Communities, Knowledge, and Fisheries of the Future*

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ABSTRACT

The ‘human dimension’ in fisheries management has historically been incorporated via a specific economic understanding of fisheries wedded to a single-species approach. Meeting the challenge of fisheries, however, will require a broadening of fisheries science toward an ecosystems-based approach. There is also the need for a parallel shift in social science understandings of fishing toward context and inter-relationships amongst and between fishermen and fishing communities. While the move toward ecosystems is well underway, a corresponding movement in fisheries social science is less well established. The latter will require a commitment to new sources of data, methods, and forms and scales of analysis. Promising initiatives that align with ecosystem-based approaches include the documentation and incorporation of local ecological knowledge, cooperative research that bridges communicative and epistemological gaps between fishermen and scientists, and community-level data collections and analyses emerging from legislative mandates and community-based advocacy. These examples suggest a reorientation of fisheries social science in step with ecosystem-approaches.

KEYWORDS

fisheries, fishing communities, fisheries management, fisheries policy, local ecological knowledge, cooperative research, ecosystem-based management, social practice of fishing, fisheries social science, human dimensions of fisheries

INTRODUCTION

Fisheries management has been viewed as ideally based on scientific knowledge of fish biology and the related enterprise of stock assessment. This reliance on the natural sciences is tempered, of course, by the politics of deciding what to do in a given instance. Those politics are persistent reminders that people and their activities, not the fish themselves, are what are being managed, and furthermore that human desires and institutions are central determinants of how, where, and to what extent fishing takes place. We argue that the incorporation of this 'human dimension' is central to the challenge of sustainability. Yet we also note that the incorporation of this human dimension has historically been accomplished, in theory and management practice, via a particular economic understanding of fisheries and fishermen that emerged in the 1950's (Mansfield 2004a; Smith 1994). This understanding of the rational economic behavior of individual fishermen is, in practice, closely aligned with traditional single-species assessments and management initiatives (St. Martin 2001).

It is, however, well known that meeting the challenge of fisheries will require a broadening of fisheries science beyond single-species modeling and management and a movement toward an "ecosystems" perspective (Botsford et al. 1997; Pauly and MacLean 2003; Browman and Stergiou 2004a). In the latter, fisheries are understood as constituted by complex relationships and processes between and amongst species and environments across a number of scales (Langton et al. 1995). To some, the movement toward ecosystem approaches constitutes a necessary "paradigm shift" in fisheries science and management (Caddy 1996; Costanza et al. 1998; Sainsbury 1998). Meeting the challenge of ecosystem-based fisheries management (EBFM) will, however, require a broadening attention to the social dimensions of ecosystems (McCay 2000a). That is, there is the need for a parallel and complementary shift in our social science understandings of fishing toward context and inter-relationships amongst and between fishermen and fishing communities; a sensitivity to locations and how they are inhabited by communities; and multiple scales of socio-economic processes and fish harvesting practices (Grafton et al. 2005; McCay and Jentoft 1996; Wilson, J. et al. 1999; Wilson, J. 2006).

Just as a wide range of alternative understandings, data collection innovations, forms of analysis, and management initiatives are loosely grouped under ecosystem approaches, so too a wide range of alternative understandings, data collection innovations, forms of analysis, and management initiatives emerge from social science under the rubric of community approaches, which we posit as a necessary complement to or component of ecosystem approaches. In using the term "community," we do not wish to reduce the social and ecological dynamic of fisheries to a function of some difficult-to-imagine, discrete, bounded, and/or traditional community but to see that dynamic as constituted by, in part, a host of community-level practices and processes. Community-level processes, practices, interactions, and interdependencies can be *starting points* for understanding the relationship between the rich and complex social practice of fishing and equally rich and complex marine ecosystems.

We begin by briefly reviewing the nature of a paradigm shift relative to fisheries social science. We then focus on three areas of social science inquiry directly relevant to EBFM and the community approach. The first instance repositions fishermen as knowing subjects interested in using their knowledge to sustain fisheries. We examine fishermen's local ecological knowledge (LEK) and its relationship to dominant forms of fisheries knowledge and management in Canada. The second instance is the case of cooperative research in the Northeast United States. The research discussed there asks: what is the fate of LEK once it comes into contact with

standard forms of science and management? The third instance is the re-thinking and repositioning of fishing communities themselves. Just as fishermen are recast as knowing subjects and stewards of resources, we note the ongoing struggle to recast communities as more than just sites of impact but as determinant of both fisheries dynamics and management options.

NEW VOICES IN FISHERIES SCIENCE AND MANAGEMENT

Fisheries economics, building upon the initial neoclassical insights of Gordon (1954), Scott (1955), and others, has as its entry point and ontological foundation an understanding of fishers as individuals competing on an open access commons (Feeny et al. 1996; St. Martin 2001, 2005a; Mansfield 2004a). As such, fisheries economics gives to fisheries science an explanation of the propensity for fishing effort to increase beyond what is economically optimal and ultimately damaging to fisheries resources (e.g. Iudicello et al. 1999). The assumptions of fisheries economics align well with single species modeling of fish stock that has dominated fisheries science and management over the last half-century (Smith 1994). In both cases, management units are large and homogenous containers of quantities of single species of fish (Booth 2000) and fishermen, within these logics, are conceived of as the bearers of an aggregate and distributed effort which is the essential cause of fisheries degradation (St. Martin 2001).

"The problem of fishing" is then the problem of individual fishermen maximizing their utility on an open access resource, and to solve that problem fisheries economics suggests creating exclusive and tradeable property rights, specifically individually transferable quotas (ITQs) (Hannesson 2004; Iudicello et al. 1999). While appropriate and effective in many contexts, the narrow set of management solutions that emerge have a number of socio-economic shortcomings that trouble many academics (Apostle et al. 2002; Davis 1996; Mansfield 2004b; McCay 1995; St. Martin 2005b) as well as many within fishing communities themselves (Shivlani and Milon 2000). In some cases this has led to civil disobedience and experiments in community-based alternatives, such as the Community Management Board system in Atlantic Canada (Kearney et al. 1998; McCay 2000b, 2004).

Fisheries science has not, however, been restricted to the formal single-species modeling so clearly aligned with fisheries economics and institutionalized in fisheries management. The call to implement EBFM approaches in opposition to the single-species model has been heard clearly by all and heeded by many (Botsford et al. 1997; EPAP 1999; McLeod et al. 2005). While EBFM remains only broadly defined and rarely implemented, it has had the welcomed effect of providing a space within which to re-imagine new forms of fisheries management, such as incorporating marine reserves both to protect critical habitats or life cycle events and to aid in adaptive management through experimentation (Grafton and Kompas 2005; Kaufman et al. 2004). The movement toward EBFM relies, however, upon more than a shift in perspective or attitude on the part of fisheries scientists and managers. It requires new ontological foundations and forms of data as well as new methods and scales of analysis (Langton et al. 1995; Pauly 1997; St. Martin 2004; Wilson, J. et al. 1999).

Similarly, fisheries social science is broader than the neoclassical understanding of fishermen's aggregate economic behavior vis-à-vis single species of fish. In particular, anthropologists, sociologists, geographers, and other social scientists point to the importance of social and political as well as economic relationships, cultural as well as economic valuation, communities as well as individuals, and diverse sources of knowledge. Although not denying the role of individual competition and desires to maximize utility, these scholarly traditions

emphasize the institutions and mechanisms that are embedded within and constitutive of fishing communities as the source of solutions (or potential solutions) to the problem of fishing (Jentoft, et al. 1998; McCay and Jentoft 1998). The movement toward communities heralds a foregrounding of context, inter-relationships, process, heterogeneity, and multiple scales of analysis that is aligned with the conceptual foundations of EBFM. Indeed, seeing communities as fundamental to the dynamic of fisheries is an important element within any critical re-thinking of fisheries management models that have traditionally relied upon an ontologyof competing individual fishermen (cf. Dyer and McGoodwin 1994; Jentoft 2000; McCay and Jentoft 1998; Pinkerton 1989; Wilson, D. 1999).

Unlike new biological understandings of fisheries essential to EBFM which build upon decades of in situ biological research and enjoy wide acceptance amongst fisheries biologists, the movement toward community will require the collection and integration of previously non-existent baseline data such as the socio-cultural composition of fishing communities, their interactions and connections, the diversity of their fishing practices, their local environmental knowledge, and their spatial domains (cf. Hall-Arber et al. 2001; McCay et al. 2002a, 2002b). The goal of community-level research should be less to precisely define the boundaries of discrete communities, than, like ecosystems research, to build upon an alternative and holistic understanding of fisheries dynamics.

THE NATURE OF LOCAL KNOWLEDGE

The traditional role of social science in fisheries (i.e. fisheries economics) has been to make clear the impact upon fish stocks of competitive individual fishermen's aggregate efforts to maximize utility. Knowledge, within this model, is individually possessed and utilized toward individual gain. Yet, other traditions within social science have documented the vital role of fishermen's local ecological knowledge (LEK) in traditional, cooperative, and community-based systems of fisheries management (Johannes 1981; Neis and Felt 2000). LEK is based on personal, shared, and inherited experience and while the term 'ecological' is often used to describe this knowledge, it is much broader. Murray et al. (2006) view fish harvesters as embedded in webs of relations, or 'networks,' that include not only the surrounding bio-physical environment, but also such things as management regulations, kinship ties, peer pressure, social support mechanisms, and the global seafood market. In their view, LEK is a *social-ecological product*, an outgrowth of community-level practices and processes.

In addition, researchers have, more recently, developed methods that solicit LEK from cooperating fishermen and incorporate it into science-based systems of fisheries management. In particular, LEK can be used to address issues where other data are wanting (Ames et al. 2000; Wroblewski, 2000) and, combined with archival sources, it can be used to reconstruct and interpret the history of fisheries (Hutchings and Ferguson, 2000; Rosenberg et al. 2005). Neis and Felt (2000) have argued that, with the involvement of fish harvesters, contemporary LEK can be documented in a systematic and ethical fashion and can be aggregated to construct a larger scale, finely textured picture of regional fisheries extending back several decades (see also Neis et al. 1999a). In both traditional and contemporary management regimes, LEK recasts fishermen as not only knowledgeable subjects but also as cooperators and stewards (or nascent stewards) of the environment.

Fishermen's knowledge is, however, largely qualitative, gained through and maintained by interactions within communities (Pálsson 1994), and is relative to distinct locations.

Therefore, management regimes that incorporate fishermen's knowledge and are built from the "bottom up" (McCay and Jentoft 1996) are primarily enacted at the level of communities and in locations where technocratic systems of fisheries management have not been institutionalized (e.g. third world settings). To operationalize LEK at other scales, in conjunction with state sponsored and science-based fisheries management systems or within more highly industrialized fisheries, will require a broader institutionalization of qualitative and participatory methods, new systems of cooperation between fishing communities and fisheries scientists and managers, and an understanding that LEK might be appropriate for ecosystem- and community-based management practices.

Complementary Knowledge Systems: Newfoundland and Labrador Case Study

As part of a recent interdisciplinary project in the Canadian Province of Newfoundland and Labrador, researchers collected, analyzed and combined information drawn from different knowledge systems (LEK, natural sciences, governance, and social sciences) in order to track socio-ecological interactions over time, to compare that information, and to assess potential consequences for the health of fishery dependent communities as well as fish and shellfish stocks. The information used included results of LEK interviews with fish harvester experts, information developed from archival sources, and scientific data (primarily government trawl survey results). The goal was to find common ground that allows complementary use of different types of knowledge and thereby movement toward a nuanced and informed understanding of the complex environmental history of fish and fisheries in the study area. Through a better understanding of the past, the researchers ultimately sought to facilitate movement towards health (broadly defined) in the social-ecological systems of coastal Newfoundland.

The use of interdisciplinary teams to design and conduct research related to LEK is one way to help resolve some important methodological issues. Social scientists, for example, are relatively familiar with interviewing techniques and with the dynamics of fisheries, local fisheries terminologies and technologies, but less familiar than natural scientists with fish ecology. Together, they provide a more informed position when interviewing and observing fishermen (see Neis et al. 1999a; Murray et al. submitted, for details on the studies and methods used). In this research, interviews with fish harvesters involved the use of nautical charts and a range of topics pertinent to EBFM and/or community approaches. For example, topics included biophysical considerations such as spawning locations, juvenile nursery areas, and migration routes, but also included such community oriented topics as kinship ties, crew structure, traditional management measures, and the influence of the market and learning (Murray et al, 2006). Information from the interviews was then organized using GIS and qualitative analysis software, allowing for the 'aggregation' of LEK to a regional scale, which also facilitated comparison with existing fisheries science. Finally, these results were presented at a series of feedback sessions, and were used to help spark discussion about policy recommendations, management alternatives, and the future of Newfoundland and Labrador's resource dependent fishing communities.

Generally, the researchers found that by combining and contrasting insights from different knowledge systems and by looking at processes that have shaped interactions between different groups of actors in these socio-ecological networks, they were able to develop a more nuanced, subtle and effective description and analysis of the history and dynamics of the fisheries studied. These results suggest that LEK is not only compatible with single-species assessments but with a broad ecosystem-based approach to fisheries management as well.

Indeed, an ecosystems approach might better incorporate fishermen's qualitative knowledge of habitat, species interactions, spawning locations, etc. Assembling knowledge through talking to fishermen provides valuable insight into micro-scale processes, conditions and variability because it is built from the 'bottom up.' Drawing on different sorts of information broadens the diversity of available information, fundamentally involves fishermen in the very process of knowledge creation, and strengthens the basis for truly participatory, future-oriented discussions.

COOPERATIVE RESEARCH AND THE FATE OF LEK IN THE NORTHEASTERN U.S.

Recent research in the Northeastern U.S. allows us to examine the role of cooperative research for valuing LEK, and integrating it into and potentially transforming the decision-making process. Fisheries research that is carried out cooperatively by scientists and fishermen offers a tentative solution to the challenge of incorporating fishermen's knowledge and hence community experience into the decision-making process for fisheries management (Bernstein and Iudicello 2000; National Research Council 2004; Neis and Felt 2000; Wilson, D. 2003). It also makes clear the current barriers to that incorporation.

In the Northeastern United States, interest in and opportunities for cooperative research are at an unprecedented level (Sissenwine 2001). A diversity of projects that range from community-based mapping to gear selectivity studies have focused on some aspect of virtually all important species of fish and shellfish as well as on habitat and environmental conditions (Hall-Arber and Pederson 1999). Indeed, many fishermen now make their annual business plans based on how much financial support they will receive from collaborative research. The recent growth of cooperative research attests to the potential for institutional change and the willingness of all parties to entertain a paradigm shift.

The Use of LEK in Cooperative Research

Fishermen and their LEK, particularly knowledge regarding where, when, and how to catch fish, are integrated into cooperative research programs in different ways depending upon the type of research conducted. For example, in cooperative survey research, sampling stations are selected randomly, and so these surveys seemingly do not utilize fishermen's knowledge. However, fishermen's knowledge and skill have proven important when these random stations are areas of complex and rocky bottom making successful sampling (via the towing of bottom nets) difficult without experience. Moreover, such cooperation is necessary when, as in the case researched, the survey was focused on a smaller inshore area than had been traditionally sampled. Indeed, the "industry-based survey" project we examined emerged from fishing community complaints that inshore areas (fishing grounds accessible to inshore vessels and vital to local community survival) were excluded from region-wide sea sampling programs but subject to the regulations they informed; it was argued that the latter could not then reflect local stock conditions, species interactions, or habitat considerations. Intimate knowledge of bottom type within specific localities became essential to surveying at new scales.

In cooperative tagging studies, fishermen provide their knowledge about fishing locations (both spatial and temporal knowledge), catching fish (using gear and vessels), and handling fish (including recreational angler knowledge). Tagging programs also rely on fishermen's skills in catching fish to get tag returns, and in some cases, fishermen have been trained to do the tagging themselves in the absence of scientists on board. Including fishermen directly increases their compliance and, therefore, the number of returned tags. While the tagging programs examined

have had, to date, only limited effect relative to fisheries management, many participants (scientists and fishermen) were impressed by the way these programs changed the culture of scientist/fishermen relations. The projects facilitated new appreciations and understandings across what had been a significant boundary and have, perhaps, laid the foundations for future cooperative projects.

Finally, participatory gear studies have long been successful at integrating fishermen's LEK. While gear studies were originally focused on fleet modernization and increasing catch, they are, today, focused on species and size selectivity. Interestingly, fishers are as interested to cooperate in the latter as they were in the former. In both cases, fishermen's technical knowledge about gear design and deployment and vessel operations are vital. However, fishermen also provide ecological knowledge to such studies. They know how different gear interacts with different environments and how it will be used relative to the behavior of fish. Today, the norm is to see fishermen working with scientists designing gear, testing models in flume tanks, testing gear at sea, and recommending modifications for future research. An outside observer might have a difficult time differentiating the "scientists" from the "fishermen" in these projects.

Integrating Cooperative Research into Management

Integrating cooperative research into the fisheries science used for management has proven more challenging than integrating fishermen and their knowledge into cooperative research. To be effectively integrated in the stock assessment process, for example, industry-based surveys must be standardized and replicated over a relatively long period of time. Standardization itself calls for experimentation and learning, such as calibration experiments; and a relatively long time-series of data is desired for stock assessment, resulting in delays in the use of data from cooperative research projects and hence difficulty assessing their use. Yet, as the tagging studies illustrated, such projects produce new possibilities for cooperation as they reposition both fishermen and scientists in new relationships to each other and the environment. In addition, cooperative research, which by definition does not replicate large-area science based surveys, is creating new knowledge of species, interactions, and habitat at new scales that may prove to be appropriate for ecosystem-based endeavors.

The incorporation of LEK will clearly vary by project objectives and design as well as the species-specific information needs of stock assessment. Most of the examples where cooperative research has been incorporated into management are gear studies, which provide immediate answers to pressing management problems. For example, several "special access programs" were created based in part on data produced through cooperative gear selectivity research (e.g., yellowtail flounder access in a closed area and a haddock hook fishery) (Plante 2004; Plante 2005). And an exempted whiting fishery exists because of data produced through cooperative research (Plante 2003). Including fishermen and their LEK from design to implementation produces management outcomes that are more likely to be widely (or easily) accepted by fishing communities or relevant to the problems faced by those communities.

THE LIMITATIONS OF LEK AND CHALLENGES IN LEK RESEARCH

The projects outlined above recognize the local knowledge, insights, and experiences of fishermen. They enlarge the field of what is credible and thereby produce new conditions for what is possible (cf. Gibson-Graham 2005). While these projects do not necessarily alter the trajectory of fisheries science and management, the intermingling of what was once ontologically

and spatially divided creates new opportunities and engages participants in new imaginings of the future of fisheries. Yet this intermingling produces frictions even as it suggests new possibilities. LEK is not universally celebrated as a solution to the problems of fisheries, and substantial barriers to its incorporation persist. Similarly, in cooperative research only particular forms of LEK (i.e. knowledge of fish locations and/or gear handling) are readily merged within existing procedures of science and management.

Barriers to the integration of LEK may be internal to LEK and the methods by which it is documented. For example, critiques of LEK research and/or the usage of LEK in fisheries management have focused on the validity of LEK itself, particularly as compared to 'objective,' positivistic Western science upon which fisheries management is ostensibly built (see Neis and Felt, 2000; Neis et al. 1999a). In short, the data contained in fishermen's knowledge have a high degree of complexity and are not usually standardized as to temporal scale, territorial coverage, technology, effort and expertise (Murray et al. 2005). Because LEK is largely motivated by fishing success rather than scientific criteria of consistency and generality, it is also more difficult to 'take out of people' and present to an audience so that it can be digested and understood. There also has been a lack of methodological consistency and clarity in LEK research (Murray et al. submitted). Researchers, for example, sometimes fail to explain their selection of "local experts" (Davis and Wagner 2003). Moreover, the methods and practices of LEK researchers, including the abstraction of LEK from local contexts, can sometimes tend to subordinate LEK to science (Holm 2003; Agrawal 1995; Pálsson 2000; Gray 2002; see also Neis 2003).

Our research suggests that, in addition to the nature of LEK itself, there are substantial institutional barriers to its incorporation and use. For example, in the U.S. new legislative acts mandate standards and assessments of data quality; such procedures may hinder or delay the incorporation of cooperative research in management where data emerges from a variety of non-traditional and unfamiliar sources that make technical and peer review challenging. This is a delicate issue since on the one hand there are requirements for transparency, public review, and information quality standards, which take time, while on the other hand there are desires for more flexible, adaptive, and responsive management that can respond to new information provided from a variety of knowledge sources, including LEK, traditional science, and cooperative research.

In addition to accepting the validity of LEK and cooperative research outcomes, there remains the issue of its integration into existing systems of, for example, stock assessment. The latter requires specific forms of data over long time periods and at specific scales (typically produced by sea sampling and landings monitoring for large regions). In our research, stock assessment scientists who were interviewed clearly appreciated fishermen's knowledge but saw little use for it relative to region-wide stock assessment. They pointed to the differences between fishermen's and scientific knowledge (e.g. in terms of scale and review) as well as a profound cultural and communication gap between fishermen and scientists. While they saw cooperative research as a way to address the latter, they also saw the results of such research as largely superfluous relative to current systems of stock assessment.

Yet, our work also suggests that the formal institutions of fisheries science and management are neither static nor necessarily hostile toward LEK and/or cooperative science, and that there are new methods and frameworks forming to accommodate such non-traditional research. For example, in the Northeast U.S., in addition to the formalization of cooperative

research funding mechanisms and a number of "successful" projects, there is the recent initiative by one of the regional management councils to formalize the review of cooperative research outcomes with the goal of directly using such outcomes in decision-making and management. While others have noted the ways that the incorporation of LEK into formal management practice threatens to discipline and essentially alter LEK (e.g., Holm 2003), we are interested in how its incorporation also foments institutional change. The presence of valid and vetted knowledge relative to localities, lifetimes of environmental observation, and community practices, makes possible new understandings of fisheries that are compatible with ecosystem- and community-based forms of management.

LINKING COMMUNITIES AND ECOSYSTEMS

LEK and cooperative research may be the source of information necessary for, or productive of, a paradigm shift in fisheries science and management, yet it is the broad notion of community that provides a framework for their understanding and operationalization. While there is no definitive answer as to what constitutes a fishing community or what are its bounds (see below), the notion of community can nevertheless act as a frame for the analysis of the relationship between fishermen and fisheries and as a rubric for policy development (Olson 2005). Like ecosystems, communities foreground understandings of interrelationships (between and amongst fishermen), multi-scalar approaches (to social and economic processes), the importance of context (cultural and historical), and embeddedness in locality (of fisheries and fishing communities) *even as it remains poorly defined*. Community, as an analytical frame increasingly incorporated into the institutions of fisheries science and management, is, then, our third instance where we see a potential for an emerging paradigm shift.

Community as Site of Regulatory Impact

The United States provides an excellent opportunity for examining questions about community and fisheries because legal mandates governing U.S. federal fisheries management require the application of social science in the examination of impacts to both occupational groups and place-based communities (e.g. McCay et al. 2002a, 2002b). Mandates with the most direct relevance to the study of fishing communities come from the Magnuson-Stevens Fishery Conservation and Management Act (MSA) and its 1996 amendment where, for the first time, the entity known as a "fishing community" appeared in national legislation.[1] The Act defines "fishing community" as "a community which is substantially dependent on or substantially engaged in the harvesting or processing of fishery resources to meet social and economic needs, and includes fishing vessel owners, operators, and crew and United States fish processors that are based in such communities" (Sec. 3 Definitions 16 U.S.C. 1802). The definition assigns community to a geographical place that is characterized by the presence of landing sites, processors, and/or residences of those who participate in fisheries. This place-based definition, like any definition that attempts to limit community to a single characteristic, makes it difficult to analyze the complexity of social, economic, and cultural processes that constitute community and do not map onto discrete locales.

Our research in the Mid-Atlantic region of the U.S., itself emerging from the federal mandate to assess fishing communities, suggests that ports and other discrete places, defined in a strict, geopolitical sense, are not necessarily the privileged or exclusive loci of fishing communities. In short, the sociocultural, political and economic ties that cross geopolitical boundaries are essential to understanding social impacts experienced in any one place. This is

because multiple places are intimately connected in space and time by the social, economic, and cultural networks established by various actors moving between places (Clifford 1994; Malkki 1995). Fishing communities, as experienced by their members, may not be contiguous with the boundaries of discrete locales at all, or, put another way, the places relevant to communities of fishermen may have multiple localities (cf. Gupta and Ferguson 1997).

Our research has reinforced our contention that defining communities along single axes or bounding them by particular geographies contradicts rather than complements the movement toward ecosystems-based science and management. For example, multi-local socioeconomic and cultural networks constitute some of the most salient aspects of fishing communities in the Mid-Atlantic. Members of these communities are mobile at sea, on land, and in the virtual world. They are embedded in local, regional, national, and global systems of capital flow. Their members are regulated at the local, state, and federal levels and their activities are tied to the global political economy. The official definition of fishing communities neither captures the reality of these communities nor directly proposes that community be anything more than a site of regulatory impact (c.f. McCay 2005; St. Martin 2006). Nevertheless, we are heartened by the establishment of fishing communities as objects of analysis within the institutions of fisheries science and management.

While initially limited, fishing communities are increasingly visible as, for example, in the "Community Panels Project" that engages fishing community members in the ongoing assessment of their own communities and economies relative to fisheries management in the Northeast.[2] Implemented in a variety of ports across New England, the panels reflect upon social, cultural, and economic transformations of their communities relative to existing and pending fisheries management legislation. The results of the project inform policy makers but also serve to bring to the fore processes of community and culture that are more typically treated as secondary concerns by the institutions of fisheries management (Hall-Arber 2006b). In this and other projects, communities exceed their boundaries and become more than just sites of impact; they, in short, are beginning to "take on the muscle of reality" (Popper and Popper 1999).

Community as Constitutive of Fisheries

Like LEK and cooperative research, working with and building upon "communities" will require new methods that not only incorporate communities into fisheries science and management as sites of impact but reveal community-based processes as constitutive of fisheries and ecosystem processes directly (McCay 2005). Whereas aggregate fishing effort has long been seen as the major determinant of the (degraded) status of fisheries, a communities framework calls for examining disaggregated effort and the differentiation of fishing practices across space and within communities; it suggests that we examine the complexity of cultural, social, and economic processes that together produce that differentiation. Recognition and documentation of the heterogeneous nature of the social landscape that overlays, interacts with, and, in part, constitutes the natural environment is needed if ecosystem-based approaches to fisheries are to be comprehensive and sustainable.

The necessity of considering communities relative to ecosystems is perhaps best illustrated by the example of marine protected areas (MPAs). MPAs are increasingly advocated as mechanisms for fisheries management. Widely associated with ecosystem-based approaches to marine resource management (McLeod et al. 2005; Browman and Stergiou 2004b; but see Sissenwine and Murawski 2004), MPAs restrict a variety of human activities across marine space encompassing sensitive habitats or places where species are vulnerable. These are often

large areas, difficult to monitor and protect, which makes them vulnerable to incursion. Thus, voluntary compliance is extremely important. The success of MPAs is contingent on the involvement and support of the communities of fishermen and other marine resource users who depend upon the area considered for protection (Christie et al. 2003). The participation of fishing communities in the design and implementation of the MPA can be facilitated by the incorporation of the practices and knowledge of those fishing communities (Aswani and Hamilton 2004; Aswani and Lauer 2006). In short, both community and biophysical processes associated with ecosystems must be understood and incorporated in MPA siting and design in order to produce a management regime that is sustainable over time.

CONCLUSION: TOWARDS A RESEARCH AGENDA?

In this article we have examined work that traces the existence of processes and practices that emerge from and serve to constitute fishing communities in North America. This work, with its roots in the anthropological tradition, includes a variety of initiatives from the documentation of LEK to the institutionalization of community panels. We believe these initiatives represent new opportunities for fisheries science (biological and social) and point to alternative foundations upon which to base an emerging ecosystems-based approach to fisheries management. Although results from such work are only recently and weakly incorporated within fisheries science and management, it is increasingly clear that the processes and practices documented are present within a much wider range of fisheries than previously imagined.

The work reviewed above suggests a research agenda that would include a variety of initiatives that first make visible, map, or otherwise document processes such as LEK that have been neglected or displaced. It would examine the many sites, such as cooperative research projects, where such processes intersect with standard fisheries science and management and would examine closely the effects of these encounters. It would critically assess the insertion and/or adoption of community as a category and framework for analysis within fisheries science and management, and it would focus on the shift toward community as a fundamental element of a broader shift toward ecosystems-based fisheries management. Finally, it would acknowledge the ways that an ecosystem- and community-based approach might transform fishing communities themselves, for example by developing stronger local identities and institutions for environmental stewardship (cf. Agrawal 2005).

Along with others who have demonstrated the relevance of anthropological and related work in the North American context (Dyer 1994; Clay and McGoodwin 1995), we have pointed to the growing body of research that is currently defining and revealing fishing communities and community-based processes. It is our contention that a focus on these processes, for example LEK, helps to create alternative foundations upon which to build fisheries futures. Such foundations are needed given the fact that decades of the dominant model of fisheries science and management have not worked. The shift toward ecosystems, to which we add a complementary shift toward communities, provides a loose but ultimately generative framework for articulating new understandings of fisheries, new forms of data and analysis that incorporate multiple scales, and the expansion of fisheries management possibilities.

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[1] NOAA Fisheries is the federal agency responsible for overseeing the execution of impact assessments related to federal fisheries. NOAA Fisheries, which is a division of the Department of Commerce, is responsible for the management and conservation of living marine resources within the Exclusive Economic Zone of the United States (waters between three and 200 miles offshore). For additional information on the mandates pertaining to social impact assessments in fisheries, see http://www.st.nmfs.gov/st1/econ/impact.html.

[2] The Community Panels Project (principal investigators: David Bergeron, Madeleine Hall-Arber, and Bonnie J. McCay) was a project of the Massachusetts Fishermen's Partnership and was funded by Northeast Consortium and Saltonstall-Kennedy grants of the National Oceanic and Atmospheric Administration (NOAA) of the United States. http://www.mass-fish.org/communit.htm.