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Stakeholder Collaboration in Fisheries Research: Integrating Knowledge Among Fishing Leaders and Science Partners in Northern New England

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Cooperative research in fisheries science and management is increasing throughout the United States, in part because of the increasing trust and credibility divide between fishermen and scientists. For example, the Northeast Consortium was established to, among other goals, help bring fishermen's information, experience, and expertise into the scientific framework needed for fisheries management. This research begins to examine whether cooperative research integrates fishermen's and scientists' knowledge, particularly among highly engaged industry leaders and their science partners. Findings are presented from three surveys—individuals engaged in commercial fishing in northern New England (n = 295), and fishermen (n = 60), and scientists (n = 37) participating in Northeast Consortium projects—examining: (1) whether knowledge integration was considered important and achievable, and why; and (2) whether and how fishermen and scientists learned about the scientific process or fishermen and fishing, respectively, from participating in cooperative research. Ramifications of the study and recommendations for research program managers are discussed.

Keywords cooperative research, fisheries policy, fishermen's knowledge, scientists, knowledge, stakeholders

Cooperative research among U.S. commercial fishing industry and fisheries scientists was prevalent throughout the mid-1900s. After a decline from the 1970s through the 1990s, cooperative research has expanded in recent years both nationally (National Research Council 2004; Read and Hartley 2006) and in New England (Hartley and Robertson 2006a). This growth will likely continue based on the new provisions in the 2006 reauthorization of the federal fisheries management statute, the Magnuson–Stevens Fishery Conservation and Management Act, calling for the establishment of regionally based cooperative research and management programs nationwide (see U.S. Public Law 109–479, Title II, §318). Cooperative research directly involves stakeholders (particularly the fishing industry and coastal

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community organizations) in the design, planning, data gathering and analysis, and communication of findings from fisheries-related research, although the degree of involvement and specific nature of the partnerships can vary. "Cooperative" research exists along a continuum from lower levels of cooperation (e.g., chartering vessels, fishermen log books) to more fully "collaborative" research with fishermen and scientists worked closely throughout the research process (National Research Council 2004; Taylor Singer 2006).

In New England, the expansion of cooperative research since 2000 emerged from a climate of socioeconomic hardship, depressed fish stocks, and intense distrust and debate between scientists and fishermen over fisheries science (Hartley and Robertson 2006a). Several models of cooperative research exist in New England, including industry sectors setting aside a portion of their profits for research, competitively awarded federal resources dedicated to cooperative fisheries research, and nonprofit community development loans to fishermen with research contract conditions. One program, the Northeast Consortium, was established in 1999 to "encourage and fund effective, equal partnerships among commercial fishermen, scientists, and other stakeholders to engage in cooperative research and monitoring projects in the Gulf of Maine and Georges Bank" (Northeast Consortium 2006, 1). It has been funded through annual Congressional appropriations of approximately \$2 million in FY2000 and \$5 million thereafter until FY2007 when there were no earmarks, although \$2 million was awarded through the National Marine Fisheries Service (NMFS); there was no earmark funding for the Northeast Consortium in FY08 and a NMFS award has yet to be determined. Each year the Northeast Consortium administered two competitive rounds of research grant making. The Northeast Consortium has four goals, to (1) develop partnerships between commercial fishermen and scientists, educators, and coastal managers; (2) help bring fishermen's information, experience, and expertise into the scientific framework needed for fisheries management; (3) enable commercial fishermen and commercial fishing vessels to participate in cooperative research and the development of selective gear technologies; and (4) equip and utilize commercial fishing vessels as research and monitoring platforms.

Earlier research on the Northeast Consortium examined the nature of partnerships between fishermen and scientists (Robertson and Kennedy 2004; Hartley and Robertson 2006b). In New England, there is a considerable trust and respect gap between fishermen and scientists (Dobbs 2000). Further, 55% of surveyed fishermen in northern New England expressed more trust in university-based scientists than government scientists at the NMFS and 70% reported respecting university-based scientists while only 30% respected NMFS scientists (Robertson and Kennedy 2004). Recent errors in operations on the NMFS research vessel conducting stock surveys led to claims of "trawlgate" throughout the fishing industry (e.g., Cook and Daley 2003; New England Fisheries Management Council 2003; Malakoff 2002). Nonetheless, fishermen participating in cooperative research reported forming better partnerships with more trust in scientists and generated more credible science than they had expected; participating fishermen were more likely to believe the science to be credible (Hartley and Robertson 2006b). Fishermen and scientists participating in cooperative research reported greater mutual understanding and likelihood of long-lasting partnerships (Hartley and Robertson 2006b).

This article focuses on the Northeast Consortium's second objective regarding the integration of fishermen's knowledge with scientists' knowledge. It has been suggested that cooperative research could be an innovative and important method to recognize and integrate different expertise among fisheries stakeholders (Kaplan and McCay 2004; McCay et al. 2006).

Fishermen's and Scientists' Knowledge

There are many types of knowledge and expertise when it comes to fisheries, the oceans, and social and ecological systems. Experience-based knowledge is considered knowledge that individuals possess but do not often express publicly; it is passed along person-to-person in families, communities, or apprenticeships. It is commonly called tacit knowledge, local ecological knowledge (LEK), traditional ecological knowledge (TEK), or in the fisheries context, fisher knowledge (Maurstad 2002), experience-based knowledge (McCay et al. 2006), and fishery workers' social-ecological knowledge (Neis and Felt 2000). Sometimes it is referred to as anecdotal data or self-serving information, although researchers have claimed that this devalues the knowledge relative to scientists' research-based knowledge (Wilson 2003). Local, experience-based knowledge integrates a vast array of social and ecological information about a particular place. It is nondiscursive, i.e., it is not a rhetorical framing of broader problems and solutions into discourses to convince others to change their views or join together to influence others; thus conceptually, experience-based knowledge is difficult to communicate (Wilson 2003).

Literature on the sociology of science and knowledge is extensive and describes the various forms of a scientist's research-based knowledge. Robert Merton claims truth is discovered through setting science aside from socioeconomic, cultural, and political context and disinterestedly evaluating hypotheses with preestablished criteria, disclosing data and findings, and remaining skeptical (Merton 1996). Others describe science as more integrated with society and societal factors (Pickering 1992), although remaining true to the idea that a valid, objective scientist's knowledge and fact emerges from scientific procedures independent of personal experience (Wilson 2003).

Fishermen's knowledge and scientists' knowledge are often considered at odds with one another, with fishermen and scientists seeing the world differently and accusing the other of lacking common sense (Smith 1995). Close and Hall (2006) identified four inhibiting factors to the integration of fishermen's and scientists' knowledge, including: acceptability, validity, and inequality of fishermen's knowledge; conflicting and incomplete data sets of fishermen's knowledge; fundamentally different worldviews of fishermen and scientists; and confidentiality concerns limiting the sharing of fishermen's and indigenous knowledge. The disconnect between fishermen and scientists and the resulting distrust and suspicion are present in New England fisheries, where fishermen felt they had few opportunities to contribute their knowledge and scientists considered fishermen's information irrelevant and rejected it as anecdotal (Dobbs 2000; Heinz 2000). In fact the contentious climate and the disputed facts contributed to the creation of the Northeast Consortium cooperative research program (Hartley and Robertson 2006a).

Wilson (1999) argues that cooperative research, what he called "community science," is a means of promoting open communication about scientific problems and to use collaboration on science as a means to resolve and move beyond differences between experience-based and research-based knowledge. Thus, while cooperative research may not be discursive because experience-based knowledge is difficult to explain (Wilson 2003), it could be deliberative—i.e., iterative, ongoing communication over sufficient time to permit contemplation, questions, and iterative information exchange to build mutual understanding (see Dryzek 1990; Habermas 1984; Innes 1998).

The study reported explores whether deliberation and integration between knowledge types is achieved through cooperative research by asking whether fishermen (particularly highly engaged leaders) are learning the scientific process, whether scientists are learning fishing practices, and how each best learns about the other.

Methods

This article reports on the data analyzed from three separate mail questionnaires that were administered to three separate, but potentially overlapping populations in two of the three surveys. The data were collected via mail surveys that were designed and then administered using standard survey data collection procedures and quality controls (Dillman 1999). To ensure that the researchers and the research instrument did not bias the survey response, drafts were reviewed and pretested with an industry and scientist advisory group. The first survey was administered to individuals who were actively engaged in federally managed commercial fishing in New England in 2002–2003. The second questionnaire went to active commercial fishermen who received funding to participate in a Northeast Consortium-funded cooperative research project. The third was administered to scientists who received funding to participate in a Northeast Consortium-funded cooperative research project. Questionnaires 2 and 3 were sent to fishermen and scientists who elected to participate in cooperative research. The following sections detail the methods for each of the data collection initiatives, including a brief discussion of response bias—these are self-selected respondents, reflecting engaged leaders, and thus not representative of the general fishing or scientific community. That said, these are critical industry leaders and scientists whose perceptions will be important to determining the success of cooperative research.

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

Addresses were obtained via a mailing list provided by the New England Fishery Management Council (NEFMC) in 2001, which had originally come from the National Marine Fisheries Service (NMFS) permit holders list. The original list contained 1,802 names of fishermen and those with 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 active 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× 11 sheet of paper folded in half) questionnaire mailing was sent to the refined list of 1,024 people. A total of five follow-up 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 nonrespondents, for a total return of 399 surveys. Respondents' self-reported occupations for each returned survey were examined, and individuals whose occupation was not specifically identified as commercial fishing were eliminated from this analysis, leaving 295 cases to analyze for this study ($n = 295$). This represents a 35% response rate from the modified NMFS list. The mean age was 52 years and 93% of respondents were male.

At the time the study began in 2001, NMFS did not have a publicly accessible list of vessel permit list, as it does today (National Marine Fisheries Service 2008) and our requests to NMFS for a mailing list were redirected toward the NEFMC list. Further research on this topic will need to consider the strengths and limitations of the two mailing lists as the starting point for survey research. The NEFMC list has one significant advantage over a NMFS permit list; it does not include the large number of latent permits. We were interested in the perceptions and opinions of active fishermen in northern New England who were on the docks, interacting with other active fishermen. The NMFS permit list will also include permit holders from as far south as North Carolina; it includes fishermen who fish in southern New England, Georges Bank, and the Mid-Atlantic. Thus, for the study reported here the NEFMC list sample among the general commercial fishing industry is more comparable to the subset of active fishermen who self-select to participate in cooperative research and responded to survey 2 than to a NMFS permit list sample, which could include large numbers of latent permits, including former commercial fishermen who moved on to other occupations several years ago but maintain their permits, and fishermen outside the geographic scope of the research.

Follow-up contacts were made with nonrespondents in order to better understand the response bias in this study. There were no significant differences across size or format of questionnaires, i.e., long versus shorter versions. There were significant differences across state, Maine, New Hampshire, Massachusetts, Rhode Island, and Connecticut (chi-square 13.73; significance, .008). Specifically, Massachusetts fishermen were the most likely to be nonrespondents. There were no significant differences across all the fishing behavior (i.e., level of engagement, fishing sector, and attitudes toward and support for cooperative research) and demographic variables. Nonetheless, while we concluded that there is a potential for response bias between states and the sample list is biased toward more actively engaged commercial fishermen in northern New England, the focus of this article is not impacted by the nonresponse bias because we are more interested in the views of the engaged subsample than of the broader population of commercial fishermen. The response bias and the study's focus on engaged fisheries leaders make it inappropriate to generalize about the broader commercial fishing industry in New England.

Survey 2: Fishing Industry Participants in Northeast Consortium 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 reflect responses from 60 fishermen out of the 142 who have received Northeast Consortium support between 2000 and 2004 ($n = 60$). 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. While follow-up reminders were sent to increase response rates, the respondents represent a sample of fishermen from a population of self-selected participants in cooperative research. Nonetheless, the distribution of respondents and nonrespondents by year the project was funded and the type of project (e.g., conservation engineering/gear design, fisheries biology, habitat/ecology, oceanography, social science) showed no observable bias.

Survey 3: Scientist Participants in Northeast Consortium 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. The data reflect responses from 37 scientists out of the 96 who have received Consortium support between 2000 and 2004 ($n = 37$). 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, nonprofit, and academic scientists. Mean age for respondents was 52 years and 83% of respondents were male and respondents had a mean of 27 years in their profession. While follow-up reminders were sent to increase response rates, the respondents represent a sample of scientists from a population of self-selected participants in cooperative research. Nonetheless, the distribution of respondents and nonrespondents by year the project was funded and the type of project (e.g., conservation engineering/gear design, fisheries biology, habitat/ecology, oceanography, social science) showed no observable bias.

Data Collection and Analysis

Questions consisted of five-scale quantitative measures (strongly disagree, disagree, neither, agree, or strongly agree) and open-ended qualitative measures. The actively engaged commercial fishing industry in New England was asked how important and how achievable the following Northeast Consortium goal statement might be: "to help bring fishermen's information, experience, and expertise into the scientific framework needed for fisheries management." They were also asked an open-ended question, "why" they believed it was (or was not) important and achievable. In addition, actively engaged commercial fishermen (AECF) were asked a range of attitude and opinion questions regarding fisheries science and scientists. Various scales were used to measure whether fishermen's and scientists' participation increased the knowledge of participating fishermen (PF) and participating scientists (PS) about the other partner's profession and how. In some cases we collapsed the scale to insure that there were adequate responses in each category and the quantitative data were analyzed with descriptive statistics. Quantitative data on open-ended questions were coded for content that identified themes and patterns among segments of text responses employing standard content analysis and quality control protocols (Lofland and Lofland 1995; Miles and Huberman 1994).

Findings

Respondents to the first survey were highly engaged leaders among the broad commercial fishing industry in northern New England. For example, 72% reported attending a New England Fisheries Management Council meeting, 69% contributed money to a fishery-related cause, 67% called a government representative about fishing issues, and 63% commented on a fishery management plan. Respondents

Table 1. Survey 1: Importance and achievability of integrating fishermen's knowledge

Goal statement	Important ($n = 251$)	Achievable ($n = 243$)
Help bring fishermen's information, experience, and expertise into the scientific framework needed for fisheries management.	Very: 91.6% Somewhat: 7.6% Not: 0.8%	Very: 38.7% Somewhat: 49.4% Not: 11.9%

from the broad survey, AECF, were extremely supportive of the goal to integrate fishermen's knowledge with science, however they were not as convinced that it was achievable (Table 1). While nearly 92% of respondents thought it was very important, only 49% thought it was somewhat achievable and nearly 12% thought it was not achievable.

When asked "why" they rated the achievability as they did, the AECF reported obstacles to integration. A total of 83 responses were provided; each was coded for themes and themes counted (Table 2). The most prevalent barrier was the perception that NMFS scientists and managers and academic scientists were unwilling to listen, accept, or trust fishermen and their knowledge and information. The AECF in New England considered scientists arrogant. According to AECF, there was inadequate communication between the stakeholders, lack of trust, and a perception of hidden political agendas at play. They acknowledged that the industry was also resistant to share and reluctant to work with scientists.

The second and third surveys asked questions of self-selected fishermen and scientists who were participating in Northeast Consortium-funded cooperative research. Table 3 summarizes participating fishermen (PF) and participating scientists (PS) responses for both surveys.

PF were learning about science; 73.6% said they improved their understanding of the scientific method and 51.0% claimed to have gained insights into what scientists do as a result of participating in cooperative research. Likewise, many PS reported learning about fishing (83.3%) and what it meant to be a fisherman (61.6%) as a result of cooperative research. PS confirmed PF's belief that the PF were learning about science, as 97.3% ($n = 37$) agreed with the statement, "fishermen are learning about science from participating in cooperative research." PF (84.9%) enjoyed teaching scientists about fishing, while 88.6% of PS reported enjoying teaching fishermen about science.

PF felt they had a positive influence on the research projects, e.g., 86.3% agreed that "my knowledge and skills improved our research project" ($n = 51$). While 13.7% replied "neither" to this statement, no PF disagreed that their involvement improved the research project. PS were not asked this question because during pretesting of the questions, scientists felt it implied that research to date was of poor quality. Further, given the AECF's perceptions from survey 1 that scientists do not value fishermen's information, contribution or interests, the PS questionnaire contained an additional measure about whether they valued the fishermen's knowledge and experience. All PS (100%) agreed with the following statements: "fishermen's knowledge and experience are important to the scientific research"; "fishermen's knowledge and experience are

Table 2. Survey 1: Achievability obstacles to integrate fishermen's knowledge with science

Fishermen's perceptions (coded themes, open-ended questions):	Responses (number and %)		Sample of responses
Academics and NMFS reluctant to listen to, accept, or believe fishermen and their information.	35	42.2%	• NMFS does not listen. • Northeast Science Center will be slow to recognize/appreciate industry as experts or even intelligent.
Existing gap between fishermen and scientists too great.	14	16.9%	• Evidential experience opinion and science are far apart. • They [scientists] live and operate under different realities.
Lack of trust between fishermen and scientists.	11	13.2%	• Biggest problem: trust. • Distrust between the groups.
Arrogant scientists.	9	10.8%	• Arrogance and know-it-all personalities. • Because of ivory tower eggheads.
Reluctant fishing industry that is unwilling to share information and wary of research.	9	10.8%	• When they get it [fishermen's information], they use it against us. • Fishermen are wary of research.
Hidden agendas and political interests working against fishermen.	5	6.0%	• Fisheries managers have preconceived answers, which they hire researchers to prove; if the information they gather is contrary, they discard it. • NMFS wants us out of business.

important to fisheries management"; and "I can learn from fishermen and they can learn from me."

When asked an open-ended question, "what activity or task taught me the most about science," PF reported many activities associated with discussing, planning, and designing the research, collecting the data, analyzing and interpreting data with

Table 3. Surveys 2 and 3: Responses of participating fishermen and scientists

Statement	Agree (%)	Neither (%)	Disagree (%)
Fishermen: My participation in cooperative research has improved my knowledge of the scientific method. ($n = 53$)	73.6	18.9	7.6
Scientists: My participation in cooperative research has improved my knowledge of fishing method. ($n = 36$)	83.3	8.3	8.4
Fishermen: Cooperative research has shown me what it means to be a scientist. ($n = 53$)	51.0	35.8	11.3
Scientists: Cooperative research has shown me what it means to be a fisherman. ($n = 36$)	61.6	22.2	16.7
Fishermen: Teaching scientists about fishing is rewarding. ($n = 53$)	84.9	9.4	5.7
Scientists: Teaching fishermen about science is rewarding. ($n = 35$)	88.6	11.4	–
Fishermen: My knowledge and skills improved our research project. ($n = 51$)	86.3	13.7	–

scientific tools, and communicating the findings in public meetings. As one PF said, they learned about science by "discussing experimental design—how best to characterize growth and migration patterns of codfish." In addition PF identified the direct, one-on-one contact with PS and the appreciation they gained about how hard-working, dedicated, and well-intended many PS were, e.g., a PF noted he learned from "one on one with scientists—they ARE good intentioned people" (emphasis original).

When PS were asked their impressions about what activity taught PF the most about science in an open-ended question, they emphasized tasks associated with the research design and implementation and the direct, one-on-one contact. A PS said he felt fishermen learned about science by "participation in program planning/review meetings, including U.S., state and federal DFO [Canada], and equipment manufacturers." Further, PS commented that the one-on-one contact provided an important opportunity to demonstrate respect for the PF and the fishermen's knowledge, e.g., one PS noted that he felt fishermen learned science because of his "courteousness and respectful demeanor."

The PS were asked what activity or task taught them the most about fishing in an open-ended question. PS identified the one-on-one time, directly communicating with PF about fishing, particularly while on their fishing vessels, and gaining an appreciation for PF's skills, abilities, and knowledge as leading to a greater understanding and appreciation of fishing and fishermen. One PS said he learned the most about fishing through the time together, "It was all about the time we spent with each other; we had very long days and lots of time to talk." Further, PS learned about fishing and fishermen during the research planning, design and implementation, particularly as they discussed the operational details of conducting research on a commercial fishing vessel, e.g., one noted, "negotiating the project contracts" and another identified the "collaborative design of the project" as helpful in learning about fishing and fishermen.

When PF were asked what they thought taught PS the most about fishing and fishermen in an open-ended question, they identified the general awareness and respect for fishermen's knowledge that would emerge from direct experience and time together directly communicating while on a fishing vessel. One fisherman said scientists learned about them by "catching the fish and having to be stuck with me on the boat and listen to all my crap." A perceived recognition among PS that PF understood the marine environment was an additional theme within the comments about direct, one-on-one communication and experience; e.g., one identified the "agreement [between fishermen and scientists] that we are good at what we do and we care about the environment and the fish." PF likewise identified the project planning, design, and implementation activities as important in teaching PS about fishing, e.g., "fishermen's point of view of the overall project and how it was carried out."

Discussion

The three surveys present a comprehensive picture of the context, challenges, likelihood, and strategies for integrating fishermen's and scientists' information, experience, and knowledge among those most engaged and interested in participating in cooperative research. While the actively engaged commercial fishing industry in northern New England appeared to believe strongly that integrating fishermen's knowledge and scientists' knowledge is very important, they were more skeptical that it can be achieved. These fishermen believed that scientists did not respect or value their information, did not trust them, and may be actively seeking to eliminate fishing. Further, these same actively engaged, northern New England commercial fishermen surveyed acknowledged that industry was reluctant to partner with scientists and that there was inadequate communication to overcome the distrust and any misperceptions. Thus the fisheries science and management climate in northern New England would not seem to promote the integration of fishermen and scientist's knowledge; those highly engaged among the fishing industry were not reporting a climate conducive to integration. Consistent with Close and Hall's (2006) reported barriers, fishermen's knowledge was not accepted as valid or equal to scientific knowledge and there were concerns that limited the sharing of fishermen's knowledge.

Nonetheless, cooperative research is growing in New England (Hartley and Robertson 2006a) and a substantial number of New England fishermen are engaged in cooperative research. The self-selected group of northern New England fishermen participating in cooperative research felt knowledge integration was occurring directly as a result of participating in cooperative research, since they believed that their involvement had improved the research project. They thought that they learned about the tools and methods of science and about what it meant to be a scientist.

Self-selected participating scientists too reported learning about fishermen and fishing practices and gaining insights into what it meant to be a fisherman. Further, the participating scientists did not express the level of distrust and disrespect for fishermen or fishermen's knowledge that the fishing industry respondents from survey 1 perceived among scientists in general. So among fishermen and scientists participating in cooperative research in northern New England the picture of the likelihood of knowledge integration is different and more promising than the actively engaged northern New England fishing industry survey sample. While this could be due in part to those electing to participate being predisposed to collaboration and learning about other's perspectives, knowledge integration resulting from the act of participating in cooperative research also appear to be occurring among engaged fishermen and scientists. Survey 2 and 3 questions asked directly whether participating in cooperative research led to the knowledge integration outcomes, and in previously published findings, participating fishermen reported establishing trust, producing credible science, and increasing their knowledge *more* than they had anticipated as a result of participating in cooperative research (Hartley and Robertson 2006b).

Communication that is ongoing, iterative, and takes place in a safe and secure place is more likely to generate a common language, common set of understood facts, and greater mutual understanding, according to deliberative discourse theory (see Habermas 1984; Dryzek 1990; Forester 1999). Time and the iterative nature of communication enable messages to be repeated in different ways and context, which promotes listening and hearing of ideas (see Innes 1998). Further research could examine factors in the longitudinal process of iterative communication (e.g., what are the critical skills and abilities of cooperative research participants, what are safe and secure context for fisheries science conversations among disparate parties, how do various communication factors contribute, such as the role of questions, framing of issues, conversations while experientially learning about fishing, etc.).

As institutions, cooperative research programs design, establish, facilitate, and administer the research partnerships, public venues, and organizations that promote high-quality dialogue among fishermen, scientists, and managers. Carolan (2006) suggested that boundary organizations are needed to achieve constructive interactions between groups with differing expertise. These boundary organizations are social organizational arrangements that mediate between scientific and political institutions and facilitate collaboration between fishermen and scientists. Cooperative research raises important institutional questions and ramifications for environmental and natural resource public policy and management—what role does multistakeholder conducted scientific research have in solving complex natural resource disputes, generating public support, engaging stakeholders, and making management decisions?

In addition, cooperative research provides a rich context for sociologists of science to operationalize what an integrated experience- and research-based knowledge might look like (e.g., jointly developed hypothesis, synergistic benefits in data interpretation) and study the integration of knowledge types and methods to improve interdisciplinary research. Cooperative research that effectively integrates the tools, knowledge, and methods of fishermen and of scientists would result in knowledge that would be neither purely experience- or research-based, but rather a third type of fishermen-scientists' experience-guided and research-based knowledge.

Further, these findings contribute to practical recommendations for cooperative research program managers, particularly as they reach out to the highly engaged leaders among the fishing industry and those predisposed to collaboration among the scientific community. First, preplanning and adequate upfront discussion between fishermen and scientists during the project development and research design phases ensures effective and efficient project implementation (Read and Hartley 2006); however, it also promotes integration of knowledge. Providing ample proposal development time and further information sharing and coordinating opportunities (e.g., funding planning grants) for preplanning can facilitate integration of knowledge because it demands joint examination of the operational details of fishing and research.

Second, the professional relationship between fishermen and scientist can be distrustful and suspicious. Thus, cooperative research managers should acknowledge the importance and value of the contribution made by fishermen's and scientists' information, experience and knowledge. Participant meetings, conference symposia, or other program-wide gatherings could include fishermen and scientist-led presentations, moderated panels, or discussions. Background materials for scientists and fishermen should explain the basic operations of fishing and science and cite examples of the value produced through contributions of both fishermen and scientists. The aim should be for managers to reinforce trust, value, and usefulness of fishermen's and scientists' knowledge.

Third, the National Research Council (2004) defined cooperative and collaborative research as being on each end of a spectrum from limited "cooperative" partnerships (e.g., boat chartering, log books) to more fully integrated, "collaborative" partnerships (e.g., fishermen involved in research design, data collection and analysis, and dissemination of research findings). Cooperative research projects will not likely lead to the same level of knowledge integration as can be achieved through collaborative research. However, previously published research suggests that a multifaceted research program that provides opportunities for both cooperative and collaborative research can expand the pool of participating fishermen (Hartley and Robertson 2006b). Thus, while this research did not directly answer the question, programs that include ample cooperative and collaborative options may promote more integration of fishermen's and scientists' knowledge across a broader spectrum of the fishing industry and science (see McCay et al. 2006).

Fourth, cooperative research programs are becoming increasingly prevalent throughout the United States (National Research Council 2004), and the 2007 reauthorization of the primary U.S. federal fisheries management statute, the Magnuson–Stevens Fishery Conservation and Management Act, called for the establishment of a nationwide, regionally based cooperative research and management program (Public Law 109–479, Title II, §318). Effective programs need to be tailored to the regional context (Read and Hartley 2006); however, lessons learned and experiences from active regions (e.g., New England, Alaska and the Pacific Northwest) should be shared broadly. The findings reported here relate to those most active leaders in the fishing industry—a critical subgroup within the broader industry to reach for cooperative research to be successful. A national network of regional initiatives could more rapidly share, advance, and coordinate the best practices of cooperative research. Such a network was recommended by the U.S. Commission on Ocean Policy (2004), further refined to promote a network of regionally tailored, university-based initiatives (Glass 2006), and is reflected in the reauthorized Magnuson–Stevens act.

Conclusion

Cooperative research shows tremendous potential for integrating fishermen's and scientists' knowledge, particularly among those most actively engaged in the fishing industry. It provides a venue for ongoing, iterative communication that can break down misperceptions, promote a common language and understanding, and enhance mutual understanding and learning between fishermen and scientists. Cooperative research provides a context for higher quality deliberation than in many other contexts where fishermen and scientist gather together (e.g., fisheries management council meetings, public hearings, courtrooms). Cooperative research programs, such as the Northeast Consortium, provide the critical boundary organization function that bridges fishermen's and scientists' knowledge with the fisheries management institutions. There remain questions about the human dimensions of cooperative research and the fisheries policy and management ramifications, including questions that extend beyond the engaged leaders examined in this study—what particular features of cooperative research are more likely to promote knowledge integration, how to best design cooperative research programs regionally and nationally to advance knowledge integration, fisheries science and management, for example. However, practitioners are optimistic (see Read and Hartley 2006) and thus there should be ample opportunities for further research on the human dimensions and public policy of cooperative research.

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