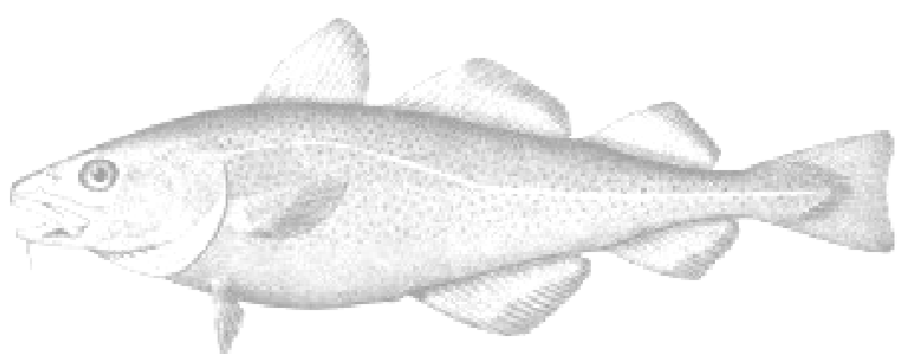
Final Report to the

Northeast Consortium

on the

Maine - New Hampshire Inshore Groundfish Trawl Survey



July 2000 – June 2001

Final Report

Fall 2000 and Spring 2001
Maine – New Hampshire
Inshore
Trawl Survey

Submitted to the Northeast Consortium
(Subcontract ZZZ-493)

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Logistically, this was a complex project that benefited from the assistance of many people not directly associated with the project. Without their help, the survey could not have been completed. Forgive us for inevitably overlooking others who provided support.

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Lastly but most especially, we appreciate the support and cooperation of thousands of fixed gear fishermen throughout the survey area who moved gear to allow us to complete the tows. Each of the Lobster Zone Councils, Maine Lobster Advisory Council, Maine Lobstermens Association and Downeast Lobstermens Association provided many comments, suggestions, and indeed challenges to make this a better project than it otherwise would have been. To all, we remain committed to improving the project and process further.

EXECUTIVE SUMMARY

This report summarizes the first year of a comprehensive bottom trawl survey of groundfish and other species for Maine-New Hampshire's inshore waters. The survey was a "proof of concept" pilot project that followed many less successful attempts at gathering fishery independent information for resource management in these inner waters. Funds set aside by Congress to assist groundfishermen were administered and distributed through the Northeast Consortium with the goal of fostering collaborative research between commercial fishermen and scientists.

This survey is intended to compliment similar surveys conducted by the National Marine Fisheries Service in the outer waters of the Gulf of Maine and one conducted by the State of Massachusetts in their inshore waters. Prior to this survey, no fishery independent information has been available for approximately 80% of the U.S. Gulf of Maine's inshore waters.

As this was a pilot project, this report emphasizes methods, collaboration and overall operational activities. In-depth analysis of only one year of data is premature. However, already some general observations may be made that confirm much of what commercial fishermen have been reporting for years.

Trawl survey data has a wide array of uses beyond simple and obvious groundfish stock assessments. In fact, it will be some years before a time series will be developed to use in stock assessment models. In truth, this is a multispecies survey that provides broad information on finfish and invertebrate populations and communities that can contribute to how we address climate change, select marine protected areas, designate Essential Fish Habitats, and study ecological patterns, processes and trophic relationships.

INTRODUCTION

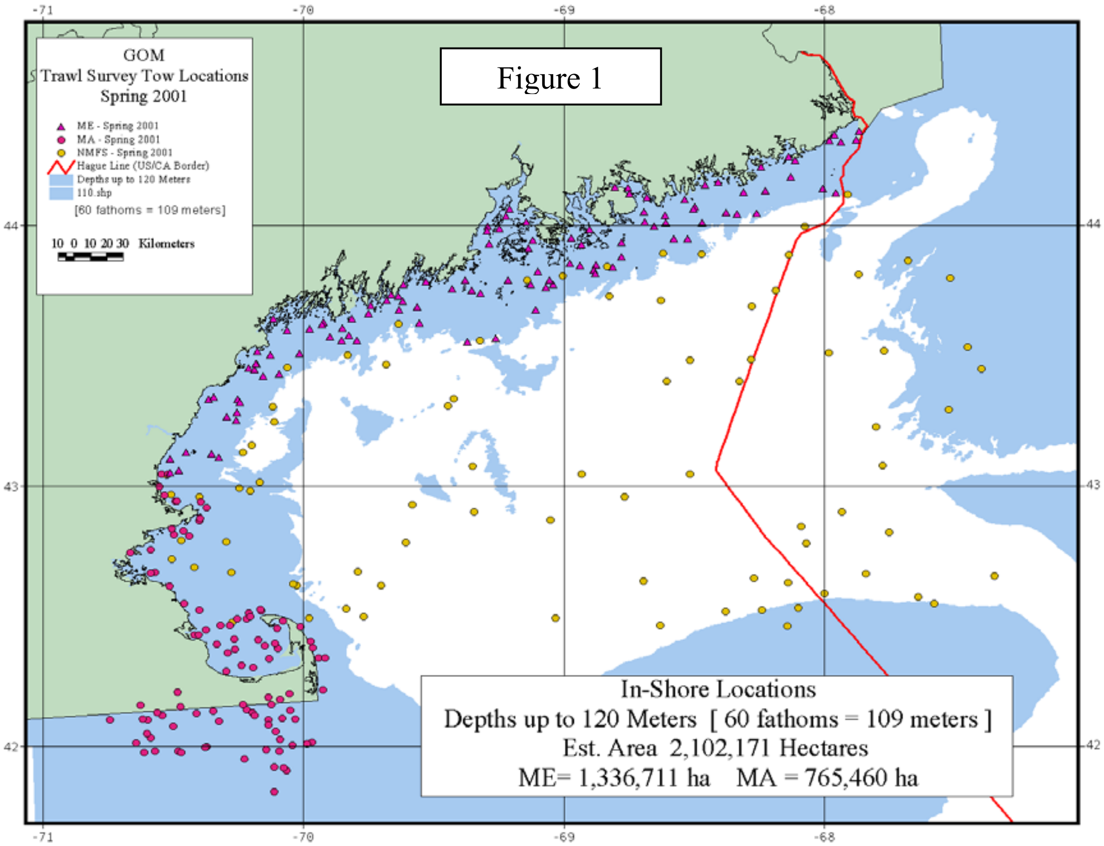
This project was a collaborative partnership between commercial fishermen and researchers to assess inshore groundfish stocks along the Maine and New Hampshire coasts. The project was funded through the Northeast Consortium from federal funds appropriated to the National Marine Fisheries Service to foster cooperative research using commercial vessels.

Assessment of fish stocks in the Gulf of Maine has been a long standing challenge, especially in the coastal waters of Maine and New Hampshire. Knowing, with confidence, population sizes, instantaneous recruitment and mortality rates, trends, and distributions are essential for effective management of any resource. Such knowledge is critical to understanding both the dynamics and the condition of that resource. The National Marine Fisheries Service has conducted bottom trawl surveys in the Gulf of Maine and Georges Bank since 1963 and the State of Massachusetts has surveyed its inshore waters since 1977. Inshore waters of Maine and New Hampshire have been only sporadically surveyed leaving the bulk of historically important inshore waters without adequate assessment. It thus seemed appropriate for the two states to cooperate in developing and implementing a fisheries independent survey of inshore waters.

The lack of survey data from large areas of the Gulf of Maine has led to significant gaps in information needed to assess current stock conditions and develop effective management strategies. With the long term intent to fill the gap in inshore stock assessments along the coasts of New Hampshire and Maine, this project was designed to monitor inshore fish stocks, assess the importance of inshore areas as nursery and spawning grounds, and to improve stock assessments.

Fishery-independent trawl surveys are a well-established and accepted method of developing relative abundance indices for fishery resources (Grosslein, 1969). They reflect changes in true abundances of fish populations, whereas commercial fishing practices change in response to market demand, fish availability, and regulations. In addition, it is difficult to measure changes in fishing power as technological improvements in commercial trawls and fish detection gear are made. Abundance indices derived from research trawl surveys are largely free of these biases. Trawl surveys also provide synoptic coverage over the total ranges of species, and comprehensive information on distribution and abundance of all kinds and sizes of fish available to the trawl within the survey area. Knowledge of distribution and abundance of juvenile (pre-commercial) fish is critical to the study of recruitment and for making predictions of future abundance.

Past efforts to survey fish stocks in the Gulf of Maine focused heavily on offshore areas. Spring and fall bottom trawl surveys for finfish resources have been conducted in offshore continental shelf waters from Cape Hatteras, NC to Nova Scotia, including the Gulf of Maine, by the NMFS since 1963. In contrast, New Hampshire and Maine inshore waters, which comprise the bulk of the known spawning and nursery areas for the Gulf of Maine (Rich, 1929; Bigelow and Schroeder, 1953) have not been continuously sampled to provide a comparable time series. The rough terrain that characterizes the bottom of the nearshore areas of northern Gulf of Maine along with the abundance of fixed gear in inshore waters limits the number of tows that can be made. Even today, NMFS surveys very few stations in waters less than 50 fathoms. Figure 1 shows an example of relative coverage between the NMFS, Massacusetts, and Maine-New Hampshire surveys using tows conducted by each during the Spring, 2001.



Sporadic attempts have been made to survey the inshore waters of the Gulf of Maine (Langton et al.1994) (Table 1). In 1979 and 1980, the Maine Department of Marine Resources (DMR) conducted groundfish surveys that were modeled after the NMFS groundfish surveys. It was hoped that this work would develop a time series of data on the relative abundance and distribution of marine resources that occur along the Maine coast. But, due to loss of funding, it was discontinued. New Hampshire had a similar effort in 1982 and 1983 (Nelson et al., 1983). In 1989, a very limited (eight stations) attempt to conduct a survey was made in Maine but not continued. From 1992 to 1994, NMFS and Saltonstall/Kennedy funded the Maine DMR to conduct biological sampling along six transects consisting of four stations each to examine seasonal co-occurrence of northern shrimp and juvenile groundfish. More recently, 1996 – 1999, surveys that focused on fish habitat were completed in the midcoast Maine area and in Saco Bay. With the possible exception of the surveys done in 1979 and 1980, none of the above described surveys were of a random design and none provided the basis for developing a long term stock assessment or time series.

Table 1
Summary of NH-ME Trawl Surveys

Year	# Tows	Vessel	Area	Depth (fm)
1979	39	Fishfinder	Maine Coast	15-80
1980	47	Fishfinder	Maine Coast	15-80
1982/3	66	Martha V	NH Coast	3-15
1989	8	Argo Maine	Maine –Mass	15-80
1992	198	Argo Maine	Maine –Mass	15-80
1993	188	Argo Maine	Maine –Mass	15-80
1994	48	Argo Maine	Maine	15-80
1996	74	Miss Grumpy	Midcoast Maine	5-70
1997	179	Miss Grumpy	Midcoast Maine	5-70
1998	194	Jeanne C	Midcoast Maine	5-70
1999	29	Jeanne C	Saco Bay	5-40

Objective
The overall goal of this project is to establish a solid foundation for a long-term fishery independent monitoring program in Maine and New Hampshire's inshore waters (5-50 fathoms). This effort will complement a similar effort begun by Massachusetts in 1976.

Specific objectives are:

- to develop, test, and refine an inshore survey method that is scientifically sound yet sufficiently pragmatic to be accomplished under the oceanographic and cultural conditions unique to the Maine and New Hampshire coasts
- to involve fishermen from communities along the coast
- to document the temporal and spatial composition and relative abundance of marine resources in the nearshore Gulf of Maine
- to develop recruitment indices for target species
- to collect environmental data, including temperature and salinity, that affect fish distribution
- to collect information on distribution, biological parameters (growth rates, feeding behavior, reproduction, habitat)
- to assist with assessment of efficacy of the inshore spawning closure, and
- to assist with refining Essential Fish Habitat (EFH) designations

MATERIALS AND METHODS
The following is only a summary of methods used for this survey. Detailed methods, shipboard procedures, reporting forms etc. are being prepared in a separate document, "Guidelines and Protocols for the Maine – New Hampshire Inshore Trawl Survey."

Sample Design
The survey is a stratified random design that closely follows methods used by the NMFS and Massachusetts Division of Marine Fisheries surveys (ASMFC, 1994). The total survey area (~10,400 km^2) was stratified by depth and region. It included three depth

strata: 5-20 fathoms, 21-35 fathoms, and 36-50+ fathoms and five regions (Table 2, Figure 2) based on oceanographic, geologic, and biological features such as current speed, temperature, geomorphology, and biological communities. Where boundaries between regions coincidentally fell very close to common geo-political features such as headlands, municipal lines and Lobster Zone Management Council borders, the geopolitical boundary was used to facilitate mailings, announcements and meetings.

Table 2

Region	Name	Dominating Characteristics
I	NH – So. ME	Slow, warm, sandy
II	Casco Bay-Midcoast	Slow, warm, indented coastline, mixed topography
III	Penobscot	Slow, warm, hard and broken bottom,
IV	Jerico-Frenchmens	Slow to fast, complex topography
V	Downeast	Fast, cold, nutrient rich, generally flat, gravel

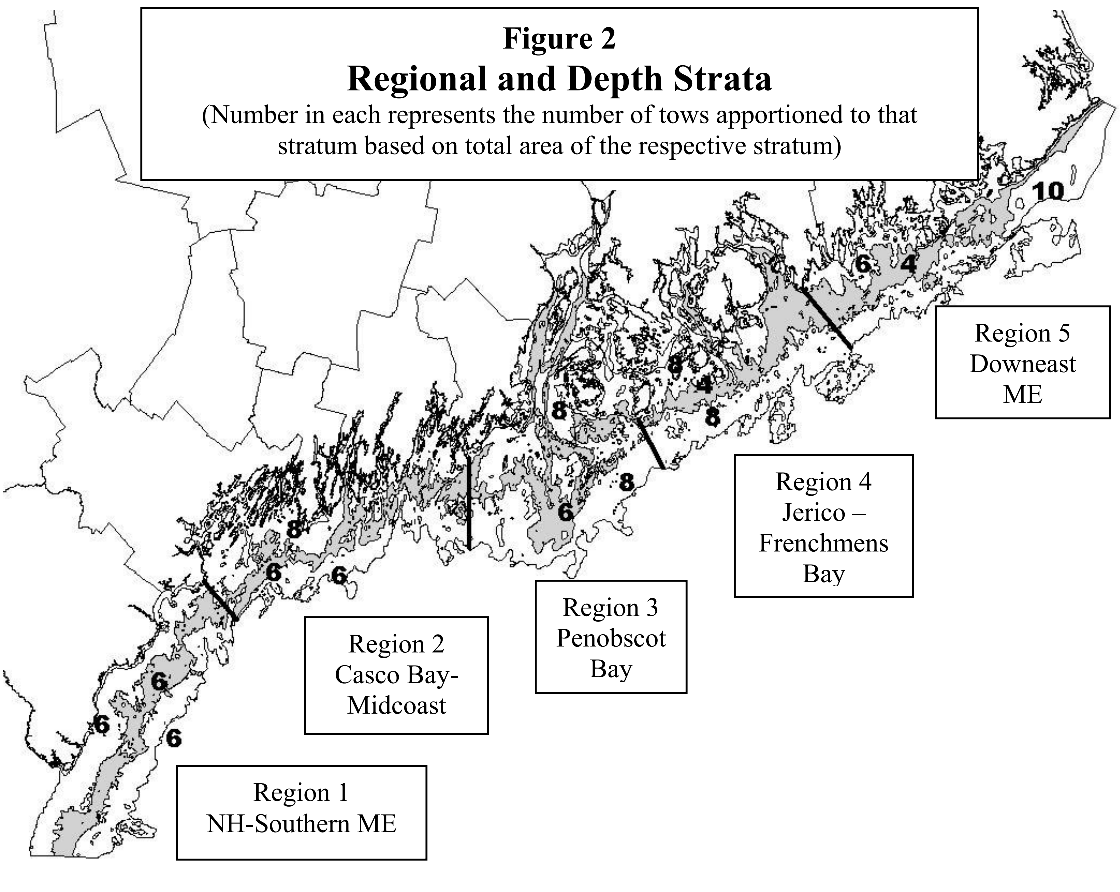
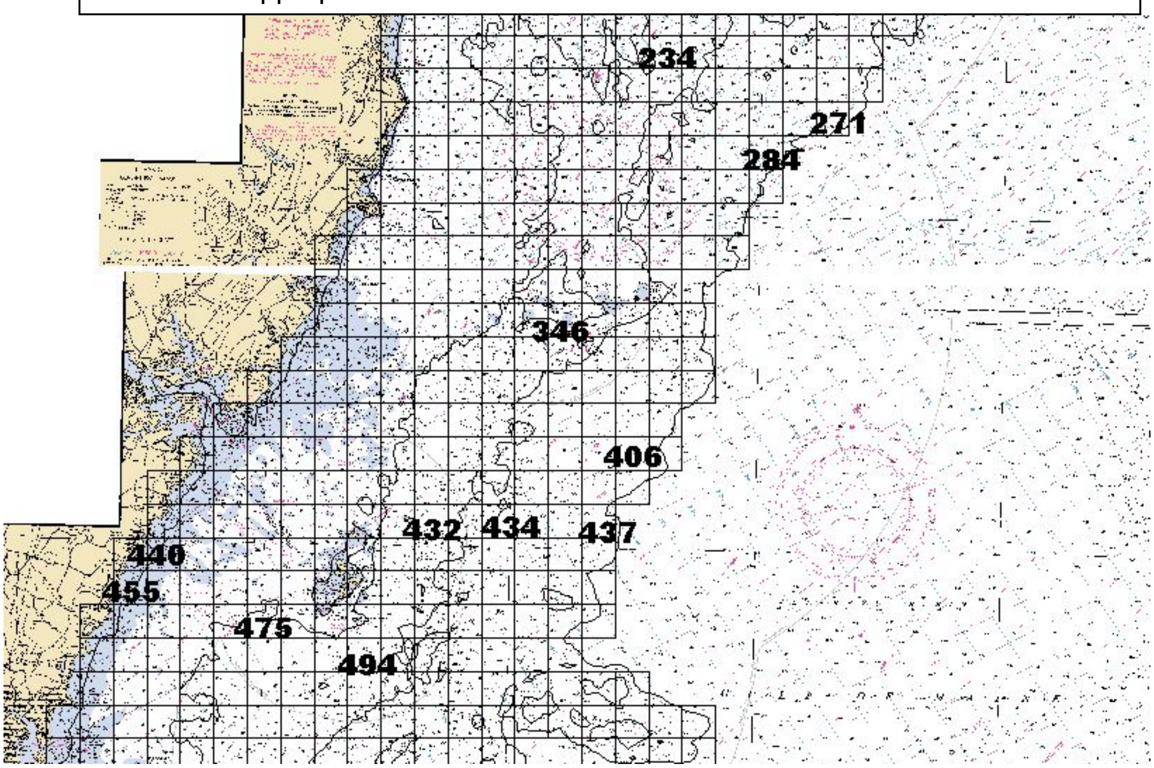


Figure 2
Regional and Depth Strata
(Number in each represents the number of tows apportioned to that stratum based on total area of the respective stratum)

The shallowest depth was based on practical constraints imposed by a 55 foot dragger while the deeper boundary was selected to meet the inner depths surveyed by the NMFS. We originally planned to also stratify the survey area according to bottom type. This would have resulted in only 2 tows per strata and the undesireable statistical implications of reducing degrees of freedom to one. The third variable, substrate type, was therefore not used. The surface area of each stratum was then delineated using ArcView. A target of 100 stations per survey was selected for sampling. To isolate interannual variation from variability introduced by a strictly random design, two fixed stations in each stratum were established based on prior knowledge that these areas were towable and "representative of the overall stratum. The remaining 70 stations were allocated in proportion to each stratum's area.

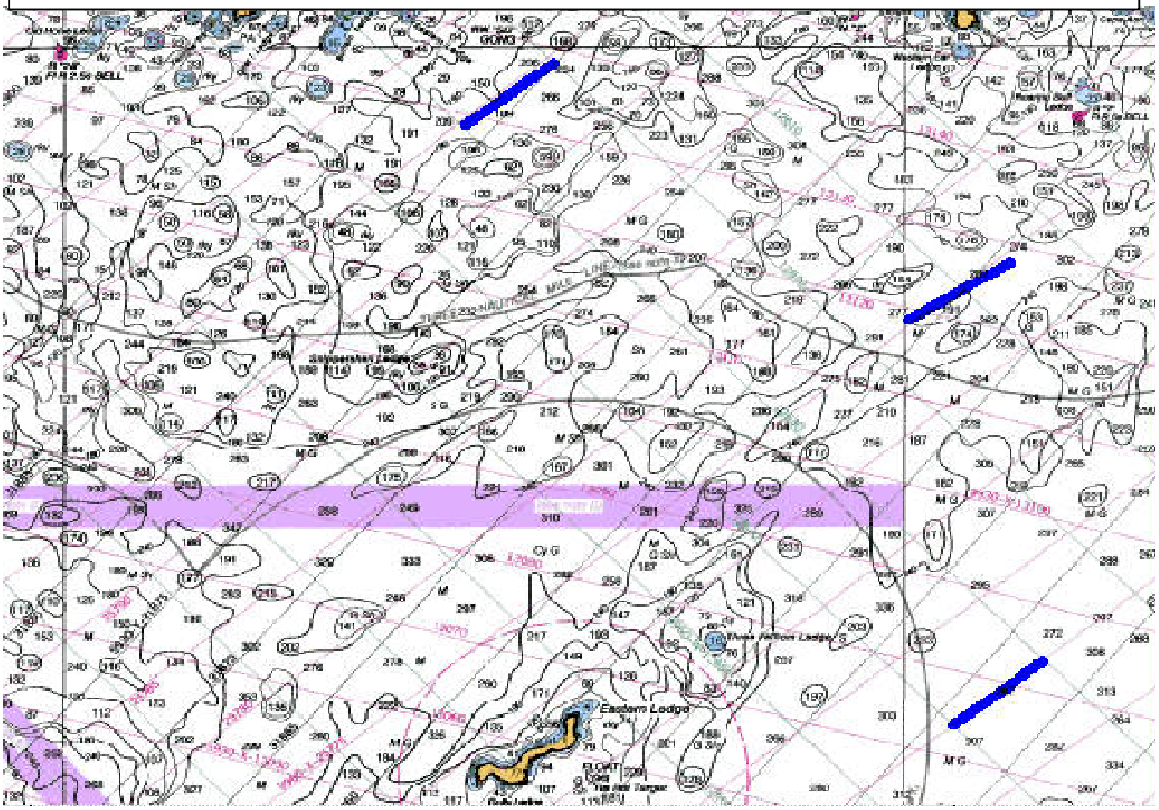
Each region was then divided into 1 NM^2 sampling grids (Figure 3) using ArcView. Large areas of the bottom that were known to be non-towable due to wrecks or "bad" bottom were eliminated from the random draw. To locate the stations, each grid within a region was sequentially numbered. Using an Excel random number generator (without replacement), the appropriate number of grids were identified within each stratum. The nearest towable bottom to the center of the grid was proposed for discussion by persons familiar with that area of the coast. To avoid obstacles, hazards, wrecks and non-towable bottom, proposed tows were presented to fishing industry members familiar with the respective areas of the coast. If a grid did not contain towable bottom, an alternate nearby tow was sought. The final survey design resulted in a sampling density of about 1 station / 30 nm^2. This density compares to NMFS 1 station / 260 nm^2 (Azarovitz, 1994) and Massachusetts' 1 station / 19 nm^2 (Correia, 1994).

Figure 3
Example of 1 NM by 1 NM grid used to divide the coast into sample units that are assigned a unique number. Sample stations are randomly drawn until the appropriate number of tows for each stratum is achieved.



Once the appropriate number of grids within each stratum have been selected, then the nearest towable bottom is identified and plotted on a chart (Figure 4). Local fishermen are used in this process to locate areas that are towable and free of objects such as wrecks or uncharted obstacles. Where possible, to assist lobstermen locate the tows, lines follow loran lines. Each tow is scheduled for a specific day on the cruise weather permitting.

Figure 4
Example of potential tows identified from charts and local knowledge.



Gear and Vessel Design
The guiding principles for designing the gear for this survey were as follows:

- Approximately comparable to the Massachusetts Survey
- Vessel size adequate to fish out to 50-60 fathoms yet small enough to fish in shallow waters
- Nets useable by other vessels in the inshore Maine-NH fleet, designed to fish effectively with low impact to the bottom, and contain modern and available materials for ease of maintenance.

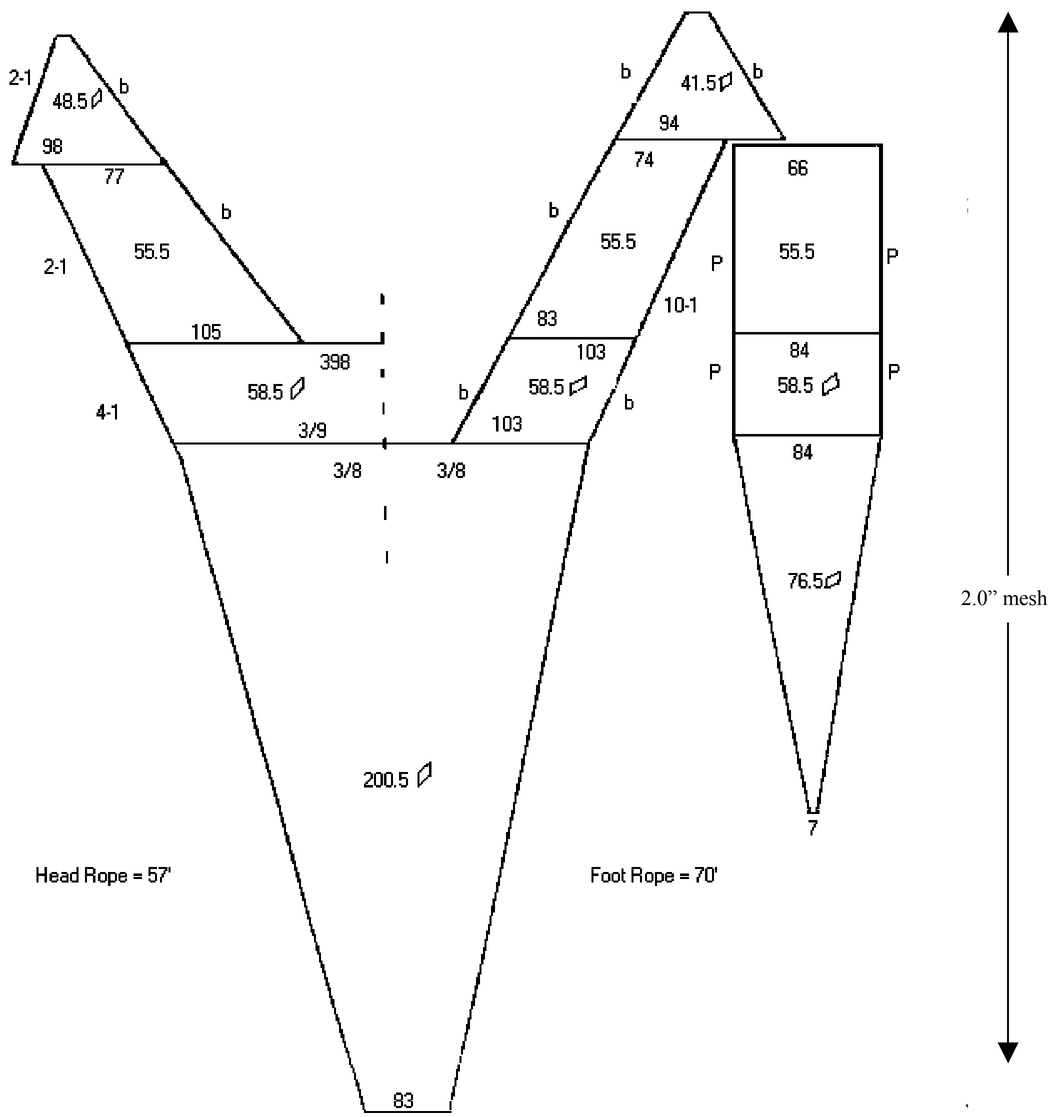
Vessels
Two, virtually identical commercial fishing vessels, the F/V Tara Lynn and F/V Robert Michael, and crew were used for the survey. While only one vessel at a time was planned for each survey, in the event of an equipment breakdown, the other could be made immediately available so that the survey could be completed on schedule. Both

vessels are Down East 54's of solid fiberglass with full displacement hulls taken from the same mould. They are powered by 8-cylinder GMC diesel engines producing 325 H.P. The reverse gear is a twin disk; 3in. stainless steel shaft that goes to a 4-bladed power propeller. The vessel's hull displacement is 33-net ton allowing it to perform well in sea states up to eight feet.

Net

Trawl design considerations for the survey include effectiveness of the gear for sampling the complex bottom in the Gulf of Maine and approximate comparability with previous and ongoing surveys. The net is a scaled down version of the most common shrimp and modified shrimp net design used by Maine's dragger fleet (Figure 5).

Figure 5
Net Design for the Maine – New Hampshire Inshore Trawl



The net was designed by the vessel owner and his net designer, Jeff Flagg, to fish effectively, be easily maintained, and be towed by vessels ranging from 45 – 70 ft. with nominal horsepower. Net tapers were cut to permit the shape of the net to get maximum height, while allowing the net to remain tight on the bottom. The net is shackled from the footrope to the frame using two 3/8-inch shackles to a banded wire that runs parallel with the footrope. Heavy rubber wing bobbins retard bottom wing lift. The top leg is 3/8th inch wire, 15 fathoms long, and the bottom leg is 15 fathoms. The net is constructed of 2 inch mesh overall with a ½ inch mesh liner in the cod end. Doors are #7.5 Bisons. The 70 ft. footrope includes 70' of 6 inch cookies. Chain sweeps were not used. Between surveys, the net is sent back to the manufacturer where it is returned to specification.

Because the net had never been used for assessment work, it was tested and adjusted before the survey began. The crew spent one day off Portland conducting side-by-side comparisons of the survey net with a commercial net that the vessel captains were familiar with. Catches between the nets were compared for relative proportions and species caught. Absence of sedentary benthic specimens such as seastars would suggest that the net was not fishing close to the bottom while sign of mud in the cookies would suggest that it was fishing too heavily. This "pre-survey" trial gave the Captains experience with the net before the actual survey tows were made and ensured that the net was fishing properly.

Public Participation

Well before the project design was finalized, discussions began with representatives of both the groundfish and lobster industries to understand their interests and concerns and to gain their cooperation. From the groundfish industry we heard that if we were to do these surveys, they had to be done in a sufficiently professional way to be used by the NMFS and State managers. They were concerned that the science and methods we used be rigorous and that participation by fishermen not impair the credibility of the data collected. We also held three evening planning meetings with groundfishermen invited from throughout the coast in Ellsworth, Rockland and Portland to review the proposed tows, identify whether they were in fact towable, and if not locate the nearest tow to the randomly drawn grid. We also requested information on berthing, navigation problems, and local persons knowledgeable of the area so that we could use them as a resource once underway.

It was obvious that much effort would be needed to earn the cooperation of lobstermen who we hoped would move gear 1/8th mile back from either side of the planned tows. Therefore, a second series of meetings were held with lobstermen. The potential for conflict with fixed gear such as lobster traps was a high concern from the outset. Both the Massachusetts and NMFS surveys have encountered difficulty with fixed gear. Considerable time was spent writing news articles, meeting with lobster associations, and individual fishermen. Trawl survey staff attended all seven Maine Lobster Zone Management Council meetings at least once and some as many as three times prior to the fall 2000 survey to address questions about the upcoming survey as well as receive suggestions on how to gain cooperation by fellow industry members.

Table 5
Partial List of Outreach Meetings and Presentations

Date	**Location**	**Meeting**
August 1	Portland	Western ME and NH Advisors
August 2	Ellsworth	Eastern ME Advisors
September 6	Yarmouth	Zone F
September 11	Kennebunk	Zone G
September 12	Rockland	Zone D
September 13	Hallowell	Lobster Advisory Council
September 13	Hallowell	Fishery Advisory Council
September 20	Mt. Desert	Zone B
October 4	Yarmouth	Zone F
October 5	Portland	Western lobster and groundfish to id trawls
October 11	Ellsworth	MLA
October 12	Machias	Zone A
October 12	Wiscassett	Zone E
October 19	Stonington	Zone C
October 20	Ellsworth	DELA
October 23	Machias	Eastern lobster and groundfish to id trawls
October 26	Machias	Zone A
January 11	Rockland	Zone D
January 17	Hallowell	LAC
January 24	Hallowell	Maine AC
March 3	Rockland	Maine Fishermens Forum
April 10	Scarboro	Western Maine
April 11	Hallowell	Maine Lobster Advisory Council
April 12	Damariscotta	Midcoast Maine
April 18	Ellsworth	Downeast Maine

Many suggestions by lobstermen and fishermen were incorporated in the workplan. Not surprisingly, fishermen unanimously wanted to lose as little fishing opportunity as possible (fall being their prime fishing time). They insisted on predictability and the smallest tow swath possible. However, the actual methods recommended to achieve these were not universal thus necessitating redundancy in the system we ultimately used. Proposed tows with a daily schedule were prepared in detail depicting the actual tow lines on a nautical chart as well as beginning and ending Loran C (W-X Range) coordinates. Sets were mailed to licensed lobstermen in New Hampshire and Maine (~7,500) at least two weeks prior to the tow.

To stay on a predictable schedule around which fishermen could conveniently plan, a conservative number of tows, usually four, were scheduled on any given day. Although we easily could have done more tows per day, we elected to not do so to avoid falling behind which would then prolong the length of time fishermen could not fish the tow area. In addition, we chose to work the first five good days of the week leaving two to make up for days when weather or equipment prevented us from working. This approach is in contrast to the Massachusetts and NMFS surveys that run continuously until the surveys are done. Despite the greater inconvenience to the crew, we deliberately elected to add an extra week to adhere to a schedule that fixed gear fishermen could rely on.

To aid predictability, several other means of communication were established. A web site was dedicated to providing full details of the daily schedule, similar to that sent in the mailings. Pre-recorded announcements were broadcast over the NOAA weather radio. Because they were recorded two days before, they were not considered "real time" but rather reminders that the survey was in the area. For accurate daily information, a 24 hour toll-free telephone recording was updated by 4 AM each morning during the survey. For "real time" information, we encouraged fishermen to contact the trawl survey vessel on Channel 16 or 13. Finally, both office and home phone numbers of key survey staff were provided to fishermen to assure availability during the survey.

Sample Collection (Towing)
Before each tow, at least one pass, and often two passes, was made along each planned tow line. On each pass, the area was surveyed for fixed gear and the bottom sounded to identify bottom obstructions. Where bottom was deemed towable and a route through gear identified, the net was dropped to the bottom. Tow times were recorded when the net arrived on bottom to when haul-back began. A target time of 20 minutes was sought, although as per NMFS and Massachusetts, a minimum tow time of 13 minutes was acceptable. Location (Loran C co-ordinates, latitude, and longitude), time, depth, direction, and duration were recorded for each tow. Bottom temperatures and salinities were collected at each station for using a SeaBird Model SBE 19-03 CTD. Other environmental data, including air temperature, wind, sea state, tide, and weather were also recorded at each station. All tows were conducted during daylight.

Handling Catch
After each tow, the net was brought aboard and emptied onto a sorting table. All lobsters were immediately separated from the rest of the catch by sex and placed into plastic baskets to minimize mortality and damage, concerns expressed by lobstermen. Total weights (by sex), carapace length (mm), shell condition, presence of eggs V-notch condition, and trawl damage as well as old damage were recorded. Similarly, care was taken to immediately separate, measure, weigh and release alive those rare or "valuable" species including cod, haddock, halibut, and sturgeon.

All individuals were identified and sorted by species. Finfish lengths were measured as total central length to the nearest centimeter. Crabs were measured using carapace length (cm). Scallops were measured using the width (cm) of the shell. Other bivalves were measured using the length of the shell. Squid were measured using mantle length. All other invertebrates were enumerated. Aggregate weights were taken for all species. With the exception of lobster data, all data were logged on a data form. Lobster data was recorded on mini-cassette tape recorders. When catches were large (ie. > ~200), as in herring and whiting, a subsample of at least 100 representative individuals was taken, measured and weighed. Total catch statistics were then expanded based on the total catch weight. Lobsters were not routinely subsampled but rather all individuals were measured.

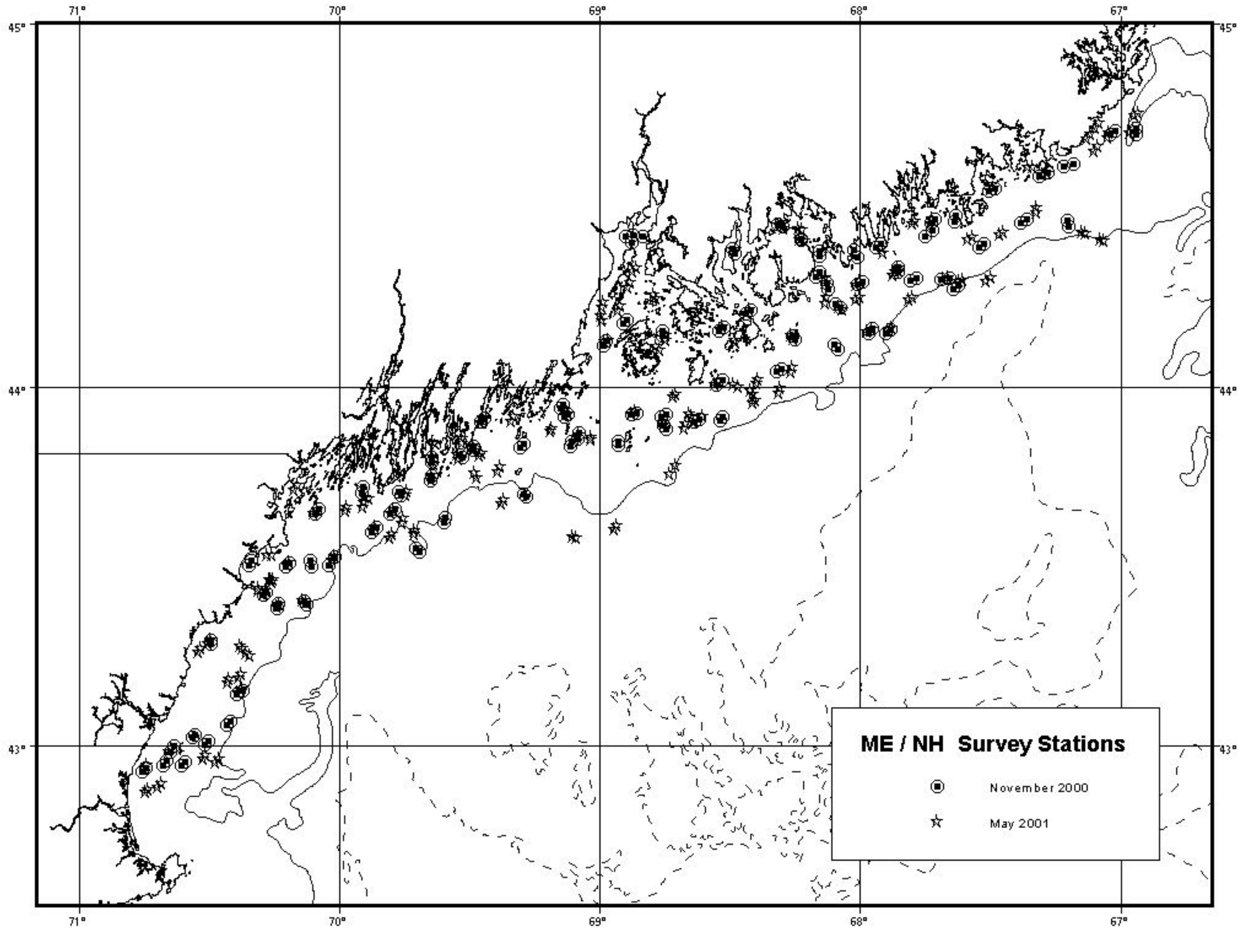
In the spring 2001 survey, additional biological data were collected. For example, individual weights were recorded for selected groundfish species such as cod, haddock, and winter flounder. Sex and maturity stage of individuals was determined for these species using the methods described in Burnett et al. (1989). Fish examined were designated as immature (I), developing (D), ripe (R), ripe/running (U), spent (S), or resting (T). When possible, all groundfish were examined, a sub-sample was taken if the catch of a particular species was large. Otoliths were collected for winter flounder in the spring as well.

Confidentiality of Data
In direct response to concerns expressed by Maine's fishing communities, we are treating the raw data collected from individual tows as confidential. This is provided for under Maine Statute (MRSA 6173). In actuality, doing so does not diminish the value of the survey since the results will be evaluated and presented in aggregate form for each strata and not on an individual tow basis.

RESULTS

Two surveys were conducted; one in the fall beginning October 30, 2000 and a second in the spring, beginning on April 23, 2001. Each cruise required 25 days over a period of five weeks. Completed tows for each survey appear in Figure 6. Descriptive data, including geo-references, trawl duration, depth, salinity and temperature for each survey are presented in Appendix A.

Figure 6
Locations of Fall 2000 and Spring 2001 Tows



Obviously, a single year of data affords no ability to develop a time series to be used for more than anything but the most general of conclusions. Also, since this was the first year, the first few weeks of the fall survey, especially, was a period in which the crew was testing and developing skills, procedures, and methods. Nevertheless, data collected from this first year does reveal some interesting findings.

Ninety-nine taxonomic groups of fish and invertebrates were caught (see Taxa List - Appendix B). For this report, we have selected examples for which we can report results. The complete catch result summaries are presented by species for each stratum in Appendix C.

Fall 2000 Summary

Seventy eight of the 96 planned tows were made. Untowable bottom and presence of fixed gear prevented us from towing the 18 not towed. The volume of the total mixed catch varied from a minimum of 4 kg to a maximum of 640 kg per tow. The average weight of catch was about 122 kg per tow. The total number of species caught in the fall was 80 with a low of 7 and high of 31 in any particular tow. Relative coastwide ranking for the top 10 species is reported below in descending order.

By Number	**By Weight**
Herring*	Silver Hake*
Silver Hake*	Lobster
Mixed Shrimp	Herring*
Alewife	Dogfish*
Lobster	Alewife
Rainbow Smelt	Winter Flounder*
Scallop*	Red Hake*
Winter Flounder*	Longhorn Sculpin
Longhorn Sculpin	Monkfish*
Menhaden	White Hake*

* Species managed by the New England Fisheries Management Council

Spring 2001

One hundred eleven tows were made in the spring. We were able to achieve this by anticipating untowable bottom and planning 1 extra randomly selected alternate tow per stratum for a total of 115 planned tows. Weight of total mixed catch varied from a minimum of 4.5 kg to a maximum of 5,007 kg per tow, with an average of 87 kg per tow. Number of species caught per tow ranged from 4 to 31. Total number of species caught during the Spring 2001 survey was 87. Relative coastwide ranking for the top 10 species is reported below in descending order.

By Number	**By Weight**
Herring*	Herring*
Mixed Shrimp	Lobster
Alewife	Longhorn Sculpin
Silver Hake*	Sea Cucumber
Blue-back herring	Silver Hake*
Longhorn Sculpin	Alewife
Lobster	Winter Flounder*
Scallops*	American Plaice*
Winter Flounder*	Sea Scallop*
American Plaice*	Sea Raven

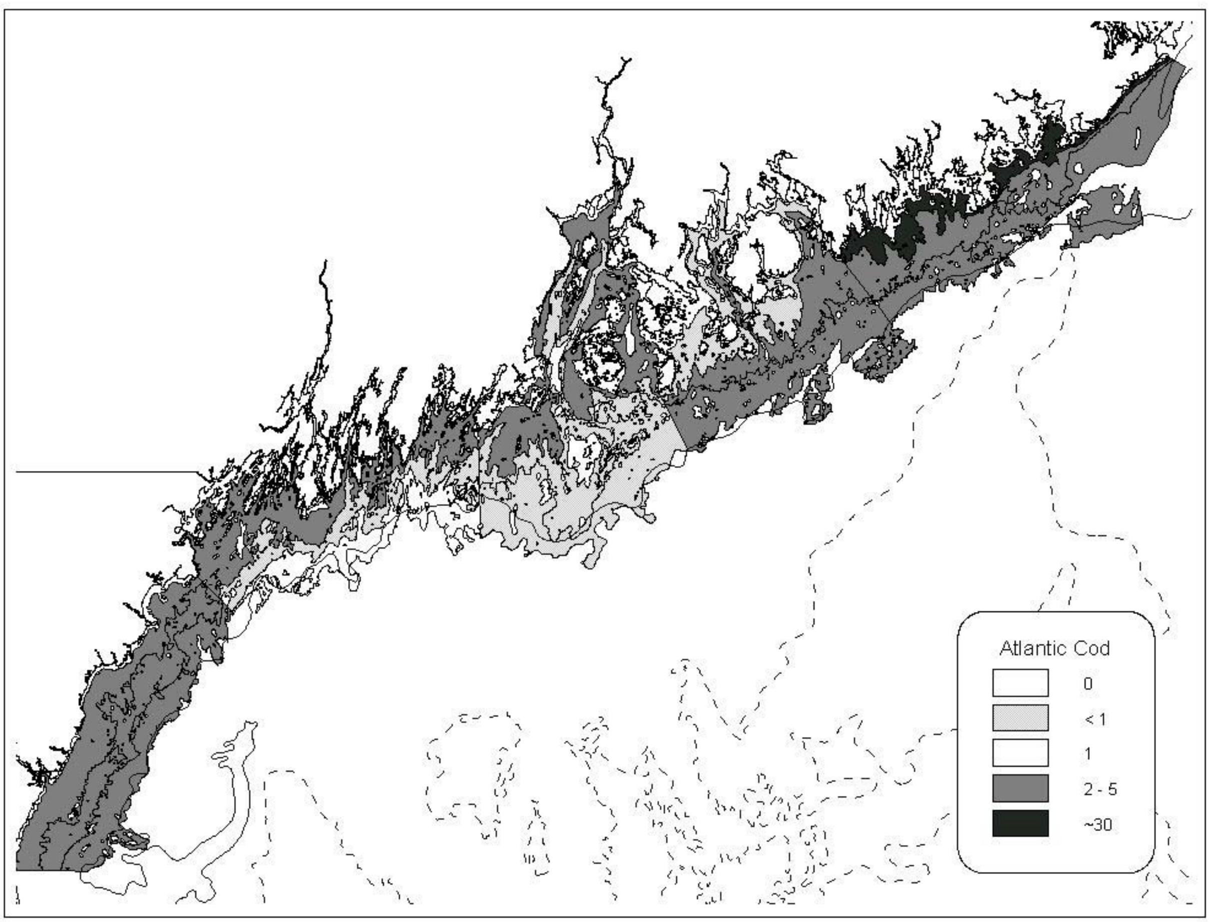
* Species managed by the New England Fisheries Management Council

With 61 finfish species and 38 types of invertebrates sampled, a species by species presentation of results is not practical for this report. However, following are some examples of the sorts of results that this survey can produce. Note that we include some examples of non-groundfish species to demonstrate another attribute of a fisheries independent survey; that the survey can provide information beneficial for management of the system and not focus soley on a select suite of target species. Information is gathered on an ecological community level. Rainbow smelt, for example, may not be directly exploited commercially but it provides enjoyment to upland recreational anglers and on an ecological level is a forage species for higher trophic levels. Sculpins, cartilaginous species, and predator-prey ratios, for example, have been used as indicators of system-wide health. Landings data do not include information on these species. Over the long term, system shifts as a result of climate change may be assessed as exemplified when the Fall Survey encountered species such as barracudina and scup that historically have not been common north of Cape Ann, Massachusetts.

Cod

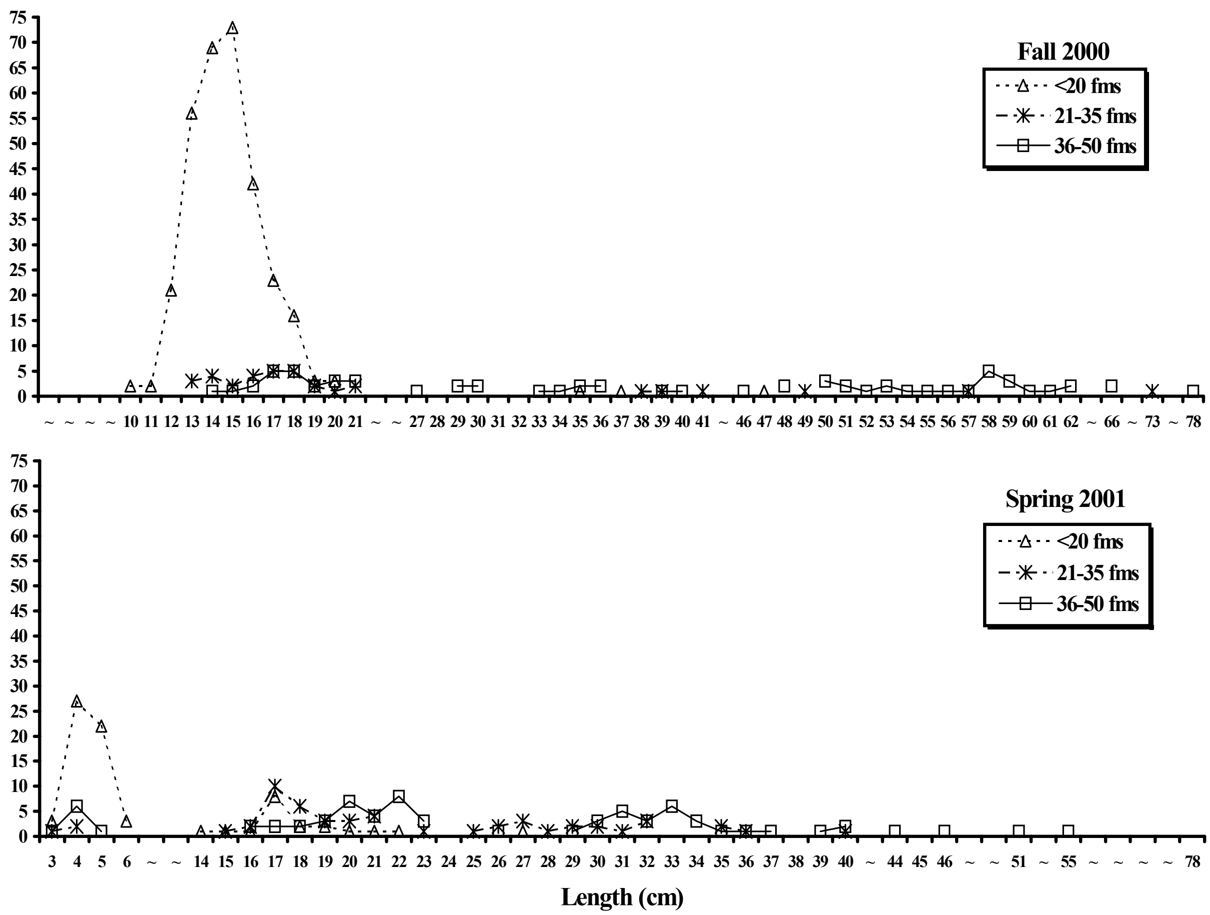
Figure 7 shows the distribution of cod caught along the coast in the fall and spring surveys combined.

Figure 7
Cod Distribution Along the Maine – New Hampshire Inshore Waters
Fall and Spring Inshore Trawl Survey



By looking at population structure as well as distribution, the importance of shallow inshore habitat for cod becomes clear. The Fall 2000 portion of Figure 8 shows a year class of cod that probably hatched in February-April 1999. Most are still in the shallowest strata. As the fish grow, they move offshore and disperse into deeper water. In the Spring 2001 portion of Figure 8, one can see young of the year in the shallow strata. Offshore in the spring, there appears to be more cod in the deeper strata but certainly not in the numbers that were observed the previous fall. From a single year's tow, it is not possible to know whether or not the spring survey missed the next year class due to late inshore migration or whether there simply was a weak year class. Cod, and most other groundfish species, move into deeper (warmer) water in late fall to return in the spring as inshore waters warm. Whether the fish were still farther offshore and had not migrated in at the time of the spring survey, we cannot determine. The spring of 2001 was cooler than normal. Subsequent year's tows and comparisons with the offshore NMFS data set will help to resolve this question. As the Maine spring spawning closure for groundfish "sunsets" at the end of 2002, trawl survey data will be used to evaluate the need to extend the closure during the next Maine legislative session.

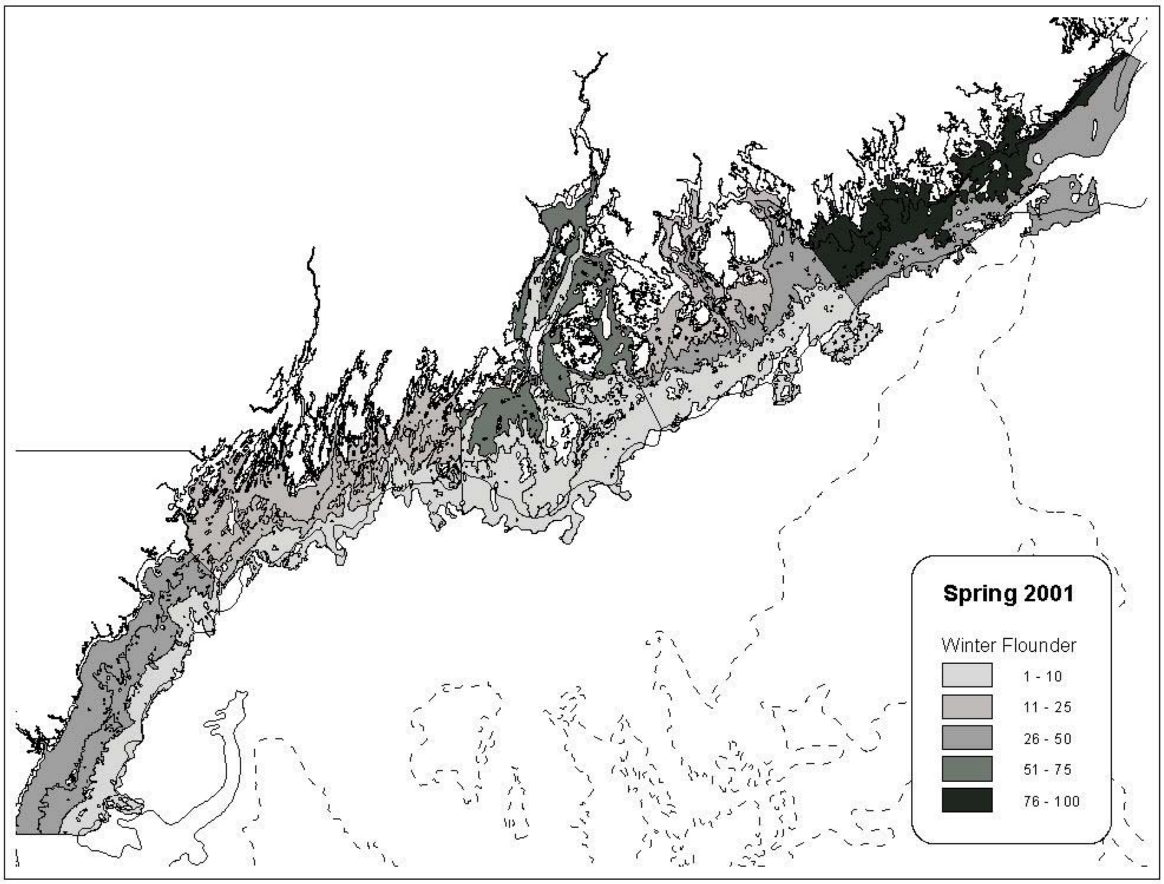
Figure 8.
Atlantic Cod Length Frequencies
Maine-New Hampshire Inshore Trawl Survey



Winter Flounder

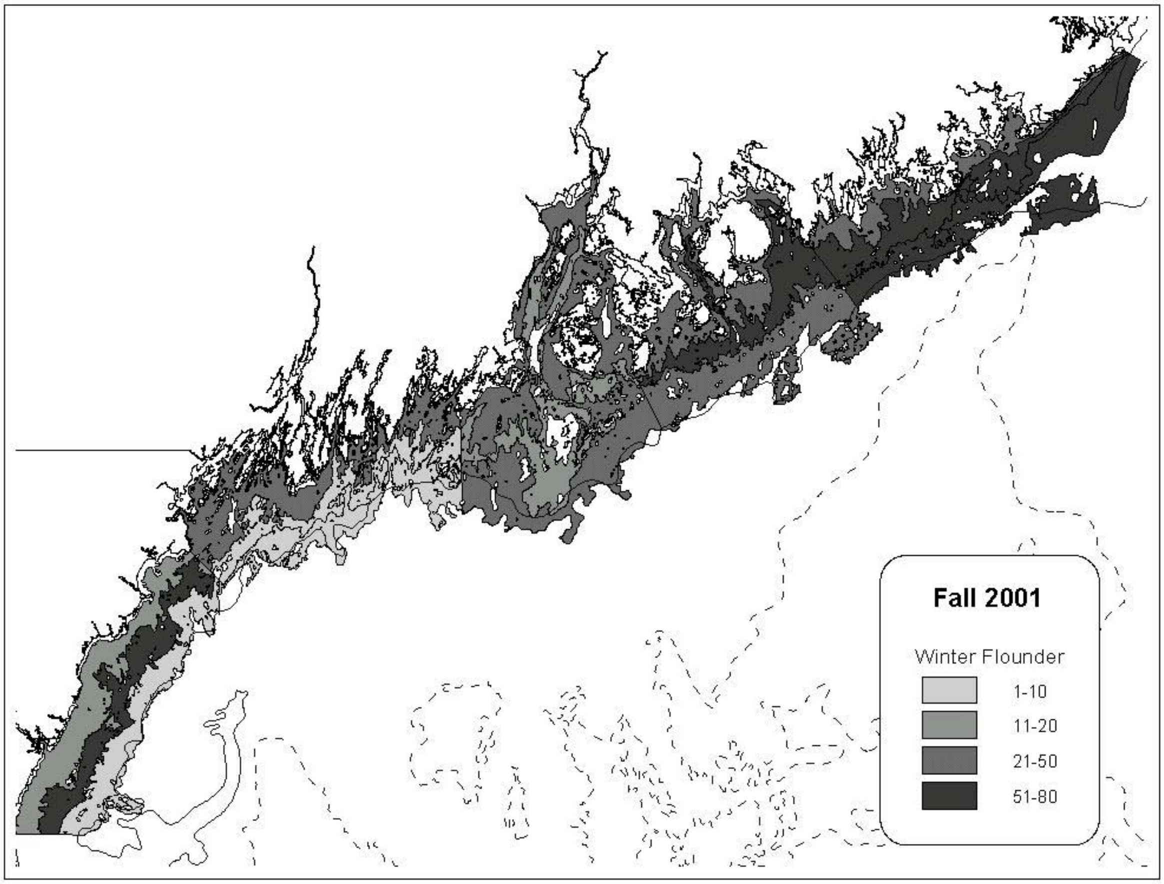
Figure 9 shows the distribution along the coast of winter flounder caught for the spring of 2001.

Figure 9.
Winter flounder Distribution Along the Coast
Spring Inshore Trawl Survey



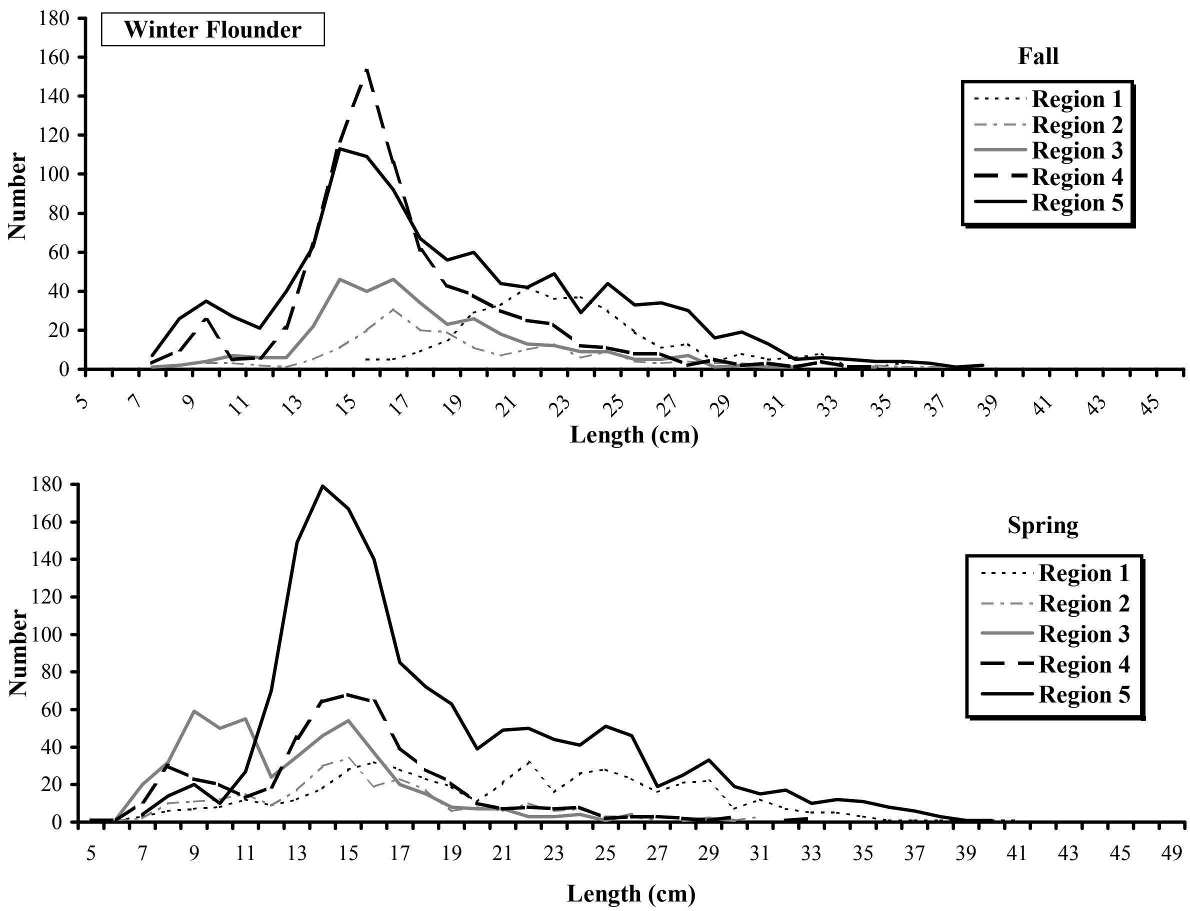
Winter flounder were one of the most ubiquitous species found in the surveys being caught 95% of the time. They were slightly more abundant in the spring than the fall in this first year. The largest concentration of fish was seen in the eastern part of the coast and in the shallowest strata. Figure 10 illustrates the distribution of winter flounder along the coast in the fall of 2000. Although overall abundance was somewhat less, they were more abundant in the east in the fall as well. As differences between the fall and spring means were within their standard errors, the seasonal variation may not be significant. Concentrations appeared to be greater at increasing depths in that area.

Figure 10.
Winter Flounder Distribution
Fall Inshore Trawl Survey



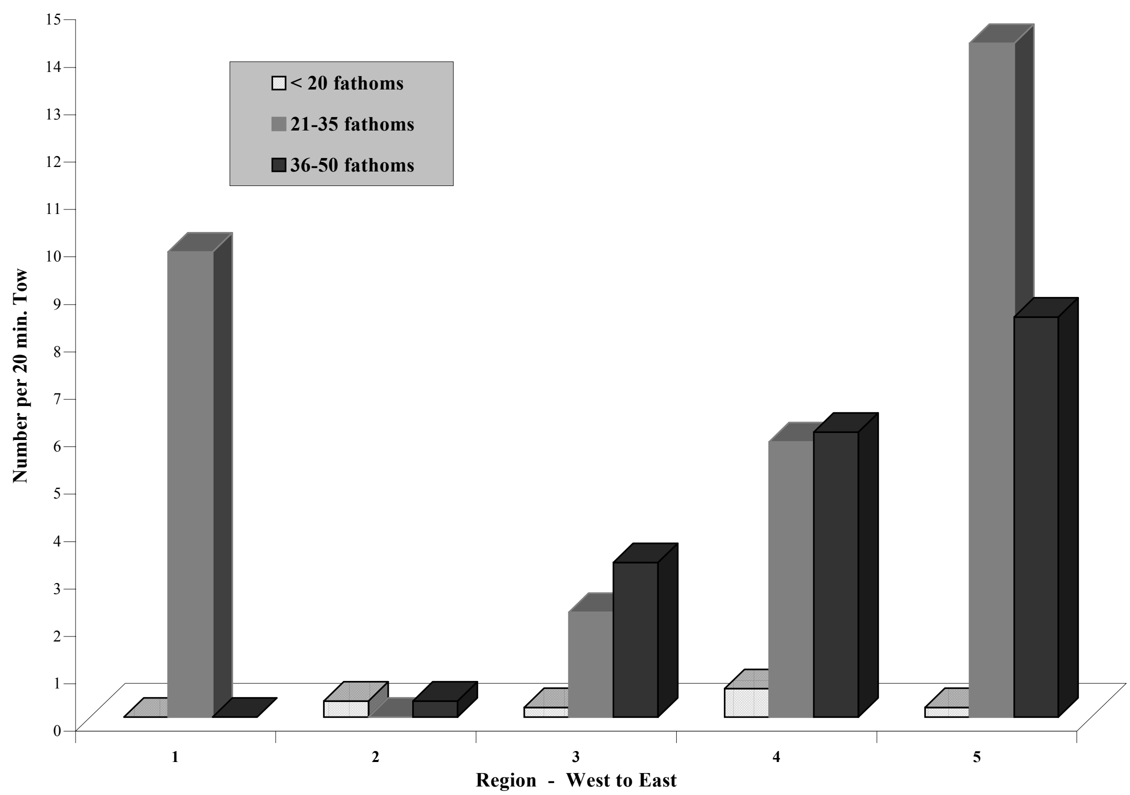
The majority of winter flounder caught were small; mean length per strata ran between 13 to 28 centimeters for the fall and 13 to 27 centimeters for the spring (Appendix C.). As seen in the length frequency distributions in Figure 11, larger fish occurred in greater numbers in the southwest (Region 1) and the northeast (Region 5). Generally, the size distribution was similar for the entire coast.

Figure 11
Length Frequency Distributions of Winter Flounder
Distinguished by Region Along the Coast



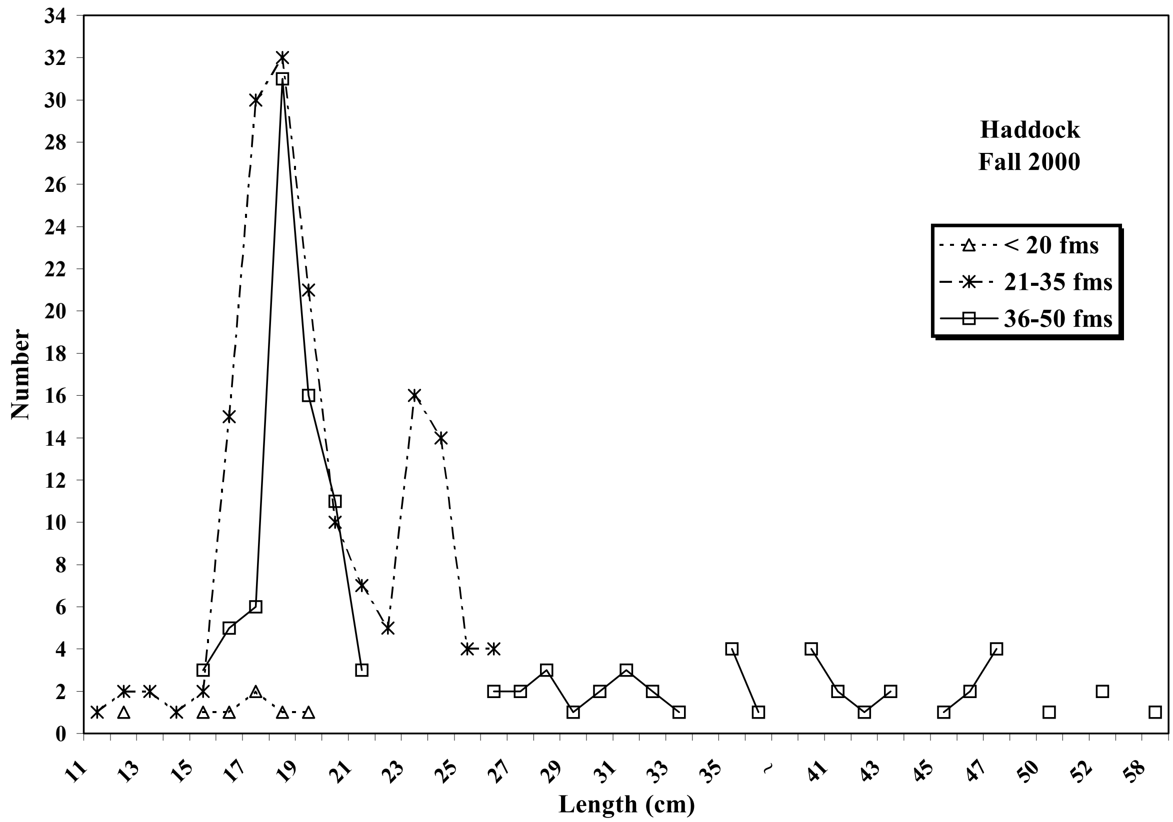
Haddock
Haddock distribution for the fall of 2000 is shown in Figure 12. Only one three-centimeter specimen was caught in the spring in eastern Maine at 21-35 fathoms. It is conceivable that the haddock were at areas of greater depth during the spring of 2001. Abundance was usually low; aside from one larger catch along the southwestern coast, it increased towards the east. Haddock abundance was low in the shallowest depths.

Figure 12
Haddock (Melanogrammus aeglefinus)
Distribution Along the Coast by Depth Stratum in the Fall



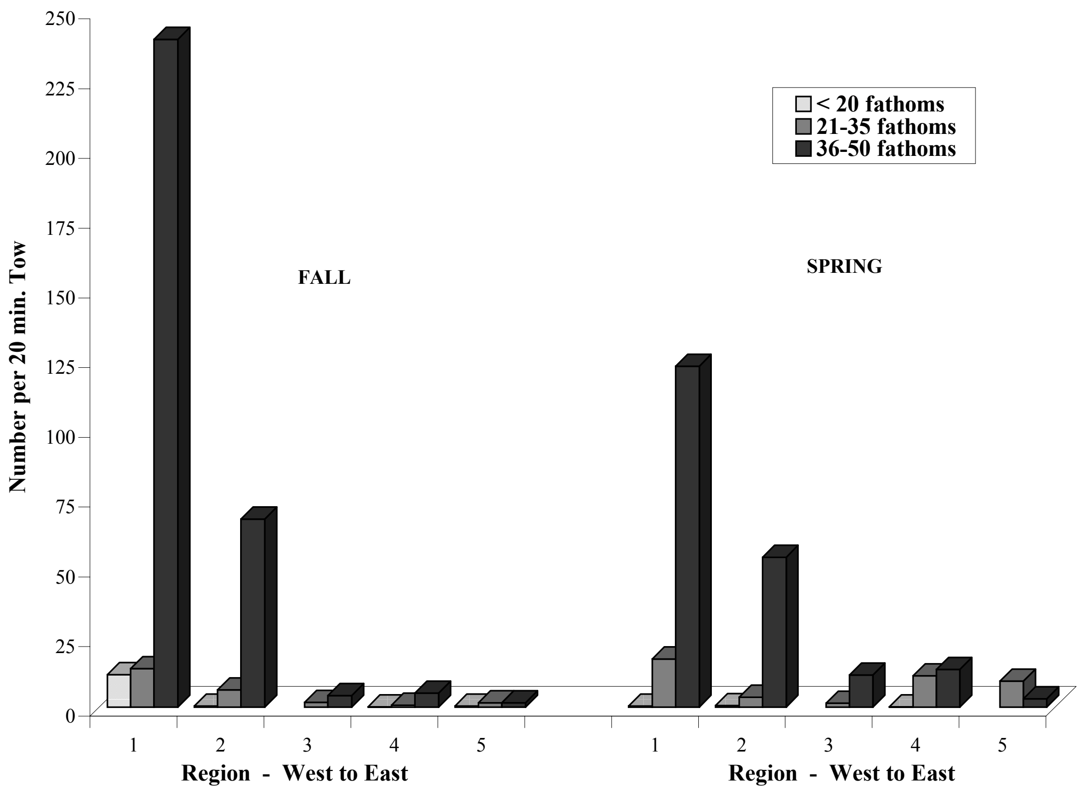
The majority of fish caught were juveniles as seen in Figure 13, only three fish of legal size were caught. The inshore waters of the Gulf of Maine appear to be an important habitat for juvenile haddock. Results from previous DMR surveys indicate that young of the year cod and haddock can be found utilizing the same habitats (Sherman, unpublished).

Figure 13.
Length Frequency of Haddock
Fall Inshore Trawl Survey



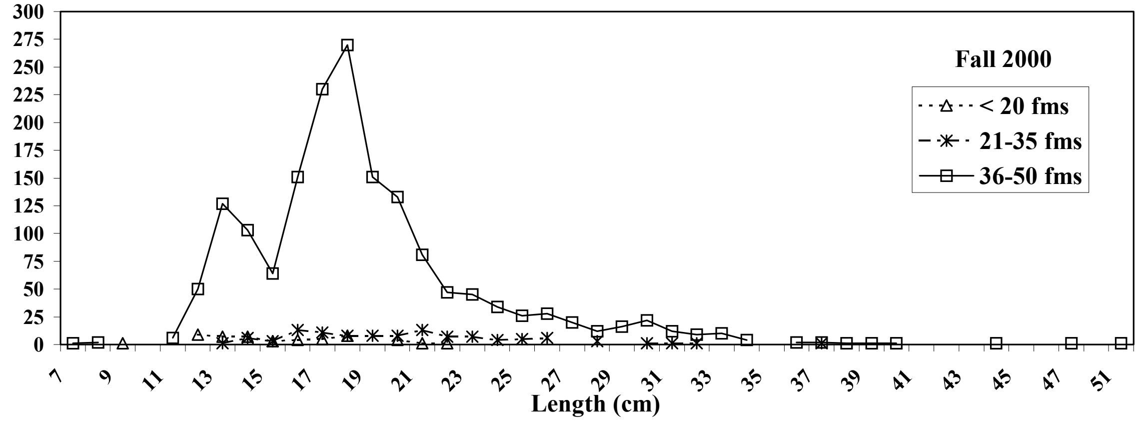
American plaice
Figure 14 displays the distribution of plaice along the Maine/New Hampshire coasts. Greater numbers of individuals were caught along the southwest coast in the deepest strata. In region 1, which encompasses New Hampshire and Southern Maine, approximately twice the number of plaice were caught in the fall. Seasonal differences along the remainder of the coast were not as evident.

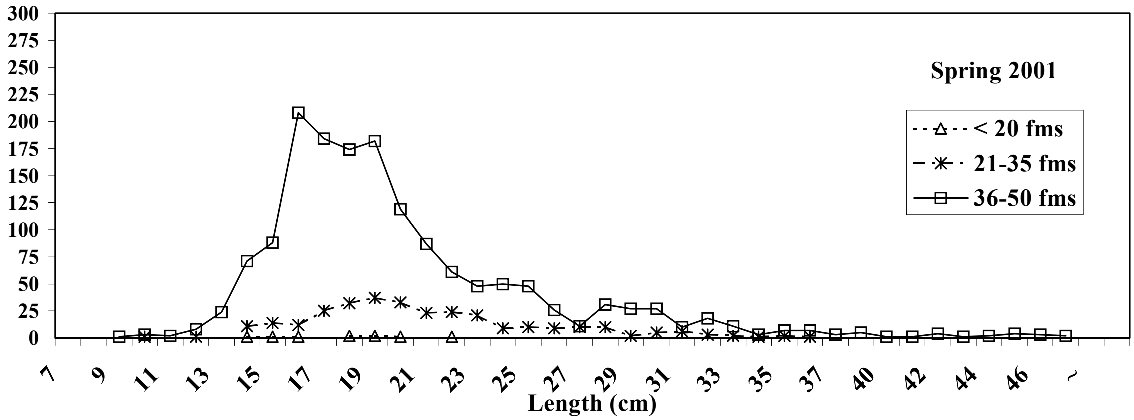
Figure 14.
American Plaice Distribution
Seasonal Distribution Along the Coast by Stratum



Two year classes of American plaice can be seen in the length frequency graphs in Figure 15. The strongest concentrations of juveniles are seen to be in greater than 36 fathoms; smaller concentrations are seen in the shallower depths. Adult fish are almost exclusively seen in the deepest stratum, with the incidence slightly greater in the spring.

Figure 15
Length Frequency Distributions for American Plaice

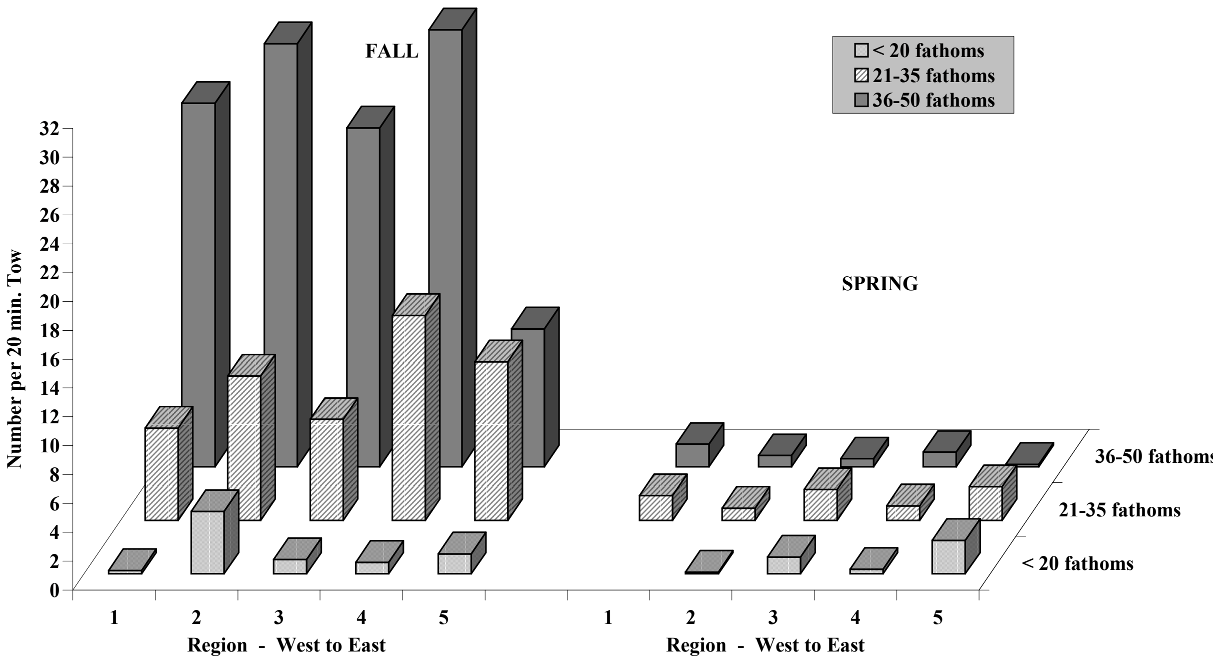




White Hake

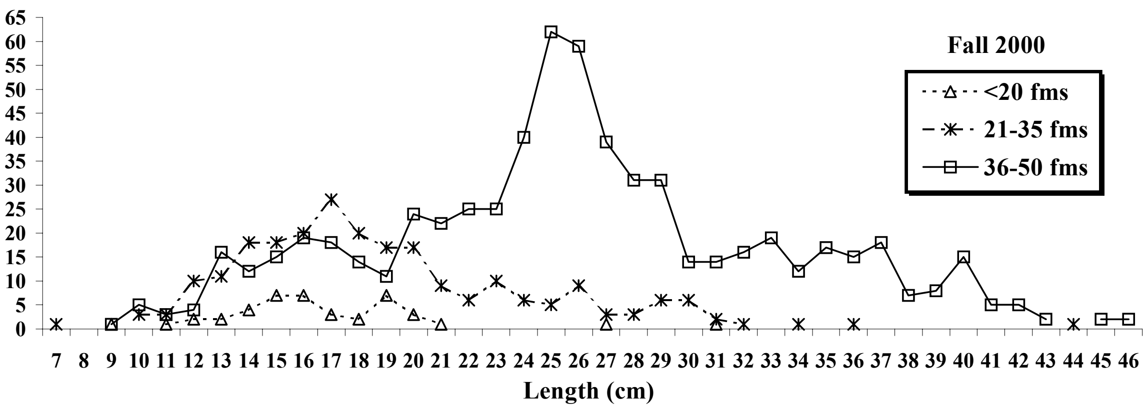
White hake are typically more abundant in the inshore waters in the late summer and fall as seen in Figure 16. In this survey, they were consistently more abundant in deeper waters along the entire coasts of Maine and New Hampshire in the fall.

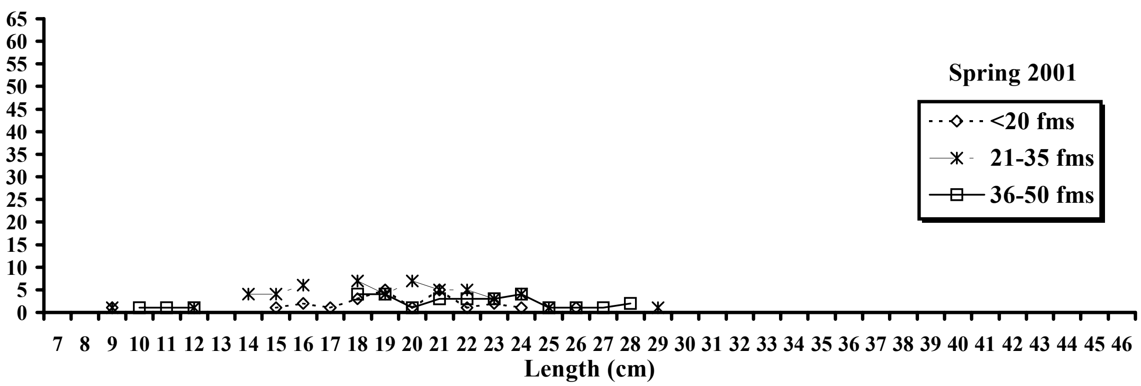
Figure 16.
White Hake
Seasonal distribution by Stratum Along the Coast



The fall length frequency graph of Figure 17 shows at least two year-classes of white hake. The juvenile fish tend to occur more often in the shallower strata and the adults are found in good numbers in the cooler, deeper waters. Only juveniles remain in the inshore waters in the spring moving farther offshore as they grow.

Figure 17.
Seasonal Length Frequencies of White Hake

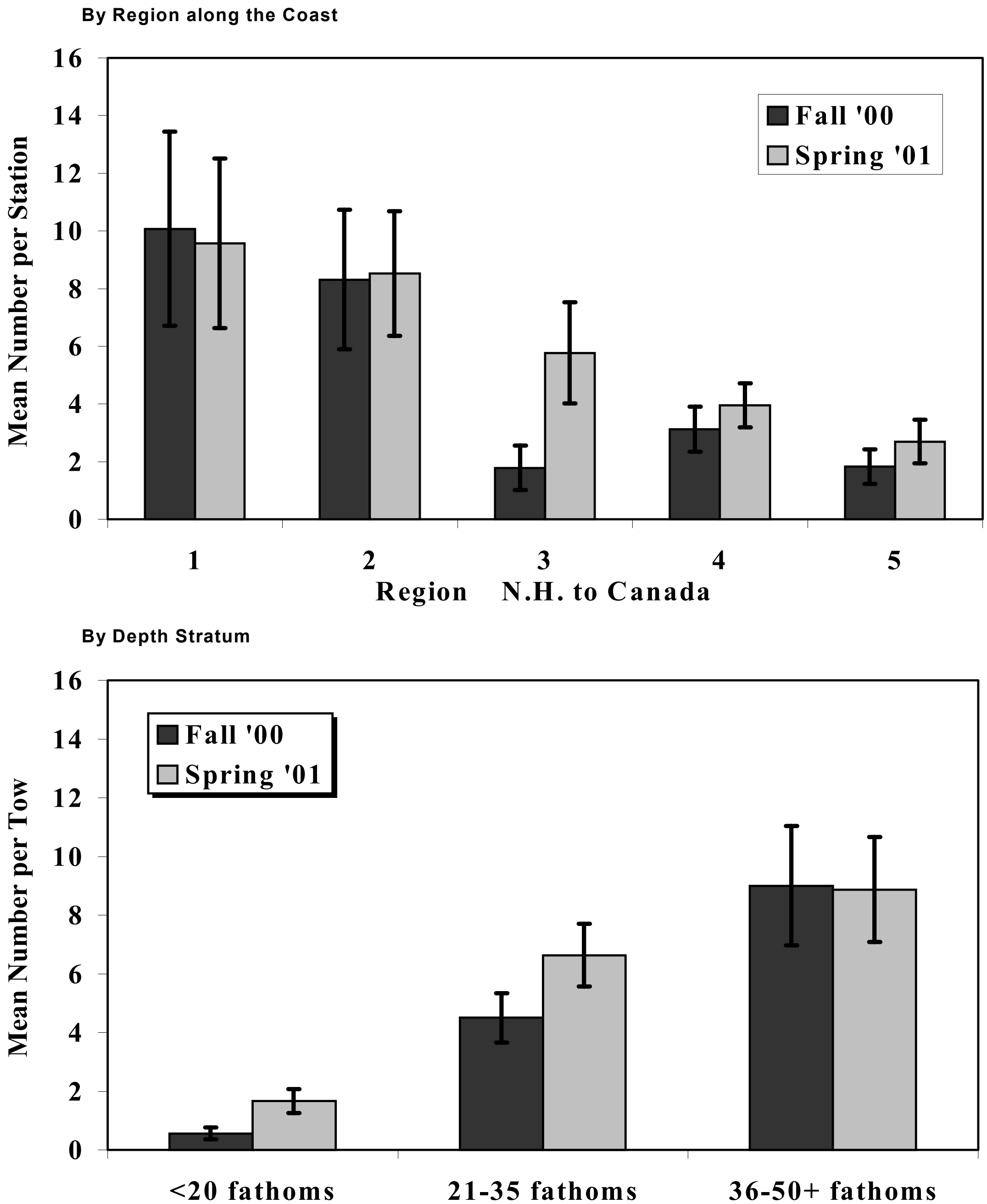




Goosefish

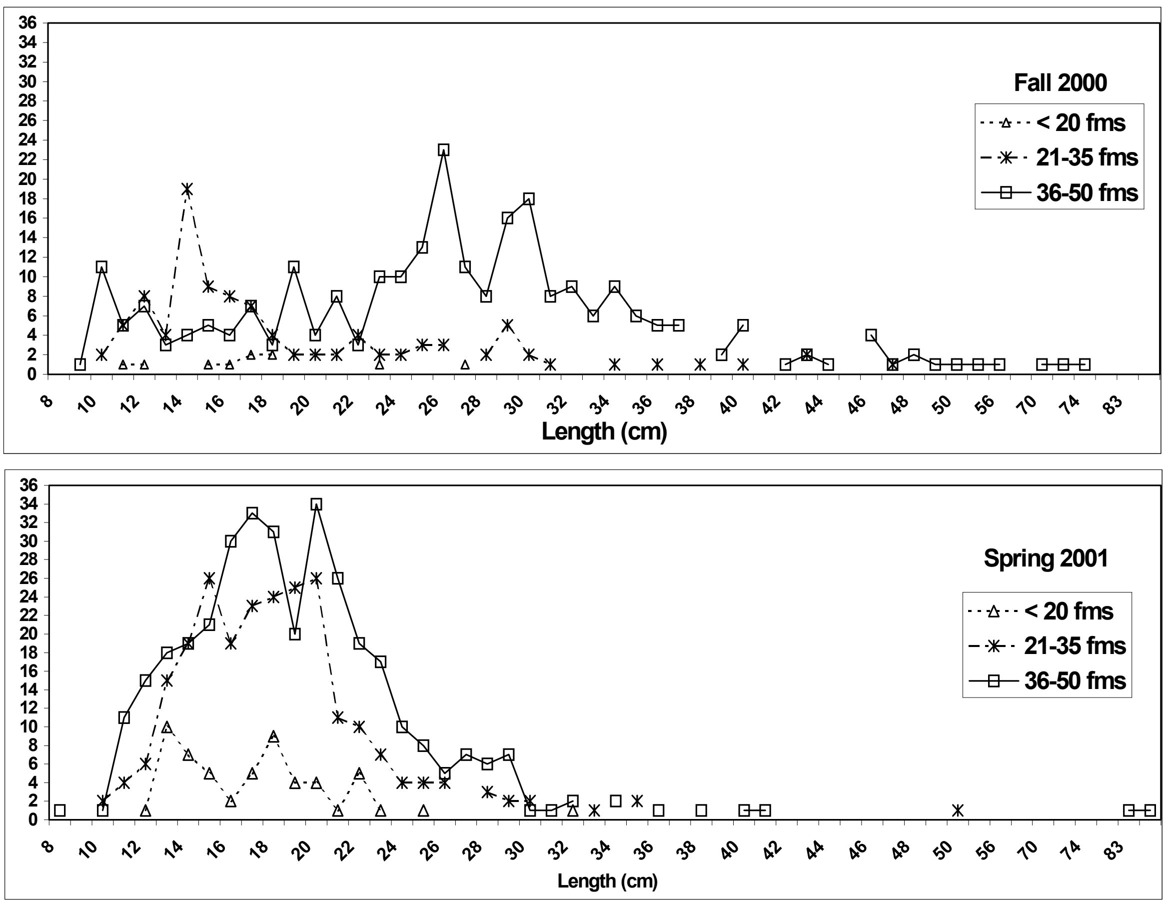
Goosefish (or monkfish) were definitely more numerous in the southwest coastal areas (Figure 18.). Abundance increased with increasing depth.

Figure 18
Distribution of Goosefish
Seasonally by Region and by Depth



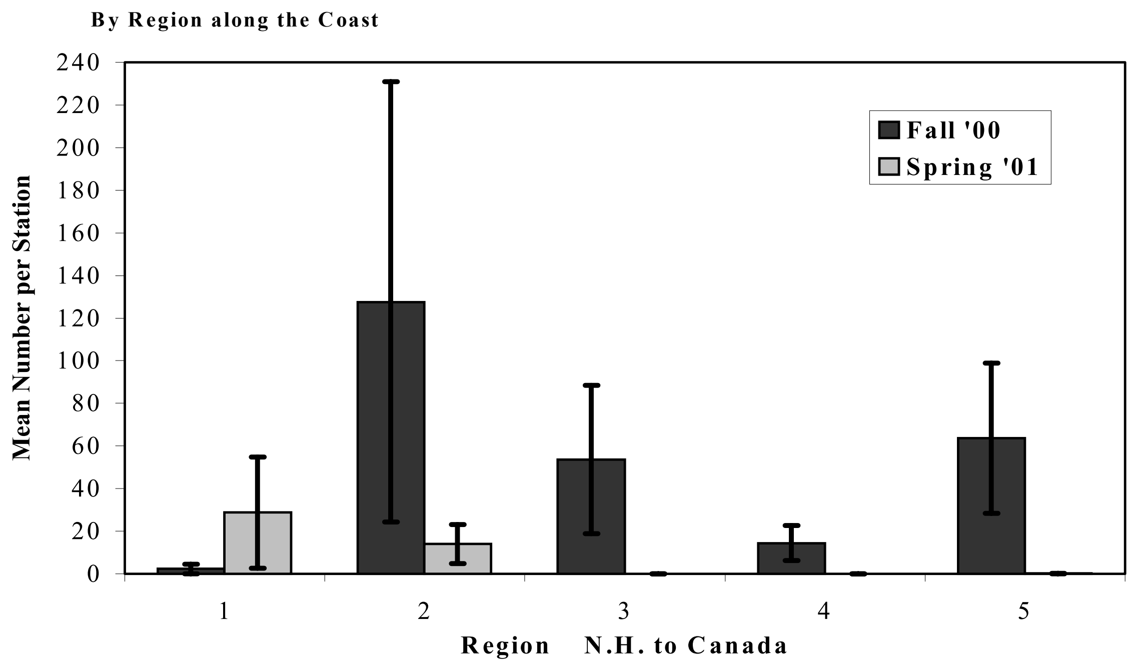
The majority of goosefish caught were juveniles as seen in Figure 19. In the fall, only 6% of the goosefish caught would have been mature. For the spring, that number is less than one percent. The numbers of goosefish have increased along the coast since previous survey work (Sherman, unpublished).

Figure 19.
Goosefish
Seasonal Length Frequencies by Depth



Rainbow Smelt
Unlike the previous species, rainbow smelt were most common in the inshore shoal waters along the coast. Figure 20 illustrates smelt distribution both by region along the coast and by depth. Smelt were almost non-existent in the deeper waters. Abundance was varied along the coasts of Maine and New Hampshire. As an anadromous species, smelt should commonly be closely associated with estuarine systems. Smelt were one of the more abundant species observed in the fall survey.

Figure 20
Rainbow Smelt Distribution



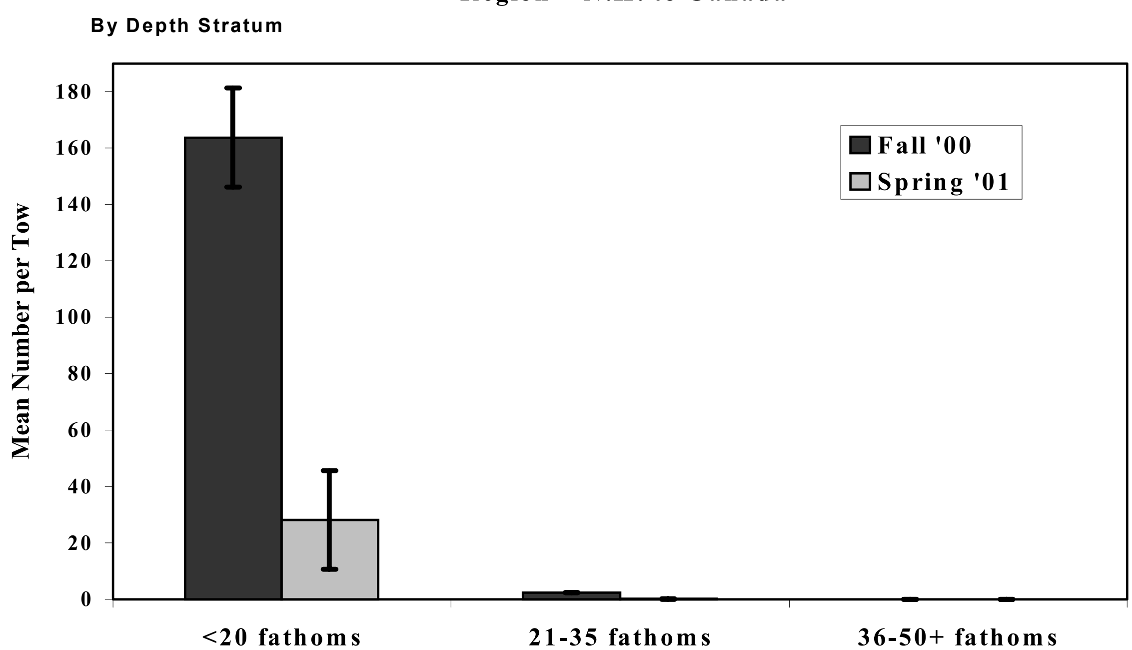
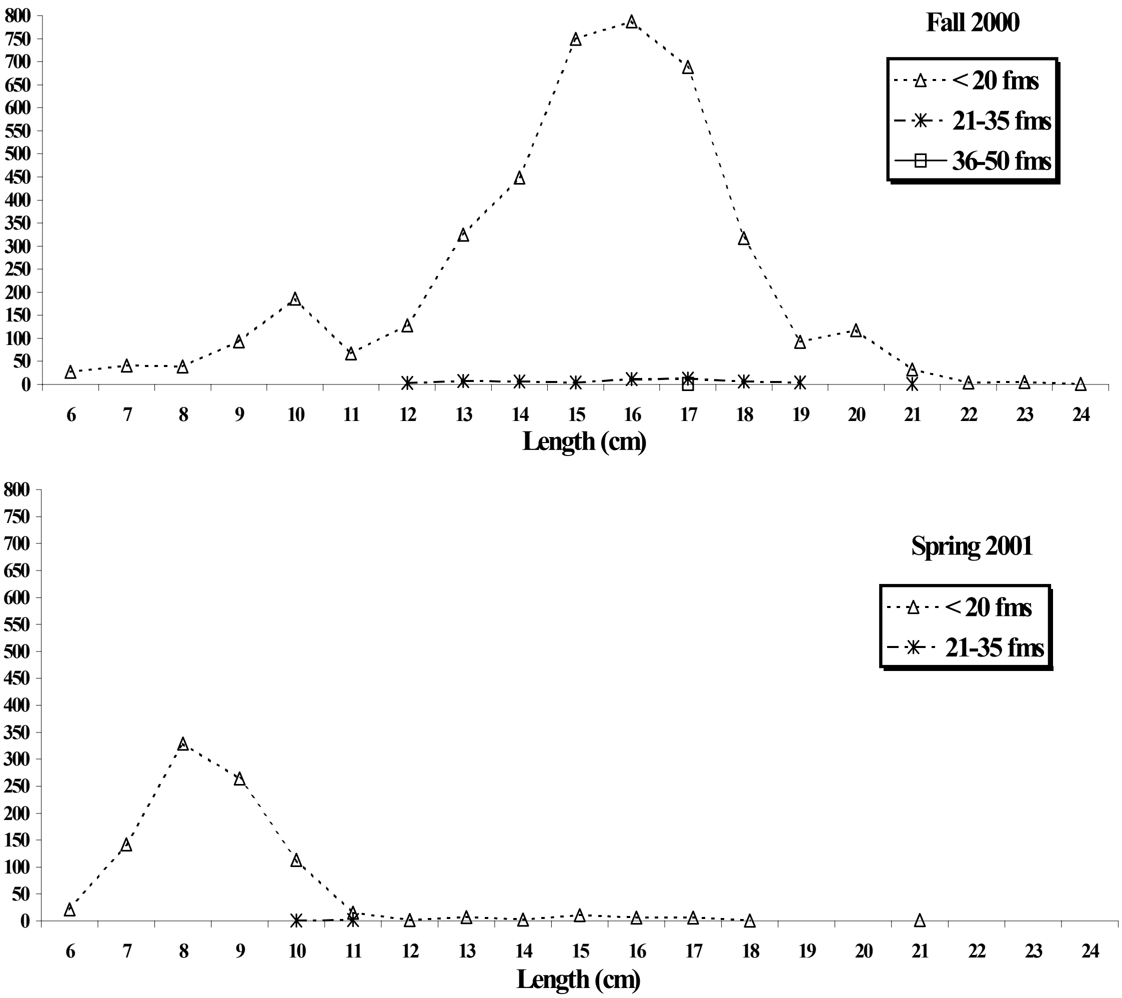


Figure 21 (bottom) clearly shows young of the year smelt caught in stratum 1 in the spring. The fall length frequency shows the remnants of the previous springs fry and the influx of adults returning to the rivers.

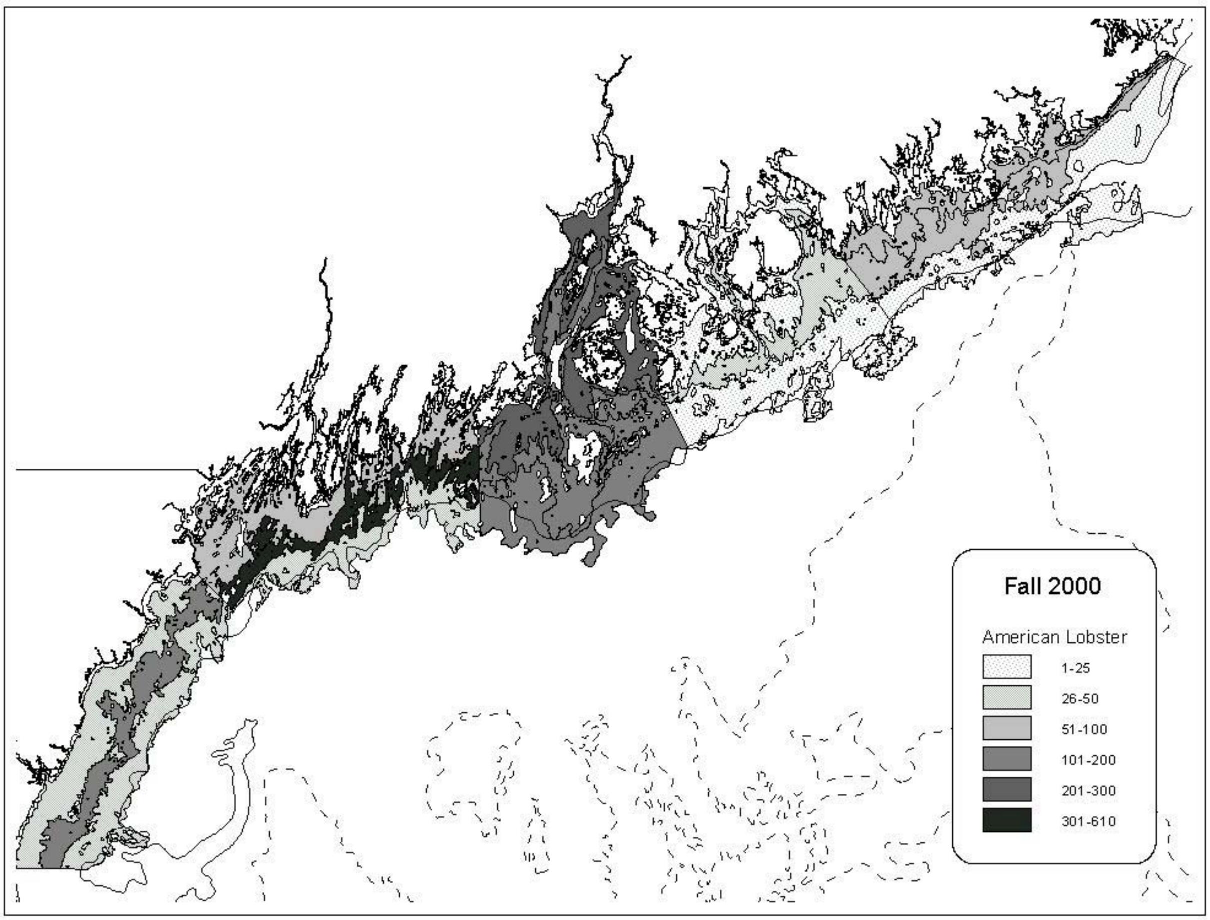
Figure 21
Rainbow Smelt
Length Frequencies



Lobster

Although this survey was principally a groundfish survey, information is generated on other species such as lobsters. Lobsters were most abundant in Region 3, the region that includes Penobscot Bay and in the mid-depth stratum of midcoast Maine (Figure 22). This is consistent with landings data, larval lobster sampling and lobster settlement surveys (Steneck and Wilson, 2001).

Figure 22
Distribution of Lobster Abundances from Fall 2000
Maine-New Hampshire Inshore Trawl Survey

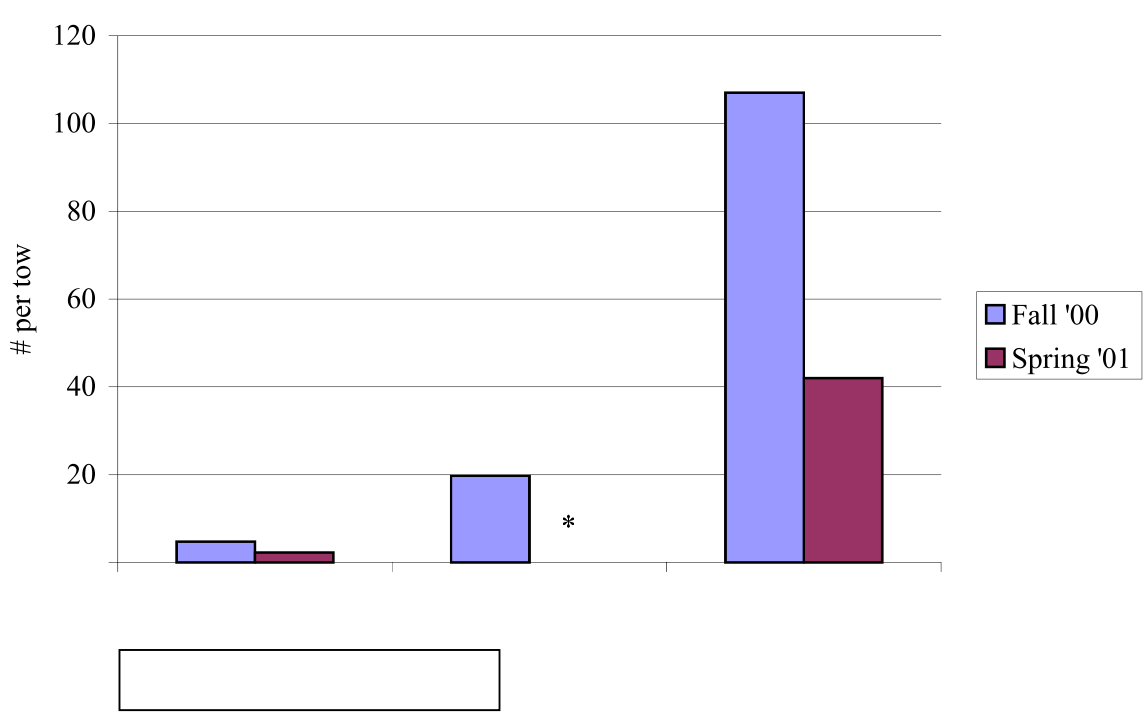


Some lobstermen have claimed that trap data provided by lobstermen are sufficient and that the trawl survey is unnecessary. Aside from the fact that this is a multi-species survey designed to gather information on finfish, the trawl survey has the potential to add value to lobster assessment. Certainly, sea-sampling, landings data, port sampling, and other surveys such as the larval settlement project and SCUBA surveys are providing valuable information. However, each of these methods are selective for different sizes of lobsters and each is biased based on methodological considerations. This obviously also holds true for trawl survey data.

Unlike trap data, that are fishery dependent, catches from the trawl survey are not affected by baiting, variable soak times, effort, and lobster distribution. Fishery independent surveys, such as trawl and diver surveys, are considered free of fishing biases yet have their own unique set of shortcomings. Together, however, fishery dependent and fishery independent data complement each other for a more complete and accurate assessment.

For these reasons, the 2000 ASMFC Lobster Stock Assessment (ASMFC, 2000) recommended increasing the use of trawl survey data. Until now, no trawl data has been available from the area where 80% of the Gulf of Maine's lobsters are caught, coastal Maine and New Hampshire. Steneck and Wilson (2001) refer to this as a "blind spot" in our ability to monitor lobster stocks. As trawl data is the <u>only</u> fishery independent data used in the ASMFC's Delury Model, a large void in coverage exists for input into the lobster management models, prompting the ASMFC to acknowledge it may be underestimating the Gulf of Maine stocks. In the fall survey alone, we censused more lobsters than in all the NMFS Gulf of Maine trawl surveys combined since their program began in 1963. Similarly, we are seeing significantly more lobsters in our survey per unit of effort than Massachusetts (Figure 23).

Figure 23
Comparison of Lobster Catch per Tow between Three Trawl Survey's in the Gulf of Maine



It is unlikely these differences between trawl surveys are an artifact of using different gear since the NMFS' Yankee 36 trawl net uses the same mesh size but the net itself is larger than ours (100' versus 70' footrope) and towed for 50% longer time. And, the Massachusetts net is very similar to ours. We consider this to be highly significant but most importantly, valuable for more accurate lobster stock assessments. Since the number and ratio of pre-recruit females forms the basis for the ASMFC's Egg per Recruit (EPR) Model, we believe that the Maine-New Hampshire survey could improve the EPR Model accuracy as well as contribute toward the development of a model specifically designed for lobster.

Discussion

Despite initial concerns about weather, conflict with fixed gear, locating suitable bottom for tows, and loading up the net with ghost gear, the first year of the survey was an overall success. We demonstrated that a survey of this magnitude and coverage is feasible. Not only did the survey complete tows in all the planned strata between Massachusetts and New Brunswick, it did so mostly on schedule, within the experimental design and with the considerable cooperation of fixed gear fishermen. As evidenced by the diversity of species caught and total catches, the net appears to have fished well.

No serious problems occurred that could not be overcome with extra effort. We attribute this to the commitment of all project team members and extensive planning prior to the project. We were able to identify most every type of problem early on and develop contingency plans to avoid delays in the survey. The plan to fish only the first 5 fishable days of a 7 day week and only to plan 4-5 tows a day was especially valuable as it built in time to accommodate weather, gear, and to resolve problems without causing the survey to fall off schedule farther along the coast. Sticking to a schedule was important in helping minimize inconvenience to fixed gear fishermen. Of all the modes we used to notify fishermen of our presence, fishermen almost unanimously favor the daily NOAA broadcast and vessel-to-vessel communication as the most helpful.

Gear conflict was a concern and continues to be. Despite the fact that we cruised all the tows prior to towing, we caught gear on a total of 16 occasions. It seems that some buoys were under water or we simply did not see them. On most occassions, it was simply a matter of slipping the pot warp off the doors. A few times, traps were brought on board and either given directly to their owner or when the owner was not present, given to the Marine Patrol Officer who returned the gear. On 4 occasions gear could not be saved due to unsafe conditions for the crew. This resulted in a total loss of 5-6 traps. When that happened, we recorded Loran bearings and reported those to local fishermen and/or the Marine Patrol.

While following up on gear incidents, we discovered a discrepancy between locations from tows planned off charts and actual tows on the water. The charted positions used charted Loran coordinates. Since radio signals are distorted, Loran positions are not always accurate. The distortion is different in different parts of the coast, especially close to land. This occasionally resulted an offset between when fishermen cleared tows using the Loran instead of satellite based GPS.

Collaborative Research between the Commercial and Scientific Sectors

While not the primary impetus for the project, engaging commercial fishermen with scientists and scientists with commercial fishermen was an integral and necessary element of the project. Congressional funds were specifically earmarked to assist the groundfish industry through the economic challenges that have emerged as a result of fishing restrictions.

The nature of this collaboration deserves at least a brief discussion.

The Gulf of Maine Aquarium -- Initially, each side, commercial and science, was skeptical of the other's capabilities and committment. A third partner in this project, the Gulf of Maine Aquarium, played the important role of facilitating early meetings, clarifying positions and concerns, and generally helping the project move forward. The Aquarium's Don Perkins negotiated the contract between the parties, administered grant funds, and assured that timely payments to the vessel were made, something a state agency could not have easily done.

T/R Fish – The vessel owners brought both the technical expertise and experience of successful commercial fishing to the project. T/R Fish hired an experienced fishing captain (Curt Rice) specifically as Research Captain to work along side both boat captains as liason between the science crew and vessel crew. T/R Fish was crucial in "troubleshooting" the project design from the beginning. They were responsible for the net design and made realistic recommendations on how to manage problems if they came up. In addition to their technical expertise, their presence at many of the early meetings with fishermen added credibility to the project.

State of Maine and New Hampshire -- Cooperation between New Hampshire and Maine state marine resource agencies has also been an important aspect in this study. Both states are partners in the Atlantic States Marine Fisheries Commission's (ASMFC) and Northeast Area Monitoring and Assessment Program (NEAMAP). NEAMAP's mission is to provide and integrate cooperative state/federal programs to facilitate collection and dissemination of fisheries independent data in the northeast (Gulf of Maine to Cape Hatteras, NC). Both New Hampshire and Maine and were responsible for the overall survey design but also relied on feedback from NMFS and University of Maine statisticians. Logistical details of the survey included significant effort on the part of both states in notifying fishermen, making travel arrangements and responding to the media interest.

General Discussion on Collaborative Research

Collaboration does not necessarily come easy, especially between two groups (fishermen and scientists) who are both very independent by nature and have traditionally been suspicious of, if not at odds with, each other. Perhaps the most obvious difficulty with collaborative research is trading the ease of autonomy to make decisions quickly with the effort needed to find consensus. This slowed the project down, however, over the long run, resulted in sound decisions. Initially, it took time to define and clarify the details of roles between all members of the project team. None of the above problems, however, are unique to collaboration between scientists and fishermen but rather are probably common to any project involving many people.

Using a commercial vessel had trade-offs. For example, a vessel rigged to commercially fish with a crew of 3 or 4 is not the same as a vessel geared for research that supports an additional crew of scientists. Although the commercial crew was very adept at rapidly processing fish, it took time to develop the skills and attention to detail required of science. Initially, this transition required much oversight by the Chief Scientist and Research Captain but the crew adapted early on and found the work interesting.

Also, the vessels we employed had insufficient berthing for both the fishing and science crews. Accordingly, we were required to return to port for the science crew to sleep. A huge effort went into making overnight reservations, especially the first fall during fall foliage season! Because the vessel did not always return to the same port it had left that morning, a land-based crew was needed to shuttle a fleet of vehicles around the coast. Travel time to and from ports each morning and night also added to vessel fuel costs and reduced the number of tows we could make each day. A full research vessel might have avoided some of these logistical difficulties.

Not surprisingly, a clear benefit of having a commercial vessel is in the crew's expertise in handling and operating the gear, seamanship, and intimate knowledge of the bottom. Scientists working on this project who have participated on trawl surveys on research vessels agree that the commercial vessel crew was able to tow in areas that a research vessel could not. This was not simply a matter of vessel size. The commercial crew could better discriminate between towable and non-towable bottom, tow in very tight areas that would not be attempted by most research captains, and were able to do so with minimal disturbance to adjacent fixed gear. Tows that appeared to be untowable on a depth sounder were towed based on the local knowledge of the Captain, crew, and other commercial fishermen. The commercial crew's ability to rapidly repair gear was also a big advantage.

This project clearly demonstrated that incorporating commercial fishermen in the science far outweighs the inconveniences asked of the science crew. The cooperative survey resulted in good quality data and information, fully comparable information from both states, and was a cost effective means of filling a large information void for a significant portion of the Gulf of Maine. Without a doubt, from the planning stages through to completion of the survey, this project would not have been as successful without the threeway partnership of scientists, commercial fishermen and neutral facilitator.

Recommendations

Although we met the objective of developing a workable methodology and completing a comprehensive survey of the Maine and New Hampshire inshore waters through collaborative research between fishermen and scientists, in the end, this was a "proof of concept" pilot project. Far more information resulted from this project than can reasonably be covered in this report. Much needs to be done before the data can be used for management decisions and much can be added to the project at minimal cost to further add value to the project and much remains to be done on the dataset collected this first year.

Clearly the most important recommendation is to secure funding to develop an adequate time series sufficient for groundfish stock assessment and resolve remaining technical and political issues that are currently constraining the survey's potential.

Such tasks include the following:

- complete a manual of Methods and Procedures
- determining catchability quotient for the nets – requiring net mensuration, video work, and perhaps comparison tows
- prepare a web site where more results may be presented as they develop
- continue to work with fixed gear fishermen to improve cooperation
- address, through research, concerns raised about impact of trawling on lobsters and habitat
- work out Loran/GPS differences that resulted in confusion about tow locations
- improve efficiency of cruise data entry and analysis
- add icthyoplankton
- otoliths, scales and maturation studies
- toxic contaminant
- test feasibility of using another vessel
- side by side gear comparisons

References

Atlantic States Marine Fisheries Commission. 1994. Proceedings fo the Workshop on the Collection and Use of Trawl Survey Data for Fisheries Management. Special Report No. 35.

Atlantic States Marine Fisheries Commission. 2000. American lobster Stock Assessment Report for Peer Review. Stock Assessment Report No. 00-01 (Supplement).

Azarovitz, T.R. 1994. Northeast Fisheries Science Center Bottom Trawl Surveys. In: Atlantic States Marine Fisheries Commission. 1994. Proceedings fo the Workshop on the Collection and Use of Trawl Survey Data for Fisheries Management. Special Report No. 35.

Bigelow, H.B. and W.C. Schroeder. 1953. Fishes of the Gulf of Maine. Fishery Bulletin of the Fish and Wildlife Service Vol. 53. Washington, D.C.

Correia, S.J. 1994. Massachusetts Inshore Bottom Trawl Survey. In: Atlantic States Marine Fisheries Commission. 1994. Proceedings fo the Workshop on the Collection and Use of Trawl Survey Data for Fisheries Management. Special Report No. 35.

Gosslein, M.G. 1969. Groundfish survey program of BCF Woods Hole. Commercial Fisheries, Review 31 (8-9): 22-35.

Nelson, J. I., S. Perry, D. Miller, and G. Lamb. 1983. Inventory of New Hampshire Marine Coastal Fisheries. New Hampshire Fish and Game Department, Concord, NH. 35 pp.

Rich, W.H. 1929. Fishing Grounds of the Gulf of Maine. Report of the United States Commissioner of Fisheries, for the Fiscal Year 1929. U.S. Department of Commerce, Bureau of Fisheries. Washington, D.C.

Steneck, R.S. and C.J. Wilson. 2001. Large-scale and long-term, spatial and temporal patterns in demography and landings of the American lobster, _Homarus americanus_, in Maine. Mar. Freshwater Res. Vol. 52: 1303-19.

Appendix A
Individual Station Descriptions

Date	Region	Grid	Loran W C	Loran X C	Lat Deg / Min	Long Deg / Min	Start Time Min	Tow Duration Min	Ave. Depth FA	Temp °C	Salinity PPT

Fall 2000

Date	Region	Grid	Loran W C	Loran X C	Lat Deg / Min	Long Deg / Min	Start Time Min	Tow Duration Min	Ave. Depth FA	Temp °C	Salinity PPT
10/30/00	1	392	13645.50	25930.80	43 01.785	70 33.366	10:29	17	31.50	10.19	32.37
			13652.10	25931.20	43 01.292	70 33.945					
10/30/00	1	409	13631.70	25906.50	43 00.641	70 30.206	11:47	20	46.00		
			13640.00	25908.00	43 00.119	70 31.028					
11/01/00	1	472	13760.70	25965.00	42 55.456	70 45.507	08:30	20	13.50	10.13	32.39
			13752.10	25964.40	42 56.125	70 44.769					
11/01/00	1	445	13723.30	25943.30	42 56.597	70 40.774	10:47	20	24.00	10.79	32.40
			13714.10	25943.00	42 57.330	70 39.999					
11/01/00	1	464	13695.60	25918.50	42 56.603	70 36.520	12:15	20	34.50		
			13687.00	25917.00	42 57.165	70 35.686					
11/01/00	1	417	13688.40	25947.00	42 59.808	70 38.220	14:30	20	13.00		
			13699.70	25946.60	42 58.846	70 39.111					
11/02/00	1	368	13589.00	25900.00	43 03.399	70 26.053	08:18	20	49.00	8.82	32.88
			13579.00	25899.70	43 04.150	70 25.178					
11/02/00	1	305	13531.00	25914.00	43 09.195	70 22.336	10:02	20	47.00		
			13543.60	25917.20	43 08.526	70 23.682					
11/03/00	1	171	13531.20	25998.50	43 17.164	70 29.782	09:05	14	18.50		
			13527.20	26002.00	43 17.809	70 29.768					
11/03/00	1	68	13394.50	25980.00	43 25.841	70 16.899	13:05	20	32.50	9.83	32.80
			13403.00	25980.50	43 25.252	70 17.650					
11/03/00	1	11	13383.00	26025.00	43 31.089	70 20.238	14:46	20	7.50	9.54	32.51
			13392.50	26024.60	43 30.332	70 20.966					
11/04/00	1	27	13339.10	25981.40	43 30.101	70 12.435	07:37	20	34.00	10.44	32.85
			13330.20	25981.00	43 30.719	70 11.655					
11/04/00	1	100	13349.00	25924.00	43 23.762	70 07.700	11:00	18	49.50	10.43	33.01
			13349.00	25930.00	43 24.347	70 08.281					
11/04/00	1	96	13396.80	25953.10	43 23.062	70 14.549	09:25	20	47.00		
			13388.10	25955.30	43 23.923	70 14.025					
11/04/00	2	556	13276.00	25936.70	43 30.311	70 02.675	12:25	20	54.00	10.27	33.13
			13256.50	25937.10	43 31.755	70 01.042					
11/04/00	2	553	13302.00	25953.80	43 30.118	70 06.603	13:52	20	41.00	10.32	33.13
			13297.30	25959.90	43 31.064	70 06.814					
11/06/00	2	362	13230.00	25997.00	43 39.651	70 04.939	08:20	20	19.50	9.95	32.47
			13240.00	25997.00	43 38.924	70 05.772					
11/06/00	2	220	13149.55	25967.00	43 42.395	69 54.999	10:48	20	12.00	10.23	32.51
			13140.00	25971.20	43 43.499	69 54.635					
11/07/00	2	463	13166.40	25921.70	43 36.615	69 51.605	09:42	20	46.00	10.43	33.13
			13176.90	25922.10	43 35.918	69 52.569					
11/07/00	2	375	13120.00	25920.00	43 39.685	69 47.334	12:16	20	20.00	10.37	32.88
			13131.90	25920.00	43 38.856	69 48.384					
11/07/00	2	264	13094.10	25925.90	43 42.089	69 45.698	14:26	20	14.00	10.36	32.84
			13094.10	25931.70	43 42.684	69 46.342					
11/08/00	2	108	13008.60	25930.50	43 48.461	69 38.652	09:00	20	19.00	9.85	32.79
			13014.80	25926.40	43 47.609	69 38.726					
11/08/00	2	194	13031.50	25914.70	43 45.250	69 38.860	10:54	20	35.00	10.08	32.81
			13037.20	25911.40	43 44.517	69 38.991					

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Individual Station Descriptions

Date	Region	Grid	Loran W C	Loran X C	Lat Deg / Min	Long Deg / Min	Start Time Min	Tow Duration Min	Ave. Depth FA	Temp °C	Salinity PPT
11/08/00	2	533	13132.20	25864.90	43 33.224	69 42.388	13:21	20	63.50	10.20	33.26
			13132.70	25857.80	43 32.466	69 41.654					
11/08/00	2	446	13059.10	25865.90	43 38.309	69 35.769	15:08	18	54.00	10.27	33.23
			13066.50	25862.60	43 37.467	69 36.078					
11/09/00	2	88	12968.50	25906.80	43 48.711	69 32.256	08:35	16	30.00	10.06	32.81
			12968.40	25902.60	43 48.276	69 31.743					
11/09/00	2	55	12940.90	25902.90	43 50.162	69 29.276	10:34	18	36.00		
			12945.30	25899.50	43 49.507	69 29.264					
11/09/00	2	6	12893.50	25917.00	43 54.851	69 26.724	12:55	16	12.00	9.66	32.70
			12901.50	25916.30	43 54.238	69 27.357					
11/10/00	2	284	12926.40	25814.70	43 41.750	69 17.049	09:38	14	54.50		
			12927.00	25818.60	43 42.128	69 17.595					
11/10/00	2	63	12878.80	25862.50	43 50.004	69 18.505	12:20	20	34.00	10.42	32.95
			12868.60	25862.50	43 50.677	69 17.543					
11/13/00	3	446	12804.40	25826.40	43 50.949	69 06.615	10:32	20	35.50	10.14	33.11
			12811.30	25822.80	43 50.108	69 06.810					
11/13/00	3	399	12783.10	25828.40	43 52.548	69 04.790	12:15	18	32.00		
			12792.00	25823.90	43 51.479	69 05.054					
11/13/00	3	317	12785.60	25852.60	43 55.037	69 08.315	13:57	21	19.50	10.04	32.65
			12776.10	25852.00	43 55.592	69 07.319					
11/13/00	3	290	12779.90	25863.00	43 56.552	69 09.173	15:30	20	18.50		
			12772.00	25864.00	43 57.180	69 08.553					
11/14/00	3	993	12490.70	25939.00	44 23.962	68 52.686	10:48	20	11.00	10.24	32.52
			12490.10	25948.80	44 25.111	68 54.133					
11/14/00	3	995	12468.90	25935.00	44 24.941	68 50.014	12:00	20	10.00		
			12479.60	25943.90	44 25.247	68 52.400					
11/14/00	3	93	12600.00	25883.40	44 10.547	68 54.731	14:03	20	26.50	10.06	32.70
			12590.00	25883.70	44 11.232	68 53.804					
11/14/00	3	126	12650.70	25881.60	44 07.042	68 59.369	15:15	20	36.00		
			12640.40	25882.70	44 07.837	68 58.534					
11/15/00	3	454	12747.60	25789.60	43 50.543	68 55.807	08:45	10	17.00	9.57	33.67
			12744.00	25792.00	43 51.040	68 55.779					
11/16/00	3	328	12695.00	25805.00	43 55.627	68 52.642	08:46	16	48.50	9.96	33.03
			12689.20	25802.40	43 55.707	68 51.670					
11/16/00	3	359	12662.00	25781.90	43 55.125	68 45.805	10:59	17	49.00	10.01	32.95
			12654.10	25781.20	43 55.547	68 44.869					
11/16/00	3	384	12670.40	25773.60	43 53.651	68 45.440	12:34	26	49.00		
			12670.00	25769.00	43 53.154	68 44.705					
11/20/00	3	121	12559.40	25849.30	44 09.339	68 45.556	08:01	20	28.50	9.41	32.70
			12565.70	25844.90	44 08.435	68 45.513					
11/20/00	3	364	12620.20	25754.90	43 54.675	68 37.186	15:55	16	49.50	10.10	33.02
			12628.20	25755.40	43 54.231	68 38.134					
11/21/00	4	250	12482.30	25811.70	44 09.983	68 31.561	07:52	18	16.00	8.78	32.74
			12492.00	25812.00	44 09.398	68 32.640					
11/21/00	4	492	12545.70	25771.90	44 01.338	68 31.809	10:04	20	40.00	9.34	32.84
			12559.50	25771.90	44 00.466	68 33.309					
11/21/00	4	589	12588.40	25742.30	43 55.208	68 31.675	12:40	20	50.00	10.12	32.99
			12596.60	25740.10	43 54.439	68 32.230					
11/21/00	4	456	12466.40	25743.60	44 03.005	68 18.136	14:51	19	47.00	9.74	32.81

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Date	Region	Grid	Loran W C	Loran X C	Lat Deg / Min	Long Deg / Min	Start Time Min	Tow Duration Min	Ave. Depth FA	Temp °C	Salinity PPT
			12474.70	25744.70	44 02.616	68 19.281					
11/22/00	4	286	12414.60	25763.40	44 08.639	68 15.769	07:30	20	30.00	9.45	32.73
			12415.20	25758.70	44 08.040	68 14.985					
11/22/00	4	175	12439.40	25807.80	44 12.277	68 26.310	10:00	27	15.50	8.84	32.73
			12429.90	25807.50	44 12.851	68 25.232					
11/22/00	4	31	12375.20	25865.40	44 23.090	68 29.412	12:15	20	13.00	9.14	32.54
			12379.80	25860.00	44 22.168	68 28.961					
11/27/00	4	322	12381.40	25727.40	44 06.382	68 05.173	12:20	20	49.00	9.40	32.68
			12380.40	25732.80	44 07.112	68 06.098					
11/27/00	4	165	12329.60	25761.90	44 13.902	68 05.730	14:41	20	39.00	8.95	32.25
			12329.20	25756.70	44 13.303	68 04.685					
11/28/00	4	77	12307.80	25794.70	44 19.215	68 09.453	06:36	20	27.00	8.49	32.75
			12317.70	25793.30	44 18.408	68 10.308					
11/28/00	4	94	12319.70	25777.10	44 16.356	68 07.481	08:08	20	35.00	8.62	32.68
			12313.80	25782.10	44 17.332	68 07.753					
11/28/00	4	37	12281.70	25809.70	44 22.677	68 09.352	09:45	20	27.50	8.20	32.73
			12289.00	25805.50	44 21.708	68 09.375					
11/28/00	4	15	12287.40	25829.80	44 24.659	68 13.756	11:00	20	8.00	7.98	32.67
			12288.70	25828.10	44 24.376	68 13.581					
11/28/00	4	911	12293.10	25854.40	44 27.154	68 18.893	12:22		8.00		
			12292.10	25849.10	44 26.603	68 17.820					
11/29/00	4	273	12314.10	25712.90	44 08.950	67 54.254	08:08	20	54.00	9.80	32.88
			12303.40	25713.30	44 09.685	67 53.012					
11/29/00	4	270	12331.40	25722.30	44 08.990	67 58.243	09:26	22	47.00		
			12321.70	25723.30	44 09.736	67 57.268					
11/29/00	4	99	12283.40	25764.20	44 17.150	68 00.765	13:46	19	35.50	8.88	32.46
			12275.70	25762.90	44 17.489	67 59.599					
11/30/00	5	615	12225.00	25738.40	44 17.809	67 48.450	08:28	15	36.00	9.54	32.68
			12217.20	25737.00	44 18.148	67 47.182					
11/30/00	5	510	12220.80	25754.60	44 20.045	67 51.316	10:15	22	31.00	8.50	32.41
			12227.70	25750.20	44 19.064	67 51.247					
11/30/00	5	427	12219.80	25780.10	44 23.179	67 56.431	12:10	10	17.00	8.71	32.38
			12209.80	25779.80	44 23.796	67 55.184					
11/30/00	5	453	12244.90	25790.50	44 22.792	68 01.451	13:45	20	15.50		
			12250.00	25783.20	44 21.589	68 00.599					
12/01/00	5	588	12195.20	25710.00	44 16.264	67 38.507	09:34	20	52.00	8.99	32.68
			12186.40	25710.40	44 16.887	67 37.440					
12/01/00	5	566	12194.00	25723.40	44 17.999	67 41.309	11:13	21	47.50	9.02	32.67
			12184.60	25720.40	44 18.244	67 39.432					
12/01/00	5	261	12157.20	25761.90	44 25.108	67 45.029	14:04	20	24.00	8.30	32.48
			12144.10	25761.90	44 25.976	67 43.401					
12/01/00	5	264	12135.10	25767.80	44 27.286	67 43.570	15:10		15.00	7.79	32.40
			12127.70	25768.80	44 27.899	67 42.870					
12/02/00	5	268	12113.50	25756.80	44 27.396	67 38.413	07:13	20	14.50	7.56	32.64
			12105.00	25760.40	44 28.400	67 38.141					
12/02/00	5	406	12121.70	25726.90	44 23.196	67 32.650	09:17	21	46.00	8.93	32.73
			12112.90	25726.90	44 23.783	67 31.480					
12/02/00	5	275	12054.70	25724.10	44 27.366	67 22.920	11:35	22	36.00	9.06	32.75
			12046.40	25723.90	44 27.908	67 21.723					

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Date	Region	Grid	Loran W C	Loran X C	Lat Deg / Min	Long Deg / Min	Start Time Min	Tow Duration Min	Ave. Depth FA	Temp °C	Salinity PPT
12/02/00	5	173	12044.70	25760.40	44 32.476	67 30.338	14:03	23	17.00	8.14	32.78
			12036.90	25759.00	44 32.841	67 28.978					
12/03/00	5	118	11983.60	25746.40	44 35.006	67 18.664	08:13	20	31.00		
			11973.20	25744.70	44 35.531	67 16.780					
12/03/00	5	314	11953.40	25741.90	44 36.595	67 13.255	10:10	20	48.00	9.00	32.84
			11943.50	25738.60	44 36.904	67 10.962					
12/03/00	5	103	12015.80	25704.20	44 27.576	67 12.378	12:25	15	59.00	9.12	32.68
			12021.90	25699.50	44 26.566	67 12.042					
12/04/00	5	38	11881.40	25741.20	44 41.737	67 02.538	08:52	20	45.00	8.94	32.77
			11872.90	25740.90	44 42.331	67 01.173					
12/04/00	5	41	11862.80	25730.30	44 41.810	66 56.584	10:45	20	55.00		
			11854.10	25734.10	44 42.919	66 56.336					

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Date	Region	Grid	Loran W C	Loran X C	Lat Deg / Min	Long Deg / Min	Start Time Min	Tow Duration Min	Ave. Depth FA	Temp °C	Salinity PPT

Spring 2001

04/23/01	1	529	13767.60	25938.80	42 52.482	70 44.027	08:11	20	19.00	3.65	32.35
			13774.00	25938.90	42 51.950	70 44.555					
04/23/01	1	513	13743.50	25926.80	42 53.411	70 41.126	09:36	20	30.00	3.88	32.33
			13750.90	25927.30	42 52.838	70 41.772					
04/23/01	1	472	13755.00	25964.80	42 55.918	70 45.034	11:23	20	16.00	3.71	32.29
			13748.10	25965.30	42 56.544	70 44.519					
04/23/01	1	417	13693.60	25947.10	42 59.392	70 38.653	12:45	20	12.00		
			13701.30	25947.20	42 58.769	70 39.290					
04/24/01	1	469	13633.80	25875.40	42 57.607	70 27.817	07:32	20	53.00	3.62	32.39
			13641.20	25875.30	42 57.013	70 28.442					
04/24/01	1	467	13656.40	25894.50	42 57.567	70 31.302	09:40	21	46.50	3.57	32.40
			13649.40	25896.00	42 58.264	70 30.834					
04/25/01	1	278	13540.00	25940.90	43 11.033	70 25.445	06:19	19	35.50	3.50	32.33
			13545.50	25939.50	43 10.475	70 25.782					
04/25/01	1	305	13540.80	25917.00	43 08.724	70 23.428	07:52	23	47.00	3.47	32.35
			13532.30	25916.70	43 09.349	70 22.682					
04/25/01	1	268	13522.50	25930.20	43 11.373	70 23.040	09:56	18	45.00	3.54	32.36
			13516.00	25930.80	43 11.929	70 22.546					
04/25/01	1	192	13488.90	25959.20	43 16.697	70 22.811	13:40	17	33.50	3.50	32.31
			13487.80	25953.80	43 16.267	70 22.234					
04/25/01	1	225	13486.20	25938.80	43 14.963	70 20.752	14:45	20	42.50	3.52	32.33
			13488.00	25944.70	43 15.386	70 21.433					
04/26/01	1	185	13557.40	26004.10	43 15.639	70 32.387	06:57	21	17.50	3.46	32.10
			13549.70	26005.30	43 16.359	70 31.873					
04/26/01	1	171	13527.60	26001.10	43 17.692	70 29.720	08:02	20	17.50	3.52	32.15
			13534.80	26000.70	43 17.091	70 30.267					
04/26/01	1	67	13404.70	25990.10	43 26.055	70 18.695	11:53	20	18.00	3.53	32.10
			13402.30	25992.50	43 26.468	70 18.724					
04/26/01	1	57	13375.50	25981.00	43 27.358	70 15.420	13:11	17	32.00	3.51	32.24
			13375.80	25986.30	43 27.853	70 15.951					
04/27/01	1	100	13347.70	25925.30	43 23.984	70 07.714	07:45	20	51.00	3.66	32.40
			13350.50	25931.30	43 24.364	70 08.535					
04/27/01	1	96	13394.40	25953.10	43 23.241	70 14.347	09:39	20	48.00	3.54	32.29
			13387.70	25953.20	43 23.749	70 13.792					
04/27/01	1	68	13401.10	25980.00	43 25.346	70 17.446	11:46	20	32.00	3.92	32.18
			13393.30	25980.30	43 25.960	70 16.828					
04/27/01	1	47	13371.40	25982.40	43 27.801	70 15.214	13:04	20	30.50	3.58	32.17
			13378.10	25987.00	43 27.749	70 16.208					
04/27/01	1	5	13355.00	26011.80	43 31.900	70 16.696	14:35	20	12.00	4.45	31.90
			13347.90	26007.20	43 31.979	70 15.670					
04/27/01	1	27	13337.50	25981.20	43 30.199	70 12.282	16:00	20	34.50	3.59	32.21
			13329.40	25980.00	43 30.680	70 11.491					
04/30/01	2	556	13257.20	25936.80	43 31.675	70 01.071	07:30	20	55.00	3.60	32.35
			13265.20	25936.70	43 31.089	70 01.748					
04/30/01	2	362	13231.80	25996.90	43 39.510	70 05.080	11:47	20	20.00	3.85	31.97
			13240.20	25997.10	43 38.919	70 05.799					

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Date	Region	Grid	Loran W C	Loran X C	Lat Deg / Min	Long Deg / Min	Start Time Min	Tow Duration Min	Ave. Depth FA	Temp °C	Salinity PPT
04/30/01	2	248	13233.90	26039.00	43 43.593	70 09.575	13:20	20	6.50	6.26	30.69
			13244.00	26039.00	43 42.849	70 10.395					
05/01/01	2	331	13186.50	25969.50	43 40.015	69 58.419	8:42	20	30.00	3.78	32.09
			13191.70	25966.00	43 39.290	69 58.493					
05/01/01	2	298	13145.60	25954.50	43 41.404	69 53.315	10:16	17	13.00	5.22	31.70
			13148.20	25958.80	43 41.657	69 54.001					
05/01/01	2	334	13163.20	25953.00	43 40.007	69 54.670	11:10	20	23.00	4.06	32.37
			13155.90	25955.00	43 40.726	69 54.256					
05/01/01	2	463	13173.60	25922.10	43 36.150	69 52.279	12:47	20	43.50	3.70	32.25
			13167.00	25923.20	43 36.725	69 51.818					
05/01/01	2	491	13159.00	25899.10	43 34.846	69 48.527	14:50	20	52.50	3.55	32.28
			13151.00	25899.90	43 35.484	69 47.899					
05/01/01	2	441	13118.10	25903.20	43 38.103	69 45.320	16:40	20	44.50	3.62	32.25
			13124.50	25899.70	43 37.303	69 45.508					
05/02/01	2	265	13089.00	25921.10	43 41.951	69 44.713	07:13	20	19.00	4.33	31.92
			13083.00	25923.90	43 42.654	69 44.494					
05/02/01	2	375	13130.30	25920.00	43 38.968	69 48.243	08:34	22	24.00	3.98	32.13
			13122.10	25920.10	43 39.549	69 47.530					
05/02/01	2	494	13115.60	25880.80	43 35.987	69 42.625	11:15	17	51.50	3.52	32.27
			13120.70	25878.70	43 35.422	69 42.856					
05/02/01	2	194	13031.40	25914.80	43 45.267	69 38.863	13:22	20	32.00	3.73	32.08
			13037.10	25910.80	43 44.462	69 38.913					
05/02/01	2	108	13008.90	25929.80	43 48.367	69 38.597	14:31	21	16.50	4.12	32.18
			13015.20	25921.20	43 47.040	69 38.156					
05/03/01	2	6	12894.00	25917.40	43 54.860	69 26.819	07:09	20	15.00	4.12	31.94
			12902.90	25915.90	43 54.101	69 27.434					
05/03/01	2	55	12946.80	25898.50	43 49.300	69 29.280	09:18	20	38.00	3.61	32.16
			12940.70	25902.30	43 50.112	69 29.185					
05/03/01	2	92	12935.30	25888.90	43 49.058	69 27.058	10:49	18	33.00	3.63	32.23
			12942.50	25888.10	43 48.491	69 27.623					
05/03/01	2	201	12971.30	25872.60	43 44.926	69 28.408	12:26	21	47.00	3.53	32.26
			12970.00	25878.20	43 45.602	69 28.961					
05/03/01	2	41	12946.20	25918.70	43 51.473	69 31.674	14:13	20	17.00	4.17	32.00
			12951.60	25914.20	43 50.633	69 31.616					
05/04/01	2	22	12859.70	25890.90	43 54.319	69 20.346	07:34	20	12.50	4.64	31.70
			12852.40	25893.20	43 55.051	69 19.964					
05/04/01	2	173	12935.80	25859.10	43 45.866	69 23.451	09:37	20	47.00	3.69	32.19
			12927.60	25861.10	43 46.623	69 22.926					
05/04/01	2	316	12966.30	25828.90	43 40.645	69 22.659	13:21	17	59.50	3.56	32.24
			12959.90	25830.10	43 41.194	69 22.191					
05/04/01	2	88	12975.60	25904.90	43 48.031	69 32.672	15:54	20	30.00		
			12971.90	25909.70	43 48.786	69 32.910					
05/07/01	3	369	12813.70	25852.00	43 53.134	69 10.979	08:25	15	18.00	4.87	31.67
			12818.00	25850.70	43 52.712	69 11.220					
05/07/01	3	317	12781.10	25852.20	43 55.283	69 07.867	10:24	20	20.00	5.10	31.60
			12774.10	25851.10	43 55.620	69 07.044					
05/07/01	3	399	12790.20	25825.00	43 51.711	69 05.060	12:32	14	34.50	4.63	31.96
			12785.60	25825.80	43 52.096	69 04.716					
05/07/01	3	427	12773.50	25815.20	43 51.714	69 02.036	14:36	13	33.50	4.87	31.93

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Date	Region	Grid	Loran W C	Loran X C	Lat Deg / Min	Long Deg / Min	Start Time Min	Tow Duration Min	Ave. Depth FA	Temp °C	Salinity PPT
			12776.20	25812.60	43 51.253	69 01.944					
05/08/01	3	126	12637.40	25881.10	44 07.854	68 58.020	9:43	20	38.00	4.37	31.68
			12645.30	25882.80	44 07.528	68 59.030					
05/08/01	3	56	12582.20	25898.30	44 13.380	68 55.239	11:25	21	22.00	4.46	31.56
			12590.70	25896.60	44 12.633	68 55.801					
05/08/01	3	14	12541.40	25910.10	44 17.371	68 53.088	12:54	21	20.00	4.41	31.52
			12549.00	25907.70	44 16.604	68 53.455					
05/08/01	3	3	12516.00	25916.50	44 19.756	68 51.632	14:09	20	15.00	4.17	31.49
			12524.10	25916.10	44 19.180	68 52.344					
05/08/01	3	53	12599.30	25913.60	44 13.973	68 59.124	16:36	19	28.00	4.22	31.66
			12606.50	25911.00	44 13.209	68 59.423					
05/08/01	3	77	12621.80	25901.30	44 11.124	68 59.459	17:56	20	32.00	4.40	31.60
			12617.70	25905.90	44 11.906	68 59.739					
05/09/01	3	960	12906.80	25739.80	43 34.901	69 05.484	10:21	16	77.50	4.09	32.47
			12911.00	25743.00	43 34.983	69 06.341					
05/09/01	3	994	12842.50	25721.40	43 36.933	68 56.220	12:37	20	71.00	3.74	32.27
			12850.60	25719.20	43 36.179	68 56.781					
05/10/01	3	328	12688.70	25804.30	43 55.950	68 51.898	07:59	19	46.50	4.89	31.86
			12696.00	25804.90	43 55.549	68 52.731					
05/10/01	3	259	12619.70	25790.00	43 58.732	68 42.597	10:06	16	39.00	4.45	31.93
			12625.50	25789.80	43 58.340	68 43.176					
05/10/01	3	143	12586.20	25841.20	44 06.694	68 47.019	12:00	20	15.50	5.96	31.03
			12585.70	25836.50	44 06.195	68 46.251					
05/10/01	3	48	12527.10	25883.70	44 15.321	68 47.649	13:51	20	15.50	5.25	31.01
			12528.70	25879.10	44 14.697	68 47.095					
05/10/01	3	121	12566.40	25839.70	44 07.799	68 44.785	16:17	20	34.00	6.06	31.27
			12560.30	25843.50	44 08.623	68 44.754					
05/11/01	3	564	12701.10	25731.50	43 46.917	68 42.398	08:21	20	56.50	3.82	32.14
			12718.10	25728.60	43 45.524	68 43.820					
05/11/01	3	387	12641.80	25759.00	43 53.789	68 40.166	10:33	20	51.50	4.01	31.99
			12648.80	25756.40	43 53.050	68 40.519					
05/14/01	3	359	12660.70	25778.70	43 54.843	68 45.188	07:26	21	51.00		
			12668.60	25775.70	43 54.002	68 45.568					
05/14/01	3	364	12612.70	25754.70	43 55.120	68 36.340	09:47	17	49.00		
			12629.50	25754.60	43 54.055	68 38.151					
05/14/01	3	337	12625.10	25761.40	43 55.116	68 38.738	11:50	16	48.50		
			12624.40	25765.60	43 55.643	68 39.317					
05/14/01	4	495	12536.60	25756.00	44 00.057	68 28.181	15:12	20	43.50		
			12539.60	25760.00	44 00.335	68 29.178					
05/14/01	4	309	12484.80	25794.60	44 07.840	68 28.974	17:13	16	14.00		
			12487.30	25791.30	44 07.298	68 28.690					
05/15/01	4	250	12482.90	25812.60	44 10.047	68 31.776	07:19	16	15.00		
			12488.70	25811.40	44 09.538	68 32.192					
05/15/01	4	475	12505.00	25750.00	44 01.342	68 23.638	9:43	20	45.50		
			12511.70	25747.20	44 00.591	68 23.913					
05/15/01	4	521	12525.70	25745.40	43 59.501	68 25.184	11:06	20	48.00		
			12528.00	25740.70	43 58.803	68 24.647					
05/15/01	4	492	12559.70	25772.00	44 00.465	68 33.350	12:58	20	41.00		
			12552.40	25772.30	44 00.961	68 32.606					

Appendix A
Individual Station Descriptions

Date	Region	Grid	Loran W C	Loran X C	Lat Deg / Min	Long Deg / Min	Start Time Min	Tow Duration Min	Ave. Depth FA	Temp °C	Salinity PPT
05/15/01	4	562	12539.10	25733.80	43 57.295	68 24.735	15:17	16	51.00		
			12533.40	25734.00	43 57.674	68 24.122					
05/16/01	4	175	12431.00	25807.80	44 12.815	68 25.403	06:56	20	15.50		
			12438.60	25807.70	44 12.315	68 26.207					
05/16/01	4	286	12415.10	25763.20	44 08.582	68 15.789	09:06	20	29.00		
			12418.40	25759.20	44 07.895	68 15.441					
05/16/01	4	432	12458.80	25735.50	44 02.511	68 15.817	11:09	20	49.50		
			12452.70	25738.40	44 03.241	68 15.630					
05/16/01	4	525	12498.00	25726.80	43 59.025	68 18.820	12:47	20	52.50		
			12491.40	25729.40	43 59.746	68 18.512					
05/17/01	4	911	12293.30	25851.40	44 26.792	68 18.367	08:05	20	8.00		
			12293.30	25847.10	44 26.292	68 17.582					
05/17/01	4	5	12277.30	25838.50	44 26.334	68 14.273	09:23	20	22.00		
			12275.70	25834.60	44 25.984	68 13.372					
05/17/01	4	15	12289.10	25829.10	44 24.468	68 13.810	10:44	20	8.00		
			12287.10	25825.10	44 24.131	68 12.846					
05/17/01	4	28	12262.90	25807.40	44 23.626	68 06.799	12:13	19	17.00		
			12269.60	25804.90	44 22.896	68 07.076					
05/17/01	4	94	12315.00	25782.50	44 17.302	68 07.965	12:39	20	34.00		
			12309.70	25786.20	44 18.083	68 08.062					
05/17/01	4	165	12329.90	25752.90	44 12.799	68 04.035	15:10	19	45.50		
			12329.60	25756.90	44 13.300	68 04.769					
05/17/01	4	142	12339.00	25767.50	44 13.967	68 07.881	16:57	21	33.50		
			12332.50	25771.00	44 14.805	68 07.796					
05/18/01	4	273	12301.60	25713.00	44 09.762	67 52.724	09:07	20	54.50		
			12309.20	25713.20	44 09.299	67 53.707					
05/18/01	4	270	12323.00	25722.80	44 09.589	67 57.322	10:29	20	47.00		
			12330.30	25723.20	44 09.169	67 58.284					
05/18/01	4	130	12296.50	25752.20	44 14.861	67 59.953	12:41	20	38.00		
			12303.50	25752.70	44 14.471	68 00.882					
05/18/01	4	99	12278.20	25764.00	44 17.459	68 00.111	14:04	20	34.50		
			12285.50	25764.10	44 17.001	68 00.992					
05/21/01	5	510	12226.50	25749.90	44 19.108	67 51.050	09:07	20	32.00		
			12221.70	25753.60	44 19.857	67 51.200					
05/21/01	5	534	12236.30	25750.30	44 18.512	67 52.319	10:36	20	32.50		
			12229.00	25751.80	44 19.166	67 51.756					
05/21/01	5	428	12214.80	25775.70	44 22.992	67 54.935	12:53	20	20.50		
			12219.10	25771.80	44 22.211	67 54.647					
05/21/01	5	291	12148.80	25777.40	44 27.544	67 47.316	15:32	17	18.50		
			12154.80	25776.70	44 27.031	67 47.876					
05/22/01	5	264	12136.50	25767.00	44 27.101	67 43.588	08:58	20	20.50		
			12130.40	25770.00	44 27.874	67 43.462					
05/22/01	5	611	12244.00	25724.60	44 14.902	67 47.925	11:25	20	48.00		
			12251.30	25724.90	44 14.468	67 48.909					
05/22/01	5	566	12187.10	25720.50	44 18.091	67 39.785	13:12	20	48.50		
			12192.70	25722.20	44 17.937	67 40.875					
05/22/01	5	569	12175.00	25712.00	44 17.829	67 36.298	14:56	20	47.50		
			12181.60	25712.50	44 17.452	67 37.254					
05/22/01	5	572	12148.30	25699.90	44 18.069	67 29.948	16:28	20	58.50		

Appendix A
Individual Station Descriptions

Date	Region	Grid	Loran W C	Loran X C	Lat Deg / Min	Long Deg / Min	Start Time Min	Tow Duration Min	Ave. Depth FA	Temp °C	Salinity PPT
			12155.10	25699.90	44 17.622	67 30.874					
05/23/01	5	369	12115.50	25737.00	44 24.848	67 34.172	06:32	20	35.00		
			12121.70	25737.70	44 24.528	67 35.136					
05/23/01	5	339	12083.10	25725.00	44 25.554	67 26.994	08:18	20	43.00		
			12089.60	25725.30	44 25.146	67 27.968					
05/23/01	5	223	12030.50	25723.50	44 28.934	67 19.350	10:27	20	34.00		
			12024.90	25726.90	44 29.751	67 19.478					
05/23/01	5	118	11974.90	25744.30	44 35.366	67 16.917	15:45	20	31.00		
			11980.70	25745.30	44 35.070	67 17.961					
05/23/01	5	98	11983.60	25757.10	44 36.305	67 21.375	16:59	20	16.50		
			11979.40	25755.00	44 36.334	67 20.269					
05/23/01	5	173	12043.50	25760.20	44 32.536	67 30.106	18:41	20	16.00		
			12037.50	25760.00	44 32.924	67 29.276					
05/24/01	5	351	12015.70	25687.60	44 25.508	67 07.994	07:32	20	55.50		
			12017.30	25690.20	44 25.710	67 08.906					
05/24/01	5	388	12010.40	25675.20	44 24.299	67 03.826	09:03	18	64.50		
			12012.10	25677.20	44 24.433	67 04.652					
05/24/01	5	46	11880.70	25741.80	44 41.958	67 02.756	14:35	11	45.00		
			11886.10	25740.40	44 41.276	67 02.913					
05/24/01	5	64	11904.40	25738.30	44 39.706	67 05.143	15:53	21	45.00		
			11912.10	25737.20	44 39.005	67 05.949					
05/25/01	5	41	11857.90	25734.80	44 42.703	66 57.112	05:51	20	54.00		
			11865.10	25733.60	44 42.020	66 57.881					
05/25/01	5	18	11836.70	25742.30	44 45.221	66 55.999	07:06	20	47.00		
			11841.60	25742.70	44 44.870	66 56.877					
05/25/01	5	27	11883.70	25751.90	44 42.821	67 05.854	08:52	20	22.50		
			11875.00	25753.70	44 43.682	67 05.069					
05/25/01	5	43	11902.80	25748.50	44 41.039	67 07.696	10:25	20	34.00		
			11894.50	25749.60	44 41.782	67 06.804					

Appendix B
Taxa List

Finfish species

Flatfish

Atlantic halibut	*Hippglossus hippoglossus*
American plaice	*Hippoglossoides platessoides*
Summer flounder	*Paralichthys dentatus*
Four-spot flounder	*Paralichthys oblongus*
Yellowtail flounder	*Limanda ferruginea*
Winter flounder	*Pseudopleuronectes americanus*
Witch flounder	*Glyptocephalus cynoglossus*
Windowpane	*Scophthalmus aquosus*
Gulf Stream flounder	*Citharichthys arctifrons*

Gadids

Atlantic cod	*Gadus morhua*
Haddock	*Melanogrammus aeglefinus*
Pollock	*Pollachius virens*
Silver hake	*Merluccius bilinearis*
White hake	*Urophycis tenuis*
Red hake	*Urophycis chuss*
Spotted hake	*Urophycis regia*
Four-beard rockling	*Enchelyopus cimbrius*

Other Benthics

Acadian redfish	*Sebastes fasciatus*
Ocean pout	*Macrozoarces americanus*
Goosefish	*Lophius americanus*
Spiny Dogfish	*Squalus acanthias*
Atlantic hagfish	*Mxyine glutinosa*
Sea raven	*Hemitripterus americanus*
Alligatorfish	*Aspidophoroides monopterygius*
Lumpfish	*Cyclopterus lumpus*
Winter skate	*Raja ocellata*
Little skate	*Raja erinacea*
Smooth skate	*Raja senta*
Thorny skate	*Raja radiata*
Longhorn sculpin	*Myoxocephalus octodecemspinosus*
Shorthorn sculpin	*Myoxocephalus scorpius*
Moustache sculpin	*Triglops murrayi*
Northern searobin	*Prionotus carolinus*
Snakeblenny	*Lumpenus lumpretaeformis*
Daubed shanny	*Lumpenus maculatus*
American sand lance	*Ammodytes americanus*
Atlantic silverside	*Menidia menidia*
Three-spine stickleback	*Gasterosteus aculeatus*

Black sea bass	*Centropristis striata*
Cunner	*Tautogolabrus adspersus*
Grubby	*Myoxocephalus aenaeus*
Striped seasnail	*Liparis liparis*
Seasnail	*Liparis atlanticus*
Gelationous seasnail	*Liparis fabricii*
Radiated shanny	*Ulvaria subbifurcata*
Wolf eelpout	*Lycenchelys verrillii*
Wrymouth	*Cryptacanthodes maculatus*
Sturgeon	*Acipenser sp.*
Pelagics	
Atlantic herring	*Clupea harengus*
Alewife	*Alosa pseudoharengus*
Blueback herring	*Alosa aestivalis*
American shad	*Alosa sapidissima*
Atlantic menhaden	*Brevoortia tyrannus*
Rainbow smelt	*Osmerus mordax*
Buckler dory	*Zenopsis conchifera*
Atlantic mackerel	*Scomber scombrus*
Butterfish	*Peprilus triacanthus*
Scup	*Stenotomas chrysops*
Rough scad	*Trachurus lathami*
Silver anchovy	*Engraulis eurystole*
Barracudina sp.	*Paralepidae spp.*
Invertebrates	
Crustaceans	
American Lobster	*Homarus americanus*
Jonah Crab	*Cancer borealis*
Rock Crab	*Cancer irroratus*
Spider Crab unclass.	*Majidae spp.*
Northern Stone Crab	*Lithodes sp.*
Snow Crab	*Chionectes opilio*
Green Crab	*Carcinus maenus*
Sevenspine Bay Shrimp	*Crangon septemspinosa*
Spiny Lebbeid	*Lebbeus groenlandicus*
Bristled Longbeak	*Dichelopandalus leptocerus*
Aesop Shrimp	*Pandalus montagui*
Northern Shrimp	*Pandalus borealis*
Mantis Shrimp	*Stomatopod sp.*
Hermit Crab (unclass.)	*Diogenidae/Paguridae sp*
Molluscs	
Blue Mussel	*Mytilus edulis*
Sea Scallop	*Placopecten magelanicus*

Iceland Scallop	*Chlamys islandica*
Horse Mussel	*Modiolus modiolus*
Ocean Quahog	*Arctica islandica*
False Quahog	*Pitar morrhuana*
Northern Cardita	*Venercardia borealis*
Ax Head Clam	*Yoldia thraciaeformis*
Waved Astarte	*Astarte undata*
Squid (unclass.)	
Shortfin Squid	*Illex illecebrosus*
Longfin Squid	*Loligo pealei*
Octopus (unclass.)	*Cephalopoda spp*.
Ten-Ridged Whelk	*Neptunea decemcostata*
Stimpson's Whelk	*Colus stimpsoni*

Others

Sand Dollar	*Echinoidae sp*.
Sea Urchin	*Stronglyocentrotus droebachiensis*
Starfish (unclass.)	various species
Boreal Asterias	*Asterias vulgaris*
Sea sponges	various species
Rat-tail Cucumber	*Caudina arenata*
Sea Cucumber	*Cucumaria frondosa*
Anemone	various species
Barnacle	various species