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Integration of fisheries into marine spatial planning: Quo vadis?

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ABSTRACT

The relationship between fisheries and marine spatial planning (MSP) is still widely unsettled. While several scientific studies highlight the strong relation between fisheries and MSP, as well as ways in which fisheries could be included in MSP, the actual integration of fisheries into MSP often fails. In this article, we review the state of the art and latest progress in research on various challenges in the integration of fisheries into MSP. The reviewed studies address a wide range of integration challenges, starting with techniques to analyse where fishermen actually fish, assessing the drivers for fishermen's behaviour, seasonal dynamics and long-term spatial changes of commercial fish species under various anthropogenic pressures along their successive life stages, the effects of spatial competition on fisheries and projections on those spaces that might become important fishing areas in the future, and finally, examining how fisheries could benefit from MSP. This paper gives an overview of the latest developments on concepts, tools, and methods. It becomes apparent that the spatial and temporal dynamics of fish and fisheries, as well as the definition of spatial preferences, remain major challenges, but that an integration of fisheries is already possible today.

1. Introduction

Fisheries in MSP has only been evaluated to a limited extent, even while the concept of MSP has been promoted in various marine regions around the world over the last two decades (e.g. revision of Australia's Great Barrier Reef Marine Park, Ocean Acts in the U.S. states of Oregon and California, Canada's Ocean Act, European Integrated Maritime Policy, EU Natura 2000 areas, ocean zoning in China and Taiwan, UNESCO-IOC initiative on MSP). Several scientific studies highlighted the extensive relevance and significance of fisheries in MSP (e.g. Gray et al., 2005; Crowder and Norse, 2008; Berkenhagen et al., 2010; van Deurs et al., 2012; Bastardie et al., 2015). However, fisheries are usually not or not fully integrated into today's marine spatial plans (if regulations on marine protected areas are understood as conservation law, not as spatial planning regulations). The English East Inshore and East Offshore Marine Plans (HM Government, 2014), for example, seek to integrate fisheries, but ultimately they do not come up with spatial designations, but instead pass the issue on to subsequent licensing procedures. The Norwegian Integrated Management Plan for the Barents Sea-Lofoten area (NME, 2011) mentions fisheries, but the plan actually focuses mainly on sectorial fisheries management. Canada is currently developing integrated management plans for its marine regions that shall also address fish and fisheries. As seen in the example of the Gulf of St. Lawrence Integrated Management Plan, this also included, during the preparation phase,

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the identification of spawning grounds, but in the end the management plan resulted only in a strategic plan (DFO, 2013). For the preparation of the U.S. Rhode Island Ocean Management Plan, spatial demands of fisheries and of fish species during different life stages were mapped, but this management plan also did not come up with spatially explicit solutions for the integration of fisheries (CRMC, 2010). A bit different is the example of the Great Barrier Reef Marine Park zoning, which gives spatial designation for fisheries and other human uses (GBRMPA, 2004).

Modern MSP plans do not seem to achieve their theoretical integration potential when it comes to fisheries. While several studies proposed ways in which fisheries could principally be included in MSP (e.g. Douvere et al., 2007; Fock, 2008; Stelzenmüller et al., 2008), an often-cited argument for the non- or partial integration is that data on spatial demands of fish and fisheries cannot yet be provided in a spatial and temporal quality adequate for MSP purposes (Petra Schmidt-Kaden, personal communication, January 15, 2014). This raises the question of the current state of knowledge on spatial demands of commercially important fish species and fisheries.

In this article, we present brief overviews of the state of the art of approaches which seek to overcome fisheries integration challenges by providing spatially explicit knowledge for the inventory, draft development, and negotiation phases of MSP processes. The aim is to give an overview of the progress in providing data and knowledge for MSP processes. We define six sub-challenges on the integration of fisheries and MSP, and for each of them, progress is checked against the applicability in MSP practice.

2. Methodology/approach

In formulating a suitable methodology for the review, an initial conceptualization of the challenges in the integration of fisheries into MSP was undertaken. Based on guiding MSP principles (e.g. Ehler and Douvere, 2009; Ramieri et al., 2014), scientific support for the inventory, draft development, and negotiation phases of MSP processes, in particular, was thought to be necessary. As highlighted by Jentoft and Knol (2014) and de Groot et al. (2014), being able to table good spatial data is crucial in many MSP processes. According to Hopkins et al. (2011) and HELCOM-VASAB (2015), the above-mentioned MSP steps are of great importance for the integration of ecosystem-based activities, such as fisheries. In order to identify relevant literature on the integration of fisheries into MSP, a structure of MSP-relevant knowledge challenges was developed as follows:

- MSP inventory phase:
  - Where do fishers actually fish (effort allocation)?
  - Which areas are more, which are less valuable for fishers?
  - What locations do commercially important fish species need access to during their different life stages?
- MSP draft plan development and negotiation phase
  - Long-term changes in species and life stage distributions, e.g. due to climate change, eutrophication, etc.
  - Effects of fisheries management (CFP, national) on MSP goals.
  - Effects of MSP and human maritime uses on fisheries.

This structure laid the basis for a literature review with the aim to draw together information on the progress in research on the above-mentioned integration challenges and the applicability of today's scientific approaches in MSP practice.

Articles published from 2000 to 2015 were selected by means of a structured literature search in SciVerse (ScienceDirect & Scopus), Web of Science, Google Scholar, and OCLC WorldCat. Supplementary papers were found by following the references of articles found in the above-mentioned databases and search engines. Search words were combinations of “MSP”, “marine/maritime spatial planning”, “fisheries”, “spatial”, “effort”, “closure”, “spawning”, “EBM”, “VMS”, “anchovy”, “cod”, “flatfish”, “herring”, “plaice”, “saithe”, and “sole” in differing dictions and including Latin names of fish species. Studies were included in this review if they dealt with one of the above-mentioned challenges, had a marine focus, led to spatially explicit results with an extent comparable to the average MSP planning regions, and if they were written in the English language. In the case of identical or conceptually similar studies, those studies were included in this review that best summarize longer development trends or had the stronger focus on MSP requirements.

To get an overview about the different types of contributions to the integration of fisheries into MSP we structured the publications by using the Grounded Theory methodology (Strauss and Corbin, 1994). Each publication was assigned within four dimensions via open and axial coding on the basis of the paper titles, abstracts, and keywords. The categorisation was based on contrasting pairs (model-based - sample-based; fleet – fish; inventory – projection) and the axial coding elements as defined by Strauss and Corbin (1998).

3. Results

The literature search led to more than 3000 results with general relevance to the topic. Of these, 121 studies had higher significance for the integration of fisheries into MSP. Most of these were studies which focus on conceptual issues, aspects of stakeholder integration and participation, and details of interdependencies of ecosystem components or of human activities and fish stocks. Thirty-four of those 121 studies fulfilled the above-mentioned criteria, whereof 25 studies were published since the year 2010 (see Table 1 below and Table 2 in chapter 3.2).

As a result of the coding the majority of reviewed papers were identified as having a focus on model-based assessments of the behaviour of fishing fleets (16 papers). Nine of those studies included information on the wider context or on the effects of interventions on fishermen's decision-making (see Fig. 1). A total of eight papers described mainly phenomena, another eight articles included causal conditions, while only five studies were so applied to give concrete advice on MSP action strategies or similar. The smallest group of papers used sampling to deduce the effects of managements measures on stock development or species behaviour (3 papers). Model-based approaches clearly predominate the reviewed studies (26 articles), while the relation between stock-taking studies and those that make use of projections is balanced. Studies coded as containing information on context, intervention, action strategies, or consequences were later on more frequently considered as offering advice not only for the MSP inventory phase (Table 1), but also for the plan development and negotiation phase (Table 2).

3.1. MSP inventory phase

3.1.1. Mapping fishing effort in space and time

The spatial resolutions of ICES statistical rectangles (30′ latitude x 60′ longitude) or other grid-based landings and fishing effort statistics are usually too coarse to fulfil the information requirements of MSP on fisheries' demand for space. Suitable resolutions have been defined, for instance, by Jin et al. (2013), who suggest a grid system of maximum 10′ x 10′ to be able to assess economic values of marine space. Marchal et al. (2014a) recommend a more delicate system of 3′ x 3′ to be able to analyse the interactions between fishing activities and other human offshore

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