 160 fm. 50% of regular floatation (1 floats/2 fm). No tie-down twines.
- 8 R - Regular hung 8 MD net, regular (50%) hanging ratio top & bottom, 50% of regular floatation (1 float every 2 fm). No tie-down twines.

All nets were made with #14 monofilament nylon, 6 ½" mesh size and was dark green in color. All nets were 50 fm hung length, except for 8S which was 48 fm in the headrope and 52 fm on the footrope.

Similar to Maine experiments, ten nets, two each type were connected in a fleet. There was a 10 fm rope between the net. The net sequence were rotated to give each types of net similar opportunity on the end or in the middle of a fleet. Four fleets of net were fished each day. A total of twenty days were fished.

In addition, two fleets of the nets from F/V “Barbara & Lynn” were also fished towards the end of the sea trials.

F/V “Holly & Abby”, Scituate, MA:

Five types of nets will be fished off Scituate, MA onboard F/V “Holly & Abby”. The gears will be similar to those used in NH, except that #10 mono twine will be used. Sea trials are planned for July. Eight fleets of net will be fished. Some nets from ME and NH trials will also be used to compare the effect of twine size on flounder catch.

Sampling, Measurement and Analysis.

One UNH technician was onboard ME and NH fishing vessels to record sizes and species of fish caught and the position of fish caught in the net. Measurements include fish length. In addition to commercial species, discards and “trash” fish and shellfish were also be recorded and compared. “Spoiled” commercial species were recorded. A technician from Massachusetts Division of Marine Fisheries will be onboard F/V ‘Holly & Abby’ during fishing trials in MA.

Data are stillbeing entered into computer, and analysis will be carried out soon. Analysis will be carried out in terms of the number of fish caught from each type of net, size distribution, species composition, and variations between locations, days, and vessels. Analysis of variation may be carried out to evaluate if the data from the net of the same design can be combined. ANOVA or paired t-tests may be carried out between and among adjacent nets of different designs. Other statistical analysis, such as log-transformations to normalize the data, may be carried out if warranted.

Partnership

There are three fishing vessels involved in the project. The vessels are from three states around the Gulf of Maine. The project also involves in Massachusetts Division of Marine Fisheries which will coordinate and conduct sea trials on board the MA vessel F/V “Holly and Abby”. Partnership among the research team is very strong.

Work Completed to Date

The following items have been completed:

- Conceptual design of two designs of the low vertical gillnet
- Work plan
- Permit application
- Gear construction
- Sea trials with F/V “Barbara & Lynn”
- Sea trials with F/V “Capt. Al”
- Preliminary analysis of data from F/V “Barbara & Lynn” and F/V “Capt. Al”

The following items will be carried out:

- Sea trials with F/V “Holly & Abby”
- In depth analysis of data

Results to Date

F/V “Barbara & Lynn” fished between 05/7/06 and 06/07/06, 2006 for a total of fifteen days (retrievals). Thirteen fishing days were in open fishing area (Session 1) and two last days were fishing inside the Rolling Closure area (Session 2). Catch rates were very low during Session 1, and were reasonable during Session 2. Catch data from the two sessions are analyzed separately.

During Session 1, catch of roundfish (cod, haddock and pollack) were very low, but there is a trend of reduced catch by the 12 MD, 8 MD Regular and 8 MD Slack nets. Catch of roundfish between two types of 25 MD nets (25 Regular and 25 tie-down) were very similar (Exhibit 3, top). On the other hand, 25 MD tie-down caught more flounders than other four types of nets.

Catch rates were higher during Session 2. Even though only 12 fleets of net were retrieved, the difference of catch of roundfish and flounders by different net types were clear (Exhibit 3, bottom), with reduced catch of cod by the gillnets of low headrope height (12 MD and 8 MD nets). The 25 MD tie-down nets caught more flounders, but the difference was not significant. Fleet by fleet comparison of the catch of cod is shown in Exhibit 4.

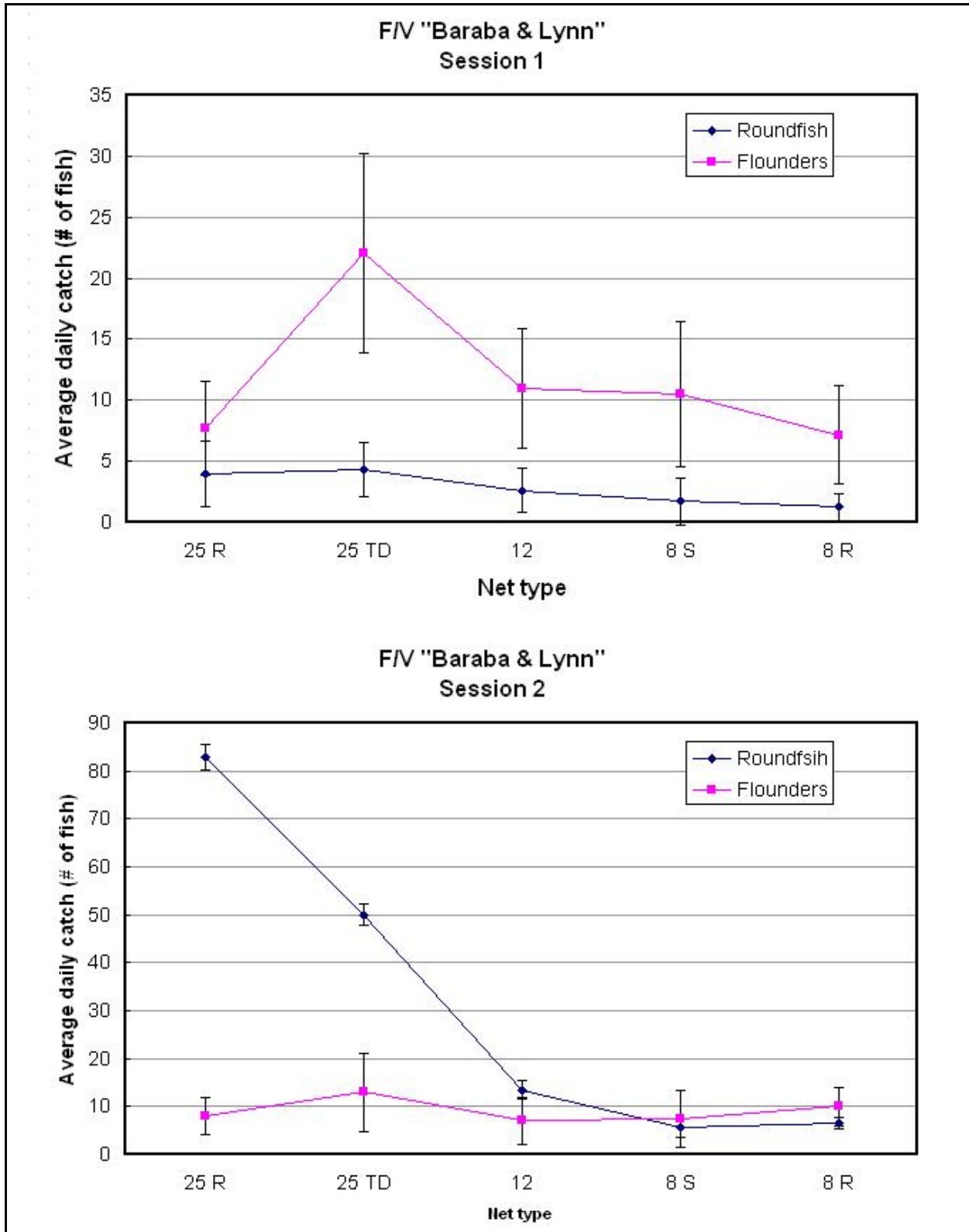


Exhibit 3. Catch rates of roundfish (mainly cod and pollack) and flounders (dab, yellowtail and winter flounder) by five different types of nets during Session 1 and Session 2, off Portland ME.

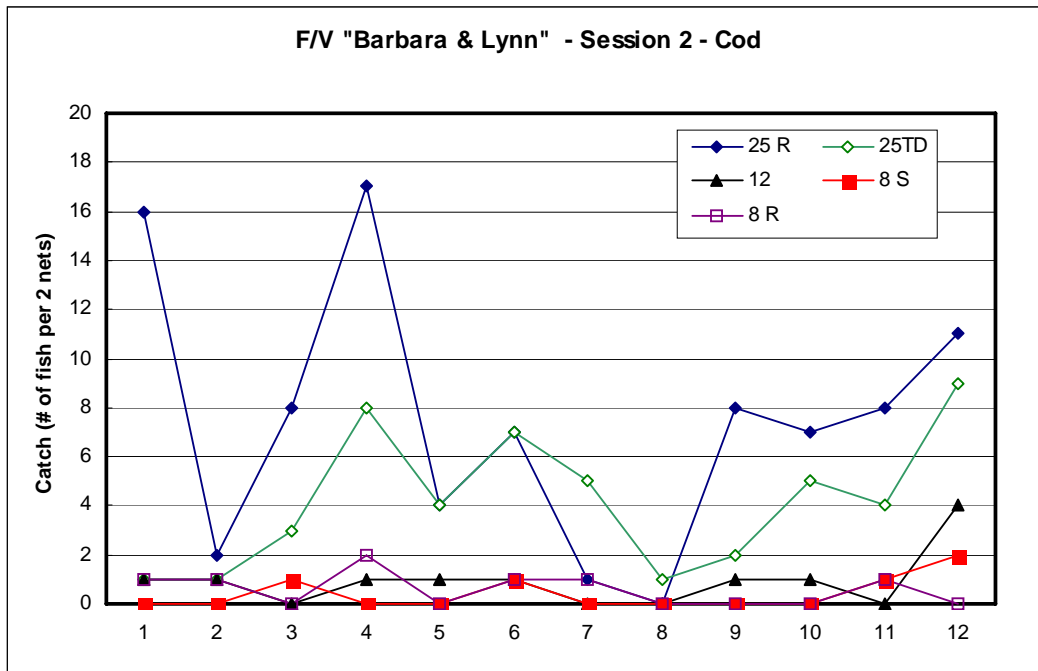


Exhibit 4. Fleet by fleet catch rate of cod by different types of net during Session 2.

F/V “Capt. Al” fished for 20 days between 5/31/06 and 6/25/06. For the original four fleets of five net types were fished for 18 hauls while the other two were fished for 6 hauls and then replaced with two fleets of nets from F/V “Barbara & Lynn”. These nets (3P and 4P) were fished for a total of 12 hauls, with 9 hauls in their original configuration and 3 hauls with all the tie downs cut on the 8 Mesh Deep Regular (experimental 1), 8 Mesh Deep Slack (experimental 2) and 12 Mesh Deep. Fishing took place approximately 6 miles off the coast of Hampton Beach between Cape Ann and the Isle of Shoals (Bigelow Bight) and the depth range was between 25 and 35 fathoms. The net configurations were as in Exhibit 5.

Fleet 1:	ST	TD	FC	8R	8S	ST	TD	FC	8R	8S
Fleet 2:	TD	FC	8R	8S	ST	TD	FC	8R	8S	ST
Fleet 3:	FC	8R	8S	ST	TD	FC	8R	8S	ST	TD
Fleet 4:	8R	8S	ST	TD	FC	8R	8S	ST	TD	FC
Fleet 3P:	12	8R	8S	ST	TD	12	8R	8S	ST	TD
Fleet 4P:	8R	8S	ST	TD	12	8R	8S	ST	TD	12

Exhibit 5. Fleet composition for F/V “Capt. Al”.

Preliminary analysis of the data from F/V “Capt. Al” is shown in Exhibit 6. It can be seen that the standard cod net catch more cod than each of the four other nets. Nets of 8 meshes deep (8S and 8R) catch less cod than other three nets 25 mesh deep. However, Tie-down nets (TD) and foamcore nets (FC) caught much more flounders than other three net types (Exhibit 6).

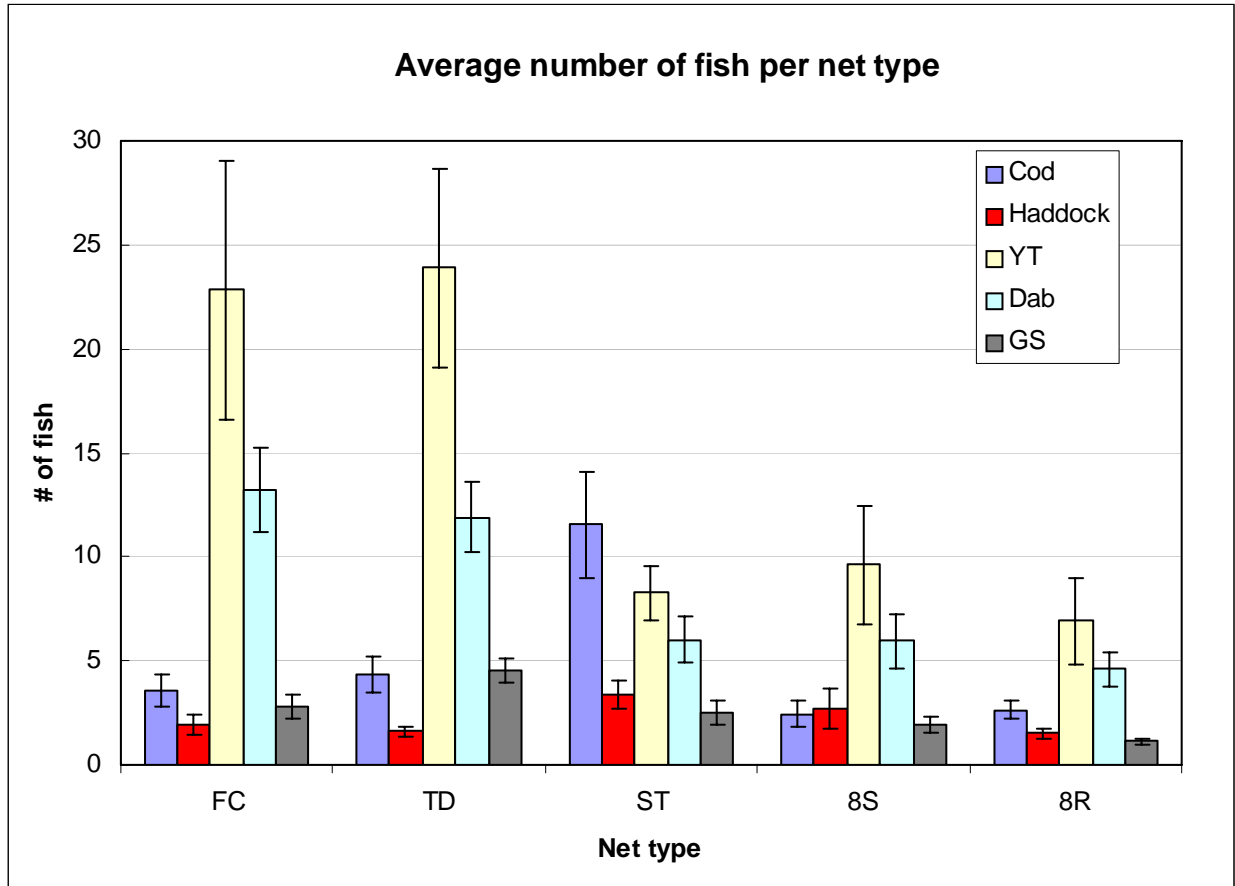


Exhibit 6. Catch of major commercial species (in number) by different types of nets. FC- 25 meshes deep foamcore nets, TD - 25 meshes deep tie-down nets, ST - standard 25 meshes deep cod nets, 8S - 8 meshes deep slackly hung net, 8R - 8 meshes deep regular hung nets.

Impacts and Applications

The major impact of the project will be the contribution to bycatch reduction of depleted stocks while sustaining commercial fisheries targeting healthier stocks. Suitable gillnet designs will have potential for “B” DAS used as proposed in Amendment 13 and subsequent Framework Adjustments

to the Northeast Multispecies fisheries Management Plan. Even though it may not be possible to evaluate reduction in marine mammal interaction through the use of low vertical profile gillnets, the use of such nets will most likely have positive effect in reducing such interaction.

The end-users of the project will include fisheries managers including NEFMC and NMFS who are striving to identify technical modifications on gear design to reduce cod mortality, and implement “B” DAS gear for the gillnet sector. The basic information on the performance of tie-down nets will fill a data gap in management. The project will benefit the gillnet sector in potential utilization of “B” DAS which otherwise will not be able to access. Potential saving in the cost of net will be an added benefit to the fishing industry.

Related Project

Design and test of low profile flounder gillnet to reduce cod bycatch, funded by NEC, 2002. This project is a continuation of the 2002 project with wider industry participation.

Student participation

One UNH senior undergraduate student participated in the project.

Literature Cited

- Angelsen, K. K., K. Haugen & S. Floen, S. (1979). The catching efficiency of cod gillnets with different hanging ratio (E) and different floatline buoyancy. ICES CM, 1979/B:19.
- Angelsen, K. K. (1981). Engineering and fish reaction aspects of gillnetting - a review. ICES CM, 1981/B:34.
- He, P. (2003). Swimming behavior of winter flounder (*Pleuronectes americanus*) on natural fishing grounds as observed by an underwater video camera. Fish. Res. 60: 507-514.
- He, P. (2006). Effect of the headline height of gillnets on species selectivity in Gulf of Maine. Fish. Res. 78: 252-256.
- He, P. & R. Gauron, (2003). The effect of vertical profile of gillnets on species selectivity in the

- Gulf of Maine. University of New Hampshire, Durham, NH. UNH-FISH-REP-2003-006. 9 pp.
- Howard, P. (2003). Rebuilding New England's Fisheries. Presented at the Conference "Managing Our Nation's Fisheries: Past, Present and Future". Washington DC. Nov. 12-14, 2003.
- Madsen, N., R. Holst, D. Wileman & T. Moth-Poulsen. (1999). Size selectivity of sole gill nets fished in the North Sea. *Fisheries Research* 44: 59-73.
- Moth-Poulsen, T. (2003). Seasonal variations in selectivity of plaice trammel nets. *Fisheries Research*, 61 (2003) 87-94.
- NEFMC (2004). Draft Framework Adjustment 40A to the Northeast Multispecies Fishery Management Plan. May 4, 2004 Online. <http://www.nefmc.org/nemulti/index.html> Accessed June 22, 2004.
- NOAA (2003). NOAA NMFS Northeast Region: Current Bycatch Priorities and Implementation Plan. Online: <http://www.nero.noaa.gov/bycatchconf/03bycatchplan.pdf>. Accessed: June 14, 2004
- NOAA (2004). NMFS Strategic Plan for Fisheries Research. US Department of Commerce, National Oceanic and Atmospheric Administration.
- Pol, M., A.H. Carr & R. MacKinnon. (2003). Testing of a low profile, low cod bycatch gillnet. Submitted to the Northeast Consortium. Massachusetts Division of Marine Fisheries, Pocasset, MA.
- Springle, J. (2002). Reducing cod by-catch in the 4R gillnet fishery for American plaice (II). Project Report: EACT-3.2002.DFO (FDP 290). 7 pp.
- Stewart, P. A. M. (1988). Measurements of the effect of tidal flow on the headline height of bottom-set gillnets. *Fish. Res.* 6: 181-189.
- Trippel, E. A., J. Y. Wang, M. B. Strong, L. S. Carter & J. D. Conway (1996). Incidental mortality of harbor porpoise (*Phocoena phocoena*) by the gillnet fishery in the lower Bay of Fundy. *Can. J. Fish. Aquat. Sci.* 53: 1294 - 1300.