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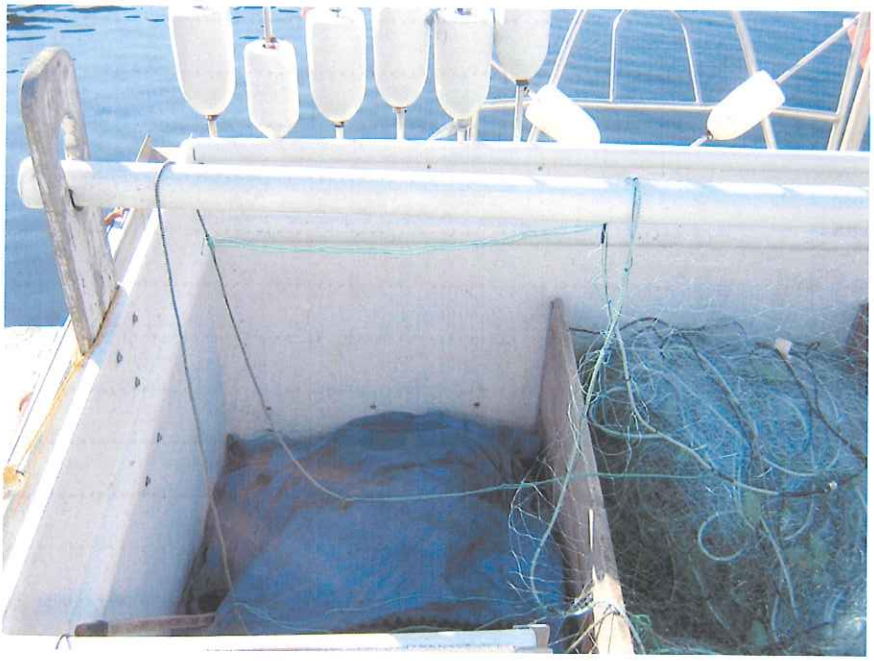
Testing Raised-Webbing Gillnets to Reduce Bycatch of Cod While Targeting Pollock



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Submitted By:

Steve Eayrs & Daniel J. Salerno
Gulf of Maine Research Institute

Prepared By:

Daniel J. Salerno
207-228-1671, dsalerno@gmri.org

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ABSTRACT

Pollock is a Gadoid fish species that is a target for many commercial fishermen using sink gillnets in the Gulf of Maine. This gear is made up of a wall of webbing extending upwards from the seabed and are used to catch many demersal and benthic groundfish species. From a stock assessment perspective, pollock are considered to be healthy and robust stock as the stock is not overfished and overfishing is not occurring. However, other fish stocks such as Atlantic cod, white hake and yellowtail flounder are not as well off and are considered species of concern due to their stock status.

The ability to target healthy fish stocks with minimal impact to species of concern has become an essential issue for fishermen and managers in the New England region. Amendment 13 to the Northeast Multispecies Fishery Management Plan developed a measure for Special Access Programs to allow fishermen to access healthy fish stocks as long as there was minimal bycatch and impact on less robust stocks. With this in mind, two Gloucester based fishermen approach GMRI with a gillnet design that could potential achieve this goal. Their design, based on observations made during commercial fishing trips, was to raise the webbing of gillnets off the seabed in order to decrease the Atlantic cod bycatch while targeting pollock. The raised-webbing would be attached across the bottom to a neutrally buoyant foot line which would be attached to the lead line by norsel lines.

Gear trials of the raised-webbing gillnets against standard commercial gear were conducted in the inshore and offshore waters in the Gulf of Maine in the winter of 2007 and 2008. Results indicated that the raised-webbing nets did indeed decrease catch, significantly for some species while maintaining similar catch rates for pollock. These results, however, should be treated as preliminary as it is believed that several factors during field trails may have influenced these findings. One factor specifically was the real time performance of the raised-webbing gillnets during the soak duration.

INTRODUCTION

Pollock, *Pollachius virens*, is a member of the Gadoid family that inhabits the North Atlantic Ocean. Regionally, they are most abundant in the Gulf of Maine [GoM], in the Great South Channel and on Georges Bank [GB] (Cargnelli et al. 1999). Pollock are a schooling species that can be found at any water level between the surface and seabed depending on season and food supply (Bigelow and Schroeder 1953). Total US commercial landings for pollock peaked at 24,500 metric tons in 1986 and then declined substantially. From 1999 to 2005, landings have fluctuated between 4,000 and 6,500 metric tons (Mayo 2006). Of the total US landings between May 2005 and January 2008, the gillnet fishery has accounted for 43% of the pollock catch[1].

Typical bottom gillnet gear consists of a wall of monofilament netting anchored to the seabed. Float lines and lead lines on the gear results in a vertical profile of the netting extending upward from the seabed. Fish are caught as they attempt to pass through the net (Sainsbury 1996). In the New England gillnet fishery, the target species of bottom gillnet fishing are usually demersal and benthic groundfish species.

There is concern for a number of these species with regard to stock status. Current stock assessments indicate that overfishing is occurring on GoM/GB Atlantic cod, white hake, and all yellowtail flounder stocks, all of which are assessed as already overfished (NEFSC 2005). For GoM/GB haddock and American plaice, overfishing is not occurring but these species are also considered to be overfished. Pollock, on the other hand, is considered to be in good shape as the stock is not overfished and overfishing is not occurring.

An effort control measure developed in Amendment 13 to the Northeast Multispecies Fishery Management Plan was categorical days at sea (DAS) allocation. A portion of a vessel's permitted DAS allocation is listed as Category B DAS. These days can only be used to target healthy stocks with stringent trip limits for stocks of concern through approved Special Access Programs as defined by the New England Fishery Management Council (NEFMC 2004). The ability to target healthy fish stocks with minimal impact on stocks of concern is essential for commercial fishermen. If a pollock fishery could be developed with minimal bycatch, perhaps a Special Access Program could be developed as this stock is considered healthy and robust.

In 2005, two Gloucester based fishermen approached GMRI with a new gillnet design that could potentially target pollock with reduced bycatch of Atlantic cod and other demersal species of concern. The design of the new gear was based on observations made during participation in the Gulf of Maine gillnet fishery. They noted that Atlantic cod are most commonly caught in the lower portion of the gear while pollock tend to be caught in the upper portion. To target pollock, they proposed to construct and test gillnets which raise the mesh netting off the seabed. The netting would be attached

[1] NMFS Northeast Multispecies Preliminary Fisheries Statistical Reports. http://www.nero.noaa.gov/ro/fso/mul.htm

across the bottom to a neutrally buoyant foot line which would be attached to the lead line by norsel lines (Figure 1).

Norsel-mounted gillnets of similar design were tested in 1999 and 2001 in northern Norway in order to address problems of red king crab bycatch in a cod gillnet fishery (Godøy et al. 2003). The gear did successfully reduce crab catches but catch rates of cod were also diminished. In the UK, dropper-equipped (similar to norsel lines) gillnets were tested and showed severely reduced cod catch rates with satisfactory hake retention (ICES 2000).

OBJECTIVE

The project proposed to evaluate the use of raised-webbing gillnets to reduce the bycatch of Atlantic cod and other demersal species of concern while targeting pollock in the Western Gulf of Maine. This objective addresses a research priority in Amendment 13 to the Northeast Multispecies Fishery Management Plan, i.e. "Research fishing practices or gear modifications that may change the ratio of component catch species or improve selectivity of gear" (NEFMC 2004). This project also addresses the Northeast Consortium's research priority on fishing gear selectivity, specifically "gear research the enhances selectivity, targets healthy stocks, and minimizes harvest loss and bycatch".

PARTICIPANTS

Steve Eayrs
Research Scientist
Fish Behavior / Gear Technology
Gulf of Maine Research Institute
350 Commercial Street
Portland, Maine 04101

Daniel J. Salerno
Collaborative Research Technician
Gulf of Maine Research Institute
350 Commercial Street
Portland, Maine 04101

Shale Rosen
Collaborative Research Operations Manager
Gulf of Maine Research Institute
350 Commercial St
Portland, ME 04101

Bill Muniz
F/V Lady Shannon
8 Links Road
Gloucester, MA 01930

Terry Alexander
F/V Rachel T
67 Grover Lane
Harpswell, ME 04079

Dave Marciano
F/V Hard Merchandise
8 Story Avenue
Gloucester, MA 01930

Pete Shoares
F/V Hard Merchandise
13 Highland Street
Gloucester, MA 01930

METHODS

2007

In January 2007, sea trials of the experimental gillnet gear (Figure 2) were completed aboard the F/V Lady Shannon (State Reg. # MS10BM, Figure 3). Two strings of gillnets were constructed of six individual nets each, alternating between the experimental and standard net. The experimental nets were identical in configuration to the standard nets with the exception of the raised-webbing (Table 1). Both strings were set overnight in Massachusetts Bay (Figure 4). Individual species catch weight was recorded to tenths of kilograms separately for the experimental and standard nets.

	experimental net	standard net
number of nets per string	3	3
individual net length	300′	300′
net webbing height	12′	12′
norsel height	**48″**	**0″**
mesh size	7″	7″
vertical mesh count	25	25
twine size	0.62 mm	0.62 mm
hanging ratio	1/2	1/2

Table 1. Experimental and standard gillnet gear characteristics, 2007.

2008

As there were several research days left for field trials of the raised–webbing gillnets after the 2007 season, GMRI continued with testing the experimental gear in 2008. In February, sea trials of the experimental gear were conducted aboard the F/V Rachel T (State Reg. # ME685GG, Figure 5) in Massachusetts Bay (Figure 6a) and the offshore waters of the Gulf of Maine (Figure 6b). Standard nets used during this time period differed from the experimental nets with respect to mesh size, vertical mesh count and twine size along with the raised-webbing (Table 2).

	experimental net	standard net
individual net length	300′	300′
net webbing height	12′	12′
norsel height	**48″**	**0″**
mesh size	7″	**6.5″**
vertical mesh count	**25**	**30**
twine size	**0.62 mm**	**0.66 mm**
hanging ratio	1/2	1/2

Table 2. Experimental and standard gillnet gear characteristics, 2008.

Gillnet string configurations were also different during this time period. Individual experimental nets were tied randomly into the vessel's standard gillnet strings. Table 3 indicates the number of experimental and standard nets used for each haul completed in 2008. Again, individual species catch was recorded to tenths of kilograms separately for the experimental and standard nets.

Trip	Haul	number of experimental nets	number of standard nets	total number of nets
1	1	2	25	27
	2	4	25	29
	3	2	25	27
	4	2	25	27
	5	2	25	27
2	1	1	19	20
	2	1	14	15
	3	1	24	25
	4	1	25	26
	5	1	24	25
	6	1	24	25
	7	1	25	26
	8	1	24	25
	9	1	25	26

Table 3. Number of experimental and standard nets by haul, 2008.

Net Performance

In 2008, measurements were collected on the norsel height (Figure 1) or the distance between the neutrally buoyant foot line and lead line. Star-Oddi data storage tags were mounted on the foot line and lead line of two experimental nets. Location of the tag on the foot line was centered between the perpendicular norsel lines and in the corresponding position on the lead line. The data storage tags were set to record depth, in meters, every half hour to gather data on the norsel space throughout the soak duration.

DATA

Data collected for this project included gillnet gear characteristics of the standard and experimental nets, location and timing of the sets and the associated catch data in kilograms as well as environmental data for all hauls conducted. Biological sampling included total weights for all species for both the experimental and control nets and fish lengths in centimeters were collected when sampling allowed. A Microsoft Office Access Database was created for data management and will be submitted for inclusion into the Northeast Consortium Fisheries & Ocean Database.

RESULTS

2007

In 2007, the project participants tried to test the gear in areas where both Atlantic cod and pollock could be found on the inshore fishing grounds off Massachusetts. However, in order to control regulatory discarding of Atlantic cod, the captain chose set locations on the periphery of where the majority of Atlantic cod could be found within Massachusetts Bay while still trying to maximize the overall project catch. Six fishing trips were completed for a total of twelve hauls.

After the first trip, which yielded low catch rates of all species (Table 4), the captain relocated the gear. For the next three trips, the catch was dominated by spiny dogfish in both the standard and experimental gear with modest amounts of Atlantic cod and pollock caught. For the last two trips, set locations were moved to the north in order to avoid the large catches of spiny dogfish, but these sets yielded very little catch of any species. Because of these poor catches of Atlantic cod and pollock and high spiny dogfish bycatch, the project participants decided to suspend gear testing until the following year.

The total catch summary for 2007 can be found in Table 5. A total of just over 3000 kg of fish were caught in both gears combined, with the standard nets retaining 60% of the total catch. The standard gear caught more (by weight and by number) of all species than the experimental gear with the exception of Acadian redfish. The three most abundant species observed during this time period were spiny dogfish, Atlantic cod and pollock although the total catches for Atlantic cod and pollock were much lower than the spiny dogfish catch. All other species were poorly represented in the catch of both gears for the six trips completed.

		Atlantic cod (kg)		pollock (kg)		spiny dogfish (kg)		all other species (kg)	
trip	haul	std net	exp net	std net	exp net	std net	exp net	std net	exp net
1	1	0.0	4.3	0.0	0.0	0.0	0.0	5.6	0.0
	2	31.4	0.0	0.0	0.0	0.0	3.1	3.0	0.2
2	1	20.5	12.9	9.7	9.6	135.8	84.7	5.1	0.9
	2	17.5	7.2	18.5	0.0	161.0	46.4	3.3	0.0
3	1	15.0	0.0	18.3	0.0	377.9	200.7	2.2	0.0
	2	4.3	3.0	6.6	5.2	231.4	202.6	13.5	1.3
4	1	22.7	0.0	0.0	0.0	187.1	119.8	2.2	0.0
	2	1.8	20.6	0.0	0.0	425.0	449.7	1.7	0.2
5	1	0.0	3.5	5.6	0.0	11.4	0.0	0.8	2.7
	2	0.0	0.0	0.0	0.0	5.4	0.0	3.5	0.0
6	1	0.0	0.0	6.4	0.0	23.3	15.9	3.2	0.0
	2	2.7	1.4	3.9	0.0	14.1	3.9	1.6	0.0
total		**115.9**	**52.9**	**69.0**	**14.8**	**1572.4**	**1126.8**	**45.7**	**5.3**

Table 4. Weight of dominant species by haul for standard and experimental nets, 2007.

	standard nets		experimental nets		total
	weight (kg)	number	weight (kg)	number	weight (kg)
spiny dogfish	1572.4	531	1126.8	430	2699.2
Atlantic cod	115.9	23	52.9	12	168.8
pollock	69.0	16	14.8	3	83.8
American lobster	14.9	11	-	-	14.9
skate spp.	8.2	2	-	-	8.2
crab spp.	6.1	28	0.1	1	6.2
haddock	5.1	4	1.2	1	6.3
Atlantic mackerel	3.6	12	1.0	3	4.6
flounder spp.	2.4	4	0.5	1	2.9
monkfish	2.4	1	-	-	2.4
sea raven	2.3	2	2.1	1	4.4
Acadian redfish	0.4	3	0.5	2	0.9
longhorn sculpin	0.3	2	-	-	0.3
total	**1803.0**	**639**	**1199.9**	**454**	**3002.9**

Table 5. Catch summary of all species by total weight and total number for standard and experimental nets, 2007.

A Mann-Whitney U Test was conducted to examine differences in weight and differences in number between the standard and experimental gears on a haul by haul basis for each species. Significant differences in catch levels were only observed by weight and by number for American lobster and crab spp. between the two gears (Table 6).

	p - level	*p - level*
spiny dogfish	0.488	0.525
Atlantic cod	0.371	0.299
pollock	0.065	0.057
American lobster	0.002 *	0.002 *
skate spp.	0.729	0.729
crab spp.	0.023 *	0.026 *
haddock	0.299	0.286
Atlantic mackerel	0.603	0.603
flounder spp.	0.286	0.286
monkfish	0.729	0.729
sea raven	0.772	0.773
Acadian redfish	0.840	0.686
longhorn sculpin	0.488	0.488

* Significant at $\alpha = 0.05$

Table 6. Results from Mann-Whitney U Tests on individual weight and number per haul between gear types, 2007.

2008

In 2008, the experimental nets were tested in both the inshore and the offshore fishing grounds of the Gulf of Maine. Two trips were accomplished for a total of 14 hauls; however, haul 3 from trip 1 was omitted from analysis due to a significant amount of damage that occurred to the experimental nets.

The total catch summary for 2008 field work can be found in Table 7. The weight per net and number per net is equal to the total weight and total number of species caught divided by 304 nets for the standard gear. For the experimental gear, the weight per net and number per net is equal the total weight and total number of species caught divided by 19 nets. With the exception of monkfish, the standard gear caught more per net than the experimental gear for all species with respect to weight and number per net. Spiny dogfish, Atlantic cod, pollock and Acadian redfish were the most numerous species encountered by weight per net and number per net.

A Mann-Whitney U Test was conducted to examine differences in weight per net and differences in number per net between the standard and experimental gears on a haul by haul basis for each species. Significant differences were observed in weight per net and in number per net for Atlantic cod, white hake, American shad, haddock, American lobster as well as crab and skate species. between the two gear configurations. For flounders, a significant difference was detected for number per net but not for weight per net (Table 8).

	standard gear (n = 304)		experimental gear (n = 19)	
	weight (kg) / net	number / net	weight (kg) / net	number / net
spiny dogfish	7.78	3.8	4.00	2.0
Atlantic cod	6.42	2.0	0.73	0.2
pollock	5.40	1.6	2.67	0.8
Acadian redfish	1.49	3.0	1.07	2.2
white hake	0.98	0.2	0.22	0.1
American shad	0.35	0.2	-	-
haddock	0.30	0.2	-	-
American lobster	0.25	0.1	-	-
crab spp.	0.14	0.4	0.02	0.1
skate spp.	0.11	0.1	-	-
monkfish	0.10	< 0.1	0.35	0.1
cusk	0.07	< 0.1	-	-
flounder spp.	0.03	< 0.1	-	-
silver hake	0.02	< 0.1	-	-
sea raven	0.01	< 0.1	-	-
red hake	< 0.01	< 0.1	-	-
total	**23.45**	**11.8**	**9.05**	**5.3**

Table 7. Catch summary of total weight per net and total number per net for standard and experimental nets, 2008.

	p - level	*p - level*
spiny dogfish	0.077	0.077
Atlantic cod	0.003 *	0.003 *
pollock	0.130	0.112
Acadian redfish	0.137	0.137
white hake	0.015 *	0.015 *
American shad	0.020 *	0.020 *
haddock	0.008 *	0.008 *
American lobster	0.003 *	0.001 *
crab spp.	0.005 *	0.005 *
skate spp.	0.003 *	0.001 *
monkfish	0.555	0.555
cusk	0.739	0.739
flounder spp.	0.097	0.046 *
silver hake	0.505	0.505
sea raven	0.505	0.505
red hake	0.505	0.505

* significant at $\alpha = 0.05$

Table 8. Results from Mann-Whitney U Tests on weight per net and number per net between gear types on a haul by haul basis, 2008.

Net Performance

Data on the distance between the foot line and lead line was collected from four hauls on trip 1 and from three hauls on trip 2 in 2008. Figures 7a – 7g display the real time lead line and foot line depth for these seven hauls. The dashed line (red) is the theoretical foot line depth. This depth is equal to the depth of the lead line minus the measured norsel line length of 1.219 meters (48″). The sigmoid curve of these lines are indicative of the local tidal cycle. For the lead line, the shallowest data points reflect slack low tide and the deepest data points reflect slack high tide. Measurements indicate that while the lead line remained stable, the depth of the foot line fluctuated throughout the soak duration. Also the real time norsel height (distance between the foot line and lead line) was at times greater than the measured norsel line length. In the case of trip 1, haul 4 (Figure 7c) and trip 2, haul 5 (Figure 7g), the real time norsel height was greater than the theoretical throughout the entire soak duration.

CONCLUSIONS

It would appear that the experimental gear was effective in reducing the bycatch of Atlantic cod while targeting pollock. Decreases in Atlantic cod catches by weight and by number were observed in the experimental gear in both years. In 2008, the decrease in catch rates was significant. For pollock, the data indicated that the experimental gear also caught less weight and number in both years; however, the differences in catch were not significant at the 95% level.

For other demersal species of concern, results were also encouraging. For 2007, catches of American lobster and all crab species were significantly reduced in the experimental gear by weight and by number. All other species caught showed a reduction in catch rates by weight and by number for the raised-webbing gear over the standard gear; however, none of these differences were significant. With the exception of spiny dogfish, this is probably due to the very sparse occurrence of these species in both gear configurations.

In 2008, American lobster, crab and skate species as well as white hake showed significant reductions in catch weight per net and number per net in the experimental gear over the standard gear. The catch of flounder number per net was also significantly lower in the raised-webbing gear. By weight per net, the lower catch rate of flounders observed in the experimental gear was not significant at the 95% level of confidence, but was significant at a slightly lower level of 90%.

These conclusions indicate that the raised-webbing gillnets were useful in decreasing bycatch which led to less discarding. Overall, the experimental gear caught less by weight and by number for all species than the standard configuration in both years of sea trials. However, these findings should be only considered preliminary because of several factors that may have influenced the project outcome.

One factor was that this project had to be completed using Category A days-at-sea which have daily catch limits for Atlantic cod. In 2007, project participants were strongly concerned that catching too many Atlantic cod would result in large amounts of regulatory discarding. Therefore, the vessel captain tried to set the gear in areas where he felt Atlantic cod and pollock could be located without saturating the gear with Atlantic cod. This, however, resulted in extremely low catches of both Atlantic cod and pollock as well as most other species in both the standard and experimental gear. It is believed that these low catch rates had a strong influence on the results in 2007.

Fishing in areas while trying to avoid large amounts of regulatory discards also led to working in an area with a high abundance of spiny dogfish. Our results confirm the notion by fishermen that in areas of high spiny dogfish abundance, the abundance of other species will be reduced or low. One positive outcome of the large spiny dogfish catch in the inshore area is that the experimental gear displayed reductions in catch by weight and number for this species over the standard gear. This may be an area of further study as the spiny dogfish population has been suffering from a record low recruitment in recent years (NEFSC 2006). These large catches of spiny dogfish were part of the reason the project participants decided to suspend gear testing until the flowing year.

In 2008, the fishing vessel from the previous year was not available for gear testing; therefore, the remaining sea days for the project were completed aboard a different fishing vessel. Unfortunately, this meant that the standard gear from the year previous was also not available. The standard gear used in 2008 differed from 2007 with respect to mesh size, vertical mesh count and twine size. Differences in catches between the experimental gear and the new standard gear can mostly be attributed to the differences in gear mesh size. The standard gear employed a 6.5″ mesh size while the experimental gear was comprised of 7″ mesh. Mesh size is one off the most important factors that influence gill net selectivity and catch (Nichols et. al 2001). Both captains in 2008 felt that the catch in the experimental nets would have been higher if the gear was made of 6.5″ mesh. This may be another area of further study; testing raised-webbing gear constructed with small sized meshes.

Net Performance

No data storage tags were available for use in 2007. The information collected in 2008 confirmed that the norsel lines maintained a space between the foot and lead line throughout the soak duration of the gear. However, the data showed there was a fluctuation in norsel height during the soak periods suggesting that the experimental gear was affected by tidal currents. The general trend seen in Figures 7a-g indicate that as the tidal force increased on either the outgoing or incoming tide, the norsel height would decrease. The norsel height would then increase as the tide reach either slack low or slack high tide. Godøy et al. (2003) proposed currents as a possible reason for norsel-mounted gillnets not working properly. The force of the current would cause the gear as a whole to lean over resulting in a lowering of the foot line and in turn a lowering of the norsel height. These fluctuations in height could possibly explain why no significant

differences in catch were detected for some demersal species such as flounders and skates in 2007 and monkfish in 2007 & 2008 where it was expected.

The height of the foot line from the lead line should have been no more 1.2 m. This distance is equal to the actual length of the norsel lines. However, the foot line did exceed this distance. A possible cause of this was a lack of horizontal tension on the gear during setting of the gillnets. Without this tension, the gear will be slack in the horizontal plane allowing the float line to exert more upward force on the foot line. Although no measurements were not take with depth tags, this may have not been an issue in 2007 as the F/V Lady Shannon employs spreader bars, a frame of metal tubes used to keep horizontal tension on the gillnets during the setting process. The F/V Rachel T, however, does not use spreaders for setting gear.

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PARTNERSHIPS

Dave Marciano and Pete Shoares, Gloucester fishermen who participate in the Gulf of Maine day gillnet fishery, approached GMRI to develop the idea of raised-webbing gillnets. They felt that this type of gear could be used in a commercial setting to target pollock while reducing the bycatch of Atlantic cod and other demersal species of concern. Unfortunately, changes in regulations and fishing business plans led to their discontinued participation in the project. Dave Marciano discussed the project with Bill Muniz, another Gloucester fisherman, and he agreed to conduct the gear testing aboard his vessel. After field work in 2007, Bill Muniz relayed to GMRI that he had sold his vessel and that he could no longer participate in the project due to his new vessel's smaller size. As there were several days left of field work, GMRI contacted several captains from Gloucester to finish the remaining days. However, none of the vessels were eligible due to insurance reasons. Finally, Terry Alexander, a gillnet vessel owner from Cundys Harbor, Maine, was contracted to finish the field trials of the experimental gear.

All fishermen involved with the project believed that the concept of raised-webbing gillnets to target pollock should be feasible and provided good comments on future modifications to the gear.

IMPACTS / APPLICATIONS

The beneficial impacts of this project were the decrease in bycatch in the experimental raised-webbing gear. Significant decrease in American lobster and crabs species catches were seen in both years of field testing. Disentangling these species from gillnets is difficult and usually result in loss of legs and/or claws which can increase mortality. In 2008, significant decreases in catch were recorded for Atlantic cod, white hake, American shad and skates, all of which are species of concern from a stock assessment perspective. Results from this study indicate that raised-webbing gillnets can be used to target pollock with minimal bycatch of demersal species.

RELATED PROJECTS

This study was not a part of any other work.

PRESENTATIONS

No presentations were made with regard to this project.

STUDENT PARTICIPATION

No students were associated with this project.

PUBLISHED REPORTS / PAPERS

No reports or papers have been published as a result of this study.

FUTURE RESEARCH

Future research should continue in order to better develop the raised-webbing gillnets. The project partners believe that this gear can be effective in reducing unwanted bycatch of species of concern with some modifications and further testing. Modifications should include closer norsel line spacing to better control the influence of currents on the norsel height and longer norsel lines to increase the norsel height to increase the reduction of demersal species bycatch. This testing should include more depth sensor tags to better assess the raised-webbing gear performance. Any further research on this experimental gear would also be completed against standard gear of the exact same characteristics (i.e. mesh size) with the exception of the raised-webbing as seen in 2007 field trials.

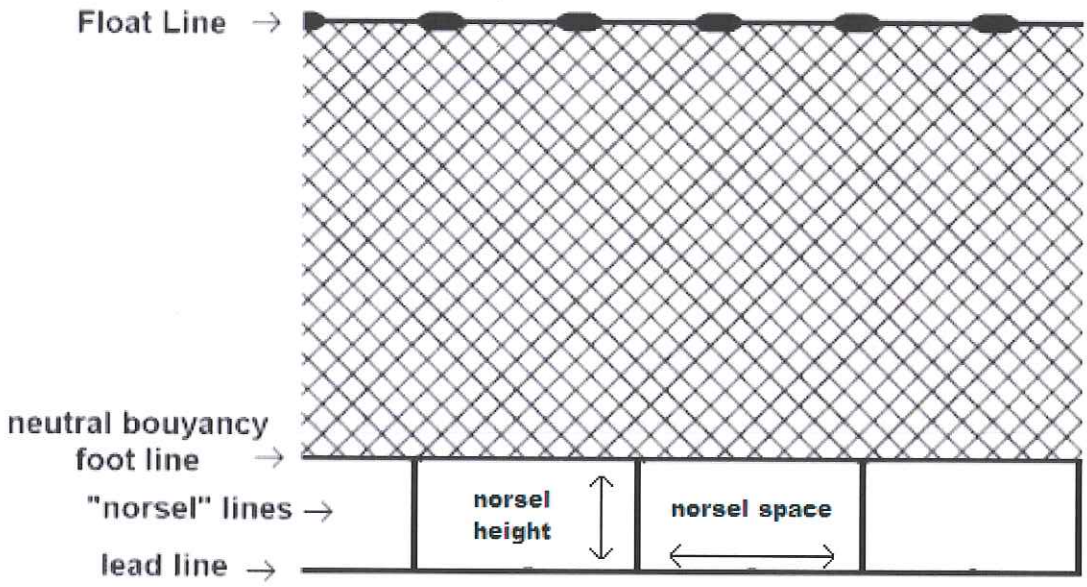


Figure 1. Sketch of proposed raised-webbing or "norsel-mounted" gillnet.

Figure 2. Experimental gillnet gear on deck.

Figure 3. F/V Lady Shannon, Gloucester, Massachusetts (45′ LOA).

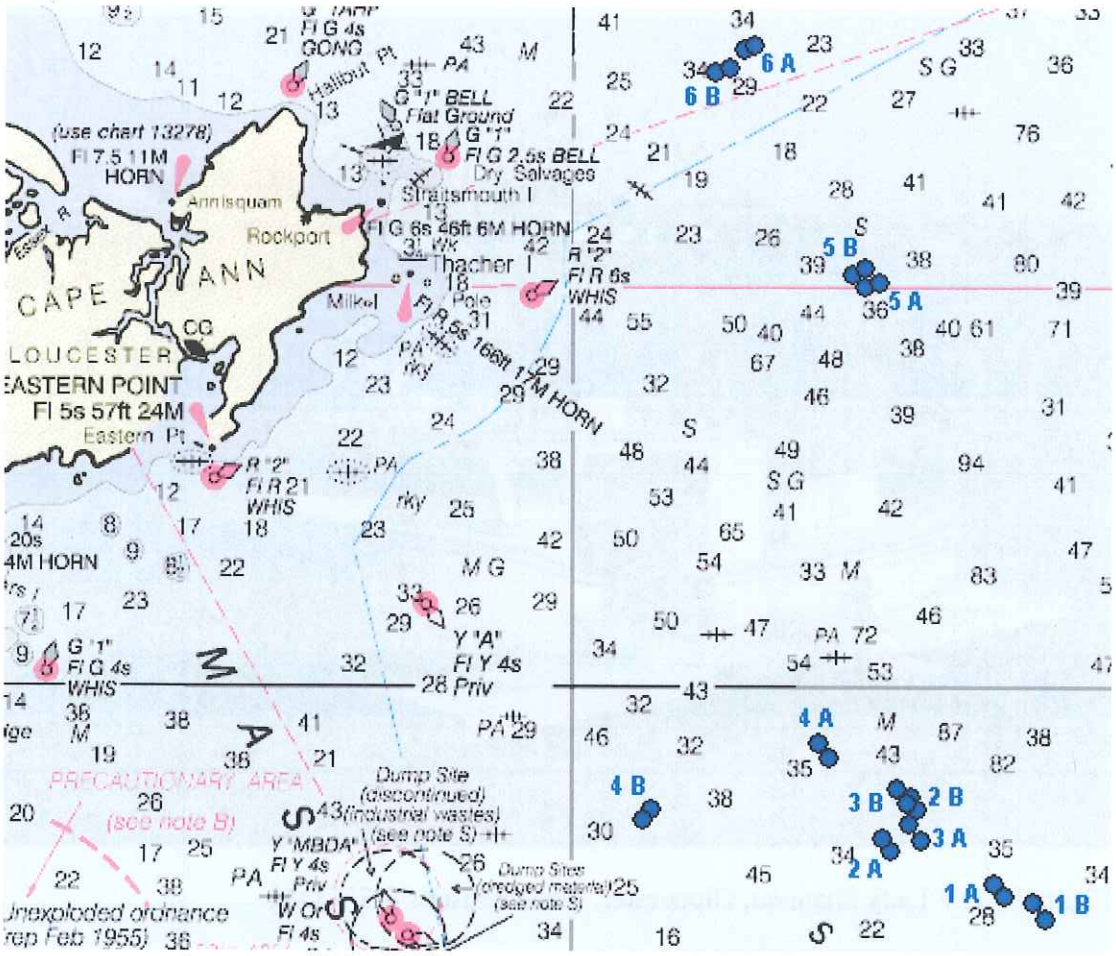


Figure 4. January 2007 pollock gillnet study set locations in Massachusetts Bay. (A & B designation refer to individual gillnet strings by trip.)

Figure 5. F/V Rachel T, Harpswell, Maine (43′ LOA).

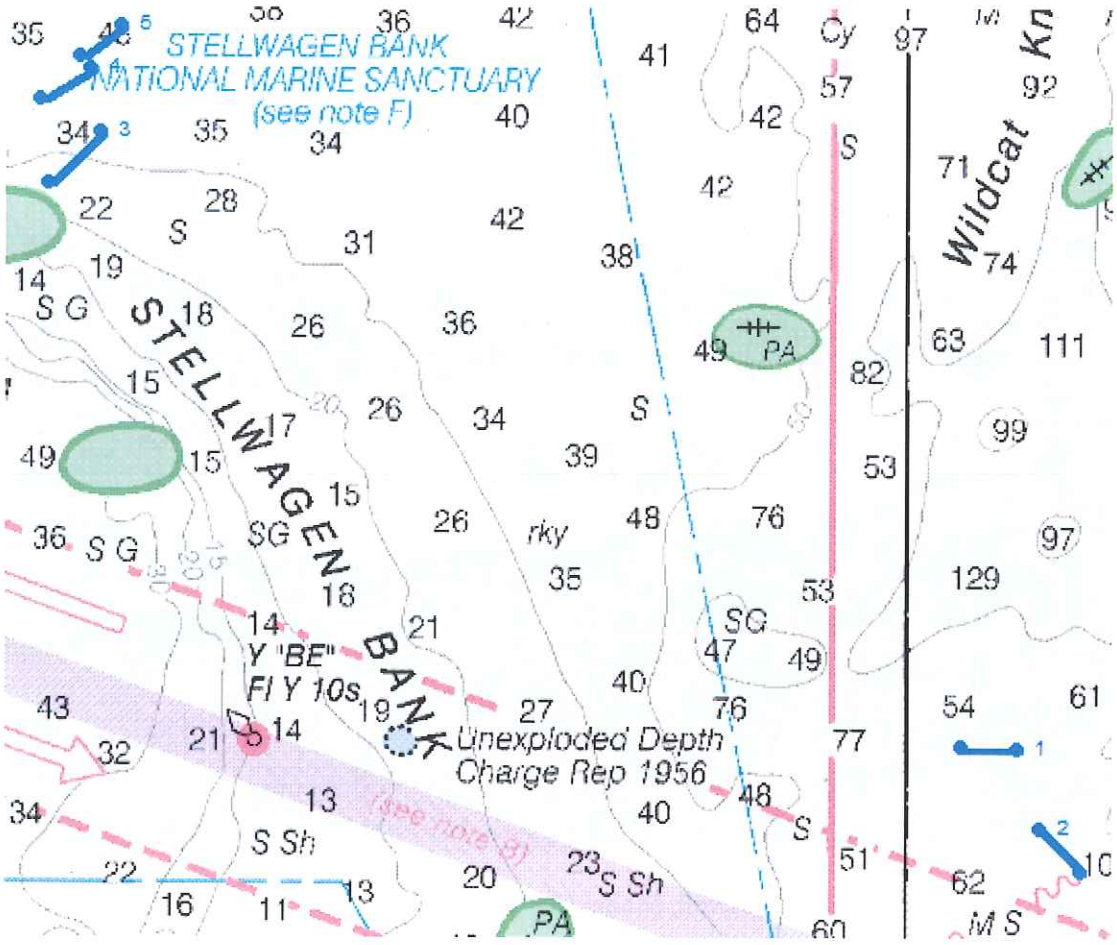


Figure 6a. February 2008, trip 1 pollock gillnet study set locations in Massachusetts Bay.

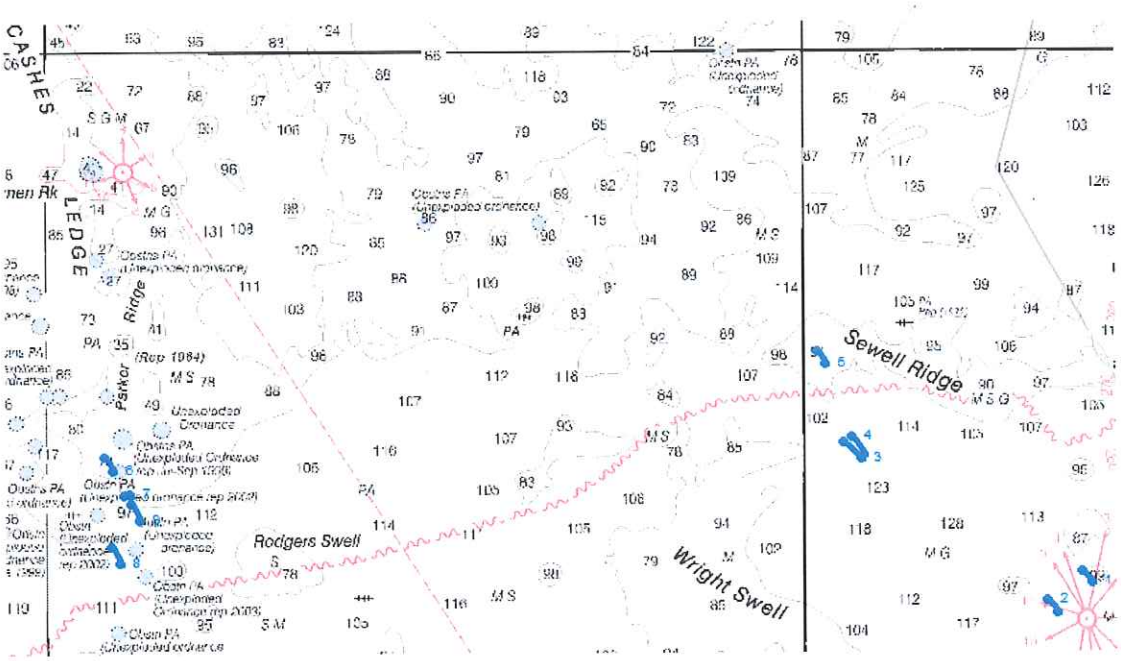
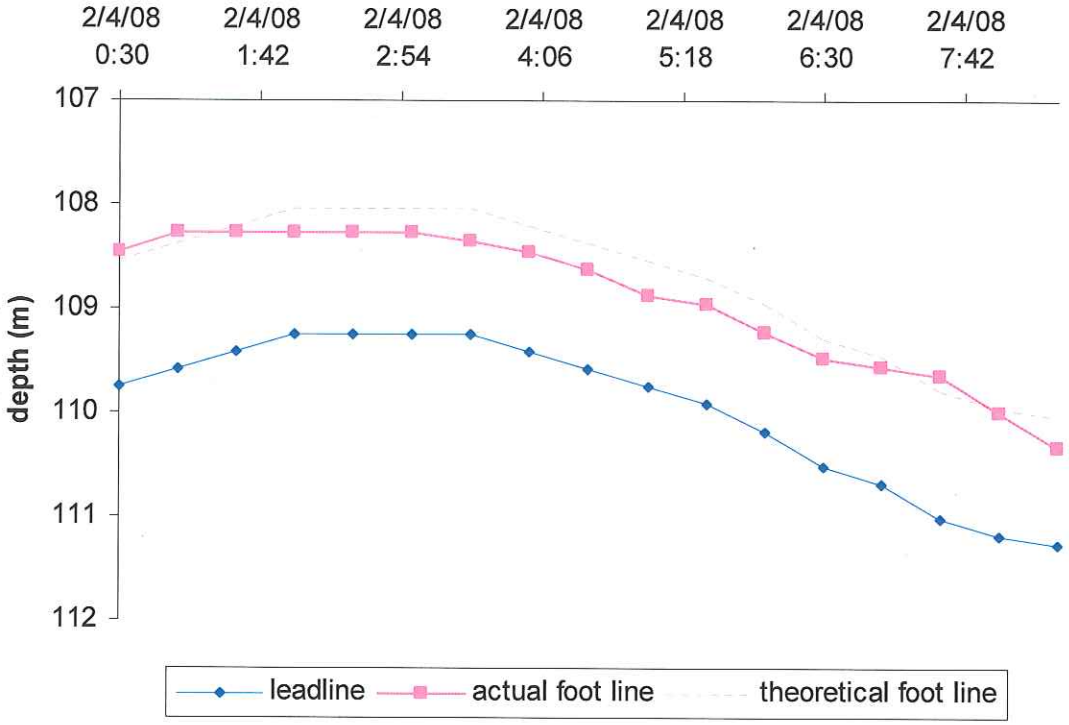
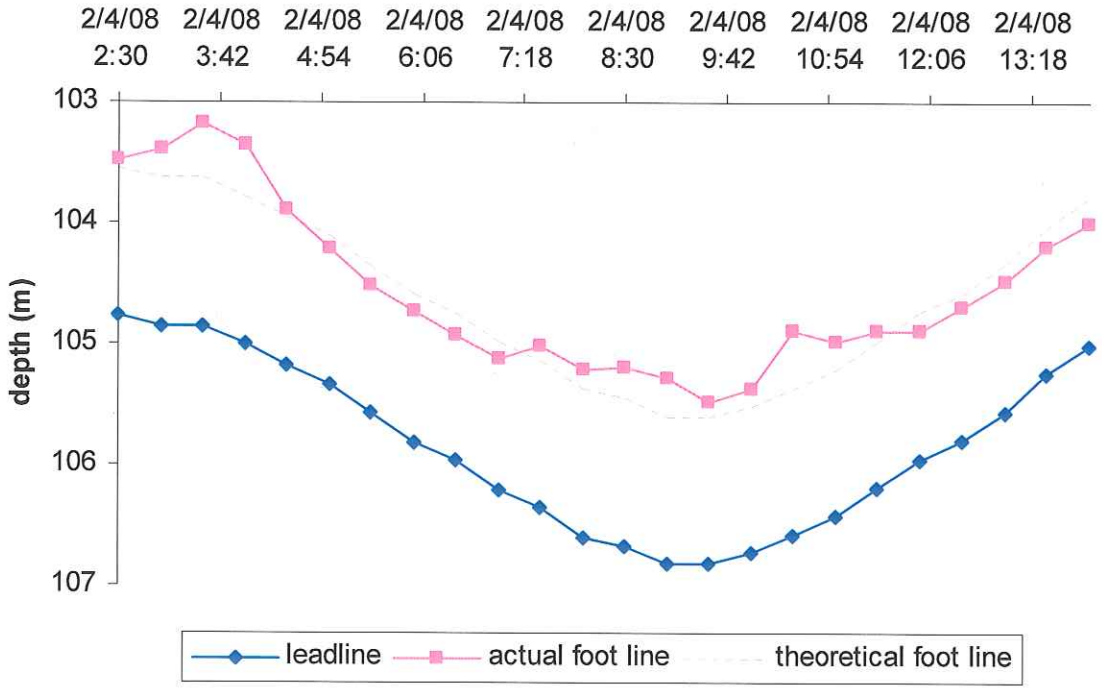


Figure 6b. February 2008, trip 2 pollock gillnet study set locations in the Gulf of Maine.

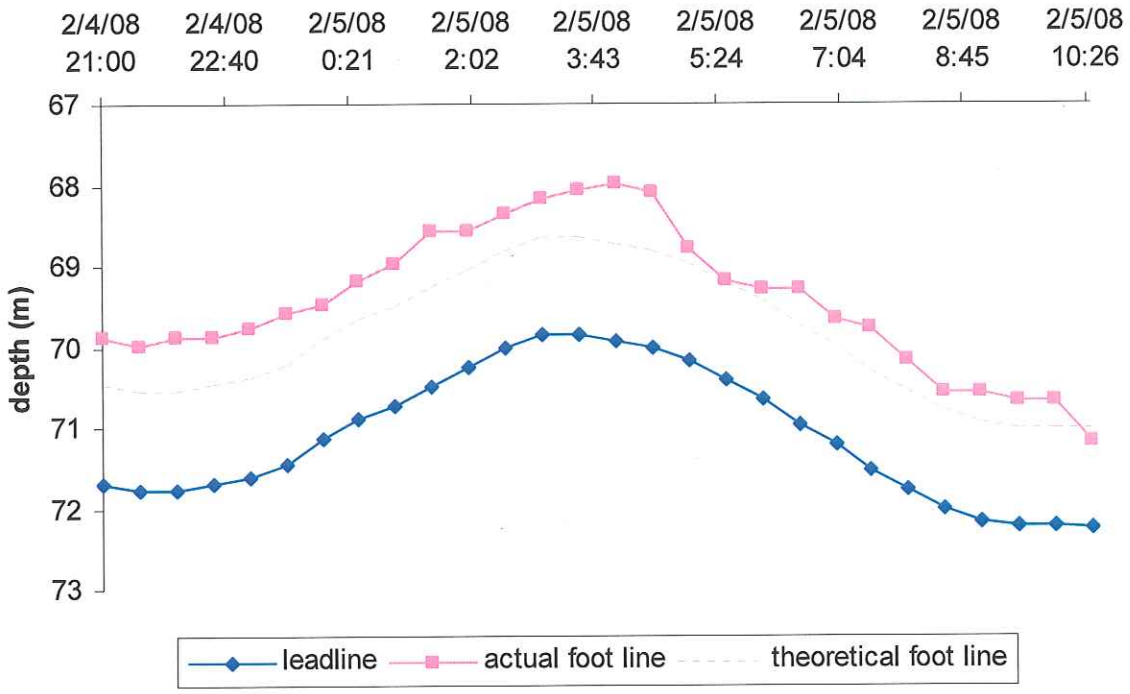
7a. 2008, trip 1, haul 1



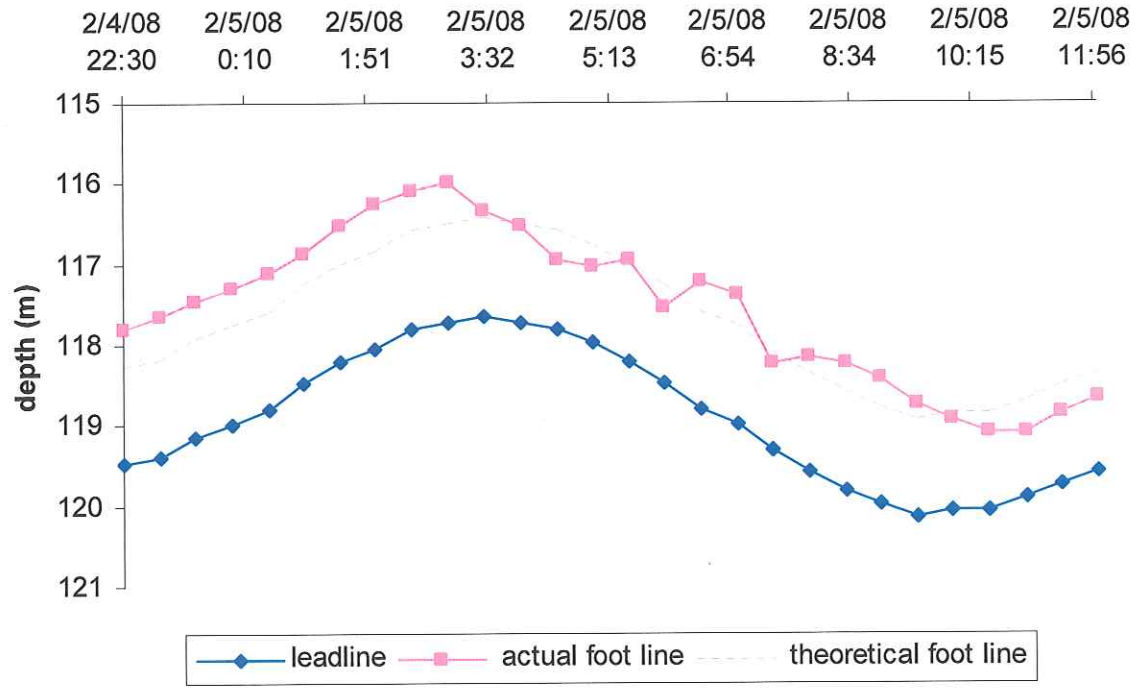
7b. 2008, trip 1 haul 2



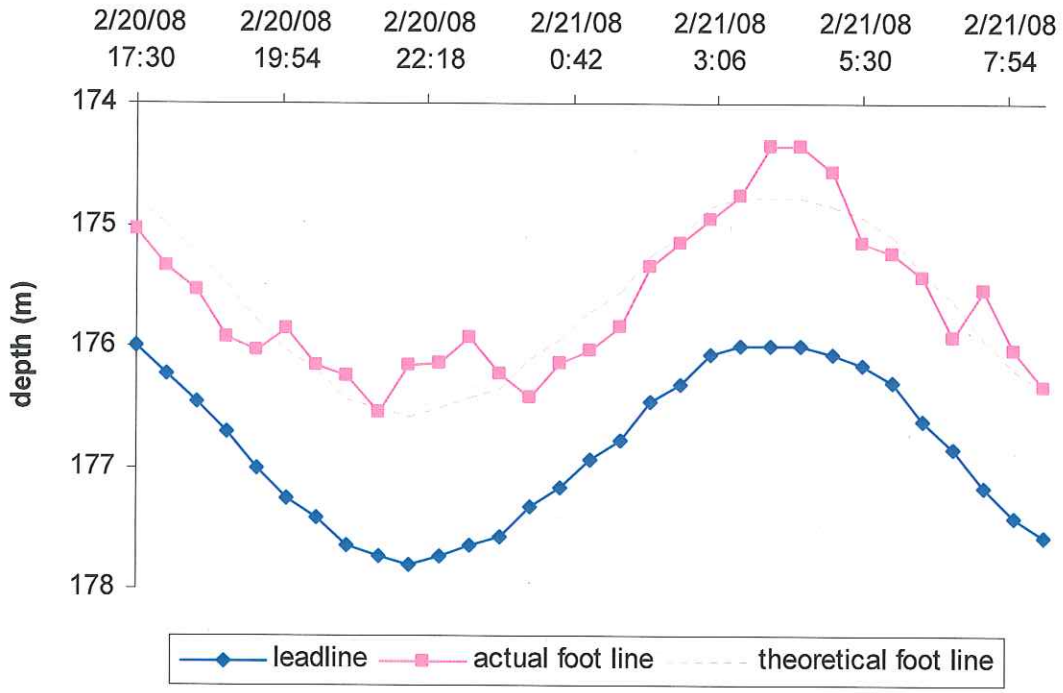
7c. 2008, trip 1, haul 4



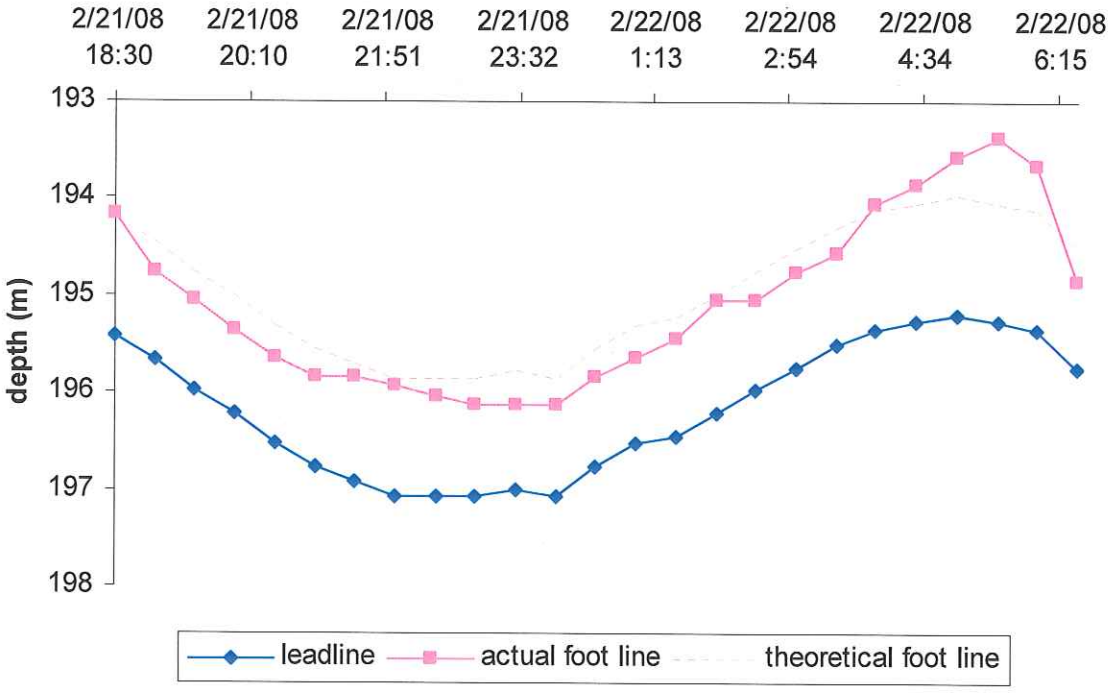
7d. 2008, trip 1, haul 5



7e. 2008, trip 2, haul 1



7f. 2008, trip 2, haul 3



7g. 2008, trip 2, haul 5

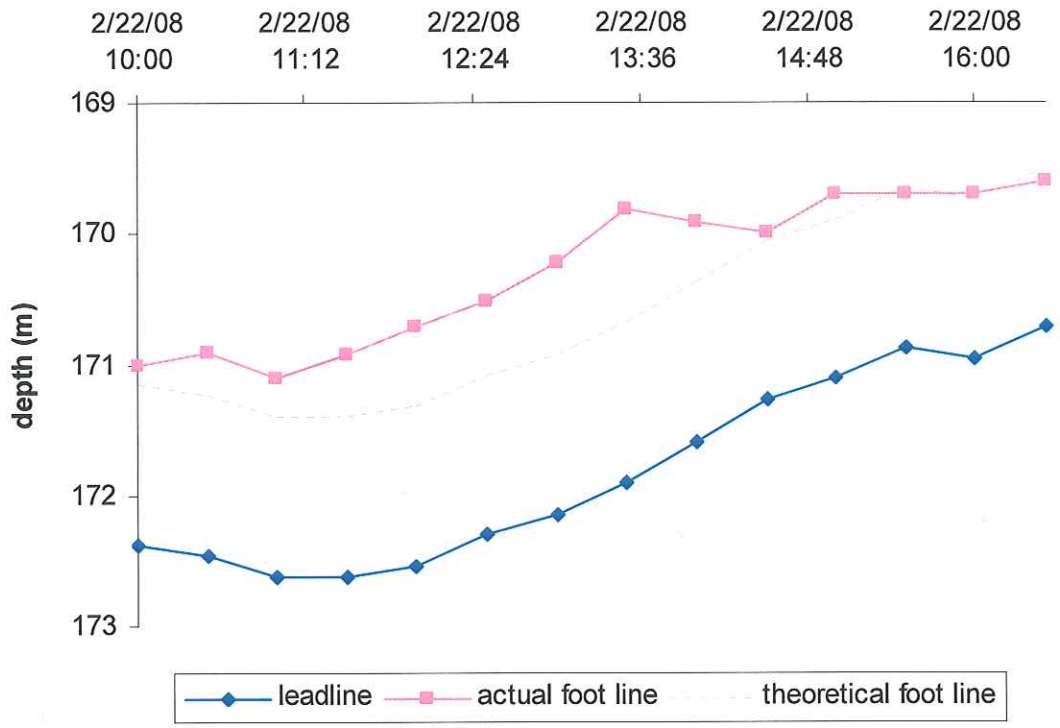


Figure 7. Real time lead line and foot line depth for seven hauls completed in 2008.

Gulf of Maine
Research Institute

350 Commercial Street, Portland, Maine 04101 · Ph. 207-772-2321 · Fx. 207-772-6855 · www.gmri.org