SOCIO-CULTURAL BARRIERS TO APPLYING FISHERS' KNOWLEDGE IN FISHERIES MANAGEMENT: AN EVALUATION OF LITERATURE CASES

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Date

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Abstract

The tenacity of barriers to the application of Fishers' Knowledge in fisheries management has been underestimated and under-examined. This conclusion was the culmination of a research process which examined the Integration Project as portrayed in the literature, in order to identify, describe, and theorize barriers. I use the term "Integration Project" to reflect the need for a critical assessment of how this endeavour has been conceptualized and implemented.

In recent decades, there has been increased interest in the integration of Traditional and Local Knowledge into natural resource management, reflecting the need to improve natural resource management (NRM) outcomes. If this endeavour is considered worthwhile, it is important to examine factors interfering with its success. Broadly defined, Traditional and Local Knowledge (of which Fishers' Knowledge is one type) is gained through life experience in a particular place and concerns the relationship of humans with their environment.

Using grounded theory to construct categories for analysis, I created an evaluative framework to identify conceptual and operational characteristics of the Integration Project in 32 papers from two conferences. These papers mainly addressed commercial Fishers' Knowledge from "developed" countries. In order to understand the results of the evaluation, it was necessary to draw upon nested theoretical frameworks which recognize that the Integration Project is part of a larger "paradigm shift" occurring within NRM, which in turn reflects societal-level changes in the Dominant Social Paradigm.

The research ultimately explored and demonstrated in detail the connection between entrenched beliefs or "frames" at the societal level; conceptual and operational aspects

of fisheries science and management; and beliefs and attitudes of practitioners – all of which can prevent or constrict the application of Fishers' Knowledge to fisheries management. This is an important and unique contribution to theory on knowledge production and to the implementation of the Integration Project. Barriers can only be removed if a fuller picture of the issues and their "depth and range" is shared by all stakeholders. Toward this end, the evaluative framework can be used in future field work to examine applied approaches and whether these are consistent with the goals and objectives of management agencies.

Dedication

This thesis is dedicated to the memories of the following people.

Joyce Dangeubun, friend and sister, keen marine scientist, and promoter of the people's knowledge of her Kei Islands (Eastern Indonesia). She was in the process of researching appropriate scientific and local resource management technologies for the recovery of topshell, *Trochus niloticus* , when she became another victim of senseless hatred.

Bob Johannes, who brought the richness of people's knowledge to the attention of marine scientists, who inspired me early on, and who I had the privilege to meet in Ambon, Indonesia.

Guillermo Burgos, friend, Argentinian fisheries biologist, who convinced me of the advantages of focusing my energy.

Bob Everton, friend, activist, creative intellectual, who worked on the project of "social change" in its many dimensions.

You are all sorely missed.

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1. Introduction

> The resolution of...problems relating to traditional fisheries will not progress satisfactorily...without fishermen, biologists, and social scientists understanding each other's knowledge, customs and perceptions.
>
> Johannes (1988)

> To explore these tensions and difficulties, we have found it necessary to cross disciplines and a diversity of theoretical frameworks...Moving into a truly transdisciplinary mode is both an intellectually and personally challenging process...New conceptual frameworks and languages that are shared across disciplines are required. It is down such a path we have gone in full recognition of the pitfalls, not the least being those who judge such endeavours not in terms of the broader challenge but from the safety of their own disciplinary perspective.
>
> Woodhill and Röling (1998)

In recent decades, with the collapse of a number of fish stocks and the demand for involvement by resource users, Fishers' Knowledge has been increasingly discussed in the policy and academic literature and applied within fisheries management. In this thesis, my research questions are twofold: what is involved in this endeavour? And what are the barriers to its success? Specifically, I critically assess how the integration of Fishers' Knowledge into fisheries management has been conceptualized and implemented in "literature cases", papers from two recent conferences on Fishers' Knowledge (Section 1.4). In analyzing these papers, I describe and theorize barriers to this endeavour, which I refer to here as the "Integration Project". This term is shorthand for *the application or integration of Fishers' Knowledge into fisheries management.* However, it is also used to focus attention on particular aspects of this "integration" (discussed in Section 1.3). The grounded theory approach to qualitative research (Glaser and Strauss 1967) provides a means of exploring these questions, since it entails an iterative research process in which important themes and relationships emerge from the data. Thus, the first step in the research is an examination of a broad range of literature on Traditional or Local Knowledge[1], (TLK), of which Fishers' Knowledge is one type[2]; and identifying emergent themes, patterns, and preliminary barriers to its application. I also identify relevant theoretical frameworks, create an evaluative framework with which to analyze literature cases from the two conferences, and apply the framework to these cases.

The research is ultimately intended for fisheries management practitioners[3] who are either thrust into more collaborative management arrangements through necessity or who are genuinely interested in working with Fishers' Knowledge. I focus on barriers which are based in management agencies, recognizing that other barriers originate with fishers (collectively and individually). I chose this focus both in order to narrow the scope of the research project and more importantly, because scientific knowledge is "privileged" within natural resource management (NRM) (Pálsson 2000) relative to Fishers' Knowledge. The rationale for the thesis is pragmatic, that is, oriented towards the improvement of fisheries management. It is based on three premises. First, Fishers' Knowledge can contribute more to fisheries management than it has. Second, if the integration of Fishers' Knowledge into fisheries managegment is considered a worthwhile endeavour and is consistent with the stated goals and objectives of

1 I capitalize several terms in the thesis: I do so because these terms are key concepts within the thesis; they may have variable meanings in the literature; and I use them in particular ways here (see e.g., Morrow and Hensel 1992; Scarce 2000). TLK and Fishers' Knowledge are elaborated in the next section.

2 The premise is that there are common issues of relevance to the Integration Project to be found in other literature on TLK, particularly in the wildlife management literature on Traditional Knowledge (Section 1.1).

3 This includes fisheries natural and social scientists, whether agency or university based, and fisheries managers.

management, it is important to examine factors which interfere with its success. Third, as alluded to in the opening quote by Johannes (1988), if a fuller picture of the depth and range of issues surrounding the application of Fishers' Knowledge to fisheries management is shared by all stakeholders[4], the likelihood of successful fisheries management outcomes is increased.

In this chapter, I introduce the research both thematically and structurally. This thesis is original because it is a qualitative social science research project, even though my background is in natural science[5], and it is intended for an audience of fisheries management practitioners who are often natural scientists. I wrote it in a narrative style which includes an account of how the research project evolved. This account begins below in Section 1.2 and continues throughout the thesis. In addition, rather than a single, extensive literature review as part of an introduction, I review literature as necessary within particular contexts, in order to provide sufficient background to the reader and/or to elaborate on theoretical frameworks used in the thesis.

I begin this chapter with a brief definition of three terms used in the thesis: Traditional Knowledge, Local Knowledge, and Fishers' Knowledge. I then set the context for the study by reviewing a number of societal trends which have led to an increased interest in TLK. Following this, I describe how the research project evolved (Section 1.3) and provide the rationale and goals of the research (Section 1.4). This is followed by a summary of the contributions of the research (Section 1.5) and an explanation of how the thesis is organized (Section 1.6).

4 For purposes of this thesis, government actors are also considered stakeholders following Pinkerton and Weinstein (1995) and Jentoft, McCay, and Wilson (1998).

5 See Section 4.2 for further elaboration on my background.

1.1 Brief definition of the terms Traditional, Local, and Fishers' Knowledge

The terms I have chosen to use here, Traditional Knowledge and Local Knowledge, are two of many terms used to describe "knowledge which is gained through life experience in a particular place, about the relationship of humans with their environment; 'ecological' knowledge in the broad sense" (Berkes 1999). The term "traditional" in this context generally refers to a body of knowledge, practice and beliefs that is culturally transmitted across generations (Berkes 1999). This kind of knowledge "is an attribute of historical continuity in resource use on a particular land" (Berkes 1999). Where interaction between harvesters and the environment is ongoing, Traditional and Local Knowledge is continuously being generated, evaluated and potentially communicated. It is *dynamic.*[6]

In this thesis, I use the term Traditional Knowledge to refer specifically to knowledge held by indigenous people. I also include knowledge which is gained by an individual or passed between individuals or collectives *within a generation*, or which has been gained relatively recently, within the term Traditional Knowledge. Furthermore, following a number of authors, I use the term Local Knowledge to refer to a similar type of knowledge held by all others, within a range of contexts including and beyond NRM (e.g., Neis and Felt 2000a).[7] When I refer to this type or category of knowledge in general, I use the term Traditional and Local Knowledge (TLK).[8] Thus, the term TLK

[6] For this reason, the use of the adjective "traditional" to identify this knowledge has been critiqued, since it may imply knowledge which is *unchanging* (Ruddle 1994; Berkes 1999).

[7] This may be confusing since, for example, Kofinas (1998) uses "local knowledge" for indigenous knowledge of caribou.

[8] This thesis focuses mainly on the TLK of harvesters, but TLK of the marine environment is possessed by any who live by it or frequent it. For example, recreational users such as sailors and kayakers may possess knowledge on marine mammal distribution and behaviour.

includes Fishers' Knowledge. In the thesis, the term Fishers' Knowledge is generally reserved for discussion of the literature cases and their analysis. However, the authors of the literature cases sometimes discuss TLK as a category, citing literature beyond the field of fisheries management.

1.2 Setting the context: Nested paradigm shifts and the developing interest in TLK

The interest in TLK is part of a larger "paradigm shift" in NRM that has been occurring within the last several decades. Recognizing and describing this greater context in some detail is relevant for understanding the emergence of the interest in TLK, and in understanding key theoretical frameworks in the thesis (Chapter 5). Therefore, I raise it here.

Kofinas (1998) notes in reference to the North American Arctic:

> Forty years ago, the suggestion that northern hunting communities should share legal authority with state agencies in management of caribou would have been considered heretical in many government quarters. At that time, the conventional wisdom held that southern-based governments create law, government agencies implement policy, scientists establish fact, and wildlife officers police hunters.

One aspect of this shift is the

> …noticeable trend towards the recognition that different knowledge frameworks exist and that, together, they might provide an improved understanding of the world around us (Berkes 1999).

In the discussion below, I describe how this shift in "conventional wisdom" within NRM agencies reflects trends at "higher levels": the international and societal-level (the level of social paradigms, see below).

1.2.1 The international/societal-level contexts

Challenges to the Dominant Social Paradigm[9] began to intensify during the 1960s, during which a number of interrelated issues surged to attention internationally along with a wave of intellectual creativity and social action. Some highlights of these events include: the formation of the non-aligned movement to address colonialism and its ongoing legacy; and social movements such as the women's, ecology, socialist, Black Power, American Indian, and Pan African movements, a number of which Tandon (1993) summarizes. Five interrelated trends were part of this shift in the Dominant Social Paradigm and are of particular relevance in this thesis:

1. increasingly complex and serious environmental problems such as global warming and the destruction of the ozone layer (World Commission on Environment and Development (WCED) 1987);

2. citizens' pressure for increased involvement in government planning and policy-making (Wilson 1997);

3. pressure for improvements in livelihood and autonomy by peoples who have been marginalized, including inhabitants of the "Third World" and aboriginal peoples (Agrawal 1995);

4. increase in decentralization and devolution of decision-making authority (Kooiman 1999); and

5. "challenges to Western scientific understanding" (McGoodwin et al. 2000).

The second and third trends are similar – they represent a push against structures of power (including government) for more direct control over decision-making. This pressure appears to have affected government policies and their implementation, which have included increased emphasis on participation (Rodal and Mulder 1993;

[9] A social paradigm is "the belief structure that organizes the way people perceive and interpret the functioning of the world around them" (Dunlap and van Liere 1978). Specifically, the Dominant Social Paradigm refers to a paradigm which originated in the West and is now global, which some have denoted as the Industrial Worldview (Olsen et al. 1992). Its features are elaborated in Chapter 5 (Section 5.4.1).

Kooiman 1999). However, increased participation may also be part of a "frame shift" (see Section 5.3) from historically centralized and hierarchical decision-making (see Section 7.2.3) to increased decentralization and devolution of decision-making power for economic reasons.[10] In any case, these influential factors appear to have contributed to the emergence of TLK in international policy.

Specifically, in the environment and development context, these trends came together in the 1980's and "congealed" around the notion of sustainable development, with the Brundtland Commission and the writing of *Our Common Future* (WCED 1987). Globally, citizens have become increasingly aware of these issues through the mass media.

In the world of international development, failures of many top-down, expert-driven projects gave donors a sense that they had "something to learn" from local peoples regarding sustainable development practice and indigenous knowledge (Ostrom 1992; Tandon 1993; Agrawal 1995; Sillitoe 1998). Participatory Research was expanded and adapted to international development work in assessment tools such as Participatory Rural Appraisal (Tandon 1993).

Within the intellectual and academic sphere, a similar challenge to the predominant world view has occurred – expressed in, for example, the emergence of dependency, feminist, and poststructuralist or postmodern theories (Harding 1991). The fields of philosophy, sociology, and history of science have expanded, and challenged long-held beliefs (see Section 5.4.2).

[10] Decentralization may be seen as more effective as well as efficient in a time of increasingly scarce fiscal resources and pressures for "less-government" (Simrell King and Stivers 1998; Kooiman 1999).

Within the field of NRM, McGoodwin et al. (2000) contextualize the interest in TLK within changes in Western society, including "challenges to Western scientific understanding": They note:

> Some researchers, such as Beck (1992), see the replacement of a science-dominated belief in certainty, predictability, and progress by diverse and less hegemonic systems of belief as part of a new modernity.

A detailed elaboration on modernity is beyond the scope of this thesis. However, it is raised again under the name "Dominant Social Paradigm" in Chapter 5, in which its basic characteristics are described.

Thus, the cumulative effect of the trends above appears to have provided the context for increasing interest in the use of TLK. Both Our Common Future (WCED 1987) and several chapters in Agenda 21 (United Nations 2000) call for the recognition and application of TLK within a range of sustainable development contexts.

1.2.2 The state-level/resource management agency context

The Canadian government has been influenced by these international discussions and events (as well as by aboriginal peoples' movements at home, see below). It has signed international agreements and created national Secretariats to address some of these issues (e.g., Indigenous Peoples' Secretariat (Canada) on the Convention on Biological Diversity).[11] The Canadian International Development Agency, CIDA, has recently published a manual on Traditional Knowledge use (Emery 2000).

In the field of NRM specifically, the trends or shifts discussed above have also been significant and are connected to the appearance of TLK on the policy agendas of

[11] For a list of many of these see Fisheries and Oceans Canada (FOC 1997).

government NRM agencies. In this section, I briefly summarize them, using fisheries management in Canada as a particular focus.

First, an estimate has been made that up to ninety percent of the world's fish stocks have been overexploited (Alverson et al. 1994), while environmental problems in the oceans include pollutants, introduced species, disease, habitat degradation, increased ultraviolet radiation, and global warming (Allison et al. 1998; Norse 1993). In Canada, FOC presided over the collapse of what was once the largest and most productive cod fishery in the world (Hutchings 1999).[12]

Second, historically, resource management agencies have acted as hierarchical management authorities, maintaining control over all aspects of resource management (Yaffee 1997). Since the 1980's, there has been a proliferation of influential literature and initiatives addressing partnerships, co-management, community-based resource management, and participatory planning (Pinkerton 1989; Pinkerton and Weinstein 1995; Young 1996; Wilson et al. 2003). FOC policy and strategic planning frequently focus on partnerships, shared-decision making, and collaboration (*Oceans Act* 1996; FOC 1997; FOC 2000; FOC 2002).

Although participatory strategies represent significant challenges and require resources, the benefits are thought to include increased sharing of accountability and decisions which are acceptable to a greater number (FOC 2000). "Restoring confidence and credibility" - the name of the Strategic Plan (FOC 2000) implies the creation of relationships of increased trust through improved communication (Decker and Krueger 1993). Increased involvement is said to lead to an increasing sense of empowerment

[12] The Atlantic cod was at 1% of its historical maximum biomass when the moratorium was finally declared in 1992 (Hutchings 1999).

among stakeholders (McMullin and Nielsen 1991), which is likely seen by FOC as facilitating communication and reducing conflict.

Charles (1997) noted that since the collapse of Atlantic cod, FOC has shown increased willingness to involve users in actual management planning, compared to previous involvement of sector groups in a more advisory role. He further noted that there appeared to be a sense within FOC policy that management practice will be improved by involving other resource users (Charles 1997). For example, harvesters have been known to make stricter regulations than those planned by the agency (Pinkerton and Weinstein 1995; Charles 1997).[13] The above discussion demonstrates management agencies' increased interest in user participation and what are likely seen as its strategic benefits.[14]

Third, the inclusion of TLK in FOC policy can be seen as stemming from the larger political context of the struggle for increased autonomy by indigenous peoples in Canada (Gombay 1995; Burgess 1999). The last several decades have seen increased efforts in treaty-making, the resolution of some land claims agreements, and critical court decisions outlining aboriginal rights to hunt and fish (Pinkerton 1994; Walter et al. 1999). The 1997 Supreme Court decision in *Delgamuukw v. British Columbia*, declares that aboriginal title is not extinguished and further stresses the importance of meaningful and substantive consultation with First Nations in all decisions affecting them as does the decision in *Haida Nation v. Minister of Forests and Weyerhauser* of 2002.[15]

[13] This was demonstrated in three of the analyzed literature cases: Blyth et al. (2003), Camirand et al. (2003), and Prince (2003).

[14] Since the Integration Project involves resource users, these strategic benefits are assumed to apply to it as well.

[15] These decisions, the higher profiles of aboriginal leaders, artists, etcetera, as well as events such as the Oka crisis, have increased awareness of aboriginal issues and rights in the media and in society more generally as well as in government. In terms of paradigm shifts, this transmission of ideas is important.

Fourth, societal-level shifts in thinking about the scale and distribution of government has also affected FOC. In recent years, it has decentralized many programs[16] and increasingly devolved some management responsibilities to fishers. As an inseparable part of the shift to "less government" previously mentioned, this strategy is a response to financial constraints and budget cutbacks (Section 3.5). However, it also reflects fishers' desire for increased involvement, a rationale which the Newfoundland cod crisis strengthened considerably (e.g., Neis and Felt 2000b).

In Canada, the *Oceans Act* (1996) responds to degradation and resource conflicts in the oceans (FOC 1997) and the trend of increased public involvement in public policy initiatives (McMullin and Nielsen 1991; Decker and Krueger 1993; FOC 2000). It can also be read as responding to the third issue of addressing inequities and biases, perceived or otherwise (FOC 2000). Throughout the Act, certain groups – "aboriginal organizations, bodies established under land claims, and coastal communities" - are repeatedly named in contexts referring to collaboration and consultation. Coastal communities are also singled out in the preamble of the Act to benefit from ocean resources.

Fifth, as mentioned previously, the emergence of TLK can also be seen as a challenge to the "hegemony of science" (McGoodwin et al. 2000). Several strains of this perspective are apparent in academic discourse on TLK (see Agrawal 1995; Nadasdy 1988; Holm 2003).

In fisheries management, I suggest that the emergence of Fishers' Knowledge is also a "bottom-up", or "grounded" phenomenon which reflects the political, social, and biological impacts of stock collapses. These have particularly contributed to the

[16] Actually, FOC has gone through different "rounds" of de- and re-centralization which are beyond the scope of the thesis.

motivation for management agencies and others to seek out additional knowledge and information, including TLK, to improve fisheries management. In this context, King and Durrenberger (2000) note that:

> …the issues at stake are how better to organize and develop management programs, institutions, and practices that can prevent the tragedy [the collapse of cod] that occurred in Atlantic Canada. Among whom shall the benefits of resource appropriation be distributed? *What are relevant data to be used in this process? Who will make the analyses and rules?* Who will do the work and who will share the rewards? [emphasis mine]

As a result, considerable interest in the application of TLK to fisheries management has been expressed in policy, for example, in the *Oceans Act* (1997) and in Canada's Oceans Strategy (FOC 2002). It has also been expressed in the academic literature, for example, Inglis et al. (1993), Berkes (1999), Neis and Felt (2000b), and Haggan et al. (2003).

At both the international/societal-level and state/agency-level, a number of trends or shifts have facilitated the conditions for the emergence of TLK. Thus, the emergence of the Integration Project is part of paradigm shifts in NRM, which reflect shifts in the "guiding principles", beliefs, or "frames" (see Section 5.3) of the Dominant Social Paradigm. For this reason, I refer to "nested" paradigm shifts, to indicate that shifts in NRM are part of or embedded in societal-level shifts. Collectively, these shifts have contributed to the appearance of TLK in some government agencies' policies, including fisheries management agencies.

The concept of "nested paradigm shifts" contains two aspects: paradigm shifts, and *nested* levels of organization. I elaborated above on the emergence of TLK on the policy agenda within the context of paradigm shifts. Paradigm shifts are raised again in the context of the analysis of literature cases in (Sections 8.5 and 8.6). The second aspect, nested levels of organization, is a key facet of a number of theoretical frameworks discussed in Chapter 5.

1.3 The evolution of the research project: *what is this thing called the Integration Project?*[17]

In this section, I review the events which led me to more carefully examine the Integration Project. I used a grounded theory approach (Section 2.4), thus the research was a *process* which evolved – and in which I evolved (see Section 2.2). I began the research with a pragmatic interest in how Fishers' Knowledge could *better* contribute to improving fisheries management. As a natural scientist, I shared the increasing interest in Fishers' Knowledge.

In the first step of the research – reading a wide range of TLK literature – I observed the sense among many papers that TLK could contribute considerably more to improve fisheries management than it has to date (e.g., McGoodwin et al. 2000), exemplified by the title of the article "Ignore fishers' knowledge and miss the boat" (Johannes et al. 2000). Indeed, a number of researchers refer to or discuss the "barriers" or "difficulties" in using Fishers' Knowledge in fisheries management (e.g., McGoodwin et al. 2000). Others have noted that some natural scientists express doubts about and disparagement towards TLK (e.g., Johannes 1989; Ruddle 1994).

I also directly observed evidence of barriers. First, when I raised the general topic of TLK with several FOC and university colleagues, I was met with rather curt and immediate responses regarding "scientific defensibility". This appeared to be almost a

[17] This title is a "takeoff" on the title of a popular and often utilized book in Zoology graduate schools: *What is this Thing Called Science?* (Chalmers 1999).

“reflex” response before any discussion of potential contexts for its use was possible. These experiences led me to question whether deeply held societal beliefs might be involved in this response since not all agency activities require the same level of defensibility as would a court case for charges under the *Fisheries Act*.

Second, I began to notice a difference between the literature on Traditional Knowledge and on Fishers' Knowledge in terms of the themes or issues discussed by authors. It appeared that a richer discussion of the range of issues, including contentious aspects of the Integration Project, was often absent from the literature on Fishers' Knowledge compared to Traditional Knowledge literature (particularly literature on wildlife management in the Arctic). This quotation from Burgess (1999) is an example:

> …there is a good deal of confusion regarding traditional knowledge: what it means, who has it, who should have access to it, what relevance it has in the Arctic today, whether traditional knowledge has relevance for the 'management' of renewable resources in the Arctic, the suitability or even possibility of attempting to 'incorporate' or 'integrate' traditional knowledge into Western science, or even if that is desirable, whether 'integration' will ultimately mean 'assimilation.' What role, if any, does traditional knowledge…[have in] the practice of co-management, who 'controls' traditional knowledge, do holders of traditional knowledge hold intellectual property rights over their knowledge and customs…

Underlying these questions is a recognition and analysis of differences in power and culture which are inherent in the relationships between stakeholders in Northern NRM. This recognition is typified by literature including Gombay (1995), Bielawski (1996), Irlbacher (1997), Stevenson (1997), Kofinas (1998), and Nadasdy (1999). In the lens of these analyses, how TLK is conceptualized and applied, and by whom, is influenced by unequal power relationships and socio-cultural factors. Only relatively recently has there been increased focus on related social and cultural issues in the context of Fishers' Knowledge (e.g., Maurstad 2000; Pálsson 2000; McGoodwin et al. 2000; and Roepstorff

2000) with some of the most critical perspectives published since this thesis was conceived and partially written, for example Holm (2003) and a series of responses to him as a collection in the journal MAST.

As a result of reading this literature, I created the term "Integration Project" to draw attention to the process of integrating Fishers' Knowledge into fisheries management. Following Morrow and Hensel (1999), the Integration Project is theorized here as a concept of variable meaning which involves potentially hidden relations of power (see Section 5.2 for an elaboration). Second, the word "integration" is potentially charged with meaning[18] and begs the questions: what is being integrated? into what? and by whom? Finally, the word "project" can be used to denote "an undertaking with a particular aim" or "a piece of research work" (Barber et al. 2005). The latter definition generally refers to a shorter-term undertaking. Thus, the term implicitly raises questions about the degree of "institutionalization" or incorporation into the procedures of management agencies (Pinkerton 2003).

The contrast between issues discussed within Traditional Knowledge and Fishers' Knowledge fora was also evident at the conference "Putting Fishers' Knowledge to Work" held at the University of British Columbia in 2002 (Haggan et al. 2003). A number of presentations appeared to emphasize technical and methodological aspects of the Integration Project, including concern with validation of Fishers' Knowledge. Conversely, few papers appeared to raise other potential complications or barriers, particularly of socio-cultural origin. Third, and in a related vein, literature from the Arctic

[18] Buscher and Mutimukuru (2004) examine a number of "buzzwords" which are used in environment and development policies internationally including "community participation", "empowerment of the poor", etcetera, and their potential impacts at the grassroots level in an African forest management case. Both Stanley and Rice (2003) and Roepstorff (2000) comment on the "catchy phrases" used to refer to TLK and Stevenson (1998) refers to the "bandwagon" and “sacred cow” that Traditional Knowledge has become in the North. For this reason, Stanley and Rice (2003) use the term "*-knowledge" in their paper.

and the fisheries literature appeared to have distinct perspectives regarding *what TLK is* and *how it can be used*.[19]

The observations of barriers in the literature combined with my own observations and impressions led to the research project introduced below. Thus, a general literature review which began in order to design *field research*, gradually morphed into an increasingly critical evaluation of the Fishers' Knowledge literature. As I read, synthesized, and critiqued what I read, I was developing preliminary analytical frameworks for classifying different types of barriers. The evolving research questions and evaluative framework reflect this analysis. New or refined questions led me to read additional literature and search out or create applicable theoretical frameworks (Chapter 2) for example, to be able to propose the preliminary barriers (Chapter 3). This iterative process is a key characteristic of the grounded theory approach (Creswell 1994) and it continued throughout the research and writing.

1.4 The research goal

The research goal is to critically and systematically examine literature on Fishers' Knowledge, that is, to examine the kinds of discussion and practices reported therein[20],

[19] A difference in focus and emphasis is evident between literature on Fishers' Knowledge and, for example, the proceedings and title of a recent conference on Traditional Knowledge in the North: "Relations between traditional knowledge and western science", sponsored by the *Natural Sciences and Engineering Research Council* Northern Chair at Carleton University, The Canadian Polar Commission, The Royal Canadian Geographical Society, and the Association of Canadian Universities for Northern Studies (Burn 2003). Although Traditional Knowledge researchers who raise socio-cultural issues tend to be social scientists, exceptions include for example, Burgess (1999) and Berkes (1999) who are natural scientists. It appears that the politicized environment of the North (in terms of indigenous peoples with a legacy of colonization, who are pushing for autonomy and management of contested natural resources) may have generated understanding and awareness of the issues involved that is more widely shared among researchers of all disciplines. These observations raise questions regarding the potential effect of contextual factors such as disciplinary background of the researchers, geographical location, or type of TLK-holder; and informed the creation of the evaluative framework (Chapter 4).

and to analyze whether these reveal barriers to the Integration Project.[21] Barriers are defined here as factors or conditions which slow or prevent the use of Fishers' Knowledge.

The rationale for the thesis research is that there has been insufficient focus in the literature on the identification of barriers, their origin and expression in fisheries management practice, and the theoretical relationship among barriers and between barriers and other relevant phenomena. In particular, it appeared that socio-cultural issues and barriers were neglected in the literature, particularly analyses that examine the role of Science and power, and the potential influence of training or academic background, beliefs, and attitudes of stakeholders. For example, Science is largely understood to be the superior way of knowing within the Dominant Social Paradigm (DSP), and this perspective may act as a barrier to the Integration Project (Section 5.4) (the term "Science" refers to science as exemplified by the natural sciences[22]).

Furthermore, in the Introduction to *Finding Our Sea Legs*, a collection of contributions on Fishers' Knowledge from a conference in Newfoundland, Neis and Felt (2000a) noted that they encouraged contributing authors:

> not only to document their projects, but also to explore their assumptions, methodologies, and the interdisciplinary, interpersonal dynamics associated with those projects. The extent to which they have actually done this varies.

The examination of assumptions, as well as beliefs and attitudes, can help individuals and collectives to be more aware of their role in interaction with others. Ideally it opens

[20] I examined 32 papers from two conferences on Fishers' Knowledge held in Canada: *Finding Our Sea Legs* (Neis and Felt 2000b) and the proceedings of the conference *Putting Fishers' Knowledge To Work* (Haggan et al. 2003) (see Chapter 4).

[21] This goal is a re-expression of the two, broad research questions posed previously in Section 1.0.

[22] "Science" refers to both product and process (Chalmers 1999). It is capitalized because it is a contested concept, and one of particular focus within the thesis. This is a convention within social constructivist literature (e.g., Scarce 2000).

the opportunity for learning and conflict reduction (Schön and Rhein 1994). The thesis research expands upon the intent, analyses, and discussions raised in Neis and Felt (2000a).

1.5 Research contributions

Expected benefits of the research include conceptual clarification of a complex topic. Conceptual clarification has been demonstrated by a number of authors to be a significant contribution to areas of inquiry as wide ranging as policy studies (Brenneis and M'Gonigle 1992; Rodal and Mulder 1993; Clark and Wallace 1998) and ecology (Shrader-Frechette and McCoy 1993). The thesis is an interdisciplinary analysis which brings together ideas from varied literatures to create several conceptual frameworks. It draws from fields including public administration and policy analysis, planning, communications, anthropology, history, sociology of science, and NRM, including stakeholder analysis, conflict resolution, collaborative management, and co-management.

Conceptual clarification is expected to have pragmatic ramifications. Stakeholders may have different approaches to the Integration Project, including different definitions and motivations for the application of Fishers' Knowledge. In a policy environment where resource conflicts are rife (FOC 2002), confusion and varied expectations among those attempting to use Fishers' Knowledge could contribute to further conflict if left unexamined.

The conceptual and evaluative frameworks (Chapters 2 and 4, respectively) and the critical analysis of barriers (including the influence network, Chapter 6) are expected to assist stakeholders in examining dimensions of the Integration Project in relation to their own and others' objectives. Insight gained by the reader should facilitate future policy generation and implementation regarding the Integration Project. Furthermore, an improved understanding of the issues involved would ideally translate into enhanced communication between stakeholders and a renewed commitment to versions of the Integration Project which benefit the fisheries management process and all participating stakeholders. Finally, the evaluative framework is also a research product which is adaptable for future use in the analysis of literature and in field studies.

1.6 Organization of the thesis

This first chapter has provided a general overview of the rationale for the study. The organization of the remainder of the thesis reflects the iterative nature of qualitative research.[23] This organizational structure is, at times, awkward – I had to decide where best to *introduce* topics, and where best to *discuss them in detail*, that is, I had to make a complex, iterative, process into a linear story. Thus, I present the project in stages (Miles and Huberman 1994; Creswell 1998). The research can be roughly divided into three stages: open coding, creation and application of the evaluative framework, and analysis of the results. In Chapter 2, I describe a number of facets of the research approach and design, focusing on the characteristics of qualitative research, particularly the grounded theory approach. I also describe the open coding process which led to the identification of a number of variables and a preliminary version of the evaluative framework. In addition, observations of connections between variables or themes led to

[23] Readers may wish to skim over Chapter 2, especially those familiar with qualitative research. Chapter 3 is essentially reiterated in Chapter 7 and elaborated upon using the analysis of the 32 literature cases on Fishers' Knowledge. However, I recommend reading Sections 3.0 and 3.1 since 3.0 summarizes the proposed barriers in Table 2, and 3.1 describes how Fishers' Knowledge is conceptualized (as 3 kinds or "levels" of Fishers' Knowledge) within the thesis.

the identification of a number of coded themes. Chapter 3 raises some of these themes and identifies preliminary barriers and their proposed impacts on the Integration Project. These were drawn from the literature on Local Knowledge, Traditional Knowledge, and Fishers' Knowledge.[24] I combined key themes and barriers identified here with theoretical frameworks discussed in Chapters 4 and 5 to create the principle tool for data gathering: the evaluative framework (and the thematic codes which accompany it, which are also summarized in Chapter 4). Chapter 5 addresses a number of theoretical frameworks which were utilized in the analysis of the data. Specifically, I summarize relevant literature on each framework and then explain its role in generating the results or theory (*sensu* Glaser and Strauss 1967, see Section 2.4). Chapter 6 describes the analysis of the completed evaluative frameworks and their synthesis into a web diagram or "influence network". Barriers are situated within this visual summary, which demonstrates important links between various phenomena within the Integration Project and fisheries science and management. In Chapter 7, I discuss these results in detail drawing extensively from patterns and trends in the literature cases. Chapter 8 serves to “take stock” of the portrayal of the Integration Project within the literature cases. I also briefly consider the ability of the Integration Project to meet agency stakeholders’ goals, and discuss the *potential* role of the Integration Project in fisheries management. Chapter 9 concludes the thesis with a summary of general and specific findings in the thesis and recommends directions for future research.

[24] I began to draw upon additional literature and to seek out theoretical frameworks to describe the preliminary relationships I was finding. However, a discussion of these theoretical frameworks appears in Chapter 5, as the foundation for the analysis of barriers in the literature cases (Chapter 6).

2. The research approach and the first phase of research

> From the beginning of data collection, the qualitative analyst is beginning to decide what things *mean*, is noting regularities, patterns, explanations, possible configurations…. The competent researcher holds these conclusions lightly, maintaining openness and skepticism, but the conclusions are still there…vague at first, then increasingly explicit and grounded, to use the classic terms of Glaser and Strauss (1967). "Final" conclusions may not appear until data collection is over…but they have often been prefigured from the beginning, even when a researcher claims to have been proceeding "inductively".
>
> Miles and Huberman (1994)

In this chapter, I describe a number of facets of the research approach and design, focusing on the characteristics of qualitative research, particularly the grounded theory approach. First, the research approach is briefly reviewed by comparing it to two other models of qualitative research (Section 2.1). This is followed by a discussion of the ontological approach in the thesis, which is akin to the "soft-nosed logical positivism" of Miles and Huberman (1994) (Section 2.2). I then briefly explain aspects of my background which motivated the interest in the research (Section 2.3). The research design section (2.4) elaborates on the combination of grounded theory and discourse analysis used here. I also describe the open coding process which led to the identification of a number of variables, key themes, and barriers (Chapter 3), and a preliminary version of the evaluative framework (Section 2.6).

2.1 An overview of the research approach

This thesis is based on qualitative research, which is well suited to taking an exploratory approach in a research project and to asking "what is going on?" (Creswell

1998). I locate the approach to qualitative inquiry in this thesis as a combination of the approaches of Miles and Huberman (1994) and postpositivist researchers such as Creswell (1994; 1998). This study both resembles and differs from each of the two models (Table 1). Six facets of the qualitative approach to research are summarized in Table 1. In all three research models, the researcher is the "instrument of data collection" (Creswell 1998) and words are analyzed (Miles and Huberman 1994; Creswell 1998).

2.2 Ontological approach

In the context of design of social research, ontology concerns the nature of social reality (Blaikie 2000). Mason (1996) notes that "there are different versions of the nature and essence of social things".[25] Miles and Huberman (1994) in their *Sourcebook on Qualitative Research Methods*, refer to their approach as "soft-nosed logical positivism" in that they "believe that social phenomena exist not only in the mind but also in the objective world".[26]

[25] In Section 5.1, I summarize theoretical frameworks and premises of the thesis. These contain ontological components which, compared to examples in Mason (1996), are a complex combination. They include: paradigms and cultures; beliefs or "frames" and attitudes; discourse and texts; social actors (individuals) and their actions; organizations; institutions; and conceptualizations (conceptual models or social constructions). Although I borrow from social constructivism (the thesis examines TLK as a social construct with a number of potential conceptualizations), the thesis does not fall within the category of social constructivism (for a critical discussion, see for example, Carspecken 1996).

[26] In recent years, many qualitative researchers who write about methodology refer to qualitative and quantitative "research paradigms", for example, Denzin and Lincoln (1994) and Creswell (1994; 1998). In Creswell (1994), the qualitative research paradigm is described as constructivist, naturalistic, postpositivist or postmodern. In contrast to an "objective world", postpositivist researchers see reality as constructed by the individuals in the research situation and "multiple realities exist in any given situation" (Creswell 1994). The quantitative research paradigm is referred to as traditional, positivist, experimental, or empiricist. However, this view overlooks the stance of some *qualitative* researchers who still draw on the *positivist* tradition, such as Miles and Huberman (1994) and myself.

Table 1. Summary of approach to qualitative research compared to models proposed by Creswell (1994, 1998) and Miles and Huberman (1994)

Qualitative research (Creswell 1994, 1998)	**Qualitative research (Miles and Huberman 1994)**	**Thesis approach**
multiple realities	"social regularities" exist – objective reality	social regularities exist *and* researchers' ability to perceive or identify them is influenced by social paradigms
value laden and biased	objective	personal bias somewhat affects research – both objective and subjective
inductive – emergent research design	mixture of inductive and deductive – "interactive, cyclical data analysis" both emergent and "pre-figured"	as in Miles and Huberman (1994)
extensive field work – "natural setting"	field work of varying intensity	no field work
words (or pictures) are analyzed from a variety of sources, especially interviews	words are analyzed from a variety of sources, especially interviews	words are analyzed in published texts
"verification" through peer review, external audits, clear documentation of research steps	qualitative research can produce "clear, verifiable, replicable meanings"; documentation as an "audit trail"	"quality" ensured through peer review, external audits, clear documentation of research steps

As in Miles and Huberman (1994), my perspective on "reality" is that the world, whether biological or social, exhibits detectable patterns and dynamics on a variety of scales. The stand I take is more akin to those who criticize an "extreme relativist perspective" (a term used in Neuman (2000), and which Schön and Rhein (1994) refer to as the "ultimate futility"). After all, there could be no communication if humans could not agree on some essentials (Carspecken 1996). To quote a natural scientist, Jan Sundet, (Maurstad 2000): "Some things are truer than others". In order to detect patterns and relationships between variables, the scientific method is a powerful and often highly effective means of investigation. However, although unbiased researchers may be desirable for many kinds of research, any human endeavour, including research, involves some degree of social construction of the world (*sensu* Potter 1996a) or presupposition about the world (*sensu* Ray and Mayan 2000) in order to interact with it. Researchers are embedded in several cultures[27] which influence perception (Section 5.6). Depending on particulars such as the area of research and methods chosen and cultures to which researchers belong, perception affects the research endeavour to varying degrees, including which questions are asked, choice of methods, analysis, and conclusions (Morse et al. 2000).[28]

Nonetheless, Carspecken (1996) notes the role of methods and methodology in ensuring that the value orientations of "criticalists" not determine their research findings.[29] Similarly, although I am interested in seeing more Fishers' Knowledge used in fisheries management and more effective participation of fishers in management, I assert my ability to analyze the issues in a clear and traceable manner. The issue of personal bias is further addressed in Section 2.5 below.

2.3 Personal statement

> As this [totem pole] is now national property, government property, I have to ask for permission. If I find that your claim is acceptable…, because I mean, we didn't have any papers. They couldn't prove "I am the proper owner of the totem pole", so we started a long period of discussions.
>
> Through the discussions, we and I, I must say for *myself, I* had to accept their [the representatives of the Haisla First Nation] way of reasoning. Its

[27] For example, a researcher is embedded within a culture based on her or his ethnicity as well as within an agency culture.

[28] From my perspective as both a natural and social scientist, I see a kind of ethical ideal which many scientists aspire to, that is, *approaching* "truth" or "reality" by gaining a clearer understanding of a particular context and its workings. Historically, natural scientists have been more focused on revealing universal laws and generalizing, however in ecology there has been an increased appreciation of the importance of context specificity – the role of temporal and spatial scale - in understanding patterns or their absence (e.g., Roughgarden et al. 1988; Levin 1992). This parallels changes in thinking in the social sciences (see Section 5.6).

[29] "Criticalists" are researchers who use critical epistemology and whose research is directed towards social change (Carspecken 1996).

> not a matter of a legal discussion – its more a matter of an ethical discussion: who has the proper right to it, who…has the better *use* of it, if I can use a word like that, and for whom does this pole *mean* something?
>
> Per Kaks, ex-director of the Museum of Ethnography in Sweden[30]

Reflexivity in research is a form of "critical self-scrutiny" (Mason 1996). Thus, as is common in qualitative research, (Mason 1996), I summarize some of my own background and experience to orient the reader to my potential biases and interests. I became interested in the potential contribution of TLK to marine resource management in the early 1980s when I read the late Bob Johannes' paper which addressed Pacific women's knowledge of the intertidal zone (Johannes 1978). Many years later after living for two years in Eastern Indonesia (and finally getting to meet my mentor there!), I circled back to this general topic as a doctoral student, finding myself part of a now much expanded group of researchers and policy makers.

As someone trained as a marine biologist, I began this research with the pragmatic goal of improving NRM and with the premise that TLK could contribute considerably more toward this goal than it currently does. However, this thesis became a journey of learning. The more I learned about the many dimensions of TLK, including the ethical dimensions, the more the project evolved. This is why I quoted Per Kaks at the beginning of the Section. Several key papers on Traditional Knowledge in the North, as well as my life experience[31], contributed to my asking questions about issues of

[30] This quote is taken from the film "Totem: the return of the G'psgolox pole" (National Film Board 2003). In it, Kaks is describing his learning process, through a three-year negotiation with representatives from the Haisla First Nation in British Columbia who were attempting to retrieve a pole which had been removed in 1929 and is held in Sweden.

[31] For example, I am a social and environmental activist, a bicultural (Chilean/Anglo-american) woman, and I worked in Indonesia for two years in an international development setting.

power and culture within the Integration Project. I also began to question "basic" concepts, including Science, TLK, and NRM. For example, I realized that my definition of better fisheries management is concerned with both the health of fish stocks and of human communities, which also expanded my notion of what knowledge needed to be brought to bear in management processes.

From the position of an interdisciplinary scientist years later, my desire to improve fisheries management remains the principle driver of the research. One way to do so is to share what I learned with colleagues in the spirit of constructive criticism of approaches to the Integration Project. I deliberately wrote the thesis in a way which mirrors my learning process. To me, this approach is consistent with the spirit of the opening quote of the thesis (Johannes1988).

2.4 The research design

The research interweaves aspects of three qualitative methodological approaches: qualitative inquiry according to Miles and Huberman (1994), grounded theory (Glaser and Strauss 1967; Strauss and Corbin 1994; Creswell 1998) and discourse analysis[32] (Gill 1996; Potter 1996a; Janks 1997; Fisher 2000). Grounded theory originates in the discipline of sociology (Creswell 1998) and refers to the use of multiple stages of data collection (typically interviews) and the refinement and interrelationship of categories of information in order to derive a theory (Strauss and Corbin 1994). In this context, theory refers to a plausible relationship among concepts

[32] As the writing evolved, I realized that I was essentially doing a kind of discourse analysis for which there are volumes written on specific methods and for which there are university departments. However, I made a decision to delve little into this field – only enough to clarify this project. I made this decision in order to narrow the scope of the thesis and because similar principles for analysis could be used from the more general qualitative methods literature. I also did so because much discourse analysis is done within postpositivist or postmodern approaches, and although this thesis is a combination of approaches, it is still firmly rooted in positivism.

and sets of concepts and can be expressed as propositions or as a logic diagram – a visual representation of relationships among concepts (Strauss and Corbin 1994).[33] Discourse analysis is used to analyze texts (Gill 1996; Potter 1996a) such as the published literature used in this study. Discourse refers to recurrent statements, themes and wordings across texts, which represent orientations to the world (Fisher 2000).

All three approaches are inductive to a varying degree, that is, abstractions, concepts, hypotheses, and theories are built from details (Merriam 1988) in the data which are identified as themes, dimensions, codes, or categories (Creswell 1994). A variety of adjectives have been used in the qualitative research literature to describe research designs, including cyclical, iterative (Miles and Huberman 1994), emergent, and evolving (Creswell 1998). Questions are shaped during an exploration of the data and change during the process of research to reflect an increased understanding of the problem. This form of research lacks firm guidelines or specific procedures (compared to quantitative research) which "complicates…telling others how one plans to conduct a study and how others might judge it when the study is done" (Creswell 1998). Although the methods in Miles and Huberman (1994) involve induction, they stress the value of a deductive strategy.[34] In the latter, orienting constructs such as a conceptual framework frame research questions, sampling, and methods.[35] This research project, like most qualitative research, lies between the extremes of "tightly prestructured" and "loose, emergent" designs (Miles and Huberman 1994).

[33] I did both (Chapter 3 and Chapter 5, respectively).

[34] Miles and Huberman (1994) refer to an experience where they "drowned in tidal waves of shapeless data that would have taken years to analyze well".

[35] This was the case here – I had initial hunches or impressions about which phenomena were important. I also adapted theoretical frameworks from, for example, the sociological literature.

Both Creswell (1998) and Miles and Huberman (1994) agree on the value of the researcher's demonstrating the steps that were undertaken, noting that the iterative nature of qualitative research may lead researchers to present their studies in stages. This study consists of a *mainly* inductive initial phase of opening coding, although I began with the following orienting constructs: the premises mentioned in the Introduction (that Fishers' Knowledge can contribute more to improving fisheries management and that there are barriers to using Fishers' Knowledge); and a focus on the potential influence of societal-level beliefs about Science on the Integration Project. The second phase was both inductive and deductive and involved the iterative creation of an evaluative framework. The third phase was the application of the framework to the literature cases and analysis of the results (methods described in Chapter 6).

2.5 Ensuring the quality of the research

> A research report consists of a series of *validity claims*: claims that the data or field records produced are true to what occurred, claims that the analysis performed on the data was conducted correctly, and claims that the conceptual basis of the analytic techniques is sound (Carspecken 1995).

Issues regarding “the quality of research”, a term used by Creswell (1998), are approached in different ways by various types of qualitative researchers. Miles and Huberman (1994) note for qualitative research that "meanings emerging from the data have to be *tested* for their plausibility, their sturdiness, their 'confirmability' – that is, their *validity*. Otherwise we are left with interesting stories."[36] This research fits mainly in the "soft-nosed" positivist paradigm of Miles and Huberman (1994). In the positivist

[36] Creswell (1994) prefers the term "verification" in reference to qualitative research rather than validity because validity implies that there is a single objective reality. Guba and Lincoln (1981) are post-positivists and they refer to the "dependability or the confirmability" of the "bookkeeping" or "audit trail".

paradigm, a good scientific study considers generalizability, accuracy, and replicability (Creswell 1994). These are the criteria which determine validity and reliability.

Generalizability refers to whether the results can be applied beyond the research project. Miles and Huberman (1994) ask whether the cases examined are "a reasonable sample of a larger universe". They note that increasing the number of cases and randomization enhance "internal validity" (a term used by experimental researchers). Choosing a large number of case studies improves the generalizability of a study (Creswell 1998). In this thesis, I analyzed 32 papers as a means of generating generalizable results. I have tried to better understand a particular phenomenon, the Integration Project, for pragmatic reasons. There are some universal social and/or behavioural influences or dynamics at work. However, this study is a "snapshot" of a dynamic social situation (see Section 7.7). Some patterns may be long standing and deeply rooted in history, and these may be generalizable,whereas others may be relatively dynamic (that is, specific to a particular situation and time period). For example, resource management science is becoming more participatory. Although I expect the evaluative framework to remain a useful and generalizable tool for some time, the results obtained by using it may differ in other settings or in the same setting in the future.

Accuracy refers to whether a study comes close to reflecting the truth of objective reality (Creswell 1994). Rather than getting caught in debates about the nature of reality, I prefer the concept used by Carspecken (1996) of "objective truth claims" which are "accessible to multiple observers". Accuracy can be affected by personal bias. I consider this thesis to be "accurate" if, for example: the "essence" of the cases is reflected in my evaluative framework; the barriers I identify and their interrelationships make sense and approximate what is occurring in the Integration Project; and I correctly identified key influencing factors or conditions. However, there are no experiments with quantitative results which can be checked (Miles and Huberman 1994).

Finally, as a means of providing for potential reproducibility and corroboration of the research, Miles and Huberman (1994) emphasize the importance of clearly describing one's research procedures. They cite Guba and Lincoln's (1981) analogy of this type of documentation as an "audit trail". For this reason, I have explained and justified the theoretical frameworks and preliminary barriers which formed the basis of the research (Chapters 2 and 3) and elaborated upon the coding of themes and the variables chosen for inclusion in the evaluative framework. During the data collection and analysis process, all except two of the 12 "tactics for generating meaning" from qualitative data (Miles and Huberman 1994) were used. As part of the tactics for "testing and confirming findings" which strengthen the validity of a study (Miles and Huberman 1994), I relied on triangulation, making contrasts and comparisons, checking outliers, and checking rival explanations.

I suggest that other researchers, once familiar with the TLK literature, could potentially apply the evaluative framework to these literature cases and obtain relatively similar results. Furthermore, if exposed sufficiently to the theoretical frameworks and discussion of Chapter 2, others might generate similar barriers, frames, and conclusions. However, I "crafted" the influence network (*sensu* Ostrom 1992) by weaving together findings from the analyses, proposed frames, and theoretical frameworks. It is less likely that a similar version could be produced by another. Thus researchers must assess whether they find the various research steps and their products plausible. Fischer (2000) similarly justified the documentation of his research process in a critical discourse analysis of concepts of conflict in educational materials. Creswell (1994) points out that validity or "verification" can also be demonstrated through peer review and external audits, in this case, through my thesis supervisory and examination committees. Even so, Schön and Rhein (1994) note that frame analysts are not neutral and may still, after analysis and reflection, differ in their conclusions and recommendations.

2.6 Open coding of literature

The research began with general reading in the areas of TLK and fisheries policy. The areas of focus included examinations of:

- some Fisheries and Oceans Canada (FOC) policy statements including the Oceans Act of 1997;
- literature on TLK in fisheries and wildlife management; and
- a range of literature from other fields including sociology, history, organizational development, political science, policy analysis, and common property theory.

At this stage of the research, I read papers on wide ranging aspects of TLK and did not make special efforts to find these papers: journal papers and books that were available in libraries, and other papers recommended by colleagues. This is convenience sampling (Miles and Huberman 1994). The examination of papers on wildlife management in the Canadian North was appropriate for several reasons: the history and practices of wildlife and fisheries management are similar; there is considerable experience working with Traditional Knowledge in NRM in the North; and there are commonalities between the interactions of the state with indigenous and non-indigenous stakeholders in the context of TLK and NRM.

I also attended the international conference at UBC, "*Putting Fishers' Knowledge to Work*". During this first stage, I gradually developed a detailed coding system of recurrent themes within the literature, which covered a much broader range of aspects of TLK and NRM than eventually examined in the thesis.[37] This is the nature of *open coding* (Glaser and Strauss 1967).[38] A number of key issues began to emerge (Creswell 1998) which combined with other observations of potential barriers (mentioned in Section 1.3).

Following Miles and Huberman (1994), I began to categorize variables and to see potential connections between them. For example, there appeared to be a relationship within the literature between the *approach* to the Integration Project (for example, the definition of TLK used) and *contextual* variables such as location of the study and type of author (natural or social scientist). I decided to examine this further. Therefore, I began to create an evaluative framework dividing variables into two types – "approach variables" and "context" variables. Approach variables describe dimensions of how the Integration Project is approached conceptually and operationally. Context variables refer to those variables which are likely to play a role in influencing the Integration Project. They describe aspects of the context in which the literature case

37 A reduced version is found in Table 4 in conjunction with the evaluative framework created to analyze the literature cases (Section 4.2).

38 Although I refer to the phases or stages of research here, each of these involved several iterations of reflection, noticing patterns, additional coding, and refinement. In this vein, Miles and Huberman (1994) note three types of data analysis activity: data reduction, data display, and conclusion drawing/verification. These combine in an *interactive, cyclical process*: "data reduction" refers to the selection and transformation of "raw" data, while "data display" functions to organize information in ways that permit conclusion drawing. Creswell (1998) refers to data analysis as a spiral which includes the key activities of reflection and writing notes.

was generated (see Section 4.2).

This initial research led to increasing clarity in the development of *research questions*[39] which included the following:

Is there evidence of barriers to the Integration Project in the literature cases?

a) Are there patterns in the approaches to the Integration Project as expressed in the literature cases which are indicative of barriers? For example, is there a pattern in how the Integration Project is approached which is connected to author type? If so, is there a connection between this pattern and a potential barrier? How?

b) Do societal-level beliefs about Science affect approaches to the Integration Project?

c) What other phenomena appear to affect approaches to the Integration Project? Are these phenomena interconnected?

This process was iterative and culminated in the following activities and outcomes: an investigation of a range of TLK literature; the identification of key themes and preliminary barriers to the Integration Project (next chapter); the examination of literature from other fields for relevant theoretical frameworks and background; and the beginning of the creation of an evaluative framework to apply to literature cases.

[39] In the early stages of a study, research questions are more appropriate in qualitative research rather than hypotheses or propositions (Mason 1996).

3. The identification of key themes and preliminary barriers

In this chapter, I selectively review and discuss a range of literature which informed both the identification of preliminary barriers to the Integration Project; and the construction of the data collection tool used to analyze the literature cases – the "evaluative framework". Since I was the "instrument of data collection" (Miles and Huberman 1994), this chapter provides transparency from a methodological perspective and demonstrates the evolution of ideas within the research process.[40] It also provides additional background information for the reader. As mentioned previously, during the process of reading and open coding the literature, many issues were identified and became "coded themes". Furthermore, I began to see connections between these themes and various phenomena (Section 2.6) – some of which are discussed in this chapter.[41]

In the first section, I address the "expansive" and layered conceptualization of TLK which I incorporated into the evaluative framework (adapted from Berkes 1999), explain why I chose it, and elaborate using examples from the literature. This section also provides background information for other discussions which follow (especially 3.2 and 3.3.1). Next, I focus on the characteristics of TLK associated with its

[40] Carspecken (1996) critiques most research as ignoring steps which serve to reveal researcher bias and the analytical lenses - both social ontology and specific theoretical frameworks and propositions - which underlie the research.

[41] This process of identification of themes and the connection between themes was an ongoing one and necessitated a search for appropriate theoretical frameworks with which to understand these emerging connections. As mentioned previously (Section 1.6), establishing the organizational structure of the thesis was challenging. For example, I implied that a power differential exists between TLK-holders and scientists within the context of the privileged position of Science in NRM (Section 1.3). However, I chose to discuss theoretical frameworks of power in Chapter 5, since in that position, theoretical frameworks serve to set up the principle discussion of barriers in the thesis (Chapter 7). I chose to place the table of coded themes (Table 4) in the discussion of the completed evaluative framework (Section 4.2).

"embeddedness" and the ramifications of these characteristics for the Integration Project, particularly methodological considerations. I then present the summary of the preliminary barriers and their potential impacts on the Integration Project in table form (Table 2) with a brief clarification. The ensuing discussion elaborates on the barriers appearing in Table 2. First, I briefly review the conceptualizations in the literature of TLK, fisheries management, and the Integration Project and how these conceptualizations may act as barriers to the Integration Project. Since these conceptualizations reflect the role of Science in NRM and/or beliefs about Science, I categorized them as "barriers connected to Science". Next, I briefly mention barriers which may originate in cultural differences between stakeholders. Finally, potential barriers associated with the nature of bureaucracies are discussed.

3.1 Perspectives on TLK and the conceptualization of Fishers' Knowledge in the thesis

In this section, I discuss how I conceptualize both TLK and Fishers' Knowledge within the thesis. For reasons discussed below, I deliberately chose the most "expansive" interpretation of TLK in the literature, the definition in Berkes (1999), as a basis for comparison with the usage in the literature cases. Berkes (1999) notes that Traditional Knowledge can be conceptualized as having four interrelated levels, pictured schematically as four concentric ellipses, from the innermost outward: 1. local knowledge of animals and land; 2. land and resource management systems, 3. social institutions, and 4. worldview. It is a knowledge-practice-belief complex, with particular kinds of knowledge occurring at each level.

This conceptualization is consistent with the use of the terms "indigenous knowledge" and "'traditional knowledge" to refer to all aspects of a cultural system (Wenzel 1999). For example, Legat (1991) defines Traditional Knowledge as:

> knowledge that derives from, or is rooted in the traditional way of life of Aboriginal people. Traditional Knowledge is the accumulated knowledge and understanding of the human place in relation to the universe. This encompasses spiritual relationships, relationships with the natural environment and the use of natural resources, relationships between people, and is reflected in language, social organization, values, institutions, and laws.

Some social scientists and indigenous people challenge whether it is appropriate to extract parts of the knowledge from its social and spiritual context for ethical as well as practical reasons (Legat et al. 1991; Irlbacher 1997; Nuttall 1998; Berkes 1999). Gombay (1995) highlights the difference between an academic perspective that tends to break the concept of Traditional Knowledge down into sub-concepts, and an indigenous perspective which retains the whole. Although in principle I agree with these ideas, the extraction of knowledge has occurred and continues to occur. I suggest that a conceptual separation similar to Berkes (1999) assists in understanding the multi-faceted nature of TLK.

At the opposite end of the spectrum, TLK has been conceptualized in much of the literature within NRM as harvesters' empirical knowledge of factors such as environmental conditions, species' biology, harvesting and abundance trends (e.g., Potter 1996b; Poizat and Baran 1997). In order to analyze the literature cases' conceptualization of Fishers' Knowledge along this spectrum, I adapted Berkes' four levels into three. Thus, "Level of Fishers' Knowledge", became a variable in the evaluative framework. This rationale is similar to Pinkerton (2003) in which she examined a range of definitions or understandings of co-management, using a "fully-developed case" as a reference point. The three Levels of Fishers' Knowledge are depicted in Figure 1 and defined as:

Level 1 Fishers' Knowledge: encompasses knowledge of humans' interaction with the nonhuman ecosystem (animal behaviour, weather, breeding locations, etc.) including technical aspects such as fishing methods, boat operation, fish processing.

Level 2 Fishers' Knowledge: encompasses knowledge of social institutions within resource management systems. I include here knowledge of: social practices involved in activities such as fishing; actual or potentially appropriate management institutions (rules and arrangements); policy impacts (actual or potential); and fishers' or others' probable behaviour.

Level 3: Fishers' Knowledge includes knowledge in the form of, or which pertains to, beliefs.

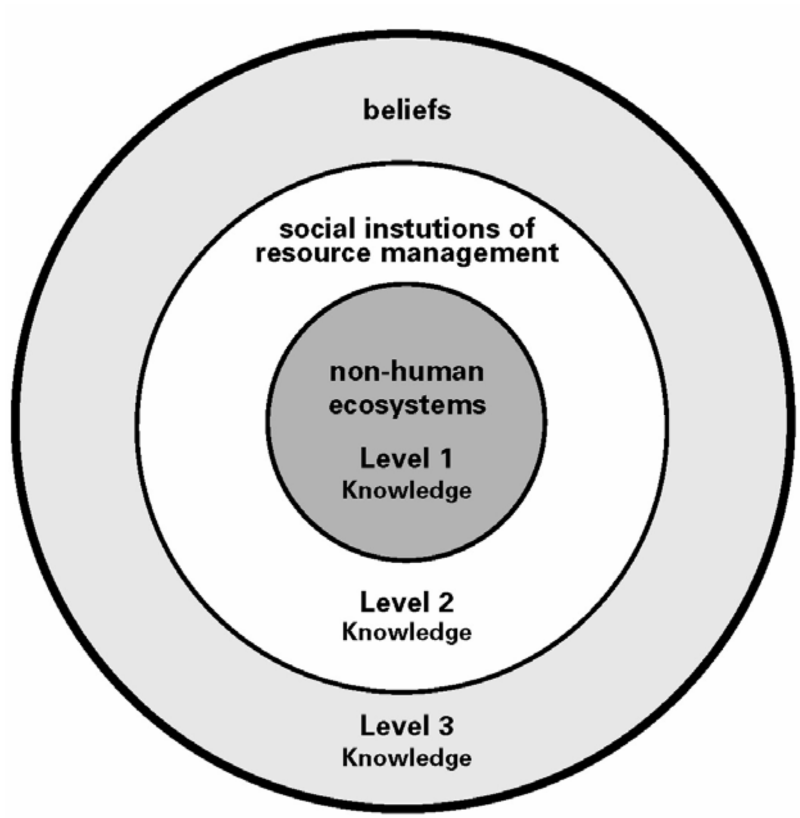
Kofinas (2002), in a paper on Arctic caribou, conceptualizes TLK in a different yet related way. He notes that three elements comprise all knowledge systems: "values and preferences, theories and explanations, [and] observations." In this classification, values and preferences equate with the outer ring of Berkes, and theories, explanations, correlations and observations are contained in the innermost circle, "the knowledge of animals and land" (Level 1 Fishers' Knowledge, Figure 1).

Scott (1998) analyzes a closely related category of knowledge which he refers to as métis, from the Greek. This knowledge also fits within Level 1 TLK (Figure 1) and includes practical skills, common sense and experience – "acquired intelligence in responding to a constantly changing natural and human environment".[42] Furthermore, métis is learned through engaging in the activity, and involves an acquired feel that "all but defies being communicated in written or oral form". Most of Scott's examples of métis fit with the latter point, for example, steering a ship in difficult currents of local waters. However, another of his examples - Squanto's telling the pilgrims to plant corn

[42] Ostrom (1992) refer to this as "skills" and "human capital" (in an agricultural context).

when oak leaves are the size of a squirrel's ear (to avoid frost) - can indeed be conveyed orally quite simply. (This point has relevance in Section 7.1.3)[43] Fishers and hunters most certainly possess métis, which is a form of TLK.

Figure 1. The conceptualization of Traditional and Local Knowledge in the thesis.



Note. Traditional and Local Knowledge is conceptualized as pertaining to three levels of organization: human interaction with non-human ecosystems; social institutions of resource management; and beliefs (based on Berkes 1999).

Durrenberger and King (2000) speak of social-ecological knowledge which "includes appropriate and legitimate capacities for allocating access, appropriation, and distribution of fisheries resources" - the second and third layers of Berkes' framework.

[43] It is an example of a correlation based on repeated observations over time – something which Kofinas' (2002) data also contained but which he did not discuss.

Examples of these are seen in relatively self- or locally-managed systems, where rules have evolved regarding many aspects of management (Pinkerton 1989; Schlager and Ostrom 1993; Dyer and McGoodwin 1994; Pinkerton and Weinstein 1995). Specific knowledge is passed on regarding when and how to hunt or fish, what numbers to take, and where (Bailey and Zerner 1992; Newell 1993; Berkes 1999). Charles (1997) notes that in addition to strictly biological knowledge, fishers are aware of the weaknesses in the management system, for example, how and why they cheat on the rules (dumping, discarding) and creative ways to improve them. This knowledge also falls under Level 2 Fishers' Knowledge: social knowledge of resource management systems.

The outermost layer, worldview, was examined by Kurien (1998) in five proverbs which reveal the wisdom of coastal communities in relation to their ecosystems. Many authors have noted the teachings and philosophies regarding respect for all beings in North American aboriginal cultures (Winkelaar 1990; Wolfe 1991; Gombay 1995; Irlbacher 1997). In indigenous as well as other cultures, stories and metaphors may provide important morals and lessons. An example within NRM is a Yupik leader who, in the context of negotiating an agreement to share power in wildlife management, likens the process to a husband and wife who share control of the household (Bista and Davidson 1976). There is power in the simplicity and succinctness of a story in conveying a moral lesson or persuasive idea. Not only do stories transmit knowledge but particular knowledge is required to tell them effectively. Thus, Bista and Davidson (1976) also discuss a cultural camp in which youth are being taught to tell stories "properly " by Elders.

3.2 The embeddedness of TLK and related methodological challenges for the Integration Project

The portrayal of TLK as concentric circles by Berkes (1999) (Figure 1) conveys a key idea reflected in a wide range of literature in the social sciences: that knowledge is generated within and reflects a social context. It is embedded within a greater cultural system and its institutions. This theme of embeddedness has also been raised in the TLK literature, including a number of related aspects which have ethical, practical, and political ramifications in terms of its application. Whether and how these potentially contentious themes were raised in the literature cases is of interest. Thus, I briefly review various facets of the embeddedness of TLK and related methodological considerations to its application and flag a number of these themes for incorporation into the evaluative framework.[44] In doing so, I also provide necessary background information to the reader on various aspects of TLK relevant to the Integration Project. Finally, I identify two potential barriers to the Integration Project as part of the discussion.

The fact that TLK is held by people raises ethical issues of conducting research with humans such as confidentiality, eventual use of the research, getting permission from particular individuals and/or collectives and the negotiation and creation of formal research agreements (Neuman 2000). A growing literature examines the ethics of Traditional Knowledge use, research protocols and the subject of intellectual property rights (Schnarch 2004; Bannister 2005). In the context of this thesis, I focus mainly on

[44] Themes were incorporated into the evaluative framework either as codes or as variables, e.g., IPR (intellectual property rights) and "Definition of Fishers' Knowledge", respectively (see Section 4.2).

intellectual property as it relates to fishing, namely secrecy and confidentiality of fishing locations, and techniques which play a key role in earning a livelihood.[45]

Another dimension of the embeddedness of TLK is the connection between knowledge and the interests of the knowledge-holder, which is inherently political (Nuttall 1998). In the face of power exerted by governments, Traditional Knowledge is a means for reclaiming power and control for the subordinate group (Usher and Weinstein 1991; Agrawal 1995; Gombay 1995; Nuttall 1998).[46] Said more simply, knowledge-holders want to see their knowledge benefit their interests (Bannister 2005) whether individually or collectively; and as noted above, they use their knowledge to influence and participate in decision-making. Thus, an obvious barrier to the Integration Project is that TLK-holders may not wish to share their knowledge if they perceive that doing so does not serve their interests.[47]

In terms of practical aspects of the application of TLK, TLK is variable in content and quality depending on the holder and the knowledge system. The connection between TLK and the holders' interests may result in excessive bias [my term] and therefore difficulty for researchers in discerning opinion from empirical knowledge (Johannes 1993).[48] TLK may be acquired both across and within generations and be held by individuals or collectives. There is individual variability in observational skill

[45] Another ethical dimension touched on in Section 3.1, that of whether TLK should be compartmentalized and/or extracted from its culture, is not further examined in the thesis.

[46] In the Canadian North, Inuit and First Nations have linked Traditional Knowledge to issues of increased community control and self-government in the wider context of constitutional development (Legat et al. 1991; Irlbacher 1997). Use of Traditional Knowledge is part of a move to revitalize culture (Berkes 1999) and achieve increased autonomy and self-management (Feit 1988) in all areas, including NRM.

[47] In the thesis, I touch on a few barriers stemming from fishers only. These tie in particularly well with the thesis' focus on agency-based barriers.

[48] This idea appeared to be implicit in some of the ways TLK is conceptualized in the literature and in conversation with colleagues (e.g., as anecdotal or subjective, see Section 3.2.1 below).

noted by researchers of TLK (Johannes and Lewis 1993; Nuttall 1998, Neis et al. 1999; Wenzel 1999). Furthermore, not all people have access to the knowledge for cultural reasons (Newell 1993; Nuttall 1998; Berkes 1999). In many indigenous cultures, particular community members carry specific knowledge of NRM, for example, the 'kewang' in Eastern Indonesia (Bailey and Zerner 1992), Cree stewards (Berkes 1999), and House chiefs of the Gitksan and Wet'suwet'en (Newell 1993). In other fisheries, knowledge may not be shared, or only between specific groups of fishers for economic reasons (Pálsson 1991). In many cases, people are not aware of their possession of knowledge or their reasons for doing things a certain way - their knowledge is tacit knowledge (Scott 1998). Informants might not be able to answer questions posed by researchers (and researchers may not know the right questions to ask (Johannes and Lewis 1993). Dynamics of cross-cultural interaction may further complicate accessing TLK (see Section 3.4). Anthropologists address some of these issues by residing longer periods of time in their study sites and using participant observation (Johannes and Lewis 1993). Thus, finding out who is knowledgeable and reliable may require patience, time, interpersonal skills, and other particular skills and training. Many of these issues and methodological approaches to addressing them are raised in McGoodwin et al. (2000), Neis et al.(1999), and Holm (2003).

Given the varied characteristics of TLK and the human dimensions involved, the skills and training of TLK researchers warrants consideration. Anthropologists and sociologists receive particular training on ethical issues and research projects whereas biologists do not. Biologists may have to expand their knowledge and skills, deliberately or out of necessity, depending on the project, or work with social scientists in an interdisciplinary approach (Johannes and Lewis 1993; Neis et al. 1999). Considerable inputs of time and energy may be required to create relationships, establish research agreements, and involve knowledge-holders in research or management. Thus, from both the researchers' and the holders' perspectives, working with TLK may be costly, especially if time-consuming and ongoing meetings are involved and participants do not feel sufficiently compensated (Kofinas 1998) (the barrier of limited resources is raised below, Section 3.5). The above discussion has touched on a number of aspects associated with TLK which can create challenges to working with it, but whether these act as barriers is discussed below (Section 3.4.2).

3.3 Summary of preliminary barriers

Several themes and barriers of potential importance were touched upon above. This section summarizes preliminary barriers of particular interest in the thesis and their potential impacts (Table 2) before discussing them further in the ensuing sections. Note that these proposed barriers are deliberately not extensively referenced since they are elaborated upon in considerable detail in Chapter 7 using the literature cases as evidence. Most of the proposed barriers were my "impressions" at the time (i.e., prior to analysis of the literature cases using the evaluative framework), based on one or a combination of the following: TLK literature (e.g., A2 and 3 in Table 2); literature which informed theoretical frameworks (discussed in Chapter 5) (e.g., C2, and D2 in Table 2); "other literature" (which does not fit in the first two categories) (e.g., D1 and E, which address general barriers to innovation associated with bureaucracies); and personal

Table 2. Summary of preliminary barriers and proposed impacts on the Integration Project.

Preliminary barrier	***Source***
A. How TLK is conceptualized	
1. TLK is defined in a limited way, for example, generally as Level 1. **Impact:** Some TLK is overlooked, for example, Level 2 and 3.	TL TL, L
2. TLK is seen as "not Science". (It is described by a series of characteristics which are the opposite of Science.) **Impact:** a. Other facets of TLK may be ignored or overlooked. b. TLK is assumed to be unreliable or inferior to Science, and dismissed or disparaged.	TL L, TL TF,TL,L, PO
B. How fisheries management is conceptualized	
Fisheries management is conceptualized as Science-based procedures. **Impact:** TLK does not "fit".	OL, PO L, PO
C. How TLK and fisheries management are conceptualized = How the Integration Project is conceptualized	
1. The "integration" of TLK and Science is seen as the integration of TLK into Science-based fisheries management. **Impact:** Other creative options for the Integration Project will not be examined.	TL,TF TL, L
2. TLK is seen as unwieldy, i.e., methodologically challenging (given current procedures of Science-based fisheries management). The strength of this barrier depends on other factors such as attitudes of researchers or financial resources. **Impact:** Limited applications of TLK may result.	TL,TF L,TL
3. There is a lack of awarenesss of the range of issues of potential relevance within the Integration Project. **Impact:** Conflicts between stakeholders may be more difficult to resolve.	TL TF
D. ***Barriers associated with culture*** 1. Cultural differences… **Impact:** …inhibit or obstruct communication between stakeholders.	 TL,OL TL,OL
2. Assumptions of cultural superiority (conscious or otherwise, e.g., educated, urban, scientific)… **Impact:** …may prevent the use of TLK, or if it is used, affect attitudes towards it and its holders.	TL,TF TL,TF

Preliminary barrier	*Source*
E. *Barriers associated with bureaucracies* Characteristics of large government bureaucracies: 1. fragmentation of responsibilities and authorities, 2. hierarchical and centralized decision-making authority, 3. the risk averse and gradualist approaches, 4. limited financial resources and climate of continued cutbacks, and 5. professionalism including recruitment and promotion procedures;…	OL
Impact: …interfere with management agencies' ability to innovate.	OL

Note. "Source" refers to the source of the proposed barrier and is indicated by the following codes: TL=TLK literature, OL=other literature, TF=theoretical frameworks, L=logic, PO=personal observation).

observations.[49] In addition to the above sources, proposed impacts of barriers on the Integration Project were also generated by logic, that is, if-then statements I made by asking "if this is a barrier, how might it affect the Integration Project?" (e.g., impacts A1, A2a, and B in Table 2). Note that Table 2 refers to TLK, since papers on Traditional Knowledge, Local Knowledge, and Fishers' Knowledge were coded in this phase of the research.

3.4 Barriers connected to Science

3.4.1 The conceptualization of TLK

The conceptualization of TLK seemed to be a barrier connected to either the role of Science in NRM or beliefs about Science. First, it appeared that within the context of NRM, Level 1 TLK (Section 3.1) was the most common definition. This appeared to be

[49] An example of how coding was used to generate barrier A1 in the table is as follows. One of the first codes I identified in the open coding phase was "conceptualization or definition of TLK". Thus, in each paper I read I noted this code and its particulars. In time, I observed patterns which led me to choose Berkes' (1999) definition and create the variable "Level of FK examined" (Table 3, the evaluative framework). It also led me to propose barrier A1 – if TLK tends to be defined as Level 1, then other relevant knowledge may be missed (Levels 2 or 3).

the case for both Northern wildlife management (e.g., Gombay 1995; Kofinas 1998) and fisheries management (e.g., Poizat and Baran 1997). This is not surprising considering the central role of natural science within current NRM practice. However, if this is an operating assumption among practitioners, it may result in limits on the contribution of Level 2 and 3 TLK to the Integration Project (A1, Table 2).

Second, TLK was frequently conveyed in contrast to Science - as a series of opposing characteristics (e.g., Johnson 1992; Berkes 1993). As a result, facets of TLK which do not match the typical list of characteristics might be ignored or overlooked. In addition, given the privileged position of Science mentioned previously (and elaborated in Section 5.4), the conceptualization of TLK as subjective, anecdotal, qualitative, local, etcetera, might be connected to the dismissal or disparagement of TLK. Agrawal's (1995) article titled "Dismantling the divide…" was critical in alerting me to the constraints of this dualistic thinking. In fisheries management, researchers have noted the views of scientists toward TLK as dismissive and overlooked (Finlayson 1994; Johannes 1994; Mackinson and Nøttestad 1998), and undependable, and inconsistent (Neis 1992). Whether these views stem from fisheries scientists' *actual experience* with Fishers' Knowledge or from a *cultural perspective* was unclear and became a key question for further analysis in the literature cases. However, I suspected the latter, given the position of Science in society (Section 5.4) and attitudes towards TLK in general. For example, Nader (1996) and Scott (1998) also note that local knowledge is generally overlooked or considered as insignificant, respectively (A2, Table 2).

3.4.2 The conceptualization of fisheries management and the Integration Project

As several social scientists have documented, fisheries management is conceptualized as a process that is based upon Science (e.g., Evenden 2000; Scarce 2000; Weeks 2000). Clearly this conceptualization will act as an immediate barrier to TLK, if TLK is seen as "not Science" (as noted above). The emphasis in this barrier is on what fisheries management *is:* Science is the basis of fisheries management by definition, law, and/or job description, and TLK does not "fit". As a result, it may not be used (B, Table 2).

In cases where TLK was applied, it appeared that the "integration" of TLK and Science tended to be the integration of TLK *into* Science-based fisheries management procedures (C1, Table 2). I also had the impression that fisheries scientists might resist using TLK because it is perceived as unwieldy. There seemed to be a continuum of how TLK was discussed ranging from methodological considerations to difficulties. By way of illustration, contrast proposed barrier C2 (Table 2) restated as assertions which seem to be implicit in some of the literature, with the second, more benign perspective in the following pair of statements:

> TLK is unwieldy. It is difficult to work with (for the reasons mentioned previously, Section 3.2).
>
> TLK has a number of characteristics which are connected to its embeddedness within individuals and cultures. These characteristics may require that researchers pay particular attention to appropriate methods and training of researchers.

Although there are "technical" challenges and material constraints affecting the Integration Project, I suspected that practitioners' *perspectives* on the level of difficulty involved might also stem from "higher level" values, beliefs and institutions.[50] A paper by Nadasdy (1999) combined with my own impressions stimulated this line of analysis of the context within which author-stakeholders discuss methods, challenges, and difficulties associated with the application of TLK.

Finally, as alluded to previously (Section 1.3), it appeared that the range of issues raised in the literature on the Integration Project might be wider for social scientists than for natural scientists. I considered this a facet of the conceptualization of the Integration Project. Schön and Rhein (1994) and Wright (2001) suggest that the awareness by stakeholders of the range of issues involved may facilitate the resolution of conflicts in policy and fisheries contexts, respectively (Section 5.1). By the same token, I propose that a lack of awareness of the range of issues involved in the Integration Project may be a barrier (C3, Table 2). A summary of some of the relevant issues discussed thus far includes the following: embeddedness of knowledge (particularly of TLK); intellectual property/issues of confidentiality; ownership and control of research; methods perceived as challenging or even problematic; and the connection between the TLK-holder and their interests. These issues were given codes and tracked in the analyzed literature (see Section 4.2).

3.5 Barriers connected to cultural differences

A number of authors writing in the field of NRM have raised issues associated with cultural differences which may be relevant to the Integration Project. Decker and Krueger (1993) and Harms and Sylvia (2001) elaborate on cultural differences which

[50] This and other observations noted in in this chapter led me to search for theoretical frameworks which would depict "higher level" or macro-scale influences at the operational level or micro-scale (see Chapter 5).

inhibit or obstruct communication between resource users and scientists or managers (D1, Table 2). Weeks (1995; 2000) examines the differences in language and communication of fishers and scientists from management agencies. In a study of Texas shrimp fisheries, she notes that in policy settings, actors from particular organizations speak particular languages, considerably affecting their ability to communicate. The difference between the life experiences of agency staff (scientists or managers) and knowledge-holders is considerable. In the North, cultural differences contribute to the challenge of using TLK (Bielawski 1984; Kofinas 1998). Even so, there may be variation in culture and values within an agency depending on the branch, location, and positions of staff, for example, research scientists compared to managers (Bullis and Kennedy 1991; Irlbacher 1997). In some of this literature, where the ability to communicate between two parties is emphasized, authors appear to assume that all stakeholders are equal and simply lack sufficient understanding of each others' differences, that is differences are "neutral".[51]

In other papers, hierarchical relations of power are examined as part of cross-cultural interactions. For example, Bielawski (1984) and Winkelaar (1990) explain the dominant-subordinate cross-cultural interaction between scientists and indigenous Northerners as a legacy of colonization. Researchers draw on literature and lenses from one of the major theoretical frameworks within social theory, conflict theory (Neuman 2000) and its offspring. This literature examines how divisions of people into superior and inferior social groupings defined in terms of race, class, religion, and gender

[51] This version corresponds to the first face of power (Bacharach and Baratz 1970), elaborated in Section 5.2.

manifest in social structures, in policies, and in peoples' lives (Sennett and Cobb 1972; Mies 1986; Bishop 2002).

In a fisheries management context, differences between scientists and fishers may involve dynamics of power. Weeks (2000) notes that "[s]cientists hold a ‘privileged position’ relative to the public in the policy arena as a result of their mandates to manage based on the best available science." Within the Dominant Social Paradigm (see Section 5.4), there is emphasis on both specialization and "professionalism" which has served to divide expert and lay people (Schön 1983; Woodhill and Röling 1998). Restrictive assumptions or negative stereotypes among the educated towards the less educated (Winkelaar 1990) may also affect fishers in their dealings with scientists since they tend to have less formal education (Davis 1991).

Potential beliefs or assumptions of cultural superiority (conscious or not) held by practitioners or author-stakeholders might be expressed as negative attitudes toward TLK and TLK holders.[52] These attitudes would not only interfere with communication but might prevent or slow the application of TLK (D2, Table 2).[53]

3.6 Barriers associated with bureaucracies

NRM agencies are large government bureaucracies and are therefore constrained by a number of factors which have been well-studied (Downs 1967, Wilson 1989) and tend to create resistance to change. These features which generally create resistance to change in large government bureacracies are expected to act as barriers to

[52] An important dynamic and potential barrier can also occur where fishers think scientists have little relevant knowledge regarding fisheries. However, the focus here is on agency-based barriers.

[53] Furthermore, these dynamics may not be obvious, as is the case with the second face of power (Bacharach and Baratz 1970) (see Section 5.2).

using TLK since explicitly using TLK is a new policy directive and therefore an innovation (E, Table 2). I will briefly summarize the key aspects here.

Fragmentation of responsibilities and authority (Pinkerton and Weinstein 1995; Morgan 1997; Yaffee 1997) is demonstrated in NRM agencies since different aspects of biology and management of marine resources are divided among different branches or directorates (e.g., stock assessment, habitat and enhancement, and research). In contrast, holders of TLK likely have knowledge across a number of these. Hierarchical (Downs 1967) and centralized decision-making authority has impacts on the capacity for power-sharing in field situations, including local-level co-management boards (Pinkerton and Weinstein 1995). Generally, the local leaders who are present have authority and sufficient knowledge to be able to act, while agency representatives must seek permission to pursue new courses from higher authorities (Gombay 1995). While the latter structure may be viewed as effective for an agency since it limits liability involved in decision-making (Yaffee 1997), it can cause tension and difficulties when agreements or flexible arrangements are made during a meeting and then undone later as has been documented in indigenous contexts (Gombay 1995). Another aspect of the latter scenario is that there also tends to be more sensitivity and experience with TLK in the field, which may not be understood by the center (Gombay 1995; Irlbacher 1997).

Risk averse and gradualist approaches of bureacracies may stifle creativity (Wilson 1989).[54] However, even if the political will were there to challenge bureaucratic resistance, the financial resources are not. One of the biggest barriers to innovation is the continuing climate of cutbacks in NRM agencies (Kofinas 1998). For example,

54 Much literature has recently been written about learning organizations and relevant leadership, total quality management, and building social capital. FOC has picked up on the term “learning organization” in their Strategic Plan of 2000 (FOC 2000), but the initiatives listed rather lack creativity compared to those mentioned in, for example, Senge (1990) and Wilson (1997).

Patton (1993) mentioned a cut of 579 person years in FOC in 1990-91. The Interim Report on Canada's new and evolving policy framework for managing fisheries and oceans (Standing Senate Committee on Fisheries and Oceans 2005) documented effects of severe budget restrictions, with staff witnesses testifying to their inability to accomplish their mandate. Especially in these circumstances, as is characteristic of bureaucracies, staff within different branches may work to protect "turf" in the form of resources (Wilson 1989; Pinkerton and Weinstein 1995; Yaffee 1997).

Finally, professionalism, including recruitment and promotion procedures may act as a barrier to TLK use. Irlbacher (1997) summarizes a number of these, of which the most relevant are: recruitment on the basis of achievement (considered in professional terms), universalistic rather than particularist criteria for promotion, and the focus on maintenance of professional standards. Working with TLK may require other perspectives, including practitioners, particularly natural scientists, working with people. This requires time and skills not currently rewarded in current incentive structures (Kofinas 1998) (see also Section 7.4.4 and the Conclusion). These five features of the structure and culture of large government bureaucracies such as NRM agencies are summarized as preliminary barrier E (Table 2).

4. Development of the evaluative framework

At this point in the research process, the evaluative framework, the data collection tool for analysis of the literature cases, was partially constructed. I had identified the main themes of interest and preliminary barriers to the Integration Project and had begun to incorporate them into the evolving evaluative framework. I had investigated some relevant literature from other fields. Furthermore, as patterns emerged in the data, I had begun to utilize, adapt, or create theoretical frameworks which would facilitate the creation of *insightful categories of analysis* (Creswell 1994).

In this chapter, I focus on various aspects of the evaluative framework: its completion, content, and application. I first address a conceptual model of the Integration Project as a continuum between two poles (Section 4.1). One pole represents the Integration Project within "status quo" or "conventional" fisheries management and the other pole represents the Integration Project within a more "fully developed case" (*sensu* Pinkerton 2003). An example of the latter might occur within a co-management agreement in the Canadian Arctic – with considerable participation of harvesters and explicit incorporation of their knowledge within recognized institutions (such as the case described in Kofinas 1998). I elaborate on the usefulness of this model in *further defining variables for the evaluative framework*.

Section 4.2 reviews the application of the evaluative framework to literature cases and methodological considerations in this second phase of data collection and analysis. I elaborate on the final version of the framework, describing each variable, including “coded themes”.

4.1 A conceptual model of the Integration Project

I sought to situate the versions of the Integration Project conveyed within the literature cases along a range of conceptual and operational "potential". For this purpose, I elaborated on "two proposals" observed by Neis and Felt (2000a) in summarizing approaches to the Integration Project in fisheries management: one in which Fishers' Knowledge is *accessed* by scientists and used to improve *fisheries science*, and the other which extensively involves fishers and their knowledge in fisheries management. Specifically, I describe a model which characterizes the Integration Project in terms of a number of dimensions or variables. These variables can be conceptualized as occupying a position or state along a continuum between two extremes or poles, which represent a range of *possible* states for that dimension.

The first pole represents a kind of status quo referred to by some as "traditional" or "conventional" fisheries management (e.g., Ames et al. 2000; Maurstad 2000; and McGoodwin et al. 2000) with properties closer to that described by Kofinas (1998) in the opening quote of Section 1.2. The opposite pole could be exemplified by Northern wildlife management as encompassed in Land Claims agreements. In these, the use of TLK is institutionalized through Hunters and Trappers Committees and co-management boards, which incorporate TLK through the participation of hunters, for example Kofinas (1998).[55] Between these two poles, each variable has a range of possible values. For example, "Level of TLK" is conceptualized here as having three potential levels (Section 3.1), but Level 1, mainly biological information, appears to be the most commonly

[55] This thesis is not prescriptive – it does not seek to recommend a "one size fits all" approach to the use of TLK. Thus, the latter pole is not necessarily desirable – in fact, Kofinas (1998) is aimed at evaluating transaction costs for local peoples of these more participatory initiatives. A separate project is necessary to evaluate co-management systems in terms of their ability to incorporate TLK. (Most of the cases analyzed here involve government management).

considered. This conceptual model was critical in identifying several variables for incorporation into the evaluative framework.[56]

4.2 Completing the evaluative framework: its content and application

The evaluative framework was applied to two fisheries-specific texts, representing the written products of the most recent major conferences on Fishers' Knowledge in the Canadian fisheries sphere, one organized on each coast: Newfoundland and British Columbia. An edited book, *Finding Our Sea Legs* (Neis and Felt 2000b), was produced from the former. Results of the latter were published as a proceedings of the conference "*Putting Fishers' Knowledge to Work*" (Haggan et al. 2003). I consider this combined collection of "literature cases" to be representative of the state of the Integration Project among those with an interest in it.[57] Focusing mainly on commercial fishery papers in "developed" countries provided a somewhat arbitrary way of bounding the study since the TLK literature is voluminous. A total of 32 papers

[56] Other variables include "degree of participation of users"; "degree of institutionalization"; and "language used to describe the Integration Project".

[57] These authors had sufficient interest and time (or they "made" the time) to write a paper about the Integration Project. The sample analyzed here is therefore biased compared to the "average" level of interest and attitudes toward the Integration Project among fisheries practitioners. The sample is also biased because the literature cases include few cases of interactions between a management agency and fishers' advisory committees or other representative bodies (but see Glaesel and Simonitsch (2003), Lydon and Langley (2003), and Wilson (2003)). Most fisheries scientists and managers are engaged in the Integration Project regularly but may lack the time and/or sufficient incentive (see Section 7.4.4) to investigate it (but see Section 7.3.1 and 7.3.2. for why this is unfortunate). Field work should be done in future utilizing the evaluative framework, participant observation, and interviews. Finally, the texts report on cases which are already several years old. However, given the longstanding nature of many of the dynamics examined here, this bias is not expected to be significant.

were analyzed: 15 from Neis and Felt (2000b) and 17 from Haggan et al. (2003).[58] A few of these papers were the same ones which I used to develop the evaluative framework. However, none of these papers were assessed using a completed framework until the formal analysis stage of the research.[59]

Obviously, the research did not directly analyze actual fisheries management processes but rather focused on written reports. It was an analysis of literature on fisheries and wildlife management, examining cases as they were portrayed by their authors. The author of each report is a participant in an intellectual discussion about the use of Fishers' Knowledge in fisheries management. In addition, many authors were direct participants in working with Fishers' Knowledge in fisheries management processes. Thus, the major focus of the research is on these author-stakeholders. Since academic literature is a product of the NRM system, it is generally not expected to represent the voice and interests of the TLK holder. As previously mentioned, agency-based barriers are the principle focus of the thesis. Nonetheless, fishers' perspectives were cursorily examined in three ways:

1. fishers were the authors of a few of the analyzed articles;
2. some articles written by scientists or others address issues of concern to fishers or contain direct quotes by fishers; and
3. variables were incorporated into the evaluative framework which address aspects of fisher participation in management (see below).

The evaluative framework summarizes in the form of variables, what the authors

[58] In the former, all papers in the book were analyzed within one exception, a case from Nicaragua (Fisher 2000). This includes one paper on a commercial fishery in Greenland in which fishers are indigenous (Roepstorff 2000) and one sport fishery case (Sutton 2000). In the latter, all commercial fishery papers, one sport fishery paper (Wilson 2003), and one paper analyzing social capital in developing country cases (Rudd 2003) were analyzed.

[59] In addition, I am generating theory here, not testing hypotheses.

of the papers "did" at two levels: in the writing of the paper (e.g., which themes were raised; how Fishers' Knowledge was conceptualized), and in the application of Fishers' Knowledge (what was done in the field). Specifically, I used what authors said[60] in three potential ways:

1. authors' statements or assertions (implicit or explicit) were used as direct evidence, for example, authors directly identified barriers;

2. authors' statements were documented or summarized for use as "raw data" which required further analysis; and

3. authors' statements, perspectives (implicit or explicit), or deeds were interpreted or critiqued by myself in accordance with the theoretical frameworks and proposed barriers established in Chapters 3 and 5.[61]

Table 3 lists the variables under four headings: "context", "approach", "barriers", and "evaluative" variables. For some variables not described in Table 3, I briefly review them here. Several variables including "type of management system", "geographic scale", "degree of institutionalization", and "management activities" were adapted from common property and co-management theory, particularly frameworks from Schlager and Ostrom (1993) and Pinkerton and Weinstein (1995), respectively. The evaluative framework was originally designed for a much wider range of papers, including Traditional Knowledge and policy papers. As a result of my choice to narrow the analysis to mainly commercial fishery cases, the contextual variables such as "type of

[60] I have used quotes extensively both in the completed evaluative frameworks (Appendix A) and within the body of the thesis as an attempt to faithfully convey the authors' intention. However, interpretation is unavoidable (particularly with what I refer to as *implicit* material). It was not possible to check with authors regarding what they *actually meant* (as is desirable with interviews (Miles and Huberman 1994)). The large number of papers analyzed was intended to reduce the importance of particular misinterpretations. I also wish to emphasize that my interest is *not* in criticizing individual researchers. I identify patterns in what several to many authors said and did to draw inferences about potential barriers to the Integration Project, and use individual papers to illustrate these patterns.

[61] See "Additional comments" section in the evaluative frameworks in Appendix A.

Table 3. Evaluative framework used for analysis of literature cases.

Identification of Paper

by author
last name of first author
source (SL or PW)
SL = *Finding our Sea Legs*; PW = *Putting Fishers Knowledge to Work*

Context

author type
N = natural scientist; S = social scientist; ID = significant training in both NS and SS (e.g. geographer) or other; F = fisher; FS = fisher with training as a scientist; O = other;

lower case letters refer to affiliation: g = government, a = academic, i = independent or First Nation affiliation

case study location
geographic scale
"local scale" refers to anything smaller than provincial or regional, where "region" arbitrarily and roughly refers to the size of the Gulf of Maine
category of knowledge holders
commercial fishers – inshore or offshore; invertebrate fishers – species specified; sport fishers
context of Fishers' Knowledge use
specific context
elaborate on institutional context or other relevant contextual issues
type of management system; level of governance
local; government; co-management
rationale for Fishers' Knowledge use
authors' goals

Approach

term used for 'Fishers' Knowledge'
term used for knowledge holders
Fishers' Knowledge definition
level of Fishers' Knowledge (see Figure 1)
coded themes
(see Table 4)
theoretical/applied orientation
theoretical; applied; both
key issues addressed
focus or premise of paper, major points made
methods used
general description
degree of participation of knowledge holders in research (or other management activity)
1a data collection (following scientists' protocols)
1b interviewed only or very limited participation
2 formulation of hypothesis or methods and subsequent data collection or some "intermediate" level of participation
3 data interpretation, analysis, conclusions and/or writing in addition to 2, or extensive participation

Approach (continued)

aspects of research methods
(i) protocols for permission
(ii) how is Fishers' Knowledge used/where is it stored?
scope of management activities
A. fisheries biological research
B. fisheries social research

1. policy and law making including allocation, priorities (ecosystems etc.), design of licensing systems
2. stock assessment, determining TAC and monitoring
3. planning and co-ordinating the fishery harvest (openings – timing and space, rules, timing and space)
4. enforcement
5. ensuring the productive capacity of the resource (including habitat and enhancement, protected areas)
6. maximizing benefits to fishermen (marketing, increasing efficiency, reducing costs)

Theoretically, in each literature case, Fishers' Knowledge may be part of a research project, either biological (coded as 'A') or social (coded as 'B'). A second option is that Fishers' Knowledge (Fishers' Knowledge) may be *directly* applied to the six areas or activities of management. In this case, only a number will appear, for example, '6'. If research involving Fishers' Knowledge was done within any of these six activities, *and* this research was then *applied in actual management* (e.g., recommendations were made and then applied as in Gendron (2000)), I coded the case as follows: A or B plus activity numbers without brackets. If the research fell under one of the 6 activities and the authors did not state that it was applied in management, I placed the numbers *in brackets.*

degree of institutionalization
none or negligible; some (elaborated in the thesis)
language used to describe Fishers' Knowledge
language used to describe Science and scientists
language used to describe the Integration Project
includes language such as collect, interview, gather, etc;

Summary scheme for interaction of knowledge systems:
1 Fishers' Knowledge -> FS (fisheries science) as indicated by language "integrating into" FS or implicit in other language
2 Fishers' Knowledge ->FM (fisheries management) as indicated by language "integrating into" FS *and* FM or into FM
3 Fishers' Knowledge+FS (+FM) - 'with' 'combining' two kinds of knowledge (for example Fishers' Knowledge and Science into stock assessment or as a basis for FM)
4 in addition to 3, more obviously collaborative language and/or an approach of Science "into" Fishers' Knowledge
Barriers
raised explicitly or implicitly
Evaluative variables
stakeholder goals
indication of degree of success as relates to stakeholder goals
additional comments
author of the thesis' comments based on theoretical frameworks, additional literature, and occasionally opinion

management system", "geographic scale", and "category of knowledge holders" lack sufficient variation to add more than a bit of additional description of a case. "Author type" was determined using information appearing in the texts (either institutional affiliation, or short paragraphs provided in *Finding our Sea Legs*, and information directly available on the Internet). "Context of Fishers' Knowledge use" is a variable which briefly helps to explain author-stakeholders' and/or institutional motivation to use Fishers' Knowledge. For example, a fisheries management crisis is often one of the "contexts of Fishers' Knowledge use". "Specific context" elaborates on policy interest or background of the agency or fishery which gave rise to the interest in or application of Fishers' Knowledge. The type of management system was not stated in most papers – it was assumed to be "government management" unless otherwise stated. "Rationale for Fishers' Knowledge use" is an explanation usually given by the author in the introduction of the paper, where the use of Fishers' Knowledge in fisheries management is contextualized in a general way. "Authors' goals" addresses goals of the paper and/or of the particular application of Fishers' Knowledge.

"Approach variables" encompass how Fishers' Knowledge is conceptualized and operationalized. The first three approach variables are straightforward (Table 3). "Level of Fishers' Knowledge" was elaborated in Section 3.1. "Coded themes" is a list of codes from Table 4 which applied to the literature case. Themes which were raised by authors had to be mentioned in more than one sentence to be counted. These data were used in analyses described in Chapter 6. "Theoretical/applied orientation" refers to whether the paper is mainly conceptual, applied, or both. "Key issues addressed" and "methods used" elaborate in point form on additional information summarizing the case. "Degree of participation of knowledge holders in research" was loosely adapted from

Table 4. Coded themes which were used in the analysis of literature cases.

General category	Code[62]	Definition
Knowledge, Science	DOUBTQ	authors demonstrate doubts, skepticism, or disparagement of Fishers' Knowledge
	ADOUBT	authors acknowledge the expression of doubts, disparagement, or dismissal of Fishers' Knowledge or its lack of use
	EMBEDQ	authors explicitly mention that Fishers' Knowledge is embedded or context specific (overlaps with the "local" aspect of Fishers' Knowledge)
	ESCI	authors explicitly mention that Scientific knowledge is embedded or context specific
	AHK	authors are aware of the dominant position of Science (within the NRM social system) and thus, the hierarchy of knowledge
	SSNS	authors discuss differences or relationship between natural and social scientists
	SBELIEF	Scientists beliefs or attitudes are mentioned
	VALIDQ	authors mention validity (or related idea); or discuss or question the validity of Fishers' Knowledge as a category; or assume that Fishers' Knowledge must be validated by Science
	AVALID	authors note that scientists doubt the validity of Fishers' Knowledge
	VALSCI	authors raise issues of fact and validity in Science or fisheries science including bias or political influence
	FVALID	authors mention fishers' doubts about the validity of Science
Dualistic aspects/ labelling of TLK/FK; character-istics of TLK/FK	DUALQ	implicit or explicit dualistic labelling of Fishers' Knowledge; lists contrasting or emphasis on the differences between Fishers' Knowledge and Science; including Fishers' Knowledge may be tacit or involve intuition, oral, qualitative; local (aside from its name) that Fishers' Knowledge applies to local settings, is context specific, not generalizable; (all implicitly or explicitly in contrast to Science)
	ADUALQ	authors demonstrate awareness of the above dualistic labelling and/or its connection to the dismissal of Fishers' Knowledge
	COMPLEXQ	authors note that Fishers' Knowledge is methodologically challenging or difficult to work with
	ACOMPLEX	authors link technical difficulties associated with Fishers' Knowledge application to its lack of use
	DYNFK	authors comment on the dynamic quality of Fishers' Knowledge, i.e., it is generated in an ongoing manner
	INTQ	Fishers' Knowledge is linked to its holders' interests; it may be used politically
	METHODQ	authors place emphasis on the importance of methodology in the collection of Fishers' Knowledge or discuss methods for a significant portion of the article (greater than one-fifth of its length)
	SIMIQ	similarities between Science and Fishers' Knowledge are raised
	SUBJQ	authors note implicitly or explicitly that Fishers' Knowledge may be subjective, political, and/or biased
	ASUBJ	authors note implicitly or explicitly that Fishers' Knowledge has been assumed to be political or biased

[62] In order for database search functions to recognize the code and not the portions of a word like SCI of science, some codes have Q on the end of those words to distinguish them.

General category	Code	Definition
Technical aspects of fisheries	EFFCHAN	authors document Fishers' Knowledge on changes in effort in the fishery[63]
	FSQ	authors mention importance of smaller-scale habitats or distribution of fish species; or Fishers' Knowledge of local stocks or subpopulations of fish species
	HP	authors convey the perspective that Science (and therefore) fisheries science is hypothesis testing
	SAMPI	authors note procedural inertia in stock assessment and modelling
Social aspects of fisheries[64]	BUREAUQ	bureaucratic barriers are evident – noted by authors or myself
	CON-FLICTQ	authors explicitly note conflict between fishers and scientists
	CONFM	conceptualizations/paradigms of fisheries management are critiqued or alternatives are raised
	CROSSQ	authors raise issue of cultural differences between fishers and scientists and/or related communication issues
	EFFICQ	increased efficiency in fisheries management from use of Fishers' Knowledge – noted by authors or myself
	ETHIQ	authors raise issue of integrity and respect for Fishers' Knowledge
	IPRQ	authors raise confidentiality and intellectual property rights
	MONEYQ	authors raise financial constraints
	NSQSS	natural scientists quote social scientists' research (other than Fishers' Knowledge literature)
	NEGSOC	authors mention the neglect of aspects of social policy and users' perceptions of fisheries in fisheries management
	NSD	authors' focus on social dimensions of fisheries and/or fisheries management is negligible
	NEGID	insufficient recognition of success factors and their relationship to institutional design (generally *is* some recognition) (not counting social capital which is coded separately)
	NSOCCAP	insufficient recognition of importance of social capital within the literature case
	NFK	authors do not recognize contribution of one or more components of Fishers' Knowledge to endeavour studied (they may not refer to the component as *knowledge* but if its contribution is mentioned, it is not coded)
	APARTQ	authors note importance of or need for fisher participation in Integration Project or fisheries management
	POLIQ	authors note that fisheries management is a politicized forum
	PROTO-COLQ	authors mention protocol agreements with fishers
	APREDQ	authors note that fishers are seen to be motivated by self-interest only; act as predators; negative connotation beyond bias – implicitly "bad reputation"

63 Effort is a fisheries technical term.

64 This is a broad category for purposes of the table only. "Social issues" analyzed in Section 7.3.4 encompass additional or different coded themes than are listed within this "general category" (Appendix C).

General category	Code	Definition
Social aspects of fisheries (cont.)	SOCCAP	importance of social capital, trust, respect, or good relationships between stakeholders is indicated by authors
	SOCLEARN	authors refer to mutual learning or explicitly acknowledge learning from fishers
	ASQIP	authors implicitly or explicitly critique the "status quo" model of the Integration Project
	TRAINQ	disciplinary training is raised
	VALUEQ	authors mention that values play a role in fisheries management
Miscel-laneous	INDIVQ	individual variation is exemplified within the literature case or the theme of individual variation is raised by the authors
	ORGVAR	organizational variation is exemplified within the literature case or the theme of organizational variation is raised by the authors
	POLICYQ	economic and social policies based on modernization theory raised or alluded to or bio-economic model and large-scale/centralized management referred to
	REFLQ	authors demonstrate reflexivity (self-conscious reflection on their research, assumptions, etc. – not only critique others)

Arnstein's (1969) ladder of participation. It applies to research *or related activities* such as mapping. Both "protocols for permission" and "how is Fishers' Knowledge used/where is it stored" may indicate an awareness of issues of ownership and control of the generated data (touched on in Section 3.2) and the potential sensitivity of these issues from the perspective of fishers. "Scope of management activities" was adapted from Pinkerton and Weinstein's (1995) division of fisheries management into management activities. When results for all applied papers are cumulated, this variable is intended to serve as an indicator of how broadly Fishers' Knowledge was used in management in the literature cases, compared to how it might potentially be used. "Degree of institutionalization" documents whether the use of Fishers' Knowledge reported in the case was a "one-off" project or occurred within the context of a larger program or organization. The next three variables examine language used to refer to Fishers' Knowledge, Science, and the Integration Project and were aimed at the underlying assumptions and attitudes of the author.[65] As part of grounded research, barriers which were explicitly identified by authors or which I was able to identify were documented.

The evaluative variables apply only to cases where Fishers' Knowledge was actually used. "Stakeholder goals" gives a preliminary indication of whether the application of Fishers' Knowledge as reported in the paper appeared to meet stated or presumed goals.[66] If there was any information or indication about this, I summarized it under each stakeholder type in Appendix A. I only mentioned fishers' goals when there was a particularly clear case of benefit. Author-stakeholders' goals were elaborated if there was a point of particular interest, if goals were not met, or if they could have been better met (either the author's or my perspectives). Additional comments are a "catch-all" where I draw on theoretical frameworks to raise or elaborate on other relevant issues. With the wide range of papers analyzed, not all variables were applicable to each case.

In applying the evaluative framework to the literature cases, it continued to evolve. I converted several variables which were initially written descriptions to simpler coded versions as a means of summarizing and analyzing the data, for example, I created four numerically coded options for "level of participation" (Table 3). New frames and barriers emerged as well as their potential connections. I expressed these in an

[65] However, people may say, think, and do things that are contradictory or inconsistent. In addition, authors may write for particular target audiences and choose their language and arguments accordingly even though they have different or more complex understandings (e.g., Huntington, pers. comm.); or they may deliberately not express their real opinions because they go against popular opinion, for example, political correctness. I addressed related concerns of representativeness of papers in Footnote 60.

[66] Particular interests or goals of each stakeholder type may facilitate the use of Fishers' Knowledge or act as barriers, and conversely, particular uses of Fishers' Knowledge may help to meet stakeholders' goals. This is an important area of research which I could only begin to examine here, using literature.

increasingly complex web diagram, similar to a causal network (Miles and Huberman 1994) (see Section 6.2). In order to further investigate these connections, several additional codes were created or refined. For example, "doubts about the value of Fishers' Knowledge" was initially a general theme, coded as DOUBTQ. However, there were two kinds of statements about doubts:

1. authors of a paper noted the existence of doubts (in the literature or through personal observation); and

2. authors asserted or implied their own doubts about Fishers' Knowledge.

In the first case, authors demonstrate *awareness of* a phenomenon and in the second case, authors' assertions are *examples of* this phenomenon. I distinguished these two types of codes.[67] I also created a number of new codes to reflect emerging themes or themes interpreted in light of theoretical frameworks or other literature (e.g., NEGID which addresses institutional design, Table 4).

Table 4 is a final selection of themes for which I coded the literature cases. Within each “General category”, codes are listed in semi-alphabetical order according to theme. For example, under the “Knowledge, Science” category, the themes are doubt, embeddedness, hierarchy of knowledge, scientists’ relationships and beliefs, and validity. Table 4 includes the great majority of themes which were raised. In order to investigate and test newer "hunches", I needed to undertake a final application of the evaluative framework, using Table 4, and to more closely examine whether and how

[67] I placed an A in front of the original code to indicate option 1 above. Number 2 remained DOUBTQ. This facilitated relocating the originally coded papers and examining their context further in order to recode. This is a form of "variable splitting", one of 12 tactics used to "generate meaning" during the analysis and initial drawing of conclusions (Miles and Huberman 1994).

authors raised particular themes of interest.[68] Completed evaluative frameworks for all analyzed papers appear in Appendix A. Aspects of their analysis are addressed in Chapter 6 to 8.

[68] The iterative nature of this research is worth mentioning here. When I recoded papers the last time, the thesis was mostly written, all papers had been evaluated using an earlier version of the evaluative framework, and half the papers had been evaluated using a more refined version of the evaluative framework. For example, I was attempting to understand the source of authors' doubts about Fishers' Knowledge: why did authors perceive using Fishers' Knowledge as challenging? Did they home in on methods? Why? And was there a connection between these two? I needed to carefully examine the context in which authors raised these themes.

5. Key theoretical frameworks and premises

This chapter reviews theoretical frameworks and relevant background information which I drew upon in order to analyze the data generated by the application of the evaluative framework to the 32 literature cases. Recall that I began the study with some ideas and preliminary observations about what might be the important phenomena influencing the Integration Project. For example, given the elevated position of Science in society and the power of the state in NRM relative to fishers, I needed to examine theoretical frameworks which address power and its social expression as well as address how a societal-level or macro-scale phenomenon might affect the operational level, that is, the implementation of the Integration Project.

I begin with a summary of the theoretical premises which form the foundation of the research. The discussion in the remainder of the chapter selectively reviews the literature and theoretical frameworks from which these premises were drawn and highlights their relevance to this study. I first briefly review theoretical frameworks which conceptualize the exercise of power within political systems and policy contexts (Section 5.2). Next I elaborate on theoretical frameworks which describe "social systems" and "frames" (Section 5.3). I emphasize the importance of the nested or hierarchical structure of these frameworks and the key role of "high level phenomena" such as deeply held societal beliefs or "metacultural frames". I then discuss the Dominant Social Paradigm, a key part of the social system in which NRM occurs (Section 5.4). Specifically, I briefly analyze the dominant or privileged position of Science as a way of knowing within society, specifically, its evolution within the Dominant Social Paradigm of the West. In doing so, I utilize two additional theoretical lenses, that of "hierarchical dualisms" in which one of a pair of contrasted entities is valued over the other. I note that humans' tendency to structure categories in this way (Yaffee 1997) is ancient and comprises another high level phenomenon, which I refer to as "behavioural tendencies". I combine the aforementioned frameworks and discussion into a larger framework used to make sense of TLK/Fishers' Knowledge and Science within two interacting social systems in fisheries management (Section 5.5). Finally, I locate stakeholders (scientists and fishers) as individuals who belong to a range of embedded institutions within these larger social systems (Section 5.6).

5.1 Summary of theoretical premises

Before elaborating on the theoretical frameworks in detail, I summarize them here in the form of theoretical premises.[69]

1. "Social systems" are comprised of three *nested* or hierarchical levels of interest: the societal level or macro-scale; institutional and organizational level; and the operational level. Three key phenomena of interest at these levels are: social paradigms, institutions and organizational structures, and stakeholders' actions, respectively.
2. "Social paradigms" are societal-level belief structures which organize the social system and are made up of interlinked beliefs or "metacultural frames".
3. Frames are socio-cultural beliefs which operate at the three levels of specificity in social systems (Schön and Rhein 1994). Thus, they are also nested such that metacultural[70] or "high level" frames contain or influence "institutional action frames" (management agency-level frames) which contain or influence lower level or operational frames.

[69] References for the premises are also found in the ensuing discussion.
[70] "Metacultural" is the spelling used by the authors (Schön and Rhein 1994).

4. "Institution" refers to a combination of "rules-in-use" (Ostrom 1992), norms, values, customs, and beliefs. It also includes the notion of "organizational structures" (Bacharach and Baratz 1970).

5. Social systems develop a "set of predominant values, beliefs, rituals, and institutional procedures (“rules of the game”) that operate systematically and consistently to the benefit of certain persons and groups at the expense of others" (Bacharach and Baratz 1970).

6. Power is exercised in social systems in two ways: when one group participates in decisions which affect another; or when a person or group – consciously or unconsciously - *creates or reinforces barriers* to the public airing of policy conflicts (Bacharach and Baratz 1970).

7. These barriers may exist in the form of *institutions and organizing structures* within social systems (Bacharach and Baratz 1970). They can also exist in the form of *"taken-for-granted" or supposedly value-neutral ways of defining reality* or what has value (Ramirez 1999).

8. The Dominant Social Paradigm (DSP) is a phenomenon to which criteria 5 - 7 above can be argued to apply. In section 5.4, I suggest that in the context of the Integration Project, the DSP may result in the creation or reinforcement of barriers to the Integration Project through the privileging of Science as a way knowing within NRM. Furthermore, this may occur in subtle ways – through the unquestioned defining of reality. In particular, the current hierarchy of knowledge is longstanding and can be traced to the evolution of the DSP (and of Science within it). Specifically, Science is seen as the

singular legitimate way of knowing.[71] In addition, technological and scientific approaches to societal problem-solving appear to predominate.

9. The concept of "hierarchical dualisms" defines the result of dualistic thinking which overvalues one half of a pair of categories and undervalues the other. The tendency to categorize Science and TLK as superior/inferior is an example of a hierarchical dualism. Humans' use of hierarchical dualisms is considered to be a "behavioural tendency", that is, a behaviour with ancient roots.[72]

10. Behavioural tendencies are classified as "high level phenomena" along with metacultural frames.

11. Knowledge holders (fishers and scientists) belong to social systems of unequal power. The NRM system is nested within the Dominant Social Paradigm. The position of Science in society directly confers power to government fisheries scientists, which combines with state authority in the form of the management agency.[73]

12. Paradigm shifts appear to be occurring at two nested levels of the Dominant Social System (at the societal level and at the institutional level, for example, the agency) (Section 1.2) such that the power relations between the NRM system and other systems, such as local resource management systems, appear to be changing. Of particular interest in this thesis is whether the analysis of literature cases can shed light on the "depth" or "degree" of this change.

[71] This belief appears to be deep-seated; it dates back several hundred years - but is also related to even older dualistic elements of the DSP (including in particular the rational/irrational; body/mind; and human/nature dichotomies).

[72] These roots or dynamics are not further examined in the thesis.

[73] This is not to say that government scientists agree with managers or decision-makers in higher positions. For example, the Newfoundland cod crisis highlighted the frustration of scientists who felt their warnings were not heeded (Hutchings et al. 1997).

13. Stakeholders' actions, including the pursuit of their interests, occur within sets of hierarchically embedded or nested institutions, each with its own set of rules, beliefs, values and interests.

14. Stakeholder behaviour is *constrained but not determined* by higher levels of social organization and behavioural tendencies of humans. Although stakeholders' behaviour is generally expected to be constrained by predictable higher level socio-cultural factors (beliefs/values), it may also vary from the expected pattern, influenced by potentially identifiable contextual factors. This variability may permit original, creative responses to new situations and social learning.[74]

15. Finally, an aspect of Schön and Rhein's (1994) framework which is not elaborated further here, is that becoming aware of our frames is a necessary step in overcoming policy conflicts. Specifically, they note:

> …we propose that human beings can reflect on and learn about the game of policy making even as they play it...In our view, human beings are capable of exploring how their own actions may exacerbate contention, contribute to stalemate…or…how their actions might help to resolve [problems].

5.2 Power

From a political science perspective, Bachrach and Baratz (1970) develop an analysis of power with two faces. The first face of power is exercised when one party participates in the making of decisions that affect another. This is the face visible to the pluralists who, in examining the pluralist system, assume that people and groups have access to the political system and the exercise of power *can be observed directly* through direct conflicts between actors (Lukes 1974). Bacharach and Baratz (1970)

[74] Woodhill and Röling (1998) refer to social learning as "integrating the creative capacities of people".

note that the second face of power is exercised when a person or group – *consciously or unconsciously* - creates or reinforces barriers to the public airing of policy conflicts. Furthermore, political systems develop a "set of predominant values, beliefs, rituals, and institutional procedures ('rules of the game') that operate systematically and consistently to the benefit of certain persons and groups at the expense of others" (Bacharach and Baratz 1970). Within a policy process of decision-making, Bacharach and Baratz (1970) define non-decision-making as "a means by which demands for change in the existing allocation of benefits and privileges in the community" can be removed in various ways from the agenda by those in power. Lukes (1974) goes further and identifies:

> …something like an inarticulate ideology in political institutions, even in those that appear to be most open-minded, flexible and disjointed - an ideology in the sense that it promotes the selective perception and articulation of social problems and conflicts.

Several areas of more recent social research have expanded on these ideas and include: critical theory as applied to ethnography (Carspecken 1996) or discourse analysis (Fisher 2000), communicative approach to policy (Dryzek 1987, 1990; Weeks 1995, 2000), policy frames (Schön and Rhein 1994), and social constructionism or constructivism (Finlayson 1994; Scarce 2000). These subfields share an analysis of language, social interactions, frames (Schön and Rhein 1994), or ideologies (Trigger 1996) within settings of power relations between groups of social actors. A central perspective in some of this literature is summarized by Philibert (1990): "The ability to dominate derives in part from imposing one's construction of reality as the natural order of things”. Thus, the definition of "dimensions of power" in Ramirez (1999) includes the power to define reality, including what is of value, in addition to the power to influence another's behaviour, and the power to make decisions which can force compliance by others. In an analysis of resource conflicts, Trigger (1996) notes that ideologies reflect sets of values and provide an "organizing framework through which people make "sense" of [their world]". Ideologies are said to be in "contests", that is, competing to be considered "reality" (Trigger 1996). In a similar vein, Schön and Rhein (1994) refer to "contestants in a symbolic contest" who "enter into it on the basis of their interests in the policy situation". Weeks (2000) in a study of Texas shrimp fisheries, uses a framework of "competing languages" and notes that in policy settings, actors from particular organizations speak particular languages. However, these contests may not always happen through debate since one or more sides may be part of the "world of common sense" or "taken-for-granted" (Trigger 1996; Schön and Rhein 1994; respectively).

In the Arctic, Morrow and Hensel (1992) note that the "dominating Euroamerican construction of reality is presented as a culture-free scientific paradigm". Using examples from debates over "essentially negotiable concepts" ("subsistence", "conservation", "customary and traditional use"), Morrow and Hensel (1992) examine policy negotiations between Alaska Natives and non-Native governmental representatives. They suggest that:

> …negotiating parties often assume that contested terms represent congruent realities, and that this assumption may mask deeper cultural disagreements. Nonetheless, Alaska Natives are pressured to *defend their practices* in a manner consonant with approved patterns of Western discourse and logic. [emphasis mine]

Jackson (1995) in an Australian marine context, argues that:

> the dominance of western views and concepts of nature and landscape predicated on western knowledge and values marginalises indigenous concepts of nature and undermines effective indigenous control of social space.

The above discussion goes far in explaining the "TLK policy lag". Specifically, a sense of the extent or strength of socio-cultural barriers to TLK can be gained if we consider the history of Traditional Knowledge in Canada. Traditional Knowledge was first used officially in 1974 during the Mackenzie Valley pipeline hearings and as part of the James Bay and Northern Quebec Agreement in 1975 (Gombay 1995); it has been part of international discourse since the 1980's, including agreements that Canada has signed; it has equal standing with natural science in NRM in Nunavut (McGoodwin et al. 2000) and Inuvialuit (Turpel 1991); yet Traditional Knowledge was incorporated in FOC policy in the late 1990's and remains sparsely used in fisheries management (Neis 1997). Burgess 1999) notes that:

> ...a considerable *rhetoric of acceptance* regarding traditional knowledge has become widespread and this is a credit to the political abilities of indigenous peoples' organisations…However, there is a gap between rhetoric and reality. [emphasis mine]

In the concluding chapter of *Finding our Sea Legs*, McGoodwin et al. (2000) refer to the level of "equality between knowledge frameworks" and they briefly mention the "question of power relations between different groups of knowledge producers". This notion is not further addressed in their paper which serves as a synthesis of the book, although in the same paper in a somewhat different context (political power and the influence of particular interest groups on the state), they note: "powerful groups, including fisher organizations, may decisively define not only the management issues in a fishery, but also the knowledge (i.e. data) necessary to resolve them". Thus, McGoodwin et al. (2000) recognize that power plays a role in defining knowledge and how it is used. However, power has generally been less *explicitly* examined within the context of Fishers' Knowledge, with exceptions within the same volume (Maurstad 2000; Pálsson 2000; Roepstorff 2000) and more recent exceptions (e.g., Holm 2003; Wilson 2003).

In the context of the thesis research, the above literature and frameworks assisted in clarifying ways in which power may be involved in the Integration Project.

Agency scientists have more power than fishers in the role of knowledge production because of the authority attached to government and because of the position of Science in society (Section 5.4.2). Theoretically, they may exercise power within fisheries management by deciding which knowledge is legitimate and which is not.[75] Power may also be exercised through the definition of important terms used in management (Morrow and Hensel 1992); through framing policy (Schön and Rhein 1994); and through institutional structures (see Bacharach and Baratz 1970 in Section 5.6). Frameworks which analyze the hiddenness or invisibility of particular issues as reflecting the exercise of power are particularly important. The above literature affected my decision to not only examine the Integration Project in terms of what was discussed and implemented in the field as conveyed by the literature cases, but to examine what was not discussed and not done. Thus, in developing the evaluative framework to analyze literature cases, I conceptualized approaches to the Integration Project in terms of a range of *possible* approaches. I also analyzed the "coded themes" with this in mind (Section 6.1).

5.3 Social systems and frames

In this thesis research, I examined barriers to the application of Fishers' Knowledge within an analytical framework of "social systems" with a number of relevant features. This framework permitted the examination of the connection between "high level" phenomena, such as predominant belief systems, and how the Integration Project is conceptualized and operationalized.

[75] However, at a higher level of the government hierarchy, scientists may lack the power to influence decisions with the knowledge they produce (e.g., Hutchings et al. 1997). At still higher levels (inter-Ministry and international), fisheries may be considered "unimportant" relative to other priorities such as international relations. This was noted by a high level politician in the context of whether to exclude foreign trawlers from Canada's 200 mile exclusive economic zone near the Grand Banks (Skip McCarthy, personal communication).

A "social system" as defined here includes features mentioned in Bacharach and Baratz' (1970) definition for political systems above: "a set of predominant values, beliefs, rituals, and institutional procedures ('rules of the game')". I also borrowed from Berkes' (1999) concentric circles[76] to depict a social system with a generalized structure shown in Figure 2. The social system consists of a series of nested phenomena as follows:

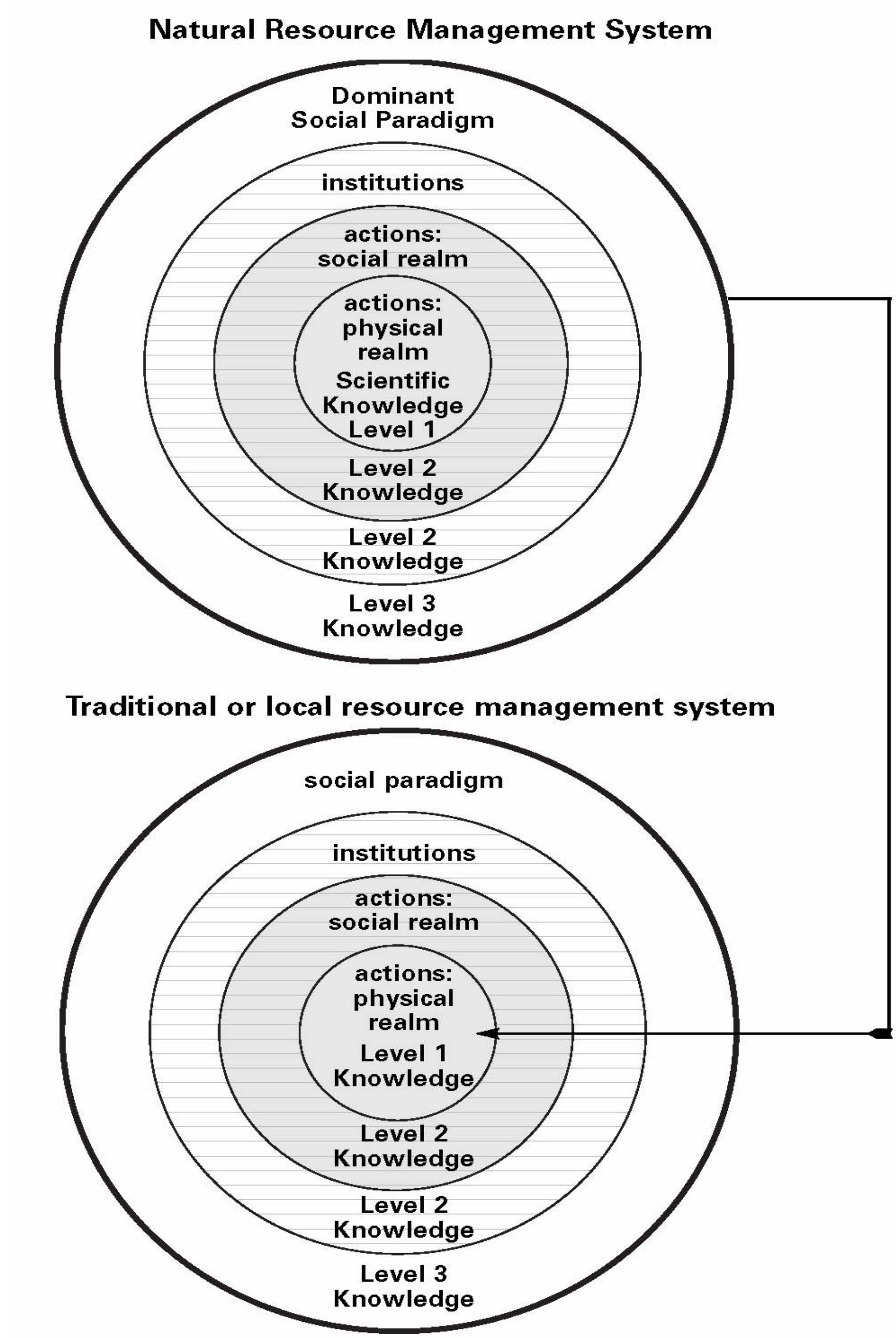
1. "Actions" occupy the innermost pair of spheres (Figure 2) and refer to the situated[77] "actions" of humans. These actions may involve individuals or collectives of varying size. The emphasis is on actions or activities. Within the context of NRM, this level could include fishing, fisheries management activities, or activities associated with the Integration Project (writing about the Integration Project or applying Fishers' Knowledge in a field situation). Human actions are divided for conceptual convenience into actions concentrated within the physical realm and actions in the social realm.[78] In the context of the Integration Project and the levels of Fishers' Knowledge defined here, this division was conceptually helpful. For example, in the NRM system (Figure 2), Scientific research is an action occurring at the level of the physical realm – it produces Level 1 knowledge as previously defined. I designed the analytical framework of a social system to be consistent with Figure 1, thus three corresponding levels of knowledge are shown in Figure 2. This also means that the model of TLK depicted in Figure 1 can be

[76] These concentric circles were used to depict the four levels in which Traditional Knowledge was considered (described in Section 3.1).

[77] The term "situated" reflects context specificity (Lave and Wenger 1991).

[78] This system is therefore a "social-ecological system" as discussed in Durrenburger and King (2000) and in Neis (2003).

Figure 2. Schematic of the interaction between two social systems: the Natural Resource Management system and a Traditional (indigenous) or local resource management system (after Berkes 1999).



applied to knowledge within all social systems. Actions in the physical realm are embedded in the social realm of actions, institutions, and beliefs. "Actions in the social realm" emphasize social interaction and could include meetings, conferences, demonstrations, etcetera.

2. "Institutions" are defined broadly here to include sets of rules-in-use (Ostrom 1990), codes of relationships (Berkes 1999), and the idea of "structured…social interaction" such as government institutions or the institution of marriage (Guy 1990).

3. "Social paradigm" is used synonymously with the notion of world view (Berkes 1999). It may be defined as a "belief structure that organizes the way people perceive and interpret the functioning of the world around them" (Dunlap and van Liere 1978). The concept of the Dominant Social Paradigm (DSP) is a key concept in the thesis. It refers to the dominant belief structure in the West and was alluded to in the quotes of Morrow and Hensel (1992) and Jackson (1995). It is further elaborated in Section 5.4 below.

Another key framework used in the thesis integrates well with the framework of a social system. It concerns the analysis of influential socio-cultural beliefs or frames, elaborated in Schön and Rhein (1994). These authors note that frames "organize our actions, thoughts, and perceptions". "Action frames" inform policy practice. There are three types of action frames, which "operate at different levels of specificity". At the highest and most abstract level, metacultural frames are "broad, culturally shared systems of belief". When metacultural frames are expressed increasingly "locally", they are referred to as "institutional action frames" and "policy frames" (Schön and Rhein 1994). "[I]nstitutions possess characteristic points of view, prevailing systems of beliefs, category schemes, images, routines and styles of argument and action, all of which inform their action frames" (Schön and Rhein 1994). Policy frames are expressed at the policy level in creating or analyzing a particular policy situation (Schön and Rhein 1994). I adapted this approach for application to the thesis research (Table 5). I use the term metacultural frames to refer to particular, general, and influential frames which are part of the DSP. I use the term “institutional action frames” to refer to frames of interrest at the resource management agency level. "Operational" frames refer to frames which apply most clearly to the Integration Project from an *operational* level[79] (see Chapter 7).

These two frameworks and the knowledge framework of Figure 1 share a key feature which is particularly helpful analytically in this thesis – they are nested, or organized hierarchically. Thus lower levels are influenced by the levels above.[80] Table 5 summarizes the frameworks for social systems and frames. As in Figure 1, I use the term "level" to refer to layers of this nested structure. In these frameworks, "High level" phenomena refers to the outermost layer and "low level" to the core position.

Table 5. Summary of the nested components of a social system and of frames.

Level of phenomenon	**Structure of a social system**	**Terms used for frames in the thesis**
High	social paradigm	metacultural
	institutions	institutional action (government agency)
Low	actions – situated activity	operational (Integration Project)

For theoretical purposes, the DSP is considered to be the social paradigm of the social system which includes the Western approach to NRM. In this thesis, I focus on a subsystem of this greater social system, the NRM system, one of two social systems

79 In this thesis "operations" include both writing about and applying Fishers' Knowledge.

80 This is similar in structure and idea to the nested levels of decision-making in Ostrom (1990).

depicted in Figure 2. However, before discussing the interaction between these two systems (Section 5.5), it is necessary to elaborate on the DSP and the connection between it and the position of Science in society and in NRM.

5.4 The Dominant Social Paradigm, Science, and hierarchical dualisms

5.4.1 The Dominant Social Paradigm

The DSP is "the dominant belief structure that organizes the way people perceive and interpret the functioning of the world around them" (Dunlap and van Liere 1978). I suggest that it is arguably the dominant social paradigm in much of the world.[81] A dominant social paradigm consists of “the values, metaphysical beliefs, institutions, habits, etc., that collectively provide social lenses through which individuals and groups interpret their social world” (Milbrath 1984). The DSP reflects the "massive change in the social and economic organisation of Western societies over the last 500 years" (Olsen et al. 1992). These historical developments include: exploration and colonization of lands by European powers, a shift from feudal systems to democratic systems, a shift from rural communities involved in agriculture to urban populations employed in industry (and more recently in service sectors).

Both capitalist and Marxist perspectives theorize a single trajectory of progress (Agrawal 1995), that of 'development' or 'modernization,' which includes the elements of industrial growth and wage labour (Usher and Weinstein 1991). The DSP encompasses

[81] Clearly, there is no "one" paradigm that is dominant everywhere. In reality, there is a mix of competing paradigms, and shifts that are occurring as a result (Section 1.2; Charles 1992; Olsen et al. 1992). However, a premise of this thesis is that there remains a powerful dominant social paradigm with particular and highly influential features discussed in this thesis.

the values and institutions of democracy, acceptance of regulated capitalism, individualism, economic growth, the notion of progress, and *a faith in science and technology* (Olsen et al. 1992). Taylor (1991) refers to "scientific management combined with maximization of independence for each individual" as a key goal of modern society. Beck (1992) refers to "a science-dominated belief in certainty, predictability, and progress." Instrumental reason, which emphasizes means-oriented approaches (Neuman 2000), became a key mode of thought (Taylor 1991; Woodhill and Röling 1998). It is "the kind of rationality we draw on when we calculate the most economical application of means to a given end" such as cost-benefit analysis (Taylor 1991).

> The primacy of instrumental reason is also evident in the prestige and aura that surround technology, and makes us believe that we should seek technological solutions even when something very different is called for (Taylor 1991).

In the context of the extraction and management of natural resources, the faith in technological solutions to problems facing humans has been refered to as , a technocentric perspective, techno-utopianism, and techno-optimism (Pearce and Turner 1990; Guha and Martinez-Alier 1998; Wackernagel 1999; respectively). Guha and Martinez-Alier (1998) refer to:

> scientific industrialism [which] seeks to replace the anarchy of the market with a rational programme of state control. Industrial capitalism may be ecologically wasteful, but scientific expertise, if backed by legislation and an activist state, can assure the sustained yield of natural resources so crucial for human welfare.

The above brief summary of some of the key components of the DSP make evident the influential and important position of Science within the DSP and also imply that the evolution of Science is inseparable from the evolution of the DSP.

5.4.2 The rise of Science

Wilber (1998) notes that the process leading to the "dignity of modernity" involved "the differentiation of art, morals, and science…[which] permitted all three spheres to be pursued unencumbered by brutal domination of the other spheres" (Wilber 1998). He uses Galileo as an example of the Church's domination of the scientific search for truth (Wilber 1998). The "stunningly successful methods" of Science (Gould 2003) have transformed human societies materially through the eradication or control of certain diseases and the provision of lifestyles of relative ease for many on the planet. These successes fall under Wilber's (1998) notion of "the dignity of modernity". Within the DSP, Taylor (1991) notes "the prestige of science" and Chalmers (1999) notes that "science is highly esteemed". Gould (2003) quotes historian of Science, Richard S. Westfall: "The Scientific Revolution was the most important 'event' in Western history…For good and for ill, science stands at the center of every dimension of modern life."

The successes of Science have also generated positive societal attitudes towards it, which have been reinforced through education and the media. Today, the societal value placed on Science manifests in NRM institutions' policies and guiding principles which specify the "best available Science" (Weeks 2000). The Province of British Columbia uses the term "science-based" repeatedly in their policy and promotional material, as on the cover of a recent brochure on the “New Era of Land, Water, and Air”. Of four bulleted points, two mentioned the phrase “science-based”. "Scientific excellence" appears in the 5-component vision of FOC (FOC 2000). The influence of Science also manifests in the way that various interest groups use Science to legitimize their perspectives.[82]

The successes of the Scientific method are attributed to a number of its features (Chalmers 1999; Neuman 2000). Gould (2003) refers to the "modern concept of science" as "discovering new truths of nature through observation and experiment". This involves utilizing systematic procedures and recording them in detail so they may be replicated by other scientists (Chalmers 1999; Gould 2003). The disinterested, objective observer is fundamental (Chalmers 1999; Neuman 2000). In addition, quantification of observations is highly valued (see below). Through this combination, Science is considered to generate knowledge which is valid and reliable.[83]

In the discussion which follows, I focus on two characteristics of Science which are particularly valued within the DSP: objectivity and quantification. Nader (1996) notes that Western science is generally considered separate from (or in other words, not "embedded in") social, political, economic, and even technological contexts. Although this has changed in many intellectual spheres including both the philosophy and

[82] For example, debates are raging regarding the extent and cause of global warming, and oil companies are actively funding scientific research and media campaigns to combat a global scientific consensus (Mooney 2005). Environmental non-governmental organizations (ENGOs) employ scientists and their studies to further their advocacy work and provide alternative perspectives from government. Given this thesis topic, an interesting example involves a collective of ENGOs in British Columbia. They recently criticized FOC's choice of Rockfish Conservation Areas as being not sufficiently scientific. The areas were selected in a participatory process involving fishers.

[83] Chalmers (1999) examines the notion of objectivity and a series of claims regarding the commonly held perspective that "science is derived from the facts". Although he deconstructs much of this notion, ultimately he formulates a "defensible version of it".

sociology of Science[84], Science was accepted by key thinkers as recently as the 1970's as a special case in the field of sociology of knowledge, as expressed by Mannheim: "… natural science, especially in its *quantifiable* phases, is *largely detachable* from the historical-social perspective of the investigator" [emphasis mine] (Mulkay 1979). The assumption is that it is easier to be objective when measuring something, especially if the protocols are described in detail and therefore potentially repeatable by others (Chalmers 1999). Mulkay (1979) summarizes the methods and concepts of natural science as concerned with: "notions of the natural world as timeless, static, unchanging, and universal"; consisting of "objective phenomena", knowledge of which can only be obtained by "reliance on sense data and by accurate measurement". Thus, an objective natural science reveals natural laws through the combination of: "agreed upon methods and criteria", and "unbiased, detached, observation" of "invariant nature".

Up to this point, the discussion has focused on the positive aspects of Science in terms of material outcomes and touched on characteristics of this approach to inquiry which permits the investigation of nature in a relatively objective way. However, the evolution of Science within the DSP also impacted other spheres. The rest of the quotation from Westfall in Gould (2003) is: "[Science] has shaped most of the categories

[84] Scholars in many fields, especially since the 1970's have challenged the disembeddedness of Science (Latour 1987; Longino 1990; Hellyer 2003) as well as the predominant versions of the history and workings of Science as linear accumulations of knowedge (Kearney 1971; Hellyer 2003). The "theory of practice" focuses on how knowledge and cognition, including Science, are situated in particular contexts (Latour 1987; Lave 1988). Kuhn's (1962) seminal work on paradigms and science was the first to identify social influences on the acceptance of new ideas and discoveries. Researchers have shown both historically and recently that a researcher's experiences and views potentially affect the questions and hypotheses that are formulated, what is observed (Chalmers 1999), the research and analytical methods selected (including spatial and temporal scale), and interpretation of results. Gould (2003) and Chalmers (1999) discuss the knowledge and frameworks which are prerequisities to the generation of knowledge. Bias, manipulation of data, and the influence of ideas or powerful interests on funding and research outcomes including publication have been demonstrated (Chambers 1983; Neuman 2000). Within the context of Fishers' Knowledge, Neis (2003), Pinkerton (2003), and Pálsson (1995; 2000) are some of the authors who have discussed the embeddedness of both Science and TLK.

in terms of which we think, and in the process has frequently subverted humanistic concepts that furnished the sinews of our civilization". Wilber (1998) also refers to "the disaster of modernity", which is characterized by a "powerful and aggressive science…[which began] to invade and dominate the other spheres, crowding art and morals out of any serious consideration in approaching 'reality' ".[85] This dynamic has been referred to by philosophers as "scientism" (e.g., Dupre 1976; Wilber 1998). Similarly, Gould (2003), in his book with the subtitle "mending the gap between science and the humanities", notes that scientists "have often ventured beyond their sources of genuine expertise and claimed special insight into ethical issues for the logically invalid reason of superior factual knowledge about questions relevant to the debate at hand".[86] Brown (1989) notes:

> To the degree that a positivist theory of scientific knowledge *has become the criterion for all knowledge*, moral insights and political commitments have been delegitimized as irrational or reduced to mere subjective inclination. Ethical judgements are now thought of as personal opinion [emphasis mine].

The role of quantification in the superior position of Scientific knowledge is evident in the following:

> …the ideal of true knowledge was so construed that all attempts to attain a type of knowledge aiming at the comprehension of *quality* are considered as methods of *inferior* value [emphasis mine] (Mulkay 1979).

Lord Kelvin (Sir William Thompson) conveyed a similar sentiment in this particularly well-

[85] The personification of Science occurs frequently in the writing of both scientists and non-scientists.

[86] Gould (2003) also refers to "the perception of certain humanistic modes of study as impediments to be swept aside" which existed at the time of the "beginning of modern science". His thesis to account for this overstepping of Science is that this crucial time of the birth of Science necessitated a kind of defensive strategy. However, the early "natural scientists" he quotes in Chapter 3 did not appear to be in danger of being persecuted by the thinkers they were critiquing (actually belittling). Nor does Gould provide evidence of the Renaissance-style humanists, for example, disparaging the "new scientists". Thus, the dismissive tone directed at those whose work reflected distinct intentions from the new scientists, hardly appears necessary for "defensive" reasons.

known quotation:

> When you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge of it is of a meager and unsatisfactory kind; it may be the beginning of knowledge, but you have scarcely, in your thoughts, advanced it to the stage of science (Thompson 1883).

This perspective on quantification persists and thrives today. Within social science, Neuman (2000) discusses a number of factors which led to the dominance of positivist social science research (in the language of this thesis: "social Science"). He notes the shift toward "objectivism – a strong version of positivism" during the 1920s in the U.S. and the value placed on quantitative and "value-free" techniques. At the World Fisheries Conference 2004, one of the keynote speakers noted: "If you can't measure it, it doesn't exist".

5.4.3 Hierarchical dualisms

An explanation of how and why Science came to dominate other ways of knowing is beyond the scope of the thesis. However, it is worth noting in this context that the evolution of Science is inseparable from the evolution of the DSP.[87] I suggest that a key theoretical concept which contributes to an explanation of the evolution of the dominance of both is the concept of "hierarchical dualisms". A hierarchical dualism is a

[87] Both the Scientific revolution and the DSP reflect the emphasis on reason from times pre-dating the Scientific revolution. See for example Kearney (1971), Dupre (1976), Capra (1982), and de Bono (1990), for various accounts of how this emphasis evolved and combined with the increased emphasis on empiricism in the 16th century within the new Science. In terms of the evolution of the DSP, the word "dominant" within the term DSP suggests that some beliefs and ideas prevail over others. Researchers have noted that the exercise of power and control over both people and nature has been an important component of the historical developments leading to the DSP (Merchant 1980; Capra 1982; Lertzman 1998). Power was exercised in deeds, through colonization, slavery, trade, and industrialization. Merchant (1980) notes the use of Science as a tool quickly harnessed by the bourgeousie to develop the technology for industrialization. Irlbacher (1997) notes how Science and scientific institutions have accompanied the increased resource extraction that is a part of colonization of the Arctic. Harding (1991) and Smith (1999) critique Science as inseparable from structures of power which have oppressed women and colonized peoples.

pair of entities or concepts which are contrasted such that their differences are over-emphasized or demarcated, then one of the two is devalued (see Section 7.1.3). Feminist theory and other social theory have pointed out that hierarchical dualisms reflect the exercise of power, for example, in which a dominant social group defines which values, ways of knowing, or peoples, are superior and inferior (Kabeer 1994). For example, Mies (1986) refers to "dualistic and hierarchically structured divisions" and gives a range of examples: humans and nature, rational and emotional, body and mind, etcetera. Influential hierarchical dualisms are ancient. For example, the body/mind dichotomy dates back to the time of Plato (Damasio 1994) and the human/nature dichotomy to at least 4000 years ago (Scarce 2000). Humans' use of hierarchical dualisms falls within a theoretical category which I refer to as "behavioural tendencies". This type of "behavioural tendency" probably originated in a mixture of biological and cultural evolution. I will not examine details or origins of human behaviour further. The term "behavioural tendency" was used as an additional category of high level phenomena along with the DSP and its metacultural frames. It was a helpful category in terms of tracking the origin of certain influential phenomena in the Integration Project (Section 7.1.3).[88]

Hierarchical dualisms are implicit in historical references to women and peasants (Merchant 1980) and the inhabitants of colonized lands.[89] They were also apparent in scientific inquiry during the evolution of the DSP. Fisher (1980) tracks the notion of

[88] Specifically, I connected behavioural tendencies to dualistic thinking characterizing the conceptualization of TLK and Science (Section 7.1.1 and 7.1.3) and power relations based in culturally defined tendencies (Section 7.5).

[89] For example, Henry VII of England in 1496 instructed John Cabot to "conquer, occupy and possess" the lands of "heathens and infidels" (Fleet 1997). Captain Vancouver referred to individual Indians as behaving "more like a brute animal than a rational Creature" (quoted in Fisher 1980), and women were similarly labelled as "irrational creatures" as a result of their “weak and emotional” natures (Smith 1976).

British superiority and aboriginal inferiority in the late 1700s through the 1800s, noting that by the late 1850s, "[it] was being solidified from a generally held hypothesis into an empirically proven doctrine by the work of scientists". Gould (1981) also documents how scientific studies were conducted to examine the inferiority of particular peoples and genders by measuring brain size. This quotation from 19th-century geologist and explorer John Wesley Powell reflected a strong current of the time period: "In savagery, the powers of nature are feared as evil demons; in barbarism, the powers of nature are worshipped as gods; in civilization, the powers of nature are apprenticed as servants" (Guha and Martinez-Alier 1998). Even the terms the "Dark Ages" and the "Enlightenment" are informative (Lertzman 1998). The expression "out with the old, in with the new" captures the perspective towards knowledge which emerged with modernity and is also an example of a general and timeless dualism within the English language.

A hierarchical dualism in the form of the historical "overvaluing" of values connected to objectivity helps to explain a number of trends including the emergence of Science as the dominant way of knowing; and the undervaluing of art and morals (Wilber 1998), social science,[90] and other ways of knowing including TLK.[91] I refer to the

[90] Mulkay (1979) found a prevalence of thought, in reviewing the sociology of knowledge, that strongly distinguished between methods and concepts from the natural sciences and those of the social sciences. In the latter, the "products of human culture must consider aspects of time," (for example history), and therefore cannot be observed in a "detached, uniform" way. Seachrist (1996) reported on two Congressional bills in the U.S. which attempted to eliminate the National Science Foundation's social science branch. Frost (1995) summarized researchers at Columbia in a news article: "Although the social sciences are integral to news reporting, experts say, the public generally doesn't consider these sciences truly scientific. Lay people and academicians alike tend to judge fields such as sociology, psychology, and political science as "soft" because they are presumed to be understandable, devoid of mathematical rigor, and concerned with everyday concepts such as interpersonal relationships. On the other hand, astronomy, physics, and biology are more "scientific" because they are deemed difficult, demand exactitude, and concern discoveries far removed from routine human experience, such as atomic forces or DNA." Within the environmental and social sciences, qualitative research is undervalued in comparison with quantitative research (Lawrence 1993; and Madjar and Walton 2000; respectively).

hierarchy of knowledge to summarize this phenomenon. The overvaluing of one mode of knowledge production to the exclusion or undervaluing of others has not only ethical but pragmatic implications. The latter may involve constraint on humans' ability to see or seize new opportunities, which in turn affects the ability to learn and adapt to change (Woodhill and Röling 1998).[92] This idea is expanded in the discussion with specific reference to fisheries management (Section 7.1.3).

The section above (and its three subsections) have attempted to situate the evolution of Science in a social context which results in the belief in its superiority, to the exclusion of other ways of knowing. My interest in this thesis is to examine attitudes toward Science and Fishers' Knowledge in fisheries management, and if warranted, to identify their connection to beliefs and values which emerge from the history of the DSP. These beliefs and values are expected to be prevalent in state fisheries management bureaucracies and in university fisheries departments.[93]

91 Other ways of knowing includes women's ways of knowing (Harding 1991) and knowledge gained through intuition or revelation (Lertzman 1998; Wilber 1998). Damasio (1994) notes: "The fact that psychological disturbances…can cause diseases of the body proper is finally beginning to be accepted…Of course our grandmothers knew all about this: they could tell us how grief, obsessive worry, excessive anger…could damage hearts, give ulcers, destroy complexions…But that was all too "folksy", too "soft" as far as science was concerned…" Lave (1988) discusses "dualistic distinctions" of many types and how they have resulted in "great divide" theories in anthropology and elsewhere. These theories divide societies into those that are "knowledgeable and powerful from those that are not, but couched in apparently value-neutral dichotomies between 'civilized' and 'primitive' cultures, 'scientific' and 'everyday' spheres of activity and/or modes of thought."

92 Antonio Damasio (1994), a renowned neurobiologist discusses the body/mind split and how Descartes' re-emphasis of it ("I think therefore I am") is still highly influential in medicine today. He notes that “many cognitive scientists who believe they can investigate the mind without recourse to neurobiology would not consider themselves dualists. Both the psychological consequences of diseases of the “body-proper” and the body-proper effects of psychological conflict are neglected as a result of this dualistic split. The prevailing thinking from Hippocrates to the Renaissance was "the organismic, mind-in-the body approach".

93 In this vein, Woodhill and Röling (1998) critique: “ways of thinking, approaches to problem solving and institutions founded on the ideological view that empirical science is the epitome of human reason and the primary route to truth and human understanding. Contemporary philosophy, social science and physics have shown many earlier beliefs about science and its place in human affairs to be demonstrably false. However, despite this emerging realisation, the professional practice and organisational culture of many institutions, and notably those with EM [environmental management] responsibilities, remain dominated by patterns of what Miller (1985) refers to as "technological thinking’ ”.

5.5 Interactions between two resource management systems

The framework in Figure 2 is one conceptualization of the "integration" of TLK into fisheries management. It depicts the interactions between two systems: the NRM (NRM) system and a Traditional or local resource management system. Natural Resource Management System is capitalized in Figure 2 because it refers to a particular social system which falls within the DSP and contains the state apparatus to manage fisheries. Knowledge emerges within a system and is depicted as embedded within various layers within these systems. Both systems are products of historical and social processes. “Traditional” in Traditional management system is capitalized since it refers to indigenous peoples’ knowledge. However, “[Traditional] or local management system" is not capitalized since it is intended to apply as widely as possible, to cases ranging from self-management (a local or Traditional resource management system, where still existent, for example, the James Bay Cree as reported in Berkes (1999)), to a high-technology, large-scale fishery, which is much more integrated into the NRM system. Depending on the particular case of TLK application, these two systems will differ from each other to varying degrees.

Cultural ecologists would argue that TLK has always existed as part of humans' ability to adapt and problem-solve in their environments (Berkes 1999). This knowledge has acquired particular names and conceptualizations as its potential usefulness to those not possessing it has increased. The arrow in the framework depicted in Figure 2 is shown as stemming from the NRM system, pointing at Level 1 TLK. It is intended to represent the greater power of NRM systems compared to TLK systems (where power is the ability to define "reality" and influence decisions – here, within the realm of knowledge production).[94] The arrow also depicts what appears to be the NRM system's focus of interest – Level 1 TLK.[95] This depiction of the Integration Project as two interacting systems recognizes the *probable* dynamic of a "knowledge extraction" model, given the previous discussion in this chapter. However, I began the thesis by contextualizing the emergence of TLK as a paradigm shift. Thus, the research investigates the possibility of other dynamics between the two systems in the literature cases examined. These could be represented as arrows pointing in the opposite direction or at different levels between the systems as opposed to the single arrow portrayed in Figure 2.

5.6 Interactions among stakeholders

At the operational level, each of the systems is conceptualized to contain stakeholders which interact with each other. Stakeholders are conceptualized as actors who belong to various social groups and institutions which are located within nested and overlapping hierarchies. These institutions may have their own distinct cultures.[96] In this model, both the interests which actors pursue (Schön and Rhein 1994) and the constraints on their behaviour vary at different levels of the hierarchy. Thus, a more accurate diagram than Figure 2 would locate stakeholders within overlapping and multiple layers of nested institutions, beliefs, and values. For example, since this thesis

[94] Exceptions may include less frequent cases in which there is minimal interaction between state fisheries management systems and local systems.

[95] The arrow is not meant to represent that TLK-holders are merely passively acted upon by other actors or stakeholders. That stakeholders in Traditional or local management systems are interested in Science and interact with the NRM system is also the case.

[96] Social groupings or institutions to which stakeholders belong include, for example, family, village, occupational, religious, government, ethnic, national, etcetera. Guy (1990) defines culture as including the following: beliefs, customs, expectations, attitudes, traditions, symbols and values.

focuses mainly on commercial fishery cases with state management, Figure 2 would more accurately depict the Fishers' Knowledge system as a smaller circle or subsystem partially or even completely contained within the NRM system, or larger circle.

This model links grand social theory on the influence of society (e.g., the class conflicts of Marx), with more complex and recent social and ecological theory.[97] It acknowledges that actions and decisions of individuals are influenced by conscious or unconscious beliefs and values as well as institutional structures operating at a number of scales. Bacharach and Baratz (1970) refer to the effects of "collective forces" and “systemic or organisational arrangements in which biases in political agendas *automatically result* from the form of organisation”. Thus, "collectivities and organisations are made up of individuals but the power they exercise cannot be simply conceptualised in terms of individuals' decisions or behaviour" (Bacharach and Baratz 1970). Taylor (1991) refers to "the institutions and structures of industrial-technological society [which] severely restrict our choices". In the context of the thesis, this theoretical framework points to the existence of structural or systemic barriers to the Integration Project. Clearly, it is insufficient to focus on individuals' behaviour within the context of the Integration Project.

Another form of potential constraint on stakeholders reflects the legacy of biological and cultural evolution. As previously mentioned, I refer to behaviour which appears to have ancient roots as "behavioural tendencies". However, the model I elaborate here allows for the potentially critical role of individual and organizational

[97] This is an approach shared by both ecology and social science, where at different scales or institutional levels, respectively, key influential factors vary (Lave and Wenger 1991; Kabeer 1994; Holling 1995; Jentoft et al. 1998; Steins and Edwards 1999). See Wright (2001) and Finlayson (1994) for examples of this thinking applied in a historical and political analysis of the industrialization of the Newfoundland fishery and a sociopolitical analysis of the collapse of the Newfoundland cod fishery, respectively.

variation (Schön and Rhein 1994). Behaviour is seen to be constrained but not *determined* by social (or biological) influences.[98]

I began this research with the following stakeholders in mind: social scientists, natural scientists (university and government), fishers, fisheries managers, and policy makers. However, the first three of these ultimately became the focus.[99] These stakeholders are presumably pursuing their interests in a variety of ways including through their involvement in the Integration Project. Stakeholders' contribution to a fisheries management process will be affected by their beliefs and values, only some of which will be shared (Ostrom 1992). For example, although research scientists may share some common perspectives and training, natural and social scientists will differ.[100] More specifically, although the DSP is considered to influence all stakeholders, its beliefs and values are not evenly shared within and among the stakeholder groups. In particular, beliefs regarding the superiority of Science are expected to be stronger among natural scientists, and these beliefs may act as barriers to the use of Fishers' Knowledge (see Sections 3.4, 7.3.4, and 7.5).

As implied by the model just described, the strength of barriers to using Fishers' Knowledge will depend on a dynamic interplay among various levels and kinds of influencing factors. This thesis research attempts to identify in a *preliminary manner*,

98 Recognizing the ancient origin of behavioural or cultural patterns does not have to provide an excuse for the *status quo* (in the way of biological determinist schools) since there are numerous examples of human societies and individuals who have changed longstanding practices, for example, the abolition of slavery.

99 The thesis' focus was *literature* cases, and none of the papers analyzed was written by a policy maker or fisheries manager (although the differences between agency scientists and fisheries managers may vary with fishery and agency).

100 Similarly, fishers may share some interests, perspectives, beliefs and/or knowledge. However, consider potential differences between inshore fishers living in rural areas and offshore fishers living in urban areas. This research lacked sufficient information for these kinds of differences to be examined.

patterns and related factors, even in apparently exceptional cases. For example, individuals may behave in relatively autonomous ways despite their institutional affiliations (see e.g., Winkelaar 1990; Irlbacher 1997), or there may be variability within the organization among position, branches, or geographical regions (e.g., Bullis and Kennedy 1991; Irlbacher 1997).

Barriers to the Integration Project are consciously or unconsciously erected/reinforced in two settings of interest. The first site is within the often peer-reviewed literature on NRM. The second site is the fisheries management process. Analyzing literature cases allows for the direct examination of the former and the indirect examination of the latter (see Chapter 4). Authors of analyzed papers are stakeholders who participate in the first or both of these settings. The theoretical frameworks summarized in this chapter combine to form the foundation or lenses through which I then analyzed the completed evaluative frameworks.

The DSP is clearly an oversimplification of the current situation, generally and within fisheries. Beck (2000) sees its "replacement by diverse and less hegemonic systems of belief as part of a new modernity". A shift is occurring, and the opening up of fisheries management to include other ways of knowing is part of this process.[101] My interest is precisely in investigating *the range* of conceptualizations of Fishers' Knowledge and its use in fisheries management and attempting to identify and understand related patterns. In doing so, one of the principle areas of research is to investigate whether and how the legacy of the DSP currently affects the Integration Project.

[101] Similarly, Holm (2003) refers to two kinds of Science and Funtowicz and Ravetz (1993) refer to post-normal Science.

6. Analysis of evaluative frameworks and building the influence network

In this chapter, I explain how the data, in the form of completed evaluative frameworks (Appendix A, B),[102] were analyzed and how particular theoretical premises and frameworks contributed to interpreting findings. I used two key methods of analysis. First, I analyzed the coded themes which were raised in the literature cases. I did so in a number of ways and for a number of purposes which are described below (Section 6.1). Then, building on the patterns identified in these analyses, I began to construct an "influence network" (Section 6.2). This is a complex web diagram which connects patterns and observations in the data with theoretical frameworks and additional literature to construct a "theory" *sensu* Strauss and Corbin (1994) of barriers to the Integration Project.

6.1 Analysis of coded themes

Recall that as part of the evaluative framework, I coded the literature cases for the themes listed in Table 5. I created a database in a spreadsheet format of coded themes raised in each paper. Since it is common within scientific literature to at least mention potentially relevant factors pertaining to one's research topic, I assumed that the profile of themes raised in the sample of 32 papers was indicative of authors' *collective* interests and/or awareness of issues[103], and that by extension, this is indicative of the

[102] The completed evaluative frameworks are found in Appendix A. I also created a spreadsheet which summarizes the main points from the evaluative frameworks, Appendix B. Several "text-heavy" variables are not included in Appendix B.

[103] *Individual* papers discuss issues which connected to specific goals of the research. The assumption only applies to the *collection* of papers.

current range of perspectives in fisheries management regarding the Integration Project.[104]

Following Miles and Huberman (1994) and Carspecken (1994), I tracked the frequency with which issues were mentioned. This demonstrated two patterns of particular interest: issues which were mentioned (relatively) frequently, and those which were underrepresented or absent from discussions. The over and under emphasis of issues was particularly revealing in terms of how the Integration Project, fisheries science, and even fisheries management were conceptualized. The discussion and theoretical frameworks of power (Section 5.2) were key here since they suggest that assumptions or "taken-for-granted" versions of reality underlie these results.

The data on the frequency with which themes were mentioned were used in potentially different ways depending on the context. If a particular coded theme represented authors' *assertions* (i.e., authors pointed out a phenomenon) and appeared in several literature cases, this pattern could be considered as additional, *direct*, evidence to support a preliminary barrier (Table 2).[105] If a particular coded theme represented an *example* of a new phenomenon (see Section 4.2) and this theme was mentioned frequently, the pattern required an explanation.[106] Alternatively, the pattern could be connected to preliminary barriers and theoretical frameworks (Section 5.2). For example, many authors mentioned the issue of validity of Fishers' Knowledge (VALIDQ), and only one mentioned the validity of Science. This too required an explanation.

[104] Recall also that this sample may be biased in terms of authors' interest in and support of the Integration Project relative to other researchers and agency staff.

[105] For example, six authors raised the issue of the hierarchy of knowledge/superior position of Science in society, and linked it to "doubts" about Fishers' Knowledge. This provided additional evidence related to preliminary barrier A2b (Table 2) (code AHK, as discussed in Section 7.1.2).

[106] For example, the repeated mention of local stocks in the literature seemed to be indicative of a barrier not previously considered. It therefore required an explanation (code FSQ, see Section 7.2.2.3 and 7.2.3).

However, there was already a context within which to search for it – preliminary barrier A2 (Table 2) and related theoretical frameworks.

The previous example also illustrates how I used this approach to examine dualistic contrasts between Science and TLK/Fishers' Knowledge (preliminary barrier A2, Section 7.1.3). Coded themes facilitated an assessment of whether authors raised issues which applied to *both* Science and TLK – the premise being that if two phenomena are being "integrated", both need to be examined. This is somewhat similar to a chi-square test (Siegel and Castellan 1988) in which the ratio of the observed pattern is compared to the expected (for example, skewed sex ratios when one expects a 50-50 sex ratio). In this thesis research, there tends not to be an expected proportion of themes or statements. Nonetheless, patterns which demonstrate *conspicuous* absences and emphases require attention and explanation (Miles and Huberman 1994).

I compared the frequency with which particular themes were mentioned in literature cases written by natural and social scientists as a means of exploring the purview of each within the Integration Project. These trends were sometimes revealing in terms of preliminary and emerging barriers.[107] In addition, I analyzed the frequency with which "social issues" were raised by each author type. The results of this analysis as well as the codes which were classified as "social issues" are listed in Appendix C and elaborated in Section 7.3.4.

Finally, another way in which I tracked themes was to more closely investigate the context within which the author raised the coded theme. For example, for the code ADOUBT (Table 4), I returned to the literature cases and explored the reasons authors

[107] When these frequencies were obviously different, I discussed the coded theme in the relevant context in Chapter 7.

noted in connection with the doubt or disparagement of Fishers' Knowledge. These data are not summarized but appear within elaborations of trends discussed in Chapter 7.

6.2 The analysis of barriers – creating the influence network

As alluded to above, I could sometimes directly identify barriers through authors' assertions or implicitly, based on the preliminary barriers (Table 2). However, even when barriers were named or implicit within the literature cases, the mechanism - how the barrier slows or prevents the application of Fishers' Knowledge in fisheries management - was often unclear. This was the purpose of the influence network: to reveal how frames or conceptualizations of key phenomena such as Fishers' Knowledge or fisheries science[108] might constrain the Integration Project.

I created a conceptual diagram in pieces which continued to grow and become increasingly complex. As I attempted to understand the nature of barriers to the Integration Project, the use of a conceptual framework of hierarchical levels of organization became necessary (Section 5.3). Recall that at the highest level of the hierarchy of Schön and Rhein (1994) are metacultural frames which are more abstract, and which refer to the societal or the broadest level of human organization. At the intermediate level are institutional action frames, and at the lowest level are operational frames (Table 5). This framework permitted the identification of links between approaches to the Integration Project within the analyzed literature cases, "low level"

[108] How various key phenomena were conceptualized in the literature cases was investigated directly using particular variables (e.g., Level of Fishers' Knowledge, Table 3) and codes (e.g., HP codes for the conceptualization of Science as hypothesis testing, Table 4).

phenomena, and societal level or "high level" phenomena.[109] The influence network I produced is a schematic depiction of these links between high and low level phenomena.

The influence network is adapted from Miles and Huberman's (1994) "causal networks", a map which shows interconnections between variables and proposes relationships of cause and effect. In this thesis I am not trying to attribute cause and effect in the strict sense, nor do I have the kind of data which would permit this. I am, however, attempting to examine how high level phenomena might interact with or influence observed phenomena within the evaluated literature cases and, in turn, how the latter phenomena might act as barriers by contributing to specific impacts on the Integration Project.[110] Thus, I use the term "influence network". I used a combined approach to construct the network. I used an inductive approach in that much of it was built on evidence gleaned from evaluating the literature cases as well as evidence from other literature (as mentioned with reference to Table 2). As mentioned above, evidence from these sources was generally in the form of patterns of coded themes which were either emphasized or underrepresented. I also used a deductive approach in that I utilized theoretical frameworks (Chapter 5).

Miles and Huberman (1994) discuss the importance of noting relationships between variables and building a logical chain of evidence:

> One thinks, roughly, "These variables are present or absent together, while others look random or unconnected." This is a sort of "abstracting induction" (Duncker, 1945). But with more knowledge, one begins to

[109] These high level phenomena include metacultural frames within the DSP and behavioural tendencies which long pre-date the DSP, for example, beliefs about Science and the use of hierarchical dualisms, respectively (Section 7.1).

[110] By using the term "contributing to", I leave open the possibility that other potential causes or influences are important. I can consider these theoretically, but cannot really test them since this is a literature-based analysis. Field workers can interview specific groups of people or choose specific sites which assist in testing which phenomena are more influential.

> think, "Some of these variables are coming into play *before* others, varying *with* others, or having an *effect* on others…" One is, actually, using the standard canons of inductive inference: temporal precedence, covariation, and directional influence.

I used the same principle and examined the relationships between coded themes and emerging frames. Other data collected using the evaluative framework served to potentially support or contradict the emerging relationships depicted in the influence network.

Another tactic which I used to generate the influence network was "subsuming particulars into the general" (Miles and Huberman 1994). They encourage asking: "What is this specific thing an instance of? Does it belong to a more general class?" In a related way I frequently asked: is there something that these observed patterns from the analyzed literature have in common? This helped me to "move up the hierarchy" from the level of data collected in the evaluative framework and to begin to fill in mid- or high-level pieces of the influence network. I also repeatedly asked: how did this come to be? What might be the origin of this entity? What higher level phenomenon influences this entity?

In the course of analyzing the literature cases and creating the influence network, I identified four metacultural frames to which barriers to the Integration Project appeared to be traceable. The first, the Science frame (which is shorthand for a belief in Science as the only valid or superior way of knowing) was raised in Chapter 5. The other three, the Economic, Technology, and Governance frames, emerged from the analysis of literature cases.

The other key step in the analysis and building of the influence network was to "move down the hierarchy" and anticipate or ask: what will occur if a practitioner acts on the basis of this frame or emphasizes these particular phenomena? What are the likely impacts on the acceptance or use of Fishers' Knowledge in fisheries management? Recall that this was the logic I used to generate the impacts in Table 2, Chapter 3.

How the influence network "works" will become clearer to the reader in Section 7.1, in which I explain in detail and sequentially the portion of the influence network depicted in Figure 4 – how it was constructed and why. In doing so, I further elaborate on the frames and barriers which emerged from the analysis. In general, however, once observations and patterns were identified, I then examined whether they were consistent with preliminary barriers (Chapter 3) or whether they were illuminated by theoretical premises (Chapter 5) or other literature (Traditional Knowledge, sociology, etc.).

Miles and Huberman (1994) note that “the quality of a causal network is determined by the quality of the data collected and the trustworthiness of the data collection methods". I would add that the influence network which I generated will only be as acceptable to the reader as are the premises and theoretical frameworks elaborated in Chapter 5, and the other literature which I introduce in Chapter 7 as evidence of particular connections (depicted in the figures in Chapter 7).

7. Frames and barriers

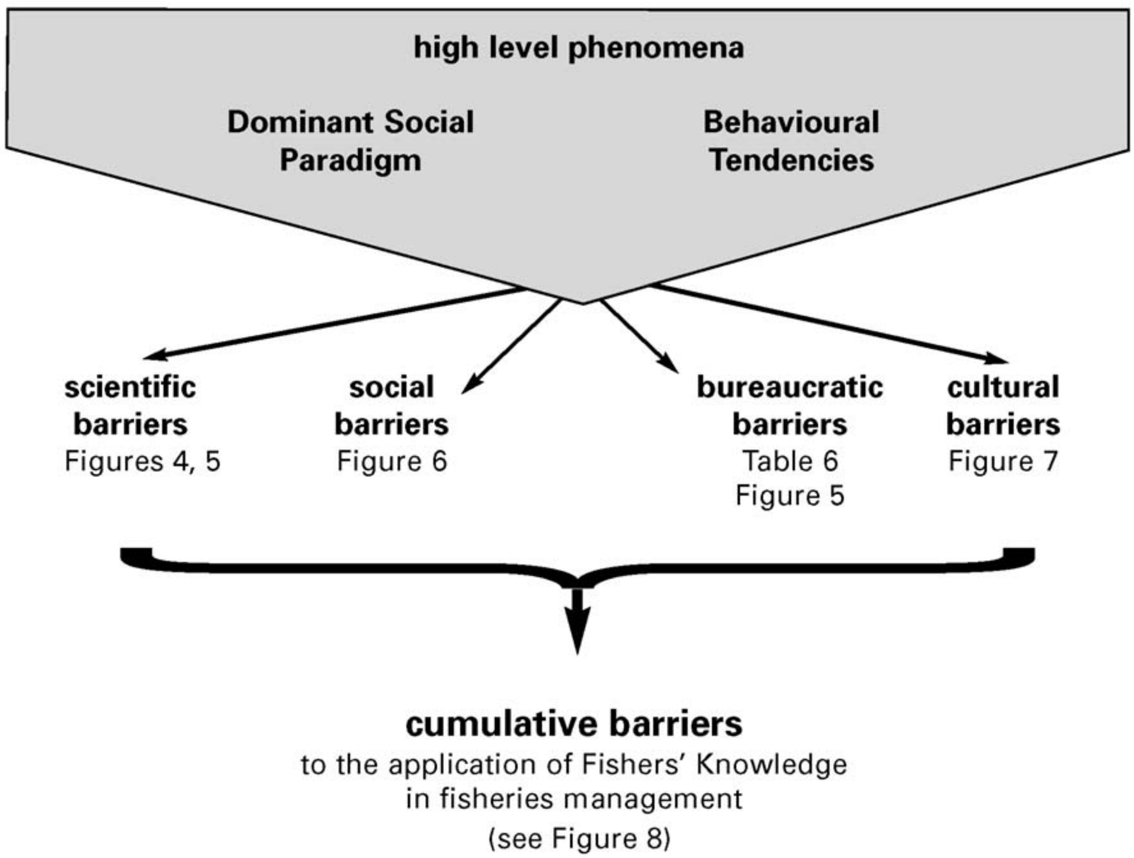
Barriers to using TLK have been described and alluded to in a wide range of literature, yet there has been little attempt to trace their origin or articulate the relationship between them. In this chapter, I propose barriers to the Integration Project and their interrelationships in the form of a large proposed framework, which I refer to as an "influence network" (Section 6.2). Ideally, this would be expressed in a single three dimensional model resembling an interconnected web. However, because of its size and complexity, I have divided it into parts.[111] Barriers are conceptualized as acting cumulatively to slow or prevent the application of Fishers' Knowledge. They interact with forces pushing for the use of Fishers' Knowledge, which include policies, individuals, and organizations (discussed in Section 8.1).

Barriers discussed within the context of the influence network include all of those proposed previously in Chapter 3 and several new ones suggested by the analysis. Figure 3 demonstrates four categories of barriers. Within Figure 3 all categories of barriers are depicted on the same horizontal level for convenience only. The other figures (Figures 4-7) are designed to schematically represent the hierarchical relationship between various barriers and frames. I selected the categories of barriers and their names for analytical convenience (scientific, social, bureaucratic and cultural barriers). Barriers from three of the categories were raised in Chapter 3. The new one, "social barriers", are barriers which are linked to neglect of the social dimensions of fisheries management. All the barriers discussed here could be considered to be "cultural". However, I make an admittedly "artificial analytical distinction" (Wilson 2003)

[111] Figure 3 contains the other Figures (4-7) and Table 6.

and use this term to apply to barriers which have their origin in *cultural differences* (that is, differences recognized or defined within cultures).

Figure 3. A summary of the influence network is depicted here and in Figure 8.



Note. Here, the proposed links are shown between high level phenomena (frames of the Dominant Social Paradigm and Behavioural Tendencies) and barriers of various categories.

There are numerous links and overlaps of content between phenomena examined in this thesis. This interconnectedness makes it difficult to talk about barriers and research themes in any kind of order, and the reader must keep this in mind. As much as possible, I first review relevant results of the evaluation of literature cases, that is, observed patterns of emphasis in the literature. I then move up the hierarchy in an attempt to explain them or to situate them in a larger context. I did this with the intention of keeping both the thesis and the reader "grounded" in the empirical data before moving into territory that involved more interpretation. I use the figures in this chapter as a basis to assist in structuring the discussion.

I chose to discuss scientific barriers first. They are of principle interest in the Integration Project. In addition, the portions of the influence network depicted in Figure 4 and 5 are the most firmly grounded in the analyzed literature cases since there was more relevant data available on these barriers (the most commonly coded issues concerned Science).[112] In the first three subsections (7.1-7.3), I present evidence which suggests that the Science frame is a highly influential belief within fisheries management and the source of several inter-related barriers to the application of Fishers' Knowledge.[113] Specifically, I propose that the Science frame affects the Integration Project in three main ways. First, it affects how Traditional and Local Knowledge, including Fishers' Knowledge, is conceptualized – TLK/Fishers' Knowledge were and still are contrasted with Science and generally found to be wanting (Section 7.1). Second, the Science frame and several other metacultural frames (which will be elaborated in context) affect how fisheries science and management are conceptualized. Specifically, fisheries science is conceptualized as a Science-based process of specific methods and procedures which are used to generate management regulations (Section 7.2). Third, this same conceptualization of fisheries management is linked to "social barriers", which are associated with the neglect of the social dimensions of fisheries management

[112] All content depicted in the nodes or information points has a basis in the analyzed literature cases. As already mentioned, this content was linked together using a combination of theoretical frameworks and other literature.

[113] See Figures 4, 5, and 6 within the discussions which follow.

(Section 7.3). All of these conceptualizations may act as barriers to the Integration Project, with specific impacts depicted in the respective figures, which are elaborated below.

A brief review of bureaucratic and cultural barriers follows. Literature cases and additional literature supported the five proposed barriers associated with characteristics and/or structures of NRM bureaucracies (Section 3.4, Table 2) as well as a new one, institutions of fisher representation and consultation.[114] The latter appeared to be directly connected with hierarchical and centralized decision-making, which was identified as a key Governance frame (Section 7.5). Evidence of cultural barriers associated with both theoretical lenses - neutral cultural differences or differences involving power relations – were identified (Section 7.5). Regardless of lens, cultural barriers may contribute to conflict or poor communication, and therefore affect the creation of social capital. Differences based in a range of power relations including the scientists/non-scientist dichotomy may also contribute to the perception that fishers are "not scientists" (discussed in Section 7.1.3).

7.1 The conceptualization of Fishers' Knowledge as a category – the influence of the Science frame

In this section, I examine common conceptualizations of Fishers' Knowledge in the literature cases and their relationship to the conceptualization of TLK in other literature and historically. The focus here is on how Fishers' Knowledge is discussed in general terms, that is, as an entity or *category*, as distinguished from practitioners' concerns about specific Fishers' Knowledge in specific fisheries contexts.

[114] These preliminary barriers are re-expressed in Table 6.

Conceptualizations of Fishers' Knowledge emerged from themes and observations detected in the analyzed literature, which appear in the influence network (Figure 4) and include the following:

1. many authors implicitly or explicitly emphasized the differences between TLK/Fishers' Knowledge and Science, often using Science as the reference point for comparison (Sections 7.1.1 and 7.1.3);

2. many authors noted that doubt and dismissal of TLK/Fishers' Knowledge occurs and made the link between these doubts and the superior position of Science as well as the further link with dualistic contrasts (Section 7.1.2);

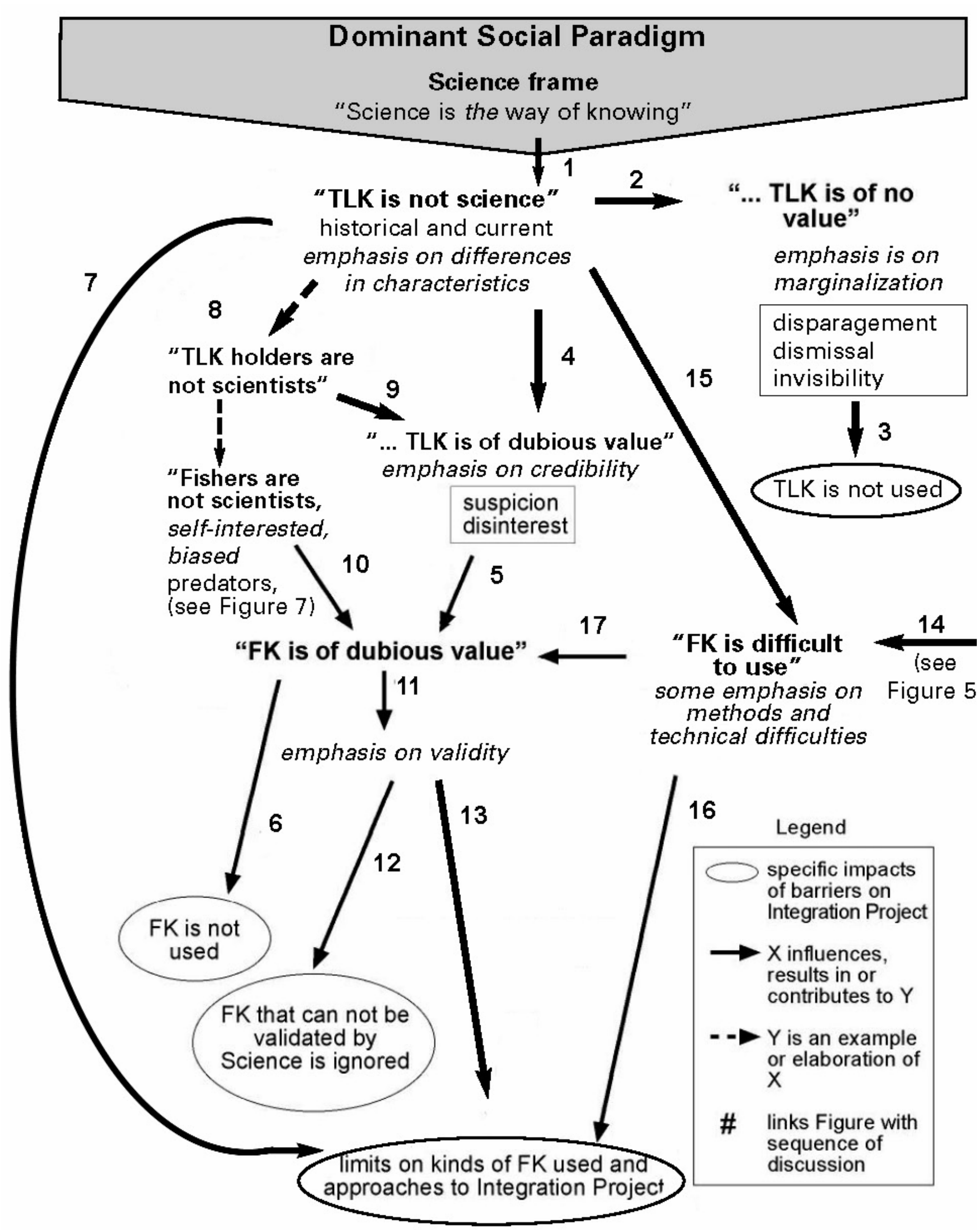
3. a number of authors emphasized the issue of validity of Fishers' Knowledge without mentioning the validity of Science (Section 7.1.4); and

4. several authors emphasized methodological challenges of working with Fishers' Knowledge while paying less attention to other challenges (barriers) of the Integration Project (Section 7.1.5).

I have re-expressed these conceptualizations of TLK/Fishers' Knowledge in the form of beliefs or frames, indicated in quotes. I chose to express these as simple informal statements, such as "TLK is of dubious value". Alternatively, I could have used codes directly, or the statements which define them such as: authors mention doubts about the value or utility of TLK (Table 4). However, expressing these statements as frames serves the "rhetorical goal" (*sensu* Finlayson 1994) of emphasizing to the reader the potentially "sweeping" nature of generalizations. Readers may be confronted with their own response to the statement, for example, immediate agreement, disagreement, or reflection about it.

Through ongoing analysis I realized that these conceptualizations were interconnected and originated, at least in part, in the Science frame. I elaborate upon this using Figures 4 and 5 as a basis for discussion. I also elaborate on how particular conceptualizations of TLK/Fishers' Knowledge might act as barriers to the Integration Project.

Figure 4. ***The influence of the Science frame on the conceptualization of Fishers' Knowledge as a category.***



Note. The portion of the influence network is shown which links the Science frame (the belief that Science is *the* way of knowing) with: various conceptualizations of TLK as a general category (including Fishers' Knowledge (FK)) as conveyed in literature cases; additional patterns of emphasis in literature cases (in italics); and their potential impacts on the Integration Project. (Numbered arrows are referred to in the essential, accompanying discussion (Section 7.1).

7.1.1 "Fishers' Knowledge is not Science…"

One common conceptualization of Fishers' Knowledge in the literature cases is that it is "not Science," that is, it shares few or no characteristics with Science (for an exceptional perspective, see the quote from Stanley and Rice (2003) in Section 7.1.3). Generalizations about Science and TLK/Fishers' Knowledge were often made in the form of dualistic contrasts (Arrow 1, Figure 4), that is, a suite or list of descriptors was generally used to typify and contrast the two knowledge systems, usually without qualifiers. Dualistic contrasts were made in eight literature cases whereas in only three cases, single shared characteristics were mentioned.[115] The following excerpts are examples. Dualistic contrasts are discussed in further detail in Section 7.1.3. McGoodwin et al. (2000) refer to the "non-quantitative, narrative structure" of Fishers' Knowledge which differentiates it from Science. They also note that:

> The qualitative, local and coastal character of fishers' observations are, in some ways, complementary to the quantitative, large scale and often offshore focus in fisheries science (Éythorsson 1993; Freeman 1985).

Note that in the above quote generalizations about the former are not qualified but that "often" qualifies the generalization about the latter. Maurstad (2000) cites Wolfe et al. (1991), noting that "[i]ndigenous knowledge is oral, intuitive, and holistic, while scientific knowledge is analytical, literate, and reductionist". This conceptualization of TLK/Fishers' Knowledge is also common in the Traditional Knowledge literature, for example in the form of tables with contrasting characteristics of Traditional Knowledge and Science (Johnson 1992; Berkes 1993, but see Berkes 2000 for a qualified discussion).

115 If natural and social scientists do not obviously differ in their frequency of mentioning an issue, I do not discuss this potential difference.

I suspected that this emphasis on the differences between TLK/Fishers' Knowledge and Science was related to the influence of the Science frame. Of the eight papers which demonstrate an awareness of this dualistic dynamic, seven implicitly or explicitly connected dualistic contrasts between TLK and Science with the position of Science and the marginalization of TLK (MacNab 2000; Maurstad 2000; Pálsson 2000; Power 2000; Baelde 2003; Stanley and Rice 2003; Wilson 2003). Wilson (2003) notes that considering TLK and Science (he uses "LEK" and RBK (research-based knowledge)) as "ideal types…will likely sterotype LEK while idealizing RBK", citing Agrawal (1995). The next sections (7.1.2 and 7.1.3) elaborate on these connections.

7.1.2 "…therefore Fishers' Knowledge is of dubious value" – resistance towards Fishers' Knowledge as a category

Rather than begin with grounded observations from the analyzed literature, in this subsection I start from the top of Figure 4 and move down the hierarchy. I frame the discussion here using a narrative structure which describes how high level barriers prevented the use of TLK until relatively recently. In doing so, I also tie together the above observation from the literature cases, "TLK/Fishers' Knowledge is not Science", with additional observations reported here, in which doubts about TLK/Fishers' Knowledge are expressed or discussed. In creating this portion of the influence network I considered:

- what effect the Science frame had on beliefs about TLK in the past;
- what effect the Science frame had on beliefs about Fishers' Knowledge until relatively recently; and
- what effect does the Science frame have on the Integration Project now?

As discussed in Chapter 5, in the last several hundred years, the focus of knowledge production has been on Science. Other ways of knowing, including TLK, have been contrasted with Science for a similar period of time, and readily dismissed or even disparaged since they allegedly lacked these characteristics (Section 5.4). Thus, the oldest or most entrenched version of the Science frame as it has been expressed in the context of TLK *as a category* appears to be: "Science is *the* way of knowing; TLK is not Science; therefore it is of no value". The historical impact of the Science frame is that TLK was of no interest – it was essentially invisible - in many fields including medicine and agriculture. This dynamic is depicted in Figure 4 by arrows 1 to 3.

At the level of agencies and individuals involved in younger fields such as international development and fisheries and wildlife management, this sweeping belief was predominant until relatively recently. In the last 20 years or less, the phase of total dismissal and explicit disparagement of TLK as a category of knowledge has been *largely* overcome. For reasons briefly reviewed in the Introduction and as a result of a push in favour of TLK, a shift has been occurring from outright rejection of TLK to varying degrees of acceptance, depending on the specific context (Section 1.2). Seen through the theoretical framework of frames, it appears that a societal or metacultural frame (Schön and Rhein 1994) resembling "other ways of knowing have value" has emerged. This frame has had sufficient influence such that specific frames which view TLK more positively have also emerged, for example, "TLK is potentially of value”. This particular frame has contributed to the consideration and potential use of TLK in various fields. It is evident in much of the literature on the application of TLK in NRM, including the analyzed literature on Fishers' Knowledge, in which *value* tends to be equated with *utility* (as I have done for strategic reasons, Section 8.3).[116]

"TLK is potentially of value" has found expression at the policy and implementation levels of fisheries management agencies and universities. (Due to space limitations I have not shown all frames mentioned in the text in Figure 4.) The emergence of this frame has been accompanied by increased application of Fishers' Knowledge. For example, before the implementation of cases analyzed here, Fishers' Knowledge had rarely been applied to improve the understanding of habitat (Bergmann et al. 2003) and changes in fishing effort (Gendron et al. 2000; Hutchings and Ferguson 2000). MacNab (2000) notes:

> Before the groundfish moratorium, the concerns and knowledge of Newfoundland fishers were often disregarded - indeed marginalized - by biologists and ocean-related agencies. Communities now expect to participate actively in every facet of fisheries science and management, especially where spatial and temporal limitations to harvest may be implemented.

However, evidence of the Science frame remains. Maurstad (2000) relates an incident of disparagement at a workshop on Fishers' Knowledge:

> As a Northerner and a former fisher, I had been insulted by the way the marine biologist at the workshop treated my culture...find[ing] low

[116] New metacultural frames reflect competing paradigms and related paradigm shifts. The processes by which new frames and paradigms emerge is beyond the scope of the thesis. I have not attempted to categorize individual papers as representing or holding a particular frame. *As in society and organizations*, individuals are considered to hold a number of frames which may be contradictory and context specific. My purpose was to identify barriers in government agency and academic settings. Papers were used *collectively* to do this and the identification of frames became one means to do so. The frames I identified (Figures 4,5) are those which tend to act as barriers. There are other positive frames which fall under the "push for FK use" and include the various reasons for using FK (the variable RATFK summarized in Section 8.3). Thus, I am attempting to identify influential barriers (including frames). I am not trying to say "how" influential they are, although I may try to imply based on evidence, some sort of general degree of importance within the Integration Project. However, the relative importance of barriers is expected to vary with context. As briefly mentioned previously, some barriers may be overcome by some agencies or departments or individuals, but they may still be present and important in other situations. (I had hoped to begin to address this with the "contextual variables", but this will need to be explored in field work with a wider range of cases.)

> precision in certain knowledge areas, and conclud[ing] that my cultural knowledge was of little value.

The marine biologists' "evidence for this claim was the lack of precision in the northern Norwegian taxonomy for birds where all small birds are commonly labelled *Titting*". In contrast, Maurstad (2000) noted the adequacy of this taxonomy within its context, and that northern Norwegians' taxonomy for cod is in fact richer than scientific taxonomy. Within the context of this thesis, it is noteworthy that the biologist knew little about the specific knowledge base and context of which he spoke, yet readily dismissed a whole category of knowledge based on one example. In setting out the challenge for the *Finding our Sea Legs* volume, Neis and Felt (2000a) refer to Broderick (2000), a fish harvester, who noted that

> harvesters are frustrated with the lack of recognition of their knowledge and they are tired of lip service…Their knowledge must be respected, taken seriously, and used when developing stock assessments.

These examples suggest that the dynamics indicated by Arrows 1 to 3 (Figure 4) may at times still be operative, that is, TLK may still be considered of little or no value. Another frame which sits between the latter and "TLK is potentially of value" is "TLK is of dubious value" (Arrows 1,4). Thus, I conceptualize a continuum of acceptance of TLK as a category of knowledge – a gradual process which passes through phases from the "rhetoric of acceptance" (Burgess 1999),[117] to grudging acceptance, cautious acceptance, etcetera. A similar process is discussed in the literature on adoption of innovation but uses different terminology (Rogers 1986).

[117] Politically correct behaviour may occur while dismissal and disparagement continue more quietly. Where concerns are more vocal, repercussions may follow. In the context of Northern Traditional Knowledge, loss of employment was part of the political fallout of one Arctic researcher's questioning the appropriateness of using Traditional Knowledge in environmental assessment (see Howard and Widdowson 1996 for the original article and Stevenson 1997 for a rebuttal).

Additional evidence from the analyzed literature demonstrates that doubts and marginalization of TLK as a category are ongoing and, according to a number of authors, linked to the position of Science (see below). In terms of the explicit expression of doubts about TLK/Fishers' Knowledge, none of the authors was directly disparaging or dismissive of TLK/Fishers' Knowledge, which is not surprising since they are a sample of stakeholders with sufficient interest in Fishers' Knowledge to work with it, attend a conference, and write a paper about it. However, the following quotation from the conclusion (and a similar one in the abstract) of Zwanenburg et al. (2000) indicates a large measure of caution:

> Although the FSRS recognizes the value of incorporating Fishers' Knowledge, it is not sensible or desirable to develop a process based on unreliable information, opinion, or hearsay. The Society thus insists on reliable and valuable information even though this presents problems in the attempts to incorporate local knowledge. Without this as a point of departure, we would be building a house of cards.

Thirteen literature cases noted the existence in the present and recent past of doubts about or dismissal of Fishers' Knowledge as a category. The frequency of this code differed between natural scientists and social scientists (21% and 75% respectively, Table A in Appendix C). Baelde (2003) notes scientists' "lack of curiosity and interest" in Fishers' Knowledge as well as their "reluctance to acknowledge, or at least test, the value of Fishers' Knowledge". McGoodwin et al. (2000) refer to "ignoring or discounting Fishers' Knowledge and social institutions" in reviewing the history and literature on Fishers' Knowledge in fisheries management.

Comments within 10 literature cases support the premises established in Chapter 5 regarding the position of Science within the DSP, the existence of a hierarchy of knowledge, and the marginalization of Fishers' Knowledge.[118] McGoodwin et al. (2000) begin their article by placing the discussion of the Integration Project within the context of "hegemonic systems" and refer to the lack of equality of knowledge systems. Roepstorff (2000) mentions the literature on the "inherently politicized exchange of information between managers and managed" and that knowledge exchange may be "infected with power and position." Stanley and Rice (2003) referred to "the "we vs they", and the "dichotomies" between Fishers' Knowledge and Science in the TLK literature.[119] They also refer to "the hierarchical vision of knowledge" and "higher order science" (see Section 7.1.2 for the full quotation). Maurstad (2000) made an implicit connection between the "strength" of the position of Science in management, the inferior position of social science[120], and limiting attitudes and approaches towards Fishers' Knowledge.

As mentioned above seven papers also noted a link between the Science frame, dualistic contrasts with Science, and doubts about or undervaluing of TLK/Fishers' Knowledge. For example:

> Western tradition is preoccupied with analytic and theoretical ways of knowing, which in the process devalue and misrepresent practical and contextual knowledge. It tends to glorify science and reduce local knowledge to mere trivia. This tradition is based on the incorrect assumption that scientific expertise and the practical skills of resource users represent radically different types of knowledge. Western discourse has tended to separate scholarly knowledge and everyday

[118] Eleven per cent of natural and 67% of social scientists raised the hierarchy of knowledge (AHK, Table A in Appendix C).

[119] Stanley and Rice (2003) chose to use the term "* - knowledge" as a means of critiquing the way that a "catchy first word and "knowledge"" has been used, largely to refer to a model of filtering and adding-on this knowledge rather than fully involving fishers in fisheries management.

[120] Maurstad (2000) and Glaesel and Simonitsch (2003) are the only papers which mentioned this dynamic. The latter noted that Fishers' Knowledge is generally gathered by "social scientists, but it is knowledge gained by narrowly defined experts in the "hard" sciences that informs policy making" citing (Huntington 2000). Although the hierarchy of knowledge is fundamental to the dynamics between natural science and social science in fisheries, it is rarely discussed in the fisheries literature.

> understanding. Schooling and science, it has often been assumed, involve the objective exploration and modelling of reality, on the basis of rational methods and detached observations, while "lay" or "folk" understanding presumes a particular and limited world of local concerns (Pálsson 2000).

Baelde (2003) contrasted "the moral authority of science" with the "suspicion attached to fishers' information (subjective, non-tested and perceived as biased by vested interests)”. In a similar vein, Maurstad (2000) noted the "organized, institutionalized structures for creating scientific 'truths' [which] give science credibility while making indigenous knowledge appear anecdotal and unsubstantiated”. Johannes (1993) stated that many biologists dismiss TLK for related reasons, referring to this as an "attitude problem" (Maurstad 2000). MacNab (2000) noted:

> Local knowledge is often dismissed as being qualitative and unscientific, particularly within a positivist conservation paradigm that "gives credibility to opinion only when it is defined in scientific language" (Pimbert and Pretty 1995: 8)…Geomatics…provides a more technical and precise if not more "scientific" means of capturing the spatial components of local knowledge. When cognitive landscapes are inscribed and geo-referrenced in the field…, local knowledge assumes far more authority than possible with oral descriptions and simple sketch maps… .

Thus, within the analyzed literature cases, there is some level of consensus which is consistent with the dynamics shown in Figure 4 (Arrows 1,4,5).[121]

However, few authors explicitly addressed how these hierarchical dynamics above, which are related to the Science frame, translate into barriers to TLK in practice or how they might affect social interactions between scientists and fishers (or between natural and social scientists). Baelde (2003) comes closest to explicitly making the

[121] It may be worth noting that two of these papers were written by natural scientists, one by a geographer, and three by social scientists. Thus, there is a degree of consensus here among practitioners from different backgrounds.

connection between the position of Science, scientists attitudes,[122] and the interactions between stakeholders within fisheries management:

> Possibly the greatest difficulty with the partnership approach is overcoming existing socio-cultural barriers that hamper communication and collaboration between fishers and scientists/managers…The lack of curiosity and interest that scientists showed in the wealth of information that was collected…was surprising at first. However, it quickly became obvious that scientists' attitudes toward Fishers' Knowledge were influenced by the socio-cultural barriers so often described by social scientists (e.g. Finlayson 1994; McCay 1999; Neis and Felt 2000 and references therein; Wilson, this vol.).

Although Baelde (2003) noted that these barriers have been "often described", a closer reading of the literature shows that within the context of Fishers' Knowledge, the deep-seated belief in Science has been little examined for its potential impacts on the Integration Project. That this link is not made by more authors may indicate the pervasiveness of the Science frame within fisheries management. This is in contrast to, for example, papers from the Arctic (e.g., Bielawski 1990; Nuttall 1998; Nadasdy 1999). An original contribution of this thesis is that it explicitly makes the links between the Science frame, the authors' language and approach within the analyzed case studies, and the potential barriers to the application of Fishers' Knowledge.

Thus, it appears that the Science frame remains influential within resource management and academic institutions. The category of TLK, which includes Fishers' Knowledge, is still contrasted with Science (Sections 7.1.1 and 7.1.3) and this appears to contribute to ongoing doubts about its credibility. A revised version of the Science frame appears to be: "Science is *the* way of knowing; TLK is not Science; therefore TLK is of dubious value" (Arrows 1, 4 in Figure 4). In Figure 4, I reiterate this frame as

[122] For example, Baelde (2003) notes "scientists' reluctance to acknowledge the value of Fishers' Knowledge" and that" scientists assume that [fishers] accept the purpose and methods of science, and that their role is to fill gaps in scientific knowledge."

"Fishers' Knowledge is of dubious value" in order to emphasize the link between resistance to Fishers' Knowledge at the level of fisheries management practice and beliefs about TLK as a category at the metacultural level (Arrow 5 Figure 4). In terms of the framework of Schön and Rhein (1994), I have re-expressed a metacultural frame as an institutional action frame.

I suggest that the concept of "resistance" or "inertia" towards TLK as a category is a useful one to summarize a structural legacy connected to the Science frame. This structural resistance emerges through policy and through stakeholders' beliefs, attitudes, and actions on the ground. I did not depict "resistance" in Figure 4 – I conceptualize it as permeating all approaches to the Integration Project. We have seen above that resistance toward TLK may be expressed in obvious ways through dismissal or disparagement such as the "titting example" or as suspicion or disinterest (Figure 4). Resistance may also exist as subconscious bias or an unfavourable predisposition towards TLK. It is possible that in some fisheries management settings, resistance may be sufficient such that Fishers' Knowledge is still not considered or used (Arrow 6 Figure 4).

The influence of the Science frame and related resistance towards TLK may also be expressed in subtler ways in discourse on the Integration Project, for example, through the way that particular themes are contextualized. In subsequent sections (7.1.4 and 7.1.5), I suggest that the emphases placed within the literature cases on validity of Fishers' Knowledge and methodological challenges of working with it may in part reflect the influence of the Science frame and related resistance. Before addressing these topics, I further examine the dynamics underlying dualistic contrasts and how authors' continued use of dualistic contrasts may prevent the application of Fishers' Knowledge in fisheries management.

7.1.3 Dualistic contrasts and labelling

I use the term dualistic contrasts to indicate when two entities are contrasted such that their differences are over-emphasized.[123] In this dynamic, the focus of attention is placed on an entity, generalizations are made about it, and an attachment to these generalizations follows. This dynamic is referred to as "essentializing" within a substantial literature on race, ethnicity, and gender (e.g., Dei and Calliste 2000; Bishop 2002). I prefer the simpler term "labelling" and will use it here. Hierarchical dualisms, mentioned previously (Section 5.4.3), are a special case of dualistic contrasts in which two entities are labelled as opposites, then one of the two is devalued.

Humans learn and organize their knowledge through contrasting, comparing, naming, and categorizing entities (Goode 2002).[124] Any definition requires generalization to some extent, and generalizations often contain elements of truth. However, when they emphasize particular characteristics of an entity and are used repeatedly and in an unqualified manner, they may render other characteristics invisible. When those in power employ hierarchical dualisms, they choose or exemplify the standard to which the

[123] This differs from a more balanced consideration of similarities and differences between two entities. Clearly there is no obvious demarcation between these two states. As in Finlayson (1994) these states are viewed as poles in a continuum.

[124] Both biological and cultural evolution are involved, although there appears to be cultural variation in the degree of dualistic thinking, for example, ability to “hold” contradictions. Goode (2002) described a series of studies comparing European Americans to East Asians undertaken by R. Nisbett and colleague in which they discovered that people who grow up in different cultures think in different ways. Goode (2002) quoted Nisbett: "We used to think that everybody uses categories in the same way, that logic plays the same kind of role for everyone in the understanding of everyday life, that memory, perception, rule application and so on are the same…But we're now arguing that cognitive processes themselves are just far more malleable than mainstream psychology assumed." A deeper examination of human behavior is beyond the scope of the thesis.

other entity is compared (referred to as "the Other" in a large body of literature, e.g. Smith 1999).[125] The use of rigid categories can prevent their users from important insights, affecting their ability to adapt to change (Rölings and Wagemakers 1998).

Practitioners' or authors' continued use of dualistic contrasts and labelling can ultimately contribute to a range of potential impacts on the Integration Project. Figure 4 demonstrates this graphically with Arrow 1 and the many arrows emanating from "TLK is not Science", culminating in impacts on the Integration Project (depicted as ovals).[126] Generalizations about TLK and Science may also obscure practitioners' awareness of the actual range of characteristics and quality of both Fishers' Knowledge and fisheries science "on the ground". Rigid categories prevent practitioners from identifying relevant similarities between Fishers' Knowledge and Science as well as identifying important exceptions to the generalizations about each knowledge category. These effects of labelling are depicted by Arrow 7 in Figure 4.

In the remainder of this section, I examine generalizations about TLK/Fishers' Knowledge - how the literature cases portrayed typical characteristics of TLK/Fishers' Knowledge as contrasted with Science and how particular generalizations may limit the application of Fishers' Knowledge in the Integration Project. The theme emphasized

[125] Hierarchical dualisms are a part of structured social relations based on race, class, gender, etcetera. Because they are part of a dominant culture, they can have widespread and debilitating impacts on those considered to be Other or lesser. For example, values associated with race (which played a key part in colonization) were absorbed by colonized peoples such that in the Caribbean and Africa, dark skin and frizzy hair have been devalued (Alleyne 2002). In the context of the Integration Project, some fishers may come to place more value on Science and undervalue their own knowledge. It is interesting to consider these issues within the context of the Integration Project. For example, Zwanenburg et al. (2000) noted that "before, fishers deferred to DFO scientists for what science needed to be done...now the fishers decide what science they want to do and how to do it. *They have more confidence in their own knowledge* and understanding of the fishery, and their abilities to *participate in science* and use the results when making management and conservation decision" [emphasis mine]. Fishers' beliefs are not further elaborated since the focus of the thesis is on agency and academic barriers.

[126] The pathway of Arrows 5,6, and 7 was already discussed in Section 7.1.2. Impacts connected to the emphasis on validity and methods will be discussed in Sections 7.1.4 and 7.1.5, respectively.

here is that what is not seen cannot be applied (Arrow 7 Figure 4). When applicable, for each characteristic of TLK (which is part of an implicit or explicit dualistic contrast), I summarize authors who mention it; authors who make a link to the dismissal of TLK; and authors' and my own exceptions to these generalizations.

Irlbacher (1997) and others note that TLK is commonly conceptualized as subjective in nature. Only one literature case directly referred to the potential subjectivity of Fishers' Knowledge (Zwanenburg et al. 2000 quoted in Section 7.1.2). However, three authors noted that Fishers' Knowledge has been dismissed as a category of knowledge for being biased (Baelde 2003). Stanley and Rice (2003) referred to

> …the early days of stock assessment in BC...till the mid 1990s [when] fishers were excluded from assessment meetings because...it was felt that their presence would promote biased interpretations of results and inhibit debate among the scientists...*[It] was assumed that the financial interests of fishers would render them unwilling to contribute objectively.* [emphasis mine]

Pálsson (2000) noted that

> comments and suggestions made by fishers regarding the behaviour and size of fishing stocks are often thought by managers to be *solely* motivated by a selfish concern to increase catch-quota allocations. [As a result, their knowledge] is assumed to have no place at all in shaping management policy. [emphasis mine]

The assumption that commercial fishers behave like predators leading inevitably to the "tragedy of the commons" is rife within fisheries management (Pinkerton and Weinstein 1995).[127] McGoodwin et al. (2000) noted that scientists may regard fishers as threats to the resource (see below) while Williams and Bax (2003) and Melvin and Parrish (2003) acknowledged negative societal perceptions of fishers. Since fishers are

[127] When I went commercial fishing for a month in 2003, the captain and his colleague (both owners of 40 foot trollers) lamented that they are viewed as criminals by many in society. However, these perspectives have been challenged for years since they oversimplify human behaviour and the capacity for collective action, given appropriate incentives (Pinkerton and Weinstein 1995).

the source of Fishers' Knowledge, how they are conceptualized by others, particularly scientists, affects how their knowledge is perceived. These examples demonstrate a perception that fishers are biased and, therefore, implicitly lack the qualities necessary to undertake Science, including objectivity, rigour, and disinterest (Neuman 2000). I summarize this with the frame "fishers are not scientists" (Figure 4).

Given the previous discussion of the influence of the Science frame, and the related structure of the influence network, I was able to identify this perception of fishers as, in part, a particular version of the frame "TLK is not Science", where "TLK holders are not scientists" (Arrow 8, Figure 4). As touched upon in Chapter 5, historically, TLK holders, particularly indigenous peoples, were described as savages, illiterate, irrational, backward, superstitious, or culturally inferior, and these perspectives may persist in some form today (Maybury-Lewis 1997). Clearly, knowledge held by people of these descriptions was perceived as of dubious value and credibility (Arrow 9, Figure 4). Sadly, some of these perspectives still exist in society as well as in the scientific community, although they may only be explicitly admitted by sensationalistic radio talk show hosts. Burgess (1999) in an extensive review of Traditional Knowledge quoted British Columbia's controversial Rafe Mair regarding the increased use of oral history as..."promoting the ramblings of self interested Native elders to not only be heard, but given a special weight."

Categorizations of people as defined within the dominant culture may play a role here. Thus, conceptualizations of fishers as biased may merge with other perceptions of fishers discussed in Section 7.5 (see also Figure 7). However, it is important to note that the perception of fishers as biased is not surprising within the context of conflicts between fishers and agencies where exaggerations and fingerpointing abound. For example, Stanley and Rice (2003) allude to fishers' attempts at "getting attention" (full quotation in Section 7.3). Chiarappa (2003) makes reference to the "rhetorical use [of TLK] in confrontational fishing policy debate", "strident positions", and "contested relations":

> Extreme posturing by each constituency often meant that valuable management perspectives from each stakeholder group - historical and cultural views of fisheries resource use - were ignored, derided, or mishandled in deliberations that made Lake Michigan the most "political" of all the Great Lakes…[T]he longtime debates ...were consistently waged through a simplified dialogue of selected economic and allocation issues.

In this acknowledged context of conflict, the possibility that opinions and information conveyed by fishers might be empirically well-founded seems unlikely or impossible to those in attendance (10 cases referred to stakeholder conflicts within fisheries management and 4 to the political nature of fisheries management).[128]

Since characteristics associated with the subjectivity or arbitrariness of TLK are implicitly or explicitly contrasted with Science, the unstated assumption in many papers seems to be that Science is value free and that scientists do not have interests which may affect their work. Exceptions are McGoodwin et al. (2000) and Neis and Felt (2000a) who summarize them, who explicitly note that political and social forces affect both scientists and fishers and their knowledge. For this reason, in their conclusions McGoodwin et al. (2000) refer to the desirability of "semi-autonomous research

[128] Fishers knowledge may indeed be biased or "interested", for example, in Bergmann et al. (2003) some fishers deny that their gears cause damage to habitat, and Power (2000) noted fish workers' fears about raising their early observations of problems in the fishery in case of closures. As mentioned in the introduction in the context of First Nations' autonomy, the embeddedness of knowledge in a social system means that it can be used politically or to support particular interests. This also occurs in the context of Fishers' Knowledge (Chiarappa 2003). Nonetheless, this does not mean that all information from these "political" individuals should be dismissed as biased or erroneous, nor does it invalidate Fishers' Knowledge as a category. This potential subjectivity raises questions for all stakeholders of how to discern which information is most reliable. It also raises a critical question regarding which kinds of settings encourage genuine collaboration, rather than adversarial dynamics such as grandstanding and having to be seen as "strong" by those one represents (Chiarappa 2003).

institutions" (see Hutchings et al.1997). Stanley and Rice (2003) and Prince (2003) were the only natural scientists to mention bias within Science or fisheries science (see Section 7.1.4).[129] Baelde (2003) referred several times to scientists' "beliefs" and "attitudes" regarding Fishers' Knowledge as well as to "scientists' discourse on fishers and fishing":

> Scientists tend to see themselves as possessors of universal knowledge and custodians of the sea (McGoodwin et al. 2000), as defenders of natural resources against an irresponsible fishing industry and an inefficient, or ambivalent, management (Finlayson 1994).

Specifically, McGoodwin et al. (2000) noted that "[s]cientists or managers may assert proprietary interests in resources, feeling they are "theirs", while regarding fishing peoples as threats to them".

In a similar vein, the "house of cards" quotation from Zwanenburg et al. (2000) in Section 7.1.2 reveals an assumption that "opinions and hearsay" are unreliable, that is, it expresses dualistic thinking in which Fishers' Knowledge is either reliable or unreliable. The paper in which this quotation is found repeatedly emphasized the importance of Science, validity, and reliability. This perspective of Fishers' Knowledge is rather limited and probably limiting (Arrow 7, Figure 4). Concepts of uncertainty, risk, or confidence limits used in fisheries science are not extended to Fishers' Knowledge. In fact, "the process" they refer to above most likely starts with a range of opinions and observations, some of which receive a greater degree of consensus among fishers and are thus deemed worthy of further investigation. In summary, the perceived subjectivity and arbitrariness, which may characterize Fishers' Knowledge, contributes to doubts about

129 The discussion in this and the previous paragraph raises a much bigger issue of values and subjectivity and their role in Science generally and in NRM, both which are beyond the scope of this thesis.

its value, reliability, and validity and ultimately impact the Integration Project in a number of ways (ovals depicted in Figure 4).

Another common dualistic contrast in the TLK literature is that TLK is local and/or context-bound, whereas Science is large-scale and/or generalizable (Agrawal 1995). Kloppenburg (1991) provides an example of a frequently cited definition in the TLK literature:

> Local peoples gain knowledge about their immediate environment through "the direct experience of a labour process which is itself shaped and delimited by the distinctive characteristics of a particular place with a unique social and physical environment".

Similarly, Felt (1994) notes that Fishers' Knowledge is a "social construction in which particular experiences are given meaning within a specific cultural context" and that Fishers' Knowledge is "diverse, and often fragmented".

In the literature cases, McGoodwin et al. (2000) contrast the local, coastal character of Fishers' Knowledge with the offshore, large-scale, quantitative character of fisheries science. They and others note the potential importance to fisheries management of this finer-scale information (Wroblewski 2000; Gosse et al. 2003; Williams and Bax 2003). Pálsson (2000) was exceptional in noting the connection between the perception of TLK as pertaining to "a limited world of local concerns" and its dismissal. The paper by McGoodwin et al. (2000) was the only one to note that Fishers' Knowledge can be cumulated spatially to form regional or larger-scale analyses.[130] In terms of scale, a potential impact of the overemphasis on the "local" is to overlook knowledge held by fishers of wide-ranging, offshore commercial fisheries (Arrow 7,

[130] In fact, this is occurring in the north with caribou (Kofinas 2002). Wilson (2003) alludes to this but accepts the stance of managers that the combination of large scale and detail overwhelms the management system.

Figure 4).

None of the papers by natural scientists mentioned that Science is also context-bound, however 7 of 12 papers by social scientists did (ESCI, Table A in Appendix C). In particular, Pálsson (2000) and McGoodwin et al. (2000) noted that both Science and Fishers' Knowledge arise out of highly context-specific practices, citing "theories of practice" (Latour 1987; Lave 1988). However, they then focus on how these ideas apply to Fishers' Knowledge.[131] Thus, I find it worth noting that the products or results of Science are only generalizable within particular contexts. Werner Heisenberg noted in Capra (1972) that "every word or concept, clear as it may seem to be, has only a limited range of applicability". For example, ecological relationships observed at smaller spatial or temporal scales may not hold at larger scales (e.g., Roughgarden 1988; Magnuson 1995).

None of the analyzed papers (or any literature I have encountered on TLK) challenges the assumption that TLK is not generalizable.[132] Wilson (1999) quoted in Holm (2003) in characterizing "the Traditional Knowledge model" noted: "No one claims that TEK produces generalizable, scientific information" and that local knowledge is "not generalizable". However, Fishers' Knowledge of, for example, human and fish behaviour, ecosystem function, and how to catch fish, may translate to other contexts.

The labelling of TLK as "qualitative" is another common contrast with Science in the literature. However, this may prevent the appreciation of the quantitative basis of knowledge held by people who earn livelihoods by catching fish which are measured by

131 Neither paper elaborates on how these ideas as applied to Science are relevant to the Integration Project. I apply theories of practice to fisheries-science-in-practice in Section 7.2.1.

132 For example, Stoffle (2004) treats the minds of newly arrived African slaves in the Bahamas as *tabula rasa* because knowledge based on their prior experiences would not be relevant to their new context.

weight and ultimately by monetary currency (Arrow 7, Figure 4).[133] Two authors mentioned that TLK was qualitative (McGoodwin et al. 2000 and Rowe and Feltham 2000), the latter qualifying this term with "generally". Other authors linked the dismissal of TLK to this characteristic, for example "qualitative" and "unscientific" (MacNab 2000) and "anecdotal and unsubstantiated (Maurstad 2000). Roepstorff (2000) interpreted Greenlandic Fishers' Knowedge as focused on "the fish as an active, living being in a dynamic environment, where both the fish and the fishery are highly localized in time and space". He notes that "[f]ish are talked about in relation to their presence and non-presence rather than in terms of absolute quantities". However, he then gives two examples of informants who describe relative changes in abundance. One fisher identifies declines in catch in a particular fjord as related to harvest. Roepstorff (2000) takes the purported absence in fishers knowledge of a "clear relationship between the amount of fish landed and the amount of fish left in the water" to be a function of worldview (the Greenlandic commercial fishers in the case study are indigenous). However, an alternative possibility is that this perspective reflects the empirical world as observed by fishers to date, that is, there has been a lack of correlation between these two amounts as a result of historical catch rates and fluctuations in ocean productivity.

Pálsson (2000) placed considerable emphasis on the tacit and intuitive aspects of Fishers' Knowledge and minimal emphasis on consciously-held and verbally-transmitted Fishers' Knowledge, such as that held by skippers and selectively shared within informal clubs (Gatewood 1984). For example, he quotes Gladwin (1964):

> ...a Trukese navigator "cannot possibly put into words all of the myriad perceptions which have led him to be sure at that moment where the island is…The European navigator proceeds from general principles to

133 Berkes (1999) notes that "quantitative thinking can be part of traditional systems of management", citing an example from the Cree of James Bay.

> details, whereas the Trukese navigator seems to "start with details, but never arrives at any discernible principles.

This emphasis, without an accompanying qualification of the considerable knowledge which can be verbally transmitted, can ironically serve to relegate Fishers' Knowledge as being too different, complicated, or not useful, and to reinforce the very hierarchy of knowledge which Pálsson wishes to rectify. On the other hand, I have yet to read a paper within NRM[134] which refers to intuition in Science or decision-making. However, Hilborn and Walters (1992) refer to the use by analysts of "considerable judgement and imagination" in the context of exploring active adaptive management policies. In a rare study, Pestal (2004) implicitly addresses the role of tacit knowledge and decision-making in fisheries science.

In summary, labels can prevent us from seeing exceptions and possibilities, depicted by Arrow 7 (Figure 4). For example, the focus on the contrast between Science and TLK/Fishers' Knowledge in several of the cases above may have obscured an important similarity noted by Stanley and Rice (2003):

> Although the scientific skillls of resource users are now well recognised in agricultural research, they are rarely acknowledged in fisheries literature even by those who emphasize that fisher knowledge is under-utilised."

Stanley and Rice (2003) refer to fishers' skills in hypothesis formulation, research design, and interpretation. In Stanley's presentation of the paper at the UBC Conference he noted: "Its not entirely obvious who's doing the science any more." Thus, within the Integration Project, the continued over-identification of Fishers' Knowledge with the

[134] In the context of medicine, Ramachandran and Blakeslee (1998) address "speculation," a concept closely related to intuition: "...I'd also like to say a word about speculation, a term that has acquired a pejorative connotation among some scientists. Describing someone's idea as 'mere speculation' is often considered insulting. This is unfortunate. As the English biologist Peter Medawar has noted, 'An imaginative conception of what *might* be true is the starting point of all great discoveries in science'. Every scientist knows that the best research emerges from a dialectic between speculation and healthy skepticism. Ideally the two should exist in the same brain, but they don't have to. Since there are people who represent both extremes, all ideas eventually get tested ruthlessly."

above characteristics (through the use of dualistic contrasts and labelling) reinforces the historical dynamics depicted in Figure 4.

7.1.4 "Fishers' Knowledge is of questionable validity"

The considerable emphasis on the validity and reliability of Fishers' Knowledge within a number of literature cases suggested a connection to the influence of the Science frame and related doubts about the value of TLK/Fishers' Knowledge (Arrows 5 and 11, Figure 4). Given that skepticism is an integral part of Science (Berkes 1999), as is the production of valid and reliable results, concern about validity by scientists is to be expected. However, several observations were indicative of a barrier. Two authors noted that scientists are skeptical of the validity of Fishers' Knowledge (implicitly as a category), characterizing it as "non-tested" (Baelde 2003), "anecdotal and unsubstantiated" (Maurstad 2000). The need to ensure the validity of Fishers' Knowledge was raised directly or doubts about validity were insinuated in 15 literature cases. This issue was the most frequently raised of any issue coded. However, this is largely a reflection of natural scientists, 63% of whom raised it compared to 25% of social scientists (Table A, Appendix C).[135] The assumption among several of these authors appeared to be that Fishers' Knowledge is not valid until validated by scientific methods. Several authors used the term "belief" or "fishers believed" when referring to fishers' assertions of knowledge (Sutton 2000; Wroblewski 2000). Zwanenburg et al.(2000) noted that "[f]ishermen and others have contended that there is a large store of local knowledge…". In Gosse et al. (2003), Fishers' Knowledge is seen to lack the means to validate knowledge, thus Science provides "a more complete understanding of

[135] Interestingly, the issue raised by the greatest percentage of social scientists was the existence of doubts about Fishers' Knowledge (75%), followed by an awareness of the hierarchy of knowledge, the embeddedness of Fishers' Knowledge, and cross-cultural issues (all tied at 67%).

nature" (see also Section 7.2.1).[136] McGoodwin et al. (2000) appear to be aware of this dynamic and mention the importance of corroboration of Fishers' Knowledge with Science so that Fishers' Knowledge is more likely to be used (see next section). However, opportunities may be missed if the only Fishers' Knowledge which is considered for application is that which is scientifically validated (Arrow 12, Figure 4).[137]

A genuine concern for validity of information/knowledge should be expressed with vigour regardless of the source or type of knowledge. Thus, one would predict that authors would also raise issues of the validity and reliability of fisheries science and Science within the context of the Integration Project (since we are theoretically integrating two types of knowledge). In fact, in recent years, this is occurring in fisheries management as a field, using the concepts and discourse of uncertainty (e.g., deYoung et al. 1999). However, among the analyzed literature, the paper by Stanley and Rice (2003) was exceptional in addressing potential bias and weaknesses of both Fishers'

[136] This raises questions about how TLK is tested *in situ* by its holders, which are beyond the scope of the thesis.

[137] As these cases demonstrate, there are a range of ways of potentially using Fishers' Knowledge. Sometimes Scientific validation, that is, through quantitative means is unnecessary, inappropriate, or impossible. For example, Fishers' Knowledge may be descriptive. In some instances, fishers may be the best available source of knowledge given uncertainty and resources. Fisheries management involves decision-making which is ideally based on some level of consensus about the state of "reality". As in social science research, stakeholders act as "checks" on the reliability of each others' information and opinions within fisheries management. The adaptive management approach explicitly recognizes this within the context of uncertainty and intentional improvement of information over time (Walters 1986). Stanley and Rice (2003) are cognizant of this issue but couch it in terms which are hard to penetrate (see quotation in Section 7.2.1). They want to be "rigorous", but the reality of uncertainty makes this difficult (see Norton 1995 for an interesting perspective on economic valuation, values, risk, and uncertainty).

Knowledge and Science. For example, they discuss how fisheries data are "highly uncertain" (see also 7.1.4.1) and mention the existence of "confirmatory bias" (finding what is expected) in Science.[138]

In Wroblewski (2000), Fishers' Knowledge of a local cod stock in Gilbert Bay was treated as a scientific hypothesis which was "validated" through genetic and morphometric tests. Specifically, Wroblewski (2000) asserted that genetic studies needed to be done (as well as coloration experiments, bringing offshore populations into Gilbert Bay waters and observing colour change (Wroblewski 2003)) because colour *"taken alone"* was insufficient to identify a distinct subpopulation. However, he does not appear to have fully considered fishers' basis for identification of a local stock. It is evident through a careful reading of the article that body colour alone was never the sole indicator - fishers utilized a suite of factors taken together. I elaborate on this with respect to each of the "characteristics *that fisheries scientists use* to distinguish subpopulations of northern cod [emphasis mine]" (Wroblewski 2000):

1) "discontinuity in spatial distribution, i.e., residence in a geographic area and spawning ground fidelity";

Fishers detected spatial discontinuity by fishing year round.

2) "local differences in life history parameters such as growth rate and reproductive rate (fecundity)";

Fishers would have observed growth rates of inshore stocks through winter fishing inshore (traps would have caught a range of sizes). Since growth and reproductive rate are correlated with body size, observation of consistent size differences between in-

[138] This lack of critique of fisheries science within discourse on the Integration Project is discussed in Sections 7.2.1 and 7.3.3, and depicted in Figures 5 and 6.

migrating fish and reddish brown- or "golden" -coloured fish are indicators of these life history parameters.

3). "local variation in phenotype, i.e., morphometrics (e.g., size-at-age)";

Size and colouration are aspects of phenotype. The *combination* of colour, size and time of catch in a single local area, was surely used by fishers to distinguish the stock although this was not explicitly mentioned by Wroblewski. Specifically, "big" fish were never brown, fish found in the fall and winter were always brown, and were never big; smaller fish found in the summer were either colour. (Although not mentioned, fishers probably also have knowledge of spawning times, which would have contributed to discerning the stocks).

4) "population genetics substructure."

This is obviously not part of Fishers' Knowledge.

Thus, fishers had observed facets of 3 out of 4 scientific criteria for subpopulation identification. The fourth is a relatively recent addition to scientists' toolbox. Purps et al. (2000) note:

> At the beginning of the twentieth century, biological science consisted almost exclusively of descriptive documentation, but the production of numeric results and the use of simple statistical methods soon led to the application of more sophisticated statistical approaches (Sokal & Rohlf, 1995).[139]

To reiterate, some author/practitioners appeared to place a rather imbalanced emphasis on the validation of Fishers' Knowledge as a category - a kind of

[139] What is considered to be "scientific" varies over time and depends in part on the context of observations, including who, how and why they were made. Although the act of fishing can generate a form of sampling which results in repeated and systematic observations over time, it is not done by scientists for the purposes of Science. During fishing, knowledge is created as *byproduct* of a process with the goal of making a living, thus it is not the *principal goal* of the activity. In fisheries science, knowledge for its own sake is also generally not the goal, since it is an applied science directed toward meeting policy goals through appropriate regulation (see Section 7.2.1 on the difference between Science in theory and Science as practiced.)

"preconceived skepticism". Fishers' Knowledge must be validated, regardless of particulars - even where structurally there is a closer resemblance to Science as in the example above. I suggest that deeper historical resistance towards TLK is part of this overemphasis (Section 7.1.2; Arrows 1,4, and 5 in Figure 4). However, resistance towards TLK combines with behavioural tendencies. Within Science and fisheries management, casting doubt on validity through labelling and subtle or not so subtle disparagement is not unique to Fishers' Knowledge. Wilson (2003) noted that a scientific report produced by the state-level Bluefish Technical Committee stated that "whole otoliths are not reliable for aging bluefish beyond age three..." and that aging them beyond six was "a crap shoot". At a meeting the following month, federal scientists referred to "the *unsubstantiated rumors* that you can't age fish" (see also Sections 7.2.2 on procedural inertia in fisheries science and 7.4.1 on bureaucratic inertia). Likely impacts of the "imbalanced critique" on the Integration Project (besides Arrow 12) are discussed in Section 7.3.3 in the context of the importance of social capital in fisheries management.[140]

7.1.5 "Fishers' Knowledge is difficult to use"

In Chapter 3, I proposed a barrier to the Integration Project related to methodological challenges of applying Fishers' Knowledge given current, Science-based procedures of fisheries management (Table 2, C2). Accordingly, I coded two relevant themes: authors' focus on methods and authors' mention of technical difficulties associated with the Integration Project. I expected more emphasis by authors on specifics of methodology given Nadasdy’s comments (1999) and considerable literature

[140] It is my intention to write a paper on a more balanced version of skepticism or "collective validation", which draws from these literature cases.

on TLK (e.g., Usher and Wenzel 1987; Johannes 1993; Ruddle 1994; Neis et al. 1999; Huntington 2000). However, detailed discussion of methods of collecting and validating Fishers' Knowledge was found only in McGoodwin et al. (2000). Just over one-third of this paper, the concluding and summary chapter of *Finding our Sea Legs,* focused on methods (McGoodwin et al. 2000). This emphasis appeared to be based on the premise that there are "some important methodological issues" which need to be "resolved"[141]:

> Earlier studies used a variety of research designs and methods to elicit and describe Fishers' Knowledge. The studies did not lend themselves readily to making comparisons, to quantification or to replication, thus making it difficult to develop a "science" of Fishers' Knowledge. As indicated by this collection, this diversity has persisted, but some of the problems with earlier research have begun to be addressed.

This quotation is then followed by an examination of sampling. One of their final recommendations is that "New methodologies must be developed and rigorously tested". Although they briefly mention that methods depend to some extent on researchers' goals, this degree of emphasis on methods in the closing article of the volume seems to suggest that the standardization and improvement of methods for *collecting* Fishers' Knowledge is of key importance in increasing and improving its application. Neis and Felt (2000b), in the Introductory chapter of *Sea Legs* provided the context for this emphasis in laying out the four "substantive issues" for both readers and contributors to

[141] In McGoodwin et al. (2000), this focus on methods occurs along with a lack of focus on the impacts of the hierarchy of knowledge within the Integration Project (even though they begin the paper by placing the Integration Project in the context of the "hegemony of systems of belief" and the related "challenges to scientific research and scientific experts"). This focus is suggestive of the degree of influence of the Science frame. However, they do acknowledge that the collection "probably pays too little attention to the larger context: the political ecology of knowledge production and management within fisheries”.

reflect upon, two of which involved methods - to collect Fishers' Knowledge and to validate it.[142]

Given the existence of doubts about TLK/Fishers' Knowledge, and the emphasis on validity documented here, some practitioners may look to methodology as a means to generate "valid and reliable" Fishers' Knowledge. It may also be a deliberate and pragmatic strategy on the part of the editors and authors, all three of whom are social scientists who recognize "[the lack of] equality between knowledge frameworks", to focus on ways to "improve the reliability/validity" of Fishers' Knowledge in order to help move the Integration Project forward. The following quotation regarding the "benefits of corroboration" seems to suggest this: if "such [corroborative] research is not forthcoming…the likelihood of fishery workers' knowledge getting incorporated…will likely be less". The introductory and concluding chapters of *Finding Our Sea Legs* were unique contributions, providing the functions of context-setting, reviewing contributed papers, and summarizing key issues of the Integration Project. (Unfortunately, *Putting Fishers' Knowledge to Work* cannot be compared because it is a conference proceeedings).[143]

Natural scientists did not emphasize methods in their papers (recall that the code defines emphasis as greater than one-fifth of the length of the paper). This was probably because their papers tended to report on applied fisheries management cases

[142] The four substantive issues were: 1. "alternative methodologies for *collecting* ecological and fisheries-related information *from* resource users (although the questions which follow this first issue get at power relations, this is not mentioned explicitly in the chapter); 2. testing the "validity and reliability of the data provided" and how this was done; 3. "benefits and risks of trying to collect these data in a [form compatible with Science]"; 4. "larger debates about the the relations between different knowledge systems,…benefits and risks of more democratic approaches to knowledge production and fisheries management" (Neis and Felt 2000b).

[143] Although Maurstad, a social scientist, focused on methods, her paper was a reflexive and critical analysis of her own attempt, with a biologist colleague, to "combine the two knowledge systems".

with specific objectives and reasonably straightforward methods of data collection or conversely, more participatory approaches involving dynamic Fishers' Knowledge.

Several authors referred to the technical difficulties of Fishers' Knowledge application. They appeared to associate the differences between the two knowledge systems with "obstacles to gathering information from fishers and integrating it with science" (Maurstad 2000) or "difficulties" (McGoodwin et al. 2000). McGoodwin et al. (2000) note that one reason for "rough waters and queasiness" in the Integration Project is that "the dynamics of users' knowledge and its evidentiary basis differ significantly". The authors then examine a range of differences between Fishers' Knowledge and Science connected to knowledge production. They mention "the problems of making Fishers' Knowledge *relevant for* fisheries science and management" [emphasis mine] which appear to be connected to the following:

> The data contained in Fishers' Knowledge have a high degree of complexity and are not standardized in terms of temporal scale, territorial coverage, technology, effort and expertise.

Baelde (2003) referred twice and without any qualifying statements to the difficulties of integrating Fishers' Knowledge and Science due to their divergent characteristics (citing McGoodwin et al. 2000). Maurstad (2000) briefly discussed three more specific obstacles to collecting Fishers' Knowledge: fishers' secrecy, variability of Fishers' Knowledge, and the need for interpretation of Fishers' Knowledge within its particular social context. MacNab (2000) refers to "challenges of collection, veracity, analysis, application and ultimately, ownership".

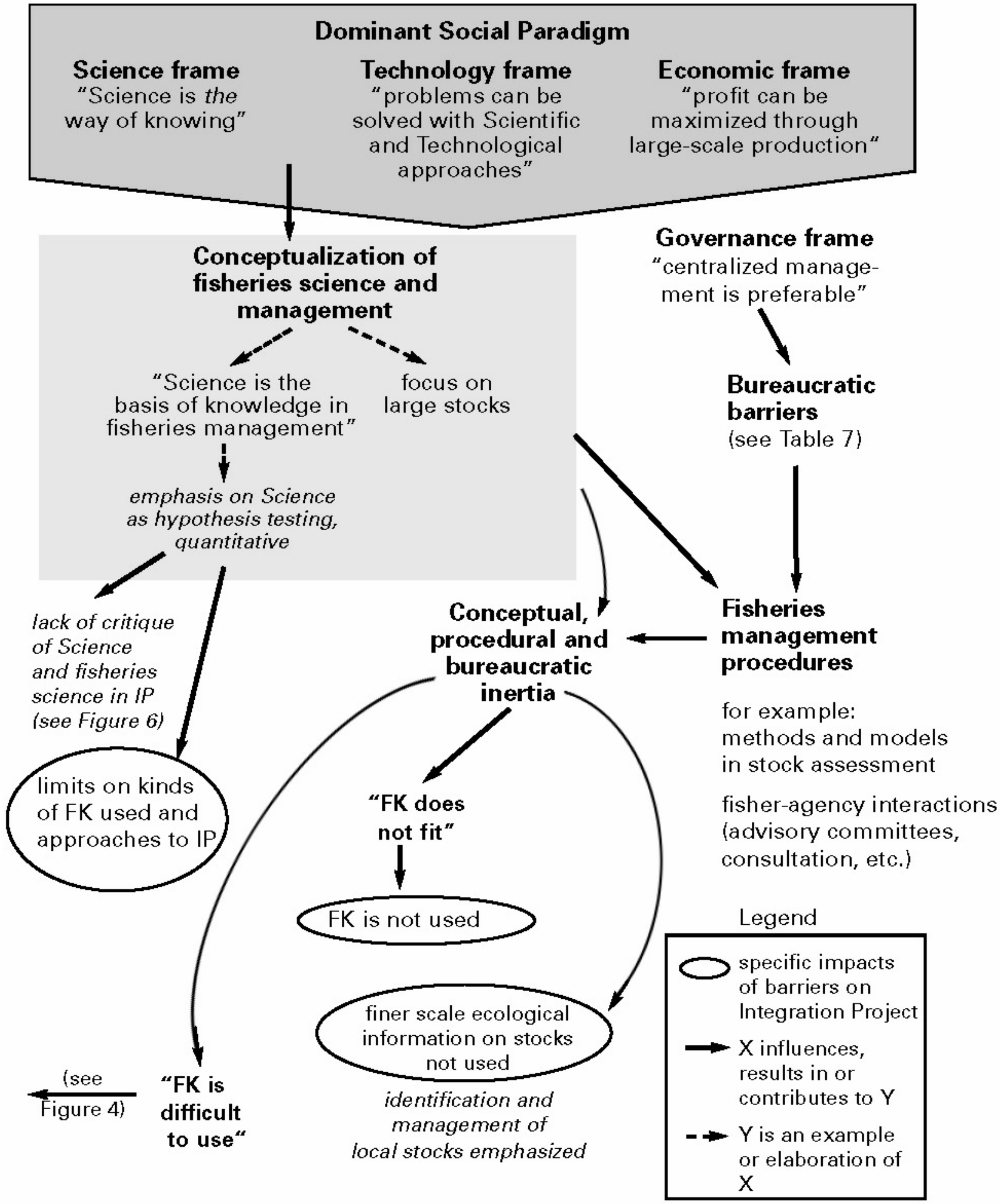
I have summarized these ideas with the frame "Fishers' Knowledge is difficult to use". My intention was to capture the sense of both the perception and "reality" of the frame. The conviction attached to this frame among fisheries management practitioners is influenced by both "what FM is" conceptually and operationally,(see Section 7.2. for a discussion, Figure 5, and Figure 4 Arrow 14) and "what Fishers' Knowledge is" conceptually (Figure 4 Arrows 1,15). The frame "Fishers' Knowledge is difficult to use" does reflect the reality of current procedures and pragmatic considerations within fisheries management. This is elaborated in Section 7.2.2.2 and in Figure 5. For natural scientists, working with Fishers' Knowledge may be difficult compared to, for example, data collection which involves taking measurements of particular variables, followed by statistical analysis.[144] Fishers' Knowledge may not fit into current stock assessment methods (or other management activities) easily or at all (Section 7.2.2.2). Furthermore, there is a lack of resources to take on new initiatives in fisheries agencies (see Section 7.4.6). In this vein, McGoodwin et al. (2000) noted:

> While some of the problems with information exchange have to do with bureaucratic rigidity and poor communication, we would suggest that *a substantial amount can be attributed to more practical concerns* relating to how to organize and use Fishers' Knowledge within a bureaucratic decision-making structure dependent upon scientific estimates of the number of fish available for harvest. *Perplexed by the structure, form and scale of fisher's knowledge*, even the most sympathetic fisheries scientist or manager all too often retreats to the security and familiarity of bureaucratic rules and the unquestioned legitimacy of a normalized, highly quantified fisheries science (Finlayson 1994) [emphasis mine].

Baelde (2003) also acknowledged what I refer to as "procedural inertia", paraphrasing McGoodwin.

144 The perception of "difficulty" has a context. Thus, the unwieldy aspects of TLK are probably perceived as less of a difficulty for social scientists who are trained in using relatively qualitative forms of data. Nonetheless, as a biologist, my experience doing this thesis research has shown me that not only perception is involved. Qualitative research *is* complex, difficult, and potentially much more time consuming!

Figure 5. Influence of metacultural frames on the conceptualization and procedures of fisheries science and management and ultimately on the Integration Project.



Note. Influence network demonstrating the proposed links between several metacultural frames; conceptualization and procedures of fisheries management and bureaucratic barriers; and their related impacts on the Integration Project.

There are three common components within the two quotations above: inertia associated with routine, *scientific* practices, and the "complexity" of Fishers' Knowledge. These same three components along with a fourth are evident in this explanation for institutional barriers to "practical knowledge":

> The knowledge of fishers is not collected into scientific format. Experts often view practical knowledge as a collection of "cracker barrel" information. Scientists are most comfortable with knowledge that is the product of controlled experiments that can be repeated (Glaesel and Simonitsch 2003).

However, the "cracker barrel" comment and the "unquestioned legitimacy…of science" in the quotations above suggest that structural resistance to Fishers' Knowledge associated with the influence of the Science frame (Section 7.1.2) might also be part of the inertia described above (i.e., it is not just procedural). Recall from Chapter 3, that I proposed that the strength of the barrier of technical difficulties would depend on other constraints such as attitudes of researchers or financial resources. Baelde (2003) was exceptional among the authors in noting the emphasis on the technical difficulties of integrating Fishers' Knowledge into scientific methods within fisheries management. Furthermore, she referred to their *effects*, which is for "scientists [to] maintain a narrow and prescriptive view of the nature and value of Fishers' Knowledge (Baelde 1998, Maurstad 2000)." This is indicated by Arrow 16 (Figure 4). One of the specific impacts on the application of Fishers' Knowledge is to ignore knowledge which cannot be expressed quantitatively. Another possible effect is less direct: the focus on appropriate methods tends to direct attention toward methods to *collect* Fishers' Knowledge and may therefore preclude the incorporation of dynamic Fishers' Knowledge within more participatory approaches (Section 7.4; Soto in prep.). Baelde (2003) was also exceptional in noting that "[fisheries] scientists tend to believe that the *usefulness* of

Fishers' Knowledge is limited because of the difficulties inherent in quantifying it". I added Arrow 17 to the influence network to convey this link (Figure 4). This echoed Nadasdy (1999) who critiqued the most common approach to the Integration Project:

> This approach views the present lack of progress toward integration as resulting from the complexity of these problems [of purportedly incompatible types of knowledge] and the difficulty in developing strategies and methodologies capable of effectively dealing with them. This official type of explanation, by focusing on the "integration of knowledge systems" as a technical problem, is inadequate because it ignores the political dimensions of the issue of knowledge integration.

In a related vein, Stanley and Rice (2003) questioned the "data collection" model which "assumes that for local knowledge to contribute it must be systematised, stored, manipulated, and *made intelligible* to others in a manner similar to the treatment of data from conventional monitoring sources (Ferradas 1998)" [emphasis mine].

7.1.6 Summary

Humans' actions and attitudes reflect a combination of influences and constraints which are difficult if not impossible to separate analytically. Practitioners' beliefs and attitudes reflect pragmatic considerations related to bureaucratic and scientific procedures as well as many other influences (bureaucratic and procedural inertia are further discussed in the next section.) Even so, the thesis results discussed in Section 7.1 suggest that a considerable portion of the above-mentioned "retreat" of fisheries scientists and managers (Section 7.1.5) is not just a result of "perplexity" at the unwieldy nature of Fishers' Knowledge, but stems from the influence of the Science frame and related resistance to Fishers' Knowledge as a category.

7.2 The conceptualization of Science, Scientific procedures in fisheries management, and their relationship to the DSP

This Section examines several barriers associated with the conceptualization and procedures of fisheries science and management. In doing so, I again discuss the influence of the Science frame as well as several other relevant metacultural frames. This portion of the influence network (Figure 5) is based upon the emergence of a number of interconnected themes in the literature cases. These themes fell under the broad heading of *what fisheries management is* in conceptual and operational terms.

A key frame within fisheries management which influences various aspects of the Integration Project is: "Science is the basis of knowledge in fisheries management" (Figure 5).[145] I take this as a premise, although there is no shortage of literature to . demonstrate the point. Until approximately twenty years ago, this frame dominated fisheries management thinking and discourse regarding knowledge production. It is essentially a re-expression of the Science frame at the institutional level of fisheries management. In the past, Fishers' Knowledge was not used because it was "not Science" (Section 7.1, Figure 4). In Section 7.2.1.1, I first address how the conceptualization of Science as hypothesis testing in some literature cases may be indicative of a barrier to Fishers' Knowledge at the operational level in fisheries management (rather than the "higher" or "value judgement" level of Section 7.1).

I next examine various procedural aspects of fisheries science as potential barriers to the Integration Project. The literature cases suggest a frame which can be summarized as "Fishers' Knowledge does not fit", given current procedures of fisheries

145 Compared to the frame "…TLK is not Science…Therefore, it is of no value" (Figure 4), it is a more recent frame, since government-run fisheries management has existed for about 100 years in most developed countries.

science and management. Revisiting Section 7.1.5 , I attempt to separate out the "belief" and "pragmatic" components associated with this frame. Specifically, I examine how scientists' beliefs about and "commitment" to Scientific procedures may affect the participation of fishers and their knowledge in fisheries science and management. I then address how routinized or entrenched scientific methods and procedures in fisheries management can act as barriers, drawing on examples in the literature cases. This discussion flows into a more focused examination of the socio-cultural and institutional roots of the neglect of attention on local stocks and smaller-scale ecological phenomena within fisheries science. I use this opportunity to elaborate on additional influential frames, including the Economic, Technology, and Governance frames, which, together with the Science frame, have influenced the evolution and institutionalization of the *procedures* of fisheries science (Section 7.2.3).

7.2.1 "Science as hypothesis testing" and fisheries science in practice

This section examines a particular version of the "Science is the basis of knowledge in fisheries management" frame. Specifically, the mode of Science held up as ideal in five papers written by natural scientists appeared to be the hypothetico-deductive mode, which involves hypothesis testing through performing experiments (Chalmers 1999).[146] For example, Bergmann et al. (2003) imply that the goal of fisheries science is to test scientific hypotheses. Four of these authors stated that Fishers' Knowledge is information to be used to generate hypotheses (with the exception

[146] Although this number is not a large one, this result, combined with the large number of papers mentioning validity, as well as other evidence (which I incorporate into the discussion below and elswhere in the thesis) make this theme of how Science is conceptualized in fisheries management a critical one to discuss in terms of barriers to the Integration Project.

of Bergmann et al. 2003). In Gosse et al. (2003), the authors acknowledge the value of Fishers' Knowledge in informing hypotheses or research questions. Science is seen as the basis for determining validity of knowledge because it involves testing hypotheses with field work or experiments - this is the closing of the induction-deduction loop of knowledge referred to in the title of their paper. Fishers' Knowledge is seen to lack the means to validate knowledge. Hutchings and Ferguson (2000) list two criteria which determine the "ultimate value of fishers' local knowledge to *fisheries science*": "its ability to *generate testable hypotheses* about the behaviour and ecology of fishes (e.g., migration, reproduction, habitat associations) and…its ability to provide *measurable* data on stock status....[emphasis mine]. I address these two inter-related criteria below.

The conceptualization of fisheries science as hypothesis testing can be a barrier to Fishers' Knowledge use in fisheries management because not all useful fisheries information, whether obtained by fishers or scientists, warrants being treated as hypotheses to be tested in experiments.[147] For example, Level 1 Fishers' Knowledge used in mapping of habitat and spawning areas was descriptive and qualitative information that was not used to create hypotheses (MacNab 2000; Bergmann et al. 2003; Williams and Bax 2003)[148]. To their credit, Hutchings and Ferguson (2000) separate the contribution of Fishers' Knowledge to fisheries science and to

[147] As already stated, much biological science prior to 1900 was descriptive. Information on the ecology and life history of fish species is an important if at times neglected area within fisheries science, as FishBase and other related databases are attempting to rectify (Pauly 1998). Johannes (1973) illustrated the immense volume of ecological knowledge, including species' identification, fish behaviour, and ecology possessed by some Pacific fishers.

[148] Instead, some level of consensus by multiple observers was generally required.

management.[149] However, since agency scientists tend to be involved with many aspects of management, a potential fixation on testability of hypotheses as the key criterion for contribution of Fishers' Knowledge can limit options, including the use of Level 2 Fishers' Knowledge (Figure 5).

Furthermore, there is a considerable difference between the idealized view of Science mentioned above and fisheries science as generally practiced. Here I borrow from literature in the sociology of science, which contrasts an idealized version of Science with "science-as-practice" (Latour 1987). Stock assessment is perhaps the key activity within "fisheries science". However, the actual testing of hypotheses regarding the status of fish stocks through experimentation is generally not done. This is referred to as active adaptive management (Hilborn and Walters 1992).[150] Fisheries hypotheses are difficult to test experimentally in nature. Adaptive experimental management approaches are challenged by practical difficulties of scale and heterogeneity of units, temporal change (including environmental fluctuations such as temperature), expense, discount rates, and risk averse managers (Hilborn and Walters 1992).

Currently, modelling approaches may be used to "test hypotheses" of sustainable harvest rates under a range of potential conditions through computer simulations. Furthermore, modellers may use Bayesian approaches which do not involve falsification

[149] However, one gets the impression in fisheries literature and management settings that fisheries scientists sometimes blur potential distinctions between stock assessment, fisheries science, and fisheries management. A potentially related and worthwhile study would examine the extent to which this occurs among key stakeholders in fisheries management. For example, two esteemed fisheries scientists note in the introduction to their stock assessment textbook (in a subsection on computers): "…quite frankly, if you are not comfortable writing computer programs and playing with numbers, you should not be interested in fisheries *management*!" [emphasis mine], yet in their discussion on the dynamics of fishing fleets they stress that an overly biological and statistical view of stock assessment has led to ignoring the "dynamic responses of fishermen", the "predators" in the system (Hilborn and Walters 1992).

[150] For example, different fishing regimes can be applied to spatial replicates to examine alternative hypotheses, which, in this context, are generally alternative models and/or model parameters to describe spawner-recruitment or effort and catch relationships.

and to which new information can be added to improve estimates through reducing uncertainty (Hilborn and Walters 1992). However, Stanley and Rice (2003) note that given how "highly uncertain" fisheries are,

> …the reliance on formal use of probability-based methods [is] more form than reality (Patterson et al. 2001). Often the nature of the dialogue in an assessment meeting must focus more on the justification for assuming that alternative information sources and interpretations are reliable and credible, rather than on statistical nuances that have weak empirical foundations. Hence, without actually lowering their standards of rigour, the science participants may find other grounds for accepting and rejecting ideas that are both sounder and more meaningful to their research partners.

The second sentence in this quotation seems to imply in a roundabout way, that fisheries scientists and fishers (the research partners) should consider other ways of *collectively validating* (Soto in prep.) sources of information. Although they implicitly insist that high "standards of rigour" are attainable, their paper as a whole implicitly argues for a closer examination of the question: who decides what is rigorous, and how? Then there is the process of how information gets used to make decisions. In this context of uncertain data in fisheries science, which models and parameters are most appropriate and how are these decisions made? These have important ramifications on stock recruitment predictions and therefore upon calculations of Total Allowable Catch (TAC) and fishers' livelihoods. Rice mentions a potential scenario of fisheries decision making once the "*empirical* part of the science is over" (my emphasis, since this implies that there is another "part of the science"):

> maybe we take a leap which we all agree is *not* scientifically pure, and *go* with Q [a particular person's opinion/judgement among several others], just because Q has a good track record for calling past decisions right. (quoted in Finlayson 1994).

The "best available science" may therefore reflect a combination of factors including quality of data, competing models and opinions about which are best and why, and financial constraints in terms of testing the models or obtaining additional data (Wilson 2003). And this is before considering more "obvious" political influence on decision-making in fisheries![151] Returning to the Integration Project, the paper by Stanley and Rice (2003) was unique since it extended the notion of science to include knowledge and approaches utilized by fishers, noting that they "do research" and apply "elements" of the scientific method. Clearly, fisheries science in practice is variable and occurs within a social context.

The concept of hypothesis testing is also a variable one. For example, even in this smaller sample of scientific approaches to Fishers' Knowledge application, there is a range. Wroblewski (2000) took an experimental approach. Hutchings and Ferguson (2000) collected data in interviews with fishers retrospectively and noted that: "These data are consistent with the hypothesis that the collapse of northern cod was neither sudden nor precipitous". In these two cases, the terms "hypothesis" and "test" are used differently.

In Newfoundland, fishers pointed out evidence of declines many years before the moratorium, based on their own experiences and indicators of increased effort. However, this consensus among many inshore fishermen was not considered a hypothesis to be tested until the post-hoc analysis of Hutchings and Ferguson (2000). In contrast to fishers' agitated and repeated statements at meetings with agency staff about how they had to use finer mesh, more nets, travel farther, etcetera, Hutchings and Ferguson (2000) systematically documented through interviews with a large number of fishers the first two of these indicators: an estimated increase in the *number* of nets used

[151] See Finlayson (1994) for an in depth discussion of macro- and micro-level influences on the development of the crisis and moratorium in the Atlantic cod fishery in Newfoundland.

and changes in mesh size (a qualitative change which has quantitative impacts, i.e., on the number and size of fish caught). Hutchings and Ferguson (2000) noted that these indicators of increased fishing effort "can be used in conjunction with stock assessment models to provide information on the temporal and spatial extent of fishery declines".[152] However, a strict interpretation of "the ability [of Fishers' Knowledge] to provide measurable data on *stock status*" [emphasis mine] may have precluded this very information in the recent past, especially because these variables do not input directly into stock assessment models (see Section 7.2.2.2).

To reiterate, fisheries science, particularly stock assessment, often does not involve experimental hypothesis testing in the field; much information of relevance to fisheries science does not fit in the framework of hypothesis testing *sensu strictu*; and scientists may or may not accept fishers' observations as hypotheses worthy of "testing". Key concepts and language are used with reference to the role of Science in fisheries management in inconsistent ways which may inadvertently reinforce power dynamics. How Science is conceptualized by some fisheries scientists may act as a barrier to Fishers' Knowledge by contributing to the frame "Fishers' Knowledge does not fit…(because *this* is what fisheries science is: Science which tests hypotheses quantitatively)" (Figure 5).[153] As mentioned above, this may limit options in the Integration Project, for example, the use of descriptive Level 1 or Level 2 Fishers' Knowledge (Figure 5). Furthermore, given the above discussion which raises the social context of fisheries science procedures, the often strongly held perception of rigour,

[152] The degree to which observations are submitted to various kinds of tests of validation may depend on whether the observer is a scientist or not; how the observations are compiled, analyzed, and conveyed; and by whom (recall Wroblewski 2000, Section 7.1.4).

[153] This dynamic involving Fishers' Knowledge (the applied level of analysis) resembles the dynamic discussed previously where "TLK is not Science" (Section 7.1.1) (Arrows 1, 2 in Figure 4).

objectivity, and hypothesis testing within fisheries science seems questionable, particularly since it may contribute to the conscious or unconscious marginalization of Fishers' Knowledge. These generalizations about Science also inadvertently contribute to the relative lack of critique of science and fisheries science as practiced, which were observed within the analyzed papers (raised in Section 7.1.4). The potential impact of this lack of critique on the Integration Project is raised in the context of social capital and fisher-scientist relationships in Section 7.3.3.

7.2.2 Procedural inertia in fisheries science

In this section, I introduce the notion of procedural inertia and its relevance to the Integration Project. I use this term to refer to "attachment" to particular methods and practices (e.g., data collection methods, models and assumptions) associated with fisheries science on the part of fisheries scientists and/or the management agency. The concept shares features with Finlayson's "operational inertia" and Baelde's (2003) "established scientific practices " (mentioned in Section 7.1.5). There are several inter-related aspects of procedural inertia of interest here. In Section 7.2.2.1, I address fisheries scientists' beliefs about and "commitment" to Scientific *procedures* which may result in the perception that "Fishers' Knowledge does not fit" within fisheries science. I also examine the issue of the technical difficulty of these practices and touch on how this may affect the participation of fishers and their knowledge. In Section 7.2.2.2, I explore examples of particular methods and procedures raised in the literature cases and how they can prevent the use of Fishers' Knowledge. The general human preference for routine, maintaining the status quo, and for risk averse behaviour also affect innovations such as the Integration Project (Ostrom 1992). I briefly discuss this in Section 7.4.1 under the subheading "bureaucratic inertia" (Figure 5).[154]

7.2.2.1 *"Fishers' Knowledge does not fit" – the belief component of procedural inertia*

The use of Science (capital 'S' Science is quantitative) in fisheries management became more pronounced after World War II (Evenden 2000; Pitcher and Haggan 2003). This was made possible by the increased use of statistical methods, improvements in computing technology, and therefore in computer models which could process large amounts of data (Sokal and Rohlf 1995). These developments, along with the emphases on centralized and large-scale industrial fisheries (see Section 7.2.3), increasingly distanced Fishers' Knowledge from management in two key ways: through the association of Science with these procedures and the necessity of trained experts whose job it was to conduct these increasingly specialized procedures.

Given the frame "Science is the basis of knowledge in fisheries management", it follows that the *procedures* involving the above-mentioned methods, models, and technologies are considered to be Scientific, and given the influence of the Science frame, superior. In a related and particularly honest comment, Dr. Richard Stanley noted in his presentation at the UBC conference: "Earlier in my career I would have said I don't really care what's in your nets...my statistics tell me what I need to know".[155] Stanley and Rice (2003) also mention that in working with fishing captains, "scientists had to abandon the attitude of ‘leave the science to us.’ " I suggest that these quotations demonstrate a combination of two frames behind the exclusion of Fishers' Knowledge:

[154] Hilborn and Walters (1992) note the tendency for risk aversion among "most agency biologists" as well as the slowness to change associated with management agencies.

[155] In the paper, Stanley and Rice (2003) make a somewhat similar comment.

"Science and *Scientific procedures* are the basis of knowledge and Fishers' Knowledge does not fit" (Figure 5). Baelde, in the general discussions in the Proceedings of *Putting Fishers' Knowledge to Work* (Haggan et al. 2003) noted: "Many of the talks today referred to taking fishers' knowledge and transforming it to the benefit of science. We should accept their knowledge without having to fix it until it fits with our knowledge".[156] This frame combines with the longer standing frame regarding the dubious value of Fishers' Knowledge as a category (Figure 4). In addition to "*we* have the procedures", the quotation also has the flavour of "we have nothing to learn from you".[157] With the push for increased involvement of fishers and their knowledge, the frame "Fishers' Knowledge does not fit" may be relaxed to "Fishers' Knowledge is difficult to use" (recall Section 7.1.5 and see Section 8.1 for further discussion).[158]

Another related issue raised in four literature cases involves the expertise required to conduct these specialized fisheries procedures, and whether they are too difficult for fishers to understand. Two differing perspectives are offered in the following, the first by the "scientific liaison" (background unknown) and a natural scientist from SeaFic (Lydon and Langley 2003; see Appendix A):

> The interpretation of scientific analysis can be challenging and some fishers choose to opt out and not contribute local knowledge. It may not just be because of a lack of understanding - the scientific terms, jargon and concepts can be too abstract. Opting out can also be due to apathy,

[156] Weeks (2000) noted this tendency in the context of Texas shrimp fisheries: "Appeals to other types of thinking…are not considered relevant to decision-making, which should be based on sound science...For agency personnel, statistics take precedence over fishermen's experience on the water".

[157] Thus, it was of interest to analyze whether natural scientists mentioned learning from fishers or mutual learning within the literature cases. Three papers did: Williams and Bax (2003), Stanley and Rice (2003), and Rowe and Feltham (2003). Furthermore, Wilson (2003) mentioned in the bluefish case that state biologists were more willing to engage with fishers and their knowledge and to learn from them compared to federal scientists.

[158] In some of the literature cases, these frames were not applicable - innovative ways of working with Fishers' Knowledge or ways which complemented stock assessment were examined (see Section 8.1).

> self interest, feeling insubstantial, a reliance on others or simply a lack of time to take part...Fishers can find that fisheries management meetings are at times very technical in nature...the learning curve can be steep. It takes time to get to know the individuals and personalities, and to develop trust and respect. To the average fisher, scientists can appear as 'boffins' and modelers as 'number crunchers.' At first for fishers attending meetings, the adage of Mark Twain can hold true - "that it is better to keep your mouth shut and appear stupid than open it and remove all doubt". A more effective and credible option has been for fishers to collect information…themselves...and contract SeaFIC scientists to analyse and present the results to the fishery management meetings. By taking part in and funding an AMP [adaptive management plan] such as BNS 1, the fishers become more involved in the decisions made and gain ownership of the research.[159]

The second quotation is from a social scientist and a fisherman (Glaesel and Simonitsch 2003):

> Often the result of being excluded is to be distrustful, apathetic and cynical, as the hopelessness of an outcome based on genuine collective deliberations becomes apparent (Brower 1993). The vast majority of harvesters view themselves as politically included only by virtue of having to comply with the council's rule making...Fishing people have become burdened with a self-fulfilling prophecy. The less they are involved, the less they *understand.* The more incompetent they appear the more justification exists for continued exclusion from the process (Simonitsch 1998).

Certainly, the complexity and technicalities associated with modelling and statistical procedures in fisheries science (and the decisions made based upon them) are issues which can serve to alienate fishers from contributing their knowledge.[160] However, if the will on the part of fisheries scientists is there, it is possible to make these procedures more "user friendly", for example, the participatory research of Stanley and Rice (2003) was facilitated by "mutually understandable graphic images" and computer

[159] Given their own comments which contextualize constraints on participation (Lydon and Langley 2003 Section 7.4.3), the degree to which fishers "become more involved in the decisions made" or just become data collectors is unclear.

[160] The other option, which also occurs is for fishers to learn the language of Science (Felt 1994; Weeks 1995; Maurstad 2000) (see also Section 5.5 which summarizes various facets of the "integration" part of the Integration Project).

technology - real time estimates of biomass on shipboard which provided rapid feedback from acoustic data. Both Prince (2003) and Baelde (2003) referred to participatory modelling involving fishers in this context, the former noting:

> [T]he real power of the Walters' toolbox is visualization, both for visual analysis of historic trends, and also for real-time scenario gaming of alternative futures (Walters 1986). It has the potential for unlocking insight and community involvement through visualization.

7.2.2.2 Procedural inertia as routine practices in fisheries science

This section focuses on examples of actual routines and procedures in fisheries science which have become entrenched and their potential influence on the Integration Project. The emphasis in fisheries science has been on the quantification and modelling of fish stocks (Hutchings and Ferguson 2000) using particular concepts, methods, and models. For example, Roepstorff (2000) mentions the particular approach to defining stocks and assessing them. Ames et al. (2000) note that in conventional fisheries management, there exists:

> the idea that the manipulation of a single variable - fishing mortality - at a single spatial scale - the range of the stock - and a single temporal scale - one year - can control overfishing.

Particular kinds of stock assessment models have been used in fisheries science and these models have particular parameters which necessarily limit the ways in which new information can enter. Roepstorff (2000) and Pitcher and Haggan (2003) noted that past approaches to fisheries science have precluded a more ecology-centered approach, which new policies on ecosystem management aim to rectify (e.g., Canada's *Oceans Act* 1996. Ecosystem and spatial modelling are relatively new (e.g., Christensen and Pauly 1992; Walters et al. 1999) and have challenges associated with their application. For example, models can support a limited number of parameters

(Hilborn and Walters 1992). However, these kinds of models may better allow for the inclusion of Fishers' Knowledge of habitat, fish distribution, and local stocks or subpopulations (see Section 7.2.2.3 below for further discussion of the scale of application of fisheries science and management and the neglect of Fishers' Knowledge on local stocks).

Increases in fishing effort have frequently been ignored in the past, and this has contributed to stock collapses (Gendron et al. 2000; Hutchings and Ferguson 2000). As mentioned in the previous section (Section 7.1.2.2), ignoring changes in fishing effort may partially be attributed to fisheries scientists' concentration on estimating stock abundance directly. Baelde (2003) learned through interviews with fishers that their behaviour on the grounds diverged substantially from assumptions which permit the use of catch per unit effort (CPUE) as an abundance indicator. However, the results of interviews were not taken into account in stock assessment:

> …after initially welcoming the results of the survey, scientists then appeared to quickly lose interest…They failed to appreciate the need for dedicated and specialised work to turn this knowledge into a useful form for science. Institutional inertia quickly overcame their initial interest in favor of established fisheries science practices (Baelde 2003).

Accordingly, the application of effort change data to models for the real time management of fisheries was not mentioned in any of the papers. Gendron et al. (2000) used the results to generate consensus among fishers for subsequent changes in management and Hutchings and Ferguson's (2000) study was retrospective.

There is a need to work with fishers to track this effort change, incorporate it into models, and adapt regulations accordingly. To do so is challenging, not because it is "Fishers' Knowledge", but because fisheries science is challenging. Modelling requires "judgement and imagination" (Hilborn and Walters 1992), especially since, in a case like

Hutchings and Ferguson (2000), quantitative relationships between gear changes and catch had not been established.[161]

Current modelling approaches and Bayesian statistical methods allow for exploration of uncertainties (e.g., Peterman et al. 1998). A range of values for parameters can be explored (e.g., fishing mortality or catchability) which appear to be reasonable based on various kinds of information. Baelde (2003) raises newer participatory modelling approaches in which hypotheses are identified using "available data and expert opinion from scientists, various fisher groups and managers" (e.g., Punt et al. 2001).

Making assumptions in stock assessment models and fisheries research can also preclude the gathering or incorporation of relevant information. Since the model's output and its application are the focus of efforts, once the assumptions are made, they may remain untested. For example, Hutchings and Ferguson (2000) noted that three previous studies of trap catches incorporated the implicit assumption that all traps have equal fishing power, and that given the results of their interviews with fishers,

> such an assumption *now appears untenable*...From a management perspective, it would clearly be advantageous to know how these modifications to trap design influenced selectivity and fishing power. [emphasis mine]

This example also implies that either fishers were not previously asked or not listened to. However, they knew their traps differed in fishing power – that is why they chose to modify or replace them, given their reduced catches.

[161] As is often the case in fisheries, the time and effort it would take to research estimates of this relationship are not justifiable, especially given the range in kinds of gear. In addition, the declines in cod abundance (or natural variability) would have meant that there were no "controls" in terms of exposing the gear to a stable population over time, to isolate the catchability/selectivity of the gear itself. Thus, quantitative data (here, collected by Hutchings and Ferguson 2000) can still be awkward and difficult to use if it does not "plug in" conveniently to the current system.

The flexibility of stock assessment methods is also constrained by the necessity of following sampling schemes established in the past, which may no longer reflect the distribution of stocks of interest, for example, given changes in fish behaviour in response to environmental conditions. Zwanenburg et al. (2000) noted that "FOC has operated *highly standardized, scientifically and statistically rigorous* groundfish surveys...since 1970….[But there is] limited spatial and temporal coverage..." [emphasis mine]. Williams and Bax (2003) make a similar observation, referring also to the "high number and frequency of commercial sampling". Sampling may therefore not be representative of the actual status of stocks or portions of stocks. Pálsson (2000) noted:

> ...while the design of controlled surveying has an obvious comparative rationale, it is also a straitjacket, preventing a more flexible and dynamic sensing of ecological interactions in the sea...Many skippers pointed out during interviews that, fixed to the same paths year after year, the rally fails to respond to fluctuations in the ecosystem, thus providing unreliable estimates; one of them, a skipper who had participated in the trawling rally, remarked that, knowing how the biologists worked, he had lost all faith in scientific procedures!

In the case of Bering Sea scallops (*Patinopecten yessoensis)*, a graduate student (Turk 2000 in Orensanz et al. 2005) created maps juxtaposing the trawl survey locations and locations of commercial beds using catch and effort information from logbooks. This revealed that the 25 year old trawl survey conducted by the US National Marine Fisheries Service had never detected the scallop beds (Turk 2000).

Stanley and Rice (2003) elaborated in some detail on the use of a "statistical short-cut" which yields incorrectly narrow confidence limits around biomass estimates.[162] Fishers pointed to the much higher variation in abundance based on their knowledge. The procedure was further examined by scientists, found to be flawed, and the practice

[162] Stanley and Rice (2003) note that the "assesssment staff were using the relative error calculated from individual surveys as a surrogate for the expected ‘within-year’ variance of the abundance index."

was abandoned for the stocks in question. However, the practice "results from the prohibitive expense of conducting replicates or extending the duration of surveys" and continues as a common practice in stock assessment in other fisheries (Stanley and Rice 2003). The examples above demonstrate how an attachment to specific procedures utilized in fisheries science can result in the screening out of knowledge obtained by other procedures, including Fishers' Knowledge.

7.2.2.3 The emphasis on local stocks and their inappropriate management in the literature cases

In recent years, increasing numbers of local stocks have been identified, many with the contribution of Fishers' Knowledge. Issues connected to finer-scale habitats and stocks within fisheries management was the second most frequently raised theme overall (by a similar percentage of both natural and social scientists (FSQ in Table B of Appendix C). Local stocks or stock substructure in the following species was mentioned: abalone, *Haliotis rubra* in Tasmania (Prince 2003); Atlantic cod, *Gadus morhua,* in coastal Norway (Maurstad 2000); turbot (*Reinhardtius hippoglossoides*), in Greenland (Roepstorff 2000) and the Gulf of St. Lawrence (Camirand et al. 2003); and lobster, *Homarus americanus,* in Nova Scotia (Zwanenburg et al. 2000). Ames et al. (2000) identified 88 different spawning locations for several groundfish species in the Gulf of Maine. Wroblewski (2000) referred to the relatively recent discoveries by scientists of genetically distinct inshore and offshore spawning components of Atlantic cod in Newfoundland (e.g., Taggart et al. 1998). However, the existence of local stocks was raised in the 1960's by inshore fishers in Gilbert Bay, Newfoundland (Wroblewski 2000), and "coastal populations" were introduced into the management system in Norway in the 1960's and 1970's (Maurstad 2000). Ames et al. (2000) suggested that in the Gulf of

Maine, the "multiple populations" they identified "may have comprised a complex, larger 'metapopulation' " rather than a homogeneous population as has been the "traditional perspective". The proceedings edited by Von Herbing et al. (1998) are the relatively recent product of a conference which examined heterogeneous stock structures of fish species.[163] A recent presentation at the World Fisheries Congress demonstrated population substructure in mackerel icefish,*Champsocephalus gunnari*, "at large geographic scales, around the Southern Ocean, and surprisingly at smaller scales within local and regional areas" suggesting that the "high dispersal capacity in the marine environment" may not be matched by gene flow, and this has important implications in fisheries management (Wilcock et al. 2004). Thus, it seems that fisheries science approaches have tended to exclude finer-scale ecological information, *regardless of its source*. This tendency within fisheries management also acts as a barrier to Fishers' Knowledge (Figure 5).

Furthermore, the scale at which fisheries science and management has been applied has not matched the scale of the actual biology of many species. Sutton (2000) referred to the "large-scale management strategy" in which salmon management measures in Newfoundland tend to apply to "wide geographic areas within the province". He further notes that "the current management system does nothing to recognize the value of the [local salmon] population for its unique ecological characteristics or the unique fishing experience it produces". Prince (2003) noted that many stocks are much less widely distributed than thought. He referred to "the tyranny of scale" and discussed

[163] At least two trends are contributing to a shift in the "large-scale" focus: stock declines and collapses in fisheries are revealing the inadequacies of previous scientific methods of stock assessment and management; and there is increased scientific interest in the complexity of ecosystems, including, the importance of temporal and spatial scales in species and ecosystem behaviour (Holling 1995; Maurer 1999).

the notion of micro-stocks, using abalone, *Haliotis rubra*, as a case study (discussed in more detail in Section 7.1.2.3):

> I began my studies by talking and diving with [the abalone divers]. Then I read the literature on long dispersal distances of larvae…Size at maturity was assumed to be relatively uniform. The fishery was managed regionally with minimum size limits…But the divers did not ascribe to the scientific dogmas. They described "non-recovery bottom" which did not sustain fishing, local extinctions that were common at scales of hundreds to thousands of metres.

Centralized management regulations, by design, ignore finer stock structure. In Chilean case similar to Prince (2003), Meltzoff (2001) gives examples of a single size limit for an abalone-like invertebrate, "loco" or *Concholepas concholepas*, and uniform closure for sea urchin spawning for the entire Chilean coast, citing Zamora and Stotz (1992):

> Fishermen distinguish between operating beyond the legal parameters and hurting a resource base. They perceive flaws in a generic management regime that sometimes closes seasons or sets limits that do not match the biological reality of their specific region (Meltzoff 2001).

Ames et al. (2000) concluded that the localized stock structure of many fisheries may require related changes in governance structures. In the next section, I make the connection between frames in the DSP; institutions and practices in fisheries science, management, and governance; and the tendency to neglect the study and management of local stocks.

7.2.3 The link between large-scale centralized fisheries science and management and the DSP

In this section I argue that the scale and level of detail of ecological knowledge which tends to be utilized in fisheries science and management is attributable to historical developments which influenced the evolution and therefore conceptualization of fisheries science and management. This connection was made by moving up the hierarchy of the developing influence network and asking "what gave rise to the neglect of smaller-scale approaches within fisheries science and management?" There are three features of particular interest which characterize approaches to fisheries science and management and which bear on the grounded results described above. They include:

1. fish populations have been conceptualized as wide ranging and homogeneous (genetically, physically, and behaviourally) (von Herbing et al.1998);

2. most effort in fisheries management has focused on highly abundant fish populations (Newell 1993; Finlayson 1994)[164]; and

3. arbitrary and large statistical management areas have been used (Clay 1996).

In exploring this issue, it became apparent that the evolution of these and other features of fisheries science and bureaucratic management agencies was inextricably linked to a number of high level frames. One influential frame, which I will not further examine, is the longstanding perception of the oceans as "vast" and fish stocks as infinitely abundant (Costanza 1999).[165] Three key frames (and associated institutions) of the DSP help to better explain the neglect of finer-scale ecological knowledge and the three related features just mentioned within fisheries science and management. These frames involve approaches to economics, societal problem-solving, and governance.[166]

First, government economic policy has often favoured strategies of large-scale industrial exploitation, and this has been accompanied by centralization of government powers (Kooiman 1994; Scott 1998). Since World War II, modernization theory has

[164] Wroblewski (2000) noted that inshore components of cod stocks in Newfoundland "were considered of minor importance in the management of the resource" citing Lilly (1996).

[165] Recent research by Ruggerone et al. (2003) suggests the occurrence of "largely unknown" competition among salmon species originating in Asia and Alaska in "offshore marine communities" (the North Pacific Ocean and Bering Sea). In the context of the above beliefs about the ocean, the idea that the fish food supply in the "open ocean" might be limited is somewhat less surprising.

[166] These same frames will also be used to explain other observed patterns in the literature cases. I chose to raise them here because the order of the grounded discussion required it.

been used to explain trends in development. According to Rostow (1953) modernization is

> a series of stages [through which nation states pass] during which [their] people build economic capacity, shed traditional and adopt modern ways, and from which they emerge as fully modern, prosperous states.

Fisheries socio-economic policies have also reflected this emphasis on modernization (Wright 2001). These policies have included interventions in human communities, such as encouraging the move to larger population centers from outports (e.g., Newfoundland under Premier Smallwood (Wright 2001)), as well as government subsidized fleet expansion (an increase in the number and size of boats carrying new technologies) (Durrenburger and King 2000; Evenden 2000; Power 2000; Wright 2001).[167] Six papers, including two by natural scientists, mentioned related aspects of fisheries policies. McGoodwin et al. (2000) referred to policies favouring "economic maximization". Large-scale industries required highly abundant stocks.[168] In this vein, Prince (2003) noted:

> We fisheries ecologists have been high-grading, selectively targeting the biggest chunks of protein (and funding) first. Research and scientific understanding has focussed on the conspicuous offshore industrial scale fisheries (Orensanz and Jamieson 1998).

He also noted the connection between centralized management of government agencies and "big science" and "science for science's sake". Pitcher and Haggan (2003) noted

[167] The new variation of this dominant paradigm is a focus on privatization and the push for less government (Kooiman 1994). In fisheries, the move to Individual Transferable Quotas is seen by many governments as the policy solution for both economic and biological sustainability and is accompanied by the devolution of some management responsibilities (see Pinkerton 1999) for a critical discussion).

[168] For example, Newell (1996) documented the transition in Pacific coast salmon fisheries from widely scattered indigenous villages with terminal salmon fisheries which targeted local stocks to industrial, offshore (coastal) fisheries feeding an ever reduced number and spatial distrubution of canneries owned by fewer people, (Marchak et al. 1987). Slaney et al. (1996) review the status of salmon stocks in British Columbia and document the intense exploitation and enhancement of particular runs to the detriment of smaller runs.

the post war transition in British Columbia fisheries from local managers who used semi-quantitative ecological and locally-based management to "large-scale corporate fisheries managed with highly quantitative single-species techniques run by a bureaucracy perceived as remote". I summarize these "large-scale", profit and efficiency-maximizing economic approaches with the term the "Economic frame" (Figure 5).[169]

Second, large-scale, centralized scientific and management approaches also appear to be inseparable from centralized and large-scale approaches to governance, which I refer to here as the "Governance frame" (Figure 5[170]). Glaesel and Simonitsch (2003) summarized a number of factors which contributed to shaping the fisheries governance system (the same factors which shaped the broader system): exigencies of administration and information needs; "strong societal belief in the abilities of scientists and professional managers"; and confidence of the federal government in its ability to problem solve from a position of centralized control. They cite the influence of the Marshall Plan's success in rebuilding post-war Europe with the "centralized use of expert managers, engineers and scientists". Two other tightly connected frames also appear to have played a role in these developments, the Science frame and the "Technology frame", the latter which I have summarized as "Problems can be solved with Scientific and Technological approaches" (Figure 5).

Several other literature cases made this connection between the Integration Project and these frames, for example, this quotation from Prince (2003), a natural scientist:

169 There are a number of facets to the Economic frame which are not further explored in the thesis.

170 The Governance frame in Figure 5 is shown as just below the DSP in attempt to acknowledge that paradigms do shift. HIstorically, centralization was a key part of the evolution of nation states (Scott 1998) and remains a strong "frame". However, in the last decade or two, there has been an increasing shift towards decentralization as mentioned in Section 1.2.1.

> In the over-developed countries, fisheries management remains the last great bastion of the Command-Control Theory of government. Management, monitoring and assessment processes are [seen as] the proper role of centralized governments. Fishers cannot be trusted and must be compelled by legislation to fish sustainably.

Power (2000) noted in the context of the history of the Newfoundland fishery, the "unjustified "techno-utopian" faith in the capacity of the state to monitor and control the effects of fishing", citing Finlayson (1994).[171] Clearly these frames and associated values have evolved. For example, the complexity of marine ecosystems has been increasingly recognized.[172] Nonetheless, I argue that these earlier ideas continue to constrain our approaches to fisheries management. Centralized management and the governance frame are further addressed in Section 7.4.2 in the context of management agencies as bureaucracies.

7.2.4 Summary

A key concept which applies to the above discussion is "inertia" - the slugglish response to change, where change is the push for increased application of Fishers' Knowledge to fisheries management (see Figure 8) and inertia stems from the management agency and its embedded institutions and stakeholders. I examined three interconnected kinds of inertia in fisheries management agencies. "Conceptual inertia" (Finlayson 1994) refers to the conceptual basis of fisheries science and management.

[171] A significant body of literature in environmental philosophy has examined the metacultural frame concerning "nature" within the DSP, which resembles: "Nature is something that can be managed and controlled" (e.g., Capra 1982; Merchant 1980; Lertzman 1998). Historically, within wildlife and fisheries management, a stock or population was an entity which could theoretically be maintained at a stable level, while harvesting the "surplus" (Freeman 1985). Ames et al. (2000) and Roepstorff (2000) in the literature cases, and Hilborn and Walters (1992) critique the focus on controlling fishing mortality (Section 7.2.2.2).

[172] Fourteen papers (37% of natural and 58% of social scientists, respectively) raised issues which critiqued current or conventional fisheries management or addressed applied cases that involved different conceptualizations of fisheries management (e.g., local or community-based management, ecosystem management, (CONFM, Table A in Appendix C).

In this context, it refers to the influence of the Science frame expressed at the operational level of fisheries science. "Procedural inertia" refers to the institutional attachment to particular methods and procedures which can be expressed as beliefs or routines. These combine with bureaucratic inertia including financial constraints to affect how Fishers' Knowledge is perceived and approached at the *operational level* of fisheries management (Figure 5). My assumption is that resistance to Fishers' Knowledge as a category also contributes to this inertia.[173]

7.3 "Social barriers" – the neglect of the social dimensions of fisheries management

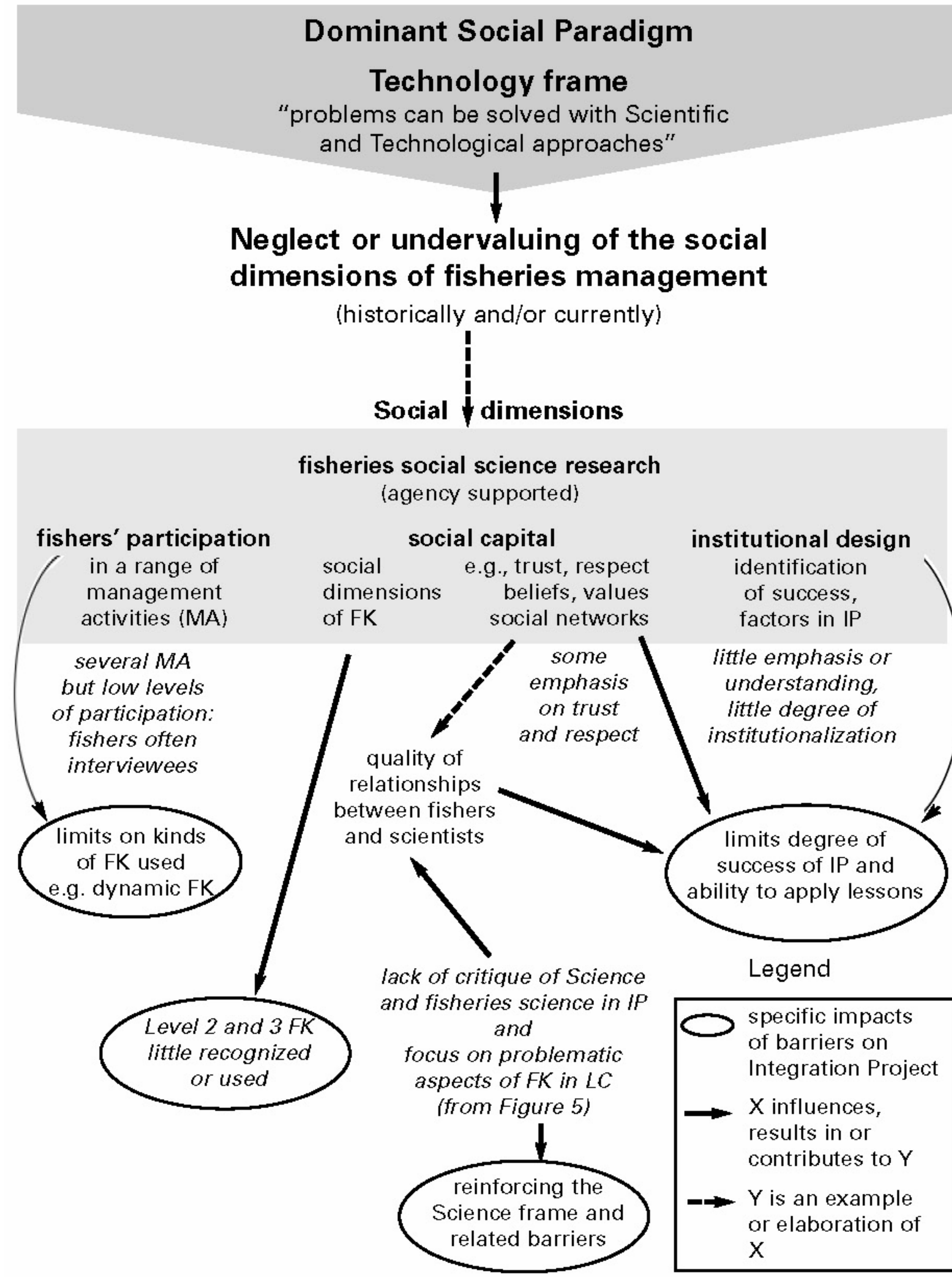
I observed a number of patterns in the literature cases which appeared to be indicative of barriers to the Integration Project and which fell under the general category of neglect of the social dimensions of fisheries management. Furthermore, in order to account for these, I needed to include the perspective within the DSP summarized by the Technology frame: "problems can be solved using a combination of Science and Technology". Given the analysis of literature cases and assertions in additional literature which follow, the Science and Technology frames combine to influence the conceptualization of fisheries management, that is, both the focus on fisheries science, particularly stock assessment (Figure 5) and the neglect of the social dimensions of fisheries and fisheries management.

[173] I make an arbitrary but useful distinction between resistance to Fishers' Knowledge as a category and inertia associated with management institutions. "Resistance" as used here is a kind of "high level value judgement" of Fishers' Knowledge directly rooted in the DSP) (the focus is on *what is Fishers' Knowledge*). "Inertia" refers to beliefs and institutions (structures, characteristics, procedures, and related conceptualizations) within fisheries management agencies (the focus is on *what fisheries management is* and the response to Fishers' Knowledge is examined from this position). (Clearly, these two perspectives comprise a continuum).

Figure 6 is the portion of the influence network which demonstrates the link between neglect of the social dimensions in fisheries management and specific impacts on the Integration Project. Although several of these impacts directly involve limits onthe application of Fishers' Knowledge (as in Figures 4-5), several others are less direct: they involve impacts on the quality of relationships between fishers and scientists (Figure 6). I elaborate on the ideas which are summarized in Figure 6 in the remainder of this Section.

The neglect of the social dimensions of fisheries management has been noted by many (e.g., Pinkerton and Weinstein 1995; Cochrane 1999; Caddy and Cochrane 2001). Hilborn and Walters (1992) discuss the lack of focus on fishing behaviour and fleet dynamics. Increased emphasis on the social dimension of fisheries management appears to be slow in coming if we consider that Peter Larkin noted as early as 1975: "we're not managing fish, we're managing people". At the World Fisheries Congress in 2004, some of the world's most eminent fisheries scientists Kevern Cochrane, Carl Walters, and Ray Hilborn as well as FOC modeller Schnute all mentioned in their presentations the importance of social dimensions in fisheries. Yet social scientists were absent from the conference organizing committee and from the keynote speakers (other than one economist).

Figure 6. Influence of the Technology frame on the neglect of the social dimensions in fisheries management.



Note. Influence network demonstrating how the neglect of the social dimensions of fisheries management may affect the Integration Project (IP). Fishers' Knowledge is abbreviated as FK. Findings from literature cases are italicized.

In the literature cases, McGoodwin et al. (2000) also noted that the importance of the human dimension in fisheries "has become a mantra" and yet implementation has been slow. Maurstad (2000) cited Wilson et al. (1994) who "advocate focusing on how the fishery is performed; *where, when* and *how* people fish, as opposed to today's scientific focus on how many fish swim in the sea". She further notes:

> if science is on the right track, we should pursue fishers' biological knowledge thereby improving science and management...But...what if our search for better management requires solutions beyond natural science? (Maurstad 2000)

Power (2000) analyzed the insights and experiences shared by women fish workers about their lives which included their lack of options, their observations (including Level 1 Fishers' Knowledge), fears, and concerns. In a broadened policy environment, these insights would be investigated and explicitly valued as contributions to the goals of fisheries management (Power 2000).

7.3.1 The role of social science research in fisheries management

If fisheries are social endeavours, prosecuted *by* people *for* people, then re-conceptualizing fisheries management also includes recognition of the importance of social science research. Historically and recently there has been little social science research within fisheries management agencies in Canada and the U.S (Figure 6). In 1998, Dr. Peter Fricke was the only sociologist or anthropologist on the entire staff of the U.S. National Oceanographic and Atmospheric Agency. Currently, I am unaware of any non-economist social scientists within FOC Pacific Region.

Although change is slow, it is evident. Social aspects of fisheries are increasingly being addressed. Recently in the U.S., social scientists have been hired in each region to contribute a sociological perspective, and social scientists were invited by the US National Marine Fisheries Service and FOC to participate in the design of marine protected area policy through a targeted workshop. Baelde (2003) noted the inclusion of fishers' operational and socio-economic dependency on the fishing grounds as part of recent spatial management activities, citing Williams and Bax (2003). In Canada, the Oceans Management Research Network was recently created through funding from FOC and the Social Sciences and Humanities Research Council. Three of the papers analyzed here were written by natural scientists who incorporated literature or analyses from a social science perspective (Baelde 2003; Blyth et al. 2003; Stanley and Rice 2003) (see also Section 7.3.4 below).

The general undervaluing of social science research by management agencies is expected to affect the Integration Project. Social scientists, since they receive specialized training, can not only assist natural scientists with the collection or application of Level 1 TLK (Maurstad 2000), but facilitate the recognition and application of the social dimensions of Fishers' Knowledge (Level 2 or 3) (see the next section). Another area to which social science research can contribute is the sociological and cultural dynamics underlying the Integration Project, that is, underlying knowledge production; the interaction between fishers and scientists; and the interaction between the NRM system and other social systems. This thesis is an attempt to contribute insights in this area. Maurstad's (2000) paper focuses on how social and natural scientists can improve their collective research capacity in the context of the Integration Project. She noted that one of her roles was to "contextualize fishers' information" or "situat[e] the biological knowledge in its social framework".

The Integration Project is also expected to benefit from applied social science research within three other neglected dimensions of fisheries management: institutional design, fisher participation in the Integration Project, and social capital and the social dimensions of Fishers' Knowledge (Figure 6). These topics are discussed below.

7.3.2 Institutional design

One area of focus within social science is the identification of the conditions which contribute to the success of an endeavour such as the Integration Project (e.g., the work of Pinkerton 1989; Pinkerton and Weinstein 1994; Ostrom 1990; Schlager and Ostrom 1993). This research falls under the heading of institutional design and analysis of common property resources (CPR). Of the range of conditions or factors this literature examines, the importance of social capital is of particular interest within the context of the Integration Project. Social capital is associated with mutually beneficial collective action (Uphoff and Wijayaratna 2000). Putnam (1993) uses the term to refer to "features of social organization, such as trust, norms, and networks, that can improve the efficiency of society by facilitating coordinated actions". Social capital has been little examined by fisheries management agencies (Pinkerton and Weinstein 1995).

In a related vein, Baelde (2003) noted that the study of interactions between stakeholders and how to improve them has not been a part of agency-based programs In the Australian context:

> …while government policies and legislation on resource management never fail to mention the importance of stakeholders' participation, they rarely provide practical details and critical accounts of approaches taken (Baelde et al. 2001). [Footnote:] Morever, government policies tend to expect more and more from consulting with fishers...e.g. provide expert environmental knowledge, provide socio-economic information and assist integrated management by reducing conflict between users. [However], *there is no dedicated research* to design protocols that would lead to effective consultation and integration of fishers' interests and expertise. [emphasis mine].

Institutional arrangements for fisher participation and representation may be a barrier to the application of *dynamic* Fishers' Knowledge (i.e., knowledge that is continually being revised and updated with experience) (see Section 7.4.3 below).

The degree of institutionalization of the Integration Project within the applied literature cases was minimal (Figure 6). Fishers and Scientists Research Society and the Eastport Peninsula Lobster Protection Committee (EPLPC) were the only formal institutions. The EPLPC was unique since it is an organization embedded in a local management system, with partners in other organizations including FOC, Memorial University, Parks Canada, and the broader local community. In contrast, the majority of applied cases were "one-off" projects which involved interviews with fishers. However, four of these were in contexts where agencies have ongoing relationships with the fishers. Interviews in Lessard et al. (2003) were part of a developing fishery with extensive fisher involvement. The results of interviews reported in Gendron et al. (2000) was both part of a larger study and part of a larger policy initiative.[174] Similarly, Williams and Bax (2003) are employees of CSIRO, the Australian federal fisheries research institution. Their case reflects shifts in fisheries policy to align with Australia's Oceans Policy of 1998, in particular, the shift towards spatial management of the oceans and ecosystem management ("where and how fishing occurs, and with what impacts"). Southeast Australia is the test case for regional marine planning - it is the first of 13 "large marine domains" (Williams and Bax 2003). Williams and Bax (2003) and Stanley

[174] Specifically, the paper reports on one dimension of a much larger "experimental project" involving collaboration between Science Branch of Maurice Lamontagne Institute (FOC) and anthropologists from Laval University. Furthermore, the larger context was an FOC Quebec and Atlantic region pilot project, the Scientific Information and Liaison Strategy, with goals to enhance communication between scientists and fishers, "involve fishers in the stock assessment process by promoting the exchange of knowledge", and increase fisher understanding of scientists' activities and research results. This became a long term program in 1993, which has resulted in improved communication between scientists and fishers (Gendron et al. 2000).

and Rice (2003) probably represent dynamic applications of Fishers' Knowledge currently occuring between management institutions and fishers, which are generally not reported in the literature. Increasing future benefits from the Integration Project are unlikely outside of ongoing and deliberate institutional contexts.

Another facet of institutional design involves the establishment of protocols and agreements between fishers and scientists. Ethical research protocols generally require an individual's permission to be interviewed. Furthermore, agreements are important in order to address fishers' concerns about confidentiality of their information. The paper by Williams and Bax (2003) was one of the few to mention this aspect of research (sensitivity and research protocols). It was the only case where a *collective* agreement was made with fishers.[175] Through this agreement, fishers gained a level of "ownership" over the process, and scientists developed understanding of fishers' concerns (Williams and Bax 2003).

Factors which contributed to the success of several applied literature cases were raised by authors. However, their research and analyses would have benefited from familiarity with the CPR literature. I discuss two cases from the literature here and others in the next section in a focus on the neglect of social capital and Level 2 Fishers' Knowledge.

The Eastport Peninsula Lobster Protection Committee (EPLPC) originated in a local management system with a history of its own internal regulations (Rowe and Feltham 2000). The initiatives of the committee included:

[175] This is in considerable contrast to the emphasis placed on intellectual property and ethical research protocols in the sphere of Traditional Knowledge (e.g. Schnarch 2004; Bannister 2005). Williams and Bax (2003) can be contrasted with Bergmann et al. (2003), university-based investigators, who used a questionnaire format and note that as a result of fishers' concerns about confidentiality, they were less forthcoming with identifying their grounds on maps for fear of "negative management developments".

- implementing an agreement with other local lobster fishers (Bonavista Bay) to trade rights to particular areas and gaining official support from FOC;
- the selection of marine protected areas based on Fishers' Knowledge of currents and of areas of high previous productivity;
- working with other partners, including other agencies and FOC, to do scientific research; and
- actively engaging others who do not fish, including family members and the local school, in data collection and management projects thereby increasing understanding of fisheries management.

Rowe and Feltham (2000) did not emphasize or elaborate upon the range of knowledge and facilitating factors which contributed to the EPLPC 's success. The authors are a biologist and a fisherman, respectively. The former likely lacks the training, and the latter may take Level 2 Fishers' Knowledge for granted. Their focus was more of a pragmatic description of what was done. In addition to strictly ecological knowledge, fishers knew their community - for example, what would work as incentives to cooperate in the implementation of the proposed protected area - and how to communicate with their peers and others in the community to rally support for their initiatives. Furthermore, as predicted by Common Property Resource (CPR) theory, a number of factors play a role in this successful example of collective action: a relatively homogeneous group of fishers operating at a tangible, enforceable geographic scale; a history of local management of access to lobsters; cooperation from higher governance levels (nested institutions); and peer enforcement with graduated sanctions (Ostrom 1990). Thus, incentives are high to protect future benefits. The authors did stress the importance of the development and maintenance of trust between all stakeholders and the importance of "the involvement of only known, local harvesters" in reversing the "tragedy of the commons" (Hardin 1968). They note that the "Committee's success offers a model for effective fishery management and establishment of similar programs elsewhere". However, if stakeholders wish to build upon success or *maintain it in the face of change*; or to apply lessons to other scenarios, recognition of key factors is important, as also noted by Sutton (2000) in the context of pilot community watershed management projects (Figure 6).

Blyth et al. (2003) elaborate on an intersectoral agreement in England - the Inshore Potting Agreement (IPA) - and the management system to which it applies:

> [The IPA]…was conceived and established by fishers to reduce conflict between those that operated static gears (trap and nets) and those that used towed gears (trawls and dredges). At present, there is no legal recognition of the system, though the IPA is generally well observed by fishers from both sectors of the industry...The IPA is regarded as...successful...because it has continued to function effectively for several decades.

Static fishers appear to have territories ("informal ownership arrangements") which are generally respected by other fishers within and between gear sectors. Thus, crab fishers are managing to maintain their livelihoods through some level of territorial protection (both gear and habitat) given a larger context of potential towed gear dominance. Blyth et al. (2003) state that they are interested in understanding "the characteristics of the management system" and their potential application elsewhere. They introduce their paper with some discussion of social science literature on property rights. However, they focus only on technical and quantitative details of changes in surface area of sector zones using GIS and maps. Two key areas of social research could have been acknowledged or investigated: why "fishers were driven to form the IPA" and the role of social capital and Level 2 Fishers' Knowledge in reaching and maintaining the agreement (for details see Appendix A and the next section). They could also have investigated how fishers' biological and oceanographic knowledge of the grounds (Level

1) contributes to informal and flexible arrangements between individual fishers from the two sectors over particular "pieces of ground".

7.3.3 The social components of Fishers' Knowledge and social capital

Fisher' Knowledge of the social aspects of fisheries (Level 2 Fishers' Knowledge) was rarely mentioned or examined in the literature cases. (Knowledge associated with beliefs, Level 3, was not explicitly mentioned). However, Rudd's (2003) discussion of social capital can be read as including both (see below). Glaesel and Simonitsch (2003) implicitly noted that Level 2 Fishers' Knowledge can either serve or detract from sustainability of fisheries. Specifically, the Regional Fisheries Council:

> [lacked the] understanding of what made the fish harvesting business actually work. The various rules and regulations were, to a large degree, an abstraction and failed to include recognition of the resourcefulness and competitive nature of fishing, the marketplace, and fishing people. Fishers immediately found many loopholes. Simply having to follow the rules, rather than having been genuinely involved with identifying and incorporating actions for achieving sustainable fishing practices, led to a disaster.

The potential and resultant impacts of policies on fishers' social and economic well-being was implicitly considered a form of Level 2 Fishers' Knowledge by Power (2000). Fishers' ideas of how to more appropriately manage or regulate particular fisheries were included in the surveys of Gendron et al. (2000), Hutchings and Ferguson (2000), and Sutton (2000), Lessard et al. (2003). In one of the cases reported in Stanley and Rice (2003), fishers conveyed their knowledge of changes in fleet behaviour within the context of debates about the validity of stock assessment surveys. Baelde's (2003) survey elicited similar knowledge. Maurstad (2000) reported beginning their project examining all aspects of Fishers' Knowledge but then focusing on Level 1 as a result of resource constraints (and being "trapped in biology"). The project in MacNab (2000) revealed social knowledge:

> …committee members continue to regulate fishing space within their communities by means of informal boundaries, individual tenure for lobster territories and acceptance of local customs for net spacing. Much of this area management is accomplished with local toponyms to denote [geographic and hydrographic features].

McGoodwin et al. (2000) implicitly include Level 2 knowledge in their review of the history of TLK/Fishers' Knowledge and its application in fisheries. In the EPLPC (Rowe and Feltham 2000) and the Inshore Potting Agreement (Blyth et al. 2003), fishers' role in agenda setting and/or the use of their knowledge appeared to contribute to positive outcomes (Appendix A) through the creation of appropriate (locally adaptive) incentives, rules, and relationships. Level 2 and 3 Fishers' Knowledge was clearly used in both although it was not discussed by the authors. Examples of Level 3 "knowledge", fishers' values and worldview, include the "slippage" in the IPA, that is, allowance for some level of violation:[176]

> Most static gear fishers commented that they had experienced inter-sector conflict problems...Despite this, only half the interviewees from [it] felt that towed gear fishers broke *the spirit of the agreement* by fishing in [their] zones (Blyth et al. 2003).

I suggest that key beliefs and values also underpinned the goals, initiatives, and partnerships of the EPLPC. Level 3 Knowledge, or the "container" of beliefs, norms, values etc. which facilitate collective action needs more investigation in fisheries contexts [177]

[176] The benefits of flexibility inherent in informal arrangements, a characteristic of management systems that can be lost when these are formalized (Ostrom 1992), are also implied by the towed gear sectors' resistance to legalization of the agreement.

[177] See Loucks' (2005) analysis of fisheries transaction costs and "credible commitment" in a snow crab fishery.

Level 2 and 3 TLK, as defined here, have generally not been conceived of as Knowledge within TLK discourse. Until recently, social scientists have discussed the social components of local knowledge within studies of "folk management" (Dyer and McGoodwin 1994), institutions or "rules in use" within CPR regimes (Ostrom 1990), community-based resource management (Loucks et al. 1998), and co-management or co-operative management (Pinkerton and Weinstein 1995; Pinkerton 1989). Two natural scientists were exceptional in examining, in the 1970s, social components of Fishers' Knowledge within local management institutions of the tropics (Johannes 1978) and the Canadian North (Berkes 1977), respectively.

Both social capital and Level 2 and 3 TLK appeared to be important in the successes of 14 literature cases. However, in six of these, the authors did not identify higher levels of Fishers' Knowledge or sufficiently address the importance of social capital to successful outcomes.[178] Social capital is particularly relevant because fisheries management, and the Integration Project in particular, require the building or improvement of relationships between stakeholders who have or have had conflicts and come from different cultures (see Section 7.5). Broderick (2000) noted:

> I'm beginning to feel like a broken record when it comes to this topic...The relationship among fish harvesters, scientists, and managers has become critical to the future fishery, and like any healthy relationship it must be based on trust and respect. We all know that this relationship is far from healthy because it lacks those fundamental characteristics. It is an

[178] Some Level 2 and 3 TLK could be considered social capital. Specifically, the norms and values which facilitate cooperation have been defined as cognitive social capital (Uphoff and Wijayaratna 2000). Thus, beliefs which facilitate cooperation (and which I would consider Level 3 TLK) could also be considered as cognitive social capital. Furthermore, the rules, procedures, and protocols that facilitate cooperation have been defined as structural social capital (Uphoff and Wijayaratna 2000) and fall under Level 2 TLK here along with knowledge of each others' likely behaviour (including potential responses to management interventions). However, my emphasis in this thesis is on Level 2 TLK as *knowledge* (e.g., knowledge of rules or regarding which rules would be appropriate, and knowledge of behaviour or *potential* behaviour) and social capital as "grease in the wheels" of *relationships*.

> understatement to say that fish harvesters have been frustrated with the entire consultation process in both science and management areas.

Zwanenburg et al. (2000) briefly noted the importance of trust building in the Fishermen and Scientists Research Society (FSRS), contextualizing it as both challenge and accomplishment.[179] However, they did not consider that their policy of separation of "science" and "politics" might have functioned inadvertently as a tool to build social capital by setting aside many sensitive conflicts. This allowed stakeholders to begin to collaborate on projects and then to build on their successes. Pickering (2006) in a recent book entitled "Bridging social capital" notes that workplaces "create opportunities for repeated horizontal interaction focused on tasks that promote interdependent relationships". Similarly, in the context of fisheries co-management, Pinkerton (1989) noted that "co-management is most likely to develop when there is…experimental co-management of one simple function, which may later be expanded to other functions". For the FSRS, while this strategy of taking "politics off the table" has clear advantages, if held to indefinitely, this rather false separation could preclude working together toward preferred policy solutions.

Melvin and Parrish (2003) report on two cases involving problems of seabird bycatch in the gillnet fishery of Puget Sound and in the Alaska longline fisheries. They refer to management agencies which are in "conflict with industry" and "environmental groups [which are] seen by industry as biased against harvesters". They developed and applied a "cooperative research model". These cases were successful for many reasons – most of which are touched on by the authors, but which are "rich" in terms of the potential to better understand success factors. In setting the context for their cases,

[179] An FSRS handout goes further and refers to feelings of mistrust and suspicion (Appendix A).

they identify an institutional barrier: "no standard mechanisms exist within stewardship and regulatory authorities to go beyond problem identification to crafting solutions".[180] However, they did not elaborate on how the cooperative research model was developed, for example, mistakes made or how they might have had to reorient or adapt thinking or methods; or who contributed various ideas. They also did not refer to social science literature in cooperative fisheries management. The emphasis in this paper is on action – "focusing and testing" - and "common sense" as conveyed in its title. However, a careful read of the paper suggests that key success factors of the project involved the building of social capital (and particular conditions which supported it) and Level 2 Fishers' Knowledge (see Appendix A).

Several other authors also recognized to some degree, the importance of social capital (although not explicitly using the term) in their work (Figure 6). Gendron et al. (2000) emphasized the importance of relationships and the link with increased opportunities for collaboration, noting:

> Positive attitudes…[and]...increased interaction...helped these two stakeholder groups [fishers and biologists] to know and understand each other despite fundamental differences in their respective mandates, objectives, and work methods, fostering recognition of the expertise of all those involved. This recognition has given rise to more far-reaching projects initiated both by fishers and by scientists. The involvement of fishers in such projects is varied, ranging from gathering information on their fisheries to sharing with scientists varying amounts of responsibility for operations or decision-making.

MacNab (2000) noted that honesty contributed to "an open exchange of ideas and information". The trust which developed between fishers and scientists in Rowe and Feltham (2000) may have facilitated the selection of marine protected areas based on

[180] Interestingly, they use a key word from the institutional economics literature (e.g., the book "*Crafting institutions for irrigation*" (Ostrom 1992).

Fishers' Knowledge of currents and of areas of high previous productivity. (There is no mention of validating the former using oceanographic methods such as drogues to measure currents.). Maurstad, a social scientist, noted that the friendship with her natural scientist co-researcher Jan Sundet, was one of three key factors in their interdisciplinary research. It helped them to persist with the project when their frustrations and challenges appeared insurmountable, allowing them to eventually better understand their differing perspectives and learn from each other:

> ...[A]t some point in time we found ourselves switching roles...I began asking about fish biology, Sundet began dealing with social characteristics. Amused by this, we saw our development from the initial problems as a success (Maurstad 2000).

Stanley and Rice (2003) describe two case studies which evolved out of disagreements between a stock assessment scientist (Stanley) and fishers regarding biomass of rockfish (*Sebastes* sp.) and assumptions used in stock assessment. Fishers and the research scientist collaborated in all facets of scientific research. Research involved cruises with both commercial and FOC research vessels (Stanley sometimes on board trawlers and a trawler captain on board the FOC's vessel) and acoustical methods to estimate biomass. The reported benefits of collaboration are implicitly contrasted with "the cost of not communicating during the early days of stock assessment in BC".

The cases described in Stanley and Rice (2003) resulted in mutual learning, which the authors later reflected upon and placed in the context of TLK and Participatory Research literature. They imply that the kind of information they got would never have come out of "Science/fisheries management as usual" – previous hierarchical relationships, advisory committee meetings, etcetera. Furthermore, they highlight a number of attributes as important to their success including "the two-way process" of building mutual respect and the related "willingness of both parties to view and identify the problems with respect to *each party's terms of reference"* [emphasis mine]. Neither party "felt threatened". Furthermore, they note that "[t]his risk [of bias related to financial interests] cannot be ignored, but we have found that trust and respect...can be a sound foundation for candid and objective exchanges." "[T]ime away from traditional roles and being on the other's "turf" was also an important ingredient.[181] Stanley and Rice (2003) further noted that

> participants questioned each other with ‘appropriate respect’ and the answers had to be complete and non-defensive. The scientists had to abandon the attitude of ‘leave the science to us’, as the fishing captains had to accept that objective, quantitative verification of viewpoints is essential to resolving differences in points of view or hypothesis testing.

They conclude their paper with the following:

> It seems like a dazzling glimpse of the obvious, but if it were so obvious, examples of PR [Participatory Research] in fisheries and marine science would be common, not rare. *The overall issue is building effective working relationships*, a goal that should be ‘dazzingly obvious’ " [emphasis mine].

An important point which is implicit yet unstated in the article is that Stanley was open to having his viewpoint/hypothesis tested. I strongly suspect that Stanley's openness to learn from fishers was an influential factor in the successes documented in the case. This 'open-to-learning' and pragmatic attitude can take the form of "small things", which in terms of fisheries can be significant. For example, Prince (2003) prepared a map with "one of the first abalone divers in the area. The original size of the abalone is mapped, which is indicative of the original size of maturity." This example stands in contrast to a scientist researching grouper in Belize who noted at the World

[181] Social learning and relationship building is easier with fewer people who have more in common (Ostrom 1990), which was the case here, compared to FSRS, which has large numbers of fishers from various sectors.

Fisheries Congress 2004 the lack of data on historical size of groupers. Local fishermen and their knowledge were not mentioned. Thus, individual variability in personality, attitudes, and motivation can play a key role in creating social capital and in successful collaborative management.[182]

In contrast to a case such as Stanley and Rice (2003), neglecting the importance of relationships of trust and respect can reduce the cooperation of fishers in the Integration Project (Figure 6). Since particular beliefs and attitudes are also "features of social organization" (Putnam 1993), they can contribute or detract from social capital – either reducing or exacerbating tension or conflict between stakeholders, respectively. Thus, the lack of critique of Science and fisheries science in the Integration Project and the focus on "problematic aspects" of Fishers' Knowledge[183] could discourage cooperation by fishers as follows. These emphases contribute to defensiveness on the part of fishers in terms of their knowledge, particularly if accompanied by smugness of scientists. Conversely, the tone in the papers by Stanley and Rice (2003) as well as several others written by natural scientists (Melvin and Parrish 2003; Rowe and Feltham 2003; and Williams and Bax 2003), conveys to the reader a sense of "rolling up the sleeves" and working together in a respectful and less hierarchical way. Although Stanley and Rice (2003) and Williams and Bax (2003) both refer to the importance of validity, their papers emphasize mutual learning and learning from fishers, respectively. The tone in Williams and Bax (2003) demonstrates respect:

> [T]he distinct patterns [of movement] known to fishers would be very unlikely to be detected by a typical scientific survey or by analysis of

182 These cases illustrate the importance of theory that allows for variation in individual actors (stakeholders), that is, actors' behaviour is influenced but not determined by higher level phenomena (Kabeer 1994; Section 5.6).

183 I include here the emphasis placed on the necessity of validating TLK and its "problematic" nature in terms of methods (Sections 7.1.4 and 7.1.5, respectively).

> logbook data, and *this is just one of the many examples* for individual species. Information at this fine spatial and temporal resolution, unless provided by fishers, is not available to survey design, for the interpretation of CPUE or other fishery statistics, nor to assist an understanding of species ecology...[emphasis mine].
>
> [W]e needed to survey a range of characteristic rocky reef habitats...This is where we really started to benefit from our dialogue from fishers - they told us where to look.

This attitude is reminiscent of the original impetus of pragmatism and admiration for the extent of Fishers' Knowledge behind the first marine scientist to promote the use of Fishers' Knowledge in fisheries management, the late Robert Johannes (e.g., Johannes 1973; 1978).

7.3.4 Social or contextual issues raised in the literature cases

In this section I briefly review the results of an analysis of the extent to which "social" or "contextual" issues were raised in the literature cases.[184] By social or contextual issues I refer to coded themes which demonstrate that authors placed the Integration Project, Science, and/or Fishers' Knowledge within a broader social context (e.g., critical awareness of the hierarchy of knowledge or dualistic labelling of Fishers' Knowledge); or they raised social dimensions in fisheries and fisheries management (e.g., conflict, values, critiques of the conceptualization of fisheries management). Awareness and attention to these issues, including social capital, intellectual property rights/confidentiality and making protocol agreements with fishers, is expected to ultimately affect the Integration Project through improved quality of relationships

[184] In Chapter 3, I proposed barrier C3 (Table 2, Section 3.3) which connected a "lack of awareness of *the range of issues of potential relevance* within the Integration Project" to potential difficulty in resolving conflicts between stakeholders. In this analysis, I refined this notion given the emerging results regarding the neglect of the social dimensions in the Integration Project and within fisheries management. The results of this analysis do not appear in Figure 6. They *complement it* by providing additional evidence of the potential neglect or undervaluing of the social dimensions of the Integration Project.

between stakeholders, improved institutional design, and presumably better fisheries management outcomes. I focus here on several issues which may be influential within the Integration Project but which I do not elaborate upon within other contexts. At the same time I investigate the potential importance of individual variation in awareness of these themes.

Not surprisingly, the "average" number of these issues raised within papers first-authored by social scientists was greater than that of papers written by natural scientists (10 and 6, respectively, Table B of Appendix C). This kind of indicator could be used to analyze a larger sample of the fisheries management literature. If this were done, I suspect that the difference between the two author types would be far greater, that is, natural scientists who are consciously engaged in the Integration Project (such as these authors) are probably not representative of priorities, interests, and awareness of social issues in the broader population of fisheries natural scientists.[185]

In addition to the goals and focus of each paper, the issues which authors raised are expected to reflect a combination of authors' training or career, cultural/institutional variation, and individual variation. In the context of the Integration Project, authors may not be aware that certain issues influence their work and desired outcomes, or they may not have the interest, resources, or mandate to address them. Two authors noted that natural and social scientists' training differs. Maurstad (2000) noted that social scientists have an understanding of the social context of knowledge. She also noted that they are taught to "question their assumptions". She alone emphasized the latter point. Her training in anthropology and sociology is implicit in this quote:

[185] Furthermore, this type of analysis could be applied over time to a social innovation such as the Integration Project, as a means of observing and measuring the rate of social change or a paradigm shift (see Conclusion).

> My [social] scientific and practical knowledge made me sceptical about *who* should manage and interpret Fishers' Knowledge, because this would influence *what* would be presented as knowledge.

Maurstad's (2000) paper is a critical inquiry into the Integration Project from the perspective of interdisiplinary interactions between natural and social scientists. Her focus on methodological challenges is both practical and reflexive: "We continuously discussed interpersonal and interprofessional aspects of our collaboration". In some types of social science, "reflexivity" indicates a self-conscious critique of one's research methods, assumptions, results, etcetera (Mason 1996).

Maurstad (2000) seems to assume that all social scientists would "pick up" on the same things that she does. In fact, Maurstad was unique among authors in raising and emphasizing certain issues, and these perspectives may be connected to her "practical knowledge" – her life experience as a woman, as a northern Norwegian, and as a previous commercial fisher. Significant individual variation of authors compared to their author type (or compared to all authors) was evident in these data. Perhaps the most interesting result was that papers written by two natural scientists raised the most social issues: 22 and 18 (Baelde 2003 and Stanley and Rice 2003, respectively) compared to 15 for both Maurstad (2000) and Wilson (2000). McGoodwin et al. (2000) raised 21 in the review-style, concluding chapter of *Finding our Sea Legs*.[186] Kofinas (1998) discusses the potential importance of agency staff who have gone through a process of social learning through collaborative research with indigenous harvesters in the Arctic. He refers to them as potential agents of change and documents tensions between natural scientists and/or managers who have different approaches within an

[186] I stress that this is not a "competition"! Authors wrote about *particular* projects or addressed *particular* goals in their papers. Thus, it is the results of papers analyzed as a *collective* which is key in this thesis. Nonetheless, individual paper counts relative to the mean in each category serve as an indicator of individual variation.

agency. The potential importance of individuals to the spread of innovation has been addressed in an extensive literature (e.g., Rogers 1986). This topic is briefly raised in Section 8.5.

Maurstad (2000) was also the only author who focused on the ethical and cultural issue of respect for or integrity of Fishers' Knowledge. She noted that "as the social scientist, *I had the responsibility* of situating the biological knowledge in its social framework...to [not] distort Fishers' Knowledge," as would a strict focus on biology" [emphasis mine]; and furthermore that her "other role was to protect their knowledge against abuse by scientists". In the context of her paper, this "abuse" is essentially disrespect of a culture.

Ethical research protocols, including ownership and control of the data emerging from a study are "front and center" in the Traditional Knowledge literature (e.g., Schnarch 2004; Bannister 2005). However, few papers raised these issues. MacNab (2000) raised the issue of community control over projects, noting in particular that map products belonged to Eastport Peninsula Inshore Fishermen's Committee. Williams and Bax (2003), both natural scientists, were exceptional among authors in creating and discussing a collective protocol for collaboration with fishers.[187]

Stanley and Rice (2003) and Baelde (2003) reflected on their experiences and placed them in wider social contexts, moving well beyond their professional frames. For

[187] This suggests insufficient emphasis on factors which have been demonstrated to be of importance to fishers. Specifically, if knowledge is taken without permission or shared and then used in a different context than originally stated, it may cause fishers economic harm, for example, favourite fishing spots becoming public knowledge (Maurstad 2003), and damage relationships between or within stakeholder groups. Interestingly, the reverse can also occur. For example, in one scenario, staff members of FOC were so cautious about fisher confidentiality that they were reluctant to apply fisheries data to an integrated coastal zone management application. Working with fishers more closely on how to appropriately convey data for different purposes is necessary. However, doing so, and then processing the data accordingly requires additional scarce resources (pers. obs.).

example, Baelde (2003) was the only natural scientist who mentioned issues related to the dignity, self-esteem and pride which fishers associate with their occupation and knowledge. It was interesting to note the difference between Baelde's relative emphasis on socio-cultural barriers and technical difficulties/methods compared to McGoodwin et al. (2000), who are three social scientist authors of the review/concluding chapter of *Finding our Sea Legs*. (The ratio of pages devoted to these themes relative to the whole paper was approximately 4:1;and 1:4, respectively.) Furthermore, Baelde (2003) and Stanley and Rice (2003) authored two of three papers which recognized the limitations of dualistic categorizations of knowledge. Finally, Stanley and Rice (2003) were exceptional in critiquing the language typically used in the Integration Project:[188]

> Phrases such as ‘incorporating fisher (local, or traditional) knowledge’ are not only incorrect but are pejorative in implying that fishers are limited in what they can contribute to the scientific process.

Baelde (2003) was also exceptional among natural scientists in noting the failure to recognize Fishers' Knowledge as a distinct "knowledge framework and value system" with its own standing, which merits further study.

The section above touches on differences between the emphasis of natural and social scientists in addressing social issues of relevance to the Integration Project. It also demonstrates the potential importance of individual differences among researchers. Nonetheless, given the thesis' premise that problems and challenges cannot be addressed if they are not "on the radar screen," the results provide support for increased involvement of social scientists in the Integration Project and in fisheries management more generally.

[188] Recall that Stanley and Rice (2003) were also the only authors who raised issues of validity and bias in Science and fisheries science (Section 7.1.4).

7.3.5 Fishers' participation in the Integration Project

From post World War II until the 80s and 90s, fishers were little involved in fisheries management. Relatively recently, as previously mentioned, participation or involvement of resource users in management has been seen as desirable by policy makers (Section 1.2). Currently, within fisheries management generally, fisher participation in the full range of management activities as outlined in Pinkerton and Weinstein (1995) is variable and less than optimal (Jentoft and McCay 2003). The same might be said for the literature cases analyzed here. The importance and/or degree of participation of fishers and their knowledge in the Integration Project and/or in fisheries management was raised in 42% and 38% of cases with natural scientist and social scientist first authors, respectively.[189] However, fishers were often minimally involved in the activities reported in the literature cases, mainly as interviewees.[190] Most management activities were addressed within applied literature cases *collectively*. The most common activity was biological research, which was directed at a range of management activities (e.g., stock assessment, habitat protection). In a number of cases, this research was applied to management. However, authors gave little detail regarding whether and how fishers participated in the transfer of knowledge which emerged in the literature cases and whether it ultimately influenced management.[191] In a number of cases, participation was extensive (MacNab 2000; Rowe and Feltham

[189] For the former, this was the fourth most frequently raised coded theme (APARTQ). In addition, fisher involvement was a rationale for using FK in four literature cases (Appendix B). (This is a variable in evaluative framework, Table 4).

[190] Approximately 15 of 25 applied cases scored 1 for minimal participation (Table 3), and of these, 13 were interviews.

[191] It appears that in Maurstad (2000), the biologist Jan Sundet took information forward to meetings and this had some effect on regulations (see Appendix A). In Gendron et al. (2000) the project facilitated a common understanding of the status of the stock and consequently more appropriate conservation measures.

2000; Zwanenburg et al. 2000; Stanley and Rice 2003).

The impact of limited fisher participation shown in Figure 6 is a logical outcome: if fishers do not participate more fully, the application of *dynamic* components of Fishers' Knowledge is compromised. For example, newer observations, insights, or tacit knowledge may best emerge through interactions between scientists and fishers on the water (e.g., Stanley and Rice 2003; and Williams and Bax 2003). Ongoing interactions may also allow the inclusion of Level 2 and even Level 3 Fishers' Knowledge. In the conceptual part of his paper, Sutton (2000) described how Community Watershed Management:

> will not focus on anglers' knowledge *per se,* but will incorporate the knowledge system into management by including anglers as an integral part of the management process. Direct participation...preserves the contextual linkages of the knowledge system. Unlike the collect-and-combine strategy..., a participatory approach also provides a mechanism whereby new knowledge (local or scientific) gained by anglers...can be applied directly to management problems in a timely manner (Sutton 2000).

These issues are returned to in a more general review and summary of approaches to the Integration Project (Section 8.1).

7.4 Bureaucratic inertia and barriers

The application of Fishers' Knowledge represents new challenges for fisheries management agencies as bureaucracies. The Integration Project represents innovation. Therefore, any characteristic or structure of a management bureaucracy that results in avoidance of or inability to change may act as a barrier to it and qualifies as "bureaucratic inertia". Risk averse and gradualist approaches which are characteristic of bureaucracies are discussed first. In the remaining discussion, I briefly touch on *specific* bureaucratic structures which appeared to act as barriers to the Integration

Project as raised in the literature cases. These include the five structures or characteristics of bureaucracies raised in Chapter 3, along with a new one, "institutions of fisher representation and consultation". Finally, I finish with a discussion of limited financial resources. Although this is not a barrier which is particular to bureaucracies, I place it in this section because ultimately it is up to NRM agencies to prioritize and enable new policy initiatives including the Integration Project by allocating sufficient funding. Barriers discussed are summarized in Table 6.

Table 6. Barriers to the Integration Project associated with bureaucratic characteristics and structures.

Risk averse and gradualist approaches • avoidance of conflict and political fallout of decisions • routines and habits
Hierarchical and centralized decision-making
Inappropriate institutions of fisher representation and consultation
Inappropriate recruitment and promotion procedures
Fragmentation of authority and "turf"
Limited financial resources

7.4.1 Risk averse and gradualist approaches

Wilson (1989) noted that bureaucracies tend toward risk averse and gradualist approaches. These approaches may reflect a tendency to avoid potential political fallout from the impacts of changes in policies and regulations (Lindblom 1959; 1979). Avoidance of the negative consequences of decisions may affect the acceptance of new information, regardless of its source. For example, in the case of bluefish aging (Wilson 2003), the scientist who referred to “rumors” regarding aging (Section 7.1.4) also noted that "he does not want to get blindsided by this stuff".[192] For analyses of the resistance on many levels to closure of the Newfoundland cod fishery prior to the moratorium in 1992, see Finlayson (1994) and Hutchings et al. (1997).

Gradualist approaches may also reflect *entrenchment* in procedures connected to the human tendency to resist change and the related preference for routine expressed at a collective level. The concept of path dependence elaborated in Ostrom (1992) is relevant here as an explanation of how collective practices become established as routines and become difficult to change.

The desire to maintain the status quo stifles political creativity (Glaesel and Simonitsch 2003 cite Unger 1998). In NRM agencies, procedural inertia associated with fisheries science and the Science frame (Section 7.2.2) is an inseparable part of bureaucratic inertia (Ostrom 1992; Yaffee 1997). Recall that Baelde (2003) referred to both "institutional inertia" and "established scientific practices" and McGoodwin et al. (2000) to "bureaucratic rigidity" and the "security and familiarity of bureaucratic rules".

One of the literature cases provides an example of conceptual, procedural, and bureaucratic inertia combined. Recall from Section 7.1.2.1 above that a number of inter-related factors may have played a role in minimizing the attention on finer-scale variation in fish populations. However, once discoveries of multiple spawning stocks or subpopulations are made, the willingness and capacity of government management agencies to address their ramifications in terms of both stock assessment and management is in question. Maurstad (2000) noted that the two coastal stocks in Norway (accepted since the 1970s) were sometimes called "paper fish" because they

[192] This is because of the potential ramifications of using a model which combines all fish above 6 as 6+ and as a result decreases the estimate of stock size by half in 1982 and a factor of four in 1996, compared to one which uses 9+ as the oldest year class.

were assigned a fixed quota of 40,000 tons each, unchanged since the time the paper was written. After the cod crises of the late 1980s in Norway, the status of coastal populations increased in importance for fishers. Fishers asserted that one of the categories of coastal stocks (NC) consisted of several stocks, and research with fishers revealed as many as 44 local stocks. If some of these were healthy, "the restrictions on the fishing industry - introduced because the state of the NEA cod [the other category] was critical - could be less severe."[193]

7.4.2 Hierarchical and centralized decision-making authority

In the context of the Integration Project, two potentially important aspects of centralized and hierarchical decision-making authority emerged from the literature cases. First, the reporting structure of a bureaucracy can impede the Integration Project when gains achieved through trust building and mutual learning at lower levels of the bureaucratic hierarchy are questioned or eroded by higher levels (Irlbacher 1997). A similar dynamic is implied in the following quotation from Stanley and Rice (2003):

> Even after individual fishermen and scientists have learned to respect and value each others' creative hypotheses, criticism and sources of new information, the relationship can be strained by the challenge function of peer review.

The second impact is to reduce the ability of fishers to communicate their knowledge. Glaesel and Simonitsch (2003) noted that in "New England, the majority of fishing people are oriented toward a small local community life style, yet the council system is single level, regional and national". The creation of eight large regional

[193] Not only does this case demonstrate combined inertia (including institutional, regulatory, and financial constraints) when faced with the complexity of social and ecological reality, it also demonstrates the connection between Fishers' Knowledge and their interests.

councils was a "small but incomplete step towards devolving federal power".

Furthermore:

> …fishers recognize that their own voice is often ineffectual at council meetings....local organizations do not have a *formal* place within the regional council system. Frequently the principal reason for attending is fear that appointees at the council level do not understand *the variety of the consequences of their decisions from Maine to Connecticut* [emphasis mine] (Glaesel and Simonitsch 2003).

Glaesel and Simonitsch (2003) look to the history of the DSP to account for current structures of governance, quoting from James Scott's *Seeing Like a State* regarding the evolution of "a governance system where decision making was given to appointed experts, while the public role was reduced to providing ‘input’ to the experts".

The interrelated issues of fishers' representation, participation, and communication of their knowledge are further addressed in the next section.

7.4.3 Design of institutions to represent fishers

Both government agencies and fishers' organizations are bureaucracies with mechanisms to consult with stakeholders and members, respectively. These mechanisms may be inadequate in terms of generating dynamic Fishers' Knowledge within the Integration Project. Issues of fisher representation (who and how) are therefore relevant and were raised by several authors. Lydon and Langley (2003) refer to members of groups which represent fishers and seafood industry interests as:

> 'bureaucrats' [who] are more likely to attend Government research or stock assessment meetings. They often personally obtain Fishers' Knowledge and input before attending fishery management meetings. When an important fishery issue is on the agenda, experienced fishers are often asked if they can also attend to contribute their knowledge and convey the impact a decision will make on their fishing operation.

However, Pálsson (2000) noted that "[s]ince ecological knowledge is socially distributed, shared by the actors involved, it is not sufficient to bring the leaders of fishing operations to the management table." Similarly, Rutherford (pers. comm.[194]) pointed out that many of the individuals on advisory committees are from processing companies or do not spend much time on the water. Therefore, it cannot be assumed that Fishers' Knowledge will be transmitted through advisory committee structures.

McGoodwin et al. (2000) note the importance of "the state's construction of the advisory and policy-making apparatuses" as well as the role of political power within management processes, where:

> scientists and managers are mainly responsive to whichever groups they feel assert the greatest political power…[P]owerful groups, including fishers' organizations, may decisively define not only the management issues in a fishery, but also the knowledge (i.e. data) necessary to resolve them, with local fishery people relegated to the sidelines…

Glaesel and Simonitsch (2003) have much to say about the structure of the New England Regional Council and the how it limits the participation of fishers and their knowledge:

> Many council committees have industry advisory groups...advisors are volunteers; the Council Executive Committee appoints them in closed session;…no mechanism or requirement exists for advisors to gather local knowledge….Advisors are not required to disseminate meeting results locally, nor could they do so given *the relatively small number of advisors, large areas and limited council budgets* [emphasis mine] .

Gendron et al. (2000) stressed the value of "direct input from the fishers" in the context of the emergence of important and useful information.

The design of effective consultation is a challenge all governments and other representative bodies face. As Baelde (2003) noted in the fisheries management context, it requires a dedicated and generally lacking expertise and resources. However, "consultation" tends to reflect a top-down dynamic. Focusing on it as the sole means of transmitting Fishers' Knowledge may preclude the consideration of more

[194] Bob Rutherford, previously of FOC, Thaumas Environmental Consultants Ltd., Dartmouth N.S.

participatory institutions for the Integration Project. Applied cases within the analyzed literature cases involved varying degrees of fisher participation in institutional arrangements other than advisory committees. Scale and structure of both fisheries management bureaucracies and fisheries are a factor. Although this is beyond the scope of the thesis, it is worth considering the difference between the case in Stanley and Rice (2003) where one scientist worked with several fishing captains and an attempt to reflect the knowledge within an entire fishery, such as Gendron et al. 2000 (and this was a relatively small fishery).[195]

7.4.4 Recruitment and promotion procedures

Agency recruitment and promotion criteria may act as a hindrance to working with fishers and their knowledge in more participatory ways. For example, agency research scientists tend to be rewarded for publishing in scientific journals with peer review communities which do not recognize TLK as legitimate (Irlbacher 1997). In addition, most merit systems reward scientists with more points for publishing frequently, and as sole or first author.[196] Working with TLK often requires spending time in meetings and collective research processes (Kofinas 1998; 2002), which can lengthen time between publications or so-called productivity levels. Thus, Stanley and Rice (2003) note that "[a]ctions necessary for *career advancement or even fulfilling one's job commitments* may not align with increased time demands of participatory

[195] A follow-up study of the Fishers' Knowledge project reported in Gendron et al. (2000) would be particularly worthwhile: to better understand how managers integrated survey results with their dealings with fishers as a collective. Tthere is only brief reference to the importance of the survey in contributing to consensus about the state of the stocks. This study would also reveal how the rest of the Fishers' Knowledge obtained in interviews was applied (only a small portion of the overall study was reported).

[196] In the context of collaborative pubishing, it is worth noting that three literature cases had shared authorship between scientists and fishers, two which were co-authored with social scientists, and one with a university student in the natural sciences (Appendix B).

research/management" [emphasis mine] (see also Section 7.4.6 below). Prince (2003) referred to the "'publish or perish' imperative" that characterizes "big science", contrasting it to the kind of ecological science required within fisheries management addressing the reality of "micro" and local stocks (Sections 7.2.2.3 and 7.2.3).

7.4.5 Fragmentation of authority and "turf"

As a result of fragmentation of responsibilities and authority between and within government bureaucracies, fishers (as individuals and collectives) may be forced to interact with several agencies or branches of agencies in an attempt to convey their knowledge and interests. The only example of this in the analyzed literature is the third case of Baelde (2003) which focuses on the Australian Ministry of the Environment's Marine Protected Area (MPA) consultation process. This process failed to sufficiently engage fishers - particularly their knowledge of habitats and operational and socio-economic dependency on the fishing grounds.[197] Baelde (2003) notes that:

> fisheries and conservation agencies show little willingness to cooperate on MPA issues or to accommodate their differing philosophical beliefs and legislative responsibilities….[Specifically,] by relying on spatial management, the [Ministry of the Environment's] development of marine protected areas tends to conflict with…current trends [and policies of fisheries management agencies.]

In addition to fragmentation of mandates and poor design of consultation processes, this case also seems to suggest that a portion of the lack of willingness to address fishers' concerns is not limited to agencies involved with stock assessment and fisheries management. It not only demonstrates a lack of appreciation of fishers' input but of

[197] Baelde (2003) notes that the Southeast trawl fishery has recently begun to do so, citing Williams and Bax (2003).

fishers' political power since the MPA bill had to be withdrawn after "stormy street demonstrations".

The notion of "turf" has been applied to bureaucracies and their divisions, mandates, and the related protectiveness which can result (Yaffee 1997). However, this notion can also apply to interactions between agencies and fishers in the context of the Integration Project (McGoodwin et al. 2000; Baelde 2003). Baelde (2003) mentions that:

> Scientists' reluctance to acknowledge, or at least test, the value of Fishers' Knowledge is anachronistic in today's circumstances. Like fishers, they are running the risk of being accused of resisting changes in order to protect their own entrenched professional interests.

Recall that Stanley and Rice (2003) referred to scientists' attitude of "leave the science to us" (Section 7.2.2.1). They also refer to the benefits of fishers and scientists being "on each others' turf."

7.4.6 Limited financial resources

Innovation not only requires flexibility and responsiveness but generally requires additional resources. An important barrier to using Fishers' Knowledge is the scarcity of agency funding (Baelde 2003) for both "traditional" fisheries management activities and any new policy intitatives (Hilborn and Walters 1992), especially those which may be relatively time consuming and require different kinds and amounts of human resources – *potentially* the case with Fishers' Knowledge.

This is indeed the case with local stocks in which "the cost of the required research is not strongly linked to the value of resources, but more clearly related to the number of units involved" (Prince 2003). In the case of bluefish and the potential use of Fishers' Knowledge, Wilson (2003) noted:

> The most critical problem, especially for NMFS, is one of scale. It includes the logistical issue of processing detailed information from

> across the breadth of the Northeast Region, and the conceptual problem of translating local observations into meaningful information at a larger scale. One attempt to use logbook information...was overwhelmed just by data entry demands.[198]

However, the issue of scale is also not specific to local knowledge (Section 7.2.2.3). It is part of the bigger question of how to do fisheries science in ways which better reflect real ecosystem dynamics.

As previously mentioned, Baelde (2003) noted the general lack of training and expertise to design effective consultation with fishers. Additional training or the employment of appropriate expertise is therefore necessary. Eight authors referred implicitly or explicitly to this constraint in the context of the Integration Project.

Although working with Fishers' Knowledge may require additional resources, this is context specific. It is certainly the case if larger programmatic changes were planned within the agency. However, in some cases, new Fishers' Knowledge-related transaction costs (Kofinas 1998; Kofinas 2002; Stanley and Rice 2003) may decrease over time and the benefits of improved social relations (increased social capital) may reduce other longstanding transaction costs, for example, costs of conflicts and poor communication (Stanley and Rice 2003). These issues have been analyzed in the context of co-management by Hanna et al. (1998) and Kuperan et al. (1998). Fishers' Knowledge that contributes to better-accepted regulations can potentially reduce enforcement costs through improved compliance. The cases elaborated by Gendron et al. (2000) and Sutton (2000) were suggestive of this potential.

[198] Wilson et al. (1994) discuss the issue of scale and the cost of data collection which is outstripping management capacity.

Results showed that Fishers' Knowledge is principally seen as a way of supplying missing information.[199] Many scientists raised the lack of proper coverage of stock assessment or habitat data, and explicitly or implicitly, the complementarity of the long term and detailed local spatial coverage of Fishers' Knowledge (e.g., Zwanenburg et al. 2000; Bergmann et al. 2003; Williams and Bax 2003; Wilson 2003). Information may have economic value in the short term[200] as well as a less tangible value through increasing understanding of fisheries systems over the long term (as does basic scientific research). Williams and Bax (2003) were keen about the wealth of knowledge fishers have to offer to apply to a variety of management activities, for example, planning protected areas, designing new sampling regimes and mapping. Hutchings and Ferguson's (2000) study yielded much valuable information, both on the decline of cod as well as fishers' suggestions for improved management. Similarly, Gendron et al. (2000) noted that their semi-structured interview style

> …brought us more new information than we expected...[W]e ended up studying a large segment of fishers' sphere of knowledge in a relatively short time...[No] questionnaire, regardless of how complete, could ever hope to match the kind of exchange we had with fishers.

Sutton (2000) noted:

> Anglers' knowledge about the range and distribution of the population appeared to be much more extensive than the data collected over two summers of direct sampling. Whereas sampling over such a large area can be time-consuming, costly, and methodologically problematic due to the high spatial and temporal variability of natural systems…[Fishers' Knowledge] appears to integrate spatial and temporal patterns observed over numerous years…

199 Approximately 80% of papers which mentioned a general rationale for FK use early in their papers (the variable "RATFK use", Table 4) mentioned missing information or knowledge (Appendix B).

200 Models may be used to estimate the "value of Information" when uncertainty in stock assessments is reduced (Hilborn and Walters 1992).

Furthermore, Sutton (2000), citing Poizat and Baran (1997), suggested that angler's knowledge could increase the efficiency and effectiveness of sampling programs, particularly of populations not studied previously.

Efficiency in attempting to understand a phenomenon may potentially be increased if researchers are more strategic. Rather than trying to demonstrate large sample sizes or *representative* samples, fewer, *key* informants may be interviewed to generate likely hypotheses for further collective examination by scientists and fishers. Identification of key informants may be done by fishers. This can occur as trust increases. Specifically, in working together, both fishers and scientists get to know who has integrity, is knowledgeable, trustworthy, and is respected by his or her peers. Yamanaka (pers. comm.[201]) mentioned that she had gotten to know which fishermen were reliable sources in her work with inshore rockfish fishers.

Researchers in Newfoundland have obviously spent considerable funds to confirm local knowledge on particular subpopulations, including Wroblewski's field work (2000; 2003), genetic studies (Ruzzante et al. 1997), and the work of Green et al. (1998) who did sonic tracking to demonstrate residency and collected data on local spawning. Rather than repeating this kind of work for each subpopulation, strategic collaboration with fishers regarding stock structure of populations is expected to yield efficiencies. In Gendron et al. (2000), interviewing fishers was an efficient and effective way of obtaining key information - specifically that effort was increasing and how and why this was so. This shed light on a number of alternative hypotheses which had already received considerable research attention in attempts to explain biological indices of lobster. Interviewing fishers earlier, prior to crises, could save scarce research resources. In

[201] L. Yamanaka, Fisheries and Oceans Canada, Nanaimo, BC.

addition, fishers often have clever and potentially cheaper ways of doing things; full-scale research projects, expensive vessel cruises and technologies may not be necessary. In the case of bluefish above (Wilson 2003), if fishers were asked, they may have creative solutions to the scale issue (e.g., 'indicator' areas or areas which are pooled on the bases of geographical scale and habitat).

In the case reported in Rowe and Feltham (2000), money was saved by using Fishers' Knowledge of local currents rather than using oceanographic methods. FOC saved money when Stanley and Rice (2003) took fishers' advice and avoided an unnecessary survey. Fishers' Knowledge of coastal stocks in Norway can assist fisheries scientists (Maurstad 2000):

> Carrying out traditional stock assessment in coastal waters is difficult because the variation in ecological and environmental conditions between fjords and regions makes the research costly and poses methodological challenges. [Sundet] saw interviewing fishers as a way to augment existing scientific data on coastal resources….In addition, he wanted to learn more about the distribution of these [various coastal] species in time and space – information that would be costly to obtain using traditional means.

Thus, working increasingly closely with fishers and their knowledge may not always require additional resources, and it may produce enhanced effectiveness and efficiency. Furthermore, lack of funding is not only a barrier to Fishers' Knowledge but may actually provide incentives to use it, forcing innovation, for example, as in the design and methods for goose neck barnacle sampling reported in Lessard et al. (2003) (J. Osborne, pers. comm.[202]).

[202] J. Osborne, co-author of Lessard et al. (2003), previously of the Nuu Chah Nulth Tribal Council fisheries department.

7.5 Cultural barriers

Barriers related to cultural differences between fishers and scientists are implicit or explicit in a number of analyzed papers. Maurstad (2000) refers to fishers' learning from scientists and trying to speak scientific language in order to be "taken seriously". Lydon and Langley (2003) noted:

> SeaFIC often acts as the interface between the seafood industry and the Ministry of Fisheries. In this buffer role, it is able to encourage open communication between the different sectors, providing a filter for the more extreme views.

Stanley and Rice (2003) elaborated on a number of conditions which contributed to improved communication. They emphasized the importance of mutual respect in developing "working relationships":

> As government staff work to change their style (McGoodwin et al. 2000), and mature the relationships with their clients, so must their clients. Candid commentary can only be expected in an atmosphere of respect (B. Dickens, pers. comm.), and when all participants share a goal of finding solutions, not merely getting attention.

MacNab (2000) refers to "problems of cross-cultural communication" and the suggestions for cross-cultural training in McGoodwin et al. (2000) implies there is a problem. Pálsson (2000) noted that the trawling rally was partly a means to improve relationships between scientists and fishers, as well as to improve "the image of the [Marine Research] Institute among the general public". Broderick (2000) mentions both the lack of trust and respect in between fishers and scientists as well as scientists' and managers' lack of respect and recognition of Fishers' Knowledge.

Cultural differences between fishers and scientists appear to affect communication. The level of conflict and strain in the relationships described above and elsewhere in the thesis suggest that relations of power may be involved, although the examples above do not mention them. However, several authors briefly mention differences between fishers and scientists that relate to sociological theories of conflict and relations of unequal power. For example, Pálsson (2000) contextualized a fishers' comment by referring to the "cultural and economic tension between social classes and between center and periphery". Center and periphery refer to unequal power relations within or between states, ideas developed in dependency theory (McMichael 1996). Maurstad (2000) appears to analyze the *titting* example by implicitly acknowledging a power dynamic between southern and northern Norwegians (a version of center and periphery)[203] and between TLK holders and scientists. McGoodwin et al. (2000) referred to "the ethnic, class and experiential boundaries dividing fishers, fishery workers and researchers". Stanley and Rice (2003) implicitly recognize a high-level structural barrier which interferes with fisher/scientist relationships when they draw attention to the value in "changing the *nature of the interaction*" between fishers and scientists and the "greater *potential* benefit and enrichment that comes from *working with equals*" [emphasis mine]. Furthermore, they refer to the "the hierarchical vision of knowledge wherein the higher order science is considered the work of the privileged and the business of people formally trained in public institutions (Pálsson 2000)". Power (2000) uses the theoretical concept of gender to analyze the marginalization of women's knowledge within fisheries, fisheries science and management generally and in Newfoundland.[204] In this case, the relation of power is not overtly expressed as conflict between women fish workers and scientists, but is expressed through women's lack of

[203] In the Canadian context, "the center" is generally seen as southern Ontario and Quebec and the periphery includes for example, the North, the Maritimes, and Newfoundland and Labrador.

[204] Power (2000) notes that "[w]omen's knowledge is shaped by their distinctive experiences in societies characterized by sexual divisions of labour, gendered policies and practices, and patriarchal ideologies". Furthermore, "researching from the standpoint of women and other marginalized groups can expose implicit socio-cultural biases embedded within dominant knowledges" (Harding (1991) in Power (2000).

input into decision-making at several levels (Power 2000).

I have already demonstrated that the superior position of Science in society affects how scientists conceptualize TLK holders including fishers and their knowledge. It was in creating the influence network and repeatedly asking "is this entity/phenomenon a part of something bigger" that I more clearly saw the hierarchical dynamic involving Science as part of a high-level socio-cultural dynamic[205] with other possible dimensions including, for example, class or education level. The portion of the influence network depicted in Figure 7 summarizes a number of ways in which fishers and scientists may differ. As mentioned previously (Section 3.3.), these differences may be seen as neutral or as involving power relations (Henry 2000; Bishop 2002). The latter differences which are listed in Figure 7 are only those gleaned from the literature cases. Scientists' perception of fishers and their knowledge may also reflect several of these other ways of differing, that is, not only are fishers biased (Section 7.1.3), but "Fishers are not scientists" for other potentially significant reasons. As occurred historically (Section 5.4.2), scientists may unknowingly or knowingly harbour assumptions of superiority based on these differences (this dynamic feeds into Arrow 9, Figure 4).[206] These assumptions may create conflict which contributes to misunderstandings or conflicts that derive from more neutral differences. Thus communication and the creation of social capital are expected to be affected by either type of cultural difference as shown in

[205] It is part of the same phenomenon of behavioural tendencies and related social structures/ organization which generates hierarchical dualisms. As mentioned previously, deeper analysis or description of these high level phenomena is beyond the scope of the thesis. The important point is that when approaches and interactions on the ground are clearly connected to this level, they are quite entrenched and need to be seen as such.

[206] Recall the theoretical framework of nested layers of cultural influence within which a stakeholder or an organization is embedded (Section 5.6).

Figure 7. Influence network demonstrating the links between cultural differences and impacts on the Integration Project.

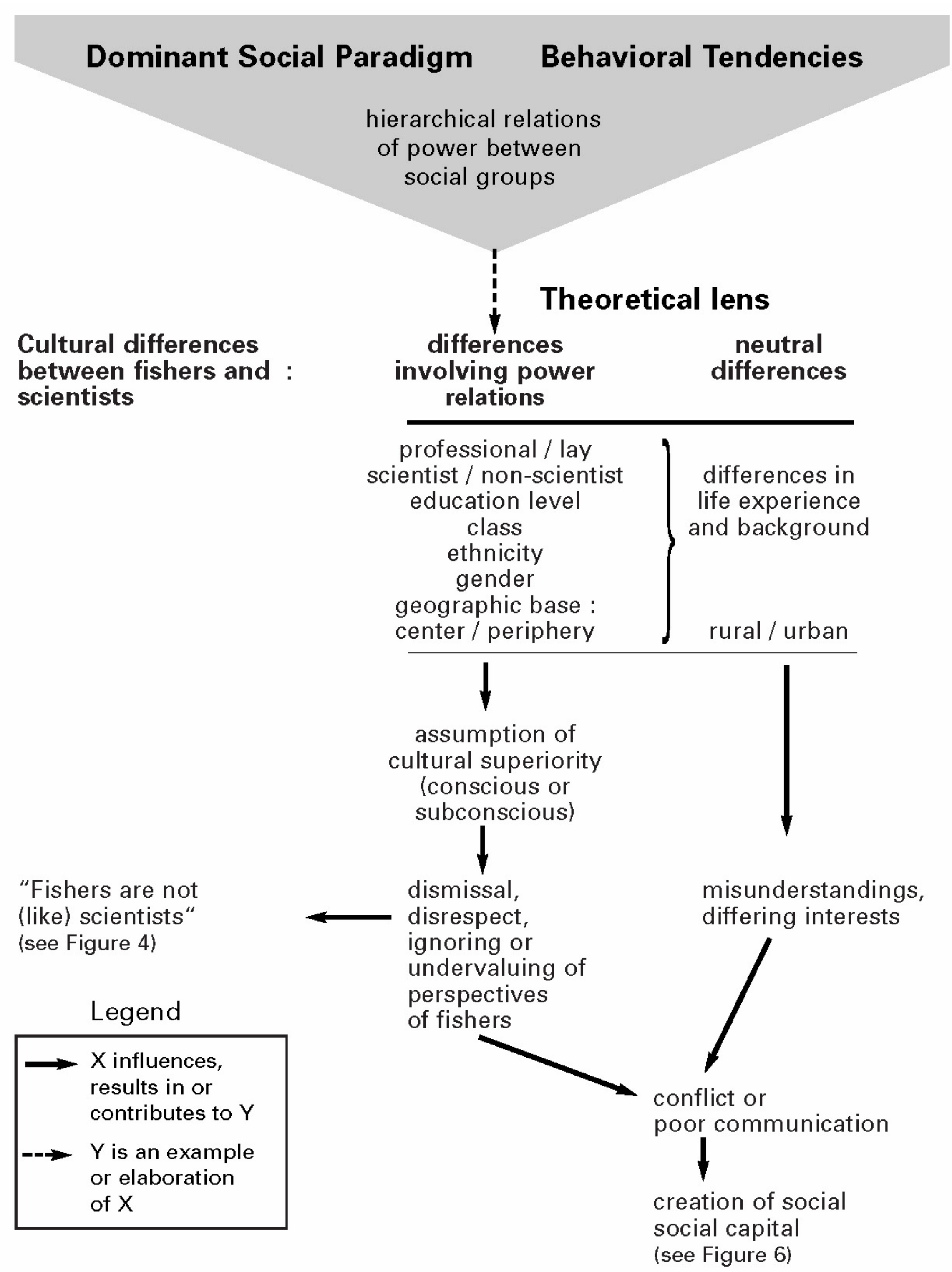


Figure 7.[207] This dynamic therefore connects to the portion of the influence network depicted in Figure 6.

Figure 7 was created by combining the little data there was from the analyzed literature with longstanding sociological theory and using logic to generate potential impacts of power relations and connect them with other parts of the influence network. This is an important theoretical contribution since the fisher/scientist relationship within the Integration Project has been little analyzed as a power relation.

Whether cultural differences are "neutral" or involve power relations, compromised communication and potential conflict may result. I expect that a number of proposed solutions might improve communication problems connected to both dynamics. At the level of implementation of the Integration Project, social connections and shared cultural background can contribute to improved communication. For example, MacNab (2000) and Maurstad (2000) attribute some of their success with fishers to having commercial fishing experience. In addition, both Sundet and Maurstad are northern Norwegians (Maurstad 2000). MacNab (2000) showed his willingness to learn from fishers by going out on their fishing boats. At a presentation during their tour in BC in 2004, Randy Baker, a fisherman working with FSRS, noted that Paul Fanning, a FOC scientist "was the kind of guy you could have a beer with."

Deliberately incorporating cross-cultural training into government or university programs has been suggested in a range of literature, including TLK literature and international development literature. Wilson (1997) summarizes a form of cross-cultural training in Bangladesh where professionals with Masters degrees who are hired by the

[207] I consider relatively neutral cultural differences to exist. For example, when humans have lived very different lives, have different values and assumptions, etcetera, there is a necessary process of learning to understand each other which often involves misunderstandings and conflict.

Grameen bank spend six months of intensive training in villages working directly with the poor. Irlbacher (1997) notes the importance of familiarizing government staff, especially those who work in offices, with experiences which create understanding of the basis and potential richness of TLK and its holders' lives. In a similar vein, McMullin and Wolff (1995) suggested that those training to be fisheries scientists and managers should reside and work with fishing families for a period of time. If time does not permit agency employees' participation in longer-term activities, then other forms of cross-cultural education and training is desirable (Legat et al. 1991; Irlbacher 1997). Working together on co-management boards, advisory councils or other groups may allow both parties to familiarize themselves with each other, potentially create trust (Pinkerton 1989), and "demystify the other's knowledge" (Gombay 1995).[208]

These kinds of suggestions are expected to reduce barriers at the level of interaction between smaller numbers of people within the Integration Project. However, as previously noted, understandings and relationships created "locally" can be undermined by structural barriers at higher levels within an organization. Weeks (2000) emphasizes the importance of:

> …differences in regulatory language and cultural models/world views played out against a background of unequal and disputed notions of whose knowledge is authoritative and who has what "rights," as well as of unequal access to political power. Privileging one model over others is a significant component of the rise and continuation of the barriers to rational communication and hence frustrating and often inappropriately politicized processes (McCay 2000).

Clearly, dynamics involving difference and power are structural in nature and involve more than communication – policies and institutional structures will also be affected.

[208] Other aspects of improving relations between fishers and scientists were discussed previously in Section 7.3.3.

Thus, focusing at the level of individuals is insufficient and institutional strategies are necessary (Bishop 2002). In this thesis, I have concentrated on systemic or structural barriers to the Integration Project associated with the role of Science in society, in the NRM system, and in the Integration Project. An examination of structural barriers associated with other cultural differences involving power relations is beyond the scope of the thesis.[209]

[209] However, discussions of these issues, and strategies for addressing related barriers from literature in other fields may be informative (e.g., Razack 1994; Dei and Calliste 2000; Bishop 2002; and Graveline 2005).

8. Assessing the status of the Integration Project within fisheries management

This chapter serves to "take stock" of the Integration Project. It does so by summarizing key approaches to the Integration Project as exemplified by the literature cases. This summary is then used as a basis to briefly consider the ability of the Integration Project to meet agency stakeholders' goals, and to consider the Integration Project within the greater context of a paradigm shift in fisheries management.

The chapter begins with a discussion of how cumulative barriers ineract with the the push for Fishers' Knowledge use to determine particular approaches to the Integration Project.. A number of facets of the Integration Project as it was represented and implemented in the literature cases are then summarized (Section 8.1). In particular, I contrast the most commonly observed and the most innovative approaches in the applied literature cases (those which involved direct interaction with fishers). In the next section, I make the observation that increased participation in fisheries management may not lead to increased application of Fishers' Knowledge. I then summarize various approaches to the Integration Project in terms of fishers' participation *as knowledge-holders* in the literature cases (Section 8.2). Section 8.3 provides a summary of data on the rationale for Fishers' Knowledge use as well as the general circumstances or contexts in which the Integration Project was discussed or implemented within the cases. This summary is indicative of author-stakeholders' general perspectives on the utility of applying Fishers' Knowledge in fisheries management. It also dovetails with agency stakeholders' presumed and stated goals regarding the Integration Project. Whether these goals were met in the applied cases is evaluated in a preliminary manner in Section 8.4.. Next, I briefly consider the Integration

Project as part of a potential paradigm shift occurring within fisheries management. Section 8.5 briefly addresses the role of individual and organizational variation within this shift. Finally, the status of the Integration Project as exemplified by the literature cases is discussed as a “snapshot” within the context of a paradigm shift (Section 8.6).

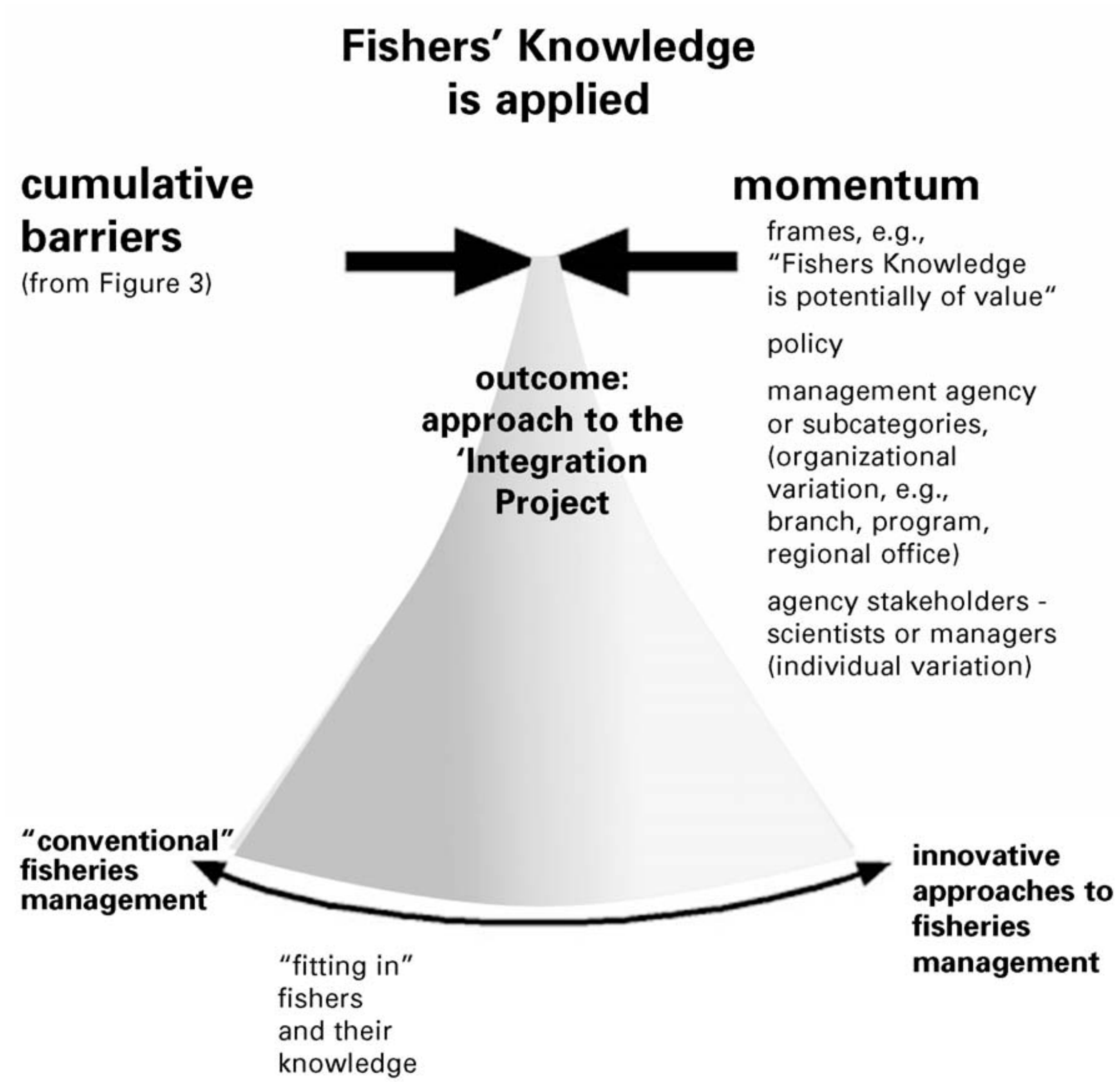
8.1 Summary of approaches to the Integration Project in the literature cases

The literature cases analyzed here suggest that although some level of acceptance or push for Fishers’ Knowledge use is occurring, the influence of frames of the DSP is considerable. A simple conceptual framework summarizes how these barriers pool with others to form "cumulative barriers" depicted in Figure 3. Cumulative barriers then interact with pressure or "momentum" supporting the application of Fishers’ Knowledge within the NRM system (Figure 8).

Cumulative barriers may constrain how the Integration Project is conceptualized and implemented to formats compatible with versions of fisheries science and management which are *relatively* conventional.[210] However, particular combinations of facilitating factors may create sufficient momentum to overcome cumulative barriers to a variable degree. These may permit more innovative approaches to the conceptualization and implementation of the Integration Project, thus the spectrum shown in Figure 8.

[210] Authors of literature cases referred to "conventional" or "traditional" fisheries management (Ames et al. 2000; Maurstad 2000; and McGoodwin et al. 2000).

Figure 8. ***Cumulative barriers interact with "momentum" of various types to determine the approach to the Integration Project.***



The literature cases documented here involved creativity, innovation, and collaboration in varying degrees. Table 7 summarizes and contrasts characteristics of the most frequent or “common” approaches with “innovative” approaches to the Integration Project. Individual cases generally demonstrated a combination of characteristics from each column.[211] Generally, the most common conceptual and operational approaches to the Integration Project appeared to fall within a category which I describe as "fitting in fishers and their knowledge" (Figure 8). These approaches had characteristics which resembled conventional fisheries management or which were most readily compatible with it. However, the literature cases also included approaches which were considerably more innovative (discussed in the following Section).

Several authors of literature cases discussed this "fitting in" dynamic, variously referred to below. Baelde (2003) refers to a "science-driven approach" in which "scientists assume that [fishers] accept the purpose and methods of science, and that their role is to fill gaps in scientific knowledge". Sutton (2000) contrasts the Community Watershed Management approach which involves anglers' direct participation in management to a "collect-and-combine" approach to the Integration Project.

Two other literature cases noted similar dynamics (see also Rowe and Feltham 2000):

[211] For example, Maurstad (2000) was aware of a number of contentious social issues involving the Integration Project, and used egalitarian language to refer to it, but the study focused on Level 1 FK (for reasons she explains – becoming "trapped in biology"), and minimally involved fishers. Conversely, Zwanenburg et al. (2000) used conventional language to refer to the Integration Project, but extensively involved fishers as co-experimenters (see collective validation, Table 8).

Table 7. A summary of common and innovative approaches to the Integration Project in the applied literature cases.[212]

Tendencies in Conventional fisheries management	**Common approaches to the Integration Project**	**Innovative approaches to the Integration Project[213]**
Neglect of the social dimensions		
a) historically low participation of fishers	limited participation of fishers: projects often interviews (14/25)[214] projects designed by scientists (of either type)	extensive participation, e.g., in research (Stanley); mapping (MacNab); collaborative spatial mapping and interpretation (Williams)
b) little attention to institutional design	little or no institutionalization of FK[215] most cases were one-time research projects (17/23)	Integration Project part of an organization in only two cases (FSRS in Zwanenburg; and EPLPC in Rowe)
c) little recognition of the importance of social capital	concentration on technical and operational aspects of the case	importance of trust and respect and/or mutual learning among stakeholders is recognized,e.g., Williams
Focus on Science		
a) Scientific knowledge	Level 1 FK – biophysical information sought in all cases most cases focused on biological research and/or understanding the status of fish stocks[216]	Level 2 FK knowledge also considered (see Section 8.6)
b) emphasis on methods and replicability (validity of a study)	emphasis on validity of FK	less emphasis on FK; more emphasis on pragmatic means of collaborative problem solving

212 "Applied cases" refers to cases in which authors worked directly with fishers. Data are summarized from Appendix B. Since some cases do not fit into the categories above, denominators may change at times (e.g., see Footnote 216).

213 For brevity, the author code (surname of first author) is used to identify papers here.

214 “Limited” participation refers to cases ranked as 1 for “degree of participation”. The next section elaborates on the range of fishers’ participation within the literature cases.

215 I do not count Purps et al. (2000) since this is a case of fishers' collection of logbook data for an agency based program.

216 Several studies which addressed some aspects of fishers social knowledge (Level 2) were aimed at understanding changes in fishing effort and therefore changes in stock abundance.

> Instead of simply inviting fish harvesters to comment on science and management intiatives, hiring them as data-collecting technicians, or even systematically collecting their knowledge in a form that fits with the requirements of existing science, we need to explore the benefits of participatory research and seriously consider…new approaches to both fisheries science and management (Neis and Felt 2000a).

> [T]he greatest gains may come from changing the nature of the interaction [between fishers and scientists]. We suggest that compartmentalising and confining the potential contributions from resource users as cheap data collectors or as sources of background knowledge is missing the point, if not condescending. It ignores the greater potential benefit and enrichment that comes from working with equals..." (Stanley and Rice 2003).

The exercise of power is implicit here. This is akin to what Wilson (1999) in Holm (2003) refers to as the "deference model":

> Scientists are seen as the experts and the best way to get an accurate picture of nature is to rely on their professional judgement…[T]he scientist is…assigned the role of the gatekeeper who has the final word on what is or is not known to be true about nature.

Holm (2003) describes the process of filtration and conversion of Fishers' Ecological Knowledge *in situ,* "raw fishermen's knowledge[,]…a huge pile of assorted items" or FEK, into the "small, well-ordered and consistent set of valid truths" which he terms FEK*. Stanley and Rice (2003) also recognize these issues:

> The tendency to compartmentalise the potential contribution by fishers results from a reliance on the "data collection" model for linking fisher knowledge (Fischer 2000) to other sources of information on stock status. It assumes that for local knowledge to contribute it must be systematised, stored, manipulated, and made intelligible to others in a manner similar to the treatment of data from conventional monitoring sources (Ferradas 1998). Although there is a place for this model, it represents an appending of fishers to conventional scientific research as junior partners. It maintains for researchers, the "we vs they", and the "*-knowledge vs science" dichotomies...We argue that fishers' experiential knowledge is not only sophisticated, but also derived from their skills as experimenters. Fisheries research should move towards the Participatory Research (PR) model long recognized in agriculture (Chambers et al. 1989, Sajise 1993) but only recently acknowledged in fishery research (McGoodwin et al. 2000; Neis and Felt 2000).

Similar observations regarding Traditional Knowledge and NRM systems have been made by Stevenson (1998) in the context of co-management in the North:

> [T]he dominant culture has a long history of exploiting only that knowledge that serves its own interests – most often some aspect of traditional environmental knowledge that addresses some specific information gap which western scientific knowledge needs to fill…This procedures almost always entails sanitizing and rendering Traditional Knowledge into a form that is palatable, recognizable, and usable to the dominant culture.

8.2 Fishers' participation as knowledge-holders

Recently within fisheries management, fishers may participate in, for example, advisory committees, consultative processes, or co-management arrangements. However:

> In a co-management situation, scientists have learned to respect fishers' political power, but they have remained skeptical of the validity of their knowledge. In his analysis of the northern cod fishery, Finlayson (1994) showed that scientists made a clear distinction between fishers' involvement *in the scientific process* and the *incorporation of their knowledge* in that process [emphasis mine] (Baelde 2003).

This quotation from one of the literature cases (Baelde 2003) is important because it distinguishes three potential roles of fishers in fisheries management:

1. political actors;
2. participants in "the scientific process"; and
3. knowledge-holders.[217]

The quotation implies that increased participation in management may not always lead to increased use of Fishers' Knowledge. Table 8 is a summary of approaches in the literature cases as they occur along a spectrum of degree of participation of fishers and

[217] There is no indicator for fishers' participation as *knowledge-holders* in decision-making because there was little mention by authors of this connection. I tried to examine this through the variable "management activities" and whether FK was *actually* applied (see Table 4; Appendix B).

their knowledge in fisheries science and management, that is, the participation of *fishers as knowledge holders.*

Table 8. Summary of fishers' participation as knowledge-holders in the literature cases.

Approach	*Description*
1. Data collection a) fishers collect scientific data	contributes to scientific program, e.g., Purps (testing logbook data)
b) fishers contribute Level 1FK in interviews	contributes to fisheries science procedures and/or data, e.g., Maurstad
c) fishers contribute Level 2 FK in interviews d) interviews plus some involvement in management and decision-making	used to inform fisheries scientists and managers of stock status and to inform or modify management regulations, harvest plans, etc., e.g., Gendron[218] (c+d)
2. Hypothesis generation	FK is tested by fisheries scientists (fishers do not participate), e.g., Wroblewski, Gosse
3. Collaboration *Agency-driven collaboration*	FK emerged in dynamic collaboration to address agency objective, e.g., Williams (spatial management)
Collective validation fishers are co-experimenters and collaborators	FK generated hypotheses which are tested by scientists and fishers together, e.g., Zwanenburg, Stanley
	FK used to create and test new fishing technology to avoid bycatch, e.g., Melvin
4. Management input *Participatory computer modelling*	fishers use their knowledge as a basis to explore potential management scenarios with scientists and managers, e.g., Baelde[219]
5. Community-based management fishers set the agenda in collaborations with others	Science is used by community-based fishers to assist and expand upon FK, e.g., Rowe

In cases falling within Approaches 1- 3 above, fishers contribute to a *scientific process* through roles ranging from data collectors to co-experimenters. Thus, relative to the history of fisheries management, cases of collective validation are innovative. In

[218] However, it is unclear how fishers were involved in discussions regarding the outcome of the project and proposed more precautionary approaches.

[219] Baelde (2003) discussed this scenario as a new possibility and cited other publications (e.g., Punt et al. 2001).

approaches 1-4, Fishers' Knowledge is "fit in" to the NRM system, that is, fisheries science and management procedures. The NRM system is not modified by the "encounter" with Fishers' Knowledge.

Below, I elaborate on two cases with extensive fishers' participation as a means of illustrating several additional aspects of innovative approaches. The first, Williams and Bax (2003), is a case of collaboration in which Fishers' Knowledge is used within the NRM system. A genuine partnership (*sensu* Baelde 2003; Glaesel and Simonitsch 2003) is implicit in protocol, language, and attitudes. They were one of only two cases to make a protocol agreement with fishers as a collective. This helps fishers to have a level of "ownership" over the process, given concerns expressed below. Authors' attitudes appear to have contributed to success of the projects (Appendix A). "Verification and validation" of data is mentioned once, but not emphasized. Furthermore, this is one of the few cases in which authors admitted to learning from fishers. Their tone demonstrates enthusiasm and respect[220].

These authors also expressed a rare and pragmatic understanding of fishers' concerns. This is a particularly interesting quotation:

> We have broad support from industry because *the project is viewed as a mechanism to have industry information considered in decision-making* processes for the fishery, and that *informed* decisions will result. However, support is not unanimous and this is due, in large part, to many fishers remaining skeptical that their information will not be used appropriately...[or will be]...used against them, especially for closing off valuable fishery areas - they are well aware of the link between areas of high fishery productivity and areas of high biodiversity. [emphasis mine]

Williams and Bax (2003) als note that industry also sees the projects as an opportunity to improve its public image regarding the environment, which they view as:

[220] See quotations in Section 7.3.3 (p. 180).

> poorly informed and often misleading [given] media and scientific reporting. This project will provide industry with some hard facts that they can use to demonstrate their real level of impact on the seascape - the trawl sector is particularly keen to be able to demonstrate that large areas of the fishery are untrawlable or untrawled…With their information systematically collected and rigorously evaluated, fishers would be positioned to critically evaluate proposed spatial management plans, such as the placement of MPAs, and require management agencies to have clearly defined and measurable aims for their proposed management options.

The second case, Rowe and Feltham (2000) report on the Eastport Peninsula Lobster Protection Committee (EPLPC), which drew upon Fishers' Knowledge to create lobster protection zones.[221] Their perspective on the Integration Project was also reflected in language: "[b]oth harvesters' local knowledge and fisheries science can make important contributions to fisheries knowledge and management. What differentiates Rowe and Feltham (2000) from other cases is that Fishers' Knowledge was used within *an agenda set by fishers*. Collaborators, including scientists, assisted where needed.[222] Rowe and Feltham (2000) noted that local knowledge was an important facet of a larger project – "the fishers have undertaken these initiatives so that they, their community, and future generations can earn a reasonable portion of their living from lobsters". Gathering and generating knowledge and creating protected areas serve the long-term goal of continuing to fish for a living. The expanded range of participation of fishers is evident in the following quotation from Rowe and Feltham (2003):

> Together these partners would draw on their very different knowledge bases to identify questions that were relevant[,]... formulate hypotheses and decide how best to test them, collect the necessary data, and interpret the results. *Instead of trying to insert Fishers' Knowledge into fisheries science and management*, the Committee decided to take a

[221] Levels 1 to 3 Fishers' Knowledge were used but the authors did not conceptualize Level 2 and 3 as knowledge.

[222] MacNab (2000) noted regarding this model: "Outsiders might provide elicitation skills and technical support, but ideally the knowledge is captured, held and applied by the community". His participatory mapping case shared several features with that of Rowe and Feltham (2000) raised here. It was also located in Eastport and probably involved some of the same stakeholders.

> different approach: integrating scientific methodology into their LEK base. As a result, the group has been able to gather scientifically rigorous data (quantitative in nature and collected using standardized techniques) and has benefited from local knowledge (typically qualitative in nature) particularly during the planning and interpretive stages. [emphasis mine]

This case demonstrated the highest degree of fisher participation in research, in management activities, and in agenda setting for the protected area as it fit within their long-term greater agenda.

In terms of the Integration Project, the quotation above indicates a reversal of the most common version of the Integration Project (as depicted in Figure 2). Fishers[223] actively collaborate with scientists to *integrate Science into their local management system.* Stevenson (1998) also noted that aboriginal people involved in co-management may deliberately adopt Scientific strategies and methods of the "environmental resource management systems of the state [in order to] serve their interests" and simultaneously work to strengthen their Traditional Knowledge system.

8.3 The potential utility of the Integration Project as conveyed in literature cases

In the ensuing discussion, I synthesize and summarize the general kinds of contexts within which the Integration Project was deemed necessary or useful in the literature cases. I also summarize the "rationale for Fishers' Knowledge use".[224] This information is useful in terms of providing evidence of stakeholders' goals and/or expectations in applying Fishers' Knowledge in fisheries management.

[223] More realistically this would be decision-making authorities from the fisher group.

[224] This variable (RATFK, Table 3) was found in the introduction of a paper, and is comprised of general comments (and often review of literature) concerning the utility of TLK/FK. It may overlap with authors own particular reasons for using FK or their specific case, or not. Nonetheless, in terms of understanding the broader thinking in NRM regarding TLK/FK, this is a potentially useful variable.

First, fisheries collapses or declines were noted as the most common context for the specific discussion or project involving Fishers' Knowledge in the literature cases.[225] In four cases, communication problems or conflicts between fishers and scientists or between fishing sectors was raised, and fisher involvement was raised in two cases.

The most frequent rationale for applying Fishers' Knowledge in fisheries management" was to provide missing information (80% of cases).[226] The logic appears to be that stock declines and crises are the result of insufficient information. Resource users have information which is "missing", "not readily available", or "difficult" or "impossible to obtain". This knowledge is seen as important and useful in fisheries management, and the implicit assumption is that fisheries management would be more successful if it were used. Generally, one gets a sense reading the literature that, given the extent of fisheries failures, "something is very wrong", and increasingly involving fishers and their knowledge can only improve matters.

The Integration Project is also seen as a means of increasing user participation with a number of related benefits: increased legitimacy of the fisheries management process and therefore of the agency (Maurstad 2000; Gendron et al. 2000) and improved compliance.[227] For example, Lydon and Langley (2003) noted that "[t]hose that do contribute to the decision-making process are more likely to understand and accept the ultimate outcomes and have a sense of ownership especially if they are involved in data gathering". Conflict reduction and improved communication was also mentioned as a rationale (Gendron et al. 2000; Zwanenburg et al. 2000). Bergmann et al. (2003)

[225] The "context of Fishers' Knowledge use" is a variable in the evaluative framework (Table 3; Appendix A,B). Authors' generally described the actual context of their work near the beginning of the paper.

[226] Twenty of 25 cases which listed a rationale for FK use cited missing information (Appendix B).

[227] Fisher involvement was also mentioned in four cases (RATFK).

noted the connection between collaboration and Fishers' Knowledge in their introduction: "The need to *improve the collaboration* between scientists and the fishing industry is widely recognized by scientists and fishers alike" (they cite seven studies).[228]

The following quotation in Power (2000) and generally, the content of the article, demonstrate a range of reasons for using Fishers' Knowledge:

> Incorporating the knowledge of plant workers and fishers' wives into fisheries science and management is important not only because they have valuable local knowledge, but also because they have paid and will continue to pay for resource mismanagement with their own and their families' well-being. Their inclusion could increase the likelihood that resource management initiatives will be perceived as legitimate, complied with and thus will be more likely to achieve sustainability.

Power (2000) implies that those affected by decisions should participate in making them. This is a general democratic and ethical principle (Loucks et al. 2003). By extension, and given the tight link between fishers' interests and their knowledge (Section 3.2), if Fishers' Knowledge is utilized in fisheries science and/or management, it is surely appropriate for fishers to have a say in *how* it is used. Power and Mercer (2003) also assumes the inseparability of knowledge and knowledge holders from decision-making and that "inclusion" of people *and* their knowledge will improve the decision-making process and resultant outcomes.

An additional reason for involving fishers extensively and in an ongoing manner is little recognized in the literature cases. Fishers' participation is necessary for the inclusion of *dynamic* Fishers' Knowledge (Section 7.3.5), that is, Fishers' Knowledge which is continuously being generated. In addition, Fishers' Knowledge must be

[228] This is an example of the difference between what is idealized in discourse and what is implemented. Their study involved interviews with fishers, some of which were on the water. However, *collaboration* tends to denote more participatory methods (Gray 1989).

interpreted by fishers in its social (Maurstad 2000) and biological contexts. The latter point is emphasized in Williams and Bax (2003):

> [C]ollaboration with industry is not limited to acquiring their data, but requires an ongoing dialogue if the data are to be interpreted judiciously, and industry is to understand the value of any proposed management measures (Neis 1995). Developing maps of the seabed is one thing, but interpreting them to provide the basis for improved management of the fishery that accounts for the diversity and specialization of fisher's daily activities is another.

I raise this point again in a later discussion (Chapter 9).

8.4 A preliminary evaluation of the Integration Project in meeting agency stakeholders' goals

A structured examination of stakeholders' goals, both fishers' and scientists', and whether and how the application of Fishers' Knowledge was able to meet them, was beyond the scope of the research. This remains an important piece of work to be done in future field work. However, the discussion above and limited data on potential successful management outcomes in the literature cases provide preliminary observations. I briefly touch on evidence with respect to meeting strategic management goals and policy goals of agency-based stakeholders

In total, 13 of 15 literature cases with direct agency connections demonstrated outcomes which can be considered as implicitly or explicitly meeting agency management goals (see Appendix B).[229] A number of these cases have been mentioned in Chapter 7, therefore I do not elaborate on them here. Missing biological or Level 1

[229] The variable is "stakeholder goals" in Appendix B. Direct agency connections refers to authors who work for management agencies, who are consultants engaged in fisheries management (e.g., Prince 2003), or who collaborate with agencies (e.g., Rowe and Feltham 2003; Lydon and Langley 2003). Baelde (2003) is not included since information from the interviews in Case 1 were not implemented. In addition, only 1 of Wroblewski (2000) and Gosse et al. (2003) were counted since they address the same management issue (stock substructure in cod).

information on harvested stocks contributed positively to outcomes related to management or biology of fish stocks in 12 of these 15 cases (e.g., Wroblewski 2000; Prince 2003; Stanley and Rice). Three cases recognized and utilized Level 2 Fishers' Knowledge in positive outcomes (Gendron et al. 2000; MacNab 2000; Lydon and Langley 2003). Unrecognized Level 2 Fishers' Knowledge also contributed to successful outcomes as discussed previously (Section 7.3.3) (Rowe and Feltham 2003; Melvin and Parrish 2003; Prince 2003).

The policy goals of reducing conflict and improving communication were accomplished in several cases discussed in Section 7.3.3, which addressed the importance of social capital, trust, respect, and mutual learning. For example, social capital, including unrecognized Level 2 Fishers' Knowledge, contributes to conflict reduction in the long-term success of the Intersectoral Potting Agreement (Bergmann et al. 2003).

FOC policy and strategic planning frequently focus on partnerships, shared decision making, and collaboration (*Oceans Act* 1996; FOC 1997; FOC 2000; FOC 2002), and these are seen as a means of improving communication, sharing accountability, making more widely supported decisions, and increasing agency legitimacy (FOC 2000) (Section 1.2.2). Regarding the achievement of policy goals, which increased participation would presumably facilitate, there appears to be a disjuncture between the emphasis placed on the importance of fishers' involvement (40% of the authors of both types) and the actual implementation of the Integration Project within the literature cases, in which levels of fisher participation tended to be low. Statements about the need for "genuine" or "authentic" participation (Baelde 2003;

Glaesel and Simonitsch 2003) may, in part, reflect this “lag” or difference between the intent and/or awareness of an issue or goal and its implementation.[230]

8.5 Paradigm shifting – role of individuals and organizations

In Figure 8, four potential sources of momentum are listed:[231] new metacultural and institutional frames; new policy; organizational variation in the form of a particular management agency or a smaller part of the organization (e.g., branch, program, or regional office); and individual variation, for example, particular agency scientists or managers.[232] The innovative cases here raise the issue of the importance of individuals as “agents of change” within their agencies or spheres of influence (Kofinas 1998). For example, two fisheries scientists demonstrated a particularly wide grasp on the social issues involved in the Integration Project (Baelde 2003; Stanley and Rice 2003, Section 7.3.4). There was insufficient evidence in the data to examine organizational variation. However, FOC does seem regionally variable, for example, there is not currently an institution like the FSRS in the Pacific Region nor has it participated in a comparable, extensive, interdisciplinary research project investigating Fishers’ Knowledge within a fishery such as the one reported in Gendron et al. (2000).

8.6 Signs of a paradigm shift

Categorizing the literature cases along a continuum of possiblity means that once analyzed, they are a kind of "snapshot". From one perspective, this snapshot can be

230 It was in attempting to discern this type of difference that I coded authors’ *statements* as well as authors’ deeds.

231 These were drawn from literature discussed in Chapters 3, 5, and 7.

232 Institutional and organizational variation were briefly mentioned in the context of theoretical frameworks (Section 5.6).

considered a description or characterization of the state of the Integration Project (in an already admittedly positively biased sample). This is already informative in terms of the opportunity to compare and contrast different approaches. However, this notion can also be extended by incorporating a theoretical framework of paradigm shifts, such that the results of applying the evaluative framework to literature cases can be seen as a "snapshot *in time*" (the two conferences were held five years apart). If placed within a historical context of a paradigm shift in which 30 years ago TLK was not used in NRM,[233] then the snapshot can be seen as a measure of where we are on a trajectory of change.

Sections 8.1 and 8.2 touched on several approaches to the Integration Project which were relatively innovative. Signs of a paradigm shift were also evident in other data. Level 2 Fishers' Knowledge was utilized in 10 of 24 applied cases.[234] This is an encouraging sign, given the neglect of the social dimensions of fisheries management discussed previously (Section 7.3), and something which probably would not have occurred 10 years ago.

Of 16 cases involving management agency staff or stakeholders who directly engage with management agencies, only four placed Fishers' Knowledge into databases[235], and two of these indicated ongoing involvement with fishers with the database and with other management activities. Furthermore, nine of 15 cases involving

[233] TLK as a concept emerged recently in particular fields – in the 1970's in Canada in the context of land claims agreements and the Mackenzie Valley pipeline hearings (Gombay 1995). Prior to this, the study of culturally transmitted ecological knowledge was limited mainly to anthropology, or ethnoecology and ethnobotany where "folk taxonomy" was the priniciple interest (Berkes 1999).

[234] Of 16 cases of agency-based first authors or authors in collaboration with agencies, seven utilized Level 2 FK; of eight FOC papers, three utilized it (two of these were from Maurice Lamontagne Institute) (Appendix D Table A).

[235] Database approaches to Fishers' Knowledge are quite common and accompany the data collection model. For example, the Report of the Partnership for Sustainable Coastal Communities and Marine Ecosystem notes: "There is a neglect of fishers' information and an absence of serious efforts to use this to *supplement scientific research*. *Partnerships should be established and supported between federal and provincial governments to develop appropriate databases* for integrating scientific and traditional knowledge." [emphasis mine] (National Round Table 1995).

agencies are indicative of ongoing relationships between particular fishers and scientists in which Fishers' Knowledge may be applied.[236]

Finally, in 15 papers, both natural and social scientists strongly critiqued current fisheries management and/or suggested different models. For example, Ames et al. (2000) conceptualized nested levels of governance, Pitcher and Haggan (2003) ecosystem management, and several other papers local or community-based management (e.g., Sutton 2000). In the summary and recommendations of the final chapter, I continue this discussion by addressing what the Integration Project might become within an ongoing paradigm shift.

[236] Purps et al. (2000) was not included. Stakeholders with direct agency connections were, e.g. Baelde (2003) and Lydon and Langley (2003).

9. Conclusions

"People don't like to change their ideas and it takes a very long time…"

Joseph Stiglitz[237]

We have seen that the Integration Project can be conceptualized and implemented in a range of ways. Recall that I created the term "Integration Project" for "the application of Fishers' Knowledge to fisheries management" not only as an abbreviation. I wished to emphasize that the application of Fishers' Knowledge to fisheries management has sometimes been treated as a short-term project rather than as part of an ongoing process. I particularly wanted to bring attention to the notion of "integration" and its meaning in theory and in practice.

The research began with the premise that policy and academic interest in the application of Fishers' Knowledge to fisheries management was genuine. Therefore, identifying the barriers to the Integration Project was a worthwhile endeavour, which could ultimately contribute to the improvement of fisheries management. A grounded theory of barriers to the Integration Project was produced, the key results of which are summarized in general terms in Section 9.1 and elaborated upon in Section 9.2. In the process of uncovering the barriers, the research generated other useful contributions to the study and application of Traditional and Local Knowledge in natural resource management, as well as to fisheries management more generally. Specifically, I developed a conceptual model of the Integration Project and the accompanying

[237] He spoke on January 27, 2005 in Vancouver as part of a forum organized by Van City.

evaluative framework which functions as a data collection tool to analyze cases (Section 9.3). I also adapted and combined particular aspects of several theoretical frameworks to assist in the analysis of barriers. This theoretical work contributes to current social theory in the Fishers' Knowledge and fisheries management literature. The chapter then turns toward the future with discussion and recommendations in two broad research areas, beginning with the examination of potential economic efficiencies of the Integration Project (Section 9.4.1). I conclude the thesis by posing the research question: how would appropriate institutions be designed to capture apparently desirable features of the Integration Project: the extensive participation of fishers, the incorporation of dynamic Fishers' Knowledge of various levels (as defined here), and the building of trust and respect among stakeholders? (Section 9.4.2)

9.1 General findings

In the early stages of this research, my attention was focused on beliefs and attitudes of *stakeholders*. However, during the analysis of the literature and the creation of the influence network, my focus shifted to the *structures that influence* individuals. This is the principle contribution of the research – it makes the explicit links between approaches to the Integration Project at the operational level and widely held and longstanding beliefs in society. In the language of the thesis, I have identified and traced the path of influence of particular and interconnected metacultural frames of the Dominant Social Paradigm through institutions and their respective frames, to *specific* constraints on approaches to the application of Fishers' Knowledge to fisheries management, what I have termed here, the Integration Project. These metacultural frames permeate the thinking, institutions, and organizational structures of fisheries management agencies and the field of fisheries science generally. Of particular interest are the Science and Technology frames,[238] which appear to have restricted the way in which fisheries science, fisheries management, and the Integration Project are conceptualized. Other than a general association of the "hegemony of science" with the lower status or disparagement of Fishers' Knowledge (e.g., McGoodwin et al. 2000; Maurstad 2000), its *specific* impacts on the Integration Project as a concrete or "situated" activity (Schön and Rhein 1994) had been little elaborated.[239] As mentioned in Chapter 5, a premise of this research is that problems cannot be solved – in this case, barriers cannot be removed – if they have not been properly identified (Schön and Rhein 1994; Wright 2001).

TLK emerged in environmental policy, in part, because of macro-scale influences – trends which appeared to be indicative of some level of shift within the Dominant Social Paradigm. Although innovation was evident in the literature cases, the current state of the Integration Project tended toward conventional fisheries management approaches – minimal participation and institutionalization, and generally the utilization of Level 1(biological) Fishers' Knowledge. This is understood to reflect to a considerable degree, the *entrenchment* of the Dominant Social Paradigm.[240] For this reason, I begin the conclusion of the thesis by quoting Joseph Stiglitz, who is a Nobel Prize-winning economist. The context of this comment was his puzzling about the research which won

[238] Recall that these are the belief in the superiority of Science and the (over)commitment to Scientific and Technological means of problem solving.

[239] Maurstad (2000) and Wilson (2003) are perhaps the best examples. However, the former was focused on the impacts of the authority of Science on the capacity to do interdisciplinary research, rather than on impacts of fishers' ability to communicate their knowledge. The latter did not sufficiently show the link between the debate about bluefish models and the relative influences of the Science frame on fisheries science-in-practice, procedural inertia in staying with a "tried and true" model, or other potential factors. (The rejected model was capable of incorporating the displacement hypothesis favoured by fishers).

[240] I attempted to capture the dynamic of tension between forces of change and resistance in Figure 8.

him the Nobel Prize. He had demonstrated that “one of the reasons the ‘invisible hand’ was invisible was because it wasn’t there”. He had naively thought that this would change the way economics was done.

9.2 Specific findings – barriers to the Integration Project

A key contribution of the thesis is to present *specific* evidence that the Science frame is a highly influential belief within fisheries management and the source of several inter-related barriers to the Integration Project. Specifically, I propose that the Science frame affects the Integration Project in three key ways:

1. It affects how Traditional and Local Knowledge, including Fishers' Knowledge, is conceptualized – TLK/Fishers' Knowledge were and still are contrasted with Science and generally found to be lacking as a result of assumptions regarding validity or in connection with a series of dualistic characteristics attributed to TLK and Science.

2. The Science frame and several other metacultural frames affect how fisheries science and management are conceptualized. Specifically, fisheries science is conceptualized as a Science-based process of specific methods and procedures which are used to generate management regulations. In addition, some of these methods are entrenched, generally as a result of the routinization of procedures and assumptions of their efficacy. Some methods reflect large-scale and centralized ways of conceptualizing the marine environment both in biological/spatial terms and in terms of governance (the Governance frame) and managing the resource. In addition, the Economic frame tends to result in an emphasis in fisheries science on abundant and valuable stocks. These influences have serious ramifications for the ability of fisheries science to address the rapidly emerging reality of the substructure of fisheries stocks.

3. The Science and Technology frames (and the Science-based conceptualization of fisheries management) are linked to "social barriers" associated with the neglect of the social dimensions of fisheries management. These dimensions include fisheries social science research, social capital, institutional design and fishers’ participation.

All of the above conceptualizations may ultimately act as barriers to the Integration Project through contributing to the following kinds of impacts:

- Fishers’ Knowledge is not used or it is treated with suspicion;

- Fishers' Knowledge is used in limited ways relative to its potential applications;
- particular kinds of Fishers' Knowledge are ignored because they do not fit within current procedures in fisheries science and management; or
- they are ignored because they comprise social knowledge (Level 2 Knowledge), and social dimensions of fisheries management tend to be neglected.

Conflict or poor communication between fisheries scientists and fishers may be exacerbated by differences based in culture in addition to the "Scientist/lay person" key difference (for example, class or cultural differences between rural and urban dwellers). I refer to these as cultural barriers. A number of bureacratic barriers are also elaborated upon, particularly characteristics of bureaucracies which are not amenable to the Integration Project. For example, collaborative work generally does not fit within current agency promotional schemes for fisheries scientists. In addition, bureaucracies' tendency toward incremental change may slow the acceptance of the Integration Project as "innovation". Limited financial resource further constrain resource management agencies' ability to innovate. Finally, Fishers' Knowledge is dynamic and potentially difficult to convey within the restricted settings of fisher participation and representation currently in place within management agencies.

9.3 Conceptual models and theoretical frameworks

This thesis expands upon previous literature on TLK in answering the question "what is this thing called the *Integration Project*?" The answer is that the Integration Project encompasses a *range* of possibilities which the creation of the conceptual model and the evaluative framework helped to describe/characterize.

As discussed in the thesis (Chapter 5), in order to explain or understand the patterns and observations which emerged during the research, it was necessary to draw upon, and to combine in an original way, a number of theoretical frameworks. This theoretical work was an elaboration upon what was available in the Fishers' Knowledge literature, which in terms of models of the Integration Project appeared to be Neis and Felt's (2000a) two proposals (Section 4.1) and a model critiqued recently in Holm (2003), which appears to be similar to the "data collection model" discussed here (Table 8). In this thesis, I characterize the two proposals observed in Neis and Felt (2000a) as occupying two poles in a continuum. At one extreme, the NRM system *accesses* Fishers' Knowledge with little involvement of fishers and little formal institutionalization and at the other extreme, fishers participate as knowledge holders in a range of management activities within formal and informal institutions. This conceptual model was critical in terms of describing and categorizing various observed and potential characteristics of the Integration Project, including level of participation of fishers, type of Fishers' Knowledge used, etcetera (the variables in the evaluative framework).

The suite of theoretical premises (Chapter 5) and the depiction of two interacting, nested, social systems is a contribution to theory since it combines frameworks used in Ostrom (1992) (nested levels of institutions and decision-making authority) and Finlayson (1994) (merging macrostructural influences with context-specific phenomena) with the frames of Schon and Rhein (1994). Ostrom's (1990; 1992) work is highly influential within institutional economics, and particularly as applied to institutions for agricultural and natural resource management. However, she emphasizes institutions as rules-in-use and does not appear to sufficiently examine the influence of beliefs, norms, and values, particularly metacultural frames, on the institutions of interest.

This conceptual model and evaluative framework also contribute toward better attaining policy goals. They do so by identifying and contrasting several key features of the Integration Project which *may or may not be compatible* with policy goals. I do not attempt to advocate a one-size fits all approach to the Integration Project, that is, more participation is better.[241] Policy and stakeholder goals must provide the lens through which to evaluate the success of an endeavour.[242] A detailed examination of stakeholders' goals, both fishers' and scientists', and whether and how the application of Fishers' Knowledge was able to meet them, was beyond the scope of this research project. This remains an important piece of work to be done in future field work. Nonetheless, this thesis serves to contribute to a more systematic examination of the Integration Project in terms of its ability to improve management outcomes.

9.4 Recommended research

9.4.1 Examination of economic efficiencies and reduced transaction costs in the Integration Project

A number of the cases examined here demonstrated increased efficiency and/or reduced costs through using Fishers' Knowledge (Lessard et al. 2003; Stanley and Rice 2003; Williams and Bax 2003) (Section 7.4.6). This suggests that Fishers' Knowledge could contribute considerably more to cost savings. Gough (2004), an ex-

241 Furthermore, participatory institutions do not preclude the data collection model when stakeholders collectively decide it is desirable. More participation is not necessarily "better" from both TLK-holders' and scientists' perspective (Kofinas 1998; Stanley and Rice 2003; respectively.)

242 This raises the issue of the need for clarity in policy objectives which has been discussed by FAO-based fisheries scientist Kevern Cochrane in several papers, for example, one in which he emphasized the importance of social policy goals of fisheries management in post-apartheid South Africa (Cochrane 1999) and another which addresses management objectives (Cochrane et al. 1998).

communications director with FOC for 20 years, elaborates in some detail on the costs of monitoring compliance within FOC. He also examines the potential benefits of improving communication and genuine participation of fishers and their knowledge within fisheries management, as so many major departmental reports since the 1970s have suggested. Ostrom (1992) and Rudd (2003) analyze the reductions in transaction costs which can occur in institutions that are well designed. In particular, Ostrom (1992) examines how perverse incentives which are hidden or ignored can be costly. Similar research needs to be undertaken on the potential benefits and costs of the Integration Project over the longer term.

9.4.2 What might the Integration Project become in an ongoing paradigm shift?

We have seen the considerable emphasis on participation in the literature cases within the context of the Integration Project and in the general policy and academic literature in fisheries management (Section 1.2.2). Canada's recent Ocean's Strategy frequently mentions co-management, collaboration, and integrated management (a participatory form of spatial multi-stakeholder management). In addition, "building capacity, confidence, trust, and respect among participants" is noted (FOC 2002). We have also seen evidence of considerable interest in Fishers' Knowledge in the academic fisheries literature (Section 1.2.2) and in FOC policy. For example, recent policy contains references to "traditional ecological knowledge" (*The Oceans Act* 1996) and local and traditional knowledge (FOC 2002). Evidence of the potential for Fishers' Knowledge of both Level 1 and 2 to assist in meeting concrete agency goals was demonstrated in the literature cases. Finally, the potential value of Fishers' Knowledge as a dynamic form of knowledge has been discussed.

Taken together, the above assertions suggest that stakeholders should collectively examine and design or adapt institutions which encourage the potential *extensive* and *ongoing* participation of fishers as both *decision-makers* and *knowledge-holders*. However, as Stevenson (1989) noted: “Partnerships cannot be celebrated fully until the sharing of power and responsibility *meets the goals and aspirations of each partner”* [emphasis mine]. Clearly, there is considerable scope for additional research on how the Integration Project can contribute to meeting *all* stakeholders’ goals. This includes research into the kinds of institutions which might serve this purpose.

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Appendices

Appendix A. Completed evaluation frameworks for 32 literature cases[243]

Ames, E.; Watson, S.; Wilson, J.

Rethinking overfishing: insights from oral histories with retired groundfishermen.

Identification of Paper
by author
Ames
source (SL or PW)
SL
Context
author type
FS,Sa,ID
case study location
Gulf of Maine
geographic scale
local
category of knowledge holders
commercial fishers (retired groundfishermen)
context of Fishers' Knowledge use
fisheries collapse
specific context
collapse of Gulf of Maine groundfisheries
type of management system; level of governance
government management
rationale for Fishers' Knowledge use
missing information ("otherwise unobtainable" and critical to improving management)
authors' goals
to convey the shortcomings of status quo fisheries management and to advocate for local involvement in fisheries management and governance (including information from fishers)
Approach
Term used for 'Fishers' Knowledge'
oral histories
Term used for knowledge holders
fishermen
Fishers' Knowledge definition
not defined
level of Fishers' Knowledge
level 1 examined, level 2 implied
coded themes
IPRQ FSQ ("small-scale spatial and multiple temporal scale information")

[243] Appendix A is comprised of completed evaluative frameworks (see Table 3) for each literature case, in alphabetical order according to first author. Table 4 lists the codes used here and their definitions. "NA" designates "not appropriate". "ND" designates "not defined" and was used when variables were not defined.

theoretical/applied orientation
both
key issues addressed
Authors use Fishers' Knowledge (identification of 88 spawning grounds) to retrospectively explain the groundfish collapse as cumulative effects of serial depletion of discrete inshore stocks.
"We advocate the need to incorporate fine spatial and temporal scale information in managing fisheries with fishing communities providing this detailed information." This information should be part of a "multi-scale fisheries governing institution".
Results led them to question key concepts in fisheries management including random distribution of fish populations and overfishing: "overfishing of cod populations occurred over a much longer time period than the last two decades as suggested by the current fisheries management institutions".
"[T]hese multiple populations may have...comprised a complex, larger "metapopulation"…[rather than]…the "traditional perspective which treats the Gulf of Maine cod as a homogeneous population."
methods used
interviewed 24 retired fishing captains - standardized interview format: years spent fishing, target species, ports, fishing methods; locations of ripe or juvenile cod and haddock caught and time of year. Grounds had to be identified independently by two or more fishers.
degree of participation of knowledge holders in research
1b interviewed
aspects of research methods
(i) protocols for permission ND
(ii) how is Fishers' Knowledge used/where is it stored?ND
scope of management activities involving Fishers' Knowledge
A (5)
degree of institutionalization of the Integration Project
none (one-time study)
language used to describe Fishers' Knowledge
fishers are seen as possessing critical information for management: "the only people who can provide [it]"
language used to describe Science and scientists
Authors critique"traditional approach" to fisheries science regarding stock concepts, spatial and temporal scale and overfishing.
"Traditional marine science literature" on scale and inshore fishery systems is lacking.
language used to describe the Integration Project
3 (vague but a combination of quotes below suggests it)
"local stakeholder involvement is essential for effective management"
"The scientific support behind a multi-scale fisheries governing institution would have to incorporate fishing community members who are the only people who can provide small spatial scale and multiple temporal scale information about the system."
"Fishermen, and other local stakekholders, can suggest relevant hypotheses for future scientific examination and fisheries management strategies." (Level 2 Fishers' Knowledge implied here)
Barriers
implied that the inappropriately large-scale of "traditional" fisheries management has been a barrier to Fishers' Knowledge FSQ
Evaluative variables
stakeholder goals
Authors accomplished theirs; fishers are retired
additional comments
They go into consider detail about ecological systems and recommend governance institutions, but it seems inappropriate given the scope of their study, which focuses on spawning areas and some on fish migratory movements. The paper moves from asserting that 1. this type of fishers'

information is important, to 2. local people have it to 3. local people should be "involved" in *governance institutions*. Additional connections between their own study results and their recommendations, as well as substantiation from other literature would have strengthened the paper.

Baelde, P.

Using Fishers' Knowledge goes beyond filling gaps in scientific knowledge- analysis of Australian experiences
Identification of Paper
by author
Baelde
source (SL or PW)
PW
Context
author type
Na
case study location
Australia
geographic scale
regional
category of knowledge holders
trawl fishers
context of Fishers' Knowledge use
fisheries failures; public demand for increased environmental protection, changes in "principles and practices" of fisheries management (more emphasis on uncertainty, precautionary approach and ecosystems)
specific context
Case 1: South-east commercial trawl fishery – stock assessments for most species use catch per unit effort (CPUE) analysis using catch and fishing effort data from logbooks (used since 1986)
Case 2: Fishery with limited data available and complex fleet and stock behaviour; a multi-stakeholder working group just created
Case 3: Ministry of Environment and Conservation of State of Victoria – lack of proper consultation of fishers regarding the design and implementation of Marine Protected Areas (MPAs)
type of management system; level of governance
government management and/or "partnership models" – some level of co-management (shared responsibilities and costs for research and management)
rationale for Fishers' Knowledge use
improve management
authors' goals
to examine the role and value of Fishers' Knowledge within industrial fisheries management undergoing changes using three cases studies
Approach
term used for 'Fishers' Knowledge'
Fishers' Knowledge (usually), expert environmental knowledge, expert advice, complementary knowledge [to science]
term used for knowledge holders
fishermen, fishers, experts
Fishers' Knowledge definition
"detailed knowledge that fishers have of fish stocks, their environment and their exploitation patterns"
level of Fishers' Knowledge

Case 1 – L1,2
Case 2 – L1,2,3 (values affect decisions on what to model and why, and decisions based upon particular simulations)
Case 3 - NA
coded themes
EMBEDQ, INTQ, AHK, COMPLEXQ, CONFLICTQ, ACOMPLEXQ, DUALQ, ADOUBT, ETHIQ, BUREAUQ, EFFCHAN, POLIQ, SAMPI, VALUEQ, ADUALQ, REPQ, FVALID
theoretical/applied orientation
both
key issues addressed
Case 1: Baelde's aim was to "provide scientists with information that would help them improve their analysis of logbook data." The survey identified a number of changes in fishing technology, strategies, and fleet dynamics (some as a response to management under Individual Transferrable Quotas) which mean that CPUE is not representative of stock abundance. These changes were not taken into account in stock assessments because of a lack of interest in the knowledge and a failure "to appreciate the need for dedicated and specialised work" to apply it.
Case 2: In future simulation modelling of blue eyed trevalla (*Hyperoglyphe antarctica*, Centrolophidae), fishers, managers, and scientists will collaborate. Challenges include unfamiliarity with the approach; commitment to the process and "genuine participation" in hypothesis development; and agreeing on how to use the results of simulations to determine "a set of decision rules that trigger management actions"
Case 3: Level of public consultation was insufficient for meaningful fisher input which contributed to fishers' defeating a draft MPA bill for designation of 12 areas
fishers' role should be evolving beyond "simply filling gaps in scientific knowledge to providing expert advice on fisheries research and management"; and there was a lack of research into effective partnerships
methods used
Case 1: Southeast Trawl survey – semi-structured face to face interviews gave fishers opportunity to elaborate and discuss wider issues; collected quantitative information, (e.g. number and type of vessels and gear) and qualitative information (e.g., fishing practice preferences, information on changes in environmental conditions, etc.); built in mechanisms to assist scientists in "quantifying and analysing the information collected"; 45 of 47 skippers approached participated (over half the fleet)
Case 2: simulation modelling approach not yet undertaken; involves collaboration of scientists, managers, and fishers in hypothesis creation and testing in model simulations
Case 3: ND
degree of participation of knowledge holders in research
Case 1: 1b
Case 2: 3 (hypothetical)
Case 3: 1b
aspects of research methods
(i) protocols for permission ND
(ii) how is Fishers' Knowledge used/where is it stored?ND
scope of management activities involving Fishers' Knowledge
Case 1: A,B (2)
Case 2: NA (hypothetical) potentially 1,2,3,5,6
Case 3: NA (MPA consultation)
degree of institutionalization of the Integration Project
negligible
language used to describe Fishers' Knowledge
expert advice
"challenges in accessing and validating [Fishers' Knowledge]"
Fishers' Knowledge has value unto itself

"suspicion attached to fishers' information (subjective, non-tested and perceived as biased by vested interests)
language used to describe Science and scientists
"scientists believe"
"scientists assume…"
"scientists attitudes towards Fishers' Knowledge were influenced by socio-cultural barriers…"
"the moral authority of science (collectively accepted by society and legitimised through rigorous objectivity rules)"
"Scientists tend to see themselves as possessors of universal knowledge and custodians of the sea (McGoodwin et al. 2000)…"
language used to describe the Integration Project
code 4
she contrasts Case 1 - "fishers as information providers" ; "collect information" "provide scientists with information" with Case 2 - "fishers as active collaborators"; "collaboration"; "expert advice to management"
fishers' role should be evolving beyond "simply filling gaps in scientific knowledge to providing expert advice on fisheries research and management"
"scientists assume that [fishers] accept the purpose and methods of science, and that their role is to fill gaps in scientific knowledge"
"accommodate each other's complementary knowledge and expertise and put them to best use"
Barriers
"Possibly the greatest difficulty with the partnership approach is overcoming existing socio-cultural barriers that hamper communication and collaboration between fishers and scientists/managers." CROSSQ
scientists may not acknowledge the legitimacy of Fishers' Knowledge ADOUBT
"generally limited resources and expertise, and sometimes limited willingness, within government agencies to design and engage in effective consultation with the commercial fishing industry." MONEYQ
challenges in accessing and validating knowledge which is in part motivated by fishers' self-interest (especially with industrial fisheries)
tendency to seek Fishers' Knowledge when "fisheries are already in difficulties"
Evaluative variables
stakeholder goals
author's and fishers': Case 1 – short term success because of degree of fisher participation in the survey and diverse amount of important information which emerged; ultimately frustrating since results were not incorporated in stock assessments
additional comments
interesting to note the difference between Baelde's relative emphasis on socio-cultural barriers and technical difficulties/methods compared to McGoodwin et al. 2000(about 4:1; 1:4, respectively)

Bergmann, M.; Hinz, H.; Blyth, R.; Kaiser, M.; Rogers, S.I.; Armstrong, M.

Using expert knowledge to identify possible groundfish 'essential fish habitats'

Identification of Paper
by author
Bergmann
source (SL or PW)
PW
Context
author type

Na,Ng,Na…
case study location
Irish Sea
geographic scale
regional
category of knowledge holders
"demersal fishers"
context of Fishers' Knowledge use
increasing recognition of importance of fish habitats (*Magnuson-Stevens Fisheries Conservation and Management Act (1996)* of U.S.)
specific context
first European study that aims to identify essential fish habitats of commercially important species
type of management system; level of governance
government
rationale for Fishers' Knowledge use
lack of knowledge; fishers 'sample' more intensively; involvement (including through knowledge) can mean 'buy in' to regulations (through improved "credibility of fisheries science")
authors' goals
to learn more "about the precise distribution of the major commercially exploited fish species and their habitat" because "scientists know surprisingly little" (identify "essential fish habitats" for cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus*) and whiting (*Merlangius merlangus*))
"to liase with the fishing industry to refine our broad scale fish maps for future survey"
Approach
Term used for 'Fishers' Knowledge'
expert knowledge; fishers' views and knowledge
Term used for knowledge holders
fishers
Fishers' Knowledge definition ND
level of Fishers' Knowledge
Level 1
coded themes
ADOUBT, VALIDQ, FSQ, NSD, APARTQ, IPRQ, habitat and fishing areas
theoretical/applied orientation
applied
key issues addressed
Fishers' Knowledge can be useful for identifying habitats as well as other trends in fisheries (negative impacts of varying types)
methods used
project announced initially in Fishing News (industry newspaper)
questionnaire-based interviews and maps generated at several fishing exhibitions(n=26)
questionnaires also sent to several fishers' organizations for distribution amongst members; total of 39 questionnaires completed and 19 maps converted to GIS
16 questions, only six of which were analysed in this paper
"The interviews were designed to study fishers' perceptions of the relationship between fish and habitat features, perceived changes in habitats and to gain information about the location of potential EFH."
degree of participation of knowledge holders in research
1b - interviewees
aspects of research methods
(i) protocols for permission ND
(ii) how is Fishers' Knowledge used/where is it stored?ND
scope of management activities involving Fishers' Knowledge
A (5)

degree of institutionalization of the Integration Project
none - project
language used to describe Fishers' Knowledge
"...several fishers highlighted [similar] areas...independently, which increases the confidence in these data."
language used to describe Science and scientists NA
language used to describe the Integration Project NA
Barriers NA
Evaluative variables
stakeholder goals
Authors: "The fishers' information has added to our confidence that high density sites indicated by the fisheries survey are indicators of areas targeted by fishers. These areas presumably have features that consistently attract fish in sufficient numbers and quality to be of interest to fishers."
additional comments
Only six of 16 questions were reported on. Presumably the other questions were more specific with reference to critical life stages of target species. These six questions seemed quite general and therefore elicit general responses (e.g. "weather" and "season" were listed as factors that affect targeted habitats). The authors noted that interviews "yielded the best data since trust could be established and technical terms or ideas elaborated upon". Protocol agreements between institutions to address confidentiality concerns might have addressed fishers' concerns about confidentiality of fishing ground information. It is unclear how these results will be used and by whom, or the connections of the principal researchers to management agencies.

Blyth, R.; Kaiser, M.J.; Hart, P.J.B.; Edwards-Jones, G.

An example of conservation and exploitation achieved through a voluntary fisher management agreement

Identification of Paper
by author
Blyth
source (SL or PW)
PW
Context
author type
Na,Na,Na,Na
case study location
south Devon
geographic scale
local
category of knowledge holders
inshore fishers (mainly crab fishers) and towed gear sector
context of Fishers' Knowledge use
intersectoral conflict and fishing agreement
specific context
reduce conflict through voluntary agreement between fishers' organizations mediated by management institution
inshore fisheries - "local area byelaw of the Devon Sea Fisheries Committee prevents vessels longer than 17.24 m from operating within six miles of the Devon coastline."
type of management system; level of governance
local management and government management
rationale for Fishers' Knowledge use

to prevent further fisheries decline ("utilise management systems that were historically successful in local environments")

authors' goals

"We have sought to understand the perceived and actual benefits of the system for the fishers whom it affects." Specific aims are to identify success factors and areas for potential improvement, and to characterise features applicable globally.

Approach

Term used for 'Fishers' Knowledge'

Fishers' Knowledge (once in Abstract), traditional ecological knowledge (TEK) in Introduction

Term used for knowledge holders

fishers

Fishers' Knowledge definition

"TEK is information generated and transmitted over time by people who live and work in a particular location. The development of TEK enables people to survive and prosper in their local environment. Examples of TEK may include an awareness of which crops will grow under local conditions, or where migratory animals will be found at certain times of the year."

level of Fishers' Knowledge

Level 2 (Fishers' Knowledge/evaluation of aspects of economic and social aspects of the agreement) (Level 1 and L2 knowledge of fishers' behaviour, norms and values important in the agreement but not examined)

coded themes

CONLFLICTQ, VALIDQ, NSOCCAP, NEGID, PROTOCOLQ, NSQSS

theoretical/applied orientation

both (mainly applied)

key issues addressed

Inshore Potting Agreement (IPA) "was conceived and established by fishers to reduce conflict between those that operated static gears (trap and nets) and those that used towed gears (trawls and dredges). At present, there is no legal recognition of the system, though the IPA is generally well observed by fishers from both sectors of the industry...The IPA is regarded as...successful...because it has continued to function effectively for several decades."

Static fishers appear to have territories ("informal ownership arrangements") which are generally respected by other fishers within and between gear sectors. Thus, crab fishers are managing to maintain their livelihoods through some level of territorial protection (both gear and habitat) given a larger context of potential towed gear dominance.

methods used

semi-structured interviews with fishers at sea under normal working conditions; interviewed fishers through approaching their associations - "meetings were organised to introduce the project to fishers, interviewees were reminded of the aims of the project, asked a series of background questions about their participation in the fishery and other socioeconomic data (began with "non-emotive issues"); then "more contentious issues were covered, including what services the IPA provided each fisher, whether they felt the IPA served other fishing sectors, and any means by which the IPA could be improved."; also asked about intra- and inter-sectoral conflicts. Skippers of nine static gear boats and one committee member from the SDCSA, and five inshore towed gear boats and two SWFPO committee members. (They intended to "determine relevant organisational positions" but these are not specifically identified. No information on what percentage of fishers in the area the sample sizes represent.). They obtained copies of the 1978, 1982, 1984, and 1993 Inshore Potting Agreements, digitised them, and calculated the total area of exclusive use.

degree of participation of knowledge holders in research

1b – interviewees (3 – apparently extensive participation in the formation and maintenance IPA)

aspects of research methods

(i) protocols for permission approached fishers' associations

(ii) how is Fishers' Knowledge used/where is it stored?ND

scope of management activities involving Fishers' Knowledge
IPA: 1,3,5 policy-making and regulating fishery access; co-ordinating the fishery harvest; ensuring the productive capacity of the resource (through maintaining a relatively protected area)
degree of institutionalization of the Integration Project
NA (agreement does not explicitly incorporate Fishers' Knowledge)
language used to describe Fishers' Knowledge
generally: fishers "responded, stated, commented, reported"; less frequently "claimed, felt, expressed an opinion, suggested, recommended, thought, believed"
language used to describe Science and scientists
section in the Discussion on "Fishery Benefits" is mainly biology which compares fishers responses with biological data. "Matter of fact" language used: supported or not supported by scientific evidence e.g. "no published evidence to support this"; "the argument that the IPA does not protect benthic habitats because static gears also cause damage to the seabed is difficult to support."
language used to describe the Integration Project NA
Barriers
Evaluative variables
stakeholder goals
fishers: The agreement is an example where Fishers' Knowledge is incorporated into decision-making (although, ironically, the paper does not demonstrate this well). Interviews showed it was "commonly considered that inter-sector conflict would be worse without the IPA. A typical comment was: "It works 90% of the time. It isn't perfect, but whatever is done isn't going to be perfect."
authors: The authors have accomplished their goals to some extent. They have identified a number of "the perceived and actual benefits of the system for the fishers whom it affects". These are essentially outputs or products of the management system.
additional comments
However, the authors are interested in understanding "the characteristics of the management system" and their potential application elsewhere, which they claim to discuss "in the context of the Fishers' Knowledge that designed them". The authors note the modern context of "increasing pressures of lower catches but higher expectations of earnings and living standards. Because of this, fishers should be commended for the creation and function of the IPA". They then summarize the successful features of the system – 6 of 8 which address aspects of management zones and gear deployment in time and space. They focus considerable attention on technical and quantitative details of changes in surface area of sector zones using GIS and maps.
The final two success features make brief mention of aspects of management, the agreement, and conflict avoidance and are not based on previous discussion in the paper. Additional focus on institutional design and social capital would have revealed much more about the IPA. For example, although they state, "as a voluntary agreement, the IPA is based on goodwill," there appears to be no line of questioning to examine this "goodwill", its social origins, and how it contributed to establishing and maintaining the agreement. Methods - no minutes from meetings!!!, no interview questions targeted to fishers who were alive and participated in the original agreement!
The authors mention and define the term TEK in the introduction (2 of 5 paragraphs). It may be that the authors attempted, perhaps hurriedly, to place their research in the context of the UBC Conference by adding this section, since they never refer to TEK or Fishers' Knowledge explicitly again. The section of the Discussion, "Fishers Benefits" is an attempt to compare or probably validate fishers' responses with reference to the scientific literature, although, again, this is not stated outright.
I address two facets of Fishers' Knowledge here: the paper as a case study and how the authors approached FK; and the FK which was presumably involved in forming and maintaining the IPA (little addressed by the authors).

Camirand, R.; Morin, B.; Savard L.

Historical and current knowledge of the Greenland halibut from Quebec fixed-gear fishers in the Gulf of St. Lawrence

Identification of Paper
by author
Camirand
source (SL or PW)
PW
Context
author type
Ng,Ng,Ng,
case study location
Gulf of St. Lawrence
geographic scale
local
category of knowledge holders
commercial fishers - mainly gillnetters in directed turbot fishery (Greenland halibut, *Reinhardtius hippoglossoides*)
context of Fishers' Knowledge use
fisheries declines
specific context
groundfish fisheries declines including turbot in the Gulf of St. Lawrence in the beginning of the 90s; policy of precautionary approach to management
type of management system; level of governance
government
rationale for Fishers' Knowledge use
lack of available information on fishery and stock dynamics
authors' goals
to use fishers' historical and current knowledge to clarify the factors responsible for the fluctuations in landings in turbot over several decades (whether landings were representative of abundance or were caused by a change in the fishing strategy)
"to compile a qualitative database of information from the fishers and to integrate this information into stock status assessments and to bring a better understanding to past assessments"
Approach
Term used for 'Fishers' Knowledge'
"historical and current knowledge of the fishery"; "information from the fishers"
Term used for knowledge holders
fishers
Fishers' Knowledge definition ND
level of Fishers' Knowledge
level 1, 2 (knowledge of changes in fishing practices and strategies, rules, territories and competition for them, fishers' behaviour)
coded themes
SD, EFFCHAN
theoretical/applied orientation
applied
key issues addressed
..."the description of the relationships between the fishing practices, the prevailing socio-economic context, and the turbot fishing sucess (e.g., landings) is presented for five periods that cover the whole fishery, from the beginning of the 1970s to the end of the 1990s."

"Our approach allowed us to identify the main events associated with the five different landing periods and also to show the *relative importance* of resource abundance and fishing practices in the fishery success and in the landing fluctuations...[Therefore] the variations in landings are not linked exclusively to the abundance of turbot but also to changes in fishing practices and efficiencies that affected the fishing effort".

methods used

"semi-directed individual interviews" (semi-structured) with 21 fishers, approximately two hours in length, taped and transcribed; six had been involved in mid-1970s;
selected in two steps: 1. 55 identified through consultations with fishers' associations and FOC (had to be boat captains and owners and at least 5 years experience in directed fishery for turbot - these were contacted directly); 2. narrowed to 43 with aim of including different age groups and those who showed "interest and openness in being interviewed", then randomly and proportionately drawn from both shores to yield 21; '"ten were fully analyzed for the present study";
information collected [but not presented or mentioned] on four areas: evolution of fishing practices; empirical knowledge of turbot biology and environment, social dimensions such as internal rules governing share and access to fishing grounds and perceptions and interpretation of FOC's science and management
individual fishers' information on fishing practices was placed in chronological order and then merged with other fishers' information

degree of participation of knowledge holders in research

1b - interviewees

aspects of research methods

(i) protocols for permission ND

(ii) how is Fishers' Knowledge used/where is it stored?ND

scope of management activities involving Fishers' Knowledge

A, B (1,2,3,6)

degree of institutionalization of the Integration Project

minimal – research project

language used to describe Fishers' Knowledge

"valuable knowledge…not available elsewhere"
"There are *strong indications* that fishers haul their gillnets less often..."
(descriptive article which details the history of the fishery based on interviews with fishers)

language used to describe Science and scientists

very little specific mention other than in context of fisheries management e.g. determination of Total Allowable Catch, "a stock assessment is performed....";

language used to describe the Integration Project NA

Barriers NA

Evaluative variables

stakeholder goals

authors: now have a better understanding of factors contributing to stock fluctuations and therefore a better understanding of past assessments.

additional comments

They report on 10 of 21 interviews, so it appears to be a work in progress. Even so, there is no information or mention of how this historical information would be integrated into current stock assessments, even though it is a stated specific objective. Information was reportedly also collected on turbot biology and perceptions of FOC management (mentioned in the methods), but not reported upon.

Chiarappa, M.J.

Harvesting an inland sea: folk history, TEK, and the claims of Lake Michigan's commercial fishery

Identification of Paper
by author
Chiarappa
source (SL or PW)
PW
Context
author type
Sa
case study location
Lake Michigan
geographic scale
unclear
category of knowledge holders
unclear
context of Fishers' Knowledge use
policy debate
specific context
Oral history expresses an "...an extensive array of historical perspectives [which]...either go undocumented or are not carefully interpreted in the process of fisheries policy debate". Environmental policy historians have not sufficiently considered TEK and traditional management schemes, and "commercial fishing technology and material culture...when interpreting occupationally-specific resource use values and their ultimate relationship to government policy".
type of management system; level of governance
government
rationale for Fishers' Knowledge use NA
authors' goals
..."to better understand the history and culture that informed each group's fisheries management perspective"
Approach
Term used for 'Fishers' Knowledge'
traditional ecological knowledge, TEK
Term used for knowledge holders
fishers
Fishers' Knowledge definition
Traditional ecological knowledge includes "an understanding of fish behaviour and fishing grounds, the development of technology and shoreside facilities to pursue these species, and the evolution of local management systems."
level of Fishers' Knowledge
level 1,2,and 3
coded themes
ADOUBT, ASUBJ, CONFLICTQ, NEGSOC, POLIQ, FSQ, FVALID, SD, VALUEQ
theoretical/applied orientation
conceptual
key issues addressed
"Of all the groups documented, Lake Michigan's commercial fishers made traditional ecological a principal theme of their oral and folk histories. Specifically, they used the theme of TEK in their oral histories to explain, justify, and claim...[the] fishery as their economic and cultural patrimony."

"…commercial fishers use oral history to invoke TEK's authority…and enlist it in on-going claims over the right to use Lake Michigan's fish".
"In developing new co-management schemes, fisheries managers can use these narratives for their sheer content or they can ethnographically observe their use in various contexts within the commercial fishing community. In either case, our view of Lake Michigan fisheries management and policy will be revised and will embrace far greater criteria; in short, by mapping human sentiment, oral history reminds us that fisheries management and policy is the exercise and expression of values, needs, and ecological relationships."
methods used
two year documentation project - Source material included written documents, information and observation of fishing technology and the cultural landscape, and the collection of oral history through interviews (and implicitly observing conversations, meetings and debates.) "Interviewees were asked to chronicle their lifetime involvement in LM's fisheries and their group's fish management priorities and resource-use values. From these interviews, each group's custodial view of Lake Michigan's fish emerged as their own unique historical perspective – folk histories that justified their claim to the resource."
degree of participation of knowledge holders in research
1b – interviewees
aspects of research methods
(i) protocols for permission ND
(ii) how is Fishers' Knowledge used/where is it stored?ND
scope of management activities involving Fishers' Knowledge NA
degree of institutionalization of the Integration Project NA
language used to describe Fishers' Knowledge
descriptive - a lot of focus on social context of TEK e.g. discusses the "interface between TEK and technology"; "new TEK" as more recent knowledge gained through adapting technologies; "commercial fishers use oral history to invoke TEK's authority"; "inextricable relationship between TEK and folk historical identity"; "multi-faceted occupational and environmental experience"; "old and new TEK"
language used to describe Science and scientists NA
language used to describe the Integration Project NA
Barriers
polarized policy debates
Evaluative variables
stakeholder goals
accomplished
additional comments
The author repeatedly places fishers' discussions of fishing and their knowledge in the context of "competing claims". However, in the one quote in which another "competitor" [my word], Native people, are mentioned, the fisher contextualizes the transfer of that fishery as one more change in a long line of adaptations (mainly technical) which he discusses. All quotations in the paper were descriptions of fishing, boat handling, and/or how fishers learned specifics of fish habitat behaviour and appropriate gear. Several quotes mention that some of this knowledge was passed down, and some of it was newly acquired, given new technologies or exotic species. The only quotation which fits within "policy debate" addresses management in a way which can be read as a plea for improved management based on specific and detailed knowledge. Peter LeClair states:

> The fishery is so up and down it's almost impossible to manage it by sitting at your desk in Madison - saying we have to put quotas on them and we have to do this when they do not even know what's out in that lake or what the biomass really is. Fish and Wildlife go around once a year with their small net and their boat. It is just a waste of time because if you go one week earlier or one week later from when they go, or if you go in a different depth of water, the whole

> project would be turned right around. You can get a ton of smelt and you go out the next day you cannot find one and you're in the same depth of water and same area. So, the current, the water temperature - it all changes and you cannot do this by going around the lake 2 weeks out of the year and say this is what is out in the lake. That's false. It's very, very, very, disturbing when you try to manage a lake off this kind of a data. You just cannot do it and we would like to be part of a research program where we could go and make test drags with our nets... - take the DNR people out there and monitor our catches, study the classes, study the gross factors, study the sex ratios and really know what's going on out on that lake. If you have more forage fish, you have to plan more predator fish. If the forage fish is down you plant less predator fish. If you do thik, you can mantain a perch fishery, maintain a sports fishery and maintain a commercial fishery that produces food for human consumption. This is what this is about.

Furthermore, there was no mention of application of the research results to policy debates or policy formation. The context in which the author places the fishers' quotations does not appear to adequately reflect their perspectives.

Gendron, L.; Camirand, R.; Archambault, J.

Knowledge-sharing between fishers and scientists: towards a better understanding of the status of lobster stocks in the Magdalen Islands

Identification of Paper
by author
Gendron
source (two fisheries texts or other fish and wildlife papers)
SL
Context
author type
Ng,Ng,Sa
case study location
Magdalen Islands, Quebec
geographic scale
local
category of knowledge holders
lobster
context of Fishers' Knowledge use
"climate of mistrust" and "communication gap" between fishers and scientists; regional context of cod collapse and problems with other Atlantic groundfisheries led to creation of Fisheries Resource Conservation Council in 1992 to increase input of fishers
specific context
FOC Quebec and Atlantic region pilot project, Scientific Information and Liaison Strategy, with goals to enhance communication between scientists and fishers; "involve fishers in the stock assessment process by promoting the exchange of knowledge"; increase fisher understanding of scientists' activities and research results; became a long term program in 1993 which has resulted in improved communication between scientists and fishers (ORGVAR)
paper reports on one dimension of a much larger "experimental project" (collaboration between Science Branch of Maurice Lamontagne Institute (FOC) and anthropologists from Laval University) which also considered Fishers' Knowledge of lobster biology and changes in

abundance, their social organization and internal rules for managing the fishing grounds, and their perception of fisheries management
no crisis in the fishery (believed to be a contributing factor to fisher cooperation and support for the research)
type of management system; level of governance
government management
rationale for Fishers' Knowledge use
missing information, improved communication, increase legitimacy of NRM agency, increase fisher participation
authors' goals
"collecting information on traditional and local knowledge and making it available to the biologist in charge of the resource assessment" (information not generally available in order to improve stock assessment)
Approach
Term used for 'Fishers' Knowledge'
traditional and local knowledge]
Fishers' Knowledge definition
not defined
level of Fishers' Knowledge
Level 1 and 2
coded themes
EFFCHAN, IPRQ, CROSSQ, SOCCAP, ORGVAR, EFFICQ
theoretical/applied orientation
applied
key issues addressed (premise of paper, major points made)
fishers explained many dimensions of the evolution of fishing practices, providing context to help explain particular scientific observations (e.g., lobster size and CPUE patterns)
demonstrated that effort was actually increasing: "information on changes in fishing efficiency highlighted that...[this] occurred despite tight regulation of fishing effort...and raises the question of the effectiveness of [effort control]"
project facilitated collective acknowledgement of effort increase thus scientists and fishers better able to agree on stock status and make appropriate conservation measures
methods used
ethnographic approach - semi-structured interviews conducted by one anthropologist and one biologist; taped and transcribed; 220 variables - 50 reported here on fishing gear and practices; 40 people interviewed 37 used (good participation rate); average interview 2 hours
degree of participation of knowledge holders in research
1b
aspects of research methods
(i) protocols for permission ND
(ii) how is it used/where is the TLK 'stored"?
ND (implicitly used and stored by government scientists)
scope of management activities involving Fishers' Knowledge
A,B, 2 stock assessment
degree of institutionalization of the Integration Project
some (may be one-off project but seated within a larger institutional approach)
language used to describe Fishers' Knowledge
"information essential to understanding the evolving fishing strategy"
"This new information provided some background to help explain…"
"In addition to providing solid contextual information on changes in fishing efficiency….[the research also] highlighted two important processes that need to be considered closely by biologists and managers…"
language used to describe Science and scientists

pragmatic references to stock assessment which is considered the central activity – TLK adds information and understanding to this

language used to describe the Integration Project

code 2

sharing of knowledge, collecting

TLK provides context and seems to complement the Science

"collaborative research" – "…fostering recognition of the expertise of all those involved…The involvement of fishers in such projects is varied, ranging from gathering information on their fisheries to sharing with scientists varying amounts of responsibility for operations or decision-making."

Barriers

communication

Evaluative variables

stakeholders' goals

Authors: accomplished goals e.g. "contributed to the successful implementation of stronger conservation measures, to which fishers were very receptive."

social capital was created which they realize will be potentially useful in the future: "We hope that the network of communication and exchange that has been established between scientists and fishers...will be maintained and will be helpful if ever a crisis in this fishery should occur."

Fishers: presumably fishers' benefit by consciously and collectively realizing the increase in effort and the impact it has on the stocks

additional comments

interviewing fishers was an efficient and effective way of obtaining key information which shed light on a number of alternative hypotheses explaining biological indices of lobster - doing so earlier and in other fisheries could save resources (EFFICQ)

collaboration between social and natural scientists led to effort to retain some connection between knowledge and its social context and showed the importance to fisheries management of understanding fishers' behaviour and incentives (e.g. variability in territoriality on North and South of Magdalen Islands)

Glaesel, H., Simonitsch, M.

The discourse of participatory democracy in marine fisheries management

Identification of Paper

by author

Glaesel

source (SL or PW)

PW

Context

author type

ID,F

case study location

New England

geographic scale

regional

category of knowledge holders

various commercial

context of Fishers' Knowledge use

fisheries collapses; U.S. Fisheries Councils

specific context

fishers' participation in Regional Fisheries Councils established under the *Magnuson-Stevens Fishery Conservation and Management Act* (1996)
type of management system; level of governance
regional
rationale for Fishers' Knowledge use
it is implied missing information of an appropriate scale, and which takes into account fishers' incentives and behaviour can contribute to improved management
authors' goals
to include fishermen and local people in fisheries management decision-making and meet conservation and other social and economic objectives (long-term goal is fish stock recovery) - they have a concern with fair and equitable processes
Approach
Term used for 'Fishers' Knowledge'
fishermen's knowledge; fishing knowledge; practical knowledge; local knowledge
Term used for knowledge holders
fishermen; fishers
Fishers' Knowledge definition
skills, intelligence and experience of ordinary working people; understanding of how the "fish harvesting business works"
level of Fishers' Knowledge
Level 1,2,3 (also discuss ethical principles)
coded themes
AHK, ACOMPLEXQ, ADOUBT, CONFLICTQ, NEGSOC, SD, FSQ, APARTQ, BUREAUQ (representation, inertia, centralized management and scale), MONEYQ, CROSSQ, VALUEQ, INTQ, CONFM, INDIVQ (note the influence of "strong personalities in the system")
theoretical/applied orientation
theoretical
key issues addressed
Authors identify a key reason for fisheries failure of the New England coast as conflict between fishers and regulators, generated by lack of authentic fisher participation (including their knowledge) in decision-making. These must be formally institutionalized into management processes. Currently, the "fisheries governance system…only permits symbolic use of Fishers' Knowledge".
They mention the non-governmental organization Northwest Atlantic Marine Alliance, NAMA, with diverse multi-state membership, a "self-governing constitution" involving a set of ethical principles and the idea of nested governance institutions. "Members work to develop connected, self-governing community-based organizations…to protect and promote individual rights and responsibilities and the sustainability of common property resources."
Ways to incorporate fishers and their knowledge include: "fisher-run workshops for state employees, to swapping a day at work periodically with someone in another area of fisheries management, to establishing centers for indigenous fisheries knowledge, and formally reconstituting the management process with internal mechanisms that decentralize authority and create authentic participatory roles for fishers and all other interested parties."
methods used
The paper presents a perspective and discussion which draws on the authors' experiences - Glaesel from "library research and dozens of semi-formal interviews wtih stakeholders from various levels of authority in fisheries management" from 2000-2001 and Simonitsch from 35 years of fishing experience in New England and involvement in fishing co-operatives in many countries. They review and analyze Regional Fisheries Councils drawing in particular on the New England example (I do not examine their Kenya case) and briefly touch on more participatory government management examples to illustrate their perspectives.
degree of participation of knowledge holders in research
minimal (authors' assessment)

aspects of research methods
(i) protocols for permission ND
(ii) how is Fishers' Knowledge used/where is it stored?ND
scope of management activities involving Fishers' Knowledge NA
degree of institutionalization of the Integration Project
negligible
language used to describe Fishers' Knowledge
"fishing knowledge is history"
"…the expert rule makers had been devising plans that lacked an understanding of what made the fish harvesting business actually work. The various rules and regulations were, to a large degree, an abstraction and failed to include recognition of the resourcefulness and competitive nature of fishing, the marketplace, and fishing people."
language used to describe Science and scientists
"strong societal belief in the abilities of scientists and professional managers"
"Scientists are most comfortable with knowledge that is the product of controlled experiments that can be repeated."
language used to describe the Integration Project
needs to be authentically participatory
Barriers
institutional barriers include governance and bureaucratic structures which limit participation; societal beliefs about Science and technology
Evaluative variables
stakeholder goals NA
additional comments
Methods were not elaborated upon and it was not possible to distinguish authors' opinions from interviews or from literature.

Gosse, K., Wroblewski, J., Neis, B.

Closing the loop: commercial fish harvesters' local ecological knowledge and science in a study of coastal cod in Newfoundland and Labrador, Canada

Identification of Paper
by author
Gosse
source (SL or PW)
PW
Context
author type
Na, Ng, Sa
case study location
Newfoundland
geographic scale
local
category of knowledge holders
inshore fishers
context of Fishers' Knowledge use
fisheries failures
specific context
part of Coasts Under Stress project - a project to examine changes in the human and environmental health of coastal environments

type of management system; level of governance
government management
rationale for Fishers' Knowledge use
lack of information available for science; involve fishers
authors' goals
to work together with harvesters "to provide a more detailed assessment of stock structure to be used in management decisions"; "to use a combination of LEK and science to identify locations...where coastal populations of Atlantic cod exist or may have existed..."; interviews specifically aimed to "create a baseline of information from which to generate further questions and research objectives"; to achieve a "flow of information" between fishers and harvesters
"This paper outlines a framework for how LEK and science can be combined to produce effective knowledge about fisheries and fish ecology."
Approach
Term used for 'Fishers' Knowledge'
local ecological knowledge (LEK), knowledge as "experience and observations"
Term used for knowledge holders
fishers or local experts
Fishers' Knowledge definition
implicit: observations or information which can be used for scientific hypothesis testing; continuous observations within small local fishing areas (Fisher 2000); "facts obtained through firsthand experience during years of observation while fishing"
level of Fishers' Knowledge
Level 1
coded themes
DUALQ, LOCALQ, VALIDQ, HP, FSQ, MONEYQ, TX, NSD
theoretical/applied orientation
both applied and theoretical
key issues addressed
The authors acknowledge the value of Fishers' Knowledge in informing hypotheses or research questions since previously no scientific research had identified colour as a potential indicator of stock structure in Newfoundland. In this case LEK regarding colour and existence of inshore stocks is concentrated upon and a colour experiment is designed by scientists to test some aspects of diet and fish colouration. Science is seen as the basis for determining validity of knowledge because it involves testing hypotheses with field work or experiments - this is the closing of the induction-deduction loop of knowledge referred to in the title. LEK is seen to lack the means to validate knowledge, thus Science provides "a more complete understanding of nature."
"[LEK] of brown cod, when integrated with a formal scientific study of cod coloration, can play an important role in the identification of local stocks of cod."
methods used
tape-recorded interviews of 26 retired fishermen about location and history of inshore cod; fishers were shown pictures of different colour cod and asked questions about cod spawning and migration patterns; diet experiments involving offshore and Gilbert Bay cod
degree of participation of knowledge holders in research
1b – interviewees "plus"
The color change experiment appears to be the product of a "joint research team". Fishers' involvement includes (but may not have been limited to) setting up holding pens; pointing out places to catch fish for experiments; and "providing helpful advice and comments".
"The project is not to just take knowledge and run away with it. Coasts Under Stress is organized in such a way that we work continuously with the people, have meetings and tell them what we found."
aspects of research methods
(i) protocols for permission ND

(ii) how is Fishers' Knowledge used/where is it stored?ND
scope of management activities involving Fishers' Knowledge
A (2) 5
degree of institutionalization of the Integration Project
some degree - research is part of a multi-year project and the identification of an MPA indicates that longer term relationships will continue
language used to describe Fishers' Knowledge
a "wealth of information that is often not readily available to science"
"the detailed observations...they aquire are highly valuable to science. This knowledge *has* [emphasis mine] to be blended with..." (see also below)
language used to describe Science and scientists (see next variable)
language used to describe the Integration Project
In the introduction of the paper the following is noted: "The strength of fish harvesters knowledge lies in their years and sometimes generations of continuous interaction with local environments, whereby they acquire a wealth of information that is often not readily available to science. The strength of science lies in the rigorous procedures that allow scientists to test some of the assumptions found in harvesters' knowledge and the validity of their interpretations….[A] potentially more fruitful approach [than the "extraction" approach' involves scientists and fishers working together in participatory research projects (Fisher 2000). Joint research teams combine LEK and scientific knowledge…"
The paper concludes with the assertion that LEK "*has to be blended* with scientifically rigorous forms of research that close the induction-deduction loop, providing a more complete understanding of nature." [emphasis mine]
Barriers
LEK is not Science
Evaluative variables
stakeholder goals
Fishers: There does appear to be enhanced communication between fishers and scientists, and fishers desire to make decisions based on outcomes of "joint research" seem to be heeded, since Gilbert Bay was put forward by them as an MPA. This indicates some level of empowerment.
Authors: The authors acknowledge the value of Fishers' Knowledge in informing hypotheses or research questions; achieve some (minimal) level of collaboration with fishers
additional comments
The colour experiment isolated one variable, colour, whereas Fishers' Knowledge was actually based (but not understood or acknowledged to be) on a number of factors in determining the presence of a local stock (see Section 7.1.4): colour, migration patterns, time of year caught and geographical location. The authors showed that brown cod *can* change color if fed a different diet, thus diet affects coloration. Therefore, *if* brown cod were to move offshore they would change color. However, this result does not change the fact that the brown cod have a particular life history which is linked to their feeding, depth, etcetera. The authors note: "Our research suggests two hypotheses: 1) brown cod represent offshore cod that came into the bays in spring/summer, feed on carotenoid-rich inverts and turn brown [it is possible that *some* do, but but fishers knew that some brown cod stayed all year from trap catches]; 2) brown cod represent cod that remain in the bays year round, feeding predominantly on carotenoid rich benthic invertebrates. Then they discuss scientific literature on cod behaviour, specifically that offshore cod follow in capelin during the spring and feed almost exclusively on it, which supports their second hypothesis. However, fishers also know this. What fishers might not have known was the dietary *mechanism* for the more reddish brown coloration (invertebrates).

Hutchings, J.; Ferguson, M.

***Links between Fishers' Knowledge, fisheries science, and management: Newfoundland's inshore fishery for Northern Atlantic cod,* Gadus morhua**

Identification of Paper
by author
Hutchings
source (SL or PW)
SL
Context
author type
Na,Si
case study location
south east Newfoundland
geographic scale
local
category of knowledge holders
inshore fixed gear fishers
context of Fishers' Knowledge use
collapse of the northern cod
specific context
post-moratorium investigation of the fishery
type of management system; level of governance
government management
rationale for Fishers' Knowledge use
missing information
authors' goals
"to describe temporal changes in catch rate and fishing effort for the inshore sector of the northern cod fishery" implicitly in order to better understand how and why the northern cod collapsed
to ask fishers for their suggestions about "conservation and means of achieving sustainable fisheries" (implicit)
Approach
Term used for 'Fishers' Knowledge'
Fishers' Knowledge; fishers' local knowledge
Term used for knowledge holders
fishers
Fishers' Knowledge definition and characteristics
ND
level of Fishers' Knowledge
1, 2 (employment of gear is fisher behaviour – exceptional example because no other social aspects investigated – amount of gear treated quantitatively)
coded themes
FSQ, HP, EFFCHAN
theoretical/applied orientation
applied
key issues addressed
given absence of data on fishing effort and temporal and spatial changes in fisheries, they documented declining catch rates between 1980 and 1991, and changes in gear design over a longer period

increases in numbers of nets and traps deployed were accompanied by reduced mesh sizes and by increased use of a variety of trap designs – this was necessary for fishers to "maintain or to slow the rate of decline of their catch rates"
data were "consistent with the hypothesis that the collapse…was neither sudden nor precipitous"
"fishers expressed support for (1) gear restrictions in the inshore and offshore fishery, (2) introduction of individual quotas, (3) banning of fishing during the spawning period of cod, and (4) increased monitoring and enforcement of fishery regulations"
methods used
structured interviews with 47 inshore fishers; "random sampling of fishermen was precluded by the lack of an accurate list of fulltime fishermen...and high rates of non-participation among potential interviewees;" selected from a Fish, Food and Allied Workers' Union list supplemented by "snowball" sampling (interviewees suggest others); future suggestions came from 15 inshore fishers and 6 trawlermen
degree of participation of knowledge holders
1b
aspects of research methods
(i) protocols for permission individually signed release forms guaranteeing anonymity
(ii) how is Fishers' Knowledge used/where is it stored?ND
scope of management activities involving Fishers' Knowledge
A fisheries research (2)
degree of institutionalization of the Integration Project
none
language used to describe Fishers' Knowledge
"local knowledge…could be applied to elements of fisheries science"
"The data we have compiled from interviews with fishers contribute to our knowledge...";
"an important role for fishers' opinions and recommendations, most of which can be said to be based on local knowledge, in matters pertaining to fisheries management"
language used to describe Science and scientists
Science as hypothesis testing
clear distinction between fisheries science and fisheries management
language used to describe the Integration Project
code 2
"We are persuaded that there is considerable value in linking fishers' local knowledge with fisheries science, notably stock assessment, and fisheries management."
"The ultimate value of fishers' local knowledge to fisheries science rests on its ability to generate testable hypotheses about the behaviour and ecology of fishes…and on its ability to provide measurable data on stock status."
Barriers
that "individual resolve and institutional commitment" are needed to apply Fishers' Knowledge indicates barriers which are not named
conceptualization of Science may limit how Fishers' Knowledge can contribute (CS)
Evaluative variables
stakeholder goals
additional comments
Regarding the broader goal of sustainable fisheries, they unfortunately do not comment on how data such as they collected on effort changes might actually be incorporated into stock assessment models.

Lessard, J., Osborne, J., Lauzier, R., Jamieson, G., Harbo, R.

Applying local and scientific knowledge to the establishment of a sustainable fishery: the West Coast of Vancouver Island goose barnacle fishery experience

Identification of Paper
by author
Lessard
source (SL or UBC)
UBC
Context
author type
Ng, IDi (1 First Nation-employed fisheries scientists - multidisciplinary Masters degree), Ng, Ng, Ng,
case study location
West Coast of Vancouver Island (WCVI)
geographic scale
local
category of knowledge holders
commercial and First Nations fishers - small scale
context of Fishers' Knowledge use
fishery closed due to concern about lack of information and potential overfishing
specific context
FOC policy context regarding new and developing fisheries - ecosystem-based management and precautionary approach must be used; phased approach to data collection and fishery development in order to re-open fisheries.
Invertebrate fisheries in BC have long had user involvement in stock assessment and management. Participation in stock assessment includes helping to select the general locations of surveys and provide logistic and personnel support for them; fishers may also advise in setting quotas for some fisheries.
Gooseneck Barnacle Working Group (GBWG) operates under the guidelines of a joint policy framework to establish area-based management in the Nuu-chah-nulth Tribal Council (NTC)/WCVI area.
type of management system; level of governance
government management
rationale for Fishers' Knowledge use
missing information
authors' goals
to gather and use harvesters' knowledge on goose barnacles and to apply it within the context of the new and developing fisheries framework (within longer term contexts of fishers' participation); immediate goal: obtain a total harvestable biomass estimate
Approach
term used for 'Fishers' Knowledge'
local knowledge; harvesters' knowledge; traditional knowledge; historical, traditional, and anecdotal information
term used for knowledge holders
harvesters
Fishers' Knowledge definition ND
level of Fishers' Knowledge
Level 1 and 2 (there were informal rules on who was allowed to harvest and where; knowledge on when and how to harvest, "Harvesters' knowledge has also provided insight into why previous management strategies and license conditions, such as catch reporting, were not successful")
coded themes

VALIDQ, FSQ, CROSSQ, EFFICQ, APARTQ, TX, SUPQ, ORGVAR (degree of participation in invertebrate management)
theoretical/applied orientation
applied
key issues addressed
"Harvesters are playing an active role in the development of assessment and management frameworks for a sustainable fishery…"
"Harvesters provided previously unreported information about the locations of …populations, food fishing areas, and harvesting practices…[which] has been used in developing currently on-going stock assessment and [other] studies and determining experimental harvesting sites. Harvesters' knowledge has also provided insight into why previous management strategies and license conditions, such as catch reporting, were not successful."
methods used
informally interviewed 21 harvesters by phone or through the GBWG (Josie Osborne of NTC)
degree of participation of knowledge holders
2
specific survey sites were selected with help from harvesters (mixed survey crews - 2 FOC and 2 harvesters); field data sheets modified given harvester input; experimental harvest plans for following year changed with harvester input
broader context of invertebrate stock assessment: LEK enters in helping to select the general locations of surveys; advice in setting quotas for some fisheries; intention is that harvesters would eventually assist in developing management strategies when fishery reopened (Lauzier 1999)
aspects of research methods
(i) protocols for permission ND
(ii) how is it used/where is the Fishers' Knowledge 'stored"?
fishing locations digitized in GIS - implicitly stored with FOC
scope of management activities involving Fishers' Knowledge
A 1,2,5
degree of institutionalization of the Integration Project
some - ongoing because of GBWG and its operation within joint policy framework on area management for NTC/WCVI
language used to describe Fishers' Knowledge/attitudes conveyed
"Anecdotal data used in this study is the result of long-term (years and generations) personal observations."
language used to describe Science and scientists
"Experimental survey design and statistical analysis are concepts that are difficult to explain and justify to people with no formal scientific training." (see next variable)
language used to describe the Integration Project
2 (mixture)
"knowledge…was gathered and used…in the new and developing fisheries framework."
"How both harvesters' knowledge and scientific knowledge are being incorporated in the development of a sustainable goose barnacle fishery is discussed."
"Lauzier (1999) recommended the mandatory participation of trained harvesters to collect data for stock assessment, including on-going surveys and gathering of biological information. Such involvement would give harvesters some understanding of the requirements to collect scientifically rigorous information, and allow FOC the opportunity to incorporate and confirm historical, traditional, and anecdotal information. Harvesters...would assist in developing management strategies."
Barriers
Evaluative
stakeholder goals
authors/fishers: improved communication: two way flow of information between harvesters and researchers

increased harvester cooperation with FOC and this is directly attributed to fishers' participation in the work (see above) and "soliciting and *seriously considering* [my emphasis] their advice"
"with improved working relationships, common short-term and long-term goals have been established. The GBWG is expected to continue to have a significant role in defining who will participate in any future commercial fishery...[and] influence the development of the final management strategy."
additional comments
1. The immediate goal of scientists to determine the total harvestable biomass estimate may be "diverging" with fishers' goals, because fishers have clear ideas of which *areas* are harvestable and these are the areas that need to be managed sustainably - they are therefore interested in seeing research and experimental harvests which focus on these areas, and the idea of "total harvestable biomass" is not relevant to them. In fact this is a higher level clash of goals where scientists may need to rethink what the *goals* of the fishery are and *whether and how their scientific research fits in with them* (since scientific stock assessment methods can be applied to subpopulations as well). Thus the following comment apears to miss the point: "Experimental survey design and statistical analysis are concepts that are difficult to explain and justify to people with no formal scientific training. The immediate goals of science staff and harvesters appeared to diverge..." They may diverge, but perhaps not because fishers do not understand statistics.
2. Harvesters turned out to be having less impact than FOC thought. "First Nations harvesters have long thought that harvesting improved the productivity of goose barnacles at particular locations. Initially this information *seemed to conflict* [it did conflict] with information gathered from the scientific literature and the results of past scientific experiments (see Austin 1987). Science staff *assumed* that recruitment and recovery mechanisms were driven mainly by [external] processes... [but] quickly realized [otherwise]." The authors then explain the probable biological mechanisms for First Nations' knowledge. This is a good example of how scientists advance their understanding rapidly based on TLK: "One of the lessons learned in this study is that a large amount of anecdotal information provided tendencies and directions that would have taken years to assimilate in a scientific study."

Lydon, G.; Langley A.D.

How local Fishers' Knowledge improves the management of fisheries in New Zealand - a seafood industry perspective

Identification of Paper
by author
Lydon
source (SL or PW)
Context
author type
SeaFic's Science officer (unknown background), Ni
case study location
northern North Island, New Zealand
geographic scale
local
category of knowledge holders
longliners
context of Fishers' Knowledge use
"one of the objectives of the present Government is to involve stakeholders in the management framework"
"a vision of increased stakeholder responsibility for fisheries management as set out in Fisheries Act 1996"

specific context
SeaFIC is the NZ Seafood Industry Council: "One of the main conduits of Fishers' Knowledge" - formed in 1997 to "represent fishers' generic interests"; "a partnership between fishers and their representatives"; "company owned by 20 shareholders and managed by a Board of Directors elected by a majority of industry interests." Shareholders each "represent a particular sector of the seafood industry", "collectively representing over 90% of the industry by value". "A majority of the fishing industry recently voted to fund SeaFIC by a compulsory levy collected on all fish landed and processed." Adaptive Management Programme (AMP) introduced by Ministry of Fisheries in 1991 as a tool to vary TACs for stocks with limited information on stock size. "The AMP is an integrated research programme which uses "fisher power" to obtain some of the scientific information. Once TACs are changed, monitoring follows, and can include: trawl surveys, analysis of catch and effort data, fishers' logbooks, and catch sampling. Annual reviews assess results. The AMP places "emphasis on gaining useful information and improving the management of the fish stock." The incentive for industry is to increase quota and to face a "reversal of the TACC [commercial catch] and loss of credibility" if they do not fulfill their commitments within the AMP.
type of management system; level of governance
unclear – a type of co-management: seafood industry pays for both fisheries management and research; government regulates
rationale for Fishers' Knowledge use
insufficient information on stocks; increase fisher involvement in management
authors' goals
"One of the ongoing success stories of the Adaptive Management Programme is the bluenose [*Hyperoglyphe antarctica* from Quota Management Area 1, BNS 1] fishery, presented here as a case study of how local Fishers' Knowledge and dedication improves the management of fisheries in NZ.
Approach
Term used for 'Fishers' Knowledge'
Fishers' Knowledge
Term used for knowledge holders
fishers
Fishers' Knowledge definition ND
level of Fishers' Knowledge
Level 1, 2 (knowledge of fishers' behaviour)
coded themes
SOCCAP, CROSSQ, BUREAUQ (REPQ), APARTQ, EFFICQ, FVALID, INDIVQ
theoretical/applied orientation
applied
key issues addressed
project: 1996 - SeaFIC proposed that BNS 1 fish stock be included within the AMP, with the intent of increasing the understanding of the biology of bluenose, determining the geographical extent of the species, and estimating the long-term sustainable yield for the stock. The programme involved an increase in the level of monitoring of the BNS 1 fishery in conjunction with an increase in the TACC from 705 to 1000 t."
"By being actively involved in the design, implementation and interpretation of the results of the logbook programme, local fishers have guided the project with their knowledge and experience." They note that fishers are able to place the fishery in a historical perspective and point out effects of changes in technology on catchability etc. as well as explain fishers' behaviour in response to various factors, thus, improved information improves stock assessments.
methods used
Fishers' Knowledge was not specifically gathered here - it seems to emerge in industry and management discussions, but the authors are vague about this. "Fishers' Knowledge and practical ability has been an important component of the annual review of information collected

for the BNS 1 stock assessment. The participation of fishers, particularly in the programme design and initial discussions has enabled the AMP to be put into the context of the commercial fishery, including its operational constraints." The authors then list a number of areas in which fishers have knowledge (e.g. what factors influence their fishing behaviour) but they do not elaborate on how this knowledge is actually used to contribute to the stock assessments (e.g. interpret CPUE) or guide the AMP. It appears to potentially enter in meetings of the two industry stakeholder groups.
"use sole-operator fishermen on the smaller vessels or crew members where they are available to sample the biological characteristics of their own catch while actively fishing" - 10 fish sampled for sex, size, etc. "routinely and frequently" - logbooks on most vessels: catch, effort, location. "Analysis of logbook data has enabled a confirmation of trends in CPUE derived from the statutory reporting data nad has enabled trends in fishing activity to be examined in more detail."
degree of participation of knowledge holders in research
intermediate (see 'additional comments' below)
aspects of research methods
(i) protocols for permission ND
(ii) how is Fishers' Knowledge used/where is it stored?ND
scope of management activities involving Fishers' Knowledge
A 2
degree of institutionalization of the Integration Project
some degree – through logbooks and fishers' potential input in meetings
language used to describe Fishers' Knowledge
positive, supportive, e.g. lists "a knowledge of their environment that could never be gained in a classroom or by statistical analysis"
"the skills, knowledge and expertise of local fishers in NZ has a recognized and important role in management decisions..."
language used to describe Science and scientists
"credible scientific research"
language used to describe the Integration Project
3
"the skills, knowledge and expertise of local fishers in NZ has a recognized and important role in management decisions..."
"By being actively involved in the design, implementation and interpretation of the results of the logbook programme, local fishers have guided the project with their knowledge and experience."
Barriers
authors imply that representation in a larger bureaucratic organization may be a barrier
Evaluative variables
stakeholder goals
"Local Fishers' Knowledge is crucial to this process [of increasing stakeholder responsibility, the direction of FM in NZ] and is provided by representation, participation in data collection and invesment in credible scientific research."
additional comments
The goal of the paper was to show "how local Fishers' Knowledge and dedication improves the management of fisheries in NZ". However, they have demonstrated how fisher participation in data gathering can contribute to improving databases available for stock assessment. The emphasis of the article is on fishers' collection of logbook data and sampling of catch. In this capacity they are essentially acting as technicians, even though where they are fishing and how much they catch are both products of their knowledge and choices. The article is vague about how other aspects of fishers knowledge (e.g., on the behaviour of fish, fishers, environmental factors, changes in catchability related to technology) enter stock assessment, although they allegedly do. One of the aims of the case was to improve understanding of bluenose biology but again, Fishers' Knowledge of this is not mentioned. How fishers *participate in decision-making* is not explained, other than fishers' invited attendance to speak at stock assessment meetings

which may impact their fisheries. However, their comments on the bureaucratic aspects of one of the two stakeholder organizations as well as the scientific jargon at these meetings implies that they are not accessible to many fishers (see Glaesel and Simonitsch 2003). (It would be interesting to know whether a cross-section of fishers feel sufficiently represented by SeaFIC and whether they feel their knowledge enters decision-making).

MacNab, P.

Drawing from experience: harvester mapping of fishing grounds in Bonavista Bay, Newfoundland

Identification of Paper
by author
MacNab
source
SL
Context
author type
IDgF
case study location
Bonavista Bay, Newfoundland
geographic scale
local
category of knowledge holders
inshore fishers
context of Fishers' Knowledge use
fisheries collapse or decline (cod moratorium; lobster decline)
specific context
Parks Canada's interest in marine conservation initiatives in Bonavista Bay; research described "evolved over three years (1994-97) during several work terms with Parks Canada"
lack of biophysical and human activity data
"reaction to industry demands that government managers and conservation agencies acknowledge and incorporate local knowledge"
type of management system; level of governance
government management
rationale for Fishers' Knowledge use
missing information (for protected area planning)
authors' goals
initial goal: to use fishers knowledge "to provide valuable information about sensitive areas and thus help to guide further scientific investigations and conservation planning efforts" (government initiatives) then evolved towards supporting and facilitating:
the committee's: to create "harvest area maps for their own deliberations and in dealings with outside agencies"
Approach
term used for 'Fishers' Knowledge'
local knowledge
term used for knowledge holders
harvesters
Fishers' Knowledge definition
ND
level of Fishers' Knowledge
1 and 2

coded themes
EMBEDQ, INTQ, AHK, IPRQ PROTOCOLQ, ADUALQ, ADOUBTQ, SOCCAP, SOCLEARN, APARTQ, COMPLEXQ, VALIDQ
theoretical/applied orientation
both
key issues addressed
collaborative project (6 agencies including 4 government agencies) to map local fisheries knowledge but fishers control the process and own the resultant maps – evolved into a community-based project
maps lend credibility to Fishers' Knowledge
Fishers' Knowledge can be mapped for use by themselves in their interactions with management agencies and can be useful in coastal zone management and park planning activities undertaken by agencies
funding and capacity are important for success
see also Barriers below
methods used
series of community meetings; then project approved by the Eastport Peninsula Inshore Fishermen's Committee; individuals and small groups ("built-in peer review") created mylar thematic overlays; author facilitated; fishers created them, and had opportunity to review and correct them; strived for relaxed rapport; they are the owners of the maps and GIS database and decide how to use in discussion with outside agencies
degree of participation of knowledge holders in research
3
aspects of research methods
(i) protocols for permission
sought project approval from Easport Peninsula Inshore Fishermens' Committee
(ii) how is Fishers' Knowledge used/where is it stored?
Committee owns maps – protected in a user agreement
scope of management activities involving Fishers' Knowledge
A, B (this mapping was both fisheries biological and social research)
degree of institutionalization of the Integration Project
some level – unclear: project's main partner is a committee of fishers (presumably ongoing), draft maps produced but project's fate unclear
language used to describe Fishers' Knowledge
"Clearly, local knowledge - spatial, biological, technical, ecological, and historical – continues to inform the cognitive basis of inshore fishing."
"Local knowledge is often dismissed as being qualitative and unscientific…" ADOUBTQ With increasingly sophisticated technologies used in fishing, "the potential for verifying local knowledge against reality and for continued documentation is unlimited."
..."on the water, fishers were clearly the specialists possessed of their own unique brand of expertise."
"What often goes missing in such broad calls, however, are the challenges of collection, veracity, analysis, application and ultimately, ownership. Many writers suggest that local knowledge should be integrated or somehow blended with scientific forms of knowledge after collection and careful evaluation by "outsiders" (e.g., DeWalt 1994; Murdoch and Clarke 1994; Maquire et al. 1995). Others argue that local knowledge is developed and transmitted *in situ*, and therefore must be captured and applied by people that live "inside" the socio-cultural setting where it has evolved (e.g. Agrawal 1995; Heyd 1995; Poole 1995; Chambers 1997). Is it really a "black and white" case of one way or another? Is there not some middle ground that could accommodate both of these perspectives?"
languaged used to describe Science and scientists
"…a positivist conservation paradigm that "gives credibility to opinion only when it is defined in scientific language" (Pimbert and Pretty 1995: 8)"

"Geomatics…provides a more technical and precise if not more "scientific" means of capturing the spatial components of local knowledge."
language used to describe the Integration Project
code 4
collaborative, participatory
"The inventory was presented not as an extractive government exercise or an impersonal academic survey, but as a way for fishers to communicate their knowledge".
community-based local management and conservation using local and other knowledge - collaborators assist where needed
Barriers
(surmounting them in brackets)
local knowledge implicitly lacks "authority" (mapping helps it to "assume far more") AHK
..."if the information flow is only in one direction - knowledge extracted for use by outsiders - communities will most certainly be reluctant to contribute."
cross-cultural communication
in interviewing and facilitating mapping (use local people to act as facilitators)
communities attempts to collect and communicate their results given "limited access to government information and limited experience with acceptable documentation procedures" (help from academic and NGO's in capacity building) CROSSQ
"funding, academic commitment, reporting deadlines, technical glitches... limited the final outcomes of the exercise" (importance of senior-level interest, funding support and staff commitments from one or more organizations including government; use both funding and in-kind donations) MONEYQ
trust between stakeholders (open and honest communication and formal agreements) SOCCAP
concerns of secrecy and ownership of information, suspicion of government (help from other collaborators, protect and control access to knowledge through user agreements IPRQ PROTOCOLQ
implicit barrier is top-down management (project implicitly addresses power in terms of participatory mapping methods: support and reinforce traditional stewardship activities, community control over management and knowledge with collaboration of other agencies and organizations)
Evaluative variables
stakeholder goals
fishers: "Eastport fishers have used these maps...with scientists and managers to help establish lobster closures and to define community boundaries."
government: "Potential applications in coastal zone management such as oilspill planning and aquaculture siting have been identified by government agencies."
additional comments

Maurstad, A.

"Trapped in biology" - an interdisciplinary attempt to integrate Fishers' Knowledge into Norwegian fisheries management

Identification of Paper
by author
Maurstad
source
SL
Context
author type
SaF

case study location
coastal Norway
geographic scale
local
category of knowledge holders
inshore fishers
context of Fishers' Knowledge use
fisheries decline
specific context
research follows after "the cod crisis of the 1980s"
biologist Jan Sundet involved with "program to assess Norwegian coastal resources" initiated in 1991; he and Maurstad organize a seminar on Fishers' Knowledge and its benefits for scientific research, attended by 30 researchers; related research program funded by Man and Biosphere Program; Sundet's project funded on using Fishers' Knowledge in stock assessments and Maurstad is initially research assistant then research partner (with her own funding) in an interdisciplinary collaboration on which the paper reports and reflects
type of management system; level of governance
government management
rationale for Fishers' Knowledge use
missing information; "increase the legitimacy of resource management institutions"
authors' goals
teams' goals initially: "search for knowledge on local stock biology, explore what 'Fishers' Knowledge' was, and particularly how it was grounded in fishing;" and explore "methodological aspects of interdisciplinary work" ("Joining forces...implied negotiating a common approach to understanding Fishers' Knowledge.")
Sundet's goals:
1. "augment existing scientific data" for stock assessment purposes (collect information on local stock biology)
2. "discuss results from ongoing coastal scientific research program with the fishers"
a) specifically if abundance estimates "sounded reasonable"
b) "learn more about distribution of species in space and time - information that would be costly to obtain using traditional means" (MONEYQ EFFICQ)
3. "increase the legitimacy of scientists among fishers through personal contact"
Maurstad's goals:
1. provide a richer understanding of how knowledge (including biological) is socially embedded
2. "ensure fishers and their knowledge are treated with respect"
3. explore what Fishers' Knowledge was, and particularly how it was grounded in fishing (both the practice of fishing and the culture in which it occurs, realizing there is a relationship between the two)
Approach
Term used for 'Fishers' Knowledge'
Fishers' Knowledge
Fishers' Knowledge definition
not defined
level of Fishers' Knowledge examined
originally level 1 and 2, then narrowed to level 1
coded themes
EMBEDQ, ESCI, INTQ, METHODQ, COMPLEXQ, AHK, DUALQ (intuition, oral, etc.) ADOUBT, IPRQ, ETHIQ, SOCCAP, TRAINQ, CROSSQ, FSQ, REFLQ, fisher variability in knowledge
theoretical/applied orientation
both
key issues addressed

challenges of interdisciplinary research – written in the 'reflective voice' - she is both subjective in recounting her experience of the project and attempts to be objective in also presenting Sundet's side and their interdisciplinary process of learning (REFLQ)
natural scientists can be disparaging of TLK (DOUBTQ)
had arguments related to their being from different disciplines - Sundet felt interviews were not structured enough to get the biological data given issues of timing and his goals and Maurstad was pleased with the information
"I think three factors made us continue with the research: 1) my dual identity as a researcher and a fisher; 2) our friendship (SOCCAP); and 3) our professional interest in the research - in that order..." Changed their approach to focus on biology and "local activity"; "structured the professional space by dividing the interview time" and developing signals to take turns and to pursue important leads.
Maps "revealed 44 spawning places for coastal cod in the county of Finnmark...imply[ing] 44 different stocks. Previous scientific knowledge had anticipated the existence of only 5 or 6 local stocks."
other key issues are quoted throughout this summary
methods used
initially somewhat open, unstructured;
to select interviewees, they: used information from public records; asked local fishing administrators as well as fishers for advice; preferred those suggested by all 3 sources but also chose unnamed fishers "to avoid the caveats of snowball-sampling, i.e. accessing a group of similar opinions or statuses." Sampled to get a range of age, activity and vessel type. Generally interviewed in fishers' homes.
degree of participation of knowledge holders in research
2 - interviewed
aspects of research methods
(i) protocols for permission ND
(ii) how is Fishers' Knowledge used/where is it stored?ND
scope of management activities involving Fishers' Knowledge
A,B, 2. stock assessment
degree of institutionalization of the Integration Project
none
language used to describe Fishers' Knowledge
"treat Fishers' Knowledge with *appropriate respect.*"
"My other role was to protect their knowledge against abuse by scientists." (see below)
language used to describe Science and scientists
"As a Northerner and a former fisher, I had been insulted by the way the marine biologist at the workshop treated my culture...find[ing] low precision in certain knowledge areas, and conclud[ing] that my cultural knowedge was of little value." ("His evidence for this claim was the lack of precision in the north Norwegian taxonomy for birds where all small birds are commonly labelled *Titting*.") In terms of cod, ..."it is science that lacks detailed taxonomic knowledge."
"my experiences from fishing and science told me that it could be dangerous for fishers to "let biologists out there alone" and here was my biologist fulfilling my worst expectations of a biologist's approach to Fishers' Knowledge!"
"It was the biologists who had the "red phone-line" to the conventional procedures of management. As a social scientist, my line had never been installed...I thought that using the biological knowledge of fishers and mailing it through Sundet was a smart way of convincing other biologists and managers."
"[Maps] would be a representation of Fishers' Knowledge that they [biologists] could relate to easily."
.."a strictly biological approach to translating Fishers' Knowledge into science has weaknesses...[as does] a strictly social scientific approach. Sundet was right when he said:

"Some things are true." As a social scientist with a constructionist perspective on the world this is hard to grasp."
language used to describe the Integration Project
code 2
collect, interview, gather
"[we] began discussing the potential benefits for scientific research of interdisciplinary work drawing on Fishers' Knowledge"
"integration of Fishers' Knowledge into management"
"opening up management to Fishers' Knowledge, as is our goal..."
"My worry is...when we, the researchers decide *what* parts of Fishers' Knowledge are interesting, I would say that fishers...[are] the *research assistants...*One risk [in focusing on biological knowledge only] is that instead of learning..., we will teach them more about what is *proper knowledge*...[Then] we are in danger of limiting the opportunities of ever finding answers to biological and management questions beyond the scientific paradigm we already know." AHK ETHIQ CONFM
Barriers
complexities of TLK which require particular methodological consideration e.g. intellectual property and fisher variability COMPLEXQ
"the problem of combining very different knowledge systems" of TLK and Science - lists some of the typical differences DUALQ
"*organized institutional structures* [give] science credibility while making indigenous knowledge appear anecdotal and unsubstantiated" [emphasis mine]; linked to dismissive attitudes of biologists towards TLK AHK
"gap between our sciences" - hierarchy implicit "red phone to management" AHK
training affects how TLK is conceptualized (both what is is and judgements of its value): "My [social] scientific and practical knowledge made me sceptical about *who* should manage and interpret Fishers' Knowledge, because this would influence *what* would be presented as knowledge." "...as the social scientist, *I had the responsibility* of situating the biological knowledge in its social framework...to [not] distort Fishers' Knowledge," as would "a strict focus on biology". [emphasis mine] TRAINQ ETHIQ
"training"- issues of how to collect TLK; interpretation of information; embeddedness and contextualizing information both within local rules and understandings and ethical issues (see previous quote; regarding ethical aspects of research with humans i.e. responsibility to people work with or interview): she implicitly connects training to the dismissive attitude and to a broader lack of understanding of TLK, especially of the social context of knowledge: "our understanding of Fishers' Knowledge was likely to be limited by our training, causing us to miss important information" - "I was trained to question all my assumptions." "Lacking experience with interviewing fishers, [Sundet] wanted a research partner with social scientific training...." TRAINQ
cultural barriers and distrust from fishers (see successes) CROSSQ
Evaluative variables
stakeholders' goals
Authors: covered both natural and social science perspectives
committed social learning process (in which their friendship played a key role) (SOCCAP) where they came to value each others' perspectives (and eventually even switched roles in the interviews at times)
both being Northerners and having fishing experience aided in more open communication with fishers SOCCAP CROSSQ
Maurstad (social scientist): "Sundet did not have the "attitude problem"...I saw the two of us as a good team able to treat Fishers' Knowledge with *appropriate respect.*"
"trapped in biology": an increased focus in their interviews was a positive aspect of their success - logistically and conceptually - but loss in ability to deal with knowledge that did not fit in the box yet is crucial to fisheries management
Sundet (natural scientist): Fishers' Knowledge entered some aspects of stock assessment

study generated a lot of information unknown to biologists
Fishers: fishers lives reportedly improved a bit because quotas on capelin reflected their knowledge and concerns

McGoodwin, J.R., Neis, B., Felt, L.

Integrating fishery people and their knowledge into science and management: issues, prospects and problems

Identification of Paper
by author
McGoodwin
source (SL or PW)
SL
Context
author type
Sa,Sa,Sa,
case study location NA
geographic scale NA
category of knowledge holders NA
context of Fishers' Knowledge use
shifts in Western culture including in Science and how it is understood; fisheries collapses and conflict between managers, scientists, and fishers
specific context NA
type of management system; level of governance NA
rationale for Fishers' Knowledge use
conflict reduction; increased management effectiveness; missing information; improve communication between fishers and scientists
authors' goals
generally review the topic "integrating fishery people and their knowledge into science and management: issues, prospects, and problems"
reflect on the contributions in the volume
make recommendations for how to "achieve effective collaboration"
Approach
Term used for 'Fishers' Knowledge'
Fishers' Knowledge
Term used for knowledge holders
fishers, fishery people
Fishers' Knowledge definition
ND but this is the concluding chapter and complements the introduction (where it was defined)
level of Fishers' Knowledge
1,2
coded themes
EMBEDQ, ESCI, INTQ,SIMIQ (both systematic observations), METHODQ, COMPLEXQ, AHK, DUALQ, ADOUBT, VALIDQ, NEGSOC, CONFLICTQ, SOCCAP, TRAINQ, APARTQ, CROSSQ, BUREAUQ, POLICYQ, VALUEQ, POLIQ, CONFM
Other: gendered, spatial temporal scale of TLK
theoretical/applied orientation
theoretical (review of concepts and other papers - no new data from the field)
key issues addressed
summarizes the history and context of the use of Fishers' Knowledge in fisheries management

discusses "barriers" to integration, including differences between LEK and Science, disciplinary boundaries, methodological challenges
the larger context of political ecology is raised and noted to be little addressed in the contributions – several aspects are briefly discussed: assumptions regarding fisheries management as science-based; whose knowledge, what is valid, and how knowledge is made; fishers' skepticism of science; power and representation in stakeholder processes
recommendations:
1. scientist and managers need to learn more about users' knowledge from "ethnographies and related studies" through professional training
2. fishers are learning about Science but scientists need to learn more about fishing and fishers' lives possibly through "internships"
3. greater attention to questions of how knowledge is produced, by whom, and how it can be verified – all knowledge is embedded "to some degree"
4. collaborative, interdisciplinary projects yield positive benefits and should be encouraged
5. the human dimensions of fisheries must be recognized in plans and policies
6. accountability is key and is preferably achieved through institutions with a number of features including a level of autonomy from both government and industry
7. trust is key in relationships between stakeholders; especially so for fishers cooperation – management needs to encourage this through "sharing of real authority and control over decision-making"
methods used NA
degree of participation of knowledge holders NA
aspects of research methods NA
   (i) protocols for permission
   (ii) how is it used/where is the TLK 'stored"?
scope of management activities involving Fishers’ Knowledge NA
degree of institutionalization of the Integration Project NA
language used to describe Fishers’ Knowledge
reflects the connection between knowledge and its holders, e.g."integrate them and their knowledge"; "resource users develop detailed knowledge...and that they should be more involved in fisheries science and management"
Level 2 knowledge about approaches to management exists: "local management approaches and the knowledge upon which they were based..."; and "Fishers' Knowledge and social institutions"
observations often are likely valid even if interpretations are not (Gunn et al. 1988)
"non-quantitative, narrative structure"; "qualitative, local, and coastal character of fishers' observations"
"Fishers' Knowledge, when collected in a systematic fashion…"
"...scientific research including tagging studies and genetic research can help verify fishers' observations and interpretations"
"checking their [the results from TLK research] reliability and validity"
language used to describe Science and scientists
"failure of conventional management approaches and conventional science"
"The observations of scientists are generally dictated by research protocols. They often use different sampling technologies, operate at larger spatial scales and rely on less frequent observations than fishers...Scientific observations are supposed to be recorded at the time of observation, and scientists favour written records over information that is orally transmitted. Knowledge is subject, to some degree, to a peer review process that is part of a larger process of professionalization. Like fishers, scientists have their own specialized terminology and science take place within a scientific subculture with local variations from lab to lab."
Both scientific knowledge and Fishers' Knowledge "depend upon systematic observations".
"the hegemony of fisheries science"

"While methodological diversity poses problems for attempts to construct a "science" of fishery people's knowledge, it reflects, to some degree, a variety of agendas behind attempts to collect and integrate fishers and their knowledge. It also reflects the reality that research of this kind is in a developmental phase."

language used to describe the Integration Project

generally code 2, also 3

"combining fishers' and scientific knowledge"

"the problems of making relevant Fishers' Knowledge for fisheries science and management"

recognize one model (natural scientist authors) where "knowledge is a resource ready to be harvested, albeit with caution, careful scrutiny, and some scientific verification, and added on to existing science…"

"rough waters and queasiness are to be expected when we attempt to integrate fishery people and their knowledge into science and management."

Barriers

refer to "barriers", "problems", "difficulties associated with combining fishers' and scientific knowledge"

cross-cultural communication e.g. "Barriers…have included the disciplinary boundaries that separated those interested in Fishers' Knowledge (primarily social scientists) in the past, from those responsible for science and management"; "the ethnic, class and experiential boundaries dividing fishers, fishery workers and researchers"; and several recommendations are aimed at these barriers CROSSQ

methodological challenges COMPLEXQ

"[Integration]...will be difficult indeed if the established scientists and managers are not sympathetic with the interests of resource users, are already co-opted by other interests in the larger society, or see the integration of such knowledge into science and management as a threat to their continued employment, authority, and/or accustomed prerogatives." BUREAUQ

centralized, "autocratic and paternalistic modes of management"; "the state's construction of the advisory and policy-making apparatuses" BUREAUQ

Evaluative variables

stakeholder goals

briefly reflect on some of the contributions in the volume

additional comments

the barriers considered in the most depth are methodological (the largest section of the paper discusses specifics of methodology), followed by interdisciplinary issues

they identify the assumption that fisheries management is science-based (in the context of the pursuit of profit and depletion of stocks) and the "privileged position of scientific knowledge" (including the model which cautiously adds TLK onto science) but not how these assumptions might affect the ability of fishers and scientists to work together (or how some of the papers in the collection moved beyond this)

furthermore almost no focus on trust and relationship building between stakeholders as a key issue (thrown in at the end with no reference to any paper in their collection although it was important)

the focus on interdisciplinary teams is raised initially in the context of methodological specifics then turns to learning - fishers are briefly mentioned in this context of potential participation in research teams

their discussion reveals tension and contradiction between the desire to "develop a 'science' of Fishers' Knowledge" and the recognition that methods reflect research goals and are diverse for this reason

Melvin, E.; Parrish, J.K.

Focusing and testing fisher know-how to solve conservation problems: a common sense approach

Identification of Paper
by author
Melvin
source (SL or PW)
PW
Context
author type
Na,Na,
case study location
Washington, Alaska
geographic scale
local, regional
category of knowledge holders
context of Fishers' Knowledge use
"motivating crisis"
specific context
Endangered Species Act and potential related closure of fisheries
type of management system; level of governance
government
rationale for Fishers' Knowledge use ND
authors' goals
to solve problems of bycatch in fisheries
(to communicate a cooperative model they have developed)
Approach
Term used for 'Fishers' Knowledge'
fishers' know-how; fishers' ideas
Term used for knowledge holders
fishers
Fishers' Knowledge definition ND
level of Fishers' Knowledge
Level 1 (includes fishing techniques) (also Level 2 - industry leaders and others "craft" appropriate approaches and strategies based on knowledge of their own stakeholder groups' behaviour, which enters into communications at all stages and in making recommendations appropriate for regulation)
coded themes
VALIDQ, SOCCAP, NSOCCAP, CONFLICTQ, BUREAUQ, MONEYQ, INDIVQ, ORGVAR, APREDQ, NEGID
theoretical/applied orientation
applied
key issues addressed
conservation problems - "incidental capture or bycatch of marine organisms", specifically seabirds; "no standard mechanisms exist within stewardship and regulatory authorities to go beyond problem identification to crafting solutions" (see methods used)
methods used
Melvin of Washington Sea Grant Association seemed to be quite involved with securing funding and linking with various stakeholders in both cases and facilitating and guiding the initiative. Three main stages in the cooperative research model are: 1. industry involvement and development of operational practices; 2. testing new methods using "strict scientific protocols

under actual fishing conditions", which required incentives (financial and otherwise) for fishers to "host scientists to collect necessary data" and "adhere to the specific scientific protocol within their standard operations"; 3. crafting new regulations based on research outcomes in cooperation with industry, agencies and conservation organizations. Fishers' Knowledge enters at all stages, although this is not explicitly recognized by the authors (beyond technical stages and "know-how", conceptualized as "participation" and "cooperation").

Puget Sound Gillnetters Association PGSA - lead industry organization - "promoted cooperation within the association, identifying individual cooperators, and establishing a forum to identify possible solutions. Washington Department of Fisheries and Wildlife provided the financial incentive for fishers to participate in research and organized multistakeholder meetings.

Funding obtained for "two seasons in the Gulf of Alaska sablefish and halibut fisheries and the Bering Sea Pacific cod fishery. *Ad hoc* industry committee established through the Fishing Vessels Owners Association and the North Pacific Longline Association with participation by NMFS and USFWS representatives. Series of meetings of committee identified potential fishing technologies. Managers created various financial incentives. For sablefish, cooperating fishers received free NMFS-required observer coverage.

degree of participation of knowledge holders in research

3- extensive

aspects of research methods

(i) protocols for permission ND

(ii) how is Fishers' Knowledge used/where is it stored?ND

scope of management activities involving Fishers' Knowledge

A 1 – biological research led to regulations

degree of institutionalization of the Integration Project

minimal – short term research projects which received particular funding

language used to describe Fishers' Knowledge

"pragmatic" attitude i.e. Fishers' Knowledge useful for solving problems

language used to describe Science and scientists

pragmatic - language reflects the realities of *Endangered Species Act* required "scientific defensibility" [but sense is not an excuse but "that's the way it is"], and that the "strict scientific protocols" which serve as "proof" or "certification of the results" to others, specifically the regulatory, academic, and conservation communities.

language used to describe the Integration Project NA

Barriers

funding, mandate, and time of neutral third-party scientist BUREAUQ, MONEYQ

Evaluative variables

stakeholder goals

all stakeholders were united to solve a common goal and had incentive to do so because of the crisis nature of the problem. Agencies risked being sued for violating endangered species legislation and fishers risked being shut down. They solved the problem together by satisfying three key criteria: reduce bycatch (overall goal) without reducing target catch (fishers' goal) or increasing bycatch of other species (agency and conservation organization goals); be acceptable and practicable for fishers; be scientifically acceptable to managers, conservation organizations and the public

additional comments

They identify an institutional barrier: "no standard mechanisms exist within stewardship and regulatory authorities to go beyond problem identification to crafting solutions". Interestingly, they use a key word from the institutional economics literature, "crafting" (i.e., *Crafting Institutions for Irrigation*, Ostrom (1992)). This suggests some awareness that their process involved a blending of a number of facets ranging from human dynamics to social and natural scientific aspects. They developed a cooperative research model which is used in both cases they summarize. Unfortunately they do not elaborate on how it was developed, for example, mistakes made or how

they might have had to reorient or adapt thinking or methods; who contributed various ideas; nor do they refer to literature in cooperative fisheries management literature.
In addition to the three "key elements" to the cooperative research model identified above (see Methods), others they identified include:

- the establishment of trust
- sufficient funding - crisis aspect is an external factor that contributed to this
- motivation to collaborate, in this case through legal pressure, obtaining funds, and providing incentives to fishers to participate

They mention the importance of establishing trust through "independent third parties" and that "cooperation with managers and agency scientists, academic scientists, and representatives of the conservation community is also essential" . However, there was no actual discussion of how this trust was developed or cooperation achieved. The brief conclusion does note that "a collaborative process with a field program takes a great deal of effort and trust, and perhaps, some luck". They note that Melvin was dedicated to the project almost full-time, which is unusual; they imply that collaborations with various agencies and the university were key and that they had the "good fortune to work with fishing industry associations and fishers with vision and dedication…" – that "when the circumstances and the people are right", the model works, and finally that it is "simply common sense". However, their own comments and the literature on institutional design suggest that much more than common sense was involved. For example, Fishers' Knowledge played a key role not only in designing appropriate fishing methods but in communicating them to peers. Key individuals were pivotal in the creation of social capital. Innovative thinking by the agencies[244] was also important as was their respect for fishers which is suggested by the fisher-led approach to technology innovation (critical given levels of antagonism and public perceptions of fishers).

Neis, B., Felt, L.

Introduction [to Finding our Sea Legs]

Identification of Paper
by author
Neis
source (SL or PW)
SL
Context
author type
Sa, Sa
case study location
various
geographic scale
various
category of knowledge holders
various
context of Fishers' Knowledge use
numerous stock collapses and the related "crisis of confidence in existing management systems"
specific context

[244] They provided financial incentives to fishers, e.g., arrangements involving fishing out of season, selling test-fish catch, etc. They also committed to a research program to solve a problem, then implemented fishers' suggested regulations as new regulations. In the CPR literature, this is a criterion where government backs solutions reached at a lower level of nesting, rather than opposing or ignoring them.

introductory chapter to *Finding our Sea Legs*
type of management system; level of governance
various
rationale for Fishers' Knowledge use
the need to improve knowledge and understanding of marine ecosystems and fisheries (especially long-term and fine-scale ecological and social knowledge)
authors' goals (authors are editors of the volume)
to provide context, impetus, and the goals for the volume and briefly summarize the sections and articles
to attempt to "bridge the gap between fishery people, scientists, and managers"
to encourage contributing authors to document their projects, but also to "explore their assumptions, methodologies and the interdisciplinary, interpersonal dynamics associated with those projects"
to "take stock" of the diversity of projects which address "integrating …knowledge and the resource users…into science and management" including reflecting upon their characteristics, results, lessons learned, and how to "strengthen future initiatives of this kind"
to address the associated "challenges" including that of fishers' "frustrat[ion] with the lack of recognition of their knowledge [and the] lip service."[245]
Approach
term used for 'Fishers' Knowledge'
fishery people's ecological knowledge, local ecological knowledge (LEK) of fishery people
term used for knowledge holders
fishery people
Fishers' Knowledge definition
"Traditional Knowledge is cumulative over generations, empirical in that it must continuously face the test of experience and dynamic in that it changes in response to socioeconomic, technological, physical or other changes...[As applied specifically to non-indigenous commercial fishery people, Local Ecological Knowledge] LEK is a form of "vernacular" knowledge, or knowledge derived through experience (Franklin, 1990). This knowledge is local in that "it is derived from the direct experience of labour process which is itself shaped and delimited by the distinctive characteristics of a particular place with a unique social and physical environment (Kloppenberg 1991)...Like Traditional Knowledge, LEK is not necessarily a fragmented, instrumental strategy for knowing something specific, but rather can be seen as "an integrated system of knowledge, practice and beliefs" (Berkes 1993)."
level of Fishers' Knowledge
1,2,3 (use Berkes definition)
coded themes
EMBEDQ, ESCI, AHK, ADOUBT, METHODQ, CONFLICTQ, SOCCAP, COMPLEXQ, VALIDQ, BUREAUQ (CMQ), CROSSQ, SAMPI, DYNFK, ASQIP, APARTQ,encouraged reflection in contributors, scale of TLK,
theoretical/applied orientation
both
key issues addressed
need to deepen our understanding and knowledge of social and biological interactions involved in fisheries harvesting and management
use of TLK and increased user involvement can contribute much to this knowledge and understanding; increased interest in TLK
important to document, reflect upon, and learn from collected experiences of how to integrate LEK into science and management (see goals above)

[245] Excerpt from a bigger quote by Broderick (2000).

"Methodological sophistication, interdisciplinary teams and community collaboration, and meaningful partnerships are required."
"substantive issues" identified as follows (paraphrased here from original question format): methodologies – including who and how, "benefits and risks" of potential methods
validity and reliability of data; "relationships between science and local knowledge, between natural and social science, as well as between resource users and natural and social scientists"; "democratic approaches to knowledge production and fisheries management" including their "benefits and risks"; and "need to explore the benefits of participatory research and seriously consider…new approaches to both fisheries science and management"
methods used
brief synopsis of each paper
degree of participation of knowledge holders in research NA
aspects of research method NA
(i) protocols for permission
(ii) how is it used/where is the TLK 'stored"?
scope of management activities involving Fishers' Knowledge NA
degree of institutionalization of the Integration Project NA
language used to describe Fishers' Knowledge

- temporal scale and "fine spatial scale" of LEK can "exceed that found in science"
- fishery people's knowledge "represents a potentially powerful and practical ingredient for fisheries science and management"
- a sub-section defines and discusses characteristics of Traditional Knowledge and LEK
- TLK is embedded (see below)

language used to describe Science and scientists
"The different knowledge traditions of fishery people, scientists, and managers are both individual and collective. They are social, historical, and environmental products that are shaped by local ecology, technologies, divisions of labour, gender, and generational and other social relations, as well as by cultural practices and institutional relationships. These factors influence who professes to be knowledgeable, about what, and when – among scientists and managers, as well as among fishery people."
language used to describe the Integration Project
code 3
"anyone with an interest in collecting the LEK of fishery people as well as their other knowledge and in integrating that knowledge and the resource users themselves more effectively into science and management"
"In fisheries, …one proposal for improving knowledge involves tapping the reserves of knowledge held by resource users and using them to enhance fisheries science (Berkes, 1999). A related proposal is to increase resource users' involvement in fisheries management, so-called co-management (Felt, Neis & McCay, 1997; Pinkerton, 1989, 1994a)."
"Traditional Knowledge researchers argue that it represents at least a critical supplement to "normal" scientific research, and perhaps an equal, alternative paradigm upon which to base science and management (Berkes, 1993; Mailhot, 1993; Kloppenberg, 1991)."
"diverse perspectives on the relationships between science and local knowledge, between natural and social science, as well as between resource users and natural and social scientists"
scope of management activities involving Fishers' Knowledge NA
degree of participation of knowledge holders NA
Barriers
barriers are referred to as "challenges" and "the lack of recognition" of Fishers' Knowledge pointed out by a commercial fishermen (DOUBTQ)
there is a "gap between fishery people, scientists, and managers"
Evaluative variables
stakeholder goals
additional comments

This chapter is the Introduction to the collection yet the authors do not explicitly acknowledge a hierarchy of knowledge nor do they provide a social or historical context for the emergence of TLK as a potential contributor to fisheries management. Several references which imply this hierarchy are subtle and include: the quote above "perhaps an equal and alternative paradigm…" reference to three articles in the volume (Maurstad 2000 and the "risk of turning social scientists into the idiots of science"; McGoodwin et al. 2000 and the "hegemony of science" which they co-authored); and reference to Pálsson's paper and the "strong challenge from social science" which is implicitly to natural science); the need to "accord some symmetry to the treatment of these knowledge traditions" (no elaboration on the asymmetry); and reference to "relationships" between kinds of knowledge and between stakeholders

Pálsson, G.

'Finding one's sea legs': learning, the process of enskilment, and integrating fishers and their knowledge into fisheries science and management

Identification of Paper
by author
Pálsson
source (SL or PW)
SL
Context
author type
Sa
case study location
Iceland
geographic scale
NA
category of knowledge holders
commercial fishers (general)
context of Fishers' Knowledge use
goverment management
specific context - elaborate on institutional and otherwise
NA
type of management system; level of governance
NA
rationale for Fishers' Knowledge use
improved fisheries management [implicit that important "practical knowledge" is being overlooked]
authors' goals
to apply theories of practice to the Integration Project in order to "advance a meaningful dialogue between fishers, managers and scientists"
to "question the assumptions of a hierarchy of knowers"
Approach
term used for 'Fishers' Knowledge'
fishers knowledge and 'enskilment', practical knowledge
term used for knowledge holders
fishers
Fishers' Knowledge definition
knowledge acquired through the practice of fishing
level of Fishers' Knowledge
level 1 (focus), level 2
coded themes

EMBEDQ (acquired through practice); ESCI; AHK; ADUALQ, DUALQ (intuition emphasized), ADOUBT, POLICYQ, IPRQ, BUREAUQ (REPQ), INDIVQ, is collectively and individually held, TLK is dynamic,
theoretical/applied orientation
conceptual
key issues addressed
theme is knowledge and how it is acquired – his "approach is informed by theories of practice and practical knowledge… [which see] cognition as situated activity and the scientific knowledge of marine biologists, as well as the skills of fishers as practical skills, applied and developed in particular contexts." (Science is also embedded.) ESCI EMBEDQ
hierarchy of knowledge in which Science is privileged and Fishers' Knowledge is marginalized AHK
elaborates on how Fishers' Knowledge is tacit ("unspecifiable"), and intuitive, and how fishers sense their world and practice fisheries through "extensions" of themselves including gear, crew, the fleet and shore based social networks
example of Iceland "trawlers' rally" - commercial vessels are hired annually to do a cruise for stock assessment process; fishers' frustration with the inflexibility of scientific design which fails to respond to ecosystem fluctuations and presumably result in unreliable estimates - ecosystem complexity necessitates finer scales of spatial and temporal knowledge;
due to embeddedness and dynamism, database approaches to Fishers' Knowledge are likely to fail and could reinforce "hierarchies of knowledge"
methods used
NA (develops his argument "with reference to [his] own work on Icelandic fishing" and social scientific research of others)
degree of participation of knowledge holders NA
aspects of research methods
(i) protocols for permission NA
(ii) how is Fishers' Knowledge used/where is it stored?NA
scope of management activities involving Fishers' Knowledge
NA (example of fishers' hired to duplicate stock assessment cruise grids)
degree of institutionalization of the Integration Project NA
language used to describe Fishers' Knowledge
"fishers' long practical experience with and knowledge of the ecosystem."
language used to describe Science and scientists
"science itself is now seen as an embedded enterprise -- as a local concern. Western tradition is preoccupied with analytic and theoretical ways of knowing, which in the process devalue and misrepresent practical and contextual knowledge. It tends to both glorify science and reduce local knowledge to mere trivia." ESCI
"The biologists at the core of such management regimes tend to ignore the fishers' [experience and knowledge]." ADOUBT
language used to describe the Integration Project
code 2
"to integrate fishers and their knowledge more effectively into science and management."
Barriers
Science as the privileged mode of knowing with consequent devaluing of Fishers' Knowledge (FK)
Evaluative variables
stakeholder goals NA
additional comments
Pálsson's "enskilment" seems to focus mainly on Scott's "métis" and is contrasted with "cognitive models" of learning via cultural transmission. The tacit aspects of this knowledge are emphasized, i.e, the holder is not really aware of it or cannot explain it. This kind of focus without qualifying that that there is much FK which can be verbally transmitted, can ironically

serve to relegate FK to being different, too complicated, or not useful. For example, he quotes Gladwin (1964: 174): "...a Trukese navigator "cannot possibly put into words all of the myriad perceptions which have led him to be sure at that moment where the island is." The European navigator proceeds from general principles to details, whereas the Trukese navigator seems to "start with details, but never arrives at any discernible principles." (ibid., 175). He dwells more on this type of Fishers' Knowledge, placing minimal emphasis on the (conscious) verbally-transmitted knowledge held by skippers and selectively shared within informal clubs. Thus although Pálsson suggests that "management ..should look for ways that knowledge can be employed to a greater extent", he discusses few ramifications of the enskilment perspective on the Integration Project or suggestions for how to include and use FK in fisheries management.

Pitcher, T.J.; Haggan, N.

Cognitive maps: cartography and concepts for an ecosystem-based fisheries policy

Identification of Paper
by author
Pitcher
source (SL or PW)
PW
Context
author type
Na,IDa
case study location
British Columbia
geographic scale NA
category of knowledge holders
commercial fishers, First Nations
context of Fishers' Knowledge use
ecosystem restoration
specific context
shift from single species to ecosystem emphasis in fisheries management; Back to the Future project (see below)
type of management system; level of governance
government
rationale for Fishers' Knowledge use
implicitly the lack of information on ecosystems past and present
authors' goals
to use the structure and abundance of past ecosystems to guide restoration policy, and to engage all sectors in positive and remedial action through the Back to the Future approach ("traditional and local knowledge" can contribute to this).
Approach
Term used for 'Fishers' Knowledge'
traditional and local knowledge; T/LEK
Term used for knowledge holders
aboriginal or traditional harvester; commercial fisher (T/LEK scarcely mentioned)
Fishers' Knowledge definition ND
level of Fishers' Knowledge
implicitly Level 1 (although the notion of "cognitive maps" and values underlying fisheries policies which they wish to engage could be considered Level 3, e.g., the contrasting of First Nations

world view and older more wholistic approaches to fisheries management with single species approaches)
coded themes
SD, FSQ, POLICYQ, VALUEQ, CONFM
theoretical/applied orientation
both
key issues addressed
introduces an approach to ecosystem restoration using modelling and various kinds of information
Mental concepts ["cognitive maps"] of the health of a marine ecosystem and its fisheries can influence the goals and design of management policies. "The first challenge in creating a common cognitive map of the entire ecosystem is to make disparate maps mutually comprehensible."
"[D]ifferent knowledge systems [including T/LEK], history, archaeology and other sources are combined to reconstruct past [ecosystem] abundance as a way to set restoration goals that relate to productive potential rather than present scarcity…"
Given the differences in various stakeholders' maps (see methods), "*Back to the Future* is, in fact, a deliberate 'cognitive intervention' designed to expand knowledge of the system and the potential for restoration. The political drivers of change are intended to be public awareness of the extent of ecosystem depletion in relation to the past, coupled with re-kindled belief in the potential for restoration."
methods used
"[T]he spatial version of ECOPATH[246], ECOSPACE...open[s] the door to the possibility of transferring detailed spatial knowledge of species from scientific surveys, T/LEK...and other sources."
Back to the Future includes "perceptions of change in each of the main trophic linkages" (no reference is made to how this is done and how the resultant models were tested).
The differences between different stakeholders' [my term] maps (First Nations, commercial fishers, stock assessment scientists, ecosystem-oriented scientists, conservationists) was examined through interviews. Community members were interviewed (using the snowball technique) in Prince Rupert (north coastal British Columbia) as to the number and type of organisms considered important in the food web – their "cognitive maps".
degree of participation of knowledge holders in research
1b - interviewees
aspects of research methods
(i) protocols for permission ND
(ii) how is Fishers' Knowledge used/where is it stored?ND
scope of management activities involving Fishers' Knowledge
A (1,5)
degree of institutionalization of the Integration Project
negligible (university-based project)
language used to describe Fishers' Knowledge
rarely mentioned
language used to describe Science and scientists
rarely mentioned
language used to describe the Integration Project NA
Barriers NA
Evaluative variables

[246] "ECOPATH is a mass balance approach (Christensen and Pauly 1992)...that tracks the trophic flows between predators and prey…[It] opened the door to the use of T/LEK information on presence/absence, relative abundance, and trends to improve the models by scientists (Pitcher 1998)."

stakeholder goals NA
additional comments

Power, A.S.; Mercer, D.

The role of Fishers' Knowledge in implementing Ocean Act initiatives in Newfoundland and Labrador

Identification of Paper
by author
Power
source (SL or PW)
PW
Context
author type
?g, ?g
case study location
Newfoundland
geographic scale
local
category of knowledge holders
inshore fishers
context of Fishers' Knowledge use
collapse of commercial Northern cod fishery; Oceans Act addresses competition for ocean space through Integrated Management (multistakeholder process)
specific context
FOC's initiatives in the region as reflective of the Oceans Act: Community-based Coastal Resource Inventories (CCRIs) and Marine Protected Areas (MPAs) within the context of Integrated Management
type of management system; level of governance
government (some degree of local management recognized, e.g., Eastport)
rationale for Fishers' Knowledge use
"conflict resolution and prevention" is the rationale for "involving all interested and affected stakeholders" (in context of fisheries collapse); FK is implicitly seen as an aspect of stakeholder involvement
authors' goals
to demonstrate examples of "emerging community-based approaches to management [which] reflect the changing role of government"
Approach
term used for 'Fishers' Knowledge'
Fishers' Knowledge, local knowledge, traditional knowledge
term used for knowledge holders
fishers, fishermen, stakeholders
Fishers' Knowledge definition ND
level of Fishers' Knowledge
Level 1 (various); 2 (recognition of traditional fishing areas i.e. is a system of boundaries/rules; "local knowledge and expertise in identifying potential conflicts, identifying information gaps, providing project coordination");
[CGS: could include Level 3 (e.g., values which enter in siting of two closed areas in Eastport based on knowledge which strikes a balance between maximizing recruitment and minimizing displacement of fishers)]
coded themes

SD, SOCCAP, APARTQ, VALUEQ, ORGVAR

theoretical/applied orientation

both

key issues addressed

CCRI program to inventory coastal resources using a community-based approach "to ensure that communities were included and encouraged in the collation of local knowledge"

"Interested and affected stakeholders can use the CCRI info for planning economic development and diversification activities, and highlighting emerging eco-tourism, recreation, or fisheries prospects."

MPA program in Newfoundland and Labrador has 3 pilot projects referred to as Areas of Interest: "All...were grass roots driven with proposals being received from local community sponsor groups..."

"Building on their success, the EPLPC is now considering expanding their conservation and protection initiatives to include other species such as lumpfish (*Cyclopterus lumpus*) and sea urchins (*Strongylocentrotus droebachiensis*)."

"FOC has used this success in Eastport as an example for other groups interested in similar initiatives, not only from a scientific or technical perspective, but to illustrate the importance of community support and resource stewardship, transparent consultations, and information exchange."

methods used

CCRIs: procedures manual was developed to guide the process; extensive community involvement in partnership with FOC: "planning, soliciting funding, training, project monitoring, and quality control"; "collection of information required in ocean management
interviews of those with "special knowledge, interests, or expertise...e.g. types of fish, marine mammals, spawning areas, types of commercial fisheries, wharf location, plants, boat repair facilities"; deliverables are final hardcopy, digital report, database which can be used to make resource maps

MPAs: Steering committees which consist of co-chairs from FOC and fishing community - for all 3 Areas of Interest are being or have been set up - comprised of affected stakeholder groups - "FOC would assist the Steering Committee in undertaking public consultations, developing a management plan for the area, soliciting funding, etc. The Steering Committee members, including the local fishers, would provide local knowledge and expertise in identifying potential conflicts, identifying information gaps, providing project coordination, etc." (The history of the Eastport case is elaborated in more detail (see Rowe and Feltham 2000).

degree of participation of knowledge holders in research

extensive

aspects of research methods

(i) protocols for permission ND

(ii) how is Fishers' Knowledge used/where is it stored?

final hardcopy and digital report, database – not stated where it is stored or issue of ownership or access

scope of management activities involving Fishers' Knowledge

degree of institutionalization of the Integration Project

CCRI was a program but once inventories are done, unclear whether program ends; MPA program ongoing

language used to describe Fishers' Knowledge

pragmatic and always linked to collaborative processes

CCRI: "collection of information" reportedly done in partnership between community groups and FOC

MPAs -"fishers had great knowledge" and "undertook consultations with others..."

"groups (MUN, FOC and EPLPC) have collaborated on projects"

"information exchange" [tone is implicitly that FOC can learn]

language used to describe Science and scientists NA

language used to describe the Integration Project
"Traditional and scientific knowledge can complement and enhance each other"
Barriers
Evaluative variables
stakeholder goals
FOC deems the work in Eastport a success which is extending to other areas and initiatives - success in many terms: scientific and technical, community support and stewardship, transparent consultations and information exhange
additional comments
FK is not mentioned in the Background section of the paper which sets the context of fisheries collapse and the Oceans Act. The community-based, multistakeholder CCRI process appears to be an example of organizational variation.

Power, N.G.

Women processing workers as knowledgeable resource users: connecting gender, local knowledge, and development in the Newfoundland fishery

Identification of Paper
by author
Power,
source (SL or PW)
SL
Context
author type
Sa
case study location
Bonavista Bay, Newfoundland
geographic scale
local
category of knowledge holders
women fish processors
context of Fishers' Knowledge use
fisheries collapse
specific context
post-moratorium and the "struggle for survival" of women, families and communities in Newfoundland; neglect of attention to women's knowledge within the area of Fishers' Knowledge
type of management system; level of governance
government management
rationale for Fishers' Knowledge use
missing information on the marine environment and fishing practices
ethical argument – women's knowledge and ideas should be incorporated because they are affected by decisions, and disproportionately so
authors' goals
"to document women fish processing workers' knowledge about the fish they work with, and consider its relevance for fisheries science and management"
to improve our "understanding of how social institutions affect nature and the options and requirements for ecological recovery"
more generally to raise awareness of patriarchal ideologies and how they play out in fisheries, fisheries science, and management
Approach
Term used for 'Fishers' Knowledge'

Fishers' Knowledge, resource-users' knowledge, local knowledge, women's knowledge
Term used for knowledge holders
women processing workers; resource users
Fishers' Knowledge definition and characteristics
"Local peoples gain knowledge about their immediate environment through "the direct experience of a labour process which is itself shaped and delimited by the distinctive characteristics of a particular place with a unique social and physical environment" (Kloppenburg 1991 p. 528). Women's knowledge is shaped by their distinctive experiences in societies characterized by sexual divisions of labour, gendered policies and practices, and patriarchal ideologies."
level of Fishers' Knowledge
level 1, 2, 3 (3 is implicit)
coded themes
EMBEDQ, ESCI, AHK, POLICYQ, NEGSOC, INTQ, gender
theoretical/applied orientation
both
key issues addressed
women's knowledge has been marginalized within fisheries, fisheries science and management generally and in Newfoundland
"researching from the standpoint of women and other marginalized groups can expose implicit socio-cultural biases embedded within dominant knowledges" (Harding 1991)
"women's knowledge is insightful, but like Fishers' Knowledge, limited, because women do different work than men and in different social environments"
they gave feedback on fish quality and waste, impacts of the moratorium on their ability to access high quality fish, and "[c]hanges in the volume of fish, its average size and the texture of the flesh [which] were associated with changes in fishing duration, locations, and increased transport time" (the latter "could be indications of stock decline"); "very concerned about practices and policies [fishing, company and management agency] that encourage waste and threaten quality"; "old and young, critiqued the modernised, industrial fishery favoured in fisheries policy"
"If we limit our attempts to broaden information provided to fisheries science and broaden participation within fisheries science and management to men fishers, we may well be missing important information women processing workers can provide and increasing the risk that they will suffer disproportionately from the negative effects of fisheries mismanagement."
policies were "guided by masculinist ideas about progress, rationalisation and modernisation" which Power connects to the failure of fisheries management in Newfoundland (e.g., modern and educated men in new fishery; "techno-utopian faith" in ability to manage fisheries; women belonged at home preparing meals – not fishing).
methods used
semi-structured, open-ended interviews in summer of 1995 with 26 processing workers (mostly women); inshore plant that sourced fish primarily from small boat fishers, or in an offshore plant that sourced fish from large trawlers (both "owned and operated by a single, large, multinational company"); some were old enough to have worked salting fish pre-World War II
degree of participation of knowledge holders in research
1b - interviewees
aspects of research methods
(i) protocols for permission ND
(ii) how is Fishers' Knowledge used/where is it stored?ND
scope of management activities involving Fishers' Knowledge
AB
degree of institutionalization of the Integration Project
one-off, negligible
language used to describe Fishers' Knowledge
"investigations of resource-users knowledge" "I document women fish processing workers' knowledge..."

"women fish processing workers' knowledge about the fish they work with... is insightful...but like Fishers' Knowledge, limited, because women do different work than men and in different social environments"
"Understanding women's experiences...I argue that an exclusion of *such knowledge*..."
language used to describe Science and scientists
"dominant knowledges"
"rational" scientific approaches that have been violent towards nature and women..."
"normal fisheries science" [*sensu* Kuhn]
language used to describe the Integration Project
code 2
"attempts to broaden information provided to fisheries science and broaden participation within fisheries science and management"
"incorporating the knowledge...into fisheries science and management..."
Barriers
patriarchy and its role in hierarchies of knowledge, and socioeconomic policies
Evaluative variables
stakeholder goals
additional comments

Prince, J.D.

The barefoot ecologist's toolbox

Identification of Paper
by author
Prince
source (SL or PW)
PW
Context
author type
Ni
case study location
Cape Leeuwin, Tasmania
geographic scale
local
category of knowledge holders
abalone divers
context of Fishers' Knowledge use
fisheries failure
specific context
Abalone (*Haliotis rubra*) management is failing because of regional approaches to management which do not match the biology of the species.
type of management system; level of governance
government
rationale for Fishers' Knowledge use NA
authors' goals
to communicate problems with centralized management and the overlooked importance of fine-scale stock structure to proper fisheries management; to promote a new kind of fisheries biologist to address this: the barefoot ecologist
Approach
term used for 'Fishers' Knowledge'
not specifically addressed as such – see below

term used for knowledge holders
harvesters, fishers, divers
Fishers' Knowledge definition NA
level of Fishers' Knowledge
Level 1; 2 (rules and institutions for management) - neither fully recognized
coded themes
NEGID, FSQ, SAMPI, INTUITQ, NEGSOC, NSOCCAP, NFK, BUREAUQ (CMQ, promotions), MONEYQ, CONFM, VALUEQ, POLICYQ, VALSCI
theoretical/applied orientation
both
key issues addressed
The scale of management of fisheries is inappropriate - many stocks are much less widely distributed than thought. The author refers to "the tyranny of scale" and discusses the notion of micro-stocks. A new breed of ecologist, the "barefoot ecologist" is necessary to work with local resource users in management of local stocks, implicitly incorporating FK.
Abalone management is examined in Cape Leeuwin. A divers' system of voluntary minimum size limits operated based on their "point of view" that local stocks existed, and that regional size limits were insufficient to manage them. This agreement between divers stabilized catches...during the early 1980s [until] a single 'bad egg' broke the voluntary agreement [which resulted in] a short-lived competitive gold rush". The fishery declined and when this person was later arrested (implicitly for other reasons), the fishery rebuilt.
He then does an analysis of how proper-scale management could be done for abalone which would fall within Larkin's suggested 10-20% of the value of the fishery, but a problem is that revenue from license fees goes into general revenue.
methods used
The paper is a discussion which addresses a range of issues. In the case study, information on the biology and behaviour of abalone, and the behaviour and organization of divers was conveyed to the author through conversations and diving together. These discussions are implicitly a critical information gathering step and imply that fishers' "point of view" was one of the hypotheses he tested in his Phd. The most experienced diver helped to map original sizes of abalone.
degree of participation of knowledge holders in research
1b some recognition by author of fishers as information providers (minimal); [3 is my assessment of the case – fishers' informal research is basis of their *de facto* self-managed fishery]
aspects of research methods
(i) protocols for permission NA
(ii) how is Fishers' Knowledge used/where is it stored?NA
scope of management activities involving Fishers' Knowledge
A 2,3,5 (*de facto*) extensive (Cape Leeuwin divers were *de facto* surveyors, stock assessors, and collective managers of their resource although this was not explicitly stated as such by the author)
degree of institutionalization of the Integration Project
some (*de facto* local institution)
language used to describe Fishers' Knowledge
He pays respect to abalone divers' spearfishing skills so "naturally [he] began [his] studies by talking and diving with them." They have "alternative points of view". Single references are made to "some intuitive understanding of abalone"; "knowledge of fishers"; "the information of fishers"; "insight".
language used to describe Science and scientists
"Barefoot ecologists will serve the communities to which they belong rather than central government agencies, "big science", "science for science's sake", or the "publish or perish" imperative." They are "agents of change".
language used to describe the Integration Project NA

Barriers
bureaucracy – centralized management and scientists' incentives (e.g. publishing) BUREAUQ
Evaluative variables
stakeholder goals
additional comments
The Cape Leeuwin abalone case is a case of *de facto* local management. However, the author does not consciously recognize the kind and extent of Fishers' Knowledge involved, e.g., the voluntary system of rules, and the social and biological knowledge upon which it is based. Neither does he see this as a case to be analyzed for the conditions contributing to its demise and recovery (*sensu* the collective action/ CPR literature) which can potentially be applied elsewhere (see Section 7.3.2).

Purps, N., Damm, U., Neudecker, T.

Checking the plausibility of data derived from fishing people of the German Wadden Sea

Identification of Paper
by author
Purps
source (SL or PW)
SL
Context
author type
Na,Ng,Ng
case study location
Wadden Sea, Germany
geographic scale
local
category of knowledge holders
commercial shrimp trawlers
context of Fishers' Knowledge use
increase in programs involving fishers in data collection
specific context
part of a larger program on bycatch
type of management system; level of governance
government management
rationale for Fishers' Knowledge use
NA (data collection "can produce, relatively cheaply, large amounts of quantitative data")
authors' goals
"to quantify the degree of reliability in sampling done by fishers and other non-experts" in the study
"to develop some essential guidelines for generating acceptable data for detailed scientific analysis" in order "to improve scientists' readiness to accept data obtained from [non-scientists]"
Approach
term used for 'Fishers' Knowledge'
NA - not TLK
term used for knowledge holders NA
program participants: fishers and untrained personnel
Fishers' Knowledge definition and characteristics NA
level of Fishers' Knowledge NA
coded themes

VALIDQ, ADOUBT, NSD
theoretical/applied orientation
applied
key issues addressed
after being assessed for plausibility, most of the data (about two-thirds) was useful for future scientific analyses, but there were some problems with two of five series (from different geographical locations) - discrepancies in size distribution led one to be completely omitted
recommendations: analyze on a timely basis after sampling and recording; close contact with personnel; the scientist analyzing the data needs to be personally familiar with the sampling procedures; compare the acquired data with similar data from other sources as soon as possible after collection; and "[b]iological findings [data collected from logbooks, etc.] should be tested using the known characteristics of the investigated species," including range, general species composition of catches typical of the area
methods used were effective for detecting copying, errors and forgeries
methods used
fishers took samples "from regular, unsorted catches, yielding up to five 10 litre buckets of catch per fishing week and landing port....resulting in a total of 12,000 samples"; about 100 people participated in identification of species, length and weight measurements (contracted residents of the landing port "without a scientific background", or staff of the Federal Research Center); data kept as handwritten records between 1954 and 1993 and transferred through this project into a computer database; a variety of statistical techniques (biological plausibility using "common sense", chi-square method, and length-weight relationships) used to identify unreliable data
degree of participation of knowledge holders in research
1a
aspect of research methods
(i) protocols for permission NA
(ii) how is Fishers' Knowledge used/where is it stored?NA
scope of management activities involving Fishers' Knowledge
A
degree of institutionalization of the Integration Project
agency program – assumed to be ongoing
languaged used to describe TLK NA
language used to describe Science and scientists
"An inclusive plausibility check was applied..."
"Statistical and biological methods were applied ..."
see Additional Comments below
language used to describe the Integration Project
"Projects that rely on fishers to collect and record information on fisheries for use by scientists...represent one approach to integrating fishers and their knowledge into science and management…However, tools are required to test the scientific plausibility of data collected by fishers and analysed and recorded by other scientifically untrained individuals…It is not our intent to raise doubts about these fishers' credibility or about the reliability of their information. On the contrary, the methods we present are meant to improve scientists' readiness to accept data obtained from people who are only indirectly involved in biological research…"
Barriers
the quote above implies scientists' reluctance to "accept data" from non-scientists (ADOUBT) (they acknowledge doubts about TLK as a category in scientific community - their study is specific examination thus not coded as DOUBTQ
Evaluative variables
stakeholder goals
additional comments
The authors mention that "close contact with fishers and the untrained personnel is absolutely necessary" but does not elaborate on why. Perhaps these nonspecialists' performance is less

related to educational or scientific training and what may have been required was improvement in handwriting, eyesight, or commitment to doing mundane tasks with insufficient reward or understanding of its purpose (issue of authentic participation PARTQ). Zwanenburg et al. (2000) stress the latter point, that is, that understanding the goals and reasoning behind projects is important for motivation.
This "testing of scientific plausibility" is not placed in a general context. For example, similar kinds of programs with trained personnel are not mentioned, nor is human error, and forgery considered in Science more generally.

Roepstorff, A.

The double interface of environmental knowledge: fishing for Greenland halibut

Identification of Paper
by author
Roepstorff
source (SL or PW)
SL
Context
author type
ID
case study location
Greenland
geographic scale
local
category of knowledge holders
inshore commercial fishers
context of Fishers' Knowledge use
NA - no mention of Fishers' Knowledge being used in fisheries management of Greenland halibut (*Reinhardtius hippoglossoides)*
specific context
NA
type of management system; level of governance
government management
rationale for Fishers' Knowledge use
ND
authors' goals
to develop a deeper "understanding of the fishery and its consequences for the fish" through exploring how knowledge is made at two interfaces (see below)
to reconcile "knowledge traditions" such that more "fruitful and egalitarian" exhanges can occur between knowledge holders (implicit)
Approach
Term used for 'Fishers' Knowledge'
fishery knowledge
Term used for knowledge holders
fishers
Fishers' Knowledge definition
ND, embedded, arises from the practice of fishing
level of Fishers' Knowledge
Level 1 [CGS: 2 is implicit]
coded themes
EMBEDQ, ESCI, AHK, DUALQ, ADUALQ, CROSSQ

theoretical/applied orientation
conceptual
key issues addressed
"explores how knowledge simultaneously exists at these two interfaces: between people and their surroundings, and between different partners"
two different frames for understanding fish and fisheries - reflect different aspects of the fish and the fishery
"In both cases knowledge is constituted at the interface between people and practices, but the models, concepts and metaphors used are very different. Recently the two traditions have been forced to interact..."
examining the two frames leads to a "better understanding of the fishery and its consequences for the fish": biological knowledge is organized around the notion of the stock and a series of human activities, equations and assumptions which translate actual fish caught in sampling programs to estimates of stock size while fishery knowledge focuses on fish in a dynamic environment, where both the fish and the environment are highly localized in time and space.
the notion of "stock" is contested between fishers and biologists
suggests that a productive framework for both biologists and fishers is one which focuses on "organisms in their environment"
methods used
"we will go fishing among people, using the media of interviews and texts, practices and mathematics;" methods are not described and little information summarized from interviews
degree of participation of fishers in research NA
aspects of research method ND
  (i) protocols for permission ND
  (ii) how is Fishers' Knowledge used/where is it stored?NA
scope of management activities involving Fishers' Knowledge NA
degree of institutionalization of the Integration Project NA
language used to describe Fishers' Knowledge
His tone is critical and even skeptical when discussing TLK in context of literature – "a catchy first word...followed by *knowledge* [which has] "recently become popular in the literature on applied anthropology."
(see also below)
language used to describe Science and scientists
"My goal is not to do 'biologists bashing', a popular sport among local knowledge advocates." He places the Science of stock assessment (of greenland halibut) in the context of normal science (Kuhn 1970) which has particular purposes (administrative, communicative, for peer recognition, etc.)
"This process [of transformations] is not wrong; it simply represents science in action (Latour 1987)."
"scientific concepts which are necessarily general and global…"
language used to describe the Integration Project
code 3
"Recently the two traditions have been forced to interact..."
"seek to integrate practices and people, thereby meshing knowledge from biologists with Fishers' Knowledge rather than dichotomizing them."
both biological knowledge and fishery knowledge are particular "bodies of knowledge" which reflect different aspects of the fish – the deliberately symmetrically named them (implies equality – also refers to "more fruitful and egalitarian exchanges" between fishers and biologists)
Barriers
big difference between knowledge "traditions" since focus on such different aspects (could be considered partly "cultural" CROSSQ
conceptualization of fisheries science
Evaluative variables

stakeholder goals
additional comments
There are few descriptions of exchanges between fishers and biologists, no references to policy debate or actual management processes, and how and why these knowledge traditions are being "forced to interact".

Rowe, S.; Feltham, G.

Eastport Peninsula lobster conservation: integrating harvesters' local knowledge and fisheries science for resource co-management

Identification of Paper
by author
Rowe
source (SL or PW)
SL
Context
author type
Na,F
case study location
Eastport Peninsula, Newfoundland
geographic scale
local
category of knowledge holders
inshore fishers
context of Fishers' Knowledge use
fisheries collapse and decline (groundfish and lobster, respectively)
specific context
moratorium on cod resulted in increased pressure on lobster stocks; declining lobster recruitment, recommendations from Fisheries Resource Conservation Council
type of management system; level of governance
local management (nested within government management)
rationale for Fishers' Knowledge use
ND
authors' goals
document and participate in the Eastport Peninsula Lobster Protection Committee process
goals of Committee:
1. conserve and enhance the industry for their and future generations' benefit
2. "to learn and educate by using sound professional methods and practices in fishing lobster"
3. to provide vital information and statistics for management
4. to demonstrate that professional fish harvesters can successfully harvest and manage the fishery to its fullest potential
Approach
Term used for 'Fishers' Knowledge'
fishers' local knowledge, harvesters' knowledge
Fishers' Knowledge definition ND
level of Fishers' Knowledge
Level 1, 2, 3
coded themes
DUALQ, SOCCAP, SOCLEARN, ASQIP, DYNFK, INTQ, local management
theoretical/applied orientation
applied

key issues addressed
local knowledge can be used as a basis along with science to do community-based fisheries management
the Committee initiated a number of activities: meetings with fishers to communicate benefits of waiting for lobster to reach legal size, negative consequences of excessive effort, etc.;
1996 - V-notching berried females (result is protection of known spawners for several additional years);
1997 - realized needed more measures so "applied to FOC to restrict fishing in the Eastport area to traditional users"
lobster fishers traded rights to space such that Eastporters stayed local and outsiders no longer fished there - easier to manage resource when fewer landing points and fewer participants involved (exclusive access allows for "reversal of the tragedy of the commons" and acts as incentive to receive benefits of their efforts through local agreements and control);
requested two areas of prime lobster habitat be protected (based on their knowledge of water circulation patterns);
need for quantitative biological data recognized, otherwise difficult to demonstrate the results of conservation; and asked for assistance from the scientific members of the group -collectively decided to do mark-recapture
partnership with FOC, Memorial University, and Parks Canada; also involved people who do not fish, including family members and the local school in data collection and management projects, which increases understanding of fisheries management
Committee established a system of peer enforcement with backup from FOC as requested
Learnings:
"conservation measures initiated from the grass roots are widely accepted and are thus more effective";
local education and stewardship lead to effective enforcement;
"[b]oth harvesters' local knowledge and fisheries science can make important contributions to fisheries knowledge and management";
harvesters and scientists can successfully cooperate; and trust between all stakeholders "must develop and be maintained" for success
methods used
ND (fishers created a committee and investigated means for improving abundance and recruitment and as part of planning and designing protected areas and related research - local knowledge used in all these activities)
degree of participation of knowledge holders in research
3
aspects of research methods
(i) protocols for permission ND
(ii) how is Fishers' Knowledge used/where is it stored?ND
scope of management activities involving Fishers' Knowledge
A 1,2,3,4,5,6
degree of institutionalization of the Integration Project
committee with government partners; some funding
language used to describe Fishers' Knowledge
see below
language used to describe Science and scientists
the Committee recognized the need for local quantitative data, otherwise difficult to demonstrate the results of conservation
"asked for assistance from the scientific members of the group"
see below
languaged used to describe conceptualization of the Integration Project
code 4

"Both harvesters' local knowledge and fisheries science can make important contributions to fisheries knowledge and management."
authors refer to "co-management" where local knowledge is part of community driven management initiatives and rules; Science helps to accomplish their objectives
"Together these partners drew on their very different knowledge bases to identify questions,... formulate hypotheses and decide how best to test them, collect the necessary data, and interpret the results. Instead of trying to insert harvesters' knowledge into fisheries science and management, the Committee decided to take a different approach: integrating scientific methodology into their local ecological knowledge base. As a result, the group has been able to gather scientifically rigorous data (quantitative in nature and collected using standardized techniques) and has benefited from local knowledge (typically qualitative in nature) particularly during the planning and interpretive stages."
"integrating harvesters' local knowledge with fisheries science"
Barriers
Evaluative variables
stakeholder goals
fishers and managers/scientists: increased abundance of lobster appears to be related to protected areas which were chosen, designed, implemented researched and enforced using Fishers' Knowledge
all Committee goals are also being met through using a mix of science and Fishers' Knowledge
additional comments
Some success factors are identified, such as rust and exclusive access **-** most are briefly mentioned but not emphasized or placed in a theoretical context. According to CPR theory, collective action is occurring because incentives are sufficiently high among lobster fishers - related to a number of factors: homogeneous group; area is "small" with enforceable boundaries; remote; they effectively control access to the resource which is also local; higher levels of government are cooperating through facilitating these agreements and with scientific expertise (nested institutions); established a system of peer enforcement with graduated sanctions (Ostrom 1990).

Rudd, M.

Accounting for the impacts of Fishers' Knowledge and norms on economic efficiency

Identification of Paper
by author
Rudd
source (SL or PW)
PW
Context
author type
Sa
case study location
tropics - various
geographic scale
local/regional
category of knowledge holders
inshore fishers
context of Fishers' Knowledge use

NA (the context is conceptual: Fishers' Knowledge as it links with social capital - no field work - "cases" are literature cases. I selected this paper because potential lessons are not specific to the tropics.)

specific context

NA (Author's contention is that fisheries policy does not take Fishers' Knowledge seriously because it has not been linked to economic outcomes. Social capital is seen as a means to do this; thus most of the paper is an elaboration on social capital and its dimensions.)

type of management system; level of governance

various

rationale for Fishers' Knowledge use

reduce transaction costs

increase legitimacy of and compliance with regulations

authors' goals

implicitly to demonstrate that social capital is an important "variable affecting fishery sustainability"; and to show how "social capital links Fishers' Knowledge to ecological and economic outcomes", reportedly in order to legitimize Fishers' Knowledge at the policy level

Approach

term used for 'Fishers' Knowledge'

Fishers' Knowledge; local knowledge; ("context-dependent knowledge" used once)

term used for knowledge holders

fishers

Fishers' Knowledge definition and characteristics

ND

level of Fishers' Knowledge

level 1 (Fishers' Knowledge "about the world"); 2 ("knowledge of others' behaviour");

3 (norms and values although he does not conceive of this as knowledge as the paper's title indicates)

coded themes

ADOUBT, NEGSOC, SOCCAP, EFFICQ, CONFLICTQ, CONFM

theoretical/applied orientation

theoretical

key issues addressed

Various cases from the literature are very briefly reviewed and contrasted in terms of potentially varying levels of social capital at the community level and higher level governmental support, and relative degree of "success" in harvesting benefits from the reef ecosystem over the longer term

"Knowledge about the behaviour of others increases the likelihood of successful collective action needed to solve social dilemmas such as the "Tragedy of the Commons"… potentially reducing the transaction costs of fishery management."

"Institutions based on trust and reputation can help constrain opportunism, solve social dilemmas and, hence, increase the economic efficiency of producing public goods."

"Having a theoretical basis that accounts for Fishers' Knowledge allows for rigorous approaches to marine ecosystem-based policy development that incorporates both social and ecological variables in management experiments."

"Understanding social capital will be crucial for choosing policy instruments that can increase the likelihood of ecological and economic sustainability. This requires that we understand and account for Fishers' Knowledge about the world and the behaviour of other resource users."

methods used NA

degree of participation of knowledge holders

NA (insufficient information)

aspects of research methods

(i) protocols for permission NA

(ii) language used to describe methods NA

(iii) how is Fishers' Knowledge used/where is it stored?NA

scope of management activities involving Fishers' Knowledge ND
degree of institutionalization of the Integration Project NA
language used to describe Fishers' Knowledge
"knowledge about the behaviour of others"; "innovations"; "information about fishing conditions"
language used to describe Science and scientists NA
language used to describe the Integration Project NA
Barriers
Fishers' Knowledge "not taken seriously" is connected to the "emphasis of economic performance in public policy decisions" (Economic frame)
Evaluative variables
stakeholder goals
additional comments
This paper does not fit the framework well - in terms of the authors' goal, this paper reviews social capital well but does not link TLK with it clearly enough. However, several examples from the literature which the author briefly reviewed indicate that traditional management systems (which are implicitly built on and represent local knowledge at all three levels) are successful when social capital, or community capacity is high, along with a high state level backing or capacity to help enforce the local systems.

Stanley, R.; Rice, J.D.

Participatory research in the British Columbia groundfish fishery

Identification of Paper
by author
Stanley
source
PW
Context
author type
Ns,Ns
case study location
central coast of British Columbia
geographic scale
local
category of knowledge holders
groundfish trawl fishers
context of Fishers' Knowledge use
stock assessment procedures
specific context
disagreement between stock assessment scientist and fishers regarding biomass of rockfish and assumptions used in stock assessment
no targeted research on particular species of rockfish (widow, *Sebastes entomelas*; and silvergray, *Sebastes brevispinis*)
rationale for Fishers' Knowledge use
missing information
type of management system; level of governance
government management
rationale for TLK use
improve fisheries research
authors' goals
improve stock assessment research

improve communication with fishers
Approach
term used for ‘Fishers’ Knowledge’
*-knowledge
term used for knowledge holders
fisher, trawl captain, industry associate, client, participant
Fishers’ Knowledge definition
ND
level of Fishers’ Knowledge
1
coded themes
VALUEQ, EFFCHAN, CROSSQ, BUREAUQ, ADUALQ, SIMIQ, AHK, SAMPI (inertia related to funding), SOCCAP, SOCLEARN, VALSCI, EFFICQ, FVALID
theoretical/applied orientation
both
key issues addressed
the term "incorporating fisher knowledge" is pejorative (see below); "genuine participation" through a Participatory Research model is preferable
two case studies demonstrate the benefits of collaborating with fishers in research; fishers and scientists learned from each other (see Evaluation variable below) and improved stock assessment science, cooperation, and understanding, which allowed for further expansion of activities
the "process of building mutual respect" was key
"the project benefited from being small and narrowly defined in scope"
importance of "growing role of industry-funded research…[which] by decentralizing the control of resources leads to new research directions"
methods used
collaborative scientific research (cruises, acoustical methods to estimate biomass); used commercial and FOC research vessels (Stanley sometimes on board trawlers and the trawler captain on board the FOC's vessel Ricker)
degree of participation of knowledge holders
3
aspects of research methods
(i) protocols for permission NA
(ii) how is Fishers’ Knowledge used/where is it stored?NA
FK was dynamically used to plan and interpret research and stock assessment results
scope of management activities involving Fishers’ Knowledge
A2
degree of institutionalization of the Integration Project
some – ongoing relationships between authors and "clients";
language used to describe Fishers’ Knowledge
"…it is a mistake to focus on fishers simply as data collectors or knowledge sources…"; they have "rarely acknowledged" "scientific skills"
"fishers' intuition"
language used to describe Science and scientists
scientists; science participant
"hypothesis formulation, experimental design, and interpretation"
"framers and testers of hypotheses"
"As posed by Sajise (1993), how could knowledge accrue (as opposed to just being passed on) without someone applying elements of the scientific method…" (followed by Sajise's quote that local people "do research")
"without…lowering standards of rigour"
language used to describe the Integration Project

code 4
"Phrases such as ‘incorporating fisher (local, or traditional) knowledge’ are not only incorrect but are pejorative in implying that fishers are limited in what they can contribute to the scientific process."
"The call to make better use of *-knowledge is justifiable; however, the greatest gains may come from changing the nature of the interaction [from top down to Participatory Research]” since in Participatory Research, "the so-called researcher…does not occupy the top position in the traditional hegemonic framework."
Barriers
scientists see and approach fishers and their knowledge in ways which are limiting, "if not condescending" ("data collectors" or "background knowledge")
"hierarchical vision of knowledge" and dualistic thinking centered on differences between training and education
limited financial and human resources ("meeting fatigue")
challenges of peer review processes (criticism)
Evaluative variables
stakeholder goals
Both scientists and fishers were able to resolve disagreements regarding stock status.
Authors/scientists: learned how to improve communication with fishers through the establishment of trust and respect; and fleet movements related to Individual Vessel Quota implementation affected the size composition of the catch and consequently their sampling regime; aspects of acoustics
Fishers: learned about scientific research and biomass estimation e.g. the relationship between their acoustical signal, catch rate and biomass; how to employ shipboard acoustics for biomass estimation specifics of acoustical technology, which will be used to reduce bycatch (ultimately has economic benefits)
Managers: money was saved through fishers' advice against doing a coast wide survey (based on their knowledge of variability of distribution of rockfish)
additional comments
What is unclear is the relationship between what is reported and discussed here and fishers' ability to affect decision-making regarding changes in quotas and regulations, i.e., management policy.

Sutton, S.

Local knowledge of a unique population of Atlantic salmon: implications for community-based management of recreational fisheries in Newfoundland and Labrador

Identification of Paper
by author
Sutton
source (SL or PW)
SL
Context
author type
Na
case study location
Bonavista Bay, Newfoundland
geographic scale
local
category of knowledge holders

recreational fishers
context of Fishers' Knowledge use
consideration of shift to community watershed management (CWM) of salmon from a "large-scale management strategy"
"social, cultural, and economic value of recreational fisheries" to Newfoundlanders, and the lack of studies of anglers' knowledge
specific context
Anglers' knowledge part of a larger scientific study of a "unique population of Atlantic salmon...inadequately managed at present, and for which no scientific data has been collected previously."
"anglers' frustration caused by lack of concern shown by fisheries management agencies for the health of the population,…its unique ecological characteristics or the unique fishing experience it produces."
type of management system; level of governance
government management
rationale for Fishers' Knowledge use
missing information ("expand the ecological database" especially in absence of scientific data)
authors' goals
"to assess the potential contribution of anglers' local ecological knowledge to recreational fisheries management under a community-based arrangement" - includes an assessment of whether anglers are able to "recognize and understand management problems and use their knowledge to formulate workable solutions that are acceptable to the wider angler population"
stated goals of CWM include "resource conservation" "providing a quality angling experience and maximizing local economic benefits."
Approach
Term used for 'Fishers' Knowledge'
anglers' local ecological knowledge (and understanding - once); anglers' knowledge
Term used for knowledge holders
anglers
Fishers' Knowledge definition ND
level of Fishers' Knowledge
Level 1, 2
relevant issues withn the Integration Project
FSQ, SD, APARTQ, DYNFK, SOCCAP, VALIDQ, NEGID, EFFICQ, DOUBTQ, EMBEDQ, INTQ, ASQIP, CONFM
theoretical/applied orientation
both
key issues addressed
Anglers' knowledge was shown to be in depth and useful to management through the provision of data and management recommendations.
Four recommendations were tailored from the results of the study, two of which "a group of local stakeholders has successfully lobbied to implement."
He advocates the CWM approach where anglers' direct participation in management is proposed as an alternative to an approach to FK which would "collect-and-combine" it with Science.
CWM can be more sensitive to users' concerns, increasing legitimacy of management; creates a sense of stewardship and responsibility which should "discourage abuse"; allows for watershed specific management; and "increases public awareness of management problems"
methods used
15 experienced anglers identified "through individuals involved in an ongoing trout research project in a nearby watershed"; "standardized questionnaire administered over the telephone followed by more informal conversations in the field"; "data collected on range, distribution, life history, and migratory patterns of the population, patterns of exploitation, changes in the population over time, possible reasons for these changes, and anglers' suggestions for improving

management of the population"; interviewed 81 anglers on the fishing site - survey of whether approve or disapprove of 8 possible regulatory initiatives derived from original 15 interviewees' suggestions
degree of participation of knowledge holders
limited here (but potentially extensive under proposed model of CWM)
aspects of research methods
(i) protocols for permission ND
(ii) how is Fishers' Knowledge used/where is it stored?ND
scope of management activities involving Fishers' Knowledge
A,B 1,3
degree of institutionalization of the Integration Project
negligible
language used to describe Fishers' Knowledge
"anglers were knowledgeable about a number of aspects of the population's ecology..."
"managerial relevance of anglers' unique knowledge"
"anglers believed" "according to anglers" "juvenile stages are believed to..."
"[management] problems recognized by anglers"
"Anglers'...belief that the saltwater phase of the life cycle was of shorter duration (2-3 months) than that of a typical salmon (1-3 years) was confirmed by detailed analysis of otoliths and scales."
"in-depth knowledge" "in-depth understanding"
language used to describe Science and scientists
Science is used to "confirm" FK
language used to describe the Integration Project
4 when author discusses CWM, otherwise mixed 1,2,3
"Local knowledge was gathered..." "anglers' knowledge has the potential to provide data...."
"The effectiveness of including anglers in the management process...will be enhanced to the extent that anglers possess ecological knowledge... and are able to interpret this knowledge within the context of recreational fisheries management."
"this knowledge and insight must be translatable into regulations that can be used to accomplish specific management objectives"
"The study was not aimed at exploring the full scope of Anglers' Ecological Knowledge, rather anglers were asked specific questions to elicit information [relevant to management]"
CWM ..."will not focus on anglers' knowledge *per se,* but will incorporate the knowledge system into management by including anglers as an integral part of the management process. Direct participation...preserves the contextual linkages of the knowledge system. Unlike the collect-and-combine strategy..., a participatory approach also provides a mechanism whereby new knowledge (local or scientific) gained by anglers...can be applied directly to management problems in a timely manner."
Barriers
that anglers' knowledge is confirmed by scientific research "adds some measure of legitimacy to the idea of integrating anglers into the research and management process" but this is not further elaborated upon DOUBTQ
Evaluative variables
stakeholder goals
Author: met goals
Fishers: project seemed to facilitate consensus building among fishers such that two of the recommendations were lobbied for and successfully impemented
additional comments

Williams, A; Bax, N.

Integrating fishers' knowledge with survey data to understand the structure, ecology and use of a seascape off Southeastern Australia

Identification of Paper
by author
Williams
source (SL or PW)
PW
Context
author type
Ng, Ng
case study location
southeast Australia
geographic scale
regional
category of knowledge holders
trawl and line fishing
context of Fishers' Knowledge use
Australia's Oceans Policy of 1998
specific context
shift towards spatial management of the oceans and ecosystem management; southeast Australia is the test case for regional marine planning (first of 13 large marine domains) - impending new legislation affecting fisheries
type of management system; level of governance
government
rationale for Fishers' Knowledge use
to provide otherwise unavailable information to managers; to increase "fisher empowerment", understood as active involvement in management options
authors' goals
"improved management of the fishery"
ecosystem project: "the core aim...was to understand the importance of habitat to fisheries productivity"
the mapping project aim is to "incorporate Fishers' Knowledge of the seascape into strategic management planning"
Approach
term used for 'Fishers' Knowledge'
Fishers' Knowledge, fishers' information
term used for knowledge holders
fishers
Fishers' Knowledge definition ND
level of Fishers' Knowledge
Level 1
coded themes
VALIDQ, SD, SOCLEARN, SOCCAP, NSOCCAP, SIMIQ ("commercial sampling" differences "in timing and frequency of sampling"), FSQ, IPRQ, PROTOCOLQ, APARTQ, EFFICQ, VALUEQ, POLIQ, APREDQ, DYNFK, INTQ, ORGVAR, CONFM (equitable fisheries management and scale)
theoretical/applied orientation
applied

key issues addressed
"[F]ishers potentially provide the means for cost-effective acquisition of mapping data over large areas, and they have an important stake in ensuring that any spatial management of the seabed is based on reliable information interpreted appropriately. Acquiring reliable data requires a structured, verifiable collection process, and methods to resolve conflicting information."
"Information at this fine spatial and temporal resolution, unless provided by fishers, is not available to survey design, for the interpretation of CPUE or other fishery statistics, nor to assist in understanding of species ecology." Fishers provide a means to do more cost-effective scientific surveys and to map large areas of seascapes, e.g., they identified locations and boundaries of habitats thus scientists were able to rapidly "build a focused study of habitats into the field surveys to intensively sample at a relatively small number of sites". Identification of habitats and boundaries helped scientists to "understand the ecological roles of particular features, and their often small spatial scales (100s of meters to a few kilometers), e.g., the use of prominent reef edges by commercially important...feature-associated species". "[S]uccessful fishers have considerable insights into structures and processes that affect production...Successful fishing depends on knowing when and where the right combinations of depth, bottom types, currents and good feed marks occur together." Fishers' Knowledge of seascapes is important for spatial oceans management, particularly because it includes knowledge of seascapes at suitable scales
methods used
The "ecosystem project" was geared toward species-habitat associations and approached with available mainly bathymetric maps, scientific survey data, and species-habitat associations of 24,000 km^2 of the continental shelf. Fishers' Knowledge added to this. Two-pronged industry liaison program exists with the project team "involved in formal fishery management and assessment meetings, and/or spent time in the two big ports...and did trips to sea on fishing boats." "These interactions enabled us to establish contact with a range of industry personnel from the working skippers to the association executives...We maintained fairly regular contact with a core group of operators. The project "lacked systematic planning or protocols, and there were no obvious benefits for industry".
The "mapping project" had a planned methodology for collection, including review and release of industry data. However, it was still adaptive and somewhat flexible. The habitat questionnaire was developed with fishers. "Fishers provided detailed information on the fishery navigation, fishing effort distribution, individual species, fish behaviour, [factors associated with ocean] productivity, seabed biology, geology and oceanography. A key result was an interpreted seascape map." ".[O]ur 'fishers' map' [is] a coarse-scale map of habitats, although its units - fishing grounds - are actually a hybrid mix of geomorphological features, such as sediment plains and rocky bans, and...biotope types - patches of substratum dominated by one particular community or animal."
degree of participation of knowledge holders in research
3 - extensive
(industry involvement in field sampling from industry vessels, interviews at port and at sea, developing the questionnaire, control of map products, representation on project Steering Committee; input involves interpretation of their knowledge and maps through "ongoing dialogue"; will eventually involve decision-making)
aspects of research methods
(i) protocols for permission
fishers' mapped knowledge is protected through formal agreements protecting confidentiality: "The project is structured...to give fishers a high degree of control over the form in which information is released and the timing of various outputs. We have agreed that habitat maps of the area will be released following review by individual contributors and the relevant associations, and that these maps will include summary detail from commercially confidential information." Permission of individual fishers would be required for the release of higher resolution maps of

specific areas...We have an explicity step-wise protocol for making, reviewing and releasing maps..."

(ii) how is Fishers' Knowledge used/where is it stored?

ND, but "registration and strictly controlled storage of industry's information"

scope of management activities involving Fishers' Knowledge

A (5)

degree of institutionalization of the Integration Project

some - the research began as a project which is being extended to a greater area, but implication that lessons and methods could be extended into spatial management of other large marine domains

language used to describe Fishers' Knowledge

"spans a wide range of spatial scales of resolution from 10s to 100s of km"; "temporally and spatially frequent sampling"

fishers "provided detailed information" "interpreted" "told us where to look"

Respect is demonstrated: "considerable insights"; the detailed description of Fishers' Knowledge of *morwong* [a fish species] compared to scientists' understanding ("and this is just one of the many examples for individual species").

"…differences in observations between fishers and scientists in terms of spatial and temporal resolution of sampling...[S]ome skippers average over 200 days per year and sustain this for many years, building on the experience of their parents or other older skippers."

"fishers' information was so useful that we developed a second study..."

language used to describe Science and scientists

"Fishers' Knowledge may permit scientific observing to be better targeted, and more insightful, while survey data can provide the detail that leads to a more rigorous interpretation of Fishers' Knowledge."

straightforward about pointing out limits in the scientific survey: "surveys represent very brief snapshots in time and space"

"verification and validation procedures to ensure data are scientifically rigorous" is the only reference to questions of validity in the body of the article. (I interpret this lack of emphasis as demonstrating the authors' focus and enthusiasm for what they are learning from working with fishers and its various applications, rather than focusing on potential "weaknesses" or "indefensibility" of Fishers' Knowledge. Specifically, if I were to do a content analysis of papers some would stand out as being relatively more concerned with the latter.

language used to describe the Integration Project

4

"…direct benefit of combining our knowledge...is an improved understanding of the seascape."

"fishers and scientists...observations [related to scale] are often complementary"

"...collaboration with industry is not limited to acquiring their data, but requires an ongoing dialogue if the data are to be interpreted judiciously…"

They also show evidence of understanding fishers' concerns by discussing them and accounting for them in methods (development of protocols).

A genuine partnership is implicit in methods, protocol and language. Fishers have a level of "ownership" over the process and scientists have developed a level of understanding of fishers' concerns.

"With their information systematically collected and rigorously evaluated, fishers would be positioned to critically evaluate proposed spatial management plans, such as the placement of MPAs, and require management agencies to have clearly defined and measurable aims for their proposed management options." It implies a potential turning of the tables on government, in terms of future shut downs if fishers can demonstrate sustainable fishing. The "systematically collected and rigorously evaluated" is implicitly in partnership because again, the language used never suggests that fishers are not also rigorous. A balance and reciprocity of knowledge and power is implied in the language used.

Barriers

Evaluative variables
stakeholder goals
Fishers' and industry goals: Fishers not only want to be heard but want their information to be incorporated into decision-making. The following quote implies this has not happened in the past (which indicates a barrier but no evidence in this paper as to which one). "We have broad support from industry because the project is viewed as a mechanism to have industry information considered in decision-making processes for the fishery, and that *informed* decisions will result. However, support is not unanimous and this is due, in large part, to many fishers remaining skeptical that their information will not be used appropriately...[or will be]...used against them, especially for closing off valuable fishery areas - they are well aware of the link between areas of high fishery productivity and areas of high biodiversity." Industry also sees this as an opportunity to improve its public image regarding the environment, which results from "poorly informed and often misleading media and scientific reporting. This project will provide industry with some hard facts that they can use to demonstrate their real level of impact on the seascape - the trawl sector is particularly keen to be able to demonstrate that large areas of the fishery are untrawlable or untrawled."
Authors' goals: These scientists appear to recognize that their interests in a more sustainable fishery will only be met through supporting industry's goals of becoming more involved in decision-making and information management. The outcome will be that all parties will be more aware of industry's actual impacts. "Our hope...is that the project will encourage proactive thinking and actions from industry *to enhance the sustainability of their fishery* [my emphasis]...[and provide] a tool for improving its public image."
additional comments
Success factors: (mentioned by authors - I reorganized and elaborated)
1. "project staff are known and trusted by fishers": the project invested time in building "contacts" and created trust which "proved crucial in garnishing support for the second project..." and later expanding it;
2. efforts were made to address fishers' concerns regarding confidentiality of data through formal arrangements and protocols: 1."a statement of arrangements and responsibilities of CSIRO and industry" within an MOU; 2. "explicitly step-wise protocol for making, reviewing and releasing maps" at appropriate scales; 3. "registration and strictly controlled storage of industry's information";
3. industry involvement: in field sampling from industry vessels, interviews at port and at sea, developing the questionnaire, control of map products, "continued involvement through the associations"; representation on project Steering Committee;
4. effective use of technologies and skills of the project team: "using fishing vessel trackplotters with GIS" to collect data rapidly; custom-designed spatial database; high-tech camera system developed and deployed from fishing vessels; "value adding with scientific survey data (geology/oceanography/video)"
5. "verification and validation procedures to ensure data are scientifically rigorous"

It appears that the authors' attitudes also contributed to success. The authors tone and approach is enthusiastic, pragmatic and innovative. They admit they are learning from fishers. "Verification and validation" of data is mentioned once, not emphasized. They understand that fisheries issues are political – that interests are involved and that management must meet various stakeholders' interests in order for sustainability goals to be met.
They do not elaborate on the various skills, knowledge, and relationships within their project team and with key fishers or leaders although they had extensive collaborations with industry assocations, individual fishers, CSIRO Marine Research including the Marine Acoustics group (seabed habitat mapping) and the Ocean Engineering Group; other key scientists with links to the trawl industry (Prince); Baelde - mapping project; funding from CSIRO Marine Research and the Fisheries Research and Development Corporation.

Wilson, D.

Examining the two cultures theory of fisheries knowledge: the case of the Northwest Atlantic bluefish

Identification of Paper
by author
Wilson
source (SL or PW)
PW
Context
author type
S(g?)
case study location
Northeast region, U.S.
geographic scale
regional
category of knowledge holders
recreational fishers
context of Fishers' Knowledge use
general failures of fisheries management which some attribute to too much influence by industry in the Fisheries Council system since 1976
specific context
1996 changes in Federal Law - more precise definition of ten National Standards that all federal Fisheries Management Plans must meet, specifically important: specifying "objective and measurable criteria" for overfishing, either maximum rate of fishing mortality, or a minimum acceptable stock size (or both as in bluefish);
"The case study ...is part of a larger study of the tensions between science and public participation in fisheries management." It focuses on the debate between stakeholders regarding the stock status of Atlantic bluefish (*Pomatomus saltatrix*).
type of management system; level of governance
government
rationale for Fishers' Knowledge use
NA
authors' goals
to "try to understand social influences on the knowledge base used for fisheries management", specifically to examine the relative influence of institutional factors and cultural factors in disputes over bluefish science
Approach
term used for 'Fishers' Knowledge'
local ecological knowledge (LEK); Fishers' Knowledge
term used for knowledge holders
fishers, fishery workers
Fishers' Knowledge definition ND
level of Fishers' Knowledge
Level 1
coded themes
ESCI, EMBEDQ, VALSCI, ADUALQ, SOCLEARN, SAMPI, BUREAUQ (state/fed), CROSSQ, MONEYQ, VALUEQ, ORGVAR, FVALID
theoretical/applied orientation

both

key issues addressed

Wilson's premise is that social scientists have examined cultural differences as they influence interactions between scientists and fishers but have paid insufficient attention to institutional factors, which he concludes are the most influential in the bluefish debate and outcome. "The paper raises seven disputes over bluefish science." Fishers and scientists were in "broad agreement" about "most of the central facts in the debate over the condition of the bluefish stock…The final outcomes of the debate, however, involved a wholesale and specific rejection by the scientists of the 'anecdotal' information that the fishers considered important. This happened in spite of the fact that most of the scientists involved believed that the anecdotal data accurately reflected the condition of the stock. The reasons for this outcome, which satisfied no one, are to be found in institutional factors that constrained and distorted the scientific debate, rather than in differences in culture among the parties concerned." "It was the institutions of fisheries management, i.e. the legal requirements for specific types of answers, the administrative need for a peer review process that does not use "ad hoc" judgements, and the political need for an outcome which was precautionary but not too draconian, that made the ASPIC [see (Wilson 2003)] model the best science available." This occurred despite considerable FK, and fishers' and some scientists' consensus that larger bluefish had moved offshore, the "displacement hypothesis". The ASPIC model has a key assumption that all fish are available to the fishery.

methods used

The author evalutes seven disputes. FK enters several of the disputes within the debate about stock status. This study includes two other Northeast Region species case studies and two random sample surveys, one of marine fisheries scientists and the other of the general population of people active in fisheries management in the Northeast region....[The study involved] formal key informant interviews with 24 scientists, 21 fishers (many of whom served on advisory panels), nine activists in, or active observers of, the fisheries management system, and four administrators. Approximately 200 management-related documents were reviewed, including ten complete transcripts of the Council and/or Commission meetings, of which four related directly to bluefish. We also observed a total of 43 meetings." (Information on the questions asked is not given).

degree of participation of knowledge holders in the research

1 b – interviewees; [in the Council: minimal (input at meetings of different levels of governance)]

aspects of research methods

(i) protocols for permission ND

(ii) how is Fishers' Knowledge used/where is it stored?ND

scope of management activities involving Fishers' Knowledge

unclear

degree of institutionalization of the Integration Project

negligible

language used to describe Fishers' Knowledge

many more than two knowledge cultures in both LEK and "RBK" [research-based knowledge]; concern for stereotyping of LEK and idealizing RBK through listing them as "two types"; appropriate to consider "cultural explanations of LEK and RBK within a particular management situation" (i.e., context specificity or embeddedness of LEK and Science)

language used to describe Science and scientists

"science is made up of many communities with different scientific cultures and standards of validity (Barnes et al. 1996)"

language used to describe the Integration Project NA

Barriers

institutional factors (see *key issues* above); constraints of the two fisheries scientific models – choosing one in order to avoid "unreliable aging and survey data" (but accepting the one with a very dubious assumption – that all fish are available to the fishery); wanting to avoid political constraints (looking for an "intermediate" solution - "precautionary but not too draconian")

Evaluative variables
stakeholder goals
The author answered his principle question: institutional factors were more influential than cultural differences in affecting the outcomes of scientific debates.
additional comments
Two different worldviews are in fact clashing in the overall dispute between bluefish Fishers' Knowledge and Science. The precautionary approach is based in a conservation-oriented ethic which, given uncertainty, says "be cautious, reduce catch" while fishers like the one quoted, who have their livelihoods on the line, say "we're not sure what's happening, but I'm sure if we reduce catch I'm going out of business". If I were a fisher, ignoring the displacement hypothesis would be especially disturbing. A considerable number of very detailed observations by *uninterested* parties (e.g., tuna fishers) could have been investigated and expanded upon in a more systematic manner by scientists. These observations documented bluefish being caught offshore and provided further evidence for the hypothesis of an offshore shift of larger bluefish, which state scientists had also identified. No actions were taken (or at least mentioned) to do research which would test this hypothesis *using a range of information*. Furthermore, given the obviously considerable uncertainty regarding the status of bluefish and therefore the appropriateness of competing models, it would have been feasible to examine the ramifications of using each model explicitly and to discuss and debate this in an open forum. Given that modellers' can potentially do risk analyses and creative modelling approaches, the choice of a model which denied "the possibility of the offshore hypothesis" is difficult to accept as the "best available science".[247]

Wroblewski, J.S.

The colour of cod: fishers and scientists identify a local cod stock in Gilbert Bay, Labrador

Identification of Paper
by author
Wroblewski
source (SL or PW)
SL
Context
author type
Ng
case study location
Newfoundland
geographic scale
local
category of knowledge holders
inshore fishers
context of Fishers' Knowledge use
fisheries collapse
specific context
"heightened scientific interest in the population structure and dynamics of inshore northern cod" related to reports of large aggregations inshore and their absence offshore
type of management system; level of governance

[247] This raises bigger questions not only about the use of FK, but about our capacity to do adaptive management (Walters 1986) given the restrictive basis of laws. Regulations are necessary, but how can *flexibility* be built into these? What is the role of Science and new ways of modelling in this? What are other countries such as Australia and New Zealand doing in this regard?

government management
rationale for Fishers' Knowledge use
missing information
authors' goals
improved fisheries science
Approach
term used for 'TLK'
local or fishers' ecological knowledge
term used for knowledge holders
fishers
Fishers' Knowledge definition
not defined
level of Fishers' Knowledge
1
coded themes
FSQ, VALIDQ, NSD
theoretical/applied orientation
applied
key issues addressed
"Fishers of cod in nearly landlocked Gilbert Bay suspect a group of reddish and golden-brown coloured fish is resident in the bay," thus, the working hypothesis was that there is a resident subpopulation of cod in Gilbert Bay.
Taken alone, colouration of the body may not be sufficient to identify a distinctive stock. "[I]t might be possible for northern cod to migrate into Gilbert Bay and acquire a reddish or golden-brown colour over time. Without corresponding evidence for distinctness from DNA genotyping, body colour alone is a non-conclusive index."
Genetic studies revealed a "reproductively isolated subpopulation" is resident in the bay, which raises the issue of the need for its separate management.
methods used
scientific methods described: sampling fish, colour categorization, genetic analysis (two fishers "provided a history of the family's cod trap fishery"; two others identified colour)
degree of participation of knowledge holders in research
1b (very limited - fishers ranked colour of cod; intitial transfer of knowledge about colour and stock)
aspects of research methods
(i) protocols for permission NA
(ii) how is Fishers' Knowledge used/where is it stored?NA
used as a hypothesis to do scientific research to "validate" it
scope of management activities involving Fishers' Knowledge
A
degree of institutionalization of the Integration Project
none
language used to describe Fishers' Knowledge
"Many fishers *believe*, however, in the existence of "bay" stocks and differentiate [them] ...by the appearance of the fish..." [emphasis mine]
"...a belief based on colour differences..."; "fishers suspect…"
"Fishers ecological knowledge...can be restated as a scientifically testable hypothesis..."
languaged used to describe Science and scientists
scientists – study, investigate, test hypotheses
..."many residents expressed interest in these scientific fndings."
"This new scientific knowledge and the local ecological knowledge we now have of Gilbert Bay cod can be used together by community organizations..."

"Fishers alerted researchers to ...a resource...that had not been scientifically investigated. Fishing people were the initiators of the research in that sense."
"Having documented the local nature of the cod in Gilbert Bay [the author and colleagues]…we need to address the question of how to manage a commercial fishery for a large stock complex…"
language used to describe the Integration Project
1
"If the hypothesis is validated by the research, then Fishers' Knowledge about the Gilbert Bay subpopulation would be supported by new scientific knowledge."
Barriers
hierarchy of knowledge is implicit in subtleties of language (Fishers' Knowledge must be confirmed by Science) HK
Evaluative parameters
stakeholder goals
author: learned new and important biological information
additional comments
Details about how the author learned about the Gilbert Bay cod are not mentioned. He references Powell 1987; and names three fishers as personal communications from 1996.

Zwanenburg, K.; King, P.; Fanning, P.

Fishermen and Scientists Research Society: a model for incorporating fishermen and their knowledge into stock assessment

Identification of Paper
by author
Zwanenburg
source (SL or PW)
SL
Context
author type
Ng,I,Ng
case study location
Nova Scotia
geographic scale
local
category of knowledge holders
inshore fishers, including lobster
context of Fishers' Knowledge use
recognition of need for communication and cooperation between FOC and fishers
specific context
1989 Haché Task Force recommendations: "improved communication of the work done by the Science Branch [of FOC] to members of the industry would help to increase the quality of commercial data supplied by fishermen"; and cooperation should be enhanced
later survey indicated that fishermen also thought there was a communication problem, and that they had knowledge to share
FSRS powerpoint presentation on Nov 2002 BC Tour: Sentinel Program "resulted from the 1992/93 cod moratoria throughout much of Atlantic Canada" and Paul Fanning noted this was "a big shock to the system...a crucial factor in why the society idea took off when it did".
type of management system; level of governance
government management

rationale for Fishers' Knowledge use
missing information useful for sustainable fisheries
authors' goals
"to explore the evolution of the Society's approach to bringing fish harvesters and scientists together"
[to] "illustrate the system developed to incorporate fishermens' knowledge into resource assessment and to enhance their involvement in fisheries science"
Approach
term used for 'Fishers' Knowledge'
fishermens' knowledge
term used for knowledge holders
fishermen, fish harvesters
Fishers' Knowledge definition
ND
level of Fishers' Knowledge
1
coded themes
FSQ, HP, CONFLICTQ, SOCCAP, NSOCCAP, DUALQ, MONEYQ, CROSSQ
theoretical/applied orientation
applied
key issues addressed (focus or premise of paper, major points made - elaborate)
key objectives of the Fishermen and Scientists Research Society (FSRS):
"to establish and maintain a network of trained fishing industry personnel to collect information relevant to the long-term sustainability of the marine fishing industry in the Atlantic Region"; "to facilitate and promote effective communication between fishermen, scientists, and the general public"; to collect information for various projects; to generate revenue where possible to be able to continue to operate; to analyze and disseminate information generated through FSRS
to provide training for members; and to avoid being perceived as a lobby group of "either the fishing industry or the scientific community"
examples are given of successful projects - fishers' participation in scientific data collection for stock assessment; and those involving Fishers' Knowledge (e.g., inshore tagging studies of cod, halibut and haddock; sensitive habitat mapping; lobster research)
improving trust between fishermen and scientists was both an accomplishment and a challenge
finances to fund their work is an ongoing challenge
methods used
interviews for sensitive habitat; training fishers to tag and collect data; fishers participate in research with ideas
degree of participation of knowledge holders in research
1a,b,2 (different projects)
aspects of research methods
(i) protocols for permission ND
(ii) how is Fishers' Knowledge used/where is it stored?ND
scope of management activities involving Fishers' Knowledge
A 2 (2) [some projects appear to be part of or used by management; others, fate of TLK unclear e.g., mapping]
degree of institutionalization of the Integration Project

non-profit organization[248]

language used to describe Fishers' Knowledge

"valuable information"

"Fishermen and others have contended that there is a large store of local knowledge…"

"fishermen recommended new and possibly better ways of doing the science based on their experience…[E]arly indications are that [their lobster] trap design…is more effective...Hence, fishermens' input is contributing to improved science."

language used to describe Science and scientists

"[FOC] has operated highly standardized, scientifically and statistically rigorous groundfish surveys...since1970…[But there is] limited spatial and temporal coverage..."

"Ensuring reliable, quality information is of paramount importance to useful science. All FSRS projects include training and quality control measures. A key element in ensuring quality data is making sure fishers understand the importance of good science, how science is done and how they will benefit from the results. If they do not understand and support the purpose of the project they are participating in and understand how they can use the results to better manage their fishery, they will not be concerned about reporting accurate information".

"Regardless of what else they may or may not agree on, fishermen and scientists agree there is a need for more and better science if we are to conserve and manage our resources better. The FSRS is one of a growing number of initiatives that can make that science happen…"

language used to describe the Integration Project

1

"to incorporate fishermens' knowledge into resource assessment and to enhance their involvement in fisheries science"

"Fishers do science themselves (with assistance from scientists to create protocols) or their knowledge is obtained by scientists for use in fisheries science."

"Although the FSRS recognizes the value of incorporating Fishers' Knowledge, it is not sensible or desirable to develop a process based on unreliable information, opinion, or hearsay. The Society thus insists on reliable and valuable information even though this presents problems in the attempts to incorporate local knowledge. Without this as a point of departure, we would be building a house of cards."

"Before fishers deferred to [FOC] scientists for what science needed to be done and now the fishers decide what science they want to do and how to do it. They have more confidence in their own knowledge and understanding of the fishery, and their abilities to participate in science..."

(process of teaching them to become scientists - a model of "democratizing" science or participatory science)

"These different FSRS projects illustrate the different degrees to which projects can incorporate Fishers' Knowledge and involve fishers. Involvement of fishers can range from obtaining traditional knowledge to having the fishers independently conduct scientifically rigorous projects."

Barriers

trust between fishermen and scientists SOCCAP

separating reliable information in FK from unreliable such as opinion and political motivation (subjectivity) (scientists do this) COMPLEXQ HK

financial challenges to maintain the organization and continue with projects MONEYQ

Evaluative variables

[248] organization founded in 1994 - fall of 1995 - Sentinel Program (Sentinel Stratified Random Survey) began 1997 and was extended through a Joint Project agreement between FSRS and[FOC]; as of 1999 FSRS has 157 fishers and 44 scientists (from government, academic and private sector - both social and natural) (As of November 2002, 286 members 205 fishers and 85 others; funding from variety of sources including approximately $500,000 annually from [FOC] $360,000 of which goes to the Sentinel Project. Executive, Scientific Program and Communications committees; [FOC] scientists play a role on the committees but are restricted from voting positions; Annual General Meeting; Source: handout from FSRS Speaker Tour November 2002, BC)

stakeholders' goals
Authors: from this article alone, communication has improved but has been challenging. Fishers have participated in the data collection and also designed and participated in projects with assistance from scientists.
additional comments
There are no fishers as co-authors even though the organization is a partnership (however at UBC conference a fishermen presented; another was co-author (Zwanenburg et al. 2003) and a fishermen participated in the BC tour).
The tone, language, and some of the content is different in this article compared to King (1999), to FSRS literature, and even to Paul Fanning's (FOC scientist) presentation on a tour in British Columbia in November 2002. For example, the word "co-education" is used in the FSRS promotional pamphlet, as is "working together to collect and interpret information about fish stocks and the marine ecosystem. All members are committed to a process of co-education, regardless of whether they are fishermen or scientists." Reference is made to the Society which "educates fisheries scientists by making them realize the wealth of knowledge about fishes and fishing that fishermen gain by experience. In turn, fishermen gain an increased understanding of the scientific methodologies and processes involved in managing the fisheries resource."[249]
Fanning, in his tour presentation overheads, mentions collaborative research and co-education as the two goals when established in 1994.
Zwanenburg et al. (2003) refer to the challenge and accomplishments of '"building trust between fishermen and scientists" and to the "changing of attitudes", but what these are and who they belong to are not specified. King (1999) as sole author is again more explicit: "Changing attitudes between these two historically adversarial groups is not an easy or quick process, however, as the two work more and more together they are learning to speak a common language and have developed a better understanding of each other." Furthermore, the overview handout of FSRS notes "the significant mistrust that had developed between the two groups. Many fishermen felt that scientists had nothing to offer because they were not fishermen, and many scientists felt that fishermen, without formal training, could not participate in scientific discussions about fish stocks. From these humble beginnings, with not much more than a willingness to talk and a feeling that co-operation was better than confrontation, [FOC] scientists, and fishermen (among others) worked toward the evolution of the Society." TRUSTQ SOCCAP CROSSQ The consistent differences in clarity and forthrightness is interesting to note and raises issues of writing style, target audience, and content which is perceived as relevant by authors.

[249] Overview of the Fishermen and Scientists Research Society, one page handout received during BC Tour (is more recent than March 2000).

Appendix B. Summary of evaluative frameworks

Identification	Context
Authors	**Author type**[250]
Baelde, P.	Na
Bergmann, M.; Hinz, H.; Blyth, R.; Kaiser, M.; Rogers, S.I.; Armstrong, M.	Na,Ng,Na
Blyth, R.; Kaiser, M.J.; Hart, P.J.B.; Edwards-Jones, G.	Na,Na,Na,Na
Gosse, K., Wroblewski, J., Neis, B.	Na,Ng,Sa
Hutchings, J., Ferguson, M.	Na/Si
Melvin, E.; Parrish, J.	Na,Na
Pitcher, T., Haggan, N.	Na,IDa
Sutton, S.G.	Na
Camirand, R.; Morin, B.; Savard, L.	Ng,Ng,Ng
Lessard, J., Osborne, J., Lauzier, R., Jamieson, G., Harbo, R.	Ng, IDi, Ng, Ng,Ng
Purps, M., Damm, U., Neudecker, T.	Na,Ng,Ng
Stanley, R., Rice, J.	Ng, Ng
Williams, A; Bax, N.	Ng,Ng
Wroblewski, J.	Ng
Zwanenburg, K., King, P., Fanning, P.	Ng,I,Ng
Lydon, G.; Langley, A.D.	?,Ni
Prince, J.D.	Ni
Gendron, L., Camirand, R., Archambault, J.	Ng,Ng,Sa
Rowe, S., Feltham, G.	Na, F
Power, A.S., Mercer, D.	?g,?g (manager)
MacNab, P.	IDgF
Roepstorff, A.	ID
Ames, E., Watson, S., Wilson J.	FSi,Sa,ID
Glaesel, H., Simonitsch, M.	Sa,F
Maurstad, A.	SaF
Rudd, M.	Sg
Wilson, D.	S(g?)
Chiarappa, M.J.	Sa
McGoodwin, R., Neis, B., Felt, L.	Sa,Sa,Sa
Neis, B., Felt, L.	Sa,Sa
Pálsson, G.	Sa
Power, N.G.	Sa

250 Authors are arranged in alphabetical order within subgroupings: N = natural scientist; S = social scientist; ID = significant training in both NS and SS (e.g. geographer) or other; F = fisher; FS = fisher with training as a scientist; O = other;"subscripts" refer to affiliation: g = government, a = academic, i = independent or First Nation affiliation. For purposes of analyses, the first 19 papers were classified as “natural scientist” and the last 12 papers as “social scientist”. Power and Mercer (2003) was not used in the analysis since information was not available regarding their background.

Author code	Location	Geog. scale	Knowledge holders
Baelde	Australia	various	various
Bergmann	Irish Sea	regional	demersal fishers
Blyth	south England	local	inshore and towed gear
Gosse	Newfoundland	local	inshore fishers
Hutchings	Newfoundland	local	inshore fishers
Melvin	Washington, Alaska	local/regional	gillnetters, longliners
Pitcher	Prince Rupert	unclear	commercial, aboriginal
Sutton	Newfoundland	local	recreational fishers
Camirand	Gulf of St. Lawrence	local	gillnetters
Lessard	Vancouver Island	local	barnacle fishers
Purps	Germany	local	shrimp trawlers
Stanley	British Columbia	local	groundfish trawl
Williams	southeast Australia	regional	trawl and line fishers
Wroblewski	Newfoundland	local	inshore fishers
Zwanenburg	Nova Scotia	local	inshore fishers
Lydon	North Island, N.Z	local	inshore longliners
Prince	Tasmania	local	abalone divers
Gendron	Quebec	local	lobster fishers
Rowe	Newfoundland	local	lobster fishers
Power A	Newfoundland	local	inshore fishers
MacNab	Newfoundland	local	inshore fishers
Roepstorff	Greenland	local	inshore fishers
Ames	Gulf of Maine	local	inshore fishers
Glaesel	New England	regional	various
Maurstad	Norway	local	inshore fishers
Rudd	tropics - various	local/regional	inshore fishers
Wilson	Northeast U.S.	regional	recreational fishers
Chiarappa	Lake Michigan	unclear	unclear
McGoodwin	NA	NA	commercial (1 recreational)
Neis	NA	NA	commercial (1 recreational)
Pálsson	Iceland	NA	NA
Power N	Newfoundland	local	women fish processors

Author code	Context of Fishers' Knowledge use	Specific context
Baelde	fisheries failures; public demand for environmental protection; changes in fisheries management	various
Bergmann	habitat focus	interest in "Essential Fish Habitat"
Blyth	intersectoral conflict	intesectoral voluntary agreement
Gosse	fisheries collapse	Coasts Under Stress project
Hutchings	fisheries collapse	post-moratorium investigation of the fishery
Melvin	seabird bycatch	bycatch and Endangered species legislation
Pitcher	ecosystem restoration	*Back to the Future* approach - modelling past, present, and future ecosystems
Sutton	potential shift to community watershed management	larger project on unique salmon population; lack of anglers' knowledge
Camirand	fisheries decline	policy of precautionary approach
Lessard	lack of information and local stock decline	FOC policy on new and developing fisheries – precautionary approach
Purps	increase in fisher involvement in data collection	agency bycatch program
Stanley	stock assessment	disagreement between stock assessment scientists and fishers on abundance of rockfish
Williams	Australia's Oceans Policy	shift toward spatial management of oceans and ecosystems
Wroblewski	fisheries collapse	interest in local stocks
Zwanenburg	communication problems	Task force recommendations; fishers' survey
Lydon	increased fisher involvement	Adaptive Management Programme and logbook monitoring
Prince	fisheries failures	abalone fisheries and centralized management
Gendron	communication problems	program and project to improve communication, involve fishers
Rowe	fisheries collapse	moratorium increased pressure on lobster
Power A	fisheries collapse	Integrated Management within FOC
MacNab	fisheries collapse	Parks Canada's interest potential protected area
Roepstorff	NA	NA
Ames	fisheries collapse	collapse of groundfisheries
Glaesel	fisheries collapse	U.S. Regional Fisheries Councils
Maurstad	fisheries decline	funding for Fishers' Knowledge in SA
Rudd	NA	NA
Wilson	fisheries decline	post 1996 Fisheries Management Plans; tensions between science and public participation (including knowledge) in FM
Chiarappa	stakeholder conflict	historical perspectives neglected in policy debate

Author code	Context of Fishers' Knowledge use	Specific context
McGoodwin	shifts in Western culture; changes in Science	concluding chapter of Sea Legs
Neis	fisheries collapse, crisis of confidence in management, user involvement	introductory chapter of Sea Legs
Pálsson	NA	NA
Power N	fisheries collapse	post-moratorium life of women and their neglected knowledge base

Author code	Rationale for Fishers' Knowledge	Author's goals
Baelde	improve management	to examine the role and value of Fishers' Knowledge in industrial fisheries
Bergmann	missing information, fisher participation	to learn about finer-scale fish distribution
Blyth	prevent fisheries decline	understand success factors and benefits of agreement
Gosse	missing information on local stock	to investigate Fishers' Knowledge of coloration and a local stock
Hutchings	missing information	describe temporal changes in fisher; fishers' suggestions of management improvements
Melvin	ND	to solve bycatch problem with cooperative model
Pitcher	missing information	to use past ecosystems to guide restoration policies
Sutton	missing information	document and assess anglers' ecological knowledge
Camirand	missing information	understand abundance and effort changes
Lessard	missing information	incorporate Fishers' Knowledge into stock assessment and management
Purps	NA	assess data collected by fishers (and others) and develop guidelines
Stanley	missing information	improve stock assessment research and communication with fishers
Williams	missing information; involvement	to identify important habitat features which influence producitivyt; incorporate Fishers' Knowledge into strategic planning
Wroblewski	missing information	improve fisheries science
Zwanenburg	missing information	to demonstrate FSRS projects and function
Lydon	missing information	to describe a successful case
Prince	NA	to discuss fine-scale stock structure and inappropriate management
Gendron	missing information, improve communication, increase agency legitimacy, increase fisher participation	collect Fishers' Knowledge for input into stock assessment

Author code	Rationale for Fishers' Knowledge	Author's goals
Rowe	ND	document and participate in Committee process
Power A	involvement; missing information	to review a number of examples
MacNab	missing information	supporting Committee's mapping project
Roepstorff	NA	to explore how knowledge is made through practices and interactions between people; reconcile knowledge traditions and improve exchanges between fishers and biologists
Ames	missing information	critique "traditional FM" in terms of scale
Glaesel	missing information; better fisheries decisions	to include fishers in meaningful decision-making
Maurstad	missing information; increase legitimacy of NRM institutions	various interdisciplinary
Rudd	reduce transaction costs	to link conceptually link social capital with Fishers' Knowledge
Wilson	NA	examine the relative influence of institutional factors and cultural factors in disputes over bluefish science
Chiarappa	NA	to better understand history and culture informing fishers' perspectives
McGoodwin	improved communication; missing knowledge, etc.	discuss issues, prospects, problems of integration; make recommendations
Neis	improve knowledge and understanding of ecosystems and fisheries	various including place the contributed papers in context
Pálsson	improve fisheries management	improve relationships between stakeholders; address hierarchies of knowledge
Power N	missing information (biological and social impact)	document women’s knowledge, raise awareness of impacts of patriarchy on policies, nature and human behaviour

Approach variables		
Author code	**Focus**	**Key issues**
Baelde	both	specific efforts needed for FK to be incorporated into SA; participatory modelling a potential but challenging way to involve fishers; meaningful consultation necessary in MPA processes; FK goes beyond "filling gaps in science"
Bergmann	applied	fishers' information agreed with larger-scale survey data
Blyth	both	agreement provides some level of territorial protection (both gear and habitat) given context of potential towed gear dominance
Gosse	both	experimental Science permits the validation FK; dietary experiments contributed to information on local stock
Hutchings	applied	FK of effort increases consistent with more gradual decline
Melvin	applied	co-operative research model solved two cases of bycatch problems
Pitcher	both	*Back to the Future* can incorporate TLK in models which reconstruct past ecosystems as a means to generate policy discussion
Sutton	both	anglers’ ecological knowledge useful, confirmed by scientific studies, recommendations made, two implemented
Camirand	applied	fluctuations in catch reflected changes in abundance and effort
Lessard	applied	harvesters' participation and knowledge in goosebarnacle assessment
Purps	applied	about two-thirds of data useable in further analyses; recommendations
Stanley	both	Participatory Research model in which fishers are co-researchers
Williams	applied	FK contributes to cost-effective mapping over large area; fishers have stake in spatial planning
Wroblewski	applied	assess whether FK-identified local stock is distinct
Zwanenburg	applied	objectives of FSRS, examples of projects, trust is important, money remains a challenge
Lydon	applied	fishers' participated in a logbook program which improved stock assessment
Prince	both	local stocks are critical to communities and cannot be managed centrally; need for fisheries ecologist to work locally; case of voluntary abalone agreement involving *de facto* local management
Gendron	applied	FK of effort increases helped explain biological indices
Rowe	applied	lobster local management through a Committee with partnerships; innovations and use of local knowledge
Power A	conceptual (review of program)	emphasis on degree of participation in Community-based Coastal Resource Inventory and Marine Protected Areas programs

Approach variables		
Author code	**Focus**	**Key issues**
MacNab	both	collaborative project with many agencies but fishers' committee-controlled; maps serve several functions; funding an issue
Roepstorff	both	biological knowledge focuses on concept of stock; fishery knoweldge on fish as "organism" in dynamic environment
Ames	both	groundfish collapse as cumulative effects of serial depletion of discrete inshore stocks; importance of temporal and spatial scale in management and governance; FK provides key info
Glaesel	conceptual	fishers' participation (including know-ledge) must be incorporated into fisheries management institutions
Maurstad	both	interdisciplinary challenges in Integration Project
Rudd	conceptual	FK contributes to social capital and can reduce transaction costs of fisheries management
Wilson	both	institutional factors, including political, legal and administrative contraints, influenced science debates; FK was rejected
Chiarappa	conceptual	"fishers use oral history to invoke TEK's authority…in ongoing [resource] claims"
McGoodwin	conceptual	summarizes history and context of TLK use; barriers; methodologies; recommendations
Neis	conceptual	TLK can contribute positively; importance of reflecting and learning from cases
Pálsson	conceptual	knowledge arises through practice -focus on fishers' "enskilment" and social embeddedness; Science as privileged
Power N	both	women's knowledge has been marginal-ized within fisheries, fisheries science and management; critique of policies; examples of WK of impacts of overfishing on cod and snow crab and on their lives

Author code	Proto-cols	Used/ Stored	Partici-pation	Management Activities	Institutional-ization	Lang-uage of IP	FK level[251] (author)	FK level (Soto)
Baelde	ND	ND	1b;3;1b	A,B (2)[252]; NA	negligible	4	1,2	1,2,3
Bergmann	ND	ND	1b	A (5)	negligible	NA	1	1
Blyth	yes	ND	3 in IPA	1,3,5	NA	NA	2	2
Gosse	ND	ND	1	A (5)	some	1	1	1
Hutchings	yes	ND	1b	A, (2)	negligible	2	1	1

251 FK level (authors) indicates that authors show some awareness of the contribution of what is defined here as three levels of knowledge. FK level (Soto) indicates that other levels of knowledge are indicated in the case but authors have not considered them.

252 Participatory modelling was a hypothetical case with the potential activities: 1,2,3,5,6.

Author code	Proto -cols	Used/ Stored	Partici- pation	Management Activities	Institutional- ization	Lang- uage of IP	FK level (author)	FK level (Soto)
Melvin	ND	ND	3	A 1	negligible	NA	1	1,2,
Pitcher	ND	ND	1b	A (1,5)	negligible	NA	1	1
Sutton	ND	ND	1b	A,B, 1,3	negligible	4	1,2	1,2
Camirand	ND	ND	1b	A,B (1,2,3,6)	negligible	NA	1,2	1,2
Lessard	ND	ND	2	A 1 2 5	some	2	1,2	1,2
Purps	ND	ND	1a	A	agency program	1	1	1
Stanley	NA	NA	3	A 2	some	4	1	1
Williams	yes	ND	3	A (5)	some	4	1	1
Wroblewski	NA	NA	1b	A	negligible	1	1	1
Zwanenburg	ND	ND	1a,b, 2	A 2 (2)	non-profit organization	1	1	1
Lydon	ND	ND	2	A 2	some	3	1,2	1,2
Prince	ND	ND	3	A 2,3,5,	some	NA	1	1,2
Gendron	ND	ND	1b	A,B, 2	some	2	1,2	1,2
Rowe	ND	ND	1a,b,2,3	A, 1,2,3,4,5,6	organization with partners and funding	4	1	1,2,3
Power A	ND	ND	3	A B 5	some	4	1,2	1,2,3
MacNab	yes	FC[253]	3	A,B	some - unclear	4	1,2	1,2
Roepstorff	NA	NA	NA	NA	NA	3	1,2	1,2
Ames	ND	ND	1b	A	negligible	3	1	1
Glaesel	NA	NA	1b	NA	negligible	4	1,2	1,2,3
Maurstad	ND	ND	1b	A,B, 2	negligible	2	1	mainly 1
Rudd	NA	NA	NA	NA	NA	NA	1,2,3	1,2,3
Wilson	ND	ND	1a	unclear	negligible	NA	1	1
Chiarappa	ND	ND	1b	NA	NA	NA	NA	1,2,3
McGoodwin	NA	NA	NA	NA	NA	2,3	1,2	1,2
Neis	NA	NA	NA	NA	NA	3	1,2,3	1,2,3
Pálsson	NA	NA	NA	NA	NA	2	1	1
Power N	ND	ND	1b	A,B	negligible	2	1,2,3	1,2,3

[253] Fishers control the use of the maps.

Appendix C. Analyses of coded themes[254]

Table A. Percentage of natural and social scientist authors who mentioned particular coded themes.[255]

Author type	AHK	ADOUBT	VALIDQ	NEGSOC	SOCCAP
NS	11	21	63	11	42
SS	67	75	25	42	42

Author type	CROSSQ	ASQIP	APARTQ	EMBEDQ	ESCI
NS	32	21	42	0	0
SS	67	17	33	67	58

254 I counted the first 19 papers in Appendix A as "authored by natural scientists", and the final 12 papers as "authored by social scientists" (which includes the category interdisciplinary). Generally, the first author of the paper was of the type in which I classified the paper. Exceptions were Ames et al. (2000) who is a fisherman and whose co-author was a social scientist (classified as “social scientists”), and Lydon and Langley (2003): unknown first author and natural scientist second author (classified as “natural scientists”). I omitted Power and Mercer (2003) since I had no information regarding their backgrounds. Values are expressed as a percentage of the total number of papers of each author type (19, and 12, respectively).

255 Only codes which differed by a considerable amount or were unexpectedly similar are shown here.

Table B. Most frequently mentioned coded themes in literature cases by natural scientist and social scientist first authors.

Natural scientist		Social scientist	
Coded theme	**Percentage**	**Coded theme**	**Percentage**
VALIDQ	63	ADOUBT	75
FSQ	47	AHK	67
SOCCAP	42	**CROSSQ**	67
APARTQ	42	EMBEDQ	67
CONFM	37	ESCI	58
CROSSQ	32	**CONFM**	58
BUREAUQ	32	ADUALQ	50
EFFICQ	32	CONFLICTQ	50
HP	26	INTQ	50
EFFCHAN	26	**SOCCAP**	42
MONEYQ	26	**FSQ**	42
		NEGSOC	42
		BUREAUAQ	42

Table C. Differences in number of social issues raised per literature case between natural- and social scientist-authored literature cases.[256]

Social scientist	**Natural scientist**
Mean = 10.8 n=12 (10.6 if cut highest and lowest value) Maurstad =15 Wilson = 15 McGoodwin et al. (review paper) = 21	Mean = 6.2 n=19 (5.6 if cut highest and lowest value) Baelde = 22 Stanley = 18

Coded themes which are categorized as "social" or "contextual" issues[257]

AHK
DUALQ
SIMIQ
ADUALQ
ASUBJ
ADOUBT
AVALID
VALSCI
FVALID
POLICY
EFFCHAN
SAMPI
NEGSOC
SD
CONFLICTQ
SOCCAP
SOCLEARN
IPRQ
PROTOCOLQ
ETHIQ
TRAINQ
CROSSQ
BUREAUQ
ASQIP
APARTQ
DYNFK
EMBEDQ
ESCI
INTQ
VALUEQ
POLIQ
CONFM

[256] Mean number of social issues raised per literature case is calculated by summing the number of social issues raised in each case, then calculating the mean for each *type* of author (i.e., cases which were first-authored by natural or social scientists).

[257] The code SD – at least one social dimension of the Integration Project is raised – is utilized in this analysis only. (It was such a frequent code that it was less informative than NSD which is listed in Table 5).

Appendix D. Analysis of variables in the evaluative framework

Table A. Levels of Fishers' Knowledge utilized in applied literature cases.[258]

Level of FK	Agency applied cases[259] (n=16)	Other applied cases[260] (n=8)
Level 1	16	7
Level 2	6	4
Knowledge of fishers' behaviour:	Baelde, Camirand	
Feedback on management system, including recommendations:		Blyth, Sutton, Power
Both of the above:	Gendron, Lessard, Lydon	Hutchings
Knowledge on local management systems:	MacNab[261]	

258 "Applied cases" refer to cases in which authors worked directly with fishers.

259 In this analysis, Prince, Baelde, Melvin and Parrish, Rowe and Feltham, Lydon and Langley were included since the interact with agencies in their work. Purps et al. (2000) was included here. Power and Mercer (2003) were not, since their paper did not involve directly working with fishers (it was a program review). Thus n=16.

260 This includes social scientists and natural scientist based in universities who worked directly with fishers in their reported cases. (I did not include Roepstorff, Pálsson, and Chiarappa, whose papers involved interviewing fishers at some point in their work, but whose papers are quite distinct in their conceptual frameworks).

261 This was also utilized in Rowe and Feltham (2000) but they did not appear to conceptualize this as Fishers' Knowledge, thus I did not count it here.