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Capacity-building paper

Science, uncertainty and changing storylines in nature restoration: The case of seagrass restoration in the Dutch Wadden Sea

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ABSTRACT

Marine areas have been heavily affected by human activities, resulting in current attempts to both conserve and restore nature. In decisions about nature restoration, ecological knowledge plays a crucial role and is closely linked to nature preferences and political views. In this study, the empirical case of seagrass (*Zostera marina*) restoration in the Dutch Wadden Sea (1989–2017) is analysed. The impact of storylines and uncertainty perceptions, together with socio-political context factors, on decisions concerning restoration action and research are investigated. This case illustrates the difficulties of establishing seagrass fields and the dynamic process in which meaning is attributed to nature restoration. Two basic storylines – authenticity and the ecological function of ecosystem engineers – supported the restoration efforts. Three different episodes are distinguished based on different views of research in restoration efforts. The dominant perception of uncertainty was incomplete knowledge, and this perception resulted in research projects. Furthermore, the unpredictability of the success of restoration efforts and the ambiguity regarding the feasibility of restoration also influenced decisions. Two concepts – ecosystem engineer and pilot project – facilitated collaboration among science-based experts, NGOs and governmental organisations.

1. Introduction

Over the past few decades, nature restoration – in addition to nature preservation – has become an important component of nature protection. At the moment, increasing efforts are being made to restore marine and coastal areas, which involve more 'invisible' nature compared with terrestrial areas. In the face of on-going degradation of marine areas and loss of biodiversity, attempts are being made to restore species or even to develop new natural habitats. While nature preservation mainly aims at safeguarding existing nature values, the aim of nature restoration is to change a particular natural environment, transitioning it towards an envisioned restored state (France, 2016; Light and Higgs, 1996). In many respects, this makes restoration an even more complex process than preservation. Ecological knowledge is crucial in guiding this process, and scientists play a key role in restoration activities, from initiating restoration projects to operationalizing restoration techniques. The emergence of restoration ecology as a new subdiscipline of biology reflects this development (Choi, 2007; Gross, 2010; Higgs, 2005; Light and Higgs, 1996). Science alone, however, is not sufficient to cope with the challenges of restoration. As several authors have noted, restoration is intertwined with political choices and cultural preferences, which significantly influence the potential aims and outcomes of restoration projects (Baker and Eckerberg, 2013; France, 2016; Light and Higgs, 1996). In addition, the complexities of restoration entail persistent uncertainties about interventions and their consequences to the ecosystem. In combination with the urgency of making ecological improvements and the limits of available funding, these uncertainties may lead to conflicts between taking immediate action versus gathering more knowledge through ecological research (Allison, 2007; McDonald-Madden et al., 2010).

Restoration, in sum, is subject to a dynamic interplay of different factors: socio-political context, ecological knowledge, uncertainties, and action-research dilemmas. While several studies (Baker and Eckerberg, 2013; France, 2016; Gross, 2010; Light and Higgs, 1996) have identified and investigated these factors, few have analysed how they interact with one another in restoration projects. This article contributes to the literature on the social and political aspects of nature restoration (Baker and Eckerberg, 2013; France, 2016) and the literature on science-policy interactions in environmental issues (Wesselink et al., 2013; Weingart, 1999).

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We aim to shed more light on these issues by analysing efforts to restore seagrass in the Dutch Wadden Sea during the period 1989–2017. Globally, there is a long history of efforts to restore seagrass fields in response to a plant disease in the 1930s and declines caused by fishing and dredging (Cunha et al., 2012; Van Katwijk et al., 2016). Moreover, the global importance of seagrass fields is well recognized as they provide several functions, ranging from fish breeding grounds to carbon sequestration (Duarte et al., 2013). Currently, there are large-scale restoration projects underway in the US, Australia, China and Europe (Van Katwijk et al., 2016). As we will demonstrate, the case of seagrass in the Dutch Wadden Sea is particularly interesting because it entails a relatively long-term and continuing effort that is directed at a specific type of vegetation in a political and ecological environment characterized by change and uncertainty. Adding to these dynamics is the fact that the restoration is situated in a marine environment where many vital processes are hidden from view. Another noteworthy feature of this case is that the restoration efforts have not, so far, been successful in establishing long-term seagrass fields.

This article is structured as follows. First, we elaborate on our conceptual framework, present conceptually refined research questions, and specify our methods. Then, we describe and analyse the Dutch case of seagrass restoration. Finally, we discuss noteworthy outcomes and draw conclusions.

2. Storylines and dealing with uncertainties

Decisions concerning nature restoration are based on why certain actions are required and to what extent there is sufficient and accurate knowledge to support taking these actions. Two key concepts we use to analyse the case of sea grass restoration and to address these issues are storylines and uncertainties. Storylines are used to characterize how the restoration of seagrass is framed by the actors involved. In our use of storylines, we build on Wesselink et al. (2013, p.4), who state that "the multiple, dynamic interactions between processes of knowledge production and decision-making result in stories where both elements are intimately interwoven". These storylines are narratives that give meaning to specific phenomena, in our case seagrass restoration. Through such storylines, "ideas of 'blame' and 'responsibility' and 'urgency' and 'responsible behavior' are attributed" (Hajer, 1995, p.65). In storylines, actors frame problems and their preferred solutions in a convincing way, using facts, interests and metaphors to persuade others (Stone, 2012; Wesselink et al., 2013). For example, a storyline that is frequently found in restoration efforts runs as follows: historically, there existed a rich and well-functioning ecosystem, but vital components were lost and should be reintroduced to restore the full, authentic ecosystem (Baker and Eckerberg, 2013). As we will show, this storyline is found in our seagrass case.

To deepen our understanding of the science-policy debates, we analyse how actors address uncertainties. In doing so, we take a relational perspective on uncertainties, seeing them as constructed in particular settings (Shackley and Wynne, 1996; Van den Hoek, 2014). As Brugnach et al. (2008, p. 5) observe: "the definition of a problem and what is uncertain about it depends not only on scientific or expert understanding, but on the knowledge, views, and preferences of the decision maker in relation to those of other actors with whom the decision maker interacts to make sense of the situation" (Brugnach et al., 2008, p.5). In this study, we examine perceptions of uncertainty among the actors involved in making decisions about nature restoration. Among all potential uncertainties, which ones are acknowledged and addressed as meaningful in the decision-making process?

Building on (Dewulf et al., 2009; Floor et al., 2016; Van den Hoek et al., 2014), we distinguish three types of perceptions of uncertainty: incomplete knowledge, unpredictability and ambiguity; see also Fig. 1. Uncertainty can be characterized as incomplete knowledge when actors expect that certainty can be obtained by additional research. When uncertainty is perceived as unpredictability, the issue at stake is deemed

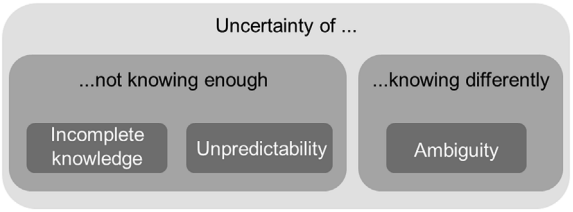

Fig. 1. Schematisation of types of uncertainties based on Van den Hoek (2014).

to be unknowable because it is beyond the grasp of research given the present state of science and the complexity of the issue. We characterize uncertainty as ambiguity when actors present diverging knowledge claims rather than thinking that they do not know enough. Thus, ambiguity can be defined as "the existence of two or more equally plausible interpretation possibilities" (Dewulf et al., 2005, p.116).

Related to these different perceptions of uncertainty, there are different strategies of dealing with uncertainties in decision-making processes. When uncertainty is posited as incomplete knowledge, a strategy to address this uncertainty could be investing in more research, for example through additional data collection, either alongside or before making a decision. It is worth noting that such a strategy is not, per se, effective: more research may also result in the acknowledgement of more uncertainties, as observed by Turnhout et al. (2008). When uncertainty is perceived as resulting from unpredictability, more research makes no sense, and the strategies of decision-makers instead revolve around accepting the unpredictability and acknowledging the risks implied. At the same time, risks can be reduced by anticipating several possible scenarios, diversifying the measures taken, and increasing society's capacity to respond to different potential outcomes, for instance through adaptive management (Brugnach et al., 2008). The perception of uncertainty as ambiguity implies that there are multiple, conflicting interpretations of a situation, each with its own plausible knowledge base. In a cold conflict, actors distance themselves from each other and avoid confrontation; in a hot conflict, the issue is politicised and actors explicitly criticize the opposite camp (Brugnach et al., 2008; Floor et al., 2016). Decision-makers' strategies to address this uncertainty can range from supporting one of the camps against the other to pushing for consensus by stimulating the exchange of views and mutual learning. As we will demonstrate in our case study, these perceptions of uncertainty play a central role in disputes on research and intervention.

Building on these key concepts, we can organize the aims of our study into the following research questions.

1. Which storylines about seagrass restoration emerge in the Wadden Sea case?
2. Which perceptions prevail regarding knowledge uncertainties?
3. What is the impact of storylines and uncertainties, together with socio-political contextual factors, on decisions concerning restoration action and research?

3. Methodological approach

We used an interpretative research approach (Yanow and Schwartz-Shea, 2006) because it is particularly suitable for our conceptual framework. As Wesselink et al. (2013, p.4) note, "a core tenet of interpretative approaches is the likelihood of multiple meanings, or interpretations, of problem definitions and policy texts, and also of the expertise relating to the policy issues". Following this interpretative tradition, we analysed the different understandings that were expressed in our case study.

First, we analysed the reasons for active restoration efforts. Second, we analysed the perceived role of research in the restoration efforts. Third, we analysed how uncertainties were interpreted by the actors involved, both in the legitimation for restoration projects and in the