The Saltonstall-Kennedy Grant Program

Fisheries Research and Development

REPORT 2006

August 1, 2006

DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

The Saltonstall-Kennedy Grant Program: Fisheries Research and Development

Report 2006

August 1, 2006

U.S. DEPARTMENT OF COMMERCE
Carlos M. Gutierrez
Secretary

National Oceanic and Atmospheric Administration
Conrad C. Lautenbacher, Jr., Vice Admiral, U.S. Navy (Ret.)
Under Secretary of Commerce for Oceans and Atmosphere
and NOAA Administrator

National Marine Fisheries Service
William T. Hogarth, Ph.D., Assistant Administrator

Office of Management and Budget
Gary Reisner, Director

Prepared by
Financial Services Division
Charles Cooper, Acting Chief
Silver Spring, Maryland

Cover Design: Barbara Comstock, National Marine Fisheries Service, Pascagoula, Mississippi

The Saltonstall-Kennedy Grant Program: Fisheries Research and Development

REPORT
2006

August 1, 2006

U.S. DEPARTMENT OF COMMERCE
Carlos M. Gutierrez, Secretary

National Oceanic and Atmospheric Administration
Conrad C. Lautenbacher, Jr., Vice Admiral, U.S. Navy (Ret.)
Under Secretary of Commerce for Oceans and Atmosphere
and NOAA Administrator

National Marine Fisheries Service
William T. Hogarth, Ph.D., Assistant Administrator

TABLE OF CONTENTS

I. INTRODUCTION

This report to Congress on the Saltonstall-Kennedy (S-K) Grant Program, administered by the National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), U.S. Department of Commerce, covers fiscal year (FY) 2006. The report contains information on the S-K Program regarding its legislative authority, the application solicitation and grant selection process, recipients, and funding.

Due to an insufficient funding allocation for FY 2006, the competitive program was not conducted.

This report is submitted pursuant to the Saltonstall-Kennedy Act (S-K Act), as amended, which requires that the following information be submitted annually to Congress:

1. The fisheries development goals and funding priorities for a national program of research and development for the next fiscal year (page 5).

2. A description of all pending fisheries research and development projects (page 8).

3. A list of those applications approved and disapproved and the total amount of grants made (not provided, as the FY 2006 Grant Program was not conducted due to lack of funds).

4. A statement of the extent to which available funds were not obligated or expended by the Secretary for grants (page 6).

5. An assessment of each project completed in the preceding fiscal year regarding the extent to which objectives of the project were attained and the project contributed to fishery development (page 24).

The Appendix provides addresses of NMFS Headquarters and Regional Offices from which information regarding the S-K Program may be obtained.

II. BACKGROUND

The S-K Act, as amended (15 U.S.C. 713c-3), established a fund (known as the S-K fund) that the Secretary of Commerce uses to provide grants or cooperative agreements for fisheries research and development projects. Under this authority, grants and cooperative agreements are made annually on a competitive basis (subject to funding) to assist in carrying out projects related to U.S. commercial and recreational fisheries.

The S-K Grant Program funding priorities are consistent with the goals and objectives of the NOAA and NMFS Strategic Plans and the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act). The objective of the S-K Grant Program is to address the needs of fishing communities (as defined in the Magnuson-Stevens Act) in optimizing economic benefits within the context of rebuilding and maintaining sustainable fisheries, and in dealing with the impacts of conservation and management measures.

Proposals received in response to a solicitation are evaluated for merit by appropriate private- and public-sector experts and for usefulness by representatives of various fisheries constituencies. Proposals are ranked by their average scores. After proposals have been evaluated and ranked, recommendations for funding are developed and submitted to the Assistant Administrator for Fisheries, who determines the projects to be funded.

In addition, 15 U.S.C. 713c-3(d) authorizes the Secretary of Commerce to carry out a national program of research and development (National Program) to address aspects of U.S. fisheries not adequately addressed by projects assisted under the Grant Program.

In FY 2006, NMFS is using the National Program authority to amend an existing grant to fund the Wild American Shrimp marketing program for an additional $5 million as directed by Congress. In addition, NMFS is providing $300,000 under the National Program for contracts to support the establishment of a comprehensive, environmentally sound permitting system for marine aquaculture. Summaries of these projects are included in Section IV of this document. During FY 2005, NMFS also provided $100,000 to the City of New Bedford, Massachusetts, for workshops on vessel safety training for commercial fishermen, and $100,000 to the Herring Gut Learning Center for an education project under the National Program. Descriptive summaries are included in Section IV of this report.

For FY 2007, NMFS will determine whether sufficient funding is appropriated to conduct either a National Program or a competitive program. Funding priorities to optimize economic benefits within the context of rebuilding and maintaining sustainable fisheries, and in dealing with the impacts of conservation and management measures, will be developed as soon as this determination is made.

Public Law 109-108 (Section 208) directed $7 million of S-K funds noncompetitively to the Alaska Fisheries Marketing Board. NMFS provided this funding as an unconditional award for no specified purpose, consistent with legislative direction. Therefore, these funds will not be monitored under the S-K Program and are not addressed further in this report.

The S-K program is capitalized through annual transfers by the Secretary of Agriculture to the Secretary of Commerce into the Promote and Develop Fishery Products account of amounts equal to 30 percent of the gross receipts collected under the customs laws on imports of fish and fish products. Table 1 indicates the total duties collected on fishery products; the total receipts in the Promote and Develop account for FY 2006; the amount transferred to operations, research, and facilities (ORF); and the amount allocated for the S-K Program, including the competitive Grant Program, the National Program, and program administrative costs, including monitoring of ongoing awards. Table 2 provides the recent funding history of the S-K Program.

Table 1. S-K Funding for FY 2006 ($ in millions)

Funding Item	Amount
Total Duties Collected on Fishery Products	$264.28
Total Transfer to Promote and Develop Account	79.28
ORF Transfer	(67.00)
S-K Allocation	12.28
Carryover[1]	0.66
Total	12.94
Unconditional Awards to Specified Recipients[2]	(7.00)
Total Available for S-K Program	5.94
S-K Program Obligations/Commitments	
FY 2006 Grant Program	0
National Program[3]	5.00
Program Administration	0.50
Aquaculture Development[4]	0.30
Estimated Unobligated Balance	0.14
Total	5.94

[1] Includes unanticipated prior year recoveries as well as unobligated funds.
[2] Alaska Fisheries Marketing Board; not part of the S-K Program, directed by appropriations language.
[3] For Wild American Shrimp program, directed by appropriations language.
[4] Environmental and economic studies to establish and implement a regulatory system for offshore aquaculture in the United States.

Table 2. S-K Funding, 1996–2006 ($ in millions)

Fiscal Year	Total Duties	Total P&D Transfer	ORF Offset	Funds Directed to Non-S-K Activities in Appropriations Legislation	Available S-K Program Allocation	S-K Program Allocation as % of Transfer to P&D
1996	221.27	72.89	63.00	-	9.89	13.57
1997	221.27	66.38	66.00	-	0.38	0.57
1998	219.11	65.73	62.38	-	3.35	5.10
1999	221.42	66.43	63.38	-	3.05	4.59
2000	233.07	69.92	68.00	-	1.92	2.75
2001	242.76	72.83	68.00	-	4.83	6.73
2002	263.77	79.13	68.00	-	11.13	14.07
2003	250.75	75.22	65.00	10.00	0.22[5]	0.29
2004	265.75	79.72	62.00	17.00	0.72[6]	0.90
2005	258.46	77.54	65.00	10.00	2.54[7]	3.28
2006	264.28	79.28	67.00	7.00[8]	5.28	6.66

[5] Another $10 million was allocated, but directed to the Alaska Fisheries Marketing Board, outside of the S-K Program.
[6] Another $17 million was allocated, but directed to the Alaska Fisheries Marketing Board, Gulf and South Atlantic Fisheries Foundation, Inc., South Carolina Seafood Alliance, Oregon Trawl Commission, and Oregon State University Seafood Laboratory, outside of the S-K Program.
[7] Another $10 million was allocated, but directed to the Alaska Fisheries Marketing Board, outside of the S-K Program.
[8] Allocation directed to Alaska Fisheries Marketing Board, per Public Law 109-108, Section 208.

III. PENDING GRANT PROGRAM PROJECTS

This section contains a description of all pending (ongoing) projects under the S-K Grant Program, along with the name of the grantee, grant number, project title, federal funding level, recipient funding level (i.e., cost share), and the NMFS contact, addresses for whom are in the Appendix. The projects are listed by grantee within each subject area.

FISHERIES UTILIZATION

Grantee: Kake Foods, Inc., Kake, Alaska
Grant No.: NA03NMF4270111 *NMFS Contact*: F/AKR
Project Title: Economic and Resource Full Utilization of the Seafood Processing Waste Stream: Discards, Underutilized Species, Byproducts and Carcasses through Conversion into High Value Organic Composts on an Industrial Scale Operation
Funding: *Federal*: $180,634 *Recipient*: $180,633

Description: To develop usable products from economic discards (defined in the Magnuson-Stevens Act as "fish which are the target of a fishery, but which are not retained because they are of undesirable size, sex, or quality, or for other economic reasons"), underutilized species, and by-products of processing.

Grantee: University of Michigan, Ann Arbor, Michigan
Grant No.: NA03NMF4270149 *NMFS Contact*: F/NER
Project Title: Gear, Product, and Market Development for the Underutilized, Yet Burgeoning Populations of Freshwater Cod *(Lota lota)* in the Great Lakes
Funding: *Federal*: $120,284 *Recipient*: $29,791

Description: To (1) develop gear that will more efficiently harvest live burbot and reduce bycatch, (2) determine methods to handle and preserve fish for product research and testing, and (3) develop fish products for public consumption and test them using established markets and marketing strategies.

Grantee: University of Washington, Seattle, Washington
Grant No.: NA03NMF4270156 *NMFS Contact*: F/NWR
Project Title: Potential for Sustainable Expansion of the Dogfish *(Squalus acanthias)* Fishery in the Northeast Pacific
Funding: *Federal*: $157,431 *Recipient*: $25,958

Description: To provide basic data on stock structure, stock assessment, and socioeconomic issues for an expanded, sustainable international fishery on dogfish in the northeast Pacific Ocean. The project will identify self-recruiting stocks of dogfish on the West Coast using genetic markers, compare population parameters along a latitudinal gradient, and determine appropriate socioeconomic indicators of the existing fishery.

MANAGEMENT ALTERNATIVES AND FISHERIES USER CONFLICTS

Grantee: University of Rhode Island, Kingston, Rhode Island
Grant No.: NA03NMF4270146 *NMFS Contact*: F/NER
Project Title: A Compliance Diagnostic for the Northeast Groundfish Fishery
Funding: *Federal*: $50,052 *Recipient*: $15,258

Description: To survey groundfish fishermen and analyze the data to reveal salient linkages between the procedures used for establishing and implementing policy and fishermen's compliance decisions.

Grantee: Massachusetts Fishermen's Partnership, Inc., Gloucester, Massachusetts
Grant No.: NA16FD2302 *NMFS Contact*: F/NER
Project Title: Institutionalizing Social Science Data Collection: A Pilot Project
Funding: *Federal*: $136,250 *Recipient*: $17,900

Description: To bring fishermen, researchers, community members, educators, and coastal managers together on panels that will work together to develop a process for the ongoing collection of social science information pertinent to both fisheries management and coping with change. Such a process, if successful, will provide NMFS with a model to meet Sustainable Fisheries Act requirements of National Standard 8.

Grantee: University of Maryland, Cambridge, Maryland
Grant No.: NA96FD0071 *NMFS Contact*: F/NER
Project Title: Test of Two Stock Hypotheses for Atlantic Bluefin Tuna Using Otolith Elemental Fingerprints
Funding: *Federal*: $88,374 *Recipient*: $22,207

Description: To determine the spatial and temporal stability of elemental fingerprints classified for Mediterranean and western Atlantic bluefin tuna nurseries, using results from a previous S-K project on otolith microconstituent analysis. Juvenile otoliths collected over 2 years and among several sites within each nursery will be analyzed. Inductively coupled plasma mass spectrometry will also be evaluated to determine the elemental fingerprints associated with the first year of life.

Grantee: University of Maryland, Cambridge, Maryland
Grant No.: NA96FD0073 *NMFS Contact*: F/NER
Project Title: Recruitment Dynamics of Northern Shrimp *(Pandalus borealis)*
Funding: *Federal*: $92,789 *Recipient*: $21,871

Description: To investigate the influence of physical factors, excluding temperature, on northern shrimp recruitment. The match–mismatch hypothesis in relation to shrimp recruitment will also be investigated. A stock-recruitment model, incorporating the effects of significant environmental and ecological variables, will be developed. In addition, potential overfishing definitions of northern shrimp, with explicit consideration of the impact of environmental and ecological variation, will be explored.

Grantee: University of Maryland, Cambridge, Maryland
Grant No.: NA96FD0076 *NMFS Contact*: F/NER
Project Title: Density-Dependent Growth and Reproduction of Chesapeake Bay Striped Bass
Funding: *Federal*: $88,702 *Recipient*: $23,404

Description: To estimate the age and year class-specific growth rates of Chesapeake Bay striped bass juveniles, pre-migrant sub-adults, and migratory females. Evidence for density dependence in growth will also be examined. Fecundity and age at first maturation for females of year classes varying in initial abundance will be estimated, and the density effects on these rates will be tested. Finally, the importance of these density-dependent effects in calculating biological reference points and overfishing thresholds will be evaluated.

Grantee: Virginia Institute of Marine Science, Gloucester Point, Virginia
Grant No.: NA16FD2294 *NMFS Contact*: F/NER
Project Title: Population Structure Analysis of Atlantic Bluefin Tuna Using Hypervariable, Nuclear DNA Markers
Funding: *Federal*: $126,793 *Recipient*: $23,445

Description: To critically examine population structure of the Atlantic bluefin tuna. Through an ongoing Saltonstall-Kennedy award, the investigator has developed a suite of hypervariable, nuclear-DNA markers that reveal considerable genetic variation within the Atlantic bluefin tuna. The investigator will use these genetic tools to screen biologically meaningful collections of young bluefin collected from the western and eastern North Atlantic Ocean to determine if there is significant spatial or temporal partitioning of genetic variation among collections. Hypotheses of stock structure of the Atlantic bluefin tuna will be tested. The investigators also will use these markers to screen bluefin taken in the central North Atlantic.

Grantee: Gulf & South Atlantic Fisheries Foundation, Inc., Tampa, Florida
Grant No.: NA17FD2367 *NMFS Contact*: F/SER
Project Title: Development of a Vessel Buyout Business Plan for the Southeastern U.S. Commercial Shark Fishery
Funding: *Federal*: $366,560 *Recipient*: $43,999

Description: To involve industry representatives in work with Gulf & South Atlantic Fisheries Foundation, Inc., project staff and subcontracted experts to draft a Preliminary Commercial Shark Fishery Vessel Buyout Business Plan. This will be followed by integrated research involving field data collection, processing, and analysis to evaluate the technical, financial, socioeconomic, and management feasibility of the preliminary plan, as well as different commercial shark fishing vessel buyout options. The results of this multidisciplinary study will then be used to develop and refine a Final Commercial Shark Fishery Vessel Buyout Business Plan acceptable to the majority of those engaged in the industry, the Gulf of Mexico and the South Atlantic Fishery Management Councils, and NMFS.

Grantee: Florida State University, Tallahassee, Florida
Grant No.: NA03NMF4270086 *NMFS Contact*: F/SER
Project Title: Incorporating Fisher Behavior into Management Models: A Case Study of the Reef Fish Fishery of the Eastern Gulf of Mexico
Funding: *Federal*: $210,425 *Recipient*: $37,319

Description: To characterize fisher behavior using data from NMFS logbooks and the Florida Marine Research Institute trip tickets for grouper-snapper fishers operating in the eastern Gulf of Mexico. All data will be kept confidential. The intent is to produce a predictive model of fisher behavior in response to fishery regulations, particularly spatially explicit regulations including marine protected areas. Results will be integrated with a stage-based life history model of groupers being developed by one of the investigators.

Grantee: Texas A&M Research Foundation, College Station, Texas
Grant No.: NA03NMF4270091 *NMFS Contact*: F/SER
Project Title: Characterization of Atlantic Bluefin Tuna Stock Structure Using Stable 13C and 18O Isotopes in Otolith
Funding: *Federal*: $112,779 *Recipient*: $19,946

Description: To quantify stable d13C and d18O isotopes in otoliths of Atlantic bluefin tuna to predict nursery origin and use these natural markers to estimate mixing rates of sub-adult and adult bluefin tuna. Past research by this group supported by S-K grants has developed and evaluated protocols for quantifying trace element chemistry to delineate stocks of Atlantic bluefin tuna from western or eastern nurseries. This project will take the next logical step, and integrate stable d13C and d18O isotopes into our current evaluation of population connectivity. The aims of the proposed study are to (1) assess the utility of stable d13C and d18O isotopes as a tool to examine stock structure, and (2) estimate mixing rates of Atlantic bluefin tuna between eastern and western nurseries.

Grantee: University of California, Santa Cruz, California
Grant No.: NA03NMF4270155 *NMFS Contact*: F/SWR
Project Title: Measuring Impacts on Fishing Communities: A Framework for Integrated Socioeconomic Assessment
Funding: *Federal*: $149,987 *Recipient*: $24,998

Description: To conduct a two-part study using the combined approaches of fisheries sociology and economics to (1) conduct ethnographic interviews and small surveys and archival research to estimate an input–output (I/O) matrix for the Moss Landing fishing community, compute community-specific multipliers, and compare the community-level and county-level I/O data and multipliers, as well as the tradeoffs of these two approaches; and (2) using this information, work with the Moss Landing community to develop and analyze scenarios that reflect alternative definitions of community and potential management actions, to determine and compare their potential socioeconomic impacts on the community.

FISHERIES BYCATCH

Grantee: Massachusetts Division of Marine Fisheries, Boston, Massachusetts
Grant No.: NA03NMF4270139 *NMFS Contact*: F/NER
Project Title: Further Testing of Cod Avoiding Trawl Net Designs
Funding: *Federal*: $318,760 *Recipient*: $44,085

Description: To further verify the effectiveness of two cod-avoiding trawl net designs—the "Ribas" and "Topless" trawls—using larger versions of the designs and including nighttime testing.

Grantee: Manomet, Inc., Manomet, Massachusetts
Grant No.: NA03NMF4270208 *NMFS Contact*: F/NER
Project Title: Relating Fish Shape to Mesh Size: How Morphometric Variability Affects Trawl Net Selectivity in the Gulf of Maine
Funding: *Federal*: $92,776 *Recipient*: $18,877

Description: To collect morphometric measurements of key groundfish species during standard fishing operations on commercial fishing vessels in the Gulf of Maine. Variability of body measurements for each length class of fish will be calculated. A simple model will be formulated to estimate the mesh size and configuration through which commercial fish species of any size will be most likely to escape. The model will enable managers and the fishing industry to predict potential retention rates of major commercial fish species for a range of mesh sizes and configurations.

Grantee: Washington Department of Fish and Wildlife, Olympia, Washington
Grant No.: NA03NMF4270133 *NMFS Contact*: F/NWR
Project Title: Evaluate Selective Fishing Methods
Funding: *Federal*: $174,370 *Recipient*: $35,910

Description: To evaluate and compare selective fishing methods for coho salmon in an estuarine environment (Willapa Bay, Washington). The objectives include: (1) compare the number of and condition of coho caught in tangle nets and conventional gill nets; (2) estimate and compare the immediate and long-term survival of hatchery coho salmon caught in the tangle net and conventional gill net and hook and line gear; (3) enumerate the immediate mortality of untargeted animals caught in the tangle net and conventional gill net and hook and line gear; (4) estimate the egg-to-fry mortality of hatchery coho released from the tangle net, gill net, and hook and line gear and that return to the hatchery; and (5) estimate hooking mortality rate for hatchery coho captured in an estuary.

Grantee: University of Hawaii, Kaneohe, Hawaii
Grant No.: NA03NMF4270187 *NMFS Contact*: F/PIR
Project Title: Broadband Sonar Identification of Hawaiian Bottom Fish Species
Funding: *Federal*: $128,155 *Recipient*: $14,240

Description: To obtain critical information that will allow for the design and fabrication of a prototype broadband sonar that may be used to identify and monitor bottom fish species from the surface. Specifically, to develop a management tool to monitor the state of overfished areas set aside as a reserve and monitor critical fishing areas for conservation and management.

Grantee: University of North Florida, Jacksonville, Florida
Grant No.: NA03NMF4270084 *NMFS Contact*: F/SER
Project Title: The Effectiveness of Bycatch Reduction Devices on Crab Pots on Reducing Capture and Mortality of Diamondback Terrapins and Enhancing Capture of Blue Crabs
Funding: *Federal*: $51,733 *Recipient*: $9,512

Description: To study the effects of Bycatch Reduction Devices (BRDs), 15 standard crab pots will be equipped with wire rectangle BRDs (4.5 x 12.0 cm) attached to the inside openings of all entrance funnels. Another 15 pots without BRDs will be used as controls. Pots will be deployed in tidal creeks in rows with alternating pot treatments no more than 20 m apart. All pots will be baited with fish and checked daily. The 30 pots will be fished for 10-day periods in two different counties during the month of May in each year, for a total of four counties. All terrapins will be sexed, measured, weighed, microchipped, and released. Crabs will be sexed and carapace length, height, and width measured. One crab trapper from each county will be selected to assist with the project, to suggest appropriate placement of the pots, and to help set and collect the pots. As incentives, the trapper will receive a $200 stipend and all legal-sized crabs caught during the project.

Grantee: The Regents of the University of California, Santa Cruz, California
Grant No.: NA03NMF4270098 *NMFS Contact*: F/SWR
Project Title: Pilot Project: Testing the Feasibility of Pot Gear to Catch Petrale Sole and Reduce Rockfish Bycatch
Funding: *Federal*: $117,400 *Recipient*: $35,282

Description: To determine appropriate bait for petrale sole by returning live fish to the laboratory facility and introducing different types of fish, mollusks, and crustacea. The investigators will then work with expert fishermen and gear designers to develop up to four trap designs for initial testing on petrale sole. The most effective design will be more thoroughly tested for its effectiveness in catching petrale and minimizing bycatch of overfished species of rockfish.

PRODUCT QUALITY AND SAFETY

Grantee: Louisiana State University, New Orleans, Louisiana
Grant No.: NA03NMF4270085 *NMFS Contact*: F/SER
Project Title: Anti–*V. vulnificus* Oyster Defensin: Its Synthesis and Use to Reduce the *V. vulnificus* Load in Oysters That Are to Be Eaten Raw
Funding: *Federal*: $190,189 *Recipient*: $94,029

Description: To synthesize and study the effects of anti–*V. vulnificus* oyster defensins (AVVOD). Acetic acid extracts of the oyster *(Crassostrea virginica)* were shown to inactivate the Gram-negative pathogen *Vibrio vulnificus*. These extracts contained at least two heat-stable peptides considered to be AVVOD. A seasonal relationship appears to exist where AVVOD is induced in oysters when Gulf waters are warm and the *V. vulnificus* populations in such waters are dense. In contrast, when Gulf waters are cool and unfavorable for *V. vulnificus* growth, AVVOD levels in the oyster tissue are low or absent, suggesting that AVVOD may be a means of protection against tissue invasion by *V. vulnificus*. We have shown that the *V. vulnificus* load in oysters can be reduced after exposure to AVVOD and subsequent refrigeration.

Grantee: South Carolina Department of Natural Resources, Charleston, South Carolina
Grant No.: NA03NMF4270090 *NMFS Contact*: F/SER
Project Title: Evaluation of Ecological and Commercial Impact of White Spot Syndrome Virus (WSSV) Infection in the White Shrimp *(Litopenaeus setiferus)* and the Blue Crab *(Callinectes sapidus)* in Southeastern United States Using an Immunoassay Technique
Funding: *Federal*: $175,631 *Recipient*: $24,884

Description: To evaluate the potential impact of WSSV in reproductive stocks of the white shrimp *(L. setiferus)* and blue crab *(C. sapidus)* using an immunoassay technique to detect infection. Sensitivity of this technique will be assessed. Recently funded S-K work confirmed the presence of WSSV in South Atlantic stocks of *L. setiferus* and in brown shrimp *(Farfantepenaeus aztecus)*; however, the extent of infection is not known. Published reports have indicated that stress due to spawning increased shrimps' susceptibility to viral infection, hence reproductive populations will be the subjects of this study. Participation of shrimpers in disease diagnosis is a major component of this project. Information generated will provide a crucial foundation for disease risk assessment and risk management practices, as well as development of regional management protocols.

Grantee: University of Florida, Gainesville, Florida
Grant No.: NA03NMF4270088 *NMFS Contact*: F/SER
Project Title: Effect of High-Pressure Treatment on Omega-3 Fatty Acids in Fish Muscle
Funding: *Federal*: $51,759 *Recipient*: $16,273

Description: To evaluate the effect of high-pressure treatment on the lipid fraction of fish muscle and on the activities of endogenous muscle pro- and antioxidants. The effect of high-pressure treatment will be evaluated by comparing the fatty acid profile of treated and untreated sample (intact muscle and extracted lipids), as well as comparing the pro- and antioxidant capacity of soluble muscle compounds before and after treatment. Thiobarbituric acid and lipid hydroperoxides will be used as indexes of oxidation. A storage study will be carried out to examine the stability of high-pressure treated samples during refrigerated and frozen storage.

AQUACULTURE

Grantee: Pisces Molecular LLC, Boulder, Colorado
Grant No.: NA03NMF4270132 *NMFS Contact*: F/NER
Project Title: Development of a Reverse Genetics System to Produce Live, Attenuated Infectious Salmon Anemia Virus (ISAV) Vaccine Candidates
Funding: *Federal*: $252,834 *Recipient*: $33,129

Description: To develop a reverse genetics system for reconstituting ISAV particles from laboratory constructed plasmid molecules and to demonstrate the ability to produce attenuated virion particles that will be compelling candidates for a live attenuated ISAV vaccine.

Grantee: Maine BioTek, Inc., Winterport, Maine
Grant No.: NA03NMF4270119 *NMFS Contact*: F/NER
Project Title: Whole Killed ISA Virus Vaccine
Funding: *Federal*: $157,591 *Recipient*: $31,326

Description: To refine a prototype ISA virus vaccine with respect to virus inactivation, dose, and heterologous protection. The project will also define the role of the humoral immune response in virus clearance from ISA virus–infected Atlantic salmon. The study will enhance the preparation of an efficacious whole killed vaccine by identifying the optimal vaccine formulation required for a robust immune response.

Grantee: University of Southern Maine, Portland, Maine
Grant No.: NA03NMF4270123 *NMFS Contact*: F/NER
Project Title: Atlantic Salmon Aquaculture Considering Endangered Status of Atlantic Salmon and Clean Water Act
Funding: *Federal*: $76,204 *Recipient*: $13,413

Description: To publish guides to be used during preliminary discussions with stakeholders (e.g., "How Does the ESA Apply to Aquaculture Operations in Maine?" and "How Does the Clean Water Act Apply to Aquaculture Operations in Maine?"). Identify ESA and Clean Water Act (CWA) enforcement impacts on Maine Atlantic salmon aquaculture operations, provide aquaculture operators with information on achieving compliance with ESA and CWA, and facilitate communication between nongovernmental organizations and aquaculture operators as part of overall efforts to reduce litigation.

Grantee: Capricorn Products, Incorporated, Scarborough, Maine
Grant No.: NA03NMF4270174 *NMFS Contact*: F/NER
Project Title: Development of Three Rapid, Sensitive, Reproducible Blood Tests for the Detection of Infectious Salmon Anemia Virus
Funding: *Federal*: $333,748 *Recipient*: $57,275

Description: To develop three assay formats for the detection of ISAV for the aquaculture industry. These assays are designed to accommodate both laboratory and pen-side testing. The tests offer improved sensitivity, speed, and reproducibility over currently used assays.

Grantee: Advanced BioNutrition Corporation, Columbia, Maryland
Grant No.: NA03NMF4270163 *NMFS Contact*: F/NER
Project Title: Novel Oral Vaccine for Infectious Salmon Anemia
Funding: *Federal*: $190,400 *Recipient*: $56,290

Description: To develop and test methods for producing an orally active ISA vaccine built on multifunctional display of antigens on an IPNV virus–like particle platform. The project will include design, implementation, and testing of the dual functionality of the vaccine to deliver effective control of both ISA and IPN at a low cost.

Grantee: University of New Hampshire, Durham, New Hampshire
Grant No.: NA03NMF4270183 *NMFS Contact*: F/NER
Project Title: Engineering Design and Analysis for More Secure Salmon Net Pen Systems
Funding: *Federal*: $472,662 *Recipient*: $61,648

Description: To work at Heritage Salmon's 20-cage site in Broad Cove near Eastport, Maine, to evaluate the structural integrity of the system for offshore application. To perform the analysis, computer models calibrated with field measurements will be used to provide mooring and cage stress and reliability analysis to minimize the escapement of the contained salmon in an offshore application.

Grantee: University of Maine, Orono, Maine
Grant No.: NA03NMF4270167 *NMFS Contact*: F/NER
Project Title: Demonstration of Sustainable Cod Farming from Egg to Grow-out in Maine
Funding: *Federal*: $358,022 *Recipient*: $187,883

Description: To assess the economics of Atlantic cod production in net pens in Maine and to establish a disease-free industry source of Atlantic cod eggs.

Grantee: Texas A&M Research Foundation, College Station, Texas
Grant No.: NA16FD2295 *NMFS Contact*: F/NER
Project Title: Estimation of Wave Conditions Influencing Distribution of Fish Farm Wastes and Structural Integrity of Aquaculture Units
Funding: *Federal*: $145,059 *Recipient*: $28,768

Description: To develop appropriate wave modeling methodology and determine wave conditions in four bays in Maine for aquaculture applications. A dynamic wave environment enhances the dispersal of net pen wastes. However, it also causes damage to fish farms, allowing escape of aquacultured fish. This project will use field data and models to estimate the frequency of various wave conditions in Maine.

Grantee: University of Washington, Seattle, Washington
Grant No.: NA03NMF4270112 *NMFS Contact*: F/NWR
Project Title: Restoration and Aquaculture of Northern Abalone *(Haliotis kamtschatkana)* in Washington State: Status of the Resource, Population Genetics, Habitat and Culture of Captive Abalone
Funding: *Federal*: $274,418 *Recipient*: $80,776

Description: To (1) quantify adult and juvenile northern abalone densities and characterize abalone habitat at eight to 12 sites in the San Juan Islands, (2) analyze abalone genetic variation and effective population size for use in species management and enhancement efforts, (3) develop captive breeding and rearing protocols for pinto abalone aquaculture development, (4) develop rearing methods for enhancement, (5) quantify behavioral differences in juvenile abalone reared in "natural habitats" versus those reared using conventional methods, and (6) convene a workshop to engage the public in abalone restoration.

Grantee: Florida Fish and Wildlife Conservation Commission, Port Charlotte, Florida
Grant No.: NA03NMF4270093 *NMFS Contact*: F/SER
Project Title: Restoration of Bay Scallop *(Argopecten irradians)* Populations on the West Coast of Florida
Funding: *Federal*: $251,979 *Recipient*: $44,361

Description: To continue successful bay scallop population restoration efforts along the Florida west coast between Anclote and Crystal River, which so far have resulted in a 2-orders-of-magnitude increase in scallop abundance in that area. Scallops will be collected, spawned in the laboratory, and the resultant offspring planted in protective cages in each area from which the parental stock was harvested. Separately, as part of a continuing State-funded monitoring program, changes in recruitment and adult abundance in the target area will be monitored to assess the success of those efforts. The recently initiated scallop restoration program in Sarasota Bay will be continued, in an effort to expand the range of viable local populations comprising the bay scallop metapopulation in the eastern Gulf of Mexico. Parental stock will be collected from Sarasota Bay or the geographically closest population (because scallops are extremely rare in Sarasota Bay) and cultured in the laboratory, and the resultant broodstock will be planted in protective cages at three sites in Sarasota Bay. Additional scallops will be free-planted in those

same seagrass beds. Survival, growth, and reproductive development will be closely monitored for each planting treatment, including biochemical assessment of the health of eggs produced by scallops under each treatment. Potential offspring harvested from recruit collectors will be tested for relatedness using a variety of genetic techniques. A hydrodynamic model will be used to determine sites least likely to be exposed to red tide and to predict the dispersal of larvae from those sites. Results will be disseminated via local public meetings, reports to NMFS, and publication in international peer-reviewed journals.

Grantee: Florida Marine Research Institute, St. Petersburg, Florida
Grant No.: NA17FD2368 *NMFS Contact*: F/SER
Project Title: Bay Scallop *(Argopecten irradians)* Population Restoration on the West Coast of Florida
Funding: *Federal*: $206,753 *Recipient*: $41,798

Description: To (1) continue the successful bay scallop population restoration efforts along the Florida west coast between Anclote and Crystal River; and (2) continue the recently initiated scallop restoration program in Sarasota Bay, in an effort to expand the range of viable local populations composing the bay scallop metapopulation in the eastern Gulf of Mexico. The investigators will collect parental stock from the target site (Sarasota Bay, or the geographically closest population as scallops are extremely rare in Sarasota Bay), culture them in the laboratory, and plant the resultant broodstock in protective cages at three sites in Sarasota Bay. Additional scallops will be free-planted in those same seagrass beds. Survival, growth, and reproductive development will be closely monitored for each planting treatment, including a biochemical assessment of the health of eggs produced by scallops under each planting regime. Potential offspring harvested from recruit collectors will be tested for relatedness using mitochondrial DNA.

Grantee: University of West Florida, Pensacola, Florida
Grant No.: NA03NMF4270089 *NMFS Contact*: F/SER
Project Title: Evaluation of Ciliate Protozoans as a First Food for Red Snapper *(Lutjanus campechanus)* Larvae
Funding: *Federal*: $87,151 *Recipient*: $14,426

Description: To isolate microzooplankton protozoans from Gulf of Mexico waters and establish culture techniques. The species most practical to culture will be offered as a first food to red snapper larvae, and the fish survival and growth compared to that obtained using only copepod *nauplii*. Microzooplankton enrichments will be evaluated as a less-intensive alternative to culturing, and assessed for larval survival and any prey preference by snapper larvae among microzooplankton organisms.

Grantee: University of Georgia Research Foundation, Inc., Athens, Georgia
Grant No.: NA03NMF4270087 *NMFS Contact*: F/SER
Project Title: Examination of Coastal Aquaculture Effluent and Receiving Water Quality throughout the Tidal Cycle
Funding: *Federal*: $94,094 *Recipient*: $10,470

Description: To examine water quality of the receiving water and effluent at five commercial marine aquaculture facilities throughout several tidal cycles, and estimate effluent dilution factors. Selected facilities will have outfall locations ranging from the intercoastal waterway to small tidal creek tributaries. Study results should suggest the relative magnitude of the need to consider receiving water changes throughout the tidal cycle and effluent changes throughout the daily cycle as part of best management practices. Tidal cycles will be monitored during periods of high discharge (i.e., late season and harvest). At each facility, samples will be collected throughout the tidal cycle, at both the outfall and in the receiving water prior to effluent discharge. Analyses will include suspended solids, turbidity, total nitrogen, total ammonia nitrogen, biochemical oxygen demand, and chlorophyll. Data sondes will concurrently measure dissolved oxygen, pH, salinity, and temperature in the receiving water and effluent. Semi-continuous measurements with an area velocity meter will monitor effluent volume throughout the tidal cycle. Dye will be used to determine effluent dilution during periods representing an average to lower-than-average tidal height.

Grantee: Texas Agricultural Experiment Station, College Station, Texas
Grant No.: NA17FD2371 *NMFS Contact*: F/SER
Project Title: Development of DNA Microsatellites for Genetic Applications in Cobia *(Rachycentron canadum)*
Funding: *Federal*: $120,627 *Recipient*: $40,542

Description: To develop 25 to 30 polymorphic microsatellite DNA markers specific for cobia that can be used in forensic, quantitative genetic (broodstock enhancement), and stock-structure applications. Optimization of experimental conditions for assay of the microsatellites is a key experimental objective. Effective distribution/dissemination of project results is another key objective.

IV. PENDING NATIONAL PROGRAM PROJECTS

This section contains a description of all pending (ongoing) projects under the S-K National Program, along with project number, project title, federal funding level, and the NMFS contact.

PRODUCT QUALITY AND SAFETY

Grantee: Gulf and South Atlantic Fisheries Foundation, Inc., Tampa, Florida
Grant No.: NA03NMF4270393 *NMFS Contact*: F/SER
Project Title: At-Risk *Vibrio vulnificus* Educational Program Targeting the Medical/Professional Community
Funding: *Federal:* $1,473,800 *Recipient:* $0

Description: To evaluate the success or failure of past at-risk consumer education efforts and to identify and develop appropriate strategies, programs, and educational materials aimed at reducing *V. vulnificus*–related illnesses among the at-risk segment of the population. The target audience is the *V. vulnificus* at-risk segment and the medical and health care professionals who diagnose and provide medical advice to such patients and clients. The core states of Florida, Louisiana, and Texas will be targeted for a multifaceted educational campaign regarding the dangers to at-risk individuals of *V. vulnificus* illness from raw oyster consumption. Direct mailing to health care professionals will be made to educate and warn them of symptoms and treatments and the risks of raw oyster consumption, and to characterize the at-risk consumer. Radio and television advertisements will be created to educate the general public. In addition, a website will be developed that will focus on educating the public at-large.

Grantee: Wild American Shrimp, Inc., Tarpon Springs, Florida
Grant No.: NA05NMF4271149 *NMFS Contact*: F/SER
Project Title: Wild American Shrimp Certification Program
Funding: *Federal:* $1,000,000 *Recipient:* $0

Description: To develop a certification program to ensure all shrimp branded as "Wild American Shrimp" meet quality standards developed in cooperation with the NMFS Seafood Inspection Program. This will be accomplished with assistance from Sea Grant College participants in the Southeast United States.

AQUACULTURE

Project No.: 05-HQ-AQ *NMFS Contact*: F/MB5
Project Title: Development of a Permitting System for Marine Aquaculture
Funding: *Federal:* $300,000 *Recipient:* $0

Description: $300,000 in S-K funds will be used to prepare background environmental and economic studies and outreach and education materials to implement the National Offshore Aquaculture Act. The funding will cover contracts for environmental and economic studies needed to develop a regulatory system and for education and outreach tools and materials to inform the public on issues associated with offshore aquaculture. The proposed work was not considered for funding under the competitive S-K Grant Program because we did not have a competitive program in FY 2006, due to insufficient funding. We consider a "critical mass" of at least $1 million as the minimum needed to conduct the competitive program. Furthermore, the Administration's budget request and congressional action to date indicate the funding allocation will be insufficient for the competitive program in FY 2007.

TRAINING AND EDUCATION

Grantee: City of New Bedford, New Bedford, Massachusetts
Grant No.: NA05NMF4271296 *NMFS Contact:* F/NER
Project Title: Safety Training for Commercial Fishermen
Funding: Federal: $99,960 *Recipient:* $46,494

Description: The primary goals of this award are to reach as many commercial fishermen as possible on a voluntary basis to provide them with hands-on safety and survival skills that will give them enough knowledge and experience to prepare for emergencies. This is Phase I of the program and is a continuation of the very successful pilot program (in progress) funded by the City of New Bedford. In addition, Phase II is designed to foster a sustainable safety consciousness and expertise by ensuring each vessel has a trained expert on board who can conduct effective monthly safety drills.

Objectives for this funding are to:

- Continue with Phase I basic safety training to reach as many individual fishermen as possible with the funding provided.
- Train Certified Fishing Vessel Drill Conductors for each fishing vessel using U.S. Coast Guard Certified Fishing Vessel Safety Instructors.
- Conduct safety drills with each certified drill conductor to ensure he/she can safely and effectively conduct drills on board his/her vessel.

Overall, the training will increase the knowledge and skills of individual fishermen and improve the safety climate of each vessel, which will reduce the number of on-board emergencies, reduce the number of injuries to crew, and reduce the number of crew fatalities.

Grantee: Herring Gut Learning Center, Port Clyde, Maine
Grant Number: NA05NMF4721128 *NMFS Contact*: F/NEC
Project Title: Aquaculture and Marine Science Program Expansion Project
Funding: *Federal*: $100,000

Description: The project goal is to expand the portfolio of educational/aquaculture programs at Herring Gut Learning Center (HGLC). The funding will support several educational programs that introduce students to the latest methods and materials of marine science. Students will also learn about the sociological, economic, and communications aspects of the most current scientific technology. Specific projects include:

(1) Aquaponic Greenhouse – Students will help design, build, repair, and maintain the physical aquaponics system (tanks, plumbing, carpentry) as well as learn the biological and aquacultural aspects.
(2) Oyster Business Project – Integrates real-world experience through a student-run aquaculture business. Students design a *pro forma* budget based on projected income and expenses generated by a theoretical social-purpose aquaculture enterprise.
(3) Finfish Project – Students develop and maintain three recirculating systems and learn firsthand what it takes to raise finfish in captivity.
(4) Science for the Sustainable Future – Uses the finfish aquaculture systems (greenhouse system, and two smaller cold-water systems that currently house rainbow trout) to help students meet high school science requirements through a more hands-on teaching method.

Objectives for this funding:

The HGLC will contribute to the NOAA strategy of developing coordinated regional and national outreach and education efforts to improve public understanding and involvement in stewardship of coastal and marine resources to create a well-informed public that acts as steward for these resources. Meeting these NOAA objectives is particularly important in coastal Maine, where fishing communities have been impacted by downturns in fisheries. Evidence of this impact on communities, such as the decline in groundfishing activities and increased unemployment, is found in documents such as those prepared for amendments and framework actions to federal fishery management plans.

Goals of the program include inspiring future marine scientists and aquaculturists and preparing students for jobs in marine fisheries. HGLC's program directly supports the objectives of the NOAA Aquaculture Policy to:

- Create new employment opportunities in the field of aquaculture;
- Develop a robust aquaculture industry; and,
- Provide economic opportunities for fishing communities impacted by downturns in fisheries.

V. COMPLETED GRANT PROGRAM PROJECTS

This section contains an assessment of each S-K Grant Program project completed during the period June 1, 2005, through May 31, 2006, regarding the extent to which the objectives of the project were attained and the project contributed to fishery development. The projects are listed by grantee within each subject area, along with the grant number, project title, federal funding level, recipient funding level (i.e., cost share), and the NMFS contact.

FISHERIES UTILIZATION

Grantee: University of Alaska, Fairbanks, Alaska
Grant No.: NA16FD2387 *NMFS Contact*: F/AKR
Project Title: Utilizing Bycatch: Developing Products from Arrowtooth Flounder and Other Economic Discards
Funding: *Federal*: $78,636 *Recipient*: $16,545

Assessment: This project developed a mince, washed mince, and/or surimi from arrowtooth flounder that will have textural properties similar to beef sausages for use in food service products. The softness of the washed and unwashed mince can be attributed in part to the protease activity remaining in the raw material. Arrowtooth flounder is well known for its endogenous protease. It is the main reason for the low interest in harvesting and processing this fish. It was expected that products made from unwashed arrowtooth mince would have considerable protease and be unsuitable for a raw material in this application. It was hoped that the washing process would remove enough protease to improve the characteristics of the mince to produce acceptable products. Although washing did remove 85 percent of the protease activity, enough enzyme remained to soften the finished products, producing a slightly mushy texture. It would be expected that extended storage would increase this defect. By contrast, the washed/stabilized mince with the addition of cryoprotectants both diluted and reduced the protease activity 95 percent. This product compared favorably with the commercially produced sample, suggesting this material is best suited as a potential ingredient for sausage manufacture.

Grantee: Cornell University, Ithaca, New York
Grant No.: NA16FD2389 *NMFS Contact*: F/AKR
Project Title: Optimizing the Utilization of Pollock Byproducts Focusing on Skin, Bones, Scales, and Viscera
Funding: *Federal*: $150,613 *Recipient*: $49,648

Assessment: The Lowry and Biuret assays are colorimetric methods widely used for total protein determination. The color responses of gelatins varied significantly in both assays, and the different imino acid content was the main reason for this variation. It is suggested that gelatins could be classified into two major groups based on their color development ability. Thus, for the more accurate determination of total protein in gelatin solutions with the Lowry or Biuret method, the choice of the reference standard is important, and only gelatin from the same source

or at least the same group should be used as the standard. This finding may also be extended to the total protein content determination of collagen, which is the parent protein of gelatin.

Grantee: University of Maine, Orono, Maine
Grant No.: NA03NMF4270124 *NMFS Contact*: F/NER
Project Title: Recovery of Value from Crustacean Waste: Production and Assessment of an Improved Chitosan-based Heavy Metal Adsorbent
Funding: *Federal*: $57,772 *Recipient*: $9,218

Assessment: Chitosan membranes with high specificity for "soft" metals were synthesized for use in ultrafiltration and as a sensor. The synthesis involved dissolution of chitosan in a weak organic acid, followed by the addition of silica beads to the solubilized chitosan. The silica beads were then dissolved in hot base that also serves to gel the chitosan solution into a ~500 μm thick layer with 20 μm average internal pore diameter. The chitosan membranes were then cross-linked using glutaraldehyde and epichlorohydrin, and thiol groups were grafted onto the membranes using cysteine and thiourea. It was shown that epichlorohydrin with thiourea produced chitosan membranes with fastest Hg absorption kinetics. Field deployment of chitosan membranes in brackish estuarine sediments resulted in adverse physical, and possibly chemical, effects on the membranes possibly because of osmotic stress, rendering the biomembranes not useful for deployment in high ionic strength systems. We therefore conclude that chitosan membranes are best suited for use in freshwater environments. The relatively high Hg uptake kinetics of these membranes indicate they may especially be useful where rapid variations in ambient geochemistry affect the potential mobility of the porewater Hg pool on short time scales.

Grantee: National Fisheries Institute, Inc., Arlington, Virginia
Grant No.: NA03NMF4270275 *NMFS Contact*: F/NER
Project Title: Development of the "Chub" Mackerel Fishery, an Underutilized Species
Funding: *Federal*: $117,410 *Recipient*: $28,840

Assessment: Two freezer trawlers from Cape May, New Jersey, that can also operate as refrigerated seawater vessels participated in the experimental chub mackerel fishery using Atlantic mackerel nets. Eight paired tows were conducted in depths ranging from 56.7 to 84.5 fathoms off of southern New Jersey and the Eastern Shore of Virginia in 2003. Average search time before starting a tow was 13.17 hours. When towing the net, the two boats were 0.11 mm apart, and tow time averaged 2.73 hours. Chub mackerel were caught in five of eight tows and averaged 5,589.07 kg per tow. Total catch of chub mackerel was 44,712.7 kg. Mean catch per trip ranged from 88.45 kg for the June trip to 14,837.03 kg for the first August trip. A total of three tows did not catch chub mackerel. *Illex* squid was the dominant bycatch species with 12,505.1 kg caught and averaged 1,563.14 kg per tow. The remaining bycatch species were caught in small quantities. An economically viable fishery can probably be developed. However, vessels must learn how to catch these fish, which requires a considerable amount of time and investment in nets and electronics. The processor can also make a profit on the purchase and sale of chub mackerel and markets are readily available. During years of poor

Illex fishing, targeting chub mackerel may be a viable option for vessels in the Mid-Atlantic Bight.

Grantee: Louisiana State University Agricultural Center, Baton Rouge, Louisiana
Grant No.: NA03NMF4270092 *NMFS Contact*: F/SER
Project Title: Purification of Lysozyme from Shell Liquor of Eastern Oysters *(Crassotrea virginica)* and Potential Commercial Use
Funding: *Federal*: $117,437 *Recipient*: $28,613

Assessment: To purify lysozyme from oyster shell liquor obtained from oyster processors in spring, summer, fall, and winter. The lysozyme yield in mg. protein/liter of shell liquor will be determined for each season. The minimum concentration of lysozyme inhibiting the growth of bacteria responsible for food poisoning and food spoilage will be measured using protocols of the National Committee for Clinical Laboratory Standards. The allergenicity of oyster lysozyme will be determined by western blotting, enzyme-linked immunosorbent assay (ELISA), and passive cutaneous anaphylaxis test.

MANAGEMENT ALTERNATIVES AND FISHERIES USER CONFLICTS

Grantee: University of Massachusetts, Dartmouth, North Dartmouth, Massachusetts
Grant No.: NA03NMF4270265 *NMFS Contact*: F/NER
Project Title: Full-time Employment and Income in New Bedford Before and After Days at Sea
Funding: *Federal*: $79,128 *Recipient*: $20,201

Assessment: This report focuses on the changes in employment, income, and working conditions in the port of New Bedford since the initiation of Days at Sea (DAS) for scallops and multispecies. Specifically, this report compares fishing employment, income, and working conditions in 1993, before DAS began, with the same variables in 2002, nine years later. Other changes, however, affected these fisheries as well. Stock sizes increased or decreased in part due to landings, but also due to additional factors, largely environmental. Regulations also changed, especially in scalloping with closing and then opening areas to scallop fishing. The simple comparison of these variables from one period to another, therefore, cannot be attributed to the effect of DAS alone.

Sections of this report describe the research methodology and data collection, New Bedford landings, vessels, infrastructure, and management plans, and changes in employment, income and working conditions between 1993 and 2002. In our conclusion, some preliminary connections between DAS and employment, income, and working conditions in New Bedford can be drawn.

Grantee: University of Rhode Island, Kingston, Rhode Island
Grant No.: NA03NMF4270181 *NMFS Contact*: F/NER
Project Title: An Economic Analysis of an Alternative Atlantic Sea Scallop Management: Harvesters Cooperatives and Scallop Enhancement
Funding: *Federal*: $109,894 *Recipient*: $29,690

Assessment: The project was conducted in two separate but interrelated phases. In the first phase, a comprehensive model of the U.S. Atlantic sea scallop fishery was developed to evaluate the potential economic contribution of a large-scale stock enhancement program. The same model was used to evaluate the effectiveness of a simple mechanical rotation scheme of the closed areas in Georges Bank. Results in this phase of the project indicated that enhancement could potentially provide an effective buffer against natural fluctuations in scallop recruitment; however, achievement of these objectives would hinge on the development of a complex infrastructure of hatcheries, which in turn would require substantial investments from the public and/or private sectors. In contrast, rotation of fishing areas was demonstrated to be a much simpler and highly effective management tool to improve utilization of the resource. More specifically, the model illustrated how many of the problems the fishery faced during the 1990s could have been mitigated by the demarcation of and controlled access to rotational fishing areas.

Given the preliminary results pointing out rotation of fishing areas as a robust management strategy, the second phase of the project focused on the development of a bioeconomic model aimed at the identification of optimal exploitation patterns for the sea scallop resource. Results unequivocally selected rotation of fishing grounds as the optimal management scheme. In addition, optimal rotation periods were determined separately for the Georges Bank and Mid-Atlantic Bight regions. A comparative analysis was also conducted to evaluate the relative effectiveness of the optimal pattern of rotational exploitation and a number of mechanical area rotation policies proposed by the NEFMC.

Findings from the first phase of the project were presented at the 2004 Biennial Meeting of the International Institute of Fisheries Economics and Trade (IIFET) held in Tokyo, Japan. A paper entitled "Designing Management Alternatives for the U.S. Atlantic Sea Scallop Fishery: Potential Contribution of Stock Enhancement Programs and Rotation of Fishing Areas" was prepared for the conference proceedings. Results from the second phase of the project were presented at the past 2005 Forum of the North American Association of Fisheries Economists (NAAFE) held in Vancouver, Canada. A manuscript summarizing these results is being prepared for publication in a special issue of *Land Economics*.

The results from our research are presented in this report in two parts, each corresponding to a different phase of the project. We believe the research generated important implications toward improved management of the resource. In particular, we hope to have sufficiently stressed the importance of fully incorporating rotation of fishing areas in the management framework for Atlantic sea scallops. It is our conviction that our recommendations will contribute to preserving and enhancing the conditions that have recently resulted in the most lucrative period in the history of the fishery.

Grantee: University of Rhode Island, Kingston, Rhode Island
Grant No.: NA03NMF4270107 *NMFS Contact*: F/NER
Project Title: Development of a Southern New England Working Group: Focus on Bycatch and Gear Conservation Engineering
Funding: *Federal*: $52,912 *Recipient*: $8,043

Assessment: The sharing of expertise and information is critical for the successful use of gear technology and fish behavior as tools in fisheries management. This project has provided a mechanism for increased interaction among gear researchers, managers, and fishermen. The educational workshops have unified the community in the search for correct and standardized methodology for the design and analysis of selectivity and catch comparison experiments. The researchers all have access to written information and software for standardizing data analysis. The website provides a central location of all information, easily available and updated.

FISHERIES BYCATCH

Grantee: William E. Donaldson, Dublin, New Hampshire
Grant No.: NA16FD2388 *NMFS Contact*: F/AKR
Project Title: Development of a Field Techniques Manual for the Collection of Data on King Crabs, *Lithodes* and *Paralithodes*
Funding: *Federal*: $29,800 *Recipient*: $7,055

Assessment: The field guide produced primarily concerns four commercially fished species of king crabs in the North Pacific Ocean and Bering Sea, namely *Paralithodes camtshaticus, P. platypus, Lithodes aequispinus,* and *L. couesi*. However, the information may be applicable to other related species. The publication is complementary to "Biological Field Techniques for *Chionoecetes* Crabs" (Jadamec et al. 1999) and is designed to mirror that publication where appropriate. State, federal, and university scientists have used different criteria when collecting data on king crabs. This leads to problems in data compatibility and interpretation. The intent here is to allow for standardization of data collection by fisheries observers, shore-side samplers, shellfish scientists, and fishermen. Such standardization would improve data accuracy, and thus

King crab circa 1967,
DOC/NOAA Photo Library

promote better management of these commercially important crabs. When data are collected citing this publication, there should be little or no ambiguity as to measurements taken and definitions used. The guide is not all-inclusive, but is intended to identify structures and organs, measurements and descriptions, and techniques commonly used in lab and field studies on king crabs.

Grantee: Massachusetts Division of Marine Fisheries, Boston, Massachusetts
Grant No.: NA16FD2297 *NMFS Contact*: F/NER
Project Title: Reducing Blue Shark Bycatch in Pelagic Longline Fisheries
Funding: *Federal*: $53,050 *Recipient*: $8,311

Assessment: To evaluate the effectiveness of bait selectivity in reducing blue shark (*Prionace glauca*) bycatch, artificial baits with differing characteristics were developed and tested on this species. Three batches of baits were prepared with varying binders, attractants, and attractant levels. Artificial and natural baits were presented to blue sharks attracted to a research vessel in offshore waters, approximately 20 to 30 nautical miles south of Martha's Vineyard Island. The reaction of blue sharks to artificial baits was compared to their response to squid, a standard longline bait. Bait interactions were defined and quantified based on whether the bait was bitten, bitten and released, or ignored. During 11 offshore field trials in 2003 and 2004, 445 bait interactions were recorded using 21 artificial and 3 natural baits with approximately 36 blue sharks. Carregeenan was the most effective binder relative to texture and hook retention. It was found that blue sharks were somewhat selective as to what they bite, but were likely to bite artificial bait as frequently as natural squid bait if it contained an olfactory attractant. The blue sharks in this study did not always consume the bait, which indicates that some baits were not palatable. Artificial baits prepared with pollock liver extract not only resulted in a significantly lower number of bites, but were rejected after biting in over 40 percent of the interactions. This artificial bait may represent a potential candidate for additional studies. Although the most effective artificial baits deployed in this study did not contain attractants, it is highly unlikely they would be effective for target species in longline operations.

Grantee: New England Aquarium Corporation, Boston, Massachusetts
Grant No.: NA03NMF4270126 *NMFS Contact*: F/NER
Project Title: Juvenile Bycatch and Survival Assessment of Spiny Dogfish *(Squalus acanthias)* in a Western Atlantic Trawl Fishery
Funding: *Federal*: $169,580 *Recipient*: $28,147

Assessment: Discard mortality in dogfish fell below the 50 percent presently estimated following trawl capture in the wild. It can be concluded from the relatively low percentage of dying animals following the 72-hour period and the acid-base recovery demonstrated by survivors that spiny dogfish are able to survive at a high percentage when faced with routine trawl-capture stress. Additional work should address the effects of greater fluctuations in tow times, tow weights, seasonality, air and seawater temperatures, air exposure (in the lab and the field), capture modes (e.g., gillnetting) and physical and behavioral indices as primary study parameters. The apparent influence of gender on dogfish mortality also requires additional investigation under more controlled settings. For studies seeking to assess mortality through the use of holding pens at sea, the integration of a camera system is highly recommended in order to document occurrences potentially influencing mortality or physiology. As dogfish have demonstrated the ability to quickly acclimate to round seawater holding tanks (personal observation), the use of round as opposed to more narrow rectangular holding pens are also endorsed if monitoring motile species post-capture.

Grantee: Pacific Whiting Conservation Cooperative, Seattle, Washington
Grant No.: NA16FD2447 *NMFS Contact*: F/NWR
Project Title: A Project to Evaluate the Influence of Oceanographic Variables on Non-Target Species of Bycatch in the At-Sea Pacific Whiting Fishery
Funding: *Federal*: $17,022 *Recipient*: $11,000

Assessment: The objective was to install on five Pacific Whiting catcher processor vessels conductivity, temperature, and depth (CTD) meters to collect physical oceanographic data and to construct a quantitative measure of risk salmon and rockfish bycatch. Data was collected in 2003 and 2004. Bycatch species occurred in 69 percent of the observed hauls in both years. However, the overall bycatch of these species were 0.05 percent and 0.03 percent of the total catch in 2003 and 2004. The very low bycatch rate was primarily due to the recruitment of a very strong 1999 year class of Pacific whiting to the fishery in 2003, as well as proactive bycatch avoidance efforts by the fleet. Because the levels of bycatch were so low, it was not possible to establish a significant correlation between bycatch and temperature and salinity. In addition, the study found that the use of "fish tag" CTD in trawls were easier to deploy than standard CTDs and that accuracy was suitable for this type of research. However, several of the units failed due to damage from hauling or setting or the breakdown of the CTD radio transmitter.

Grantee: Pfleger Institute of Environmental Research, Oceanside, California
Grant No.: NA16FD2470 *NMFS Contact*: F/SWR
Project Title: Can Leatherback Sea Turtle Bycatch Be Reduced in the Swordfish Longline Fishery by Modifying Fishing Methods?
Funding: *Federal*: $105,518 *Recipient*: $25,168

Assessment: Final progress report pending.

Leatherback turtle, DOC/NOAA Photo Library

PRODUCT QUALITY AND SAFETY

Grantee: Kenai Peninsula Borough, Soldotna, Alaska
Grant No.: NA03NMF4270109 *NMFS Contact*: F/AKR
Project Title: Cook Inlet Sockeye Salmon Branding Program
Funding: *Federal*: $399,659 *Recipient*: $75,672

Assessment: The complete program included two interdependent phases—one to establish a quality certification program for Cook Inlet salmon, creating a higher value product, and another to promote that product to high-end niche markets, creating higher margins for Cook Inlet processors and fishers.

The program met or exceeded NOAA goals by establishing industry standards that strengthen the industry by producing a more marketable product. Local processors and fishers have learned the value of instituting quality standards and are expected to continue using them in the future. This should lead to a more sustainable fishery for the Cook Inlet area.

Grantee: University of Rhode Island, Kingston, Rhode Island
Grant No.: NA16FD2301 *NMFS Contact*: F/NER
Project Title: Quality and Safety Assessment of Commercially Produced Tasteless Smoked Seafood Products
Funding: *Federal*: $98,948 *Recipient*: $28,969

Assessment: Filtered smoke treatment does not appear to be a panacea or "cure-all" for seafood quality stabilization or enhancement. The only significant impacts that could be categorically documented were on the lipid oxidation profiles and significant different initial color that held up with freezing. The impact on lipid oxidation would be important as this would help protect the omega-e fatty acids that are so important in our diet to protect against heart disease. From a quality perspective, keeping the "red" color under frozen conditions so the myoglobin does not turn brown is valuable. However, the color may or may not change—the results were not consistent. In most cases, TMA-N analyses of samples resulted in negligible quantities, in some cases below the lowest detection limit and, therefore, had little value.

Microbiological and chemical markers as well as sensory assessment clearly showed that inferior quality attributes will not be "smoked" away. It was clear from this study that at retail, products that are being treated may not always be the best quality. This does not mean they are unacceptable; it does mean that lower-quality product has been used for these products. From our study, it appears there was no safety issue. However, freezing was the causative agent, not the filtered smoke. "Garbage in, garbage out" applies to the treated products as well as fresh, untreated seafood products. Our results did not show increased shelf life as a result of filtered smoke processing.

Grantee: Pacific Shellfish Institute, Olympia, Washington
Grant No.: NA03NMF4270186 *NMFS Contact*: F/NWR
Project Title: Risk Management of a New U.S. Oyster Disease Threat
Funding: *Federal*: $76,791 *Recipient*: $14,732

Assessment: The objective was to ensure the continued ability of West Coast shellfish seed producers to export seed free of Denman Island disease and to perform a risk analyses for the disease on the West Coast. Denman Island disease, which is caused by a parasite, was found in oysters for the first time in Washington State in 2002. The recipient prepared a risk assessment report for Denman Island disease for the Office of International Epizooties (OIE; an international body acting as the arbiter of non-tariff trade disputes, of which the United States is a member). Members of the OIE are required to report disease occurrences. The authors of the risk assessment report concluded there is a negligible risk of exporting Denman Island disease with live shellfish products from the seven West Coast oyster seed production areas. Also, this award supported a workshop of regional shellfish experts who reviewed and commented on a draft of the risk assessment report.

AQUACULTURE

Grantee: Micro Technologies, Inc., Richmond, Maine
Grant No.: NA03NMF4270118 *NMFS Contact*: F/NER
Project Title: Environmental Monitoring for Infectious Salmon Anemia Virus (ISAV) in and around Atlantic Salmon Marine Aquaculture Sites
Funding: *Federal*: $134,019 *Recipient*: $20,876

Assessment: Seawater, cage pontoon and boat hull surfaces, and blue mussels (*Mytilus edulis*) were evaluated for use in the detection of infectious salmon anemia virus (ISAV) at marine Atlantic salmon (*Salmo salar*) grow-out sites and as an early warning system to potential infection of fish and disease occurrence. Methods were developed and optimized for each sample type and implemented on field samples using cell culture and reverse transcription polymerase chain reaction (RTPCR) for ISAV detection. ISAV was consistently detected only by RTPCR in concentrated seawater samples collected up to 1.5 km from an affected site. Surface swab sample results correlated well with those from seawater, while mussels did not prove useful as potential sentinels in ISAV detection. Laboratory trials on ISAV longevity in seawater and freshwater showed that viability was directly correlated to temperature and biological activity, but the effect of temperature on detection by RTPCR was inversed in the two systems; whereas the longest period of ISAV detection by RTPCR in seawater was 11 weeks at 4°C, in freshwater this was 18 weeks at 16°C instead. Laboratory evaluation of mussels indicated they did not significantly bioaccumulate ISAV from seawater and conversely may be destroying the virus through the filtration process. A quantitative RTPCR method was developed for ISAV and used to determine copy numbers in laboratory and field samples, and compare values to titers of viable virus determined through cell culture. All samples of fresh ISAV supernatant showed that a very high percentage of the virus detected by RTPCR was viable, while field samples indicated a 1,000-fold difference. In ISAV longevity trials, despite the loss of viable virus early on, ISAV copy numbers remained unchanged for many weeks, suggesting that a similar phenomenon is likely occurring in the field and that testing of concentrated seawater samples by RTPCR is probably the best method for the detection of ISAV shed into the environment.

Grantee: University of Maryland Biotechnology Institute, Baltimore, Maryland
Grant No.: NA03NMF4270150 *NMFS Contact*: F/NER
Project Title: Ultrasound Mediated Delivery of Vaccines for Aquaculture
Funding: *Federal*: $150,079 *Recipient*: $54,724

Assessment: The overall goal of the proposed study was to develop an ultrasound-mediated delivery protocol for non-invasive, mass vaccination of Atlantic salmon against infectious salmon anemia (ISA) using a whole-killed virus vaccine. Because of delays in obtaining Atlantic salmon fry of the appropriate size, this project was initiated using rainbow trout as a surrogate model.

Studies were also conducted that raise doubts as to whether the proposed mode of vaccination will elicit an immune response using a whole, formalin-killed ISA vaccine. In collaboration with

a commercial trout grower, a whole, formalin-killed vaccine for IHNV was administered to rainbow trout fingerlings via several routes: intraperitoneal (IP) injection, intramuscular (IM) injection, immersion, or immersion coupled with ultrasound treatment. Although IP-injected fish were able to mount an immune response, none of the other treatment groups produced antibodies to the whole killed virus. The fact that IM-injected fish were not successfully vaccinated indicates that the route of entry for this and possibly other whole killed vaccines is important. Because such large particles are likely to be shed with the natural sloughing of the fish skin, we suspect the presence of whole killed viral particles in the skin is not likely to elicit an immune response. It should be noted that vaccination of salmon for ISA is done around the time of smoltification via IP injection. In addition, the whole killed ISA vaccine used in the present study was only recently developed, and has not been well-characterized in terms of efficacy.

Because of these issues, we have turned our attention toward alternative vaccines, which we plan to test in conjunction with our ultrasound-mediated delivery method. One alternative is a commercially available recombinant ISA vaccine, available from MicroTek International. This vaccine has been shown to confer immunity in laboratory challenge tests. Significant advantages to recombinant vaccines include small particle size, ease of preparation and handling, and engineering of adjuvant-like epitopes into the vaccine to elicit robust immune responses at the cellular as well as humoral level. Another alternative currently being pursued is a DNA vaccine encapsulated in cationic nanoparticles. These nanoparticles are presently being produced by a start-up company and the manner in which they are produced may not be described at this time. Several months ago we carried out preliminary challenges using such a viral DNA vaccine. We compared naked DNA (positive control) to the DNA incorporated into the nanoparticles, by IM injection. Significant differences in protection were not found between the two preparations, indicating these particles are indeed suitable for DNA vaccination in fish.

Grantee: University of Maryland Biotechnology Institute, Baltimore, Maryland
Grant No.: NA03NMF4270153 *NMFS Contact*: F/NER
Project Title: Ensuring Biosecurity in the Atlantic Salmon Farming Industry through a Novel Approach to Inducing Sterility: Disrupting Establishment of the GnRH System
Funding: *Federal*: $159,484 *Recipient*: $58,321

Assessment: The main goal of this project was to develop a simple and efficient technology for inducing hypogonadism and sterility in Atlantic salmon that is based on disrupting the developmental establishment of the GnRH neuronal system. The proposed technical objectives sought to accomplish this goal by immersing Atlantic salmon embryos, during defined developmental time periods, in γ-aminobutyric acid (GABA), a naturally occuring neurotransmitter.

The use of zebrafish as a test model in this set of experiments enabled us to quickly determine whether any of these other compounds were worth pursuing. Zebrafish reach sexual maturity fairly quickly (3 months) and have a rapid embryonic development (3 days to hatch), compared to salmonids. Moreover, our laboratory has studied the development of the GnRH system in zebrafish, and possesses the molecular tools necessary for the relevant experimental analyses. In addition, zebrafish have two forms of GnRH, as is found in salmonids.

Grantee: Atlantic Salmon Federation, Inc., Calais, Maine
Grant No.: NA03NMF4270184 *NMFS Contact*: F/NER
Project Title: Tracking Experimentally Released Escaped Farmed Salmon in the Bay of Fundy Region to Determine Recapture Feasibility and Potential Interactions with Wild Atlantic Salmon
Funding: *Federal*: $227,020 *Recipient*: $46,500

Assessment: The recipient sonically tagged and experimentally "escaped" farmed Atlantic salmon from a cage site in Cobscook Bay, Maine, to document movement patterns and fates of the fish. Cobscook Bay and the surrounding Bay of Fundy region are dominated by intense tidal currents. Fish were liberated in either the winter or spring, which are the peak storm seasons. Tagged salmon dispersed away from cage sites within a few hours post-release. There were high mortalities of the fish within Cobscook Bay and the surrounding coastal region (56 percent of winter release fish; 84 percent of the spring group), probably due to seal predation. Surviving fish exited the coastal zone to the Bay of Fundy primarily by following the dominant tidal currents in the region through Canadian waters. One fish showed an extended course track, running from the release site down to the Narrguagus River estuary, then returning to the release area, where it meandered extensively back and forth across the U.S./Canada border. No sonically tagged fish were detected during the autumn spawning season in any of 40 monitored Atlantic salmon rivers draining into the Bay of Fundy. The results suggest that in this region farmed salmon cannot be effectively captured after an escape and that few farmed salmon released in winter and spring will survive to spawn with wild fish. However, maturing fish escaping in autumn may survive long enough to pose a significant introgression risk. In addition, the extended course track of one fish raises concerns about its possible impacts if it has been a disease carrier. Continued attention to containment methods and disease control at farms is warranted.

Grantee: New England Aquarium Corporation, Boston, Massachusetts
Grant No.: NA03NMF4270121 *NMFS Contact*: F/NER
Project Title: The Use of Acoustic Conditioning to Reduce the Impact of Escapement in Atlantic Salmon Net Pen Aquaculture
Funding: *Federal*: $128,845 *Recipient*: $23,081

Assessment: This research demonstrated that both salmon and trout exhibit the ability to be conditioned, and will maintain a conditioned response for an extended period of time even in the absence of reinforcement. However, the success of the laboratory did not translate into success in the field, as demonstrated by the lack of fish that were recaptured.

This lack of success may indicate a number of issues:

1. The fish do not discriminate the tone in a "noisy" environment. The fish may need additional information (e.g., a light) to conduct fine scale movement patterns in a natural environment. Turbidity within Narragansett Bay may limit the visual acuity of fish attempting to locate the pen or feeding ring. Sound direction can be difficult to distinguish, and this may not allow for the fish to return to the exact location of the cage.

2. The sound generation equipment was not sufficient for the marine environment. There were initial difficulties with the combination of the tone generation equipment and the confined metal tank that resulted in sound wave overlap, and a reduced ability to generate low-decibel sounds (described in the companion report prepared by Dr. Ken Baldwin). As a result, the sound would not propagate very far in the water considering the estimated sound level. There is also a good deal of ambient noise in this frequency range and Narragansett Bay is a busy place, making for ample opportunities to mask the intended tones.

3. The fish are of "wild" origin, and may have a rapid flight response as observed by Dr. Fred Whoriskey of the Atlantic Salmon Federation. "Domesticated" salmon may be more likely to return to a cage and thus more appropriate for this type of work. This is based on the more rapid condition exhibited by rainbow trout in the laboratory and the penchant for trout to stay near net pens upon escape (Bridger and Barger 2002, in Costa-Pierce, Ecological Aquaculture). It is also possible that the release activity itself may stress the animals, which would be a correlate of their degree of domestication.

Grantee: Great Bay Aquaculture, LLC, Portsmouth, New Hampshire
Grant No.: NA03NMF4270114 *NMFS Contact*: F/NER
Project Title: Development of Disease-Free Cod Broodstock and Juveniles for Cage Culture
Funding: *Federal*: $289,774 *Recipient*: $80,747

Assessment: The commercialization of Atlantic cod aquaculture in New England and Atlantic Canada has tremendous potential, as salmon farmers are looking at alternative species for diversification. There are, however, impediments to commercialization that represent substantial risk, chief among them the predictable supply of healthy juveniles, consistent supply of juveniles, and quality brookstock that can supply on a near year-round basis superior gametes for production.

The two major pathogens to date are Vibrio species of bacteria and the Atlantic cod nodavirus that devastates juvenile production. Vibriosis is treatable if detected early, and work with vaccination is underway. Some preliminary results are discussed in this report. There are no known treatments for viral nervous necrosis caused by an infection from nodavirus, or non-lethal detection methods, or vaccines available for cod. This project positioned nodavirus as a primary pathogen of concern that further research needs to address. Nodavirus is a serious pathogen that is known to affect over 30 species of marine fish, including cultured halibut, haddock, sea bass, grouper, flounder, and barramundi. As a direct result of this project, active research is underway to develop a nodavirus vaccine for cod.

Broodstock were collected from two spawning populations—one winter and one spring—and held in tanks under a photothermal regime and induced to spawn over an extended period of time. Fertilized eggs were obtained by both communal tank spawning and strip spawning. Cod were successfully induced by photothermal cues to spawn from September through February and from May through July.

Techniques for DNA fingerprinting of the brood and resulting progeny were refined and an online database established. A plan for the selective breeding of cod has been developed with regional research institutions.

Over 100,000 juveniles were produced and placed with commercial growers in Maine and Canada. The survival and growth has been acceptable by commercial standards. An HACCP-based plan has been developed for the production of Atlantic cod at the Great Bay Aquaculture hatchery facility.

Concerning the predictable supply of disease-free juveniles, the risk of disease has been mitigated and has advanced significantly from where the industry was 2 years ago as a direct result of this project.

Grantee: Woods Hole Oceanographic Institution, Woods Hole, Massachusetts
Grant No.: NA16FD2291 *NMFS Contact*: F/NER
Project Title: Open-Ocean Aquaculture: Economic Measures for Mitigating Risk and Encouraging Development
Funding: *Federal*: $107,257 *Recipient*: $46,501

Assessment: Open-ocean aquaculture is an emerging industry, in which potentially significant opportunities exist for the fishing community and other businesses to profit from the production and processing of seafood grown in the ocean. The economic costs of risk and uncertainty, however, represent significant barriers to economic growth in this industry. In the face of these costs, entrepreneurs are unlikely to make investments, and industrial growth will not take place. This project focused on identifying and characterizing sources of risk and uncertainty associated with open-ocean aquaculture, estimating the levels of those risks that are measurable, describing uncertainties for which risks cannot be estimated, estimating the expected net economic benefits from aquaculture operations under risk and uncertainty and developing estimates of potential industry investment levels, and identifying institutions or policy instruments for managing risk and uncertainty. These objectives were pursued through four major study components: (1) review and analysis of aquaculture policy and regulation; (2) development of a firm-level investment-production model and risk assessment framework with a simulation of the production of Atlantic cod (*Gadus morhua*); (3) in-depth profile of the U.S. industry and market for blue mussels (*Mytilus edulis*) as a prospective open-ocean aquaculture product; and (4) identification of institutional mechanisms for mitigating risk and uncertainty. This final report provides detailed accounts of the four study components and the resulting findings and conclusions.

Grantee: MER Assessment Corporation, Brunswick, Maine
Grant No.: NA03NMF4270151 *NMFS Contact*: F/NER
Project Title: Evaluation of LiftUp® System in the Mitigation of Environmental and Fish Disease Impacts in Net-Pen Aquaculture
Funding: *Federal*: $110,704 *Recipient*: $54,742

Assessment: LiftUp® technology was evaluated for its possible use in the mitigation of environmental impacts and fish health management at a commercial salmon growout facility in Machias Bay, Machiasport, Maine, operated by Atlantic Salmon of Maine LLC. Four treatments, LiftUp-equipped cages, standard cages, 30m distance from cages (regulatory compliance boundary distance), and a reference site were compared using biological and sediment chemistry metrics to measure organic enrichments and environmental degradation. Quality of the water within the LiftUp-equipped and standard cages, as well as the LiftUp discharge, were also measured. Additionally, fish health was evaluated for both LiftUp-equipped and standard cages using measures of growth and mortality, clinical evaluation during routine veterinary site inspections, and periodic measures of packed cell volumes and white cell counts from subsets of apparently healthy fish; evaluation of potential impacts to pathogen exposure pathways was done using stable isotope concentrations as a measure of exposure to fish carcass or excretory products.

No statistically significant differences were seen between the LiftUp and non-LiftUp cages at the end of the project; early in the project, statistically significant differences were seen for certain parameters. Nevertheless, consistently lower states of organic enrichment were observed under the LiftUp cages compared to the non-LiftUp cages based on both benthic infauna and sediment chemistry results. No statistically significant differences in standard fish health metrics were noted between LiftUp and diver-based mortality recovery systems. However, significant differences in isotopic composition of fecal material (and trends in fish growth) raise questions about alterations in diet. Dissolved and particulate material resulting from LiftUp operation surface discharge does not raise environmental concerns due to its brevity (<100 seconds), very small area (5m x 10m oval), and intermittent frequency (1 to 3 times per week); however, surface discharge does raise concern over spread of disease during presence of infection or parasites.

Clogging of the china hats, due at least in part to freeze-up in winter, appears to have been the most influential/confounding factor in obscuring differences between LiftUp and non-LiftUp cages over the course of the project. Sediment grain size shift toward coarser material at all sampling stations was not expected, and is unexplained at present. This sediment grain size shift may also have contributed to obscuring differences between LiftUp and non-LiftUp cages.

Overall, and with several strong caveats, this project demonstrated that LiftUp-type technology may offer some potential environmental benefits for a very specific selection of site types. However, it is unclear whether those same benefits can be achieved more cost-effectively through employment of traditional best management husbandry, as environmental conditions under the non-LiftUp pens generally remained within legal standards set forth in the MePDES permit throughout the project period. Use of LiftUp-type technology is not possible under subfreezing conditions, in areas shallower than 65 ft. at low water, or at high-energy sites, and may not be warranted even under slower current regimes. LiftUp is clearly neither warranted nor practicable at all sites, and its applicability in Maine may be limited to very specific circumstances.

VI. COMPLETED NATIONAL PROGRAM PROJECTS

No S-K National Program projects were completed during the period June 1, 2005, through May 31, 2006. All current S-K National Program projects are ongoing.

APPENDIX:
NATIONAL MARINE FISHERIES SERVICE OFFICES

Information regarding the Saltonstall-Kennedy Grant Program may be obtained from the following offices of NOAA's National Marine Fisheries Service:

NMFS Headquarters
Steve Aguzin
National Marine Fisheries Service
Financial Services Division
1315 East-West Highway
Silver Spring, MD 20910
Telephone: (301) 713-2358
Email: stephen.aguzin@noaa.gov

Northeast Region
Joyce Lacerda
National Marine Fisheries Service
State, Federal & Constituent Programs Division
One Blackburn Drive
Gloucester, MA 01930
Telephone: (978) 281-9256
Email: joyce.lacerda@noaa.gov

Southeast Region
Ellie F. Roche
National Marine Fisheries Service
Cooperative Programs Division
263 13th Avenue, South
St. Petersburg, FL 33701
Telephone: (727) 824-5324
Email: ellie.roche@noaa.gov

Southwest Region
Trisha Culver
National Marine Fisheries Service
Fisheries Management Division
501 West Ocean Boulevard, Room 4200
Long Beach, CA 90802-4213
Telephone: (562) 980-4030
Email: trisha.culver@noaa.gov

Pacific Islands Region
Scott Bloom
National Marine Fisheries Service
Fisheries Management Division
1601 Kapiolani Boulevard, Suite 1110
Honolulu, HI 96814-4704
Telephone: (808) 944-2218
Email: scott.bloom@noaa.gov

Northwest Region
Kevin A. Ford
National Marine Fisheries Service
Trade and Industry Services Division
7600 Sand Point Way, N.E.
BIN C15700, Building 1
Seattle, WA 98115
Telephone: (206) 526-6115
Email: kevin.ford@noaa.gov

Alaska Region
Shawn Carey
National Marine Fisheries Service
Office of Management and Information
Federal Building
709 West 9th Street, 4th Floor
Juneau, AK 99801
Telephone: (907) 586-7845
Email: shawn.carey@noaa.gov