

Stakeholder Engagement, Cooperative Fisheries Research and Democratic Science: The Case of the Northeast Consortium

Troy W. Hartley¹ and Robert A. Robertson²

Department of Resource Economics and Development
University of New Hampshire
310 James Hall
Durham, NH 03824

Abstract

Cooperative research among fisheries scientists, industry and managers in the Northwest Atlantic has expanded since 2000, in part due to increasingly disputed science, adversarial politics, and socioeconomic hardship. Surveys of individuals actively engaged in commercial fishing in New England (n=295), and fishermen (n=60) and scientists (n=37) participating in Northeast Consortium-funded cooperative research examined improvements in stakeholder engagement, the distinction between levels of cooperation, and the extent that cooperative research reflects democratic science. We found that through cooperative research, fishermen and scientists are more informed about science and fishing, respectively. These fishermen are more likely to believe the science to be credible. Fishermen and scientists report greater mutual understanding, trust, and likelihood of long-lasting partnerships. Fishermen in particular, but scientists as well, became more active in management after participating in cooperative research. Multiple participation choices are important to ensure broader participation. Last, fishermen and scientists remain skeptical about cooperative research's impact on management.

Keywords: fisheries research, knowledge integration, learning, public dialogue

Introduction

Involving stakeholders in information gathering and science is not new. There exists extensive literature and practical resources on participatory action research, community-based participatory research, citizen science, and other practices that aim to make the scientific process more democratic by involving more stakeholders and types of expertise. Cooperative fisheries research has a long history as well, although it has expanded rapidly since 2000, particularly in New England (National Research Council 2004). Numerous

models of cooperative research exist in New England (e.g., industry sectors setting aside a portion of fish sales for research, competitively-awarded federal resources dedicated to cooperative fisheries research, and non-profit community development loans with cooperative research contract conditions). Cooperative research directly involves stakeholders, particularly the fishing industry and coastal community organizations, in the design, conduct and communication of biophysical, gear design and engineering, and social science research, although the degree of involvement and nature of the partnership can vary. Cooperative fisheries research can employ any scientific paradigm, from action and participatory research to hypothesis-driven, deterministic research. Many of the individual research projects directly consider the questions and data underpinning the scientific management and regulatory decisions of fisheries managers.

One cooperative research program in northern New England, the Northeast Consortium, has emerged from the political demands for greater industry input into the scientific process, the disputed scientific context of fisheries management, the socioeconomic hardship experienced by coastal communities, and the stakeholders' agreement that research findings should guide fisheries management (Hartley and Robertson 2006). The Northeast Consortium also reflects an experiment in a more democratic form of science. This paper reports on the Northeast Consortium and whether it achieved the pragmatic expectations of industry (i.e., greater involvement in science, more informed and empowered fishermen to engage in management) and specific theoretical propositions of democratic science (i.e., social learning, greater mutual understanding, knowledge integration, credible science, and improved public dialogue around fisheries management).

After discussing the current state of stakeholder involvement in fisheries management and the emergence of cooperative research, the paper introduces the concept of democratizing science. Next we describe the Northeast Consortium, the study methods and the findings from three surveys of individuals actively engaged in commercial fishing in New

England, and fishermen and scientists participating in Northeast Consortium-funded cooperative research. The paper concludes with a discussion of what was learned about the practice and theory of cooperative research and further research questions to fully understand this emerging stakeholder involvement practice and possible example of democratic science.

The Practice and Theory of Cooperative Fisheries Research

Cooperative fisheries research has emerged within a contested political and social context. Stakeholders, particularly fishermen, have demanded greater industry involvement in New England fisheries management (Hartley and Robertson 2006). Cooperative fisheries research has expanded in New England, as exhibited by the emergence of the Northeast Consortium, which funds and encourages cooperative fisheries research in the Gulf of Maine and on Georges Bank. It can be suggested that cooperative fisheries research is a form of democratic science. Consequently, specific propositions emerge from fisheries management and cooperative research and the literature on democratizing science, and these propositions can be used to assess cooperative fisheries research. In this paper, a case study of the Northeast Consortium provides the example of cooperative fisheries research for which the following propositions are assessed (see Table 1 below).

Table 1. Practical and Theoretical Propositions about Cooperative Research

Are stakeholders more involved in fisheries science and management?

Are they more:

- Informed
- Engaged
- Empowered

Does cooperative research re-connect and integrate scientific and community discourse, bridging the gap between scientific research and fisheries policy and management? Does it enhance:

- Social learning, mutual understanding and trust
- Integration of fishermen's and scientists' knowledge
- Credible science
- Constructive public dialogue

In the following sections, we elaborate on these propositions through a discussion of the current practice of stakeholder participation in fisheries management and science, the practice of cooperative research, and the literature on democratic science.

Stakeholder Participation in Fisheries Management

Fisheries management in U.S. federal waters is conducted under the Magnuson-Stevens Fishery Conservation and Management Act, passed in 1976, and amended by the Sus-

tainable Fisheries Act in 1996. It established a stakeholder management system through eight regional fisheries management councils and the Exclusive Economic Zone (EEZ) between three and 200-miles from shore, with States continuing to manage fisheries inside three miles. The councils produce Fisheries Management Plans (FMPs) that detail the status of a particular fishery and make recommendations for regulations intending to maintain a sustainable fishery. The Secretary of Commerce approves the council recommendations and codifies the management measures into federal regulations, which are enforced by the National Marine Fisheries Service (NMFS), U.S. Coast Guard, and the state enforcement agencies (see Wallace and Fletcher 2000; McCay and Creed 1999; Heinz 2000).

Councils form advisory groups with expertise from state and federal agencies, academic institutions, stakeholder groups and the general public. Scientific, management and statistical committees include experts on the technical dimensions of a fishery, while stock assessment panels with biological scientists review the available biological data and produce recommended acceptable levels of catch for species. The councils have their own staffs that coordinate the work of the council and advisory committees. Fisheries management plans incorporate the analysis of biological, environmental, economic and social factors impacting the fisheries prior to public comment periods, although the regularly scheduled council and plan development team meetings are open to the public. The process of developing a fisheries management plan involves a standard federally-mandated public participation process (i.e., scoping, public comment periods, hearings). For any potential rule change, public hearings are held throughout the region and at regularly scheduled council meetings where the final action decision is made.

The council process has been criticized for the inconsistent manner in which different regions use scientific and interest group advisors (Heinz 2000), conflict of interest among participants (Richardson 2005; Okey 2003), and insufficiently robust public participation and impact assessments (Butler et al. 2001) (also see Witherell 2004 and 2005). This climate of scientific and socioeconomic complexity, political interests and disputes, and difficult allocation of a declining resource, has contributed to stakeholder pleas to Congress, Congressional intervention, and a great deal of litigation (Heinz 2000). In fact, the convergence of these fisheries policy dynamics in New England contributed directly to the fishing industries demands for more involvement in the science and for more cooperative research (Hartley and Robertson 2006).

Stakeholder Participation in Fisheries Science

Cooperation between the fishing industry and government scientists was common in the mid 20th century. Fishing

vessels assisted in the first haddock stock assessments in the 1920 and 30s and made up the first “study fleet” of vessels available to scientists (Sissenwine 2001). As early as 1954, recreational and commercial fishermen in Florida were tagging sailfish, blue and white marlin, swordfish, bluefin and yellowfin tuna in coordination with government scientists. Alaska fishing vessels were research platforms in the 1950s and later became integral to stock assessment surveys and gear design research (Singer forthcoming).

In 2004 the National Research Council (NRC) completed a review of the National Marine Fisheries Service (NMFS) cooperative research efforts. NRC developed a working definition of “cooperative and collaborative research” (National Research Council 2004, 8):

The nature and level of cooperation can vary greatly among projects. At one end of the spectrum are projects with relatively low levels of cooperation, such as NMFS chartering commercial vessels for surveys (in which the primary form of cooperation is commercial crews helping in the actual daily operations of the surveys) or fishermen keeping logs of fishing activities. On the other end of the scale are cooperative research projects where fishermen and agency personnel work together in all phases of the project, including development of the research question design of the project, performance of research, analysis and interpretation of results, and communication and dissemination of study findings. These types of projects are often referred to as “collaborative research.”

While acknowledging the distinction between cooperative and collaborative research, Singer (forthcoming) identified several core elements to cooperative fisheries research summarized in Table 2 below.

The variation in the fishing industry’s level of involvement, and thus their role in the project, underscores the distinction between cooperative and collaborative research.

Scientists often maintained a similar lead principal investigator role. Some projects are thoroughly designed and fully funded before fishing vessels are solicited and utilized as research platforms. Early stock assessment surveys conducted by NMFS took this form. As a research partnership moves toward the “collaborative” side of the spectrum, fishermen and scientists jointly develop an idea and research question and work together to locate funding, conduct the research, and disseminate the findings. Cooperative research examples exhibit a fair degree of variation in partnership structure, objectives, and outcomes. Nonetheless, they tend to have specific and practical fisheries management or industry outcomes.

There are several models of cooperative research funding programs in New England, including NMFS-directed Cooperative Research Partnership Program (CRPP) and issue-specific Requests for Proposals, scallop set-aside funds, lobster license fee research seed funding, conditional revolving loan funds requiring participation in cooperative research (e.g., Coastal Enterprises Inc.’s FISHTAG loan fund), and other traditional scientific funding sources. This paper focuses on one model, the Northeast Consortium, a federally-funded, university-based cooperative research funding program, described in more detail later in the paper.

Democratic Science

Practices that aim to democratize science are particularly prevalent in the social science fields and among researchers interested in advancing social change and justice. For example, George et al. (1996, 7) defined participatory action research as the “systematic investigation with the collaboration of those affected by the issue being studied, for the purposes of education and taking action or effecting social change.” Participatory action research is not a method, but rather an approach (Greenwood and Levin 1998; Krimmerman 2001) that challenges the power relationships that exist in the development of knowledge (Deshler and Grudens-Schuck 2000). Political scientists in science, technology and democracy have called for

Table 2. Elements of Cooperative Fisheries Research

Elements	Characteristics
Participants	<ul style="list-style-type: none"> • Industry – varied roles and responsibilities • Scientists – similar roles and responsibilities as scientific lead • Fisheries managers – rarely participate directly, although may serve advisory role
Partnerships	<ul style="list-style-type: none"> • Formal arrangements detailing project objectives, partners’ roles and responsibilities, etc. • Variety of structures (e.g., number of partners, types of payment arrangements, level of formality in agreement)
Goals	<ul style="list-style-type: none"> • Clear, specific objectives, meeting a specific management or industry objective • Scope of goal varies from narrow (e.g., applied research on a specific fishery’s gear designs) to broad (e.g., ecosystem analysis and oceanographic monitoring).
Outcomes	<ul style="list-style-type: none"> • Scientific data, fishing and research technologies, and other findings that are of practical value to management, industry or other stakeholder group.

integrating democratic principles of inclusiveness, openness and accountability into science that attends to questions of public interest. Guston (2004, 25-26) noted:

What democratization does mean, in science as elsewhere, is creating institutions and practices that fully incorporate principles of accessibility, transparency, and accountability. It means considering the societal outcomes of research at least as attentively as the scientific and technological outputs. It means insisting that in addition to being rigorous, science be popular, relevant, and participatory.

In the natural resource and environmental context, deliberation between communities, scientists, and managers over contentious resource management issues often encounters intractable cultural and language deadlocks (Williams and Matheny 1995). Science language uses abstract, generalizable and absolute theoretical and empirical representations of the world, such as predictive models, technical diagrams and papers (Lee and Roth 2006). Scientific language can effectively frame, dominate and regulate other participants in public discussions, creating a divide between experts and laypersons that unequally and unfairly supplies power and influence to science (Wynne 1996). Meanwhile, communities use a communal, populist language to build an enlightened citizenry, while managers use a language that promotes the technical aspects of regulations, policy, and expertise (Williams and Matheny 1995). In the end, there are few public spheres available where these distinct discourses can come together, work toward a common language, and overcome inherent power disparities.

Consequently, democratic science proposes re-connecting and integrating scientific and community discourse (Lee and Roth 2006), expanding citizen science or participatory inquiry (Fischer 2000), and establishing additional public venues that promote integration. Bridging the gaps between science and the community and between scientific research and policy and management involves a social learning process that takes place through research, stakeholder participation, adaptive management strategies, and the growth of democratic values, skills and institutions (Oliver et al. 2005). This paper examines the Northeast Consortium and considers whether the Northeast Consortium's cooperative research has democratized science and met other practical stakeholder involvement objectives.

The Northeast Consortium: A Cooperative Research Model

The Northeast Consortium was created in 1999 to "encourage and fund effective, equal partnerships among com-

mercial fishermen, scientists, and other stakeholders to engage in cooperative research and monitoring projects in the Gulf of Maine and Georges Bank" (Northeast Consortium 2005). It has been funded through annual Congressional appropriations of approximately \$2 million in FY2000 and then \$5 million thereafter, and each year administers two competitive rounds of cooperative research grant-making. The Northeast Consortium maintains four objectives. Two are broad and aim to improve partnerships and knowledge integration (i.e., develop partnerships between commercial fishermen and scientists, educators and coastal managers; and help bring fishermen's information, experience and expertise into the scientific framework needed for fisheries management). Two objectives are more specific and seek to build capacity in the industry to participate in research (i.e., enable commercial fishermen and commercial fishing vessels to participate in cooperative research and the development of selective gear technologies; and equip and utilize commercial fishing vessels as research and monitoring platforms).

Organizational Structure

Four research institutions comprise the consortium, the University of New Hampshire (UNH), University of Maine, Massachusetts Institute of Technology (MIT), and Woods Hole Oceanographic Institution (WHOI). Each provide a representative and along with the Northeast Consortium Director, are the decision-making body of the organization, selecting projects to fund, setting program policies, and conducting strategic planning. Two full-time and three part-time staff provide program administration, stakeholder outreach and capacity-building, and technical functions that advance the application of cooperative research findings.

The Northeast Consortium maintains an approximately 30 member Advisory Committee composed of all the major stakeholder groups, including commercial fishing industry, research (academic and government scientists), state and federal management and regulatory agencies, conservation organizations, and other community-based non-profit organizations. The Advisory Committee supplies program advice and guidance, reviews the calls for proposals and submitted proposals, and makes proposal funding recommendations to the representatives based upon their review of the proposals.

Funding Priorities

Two competitive requests for proposals are issued per year, accounting for approximately \$4 million annually with nearly \$1 million per year dedicated to program administration and outreach. The Northeast Consortium has funded 155 projects between 2000 and 2005, involving over 335 paid and volunteer fishermen and 185 scientists. It has overseen the completion of over 40 funded projects. Over a third of the

funded projects, 35%, are conservation engineering and gear design projects that aim to improve efficiencies of fishing gear and reduce bycatch species of concern, followed by 20% fisheries biology, and the closely related stock structure and assessment studies (17%), particularly on the commercial fish species and bycatch species of concern. Ecosystem and habitat research makes up the next most prevalent research topic area, 11%, with socioeconomic impact studies (7%), oceanography and environmental monitoring (5%) and educational activities (5%) rounding out the portfolio.

Outreach and Capacity-Building

In 2000, the Northeast Consortium Advisory Committee strongly recommended that a significant outreach effort be undertaken to draw more commercial fishermen into cooperative research, help them prepare competitive proposals based upon integrating their knowledge with scientific methods, and assist in linking interested fishermen and scientists. The Northeast Consortium worked closely with five community-based organizations in Maine, New Hampshire and Massachusetts to conduct outreach, which were guided and assisted by Northeast Consortium outreach staff. The initial outreach strategy from 2000 to 2003 aimed at increasing general awareness of the funding, matching fishermen and scientists interested in similar topics, and reaching diverse fishing industry sectors and communities from Southern New England to Downeast Maine. Activities focused on workshops, newsletters, trade-show booths and presentations, websites, and one-on-one consultations. The Northeast Consortium achieved high levels of awareness — 68% of the active commercial fishermen in New England responding to a survey were aware that assistance is available to match fishermen and scientists on cooperative research projects (Robertson and Kennedy 2004).

Since 2003, the outreach strategy has been shifting toward targeted and specific communication messages and outreach needs (e.g., promoting greater regional coordination among investigators and involving more geographically isolated and under-represented industry participants). Additional outreach has targeted the broader scientific community of the region and sought to build capacity among scientists to conduct cooperative research. Activities have included sponsored topic-specific regional meetings of scientists, managers and fishermen, and targeted information and messages toward segments of the fishing industry. Staff have made presentations at scientific conferences, sponsored symposia, and coordinated with regional scientific associations.

Applications of Cooperative Research Results and Findings

While the Northeast Consortium has not prioritized spe-

cific management-related topics for funding, the stakeholders considered issues, findings, and data that impact fisheries management decisions to be critically important. For example, Robertson and Kennedy (2004, 12) reported that commercial fishermen responding to a questionnaire overwhelmingly identified “generating sound scientific data” (83%) and “assurance that the data generated would be used in making management decisions” as very important incentives for participating in cooperative research.

To address this strongly held interest among fishing industry stakeholders, the Northeast Consortium has dedicated staff and resources toward administering peer reviews of cooperative research findings, consultation with end-users (particularly the fisheries management community) and coordinating with technology transfer experts (e.g., NH Sea Grant fisheries extension specialist). The peer review criteria and procedures were developed in conjunction with fisheries management representatives to ensure that the review would be readily accepted by the managerial end-users.

In addition to federal fisheries management end-users, fishermen and coastal communities have directly benefited from cooperative research projects. For example, a modified Nordmore grate and square-mesh codend configuration was shown to remove smaller Northern shrimp, resulting in cleaner catch and less culling time for fishermen (LaValley 2005). In another example, a cooperative social science research project produced a community assessment that was directly integrated into the Gloucester (MA) Harbor Plan and Designated Port Area Master plan (Robinson 2005).

Program Evaluation

The Northeast Consortium has maintained an on-going program evaluation effort since 2000 to evaluate the effectiveness of cooperative research, the context in which cooperative research is functioning, and the impacts in the region. Multiple strategies have been employed, including: media coverage monitoring; participant interviews; key informant interviews and consultations; project site visits; and independent socio-economic impact assessments. The Associate Director for Awards and Assessment has conducted and overseen many of these activities, which provided information on the features and structures, challenges and obstacles, and lessons learned of successful research partnerships. It has provided program feedback, guided outreach strategies and program initiatives, and promoted a flexible, adaptive organizational culture.

Methods

Data analyzed in this paper come from three separate mail questionnaires which were administered to three sepa-

rate, but potentially overlapping populations. The first was administered to individuals who were actively engaged in commercial fishing in New England in 2002-2003. The second questionnaire was administered to active commercial fishermen who received financial support from the Northeast Consortium to participate in cooperative research. The third was administered to scientists who received support from the Northeast Consortium to participate in cooperative research. The following sections detail the methods for each of the data collection initiatives. We have included a brief discussion of the potential for response bias.

Survey 1: Individuals Actively Engaged in Commercial Fishing in New England

The data was collected via a mail survey that was designed and then administered using standard data collection procedures and quality controls (Dillman 1999). To ensure that the researchers and the research instrument did not bias the survey population towards a predisposition to support or oppose cooperative research, drafts were reviewed and pre-tested with an industry advisory group. Addresses were obtained via a mailing list provided by the New England Fishery Management Council in 2001, which had originally come from the National Marine Fisheries Service (NMFS) permit holders list. The original list contained 1,802 names that were comprised of fishermen and other occupations (including vessel owners, fishery equipment suppliers, retailers, wholesalers, writers, recreational fishers, educators, environmentalists, scientists and managers). To limit the questionnaire mailing to only those who were members of the commercial fishing community, the list was manually scanned for names that were obviously not fishermen (e.g. those with addresses at a university, government office, environmental organization, etc.), and these names were removed. The first eight-page booklet (8¹/₂ x 11 sheet of paper folded in half) questionnaire mailing was sent to the refined list of 1,024 people. A total of five contacts were made. Twenty-four questionnaires were returned as undeliverable. Forty questionnaires were returned uncompleted because the respondents felt they were not knowledgeable enough or in an unrelated occupation; 552 were non-respondents, for a total return of 399 surveys, with an overall response rate of 42%. Respondent's self-reported occupations for each returned survey were examined, and individuals whose occupation was not specifically identified as commercial fishing were eliminated, leaving us with 295 cases to analyze for this study. This represents a 35% response rate from the modified NMFS list.

Follow up contacts were made with non-respondents in order to better understand the potential for response bias in this study of the NMFS list. We concluded that though there is a potential for response bias, these data are the best avail-

able data on this difficult to reach population. This conclusion is based on analysis of variables considered to be most likely to indicate a biased sample (i.e., level of engagement and attitudes towards and support for cooperative research) where there were no significant differences between respondents and non-respondents.

Survey 2: Fishing Industry Participants in Northeast Consortium-funded Cooperative Research

Data on fishing industry participants in cooperative research were obtained via a mail questionnaire distributed to all commercial fishermen who had obtained support from the Northeast Consortium. Data reflects responses from 60 fishermen out of the 142 who have received Northeast Consortium support between 2000-2004. This represents an overall response rate of 42%. The survey was administered during the summer and fall of 2004. Respondents included a mix of commercial fishermen actively participating in both a variety of fisheries and cooperative research projects. Mean age for respondents was 51 years and 93% of respondents were male.

Survey 3: Scientists Participating in Northeast Consortium-funded Cooperative Research

Data on scientists participating in cooperative research were obtained via a mail questionnaire distributed to all scientists who obtained support from the Northeast Consortium. Data reflects responses from 37 scientists out of the 96 who have received Consortium support between 2000-2004. This represents an overall response rate of 39%. The survey was administered during the summer and fall of 2004. The respondents represent a diverse range of interests and areas of expertise. Respondents included a mix of federal, state, non-profit and academic scientists. Mean age for respondents was 52 years, 83% of respondents were male, and respondents had a mean of 27 years in their profession.

Findings

Selected survey data are presented here from three questionnaires of individuals actively engaged in commercial fishing in New England (n=295), and fishermen (n=60) and scientists (n=37) participating in Northeast Consortium-funded cooperative research that address the propositions raised by the theory and practice of stakeholder involvement in cooperative fisheries research.

Stakeholder Involvement: Informed, Engaged, Empowered

Fishermen and scientists reported becoming more informed from participating in cooperative research. Seventy-

three percent (73%) of fishermen participating in Northeast Consortium-funded research responding to the survey agreed that “participation in cooperative research has improved my knowledge of the scientific method” and 83% of scientists concurred that their participation “improved my knowledge of fishing methods.” Fifty-seven percent (57%) of participating scientists said they were “a better scientist as a result of my participation in cooperative research,” and 33% of fishermen concurred that their participation in cooperative research made them “better fishermen.” Twenty-eight percent (28%) of participating fishermen identified enhanced personal knowledge and 28% identified cooperative learning with scientists and networking as their co-primary benefit of cooperative research. One fisherman wrote, “I have a new understanding of the bottom that I have been fishing for the past 35 years.”

Fishermen and scientists reported greater engagement in fisheries management after participating in cooperative research. Sixty-five percent (65%) of fishermen agreed that “participation in cooperative research has led me to be more active in fishery management” and 39% of participating scientist respondents agreed that they became more active in management as a result of cooperative research. While fewer scientists than fishermen expressed an interest in direct engagement in management, 80% of participating scientists felt that the “data from my project has or will be applied to fishery management.”

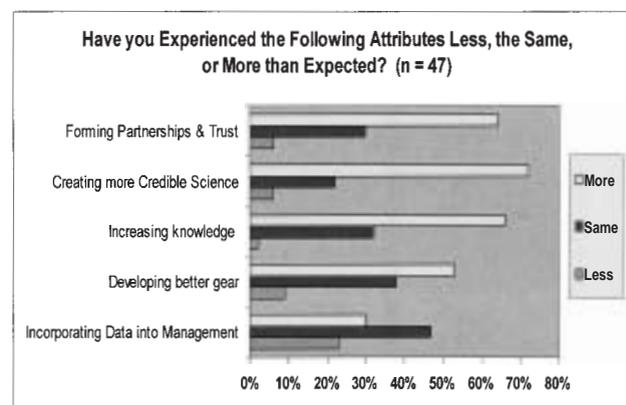
However, fishermen were less convinced that they were empowered to impact management. In fact, while 30% expected that fisheries managers might use the data from their project, 23% found that management used the cooperative research results less than they had expected. When asked whether they felt their cooperative research project was successful, 35% said they were unsure. They said they were withholding judgment until they saw whether future management decisions incorporated their findings. One fisherman noted that his cooperative research project produced “better information on the shrimp resource, even though Atlantic States [Marine Fisheries Commission] didn’t use the information to adjust the shrimp season.”

Social Learning, Knowledge Integration, and the Public Dialogue

To examine how participating in a cooperative research project might change fishermen’s and scientists’ knowledge, opinions and attitudes about each other and the future, participants in Northeast Consortium-funded research were asked how their cooperative research experience compared to their expectations and were asked questions about learning, mutual understanding, partnerships, trust, and fisheries management. The expectations are reported in Graph 1

(47 of the 60 fishermen respondents completed this question).

Graph 1. Fishermen Participating in Cooperative Research



Social learning occurred, and mutual understanding and trust was built through participation in cooperative research. Between 60% and 70% of fishermen respondents felt they had formed better partnerships with more trust in scientists, created more credible science, and increased personal knowledge more than they had expected by participating in cooperative research. Fishermen (51%) reported “cooperative research has shown me what it means to be a scientist,” and 100% of scientists agreed that “fishermen’s knowledge and experiences are important to scientific research.” Scientists (82%) also reported that “partnerships formed through cooperative research will be long-lasting” and 83% of fishermen agreed.

To assess knowledge integration, individuals actively engaged in commercial fishing in New England (N=295) were asked how they wanted to participate in cooperative research. Commercial fishermen respondents were extremely supportive of cooperative research, with 95% agreeing that “cooperative research is important” and 77% agreeing that “cooperative research is important to me personally.” Given this level of support, Table 3 summarizes the responses to questions about how they wanted to participate in cooperative research (288 of the 295 respondents completed this set of questions).

Table 3. Fishermen Interest in Varying Levels of Participation

Statement	%
I’m interested in participating as a collaborator (e.g. offering use of your boat) (n=288)	40%
I’m interested in reviewing project proposals (n=288)	32%
I’m interested in just using the data that results from projects (n=288)	27%
I’m interested in serving as an advisory committee member (n=288)	24%
I’m interested in participating as a lead- or co-investigator (n=288)	23%
I’m not interested in participating in cooperative research (n=288)	15%

In a highly supportive universe of fishermen, there were a wide range of interests along the spectrum from cooperative (e.g., 40% chartering their boat; 24% serving as an advisor) to collaborative (e.g., 23% co-principal investigator) research. Not all fishermen wanted to be equal partners. In fact, while 95% felt cooperative research was important, 15% did not want to participate themselves. Others wanted a more equal partnership with scientists, seeking to more fully integrate their knowledge with the scientific framework and tools.

An outcome of cooperative research is that it produced science that is credible to the fishermen and products of value to the industry (e.g., fishing gear designs). Seventy-two percent (72%) of participating fishermen reported that the scientific findings of their projects were more credible than they anticipated. Sixty-one percent (61%) reported that the data from their projects has or will be applied to fishery management. Furthermore, the outputs of cooperative research can produce value directly to fishermen. For example, 53% of participating fishermen stated that the gear technologies developed through cooperative research were better or more selective than they anticipated — enhanced selectivity of gear improves the ability of fishermen to catch particular marketable fish of appropriate size, age, species, etc. while avoiding fish in need of conservation.

Cooperative research has impacted the public dialogue, particularly within the scientific and fishing communities. For example, 64% of participating scientists surveyed reported “I make a point of talking about cooperative research with fellow scientists,” and 74% of participating fishermen surveyed concurred that they “make a point of talking about cooperative research with fellow fishermen.” Both enjoyed teaching the other about their professions, 88% of participating scientists and 85% of participating fishermen called

teaching the other “rewarding.” A fisherman commented on his primary benefit: “I have a better working relationship with several different academic fields and organizations.” A scientist concurred: “The Northeast Consortium projects that I have been involved with introduced me, in a working environment, to some great fishermen with lots of ideas.” Nonetheless, fisheries managers are not often directly participating in research tasks on cooperative research projects in New England, although they have increasingly been serving advisory roles. Conservation organizations rarely have participated in Northeast Consortium projects.

Furthermore, a considerable trust and respect gap between fishermen and scientists, particularly NMFS scientists, has been identified in New England. For example, in the general survey of individuals actively engaged in commercial fishing in New England, 55% expressed more trust in university-based scientists than NMFS scientists. Sixty-five percent (65%) *disagreed* with the statement that NMFS scientists have respect for fishermen. The trust and respect values are reversed among fishermen and scientists participating in cooperative research. Eighty-four percent (84%) of participating scientists say they “trust the fishermen that are involved with my project” and all 100% said they had respect for fishermen. Nonetheless, 68% of these participating scientists reported having “more respect for fishermen as a result of my participation in cooperative research.”

Discussion

In closing, Table 4 below summarizes how cooperative research in the Northeast Consortium measures up to the propositions arising from the practice and theory of cooperative fisheries research.

Table 4. Overview of Cooperative Research as Public Participation Mechanism

Propositions	Findings from the Northeast Consortium
Are stakeholders more involved in fisheries science and management? Are they more: <ul style="list-style-type: none"> • Informed • Engaged • Empowered 	<ul style="list-style-type: none"> • Fishermen and scientists are more informed about fisheries science and fishing practices, respectively. • Both fishermen and scientists (to a lesser extent) are more engaged in management. • Both fishermen and scientists remain skeptical about cooperative research’s impact on management.
Does cooperative research re-connect and integrate scientific and community discourse, bridging the gap between scientific research and fisheries policy and management? Does it enhance: <ul style="list-style-type: none"> • Social learning, mutual understanding and trust • Integration of fishermen’s and scientists’ knowledge • Credible science • Constructive public dialogue 	<ul style="list-style-type: none"> • Fishermen and scientists report more likelihood of long-lasting partnership formation and greater mutual understanding and trust. • All degrees of cooperation are important to ensure broadest participation. • Fishermen believe that the scientific outcomes of cooperative research are more credible and valuable to management and industry. • Remains unclear how cooperative research will change the public dialogue, although there is some preliminary evidence that it may lead to more dialogue and less adversarial public discussions.

Stakeholder Involvement: Do Participants Learn, Engage More, and Become Empowered?

For fishermen and scientists, the act of participating in a cooperative research project resulted in a greater understanding of what each other do and how and why they do it. Cooperative research produced valuable scientific data and gear technologies and increased fishermen's knowledge about the marine environment. Scientists reported learning about fishing practices and fishermen learned about the scientific method. However, while fishermen in particular said they were more active in fisheries management after participating in cooperative research (scientists became more active too, but to a lesser extent than fishermen), there is less evidence that fishermen are feeling more empowered in the management process. Skepticism about the impact of cooperative research findings on management remains high among fishermen. Given the limited direct participation of fisheries managers in Northeast Consortium projects, it is less clear that fisheries managers have learned from the cooperative research experience in the same way that fishermen and scientist have. Further study is needed on projects with active management participation, or those with managers, serving on project advisory groups. In the end, cooperative research may have increased inclusiveness and openness in fisheries science but has not challenged the existing power structure or led to more shared authority and accountability.

There is some preliminary evidence from other studies that empowerment is possible. For example, in an Australian anti-poverty program, cooperative research was shown to train and empower community members, provide a social learning setting for all partners, and build bridges between government institutions and disadvantaged communities (Eversole and Routh 2005). In the community health field, Lasker and Weiss (2003) discussed the individual empowerment, expanded social capital, and improved synergistic problem-solving capabilities of communities that emerge from collaborative research and practice. However, poverty and health programs are typically less regulatory than fisheries management and thus, empowerment and stakeholder impact on management decisions may be easier to achieve in the poverty or community health context than in highly regulated fisheries.

Furthermore, the trust and respect gap between the general fishing industry and NMFS scientists is considerable. This will interfere with the learning and engagement that contributes to empowerment and thus, stakeholder empowerment in fisheries management will likely remain illusive. This trust and respect trend is reversed among fishermen and scientists participating in cooperative research. The act of participating in cooperative research did enhance trust among fishermen more than they anticipated. Mutual respect is

higher among participating fishermen and scientists than the general fishing community; scientists reported more respect for fishermen as a result of participating in cooperative research. More research is needed to tease apart the degree cooperative research increases trust and respect from the pre-existing trust and respect levels among fishermen and scientists that led them to choose to participate in cooperative research in the first place.

Social Learning, Knowledge Integration and the Public Dialogue

These findings support the idea that participating in cooperative research may contribute to greater mutual understanding and trust. The scientific findings from cooperative research are perceived as more credible, legitimate and acceptable than non-cooperative research. Both fishermen and scientists reported that they were more likely to form partnerships with the other and expected those partnerships to be long-lasting. They find working with each other rewarding. The scientific results from cooperative research were considered more credible and were likely to produce outcomes of direct value to the fishing industry and fisheries, such as better and more selective fishing gear technologies.

Knowledge integration was demonstrated to be more complicated than simply advocating for highly cooperative "collaborative" research over less integrated "cooperative" research options, as defined by the National Research Council (2004, 8). Given the diverse interests of fishermen in different types and degrees of participation (Table 3), all levels of involvement along the cooperative-collaborative spectrum appear to be equally important and it would be advantageous for cooperative research funding programs to offer the full spectrum of involvement options. Offering multiple participation options promotes greater overall participation because it meets the needs of a broader portion of the commercial fishing industry. The data reported do not show how individual fishermen's interests may change with multiple cooperative research experiences. Fishermen may progress up the spectrum from cooperative to collaborative research over time, as their experience, knowledge, skills and interests expand. Funding programs like the Northeast Consortium should provide multiple levels of cooperation and thus continually bring in new fishermen to cooperative research, while providing veteran fishermen participants further opportunities for social learning and knowledge integration.

While cooperative research may improve the public dialogue among fishermen and scientists participating in cooperative research, it is less clear whether cooperative research improves the broader public dialogue in fisheries management. Fisheries managers and other stakeholders (e.g. conservation organizations and other NGOs) are infrequent par-

ticipants and considerable trust and respect gaps between non-cooperative research participating fishermen and scientists (particularly NMFS scientists) exist in the broader fishing industry. Broader involvement in cooperative research with additional industry participants, fisheries managers, representatives of conservation organizations, and other stakeholders, is needed to expand the breadth of social learning and knowledge integration.

The possibility of transferring social learning, knowledge integration, and improved public dialogue benefits from many individual cooperative research projects to a broader management context has been suggested elsewhere. For example, at the September 2005 American Fisheries Society/Sea Grant symposium, *Partnerships for a Common Purpose: Cooperative Fisheries Research and Management*, Elizabeth Clark, with NMFS's Northwest Fisheries Science Center, commented that she has seen an improvement in public hearings and "the value of being able to go to a public hearing and have a constructive, non-adversarial conversation" as a result of the Northwest Fisheries Science Center's cooperative research program (Hartley and Read forthcoming). Further research is needed to test this hypothesis and understand how benefits might best transfer to the management arena.

In sum, cooperative fisheries research in the Northeast Consortium is a real-world proxy for normative democratic science. Cooperative research provides a public sphere for enhancing social learning, bridging different discourses, and integrating fishermen's and scientists' knowledge. Nevertheless, cooperative fisheries research appears more successful at re-connecting and integrating the scientific and fishing communities than it is at advancing social change and empowering participants.

Conclusion

The Northeast Consortium emerged, in part, as an alternative model to engage stakeholders, particularly industry, in fisheries science and management. The Northeast Consortium has contributed substantially to informing and engaging fishermen and scientists, increasing social learning, mutual understanding and trust, and producing scientific findings that are considered more credible to industry. It provides multiple participation options for fishermen, which allows broader fishing industry participation, social learning, and the integration of fishermen's and scientists' knowledge. Nevertheless, it remains unclear how fully empowered stakeholders have become, what impact cooperative research has had on management decisions, and whether the quality of the public dialogue surrounding fisheries management has improved. Nonetheless, cooperative research through the Northeast Consortium has provided a new public sphere

where scientists and fishermen can re-connect, integrate their discourses and bridge scientific-fishing community gaps.

More research is needed on the expanding phenomenon of cooperative fisheries research to understand its place in fisheries science and management, stakeholder involvement in natural resource management and policy, and democratic science. For example, how exactly does trust get built through these processes? Can the social learning achieved on a cooperative research project transfer over to a management decision-making process? If so, how? What are the incentives and disincentives for greater NGO and fisheries manager participation on cooperative research projects? What might cooperative research achieve in other environmental or natural resource contexts? These are but a few of the many remaining questions that have been raised by the promise demonstrated by coastal, marine and fisheries cooperative research through the Northeast Consortium in the Northwest Atlantic.

Endnotes

1. Author to whom correspondence should be directed: troy.hartley@unh.edu
2. E-mail: robertr@christa.unh.edu

Acknowledgements

The authors would like to thank the fishermen and scientists participating in cooperative research in northern New England for their commitment to research and for their time in completing our surveys. The authors are grateful for the valuable comments from Seth Tuler, Tom Webler and an anonymous reviewer.

References

- Butler, M.J., L.L. Steele, and R.A. Robertson. 2001. Adaptive resource management in the New England Groundfish Fishery: Implications for public participation and impact assessment. *Society and Natural Resources* 14, 9, 791-801.
- Deshler, D. and N. Grudens-Schuck. 2000. The politics of knowledge construction. In A.L. Wilson and E.R. Hayes (eds.), *Handbook of Adult and Continuing Education*, 592-611. San Francisco: Jossey-Bass, Inc.
- Dillman, D.A. 1999. *Mail and Internet Surveys: The Tailored Design Method, 2nd edition*. New York, NY: John Wiley & Sons.
- Eversole, R. and R. Routh. 2005. Collaborative research as an anti-poverty tool: A research partnership between police and indigenous Australians. *Development in Practice* 15, 5, 631-642.
- Fischer, F. 2000. *Citizens, Experts and the Environment: The Politics of Local Knowledge*. Durham, NC: Duke University Press.
- George, M.A., L.W. Green, and M. Daniel. 1996. Evolution and implications of par for public health. *Health Promotion and Education* 3, 6-10.

- Greenwood, D.J. and M. Levin. 1998. *Introduction to Action Research: Social Research for Social Change*. Thousand Oaks, CA: Sage Publications, Inc.
- Guston, D.H. 2004. Forget politicizing science. Let's democratize science! *Issues in Science and Technology*, 25-28. www.cspo.org/ourlibrary/documents/gustonlayout.pdf.
- Hartley, T.W. and A.N. Read. Forthcoming. Fisheries managers, scientists and industry participants explain their success. In T.W. Hartley and A.N. Read (eds), *Partnership for a Common Purpose: Cooperative Fisheries Research and Management. Proceedings from the 4th Sea Grant Sponsored American Fisheries Society Symposium*. September 11-15, 2005, Anchorage, AK. Washington, DC: American Fisheries Society.
- Hartley, T.W. and R.A. Robertson. 2006. Emergence of multi-stakeholder driven cooperative research in the Northwest Atlantic: The case of the Northeast Consortium. *Marine Policy* 30, 5, 580-592.
- Heinz, John. 2000. The H. John Heinz III Center for Science, Economics and the Environment. *Fishing Grounds: Defining a New Era for American Fisheries Management*. Washington, DC: Island Press.
- Krimmerman, L. 2001. Participatory action research: Should social inquiry be conducted democratically? *Philosophy of the Social Sciences* 31, 1, 60-83.
- Lasker, R.D., and E.S. Weiss. 2003. Broadening participation in community problem solving: A multidisciplinary model to support collaborative practice and research. *Journal of Urban Health* 80, 1, 14-47.
- LaValley, K. 2005. Cooperative research aids shrimp grate advance. *Commercial Fisheries News* 37, 7, 2B.
- Lee, S. and W.M. Roth. 2006. Community-level controversy over a natural resource: Toward a more democratic science in society. *Society and Natural Resources* 19, 5, 429-445.
- McCay, B.J. and C.F. Creed. 1999. *Fish or Cut Bait: How to Participate in the Fisheries Management System*. Available at nsgl.gso.uri.edu/njmsc/njmscg99002.pdf. Fort Hancock, NJ: New Jersey Marine Science Consortium.
- National Research Council. 2004. *Cooperative Research in the National Marine Fisheries Service*. Washington, DC: The National Academies Press.
- Northeast Consortium. 2005. About Us: History. Available at www.northeastconsortium.org/aboutus.shtml.
- Okey, T.A. 2003. Membership of the eight regional fishery management councils in the United States: Are special interests over-represented? *Marine Policy* 27, 3, 193-206.
- Oliver, P., J. Whelan, and J. Mackenzie. 2005. *Barriers and Bridges to Collaborative Natural Resource Management in South East Queensland*. Indooroopilly, Queensland AU: Coastal CRC. www.coastal.crc.org.au/pdf/Barriers_and_Bridges.pdf.
- Richardson, J. 2005. Workshop summary: Fisheries governance. In D. Witherell (ed.), *Proceedings from a Conference on Fisheries Management in the United States*. Washington, DC, March 24-2, 2005, 129-132. Anchorage, AK: North Pacific Fishery Management Council.
- Robertson, R.A. and J.H. Kennedy. 2004. Assessment of commercial fishing, cooperative research and the Northeast Consortium: A study of New England's commercial fishing industry. Technical Report # 04-11-2004, 12. Durham, NH: University of New Hampshire, Department of Resource Economics and Development.
- Robinson, S. 2005. Project studies Gloucester fishing infrastructure. *Commercial Fisheries News* 32, 12, 20A-21A.
- Singer, L.T. Forthcoming. Cooperative research in the United States. In T.W. Hartley and A.N. Read (eds.), *Partnerships for a Common Purpose: Cooperative Fisheries Research and Management. Proceedings from the 4th Sea Grant Sponsored American Fisheries Society Symposium*. September 11-15, 2005, Anchorage, AK. Washington, DC: American Fisheries Society.
- Sissenwine, M. 2001. Fisheries cooperative research. Testimony of Dr. Michael Sissenwine, Director of the Northeast Fishery Science Center, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Department of Commerce before the Committee on Resources, Subcommittee on Fisheries Conservation, Wildlife and Oceans, U.S. House of Representatives. Ocean City, MD. www.nefsc.noaa.gov/Sissenwine-Final-Testimony.pdf
- Wallace, R.K. and K.M. Fletcher. 2000. *Understanding Fisheries Management: A Manual for Understanding the Federal Fisheries Management Process, Including Analysis of the 1996 Sustainable Fisheries Act, Second Edition*. MASGP-00-005 (<http://nsgl.gso.uri.edu/masgc/masgch00001.pdf>). Mobile, AL: Mississippi-Alabama Sea Grant Consortium.
- Williams, B.A., and A.R. Matheny. 1995. *Democracy, Dialogue, and Environmental Disputes: The Contested Languages of Social Regulations*. New Haven, CT: Yale University Press.
- Witherell, D. (ed.). 2004. *Managing Our Nation's Fisheries: Past, present and future. Proceedings from a Conference on Fisheries Management in the United States*. Washington DC, November 13-15, 2003. Anchorage, AK: North Pacific Fishery Management Council.
- Witherell, D. (ed.). 2005. *Managing Our Nation's Fisheries II: Focus on the Future. Proceedings from a Conference on Fisheries Management in the United States*. Washington, DC, March 24-26, 2005. Anchorage, AK: North Pacific Fishery Management Council.
- Wynne, B. 1996. Misunderstood misunderstandings: Social identities and public uptake of science. In A. Irwin and B. Wynne (eds.), *Misunderstanding science? The Public Reconstruction of Science and Technology*, 19-46. Cambridge, UK: Cambridge University Press.