Structuring societal information for the Marine Strategy Framework Directive

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Summary: The Marine Strategy Framework Directive (MSFD) adopted by EU emphasizes the need for integrating environmental and social analyses. We propose and test a general framework for identifying and structuring environmentally relevant societal information. Our framework, called BPSIR (Behaviour, Pressure, State, Impact, Response), pays special attention to the behaviour of different groups of actors along the pathway from measures to changes in the pressure on the marine environment. In particular, it draws attention to the crucial role of actors that *indirectly* drive the use of marine resources or influence the marine environment. Case studies of shipping, cod fishery and the input of nutrients to the marine environment demonstrated that consumers of goods, supply chain managers, importers, retailers and public procurers all can play an important role in the development and monitoring of the programmes of measures that shall ensure good environmental status of marine waters.

Introduction: The pressure on marine environments is influenced by a large number of activities and actors. Emissions of carbon dioxide, which can lead to acidification of sea water, are influenced by consumption patterns and the mobility of people and goods. Marine litter is a consequence of the behaviour of a large number of people. Eutrophication of marine waters is driven by the demand for food, as well as agricultural practices and the handling of wastes. The existence of such strong links between the marine environment and the society demonstrates the need for integrating environmental and social analyses.

The Marine Strategy Framework Directive (MSFD) adopted by EU strongly promotes structuring information about both the state of the marine environment and the pressure on such environments expressed as physical, chemical and biological disturbances. In particular, substantial efforts have been made to develop indicators that summarize crucial information about the state of complex ecosystems. Societal information that is needed for efficient management of the environment is gathered and evaluated in a much less systematic manner.

Materials and methods: We propose a general framework for identifying and structuring environmentally relevant societal information. Moreover, we use the results of selected case studies to discuss how our approach can help develop and follow-up measures to reduce the pressure on the marine environment. Our framework, called BPSIR (Behaviour, Pressure, State, Impact, Response), is compatible with the widely recognized DPSIR (Driving forces, Pressure, State, Impact, Response) framework, but substitutes the vague concept of driving forces for an explicit identification of actors and their behaviour. The case studies in which our framework was tested addressed the impact of shipping, cod fishery and inputs of nutrients to the marine environment.

Results and discussion: Our research demonstrated that the BPSIR framework can make actors and their behaviour more visible and render the meaning of impact more precise. In particular, we found it useful to distinguish between: (i) actors directly involved in activities causing physical, chemical or biological disturbances, and (ii) actors that indirectly drive the use of marine resources. The latter group includes consumers of goods, supply chain managers, importers and retailers, public procurers and many other groups of actors whose behaviour can strongly influence the pressure on the marine environment.

A case study of shipping illustrated that the impact of human activities on the marine environment is often described from a rather narrow perspective, with a focus on technical aspects. For example, there is an extensive literature describing emissions of greenhouse gases as a function of the design of the ship, its engines and its velocity. When the same issue is studied from a wider perspective, it is obvious that there is a number of other factors and numerous actors that can influence the magnitude of such emissions. General political choices influence both the need for transports and the choice of logistic solutions. Moreover, shipping is operating on a market where contracts play a crucial role and buyers of transport services can impose environmental requirements. Case studies of cod fishery and the flow of nutrients from land to sea provided further examples of the numerous actors whose behaviour indirectly influences the pressure on the marine environment (Sundblad et al, 2014). Consumers, importers, retailers, and public procurers can all play a crucial role.

We claim that effective development and monitoring of programmes of measures requires that the current ecosystem monitoring is balanced with systematically collected and organized information about both direct and indirect actors, their adaptation to policy measures, and the role of general societal trends in consumption and production. The BPSIR framework, along with a thorough identification of direct and indirect actors, provides a suitable theoretical basis for such work. Development of societal indicators that can help understand and monitor the complex relationships between society and the marine environment is an urgent task for the scientific community.

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