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A GIS-based protocol for the collection and use of local knowledge in fisheries management planning

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Abstract

Despite a heavy reliance on scientific knowledge as the primary source of information in resource management, many resources are in decline, particularly in fisheries. To try and combat this trend, researchers have drawn upon the knowledge of local resource users as an important supplement to scientific knowledge in designing and implementing management strategies. The integration of local knowledge with scientific knowledge for marine species management, however, is problematic stemming primarily from conflicting data types. This paper considers the use of spatial information technology as a medium to integrate and visualise spatial distributions of both quantitative scientific data and qualitative local knowledge for the purposes of producing valid and locally relevant fisheries management plans. In this context, the paper presents a detailed protocol for the collection and subsequent use of local knowledge in fisheries management planning using geographic information systems (GIS). Particular attention is paid to the use of local knowledge in resource management, accuracy issues associated with the incorporation of qualitative data into a quantitative environment, base map selection and construction, and map bias or errors associated with the accuracy of recording harvest locations on paper map sheets, given the complications of map scale.

Keywords: GIS; Local knowledge; Fisheries management; Map bias

1. Introduction

In recent years, increasing evidence has been assembled to support the view that local fishermens' knowledge is fundamental to the management of fish species (Berkes et al., 2001; Berkes, 1993; Neis and Felt, 2000; Johannes, 1989; Wavey, 1993; Johnson, 1992; Maurstad, 2002). However, this knowledge has tended to be neglected in management plans due to the notion that local knowledge is fragmented and subjective, and thus lacking in scientific merit. This view is currently undergoing re-evaluation as the importance of local knowledge is being increasingly recognized, especially in light of the failures of management policies derived solely from the use of scientific knowledge.

Fishermen, because they are on the water most days of the week, depending on season and weather, experience patterns in climate, water currents, fish migration patterns and species' behaviour first hand that may not be fully represented during the times when a scientific study takes place (Johannes, 1989). Hence, they tend to have better local and temporal knowledge than scientific data gathering can capture unless data are captured over substantial time periods. A striking example of such behavioural knowledge concerns the Giant Squid (*Architeuthis dux*) that live off the coasts of Australia, Tasmania and New Zealand. Very little is known about this creature, with less than 50 sightings over the last century. What is known was anecdotal from fishermen describing whales in 'fierce battles' with these creatures. These claims went unrecognized by the scientific community until whales where caught with large tentacle marks on their bodies and large squid 'beaks' in their stomachs (CNN, 2002).

One reason such local knowledge is important as an information source for researchers and fisheries resource managers is its inherent spatial component (Johannes, 1993). Fishermen tend to perceive the environment as

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a non-linear representation of space, often orientating themselves based on place, such as how far a fishing spot is from a particular island or where a location is along a riverbank (Brodnig and Mayer-Schönbergerm, 2000; St. Martin, 1999). These types of spatial interactions represent features at a finer, or more localised scale than other types of information. In effect, fishermen identify where they fish by a series of environmental cues. In this context, local knowledge has the potential to be very effective if integrated successfully with quantitative data on numbers of, for example, species harvested or total gross weight. In addition, if collected over a multi-year period, this knowledge can illustrate a temporal representation of the population and health of fish stocks.

Spatial information technologies (SIT), specifically geographical information systems (GIS) and remote sensing (RS), are increasingly being used by fisheries scientists (Meaden, 2001). However, SIT in fisheries science have been slow to evolve relative to terrestrial applications, largely due to the fluid nature of aquatic systems (Nishida et al., 2001). Further complicating this inherent property is the fact that GIS software is typically designed to process hard, quantitative data rather than the soft or subjective qualitative data that characterize local knowledge systems. In the latter case locational representation by species harvesters is much more subjective than, for example, the use of global positioning systems to identify the location of fishing grounds. Given this, there is a conceptual and operational challenge in integrating these two knowledge systems, especially since scientists and fishermen tend to view the world differently.

A scientist's view of the world is primarily Cartesian, or humans above and separate from nature, where reality is ordered and explored through a quantitative scientific method. In contrast, local knowledge tends to be a more qualitative, informal world-view of humans co-existing with and being an intricate part of the natural world, where respect for nature may often lead to a more sustainable relationship (Berkes, 1993; Gadgil et al., 1993; Kalland, 2000; Raedeke and Rikoon, 1997)

Recognizing the dichotomy between scientific and informal or local world-views, this paper argues that local knowledge is an important element in the future success of fisheries management and that through visualization of spatial distributions of data from both traditional science and local knowledge perspectives, GIS can serve as a common ground where both views converge to produce scientifically valid and locally relevant fisheries management planning. The paper presents a protocol for the collection and use of local knowledge beside traditional scientific data in fisheries management planning using GIS. Specifically, procedures are identified to select and interview key informants, to collect data, and to represent the inherent local knowledge that is embodied in harvester activities.

2. Local knowledge in resource management

Before presenting the local knowledge assembly protocol, the resource knowledge bases and resource management decisions that exist within a general resource management framework must be considered. Resource management decisions are influenced directly by the quality and quantity of information available in relevant resource knowledge bases, hence knowledge and resource decision-making are intrinsically connected. However, scientific knowledge (SK) is at best patchy in many resource areas in terms of information on species biology and on their distribution relative to associated environmental characteristics (Berkes et al., 2001; Neis and Felt, 2000).

To alleviate this problem, scientists have begun to consider seriously the knowledge and activities of local resource harvesters. This knowledge source has gained increasing prominence in the resource management field and is generally referred to as local knowledge (LK). Rather than regarding LK merely as a supplement to scientific knowledge, it is generally agreed that it is, in and of itself, of equal importance to SK in understanding harvester and species interaction. There are a variety of problems, however, when dealing with local resource users, not only in terms of understanding their knowledge, but more importantly, in collecting and assembling it into useable formats that resource managers can read and decipher for the purpose of implementation into management decisions.

There are four main factors that impede the collection and integration of LK into resource management knowledgebases and decision-making, namely (1) the acceptability, and for some, the validity of LK and the treatment of local resource users as equals, (2) conflicting and often incomplete data types, specifically qualitative versus quantitative data, (3) differences in world-views, and (4) socially sensitive and/or confidentiality issues that limit the ability to share data and information derived from LK sources. While each of these impediments contributes to the problem of knowledge integration, this paper focuses primarily on points 2, 3 and 4. Within these, GIS are proposed and used as a medium to facilitate the integration of qualitative and quantitative source data within the resource management framework of a small-scale, artisanal fishery.

The relationships between resource management knowledge and decisions, SK, LK and the use of GIS as a unifying and facilitatory mechanism are portrayed in a general conceptual framework shown in Fig. 1. This framework suggests that resource knowledge can originate from two disparate, yet related sources (LK and SK) that implicitly (within the context of Fig. 1) commence with the collection of data, transformation of these data into information and then into knowledge that fills the knowledge base both directly and indirectly, as illustrated in the diagram. LK and SK pass through a spatial information translator that takes both data sources and unifies them into a common