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Knowing in context: An exploration of the interface of marine harvesters' local ecological knowledge with ecosystem approaches to management

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ABSTRACT

Marine resource crises have initiated a search for alternative approaches to resource assessment and management that has culminated in a global focus on ecosystem approaches to management (EAM). Here, the ecosystem extends to humans as drivers and recipients of ecosystem change. More specifically, attention is being paid to identifying specific qualities of local resource users' experiences and knowledge that might productively inform resource management, while also providing local users with substantial "voice" in shaping new management policies and practices. Here an evaluation is provided of the extent to which local ecological knowledge (LEK) can provide advice for an ecosystem approach to inshore coastal management, specifically, the identification of ecologically and biologically significant areas, based on the results of two comprehensive studies of coastal Nova Scotian commercial harvesters' local ecological knowledge. While spatially explicit, local ecological knowledge displays strengths and limitations that must be explicated for it to prove useful for strengthening "voice" and providing EAM inputs.

1. Introduction

Marine resource crises have initiated a search for alternative approaches to resource assessment and management that has culminated in a global focus on ecosystem approaches to management (EAM) [1,2]. In an EAM, the concept of ecosystem is explicitly extended to embrace humans, as drivers and recipients of ecosystem change [3,4], and as holders of experiential knowledge. With respect to this, attention is being paid to local resource users' experiences and knowledge that might productively inform resource assessment and management, while also providing local users with substantial "voice" in shaping new management policies and practices [5,6]. In particular, marine harvesters' knowledge of key local ecosystem attributes is presumed important for identifying and supporting integrated resource management plans. These include new ecosystem-referenced management initiatives such as the definition of ecologically and biologically significant areas and implementation of marine protected areas (MPAs). Exploring attributes of this is a central focus of this paper.

The Canadian federal government, through Fisheries and Oceans Canada (DFO), leads the Canadian initiatives in the development and implementation of ecosystem approaches to oceans and coastal management. The collapse of many key groundfish resources on Canada's east coast in the late 1980s–early 1990s motivated the federal government to examine alternatives to obviously failed resource management policies. At more or less the same time and in response to similar situations, world governance institutions such as the United Nations launched consultative initiatives that resulted in outcomes such as the 1987 "Brundtland Commission", *Our Common Future*, and the 1992 United Nations Conference on Environment and Development. The latter produced a document titled "Agenda 21" in which commitment to sustainable development engaging protection of ecosystems was placed front and centre [7]. Canada was one of the many global signatories to this undertaking, developing and adopting in 1997 "the Oceans Act" as the major legislative initiative intended to frame future national approaches to ocean and coastal policy and management [8]. This Act provides the legislative framework for an integrated ecosystem-approach to Canadian oceans management.

The Oceans Act has enabled several Canadian initiatives intended to guide the development of specific ways to achieve ecosystem management. At the national level in 2005, DFO launched its "Oceans Action Plan" [9]. Central to this plan was the expressed commitment to achieve sustainable, ecosystem approaches to management through engaging key-stakeholders in an integrated and collaborative process ranging from harvesters and their communities, through communities of interest such as non-governmental organisations and industry groups, to all

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levels of government. In the Maritimes, the Eastern Scotian Shelf Integrated Management (ESSIM) collaboration [10], for example, attempted to build the type of broad-based collaborations requisite for effective integrated management, including EAM.[2] More recently, the federal government signed a memorandum of understanding with the Nova Scotia provincial government in which each commits to collaboration on ''…facilitating integrated approaches to coastal and oceans management'' [12]. Identifying and developing the ways and means to access and engage marine harvesters' experienced-based knowledge of coastal and oceans eco-systems is expressed commonly as a key attribute within these and many other integrated management initiatives.[3]

A more global ecosystem-based initiative is the definition of EBSAs, which are, among other things, precursors for marine protected areas (MPAs). The Convention for Biological Diversity, an international treaty, to which Canada is a signatory and conceived as a tool to translate the principles of Agenda 21 into reality (The Convention on Biological Diversity—http://www.cbd.int/convention/) adopted a set of seven scientific criteria to identify ecologically or biologically significant areas in need of protection in the open oceans and deep seas in 2008 (CBD Decision IX/20, Annex 1). Although Canada has endorsed the CBD criteria, prior to their development, Canada had defined its own EBSA criteria, which are comparable to those of the CBD [13].

Canada's Oceans Act authorises DFO to provide enhanced protection to areas of the oceans and coasts that are considered to be ecologically or biologically significant. Here, definition of an area as ''significant'' indicates that if the area was disturbed or disrupted, the ecological consequences would be greater than an equal disturbance of most other areas [14]. Significance has several dimensions and can refer to the role of habitat (benthic or pelagic), a community attribute or the role of a species in the ecosystem. An internal DFO Science meeting developed a framework in 2004 for the definition of EBSAs [14]. The framework outlines the entire process for establishing EBSAs, from their definition to their operationalisation in a management context, and is described as a ''continuum of activities''. All steps in this continuum are ''science-based'', but the role of science changes along the continuum. Here ''science-based'' is defined as ''work[ing] from scientifically sound information'', which is inclusive of experiential knowledge, defined as ''a term including ''Aboriginal traditional knowledge'', ''fishermen's knowledge'', and other ways that ecological knowledge is acquired through extensive experience with the marine environment'' [14,3]. Three steps are outlined, the first of which is a ''Science-led process, wherein the area(s) of interest are evaluated within the framework that has been developed. ''Experiential knowledge'' should be fully included in these steps. These steps should lead to some structured output, such as a quantitative or qualitative ranking of different areas relative to their Biological and Ecological Significance'' [14,3]. The second and the third steps relate to the degree of management aspects of EBSAs. The second is described as ''…an even more inclusive Oceans-led process that considers how to match degree of management protection to sites along the ranking of areas on their Biological and Ecological Significance.'' [14,3]. The third step is the implementation of management regulations where it must be clearly specified ''…what management measures will be used at the various sites, and under what conditions'' [14,3].

Focussing on the first step, the DFO framework specifies five science-based ecological criteria for the identification of EBSAs: uniqueness, aggregation, fitness consequences, resilience, and naturalness [14]. The first three criteria are considered the main dimensions for defining EBSAs while resilience and naturalness are secondary. Each of these is a continuum and can refer to a mix of attributes such as species, communities, or an area's physical features. Uniqueness refers to areas whose characteristics are ''unique, rare, distinct, and for which alternatives do not exist'' [14,4]. In practice this is a relative measure and scale dependent. At the coastal level, what is unique or rare in one bay may be common to all bays. Aggregation refers to areas where species collect for part of the year for a specific life-history function (e.g. spawning) or where some specific and key ecological process takes places (e.g., convergence zones leading to aggregation of prey and nutrients). Fitness consequences refer to features that are important to the survival of one or more species. For example, an area which is the only feeding area for a species has important fitness consequences for that species. In practice, potential EBSAs are scored on all 3 criteria, then ranked, based on a prioritisation process [15].

In this paper we explore the specific directive to include ''experiential knowledge'' in the definition of EBSAs. Specifically, we examine how harvesters' local ecological knowledge (LEK) can contribute to the process of characterising EBSAs by focussing on the uniqueness, aggregation, and fitness consequences criteria. We present an initial description and analysis of the results of two comparable, comprehensive studies of coastal Nova Scotian commercial harvesters' local ecological knowledge, one of which was designed to collect LEK to support the identification of EBSAs.

The paper begins with a discussion of what we mean by LEK and consideration of some of the conceptual challenges associated with characterising and researching LEK. This is followed by a review of the research design and methods we have employed to document marine harvester LEK. Initial outcomes from this research are then presented and discussed. We conclude by profiling the strengths and limitations of harvester LEK with respect to developing EAM initiatives, with particular emphasis given the criteria designated as key to determining biological and ecological significance.

2. What do we mean by local ecological knowledge?

In the tradition of Odum, ecology is defined as ''…the study of the structure and function of nature'' [16,1], meaning that ecology encompasses intra- and inter-species interactions and species interactions with their environment. It is the science of ecosystems. Odum further characterises ecosystems as the inter-relation of an entire biological community and its non-living environment [16,4]. A scientific approach seeks to understand these relationships through repeated observations, development and testing of hypotheses and quantification of these relationships. Science-based understandings are derived from replicable, evidence tested ideas, i.e., the subjection of hypotheses to the burden of proof defines science-based epistemology.

[2] For instance, recently the ESSIM initiative issued four theme papers for the State of the Scotian Shelf Report: At Risk Species; Marine Habitats and Communities; Trophic Structure; and Ocean Noise. Also, the Technical Report of Fisheries and Aquatic Sciences #2880, *Ecological and Human Use Information for Twenty Areas on the Atlantic Coast of Nova Scotia in Support of Conservation Planning*, is now available [11], the latter is intended to provide baseline information for coastal management initiatives on the Atlantic coast of Nova Scotia, with particular relevance to DFO's Integrated Management and Marine Protected Area and Conservation Planning Programs.

[3] ''Integrated management includes explicit commitments to incorporate ecosystem considerations with the understanding that: ecosystem-based management is an integrated or holistic approach to making decisions about ocean-based development and conservation activities. It means considering the environmental impact of an activity on the whole ecosystem, not simply the specific resource targeted. It also means taking into account the cumulative impact of all human activities on the ecosystem within that area'' (http://www.dfo-mpo.gc.ca/oceans/management-gestion/integratedmanagement-gestionintegree/index-eng.htm).