FINAL REPORT

Continuation of the Maine-New Hampshire Inshore Trawl Survey
NEC Contract # PZ06089

January 1, 2006 to March 31, 2007

Submitted December 11, 2007

By

Sally A. Sherman, Keri L. Stepanek and John Sowles
Maine Department of Marine Resources
P.O. Box 8
West Boothbay Harbor, Maine 04575
(207) 633-9500
sally.sherman@maine.gov
keri.stepanek@maine.gov
john.sowles@maine.gov

Douglas E. Grout
New Hampshire Fish and Game Department
225 Main Street
Durham, NH 03824-4732
(603) 868-1095
dgrout@nhfgd.org

Robert Tetrault, T/R Fish, Inc.
2 Portland Fish Pier, Suite 211
Portland, ME 04101
(207) 761-4418
bobt@cobank.com

Abstract:

This report summarizes results from the 2006 sampling season of a comprehensive bottom trawl survey of groundfish and invertebrate species along the coast of Maine and New Hampshire. Prior to 2000, fishery-independent data had been absent for nearly 80% of the inshore Gulf of Maine's inshore waters. The Maine-New Hampshire Inshore Trawl Survey was initiated to fill the information gap and collect valuable information on the fish and biological communities in this area and establish a time series for long-term monitoring of inshore stocks. The survey has a stratified random design similar to the National Marine Fisheries Service's Gulf of Maine survey and the Massachusetts Division of Marine Fisheries inshore survey, with an additional fixed station subset. Using a specially designed net and a commercial fishing vessel, the survey has proven to be a successful example of fishermen and scientists working together to benefit fisheries management. Two annual surveys are conducted, fall and spring, to create a rich database on fish and invertebrate species that is accessible to fishery managers, academic researchers, fishing industry members, graduate students, non-governmental organizations, and the general public. With six complete years and a seventh underway, clear patterns of distribution and abundance have emerged for many species. Information from the survey is used in the assessment and management of several fisheries, and additional requests for and uses of these data have provided new insight into communities and populations in the Gulf of Maine.

Large cod catch from fall 2006 survey

Introduction:

The Maine-New Hampshire Inshore Trawl Survey is a collaborative partnership between commercial fishermen and state researchers to assess inshore fish stocks along the Maine and New Hampshire coasts. Beginning in the fall of 2000, the survey has completed six years of biannual survey work, and the seventh year is now underway. The 2006 spring and fall surveys were funded through the Northeast Consortium. From its inception, the project has been supported by federal funds appropriated to the National Marine Fisheries Service to foster cooperative research using commercial vessels. Collaborative research enables fishermen to contribute their knowledge and experience toward the progress of scientific data collection and ultimately to resource management decisions, and strengthens the trust between fishermen and scientists.

Fishery-independent trawl surveys help to provide a baseline index of the distribution and abundance of a variety of fish and invertebrate species. As they continue on an annual basis, these surveys more truly reflect changes in abundances of populations than commercial fisheries catch statistics. Abundance indices derived from research trawl surveys that maintain consistent and standardized efforts can be utilized to enhance catch statistic based assessments and with additional research efforts could eventually give rise to population abundance estimates.

Surveying the inshore waters of the Maine and New Hampshire coasts has been difficult due to a complex bottom and abundance of lobster gear. The survey has seen an average success rate of 95% in the spring and 71% in the fall. Dealing with the large quantity of fixed gear, especially in the fall, still limits the number of tows that can be made, but continual and extensive public outreach has maintained a satisfactory level of tow completion. The coverage this survey provides promises to be very valuable to better understanding marine ecosystems in the Gulf of Maine. We are confident that the northern Gulf of Maine can be successfully and consistently sampled via trawl survey indefinitely, with sustained funding.

The Maine-New Hampshire Inshore Trawl Survey has demonstrated its value in meeting a wide range of interests and needs within the commercial fishing and fishery management sectors. The continuation of the survey is not only appropriate and consistent with the principles of the Northeast Consortium: “to engage in cooperative research and monitoring projects in the Gulf of Maine and Georges Bank,” but enhances the Northeast Consortium’s programmatic value and credibility.

Project Objectives:

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 (5-80^{+} fathoms).

Specific objectives are:

- To document the distribution and relative abundance of marine resources in the nearshore Gulf of Maine.
- To improve survey logistics to gain cooperation of the fixed gear fishermen.
- To develop recruitment indices for assessments of target species.
- To involve fishermen in scientific data collection.
- To collect environmental data, including temperature and salinity, which affect fish distribution.
- To gather information on biological parameters (growth rates and reproduction).

Participants:

Science Crew:

Maine Department of Marine Resources Scientists

John Sowles, Ecology Division Leader

Sally Sherman, Chief Scientist

Keri Stepanek, Scientist

New Hampshire Department of Fish and Game

Doug Grout, Scientist

Commercial Boat Crew:

Robert Tetrault, owner, T/R Fish, Inc.

F/V Robert Michael crew members

Captain Curt Rice, Jerry Balzano and Edgar Googins

Shore Engineer Randy Greenleaf

Left: DMR Scientist Keri Stepanek and NH F&G Scientist Doug Grout work up the catch
Right: Capt. Curt Rice discusses fishing with DMR Commissioner George Lapointe

Net Design, Construction, Repair and Transport

Jeff Flagg, Portland Trawler Supply
695 Dugway Road
Brownfield, ME 04010
207-935-4747

Daniel Libby
D&E Enterprises
Portland, Maine
207-838-5536

Volunteer Scientists

DMR (207-633-9500) – Laurice Churchill, Kathleen Reardon, Brian Tarbox

NHF&G (603-868-1095) – Rob Royer, Kevin Sullivan, Josh Borgeson, Karina Jolles, Jessica Fischer, Ryan MacDonnell, Beckey Heuss, Hannah Baldwin

Fishermen Observers

Stephen Train, Long Island, Maine 207-766-4493

John Nicolai, Bar Harbor, Maine 207-963-2341

Marine Patrol Escort and Participation

Colonel Joe Fessenden, Lieutenants Dave Mercier and Alan Talbot,
20 Marine Patrol Officers, Patrol Boat Captains

Contact: Colonel Joseph Fessenden
Maine Department of Marine Resources
State House Station 36
Augusta, Maine 04333
(207) 624-6550

Fisherman Steve Train helps sort catch while Maine Marine Patrol watches in background

Permits

NOAA Permitting Office, National Marine Fisheries Service, Gloucester, MA
Doug Grout – New Hampshire Department of Fish and Game, Concord, NH
Laurice Churchill – Maine DMR, Boothbay Harbor, ME

Notification

James Mansfield, NOAA National Weather Service, Gray, Maine 207-688-3224
Mark Turner, NOAA National Weather Service, Caribou, Maine 207-492-0170

Methods:

Methods are described under separate cover in "Maine-New Hampshire Inshore Groundfish Trawl Survey Procedures and Protocols (2005)," available on-line at http://www.maine.gov/dmr/rm/trawl/trawl.htm. The manual includes detailed descriptions of survey design, station selection, survey vessels, net design, public notification, sample collection and catch handling, and other information on survey methods and operations.

Data:

Data collected on the Maine-New Hampshire Inshore Trawl Survey includes:

- Station information (date, time, tow coordinates, depth, etc.)
- Environmental data (salinity, temperature)
- Total weight and quantity for all species encountered
- Length frequency data for nearly all species
- Biological data (sex, maturity, stomach contents, etc.) for selected commercially-important species

Summary data are contained in the "Final Report to the Northeast Consortium on the Maine-New Hampshire Inshore Groundfish Trawl Survey" accessible on-line at http://www.maine.gov/dmr/rm/trawl/trawl.htm. Raw data are available to the public on request in unprocessed format. These data will also be submitted to the Northeast Consortium on separate CD.


Left: DMR scientist John Sowles is assisted by crewmember Jerry Balzano in collecting samples
Right: DMR chief scientist Sally Sherman and GMRI scientist Catherine Salerno sort the catch

Results and Conclusions:

Spring 2006 survey

The spring survey began on May 1, 2006, and 109 out of 115 targeted tows were completed for a success rate of 95%. The weight of the total mixed catch varied from a minimum of 2 kg to a maximum of 503 kg, with a mean of 89 kg and a median of 65 kg. The total number of species caught over the course of the survey was 95. A low of 8 and a high of 32 species were seen in any particular tow, with an average of 21 species. A complete listing of tow locations, coordinates, dates, times, and depths can be found in Appendix A.

Several species of fish of note were caught on the Spring survey. A 28 cm (.24 kg) striped bass, *Morone saxatilis*, was caught off Wells Beach. A second capture of cusk, *Brosme brosme*, (55 cm, 1.55 kg) was at Skate Bank (the first occurrence being in spring 2003). This fish was examined for maturity and it was found to be a resting male, and its otoliths were extracted for future age estimation. Three Atlantic menhaden, *Brevoortia tyrannus*, never before seen in a spring survey, were caught in two separate tows, west of Small Point Mud and east of Seguin Island. These were larger individuals, consisting of two 30-cm and one 31-cm fish, and had a combined weight 1.3 kg. Three Atlantic wolffish, *Anarhichas lupus*, were caught, one (98 cm, 10.28 kg) at the Tanta fishing grounds, and two young-of-the-year (7 and 8 cm) off of Mount Desert Rock. Finally, two Atlantic sturgeon, *Acipenser oxyrhynchus*, were caught at Richmond Island. They weighed a total of 28.9 kg and were 135 and 137 cm in length.



Left: Atlantic menhaden, *Brevoortia tyrannus*
Center: Atlantic wolfish, *Anarhichas lupus*
Right: Scientist Keri Stepanek shows an Atlantic sturgeon

Overall catches were comparable with previous surveys, if not somewhat larger. Sea herring, lobsters, northern shrimp, alewife, and plaice were the most abundant. Average bottom temperatures were near 5 ^{o} C at the start of the spring survey, which is about 1.5 ^{o} C warmer than the previous spring. Average bottom temperature by stratum ranged from 4.8 to 7.8^{o} C (Table 1). The overall average temperature for spring 2006 was 6.2 ^{o} C which was the warmest spring survey (Figure 1).

Table 1. Average Bottom Temperature (^oC) for the Spring 2006 Survey

	Region					
		1	**2**	**3**	**4**	**5**
Stratum	**1**	5.9	7.1	7.0	7.8	7.1
	2	5.3	6.1	6.5	6.9	6.6
	3	4.8	5.7	6.3	6.1	6.9
	4	4.8	5.2	5.8	6.1	6.8

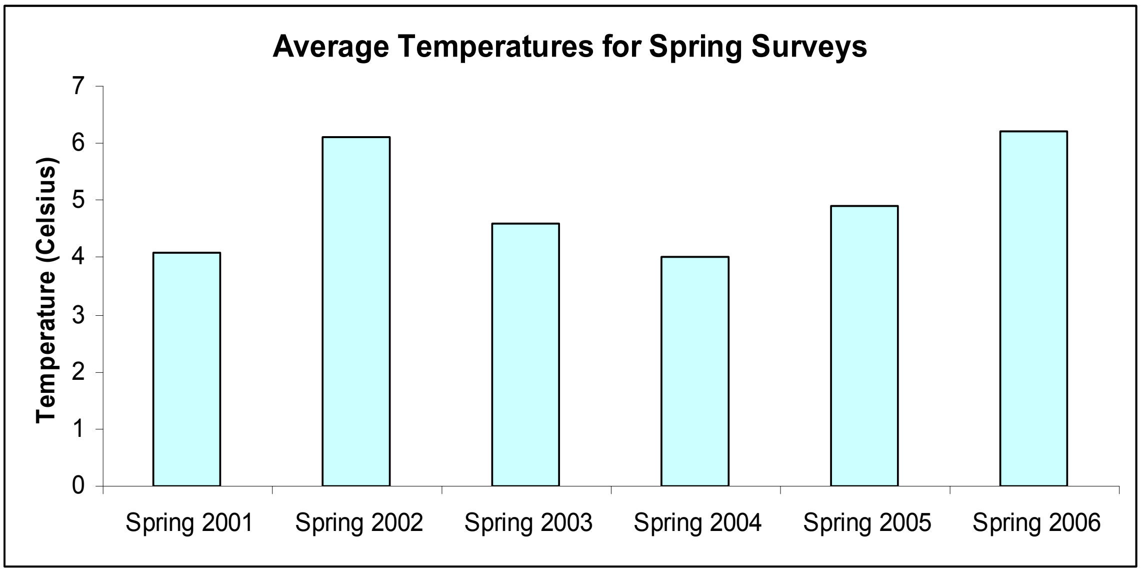


Figure 1. Average Bottom Temperature for All Spring Surveys

DMR Commissioner George Lapointe helps scientist Keri Stepanek record data

Fall 2006 survey

The fall survey began on October 2, 2006 along the coast of New Hampshire. Of the 115 targeted tows, 85 total tows were completed for a success rate of 74%. This was our second-highest success rate for a fall survey since its inception in 2000. The volume of total mixed catch varied from 22 kg to 588 kg, with an average of 127 kg and a median of 85 kg. The total number of species caught was 106, with a low of 12 and high of 34 in any particular tow, and an average of 23 species. A complete listing of tow locations, coordinates, dates, times, and depths can be found in Appendix A.

Unusual occurrences included striped anchovy, *Anchoa hepsetus*, which was seen for the first time in the trawl survey, with a total of 31 fish being caught in 3 tows in Penobscot Bay. Two more striped bass (35 cm, .58 kg; 40 cm, .72 kg) were caught off Hampton Beach and Cape Elizabeth. One Atlantic sturgeon, *Acipenser oxyrhynchus*, (111 cm, 6.06 kg) was caught off Seguin Island. A headlight fish (*Diaphus* sp.) was caught in a tow approximately 10 miles south of Great Wass Island, but unfortunately it was in too poor shape to identify the species.



Above: Crew member Jerry Balzano displays a striped bass
Left: DMR chief scientist displays an Atlantic sturgeon
Right: Headlight fish

Also of note, a few species were caught that haven't been present in the trawl survey for a few years. Forty-eight Atlantic moonfish, *Vomer setapinnis*, were caught off Hampton Beach in New Hampshire and off Long Island in Casco Bay; these had not been seen since the fall 2002 survey. Three buckler dories, *Zenopsis conchifera*, not captured since fall 2000, were caught in the Boon Island Area. A gulf stream flounder, *Citharichthys arctifrons*, absent from the survey since spring 2003, was caught off Matinicus Island.

Average bottom temperatures by stratum ranged from 7.7 to 12.6°C, with an average of 10.4 °C for the whole survey (Table 2). This was one of the warmer fall surveys on record (Figure 2).

Table 2. Average Bottom Temperatures (°C) for the fall 2006 Survey.

		Region				
		1	2	3	4	5
Stratum	1	11.2	12.6	12.4	12.0	9.7
	2	8.8	11.3	12.1	11.5	10.4
	3	8.0	9.9	10.8	10.5	10.2
	4	7.7	9.0	10.1	10.1	9.7

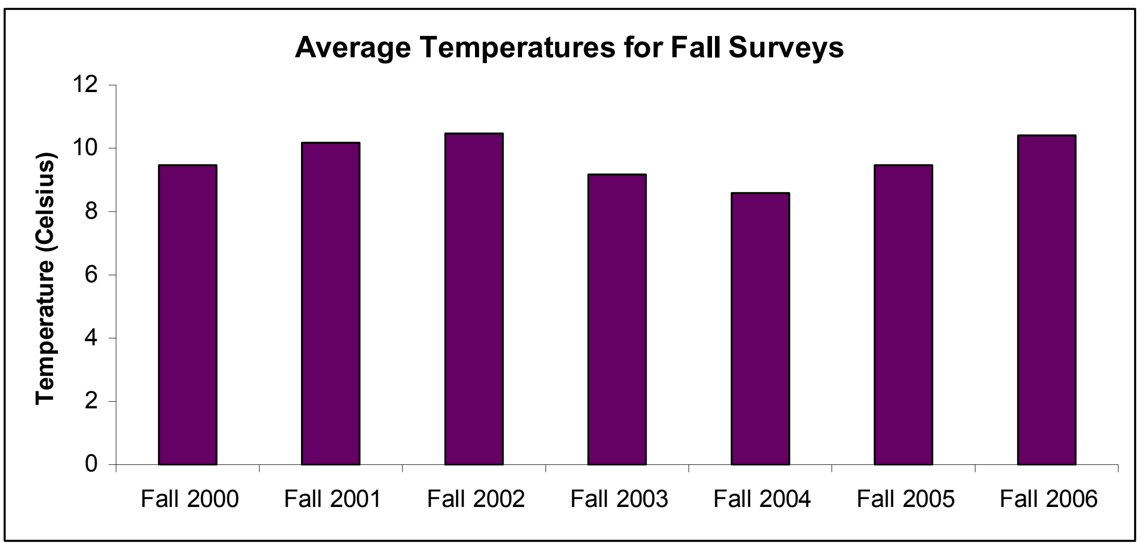


Figure 2. Average Bottom Temperatures for all Fall Surveys.

Trends:

The following results represent species that have shown a change in abundance or distribution in the last year or few years.

Atlantic Cod, *Gadus morhua*

Atlantic cod abundance varies greatly from year to year in the spring surveys and has been fairly steady for the four most recent fall surveys (see Appendix B). The overall catch of cod is small compared to many other species. The majority of cod caught in the spring survey are juveniles ranging from 95 % juveniles (length less than 35 cm) in 2004 and 73 % in 2005. Spring 2006 cod abundance was the lowest since 2003 (Appendix B) and 80 % of the individuals caught were juveniles (Figure 3). The fall 2006 survey shows an increase of the percentage of larger cod (46%) in the southern survey area (Figure 4), but the overall abundance remained fairly constant (Appendix B).

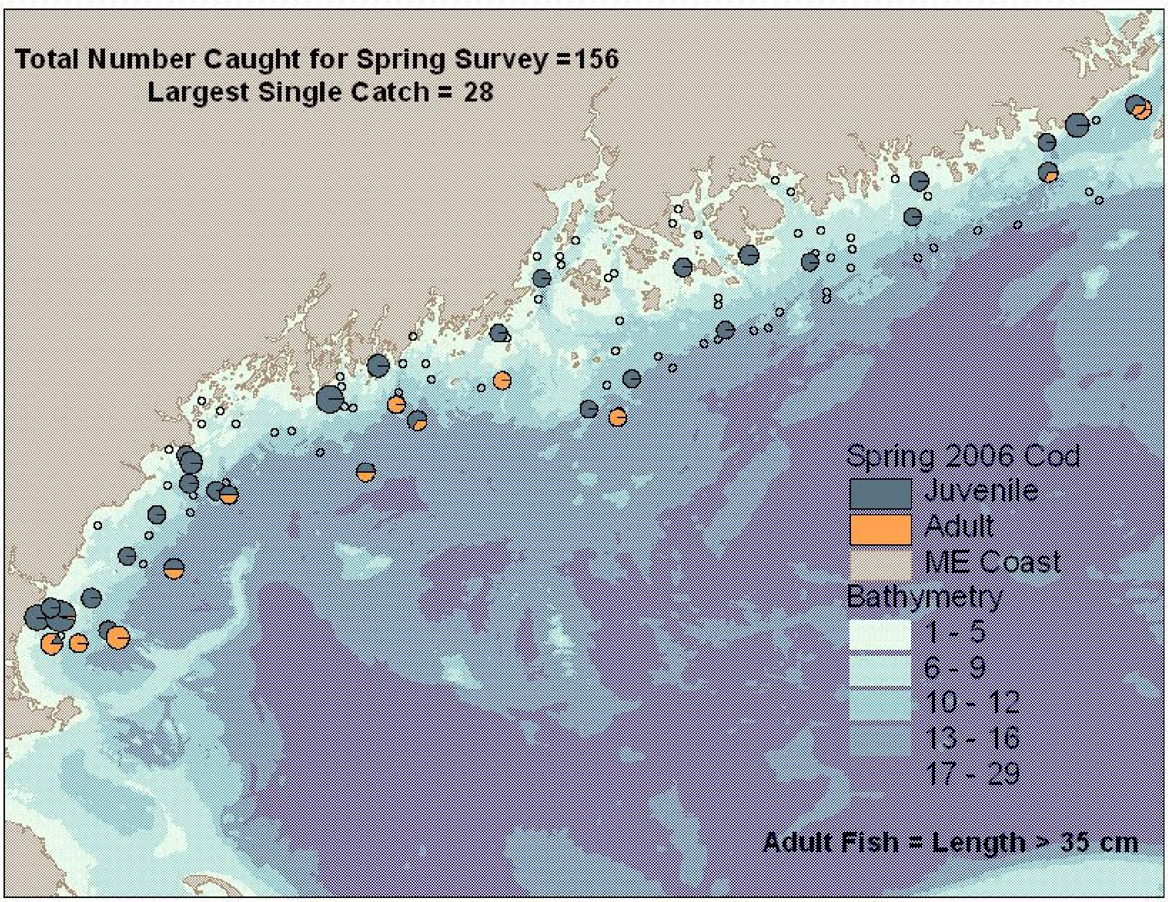


Figure 3. Distribution of adult and juvenile cod for the spring 2006 survey.

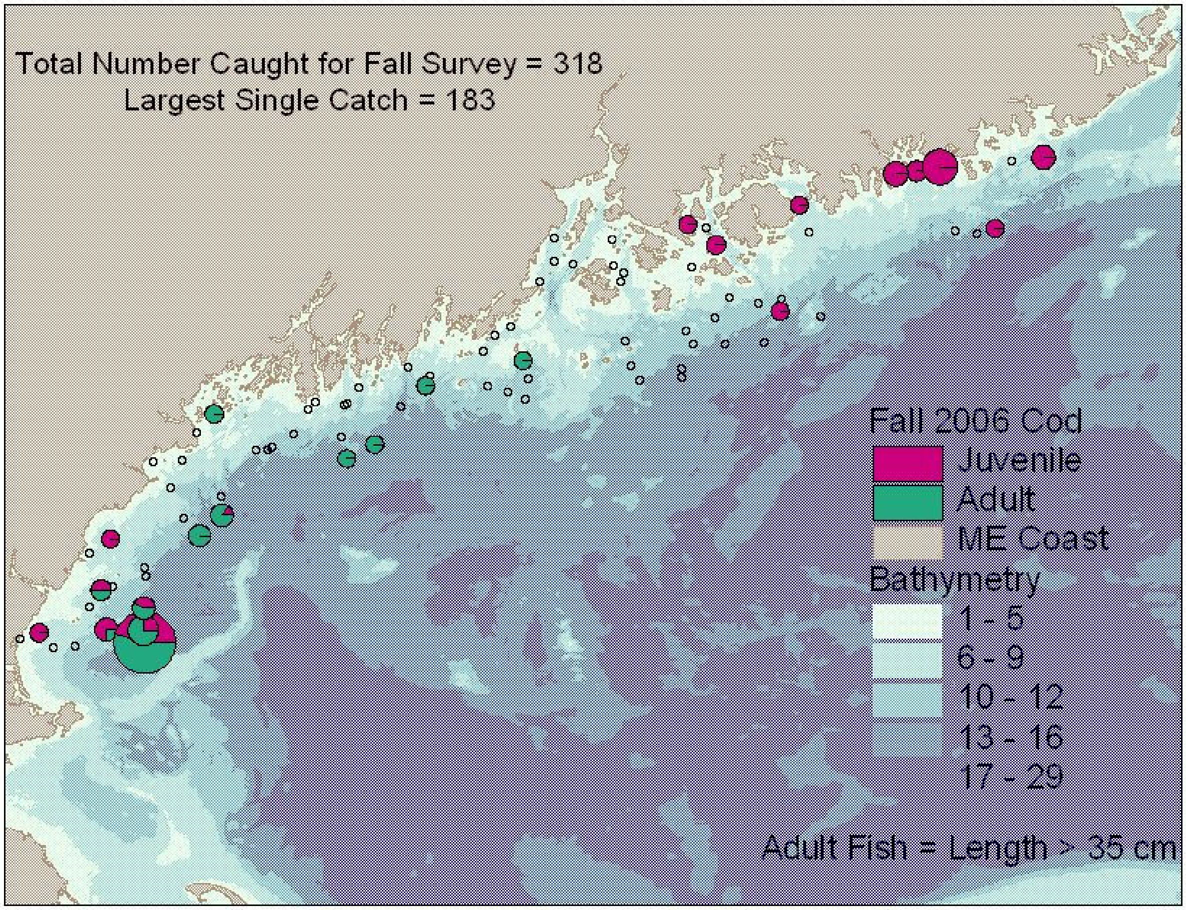


Figure 4. Distribution of juvenile and adult cod in fall 2006.

White Hake, *Urophysis tenuis* / Red Hake, *Urophysis chuss*

White and red hake are typically more abundant in the fall survey catches (Appendix B). The sizes of the catch of both species are similar. In the last two year the survey has encountered an increase in numbers of juvenile white hake not seen previously (Figure 5), while red hake abundance appears to be decreasing (Figure 6). Figure 7 shows the percentages of red and white hake in the fall 2006 survey catches with pie charts. Red hake usually comprise a larger portion of the catch in the southwestern coastal area.

In the following figures, N represents the total number of fish sampled.

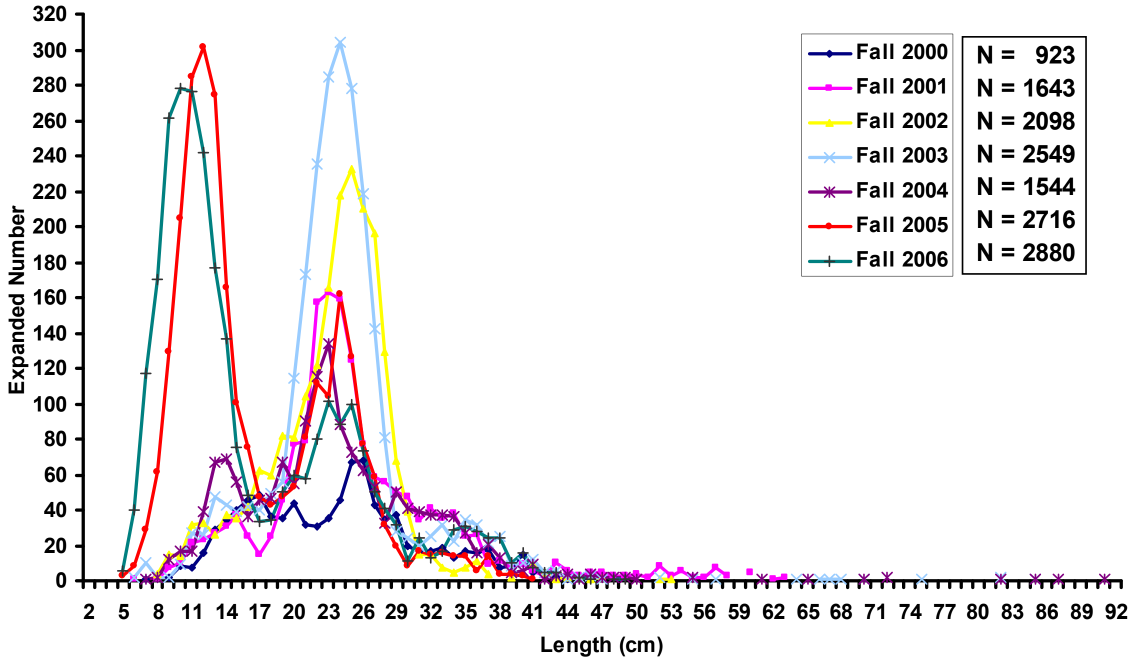


Figure 5. Fall length frequencies for white hake over the entire survey area.

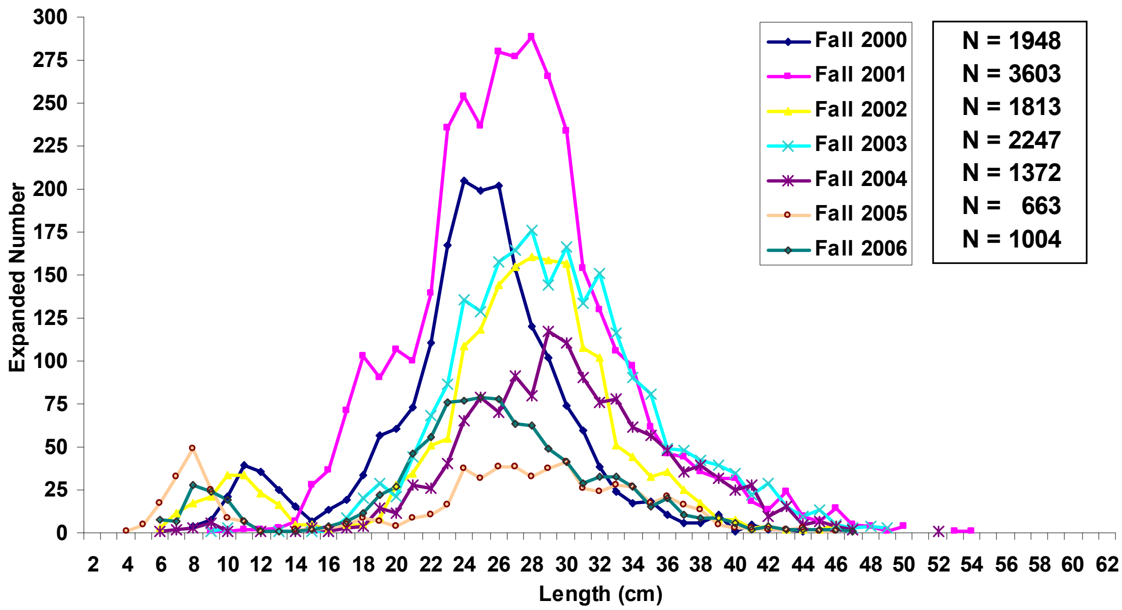


Figure 6. Fall length frequencies for red hake over the entire survey area

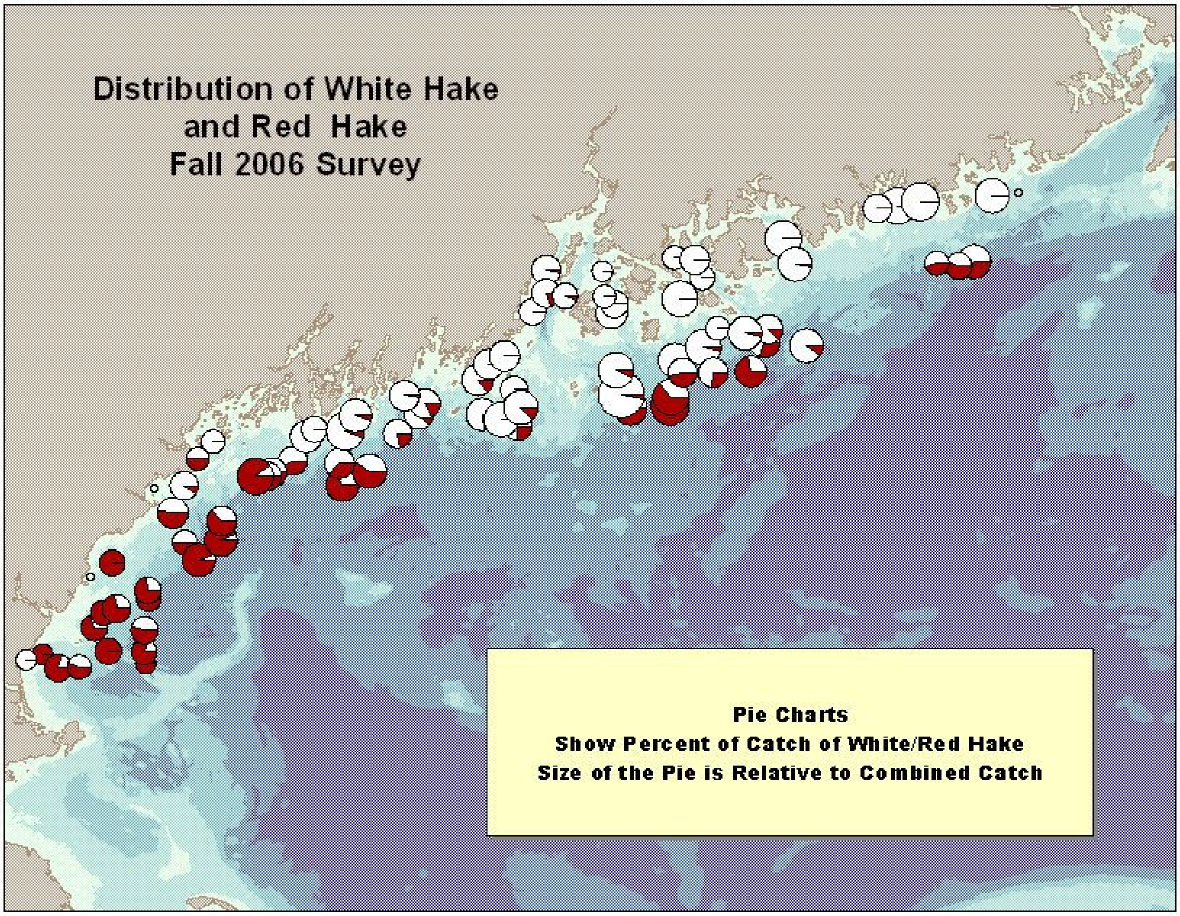


Figure 7. Distribution of white and red hake in the fall 2006 survey

American Plaice, *Hippoglossoides platessoides*

Spring abundance of American plaice increased in 2002 (Appendix B) and has stayed fairly stable since then, while fall numbers have been generally on the rise since 2003. The largest numbers appear in tows conducted in the southwestern portion of the survey area (Figure 8). Length frequency distributions are similar for each year of the spring survey since they began in 2001 (Figure 9). Numbers of individuals in all size classes appear to be increasing.

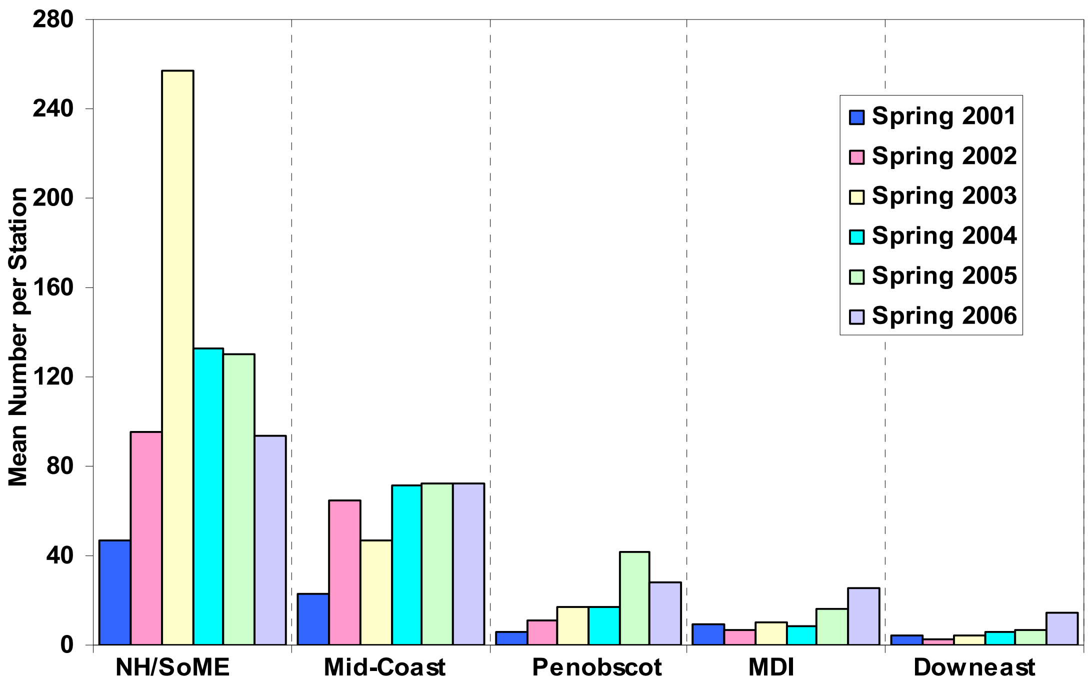


Figure 8. Yearly CPUE in number per tow for plaice by geographic regions.

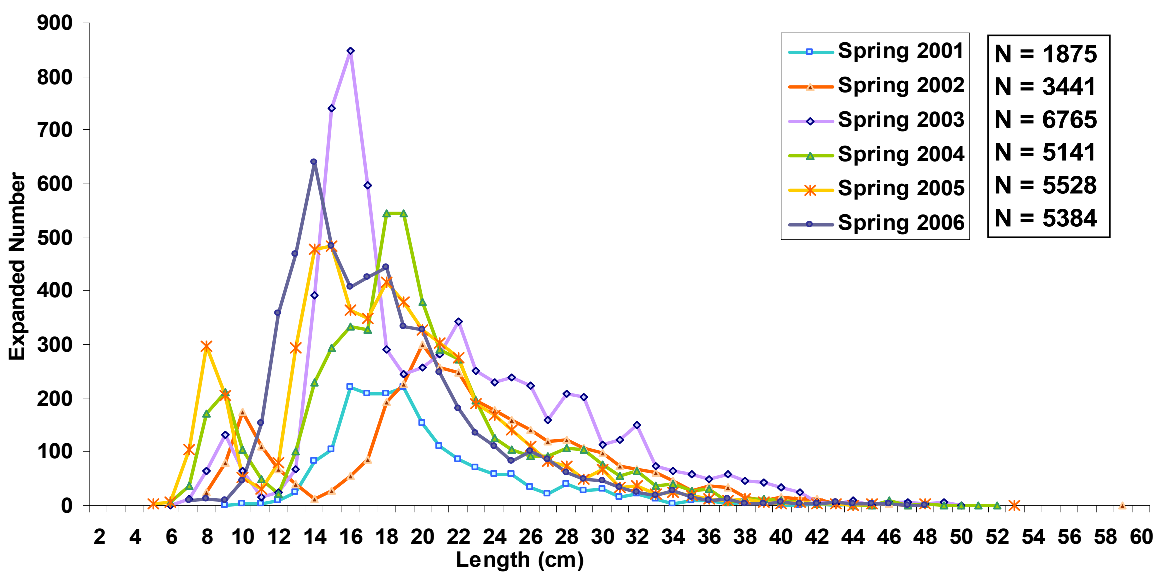


Figure 9. Spring length frequencies for plaice in all regions

Silver Hake, *Merluccius bilinearis*

Silver hake were a large part of the total catch in the first five years of fall surveys,. Single catches ranged from none to over 5000 fish per tow (Figure 10). Catches declined noticeably in the last two fall surveys (Figure 11) with numbers per tow ranging from none to under 1000. The drop is seen in both the 8 to 10 cm range and the larger size class of 18 to 26 cm (Figure 12).

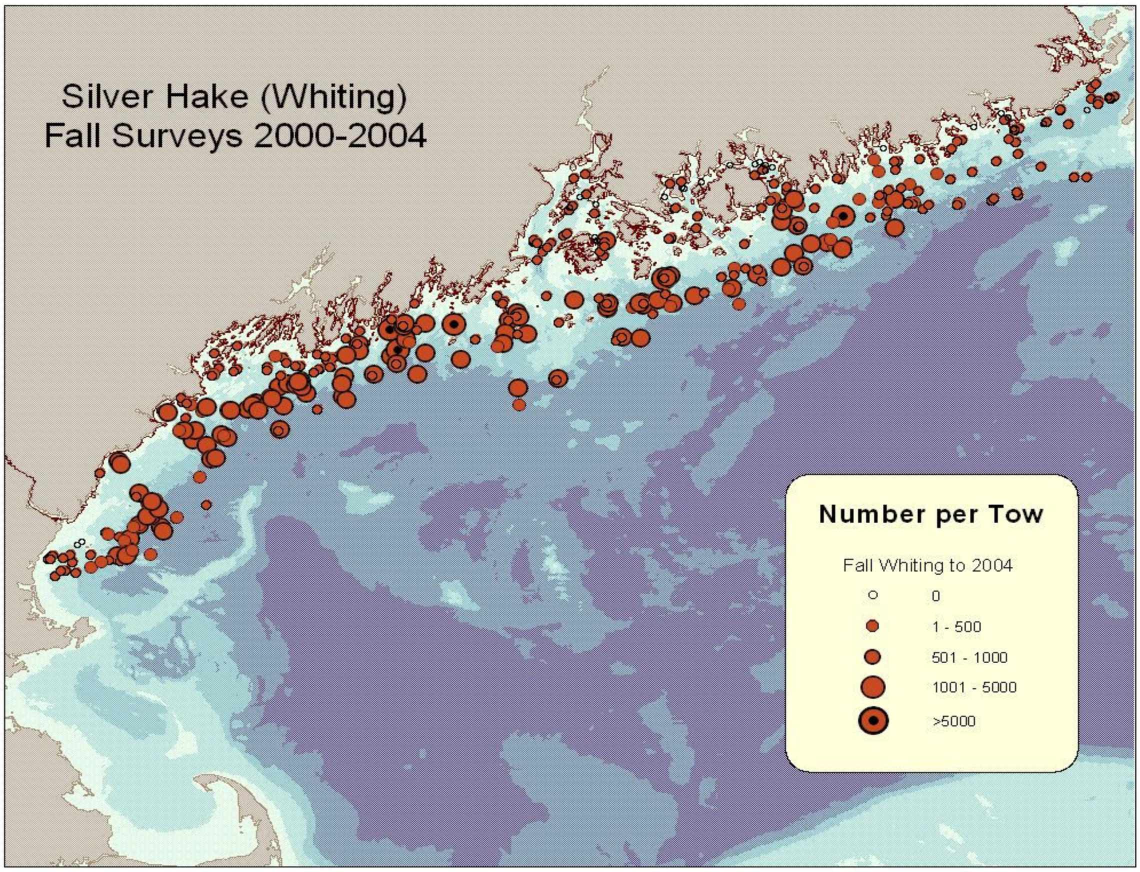


Figure 10. Distribution and abundance of silver hake for fall surveys up to 2004.

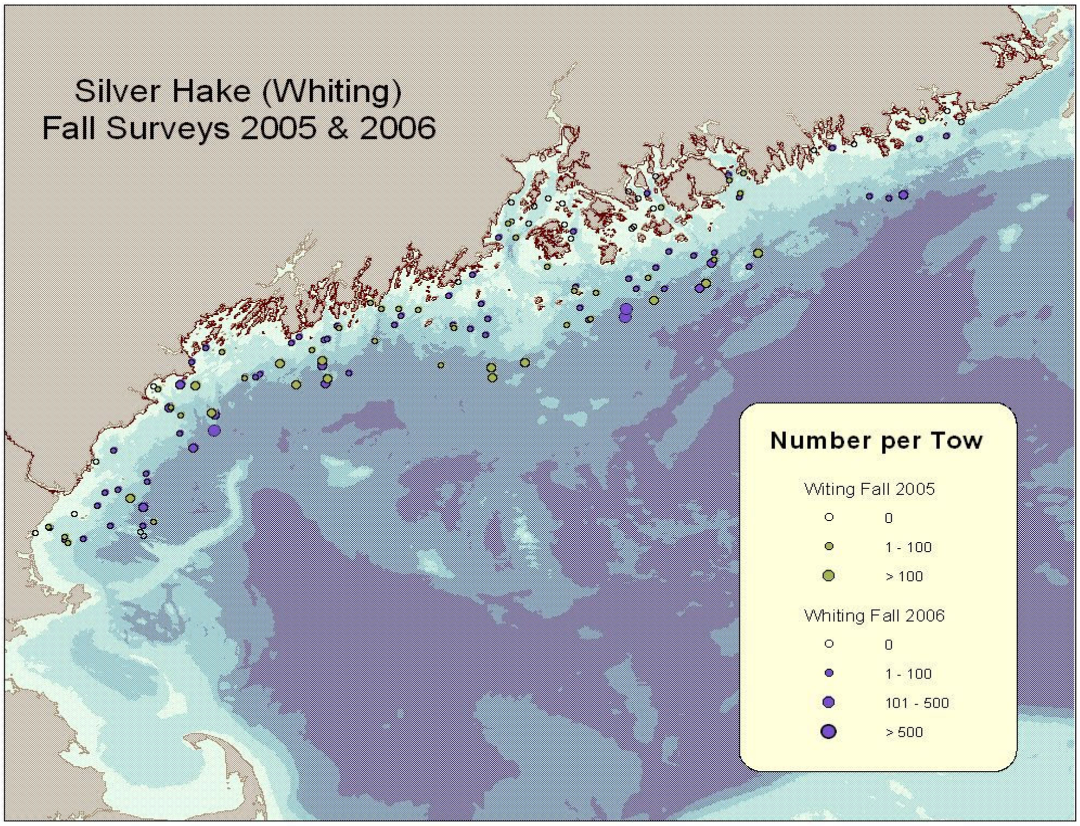


Figure 11. Distribution and abundance of silver hake for fall 2005 and 2006.

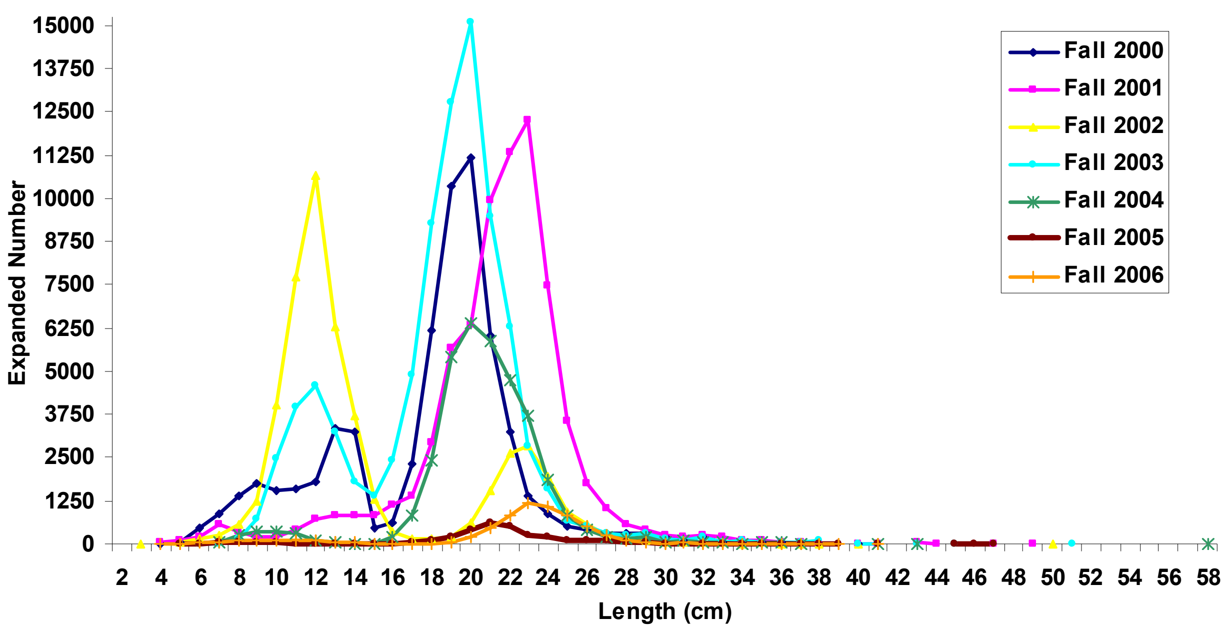


Figure 12. Fall length frequencies of silver hake for all strata combined.

Butterfish, *Peprilus triacanthus*

Butterfish are much more abundant in the fall surveys and occur mainly in the shallower depth strata (Figure 13), although in 2006 a greater proportion of fish were caught in the 36 to 55 fathom stratum. The size range of butterfish captured in the 2006 survey was larger than prior years (Figure 14).

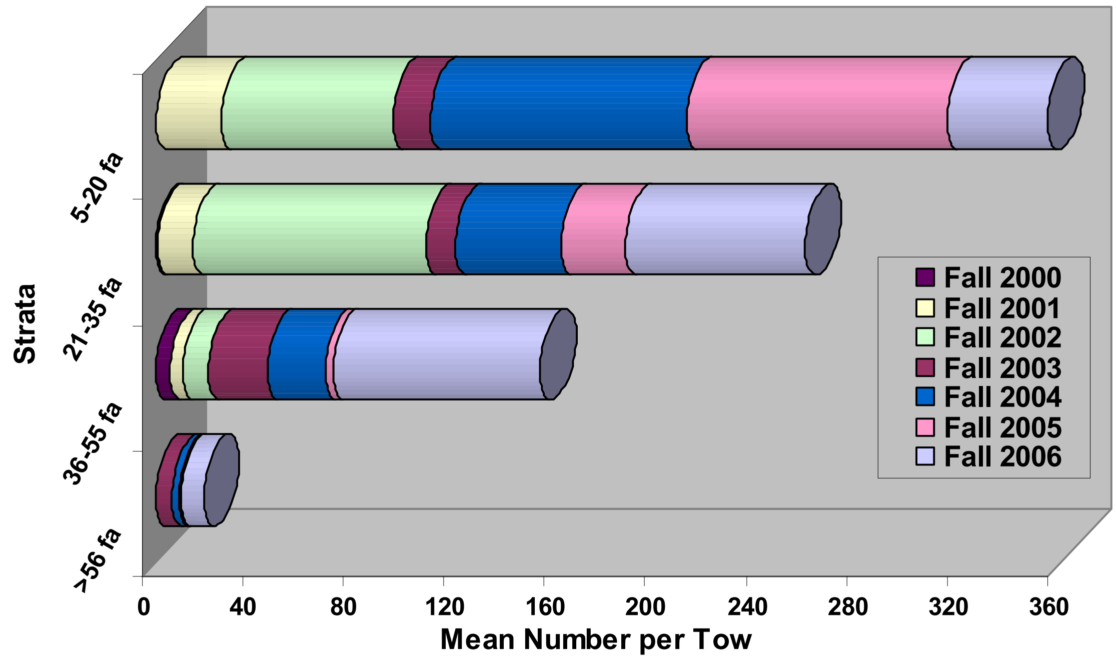


Figure 13. Yearly abundance for butterfish in each depth strata for the fall surveys.

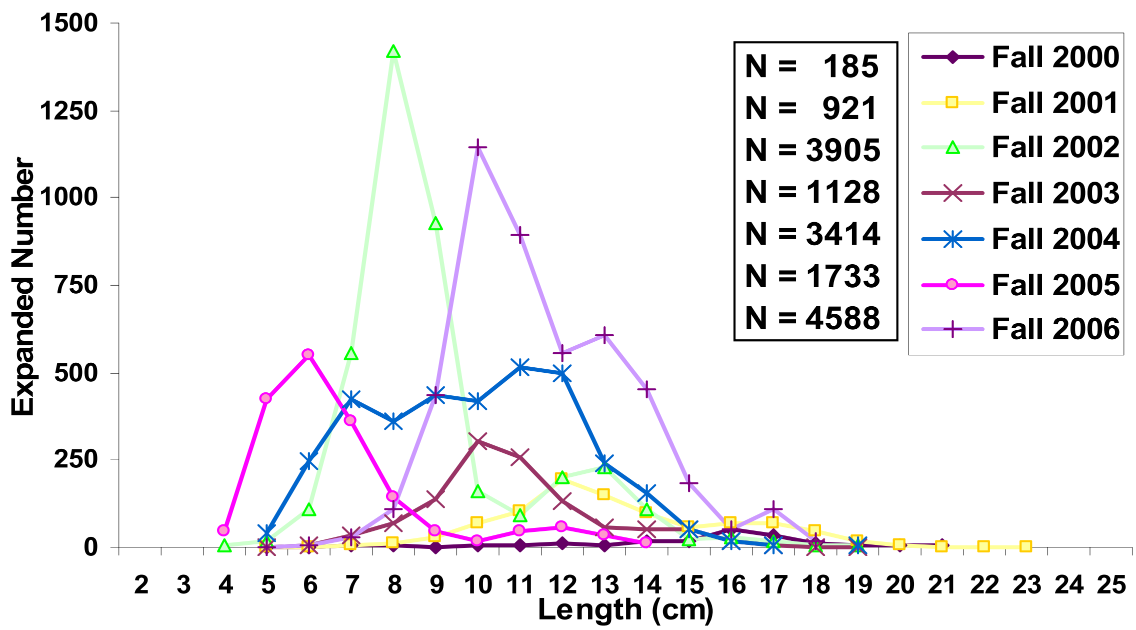


Figure 14. Fall length frequencies for butterfish in all strata.

American Shad, *Alosa sapidissima*

The number of shad seen in the spring 2006 survey rose by quite a margin while the fall abundance index remained stable (Appendix B). Figure 15 shows the distribution of the spring 2006 catches. Although the numbers increased, the size range of the fish sampled remained the same as previous years (Figure 16).

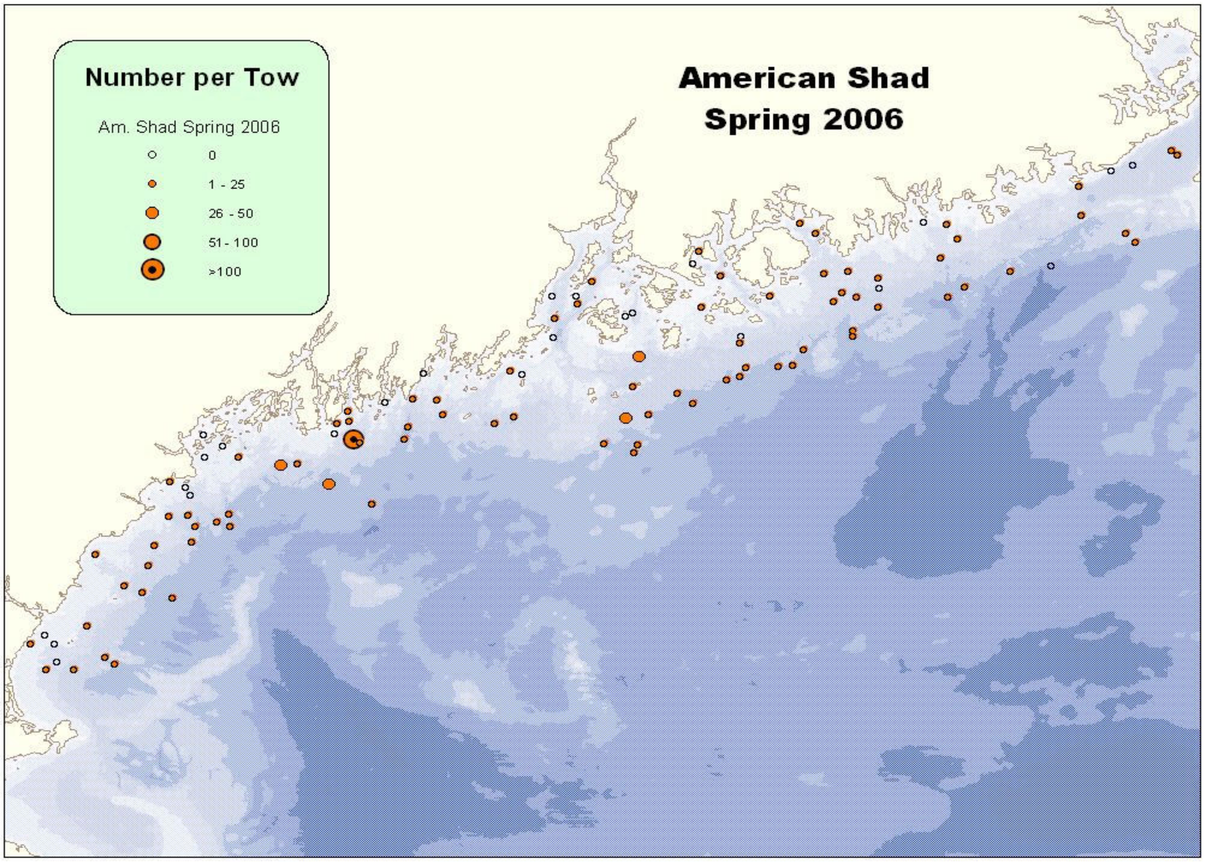


Figure 15. Abundance and distribution of shad in the spring 2006 survey.

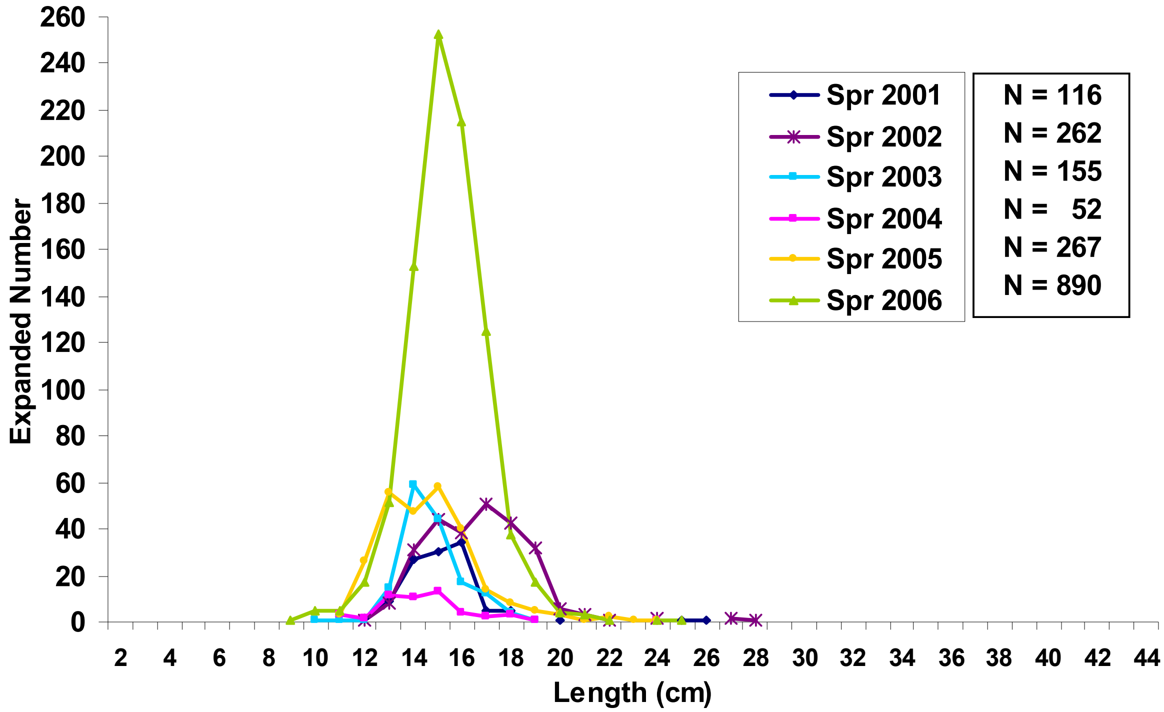


Figure 16. Yearly spring length frequencies for shad for the entire survey area

American Lobster, *Homarus americanus*

Lobsters are a fairly consistent part of the survey catches accounting for the second highest percentage of the catch weight for all spring surveys. In 2006, they ranged from the largest to the fourth largest portion by weight in all fall surveys. The spring abundance is more variable differing as much as 31% from the mean catch. There appears to be some correlation between the mean catch numbers and the average spring water temperature at depth (Figure 17).

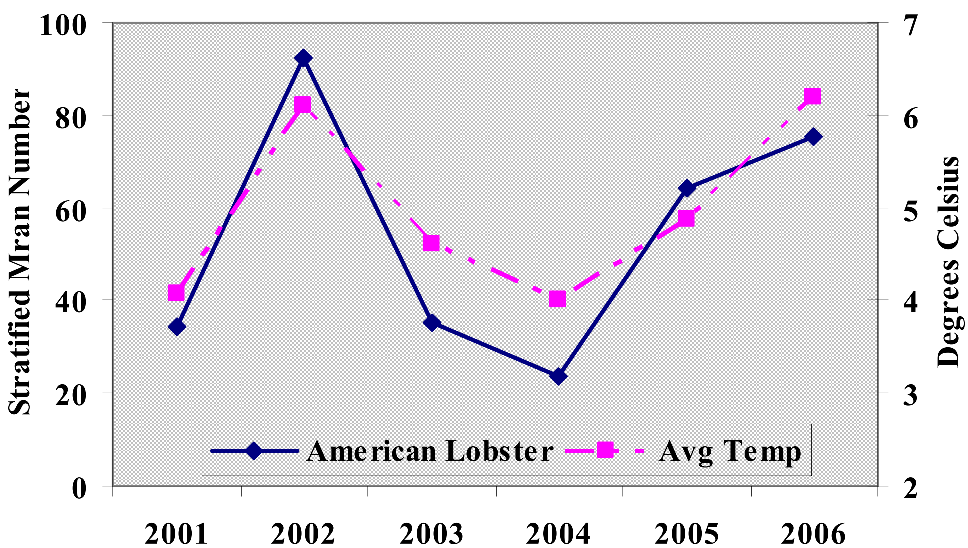


Figure 17. Lobster catch and average water temperature at depth for the spring surveys.

Northern Shrimp, *Pandalus borealis*

Abundance of northern shrimp has been increasing along the survey area in both the spring and fall surveys (Appendix B). Figure 18 illustrates the distribution of shrimp by catch weight in the spring 2006 survey.

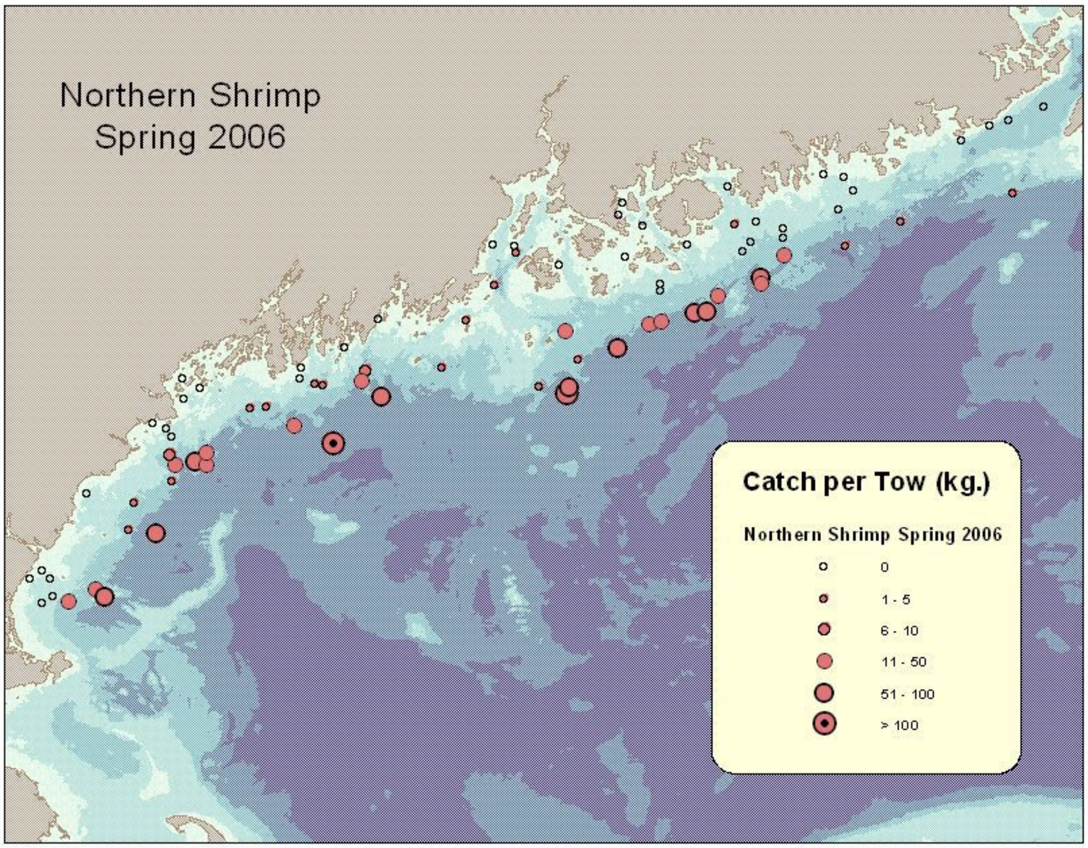


Figure 18. Northern shrimp distribution for the spring 2006 survey.

Partnerships:

The fisherman-scientist partnership during this project has been consistently strong. Foremost is the partnership between the scientific staff and commercial boat crews. The commercial crew of the F/V Robert Michael has proven to be completely dedicated to this project. Not only did the crew operate the boat and handle the gear, they have become equal partners in solving problems related to gear conflicts, communications, scheduling and logistics. Their participation involves far more than boat operations and gear handling, including sorting the catch, weighing and measuring samples, and collecting biological specimens including otoliths and gonads. Their involvement has resulted in significant improvements to survey efficiency while we adhere to standard protocols.

Although fishermen observer participation is down from the initial years of the survey, those participants who have come aboard have all left with a better understanding of the survey's importance. They have also learned from first hand experience that the science crew has come to appreciate and understand many of the concerns held by commercial fishermen. As a result of the participation by these fishermen, the survey staff has adopted lobster handling techniques in order to reduce damage. Furthermore, new and constructive working relationships with lobstermen are building along certain parts of the coast.

Scientists and fishermen work together to sort the catch

Impacts and Applications:

Primary impact is the provision of data and information for 80% of the nearshore waters of the Gulf of Maine. Prior to this project, information and data from this area of water was not incorporated into any stock assessment. No contemporary information existed on which to assess populations, trends and distributions. The completion of six full survey years strengthens the ability of managers to begin stock assessments and develop more effective management strategies.

Related Projects:

Maintaining proper net performance in high current areas downeast has presented both challenges and questions over the years. In 2006, the Maine-New Hampshire Inshore Trawl Survey was granted funds by the Atlantic States Marine Fisheries Commission to investigate the effects of current and tidal orientation on the trawl net. In July 2006, Sally Sherman, Keri Stepanek, Bob Tetrault and Curt Rice visited the flume tank at Memorial University in Newfoundland. Test tows were performed at a variety of speeds and doorspreads using a 1:5 scale model of the trawl survey research net. The model net performed excellently under most conditions in the tank, and net mensuration data was collected for a variety of standard and altered configurations. The information learned from this experience adds confidence levels to the net mensuration colleceted on each survey, and can be added as a data qualifier when assessing tow quality.

For the second part of the investigation, field trials were conducted during August 2006. Six different sites, ranging from southern Maine (low tidal currents) to the Grand Manan Channel (high current velocities), were visited. At each site, an acoustic Doppler current profiler was deployed to determine the direction and strength of the bottom tidal currents. Four different tow orientations (with the tide, against the tide, cross-with and cross-against) were tested, and trawl catch data (weights, numbers and length frequencies) were recorded for each tow. Results from these field trials were inconclusive due to the small sample size (only 23 tows) and the high variability associated with certain locations. Additional work is needed in the extreme eastern portion of the survey area with high current velocities to determine whether the seemingly undersized catches are indeed representative of the species in the area, and whether the standard protocol of towing with the tide at a speed of 2.5 knots is appropriate for these areas.

Left: Boat owner Robert Tetrault, DMR scientists Keri Stepanek and Sally Sherman, Capt. Curt Rice, and VIMS scientist James Gartland visit the flume tank at Memorial University in Newfoundland; behind them is the scale model of the trawl survey research net.
Right: Acoustic Doppler Current Profiler being deployed on August 2006 tidal study.

Presentations:

Maine Fisherman’s Forum (March 2006), Rockland ME – session, “The Maine-New Hampshire Inshore Trawl Survey – How Is It Useful?”; poster presentation, “Maine-New Hampshire Inshore Trawl Survey”

Maine Coastal Waters Conference (April 2006), Rockland ME – poster presentations, “Maine-New Hampshire Inshore Trawl Survey” and “Abundance Trends of Anadromous Fish in the Maine-New Hampshire Inshore Trawl Survey”

ICES (October 2006), Boston, MA – poster presentation, “First You Catch It, Then You Don’t – Investigations Into Tidal Current Influences on a Research Survey Net”

Northeast Consortium Project Participants’ Meeting (December 2006), Portsmouth NH – poster presentation, “The Maine-New Hampshire Inshore Trawl Survey; A Collaborative Effort to Collect Fishery-Independent Data”

Maine Fishermens Forum (March 2007), Rockland ME – session, “Industry Based Trawl Surveys”; poster presentation, “Maine-New Hampshire Inshore Trawl Survey”

Student Participation:

No students directly utilized the Maine-New Hampshire Inshore Trawl Survey as a research platform during 2006. However, four students (2 high school, 2 graduate) were able to participate on the survey for a day to gain at-sea research experience and see how the survey is conducted.

Mike Errigo, Danielle Brzezinski – University of Maine
Ladd Oleson, Sam Rosen – Vinalhaven High School

Vinalhaven students Ladd Olsen and Sam Rosen help DMR scientist Keri Stepanek sort the catch.

Published Reports and Papers:

The Northeast Consortium has played a key role in providing the funding to initiate and continue the Maine-New Hampshire Inshore Trawl Survey. This is the sixth annual report published, and can be found on our website, along with the previous five reports.

Trawl Survey Website: http://www.maine.gov/dmr/rm/trawl/trawl.htm

Annual Reports:

Sowles, J., S.A. Sherman, H. Smith, D. Grout, D. Perkins, R. Tetrault and C. Rice. 2002. Final Report to the Northeast Consortium on the Maine-New Hampshire Inshore Groundfish Trawl Survey. Maine Department of Marine Resources. Research Reference Document 02/02.

Sherman, S.A., V. Manfredi, J. Brown, H. Smith, J. Sowles, D. Grout, and R. Tetrault. 2003. Final Report to the NOAA Fisheries – Northeast Region Cooperative Research Partners Initiative on the Maine-New Hampshire Inshore Groundfish Trawl Survey. Maine Department of Marine Resources. Research Reference Document 03/01.

Sherman, S.A., V. Manfredi, J. Brown, K. Stepanek, J. Sowles, D. Grout, and R. Tetrault. 2004. Final Report to the NOAA Fisheries – Northeast Region Cooperative Research Partners Initiative on the Maine-New Hampshire Inshore Groundfish Trawl Survey. Maine Department of Marine Resources. Research Reference Document 04/02.

Sherman, S., K. Stepanek, J. Sowles, D. Grout, and R. Tetrault. 2005. Final Report to the Northeast Consortium on the Maine-New Hampshire Inshore Groundfish Trawl Survey Maine Department of Marine Resources. Research Reference Document 05/02.

Sherman, S.A., K. Stepanek, J. Sowles, D. Grout, and R. Tetrault. 2005. Final Report to the NOAA Fisheries – Northeast Region Cooperative Research Partners Program on the Maine-New Hampshire Inshore Groundfish Trawl Survey. Maine Department of Marine Resources.

In addition to the annual reports, a manual outlining survey methods has been published:

Sherman, S., K. Stepanek, and J. Sowles. 2005. Maine-New Hampshire Inshore Groundfish Trawl Survey Procedures and Protocols. Maine Department of Marine Resources. Research Reference Document 05/01.

Other related papers:

Chen, Y., S. Sherman, C. Wilson, J. Sowles, and M. Kaniawa 2005. A comparison of two fishery-independent survey programs in characterizing population structure of American lobster, *Homarus americanus*, in the Gulf of Maine. Fisheries Bulletin. In press.

Sherman, S. and K. Stepanek. 2006. Completion Report to the Atlantic States Marine Fisheries Commission on Improving the Efficiency of the Maine-New Hampshire Trawl Survey: An Investigation of Current and Depth Influences on the Research Trawl Net. Maine Department of Marine Resources.

Future Research:

Research questions and opportunities have continually emerged as the trawl survey reveals new information for the inshore areas that lack a historical record. The survey has encountered and had to address physical conditions that other surveys have not had to address but that could potentially affect survey results. Species not known to exist in this portion of the Gulf of Maine have been collected. Maintaining proper net performance in high current areas downeast has presented both challenges and questions.

Where possible the survey has been a free (no-cost) platform for ancillary research conducted by NMFS, University of Maine, and other institutions. Topics have included, for example, green crab predation, *Crangon*, age-growth studies, infectious salmon anemia hosts, and others.

Future research falls into two major categories; biological and methodological. The survey itself has a series of questions that we would like to address in the future.

Biological questions include the following:

- What the patterns of distribution, timing, and abundance of icthyoplankton?
- What are the important prey species in inshore waters? Following the technical peer review that was conducted in 2005, a food study component was added to the catch workup. Several surveys worth of data on a variety of species are needed to get a clearer picture of predator-prey relationships.
- Age and growth studies of species that have not been recently well described. Maturity data is collected on selected species. Combined with age estimations performed on otoliths, age-at-length keys can be produced for a number of commercially important species.
- What is the relationship between habitat type (soft, hard, complex) and catch?

Methodological questions include the following:

- What is the effect of tow direction relative to bottom currents on catch efficiency? While this was addressed in the 2006 study funded by ASMFC, the results are still inconclusive. More work needs to be done to increase the confidence in trawl data collected from areas of high tidal currents.
- What is the catch coefficient of the net?

By addressing these and other questions that arise, we can increase our confidence in trawl data and provide better information to managers, thus benefiting the fish and the fishing industry alike.

Chief Scientist Sally Sherman takes biological data on white hake

Appendix A
Individual Station Descriptions

DATE	REGION	TOWID	LORAN W	LORAN X	LAT deg/min	LON deg/min	Time	Tow Duration	Depth (FA)	Temp C º	Salinity ppt
Spring 2006											
5/1	1	SP06__1	13750.4	25963.5	4258.212	7044.607	0742	20	15.0	5.65	31.89
5/1	1	SP06__1	13758.4	25964.2	4258.601	7045.302	0802		13.4		
5/1	1	SP06__2	13706.9	25948.3	4258.427	7039.866	1109	19	16.3	4.83	32.19
5/1	1	SP06__2	13715.1	25952.5	4258.130	7040.870	1128		18.5		
5/1	1	SP06__3	13643.9	25933.4	4302.168	7033.522	1326	20	33.1	4.58	32.25
5/1	1	SP06__3	13650.0	25929.2	4301.325	7033.680	1346		32.1		
5/1	1	SP06__4	13709.0	25969.1	4300.195	7041.857	1534	16	14.1	6.75	31.53
5/1	1	SP06__4	13713.0	25976.5	4300.510	7042.620	1550		12.2		
5/2	1	SP06__5	13750.7	25926.3	4252.798	7041.722	0811	20	28.2	5.23	32.01
5/2	1	SP06__5	13759.2	25926.9	4252.147	7042.456	0831		23.2		
5/3	1	SP06__6	13725.5	25923.4	4254.580	7039.430	0742	19	31.0	5.86	31.87
5/3	1	SP06__6	13731.8	25920.6	4253.820	7039.730	0801		33.0		
5/3	1	SP06__7	13714.3	25893.7	4252.897	7036.148	0920	20	44.0	4.34	32.38
5/3	1	SP06__7	13716.0	25886.6	4252.044	7035.732	0940		46.5		
5/3	1	SP06__8	13659.7	25874.7	4255.527	7030.044	1125	20	54.5	4.51	32.62
5/3	1	SP06__8	13651.4	25872.6	4255.997	7029.188	1145		55.4		
5/3	1	SP06__9	13655.0	25855.4	4254.145	7028.076	1249	20	59.7	4.58	32.69
5/3	1	SP06__9	13655.7	25847.7	4253.381	7027.507	1309		63.7		
5/4	1	SP06_10	13545.8	25942.4	4310.777	7026.103	0727	20	37.3	4.36	32.29
5/4	1	SP06_10	13551.8	25938.6	4309.937	7026.298	0747		35.7		
5/4	1	SP06_11	13531.5	25915.1	4309.295	7022.524	0835	20	43.2	4.34	32.46
5/4	1	SP06_11	13540.4	25916.1	4308.725	7023.357	0855		48.4		
5/4	1	SP06_12	13500.2	25878.1	4308.191	7016.537	1023	20	66.6	4.89	32.00
5/4	1	SP06_12	13500.5	25871.0	4307.451	7015.895	1043		72.5		
5/4	1	SP06_13	13487.8	25942.5	4315.011	7021.298	1243	21	45.1	4.74	32.40
5/4	1	SP06_13	13479.4	25944.9	4315.997	7020.665	1304		42.3		
5/4	1	SP06_14	13544.3	26010.4	4317.284	7031.934	1437	20	16.0	6.56	31.22
5/4	1	SP06_14	13549.3	26005.2	4316.438	7031.904	1457		19.5		
5/4	1	SP06_15	13455.7	25958.9	4319.246	7020.097	1657	16	37.5	5.77	32.27
5/4	1	SP06_15	13462.8	25958.4	4318.664	7020.653	1713		34.8		
5/5	1	SP06_16	13405.2	25927.0	4319.963	7012.868	0753	20	52.8	4.70	32.42
5/5	1	SP06_16	13413.5	25926.6	4319.300	7013.550	0813		54.3		
5/5	1	SP06_17	13380.0	25942.3	4323.319	7012.184	0920	20	52.3	4.80	32.43
5/5	1	SP06_17	13385.9	25938.5	4322.480	7012.320	0940		54.6		
5/5	1	SP06_18	13347.1	25926.6	4324.170	7007.847	1034	20	58.5	4.70	32.44
5/5	1	SP06_18	13347.0	25919.1	4323.480	7007.137	1054		59.6		
5/5	1	SP06_19	13336.2	25909.8	4323.355	7005.304	1208	20	74.7	4.60	32.57
5/5	1	SP06_19	13341.8	25906.6	4322.836	7005.338	1228		79.5		
5/5	1	SP06_20	13321.0	25925.5	4325.958	7005.522	1334	20	70.3	4.98	32.37
5/5	1	SP06_20	13314.7	25929.6	4326.811	7005.386	1354		64.8		
5/5	1	SP06_21	13373.4	25961.3	4325.619	7013.454	1506	20	48.3	5.86	32.31
5/5	1	SP06_21	13364.7	25959.3	4326.060	7012.510	1526		48.6		
5/5	1	SP06_22	13400.0	25979.6	4325.425	7017.394	1616	18	31.7	5.74	32.00
5/5	1	SP06_22	13392.6	25979.2	4325.920	7016.790	1634		34.6		
5/6	1	SP06_23	13351.6	26018.1	4332.788	7017.122	0718	19	8.7	6.06	31.60

Appendix A
Individual Station Descriptions

DATE	REGION	TOWID	LORAN W	LORAN X	LAT deg/min	LON deg/min	Time	Tow Duration	Depth (FA)	Temp C º	Salinity ppt
5/6	1	SP06_23	13359.8	26018.8	4332.250	7017.840	0737		7.5		
5/6	1	SP06_24	13340.1	25996.7	4331.538	7014.100	0858	20	19.5	5.67	32.07
5/6	1	SP06_24	13349.1	25998.9	4331.090	7015.040	0918		19.4		
5/6	1	SP06_25	13343.6	25982.7	4329.941	7013.016	1058	20	27.7	5.64	32.09
5/6	1	SP06_25	13352.7	25982.7	4329.240	7013.760	1118		24.8		
5/8	2	SP06_26	13244.9	26038.7	4342.764	7010.482	0702	20	8.7	6.84	31.26
5/8	2	SP06_26	13237.3	26040.7	4343.521	7010.076	0722		7.2		
5/8	2	SP06_27	13273.9	26013.8	4338.131	7010.315	0828	20	12.5	6.09	31.87
5/8	2	SP06_27	13266.4	26016.3	4338.930	7009.950	0848		14.6		
5/8	2	SP06_28	13235.3	26009.6	4340.536	7006.677	0933	20	12.7	6.04	31.93
5/8	2	SP06_28	13243.6	26008.8	4339.840	7007.320	0953		16.1		
5/8	2	SP06_29	13230.5	25981.7	4338.093	7003.474	1047	20	34.4	5.96	31.81
5/8	2	SP06_29	13237.8	25979.0	4337.318	7003.814	1107		31.3		
5/8	2	SP06_30	13193.3	25935.6	4336.147	6955.477	1229	20	45.0	5.09	32.37
5/8	2	SP06_30	13202.9	25935.8	4335.540	6956.250	1249		47.8		
5/9	2	SP06_31	13168.1	25923.4	4336.580	6951.870	0733	20	47.5	5.53	32.33
5/9	2	SP06_31	13176.7	25923.6	4336.044	6952.625	0753		47.5		
5/9	2	SP06_32	13161.0	25873.1	4332.082	6945.975	1006	20	67.5	5.01	32.44
5/9	2	SP06_32	13155.7	25876.9	4332.841	6945.868	1026		63.7		
5/9	2	SP06_33	13134.3	25814.7	4327.971	6937.107	1252	20	82.5	5.65	33.06
5/9	2	SP06_33	13133.1	25820.9	4328.697	6937.676	1312		74.9		
5/10	2	SP06_34	13046.0	25929.0	4345.662	6941.724	0739	20	31.1	5.69	32.19
5/10	2	SP06_34	13051.9	25924.9	4344.840	6941.770	0759		31.8		
5/10	2	SP06_35	13033.1	25940.5	4347.759	6941.902	0909	20	28.3	5.65	32.20
5/10	2	SP06_35	13039.1	25936.4	4346.910	6941.940	0929		27.5		
5/10	2	SP06_36	13064.1	25935.6	4345.086	6944.066	1036	20	10.7	7.58	31.39
5/10	2	SP06_36	13070.6	25932.1	4344.280	6944.240	1056		12.0		
5/10	2	SP06_37	13081.5	25926.3	4342.928	6944.537	1148	20	15.3	7.07	31.91
5/10	2	SP06_37	13089.0	25923.7	4342.140	6944.910	1208		17.1		
5/10	2	SP06_38	13067.7	25904.1	4341.666	6940.973	1319	20	39.1	5.93	32.16
5/10	2	SP06_38	13074.2	25900.3	4340.840	6941.110	1339		41.3		
5/10	2	SP06_39	13061.3	25895.8	4341.258	6939.428	1518	20	46.1	5.68	32.22
5/10	2	SP06_39	13055.2	25900.2	4342.060	6939.250	1538		42.4		
5/11	2	SP06_40	12983.5	25875.4	4344.432	6929.970	0806	20	59.0	5.84	32.18
5/11	2	SP06_40	12989.5	25871.5	4343.610	6930.060	0826		59.4		
5/11	2	SP06_41	13006.6	25865.7	4341.778	6930.804	0925	20	64.1	5.13	32.50
5/11	2	SP06_41	13012.1	25861.3	4340.930	6930.780	0945		70.0		
5/11	2	SP06_42	13002.3	25831.6	4338.552	6926.492	1306	21	76.7	5.10	32.61
5/11	2	SP06_42	13003.6	25825.6	4337.830	6925.890	1327		78.6		
5/11	2	SP06_43	12924.2	25864.2	4347.205	6923.053	1546	20	47.5	6.37	30.96
5/11	2	SP06_43	12930.9	25860.6	4346.380	6923.240	1606		45.8		
5/12	2	SP06_44	12975.0	25921.9	4349.777	6934.549	0758	20	15.2	7.93	31.36
5/12	2	SP06_44	12968.1	25925.4	4350.620	6934.350	0818		13.8		
5/12	2	SP06_45	12887.7	25923.3	4356.000	6926.930	1141	20	7.0	8.16	31.31
5/12	2	SP06_45	12879.3	25925.9	4356.770	6926.580	1201		7.7		
5/15	2	SP06_46	12938.4	25902.5	4350.316	6929.080	0720	20	33.2	6.52	32.00
5/15	2	SP06_46	12945.4	25899.6	4349.520	6929.350	0740		37.8		
5/15	2	SP06_47	12911.0	25884.8	4350.274	6924.377	0907	20	31.0	6.58	31.78

Appendix A
Individual Station Descriptions

DATE	REGION	TOWID	LORAN W	LORAN X	LAT deg/min	LON deg/min	Time	Tow Duration	Depth (FA)	Temp C º	Salinity ppt
5/15	2	SP06_47	12997.0	25889.9	4351.080	6924.630	0927		30.1		
5/15	3	SP06_48	12878.8	25818.8	4345.233	6912.832	1145	20	50.1	6.37	32.15
5/15	3	SP06_48	12882.8	25813.9	4344.479	6912.600	1205		53.0		
5/15	3	SP06_49	12847.6	25813.5	4346.706	6909.049	1340	20	45.1	6.59	32.21
5/15	3	SP06_49	12854.5	25810.4	4345.924	6909.342	1400		51.1		
5/15	3	SP06_50	12776.8	25853.8	4355.704	6907.501	1623	16	19.6	6.85	31.92
5/15	3	SP06_50	12784.3	25853.5	4355.177	6908.170	1639		18.8		
5/15	3	SP06_51	12784.5	25865.4	4356.458	6909.800	1824	20	19.7	6.89	31.73
5/15	3	SP06_51	12792.9	25865.9	4355.971	6910.681	1844		21.2		
5/16	3	SP06_52	12685.8	25870.3	4403.535	6901.163	0742	19	35.2	6.08	31.79
5/16	3	SP06_52	12691.3	25866.5	4402.765	6901.157	0801		38.0		
5/16	3	SP06_53	12655.5	25889.6	4407.645	6901.003	0909	20	33.0	5.74	31.68
5/16	3	SP06_53	12662.8	25886.7	4406.863	6901.275	0929		31.1		
5/16	3	SP06_54	12623.9	25914.5	4412.370	6901.452	1051	17	13.2	6.50	31.43
5/16	3	SP06_54	12630.4	25912.3	4411.734	6901.714	1108		12.2		
5/16	3	SP06_55	12609.5	25889.9	4410.596	6856.452	1213	20	29.3	6.38	31.78
5/16	3	SP06_55	12617.6	25887.8	4409.935	6857.082	1233		28.6		
5/16	3	SP06_56	12599.5	25898.6	4412.211	6856.787	1331	20	12.0	6.76	31.55
5/16	3	SP06_56	12591.0	25899.6	4412.901	6856.100	1351		15.0		
5/16	3	SP06_57	12558.8	25903.1	4415.444	6853.686	1455	20	23.0	6.24	29.20
5/16	3	SP06_57	12551.2	25905.7	4416.257	6853.351	1515		24.4		
5/17	3	SP06_58	12731.7	25740.7	4346.063	6847.064	0923	18	54.8	6.38	32.17
5/17	3	SP06_58	12726.2	25744.3	4346.836	6847.001	0941		50.5		
5/17	3	SP06_59	12770.0	25700.4	4339.112	6845.325	1254	19	88.4	5.82	32.61
5/17	3	SP06_59	12762.5	25701.8	4339.721	6844.706	1313		79.9		
5/17	3	SP06_60	12755.9	25706.5	4340.697	6844.592	1411	18	69.5	5.82	32.59
5/17	3	SP06_60	12750.3	25710.1	4341.426	6844.670	1429		70.7		
5/17	3	SP06_61	12789.8	25727.4	4340.867	6851.261	1555	20	61.1	5.82	32.46
5/17	3	SP06_61	12781.8	25727.0	4341.402	6850.484	1615		65.2		
5/18	3	SP06_62	12700.7	25732.1	4347.034	6842.410	0826	20	57.4	5.86	32.31
5/18	3	SP06_62	12692.7	25731.9	4347.518	6841.515	0846		56.0		
5/18	3	SP06_63	12639.3	25719.8	4349.437	6833.691	1012	20	67.3	5.79	32.53
5/18	3	SP06_63	12646.8	25720.0	4348.991	6834.589	1032		67.6		
5/18	3	SP06_64	12638.5	25738.8	4351.699	6836.600	1159	21	59.0	5.87	32.30
5/18	3	SP06_64	12630.3	25738.9	4352.208	6835.718	1220		57.7		
5/18	3	SP06_65	12667.4	25775.6	4353.090	6845.392	1358	20	50.4	6.49	31.81
5/18	3	SP06_65	12661.5	25779.5	4353.903	6845.351	1418		53.7		
5/19	3	SP06_66	12625.8	25797.7	4359.263	6844.440	0831	20	41.6	6.81	31.88
5/19	3	SP06_66	12631.9	25800.5	4359.181	6845.501	0851		37.5		
5/19	3	SP06_67	12582.9	25842.0	4408.054	6846.830	1053	10	12.3	7.85	31.61
5/19	3	SP06_67	12584.9	25840.2	4408.690	6846.762	1103		12.0		
5/19	3	SP06_68	12563.5	25846.6	4408.804	6845.575	1156	20	25.6	7.81	31.63
5/19	3	SP06_68	12567.8	25842.2	4408.040	6845.343	1216		29.1		
5/22	4	SP06_69	12484.3	25812.0	4409.914	6831.877	0702	20	17.1	8.50	27.08
5/22	4	SP06_69	12492.5	25811.3	4409.325	6832.619	0722		14.1		
5/22	4	SP06_70	12489.7	25762.5	4403.821	6824.132	1057	20	30.3	6.40	31.82
5/22	4	SP06_70	12489.9	25757.8	4403.254	6823.361	1117		37.0		
5/22	4	SP06_71	12501.5	25756.0	4402.313	6824.342	1212	20	40.0	6.27	31.84

Appendix A
Individual Station Descriptions

DATE	REGION	TOWID	LORAN W	LORAN X	LAT deg/min	LON deg/min	Time	Tow Duration	Depth (FA)	Temp C º	Salinity ppt
5/22	4	SP06_71	12507.2	25758.0	4402.285	6825.471	1232		39.8		
5/23	4	SP06_72	12571.5	25726.0	4354.374	6827.063	0822	20	64.4	5.87	32.58
5/23	4	SP06_72	12579.6	25726.3	4353.910	6828.009	0842		60.5		
5/23	4	SP06_73	12552.1	25722.7	4355.198	6824.281	0943	20	61.9	5.87	32.57
5/23	4	SP06_73	12560.3	25722.6	4354.669	6825.207	1003		61.2		
5/23	4	SP06_74	12538.5	25731.3	4357.054	6823.176	1118	20	51.4	5.99	32.34
5/23	4	SP06_74	12546.8	25730.7	4356.462	6823.021	1138		51.3		
5/23	4	SP06_75	12500.6	25712.4	4357.227	6816.806	1259	20	57.1	6.03	32.44
5/23	4	SP06_75	12507.8	25709.9	4356.471	6817.206	1319		54.5		
5/23	4	SP06_76	12484.5	25707.3	4357.608	6813.980	1413	20	58.7	6.16	32.75
5/23	4	SP06_76	12491.9	25707.7	4357.187	6814.938	1433		60.0		
5/23	4	SP06_77	12450.0	25717.1	4400.939	6811.691	1544	20	54.2	6.07	32.18
5/23	4	SP06_77	12451.4	25721.4	4401.369	6812.615	1604		56.5		
5/24	4	SP06_78	12399.0	25868.2	4421.916	6832.482	0827	20	14.7	7.64	31.58
5/24	4	SP06_78	12393.7	25872.3	4422.724	6832.629	0847		13.4		
5/24	4	SP06_79	12424.2	25858.8	4419.199	6833.496	0926	20	14.5	7.88	31.81
5/24	4	SP06_79	12428.7	25854.4	4418.402	6833.219	0946		12.5		
5/24	4	SP06_80	12416.7	25832.3	4416.630	6828.175	1031	20	21.5	8.12	31.70
5/24	4	SP06_80	12414.4	25827.4	4416.214	6827.107	1051		31.4		
5/24	4	SP06_81	12399.1	25786.8	4412.427	6818.313	1314	20	15.6	7.68	31.69
5/24	4	SP06_81	12398.8	25782.0	4411.894	6817.445	1334		20.0		
5/25	4	SP06_82	12328.2	25753.7	4413.052	6804.132	0749	20	42.1	6.22	32.06
5/25	4	SP06_82	12327.3	25758.4	4413.685	6804.923	0809		40.1		
5/25	4	SP06_83	12350.6	25748.8	4411.018	6805.824	0936	20	42.2	6.19	31.96
5/25	4	SP06_83	12345.9	25745.7	4410.959	6804.677	0956		43.2		
5/25	4	SP06_84	12321.2	25742.6	4412.157	6801.143	1119	20	45.2	6.08	32.39
5/25	4	SP06_84	12319.8	25738.5	4411.743	6800.164	1139		45.8		
5/25	4	SP06_85	12319.4	25722.8	4409.857	6757.015	1247	20	48.2	6.09	32.50
5/25	4	SP06_85	12327.4	25722.7	4409.340	6757.955	1307		47.5		
5/25	4	SP06_86	12376.6	25712.4	4404.974	6801.967	1413	20	54.3	6.11	32.63
5/25	4	SP06_86	12377.6	25716.3	4405.382	6802.848	1433		54.1		
5/25	4	SP06_87	12390.9	25708.9	4403.647	6802.021	1509	20	58.2	6.36	32.90
5/25	4	SP06_87	12398.6	25708.4	4403.097	6802.870	1529		64.8		
5/26	4	SP06_88	12256.6	25839.7	4427.855	6812.380	0716	20	11.5	7.49	31.71
5/26	4	SP06_88	12264.9	25839.6	4427.293	6813.254	0736		14.8		
5/26	4	SP06_89	12259.0	25821.8	4425.555	6809.236	0830	20	26.0	7.24	31.66
5/26	4	SP06_89	12259.0	25826.4	4426.137	6810.045	0850		22.5		
5/26	4	SP06_90	12289.9	25771.7	4417.649	6803.039	1039	17	35.7	6.48	31.77
5/26	4	SP06_90	12289.7	25775.4	4418.097	6803.712	1056		33.9		
5/26	4	SP06_91	12316.2	25780.5	4416.993	6807.781	1200	20	36.6	6.43	31.80
5/26	4	SP06_91	12310.0	25783.7	4417.780	6807.670	1220		35.6		
5/29	5	SP06_92	12273.7	25750.0	4416.106	6756.878	0752	20	33.7	6.56	31.93
5/29	5	SP06_92	12281.2	25750.1	4415.631	6757.784	0712		34.2		
5/29	5	SP06_93	12289.4	25740.0	4413.878	6756.759	1046	17	40.2	6.32	32.18
5/29	5	SP06_93	12283.7	25739.4	4414.164	6755.956	1103		40.2		
5/29	5	SP06_94	12190.7	25740.3	4420.299	6744.711	1317	20	37.7	6.51	32.07
5/29	5	SP06_94	12198.3	25740.0	4419.778	6745.585	1337		38.2		
5/29	5	SP06_95	12145.2	25750.6	4424.546	6741.180	1510	20	26.5	6.72	31.89

Appendix A
Individual Station Descriptions

DATE	REGION	TOWID	LORAN W	LORAN X	LAT deg/min	LON deg/min	Time	Tow Duration	Depth (FA)	Temp C º	Salinity ppt
5/29	5	SP06_95	12152.4	25748.0	4423.767	6741.532	1530		27.8		
5/30	5	SP06_96	12236.6	25706.3	4412.136	6743.201	0838	20	68.3	6.70	32.27
5/30	5	SP06_96	12229.4	25708.3	4412.850	6742.714	0858		71.7		
5/30	5	SP06_97	12215.7	25703.7	4414.164	6739.903	1018	20	56.5	6.27	32.45
5/30	5	SP06_97	12209.9	25707.2	4414.976	6739.910	1038		52.4		
5/30	5	SP06_98	12154.8	25699.2	4417.573	6730.727	1159	20	60.1	6.39	32.41
5/30	5	SP06_98	12147.5	25699.2	4418.066	6729.753	1219		62.1		
5/30	5	SP06_99	12115.1	25688.0	4418.804	6722.688	1358	20	102.5	7.74	34.08
5/30	5	SP06_99	12108.3	25689.0	4419.400	6721.978	1418		94.2		
5/31	5	SP06100	12146.3	25780.5	4428.114	6747.820	0723	16	13.7	7.19	31.85
5/31	5	SP06100	12147.3	25777.2	4427.688	6747.219	0739		18.1		
5/31	5	SP06101	12131.8	25768.2	4427.580	6743.341	1023	16	18.0	7.22	31.72
5/31	5	SP06101	12127.3	25770.8	4428.210	6743.362	1039		16.7		
6/3	5	SP06102	11974.2	25744.9	4435.516	6717.125	0854	20	31.7	6.93	31.88
6/3	5	SP06102	11981.0	25745.1	4435.074	6718.108	0914		28.9		
6/3	5	SP06103	11926.8	25746.2	4439.040	6710.814	1153	20	19.1	6.96	31.71
6/3	5	SP06103	11920.1	25746.0	4439.503	6709.788	1213		24.3		
6/3	5	SP06104	11905.9	25742.1	4440.073	6706.608	1342	18	43.8	6.92	31.71
6/3	5	SP06104	11899.8	25741.8	4440.486	6705.662	1400		43.4		
6/3	5	SP06105	11862.1	25734.9	4442.342	6657.624	1540	20	54.1	6.79	31.72
6/3	5	SP06105	11854.8	25736.0	4443.012	6656.802	1600		58.2		
6/3	5	SP06106	11860.1	25740.4	4443.165	6658.837	1701	20	48.0	6.83	31.71
6/3	5	SP06106	11853.4	25742.0	4443.832	6658.329	1721		47.1		
6/5	5	SP06107	12017.7	25719.7	4429.392	6716.826	0819	20	45.2	6.99	31.99
6/5	5	SP06107	12024.8	25719.4	4428.873	6717.749	0839		42.6		
6/5	5	SP06108	12020.8	25676.9	4423.805	6705.983	1306	20	75.3	6.83	32.39
6/5	5	SP06108	12015.0	25676.1	4424.118	6704.885	1326		69.4		
6/5	5	SP06109	12014.7	25687.3	4425.551	6707.858	1430	15	52.1	7.12	32.93
6/5	5	SP06109	12016.0	25689.0	4425.685	6708.513	1445		54.7		

Fall 2006

10/2	1	FL06__1	13750.8	25961.4	4255.966	7044.483	0852	15	17.7	9.16	32.15
10/2	1	FL06__1	13756.5	25960.8	4255.441	7044.891	0907		17.5		
10/2	1	FL06__2	13779.8	25975.3	4254.789	7047.899	1148	19	2.5	12.54	31.54
10/2	1	FL06__2	13785.4	25972.9	4254.093	7048.145	1207		2.3		
10/2	1	FL06__3	13745.9	25925.2	4253.091	7041.233	1324	20	29.8	7.71	32.37
10/2	1	FL06__3	13738.7	25926.5	4253.791	7040.755	1344		30.7		
10/3	1	FL06__4	13716.2	25900.8	4253.310	7036.859	1447	20	41.2	7.49	32.57
10/3	1	FL06__4	13708.1	25900.5	4253.947	7036.166	1507		40.7		
10/3	1	FL06__5	13658.7	25885.7	4256.612	7030.847	0929	20	47.1	7.42	32.55
10/3	1	FL06__5	13667.0	25886.9	4256.023	7031.622	0949		46.1		
10/3	1	FL06__6	13624.0	25827.4	4254.005	7023.082	1119	20	47.7	7.91	32.59
10/3	1	FL06__6	13631.0	25832.8	4253.956	7024.147	1139		46.3		
10/3	1	FL06__7	13611.7	25844.1	4256.489	7023.367	1236	20	67.2	6.74	32.82
10/3	1	FL06__7	13617.4	25850.8	4256.673	7024.433	1256		65.4		
10/3	1	FL06__8	13582.4	25870.3	4300.946	7023.305	1415	20	62.6	6.50	33.00
10/3	1	FL06__8	13593.3	25870.1	4300.315	7023.960	1435		61.7		

Appendix A
Individual Station Descriptions

DATE	REGION	TOWID	LORAN W	LORAN X	LAT deg/min	LON deg/min	Time	Tow Duration	Depth (FA)	Temp C °	Salinity ppt
10/3	1	FL06__9	13649.6	25930.6	4301.489	7033.751	1606	17	31.1	8.64	32.46
10/3	1	FL06__9	13647.2	25935.0	4302.084	7033.928	1623		31.4		
10/4	1	FL06_10	13619.9	25938.4	4304.564	7031.955	0808	11	33.4	9.02	32.50
10/4	1	FL06_10	13615.6	25937.4	4304.824	7031.485	0819		27.8		
10/4	1	FL06_11	13596.5	25927.8	4305.426	7029.103	0917	20	36.7	8.75	32.58
10/4	1	FL06_11	13587.8	25924.0	4305.769	7028.037	0937		38.9		
10/4	1	FL06_12	13542.0	25904.1	4307.444	7022.455	1057	20	55.1	7.74	32.77
10/4	1	FL06_12	13550.6	25907.1	4307.134	7023.516	1117		53.5		
10/4	1	FL06_13	13532.6	25915.4	4309.235	7022.638	1235	20	48.0	8.22	32.65
10/4	1	FL06_13	13541.2	25917.1	4308.732	7023.533	1255		47.7		
10/4	1	FL06_14	13580.7	25988.3	4312.344	7033.966	1512	15	15.0	9.93	32.24
10/4	1	FL06_14	13582.3	25984.0	4311.759	7032.769	1527		17.1		
10/5	1	FL06_15	13546.0	25986.7	4314.919	7030.007	0929	20	25.0	9.50	32.42
10/5	1	FL06_15	13553.8	25985.8	4314.222	7030.557	0949		25.7		
10/5	1	FL06_16	13422.8	25932.8	4319.209	7014.928	1303	20	54.1	8.54	32.80
10/5	1	FL06_16	13431.0	25933.8	4318.686	7015.720	1323		51.8		
10/5	1	FL06_17	13426.9	25898.9	4315.562	7011.995	1458	20	63.0	9.39	33.01
10/5	1	FL06_17	13418.1	25896.5	4315.985	7010.998	1518		65.0		
10/5	1	FL06_18	13872.6	25900.5	4319.702	7007.443	1655	20	64.1	8.15	32.97
10/5	1	FL06_18	13372.6	25906.4	4320.363	7008.118	1715		60.2		
10/6	1	FL06_19	13346.5	25921.0	4323.682	7007.255	0848	20	60.7	7.91	33.05
10/6	1	FL06_19	13347.4	25927.6	4324.268	7007.983	0908		54.1		
10/6	1	FL06_20	13400.2	25979.2	4325.369	7017.381	1100	18	30.1	9.22	32.62
10/6	1	FL06_20	13392.7	25978.8	4325.882	7016.716	1118		35.7		
10/6	1	FL06_21	13389.2	26025.3	4330.679	7020.843	1349	20	6.6	13.01	31.82
10/6	1	FL06_21	13397.0	26023.8	4329.932	7021.338	1409		6.5		
10/6	1	FL06_22	13349.9	25998.4	4330.990	7015.054	1545	17	18.4	11.59	32.37
10/6	1	FL06_22	13342.7	25996.5	4331.342	7014.278	1602		19.1		
10/9	2	FL06_23	13174.6	25923.7	4336.169	6952.474	0903	20	45.3	9.73	33.04
10/9	2	FL06_23	13165.9	25923.0	4336.716	6951.631	0923		42.5		
10/9	2	FL06_24	13216.5	25928.5	4333.774	6956.764	1104	20	55.5	9.21	33.14
10/9	2	FL06_24	13216.1	25934.5	4334.416	6957.348	1124		51.6		
10/9	2	FL06_25	13228.8	25929.2	4332.962	6957.899	1223	20	60.3	9.32	32.94
10/9	2	FL06_25	13228.0	25935.4	4333.655	6958.474	1243		58.4		
10/9	2	FL06_26	13243.8	25939.2	4332.908	7000.240	1420	20	54.3	8.83	32.95
10/9	2	FL06_26	13252.4	25938.7	4332.237	7000.920	1440		54.1		
10/10	2	FL06_27	13252.7	26018.5	4340.165	7009.052	0854	15	12.7	12.92	31.69
10/10	2	FL06_27	13259.2	26018.5	4339.678	7009.597	0909		16.0		
10/10	2	FL06_28	13295.9	26014.8	4336.610	7012.225	1050	15	10.2	13.05	31.50
10/10	2	FL06_28	13290.8	26016.9	4337.198	7012.019	1105		8.2		
10/10	2	FL06_29	13124.4	25938.8	4341.224	6949.690	1510	9	16.3	12.06	32.43
10/10	2	FL06_29			4341.102	6950.153	1519		14.2		
10/10	2	FL06_30	13103.8	25939.6	4342.745	6947.984	1642	20	10.1	12.44	32.30
10/10	2	FL06_30	13111.7	25942.5	4342.494	6948.994	1702		8.9		
10/11	2	FL06_31	13144.0	25852.1	4331.150	6942.138	0853	20	68.2	8.79	33.28
10/11	2	FL06_31	13147.2	25846.4	4330.335	6941.794	0913		70.1		
10/11	2	FL06_32	13091.8	25845.5	4334.017	6936.512	1125	20	77.7	8.83	33.68
10/11	2	FL06_32	13099.6	25845.3	4333.456	6937.246	1145		77.1		

Appendix A
Individual Station Descriptions

DATE	REGION	TOWID	LORAN W	LORAN X	LAT deg/min	LON deg/min	Time	Tow Duration	Depth (FA)	Temp C °	Salinity ppt
10/11	2	FL06_33	13118.6	25879.2	4335.664	6942.763	1354	20	54.2	10.41	33.18
10/11	2	FL06_33	13111.8	25882.1	4336.401	6942.474	1414		48.1		
10/13	2	FL06_34	13072.5	25911.0	4342.060	6942.184	1103	18	35.7	11.97	32.46
10/13	2	FL06_34	13068.8	25915.4	4342.777	6942.354	1121		31.1		
10/13	2	FL06_35	13066.5	25909.9	4342.364	6941.522	1502	17	33.6	11.43	32.58
10/13	2	FL06_35	13060.5	25912.2	4343.021	6941.252	1519		32.2		
10/13	2	FL06_36	13032.8	25919.4	4345.575	6939.438	1617	15	30.5	11.50	32.43
10/13	2	FL06_36	13026.9	25920.2	4346.077	6939.000	1632		29.0		
10/14	2	FL06_37	13005.1	25864.7	4341.836	6930.683	0754	20	62.1	9.12	33.16
10/14	2	FL06_37	13010.9	25861.0	4341.055	6930.787	0814		68.6		
10/14	2	FL06_38	12952.0	25868.7	4345.836	6926.216	0947	20	43.7	10.16	32.98
10/14	2	FL06_38	12955.3	25863.6	4345.072	6925.903	1007		44.5		
10/14	2	FL06_39	12929.4	25875.5	4348.051	6924.929	1208	20	36.6	11.24	32.89
10/14	2	FL06_39	12922.0	25878.7	4348.833	6924.724	1228		30.2		
10/14	2	FL06_40	12943.0	25900.3	4349.761	6929.230	1353	20	37.7	10.17	32.68
10/14	2	FL06_40	12936.8	25903.3	4350.508	6929.024	1413		33.1		
10/16	3	FL06_41	12876.6	25822.6	4345.809	6913.107	0838	20	48.1	10.59	33.22
10/16	3	FL06_41	12876.8	25816.8	4345.165	6912.376	0858		50.0		
10/16	3	FL06_42	12832.2	25862.5	4353.023	6913.992	1029	20	33.2	11.45	32.75
10/16	3	FL06_42	12840.7	25861.3	4352.326	6914.637	1049		32.9		
10/17	3	FL06_43			4356.270	6911.687	0848	20	16.0	11.85	32.68
10/17	3	FL06_43	12804.7	25870.2	4355.655	6912.381	0908		15.1		
10/17	3	FL06_44	12766.4	25868.4	4357.974	6908.457	1053	18	16.2	12.05	32.62
10/17	3	FL06_44	12772.9	25870.2	4357.739	6909.330	1111		16.4		
10/17	3	FL06_45	12804.0	25826.5	4350.958	6906.476	1235	20	33.5	10.96	33.06
10/17	3	FL06_45	12810.6	25823.2	4350.154	6906.679	1255		36.2		
10/17	3	FL06_46	12851.3	25785.0	4343.363	6905.650	1435	20	50.7	10.51	33.26
10/17	3	FL06_46	12858.8	25783.3	4342.692	6906.180	1455		54.9		
10/17	3	FL06_47	12861.1	25803.9	4344.784	6909.131	1556	20	55.3	10.65	33.18
10/17	3	FL06_47	12852.8	25804.8	4345.422	6908.419	1616		58.9		
10/17	3	FL06_48	12821.2	25803.2	4347.280	6905.043	1705	20	44.5	11.17	33.02
10/17	3	FL06_48	12813.4	25805.8	4348.066	6904.607	1725		43.4		
10/18	3	FL06_49	12667.7	25892.7	4407.201	6902.590	1011	20	23.2	12.50	32.33
10/18	3	FL06_49	12674.0	25889.7	4406.456	6902.783	1031		22.8		
10/18	3	FL06_50	12589.0	25924.7	4415.926	6859.768	1221	15	30.9	12.54	32.31
10/18	3	FL06_50	12594.9	25923.8	4415.418	6900.190	1236		27.5		
10/18	3	FL06_51	12624.7	25902.9	4411.055	6859.814	1343	19	34.1	12.43	32.37
10/18	3	FL06_51	12630.3	25898.8	4410.323	6859.907	1402		31.2		
10/18	3	FL06_52	12606.8	25854.5	4410.513	6855.849	1451	20	33.4	12.55	32.31
10/18	3	FL06_52	12614.6	25884.7	4409.774	6856.334	1511		31.0		
10/18	3	FL06_53	12527.5	25886.4	4415.631	6848.113	1631	20	14.7	12.66	32.07
10/18	3	FL06_53	12526.5	25881.3	4415.107	6847.212	1651		13.0		
10/19	3	FL06_54	12699.4	25732.0	4347.101	6842.256	0839	20	56.8	10.39	33.35
10/19	3	FL06_54	12691.4	25731.7	4347.571	6841.333	0859		52.5		
10/19	3	FL06_55	12653.7	25711.6	4347.582	6834.018	1032	20	68.5	9.76	33.67
10/19	3	FL06_55	12645.4	25711.4	4348.048	6833.106	1052		77.9		
10/19	3	FL06_56	12640.1	25720.2	4349.430	6833.848	1201	20	65.1	9.79	31.72
10/19	3	FL06_56	12647.9	25719.8	4348.900	6834.671	1221		68.0		

Appendix A
Individual Station Descriptions

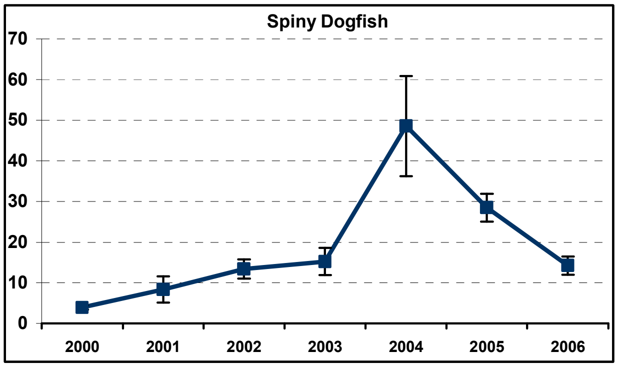
DATE	REGION	TOWID	LORAN W	LORAN X	LAT deg/min	LON deg/min	Time	Tow Duration	Depth (FA)	Temp C º	Salinity ppt
10/19	3	FL06_57	12689.6	25751.9	4349.996	6844.199	1435	15	52.6	10.89	33.19
10/19	3	FL06_57	12693.3	25754.1	4350.011	6844.931	1450		53.4		
10/19	3	FL06_58	12659.9	25779.7	4355.037	6845.226	1607	20	51.5	11.40	32.99
10/19	3	FL06_58	12665.9	25776.6	4354.292	6845.385	1627		46.5		
10/20	3	FL06_59	12580.3	25839.6	4406.934	6846.197	0934	18	16.7	12.59	32.04
10/20	3	FL06_59	12575.6	25843.3	4407.662	6846.297	0952		16.6		
10/20	3	FL06_60	12563.9	25846.4	4408.769	6845.593	1235	20	26.7	12.43	32.24
10/20	3	FL06_60	12568.5	25842.1	4407.978	6845.390	1255		29.5		
10/20	3	FL06_61	12563.5	25861.3	4410.380	6847.667	1417	20	7.4	12.66	31.73
10/20	3	FL06_61	12565.9	25856.5	4409.680	6847.168	1437		9.8		
10/23	4	FL06_62	12485.1	25812.0	4409.873	6831.960	0912	17	16.4	11.92	32.43
10/23	4	FL06_62	12491.8	25811.6	4409.400	6832.583	0929		13.1		
10/23	4	FL06_63	12582.3	25755.0	4357.089	6833.000	1420	20	47.3	10.62	33.28
10/23	4	FL06_63	12589.8	25755.3	4356.649	6833.876	1440		46.2		
10/23	4	FL06_64	12592.1	25738.4	4354.545	6831.401	1633	20	53.1	10.21	33.41
10/23	4	FL06_64	12599.3	25736.4	4353.857	6831.878	1653		52.1		
10/24	4	FL06_65	12532.7	25751.5	4359.818	6827.070	0858	16	46.3	10.77	33.26
10/24	4	FL06_65	12533.5	25755.0	4400.179	6827.754	0914		45.5		
10/24	4	FL06_66	12560.4	25721.5	4354.537	6825.048	1049	20	58.4	10.15	33.52
10/24	4	FL06_66	12553.3	25723.0	4355.151	6824.467	1109		59.9		
10/24	4	FL06_67	12520.0	25701.6	4354.709	6817.190	1235	20	67.0	9.69	33.74
10/24	4	FL06_67	12517.6	25705.2	4355.299	6817.525	1255		62.8		
10/24	4	FL06_68	12490.0	25761.9	4403.739	6824.085	1633	20	34.5	11.42	32.95
10/24	4	FL06_68	12490.6	25757.5	4403.180	6823.389	1653		36.7		
10/25	4	FL06_69	12429.6	25819.3	4414.284	6827.325	1108	20	13.2	11.87	32.31
10/25	4	FL06_69	12427.9	25824.1	4414.965	6827.978	1128		15.5		
10/25	4	FL06_70	12427.8	25854.2	4418.427	6833.088	1256	20	12.2	12.30	32.33
10/25	4	FL06_70	12424.8	25858.6	4419.145	6833.526	1316		14.3		
10/25	4	FL06_71	12409.7	25840.2	4417.992	6828.853	1437	20	20.8	11.84	32.46
10/25	4	FL06_71	12413.7	25835.9	4417.234	6828.474	1457		24.8		
10/26	4	FL06_72	12463.0	25723.5	4400.896	6814.355	0737	20	52.2	10.06	33.61
10/26	4	FL06_72	12471.0	25723.0	4400.336	6815.219	0757		54.7		
10/26	4	FL06_73	12440.1	25733.9	4403.579	6813.564	0955	16	48.8	10.35	33.51
10/26	4	FL06_73	12440.3	25730.7	4403.170	6812.997	1011		51.5		
10/26	4	FL06_74	12469.4	25742.2	4402.722	6818.425	1253	20	50.1	11.10	33.10
10/26	4	FL06_74	12477.1	25741.9	4402.201	6819.270	1313		48.7		
10/26	4	FL06_75	12427.9	25699.1	4400.140	6805.668	1554	20	62.2	10.46	33.37
10/26	4	FL06_75	12435.4	25697.3	4359.446	6806.261	1414		66.1		
10/27	4	FL06_76	12289.3	25810.9	4422.345	6810.494	0807	20	22.9	11.44	32.74
10/27	4	FL06_76	12293.3	25806.9	4421.609	6810.175	0827		24.5		
10/27	4	FL06_77	12316.7	25781.4	4417.071	6808.008	1009	20	35.5	11.30	32.94
10/27	4	FL06_77	12310.0	25784.2	4417.840	6807.763	1029		34.5		
11/7	5	FL06_78	12133.5	25782.7	4429.210	6746.721	0916	16	11.7	9.95	32.61
11/7	5	FL06_78	12127.6	25784.8	4429.857	6746.452	0932		11.5		
11/7	5	FL06_79	12155.0	25790.1	4428.674	6750.919	1345	20	6.5	9.85	32.69
11/7	5	FL06_79	12152.6	25786.2	4428.362	6749.796	1405		9.8		
11/7	5	FL06_80	12107.7	25776.5	4430.061	6742.000	1611	20	7.9	9.26	32.62
11/7	5	FL06_80	12100.9	25777.1	4430.705	6741.491	1631		5.4		

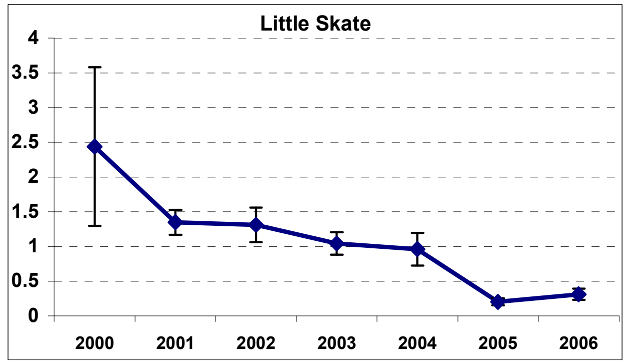
Appendix A
Individual Station Descriptions

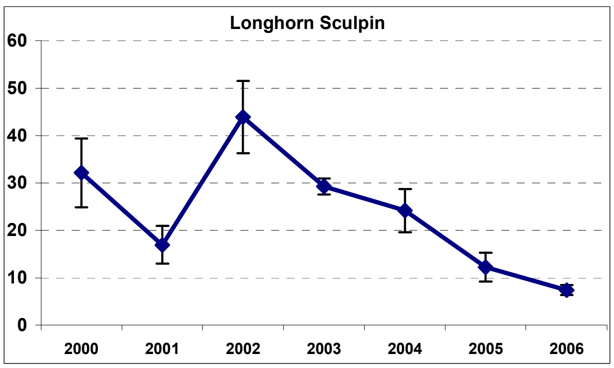
DATE	REGION	TOWID	LORAN W	LORAN X	LAT deg/min	LON deg/min	Time	Tow Duration	Depth (FA)	Temp C º	Salinity ppt
11/8	5	FL06_81	12154.7	25699.5	4417.623	6730.801	1138	20	57.5	9.92	33.60
11/8	5	FL06_81	12147.9	25699.3	4418.047	6729.826	1158		62.1		
11/8	5	FL06_82	12173.7	25702.1	4416.680	6733.978	1319	20	61.8	9.57	34.02
11/8	5	FL06_82	12181.1	25699.8	4415.926	6734.420	1339		67.3		
11/8	5	FL06_83	12187.6	25713.9	4417.271	6738.495	1432	15	53.8	10.19	33.45
11/8	5	FL06_83	12188.0	25711.3	4416.902	6737.926	1447		52.0		
11/11	5	FL06_84	12040.8	25748.2	4431.298	6727.026	1028	20	25.7	10.35	32.81
11/11	5	FL06_84	12033.1	25749.2	4431.944	6726.208	1048		27.0		
11/11	5	FL06_85	12013.7	25738.5	4431.980	6721.011	1252	11	24.4	10.40	32.93
11/11	5	FL06_85	12012.5	25740.4	4432.302	6721.329	1303		23.8		

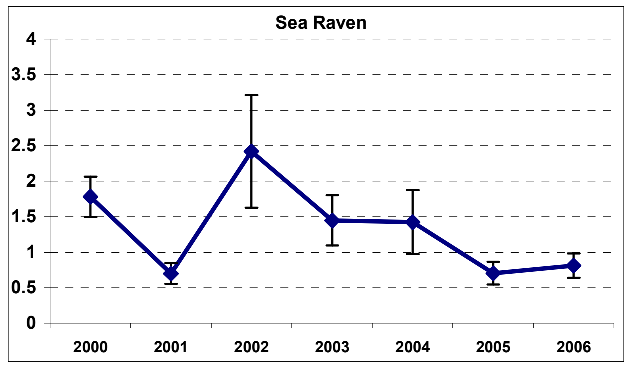
Appendix B

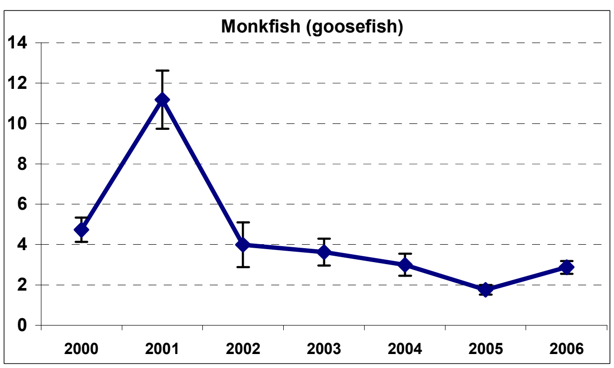
Selected Species
Stratified Mean Number per Standard Tow for Fall Surveys
2000-2006

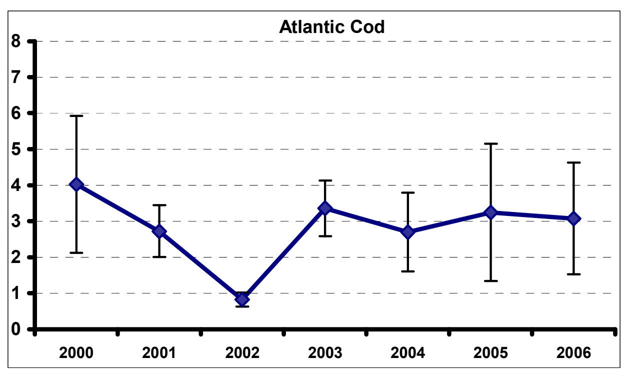


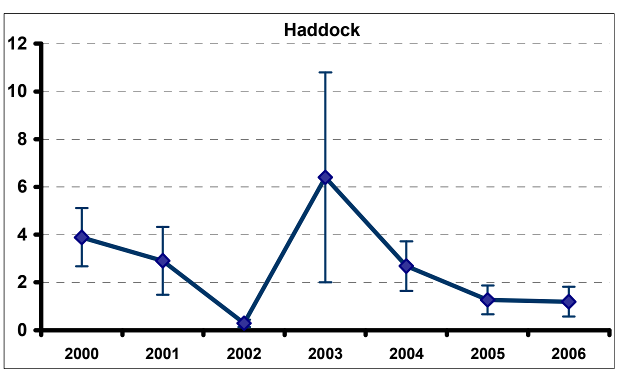


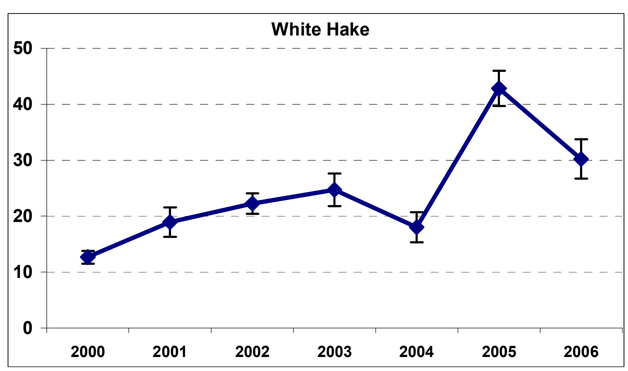






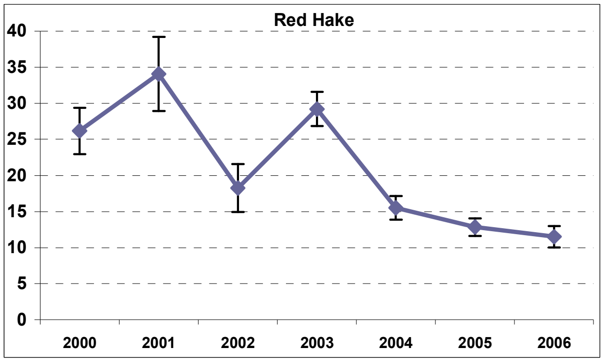


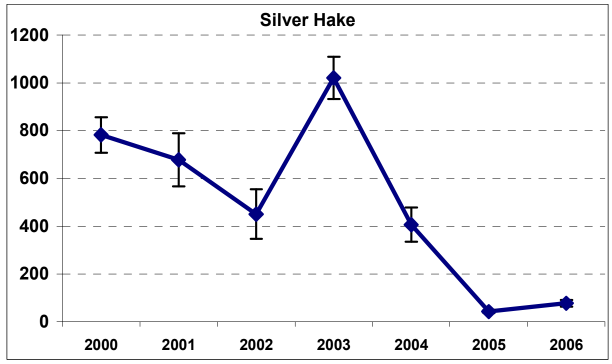


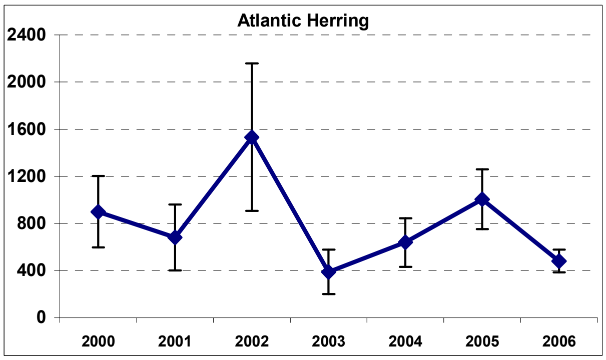


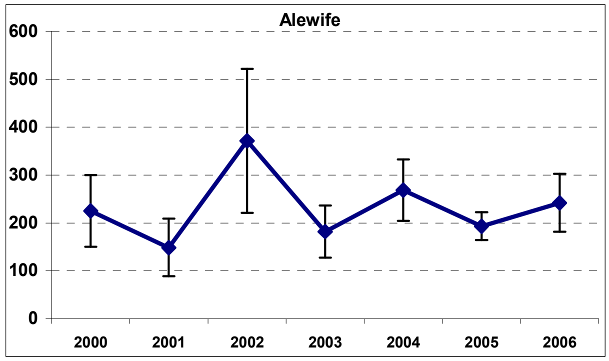
Appendix B

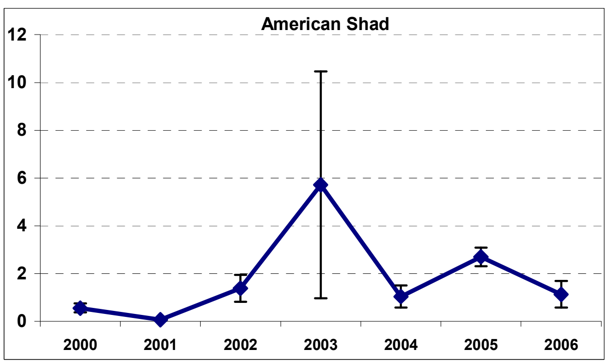
Selected Species
Stratified Mean Number per Standard Tow for Fall Surveys
2000-2006

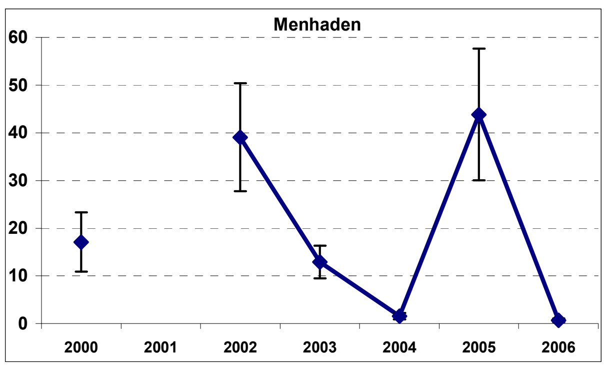


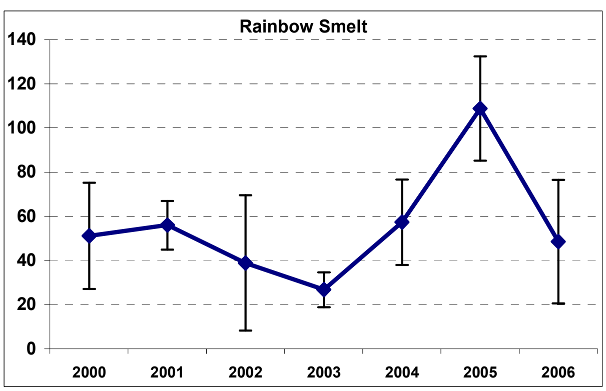


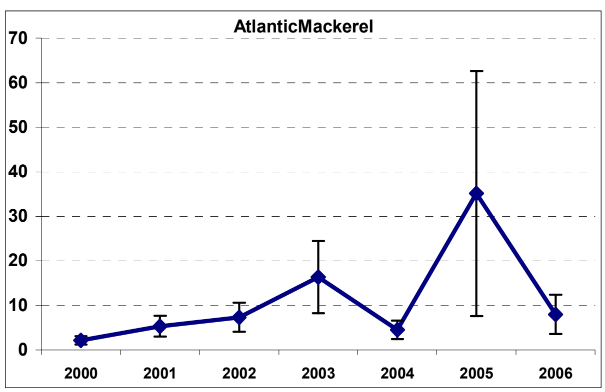






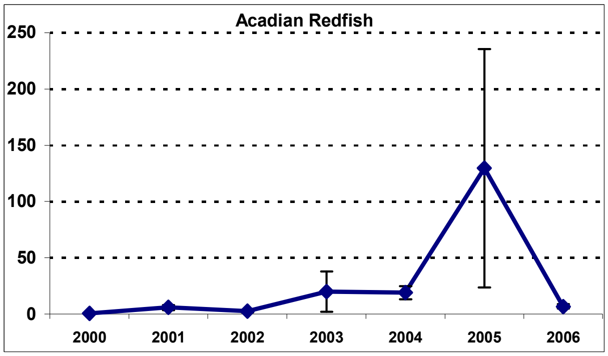


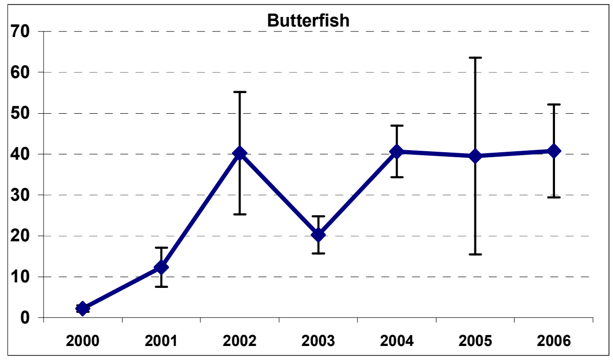


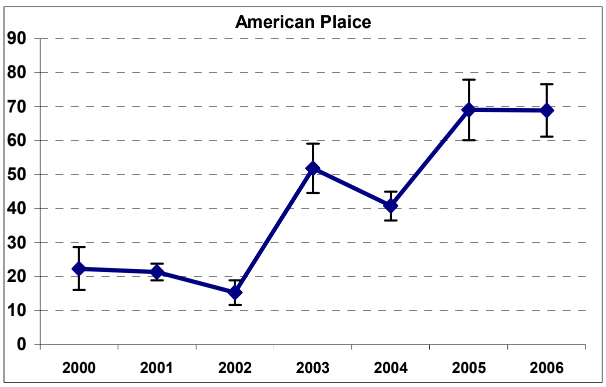


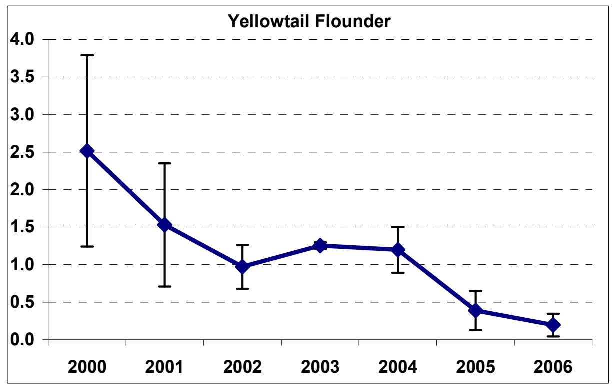
Appendix B

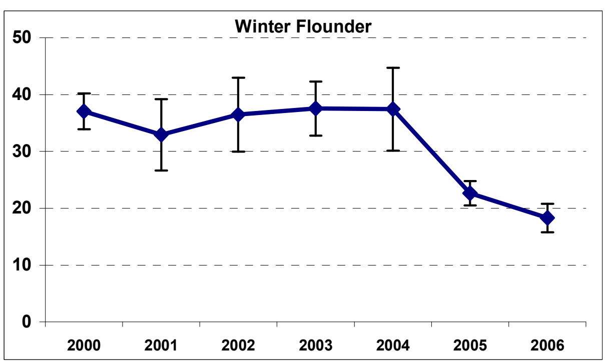
Selected Species
Stratified Mean Number per Standard Tow for Fall Surveys
2000-2006

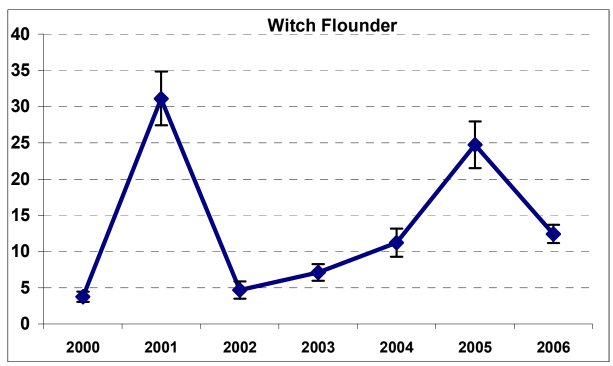


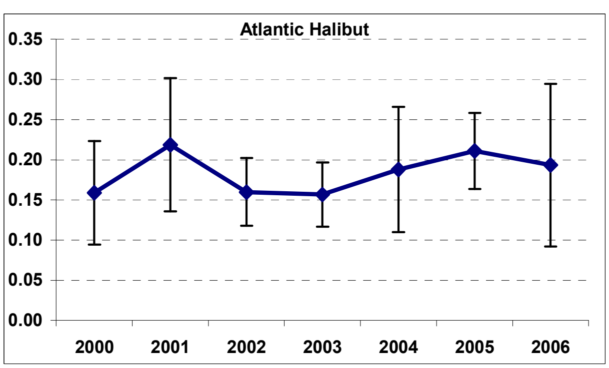


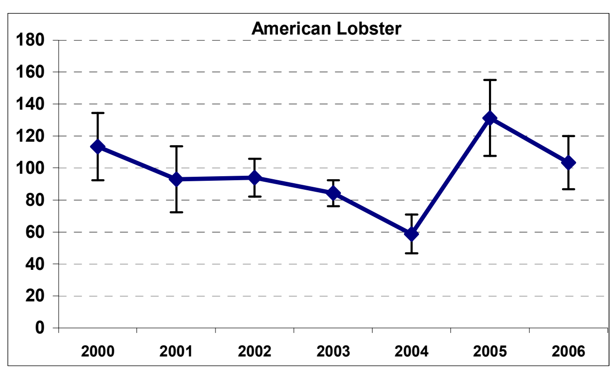






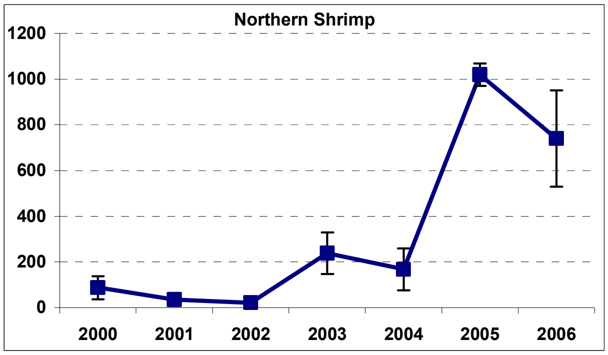


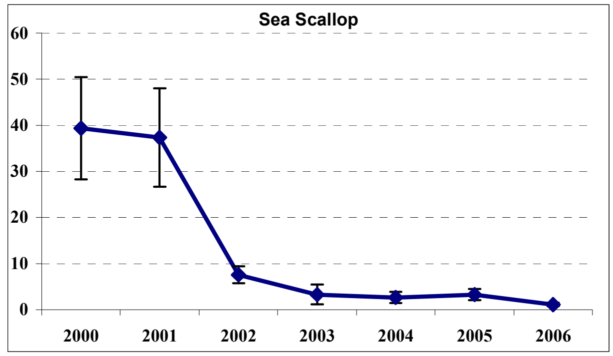




Appendix B

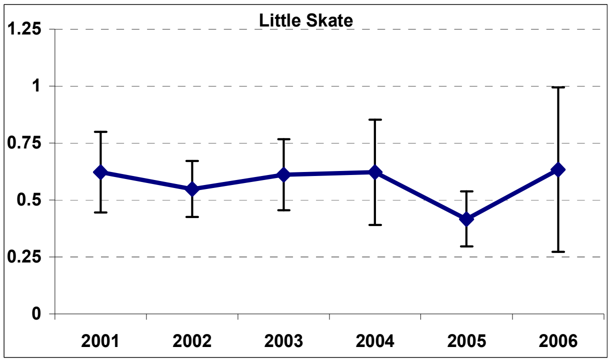
Selected Species
Stratified Mean Number per Standard Tow for Fall Surveys
2000-2006

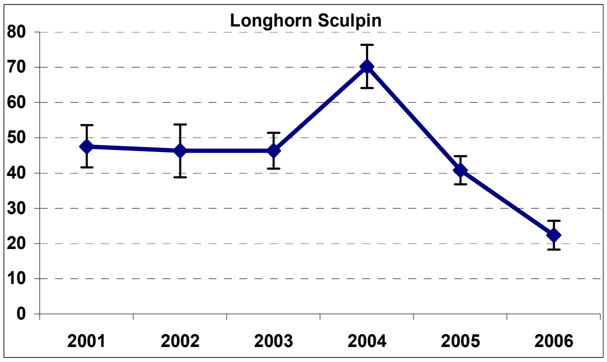


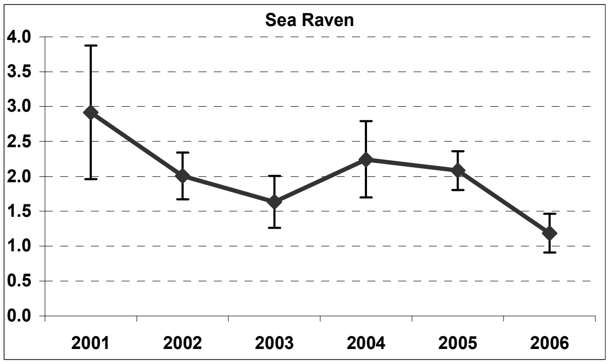


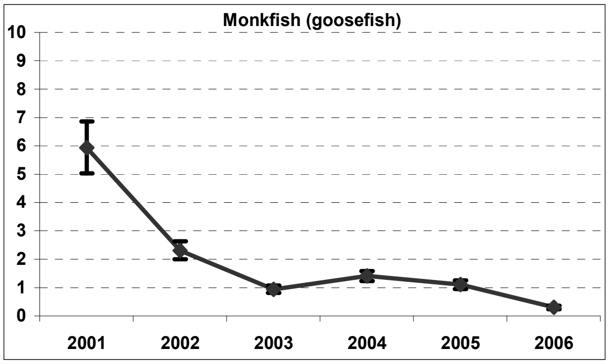
Appendix B

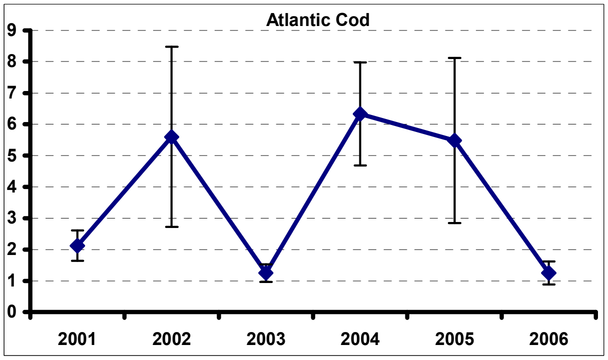
Selected Species
Stratified Mean Number per Standard Tow for Spring Surveys
2001-2006

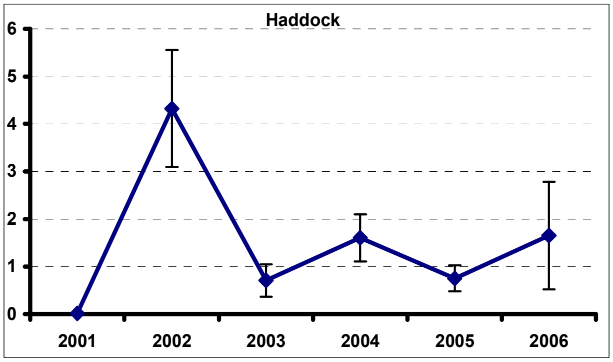


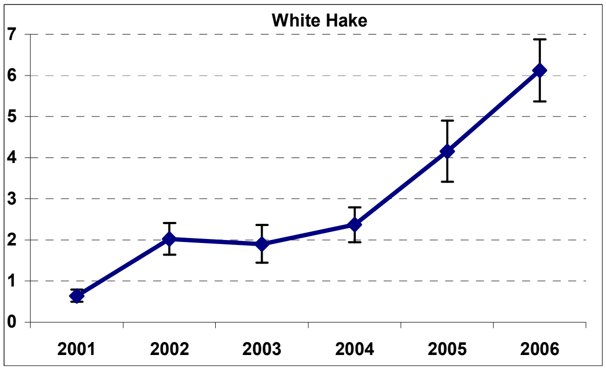


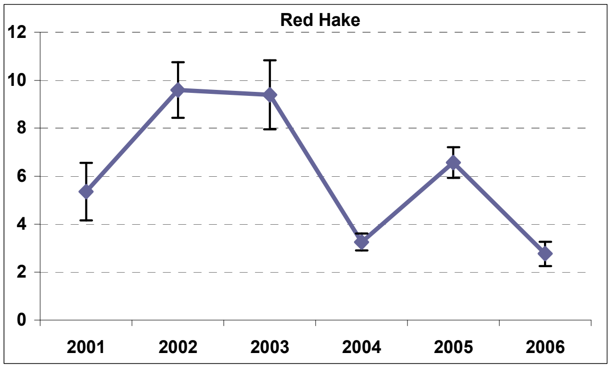




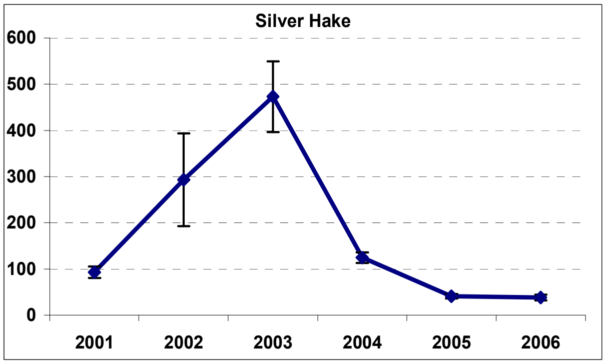


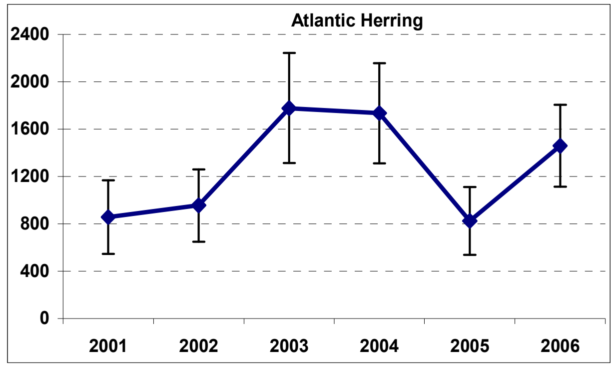


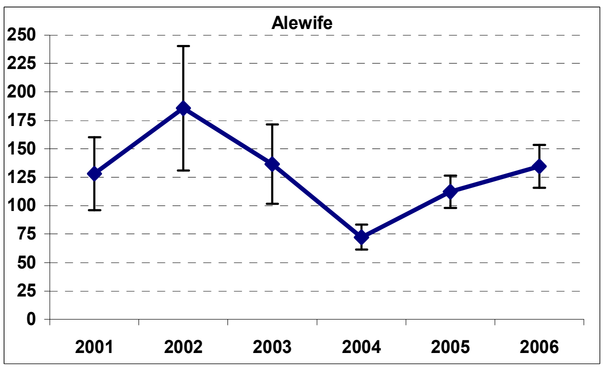


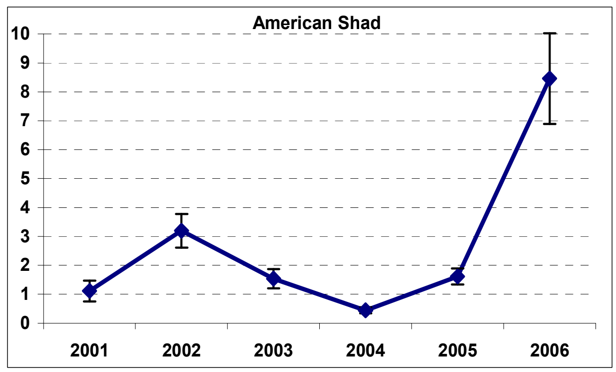


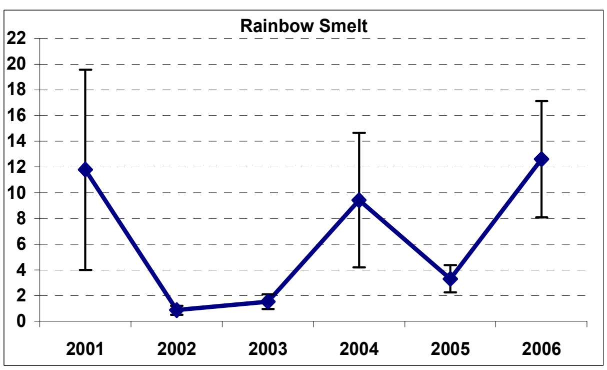
Selected Species
Stratified Mean Number per Standard Tow for Spring Surveys
2001-2006

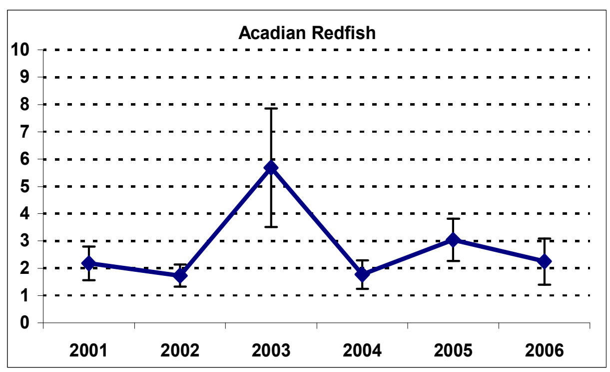


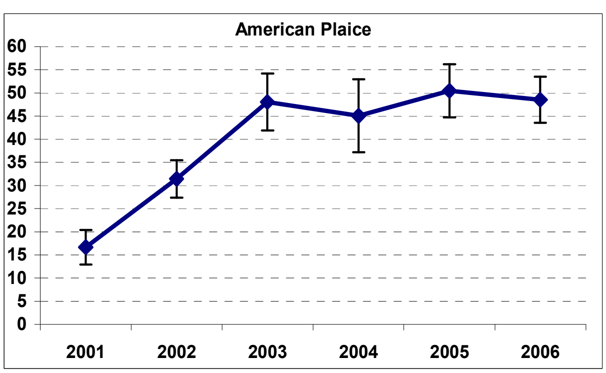


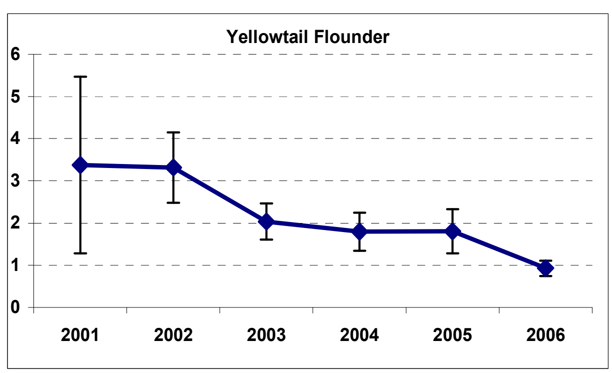












Selected Species
Stratified Mean Number per Standard Tow for Spring Surveys
2001-2006