



Editorial

Organizing productive science–policy interactions for sustainable coastal management. Lessons from the Wadden Sea



Coastal areas worldwide are intensively used for recreation, transport, fisheries, resource extraction, and other economic activities. These areas host more than 45% of the human population and include 75% of the world's largest urban agglomerations (Turner et al., 2014). As a consequence, ecosystems are often under pressure: habitat loss, pollution and coastal erosion are reported from many coastal regions (Agardy et al., 2005; Jackson, 2008). It is recognized that specific policies are needed in order to seek a balance between the economic, ecological and social functions of coastal areas and many countries are looking for the so-called integrated management approaches, for instance under the heading of Integrated Coastal Zone Management (Douvere and Ehler, 2009; Weinstein et al., 2007).

Scientific knowledge plays or is supposed to play an important role in the management of coastal areas by providing knowledge of ecosystems, the use of ecosystem goods and services, and the ecological limits to the exploitation of natural resources (Bremer and Glavovic, 2013). This knowledge is used for ex post and ex ante policy evaluations, for the underpinning and implementation of policy and management measures, and functions in learning processes between policy-makers, scientists and stakeholders. In order to align scientific knowledge and policy, several practical frameworks and institutions have been developed, such as Environmental Impact Assessment, Strategic Environmental Assessment, co-management procedures, Environmental Assessment Agencies, and Scientific Advisory Boards. Also more informal and temporary frames and arrangements may function as science policy interfaces, such as workshops, joint committees, common reports and integrating concepts. These arrangements complement, and partly overlap, existing institutional arrangements (McNie, 2007).

Despite these efforts, relations between science and coastal management are often problematic. In many cases, the supply of scientific knowledge does not meet the requirements of users of knowledge in terms of the speed with which knowledge is delivered, its level of detail, its scale, its relevance or the extent to which certainties have been reduced. In other cases, there are more strategic problems in science–policy interactions, which are expressed in contested knowledge or the selective provision or use of knowledge. (McFadden, 2007; Bremer and Glavovic, 2013).

But there is also a more principal aspect. Many authors in the fields of science and technology studies and policy sciences, but also in coastal management, applied ecology and socio-ecological systems literature have explored and exposed the changing

character of scientific knowledge production in recent decades, and developed new approaches to describe and understand this changing character and social role of science. They share the idea that there is no sharp distinction between science and policy and that the development of science and policy are mutually dependent, at least in regulatory contexts. They developed concepts such as “post-normal science” (Funtowicz and Ravetz, 1993; Haag and Kaupenjohann, 2001), “Mode 2” science (Gibbons et al., 1994) and engaged knowledge production (Van de Ven, 2007; Hartmann and Dewulf, 2009). These interactive models of knowledge production offer a strategy for seeking solutions for wicked social and policy problems. Van de Ven and Johnson (2006) propose that through a process of knowledge coproduction, scientists and practitioners can create knowledge that is not only relevant for practice, but also contributes to the accumulation of scientific theory. Mode 2 Science is contingent on social context factors, problem-oriented, subject to multiple accountabilities and transdisciplinary in character (Nowotny et al., 2001). These new forms of knowledge production converge in transdisciplinarity and the extension of the peer community beyond scientists (Funtowicz and Ravetz, 1993). More specifically, methods are tailored to real-world problems instead of adapting the problems to disciplinary boundaries and methods, there is a democratization of science and scientific knowledge, and the interests of stakeholders are warranted in processes of joint knowledge production.

Several authors have articulated guidelines for transdisciplinary research, in which scientists and other societal actors collaborate in the co-construction of relevant knowledge (e.g., Pohl, 2005). In addition, the scholarly literature has developed a range of concepts—such as ‘boundary objects’, ‘boundary organisations’, ‘boundary spanners’ and ‘knowledge co-creation’ – to facilitate science–policy interactions and to analyze and assess science–policy interfaces, frames and arrangements. In particular, the concept of *boundary objects* turned out to be useful to understand and analyze the way science functions in heterogeneous contexts (Star and Griesemer, 1989). Boundary objects have different meanings in different social worlds but their structure is common enough to make them recognizable to more than one world, a means of translation. The creation and management of boundary objects is a key process in developing and maintaining coherence across intersecting social worlds (Star and Griesemer, 1989; Turnhout, 2009). The concept of boundary work is used to describe how actors connect and translate between different worlds and their viewpoints, i.e. scientists from differing

disciplines, but also other actors (Gieryn, 1983). It has developed from a method to distinguish science from non science to demarcating science from policy and doing science as a heterogeneous activity conducted by involved actors (see for example Metze, 2010; Turnhout, 2009; Shackley and Wynne, 1996).

Based on these theoretical and practical considerations and despite the on-going call for better and more scientific knowledge, even in civilized countries with a long scientific tradition (EEA, 2013), there is a growing consensus that more knowledge is not the only or even not the most important issue in the search for more productive science–policy interactions. In an advisory context, scientific knowledge should be both scientific robust as well as political or social robust (Lentsch and Weingart, 2011). Scientific robustness relies on reliability of knowledge but also on other aspects of credibility such as the way different perspectives are taken into account, and how it is dealt with uncertainties. Social robustness refers to salience, the perceived practical and societal relevance, and to legitimacy, the extent to which knowledge production has been respectful of the divergent values and beliefs of stakeholders, unbiased in its conduct and fair in its treatment of opposing views, information and interests (Cash et al., 2003; Hegger et al., 2012). Successful joint knowledge production should meet all these interests. In addition, in all stages, scientists and non-scientists should be involved and the process requires transparency and exchange of information (e.g., Hegger et al., 2012; Lentsch and Weingart, 2011; Redpath et al., 2013). However, how this is achieved, and under which conditions, still is subject to debate and requires more systematic and empirical comparative research.

The goal of this special issue is to provide more insight into the dynamics of (joint) knowledge production and how, and under which conditions, specific arrangements for organizing science–policy interactions contribute to scientifically and socially robust – i.e. credible, salient, and legitimate – knowledge. We focus on coastal areas, in particular the Dutch Wadden Sea. The Wadden Sea is an area of specific national and international interest (which is expressed in its status as World Heritage since 2009), hosting many migratory birds and with special scenic value. But the area includes also some industrial zones and is very important from an economic perspective, e.g., gas mining, transport, fisheries and recreation. In most of the resulting conflicts, scientific information plays a substantial and sometimes crucial role. Much research has been done with regard to the coastal dynamics and ecological values (e.g., Wang et al., 2012; De Paoli et al., 2015), but there are fewer studies on the role of scientists in policy processes, and more specifically on science–policy interactions (e.g., Van der Windt, 1992; Swart and Van Andel, 2008; Turnhout et al., 2008), despite the intensive science–policy interactions that take place and have taken place in the area.

The papers in this special issue address two important themes that are related to the goal of this special issue, namely the understanding of the relation between knowledge production and governance; and more specifically, the understanding of boundaries and boundary objects in science–policy interactions and joint knowledge production.

The papers of Floor et al. (2016), Seijger et al. (2016), Döring and Ratter (2015), and Van Enst et al. (2016) deal with different science–policy interfaces. In their contribution, Floor et al. (2016) analyze two conflicts about the so-called ‘significant effects’ of activities, the conflict over the 2006-permits of the mussel seed fishery and the 2011-permit for the planned World Championship powerboat races as examples of boundary objects, to understand the processes of meaning making in science–policy interactions and decision-making. Seijger et al. (2016) analyze and develop conditions for socially robust knowledge as the outcome of interactive knowledge production. The focus in this contribution is

on the role of ‘boundary spanners’ in coastal zone projects. Döring and Ratter (2015) explore the potential of the German concept of ‘Heimat’ as a boundary object to assess its applicability to study place-based meanings and to illustrate it as a practice-oriented point of entry to initiate productive science–stakeholder interaction in managing the North Frisian Wadden Sea. In their contribution, Van Enst et al. (2016) focus on the role of ‘boundary organisations’. Boundary organizations provide solutions by acting as a bridge between science and policy. Van Enst et al. (2016) present a framework and empirical analysis of different boundary organizations in the Wadden Sea, focusing on the participating actors, the presupposed goals and their strategies, to provide a better understating of the strategies by which the organizations aim to promote the selection, production and use of credible, legitimate and/or salient knowledge.

The contributions of Giebels et al. (2016), Van der Molen et al. (2016) and De Jong (2016) all deal with joint knowledge production in relation to governance and decision-making. In this paper they analyze the co-evolutionary relation between knowledge systems and governance arrangements, illustrated with a case study on the governance of sailing recreation in the Dutch Wadden Sea. Giebels et al. (2016) bring in the international dimension by analyzing how Eco-system Based Management (EBM) is implemented in the Netherlands, Denmark and Germany. The analysis focuses on the role of the Trilateral Wadden Sea Cooperation and to what extent national differences hinder the implementation of EBM. Finally De Jong (2016) analyses the use of ecological knowledge in international marine eutrophication policies and how science–policy relationships and knowledge use develop over time. The paper by Puente-Rodríguez et al. (2016) focuses on methodologies for the participatory production of knowledge. These authors make explicit how these participatory methodologies are designed and deployed to facilitate the eco-certification of ports in the Wadden Sea area, but also how these methods may trigger social learning among multi-stakeholder platforms.

In the concluding paper (Runhaar et al., 2016) we draw conclusions and explore lessons from the contributions in this special issue regarding the ways in which science and policy are and can be brought together, how different science–policy interaction arrangements work, how their outcomes can be evaluated, and how the functioning of science–policy interaction arrangements is enabled but also constrained by specific contextual factors.

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