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Northeast Area Monitoring and Assessment Program Near Shore Trawl Survey 11/08

Northeast Area Monitoring and Assessment Program

NEAMAP Near Shore Trawl Survey

Peer Review Documentation

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Chapters

Notes:

1. Table and Figure numbers are specific to each chapter, however acronyms and species names are only defined at first usage for the entire document.
2. Trademarked commercial hardware and software products are so noted on first use but for simplicity are thereafter referred to without trademark or copyright notation.
3. While the authors have attempted to minimize duplication of information in the various chapters of this document, some such duplication is present for the reader's convenience.

Program Background

History and Development

Concerns regarding the status of fishery-independent data collection from the continental shelf waters between Cape Hatteras, North Carolina and the U.S. / Canadian border led the Atlantic States Marine Fisheries Commission's (ASMFC) Management and Science Committee (MSC) to draft a resolution in 1997 calling for the formation the Northeast Area Monitoring and Assessment Program (NEAMAP) (ASMFC 2002).

NEAMAP is a cooperative state-federal program modeled after the Southeast Area Monitoring and Assessment Program (SEAMAP), which has been coordinating fishery-independent data collection south of Cape Hatteras since the mid-1980s (Rester 2001). The four main goals of the NEAMAP program directly address the deficiencies noted by the MSC for this region and include:

1. Developing fishery-independent surveys where current sampling is either inadequate or absent.
2. Coordinating data collection amongst existing surveys as well as any new surveys.
3. Providing for efficient management and dissemination of data.
4. Establishing outreach programs (ASMFC 2002).

The NEAMAP Memorandum of Understanding was signed by all partner agencies by July 2004.

One of the first major efforts of the NEAMAP was to design a trawl survey intended to operate in the coastal zone of the Mid Atlantic Bight (MAB - i.e., Montauk, New York to Cape Hatteras, North Carolina). While the National Marine Fisheries Service (NMFS) Northeast Fisheries Science Center's (NEFSC) Bottom Trawl Survey has been sampling from Cape Hatteras to the U.S. / Canadian border in waters less than 91.4m since 1963, few stations are sampled in waters less than 27.4m due to the sizes of the sampling area and vessels (NEFSC 1988, R. Brown, NMFS, pers. comm). In addition, of the six coastal states in the MAB, only New Jersey conducts a fishery-independent trawl survey in its coastal zone (Byrne 2004). This new NEAMAP Near Shore Trawl Survey is intended to fill the aforementioned gap in fishery-independent survey coverage, which is consistent with the program goals.

Program Structure and Organization

The following is taken from the NEAMAP website, www.neamap.net, with minor modification.

Program partners include the state marine fishery agencies from Maine through North Carolina, the ASMFC, the NMFS NEFSC, the New England and Mid-Atlantic Fishery Management Councils, the U.S. Fish and Wildlife Service, the Potomac River Fisheries Commission, and the District of Columbia. Other participants include SEAMAP, Atlantic Coastal Cooperative Statistics Program (ACCSP), and the Environmental Protection Agency.

The NEAMAP Board serves as the executive level committee for the program, and includes representatives from all partner agencies. The Board oversees the implementation of NEAMAP, establishes policy to guide program and partner participation, and serves as the final decision making authority for the program.

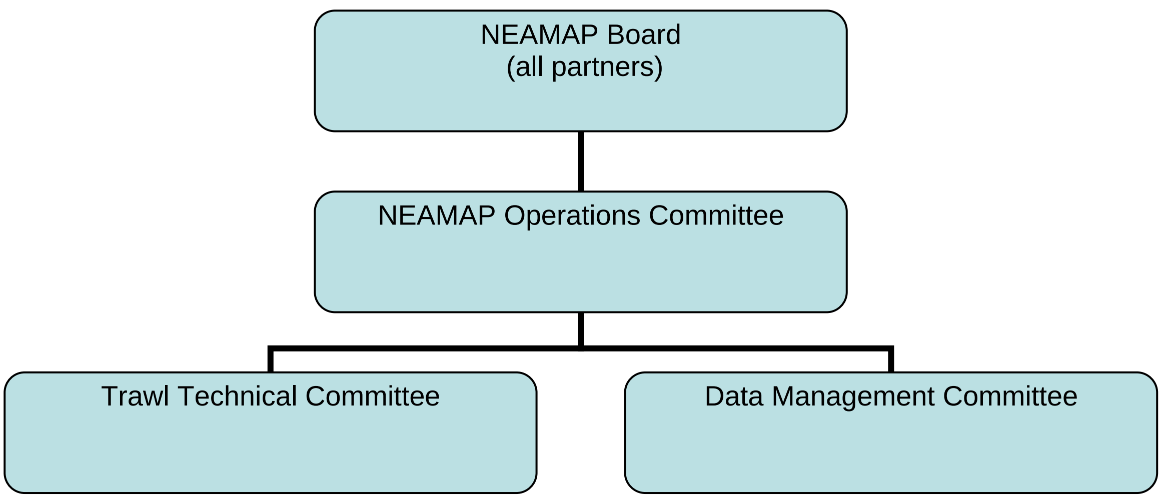
The Operations Committee, composed of representatives from partner agencies, is responsible for recommending program priorities, funding criteria, research possibilities, and other items as requested by the NEAMAP Board. The Operations Committee is the vehicle for coordination of Technical Committee input into the program. The Operations Committee also presents recommendations from the Trawl Technical Committee and the Data Management Committee to the NEAMAP Board (Figure 1).

Technical committees are assigned to develop technical details of individual surveys and perform relevant tasks assigned by the Operations Committee and the NEAMAP Board. Committee makeup varies depending on the function of the committee. Technical committees report back directly to the Operations Committee.

Whenever possible, all committees reach decisions by consensus. If consensus is not possible, the NEAMAP Board reaches a final decision by vote, with each partner agency casting one vote. If consensus is not possible at any other committee level, the committee shall identify options and present the benefits and drawbacks to each option. These options will be forwarded to the next higher committee level for review and possible inclusion into the development of a recommendation.

The ASMFC provides staff support and other administrative functions.

Figure 1. ASMFC NEAMAP Organizational Chart



Funding

In early 2005, the ASMFC made $250,000 of “plus-up” funds that it had received through the Atlantic Coastal Fisheries Cooperative Management Act (ACFCMA) available for pilot work in an effort to assess the viability of the NEAMAP Near Shore Trawl Survey. The Virginia Institute of Marine Science (VIMS) provided the sole response to the Commission’s request for proposals and was awarded the funding in August 2005. Two brief pre-pilot cruises and the full Pilot Cruise were conducted in 2006 (Bonzek et al., 2007).

Early in 2007 ASMFC bundled funds from ACFCMA (Year 2) and the NEFSC Cooperative Research Program, which enabled full scale sampling operations to begin in the fall of 2007. In 2008, a combination of ACFCMA (Year 3) and Mid-Atlantic Fisheries Management Council (MAFMC) Research Set Aside (RSA) funds were sufficient to fund both field and laboratory operations for the spring and fall surveys.

For 2009 it is anticipated that MAFMC RSA funds, coupled with grants to ASMFC from the state of New York, will support the program. Long term funding is not currently available.

Original Survey Design

During the program's developmental stage (1997-2003) a subcommittee of the ASMFC MSC developed the general outlines of the proposed mid-Atlantic near shore survey and produced the NEAMAP Mid-Atlantic Near Shore Trawl Survey Design Document (Design Document). The general survey parameters included in the Design Document are:

- The survey area should be from Montauk, New York to Cape Hatteras, North Carolina.
- Sampling should occur in depths ranging between 5.5m and 27.4m.
- The number of sites sampled per cruise should coincide with a sampling intensity of approximately 1 tow per 30nm^2 (originally estimated to be 200 stations per cruise).
- Sampling should occur quarterly, or if funds are limited, should be in spring (beginning in mid-April) and fall (beginning in mid-September).
- Stratification should follow the design used by the NEFSC Bottom Trawl Survey.
- Within each stratum, cells should be defined at 2.5 minutes latitude by 2.0 minutes longitude with each cell representing a sampling unit.
- Stations should be allocated to strata in proportion to the surface area of the strata.
- Sampling gear should be a 50-60ft. (headrope length) high-rise trawl net with a cookie sweep and no chaffing gear.
- Tows should be 20 minutes in duration.
- Tow speed should be at the optimal speed based on net design.

Implemented Survey Design

The survey as implemented closely follows the specifications described above and in the original Design Document, with a number of modifications and improvements:

- NEFSC contributed significant funds toward NEAMAP full implementation with the provision that the under-sampled areas of Block Island Sound (BIS) and Rhode Island Sound (RIS) be added to the NEAMAP sampling area. These areas are deeper than other NEAMAP regions but from a 'distance from shore' standpoint are within the range covered by NEAMAP in other states.
- In 2007 NEFSC took delivery of the *FSV Henry B. Bigelow*, began preliminary sampling operations, and determined that the vessel could safely operate in waters as shallow as 18.3m. NEFSC then made a determination that future surveys would likely extend inshore to that depth contour (R. Brown, NMFS, pers. comm.). The NEAMAP Operations Committee subsequently decided that the offshore boundary of the NEAMAP survey coastal sampling (i.e., Montauk to Cape Hatteras) should be realigned to coincide

- Based on the redefined north-to-south and inshore-to-offshore survey area and on the specified sampling rate of one station per $30nm^2$, the number of sites to be sampled per cruise was changed to 150 (Table 1).
- Available funds are adequate only for spring and fall surveys, with start dates as recommended.
- The recommended stratification criteria were followed in general but with some specific modifications. Latitudinal (in New York, BIS, and RIS longitudinal) region boundaries were maintained from the NEFSC Bottom Trawl Survey strata definitions, with very minor changes such that to the extent possible region boundaries correspond to state boundaries. Further, using bathymetric soundings data from the National Ocean Service (NOS) it was determined that NEFSC depth-based stratum boundaries (which were established at least 45 years ago) did not always correspond to actual depth contours. Further, to assure sufficient inshore-to-offshore station selection and to attempt to minimize within stratum variance, depth strata were defined using the 6.1m-12.2m and 12.2m-18.3m depth contours within each major region.
  As previously noted, waters in BIS and RIS are considerably deeper than the 18.3m outer depth used in the rest of the survey area. Depth strata in these regions are defined as 18.3m-27.4m and 27.4m-36.6m (Figure 2).
- Cells representing the sampling units were delineated at 1.5 minute x 1.5 minute intervals. Depth contours and habitats within these smaller (compared to the specified 2.0 x 2.5 minute) units were thought to be more uniform and consistent. As the typical tow distance should be about 1nm (3.0kt x 0.33h), a complete tow could easily occur with each cell.
- Station allocation is proportional to the surface area of each stratum, with a minimum of two samples per stratum. As some strata are fairly small, some strata are sampled at a density considerably higher than the $1{:}30nm^2$ target.
- The sampling gear, at approximately 78ft headrope length, is considerably larger than recommended in the Design Document. The net is the same industry-recommended design to be used aboard the *Bigelow*. Trawl doors used are 66" Thyboron™ Type IV weighing approximately 360kg each. Net dimensions while fishing average 33.3m door spread, 13.5m wing spread, 5.5m headrope height. We believe that industry acceptance and compatibility with NEFSC makes this trawl package an excellent choice. The net has proven to fish well and consistently in the NEAMAP context.
- Full tows are 20 minutes in duration. If forced to cut a tow short due to surface traffic, obstructions, fixed gear, etc., a 15 minute tow is considered complete.
- Tow speed is typically between 2.9kt and 3.3kt, speed over ground. Flume tank tests and later field trials have shown that the net fishes well within design specifications at these speeds. No effort is made to fish either with or against the current, though tow direction relative to the current is recorded.

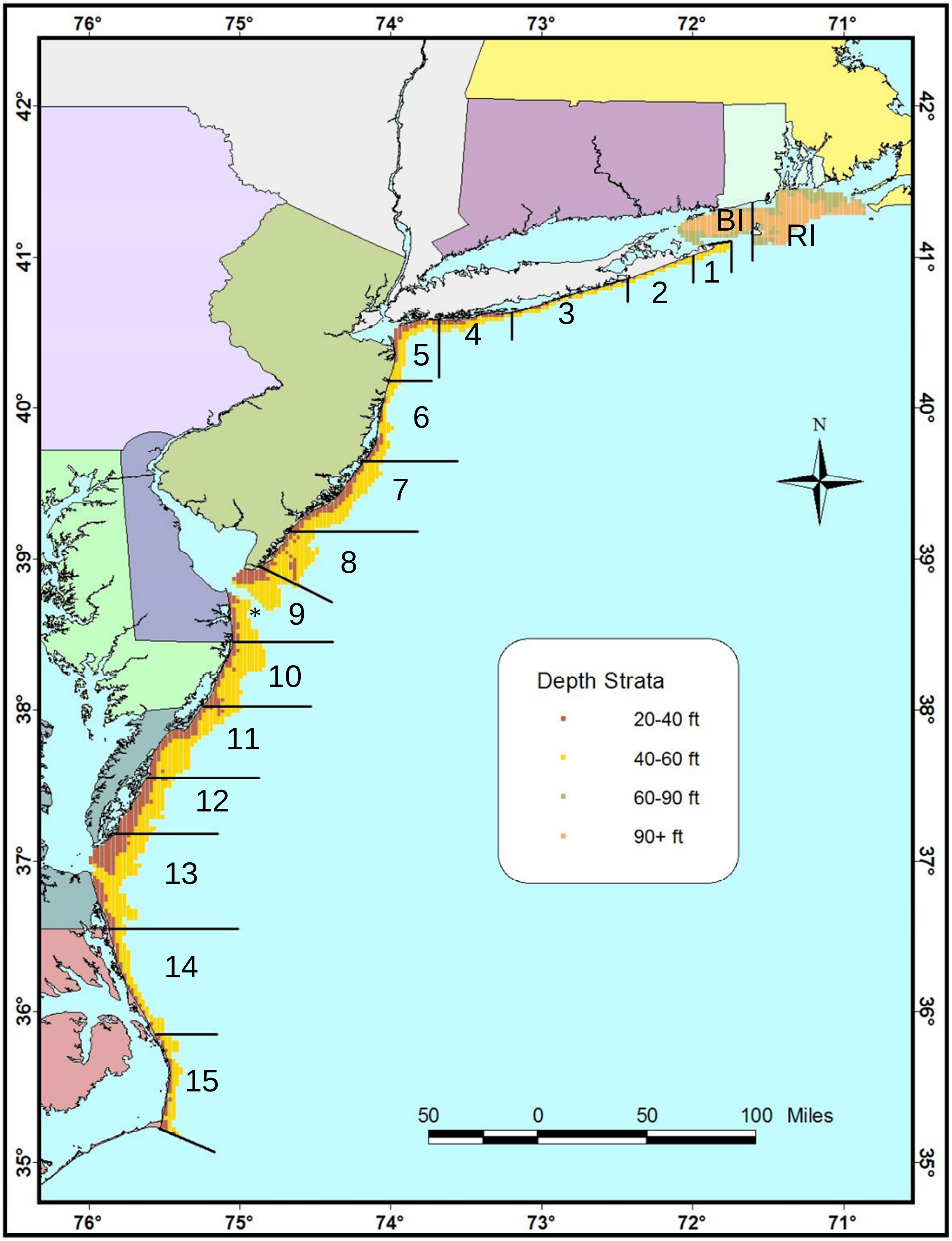
Table 1. Number of available sample cells and number sampled in each stratum.

Region	State*	Stations Sampled								
		20ft.-40ft.		40ft. – 60ft.		60ft. – 90ft.		90ft. – 120ft.		Sq. nm. per Station
		Stations sampled	Total cells	Stations sampled	Total cells	Stations sampled	Total cells	Stations sampled	Total cells	
RI Sound	RI					6	85	10	161	34.6
BI Sound	RI					3	42	7	88	29.2
1	NY	0	0	2	19					21.4
2	NY	2	8	3	19					12.2
3	NY	2	16	3	28					19.8
4	NY	2	16	3	29					20.2
5	NY	2	27	3	45					31.1
6	NJ	2	20	3	42					27.9
7	NJ	4	49	6	97					32.9
8	NJ	2	32	7	90					30.5
9	DE	4	54	8	113	5	68			31.1
10	MD	2	33	8	114					33.1
11	VA	5	62	8	122					31.8
12	VA	4	60	5	67					31.8
13	VA	6	94	10	142					33.2
14	NC	2	24	5	61					27.3
15	NC	2	25	4	55					30.0
Total		41	520	78	1043	14	195	17	249	30.1

* Note that region boundaries are not perfectly aligned with all state boundaries:

- Some stations in RI Sound may occur in MA
- Some stations in BI Sound may occur in NY
- Region 5 spans the NY-NJ Harbor area
- Some stations in Region 9 may occur in NJ

Figure 2. NEAMAP Near Shore Trawl Survey sampling area with region boundaries and depth strata.



* Sampling in the deeper channel areas leading to Delaware Bay was initiated during the Fall 2008 cruise.

Pilot Surveys

As mentioned, in early 2005 the ASMFC made $250,000 of "plus-up" funds that it had received through the ACFCMA available for a pilot survey to assess the viability of the NEAMAP Near Shore Trawl Survey. VIMS provided the sole response to the Commission's request for proposals and funding was awarded in August 2005. Two brief pre-pilot cruises and the full Pilot Cruise were conducted in 2006.

On 9-10 May 2006, a pre-pilot cruise was completed aboard the *F/V Darana R* using the bottom trawl developed by the NEFSC Trawl Advisory Panel and Thyboron Type IV, 66" trawl doors. Prior to this cruise, this combination of net and doors had yet to be tested in the field. This short pre-pilot cruise was considered necessary for several reasons:

- To provide an opportunity for the vessel crew and scientific crew to begin operating as a cooperative single unit.
- To assure that the various electronics could be deployed correctly and would operate satisfactorily.
- To assure that the net-door-vessel combination produced satisfactory gear performance.
- To test the reaction of the gear to changes in settings and fishing conditions (e.g. varying speeds, scopes, depths, tow directions, net and door adjustments, etc.) to establish parameter standards for the full Pilot Cruise.
- To allow the vessel crew to become familiar with deployment and retrieval of the gear.
- To provide the scientific crew with estimates of average catch rates which would aid in preparing for the full Pilot Cruise.
- To provide the science crew the opportunity to practice workup procedures and to test the layout of workstations.

Net geometry results from the vessel/door/net combination, as measured by VIMS Netmind™ trawl monitoring equipment were much closer to design specifications and flume tank results, compared to several door/net combinations previously used by NMFS aboard the *R/V Delaware* as measured by NMFS Scanmar™ apparatus. To test whether the difference in measured net geometry was simply due to a difference in the two monitoring gears, a second two-day cruise was arranged during which both Netmind and Scanmar gear would measure gear performance. This cruise occurred on 29-30 June 2006 and representatives from both VIMS and the NEFSC participated. NMFS net monitoring apparatus measured door spread in addition to wing spread and headrope height. VIMS did not acquire door sensors until the summer of 2007. For several tows, Netmind and Scanmar gear was interchanged and the net was fished under similar conditions. Eventually, it was determined that the two systems did not interfere with one another so both sets of equipment were mounted simultaneously. For the final several tows both systems were employed, however, equipment malfunctions and computer crashes resulted in a small amount of data loss from one system or the other on some tows. It was found that the Scanmar headrope height sensor was slightly mis-calibrated, but otherwise the different systems measured similar gear geometry.

For the full Pilot Cruise, it was estimated that the budget allowed for approximately 100 stations between Montauk, NY and Cape Hatteras, NC to be sampled. At this point in time the sampling area had not been expanded to include BIS and RIS, and the survey area still extended to the

27.4m contour. Between 25 September and 15 October 2006, 98 stations were sampled. Catch magnitudes were manageable and sample workup procedures were refined. It was determined that the survey was feasible using the vessel, trawl package, scientific crew, and procedures as established. Reasonable budget estimates for full scale sampling were developed as a result of the Pilot Survey.

Full Scale Surveys – 2007-2008

In early 2007 ASMFC packaged together funding from the ACFCMA and the NEFSC Cooperative Research Program to fund the first full scale NEAMAP surveys. The contract with VIMS to conduct NEAMAP survey operations was continued.

The process of scaling up from the 2006 Pilot Survey to full survey operations occurred during the first half of 2007. Additional personnel were recruited, gear, equipment, and supplies were purchased, electronics and software were prepared, and so on.

The Fall 2007 survey occurred between 25 September and 20 October. Sampling occurred in a north-to-south direction so as to follow the general migration pattern of most species. The targeted 150 stations were successfully sampled, with approximately 87% at the selected ‘Primary’ location (see “Survey Design” section). An average of 6 (counting all days at sea) to 8 (counting only full working days) sites were sampled per day, with tows conducted only during daylight hours. Workdays usually lasted between the hours of approximately 5:30am and 9:00pm.

As was experienced during the Pilot Survey, the fishing package performed consistently and within design parameters (Figure 3).

Catch biomass at each station ranged between 7.5kg and 6,396kg and between 75 and 152,000 individual fishes were collected. Between 8 and 36 species were captured at each station. A summary of total catch, number measured, and number of laboratory samples taken for diet and age determination at VIMS is presented for Priority A, B, and C (see “Survey Procedures” section for definitions) species (Table 2).

The first spring survey occurred between 23 April and 15 May 2008. Sampling was conducted in a south-to-north direction, this time to follow the general spring migratory patterns of targeted fishes. Again, the target number of 150 stations was sampled with about the same number of Primary and Alternate stations as in the Fall 2007 survey. Stations were sampled slightly faster than during the Fall 2007 survey due mainly to somewhat smaller catches and to an increase in processing efficiency.

For all but the last six stations, a new net (same design), different from the one fished in the Pilot Survey and Fall 2007 cruise, was used. The primary reason for switching nets was to test whether a second net would perform with the same geometry and in the same consistent manner as the one fished previously. The new net did indeed fish with very similar height and spread and performed very consistently on a tow-to-tow basis (Figure 4).

Total biomass collected at each station was between 6.2 kg and 2,293kg and between 58 and 41,000 individual specimens were captured. Between 10 and 30 species were encountered at each station. A summary of total catch, number measured, and number of laboratory samples taken for diet and age determination at VIMS is presented for Priority A, B, and C species (Table 3).

Table 2. Summary of total catch, number measured, and number of laboratory samples for Priority A, B, and C species for the Fall 2007 NEAMAP Near Shore Trawl Survey cruise.

Priority	Species	Number	Biomass (kg)	Number Measured	Number of Age Samples	Number of Stomach Samples
A	black seabass	401	85.26	401	219	210
A	bluefish	4,635	394.54	2,613	588	485
A	butterfish	148,182	1,904.93	6,015	538	11
A	scup	276,234	3,928.70	13,718	808	797
A	silver hake (whiting)	346	24.79	346	59	59
A	striped bass	17	66.26	17	16	16
A	summer flounder	960	625.50	926	716	448
A	weakfish	60,990	4,168.11	5,747	572	471
A	winter flounder	391	98.74	391	118	114
B	American shad	9	0.80	9	9	9
B	Atlantic croaker	58,763	7,616.46	2,843	211	193
B	Atlantic menhaden	740	30.22	288	78	78
B	bluntnose stingray	349	1,178.89	307		
B	bullnose ray	731	1,155.04	631		
B	clearnose skate	1,499	1,847.71	1,355	340	324
B	cownose ray	451	3,976.61	150		
B	Leucoraja spp.	20	5.66	20		
B	little skate	5,288	3,026.20	2,659	194	187
B	monkfish	6	31.24	6	6	6
B	roughtail stingray	92	510.13	92	1	1
B	skate spp.	60	37.00	60		
B	smooth butterfly ray	292	557.11	292		
B	smooth dogfish	1,690	1,555.62	765	202	200
B	southern stingray	18	138.99	18		
B	spiny butterfly ray	133	1,366.73	133		
B	spiny dogfish	17	51.31	17	13	12
B	spot	44,437	3,941.98	2,507	160	9
B	winter skate	951	925.26	735	171	160
B	yellowtail flounder	1	0.13	1	1	1
C	alewife	56	3.15	56	24	24
C	Atlantic herring	198	5.39	198	20	20
C	Atlantic mackerel	3	0.28	3	3	1
C	black drum	35	5.79	35	33	25
C	blueback herring	50	1.62	50	18	18
C	red drum	2	14.86	2	1	1
C	tautog	4	3.74	4	4	4

Table 3. Summary of total catch, number measured, and number of laboratory samples for Priority A, B, and C species during the NEAMAP Near Shore Trawl Survey Spring 2008 cruise.

Priority	Species	Number	Biomass (kg)	Number Measured	Number of Age Samples	Number of Stomach Samples
A	black seabass	166	83.89	166	140	119
A	bluefish	37	10.93	37	27	24
A	butterfish	47,742	689.21	8,315	746	
A	pollock	3	0.03	3	2	1
A	scup	51,629	1,256.07	7,167	869	754
A	silver hake (whiting)	28,765	549.81	3,063	409	397
A	striped bass	40	171.13	40	39	33
A	summer flounder	768	527.01	768	522	373
A	weakfish	39,580	2,198.83	2,174	305	279
A	winter flounder	1,863	554.15	1,525	466	450
B	American shad	1,205	40.77	1,205	327	321
B	Atlantic croaker	467	24.99	212	41	38
B	Atlantic menhaden	32	2.03	32	10	10
B	Atlantic stingray	7	17.02	7		
B	barndoor skate	2	1.20	2	1	1
B	bluntnose stingray	84	308.24	26	2	2
B	bullnose ray	3	50.36	3		
B	clearnose skate	3,216	4,234.09	1,047	209	202
B	little skate	9,876	5,868.41	2,994	315	303
B	monkfish	31	130.77	31	31	23
B	roughtail stingray	1	0.86	1		
B	skate spp.	901	209.85	740		
B	smooth dogfish	927	2,501.68	688	297	288
B	spiny dogfish	1,329	3,389.80	947	322	243
B	spot	28,561	1,059.19	1,220	61	
B	winter skate	1,713	3,168.29	1,214	317	299
B	yellowtail flounder	1	0.33	1	1	
C	alewife	2,419	141.77	1,572	350	344
C	Atlantic herring	187	15.58	177	54	45
C	Atlantic mackerel	11	1.53	11	11	10
C	black drum	5	140.86	5	5	
C	blueback herring	3,692	62.20	1,773	236	234
C	tautog	8	15.98	8	8	8

Figure 3. Average gear performance parameters, in chronological order, for the Fall 2007 NEAMAP Near Shore Trawl Survey cruise. Data points represent station averages for each of the parameters, dotted lines represent optimal ranges, and numerical values represent overall survey averages.

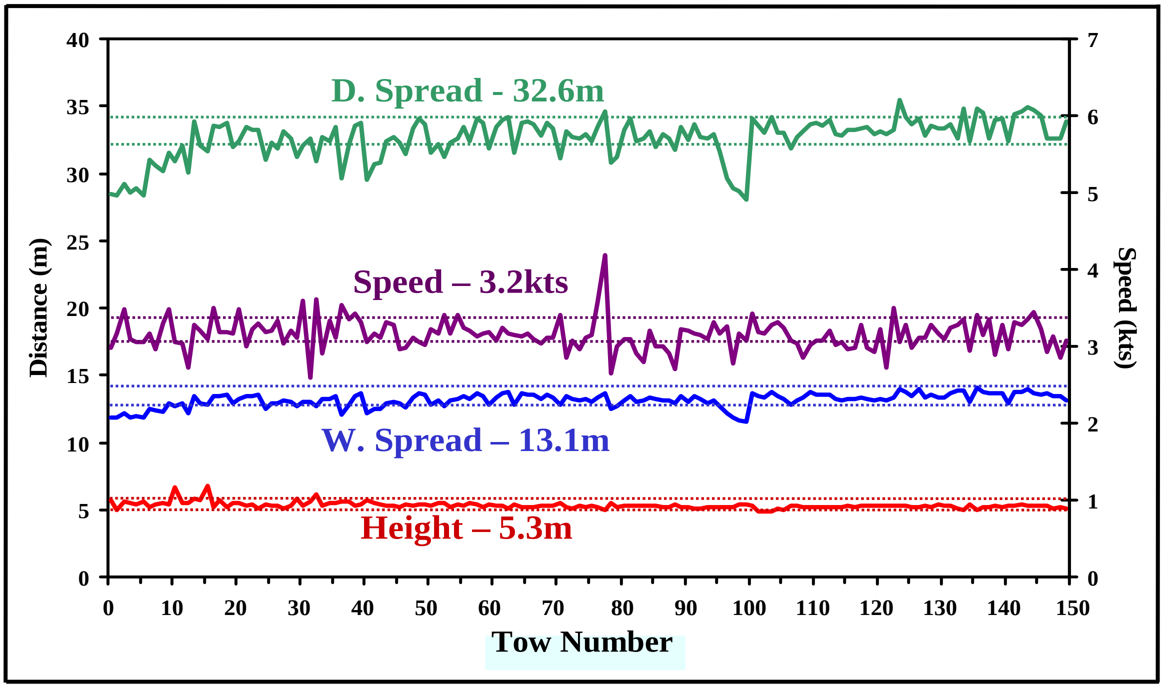
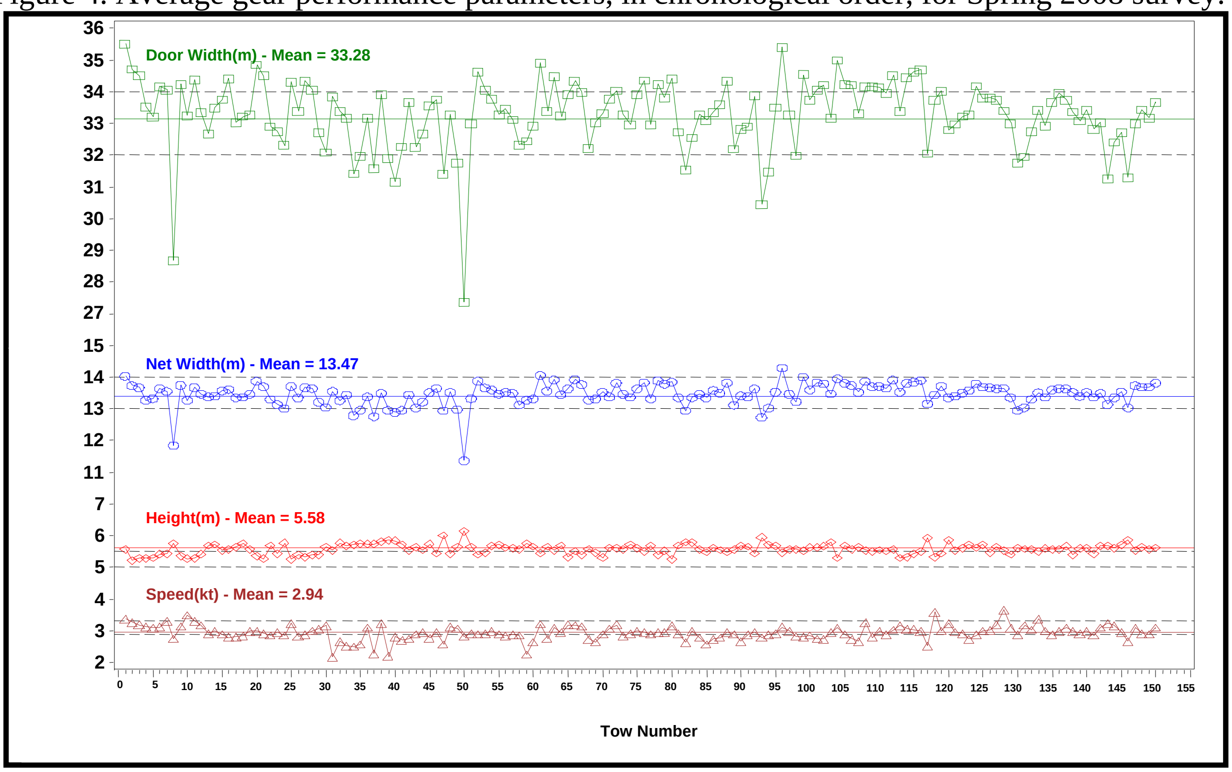


Figure 4. Average gear performance parameters, in chronological order, for Spring 2008 survey.



Literature Cited

Atlantic States Marine Fisheries Commission (ASMFC). 2002. Development of a cooperative state/Federal fisheries independent sampling program. ASMFC Document, Washington, DC.

Bonzek, C.F., J. Gartland, R.J. Latour. 2007. NEAMAP pilot survey final report. Submitted to Atlantic States Marine Fisheries Commission. 97pp.

Byrne, Don. 2004. Counting the fish in the ocean. Online. Internet. <http://www.state.nj.us/dep/fgw/artoceancount.htm>

Northeast Fisheries Science Center (NEFSC). 1988. An evaluation of the bottom trawl survey program of the Northeast Fisheries Center. *NOAA Tech. Memo*. NMFS-F/NEC-52, p. 83.

Rester, J.K. 2001. Annual report to the Technical Coordinating Committee Gulf States Marine Fisheries Commission. Report of the Southeast Area Monitoring and Assessment Program (SEAMAP) to the Gulf States Marine Fisheries Commission, Ocean Springs, Mississippi.

Survey Design

Survey Gear (Net and Doors)

<u>NEFSC Trawl Advisory Panel:</u>
One element in the NEFSC Bottom Trawl Survey response to the trawl warp measurement incident that occurred in 2002 was to institute an advisory panel led by industry advisors and also including gear manufacturers, NEFSC scientists, and outside academics. The Panel was charged with developing a new gear package which would balance the simultaneous needs of collecting a representative sample of the finfish and invertebrate communities in the survey area, while not overwhelming the scientific crew responsible for catch processing with excessively large catches (and thereby unnecessarily killing more fish than necessary). Further, this gear needed to achieve its intended geometry (i.e., door spread, wing spread, headrope height, etc.) consistently when fished from the new NEFSC research vessel, the *FSV Henry B. Bigelow*, which was then under construction. Over the next two years the Panel developed a net design which was accepted by all Panel members and most outside agents as well. A full description of this gear package is given below under “NEAMAP Gear Description”.

<u>Flume Tank Testing:</u>
In 2005 Panel members attended three days of thorough testing of a model of the proposed survey net at the flume tank facility at Memorial University’s Marine Institute in St. John’s, Newfoundland. The Panel made adjustments to improve net performance and to achieve better bottom-tending. Panel members also conducted a full series of net geometry measurements under a variety simulated environmental conditions and gear settings.

<u>NEAMAP Gear Selection:</u>
NEAMAP benefited from fortunate timing in commencement of field survey operations. Funding for the Pilot Cruise became available at virtually the same time that Trawl Panel net recommendations were being finalized. The original NEAMAP Design Document was very general with respect to its recommendations for the trawl to be used by the Near Shore Trawl Survey, so the survey was not bound to any particular gear. Also, by this time it had become clear that the *Bigelow* would not be able to sample in shallower state waters (i.e., NEAMAP’s survey area) due to draft restrictions of that vessel, meaning that NEAMAP had transitioned from a survey that would be providing supplemental data for the inshore waters of the MAB to one that would be effectively the only data source for most of these waters. It therefore became a relatively simple choice for NEAMAP to use the same net design as developed for NEFSC. VIMS proposed this choice, which was then approved by the Operations Committee and NEAMAP Board.

With respect to the doors, the NEFSC had undertaken field testing of the Panel net with an array of trawl door designs and sizes by the time that NEAMAP was preparing for its pilot surveys. Only weeks before the first NEAMAP pre-pilot survey was set to begin, the NEFSC Trawl Advisory Panel recommended that the new net be fished with a set of Thyboron, Type IV 66” doors. VIMS personnel were able to acquire a set of these doors within days (with the help of the NEAMAP survey vessel captain), and the NEAMAP pre-pilot cruise represented the first field test of this new net/door combination. Additional details are provided in the “Background” chapter under the “Pilot Surveys” heading.

NEAMAP Gear Description:

Net:

The following net description is taken from the document entitled "Design of a proposed research survey bottom trawl to conduct standardized resource surveys on a newly designed research vessel". This document was submitted by Reidar's Manufacturing Inc., Superior Trawl, and Trawlworks Inc. to the NEFSC Trawl Advisory Panel for use as a general purpose trawl for the NEFSC Bottom Trawl Survey, which operates in the MAB and New England. VIMS currently owns three of these nets. Each was acquired through a bid process, where the aforementioned gear vendors were given an opportunity to submit a bid for the construction of each of these nets. In each instance, Reidar's Manufacturing Inc. secured the order and constructed the net.

The net used by the NEAMAP Near Shore Trawl Survey is a three bridle trawl, the fishing circle of which is 400 meshes of 12cm, 4mm braided polyethylene (PE) twine (4800cm fishing circle) (Figure 1). The top square, top bellies, and second and third bottom bellies are 6cm, 2.5mm braided PE. The second, third, and fourth side panels are also 6cm, 2.5mm braided PE. The first side panel is 12cm, 4mm braided PE. This panel was 6cm, 2.5mm braided PE webbing in the original net plans at the request of scientists at the NEFSC concerned with the ability of this net to retain small fishes, which was approved by the NEFSC Trawl Advisory Panel. This panel of webbing was later changed to 12cm, 4mm braided PE, again at the request of the NEFSC, which again was approved by the Advisory Panel. This panel of webbing was combined with the 5.5meshes of 12cm, 4mm braided PE located ahead of it in the original plans, and is now referred to as the first side panel. Top and bottom wings, along with bunts and the first bottom belly, are made of 12cm, 4mm braided PE. The selvedge, 8 meshes deep on bottom wing bars and 5 meshes deep on top wing bars, is made of 12cm, double 4mm braided PE. All top, bottom, and side jibs are made of this 12cm, double 4mm braided PE webbing as well. All webbing, with the exception of the codend liner, is dark green. Four full meshes are put into each gore (with the exception of the codend and liner, see below). Port gores are wrapped using orange braided PE while starboard gores are wrapped using dark green braided PE.

The codend is made of 12cm, double 4mm braided PE with a 2.54cm knotless nylon liner. The codend is 75 meshes in diameter (clear count, not including meshes in the gore) and 75 meshes deep, with 30, 0.6cm x 5.1cm stainless steel rings at the terminus. The codend has two gores, each including 5 meshes (2.5 from each of the top and bottom panels). Two 20.3cm orange center-hole floats (Nokalon™) were added for buoyancy to counterbalance the Netmind catch sensor that is installed in the codend during survey operations (Figure 2). A splitting strap and bull rope have also been added to facilitate "splitting the bag" for larger catches. This arrangement consists of three 3.05m, 2.5cm diameter polydacron rib-lines, a 5.2m, 3.2cm diameter polydacron splitting strap, 12 plastic splitting rings (1.5cm x 9cm), and a 32m, 2.9cm diameter polydacron bull rope. The liner has a single gore, which includes 8 meshes (4 from each side) and is rigged to facilitate a quick change of codend liners, if necessary (i.e., mesh has been added to allow sewing into net at a "1-to-1" pick-up) (Figure 3). The liner material is dipped in black Rit-dye™, which aids the vessel crew in ensuring that all fishes are removed from the codend after each tow (silvery and white fishes can be difficult to see in a white liner).

Figure 1. Schematic net plan for the NEAMAP Near Shore Trawl Survey trawl net. Note the webbing change in the first side panel.

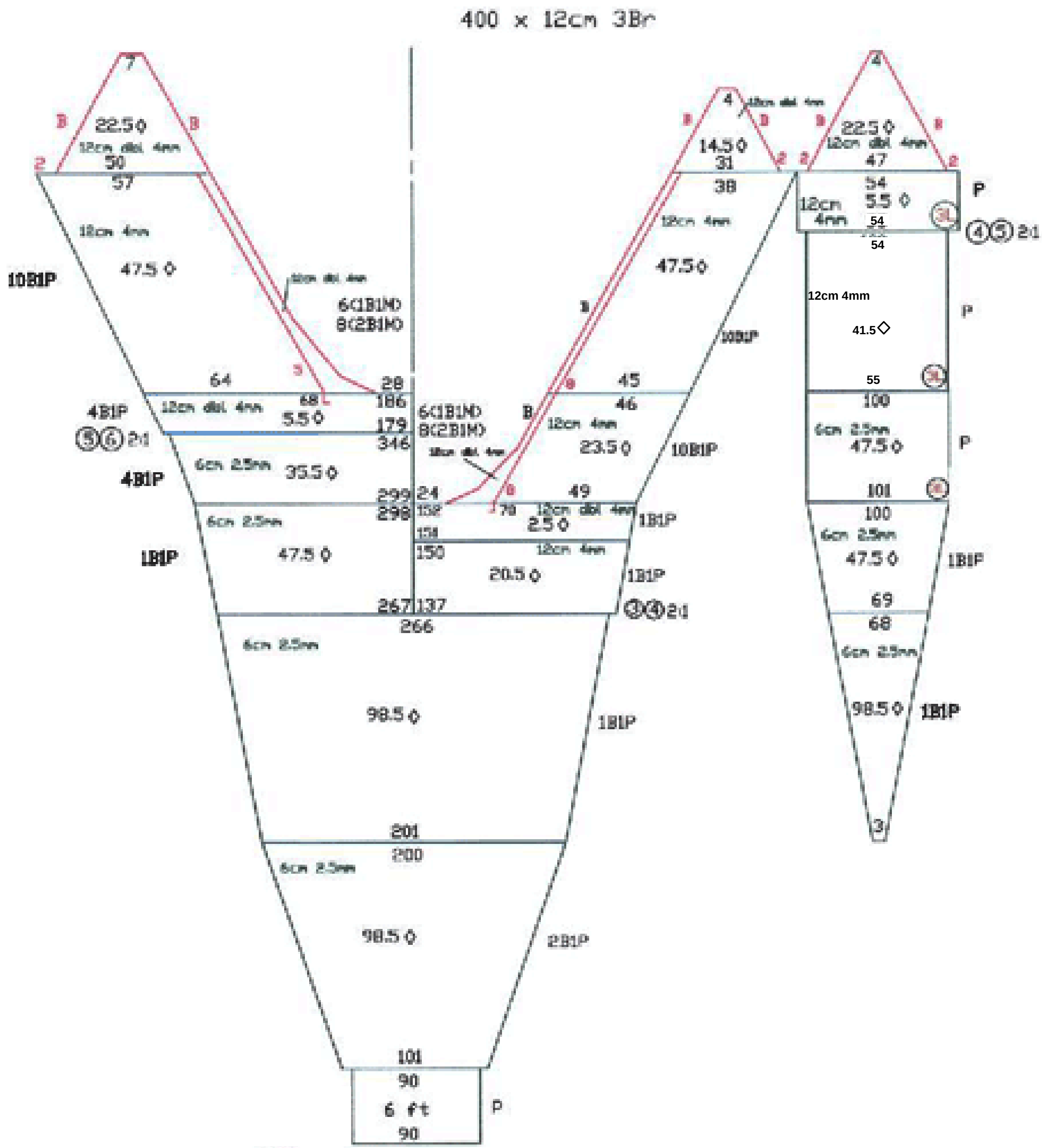
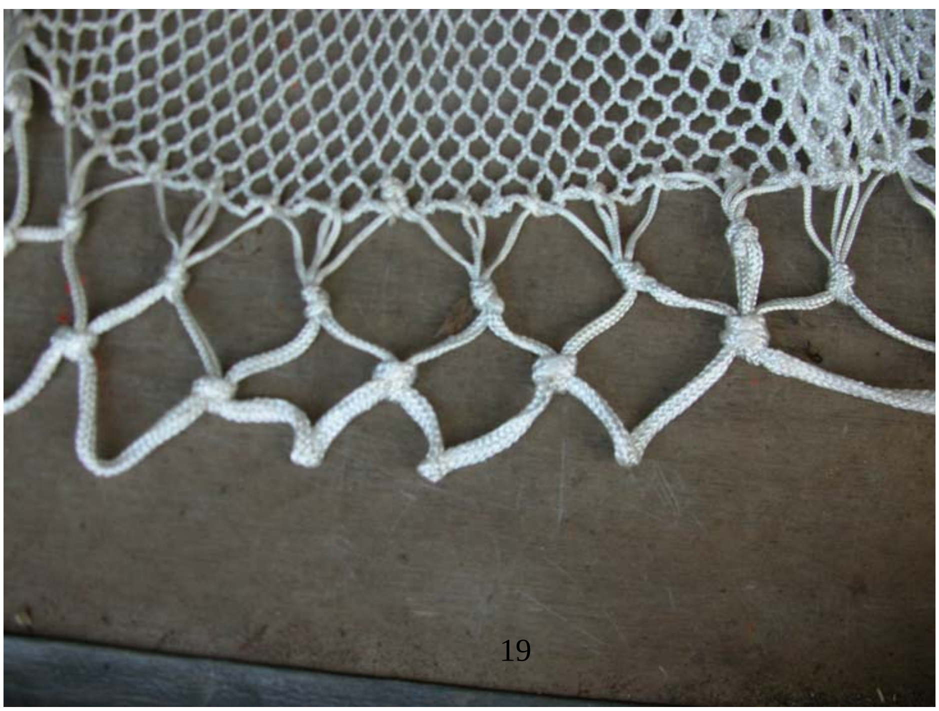


Figure 2. Float placement and splitting arrangement (including rib-lines, splitting strap, splitting rings, and bull rope) for the NEAMAP Near Shore Trawl Survey codend. Additional splitting rings have been added since this picture was taken.

Figure 3. Arrangement of meshes added to the liner used by the NEAMAP Near Shore Trawl Survey. These meshes are added to facilitate a quick change of liners, if necessary.



The headrope is 2070cm, eye to eye, and is made of 1.9cm stainless steel IWRC combination cable. Eyes are made of 1.9cm stainless steel HWR thimbles. The headrope eye, top jib end meshes, and top eye of the upper wing end are put into a 1.9cm galvanized Blue Line™ bow shackle (Figure 4) which is connected to a 1.3cm hammerlock (differs slightly from the drawing in Figure 4). A headrope extension chain of 11mm long link Trawlex™ chain comes from that hammerlock. The chain is 124cm, with an additional 50cm added to allow slacking out of the headrope. The NEAMAP net is fished with the extension chain fully slacked out. Total headrope length (including extension chains, hammerlocks, shackles, and combination cable) is 2360cm (2460cm when adding additional 50cm of slacking chain on each side).

Sixty, 20.3cm orange center-hole floats (Nokalon) are mounted vertically in two 30-float strings (Figure 4). The first float for each string is attached 50cm from the center of the headrope; the first 24 floats (from the center) are mounted 25cm on center while the remaining 6 floats of each string are mounted 50cm on center. The float line is made of 1.9cm Polysteel™ blue float rope with orange tracer, and floats are mounted with white #8 virgin polyester twine.

Wing ends are made of 1.6cm IWRC stainless steel combination cable. The upper wing end is 552cm, eye-to-eye, while the lower wing end is 459cm, eye-to-eye (Figure 4). Eyes are made of 1.6cm stainless steel HWR thimbles. The top eye of the upper wing end goes to a 1.9cm galvanized Blue Line bow shackle (referenced above). The bottom eye of the upper wing end, middle jib end meshes, and top eye of the bottom wing end are put into a 1.9cm galvanized Blue Line bow shackle. A middle extension made of 1.6cm stainless steel wire with 1.6cm stainless HWR thimbles in the eyes comes from the aforementioned bow shackle. The extension is 124cm, eye-to-eye (133cm when adding in the bow shackle), and is fitted with a 20.3cm rubber cookie. The bottom eye of the lower wing end, bottom jib end meshes, and the 1.6cm hammerlock extending from the footrope, are all put into a 1.9cm galvanized Blue Line bow shackle. A 125cm eye-to-eye extension wire (1.6cm stainless steel wire with 1.6cm stainless HRW thimbles) extends from this shackle, and this wire is also fitted with a 20.3cm rubber cookie.

The footrope is 2413cm, eye to eye, rubber covered wire (1.6cm stainless steel). The wire is covered with 6cm rubber spacer cookies. Two hundred, 2-hole hangers are used to connect the footrope to the selvedge (green 5mm, braided PE twine to connect 2-hole hangers to selvedge), and 38, 1-linkers (1.3cm Trawlex chain) are used to attach the footrope to the zipper traveler (Figure 5). The extension wire extending from the bottom eye of the lower wing end/bottom jib end meshes/footrope is referenced above. The total footrope length (footrope, hammerlocks, shackles, extension wires) measures 2700cm.

Figure 4. Diagram of headrope, float arrangement, and wing ends of the trawl used by the NEAMAP Near Shore Trawl Survey.

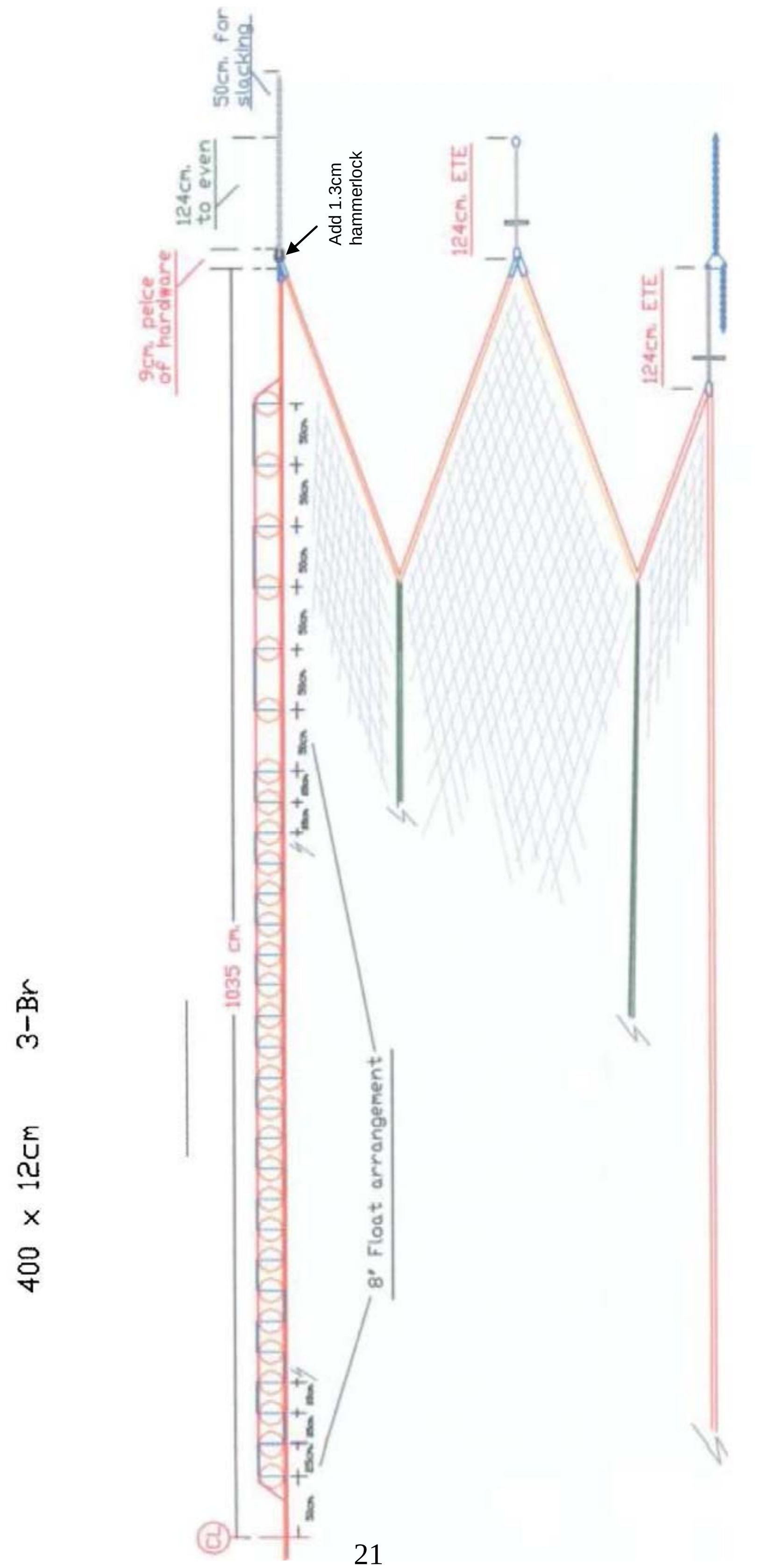
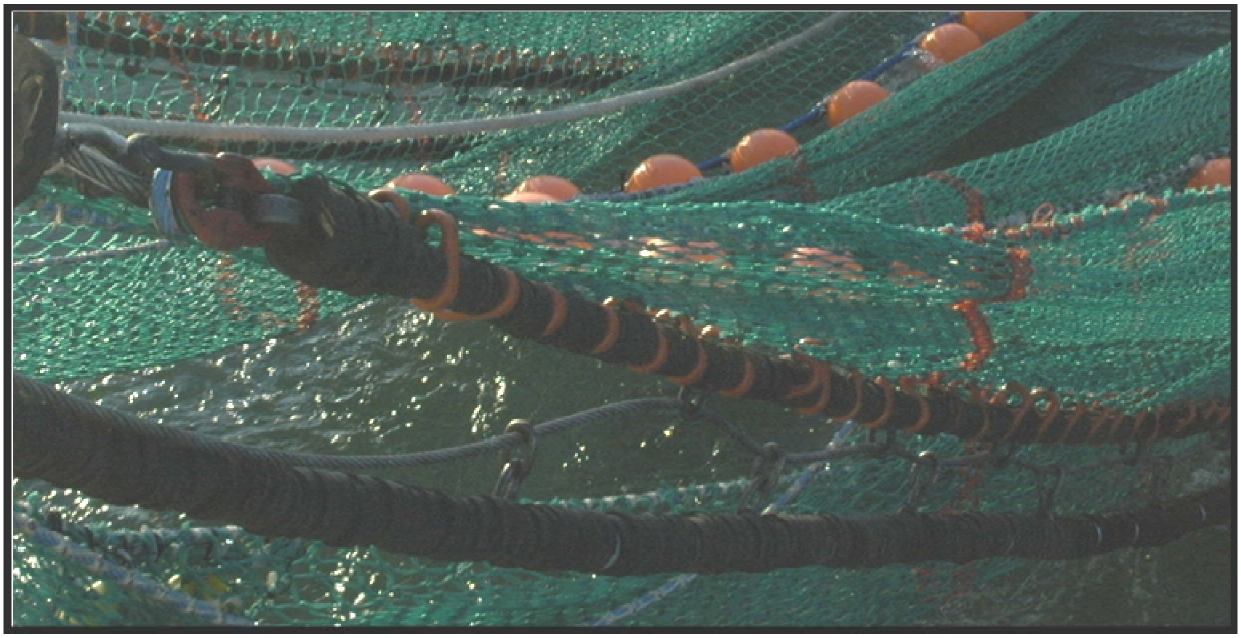


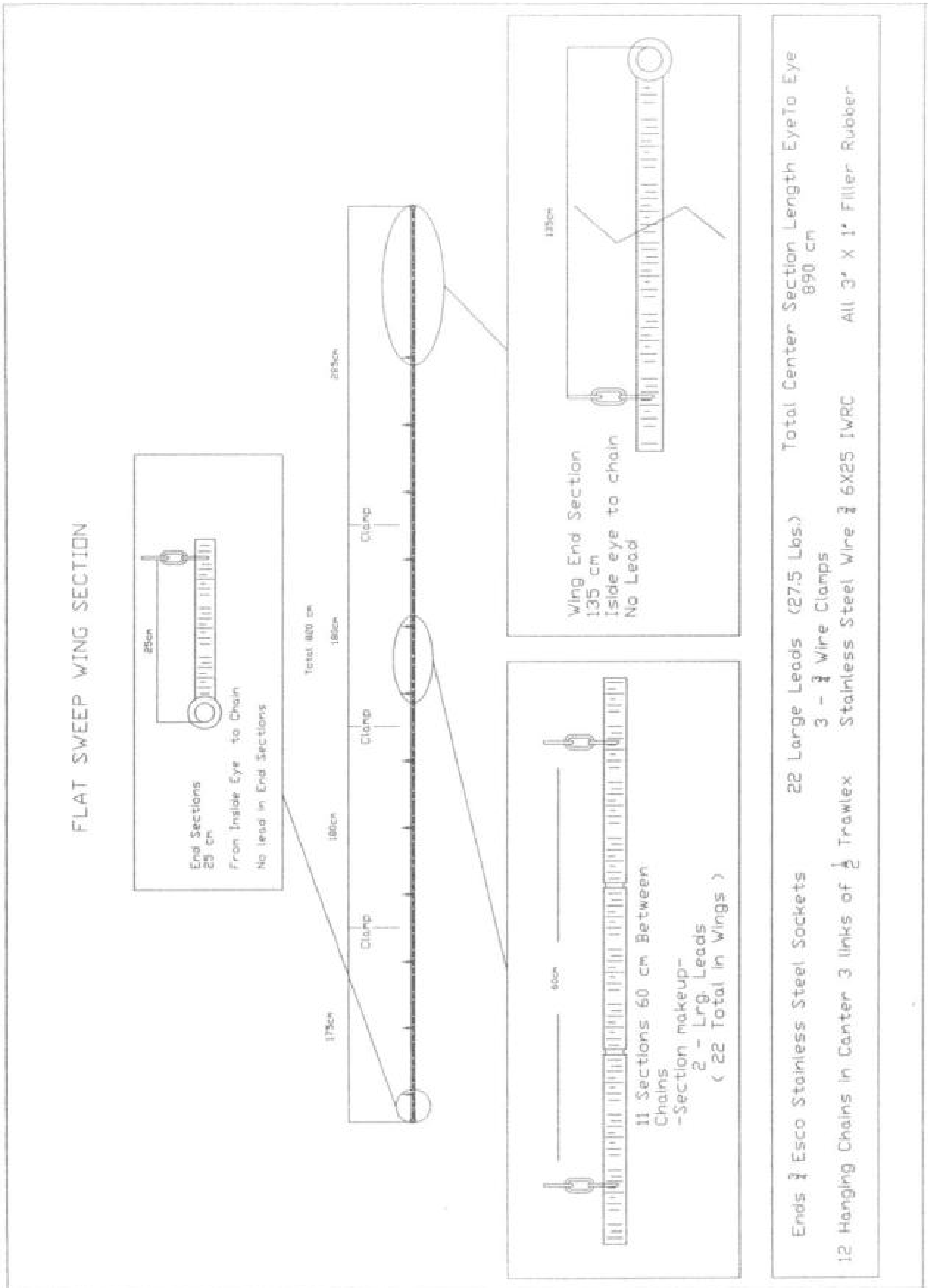
Figure 5. The footrope/traveler/sweep arrangement for the trawl net used by the NEAMAP Near Shore Trawl Survey.



The sweep used by the NEAMAP Near Shore Trawl Survey is the "flat sweep" recommended by the NEFSC Trawl Advisory Panel for use in the MAB (the relative lack of "hard bottom" areas in the MAB/Southern New England (SNE) precludes the need for a rock-hopper or roller-style sweep by the NEAMAP survey). The sweep is made of three sections (Figure 6). The center piece measures 890cm (eye-to-eye), is constructed of 1.9cm stainless steel wire, and is covered with 7.6cm rubber cookies. Fifteen drop chains, made of 3-link, 1.3cm Trawlex chain, are used in the center section. The first and last drop chains are spaced 25cm from each end of the center section, while the remaining 13 drop chains are spaced 60cm apart between these two. Eight leads, weighing 0.6kg each, are placed between each drop chain (no leads between first and last chain and eyes), for a total of 112 leads in the center section. There are four clamps in the center section. The first and last clamps are placed 175cm from each eye, and the four clamps are spaced evenly.

Each of the two sweep wing sections measure 820cm eye-to-eye. Like the center section, the wing sections are made of 1.9cm stainless steel wire and are covered with 7.6cm rubber cookies. Each wing section has 12 drop chains, again made of 3-link, 1.3cm Trawlex chain. The first drop chain (i.e., at the "center end" of the wing section) is spaced 25cm from the eye, while the last (i.e., at the "wing end" of the center section) is spaced 135cm from the eye. The remaining drop chains are spaced evenly at 60cm. There are two 0.6kg leads between each set of drop chains, and no leads between the eyes and each of the end chains. Each wing section has 4 clamps, and each is attached to the center sweep section using a 1.6cm hammerlock. A 1.6cm hammerlock connects each sweep wing section to a piece of 1.6cm Trawlex chain (10 links long) which is used to adjust the positioning of the sweep. The NEAMAP Survey has sets the adjusting chains at 10 links so that the sweep rides slightly ahead of the footrope and traveler when fishing.

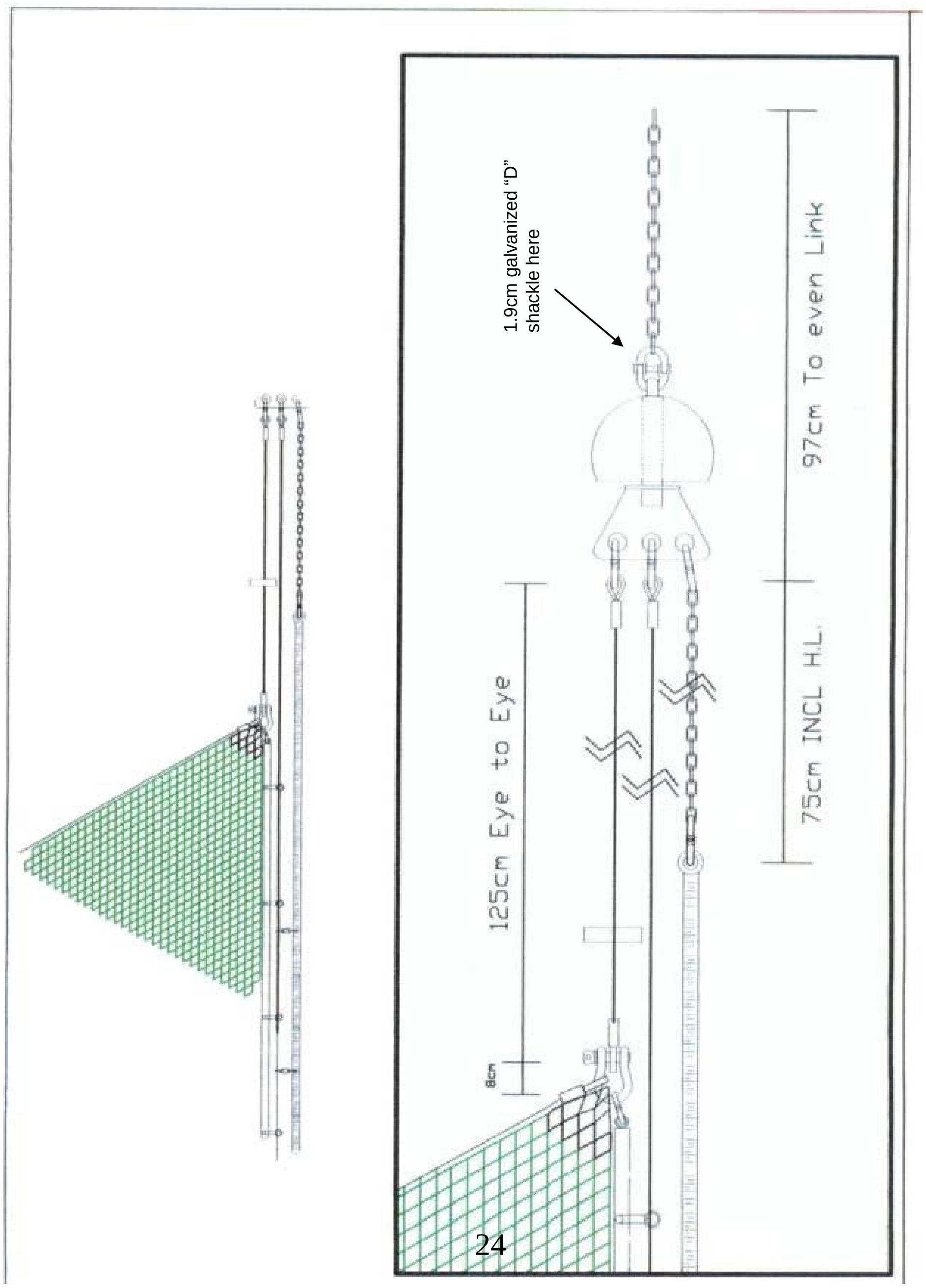
Figure 6. Diagram of the flat sweep used by the NEAMAP Near Shore Trawl Survey.



The zipper traveler is made of 1.4cm galvanized wire, measures 2700cm eye-to-eye, and is used to connect the footrope to the sweep. This traveler is run through the 1-linkers on the footrope and the drop chains on the sweep (Figure 5).

The extension wire from the lower wing end, the traveler wire, and the sweep adjusting chain are each attached to a 22.9cm bobbin via three, 1.6cm hammerlocks (Figure 7). A 9-link piece of 1.6cm Trawlex chain extends from the forward portion of the bobbin and is connected to the bobbin using a 1.9cm galvanized GreenPin™ "D" shackle (differs from hammerlock shown in Figure 7). This chain is covered with three 20.3cm rubber cookies on the aft section of the chain and three 15.2cm rubber cookies ahead of those.

Figure 7. Diagram of the lower wing end and bobbin arrangement of the survey net used by the NEAMAP Near Shore Trawl Survey.



Bridles:

Each upper wing extension is attached to an 18.3m eye-to-eye (1.3cm diameter – soft eyes) galvanized bridle using a 1.3cm galvanized GreenPin "D" shackle. The middle wing extensions are also each attached to an 18.3m eye-to-eye (1.3cm diameter – soft eyes) galvanized bridle using a 1.6cm galvanized GreenPin "D" shackle. The "door end" eyes both of these bridles are connected to a third 18.3m eye-to-eye (1.3cm diameter- soft eyes) galvanized bridle using at 1.9cm galvanized Blue Line bow shackle. The 9-link piece of 1.6cm Trawlex chain extending from the forward portion of the bobbin is connected to a 36.6m eye-to-eye (1.9cm diameter – soft eyes) galvanized bridle using a 1.9cm galvanized GreenPin "D" shackle. The third 18.3m bridle mentioned above and the 36.6m bridle are each connected to a 1.9cm steel triangle plate with three 1.6cm swivels attached to it. The 18.3m bridle is connected using a 1.6cm galvanized GreenPin "D" shackle, while the 36.6m bridle is connected using a 1.9cm galvanized GreenPin "D" shackle. The "door end" of the triangle plate is connected to a piece of 1.6cm Trawlex chain (10 links) using a 1.9cm galvanized GreenPin "D" shackle. The chain is covered with five 20.3cm rubber cookies on the aft section of the chain and eight 15.2cm rubber cookies ahead of those. This piece of chain is connected to a 2.5cm flat (or recessed) link using a 1.3cm hammerlock. A 5.18m galvanized idler wire (1.6cm diameter) is also attached to this flat link using a 1.6cm galvanized GreenPin "D" shackle. The idler wire is covered in 1.6cm (inner diameter) yellow hose. The "door end" of the idler wire connects to a 1.6cm g-hook on the inside of the door using a 1.3cm galvanized GreenPin "D" shackle/1.6cm plain link/1.6cm flat link arrangement.

Doors:

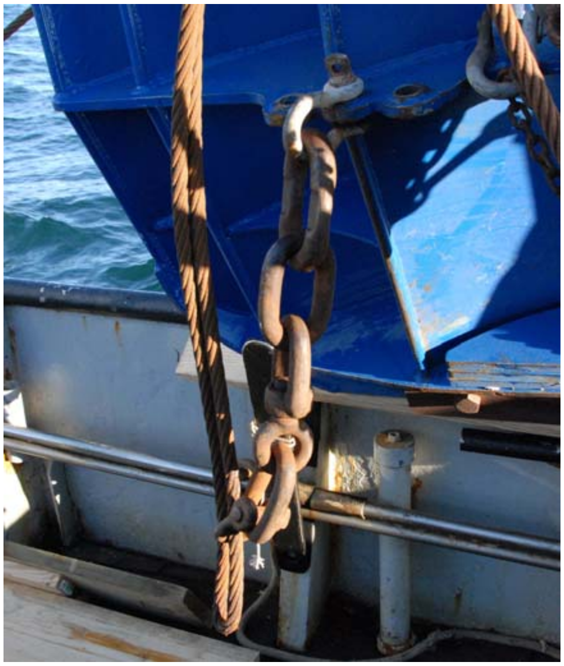
As mentioned, the NEAMAP Near Shore Trawl Survey uses a set of Thyboron, Type IV 66" doors (Figure 8). These doors weigh 360kg each and have a surface area of 2.25m^2. Backstrap chains are connected to the doors using 1.3cm galvanized GreenPin "D" shackles and consist of three lengths of 1.1cm Trawlex long link chain. Each length is connected to a 1.6cm sling link using 1.3cm galvanized GreenPin "D" shackles. The front chain is 24 links long, the top chain is 12 links long, and the bottom chain is 11 links long. One link was taken in on the connection between the top chain and the door as well as between the bottom chain and the door, while two links were taken in between the front chain and the door. A 3.66m (1.9cm diameter) stainless extension wire is connected to the sling link using a 1.6cm hammerlock. The "net end" of this wire consists of a 2.5cm plain link/2.5cm g-hook attached to the wire using a 1.6cm hammerlock.

Warps:

Trawl warps are 1.9cm diameter steel wire. The warps connect to the aft-most fixed tow point on each door via a 2.2cm galvanized GreenPin "D" shackle, a 2.5cm plain link, a 2.5cm swivel, a second 2.5cm plain link, a 2.5cm flat link, and a 1.9cm galvanized Blue Line bow shackle (Figure 9).

Figure 8. Thyboron, Type IV 66” door used by the NEAMAP Near Shore Trawl Survey.

Figure 9. Photograph of hardware used by the NEAMAP Near Shore Trawl Survey to connect Thyboron, Type IV 66” doors to the tow warps. Note that the warp attachment has since been moved to the aft-most fixed tow point.



Vessel

When choosing a vessel for the NEAMAP Near Shore Trawl Survey, the ASMFC NEAMAP Committees (i.e. Board, Operations, and Trawl Technical) outlined several options. These included the construction of a new vessel, the purchase and refitting of an existing commercial vessel, and the charter of either a research or commercial boat. The advantages and disadvantages of each of these options, as well as the order of preference of the ASMFC NEAMAP Committees, are outlined in the ASMFC document entitled “Mid-Atlantic near shore trawl survey design and operational options.”

Upon securing the contract to conduct the NEAMAP Pilot Cruise in 2006, VIMS personnel were responsible for acquiring a vessel for the survey. VIMS personnel visited a number of research and commercial vessels. In accordance with established VIMS procurement procedures, a request for proposals (RFP) was drafted outlining all of the vessel, captain, and crew requirements for the NEAMAP Survey; this RFP addressed both fishing and safety considerations. VIMS received a single response, from Captain James A. Ruhle, Sr. of Wanchese, North Carolina, to its RPF, and subsequently contracted Capt. Ruhle, his crew, and his vessel for the Pilot Survey. A similar RPF/contract process was followed for 2007 and 2008, and Capt. Ruhle was contracted for those years as well. Due to the uncertain nature of funding for the NEAMAP Near Shore Trawl Survey, all contracts to this point have had a term of one year.

Capt. Ruhle’s vessel, the *F/V Darana R*, is a 27.4m (length at the waterline) steel stern trawler (Figure 10). The boat’s gross tonnage is 166 tons, and the boat is powered by two 335HP, Caterpillar 343 diesel engines. The clutch ratio is 6:1. The vessel has two propellers, each 1.6m in diameter (1.4m pitch), and both are clear of the keel. With respect to deck gear, the *Darana R* has a single net drum built into the vessel’s gallus frame located at the stern of the vessel. Craft Machine™ trawl blocks (each 30cm sheave diameter) hang on either side of the gallus frame. The *Darana R* is equipped with two W1170 Marco™ hydraulic winches (capacity – 1097m of 1.9cm wire), mounted onto the working deck and located approximately 9.3m ahead of the gallus frame. Capt. Ruhle docks his vessel at L.D. Amory & Co., Inc. (Amory’s Seafood) in Hampton, VA.

Figure 10. *F/V Darana R*, the commercial vessel chartered by VIMS for the NEAMAP Near Shore Trawl Survey

Tow Parameters

The sampling gear (i.e., trawl net and doors) used by the NEAMAP survey was designed to achieve optimal performance when towed between 2.9kts and 3.3kts, vessel speed over ground. This range of speed was determined by the three manufacturers involved in the design of the gear package and confirmed during the 2005 flume tank trials at Memorial University's Marine Institute.

When towed within this range of speeds, door spreads should range between 32m and 34m, wing spreads should be 13m to 14m, and headrope heights between 5.0m and 5.5m should be achieved.

During NEAMAP survey operations, vessel speed over ground and position are measured using a Northstar™ Explorer 557 GPS and are recorded to an ASCII text (.txt) file every 2 seconds.

As mentioned previously, the geometry of the survey gear is monitored and recorded using a digital Netmind trawl monitoring system. The NEAMAP Near Shore Trawl Survey currently owns six of the sensors available for this system: headline height, door master, door symmetry, wing master, wing symmetry, and catch. Capt. Ruhle purchased and installed dual (port and starboard) hull-mounted Netmind hydrophones in the *Darana R* for his own fishing operations, and allows NEAMAP to utilize them for the survey work. NEAMAP also owns a towable hydrophone which can be used as an emergency backup. Taken together, the components of the system enable NEAMAP scientific personnel to monitor headrope height, door spread, door symmetry (i.e., offset of the doors relative to each other along the longitudinal axis of the trawl gear), wing spread, and wing symmetry in near-real time on a laptop computer located in the wheelhouse. When the survey gear is deployed, these parameters are updated every 5 to 30 seconds (frequency of updates varies among the sensors) on the laptop display and are concurrently recorded into .csv (comma separated values) files.

Because scientific personnel have a near-real time picture of the survey gear when towing, it is possible to identify and eliminate tows in which gear performance is sub-optimal, thus promoting consistency in gear performance and sampling. If, when monitoring gear performance in the wheelhouse, during a tow, scientific personnel observe headrope height, wing spread, or door spread varying from the optimal ranges defined above by more than 15% of the midpoint of these ranges consistently for at least five minutes, the tow is considered invalid, and a re-tow is required. Specifically, if headrope height is greater than 6.3m or less than 4.2m, and/or wing spread is greater than 16.0m or less than 11.0m, and/or door spread is greater than 39.0m or less than 27.1m consistently for five minutes or more, the tow is to be terminated and a re-tow initiated.

It is important to note that, while desirable, is not necessary for scientific personnel to remain in the wheelhouse and continuously monitor gear performance throughout a tow. The Netmind system is configured to display 20 minute (equivalent to tow time, see below) time series graphs for each gear parameter, so the evaluation of gear performance and tow validity can be made by the scientists at the initiation of haul-back by inspecting these graphs. Further, vessel personnel typically monitor gear performance as well and often notify the chief scientist if gear parameters

are out of the acceptable bounds for an extended period of time. If, by chance, scientific personnel fail to recognize in the field that any of the tow parameters are out of bounds, all resulting data collected from that tow will be disqualified from the NEAMAP database during the post-cruise error-checking process. And finally, tows in which gear parameters vary grossly from their optimal ranges (i.e., >>15%) can be terminated at any time in favor of a re-tow at the discretion of the acting chief scientist and captain.

All standard tows for the NEAMAP Near Shore Trawl Survey are to be 20 minutes in duration. The beginning of a tow is defined as the time at which the brakes are set on both of the vessel's trawl winches, while the end of the tow occurs when the winches begin to power back (i.e., initiation of haul-back). While the goal is to tow for 20 minutes at each sampling site, situations arise where it is necessary to haul-back before 20 minutes have elapsed (e.g., vessel traffic, fixed gear ahead, etc.). In these instances, if towing has occurred for at least 15 minutes, the tow is considered valid. The chief scientist will make a note of the reason for truncating the tow. Tows shorter than 15 minutes will be considered invalid, and a re-tow will be necessary.

North/South – Inshore/Offshore Extent

As noted in the "Background" chapter, the NEAMAP Near Shore Trawl Survey area extends from the western shores of Martha's Vineyard, Massachusetts to a line extending approximately east-southeast from Cape Hatteras, North Carolina (Figure 2 in the "Background" chapter). Inshore waters beyond Martha's Vineyard are sampled by the Massachusetts Department of Marine Fisheries Trawl Survey, while those south of Cape Hatteras are sampled by SEAMAP, and waters outside the depth range of NEAMAP are sampled by NEFSC.

Sampling in the RIS and BIS is bounded inshore by the 18.3m depth contour and offshore by the 36.6m contour. Sampling shallower than 18.3m in these Sounds is not feasible. Bottom depths increase very rapidly between the land and the 18.3m contour in this area, so sampling inshore of this contour would place the survey vessel dangerously close to land. The 36.6m outer boundary was arbitrarily chosen by VIMS personnel and approved by the NEAMAP Operations Committee and Board.

Sampling in the Mid-Atlantic region (i.e., Montauk to Cape Hatteras) occurs between the 6.1m and 18.3m contours. Sampling in waters shallower than 6.1m is not desirable due to the risk of grounding (NEAMAP vessel has a draft of 3.9m). The offshore limit will correspond with the inner boundary of the NEFSC Bottom Trawl Survey when *FSV Henry B. Bigelow* becomes the primary sampling platform in spring of 2009.

The NEAMAP survey area covers 4515nm^2. As mentioned previously, the survey area is divided into 7 longitudinal zones from Martha's Vineyard through New York and 10 latitudinal zones from New Jersey to North Carolina (Figure 2 in the "Background" chapter). The boundaries of these zones correspond roughly with those established by the NEFSC Bottom Trawl Survey. The survey area is also stratified by depth. Between New York and North Carolina, each of the aforementioned boundaries is stratified into a 6.1m to 12.2m zone and a 12.2m to 18.3m zone. Boundaries in BIS and RIS are split into 18.3m to 27.4m and 27.4m to 36.6m depth zones. A number of sites are sampled in each of these latitude/depth and

longitude/depth strata during each cruise to ensure that adequate north to south and inshore to offshore sampling coverage is achieved. The method by which sampling sites are allocated to each stratum and selected for each cruise is discussed in the next section.

Sampling Frame

The sampling frame consists of 2,006 1.5minute x 1.5minute cells, with each cell considered to be a sampling unit (i.e., potential sampling site). Each cell is assigned to one of the 17 major latitudinal (from New Jersey and south) or longitudinal (in Rhode Island and New York) regions and one of the four depth strata (Figure 2 in the "Background" chapter). Cells were assigned to depth strata from bathymetric sounding data available from the NOS. Approximately 5,000,000 georeferenced soundings data points, taken from an area somewhat larger than the expected sampling boundaries, were downloaded. Each point was assigned to a possible sampling cell from a grid representing the 1.5nm x 1.5nm cells which was conceptually overlaid on the soundings data base. Each cell was designated with a unique ID number. Average depth, minimum and maximum depths and standard deviation within each cell were calculated, and cells were then assigned to one of the aforementioned depth strata. Cells with no or few soundings were assigned to a depth stratum based on depth designations on nautical charts. Cells which overlap with the shoreline and/or which contain significant amounts of water shallower than the 6.1m contour are assigned a database field indicating the approximate percentage of untowable area within the cell. This figure is used to reduce the probability of selecting the cell for sampling; the amount of the reduction is proportional to the percentage of untowable area. The figure is also used to decrease the area expansion calculations for estimation of abundance per unit area. A few cells are designated as untowable due to known obstructions. These cells are unavailable for selection as sampling sites but are retained in the database for estimation of abundance (Table 1).

Table 1. Sample of the NEAMAP stations database.

Region	Depth Group	CELL	Hang	Percent Untrawlable	Lat	Lon	LatSW	LatSE	LatNW	LatNE	LonSE	LonSW	LonNE	LonNW	AvgDepth	NDepth	MinDepth	MaxDepth	StdDepth	Comments
12	20-40	164-096			37.387	-75.688	37.375	37.375	37.400	37.400	-75.675	-75.700	-75.675	-75.700	20.0	886	15.1	20.7	1.4	
12	20-40	164-097		50	37.412	-75.688	37.400	37.400	37.425	37.425	-75.675	-75.700	-75.675	-75.700	20.0	247	15.1	19.7	1.1	
12	20-40	165-088			37.187	-75.713	37.175	37.175	37.200	37.200	-75.700	-75.725	-75.700	-75.725	39.1	531	34.1	46.6	2.7	
12	20-40	165-089			37.212	-75.713	37.200	37.200	37.225	37.225	-75.700	-75.725	-75.700	-75.725	35.7	512	29.5	44.6	2.4	
12	20-40	165-090			37.237	-75.713	37.225	37.225	37.250	37.250	-75.700	-75.725	-75.700	-75.725	32.7	532	26.9	39.7	2.5	
12	20-40	165-091			37.262	-75.713	37.250	37.250	37.275	37.275	-75.700	-75.725	-75.700	-75.725	28.7	475	23.0	35.1	2.4	
12	20-40	165-092			37.287	-75.713	37.275	37.275	37.300	37.300	-75.700	-75.725	-75.700	-75.725	24.4	676	16.7	30.8	3.0	
12	20-40	165-093			37.312	-75.713	37.300	37.300	37.325	37.325	-75.700	-75.725	-75.700	-75.725	20.0	659	15.1	25.3	2.0	
12	20-40	165-094	Y	15	37.337	-75.713	37.325	37.325	37.350	37.350	-75.700	-75.725	-75.700	-75.725	20.0	158	15.1	47.2	2.8	
12	20-40	165-095	Y	40	37.362	-75.713	37.350	37.350	37.375	37.375	-75.700	-75.725	-75.700	-75.725	33.2	663	15.1	77.4	15.1	
12	20-40	166-088			37.187	-75.738	37.175	37.175	37.200	37.200	-75.725	-75.750	-75.725	-75.750	32.8	412	26.6	39.7	2.5	
12	20-40	166-089			37.212	-75.738	37.200	37.200	37.225	37.225	-75.725	-75.750	-75.725	-75.750	28.7	404	20.3	36.4	3.5	
12	20-40	166-090			37.237	-75.738	37.225	37.225	37.250	37.250	-75.725	-75.750	-75.725	-75.750	23.5	439	15.1	31.5	3.8	
12	20-40	166-091			37.262	-75.738	37.250	37.250	37.275	37.275	-75.725	-75.750	-75.725	-75.750	20.8	413	15.1	27.2	2.9	
12	20-40	166-092			37.287	-75.738	37.275	37.275	37.300	37.300	-75.725	-75.750	-75.725	-75.750	18.2	437	15.1	23.6	1.5	
12	20-40	166-093		5	37.312	-75.738	37.300	37.300	37.325	37.325	-75.725	-75.750	-75.725	-75.750	20.0	184	15.1	17.4	0.6	

Sample Selection

Prior to each cruise, a random sample of 150 cells is selected, and these cells are designated as the "Primary" trawl sampling sites for the cruise. The number of Primary stations selected in each Region-Depth stratum is proportional to the total surface area of the stratum, with a minimum number of two stations per stratum. A second round of stations (between 4 and 8 per

stratum) is then selected as “Alternate” sampling locations. These are used if a Primary location is determined to be untowable due to vessel traffic, previously unknown hangs, fixed gear, etc. As the Alternate stations are initially selected using a random process, selection of an Alternate cell in the field (one of the 4-8 available Alternates) is based mainly on logistics and is described further in the “Survey Procedures” chapter. Typically, few Alternate stations are sampled between Montauk, New York and Cape Hatteras, North Carolina, while the frequency of sampling Alternates increases in RIS and BIS due to bad bottom, unfamiliarity with the area, and an abundance of fixed gear (Table 2). It is expected that as familiarity is gained with the area, the ratio of Primary to Alternate stations sampled in the Sounds will increase.

Selected station boundaries and identifying information are printed for use by vessel crew and scientists in tabular form (Figure 11) and on paper GIS maps (Figure 12). Further, data from selected cells are formatted for input to the P-Sea Windplot™ charting software used by both the vessel crew and scientists onboard (Figure 13). The details of this process are described in the “Survey Preparation” chapter.

Table 2. Number of Primary and Alternate stations sampled during the Spring 2008 NEAMAP Near Shore Trawl Survey cruise.

Region	Primary Stations	Alternate Stations	Total	Region	Primary Stations	Alternate Stations	Total
RI Sound	7	10	17	**8**	9	0	9
BI Sound	6	4	10	**9**	12	0	12
1	1	1	2	**10**	10	0	10
2	4	1	5	**11**	13	1	13
3	5	0	5	**12**	9	1	10
4	5	0	5	**13**	18	0	18
5	4	1	5	**14**	7	0	7
6	4	1	5	**15**	6	0	6
7	10	0	10	**Total**	**130**	**20**	**150**

Figure 11. Representative page of selected station location information from the NEAMAP Near Shore Trawl Survey Fall 2008 cruise.

NEAMAP Stations — Fall 2008

Station	Depth Strat.	Avg Depth	Max Depth	Pct. Un-trawlable	Latitude North	Latitude South	Longitude West	Longitude East	Comments	Cell Num.
REGION BI		**Block Island Sound**								
125	60-90	64.7	104.0		41 09.000	41 07.500	71 51.000	71 49.500	NM0709 Selected Alternate - Not Towed	940-906
126	60-90	73.1	115.2		41 09.000	41 07.500	71 52.500	71 51.000		941-906
127	60-90	69.8	101.1		41 07.500	41 06.000	72 03.000	72 01.500		948-905
128	90+	126.3	149.9		41 12.000	41 10.500	71 42.000	71 40.500		934-908
129	90+	105.5	112.9		41 13.500	41 12.000	71 46.500	71 45.000		937-909
130	90+	92.0	133.9		41 18.000	41 16.500	71 46.500	71 45.000		937-912
131	90+	131.5	149.0		41 10.500	41 09.000	71 51.000	71 49.500		940-907
132	90+	100.6	121.1		41 10.500	41 09.000	71 55.500	71 54.000		943-907
133	90+	108.3	145.0		41 13.500	41 12.000	71 55.500	71 54.000		943-909
134	90+	126.0	149.9		41 15.000	41 13.500	72 00.000	71 58.500	NM0709 Selected Alternate - not towed	946-910
REGION RI		**Rhode Island Sound**								
135	60-90	78.8	104.0		41 18.000	41 16.500	70 52.500	70 51.000		901-912
136	60-90	76.5	86.6		41 24.000	41 22.500	71 07.500	71 06.000		911-916
137	60-90	65.4	79.7		41 27.000	41 25.500	71 09.000	71 07.500		912-918
138	60-90	82.1	91.5		41 06.000	41 04.500	71 33.000	71 31.500		928-904
139	60-90	78.0	90.6		41 07.500	41 06.000	71 34.500	71 33.000		929-905
140	60-90	66.9	100.1		41 13.500	41 12.000	71 36.000	71 34.500		930-909
141	90+	93.1	104.0		41 21.000	41 19.500	71 09.000	71 07.500		912-914
142	90+	122.6	136.2		41 15.000	41 13.500	71 15.000	71 13.500		916-910
143	90+	97.6	113.9		41 21.000	41 19.500	71 16.500	71 15.000		917-914
144	90+	119.3	130.9		41 15.000	41 13.500	71 21.000	71 19.500		920-910
145	90+	113.1	126.0		41 18.000	41 16.500	71 21.000	71 19.500		920-912
146	90+	111.1	115.8		41 22.500	41 21.000	71 21.000	71 19.500	NM0709 Selected Alternate - Not Towed	920-915
147	90+	107.3	110.2		41 22.500	41 21.000	71 25.500	71 24.000		923-915
148	90+	108.4	121.1		41 06.000	41 04.500	71 27.000	71 25.500		924-904
149	90+	123.1	128.0		41 15.000	41 13.500	71 28.500	71 27.000		925-910
150	90+	131.6	141.1		41 16.500	41 15.000	71 28.500	71 27.000		925-911

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Figure 12. Sample GIS map of selected sampling locations showing Region boundaries, Stratum cells, and selected Primary and Alternate stations used by the NEAMAP Near Shore Trawl Survey.

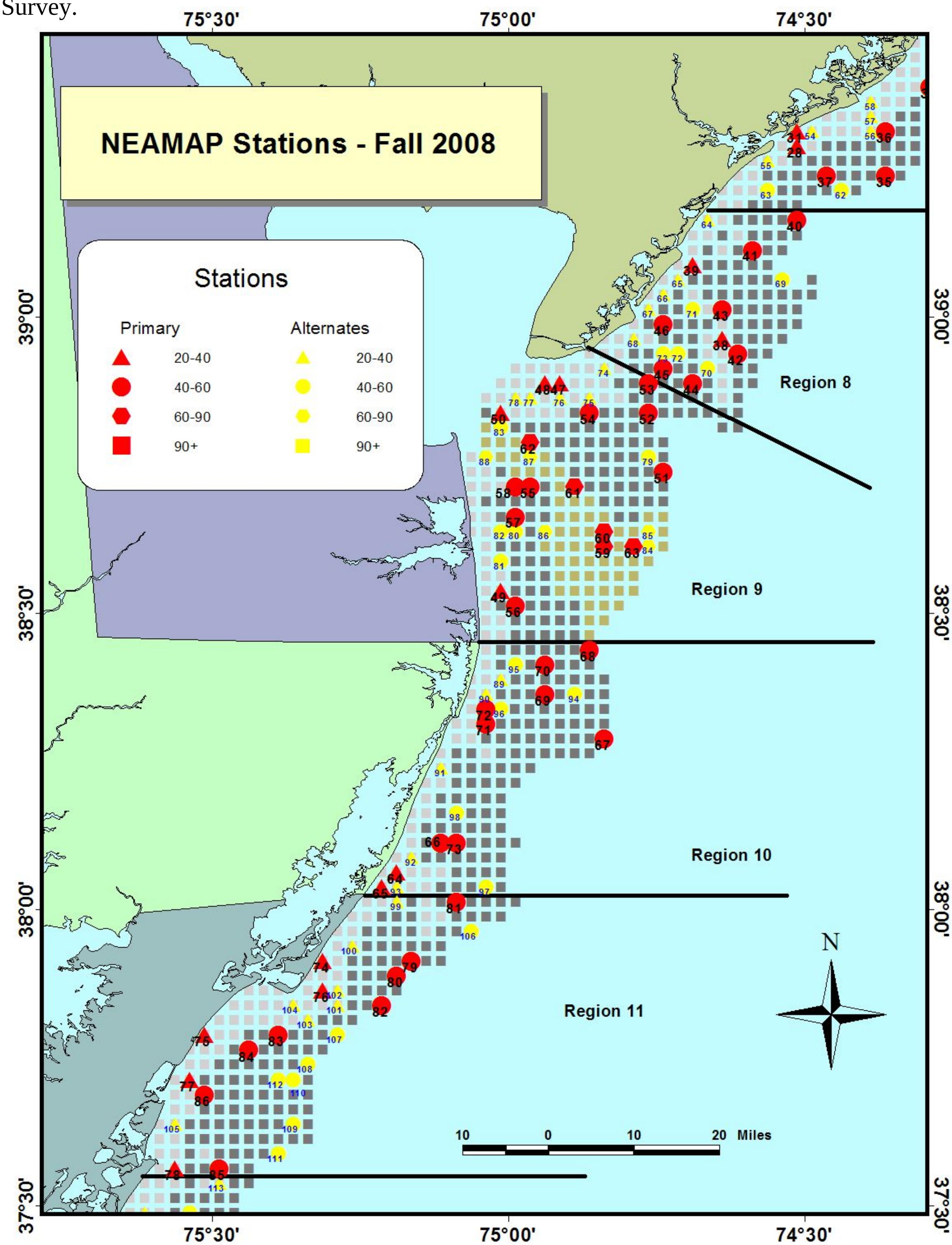
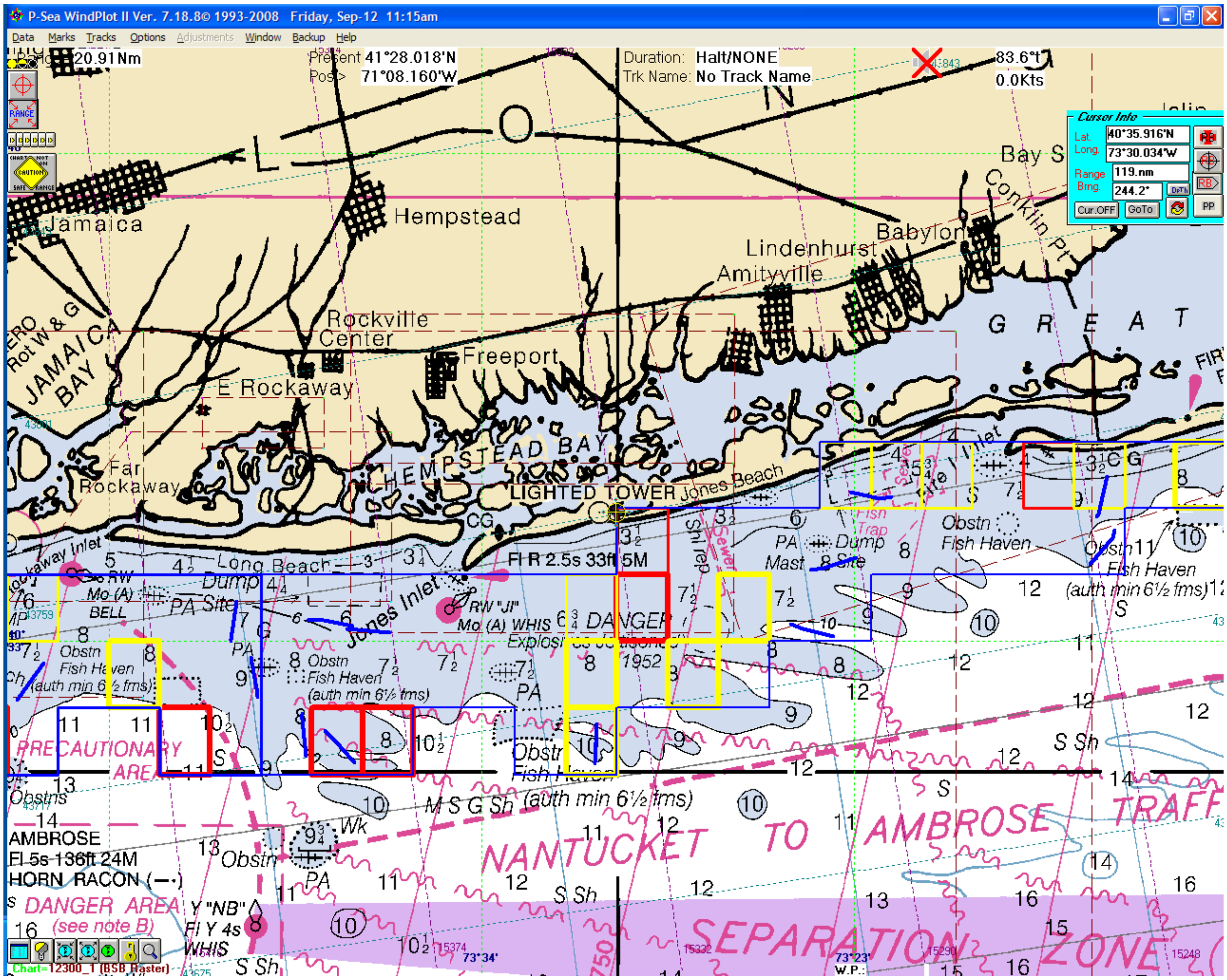


Figure 13. Screen-shot of P-Sea Windplot charting software used by the NEAMAP Near Shore Trawl Survey showing Primary stations (red), Alternate stations (yellow), Region boundaries (blue shapes), and previous successful tows (blue lines). Shallow strata station boundaries are represented by thinner lines and deep strata boundaries by thicker lines.



Survey Preparation

Checklist of Equipment and Supplies

The following is a comprehensive checklist of equipment and supplies that need to be onboard the NEAMAP vessel at the start of each survey cruise (Table 1). This list was developed by NEAMAP scientific personnel and is referenced frequently between survey cruises, during pre-cruise vessel loading, and at sea. Between survey cruises, scientific personnel check all field equipment and supplies against this list and note equipment that may be missing or in need of repair, as well as supplies that need to be replenished. The use of this list ensures that all field materials will be present and in working order at the time of pre-cruise vessel loading. Prior to the initiation of a cruise (usually the day before departure), the chief scientist uses this list to ensure that all equipment and supplies were loaded onto the vessel and that each is in its proper place. Because this list indicates the physical location of many of the smaller items, newer personnel often use the list to locate items onboard while at sea.

Table 1. List of equipment and supplies that need to be onboard the survey vessel at the start of each NEAMAP Near Shore Trawl Survey cruise.

ITEM	HAVE
DARANA R	
Nets	2
Tripper and tripper line	2
Bull rope and split strap arrangement	2 sets
Codend liners	7
Twine to switch codend liners	2 balls
Doors	1 set
Spare webbing - 2.5mm	92 lb
Spare webbing - 4.0mm	40 lb
Spare webbing - double 4.0mm	40 lb
Spare webbing – liner	35 lb
Bridles	2 sets
Delta plate	2 sets
Towed hydrophone weights (back-up)	3
Snatch block (back-up)	1
Towed hydrophone boom (back-up)	1
Door knife edges	2 sets
STORAGE UNIT	
DECK BOX	
Zipties – small	100s
Zipties – medium	100s
Zipties – large	100s
Crescent wrenches	2

Table 1. (cont.)

Screw drivers (Phillips head)	4
PB Buster spray	1
Socket wrench set	1
Pliers	2
Screws (various sizes)	bunch
BLACK TOOLBOX	
11/16" stainless clip hooks - #2328	5
5/8" stainless clip hooks - #2327	5
1/4" stainless bow shackles	11
5/16" stainless bow shackle	18
3/8" stainless bow shackle	8
Silicon caulk	4 tubes
Marine sealant	2 tubes
Pliers	3
Screw drivers (Phillips head)	4
Screw drivers (Flat head)	6
Tape measure (300')	1
Zipties – medium	100s
Zipties – large	100s
Allen wrench set- standard	1
Deep socket wrench (3/8 ")	3
Netting needle-small	6
Netting needle-large	6
Hack saw	1
Rope cutting gun blades	2
NET RUBBERMAID	
Spare 2-hole hangers	32
4 mm green Polyethylene twine	2 balls
Delta plate	1 set
2.5mm green Polyethylene twine	2 balls
Net attachment shackles:	
Galvanized GreenPin "D" Shackles 3/4"	18
Galvanized GreenPin "D" Shackles 1/2"	31
Galvanized GreenPin "D" Shackles 5/8"	24
Welding rod	bunch
Split strap rings	20
Tripper line	2
Tarp	2
Tarp liner	1
LARGE LAB TOTE (Rubbermaid)	
Cotton twine	10 rolls

Table 1. (cont.)

Latex gloves – medium (100/box)	5 box
Latex gloves - large (100/box)	10 box
Nitrile gloves- large (100/box)	5 box
Ziploc bags - gallon (30/box)	15 box
Whirl paks	4000
Lab aprons	2
Rite in Rain paper	1 pack
Half sleeves (rubber)	2
SMALL LAB TOTES:	7
Labels Box:	
Sample labels (pairs)	8000
UnID sample labels	400
Plastic holder for dissection utensils	2
Manual pencil sharpener	1
Bucket lid opener	1
Squeegee- short handled	1
Cotton twine	10 rolls
Pencils	24
Work Gloves Tote:	
Work gloves – leather	2 pair
Work gloves - heavy dipped	2 pair
Work gloves - blue dipped	3 pair
Work gloves – Ironclad small	2 pair
Work gloves – Ironclad medium	8 pair
Work gloves – Ironclad large	4 pair
Work gloves – Ironclad gripworx large	8 pair
Work gloves – Ironclad gripworx xlarge	2 pair
Work gloves – Ironclad Gen. Util. large	7 pair
Work gloves – Ironclad Gen. Util. xlarge	4 pair
Atlas blue dipped gloves- large	5 pair
Atlas blue dipped gloves- xlarge	3 pair
Lab Gloves Tote:	
Latex gloves - small (100/box)	1 box
Latex gloves – medium (100/box)	5 box
Latex gloves - large (100/box)	5 box
Nitrile gloves - large (100/box)	5 box
Cleaning Supplies Tote:	
409 cleaner	4
Orange cleaner spray bottles	5
Goo Gone	3
Dish soap	7

Table 1. (cont.)

Sponges	11
Scrubbie brushes	8
Simple green (1 gal.)	3
Ziploc Tote:	
Ziploc bags - snack (100/box)	2 box
Ziploc bags - sandwich (100/box)	10 box
Ziploc bags - gallon (30/box)	10 box
Big Gut Bag Tote (Rubbermaid):	
Gut bags- large	200
Gut bags- small	4000
Whirl paks	2000
Whirl Pak Tote:	
Whirl paks	2000
Small Gut Bag Tote:	
Gut bags- large	200
Gut bags- small	4000
CLEANING BUCKET	
Scrubbie brushes	8
Simple green (1 gal.)	3
MISCELLANEOUS	
Fish boxes	20
Fish pans – large	14
Fish pans – small	25
Deck comp. monitor & mount	1
Deck shovels	4
Buckets	7
Deck work stations	3
Orange baskets	14
Door knife edges	2 sets
Meter sticks	4
Bungee cords (various sizes)	26
Spare totes- small rubbermaid 14 gal	4
Spare totes- small rubbermaid 18 gal	5
Squeegee- long handled	3
Normalin buckets w/ lids	24
Normalin totes w/ lids	11
Crab pot line spool	1
Freezer	1
Laboratory floor mats	3
Lab processing table	1
Spool of line (0.5 in. D braided)	1

Table 1. (cont.)

Spare net (left at VIMS)	1
Spare net floats	15
HALL HOUSE	
SMALL TOTE	
Laboratory overhead lights	5
Extension cords	3
Power strips	2
LARGE STANLEY BOX	
Mending twine - size 21 (twisted nylon)	4
Mending twine - size 42 (twisted nylon)	2
Mending twine - size 48 (twisted nylon)	2
Zipties – medium	100s
Zipties – large	100s
Duct tape – gray	6 roll
Duct tape – black	4 roll
Duct tape – white	3 roll
Duct tape – blue	3 roll
Duct tape – red	3 roll
Duct tape – purple	1 roll
Duct tape – aqua	1 roll
Electrical tape	5 roll
Spare "D" batteries for deck scale	44
Spare "C" batteries	6
Knife sharpener	1
Scissors sharpener	1
Trash bag box (40-60/box)	4
Bug spray	2
Suntan lotion	2
PB Buster spray	6
Pencil sharpener- electric	1
Rope cutting gun	1
Rock salt (box)	1
WHEELHOUSE BOX	
Anemometer and compass	1
Sharpies (1 in each notebook and extras)	22
Rubber bands	100s
"AA" batteries	14
"AAA" batteries	8
Large scissors	1
Pencils	60

Table 1. (cont.)

YSI BOX	
YSI	1
YSI charger	1
YSI membrane and soln. kit	4 boxes
YSI sanding disc	3
YSI scalpel blade	2
YSI O-rings	6
YSI DI water	4 bottles
SENSOR TOTE	
Net sensors	6
Net sensor shackles - 5/16" bow shackles	36
Net sensor chargers	4
Bungee for catch sensor	2
Net bags	4
Socket wrench set	3
COMPUTER STANLEY BOX	
Netmind receiver box	1
Netmind junction box	1
Netmind power supply	1
Netmind RS232 cable	1
GPS (Northstar Explorer 557)	1
Netmind laptop	2
Tough Book laptop	2
Deck/lab speakers	5
Extension cable LDCE	1
Lab board cable	1
RS232 cable runs from Box-Tough Book	2
Deck board cables (varying size)	6
USB cable runs to deck key board	1
Board charger plugs	4
Digital multimeter	1
Deck keyboard	1
COMPUTER PELICAN	
Pelican Box	1
LAB INSTRUMENT BOX	
Rounded scissors (big)	6
Pointy scissors (small)	11
Curve-tipped forceps	9
Straight-tipped forceps	6

Table 1. (cont.)

Large scissors (grey)	8
Carpet knife	2
Calipers	3
Large serrated knife	10
Small serrated knife	8
Boning knife	3
FILE BOX	
NEAMAP net plans	1
YSI instruction book	1
Station data sheets	170
Invert/habitat sheets	35
Sub sample data sheets	45
Error check data sheets	40
Manual length sheet	200
Manual full processing sheet	200
MISC.	
Measuring boards	4
Magnetic wands	6
Towed hydrophone (back-up)	1
Electronics tool box and tools	1
Deck scale (small) & calib. weights	3
Deck scale (large) & calib. weights	2
Lab scale & calib. weights	1
Hanging digital scale	1
First Aid kit	1
Digital camera & video camera	1
Computer protector for lab	1
Shark tagging kit	1
Sturgeon tagging kit	1
Species code lists	2 sets
Cordless drill and bits	1
WHEELHOUSE BINDER	
MA permit (Copy in each board)	1
RI permit (Copy in each board)	1
NY permit (copy in each board)	1
NJ permit (copy in each board)	1
DE permit (copy in each board)	1
MD permit (copy in each board)	1
VA permit (copy in each board)	1
NC permit (copy in each board)	1
NEPA findings document	1

Table1. (cont.)

Letter of Acknowledgement (LOA)	1
Liability release forms	15
NEAMAP IACUC	1
Copy of Travel Auth. form	1
Crew schedule	1
Ferry schedule	1
Crew phone list	1
VIMS phone List	1
Normalin MSDS (copy in each board)	1
Ethanol MSDS (copy in each board)	1
Z-Fix MSDS (copy in each board)	1
IACUC Modules	
BLUE BINDERS	2
Copies of Station Maps	4
GRAY CLIPBOARDS	4
Normalin MSDS (copy in each board)	1
Ethanol MSDS (copy in each board)	1
Z-Fix MSDS (copy in each board)	1
Full spp. code (copy in each board)	1
Sub sample data sheets (copy in each)	5
Error check data sheets (copy in each)	5
Sharpie (1 in each)	1
Pencils (10 in each)	10
LAB	
Normalin hand pump	1
Normalin barrels	2
ID books:	
Fishes Ches. Bay	1
Atlantic Coast Fishes - Peterson	1
Fishes of Gulf of Maine	1
Living Marine Resources	1
Atlantic Seashore - Peterson	1
Natl. Audubon Soc. Seashore	1
FAO Guides	3
SHED	
Cutting boards for table	2
REMEMBER TO BRING:	
"Suitcase" life raft	1
PFD work vests	for all
Survival suits	for all
Foul weather gears	for all

Table1. (cont.)

Striper Myco. collection supplies	1
Paper towels (roll)	30
ChesMMAP backup Netmind system	Whole system

Sampling Permits

In January of each year, the NEAMAP survey applies for sampling permits from the following agencies:

- NOAA, Northeast Regional Office (Letter of Acknowledgement)
- Massachusetts Department of Marine Fisheries
- Rhode Island Department of Environmental Management
- New York Department of Environmental Conservation
- New Jersey Department of Environmental Protection
- Delaware Department of Natural Resources
- Maryland Department of Natural Resources
- Virginia Marine Resources Commission
- North Carolina Division of Marine Resources

Each of these permits is valid for the calendar year in which they are issued (i.e., cover NEAMAP spring and fall surveys in a given year). The chief scientist is responsible for calling these permitting agencies on the Friday prior to the start of a cruise to inform each of the dates in which the survey intends to sample their waters. Each agency receives a report of NEAMAP spring and fall sampling activities in their waters by the end of December and a copy of the NEAMAP annual reports as they become available.

Pre-cruise Electronics Preparation and Testing

LDCE:

All catch, biological, station identification, hydrographic, atmospheric, and crew data collected during a cruise are placed into a DOS-based LDCE™ database (**L**imnoterra™ **D**ata **C**ollection **E**nvironment). A database file specific to each cruise must be created before each survey. The first step is to edit a data base definition/initiation ".il" text file which is used to create the database. The .il file from the previous cruise is copied and renamed. This file defines the structure of the database, the specifics regarding each field in the database, the accepted values for each field, and any default values. Usually the only field that requires editing from cruise to cruise is the name of the database. Each database is named with the cruise number. That is, a number of the form "NM*YYMM*" where *YY* is the two-digit year code and *MM* is the two digit month code (e.g., NM0809 is the NEAMAP cruise beginning in September 2008). At this point, any other default values that may have changed (e.g., Chief Scientist) from the previous cruise are to be edited. The database is then initialized using an executable program file, which creates the database file according to the instructions in the .il file. The database is then opened in DOS and the Cruise is named. Each level and field of the database is checked, assuring default values are correct and that the database contains no errors. Each of the 150 stations must be added individually to the database prior to the beginning of the cruise (data for a Station cannot be

entered until the Station exists in the data base). The stations are numbered 1-150 and initially contain only a few default values (e.g., gear specifications). Data unique to each station (e.g., date towed) are added at a later date after the station has been sampled.

Once the database is created, the Limnoterra automated fish measuring boards must be configured so that they will communicate with the current database. The boards are designated as either a "deck" or "lab" board. Usually, only one board is designated as a "lab" board and the remaining three boards are set up as "deck" boards. Prior to each cruise, the boards must be connected to the database individually and a definition file uploaded to each board. This file defines each key on the automated boards. The definition files are re-created with the current database name each time a new database is created. The only difference between the definition file sent to the "lab" board and the "deck" boards is that the boards are set up to receive data from different scales.

To assure that all components (measuring boards and weighing scales) are working properly, communicating with each other, and communicating with the database – everything is set up prior to vessel loading and tested. All equipment is set up identically to how it will be arranged during a cruise and dummy data are entered. This process assures that everything is in working order and that data are being recorded properly.

<u>Netmind</u>:
Approximately two to three weeks prior to the start of each cruise, the Netmind system is configured for use and tested to ensure that all components and are in proper working order and that data will be recorded in the proper format. These configuration and testing steps are carried out well in advance of each cruise to allow sufficient time to address any problems that may arise.

The first step in this process is to open the Netmind v5 software on the laptop designated for use in the wheelhouse during the NEAMAP cruise and verify that the settings for each of the sensors and transducers are configured properly. Sensor settings can be viewed by clicking "Setup" and then "Sensors". Frequencies and enabled statuses should match those in Table 2. Transducer settings are accessed by clicking on "Setup" and then "Transducers", and should match those in Table 3.

It is also imperative to ensure that the software has enabled both hydrophones since the *Darana R* is equipped with a pair of hull-mounted hydrophones. This is verified by clicking on "Settings" and "Hydrophones", and ensuring that both the port and starboard hydrophones are enabled.

Table 2. Frequency settings and enabled statuses for Netmind v5 software used by the NEAMAP Near Shore Trawl Survey.

Sensor	Frequency (Hz)	Enabled
Headline	28635	x
WingMaster	29120	x
DoorMaster	28800	x
Grid	28841	
Depth	28882	
Catch1	28963	x
WingSlave	28480	x
DoorSlave	28320	x
Catch2	28667	
Catch3	28718	
Temperature	28922	

Table 3. Transducer setting values for Netmind v5 software used by the NEAMAP Near Shore Trawl Survey.

Transducer	Type	Min Time	Max Time	Min Value	Max Value	Sensor	Assoc Tx	Log	Dimension
Primary	Standard	5.000	5.980	1.000	17.400	Headline	Primary	x	Length
Secondary	Standard	6.000	6.980	1.000	17.400	Headline	Secondary	x	Length
FishCount	Standard	7.000	7.980	0.000	10.000	Headline	FishCount		None
Error	Standard	4.940	4.960	0.000	0.000	Headline	Secondary		None
DoorSpread	Standard	12.000	14.000	0.000	300.000	DoorMaster	DoorSpread	x	Length
Error	Standard	11.850	11.950	0.000	0.000	DoorMaster	DoorSpread		None
WingSpread	Standard	12.000	14.000	0.000	150.000	WingMaster	WingSpread	x	Length
Error	Standard	11.850	11.950	0.000	0.000	WingMaster	WingSpread		None
Tilt	Standard	7.230	8.770	3.000	93.000	Grid	Tilt		Angle
Depth	Standard	7.000	8.600	0.000	300.000	Depth	Depth		WaterDepth
Catch1	Standard	30.000	31.000	0.000	1.000	Catch1	Catch1	x	None
DoorSymmetry	Differential	8.000	16.000	0.000	300.000	DoorSlave	DoorSpread	x	Length
WingSymmetry	Differential	8.000	16.000	-15.000	150.000	WingSlave	WingSpread	x	Length
Catch2	Standard	30.000	31.000	0.000	1.000	Catch2	Catch2		None
Catch3	Standard	30.000	31.000	0.000	1.000	Catch3	Catch3		None
Temperature	Standard	9.000	11.000	-2.000	32.000	Temperature	Temperature		Temperature

Transducer values and time history graphs are displayed for each of the sensors owned by the NEAMAP Survey. To create a transducer display, click on “View” and then “New Transducer Window”. Select a sensor in the “Sensor” window, a transducer in the “Transducer” window and preferred units in the “Units” window. Verify that both the port and starboard hydrophones are enabled by checking each of the associated boxes. Time history graphs are displayed by clicking on “Time History” and then setting both the minimum and maximum values for the graph as well as the length of the time series. As an example, to set the wing spread display, choose “Wingmaster” in the “Sensor” window, “Wingspread” in the “Transducer” window,

“Meters” in the “Units” window, and mark both the port and starboard hydrophones. Also, mark the “Time History” box, set the “Minimum Value” at 0.00m, the “Maximum Value” at 27.00m, and the “Time Series” at 1200s (i.e., 20 minutes, the length of a standard NEAMAP tow). Repeat this process for the headline, wing symmetry, door spread, door symmetry, and catch transducers.

The Netmind v5 software is capable of recording the displayed trawl geometry measurements to comma separated value (.csv) files in a location of the user’s choosing. Files for a given cruise are stored on the laptop’s hard drive (C: drive) in a folder named with the cruise number “NM*YYMM*” as previously defined. The .csv files for each station are saved to their own folder, “STA*XXX*”, where STA indicates station and *XXX* is the three digit station identification number (number between 001 and 150). To select the location for file storage, click “File” and “Select Log File Location”. Ensure that the data are to be saved to the correct drive and cruise folder, in a station folder named “Test”.

Once all settings have been verified, displays created, and file paths set, each transducer is tested to ensure communication with the software. The NEAMAP back-up towable hydrophone is used for these tests since the hull-mounted hydrophones are unavailable at VIMS. Sensor data logging is initiated by clicking “File” and then “Raw Data Log”. Each sensor is then tested in air by connecting a copper wire to the “S” and “-“ lugs of each sensor. A sensor is considered operational when measurements from that sensor are displayed by the Netmind v5 software. After all sensors have been tested, the data logging is terminated by clicking “File” and “Raw Data Log” again. Each .csv file is then inspected to verify that data were recorded from each of the sensors. If all sensors communicate with the software and data are recorded for each, the test is deemed successful. This process is repeated with a second laptop, so that a back-up is available for the cruise.

Upon successful completion of the Netmind system test, all sensors are fully discharged to assure that the NiCad batteries have not developed a charging ‘memory’. This is accomplished by leaving the copper wires connected to the sensors and allowing them to run continuously. Full discharge usually takes about one week. All sensors are then fully charged by the Thursday before the start of a survey cruise.

<u>Tow Tracks</u>:
The track of each NEAMAP tow is recorded using a Northstar Explorer 557 GPS and Netmind v3.3.1 analog software. The Netmind v3.3.1 software is the predecessor to Netmind v5, and is capable of recording latitude and longitude, time, and vessel speed data provided by a GPS unit. The software records these data to a .txt file each time the GPS unit sends a signal (presently every 2 seconds). The location to which these files are stored is again at the discretion of the user. All tow track files for a cruise are stored on the laptop’s hard drive (C: drive) in the path “:\Program Files\NTI\Netmind\ NM*YYMM*” where the cruise format follows that described above.

Again, approximately two to three weeks prior to the start of a cruise, this system is tested to ensure that all components are in working order and that data are recorded in the proper formats. The GPS is connected to the laptop computer designated for use in the wheelhouse during the

NEAMAP cruise and the Netmind v3.3.1 program initiated. To record GPS data, click "System", and then "Start Tow". Ensure that "Ship Number" is *DaranaR*, "Trip Number" matches cruise number (format described above), and that "Tow Number" is set to *Test.* Select the GPS COM port location, and click "OK". At the next window, ensure that the data will be recorded at the correct location, name the .txt file "Test" and click ok. Allow 30 seconds to pass, and then click "System", followed by "Stop Tow". Find the text file and verify that latitude/longitude, time and speed (0kts) data were recorded to that file every 2 seconds. If this file is populated with these data, the test was successful. Repeat this process with same laptop that is to be used as the back-up for the Netmind v5 system.

<u>Sample Sites on Charting Software:</u>
The SAS program that randomly selects Primary and Alternate stations creates permanent copies of the lists of selected cells in both .xls and .dbf formats. A separate SAS program is used to read these files and reformat the location data into a text file format that can be imported into P-Sea Windplot. The data in this text file are imported as 'Boundaries' which are plotted on the P-Sea Windplot charts as colored boxes. Once imported, the resulting boxes are color-coded and customized so that different station types (e.g., Primary vs. Alternate / Shallow vs. Deep) have distinguishing characteristics. Station boxes are also labeled with the station number.

<u>Calibration of YSI:</u>
Approximately one week before the start of a survey cruise, it is necessary to calibrate the YSI 650MDS water quality sampling instrument. Specifically, the conductivity (salinity), pH, depth, and dissolved oxygen probes are to be calibrated. The procedures for each calibration are given below, and the probes are to be calibrated in this order.

Conductivity

- Prepare a solution of 0.25 M KCl by dissolving 9.319g KCl in 500ml DI water; allow solution to attain room temperature.
- Place YSI sonde in solution such that sensor is covered with solution.
- Ensure that no air bubbles are trapped in the sensor by tapping on the sonde.
- On the main menu screen of the handheld display, select "Sonde Menu".
- Select "Calibrate" followed by "Conductivity" followed by "Sp Cond".
- Enter 28.787 (using the keypad) and press enter.
- Allow salinity reading to stabilize for a few minutes. When there is no change in reading, press enter. (salinity should read 17.8 after you press enter).
- Go back to menu (using "Esc" key) and select "Run", followed by "Discrete Sample", followed by "Start Sampling".
- Rinse the sonde with DI water until salinity reading reaches 0.00.

pH

- On the main menu screen of the handheld display, select "Sonde Menu".
- Select "Calibrate", followed by "ISEI pH".
- Select "2 point", press "Enter".
- Input value 7.00.
- Rinse sonde with DI water, followed by a rinse with 7.00 buffer.
- Place sonde in 7.00 buffer.

- Allow pH reading to stabilize, press “Enter”, and then press “Enter” again.
- Enter second value (10.00).
- Rinse sonde with DI water, followed by a rinse with 10.00 buffer.
- Place sonde in 10.00 buffer.
- Allow pH reading to stabilize, press “Enter”.

Depth/Pressure

- On the main menu screen of the handheld display, select “Sonde Menu”.
- Select “Calibrate”, followed by “Pressure”.
- Set depth to 0.0 and press “Enter”.
- Allow depth reading to stabilize.
- Press “Enter”.

Dissolved Oxygen

- Replaced dissolved oxygen (DO) probe membrane.
    - Remove old DO membrane.
    - File tip of probe, parallel with anodes, with a few swipes of sandpaper.
    - Rinse probe with membrane solution; cover tip of probe with solution.
    - Install new membrane; verify that no air bubbles are trapped under the membrane.
    - Allow sonde to run for six hours before calibrating DO.
- On the main menu screen of the handheld display, select “Sonde Menu”.
- Select “Calibrate”, followed by “Dissolved Oxygen”, followed by “Oxygen %”.
- Use anemometer to get a barometric pressure reading in mm Hg.
- Enter barometric pressure and press “Enter”.
- Allow DO reading to stabilize then press “Enter”.

Deck Set-up

This section of the document is intended to describe the layout of the working deck of the *Darana R* during NEAMAP survey operations (Figure 1).

Figure 1. Layout of the working deck of the *F/V Darana R* during field sampling for the NEAMAP Near Shore Trawl Survey.

A 1.3m x 2.5m wooden culling table is located in the aft portion of the working deck, about 2m ahead of the net reel. This table is approximately centered between the port and starboard rails and has been fitted with two wooden racks running the length of the center of the table. These racks were designed to hold the plastic Nalgene™ pans used by NEAMAP personnel during the catch sorting procedure. Four removable "doors" have also been added to the side rails of this table, which enable scientific personnel to quickly sort abundant species into baskets located on the deck. The aft (net end) edge of the table aligns with the aft face of a freezer hatch located directly beneath the table. Two 5.1cm x 25.4cm pieces of wood (extending from the gallus frame to the legs of the culling table) and the aft face of the freezer hatch serve as a checker.

Smaller catches (< 900kg) are dumped into this area. The checker is lined with a tarp, which is used to prevent smaller fishes from becoming stuck or lost between deck tiles.

A second checker is arranged on the starboard side of the vessel. The starboard rail, along with six 10.2cm x 15.3cm pieces of wood form the boundaries of this checker. This checker extends from the centerline of the working deck to the rail, and from approximately the center of the culling table forward to near the aft face of the fish hold hatch. Larger catches (> 900kg) are dumped into this checker.

All sorting baskets, fish boxes, and extra fish pans are located either along the sides of the culling table or along the rails during survey operations. Shovels are stored next to the aft checker or along the rails.

Three data collection work tables are located along the starboard rail. Tables measure approximately 1.9m (L) x 0.6m (W) x 1.1m (H). Tables are constructed of wood and are orientated perpendicular to the rail. The "rail-end" of each table is open, which facilitates the return of specimens to the water after measurement. The aft-most table is approximately even with the forward edge of the culling table and the forward-most table is aligned with the fish hold hatch. Each of the three tables is similarly equipped. Each has an automated fish measuring board (and magnetic pen) recessed into the table, a "small" motion compensated weighing scale (Marel™ M2000, 30kg balance with ±10g accuracy at the aft-most station and a Marel M1100, 30kg balance with ±10g accuracy at each of the other two) affixed to the table, and a waterproof speaker. A species code list, priority species list, guide for commonly mis-identified fishes and invertebrates, and a copy of sample requests by outside researchers are also supplied. A meter stick, calipers, dissection tools (i.e., knives, forceps, scissors, etc.), sample labels (both gut/otolith and unidentified specimen), whirl packs, and stomach sample bags are found at each of these stations as well. Each station has been fitted with a wind shield, as the readings from the small weighing scales have been found to be sensitive to wind.

Besides the materials listed above, the aft-most table is also equipped with a computer monitor and keyboard that connect to the database laptop located in the laboratory. This equipment allows the chief scientist to make minor modifications to the database (e.g., correct a pan number, add station information or comment, etc.) without having to leave the working deck. A clip board containing the Subsample Data Sheets, Error Check Data Sheets, copies of the sampling permits, and material safety data sheets is also located on this table, along with the calibration weight for the M2000 weighing scale. All supplies needed for NEAMAP's Atlantic sturgeon (*Acipenser oxyrhynchus*) and shark tagging are located at the base of this table, along with the large Dillon, EDjunior™ 1000kg hanging scale (accuracy ±2kg). The forward-most table is equipped with the supplies needed for NEAMAP's striped bass (*Morone saxatilis*) *Mycobacterium* sampling, and the anemometer and compass used to collect atmospheric data at each sampling site. The 10kg calibration weight for the smaller Marel M1100 scales is also located at this table.

The "large" motion-compensated weighing scales are located at the base of the forward-most and center work tables and are positioned between the tables and the centerline of the working deck. Specifically a Marel M1100 (150kg capacity, ±50g accuracy) weighing scale is located at the

base of the forward-most table, while another Marel M1100 (60kg capacity, ±20g accuracy) scale is located at the base of the center table. The 20kg calibration weights for these scales are also located at the bases of these tables.

All electrical and communications cables needed to power the automated measuring boards, speakers, and weighing scales are run through a modified deck plate located beneath the center table. A Brockskes™ 4x0.25mm^2 communication cable is run to each board from a serial port multiplexor in the laboratory. These cables supply power and enable the boards to communicate with the database. The speakers located at each work table are connected to their respective boards using a Brockskes 2x0.25mm^2 communication cable. Because the boards signal correct and erroneous keystrokes through various toned "beeps," these speakers enable the user to recognize when mistakes have been made. Each of the large and small scales is powered by extension cords running from the laboratory. The Marel M1100, 15kg and 150kg weighing scales located at the forward-most work table are capable of communicating with the automated fish measuring boards. As such, their communication cables are connected to a Brockskes 3x0.25mm^2 "splitter cable" which is connected to the measuring board at that work station. This allows either of these weighing scales to communicate with the measuring board, depending on the needs of the user. The Marel M1100, 15kg and 60kg located at the center work station are also capable of communicating with the measuring boards, and are connected to the board at that work table in a similar manner. The Marel M2000 scale at the aft-most work station is not capable of communication, so all weights must be entered manually into the measuring board.

The YSI used to collect water quality data at each station is located along the port rail forward of the forward-most work table. All survival suits and the portable life raft are located on the starboard side of the working deck in the crew "prep area", and are easily accessible at all times.

Laboratory Set-up

This section of the document is intended to describe the layout of the laboratory of the *Darana R* during NEAMAP survey operations (Figure 2).

Figure 2. Layout of the laboratory (fish hold) of the *F/V Darana R* during field sampling for the NEAMAP Near Shore Trawl Survey.

The laboratory is located in the fish hold of the vessel. Specifically, scientific personnel use the "slaughter house" (i.e., open area between the port and starboard bins) as the laboratory. A laboratory table, 2.8m (L) x 0.8m (W) x 1.1m (H) and constructed of stainless steel, is located forward of the fish hold hatch and starboard of the centerline of the vessel. An automated fish measuring board occupies the near left portion of the table, while a Marel 1100, 15kg (±5g accuracy) motion compensated weighing scale is positioned in the far left, where left and right and near and far are classified relative to the scientists working at the laboratory table. The scientists stand more or less on the centerline of the vessel when working in the laboratory. A cutting board and "labeling" board are located on the near right portion of the table, and cover the table from the right-hand edge of the measuring board to the right-hand end of the laboratory table. An aluminum rack located in the far center region of the table contains all of the dissection instruments (i.e., knives, scissors, forceps, etc.), and a small tote containing sample labels and pencils is located in the far right area of the table. A tote, which is used to store all bagged otolith and fish scale samples collected during a cruise, hangs off of the end of the right-hand side of the table.

The laboratory table has a built-in shelf (2.1m (L) x 0.3m (W)) 0.3m above the main work area. This shelf holds (from left to right): a Panasonic™ Toughbook CF-30 laptop (the database laptop - all connecters and power supplies are covered by a stainless steel box and insulation for protection and the computer is firmly affixed to the shelf), a species code list, a priority species list, a list of sample requests from outside researchers, latex and nitrile gloves of various sizes, plastic sandwich and gallon-sized bags, whirl packs, stomach sample bags, additional sample labels and pencils, and electric pencil sharpener.

This laboratory table supports three work stations (again, from left to right): one for the operator of the fish measuring board and weighing scale, one for the "cutter", and one for the scientist responsible for labeling, bagging, and storing biological samples. The responsibilities of each of these individuals are discussed in the "Survey Procedures" chapter, but it is important to note that the items mentioned above are arranged such that each scientist has easy access to the equipment and supplies necessary to complete his/her tasks.

The laboratory automated fish measuring board receives power and communicates with the database through a Brockskes 4x0.25mm^2 communication cable that runs from the multiplexor to this board. A speaker is connected to this measuring board using a Brockskes 2x0.25mm^2 communication cable (again to assist the user in the recognition of correct and erroneous keystrokes), and the weighing scale communicates with this board via a Brockskes 3x0.25mm^2 communication cable.

The multiplexor box mentioned above is secured to a shelf located forward of the laboratory table, starboard of the centerline of the vessel. The multiplexor box connects to the database laptop (located on the shelf of the laboratory table) via an RS232 serial cable and 9-pin D connector.

Totes containing extra latex and nitrile gloves, plastic sandwich and gallon bags, whirl packs, stomach sample bags, heavy duty work gloves, and species identification guides are located in the open space below the laboratory table.

The chest freezer used to store certain NEAMAP samples (e.g., vertebrae, unidentified specimens, etc.) is located in the forward-most bin on the port side of the fish hold. Buckets containing preservative for stomach samples are stored in the second and third port bins. All other equipment and supplies not mentioned in the "Deck Set-up" or "Laboratory Set-up" sections of this chapter are housed in the remaining fish hold bins.

Pre-cruise Check of Sampling Gear

Tow Warps:
Prior to the start of each survey cruise (usually the weekend before the cruise begins), the tow wires of the *Darana R* are pulled off of their winches and re-marked. If the warps are found to be heavily damaged in any area, they are cut so as to eliminate the damaged area and new eyes are spliced into the ends. Tow wires are marked at 25-fathom increments, as measured starting from the outside edge of the soft eye at the "door end" of the cable. Different colors of twine (or a combination of colors) are used at each mark to aid the vessel crew in determining warp length

during the setting of the gear. Measurements are made using a 300' Kobalt™ open reel fiberglass tape measure. As mentioned, the first mark is measured from the soft eye (outer end) at the "door end" of the cable to a point 25-fathom toward the winch. The second and all successive measurements are made from the middle of the previous mark to a point 25-fathom toward the winch (e.g., second mark is measured from the middle of the first mark to a point 25-fathom toward the winch). After remarking is complete, scientific personnel re-measure each mark and record their lengths. A tolerance of $\pm$ 7.6cm is allowed between the port and starboard tow warps for a given mark.

In the event that a tow wire is broken during a survey, the tow wire is repaired (i.e., new eyes spliced in), marks are stripped off, and warps are remarked using the procedures described above. If a serious hang occurs (e.g., one that results in complete gear destruction or that may have led to excessive strain on the warps, as determined by the chief scientist and captain), marks are to be re-measured.

Doors:
Thyboron, Type IV, 66" doors are designed to ride on a "knife edge" rather than a "shoe" when towing. These knife edges (two per door) are bolted, rather than welded, onto the bottom portion of the door to facilitate replacement, as necessary. While it is common practice in the commercial fishing industry to extend the life of these knife edges by turning them over as the original bottom wears, NEAMAP personnel replace the aft knife edges on each door after every survey, and the forward knife edges as necessary. Forward knife edges experience much less wear and are therefore usually replaced annually. This protocol ensures that changes in the fishing characteristics of these doors due to weight changes or knife edge wear are minimal.

All hardware used to connect each door to its towing warp is inspected before the start of each survey and is replaced if wear is evident. Backstrap chains are also inspected to verify that they and all connecting shackles and are in good condition. Specifically scientific and vessel crew look for excessive shackle and chain wear, twisting in the backstrap chains, and to confirm that all chain settings are correct (i.e., one link hanging at the "door end" of the top and bottom chains, and two links hanging on the "door end" of the forward chain). Backstrap chains, shackles, and sling links are to be replaced, at a minimum, every other year (i.e., after four full survey cruises). Hardware used to connect the extension wire to the sling link (as well as the sling link itself) is inspected and replaced if excessive wear is evident. Hardware worn excessively on the "net end" of the extension wire is also replaced. The extension wire itself is measured and, if it is 7.6cm longer or shorter than 3.66m, it is replaced. These checks are also made after serious hangs.

Finally, before each cruise, the Netmind door master and symmetry sensors are installed in stainless steel brackets set into each of the doors. These brackets are installed at 30^0 so that the sensors remain parallel while towing and are angled upward at 10^0 to facilitate communication with the hydrophones.

Bridles:
Upon receipt of a new set of bridles, each wire is pulled and measured, to ensure correct length and diameter. Each of the top and center bridles must measure 18.3m $\pm$ 7.6cm, while the bottom

bridles must measure 27.4m ± 7.6cm. Further, two bridles that are to be a "match set" (e.g., two top bridles) cannot differ in length more than 7.6cm. Measurements are made from the outside end of one soft eye to the outside end of the other. Prior to a cruise, all wires that are to be taken onboard, either for use in fishing operations or as back-up, are pulled and inspected. Any bridle showing excessive wear is discarded. All wires are measured, and if they do not conform to the tolerances specified above, are replaced. Bridles are to be re-measured after serious hangs (described above). After each cruise, bridles that were used in fishing operations are to be covered in hydraulic oil to minimize rusting. Prior to each cruise, all hardware used to connect bridles to each other, the net or the idler wire (e.g., swivel plates, flat links, shackles, chain, etc.) are to be inspected and replaced if necessary. A similar inspection of hardware will occur following serious trawl hangs.

Net:

Current:

When a new net is received from a manufacturer, the following action is currently taken:

- A tripper line and bronze tripper are installed on the codend.
- Bull rope, split strap, splitting rings, and rib lines are installed by vessel crew according to standard design.
- Codend liner is dipped in black Rit-dye.
- A mesh bag used to house the catch sensor and made of 7.6cm, #48 twisted nylon green webbing is installed inside the codend (i.e., inside the 12cm, double 4mm PE webbing, but outside the liner). This bag is sewn into the top codend panel. The front of the bag is placed 21 meshes forward of the terminus of the net and extends aft 3 meshes. The bag is centered between the codend gores.
- Twine diameter and type (i.e., single or double) is determined for each panel and codend liner and checked against standardized net plans.
- Mesh size of each panel and codend liner is checked against these same plans by eye to verify that mesh sizes look to be the correct size (no measurements taken).
- Headrope, float line, wing end lines, footrope, sweep, and traveler are inspected and approximate lengths are verified by eye (no measurements taken). The material type and construction of each of these items is checked against standard net plans.
- Headline floats are counted and each inspected for damage. Verification of proper size and manufacturer occurs as well.
- For the sweep, hardware used to connect the center and wing sections is checked against gear plans.
- A mesh bag used to house the wing sensors and made of 7.6cm, #48 twisted nylon green webbing is installed on each middle jib on the inside the net. The top of each bag is sewn along the lower portion of the upper wing end, with the leading edge beginning six meshes aft of the middle jib end meshes. Each bag extends six meshes deep (towards the bottom of the middle jib) and seven meshes aft.
- A mesh bag used to house the headline sensors and made of 7.6cm, #48 twisted nylon green webbing is installed on the headline on the inside of the net. The bag is centered on the on the headrope and the leading edge is sewn to the headline. The bag extends aft 4.5 meshes and is 5 meshes wide.
- The shackles/hammerlocks used to connect the jibs to their respective extensions are inspected to verify conformity with standard net plans.

- Each of the six extensions is checked against the net plans to verify construction and approximate length (again by eye, no measurements).
- The sweep extension chain is examined to verify proper construction and length (i.e., 10 links).
- Each of the bobbins, along with their associated hammerlocks, shackles, and leading chains, are inspected to ensure consistency with net plans.

Upon completion of the inspection (assuming that all criteria are met), the addition of the sensor bags, and the dipping of the codend liner, the new net is certified for survey use and assigned a number. If relatively minor deviations from the standard net plan are found (e.g., wrong size hammerlock or shackle, broken float, etc.) scientific and vessel personnel make the repair themselves. For major deviations however (e.g., issues involving the construction of the footrope or sweep, incorrect webbing in a panel, headrope made of the wrong material, etc.) the net would be returned to the manufacturer for repair. Within the criteria established above, no deviations from the standard net design, no matter how minor, are accepted. Nets are scheduled to be removed from survey use following their 10^{th} full survey (i.e., equivalent of 5 years).

Also, currently before each cruise (usually the weekend prior to the start of the survey), the following action is taken for the net that is scheduled to be used during fishing operations as well as the net that is to be carried as a spare (the establishment of these procedures assumes that the nets have passed inspection upon receipt from the manufacturer):

- Steel rings at the terminus of the codend, tripper line and tripper are inspected for damage and replaced as necessary.
- Bull rope, split strap, splitting rings, and rib lines are inspected and replaced as necessary.
- Codend liner is replaced.
- Twine diameter and type (i.e., single or double) is determined for each panel and codend liner and checked against standardized net plans.
- Mesh size of each panel and codend liner is checked against these plans by eye to verify that mesh sizes look to be the correct size (no measurements taken).
- Any small holes in the webbing are repaired. Large holes require that the panel be replaced. Large holes are those involving >25% of the webbing in that panel.
- Headrope, float line, wing end lines, footrope, sweep, and traveler are inspected for damage.
- Headline floats are inspected for damage and replaced as needed.
- For the footrope, 2-hole hangers and 1-linkers are inspected and replaced as necessary.
- For the sweep, clamps, drop chains, and hammerlocks used to connect the center and wing sections are checked for excessive wear and replaced as necessary.
- The shackles/hammerlocks used to connect the jibs to their respective extensions are inspected and replaced as necessary.
- Each of the six extensions is inspected, and replaced if worn excessively.
- The sweep extension chain is inspected to ensure that the extension chain is 10 links long.

- Each of the bobbins, along with their associated hammerlocks, shackles, and chains, is inspected and replaced if showing signs of excessive wear.
- For the net that is designated for use on that cruise, headline, wing master, wing symmetry, and catch sensors are installed in their respective bags. Each sensor is installed using 0.8cm stainless steel, locking pin bow shackles to secure the lugs of each sensor to the webbing of the net. A 54cm hard rubber bungee is run through the ring at terminus of the rip-cord of the catch sensor. This bungee/rip cord arrangement is woven through the 12cm, double 4mm PE webbing of the codend and attached to the 13th mesh to the right of the centerline of the sensor using three, 0.6cm stainless steel, locking pin bow shackles.

Minor repairs (e.g., replacement of shackles or hammerlocks, repair of small holes, etc.) are addressed by the vessel and scientific crews. If a net is found to need major repair (i.e., replacement of headline, footgear, sweep, replacement of large quantities of webbing) it is either returned to the manufacturer or discarded, at the discretion of the chief scientist.

Assessment of the nets, whether new or used, is conducted by scientific personnel with the aid of vessel crew. Currently, all notes regarding the status of the NEAMAP nets are recorded on notepads which are stored at VIMS.

Proposed:

VIMS personnel recognize that they must develop a more comprehensive net certification process (for both new nets and previously used nets) to ensure the consistency of their data collection efforts as well as the acceptance of these data in the scientific community. Until recently, the lack of time and of extensive knowledge of gear standardization practices have impeded the development of such a gear certification process. During the summer and fall of 2008, NEAMAP principal investigators drafted the following net certification procedures. All comments and assistance (including additions to these procedures) that Review Panel would be willing to provide would be greatly appreciated. NEAMAP personnel intend to implement these net certification procedures prior to the Spring 2009 cruise.

For all new nets (including nets currently owned by NEAMAP that have yet to be fished), the certification process is proposed to include the following.

- Count will be made of steel rings at the terminus of the codend, and a tripper line and bronze tripper will be installed
- Bull rope, split strap, splitting rings, and rib lines will be installed by vessel crew according to standard design. Measurements will be made of each of these lines. Suggestions regarding acceptable measurement tolerances ($\pm$10%?) would be greatly appreciated.
- Codend liner will be dipped in black Rit-dye
- A mesh bag used to house the catch sensor and made of 7.6cm, #48 twisted nylon green webbing will be installed inside the codend (i.e., inside the 12cm, double 4mm PE webbing, but outside the liner). This bag will be sewn into the top codend panel. The front of the bag will be placed 21 meshes forward of the terminus of the net and will extend aft 3 meshes. The bag will be centered between the codend gores.

- Twine diameter and type (i.e., single or double) will be determined for each panel and codend liner and checked against standardized net plans
- Mesh size of each panel and codend liner will be checked against these same plans. This will be accomplished by measuring 10 meshes (selected haphazardly for each panel, measured using a mesh gauge that VIMS plans to purchase in winter of 2008/2009), calculating the average, and comparing with the net plans. Suggestions regarding acceptable measurement tolerances (±10%?) would be greatly appreciated.
- Mesh counts will be made for each panel (both width and depth) and compared with standard net plans.
- Headrope, float line, wing end lines, footrope, sweep, and traveler length will be measured. Suggestions regarding acceptable measurement tolerances (±10%?) would be greatly appreciated. The material type and construction of each of these items will be checked against standard net plans.
- Headline floats will be counted and each inspected for damage. Verification of proper size and manufacturer will occur as well. Float placement will be measured to ensure conformity with standard plans. Suggestions regarding acceptable measurement tolerances (±10%?) would be greatly appreciated.
- For the footrope, rubber cookie diameter will be measured, 2-hole hangers and 1-linkers will be counted.
- For the sweep, rubber cookie diameter will be measured for each section (center and two wings). Counts of leads, clamps, and drop chains will also be made for each section. Distance between drop chains will be measured to ensure compliance with standard plans. Hardware used to connect the center and wing sections will be checked against gear plans.
- A mesh bag used to house the wing sensors and made of 7.6cm, #48 twisted nylon green webbing will be installed on each middle jib on the inside the net. The top of each bag will be sewn along the lower portion of the upper wing end, with the leading edge beginning six meshes aft of the middle jib end meshes. Each bag extends six meshes deep (towards the bottom of the middle jib) and seven meshes aft.
- A mesh bag used to house the headline sensors and made of 7.6cm #48 twisted nylon green webbing will be installed on the headline on the inside of the net. The bag will be centered on the on the headrope and the leading edge will be sewn to the headline. The bag will extend aft 4.5 meshes and will be 5 meshes wide.
- The shackles/hammerlocks used to connect the jibs to their respective extensions will be inspected to verify conformity with standard net plans.
- Each of the six extensions (chain top and wire middle and bottom, both sides) will be measured and checked against the net plans Suggestions regarding acceptable measurement tolerances (±10%?) would be greatly appreciated.
- The sweep extension chain will be examined to verify proper construction and length (i.e., 10 links). Suggestions regarding acceptable measurement tolerances (±10%?) would be greatly appreciated.
- Each of the bobbins, along with their associated hammerlocks, shackles, and leading chains, will be inspected to ensure consistency with net plans.

Again, upon completion of this inspection (assuming that all criteria are met), the addition of the sensor bags, and the dipping of the codend liner, the new net will be certified for survey use and

assigned a number. If relatively minor deviations from the standard net plan are found (e.g., wrong size hammerlock or shackle, broken float, etc.) scientific and vessel personnel may choose to make the repair themselves. For major deviations however (e.g., issues involving the construction of the footrope or sweep, incorrect mesh sizes/twine diameter in a panel, headrope made of the wrong material, etc.) the net will be returned to the manufacturer for repair. No deviations from the standard net design, no matter how minor, will be tolerated. Nets will still be removed from survey use following their 10th full survey (i.e., equivalent of 5 years).

For those nets that have been used in prior cruises, it is proposed that the following pre-cruise action will be taken for the net that is scheduled to be used during fishing operations as well as the net that is to be carried as a spare (the establishment of these procedures assumes that the nets have passed proposed inspection upon receipt from the manufacturer):

- Steel rings at the terminus of the codend, tripper line and tripper will be inspected for damage and replaced as necessary
- Bull rope, split strap, splitting rings, and rib lines will be inspected and measured. These items will be replaced if excessively worn. Suggestions regarding acceptable length tolerances (±10%?) would be greatly appreciated.
- Codend liner will be replaced
- Twine diameter and type (i.e., single or double) will be determined for each panel and codend liner and checked against standardized net plans
- Mesh size of each panel and codend liner will be checked against standardized net plans. This will be accomplished by measuring 10 meshes (selected haphazardly, measured using a mesh gauge), calculating the average, and comparing with the net plans. Suggestions regarding acceptable measurement tolerances (±10%?) would be greatly appreciated.
- Any small holes in the webbing will be repaired. Large holes will require that the panel be replaced. Large holes are those involving >25% of the webbing in that panel. The sizes of the repaired meshes will be verified using the mesh measurement procedures described above.
- Mesh counts will be made for each panel (both width and depth) and compared with standard net plans.
- Headrope, float line, wing end lines, footrope, sweep, and traveler length will be inspected for damage and measured. Suggestions regarding acceptable measurement tolerances (±10%?) would be greatly appreciated.
- Headline floats will be inspected for damage. Float placement will be measured to ensure conformity with standard plans. Suggestions regarding acceptable measurement tolerances (±10%?) would be greatly appreciated.
- For the footrope, 2-hole hangers and 1-linkers will be counted, inspected, and replaced as necessary
- For the sweep, distance between drop chains will be measured to ensure compliance with standard plans. Clamps, drop chains, and hammerlocks used to connect the center and wing sections will be checked for excessive wear and replaced as necessary.
- The shackles/hammerlocks used to connect jibs to their respective extensions will be inspected and replaced as necessary

- Each of the six extensions (chain top and wire middle and bottom, both sides) will be measured. Suggestions regarding acceptable measurement tolerances (±10%?) would be greatly appreciated. If any shows excessive wear, they will be replaced.
- The sweep extension chain will be measured and replaced if length exceeds standardized length. Suggestions regarding acceptable measurement tolerances (±10%?) would be greatly appreciated.. Links will also be counted to ensure that the extension chain is 10 links long.
- Each of the bobbins, along with their associated hammerlocks, shackles, and chain, will be inspected and replaced if showing signs of excessive wear.
- For the net that is designated for use on that cruise, headline, wing master, wing symmetry, and catch sensors will be installed in their respective bags. Each sensor will be installed using 0.8cm stainless steel, locking pin bow shackles to secure the lugs of each sensor to the webbing of the net. A 54cm hard rubber bungee will be run through the ring at terminus of the rip-cord of the catch sensor. This bungee/rip cord arrangement is woven through the 12cm, double 4mm PE webbing of the codend and attached to the 13th mesh to the right of the centerline of the sensor using three, 0.6cm stainless steel, locking pin bow shackles.

Minor repairs (e.g., replacement of shackles or hammerlocks, repair of small holes, etc.) will still be addressed by the vessel and scientific crews. If a net is found to need major repair (i.e., replacement of headline, footgear, sweep, replacement of large quantities of webbing) it will either be returned to the manufacturer or discarded, again at the discretion of the chief scientist.

Assessment of the nets, whether new or used, will be conducted by scientific personnel with the aid of vessel crew. Furthermore, scientific personnel plan to develop official gear checklists during the winter of 2008/2009, so that these forms will be available prior to the start of the Spring 2009 survey. These checklists are being developed to create a more official record of net certification, relative to the current method of recording information on notepads.

Electronic Data Collection Equipment:

LDCE:

Prior to the start of a cruise, all equipment associated with quantifying the catch (i.e., automated measuring boards, weighing scales, and the LDCE database) is tested. This is accomplished by first connecting all data collection equipment as described above in the “Deck set-up” and “Laboratory set-up” sections. All weighing scales are plugged in and boards are turned on. The chief scientist opens the database for the current cruise which, if working properly, establishes communication with the automated measuring boards both on deck and in the laboratory. The chief scientist then creates a “test” station, Station 999, using the station creation procedure described in the “LDCE” section above.

The chief scientist and technicians first test each of the automated measuring boards and weighing scales located on deck. For each board, scientific personnel enter cruise number and station “999”. The method by which data are entered into the boards is described in the “Survey Procedures” chapter. A species code is then entered, followed by “New Code”. The pan number of the individual testing the board is then keyed, and he or she adds some weight to one of the weighing scales attached to that board. The scientist then keys the “Pan Weight” button on the

board and presses the "Enter" button on the weighing scale being tested. If that weight is successfully sent to the board, the scientist will store the information and begin to enter a series of length measurements (approximately 5 to 10). If more than one weighing scale is connected to this board, the scientist will repeat the process from the "Pan Number" step using the other scale. Once all of the automated measuring boards and scales on deck have been tested, the chief scientist will verify that all of that information was relayed to the LDCE database.

Testing the laboratory automated measuring board and scale is similar to the procedure described above. The cruise, station, and a species code are entered. A pan number is entered, while pan weight is recorded as zero. The scientist conducting the test then enters an individual length measurement, and an individual weight measurement. The latter is accomplished by adding some weight to the laboratory scale, keying the "Weight" button on the board, and pressing the "Enter" button on the scale. If that weight is successfully sent to the measuring board, the scientist will then enter a sex, maturity stage, and gut status. An eviscerated weight measurement will then be entered using a procedure similar to that described for entering an individual weight. Once this information has been entered, the chief scientist will confirm that these data were successfully sent to the database.

If all of the above information was sent to the database without error, the test is considered a success. All data collected under station 999 are subsequently deleted and the database and automated measuring boards are closed.

Netmind & Tow Tracks:

Once the laptop that is to be used to run both the Netmind v5 software and Netmind v3.3.1 software (to record tow tracks) is mounted in the wheelhouse and connected to the Netmind receiver box and Northstar Explorer 557 GPS, a test is conducted to ensure that all systems are communicating and data are being recorded in the correct location. The Netmind v5 system is tested by lowering each sensor off of the stern of the vessel (because the system is now using hull-mounted hydrophones) and verifying that data are being received by the software. During these tests, the data are logged in the cruise folder described above in a "Test2" folder created by the chief scientist specifically for this test. After verifying that data were received from all sensors, the .csv files in the "Test2" folder are examined to ensure that these data were recorded correctly. If each of the sensors communicates with the software, and the resulting data are recorded in the .csv files, the test is deemed a success.

To test the recording of tow tracks, the Netmind v3.3.1 software is opened and the Northstar GPS is turned on. The test is conducted in the same manner described above for tow track testing, except that the latitudinal/longitudinal data from this test are recorded into a .txt file named "Test2". After allowing the software to record the GPS data for 30 seconds, the test is terminated, and the chief scientist inspects the file to ensure that these data were recorded. A file containing latitude/longitude, time, and vessel speed (which should be 0kts during the test) data recorded every 2 seconds for a 30 second period is indicative of a successful test.

Miscellaneous

Prior to the beginning of a cruise (usually the day before departure), the chief scientist verifies that all other equipment and supplies have been loaded onto the vessel and are in their proper location.

Survey Procedures

The following documentation is intended to promote consistency in NEAMAP survey field sampling by detailing all field protocols and procedures. Due to the unpredictable nature of field work, situations will arise which are not addressed in this chapter. Improvisation in these instances is inevitable, and it is imperative that these situations and resulting actions be documented by the chief scientist to ensure that the data are interpreted correctly.

Responsibilities of the Vessel/Scientific Crew

In general, the vessel crew is responsible for all of the vessel operation, fishing, and safety aspects of each survey. The command structure for these categories is as follows: captain, first mate, deckhand. With respect to vessel operation, this crew is responsible for operating the vessel while steaming and fishing as well as for maintaining all watches. The fishing responsibilities of the vessel crew include the setting and hauling of the gear, dumping the catches in the appropriate checker, and maintenance and repair of the net, doors, and associated hardware (excluding Netmind sensors) at sea. As noted, the vessel crew is responsible for safety during each survey. Briefly, this includes conducting a safety orientation (identify location of all safety equipment, observe all personnel practice the donning of a survival suit, etc.) for all vessel and scientific personnel at the start of each cruise and whenever replacement personnel arrive as well as taking charge in any emergency situation. While scientific personnel are never involved with the operation of the vessel or maintenance of watches, they assist with the fishing and safety aspects of the survey as necessary.

The crew of the *F/V Darana R* are highly experienced and qualified to fulfill the aforementioned roles for the NEAMAP survey. Specifically, Captain Jimmy Ruhle has 46 years of fishing and vessel operation experience, more than 34 of which have been aboard the *Darana R*. Captain Ruhle has been fishing the *Darana R* as a dragger since 1980. Robert Ruhle (Captain Ruhle's son) serves as the first mate during NEAMAP cruises. He has been fishing on the *Darana R* full time since 1995 and acts as the vessel's captain when his father is unavailable. Rigoberto Rodriguez is the deckhand and has been fishing aboard the *Darana R* since 2002.

The command structure of the scientific crew is as follows: chief scientist, alternate chief scientist (i.e., individual qualified to act as chief scientist, but not serving as chief at that moment), technicians (order of command based on length of time with the survey). The scientific crew is responsible for all of the station selection, catch processing, data collection, and biological sample acquisition aspects of each cruise. With respect to station selection, the scientific crew is responsible for determining the order in which sites are to be sampled, actual tow tracks within each sampling cell, whether sampling a particular site is possible (given bottom conditions, fixed gear, surface traffic, etc.), and appropriate Alternate sites for stations that are not towable. The scientific crew is also responsible for ensuring that the Netmind sensors remain functional and for working with the captain to determine warp lengths for each tow. The catch processing responsibilities of the scientific crew include specimen identification, size-class determination, and catch sorting. Further, the scientific crew determines when subsampling is necessary, as well as the type of subsampling to be implemented. The vessel crew does aid in the sorting process in the event of large and/or diverse catches. The scientific crew is responsible for collecting all data including station identification, net mensuration, tow tracks, atmospheric and hydrographic information, as well as all weight, length, count, sex, and

maturity stage information collected from specimens in the catch. Biological sample acquisition is the responsibility of the scientific party and includes the collection of hard parts for ageing and stomachs for diet analysis, along with any other samples (muscle tissue, internal organs, etc) needed to complete special studies. The scientific crew is responsible for tagging all Atlantic sturgeon and sharks collected.

Collectively, the current scientific crew has more than 55 years of experience conducting fishery-independent trawl surveys. Two of the project's principal investigators, both of whom participate in each cruise, led the design and implementation of a Chesapeake Bay trawl survey and were involved in the design of the NEAMAP Near Shore Trawl Survey. The Chesapeake Bay survey began in 2002, has protocols and procedures that closely match those of the NEAMAP survey, and is ongoing today. The chief scientist of the NEAMAP field activities has either led or participated in fishery-independent multispecies trawl and scallop dredge surveys since 1998. The survey technicians possess a variety of backgrounds, from leading observer programs to participating in gill net studies in SNE. This scientific team therefore has the experience necessary to conduct this survey.

Station Order

During the design phase of the NEAMAP survey, the Trawl Technical Committee recommended and the Operations Committee approved alternating the order in which sites are sampled between the spring and fall cruises. Specifically, the cruise track of the spring survey is to proceed in a general south-to-north direction, while the fall survey is to be conducted starting in the northern portion of the survey area and working toward the southern. The Trawl Technical Committee made this recommendation under the idea that the south-to-north track in the spring would follow the general northward and inshore migration of fishes at that time of the year, while the fall survey would track the fishes as they moved southward and offshore for the winter.

In practice, the NEAMAP survey begins sampling during its spring survey in Region 15 (see "Background" chapter – approximately Nags Head to Cape Hatteras, North Carolina) and works north, while starting in RIS and working south in the fall. The order in which sites are sampled within these starting regions depends on convenience, surface traffic, weather, etc. (i.e., it is not necessary to steam to the southernmost station in Region 15 to begin the spring survey).

Throughout the cruise, the exact order in which sites are sampled depends on a number of factors. Usually, sites are sampled in order based on proximity (i.e., the next station sampled will be the one closest to the site currently being sampled). There are instances, however where sites are sampled "out of order". These include situations where weather or surface traffic may preclude the sampling of a given site at a given time (e.g., too rough to sample an offshore site safely today, need to wait for this line of ships to pass, etc.), or when a port call dictates a change in the order (e.g., sample sites near the port before heading in rather than sampling the "next" sites offshore). Nevertheless, the general north-to-south or south-to-north (depending on the survey) cruise track is maintained. All decisions regarding the order in which sites are to be sampled are made by the chief scientist with input from the captain.

Station Procedures

Selected Tow Track at a Station:
As mentioned in the "Survey Design" chapter, sampling sites are defined at 1.5nm x 1.5nm cells. A tow may be made anywhere within that cell to be considered a valid tow for that station. Because a typical NEAMAP tow covers approximately 1nm, it is necessary to begin the tow (winch breaks "on") at one of the edges of the cell and tow toward the "inside" of that cell. If tows were to begin well within the cell or at the center of the cell, an appreciable portion of the tow would wind up occurring outside the cell. Even with this protocol, a portion of a tow may occur outside of the intended cell (due to currents, ship traffic, hang avoidance, etc.) at times. To date, tows in which only a small part of the sampling occurred outside of the cell were considered valid. In an effort to make the criteria for the acceptance and rejection of a tow more objective, it has been proposed that only tows in which $\geq$15minutes of the tow occur inside of the designated cell are considered to be valid. Any comments from the review panel regarding this proposal would be welcomed.

While a tow made anywhere within a cell designated for sampling is considered a valid tow for that station, it is often the case that bottom obstructions, ship traffic, fixed gear, and other obstacles render a portion of a sampling site untowable, either on a temporary or permanent basis. In these cases, the chief scientist consults with the captain to identify a suitable lane for towing. While these two individuals work together to find an acceptable tow track in these situations, final decisions are the responsibility of the chief scientist.

If a sampling site is deemed completely untowable for any of the above reasons, it is the responsibility of the chief scientist to select an Alternate site. A full list of Alternate sites is generated prior to the start of each cruise (see "Survey Design" chapter). The Alternate selected must be located in the same region/depth stratum as the original sampling site. Usually, the Alternate site closest to the original station and occupying the same region/depth stratum is selected.

Setting and Hauling the Gear:
As mentioned in the "Responsibilities of the vessel/scientific crew" section of this chapter, the vessel crew is responsible for setting and hauling the survey gear. Scientific crew assist with these duties as necessary.

To set the survey trawl, the captain begins by positioning the boat approximately 0.25nm outside the intended sampling cell, with the vessel steaming at 1-2kts toward the cell. This ensures that the tow will officially begin (winch breaks "on") near the edge of the cell. The captain engages the hydraulics, and he, the mate, and the deckhand work to deploy the net from the net drum. As the net is spooling off of the drum, both scientific and vessel crew inspect the net to ensure the gear is in good condition (no holes in webbing, etc.) and that there are no specimens left in the net from the previous tow. Once the net is off of the drum and the bridles are spooling out, the captain leaves his position at the net drum for the wheelhouse. As the flat links between the forward chains of the swivel plate and the idler wires spool off of the net drum, the mate stops the drum. Both he and the deckhand connect the extension wires from their respective doors to these flat links using g-hooks. The doors and net are now connected. At this point, the mate

resumes spooling the net drum. The strain of the net is taken up by the backstraps and extension wires of the doors, and the idler wires (still connected to the net reel lines) go slack. The mate and deckhand disconnect their idler wires from the net reel lines and connect these idlers to their respective doors via a flat link and g-hook. The captain hauls in about a foot of tow wire on each winch, which allows the mate and deckhand to remove the safety chains from their doors. The fishing system is now off of the net drum and ready for deployment.

The mate and deckhand move from the net drum to their respective winches as the captain begins to set the gear. He speeds the vessel up to approximately 4 kts and powers out 25 fathom of tow wire on each winch. At this point, the captain stops the power out, and the mate and deckhand apply the breaks to the winches and disengage each. The captain announces the amount of wire to be deployed over an intercom system. The mate and deckhand then loosen their brakes and deploy the wire in free spool, ensuring that both winches are running at approximately the same speed. When the appropriate amount of wire is deployed, the mate and deckhand set their brakes. The mate ensures that the wire marks are even, and signals to the captain that the brakes are set. The official start of the tow occurs when the captain receives this signal.

The amount of wire to be deployed depends on the depth of water, and the relationship between warp length and water depth used by the NEAMAP survey is given in Table 1. These relationships were established during the pilot surveys in 2006 and were refined during the Fall 2007 cruise. All warp measurements are from the trawl blocks to the trawl doors.

Table 1. Relationship between warp length and water depth used by the NEAMAP Near Shore Trawl Survey.

Water Depth (m)	Warp Length (fm)
<6.1	65
6.1 - 12.2	70
12.2 - 36.6	75
>36.6	100

At the conclusion of a tow, the captain slows the vessel down to between 0.5 to 1.0 kts (depending on the tide – closer to 0.5kts in a head tide and closer to 1.0kts in a fair tide) vessel speed over ground, the mate and deckhand engage the winches and loosen the breaks, and the captain begins to power back the gear. Netmind data have shown that, by slowing down to the aforementioned speeds, the doors begin to come together and fishing by the gear stops (or at least is greatly reduced) at this point. Haul back procedures are essentially the reverse of the setting process. The captain brings the doors up, and the mate and deckhand secure the doors with safety chains, disconnect the idler wires from the doors and attach them to the net reel lines, disconnect the door extension wires from the flat link, and reel in the net. As the net is being hauled in, scientific and vessel personnel inspect the gear for damage and ensure that fishes and invertebrates are not escaping. Vessel personnel remove specimens from the net or shake them down to the codend, whichever is more convenient. All specimens in the net (whether cradled in the webbing, gilled, etc.) are retained as part of the catch.

As mentioned in the "Survey Preparation" chapter, the procedure for dumping the catch depends on the size of the catch. Smaller catches (<900kg) are dumped into the checker located between

the net drum and culling table. Larger catches are taken around the starboard side of the vessel and dumped in the larger checker arranged in that area. Catches smaller than 3200kg can be taken in a single lift, while larger catches are "split," using the splitting arrangement and bull rope, and taken in portions. Once the catch has been dumped, the captain, mate, and deckhand run the codend off of the drum and remove any specimens that may have become stuck in the liner material. A member of the scientific crew verifies that the net is clean before the codend is closed.

At this point, any damage that may have occurred to the gear is repaired by the vessel crew. Additional detail is included in the "Classification of Tow Validity" section below.

Tow Beginning and Ending:

As stated above, the chief scientist is responsible for setting the order of station sampling, identifying appropriate tow tracks within each sampling cell, and selecting Alternate stations as appropriate. Prior to setting the net, a qualified member of the scientific party (qualified member includes those that have been trained by a principal investigator in the scientific duties during setting and haul back) will prepare the Netmind v5 system and Netmind v3.3.1 system for net mensuration and tow track data collection, respectively.

For the Netmind v5 system, ensure that the receiver box is on and that the program is open. Click on "File" followed by "Select Log File Location". A window will appear indicating the folder to which the net mensuration data will be saved and will ask if the user wishes to change the location. Click "Yes", and create a new folder on the hard drive under the path ":\NM*YYMM*\STA*XXX*" where "NM*YYMM*" is cruise number and "STA*XXX*" is station number, described in the "Survey Preparation" chapter. Click "OK".

For the Netmind v3.3.1, ensure that the receiver is on and the program is open. Click on "System", and then "Start Tow". Ensure that the "Ship Number" and "Trip Number" are correct on the next screen, and enter STA*XXX* in the "Tow Number" field. STA*XXX* follows the same format as described above. Click "OK". On the next screen, verify that the file name follows the format ":\Program Files\NTI\NETMIND\STA*XXX*.txt".

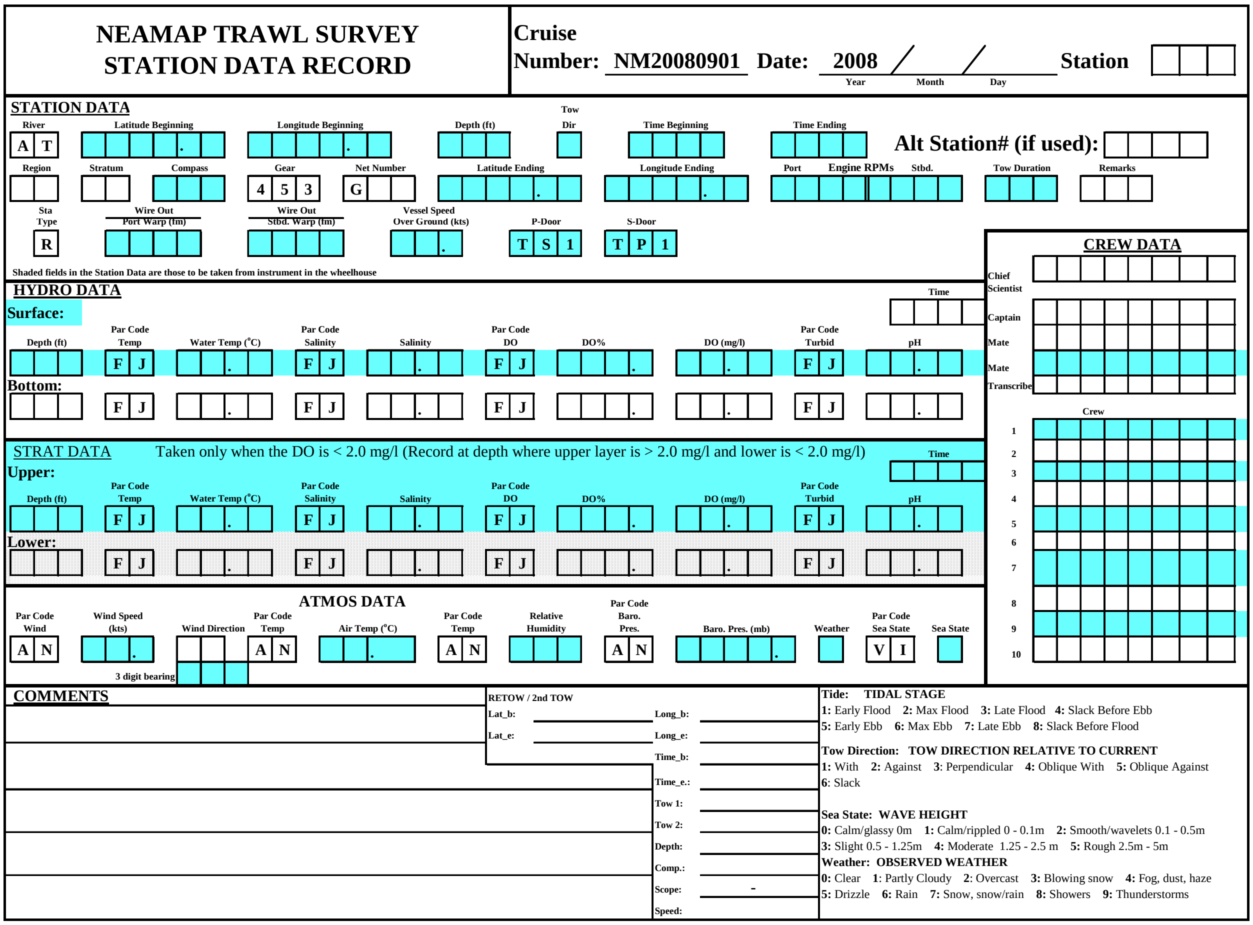
Open the "timer" program and verify that the timer is set to 20 minutes.

When the brakes are set on the winches at the start of the tow, the captain signals this information to the scientist in the wheelhouse. The scientist starts the timer, clicks "OK" on the Netmind v3.3.1 screen to start recording the tow track, and clicks "File" and then "Raw Data Log" on the Netmind v5. The scientist also keys the "Man Overboard" button on the Northstar Explorer 557 GPS to save the beginning position and time of the tow. This entire process, from starting the timer to saving the GPS position, takes approximately 3-5 seconds.

At this point, the scientist begins to fill out the Station Data Sheet (Figure 1). Specifically, the scientist enters the date, station number, beginning latitude and longitude, water depth, tow direction relative to the current, tow start time, Alternate station number (if used), region and depth stratum identification, compass course, gear code, net number, port and starboard engine RPMs, remarks, the amount of wire deployed on the port and starboard winches, vessel speed

over ground, and port and starboard door numbers. The scientist also adds comments as appropriate (see “Classification of Tow Validity” below).

Figure 1. Station Data Sheet used by the NEAMAP Near Shore Trawl Survey.


NEAMAP TRAWL SURVEY
STATION DATA RECORD

Cruise Number: NM20080901 Date: 2008 / / Station
Year Month Day

STATION DATA
River: A T | Latitude Beginning | Longitude Beginning | Depth (ft) | Tow Dir | Time Beginning | Time Ending | Alt Station# (if used):
Region | Stratum | Compass | Gear: 4 5 3 | Net Number: G | Latitude Ending | Longitude Ending | Port | Engine RPMs | Stbd. | Tow Duration | Remarks
Sta Type: R | Wire Out Port Warp (fm) | Wire Out Stbd. Warp (fm) | Vessel Speed Over Ground (kts) | P-Door: T S 1 | S-Door: T P 1
Shaded fields in the Station Data are those to be taken from instrument in the wheelhouse

HYDRO DATA
Time
Surface:
Depth (ft) | Par Code Temp: F J | Water Temp (°C) | Par Code Salinity: F J | Salinity | Par Code DO: F J | DO% | DO (mg/l) | Par Code Turbid: F J | pH
Bottom:
F J | F J | F J | F J

STRAT DATA Taken only when the DO is < 2.0 mg/l (Record at depth where upper layer is > 2.0 mg/l and lower is < 2.0 mg/l)
Time
Upper:
Depth (ft) | Par Code Temp: F J | Water Temp (°C) | Par Code Salinity: F J | Salinity | Par Code DO: F J | DO% | DO (mg/l) | Par Code Turbid: F J | pH
Lower:
F J | F J | F J | F J

ATMOS DATA
Par Code Wind: A N | Wind Speed (kts) | Wind Direction (3 digit bearing) | Par Code Temp: A N | Air Temp (°C) | Par Code Temp: A N | Relative Humidity | Par Code Baro. Pres.: A N | Baro. Pres. (mb) | Weather | Par Code Sea State: V I | Sea State

CREW DATA
Chief Scientist
Captain
Mate
Mate
Transcribe
Time
Crew
1
2
3
4
5
6
7
8
9
10

COMMENTS

RETOW / 2nd TOW
Lat_b: Long_b:
Lat_e: Long_e:
Time_b:
Time_e:
Tow 1:
Tow 2:
Depth:
Comp.:
Scope: -
Speed:

Tide: TIDAL STAGE
1: Early Flood 2: Max Flood 3: Late Flood 4: Slack Before Ebb
5: Early Ebb 6: Max Ebb 7: Late Ebb 8: Slack Before Flood
Tow Direction: TOW DIRECTION RELATIVE TO CURRENT
1: With 2: Against 3: Perpendicular 4: Oblique With 5: Oblique Against
6: Slack
Sea State: WAVE HEIGHT
0: Calm/glassy 0m 1: Calm/rippled 0 - 0.1m 2: Smooth/wavelets 0.1 - 0.5m
3: Slight 0.5 - 1.25m 4: Moderate 1.25 - 2.5 m 5: Rough 2.5m - 5m
Weather: OBSERVED WEATHER
0: Clear 1: Partly Cloudy 2: Overcast 3: Blowing snow 4: Fog, dust, haze
5: Drizzle 6: Rain 7: Snow, snow/rain 8: Showers 9: Thunderstorms

This scientist signals to the captain when 1 minute remains in the tow. The captain, mate, and deckhand prepare for haul back. The scientist signals again at 10 seconds, and finally when the timer indicates that the tow is complete. At this point, the captain initiates the haul back (see above). The responsibilities of the scientist are then as follows: for the Netmind v3.3.1, click “System” and then “Stop Tow”, and for Netmind v5, click “File” and then “Raw Data Log.” The scientist also keys the “Man Overboard” button on the GPS to save the ending position and time for that tow, and resets the timer to 20 minutes. Lastly, the scientist records ending time, ending latitude and longitude, and tow duration on the Station Data Sheet. The scientist will add comments if necessary (see “Classification of Tow Validity” below). Before moving to the working deck, the scientist verifies that the net mensuration and tow track data for that tow were recorded.

Hydrographic and Atmospheric Data:

Once the scientist responsible for recording the tow beginning/ending data has collected all of the ending data and verified that electronic data were recorded, he/she moves to the working deck to record hydrographic and atmospheric data.

Hydrographic data are collected using a YSI 650MDS water quality sampling device. As soon as the catch is on deck, the captain stops the boat to allow the scientific crew to deploy the YSI and collect these hydrographic data. The sonde portion of this instrument is lowered overboard to a depth of 0.6m to 0.9m. This is the depth at which the "surface" measurements are taken. The sensors attached to the sonde are allowed to equilibrate, and the scientist records sonde depth, water temperature (^{0}C), salinity (ppt), dissolved oxygen percent saturation, dissolved oxygen concentration (mg/L), and pH. Time at which these measurements are taken is also recorded. The scientist then lowers the sonde to the bottom; a distinctive "bump" is felt when the sonde reaches the bottom. The system is again allowed to equilibrate, and the water quality parameters identified above are recorded. The scientist then retrieves the sonde and stows it in its tote.

Atmospheric data are measured using a Kestrel^{TM} Pocket Weather Tracker. Specifically, wind speed (kts) and direction, air temperature (^{0}C), percent relative humidity, and barometric pressure (mb) are recorded. Weather is recorded using the following code system: 0 – clear, 1 – partly cloudy, 2 – overcast, 3 – blowing snow, 4 – fog, dust, haze, 5 - drizzle, 6 – rain, 7 – snow, snow/rain, 8 – showers, and 9 – thunderstorms. Sea state is recorded using: 0 – calm/glassy 0m, 1 – calm/rippled 0m-0.1m, 2 – smooth/wavelets 0.1m-0.5m, 3 – slight 0.5m-1.25m, 4 – moderate 1.25m-2.5m, and 5 – rough 2.5m-5m. Both weather and sea state designations are based on visual observation by the scientist recording these data.

<u>Classification of Tow Validity</u>:
There are a number of situations, from the time that the vessel crew begin to set the net until the time that the catch is emptied onto the deck, that could render a tow invalid and necessitate a re-tow. The NEAMAP survey does not use a "points system" to classify a tow, but instead employs more of a "pass/fail" criteria for determining tow quality and the need for a re-tow.

Due to the unpredictable nature of field sampling, it is nearly impossible to imagine all instances that would necessitate a re-tow. However, some instances that may force a tow to be discontinued in favor or a re-tow include:

- Problems during the setting procedure.
    - Vessel, winch or other mechanical failure
    - Doors flip or become crossed
    - Doors bury in the mud
    - Bridles twist or break
    - Miscommunication between the captain and deck crew regarding warp length
    - Miscommunication between mate and captain or captain and scientist regarding starting time of the tow
- Sub-optimal performance of the fishing system during the tow (defined as >15% deviation from optimal configuration for >5 minutes, or >>15% deviation for any period

of time, at the discretion of the chief scientist and captain – see “Survey Design” chapter).

- Communication failure between Netmind sensors and Netmind software for the duration of the tow.
- Radical change in tow speed or direction during a tow to avoid obstructions, surface traffic, fixed gear, etc.
- Hangs – all hangs (defined as a snag of any part of the gear on the bottom, sufficient that it is felt by the vessel and/or scientific crew), no matter how minor, will result in a re-tow.
- Tow wire breakage.
- Tows that are <15 minutes in duration.
- Problems discovered during the haul back procedure.
    - Vessel, winch, or other mechanical failure
    - Doors flipped or crossed
    - Twisted or broken bridles
    - Breakage in any of the connection hardware
    - Breakage of >5 headline floats
    - Breakage in any part of the frame of the trawl (i.e., headrope, wing ends, footrope, traveler, sweep)
    - Slippage of webbing on the frame
    - Single or multiple holes in the webbing approximately exceeding the diameter of a basketball
    - Several (i.e., three or more) holes in the webbing approximately exceeding the diameter of a baseball
    - Many (i.e., ten or more) single and/or double mesh breaks
    - Codend missing
    - Codend problems (e.g., tripper failure, liner failure, etc.)
    - Other fishing gear in the net, such that gear may have restricted fishing ability of the net

Again, situations other than those mentioned here may result in the disqualification of a tow in favor of a re-tow. The assessment of the situation and decision as to whether to re-tow is the responsibility of the chief scientist.

Any non-typical events that occur during any portion of a tow (from the time that the net is set until the catch is on the deck) are to be recorded on the “Comments” section of the Station Data Sheet. Situations that would be included in this “Comments” section include, but are not limited to:

- Reasoning for choosing a particular tow track within a cell.
- Reasoning for selection of an Alternate station.
- Identification of commercial or recreational vessels fishing in the vicinity.
- Identification of other fishing gear in the sampling cell.
- Description of any gear interactions between the NEAMAP trawl and other gear.
- Irregularities in the setting and/or hauling procedure.
- Gear damage (both type and extent).
- Failures of any electronic data collection systems.

- Reasoning for conducting a tow <20 minutes.
- Reasoning for towing outside of the boundaries of a sampling site.

While each of these comments are currently written out in full in the “Comments” section of the Station Data Sheet, NEAMAP personnel are currently working on codes that would identify the category into which each comment falls, followed by a more specific description. For example, the code for webbing tears may be “2”. If, upon haul back, the net is found to have holes in the webbing, the scientific crew could just write “2 – 2nd bottom belly” indicating that there were holes in the webbing in the second bottom belly. Such a system would aid researchers looking to classify NEAMAP tows by event types. NEAMAP personnel plan to have this comment code system established prior to the Spring 2009 cruise.

With respect to net damage, the current strategy of the NEAMAP program is to repair minor damage (that which does not necessitate a re-tow) prior to setting the gear at the next station. Nets that are damaged to the extent that a re-tow becomes necessary are replaced before the next tow. The vessel crew is responsible for making all at-sea repairs, and the scientific crew is responsible for ensuring that these repairs comply with the accepted net plans. Major repairs are completed by either the vessel crew (post-cruise) or the net manufacturer. Decisions as to who should make these repairs (and if repairs are worth making – may choose to discard the net) are made by the vessel crew, manufacturer, and scientific crew. All nets subject to major repair are re-certified, as described in the “Survey Preparations” chapter, prior to use. As noted in the “Survey Preparations” chapter, each net is numbered, which enables the scientific crew to track the use of, damage to, and repair of each.

<u>Catch Processing</u>:

Sorting and Sizing:

As mentioned, smaller (<900kg) catches are emptied into the checker that is located between the net reel and the culling table. Once the codend liner has been completely emptied by the vessel crew and the scientific crew confirms that the net is “clean,” the sorting process begins. This process, in its most basic form, occurs in the following manner. Two scientists (one on the port side of the checker and the other on the starboard) begin to shovel the catch from the checker onto the culling table. As this process is occurring, the chief scientist is inspecting the catch (which is being “turned over” by the shoveling activity) to identify modal size (length) categories for each species collected. It is important to note that modal size categories for a given species are determined by eye and are classified on a relative scale for each tow rather than by a set range of lengths. For example, supposed that the chief scientist determines that small, medium, and large size categories of Atlantic croaker (*Micropogonias undulatus*) are present in the catch. This means that the chief scientist sees what he/she believes are roughly three modal length groups of croaker in the catch. Further, these small, medium, and large designations are relative to the croakers available in that catch. Small, medium, and large from one catch may not correspond to the size ranges of these three categories in another. NEAMAP uses this procedure (as opposed to pre-set size ranges), to ensure that all sizes of a species are adequately sampled at each tow.

Once all of the catch is on the table, or the table is full (whichever comes first), the chief scientist announces the number of size-classes present for each species as well as the approximate size

ranges of each class. Following this announcement, sorting commences. Each of the scientific crew is responsible for participating in the sorting process. All specimens, fishes and invertebrates, are sorted by species and size (if appropriate). Smaller-bodied, less abundant species/size-classes are sorted into Nalgene pans located on racks running along the centerline of the table. Small, abundant species, medium-sized fishes and invertebrates, and larger-bodied animals are sorted into fish baskets and fish boxes located on the working deck. This process continues until all specimens have been sorted, and the chief scientist verifies that both the aft checker and the culling table are clear of all specimens. At this point, all pans, fish baskets, and boxes containing the same species/size-class are organized such that all of a given species/size are in the same location and are combined, when possible.

Larger catches (>900kg) are taken over the starboard side of the vessel and emptied into the starboard checker, as noted previously. The sorting process is similar; the goal is to separate fishes and invertebrates by species and size-class, if appropriate, and the chief scientist is responsible for designating size categories. By definition, however, a catch taken over the starboard side is large, and applying the basic sorting procedure described above is neither practical nor efficient. In these instances, one or multiple subsampling procedures can be used. These protocols are described below, have been adapted from the subsampling protocols of the NEFSC Bottom Trawl Survey for use on the NEAMAP survey, and have been approved for use on this survey by the NEAMAP Trawl Technical Committee, Operations Committee, and Board. The decision of which protocol, or protocols, to use is at the discretion of the chief scientist. It is important to note that the use of subsampling is not restricted to large catches taken over the side of the vessel, but may also be applied when a catch of numerous, smaller-bodied specimens is taken over the stern.

Subsampling, Straight Subsampling by Weight:

When a NEAMAP trawl tow yields a moderately large amount (e.g., 200 - 500 specimens) of a particular species/size-class, or a very large amount (e.g., 500 specimens or greater) of a species/size-class comprised of small to medium-sized specimens, "Straight Subsampling by Weight" will be used to quantify the catch for that species. If this dominant species/size-class, is on the "Priority A, B, or C" lists, 10 specimens of that species/size-class will first be removed (haphazardly) for full processing (priority lists and full processing described below). The remaining catch will then be sorted by species/size-class, as described above. Some baskets containing the dominant species/size-class will be selected (haphazardly) as a representative subsample, and all remaining (the "leftover") baskets containing this species/size-class will be weighed. These weights will be recorded, and the specimens released overboard. The number of subsample baskets selected will vary, as the goal is to obtain a sufficient number of animals (i.e., 150-200) in the subsample to generate a reliable representation of the total catch of the species/size-class. For example, 150-200 large Atlantic croaker will fill more baskets than the same number of small spot (*Leiostomus xanthurus*).

In cases where a NEAMAP trawl tow produces a moderately large (e.g., 200 - 500 specimens each) catch of each of a few (e.g., less than four) species/size-classes, subsampling will occur separately for each dominant species/size-class according to the Straight Subsampling by Weight procedure outlined above.

Subsampling, Mixed Subsampling by Weight:
"Mixed Subsampling by Weight" will be used when a moderately large (e.g., 200 - 500 specimens) amount of each of several (e.g., four or more) species/size-classes are collected, and specimens comprising each are of similar size. Species/size-classes that are either composed of relatively smaller or larger individuals or represented by relatively few individuals will first be sorted out of the catch, using the procedure outlined in the "Sorting and Sizing" section above. Other protocols defined in this chapter (i.e., No Subsampling, Straight Subsampling by Weight, and Discard by Count Subsampling) will be used to process these species/size-classes.

Ten specimens per size-class will then be removed haphazardly from the mixed pile for each Priority A, B, or C list species present in the mix. The remaining specimens in the pile will be well mixed and placed (unsorted) into baskets. Some baskets (number depending on the composition of the catch) will be selected as the subsample, such that each species/size-class in the mix is adequately represented. The weight of all baskets not chosen for the subsample (the "leftover") will be recorded to obtain the remaining weight of all species/size-classes in the mix, and the individuals in those baskets will be released. The mixed subsample will then be sorted and processed (see below).

The Mixed Subsampling by Weight protocol outlined above will also be used when a very large (e.g., 500 specimens or greater) amount of each of two or more species/size-class, is collected, and all specimens are small to medium size.

Subsampling, Discard by Count Subsampling:
On occasions when a very large amount (e.g., 500 specimens or greater) of each of one or more species/size-classes are collected, and the specimens are relatively large-bodied, "Discard by Count Subsampling" will be used. The following protocol is defined for the case in which a very large amount of a single species/size-class is collected, and all specimens are relatively large. If this dominant species/size-class is on the A, B or C Priority list, 10 individuals of that species/size-class will first be selected haphazardly for full processing. Several baskets (enough to obtain a sufficient subsample) will then be filled with specimens of this species/size-class and set aside. The remaining (leftover) specimens of this species/size-class will be counted and released overboard.

If a very large amount of each of more than one species/size-class (all specimens large) is collected, Discard by Count Subsampling will occur separately for each according to the procedure outlined above.

<u>Species Priority Designation</u>**:**
During design phase of the NEAMAP survey, the NEAMAP Operations Committee assigned fishes and select invertebrates to one of five priority lists, designated A, B, C, D, and E. The composition of each of the priority lists is given in Table 2. Priority A, B and C species are to be sampled for full processing at each site at which they are collected. Specifically, once the catch is sorted (or prior to the sort if the species is being subsampled) 10 specimens are removed from each size-class of each of the A, B, and C list species and are taken to the onboard laboratory for processing. The specimens of the Priority A, B, and C species not selected for full processing are sampled using the partial processing procedure described below. The species of the A, B, and C lists are those that are of management interest to the ASMFC, the MAFMC, and the New

England Fisheries Management Council (NEFMC). These species were originally assigned to the A, B, and C lists based on the perceived needs for biological data from each (A being most needed, C being least). The idea was that field scientists would know which species were most important (from a management perspective), so that if they became overwhelmed by quantity of laboratory processing, they could eliminate those that were least important (C list) in an attempt to create a manageable sampling load. In practice, NEAMAP personnel have been able to keep pace with all sample processing, and species from all three of these lists are taken for full processing at each site at which they are collected.

All other fishes are allocated to the Priority D list and are sampled using the partial processing procedure described below. The fifth category (Priority E) includes species which require special handling. This category includes all sharks (other than dogfish) and Atlantic sturgeon, both of which are tagged, and selected invertebrates which are processed using the partial processing procedure.

Table 2. Priority A, B, C, D, and E designations for species collected by the NEAMAP Near Shore Trawl Survey.

Priority Lists		
A LIST		
Atlantic Cod	*Gadus morhua*	Otolith
Black Sea Bass	*Centropristis striata*	Otolith
Bluefish	*Pomatomus saltatrix*	Otolith
Butterfish	*Peprilus triacanthus*	Otolith
Haddock	*Melanogrammus aeglefinus*	Otolith
Pollock	*Pollachius virens*	Otolith
Scup	*Stenotomus chrysops*	Otolith
Silver Hake	*Merluccius bilinearis*	Otolith
Striped Bass	*Morone americana*	Otolith
Summer Flounder	*Paralychthys dentatus*	Otolith
Weakfish	*Cynoscion regalis*	Otolith
Winter Founder	*Pleuronectes americanus*	Otolith
B LIST		
American Shad	*Alosa sapidissima*	Otolith
Atlantic Menhaden	*Brevoortia tyrannus*	Otolith
Atlantic Croaker	*Micropogonias undulatus*	Otolith
Spot	*Leiostomus xanthurus*	Otolith
Monkfish	*Lophius americanus*	Vertebrae
Yellowtail Flounder	*Limanda ferruginea*	Otolith
Smooth Dogfish	*Mustelus canis*	Vertebrae
Spiny Dogfish	*Squalus acanthias*	Dorsal spines

Skate and Ray Species		Vertebrae
C LIST		
Alewife	*Alosa pseudoharengus*	Otolith
Atlantic Herring	*Clupea harengus*	Otolith
Blueback Herring	*Alosa aestivalis*	Otolith
Atlantic Mackerel	*Scomber scombrus*	Otolith
Black Drum	*Pogonias cromis*	Otolith
Red Drum	*Sciaenops ocellatus*	Otolith
Speckled Trout	*Cynoscion nebulosus*	Otolith
Tautog	*Tautoga onitis*	Opercle
D LIST		
All other fishes		
E LIST		
Sharks		
Atlantic sturgeon	*Acipenser oxyrhynchus*	
American Lobster	*Homarus americanus*	
Blue Crab	*Callinectes sapidus*	
Horseshoe Crab	*Limulus polyphemus*	
Squids		

Deck Processing:

Recording Subsampling Discards:

Following the inspection of the catch, assignment of size-classes, determination of the need for subsampling as well as the method(s) to be employed, sorting of the catch, and removal of the appropriate number of Priority A, B and C specimens for full processing, collection of actual catch data begins.

First, all discard count data from species/size-classes subsampled using Discard by Count are entered manually on the NEAMAP Subsample Data Sheet (Figure 2). Note that the top of this sheet contains fields for cruise number, sampling date, and database name. To enter discard count data for a particular species/size-class, the chief scientist first fills in station number on the first row of this data sheet. "Species code" refers to a 4-digit numerical code that has been assigned to each species by personnel at VIMS; each species has its own code. The "Pan" column is used to identify the size category of the species subsampled. If no size-classes were designated for that species at that station, the pan number is recorded as "99". If the specimens subsampled using Discard by Count were of the small category, pan is "199"; the medium category is pan "299" and the large category is "399". The chief scientist will mark "C" in the "Wght/Count" column to indicate that the following numbers represent count data, and then he/she will record counts of discards in the "Values" column.

Following the entry of these count data, all of the Marel balances located on deck (i.e., two large balances located on the working deck and the three smaller balances located on the working tables) are calibrated. After each has been successfully calibrated, baskets containing the

Figure 2. Manual Subsample Data Sheet used by the NEAMAP Near Shore Trawl Survey.

SUBSAMPLE DATA SHEET

CRUISE #:________________________ DATE:_________________________ Database:________________

Sta.	Species Code	Pan	Wght (W) Count (C)	VALUES	Total	Ent. ?

leftover fishes from Straight Subsampling by Weight and Mixed Subsampling by Weight are weighed. When entering weight data from species/size-classes discarded under Straight Subsampling by Weight protocols, procedures are the same as those given above for recording Discard by Count data except that the chief scientist would enter "W" in the "Wght/Count" column and then enter the weight of each basket of fish into the "Values" column.

When recording weights of mixtures of fishes discarded under the Mixed Subsample by Weight protocols, the species codes for all species included in the mixture are entered in the same "Species Code" block. This is used during post-cruise data processing to identify all of the species that were included in the mixture. "Pan Number" is designated as 5099 to indicate that the following weights represent a mixture of fishes. All other entry procedures follow those used when recording Straight Subsampling by Weight discard data.

Recording Aggregate Weights and Individual Lengths of Fishes:

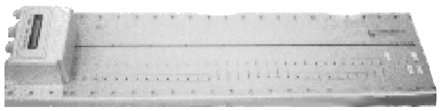
Once all of the subsample discard data have been recorded on the Subsample Data Sheet, the scientific crew will begin to record aggregate weight and length data for all fishes (i.e., all Priority D species and Priority A, B, and C specimens not taken for full processing), as well as individual length, weight, and sex for some. Invertebrate and tagging data are also recorded. The collection of these data is classified as "partial processing". Usually, two scientists remain on deck to record these data, while the other three work in the laboratory with the specimens taken for full processing. The two deck scientists occupy the center and forward-most work tables when recording these data. The aft-most table is reserved for a third scientist (i.e., one of the laboratory scientists) in the event of large and/or diverse catches.

To enter aggregate weight and individual length data for a given species/size-class of fish collected at a given station, the scientist will use one of the two Marel balances located at their work table and an automated fish measuring board (Figure 3). The automated boards are designed using "blocks" of keys which correspond with the hierarchical order of the LDCE database (described in the "Data Collection and Management" section). The scientist will first enter the cruise number by keying the "Cruise" button with the magnetic wand and then keying the "Store & Clear" button. He/she will then key the "Station" button, and then enter the 3-digit station number using the numerical keys on the board before keying the "Store & Clear" button again. These actions ensure that all ensuing data will be entered under the correct station number for the correct cruise. Once the cruise and station data have been entered, the scientist will key the "Species Code" button and enter the 4-digit code of the species that he/she plans to process. They will then key "New Code" followed by "Store & Clear". This creates a record for this species at the station and allows all weight and length data to be entered under the correct species.

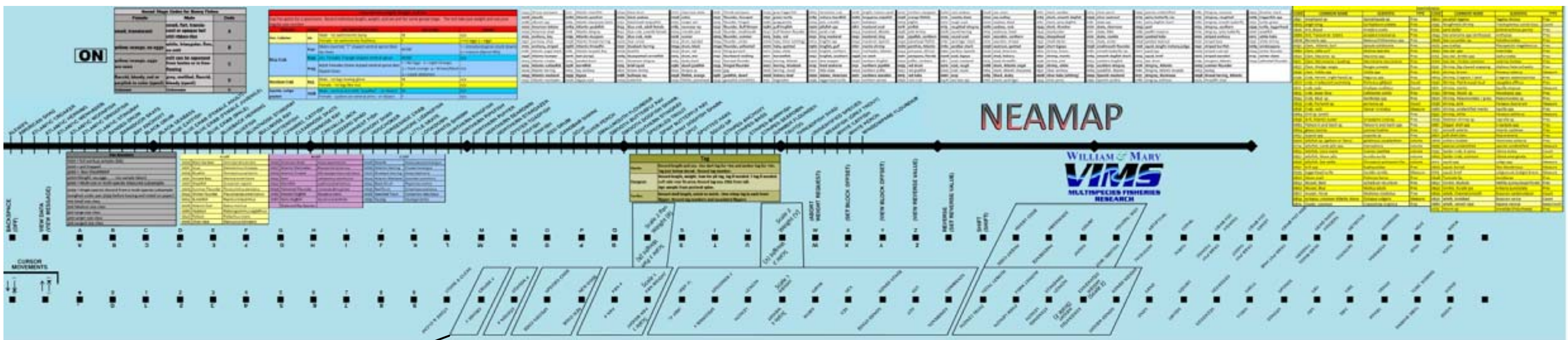
After the species code has been keyed, the scientist enters the pan number. The form of the pan number depends on the "history" of the species/size-class to be measured. Each scientist is assigned an identification number to be used when entering data. The pan number of the author is "9", for example. If entering data for a species that was not subsampled and not designated as having size-classes, the pan number to be entered is simply the scientist's identification number (e.g., "9"). If the fish to be measured were from a species that was composed of size-classes, the

Figure 3. Layout of the automated fish measuring board used by the NEAMAP Near Shore Trawl Survey.

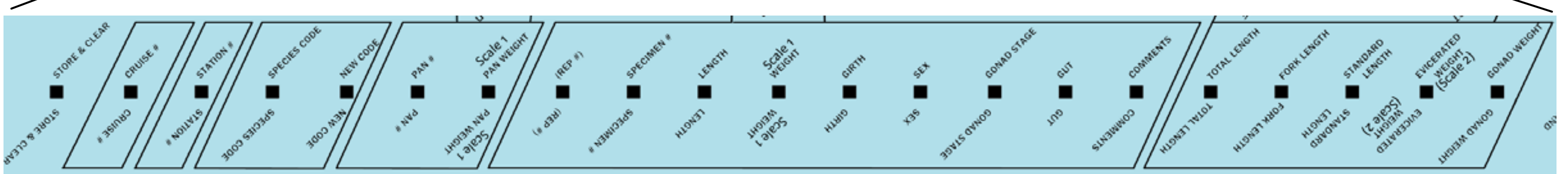
A Measuring Board



Information On the Face of the Board



Close-up of Data Entry Keys



small fish are pan = 100+ ID number (109), medium are 200 + ID number (209), and large are 300 + ID number (309). The same scheme is followed when entering aggregate weight and individual length data for a pan or basket of fish that is the subsample from Straight Subsampling by Weight or Discard by Count. Specimens taken for aggregate weight and individual length measurement as a result of Mixed Subsampling by Weight will be discussed later.

Following the entry of the correct pan number, the scientist tares the Marel balances for the appropriate container (i.e., pan, basket, fish box) and places the container of specimens onto one of the balances. He/she then keys the “Pan Weight” button on the automated measuring board, and presses “Enter” on the balance containing the container of fish. This action sends the weight from the scale to the measuring board. The scientist keys the “Store & Clear” button.

At this point the scientist is ready to measure the individual lengths of all of the specimens that he/she just weighed. To record an individual length, the scientist places a fish on the measuring board such that the nose of the fish touches the white block on the board and the body extends along the black line. The scientist touches the tail of the fish with the magnetic pen. The

automated board records the distance from the white block to the point where the pen touched the black line as the length of the specimen. Once the length is recorded by the board, the scientist releases the fish overboard. After all of the individuals in the container have been measured, the scientist can move to another species/size-class. Rather than starting back at the "Cruise" step, he or she can begin at "Species Code" ("Pan Number" if measuring another size-class of the same species).

With respect to individual length measurements, NEAMAP scientists record fork lengths for all fishes with a forked tail. Total length is measured for all other fishes. Exceptions to these rules are found in the measurement of skates and rays (disk width), sharks (pre-caudal length), crabs (carapace width), shrimps and lobsters (carapace length), and squids (mantle length).

As mentioned earlier, mixtures of fishes taken as the subsample from Mixed Subsampling by Weight are treated slightly differently when recording aggregate weights and lengths. The mixture of fishes is first sorted by species/size-class. For a resulting pan of fish, species code is entered according to the procedures outlined above. Pan number is similar, except that 5000 is added to the above designations. For example, if the author were to measure bay anchovy (*Anchoa mitchilli*) that were part of a mixed subsample and all of these anchovies were of one size-class, the pan number would be 5009 (5000 + identification number). If he were measuring the small size category of Atlantic croaker that were part of the mixture, the pan number would be 5109 (5000 for mixed subsample + 100 for small size category + identification number). Pan weights and individual lengths are recorded using the procedure outlined above.

Finally, as was alluded to in the Survey Procedures chapter, the automated measuring boards signal to the user when correct and erroneous keystrokes have been entered. Both audible (various toned "beeps") and visual signals are given. For the latter, each measuring board has a built-in display screen that provides the user with feedback. Each time that the user keys the "Store & Clear" button in the steps outlined above, the measuring board attempts to send the entered data to the database laptop. When all keystrokes were valid and data transmission was successful, the message "OK" is displayed on the display screen. Any other message is an indication of invalid data entry and a rejection of the sent data by the database. At this point, the scientist knows to investigate further to identify and correct the source of the error, rather than continue with data entry. He/she is required to enter all known information about the error onto the NEAMAP Error Check Data Sheet (Figure 4). The Error Check Data sheet is also used when a scientist enters correct keystrokes and successfully sends information to the database, but realizes that he/she entered erroneous information (e.g., entered a pan of fish under an incorrect species code, pan number, etc.). The combination of audio and visual cues work to minimize the collection of erroneous data in the field, while the Error Check Data Sheet assists in the correction of these errors during the post-cruise, error-checking process.

Figure 4. Manual Error Check Data Sheet used by the NEAMAP Near Shore Trawl Survey.

Error Check Sheet for LDCE Database

Cruise ________________

Date	**Station**	**Species code**	**Pan Number**	**Rep # (database assigned)**	**Error or question (note if corrected)**

Fill out as much information as you know about the error.

Recording Individual Lengths, Weights, and Sex of Spiny Dogfish (*Squalus acanthias*): Due to the importance of spiny dogfish to the management process, along with the ease with which sex can be determined for this species, the NEAMAP survey collects individual length, individual weight, and individual sex data for spiny dogfish not taken for full processing. These data are collected by the scientists on the working deck. The entry of cruise, station number, and species code data follows the protocols given above. Pan number is assigned by adding 4000 to the above designations (e.g., pan 4009 for non-size-classed spiny dogfish measured by the author, 4109 for the small size of spiny dogfish measured by the author, etc.). Because individual weights are to be recorded from each specimen, the aggregate weight (Pan Weight) is entered as "0". For each specimen, the scientist will key the "Length" key, place the fish on the measuring board, and measure pre-caudal length of the specimen using the methods described above. He/she will then key the "Weight" button, place the specimen on one of the appropriately tared Marel balances and press "Enter" to send the weight from the measuring scale to the board. Finally, the scientist will key "Sex" and enter "M" or "F" depending on whether the specimen is a male or female, respectively. At this point, the "Store & Clear" button is keyed, and the specimen is released overboard.

These individual length, weight, and sex data are collected for the first 25 spiny dogfish processed on the working deck. Specimens are selected haphazardly for these measurements. Any remaining spiny dogfish are processed using the Recording Aggregate Weight and Individual Lengths of Fishes protocols described above.

Recording Invertebrate Data:
Four types of invertebrates were identified by the NEAMAP Operations Committee for data collection. Specifically, these include squids (namely, *Loligo spp.* and *Illex spp.*), American lobster (*Homarus americanus*), blue crab (*Callinectes sapidus*), and horseshoe crab (*Limulus polyphemus*). Squids are processed using the Recording Aggregate Weight and Individual Lengths of Fishes protocols described above. Mantle lengths are recorded.

For American lobster, individual carapace length, weight, and sex data are recorded for the first 25 specimens using the 4000-series pan numbers and protocols as described above for spiny dogfish. Carapace length is measured from the inside of the left eye-socket to the rear of the carapace. Specimens are selected haphazardly for these individual length, weight, and sex measurements. The presence of shell disease, V-notches, and berries is noted for each specimen by entering this information in the "Comments" section of the board (i.e., key the "Comments" button and use the letter keys to add the comment). Additional lobsters are processed using the Recording Aggregate Weight and Individual Lengths of Fishes protocols.

Twenty-five blue crabs are selected haphazardly for individual carapace width, individual length, and sex measurements at each station at which they are collected. These measurements are also recorded using the 4000-series pan numbers, and additional blue crabs are quantified using the methods outlined in Recording Aggregate Weight and Individual Lengths of Fishes. Individual shell width, individual weight, and sex are recorded from 25 horseshoe crabs selected haphazardly at each station at which they are collected. The 4000-series pan numbers are used, and aggregate weight and individual shell width measurements are recorded for any additional horseshoe crabs.

In addition to those invertebrates listed above, NEAMAP scientists have decided to collect additional data for a number of other invertebrate species listed below (Table 3). For those listed under “Action” as “Agg wght/ind len”, aggregate weights and individual length measurements are collected as described in the Recording Aggregate Weight and Individual Lengths of Fishes protocols. Shell heights are recorded for sea scallops. Only count data are recorded for those whose “Action” is listed as “Count”. This is accomplished by keying the “Invert Code” button on the automated fish measuring board and entering the species code for that invertebrate, followed by “Presence,” and then “Count.” Counts are entered at this point using the numeric keys on the measuring board, followed by “Store & Clear”. The aggregate weight of jellyfish is recorded using a similar procedure, but rather than keying “Count,” the user keys “Volume/Wgt” and enters the weight data (followed by “Store & Clear”). All other invertebrates are recorded by merely noting their presence. This occurs by keying the “Invert Code” button (enter the code), the “Presence” button, and “Store & Clear”.

Table 3. Additional invertebrate species processed by the NEAMAP Near Shore Trawl Survey.

Common Name	Scientific Name	Action
Jellyfish		Agg wght
Brown Shrimp	*Penaeus aztecus*	Agg wght/ind len
Common Octopus	*Octopus vulgaris*	Agg wght/ind len
Mantis Shrimp	*Squilla empusa*	Agg wght/ind len
Pink Shrimp	*Penaeus duorarum*	Agg wght/ind len
Rock Crab	*Cancer irroratus*	Agg wght/ind len
Sea Scallop	*Placopecten magellanicus*	Agg wght/ind len
White Shrimp	*Penaeus setiferus*	Agg wght/ind len
Common Spider Crab	*Libinia emarginata*	Count
Hermit Crab	*Pagurus spp.*	Count
Knobbed Whelk	*Busycon carica*	Count
Lady Crab	*Ovalipes ocellatus*	Count
Ocean Quahog	*Arctica islandica*	Count
Sea Star	*Asteriidae*	Count
Six-Spine Spider Crab	*Libinia dubia*	Count
Smooth Whelk	*Busycon canaliculatum*	Count
Surf Clam	*Spisula solidissima*	Count

Recording Habitat:

The NEAMAP Survey also records any habitat that may be collected by the survey net. This includes materials like sand, mud, seaweeds, rocks, manmade materials, etc. Each habitat type is quantified relative to a standard NEAMAP fish tote. If the material fills ¼ of a tote, it is quantified as 1.0, ½ tote as 2.0, ¾ tote as 3.0, a full tote as 4.0, and so on. If the habitat material fills less than ¼ of a tote, it is quantified as 0.5, which denotes presence. Habitat type and quantity are entered directly into the automated fish measuring boards. The user will key the appropriate habitat button, located on the right-hand side of the board, followed by the quantity, using the numeric buttons.

Tagging:

As noted above, all Atlantic sturgeon and sharks (with the exception of the dogfishes) are tagged and released by the NEAMAP survey. Specimens of these species are removed from the catch as soon as it is emptied onto the deck, so that they can be tagged and released quickly in an effort to maximize survival probabilities.

For Atlantic sturgeon, each fish captured is first scanned using a Biomark™ PIT tag scanner to check for the presence of PIT tags. If the scanner finds a tag, the tag number (given on the display) is recorded. If no PIT tag is found, the fish is implanted with a PIT tag of the left side of the fish below the first dorsal, and the number of that tag is recorded. A T-bar tag is also implanted in this area, and the number of this tag is noted. Individual length and weight of the fish is recorded, and it is released. Individual length and weight data are entered into the automated measuring boards using the protocol described above for spiny dogfish (4000-pan series), and tag numbers are noted in the "Comments" section.

Sharks are tagged on the left-hand side of the animal below the first dorsal using a dart tag. The number of the tag is recorded, along with the individual length (pre-caudal length) and weight of each fish. These data are entered using the same protocols described for the Atlantic sturgeon.

Laboratory Processing:

Three scientists are assigned to process the specimens taken for full processing. Each fills one of three roles, referred to as the board operator, the cutter, and the labeler. To enter data for specimens taken for full processing, the board operator enters cruise, station, and species code information as described above. Pan number is assigned by adding 1000 to the previously-described designations (e.g., pan 1009 for non-size-classed specimens entered by the author, 1109 for the small size of species entered by the author, etc.). Individual weights are to be recorded from each specimen, so the aggregate weight (Pan Weight) is entered as "0".

The entry of full processing data for a specimen then proceeds using the following protocol. The board operator keys the "Specimen #" button and enters the number of that fish. Specimens are numbered beginning with 1, and numbering is reset for each new species and at each new station. For example, the board operator would assign specimen numbers of 1 to 10 for 10 bluefish (*Pomatomus saltatrix*) processed at a station. Specimen numbers would start over at 1 when the operator switches to processing scup (*Stenotomus chrysops*) for that station. They would also start at 1 again when processing bluefish collected at the next station. Multiple size-classes of a species processed from a single station are numbered successively (i.e., 20 bluefish, 10 from each of two size categories, from one station would be numbered 1 to 20).

After entering the specimen number, the board operator keys the "Length" button and enters the specimen length as described previously. He/she then keys the "Weight" button, places the specimen on the Marel 1100, 15kg motion compensated weighing scale and presses "Enter" on the scale to send the weight to the board. The specimen is then passed to the cutter. The cutter dissects the fish and determines whether it is a male or female. He/she also assesses the maturity stage of the specimen using the following criteria for bony fishes; Males – A: gonads small, flat, translucent or opaque but still ribbon-like, B: white, triangular, firm, no milt, C: milt can be squeezed from testes or is free flowing, D: grey, mottled, flaccid, bloody, spent, U: unknown;

Females – A: small, translucent, B: yellow/orange, no eggs, C: yellow/orange, eggs are seen, D: flaccid, bloody, red or purplish in color, spent, U: unknown. Male and female elasmobranches are both classified using the following scheme; 1: immature, 2: mature, 3: unknown. After determining sex and maturity stage, the cutter passes this information to the board operator. The operator scientist keys “Sex” and enters “M” or “F” as appropriate. They then key “Gonad Stage” and enter the letter describing the maturity stage. While the board operator is entering these data, the cutter removes the stomach of the fish. If the stomach is completely empty, the cutter informs the board operator, who then keys “Gut” and enters “E.” The cutter disposes of the stomach. If there are any contents in the stomach, the board operator enters “F” in the gut category. The stomach is preserved onboard for later diet analysis at VIMS. The cutter then removes the most appropriate hard part for ageing from the specimen (Table 2). This process continues for a species/size-class until five stomachs containing prey have been encountered or all 10 specimens have been processed, whichever occurs first.

The labeler is responsible for correctly labeling all stomachs and hard parts as well as storing these samples onboard. For a given specimen, the labeler makes two identical labels, one for the stomach and one for the hard part. These labels include station number, species code, specimen number, and collection date. One label is placed in a whirl pack with the ageing hard part, and the other is placed in the cloth sand sample bag with the stomach. This procedure ensures that the data collected from this stomach and hard part can each be matched up with the fish from which they were taken following processing of these samples at VIMS. The tag attached to the outside of the sand sample bag is marked with the species code of the specimen to facilitate the sorting of the stomach samples post-cruise at VIMS. All stomach samples are preserved in Normalin™ fixative, and it is the labeler’s responsibility to ensure that all stomach samples are immersed in the preservative as soon as all specimens from a given station are processed. Otoliths and scales are stored (sorted by species code) in the tote at the labeler’s end of the laboratory table. Vertebrae and opercle samples are frozen.

In addition to labeling and storing all biological samples, the labeler is responsible for reminding the laboratory crew of any additional data or samples that are to be collected for collaborating researchers. This individual is also responsible for correctly labeling and storing these samples. And finally, it is the labeler’s job to label and freeze any unidentifiable specimens that are to be brought to VIMS.

Back-up Systems

Considering the issues that could arise when using an electronic data collection system in a marine environment, the NEAMAP survey has developed a back-up data collection system. Specifically, the survey owns a battery operated weighing scale in the event that an electrical problem renders the weighing balances inoperable. Each work station (both working deck and laboratory) is equipped with a meter stick, which can be used to take individual length measurements either if the boards fail or a specimen to be measured is longer than the automated boards. Data sheets have been developed that will enable the deck crew to record the partial processing data and the laboratory crew to note the full processing data by hand.

While there is no paper back-up system for recording data from the Netmind v5 or Netmind v3.3.1 systems, these programs (in their proper configurations) are available on a second, and sometimes third, laptop. The hydrographic and atmospheric data collection instruments do not currently have back-up systems.

To guard against data loss, all net mensuration and tow track data are backed-up every night. These data are saved from the laptop computer in the wheelhouse to a thumb drive at the end of each sampling day. All information from the Station Data Sheets is entered into the LDCE database each night, and the database is subsequently copied onto a separate thumb drive.

Collaborative Research

During the design phase of the NEAMAP survey, it was decided that the survey should engage in collaborative research projects with outside researchers as time allowed. The idea is that the survey is already on the water sampling with a design that could be used to answer a number of specific questions, and the cost of collecting some additional data/samples would be miniscule relative to designing an entirely new sampling program to collect this information.

NEAMAP personnel have welcomed the opportunity to engage in collaborative projects (Table 4). Typically these collaborations are initiated when outside researchers contact NEAMAP personnel with a data/sample request. NEAMAP personnel require a full description of the proposed research along with a thorough description of how the data are to be used and/or a detailed sample collection procedure before deciding whether to work with the researcher on the project. If NEAMAP decides to participate, personnel usually request an acknowledgement (for small projects) or authorship (for large projects) on any reports/manuscripts that result from the collaboration.

In the event of a data request, one of the NEAMAP principal investigators will work to prepare the requested information. The resulting dataset is sent to the requesting researcher, along with a complete description of the manner in which these data were collected, a discussion of each data type (column), and the contact information of the principal investigator responsible for compiling the information.

Sample requests are handled in the following manner. As noted above, a thorough description of the sampling procedures is required. If the sampling will require the use of additional materials (i.e., collection equipment, storage bags, etc.), NEAMAP reserves the right to request that the researcher furnish these materials. The chief scientist then adds the request and associated sampling protocols to the "Species Requests" sheet for that cruise. These sheets are posted on the working deck and in the laboratory as a reminder to the field scientists. Following the conclusion of the survey cruise, the chief scientist is responsible to ensuring the all samples are delivered to the requesting scientist, and one of the principal scientists will compile all associated data.

Table 4. NEAMAP Near Shore Trawl survey data and sample requests received to date.

Requester	Type of Request	Purpose	Dates
Andre Buchheister / VIMS	Finfish tissue samples	Stable isotope study	Fall 2007
Rebecca Dickhut / VIMS	Bluefish, Atlantic mackerel, Atlantic herring tissue samples	Bluefin tuna trophic ecology study	Fall 2007, Spring 2008
David Gauthier / ODU	Striped bass spleens	Mycobacterium spp. study	Fall 2007-present
Todd Clardy / VIMS	Zoarcids (whole)	Taxonomic study	Fall 2007-present
Jorge Lopez / ANFACO (Spain)	Monkfish tissue	Genetics study	Spring 2008
Pat Campfield / ASMFC	Striped bass scales	Otolith/scale comparison	Spring 2008-present
Pat Campfield / ASMFC	Black sea bass scales	Otolith/scale comparison	Spring 2008-present
Mark Terciero / NEFSC	Scup data	Exploratory	Fall 2008
Pat Campfield / ASMFC	River herring catch data	Stock assessment	Fall 2008
David Gauthier / ODU	Summer flounder fin clips	Genetics study	Fall 2008-present

Laboratory Processing

Prioritization

The NEAMAP survey collects ageing and stomach samples from approximately 11,000 fishes annually. Even with a four-person laboratory crew (laboratory scientific crew is the same as the field scientific crew), it takes several months to process all of these samples, assign ages, enter data, and generate analyses. As a result, NEAMAP principal investigators set processing priorities for the laboratory to ensure that the diet and age data most urgently needed by stock assessment scientists and managers are available in a timely manner.

When setting these priorities, NEAMAP principal investigators rely heavily on the Priority A, B, and C lists developed by the NEAMAP Operations Committee. The A list species are usually processed before the B list, which are normally processed ahead of the C list species. Prioritization within each list often depends on the most current stock assessment/management needs, which are determined through contacts at the ASMFC, MAFMC, NEFMC, and the NEFSC. For example, if a stock assessment for summer flounder (*Paralichthys dentatus*) is drawing near and the principal investigators learn that the NEAMAP age structure data for this species could be useful in the assessment, they would direct the laboratory crew to begin (or switch to) processing all summer flounder otoliths. Considerations other than impending deadlines also influence processing priorities. As an example, there has been interest over the past few years in the truncated age structure observed in the weakfish (*Cynoscion regalis*) population. Processing weakfish otoliths, therefore, is consistently one of the top priorities of the NEAMAP laboratory program.

While laboratory processing generally begins with A list species and then proceeds to the B list and C list, it is possible that some B or C list species may be processed before all of the A list species have been completed. Stomach samples of spiny dogfish (B list species) are often processed ahead of several A list species, given the recent interest in generating consumption estimates for this predator.

Overall, NEAMAP laboratory processing priorities follow the guidelines established by the NEAMAP Operations Committee during the survey design phase, but maintain enough flexibility so as to address current data needs in a timely manner.

Diet

Following the completion of a survey cruise, all buckets containing stomach samples preserved in Normalin fixative are transported to VIMS. These samples are sorted by species code at VIMS such that, following the sort, each bucket contains stomach samples from a single species. Sorting all samples immediately following a survey is useful in that it enables the laboratory crew to follow processing priorities and process all samples from a given species at once, as opposed to working through an unsorted bucket and having incomplete diet information for a variety of species all at the same time. Further, this sorting proves especially useful in the event of a diet composition data request because it allows the laboratory crew to quickly and easily identify the location of all stomach samples for the requested species. For example, if an outside group was to request NEAMAP diet data for Atlantic croaker, the laboratory crew would merely have to pull all buckets containing croaker and begin processing. As a result, the diet data will

be available in less time than if samples were unsorted and workers had to sift through all buckets to find each of the croaker stomach samples.

Stomachs are processed using standard methods. Specifically, each stomach is removed from the Normalin preservative and rinsed with fresh water. The station, species code, specimen identification number, and collection date are transcribed onto the Gut Data Sheet (Figure 1). The date on which the stomach is processed in the laboratory is also recorded. The stomach is then blotted with a paper towel, and the weight of the stomach and contents recorded. The stomach is then opened, and the contents are emptied into a petri dish. After verifying that all prey items have been removed from the gut, the empty stomach is weighed, this weight is recorded, and the stomach is discarded.

Figure 1. Gut Data Sheet used by the NEAMAP Near Shore Trawl Survey.

NEAMAP GUT CONTENTS STUDY

Cruise & Stat.:	**Analysis Date:**	By:	**Entered**
Species Code:	**Stomach Full (g) :**	Cap Date:	
Specimen No.:	**Stomach Empty (g) :**		

Prey Spc Code	Prey *(Scientific Name)*	Count	Weight (grams)	Length (mm)	Length Type	Piece (P) Whole(W)	Comments

All prey items are then identified to the lowest possible taxonomic level. Usually, prey items can be identified to the species level. When this is not possible, items are almost always identifiable to genus or family. NEAMAP laboratory personnel have a number of tools at their disposal to aid in the identification of prey including standard field guides of fishes and invertebrates, NEAMAP-generated identification keys based on otoliths and scales, and a VIMS-generated invertebrate guide, to name a few.

Once each prey item has been identified, each is counted and weighed (individually for larger-bodied prey like shrimps and anchovies, and at an aggregate level for smaller prey such as mysid shrimps and copepods), and these data are recorded. For all fishes and select invertebrates (i.e., squids, shrimps, crabs), individual length measurements are recorded. Measurement strategies follow those used when collecting individual length measurements from the catch in the field. Whether each measurement is of a whole organism or a piece of a prey is also noted. The "Comments" field is used to record any unusual observations.

These data are periodically entered into an MS Access™ database at VIMS.

Age Determination

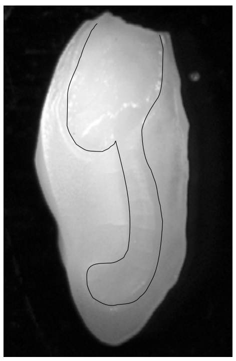
Sample Processing:
While the above protocols can be used to process the stomach samples of all of the NEAMAP priority species, the same cannot be said for the hard parts collected for ageing. Even when two species are aged using similar methods (e.g., using a thin section cut through the nucleus of an otolith, perpendicular to the sulcal groove to age both weakfish and summer flounder), the exact details of the sample processing protocols along with the methods by which annuli are counted usually differ. In general, however, otoliths are typically processed by cutting a thin section and mounting on a glass slide or reading whole. Scales are usually prepared by pressing on acetate paper and reading on a projector, and vertebrae are prepared by taking a longitudinal section through the focus of a centrum and mounting the resulting section on a glass slide. NEAMAP principal investigators and laboratory personnel have worked closely to research and develop the most appropriate processing protocols for hard parts collected from each of the priority species. An example of the processing protocol for weakfish is given in Figure 2. Unfortunately, a number of species, including some of the NEAMAP priority species, are currently aged using hard parts that have yet to be validated (either at all of for certain ages). For these species, NEAMAP personnel plan to conduct validation studies, using both survey-collected samples along with those purchased from the commercial fisheries. As an example, NEAMAP plans to initiate a validation study for scup otoliths beginning in 2009.

One aspect of the ageing procedure that is the same for all species involves the assignment of otolith identification numbers. Previous studies have shown that bias can be introduced into ageing studies when readers have knowledge of the location and/or date of sample collection. In an attempt to eliminate this source of bias, NEAMAP employs the following protocols. First, the processing of hard parts for a particular species does not begin until all field collections for the year have been completed (i.e., NEAMAP will not process 2008 weakfish ageing samples until both the Spring and Fall 2008 cruises are complete). Once all collections for a year are completed, one of the NEAMAP principal investigators creates an MS Excel^{TM} file for the species to be aged, where each row contains the data for a specimen taken for full processing. In this example, each row of the file would contain the station, specimen identification, and biological data collected from one of the weakfish taken for full processing in 2008.

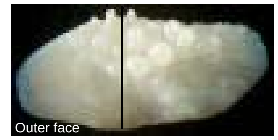
The principal investigator would create a new column in this file entitled “Otolith Identification.” Data in this column would take the form “XXXX-YYYY-ZZZZ” where “XXXX” is the four-digit code for that species, “YYYY” would be the year of collection, and “ZZZZ” is a random number. This random number ranges between 1 and the total number of specimens of that species taken for full processing that year. These numbers are assigned to each specimen taken for full processing at random, without replacement. Again, to use the continuing example, each row in the Excel file would represent a weakfish taken for full processing in 2008. Suppose 1000 weakfish were sampled for full processing in 2008, each fish would be assigned an otolith identification number between 0007-2008-0001 and 0007-2008-1000, and assignments would be at random (without replacement).

Figure 2. Ageing protocol for weakfish (*Cynoscion regalis*) used by the NEAMAP Near Shore Trawl Survey.

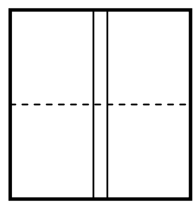
Weakfish Otolith Cutting and Reading Protocol



1. Determine which otolith is the right otolith by looking at the succal groove on the inner face. The tail of the groove of will curl to the left when the head is anterior (and to the right on the left otolith).



2. Mark nucleus with a pencil by holding the otolith up to a light. The nucleus will be a dark dot seen through the outer face. Draw a line through this area. If a dot cannot be seen, draw a line through the most protruding area.



Example of an otolith cutting sheet, with correct orientation. Place otolith on sheet so that the line you drew through the nucleus on one of the two center lines.

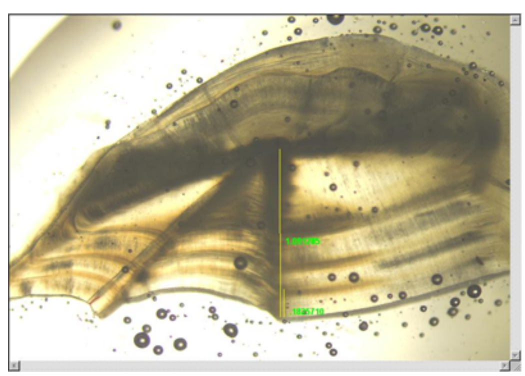
3. Mount otolith on an otolith cutting sheet with the outer face outward (groove facing sheet) and the line you have drawn though the nucleus on one of the double lines in the middle.

4. Cut using 3 or 4" Buehler Diamond Wafering Blades. Take a thin section through the center of the otolith. Mount this section on a microscope slide using crystal bond and cover section with crystal bond. Weakfish are fairly easy to cut, the section should be thin enough to allow light to pass easily and annuli to be seen clearly. A good section will have a clear defined "triangle" (see pictures below).

5. Otolith are read by counting each annulus, or dark ring. This is an age 4 weakfish. Weakfish are fairly easy to read.

6. All otoliths should be read by 3 independent readers

7. In addition, all otoliths may be measured for marginal increment analysis. Using Image Pro (or similar program), a measurement should be taken from the center of the nucleus to the edge of the otolith and from the top of the last dark ring to the edge of the otolith. This is an example using an age 3 otolith.



Now, when the laboratory crew processes these hard parts, they label each finished product with the otolith identification number instead of station/specimen identification. When these processed hard parts are read for age assignments later, the reader has no way of knowing when or where each sample was collected, effectively eliminating the aforementioned bias.

To complete the example, a reader assigning an age to a weakfish otolith section labeled 0007-2008-0058 would not know whether the sample was collected in the spring or fall, or where in the survey area the sample was taken.

Age Assignments:
Once all of the hard parts for a particular species collected in a given year have been prepared, the assignment of ages can commence. All hard parts are read independently by each of three readers one time. For each sample, a reader will record an age based on the number of annuli, whether the edge of the structure is light or dark (i.e., whether the most recent annulus on the edge or interior of the edge), the date on which the structure was read, and any comments (Figure 3). Once all structures have been read, the reader will enter these data into an Excel file. These files will then be merged back with the original file containing the station, original specimen identification, and biological data.

After each of the readers has entered their data, one of the principal investigators will generate assigned ages for each of the three resulting files. This age assignment process ensures that all specimens from the same year-class will be grouped together in the final age assignments. Most species form an annual mark on their ageing hard part sometime between March and June each year. This time period encompasses the NEAMAP spring surveys. As such, there will be certain specimens who will not yet have formed their annual mark, those in the process of forming an annual mark, and finally those that have recently formed the mark, collected during the spring cruise. Again, the goal is to make sure that all specimens of a year-class are grouped together. To accomplish this, it is necessary to examine the spring-caught fish whose "Edge" designation is "light" to see whether they have yet to form their mark for the year (broad clear area at the edge) or if they recently formed their mark (small clear area at the edge). The ages of those who have yet to have formed their mark are to be advanced 1 year from the age given by the reader, while those with a dark edge or that have recently formed a mark are to be held at the age given by the reader. For example, suppose you had collected three weakfish in the spring of 2008 that were spawned in 2005. Each belongs to the age-3 year class. If one had yet to form its mark, while one was in the process of forming and one formed recently, the first fish would be assigned to the age-2 year-class (because it would only have two annuli at that point) while the latter two fish would be assigned to age-3 (because they would have already formed their third annulus). This is incorrect. To rectify this problem, the age of the fish yet to form its mark for that year is advanced 1 year (from age-2 to age-3) under the assumption that the fish was going to form a mark shortly, but the survey collected the fish before the mark had an opportunity to form. Now each of these three fish will be grouped in the same year-class (which is correct). The above procedure is not necessary with the specimens collected in the fall, as each should have formed their marks months earlier. As a result, the assigned ages should always match those originally given by the reader.

Figure 3. Example of the data sheets used by personnel of the NEAMAP Near Shore Trawl Survey when reading ageing structures for a species.

NEAMAP Age and Growth – 2007
Weakfish (*Cynoscion regalis*)

OTOLITHID	AGE	EDGE	DATE	COMMENT
0007- 2007- 1	0	L	1/8/2008	
0007- 2007- 2	0	L	1/8/2008	
0007- 2007- 3	2	L	1/8/2008	
0007- 2007- 4	3	L	1/8/2008	
0007- 2007- 5	0	L	1/8/2008	
0007- 2007- 6	0	L	1/8/2008	
0007- 2007- 7	0	D	1/8/2008	
0007- 2007- 8	0	L	1/8/2008	fragment
0007- 2007- 9	2	L	1/8/2008	
0007- 2007- 10	0	D	1/8/2008	
0007- 2007- 11	1	L	1/8/2008	
0007- 2007- 12	1	L	1/8/2008	
0007- 2007- 13	0	L	1/8/2008	
0007- 2007- 14	0	D	1/8/2008	
0007- 2007- 15	2	L	1/8/2008	
0007- 2007- 16	1	L	1/8/2008	
0007- 2007- 17	0	L	1/8/2008	
0007- 2007- 18	1	L	1/8/2008	
0007- 2007- 19	0	L	1/8/2008	
0007- 2007- 20	2	L	1/8/2008	
0007- 2007- 21	2	L	1/8/2008	
0007- 2007- 22	0	L	1/8/2008	
0007- 2007- 23	0	L	1/8/2008	
0007- 2007- 24	2	L	1/8/2008	
0007- 2007- 25	0	L	1/8/2008	
0007- 2007- 26	2	L	1/8/2008	
0007- 2007- 27	0	L	1/8/2008	
0007- 2007- 28	0	L	1/8/2008	
0007- 2007- 29	0	L	1/8/2008	
0007- 2007- 30	0	L	1/8/2008	
0007- 2007- 31	2	L	1/8/2008	

Once age assignments have been made for the ages given by each of the three readers, these data are compiled to produce final age assignments. At this point, each hard part has three age assignments, one from each of the three readers. To generate a final age assignment for the hard part, the mode of these three measurements is calculated. If there is no mode (i.e., each of the age assignments differ) the three readers are to re-read the structure. If, following the re-assignment of ages, no mode exists, the readers are to sit down together and attempt to agree on the age of the structure. If an agreement cannot be reached, the structure is disqualified. In the situation where an alternate structure is available (e.g., second otolith, additional centra, etc.), that structure may be processed and read using the above procedure. If an alternate structure is unavailable or proves to be just as difficult to read, the specimen from which the structure(s) was taken does not receive an age assignment.

Once final ages have been assigned, these data are incorporated into the NEAMAP MS Access database.

Data Collection and Management

Onboard Fish Data Processing

As noted earlier, all biological data recorded while conducting field operations are entered into a customized LDCE database connected to up to four automated fish measuring boards. While this software system is about 20 years old and requires that computers operate in DOS mode, it is quite versatile and adaptable and is very familiar to VIMS personnel. The LDCE data base follows a strict hierarchical model, which in and of itself ensures a certain level of data integrity and error checking (e.g. fish lengths cannot be entered unless all of the parent record types exist) (Figure 1, Table 1). Field-specific data checks can be and are instituted as well.

Typically, four measuring boards are connected to the LDCE data base. One board is used during lab processing in the vessel hold and the remaining boards are mounted on the main deck for entering gross weights and individual measurements.

All weights are recorded using motion-compensated balances of varying capacity and accuracy (see the Deck Setup and Lab Setup sections of the Survey Preparation chapter). Generally, weights can be entered through balance-to-database communication though due to wind and waves it is common to have to enter the data manually via keys on the measuring boards.

Fish(es) that are so abundant in a sample that they must be processed using one of the sub-sampling procedures are generally recorded manually on paper records. These data are later entered manually into the Pan level (see below) of the LDCE data base using special codes to identify the sub-sample so that total weight and number can be properly calculated.

Figure 1. Hierarchical order of the LDCE data base used by the NEAMAP Near Shore Trawl Survey, with data level name and numerical identifier.

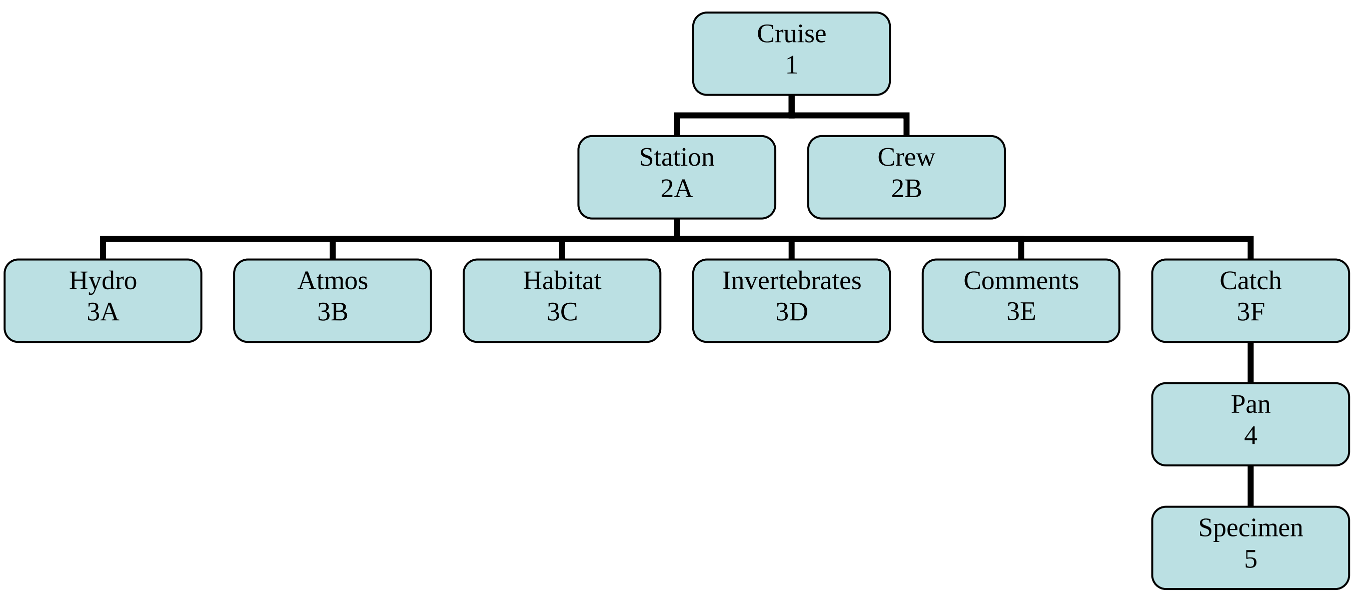


Table 1. Data elements included in each LDCE data type.

Data Level	Level Name	Number of Records	Key Field	Field Name	Type - Size	Format
1	Cruise	One per Cruise				
			*	Cruise	Char - 8	NMYYMM01
				Date Begin	Char - 8	YYYYMMDD
				Time Begin	Char - 4	HHMM
				Date End	Char - 8	YYYYMMDD
				Time End	Char - 4	HHMM
				Vessel	Char - 2	xx
				Chief Scientist	Char - 12	xxxxxxxxxxxx
				Captain	Char - 12	xxxxxxxxxxxx
				Mate	Char - 12	xxxxxxxxxxxx
				Database Name	Char - 8	NMYYMM
2A	Station	One per Station	*	Cruise	auto	
		(150 per cruise)	*	Station	Num - 6	1-150
				Water Body	Char - 2	AT (Atlantic)
				Station Date	Char - 8	YYYYMMDD
				Latitude Begin	Num - 7	DDMM.MM
				Longitude Begin	Num - 7	DDMM.MM
				Depth	Num - 6	(ft)
				Tow Dir. Rel. to Current	Num - 1	(with, ag., oblique)
				Time Begin	Char - 4	HHMM
				Region ID	Char - 2	01-15, BI, RI
				Depth Stratum	Char - 2	01 - 04
				Compass Course	Num - 3	1-360
				Gear Code	Num - 3	453
				Net Number	Char - 3	Gxx
				Latitude End	Num - 7	DDMM.MM
				Longitude End	Num - 7	DDMM.MM
				Port RPMs	Num - 4	xxxx
				Starboard RPMs	Num - 4	xxxx
				Tow Duration	Num - 5	0-20
				Remarks	Num - 4	Workup Code
				Station Type	Char - 1	R (random)
				Port Warp	Num - 4	(fathoms)
				Starboard Warp	Num - 4	(fathoms)
				Vessel Speed	Num - 6	(knots)
				Port Door Number	Char - 4	(serial num.)
				Starboard Door Number	Char - 4	(serial num.)
2B	Crew	One per person per leg	*	Cruise	auto	
		(up to ~20 per cruise)	*	Sequence Number	auto	
				Crew Member Name	Char - 12	xxxxxxxxxxxx
				Date Embarked	Char - 8	YYYYMMDD
				Date Disembarked	Char - 8	YYYYMMDD
3A	Hydro	Two per Station (S & B)	*	Cruise	auto	
			*	Station	auto	
			*	Sequence Number	auto	
				Level	Char - 1	Surface or Bottom
				Sample Depth	Num - 5	xxxx.x
				Param. Code Temp	Char - 2	Device Code
				Temperature	Num - 5	xx.xx
				Param. Code Salinity	Char - 2	Device Code
				Salinity	Num - 5	xx.xx
				Param. Code D.O.	Char - 2	Device Code
				Dissolved Oxygen	Num - 5	xx.xx
				Diss. Oxygen Pct. Sat.	Num - 6	xxx.xx
				Param. Code pH	Char - 2	Device Code
				pH	Num - 5	xx.xx
				Time	Char - 4	HHMM

3B	Atmos	One per Station	*	Cruise	auto	
			*	Station	auto	
			*	Sequence Number	auto	
				Param. Code Wind	Char - 2	Device Code
				Wind Speed	Num - 4	xx.x (knots)
				Wind Direction	Num - 3	xxx (compass deg.)
				Param. Code Air Temp	Char - 2	Device Code
				Air Temp	Num - 5	xx.xx (Deg. C)
				Param. Code Humidity	Char - 2	Device Code
				Relative Humidity	Num - 6	xxx.xx (percent)
				Parm. Code Baro. Pressure	Char - 2	Device Code
				Barometric Pressure	Num - 7	xxxx.xx (millibars)
				Weather Code	Num - 1	x
				Param. Code Seastate	Char - 2	Device Code
				Seastate Code	Num - 1	x
				Time	Char - 4	HHMM
3C	Habitat	Zero or one per Station	*	Cruise	auto	
			*	Station	auto	
			*	Sequence Number	auto	
				Artificial	Num - 4	0.1 - xxxx
				Coral	Num - 4	0.1 - xxxx
				Pot (Fishing)	Num - 4	0.1 - xxxx
				Pot (Ghost)	Num - 4	0.1 - xxxx
				Pot (Habitat)	Num - 4	0.1 - xxxx
				Dead Mans Fingers	Num - 4	0.1 - xxxx
				Detritus	Num - 4	0.1 - xxxx
				Hydroids	Num - 4	0.1 - xxxx
				Mud	Num - 4	0.1 - xxxx
				Rocks	Num - 4	0.1 - xxxx
				Sand	Num - 4	0.1 - xxxx
				Sea Squirts	Num - 4	0.1 - xxxx
				Seaweed	Num - 4	0.1 - xxxx
				Shell	Num - 4	0.1 - xxxx
				Sponge	Num - 4	0.1 - xxxx
				S.A.V.	Num - 4	0.1 - xxxx
				Tire	Num - 4	0.1 - xxxx
				Trash	Num - 4	0.1 - xxxx
				Tube Worms	Num - 4	0.1 - xxxx
				Unknown	Num - 4	0.1 - xxxx
				Wood	Num - 4	0.1 - xxxx
				Other 1	Char - 7	Code+0.1-xxxx
				Other 2	Char - 7	Code+0.1-xxxx
				Other 3	Char - 7	Code+0.1-xxxx
				Other 4	Char - 7	Code+0.1-xxxx
				Comment	Char - 46	xxxxx…
3D	Invertebrates	Zero to several per Station	*	Cruise	auto	
			*	Station	auto	
			*	Species Code	Char - 4	xxxx
				Present	Num - 1	0
				Total Number	Num - 6	xxxxxx
				Total Weight (or Volume)	Num - 8	xxxxxx.x
				Comment	Char - 45	
3E	Comments	Zero to several per Station	*	Cruise	auto	
			*	Station	auto	
			*	Sequence Number	auto	
				Comment	Char - 70	xxxx…
3F	Catch	Zero to many per Station	*	Cruise	auto	
		(one per Species)	*	Station	auto	
			*	Species Code	Char - 4	0001-9999
				Total Number	not entered	calculated later
				Total Weight	not entered	calculated later

				Num Subsampled	not entered	calculated later
				Weight Subsampled	not entered	calculated later
				Number Measured	not entered	calculated later
				Weight of Measured Fish	not entered	calculated later
4	Pan	1 to several per Catch record	*	Cruise	auto	
			*	Station	auto	
			*	Species Code	auto	
			*	Pan Number	Num - 6	see Note 1
				Total Number	Num - 7	see Note 2
				Total Weight	Num - 7	see Note 2
			Note 1:	This field contains up to 3 different data elements. It separates		
				full workup' fish from those subjected only to gross weights		
				and individual measurements; it separates fish into station-		
				specific modal size groups; it identifies the individual entering		
				data for this group of fish.		
			Note 2:	Typically these fields are calculated during post-cruise		
				processing. For groups of fish that are processed using one		
				of the sub-sampling procedures, data are entered here using		
				a specially designated Pan Number.		
5	Specimen	1 to many per Pan record	*	Cruise	auto	
			*	Station	auto	
			*	Species Code	auto	
			*	Pan Number	auto	
			*	Sequence Number	auto	
				Specimen Lab ID Number	Num - 8	xxxxxxxx
				Length	Num - 4	xxxx (mm)
				Weight	Num - 7	xxx.xxx (kg)
				Sex	Char - 2	x (F, M, U)
				Gonad Stage	Char - 2	x (A, B, C, D)
				Gut Status	Char - 1	x (F, E)
				Eviscerated Weight	Num - 7	xxx.xxx (kg)
				Comments	Char - 30	xxxx…
				(the following fields are not typically used)		
				Girth	Num - 5	xxx.x (mm)
				Total Length	Num - 4	xxxx (mm)
				Fork Length	Num - 4	xxxx (mm)
				Standard Length	Num - 4	xxxx (mm)
				Gonad Weight	Num - 7	xxx.xxx (kg)

Onboard Non-Fish Data Processing

Most parameters on the Station, Crew, Hydro, Atmos, and Comments levels are entered manually into the LDCE database after recordation on the Station Data Sheet. This is accomplished either during down times while at sea or during post-cruise processing at VIMS.

Hydro (water quality) data (depth, temperature, salinity, D.O., pH, time) are measured using a YSI model 650MDS unit and manually recorded on the Station data sheet. Typically these parameters are measured at the conclusion of a tow while the vessel is stationary during haul-back.

Atmos (weather and sea state) data (general weather condition, air temperature, wind speed and direction, barometric pressure, sea state) are measured using hand-held instruments, a compass, and visual observation. Typically these parameters are measured at the conclusion of a tow while the vessel is stationary during haul-back.

Tow Tracks:
As noted in the "Survey Procedures" chapter, tow tracks are recorded by sending GPS coordinates to a computer file every two seconds during a tow using the Netmind v 3.3.1 software. Tow track data are combined with other data types (by matching Station numbers) during post-cruise data processing. During post processing, tow distances calculated from these track files are compared to those calculated from the manually recorded beginning and ending coordinates as a data check (tow track distances should be close-to but greater than straight-line distances from the station data sheet).

Netmind:
Raw data from the Netmind sensors are combined and saved in a table in the final MS Access data base and tow averages are calculated for inclusion at the Station level in that same Access data base.

Data Post Processing

At the conclusion of each cruise, all data are brought back to the VIMS lab and stored both on the desktop computer of one of the principal investigators and on VIMS network storage. The shared network copy becomes the 'working copy' and the PI's copy is used as a safety backup of the original data as existed at the conclusion of the cruise. Both spaces are backed up at least weekly. After all data elements which require manual entry are entered, a number of SAS programs are run which serve to combine data sources, conduct various error checking protocols, convert data fields as necessary, and record data into the central NEAMAP MS Access data base.

Specifically these programs perform the following functions:

- Compare LDCE data base files to 'log' files. The LDCE program not only records data into its proprietary data format, but it also creates text-based log files which record every keystroke whether the resulting data were accepted into the data base or not. At times an operator can enter data (e.g. start measuring fish) without realizing that an error has occurred (e.g. the higher level data were not properly entered) and the data are not actually entering the data base. These data are not lost, but rather are recorded to the log files which can later be processed (using SAS in our case) and compared to the true data base. When it is determined that such errors have occurred the data can then be manually entered into the data base.

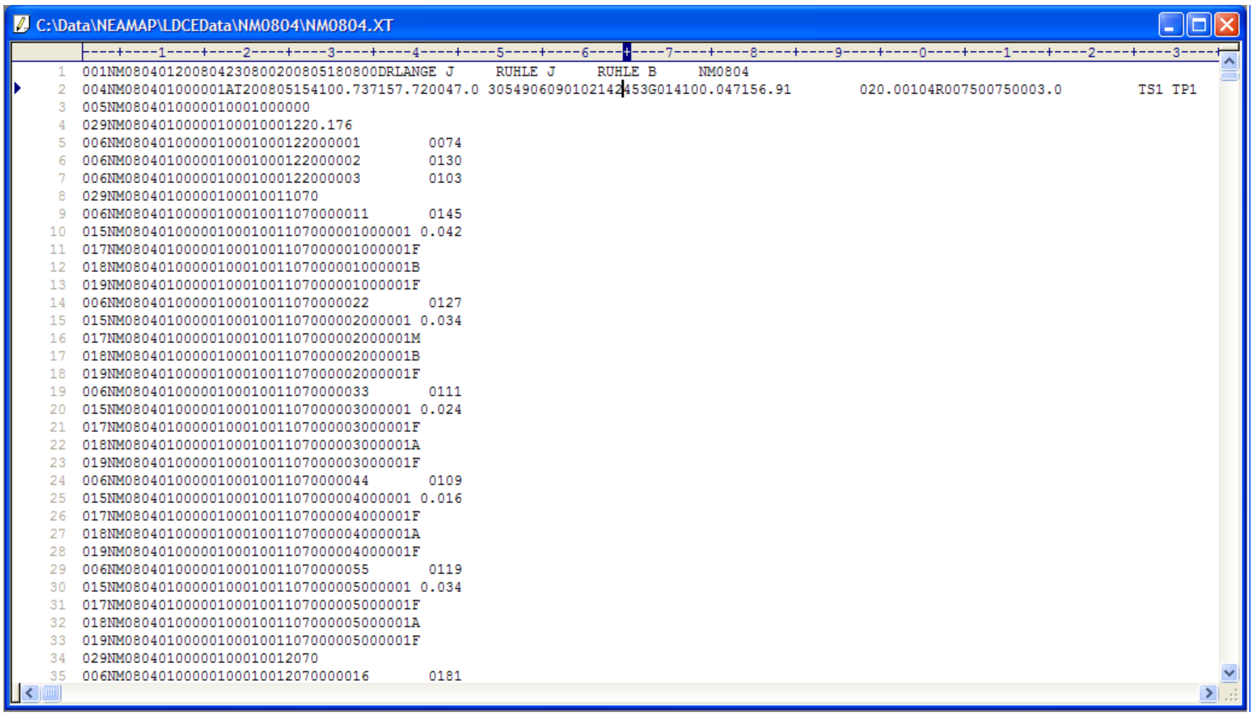
  Another data check that occurs at this level is to check the entry dates and times for each station. In general, all specimens captured at a particular station should be processed within an hour or two of the ending time of a tow. The log files (but not the data base) record the date and time at which each data element was entered. If some data (e.g. length measurements) were entered for a station outside of the normal processing window, we can check these entries and determine if perhaps they were entered using an incorrect Station designator.

- From this point forward, all steps and programs are executed iteratively. That is, as error checking proceeds and corrections are made to the LDCE data base, all steps must be performed in succession until no more errors are found. This is done to assure that in the

future, all copies and formats of the data base will be as similar as possible. That said, if a minor error is found several months after closure of the process, the correction will be made only in the final data format; the entire data process will not be repeated so the LDCE and the preparatory data sets will differ slightly from the final MS Access data format.

- Read LDCE data into SAS files. LDCE provides a mechanism to convert data from its proprietary format into an ASCII text file (Figure 2.) This file contains data from every data level and field in the data base. Using the SAS system, this file is separated into its various parts and appropriate fields are matched to each level. No particular error checking is done at this point except for fields which may contain illegal data types (e.g. a field may be defined as a character based field in LDCE but as a numeric filed in SAS. If alpha characters appear in a field that should contain only numbers, error messages appear in the SAS log window).

Figure 2. Data lines from the LDCE-created text file.



```
C:\Data\NEAMAP\LDCEData\NM0804\NM0804.XT
001NM08040120080423080020080518080ODRLANGE J     RUHLE J      RUHLE B      NM0804
004NM080401000001AT200805154100.737157.720047.0 3054906090102142453G014100.047156.91        020.00104R007500750003.0         TS1 TP1
005NM08040100000100010000000
029NM08040100000100010001220.176
006NM08040100000100010001220000001        0074
006NM08040100000100010001220000002        0130
006NM08040100000100010001220000003        0103
029NM080401000001000100110 70
006NM08040100000100010011070000011        0145
015NM0804010000010001001107000001000001 0.042
017NM08040100000100010011070000001000001F
018NM08040100000100010011070000001000001B
019NM08040100000100010011070000001000001F
006NM08040100000100010011070000022        0127
015NM08040100000100010011070000002000001 0.034
017NM08040100000100010011070000002000001M
018NM08040100000100010011070000002000001B
019NM08040100000100010011070000002000001F
006NM08040100000100010011070000033        0111
015NM08040100000100010011070000003000001 0.024
017NM08040100000100010011070000003000001F
018NM08040100000100010011070000003000001A
019NM08040100000100010011070000003000001F
006NM08040100000100010011070000044        0109
015NM08040100000100010011070000004000001 0.016
017NM08040100000100010011070000004000001F
018NM08040100000100010011070000004000001A
019NM08040100000100010011070000004000001F
006NM08040100000100010011070000055        0119
015NM08040100000100010011070000005000001 0.034
017NM08040100000100010011070000005000001F
018NM08040100000100010011070000005000001A
019NM08040100000100010011070000005000001F
029NM0804010000010001001207 0
006NM08040100000100010012070000016        0181
```

- Translate data to MS Access. The final MS Access data base is structured similarly, but not identically, to the LDCE data base. A SAS program is used to translate the initial SAS data sets to the MS Access format and exports those data to MS Access tables. No error checking is performed at this stage.

- Read Netmind data and tow track data, and combine station averages for net geometry and total calculate tow distance with Station data. A SAS program combines these three data types, calculates appropriate Station level averages and totals, and writes the

combined results out to a SAS data set.

- Translate new Station data to MS Access. A SAS program translates the SAS Station data set created in the previous step to the MS Access format.

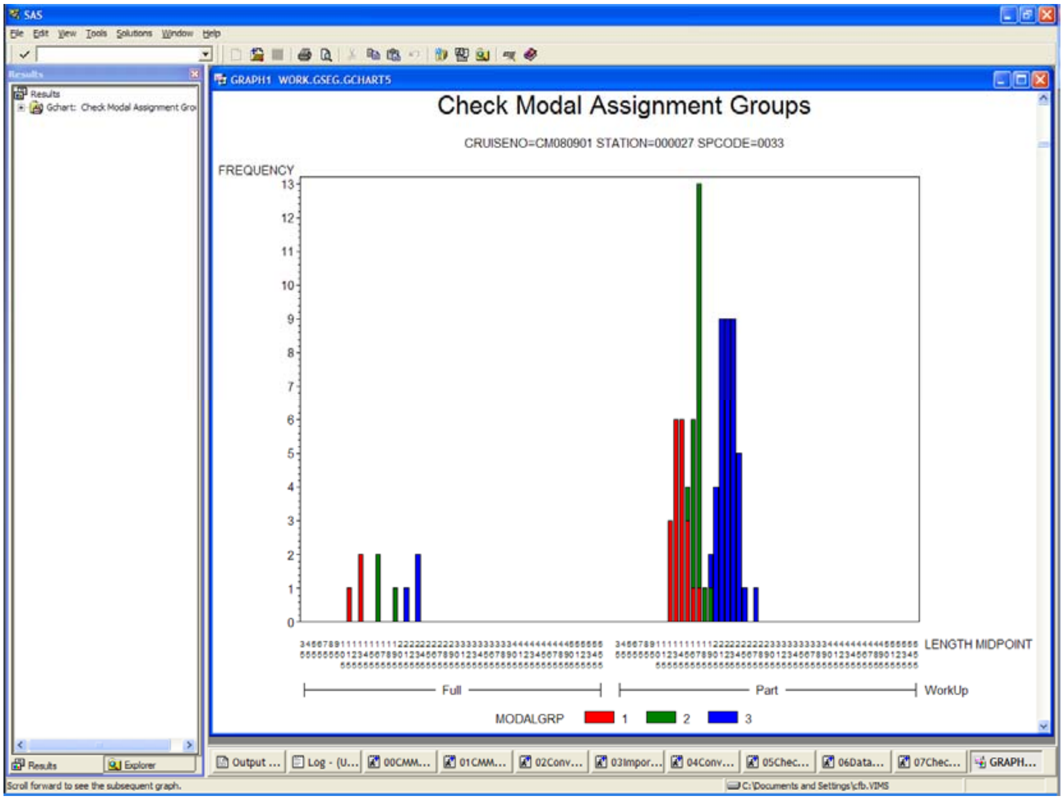
- Check specimen identification numbers. As noted in the "Survey Procedures" chapter, the laboratory board operator is responsible for assigning a specimen number to each fish processed. The operator will occasionally skip, repeat, or otherwise err in assigning and entering these identifiers and this program assures that the numbers are present, sequential, and complete.

- Next, all appropriate data fields are checked, cross-checked, and otherwise verified. Examples of the error checks include:
    - Recorded depths should be within the stratum depth parameters for each Station.
    - The time difference between the recorded beginning and ending time should match the tow duration field.
    - The recorded Region and Stratum for each Station should match the selection recorded prior to each cruise.
    - The ratio of straight-line tow distance to tow-track tow distance should be within acceptable bounds.
    - Weight-Length figures are produced for each species and outliers are investigated and corrected as necessary.
    - Average Weight-Length figures are produced using data averaged for each size group at each station to check for appropriate values for each total Pan weight.
    - Several other similar checks are made but not all are listed here.

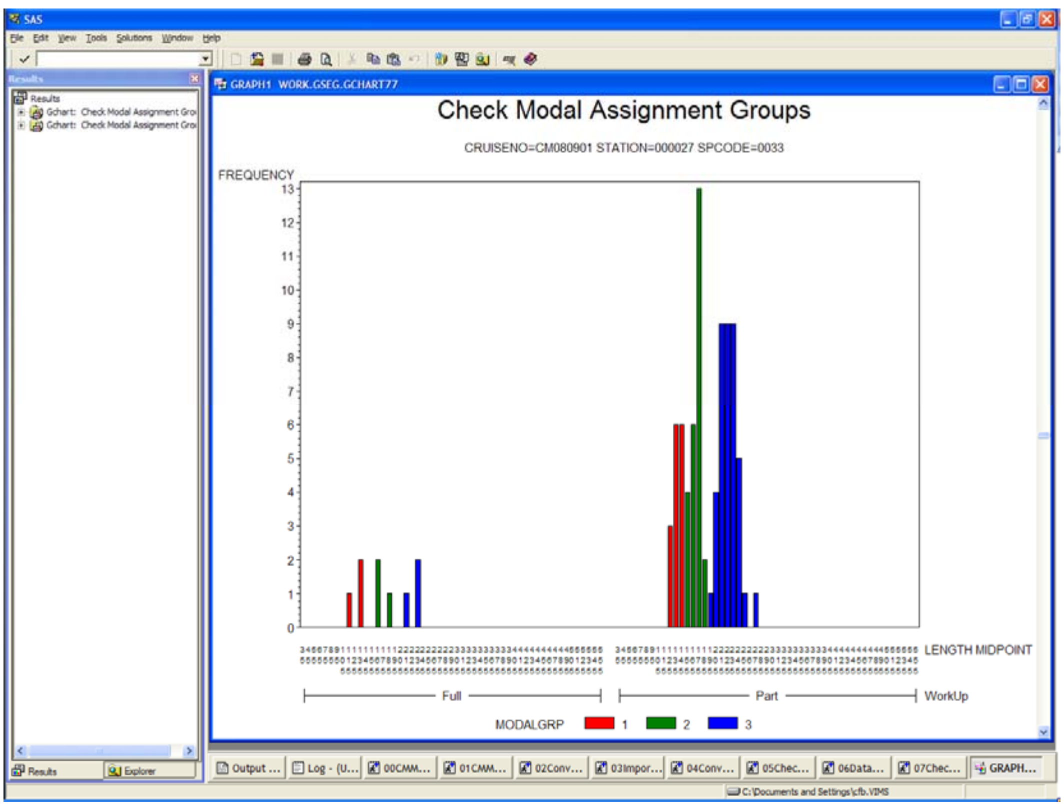
- Assignment of specimens to modal length groups at each Station are then checked. As noted if obvious modal size groups of a species are present in a catch, all specimens from that species are assigned to a group and each group is processed separately (almost as if it was a different species). As specimens are assigned by eye and not by pre-defined cutoffs it is common for specimens to overlap in their group assignments. A series of figures are produced which graphically present the reviewer with length frequency histograms, for both the full processing and partial processing specimens of a species/size-group, showing the assigned modal length groups in different colors. Where overlaps occur, the specimens are reassigned to the appropriate groups (Figure 3).

Figure 3. Modal length-group-specific length frequency histograms before (A) and after (B) reassignment of specimens.

A.



B.



- Finally, data from the present cruise are appended to the MS Access tables which contain data from previous cruises. At this point, MS Access applies referential integrity rules and some small number of remaining errors may be found.

For data security reasons, the MS Access data base which contains records of stomach contents is kept separate from the master NEAMAP data base. At the conclusion of error checking, therefore appropriate records from the Specimen level are also appended into the Guts data base.

The master NEAMAP (Figure 4) and NEAMAP Guts (Figure 5) MS Access data bases are structured similarly to the LDCE data base.

Figure 4. Table contents and relationships defined in the MS Access data base housing data from the NEAMAP Near Shore Trawl Survey.

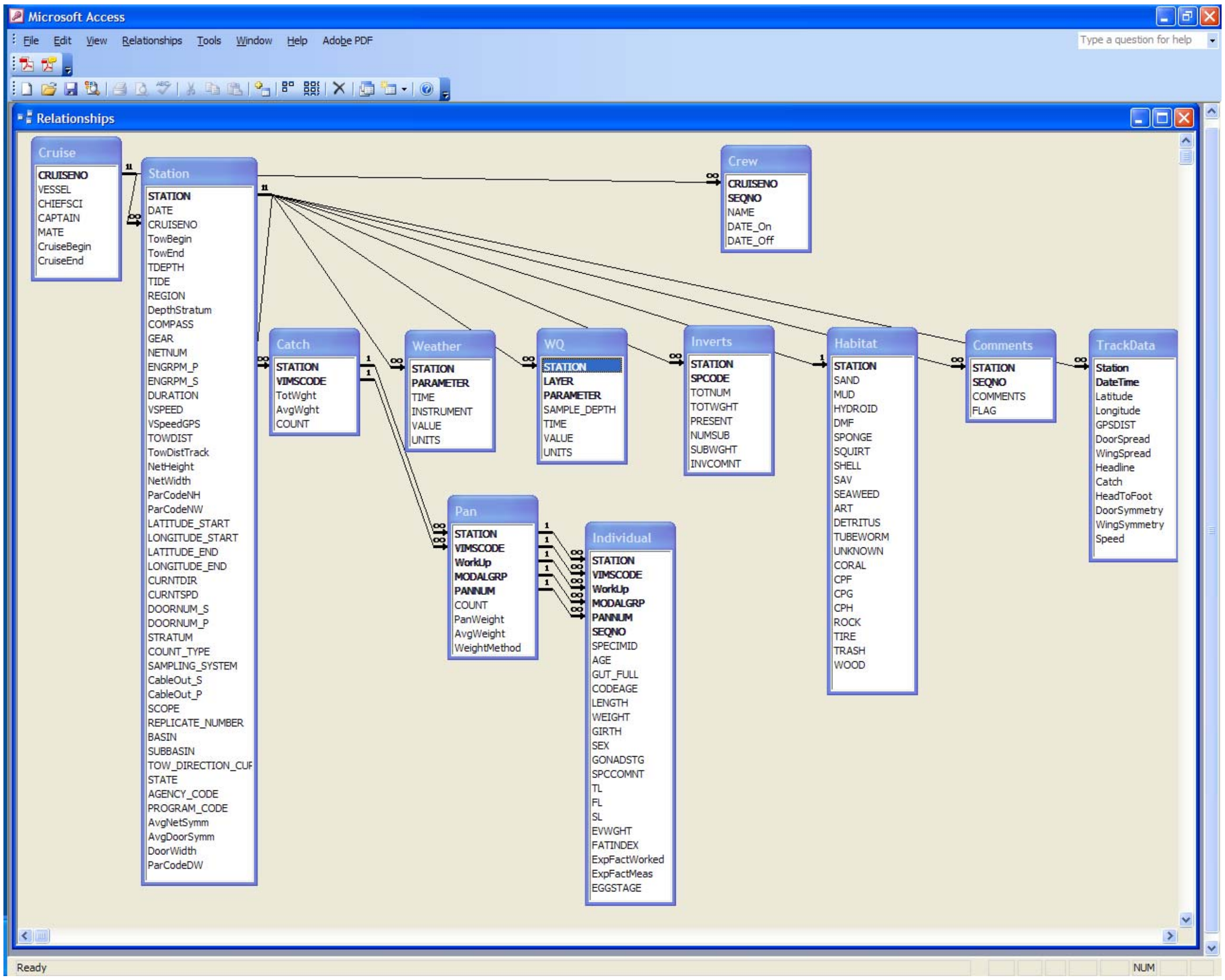
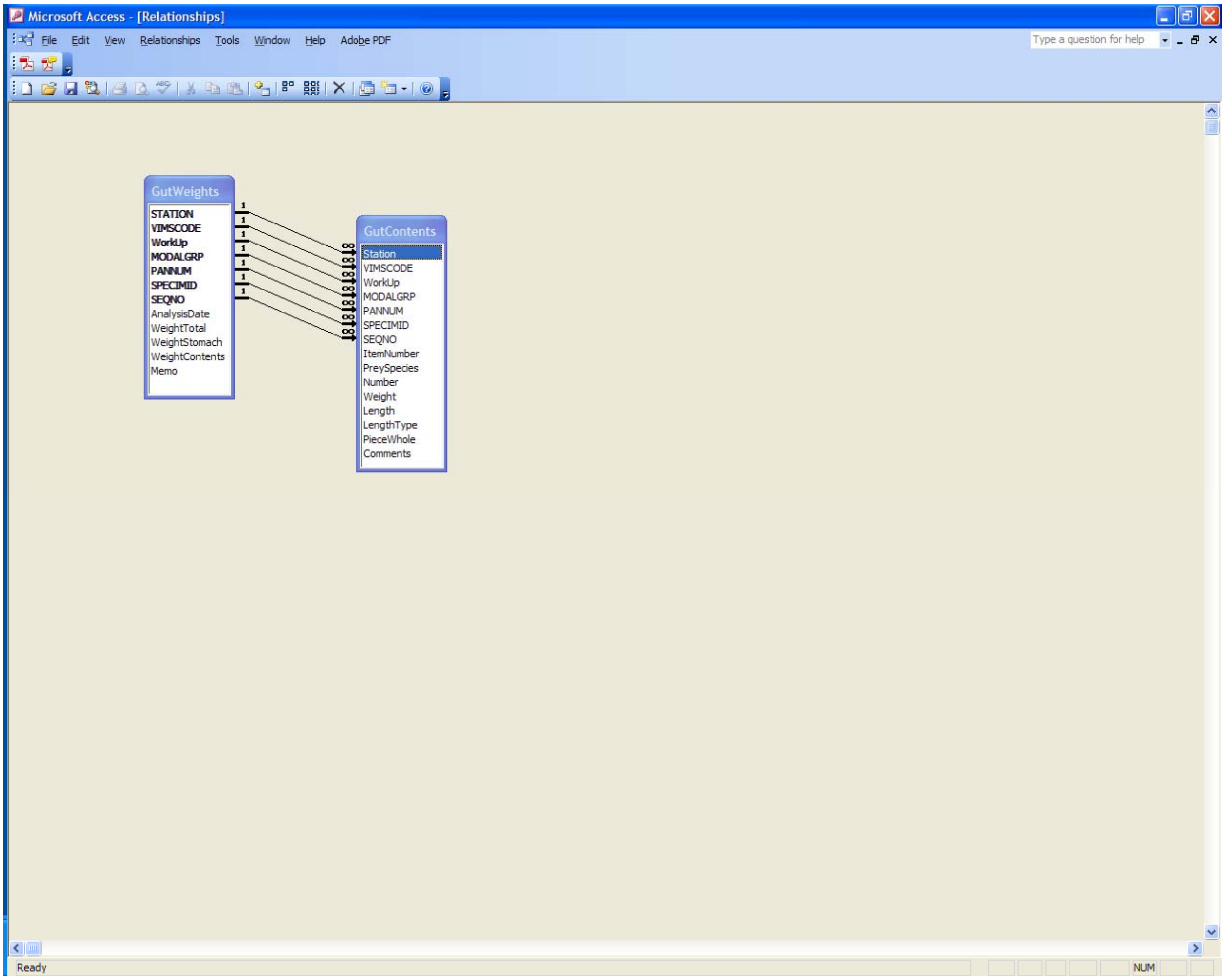


Figure 5. Table contents and relationships defined in the Guts MS Access data base used by the NEAMAP Near Shore Trawl Survey.



Appendix

Sample NEAMAP MS Access Table Contents

Cruise

Cruise						
CRUISENO	VESSEL	CHIEFSCI	CAPTAIN	MATE	CruiseBegin	CruiseEnd
NM060901	DR	GARTLAND	RUHLE J	RUHLE B	9/25/2006 4:00:00 PM	10/15/2006 9:00:00 PM
NM070901	DR	LANGE J	RUHLE J	RUHLE B	9/25/2007 3:00:00 PM	10/20/2007 4:00:00 PM
NM080401	DR	LANGE J	RUHLE J	RUHLE B	4/23/2008 8:00:00 AM	5/18/2008 8:00:00 AM

Station

Station						
STATION	DATE	CRUISENO	TowBegin	TowEnd	TDEPTH	TIDE
NM20080401001	5/15/2008	NM080401	5/15/2008 5:49:00 AM	5/15/2008 6:09:00 AM	47	
NM20080401002	5/8/2008	NM080401	5/8/2008 9:20:00 AM	5/8/2008 9:40:00 AM	46	
NM20080401003	5/15/2008	NM080401	5/15/2008 7:19:00 AM	5/15/2008 7:39:00 AM	36	
NM20080401004	5/15/2008	NM080401	5/15/2008 12:17:00 PM	5/15/2008 12:37:00 PM	63	
NM20080401005	5/15/2008	NM080401	5/15/2008 8:49:00 AM	5/15/2008 9:09:00 AM	59	
NM20080401006	5/15/2008	NM080401	5/15/2008 9:39:00 AM	5/15/2008 9:59:00 AM	45	

Station								
REGION	DepthStratum	STRATUM	COMPASS	GEAR	NETNUM	ENGRPM_P	ENGRPM_S	DURATION
01	02	0102	142	453	G01			20
01	02	0102	220	453	G02	1230	1230	20
02	01	0201	190	453	G01	1190	1190	20
02	01	0202	251	453	G01	1220	1200	20
02	02	0202	260	453	G01	1150	1140	20
02	02	0202	208	453	G01	1160	1180	20

Station							
VSPEED	VSpeedGPS	TOWDIST	TowDistTrack	NetHeight	ParCodeNH	NetWidth	ParCodeNW
3	2.95	1774.3	1820.1	5.72018279104478	NM	13.5408854166667	NM
2.7	2.53	1567.5	1564.4	5.92295317647059	NM	13.1630208333333	NM
3	2.67	1622.4	1646.3	5.86962430769231	NM	13.0366161616162	NM
3	3.11	1911.9	1918.7	5.62302165671642	NM	13.8178571428571	NM
2.7	3.09	1918.7	1907.7	5.54953975	NM	13.7354166666667	NM
2.9	2.91	1787.6	1799.1	5.65378098550725	NM	13.6930412371134	NM

Station			
LATITUDE_START	LONGITUDE_START	LATITUDE_END	LONGITUDE_END
41.0121666666667	-71.962	41.0006666666667	-71.9485
41.0223333333333	-71.9075	41.01	-71.9158333333333
40.9815	-72.0521666666667	40.9676666666667	-72.0578333333333
40.835	-72.4038333333333	40.8261666666667	-72.4218333333333
40.9093333333333	-72.2023333333333	40.9025	-72.2216666666667
40.9113333333333	-72.229	40.8976666666667	-72.2393333333333

Station						
CURNTDIR	CURNTSPD	DOORNUM_S	DOORNUM_P	STRATUM	COUNT_TYPE	SAMPLING_SYSTEM
		TS1	TP1	0102	0105	R
		TS1	TP1	0102	0105	R
		TS1	TP1	0201	0105	R
		TS1	TP1	0202	0105	R
		TS1	TP1	0202	0105	R
		TS1	TP1	0202	0105	R

Station					
CableOut_S	CableOut_P	SCOPE	REPLICATE_NUMBER	BASIN	SUBBASIN
75	75	9.57446808510638	1	AT	AT
75	75	9.78260869565217	1	AT	AT
75	75	12.5	1	AT	AT
75	75	7.14285714285714	1	AT	AT
75	75	7.6271186440678	1	AT	AT
75	75	10	1	AT	AT

Station			
TOW_DIRECTION_CURRENT	STATE	AGENCY_CODE	PROGRAM_CODE
3	NY	VIMS	NM
2	NY	VIMS	NM
1	NY	VIMS	NM
1	NY	VIMS	NM
1	NY	VIMS	NM
1	NY	VIMS	NM

Station			
AvgNetSymm	AvgDoorSymm	DoorWidth	ParCodeDW
-9.05913978494622E-02	-6.44329896907217E-02	32.7082474226804	NM
-8.78787878787877E-02	-4.32216494845361	32.059693877551	NM
0.932216494845362	-0.225	31.2852040816326	NM
-0.16159793814433	-3.46770833333333	33.6680412371134	NM
-0.68125	-2.72447916666667	33.0026041666667	NM

Station			
AvgNetSymm	AvgDoorSymm	DoorWidth	ParCodeDW
2.24183673469388	-5.45918367346939E-02	33.440306122449	NM

Crew

Crew				
CRUISENO	SEQNO	NAME	DATE_On	DATE_Off
NM080401	1	LANGE	4/23/2008	5/18/2008
NM080401	2	BUCHHEISTER	4/23/2008	5/2/2008
NM080401	3	DUKES	4/23/2008	5/2/2008
NM080401	4	MCOMBER	4/23/2008	5/18/2008
NM080401	5	BONZEK	4/23/2008	5/2/2008
NM080401	6	GARTLAND	5/3/2008	5/18/2008
NM080401	7	SPANIK	5/3/2008	5/18/2008
NM080401	8	GREGG	5/3/2008	5/23/2008

Weather

Weather					
STATION	PARAMETER	TIME	INSTRUMENT	VALUE	UNITS
NM20080401001	AT		AN	11.2	DEG_C
NM20080401001	BP		AN	1014.3	MM
NM20080401001	RH		AN	82.9	PCT
NM20080401001	SS		VI	2	N/A
NM20080401001	WD		AN	165	DEC_DEG
NM20080401001	WE		OB	2	N/A
NM20080401001	WS		AN	6	KNOTS
NM20080401002	AT		AN	12	DEG_C
NM20080401002	BP		AN	1003.6	MM
NM20080401002	RH		AN	98.2	PCT
NM20080401002	SS		VI	3	N/A
NM20080401002	WD		AN	240	DEC_DEG
NM20080401002	WE		OB	2	N/A
NM20080401002	WS		AN	5.3	KNOTS

WQ

WQ						
STATION	LAYER	PARAMETER	SAMPLE_DEPTH	TIME	VALUE	UNITS
NM20080401001	B	DO	55		8.59	MG/L
NM20080401001	B	PS	55		91.2	PERCENT
NM20080401001	B	SA	55		29.59	PPT
NM20080401001	B	WT	55		9.6	DEG_C

WQ						
STATION	LAYER	PARAMETER	SAMPLE_DEPTH	TIME	VALUE	UNITS
NM20080401001	S	DO	2		8.84	MG/L
NM20080401001	S	PS	2		94.6	PERCENT
NM20080401001	S	SA	2		29.13	PPT
NM20080401001	S	WT	2		10.19	DEG_C
NM20080401002	B	DO	44		9.63	MG/L
NM20080401002	B	PS	44		101.1	PERCENT
NM20080401002	B	SA	44		29.38	PPT
NM20080401002	B	WT	44		9.2	DEG_C
NM20080401002	S	DO	4		9.77	MG/L
NM20080401002	S	PS	4		104.2	PERCENT
NM20080401002	S	SA	4		28.59	PPT
NM20080401002	S	WT	4		10.14	DEG_C

Inverts

Inverts							
STATION	SPCODE	TOTNUM	TOTWGHT	PRESENT	NUMSUB	SUBWGHT	INVCOMNT
NM20080401001	0605	3		0			
NM20080401002	0605	5		0			
NM20080401002	0800			0			
NM20080401003	0605	5		0			
NM20080401006	0605	1		0			
NM20080401008	0605	1		0			
NM20080401008	0758			0			
NM20080401008	0800			0			
NM20080401009	0605	1		0			
NM20080401009	0758			0			
NM20080401009	0800			0			
NM20080401010	0605			0			
NM20080401010	0758			0			
NM20080401011	0605	1		0			

Habitat

Habitat											
STATION	SAND	MUD	HYDROID	DMF	SPONGE	SQUIRT	SHELL	SAV	SEAWEED	ART	DETRITUS
NM20080401049											
NM20080401055											
NM20080401058							0.5				

Habitat											
STATION	SAND	MUD	HYDROID	DMF	SPONGE	SQUIRT	SHELL	SAV	SEAWEED	ART	DETRITUS
NM20080401061							0.5				
NM20080401064		0.5									
NM20080401104			0.5				0.5				
NM20080401112			2				0.5				
NM20080401122			0.5								
NM20080401128									1		

Habitat									
TUBEWORM	UNKNOWN	CORAL	CPF	CPG	CPH	ROCK	TIRE	TRASH	WOOD
		0.5							
									0.5
		0.5							
									0.5
								0.5	0.5

Comments

Comments			
STATION	SEQNO	COMMENTS	FLAG
NM20080401001	1	ALTERNATE STATION A7, NET 1, 3'-5'GROUND SWELL	
NM20080401004	1	FIXED GEAR AROUND, LAST TOW OF NM0804	
NM20080401004	2	ALTERNATE STATION A14	
NM20080401022	1	ALTERNATE STATION A66	
NM20080401024	1	CONSIDER REMOVING STATION, BEC ALMOST 1/2 OF BOX IS INLAND.	
NM20080401027	1	ALTERNATE STATION A69	
NM20080401029	1	BOTTOM HYDRO SAMPLE TAKEN A LITTLE AWAY FROM TOWPATH, MUDTOW	

TrackData

TrackData				
Station	DateTime	Latitude	Longitude	GPSDIST
NM20080401001	5/15/2008 5:49:27 AM	41.012	-71.962	
NM20080401001	5/15/2008 5:49:34 AM			
NM20080401001	5/15/2008 5:49:35 AM			

TrackData				
Station	DateTime	Latitude	Longitude	GPSDIST
NM20080401001	5/15/2008 5:49:36 AM			
NM20080401001	5/15/2008 5:49:38 AM	41.012	-71.962	9.6
NM20080401001	5/15/2008 5:49:39 AM			
NM20080401001	5/15/2008 5:49:46 AM			
NM20080401001	5/15/2008 5:49:47 AM			
NM20080401001	5/15/2008 5:49:48 AM			
NM20080401001	5/15/2008 5:49:57 AM			
NM20080401001	5/15/2008 5:49:59 AM			

TrackData							
DoorSpread	WingSpread	Headline	Catch	HeadToFoot	DoorSymmetry	WingSymmetry	Speed
				2.595374			3
31.25							
	12.925				-23.25		
						-5.575	
							3
		6.667483					
33.9							
	13.425				12.4		
						-1.075	
		6.115238					
31.9	13.7						

Catch

Catch				
STATION	VIMSCODE	TotWght	AvgWght	COUNT
NM20080401001	0044	1.654	0.827	2
NM20080401001	0063	7.315	0.318	23
NM20080401001	0071	0.011	0.011	1
NM20080401001	0103	0.07	0.003	27
NM20080401001	0163	7.389	2.463	3
NM20080401001	0167	26.795	3.349	8
NM20080401001	0171	18.425	0.449	41
NM20080401001	0173	8.415	2.805	3
NM20080401001	0181	1.05	0.263	4
NM20080401001	1028	4.845	0.01	468
NM20080401002	0001	5.604	0.33	17
NM20080401002	0002	4.066	1.355	3
NM20080401002	0003	15.348	0.767	20
NM20080401002	0006	0.015	0.008	2

Catch				
STATION	VIMSCODE	TotWght	AvgWght	COUNT
NM20080401002	0044	0.608	0.608	1
NM20080401002	0063	10.815	0.318	34

Pan

Pan								
STATION	VIMSCODE	WorkUp	MODALGRP	PANNUM	COUNT	PanWeight	AvgWeight	WeightMethod
NM20080401001	0044	Full	0	7	2	1.654	0.827	I
NM20080401001	0063	Part	0	9	23	7.315	0.318	G
NM20080401001	0071	Part	0	22	1	0.011	0.011	G
NM20080401001	0103	Part	0	9	27	0.07	0.002	G
NM20080401001	0163	Full	0	7	3	7.389	2.463	I
NM20080401001	0167	Full	0	7	3	9.835	3.278	I
NM20080401001	0167	Part	0	409	5	16.96	3.392	I
NM20080401001	0171	Full	0	7	3	1.725	0.575	I
NM20080401001	0171	Part	0	9	38	16.7	0.439	G
NM20080401001	0173	Full	0	7	3	8.415	2.805	I
NM20080401001	0181	Part	0	22	4	1.05	0.262	G
NM20080401001	1028	Part	0	9	110	1.14	0.010	G
NM20080401001	1028	Part	0	99	358	3.705	0.010	G
NM20080401002	0001	Full	1	24	3	0.1	0.033	I
NM20080401002	0001	Full	2	24	4	0.39	0.097	I
NM20080401002	0001	Full	3	24	5	3.064	0.613	I
NM20080401002	0001	Part	3	22	5	2.05	0.41	G
NM20080401002	0002	Full	0	24	3	4.066	1.355	I

Individual

Individual						
STATION	VIMSCODE	WorkUp	MODALGRP	PANNUM	SEQNO	SPECIMID
NM20080401002	0001	Full	1	24	1	1
NM20080401002	0001	Full	1	24	2	2
NM20080401002	0001	Full	1	24	3	3
NM20080401002	0001	Full	2	24	1	4
NM20080401002	0001	Full	2	24	2	5
NM20080401002	0001	Full	2	24	3	6
NM20080401002	0001	Full	2	24	4	7
NM20080401002	0001	Full	3	24	1	8
NM20080401002	0001	Full	3	24	2	9
NM20080401002	0001	Full	3	24	3	10
NM20080401002	0001	Full	3	24	5	11
NM20080401002	0001	Full	3	24	6	12
NM20080401002	0001	Part	3	22	1	

Individual						
STATION	VIMSCODE	WorkUp	MODALGRP	PANNUM	SEQNO	SPECIMID
NM20080401002	0001	Part	3	22	2	
NM20080401002	0001	Part	3	22	3	
NM20080401002	0001	Part	3	22	4	
NM20080401002	0001	Part	3	22	5	

Individual											
AGE	GUT_FULL	CODEAGE	LENGTH	WEIGHT	GIRTH	SEX	GONADSTG	SPCCOMNT	TL	FL	SL
	F		121	0.02		U	A				
	F		115	0.04		M	A				
	F		135	0.04		M	A				
	F		185	0.108		F	C				
	F		174	0.084		F	B				
	F		188	0.12		F	C				
	F		163	0.078		F	C				
	F		320	0.704		F	C				
	F		308	0.732		F	C				
	F		283	0.442		F	C				
	F		330	0.73		M	C				
	F		270	0.456		U	3				
			233								
			268								
			240								
			310								
			251								

Individual				
EVWGHT	FATINDEX	ExpFactWorked	ExpFactMeas	EGGSTAGE
		1	1	
		1	1	
		1	1	
		1	1	
		1	1	
		1	1	
		1	1	
		2	1	
		2	1	
		2	1	

Individual				
EVWGHT	FATINDEX	ExpFactWorked	ExpFactMeas	EGGSTAGE
		2	1	
		2	1	
			1	
			1	
			1	
			1	
			1	

Sample NEAMAP Guts MS Access Table Contents

GutWeights

GutWeights						
STATION	VIMSCODE	WorkUp	MODALGRP	PANNUM	SPECIMID	SEQNO
NM20080401001	0001	Full	1	7	1	1
NM20080401001	0001	Full	1	7	2	2
NM20080401001	0001	Full	1	7	3	3
NM20080401001	0001	Full	1	7	4	4
NM20080401001	0001	Full	1	7	5	5
NM20080401001	0001	Full	2	7	6	1
NM20080401001	0001	Full	3	7	8	1
NM20080401001	0002	Full	0	7	1	1
NM20080401001	0002	Full	0	7	2	2
NM20080401001	0003	Full	2	7	6	1
NM20080401001	0003	Full	2	7	7	2

GutWeights				
AnalysisDate	WeightTotal	WeightStomach	WeightContents	Memo
9/2/2008	0.09	0.09		
9/2/2008	0.092	0.092		
9/2/2008	0.353	0.353		
9/2/2008	0.245	0.245		
9/2/2008	0.387	0.387		
9/2/2008	0.631	0.577		
9/2/2008	2.186	2.186		
9/12/2008	26.869	28.869		
9/12/2008	21.269	21.26		
7/29/2008	11.45	9.945		
7/29/2008	22.018	15.629		

GutContents

GutContents							
Station	VIMSCODE	WorkUp	MODALGRP	PANNUM	SPECIMID	SEQNO	ItemNumber
NM20080401001	0002	Full	0	7	2	2	51826
NM20080401001	0002	Full	0	7	1	1	51824
NM20080401001	0003	Full	2	7	7	2	49030
NM20080401001	0003	Full	2	7	6	1	49029

GutContents						
PreySpecies	Number	Weight	Length	LengthType	PieceWhole	Comments
0738	2	0.005				

GutContents						
PreySpecies	Number	Weight	Length	LengthType	PieceWhole	Comments
0998						
5000	1	5.693				
0053	1	1.414				

Data Analysis and Data Products

First Level Data Products

CPUE:

Catch per unit effort is always a primary data product of fish monitoring surveys and as NEAMAP continues to establish its time series, it will be so for this survey as well. Calculation of this parameter is not necessarily simple. We believe that use of a catch-per-tow or catch-per-minute calculation is not the most appropriate metric for CPUE when net monitoring equipment is employed (as is the case for NEAMAP). Catch-per-tow or catch-per-minute calculations assume that the sampling net performs identically on each tow. Use of net monitoring gear to record net geometry and a GPS to record tow tracks during each tow however, frees investigators from these assumptions. We believe that a catch-per-area-swept calculation is most appropriate. Options for calculation of area-swept CPUE include:

Minimum Trawlable Abundance

Use of equation (1), in accordance with stratified random sampling as in equation (2), results in estimates of minimum trawlable abundance (MTA) in terms of number or biomass:

(1) $$\hat{N} = \sum_{s=1}^{n_s} A_s \hat{\bar{N}}_s ,$$

where A_s is the area of stratum s, n_s is the total number of strata in which a species is captured, and $\hat{\bar{N}}_s$ is an estimate of the mean catch (number or biomass) per area swept in stratum s given by:

(2) $$\hat{\bar{N}}_s = \frac{\sum_{i=1}^{n_{t,s}} \frac{c_i}{\hat{a}_i}}{n_{t,s}} ,$$

In equation (2), c_i and $\hat{a}_i$ represent the catch (number or biomass) and an estimate of the trawl area-swept at sampling location i, respectively, and $n_{t,s}$ is the number of tows in stratum s. The a_i estimates are calculated using vessel GPS data for distance towed and net monitoring gear for measurements of net opening.

The first NEAMAP project reports used this method to describe CPUE. However, this metric can be misleading in comparing CPUE among survey sub-areas (e.g. by Region or State). For example, sub-areas with low CPUE but large strata could have higher MTA than a small area with high CPUE. Further, while the calculation is valid, managers and assessment scientists generally need to know relative catch rates without regard to stratum size. So, our most recent reports have used equation (1) to report an overall MTA (which is likely to be of interest even if it is not used in assessments) but have used catch-per-standard-unit-area (equations 3 and 4) as the primary CPUE metric.

Catch per Standard Area Swept

Removing the total survey area value from equation (1) results in estimation of mean catch per unit area (equation 3).

(3) $$\hat{N} = \sum_{s=1}^{n_s} \hat{\bar{N}}_s \; ,$$

where n_s is the total number of strata in which a species was captured, and $\hat{\bar{N}}_s$ is an estimate of the mean catch (number or biomass) per area swept in stratum *s* given by:

(4) $$\hat{\bar{N}}_s = \frac{\sum_{i=1}^{n_{t,s}} \frac{c_i}{\hat{a}_i / 25000}}{n_{t,s}} \; ,$$

where 25,000m^2 is the approximate area swept on a typical tow, so that quantity ($\hat{a}_i$ / 25000) is approximately 1. Sub-area CPUEs (e.g. by state) are calculated as if each sub-area was the entire sampling universe. Use of this metric allows a direct comparison of catch rates among regions or states (Figure 1, - also see copies of project reports).

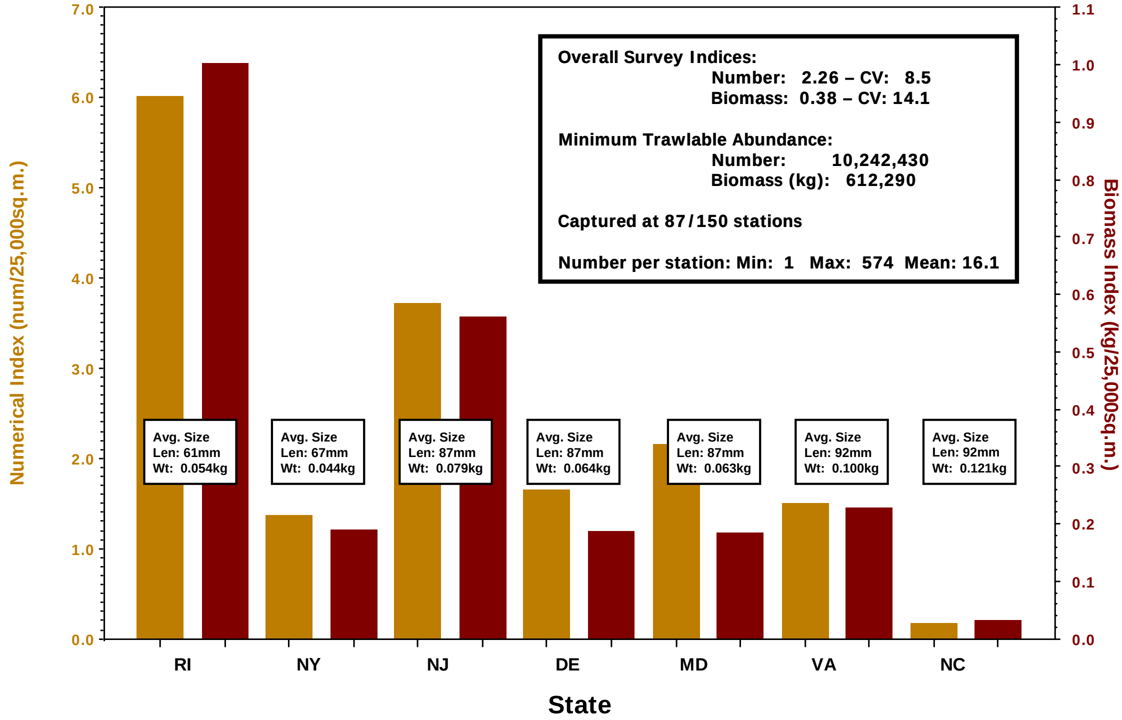
Data from fishery surveys tend not to be normally distributed. Preliminary analyses of NEAMAP data show that at least for some species catch data are log-normally distributed. Therefore, for these early data summaries, CPUE data have been analyzed using a log($c_i + 1$) transformation to calculate the geometric mean catch rate. Further analyses to determine the distribution of catch data on a species-by-species basis will be completed as more data are accumulated.

Specimen Expansion Factors:
As stated in the “Survey Procedures” chapter, not all specimens captured for a particular species in a particular tow are necessarily measured and a smaller subsample (3-10 specimens per size class) is typically subjected to the full processing protocols for individual length, weight, sex, maturity, age, and diet. Thus when subsampling of any kind occurs for a species in a tow, each fish measured in the ‘Individual’ data table represents a larger number of fish in the entire sample. Fields representing two separate expansion factors are present in that data table:

1. Each specimen subsampled for full processing has an expansion factor to translate that specimen up to the total number of fish *measured* in that species-size class group.
2. Each specimen measured has an expansion factor to translate that specimen up to the total number of fish in that species-size class captured in the tow.

So, for specimens subject to full processing, a two-stage expansion is required. The value of the expansion factor represents the number of fish that each subsampled specimen represents.

Figure 1. Geometric mean catch per area swept by state and overall, with summary catch rates, for alewife collected by the NEAMAP Near Shore Trawl Survey in Spring 2008.



As an example, in the following table (Table 1) each row represents measurements for one specimen (for brevity not all fields are shown). Two size classes of this species (butterfish) were present in this tow, and the records shown are for the larger size class (MODALGRP = 2). Three specimens were sampled for full processing (WorkUp = Full), 12 individuals were measured, and a total of 43 fish of this species-size class were caught (data not shown). The field called ExpFactWorked, with a value of 4, means that each specimen subjected to full processing represented 4 fish out of those measured, so the sum of the expansion factors (4+4+4) is equal to the number of fish measured (12). Likewise, the sum of values in the ExpFactMeas field is equal to the total number of specimens captured (43), and each full-workup specimen represents 14.332 (4 x 3.583) fish out of the entire sample.

Table 1. Example data collected for butterfish (*Peprilus triacanthus*) collected by the NEAMAP Near Shore Trawl Survey in Spring 2008.

STATION	VIMSCODE	WorkUp	SEQNO	MODALGRP	PANNUM	SPECIMID	LENGTH	Weight	SEX	GONADSTG	ExpFactWorked	ExpFactMeas
NM20080401147	0004	Part	1	2	22		157					3.583
NM20080401147	0004	Part	2	2	22		163					3.583
NM20080401147	0004	Part	3	2	22		154					3.583
NM20080401147	0004	Part	4	2	22		161					3.583
NM20080401147	0004	Part	5	2	22		158					3.583
NM20080401147	0004	Part	6	2	22		156					3.583
NM20080401147	0004	Part	7	2	22		159					3.583
NM20080401147	0004	Part	8	2	22		155					3.583
NM20080401147	0004	Part	9	2	22		159					3.583
NM20080401147	0004	Full	1	2	24	4	188	0.148	M	C	4	3.583
NM20080401147	0004	Full	2	2	24	5	162	0.088	M	C	4	3.583
NM20080401147	0004	Full	3	2	24	6	174	0.097	F	C	4	3.583

Each of the following data summary descriptions is dependent on these expansion factors. Use of the expansion factors represents estimates of the numbers which would have resulted if every specimen captured was measured and subjected to the full processing.

One analytical step which has not yet been implemented (except in the abundance calculations) is to account for the random-stratified sampling design of station selection into the biological data analyses.

Other First Level Analyses:
Sample data summarizations for length frequency, age distribution, sex ratios, maturation rates, length-weight relationships, and diets are presented here and many others are in project reports included in the peer review packets (Figures 2 – 9).

Figure 2. Length frequency histogram for summer flounder collected by the NEAMAP Near Shore Trawl Survey during the Spring 2008 cruise.

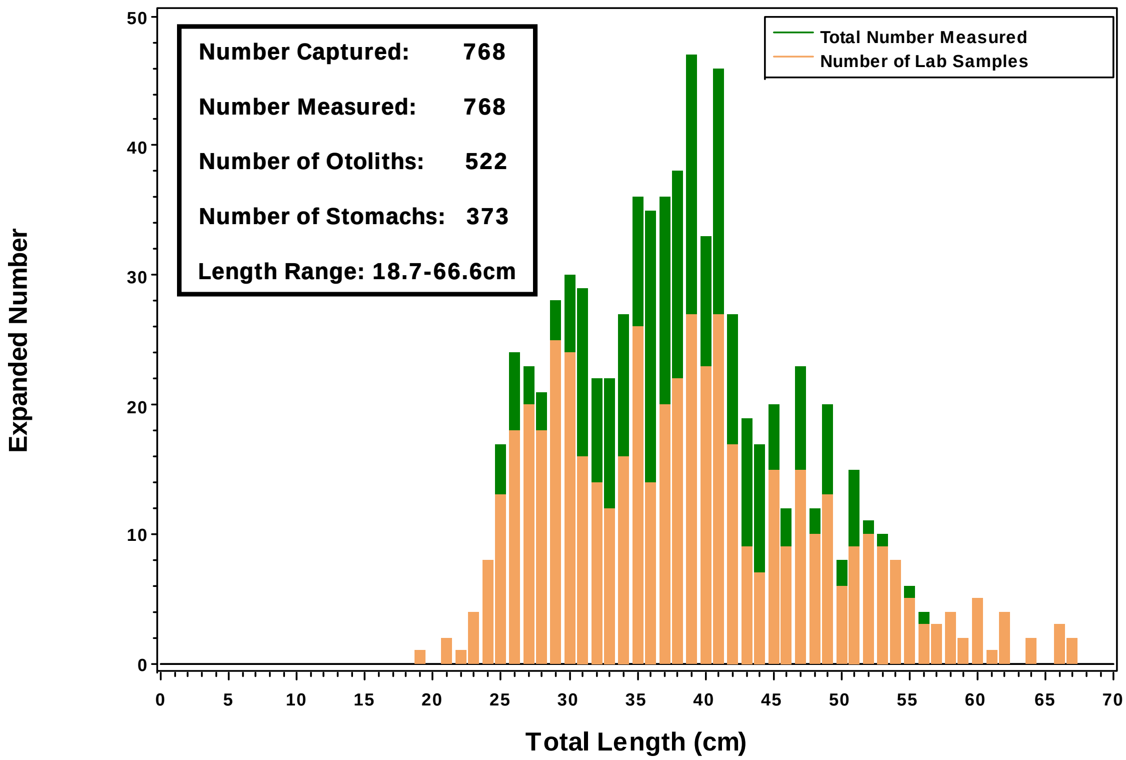


Figure 3. Sex ratios for summer flounder collected by the NEAMAP Near Shore Trawl Survey, by length group.

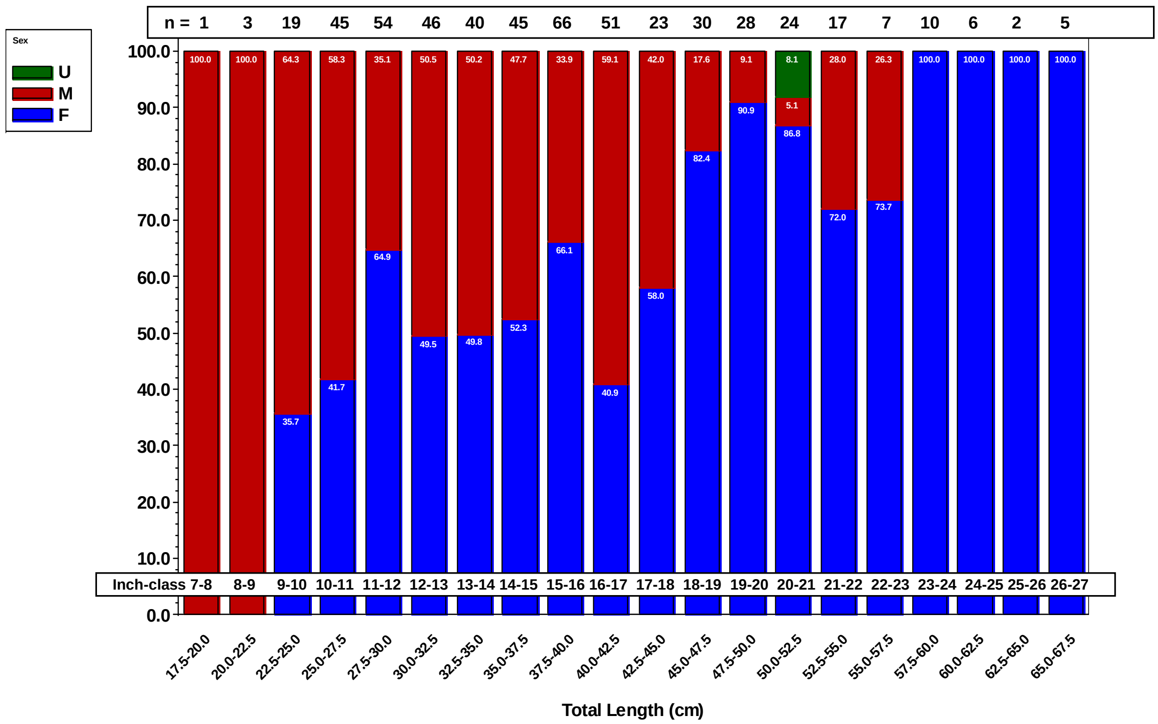


Figure 4. Maturity logistic regression for summer flounder, by sex, collected by the NEAMAP Near Shore Trawl Survey.

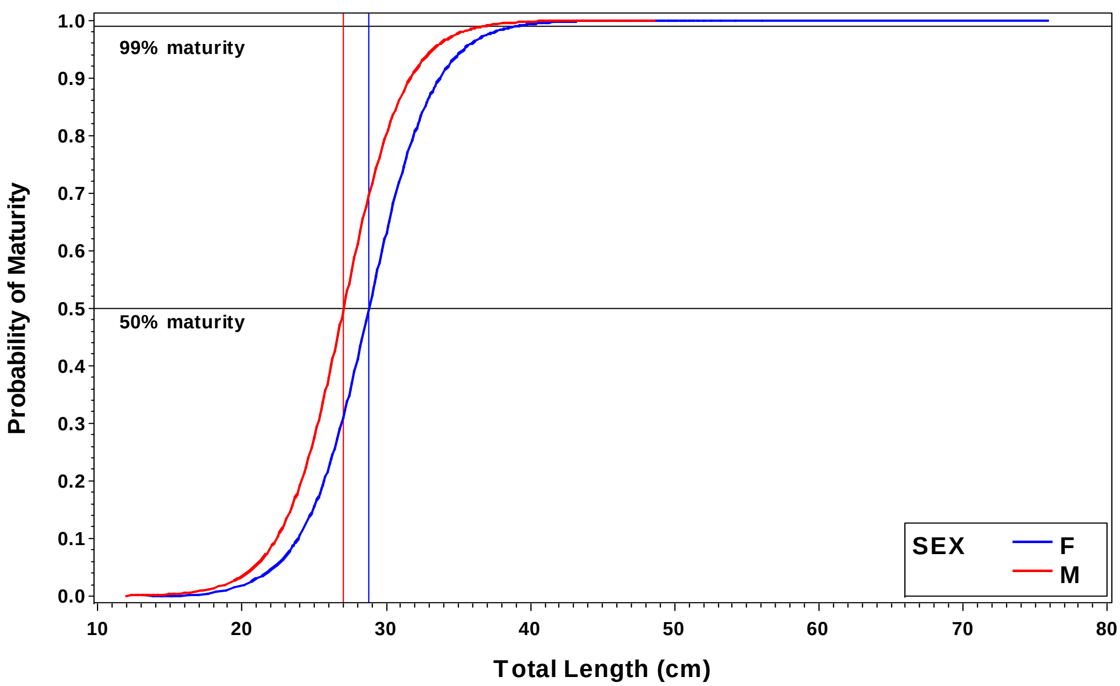


Figure 5. von Bertalanffy growth curves for summer flounder, by sex.

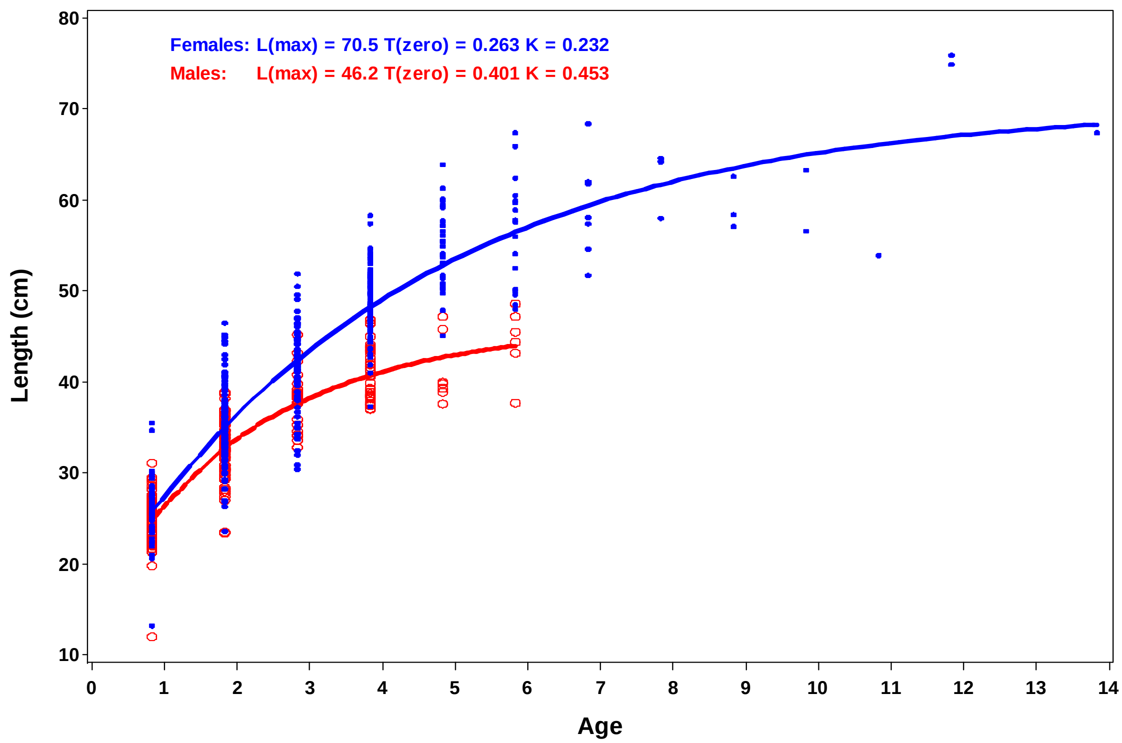


Figure 6. Age frequency histogram for summer flounder collected by the NEAMAP survey for 2007.

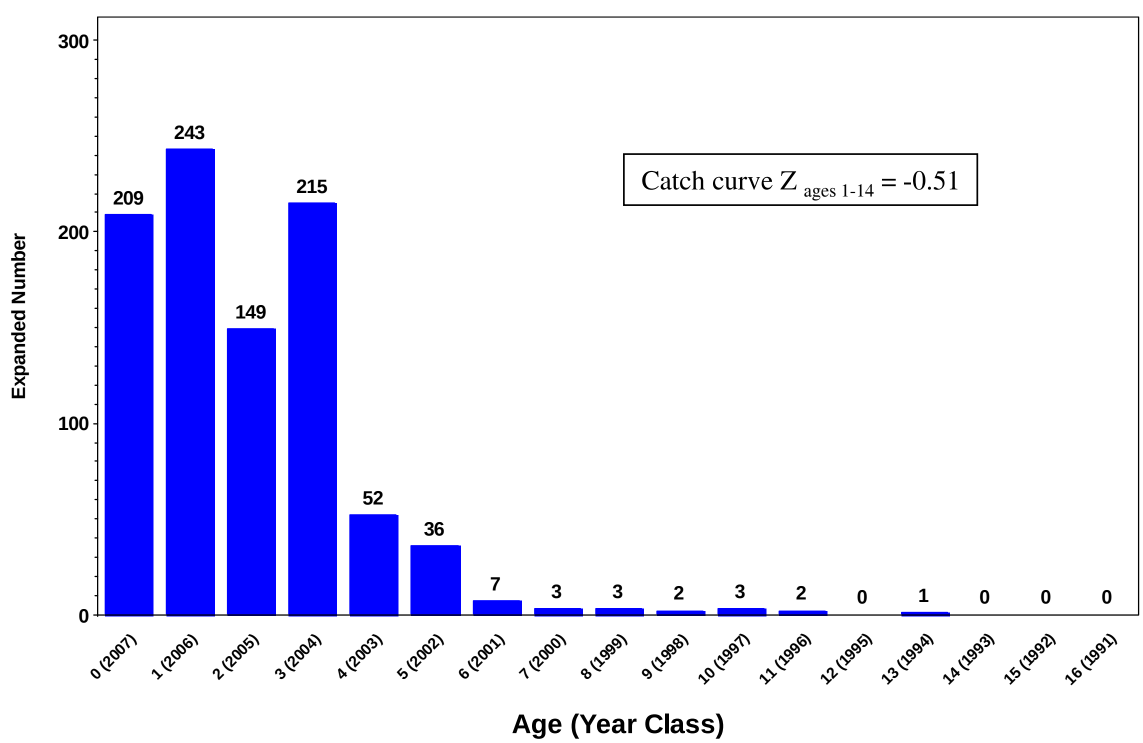


Figure 7. Length-weight regression for summer flounder collected by NEAMAP, by sex.

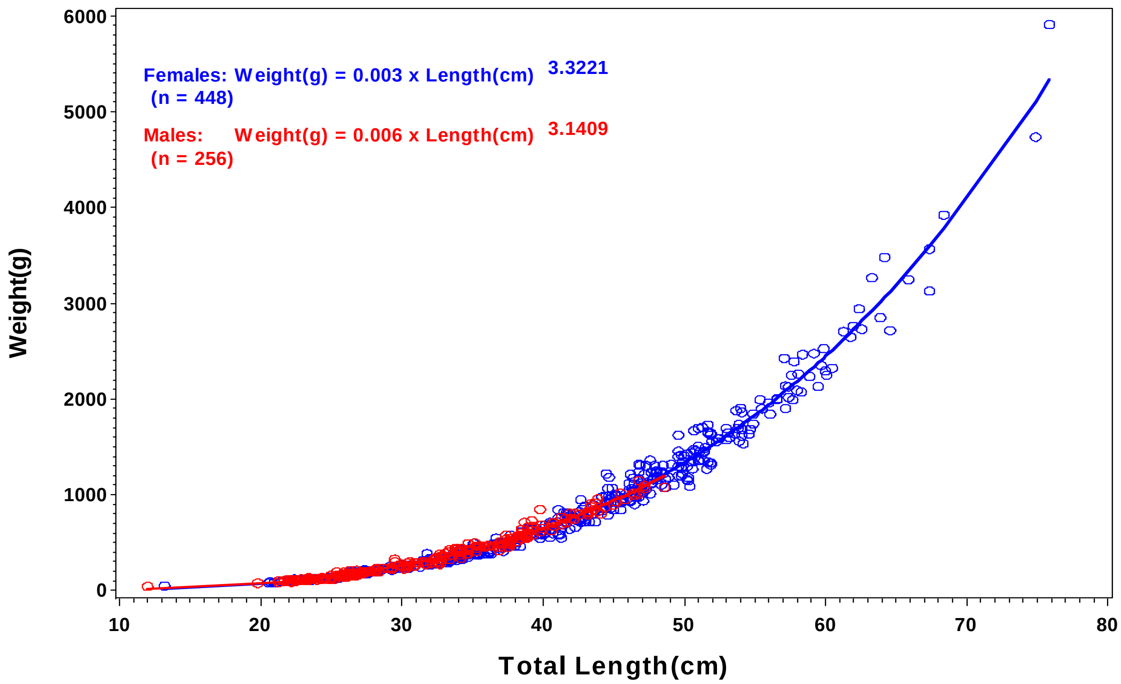


Figure 8. Age-specific length-frequency histograms for summer flounder for ages 0 through 6 collected by NEAMAP.

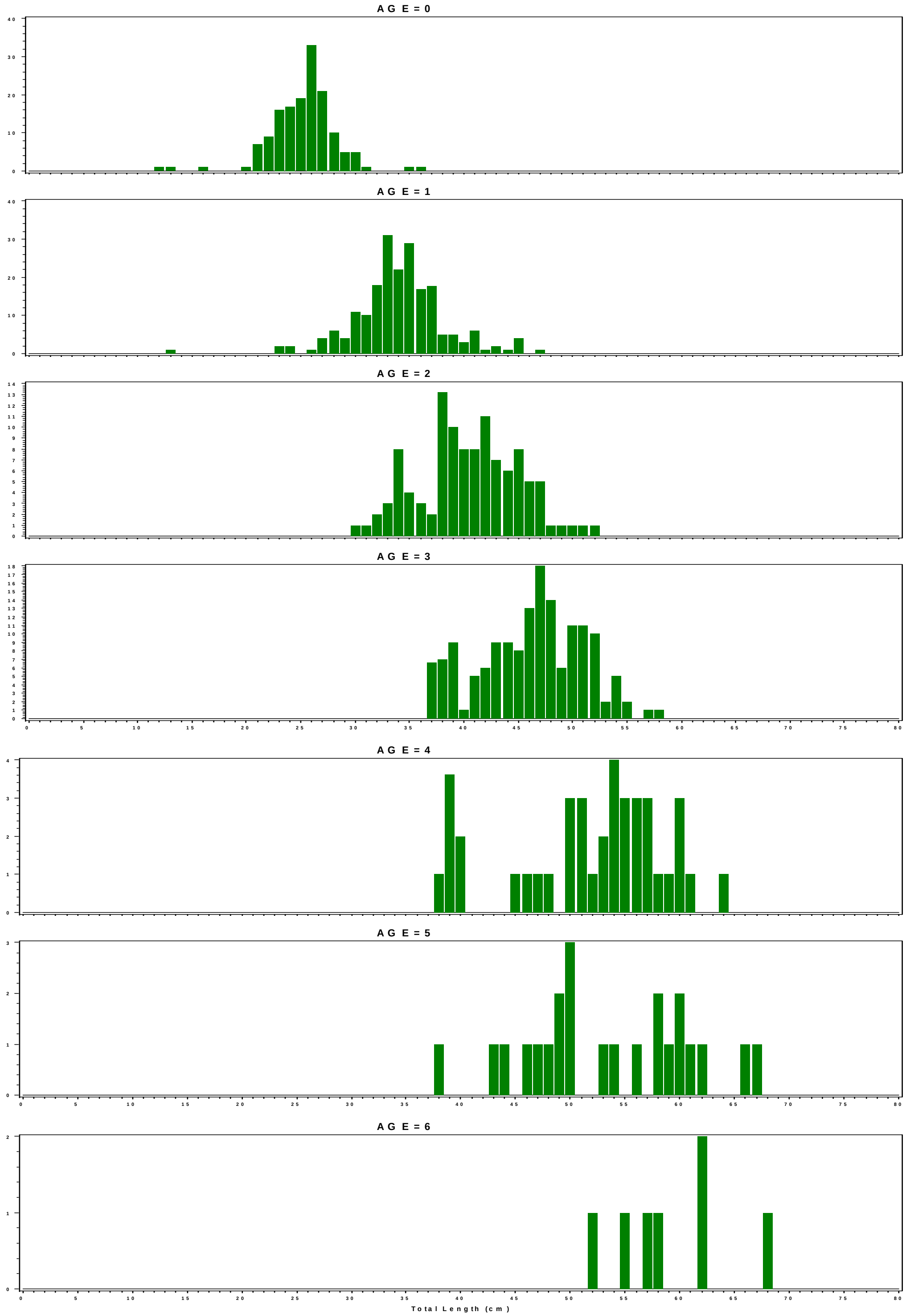
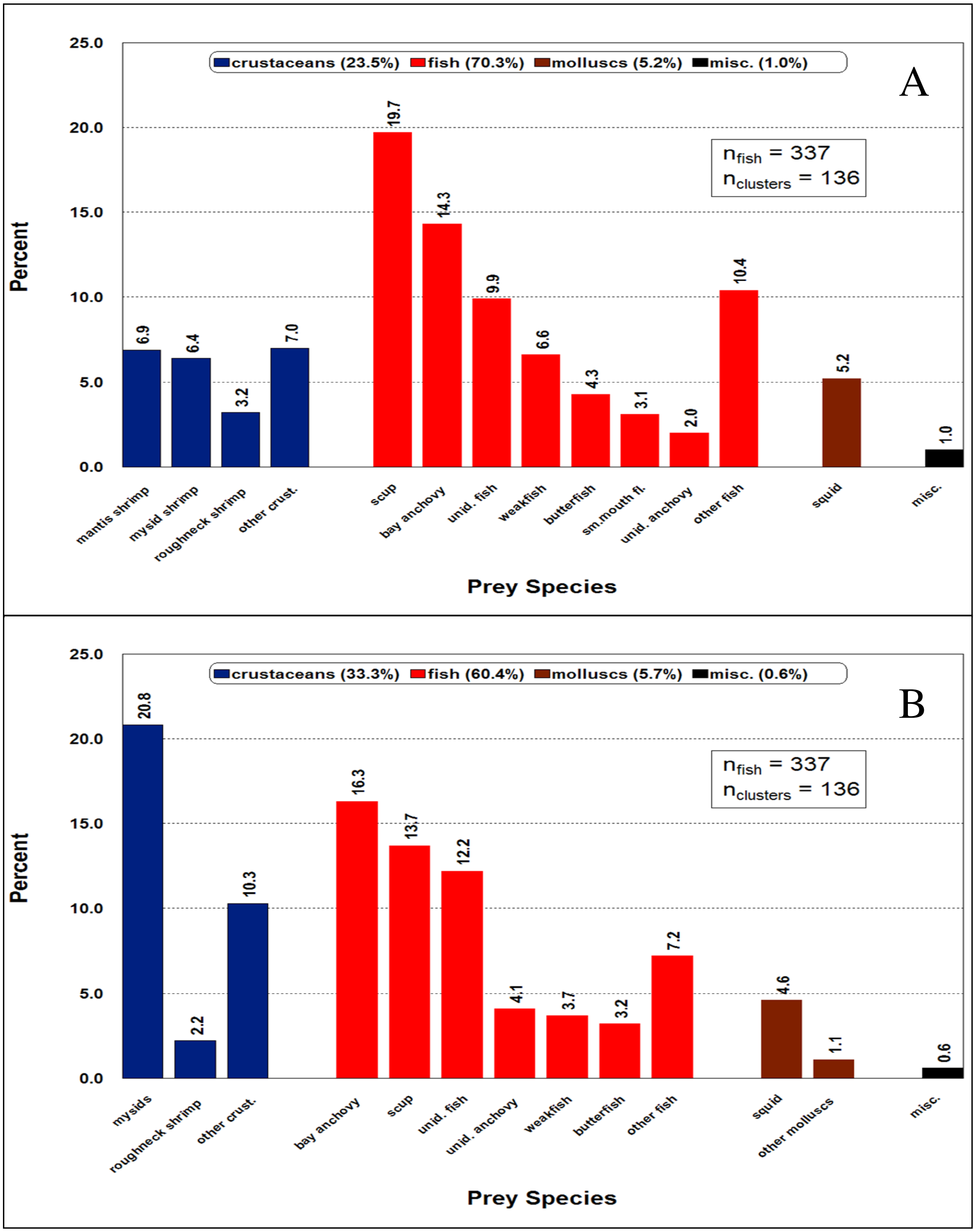


Figure 9. Diets of summer flounder collected by NEAMAP by percent weight (A) and percent number (B).



Cluster Estimators:

It is well known that fishes distribute in temporally and spatially varying aggregations. The biological and ecological characteristics of a particular fish species collected by fishery-independent or -dependent activities inevitably reflect this underlying spatio-temporal structure. Intuitively, it follows then that the diets (and other biological parameters) of individuals captured by a single gear deployment (e.g., NEAMAP tow) will be more similar to one another than the diets of individuals captured at a different time or location (Bogstad et al. 1995).

The diet index proportion by weight under a cluster sampling design can be represented by the following equation (Bogstad et al. 1995, Buckel et al. 1999):

(5)
$$W_k = \frac{\sum_{i=1}^{n} M_i q_{ik}}{\sum_{i=1}^{n} M_i} ,$$

where

$$q_{ik} = \frac{w_{ik}}{w_i} ,$$

and where n is the number of samples containing the fish species of interest, M_i is the number of that species collected at sampling location i, w_i is the total weight of all prey items encountered in the stomachs of the fish collected and processed at sampling location i, and w_{ik} is the total weight of prey type k in these stomachs. Note that in a 2-stage cluster sampling design, the number of stomachs processed for calculation of q_{ik} will be less than or equal to M_i.

This cluster sampling estimator is used to calculate the diet compositions of the NEAMAP priority species.

Potential Uses and Users

It is anticipated that as a critical mass of NEAMAP data accrues, it will become widely used for both assessment and management analyses.

For assessment, NEAMAP will provide both overall and age-specific abundance indices as a supplement to similar indices from state and federal surveys. Growth, maturity, age-size, sex, and diet data will provide crucial data for both single-species and multi-species assessments.

A potentially important use of NEAMAP data will be for examining state-specific management options. The NEAMAP survey area covers state waters to the 3-mile limit (and in most states, beyond the 3-mile limit) in all Atlantic coastal states between Rhode Island and North Carolina. Until the initiation of NEAMAP, most of these states did not have regular survey data in these waters. While the number of stations in some states is still relatively small, the possibility exists that NEAMAP data could be used to develop state-specific management options, customized to stock status and conditions in each state.

It is anticipated that data customers will include:

- Assessment specialists from states, ASMFC, NEFSC, MAFMC, and NEFMC
- Managers from all of the same organizations
- Recreational and commercial industry representatives and analysts
- We also expect that the VIMS NEAMAP staff will be able to make significant analytical contributions.

Accessibility and Data Requests

Currently, NEAMAP data are available to qualified researchers upon request, in any required format. Should it become desirable to incorporate NEAMAP data into the NEFSC's data base, that task should be relatively simple. The possibility of placing NEAMAP data into the ACCSP data base has been suggested. To date, ACCSP does not have the funding or the personnel to support that function. To make maximum use of these data, an online query tool could be developed. Such a system could be hosted at VIMS or at another site.

Literature Cited

Bogstad, B., Pennington, M., Volstad, J.H. 1995. Cost-efficient survey designs for estimating food consumption by fish. Fisheries Research 23:37-46.

Buckel, J.A., D.O. Conover, N.D. Steinberg, and K.A. McKown. 1999. Impact of age-0 bluefish (*Pomatomus saltatrix*) predation on age-0 fishes in the Hudson River estuary: evidence for density-dependent loss of juvenile striped bass (*Morone saxatilis*). Can. J. Fish. Aquat. Sci. 56:275-287.

Outreach and Challenges

Outreach

Since the NEAMAP survey was in its design phase, it has been recognized that a comprehensive outreach effort is an essential element if the program is to be successful. In fact, the establishment of such an outreach program was deemed important enough that it was included as one of the four main goals of NEAMAP.

In addition to outreach efforts that may be accomplished by ASMFC, the NEAMAP committees, and other, the VIMS NEAMAP program staff has sought to reach out to the general public, commercial and recreational fishermen, fishery managers, stock assessment and other fishery scientists, and political figures. Through contact with the general public and fishing communities, it is hoped that NEAMAP personnel will be able to provide these individuals with a clear picture of the science behind the management of the living marine resources of SNE and the MAB, and thereby generate support for the survey. Further, by providing the fishing communities (commercial and recreational) with a complete picture of the survey field and laboratory procedures, the probability that these groups will have confidence in the information generated by the survey and subsequently used in stock assessments and management decisions increases.

Informing managers and scientists regarding the activities, procedures, and data generated by the NEAMAP survey serves a multitude of purposes. Specifically, reaching out to these groups serves to introduce managers and other scientists to the existence of the NEAMAP survey, affords these groups the chance to request the collection of additional data (if necessary), and increases the opportunities for the establishment of collaborative research and the likelihood that NEAMAP data will be included in future stock assessments. Political figures are included in the NEAMAP outreach efforts to inform them of the survey's activities and value in an attempt to establish long-term survey funding.

To date, NEAMAP's outreach efforts have consisted of a four-pronged approach: formal presentations, demonstration tows, media coverage, and scientific workshop participation.

<u>Formal Presentations:</u>
Formal presentations of NEAMAP's background, survey design, field protocols, laboratory procedures, and data have been given by the NEAMAP principal investigators at a number of venues between Virginia and Rhode Island since the Fall of 2006. Following the completion of the NEAMAP Pilot Survey in 2006, the program and its Pilot Cruise results were presented to the ASMFC Board and Operations Committee. The ASMFC Policy Board received a presentation regarding NEAMAP's Pilot Cruise in January 2008. In February 2007, the results of NEAMAP's gear testing in the summer of 2006 and gear performance during the Fall Pilot Cruise were presented at the NEFMC meeting in New Hampshire. The results given in this presentation were partially responsible for the NEFMC's approval of this gear for use by the NEFSC Bottom Trawl Survey and the NEAMAP Survey. A comprehensive (i.e., 2.25 hour) presentation was then given to the MAFMC the following week. This presentation was largely responsible for the approval by the MAFMC to use RSA to partially fund NEAMAP's 2008 survey activities. While no presentations of NEAMAP's work have been given to the NEFSC

directly, representatives from the Center have been present at all of the Council presentations, as well as the majority of the ASMFC presentations.

Following the first full scale NEAMAP survey in the fall of 2007, the Councils and Commission received a second update regarding NEAMAP's progress. Specifically, NEAMAP principal investigators presented NEAMAP progress and data to the MAFMC in January 2008, the ASMFC NEAMAP Board and Operations Committees in March 2008, and the NEFMC in April 2008. NEAMAP also gave a full, 1-hour presentation to the Cape May County Party and Charter Boat Association (CMCPCBA) in Cape May, New Jersey in February 2008. The CMCPCBA is an association of charter boat and party boat captains in the South Jersey area. The results of the most recent cruise (i.e., Fall 2008) were presented to the ASMFC MSC and the Policy Board in October 2008. NEAMAP principal investigators have already been in contact with the chairman of the MAFMC to set a date to present NEAMAP's 2008 activities and resulting data to the Council.

<u>Demonstration Tows</u>

During the Fall 2007 cruise, the captain of the NEAMAP vessel and one of the principal investigators came up with the idea of conducting "Demonstration Tows" during the survey. Basically, the survey would make port calls in a number of ports throughout the survey area. Individuals representing the commercial and recreational fishing industries, management agencies, scientific agencies and institutions, the media, and local, state, and Federal government would meet the boat, and then the survey would take them out and sample a couple of sites near that port. The purpose of these tows would be to give the aforementioned individuals the opportunity to observe survey procedures and data collection first-hand, and to work toward accomplishing the goals outlined in the beginning of this chapter (i.e., inform regarding the survey process, generate support, work toward long-term funding, etc.). An entire demonstration session would be scheduled to last only a few hours to alleviate any concerns that guests may have regarding the time commitment.

NEAMAP began running these Demonstration Tows in the Spring of 2008. During this survey, NEAMAP conducted six of these trips; two from Point Judith, Rhode Island, two from Montauk, New York, and two from Cape May, New Jersey. Approximately 50 guests participated in total. These efforts were expanded during the Fall 2008 cruise. During this survey, nine of these demonstration trips were run, and more than 115 guests attended in all. These tows were made out of New Bedford, Massachusetts; Point Judith, Rhode Island; Montauk, New York; Cape May, New Jersey; and Hampton, Virginia. A list of agencies/organizations/political offices represented in the Spring and Fall 2008 demonstration trips is given (Table 1). Furthermore, the NEAMAP survey and the *F/V Darana R* participated in the New Bedford Working Waterfront Festival on September 27 and 28, 2008, running four Demonstration Tows and opening the vessel up for public tours while in port. In addition to showing guests how the field survey process is conducted through actual tows, NEAMAP personnel have also created several displays (past reports, data analyses, photographs and videos, etc.) to aid in the guests' understanding of the survey operations.

So far, all feedback from participants has been positive. Between the good reputation of our vessel captain and these outreach efforts, we now have several Rhode Island fishermen who help

us avoid untowable bottom when sampling in RIS. The bottom in this area is notoriously bad (boulders, wrecks, etc.). Now, before each cruise, we send a copy of our Primary and Alternate station layout to these fishermen. They evaluate our proposed tows and provide towing lanes for those in rough bottom areas that we would likely otherwise classify as untowable. Before we send these documents, we stress that the goal is to find areas of towable bottom, and not necessarily productive fishing locations, and note how targeting the latter would produce biased estimates for the survey. Also, recently, the survey has enlisted the help of a number of lobster fishermen in getting the word out to move gear out of towing lanes when the survey is in the area. This cooperation is the result of the captain's reputation and the survey's outreach efforts as well.

Based on the successes of these Demonstration Tows so far, the NEAMAP survey plans to continue this branch of its outreach efforts in 2009 and beyond.

Table 1. List of organizations/associations/offices represented in the Spring and Fall 2008 NEAMAP "Demonstration Tows."

Organization/Association	Cruise
Fishing Communities	
Cape May Party & Charter (Rec.)	Spring/Fall 2008
Montauk Boatmen & Captains (Rec.)	Spring/Fall 2008
RI Fisherman's Alliance (Com.)	Spring/Fall 2008
RI Commercial Fisherman's Assoc. (Com.)	Fall 2008
> 2 Dozen Independent Com. & Rec. Captains	Spring/Fall 2008
Scientists and Managers	
Univ. Rhode Island, Sea Grant	Fall 2008
Univ. Mass. Dartmouth, SMAST	Fall 2008
Stony Brook Univ.	Fall 2008
Rutgers Univ.	Fall 2008
Marine Inst., Memorial Univ. (Canada)	Fall 2008
MA Dept. of Marine Fisheries	Fall 2008
CT Dept. of Env. Protection	Fall 2008
NY Dept. of Env. Conservation	Fall 2008
NJ Marine Fisheries Council	Spring/Fall 2008
VA Marine Resources Commission	Fall 2008
Mid Atlantic Fisheries Mgmt. Council	Spring/Fall 2008
ASMFC	Fall 2008
Politicians	
Rep. Barney Frank Office (MA)	Fall 2008
Mayor Scott W. Lange (NB, MA)	Fall 2008
Rep. Jim Langevin Office (RI)	Fall 2008
Rep. Patrick Kennedy Office (RI)	Fall 2008
Sen. Jack Reed Office (RI)	Fall 2008
Sen. Sheldon Whitehouse Office (RI)	Fall 2008
Sen. Susan Sosnowski (RI)	Fall 2008
Sen. Robert Menendez Office (NJ)	Fall 2008

Media

The NEAMAP Near Shore Trawl Survey has been the subject of a number of newspaper and magazine articles since the completion of its Pilot Cruise in 2006. These articles have been found in local newspapers, as well as in both commercial and recreational fishing publications. Three local evening news stories have reported on NEAMAP's activities as well. The majority of these articles and television reports were the result of taking the reporters associated with these organizations out for the aforementioned Demonstration Tows, while a few were the product of dockside or telephone interviews.

It is worth noting that the NEAMAP survey maintains a website, www.neamap.net, and has developed a brochure for distribution at meetings, port calls, festivals, and a variety of other venues.

Newspaper and Magazine Articles

Bari, Sam. "NEAMAP: Taking Stock Aboard the Darana R." Commercial Fisheries News November 2008.

Cohen, Joe. "Researchers Aboard Trawler Try to Get Grasp on Stocks." New Bedford Times [New Bedford, MA] 29 Sept. 2008.

Miller, Carolyn. "The Fishing Line." Cape May County Herald [Cape May, NJ] 13 Aug. 2008.

Miller, Carolyn. "How Many Fish in the Sea: Part I." Cape May County Herald [Cape May, NJ] 27 Oct. 2008.

Miller, Carolyn. "How Many Fish in the Sea: Part II." Cape May County Herald [Cape May, NJ] 3 Nov. 2008.

Moore, Kirk. "Survey Breaks New Ground by Sampling Inshore Waters." National Fisherman September 2008.

Moore, Kirk. "What's Really Out There?" Asbury Park Press [Asbury Park, NJ] 17 Oct. 2008.

Moore, Kirk. "Puppy Love." National Fisherman December 2008.

Plante, Janice M. "Bigelow's Trawl Survey Gear Impresses Industry." Commercial Fisheries News March 2007.

Wall, Karen E. "Surveying the Data: A Look Inside the NEAMAP Project." The Fisherman 19 Jun. 2008.

Television News

NBC 10 Providence (RI), 13 May 2008

NBC 10 Providence (RI), 2 Oct. 2008

News12 Long Island (NY), 3 Oct. 2008

Participation in Scientific Workshops/Exchanges:
In effort to have NEAMAP data accepted by the scientific community and incorporated into the stock assessment process, NEAMAP personnel are committed to attending scientific workshops involving researchers from other agencies/institutions. To date, NEAMAP personnel have participated in an Atlantic croaker ageing workshop sponsored by the ASMFC and held in Charleston, South Carolina on October 8, 2008. The purpose of this meeting was to standardize the ageing practices for the Atlantic coast stock of croaker. NEAMAP samples were utilized during this standardization meeting.

NEAMAP principal investigators have been in contact with stock assessment scientists and fishery biologists at the NEFSC, and joint NEAMAP-NEFSC ageing workshops for summer flounder and scup are planned for 2009. NEAMAP and the NEFSC also plan to continue with personnel exchanges during field survey operations. Specifically, the NEFSC sent two field scientists to participate in the NEAMAP Pilot Cruise in 2006, and at least one of the NEAMAP field scientists plans to participate in the NEFSC Bottom Trawl Survey in Spring 2009.

NEAMAP personnel plan to participate in future scientific workshop (ageing and other) and survey personnel exchanges as these opportunities arise.

Future Challenges

The main future challenges for the NEAMAP survey fall into three main categories: funding, consistency in field operations, and data integration.

With respect to funding, one of the main objectives of the NEAMAP program at this point is to locate and secure a source of long term funding. The project is currently funded on an annual basis (see “Background” chapter). Establishing a consistent stream of funding would benefit the project in that it would free the principal investigators from the time commitments involved in finding and securing funding each year. Further, it may be that analysts could be more inclined to include datasets in their work that they are certain will remain available in the coming years.

The three main issues regarding consistency in field operations are vessel availability, standard survey net material availability, and electronic data collection system longevity. With respect to the vessel, the *F/V Darana R* and VIMS currently enter into 1-year contracts for the NEAMAP survey. Although the captain and crew of the *Darana R* are technically only bound to the contract for a year, they have informed NEAMAP personnel that as long as NEAMAP remains in existence and executed by VIMS, the vessel will be available to the project. Concerns regarding the potential retirement of the captain are alleviated by the fact that his son is planning

to assume the captain position once his father retires. Loss of vessel availability due to mechanical failure, either pre- or mid-cruise, has yet to be addressed. Ideally, NEAMAP personnel will be able to locate an acceptable alternative vessel and begin comparison work in the near to mid-future (i.e., next year or so), to resolve this issue.

Based on conversations with net manufacturers, it is apparent that some of the materials used to construct a standard gear may become unavailable in the relatively near future. Whether comparison work will be necessary will likely depend on the amount of material that needs to be substituted. Any direction from the review committee in this matter would be appreciated.

As mentioned previously, the LDCE system works well for NEAMAP's purposes and is a flexible program. It is, however, 20 years old and still operating in DOS. It is likely that this system will need to be replaced in the near future (due mainly to a catastrophic fire at the business which precludes purchase of any more of the current model of FMBs). In anticipation of this event, NEAMAP personnel have been investigating a number of options (i.e., FSCS, development of NEAMAP-specific software, etc.), but have yet to settle on a preference.

Finally, one of the main challenges for NEAMAP will be to ensure that the data generated by this program are used to their full capacity in stock assessment and, more generally, fishery science. As noted in the outreach section, NEAMAP personnel have made efforts to inform stock assessment scientists and other researchers of NEAMAP's existence and breadth of data collection, and have received positive feedback. This effort must continue, however, with NEAMAP personnel maintaining contact with outside organizations and making available the information collected from surveys.