Global Review of Social Science Integration with Natural Resource Management

Research report to the North Pacific Research Board

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Publication date:
2013

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GLOBAL REVIEW OF SOCIAL SCIENCE INTEGRATION WITH NATURAL RESOURCE MANAGEMENT

Research report to the North Pacific Research Board

Written by
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INNOVATIVE FISHERIES MANAGEMENT
- an Aalborg University Research Centre

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Executive Summary

This report aims to inform the North Pacific Research Board (NPRB) of the key developments and contemporary epistemological discussions found within the social science disciplines in relation to fisheries policy and management. The main objective is to describe relevant ways that social science is integrated with natural resource management around the world, using relevant case studies to strengthen the arguments. There are a number of reasons why social considerations have become "a distant third" in management decision over biological and economic ones, from the misinterpretation of the discipline by natural scientists, to the fact that the nature of the data social science normally provides are not easily formatted for policy-makers and managers.

As highlighted in this report, methodologies for the collection and integration of different types of data exist, but face a number of challenges. The list of such approaches presented in this review is by no means exhaustive but the authors believe that these methods are relevant for Alaska:

- Social Impact Assessment (SIA) is one of the primary methods used to incorporate social sciences into natural resource management. There are a number of social indicators, which can be used in SIA, but the form some data take limits their incorporation into fisheries management plans and policies. However, including only the data that can be quantified and which fit into the dominant disciplinary frameworks of biology and economics, though necessary, risk excluding key social and cultural dynamics that are not easily enumerated or monetized.
- A socio-ecological system (SES) perspective can help integrate social and ecological aspects of a system shifting the focus from solely the biological and economic aspects. In contrast to attempting to control natural resources for stable or maximum production and short-term economic gain, a resilience approach, where the system is able to absorb disturbance and reorganize, aims to achieve sustainable long-term delivery of environmental benefits linked to human wellbeing. By combining the insights gained through theory development and those derived from qualitative analysis of different case studies, the understanding of how social-ecological systems operate can be improved, with the possibility to extract generalities about the fundamental processes that structure the interactions between human societies and ecological systems.
- Work in ecosystem goods and services highlight efforts to fold social and cultural indicators into valuation schema, but as explained there are many limitations to the current methodologies. Nonetheless, perhaps this is one way in which social facets will inform economic models and provide more realistic predictions of fisheries systems.
- The integration of Local Ecological Knowledge (LEK) with science and management knowledge (SMK) can greatly enhance management success: i) the breadth and depth of local knowledge complements general scientific knowledge, ii) local knowledge contributes place-based, fine-scale spatial and temporal information, management techniques, and institutions; and iii) SMK contributes an understanding of contemporary large-scale ecological processes historically not encountered by LEK. Consequently, given the complementary nature of LEK and SMK, the integration of the two can potentially enhance the resilience of socio-ecological systems by providing a

diversity of knowledge and data for problem solving, though integration is not easy to achieve.

The case studies reviewed were selected because of their contextual relevance with natural resource management in Alaska. Their common message contends that management seldom works best when taken directly off the shelf and abstracted from the social, cultural, and economic context. Different methods from social science can assist in avoiding such scenarios when "one size fits all," seems to suit very few.

- The Chilean case study on the implementation of a Territorial Use Rights in Fisheries (TURFs) provided an example where the definition and differentiation of the fleet (artisanal and commercial) promoted continued diversity within the fishery, a key point in resilience both in ecological and social contexts. Nevertheless, the fact that the system failed to incorporate different facets of LEK meant that there were areas where the new regime replaced a successful traditional system, which then suffered the adverse consequences of a collapsed fishery because it ignored the local dynamics.
- The case study on Greenland and the adoption of Individual Transferable Quotas to restructure the fishery in a way that would benefit society at large showed the potential far-reaching impacts at the community level in cases where there is a limited amount of alternative livelihood opportunities. The Greenlandic case also shows that boats that were allowed to seek fishing opportunities farther away could fish out other areas important to subsistence fishing. Therefore, this case highlights how qualitative work uncovers unseen (or unrealized) subgroups and interests in natural resource management contexts. It is often that the less quantifiable aspects of fishing or those not easily operationalized in variables go unnoticed, along with the qualitative understandings of different subgroups, which limits the ability to project reality.
- The final case study presents the authors' experiences on numerous research projects in the EU on the integration of social sciences in natural resource management. Natural scientists and policymakers for example, believe that stakeholders with a large interest in a resource will find a way to be involved and express their views in the decision-making process, given that the process is open and allows for participation. That is true in the case when stakeholders have the resources and knowledge to follow such processes. In the case of more vulnerable or less politically connected groups, the ability and resources to be involved in the process are significantly less, something particularly salient in Alaska.

Alaska is a unique place when considering the integration of social science with management of natural resources. With the highest percentage of native Alaskan and American Indians, from whom many still have a traditional subsistence livelihoods and culture, natural resource management in Alaska, has a number of distinctive factors to take up, that be fisheries, forestry, mining, oil extraction, etc. Understanding local context represents a central theme in this review. The development of Community Profiles within NOAA's social science research agenda exemplifies the attention to this level of impact. The authors highlight the need for the NPRB supplementing research initiatives that will assist in filling data gaps but not solely quantitative ones. Qualitative methods and ethnography have a big role to play in understanding the value of fishing and maritime livelihoods at different spatial scales, balancing from the current attention in a bioeconomic to a more socio-ecological system.

Introduction

Historically, natural resource management has used biological and physical science disciplines and methodologies to provide the necessary data for making informed environmental policies and management decisions. From the 1970s and especially 1980s, economics was increasingly incorporated as an additional discipline to include the human aspect of natural resource harvesting into management. Though the inclusion of economics was a positive step, research and governing agencies often overlook the (non-economic) social sciences in favor of the biological and solely quantitative sciences for understanding 'natural' systems. However, human behaviors are a part of the ecological systems in which they are found. Key insights into human behavior and social systems are generated best through social science research. Consequently, successful resource management must necessarily integrate both social and natural sciences.

This report was undertaken to inform the North Pacific Research Board (NPRB) of the key developments and contemporary epistemological discussions within the social science disciplines in relation to fisheries policy and management. The main objective is to describe relevant ways that social science is integrated with natural resource management around the world, providing relevant case studies to strengthen the arguments.

Integration of the natural and social sciences in resource management is not an easy task, as the discussion will show. Yet there are examples from around the world of successful cases. There are also lessons to be learned from the less successful attempts to integrate social science with natural resource management.

This report provides case studies from Greenland and Chile to inform the Alaskan situation. The case studies include information on the social, scientific, political and management structures that form the background for natural resource management in these areas.

With the primary goal in mind, the information is organized along the following lines:

- A review of social science engagement in natural resource management, including incorporating sociocultural indicators in fisheries research, methods and directions in Social Impact Assessment (SIA), and the increasing use of quantitative methods in some fisheries social science circles;

- A discussion of challenges in defining and operationalizing key terms (e.g., fisheries dependency and social sustainability) and methods (e.g., economic analyses);

- A discussion of specific approaches to ecological research integrating natural and social sciences, including social-ecological systems perspective and resilience theory, ecosystem goods and services, and local ecological/fisheries knowledge;

- The presentation of case studies including fisheries management in Chile and Greenland;

- The presentation of fisheries management, policy, and research in the European Union (EU), including observations and reflections from our own experiences with European Commission scientific advice generation and participation on EU research projects; and

- The conclusion, which entails a synthesis of the literature, cases, and implications for management of marine resources in Alaska.

I. Social science engagement in natural resource management

I.A.1. FCMA: National Standard 8, Section 303(b)(6), and terms defined in the Act

The Magnuson-Stevens Fishery Conservation and Management Act of 1976 (FCMA) and its subsequent reauthorizations, including the Sustainable Fisheries Act of 1996, govern fisheries within the United States' Exclusive Economic Zone (EEZ). Guided by ten National Standards, the National Oceanic Atmospheric Administration (NOAA), its National Marine Fisheries Service (NMFS), and system of eight Regional Fishery Management Councils (herein, Councils) produce fisheries management plans, which are to incorporate social and economic considerations while managing at the level of optimum yield. Defined in the FCMA, optimum yield cannot exceed maximum sustainable yield (MSY) as such level can only be "*reduced* by any relevant economic, social, or ecological factor," (P.L. 94-265 § Sec. 301 104-297, emphasis added). While debated on differing views of sustainability, the FCMA no doubt tries to reconcile the interest to conserve marine fisheries while at the same time preserving, perhaps protecting, American commercial fisheries interests and reliant communities as reflected in the National Standards and in its objectives.

Evidence of the interest to preserve communities and incorporate social and cultural dimensions into fisheries policy and management exists in a few different sections of the FCMA. Numerous accounts herald National Standard 8 as the sentinel that social and cultural aspects of communities would receive due inquiry when assessing proposed regulatory changes (Colburn, Abbott-Jamieson, and Clay 2006; Abbott-Jamieson and Clay 2010). Nonetheless, the text of National Standard 8 culminates with the designed purpose to, "minimize adverse economic impacts," and no such reference to social or cultural aspects (P.L. 94-265 § Sec. 301 104-297). The full text of National Standard 8 reads:

> (8) Conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities in order to (A) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities (P.L. 94-265 § Sec. 301 104-297).

Indeed, National Standard 8 references "fishing communities" and the special interest that management shall make toward these entities, recognizing that "sustained participation of such communities" shall be considered within the context of conservation. The Act defines *fishing community* as "A community which is substantially dependent on or substantially engaged in the harvest 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 community," (P.L. 94-265 § Sec. 3. 104-297). Nonetheless, operationalizing this definition has proven difficult (Jacob et al. 2001; Jepson & Jacob 2007), a discussion to which we will return.

Less exalted, although still a key component of FCMA, Section 303(b)(6) outlines attention to "cultural and social framework relevant to the fisher and any affected fishing communities,"

when creating limited access privilege programs such as Individual Fishing Quotas (P.L. 94-265 Sec. 303(b)(6)). Furthermore, fishery impact statements, an original requirement of the 1976 Act (as opposed to National Standard 8's birth in the 1996 reauthorization), "Shall assess, specify, and describe the likely effects, if any, of the conservation and management measures on—(A) participants in the fisheries and fishing communities affected by the plan or amendment," (P.L. 94-265 Sec. 303(a)(9)). Lastly, National Standard 2 states that the best available science shall provide the basis for fisheries conservation and management (P.L. 94-265 § Sec. 301. 98-623). Consequently, National Standard 2 is often thought to promote the research agenda of biologists, ecologists, oceanographers, and others studying the biological, chemical, and physical interactions of fisheries and their habitats. However, if we reflect, how have we incorporated the "best available" social science into this interest of scientifically informed policy? Consequently, this paper tries to address this question through a review of contemporary debates among social science academics studying fisheries and through case studies that demonstrate how social science may inform policy and management.

I.A.2. Social Impact Assessment: current methods and new directions

Social Impact Assessment (SIA) is a key methodology for assessing the effects of policy or management on a community or group. We include SIA as a part of this discussion for two central reasons:

1. It is a methodology that often incorporates social, economic, and biological data; and
2. It is a methodology that focuses on the human aspect of socio-ecological systems and human behavior.

As numerous biologists have been heard to say, "we don't mange fish, we manage people," so if successful management is sought after, then the human element must be taken into consideration.

What is SIA?

First, how is the incorporation of social data achieved in policymaking? SIA is an artifact of the National Environmental Policy Act (NEPA), represents one of the primary methods for incorporating social science into natural resource management. SIA has continued to develop into what can be described as a hybrid of a social science field and a component of policymaking (Freudenburg 1986). Yet, while the field of SIA has continued to mature, the question of how to incorporate science into a largely political process still remains, at least within fishery management (Jepson and Jacob 2007). Social impact *assessment* is a systematic appraisal of the quality of life of individuals and their communities where their environment is affected by policy changes, such as through fisheries management and recovery plans (Delaney 2007). The term *social impacts* refers to changes to individuals and communities due to a management action that alters the way "in which people live, work, relate to one another, organize to meet their needs, and generally cope as members of a fisheries society," (Wilson, et al. 1998). SIA "provides a realistic appraisal of possible social ramifications and suggestions for management alternatives and possible mitigation measures," (Delaney 2007, 18). As a methodology, SIA developed across various environmental and development milieu through interactions among researchers, managers, and local groups. In the United States, the SIA methodology has been in use as part of fisheries management for more than a decade.

It is important to involve all sub-groupings of fishers during the recovery process and address the social impacts of a recovery plan. The National Environmental Policy Act (NEPA) requires federal agencies to consider the impacts of major federal actions on the human environment by using an interdisciplinary approach. The Council on Environmental Quality (CEQ) has defined "human environment" expansively to "include the natural and physical environment and the relationship of people with that environment" [40 CFR 1508.14] (Wakefield, Agnew and Mees 2007). Within fisheries management, when looking at stock recovery plans and social impact mechanisms, it is important that the distribution of new fishing opportunities is equitable among all stakeholders. This is key when assessing the social impact of alternative recovery plans to ensure marginal groups have an equitable distribution of the benefits (Wakefield Agnew, and Mees 2007; Delaney 2007).

Furthermore, fisheries management plans drafted by the Councils and approved by NOAA require the inclusion of community impact information on social and economic impact of participants in the fishery and communities (P.L. 109-479, Sec. 303 (9)(A); P.L. 109-479, Sec. 303 (9)(B)) as well as profiles of the fishery (P.L. 109-479, Sec. 303 (13)). While attention to social science in fisheries management has grown over four decades, the availability of data represents perhaps one of the greatest barriers to wider incorporation of social and cultural indicators and bears implications in fisheries management plans and policies. In response to the FCMA, social and cultural impacts are taken into account along with environmental and economic impacts for stock management and recovery plans. Consequently, a NOAA-wide methodology has been devised and there are standards for judging impacts in an equitable and scientific manner. The methodology is based in important ways on the existence of a set of Fishing Community Profiles that have been created by NMFS and provide baseline data for SIAs. In some instances, SIA provides a mechanism to evaluate the different facets of a fishery and approach the policy alternatives and trade-offs. Knowing that some hold the view that in European fisheries management, cultural impacts trump scientific advice, social impact assessments address this concern by including scientific observation of culture and society in decision-making. This approach fits with the European Commission's commitment (2001) to undertake impact assessments of all legislative based proposals (Delaney 2007) and likely parallels discussions in the United States.

I.B. Mind the data gap: Incorporating sociocultural indicators in fisheries management

I.B.1. Barriers to interdisciplinary science

Interdisciplinary research has become best practice in addressing environmental problems—or at least in the rhetoric surrounding such endeavors. Interdisciplinarity and ecosystem-based management link by recognizing humans as integrated within the ecosystem as opposed to separate, outside extractors (Grumbine 1993). In order to achieve this reconceptualization of humans as part of the natural environment, greater understanding of social and cultural values as well as the political motivations and differences in power should inform policies. According to Christie (2011) social science is overlooked, but can contribute to ocean policy in the following ways: (1) definition of the policy challenge, (2) documentation of environmental change, (3) identification of appropriate interventions, and (4) evaluation of policy effectiveness. Nonetheless, in research projects that explicitly aim to be interdisciplinary—incorporating

teams of biologists, ecologists, economists, and other social scientists—social science expertise can be viewed as a "requirement," or incorporated late in the project's development, undermining the potential of contributions of results (Sievanen, Campbell, and Leslie 2012). The incorporation of social science and the inclusion of researchers in NMFS efforts and fishery management plans often happens after the designation and selection of alternatives, which limits the ability of social science to inform policy decisions (Feeney 2012). Earlier inclusion of social science emerges as a top suggestion for improving management, and frankly a solution simpler in nature than others.

Literature on natural resource policy and ecosystem-based management suggests that the role of social scientists within government regulatory agencies and independent research teams is often misunderstood, unclear, or overly broad (Roughley and Salt 2005; Sievanen, Campbell, and Leslie 2012). In an examination of social scientist positions within Australian natural resource management agencies, Roughley and Salt (2005) find myriad expectations of social scientists working within these agencies. The responsibilities of the government-employed social scientists included undertaking research as well as spearheading multidisciplinary integration within the department and engaging, educating and even "placating" the public and communities (Roughley and Salt 2005). In a review of various interdisciplinary projects, 80% of scientists wanted a social science colleague who could produce social and economic information that would translate into human behavior change (Sievanen, Campbell, and Leslie 2012). Moreover, 70% of those interviewed did not differentiate between those scholars working to gather and produce such information and those who guided behavior change through public education (Sievanen, Campbell, and Leslie 2012). The belief that social scientists can convert the opinions and values of local stakeholders is mistaken, however prevalent in natural resource management (Roughley and Salt 2005; Campbell 2012).

Often relegated to late in the process, or disregarded and discarded altogether, social science advice in fisheries management lacks the prestige endowed upon the disciplines of biology, ecology, and economics. "When it comes to social science, everyone's an expert," represents a sentiment common among research teams and a significant barrier to wider incorporation of social science expertise (Roughley and Salt 2005). Furthermore, the compartmentalization of disciplines within research teams compromises the implementation of ecosystem-based management and research (Sievanen, Campbell, and Leslie 2012). Sievanen, Campbell, and Leslie (2012) also find that while natural scientist discredit the rigor of social science disciplines, seldom are they willing to review such sections in reports or findings. Interviewing those associated with the New England Regional Fishery Management Council, Feeney (2012) finds that decision makers, overwhelmed by the documents associated with the biological integrity of the managed stocks, will disregard the sociocultural sections of impact reports due to lack of time. New England Council members then in turn rely on statements made during public hearings or conversations with their industry contacts to inform their management decisions (Feeney 2012). Much of the unfiltered, raw data of public meetings and hearings prove difficult for managers to digest without adequate social science expertise (Sharp and Lach 2003). As a consequence, the human dimension of fisheries policy and management is viewed as anecdotal (Sharp and Lach 2003; Feeney 2012), lacking the objectivity endowed upon 'ideal' scientific inquiry.

When sociocultural aspects of fisheries management are viewed as anecdotal, it feeds into the diminished prestige granted the social science disciplines. In addition to power differentials among natural and social science researchers (Sievanen, Campbell, and Leslie 2012), resources impact the contributions of social science. Discrepancies in budget for social science versus natural and physical science on academic research projects and within agencies undermines data gathering, appropriateness of methodology, and level of prestige granted to social scientists as part of interdisciplinary teams (Christie 2011). Christie (2011, 182) is explicit on this point of resources, "Paucity of ocean social science highlights the immediate need for rebalancing. High quality, comparative social science requires significant funding commensurate with the scale of the issues identified in order to be successful." While public comment and conversations with stakeholders during coffee breaks are important points of contact for policymakers, the unfiltered nature and 'skewed' sampling put policy decisions at risk. Access to meetings—geographic proximity and personal means to attend—contributes to the representativeness of natural resource management and stakeholder engagement (Halvorsen 2003; Sharp and Lach 2003). In summary, there seems to be a misalignment of what social science is and how it contributes to natural resource management with the input of stakeholders and public comment. While social science methodologies will allow managers to analyze and synthesize the opinions of stakeholders and draw out clusters or groups sharing similar values as compared to others, social science also goes beyond such activities.

Today, in the European Union, there is some understanding of the importance of social science data for policy and decision-making, though the difficulty of obtaining data and translating it to a salient format (for managers) remains. There is also an obligation for the European Commission to assess the potential economic, social, and environmental consequences of any new initiatives (EC 2005). Impact Assessment is seen as a logical methodology, which allows the European Commission to meet these goals. SIA is seen as a process, which provides data for political decision-makers on the advantages and disadvantages of possible policy options through the assessment of their potential impact (EC 2005). It should be noted that SIA in this context is a "high-level" approach, across the EU member state level. For example, a recent Impact Assessment undertaken by Directorate General for Maritime Affairs and Fisheries (DG MARE) concerns a proposal to use a framework for marine spatial planning and integrated coastal management in the EU (SWD 2013, 65). The work being done thus, is often not at the individual management plan level (e.g. a fisheries management plan), but rather, at the higher level of EU Directives. The European Commission (EC) adopted Integrated Impact Assessment (IIA) in 2003 with the aim of replacing and integrating all sectoral assessments of direct and indirect impacts of proposed measures into one integrated system (TEP and CEPS 2010, 3). Researchers have found, however, though a framework for IIA exists in almost all member states, there is a considerable gap between the systems and the processes that exist and the extent to which they are implemented in practice (TEP and CEPS 2010, 4).

With the importance of understanding social impacts in mind, the EU (Department of Employment, Social Affairs, and Inclusion) contracted a study on mapping the extent to which

EU member states conduct *ex ante*[1] social impact assessments at the national and regional levels (TEP and CEP 2010). The primary goal of the study was to discover how to make better informed and more evidence-based political decisions. The report evaluated the extent to which the 27 EU member states integrated SIA into wider Impact Assessment processes and the rationale behind inclusion of social dimensions (TEP 2010). In another section of the report, the EU appraised in which fashion social impacts were measured and taken into account in such assessments (TEP 2010).

I.B.1.a. Qualitative methods in a quantitatively oriented paradigm

Disciplinary bias and skepticism toward the rigor of social science centers on employment of qualitative methods and the case study methodology (Flyvbjerg 2004). Of course, social science encompasses quantitative methods as well. Quantification and mathematics enable the researcher to "explain how they know something," through transparent, replicable, and consistent means (Wilson 2004, 18). Qualitative research also aims for transparent methods and arguments, but the key feature being the resistance to reductionism or the loss of context (Wilson 2004; Flyvbjerg 2004). Aiming to retain the nuance of the context or the case, narrative forms or qualitative analysis reject the idea of global comparison through measurable units and structure (Flyvbjerg 2004; Wilson 2004). Furthermore, qualitative methods often operate through induction, or moving from observation to pattern identification and sometimes theory development, but the confirmation of universal theories is not always the explicit aim (Wilson 2004, Flyvbjerg 2004). The tendency toward quantitative methods is connected to those looking for insight into the aggregate of individual behavior, whereas such methods are ill suited for understanding institutions or how social and political processes operate (Wilson 2004). Regardless of qualitative or quantitative methods in research, "The goal remains the ability to describe in a transparent fashion how the researcher knows what he or she claims to know," (Wilson 2004, 18).

Many academics underscore the importance of matching question to suitable methodology and those familiar with the philosophy of science recognize that how a researcher views 'truth' and his/her epistemological considerations will also influence the types of questions, methods, and conclusions (Campbell 2012). Nonetheless, focusing on the Council management and decision making process, a number of accounts seem to reject the use of information in narrative form arguing that only when social and cultural information matches the dominant quantitative paradigm is it of use (Gilden 2005; Pollnac, et al. 2006; Feeney 2012). Addressing the criticism that social science is not useful to management, Maiolo (2007) cites examples where research helped to inform advisory panel selections to be more representative and differentiate perceptions. The author suggests that mixed methods often help to assess different dimensions of human-environment interactions (Maiolo 2007). Pressing back on the "bias towards quantitative or modeled results," Christie (2011, 181) argues that qualitative data supplement the statistical findings providing context for understanding complexity. In addition, Flyvbjerg emphasizes, "In my interpretation, good social science is opposed to an either/or and stands for

[1] *Ex ante* indicates that these SIAs are meant to forecast results in contrast to *ex post* formats, which use the empirical data after a policy intervention to measure impact. SIA are expected to take place *ex ante* in order to inform policy decisions so that they can minimize potential impacts, yet in the fisheries in the EU, for example, these almost exclusively take place *ex post*, or in process, as descriptions of what happened or is happening.

a both/and on the question of qualitative versus quantitative methods. Good social science is problem-driven and not methodology-driven," (Flyvbjerg 2004, 432). Finally, there are two diverging interests in social science advice in natural resource management, one seeking expansion and innovation of methods (Maiolo 2007; Ingles and Sepez 2007; Pollnac et al. 2006) and the other emphasizing standardization of techniques for straightforward replication (Pollnac, et al. 2006; Ingles and Sepez 2007).

I.B.1.b. Can't beat 'em? Join 'em! Movement toward quantitative methods within NOAA Social Science Branch

Both Feeney (2012) and Gilden (2005), in their respective reviews of the New England Fishery Management and Pacific Fishery Management Councils' adoption of sociocultural indicators in fisheries management note the criticism that qualitative, narrative findings do not translate well into policy. Pollnac, et al. (2006) open with this criticism and base their conclusions on a survey published in 2003. However, in reviewing the cited article, there seems to be little evidence to support the conclusion that qualitative methods cannot be incorporated, but rather the authors' conclusion is more general, "This study suggests that the analytical frameworks and resources to collect, interpret, or integrate such information in decision-making processes are lacking," (Sharp and Lach 2003, 14). Speaking about the paper by Sharp and Lach (2003), Pollnac, et al. (2006, 1) assert, "The authors concluded that it is unlikely that community information can be used in fishery plan development or amendment processes when it is presented in a qualitative, descriptive format." This is a precarious conclusion to draw and exceeds the conclusions reached by Sharp and Lach (2003). We zero-in on this point not to up-end the work of others, but to prevent the grand dismissal of an entire segment of social science.

The dominant research paradigm of natural scientists—present a hypothesis, test it through a treatment and control group design, and evaluate the findings—does not always translate to social science inquiry, especially in instances where baseline data is lacking and where there is great complexity in the system (Christie 2011). Nonetheless, Pollnac, et al. (2006) have directed their efforts toward translating qualitative data into Likert scales to gain large datasets, with survey questions that can be asked in different places and at different times for comparative value, or pre- and post-intervention evaluations. The researchers seek to develop a sociocultural research model "more compatible with the approaches taken by fisheries biologists and economists when assessing potential effects of management actions," and continue, "Fishery Management Council (FMC) members might see social impact assessments as more useful if those assessments were provided in a format analogous to fisheries economists' and fisheries biologists' formats," (Pollnac et al. 2006, 1). In what some have referred to as the "Pollnac model" (Gilden 2005), NMFS has pushed forward with this strategy in the SIA Conceptual Model Project (Pollnac et al. 2006; Abbott-Jamieson and Clay 2010).

Quantification of what was once qualitative data is indeed a practice of many modeling exercises and has the advantage that it generates a concrete number to substantiate a policy decision (Wilson 2004). However, we can call into question whether these qualitative data can indeed be quantified and wonder whether the problems of how to measure such phenomena are resolved (Porter 1995; Wilson 2004). Furthermore, those qualitative results that translate well into standardized, quantitative form shroud those results that are not as easily

encapsulated by numbers and statistical measures (Porter 1995; Wilson 2004). Context and the value of narrative represent key themes in social science literature. We can see the tension in the following two quotations:

> Social quantification means studying people in classes, abstracting away their individuality. This is not unambiguously evil, though of late it has been much criticized, (Porter 1995, 77).

> As for predictive theory, universals and scienticism, the study of human affairs is thus at an eternal beginning. In essence, we have only specific cases and context-dependent knowledge, (Flyvbjerg 2004, 422).

First, Porter indicates that there has been some resistance to the aggregation of traits and behaviors. This criticism is perhaps rooted in the concern of predictive social science based on Flyvbjerg's sentiment. The 'problem' of prediction plagues SIA and the social scientist engaging in policy processes. Some SIA scholars have little concern about the place of prediction in social science and see SIA as a means "to understand processes of social change, to predict how they will play out in real-world settings, and to manage and respond to the sources and consequences of change towards explicit—and often hotly contested—goals," (Howitt 2011, 78). So, there is a tension within the social science academe, where efforts to quantify and predict conflict with the interest in preserving the particularity of the case.

Nonetheless, Flyvbjerg (2004) understands that to be dogmatic about case study methodology and narrative results is as problematic as holding only to quantitative research designs, where the question should inform the method. Here, we recognize Christie's point that without funding commensurate with the research agenda, we risk undermining the appropriate method for the questions of natural resource management when we overemphasize budget savings and researcher efficiency. However, the data gathering challenge to address the mission of NOAA social science, National Standard 8, and other mandates causes one to pause and consider if these researchers are just being pragmatic. Returning to the theme of transparent research design, or the researcher's ability to 'prove' what she knows, she knows with ease, "Unlike narrative data, numbers can be easily summarized and compared, and tables and graphs are often easier for managers to digest. In addition, managers and the general public generally understand methods for analyzing quantitative values better than those for analyzing qualitative information," (Gilden 2005, ES-1). Nonetheless, this statement follows with the caveat that informing managers about the collection methods, forms of analysis, and utility of such narrative data will improve the impact of social science in natural resource decision-making (Gilden 2005).

Social science data in EU fisheries policy

Challenges for fisheries management and planned data collection also occur in contexts outside the United States. In parallel with the development of the new EU Common Fisheries Policy (CFP) and the European Maritime and Fisheries Fund (EMFF), the European Commission is currently preparing a proposal for a new EU Multi-Annual Program for data collection for the period 2014-2020. Articles 37 and 38 of the CFP reform proposal set out the broad obligations

for Member States to collect biological, technical, environmental and socioeconomic data and to cooperate regionally. As of early 2013, relevant scientists of the Scientific, Technical, and Economic Committee for Fisheries (STECF), an advisory body to the European Commission, were reviewing the possibility of the inclusion of social indicators.

The European Commission produces national-scale economic statistics of European fisheries on an annual basis (EC 2006a), detailing sectoral value and employment, for example. Under the Data Collection Regulation, detailed fleet economic data—costs, earnings, employment, vessel statistics and fishing effort—is also gathered by Member States. These data were collected annually from 2007. No systematic attempt is made to collect social information on fisheries at the European scale. In the current economic climate, discussions of the "cost-benefit" serve as one of the drivers in discussions on new indicators.

Despite this data shortfall, the European Commission has stated that, "Analyses of the economic and social effects of significant changes in fisheries management are obviously desirable before management changes are made," (EC 2006b). Along these lines, the working group of the STECF Sub-group for Economic Affairs (SGECA) was asked to produce a combined biological, social and economic analysis of the Commission's proposal for a plaice and sole long-term management plan. However, due to the marked absence of relevant and accessible data relating in particular to social aspects, it was not possible to draw firm conclusions regarding the social implications of the proposal (STECF 2006). The STECF Plenary group also concluded that there were significant problems in regard to the technical integration of the three analyses. Much methodological and data-gathering work remains to be done before effective integrated impact analysis can be conducted with regard to Commission proposals. With the shortcomings of the STECF assessment in mind, the development of systems for the organization and use of socioeconomic data in fisheries is desirable; the flatfish social assessment made a start by detailing the data requirements that would be needed to underpin a social impact assessment process (STECF 2006, 74-76). Around the same time, the North Sea Regional Advisory Council (NSRAC) agreed on a protocol for the consideration of socioeconomic implications for all its advice and recommendations (personal communication, NSRAC member) and established a Socio-Economic Development Group to conduct further work on socioeconomic issues. This group played a key role in the development of the socioeconomic dataframe being tested in this project (Hatchard et al. 2006). And the NSRAC's Demersal Working Group is developing long-term management strategies to enable the sustainability—economic and social as well as biological—of key commercial fisheries (Delaney 2007). More recently, a number of fisheries researchers (personal communication) have discussed working again on social indicators, using Frangoudes's (2012) comprehensive review and the earlier Dataframe (Hatchard et. al. 2006) as starting points. Frangoudes's review is useful as it provides a thorough discussion of possible social and governance indicators for both individuals and communities. Meanwhile, Hatchard et al. emphasize a methodology for rapid assessment and data collection from available resources.

I.B.2. Challenges in defining and operationalizing *community*, *fisheries dependence*, and *social sustainability*

While we have dipped into the philosophy of science and contemplated method and its relationship to policy, we now consider what social science in fisheries management tries to clarify and what lies behind the social and cultural dimensions of fisheries management. When dealing with impact from a particular policy or management intervention, the question of who feels the impact is not straightforward. Often we talk about "community" as the entity of impact, but how community is defined will influence the outcome of analysis. As aforementioned, the FCMA defines fishing communities as being "substantially dependent on or substantially engaged in the harvest or processing of fishery resources to meet social and economic needs," (P.L. 94-265 § Sec. 3. 104-297). However, there are contending interpretations of what constitutes dependence and community in relation to fishing from both the American legal perspective and from the anthropological and sociological perspective in applied research (Clay and Olson 2007; Clay and Olson 2008; Jacob et al. 2001). Breaking apart the three constituents of *fisheries dependent community*, there are nuances in meaning for each of these three, independent of their combined meaning.

Fishing

Fishing, or fisheries, appears as the most straightforward, but apart from the actual act of pulling fish out of the sea, fisheries related activities can range from processing and on-shore support businesses and in some cases include tourism. While the inclusion of tourism may seem suspect, some fishermen who viewed their community as fisheries dependent included such businesses (Clay and Olson 2001 in Clay and Olson 2008) and furthermore, some scholarship has expanded the conception of fishing activities to include those with aesthetic and cultural connections to the industry (Brookfield, Gray, and Hatchard 2005). Additionally, people fish for different reasons—commercial, recreational, or subsistence—and creating regimes that accommodate these different users can be challenging. Occupational data often comprise the indicators for participation in the fishery, but census data can be problematic as some fishermen designate as self-employed and other categorizations combine fisheries with other natural resource sectors (Poole and Sepez 2007). Furthermore, the pluriactive or seasonal economy is a composition of persons with a number of jobs or changing employment throughout the year, which is often poorly measured or accounted for in census statistics.

Community

Before taking up the concept of *dependence*, contemplation of the various definitions of *community* is important. National Standard 8 employs a place-based definition of community. The merits of such designation have been debated (Olson 2005; Macinko 2007) and some suggest that section 303(a)(9) and 303(b)(6) allow for the description of impacts on those who identify as ethnic, gear-oriented, or other so-called virtual communities[2] (Clay and Olson 2008). It should be said though that place and the impact of rationalized fisheries management is one of definite concern, a topic raised in a subsequent section of this report. Notwithstanding, those

[2] Virtual communities are also known as communities of interest, where groups of persons with a shared affiliation or occupational identity constitute a community as opposed to a designation through place or geography.

doing research on the social and cultural dimensions of fisheries need not only apply the place-based definition. Those operating outside the federal agencies are free from such mandates. The difficulty of delineating community and its membership persist. For example, using population numbers from the U.S. Census may also contribute to incomplete pictures as the population count does not differentiate between transient inhabitants and those of longer residence (Poole and Sepez 2007). In summary, community is not a simple entity easily defined, but rather challenges social scientists to be more precise in their delineation.

Dependence

In turn, we come to the discussion of what constitutes dependence. Defining a community's or region's dependence on the fishing industry poses challenges:

> At almost any scale the notion of 'fisheries dependence' will seem a contradiction in terms. Attempts to measure the regional significance of fishing related activities will tend to yield low and potentially unconvincing results and such measurements are often complicated by the fact that in many areas fishing is embedded in a strongly pluriactive local economy. There are few regions in Europe—outside Iceland, the Faeroes and north Norway—where fishing activities account for a significant share of employment or Gross Regional Product (GRP). (Symes 2000, 4)

Phillipson (2000, 23) helps move beyond the dependent-or-not dichotomy and argues for understanding of the "nature or form of dependence," to inform policy interventions. Raakjær Nielsen, Vedsmand, and Friis (2000, 47) caution against treating coastal communities as monoliths because, "They differ in terms of the resource situation, the pattern of specialization and the industrial dynamics; each has a different development potential." While it is important to remain mindful of the permutations of fishing community, Alaskan coastal communities are often considered isolated and resource dependent (Clay and Olson 2008) and likely parallel the communities on the North Atlantic fringe to which Symes refers. Nevertheless, the economic might of the port of Dutch Harbor-Unalaska stands in contrast to indigenous communities in western Alaska. Relatedly, some of Alaska's coastal communities are defined by seasonal influxes of workers, whereas those communities with indigenous populations experience steadier intra-year population cycles (Poole and Sepez 2007).

Presently, there is an effort to operationalize indicators and indices of fishing reliance and engagement, as well as gentrification pressure in coastal communities on the East Coast (Colburn and Jepson 2012). This research tries to understand pressures on fishing communities attributed to wider trends in American society and connect fishing related data from sources like the decadal census and NMFS landings. Additionally, cluster analysis identifying groups of communities with similar attributes seeks to address the question of which communities are relevant for the task of SIA (Smith et al. 2010). In this regard, this effort seeks to develop a means of prioritizing communities to be studied more thoroughly and stand as archetypes in the climate of constrained resources (Smith et al. 2010). While these empirical endeavors do not explicitly concern the definition of fisheries dependence, they orbit the topic as they try to

develop indicators and means of classification in order to predict or postulate impacts for a certain type of coastal community.

The resilience-vulnerability dialogue frames the discussion of fisheries dependence (Clay and Olson 2008; Jacob et al. 2013). It remains unclear whether there is a paradox between fisheries dependence and resilience. If a community's lack of economic diversification hinders its ability to resist shocks to the fisheries system either due to ecological disturbance or management changes, then the drive to determine dependence and the resulting policy decisions to offset impacts may perpetuate vulnerability. For example, if a community is economically dependent on fisheries without many other opportunities, the mindset to mitigate harmful impacts is quite valid. We can also question how fisheries manifest themselves in community and individual identity and whether particular segments of the population will be unduly burdened by management decisions. Here lies a challenge for SIA practitioners and management: how does SIA resist the propensity to maintain patterns or protect communities with the designation of 'highly dependent' and the insistence that there will be adverse impacts to such communities that have few alternatives? Perhaps the investment in community institutions and livelihood alternatives with the revenues generated from fisheries provide the means of dismantling this paradox. In Alaska, the CDQ program has tried to do such a thing and use fisheries and rationalized management as a means of community development (Criddle 2012).

Additionally, dependence can manifest itself in physical attributes of the community (Clay and Olson 2007). Trying to address a research dilemma in definition of fisheries dependence, Jacob, Jepson, and Farmer (2005) draw upon *aspect dominance*. A term from forest ecology, aspect dominance refers to categorization of an area based on the plant that rises highest or is spotted most readily (Jacob, Jepson, and Farmer 2005). Using a metaphor when we call an area a "field of daisies" we are likely using the visually (or aspect) dominant species in our nomenclature, where other categories of dominance would propel us to name the field another way (Jacob, Jepson, and Farmer 2005). Jacob, Jepson, and Farmer (2005) argue that while residents in six coastal communities thought that where they lived relied economically on fishing, in actuality these places were far less reliant on the industry. The authors use the aspect dominance metaphor to help explain why people's perceptions did not align with actual economic dependence.

The work by Jacob, Jepson, and Farmer stands in contrast to other discussions of dependence. The authors take a strong stance on the implications of definitions of dependence that come closer to aspect dominance:

> In order to make dominance congruent with the idea of dependence, researchers have done a number of interesting contortions. Very often researchers will construct definitions to find "Fishing dependence" by disaggregation to sub-community (niche environment) level to find fishing dependence, which essentially becomes a sub-sample of the community. In short, if researchers restrict "community" to an area where fishers are concentrated, they can show economic dependence. Of course this is a very curious definition of community, where fishers are gerrymandered into areas that do not meet any reasonable

> definition of community, such as a place where one could meet most of their daily needs. Another dubious use of community is to define the occupation of fishing as a "community" or even fishers who pursue a specific species as a "community." Obviously, these are not acceptable social science uses of the concept of community (Jacob, Jepson, and Farmer 2005).

Nevertheless, Clay and Olson (2008) see that cultural significance of the "heritage narrative" can serve as the basis for dependence and furthermore is a valid component of establishing designation as a "fishing community" under the FCMA. What feels unresolved in aspect dominance is that if fishing, representing the daisies in the field, were to wither away how would these "fields" or communities be differentiated from places of more banal flora? This interest in why people hold to the identity of fishing is worth pursuing. Clay and Olson (2008, 147) beckon to Nadel-Klein's (1991) work, "While cultural constructions of fishing communities and vulnerability may or may not require fisheries dependence *per se*, such identities are 'political ways of framing social variety.'" Whereas fishing may not be the sole or main economic driver but rather aspect dominant in a community, Clay and Olson (2007) underscore the importance of ethnography in further understanding this dimension of the community. Returning to the skepticism toward exclusively quantitative methods, the authors note that the unique aspects of communities can be lost when only described with numbers (Clay and Olson 2007). Carothers (2008) suggests an orientation toward "community-based lifestyle fishing" as opposed to the rational, economic conception of fishing, where lifestyle and kinship represent important motivations for remaining in a fishing community.

Social Sustainability

While parsing out the meaning of *fisheries dependent communities* is key in the U.S. research context, in Europe the phrase of concern is *social sustainability*. *Social sustainability*, like sustainability itself is a term with no clearly agreed upon definition, and as such, context is of major importance. We should remember that sustainability is supported by a tripod with the three legs of environmental, economic, and social sustainability; if one leg is weakened, the entire structure may fall. There are three on-going discussions in relation to this: (1) maintenance of social, economic and ecological aspects; (2) intergenerational equity; and (3) the intertwined nature of social, economic and ecological components in rural systems (Pepperdine and Ewing 2001). There has been acknowledgement that there are gaps in understanding social dimensions. These gaps have been attributed to a lack of theoretical development of the concept *social sustainability*, as well as to a lack of detailed studies. There has been a push for formulation of indicators, but there are limitations given the agreed-upon limitation of the local-context (Pepperdine and Ewing 2001).

It is noted that sustainability is always about sustaining or maintaining *something* and to understand the concept you need first identify the focus of concern. McKenzie (2004) points out that common models for describing social sustainability in relation to economics and ecology usually treat these other two dimensions as a means to further the concept. And so, for example, social sustainability has often been approached as an add-on or as a useful tool to implement changes in relation to the other spheres. The difficulty then is that the development of definitions and measurements is usually vis-à-vis the two other areas. Another difficulty is that,

social issues have been difficult to quantify. Given that indicators in the other areas have primarily been developed with an emphasis on quantitative measures, social issues have been neglected when their data tends to be more qualitative in nature (McKenzie 2004).

There are similar struggles and issues surrounding community, social sustainability, and fisheries dependence in Europe. In 2009, the question was raised "Whatever became of social objectives in fisheries policy?" in *Fisheries Research* (Symes and Phillipson 2009). In the article, the authors argue that social concerns have all-but-disappeared in the industrialized world; in this world, national growth is believed to take its place whereby benefits are expected to trickle down (Symes and Phillipson 2009). The article, focusing on the EU and UK, expressed a concern with the viability of coastal communities and presented a message that social issues should inform fisheries policies. Yet the governance shift in Europe, where fisheries policies moved from national jurisdiction to wider EU policymaking, has translated into social objectives falling within the gaps in this multi-level governance framework (Symes and Phillipson 2009). Moreover, at the EU level social objectives in fisheries land between sectoral and regional development responsibilities and subsequently are seldom taken up by either entity (Symes and Phillipson 2009). Parallel to the struggles in U.S. federal fishery management, a primary threat to communities stems from the failure of governing bodies to develop clear, transparent social objectives at an early stage in the policy process. Not only is there the risk that social objective-related decisions will be less carefully thought-through and clear, but they are also likely to be taken at the end of the process in the heat of political debate. Consequently, decisions concerning social objectives will be made by politicians in the midst of political debate, rather than through informed decisions by policymakers (Symes and Phillipson 2009).

I.C. Engaging social science in economic analysis

Multiple dimensions of sustainability in fisheries

Before venturing into the community impacts and other social and cultural dimensions, it is probably good to pause and assess why we care about the social dimension in fisheries. Perhaps some are not so convinced of the necessity to address the social or cultural change attributed to fisheries management decisions. Moreover, some may be convinced that if fishermen are financially compensated when leaving the fishery and have done so because of free market mechanisms, then there is little more to discuss. It is important to remember that management is about choices. Larkin (1977, 10) recognized such trade-offs and how a fishery was managed was a matter of values and political philosophies, which may differ among individuals, "My personal preference is for a technocentric approach, with the fish first, the economics second, and the social problems a distant third—something we must resolve, and quickly, with sympathy and good sense." Thus, while the renowned biologist put social "a distant third," he legitimated such concerns and argued for required attention. The multi-objective fishery framework of sustainability emerged where the institutional or governance dimension was included in addition to community and social concerns, economic criteria, and ecological measures (Charles 1998). The role of (natural and social) science is to inform said choices, as confirmed in National Standard 2.

After biology, economics represents the dominant discipline in fisheries management. Attributed largely to the work of H. Scott Gordon (1954) and Milner B. Schaefer (1957), versions of the bioeconomic model of the fishery prevail in management today. In an effort to maximize the potential economic rent of the fishery, Gordon and Schaefer propose management at Maximum Economic Yield (MEY) and to achieve this goal implement limitations on the (human) effort in the fishery. On a larger scale, the ocean enclosure movement, designating sovereignty and sovereign rights and delimiting areas of the ocean, enabled nation states to determine who could fish in their EEZs. Thus with the passage of the FCMA in 1976, which created the then-called Fishery Conservation Zone, the U.S. could determine who was eligible to fish within the 200 nautical miles off its shores.

Forms and evolution of Limited Entry

Limited entry systems such as license limitation, tax incentives, and quota shares opened the set of tools available to managers to limit the number of participants in the fishery (Ginter and Rettig 1978). In the beginning, license limitation stood as the main prescription to the 'problem' of excess effort and policies began to restrict the access to fish to a select group of fishermen through fees, lotteries, and license retirement ratios. However, license limitations proved an imprecise mechanism to manage the genuine level of effort in the fishery, rather than the number of boats on the water, due to what is termed "capital stuffing," (also known as "effort creep"), where fishermen expand effort capacity by increasing technical aspects or physical means of fishing like vessel size, horsepower, etc. (Copes 1986). In turn, fisheries economists advocated rationalized management, better known today as catch share programs where segments of the fishing fleet are assigned a portion of the total allowable catch (TAC) and in most instances are allowed to trade or sell these shares.

The idea to control effort sprung out of interest in a fishery where fishing could be proscribed to those without an access privilege, or sometimes referred to as a right. License limitation schemes and taxes or fees on access to fish or fish landed represent input controls, where management is trying to address the level of effort put *into* the fishery. Fees and taxation are often rejected as potential management solutions because they are politically unpalatable (Crutchfield 1979; Copes 1986). Essentially, a healthy fishery with demonstrated profits or rents will encourage more entrants to the fishery under an open access setting zeroing out the economic gains. Thus, while limited entry may be promoted under conservation concerns, largely it is a solution to "The dilution of [fishermen's] earnings that might be caused, by either more fishermen or fewer fish than before, or by some combination of these two in the absence of compensating prices increases," (Ginter and Rettig 1978, 161). Consequently, the fishery became an entity to be managed with economic as well as conservation goals in mind.

Limited entry was represented as an expansion of the traditional management toolkit first in that it determined *who* was and was not allowed to fish. With the emergence of TACs, an output control mechanism was born, where what came *out* of the fishery was monitored and managed (Copes 1986). Nevertheless, the presence of a TAC alone without individually assigned catch shares encourages a derby or Olympic fishery where fishermen compete to get the greatest amount of fish possible before the fishery closes. Safety issues and idle capital are two central concerns of such system and thus pre-assigned catch in the form of individual quotas was

proposed (Copes 1986). Finally, the issue of transferability came into the discussion of catch share management, where proponents argued that without such mechanism to sell or trade fishing quota the system would not maximize economic gains (Crutchfield 1979). Nonetheless, the "transitional gains trap" occurs when the initial allocation of transferable quota is given to a single generation or group of fishermen, the economic gains of the fishery are lost on subsequent generations as they must buy into the fishery, which was previously free entry to previous generations and with quota holders having a tradable commodity (Copes 1986). Subsequent generations thus do not accumulate the same wealth as the initial group gifted the quota shares who often take to leasing quota to as high as 80% of the catch value (Copes and Charles 2004; Olson 2011).

Rationalization, privatization, and property

There is much discussion by fisheries economists of "rights-based" fishing and the assertion that quota shares operate as a property right (Arnasson 2000). Under the FCMA, however, Individual Fishing Quotas (IFQs), Individual Transferable Quotas (ITQs), and other transferable catch shares are considered limited access privileges (LAP), which have key legal differences. LAP programs under FCMA are considered permits and explicitly not considered a right with no guarantee of compensation (P.L. 109-479 Sec. 303A(b)).[3] Cole and Grossman (2002) argue that there are significant discrepancies in the definition of "rights" between the fields of law and economics and argue that this linguistic confusion creates problems for economic and legal analyses. Thus, there is a difference between what is *private* and what is a *right* as explained, "While ITQs do privatize fisheries in the sense of turning fishery *access* rights into privately owned marketable assets, the fish itself remains a public resource, and generally ITQs give no individual property rights at all to any specified fish or specified part the of the ecosystem," (Copes and Charles 2004, 174). Rather than referring to programs as rights-based, share-based or quota-based better capture the essence of ITQs and other privatization forms (Bromley 2006). Furthermore, Copes (1986, 288-289) cautions that proponents of individual quotas overemphasize the position of property rights within the management system, whereas "What really counts in rationalizing the fisheries is not what property rights have been installed, but what externalities remain or are newly created by the particular form of partial property rights introduced." Here, a space emerges for other social science disciplines to engage with economics, to both clarify the language and definitions put forth, but to also understand the various motivations of human behavior that are not accommodated in markets.

Scholarship on property regimes has also pushed back on initial conceptions of fisheries and other common-pool resources as being only open access. There has been confusion between open access or *res nullius*, where no property rights exist and access is free to all versus communal or common property where a select community or defined group of users share a resource, but access is restrained from outsiders (Feeny et al 1990; Bromley 1992). Moreover, with the recognition of the EEZ, fisheries resources within 200 nautical miles of the coast are state property, where the United States can determine access and how it will share the wealth of this resource. In addition, the fisheries economics literature mistakenly correlates ecological

[3] For a full explanation of the nuance between rights, privileges, and liberties and clarification of definitional discrepancies in economics and law, see Cole and Grossman (2002) or Macinko and Bromley (2004).

outcomes with presence of property right and imprecisely concludes that private property elicits stewardship (Costello et al. 2008), which is not necessarily the case.

I.C.1. Efficiency, productivity, and distributional effects

National Standard 5 promotes efficiency, but contends, "No such measure shall have economic allocation as its sole purpose" (P.L. 109-479 Sec. 301(a)(5)). This strikes at the difference between allocation and distribution. The former refers to the aggregate GDP and the benefits to the society at large, whereas the latter relates to the sites of economic activity and their geographic location. Small peripheral communities lose their comparative advantage of geography when rationalized since boats do not need to be positioned as closely to resource in a situation of pre-assigned catch. Moreover, the concentration of fishing effort results in landings going to larger ports where vertically integrated fishing operations have on-shore processors and distribution facilities (Copes and Charles 2004). Many economists emphasize the efficiency gains[4] and additional profits of limiting access and rationalizing management, recognizing the gains at the national aggregate level, but diminishing the regional or local loss of employment and revenue streams (Cunningham 1994). Within the discussion of the multiple facets of sustainability, a startling lack of attention is paid to what fishers will do when participation in the fishery moves from open access to a rationalized catch shares system, especially in coastal communities where there are few employment alternatives (Charles 1998).

While advocating rationalized approach to fishery management, Crutchfield (1979, 751) recognized a key distinction, "Any system to reduce excess capacity in a marine fishery will be suboptimal in a formal economic sense." Here, the author is confirming the accounting of utility (understood as personal preferences and valuation) or more specifically being Pareto Efficient. Part of welfare economics, Pareto Efficient refers to the point where we cannot make anyone better off without making anyone else worse off. A Pareto Improvement is when we (or the market or the state) can indeed improve the position of one person without diminishing the utility of anyone else. Thus, Crutchfield (1979, 751) continues, "Those leaving the fishery could conceivably be fully compensated for any loss of real income (and, if it could be defined, a cash payment to compensate for noneconomic satisfactions derived from participation) while leaving sufficient gross income to provide opportunity returns or better to the owners of all inputs remaining in the fishery." Just as Larkin referenced the need for swift accommodation of those leaving the fishery in terms of occupational retraining and personal financial viability, Crutchfield echoes the valuation of the oft-termed, intangible benefits of fishing. Sometimes such valuations come through revealed preferences (also referred to as implicit non-market valuation) or when a decision making body opts for a particular alternative that would cost a set amount of money because it prefers a specific aspect or probable outcome of said choice. The problem arises when relative productivity and relative efficiency are treated synonymously, whereas efficiency should include the preferences or utility functions of those involved (Saraydar 1989).

[4] Efficiency, as understood by Pareto is actually used inaccurately here, but much of fisheries economics literature employs 'efficiency' as opposed to the correct term, 'productivity'. See Saraydar's (1989) "The Conflation of Productivity and Efficiency in Economics and Economic History," for a more thorough explanation.

Scale of impact is an interesting area to consider in consolidation or contraction of opportunities in the fishery. Oftentimes those advocates of rationalization are less concerned with local impact and more keenly aware of the gains to the national Gross Domestic Product (Carothers 2008). When it comes to mobility of labor, coastal communities and those reliant on fishing feel great impacts in what often becomes a local employment vacuum. Some may be concerned about stranded capital when fish landings move to large, more central ports, but "Capital is highly mobile, labor is not, and so labor gets stranded when capital pulls out," (Bromley 2006, 222). Consequently, the question of how to address these effects of freely tradable quotas requires deliberation on design, which is likely improved by social science investigation and insight.

I.C.2. Implications of rationalized fisheries management for communities and the public
Over the past thirty years, fisheries management has gravitated toward catch share programs such as ITQ systems, which drastically consolidate the fleet, diminish opportunities in the fishery, and encourage vertical integration (Pálsson and Helgason 1995; McCay 1995; Macinko 1997; Olson 2011). Nonetheless, even when rationalized fisheries management was just beginning, Copes (1986) outlined common pitfalls of such programs and advocated an attention to the specific characteristics of the fishery managed. Measures establishing property rules and rights in order to ensure that all vital economic relations and transactions follow the rule of the market often fail to address the attributes and implications of structured and prevailing systems of social inequity, economic exploitation, and power differentials (Ruddle and Davies 2013). Iceland, arguably the ultimate example in rationalized fisheries, witnessed a decline in its small coastal communities as quota owners accumulated wealth and left their communities (Eythórsson 2000). Nonetheless, the introduction of ITQs was not the only driver of change in Iceland in the 1990s, where processing at sea led to further contraction of landside seafood processing plants and employment (Eythórsson 2000). The globalizing market for food products, including seafood, also drives change in the way fisheries operate and the access afforded to coastal communities by a widening international market (Eythórsson 2000; Brookfield, Gray, and Hatchard 2005).

Exacerbating the loss of jobs, attachment to fishing is deep and many in the industry embody a strong occupational identity (Kitner 2006; Olson 2006). Studies on job satisfaction and fisher wellbeing (Pollnac and Poggie 1988; Pollnac and Poggie 2006) predominate this literature. Operationalized differently than Pollnac's body of work, Kelty and Kelty (2011) relate self-identity and fisheries vitality to underscore the non-economic valuation of fishing. In addition to consolidation or constriction of opportunities in the fishery, ITQs also transform labor relations in the fishery, which has been a site of social science inquiry (Olson 2006; St. Martin 2007). While tallies of vessels, licenses, pounds landed, and ex-vessel price can be proxies of fishery success, the move from a share system for crew compensation to a set wage has implications that are often overlooked by management, which likely have an impact on the desirability of fishing and the resultant pool of appropriately skilled labor. Finally, McCay (1999) illustrates how the potential adoption of a transferable quota system was antithetical to the way in which an island community in Newfoundland viewed its relations to one another. Employing the concept of embeddedness, McCay (1999) explains her field observations and interviews where fishermen and those linked to the crab fishery do not follow the 'rational

actor' traits common in economic theory. In Aleut communities, limited entry likely quickened the rate of outmigration in communities of less than 500 persons (Reedy-Maschner 2008).

Alaska is perhaps one of the best examples of meeting, or trying to meet, social concerns within a rationalized fishery management system. The Community Development Quota program indeed tries to reinvest the wealth of fisheries into communities with limited access to quota and other economic opportunities. Criddle (2012) however studied the factors that influence on the resilience of four Alaskan fisheries governed by a system of durable entitlements (DE)[5] and demonstrated that DE programs are not the panacea. Such programs can contribute to biological sustainability, but cannot ensure it. Durable Entitlements can also lead to the disruption of existing social systems to the benefit of some individuals and communities but to the detriment of others.

I.C.3. Evaluation of the methodologies that help balance the role of economics

As this section has tried to demonstrate ideas from Economics permeate fisheries management with some positive and negative effects. The Gordon-Schaefer model stands as one example in fisheries economics, where economists try to model behavior and produce solutions within a set of parameters. This work can be useful, but often the less quantifiable aspects of fishing or those not easily operationalized in variables are missing in estimations, which limits their abilities to project reality. However, work can be done to place value on these less tangible aspects, as will be further discussed in the section of ecosystem goods and services.

Moreover, catch share management represents a suite of policy options and configurations. All too often catch shares are associated with a single form of management: the individual transferable quota. As demonstrated in the previous section, this form of management alters the social landscape in ways that may not be desirable. Altering or adjusting rationalized management may alleviate some of these problems, which likely would be informed by good social science research. Alternatively, if management decided to proceed with ITQs without community provisions, ownership caps, or other tools, there is still likely "something we must resolve, and quickly, with sympathy and good sense," (Larkin 1977, 10). Social science informs impact assessment, institutional design, and measures the desirability of alternatives within a multifaceted society. The following sections provide insight into approaches that integrate social science into ecological research and management.

II. Current approaches to ecological research integrating natural and social sciences

II.A. Social-ecological systems perspective and resilience theory.

While many examples of how fisheries social science informs management relate to impacts or anticipated change to the society, social science can also inform the institutional design of management. The line between political science and new institutional economics is often blurred or transcended by researchers in these fields, perhaps best exemplified by Elinor Ostrom. Theorists and those who work on notions of good governance contribute to

[5] Criddle (2012) lists as examples of durable entitlements limited entry permits, territorial user rights, transferable user rights, individual vessel quotas (IVQs), individual transferable quotas (IFQs) and other forms of rights.

management. Resilience is one of the most critical elements in the overall resource management issue, and along with vulnerability provides a bridge between the analysis of institutions and economies with the natural resources on which they ultimately depend (Adger, 2000).
A resilient system has the capacity to absorb disturbance and reorganize while undergoing change, so as to retain essentially the same function, structure, identity, and feedbacks (Walker et al. 2004; Janssen and Ostrom 2006). An adaptable system has the capacity to influence resilience without changing the dynamics of a system (Walker et al. 2004; Walker et al. 2006). However, if a system is highly adapted to a range of variability through specialized institutions it can be more vulnerable to new unknown changes (Nelson et al. 2007).

Social-ecological systems (SESs) are complex, integrated systems[6] and refer to any system from local to global level that is composed of a societal (or human) component and an ecological (or biophysical) component (Berkes 1989). The influence of humanity on biogeochemical, hydrological, and ecological processes requires an understanding that could strengthen the capacity of ecosystems to support social and economic development (Folke et al. 2004). Additionally, a SESs perspective is important if we are to understand what actions humans take that affect the ecological system and how that relates to how the society functions, who is most likely to suffer or benefit from changes in the ecological subsystem and how rigid or flexible various actions are (Gallopin 1994). A SES perspective in social sciences can provide data that help identify factors that would underpin robust SESs opposed to vulnerable SESs. It is necessary that we rely on developing a general theory based on well-supported principles from the natural and social sciences, in particular ecology, economics, and political science, and confront it through comparative analyses of many cases.

Resilience is a property that SESs possess (Walker et al., 2004), albeit the term was originally used to describe the capacity of an ecosystem to tolerate disturbance without collapsing into a qualitatively different state controlled by a different set of processes. Therefore according to Holling (1973), a resilient ecosystem can withstand shocks and rebuild itself when necessary. Resilience in SESs has the added capacity of humans to anticipate and plan for the future with the key distinction between the natural world and its human dimension being 'agency' which covers numerous aspects of human behavior including imagination, technological innovation, collective action, and anticipation (Davidson 2010). A resilience framework encompasses three interconnected aspects of a system and should be understood as one of three possible responses to disturbance along with adaptability and transformation. Therefore, resilience itself is not necessarily the preferred outcome as what is desirable or not within society is often contested.

Fisheries, an example of a resource-dependent system or SES, must deal with declining resources and increasing controls, in addition to facing socio-demographic disadvantages (Pauly et al. 1998; Robards and Greenberg 2007). The fish catching sector has learned to continuously adapt to changes such as fluctuations of the resource biomass, changes in operating costs and regulatory changes in order to remain profitable. Such adaptive strategies include: (1) transformability, where fishers shift to a different métier when ecological, economic, or social (including political) conditions make the existing system untenable (Walker et al.

[6] Taken from the Resilience Alliance glossary (http://www.resalliance.org/index.php/glossary).

2006), (2) diversification, which involves the broadening of alternatives, both within fishing and between fishing alternative livelihoods (McCay 1978), and (3) intensification, which refers to an increased commitment to an investment in one or another mode of resource procurement (McCay 1978). For example, there were times when solutions in the EU fisheries sector transformed social-ecological systems rather than helped them adapt to the current situation (Folke 2006). Decommissioning schemes and ITQs in Denmark have caused a shift in the capacity of fishing fleets (Hadjimichael 2010). In contrast, subsidies have been used to help communities adapt to new regulatory measures by acting as shock absorbers[7]. It is important to highlight however that the excessive use of subsidies by the EU distorted the economic landscape of fisheries without addressing the underlying issues such as the overcapacity of the sector (Robards and Greenberg 2007) often encouraging people to stay in a non-viable fishery.

Anderies et al. (2004) proposed a framework to study the way institutional arrangements affect the robustness and hence vulnerabilities of SESs by encouraging the investigation of all the links between the components of this framework. The framework was designed to be used by researchers with diverse disciplines as a method to analyze internal dynamics among four components of a SES; two human components: the resource and the resource users[8], public infrastructure providers and public infrastructure[9]. The resource users and the public infrastructure providers are two actors with 'different specialized tasks' leading to more complex SES (Janssen and Ostrom 2006). By studying the resilience of a resource-dependent SES, one can explore how the resource-users interact with the other three components of the system and how they react to a change that be an environmental problem i.e. stock collapse, change in the biology of the natural system, or a change in the management regime, etc. Hadjimichael et al. (under review) used the above framework to compare two fisheries SESs in the EU. The study verified the regional variability between different fishing communities in the links among the different entities in SESs, and shows there are different factors, which depend on regional sociocultural, political, and biological contexts influencing resilience.

Lebel et al. (2006) explored the association between attributes of governance and the ability to manage resilience in a set of diverse case studies. What they found was that in deciding what to do, diverse participation, open communication, and deliberation are important because they help build trust and shared understanding among diverse stakeholders needed to mobilize resources and people and to foster self-organization. In monitoring, using, and managing natural resource systems, the flexibility provided by polycentric and multilayered systems of governance can create opportunities for learning and decision making in places and scales that match social and ecological contexts much more closely than is possible in monolithic arrangements. Accountable authorities, who also pursue social justice by helping to secure the livelihoods of the most vulnerable groups, enhance the capacity of society to manage resilience.

McClanahan et al. (2009) after an analysis of progressive small-scale fisheries worldwide suggest a change in policy towards the management of small-scale fisheries that focuses on

[7] For example, fuel subsidies to fishers aim to assist fishers in times when fuel prices are too high.
[8] The resource is a form of natural capital transformed for use by resource users.
[9] The public infrastructure providers intervene to control its use through regulatory measures (public infrastructure).

facilitating socio-ecological processes rather than primarily promoting a high level of quantitative science and implementing findings, technological concepts, or tools. According to McClanahan et al. (2009) this policy change should (1) encourage professionalism (formation of "societies," setting standards, certification, self-policing, appropriate technology, etc.); (2) create forums where all opinions about solutions, the status of targeted species, and environmental requirements are represented; (3) promote social rules that consider the realities and limits of the households and local social economy; and (4) craft solutions tailored to the specific and agreed upon diagnoses.

A SESs perspective can help integrate social and ecological aspects of a system shifting the focus from solely the biological and economic aspects, which bioeconomic models focused upon. In contrast to attempting to control natural resources for stable or maximum production and short-term economic gain, a resilience approach assumes an uncertain and complex natural resource context and aims to achieve sustainable long-term delivery of environmental benefits linked to human well-being. By combining the insights gained through theory development and those derived from qualitative analysis of different case studies, the understanding of how social-ecological systems operate can be improved, with the possibility to extract generalities about the fundamental processes that structure the interactions between human societies and ecological systems[10] (Walker et al. 2006). The Resilience Alliance realizing the difficulties faced by managers in bringing forward such a focus have put together the Resilience Framework workbook which was designed to "assist in resolving specific resource issues and in developing and implementing management goals without compromising the resilience and integrity of the system as a whole," (Resilience Alliance 2010). Finally, given that the structure of SESs is controlled by dynamic processes, any interventions must allow the system to deal with ongoing change but also future disruptions. It is also important to acknowledge the needs and desires of the affected communities when considering ways to enhance their resilience or assist towards their adaption or transformation.

II.B. Ecosystem Goods and Services

II.B.1. Conceptualization of Ecosystem Goods and Services

Another way of looking at ecological management is to look at ecosystem management. One definition of ecosystem management is the application of an ecological science perspective to resource management to promote long-term sustainability of ecosystems and the delivery of essential ecosystem goods and services (Chapin et al. 2002). The key with this definition is the long-term sustainability of the production of goods and services. The benefits humans receive from the resources and processes supplied by the earth's ecosystems are termed by scientists as ecosystem goods and services (EGS). Ecosystem goods (foods, such as fish) and services (such as climate regulation) "represent the benefits human populations derive, directly or indirectly, from ecosystem functions" (Constanza et al. 1997, 253). EGS have been discussed and researched for decades, though it was Constanza et al. (1997) and the UN's Millennium Ecosystem Assessment (MA) (2005) which popularized, and later formalized, the definitions.

[10] The Resilience Network and its branch the Resilience Alliance (http://www.resalliance.org/) is a network bringing together scientists from different disciplines assessing ideas on resilience theory developed in previous work and take it further.

According to the MA, biodiversity is a critical, underlying component of ecological goods and services. These ecosystem goods and services were grouped into four broad categories: *provisioning* (e.g. food), *regulating* (e.g. climate control), *supporting* (e.g. crop pollination), and *cultural* (e.g., recreational benefits):

- Provisioning services are the "products obtained from ecosystems" (MA 2005, 40). Basically these are benefits to people that can be extracted directly from nature. Such services include food, drinking water, energy such as timber and natural gas, and plants, which can be used to make clothing such as hemp or cotton.

- Regulating services are the "benefits obtained from the regulation of ecosystem processes" (MA 2005, 40); these are the benefits humans obtain from ecosystem processes that moderate natural phenomena; these include crop pollination, waste decomposition, and even the soil held in place by tree roots.

- Supporting services are the services "that are necessary for the production of all ecosystem services" (MA 2005, 40); these are the processes without which ecosystems could not even be maintained. Examples including nutrient cycling, photosynthesis, and the creation of soils. Without supporting services, none of the other services would exist.

- Meanwhile, cultural services are the "nonmaterial benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences (MA 2005, 40). These can include cultural identity, recreation, and even the building of knowledge and spreading of ideas (http://www.nwf.org/Wildlife/Wildlife-Conservation/Ecosystem-Services.aspx).

As society has learned to acknowledge that EGS are limited, new methods are being developed to inform management decisions. One such method is the valuation of goods and services, especially the economic valuation, which is being used to help inform decision-makers on the cost of replacement of said goods and services.

Marine Ecosystems

Oceanic and coastal marine ecosystems provide a wide range of goods and services that are fundamental to continued human wellbeing. Heip et al. (2009) state, "These services are provided on both the global scale—including the production of oxygen, nutrient cycles, carbon capture through photosynthesis, and carbon sequestration via the biological pump—as well as on the regional scale, including the stabilization of coastlines, bioremediation of waste, and a variety of aesthetic and cultural uses."

In the marine realm, a conservative estimate of the total economic value of these ecosystem services indicates that it greatly exceeds—by at least two orders of magnitude—the value of the more familiar direct extraction of goods, such as fish and other marine species. Marine biodiversity underpins the functioning of marine ecosystems and their provision of services—

without biodiversity there would be no ecosystem services. "Maintaining biological diversity is crucial to maintaining ecosystem resilience and thus to the continued provision of ecosystem services," (Heip et al. 2009).

II.B.2. Valuation of Goods and Services

Very often, environmental goods and services are public goods, which are often harnessed by many without adversely affecting each other's interest. However, public goods can suffer from a "free-rider" problem, whereby users value the goods, but none has an incentive to pay to maintain them (Mishra n.d.). These goods and services may also be affected by externalities, or uncompensated side effects of human actions. Market mechanisms cannot regulate the consumption, production and allocation of public goods. Collective action for their upkeep is possible, but incurs considerable public cost (Mishra n.d.). Consequently, the valuation of such goods and services may help natural resource managers to deal with the effects of market failures, by measuring their social and opportunity costs. The costs to society can then be imposed, in various ways, on those who are responsible, or can be used to evaluate and regulate environmental impacts.

A variety of valuation methodologies have been developed to assess the social, economic and biological importance of biodiversity and ecosystem goods and services, particularly through biological valuation, quantification and economic valuation of the different goods and services, and socio-cultural valuation. The current scientific approach to the valuing of nature and the environment is based largely on two papers published in *Nature* by Costanza et al. (1997) and Costanza (1999).

Biological Valuation

The biological valuation methodology integrates all available biological information on an area into one indicator of intrinsic value of marine biodiversity, without reference to its anthropogenic use (Coastal Wiki n.d.). Biological value is not a direct measure of ecosystem health. Areas considered as having high biological value are often considered to be valuable providers of socio-economic goods and services, however, and are important in terms of environmental health. The primary difference lies in that biological valuation focuses on the features of species and communities themselves, and not on the contamination or the extractable/usable part of the ecosystem (Coastal Wiki n.d.)

Economic Valuation

One method of economic valuation is Contingent Valuation Method (CVM). CVM is an economic, non-market based valuation method used to infer individual's preferences for public goods, especially environmental quality (Heip et.al 2009). CVM uses questionnaires and asks consumers directly for their maximum willingness to pay (WTP) for specified improvements in environmental quality, including, for example, protection of marine biodiversity. CVM circumvents the absence of markets for public goods by presenting consumers with a survey market in which they have the opportunity to buy the good in question, such as the protection of marine biodiversity. Since the elicited WTP values are contingent upon the market described to the respondents, this approach is called contingent valuation method (Heip et. al 2009)

Cultural Valuation
Sociocultural valuation seeks to elicit stakeholder 'emic' (insider) perspectives and values of biodiversity. The goals of cultural valuation studies are to discover what, for example, aspects of marine biodiversity are important to people, to whom it is important, and how much and why. Approaches are developed which would elicit what aspects of biodiversity actually mattered locally. Such preferences can be crucial for developing effective strategies for the conservation of biodiversity through their inclusion in the decision-making process.

Of the three methods, Economic Valuation is the most developed and widely used. Cultural Valuation studies, though few in all ecosystems, are especially few in the marine environment. Cultural valuation is particularly difficult as it involves a mixed methods approach and the quantification of qualitative data.

II.C. Local ecological/fisheries knowledge
Local Ecological Knowledge (LEK) is a term used which includes the practical skills and wisdom developed at a local scale through earning livelihoods from the environment, over successive generations (Berkes 1999). Some use the term LEK instead of the similar, *Traditional Ecological Knowledge* (TEK) as the skills and knowledge were developed over time in traditional lifeways by traditional (i.e. indigenous) peoples. To some, however, TEK carries a slightly negative connotation through the "t" in traditional, which gives the impression of something historic, never-changing, and sometimes "backward." Others use the two terms interchangeably. *Fisheries Ecological Knowledge* (FEK) is also used to refer to the skills and wisdom of those who gain their livelihoods in aquatic, rather than terrestrial, environments.

The earliest TEK/LEK studies were undertaken by anthropologists. As with the term "sustainability" there is no agreement on a single definition. Studies of TEK/LEK begin with species identifications and classifications (i.e. ethnobiology) and proceed to people's understandings of ecological processes and their relationship with the environment (i.e. Human Ecology). TEK should be viewed as different levels in a practice and belief system, which includes local, empirical knowledge of animals, plants, and landscape (Berkes 2008). It also includes information on species identification and taxonomy, life histories, distributions, and behavior, which is nested within resource management systems, tools, and techniques. In turn, these are embedded within the social institutions, codes and norms required to implement management systems, and a worldview that shapes environmental perception (Berkes 2008). LEK should be viewed as a process, or a *way of life*, a way of knowing, not simply "knowledge" (Berkes 2008).

TEK/LEK is useful in a management context because often the breadth and depth of what locals know is often greater than scientific knowledge. Furthermore, TEK can contribute to place-based, fine-scale spatial and temporal information, management techniques, and institutions (Butler 2012). Western science and management knowledge (SMK), on the other hand, "provides understanding of contemporary large-scale ecological processes historically not encountered by TEK (Moller et al. 2004, Aitkenhead and Ogawa 2007)" (Butler 2012). Consequently, given the complementary nature of TEK and SMK, the integration of the two can potentially enhance the resilience of socio-ecological systems (SES) by providing a diversity of

knowledge and data for problem solving (Butler et al. 2012; Folke, et al. 2004; Berkes 2009), though integration, is not easy to achieve.

A great deal of research has been conducted, investigating just how to achieve the integration of LEK into natural resource management (e.g., Aswani and Hamilton 2004; DeWalt 1994, Johannes 2001). In addition to depth of knowledge, LEK can provide insights into changes in ecosystems, which are often unavailable (Garcia-Quijano 2007); SMK biologists often lack time series data that they require and the incorporation of LEK is a solution.

Some successful examples of integration can be seen around the world in as disparate locations such as Alaska and Australia. In Alaska, after the Exxon *Valdez* oil spill (USFG n.d.) federal and state agencies recognized that the Native communities had knowledge of the population sizes and ranges of many of the species injured in the spill (USFG n.d.). Combining TEK with SMK was believed to have increased the success of restoration efforts after the spill. Also in Alaska, LEK provided by Native groups was used in making the management decision to list the polar bear (*Ursus maritimus*) as a threatened species (USFG n.d.). Though the integration of the two knowledge types, as shown by these examples, has been successful, there has been little work done to explicitly explain the factors vital for the success in integrating the two. Two notable exceptions can be seen in Melanesia and the Pacific where it has been suggested (e.g. Johannes 2000 and Johannes 1998b, 2002) that it takes a catalyst for knowledge integration to take place, such as, in these cases through declining fish stocks, the lack of government capacity to respond to these declines, and community ownership of marine resources based on recognized sea tenure (Butler et al.).

One part of TEK/LEK, as stated previously, is not simply facts of individual species, but is also the nesting of the knowledge within resource management systems, tools, and techniques. Thus, TEK/LEK is accepted for the traditional management processes and fora, which are often now incorporated into co-management. In some successful contemporary management situations, co-management has developed, allowing community fishers to share power with government agencies. Doing so also fosters communication, social networking, and conflict resolution (Wilson et al. 2006; Pomeroy 2007; Kuperan et. al. 2008; Pinkerton 2009).

Integrating LEK with SMK has not only methodological problems, such as translating the languages the two "speak" (Huntington 2000) but is also impacted by power differentials between holders of the two forms of knowledge, which affects interactions (Agrawal 1995; Blaikie et al. 1997). These power differentials can prevent successful interactions even when they are willing to cooperate (Garcia-Quijano 2007).

In fisheries management, TEK can complement SMK by providing long-term baselines for stock assessments, local knowledge of species' ecology and behavior, habitat conditions and trends, as well as customary management systems (Butler 2012). In some areas of the world, the integration is further enhanced through local co-management arrangements. However, it is often understood that it must be a true co-management situation, one where power is shared with government agencies and where proper conditions exist for conflict resolution, communication, and social networking (Wilson et al. 2006, Pinkerton 2009; Butler 2012). Power-

sharing is especially important because tensions can emerge on account of the tendency of science to test, validate, and hence subjugate TEK, while Indigenous groups show reciprocal mistrust of SMK (Berkes 2008; Butler 2012). This tension is often exacerbated by varying communication styles and asymmetrical power relations among stakeholders (Wilson et al. 2006; Pinkerton 2009).

III. Cases

Now we turn our attention to three cases studies that exemplify some of the ideas discussed in the previous literature review. The case studies reviewed in section III were selected because of their contextual relevance with natural resource management in Alaska.

III.A. Fisheries management in Chile

III.A.1. Co-management as a way to improve socio-ecological sustainability

Restricting access to areas of seabed to achieve sustainable exploitation is a central component of the Chilean 1991 Fisheries and Aquaculture Law[11] (FAL), Nº 18.892 (Decreto 430, approved in September 1991). This regulation for restricted access was put in place at a time where limited access to fisheries was rarely part of national policy and arose due to the social and economic importance of the artisanal fisheries in coastal waters (Castilla and Defeo 2001). The FAL redefines artisanal fishers and incorporates new regulations that affect their user rights through three management steps. First, exclusive fishing rights within a zone that extends to five nautical miles from the shoreline are assigned to artisanal fishers. Second, the law establishes a National Register for artisanal fishers and vessels, by region along the country, aiming to build a continuous register of users and fleets and to control fishing pressure. Third, the FAL assigns exclusive diving rights to certain areas of the seabed to registered artisanal fishing unions, under what have been termed management and exploitation areas for benthic resources (Gelcich et al. 2005).

The strict specifications and definition of artisanal fishers, which include gear and vessels that artisanal fishers are allowed to use, represent an important part of the 1991 Chilean FAL. Additionally, artisanal fishers are restricted to operate within the coastal area of the syndicate they are registered in *caletas*[12]. Within the designated 5-mile artisanal fishing zone, the following measures can be decreed: establishment of closed fishing seasons and/or marine reserves; establishment of the regime known as Management and Exploitation Areas for Benthic Resources[13] (MEABRs), for legally constituted artisanal fisher organizations. The MEABR is a Territorial User Rights in Fisheries (TURFs) system. MEABR was developed as a solution for the fishery crisis of *Concholepas concholepas*, a hard bottom snail as a result of the fisheries open access policy between 1976 and 1981. The success of the MEABR led to its widespread application across different fisheries resources and social-ecological contexts (Aburto and Stotz 2012). Even though MEABRs is one of the main management tools used for the protection of the

[11] Ley de pesca y acuicultura, 1991

[12] For administrative purposes Chile is divided into 12 regions and each region has several syndicates known as caletas. Small scale artisanal fishermen are restricted to operate within the coastal area of the caleta where they are registered.

[13] Áreas de Manejo y Explotación de Recursos Bentónicos (AMERB)

marine resources in the new FAL law in Chile, their success depends upon the extent to which fishers are willing to participate and comply with these systems. Under MEABRs, fishers of a community are allocated fishing rights with which they are allowed to fish in designated geographical areas, sometimes even at specific times.

Chile's MEABR has emerged as a case of collaborative management, designed to "Constitute a fitting instrument for the conservation and rational utilization of benthic resources and the collaboration of fishers' organizations in fisheries administration," as stated in the official legislation on MEARBs [14]. The system operates by offering organizations of artisanal shellfishers exclusive access to shellfish found within tracts of seafloor close to their ports, on the condition that they take primary responsibility, under government supervision, for managing the harvest of these species. To benefit from public programs, such as the MEABR system, fishers have to establish and enlist unions or cooperatives. To be granted a MEABR, Chilean artisanal fisher organizations must develop, with the technical assistance, 5-year management plans, which must be approved by the undersecretary of fisheries (Marin et al. 2012). Fishers are also responsible for surveillance and enforcement of anti-poaching measures (Meltzoff et al. 2002). Management responsibility is delegated to organizations of artisanal shellfishers on the condition that they team with professionally trained marine biologists (Schumann 2007). The sharing of management responsibilities between state and resource users means that Chile's Management Area system meets the criteria of co-management. Co-management holds prospects in ensuring viable fisheries communities and viable fish stocks, as it allows for the integration of the community as effective agents of collective action, and even more so if the system is supported by community resource rights (Jentoft 2000). Co-management can lead to a reduction in resource conflicts and better implementation and better management of the resource as fishers and other resource stakeholders are more involved in the management of the resources and access rights are distributed more effectively and equitably (Pomeroy 1995).

III.A.2. Understanding the reasons of its success and realizing subtle problems

With a particular reference to Chile, history demonstrates that the implementation of co-management strategies together with an allocation of user-rights have been necessary for benthic invertebrate management (Castilla et al. 2006). A survey of participating fishers in Chile's Fourth and Fifth regions examined four social benefits predicted to result from this type of co-management: (1) improved rapport between fishers and the state, (2) greater awareness among fishers of ecology and the benefits of management, (3) cooperation between fishers and scientists, and (4) unity between fishers with the principal benefit being fishers' newfound "consciousness" of the value of management—within the context of co-management and territorial use rights (Schumann 2007). The role of fishers' organizations in co-management is of great importance as asserting the legitimacy of co-management regulations is depended on the legitimacy of these organizations (Schumann 2007).

However, as a "one size fits all" policy (Gelcich et al., 2006), TURFs in Chile had unintended consequences for small-scale artisanal fishers and their families for example in some cases

[14] Reglamento sobre Areas de Manejo y Explotacion de Recursos Bentonicos. No. 355. Diario Oficial de la República de Chile, August 26, 1995.

where *caletas* with existing complex webs of traditional institutions were successfully operating in terms of equity and resilience (Gelcich et al., 2006). In these cases, the effects of superimposing a government-sponsored co-management policy on this traditional system weakened these traditional institutions, which had negative effects on the levels of trust within the community and intensified conflict among users. Additionally, the "one size fits all" system can also have biological implications if the biology of the species dynamics is not taken into account. The management system's adaptive capacity was reduced, thereby jeopardizing the ecosystem's resilience. An example of this arose with the surf clam *Mesodesma donacium*, which has a highly variable population (Aburto and Stotz 2012). Traditionally, Chilean fishers followed the sporadically appearing *M. donacium* beds, migrating along the coast, a behavior now suppressed under the MEABR regime which confines fishers within a certain geographical area. Consequently, the *M. donacium* fishery collapsed within the MEARB because of lack of recruitment and high natural mortality.

Issues such as food security and nutrition can also be affected with "one size fits all" policies especially in communities where there is the issue of physical access to food besides financial access to food (Hadjimichael 2006). Hadjimichael (2006) examined how the changes in a territorial user rights management policy of a benthic resource directly affected the diet of artisanal fishers and their families in central Chile and found that the changes differed significantly between fishers in urban and rural communities due to a number of factors with the most important factor being the alternate food resource available. Rural fishers replaced shellfish in their diet with finfish due to their isolation from a readily available alternative choice of food, while urban fishers replaced shellfish with cheaper sources of protein such as chicken purchased from supermarkets. Shellfish were excluded from fishers' diets and those of their families in both rural and urban areas as shellfish had become the main source of income. This shift was not a matter of choice for fishers and none of the fishers interviewed in the specific study preferred their current diet compared to their diet either 20 or 30 years ago.

TURFs have gained attention as a tool for rights-based fisheries management implying a series of rights, among them are the right of exclusion, the right to determine intensity and type of use, the right to extract benefits, and the right to future returns (Christy, 1992). What has been highlighted is that TURFs can improve the welfare of small-scale fishing communities due to a more economically efficient use of the resources (Christy, 1992). At the same time in order to minimize any potential adverse impacts to the communities, the implementation of a TURFs system poses the challenge to carefully study the existing social-ecological system, in order to not replace it, but to integrate it with modern fishery policies (Aswani, 2005). While territorial user-rights management polices such as the one studied here are widely regarded as among the most effective approaches to achieving Ecosystem-Based Fishery Management, such management approaches can still have wide-reaching and perhaps unforeseen effects on human well-being. It is important to keep in mind therefore that a shift to co-management must be able to adapt allowing for legal adjustments that will be able to accommodate traditionally managed ecosystems that offer benefits comparable to those mandated under the formal policy. If there is insufficient information on the ways in which the systems function, then not only will the formulation of policy responses designed to countermand undesirable social or economic effects be difficult, but the implications for other aspects of the social development process—such as

gender relations, urban-rural linkages, and in this case nutrition—will also be imperfectly understood (Drakakis-Smith, 1991).

III.B. Critical dilemmas in Greenlandic Halibut fisheries management

Greenland, with an Arctic environment, and predominately Inuit people, combined with its colonial and Western-influenced resource management system, provides a useful, comparative case for Alaska. The current governmental institutions in Greenland are a product of its colonial past. Separation from Denmark and the inception of Home Rule began in 1979. When the post-colonial social class took over from Denmark, the pre-existing institutions, which lacked decentralization and democracy and local, self-management (Winther 2003) were maintained. Due to the lack of significant stakeholder opportunities for involvement, the Greenland government has difficulties in implementing policy and maintaining legitimacy (Janussen 2003). In terms of fisheries management and governance, there are unequal power relations between the coastal and offshore fleet segments.

Greenland Home Rule withdrew from the European Union in 1985 explicitly in order to manage its own fisheries, a vital resource for its economy. Fisheries and subsistence activities are not only important for local subsistence, they also make up 83% of Greenland's export value (Greenland Statistics 2010). The Fishing Act (1996) mandates that the Home Rule government has the exclusive right to make all fisheries-related decisions. Consequently, individuals who own processing industries and reside in Nuuk dictate Fishery policy, as they are the primary Home Rule government actors. The government must also consult the Fishery Council on all matters that are central to Greenlandic fishery policy, such as TACs (total allowable catches), fishing rights, and conservation measures (Jacobsen and Raakjær 2012). The Fishery Council comprises all organizations representing commercial fishers and hunters, and fishing companies. The Council also has observers from Greenlandic Ministries as well as interested organizations such as the Association of Greenlandic Municipalities.

Ever since the beginning of its independence process, Greenland has found itself in the middle of a push to profit from industries—both old and new—to finance its push to gain full economic independence from Denmark. During this time, the majority of social science research has increasingly focused on local livelihoods and the mixed subsistence economy as important for human wellbeing in the Arctic. More recently, a concern for the sustainability of fisheries stocks have led the government to institute new management regulations with the goal of conserving stocks and maximizing profits.

With the recent (2012) introduction of the Greenland Halibut management plan (presented below), Greenland Self Rule puts its trust in ITQs as the best means to restructure the fishery in a way that would best benefit the overall society. In economic terms, it focuses on formal, taxable economy as a goal and market mechanisms as the means. To understand this choice, it is important to understand the context of the Greenlandic economy: since 1979 Greenland has gradually been taking over its own political decision-making from Denmark. The running of its modern welfare state has had Greenland depend on transfers from the Danish state. Since the establishment of Home Rule through the Self Rule of today, Greenland continues to struggle to

pay the expenses of a modern welfare state. Greenland also struggles to gain economic, and hence 'real' independence from Denmark. So, while fisheries management regimes across the world may have a tendency to aim for general national growth, the incentives for doing so by Greenlandic politicians and public administrators may be particularly strong.

III.B.1. Social Impact Assessment of the Greenland Halibut Management Plan

The case study presented here stems from a section of a three-year research project on power and participation in Greenlandic fisheries governance, which also included a social impact assessment of a new fishery management plan. The management plan introduced ITQs into a fishery that previously had operated on an Olympic basis (free fishing by all until the TAC was exhausted). More than 1000 fishing licenses had been granted to 'small entities' such as dog sledges, dinghies, and snow mobiles, along with cutters to catch Greenland halibut. Consequently, the fishery reflects a variety of participants and interests. The two primary goals of the management plan were to secure biological sustainability of the stock and increase the profitability of the fishing fleet by reducing the number of participants (Medlem af Naalakkersuisut for Fiskeri, Fangst og Landbrug 2011).

The research included semi-structured interviews as well observing the management process at work in order to understand the views at play. While conducting fieldwork, researchers we were aware of other cases around the world where ITQs had been introduced and the dilemmas that an ITQ system may present (Bromley 2008; Pauly 2008; Macinko and Bromley 2004; Pálsson and Helgason 2000). We were particularly focused on the possible impacts such a structural change (introduction of ITQs) would mean for the communities. The communities in Northwest Greenland that engage in the halibut fishery have few alternatives for monetary income. Furthermore, recent prominent social science studies have documented the importance of the mixed cash/hunting economy and the cultural meaning of fishing and harvesting activities. Consequently, the SIA was proposed and undertaken in Upernavik, one of three regions in the halibut fishery.

The preliminary SIA (Delaney, Jacobsen, and Hendriken 2012) was based on interviews from fieldwork in 2011, as well as with interviews conducted by another team member from previous visits in the village of Upernavik and surrounding settlements. Statistics collected and analyzed in connection with another project on the sustainability of Greenlandic settlements also played a major part of the analysis together with a general literature review. The analysis highlighted many of the perspectives that shape the discussions of 'social sustainability' in the Arctic context: the continuance of local livelihoods and communities, including specific emphasis on the importance of the fishery for the working of the mixed cash/subsistence/informal economy. It was also concerned with principles of equity and local participation in decision-making. The study presented a number of likely positive and negative impacts on the individual and the community level. Among the potential impacts: some small-scale fishers will lose a supplementary, yet vital, source of cash income needed for their mixed economy. This income also enables fishers to pay the municipality back for social transfer payments (Delaney, Jacobsen, and Hendriksen 2012).

The new management plan also does not institute area restrictions, which (potentially) places Upernavik dinghy fishers at a disadvantage with southern fishers who are free to come north in

the summer to fish the Upernavik quota. The plan also calls for the closure of the fishery for new entrants, meaning that younger men coming into the fishery will have to wait to be able to fish independently, or not fish at all, with no foreseeable means of other employment. The plan potentially sets up inequity between two groups of boats. The government states explicitly in their management proposal that large boats will be guaranteed a minimum quota and that large boats do not risk losing quota to other fishers in case of illness, technical problems or the like. In comparison, small-scale fishers are not given the same guarantees.

The study concludes that the plan may have far-reaching impacts at the community level. Upernavik is a northern district with a limited amount of alternative livelihood opportunities: if the young men cannot fish, what will they do to earn a livelihood? The only suggestion proposed by the government is the possibility of working in the new industries such as mines, but these options are neither available now, nor are they necessarily desired or healthy (Delaney, Jacobsen, and Hendriksen 2012). The SIA was presented to the ministry charged with instituting the new Greenland Halibut Management Plan, but it had no direct influences on the decision-making process. Thus, it stands as an example of social science having difficulty influencing policy-making. It is difficult to assess the exact reasons for why a study like this did not have an impact, but as the introduction in this report summarizes, this is a theme discussed in the literature.

III.B.2. Review of definitions and measurements of social sustainability in the Arctic context

Yet, in the Arctic and in Greenland, social science has long been engaged in discussions of social sustainability and affiliated concepts. At the level of conceptual developments, one of the most encompassing endeavors has probably been the Arctic Human Development Report (2004) and the subsequent development of Arctic Social Indicators (2010), initiatives undertaken by the Arctic Council.

The mission of the Arctic Human Development Report was to explore livelihood and welfare throughout the Arctic and identify issues relevant to the Arctic next to those identified by the Human Development Index of the United Nations. The method was a literature review of existing social scientific knowledge about the Arctic communities and as such, the results can also be said to reflect the prevalent research foci of the social scientific community. A range of Arctic issues was identified and these evolved around control of destiny, cultural continuity, and a close relationship to nature and land. The report provides a synthesis of existing knowledge to assess the current state within a wide range of spheres including demography, culture, economy, political systems, legal systems, resource governance, community viability, human health and wellbeing, education, gender issues and circumpolar international relations and geopolitics.

As a follow-up project to the Arctic Human Development report, the Arctic Social Indicators Project (2010) discussed a range of 'arctic social indicators' and their potential for developing to measuring Arctic wellbeing over time for policy purposes. Another encompassing conceptual project, which was also implemented, was the 'Survey of Living Conditions in the Arctic: Inuit, Saami and the Indigenous Peoples of Chukotka'. This project set out to develop a new research design to measure living conditions and individual wellbeing relevant to Inuit, Saami and other indigenous peoples. The initiative came from Statistics Greenland under Greenland Self Rule,

deeming that new measurements of living conditions designed specifically to the Arctic region were needed.

A 1997 survey of living conditions based on the Scandinavian model had presented dilemmas that were difficult to explain in conventional wellbeing terms: why do many people choose to remain in their communities despite poor housing conditions and a low (material) standard of living? Conventional economic indices were provided insufficient explanation. Based on consultation with indigenous groups and researchers from a variety of disciplines and under an indigenous steering group, alternative indicators were developed around the role of household production, mixed cash-local harvest economy, family relationships, spirituality, social adjustment and support and ethnic identity. The survey was conducted in Canada (2001), Alaska (2002-2003), Greenland (2004-2006) and Chukotka (2004-2006). The survey concluded that productive activities, the presence of production opportunities (i.e. fish and game, jobs) and a sense of local control are associated with satisfaction with life as a whole (Poppel et al. 2007). Whereas SLICA does not operate directly with the concept of social sustainability, the concepts it developed dovetails with other discussions of social sustainability in the Arctic under the aforementioned Arctic Council programs on the social aspects of sustainable developments—such as the importance of faith control and connection to land.

The continuation in itself of local livelihoods has received particular attention in discussions of social sustainability in the Arctic and in Greenland in particular. Nuttall (2002) has for example been concerned with the continuation of local livelihoods and cultures claiming that the viability of Arctic coastal communities depends on the long-term sustainability of local livelihoods and economies based on the resources of the sea. Threats to the continuation of these livelihoods and economies are identified as:

- restructuring of fisheries, including a shift from local to international enterprises and the redistribution of wealth from traditional actors to more powerful global players;
- overfishing, national subsidies to the fishing industry;
- restrictions on market sale of sea mammals internationally;
- changing community dynamics as a fishery to a lesser extent than hunting depends upon and reproduces relations based on kinship;
- inserting ITQs due to concentration of power and wealth, enclosure of commons and exclusion of women;
- negative climate change effect on fish stocks; and
- persistent organic pollutants in the Arctic sea.

The topic of local livelihoods has also received attention by Rasmussen (1999) who takes a point of departure in the Arctic Settlement pattern and its development characterized by a shift from self-sufficiency to increased dependence on other regions and where a seemingly paradox exists in the fact that a decentralized settlement structure persists in spite of centralization policies. Rasmussen has argued for a practical approach to the concept of social sustainability that is not for deep academic scrutinizing but for structuring discussions and securing that important dimensions in the development process are taken into consideration. Rasmussen identifies such dimensions of social sustainability as being defined in the context of five conflicts in

Greenlandic planning: 1) centralization versus decentralization—the most prominent conflict, 2) small versus large scale production, 3) whether to look towards renewable or non-renewable resources for development, 4) monopoly versus market economy, and 5) self-reliance versus dependency. Rasmussen argues that defining the concept of social sustainability is a continuous process and the key is to develop ways of measuring it. But in Greenland, he argues, there is no need to start from scratch as there is a development process to build on, "There is an income structure and therefore also a formal economy which is very dependent either on transfers or single sources which makes it vulnerable. But there is also a strong informal sector which is stabilizing the development process i.e. reducing vulnerability and there is a strong subsistence sector which reduces vulnerability further" (Rasmussen 1999, 227). Thus, Rasmussen is particularly concerned with how to enhance stability. As positive factors he identifies the subsistence economy, a robust settlement structure and a continuation of local communities. As threats he identifies campaigns against traditional survival methods of sealing and whale hunting together with dependency on economic social transfers. In relation to Greenlandic marine resource management, Sejersen (2003) has linked social sustainability to the inclusion of local perspectives and local knowledge and to fairness in distribution of access rights.

In this context, the question of whether to sustain villages, small-scale fisheries and hunting can hardly be a scientific or technical question. When the Greenland Halibut SIA was unsuccessful in drawing attention to possible social impacts it may have been because it had a point of departure in one of two discourses that are, to a large extent, defined against each other. In the discourse of the SIA, the smaller scale fishery was something that needed to be maintained to sustain local livelihoods. In the discourse of the management plan and other important processes of Greenlandic fishery reform (see the Fishery Commission 2009) those local livelihoods based on the fishery were seen as a poverty trap. This controversy dives directly into core debates about how to perceive 'good development'. To some extent, this disagreement may echo the differing emphasis between the economic and social-scientific disciplines described elsewhere.

III.C. Observations and reflections from STECF and Framework 7 research projects

There is both an appreciation for social science data and its incorporation into management, as well as misunderstandings, in the European Union. In general, there is a growing acknowledgment of the need for social science data. For example, a recent chairman of the Scientific, Technical, and Economic Committee for Fisheries (STECF), a scientific advisory committee to the European Commission, was actively encouraging of the inclusion of a (non-economic) social scientist on their Committee. There are difficulties with understanding, however, as well as in the form data takes.

Some biological scientists (e.g. VECTORS) view the social science data as merely something that could potentially validate their own, key findings. Others, though fewer than a decade ago, view qualitative social science data as merely "anecdotal." Others do not even realize that social sciences are sciences, using the scientific method of hypothesis testing. Additionally, in attempts to incorporate the different stakeholders into research projects (e.g. MYFISH), natural scientists do not always appreciate the need for inclusion of the different sub-groups of fishers or other stakeholders but rather assume that stakeholders with a real stake in the issue will find

a way to take part in a project. Additionally, though some are interested in combining data, the disparate forms data take often make the task difficult. This was a major issue for the long-term plaice and sole management plan (STECF 2006). Biologists and economists, after two full days in meetings, still could not come up with parameters to enable combining their data. This mismatch of form of data is the greatest hurdle to the incorporation of social science data with natural science data.

Christie (2011) recommends a complete reconceptualization of environmental problems and solutions in order to enable more pluralistic forms of research to guide coastal and marine policies. Such reconceptualization necessarily includes paying equal attention to both social and ecological aspects. "For ethical, theoretical and practical reasons, the human dimension should not be reduced to mainly economic calculations of, albeit important, ecosystem services or quantified general principles" (Campbell et al. 2009). Just as robust ecological research must span natural history, population dynamics and genetics, social research should include attempts to understand the social context over time, the management process, institutional design principles, human adaptation and social impacts of policy (Campbell et al. 2009; Jones 2009; Christie 2011). Much of what is suggested is not new, but rather Ginter and Rettig (1978, 170) forwarded the need for anthropologists, "to identify samples of fishermen and study them over their life spans," and for sociologists to better understand the impact of regulation on society and communities.

IV. Synthesis: literature, cases, and implications for management of fisheries in Alaska

IV.A. Discussion and key conclusions

This paper has delved into current literature and combined the experiences of the authors to provide the NPRB with a review of the integration of social sciences in natural resource management. Relevant methodologies on the collection and integration of different types of data have been presented, along with the challenges faced. The case studies reviewed in section III were selected because of their contextual relevance with natural resource management in Alaska. Their common message contends that management seldom works best when taken directly off the shelf and abstracted from the social, cultural, and economic context. Different methods from social science can assist in avoiding such scenarios when "one size fits all," seems to suit very few. In this review, suggestions range from the SIA methodology for incorporating social science into natural resource management to specific approaches to ecological research where natural and social sciences are integrated. The list of such approaches presented in this review is by no means exhaustive but the authors believe that these methods are relevant for Alaska.

While social science has gained prominence within the field of fisheries management and NMFS, it still contends with a number of barriers both in the realms of research and policy. First, the potential contributions of social science suffer when they are considered late in research and policymaking processes. In addition, fellow researchers and decision-makers often do not understand the role of social science and its various formats. For example, many look for a prescription to solve fisheries problems and believe that insights into *how* to alter human

behavior will be the panacea. While the recognition that human action plays a central role in the sustainability of the fishery is a step forward, social science is not best used to develop 'fixes'. Policy design outlines a set of alternatives and ideally social science can inform choices and decisions. Furthermore, social science can explain the emergence of inequalities or social change when confronted with a management decision or a resource scarcity issue. But the abilities of social science should not be oversold: "The tortoise pace of anthropology will almost certainly never catch up with the rapid policymaking process, but more than three decades of Limited Entry Permit Plan can provide a useful means of evaluating the lasting effects of programs already in place and predicting future effects of new policies," (Reedy-Maschner 2008, 13). Trying to force social science into a single mold can be problematic, although it appears that how narrative forms fit into a policy process inundated by documents and information is unresolved. Finally, insufficient resources undermine social science in the adoption of innovative methodologies and the time necessary to understand various facets of communities, social sustainability, or other objects of inquiry.

A first step in integrating social sciences in natural resource management is to understand the important questions to ask, which data are required, and how such data can be collected and analyzed. The SIA is one of the primary methods used to incorporate social sciences into natural resource management, something that was made obligatory in the United States. Therefore, even though the realization for the need of such data is there, the data either do not exist or are in a form in which their incorporation into fisheries management plans and policies is problematic. Quantification or fitting into dominant disciplinary frameworks are seen by some as a solution, but taken with unflinching dedication problems arise. We risk overlooking aspects of the social and cultural dynamics that are not easily enumerated or monetized. We put forward the work in ecosystem goods and services to highlight efforts to fold social and cultural indicators into valuation schema, but as explained there are many limitations to the current methodologies. Nonetheless, perhaps this is one way in which social facets will inform economic models and provide more realistic predictions of fisheries systems.

The purview of social science is not limited to impacts alone, but can inform governance arrangements and institutional design. From the authors' experience on numerous research projects in the EU (section III.C.) it is suggested that natural scientists and policymakers believe that stakeholders with a large interest in a resource, will find a way to be involved and express their views in the decision-making process, given that the process is open and allows for participation. That is true in the case when stakeholders have the resources and knowledge to follow such processes. In the case of more vulnerable groups, the ability and resources to be involved in the process are significantly less, something particularly salient in Alaska. The differentiation of access to political processes and abilities to organize among communities to advocate positions in state policy arenas emerges as a key finding in the evaluation of limited entry systems in the Alaskan salmon fishery (Reedy-Maschner 2008). Along these lines, social science can inform institutional structures that improve participation and encourage wider representation (Maiolo 2007; Halvorsen 2003). Local (and true) co-management arrangements where power is shared with government agencies and where proper conditions exist can assist conflict resolution, communication, and social networking. Evidence exists of co-management regimes easing intertribal conflict resolution over salmon allocations in the Puget Sound region

and upriver-downriver disputes settled at the local or regional level (Kellert et al. 2000). Moreover, there are linkages between co-management, LEK, and SES, "…If the co-management process can evolve further to include iterative co-learning and knowledge generation through experimentation, the resulting 'adaptive co-management' can enhance the resilience of social-ecological systems," (Butler et al. 2012, 34).

We also wanted to address the dominance of fisheries economics in our review and provide different conception of a fishery to balance all three aspects of sustainability. Adopting a socio-ecological system (SES) perspective instead of, or along with, the bioeconomic paradigm helps understand what actions humans take that affect the ecological system, how that relates to the society's function, who is most likely to suffer or benefit from changes in the ecological subsystem, and how rigid or flexible various actions are (Gallopin 1994). The section on SES stood to highlight how conceptualization of the fishery as a system where information flows in numerous directions and feedback loops through the social to the ecological and back again can open up to a deeper understanding than the traditional bioecomonic model. The Chilean case provided an example where the definition and differentiation of the fleet (artisanal and commercial) promoted continued diversity within the fishery. Diversity has become a key point in resilience both in ecological and social contexts. Taken together, the section on SES and the Chilean case seek to explain how management priorities translate into particular outcomes in the composition of the fishery. This stands in contrast to many ways ITQs have been introduced, where little discussion of the balance of economic rationalization occurs and market-based approaches bear consequences sometimes unpopular and inequitable. Furthermore, the emphasis on transferring the wealth of the fishery to private ownership ignores the vested interest of coastal communities and the wider American citizenry in the potential economic rent.

Privatizing a resource by assigning ITQs has been a result of the MEY target of the Gordon-Schaefer model. Indeed "the importance of critically exploring the language, values, and assumptions of rationalization," is salient in Alaska, as Carothers (2008, 72) probes the resistance to ITQs in Kodiak, and offers, "If we assume economic efficiency to be a natural and desirable condition, we view decreased fisheries participation and population in remote indigenous fishing villages as a just outcome." If such a catch share program is planned, then one should explore what fishers would do in that case, especially in coastal communities where there are few employment alternatives (Charles 1998). Alternatively, policy provisions like community shares or ownership caps can offset the common ills of tradable, perpetual quota systems. The case study presented in this paper on Greenland and the adoption of ITQs to restructure the fishery in a way that would benefit society at large may have far-reaching impacts at the community level, especially in Upernavik where there is a limited amount of alternative livelihood opportunities. The Greenlandic case also shows that boats from the south with quota were allowed to seek fishing opportunities farther away and fish out areas important to subsistence fishing in the north. While bioeconomic models can be useful, it is often that the less quantifiable aspects of fishing or those not easily operationalized in variables go unnoticed which limits the ability to project reality. The increasing weight on economic sustainability creates the argument that social concerns have all-but-disappeared in the industrialized world.

Finally, the understanding of localized knowledge and practices should inform policy and management of natural resources. Local Ecological Knowledge (LEK) is useful in a management context because often the breadth and depth of what locals know supplements and extends the scientific knowledge base. As illustrated by the example of TURFs in Chile, the system failed to incorporate different facets of LEK and the folkways of traditional fishermen who moved down the coast in pursuit of the surf clam. The new regime replaced this traditional system and then suffered the adverse consequences of a collapsed fishery because it ignored the local dynamics. The incorporation of LEK is particularly important in Alaska as many Alaskan Native communities base their livelihoods on such knowledge and understanding the inter-relationship between ecological processes and their livelihoods. There are ongoing programs for the understanding of LEK and its use in policy management in Alaska from both the Alaska Department of Fish and Game and other NGOs such as Yukon River Drainage Fisheries Association. Moreover, NPRB explicitly calls upon Local and Traditional Knowledge under its science program and research strategy.

Understanding local context represents a central theme in this review. The development of Community Profiles within NOAA's social science research agenda exemplifies the attention to this level of impact. Furthermore, understanding the degree and the form of dependence communities or groups have on a fishery will carry forward policy discussions. However, researchers, decision-makers, and managers should not be naïve to think that provisions for a certain type of dependence will not be viewed skeptically by those shut out by definitional boundaries. At present the EU Parliament has suggested an amendment allowing small-scale passive gear users to fish during closed seasons. But as with any policy that privileges one group over another, some have asked whether the provision should extend to small-scale trawlers. Additionally, we saw this play out in the Greenlandic case and the discussions within the literature on the varying conceptions of *fisheries dependent community.* This is another instance where the employment of co-management will help to inform the definitions set forth in fisheries policy and management plans, which will promote certain actions and behavior and discourage others. The adoption of a TURFs regime for example, like in the Chilean case study can be appropriate for the majority of the coastal communities affected but can at the same time have detrimental impacts on others where local rules preexisted in communal property regimes.

IV.B. Implications for NPRB's research agenda and work in the Alaskan context

To begin, we would like to comment on a few aspects of the Alaskan setting which have been in our minds in the development of this report. Alaska is a unique place when considering the integration of social science with management of natural resources. With the highest percentage of native Alaskan and American Indians[15], from whom many still have a traditional subsistence livelihoods and culture, natural resource management in Alaska, has a number of distinctive factors to take up, that being fisheries, forestry, mining, and oil extraction.

[15] Data from the United States Census Bureau, http://quickfacts.census.gov/qfd/states/02000.html

Alaska is perhaps one of the best examples of meeting, or trying to meet, social concerns within a rationalized fishery management system. The Community Development Quota (CDQ) program indeed tries to reinvest the wealth of fisheries into communities with limited access to quota and other economic opportunities. Prior to the CDQ program, few western Alaskan Native communities had connections with the fishing industry, but since the CDQ program was introduced, many of the CDQ groups have use this income to reinvest in fishing operations with several vessels which participate in Bering Sea fisheries being partially or entirely owned by CDQ groups. Since its inception, the CDQ program has injected over $500 million into Western Alaska and generated over $100 million in wages, education and training benefits. The value of the six CDQ groups' assets increased from about $13.3 million (1992) to over $559 million (2009). However, this 'alignment' of the CDQ groups with the pollock fishing industry has caused rifts with other native communities who do not benefit from the CDQ and are dependent on salmon for their income and subsistence with the salmon bycatch taken by the pollock fisheries being a major root of controversy.

There are other attempts in Alaska for the integration of social issues into management plans and policies and the specific concerns of local communities like subsistence fishing. The Alaska Department of Fish and Game (ADFG) recognizes the importance of subsistence use where:

> Under Alaska's subsistence statute, the Alaska Board of Fisheries must identify fish stocks that support subsistence fisheries and, if there is a harvestable surplus of these stocks, adopt regulations that provide reasonable opportunities for these subsistence uses to take place. Whenever it is necessary to restrict harvests, subsistence fisheries have a preference over other uses of the stock (AS 16.05.258')[16].

The Community Subsistence Information System (CSIS), the repository of Alaska community harvest information collected by the Division of Subsistence of ADFG, is a very good start of data that can be used as social and cultural indicators.

NPRB's social science research agenda

While NPRB operates separately from the research agenda of federal and state governments, with the interest in natural resource management it is clear that the board's research priorities may fall in certain streams of policy research. Moreover, in the current political and economic climate, NPRB may serve to supplement or replace federal agencies' research initiatives rather than complementing in years past. Data gaps and insufficient data gathering mechanisms represent a prime area for support, but such efforts should not be seen as exercises in counting alone. Qualitative methods and ethnography will likely suffer under constricted agency budgets as these activities often require time and travel, two resources that will probably become increasingly scarce. There are gaps in baseline data and in understanding the value of fishing at different spatial scales be that local, regional, state, and national. Indeed we hope the discussion of debates within the social science academe and the international examples of social science engagement in fisheries management will inform your future work.

[16] http://www.adfg.alaska.gov/index.cfm?adfg=fishingSubsistence.main

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