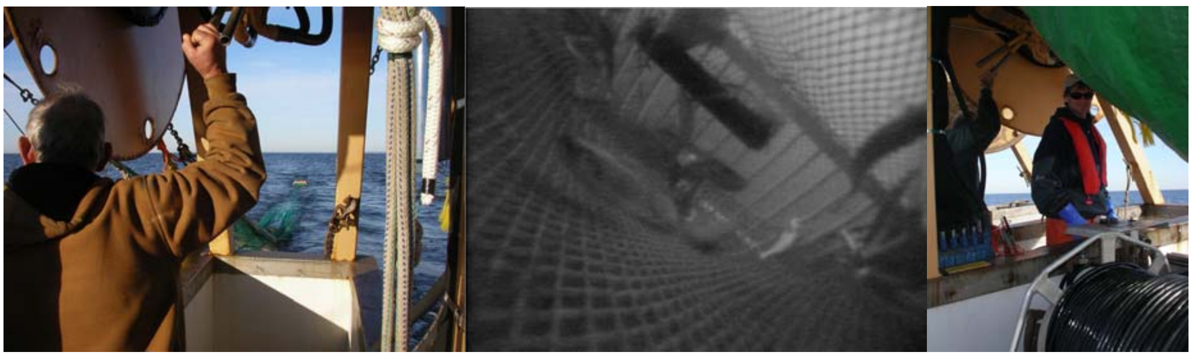
Northeast Consortium 2009 Annual Report

DOGGRATE: Development of a Spiny Dogfish Excluder in a Raised Footrope Whiting Trawl

Award Number: 09-047



Period of Performance: 8/15/2008 - 6/30/2011

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Names in **bold** played a key role in project design and implementation.

Project Objectives

Our goal is to produce and test a spiny dogfish *Squalus acanthias* excluder grate within a whiting (silver hake) *Merluccius bilinearis* net. Additionally, we plan to explore the usage of such a gear for an expanded whiting fishery area and time of year. In order to accomplish the goals, we have identified the following objectives:

1. To observe the behaviors of spiny dogfish and whiting around excluder grates using underwater video;
2. To identify the optimal excluder grate properties gauged by target species catches and spiny dogfish exclusions;
3. To continue refining the excluder grate design;
4. To produce a prototype grate design to be used in follow-up commercial trials;
5. To make recommendations for an expanded whiting fishery in Cape Cod Bay and Massachusetts Bay.

Spiny dogfish is the most abundant shark in the western North Atlantic Ocean, including the Gulf of Maine (Colette and MacPhee, 2002). Its abundance has increased markedly in recent years (Stevens, L., 2008; Sosebee and Rago, 2006) and is now considered by most fishermen and scientists to be at least a nuisance (La Valley, 2007) and by some a hindrance to rebuilding of groundfish stocks and to fishing in general (Anonymous, 2009). Spiny dogfish school by size and sex (Colette and MacPhee, 2002, Sosebee and Rago, 2006), sometimes in schools large enough to fill commercial and survey trawl nets to overflowing (Stevens, L., 2008; personal observations; DMF, unpubl. data). Large numbers of spiny dogfish have prevented fishing for whiting by us and others (pers. obs.; pers. comm.).

The northern whiting stock in the Gulf of Maine exceeds its biomass targets and landings are at a historical low (Col and Traver, 2006) although may now be improving. This fishery has traditionally been an important source of income for small trawlers in ports from Maine to Massachusetts. It became increasingly important in Massachusetts as landings of other fish declined in recent years (NEFMC, 2003). Spiny dogfish are a primary hindrance to exploiting this healthy stock.

Spiny dogfish need to be kept out of trawl nets to reduce their bycatch mortality and to prevent damage to other catch by their abrasive skin. Also, bycatch levels of spiny dogfish may become especially critical once accountability measures are put into place in 2010; high discards of dogfish could potentially close groundfish fisheries if bycatch allowances are exceeded. Furthermore, the discarding of spiny dogfish is time-consuming, a critical factor especially when days-at-sea are so valuable.

For these reasons, we are researching a grate design to eliminate spiny dogfish in a trawl net. We are using a net design currently required when fishing for whiting, the raised footrope trawl. The primary focus of this project is to observe whiting catch and spiny dogfish reaction to a grate using underwater video leading to a prototype dogfish excluder device for use in the whiting trawl fishery that could have broader application in the Gulf of Maine. This net will likely also reduce the bycatch of other species such as flatfish, which are less susceptible to a raised footrope trawl (McKiernan et al., 1998).

We completed some initial trials in October and November, 2008 within a normal whiting area (see section “Work Completed to Date” below). This work has allowed us to tune our original study plan based on some observed successes; modifications include:

1. Changes to the grate design to reinforce the grates’ structural integrities and shapes.
2. Removal of additional bar spacing tests (40 mm, 1.5 inch) since we witnessed good spiny dogfish exclusions at 50 mm (2 inch) spacing.
3. Fixing the grate’s angle within the net’s extension at approximately 45^o (on land while not towing) since spiny dogfish seemed to escape reasonably well at this angle.
4. Rather than paint one side of a grate black, two grates have been constructed, one black and the other white. This will simplify the study so the grate isn’t subject to color chipping or wearing away and will require less time for gear care.

Methods and Work Plan

A new raised footrope whiting trawl net with 2.5 inch diamond mesh codend will be used. We will configure our excluder grate in a manner similar to the one used in pre-trials conducted in 2008 (see section “Work Completed to Date” below). Two 121.9 cm (4 ft) square grates have been designed (Brooke Ocean Technology USA, Inc.) and constructed (Palco Plastics Inc.), both with approximately 50 mm (2 inch) bar spacings (Figure 1). The grates are constructed of 25 mm (1 inch) thick high density polyethylene (HDPE), one black and one white, and are capable of being wound on a net drum. The grate will be inserted into a netting sleeve extension that will be placed into the trawl net just ahead of the codend. The grate angle will initially be set at 45° from the top and bottom extension walls (Figure 2). The guiding panel (funnel) will initially lead to the top-forward portion of the grate; the escape vent will be located at the bottom of the extension, forward of the grate.

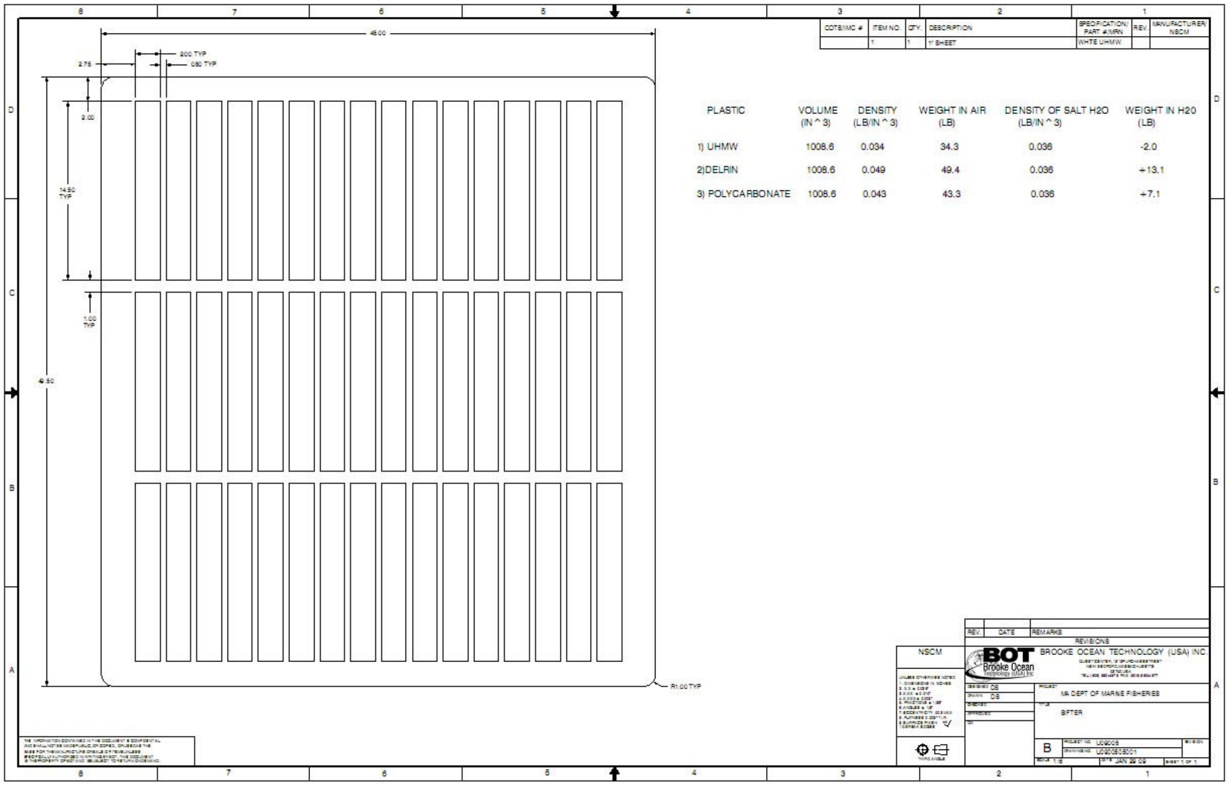

Figure 1: Schematics of the excluder grate.

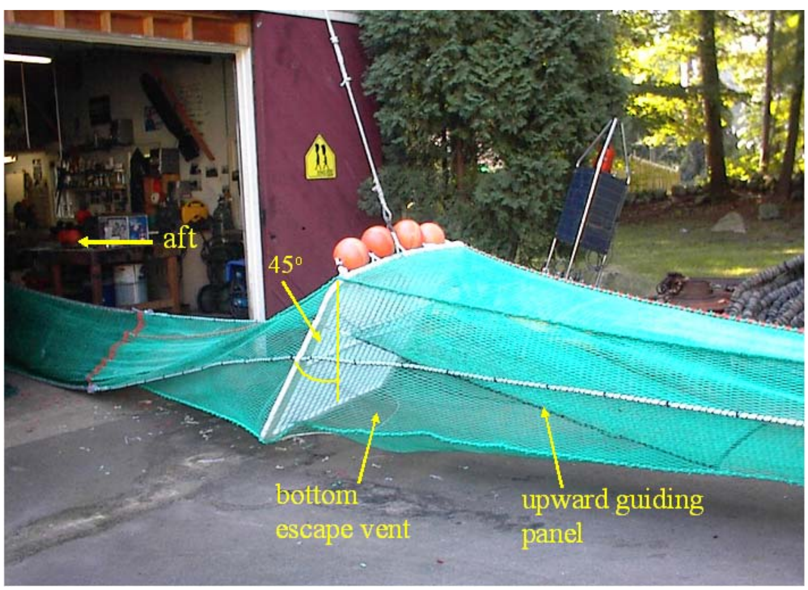

Figure 2: The grate used in the pre-trial research within the net's extension. This same arrangement of the grate, guiding panel, and escape vent will initially be used during the next field work.

An underwater camera will be attached on the guiding panel pointing aft and the images will be live-fed into the vessel wheelhouse. The first goal of the filming is to ensure proper net and grate rigging and orientation. Flotation may need adjustment. We will also deploy a net mensuration system and observe and record net characteristics. Once proper rigging has been established, we will observe reactions of spiny dogfish and whiting in real time. Video and net data will be recorded for subsequent in-depth analysis. Behavior of spiny dogfish and whiting will be analyzed by categorizing their reactions. Catches in the codend will be quantified.

Our approach needs to be flexible to respond to our observations. The white grate and black grate will be used to see if the color of the grate changes fish reactions. Other adjustments to the position of the opening, the direction of the guiding panel, the angle of the grate (upward or downward) will be made as the participants think appropriate after observing the reaction of dogfish. The approach will have to be adaptive as little is known about spiny dogfish behavior encountering grates. However, based on the initial pre-trial results, we expect to try the following tests in order:

1. Black grate, top of grate forward facing 45^o angle, upward guiding panel, lower escape vent.
2. Black grate, top of grate aft facing 45^o angle, downward guiding panel, upper escape vent.
3. White grate, top of grate forward facing 45^o angle, upward guiding panel, lower escape vent.
4. White grate, top of grate aft facing 45^o angle, downward guiding panel, upper escape vent.

We will have to be flexible on the number of days that we can test. We have recently caught whiting and spiny dogfish in June/July off Scituate, Massachusetts. The testing may be conducted there if an experimental fishing permit granting exemption for the small mesh codend is possible. If the EFP is not practical, the net can be fished legally without an EFP in the exempted whiting fishery in Cape Cod Bay in September-November.

Tow length will primarily be determined by observations of the quantity of fish on the video but are expected to be approximately 1-hour. Catch composition and weights will be determined for all captured organisms. Lengths will be recorded for spiny dogfish, whiting, red hake *Urophycis chuss*, managed species (Atlantic cod *Gadus morhua*, yellowtail flounder *Limanda ferruginea* and winter flounder *Pseudopleuronectes Americanus*, etc) and any other catch that may be landed. Operational data (location, weather, time, duration, etc.) will be recorded for each haul. Data will be recorded and entered into customized databases. Marketable fish will be landed and sold.

Task	FM	AM	MP	DC	MS
	Participant				
Acquisition of grid materials		x		x	
Fabrication and modification of grid		x		x	
Operation of vessel and fishing gear	x	x			
Project coordination			x	x	
Interpretation of behavior	x	x	x	x	x
Suggestions for grid changes	x	x	x	x	x
Handling, landing, selling fish	x	x			
Camera supply acquisition					x
Filming			x	x	x
Report writing			x	x	x
Data analysis			x	x	x
Video analysis			x	x	x
Camera deployment					x
Sea sampling			x	x	x
Administration/Invoicing			x	x	
Database development			x	x	
EFP issues				x	

Andrew Mirarchi	AM
David Chosid	DC
Frank Mirarchi	FM
Michael Pol	MP
Mark Szymanski	MS

Table 1: Participants duties. Some duties have been taken on by additional participants than shown in the proposal for efficiency.

Work Completed to Date

Approval from SMAST Institutional Animal Care and Use Committee (IACUC) was deemed unnecessary in October 2008 to complete this research. The sub-award from UNH was completed in November 2008.

Originally, field work was planned to begin outside the MA Special Access Program (SAP) Whiting Area in June-August, 2008; an Exempted Fishing Permit request was submitted to NMFS in May 2008 and granted in August 2008. However, since funding was still unavailable at this time, investigators donated their own time and equipment to perform pre-trials during the normal whiting season in October-November, 2008 in the exemption area near Provincetown.

An initial excluder grate (paid for by Frank and Andrew Mirarchi) was used and attached within the extension of their raised footrope whiting net; the configuration of the grate was as shown in Figure 2. This initial white grate had approximately 50 mm (2 inch) bar spacing and was constructed of HDPE material. The overall dimensions were approximately 114.3 cm x 125.7 cm (45 inches x 49.5 inches) with one central horizontal cross bar. Four 20.3 cm (8 inch) floats were placed along the top of the grate to keep it upright while towing. The grate itself was nearly neutrally buoyant. However, some hydrodynamic affects were expected due to the grate's angle. The grate's bar spacings were also recorded for changes during the study (see "Results to Date" section).

Due to the complexity of the pre-trial net's structure, a net plan is not included in this report. The raised footrope whiting net had a headrope of 27.4 m (90 feet) and footrope of 34.1 m (112 feet); the codend and extension used approximately 50.8 mm (2 inch) mesh; other sections of the net ranged between approximately 63.5 – 152.4 mm (2.5 - 6 inches). Warping and panel additions had occurred throughout this net prior to our usage. Mesh measurements were collected for the net before and after the field work was completed. Currently, this data has not been entered and analyzed.

An underwater camera was mounted on the guiding panel facing the grate for all but the first tow; video was recorded for the remaining eight tows. This video was later reviewed. Mensuration sensors (Notus Electronics Ltd.) were also placed on the gear. Geometry data acquired included wing distance and spread, headrope distance and height, mouth distance and opening of the net, and distance and angle of the excluder grate. The grid sensor was loaned to DMF for the pre-trial research by Notus Electronics Ltd. Additionally, temperature data was collected using an Onset Tidbit logger but this data has not been reviewed at this time.

DMF personnel and crew completed nine tows over four days on-board the F/V *Barbara L. Peters*, a 16.8 m (55 ft), 214.8 kW (288 hp) groundfish Western-rig commercial trawler with two stern ramps, two net reels, and Thyboron 1.6 m trawl doors. Fish retained in the codend were separated by species and weighed (Table 2). Length frequency data were collected for commercial species of interest but mainly included spiny dogfish, whiting, and red hake. Sub-samples were taken as time necessitated.

Modifications to the gear were made during this pre-trial work. Following are a list of modifications made to the gear that occurred during specific tows:

- Tow 2: Notus net mensuration sensors were added to the headrope, footrope, and net wings. An underwater camera was added to the guiding panel pointing towards the front of the grate.
- Tow 3: Only the Notus grid angle sensor was used to acquire geometries. The grid angle sensor orientation was readjusted since it was mounted backwards for tow 2.
- Tow 4: The floats on the grate were moved from along the top to the upper sides (two floats on each side). The original 5/16 inch drop chains were switched to 3/8 inch chain to provide added weight (~10 lbs) along the footrope. The Notus grid sensor was readjusted for correct orientation as shifting had occurred (approximately 30^{o} off center).
- Tow 6: The headrope height sensor was again added.
- Tow 7: The top of the grate was shifted forward approximately 15.2 cm (6 inches) decreasing the vertical angle by about 10% (while not towing).

Several unexpected difficulties arose during the pre-trials:

1) Poor underwater visibility prevented us from obtaining useful video in some tows or parts of tows. The addition of lighting sources could affect fish behaviors and obstruct swimming paths and were therefore not used.
2) During tow 2, as the net set out, the camera’s cable disconnected. Therefore, no video was recorded for this tow.
3) Large amounts of Atlantic herring *Clupea harengus* were caught in tow 2 and the net could not be brought aboard. We discarded approximately two-thirds of the catch before it came on board. After 17 totes were filled with Atlantic herring, the remainder discarded was approximated to be 3 more totes. All catch weights were adjusted up by the estimated discards.
4) After tow 3, the Notus grid sensor was found to have shifted giving false reading that were off by about 30^{o}. The sensor was better secured for the remaining tows.
5) During the retrieval of tow 4, the underwater camera slipped out of the net and was lost.

Backup camera units were then used.

6) The power unit for the camera winch ran out of gas during tow 4. Additionally, the power unit's battery ran dead and an o-ring seal broke. Maintenance was performed.
7) Four floats were initially placed along the top of the excluder grate. When the grate was wound on the ship's drum, the floats positioned between the drum and grate which warped the bars (and bar spacings). These floats were repositioned to the side of the grate for tows 5-9 which seemed to help.

Video and acoustic sensor results were reviewed following the field work. Tow start and end times were defined when the doors were towed on bottom. Only data acquired after at least five minutes at the start of the tow were used for sensor analyses to allow for the net to settle. Also, five minutes of data were clipped at the end of the tow to assure that the doors were actually on bottom.

All data that was analyzed was completed using the R statistical package. Unless specified, default R conventions were followed.

Net geometry data were examined using box and whisker plots (McGill et al., 1978). Boxplots were drawn using the 25th and 75th quantiles as lower and upper limits, with a bar representing the median. The distance between the quantiles is called the interquartile range (IQR); approximately 50% of observed values are within this range. Whiskers extend to at most 1.5 times the IQR and end at an observed value. Points beyond the whiskers are greater than 1.5 times the IQR and can be considered outliers (Sokal and Rohlf, 2000). Box widths are proportional to the square roots of the sample sizes within each grouping.

Results to Date

Nine pre-trial tows were completed over four days northwest of Provincetown, MA on the F/V *Barbara L. Peters* (Figure 3). Tows 1 and 2 were completed on 10/8/08; tows 3 and 4 were completed on 10/15/08; tows 5 and 6 were completed on 10/27/08; tows 7, 8, and 9 were completed on 11/3/09. Tow 1 was used to familiarize ourselves with the whiting net and grate.

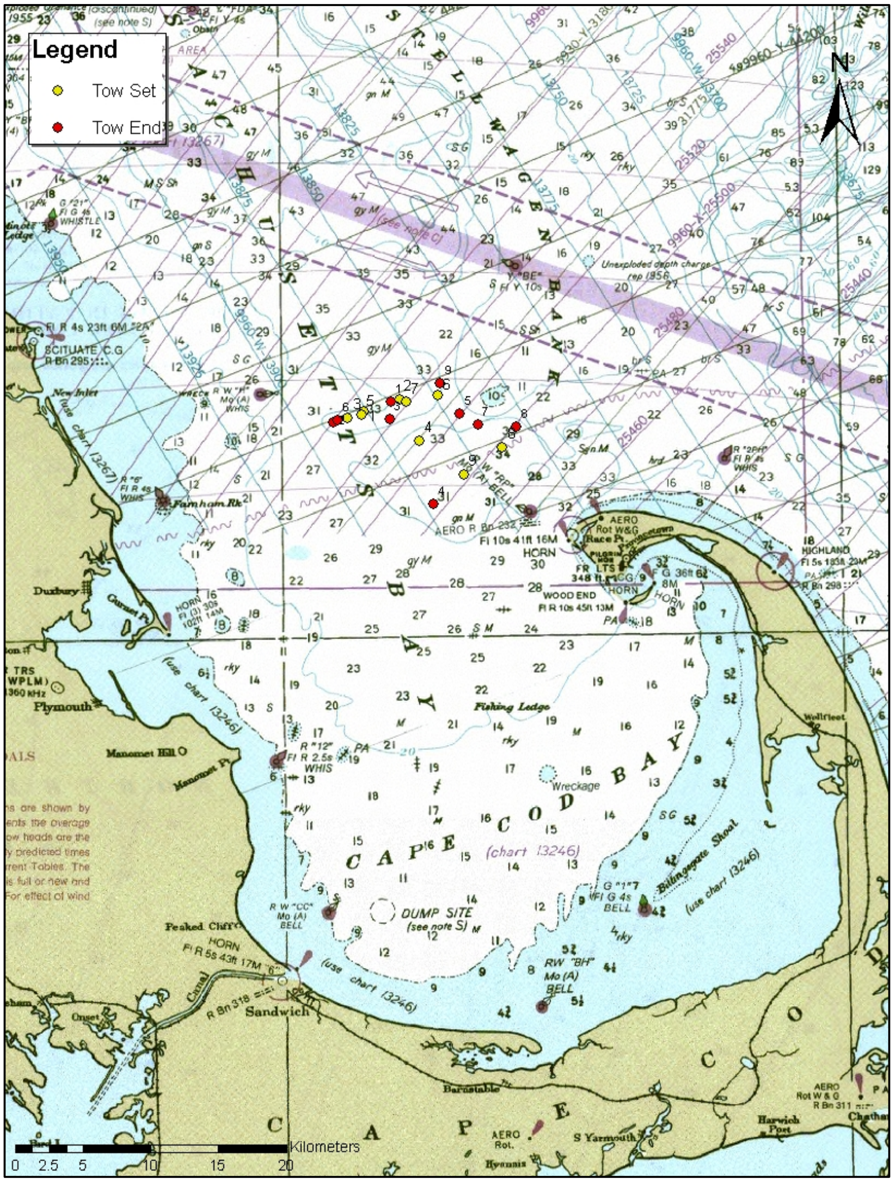

Figure 3: Pre-trial research tow locations. Numbers indicate the sequential tow.

Some geometry data was collected for the net and excluder grate (grid) and is shown in Figure 4.

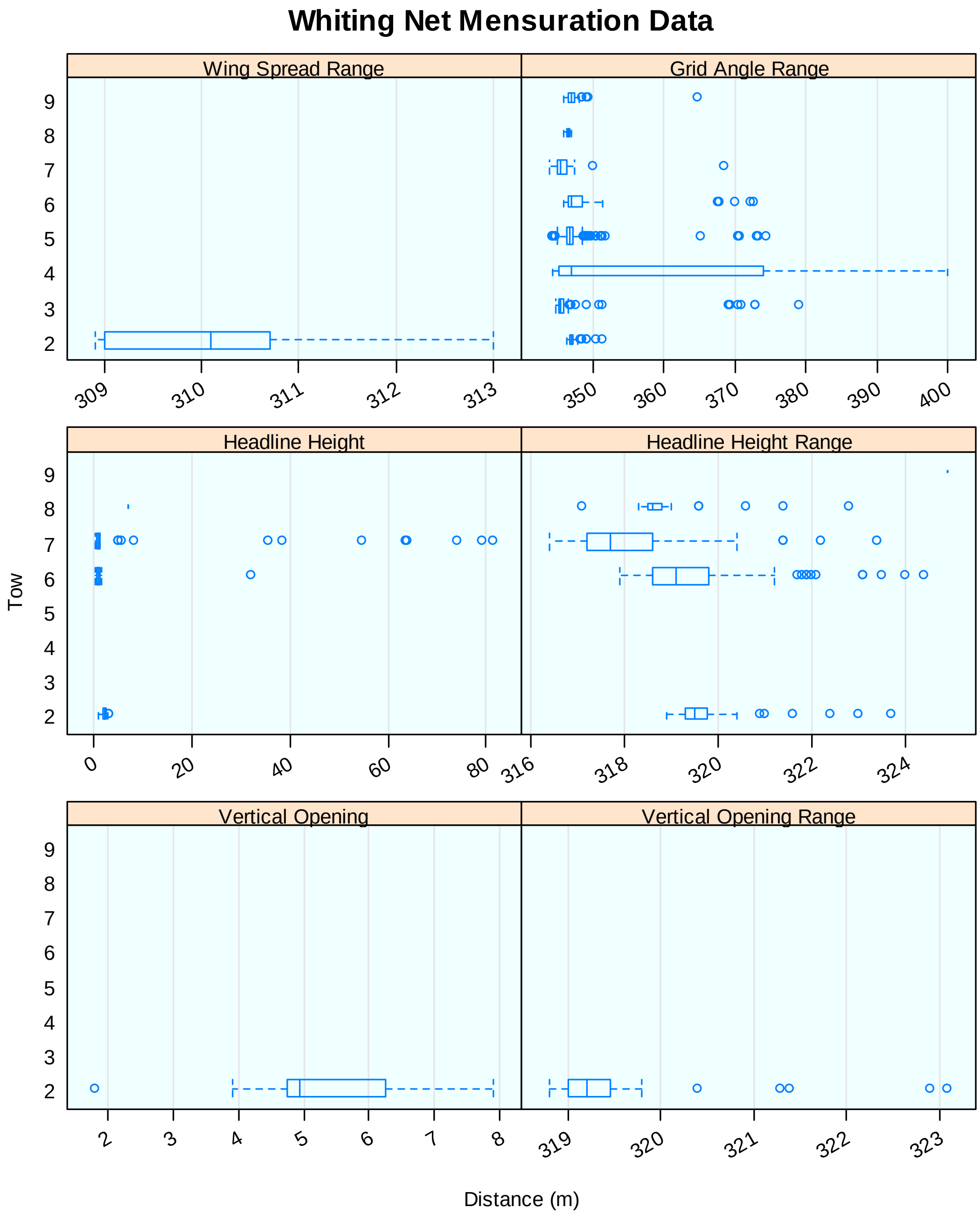

Figure 4: Box and whisker plots of net mensuration data from acoustic sensors while towing from the F/V Barbara L. Peters; each plot provides a different dimension to describe the gear on each tow. "Range" data describes the distance from the sensor to the hydrophone. The y-axis shows the tow identification numbers where data were collected.

Data was also collected on the grate's angle while towed (Figure 5-6). Since the Notus grid sensor was placed incorrectly on tow 2, no data was collected for that tow.

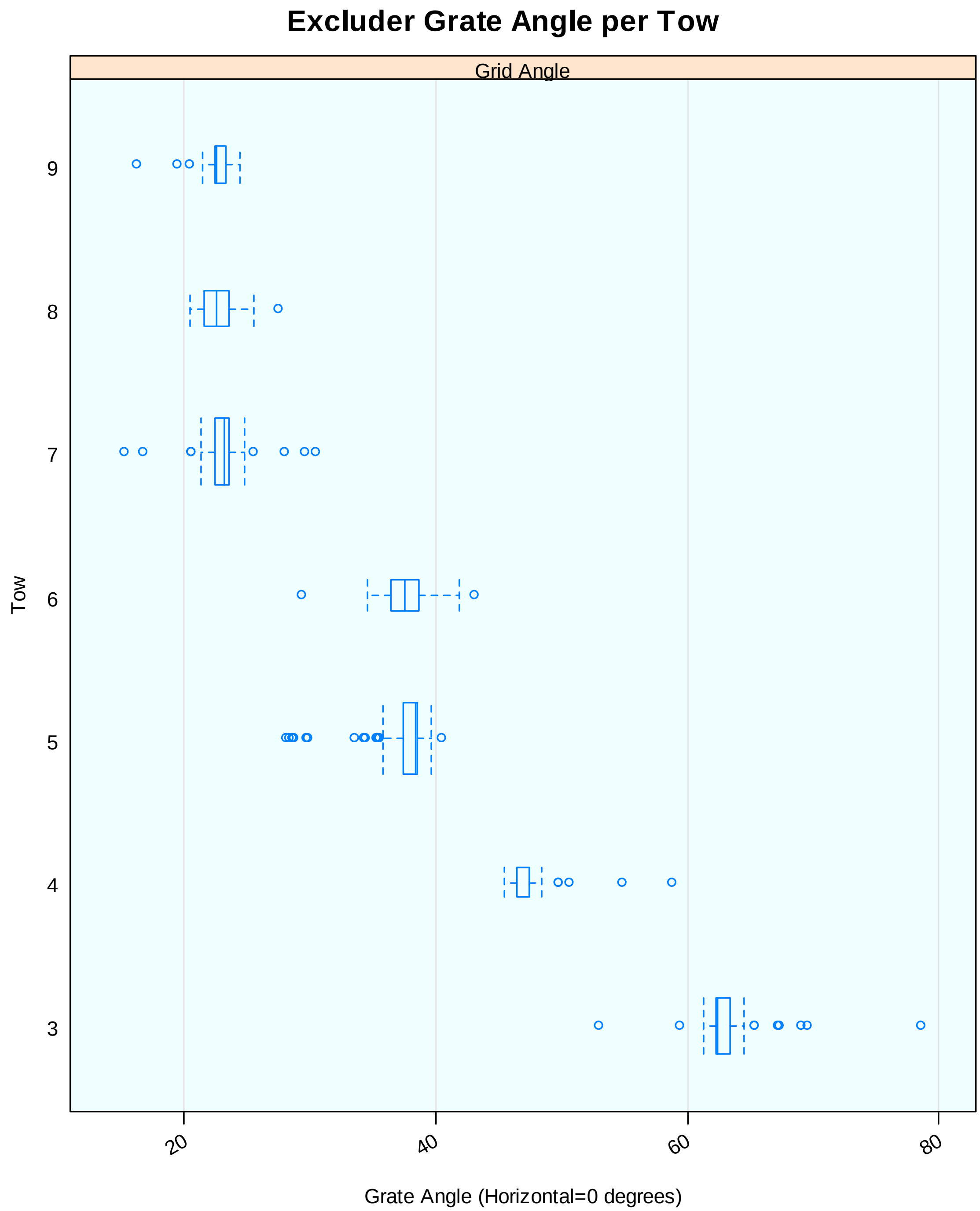

Figure 5: Box and whisker plots of grate angle data from acoustic sensor while towing. The y-axis shows the tow identification numbers where data were collected. The angle can range from 0^o (horizontal) - 90^o (vertical).

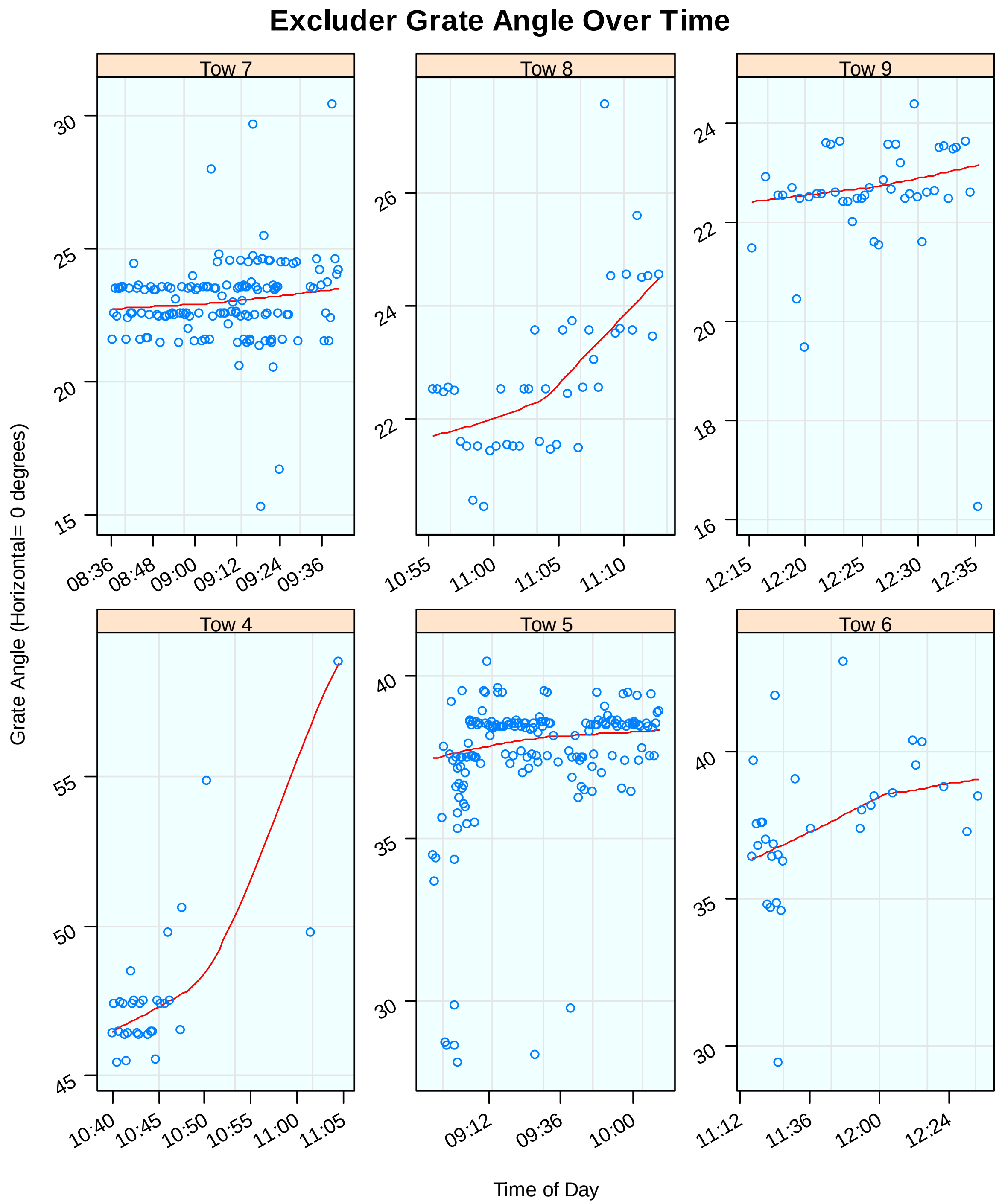

Figure 6: Plot of tow 4-9 showing the excluder grate's angle over time. The red lines show loess smoothers (α=1) (Venables and Ripley, 2002). The angle can range from 0º (horizontal) - 90º (vertical).

The net mensuration data collected was sparse and reveals little about tow variability (Figure 4). In tow 3,we believe that the grid sensor rolled out of its correct orientation giving false angle readings (Figure 5). We are unsure why the grate angles in tow 4 are larger than in tows 5 and 6 (which were all set on land at about 45º on land; tows 7-9 were set at about 35º on land) (Figure 6). In all cases there is an increasing trend of the excluder grate's angle during the tows. We theorize that this occurred due to the codend filling with fish which provided added tension to the extension area where the grate was situated.

The net that was fished during the pre-trial research was generally in poor condition. It was acquired by Frank and Andrew Mirarchi and was already used and modified by prior fishermen. We realized upon inspection that certain panels were stretched out of shape before we began using it. The most obvious warping occurred in the lower belly. A 15.2 cm (6 inch) mesh panel was added to compensate for the warped area. A triangular panel of the same approximate mesh size was added from the lower wing to the square. The lower wingends were missing and replaced with 76.2 cm (30 inch) long, 1.3 cm (½ inch) extension chains to compensate for difference with the upper wingend distances. Also, sections on the top wings were replaced with 7.6 cm (3 inch) mesh. Finally, the guiding panel was not fitted tightly in the extension. An area of depression was seen in the video footage just before the end of the guiding panel.

Some warping occurred over time to the grate's bars (Figure 7). This was likely due to pressure from winding the grate on the net's drum. Oringinally, the grate's floats were positioned between the drum and the grate which probably caused the greatest warping effect. However, some warping may also be due to the towing process itself.

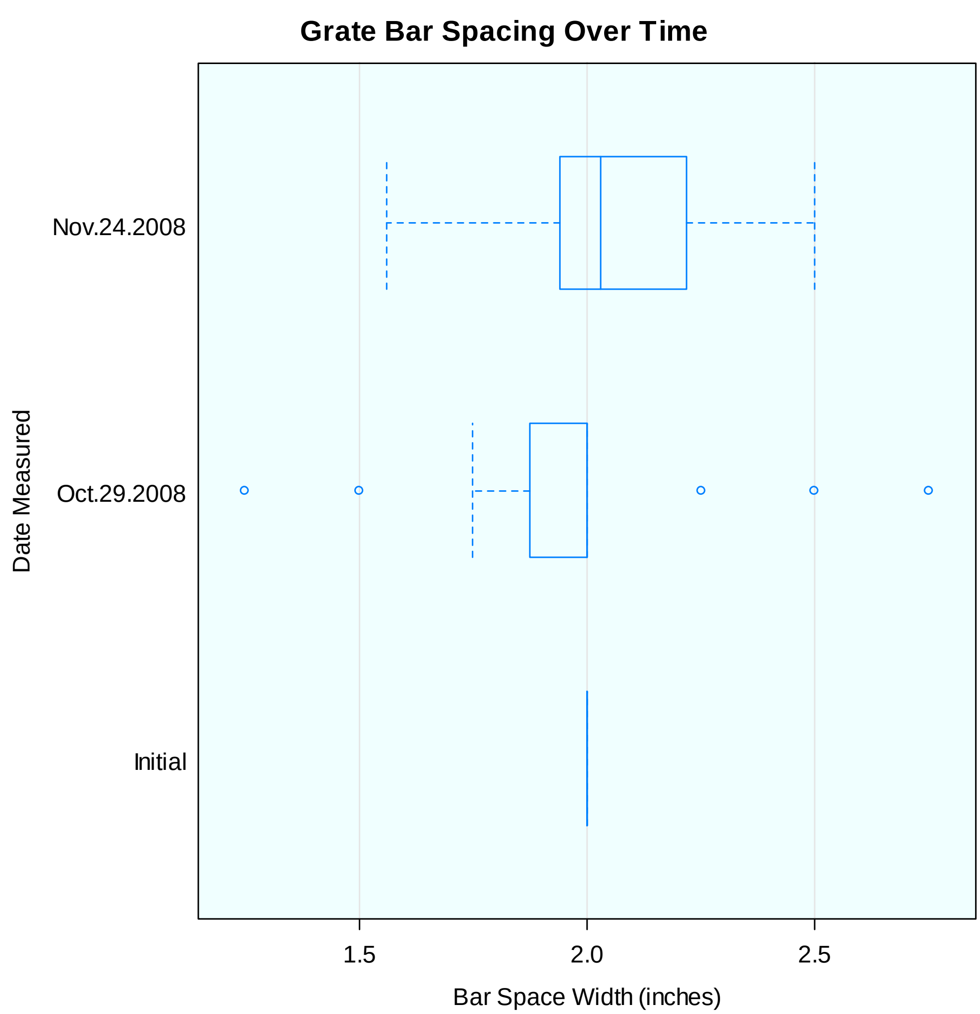

Figure 7: Box and whisker plot of the excluder grate's bar spacing during the pre-trial research. Measurements were made to the center of the upper bar spaces (n=16 for each trial).

Total catch results are provided below in Table 2; Figure 8 shows the catch/hour for selected species. Catches were adjusted for sub-samples when taken. Large amounts of Atlantic herring were caught in tow 2 and the net was not able to be brought on board until approximately two-thirds of the catch was let go. Weights that are provided represent numbers inflated to account for the estimated discards. Also, in order to quickly return excess Atlantic herring that were brought on board, an estimation of the catch amount was made for this species.

		Haul Number								
Scientific Names	Common Names	1	2	3	4	5	6	7	8	9
ALOSA	HERRING, RIVER, NK (BLUEBACK or ALEWIFE)	0.0	0.0	0.0	0.0	20.9	46.7	15.0	21.3	5.0
ALOSA PSEUDOHARENGUS	ALEWIFE	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ALOSA SAPIDISSIMA	SHAD, AMERICAN	0.0	0.7	0.0	0.0	0.5	0.0	0.0	0.0	0.0
CLUPEA HARENGUS	HERRING, ATLANTIC	252.2	3129.8	339.1	7.0	117.4	130.4	2.0	0.5	0.5
CLUPEIDAE	HERRING, NK (SHAD)	0.0	0.0	0.0	0.0	0.0	2.9	2.3	0.2	0.0
COTTIDAE	SCULPIN, NK	0.1	0.0	0.0	0.0	1.8	0.0	0.0	0.0	0.0
ENCHELYOPUS CIMBRIUS	ROCKLING, FOURBEARD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GADUS MORHUA	COD, ATLANTIC	1.1	0.0	2.7	0.9	4.5	1.8	1.1	1.1	0.2
GLYPTOCEPHALUS CYNOGLOSSUS	FLOUNDER, WITCH (GREY SOLE)	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HIPPOGLOSSINA OBLONGA	FLOUNDER, FOURSPOT	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1
HIPPOGLOSSOIDES PLATESSOIDES	FLOUNDER, AMERICAN PLAICE (DAB)	3.9	6.1	5.2	46.0	15.2	11.6	0.0	0.2	0.2
HOMARUS AMERICANUS	LOBSTER, AMERICAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ILLEX ILLECEBROSUS	SQUID, SHORT-FIN (ILLEX)	0.8	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0
Limanda ferruginea	FLOUNDER, YELLOWTAIL	0.0	0.0	0.0	0.0	1.6	0.1	1.8	1.1	3.6
LOLIGO PEALEII	SQUID, ATL LONG-FIN (LOLIGO)	0.0	1.4	2.9	1.4	0.0	0.0	3.9	0.0	0.0
MELANOGRAMMUS AEGLEFINUS	HADDOCK	0.9	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0
MERLUCCIUS BILINEARIS	HAKE, SILVER (WHITING)	32.7	39.5	24.5	306.6	160.6	60.3	229.3	157.9	333.6
MYOXOCEPHALUS OCTODECEMSPINOSUS	SCULPIN, LONGHORN	0.0	0.0	0.0	0.0	0.0	0.1	0.9	0.9	2.9
PEPRILUS TRIACANTHUS	BUTTERFISH	1.7	3.4	2.7	0.0	2.7	1.8	1.1	0.1	0.0
PSEUDOPLEURONECTES AMERICANUS	FLOUNDER, WINTER (BLACKBACK)	0.0	0.0	0.0	0.9	6.8	2.0	2.0	0.0	4.5
RAJA ERINACEA	SKATE, LITTLE	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0
RAJIDAE	SKATE, NK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SCOMBER SCOMBRUS	MACKEREL, ATLANTIC	0.0	0.0	0.0	0.0	25.9	48.8	9.1	0.1	1.4
SQUALUS ACANTHIAS	DOGFISH, SPINY	2.5	6.8	3.4	59.6	22.5	29.7	1.1	0.0	2.5
SQUID	SQUID, NK	0.0	0.0	0.0	0.0	4.3	5.0	0.0	4.5	2.9
UROPHYCIS CHUSS	HAKE, RED (LING)	19.1	9.5	19.7	49.7	42.6	31.3	7.7	8.4	1.4
UROPHYCIS REGIA	HAKE, SPOTTED	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0
UROPHYCIS TENUIS	HAKE, WHITE	0.0	0.0	0.5	0.0	0.0	0.5	0.0	0.0	0.0

Table 2: Total catch weights (kg) for each tow.

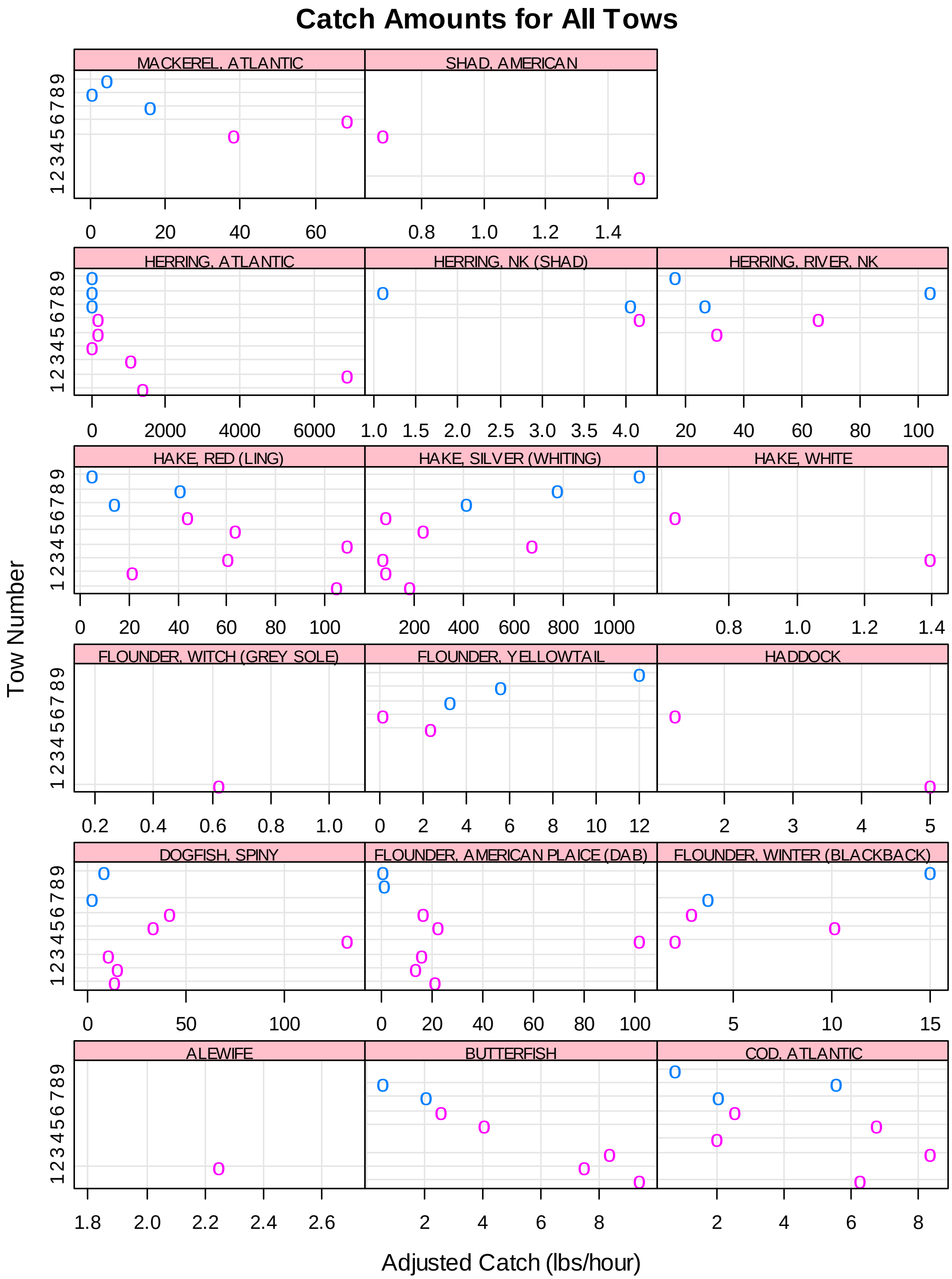

Figure 8: Catch/hour (lbs/hour) for selected species. Purple circles indicate tows completed with the excluder grate set at about 45^o (on land); blue circles indicate tows completed with the excluder grate set at about 35^o (on land).

It is worth noting that the catches for whiting and yellowtail flounder are generally larger in later tows in which the grate was set at a less steep angle (from the horizontal) (Figure 8). Other species, including spiny dogfish, generally show the opposite trend. However, these tows (7, 8, and 9) were also performed on a different day with limited samples.

Analyses of length frequency data have not occurred at this time for any species. This data will be presented in the final report.

We attempted to collect underwater video footage on tows 2-9. Video of the excluder grate were successfully acquired for tows 3-9 during the pre-trial work. Selected relatively clear video from each tow will be sent with a copy of this report.

In general, the behaviors of individual fish species were largely consistent for each tow as seen in the videos. It was difficult to identify small fast moving fish such as whiting and herrings. When video was clear, spiny dogfish could easily be identified in front of the excluder grate. Due to the limited field of view of the camera, it could not always be visually confirmed that fish would pass through the escape vent or through the excluder grate into the codend. However, based on the large numbers of dogfish often seen in the videos and the small amount retained in the codend, we feel that most spiny dogfish escaped the gear. Short term impingements of spiny dogfish were common (generally lasting a few seconds) and wedging behaviors in the grate were rarely observed and also only lasted for short periods of time. Other behaviors witnessed for spiny dogfish in the extension included side-to-side swimming as well as up and down swimming. Smaller fish would occasionally gill themselves in mesh surrounding the grate; usually gilled sea herring were identified upon net retrieval. Small fish in large groups appeared to display erratic swimming behaviors but again, is difficult to categorize in the video. Other roundfish, such as Atlantic cod or red hake, were occasionally seen passing through the grate or escaping through the vent; these fish often stayed close to the guiding panel. Flatfish species stayed low in general and were difficult to identify in the video; they were also occasionally seen turning to their sides and passing through the grate. Since the guiding panel was not taught within the extension area, some fish would occasionally rest in a depressed area that formed on this panel. Fish that displayed this behavior included herring, whiting, and flatfish (which seemed capable of remaining in that location the longest). Other behaviors witnessed by various fish include swimming back out of the excluder grate, hitting into side meshes, and swimming back up over the guiding panel.

The Notus grid sensor was located on the top corner of the grate and provided some blockage to fish (Figure 9). However, most fish seemed to avoid the sensor. Occasionally, a fish would become wedged between the sensor and grate although most would become dislodged. Larger fish (mostly spiny dogfish) rarely interacted with the sensor more than a bump behavior.

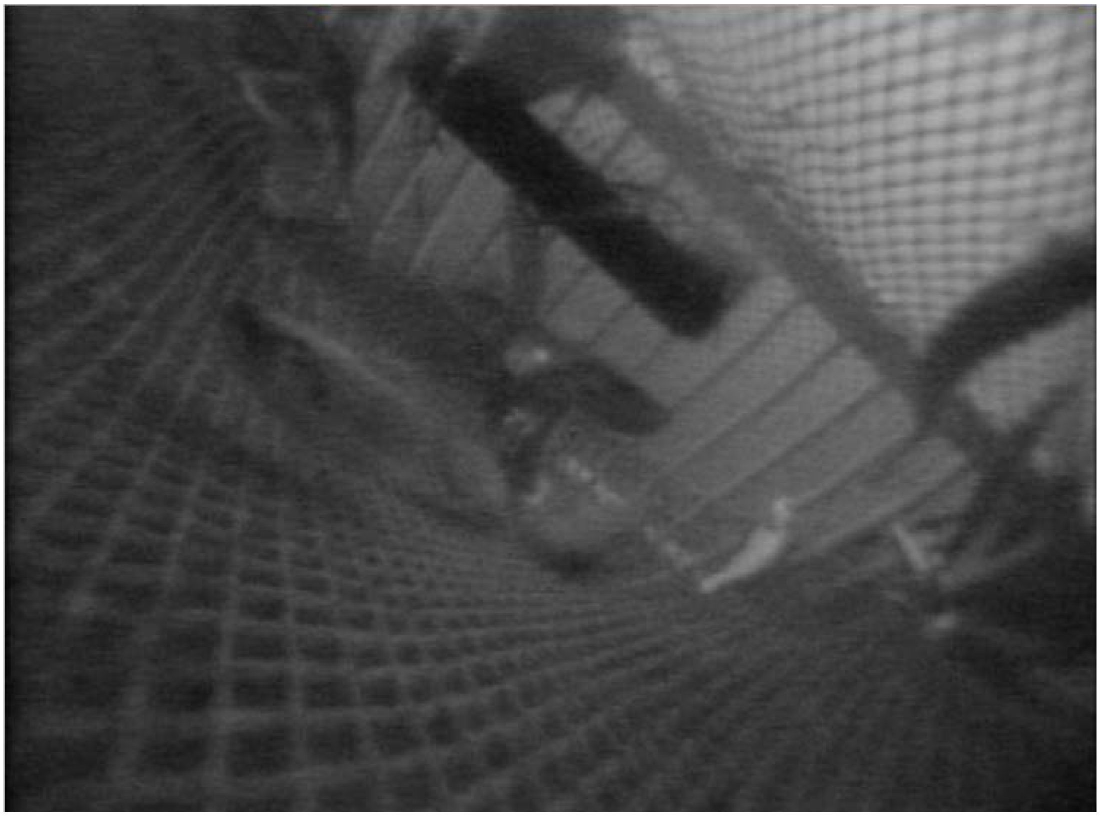

Figure 9: Underwater image of the excluder grate while fishing. A spiny dogfish is attempting to swim back over the guiding panel. A whiting is in the foreground. The Notus grid sensor is seen on the top corner of the grate.

A detailed log of all video will be included along with a final project report. The general video results are as follows:

- Tow 3: Overall dark video was captured possibly due to water sedimentation, time of day (amount of sunlight), or light blockage from large fish assemblages over the camera.
- Tow 4: Many spiny dogfish were witnessed interacting with or in front of the excluder grate. Most seem to escape. Dogfish behaviors with the grate generally involve impingements and then escape or an avoidance behavior. However, some temporary wedging did occur and some pass through the grate. Some other fish witnessed in this video include whiting, red hake, Atlantic cod, squid (species unconfirmed), flatfish (species unconfirmed), and river herring *Alosa*.
- Tow 5: Overall, this video is very dark. Species seen and identified includes spiny dogfish, whiting, winter flounder, and river herring.
- Tow 6: This video consists of large groups of spiny dogfish and other fish species but also periods of very dark video. Fish can be seen swimming behind and with the grate. Spiny dogfish behaviors can again be seen as in tow 4. Other fish seen and identified includes whiting, red hake, flatfish, haddock, Atlantic cod, squid, and butterfish *Peprilus triacanthus*.
- Tow 7: Assemblages of fish seen and identified included spiny dogfish, whiting, red hake, butterfish, and flatfish. Behaviors are consistent from earlier tows.
- Tow 8: Assemblages of fish seen and identified included spiny dogfish, whiting, red hake, river herring, flatfish, squid, and a skate *Rajidae* (which escapes). Behaviors are consistent from earlier tows.
- Tow 9: This was generally clear video. Assemblages of fish seen and identified included

spiny dogfish, whiting, red hake, Atlantic cod, yellowtail flounder, winter flounder, other flatfish, squid, and winter skate *Raja ocellata*. Behaviors are consistent from earlier tows.

Future Work

Work is planned to continue as scheduled for July-August, 2009. We are awaiting the issuance of a new EFP whose request was submitted on March 2, 2009. As a backup work window, field trials can also be conducted in the normal whiting area north and west of Provincetown, MA in September-November 2009. A new net has been constructed for the coming research (paid for by Frank and Andrew Mirarchi); the design of the net was approved by Chosid from DMF and conforms to a standard raised footrope whiting design. We plan to conduct at least nine days of testing. Video will be collected observing the behaviors of spiny dogfish and whiting whenever possible.

Our goal with this project is to produce a prototype grate arrangement for whiting. We will investigate if this grate can be used to expand the existing whiting small mesh fishery in Cape Cod Bay and Massachusetts Bay. We envision testing without cameras on a systematic broad scale in Cape Cod Bay, using catch bags on the net's escape vent to quantify excluded catch. We also envision attempting to use the grate prototype in large mesh groundfish nets.

Impacts and Applications

The pre-trails have had very positive results so far. Although, we are not able to accurately quantify the number of spiny dogfish that were excluded while using the grate, we have observed large numbers of dogfish entering the net and not retained in the codend. At the same time, commercial quantities of whiting have been retained, although the quantity lost is unknown. The partner industry members on this project already feel that the exclusion of the dogfish have significantly reduced their total fish handling time and improved the quality of their catch. Furthermore, this method likely reduces the dogfish mortality from discards.

The exclusion of spiny dogfish in a whiting net could lead to an expansion of the whiting fishery by time and/or location, if low dogfish stocks or low spawning stocks threaten the fishery. An excluder grate may be a cheap cost effective solution. Furthermore, other stocks of concern may also be excluded as a side effect.

Related Projects

None.

Partnerships

The cooperative efforts between DMF and the industry partners, Frank and Andrew Mirarchi, have brought together complimentary skill sets. The fishermen's gear understanding and have been invaluable to the DMF research institution. Communications between Chosid, Pol, and

Frank and Andrew Mirarchi have been strong in defining the research needs and practical gear designs for good fishing operations. They jointly considered logistics of deck handling of the grate, camera and sensor equipment, and the fish catch. Frank and Andrew provide the lead on determining timing of the fishing activities, tow locations, and have primary responsibility for determining safe working conditions due to weather and deck activity. Chosid is responsible for acquiring all the necessary permitting for conducting the research. Chosid and Pol provide the lead on the experimental design, database development, data analysis, and report writing. Chosid and Szymanski lead the sea sampling. Frank and Andrew Mirarchi also lead in processing the catch. Additionally, the cooperative process increases our understanding of the other partners' skills and challenges.

Presentations

Chosid, D.M. and Pol, M. 2009. [poster]. Let Slip the Dogs of War! Development of a Spiny Dogfish Excluder in a Raised Footrope Whiting Trawl. Northeast Consortium 8th Annual Project Participants Meeting, 25 March 2009, Portsmouth, NH.

Published Reports and Papers

La Valley, K. 2009. Dog-grate aims to boost access to whiting. Commercial Fisheries News. June 2009.

Data

All electronic data from this project are being entered into a customized Access relational database, and will be provided to the Northeast Consortium Fisheries & Ocean Database at the same time as final report submittal. Additionally, copies of video and images taken will also be provided at that time.

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