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[Article]

Assessing Stakeholder Perspectives on the Impacts of a Decade of Collaborative Fisheries Research in the Gulf of Maine and Georges Bank

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Abstract.—Analysis of the perceptions of commercial fishermen, marine scientists, and other stakeholders of the Gulf of Maine and Georges Bank ecosystem regarding collaborative fisheries research revealed that the benefits of collaboration have been extensive and that a loss of further research opportunities would be consequential. To date, more than 1,000 individuals have participated in research initiatives dedicated to promoting collaboration between scientists and fishermen. A series of eight public meetings were held in the summer of 2008 to determine from fishermen, scientists, and others how this collaboration has affected them, their communities, and the management of important marine resources. Of the 142 attendees, participation was greatest among fishermen (28%) and scientists (24%). The impact of collaborative fisheries research most frequently cited was an increase in the regional capacity to conduct research, utilizing the knowledge and expertise of fishermen and industry vessels as research platforms. Improvements in communication, relationships, and trust between science, industry, and other stakeholders were also lauded. In addition to the social impacts, the economic benefits included enhanced gear efficiency, new fishery opportunities, and help in sustaining fishing operations in times of more restrictive fisheries management. The most frequently cited potential impact of a loss in future funding were probable limits to the capacity of science and management to address local, emerging, or regulatory priorities. Less funding would result in fewer opportunities for stakeholders to work together, build trust, and network. We conclude that because the demands for stakeholder engagement and scientific information will only increase with the global shift toward ecosystem-based management, programs specifically designed to foster collaboration will play a critical role.

Collaborative fisheries research in the Gulf of Maine and Georges Bank is not new. Since the beginnings of fisheries as a formal science in the 1800s, fishermen and scientists have been working together (e.g., Goode 1887; Beverton and Holt 1957). In the 1970s, however, the National Marine Fisheries Service (NOAA–Fisheries) greatly increased its research capacity and infrastructure, significantly reducing its reliance on fishing vessels. By the mid-1990s, New England was engulfed by the groundfish crisis; many fishermen distrusted the reports of dramatic stock declines, and fishing communities experienced severe socioeconomic hardship as regulations tightened (Hall-Arber et al. 2001). The divide between industry, science, and management increased exponentially. Out of this adversity evolved several programs to bring industry and science together—both to increase data collection and to improve relationships among marine fisheries stakeholders through collaborative fisheries research (Hartley and Robertson 2006a). The past decade has seen a substantial investment in collaborative fisheries research focusing on the Gulf of Maine and Georges Bank ecosystems. The major programs have been the Northeast Cooperative Research Partners Program (NCRPP) of NOAA–Fisheries and the Northeast Consortium (NEC) based at the University of New Hampshire.

Commercial fishermen, scientists, students, industry associations, businesses, universities, and agencies from Eastport, Maine, to New Bedford, Massachusetts, and beyond have benefited from these collaborative

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research funding programs. Surveys of fishermen and scientists have documented how collaborative research improves partnerships and integrates knowledge (e.g., Conway and Pomeroy 2006; Hartley and Robertson 2008). Many cite that industry–science collaboration has been worthwhile, both within New England (e.g., Hartley and Robertson 2009) and across the globe (Hogarth 2006; Armstrong et al. 2008). Perhaps most importantly, collaborative research has helped bring fishermen's information, first-hand experience, and expertise—termed "traditional ecological knowledge (TEK)—into the scientific framework needed for effective management of our marine resources (Hartley and Robertson 2009; Johnson 2010).

Fishermen–scientist research partnerships can be classified along a spectrum, from minimal levels of intellectual engagement, nominally regarded as "cooperative research" (e.g., examination of fishing log books, contracting fishing vessels as boats-for-hire), to partners collaborating at every phase of a project (i.e., from proposal development to reporting and dissemination of findings; NRC 2004). We define "collaborative fisheries research" as fishermen and scientists working together as equal partners, each using their unique knowledge and expertise to better understand the marine environment, fisheries, marine communities, and fish capture systems and to promote effective and equal use of marine resources for all.

Now, almost a decade since formal collaborative research funding programs were initiated in New England, and with a bank of research projects and partnerships built, we report on the efforts of the New Hampshire Sea Grant College Program and the Northeast Consortium to take stock, through a public participation process, of the extent to which collaboration has affected New England regional fishery stakeholders intellectually, scientifically, socially, economically, and in management policy. Through informal public discussions held in eight Northeast communities, input was solicited on project impacts, how the research funding process could be improved and research results better utilized, and what the future should hold for collaborative research. Understanding the perceptions of the communities affected by collaborative research is critical to improving programming.

Background and Funding Programs

Implementation of formal federally funded programs is critical to building capacity for collaborative research in the Gulf of Maine and Georges Bank (Sissenwine 2001). Since 2000, more than 250 research projects totaling more than US$70,000,000 have been funded within the region, partnering in excess of 1,000 stakeholders. Stock assessments and research on fishing gear conservation engineering, fish biology, ecosystem processes, socioeconomic impact assessments, and outreach and education have all been supported. We report on the impacts of fishermen–scientist partnered research, the majority of which have been funded and fostered by the following programs.

Northeast Consortium

The Northeast Consortium (NEC) was created in 1999 to encourage and fund collaborative research and monitoring projects within the Gulf of Maine and Georges Bank. These projects involve effective, equal partnerships among fishermen, scientists, and other stakeholders. The program emerged from political demands for more democratic forms of fisheries science and to provide relief for the socioeconomic hardships experienced by fishing communities due to more restrictive fisheries management (Hartley and Robertson 2006a). The University of New Hampshire, the University of Maine, the Massachusetts Institute of Technology, and the Woods Hole Oceanographic Institution work together to foster this program. Awards from NOAA–Fisheries are administered by the University of New Hampshire on behalf of the NEC. Funds are distributed via open competitions for research that must involve partnerships between commercial fishermen and scientists. Achieving collaboration among partners is a key goal of the NEC (NEC 2009). Project selection criteria include importance of coastal ocean and fisheries management, likelihood of success, and potential management impacts. An Advisory Committee of stakeholders provides programmatic advice and assistance in the selection of projects to be funded on a range of topics: fishing gear technology; stock assessments; fish biology, habitats, and ecosystems; and fisheries socioeconomics, outreach, and education (Hartley and Robertson 2006a).

Since its founding, the NEC has administered approximately $32,000,000 (as of August 2008), funding 181 collaborative research and project development awards involving over 500 commercial fishing vessel owners and captains, 45 industry organizations or shoreside businesses, and 215 scientists, and 110 students and interns from 65 research institutions or agencies (duplicates removed). The majority of the research participants have been from states surrounding the Gulf of Maine (95% of fishermen and 85% of scientists and students; NEC 2008).

Northeast Cooperative Research Partners Program

The Northeast Regional Office and the Northeast Fisheries Science Center of NOAA–Fisheries devel-

oped the NCRPP in 1999 to formalize and expand cooperative research among New England's commercial fishing industry, marine science, and fishery management communities, the goals being to enhance the data upon which fishery management decisions are made and to facilitate communication and cooperation. About $23,000,000 has been administered to date (as of August 2008) by NCRPP. Three long-term programs were implemented: (1) an industry-based survey to collect fishery-independent information, (2) a study fleet to collect fishery-dependent information in higher resolution (Hogarth 2006), and (3) the Atlantic Cod Tagging Program to study cod movements and aggregation patterns (Tallack 2006). The other avenue of funding is short-term research projects (1–2 years duration) on topics such as habitats, marine mammals, gear technology, and socioeconomics. Topical workshops, safety trainings, and socioeconomic surveys have also been funded (Hogarth 2006).

Between 2000 and 2006, over 71 short-term projects were funded on research priorities identified with the input of the New England Fishery Management Council's Research Steering Committee. For the 66 projects with final reports submitted (as of August 2008), 206 commercial fishing vessel owners and captains, 181 scientists, 9 students, and 58 industry or science organizations have participated in research (duplicates removed). The majority (90% of the fishermen and 91% of the scientists and students) of the research participants have been from states surrounding the Gulf of Maine (C. Woodhead, NOAA–Fisheries, personal communication).

Research Set-Aside Programs

Research set-aside programs (RSAs) were developed by the New England Fishery Management Council, the Mid-Atlantic Fishery Management Council, and the Atlantic States Marine Fisheries Commission through fishery management plan processes. Certain fisheries set aside a portion of the annual fisherywide allocation (no more than 3%), to be harvested for the purpose of funding research. The programs are administered by the NCRPP. In New England, RSA programs have been implemented for sea scallops *Placopecten magellanicus* (since 2000), goosefish *Lophius americanus* (which the industry refers to as "monkfish"; since 2006), and Atlantic herring *Clupea harengus* (since 2008). In the mid-Atlantic, RSA programs are focused on summer flounder *Paralichthys dentatus*, scup *Stenotomus chrysops*, black sea bass *Centropristis striata*, Atlantic mackerel *Scomber scombrus*, longfin inshore squid *Loligo pealeii*, northern shortfin squid *Illex illecebrosus*, butterfish *Peprilus triacanthus*, bluefish *Pomatomus saltatrix* (all since 2001; NCRPP 2009).

Like the NEC and NCRPP programs, RSA programs promote partnership among fisheries participants, marine scientists, and fishery managers to further the understanding of northwest Atlantic fisheries and enhance information used in fisheries management decision-making. Over $28,000,000 from fisheries has been used to fund over 60 RSA projects. Of the 40 projects with final reports submitted (as of August 2008), about 85 fishermen, 5 nongovernment organizations, 46 scientists, and 5 graduate students have participated in the research (duplicates removed). Just over half of the participants (53% of fishermen and 51% of scientists and students) have been from states surrounding the Gulf of Maine (E. Meredith, NOAA–Fisheries, personal communication).

Saltonstall–Kennedy Grant Program

The Saltonstall–Kennedy Act, as amended (Promotion of the free flow of domestically produced fishery products, 1996), established a fund for NOAA–Fisheries to provide grants or cooperative agreements for fisheries research and development projects that benefit U.S. marine and Great Lakes fisheries. Funds for projects, which were first appropriated in fiscal year 1954, are intended to be distributed each year, subject to funding, through a nationwide competition. In recent years, funding topics have included aquaculture, fisheries bycatch, fisheries utilization, habitat protection, management alternatives and fisheries-user conflicts, marine recreational fisheries, and product quality and safety. Since the mid-1980s, a minimum nonfederal 10% cost share based on total project costs has been required of proposals (NOAA–Fisheries 2008a).

Additional Programs

A number of other initiatives have provided funding for marine fisheries research in which regional fishermen and scientists have gotten involved, though collaboration may or may not have been a funding program requirement. Federal, state, municipal, and nongovernmental organization funding have been utilized. Examples include the National Sea Grant College Program, the National Science Foundation, the Economic Development Administration, the Large Pelagics Research Center at the University of New Hampshire, the Island Institute, and state marine resource agencies. Most recently, the Commercial Fisheries Research Foundation was founded by commercial fishermen to promote collaborative research in southern New England, but their first round of projects commenced after the data were collected for the study we report here (CFRF 2009).

Previous Social Science Research

Before the inception of the Northeast Consortium and the NCRPP, there was a considerable gap in trust between scientists, fishermen, and fishery managers (Dobbs 2000). Social science surveys conducted between 2002 and 2004 of fishermen and scientists demonstrated that those stakeholders participating in NEC collaborative research reported forming better partnerships, and participating fishermen believed the science to be more credible (Hartley and Robertson 2006b). Of participating fishermen surveyed, 73.6% stated that their understanding of scientific methods had improved, and 86.3% felt that their knowledge and skills improved the research. The participating scientists surveyed all agreed (100%) that the knowledge and experience of fishermen are important to scientific research and fisheries management (Hartley and Robertson 2009). The overall positive impact of collaboration is further evidenced from ethnographic research (one-on-one interviews, case studies) conducted in the northeastern United States(Johnson 2007, in press). Although the benefits of collaborative research in building trust and communication pathways and in improving fisheries management have been well documented in the Northeast (e.g., Kaplan and McCay 2004; Johnson and van Densen 2007), the study we report here is a unique assessment across funding programs that gathers stakeholder perspectives on the impacts of collaborative research on science, management, and partnerships and examines the importance of research funding and ways collaborative research could improve in the future.

Methods

Stakeholder viewpoints were gathered from public meetings in the summer of 2008 on the impacts of collaborative research conducted in the Gulf of Maine and on Georges Bank. Because of the wide range of funding avenues for fishermen–scientist research partnerships and the diversity of funding sources that support many individual projects, this assessment was not focused on the impacts from any particular funding source. The following sections detail the methods for each of the data collection initiatives, including a brief discussion of response bias. Self-selected individuals voluntarily participated in the meetings and contributed viewpoints; thus, the study sample is not meant to be representative of the general suite of marine fisheries stakeholders across the region.

Public meetings.—Informal, public discussions were held in eight communities over 2 weeks in late July to early August 2008 to glean from fishermen, scientists, and others how collaboration has affected them, their communities, and the management of marine resources that are important to them. Significant effort was made to encourage broad public participation in the meetings (e.g., current and prior participants in collaborative fisheries research as well as nonparticipants). The meetings, held in states surrounding the Gulf of Maine and spaced no more than a 2-h drive apart, were held in public facilities on weekday evenings. In Maine, the meetings were held in Machias (Downeast), Stonington (Penobscot Bay), Wiscasset (midcoast), and Portland (southern Maine). The New Hampshire meeting was held in Portsmouth, and three meetings were held in Massachusetts—Gloucester (northern Massachusetts), New Bedford (southern Massachusetts), and Chatham (Cape Cod and the islands of Nantucket and Martha's Vinyard). Two individuals from each community representing commercial fishing and scientific interests served as meeting hosts, to help secure a location both convenient to and well known by stakeholders. Hosts also encouraged local stakeholder participation via personal invitations. The meetings were advertized via postal and (or) electronic mail to over 1,500 individuals on the present address lists of the New England Fishery Management Council, the Atlantic States Marine Fisheries Commission, and the Northeast Consortium. These individuals include active commercial fishermen, scientists, research project coordinators, research funding program coordinators, nongovernmental staff, and politicians in the focus region and beyond. Announcements were also posted in regional fishing trade newspapers and on the New Hampshire Sea Grant and NEC websites.

Data collection.—Each discussion (2–2.5 h in duration) was lead by an independent facilitator familiar with the topic and people. The facilitator ensured that each attendee had an opportunity to introduce themselves and share their perspectives. All views expressed were captured by two note-takers. A video recording of each meeting allowed more complete data collection.

Each meeting followed roughly the same agenda: introductions, overview of purpose, ground rules, summary of what collaborative fisheries research has occurred within the meeting's area. This was followed by a discussion of the following open-ended, qualitative questions:

(1) How has collaborative research impacted your personal, business, organizational, research, or management capacity?
(2) How has collaborative research affected communication between scientists, fishermen, and other stakeholders?
(3) How have collaborative research results been used?

TABLE 1.—Definitions of Gulf of Maine and Georges Banks fisheries stakeholder categories.

Category	Definition
Fisherman	Commercial fishing captain, vessel owner, or crew member.
Scientist	Researcher working for a federal, state, or local governmental entity or for a university or other nonprofit institution.
Student	Undergraduate, graduate, or postdoctoral fellow.
Project coordinator	An individual employed to facilitate (a) collaborative research project(s), typically on the staff of a fishing industry organization.
Program coordinator	An individual employed by a collaborative research funding program.
Other	A fishery manager, fish monger, spouse, retiree, or other individual not otherwise defined.

Can we improve the dissemination, integration, and use of collaborative research information?

(4) What improvements can be made in how collaborative research is funded and facilitated?

(5) What would result if collaborative research program funding faded away?

The facilitators sought to lead the discussions such that each attendee could have time to contribute and share honest opinions, both positive and negative.

Participation.—Three methods were used to identify the number and type of stakeholders who attended the meetings. Participants were enumerated (total attendance) and asked to identify themselves on a sign-in sheet. A video recording of the meetings helped to clarify the stakeholder type of each individual who made a comment.

The headcount data indicated that a total of 165 people attended the eight meetings. Of those 165 attendees, 151 either identified themselves on the sign-in sheets or made comments during the meetings from which stakeholder type could be identified. The other 14 individuals opted to not identify themselves on the sign-in sheets and did not provide comment at the meetings. There were a few individuals who chose to attend more than one meeting (6 attended two meetings, 1 attended four meetings). Before each meeting, the facilitator asked each repeat participant to ensure that, if they provided input, that the comments not be duplicative with what they contributed at a prior meeting and that time be allowed for others to participate. For the data analysis reported here, the 9 duplicative participants were removed by counting their attendance only at the first meeting they attended. Thus, 142 individuals participated in the meetings who could be identified to stakeholder type.

Data coding.—To identify themes from the discourse of the meetings, a grounded theory approach (Strauss and Corbin 1990) was used, in which coding emerged from the data itself, rather than being hypothesis driven. Meeting participants were characterized into the following stakeholder categories, representing their current employment: fisherman, scientist, student, project coordinator, program coordinator, and other (Table 1). The answers to the open-ended qualitative questions were coded to fit the following broad categories: science, management, partnerships, importance of funding, and ideas for improvement (Table 2). The comments were further categorized into an impact type: enhanced communication, research capacity, trust building, relationship building, economic value, multiple impacts, negative impacts, and not applicable (i.e., neutral; Table 3). Apart from negative impacts and not applicable, all impact categories are considered positive. The data set was further queried to specifically identify what stakeholders said about the potential impacts if funding for collaborative research in the region were to diminish or cease. Data were fit into the following categories: loss of research capacity, loss of partnerships, loss of economic assistance, no direct impacts, multiple impacts, and not applicable (Table 4). To determine response trends and differences in viewpoints across the region and between stakeholder types, frequencies and percentages were calculated for all the categorical variables, such as the demographics of the participants, the type of comments made during each meeting, as well as the level of prior participation in collaborative research.

Analysis of meeting attendee data.—Those who attended the meetings were self-selecting and voluntarily provided comments. The cross-tabulation of meeting location and stakeholder type (Table 5) indicates that, of the 142 attendees (duplicates

TABLE 2.—Definitions of broad response categories.

Category	Definition
Science	Fisheries, oceanography, conservation engineering, and related topics of inquiry.
Management	Project data contributing to fisheries or ecosystem management.
Partnerships	Industry–science–management relationships.
Importance of funding	Financial support for participating in collaborative work.
Idea for improvement	How the funding or facilitation of collaborative research could be bettered.

TABLE 3.—Definitions of impact-type categories pertaining to cooperative efforts.

Category	Definition
Enhanced communication	Better communication among and between fishermen, industry organizations, scientists, fishery managers, and others.
Research capacity	Increased opportunities to do research by leveraging industry vessels and the knowledge and expertise of fishermen.
Trust building	Greater value sharing, acceptance by regulators or scientists of data gathered by fishermen, and industry support of research outcomes.
Relationship building	Development of industry associations, partnerships maintained beyond the scope of a specific collaborative project, and improved collaboration between stakeholders.
Economic value	Enhanced gear efficiency, new fisheries, increased fishing opportunities, and use of collaborative research dollars to help sustain fishing operations.
Multiple impacts	More than one positive impact category.
Negative impacts	Regional research capacity, stakeholder partnerships, and economies do not benefit or are hindered by collaborative efforts.
Not applicable	The comment was an idea for improvement that did not fit into another category.

removed) who could be identified to stakeholder type, the greatest meeting participation was in southern Massachusetts (41 participants), accounting for 29% of the total participants, followed by New Hampshire (29 participants, or 20%); the meeting with the lowest participation was in southern Maine (10 participants, or 7%).

In total, fishermen as a stakeholder type had the greatest participation (40 participants, or 28%) followed by scientists (34 participants, or 24%). As direct participants in collaborative research, fishermen and scientists are key stakeholders. The relatively high industry participation was noteworthy because it is generally difficult to schedule meetings when fishermen can attend. The third largest participation group was the other category (e.g., spouses, fish mongers, legislative staff; 32 participants, or 23%), which showed that collaborative research is important to a diverse range of people.

Of meeting attendees, 108 or 76% had previously participated in collaborative research projects (Table 5). With the exception of one commercial fisherman, those who had not yet participated in collaborative research projects fit into either the program coordinator or other categories. The two easternmost meetings did not draw any attendees who had not already participated in collaborative research, and the New Hampshire meeting drew the greatest number (11).

The New Bedford meeting had the highest participation of both scientists and students. This was not unexpected given the relatively close proximity of the NOAA–Fisheries Northeast Fisheries Science Center and the University of Massachusetts School of Marine Science and Technology (SMAST). Apart from one student attending the Penobscot Bay meeting, the New Bedford meeting was the only one to attract students. One of the largest groups of fisheries students in the Northeast is at SMAST, all of whom are required to have a collaborative component to their training. Students had been specifically encouraged to attend this meeting by their advisors, one of whom was a meeting host.

Of all meetings, the New Hampshire meeting drew the greatest number of commercial fishermen and other category participants. This high industry attendance may reflect a greater engagement in collaborative research, relative to other areas, due to the proximity of Northeast Consortium headquarters at the University of New Hampshire and the relative ease of NEC outreach to that community. Thus, the engagement of stakeholders from this area might be more consistent over the years.

Although just a handful of scientists attended the Downeast and Penobscot Bay meetings, it should be noted that there are few scientists in eastern Maine who have participated in collaborative fisheries research,

TABLE 4.—Definitions of impact-type categories pertaining to the future loss of funding.

Category	Definition
Loss of research capacity	Decreased ability to study important ecosystem questions; fewer fishermen able to contribute their vessels, knowledge, and expertise for scientific research.
Loss of partnerships	Fewer opportunities for stakeholders to work together, build trust, and network.
Loss of economic assistance	Fishermen would no longer be compensated for participating in research.
No direct impacts	Regional research capacity, stakeholder partnerships, and economies would not experience notable change.
Multiple impacts	More than one impact category.
Not applicable	The comment did not relate to the potential impact of funding loss.

TABLE 5.—Number of meeting attendees by region, stakeholder type, and prior participation in collaborative fisheries research (CR) in the Gulf of Maine and Georges Banks area.

		Stakeholder type						Prior CR	
Meeting location	Sample size[a] (%)	Fisherman	Scientist	Student	Project coordinator	Program coordinator	Other	Yes	No
Maine									
Downeast	11 (7.7)	5	4	0	2	0	0	11	0
Penobscot Bay	11 (7.7)	4	1	1	3	0	2	11	0
Midcoast	12 (8.5)	4	4	0	1	2	1	10	2
Southern	10 (7.0)	4	3	0	0	1	2	8	2
New Hampshire	29 (20)	11	5	0	2	1	10	18	11
Massachusetts									
Northern	13 (9.2)	3	2	0	1	1	6	6	7
Southern	41 (29)	6	10	17	1	1	6	34	7
Cape Cod islands	15 (10.6)	3	5	0	1	1	5	10	5
Total	142 (100)	40 (28)	34 (24)	18 (13)	11 (7.7)	7 (4.9)	32 (23)	108 (76)	34 (24)
Prior CR		39	34	18	11	1	5		
No prior CR		1	0	0	0	6	27		

[a] Duplicates removed.

and virtually all who have, came to one of these two meetings. This reflects a much higher percent attendance than in other regions that have more scientific collaborative research participants.

It is difficult to compare the composition and number of meeting attendees with the universe of marine fisheries stakeholders because the boundary between stakeholder and nonstakeholder is elusive. A stakeholder could include commercial fishing vessel captains, owners and crew members, recreational fishermen, marine and coastal scientists, students, spouses, government employees in marine-related programs, resource managers, seafood consumers, and more. Based on data available from collaborative research funding programs (e.g., NEC 2008; NOAA–Fisheries, personal communication), 1,000 is a conservative estimate for the number of program participants in the past decade. That includes commercial fishermen, scientists, and project coordinators primarily from industry associations. Regardless, we consider the 142 participants in the impact analysis reported here to be a substantial number.

Stakeholder Perceptions

A total of 346 comments were documented during the meetings, each region contributing 8.1% to 15% of the viewpoints (Table 6). Each meeting lasted about the same length of time, so the meetings with fewer responses (e.g., Penobscot Bay, southern Maine) had more lengthy discussion of issues. People at less-populated meetings had more opportunities to share their ideas. The two meetings with the highest number of attendees, New Hampshire and New Bedford, Massachusetts, were also high in the number of responses, indicating that those meetings were more rapid-fire than others.

The large majority of viewpoints contributed were by actual collaborative research participants. Fishermen, who had the highest overall participation as a stakeholder group (Table 5), also contributed the highest number of responses (132, or 38%; Table 7).

TABLE 6.—Broad response categories in collaborative fishery research meetings held in the Gulf of Maine and Georges Banks area, by region.

Meeting location	Science	Management	Partnership	Importance of funding	Idea for improvement	Total (%)
Maine						
Downeast	13	12	10	9	4	48 (14)
Penobscot Bay	9	5	6	4	4	28 (8.1)
Midcoast	19	14	12	3	2	50 (15)
Southern	11	6	4	7	6	34 (9.8)
New Hampshire	14	14	7	8	7	50 (15)
Massachusetts						
Northern	12	5	11	4	9	41 (12)
Southern	19	5	10	2	13	49 (14)
Cape Cod islands	8	4	15	3	16	46 (13)
Total (%)	105 (30)	65 (19)	75 (22)	40 (12)	61 (18)	346 (100)

TABLE 7.—Perceptions of collaborative research impacts in collaborative fisheries meetings held in the Gulf of Maine and Georges Banks area, by stakeholder type.

Impact type	Fisherman	Scientist	Student	Project coordinator	Program coordinator	Other	Total (%)
Enhanced communication	15	10	1	8	1	7	42 (12)
Increased research capacity	18	24	2	10	7	7	68 (20)
Trust building	18	7	0	2	0	1	28 (8.1)
Relationship building	14	10	1	8	2	3	38 (11)
Economic value	12	11	1	1	3	3	31 (9.0)
Multiple impacts	35	32	2	6	6	10	91 (26)
Negative impacts	1	0	0	0	0	0	1 (0.29)
Not applicable	19	14	0	8	3	3	47 (14)
Total (%)	132 (38)	108 (31)	7 (2.0)	43 (12)	22 (6.4)	34 (9.8)	346 (100)

Likewise, the second highest response group, scientists (108, or 31%), was the second highest in attendance. Students, as a stakeholder group, contributed the fewest responses, just 7 (2.0%) of the total responses, and comments by program coordinators were also low, contributing just 22 (6.4%).

Thus, meeting attendants were largely characterized by commercial fishermen and scientists who had already participated in collaborative fisheries research. This is important to understand in framing the results.

Broad Response Categories

Of the 346 total responses to the key questions asked at the meetings, the largest number (105 or 30%) fit into the science impact category (Table 6), which includes comments related to collaborative research contributions to the fields of fisheries, oceanography, conservation engineering, and related topics of inquiry. Science impacts were noted at a consistently high level across meetings locations. Overall, partnerships was the second highest impact category ($n = 75$, or 22%), though at the Cape and Islands meeting, partnerships outweighed science impacts.

Importance of funding was the category with the least number of responses (40, or 12%), and of those, the least were stated at the meeting in New Bedford, Massachusetts (Table 6). This port is consistently ranked as the top commercial fishing port in the nation for value of landings (NOAA–Fisheries 2008b). Importance of funding as an impact category was most frequently cited at the Downeast and New Hampshire meetings. It follows that the funding might be less important to an area like New Bedford, relative to the overall fishing economy, than to areas with smaller-scale fisheries where the industry may be more reliant on collaborative research dollars.

Ideas for ways that collaboration and research funding programs could improve constituted 18% of the responses. Attendees of the New Bedford and Cape and Islands meetings contributed the greatest number of ideas. Those meetings had a number of NOAA–Fisheries staff attend. Because NOAA–Fisheries is a primary end-user of research data and a key coordinator of research programs, it follows that those attendees would be likely to have input about what improvements could be made to research programs.

Perceptions of Collaborative Research Impacts

Examining the data for more specific impacts across stakeholder types and the region, collaborative research was consistently cited as having significantly increased research capacity, 68 (or 20%) of all the responses falling into that category (Tables 7, 8). However, the greatest number of responses (91, or 26%) fell into the multiple impacts category. This suggests that stakeholders have seen a range of benefits stemming from collaboration, such as the building of trust and economic enhancement. Within the trust building category, fishermen provided a large majority of the responses. This supports the theory that trust of scientists and scientific processes by fishermen is generally improved by participating in collaborative research (Hartley and Robertson 2008).

Those individuals who participated in this study cited largely positive views of the impacts of collaborative fisheries research over the past decade. The 1 negative impact (0.003% of responses) was shared by a commercial fisherman who has not yet participated in collaborative research. Comments in the not applicable category (47, or 14%) are considered to be neutral because they were all ideas for improvement that did not fit into another category (Tables 7, 8) and the wording indicated that research programs should continue in the future. Because prior participants in collaborative research composed the majority of this self-selected sample group (Table 5) and all voluntarily provided comments, future studies could more broadly identify the consistency of these results with the views of marine fisheries stakeholders.

TABLE 8.—Perceptions of collaborative research impacts in collaborative fisheries meetings held in the Gulf of Maine and Georges Banks area, by region.

	Maine					Massachusetts			
Impact type	Downeast	Penobscot Bay	Midcoast	Southern	New Hampshire	Northern	Southern	Cape Cod and islands	Total (%)
Enhanced communication	4	3	10	3	3	6	7	6	42 (12)
Increased research capacity	13	6	10	5	15	9	6	4	68 (20)
Trust building	7	1	6	0	2	5	2	5	28 (8.1)
Relationship building	7	5	7	0	2	5	7	5	38 (11)
Economic value	6	2	1	6	6	4	3	3	31 (9.0)
Multiple impacts	7	8	10	14	15	5	17	15	91 (26)
Negative impacts	0	0	0	0	1	0	0	0	1 (0.29)
Not applicable	4	3	6	6	6	7	7	8	47 (14)
Total (%)	48 (14)	28 (8.1)	50 (15)	34 (9.8)	50 (15)	41 (12)	49 (14)	46 (13)	346 (100)

Potential Funding Loss Impacts

To the specific question, "What would result if collaborative research program funding faded away?" 64 responses were elicited across the meetings (Table 9). Attendees, particularly fishermen and scientists, consistently cited a loss of research capacity (31, or 48% of the responses to this question) as the greatest potential impact. The second highest response category was multiple impacts (11, or 17%), meaning the loss of partnerships and economic assistance were considered important as well.

Discussion

Based on the data analysis, collaborative fisheries research was clearly viewed among meeting attendees as having had positive impacts in the Northeast region over the past decade. The increase in research capacity that fishermen–scientists partnerships achieves was cited as the most important impact. Concurrently, the potential loss of research capacity was seen as the greatest detriment if future funding should fade away.

The data show a broad base of support for a wide range of aspects of collaborative fisheries research. A plausible hypothesis could be that fishing communities of similar size would cite impacts similarly, such that data from Portland, Gloucester, and New Bedford would cluster distinctly. This, however, did not occur. It should be noted that there was much variation in the size and stakeholder profile of the meetings. Future research could control these variables.

Each meeting was filled with the sharing of specific examples of the impacts of collaborative research, many of which are noted in the final report by Feeney and La Valley (2009), but a few of which may be given here:

(1) A collaborative survey for ocean quahog *Arctica islandica* in eastern Maine waters has helped retain the fishery.
(2) The Environmental Monitors on Lobster Traps project has engaged over 100 lobstermen to deploy oceanographic sensors, greatly increasing the regional data set of temperature, salinity, currents, and more.
(3) The Maine and New Hampshire Inshore Trawl Survey is providing multispecies stock assessment data for nearshore waters that are not achievable by NOAA–Fisheries.
(4) Development of a raised footrope trawl has opened areas previously closed to the small-mesh fishery for species such as silver hake *Merluccius bilinearis* and red hake *Urophycis chuss*.
(5) Development of a bait for haddock *Melanogrammus aeglefinus* that minimizes bycatch has allowed greater opportunities for hook-and-line fisheries.

Several individuals spoke of how important the involvement of students and fishing crew members in

TABLE 9.—Perceptions of the potential impacts of collaborative research funding loss in collaborative fisheries meetings held in the Gulf of Maine and Georges Banks area, by stakeholder type.

Impact type	Fisherman	Scientist	Student	Project coordinator	Program coordinator	Other	Total (%)
Loss of research capacity	11	10	2	6	1	1	31 (48)
Loss of partnerships	4	3	0	2	0	0	9 (14)
Loss of economic assistance	4	3	0	0	1	1	9 (14)
Multiple impacts	2	1	0	5	2	1	11 (17)
No direct impacts	1	2	0	0	0	1	4 (6.3)
Total (%)	22 (34)	19 (30)	2 (3.1)	13 (20)	4 (6.3)	4 (6.3)	64 (100)

research is to improvements in collaborative learning. The success of many research projects depends on the participation of these individuals, and the opportunity strengthens the next generation of collaborative research participants. Collaboration at the formative stages of one's profession helps to promote partnerships later on. Participation by students in collaborative research has certainly been strong over the years; over 100 have been involved in Northeast Consortium projects (as of August 2008; NEC 2009). Students, however, are more transitory than scientists and fishermen. Current students have only been involved for the past few years and may not be as committed for the long term. They are perhaps less likely to attend a nonmandatory meeting than other stakeholders. Although 18 (13%) of the total attendees were students, they contributed only 2% of the total responses (Table 7). Although the facilitators did encourage all attendees to share their viewpoints, perhaps the students deferred to others with more experience and felt that they were there to learn.

Virtually all of the fishermen who attended were owners and (or) operators of commercial fishing vessels. Most of the 500 fishing vessels involved in Northeast Consortium projects (as of August 2008) have had at least one crew member aboard (NEC 2008). Perhaps the same can be said of crew as of students: that they are more transitory and less likely to attend meetings that seek input on collaborative research impacts. Because they are not in control of the vessels they work on, they may also feel that their point of view is not of interest to funders or others.

Meeting participants contributed many ideas for improvement to collaborative science, funding streams, education, communication, and fisheries management (Feeney and La Valley 2009), including

(1) Continuance of collaborative gathering of time series data critically important to monitoring ecosystems.
(2) Expansion of the scope of research questions that fishermen are able to answer beyond the species for which they have commercial permits.
(3) Expansion of acoustics use in collaborative fisheries science.
(4) Provision for more venues for diverse stakeholders to communicate.
(5) Greater emphasis on communication about project results and technology transfer, particularly engaging industry to conduct outreach.
(6) Greater infiltration of collaborative data into mainstream data systems used for management.

Many at the meetings spoke to an emergence of a culture of collaboration in New England over the past decade. Several community-based organizations have either been created because of research or have incorporated research into their mission. Examples include the Atlantic Offshore Lobstermen's Association, the Commercial Fisheries Research Foundation, the Gulf of Maine Lobster Foundation, the Lobster Institute, the Maine Scallop Advisory Council, the Marine Fisheries Institute, the Massachusetts Fishermen's Partnership, the Penobscot East Resource Center, and the Stonington Lobster Hatchery. Such organizations represent a broad and vital investment in collaborative approaches.

Considering who did not attend the meetings, greater participation was expected at the Portland, Maine, meeting, because Portland is the largest center in Maine for commercial fishing and marine science (Hall-Arber et al. 2001), and 40% of NEC project participants from Maine have come from southern Maine (NEC 2008). However, the Portland meeting drew the least number of participants overall (10 or 7.0%). The industry host for this meeting had particular difficulty in inspiring his colleagues to participate, perhaps because fishing industry in this area was feeling down-trodden and uncertain about its future.

There are several avenues for additional social science research regarding the impacts of collaborative research funding programs. Related future studies, the choices people make in attending meetings could be examined to determine why people do or do not attend. Because our study used a self-selected sample, a follow-up study could use random sampling of stakeholders, particularly to determine how the views of fishermen and scientists who have not yet participated in collaborative research may differ. Perhaps those who provided input in our study value collaborative research more, or timing of the meetings may have been a factor. Studies could be replicated in southern New England, and in other regions around the world where collaborative research is occurring, to determine larger-scale im pacts and trends. Because several models exist for collaborative research funding programs (e.g., federal and nonprofit; Armstrong et al. 2008), studies specific to particular models would inform the development and evolution of programs.

Conclusions

The data consistently suggest that the impact of collaborative research has been extensive, and a future loss of research opportunities would be consequential. Several common themes emerged. Collaboration has improved relationships, trust, and communication between science, industry, and other stakeholders. An increase in the ability to conduct research was frequently cited and has become increasingly important

because demands for scientific information are only increasing with the national movement towards ecosystem management.

These changes would not have occurred without the sharing of knowledge and values that result from groups working together and the development of programs specifically designed to foster collaboration. Building an understanding and appreciation for both the rigors of science and the experience of industry may be the foundation that has fueled trust between science and fishermen. Many stakeholder meeting participants mentioned that partnerships have been maintained beyond the scope of any individual project. In addition to the social impacts, economic benefits included enhanced gear efficiency and new fishery opportunities that help to sustain fishing operations in times of more restrictive fisheries management.

Although the past decade has shown how much can be achieved by collaboration, many meeting participants felt that a loss of funding in the future would seriously limit research capacity and the capability for science and management to address local, emerging, or regulatory priorities. Less funding would result in fewer science and industry members participating, the outcome of which may be fewer opportunities for stakeholders to work together, build trust, and network. From the perspective of stakeholders who have been affected by collaborative fisheries research in the northeastern United States, targeted funding programs are providing opportunities for significant knowledge-sharing and stakeholder engagement in ecosystem research and management.

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