Northeast Consortium

University of New Hampshire

University of Maine

Massachusetts Institute of Technology

Woods Hole Oceanographic Institution

Summary of Completed

Cooperative Research Projects funded by Northeast Consortium

September 2007

Northeast Consortium

University of New Hampshire

University of Maine

Massachusetts Institute of Technology

Woods Hole Oceanographic Institution

September 2007

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For more information regarding Northeast Consortium projects and participants, visit the Project Information Database at www.northeastconsortium.org/projects.shtml

Dear Colleague:

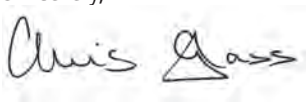
The Northeast Consortium encourages and funds collaborative research and monitoring projects within the Gulf of Maine and Georges Bank, which involve effective, equal partnerships among fishermen, scientists, and other stakeholders. A central goal of the Northeast Consortium is that the results of cooperative research efforts be fully integrated into fisheries and ocean management through ensuring public accessibility to data, facilitating technical reviews of completed projects, and outreach to fishermen, scientists, and managers.

This publication summarizes funded cooperative research projects with final reports submitted to the Northeast Consortium. It is an easy reference guide that highlights the main conclusions and products of funded projects and what next steps are taking place or should take place. As this guide is updated periodically, it will grow as more projects are completed.

All interim and final reports and other project information are internet accessible through the Northeast Consortium's Project Information Database. In addition, the Fisheries and Oceans Data Management System serves as a means of access to data from cooperative research projects funded by the Northeast Consortium.

We hope that this publication will help to communicate the results and products of our collective effort to support and engage in cooperative research in the Northeast region.

Sincerely,



Dr. Chris Glass
Director and UNH Representative

Northeast Consortium

NOAA

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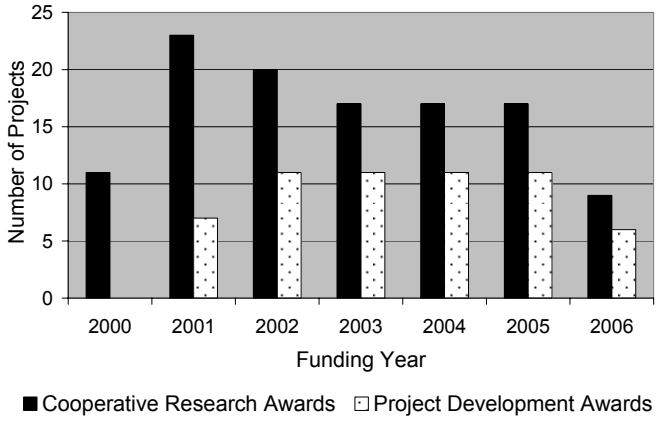
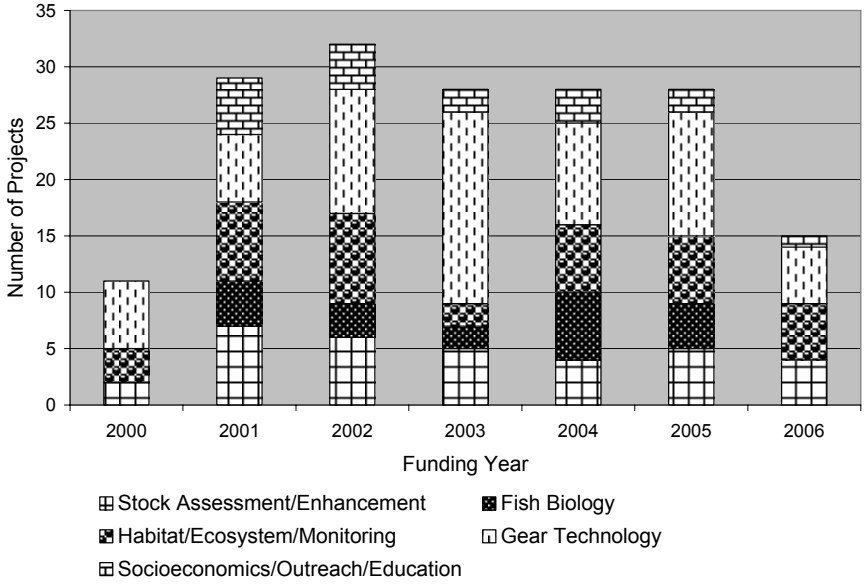
Overview

Since 2000, The Northeast Consortium has funded over 171 cooperative research projects, involving over 395 commercial fishing vessel captains/owners, 32 fishing industry organizations or businesses, and over 264 scientists (including graduate and undergraduate students) from 57 research institutions/agencies. The charts below summarize project funding to date. The first shows the number of cooperative research and project development awards that have been funded. The second shows the number of projects funded each year in five general research topic areas.

The majority of the research funding goes to awards that are usually for one or two years' duration. Projects must include as key participants both one or more scientists and one or more commercial fishermen. The required funding allocation ratio is 25% to scientists and 75% fishermen. At the encouragement of its Advisory Committee, the Northeast Consortium established a project development (PD) award program in FY2001. Up to $25,000 per project can be used to test the feasibility of an idea, try out new gear, or otherwise lay the groundwork for future cooperative research. Project development awards are granted through a proposal review process that occurs later in the year than the cooperative research award process.





Groundfish

Title:
A collaborative program to reduce bycatch and discard in Gulf of Maine otter trawl fisheries: effect of composite mesh codends on trawl selectivity

Funding:
2000 - $148,750

Participants:
Chris Glass (Manomet Center for Conservation Sciences), Timothy Feehan (Manomet), Frank Mirarchi (F/V Christopher Andrew; Scituate, MA), Greg Morris (Manomet), Russell Sherman (F/V Lady Jane; Gloucester, MA), and Proctor Wells (F/V Tenacious; Phippsburg, ME)

Summary:
This project seeks to address the need for more information on the effectiveness of composite codends on bycatch reduction, the variability due to seasonal and geographical variables, and the need to involve fishermen in research. Five different composite mesh codend configurations were tested, two of which showed promise during previous sea-trials, to determine their effectiveness in reducing bycatch and discard of key species. The codends were comprised of different configurations of 6" and 6.5" square and diamond mesh. Testing occurred using three different fishing vessels operating in different areas and a different times of year. Most sea trials were conducted using alternate tow techniques. Data was recorded at sea by NOAA Fisheries certified observers, following NMFS protocols. Videotape recordings of fish reaction behavior were be made throughout the duration of the program and later used to develop more effective species specific selection devices. The investigators found differences in the selectivity of the different codends used. Composite mesh codends (that is codends fabricated with both square and diamond meshes) are effective in significantly reducing bycatch and discard of a range of groundfish species, including cod. These preliminary trials, while demonstrating great promise (e.g. a 62% decrease in capture of sub-legal cod when employing a composite mesh codend), also indicated seasonal variation in degree of effectiveness and were conducted with legal regulated mesh sizes (6" diamond and 6" square mesh) that are likely to be superseded by larger mesh regulations (6" diamond and 7" square).

The investigators received additional funding from the Northeast Consortium in 2002 to continue the study. The effectiveness of two novel, composite mesh codends (constructed with the proposed increased minimum mesh sizes, 6" and 7" diamond and 7" square mesh netting) are being tested for reducing bycatch and discard in Gulf of Maine groundfish fisheries. Their selective efficiency is being compared with codends constructed with current minimum mesh sizes (6" diamond and 6" square) and projected minimum mesh sizes (6" diamond and 7" square).

Project results formed the scientific basis of allowing the use of composite mesh cod ends in Amendment 13 to the Northeast Multispecies Fishery Management Plan. The work has been published in scientific literature and several New England fishermen have since used composite mesh commercially.

Title:
Commercial trials of flexible trawling devices including soft trawl doors

Funding:
2000 - $200,000

Participants:
Cliff Goudey (Massachusetts Institute of Technology) and Robert Kohl (F/V Glenna & Jacob; Marston's Mills, MA)

Summary:
This project capitalized on results from a Massachusetts Institute of Technology Center for Fisheries Engineering Research (CFER) project that applied flexible hydrodynamic devices as a way to control the shape and depth of trawls. These preliminary tests were done at the Marine Institute's flume tank in St. John's, Newfoundland, and revealed significant potential benefits for trawl fishermen, including: 1. reduced habitat impacts by relying less on heavy weight and rigid doors, 2. trawl shape and depth that is independent of towing speed, 3. wider mesh openings for improved selectivity, 4. reduced cost and maintenance requirements for trawl gear, and 5. less risk on deck from heavy doors and sweeps. The project was designed to explore, at a commercial scale, the potential of flexible lifting devices as a way to control the performance of trawl nets. Potential applications to be considered include sweep kites, annular foil kites, mesh kites, and parafoil trawl doors. The annular foil kite was identified as being most promising. At-sea

trials were conducted with mixed results. The potential for the device was clear, but conditions during the trials made documentation difficult. Headrope kites developed by CFER have become standard gear aboard many midwater trawlers fishing in southern New England. With additional development efforts, the utility of flexible devices should be possible in other aspects of trawling, such as controlling trawl shape, keeping meshes open, and replacing rigid hoops such as used in experimental cod end covers or associated with separator grids.

Title:
Construction and operational efficiency of a two-seam 200 mesh x 30 cm monkfish trawl

Funding:
2003 - $25,000 (PD Award)

Participants:
Allyson Jordan (Jordan Maritime Industries, Ltd.; Portland, ME), Jeff Flagg (Portland Trawler Supply; Brownfield, ME), Greg Turner (F/V Theresa & Allyson; Portland, ME), and Manomet Center for Conservation Sciences

Summary:
This project was designed to provide solid data on the efficiency of a large mesh (10") codend built specifically to target monkfish and minimize bycatch. The net was constructed following the guidelines requested by the New England Fishery Management Council for a two-seam 200 mesh x 30 cm monkfish trawl. Sea trials were in the Wilkinson Basin area over two days for a total of 10 hauls. The experimental codend had an overall bycatch rate equal to 5% of the total catch. Monkfish below the minimum legal size of 40 cm total length (based on the regulatory tail m.l.s. of 11") made up 1% of the monkfish catch in weight. These promising results are worth further exploration, in order to assess and quantify the potential to achieve a clean monkfish fishery.

Title:
Design and test of a double grid device to reduce cod bycatch in flatfish trawls

Funding:
2001 - $356,866

Participants:
Pingguo He (University of New Hampshire), James Matheson (Commercial Fisherman, ME), Glenn McIntyre (Commercial Fisherman, ME), and Bart McNeel (F/V Aaron and Melissa II; Westbrook, ME)

Summary:
Excessive catch of cod in flounder trawls increases cod discards and discard mortality and impedes recovery of cod stocks in Gulf of Maine and Georges Bank. Successful separation of cod from flounder during capture processes will reduce discards of cod, thereby reducing unnecessary and unaccounted fishing mortality. Species separation trawls would also allow fishermen to continue to fish for flounder under limited daily cod landing limits. This project involved the design, flume tank testing, and sea trials of various grid devices to separate species of groundfish during trawling. Modifications were made using flume tank testing and sea trials. Methodologies and results from tank tests and sea trials and the potential success of selected devices and their application for use in the Northeast multispecies fisheries are discussed in the final report. Three main types of grid devices were tested, high density polyethylene (HDPE), stainless steel, and plastic over steel roller grid. The 105 mm horizontal roller grid has potential for separating roundfish from flounder, while the 90 mm roller grid and the 90 mm diagonal grid have potential for size selective harvesting of monkfish.

This research has led to follow-on work funded by NOAA Fisheries Cooperative Research Partners Program, and an article is in preparation for publication in scientific literature. The Northeast Consortium is in the process of facilitating a technical mail review of this project.

Title:
Determining groundfish species movement patterns in closed areas, including the Western Gulf of Maine Area Closure

Funding:
2000 - $214,640
2002 - $134,243

Participants:
Hunt Howell (University of New Hampshire), Vincent Balzano (F/V North Star; Portland, ME), Carl Bouchard (F/V Stormy Weather; Exeter, NH), Jim Ford (F/V Lisa Ann II; Newburyport, MA), David Goethel (F/V Ellen Diane; Hampton, NH), Frank Mirarchi (F/V Christopher Andrew; Scituate, MA), and Mike Morin (UNH)

Summary:
Two cod tagging projects have been funded, one that examines the effectiveness of the western Gulf of Maine rolling closures as a management tool (FY2000) and another that focuses on cod movements in and around the Western Gulf of Maine Area Closure (WGoMAC) (FY2002). Mark and recapture techniques were used for both.

During the first project, 91 tagging trips were conducted, making 555 tows in the four rolling closure areas. A total of 17,860 cod were tagged, as well as 1,138 haddock, 840 American plaice, 79 pollock, 41 wolf fish, 28 yellowtail flounder, 12 winter flounder, and 7 gray sole. A total of 1,086 cod (6.1%) were recaptured with enough information (exact location and date of recapture) to be usable in the study. All data have been entered, and the analyses have been completed. Overall, movement of Atlantic cod in the western Gulf of Maine appears to be associated with spawning. In the spring, cod were observed to move from offshore areas and aggregate inshore (area 133) to spawn. Post-spawning movements began in June and were characterized as a general dispersion offshore away from the spawning grounds. Cod were again observed to move inshore for spawning in December-January, suggesting the possibility of two distinct spawning groups. These spawning events were each associated with movements in and out of area 133. To determine if these were two distinct groups or the same group spawning twice, average lengths of the three observed spawning groups (spring 2001, fall 2001-winter 2002, and spring 2002) were compared. Results showed that both the spring 2001 and 2002 groups had a significantly larger average size than the winter spawning group, suggesting that these are two different age groups of fish. Genetic analyses of these fish, conducted by Kovach et al. at UNH, indicate that the two spawning groups are genetically different. Results from the project formed the basis of a thesis prepared by Mike Morin, and a manuscript for publication is currently in review.

For the second tagging project, a total of 59 days, between July 2002 and June 2003, were spent collecting and tagging cod in the WGoMAC and adjacent areas. A total of 6,953 cod were tagged. Of these, 230 (3.3%) were recaptured prior to January, 2004. Days at large ranged from 0 (recaptured the same day) to 421. Most (76.8%) were recaptured within 120 days of being tagged and released. Data analyses include movement, length, and abundance statistics. Results suggest that cod movements in this area are associated with spawning and that the time/area (i.e. rolling) closures, as currently configured, are appropriate for protecting spawning aggregations. Spawning cod moved relatively short distances (most <30 km). A low number of cod were recaptured from the WGoMAC, presumably because commercial fishing is prohibited in the area. However, the data suggests that this is not an area where adult cod are particularly abundant and that it is not an important spawning area. Nevertheless, the WGoMAC may be an important nursery area for cod. If so, then the combination of rolling closures designed to protect spawning cod, and the closure of the WGoMAC that may benefit juveniles, is probably contributing to the recovery of cod in the western Gulf of Maine.

Results from these projects formed the basis of a graduate thesis and two manuscript currently under review for publication in scientific literature. The Northeast Consortium facilitated a technical mail review of this project, the results of which were presented to the New England Fishery Management Council in July 2006. The Council is incorporating project information as appropriate.

Title:
Development and testing of a novel "rigid-mesh" bycatch reduction device for Gulf of Maine groundfish fisheries

Funding:
2002 - $24,865 (PD Award)
2003 - $186,723

Participants:
Chris Glass (Manomet Center for Conservation Sciences), Terry Alexander (F/V Jocka, Harpswell, ME), Mark Freedman (F/V Miss Sarah; Plymouth, MA), and F/V Barbara L. Peters (MA)

Summary:
This project (a project development award followed by a cooperative research award) developed and tested a novel "rigid-mesh" bycatch reduction system for the Gulf of Maine groundfish trawl fishery to reduce bycatch and discard. A panel of rigid mesh netting was inserted into the extension of a commercial fishing net and withstood the rigors of commercial fishing operations. The device was filmed underwater and data on net performance and fish behavior with respect to the net was recorded. Sea trials took place in summer 2004, summer 2005, and winter 2006. Alternate tows were made with the rigid mesh and the control net of standard fishing gear. The results from the study indicate that the rigid mesh panels that were tested do not significantly reduce bycatch and discard of undersize fish in the Gulf of Maine groundfish fisheries. No significant differences were observed in the overall amount or weight of fish caught or in individual species between the experimental and control nets.

Title:
Development of a hydrodynamic cover for conducting experiments on selectivity of trawl codends onboard fishing vessels

Funding:
2001 - $24,570 (PD Award)

Participants:
Pingguo He (University of New Hampshire) and Carl Bouchard (F/V Stormy Weather; Exeter, NH)

Summary:
The project involves the design and development of a codend cover for conducting codend selectivity studies onboard small (45') commercial trawlers in New England. The focus of the development project was to devise a suitable codend cover and to evaluate its application for codend selectivity studies using the covered codend method. The design involved the use of 12 water-borne kites attached to the codend cover to expand the cover when towed through water. Flume tank tests of the full scale prototype were carried out in December 2002 at the Marine Institute in St. John's, Newfoundland. Field tests were conducted in May/June 2003 in the western Gulf of Maine. The codend cover has been proven suitable in terms of its function, evaluated by underwater observations and catch assessment. The cover was easy to handle onboard a small inshore commercial trawler. The kite cover has since been used in a project to study the selectivity of the trawl codend of different mesh sizes and mesh shapes funded by the NOAA Fisheries Cooperative Research Partners Program during spring/summer 2003 and 2004. The kite cover is recommended for use in other vessels doing codend selectivity research, though the size of cover and the number of kites may differ due to different sizes of codends.

Results of this project formed the basis of one article published in scientific literature.

Title:
Development of a (trawl) net to reduce bycatch of cod in the flounder fishery

Funding:
2000 - $35,000

Participants:
Allan Michael (ADM Associates) and Bill Lee (F/V Ocean Reporter; Rockport, MA)

Summary:
A standard commercial groundfish trawl net was modified by the addition of a Nordmore style grate and an escape vent. The purpose was to develop a net that would allow flounder to pass through a grate to the codend, but direct cod upwards and out of the net. The gear was tested and videotaped in shallow waters in Ipswich Bay, Massachusetts. The original grate design had horizontal openings of decreasing size from an

aperture of 10" at the bottom to 2" inches at the top and was inclined towards an escape vent at the top of the net. This design proved unsuccessful, since a significant amount of cod passed through the grate during the first few trials. The design that seemed most successful used a steel grate with horizontal bars spaced 3" apart, producing a 73% reduction in the number of cod caught on the grate or in the codend and a 12% loss of flounder out of the escape vent. A by-product of the project was the development of a video system and methods for documenting trawl net performance and fish behavior. One challenge the project encountered was clogging of the grate by large monkfish and dogfish. A possible solution would be the use of a ventral escape vent for monkfish. This approach is being evaluated in a much larger, ongoing study that is analyzing a more complicated double-grate system. It received funding by the Northeast Consortium in 2001 and is led by Pingguo He of the University of New Hampshire.

The Northeast Consortium facilitated a technical mail review of this project, the results of which were submitted to the New England Fishery Management Council in January 2007. The Council is incorporating project information as appropriate.

Title: *Feasibility study for knotless codends*

Funding: 2002 - $56,180

Participants:
Kelo Pinkham (F/V Jeannie C.; Trevett, ME), Stanley Coffin (F/V Bad Penny; Edgecomb, ME), Bill Lee (F/V Ocean Reporter; Rockport, MA), Peter Johnson (F/V Bad Penny) and Dana Morse (Maine Sea Grant)

Summary:
The selectivity of knotless twine used in the codend of a groundfish trawl was tested relative to a standard codend constructed of knotted twine. In 2003, 25 tow pair (50 tows) tests were conducted. Analysis of catch per unit effort and length frequency by species detected only a small difference between catches from the knotless and knotted codends. Video footage suggests a general tendency for the knotless twine to remain more fully open during trawling. Escapees from knotless codends may suffer less scale loss and other damage during the escape process. The knotless twine is lighter, easier to handle, and more supple. Future work should focus on the health of escapees and on continued field trials, including square mesh arrangements. Larger sample sizes and covered codend experiments would help to more fully describe the selectivity of knotless twine in the Northeast groundfish fishery. Evaluations were somewhat hampered by low catches in both control and experimental tows. A research brief is available on the project, which describes some of the positives and negatives of using knotless twine.

The Northeast Consortium facilitated a technical mail review of this project, the results of which were presented to the New England Fishery Management Council in September 2006. The Council is incorporating project information as appropriate.

Title: *Fishermen assisting gear technologists and scientists*

Funding: 2001 - $87,200

Participants:
Michael Pol (Massachusetts Division of Marine Fisheries), William Amaru (F/V Joanne A II; Chatham, MA), Vincent Balzano (F/V North Star; Portland, ME), H. Arnold Carr (MADMF), John and Ernie Eldridge (Commercial Fishermen; Chatham, MA), Tim Feehan (Manomet Center for Conservation Sciences), Chip Foster (Commercial Fisherman; Chatham, MA), Chris Glass (Manomet), Cliff Goudey (Massachusetts Institute of Technology), Vincent Manfredi (MADMF), Bob Marcella (F/V Ann Marie; Hull, MA), Gregg Morris (Manomet), Thomas Moth-Poulsen (MADMF), Dan Murphy (F/V Bantry Bay; Dracut, MA), Mary O'Rourke (Trawlworks Inc.; Narragansett, RI), Luis Ribas (F/V Blue Skies; Provincetown, MA), Dan Schick (Maine Department of Marine Resources), Joe Scola (F/V Dolores Louise; Gloucester, MA), Russell Sherman (F/V Lady Jane; Gloucester, MA), Mark Simonitsch (Commercial fisherman; Chatham, MA), Mark Szymanski (MADMF), Mathew Thomson (F/V Striker; Monhegan Island, ME), Philip Walsh (Memorial University; St. John's, Newfoundland, Canada), Steve Welch (F/V American Heritage; Scituate, MA), Proctor Wells (F/V Tenacious; Phippsburg, ME), Scott Westcott (F/V Mary Elena; Wakefield, RI)

Summary:
This project facilitated the input and participation of commercial fishermen in a variety of types of projects:

- Fishermen's expertise was used to develop and test innovative fishing gears, including several trawl modifications and two designs for cod pots. The pot testing rejected one design as unworkable and unsuitable for the test area, and provided encouraging results for the other design, marking the first known recent successful catches of cod in pots in New England.
- Two industry meetings to discuss responsible fishing were held, which continued valuable industry

discussions on facing stewardship challenges.

- A trip to the Memorial Institute flume tank in Newfoundland resulted in a shared recognition of, and respect for, knowledge of fishing gear among flume tank staff, fishing industry members, and scientists. The trip also developed a network for communicating ideas and generated data on several experimental trawl net designs.
- The knowledge and skills of biologists and Chatham weir fishermen were used to help a white shark *Carcharodon carcharias* exit a shallow salt pond. The New England region cheered as the white shark escaped into Vineyard Sound.

Title:
Groundfish trawl nets designed to reduce the bycatch of cod

Funding:
2000 - $87,200

Participants:
Michael Pol (Massachusetts Division of Marine Fisheries) and Luis Ribas (F/V Blue Skies; Provincetown, MA)

Summary:
Two trawl nets, the "Ribas net" and a Faroe Island design prototype, were constructed and tested at sea on a commercial vessel against a conventional two-seam groundfish net, which served as a control. The two experimental nets both modify the top half of a trawl net; the Ribas by using large square mesh and the Faroese by removing much of the twine at the top of the net. The project goal was to reduce cod bycatch 75-90% (and perhaps dogfish (*Squalus acanthias*) bycatch as well). This net was designed to target the following species: yellow tail flounder (*Pleuronectes ferruginea*), winter flounder (*Pleuronectes americanus*), American plaice (*Hippoglossoides platessoides*), windowpane flounder (*Glyptocephalus cynoglossus*), and skate (*Rajidea*).

Seventy pairs of alternate tows with the control net resulted in reductions of cod bycatch of >76% for both nets. Catch rates of sublegal yellowtail flounder were also >74% lower for both nets compared to the control. There were, however, reductions in the legal catch of yellowtail and winter flounders. Underwater video showed cod exiting the nets through the top mesh or gap made by removal of the twine. The results of this project have been presented to the New England Fishery Management Council Multispecies Plan Development Team, which encouraged participants to demonstrate the performance of the Ribas net in off-shore areas. The participants have continued the research with Saltonstall-Kennedy funding. However, modified versions of both nets were included as options in Amendment 13 to the Multispecies Fishery Management Plan.

The Northeast Consortium facilitated a technical mail review of this project, the results of which were presented to the New England Fishery Management Council in December 2006. The Council is incorporating project information as appropriate.

Title:
Harvesting of groundfish using baited pots to reduce bycatch and seabed impact

Funding:
2002 - $24,992
(PD Award)

Participants:
Pingguo He (University of New Hampshire) and Proctor Wells (F/V Tenacious; Phippsburg, ME)

Summary:
Ten fish pots designed to catch cod and other groundfish were manufactured and tested for ten fishing days in the Casco Bay area in the spring of 2003. Based on Newfoundland pot designs, the pots were either 5' x 5' x 2.5' made of 2" square wire mesh or 4 x 4 x 2' made with 1.5 x 2" wire mesh. All could be handled easily by the 46' F/V Tenacious. These pots were also used by the industry partner for another related project funded by other agencies in spring and summer of 2003 and 2004. No substantial amount of fish was caught during sea trials. Underwater video observations of two of the pots did not show fish near the pots. We hypothesize that the reason fish were not caught is related to the time of the year the pots were fished. In future fish pot experiments, gillnets or longlines should be fished near test pots to verify abundance and feeding condition of the target species. Extensive use of underwater video or time-lapse camera systems is advised in developing fish pots for groundfish species.

Title:
Identification of life history parameters for two exploited skate species (Amblyraja radiata and Malacoraja senta) in the Gulf of Maine: Strategies for fisheries management

Funding:
2001 - $200,000

Participants:
Paul Tsang (University of New Hampshire), Joe Jurek (F/V Mystique Lady; Andover, MA), and James Sulikowski (University of Florida)

Summary:
The primary objective of the study was to foster a partnership between commercial fishermen and research scientists in order to quantify the life history parameters essential to the development of a fisheries management plan for the thorny skate, *Amblyraja radiata,* and smooth skate, *Malacoraja senta,* in the Gulf of Maine. For the thorny skate, we found that this species grows slowly (k=0.11 for males, and k=0.13 for females), is long lived (16+ years for both males and females), reaches sexual maturity at a late age and size (50% maturity occurs at a total length of 860 mm and near 11 years of age for males and a total length of 875 mm and around 11 years of age in females), and is reproductively active all year round. While the data for the smooth skate is still being analyzed, our results suggest that like the thorny skate, this species reproduces continuously throughout the year. More research will be needed to ascertain the essential fish habitats and movement patterns for these species.

Project results formed the basis of a graduate dissertation and seven articles for scientific literature (two published, two under review, and three in preparation). The Northeast Consortium facilitated a technical mail review of this project, the results of which were presented to the New England Fishery Management Council in October 2006. The Council's skate Plan Development Team are incorporating the information in their work, such as in the "Skate Annual Review," presented to the NEFMC meeting in September 2006. The information will likely be used in upcoming groundfish assessments and revisions to management plans.

Title:
Improving the selectivity and utility of demersal hook fishing

Funding:
2000 - $96,750

Participants:
H. Arnold Carr (Massachusetts Department of Marine Fisheries), Susan Goldhor (Center for Applied Regional Studies), Mark Leach (F/V Sea Holly; Harwich, MA), Tom Luce (F/V Sea Winn; West Barnstable, MA), Michael Pol (MADMF), and the Cape Cod Commercial Hook Fishermen's Association

Summary:
This project combined at-sea fishing underwater video observation of fish behavior towards baited hooks and aquarium research to expand our knowledge of the behavior of commercially important groundfish (e.g., cod, haddock, yellowtail flounder and other flatfish species) towards a variety of natural and artificial baits. The goal was to analyze fabricated baits for their cod-catching potential. Artificial baits were tested with regard to attractants, size, shape, etc. Successful baits, hook sizes, and gear types were tested in at-sea trials. Results suggest that the methods used for testing and developing artificial baits were successful at narrowing down the selection of bait types for cod and yellowtail, although preferences were difficult to establish. More research is needed to definitively determine which bait type is best at catching cod.

Title:
Maine-New Hampshire inshore trawl survey

Funding:
2000 - $38,607
2002 - $299,815

Participants:
Sherman, Sally (Maine Department of Marine Resources), Yong Chen (University of Maine), Jeff Flagg (Portland Trawler Supply; Brownfield, ME), Sam Galli (F/V Tara Lynn; Portland, ME), Doug Grout (New Hampshire Fish and Game), Hannah Smith (MEDMR), Vincent Manfredi (MEDMR), Curt Rice (F/V Robert Michael; Portland, ME), John Sowles (MEDMR), Keri Stepanek (MEDMR), and Bob Tetrault (T/R Fish, Inc.; Portland, ME)

Summary:
This project is a fishery independent multi-species stock assessment along the Maine and New Hampshire inshore waters. The overall goal of the project is to establish a solid foundation for long-term fishery-independent monitoring of the Gulf of Maine inshore waters, filling an information gap on the status and trends of groundfish and other species in this area for which assessment data would otherwise be absent. Funded in part by the Northeast Consortium and in part by the NOAA Fisheries Cooperative Research Partners Program, the survey began in the fall of 2000 and consists of annual, spring and fall stratified random surveys, each covering approximately 115 stations from New Hampshire to Canada. The project is a close partnership with commercial fishermen and the two state agencies charged with managing the inshore waters. Data is being provided for the management of a number of species including lobster, shrimp, crab, scallop, shad, herring, and groundfish. The project is contributing to stock abundance, structure, and recruitment indices for the area and compliments data from the NOAA Fisheries bottom trawl survey in the Gulf of Maine and the Massachusetts Department of Marine Fisheries inshore trawl survey.

In August 2005, a technical panel review of the project was facilitated by the Northeast Consortium, the results of which were presented to the New England Fishery Management Council and the Atlantic States Marine Fisheries Commission in October 2005. It was conducted to determine the viability of using the data in regional stock assessments and to improve the project for the future. The project received funding again in 2005 from the Northeast Consortium and the participants are incorporating many of the panel's recommendations in current and future surveys. Project results have formed the basis of one article published in scientific literature.

The project is providing key stock assessment information for over 80 species and covers 80% of the nearshore waters adjacent to Maine and New Hampshire. Examples of uses of the data to date follow:

- American lobster: 1.) The data were a key component of the new American lobster stock assessment model by Chen et al. 2.) The survey was analyzed in a recently peer reviewed paper that identified separate lobster stocks (Chen et al. 2006). That work showed the importance of assessing inshore stocks to compliment to the NOAA Fisheries Gulf of Maine Trawl Turvey. 3.) Inshore survey data directly influenced the findings of the 2006 ASFMC Lobster Stock Assessment to conclude that Maine lobster was not being "overfished."
- Monkfish: Data were used by the federal Stock Assessment Review Committee and are included in the Monkfish Stock Assessment Workshop Document #40.
- Herring: Data were used to set specifications for 2007-2009 and referenced in Amendment 2 of the Council and Amendment 1 of the ASMFC.
- Winter flounder: Data provided for use in developing Amendment 1 to the ASMFC Fishery Management Plan.
- American shad: Data are a major component of the 2007 ASMFC American Shad Assessment. Since Maine has no commercial fishery and no data on recreational catch, the Trawl Survey is the only source of information. Information on distribution appears to be revealing over-wintering areas that were heretofore unknown.
- Northern shrimp: Data used by the ASMFC Northern Shrimp Section in the determination of fishing seasons.
- Sea Scallop: Data were used to set up the experimental design for a sea scallop survey.
- Jonah Crab: Data used in the design of a video resource assessment project by MEDMR (also NEC-funded).
- Atlantic Sturgeon: Data are incorporated in Maine's annual ASMFC compliance report to indicate species distribution and index of abundance.

Since the peer review, the survey participants have interacted with surveys in other states and increased conversations with scientists from NOAA Fisheries. These have resulted in new ideas and solutions to improve the survey. The project has been reviewed by the NEMFC's Research Steering Committee who ultimately endorsed the survey as a valuable and cost effective program to help the Council. The Survey data are being used by the Council's Habitat and Groundfish Plan Development Teams. Data will likely be used in upcoming groundfish assessments and revisions to management plans.

Title:
Production and testing of an alternative bait selecting for haddock

Funding:
2003 - $25,400
(PD Award)

Participants:
Mark Leach (F/V Sea Holly; Harwich, MA), Ron Braun (F/V Peggy B II; West Dennis, MA), James Eldridge (F/V Yellowbird; West Chatham, MA), Susan Goldhor (Center for Applied Regional Studies), Eric Hesse (F/V Tenacious; West Barnstable, MA), Roger Horne (F/V William Gregory; Chatham, MA), Bruce Kaminski (F/V Never Enough; Chatham, MA), Michael Leary (F/V Lori B; Hampton Falls, NH), Paul Parker (Cape Cod Commercial Hook Fishermen's Association), Terry Pickard (F/V Wendy Jean; Chatham, MA), Tom Rudolph (Cape Cod Commercial Hook Fishermen's Association), Michael Russo (F/V Susan Lee; Orleans, MA), and Peter Taylor (F/V Seahound; Chatham, MA)

Summary:
The primary purpose of this project was to test whether fabricated baits could reduce the catch of cod, relative to that of haddock, to an extent that would allow hook fishermen to harvest haddock in areas closed to cod fishing. Eight benthic longline fishermen tested haddock baits developed in Norway and the Aleutians, as well as squid and herring. In addition, a novel fabricated bait was developed for this project by S. Goldhor and a small amount of the initial version was manufactured and tested. All three fabricated baits fished well and significantly reduced the catch rates of cod, relative to that of haddock, below that achieved with herring bait. During 494 hauls, over the course of 141 trips, the catch rate of legal-sized cod as a percent of the catch rate of legal-sized haddock (all catch measured by weight) was: Squid: 9.1%; Herring 3.6%, Novel S. Goldhor: 6.36%; Aleutian: 0.7%, Norwegian: 0.3%. It is clear from this preliminary work that fabricated baits have immense power to make hook fishing more species-selective.

The Northeast Consortium facilitated a technical mail review of this project, the results of which were presented to the New England Fishery Management Council in February 2007. The Council is incorporating project information as appropriate.

Title:
Reducing cod bycatch in flounder nets in the Gulf of Maine by using shallower gillnets

Funding:
2002 - $76,564

Participants:
Pingguo He (University of New Hampshire), Mark Gauron (F/V Captain Al; Hampton, NH)

Summary:
Species selectivity of two types of experimental gillnets with low vertical profiles, 8 mesh deep (MD) and 12 MD, was compared with that of the standard cod gillnet (25 MD) and the tie-down flounder gillnet in inshore waters of the western Gulf of Maine. The project investigated whether the low vertical profile nets could reduce the catch of Atlantic cod (*Gadus morhua*) while maintaining comparable catch of flounder. All nets were made of #14 dark green monofilament nylon (0.65 mm diameter) with a 178 mm (7") mesh size. Forty comparative fishing sets were made during July and August of 2003. The data were analyzed using paired t-test. Results indicate that the 8 MD experimental net caught significantly less cod than the standard cod net ($p<0.001$), the tie-down flounder net ($p<0.05$), and the 12 MD experimental net ($p<0.001$). The size of cod caught by the tie-down nets was significantly smaller than those by the 8 MD or 12 MD nets ($p<0.05$). The 8 MD net caught marginally more flounder than the standard cod net ($p=0.05$), but significantly less than the tie-down net ($p<0.001$). There are no significant differences in flounder catch rates between the 8 MD net and the 12 MD net ($p>0.05$). In addition, the tie-down net caught twice as much monkfish, sea raven, and rock crab, three times more American lobster, and four to eight times more thorny skates, than the other three types of nets. On the other hand, the standard cod net caught significantly more spiny dogfish, and

white hake, than the other three nets (P<0.001). The 8 MD low profile nets have great potential to substitute the standard cod net to maintain flounder catch rates while reducing the catch of cod. There are potential benefits of using low vertical profile gillnets for reduction of marine mammal interaction and subsequent mortality.

Project results have formed the basis of one article published in scientific literature. Further experiments in different fishing areas and seasons are being conducted with a follow-on award from the Northeast Consortium, funded in 2004, in partnership with the Massachusetts Division of Marine Fisheries.

Title:
Survival of sub-legal cod (Gadus morhua) in the northwest Atlantic longline fishery

Funding:
2003 - $123,612

Participants:
John Pappalardo (Cape Cod Commercial Hook Fishermen's Association), Marianne Farrington (New England Aquarium), Henry Milliken (NOAA Fisheries Northeast Fisheries Science Center), Tom Rudolph (CCCHFA), Melissa Sanderson (CCCHFA), and over 35 commercial fishermen.

Summary:
Federal fisheries regulations require that undersized individuals of commercially important species be returned to the sea and NOAA Fisheries has listed investigations into discard mortality rates as a research priority. For demersal longline fisheries, survival of discarded bycatch is uncertain. Sub-legal sized fish can incur injuries in their mouth, gills, and eyes and sometimes in the gut from hooks, as well as undergo pressure and temperature changes as they are brought to the surface. This study built on previous work that investigated the survival of sub-legal cod. The results of the previous study were hard to assess because of the large numbers of control fish that died and were questioned because the study was not conducted using commercial vessels.

The present study, was executed in collaboration with commercial vessels fishing their commercial hook and line gear. Two handling techniques were examined and compared to jigged fish that acted as the control to estimate cage induced mortality. Longline caught fish were either removed from the hook by hand (unsnubbed) or removed by allowing the hydraulic hauler to pull the fish against the parallel steel cylinders placed vertically on the gunwale, causing the hook to pull through the jaw (snubbed). At the extreme, this process can result in breaking the jaw. This study was a cooperative effort between fishermen and scientists using standard commercial fishing practices. 3,764 sub-legal cod were assessed for survival at three different depth ranges and four sea surface temperature ranges. Survival, assessed after holding the fish in cages for a minimum of 72 hours, ranged from 30.8% to 100%. Binomial logistical regression analysis indicated that depth, sea surface temperature, and de-hooking technique all affected survival. Depth and temperature affected survival more than the de-hooking technique. Survival improved as depth and sea surface temperatures decreased. Unsnubbed fish had less mortality compared to snubbed fish.

Project results form the basis of one article in preparation for publication in scientific literature. The Northeast Consortium is in the process of facilitating a technical mail review of this project.

Title:
Testing of low-profile low cod bycatch gillnets

Funding:
2000 - $78,810
2001 - $71,710

Participants:
Michael Pol (Massachusetts Division of Marine Fisheries), Thomas Bell (F/V Michael Brandon; Scituate, MA), H. Arnold Carr (MADMF), Paul Cohan (F/V Sasquatch III; Gloucester, MA), Bill Hoffman (MADMF), Rebecca Jones (MADMF), Robert MacKinnon (Massachusetts Gillnetters' Association), Scott MacKinnon (F/V Lady Irene; Scituate, MA), and Manomet Center for Conservation Sciences

Summary:
Reduction of gillnet height through the addition of spaced weights on a foamcore floatline and replacement of the floatline with another leadline was effective in maintaining flatfish catch amounts and sizes while reducing bycatch of Atlantic cod by 49% and 58%, compared to standard commercial flatfish gillnets in the Gulf of Maine. Thirty-five sets of experimental gillnets were developed collaboratively between a commercial

fisherman and Division of Marine Fisheries biologists. Catch rates of retained and discarded Atlantic cod *Gadus morhua* were reduced in the experimental nets relative to standard gillnets. No differences were found in catch rates of legal-sized winter flounder *Pleuronectes americanus* and yellowtail flounder *Limanda ferruginea* among flatfish gillnet designs. Undersized winter flounder catch rates were reduced by 88% in experimental designs. Underwater examination of nets verified that the experimental modifications lower floatline heights and increase slack in webbing. These results indicate that bycatch of cod in flatfish gillnets can be reduced by limiting floatation in the floatline.

The Northeast Consortium is in the process of facilitating a technical mail review of this project.

Title:
Trophic ecology of Atlantic cod: Insights from tri-monthly, localized scales of sampling

Funding:
2001 - $125,475
2002 - $76,250

Participants:
Frank Almeida (NOAA Fisheries Northeast Fisheries Science Center), Theodore Ligenza (F/V Riena Marie; South Chatham, MA), Jason Link (NEFSC), and Brian Smith (NEFSC)

Summary:
The project examined the small scale variation of Atlantic cod feeding based upon tri-monthly stomach sample collections from a nearshore, localized region off Cape Cod, Massachusetts. The first objective was to relate any detectable changes in cod diet and amount of food eaten with changes in temperature, spawning, prey abundance, and major weather events, filling the information gap between broad scale and in vivo laboratory studies. The second objective was to work cooperatively with the fishing industry to transform anecdotal information into quantitative data. Results suggest that the amount of food eaten by cod is generally stable throughout the year, except when pelagic forage fish migrate through the area. This corresponds to critical periods in the life history of cod. The temporal variation in diet composition remained remarkably consistent each year over the 28-months of the project, suggesting important feeding periods for cod, which correspond to environmental and biological cues. The diet is comprised primarily of several species of forage fish (e.g. Atlantic herring, sand lance, Atlantic mackerel, ophiuroids, Cancer crabs, and other small crustaceans.). Additionally, these results confirm the preference cod exhibit for prey such as herring, sand lance, and crabs. It is inferred that cod generally eat local forage fish and benthic macro-invertebrates and supplement their diet by gorge feeding upon migrating pelagic species.

The Northeast Consortium facilitated a technical mail review of this project, the results of which were submitted to the New England Fishery Management Council in July 2007. Project results have formed the basis of two articles for scientific literature, one in preparation and one in press.

Title:
Use of positively buoyant ground cables and sweep to reduce seabed contact and to enhance species selectivity.

Funding:
2003 – $25,000
(PD Award)

Participants:
Dana Morse (Maine Sea Grant) and Kelo Pinkham (F/V Jeannie C.; Trevett, ME)

Summary:
Bycatch reduction, and the minimization of benthic impacts continue to be important issues relative to Gulf of Maine fisheries. The project was an attempt to redesign the ground gear of a bottom trawl in a configuration that would minimize both bycatch and benthic impact. Standard ground gear was compared with gear that included 14 8-inch trawl floats strung directly on the lower leg wire. The project aimed to be effective in keeping legal sized cod and haddock, while allowing flatfishes, and undersized roundfish to escape. Five different configurations of the experimental net were tested to optimize off-bottom net height. Difficulties were encountered in weighting the gear sufficiently to achieve the bottom contact necessary to retain a credible catch.

A follow-up project, funded by the Northeast Consortium in 2005, continue efforts to optimize buoyancy of ground gear by constructing and testing models at the Memorial University flume tank and conducting sea trial of the most promising design(s).

Title:
Utilizing genetic techniques to discriminate Atlantic cod spawning stocks in U.S. waters: A pilot project

Funding:
2004 - $25,000 (PD Award)

Participants:
Heather Deese (Northwest Atlantic Marine Alliance), David Berlinsky (University of New Hampshire), David Goethel (F/V Ellen Diane; Hampton, NH), Adrianne Kovach (UNH), Lorraine Maceda (New York University), Frank Mirarchi (F/V Christopher Andrew; Scituate, MA), and Issac Wirgin (NYU)

Summary:
This pilot project involved commercial fishermen, recreational fishermen, and U. S. and Canadian researchers in a partnership to determine the utility of specific genetic techniques for detecting significant differentiation between cod stocks in the region. Microsatellite and single nucleotide polymorphism (SNP) DNA analyses were tested on the specific question of differentiating Atlantic cod from Georges Bank (GB) and the inshore Gulf of Maine (GoM) - are cod in these two regions a single or two genetic stocks? Where possible, we further addressed the question of whether stock subdivisions exist within the GoM and south of GB. Unlike previous efforts, this study focused on actively spawning cod, with spawning state confirmed through analysis of gonad biopsies. Additionally, the focus was on spawning aggregations thought most likely to display genetic differentiation, based on the best available information regarding ecological differences, movements, and expected stock delineations, and within the constraints of collecting new samples during winter 2004/2005.

The sampling strategy focused primarily on comparing winter-early spring spawning cod from GB with both winter and spring spawning cod from inshore, western GoM. Based on experience with genetic cod stock identification in Atlantic Canada, Europe, and recent work within U.S. waters, a total of six informative microsatellite loci and three SNP loci (*Pan I, AHR2, and ARNT2*) were tested for usefulness in distinguishing stock structure in this region. Two of the polymorphic SNP loci (*AHR2* and *ARNT2*) were newly isolated and characterized in this project. The project also focused on collecting, recording and synthesizing information on the location and timing of cod spawning aggregations in the GoM, GB, and south of GB, as a resource for future collaborative research projects, including a broader, longer-term project to identify stock structure utilizing genetic techniques. Highly significant stock differences were found among many, but not all, collections made for this study. Cod from GB were significantly different from those collected in Ipswich Bay during the spring months, but not from those collected in the winter. Most interestingly, the spring collection from Ipswich Bay was significantly different from that made at the same location during the winter along with all other collections made in the study. Fish collected from wrecks off Long Island, New York, were significantly different from the GB collection, but not those from Chatham MA or Stellwagen Bank. In summary, for the first time a highly significant genetic difference has been demonstrated between a collection of spawning cod from GB and a collection of spawning cod from the inshore GoM. The genetic results support the morphological observations of stock differences between cod collected during the winter and spring months in Ipswich Bay.

Project results have formed the basis of one article published in scientific literature. A follow-up project, funded by the Northeast Consortium in 2005, is in process to further determine the level of genetic similarity among cod spawning aggregations throughout the GoM and GB. Knowledge of stock structure is critical to effective fishery management. The results from these studies will be extremely valuable for fisheries scientists, managers, and stakeholders in formulating future management approaches for Gulf of Maine and Georges Bank cod fisheries.

Yellowtail Flounder Tagging Study

Funding:
2003 - $200,000
2004 - $106,500

Participants:
Steven Cadrin (NOAA/UMass CMER Program), David Goethel (F/V Ellen Diane, Hampton, NH), Frederick Mattera (F/V Travis & Natalie, West Kingston, RI) and at least five other scientists and ten commercial fishermen.

Summary:
New England fishermen and the Northeast Fisheries Science Center tagged over 45,000 yellowtail flounder in all three New England stock areas. The study was designed to charter commercial fishing vessels to tag yellowtail with conventional disc tags and data-storage tags with the objectives of estimating movement among stock areas and mortality within stock areas as well as providing growth observations. Preliminary results indicate frequent movement among stock areas.

This project has been augmented with funding by NOAA Fisheries and continues with funding from the Northeast Consortium in 2005. Results are expected to provide information for yellowtail flounder stock assessments and management decisions, particularly the 2008 yellowtail benchmark assessment. Project results have formed the basis of eight articles in scientific literature (five published, two in press, and one in preparation).

Habitat/Ecosystem/Oceanography

Title:
A pilot gillnet survey of the Cashes Ledge Closed Area

Funding:
2004 - $25,000
(PD Award)

Participants:
Kevin Kelly (Maine Department of Marine Resources) and Mathew Thomson (F/V Shearwater II; Monhegan Island, ME)

Summary:
This project tested the use of gillnets to inventory fish populations in the Cashes Ledge Closed Area (CLCA) of the Gulf of Maine. The CLCA encompasses historically important fishing grounds which have been closed to groundfishing, by federal regulation, seasonally since 1999 and year round since 2002. Methods were developed by which groundfish abundance can be regularly monitored in the CLCA. The expected outcome of the project will be a sampling methodology using gillnets that will minimize damage to bottom habitat and sample a variety of species and habitats effectively. This project is needed to develop eventual long term standardized measures of relative abundance of groundfish in closed areas in collaboration with the commercial fishing industry.

The Northeast Consortium is in the process of facilitating a technical mail review of this project.

Title:
An assessment of bottom habitat community recovery in the Western Gulf of Maine Closed Area

Funding:
2002 - $168,896

Participants:
Cameron McLellan (F/V Adventurer, Newcastle, ME), Allen Gontz (University of Maine), Emily Knight (UMaine), Joseph Kelly (UMaine), Laura Taylor Singer (Gulf of Maine Research Institute), and Les Watling (UMaine)

Summary:
Within the last decade, marine protected areas (MPA) have been designated in the Gulf of Maine to address concerns of declining groundfish stocks, with the hope that benthic communities affected by groundfish trawling may also recover in such areas. One such MPA, the Western Gulf of Maine Closure (WGoMCA), encompasses two regions that, as of 2004, had been closed to groundfish trawling for 6 and 4 years, respectively. In this project, changes in benthic community composition following the cessation of trawling were investigated by comparing community states of sites in the 4 and 6 year regions of the WGoMCA to sites in an actively trawled fishing ground known as the Kettle. The epifaunal and infaunal components of benthic communities were surveyed via remotely operated vehicle (ROV) and sediment grab sampling in sites of comparable depth and substrate each August from 2002 through 2004. Multivariate statistics were then used to analyze differences in benthic community composition within and between sites. Finally, family life history information for resident taxa was used to determine possible mechanisms driving observed differences between benthic community composition.

Multivariate analysis showed significant differences in benthic community composition between the Kettle and the WGoMCA, which we attributed to the cessation of chronic trawling disturbance. However, these differences cannot be conclusively attributable to one specific cause because of the lack of pre-closure samples and the distance (~30 nm) between the areas. In general, more disturbance tolerant, opportunistic families dominated benthic communities in the Kettle, while more disturbance intolerant, sessile families dominated communities in the WGoMCA. It appears that the infaunal and epifaunal components of benthic communities most likely recover at vastly different rates in open and closed areas.

The Northeast Consortium has facilitated a technical mail review of this project, the results of which were submitted to the New England Fishery Management Council in June 2007. An article is in preparation for publication in scientific literature.

Title: *Comparison of environmental contaminants on Georges Bank and Stellwagen Bank*

Funding: 2001 - $129,130

Participants:
Emily Monosson (Montague, MA), David Lincoln (Gloucester Fishermen's Wives Association), Angela Sanfilippo (GFWA), and over 14 commercial fishermen

Summary:
This project investigated the potential for contaminant-induced effects on reproduction and development in both nearshore and offshore cod. Heavy metals, polychlorinated biphenyls (PCBs), and oganochlorine pesticides (including DDTs) were measured in cod livers, gonads, and sediments from Stellwagen Bank, Georges Bank, and Wilkinson Basin. In general, concentrations of most contaminants were found to be near or below detection limits in cod gonads. Several contaminants were detected in the cod liver including PCBs and DDTs. However, concentrations from Georges Bank were drastically lower than previously published data and below concentrations linked with reproductive or developmental toxicity in fish. Analysis of heavy metals suggests that the concentrations of metals measured in this study, except for cadmium, are within range of those previously reported in cod. The vast majority of polycyclic aromatic hydrocarbons (PAHs) and metals detected in sediments were below NOAA's Threshold Effects Levels and chlorinated pesticides were below detection limits in the sediments. No one chemical was consistently detected at concentrations suspected of causing adverse effects in cod or their offspring. It would appear that levels of exposure to the chemical contaminants measured are unlikely to have had a considerable impact on the nearshore or offshore cod fishery.

The Northeast Consortium facilitated a technical mail review of this project, the results of which were presented to the New England Fishery Management Council in July 2006. The Council is incorporating project information as appropriate, particularly for the Essential Fish Habitat Omnibus Amendment currently under development. Project results have formed the basis of one article published in scientific literature.

Title: *eMOLT: Environmental monitors on lobster traps phases 1 - 4: temperature, salinity, data management, and drifters*

Funding:
2000 - $82,000
2001 - $116,000
2002 - $79,775
2003 - $164,300

Participants:
James Manning (NOAA Fisheries Northeast Fisheries Science Center), Bill Adler and David Casoni (Massachusetts Lobstemen's Association), Jeremy Cates (Downeast Lobstermen's Association), Charles Gregory (Southern Maine Community College), Clare Grindal (DLA), Tom Long (SMCC), David and Patrice McCarron (Maine Lobstermen's Association), Erin Pelletier (Gulf of Maine Lobster Foundation), David Sleeper (Spruce Head Fishermen's Cooperative), Bonnie Spinazzola (Atlantic Offshore Lobstermen's Association), Pat White (MeLA), 100+ commercial fishermen, and 15+ SMCC students

Summary:
The eMOLT project is a collaboration of industry, science, and academics devoted to monitoring of the physical environment of the Gulf of Maine and the Southern New England shelf. Low-cost strategies to measure bottom temperature, salinity and, most recently, surface current velocity have been developed with the help of nearly 100 lobstermen dispersed along the entire New England coast. The objective is to extend multi-year time series (as well as monitoring capabilities), continue integration with the Gulf of Maine Ocean Observing System (GoMOOS), and contribute to whatever operational systems are developed for our region in the future.

Having created this network of participating fishermen, the primary goal is to supply these individuals with the latest in low-cost instrumentation sufficient for maintaining continuous time series of physical variables at fixed locations and depths. As of January 2006, the database consist of 1.8 million hourly records of temperature, 80 thousand hourly records of salinity, and 50 thousand satellite drifter fixes. The mission is primarily motivated by lobster science and the need to document background conditions, but the database is accessible to the general public in the form of web served products and raw data (http://www.emolt.org).

The distribution of temperature and salinity probes in phases 1 and 2 is complete. In Phase 3, the eMOLT project set up a regional database network, so that project participants can enter, download, document, and view their data. In a quest to minimize instrumentation costs, eMOLT has partnered with both the Marine Science Department at the Southern Maine Community College and local engineers in the private sector. In Phase 4, gulf-wide surface current observations were made, documenting the degree of transport between

basins, and demonstrating the dynamic exchange of water masses. Devices have consequently been developed of interest to the oceanographic community. The first is a GPS drifter, at nearly a third the cost of conventional units that implements the SENS technology with the GLOBALSTAR low-orbiting satellite system. These units have already logged more than 50 thousand kilometers of ocean. Another is a real-time bottom temperature sensor (attached to lobster traps) that wirelessly transmits data to a shipboard system as it is hauled on deck. The drifters are now fully operational and being used by several other research groups but the wireless temperature sensor is still under development.

It is expected that the primary users of eMOLT data, aside from the lobstermen themselves, will be local ocean circulation modelers. The need for data in initialization, assimilation, and validation of their numerical simulations is becoming more and more obvious. The complex time-varying nature of the Gulf of Maine system calls for incorporating as much data as possible in order to generate realistic flow fields. The objective is to supplement the data supplied by GoMOOS by providing modelers with an extensive array of bottom observations as well as Lagrangian drifter tracks. The hope is that these numerical models will someday help in our understanding of particulate matter transport, such as lobster larvae drift and Harmful Algal Blooms, the mechanisms that govern both the short-term and long-term variability of the GoM ecosystem, and if realistic, time-varying, 3-d simulations of these changes can be generated. The eMOLT philosophy is that local fishermen already spend their days at sea, have the biggest stake in preserving our coastal marine resources, and are the most knowledgeable of the local waters. Their interest, curiosity, and enthusiasm are sincere. They should play an important part in our nation's Integrated Ocean Observing Systems.

The Northeast Consortium has facilitated a technical mail review of this project, the results of which were submitted to the New England Fishery Management Council and Atlantic States Marine Fisheries Commission in April 2007. eMOLT data has contributed to several articles for scientific literature (four published and several in preparation) and has continued with funding received from the Northeast Consortium in 2006.

Title:
Intensive study of the Western Gulf of Maine Closure Area

Funding:
2002 - $204,340

Participants:
Raymond Grizzle (University of New Hampshire), Jason Driscoll (F/V Karen Lynn; Exeter, NH), Mark Dowell (UNH), Peter Kendall (F/V Miss Alicia; Rye, NH), Michael Lesser (UNH), Greg Mavrikis (F/V Marion Mae; Eliot, ME), Larry Mayer (UNH), Rob Robertson (UNH), Andy Rosenberg (UNH), and Larry Ward (UNH)

Summary:
This project was an interdisciplinary investigation of ecological and social issues related to the Western Gulf of Maine (WGOM) closure area. It represented the initial stages of a longer-term program to determine various ecosystem-level impacts of the closure, and included gathering new and existing data from satellite imagery available on the web, multibeam sonar, direct sampling of the seabed, and public surveys. New maps are in production based on individual and combined datasets focused on a 400 km^2 (150 mi^2) study area located along the western boundary of the closure area. At the time of final report submission, all data had not been analyzed, but four major conclusions were drawn. (1) Habitat types ranged from mud bottom in deep water (>100 m) dominated by deposit-feeding infauna to hard bottom (gravel and boulders) in water <80 m dominated by epifaunal organisms. (2) Some bottom characteristics and benthic community characteristics correlated strongly with water depth, suggesting that the new multibeam bathymetry map can be used to construct high-resolution maps of bottom habitat types. (3) Maps of some benthic community characteristics had patterns indicating substantial differences when comparing sites within to similar sites outside the WGOM closure area. (4) Preliminary statistical analyses indicated significant differences for some infaunal and epifaunal benthic community characteristics for sites within the WGOM closure compared to similar sites outside. Conclusions 3 and 4 suggest that there has been dramatic recovery of some habitat types in the 8 years since establishment of the WGOM closure. Additional funds for the project were obtained from the NOAA/UNH Cooperative Institute for New England Marine Fisheries and Aquaculture.

Data has formed the basis of an article being written for publication in scientific literature. Funds to continue the research was received from the Northeast Consortium in 2003. Related projects focusing on rocky habitats in closure areas have also been funded.

Title:
Pilot project to test the use of side-scan sonar to identify seafloor features associated with pre-spawning and spawning cod aggregations

Funding:
2005 – $24,988
(PD Award)

Participants:
Kathryn Ford (Massachusetts Division of Marine Fisheries), Seth Ackerman (U. S. Geological Survey), Walter Barnhardt (USGS), Dan Blackwood (USGS), Olivia Free (Massachusetts Fishermen's Partnership), Chris Hein (Boston University), Bill Hoffman (MADMF), Hunt Howell (University of New Hampshire), Peter Marshall (F/V Venture; Essex, MA), Sam Novello (Commercial Fisherman; Gloucester, MA), and Mike Pol (MADMF)

Summary:
It has been hypothesized that cod aggregate on an annual basis in the winter time in the Cod Conservation Zone managed area in Massachusetts Bay. Research conducted by the Massachusetts Division of Marine Fisheries from December, 2005 to February, 2006 identified cod repeatedly in several specific locations. This data was corroborated by local commercial fishermen. The present study focused on determining if habitat characteristics were correlated to the site fidelity of cod. Using USGS multibeam datasets from the area and empirical information offered by commercial fishermen, sites with very similar habitats as measured by aspect, depth, and backscatter value but with contrasting cod site fidelity were identified. At these sites, correlations between cod presence and absence and seafloor characteristics (grain size, organic carbon content, and macrofauna) were analyzed using grab samples and still photos collected in June, 2006 aboard the F/V Venture. Cod were found at sites with significantly different habitats across the Cod Conservation Zone, but no seafloor features measured could be correlated to the presence or absence of cod.

This project contributed data to doctoral dissertation and was done in association with the USGS mapping of Massachusetts waters, which is a state-federal partnership. USGS provided equipment and personnel for this project.

Title:
PULSE: A cooperative partnership for pelagic ocean ecosystem monitoring in the western Gulf of Maine

Funding:
2001 - $400,000
2002 - $143,431

Participants:
Jeff Runge (University of New Hampshire), Erik Anderson (F/V Kris n' Kev; Portsmouth, NH), Jeremy and Karen Davis (F/V Karen Lynn II and F/V Chutzpah; Kittery, ME), Bud Fernandez (F/V Rhiannon Rae; Kittery, ME), Rebecca Jones (UNH), Peter Kendall (F/V Kelly Rose and F/V Elizabeth Ann; Rye, NH), George Littlefield (F/V Lady Regina; Kensington, NH), Craig Mavrikis (F/V Marion Mae; Eliot, ME), Portsmouth Fishermen's Cooperative, Dennis Robillard (F/V Julie Ann II; Eliot, ME), Lee Stevens (F/V Lynn Allison), and Alan Vangile (F/V Special K; Portsmouth, NH)

Summary:
This project demonstrates a successful partnership for a cooperative, industry-based contribution to monitoring of the pelagic ecosystem in the Gulf of Maine. The need for long-term biological data collection in the Gulf of Maine becomes critical in light of the potential for change in climate at both the regional and global scale. It is increasingly important for the fishing industry as decisions about fisheries management shift from a single or multi-species to an ecosystem-based approach. The final report describes the structure of the partnership and major results of a three year time series, between 2003-2005, of hydrographic and biological data from a fixed station at GoMOOS buoy "B" and on Jeffreys Ledge. This is the first recorded time series for the western Gulf of Maine showing both seasonal and interannual variability in phytoplankton and zooplankton biomass. It indicates a marked reduction of abundance of *Calanus finmarchicus*, a dominant Gulf of Maine planktonic copepod that is a primary prey for adult herring and the northern Right Whales, in 2004-2005, particularly in summer on Jeffreys Ledge. In addition to providing indicators of seasonal and interannual variations in abundance of plankton, the time series results serve fundamental data needs for coupled physical biological models investigating coupling between climate forcing, physical circulation and mixing, plankton production and recruitment processes in the western Gulf of Maine. Data has formed the basis of an article being written for publication in scientific literature. This project continues with funding from the Northeast Consortium in 2006.

Herring

Title:
Atlantic herring stock discreteness and migration: A coded microwire tagging pilot project in the Gulf of Maine

Funding:
2001 - $24,926 (PD Award)
2004 - $212,080

Participants:
Kohl Kanwit (Maine Department of Marine Resources), Mark Bichrest (F/V Jennifer and Emily), Danny Fill (F/V Western Venture), Steve Gough (F/V Western Wave), David Libby (MEDMR), Barry Matthews (F/V Ocean Venture), David Reingardt (F/V Thunder Bay; Wakefield, RI), and Alton West (Stinson 2000 Inc.)

Summary:
The project need was based on the lack of migration and spawning site data available for Atlantic herring in the inshore Gulf of Maine. The last tagging effort in U. S. waters occurred during the late 1970s and early 1980s. Since then, mobile gear fishing pressure on the inshore stock component increased, herring moved further from coastal waters, and the Georges Bank stock component recovered from its collapse in the 1960s. The pilot project funded by the Northeast Consortium in 2001 was designed to complement an existing tagging effort by using coded microwire tags to mark pre-spawning aggregations of herring on Jeffrey's Ledge in the Gulf of Maine. Coded microwire tags were first selected as the best option for tagging herring, because they are less invasive, result in high retention rates, and allow automated tag detection.

Field methods for obtaining live herring and tagging them with micro-wire proved successful. However, DMR began a review of the project after experiencing major difficulties with the tag recovery process. The conclusion reached by DMR, Stinsons 2001 Ltd., and various industry members after a full evaluation of the program was to abandon the microwire tagging project and initiate a more conventional anchor tagging program for Atlantic herring. The anchor tagging project began in the spring of 2003 with the Northeast Consortium funds and incorporated most of the equipment and expertise gathered from the work conducted in 2001-2002. The anchor tagging project began in the spring of 2003 through the sole support of the herring industry. This effort incorporated most of the equipment and expertise gathered from the work conducted in 2001-2002. Funding was awarded in 2004 by the Northeast Consortium for an expansion of the project in 2005 to include tagging on Georges Bank and Southern New England. Project partners continued work in 2006 using residual funds and industry contributions.

Results from this study reveal two major findings; Atlantic herring can be tagged and recovered in meaningful numbers in the context of a modern, mobile gear pelagic fishery pursued offshore and there is apparent and appreciable intermixing of the western portion of the Nova Scotian herring stock (4X) in both the Gulf of Maine and Southern New England. The first point is noteworthy, because tagging studies on the U. S. coastal complex of Atlantic herring using anything but weir caught fish have only realized limited results mostly related to short-term and short-distance migration patterns. The second point is an important finding, because the U. S. coastal complex and the Nova Scotian complex are currently assessed separately and any intermixing or straying between stocks is considered minimal and insignificant.

Title:
Commercial vessel acoustic survey of coastal herring spawning units

Funding:
2000 - $168,900
2001 - $130,215
2002 - $205,985
2003 - $198,180
2004 - $168,900
2005 - $192,919

Participants:
John Annala (Gulf of Maine Research Institute), Lendell Alexander (F/V Jennifer and Emily; Harpswell, ME), Brian Bichrest (F/V Safe Haven; Harpswell, ME), Mark Bichrest (F/V Jennifer and Emily; Harpswell, ME), Matthew Cieri (Maine Department of Marine Resources), Steve Gough (F/V Western Wave; Prospect Harbor, ME), Andrew Johnston (GMRI), Alden Leeman III (F/V Jennifer and Emily; Harpswell, ME), Cameron McLellan (F/V Adventurer; Newcastle, ME), Paul Morse (F/V Western Hunter; New Bedford, MA), David Reingardt (F/V Thunder Bay; Wakefield, RI), Shale Rosen (GMRI), Daniel Salerno (GMRI), Kevin Scheirer (GMRI), Patrick Sullivan (Cornell University), Joel Wezowicz (GMRI), and Philip Yund (GMRI)

Summary:
The temporal and special characteristics of spawning herring aggregations in coastal Gulf of Maine waters have been studied since 1998. The project has attempted to estimate the biomass of herring spawning in these waters to establish an index of spawning stock biomass. Surveys have been conducted from Cape Ann, Massachusetts to Cutler, Maine. Each year, techniques have been refined for implementing acoustic surveys and collecting representative biological samples on fishing vessels.

In March 2005, the Northeast Consortium funded and facilitated an independent peer review, which concluded that acoustic surveys are an appropriate way to survey herring in this area and recommended continuation of the project. It also recommended that future surveys focus on estimating biomass using a broad-scale systematic survey approach, as well as developing an annual "sentinel" acoustic survey of the important spawning grounds. Results of the peer review were presented to the New England Fishery Management Council and the Atlantic States Marine Fisheries Commission in May 2005.

Several project participants have sat on NEFMC Plan Development Teams and Advisory Committees for herring over the years and have contributed much empirical knowledge about the distribution and abundance of inshore herring to the management process. Prior to the peer review, data from the acoustic survey had been cited in SAFE (Stock Assessment and Fishery Evaluation) reports. Since the peer review concluded that the survey to date could not be considered a consistent time series of stock assessment data, the data has been used more qualitatively. The 2006 TRAC (Transboundary Resource Assessment Committee report discussed the use of "commercial acoustic survey biomass estimates" (GMRI acoustic survey data) as one of the three sources of information on relative proportions of the inshore and offshore components:

> *"The relative proportion of the inshore component of the overall herring stock complex was 18% based on the average proportion from three different data sources (commercial acoustic survey biomass estimates; morphometric studies; and NEFSC autumn survey swept biomass estimates)."*

Additional funds were secured from the Northeast Consortium in 2005. The peer review panel's recommendations were incorporated into the work, with surveys focused on identifying and quantifying "sentinel" spawning grounds. In fall 2006, the survey to monitored the location, timing and biomass levels of prespawning and spawning aggregations of Atlantic herring on Jeffreys Ledge and the associated nearshore area. Seven systematic parallel transect surveys were conducted and fish aggregations were sampled with a midwater trawl net to confirm species identification and to collect biological samples.

Herring were seen in all portions of the study area during most of the survey except on the northern portion of Jeffreys Ledge where no fish were encountered. Total biomass levels remained relatively low (8974 – 33,095 mt) from August through the end of October but increased three fold (99,488 mt) in early November. Prespawning biomass was highest in late August and early September and then dropped to nothing at the end of October. Spawning herring were first encountered in mid-September. Spawning biomass peaked in mid-October and dropped dramatically through early November. This survey was able to capture the complete spawning event. However, the low biomass levels encountered indicate that the area surveyed was not a key area for Atlantic herring spawning in 2006.

The Northeast Consortium is currently conducting a technical mail review of the FY2005 project.

Jonah Crab

Title:
A cooperative investigation towards an exempted trap to exclusively target Cancer borealis in Lobster Management Area 1

Funding:
2002 - $25,000
(PD Award)

Participants:
Carl Wilson (Maine Department of Marine Resources), Robert Alley Sr. (F/V Irene Renee II; Beals Island, ME), Brad Billings (F/V Bumps and Bruises; Stonington, ME), Thomas Lawson (F/V Katherine Louise; Southwest Harbor, ME), and Brent Oliver (F/V Jarsulan III; Stonington, ME)

Summary:
This project was designed to facilitate and monitor the performance of an Experimental Fisheries Permit (EFP) to be issued to 1000 lobster harvesters in Lobster Management Area 1. The EFP allows participants to develop a targeted Jonah crab trap designed to reduce or eliminate lobster bycatch. The Maine Department of Marine Resources believes it is important to increase our understanding of Jonah crabs, *Cancer borealis*, and assess the potential for a targeted trap. The project has demonstrated the development of a Jonah crab specific trap, monitored EFP activity in Lobster Management Area 1, collected detailed biological information on Jonah crabs and positioned the State of Maine, Atlantic States Marine Fisheries Commission and NOAA Fisheries to make informed decisions on the utility of a directed crab trap and/or fishery.

The results of this research formed the basis of a graduate thesis and an article in preparation for publication in scientific literature. The Northeast Consortium has facilitated a technical mail review of this project, the results of which were submitted to the Maine Department of Marine Resources in March 2007.

Title:
Distribution and abundance of Jonah crabs, Cancer borealis, in the near-shore Gulf of Maine

Funding:
2002 - $128,371

Participants:
Carl Wilson (Maine Department of Marine Resources), Yong Chen (University of Maine), Larry Knapp (F/V Lady Esther; Boothbay, ME), Oscar Look III (F/V Mary Lou and Kendra; Beals Island, ME), Brian McLain (F/V Silver Bullet; New Harbor, ME), Brent Oliver (F/V Jarsulan III; Stonington, ME), Kathleen Reardon (MEDMR), Rob Russell (MEDMR), Stanley Sargent (F/V Gale Warnings; Milbridge, ME), and Art Vuilleumier (F/V KEEP-AH; South Portland, ME)

Summary:
Jonah crab (*Cancer borealis*) has been a traditional and unregulated by-catch of the Maine lobster industry. Little is known about adult *C. borealis* biology and ecology, making the development of assessment and management approaches difficult. Much of the information available on the distribution and abundance of this species was gathered from bottom trawl surveys. Unknown gear selectivity of these survey programs with respect to crabs, and associated gear limitations in complex habitats make interpretation of these results problematic. In the spring of 2004, the Maine Department of Marine Resources collaborated with fishermen to complete an experimental video survey in the nearshore Gulf of Maine. Complex bottom habitat, shallow water, eastern survey locations, and season all contributed to the distribution patterns observed. Abundance estimates from the video survey are confounded by the relatively small area sampled at each location. The relative abundance and spatial distribution patterns of this survey did not agree with other surveys conducted in Maine inshore waters, due to the strengths and weaknesses of each survey. There remains a need to accurately document the patterns of distribution and abundance of crabs within the Gulf of Maine. Continued development of a video survey remains a likely candidate, as this methodology allows surveying of complex bottoms at depth. However, problems with area surveys and levels of detection in complex bottom should be resolved first.

The results of this research formed the basis of a graduate thesis and an article in preparation for publication in scientific literature. The Northeast Consortium has facilitated a technical mail review of this project, the results of which were submitted to the Maine Department of Marine Resources in March 2007.

Lobster

Title:
Are we using herring to farm lobsters? The effect of herring bait on lobster growth and the fate of discarded bait on bottom habitat

Funding:
2001 - $111,972

Participants:
Jonathan Grabowski (Gulf of Maine Research Institute), Erika Clesceri (GMRI), Sherman Kinghorne (Grand Manan Fishermen's Association; New Brunswick, Canada), Mike Myrick (F/V Shannon Rose; Cushing, ME), Phil Poland (F/V Charlene Gail; Cushing, ME), Laura Taylor-Singer (GMRI), Matthew Weber (F/V Griffin; Monhegan Island, ME), Phil Yund (University of New England), and Carl Wilson (Maine Department of Marine Resources)

Summary:
In order to assess the effects of herring bait on lobster population dynamics, diet composition (stomach content analyses), tissue production (nitrogen stable isotope ratio analyses), and growth (mark-recapture experiments) of large (66-83 mm CL) and small (45-65 mm CL) sublegal lobsters, lobsters were sampled in seasonally closed sites around Monhegan Island and fished sites around Georges Islands in mid-coast Maine during the summer and fall of 2002 and 2003. Collectively, the results support the notion that herring bait may be very important for lobster population dynamics in the Gulf of Maine, and therefore, the contribution of herring bait should be considered when developing management policies that affect fishing effort.

The Northeast Consortium has facilitated a technical mail review of this project, the results of which were presented to the Atlantic States Marine Fisheries Commission in December 2006. Data has formed the basis of an article being written for publication in scientific literature.

Title:
Implementation of an automated, comprehensive monitoring program for the Atlantic offshore lobster fishery

Funding:
2001 - $111,104
2002 - $129,939

Participants:
Win Watson (University of New Hampshire), Paul Bennett (F/V Hedy Brenna; Newport, RI), Denny Colbert (F/V Virginia Marie; Sandwich, MA); Bro Cote (F/V William Bowe; Hyannis MA), Nick Jenkins (F/V Eulia McGrath; Newington, NH), Marc Palombo (F/V Terri-Ann; Sandwich, MA), David Spencer (F/V Nathaniel Lee; Newport, RI), and Bonnie Spinazzola (Atlantic Offshore Lobstermen's Association)

Summary:
The overall goal of this project is to develop a monitoring program for the offshore lobster fishery, which encompasses an area extending from waters off the Gulf of Maine to Hudson Canyon. Specifically, the project is designed to: 1.) determine the size frequency distribution of lobsters caught in offshore lobster traps; 2.) map the distribution and abundance of berried females captured offshore; 3.) map the temporal and spatial patterns of shell disease in lobsters captured offshore; 4.) measure the size at maturity of female lobsters captured offshore and determine if there is a spatial pattern that is correlated with water temperature; and 5.) make management recommendations, at the end of the study, based upon the data obtained.

Results indicate that there are large differences in the size frequency distributions of lobsters captured throughout Area 3. There is a higher abundance of berried females with new eggs in the fall, both in the middle and the northern areas. However, the abundance is much greater in the north. While lobsters with late stage eggs are observed throughout the year in the middle canyons, they are rarely observed in the northern basins. This suggests that they may migrate up onto George's Bank to incubate and release their larvae during certain times of the year. The prevalence of shell disease has been extremely low in the study areas to date. Size at maturity data clearly showed that female lobsters in the northern portion of the fishery do not reach sexual maturity until ~ 93 mm carapace length.

Project data has formed the basis of four articles in scientific literature (two published and two under review). The project continues with additional funding in 2003 from the Northeast Consortium.

Title: *Influence of water temperature on the distribution of berried females and duration of egg development in American lobsters*

Funding: 2004 - $275,509

Participants:
Win Watson (University of New Hampshire), Diane Cowan (The Lobster Conservancy), Jason Goldstein (UNH), Bonnie Spinazzola (Atlantic Offshore Lobstermen's Association), Michael Tlusty (New England Aquarium), nine graduate and undergraduate students (UNH), and 24 commercial lobstermen from Maine to Rhode Island

Summary:
The continued success of the North American lobster fishery is largely attributed to a high degree of broodstock conservation through the preservation of berried (egg-bearing) females. The goal of this study is to test the hypothesis that berried lobsters undertake seasonal migrations, moving offshore during colder months and inshore during warmer months, in order to expose their eggs to a thermal regime that optimizes egg development and maximizes the survival of larvae. Berried lobsters were tagged, released, and monitored for both their movements and thermal history. All field studies were carried out in cooperation with commercial lobstermen who fished in NH, Maine and offshore waters.

Initial results of large-scale tracking from two seasons combined indicates a trend by some inshore lobsters in maximizing degree days by moving short distances (5-10 km) offshore where eggs are subject to minimal degree days below 4°C, a physiologically restraining temperature for positive egg development. In contrast, a select number of large female lobsters (>100 mm CL) appear to be moving larger distances (>15 km) from inshore to offshore locations in an overall south-southwest direction. These initial results confirm that lobster movements do influence the temperatures experienced by developing eggs. Ongoing data analyses coupled with current ultrasonic tracking laboratory studies should help determine the extent to which large movements actually enhance egg development and larval survival.

The Northeast Consortium is currently conducting a technical mail review of this project.

Title: *Inshore/offshore patterns of lobster larvae and postlarvae spatial relationships*

Funding: 2001 - $142,453

Participants:
Lew Incze (University of Southern Maine/Gulf of Maine Research Institute), Mathew Thomson (F/V Shearwater; Monhegan Island, ME), and Proctor Wells (F/V Tenacious; Phippsburg, ME)

Summary:
This project involved two field sampling efforts. The first was a two-year (2001-2002) study of the distribution, stage composition and abundance of lobster larvae and postlarvae and hydrography from the central coast of Maine to the Canadian border. Eight survey transects, conducted over a 2+ week period in the middle of the larva/postlarval season, went across-shelf from near shore to approximately the 150 m (82 fln) isobath, crossing three hydrographic and current regimes: the inner shelf or near-shore; the Eastern Maine Coastal Current (EMCC); and the stratified offshore. The objective was to understand the contribution that each area might make to lobster recruitment, both temporally and spatially. For example, the EMCC seems to move early life stages down to the central coast: how many, and where do these end up settling? How important is this compared to other processes driving postlarval abundance in that region? How many move offshore? A series of hypotheses dealing with the three regimes can be partially addressed by the survey design. The second sampling effort was directed at larval and postlarval production estimates along the central coast of Maine, immediately west of the surveys described above. This one-year effort involved a season-long study of all stages that complemented a preliminary study done in 2000. The study found that the settled abundance of Young-of-Year lobsters is determined to a significant degree by the abundance and delivery of postlarvae to appropriate settlement habitats. Settlement densities and the productivity of the lobster fishery in Maine are distinctly different east and west of Penobscot Bay. The research is helping understand the mechanisms behind those differences. Project data has formed the basis of one article published in scientific literature. More specific research has continued on egg production, circulation modeling, settlement, growth, and fisheries production. It is conducted by L. Incze and ten co-PI's and is funded by NOAA Fisheries Coastal Ocean Program.

Title:
Mapping spawning and hatching grounds of the American lobster

Funding:
2002 - $260,000
2004 - $105,175

Participants:
Diane Cowan (The Lobster Conservancy), Andrew Solow (Woods Hole Oceanographic Institution), Win Watson (University of New Hampshire), and 15+ commercial lobstermen from Friendship and Monhegan Island, ME

Summary:
The purpose of this study was to investigate the relationship between temperature, movements, and body size for ovigerous (egg-bearing) lobsters tagged recently after spawning and tracked throughout the 9-13 month brooding period. We made predictions about where and under what temperature conditions small (< size at 50% maturity) versus large (≥ size at 50% maturity) lobsters would brood. It was found that although small female lobsters were abundant in Muscongus Bay, most were not ovigerous. Small ovigerous lobsters tended to spawn and remain inside the bay where they brooded at lower winter, but higher spring and summer temperatures than large ovigerous lobsters. In contrast, large ovigerous lobsters (≥size at 50% maturity) were relatively rare, but most were ovigerous. They tended to spawn at greater distances from shore and while many stayed near where they spawned, others achieved a maximum displacement of up to 240 km. Large ovigerous lobsters were at more moderate temperatures throughout the year regardless of how far they traveled. Both small and large ovigerous lobsters experienced (1) sufficiently low winter temperatures for successful ovarian maturation, and (2) approximately the same number of degree days for egg development. These findings suggest that known thermal requirements of optimal cold temperature for successful ovarian maturation are balanced with sufficient numbers of degree-days for egg development via two distinct behaviors. Small ovigerous lobsters remain in shallow water where they experience colder winter but warmer spring and summer temperatures than large ovigerous lobsters that move to deeper water with warmer winter but colder spring and summer temperatures.

The Northeast Consortium facilitated a technical mail review of this project, the results of which were submitted to the Atlantic States Marine Fisheries Commission in January 2007. Project data has formed the basis of two articles in scientific literature (one published and one in press).

Title:
Relationship between traps, effort, and fishing mortality in the Maine lobster fishery: Manipulative experiments in the Monhegan Lobster Conservation Area

Funding:
2003 - $25,000
(PD Award)

Participants:
Carl Wilson (Maine Department of Marine Resources), Robert Bracy (F/V Pandora; Monhegan, ME), Mathew Thomson (F/V Shearwater II; Monhegan, ME), and Matthew Weber (F/V Griffin; Monhegan, ME)

Summary:
Four experimental trapping areas were established within the Monhegan Lobster Conservation Area (MLCA) to determine how the number and spatial arrangement of traps affects catch rates and fishing impacts. The number of traps and size of the experimental areas were designed to determine the joint effects of trap density and the aerial extent of fishing on lobster catch rates, population depletion, and mortality. High trap density areas significantly lowered the catch rates as compared to low density areas. The cumulative catch was higher in high trap density areas than low density areas over the course of the experiment, yet gross economic gains were largely offset when expenses were factored in. Methodologies were successfully developed that allowed accurate and high resolution quantification of the impacts of removals by lobster traps in discrete experimental sampling areas. Recaptured lobsters were easily identified by daily batch tags, and provided reliable estimates of recapture through the course of the experiment. This project development award lead to the application of the methodologies to a larger experiment within the MLCA, funded by the Northeast Consortium in 2004. This involves seven fishermen and 1,500 traps placed at different densities in eight 1 km^2 experimental areas. The work will benefit lobster management in the future, as we begin to understand how trap increases or reductions could impact the lobster population and associated fishery.

Title:
Testing a method to evaluate deepwater settlement of the American lobster

Funding:
2004 - $25,000
(PD Award)

Participants:
Rick Wahle (Bigelow Laboratory for Ocean Sciences), Rich Crowley (Bigelow), John O'Leary (F/V Captain Bligh; Wakefield, RI), Matt Parkhurst (F/V Sea Spray; Boothbay Harbor, ME), Carl Wilson (Maine Department of Marine Resources)

Summary:
The overall aim of this development project was to evaluate the feasibility and effectiveness of lobster postlarval collectors for eventual use in deep water and in areas otherwise unsuitable for diver-based sampling. Two experiments were conducted in which collectors were deployed in shallow water to evaluate their performance. The first involved artificially seeding collectors with known numbers of postlarval lobsters to determine whether there would be significant loss of settlers during retrieval. We found no difference in the number of lobsters retrieved between collectors that were covered and not covered prior to haul-back. We conclude from this experiment that it will be unnecessary to devise a mechanism that will cover the collectors prior to haul back. The second experiment was designed to determine whether the density of settlers in collectors was comparable to the density in immediately adjacent natural cobble nursery sites sampled by divers. We found that on average, collectors allowed to accumulate settlers for the entire larval season (late July-October) were populated by as many settlers as an equivalent area of natural cobble habitat nearby. The collectors were also populated by juvenile crabs and fishes through both larval settlement and immigration along the bottom. Having conducted this pilot study, we believe the collectors are an appropriate tool to assess settlement in deep waters and other areas inaccessible to divers. This project continues with funding from the Northeast Consortium in 2006.

Title:
Ventless Trap Survey (VenTS)

Funding:
2003 - $13,513
(PD Award)

Participants:
Patrice McCarron (Gulf of Maine Lobster Foundation), Erin Pelletier (GoMLF), and 47 lobstermen from Maine and Massachusetts

Summary:
The Ventless Trap Survey (VenTS) was established in Canada and the United States in 2000, to develop a low cost fishery independent index of juvenile lobster abundance that could be used as a predictive tool to help manage the lobster fishery and that directly involves the industry in data collection. Specifically, it is a trap-based sampling program conducted by volunteer lobstermen year-round in the Gulf of Maine and Atlantic Canada. The Gulf of Maine Lobster Foundation (GoMLF) manages the U.S. portion of the project. The purpose of this Northeast Consortium development project was to standardize the U.S. portion of VenTS with Canada, to expand our outreach and to recruit additional U.S. participants. The standardization was successful and the international relationship with Canadian scientists and fishermen is continuing. The level of participation in the U.S. has increased and more participants are recruited each season. The data collected through the VenTS has been used to derive fishing exploitation rates in Canada and in the most recent Canadian stock assessment. Results indicate that ventless traps are an excellent tool for monitoring juvenile abundance. The U.S. portion of VenTS has produced a 5-year time series of data that shows the overall trend in sublegal lobsters has decreased from 2000 to 2004. A comparison of the juvenile component of the catch from the VenTS project (fishery-dependent) with juvenile abundance indicators from the Maine-New Hampshire Inshore Trawl Survey (fishery-independent) indicated that VenTS and trawl survey data are highly correlated. This positive association affirms the significance of the VenTS results and the need to continue with this cost effective and low-impact study of the juvenile lobster population.

Ocean Quahog

Title:
Gulf of Maine ocean quahog (Arctica islandica) assessment

Funding:
2001 - $23,326

Participants:
Dan Schick (Maine Department of Marine Resources), Scott Feindel (MEDMR), and Kristan Porter (F/V Whitney and Ashley; Cutler, ME)

Summary:
In the spring of 2002, an industry-collaborative pilot survey was conducted of Maine's quahog resource. Base-line information was collected to begin to establish a biological basis for quota allocation. Objectives were to map the species' distribution to the 50-fathom depth contour and to obtain population structure, length-weigh, relative abundance data, and bycatch information. Work included a stratified random survey of the three management zones where fishing is currently allowed (225 stations), a systematic survey of the main known beds between Cross Island and Petit Mann Island (46 stations), and a descriptive survey of an historically fished area in Passamaquoddy Bay (23 stations). Six permanent stations were also established to track temporal trends. Few small patches of quahogs were discovered at random stations beyond known historically fished areas, but juvenile animals (<20 mm) found at some previously fished sites indicated at least some recent recruitment. The Gulf of Maine population was characterized by younger and potentially slower growing clams compared to populations found in commercially fished beds off southern Massachusetts and the Mid-Atlantic. Preliminary estimates of stock abundance were made. Parameter estimates and the distribution map obtained from this research will allow future surveys to be optimized. It was determined that a dredge-efficiency study was needed before an absolute biomass for the resources could be calculated.

The research has continued with funding from a tax dealers pay on each bushel of quahogs that they purchase. This includes additional surveys of the stock of quahogs and research on dredge efficiency, data from which is being used in conjunction with NOAA Fisheries data in a current cooperative assessment of the status of the stock of ocean quahogs. This has given Maine an active role in the management of this stock. The Northeast Consortium facilitated a technical mail review of this project, the results of which were submitted to the Mid-Atlantic Fishery Management Council in September 2006.

Red Crab

Title:
Developing stock assessment methods and evaluating beam-trawls in stock assessment surveys of the New England deep sea red crab fishery

Funding:
2001 - $113,000
2002 - $24,928 (PD Award)
2003 - $274,132

Participants:
Richard Wahle (Bigelow Laboratory for Ocean Sciences), Yong Chen (University of Maine), and Jon Williams (Benthic Fishing Corp.; Westport Island, ME)

Summary:
The four main objectives of this project were to: (1) Employ camera-based and net-trawl sampling methodology established by an earlier NMFS red crab surveys (Wigley et al. 1975) to determine whether abundance, size structure, and sex composition of the population has changed significantly at the same sites sampled in 1974, (2) Conduct sea sampling to better characterize the commercial catch, (3) Conduct tagging to obtain much needed information on red crab growth rates and movement, and (4) Develop three stock assessment modeling approaches of different complexities (size-structured yield-per-recruit model, production model, and size-structured simulation model) to evaluate the dynamics of the red crab stock, estimate current status of the fishery, and evaluate alternative management strategies. Supplemental project development support was used to compare the efficacy of otter-trawl to beam trawls in this application.

The camera and otter trawl collections generated the first population density estimates and demographic data of red crab in 30 years. The supplemental comparison of the two net trawl methods confirmed that otter trawls were the most efficient approach in these surveys. Results of the main project indicated that the

abundance of the largest crabs (males >114 mm, 4.5 inches) targeted by the fishery is down by approximately 42% since 1974. Based on at-sea sampling by the commercial fishing crew, the fishery now harvests smaller male crabs, and our camera/net surveys estimate that the standing biomass of crabs of this size is on a par with 1974 levels. The abundance of even smaller males and females is estimated to be substantially higher than in 1974. Some 9600 crabs were tagged over the course of the study, and of about 300 returns there was little evidence of growth, which is consistent with prior evidence of slow growth for this species. However, the limited growth data curtailed application of the stock assessment models. The full parameterization of these models awaits additional growth data. Models are implemented as Excel spread sheets that and are available from the PI, and will be easy for the user to update as data become available.

These results were a key component of the NMFS red crab stock assessment conducted in 2006, the first full assessment for this species since 1977. The project director led the writing of stock assessment report with the assistance of NMFS and NEFMC staff. Project results also form the basis of articles in preparation for publication in the scientific literature.

Scallop

Title:
A new role for the commercial fishing fleet in monitoring, predicting, and managing sea scallop resources

Funding:
2000 - $135,000

Participants:
Scott Gallager (Woods Hole Oceanographic Institution), Cabell Davis (WHOI), Arnie DeMello (F/V Kathy Marie; New Bedford, MA), John Doran (F/V Amy Philbrick; Newington, MA), Alan Kuzirian (Marine Biological Laboratory), Grant Moore (F/V Direction; New Bedford, MA), John Quinlan (NOAA Fisheries Northeast Fisheries Science Center), Paul Rosonina (Captain, F/V Kathy Marie; New Bedford, MA), and Richard Taylor (Commercial Fisherman; Gloucester, MA).

Summary:
The primary goal of this project was to integrate real-time data collection and transmission technologies into the commercial scallop fishing fleet for the purpose of identifying scallop larvae in the plankton and in oceanographic features where larvae aggregate in high numbers. The Larval Identification and Hydrographic DAta Telemetry package (LIHDAT) was constructed and installed aboard commercial fishing vessel Kathy Marie of New Bedford, MA. Data was collected from the vessel intake water during the course of fishing trips, with hourly averages transmitted to shore via the vessel's satellite VMS system and plotted on a project website. Novel approaches to optically identifying bivalve larvae were developed using polarized light comparing the birefringence of shell patterns of various shellfish species, with positive identification in the 90% range, significantly better than results obtained from a trained human observer. A gonadal/somatic index was developed through field sampling over the course of the project, critical for identification of exact scallop spawning time. Finally, spat collectors were deployed in three locations on Georges Bank to begin study of larval concentration and disbursement. Scallop juveniles in retrieved bags averaged 3,500 per bag at 8 mm after six months. Molecular techniques were applied to determine utility in identification of sub-populations. This project has received further funding from several sources. The instrument has received several upgrades to both hardware and software and is now fully portable and in regular use aboard R/V Tioga.

Title:
Development of an off-bottom scallop drag

Funding:
2002 - $12,200
(PD Award)

Participants:
David Autio (Commercial fisherman; Medomak, ME), Phil Averill (Ocean Adventure, Inc.!; Bristol, ME), Scott Feindel (Maine Department of Marine Resources), Frank Genthner (Commercial fisherman; New Harbor, ME), Nate Hannah (Round Pond, ME), Larry Holmes (Bristol, ME), Robert Russell (MEDMR), and Kevin Varney (Sheepscott, ME)

Summary:
This project aimed to develop a scallop drag which catches scallops, but reduces the impact of the gear on the bottom. It used a new concept involving a hydrodynamic wing that causes a turbulent lifting force behind it as it is towed over the bottom. The catch is lifted into a solid cage rather than a ring bag. The whole rig rides on skis, which are the only part that touches the bottom. Everything else is at least 3" off the bottom. Eighteen tows were made with the gear over two days in shallow (8-10 fathom) water on a known scallop bed. Diver and video observations were made of drag performance. Some scallops were caught, but

comparative tows later showed the wing drag to be much less efficient in harvesting scallops than was expected. One offshore test showed that significantly more weight would need to be added to the rig to keep it on the seafloor. Modifications were made after underwater video and diver observations, but did little to improve scallop harvest. Participants hope that more research on hydrodynamic scallop gear will occur in the future.

Title: *Field trials of 4" rings in the inshore scallop fishery of the Gulf of Maine*

Funding: 2003 - $92,932

Participants:
Dana Morse (Maine Sea Grant), Robert Holland (F/V Double J; Jonesboro, ME), and Steve Patryn (F/V Northern Eagle; Jonesboro, ME)

Summary:
In November of 2003, a project in eastern Maine coastal waters evaluated the selectivity of 4" (101.6 mm) diameter rings used in a scallop drag, as compared to a drag rigged with the regulation-sized 3.5" (88.9 mm) rings. The objective was to examine the utility of larger rings with respect to a recent state regulation that increased the minimum landing size from 3.75" to 4.00" shell height (SH). The fieldwork used side-by-side tows by two fishing vessels and a paired tow analysis. Experimental and control drags were switched between vessels each day. Data collection included catch volume of scallops and other species, scallop shell heights, location, and bottom type. After ten fishing days, a significant loss of scallops was observed with the larger rings. A lesser difference also existed for urchin catch volumes. No differences were detected for lobster, sea cucumber or rubble. Loss of legal scallops, when judged at the regulated SH of 4.00" was 3%. Sub-legal scallop catches were reduced by 25.5%. Tests in deeper waters need to occur to understand selectivity patterns more fully. Results have been distributed to industry members, Maine DMR, the Northeast Consortium and others. Video clips, photos and the final report are available from the Maine Sea Grant web site: http://www.seagrant.umaine.edu/extension/fisheries/scalring.htm.

The Northeast Consortium has facilitated a technical mail review of this project, the results of which were submitted to the New England Fishery Management Council in May 2007.

Title: *Maine scallop fishery: Monitoring and enhancement*

Funding: 2001 - $207,411

Participants:
Dan Schick (Maine Department of Marine Resources), Marsden Brewer (Commercial fisherman; Stonington, ME), Wallace Gray (F/V Foxy Lady; Stonington, ME), Scott Fiendel (MEDMR), Dana Morse (Maine Sea Grant), Craig Pendleton (Northwest Atlantic Marine Alliance), and several other scientist and commercial fishermen.

Summary:
The concern over the steady decline of scallop landings in Maine since the early 1990's and the uncertainty of other fisheries pointed to a need for a dedicated assessment program for inshore scallops in the Gulf of Maine. There has also been an interest in restoration and industry efforts to adapt stock enhancement technology for this public resource called for participation and support from the Maine Department of Marine Resources. The positive focal point of enhancement further set the stage for this industry/science collaborative project, which sought to design and implement a suite of monitoring programs including port and sea sampling and a fishery-independent survey. Methodology for these monitoring efforts were honed and evaluated. Baseline data were collected to better document the current fleet and fishing practices and to characterize the resource in terms of spatial patterns in size structure, meat yield, relative abundance, catch per unit effort, recruitment, habitat, and associated fauna. These data are especially pertinent in light of newly enacted regulations in the scallop fishery. This work culminated in an ongoing research program supported by the Maine Scallop Research Fund (supported through annual licensed fees) and an industry-led advisory council to oversee the fund. A Geographic Information Systems database has been initiated of suitable spat collection areas. Scientific support for enhancement activities is being provided, including evaluation of reseeding in the form of diver surveys, tagging, and outreach. The scallop survey has continued, with enhancement efforts and port and sea sampling activities. The fund sponsored an international scallop enhancement workshop in February 2005 held in Ellsworth, ME to lay the foundation for next steps in scallop enhancement along the Maine coast.

The Northeast Consortium facilitated a technical mail review of this project, the results of which were presented to the New England Fishery Management Council in August 2006. Project data has formed the basis of an abstract published in scientific literature.

Title:
Non-invasive, real time assessment of sea scallop abundance and habitat

Funding:
2001 - $220,000

Participants:
John Howland (Woods Hole Oceanographic Institution), Arnie DeMello (F/V Kathy Marie; New Bedford, MA), Scott Gallager (WHOI), Harlyn Halvorson (University of Massachusetts, Boston), Paul Rago (NOAA Fisheries Northeast Fisheries Science Center), Paul Rosonina (Captain, F/V Kathy Marie; New Bedford, MA), Hanumant Singh (WHOI), Ron Smolowitz (Fisheries Survival Fund), Richard Taylor (Commercial Fisherman; Gloucester, MA), and Page Valentine (United States Geological Survey).

Summary:
This project was designed to develop new optical imaging technologies to collect data on the abundance and distribution of scallop populations and scallop habitat structure. A prototype imaging sled was built and tested to photograph benthic fauna and flora and their habitat with sufficient spatial resolution to identify species, substrate composition, and distribution. Image and other data outputs from the towed vehicle were networked to the vessel wheelhouse via the fibreoptic tow cable, allowing for both realtime processing and adaptive sampling. One of the key issues addressed by this new imaging technology is the examination of appropriate sampling scale(s) for scallop populations in order to improve the precision of population estimates. It is especially useful to identify the pattern of variance associated with "quadrats" of varying size along the continuous ribbon-like mosaic. This has important implications for the estimation of precision for the NOAA Fisheries scallop survey. With contiguous blocks of samples, we can determine if the variance of density from quadrat samples was relevant to the estimation to the total and what the cost (i.e. number of samples and vessel time for survey) is to estimate the true density and variance. This has important implications for the interpretation of catch data from commercial vessels. The funding from the Northeast Consortium was to develop the hardware necessary to acquire high resolution images of the sea floor deployed from a commercial fishing vessel. The next phase is to assemble proposals to a variety of agencies to develop the software tools for target identification, mosaicing, and automated classification of substrate.

This project has received additional funding from several sources, including the Scallop Research Set Aside (NEFMC/NMFS/Industry) for both hardware and software development. An advanced version is currently (Jan 2006) in use aboard F/V Kathy Marie along the US Atlantic coast producing ~1 terabyte of imagery each day of operation. See http://www.seascallop.com/HabCam.html. Another instrument is being built for use in the Alaska scallop fishery.

Title:
Saco Bay scallop stock assessment

Funding:
2002 - $25,000
(PD Award)

Participants:
Craig Pendleton (Northwest Atlantic Marine Alliance), Heather Deese (NAMA), Scott Feindel (Maine Department of Marine Resources), Dana Morse (Maine Sea Grant), Dan Schick (MEDMR), Steve Zeeman (University of New England), and 20+ commercial fishermen

Summary:
Sea scallop (*Placopecten magellanicus*) occurred in more places and in greater numbers in Saco Bay in recent decades than they do now and supported a substantial fishery. In an attempt to rebuild a productive fishery, Saco Bay fishermen teamed with state agencies, Sea Grant, university scientists, and Northwest Atlantic Marine Alliance staff in 2000 to undertake wild scallop stock enhancement efforts in the Bay. Fishermen and scientists working together proved that they could collect wild scallop juveniles ("spat") in large numbers ($>10^6$) in netron-stuffed bags set from fall through spring in the Bay. The 6-9 month old scallops were seeded in currently or previously productive scallop beds. The Northeast Consortium-funded project began in March 2002, building on two years of spat collection and reseeding focused on learning about survival of seeded spat. Methods included environmental monitoring, observation of seeded spat in a variety of locations and conditions, and an intensive field study investigating the influence of migration and predation on spat survival immediately after reseeding. Results indicate surprisingly high spat mobility, surprisingly low interaction with predators within enclosures (starfish), and the importance of habitat type. Beyond technical results, the project was highly successful in bringing more fishermen into research and management processes and building meaningful partnerships and knowledge exchange between fishermen and local scientists.

Sea Cucumber

Title:
An evaluation of the Maine Sea Cucumber (Cucumaria frondosa) resources and impacts of exploitation

Funding:
2002 - $25,000 (PD Award)
2003 - $165,645

Participants:
Yong Chen (University of Maine), Peter Collin (Coastwide Bio Resources; Stonington, ME), Scott Feindel (Maine Department of Marine Resources), Elena Gudimova (Murmansk State University, Russia), Sheril Kirshenbaum (UMaine), David Leach (Commercial Fisherman; Steuben, ME), Russell Leach (Commercial Fisherman; Steuben, ME), Drusilla Ray (Cherry Point Products; Milbridge, ME), and Lawrence Ray (F/V Eugenia II; Milbridge, ME)

Summary:
This project fills a much needed information gap on the sea cucumber, which is an emerging fishery in Maine. The fishery began in 1988, but started expanding in 1994 when Asian markets opened up. There was little knowledge about the key life history processes that determine the population dynamics of the sea cucumber and limited data on the fishery and population. Sea cucumbers are unique in morphology, behavior, and biology relative to other commercially harvested species. A standardized procedure was therefore needed for collecting data and measuring biological characteristics.

Using the approaches developed with the support of the NEC Project Development Award, cooperative research was conducted to (1) survey the sea cucumber resources in major sea cucumber fishing grounds along the coast of Maine; (2) collect biological information of the Maine sea cucumber population; (3) evaluate the impacts of exploitation on the sea cucumber population by conducting a before- and after-fishing comparative study. Through cooperative research, both fishermen and scientists participated in a large-scale survey of the population from 2005 to 2007 in Frenchman and Narraguagus Bays, which yielded more than 90% sea cucumber landings in Maine.

The survey suggests that rock bottom appeared to be the most favorable habitat for the sea cucumber in the survey area and that exploitable stock biomass varied with depth, with sea cucumber more abundant in the shallow waters (< 20 meters). Stock biomass decreased substantially from 2005 to 2006, but was stable from 2006 to 2007. No clear pattern was observed between the experimental plot and control plot for the soft substrates. For the hard substrates, the number of sea cucumber in the experimental plot tended to increase with the time after the dredging depletion in the BACI experiment, suggesting the recovery of sea cucumber density after dredging. This study suggests that the major spawning event of sea cucumber occurs from January to March, but minor spawning events may also occur in other months. Differences in water temperature among different depths and seasons may account for differences in gonad development at different depths.

This project is the first one in this area that systematically studies the sea cucumber biology and fishery. The Maine Department of Marine Resources is developing management plan for the fishery using project information. This project has already had real and significant impacts and will have significant long-term impacts on the management of the sea cucumber fishery in Maine.

A graduate thesis and three articles for scientific literature (one on press, two in preparation) have been produced from this project.

Sea Urchin

Title:
A simulation framework for developing optimal sampling strategies for the Maine sea urchin stock

Funding:
2001 - $23,920 (PD Award)

Participants:
Yong Chen (University of Maine), Robert Grabowski (UMaine), Margaret Hunter (Maine Department of Marine Resources), and Robert Russell (MEDMR)

Summary:
A pilot study for the annual fishery-independent survey program for the green sea urchin fishery was initialized in Maine in the summer of 2001. The high degree of spatial variability in sea urchin abundance, however, prevented using standard optimization techniques, such as traditional statistics or even geostatistics. Northeast Consortium funding was then sought to conduct kernel estimation and computer simulations to characterize the large-scale spatial density structure of the sea urchin population and investigate how different sampling strategies effected realizations of density structure. Since realizations of the large-scale density structure are vital components of the sea urchin stock assessment, any changes in this structure would dramatically alter the outcome of the assessment. Therefore, an optimal sampling strategy was defined that produces realizations of the large-scale spatial structure that are similar to the original population while using less sampling intensity than the original sampling strategy. Considering that the sea urchin data will be analyzed by traditional and spatial statistics, reducing the original stratified random sampling design to 10 locations per strata is the most sensible optimization for the Maine green sea urchin fishery-independent survey at this time.

Title:
Testing the effectiveness of various escape panel configurations on urchin drags

Funding:
2004 - $31,509

Participants:
Margaret Hunter (Maine Department of Marine Resources), Andrew Gowen (Independent Consultant, New Castle, ME), and Steve Patryn (F/V Northern Eagle; Jonesboro, ME)

Summary:
Escape panels have been required on sea urchin drags in Maine since 2003, but there has never been any quantitative testing of their effectiveness in releasing small (sublegal) sea urchins. This project tested six different configurations of escape panels, and compared their performance with a control net with no escape panel.

Although panel effects varied greatly from place to place, two panel treatments consistently improved the mean size of urchins being retained, when used where urchins were generally small. However, the degree of improvement was variable, and relatively small. Further industry input is needed to determine whether the panels would be cost effective. For draggers who fish on small urchins, escape panels in the bottom or entire back of the drag will provide a modest reduction in the number of smalls in the catch.

Shrimp

Title:
Abundance, migration, and recruitment of northern shrimp in the Gulf of Maine: An industry-initiated verification survey and environmental monitoring pilot project

Funding:
2002 - $319,999
2003 - $250,721

Participants:
Dan Schick (Maine Department of Marine Resources), Vincent Balzano (F/V North Star; Saco, ME), Togue Brown (Gulf of Maine Research Institute), Yong Chen (University of Maine), Stanley Coffin (F/V Bad Penny; Edgecomb, ME), Margaret Hunter (MEDMR); Lew Incze (Bigelow Laboratory for Ocean Sciences), Dale Page (F/V Aaron & Sarah; Boothbay Harbor, ME), Craig Pendleton (F/V Susan & Caitlyn; Saco, ME), Kelo Pinkham (F/V Jeanne C.; Trevett, ME), Laura Taylor Singer (GMRI), David Townsend (University of Maine), and Lessie White (MEDMR)

Summary:
Two essential information needs were addressed by this project. The first was an evaluation of the effectiveness of the existing annual Gulf of Maine northern shrimp summer survey. The second was an understanding of what drives the inshore-offshore migration of female shrimp and the related timing and location of egg hatching and the ultimate chances for survival of the larvae. To address the first need, an industry-based survey was conducted at the same time as the summer state-federal research survey, using a stratified random design like the research survey, but with a higher sampling intensity. The *R/V Gloria Michelle* cruise successfully sampled 54 stations and the two industry cruises each successfully sampled 57 stations, for a total of 168 tows. The two industry cruise results were not significantly different from each other and may be combined to form a single survey. However, the state-federal research survey produced significantly higher biomass and abundance indices than did the industry survey.

Environmental and biological data were collected for two years to evaluate the timing of shrimp migration inshore; the different distributions and movements of ovigerous and post-hatch females and males; and the timing of hatching in relation to water temperature to address the second need. A total of 626 shrimp trawls were conducted using a combination of six fixed transect stations extending across the coastal shelf from nearshore to approximately the 160 m isobath and fishermen-selected stations. Hatching began earlier in 2002, probably because of the warmer water temperatures encountered on the shelf in fall and early winter. Interestingly, the hatching curve for 2002 progressively caught up with the curve for 2003, so while the curves differed by >30 d at 1% hatch, they differed by only 11 days at 50% hatch and only a few days at 90 and 99% hatch. In both areas and years, hatching was virtually completed by March 26. Although hatching began earlier in 2002, it did not begin while shrimp were farther offshore: the ovigerous females were already inshore when hatching commenced. Conversely, the earlier arrival of shrimp in 2003 did not result in earlier hatching, which may have been delayed by the colder water temperatures. Thus, despite different migration times and different hatching times, larvae were in both years released into the water at a similar distance offshore.

The Northeast Consortium is in the process of facilitating a technical mail review of this project.

Title:
Bycatch reduction in the northeast shrimp fishery

Funding:
2003 - $22,800
(PD Award)

Participants:
Bill Lee (F/V Ocean Reporter; Rockport, MA), Melissa Ferraro (Royalston, MA), Bob Fisher (F/V Marina Rose), David Goethel (F/V Ellen Diane; Hampton, NH), Jack Ketchopulos (F/V Special K), George Littlefield (F/V Lady Regina; Kensington, NH), Allan Michael (ADM Associates; Magnolia, MA), Dennis O'Connell (F/V Lady Elaine), Domenic Pike (F/V Muktuk), Jason Pollison (F/V Rhumboogie), Paul Sargent (F/V Joyce Marie)

Summary:
Small escape holes made from cut pieces of 6-inch PVC pipe were sewn into the net in front of the Nordmore grate in a standard shrimp net used in the northeast fishery. Preliminary tests had provided video of fish escaping through these holes during active trawling. A series of tows, with and without these holes in the nets were, made with two vessels. Seven other participating boats towed standard gear at the same time and in the same general area. Catch and bycatch were weighed and identified to provide a direct quantitative comparison of the percentage bycatch with and without the escape holes. Mean catch rate for vessels using nets without rings was 235.5 lbs shrimp/hr with a bycatch rate of 16.7 lbs/hr or 6.6%. For the

two vessels with escape rings installed in the nets, the catch rate was 228.6 lbs shrimp/hr with a bycatch of 27.5 lbs/hr or 10.7 %. The data was confounded by the large variation in bycatch rates among vessels and the limited number of tows. The experimental vessels encountered schools of pelagics (whiting or herring) on some days which heavily influenced results. One vessel appeared to show a significant reduction in bycatch rate from 19.4% without the rings to 9.4% with the escape rings installed. The other vessel had a bycatch rate of 7.5% without rings and 11.3% with the rings. A high catch of pelagics on several days during the tests with rings influenced results from this vessel. A complication to the study was a discrepancy in bycatch rates between vessels operating out of Hampton, New Hampshire and those out of Rockport, Massachusetts. The New Hampshire vessels had lower overall bycatch rates, which could be due to the area trawled, or performance of the gear. A similar study in the previous year had documented a lower catch of pelagics by the New Hampshire vessels. Future studies should involve a larger number of tows from one or two vessels.

The Northeast Consortium facilitated a mail review of this project, the results of which were submitted to the Atlantic States Marine Fisheries Commission and the New England Fishery Management Council in May 2007.

Title:
Comparison of catch and bycatch with beam and otter trawls in the Northeast shrimp fishery

Funding:
2003 - $24,950
(PD Award)

Participants:
Bill Lee (F/V Ocean Reporter; Rockport, MA), Robert Cotrino (F/V Gretchen Marie), Melissa Ferraro (Royalston, MA), Bob Fisher (F/V Marina Rose), John Hogan (F/V Odie Colonie), Jack Ketchopulos (F/V Special K), Tim MacDonald (F/V Dory I), Allan Michael (ADM Associates; Magnolia, MA), Dennis O'Connell (F/V Lady Elaine), Jason Pollison (F/V Rumboogie), Paul Theriault (F/V Terminator), and Jay VanDerpool (F/V Rover)

Summary:
A 17' beam trawl was built and tested for the possible application of this gear in the northeast shrimp fishery. The 1.75" mesh net was fitted with a Nordmore grate and towed from the fishing vessel during the months of January through March, 2004. Seven additional vessels reported their catch and bycatch while towing for shrimp using standard otter trawls during the same time period and in the same general area as the vessel using the beam trawl. The beam trawl had a significantly lower catch rate for shrimp than the vessels using standard otter trawls. This was, in part, due to the relative size of the gear since the opening of the beam trawl was 17' and that for the otter trawls ranged from 28 – 34'. Percent bycatch (by weight) for the beam trawl was 13%, whereas that for the otter trawl fleet was 10.7%. There was a wide variation in the bycatch rate among the seven vessels using the otter trawl (0.4 – 16.5%). Composition of the bycatch differed with a higher percentage of groundfish in the beam trawl and a higher percentage of pelagic fish in the otter trawl(s). Fuel consumption was greatly reduced with the use of the beam trawl. The gear is inexpensive to make and can be used with a single warp and from small vessels with lower horsepower. Further modifications might make this gear useful under specific conditions, near hard bottom, or were fixed gear is deployed. Additional research that could be done would be an evaluation of the relative impact of the lightweight beam trawl versus the standard otter trawl on the benthic environment.

The Northeast Consortium facilitated a technical mail review of this project, the results of which were presented to the New England Fishery Management Council in October 2006. The Council is incorporating project information as appropriate.

Title:
Design and testing of traps for assessment of abundance and distribution of juvenile northern shrimp, Pandalus borealis, in the western Gulf of Maine

Funding:
2004 - $24,997
(PD Award)

Participants:
Rebecca Jones (University of New Hampshire) and Bradford Parady (F/V Angela and Ashley; Kittery Point, ME)

Summary:
This project aimed to develop a standard trap design that can be used in the development of trap-based surveys of juvenile Northern shrimp (*Pandalus borealis*), ≤ 1 ½ years old, in the western Gulf of Maine for both management and research purposes. Previous research and ancillary information from fishermen supported the idea that juvenile behavior is similar to adults in that they are attracted to traps. We modified conventional lobster traps by lining the interior with 1 x 1 ½ cm mesh and fitted the tops of the traps with 3 types of shrimp "V-trough" style entry vents: a conventional 1" wide vent (Control), a ¼" narrow vent (Narrow) and a trap-wire-covered conventional vent (Wire). The wire type vent sampled significantly smaller sized shrimp species and was most effective at reducing bycatch. Overall, this study yielded some interesting results demonstrating that the wire covered vent design may be the best for juvenile shrimp sampling.

Further experiments are being conducted with a follow-on award from the Northeast Consortium, funded in 2006.

Title:
Exploring the addition of an acoustic survey to the summer Gulf of Maine shrimp survey

Funding:
2003 - $24,703
(PD Award)

Participants:
Dan Schick (Maine Department of Marine Resources), Shale Rosen (Gulf of Maine Research Institute), and Proctor Wells (F/V Tenacious; Phippsburg, ME)

Summary:
This project attempted to test whether an acoustic component could be successfully added to the annual summer survey for Northern shrimp, *Pandalus borealis*. The summer shrimp survey consists of 15-minute bottom trawl tows conducted in a stratified, random design with station density per stratum weighted by the historical presence of shrimp. Relying on a trawl survey means only a small portion of the total bottom is surveyed, due to time constraints and limited areas where a net can be towed. Additionally, it is impossible to know whether a high-catch tow represents a tow that passed through the center of a medium sized school, or one that passed through the edge of a much larger school. Acoustic survey techniques are generally not hampered by rough, untowable bottom and have the potential to cover areas more rapidly and completely than an equal amount of effort spent conducting trawl surveys. The participants hoped to demonstrate whether acoustics could be used to inform the results of the tow samples and to conduct surveys in areas that cannot be assessed using a bottom trawl. Despite carrying out operations in areas where shrimp were known to be present, and using frequencies other groups have used successfully to detect *Pandalus borealis*, shrimp schools were never recorded by the 40, 75 or 120 kHz equipment used in this project. While other equipment and techniques (different frequencies and multibeam systems for example) might be effective in detecting and discriminating shrimp, results from this project indicate the tools and techniques tested in this study were not suited to assessing shrimp in the Gulf of Maine.

Title:
Improving the size selectivity for northern shrimp through use of a modified Nordmore grate and square mesh codend

Funding:
2002 - $107,994
2003 - $76,250

Participants:
Kelo Pinkham (F/V Jeannie C.; Trevett, ME), Dan Schick (Maine Department of Marine Resources), and Les White (MEDMR)

Summary:
Comparative tows with a trouser trawl were conducted to test improved release of small shrimp and fish and retention of large shrimp using various configurations of a compound Nordmore grate and diamond or square mesh in the lengthening piece and cod end. The forward (upper) grate section had small bar spacing (7/16") sized to allow small shrimp to flow between the bars and into the cod end mounted behind this section. Two sizes of small bar space section, ½ and ¼ of the total length were tested. The ½ length sections released more small shrimp, but also retained less large shrimp than the ¼ length section compared to a standard Nordmore grate/cod end. The large shrimp were flowing out the escape hole at the bottom of the compound grate. The aft section was lengthened for better retention of large shrimp and the small bar space section was tilted (bent) another 10° to improve small shrimp release. A small bar space section with tapered openings was added to the test series as was square mesh in the lengthener and/or cod end. The two modified compound grates with the four mesh combinations produced eight test series where each gear type was judged for finfish release, shrimp weight retained, small shrimp release, and large shrimp retention. The best combination was the 7/16" bar space bent grate with diamond lengthener and square mesh cod end.

The Northeast Consortium has facilitated a technical mail review of this project, the results of which were submitted to the Atlantic States Marine Fisheries Commission and the New England Fishery Management Council July 2007.

Title:
Reducing seabed contact of trawling: Design, model test, and fishing trials of a semi-pelagic shrimp trawl for the pink shrimp fishery

Funding:
2001 - $50,000
2002 - $81,004

Participants:
Pingguo He (University of New Hampshire), George Littlefield (F/V Lady Regina; Kingston, NH), Bart McNeel (F/V Aaron and Melissa II; Portland, ME), and Richard Syphers (F/V Janice Marie; Hampton, NH)

Summary:
Bottom trawling, including shrimp trawling, alters the physical and biological structure of the seabed. While the effect of alteration on benthic ecosystems and fish/shellfish populations may vary with seabed type, bottom complexity, benthic community structure, and oceanographic conditions of the fishing grounds, reducing alteration to the seabed by fishing activities would be viewed positively by all concerned with the marine environment and fishery. This two-phase project involved gear design and model tests of a semi-pelagic shrimp trawl in a flume tank, followed by sea trials of a new semi-pelagic shrimp trawling system on board commercial shrimp trawlers in the western Gulf of Maine. In 2003, catch of shrimp from the experimental trawl was compared with the average of the vessels fishing in the same general area. In 2004, a commercial trawler was contracted to fish side-by-side the trawler fishing with the experimental semi-pelagic trawl. While catch results were variable, the semi-pelagic trawling system with trawl doors off bottom had potential to catch a similar amount of shrimp. However, the system is very sensitive to depth change, tidal current and turning. Similar catch rates can be realized with carefully controlled rigging and monitoring. However, with the existing deck machinery and fishing conditions in the Gulf of Maine, application of the semi-pelagic fishing method is not recommended in this fishery. It has potential for application in other pink shrimp fisheries where more sophisticated deck equipment is available, fishing areas are larger and sea bottom is flatter.

This work formed the basis of two publications in scientific literature. The Northeast Consortium facilitated a technical mail review of this project, the results of which were submitted to the New England Fishery Management Council and the Atlantic States Marine Fisheries Commission in April 2007. Managers are incorporating the information as appropriate. Follow-on research is being conducted by Canadian colleagues off of northeast Newfoundland.

Title:
Use of kites in shrimp codends to reduce small shrimp and bycatch species

Funding:
2003 - $162,553

Participants:
Pingguo He (University of New Hampshire), Vincent Balzano (F/V North Star; Portland, ME), Dan Schick (Maine Department of Marine Resources), Proctor Wells (F/V Tenacious; Phippsburg, ME)

Summary:
A full scale kite-assisted shrimp codend was tested at the Memorial University flume tank to determine kite size, number of kites, and their position on the codend. The resulting full scale codend was tested at sea for the pink shrimps in Gulf of Maine through comparative fishing using the two vessel parallel tow method. Seventy-seven pairs of tows were completed on two rigging designs. The results did not support the assumption that codends expanded by water-borne kites, reducing finfish and small shrimp catch in the fishery. Catch and bycatch data collected throughout sea trials showed that a significant amount of fin fish bycatch still exists in the fishery even with the use of the Nordmore Grid. This is especially true for whiting, for which a large amount of catch was discarded late in the season. This result indicates a need for continued effort in research and development for a better shrimp trawl to minimize bycatch in the pink shrimp fishery.

Social Science/Outreach/Education

Title:
A Fishing gear workshop by fishermen for non-fishermen

Funding:
2004 - $27,510

Participants:
Pingguo He (University of New Hampshire), Erik Anderson (F/V Kris n' Kev; Portsmouth, NH), David Goethel (F/V Ellen Diane; Hampton, NH), Joe Jurek (F/V Mystique Lady; Andover, MA), and Tom Lyons (F/V Marion J, Hampton, NH)

Summary:
In the past decade, fishing gear and harvesting related issues have become topics among those who have interests in fisheries but are not commercial fishermen. This group of people includes federal and state scientists and scientists who work with fishermen in cooperative research projects, staff and volunteers working for various fishing and ocean related organizations, fisheries managers, representatives of conservation organizations, and staff who work for various committees, councils, commissions and Congressional delegations. While they have various strengths in their respective professions, a lack of knowledge about fishing gear and their operations is evident. This project organized a pilot three-day workshop for sixteen such participants so that they will have a better understanding of fishing gear, operational methods, and conservation issues of commercial fishing gear used in New England. The workshop was primarily instructed by active commercial fishermen with at-sea and on-the-dock components. Two trawl skippers and two gillnet skippers were involved in instruction, discussions, practical demonstrations of gears, and fishing demonstrations at sea. Very positive feedback was received from the participants. As a result, a second workshop of a similar nature was conducted during the summer of 2006. It was organized by New Hampshire Sea Grant and funded by NOAA Fisheries Cooperative Research Partners Program.

Title:
Adopt-a-Boat: Commercial fishing vessels in K-12 education

Funding:
2001 - $193,000

Participants:
Cliff Goudey (Massachusetts Institute of Technology Sea Grant), Phil Averill (Ocean Adventure!, Inc.; Bristol, MA), Kenneth Ekstrom (MIT Sea Grant), Dean Goodwin (Kimball Union Academy; Meriden, NH), Robert Groman (Woods Hole Oceanographic Institution), Robert Kohl (F/V Glenna and Jacob; Marston's Mills, MA), Grace Lee (MITSG), Cameron McLellan (F/V Adventurer; Portland, ME), Brandy Moran (MIT Sea Grant), and Craig Pendleton (Northwest Atlantic Marine Alliance)

Summary:
The Adopt-a-Boat program is a collaboration between the MIT Sea Grant College Program, the fishing industry, and several individuals and organizations involved in education and outreach. The goal is to use commercial fishing boats as a vehicle for teaching the complexities of marine resource utilization, marine ecology, and life as a fisherman to K-12 students. By offering this program, authentic learning opportunities are provided to students. A balanced picture of commercial fishing is presented, helping to build an enlightened citizenry regarding marine resource utilization and its importance to coastal communities. During year one of Adopt-a-Boat, ten classroom/vessel partnerships were built and their collaborative activities were supported with state-of-the-art technologies. A variety of approaches were used to inquiry-based learning and curricula and lesson plans were developed that follow national and state educational frameworks. The project received continued funding from the Northeast Consortium in 2002, which expanded the Adopt-a-Boat program significantly and evaluated the curricula developed in year one. Since its initiation, Adopt-a-Boat has grown into a region-wide program involving approximately 50 fisherman/classroom partnerships in four New England states. Based on its success, new Adopt-a-Boat programs have been formed or are being developed in three other locations across the country. To date, over 2,000 school children have benefited from the program.

Title:
Charting anecdotal information and oral histories on Stellwagen Bank from local commercial fishermen

Funding:
2004 - $84,550

Participants:
Madeline Hall-Arber (Massachusetts Institute of Technology Sea Grant College Program), Christian Adams (MIT), Ed Barrett (F/V Phoenix; Marshfield, MA), David Bergeron (Massachusetts Fishermen's Partnership), Dave Casoni (Commercial Fisherman; Plymouth, MA), Bill Crossen (Commercial Fisherman; Gloucester, MA), Tom DePersia (Commercial Fisherman; Marshfield, MA), Olivia Rugo Free (MFP), Jay Michaud (F/V International Harvester; Marblehead, MA), Phil Michaud (F/V Susan C III; Provincetown, MA), Judith Pederson (MIT), and Rhonda Ryznar (MIT)

Summary:
The goal of this project was to document the extent and value of fishing activities on Stellwagen Bank over three decades and to see how this may have changed over time. Specific objectives were to involve fishermen in the data collection, charting and analysis in order to tap into their local knowledge and experience; to develop charts that depicted seasonal fishing grounds by gear sectors, target species, economic value, and sea floor characteristics on Stellwagen Bank; and to build working relationships among the commercial and recreational fishing and scientific communities.

High-resolution charts were developed that depict seasonal fishing grounds by gear sectors and target species. Interviews elicited information about the significant economic value of fishing on the Bank to multiple fishing sectors and obtained some information about sea floor characteristics. The project found that the combination of charts and interviews were an extremely valuable, non-threatening method to obtain and present information of interest to both the fishing industry and to managers.

Finally, the project accomplished the goal of documenting the patterns associated with three decades of the use of Stellwagen Bank by commercial and recreational fishermen. That clusters and patterns could be discerned for the different gear groups and target species suggest that the information recorded was accurate.

Title:
Institutionalizing social science data collection

Funding:
2001 - $113,700

Participants:
David Bergeron (Massachusetts Fishermen's Partnership), Jennifer Brewer (Clark University), Nancy Colbeth (Beals Island, ME), Madeline Hall-Arber (Massachusetts Institute of Technology Sea Grant College Program), Bonnie McCay (Rutgers University), Jay Michaud (F/V International Harvester; Marblehead, MA), Sarah Robinson (Harvard University), and Lahny Silva (Boston University)

Summary:
This project explored the potential for community-based data collection and analysis to help address the scarcity of social science data on the fishing industry and fishing communities. Community Panels were established for Jonesport/Beals Island, Maine and Gloucester and the South Shore, Massachusetts. Each panel was comprised of 10 to 12 individuals, a cross section of harvesters, processors, shore-side businesses, and other members of the fishing communities. The groups identified issues of concern to their ports, and with the help of coordinators and the PIs, gathered data through interviews and focus group meetings, and drafted and reviewed reports.

A major goal was to provide management agencies with information about the potential impacts of regulatory changes on fishing communities so that adverse impacts could be mitigated. Consequently, each of the Panels reported on the potential impacts of Amendment 13 to the Multispecies (groundfish) Fisheries Management Plan and the Panels in Massachusetts reported on the economic needs of both their fleets and shoreside businesses to a Governor's Seafood Task Force. Another goal was to establish a community-based, participatory and on-going research platform in each of the communities, and the Panels can be and have been reconvened for special topics, such as the environmental justice focus group of the Beals Island Panel.

One of the issues of major concern raised in each of the panels was the status of the fishing industry infrastructure. Elements that each panel considered essential for the sustainability of their industry were considered. The panels also documented some of the benefits of the industry to their communities, as well as the threats or constraints on their continued viability. The understanding of infrastructure and its continued importance to both the fishing fleets and the communities, now and in the future when fishing stocks have rebuilt, has influenced harbor planning in Gloucester, and helped preserve infrastructure and access in Plymouth, Cohasset and Swampscott.

Other results that have already been used to support "fishing-industry friendly" decisions in various communities are:

- Information provided in the Gloucester Harbor Planning process formed the basis for the preservation of fishing industry infrastructure and access in the working harbor.
- The only lobster pound and docking access for 30 lobster vessels in Cohasset, MA was retained.
- Commercial vehicle parking access for 150+ fishermen in Plymouth, MA was retained.
- Retained waterfront access to a net hanging facility for 12 gillnet fishermen in Swampscott, MA.
- Provided a report and recommendations to the Governor's Seafood Task Force on the distribution of $5.5 million in federal disaster assistance funding in 2002.

Among the initiatives emerging from the Community Panels Project are:

- A project to promote safety through training and incentives, funded by the NOAA Cooperative Research Partners Research Initiative, results expected in 2007.
- MFP is utilizing project data in strategic planning to develop appropriate responses to needs such as: fishing industry characterization; data on the infrastructure in 52 Massachusetts fishing ports for municipal, state, and coastal zone planning; improving the market for locally harvested seafood through labeling; utilizing best safety practices to lower insurance and labor time costs; and expansion of health insurance for fishing families in other states.

In 2003, the Saltonstall-Kennedy program funded a companion project that formed three Community Panels in Portland, ME; New Bedford, MA; and Pt. Judith, RI. Reports for both projects are accessible on the web at www.mass-fish.org. Two articles are in preparation for publication in scientific literature. Currently, the Northeast Consortium is facilitating a technical mail review of this project.

Title:
Marine Resource Education Project (MREP)

Funding:
2001 - $84,000
2002 - $232,092
2003 - $142,714
2004 - $197,518

Participants:
Mimi Larsen-Becker (University of New Hampshire), John Coon (UNH), David Goethel (F/V Ellen Diane; Hampton, NH), Andy Rosenberg (UNH), Mary Beth Tooley (East Coast Pelagics' Association), and John Williamson (Industry representative; Kennebunk, ME)

Summary:
The objective of the Marine Resource Education Project (MREP) is to take bring fishermen, scientists and managers together into a neutral setting to build trust and positive respectful relationships by exploring their common goals and their differences away from the pressure of the regulatory process. The program involves participants from the commercial fishing industry, conservation and nonprofit organizations, and state and federal governments in bi-annual six-day intensive seminars on the science and management of the fisheries resource in New England. The curriculum provides a baseline of information about the marine ecosystem and their respective communities. Tangible results from the project include: improved communication among stakeholders, the development of fishermen-scientist research partnerships, more effective participation of fishermen in fisheries science and management, improved problem solving skills, and increased trust and resource stewardship amongst stakeholders. MREP continues with funding from the Northeast Consortium in 2005 and 2006 and is now based at the Gulf of Maine Research Institute.

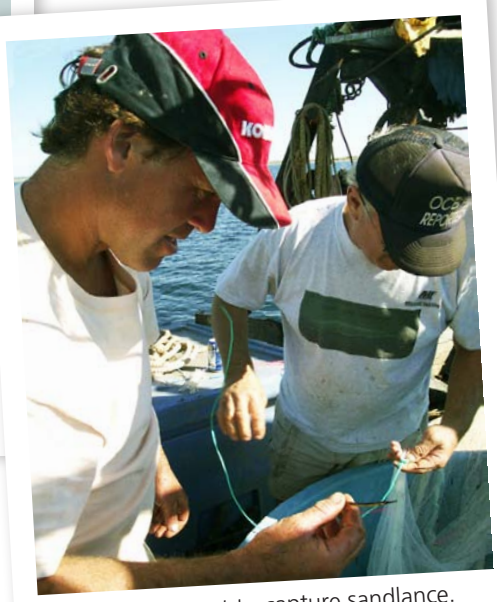
Title:
Workshop on trawl selectivity and conservation

Funding:
2001 - $24,885
2002 - $41,691
2003 - $24,992

Participants:
Pingguo He (University of New Hampshire)

Summary:
Several bi-annual, five-day custom-designed trawl gear workshops at the Center for Sustainable Aquatic Resources of Memorial University of Newfoundland were funded. Groups of eleven to twenty people from the commercial fishing industry, Sea Grant, and state and federal agencies from the three states around Gulf of Maine participated. The workshops were based at the world's largest fisheries flume tank at the university, where various trawl gears and components are demonstrated and examined. Demonstrations focused on gear performance and conservation, such as selectivity grids and seabed-friendly trawls. The workshops enhanced participants' knowledge of trawl gear and stimulated interest in engaging in cooperative research related to trawl gear selectivity in the Gulf of Maine. The workshops have been well received by the participants and have resulted in several cooperative project proposals.

The red crab stock assessment team.



Preparing a net to capture sandlance.

Testing urchin dredge escape panels.

Rigging a model net for testing in a flume tank.

The Northeast Consortium

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www.northeastconsortium.org

Projecct Information Database:
www.northeastconsortium.org/ projects.shtml

Fisheries and Oceans Data Management System:
www.northeastconsortium.org/data.shtml

Examining a sediment core while groundtruthing side-scan sonar maps.

Lobstermen tracking female lobsters in Muscongus Bay, Maine.

Lobstermen deploying a net to determine the abundance and type of plankton in the area.

Using a cage to test survivability of hook-caught sub-legal cod.

Photos courtesy of D. Cowan, K.Donahue, R. Gallant, P.He, C. Manning, and R. Wahle.