Cooperative Marine Education and Research Program

C M E R

2001
Annual Report

UNIVERSITY OF MASSACHUSETTS
Amherst
THE ENVIRONMENTAL INSTITUTE

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Cover Illustration

Cod Otoliths

UMASS/NOAA COOPERATIVE MARINE EDUCATION AND RESEARCH PROGRAM

C M E R

ANNUAL REPORT AND STATEMENT OF PROGRAM DIRECTION 2001

UMASS/NOAA CMER
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UMASS/NOAA COOPERATIVE
MARINE EDUCATION AND RESEARCH PROGRAM

Annual Report And
Statement of Program Direction - 2001

EXECUTIVE SUMMARY

The UMass/NOAA Cooperative Marine Education and Research (CMER) Program is now in its thirteenth year. Established in early 1989 under a Cooperative Agreement between the University of Massachusetts (UMass) and the National Oceanic and Atmospheric Administration (NOAA), the CMER Program combines university and agency expertise to address marine issues affecting the Commonwealth, region, and nation. The CMER Program has access to faculty, staff, and students on all five UMass campuses: Amherst, Boston, Dartmouth, Lowell, and Worcester.

As of October 2001, cooperative projects funded through the UMass/NOAA CMER Program have totaled nearly $2.3 million, have involved 37 UMass faculty and staff, and have supported 103 undergraduate and graduate students. On the NOAA side, agency scientists have been participating in the CMER Program as co-investigators, academic instructors, and chairs and members of graduate student committees. Both UMass and NOAA have also allowed participants in the CMER Program access to facilities and equipment to conduct research and training.

NOAA, through the Northeast Fisheries Science Center, provides base funding for the CMER Program. The 2001 program included new base-funds for a study of protein-bound metals in fish otoliths (UMass-Amherst).

INTRODUCTION

The UMass/NOAA Cooperative Marine Education and Research (CMER) Program is now in its thirteenth year. Established in early 1989 under a Cooperative Agreement between the University of Massachusetts (UMass) and the National Oceanic and Atmospheric Administration (NOAA), the CMER Program combines university and agency expertise to address marine issues affecting the Commonwealth, region, and nation. Through Memoranda of Agreement within the UMass system, the CMER Program has access to faculty, staff, and students on all five UMass campuses: Amherst, Boston, Dartmouth, Lowell, and Worcester.

The Northeast Fisheries Science Center of NOAA's National Marine Fisheries Service (NMFS) has provided at least $50,000 per year as base support for the Program (Figure 1). NOAA also supports an on-campus NOAA employee who serves as CMER Program Director and member of the UMass graduate faculty. In return, UMass provides office space and administrative and clerical support for the CMER Program Director, and a reduced overhead rate on CMER projects. Additional monetary support for the CMER Program is provided from other NOAA units and other federal agencies. All studies performed under the CMER Program must be consistent with the objectives and conditions of the Cooperative Agreement.

In a truly cooperative program, all parties contribute towards the objectives of the program beyond simple monetary reimbursement. The CMER Program is no exception. The Cooperative Agreement is intended "to provide for active university/agency cooperation in the advancement, organization, and operation of marine research, education, in-service training, and demonstration programs." The Cooperative Agreement requires NOAA "to cooperate with UMass in the planning, outlining, developing" of these activities. The CMER Program provides administrative oversight and control over activities funded through the Cooperative Agreement.

As of October 2001, cooperative projects funded through the UMass/NOAA CMER Program have totaled nearly $2.3 million supporting a wide array of educational and research activities (Figure 1). CMER sponsored theses and dissertations have come from many academics disciplines at the University and represent an important measure of scientific productivity (Table 1, Appendix 1). This is also reflected in the presentation of results in publication and presentations in regional and international scientific fora (Tables 2 and 3, Appendices 2 and 3). Collectively, the projects have involved 37 faculty and staff, and have supported 103 undergraduate and graduate students (Table 4, Appendix 4). Approximately one-half of the projects have addressed aspects of the biology and life history of estuarine and marine species. Topics addressed by the other projects are habitat, fishery bycatch, socio-economics, sampling techniques and statistics, business management, education and training, and fishery product quality, safety, and use (Figures 2 and 3). On the NOAA side, agency scientists have been participating in the CMER Program as co-principal investigators, research associates, academic instructors, and chairs and members of graduate student committees, in addition to collaborating in the design and execution of cooperative research projects. Access to facilities and equipment has also been granted to participants in the CMER Program by UMass and NOAA (Table 5, Appendix 5).

NEW PROJECTS SUPPORTED WITH BASE FUNDING

Base funding for the CMER Program is provided by NOAA through the Northeast Fisheries Science Center (NEFSC). Base funds available to the CMER Program in 2001 are being used to continue studies that were initiated in earlier years and to begin new projects (Table 6). Priority for supporting new projects with base funds is set by the UMass/NOAA Coordinating Committee, currently composed of the Vice Chancellor for Research for UMass (Frederick W. Byron, Jr.), the Director of The Environmental Institute at UMass (Richard Taupier), the Director of the NMFS Office of Science and Technology (William W. Fox, Jr.), and the Science and Research Director of the Northeast Region of NMFS (Michael P. Sissenwine). The CMER Program is administered on campus through The Environmental Institute. The 2001 program includes a new base-funded study in area of protein-bound metals in fish otoliths (UMass-Amherst).

Determination of the Transition Metals Associated with the Protein Matrix of Fish Otoliths
(Richard Vachet, Chemistry, UMass-Amherst (2001-01, Year 1 of 2)

The micro-constituents associated with the protein matrix of fish otoliths are poorly known. Dr. Vachet is developing methods to extract the protein from the calcium carbonate phase of the otoliths and use a combination of analytical techniques to measure the associated elements. With the use of otolith microchemistry as a tool to infer stock structure and life history patterns in a number of different species, this research could greatly enhance our understanding of the mechanisms shaping patterns of micro-constituent deposition in otoliths and other fish hard body parts.

ONGOING PROJECTS SUPPORTED WITH BASE FUNDING

Lobster vitellogenesis: uniformity or heterogeneity in egg storage proteins
(Joe Kunkel, Biology Department, UMass-Amherst (2000-02, Year 2 of 2)

Dr. Kunkel proposes to examine the serum and egg protein titers for American lobsters during the reproductive cycle while simultaneously monitoring various morphometric variables. It is hoped his approach may provide a number of indicators that could be used to assess the reproductive health of individuals and populations from different areas. It is also hoped that some of these indicators can be easily measured in the field. The techniques could also be used to evaluate various disease states of lobsters, such as emerging issues with egg coloration.

NEW PROJECTS SUPPORTED WITH EXTRA-CURRICULAR FUNDING

Development and application of a predation tag
(Ben Letcher, Natural Resources Conservation, UMass-Amherst (2001-06, Year 1 of 3)

This study seeks to develop and implement a predation detection tag that when implanted in a fish will broadcast when the animal is predated upon and potentially the general class of predator eating the fish. The electronic tag senses changes in ambient environment and is tuned to detect those changes that could only occur during digestion. Releases of these tags in Atlantic salmon juveniles will hopefully allow some inference on the time and location of predation during out-migration and what predator classes are having the greatest impact.

ONGOING PROJECTS SUPPORTED WITH EXTRA-CURRICULAR FUNDING

Occurrence, movement and behavior of the Kemp's Ridley and Other Sea Turtles in Cape Cod Bay, Massachusetts

C. Griffin, Natural Resources Conservation, UMass-Amherst (1999-08, Year 2 of 2)

Four species of sea turtles occur in Massachusetts coastal waters, including Kemp's Ridley, green, loggerhead, and leatherback turtles. However, the extent and seasonal distribution of sea turtles in coastal habitats are unknown. Similarly, there are few data available on turtle population demographics, coastal habitats used and diet. There is also increasing concern about the frequency that Kemp's Ridley turtles are found cold-stunned in Massachusetts. The purpose of this study is to deter-mine the importance of Massachusetts coastal waters in the life cycles of sea turtles.

Analysis of Foraging and Habitat Use by Cetaceans

S. Brault, Biology Department, UMass-Boston (1999-09, Year 2 of 2)

Key aspects of current research on the status of marine mammals are focused on habitat use in relation to environmental and geographical variables. Two quite different, but complementary tools for such research are spatial analysis using Geographical Information Systems and stable isotope analysis. These tools will be used to analyses the habitat use of a suite of marine mammals including Bryde's, sei and minke whales.

Stable Isotopes in the Scales of Atlantic Salmon

K.D. Friedland, UMass/NOAA CMER Program, UMass-Amherst (2000-8, Year 2 of 3)

Atlantic salmon populations in the North Atlantic have experienced unprecedented declines in abundance during the past two decades. Of greater concern for the management of US salmon populations are the trends in the two seawinter salmon, especially those comprising the populations in the ESA distinct population segment. This work is intended to analyze the stable isotopic ratios of carbon and nitrogen as a means to determine if there has been a shift in feeding of Atlantic salmon that can be related to these population declines.

PROJECTS BEING COMPLETED

A number of projects supported with CMER funds in previous years are now completed, or are in the process of being completed. A listing of projects funded since the CMER Program began in 1989 is provided in Appendix 6, and summaries of projects completed prior to 2001 are provided in Appendix 7.

Distribution and abundance of coastal and marine birds of the northwest Atlantic coast: publication of a seabird technical report

C. Griffin and J. Finn, Department of Forestry and Wildlife Management, UMass-Amherst (97-10, to be completed in 2002)

The project will support the publication of data assembled from systematic seabird

surveys undertaken by NMFS between 1980 and 1988, and colonial waterbird data collected from Maine to Virginia by the U.S. Fish and Wildlife Service. Over 160 maps developed through ARC/Info GIS, will be included in the publication. In addition, the same material will be made available as a URL site on the World Wide Web.

Limits to Recovery of Shortnose Sturgeon Populations

J. Boreman, Graduate Program in Organismal and Evolutionary Biology, UMass-Amherst (95-11, to be completed in 2002, funding provided by the NMFS Office of Protected Species)

The purpose of this study is to integrate life history strategy, genetics, and habitat preference and use into criteria for determining the limits to which shortnose sturgeon populations along the Atlantic coast can be expected to recover. Since little data are available on shortnose sturgeon, as compared to other, more abundant estuarine species, theoretical approaches will be combined with empirical ones to develop standards that can be incorporated into the species recovery plan now being prepared by the National Marine Fisheries Service.

Contemporary Use of Marine Resources for Subsistence: an Exploratory Study in the Commonwealth of Massachusetts

R. M. Muth, Department of Forestry and Wildlife Management, UMass-Amherst (94-07, To be completed in 2002)

In order to develop a better understanding of the social and economic meanings, value functions, and dependencies associated with subsistence use of marine resources, scientists, managers, and policy makers require information on the nature and extent of subsistence utilization. The overall goal of this study is to determine the extent to which there exist people in Massachusetts who rely on marine resources for subsistence production. The goal will be accomplished by: (1) identifying and describing specific individuals or groups of people characterized by subsistence use of marine resources; (2) identifying patterns of subsistence production associated with marine resources, including the nature and extent of use, the amount and variety of resources harvested, the extent of additional resource harvesting activity, resource sharing and distribution networks, contributions of marine resources to household food budgets, and the magnitude of bartering activities; and (3) identifying the different types of subsistence dependency.

Introduction of metals and metalloids into the marine food web: analytical methods development and speciation studies

Julian Tyson and Peter Uden, Department of Chemistry, UMass-Amherst (98-01, To be completed in 2002)

This proposed study is a continuation and expansion of a previous CMER-funded project, and will be undertaken in collaboration with the NMFS Howard Laboratory (Sandy Hook, NJ) and Milford (CT) Laboratory, and the National Institute of Standards and Technology (NIST). Elemental uptake by plankton is the entry point for metals and metalloids into the marine food web. Knowledge of elemental concentrations in plankton and the nature of the chemical species involved (speciation) should allow the role of these organisms in biogeochemical pathways to be defined more accurately, and should also allow investigation of the transfer of elements through the trophic chain. Tin, lead, mercury, and selenium will be studied in particular as part of a doctoral program of a graduate student in Analytical Chemistry.

Use of morphometrics and biochemical assays to study the development of larval tautog
Joseph Kunkel, Biology Department, UMass-Amherst (98-02, To be completed in 2002)

The investigator intends to show that basic biochemical measurements combined with simple landmark measurements and modern morphometric analysis can assist the assignment of a quantitative index to embryonic and larval stages of fish such that decisions can be made about the effectiveness of applied nutritional regimes.

Interactions between bacterial communities and *Alexandrium* spp in the Gulf of Maine
Juliette Rooney-Varga, Biological Sciences Department, UMass-Lowell (1999-04, To be completed in 2002)

The investigator proposes to study the relationship between *Alexandrium* spp of plankton, known to be a causative agent of paralytic shellfish poisoning (PSP), and bacteria fauna in the Gulf of Maine. Working in concert with ongoing EcoHAB-GOM investigations on harmful algal blooms, Dr. Rooney-Varga hopes to be able to detect relationships between biogeochemical factors and *Alexandrium* blooms, thus providing a predictive capability for advice on the risk of PSP poisoning from commercial seafood.

The relationship between northern right whale (*Eubalaena glacialis*) sightings and satellite-derived sea surface temperature fronts in Great South Channel, Gulf of Maine
James Bisagni, Center for Marine Science and Technology, UMass-Dartmouth (1999-06, to be completed in 2002)

This is a comprehensive project to analyze sightings of right whale in regard to satellite derived sea surface temperature distributions especially in the Cape Cod Bay and Great South Channel areas. The work will focus on the formation and persistence of fronts in the region and how they may concentration right whales, and from these relationships allow for the development of predictive models that may serve as a basis for management advisories. The investigator suggests the information could be disseminated via the World Wide Web making it a real-time management tool.

TABLE 1. RECENT CMER-SPONSORED THESES AND DISSERTATIONS

Arslan, Z. 2000. The Development of Analytical Methods for the Determination of Trace Elements in Marine Plankton. PhD Dissertation (CMER Project 98-01).

Gademann, A. 1998: Temporal and Spatial Variability of Cod Abundance in Gulf of Maine/Nantucket Shoals from commercial vessels During 1982-1993. MS Thesis, University of Massachusetts, Dartmouth, MA (CMER Project 96-06)

Hanrahan, B. 1999. School structure and individual feeding behavior of bluefin tuna (*Thunnus thynnus thynnus*). M.Sc thesis, University of Massachusetts, Amherst

Hartley, D. R. 1995. The population biology of the goosefish, *Lophius americanus*, in the Gulf of Maine. MS Thesis, University of Massachusetts, Amherst, MA. (CMER Project 91-06)

Hartling, R. 1998. Characterization of the yolk protein Lipovitellin and its developmental fate in embryos and larvae of winter flounder, *Pleuronectes americanus*. PhD Dissertation,

University of Massachusetts, Amherst, MA. (CMER Project 96-08)
Lambert, M. C. 1998. A regime shift in the Northwest Atlantic? An analysis of copepod species dominance, abundance estimation and variability in relation to the North Atlantic oscillation. MS Thesis, University of Massachusetts, Dartmouth, MA. (CMER Project 96-06)
Lanza, H. 1998. Seabird by-catch by marine fisheries. MS Thesis, University of Massachusetts, Amherst, MA. (CMER Project 93-01).
Lewandowski, T.A. 1995. U.S. federal fishery enforcement programs affecting New England Fisheries. MS Thesis, University of Massachusetts, Amherst, MA. (CMER Project 94-03)
Matiskella, K. 1997. Growth dynamics and gastric evacuation in longhorn sculpin (*Myoxocephalus octodecemspinosus*) from Georges Bank. MS Thesis, University of Massachusetts, Amherst, MA. (CMER Project 93-02)
Moses, E. 1995. Distribution of North Atlantic right whales, *Eubalaena glacialis*, in relation to oceanographic features of the Scotian shelf. MS Thesis, University of Massachusetts, Amherst, MA. (CMER Project 89-03)
Scharf, F.S. 1997. Predator size-prey size relationships and predator dynamics of marine fish on the Northwest continental shelf. MS Thesis, University of Massachusetts, Amherst, MA. (CMER Project 94-04).
Schmidek, J. 2001. Does overcapitalization and government regulation affect the offshore commercial Atlantic sea scallop industry? Honors Thesis, University of Massachusetts, Dartmouth, MA
Sigourney, D. 2002. Age and growth, sexual maturation and distribution of the Atlantic halibut (*Hippoglossus hippoglossus* L.) in the Gulf of Maine-Georges Bank region. MS Thesis, University of Massachusetts-Amherst
Still, B. in progress. Occurrence, movement and behavior of the Kemp's Ridley and other sea turtles on Cape Cod Bay, MA. MS Thesis. University of Massachusetts-Amherst. (CMER Project 99-08).
Storton, M. 2001. Chromatographic speciation of organometallic compounds in the marine food web. PhD Dissertation. University of Massachusetts-Amherst. (CMER Project 98-01)
Wagner, S. in progress. The Relationship Between Northern Right Whale (Eubalaena glacialis) Distribution and Satellite-Derived Sea Surface Temperature Fronts in Great South Channel, Gulf of Maine. MS Thesis, University of Massachusetts, Dartmouth, MA.
Wetmore, S. 2001 Stable isotope investigation into the foraging ecology of the North Atlantic right whale. MS Thesis. University of Massachusetts-Boston.

TABLE 2. CMER-SPONSORED PUBLICATIONS: 1997-2001

Arslan, Z. and J. F. Tyson. 1999. Determination of calcium, magnesium and strontium in soils by flow injection flame atomic spectrometry, Talanta, 50, 929-937.
Arslan, Z. and J. F. Tyson. Determination of lead in marine plankton by slurry sampling electrothermal atomic absorption spectrometry. in preparation
Arslan, Z. and J. F. Tyson. Determination of trace elements in silicon-containing samples by inductively coupled plasma mass spectrometry (ICP-MS) after the precipitation of silicon

as sodium flurosilicate. in preparation.
Arslan, Z., N. Ertas, J. F. Tyson, E. R. Denoyer and P. C. Uden. 2000. Determination of Trace Elements in Marine Plankton by Inductively Coupled Plasma Mass Spectrometry, Fresenius' J. Anal. Chem., 366, 273-282.
Arslan, Z., L. Elci and J. F. Tyson. Submitted. Determination of trace elements in seawater by inductively coupled plasma mass spectrometry with on-line matrix elimination and preconcentration with Chromosorb 102 resin, J. Anal. At. Spectrum.
Blackwell, B.F., G. Gries, F. Juanes, K. Friedland, and L. Stolte. 1998. A simulation of smolts exiting the Merrimack River: relative effects of fry to smolt survival, migration, and predation. North American Journal of Fisheries Management 18:31-45.
Blackwell, B.F. and F. Juanes. 1998. Predation on Atlantic salmon smolts by striped bass after dam passage. North American Journal of Fisheries Management 18:936-939.
Elci, l., Z. Arslan and J. F. Tyson. 2000. Flow injection solid phase extraction with Chromosorb 102: determination of lead in soil and waters by flame atomic absorption spectrometry. Spectrochem. Acta part B, 55, 1109-1116.
Ferrier, M. and J. N. Rooney-Varga. Submitted. Stimulation of *Alexandrium fundyense* growth by bacterial assemblages from the Bay of Fundy.
Gangopadhyay, A. and H S Kim, 1998, Multiscale forcing of the high frequency Plankton Variability on Georges Bank: Tides, Winds and Rings, Submitted ms.
Georgianna, D. 1999. The Massachusetts fishing industry. Massachusetts Benchmarks. The Quarterly Review of Economic News & Insight. Vol. 2:3.
Georgianna, D. 2000. The Massachusetts Marine Economy. Donahue Institute, University of Massachusetts.
Georgianna, D. and A. Cass. 1998. The Cost of Hook Fishing for Groundfish in Northeastern United States. Prepared for NMFS, U.S. Department of Commerce.
Georgianna, D., A. Cass, and P. Amaral. 1999. The Cost of Fishing for Sea Scallops in Northeastern United States. Prepared for NMFS, U. S. Department of Commerce.
Gurleyuk, H., J. F. Tyson and P. C. Uden. 2000. Determination of extractable arsenic in soils using slurry sampling-on-line microwave extraction-hydride generation-atomic absorption spectrometry. Spectrochem. Acta part B, 55, 935-942.
Grogan, C.S., and J. Boreman. 1998. Estimating the probability that historical populations of fish species are extirpated. North American Journal of Fisheries Management 18:522-529.
Haley, N. 1998. A gastric lavage technique for characterizing diets of sturgeons. North American Journal of Fisheries Management. 18:978-981.
Hanrahan, B. and F. Juanes. 2001. Estimating the number of fish in Atlantic bluefin tuna (*Thunnus thynnus*) schools using models derived from captive school observations. Fishery Bulletin 99: 420-431.
Hanrahan, B. and F. Juanes. Morphological and behavioral constraints on bluefin tuna prey size selection. In preparation.
Hartling, R. C., and J. G. Kunkel. 1999. Developmental fate of the yolk protein lipovitellin in embryos and larvae of winter flounder, *Pleuronectes americanus*. J. Exp. Zool. 284:686-95.
Hartling RC, Pereira JJ, Kunkel JG. 1997. Characterization of a heat-stable fraction of lipovitellin and development of an immunoassay for vitellogenin and yolk protein in

winter flounder (*Pleuronectes americanus*). J Exp Zool. 278:156-66.
Lambert, M. C. A regime shift in the Northwest Atlantic? EOS AGU/ASLO 79:48.
Ross, M. R., and S. R. Hokenson. 1997. Short-term mortality of discarded finfish bycatch in the Gulf of Maine northern shrimp fishery. North American Journal of Fisheries Management 17:902-909.
Rothschild, B.J., A.F. Sharov, A.J. Kearsley, and A.S. Bondarenko. 1997. Estimating growth and mortality in stage-structured populations. Journal of Plankton Research 19:1913-1928.
Scharf, F., F. Juanes, and R. Rountree. 2000. Predator size - prey size relationships of marine fish predators: interspecific variation and the effects of ontogeny and body size on trophic niche breadth. Mar. Ecol. Prog. Ser. 208:229-248.
Scharf, F., F. Juanes, and M. Sutherland. 1998. Inferring ecological relationships from the edges of scatter diagrams: a comparison of regression techniques. Ecology 79: 448-460.
Scharf, F., J.A. Buckel, F. Juanes, and D.O. Conover. 1997. Estimating piscine prey size from partial remains: testing for shifts in foraging mode by bluefish. Environmental Biology of Fishes 49: 377-388.
Scharf, F., R. Yetter, A. Summers, and F. Juanes. 1998. Enhancing diet analyses of piscivorous fishes in the Northwest Atlantic through identification and reconstruction of original prey sizes from ingested remains. Fishery Bulletin 96: 575-588
Scharf, F., J.A. Buckel, F. Juanes, and D.O. Conover. 1998. The influence of body size on predator mode choice and prey profitability in juvenile bluefish in the Hudson River. Canadian Journal of Fisheries and Aquatic Sciences 55: 1695-1703.
Wagner, S. and J. Bisagni. 1999. Correlation Between the Spatial and Temporal Variability of a Tidal Mixing Front and Distribution of the North Atlantic Right Whale, *Eugalaena glacialis*, in the Great South Channel, Gulf of Maine. EOS, Transactions, American Geophysical Union 2000 Ocean Sciences Meeting, Vol. 80, No. 49, pp.223, supplement.

TABLE 3. CMER-SPONSORED PRESENTATIONS: 1997-2001

Arslan, Z., N. Ertas, J. F. Tyson, E. R. Denoyer and P. C. Uden. 1999. Determination of Trace Elements in Marine Plankton by Inductively Coupled Plasma Mass Spectrometry, The 26th Annual Conference of the Federation of Analytical Chemistry and Spectroscopy Societies, Vancouver, (oral presentation).
Arslan, Z., L. Elci and J. F. Tyson, 1999 “Determination of trace elements in seawater by inductively coupled plasma mass spectrometry with on-line matrix elimination and preconcentration with Chromosorb 102 resin”, The 26th Annual Conference of the Federation of Analytical Chemistry and Spectroscopy Societies, Vancouver, (oral presentation).
Blackwell, B., and F. Juanes. 1997. Emigration mortality of Atlantic salmon smolts: potential effects on the proportion of smolts exiting the Merrimack River, Massachusetts" 53rd Annual Northeast Fish and Wildlife Conference, Framingham, MA (oral).
Ferrier, M., H. Thompson, and J. N. Rooney-Varga. 2000. Presented at the American Society for Microbiology 100th General Meeting, Los Angeles, May 2000. (poster)
Gademann, A and A. Gangopadhyay, 1998. Basin Scale Biophysical Response in the Gulf of Maine, AGU Spring meeting, Boston, (poster).

Gangopadhyay, A., H S Kim, M. Stollsteimer, and B J Rothschild, 1998, Application of SeaWifs data for AFMIS, AGU, San Francisco.

Georgianna, D. and J. Dirlam. 2000. "The Effect of Reduced Supply on Fish Processing in New England." presented at International Institute of Fishery Economics and Trade Biennial Conference, Oregon State University, Corvallis, OR (Oral)

Grogan, C.S., and J. Boreman. 1998. Estimating the probability that historical populations of fish species are extirpated. Sea Grant Workshop on Sturgeon, University of Florida, Gainesville, FL.

Hanrahan, B. and F. Juanes. 1997. School structure and individual feeding behavior of bluefin tuna, *Thunnus thynnus*. 48th Annual Tuna Conference, Los Angeles, CA (poster).

Hanrahan, B . 1998. Estimating bluefin tuna school size from limited observational data. Southern New England Chapter of the American Fisheries Society winter meeting. Bristol, RI (Saul B. Saila best student paper award)

Hanrahan, B . 1998. Estimating bluefin tuna school size from limited observational data. National Marine Fisheries Service, Inter-American Tropical Tuna Commission 49th Annual Tuna Conference. Lake Arrowhead, CA. (best student paper award)

Hanrahan, B. 1998. Bluefin tuna school size and structure may be estimated from surface observations." UMass-Amherst Graduate Research Symposium. (best student paper award)

Hanrahan, B . 1998. Bluefin tuna school size and structure may be estimated from surface observations." American Fisheries Society Annual Meeting. Hartford, CT. (Tie- best student paper)

Juanes, F., F. Scharf, F., J. Buckel, and D. Conover. 1997. Predation by juvenile bluefish: the influence of relative size and prey morphology on predator mode choice and prey vulnerability. ICES Recruitment Dynamics Workshop, Baltimore, MD (oral).

Kunkel, J.G., J. Bohannon, R. Sharma, and J. Zydlewski. 1999. Serum and slime vitellogenin in the Atlantic cod, *Gadus morhua*, and its relation to ovarian development. Amer. Zool. A119. SICB Annual Meeting, January 4-8, 2000, Atlanta, Georgia.

Lambert, M.C. 1998. A Regime Shift in the Northwest Atlantic?, EOS 79 (1) (poster).

MacNeil, P. and F. Juanes. 1999. An evaluation of striped bass predation on diadromous species in the Merrimack River below the Essex Dam. Southern New England Chapter of AFS, Hadley, MA.

Rooney-Varga, J. N., M. B. Savin, M. Ferrier, and A. B. Golay. 2000. Presented at the United States Harmful Algal Blooms Symposium, Marine Biological Laboratories, Woods Hole MA, Dec. 4-9, 2000 (poster)

Rothchild, B.J., A. Gongopadhyay, and H.S. Kim. 1998. Multiyear variability in high frequency forcing of plankton variability on Georges Bank, Backward Facing Workshop, WHOI, May 1998.

Scharf, F., J. Buckel, F. Juanes, and D. Conover. 1997. Predation by juvenile bluefish: the influence of relative size and prey morphology on predator mode choice and prey vulnerability. 21st meeting of the American Fisheries Society- Early Life History Section, Seattle, WA (oral).

Scharf, F., F. Juanes, and R. Rountree. 2000. Predator size-prey size relationships of marine fish predators: interspecific variation and the effects of ontogeny and body size on trophic niche breadth. American Society of Ichthyologists and Herpetologists, La Paz

Scharf, F., R. Yetter, and F. Juanes. 1997. Enhancing diet analyses of piscivorous fishes in the Northwest Atlantic through identification and reconstruction of prey sizes from partial remains. 53rd Annual Northeast Fish and Wildlife Conference, Framingham, MA (oral).

Still, B., T. Potter, and R. Prescott. 2001. Variables determining juvenile Kemp's Ridley cold stun events in Cape Cod Bay, Massachusetts. 21st Annual Symposium on Sea Turtle Biology and Conservation. Philadelphia (poster)

Stollsteimer, M. and A. Gangopadhyay, 1998. Spatial and Temporal Variability of the *Calanus finmarchicus* abundance in the Gulf of Maine During 1977-1987, AGU Spring meeting, Boston, (poster).

Storton, M., Z. Araslan, J. F. Tyson, and P. C. Uden. 1997. Trace element determination and chromatographic speciation in marine plankton. Federation of Spectroscopy and Analytical Chemical Societies (FACSS) Conference, Providence, RI (10/97, poster).

Storton, M., Z. Araslan, J. F. Tyson, and P. C. Uden. 1997. TP26 trace element determination in marine plankton by interfaced chromatography plasma spectrometry. Winter Plasma Spectrometry Conference, Scottsdale, AZ (1/98, Poster).

Tyson, J.F., Z. Arslan, S, Nielsen, E. Yourd and K. Neubauer, 2000. Improving detection limits and removing matrix interferences in multi-element determination by ICP-MS with flow injection solid and liquid phase extraction procedures with high efficiency sample introduction. Winter Conference on Plasma Spectrochemistry, Ft. Lauderdale. (oral)

Tyson, J.F., Z. Arslan, S, Nielsen, E. Yourd and K. Neubauer, 2000. Determination of trace elements in seawater by inductively coupled plasma mass spectrometry with ultrasonic nebulization after flow injection solid phase extraction, Pittcon 2000, New Orleans. (oral)

Wagner, S. 1999. Correlation Between the Spatial and Temporal Variability of a Tidal Mixing Front and Distribution of the North Atlantic Right Whale, *Eugalaena glacialis*, in the Great South Channel, Gulf of Maine. Right Whale Consortium fall meeting, Boston , MA (talk).

Wagner, S. and J. Bisagni. 2000. Correlation Between the Spatial and Temporal Variability of a Tidal Mixing Front and Distribution of the North Atlantic Right Whale, *Eugalaena glacialis*, in the Great South Channel, AGU winter meeting, San Antonio, TX (poster).

Wetmore, S., Brault, S., Michener, R., and P. Clapham 2000. Stable Isotopic Analysis of Baleen from "Staccato", a Known Individual: Preliminary Results, American Cetacean Society meeting, Monterey, CA (poster).

Wetmore, S. 2000. Stable Isotopic Analysis of Baleen from "Staccato", a Known Individual: Preliminary Results, Right Whale Consortium meeting, Boston, MA (talk).

Wetmore, S., Brault, S., Michener, R., and P. Clapham 2001. Stable Isotopic Analysis of Baleen from "Staccato", a Known Individual: Preliminary Results, University of Mass. Boston's graduate student assembly conference (poster).

TABLE 4. PARTICIPATION OF UMASS FACULTY, STAFF, AND STUDENTS IN THE 2001 UMASS/NOAA CMER PROGRAM.

Project No.	Short Title	Faculty and Staff (Department, Campus)	Students Funded (Position)
97-04	**Baseline Socio-**	**D. Loomis (UMass-Amherst)**	**R. Salz (Res. Asst.)**

Project No.	Short Title	Faculty and Staff (Department, Campus)	Students Funded (Position)
	Economic Party Boat	**M. Ross (UMass-Amherst)** **D. Georgiana (UMass-Dartmouth)**	
97-15	**Smolt Predation**	**F. Juanes (Forestry and Wildlife, Amherst)**	**P. MacNeil (Res. Asst.)**
98-01	**Metals and Plankton**	**J. Tyson and P. Uden (Chemistry, Amherst)**	**M. Storton (Res. Asst.)** **Z. Arslan (Res. Asst.)** **Hakan Gurleyuk (Res. Asst.)**
98-02	**Tautog Development**	**J. Kunkel (Biology Department, Amherst)** **E. Decker (Food Science, Amherst)**	**J. Zydlewski (Postdoc.)** **R. Moniz (Intern)** **R. Sharma (Intern)**
98-07	**Magnesium in Otoliths**	**K. Friedland, UMass/NOAA CMER, Amherst**	**L. Clarke (Res. Asst.)**
99-01	**Baseline Herring**	**D. Georgianna**	**A. Cass (Res. Asst.)** **K. Brough (Res. Asst.)** **E. Eastwood (Res. Asst.)** **P. Amaral (Res. Asst.)** **J. Schmidek (Res. Asst.)**
99-03	**Biology Halibut**	**M. Ross, Natural Resources Conservation, Amherst**	**D. Sigourney (Res. Asst.)**
99-04	**Harmful Algae**	**J. Rooney-Varga, Biology, Lowell**	**M. Savin (Postdoc.)** **M. Ferrier (Res. Asst.)**
99-06	**Right Whale Satellites**	**J. Bisagni, CMAST, Dartmouth** **R. Connor, CMAST, Dartmouth**	**S. Wagner (Res. Asst.)**
99-08	**Cape Cod Turtles**	**C. Griffin, Natural Resources Conservation, Amherst**	**B. Still (Res. Asst.)**
99-09	**Whale Habitat**	**S. Brault, Biology, Boston**	**S. Whetmore (Res. Asst.)**
99-10	**Sturgeon By-catch**	**K. Friedland, UMass/NOAA CMER, Amherst**	**A. Stein (Res. Asst.)**
00-02	**Lobster Maturity**	**J. Kunkel (Biology Department, Amherst)**	**J. Xu (Intern)** **S. Hasan (Intern)** **J. Schnorbus (Intern)**
00-08	**Sable Isotope in Salmon**	**K. Friedland, UMass/NOAA CMER, Amherst**	**G. Kligys (Res. Asst.)**
01-01	**Metals in Otoliths**	**R. Vachet (Chemistry, Amherst)**	**M. Miller (Res. Asst.)**
01-06	**Predator Tags**	**B. Letcher (Natural Resources Conservation, Amherst)**	**J. Pearlstein (Res. Asst.)**

TABLE 5. CONTRIBUTION OF SAMPLES, DATA, EQUIPMENT, AND FACILITIES IN 2001 TO THE UMASS/NOAA CMER PROGRAM.

Project No.	Short Title	NOAA Contribution	UMass Contribution
97-04	**Baseline Socio-Economic Party Boat**	**IMPLAN Program**	**Office space**
97-15	**Smolt Predation**	**Tagging equipment**	**Office and lab space, equipment**
98-01	**Metals and Plankton**	**Plankton Cultures**	**Office and lab space, equipment**
98-02	**Tautog Development**	**Tautog larvae and tissue samples**	**Office and lab space, equipment for PUFA analysis**
98-07	**Magnesium in Otoliths**	**Salmon otolith samples**	**Office and lab space, equipment**
99-01	**Baseline Herring**		
99-03	**Biology Halibut**	**Otolith samples, survey data, image processing facilities**	**Office and lab space, equipment**
99-04	**Harmful Algae**	**Research cruise - R/V Delaware II**	
99-06	**Right Whale Satellites**		**Satellite imagery**
99-08	**Cape Cod Turtles**	**Tagging equipment**	**Telemetry equipment**
99-09	**Whale Habitat**	**Tissue and plankton samples**	**Office and lab space, equipment**
99-10	**Sturgeon By-catch**	**Computer usage, Database access**	**Office space, equipment**
01-01	**Metals in Otoliths**	**Otolith samples**	**Analytical equipment**

TABLE 6. PROJECTS SUPPORTED WITH FY 2001 UMASS/NOAA CMER PROGRAM FUNDS.

CMER Project No.	Short Title	Investigator	Amount
00-02	**Lobster Maturity**	**Kunkel**	**34,722 (Year 2 of 2)**
00-08	**Stable Isotopes**	**Friedland**	**38,500 (Year 2 of 3)**
01-01	**Metals in Otoliths**	**R. Vachet**	**38,040 (Year 1 of 2)**
01-06	**Predator Tags**	**B. Letcher**	**34,440 (Year 1 of 3)**

FIGURES

Figure 1. UMass/NOAA CMER program funding history.

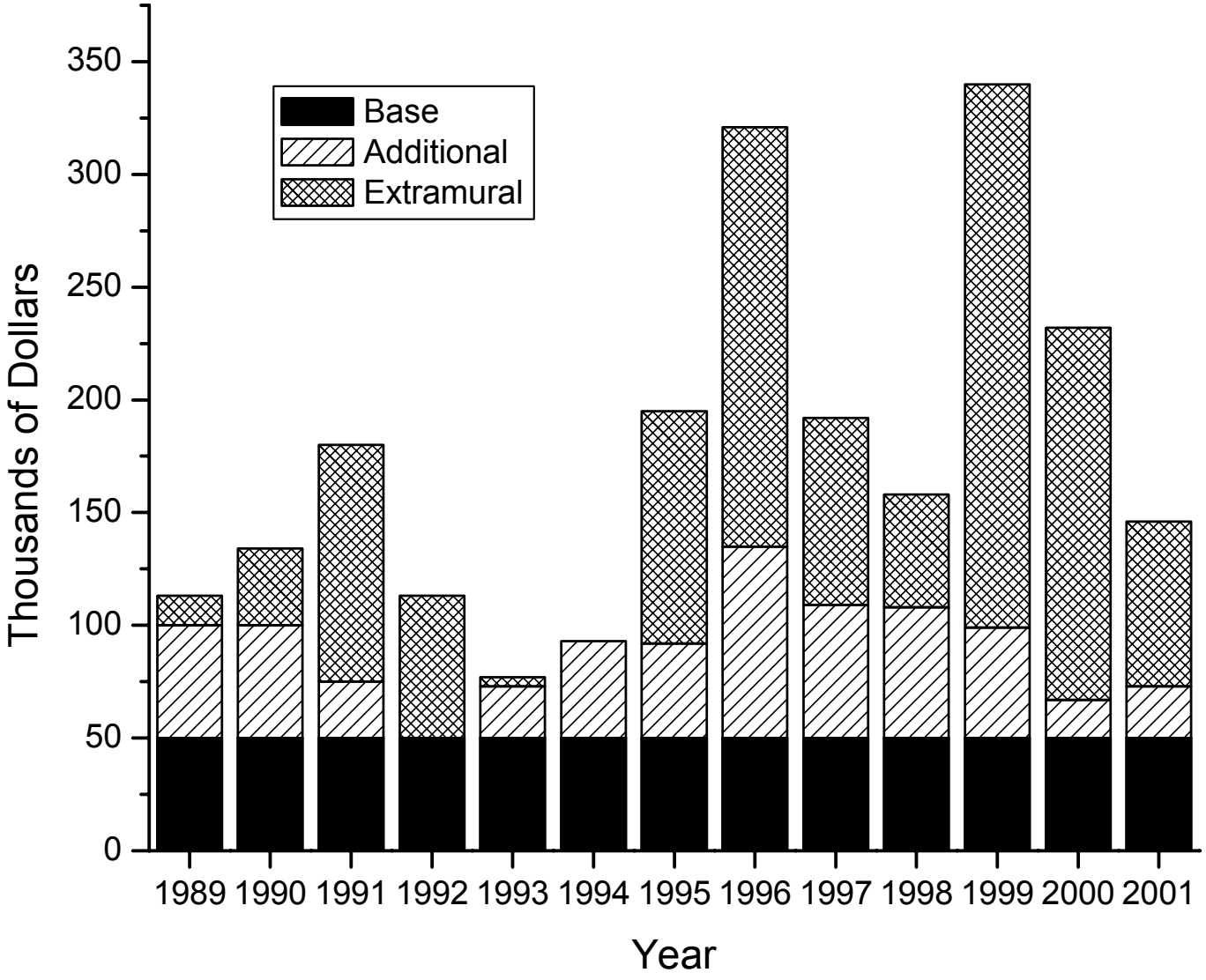

Figure 2. Number of projects in each topic addressed by the UMass/NOAA CMER program1989-2001.

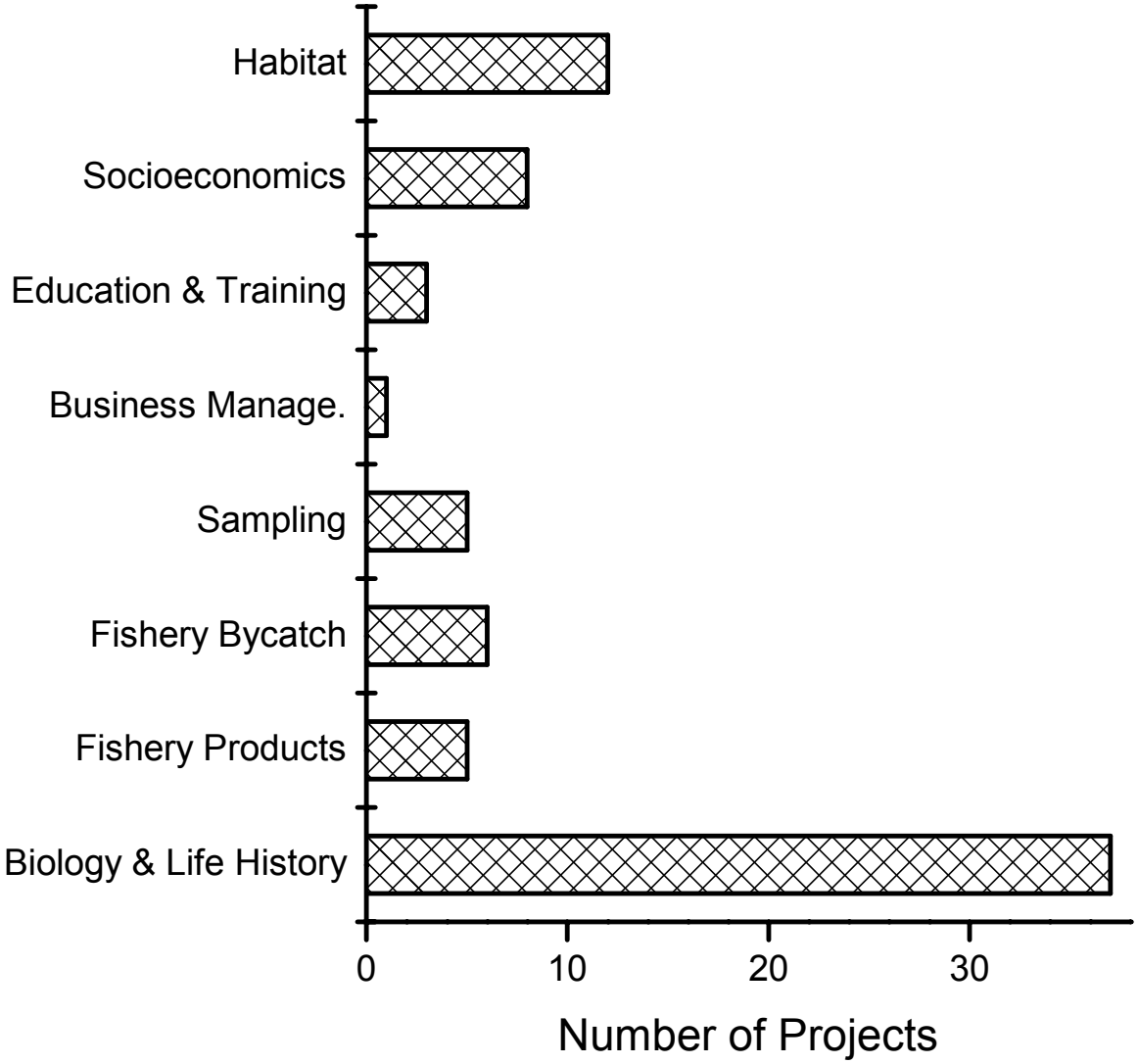

Figure 3. Relative expenditures in each topic addressed by the UMass/NOAA CMER program1989-2001.

APPENDIX 1. RECORD OF CMER-SPONSORED THESES AND DISSERTATIONS

Abend, A.G. 1993. Distribution and diet of long-finned pilot whales in the North Atlantic using carbon and nitrogen stable isotope tracers. MS Thesis, University of Massachusetts, Amherst, MA. (CMER Project 91-03)

Brady, S.L. 1994. Distribution of sea turtles and incidental take in the swordfish fishery in the northeastern United States. MS Thesis, University of Massachusetts, Amherst, MA. (CMER Project 92-04)

Dantzer, W. 1993. Effect of bacteria on paralytic shellfish toxin production by dinoflagellate algae. MS Thesis, University of Massachusetts, Amherst, MA. (CMER Project 90-01)

Fahey, D. R. 1993. Fecundity of the little skate, *Raja erinacea* (Rajiformes: Rajidae). MS Thesis, University of Massachusetts, Amherst, MA. (CMER Project 89-02)

Jia, T.-d. 1993. Glutathione peroxidase, glutathione reductase and glutathione in post-mortem fish muscle. MS Thesis, University of Massachusetts, Amherst, MA. (CMER Project 89-08)

Jury, S. H. 1992. The effects of low salinity on the physiology and behavior of estuarine lobsters (*Homarus americanus*). MS Thesis, University of Massachusetts, Amherst, MA. (CMER Project 91-04)

Nelson, G.A. 1990. Population biology and dynamics of northern sand lance (*Ammodytes dubius*) in the Gulf of Maine to Middle Atlantic Bight region. MS Thesis. University of Massachusetts, Amherst, MA. (CMER Project 89-01)

Nelson, G.A. 1993. The potential impacts of skate abundance upon the invertebrate resources and growth of yellowtail flounder (*Pleuronectes ferrugineus*) on Georges Bank. PhD Dissertation, University of Massachusetts, Amherst, MA. (CMER Project 89-05)

Silva, H. 1993. Population dynamics of the spiny dogfish, *Squalus acanthias*, in the northwest Atlantic. PhD. Dissertation, University of Massachusetts, Amherst, MA. (CMER Project 90-04)

Sprankle, K. A. 1994. Tag loss and survival trends for the Atlantic coastal migratory stock of striped bass (1969-1992). MS Thesis, University of Massachusetts, Amherst, MA. (CMER Project 90-03)

APPENDIX 2. RECORD OF CMER SPONSORED PUBLICATIONS

Abend, A.G., and T. D. Smith. 1995. Differences in ratios of stable isotopes of nitrogen in long-finned pilot whales (*Globicephala melas*) in the western and eastern North Atlantic. ICES Journal of Marine Science 52:837-841.

Almeida, F. and six co-authors. 1992. Goosefish. Pages 45-64 *in* Northeast Fisheries Science Center. Report of the Fourteenth Northeast Regional Stock Assessment Workshop. NEFSC Reference Document 92-09, Woods Hole, Massachusetts.

Athanas, R.P., C. DeMoranville, W.J. Bramlage, and S.D. Kelleher. 1993. Effects of fatty fish fertilizer on northeast agricultural crops and the manufacture of proper liquid fish products. Technical Memorandum, The Environmental Institute, University of Massachusetts, Amherst, Massachusetts, USA. 24pp.

Averill, A., C. DeMoranville, K. Deubert, B. Morzuch, and S. Edwards. 1991. Low input cranberry production: field demonstration and analysis. HortScience 26:479.

Blackwell, B.F., G. Gries, F. Juanes, K. Friedland, and L. Stolte. 1996. A simulation of smolts exiting the Merrimack River: relative effects of fry to smolt survival, migration, and predation" North American Journal of Fisheries Management (submitted).

Boreman, J. 1995. Why tag fish? Underwater Naturalist 23(2):15-17.

Brady, S., and J. Boreman. 1993. Sea turtle distribution and the documented fishery threats in the northeastern U.S. Proceedings of the 13th Annual Sea Turtle Symposium, Jekyll Island, Georgia.

DeMoranville, C. 1992. Fish fertilizer: lessons for low input production. Cranberries 56(3):12-13.

Everly, A. W., and J. Boreman. 1996. Habitat requirements of important fish species inhabiting the Hudson River estuary: availability of information. NOAA Technical Memorandum NMFS-NE (submitted).

Grogan, C. S., and J. Boreman. 1996. Estimating the probability that historical populations of fish species are extirpated. North American Journal of Fisheries Management (submitted).

Jia, T.-d., S.D. Kelleher, H. O. Hultin, R. Maney, and J. Krzynowek. 1992. Comparison of quality loss and changes in the glutathione antioxidant system in stored mackerel and bluefish muscle. Institute of Food Technologists Annual Meeting, Book of Abstracts:154 [Abstract].

Jia, T.-d., S. D. Kelleher, H. O. Hultin, D. Petillo, R. Maney, and J. Krzynowek. 1996. Comparison of quality loss and changes in the glutathione antioxidant system in stored mackerel and bluefish muscle. Journal of Agriculture and Food Chemistry 44:1195-1202.

Jia, T.-d., S. D. Kelleher, H. O. Hultin, D. Petillo, R. Maney, and J. Krzynowek. 1996. Comparison of quality loss and changes in the glutathione antioxidant system in stored mackerel and bluefish muscle. Advance ACS Abstracts, April 15, 1996.

Jury, S. H., M.T. Kinnison, W. H. Howell, and W.H. Watson. 1994. The effects of reduced salinity on lobster (*Homarus americanus* Milne-Edwards) metabolism: implications for estuarine populations. Journal of Experimental Marine Biology and Ecology 176:167-185.

Jury, S. H., M.T. Kinnison, W.H. Howell, and W.H. Watson. 1994. The behavior of lobsters in response to reduced salinity. Journal of Experimental Marine Biology and Ecology 180:23-37.

Levin, R.E. 1991. Paralytic shellfish toxins: their origin, characteristics and methods of detection - a review. Journal of Food Biochemistry 15:405-417.

Levin, R.E. 1992. Development of a tropical fish assay for saxitoxin. Journal of Food Protection 13:1-5.

Nelson, G.A., and M. R. Ross. 1991. Biology and population changes of northern sand lance (*Ammodytes dubius*) from the Gulf of Maine to the Middle Atlantic Bight. Journal of Northwest Atlantic Fishery Science 11: 11-27.

Nelson, G.D., and M. R. Ross. 1995. Gastric evacuation in little skate. Journal of Fish Biology 46:977-986.

Pelster, B., and W. E. Bemis. 1991. Ontogeny of heart function in the little skate *Raja erinacea*. Journal of Experimental Biology 156:387-398.

Petillo, D., and H. O. Hultin. 1995. Antioxidant loss in Atlantic mackerel (*Scomber scombrus*), light and dark muscle. 1995 Annual Meeting of the Institute of Food Technologists, Technical Program: Book of Abstracts, Abstract #63-9.

Petillo, D., and H. O. Hultin. 1995. Ubiquinone-10 as an antioxidant. 1995 Annual Meeting of the Institute of Food Technologists, Technical Program: Book of Abstracts, Abstract #54D-16.

Petillo, D., and H. O. Hultin. 1995. Loss of antioxidants as a possible indicator of quality in Atlantic mackerel. 1995 Annual Meeting of the Institute of Food Technologists, Technical Program: Book of Abstracts, page 20.

Richards, M. P., S. D. Kelleher, and H. O. Hultin. 1996. Effects of washing with antioxidants on quality of mackerel fillets. 1996 IFT Annual Meeting, Book of Abstracts, No. 37-3, p. 79.

Scharf, F. S., J. A. Buckel, F. Juanes, and D.O. Conover. 1996. Estimating piscine prey size from partial remains: testing for shifts in foraging mode by juvenile bluefish." Environmental Biology of Fishes, in press.

Scharf, F., F. Juanes, and M. Sutherland. 1996. Inferring ecological relationships from the edges of scatter diagrams: a comparison of least squares and quantile regression techniques. Ecology (submitted).

Sprankle, K., J. Boreman, and J. B. Hestbeck. 1996. Loss rates for dorsal loop and internal anchor tags applied to striped bass. North American Journal of Fisheries Management (16):461-464.

Weis, S.A., and W. J. Bramlage. 1992. Using fish waste hydrolysates as a fertilizer for apples and blueberries. Fruit Notes 57(3):15-19.

APPENDIX 3. RECORD OF CMER SPONSORED PRESENTATIONS

Abend, A., T.D. Smith, and B. Fry. 1992. Ecology of pilot whales with studies with stable isotope tracers in whale tissues and stomach contents. Ninth Biennial Conference on the Biology of Marine Mammals, Chicago, Illinois (poster).

Brady, S., and J. Boreman. 1992. A preliminary review of data bases that contain sea turtle sightings, strandings, and entanglements in the northeastern US Annual International Sea Turtle Conference, Jekyll Island, Georgia (2/92, poster).

Brady, S., and J. Boreman. 1993. Sea turtle distribution and the documented fishery threats in the northeastern U.S. 49th Annual Northeastern Fish and Wildlife Conference, Atlantic City, New Jersey (4/93, oral).

Brady, S. L., and J. Boreman. 1996. Incidental take of sea turtles in the longline fishery off the northeastern U.S. coast. Symposium on the Consequences and Management of Fisheries Bycatch, Dearborn, Michigan (8/96, oral).

Dantzer, W., and R.E. Levin. 1992. Studies on the effect of bacteria on paralytic shellfish toxin produced by dinoflagellate algae. Atlantic Fisheries Technological Conference (10/92, oral).

Dantzer, W., and R.E. Levin. 1992. Effects of bacteria on paralytic shellfish toxin production by dinoflagellate algae. Northeast Meeting of the Institute of Food Technologists (10/92, oral).

Hartley, D. R. 1992. Age and growth methods and determinations for Gulf of Maine goosefish. 14th Northeast

Regional Stock Assessment Workshop, Woods Hole, Massachusetts (6/92, oral).
Hultin, H.O. 1994. Technological developments on Atlantic mackerel. Atlantic Mackerel Workshop, Northeast Regional Office, National Marine Fisheries Service (11/94, oral).
Jia, T.-d., S.D. Kelleher, H.O. Hultin, R. Maney, and J. Krzynowek. 1992. Comparison of quality loss and changes in the glutathione antioxidant system in stored mackerel and bluefish muscle. Institute of Food Technologists Annual Meeting (Poster).
Jury, S.H. 1991. The effects of salinity on the physiology and behavior of estuarine lobsters (*Homarus americanus*). Presented at University of New Hampshire Math and Marine Science Program (7/91, oral).
Jury, S.H. 1992. The effects of salinity on the physiology and behavior of estuarine lobsters (*Homarus americanus*). Presented at Marine Benthic Ecology Meetings (3/92), Five College Coastal and Marine Science Student Symposia (3/92), and East Coast Nerve Net (3/92, poster).
Lanza, H. M., and C.R. Griffin. 1995. Seabird entanglement by commercial fisheries in the northwestern Atlantic Ocean: assessment of the Northeast Fisheries Science Center Bycatch Database. 51st Annual Northeast Fish and Wildlife Conference, Ocean City, Maryland (4/95, poster).
Lanza, H. M., and C.R. Griffin. 1996. Seabird entanglement by commercial fisheries in the northwestern Atlantic Ocean: assessment of the Northeast Fisheries Science Center bycatch database. Northeast Fisheries Science Center Research Symposium (4/96, poster).
Lanza, H. M., and C. R. Griffin. 1996. Seabird entanglement by U.S. commercial fisheries in the northwest Atlantic Ocean. Symposium on the Consequences and Management of Fisheries Bycatch, Dearborn, Michigan (8/96, oral).
Lewandowski, T.A. 1994. U.S. enforcement problems associated with regulation of Georges Bank fisheries. Annual Meeting, American Fisheries Society, Halifax, Nova Scotia (8/94, oral).
Matiskella, K. 1995. Age and growth of longhorn sculpin (*Myoxocephalus octodecimspinosus*) on Georges Bank. Annual Meeting, American Fisheries Society, Tampa, Florida (8/95, oral).
Petillo, D., and H.O. Hultin. 1995. Antioxidant loss in Atlantic mackerel (*Scomber scombrus*), light and dark muscle. 1995 Annual Meeting of the Institute of Food Technologists, Anaheim, California (6/95, oral)
Petillo, D., and H.O. Hultin. 1995. Loss of antioxidants as a possible indicator of quality in Atlantic mackerel. 1995 Annual Meeting of the Institute of Food Technologists, Anaheim, California (6/95, oral).
Petillo, D., and H.O. Hultin. 1995 (Poster). Ubiquinone-10 as an antioxidant. 1995 Annual Meeting of the Institute of Food Technologists, Anaheim, California (6/95, poster).
Richards, M. P., S. D. Kelleher, and H. O. Hultin. 1996. Effects of washing with antioxidants on quality of mackerel fillets. 1996 IFT Annual Meeting, New Orleans (6/96, oral).
Ryder, C.A. 1991. Age and growth of ocean pout in the northwest Atlantic. 47th Annual Northeast Fish and Wildlife Conference, Portland, Maine (5/91, oral).
Scharf, F. J. 1995. Estimating piscine prey size from partial remains: testing for shifts in foraging mode by bluefish. 1995 Annual Meeting of Polgar Fellows, The Institute for Ecosystem Studies, Millbrook, New York (8/95, oral).
Scharf, F., J. Buckel, F. Juanes, and D. Conover. 1996. Estimating prey size from partial remains: testing for shifts in foraging mode by juvenile bluefish. 52nd Annual Northeast Fish and Wildlife Conference, (4/96, oral).
Scharf, F., F. Juanes, and M. Sutherland. 1996. Comparing quantile and least squares regression techniques used to estimate the slopes of upper and lower bounds of scatter diagrams" American Association of Ichthyologists and Herpetologists (6/96, oral).
Scharf, F., and F. Juanes. 1996. Foraging tactics of bluefish in the Hudson River: the influence of body size on predator mode choice and prey profitability. Polgar Fellowship Studies Symposium (8/96, oral).
Sprankle, K.A., and J. Boreman. 1991. Exploitation of striped bass along the northeast US coast. Emergency Striped Bass Study Annual Workshop. Atlantic States Marine Fisheries Commission, Norfolk, VA (1/91, oral).
Sprankle, K.A., and J. Boreman. 1992. Exploitation of striped bass along the northeast US coast. Emergency Striped Bass Study Annual Workshop. Atlantic States Marine Fisheries Commission (1/92, oral).
Sprankle, K.A., and J. Boreman. 1993a. Tag evaluation study of the ALS tag on striped bass. Emergency Striped Bass Study Annual Workshop. Atlantic States Marine Fisheries Commission (2/93, oral).
Sprankle, K.A., and J. Boreman. 1993b. Tag retention by striped bass along the northeast US coast. 49th Annual Northeast Fish and Wildlife Conference, Atlantic City, New Jersey (4/93, oral).
Sprankle, K.A., and J. Boreman. 1993c. Exploitation of striped bass along the northeast US coast. Southern New England Chapter, American Fisheries Society, Amherst, Massachusetts (6/93, oral).

APPENDIX 4. ***PARTICIPATION OF UMASS FACULTY, STAFF, AND STUDENTS IN THE UMASS/NOAA CMER PROGRAM, 1989-1997.***

Project No.	Short Title	Faculty and Staff (Department)	Student Participant (Funded Position)[d]
89-01	**Sand Lance**	**M. Ross (Forestry and Wildl)**	**G. Nelson (Res. Asst.)**
89-02	**Little Skate**	**W. Bemis (Biology)**	**D. Fahey (Res. Asst.)** **B. Peltser (Res. Assoc.)** **J. Shardo (Tech.)** **J. Duprie (Tech.)**
89-03	**Right Whale**	**J. Finn (Forestry and Wildl)**	**E. Moses (Res Asst.)** **Z. Chen (Tech.)** **C. Capone (Tech.)** **A. Lesen (Tech.)**
89-05	**Skate Feeding**	**M. Ross (Forestry and Wildl)**	**G. Nelson (Res. Asst.)** **C. Ryder (Tech.)** **J. Barabee (Tech.)**
89-06	**Port Sampling**	**B. Morzuch, C. Willis (Resource Econ)**	**F. Du (Res. Asst.)**
89-07	**Fish Fertilizer**	**R. Athanas, C. DeMoranville, S. Kelleher (Coop Ext)** **W. Bramlage (Plant and Soil Science)**	**S. Pratt (Tech.)** **M. Abbate (Tech.)**
89-08	**Mackerel Shelf-Life I**	**H. Hultin (Food Science)**	**D. Petillo (Res Asst.)** **T. Jia (Res. Asst.)** **G. Krishnaumurthy (Tech.)**
90-01	**PSP Bacteria**	**R. Levin (Food Science)**	**W. Dantzer (Res. Asst.)** **A. Gilbert (Tech.)** **L. Ocasio (Tech.)** **P. LeFrebrve (Tech.)** **J. Delburne (Tech.)** **I. Nieves (Tech.)** **D. Silva (Tech.)** **E. Teutch (Tech.)** **A. Detro (Tech.)** **D. Walters (Tech.)**
90-02	**Fish Futures**	**T. Schneeweis, N. Milonas (Management)**	**P. Clark (Tech.)** **R. Katariya (Tech.)** **L. Snyder (Tech.)** **T. Meyerhoff (Tech.)**
90-03	**Striped Bass**	**J. Boreman (Forestry and Wildl)**	**K. Sprankle (Res. Asst.)**
90-04	**Spiny Dogfish**	**M. Ross (Forestry and Wildl)**	**H. Silva**
91-01	**Ocean Pout**	**M. Ross (Forestry and Wildl)**	**C. Ryder**
91-03	**Pilot Whale**	**J. Finn (Forestry and Wildlife)**	**A. Abend (Res. Assist.)** **T. Lewandowski (Tech.)** **B. Fitzpatrick (Tech.)**
91-04	**Lobster**	**C. Edwards (Biology)**	**S. Jury (Res. Asst.)**
91-05	**Discard Mortality**	**M. Ross (Forestry and Wildl)**	**S. Hokenson (Res. Assist.)**

Project No.	Short Title	Faculty and Staff (Department)	Student Participant (Funded Position)[d]
91-06	**Goosefish Biology**	**M. Ross (Forestry and Wildl)**	**D. Hartley (Res. Assist.)**
92-04	**Sea Turtles**	**J. Boreman (Forestry and Wildl)**	**S. Brady (Res. Asst.)** **E. Pyle (Tech.)**
92-07	**Vitellogenin Assay**	**J. Kunkel (Biology)**	**R. Hartling (Tech.)**
92-08	**Winter Flounder**	**W. Bemis (Biology)**	**K. Dietz (Tech.)** **P. Holmes (Tech.)**
92-09	**Short Course**	**J. Boreman (Forestry and Wildl)**	**K. Sprankle (Teach. Asst.)** **S. Brady (Teach. Asst.)** **B. McGowan (Tech.)**
93-01	**Seabirds**	**C. Griffin (Forestry and Wildl)**	**H. Lanza (Tech.)**
93-02	**Longhorn Sculpin**	**M. Ross (Forestry and Wildl)**	**K. Matiskella (Res. Assist.)**
93-04	**Mackerel Shelf-Life II**	**H. Hultin (Food Science)**	**D. Petillo (Res. Assist.)** **S. Subramanian (Res. Assoc.)** **M. Richards (Tech.)**
93-06	**Goosefish Development**	**W. Bemis (Biology)**	**A. Everly (Res. Asst.)**
93-07	**Student Internships**	**R. Walker (Env Sciences)** **R. Levin (Food Science)**	**A. Aiello (Tech.)** **C. Baxter (Tech.)**
94-03	**Fisheries Enforcement**	**J. Boreman (Forestry and Wildl)**	**T. Lewandowski**
94-04	**Trophic Dynamics**	**F. Juanes (Forestry and Wildl)**	**F. Scharf (Res. Assist.)**
94-07	**Subsistence Fishing**	**R. Muth (Forestry and Wildl)**	**TBA (Res. Assist.)**
94-09	**Irradiated Seafood**	**W. Nawar (Food Science)**	**E. DeGroote (Res. Assist.)**
95-01	**Hudson River Habitats**	**J. Boreman (Forestry and Wildl)**	**A. Everly (Res. Assoc.)** **H. Batten (Tech.)**
95-09	**Winter Flounder**	**J. Newsted (Environ. Sci.)**	**A. Jensen (Res. Assist.)**
95-10	**Plankton Analysis**	**J. Tyson (Chemistry)** **P. Uden (Chemistry)**	**M. Spaziani (Res. Assist.)** **N. Hardas (Res. Assist.)** **M. Storton (Res. Assist.)** **O. McPhail (Res. Assist.)** **Z. Arslan (Res. Asst.)**
95-11	**Sturgeon Recovery**	**J. Boreman (Org. and Evol. Biol)**	**C. Grogan (Res. Assist.)**
95-12	**Benthic Sampling**	**J. Boreman (Forestry and Wildl)**	**J. Collins (Tech.)** **E. Nadeau (Tech.)**
95-13	**Merrimack Salmon**	**F. Juanes (Forestry and Wildl)**	**B. Blackwell (Res. Assoc., CMER Fellow**
96-06	**Plankton Regimes**	**B. Rothschild (CMAST, Dartmouth)** **A. Gongopadhyay (CMAST, Dartmouth)**	**M. Lambert (Res. Asst.)** **A Gademann (Res. Asst.)** **M. Strollsteimer (Res. Asst.)** **H. Kim (Post-Doc.)**
96-08	**Cod Maturity**	**J. Kunkel (Biology, Amherst)** **T. Tattar (Microbiology, Amherst)**	**J. Bohannon (graduate)** **J. Zydlewski (graduate)** **C. Perlroth (Tech.)**

Project No.	Short Title	Faculty and Staff (Department)	Student Participant (Funded Position)[d]
		Amherst)	**R. Alperin-Lee (Res. Asst.)** **M. Pelak (Intern)** **R. Moniz (Intern)** **R. Sharma (Intern)**
96-10	**Fish. Mgt. Interns**	**J. Boreman (Forestry and Wildl., Amherst)**	**M. Kozlack (Intern)** **J. Lee (Intern)** **M. Jackson (Intern)** **L. Suslowicz (Intern)**
96-11	**Bluefin Tuna**	**F. Juanes (Forestry and Wildl., Amherst)**	**B. Hanrahan (Res. Asst.)**
96-13	**Fishery Study**	**D. Georgianna (Economics, Dartmouth)**	**TBA (Res. Asst.)**
97-03	**Monkfish ID**	**G. Hinkle (Biology, Dartmouth)** **R. Edgar (Biology, Dartmouth)**	**TBA (Res. Asst.)**
97-04	**Charter Fisheries**	**D. Loomis (Forestry And Wildl., Amherst)** **M. Ross (Forestry And Wildl., Amherst)** **D. Georgianna (Economics, Dartmouth)**	**R. Salz (Res. Asst.)**
97-10	**Seabird Mapping**	**C. Griffin (Forestry and Wildl., Amherst)** **J. Finn (Forestry and Wildl., Amherst)**	**H. Lanza (Tech.)**

APPENDIX 5. CONTRIBUTION OF SAMPLES, DATA, EQUIPMENT, AND FACILITIES TO THE UMASS/NOAA CMER PROGRAM, 1989-1997.

Project No.	Short Title	NOAA Contribution	UMass Contribution
89-01	**Sand Lance**	**Biological samples, fish survey data**	**Lab space and equipment, micro-computer use**
89-02	**Little Skate**	**Aquarium space, research vessel time, office and lab space for UMass student**	**Micro-computer use, histological prep. lab, microscopy lab, photo processing lab, aquarium and lab space, access to electron micro.**
89-03	**Right Whale**	**Data base conversions, whale sightings data, fish survey data**	**Micro-computer use, VAX computer access**
89-05	**Skate Feeding**	**Research vessel time, aquarium space, office and lab space for UMass student, VAX computer time**	**Lab space and equipment, micro-computer use, field sampling equipment**
89-06	**Port Sampling**	**Fisheries data**	**Computer access**
89-07	**Fish Fertilizer**	**Fish hydrolysate preparation, lab space for UMass student**	**Lab space and equipment at Gloucester Station, Cranberry Station, Waltham Station, Belchertown Food Farm**

Project No.	Short Title	NOAA Contribution	UMass Contribution
89-08	**Mackerel Shelf-Life I**	**Lab space for UMass student, analysis of selenium**	**Lab space and equipment**
90-01	**PSP Bacteria**	**Bacterial isolates, analysis of toxins**	**Lab space and equipment, computer access, algal incubation facilities**
90-02	**Fish Futures**	**Fisheries data**	**Computer access**
90-03	**Striped Bass**	**Tagging data base, research vessel time, sampling equipment, micro-computer**	**VAX computer access, field sampling equipment, fish tags**
90-04	**Spiny Dogfish**	**Office and lab space for UMass student, biological samples**	**Lab space and equipment, computer access**
91-01	**Ocean Pout**	**Office and lab space for UMass student, biological samples**	**Micro-computer use**
91-03	**Pilot Whale**	**Data base conversions, sightings data, fish survey data**	**Micro- and main frame computer use**
91-04	**Lobster**		**Lab space (Univ of NH), computer access**
91-05	**Discard Mortality**	**Data, equipment, use of computer and cooperating vessels**	**Office and lab space for student in Amherst and Gloucester**
91-06	**Goosefish Biology**	**Biological samples, data, vessel time, use of computer and organism aging facilities**	**Office and lab space, access to micro- and main frame computers**
92-04	**Sea Turtles**	**Data, use of computer**	**Office space, VAX and GIS computer access**
92-07	**Vitellogenin Assay**	**Biological samples**	**Lab space, bioassay equipment**
92-08	**Winter Flounder**	**Biological samples, preservatives, sample containers**	**Office space, lab space, and sorting equipment**
93-01	**Seabirds**	**Data, use of computer**	**Office space, computer access**
93-02	**Longhorn Sculpin**	**Biological samples, data, vessel time, use of computer and organism aging facilities**	**Office and lab space, computer access**
93-04	**Mackerel Shelf-Life II**	**Lab space for UMass student**	**Lab space and equipment**
93-06	**Goosefish Development**	**Biological samples**	**Lab space, scanning electron and light histology microscopes**
93-07	**Student Internships**	**Lab and office space, on-the-job training**	
94-04	**Trophic Dynamics**	**Data, use of computer**	**Office space, computer access**
94-07	**Subsistence Fishing**	**Data, use of computer**	**Office space, computer access**
94-09	**Irradiated Seafood**	**Analytical determinations**	**Office and lab space, and equipment**
95-01	**Hudson R. Habitats**	**Access to data**	**Office and lab space**
95-09	**Winter Flounder**	**Biological samples**	**Lab space and equipment**
95-10	**Plankton Analysis**	**Biological samples**	**Lab space and equipment**

Project No.	Short Title	NOAA Contribution	UMass Contribution
95-11	**Sturgeon Recovery**	**Access to data**	**Office and lab space**
95-12	**Benthic Sampling**	**Biological samples**	**Lab space and equipment**
95-13	**Merrimack Salmon**	**Biological samples, access to data**	**Lab and office space, equipment**
96-06	**Plankton Regimes**	**Access to data**	**Office space, computer access**
96-08	**Cod Maturity**	**Biological samples**	**Lab space and equipment**
96-10	**Fish. Mgt. Interns**	**Office space**	
96-11	**Bluefin Tuna**		**Office and lab space, equipment**
96-13	**Fishery Study**	**Access to data**	**Office space and computer access**
97-03	**Monkfish ID**	**Samples**	**Office and lab space, equipment**
97-04	**Charter Fisheries**	**Access to data**	**Office space**
97-10	**Seabird Mapping**	**Access to data, technical assistance**	**Office space, equipment**

APPENDIX 6. PROJECTS SUPPORTED THROUGH THE UMASS/NOAA CMER PROGRAM.

FY	CMER Project No.	Short Title	Investigator	Amount
1989	**89-01**	**Sand Lance Fecundity**	**Ross**	**2,246**
	89-02	**Little Skate**	**Bemis**	**20,674**
	89-03	**Right Whale**	**Finn**	**13,320**
	89-05	**Skate Feeding**	**Ross**	**13,700**
	89-06	**Port Sampling**	**Morzuch**	**3,508**
	89-07	**Fish Fertilizer**	**Athanas**	**21,000**
	89-08	**Mackerel Shelf-Life I**	**Hultin**	**19,800**
1990	**89-02**	**Little Skate**	**Bemis**	**22,421**
	89-03	**Right Whale**	**Finn**	**18,060**
	89-05	**Skate Feeding**	**Ross**	**17,940**
	89-06	**Port Sampling**	**Morzuch**	**6,853**
	89-07	**Fish Fertilizer**	**Athanas**	**16,002**
	89-08	**Mackerel Shelf-Life I**	**Hultin**	**16,002**
	90-01	**PSP Bacteria**	**Levin**	**23,760**
	90-02	**Fish Futures**	**Milonas**	**6,000**
	90-03	**Striped Bass**	**Boreman**	**14,400**
	90-04	**Spiny Dogfish**	**Silva**	**0**
1991	**89-02**	**Little Skate**	**Bemis**	**23,784**
	89-03	**Right Whale**	**Finn**	**20,275**
	89-05	**Skate Feeding**	**Ross**	**15,840**
	89-08	**Mackerel Shelf-Life I**	**Hultin**	**9,396**
	90-01	**PSP Bacteria**	**Levin**	**24,480**
	90-03	**Striped Bass**	**Boreman**	**14,520**
	90-04	**Spiny Dogfish**	**Silva**	**0**
	91-01	**Ocean Pout**	**Ryder**	**467**
	91-03	**Pilot Whale**	**Finn**	**19,216**

FY	CMER Project No.	Short Title	Investigator	Amount
	91-04	**Lobster**	**Jury**	**9,204**
	91-05	**Discard Mortality**	**Ross**	**30,000**
	91-06	**Monkfish Biology**	**Ross**	**25,000**
1992	**89-03**	**Right Whale**	**Finn**	**20,790**
	89-08	**Mackerel Shelf-Life I**	**Hultin**	**10,404**
	89-05	**Skate Feeding**	**Ross**	**2,400**
	90-01	**PSP Bacteria**	**Levin**	**24,318**
	90-03	**Striped Bass**	**Boreman**	**6,600**
	90-04	**Spiny Dogfish**	**Silva**	**0**
	91-03	**Pilot Whale**	**Finn**	**19,530**
	91-05	**Discard Mortality**	**Ross**	**0**
	91-06	**Monkfish Biology**	**Ross**	**0**
	92-04	**Sea Turtles**	**Boreman**	**15,372**
	92-07	**Vitellogenin Assay**	**Kunkel**	**9,000**
	92-08	**Winter Flounder**	**Bemis**	**3,840**
1993	**92-09**	**Short Course**	**Boreman**	**4,435**
	93-01	**Seabirds**	**Griffin**	**3,114**
	93-02	**Longhorn Sculpin**	**Ross**	**14,220**
	93-04	**Mackerel Shelf-Life II**	**Hultin**	**45,510**
	93-06	**Goosefish Development**	**Bemis**	**5,863**
	93-07	**Student Internships**	**Walker/Levin**	**3,900**
1994	**93-01**	**Seabirds**	**Griffin**	**0**
	93-02	**Longhorn Sculpin**	**Ross**	**20,670**
	93-04	**Mackerel Shelf-Life II**	**Hultin**	**0**
	94-03	**Fisheries Enforcement**	**Boreman**	**1,100**
	94-04	**Trophic Dynamics**	**Juanes**	**10,080**
	94-07	**Subsistence Fishing**	**Muth**	**34,800**
	94-09	**Irradiated Seafood**	**Nawar**	**25,440**
1995	**93-01**	**Seabirds**	**Griffin**	**0**
	93-02	**Longhorn Sculpin**	**Ross**	**0**
	93-04	**Mackerel Shelf-Life II**	**Hultin**	**22,200**
	94-04	**Trophic Dynamics**	**Juanes**	**20,626**
	94-07	**Subsistence Fishing**	**Muth**	**0**
	94-09	**Irradiated Seafood**	**Nawar**	**0**
	95-01	**Hudson R. Habitats**	**Boreman**	**9,540**
	95-09	**Winter Flounder**	**Newsted**	**23,748**
1995	**95-10**	**Plankton Analysis**	**Tyson/Uden**	**25,200**
	95-11	**Sturgeon Recovery**	**Boreman**	**36,480**
	95-12	**Benthic Sampling**	**Boreman**	**7,589**
	95-13	**Merrimack Salmon**	**Juanes**	**47,816**
1996	**93-01**	**Seabirds**	**Griffin**	**0**
	93-02	**Longhorn Sculpin**	**Ross**	**0**
	93-04	**Mackerel Shelf-Life II**	**Hultin**	**0**
	94-04	**Trophic Dynamics**	**Juanes**	**19,836**

FY	CMER Project No.	Short Title	Investigator	Amount
	94-07	**Subsistence Fishing**	**Muth**	**0**
	94-09	**Irradiated Seafood**	**Nawar**	**7,860**
	95-01	**Hudson River Habitats**	**Boreman**	**0**
	95-09	**Winter Flounder**	**Newsted**	**23,348**
	95-10	**Plankton Analysis**	**Tyson/Uden**	**24,000**
	95-11	**Sturgeon Recovery**	**Boreman**	**0**
	95-12	**Benthic Sampling**	**Boreman**	**0**
	95-13	**Merrimack Salmon**	**Juanes**	**47,816**
	96-06	**Plankton Regimes**	**Rothschild**	**25,200**
	96-08	**Cod Maturity**	**Kunkel**	**26,960**
	96-10	**Fish. Mgt. Interns**	**Boreman**	**49,476**
	96-11	**Bluefin Tuna**	**Juanes**	**31,269**
	96-13	**Fishery Study**	**Georgianna**	**59,937**
1997	**96-06**	**Plankton Regimes**	**Rothschild**	**24,600**
	96-08	**Cod Maturity**	**Kunkel**	**23,040**
	96-10	**Fish. Mgt. Interns**	**Boreman**	**7,047**
	96-11	**Bluefin Tuna**	**Juanes**	**31,269**
	96-13	**Fishery Study**	**Georgianna**	**58,600**
	97-03	**Monkfish ID**	**Hinkle/Edgar**	**27,600**
	97-04	**Charter Fisheries**	**Loomis/Ross/Georgianna**	**24,250**
	97-10	**Seabird Mapping**	**Griffin/Finn**	**5,916**
	97-15	**Smolt Predation**	**Juanes**	**25,219**
1998	**97-04**	**Charter Fisheries**	**Loomis/Ross/Georgianna**	**24,250**
	97-15	**Smolt Predation**	**Juanes**	**25,219**
	98-01	**Metals and Metalloids**	**Tyson, Uden**	**28,440**
	98-02	**Tautog Development**	**Kunkel**	**28,907**
	98-07	**Magnesium in Otoliths**	**Friedland**	**24,900**
	98-08	**Programming**	**Friedland**	**21,840**
1999	**97-15**	**Smolt Predation**	**Juanes**	**7,999**
	98-01	**Metals and Metalloids**	**Tyson, Uden**	**28,440**
	98-02	**Tautog Development**	**Kunkel**	**28,788**
	98-07	**Magnesium in Otoliths**	**Friedland**	**24,900**
	99-01	**Baseline Herring**	**Georgianna**	**60,196**
	99-03	**Biology Halibut**	**Ross**	**22,500**
	99-04	**Harmful Algae**	**Rooney-Varga**	**21,681**
	99-06	**Right Whale Satellites**	**Bisagni**	**24,914**
	99-08	**Cape Cod Turtles**	**Griffin**	**51,258**
	99-09	**Whale Habitat**	**Brault**	**52,970**
	99-10	**Sturgeon By-catch**	**Friedland**	**18,750**
2000	**97-04**	**Charter Fisheries**	**Loomis/Ross/Georgianna**	**14,600**

FY	CMER Project No.	Short Title	Investigator	Amount
	99-03	**Biology Halibut**	**Ross**	**18,840**
	99-04	**Harmful Algae**	**Rooney-Varga**	**21,525**
	99-06	**Right Whale Satellites**	**Bisagni**	**18,660**
	99-08	**Cape Cod Turtles**	**Griffin**	**69,000**
	99-09	**Whale Habitat**	**Brault**	**20,012**
	99-10	**Sturgeon By-catch**	**Friedland**	**18,750**
	00-02	**Lobster Maturity**	**Kunkel**	**11,700**
	00-08	**Stable Isotopes**	**Friedland**	**38,500**

APPENDIX 7. COMPLETED PROJECTS FUNDED THROUGH THE UMASS/NOAA CMER PROGRAM, 1989-1999.

Final reports are available from the program director.

Sand Lance Biology

M.R. Ross, Department of Forestry and Wildlife Management, UMass (89-01, completed in 1989)

Trends in temporal and spatial abundance, and population size structure of the sand lance were examined based on trawl survey data from 1963 to 1988. Reproduction, age structure, and growth were evaluated in 1986-88 from the Gulf of Maine to Middle Atlantic Bight region off the eastern U.S. coast. Relative abundance indices, which were near zero prior to 1976, increased dramatically (5-10 fold) from 1976 to 1981 in all regions studied. Subsequently, abundance dropped from 1982 to 1987.

Gonadal recrudescence of *A. dubius* begins in late July and males appeared to mature earlier in a reproductive season than females. Estimates of fecundity ranged from 1,169 to 22,904 ova per female for sand lance 137 to 213 mm total length. Maximum age estimated from otoliths and vertebrae was five years. Age at 50% maturity was age II for all regions in spring. Comparison of von Bertalanffy growth curves derived for *A. dubious* from the study regions to published values from Newfoundland and Nova Scotia suggests a decline in length and age with declining latitude.

Developmental Anatomy of the Little Skate

W.E. Bemis, Department of Zoology, UMass (89-02, completed in 1992)

The little skate (*Raja erinacea*) is a small oviparous elasmobranch abundant in the area between southeastern Newfoundland and North Carolina. Population levels of this species on Georges Bank are currently at historically high levels, prompting concern among the fishing industry and resource managers about the possibility that skates are replacing more commercially important species. This study provides the first reliable estimates of fecundity for little skates, based on procedures established in other investigations of skate fecundity in which deposition of egg cases from females maintained in aquaria are monitored to calculate a per day output. This rate of egg laying is then extrapolated into an estimate of total annual egg production. In addition to basic estimates of egg case output, this study is unique in that fertility of the egg cases deposited was monitored to allow better estimation of potential recruitment. No quantitative analysis of fertility has been provided by any previous study. Based on the fecundity and fertility estimates, the Georges Bank population of little skates probably has the ability to expand at rates higher than previously suspected.

Investigation of Right Whale Population Dynamics and Spatial Distribution in New England Waters

J.T. Finn, Department of Forestry and Wildlife Management, UMass-Amherst (89-03, completed in 1995, funding provided by Marine Mammal Investigation, NEFSC, NMFS)

The Right Whale Recovery Plan lists as one of its main objectives the "identification and protection of habitats essential to the survival of the northern right whale." It is still unknown where some segments of the population migrate during winter, and new genetic evidence indicates an additional summering ground near Greenland. During the summer and early fall, right whales are concentrated in the Gulf of Maine, in the Bay of Fundy, and on the Scotian Shelf near Browns Bank and Baccaro Bank. Methodology for this study involved plotting sightings data for right whales, sea surface temperature, bathymetry, and currents in overlaying coverages using a geographic information system (GIS).

The analysis involved looking for broad seasonal patterns. Multivariate discriminant analysis was used to determine if there is a statistically-significant relationship between locations where right whales are sighted and geophysical features. The discriminant function was then used to classify right whale habitat and predict the likelihood of right whale habitation in areas of the northwest Atlantic that have not been investigated. Factors such as food production and other biotic activity were also be incorporated into the GIS to determine how right whale occurrence may be influenced by environmental changes.

The Potential Effects of Skate Abundance Upon Georges Bank Resources

M.R. Ross, Department of Forestry and Wildlife Management, UMass (89-05, completed in 1993)

On Georges Bank, skates appear to be replacing depleted populations of economically-important demersal fishes like Atlantic cod and yellowtail flounder. Because skates share some food resources with the teleosts, NMFS biologists are concerned that food resources historically available to demersal fishes are now being consumed by the abundant skates, which could indirectly and negatively impact the growth of demersal species. The main objectives of this study were to estimate the consumptive impact of little skate and winter skate on their invertebrate prey, and to test whether these skates may indirectly affect the growth of yellowtail flounder on Georges Bank. The percentage of benthic production consumed by little skate and winter skate from 1969 to 1990 ranged from 5% to 15% and 11% to 43%, respectively, indicating that only a small to moderate proportion of the benthic biomass is consumed by these species. Results also indicate that competition is not an important regulatory mechanism in growth of yellowtail flounder; therefore, skates appear not to have had a measurable impact on the growth dynamics of the demersal teleost.

Multivariate Models for Age Sampling

B.J. Morzuch, Department of Resource Economics, UMass, C.E. Willis, Department of Resource Economics, UMass (89-06, completed in 1991, funding provided in part by Fishery Biology Investigation, Northeast Fisheries Science Center)

In 1989 efforts were initiated to develop a means of estimating variances associated with sampling commercial fisheries for age distributions, a necessary requirement for population dynamics research at the Northeast Fisheries Science Center. A small pilot study was conducted that compared two approaches to the sampling problem using a common data set provided by the Center. These efforts were expanded in the following year to develop estimators of variance and covariance associated with sampling for age/length, and the results help to provide insight into how limited resources of the Northeast Fisheries Science Center should be channeled for sampling purposes.

The Effects of Hydrolysate Prepared from Fatty Fish Wastes on Plant Culture, Soil, and Media

R. Learson, Northeast Fisheries Science Center, NMFS, Gloucester, MA, R.P. Athanas and S.D. Kelleher, UMass Cooperative Extension, Gloucester, MA, C. DeMoranville, UMass Cranberry Experimental Station, Wareham, MA, W.J. Bramlage, Department of Plant and Soil Science, UMass (89-07, completed in 1991)

New England fish processors annually produce up to 100 million pounds of fish waste, much of which is disposed of by landfills and dumping at sea. This represents a waste of potentially valuable protein material. A cooperative research effort among the Gloucester Laboratory of NEFSC, UMass Cooperative Extension, the UMass Cranberry Experiment Station, the UMass Marine Station, the UMass Department of Food Science and Nutrition, and the UMass Department of Plant and Soil Science has demonstrated that acid hydrolysis of fish wastes can be used to produce a stabilized liquid material which contains 2% nitrogen, 4% phosphorous, 1% potassium, and significant levels of micronutrients such as magnesium, calcium, iron, manganese, and boron. Field trials on bedding plants, vegetables, and cranberries have demonstrated that fish hydrolysates made from groundfish wastes were as effective as commercial fertilizers on plant growth and crop yield. In all these tests, the hydrolysate was produced from lean species of fish (approximately 1% fat). A significant volume of fish waste from fatty species such as whiting, mackerel, and herring are currently being produced in New England. Information on the performance of fertilizers made from these species is necessary to determine whether or not this technology can be used for these waste products. Results of experiments on cranberries, apple trees, and blueberries indicate that fatty fish hydrolysates were effective sources for nitrogen, potassium, and phosphorus, although the material was malodorous and problems were encountered in application.

The Effect of Selenium on the Activity of the Glutathione Peroxidase System in Post-Mortem Fish

H.O. Hultin, Department of Food Science and Nutrition, UMass Marine Station, Gloucester, MA, J. Krzynowek, Northeast Fisheries Science Center, NMFS, Gloucester, MA (89-08, completed in 1993)

Sensory evaluation of stored mackerel and bluefish muscle confirmed observations of the NMFS Gloucester

Laboratory that mackerel spoiled faster than bluefish. The difference between species was greatest during the early stages of quality loss when these species would be most apt to be consumed. No difference between the two species were observed in either their content of soluble or low molecular weight selenium, or in the activities of oxidized glutathione reductase. Bluefish had approximately 25% more activity of glutathione peroxidase than mackerel. This difference is unlikely to account for the greater stability of the bluefish muscle compared to mackerel.

Loss of glutathione was generally faster in mackerel than bluefish, which correlates with the more rapid loss of quality in stored mackerel; glutathione can function as an anti-oxidant. In both mackerel and bluefish the loss of glutathione appeared as a decrease in total glutathione (reduced plus oxidized). This was unexpected since the functioning of glutathione as an anti-oxidant in the living animal is thought to occur via its cyclic oxidation and reduction. The activity of glutathione transferase was one to two orders of magnitude greater than that of either the glutathione peroxidase or reductase, and thus could cause incorporation of glutathione into other cellular components at a high rate. However, the transferase activity was much higher in bluefish, in which the rate of loss of glutathione was less than in mackerel. Thus, this is either not an important reaction or the transferase does not control the rate-limiting step in the process. In addition, data obtained on the loss of total glutathione in bluefin tuna indicated that the loss was a surface effect and thus probably an oxidation. (Bluefin tuna was used because samples could be obtained that were large enough to evaluate the effect of distance from the surface on the loss of glutathione). In a model system of washed mackerel muscle where oxidation of the lipid was induced by enzymatically-generated free radicals, the glutathione system (glutathione plus glutathione peroxidase) was effective in inhibiting lipid oxidation. This shows that it could be an effective anti-oxidant *in situ*.

Isolation of Paralytic Shellfish Toxin Producing Bacteria from *Protogonyaulax tamarensis*

R.E. Levin, Department of Food Science and Nutrition, UMass (90-01, completed in 1994)

Dinoflagellates are of particular economic and public health significance because of the involvement with Paralytic Shellfish Poisoning (PSP). Toxic incidences occur when environmental conditions allow a large number of dinoflagellates to come in contact with filter-feeding bivalve molluscs such as mussels and clams. PSP is caused by a complex of toxins derived from the dinoflagellates. Optimum bacterial growth conditions for production of paralytic shellfish toxins is being investigated. Pure bacterial isolates are being grown and tested for paralytic shellfish toxin production in the absence of *P. tamarensis*. Studies are being performed on nutritional and environmental factors required for maximum production of toxins. Results will elucidate the role of bacteria as causal agents of paralytic shellfish toxin production in association with *P. tamarensis*. The isolation of toxin-producing bacteria will allow future development of a monoclonal antibody procedure for predicting and monitoring the occurrence of causal bacteria throughout the development of the dinoflagellate blooms. Findings to date indicate that there may be a symbiotic relationship between the dinoflagellate cells and the external contaminating organisms. Several strains of bacteria are being examined for possible excretions of nutrients vital to growth of the dinoflagellate cultures.

The Feasibility of Commodity Futures Contracts for the Fisheries Industry

N. Milonas, School of Management, UMass, T. Schneeweis, School of Management, UMass (90-02, completed in 1991)

The importance of fish products to the U.S. and world economies has brought into focus the increased need for additional means of managing price risk for the fishing industry. At present, few market-based forms of risk management for fish price variability exist. Those that do exist (e.g., forward markets) do not offer a central marketplace whereby individuals can readily insure against future price changes or estimate future cash market prices. The purpose of this project was to analyze the need for price risk management in the fishing industry and to test for the feasibility of a fish futures contract to manage the price risk. Results indicate that, for the fish species analyzed, daily price variability is extremely high. Since hedge demand may be insufficient to establish a successful futures contract for an individual species, the creation of a fish index for various market subgroups was tested as a means of establishing the basis for a fish futures contract. Correlation of the individual species with the created index indicates that, at least for some species, a futures contract based on a fish index may be feasible.

Exploitation of Striped Bass Along the Northeast US Coast

J. Boreman, Department of Forestry and Wildlife Management, UMass (90-03, completed in 1994, funding provided by the Population Dynamics Branch, Northeast Fisheries Science Center)

Striped bass are generally considered to be the most sought-after and valuable marine species for sport fishing in the Northeast US The species has also been the focus of public attention in issues such as power plant siting and operation, highway siting, estuarine pollution, and interjurisdictional fisheries management. The recent decline in several

northeast stocks has drawn attention to exploitation as a possible explanatory factor, and regulation of exploitation as a means of stock restoration. The goal of this project was to reconstruct the history of striped bass exploitation along the northeast US coast before and during the period of major stock declines, using tagging information and ancillary data. The project also evaluated the effectiveness of catch limitations imposed under the Striped Bass Management Plan (and subsequent amendments) enacted by the Atlantic States Marine Fisheries Commission. To do this, a data base containing close to 90,000 tagging records for the Atlantic migratory stock of striped bass, compiled by the American Littoral Society (ALS) from 1968-1992, was analyzed. Included in the project were experiments to determine the retention and mortality rates induced by the ALS tag. The tag retention and tagging-related mortality rates derived from the experiments were incorporated into a mark-recapture method of estimating exploitation on the migratory stock. Results indicate that annual survival of the coastal migratory stock increased by 50% after more stringent fishing regulations went into effect in the mid-1980s, presumably due to lower exploitation.

Population Dynamics of Spiny Dogfish

H. Silva, Department of Forestry and Wildlife Management, UMass (90-04, completed in 1993, funding provided through a Fulbright Scholarship)

The northwest Atlantic population of spiny dogfish has undergone a three-fold increase in abundance since the early 1970s. This study was intended to gain an understanding of the underlying population dynamics of spiny dogfish, and the changes of critical life-history parameters through time that may explain the increase in abundance. Growth rate of juvenile dogfish increased from 1968-71 to 1976-79 then decreased until 1988-90. Juvenile growth rate was inversely correlated with juvenile abundance. Significant negative correlations were also found between fecundity and abundance for most adult size classes, and maturity appeared to occur at a younger size when population abundance was low. A model used to assess the changes in reproductive dynamics of the population suggests that the observed increase in abundance of spiny dogfish is at least partially explained by changes in juvenile growth during the early 1970s, which later resulted in increases in mean size at maturity and fecundity.

Age and Growth of Ocean Pout in the Northwest Atlantic

C. Ryder, Department of Forestry and Wildlife Management, UMass (91-01, completed in 1991)

The ocean pout is a finfish of growing commercial importance. It is included in a proposed amendment to the Northeast Multispecies Management Plan, and is part of a stock assessment initiative by Massachusetts Division of Marine Fisheries to evaluate a small mesh directed fishery in Cape Cod Bay. The purpose of this study was to analyze age and growth data to estimate timing of annuli formation on the otoliths and to develop growth functions for the species. Results indicate that three regional growth patterns exist in the Northwest Atlantic: Cape Cod Bay and north, Georges Bank, and southern New England and mid-Atlantic. Ocean pout grew slowest in the Gulf of Maine and fastest on Georges Bank.

Long-Finned Pilot Whale Distribution and Diet in the North Atlantic

J.T. Finn, Department of Forestry and Wildlife Management, UMass (91-03, completed in 1993, funding provided by the Marine Mammal Investigation, Northeast Fisheries Science Center)

Much of the research involving marine mammals has been on the once-harvested large whales. Until recently, many of the smaller-sized cetaceans have been ignored with little research on their life histories being undertaken. Sighting surveys conducted by the nations of the North Atlantic have supplied valuable data on the abundance and distributions of the smaller cetaceans including the long-finned pilot whale, *Globicephala melas*. The objectives for this study were: (1) to organize the available sighting and stranding data sets to generate a new distribution map; (2) to present the known diet history; (3) to test a new methodology of diet analysis using stable isotope tracers, and predict and evaluate the consumption of known prey species from a study area; and (4) to use stable isotope tracers to determine the trophic level of pilot whales and compare the results to predict potential movement between geographic areas. Particular comparisons were drawn among the Mid-Atlantic Bight, Cape Cod, and the Faroe Islands. Isotope analysis revealed that whales from Cape Cod and the Mid-Atlantic Bight were consuming a mixed diet prior to sampling, but their medium and long-term diets were primarily squid. Faroe Island whales were feeding on prey at a different location than the other two study areas in the medium term, but feeding on prey in the same location as Cape Cod whales over the long term. This suggests that the two groups may interact at the same foraging location during their lifetimes.

Physiological Requirements of Lobsters

S. Jury, Department of Zoology, UMass (91-04, completed in 1991)

This research was based on the hypothesis that spatial and temporal distributions of lobsters by sex and size within estuaries is strongly influenced by their differential sensitivity to changes in salinity. Reproductive males will use the estuary in the late spring and early summer due to the benefits of increasing temperatures; however, females will not move into the estuary due to the risk of low salinity adversely affecting their larvae. Juveniles will be located throughout the estuary at all times of the year and will tolerate low salinities. The larger adult males will use the estuary only in seasons where "benefits" outweigh the costs of low salinity. Therefore, the larger animals use a predominately behavioral mechanism to deal with fluctuating salinities by choosing to move to optimal habitats. Results of the study indicate that lobsters are capable of detecting changes in salinity; lobsters seek to minimize exposure to low salinity water at the highly permeable gill tissue by using a type of "pulse ventilation;" low salinities, comparable to those found in the estuary, are metabolically stressful to lobster; estuarine males and females respond differently, both behaviorally and physiologically, to low salinities comparable to levels found in the estuary; and metabolic and behavioral responses to salinity may determine, in part, the distribution and migration of lobsters in natural habitats. It is likely that the effects of salinity on any individual is dependent upon the severity, rate of change, and duration of any particular low salinity event.

Biology of the Goosefish

M.R. Ross, Department of Forestry and Wildlife Management, UMass-Amherst (91-06, completed in 1995, funding provided by the Population Biology Branch, NEFSC, NMFS)

The goosefish (or monkfish) is currently under increasing fishing pressure due to an expanding fishery for the species. The life history of the species was examined to assess its status and condition as a fishery resource. Factors examined included growth, distribution, abundance, maturation, timing of spawning. A reliable technique for aging the species was also developed; length-frequency analysis was investigated as an alternative means of aging goosefish.

Sea Turtle Sightings, Strandings, and Entanglements in the Northeast Region of the United States

J. Boreman, Department of Forestry and Wildlife Management, UMass (92-04, completed in 1994, funding provided by the NMFS Office of Protected Species)

Data sources containing sea turtle sightings, strandings, and incidental take in fisheries in the northeastern United States were compiled and evaluated to determine which sources contain reliable information. The most reliable and complete data sets were developed into distributional plots by turtle species (leatherbacks and loggerheads), fishery, and season with use of Arc/Info, a geographic information system. The nature and extent of sea turtle interactions with the swordfish fishery were investigated in detail because this fishery had high catches of sea turtles relative to other fisheries operating in the region. Results from the distributional plots support previous observations that leatherbacks and loggerheads are seasonal visitors to the northeastern United States and are found in coastal waters mainly in the summer and fall. High concentrations of leatherbacks and loggerheads occur off Long Island, New York, New Jersey, and Cape Hatteras, North Carolina, suggesting that these areas are important foraging grounds. Leatherback takes in the longline fishery were significantly related targeting sharks, and loggerhead takes were significantly related to targeting swordfish and mixed tuna species.

Development of an Immunological Assay for Winter Flounder Vitellogenin

J. Kunkel, Department of Zoology, UMass (92-07, completed in 1993)

Vitellogenin is a protein which makes up the majority of protein stored as yolk in vertebrate and invertebrate eggs. The protein has been shown to be homologous in amphibians, birds, nematodes, and insects; our knowledge of the biochemistry of the protein in fish is very limited. Knowledge of the protein behavior in other life forms combined with the limited literature available on fish vitellogenin suggests several approaches to producing a microassay for the vitellogenin of winter flounder. The refined technique will be used to identify the status of reproducing winter flounder and the role contaminants and other environmental variables play in the egg development process for the species.

Zooplankton Species Composition at Selected Sites in Central Long Island Sound

W.E. Bemis, Department of Zoology, UMass (92-08, completed in 1993)

As part of a major coast-wide effort to gain an understanding of the biology and effects of contaminants on inshore populations of winter flounder, the Northeast Fisheries Science Center is determining the effects of contamination on reproductive success and the early life history of the species in Long Island Sound. This study involved sampling winter flounder at sites in Long Island Sound representing degrees of contamination, and measuring life history parameters that may be affected by contamination. The parameters included egg viability, hatching success,

and larval development. Adult winter flounder were collected during the spawning season, and early life stages were collected following the spawning season. In the larval fish collections from each site, information was obtained on the density of winter flounder collected, and the species composition of other members of the zooplankton - ichthyoplankton complex. This information was then be used to measure spawning success of winter flounder and potential trophic interactions of their early life stages. The data will be used in a life cycle model to help understand the effects of contaminants on reproductive success of the species.

Short Course: Principles of Fishery Stock Assessment

J. Boreman, Department of Forestry and Wildlife Management, UMass (92-09, completed in 1993, funding provided by the Federal Aid Division, Region 5, U.S. Fish and Wildlife Service)

Stock assessments are playing an increasingly important role in fisheries management. A typical assessment includes the state of biological knowledge of a fishery stock, abundance level patterns and analyses of factors influencing those patterns, and abundance projections given current stock conditions and probable future conditions under selected management scenarios. Availability of high-speed data processing through micro-, mini-, and main-frame computers has brought assessment capabilities to the field level. Stock assessments can now be undertaken in a fraction of the time, and desk-top computers with "canned" assessment software. As a consequence, managers are expecting more stock-based information from field biologists. Lost in the rapid evolution of stock assessments is the capability of field biologists to understand how, why, and when to apply stock assessment methodologies. Many biologists followed the traditional biology track in college and have not had sufficient quantitative training. Others have been trained in the use of stock assessment software without getting an appreciation for the biological and mathematical bases of the software applications. The short course on principles of fishery stock assessment is intended to introduce field biologists to: (1) traditional growth, mortality, recruitment, and harvest models used in stock assessments; (2) mathematical and biological bases for the traditional models; and (3) origins and definitions of terms typically used to describe fishery stock and harvest conditions. Course participants will not be expected to leave the course with an intent on advancing the state-of-the-art of stock assessments, but they should have an appreciation for the types, quantity, and quality of field data necessary to assess a particular fishery stock, and be able to know when and how to apply basic fishery models.

Biology of the Longhorn Sculpin *Myoxocephalus octodecemspinosus*

M. R. Ross, Department of Forestry and Wildlife Management, UMass-Amherst (93-02, Completed in 1996)

The longhorn sculpin may be an important competitor with or predator of commercially important species in the northwest Atlantic Ocean. However, little is presently known about the biology of the species. Two aspects of the biology of the species will be addressed in this project. First, working with the Fishery Biology Investigation of NEFSC, an analysis will be performed of the growth characteristics of the species, which is critical to ultimately understanding its production potential. Second, working with the consumption rates will be determined for a range of temperatures typical of Georges Bank.

Quality Determination in Atlantic Mackerel

H. O. Hultin, Department of Food Science and Nutrition, UMass Marine Station, Gloucester, MA, J. Krzynowek, Northeast Fisheries Science Center, NMFS, Gloucester, MA (93-04, Completed in 1996)

The Atlantic mackerel is a major underutilized species on the eastern seaboard of the U.S. One reason for its underutilization is that the fish undergoes rapid deterioration in quality after being caught. To expand both domestic and foreign markets, it is necessary to develop procedures for accurate determination of the quality of mackerel and reasonable predictions of its potential shelf-life under different conditions. Since lipid oxidation is a major cause of quality deterioration in stored mackerel, the project will compare objective measurements of lipid oxidation with sensory evaluation of different forms of mackerel to provide a means for quality determination of mackerel products.

Early Development and Metamorphosis of the American Goosefish *Lophius americanus* (Lophiidae; Lophiiformes)

W.E. Bemis, Department of Biology, UMass (93-06, completed in 1994)

The goosefish ranges from the northern Gulf of St. Lawrence as far south as Cape Canaveral, Florida, in depths from the tide line down to at least 400 meters. In waters off New England, egg veils are routinely (though unpredictably) encountered during the summer months. With the depletion of traditional fishery stocks, the goosefish has become a more important component of the catch in New England. A better understanding of the biology of this species would be an important step towards developing appropriate management strategies. This project included a thorough analysis of

the timing of development and metamorphosis in the earliest life stages of the species. Several other insights were be gained by this study. First, although there is an diverse array of early life histories known for teleosts, relatively little attention has been given to laboratory developmental studies of most marine fish species, including those of commercial interests such as the goosefish. Development of most lophiid species is completely unknown, and data available for goosefish are based on wild-caught egg veils and planktonic larvae, consisting mainly of descriptions of external morphology using light microscopy. One main objective of this investigation was to use more intensive methods and analyses, such as scanning electron microscopy and light microscopy histology, to study details of development.

Establishment of NOAA-Supported Undergraduate Summer Research Internships

R.W. Walker, Environmental Sciences Program, UMass-Amherst, R.L. Levin, Department of Food Science and Nutrition, UMass-Amherst (93-07, completed in 1995)

The undergraduate program in Environmental Sciences within the College of Food and Natural Resources at UMass presently has in excess of 250 student majors. Students may specialize in one of three program areas of concentration: Environmental Biology and Health, Environmental Toxicology and Chemistry, or Environmental Policy. The curriculum is designed to provide each student with both theory and "hands on" experience necessary to identify, analyze, and solve problems associated with the environment. This project was intended to make available, on a competitive basis, summer internships at a NMFS research facility in the Northeast Region. Students were required to submit a formal report based on their summer laboratory experience and training which also included a presentation of the data gathered and analyzed. Students had an opportunity to obtain six credits of independent study; their immediate supervisor submitted a written report assessing the student's performance and effort.

Habitat Requirements of Important Fish Species Inhabiting the Hudson River Estuary

J. Boreman, Department of Forestry and Wildlife Management, UMass-Amherst (95-01, Completed in 1996, funding provided by the NMFS Office of Habitat Protection)

The purpose of this study is to assemble available information sources from the open literature, gray literature, and private collections that relate to understanding habitat requirements of eleven important fish species inhabiting the Hudson River estuary: striped bass, white perch, American shad, alewife, blueback herring, Atlantic tomcod, Atlantic sturgeon, shortnose sturgeon, largemouth bass, bluefish, and bay anchovy. The assembled data base will be used to assess the feasibility of a full-scale study of the habitat requirements of the species in anticipation of a major habitat restoration program that will occur in the estuary.

Sorting and Identification of Benthic Grab Samples from the Hudson River

J. Boreman, Department of Forestry and Wildlife Management, UMass-Amherst (95-12, Completed in 1996)

During the summer of 1995 a project was undertaken on the Hudson River to identify areas of concentrations of juvenile shortnose and Atlantic sturgeon. In association with sampling for juvenile sturgeon, benthic grab samples were taken to determine if areas of sturgeon concentration are associated with certain food organisms. The sorting and identification of organisms in the grab samples was not funded by the sponsor of the sturgeon project (The Hudson River Foundation), but the information obtained will be key in testing the hypothesis that the summer distributions of the two sturgeon species is based on food supply.

Finfish Discard Mortality in the Gulf of Maine Small-Mesh Shrimp Fishery

M. R. Ross, Department of Forestry and Wildlife Management, UMass-Amherst (91-05, Completed in July 1997, funding provided by the Population Dynamics Branch, NEFSC, NMFS)

The short-term mortality of finfish discards in the northern shrimp fishery of the Gulf of Maine is being investigated. The study focuses on species selected by the Principal Investigator and personnel of the Northeast Fisheries Science Center based upon discard rate and importance in supporting directed fisheries. Variables that might influence survival of discards include duration of tow, time on deck, size of fish, and air and water temperatures. Such variables will be identified and assigned priority ranking. Highest priority variables will be tested on board cooperating vessels to determine their importance in survival of discarded fish. Studies aboard a commercial shrimp vessel and during the annual shrimp survey conducted by the State of Maine.

Detection of Irradiated Seafood

W.W. Nawar, Department of Food Science, UMass-Amherst (94-09, Completed in May 1997)

Irradiation preservation of food is a revolutionary technique. Its application can enhance the

commercialization of nutritious and attractive supplies of seafood and seafood products. Reliable control methods, such as the one that will be developed in this project, are essential for production, handling, processing, and compliance with rules and regulations. As important is the role such a method would play in enhancing consumer confidence and facilitating international trade. The objectives of this project are to investigate the analysis of lipid-derived volatiles as a simple technique for the detection of irradiation treatment in seafood, and to optimize parameters of the analysis to insure maximum sensitivity, repeatability, and specificity.

Prey Size and Type Selectivity and Predator Dynamics of Marine Fish on the Northeast Continental Shelf

F. Juanes, Department of Forestry and Wildlife Management, UMass-Amherst (94-04, Completed in May 1997)

Predator-prey interactions are strongly influenced by the relative sizes of predator and prey. The relationship between relative sizes is critical in food web structure and must therefore be determined to model multispecies interactions. Much of the ongoing work on food habits at the NEFSC is directed at developing a multispecies model for the Georges Bank system which will examine the role of predation on fish community dynamics. As part of this work, a large data base has been assembled on the prey composition (type and size) of selected predators on the Northeast Continental Shelf. In comparison to planktivorous fishes, little is known about the patterns or the behavioral basis of prey selection among piscivorous fish. A specific objective of this project is to determine prey size and type selectivity of key predators on the Northeast Continental Shelf by using the assembled database.

Fishery Management Internships

J. Boreman, Department of Forestry and Wildlife Management, UMass-Amherst (96-10, Completed in 1998, funding provided by the Fisheries Management Division, NMFS Northeast Regional Office)

Four internships were developed with the Fisheries Management Division offices in Gloucester, MA, for UMass-Amherst upperclass students. The student interns are responsible for assisting in an outreach effort by providing information to the public, as appropriate, concerning fishery management regulations. They are also responsible for reviewing applications for vessel permits to determine a vessel's eligibility for fishing under moratorium. Specific responsibilities include: permit qualification reviews, answering phone calls, meeting with industry members to explain the new requirements, writing letters and reports, record keeping, and other office support functions.

Molecular genetic and multivariate morphometric discrimination among putative stocks of monkfish

G. Hinkle and R. Edgar, Biology Department, UMass-Dartmouth (97-03, completed in 1999)

This project evaluated stock structure among putative stocks of monkfish using two analytical approaches. One approach will be to use micro- and mini-satellites, commonly known as highly variable nuclear tandem repeats found in DNA, as a genetic marker. These markers have been effective with other fish species due to the high mutation rate associated with repeat fragment length. In many cases they have revealed genetic separation where traditional methods such as allozyme frequencies have not shown detectable differences. The second approach will be to use otolith shape and discriminant function analyses to discriminate stocks of monkfish. The investigators will utilize material collected at the spawning sites (or close to them) near the time of spawning as representative of each stock.

Regime Shifts in the Plankton of the Northwest Atlantic

B. Rothschild, Center for Marine Science, Environment, and Technology, UMass-Dartmouth (96-06, completed in 1999)

This project evaluated aspects of regime shifts of plankton in the northwest Atlantic in terms of physical forcing and plankton variability. The possible physical basis for such shifts is now becoming clearer based on studies conducted on the North Sea and in the north Pacific. Of further interest is the observation that regime shifts in fish stocks may be coupled with zooplankton dynamics. Specific objectives of the project were to: (1) analyze statistically the interannual and decadal patterns of temperature, salinity, and other physical data; (2) apply synthetic and analytic temporal and spatial analysis to plankton data; (3) relate analyses and data in parts 1 and 2 that include vertical and horizontal stratification in plankton and other organisms, such as fish; and (4) place all analyses in the context of "regime shifts." The investigator developed simple dynamic models that relate physical and biological parameters in the context of regime shifts, and thereby provide a predictive understanding of the regime shifts phenomena.

Serum and Egg Vitellogenin Measurement in the Atlantic Cod (Gadus morhua) and its Relationship to Ovarian Development

J. Kunkel, Department of Biology, UMass-Amherst (96-08, completed in 1999)

An immunological assay was developed for Atlantic cod vitellogenin and the derived lipovitellin in order to establish an accurate protocol to determine spawning status, egg quality, and egg viability. The antiserum was used to measure the vitellogenin titer in female serum and epidermal mucus, and the lipovitellin content of ovulated eggs and pelagic larvae. The vitellogenin serum and mucus titer of individual females was correlated with the maternal age, size, and histological measure of the state of maturity of the ovary. Particular emphasis was placed on studying where the Georges Bank stock fits among cod stocks in the 35-65 cm "normal" age/size of females undergoing ovarian maturation. With these measurements it will be possible to assess the reproductive maturity of the female and the health and viability of eggs and developing embryos.

A Baseline Study of the Northeast Hook, Small Trawler, and Charter Boat Fisheries

D. Georgianna, Economics Department, UMass-Dartmouth (96-13, completed in 1999, funding provided by the Fisheries Economics Branch, NMFS Northeast Fisheries Science Center)

This project was part of a cooperative study conducted by the University of Massachusetts, University of Rhode Island, and Rutgers University to develop a data collection system that will be part of the core statistics program of NMFS. These data are used in fisheries stock assessments and economic assessments used in the fisheries management process. Data collection responsibilities are divided accordingly: UMass-Dartmouth is responsible for the hook fisheries; the University of Rhode Island is responsible for small trawlers and the design of a prototype fishing vessel simulator; and Rutgers is responsible for party and charter vessels. Principal investigators from each university are responsible for the survey design, sampling scheme, and other design elements of their assigned fishery. They are also responsible for data collection for all project fisheries in their area following the design developed for each fishery.

Effects of Endocrine-Disrupting Chemicals on Winter Flounder

J. Newsted, Environmental Sciences Program, UMass-Amherst (95-09, completed in 1999)

To date, the possible reproductive consequences of estrogen function in wild fish populations that are altered by the presence of contaminants has not been fully investigated. Thus, two major goals of this research are: (1) to evaluate and characterize the relationship between modifying factors such as sex, age, and reproductive status on biomarkers used as measures of endocrine disruption in a control (uncontaminated) population; and (2) to evaluate the relationship between environmental contaminants believed to alter the function of the endocrine systems via the aromatic hydrocarbon (Ah) receptor relative to contaminants that can act directly through the estrogen receptor. The research will be coordinated with the ongoing winter flounder project of NEFSC in Long Island Sound.

Introduction of Metals into the Marine Food Web - Analytical Methods Development

J. Tyson and P. Uden, Department of Chemistry, UMass-Amherst (95-10, completed in 1999)

The investigators developed an analytical chemistry methodology that was needed to support a study of the uptake of metals by plankton. The study was a collaboration among scientists at the University of Massachusetts - Amherst, Rutgers University, and the NEFSC Howard Laboratory. Methodology development consisted of flow-based separation methodologies to achieve sampling, concentration, separation, speciation, and full characterization, and was applied in conjunction with atomic spectrometric quantification and other appropriate methods.

School Structure and Individual Feeding Behavior of Bluefin Tuna

F. Juanes, Department of Forestry and Wildlife Management, UMass-Amherst (96-11, completed in 2000, funding provided by the NOAA Sea Grant Program through the Woods Hole Oceanographic Institution)

This study tested the hypothesis that bluefin tuna exhibit rigid, predictable three-dimensional relationships when schooling, and will quantify such relationships using digitized video images of captive schools. Selectivity for prey species and size was also examined, as was the feeding mechanics (distance, velocity, and direction of prey attacks, handling time per item, and attack success rate) by analysis of the video images. Study results were evaluated to determine the feasibility of estimating the total biomass of bluefin schools based on aerial photographs of their surface structure, and whether bluefin schools are strongly influenced by specific feeding mechanics.

Programming Tasks for the Woods Hole Assessment Toolbox

K.D. Friedland, UMass/NOAA CMER Program, UMass-Amherst. (98-08, completed in 2000)

Central to the assessment of many of the commercially exploited species in the Northeast United Sates is the estimation of population size and fishing mortality rate. Recently the ADAPT VPA program was ported to a new graphical interface environment. Though a great deal of progress has been made in developing and testing the analytical routines, little progress has been made on the development of the graphical interface. These are not analytical programming problems, but instead, simply programming tasks which agency staff has not been able to devote the requisite attention. This work will address the need for diagnostic tabular and graphical display of results of ADAPT, presentation of graphs of results in standard formats for incorporation in reports and presentations, and improvements to the interface functionality.

Seabird Entanglement by Commercial Fisheries in the Northwest Atlantic Ocean

C. R. Griffin, Department of Forestry and Wildlife Management, UMass-Amherst (93-01, completed in 2000)

There is increasing concern about seabird mortality associated with commercial fishing operations. Relatively little research has been conducted on seabird mortality in U.S. waters off the Atlantic coast. While some of the data on seabird mortality in commercial fishing gear has been summarized by the NEFSC, detailed analyses are lacking. The purpose of this project is to evaluate the quantity and quality of information available from the NEFSC regarding the extent of seabird entanglement in northwestern Atlantic domestic and foreign fisheries. This will be accomplished using the existing NMFS databases on marine bird catches; particular attention will be directed to species composition of catches, sources of temporal variability of catches, and relationships between catch and various fisheries. This analysis will help determine whether there are sufficient data to justify a larger-scale study. Additionally, the project will provide NEFSC with information to evaluate the effectiveness of their protocol for collecting bycatch data on seabirds.

Evaluation of the Presence of Elemental Magnesium in Salmon Otoliths as an Indicator of Thermal History

K.D. Friedland, UMass/NOAA CMER Program, UMass-Amherst. (98-07, completed in 2001)

This work will evaluate the incorporation of elemental magnesium in salmon otoliths as an indicator of thermal history of individual fish; and, if applicable, evaluate the thermal histories for salmon from nature. Salmon grown in sea cages, with known thermal histories, will provide sample otoliths. These growth sites are monitored with daily temperature recordings. Otoliths will be prepared for analysis by mass spectrometry using ion beam techniques. If a relationship is found between Mg/Ca and temperature, otoliths from fish of known survival patterns will be analyzed to relate thermal history during the post-smolt year to specific stock characteristics

Predation on Atlantic Salmon After Dam Passage

F. Juanes, Department of Forestry and Wildlife Management, UMass-Amherst (97-15, completed in 2001)

This project will examine the predation on Atlantic salmon smolts emigrating from the Merrimack River, specifically concentrating on feeding interactions at the Essex dam, which is the last mainstem dam on the river. The investigators will examine stomach contents from striped bass feeding in the area of the Essex dam while simultaneously estimating the size of the predator population using mark-recapture methods. These data will permit a quantitative evaluation of the impact of striped bass predation on Atlantic salmon smolts.

A baseline socio-economic study of the Massachusetts party boat industry

D. Loomis and M. Ross, Department of Forestry and Wildlife Management, UMass-Amherst, and D. Georgianna, Economics Department, UMass-Dartmouth. (97-04, completed in 2001)

This investigation is a cooperative study between investigators at the UMass Amherst and Dartmouth campuses. This study will collect data on angler motives and expectations for participating in the party boat fishery, as well as their economic expenditures and the resulting economic impacts. Information will be gathered with the intent of using it to develop models of behavioral change in response to changing resource conditions and regulatory actions. Behaviors to be parameterized include; angler switching between party boats and gear; demand for species specific fishing activity; and angler expectations concerning resource status and management actions.

By-catch and Distribution of Sturgeons

K.D. Friedland, UMass/NOAA CMER Program, UMass-Amherst (1999-10, completed in 2001)

Fishing mortality in non-directed fisheries is a continuing threat to distinct populations segments of shortnose sturgeon and an important issue in evaluating the status of Atlantic sturgeon populations occurring on the East Coast of the United States. These threats to sturgeon can only be monitored and ameliorated with better information on the rate of encounter with specific gear and a better understanding of ocean distributions for both species. This study will examine survey and commercial databases to determine the patterns of by-catch for sturgeon and other biological aspects of the species.

A Baseline Study of the Northeast Herring, Mackerel, and Other Mid-water Trawl and Purse-seine Fisheries

D. Georgianna, Economics Department, UMass-Dartmouth (1999-01, completed in 2001)

The economic status of fishing fleets is of concern to fishery managers because it affects the standard of living of fishers, their families and communities. The status of fishing fleets affect also the political and economic feasibility of management measures. Unfortunately, monitoring the status of fleets is not an easy task. One element of the task involves periodic collection and analysis of cost and earnings data. The investigator will accomplish the following: develop survey instruments for purse seine and midwater trawl fleets; use pilot surveys to test survey instruments to compare and statistically validate various survey methods; design the framework for cost data base for these fisheries to establish cost data base for these fisheries; and, begin building research tools based on these data.

Biology of the Atlantic Halibut

Michael Ross, Department of Forestry and Wildlife, UMass-Amherst (1999-03, completed in 2001)

Dr, Ross proposes an analysis of life history parameters for Atlantic halibut. Working in cooperation with various NMFS units, the growth dynamics, length-weight relationships, distribution, and historical catch will be determined. The study will build on previous investigations and those done by the Overfishing Panel Review for Atlantic Halibut.