Available online at www.sciencedirect.com
ScienceDirect
Fisheries Research 84 (2007) 162–170
FISHERIES RESEARCH
www.elsevier.com/locate/fishres

Fisher knowledge as expert system: A case from the longline fishery of Grenada, the Eastern Caribbean

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Received 4 July 2006; received in revised form 27 September 2006; accepted 20 October 2006

Abstract

We investigated a fisher knowledge generation process in the longline fishery for large pelagic fish in Gouyave, Grenada, using techniques of participant observation, interviews, and focus group discussion. We identified nine categories of knowledge that are important for finding and catching large pelagic fish: seasons, use of bait, gear technology, weather conditions, fishing practice, fish habits and behaviour, fish movement, 'folk oceanography' (seabirds, seawater colour, current), and fish stomach contents. Conceptualized as a decision-making rule structure, this information can be analyzed as an expert system, the rationale being to understand how human experts (fishers) use technological and ecological knowledge. We extract heuristic rules (expressed as IF–THEN clauses) based on fishers' description of how they make decision on how, where, and when to find and catch fish. Gouyave fishers are adaptive experts because they have the ability to learn from and deal with new situations. They rely on observation, experimentation, and experience through the feedback of fish catches and evaluation, learning adaptively to improve their understanding of the marine ecosystem and the resource.

Keywords: Fisher knowledge; Expert system; Learning; Adaptive management; Pelagic fish; Longline fishing; Caribbean; Grenada

1. Introduction

Small-scale fishing throughout the world is based primarily on fisher knowledge, but it has only been recently that this knowledge has been studied and documented. Fishers have detailed qualitative knowledge of the fishery based on continuous interaction with the environment (Johannes, 1981; Ruddle, 1994). Fisher knowledge (also referred to as local or traditional ecological knowledge) can complement scientific knowledge (Johannes, 1998; Johannes et al., 2000), improve decision-making (Berkes and Folke, 1998; Baticados, 2004), and provide practical information that can be used in management (Bergmann et al., 2004; Silvano and Begossi, 2005). Such knowledge develops accumulatively and is transmitted culturally (Berkes, 1999). In the Caribbean, fisher knowledge does not often involve multigenerational cultural transmission; there are very few studies of fisher knowledge (exceptions include Warner, 1997; Gomes et al., 1998; Breton et al., 2006).

However, the Caribbean provides a suitable setting for the examination of the fisher knowledge generation process, especially in recently developed fisheries. When a new fishing technique is introduced, fisher knowledge is created rapidly as fishers develop the capacity to learn from their experience. They build their knowledge and skills in order to understand the technology and its interaction with the marine environment (Grant and Baldeo, 2006). New knowledge is being generated continuously, and feedback learning is occurring by trial-and-error.

We know that fisher knowledge exists and is well documented. What is not known is how a fisher knowledge system actually works. In this paper we propose that fishers have an applied knowledge system that can be described as an expert system, "a branch of artificial intelligence, providing theories and methods for automating intelligent behaviour. They are computer programs that use heuristic rules to store knowledge, which is used to infer solutions and help provide assistance in solving complex problems normally handled by human experts" (Mackinson, 2001, pp. 534). According to the expert system model, human experts use heuristic rules to store knowledge used in problem solving and help provide assistance in how problems are solved (Mackinson, 2001). The knowledge used

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doi:10.1016/j.fishres.2006.10.012

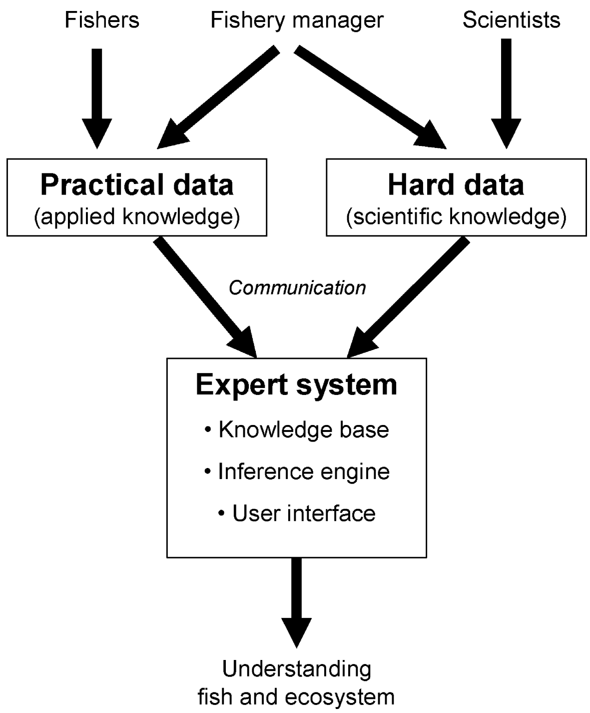

Fig. 1. Schematic representation of the model components (adapted from Mackinson, 2000).

for decision-making is not quantitative (as in scientific data) but qualitative and consists of fuzzy sets (Mackinson, 2000; Ozesmi and Ozesmi, 2004).

The expert system has three components, the knowledge base is the repository of rules, facts, general cases, exceptions and relations that can help human decision-makers solve problems. The inference engine is the mechanism for manipulating the encoded knowledge base for making inferences and drawing conclusions, using rules in the form ‘IF *a certain situation occurs*, THEN *a known outcome is likely* and may contain several conditions linked by AND, OR, NOT. Finally, the user interface provides the link from the system to the user (Fig. 1) (Mackinson, 2001; Uricchio et al., 2004).

This paper is not concerned with the technical details of the expert system; rather it focuses on the collection and application of fisher knowledge in the construction of such a system. We find the expert system construct useful as it not only allows a description of the ecological and technological knowledge of fishers (the knowledge base), but goes two steps further. It helps understand fishers' decision-support system using IF–THEN rules to find and catch fish (the inference engine), and how fishers use social relationships to access the database of knowledge and decision-support system (the user interface).

The objective of this study is to explore fisher knowledge as an expert system. We investigate how fishers strive to achieve a better understanding of the marine ecosystem in which they operate, ensuring that their decisions are appropriate to catch fish and make a living. We begin with a description of the types of knowledge that are accessed and stored by fishers to find and catch fish. Second, we illustrate the decision-making process for fishing and present the schema of a knowledge production process to explore how fisher knowledge develops. Finally, we describe how knowledge is transmitted, i.e., how fishers are granted access to this knowledge.

2. Study area and methods

2.1. Study area

Gouyave, the study site, is a fishing community on the west coast of Grenada, which is situated between 11°00′ and 12°30′ north latitude (Fig. 2). Traditionally Gouyave fishers operating close to shore used beachseine, handline, and fish trap to catch inshore pelagic species, offshore pelagic species, and demersal, respectively. During the revolution, which began in 1979, Cuban master fishers formally introduced pelagic surface longline (or simply longline) fishing to Grenadian fishers. The introduced longline technology was made from 2 by 113 kg monofilament plastic, drilled and twisted mainline and dropline with 30–50 hooks of total length 0.5 km, which was stored and deployed from a box. Traditional vessels were wooden canoes 4–5 m in length powered by oars, sail, or a 30 HP engine. By 2003, fishers made significant changes to longline technology. Twisted monofilament was replaced by single 68–227 kg plastics, the box replaced by reels, and hooks increased to over 300. The total longline length increased to 11 km, and fishers travelled up to 160 km from shore. Gouyave had over 300 fishers and 92 boats, with 82% of fishers and 72% of boats involved in longline fishing. The longline fishing fleet comprised three vessel types. Type 1 was a day-trip wooden open pirogue less than 5.5 m in length with one 48 hp outboard engine. Type 2 was a day-trip fibreglass forward-cabin pirogue between 6 and 9 m in length with two 48 hp outboard engines. Type 3 was a 4–5 days-trip fibreglass vessel between 9 and 12 m with inboard engines (Grant, 2006).

The main pelagic species caught, in terms of catch by weight for the period January to December 2002, were yellowfin tuna (*Thunnus albacares*, 49% catch by weight), Atlantic sailfish (*Istiophorus albicans*, 28% catch by weight), common dolphinfish (*Coryphaena hippurus*, 10% catch by weight), white and blue marlin (*Tetrapturus albidus* and *Makaira nigricans* combined as fishers did not distinguish the two, 6% catch by weight), and swordfish (*Xiphias gladius*, 2% catch by weight). Other species (5%) included blackfin tuna (*Thunnus atlanticus*), wahoo (*Acanthocybium solandri*), bigeye tuna (*Thunnus obesus*), and skipjack tuna (*Katsuwonus pelamis*) (Fisheries Division landings statistics, unpublished data). This study focuses on recording fisher ecological knowledge for the five main species.

2.2. Methods

This study was conducted between December 2002 and March 2004 as part of a larger research project on managing small-scale fisheries in the Caribbean (Grant, 2006). Multiple research techniques were used for data collection and verification. Such techniques include a semi-structured interview, observation, participant observation, and a focus group discussion.