On the advantages of working together: Social Learning and knowledge integration in the management of marine areas

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A B S T R A C T

The interconnectedness of ecosystems and the integration of policy and society are relevant aspects of integrated management grounded in knowledge exchange practices. Such processes may also promote social learning, the joint and collaborative knowledge to tackle environmental problems. Thus, understanding knowledge exchange is an additional strategy to promote and understand social learning. This article analyzed a knowledge exchange process related to the elaboration of a proposal for the spatial delimitation of a marine protected area in Brazil, a developing country. By combining process observation and geographical information system tools, proposed areas and criteria for delimitation elaborated by different groups of stakeholders (non-scientists and scientists), separately and in an integrated discussion, were compared and used to test the hypotheses that integration under a knowledge exchange process can bring substantive changes in the outcomes of a management process, and that knowledge exchange processes can promote social learning. Results showed that the integration of different knowledge led to results that none of the groups reached in separate discussions, such as the identification of new areas, delimitation of an area of influence and new criteria for delimitation. Changes in knowledge, the framing and reframing of the processes, understating system complexity and social context were observed, which indicates that knowledge exchange promoted social learning. Additionally, the criteria used to support the delimitation proposals in the studied area can be applied to other marine protected areas in other contexts, and the methods used to guide the discussion can be adapted to other issues.

1. Introduction

Impacts on the natural environment have grown in extent, magnitude and complexity [1–8], and challenge managers and decision-makers. To address these challenges, new management systems that consider the interconnectedness of socio-ecological systems and the integration of policy and society are needed [4,5], which demand new ways of producing, disseminating and integrating scientific knowledge in decision-making.

There are many obstacles to science-policy integration, such as cultural differences regarding the production and application of scientific information [9–11], difficulties in accessing scientific information (considering its availability, language barriers and the temporal incompatibility between information production and management exigencies), a lack of clarity about management demands [7,9,10,12,13], institutional barriers that do not encourage or support integration [12,13], and insufficient conditions to improve knowledge exchange [14].

Knowledge exchange (KE) refers to many processes of knowledge-based interactions, including:

- Knowledge translation: communication using a mediated language modified for recipients;
- Knowledge transfer: knowledge "changing place" in a linear direction, from the producer to the receiver;
- Knowledge exchange: knowledge "changing place" in a two- or multiple-path process with reciprocity and mutual benefits; and
- Knowledge co-production: knowledge that is produced through interaction with others, cooperative endeavors and mutual learning [15,16].

The type of process applied to KE depends on the social-political context, the individuals involved and the objectives of the exchange [15]. Although scientists have long been characterized as knowledge providers [11], recent studies (theoretical and empirical) have noted that greater integration between researchers and decision-makers in the

production of knowledge can lead to the production of more applicable knowledge and thereby improved participatory management [4,5,11,13,14].

Participatory processes and collaborative work are also basic elements of social learning processes (SL), the joint and collaborative learning that takes place in a process of collective discussion and search for solutions to environmental problems [3,17–20]. SL is evidenced in changes in system perception (through the acquisition of "new" knowledge), behavior (attitudes and values), and social organization (with new social arrangements and new opportunities for collaborative work) [17,19,21].

Thus, KE can be closely related to SL processes and increasing the understanding of KE processes will lead to increasing the understanding and promotion of SL processes. Most KE studies are qualitative and theoretically evidenced, and there is a lack of empirical analysis documenting and evaluating KE outcomes [14]. Studies of KE on the management of marine resources tend to focus on developed nations, where there is a clearly defined governance structure and greater access to scientific information [14], characteristics that are not shared by developing nations, like Brazil [22].

Considering this state of affairs, this article describes a process that integrated scientific and traditional knowledge and the perceptions of different stakeholder groups that resulted in a proposal for the delimitation of a marine protected area on the Northern Coast of São Paulo State, Brazil. The hypotheses tested in the article were that a delimitation proposal under a KE process could bring substantive changes to outcomes compared to a proposal elaborated by a single group of stakeholders (Hypothesis 1) and that KE processes promotes SL (Hypothesis 2).

Knowledge here is defined as information (which can be learned) and understanding (which is perceived) [8], which are differentiated in their scientific, traditional and environmental components. Scientific knowledge is knowledge obtained through scientific inquiry, is understood to be systematized, objective, explicit, and based in replicable methods, and attempts to construct general explanations of observed phenomena [11,13,23]. Traditional knowledge (also called local knowledge or local ecological knowledge) is a cumulative body of knowledge, practices and beliefs that emerge from the interaction and observation of natural phenomena by a given group and is transmitted through generations [20,23,24]. Environmental perception, in turn, expresses how an individual is aware of, understands and relates to the environment, considering both sensations (the kinetic and biochemical relationship between an individual and the environment) and cognitions (mental process mediated by personal culture and knowledge) [25].

2. Study case: delimitation of the Araçá Area

The Marine Protected Area of the Northern Coast of São Paulo State (APAMLN, acronym for Área de Proteção Ambiental Marinha do Litoral Norte de São Paulo, in Portuguese) was established with the main objective of promoting the sustainable use of the natural resources and managing economic activities within its area, that include local mangroves (25 in total), and two special areas, Araçá and "Enseada/Canto do Mar", all of which need yet be delimited [26].

The area called Araçá is a bay located in the central region of the Municipality of São Sebastião, limited by the coastline and the São Sebastião Channel from Araçá Point to the landfill of the Port of São Sebastião and surrounded by residential areas (Fig. 1). It is a place where conflicts between economic growth and social-environmental conservation are evidenced in the proposal for port expansion over the bay and the social movement against it, which advocates for the use of the area to promote environmental conservation, research, education and the *caiçara* culture (traditional people that inhabit Brazilian coast) [27], the main services provided by the bay [28–31]. In addition to APAMLN, evidencing its environmental importance, the bay is part of

the Municipal Protected Area of Alcatrazes (APA Alcatrazes) [32], which has not yet been implemented.

Given the importance of and the threats faced by the Araçá Bay, an interdisciplinary project called "Biodiversity and functioning of a subtropical coastal ecosystem: subsidies for integrated management" (Biota/Fapesp-Araçá Project) was initiated. One of the goals of the project was to develop a Local Plan for Sustainable Development (LPSD), which demanded the delimitation of the area embraced by the plan, the Araçá Area.

The delimitation of the Araçá Area was a common need of APAMLN and the Biota/Fapesp-Araçá Project, and a combined effort was carried out to promote a discussion of the boundary. Delimitation proposals were first separately elaborated in the LPSD process (two proposals) and by a group of scientists from the Biota/Fapesp-Araçá Project (referred to as the LPSD and scientific proposals) and them integrated in a single discussion. The outcomes of this process is the focus of analysis of this article.

3. Analysis strategy

For each discussion of the Araçá Area, delimitation proposals were elaborated through the following general steps:

a) Creation of an individual delimitation proposal based on a map of the region – participants were asked to draw what they understood as being the Araçá Area;
b) Presentation of the individual proposal and its explanation to the other participants in the activity;
c) Collective discussion and elaboration of a collective proposal.

The LPSD proposals were elaborated on a meeting held on September 20, 2015. The groups involved with the LPSD proposals were the local community living in the areas surrounding the Araçá Bay (Group 1) and other stakeholders interested in the discussion but who did not live in the surrounding areas (e.g., other residents of the municipality, NGOs, researchers and managers who conduct activities in the area – Group 2).

The scientific proposal was elaborated in a meeting organized with this specific objective with the leading researchers of the Biota/Fapesp-Araçá Project, held on November 16, 2015. For individual proposals, researchers were approached through in-person meetings or virtual calls, which were recorded along with their explanations.

The three proposals were later integrated in a single discussion as part of the activities of the Working Group Araçá (WG Araçá), operating within the management structure of APAMLN to promote the discussion of society's interests in the management of Araçá Bay (Integrated proposal). Group members included Araçá Bay community, representatives[1] of the DOCAS Company (manager of Port of São Sebastião), representatives of government institutions responsible for environmental conservation and inspection (APAMLN, Federal and State Environmental Agency), environmental non-governmental organizations (NGOs) and members of local research and education institutions. Meetings to discuss the Araçá Area were held on March 31, May 19 and June 24, 2016 and engaged WG members and other stakeholders from the LPSD process and the research project.

To test the hypotheses, this article considers the differences in the proposed boundaries and in the arguments supporting each proposal, which were obtained by analyzing the records of each discussion and observing the process. For every case, proposals (individual and collective) were manually digitized and organized in a georeferenced database using a Wacom pen tablet and the ArcGis 10.2 ArcView® program. Each individual proposal was represented as a polygon

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[1] In this article, "representative" refers to a person that is formally registered/nominated as the spokesperson for an organization/institution or group of people.